

# Monitoring devices



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### Safety devices

- Safety switchgears
- Multifunction and modular safety systems
- Wireless safety systems
- Safety switches
- Safety interlocks
- Safety switch- and key interlock system

### Monitoring devices

- Insulation monitors
- Equipment for insulation fault location
- Residual current monitors
- Measuring and monitoring relays
- Fault annunciators and fault annunciator systems
- SMS-Telecontrol module

### Power electronics

- Semiconductors, relays/- contactors
- Reversing contactors
- Softstarters
- Motor brake relays
- Softstarters with DC-Brake
- Intelligent motor control units

### Control devices

- CANopen field bus components
- CANopen PLC
- Interface and switching relays
- Interface relays with positive guided contacts

### Timers

- Multifunction relays
- Time relays
  - operate delay
  - release delay
- Cyclic timers
- Flasher relays
- Fleeting action relays
- Pulse extender
- Star delta timers
- Safety time relays

### Installation electronics

- Time switches
- Remote switches
- Specific installation electronics
- Time, control and monitoring relays



- Machinery and plant
- Power generation/distribution
- Oil and gas industry
- Automation
- Transport and material handling systems
- Rail technology
- Aviation/marine industry
- Paper and printing industry
- Food industry
- Rubber/plastics industry
- Heating and refrigeration
- Automotive
- Mining/metal working
- Chemical/pharmaceutical applications
- Medical technology
- Water/waste water treatment
- Cable cars/ski lifts

... and wherever safety has high priority.  
 We can cover your industrial applications as well!



# DOLD – Solutions for you



The DOLD philosophy, “Our experience. Your safety” constitutes our program: Offering solutions based on over 80 years of experience with a workforce of more than 400 employees, we manufacture high quality products using state-of-the-art production plant at our Furtwangen facility in Germany.

The comprehensive product range includes relay modules, safety relays with positively-driven contacts and electronic housings with virtually unparalleled production detail. The combination of know-how, innovation and experience makes us one of the leading worldwide manufacturers.

Apart from standard solutions, we are also the right partner when individual industrial solutions with that special touch are required.

Staying in close contact with our customers is very important to us. We listen, analyze and act by offering flexible, custom high-tech solutions, from a single source.

Thanks to our own development laboratory, highly automated production facilities with a modern tool & die shop in addition to injection moulding facility together with a well organized sales and marketing department, we guarantee high quality and short delivery times. Your benefits: Increased plant and machine availability, planning reliability and low production costs.

# VARIMETER IMD

## – Electrical safety for power supplies

An unplanned machine or system downtime due to insulation faults can have serious consequences. Through early recognition of such faults in ungrounded networks (IT networks), DOLD insulation monitors in the series VARIMETER IMD prevent failures in electric systems and guarantee a higher level of operational and system safety.



LK 5896

RN 5897



# VARIMETER EDS

## – Fault localization during ongoing operations



RR 5886

RR 5887

In large industrial facilities, localizing insulation faults can be both expensive and time consuming. The VARIMETER EDS insulation fault search system localizes insulation faults quickly and safely in complex, ungrounded AC/DC networks.

Custom-tailored measuring and monitoring solutions. from DOLD



## Electrical Safety Solutions

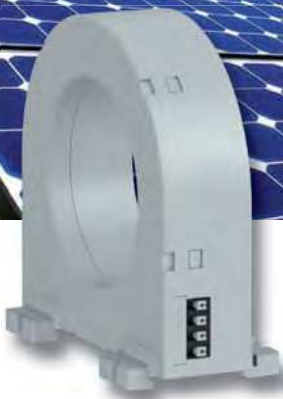
DOLD offers a comprehensive selection of measuring and monitoring relays for your unique needs. The devices detect and provide early notification if critical limits of electrical variables such as current, voltage, power, insulation resistance, et cetera are violated. This allows dangers to people and machinery to be reliably avoided. In addition, the availability of your

machines and systems will be increased and production outages will be minimized. DOLD's portfolio ranges from standard devices for the monitoring of individual variables to multifunctional devices to flexible error message systems.



RN 5883

In grounded networks, DOLD differential current monitors in the VARIMETER RCM series ensure reliable residual current monitoring. The differential current sensors can be used universally, as they can detect both direct and alternating current.



ND 5015/070

## VARIMETER RCM – Signalling instead of shutdown

## Table of contents

Function	Page	Function	Page
<b>General</b>		<b>Measuring relays</b>	
<b>Dold - Agents</b>		<b>Multifunctional relays VARIMETER PRO</b> .....	<b>21</b>
- Europe .....	<b>5</b>	Multifunctional relay .....	126
- Worldwide .....	7	Phase monitor .....	134
<b>Product range</b> .....	9	- with motor protection .....	144
<b>DOLD - The Company</b> .....	10	Over and undervoltage relay .....	149
<b>News</b> .....	12	<b>Voltage monitoring VARIMETER</b> .....	<b>22</b>
<b>Table of contents</b> .....	14	Voltage relays .....	160
<b>Alphabetical index</b> .....	16	Overvoltage relays .....	179
<b>Product selections / Forewords</b>		Undervoltage relays .....	183
- Insulation monitors .....	19	Battery symmetry monitors .....	196
- Measuring relays .....	22	<b>Current monitoring VARIMETER</b> .....	<b>23</b>
- Fault annunciators, SMS-Telecontrol modules .....	29	Current relays .....	202
<b>Accessories</b> .....	445	Over- / undercurrent relays .....	214
<b>Dimensions</b> .....	447	Overcurrent relays .....	220
<b>General technical definitions</b> .....	454	Undercurrent relays .....	231
<b>Further available devices</b> .....	456	Current monitor .....	240
<b>Function index</b> .....	457	Current-assymetry-relays .....	242
<b>General Conditions</b>		<b>Load monitoring VARIMETER</b> .....	<b>24</b>
<b>for the supply of products and services</b> .....	459	Motor load monitors .....	244
		Underload monitors .....	261
		Reverse power monitoring .....	272
		<b>Mains monitoring VARIMETER</b> .....	<b>25</b>
		Undervoltage relays .....	277
		Phase indicators .....	279
		Phase monitors .....	134
		Phase-sequence relays .....	289
		Asymmetry relays .....	297
		Frequency relays .....	304
		Neutral monitors .....	311
		Fuse monitors .....	313
		Mains frequency monitors .....	335
		<b>Measuring relays for special applications VARIMETER</b> .....	<b>27</b>
		Voltage and frequency monitors	
		for generator sets on public grid .....	341
		Mains frequency monitor for self-production plant .....	335
		Undervoltage relays f. med. areas	
		acc. to DIN VDE 0100-710 .....	*
		Over- / undervoltage relays for self-production plant .....	149
		Battery symmetry monitors .....	196
		Valve monitor .....	364
		Transformer protection .....	*

Function	Page
<b>Monitoring physical values VARIMETER .....</b>	<b>28</b>
Stand-still monitors .....	366
Speed monitors .....	372
Level sensing relays .....	387
Temperature relays .....	391
Thermistor motor protection relays .....	397
Valve Monitor .....	364
<b>Accessories for measuring relays .....</b>	<b>28</b>
Noise filter .....	409
<b>Fault annunciators, SMS-Telecontrol module</b>	
<b>Fault annunciators .....</b>	<b>29</b>
Fault annunciator systems .....	411
<b>Fault monitoring system INFOMASTER B</b>	
System overview .....	419
Common Alarm Annunciators, bus connection .....	421
New- / first- / common signal annunciators, bus connection .....	426
Text display unit, bus connection .....	431
GSM Module .....	*
SMS Telecontrol module .....	440
<b>Accessories for fault annunciators</b>	
Lamp tester .....	444

## Alphabetical index

Type	Function	Page	Type	Function	Page
<b>AA</b>			EH 5994..... Display unit..... 426		
AA 9050.....	Speed monitor.....	372	EH 5995.....	Display unit.....	426
AA 9837.....	Frequency relay.....	304	EH 5996.....	Text display Unit .....	431
AA 9838.....	Frequency relay.....	304	EH 9997.....	Fault annunciator system .....	411
AA 9943.....	Undervoltage relay .....	183	<b>EP</b>		
<b>AC</b>			EP 5966.....	Fault annunciator system .....	434
Accessories.....		445	EP 5967.....	Fault annunciator system .....	434
<b>AD</b>			<b>F</b>		
AD 5960.....	Fault annunciator system .....	413	Function Index.....		457
AD 5992.....	Fault annunciator system .....	437	Further available devices.....		456
AD 5998.....	Fault annunciator system .....	437	<b>G</b>		
<b>AI</b>			General conditions.....		459
AI 938 .....	Thermistor motor protection relay .....	397	General technical definitions .....		454
AI 941N.....	Phase sequence relay.....	289	<b>IK</b>		
AI 942 .....	Asymmetry relay .....	302	IK 8839 .....	Current monitor .....	240
<b>AK</b>			IK 9044 .....	Voltage monitor .....	177
AK 9840.....	Asymmetry relay .....	297	IK 9046 .....	Voltage monitor .....	177
<b>BA</b>			IK 9055 .....	Speed monitor.....	375
BA 9036.....	Voltage relay.....	172	IK 9065 .....	Underload monitor (cos φ).....	268
BA 9037.....	Voltage relay .....	175	IK 9076 .....	Valve monitor .....	364
BA 9038.....	Thermistor motor protection relay .....	397	IK 9094 .....	Temperature monitoring relay.....	393
BA 9040.....	Asymmetry relay .....	299	IK 9143 .....	Frequency relay.....	323
BA 9041.....	Phase sequence relay.....	289	IK 9144 .....	Standstill monitor.....	368
BA 9042.....	Asymmetry relay .....	302	IK 9168 .....	Phase indicator .....	279
BA 9043.....	Undervoltage relay .....	183	IK 9169.....	Phase monitor .....	284
BA 9053.....	Current relay.....	206	IK 9170 .....	Overvoltage relay, 3-phase.....	179
BA 9054.....	Voltage relay .....	166	IK 9171 .....	Undervoltage relay, 3-phase .....	188
BA 9055.....	Speed monitor.....	372	IK 9172 .....	Overvoltage relay, single phase .....	181
BA 9054/331.....	Battery symmetry monitor .....	196	IK 9173 .....	Undervoltage relay, single phase .....	190
BA 9054/332.....	Battery symmetry monitor .....	196	IK 9178 .....	Phase sequence indicator.....	293
BA 9065.....	Underload Monitor (cos φ) .....	261	IK 9179.....	Phase sequence monitor /-relay .....	295
BA 9094.....	Temperature monitoring relay.....	391	IK 9270 .....	Overcurrent relay.....	220
BA 9837.....	Frequency relay .....	304	IK 9271 .....	Undercurrent relay.....	231
<b>BC</b>			IK 9272 .....	Overcurrent relay.....	226
BC 9190N.....	Voltage drop detector .....	186	IK 9273 .....	Undercurrent relay.....	237
<b>BD</b>			<b>IL</b>		
BD 5936.....	Standstill monitor.....	366	IL 5201/20007.....	Overcurrent relay.....	229
BD 9080.....	Phase monitor .....	141	IL 5880.....	Insulation monitor.....	81
<b>BH</b>			IL 5881.....	Insulation monitor.....	98
BH 9097.....	Motor load monitor .....	248	IL 5882.....	Residual current monitor .....	113
BH 9098.....	Motor load transmitter .....	254	IL 5990.....	Fault annunciator system .....	415
BH 9140.....	Reverse power monitoring .....	272	IL 5991.....	Fault annunciator system .....	415
<b>D</b>			IL 8839.....	Current monitor .....	240
Dimensions.....		447	IL 9055.....	Speed monitor .....	375
<b>EH</b>			IL 9059.....	Phase sequence module.....	286
EH 5990.....	Display unit.....	421	IL 9069.....	Neutral monitor.....	311
EH 5991.....	Display unit.....	421	IL 9071.....	Undervoltage relay .....	192

## Alphabetical index

Type	Function	Page	Type	Function	Page
IL 9075	Fuse monitor	316	MH 9055N/5_0	Speed monitor	*
IL 9077	Over- and undervoltage relay	149	MH 9064	Voltage relay	160
IL 9079	Undervoltage relay to detect auto-reclosing	199	MH 9143	Mains frequency monitor	335
IL 9086	Phase monitor with thermistor motor protection	144	MH 9300	Multifunction measuring relay	126
IL 9087	Phase monitor	147	MH 9397	Motor load monitor	244
IL 9094	Temperature monitoring relay	393	MH 9837N	Frequency relay	325
IL 9144	Standstill monitor	368	MH 9837/5_0	Frequency relay	330
IL 9151	Level sensing relay	387	<b>MK</b>		
IL 9163	Thermistor motor protection relay	399	MK 5130N	Noise Filter	409
IL 9171	Undervoltage relay, 3-phase	188	MK 5880N	Insulation monitor	85
IL 9176	Undervoltage relay, 3-phase with test key	277	MK 9003-ATEX	Thermistor motor protection relay	405
IL 9270	Overcurrent relay	220	MK 9040N	Asymmetry relay	299
IL 9271	Undercurrent relay	231	MK 9053N	Current relay	206
IL 9277	Over- and undercurrent relay	214	MK 9054N	Voltage relay	166
IL 9837	Frequency relay	308	MK 9055N	Speed monitor	381
<b>IN</b>			MK 9055N/5_0	Speed monitor	*
IN 5880/710	Insulation monitor	94	MK 9056N	Phase sequence relay	291
IN 5880/711	Insulation monitor	94	MK 9064N	Voltage relay	160
INFOMASTER B	System overview	419	MK 9065	Underload monitor	265
<b>IP</b>			MK 9143N	Mains frequency monitor	335
IP 5880	Insulation monitor	81	MK 9151N	Level sensing relay	387
IP 5882.48	Residual current monitor Type A with forcibly guided indicator contacts	*	MK 9163N	Thermistor motor protection relay	401
IP 5880/711	Insulation monitor	94	MK 9163N-ATEX	Thermistor motor protection relay	401
IP 9075	Fuse monitor	316	MK 9300N	Multifunction measuring relay	126
IP 9077	Over- and undervoltage relay	149	MK 9397N	Motor load monitor	244
IP 9109.17/107	Undervoltage relay	*	MK 9837N	Frequency relay	325
IP 9109.27/107	Undervoltage relay	*	MK 9837N/5_0	Frequency relay	330
IP 9110/107	Undervoltage relay	*	MK 9994	Lamp tester	444
IP 9111/107	Transformer protection	*	MK 9995	Lamp tester	444
IP 9270	Overcurrent relay	220	<b>ND</b>		
IP 9271	Undercurrent relay	231	ND 5015	Residual current transformer	122
IP 9277	Over- and undercurrent relay	214	ND 5016	Residual current transformer	116
IP 9278	Current asymmetry relay with integrated current transformer up to 100 A	242	ND 5017	Residual current transformer	110
<b>IR</b>			ND 5018	Residual current transformer	123
IR 5882	Residual current monitor	113	ND 5019	Residual current transformer	117
<b>LG</b>			<b>OA</b>		
LG 5130	Noise Filter	409	OA 9059	Phase sequence module	286
<b>LK</b>			<b>RK</b>		
LK 5894	Insulation monitor	71	RK 9169	Phase monitor	284
LK 5895	Insulation monitor	66	RK 9179	Phase sequence monitor /-relay	295
LK 5896	Insulation monitor	59	RK 9871	Undervoltage relay	194
<b>MH</b>			RK 9872	Phase monitor	281
MH 5880	Insulation monitor	85	<b>RL</b>		
MH 9055	Speed monitor	381	RL 9836	Voltage relay	152
			RL 9853	Current relay	202
			RL 9854	Voltage relay	156
			RL 9075	Fuse monitor	313

## Alphabetical index

Type	Function	Page	Type	Function	Page
RL 9877	Phase monitor	134	SL 5990	Fault annunciator system	415
<b>RN</b>			SL 5991	Fault annunciator system	415
RN 5883	Residual current monitor, Type B for AC and DC Systems	119	SL 9055	Speed monitor	375
RN 5897/010	Insulation monitor	39	SL 9059	Phase sequence module	286
RN 5897/300	Insulation monitor	51	SL 9065	Underload monitor (cos $\varphi$ )	268
RN 9075	Fuse monitor	313	SL 9069	Neutral monitor	311
RN 9877	Phase monitor	134	SL 9071	Undervoltage relay	192
<b>RP</b>			SL 9075	Fuse monitor	316
RP 5812	SMS-Telecontrol Module	440	SL 9077	Over- and undervoltage relay	149
RP 5888	Insulation monitor	90	SL 9079	Undervoltage relay to detect auto-reclosing ...	199
RP 5990	Common Alarm System, Bus Connection..	421	SL 9086	Phase monitor with thermistor motor protection	144
RP 5991	Common Alarm System, Bus Connection..	421	SL 9087	Phase monitor	147
RP 5994	New- / First- /Common Signal Annunciator...	426	SL 9094	Temperature monitoring relay	393
RP 5995	New- / First- /Common Signal Annunciator...	426	SL 9144	Standstill monitor	368
RP 9140	Reverse power monitoring	272	SL 9151	Level sensing relay	387
RP 9800	Voltage and frequency monitor	341	SL 9163	Thermistor motor protection relay	399
RP 9810	Voltage- and frequency monitor acc. to VDE-AR-N 4105	344	SL 9171	Undervoltage relay, 3-phase	188
RP 9811	Voltage and frequency monitor	349	SL 9270	Overcurrent relay	220
<b>RR</b>			SL 9270CT	Overcurrent relay	220
RR 5886	Locating current injector	102	SL 9271	Undercurrent relay	231
RR 5887	Insulation fault locator	106	SL 9271CT	Undercurrent relay	231
<b>SK</b>			SL 9277	Over- and undercurrent relay	214
SK 9055	Speed monitor	375	SL 9277CT	Over- and undercurrent relay	214
SK 9065	Underload monitor (cos $\varphi$ )	268	SL 9837	Frequency relay	308
SK 9076	Valve monitor	364	<b>SP</b>		
SK 9094	Temperature monitoring relay	393	SP 5880	Insulation monitor	81
SK 9143	Frequency relay	323	SP 9075	Fuse monitor	316
SK 9144	Standstill monitor	368	SP 9077	Over- and undervoltage relay	149
SK 9168	Phase indicator	279	SP 9270	Overcurrent relay	220
SK 9169	Phase monitor	284	SP 9270CT	Overcurrent relay	220
SK 9170	Overvoltage relay, 3-phase	179	SP 9271	Undercurrent relay	231
SK 9171	Undervoltage relay, 3-phase	188	SP 9271CT	Undercurrent relay	231
SK 9172	Overvoltage relay, single phase	182	SP 9277	Over- and undercurrent relay	214
SK 9173	Undervoltage relay, single phase	190	SP 9277CT	Over- and undercurrent relay	214
SK 9178	Phase sequence indicator	293	SP 9278CT	Current asymmetry relay with integrated current transformer up to 100 A	242
SK 9179	Phase sequence monitor /-relay	295	<b>UG</b>		
SK 9270	Overcurrent relay	220	UG 9075	Fuse monitor	320
SK 9271	Undercurrent relay	231	<b>UH</b>		
SK 9272	Overcurrent relay	226	UH 5892	Insulation monitor	77
SK 9273	Undercurrent relay	237			
<b>SL</b>					
SL 5201/20007CT	Overcurrent relay	229			
SL 5880	Insulation monitor	81			
SL 5881	Insulation monitor	98			
SL 5882	Residual current monitor	113			



## Product selection

### Insulation monitors for non-earthed systems VARIMETER IMD

Function	System type	Nominal Voltage [V]	Response value	With auxiliary voltage	Connection for indicator	Housing style	Width [mm]	Type	Page
Insulation monitor	mixed systems	1000	adjustable, 1 kΩ ... 2 MΩ	+		Distribution board	52.5	RN 5897/010	39
Insulation monitor	mixed systems	300	adjustable, 10 kΩ ... 1 MΩ	+		Distribution board	52.5	RN 5897/300	51
Insulation monitor	mixed systems	1000	adjustable, 1 kΩ ... 2 MΩ	+	+	Switch cabinet	90	LK 5896	59
Insulation monitor	mixed systems	1000	adjustable, 1 kΩ ... 2 MΩ	+		Switch cabinet	90	LK 5895	66
Insulation monitor	mixed systems	690	adjustable, 1 kΩ ... 2 MΩ	+		Switch cabinet	90	LK 5894	71
Insulation monitor	mixed systems	AC: 400 DC: 600	fixed, 10 kΩ ... 440 kΩ	+	+	Switch cabinet	45	UH 5892	77
Insulation monitor	AC; three-phase	500	adjustable, 5 kΩ ... 100 kΩ	+		Distribution board	35; 70	IL 5880, IP 5880, SL 5880, SP 5880	81
Insulation monitor	AC; three-phase	500	adjustable, 5 kΩ ... 100 kΩ	+		Switch cabinet	22,5; 45	MK 5880N, MH 5880	85
Insulation monitor	AC; three-phase	500	adjustable, 5 kΩ ... 5 MΩ	+	+	Distribution board	70	RP 5888	90
Insulation monitor for rooms used for medical purposes	AC; three-phase	500	adjustable, 50 kΩ ... 500 kΩ	+		Distribution board	52,5; 70	IN 5880/710, IN 5880/711, IP 5880/711	94
Insulation monitor	DC	280	adjustable, 5 kΩ ... 200 kΩ			Distribution board Switch cabinet	35 35	IL 5881, SL 5881	98

Following product are also available: AI 897, AI 898, EH 5878

The data sheets are available at [www.dold.com](http://www.dold.com)

## Monitoring devices

### Product selection

#### Equipment for insulation fault location VARIMETER EDS

Function	Nominal voltage IT systems	Manual reset	Bus interface	Operating mode	Operating voltage	Width [mm]	Type	Page
Locating current injector	DC, AC, 3 AC 24...360 V	-	RS-485	Master / Slave	AC / DC 100 ... 230 V	105	RR 5886	102
Isolation fault locator	DC, AC, 3 AC 24 ... 360 V	selectable by control terminal	RS-485	Slave	AC / DC 100 ... 230 V	105	RR 5887	106
Residual current transformer	-	-	-	-	-	-	ND 5015	122
Residual current transformer	-	-	-	-	-	-	ND 5016	116
Residual current transformer	-	-	-	-	-	-	ND 5017	110
Residual current transformer	-	-	-	-	-	-	ND 5018	123
Residual current transformer	-	-	-	-	-	-	ND 5019	117

#### Residual current monitors for earthed systems VARIMETER RCM

Function	Type of voltage	Adjustable measuring ranges [A]	Relay contacts / output	Adjustable operate delay	Test button	Reset button	Broken conductor detection	Housing style	Width [mm]	Type	Page
Residual current monitor, Type A	AC; DC pulsating	0.01 ... 10; 0.01 ... 30	+	+	+	+	+	Distribution board Switch cabinet	35 35	IL 5882, SL 5882	113
Residual current monitor, Type A, with forcibly guided indicator contacts	AC; DC; pulsating	0.01 ... 10	+	+	+	+	+	Distribution board	52.5	IP 5882.48	*
Residual current monitor, Type A, with integrated transformer	AC; DC; pulsating	0.01 ... 10; 0.01 ... 30	+	+	+	+	+	Distribution board	105	IR 5882	113
Residual current monitor, Type B	AC; DC; DC pulsating	0.01 ... 3	+	+	+	+	+	Distribution board	52.5	RN 5883	119

\* Data sheet can be ordered

## Product selection

### Multifunctional relays VARIMETER PRO

Function	1-/3-phase	Standard measuring range	Measuring range max.	Contacts	Adjustable operate delay	Auxiliary voltage required	Housing Style	Width [mm]	Type	Page
Multifunctional measuring relay	1; 3	3 AC 24 ... 690 V	... 690 V	1 C/O; 2 x 1 C/O	+	+	Switch cabinet	22,5; 45	MK 9300N, MH 9300	126
Phase monitor with detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3 AC 400 V	690 V	2 C/O	+	+	Switch cabinet	45	BD 9080	141
Phase monitor with thermal motor protection, detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3/N AC 400/230 V	400 V	2 C/O			Distribution board Switch cabinet	35 35	IL 9086, SL 9086	144
Phase monitor with detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3/N AC 400/230 V	400 V	1 C/O; 2 C/O			Distribution board Switch cabinet	35 35	IL 9087, SL 9087	147
Traformer protection: Current and temperature monitoring	1	5 ... 50 A; >3,8 kΩ	50 A	2 x 2 C/O		+	Distribution board	70	IP 9111/107	*
Over-/undervoltage relay, optionally with unbalance and phase-sequence detection	3	AC 400 V	480 V	2 C/O; 4 C/O	+		Distribution board Switch cabinet	35; 70 35; 70	IL 9077, IP 9077, SL 9077, SP 9077	149

C/O = changeover contact

\* Data sheet can be ordered

## Product selection

### Voltage monitoring VARIMETER

Function	1-/3-phase	Max. measuring range	Contacts	Operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
Voltage relay	1	DC 250 V	1 C/O	+		Switch cabinet	35	RL 9836	152
Voltage relay	1	AC 300 V	1 C/O	+		Switch cabinet	35	RL 9854	156
Voltage relay, digital	1	AC/DC 300 V	1 C/O	+	+	Switch cabinet	22.5	MK 9064N	160
Voltage relay, digital	1	AC/DC 600 V	2 x 1 C/O	+	+	Switch cabinet	45	MH 9064	160
Voltage relay	1	AC/DC 1000 V	2 C/O	+	+	Switch cabinet	45	BA 9054, MK 9054N	166
Voltage relay	1	AC 660 V	1 C/O; 2 C/O	+		Switch cabinet	45	BA 9036	172
Voltage relay	1	AC 690 V	2 C/O	+		Switch cabinet	45	BA 9037	175
Voltage relay undervoltage, overvoltage, residual ripple	1	DC 24 V	1 C/O; 2 C/O	+		Distribution board	17.5	IK 9044, IK 9046	177
Overvoltage relay	3	AC 440 V	1 C/O; 2 C/O	+		Distribution board Switch cabinet	17.5 17.5	IK 9170, SK 9170	179
Overvoltage relay	1	AC 230 V	1 C/O; 2 C/O	+		Distribution board Switch cabinet	17.5 17.5	IK 9172, SK 9172	181
Over- and undervoltage relay	3	AC 480 V	2 C/O; 4 C/O	+		Distribution board Switch cabinet	35; 70 35; 70	IL 9077, IP 9077, SL 9077, SP 9077	149
Undervoltage relay	3	AC 690 V	2 C/O	+		Switch cabinet for front panel mounting	45	BA 9043, AA 9943	183
Undervoltage relay, detection of short-time phase failures	1	AC 230 V	1 C/O; 2 C/O	+		Switch cabinet	22.5	BC 9190N	186
Undervoltage relay	3	AC 500 V	1 C/O; 2 C/O	+		Distribution board Switch cabinet	17.5 35	IK 9171, IL 9171, SK 9171, SL 9171	188
Undervoltage relay	1	AC 400 V	1 C/O	+		Distribution board Switch cabinet	17.5 17.5	IK 9173, SK 9173	190
Undervoltage relay	3	AC 440 V	2 C/O	+		Distribution board Switch cabinet	35 35	IL 9071, SL 9071	192
Undervoltage relay	3	AC 400 V	1 C/O; 2 C/O			Distribution board	17.5	RK 9871	194
Undervoltage relay to detect auto-reclosing	3	AC 500 V	2 C/O	+		Distribution board Switch cabinet	35 17.5	IL 9079, SL 9079	199
Undervoltage relay for rooms used for medical purposes	1	AC 230 V	2 C/O	+		Distribution board	70	IP 9109.27/107	*
Undervoltage relay for rooms used for medical purposes	3	AC 400 V	1 NO, 2 NC	+		Distribution board	70	IP 9110/107	*
Undervoltage relay for rooms used for medical purposes	1	AC 230 V	2 NO, 2 NC	+		Distribution board	70	IP 9109.17/107	*
Battery symmetry monitor	1	0,12 ... 1,2 V DC	2 C/O	+	+	Switch cabinet	45	BA 9054/331 BA 9054/332	196

NO = normally open contact, NC = normally closed contact, C/O = changeover contact

Following product are also available: IL 9070 ; The data sheet are available at [www.dold.com](http://www.dold.com)

\* Data sheet can be ordered

## Product selection

### Current monitoring VARIMETER

Function	1-/3-phase	Max. measuring range	Contacts	Operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
RL 9853	1	AC 230 V	1 C/O	+	+	Switch cabinet	35	RL 9853	202
Current relay	1	10 A	2 C/O	+	+	Switch cabinet	22.5	MK 9053N	206
Current relay	1	25 A	1 C/O / 2 C/O	+	+	Switch cabinet	45	BA 9053	206
Over-/undercurrent relay	1	15 A	2 C/O	+	+	Distribution board Switch cabinet	35 35	IL 9277, SL 9277	214
Over-/undercurrent relay	1	100 A	2 C/O	+	+	Switch cabinet	35	SL 9277CT	214
Over-/undercurrent relay	3	15 A	2 x 2 C/O	+	+	Distribution board Switch cabinet	70 70	IP 9277, SP 9277	214
Over-/undercurrent relay	3	100 A	2 x 2 C/O	+	+	Switch cabinet	70	SP 9277CT	214
Overcurrent relay	1	15 A	1 C/O	+	+	Distribution board Switch cabinet	17.5 17.5	IK 9270, SK 9270	220
Overcurrent relay	1	50 A	1 C/O / 2 C/O	+	+	Distribution board Switch cabinet	35 35	IL 9270, SL 9270	220
Overcurrent relay	3	15 A	2 C/O	+	+	Distribution board Switch cabinet	70 70	IP 9270, SP 9270	220
Overcurrent relay	3	100 A	2 C/O	+	+	Switch cabinet	35;70	SL 9270CT, SP 9270CT	220
Overcurrent relay	1	10 A	2 C/O	+	+	Distribution board Switch cabinet	17.5 17.5	IK 9272, SK 9272	226
Overcurrent relay	1	5 A	1 C/O	+	+	Distribution board	35	IL 5201/20007	229
Overcurrent relay	1	50 A	2 x 1 C/O	+	+	Switch cabinet	35	SL 5201/20007CT	229
Undercurrent relay	1	15 A	2 x 1 C/O	+	+	Distribution board Switch cabinet	17.5 17.5	IK 9271, SK 9271	231
Undercurrent relay	3	50 A	1 C/O	+	+	Distribution board Switch cabinet	35 35	IL 9271, SL 9271	231
Undercurrent relay	1	100 A	1 C/O / 2 C/O	+	+	Distribution board Switch cabinet	70 70	IP 9271, SP 9271	231
Undercurrent relay	1	15 A	2 C/O	+	+	Switch cabinet	35	SL 9271CT	231
Undercurrent relay	3	100 A	2 C/O	+	+	Switch cabinet	70	SP 9271CT	231
Undercurrent relay	1	100 A	2 C/O	+	+	Distribution board Switch cabinet	17.5 17.5	IK 9273, SK 9273	237
Current monitor	1	10 A	1 C/O		+	Distribution board	17.5; 35	IK 8839, IL 8839	240
Current-assymetry-relay	3	15 A	1 INV; 1 NO	+	+	Distribution board Switch cabinet	70 70	IP 9278, SP 9278	242
Current-assymetry-relay	3	100 A	2 C/O	+	+	Switch cabinet	70	SP 9278CT	242

NO = normally open contact, C/O = change-over contact; / = optional

Following product are also available: ML 9701 ; The data sheet are available at [www.dold.com](http://www.dold.com)

## Product selection

### Load monitoring VARIMETER

Function	1-/3-phase	Measuring range, max.	Output contacts max.	Operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
Motor load monitor	3	12 A (8 kW)	1 C/O	+	+	Switch cabinet	22.5	MK 9397N	244
Motor load monitor	3	12 A (8 kW)	2 x 1 C/O	+	+	Switch cabinet	45	MH 9397	244
Motor load monitor	1; 3	40 A (37 kW)	2 x 1 C/O	+		Switch cabinet	45	BH 9097	248
Motor load transmitter	1; 3	40 A (37 kW)	0 ... 10 V/ ... 20 mA			Switch cabinet	45	BH 9098	254
Underload monitor (cos φ monitor)	1; 3	10 A	1 C/O / 1 C/O, 1 NO	+		Switch cabinet	45	BA 9065	261
Underload monitor (cos φ monitor)	1; 3	10 A	1 C/O + 1 C/O, 1 NO	+		Switch cabinet	22.5	MK 9065	265
Underload monitor (cos φ monitor)	1; 3	8 A	1 C/O	+		Switch cabinet Distribution board	17.5 17.5	IK 9065, SK 9065	268
Underload monitor (cos φ monitor)	1; 3	100 A	1 C/O	+		Switch cabinet	45	SL 9065CT	268
Reverse power monitoring	1; 3	40 A	2 C/O	+	+	Switch cabinet	45	BH 9140	272
Reverse power monitoring	1; 3	5 A	2 C/O	+	+	Distribution board	70	RP 9140	272

NO = normally open contact, C/O = change-over contact

Following product are also available : BA 9067 ; The data sheet are available at [www.dold.com](http://www.dold.com)

## Product selection

### Mains monitoring VARIMETER

Function	1-/3-phase	Standard measuring range *	Max. measuring range	Contacts	Operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
Undervoltage relay with test key	3	3/N AC 400/230 V	400 V	2 C/O			Distribution board	35	IL 9176	277
Phase monitor with detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3/N AC 400/230 V	400 V	1 C/O; 2 C/O			Distribution board Switch cabinet	35 35	IL 9087, SL 9087	147
Phase monitor with detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3AC 400 V	690 V	2 C/O	+	+	Switch cabinet	45	BD 9080	141
Phase monitor with thermal motor protection, detection of under-/overvoltages, unbalance, phase failure, phase sequence	3	3/N AC 400/230 V	400 V	2 C/O			Distribution board Switch cabinet	35 35	IL 9086, SL 9086	144
Phase indicator	3	3/N AC 400; 230 V	400 V				Distribution board Switch cabinet	17.5 17.5	IK 9168, SK 9168	279
Phase monitor	3	3 AC 80 ... 230 V/ 45 ... 130 V	230 V	1 C/O	+		Switch cabinet	35	RL 9877	134
Phase monitor	3	3 AC 175 ... 525 V/ 100 ... 300 V	525 V	1 C/O	+		Switch cabinet	52.5	RN 9877	134
Phase monitor	3	3/N AC 400; 230 V	400 V	1 C/O			Distribution board	17.5	RK 9872	281
Phase monitor	3	3/N AC 400; 230 V	400 V	1 C/O			Distribution board Switch cabinet	17.5 17.5	IK 9169, RK 9169, SK 9169	284
Phase sequence relay	3	AC 380 ... 690 V	690 V	1 C/O			Installationsverteiler Schaltschrank	35 35	IL 9059, SL 9059	286
Phase sequence relay	3	AC 380 ... 690 V	690 V	1 NC			Motor terminal box	62	OA 9059	286
Phase sequence relay	3	3 AC 400 V	550 V	1 C/O; 2 C/O			Switch cabinet	45	BA 9041, AI 941N	289
Phase sequence relay	3	3 AC 380 ... 500 V	500 V	2 C/O			Switch cabinet	22.5	MK 9056N	291
Phase sequence indicator	3	3 AC 400 V	3 AC 400 V				Distribution board Switch cabinet	17.5 17.5	IK 9178, SK 9178	293
Phase sequence monitor (Phase sequence relay)	3	3 AC 400 V	3 AC 400 V	1 C/O			Distribution board Switch cabinet	17.5 17.5	IK 9179, RK 9179 SK 9179	295
Asymmetry relay	3	3 AC 400 V	3 AC 690 V	2 C/O	+		Switch cabinet	75	AK 9840	297
Asymmetry relay	3	3 AC 400 V	3 AC 690 V	2 C/O	+		Switch cabinet	22.5; 45	BA 9040, MK 9040N	299
Asymmetry relay	3	3AC 400 V	3 AC 400 V	2 C/O			Switch cabinet	45	BA 9042, AI 942	302
Frequency relay	1	30 ... 90 Hz	600 Hz	1 C/O; 2 C/O	+	+	Switch cabinet	45	BA 9837, AA 9837, AA 9838	304
Frequency relay	1	5 ... 200 Hz	300 Hz	1 C/O; 2 C/O	+	+	Distribution board Switch cabinet	35 35	IL 9837, SL 9837	308
Neutral monitor	3	3/N AC 400; 230 V	415 V	2 C/O	+		Distribution board Switch cabinet	35 35	IL 9069, SL 9069	311

NC = normally closed contact, C/O = change-over contact

\* Other measuring ranges on request

## Product selection

### Mains monitoring VARIMETER

Function	1-/3-phase	Standard measuring range *	Max. measuring range	Contacts	Operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
Fuse monitor	1; 3	3 AC 110/64 V	3 AC 110 V	1 C/O	+		Switch cabinet	35	RL 9075	313
Fuse monitor	1; 3	3 AC 400/230 V 3 AC 230/130 V	3 AC 400 V	1 C/O	+		Switch cabinet	52.5	RN 9075	313
Fuse monitor	3	3 AC 380 ... 415 V	690 V	2 C/O			Distribution board Switch cabinet	35 35	IL 9075, IP 9075, SL 9075, SP 9075	316
Fuse monitor	3	3 AC 110 ... 400 V	3 AC 400V	2 C/O	+		Switch cabinet	22.5	UG 9075	320
Frequency relay	1	50; 60 Hz	50/60 Hz	1 C/O	+	+	Distribution board Switch cabinet	17.5 17.5	IK 9143, SK 9143	323
Frequency relay	1	1,5 ... 600 Hz	600 Hz	2 C/O		+	Switch cabinet	22.5; 45	MK 9837N, MH 9837	325
Frequency relay	1	1,5 ... 600 Hz	600 V	2 C/O	+	+	Switch cabinet	22.5; 45	MK 9837N/ 5_0, MH 9837/ 5_0	330
Mains frequency relay	1	50; 60 Hz	50/60 Hz	2 C/O; 4 C/O	+	+	Switch cabinet	22.5; 45	MK 9143N, MH 9143	335

NC = normally closed contact, C/O = change-over contact

\* Other measuring ranges on request



## Product selection

### Measuring relays for special applications VARIMETER

Function	1-/3-phase	Standard measuring range	Contacts	Adjustable operate delay	Auxiliary voltage required	Housing style	Width [mm]	Type	Page
Voltage and frequency monitor for generator sets on public grid	3	50 Hz; AC 230 V	2 C/O	+		Distribution board	70	RP 9800	341
Voltage and frequency monitor for generator sets on public grid acc. to VDE-AR-N 4105	3	50 Hz; AC 400 / 230 V	3 C/O	+		Distribution board	70	RP 9810	344
Voltage and frequency monitor for generator sets on public grid international	3	AC 400 / 230 V	3 NO	+	+	Distribution board	70	RP 9811	349
Mains frequency monitor for self-production plant	1	50 / 60 Hz	2 C/O; 4 C/O	+	+	Switch cabinet	22.5; 45	MK 9143N, MH 9143	335
Undervoltage relay, f. med.areas acc. to DIN VDE 0100-710	3	AC 230 V	2 NO + 2 NC	+		Distribution board	70	IP 9109.27/107	*
Undervoltage relay, f. med.areas acc. to DIN VDE 0100-710	3	AC 400 V	2 NO + 2 NC	+		Distribution board	70	IP 9109.17/107	*
Undervoltage relay, f. med.areas acc. to DIN VDE 0100-710	3	AC 400 V	1 NO + 2 NC	+		Distribution board	70	IP 9110/107	*
Over- and undervoltage relay as option with unbalance- and phase sequence detection for self-production plant	1	50 ... 500 kΩ	2 C/O		+	Distribution board	52.5; 70	IN 5880/710, IN 5880/711	94
Battery symmetry monitor	1	0,12 ... 1,2 V DC	2 C/O	+	+	Switch cabinet	45	BA 9054/331, BA9054/332	196
Valve monitor: current and broken conductor monitoring	1	< 0,7A	1 C/O		+	Distribution board Switch cabinet	17.5 17.5	IK 9076, SK 9076	364
Transformer protection: Current and temperature monitoring f. med.areas acc. to DIN VDE 0100-710	1	5 ... 50 A; > 3.8 kΩ	2 x 2 C/O		+	Distribution board	70	IP 9111/107	*

NO = normally open contact, NC = normally closed contact, C/O = change-over contact

Following products are also available: AI 940 ; The data sheets are available at [www.dold.com](http://www.dold.com)

\* Data sheet can be ordered

## Monitoring devices

### Product selection

#### Monitoring physical values VARIMETER

Function	Measuring range, max.	Contacts	Operate delay	Housing style	Width [mm]	Type	Page
Stand-still monitor		2 NO, 2 NC		Switch cabinet	45	BD 5936	366
Stand-still monitor	300000 IPM	1 C/O	+	Distribution board	17.5; 35	IK 9144, IL 9144 SK 9144; SL 9144	368
Speed monitor	10000 IPM	1 C/O	+	Switch cabinet	45	BA 9055, AA 9050	372
Speed monitor	600000 IPM	1 C/O	+	Distribution board Switch cabinet	17.5; 35 17.5; 35	IK 9055, IL 9055, SK 9055, SL 9055	375
Speed monitor	120000 IPM	2 C/O		Distribution board	22.5; 45	MK 9055N, MH 9055	381
Speed monitor	120000 IPM	2 C/O		Distribution board	22.5; 45	MK 9055N/5_0, MH 9055/5_0	*
Level sensing relay	450 k $\Omega$	2 x 1 C/O	+	Distribution board Switch cabinet	35 22.5; 45	IL 9151, SL 9151, MK 9151N	387
Temperature relay	600 °C	1 C/O, 1 NO		Switch cabinet	35	BA 9094	391
Temperature relay	300 °C	1 C/O		Distribution board Switch cabinet	17.5; 35 17.5; 35	IK 9094, IL 9094, SK 9094, SL 9094	393
Thermistor motor protection relay	> 3.8 k $\Omega$	2 C/O		Switch cabinet	45	BA 9038, AI 938	397
Thermistor motor protection relay	> 3.8 k $\Omega$	2 C/O		Distribution board Switch cabinet	35 35	IL 9163, SL 9163	399
Thermistor motor protection relay	> 3.8 k $\Omega$	2 C/O		Switch cabinet	22.5	MK 9163N, MK 9163N-ATEX	401
Thermistor motor protection relay	> 3.1 k $\Omega$	2 C/O		Switch cabinet	22.5	MK 9003-ATEX	405
Transformer protection: Current and temperature monitoring	5 ... 50 A; > 3.8 k $\Omega$	2 x 2 C/O		Distribution board	70	IP 9111/107	*
Valve monitor: current and broken conductor monitoring	< 0.7A	1 C/O		Distribution board Switch cabinet	17.5 17.5	IK 9076, SK 9076	364

NO = normally open contact, C/O = change-over contact

\* Data sheet can be ordered

#### Accessories for measuring relays

Function	3-phase	Nominal voltage $U_N$ max.		Housing style	Width [mm]	Depth [mm]	Type	Page
		without PE connectoin	with PE connectoin					
Noise filter	+	3 AC 1000 V	3/N AC 860 / 500 V	Switch cabinet	22.5	97 121	MK 5130N, LG 5130	409

## Monitoring devices

### Product selection

#### Fault annunciator systems INFOMASTER, accessories

Function	Alarm inputs	Alarm inputs, extendable up to	Operate delay	Operating principle: Energized-on-trip (A)/ de-energized-on-trip (R) de repos (R)	Visual indication	Acoustic indication	Special features	Housing style	Width [mm]	Type	Page
Fault annunciator system	6	8		R	LED	Output for horn		Front panel mounting	96 x 96	EH 9997	411
Fault annunciator system	12			A		Output for horn		Switch cabinet	45	AD 5960	413
Fault annunciator system	4	160	1; 3; 10 NO	A / R	LED	Output for horn		Distribution board Switch cabinet	35 35	IL 5990, IL 5991, SL 5990, SL 5991	415
Common alarm annunciator	8	88	0 ... 10 NO	A / R	LED		configurable; bus-compatible	Distribution board Switch cabinet	70 70	RP 5990, RP 5991	421
New- / First- / Common signal annunciator	8	88	0 ... 10 NO	A / R	LED		configurable; bus-compatible	Distribution board Switch cabinet	70 70	RP 5994, RP 5995	426
Indications panel for fault annunciator system					LED		configurable; bus-compatible	Front panel mounting	96 x 96	EH 5990, EH 5991	421
Indications panel for new-value and first-up annunciator					LED		configurable; bus-compatible	Front panel mounting	96 x 96	EH 5994, EH 5995	426
Text display unit for New-value and first-up annunciator system					LED		configurable; bus-compatible	Front panel mounting	96 x 96	EH 5996	431
Fault annunciator system	16	160	1; 3; 10 NO	A / R	LED	Output for horn		Front panel mounting	72; 144	EP 5966, EP 5967	434
Fault annunciator system	3; 6	303		A	Output for signal lamp	Output for horn		Switch cabinet	45	AD 5998, AD 5992	437
GSM-Module busconnection					LED		configurable; bus-compatible	Distribution board	70	RP 5810	*
SMS-Telecontrol module					LED			Distribution board	70	RP 5812	440
Accessories for fault annunciators: Lamp tester					LED			Distribution board Switch cabinet	17.5 17.5	MK 9994, MK 9995	444

NO = normally open contact

Following product are also available : AI 990, AI 991, AI 992, AI 998, UP 5864

## Monitoring hardware

DOLD's monitoring relays such as insulation monitors, differential-current monitors and measuring relays reliably monitor electrical quantities such as current, voltage, power, resistance, etc. and annunciate fault conditions and disturbances. Thus, these products protect also complex systems and ensure an optimal production flow. LEDs on the front provide visual status indications. Output contacts or interfaces for bus systems allow a further transmission of information from these devices, e.g. to fault annunciators.

### Monitoring electrical quantities : **System**

#### Phase

- Voltage
  - Phase failure / Asymmetrie
  - Broken neutral wire
  - Frequency
  - Insulation failures
- Undervoltage and overvoltage relays, voltage monitors, single- and three-phase
  - Phase-sequence relays, phase monitors, phase indicators
  - Unbalance relays
  - Neutral monitors
  - Frequency relays
  - Insulation / differential-current monitors

### Monitoring electrical quantities: **Load**

#### Load

- Current
  - $\cos \varphi$
  - Effective power
- Current relays
  - Underpower monitors
  - Load monitors, overload monitors, load transformers

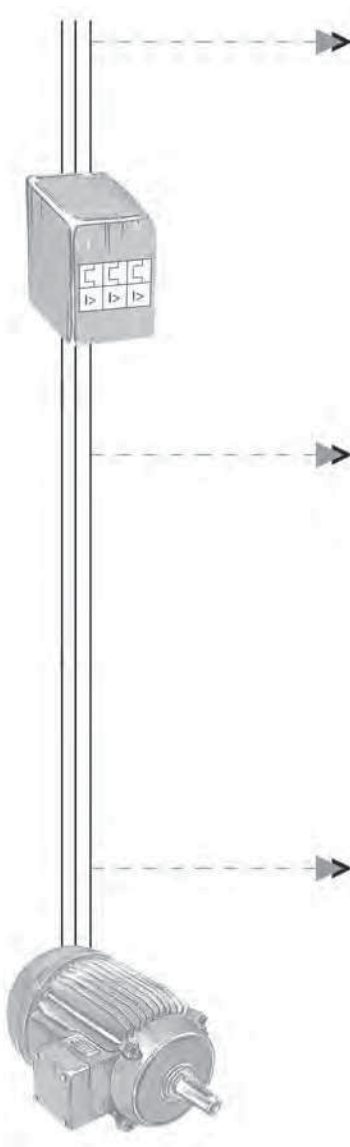
### Monitoring physical quantities : **Processes**

#### Installations

- Speed
  - Temperature
  - Level
- Speed / zero-speed relays
  - Temperature relays, thermistor motor protection relays
  - Neutral monitor
  - Level sensing relays

### Monitoring of multiple quantities / **special applications**

- Multifunctional relays
- Measuring relays for specific applications



# Insulation monitor

## Non-earthed (IT) systems

### Insulation monitor

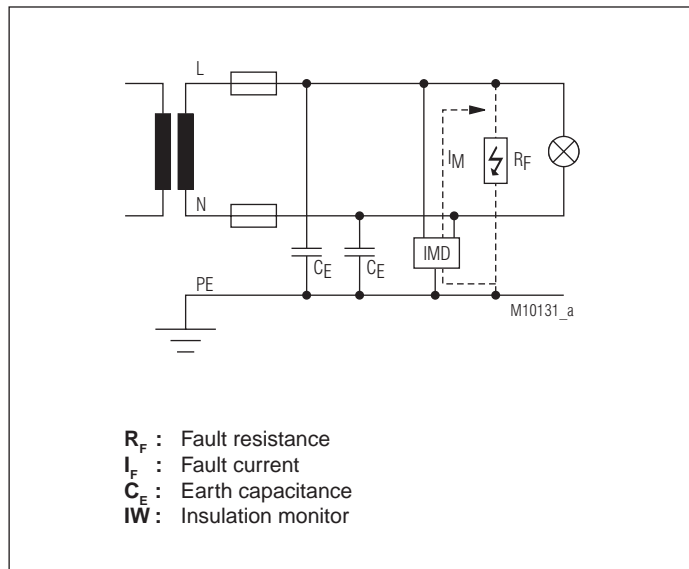
Insulation monitors are used in non-earthed systems (IT systems). They measure the insulation resistance against earth of the system to be monitored. Such systems are protected by insulation monitors the use of them in IT systems is required by law by the norm "Safety of Machinery" DIN EN 60204-1 or DIN VDE 0100-410.

Thanks to the deliberately kept simple functionality of insulation monitors from DOLD customers benefit from a considerable cost advantage combined with the high quality standard accustomed from DOLD. Insulation monitors are used to avoid accidents and downtimes in the case of insulation failures and to protect against fire and accidents.

For insulation monitoring in earthed systems, differential-current monitors are used.

#### Problem:

- The standards DIN VDE 0100-410 and DIN EN 60204-1 require the use of an insulation monitor in non-earthed systems. Our objective is to meet this standard as cost-effective as possible.
- Ensure protection against fire and accidents by early detection of earth fault currents and slowly evolving insulation faults, e.g. safeguarding fire/explosion-prone areas
- Prevent unscheduled downtimes due to earth faults in medical areas.



#### Solution:

DOLD insulation monitors are available for d.c. and three-phase systems, a.c. systems and mixed systems. Further, our insulation monitors can be used to monitor switched off loads, mobile power supply units, d.c. systems and rooms used for medical applications.

## Earthed (TN) systems

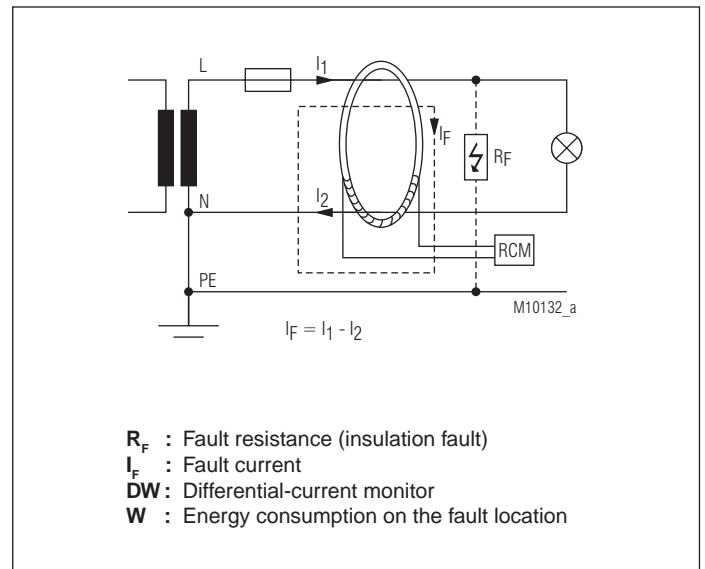
### Differential-current monitors

Differential-current monitors are used in earthed systems (TN systems). They monitor the fault current on the basis of the differential-current measurement and are mainly used to prevent expensive downtimes and fire risk that is latently present due to evolving insulation faults. They guarantee an increased safety of operating and installations.

For insulation monitoring in non-earthed systems, insulation monitors are used.

#### Problem:

- Avoid the risk of fire and accidents due to slowly evolving insulation faults: High-resistance faults to exposed conductive parts and to earth are present if the conductive connection of the fault location includes resistances. There is just a risk of fire when the power loss on the fault location is 60 W. This corresponds to a fault current of 260 mA at 230 VAC. Overcurrent devices would not operate in this case.
- Avoid costly downtimes, get an information lead to ensure high operational reliability between maintenance intervals



#### Solution:

In their standard variant, DOLD differential-current monitors can be used for d.c. systems or pulsating d.c. systems, and a universal-current-sensitive variant is available for mixed systems.

## Basics of monitoring technology in low voltage systems

### What means asymmetry (unbalance) in three-phase systems?

The most common system is the 400 V three-phase system (fig. 1) formed from three alternating voltages that are displaced in time by 120° el. (fig. 2). Between the phases L1, L2, and L3, there are 3 phase-to-phase voltages  $U_{L1-L2}$ ,  $U_{L2-L3}$ ,  $U_{L3-L1}$  that are also referred to as line-to-line voltages. Graphically represented in a phasor diagram, these voltages result in an isosceles triangle (fig. 3). This type of representation is common in electrical engineering to easily illustrate sinusoidal alternating quantities. The 3 voltages against the neutral N of the transformer are the star voltages (phase-to-neutral voltages)  $U_{L1-N}$ ,  $U_{L2-N}$ ,  $U_{L3-N}$  which can also be drawn in the isosceles triangle.

Under normal conditions in a three-phase system, all voltages are equal in their magnitude and all angles are 120° el. An deviation from this is called asymmetry (unbalance). How this affects connected loads is described below.

There are two types of asymmetry:

**Case 1:** Given a stiff system, i.e. the phase-to-phase voltages are constant, the phase-to-neutral voltages on the load (measuring point A) can change without changing the outer symmetry (fig. 4). This is the case with asymmetric loads in star connections and interrupted neutral conductor, i.e. with open neutral (star) point.

**Case 2:** However, if the phase-to-phase voltages change, this will always cause a change of the phase-to-neutral voltages too. This occurs with motive-power loads when one phase fails (fig. 1b). The motor windings U and V induce a voltage in the disconnected winding W, which does no longer correspond to the original system voltage. Therefore, the three-phase system downstream of the fuses on the measuring point B became asymmetric. This is referred to as reverse power.

To detect an asymmetry in a system, for the 1st case, the 3 phase-

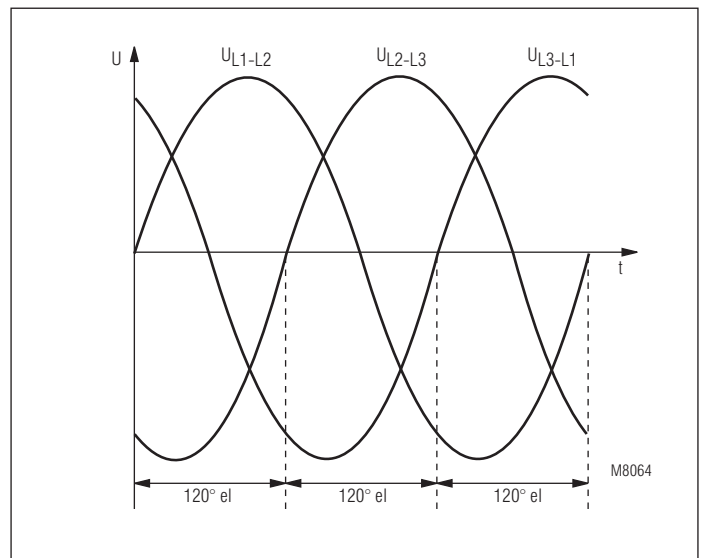
to-phase voltages against the star point (neutral conductor N) must be measured and compared to each other. Even the smallest voltage differences cause an asymmetry. It can be calculated by

$$\text{Asymmetry (Unbalance)} = \left( \frac{\text{Highest voltage}}{\text{Lowest voltage}} - 1 \right) * 100 \text{ in (\%)} \quad \text{Eq.(1)}$$

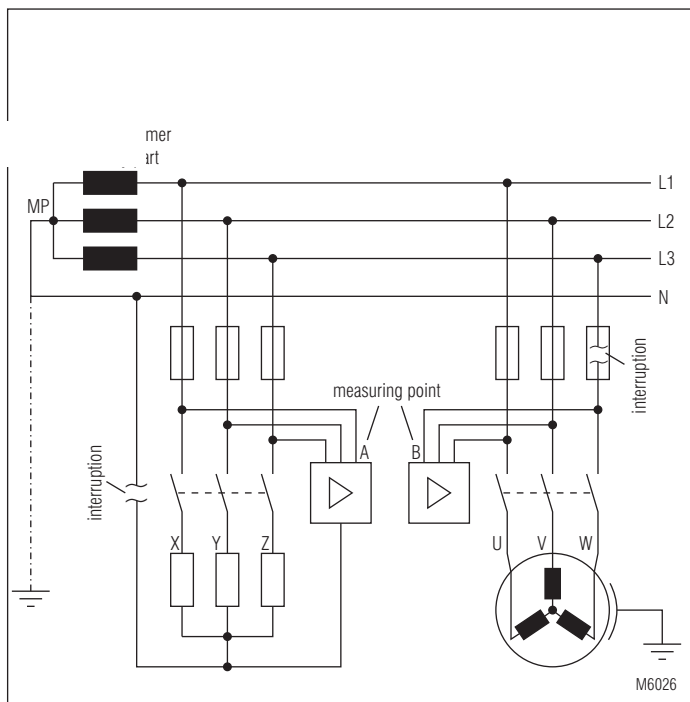
In the second case it is enough to compare the magnitude of the phase-to-phase voltages and to determine the asymmetry (unbalance) with equation (1).

### Consequences of asymmetry (unbalance) in three-phase systems

#### 1. Neutral conductor interruption

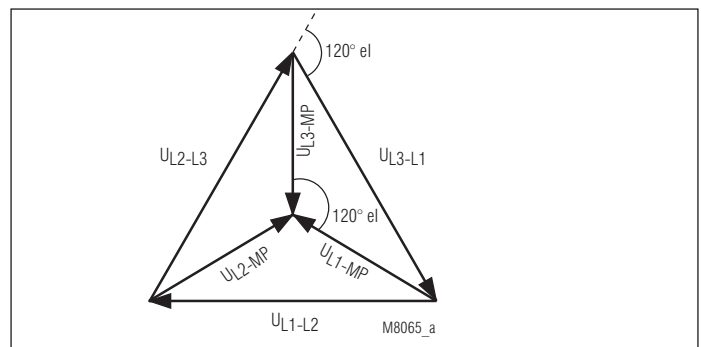


**Fig. 2:**  
Sinusoidal time characteristic

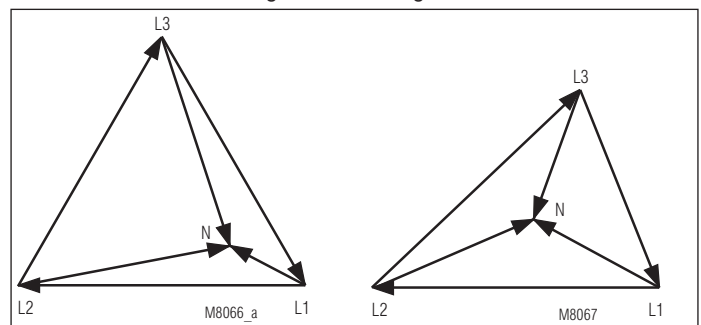


**Fig. 1a:**  
Ohmic load

**Fig. 1b:**  
Motive-power load



**Fig. 3:** Phasor diagram



**Fig. 4:**  
Asymmetrical star voltages

**Fig. 5:**  
Asymmetrical phase-to-phase voltages

## Measuring relays

At first, the case of a broken neutral conductor is considered. As shown in fig. 4, the phase-to-neutral voltages can reach dangerously high values, up to the magnitude of the phase-to-phase voltage in extreme cases. It is clear that this would damage or destroy connected loads. Such overvoltages are a consequence of a severe unbalance as is encountered frequently in private or commercial systems. This is due to the fact that the electrical devices used there are mainly single-phase consumers with different power consumptions.

Although attention is paid in building installations to symmetrically distribute loads to all 3 phases unsymmetrical loading cannot be avoided in the daily use of electric equipment. An example for a highly unsymmetrical loading may be a washing machine (2000 W) on phase L1, bulbs (100 W) on phase L2 and a radio (20W) on phase L3 (fig. 6b).

In normal system operation, the correct system voltage (230 V) is applied to all loads. However, if the neutral conductor is inadvertently not reconnected after work on the installation, for example, and the system is reconnected, the voltage on small loads can reach very high values. In our example, the radio would be at a high risk (power pack would be damaged) and the bulbs would burn out.

It should be the objective to signal even the smallest unbalances by means of measuring relays and to disconnect loads if required before dangerous conditions can evolve. Conventional over/undervoltage relays are not suited for an early detection. To detect an asymmetry of 5 %, for example, according to equation (1) only by the use of voltage relays they had to be set to a value of 2.5 % overvoltage or undervoltage. However, this would be not useful as there is no need to disconnect at an undervoltage of only 2.5 %.

Therefore, DOLD's neutral monitor IL 9069 would be a suited measuring device for this case because it detects an asymmetry of the phase-to-neutral voltages. As the phase-to-neutral voltages can reach high values in case of a fault, as mentioned above, the measuring relay must be rated for this to prevent it from being damaged. Figure 6a shows an example how the neutral monitor IL 9069 can protect an installation against overvoltage.

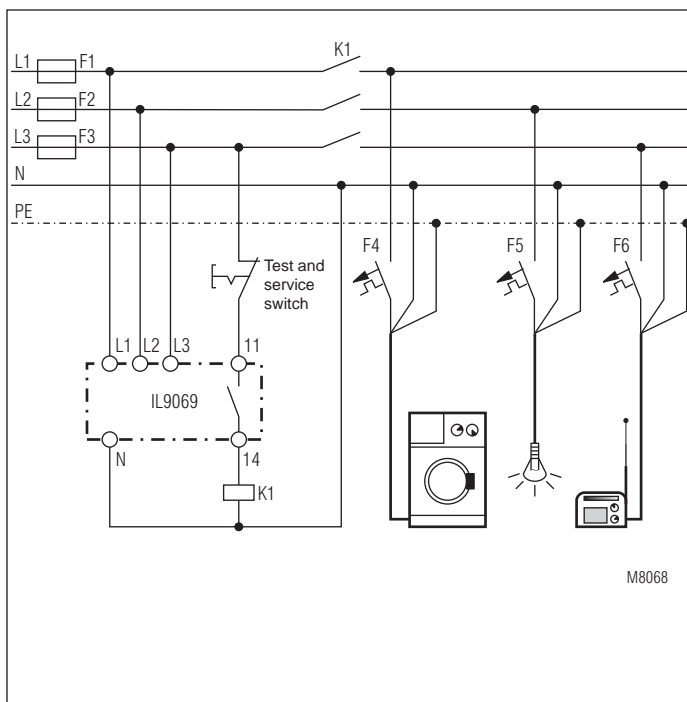


Figure 6a  
Neutral monitor

## 2. Reverse voltage

Reverse voltage, often also called reverse feeding, becomes an issue whenever a conductor is interrupted in the electrical installation. Such an interruption can be caused by a blown fuse, a broken conductor or a contact failure in a switching device, for example (Fig. 1b). However, a reverse voltage only occurs when a three-phase motor or transformer is present. Because motors running on two phases due to an interruption have the characteristic to regenerate the missing system phase by themselves. However, magnitude and angle of this voltage do not match with the original system voltage. Therefore, the three-phase system became asymmetrical downstream of the interruption point (measuring B, Fig. 1b). The extent of asymmetry depends on the type, size and loading of the motor.

In the past, the above behaviour was deliberately used to generate a three-phase system from an existing single-phase system. Today, in the age of power electronics, this is no longer necessary. In our case, it would be even detrimental when a phase fails in systems with electrical drives. The problem is that a single-phase operation cannot be immediately detected because the drives continue to operate without changes for the moment. Only when the operating condition is deliberately changed it would be detected, but then it may be too late. Three-phase motors cannot start on a single-phase system, for example.

Also a reversal of the rotational direction by plugging is no longer possible because the motor would continue to run in its original direction even after plugging. This may be dangerous if a reversal is needed for safety reasons such as with presses and calenders. Also motors for elevators and cranes would start in the opposite direction due to the pulling load.

Again, asymmetry (unbalance) relays can be used to prevent conditions of this type. But in this case, devices are needed that compare the three phase-to-phase voltages and evaluate them according to equation 1. As described for the neutral conductor, smallest amounts of asymmetry are detected, which cannot be detected by normal voltage relays.

Figure 7 represents the correct connection of a motor feeder, as an example. The undervoltage relay with integrated unbalance detection IL 9071/011 is used here. Please note that the section between asymmetry relay and motor is not monitored. If this is required for safety reasons, the undercurrent relay IP 9271 must be additionally looped in the motor feeder. With this measure, the whole drive is then optimally protected against phase failure and broken conductor.

Note: For the detection of asymmetry, also the BA 9040 would be suitable, and the broken conductor relay AI 940 for undercurrent detection. However, devices from the I range have been selected for reasons of uniformity.

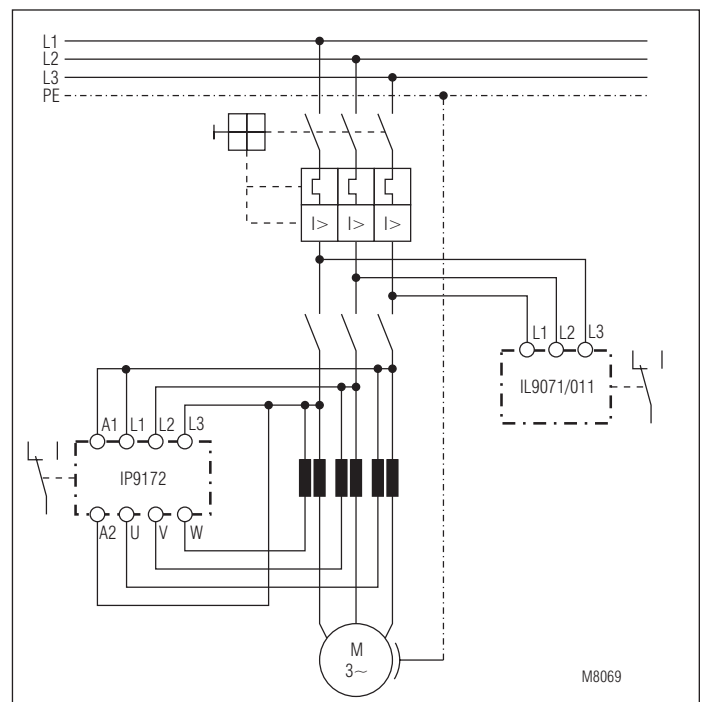


Fig. 7:  
Monitoring for broken conductor and unbalance

# Measuring relays

## Monitoring of electrical systems for undervoltage and overvoltage

### 1. Function principle of voltage measuring relays

The considerations below are not only restricted to voltage monitoring but also apply correspondingly to the monitoring of current,  $\cos \varphi$ , power, temperature, frequency, etc.

Once we have discussed above a special case of under/overvoltage, namely asymmetry (unbalance), we now deal with the normal case, i.e. the monitoring of electrical systems for under/overvoltage.

In systems where reverse feeding is not to be expected a standard voltage measuring relay is sufficient for monitoring. All DOLD measuring relays and in particular the voltage measuring relays work on the basis of the same principle, no matter whether they operate with or without auxiliary voltage  $U_H$ . In the following, the function principle is described in more detail on the example of an undervoltage relay.

With the use of an undervoltage relay, the user wants to detect a downward deviation from the nominal voltage, which underruns the permissible tolerance, e.g. 20 %. Given a 230 V AC system, this is an undervoltage of 184 V.

The device has two switching points, an upper and a lower. To prevent confusing we speak of upper and lower switching points below.

In a three-phase measuring relay, the upper switching point must **at first exceeded in all three phases at the same time** in order to enable the device with the undervoltage feature to go to the „good state“. That means in our example that the upper switching point must be set to approx. 228 V to allow the device to pick up at a system voltage of 230 V.

If then the voltage drops to a value just under 228 V, the device will not respond to it for the moment. Only when the lower switching point is underrun the relay reports a fault. For this, it is enough that **only one of the three voltages** drops under the lower switching point.

The difference between both switching points is called hysteresis and is specified either as an absolute value in Volt or relatively in percent (%) related to the threshold. In the example above, the device must have the lower switching point at 184 V resulting in a hysteresis of 44 V or 19.3 %. Figure 8 shows the connections described above in graphical form.

Measuring relays may have two different response principles when the measured value has over/underrun a switching point. In the open-circuit principle, the signal relay in the output only picks up when the fault, e.g. overvoltage occurs. With the closed-circuit principle, the output relay is permanently picked up (energized) in the „good range“ of the measured quantity and will only drop out in case of a fault.

To prevent short-time voltage dips from causing an undesired alarm the output relay can be operated with a time delay. If the system voltage reaches again its original value within the delay time  $t_1$ , the output relay will not operate. Likewise, a time delay  $t_2$  can be realized when the measured voltage returns to the „good range“ (refer to Fig. 8).

Due to the measurement principle used, namely the arithmetic averaging, a system-specific delay time  $t_0$  results in the measuring input. At each variation of the measured voltage, small capacitances in the device are caused to charge and discharge. Depending on the amount of the voltage jump, it takes between 100 ms and 1 s before the new measurement internally tunes in.

Now, the five most important parameters are known that can be set together or individually on a voltage measuring relay by the user or are fixed set in the factory. These parameters include:

**Upper switching point, lower switching point, response principle, delay time  $t_1$ , and delay time  $t_2$ .** In a block diagram, figure 9 shows the general working principle of a voltage measuring relay.

The considerations above do not only apply to three-phase system but can be also translated to single-phase and direct current systems. It is clear that there is an abundance of design variants for such devices alone from the above mentioned combination options. This wealth of variants can be arbitrarily extended by fitting the devices with further extra functions such as unbalance detection, phase angle measurement, etc.

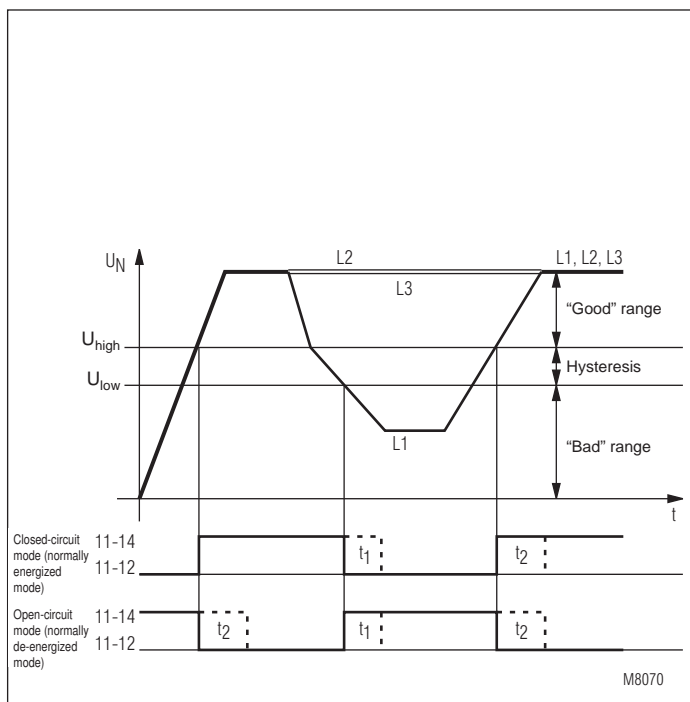


Fig. 8:

Function diagram for undervoltage relay with auxiliary supply

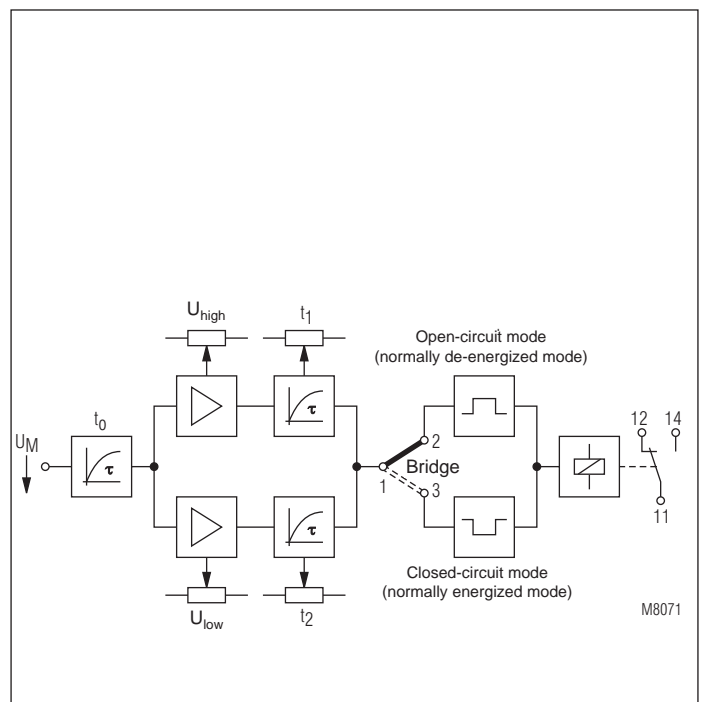


Fig. 9:

Simplified block diagram of a voltage measuring relay



## Measuring relays

### 2. Practical application of voltage measuring relays

After the theoretical preliminary consideration, we now come to the applications of measuring devices in practice. In particular, discrete devices shall be selected from the general case (figure 9).

In principle, it would be possible to combine all conceivable functions and options, e.g. over/undervoltage, unbalance, phase sequence, current, overload, time delays, etc. in a single device. However, this is not useful in practice as such a device would be too expensive on the one hand and difficult to handle on the other hand because all making conditions would have to be met at the same time to allow the device to report a faultless state at all.

Therefore, from the abundance of measuring and evaluation options, only those are selected that are really required and useful for a certain monitoring task. From these specifications, a device with specific features is then created.

#### IK 9171 (or alternatively BA 9043)

In the first example, following device features are required: three-phase undervoltage measurement, nominal voltage 400 V, N connection option, lower switching point  $0.85 U_N$  and closed-circuit principle. The solution is our standard type: IK 9171/200 3AC 400/230 V  $0,85 U_N$

#### What can this device do?

Once the system voltage is applied it goes to the "good condition" and the output contact closes. When the system voltage in only one of the phases drops under the lower switching point the output relay drops out (figure 10) and thus it signals the fault condition (closed-circuit principle). When the system voltage increases above the upper switching point again the device detects this and the output contact closes without time delay.

#### What's this device for?

It is suited for simple monitoring tasks to detect undervoltage in particular in control voltage systems. Also, it is approved for applications according to VDE 0108 (emergency power supply).

#### Variant

Now, we add the time delay  $t_2$  to the above device and change the switching point to  $0.7 U_N$ . All remaining specifications remain the same. So, you get the device IK 9171/240.

#### What can this device do?

Same functionality as above. The only difference is that the output contact only closes after the time  $t_2$  (figure 11) adjustable between 5 and 15 minutes when the voltage exceeds the upper switching point and the device detects this.

#### What's this device for?

The above device, in particular the single-phase model IK 9173/240, was designed for applications in southern (warmer) countries. The majority of houses there are equipped with air-conditioning systems. In the case of power failures, that occur frequently due to weak and unreliable systems, the cooling compressors must not restart immediately after restoration of supply. This is because the refrigerant must be allowed to return in the compressor firstly, and secondly, it must be prevented that all air-conditioning units start at the same time on the weak system, which would cause a new collapse. They must be started in a coordinated (time-staggered) manner by differently set delay times.

#### IL 9071

For the second example, there are following requirements: Three-phase undervoltage measurement, nominal voltage 400 V, N connection option, lower switching point  $0.85 U_N$ , and unbalance detection. This leads to the IL 9071/010.

#### What can this device do?

In principle, it has all features as the IK 9171/200 plus unbalance detection (figure 11).

#### What's this device for?

It can not only be used for simple undervoltage detection but also for phase failure detection. Thanks to the built in unbalance detection, it can reliably detect a phase failure also in systems with motive-power load as the phenomenon of reverse voltage is considered.

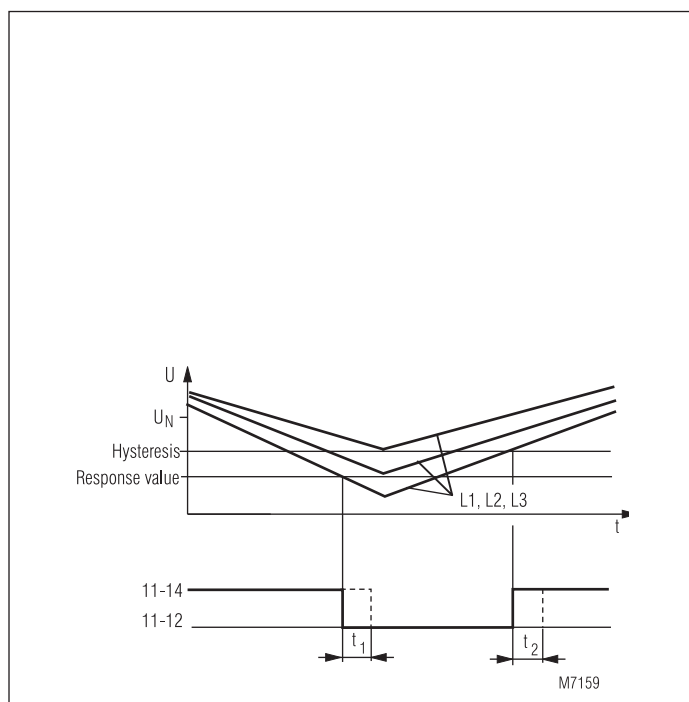


Fig. 10:  
Function diagram for undervoltage relay IK 9171

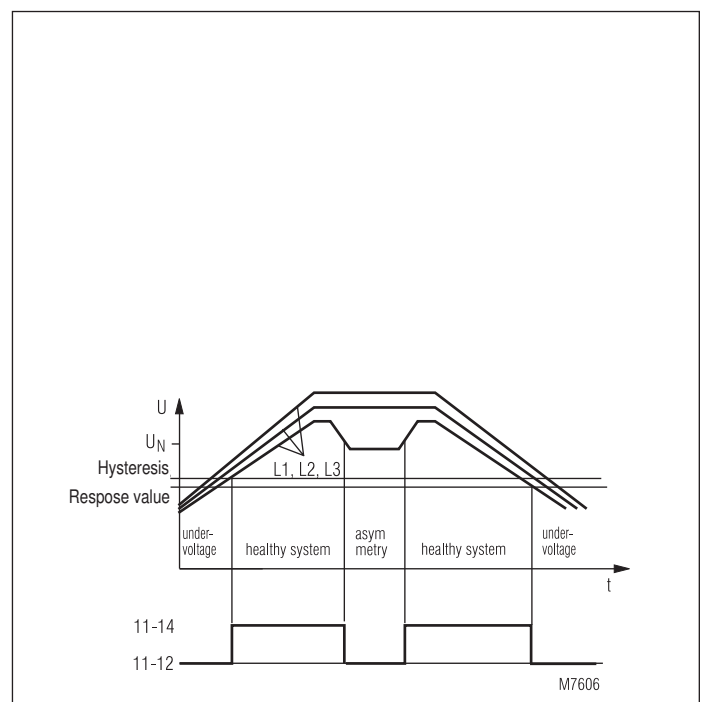


Fig. 11:  
Function diagram for undervoltage relay IL 9071

# Measuring relays

## IL 9079

For the third example, we opt for following features: three-phase undervoltage measurement, very short response time  $t_0$ , time delay  $t_2$  and closed-circuit principle for the device IL 9079.

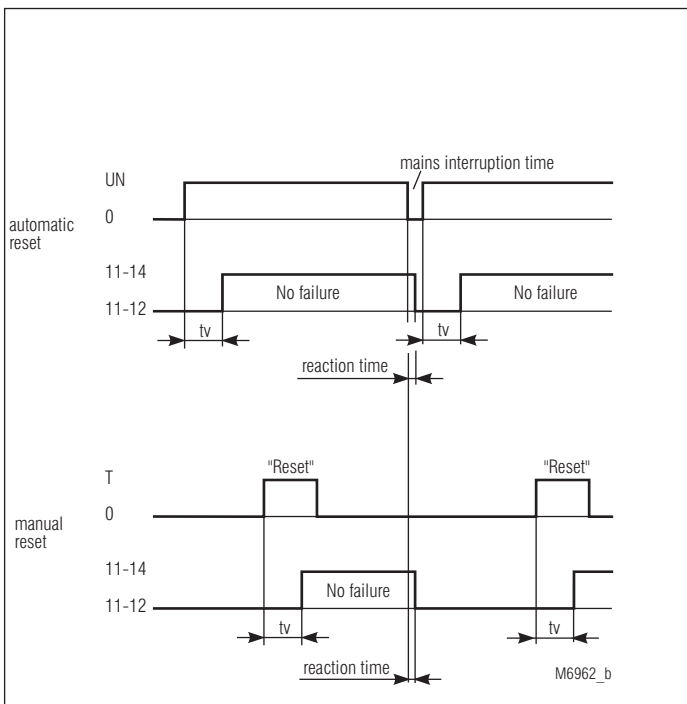
### What can this device do?

Once the system voltage is applied it goes to the "good condition" and the output contact closes (closed-circuit principle). When the system voltage drops under the lower switching point the device immediately responds within  $t_0 = 20$  ms and the output contact drops out. When the system voltage recovers the output contact only closes after a time that is adjustable between 0.2 and 2 sec. (figure 12).

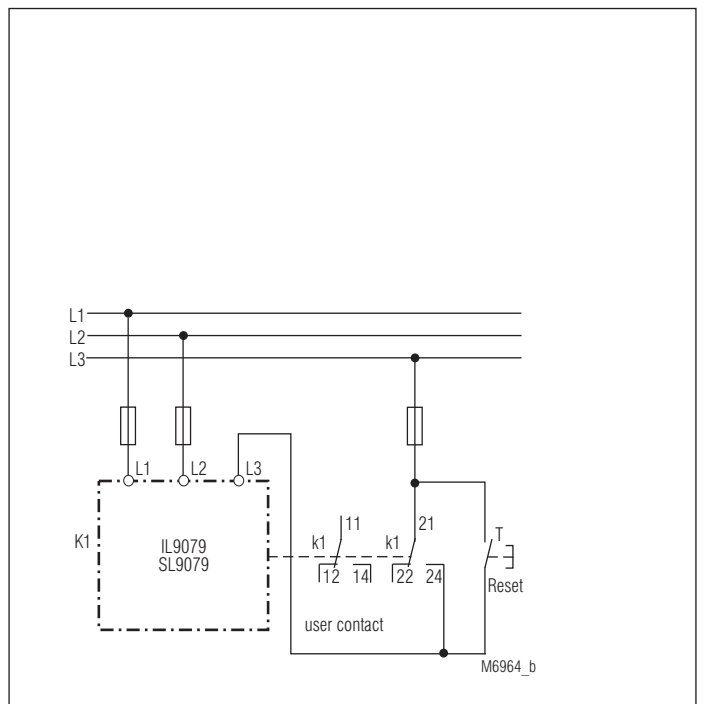
### What's this device for?

The IL 9079 was designed for the detection of automatic reclosings in three-phase systems. As such rapid auto-reclosures have a duration of only approx. 100 ms a very short response time  $t_0$  of the device matters. These rapid auto-reclosures can confuse contactor control systems. Using the IL 9079 the control system is shut down and restarted in a controlled way. With a connection trick it is possible to configure the device with reclosing lockout (figure 13).

The three examples above should be enough to demonstrate what an abundance of devices and variants are possible in the field of voltage measurement - only by smart combination of individual functionalities.



**Fig. 12:**  
Function diagram for undervoltage relay IL 9079



**Fig. 13:**  
Application example for IL 9079

### 3. General

The last section of the preface deals with general recurring issues with respect of measuring relay use.

#### Neutral connection

When to use the devices with and without neutral conductor? The basic principle is: If a 4-wire system with neutral conductor is available, you should use a measuring relay that has an N-connection, even when a three-phase connection would be enough. Because such devices are able to measure and compare all 3 phase voltages against N they are more accurate and sensitive than devices with only 3 terminals which use one phase as reference phase and can only measure and compare 2 voltages.

#### Phase terminals

Basically, three-phase devices with N terminal can also be connected to a single-phase system by bridging all 3 terminals for the phases with each other.

#### Response principle

In principle, the measuring relays can be designed for open-circuit or closed-circuit mode on the user's request. However, a fitting with open-circuit mode is not useful for an undervoltage relay without auxiliary voltage supply. Because the output relay must be energized in case of a fault (undervoltage) owing to the response principle. But when the voltage drops under the permissible tolerance or a total power failure occurs the output relay can no longer pick up because there is no more energy. Therefore, the closed-circuit principle is the only correct selection for such an application.

#### Protection of measuring circuits by fuses

One recurring question is how to correctly connect measuring relays with respect to their protection against short-circuits. The standard DIN VDE 0100 Part 430 provide information on this. Section 6.4.3 says that protective devices are not necessary when (1) the conductor or cable is made so that the risk of a short-circuit is reduced to a minimum and (2) the conductor or cable is not located close to combustible materials. Generally, this is called short-circuit-proof installation.

What does this mean in practice?

To connect a voltage relay to a busbar, for example, considerably smaller conductor cross sections are allowed. But this is only allowed when they are laid separately, equipped with reinforced insulation and shorter than 3 m. The purpose of this is to prevent any contact to each other and thus to prevent a short-circuit. If it happens against expectation, the line must be additionally routed so that it can burn out without danger.

If the user does not want to take care of the above regulations, he must install a protection device directly at the location of cross section transition (busbar to measuring conductor) as is required by the cross section and conductor laying. Then, a short-circuit on the supply conductor is cut out by the fuse without any risk. The user does not need to consider the measuring relay in this respect because a short-circuit occurring there is automatically interrupted. It goes without saying that the device can no longer be used after this.

### 4. Further applications

#### 4.1. Reverse-power protection relay IR 9140

If reverse power to the system is to be prevented, the reverse-power protection relay IR 9140 can be used. It monitors the direction of energy transport in an electrical system. This can be required at connection points to the power grid or industrial systems, for the operation of emergency power units, for generator operation of driving motors, etc.

#### 4.2. Small power stations

An example of the use of different DOLD measuring relays can be encountered in small power stations. Here, over/undervoltage relays with unbalance detection, frequency relays, reverse-power protection relays and speed relays or level sensing relays are used. For a more detailed application description for these devices please refer to our project folder P1 "Small power stations operated in parallel with the system".

#### 4.3. Hospitals

A further application of our measuring relays is the voltage switching and monitoring of the IT system in rooms used for medical applications. Here, undervoltage relays, insulation monitors, current and temperature monitors are used. For more information please refer to our associated project folder P1 "Rooms used for medical applications".

## Fault annunciators

Systems and installations become more and more complex due to increased automation, rationalization and growing use of control electronics in machinery and plants. Maintenance expenditures increase and human intervention becomes more and more difficult. So, not only the safety but also the service life of such installations is of major importance.

Avoiding failures by preventive maintenance or safely correcting failures within a short period of time helps to reduce costs. The use of fault annunciators pays off evermore because lost production time can hardly be recovered.

### Requirements and field of application

In the course of time, changes have taken place just with respect to detection and processing of faults. In the past, single components from relays, auxiliary contactors and interval time-delay relays were used besides pushbuttons for acknowledgement, horn and indicator lamps to process fault signals. Today, a single module is enough to fulfill this task.

In the meantime, function and annunciating sequences have been standardized by the standard DIN 19 235. Apart from simple electrical group fault, new-value and first-up annunciators, electronic clear text fault annunciating systems are available for complex applications.

Precisely, when using PLC or control system technology it is indispensable to install a fault alarm acquisition independent of the process level to keep control when the plant control fails and thus a damage may occur.

Typical application fields for fault annunciators include:

#### Industry:

Monitoring of production sequences and processes, monitoring of the production plant, monitoring of machine functions such as V-belt breaking, filter blocking, dry-running of pumps, etc. and the specification of maintenance intervals for preventive maintenance.

#### Buildings:

Monitoring of heating, ventilation and air-condition systems, doors, gates and windows as well as monitoring of transport and conveying systems.

#### Environment:

Monitoring of sewage treatment plants, waste incineration plants and power stations.

Group fault, new-value and first-up annunciators have normally acoustic and visual indicators and are designed for DIN rail mount-

ing or for front panel mounting.

**Group fault annunciators** are available for 6 or 12 (extendable) signals that energize a relay when a fault signal occurs. Such a relay can be de-energized by an acknowledging key. A visual (flash lamp) or an acoustic (horn) transducer is connected to this relay output.

New-value and first-up annunciators are used where the chronology of fault signals is essential.

The **new-value annunciator** highlights those alarms among a number of alarms the status of which has changed after the last acknowledgement. New-value annunciations are indicated by a flash lamp and after acknowledgement as permanent light until the fault is cleared.

The **first-up annunciator** highlights that alarm among a number of alarms the status of which has changed first after the last acknowledgement. The first occurred fault is indicated by a flashing lamp and consequential faults by permanent light.

### Text fault annunciator systems

**Text annunciator systems** echo the correct sequence of the arrived fault signals. Stored alarms can be called up and viewed on the display. Text fault annunciator systems can be operated as new-value and also as first-up annunciators.

Text fault annunciators have outputs for group annunciation, horn and system readiness. Inputs and outputs are metallicly isolated and thus ensure a maximum of interference immunity.

A printer can be used for **logging**, i.e. for printing out the fault date, time and text.

With an appropriate **programming software** also other settings such as closed-circuit and open-circuit principle as well as time delay of inputs can be defined apart from the message texts.

A decentralized fault alarm acquisition in complex installations can be configured with up to 30 modules with 8, 16, 24 or 32 inputs each. Via a separate module, these modules are connected to a two-wire line which is connected to the central fault annunciator. A maximum of 255 fault alarms can be acquired with this. Additional remote control stations complete the system.

## VARIMETER IMD Insulation monitor RN 5897/010



0274875

### Your Advantages

- Preventive fire and system protection
- Detection of symmetric and asymmetric insulation faults
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks with up to 300 V nominal voltage
- Easy adjustment of response values and setting parameter via rotational switch and menu display
- Suitable for large leakage capacitances up to 1000µF
- Optimised reaction time for large leakage capacitances
- Monitoring also with voltage-free mains
- Measuring circuit L(+)/L(-) with broken wire detection (can be switched off)
- Protective conductor PE1/PE2 with broken wire detection (can't be switched off)

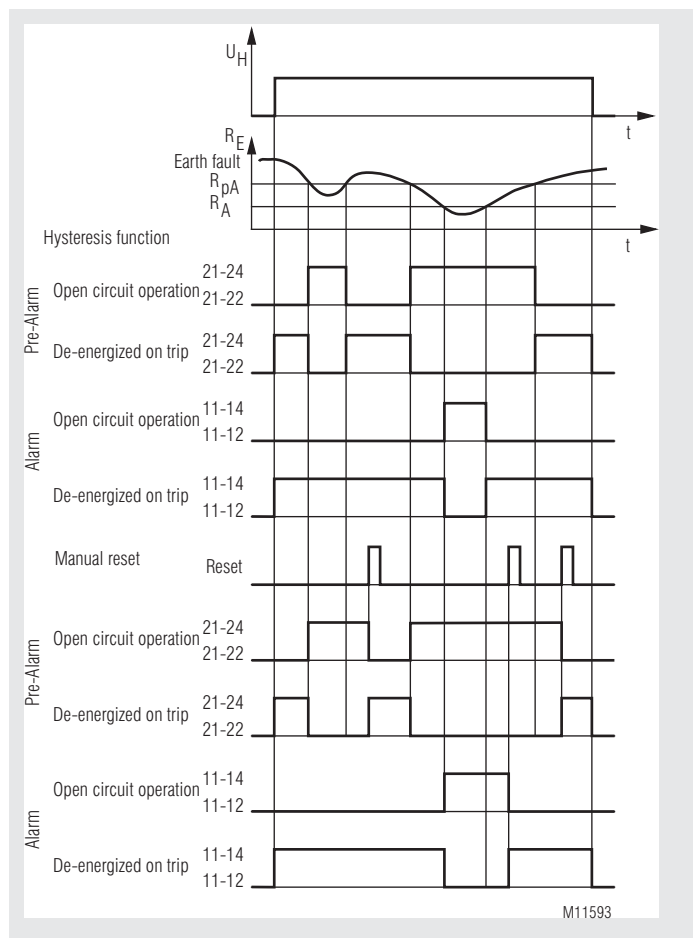
### Features

- Insulation monitoring according to IEC/EN 61557-8
- With connection facility of an external coupling device RP 5898 for voltages up to 1000 V
- Trigger output for insulation fault locating system
- 2 separate adjustable response thresholds (using e.g. for pre-Alarm and Alarm)
- Setting range of 1st response value (Pre-Alarm): 20 kΩ ... 2 MΩ
- Setting range of 2nd response value (Alarm): 1 kΩ ... 250 kΩ
- 2 changeover contacts für insulation failures-Pre-Alarm and -Alarm
- Energized or de-energized on trip can be selected for indicator relay
- Display for indication of measured value, device parameters and device status
- Setting the maximum leakage capacitance to shorten the response time
- Automatic and manual device self-test
- Alarm storage selectable
- Protection against manipulation by sealable transparent cover
- External control input for combined Test-/Reset-button
- 3 wide voltage input for auxiliary voltage
- Width 52.5 mm

### Product Description

The insulation monitor RN 5897/010 of the VARIMETER IMD family provides best and up to date insulation monitoring of modern IT systems in an optimum and state of the art way fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via display and LEDs the measured value, device parameters and device status are indicated easy to read. With a sealable transparent cover the device is protectet against manipulation.

### Function Diagram



### Approvals and Markings



### Applications

- Insulation monitoring of:
- Non-earthed AC, DC, AC/DC networks
  - UPS systems
  - Networks with frequency inverters
  - Battery networks
  - Networks with direct current drives
  - Hybrid and battery-powered vehicles
  - Mobile generator sets

## Function

The device is supplied with DC auxiliary voltage via terminals A1(+) / A2. Switching on the auxiliary voltage (Power-On) is followed by an internal self-test for 10 sec (see „Device test functions“). The test process is visible in the display. After this, measurement of the insulation resistance in the measuring circuits begins and the the colour of the backlight changes into green.

### Measuring circuit

#### (Insulation measurement between terminals L(+)/L(-) and PE1/PE2)

The insulation monitor RN 5897 can be operated either with or without coupling device. Max. mains voltage and connection diagrams have to be observed!

If the insulation monitor is operated without coupling device the terminals L(+) and L(-) have to be connected directly to the voltage system to be monitored. and the terminals VSG1/L(+) and VSG2/L(-) each have to be bridged (see also operation with coupling device).

A broken wire detection that can be disabled provides a fault signal if both terminals L(+) and L(-) are not linked by the connected network.

The type of network (AC, DC, 3NAC) has to be selected.

Also the terminals PE1 and PE2 have to be connected with 2 separate wires to the protective earth. An interruption of a wire also causes a fault signal (see section "Behavior on faulty connection"). The monitoring of the PE connection cannot be de-activated.

To measure the insulation resistance an active measuring voltage with changing polarity is connected between L(+)/L(-) and PE1/PE2. The momentary polarity of the measuring cycle is shown on the display by 2 cursor segments („MP+“ for positive phase and „MP-“ for negative phase). The duration of the positive and negative measuring phase depends on the setting of the max. leakage capacity („CE[μF]“ in programming mode), the actual leakage capacity of the monitored system and in DC systems also on the level and duration of possible voltage variations. This allows a correct and fast measurement in different network conditions.

At the end of a measuring cycle the actual insulation resistance is produced and indicated. The actual value is shown on the display. The relays for alarm K1 and pre-alarm K2 switch when dropping under the adjusted response values. In addition the backlight of the display changes to orange color on pre-alarm or to red color on alarm. An asymmetric earth fault either to „+“ or „-“ is also indicated on the display (only in DC- systems, or with a fault on the DC-side of a system).

### Manual reset of fault message

Using the display menu in programming mode, the manual reset function for insulation failures can be selected. If manual reset is activated the insulation fault signals of the measuring circuit are stored when dropping under the adjusted response values also if the insulation resistance goes back to healthy state. The minimum value is stored and can be shown on the display. Pressing the „Reset“ button on the front side, the alarm signal and the stored minimum value are reset if the actual insulation resistance is in healthy state.

### Indicator relay for insulation fault signal

For the indicator relays K1 (contacts 11-12-14, for alarm) and K2 (contacts 21-22-24, for pre-alarm) the function can be set in programming mode to energized on trip or de-energized on trip when the insulation resistance drops below the adjusted response value.

The status of the indicator relays is shown on the display with the two cursor segments "K1" and "K2". When the relay is energized, the corresponding cursor lights up.

### Trigger output for insulation fault locating system

There is an additional trigger output for an insulation fault detection system on the insulation monitor RN 5897/010.

This trigger output (Y1-Y2) can be coupled with the trigger input Y1-Y2 of RR 5886 to initiate automatic fault location with the insulation fault locating system, consisting of RR 5886 and RR 5887. The trigger output is activated when the measuring value drops under the alarm response value ( $R_E < R_A$ ). As long as it stays under the response value or an alarm is stored, the trigger output Y1-Y2 remains active.

## Function

### Broken wire detection

As described in section "Measuring circuit", the measuring circuits L(+)/L(-) and the protective conductors PE1/PE2 are constantly monitored for wire breaks – not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds. Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected.

Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage.

The device would no longer detect a connection fault on L(+)/L(-).

Especially parallel lines should be prevented over larger distances.

If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, the broken wire detection can be de-activated using the display menu in programming mode. Monitoring deactivated, monitoring only during device test or continuous monitoring (every 2 minutes for 10 sec) are the possible options. If the broken wire detection on L(+)/L(-) is de-activated no AC voltage is injected. The broken wire detection on PE1/PE2 cannot be de-activated.

### Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every full operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front for 2 sec.

With the self-test, contrary to the expanded test, the status of the Indicator relays is not affected; the sequence is as follows:

The display backlight colour changes into orange. For approx.. 2 s all pixels and segments of the LCD are shown. After that the text "Test1" comes up and the measuring pulse is switched for approx. 4 s to negative test phase.

The polarity of the test voltage is also indicated on the display by cursor segments. Within these 4 s the internal measuring circuit is checked for failures. Then the measuring pulse is switched for approx.. 4 s to positive test phase and more internal tests take place. If no failures turned up and had been recognized, the measurement continuous. The extended test procedure is started when during or at the end of the above described self-test the test button is pressed again for 2 s.

The sequence is similar to the self-test (2 measuring phases of 4 s each) but in addition the output relays go in alarm stated. The display shows "Test2". The test phases of the extended test will be repeated continuously. Pressing the reset button again for 2 s will stop the extended test immediately. The device starts the insulation measurement again.

### Behaviour with internal device faults

If internal device faults were detected during the test function, the display backlight changes into red and an error messages (failure code: „Int.1“) is indicated. The indicator relays K1 and K2 switch to the alarm state.

### Behavior on faulty connection

When detecting broken wire on terminals L(+)/L(-), the measurement is disabled. The reaction time could be up to 2 min. The monitoring relays K1 and K2 go in alarm state, the backlight changes to red. The display shows the fault message „L+/L-“. After removing the interruption the fault is automatically reset (max. reaction time up to 2 min) and the measurement of the insulation resistance is continued.

Stored alarm values remain stored. An interruption of the protective earth connections PE1/PE2 causes the same reaction as interrupting the measuring circuit, only the display shows „PE1-PE2“.

### External control input

To terminals X1/X2 an external combined Test-/Reset button can be connected. If the terminals X1/X2 are bridged for approx.. 1 s the test mode is started. This has the same function as pressing the internal test button. When bridging X1/X2 for > 3 s, a stored alarm will be reset. This has the same function as pressing the internal reset button.

## Function

### Connection of an external coupling device

An external coupling device RP 5898 can be connected to extend the input voltage range of the monitored voltage system on RN 5897/010. The terminals with the same legend of the insulation monitor and the coupling device (VSG1, VSG2, L(+), L(-)) are connected together. The network to be monitored is connected to terminals L1(+) and L2(-) on the coupling device. Using the display menu in programming mode the connection of the coupling device has to be selected and activated. The broken wire detection is active on the terminals L1(+)/L2(-) on the coupling device. A broken wire between coupling device and insulation monitor cannot be detected immediately but the measured values on interruption of 1 or 2 wires between coupling device and insulation monitor are much lower as the real values, which will cause an early response of the device.

### Programming/setting of parameters/set-up of the insulation monitor

The response values for alarm and pre-alarm can be adjusted via 2 rotary switches „R<sub>A</sub>“ and „R<sub>PA</sub>“ on the front of the device. New setting are immediately active and do not require a restart of the unit. More settings can be done with the 3 buttons and the display menu in programming mode. To start the programming mode, the button „Set/ESC“ has to be pressed for approx. 2 s. To avoid unauthorized manipulation, this button as well as the rotary switches „R<sub>A</sub>“ and „R<sub>PA</sub>“ are located behind a sealable transparent cover. When the device changes to programming mode, the measurement is stopped, the display back light changes to orange color and the first parameter is displayed. To scroll the different parameters, the button „Set/ESC“ has to be pressed short. With the 2 scroll buttons (Scroll-Up „▲“ and Scroll-Down „▼“) the settings can be modified.

The first parameter is the broken wire detection in the measuring circuit „BrWiD“. Possible setting are continuously on („on“), continuously off („oFF“) or only active during self-test. The default is „on“.

The second parameter is alarm memory „Mem.“. Here are 2 options available manual reset („on“) und auto reset („oFF“). The default value is „oFF“.

The third parameter is the relay operation principle „Rel.“. Settings are: de-energized on trip („n.c.“) and energized on trip („n.o.“). The default value is „n.c.“.

The fourth parameter is the type of network connection „Net“. Selection are AC Network („Ac“), DC-Network („dc“) or 3NAC-Network („3nAc“). The default value is „Ac“.

The fifth parameter is the setting of the maximum leakage capacity („CE[μF]“). This can be adjusted to 30 μF („30“), 100 μF („100“), 300 μF („300“) and 1000 μF („1000“). The default value is „30“.

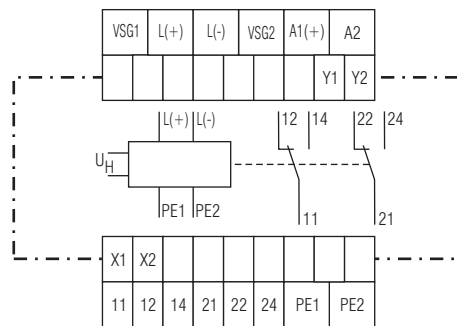
The device allow the connection of a coupling device, the sixth parameter activates („on“) or de-activates („oFF“) the coupling device.

To leave the programming mode the button „Set/ESC“ has to be pressed for 2 s. The settings will be activated and stored permanently. After that the device makes a restart similar to power on.

### Default-Setting of Parameters

Nr.	Parameter	Default-Set
1	Broken wire detect in measuring circuit "Broken Wire Detect"	on
2	Storing insulation fault message "Memory"	off
3	Switching mode of output relays "Relay"	n.c. (normally closed) de-energized on trip
4	Power supply type "Net"	AC
5	Max. line capacitance "CE[μF]"	30
6	Ext. coupling device "VSG"	off

## Circuit Diagram

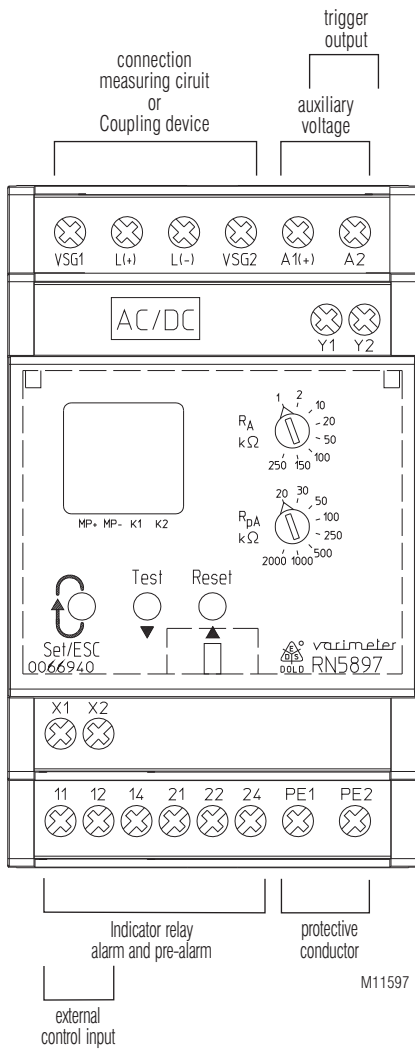


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## Connection Terminals

Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage AC or DC
L(+), L(-), VSG1, VSG2	Connection for measuring circuit or Connection for coupling device
PE1, PE2	Connection for protective conductor
X1, X2	Control input (combined external Test- and Reset-input)
Y1, Y2	Alarm trigger output for insulation fault locating system
11, 12, 13	Alarm signal relay K1 (1 changeover contact)
21, 22, 23	Prewarning signal relay K2 (1 changeover contact)

## Indicators



RN 5897/010

## Indicators

The colour of the backlight indicates the operating status of the device.

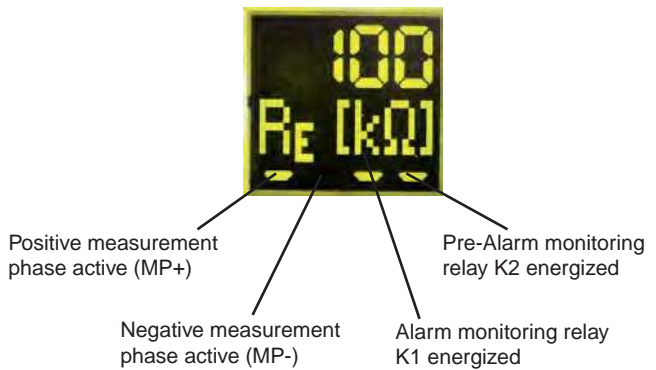
- Off:** No auxiliary voltage connected
- Green:** Normal operation (Insulation resistance in healthy state)
- Red:** Alarm (measured value below alarm response value, device failure, connection failure)
- Orange:** Warning (measured value below pre-alarm response value, test mode, Parameter set-up mode)

### Actual value display

The actual insulation resistance „R<sub>E</sub> [kΩ]“ is displayed. If the actual value is R<sub>E</sub> < 10 kohm, the value in kohm is displayed with 1 decimal place. With values 10 kOhm ≤ R<sub>E</sub> < 500 kOhm the display shows the value without decimal place, with values 500 kOhm ≤ R<sub>E</sub> < 1 MOhm the value is rounded to 10 kOhm. Insulation resistance values 1 MOhm ≤ R<sub>E</sub> < 2 MOhm are displayed in MOhm with one decimal place. If the resistance is R<sub>E</sub> > 2 MOhm the display indicates ---- showing the value is higher the 2 MOhm.






In a DC Network an asymmetric insulation resistance to „+“ or „-“ is indicated by displaying „R<sub>E</sub>+ [kΩ]“ or „R<sub>E</sub>- [kΩ]“

By pressing the scroll buttons (Scroll-Up „▲“ und Scroll-Down „▼“) more measured values can be shown. Another value is the mains voltage on L(+)/L(-). This is indicated with „U<sub>N</sub> [V<sub>AC</sub>]“ or „U<sub>N</sub> [V<sub>DC</sub>]“ in V depending on the type of network and voltage. If the unit is connected single pole to a 3NAC network the mains voltage cannot be measured. With this setting the voltage value is not displayed. When manual reset is selected, the display shows the minimum stored value of the resistance „R<sub>M</sub> [MΩ]“ or „R<sub>M</sub> [kΩ]“ after the value dropped below the response value also when the value goes back to healthy state. The stored minimum value will only be reset when acknowledging the stored Alarm signal (with the reset button). Also the firmware version can be displayed.












**Indicators**

Display-Indication	Measuring- resp. display value
	Insulating resistance in kΩ resp. MΩ („----“ complies RE ≥ 2 MΩ)
	Asymmetrical insulating resistance in kΩ against L+ or L- at DC-mains
	Measured mains voltage in V at AC- or DC-mains
	Stored min. insulating resistance in kΩ resp. MΩ
	Latest firmware-version

**Error Indication**

Display-Indication	Failure cause	Failure recovery
	Broken wire detection on L(+)/L(-).	Check measuring circuit L(+) and L (-)
	Broken wire detection on PE1/PE2.	Check protective conductor connections PE1 and PE2
	Internal failure detected in test mode	Press test button again or restart the unit by interrupting the auxiliary supply temporarily. If the fault remains permanent, send device back to manufacturer for examination.
	Faulty calibration values detected in device memory.	Send device back to manufacturer for recalibration and examination.

Display-Indication	Test function
	Display-Test
	Selftesting (measuring switching, measuring voltage, internal tests)
	Advanced Test (additional control of indicator relay)

## Notes

In one voltage system only one insulation monitor can be used. This has to be observed when interconnecting two separate systems.

Device terminals PE1 and PE2 must always be connected via separate lines to different terminal points of the protective-conductor system.

The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place e.g. with battery networks with connected inverters on the DC side, with Generators/Transformers with connected Rectifiers or inverters on the AC-side. To monitor a 3NAC system the device can be connected single pole, (L(+) and L(-) are bridged, to the neutral of the 3p4w system. The 3 phases have a low-ohmic (approx. 3 – 5 Ohm) connection via the transformer windings so also insulation failures of the not directly connected phases are detected. Via the display menu in programming mode the correct type of network needs to be selected (see „Connection Examples“).

The measuring circuit of the RN 5897/010 are designed for leakage capacities up to 1000  $\mu$ F. The measurement of the insulation resistance will not be influenced but for the measuring phases longer time periods are necessary as with smaller capacities. If the max. possible leakage capacity is known, the device can be adjusted to the required lower level, which will reduce the response time and measurement time.

Please do not connect external voltage to terminals X1/X2. The control must only be made by bridging X1 and X2.

The trigger output Y1/Y2 at RN 5897/010 is galvanic separated from the rest of the circuit. It determined to be connected to a DOLD insulation fault location system RR5886 and RR5887. Please do not connect external voltages.

### ATTENTION !



**The device must not be operated without PE1/PE2 connection!**

**Before checking insulation and voltage, disconnect the monitoring device RN 5897 from the power source!**



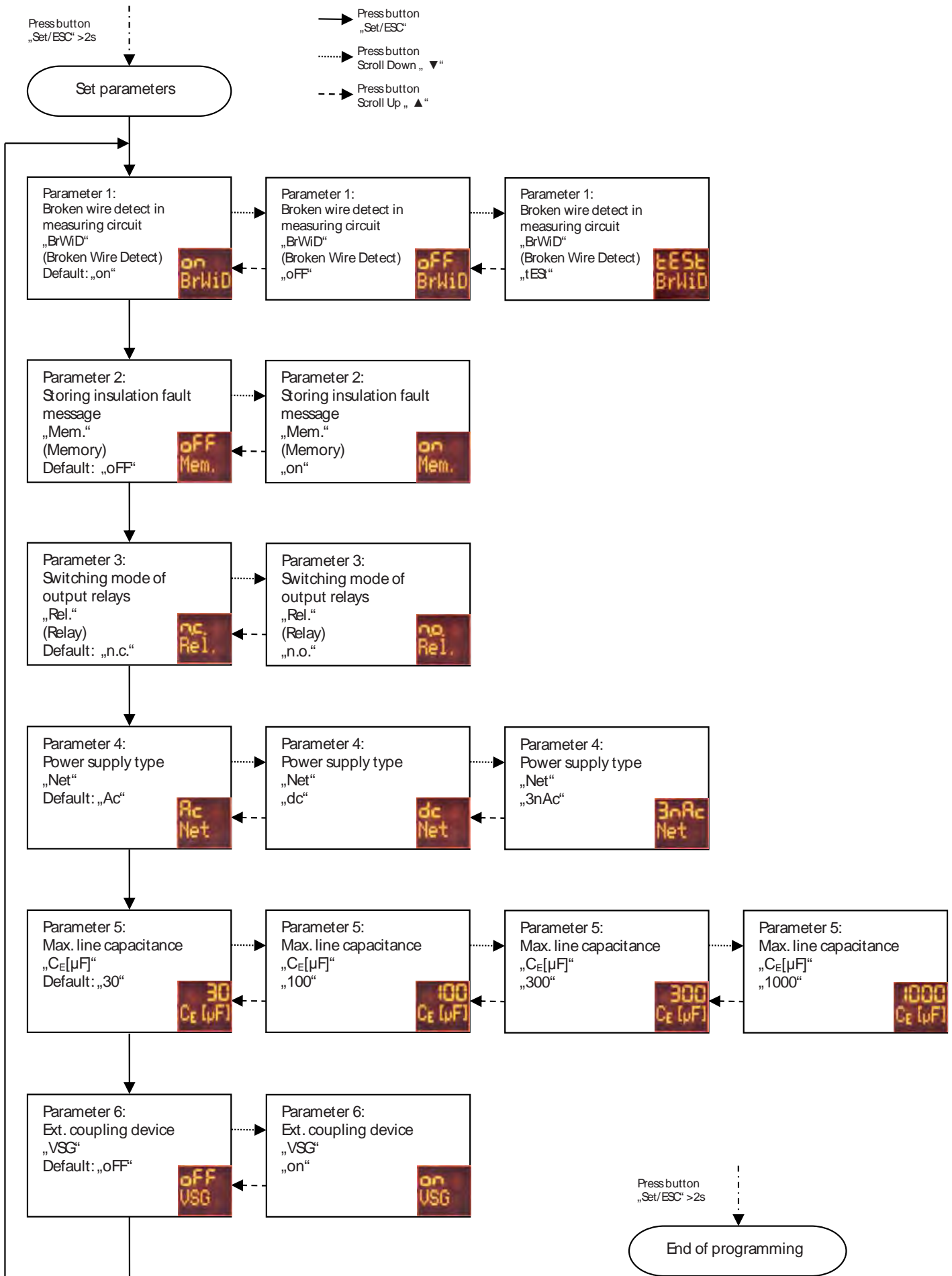
WARNING

**The device monitors HIGH-VOLTAGE!**

**Caution High-Voltage when working on the device!**

**Disconnect all power supplies before servicing equipment!**

# Running chart



### Technical Data

#### Measuring circuit L(+)/L(-) to PE1/PE2 (without coupling device)

**Voltage range  $U_N$ :** DC 0 ... max. 300 V; AC 0 ... max. 250 V  
**Frequency range:** DC or 16 ... 1000 Hz  
**Max. line capacitance:** 1000  $\mu$ F  
**Internal resistance (AC / DC):** > 90 k $\Omega$   
**Measuring voltage:** approx.  $\pm$  90 V  
**Max. measured current ( $R_E = 0$ ):** < 1,10 mA  
**Response inaccuracy:**  $\pm$  15 %  $\pm$  1.5 k $\Omega$  IEC 61557-8  
**Response value hysteresis:** approx. + 25 %; min. + 1 k $\Omega$

**On delay**  
 at  $C_E = 1 \mu$ F,  
 $R_E$  of  $\infty$  to 0,5 \* response value: < 30 s

**Measuring time:**  
 At  $C_E = 1 \dots 1000 \mu$ F,  
 $R_E$  from  $\infty$  to 1000 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 100 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 1 k $\Omega$ : see characteristics

#### Response values

Pre-warning („R<sub>PA</sub>“):

k $\Omega$ :	20	30	50	100	250	500	1000	2000
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Alarm („R<sub>A</sub>“)

k $\Omega$ :	1	2	10	20	50	100	150	250
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each adjustable via rotational switches

**Response value broken wire detection L(+)/L(-):** > approx. 90 k $\Omega$   
**Response value broken-wire detection PE1/PE2:** > approx. 0.5 k $\Omega$

#### Measuring circuit L1(+)/L2(-) to PE1/PE2 (with coupling device RP 5898)

**Voltage range  $U_N$ :** DC 0 ... max. 1000 V; AC 0 ... max. 760 V  
**Frequency range:** DC or 16 ... 1000 Hz  
**Max. line capacitance:** 1000  $\mu$ F  
**Innenwiderstand (AC / DC):** > 240 k $\Omega$   
**Messspannung:** approx.  $\pm$  90 V  
**Max. measured current ( $R_E = 0$ ):** < 0,40 mA  
**Response inaccuracy:**  $\pm$  15 %  $\pm$  1.5 k $\Omega$  IEC 61557-8  
**Response value hysteresis:** approx. + 25 %; min. + 1 k $\Omega$

**On delay**  
 at  $C_E = 1 \mu$ F,  
 $R_E$  of  $\infty$  to 0,5 \* response value: < 30 s

**Measuring time:**  
 At  $C_E = 1 \dots 1000 \mu$ F,  
 $R_E$  from  $\infty$  to 1000 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 100 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 1 k $\Omega$ : see characteristics

#### Response values

Pre-warning („R<sub>PA</sub>“):

k $\Omega$ :	20	30	50	100	250	500	1000	2000
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Alarm („R<sub>A</sub>“)

k $\Omega$ :	1	2	10	20	50	100	150	250
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each adjustable via rotational switches

**Response value broken wire detection L1(+)/L2(-):** > approx. 500 k $\Omega$   
**Response value broken wire detection PE1/PE2:** > approx. 0.5 k $\Omega$   
**Max. wire length between insulation monitor and coupling device:** < 0,5 m

#### Auxiliary voltage input A1(+)/A2

Nom. Voltage	Voltage range	Frequency range
AC/DC 24 ... 60 V	AC 19 ... 68 V	45 ... 400 Hz; DC 48 % W <sup>*)</sup>
	DC 16 ... 96 V	W <sup>*)</sup> $\leq$ 5 %
AC/DC 85 ... 230 V	AC 68 ... 276 V	45 ... 400 Hz; DC 48 % W <sup>*)</sup>
	DC 65 ... 300 V	W <sup>*)</sup> $\leq$ 5 %
DC 12 ... 24 V	DC 9.6 ... 30 V	W <sup>*)</sup> $\leq$ 5 %

<sup>\*)</sup> W = permitted residual ripple of auxiliary supply

### Technical Data

**Nominal consumption:**  
 DC 12 V, 24 V, 48 V: max. 3 W  
 AC 230 V: max. 3.5 VA

#### Control input X1/X2 for external kombinierte Test-/Reset-Taste

**Current flow:** approx. 3 mA  
**No-load operation voltage X1 to X2:** ca. 12 V  
**Permissible wire length:** < 50 m  
**Activation time for test signal:** approx. 1 s  
**Activation time for reset signal:** > 3 s

#### Outputs

**Indicator contact:** 2 x 1 changeover contact for Alarm (K1) and Pre-Alarm (K2) energized or de-energized on trip (programmable)  
 4 A

#### Thermal current $I_{th}$ : Switching capacity

to AC 15:  
 NO contact: 5 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1  
 to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1

#### Electrical life

at 5 A, AC 230 V: 1 x 10<sup>5</sup> switching cycles

#### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:** 50 x 10<sup>6</sup> switching cycles

#### General Data

**Operating mode:** Continuous operation

#### Temperature range

Operation: - 30 ... + 60 °C  
 (at range 0 ... -30 °C limited function of the LCD displaye)

Storage: - 30 ... + 70 °C

**Altitude:** < 2.000 m IEC 60 664-1

#### Clearance and creepage distances

Rated insulation voltage: 300 V  
 Overvoltage category: III  
 rated impuls voltage / pollution degree: IEC 60 664-1

measuring circuit L(+)/L(-) to auxiliary voltage A1(+)/A2 and indicator relay contacts K1, K2 and trigger output Y1/Y2: 4 kV / 2

auxiliary voltage A1(+)/A2 to indicator relay contacts K1, K2 und trigger output Y1/Y2: 4 kV / 2

indicator relay contact K1 to indicator relay contacts K2: 4 kV / 2

trigger output Y1/Y2 to indicator relay contacts K1, K2: 4 kV / 2

Insulation test voltage  
 Routine test: AC 2,5 kV; 1 s

#### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61000-4-2

HF irradiation: 80 MHz ... 1 GHz: 20 V / m IEC/EN 61000-4-3

1 GHz ... 2.7 GHz: 10 V / m IEC/EN 61000-4-3

Fast transients: 2 kV IEC/EN 61000-4-4

Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 20 V IEC/EN 61000-4-6

Interference suppression: Limit value classe B EN 55011

#### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm,

Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

**Climate resistance:** 30 / 060 / 04 IEC/EN 60 068-1

## Technical Data

<b>Terminal designation:</b>	EN 50 005
<b>Wire connection</b>	DIN 46 228-1/-2/-3/-4
<b>Cross section:</b>	0.5 ... 4 mm <sup>2</sup> (AWG 20 - 10) solid or 0.5 ... 4 mm <sup>2</sup> (AWG 20 - 10) stranded wire without ferrules 0,5 ... 2,5 mm <sup>2</sup> (AWG 20 - 10) stranded wire with ferrules
<b>Stripping length:</b>	6.5 mm
<b>Wire fixing:</b>	Cross-head screw / M3 box terminals
<b>Fixing torque:</b>	0.5 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60715
<b>Weight:</b>	approx. 205 g

## Dimensions

**Width x height x depth:** 52.2 x 90 x 71 mm

## Standard Types

RN 5897.12	DC 12 ... 24 V
Article number:	0067251
• Auxiliary voltage:	DC 12 ... 24 V
RN 5897.12	AC/DC 24 ... 60 V
Article number:	0066940
• Auxiliary voltage:	AC/DC 24 ... 60 V
RN 5897.12	AC/DC 85 ... 230 V
Article number:	0066941
• Auxiliary voltage:	AC/DC 85 ... 230 V
• Outputs:	1 changeover contact for pre-warning 1 changeover contact for alarm
• Setting range pre-warning:	20 k $\Omega$ ... 2 M $\Omega$
• Setting range alarm:	1 k $\Omega$ ... 250 k $\Omega$
• Trigger output for insulation fault locating system	
• With connection facility of a coupling device RP 5898	
• Adjustable line capacitance	
• Energized or de-energized on trip	
• Selection of type of network	
• Width:	52.5 mm

## Ordering Example for variants

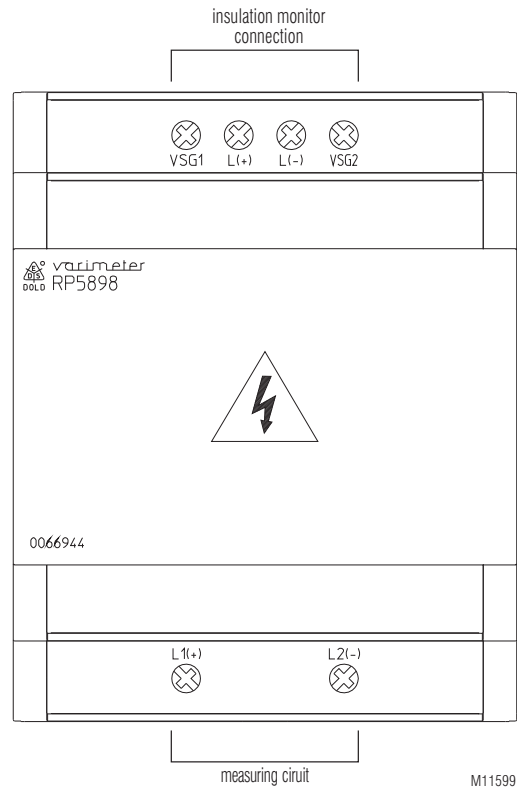
RN 5897 .12 / _ _ _ AC/DC 24 ... 60 V 20 k $\Omega$ ... 2 M $\Omega$ 1 k $\Omega$ ... 250 k $\Omega$	
	Setting range alarm
	Setting range Pre-warning
	Auxiliary voltage
	Variant, if required
	Contacts
	Type

## Accessories

RP5898:

Article number: 0066944

- Coupling device for RN 5897.12/010
- Extension of nominal voltage range  $U_N$  to DC max. 1000 V, AC max. 760 V
- Weight: approx. 110 g
- Dimensions
  - Width x height x depth: 70 x 90 x 71 mm



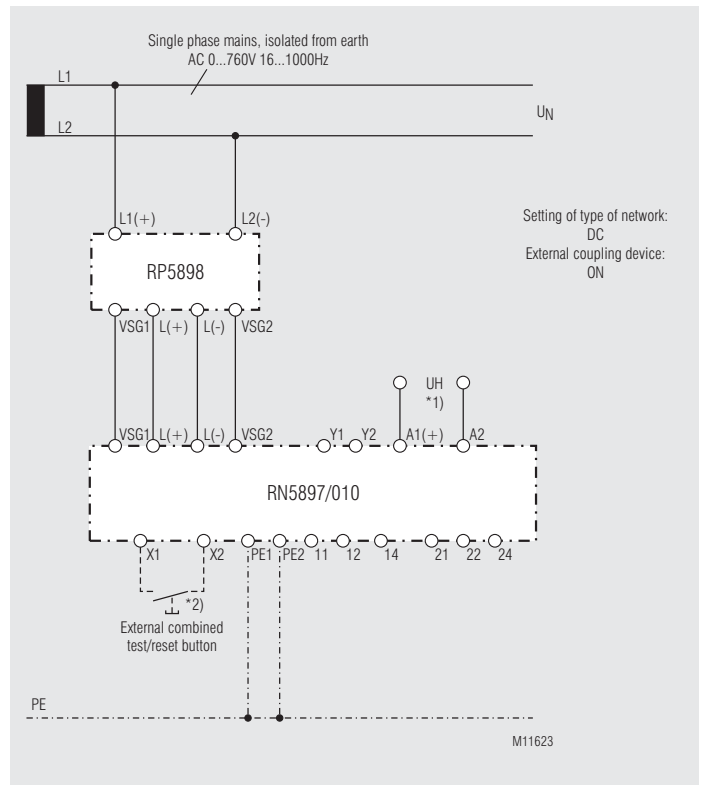
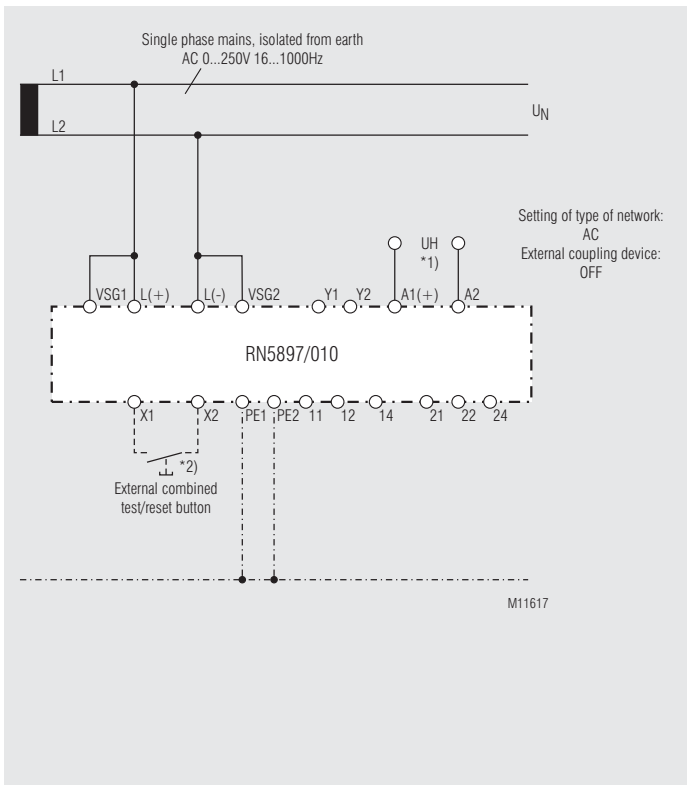
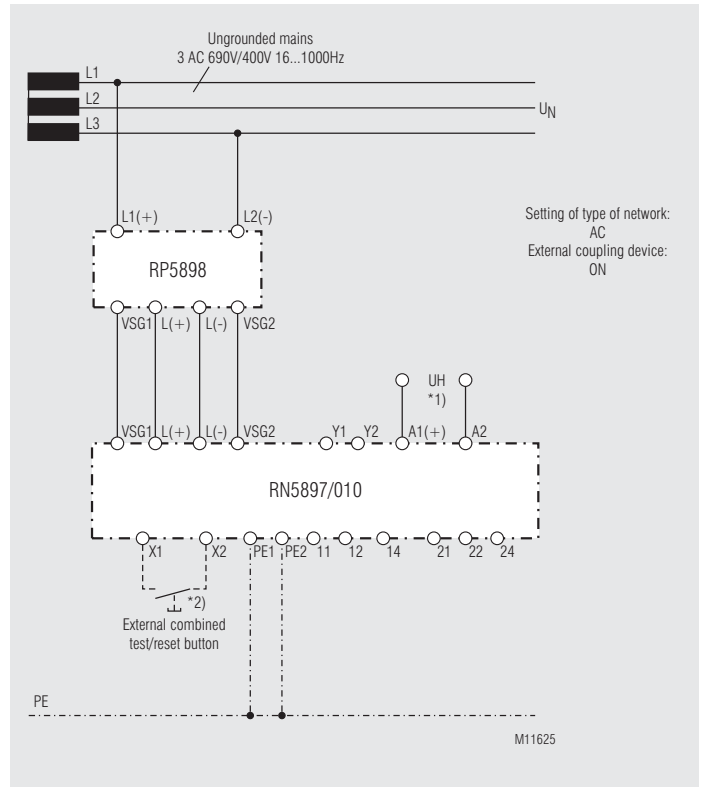
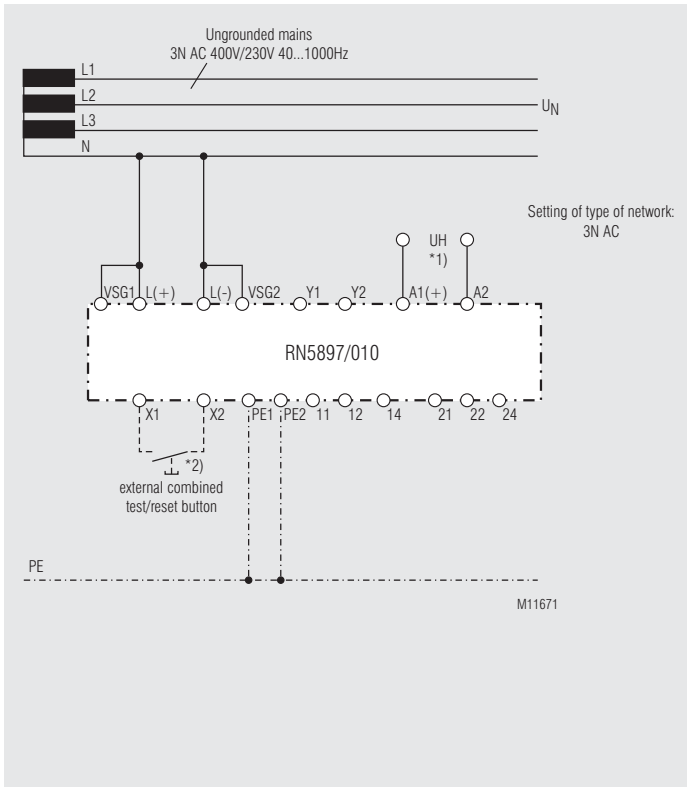
## Connection Example

\*1) Auxiliary voltage  $U_H$  (A1(+)/A2) ) can also be sourced from the monitored voltage system. The voltage range of the auxiliary supply has to be taken into account.

\*2) Control input X1/X2 for external combined Test-/Reset-button:

- Control approx. 1 s: Test function
- Control > 3 s: Reset function

## Connection Example

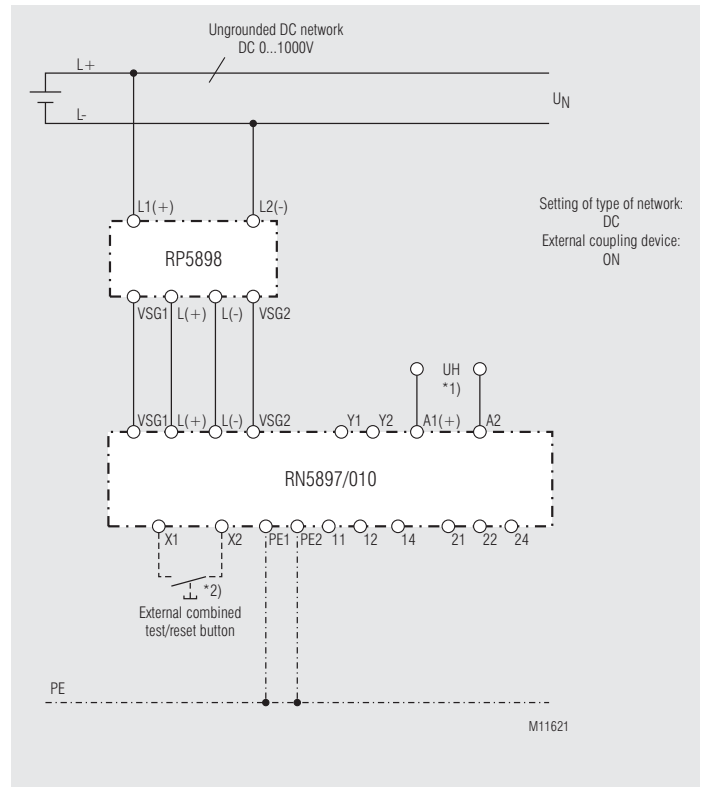
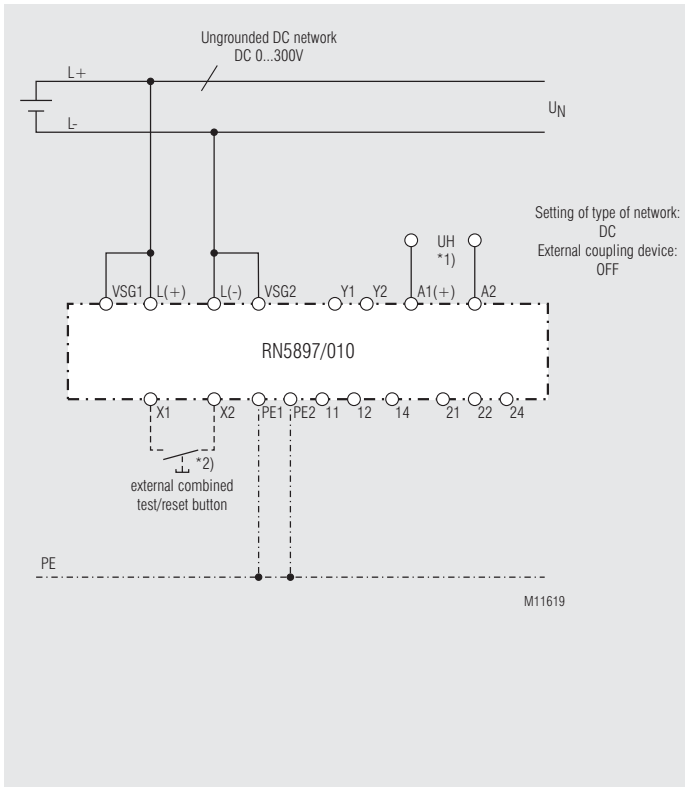


\*1) Auxiliary voltage  $U_H$  (A1(+)/A2) can also be sourced from the monitored voltage system.  
The voltage range of the auxiliary supply has to be taken into account.

\*2) Control input X1/X2 for external combined Test-/Reset-button:

- Control approx. 1 s: Test function
- Control > 3 s: Reset function

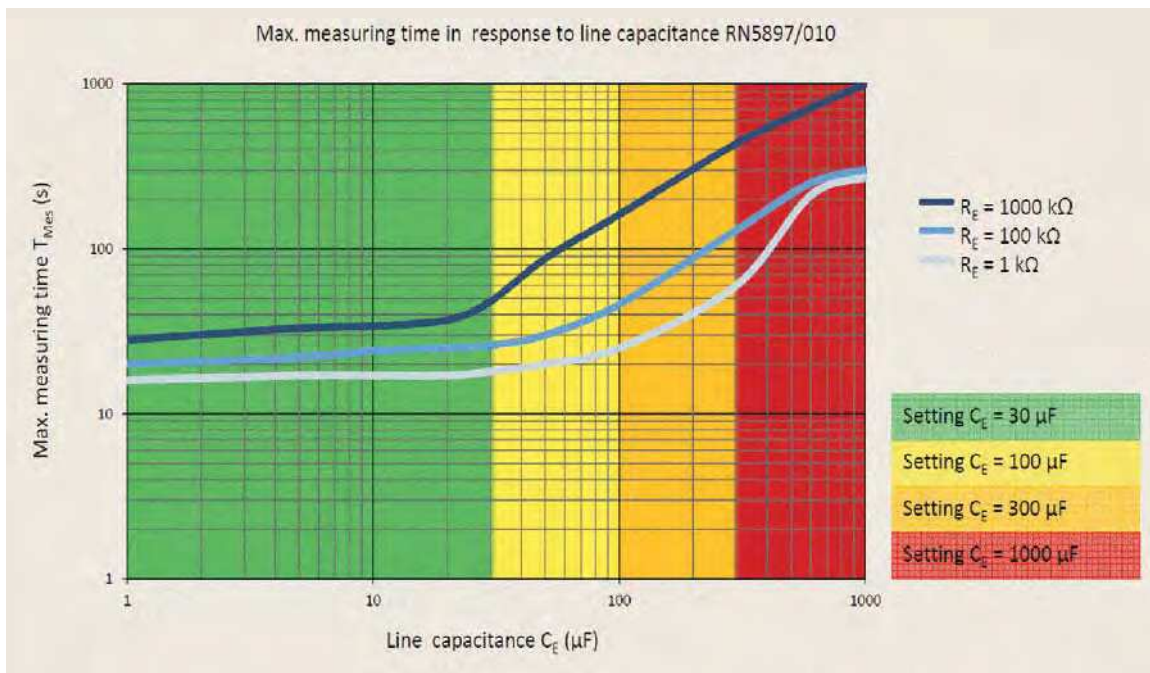
## Connection Example



\*1) Auxiliary voltage  $U_H$  (A1(+)/A2) ) can also be sourced from the monitored voltage system.  
The voltage range of the auxiliary supply has to be taken into account.

\*2) Control input X1/X2 for external combined Test-/Reset-button:

- Control approx. 1 s: Test function
- Control > 3 s: Reset function



M11605



### VARIMETER IMD Insulation monitor RN 5897/300



#### Product Description

The insulation monitor RN 5897/300 of the VARIMETER IMD family provides best and up to date insulation monitoring of modern IT systems in an optimum and state of the art way fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems. The adjustment of the setting values is simple and user friendly done on 3 rotary switches on the front of the device. Via multicolor LED the device status is indicated easy to read. With a sealable transparent cover the device is protected against manipulation.

#### Your Advantages

- Preventive fire and system protection
- Detection of symmetric and asymmetric insulation faults
- Universal application in non-earthed AC, DC, AC/DC networks with up to 300 V nominal voltage
- Easy adjustment of response values and setting parameter via rotational switch
- Suitable for large leakage capacitances up to 30  $\mu\text{F}$
- Monitoring also with voltage-free mains
- Measuring circuit L(+)/L(-) with broken wire detection (can be switched off)
- Protective conductor PE1/PE2 with broken wire detection (can't be switched off)
- No additional coupling device required

#### Features

- Insulation monitoring according to IEC/EN 61557-8
- 2 separate adjustable response thresholds (using e.g. for pre-Alarm and Alarm)
- Setting range of 1st response value (Pre-Alarm): 20  $\text{k}\Omega$  ... 1  $\text{M}\Omega$
- Setting range of 2nd response value (Alarm): 10  $\text{k}\Omega$  ... 250  $\text{k}\Omega$
- 2 changeover contacts for insulation failures-Pre-Alarm and -Alarm
- Energized or de-energized on trip can be selected for indicator relay
- LED for status indication
- Automatic and manual device self-test
- Alarm storage selectable
- Protection against manipulation by sealable transparent cover
- External control input for combined Test-/Reset-button
- 3 wide voltage input for auxiliary voltage
- Width 52.5 mm

#### Approvals and Markings



#### Applications

Insulation monitoring of:

- Non-earthed AC, DC, AC/DC networks
- UPS systems
- Networks with frequency inverters
- Battery networks
- Networks with direct current drives
- Hybrid and battery-powered vehicles
- Mobile generator sets

## Function

The device is supplied with DC auxiliary voltage via terminals A1(+) / A2. Switching on the auxiliary voltage (Power-On) is followed by an internal self-test for 10 sec (see „Device test functions“). The test process is visible in the status LED. After this, measurement of the insulation resistance in the measuring circuits begins and the colour of the status LED changes to green.

### Measuring circuit

#### (Insulation measurement between terminals L(+)/L(-) and PE1/PE2)

The terminals L(+) and L(-) are connected directly to the voltage system to be monitored. A broken wire detection creates a fault signal if there is no low-ohmic connection between both terminals.

The type of network (AC, DC, 3NAC) has to be selected.

Also the terminals PE1 and PE2 have to be connected with 2 separate wires to the protective earth. An interruption of a wire also causes a fault signal (see section "Behavior on faulty connection"). The monitoring of the PE connection cannot be de-activated.

To measure the insulation resistance an active measuring voltage with changing polarity is connected between L(+)/L(-) and PE1/PE2.

The duration of the positive and negative measuring phase depends on the actual leakage capacity of the monitored system and in DC systems also on the level and duration of possible voltage variations. This allows a correct and fast measurement in different network conditions.

At the end of a measuring cycle the actual insulation resistance is produced and indicated. The relays for alarm K1 and pre-alarm K2 switch when dropping under the adjusted response values. In addition the LED changes to orange color on pre-alarm or to red color on alarm.

### Manual reset of fault message

The rotary switch "UN" is divided in 2 sections. So additional to the type of voltage system also manual or autoreset can be selected. (Alarm storing: manual reset, no alarm storing: auto reset).

If manual reset is activated the insulation fault signals of the measuring circuit are stored when dropping under the adjusted response values also if the insulation resistance goes back to healthy state. Pressing the „Reset“ button on the front side for 2 s, the alarm signal are reset if the actual insulation resistance is in healthy state.

### Indicator relay for insulation fault signal

For the indicator relays K1 (contacts 11-12-14, for alarm) and K2 (contacts 21-22-24, for pre-alarm) the function energized on trip or de-energized on trip can be set via pre-alarm rotational switch "R<sub>PA</sub>" when the insulation resistance drops below the adjusted response value.

### Broken wire detection

As described in section "Measuring circuit", the measuring circuits L(+)/L(-) and the protective conductors PE1/PE2 are constantly monitored for wire breaks – not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds. Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected.

Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage.

The device would no longer detect a connection fault on L(+)/L(-).

Especially parallel lines should be avoided over larger distances.

If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, the broken wire detection can be de-activated using alarm rotary switch "R<sub>A</sub>". Monitoring deactivated or continuous monitoring (every 2 minutes for 10 sec) are the possible options. If the broken wire detection on L(+)/L(-) is de-activated no AC voltage is injected.

The broken wire detection on PE1/PE2 cannot be de-activated.

## Function

### Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every full operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front for 2 sec.

With the self-test, contrary to the expanded test, the status of the Indicator relays is not affected; the sequence is as follows:

The self-test is indicated via LED with orange flash code 1. For approx. 4 s to negative test phase. Within these 4 s the internal measuring circuit is checked for failures. Then the measuring pulse is switched for approx.. 4 s to positive test phase and more internal tests take place. If no failures turned up and had been recognized, the measurement continuous. The extended test procedure is started when during or at the end of the above described self-test the test button is pressed again for 2 s.

The sequence is similar to the self-test (2 measuring phases of 4 s each) but in addition the output relays go in alarm stated. The LED shows orange flash code 2. The test phases of the extended test will be repeated continuously. Pressing the reset button again for 2 s will stop the extended test immediately. The device starts the insulation measurement again.

### Behaviour with internal device faults

If internal device faults were detected during the test function, the LED flashes continuously red. The indicator relays K1 and K2 switch to the alarm state.

### Behavior on faulty connection

When detecting broken wire on terminals L(+)/L(-), the measurement is disabled. The reaction time could be up to 2 min. The monitoring relays K1 and K2 go in alarm state, the LED indicates the red flash code 1. After removing the interruption the fault is automatically reset (max. reaction time up to 2 min) and the measurement of the insulation resistance is continued. Stored alarm values remain stored. An interruption of the protective earth connections PE1/PE2 causes the same reaction as interrupting the measuring circuit, only the LED indicate the red flash code 2.

### External control input

To terminals X1/X2 an external combined Test-/Reset button can be connected. If the terminals X1/X2 are bridged for approx.. 1 s the test mode is started. This has the same function as pressing the internal test button. When bridging X1/X2 for > 3 s, a stored alarm will be reset. This has the same function as pressing the internal reset button.

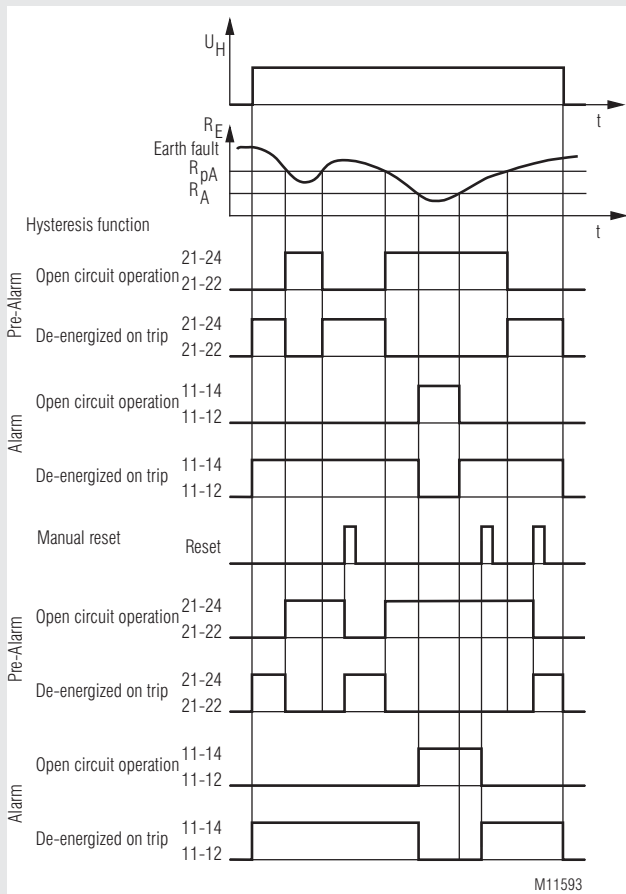
### Programming/setting of parameters/set-up of the insulation monitor

All setting are done with 3 rotary switches on the front of the unit. To avoid unauthorized manipulation of the settings, all 3 switches are located behind a sealable transparent cover. The first rotary switch "R<sub>A</sub>" sets the response value for alarm. In addition it is divided in 2 sections. If the setting position is in the first section the broken wire detection is permanent enabled, if the setting position is in the second section the broken wire detection is permanent disabled. The second rotary switch "R<sub>PA</sub>" sets the response value for pre-alarm. In addition it is also divided in 2 sections. If the setting position is in the first section, the relay output function is de-energized on trip, if the setting position is in the second section, the relay output function is energized on trip.

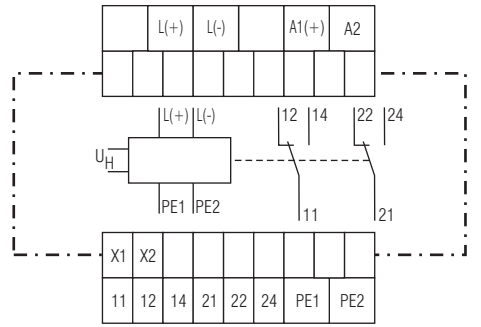
The third rotary switch "UN" selects the type of network connection. It is also divided in 2 sections. If the setting position is in the first section, the unit is on auto reset, if the setting position is in the second section, the unit is on manual reset.

New settings are accepted without restart of the device.

## Function Diagram



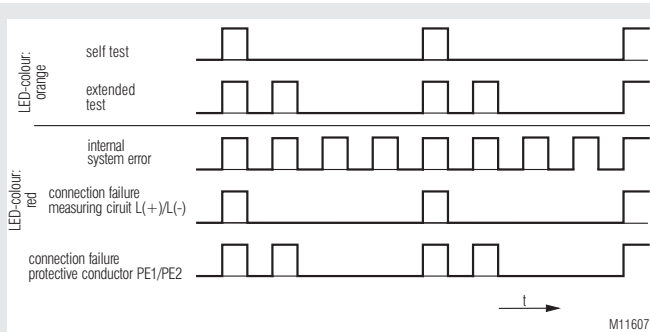
## Circuit Diagram



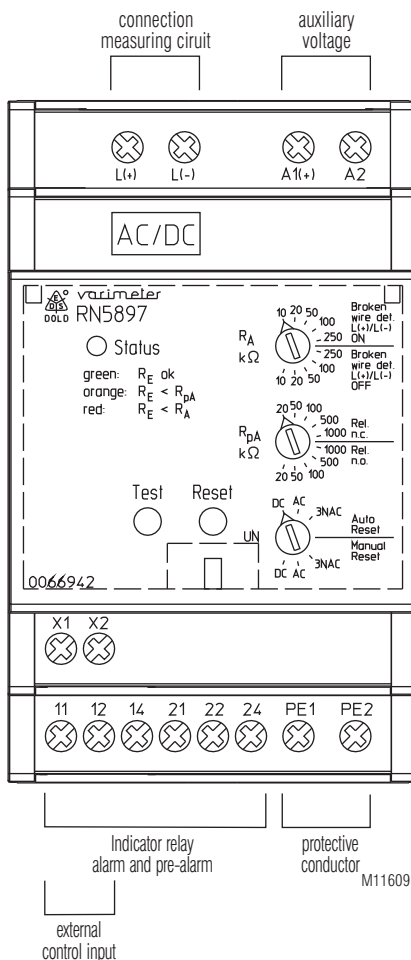
## Connection Terminals

Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage AC or DC
L(+), L(-)	Connection for measuring circuit
PE1, PE2	Connection for protective conductor
X1, X2	Control input (combined external Test- and Reset-input)
11, 12, 13	Alarm signal relay K1 (1 changeover contact)
21, 22, 23	Prewarning signal relay K2 (1 changeover contact)

## Flashing Codes LED "ERR"



## Indicators



## Error Indication

Flash code red Status-LED	Failure cause	Failure recovery
1	Broken wire detection on L(+)/L(-).	Check measuring circuit L(+) and L (-)
2	Broken wire detection on PE1/PE2.	Check protective earth connections PE1 and PE2
continuously flashing	Internal failure detected in test mode	Press test button again or restart the unit by interrupting the auxiliary supply temporarily. If the fault remains permanent, send device back to manufacturer for examination.
continuously flashing	Faulty calibration values detected in device memory.	Send device back to manufacturer for recalibration and examination.

## Indicators

The operational status of the device is indicated on a 3-colour LED:

- Off:** No auxiliary voltage connected
- Green:** Normal operation (Insulation resistance in healthy state)
- Red:** Alarm (measured value below alarm response value)
- orange:** Warning (measured value below pre-alarm response value)
- orange flashing:** Test mode procedure (see flashing code diagramm)
- red flashing:** Failure code (see flashing code diagramm)

Flash code orange Status-LED	Description
1	Selftest (measuring circuit, measuring voltage, internal tests)
2	Advanced Test (additional control of indicator relays)

## Notes

In one voltage system only one insulation monitor can be used. This has to be observed when interconnecting two separate systems.

Device terminals PE1 and PE2 must always be connected via separate lines to different terminal points of the protective-conductor system.

The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place e.g. battery networks with connected inverters on the DC side, with Generators/Transformers with connected Rectifiers or inverters on the AC-side. To monitor a 3NAC system the device can be connected single pole, (L+) and L(-) are bridged, to the neutral of the 3p4w system. The 3 phases have a low-ohmic (approx. 3 – 5 Ohm) connection via the transformer windings so also insulation failures of the not directly connected phases are detected. Via the rotational switch "UN" the correct type of network needs to be selected (see „Connection Examples“).

Please do not connect external voltage to terminals X1/X2. The control must only be made by bridging X1 and X2.

### ATTENTION !



**The device must not be operated without PE1/PE2 connection!**

**Before checking insulation and voltage, disconnect the monitoring device RN 5897 from the power source!**



**The device monitors HIGH-VOLTAGE!**  
**Caution High-Voltage when working on the device!**  
**Disconnect all power supplies before servicing equipment!**

**Technical Data****Measuring circuit L(+)/L(-) to PE1/PE2**

**Voltage range  $U_N$ :** DC 0 ... max. 300 V; AC 0 ... max. 300 V  
**Frequency range:** DC or 40 ... 1000 Hz  
**Max. line capacitance:** 30  $\mu$ F  
**Internal resistance (AC / DC):** > 120 k $\Omega$   
**Measuring voltage:** approx.  $\pm$  90 V  
**Max. measured current ( $R_E = 0$ ):** < 0,80 mA  
**Response inaccuracy:**  $\pm$  15 %  $\pm$  1,5 k $\Omega$  IEC 61557-8  
**Response value hysteresis:** approx. + 25 %; min. + 1 k $\Omega$   
**On delay**  
 at  $C_E = 1 \mu$ F,  
 $R_E$  of  $\infty$  to 0.5 \* response value:  $\leq$  1 s (at setting 3N AC)  
 $\leq$  5 s (at setting AC, DC)

**Measuring time:**

At  $C_E = 1 \dots 30 \mu$ F,  
 $R_E$  from  $\infty$  to 1000 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 100 k $\Omega$ ,  
 $R_E$  from  $\infty$  to 1 k $\Omega$ : see characteristics

**Response values:**Pre-warning („R<sub>PA</sub>“):

k $\Omega$ :	20	50	100	500	1000
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Alarm („R<sub>A</sub>“)

k $\Omega$ :	10	20	50	100	250
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each adjustable via rotational switches

**Response value broken****wire detection L(+)/L(-):** > approx. 30 k $\Omega$ **Response value broken****wire detection PE1/PE2:** > approx. 0,5 k $\Omega$ **Auxiliary voltage input A1(+)/A2**

Nom. Voltage	Voltage range	Frequency range
AC/DC 24 ... 60 V	AC 19 ... 68 V	45 ... 400 Hz; DC 48 % W*)
	DC 16 ... 96 V	W*) $\leq$ 5 %
AC/DC 85 ... 230 V	AC 68 ... 276 V	45 ... 400 Hz; DC 48 % W*)
	DC 65 ... 300 V	W*) $\leq$ 5 %
DC 12 ... 24 V	DC 9,6 ... 30 V	W*) $\leq$ 5 %

\*) W = permitted residual ripple of auxiliary supply

**Nominal consumption:**

DC 24 V, 48 V: max. 3 W  
 AC 230 V: max. 3.5 VA

**Control input X1/X2 for external kombinierte Test-/Reset-Taste**

**Current flow:** approx. 3 mA  
**No-load operation voltage**  
**X1 to X2:** ca. 12 V  
**Permissible wire length:** < 50 m  
**Activation time for test signal:** approx. 1 s  
**Activation time for reset signal:** > 3 s

**Outputs**

**Indicator contact:** 2 x 1 changeover contact for Alarm (K1) and Pre-Alarm (K2) energized or de-energized on trip (programmable)  
 4 A

**Thermal current  $I_{th}$ :****Switching capacity**

to AC 15:  
 NO contact: 5 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1  
 to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life**at 5 A, AC 230 V: 1 x 10<sup>5</sup> switching cycles**Short circuit strength****max. fuse rating:** 4 A gL IEC/EN 60 947-5-1**Mechanical life:** 50 x 10<sup>6</sup> switching cycles**Technical Data****General Data**

**Operating mode:** Continuous operation  
**Temperature range:**  
 Operation: - 40 ... + 70 °C  
**Altitude:** < 2.000 m IEC 60 664-1  
**Clearance and creepage distances**  
 Rated insulation voltage: 300 V  
 Overvoltage category: III  
 rated impuls voltage / pollution degree: IEC 60 664-1  
 measuring circuit L(+)/L(-) to auxiliary voltage A1(+)/A2 and indicator relay contacts K1, K2: 4 kV / 2  
 auxiliary voltage A1(+)/A2 to indicator relay contacts K1, K2: 4 kV / 2  
 indicator relay contact K1 to indicator relay contacts K2: 4 kV / 2  
**EMC**  
 Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61000-4-2  
 HF irradiation:  
 80 MHz ... 1 GHz: 20 V / m IEC/EN 61000-4-3  
 1 GHz ... 2.7 GHz: 10 V / m IEC/EN 61000-4-3  
 Fast transients: 2 kV IEC/EN 61000-4-4  
 Surge voltage between wires for power supply: 1 kV IEC/EN 61 000-4-5  
 between wire and ground: 2 kV IEC/EN 61 000-4-5  
 HF-wire guided: 20 V IEC/EN 61000-4-6  
 Interference suppression: Limit value classe B EN 55011  
**Degree of protection**  
 Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529  
**Housing:** Thermoplastic with V0 behaviour according to UL subject 94  
**Vibration resistance:** Amplitude 0.35 mm, Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
 40 / 070 / 04 IEC/EN 60 068-1  
**Climate resistance:** EN 50 005  
**Terminal designation:**  
**Wire connection**  
 Cross section: solid/stranded 0.5 ... 4 mm<sup>2</sup>  
 Stranded ferruled: 0.5 ... 2.5 mm<sup>2</sup>  
 Multiple wire connection: 0.5 ... 1.5 mm<sup>2</sup> (2 wires with same cross section)  
 Stripping length: 6.5 mm  
 max. fixing torque: 0.5 Nm  
**Wire fixing:** box terminal with cross recess screw  
**Mounting:** DIN rail IEC/EN 60715  
**Weight:** approx. 200 g

**Dimensions****Width x height x depth:** 52.2 x 90 x 71 mm**Classification to DIN EN 50155**

**Vibration and shock resistance:** Category 1, Class B IEC/EN 61 373  
**Protective coating of the PCB:** No

## Standard Types

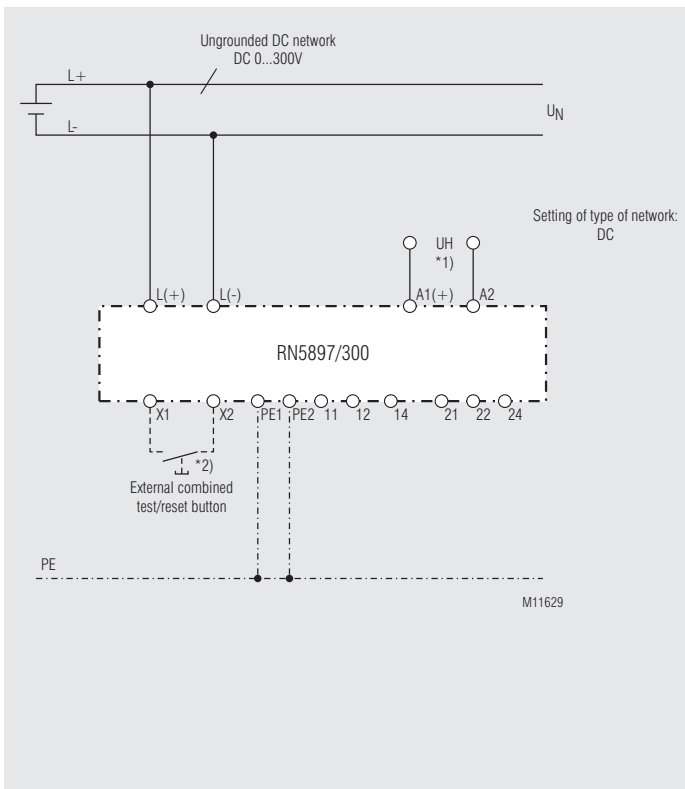
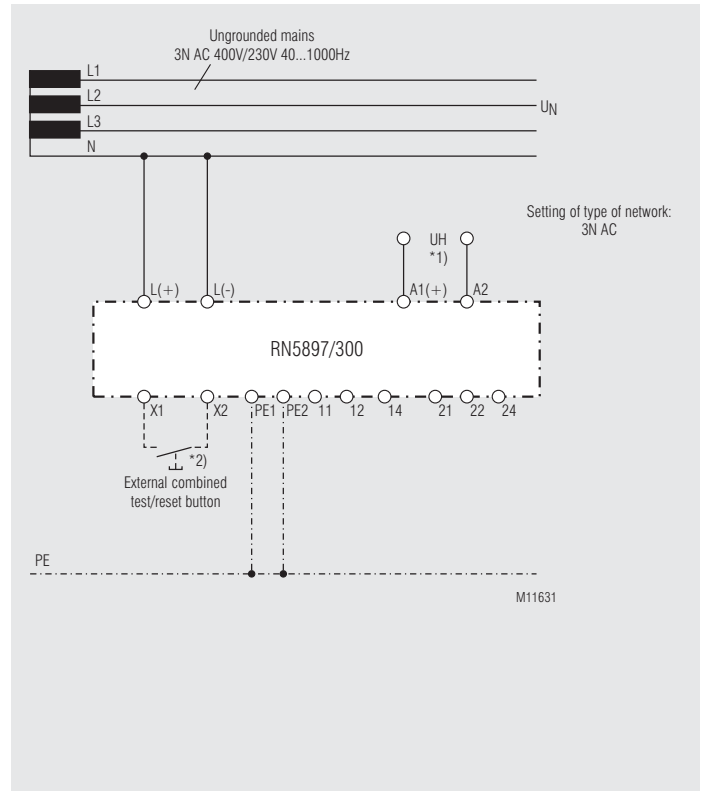
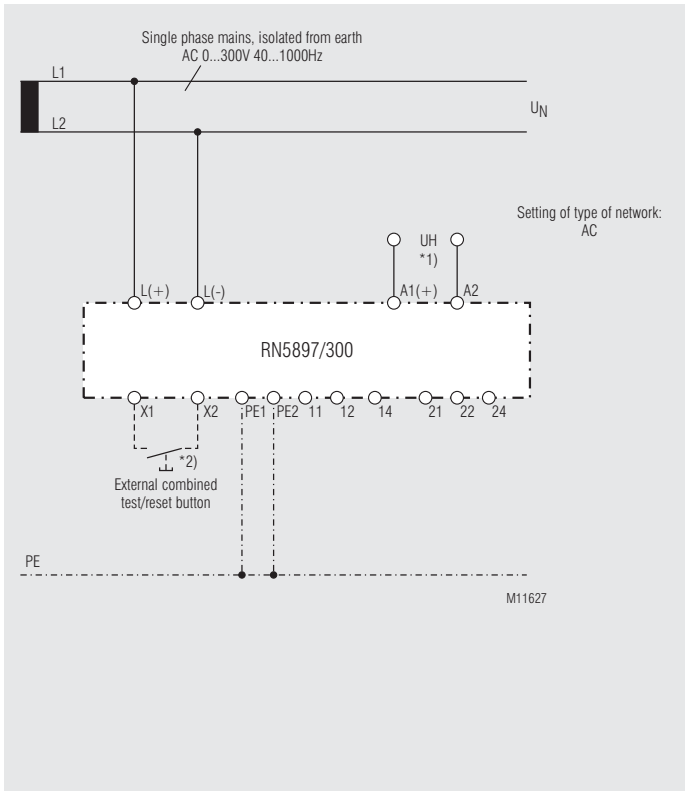
RN 5897.12/300 AC/DC 24 ... 60 V  
Article number: 0066942

- Auxiliary voltage: AC/DC 24 ... 60 V
- Outputs: 1 changeover contact for pre-warning  
1 changeover contact for alarm
- Setting range pre-warning: 20 k $\Omega$  ... 1 M $\Omega$
- Setting range alarm: 10 k $\Omega$  ... 250 k $\Omega$
- Max. line capacitance: 30  $\mu$ F
- Energized or de-energized on trip
- Selection of type of network
- Width: 52.5 mm

RN 5897.12/300 AC/DC 85 ... 230 V  
Article number: 0066943

- Auxiliary voltage: AC/DC 85 ... 230 V
- Outputs: 1 Wechsler für Pre-Alarm  
1 Wechsler für Alarm
- Setting range pre-warning: 20 k $\Omega$  ... 1 M $\Omega$
- Setting range alarm: 10 k $\Omega$  ... 250 k $\Omega$
- Max. line capacitance: 30  $\mu$ F
- Energized or de-energized on trip
- Selection of type of network
- Width: 52.5 mm

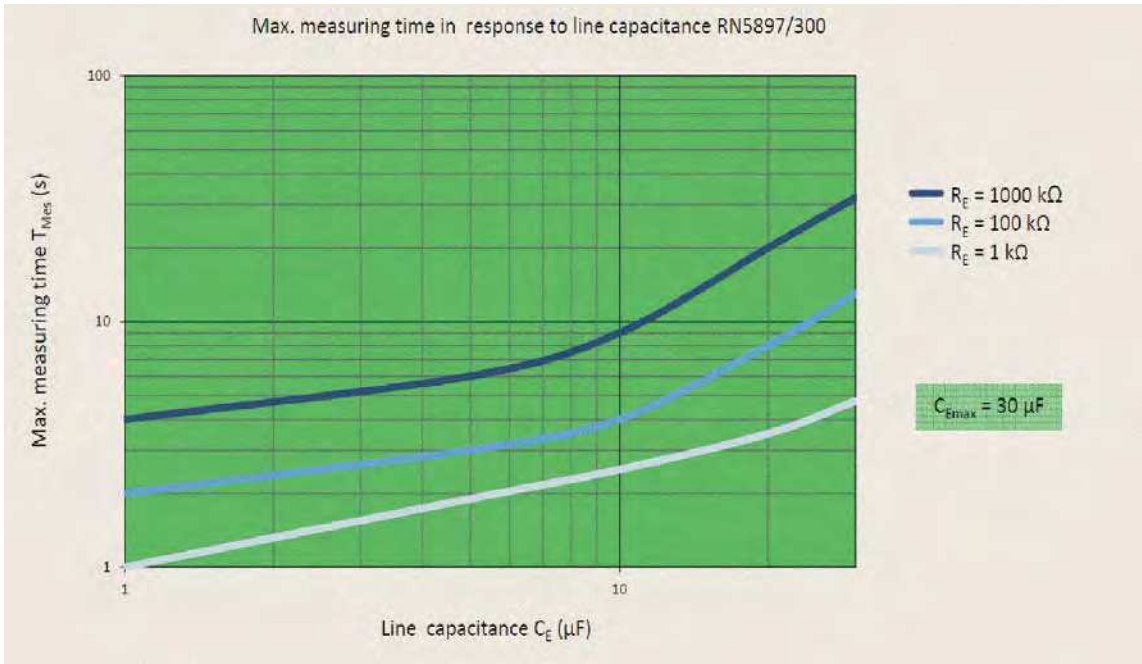
## Connection Examples



\*1) Auxiliary voltage  $U_H$  (A1(+)/A2) can also be sourced from the monitored voltage system.  
The voltage range of the auxiliary supply has to be taken into account.

\*2) Control input X1/X2 for external combined Test-/Reset-button:

- Control approx. 1 s: Test function
- Control > 3 s: Reset function



M11611





### Product Description

The insulation monitor LK 5896 of the varimeter IMD family provides best and up to date insulation monitoring of modern IT systems in an optimum and state of the art way, fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via LEDs the measured value, device parameters and device status are indicated easy to read. The unit has 3 relay contacts to signal Insulation and device failures. The analogue output provides a voltage and current signal proportional to the actual insulation resistance, which can be connected to a superior control (plc), another system or external display unit. In addition the LK 5896 provides a second measuring circuit that can be used to monitor an inverter on the AC side also when the inverter is disconnected.

### Connection Terminals

Terminal designation	Signal designation
A1+, A2	DC-Auxiliary voltage
L(+), L(-)	Connection for main measuring circuit
U, V	Connection for auxiliary measuring circuit
KE, PE	Connection for protective conductor
G, R	Control input (manual/auto reset) G/R not bridged: manual reset G/R bridged: auto reset
G, T	Control input (External test input) connection option for external device test pushbutton
G, HM	Control input (main measuring circuit deactivation) G/HM not bridged: Main measuring circuit activated G/HM bridged: Main measuring circuit deactivated
G, ZM	Control input (aux. measuring circuit deactivation) G/ZM not bridged: aux. measuring circuit deactivated G/ZM bridged: aux. measuring circuit activated
XA, GA, IA, UA	Analogue output XA/GA not bridged: UA-GA 0 ... 10V; IA-GA 0 ... 20mA XA/GA bridged: UA-GA 2 ... 10V; IA-GA 4 ... 20mA
Y1, Y2	Alarm trigger output for insulation fault locating system
11, 12, 14	Alarm signal relay (1 changeover contact)
21, 22, 24	Prewarning signal relay (1 changeover contact)
31, 32, 34	Device fault signal relay (1 changeover contact)

### Your Advantages

- Preventive fire and system protection
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks with up to 1000 V nominal voltage
- Suitable for large leakage capacitances up to 3000µF
- Simplest setting via engaging rotary switches
- For monitoring photovoltaic system, also with thinfilm technology
- Optimised measuring times - normally shorter than with known methods
- Monitoring also with voltage-free mains
- Additional measuring circuit allows AC output monitoring even with the inverter switched off, e.g. with hybrid vehicles
- Measuring circuit with broken wire detection
- No additional coupling device required
- Trigger output for insulation fault locating system
- Analogue output for value of the insulation resistance: 0 ... 10 V / 0 ... 20 mA (2 ... 10 V / 4 ... 20 mA)

### Features

- Insulation monitoring according to IEC/EN 61557-8
- Detection of symmetric and asymmetric insulation faults
- Measuring circuits can be disconnected via control terminals, e.g. for mains couplings
- 1 changeover contact each for prewarning and alarm
- 3. output relay for signalling wire break and device faults
- Prewarning threshold setting range: 20 kΩ ... 2 MΩ
- Alarm threshold setting range: 1 kΩ ... 250 kΩ
- Energized or de-energized on trip can be selected for output relay
- Setting the maximum leakage capacitance to shorten the response time
- Simple, clearly arranged adjustment of the device with screwdriver
- LED chain to indicate the current insulation resistance
- Display of active measuring circuits
- Automatic and manual device self-test
- Alarm storage selectable
- External test and reset pushbutton can be connected
- Width: 90 mm

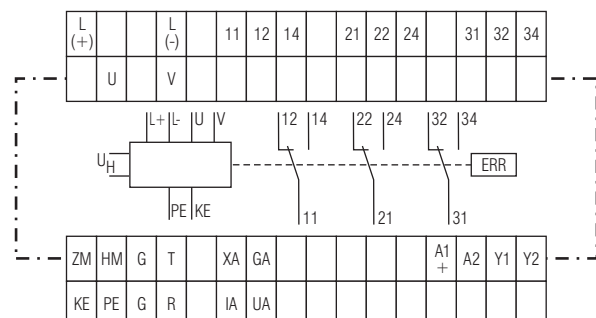
### Approvals and Markings



### Applications

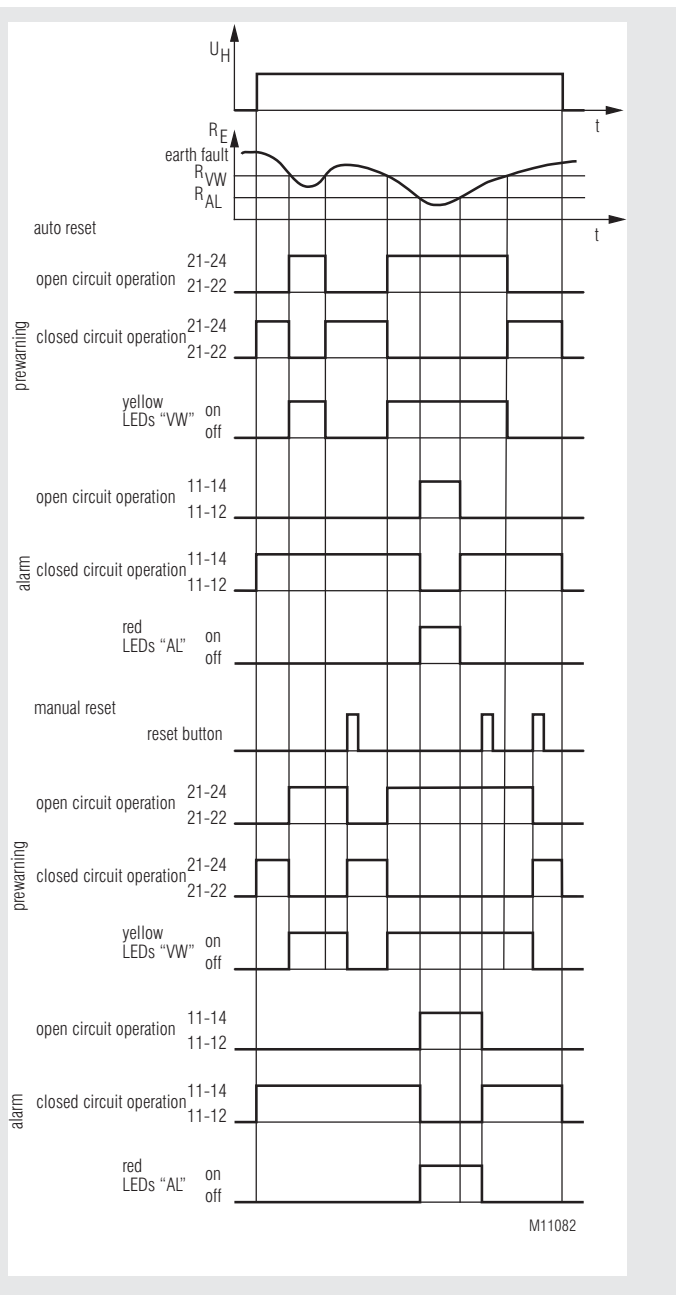
- Insulation monitoring of:
- Non-earthed AC, DC, AC/DC networks
  - UPS systems
  - Networks with frequency inverters
  - Battery networks
  - Networks with direct current drives
  - Photovoltaic systems
  - Hybrid and battery-powered vehicles

### Circuit Diagrams



M10832\_b

## Function Diagram



## Function

The device is supplied with DC auxiliary voltage via terminals A1+ / A2; a green "PWR" LED comes on. Switching on the auxiliary voltage is followed by an internal self-test for 10 sec, where the LEDs of the indicator string light up in sequence. After this, measurement of the insulation resistance in the measuring circuits begins.

### Main measuring circuit

#### (Insulation measurement between terminals L(+) / L(-) and PE / KE)

Terminals L(+) and L(-) are connected to the mains to be monitored. Broken wire detection, constantly effective during operation, generates an error messages if both terminals are not connected with low resistance through the mains.

In addition, the two terminals PE and KE must be connected to the protective conductor system via separate lines. An error message is given here as well if a line is interrupted (see section "Actions in case of connection faults").

If the main measuring circuit is activated (terminal HM open), an active measuring voltage with alternating polarity is applied between L(+) / L(-) and PE / KE to measure the insulation resistance. During the measuring phase with positive polarity, the "HM" LED flashes with a long On-phase and with negative polarity with a short On-phase.

The "HM" LEDs goes off when the main measuring circuit is switched off through bridges of terminals HM-G. Measurement is suspended and no more measuring voltage reaches the measuring circuit, so that in case of coupling to a network where another insulation monitor is already active, no interference can occur.

The length of the positive and negative measuring phases depends on the settings on the rotary switch "CE/ $\mu$ F", the actual leakage capacitance of the monitored network and with DC networks, on the level and duration of possible mains voltage fluctuations. Correct and preferably quick measurement is thus given with different mains conditions. In the event of particularly adverse conditions and major interferences, the measuring analysis can be steadied and delayed in addition with rotary switch "tv" if necessary.

The current insulation resistance is determined and analysed at the end of each measuring phase. The LED-chain and the analogue output show the resistance determined, and the output relays for prewarning "VW" and alarm "AL" switch according to the respective response values set. If the response thresholds have been undercut, the LEDs "VW" or "AL" light according to the insulation fault location: "+", "-" or "+" and "-" simultaneously for AC faults or symmetric insulation faults.

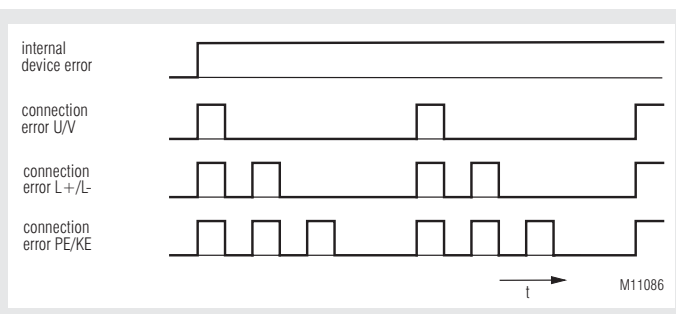
### Auxiliary measuring circuit

#### (Insulation measurement between terminals U / V and PE / KE)

The main measuring circuit is connected at the DC side for photovoltaic systems and hybrid vehicles. The AC side is disconnected as long as the inverter is switched off and can therefore not be monitored by the main measuring circuit for insulation faults. However, it is useful to monitor the AC side already before activating the inverter for insulation faults to PE for the inverter not to be even activated in the output circuit in case of insulation faults. For this reason, the insulation monitor LK5896 is equipped with an auxiliary measuring circuit determining the insulation resistance of the AC side to PE / KE. To this end, terminals U and V are connected to any phase preferred on the AC side. Broken wire detection is effective here as well and generates an error message if terminals U / V are not connected at low resistance, e.g. via load resistors, transformer or motor windings. The auxiliary measuring circuit is activated by bridging the device terminals ZM-G, for example, by the break contact of the (released) contactor that activates the inverter. The "ZM" LED lights when the auxiliary measuring circuit is activated.

The auxiliary measuring circuits monitors for the same response values as the main measuring circuit. The current insulation resistance in the auxiliary measuring circuit does not affect the analogue input but is displayed at values < approx. 1.7 M $\Omega$  on the LED-chain through corresponding LEDs, which are selected here in flashing function to distinguish from the main measuring circuit. The "ZM" LED flashes here at the same clock frequency. The LEDs of "VW" or "AL" flash if the respectively set response value is undercut only in the auxiliary measuring circuit.

## Flashing Codes LED "ERR"



## Function

### Storing insulation fault message

If terminal R is open, the insulation fault messages from the main and auxiliary measuring circuit are stored when the respective response value is undercut, but also when the insulation resistance returns to the OK-range. In addition, the temporary minimum values of the insulation resistance are indicated on the LED-chain through dimmed LEDs.

If the "Reset" button on the device front is pressed or terminal R is connected with G, the stored insulation fault messages are reset when the insulation resistance is again in the OK-range.

### Output relay for insulation fault messages

The rotary switch "CE/ $\mu$ F Rel." allows selecting the operating current (A) or standby current (R) principle for the output relays "AL" (contacts 11-12-14) and "VW" (contacts 21-22-24).

With the operating current principle, the relays respond when the response values are undercut, with the standby current principle they release when the response values are undercut.

If 2 different response values are not needed, "VW" and "AL" can be set to the same value. The output relays switch together in this case.

### Analogue output

The LK 5896 features a universal analogue output to display the current insulation resistance in the main measuring circuit: Terminal UA-GA: 0 ... 10 V and terminal IA-GA: 0 ... 20 mA. By bridging terminals XA-GA, the output can be switched to 2 ... 10 V and 4 ... 20 mA.

### Trigger output for insulation fault locating system

This trigger output (Y1-Y2) can be coupled with the trigger input Y1-Y2 of RR 5886 to initiate automatic fault location with the insulation fault locating system, consisting of RR 5886 and RR 5887. The trigger output is activated when the measuring value drops under the Alarm response value (AL). As long as it stays under the response value or an alarm is stored, the trigger output Y1-Y2 remains active. To prevent insulation monitor LK 5896 from affecting insulation fault locating, RR 5886 generates the deactivation signal for LK 5896 at its terminals H-G. It is applied to terminals HM-G of LK 5896 and deactivates its measuring circuit.

### Broken wire detection

As mentioned above, both the main measuring circuit and the auxiliary measuring circuit are constantly monitored for wire breaks – not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds. Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected.

Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage. The device would no longer detect a connection fault on L(+)/L(-).

Especially parallel lines should be prevented over larger distances.

If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, version LK 5896.13/101 (without broken wire detection on L(+)/L(-)) shall be used.

### Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every 4 operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front or with an external pushbutton connected between terminals T and G.

With the self-test, contrary to the expanded test, the status of the output relays and the analogue output are not affected; the sequence is as follows:

Switching to the negative measuring phase is performed for 4 sec. The "HM" LED flashes here with a brief On-phase. The LEDs of the LED-chain are selected in sequence and the internal circuit is checked. After this, switching to the positive measuring phase is performed for 4 sec. The "HM" LED flashes here with a long On-phase. The LED-chain cycles again and additional internal tests are performed. Insulation measurement continues normally after a pause of 2 sec if no faults have occurred.

## Function

The expanded test is started when the internal or external "Test" button is pressed (or is still held) at the end of the 8 sec self-test, described above. The sequence is the same as with the self-test (2 measuring phases at 4 sec + 2 sec pause); however, the output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and the analogue output proceeds to its lowest value.

If the Reset button is pressed during the 8 sec or terminals R-G are connected, the expanded test is terminated after these 8 sec. Otherwise, the phases of the expanded test are constantly repeated, where, in addition, the "ERR" LED and the fault signalling relay (contacts 31-32-34) constantly receive current. However, the expanded test is terminated as soon as the Reset button is pressed. The device switches to the OK-state and restarts insulation measurement.

### Behaviour with internal device faults

If internal device faults were detected during the test function, the "ERR" LED is lit continuously and the fault signalling relay (31-32-34) responds. The main measuring circuit is deactivated internally ("HM" LED goes off). The output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state. The analogue output proceeds to its lowest value and all LEDs of the LED-chain extinguish.

### Behaviour with connection faults

If the auxiliary measuring circuit is activated by bridging terminals ZM-G, broken wire detection in the auxiliary measuring circuit at U / V is signalled by the "ERR" LED flashing with "Error code 1" and the fault signalling relay responds. Measurement and analysis for the main measuring circuit continue normally.

Measurement is suspended if a line interruption is detected at terminals L(+) / L(-); the "HM" LED goes off. The state of the output relays "AL" / "VW" and associated LEDs, the display of the LED-chain and the analogue output are "frozen". This Broken wire detection is signalled by the "ERR" LED flashing with "Error code 2" and the fault signalling relay responds. Measurement of the connection insulation resistance restarts after the connection interruption has been corrected. However, stored alarm messages are preserved. If the connections PE / KE to the protective-conductor system are interrupted, the same responses take place as with an interruption at terminals L(+) / L(-), only that the "ERR" LED indicates "Error code 3".

Indicators	
green LED „PWR“:	on when auxiliary supply connected
red LED „ERR“:	permanent on: at system error flashing: at connection failure
green LED „HM“:	flashing: at active main measuring circuit, ON-OFF-ratio per measurement phase: long ON period during measurement phase with positiv polarity short ON period during measurement phase with negative polarity
green LED „ZM“:	permanent on: at active auxiliary measuring circuit, flashing: ar RE < 2 MΩ
yellow LED-chain:	8 LEDs indicate the actual insulating resistance (≤ 10 kΩ ... ≥ 2 MΩ) flashing: for auxiliary measuring circuit
yellow LED „VW +“:	permanent on: RE lower then prewarning value to + potential flashing: for auxiliary measuring circuit
yellow LED „VW -“:	permanent on: RE lower then prewarning value to - potential flashing: for auxiliary measuring circuit
yellow LEDs „VW +“ and „VW -“ simultaneity:	permanent on: AC-fault / symmetric fault flashing: for auxiliary measuring circuit
red LED „AL +“:	permanent on: tRE lower then tripping value to + potential flashing: for auxiliary measuring circuit
red LED „AL -“:	permanent on: RE lower then tripping value to - potential flashing: for auxiliary measuring circuit
red LEDs „AL +“ And „AL -“ simultaneity:	permanent on: AC-fault / symmetric fault flashing: for auxiliary measuring circuit

## Notes

Device terminals PE and KE must always be connected via separate lines to different terminal points of the protective-conductor system. The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place. Selector switch "tv / UN" should be set accordingly. For photovoltaic systems and hybrid vehicles, the main measuring circuit of the LK 5896 is connected on the DC side; the auxiliary measuring circuit can then be used to monitor the (deactivated) AC side.

For the main measuring circuit, the nominal voltage range for DC is specified with 1000 V; however, absolute values up to max. DC 1500 V are permissible.

Only one insulation monitor may be active in a network to be monitored, since the devices would otherwise influence each other. When coupling several networks or incoming feed sections, where each of them is equipped with its own insulation monitor, all of them must be deactivated except for one insulation monitor. Such deactivation can be beneficially handled via the HM-G control terminals with the LK 5896. The main measuring circuit is designed for large leakage capacitances up to 3000 µF. The selection switch "CE/µF" must be set accordingly. Measurement of the insulation resistances is not falsified by this; however, longer periods are required for the measuring phases than with small capacitances. If the maximum approximate leakage capacitance is known, the selector switch "CE/µF" can possibly be set to smaller values, which reduces the response time further.

The measuring circuit should not be connected via longer parallel guided wires, as this may interfere with the broken wire detection. Also large capacities between L(+) und L(-) have to be avoided.

No external potentials may be connected to control terminals "ZM", "HM", "T" and "R". The associated reference potential is "G" (identical with PE), and the connection of the terminals is made via bridges to "G".

The analogue output and trigger output Y1-Y2 are electrically separated from the rest of the circuitry. The trigger output is intended for connection to the DOLD insulation fault locator system, consisting of RR 5886 and RR 5887. No external voltages may be applied.

### Attention !



**The device must not be operated without KE/PE connection.**

**Before making insulation and voltage tests, the monitor LK 5896 has to be disconnected. !**

**The voltage of the monitored voltage system is connected to terminals L(+) / L(-). Please observe sufficient distance to terminals of neighbour devices and to the grounded metal cabinet or box (min 0.5 cm).**



**The device monitors HIGH-VOLTAGE  
Caution High-Voltage when working on the device!  
Disconnect all power supplies before servicing equipment!**

## Technical Data

### Main measuring circuit L(+)/L(-) to PE/KE

Nominal voltage $U_N$ :	DC 0 ... 1000 V; AC 0 ... 1000 V
Voltage range:	DC max. 1500 V; AC max. 1100 V
Frequency range:	DC or 16 ... 1000 Hz
Max. line capacitance:	3000 $\mu$ F
Internal resistance (AC/DC):	> 280 k $\Omega$
Measuring voltage:	approx. $\pm$ 95 V
Max. measured current ( $R_E = 0$ ):	< 0.35 mA

### Auxiliary measuring circuit U/V to PE/KE

Nominal voltage $U_N$ :	AC 0 ... 690 V
Voltage range:	0 ... 1.1 $U_N$
Frequency range:	16 ... 1000 Hz
Max. line capacitance:	10 $\mu$ F
Internal resistance (AC/DC):	approx. 2 M $\Omega$
Measuring voltage:	approx. 12 V
Max. measured current ( $R_E = 0$ ):	approx. 6 $\mu$ A

### Response values $R_E$

Pre-warning („VW“):

k $\Omega$ :	20	30	50	70	100	150	250	500	1000	2000
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Alarm („AL“)

k $\Omega$ :	1	2	10	20	30	50	70	100	150	250
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each adjustable via rotational switches

Response inaccuracy:	$\pm$ 15 % + 1.5 k $\Omega$	IEC 61557-8
Schaltpunkt-Hysteresis		
at range 10 k $\Omega$ ... 700 k $\Omega$ :	approx. 25 %	
out of range:	approx. 40 % + 0.5 k $\Omega$	
On delay		
at $C_E = 1 \mu$ F,		
$R_E$ of $\infty$ to 0,5 * response value:	< 10 s	
Measuring time:	siehe Kennlinie	

### Input auxiliary voltage

#### DC-Input (A1+ /A2)

Nominal voltage $U_H$ :	DC 24 V
Voltage range:	DC 20 ... 30 V
Nominal consumption:	max. 5 W

#### Control input (between ZM, HM, T, R and G)

Current flow:	approx. 3 mA
No-load voltage to G:	approx. 12 V
Permissible wire length:	< 50 m
Min. activation time:	0.5 s

### Output

Contacts:	3 x 1 changeover contacts for VW, AL and ERR
Thermal current $I_{th}$ :	4 A
Switching capacity	
to AC 15:	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
Electrical life	
at 8 A, AC 250 V:	1 x 10 <sup>4</sup> switching cycles
Short circuit strength	
max. fuse rating:	4 A gL IEC/EN 60 947-5-1
Mechanical life:	10 x 10 <sup>6</sup> switching cycles

### Analogue output

#### for actual insulating value, galvanic separation

Terminals IA(+)/GA:	0 ... 20 mA (bridge XA-GA: 4 ... 20 mA); max. burden 500 $\Omega$
Terminals UA(+)/GA:	0 ... 10 V (bridge XA-GA: 2 ... 10 V); max. current 10 mA

### Scaling

lower analogue value:	$R_E = 0$ ;
upper analogue value:	$R_E = \infty$
Middle of range:	$R_E = 289 \text{ k}\Omega$
Formula example	
for 0-10V:	$RE = 289 \text{ k}\Omega / (10V / UA - 1)$
for 2-10V:	$RE = 289 \text{ k}\Omega / (8V / (UA-2V) - 1)$

## Technical Data

### General Data

Operating mode:	Continuous operation
Temperature range	
Operation:	- 25 ... + 60 °C (device mounted away from heat generation components) - 25 ... + 45 °C (device mounted without distance heated by devices with same load)
Storage:	- 40 ... + 70 °C
Relative air humidity:	93 % bei 40 °C
Atmospheric pressure:	860 ... 1600 mbar (86 ... 106 kPa)
Altitude:	< 4.000 m IEC 60 664-1
Clearance and creepage distances	
rated impulse voltage / pollution degree	IEC 60 664-1
Main measuring circuit L(+)/L(-) to auxiliary voltage DC and relay contacts VW, AL, ERR and analogue output IA, UA, GA and trigger output Y1-Y2:	8 kV / 2
auxiliary measuring circuit U/V to auxiliary voltage DC and relay contacts VW, AL, ERR and analogue output IA, UA, GA and trigger output Y1-Y2:	8 kV / 2
auxiliary voltage DC and trigger output Y1-Y2 to relay contacts VW, AL, ERR and analogue output IA, UA, GA:	8 kV / 2
relay contact VW to relay contact AL to relay contact ERR:	4 kV / 2
analogue output IA, UA, GA to relay contacts VW, AL, ERR and trigger output Y1-Y2:	4 kV / 2
trigger output Y1-Y2 to relay contacts VW, AL, ERR:	4 kV / 2
Insulation test voltage	
Routine test:	AC 5 kV; 1 s AC 2,5 kV; 1 s

### EMC

Electrostatic discharge (ESD):	8 kV (air)	IEC / EN 61000-4-2
HF irradiation:		
80 MHz ... 2.7 GHz:	10 V / m	IEC / EN 61000-4-3
Fast transients:	4 kV	IEC / EN 61000-4-4
Surge voltages		
between A1 - A2:	1 kV	IEC/EN 61000-4-5
between L(+) - L(-):	2 kV	IEC/EN 61000-4-5
between A1, A2 - PE and L(+), L(-) - PE:	4 kV	IEC/EN 61000-4-5
between control line:	0,5 kV	IEC/EN 61000-4-5
between control line and earth:	1 kV	IEC/EN 61000-4-5
HF-wire guided	10V	IEC / EN 61000-4-6
Interference suppression:	Limit value class A*)	

\*) The device is designed for the usage under industrial conditions (Class A, EN 55011).

When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
Housing:	Thermoplastic with V0 behaviour according to UL subject 94	

### Vibration resistance:

IEC/EN 60 068-2-6	
Amplitude 0.35 mm	
frequency 10 ... 55 Hz	
Amplitude $\pm$ 1mm, frequency 2 ... 13.2 Hz	
13.2 ... 100 Hz, acceleration $\pm$ 0.7 $g_n$	
10 $g_n$ / 11 ms, 3 pulses	IEC/EN 60068-2-27

### Shock resistance:

Climate resistance:	25 / 060 / 04	IEC/EN 60 068-1
Terminal designation:	EN 50 005	

## Technical Data

<b>Wire connection</b>	DIN 46 228-1/-2/-3/-4	
<b>Screw terminals (fixed):</b>	1 x 4 mm <sup>2</sup> solid or 1 x 2,5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1,5 mm <sup>2</sup> stranded ferruled (isolated) DIN 46228-1/-2/-3-4 or 2 x 2,5 mm <sup>2</sup> stranded ferruled (isolated) DIN 46228-1/-2/-3	
<b>Insulation of wires or sleeve length:</b>	8 mm	
<b>Wire fixing:</b>	Plus-minus terminal screws M3,5 terminal with wire protection	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN rail	IEC / EN 60715
<b>Weight:</b>	approx. 584 g	

## Dimensions

**Width x height x depth:** 90 x 90 x 121 mm

## Standard Type

LK 5896.13/100 DC 20 ... 30 V

Article number:

0065131

- **Outputs:**
  - 1 changeover contact for pre-warning
  - 1 changeover contact for alarm
  - 1 changeover contact for connection- / system error
- Auxiliary measuring circuit for inverter output
- Auxiliary voltage: DC 20 ... 30 V
- Setting range pre-warning: 20 kΩ ... 2 MΩ
- Setting range alarm: 1 kΩ ... 250 kΩ
- Adjustable line capacitance
- Open- / or closed circuit operation
- Adjustable time delay / selection of AC or DC connection
- Analogue output: 0 ... 20 mA / 4 ... 20 mA; 0 ... 10 V / 2 ... 10 V
- Trigger output for insulation fault locating system
- Width: 90 mm

## Variant

LK 5896.13/101: without wire-break detection at L(+)/L(-)

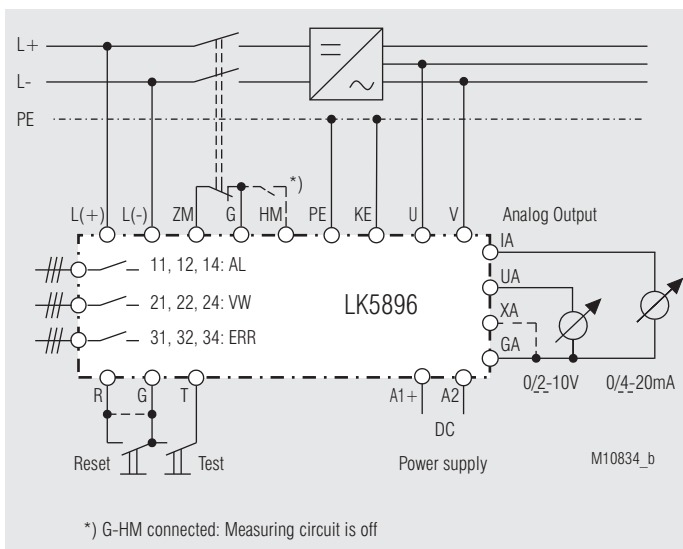
## Accessories

EH 5861/005: Indicating instrument,  
degree of protection: IP 52  
Article number: 0067516

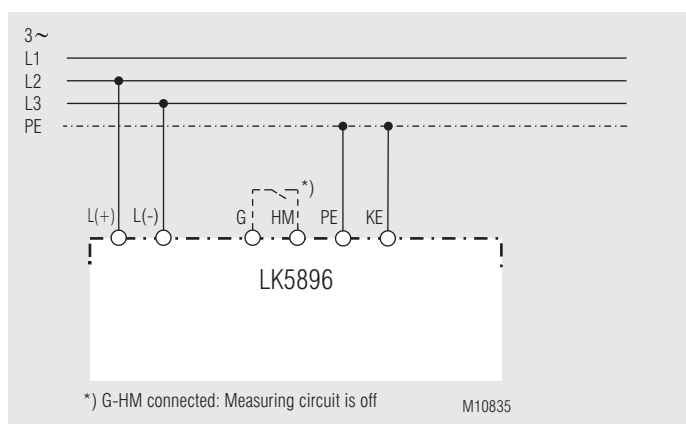


The indicating device EH 5861 is externally connected to the insulation monitor on terminals UA / GA (0 - 10 V) and shows the actual insulation resistance of the voltage system to ground.  
Dimensions:  
Width x height x depth  
96 x 96 x 52 mm

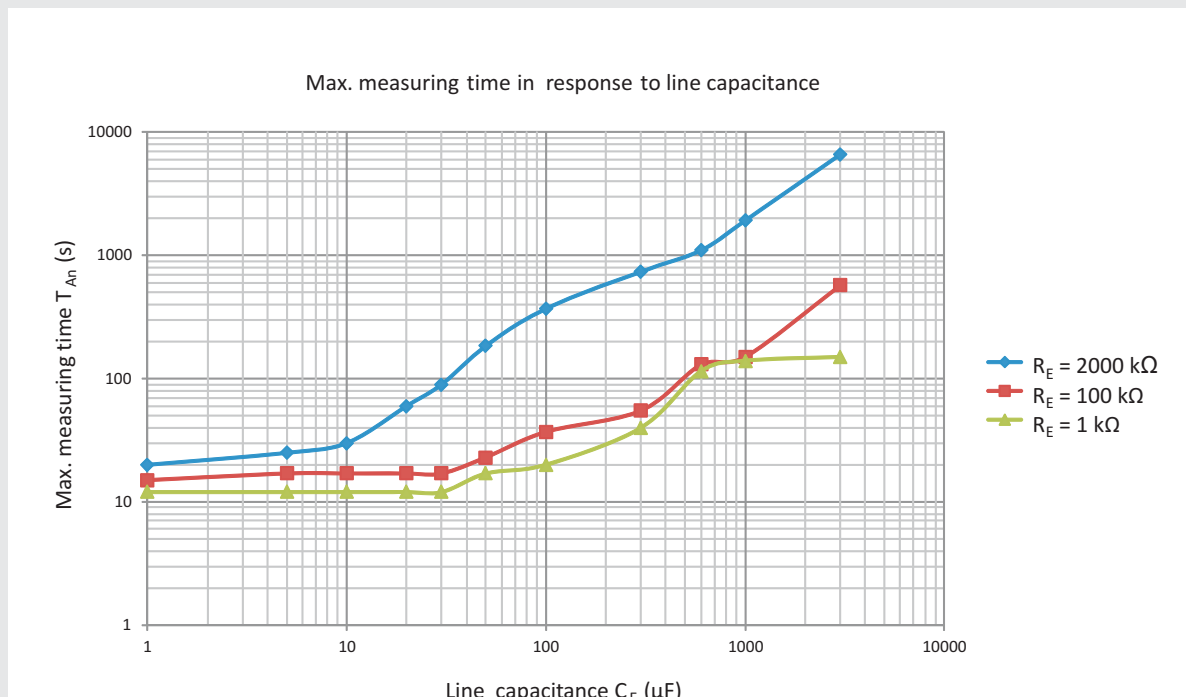
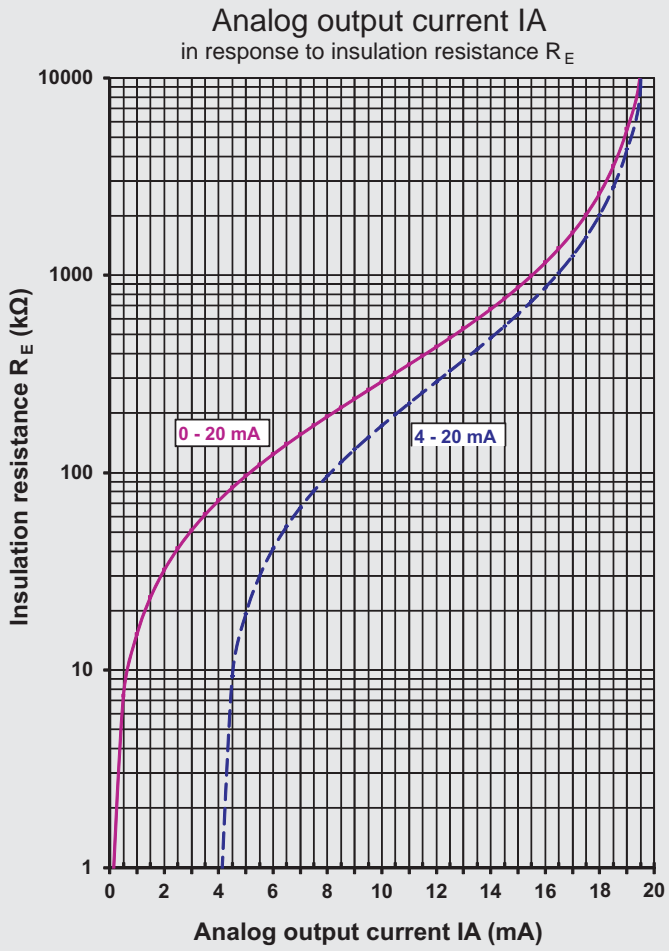
## Connection Examples



## Insulation monitoring DC-side



## Insulation monitoring AC-side



M11295

02.69336



### Your Advantages

- Preventive fire and system protection
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks with up to 1000 V nominal voltage
- Suitable for large leakage capacitances up to 3000µF
- Simplest setting via engaging rotary switches
- For monitoring photovoltaic system, also with thinfilm technology
- Optimised measuring times – normally shorter than with known methods
- Monitoring also with voltage-free mains
- Measuring circuit with broken wire detection
- No additional coupling device required

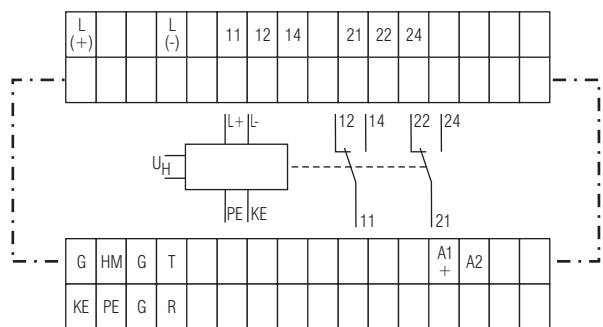
### Features

- Insulation monitoring according to IEC/EN 61557-8
- Detection of symmetric and asymmetric insulation faults
- Measuring circuits can be disconnected via control terminals, e.g. for mains couplings
- 1 changeover contact each for prewarning and alarm
- Prewarning threshold setting range: 20 kΩ ... 2 MΩ
- Alarm threshold setting range: 1 kΩ ... 250 kΩ
- Energized or de-energized on trip can be selected for output relay
- Setting the maximum leakage capacitance to shorten the response time
- Simple, clearly arranged adjustment of the device with screwdriver
- LED chain to indicate the current insulation resistance
- Display of active measuring circuits
- Automatic and manual device self-test
- Alarm storage selectable
- External test and reset pushbutton can be connected
- Width 90 mm

### Product Description

The insulation monitor LK 5895 of the varimeter IMD family provides best and up to date insulation monitoring of modern IT systems in an optimum and state of the art way fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via LEDs the measured value, device parameters and device status are indicated easy to read.

### Circuit Diagram



M10839\_a

### Connection Terminals

Terminal designation	Signal designation
A1+, A2	DC-Auxiliary voltage
L(+), L(-)	Connection for measuring circuit
KE, PE	Connection for protective conductor
G, R	Control input (manual/auto reset) G/R not bridged: manual reset G/R bridged: auto reset
G, T	Control input (External test input) connection option for external device test pushbutton
G, HM	Control input (measuring circuit deactivation) G/HM not bridged: measuring circuit activated G/HM bridged: measuring circuit deactivated
11, 12, 14	Alarm signal relay (1 changeover contact)
21, 22, 24	Prewarning signal relay (1 changeover contact)

### Approvals and Markings

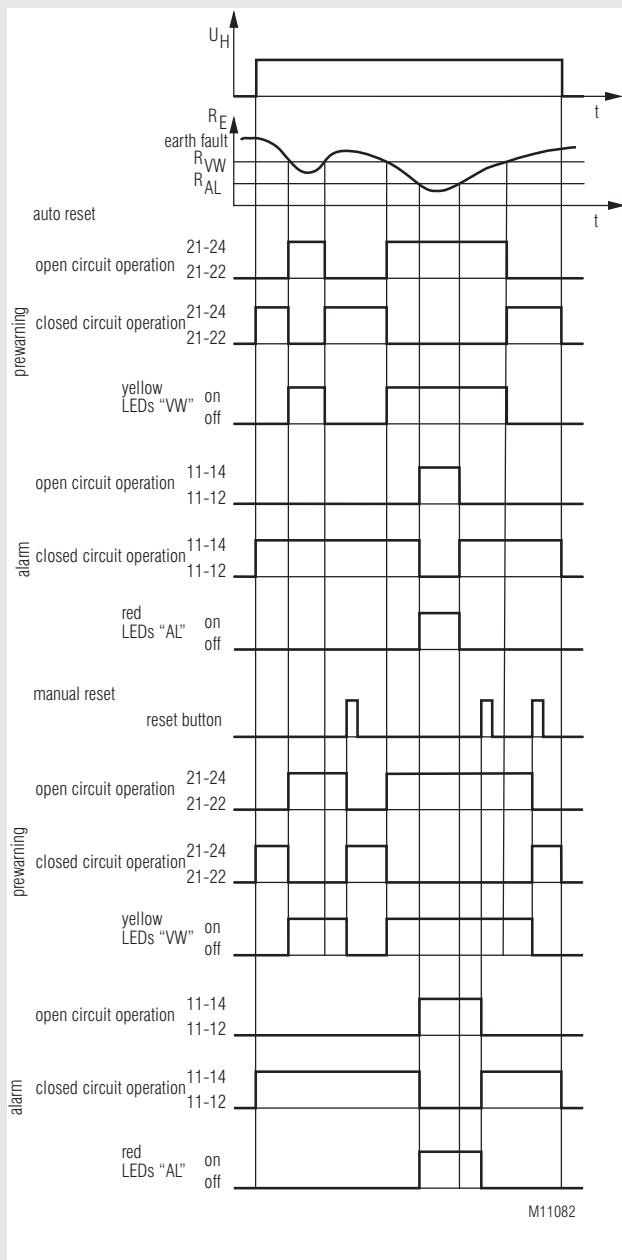


### Applications

- Insulation monitoring of:
- Non-earthed AC, DC, AC/DC networks
  - UPS systems
  - Networks with frequency inverters
  - Battery networks
  - Networks with direct current drives
  - Photovoltaic systems
  - Hybrid and battery-powered vehicles



## Function Diagram



## Function

If the device is supplied with DC auxiliary voltage, the a green "PWR" LED comes on. Switching on the auxiliary voltage is followed by an internal self-test for 10 sec, where the LEDs of the indicator string light up in sequence. After this, measurement of the insulation resistance in the measuring circuits begins.

### Measuring circuit

#### (Insulation measurement between terminals L(+) / L(-) and PE / KE)

Terminals L(+) and L(-) are connected to the mains to be monitored. Broken wire detection, constantly effective during operation, generates an error messages if both terminals are not connected with low resistance through the mains.

In addition, the two terminals PE and KE must be connected to the protective conductor system via separate lines. An error message is given here as well if a line is interrupted (see section "Actions in case of connection faults").

If the main measuring circuit is activated (terminal HM open), an active measuring voltage with alternating polarity is applied between L(+) / L(-) and PE / KE to measure the insulation resistance. During the measuring phase with positive polarity, the "HM" LED flashes with a long On-phase and with negative polarity with a short On-phase. The "HM" LEDs goes off when the main measuring circuit is switched off through bridges of terminals HM-G. Measurement is suspended and no more measuring voltage reaches the measuring circuit, so that in case of coupling to a network where another insulation monitor is already active, no interference can occur.

The length of the positive and negative measuring phases depends on the settings on the rotary switch "CE/μF", the actual leakage capacitance of the monitored network and with DC networks, on the level and duration of possible mains voltage fluctuations. Correct and preferably quick measurement is thus given with different mains conditions. In the event of particularly adverse conditions and major interferences, the measuring analysis can be steadied and delayed in addition with rotary switch "tv" if necessary.

The current insulation resistance is determined and analysed at the end of each measuring phase. The LED-chain show the resistance determined, and the output relays for prewarning "VW" and alarm "AL" switch according to the respective response values set. If the response thresholds have been undercut, the LEDs "VW" or "AL" light according to the insulation fault location: "+", "-" or "+" and "-" simultaneously for AC faults or symmetric insulation faults.

### Storing insulation fault message

If terminal R is open, the insulation fault messages (relay, LEDs) are stored when the respective response value is undercut, but also when the insulation resistance returns to the OK-range. In addition, the temporary minimum values of the insulation resistance are indicated on the LED-chain through dimmed LEDs.

If the "Reset" button on the device front is pressed or terminal R is connected with G, the stored insulation fault messages are reset when the insulation resistance is again in the OK-range.

### Output relay for insulation fault messages

The rotary switch "CE/μF Rel." allows selecting the open circuit (A) or closed circuit (R) operation for the output relays "AL" (contacts 11-12-14) and "VW" (contacts 21-22-24).

With the open circuit operation, the relays respond when the response values are undercut, with the closed circuit operation they release when the response values are undercut.

If 2 different response values are not needed, "VW" and "AL" can be set to the same value. The output relays switch together in this case („2u“).

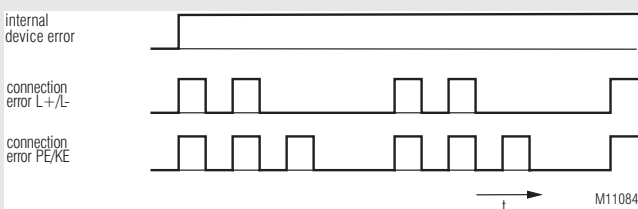
### Broken wire detection

As mentioned above, all terminals of the measuring circuit are constantly monitored for wire breaks - not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds.

Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected. Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage. The device would no longer detect a connection fault on L(+)/L(-). Especially parallel lines should be prevented over larger distances.

If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, version LK 5895.12/011 (without broken wire detection on L(+)/L(-) ) shall be used.

## Flashing Codes LED "ERR"



## Function

### Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every 4 operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front or with an external pushbutton connected between terminals T and G.

With the self-test, contrary to the expanded test, the status of the output relays and the analogue output are not affected; the sequence is as follows:

Switching to the negative measuring phase is performed for 4 sec. The "HM" LED flashes here with a brief On-phase. The LEDs of the LED-chain are selected in sequence and the internal circuit is checked. After this, switching to the positive measuring phase is performed for 4 sec. The "HM" LED flashes here with a long On-phase. The LED-chain cycles again and additional internal tests are performed. Insulation measurement continues normally after a pause of 2 sec if no faults have occurred.

The expanded test is started when the internal or external "Test" button is pressed (or is still held) at the end of the 8 sec self-test, described above. The sequence is the same as with the self-test (2 measuring phases at 4 sec + 2 sec pause); however, the output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and the analogue output proceeds to its lowest value.

If the Reset button is pressed during the 8 sec or terminals R-G are connected, the expanded test is terminated after these 8 sec. Otherwise, the phases of the expanded test are constantly repeated, where, in addition, the "ERR" LED is on. However, the expanded test is terminated as soon as the Reset button is pressed. The device switches to the OK-state and restarts insulation measurement.

### Behaviour with internal device faults

If internal device faults were detected during the test function, the "ERR" LED is lit continuously and the measuring circuit is deactivated internally ("HM" LED goes off). The output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and all LEDs of the LED-chain extinguish.

### Behaviour in the case of connection faults

If broken wire is detected on terminals L(+) / L(-), the measurement is interrupted and the LED "HM" goes off. This connection failure is indicated by LED "ERR" with "failure code 2". The output relays "AL" and "VW" as well as the corresponding LEDs go into alarm state and all LEDs of the indicator LED chain go off. After removing the the interruption the measurement of the insulation resistance starts again. Stored alarm states remain active.

When interrupting the connection PE / KE to the protective ground, the unit reacts in the same way as with an interruption on L(+) / L(-), only the LED "ERR" shows "failure code 3".

## Indicators

green LED „PWR“:	on when auxiliary supply connected
red LED „ERR“:	permanent on: at system error flashing: at connection failure
green LED „HM“:	flashing: at active main measuring circuit, ON-OFF-ratio per measurement phase: long ON period during measurement phase with positiv polarity short ON period during measurement phase with negative polarity
yellow LED-chain:	8 LEDs indicate the actual insulating resistance ( $\leq 10 \text{ k}\Omega \dots \geq 2 \text{ M}\Omega$ )
gyellow LED „VW +“:	permanent on: $R_E$ lower then prewarning value to + potential
yellow LED „VW -“:	permanent on: $R_E$ lower then prewarning value to - potential
yellow LEDs „VW +“ and „VW -“ simultaneity:	permanent on: AC-fault / symmetric fault
red LED „AL +“:	permanent on: $R_E$ lower then tripping value to + potential
ed LED „AL -“:	permanent on: $R_E$ lower then tripping value to - potential
red LEDs „AL +“ und „AL -“ simultaneity:	permanent on: AC-fault / symmetric fault

## Notes

Device terminals PE and KE must always be connected via separate lines to different terminal points of the protective-conductor system.

The measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place. Selector switch "tv /  $U_N$ " should be set accordingly.

For photovoltaic systems and hybrid vehicles, the measuring circuit of the LK 5895 is connected on the DC side; the auxiliary measuring circuit can then be used to monitor the (deactivated) AC side.

For the main measuring circuit, the nominal voltage range for DC is specified with 1000 V; however, absolute values up to max. DC 1500 V are permissible.

Only one insulation monitor may be active in a network to be monitored, since the devices would otherwise influence each other. When coupling several networks or incoming feed sections, where each of them is equipped with its own insulation monitor, all of them must be deactivated except for one insulation monitor. Such deactivation can be beneficially handled via the HM-G control terminals with the LK 5895.

The measuring circuit is designed for large leakage capacitances up to 3000  $\mu\text{F}$ . The selection switch "CE/ $\mu\text{F}$ " must be set accordingly. Measurement of the insulation resistances is not falsified by this; however, longer periods are required for the measuring phases than with small capacitances. If the maximum approximate leakage capacitance is known, the selector switch "CE/ $\mu\text{F}$ " can possibly be set to smaller values, which reduces the response time further.

The measuring circuit should not be connected via longer parallel guided wires, as this may interfere with the broken wire detection. Also large capacities between L(+) and L(-) have to be avoided.

No external potentials may be connected to control terminals, "HM", "T" and "R". The associated reference potential is "G" (identical with PE), and the connection of the terminals is made via bridges to "G".

### Attention !



**The device must not be operated without KE/PE connection.**

**Before making insulation and voltage tests, the monitor LK 5895 has to be disconnected. !**

**The voltage of the monitored voltage system is connected to terminals L(+) / L(-). Please observe sufficient distance to terminals of neighbour devices and to the grounded metal cabinet or box (min 0.5 cm).**



WARNING

**The device monitors HIGH-VOLTAGE  
Caution High-Voltage when working on the device!  
Disconnect all power supplies before servicing equipment!**

## Technical Data

### Measuring circuit L(+) / L(-) to PE / KE

**Nominal voltage  $U_N$ :** DC 0 ... 1000 V; AC 0 ... 1000 V  
**Voltage range:** DC max. 1500 V; AC max. 1100 V  
**Frequency range:** DC or 16 ... 1000 Hz  
**Max. line capacitance:** 3000  $\mu$ F  
**Internal resistance (AC / DC):** > 280 k $\Omega$   
**Measuring voltage:** approx.  $\pm$  95 V  
**Max. measured current ( $R_E = 0$ ):** < 0.35 mA

### Response values $R_E$

Pre-warning („VW“):

k $\Omega$ :	20	30	50	70	100	150	250	500	1000	2000
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Alarm („AL“)

k $\Omega$ :	1	3	10	20	30	50	70	100	150	250
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each adjustable via rotational switches

**Response inaccuracy:**  $\pm$  15 % + 1.5 k $\Omega$  IEC 61557-8

### Response value hysteresis

at range 10 k $\Omega$  ... 700 k $\Omega$ : approx. 25 %  
 out of range: approx. 40 % + 0.5 k $\Omega$

### On delay

at  $C_E = 1 \mu$ F,  
 $R_E$  of  $\infty$  to 0,5 \* response value: < 10 s

### Input auxiliary voltage

#### DC-Input (A1+ / A2)

**Nominal voltage  $U_H$ :** DC 24 V  
**Voltage range:** DC 20 ... 30 V  
**Nominal consumption:** max. 5 W

### Control input (between HM, T, R and G)

**Current flow:** approx. 3 mA  
**No-load voltage to G:** approx. 12 V  
**Permissible wire length:** < 50 m  
**Min. activation time:** 0.5 s

### Output

**Contacts:** 2 x 1 changeover contacts for VW and AL  
**Thermal current  $I_{th}$ :** 4 A  
**Switching capacity**  
 to AC 15:  
 NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical life**  
 at 8 A, AC 250 V: 1 x 10<sup>4</sup> switching cycles  
**Short circuit strength**  
**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:** 10 x 10<sup>6</sup> switching cycles

### General Data

**Operating mode:** Continuous operation  
**Temperature range**  
 Operation: - 25 ... + 60 °C (device mounted away from heat generation components)  
 - 25 ... + 45 °C (device mounted without distance heated by devices with same load)  
 Storage: - 40 ... + 70 °C  
**Relative air humidity:** 93 % bei 40 °C  
**Atmospheric pressure:** 860 ... 1600 mbar (86 ... 106 kPa)  
**Altitude:** < 4.000 m IEC 60 664-1  
**Clearance and creepage distances**  
 rated impulse voltage / pollution degree IEC 60 664-1  
 Measuring circuit L(+) / L(-) to auxiliary voltage DC und relay contacts VW, AL: 8 kV / 2  
 auxiliary voltage DC to relay contacts VW, AL: 8 kV / 2  
 relay contacts VW to relay contact AL: 4 kV / 2  
 Insulation test voltage  
 Routine test: AC 5 kV; 1 s  
 AC 2,5 kV; 1 s

## Technical Data

### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC / EN 61000-4-2  
 HF irradiation:  
 80 MHz ... 2.7 GHz: 10 V / m IEC / EN 61000-4-3  
 Fast transients: 4 kV IEC / EN 61000-4-4  
 Surge voltages  
 between A1 - A2: 1 kV IEC/EN 61000-4-5  
 between L(+) - L(-): 2 kV IEC/EN 61000-4-5  
 between A1, A2 - PE and L(+), L(-) - PE: 4 kV IEC/EN 61000-4-5  
 between control line: 0,5 kV IEC/EN 61000-4-5  
 between control line and earth: 1 kV IEC/EN 61000-4-5  
 HF-wire guided 10V IEC / EN 61000-4-6  
 Interference suppression: Limit value class A\*)

\*) The device is designed for the usage under industrial conditions (Class A, EN 55011).

When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

### Degree of protection

Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94

### Vibration resistance:

IEC/EN 60 068-2-6  
 Amplitude 0.35 mm  
 frequency 10 ... 55 Hz  
 Amplitude  $\pm$  1 mm, frequency 2 ... 13.2 Hz  
 13.2 ... 100 Hz, acceleration  $\pm$  0.7 g<sub>n</sub>  
 10 g<sub>n</sub> / 11 ms, 3 pulses IEC/EN 60068-2-27  
 25 / 060 / 04 IEC/EN 60 068-1  
 EN 50 005

### Shock resistance:

### Climate resistance:

### Terminal designation:

### Wire connection

### Screw terminals

### (fixed):

1 x 4 mm<sup>2</sup> solid or  
 1 x 2,5 mm<sup>2</sup> stranded ferruled (isolated) or  
 2 x 1,5 mm<sup>2</sup> stranded ferruled (isolated)  
 DIN 46228-1/-2/-3-4  
 or  
 2 x 2,5 mm<sup>2</sup> stranded ferruled (isolated)  
 DIN 46228-1/-2/-3

Insulation of wires

or sleeve length:

8 mm  
 Plus-minus terminal screws M3,5  
 terminal with wire protection

### Wire fixing:

### Fixing torque:

### Mounting:

### Weight:

0.8 Nm  
 DIN rail IEC / EN 60715  
 approx. 500 g

### Dimensions

**Width x height x depth:** 90 x 90 x 121 mm

### Standard Type

LK 5895.12/010 DC 20 ... 30 V

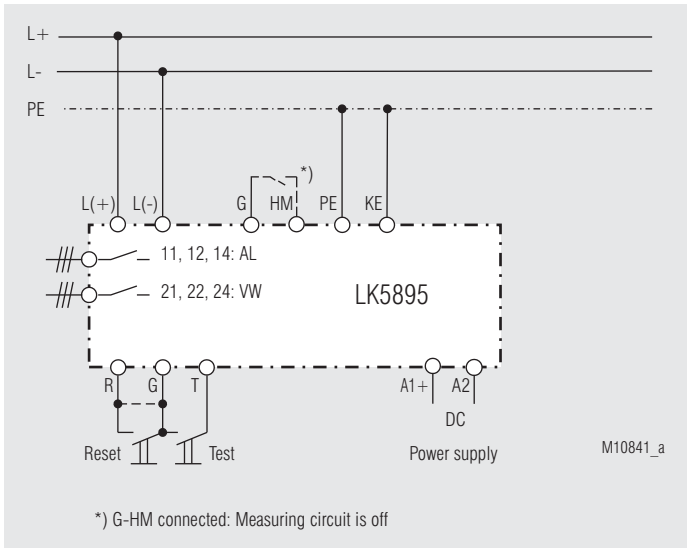
Article number: 0065217

- Outputs: 1 changeover contact for pre-warning  
1 changeover contact for alarm
- Auxiliary voltage: DC 20 ... 30 V
- Setting range pre-warning: 20 k $\Omega$  ... 2 M $\Omega$
- Setting range alarm: 1 k $\Omega$  ... 250 k $\Omega$
- Adjustable line capacitance
- Open- / or closed circuit operation
- Width: 90 mm

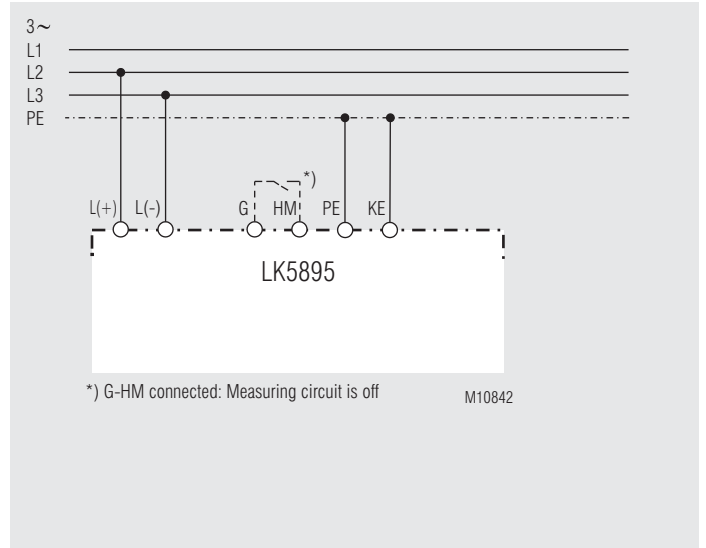
### Variant

LK 5895.12/011: without wire-break detection at L(+)/L(-)

## Connection Examples



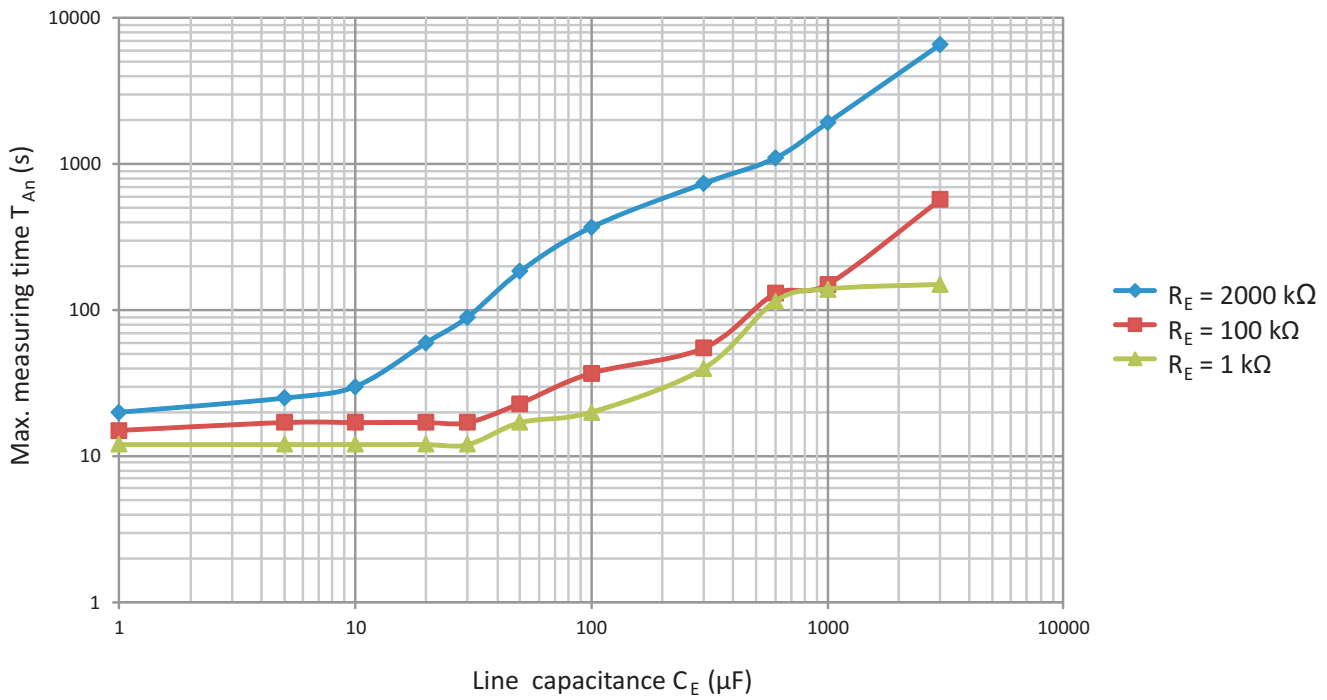
Insulation monitoring DC-side



Insulation monitoring AC-side

## Characteristic

Max. measuring time in response to line capacitance



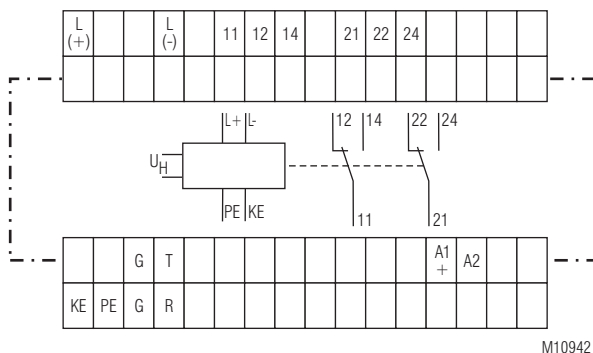
M11295



### Product Description

The insulation monitor LK 5894 of the varimeter IMD family provides best and up to date insulation monitoring of modern IT systems in an optimum and state of the art way fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via LEDs the measured value, device parameters and device status are indicated easy to read.

### Circuit Diagram



### Connection Terminals

Terminal designation	Signal designation
A1+, A2	DC-Auxiliary voltage
L(+), L(-)	Connection for measuring circuit
KE, PE	Connection for protective conductor
G, R	Control input (manual/auto reset) G/R not bridged: manual reset G/R bridged: auto reset
G, T	Control input (External test input) connection option for external device test pushbutton
11, 12, 14	Alarm signal relay (1 changeover contact)
21, 22, 24	Prewarning signal relay (1 changeover contact)

### Your Advantages

- Preventive fire and system protection
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks with up to 690 V nominal voltage
- Suitable for large leakage capacitances up to 1000µF
- Simplest setting via engaging rotary switches
- Optimised measuring times - normally shorter than with known methods
- Monitoring also with voltage-free mains
- Measuring circuit with broken wire detection
- No additional coupling device required

### Features

- Insulation monitoring according to IEC/EN 61557-8
- Detection of symmetric and asymmetric insulation faults
- 2 changeover contacts
- Prewarning threshold setting range: 20 kΩ ... 2 MΩ
- Alarm threshold setting range: 1 kΩ ... 250 kΩ
- Energized or de-energized on trip can be selected for output relay
- Setting the maximum leakage capacitance to shorten the response time
- Simple, clearly arranged adjustment of the device with screwdriver
- LED chain to indicate the current insulation resistance
- Display of active measuring circuits
- Automatic and manual device self-test
- Width: 90 mm

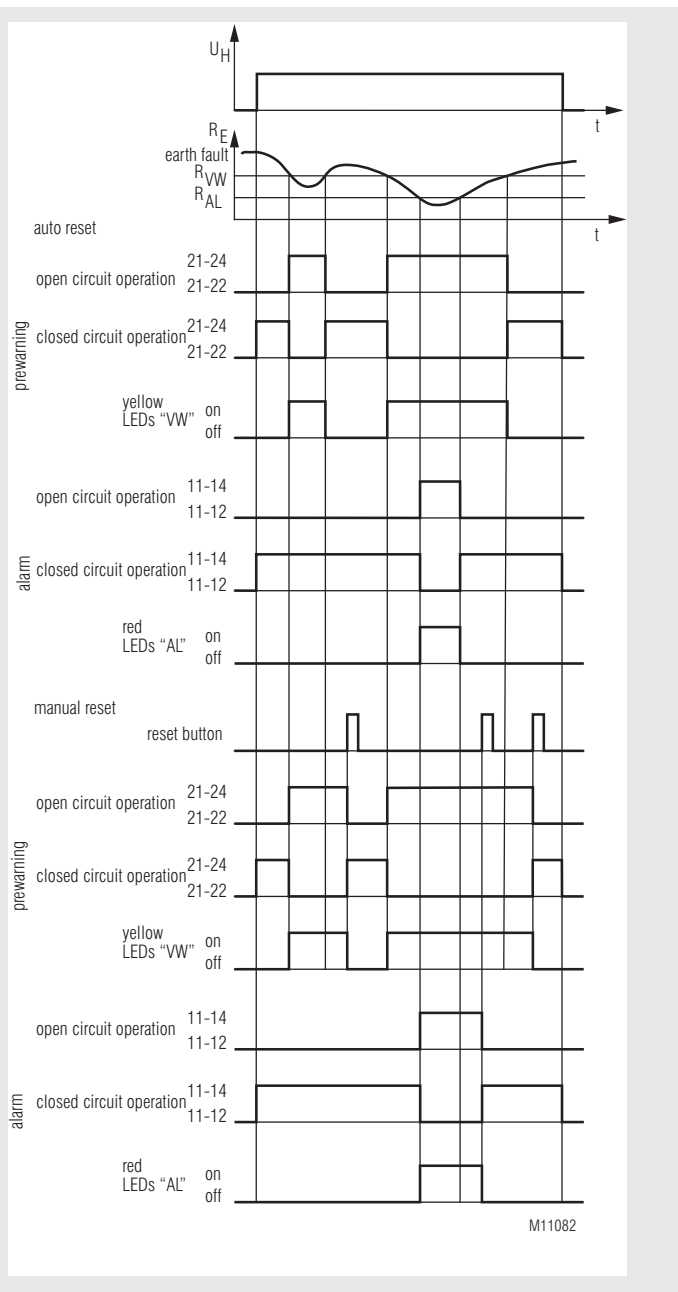
### Approvals and Markings



### Applications

- Insulation monitoring of:
- Non-earthed AC, DC, AC/DC networks
  - UPS systems
  - Networks with frequency inverters
  - Battery networks
  - Networks with direct current drives
  - Hybrid and battery-powered vehicles

## Function Diagram



## Function

If the device is supplied with DC auxiliary voltage, the a green "PWR" LED comes on. Switching on the auxiliary voltage is followed by an internal self-test for 10 sec, where the LEDs of the indicator string light up in sequence. After this, measurement of the insulation resistance in the measuring circuits begins.

### Measuring circuit

#### (Insulation measurement between terminals L(+)/L(-) and PE/KE)

Terminals L(+) and L(-) are connected to the mains to be monitored. Broken wire detection, constantly effective during operation, generates an error messages if both terminals are not connected with low resistance through the mains.

In addition, the two terminals PE and KE must be connected to the protective conductor system via separate lines. An error message is given here as well if a line is interrupted (see section "Actions in case of connection faults").

If the main measuring circuit is activated, an active measuring voltage with alternating polarity is applied between L(+)/L(-) and PE/KE to measure the insulation resistance. During the measuring phase with positive polarity, the "Active" LED flashes with a long On-phase and with negative polarity with a short On-phase.

The length of the positive and negative measuring phases depends on the settings on the rotary switch "CE/ $\mu$ F", the actual leakage capacitance of the monitored network and with DC networks, on the level and duration of possible mains voltage fluctuations. Correct and preferably quick measurement is thus given with different mains conditions. In the event of particularly adverse conditions and major interferences, the measuring analysis can be steadied and delayed in addition with rotary switch "tv" if necessary.

The current insulation resistance is determined and analysed at the end of each measuring phase. The LED chain show the resistance determined, and the output relays for prewarning "VW" and alarm "AL" switch according to the respective response values set. If the response thresholds have been undercut, the LEDs "VW" or "AL" light according to the insulation fault location: "+", "-" or "+" and "-" simultaneously for AC faults or symmetric insulation faults.

### Storing insulation fault message

If terminal R is open, the insulation fault messages from the main and auxiliary measuring circuit are stored when the respective response value is undercut, but also when the insulation resistance returns to the OK-range. In addition, the temporary minimum values of the insulation resistance are indicated on the LED chain through dimmed LEDs.

If the "Reset" button on the device front is pressed or terminal R is connected with G, the stored insulation fault messages are reset when the insulation resistance is again in the OK-range.

### Output relay for insulation fault messages

The rotary switch "CE/ $\mu$ F Rel." allows selecting the operating current (A) or standby current (R) principle for the output relays "AL" (contacts 11-12-14) and "VW" (contacts 21-22-24).

With the operating current principle, the relays respond when the response values are undercut, with the standby current principle they release when the response values are undercut.

If 2 different response values are not needed, "VW" and "AL" can be set to the same value. The output relays switch together in this case.

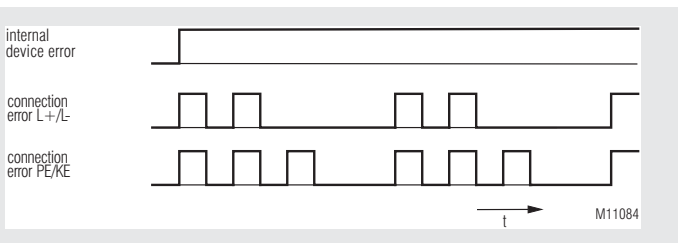
### Broken wire detection

As mentioned above, both the main measuring circuit and the auxiliary measuring circuit are constantly monitored for wire breaks - not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds.

Broken wire detection between L(+)/L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected. Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+)/L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage. The device would no longer detect a connection fault on L(+)/L(-). Especially parallel lines should be prevented over larger distances.

If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, version LK 5894.12/011 (without broken wire detection on L(+)/L(-)) shall be used.

## Flashing Codes LED "ERR"



## Function

### Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every 4 operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front or with an external pushbutton connected between terminals T and G.

With the self-test, contrary to the expanded test, the status of the output relays and the analogue output are not affected; the sequence is as follows:

Switching to the negative measuring phase is performed for 4 sec. The „Active“ LED flashes here with a brief On-phase. The LEDs of the LED chain are selected in sequence and the internal circuit is checked. After this, switching to the positive measuring phase is performed for 4 sec. The „Active“ LED flashes here with a long On-phase. The LED chain cycles again and additional internal tests are performed. Insulation measurement continues normally after a pause of 2 sec if no faults have occurred.

The expanded test is started when the internal or external "Test" button is pressed (or is still held) at the end of the 8 sec self-test, described above. The sequence is the same as with the self-test (2 measuring phases at 4 sec + 2 sec pause); however, the output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and the analogue output proceeds to its lowest value.

If the Reset button is pressed during the 8 sec or terminals R-G are connected, the expanded test is terminated after these 8 sec. Otherwise, the phases of the expanded test are constantly repeated, where, in addition, the "ERR" LED and the fault signalling relay (contacts 31-32-34) constantly receive current. However, the expanded test is terminated as soon as the Reset button is pressed. The device switches to the OK-state and restarts insulation measurement.

### Behaviour with internal device faults

If internal device faults were detected during the test function, the "ERR" LED is lit continuously and the measuring circuit is deactivated internally ("Active" LED goes off). The output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and all LEDs of the LED chain extinguish.

### Behaviour in the case of connection faults

If broken wire is detected on terminals L(+) / L(-), the measurement is interrupted and the LED "HM" goes off. This connection failure is indicated by LED "ERR" with "failure code 2". The output relays "AL" and "VW" as well as the corresponding LEDs go into alarm state and all LEDs of the indicator LED chain go off. After removing the the interruption the measurement of the insulation resistance starts again. Stored alarm states remain active.

When interrupting the connection PE / KE to the protective ground, the unit reacts in the same way as with an interruption on L(+) / L(-), only the LED "ERR" shows "failure code 3".

## Indicators

green LED „PWR“:	on, when auxiliary supply connected
red LED „ERR“:	permanent on: at system error flashing: at connection failure
green LED „Active“:	flashing: at active measuring circuit, ON-OFF-ratio per measurement phase: long ON period during measurement phase with positiv polarity short ON period during measurement phase with negative polarity
yellow LED chain:	8 LEDs indicate the actual insulating resistance ( $\leq 10 \text{ k}\Omega \dots \geq 2 \text{ M}\Omega$ )
yellow LED „VW +“:	permanent on: $R_E$ lower then prewarning value to + potential
yellow LED „VW -“:	permanent on: $R_E$ lower then prewarning value to - potential
yellow LEDs „VW +“ and „VW -“ simultaneity:	permanent on: AC-fault / symmetric fault
red LED „AL +“:	permanent on: $R_E$ lower then tripping value to + potential
red LED „AL -“:	permanent on: $R_E$ lower then tripping value to - potential
red LEDs „AL +“ und „AL -“ simultaneity:	permanent on: AC-fault / symmetric fault

## Notes

Device terminals PE and KE must always be connected via separate lines to different terminal points of the protective-conductor system.

The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place. Selector switch "tv /  $U_N$ " should be set accordingly.

For the main measuring circuit, the nominal voltage range for DC is specified with 690 V; however, absolute values up to max. DC 1000 V are permissible.

In one voltage system to be monitored, only one insulation monitor must be installed. A second insulation monitor would influence the first one. When coupling separate voltage systems that each have an insulation monitor, all insulation monitors except one have to be disabled.

The main measuring circuit is designed for large leakage capacitances up to 1000  $\mu\text{F}$ . The selection switch "CE/ $\mu\text{F}$ " must be set accordingly. Measurement of the insulation resistances is not falsified by this; however, longer periods are required for the measuring phases than with small capacitances. If the maximum approximate leakage capacitance is known, the selector switch "CE/ $\mu\text{F}$ " can possibly be set to smaller values, which reduces the response time further.

The measuring circuit should not be connected via longer parallel guided wires, as this may interfere with the broken wire detection. Also large capacities between L(+) und L(-) have to be avoided.

No external potentials may be connected to control terminals "T" and "R". The associated reference potential is "G" (identical with PE), and the connection of the terminals is made via bridges to "G".

### Attention !



**The device must not be operated without KE/PE connection.**

**Before making insulation and voltage tests, the monitor LK 5894 has to be disconnected. !**

**The voltage of the monitored voltage system is connected to terminals L(+) / L(-). Please observe sufficient distance to terminals of neighbour devices and to the grounded metal cabinet or box (min 0.5 cm).**



**The device monitors HIGH-VOLTAGE  
Caution High-Voltage when working on the device!  
Disconnect all power supplies before servicing equipment!**

**Technical Data****Measuring circuit L(+)/L(-) to PE/KE**

<b>Nominal voltage U<sub>N</sub>:</b>	DC 0 ... 690 V; AC 0 ... 690 V
<b>Voltage range:</b>	DC max. 1000 V; AC max. 760 V
<b>Frequency range:</b>	DC or 16 ... 1000 Hz
<b>Max. line capacitance:</b>	1000 µF
<b>Internal resistance (AC/DC):</b>	> 280 kΩ
<b>Measuring voltage:</b>	approx. ± 95 V
<b>Max. measured current (R<sub>E</sub> = 0):</b>	< 0.35 mA

**Response values R<sub>E</sub>**

Pre-warning („VW“):

kΩ:	20	30	50	70	100	150	250	500	1000	2000
-----	----	----	----	----	-----	-----	-----	-----	------	------

Alarm („AL“)

kΩ:	1	3	10	20	30	50	70	100	150	250
-----	---	---	----	----	----	----	----	-----	-----	-----

each adjustable via rotational switches

**Response inaccuracy:** ± 15 % + 1.5 kΩ IEC 61557-8**Response value hysteresis**at range 10 kΩ ... 700 kΩ: approx. 25 %  
out of range: approx. 40 % + 0.5 kΩ**On delay**at C<sub>E</sub> = 1 µF,  
R<sub>E</sub> of ∞ to 0.5 \* response value: < 10 s**Input auxiliary voltage****DC-Input (A1+ /A2)**

<b>Nominal voltage U<sub>H</sub>:</b>	DC 24 V
<b>Voltage range:</b>	DC 20 ... 30 V
<b>Nominal consumption:</b>	max. 5 W

**Control input (between T, R and G)**

<b>Current flow:</b>	approx. 3 mA
<b>No-load voltage to G:</b>	approx. 12 V
<b>Permissible wire length:</b>	< 50 m
<b>Min. activation time:</b>	0.5 s

**Output**

<b>Contacts:</b>	2 x 1 changeover contacts for VW and AL	
<b>Thermal current I<sub>th</sub>:</b>	4 A	
<b>Switching capacity</b> to AC 15:		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b> at 8 A, AC 250 V:	1 x 10 <sup>4</sup> switching cycles	
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	10 x 10 <sup>6</sup> switching cycles	

**General Data**

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range</b>		
Operation:	- 25 ... + 60 °C	
Storage:	- 40 ... + 70 °C	
<b>Relative air humidity:</b>	93 % bei 40 °C	
<b>Atmospheric pressure</b>	860 ... 1600 mbar (86 ... 106 kPa)	
<b>Altitude:</b>	< 4.000 m	IEC 60 664-1

**Clearance and creepage distances**rated impulse voltage /  
pollution degreeMeasuring circuit L(+)/L(-) to  
auxiliary voltage DC and

relay contacts VW, AL: 8 kV / 2

Auxiliary voltage DC to  
relay contacts VW, AL: 8 kV / 2Relay contact VW to  
relay contact AL: 4 kV / 2

Insulation test voltage

Routine test: AC 5 kV; 1 s  
AC 2,5 kV; 1 s**Technical Data****EMC**

Electrostatic discharge (ESD):	8 kV (air)	IEC / EN 61000-4-2
HF irradiation:		
80 MHz ... 2.7 GHz:	10 V / m	IEC / EN 61000-4-3
Fast transients:	4 kV	IEC / EN 61000-4-4
Surge voltages		
between A1 - A2:	1 kV	IEC/EN 61000-4-5
between L(+)-L(-):	2 kV	IEC/EN 61000-4-5
between A1, A2 - PE and L(+), L(-) - PE:	4 kV	IEC/EN 61000-4-5
between control line:	0,5 kV	IEC/EN 61000-4-5
between control line and earth:	1 kV	IEC/EN 61000-4-5
HF-wire guided	10V	IEC / EN 61000-4-6
Interference suppression:	Limit value class A*)	

\*)The device is designed for the usage  
under industrial conditions (Class A,  
EN 55011).When connected to a low voltage public  
system (Class B, EN 55011) radio inter-  
ference can be generated. To avoid this,  
appropriate measures have to be taken.**Degree of protection**

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

**Housing:**Thermoplastic with V0 behaviour  
according to UL subject 94**Vibration resistance:**Amplitude 0.35 mm IEC/EN 60 068-2-6  
frequency 10 ... 55 Hz  
Amplitude ± 1mm, frequency 2 ... 13.2 Hz  
13.2 ... 100 Hz, acceleration ± 0.7 g<sub>n</sub>  
IEC/EN 60068-2-6**Shock resistance:**10 g<sub>n</sub> / 11 ms, 3 pulses IEC/EN 60068-2-27**Climate resistance:**

25 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:**

EN 50 005

**Wire connection**

DIN 46 228-1/-2/-3/-4

**Screw terminals****(fixed):**1 x 4 mm<sup>2</sup> solid or  
1 x 2,5 mm<sup>2</sup> stranded ferruled (isolated)  
or  
2 x 1,5 mm<sup>2</sup> stranded ferruled (isolated)  
DIN 46228-1/-2/-3-4  
or  
2 x 2,5 mm<sup>2</sup> stranded ferruled (isolated)  
DIN 46228-1/-2/-3Insulation of wires  
or sleeve length:8 mm  
Plus-minus terminal screws M3,5  
terminal with wire protection**Wire fixing:****Fixing torque:**

0.8 Nm

**Mounting:**

DIN rail

IEC / EN 60715

**Weight:**

approx. 500 g

**Dimensions****Width x height x depth:** 90 x 90 x 121 mm



### Standard Type

LK 5894.12/010 DC 20 ... 30 V

Article number:

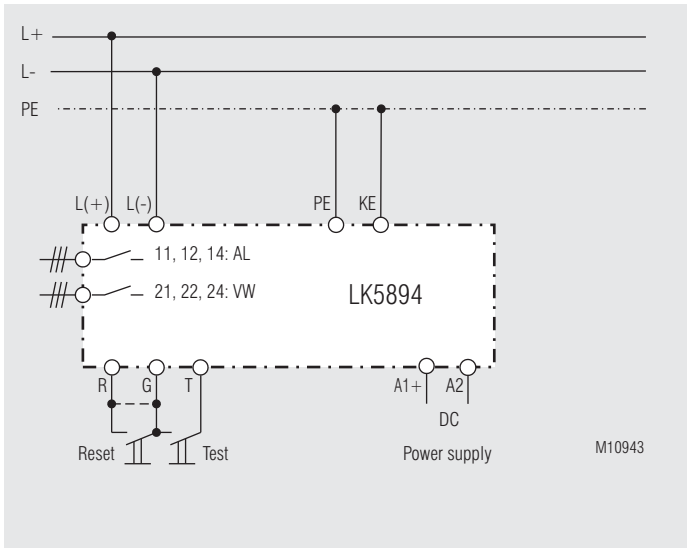
0065331

- Outputs: 1 changeover contact for pre-warning  
1 changeover contact for alarm
- Auxiliary voltage: DC 20 ... 30 V
- Setting range pre-warning: 20 k $\Omega$  ... 2 M $\Omega$
- Setting range alarm: 1 k $\Omega$  ... 250 k $\Omega$
- Adjustable line capacitance
- Open- / or closed circuit operation
- Width: 90 mm

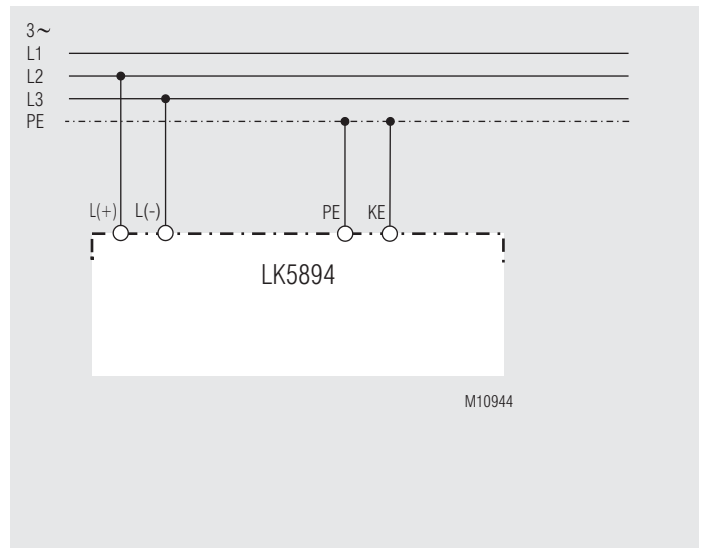
### Variants

- LK 5894.12/011: without wire-break detection at L(+)/L(-)
- LK5894.12/110: Fixed function de-energised on trip,  
the relays react immediately after  
connection of auxiliary voltage
- LK5894.12/111: Fixed function de-energised on trip,  
the relays react immediately after  
connection of auxiliary voltage;  
without broken wire detection on L(+)/L(-)

## Connection Examples



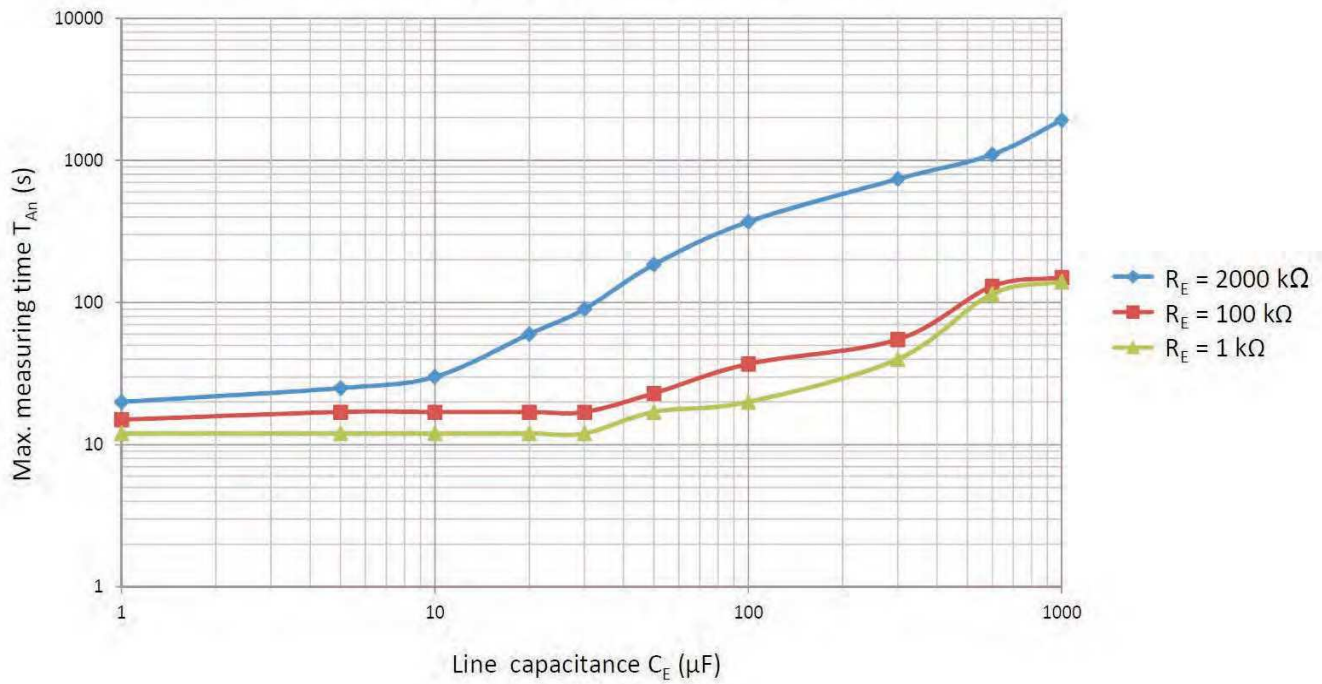
Insulation monitoring DC-side



Insulation monitoring AC-side

## Characteristic

Max. measuring time in response to line capacitance



M11584



### Product description

The insulation monitor UH 5892 of the series varimeter IMD monitors the ground resistance of isolated DC-voltage systems (IT-systems) with nominal voltage up to DC 600 V. The unit detects symmetrical as well as un-symmetrical faults. The separate auxiliary supply of AC/DC 24...60 V or AC/DC 85...230 V allows also monitoring when the system is without voltage. To indicate the actual ground resistance value the unit has an LED chain and an analogue output. When a fault is detected the relay switches and the red LED Alarm lights up, The device can be used for system with leakage capacities up to 20  $\mu\text{F}$ .

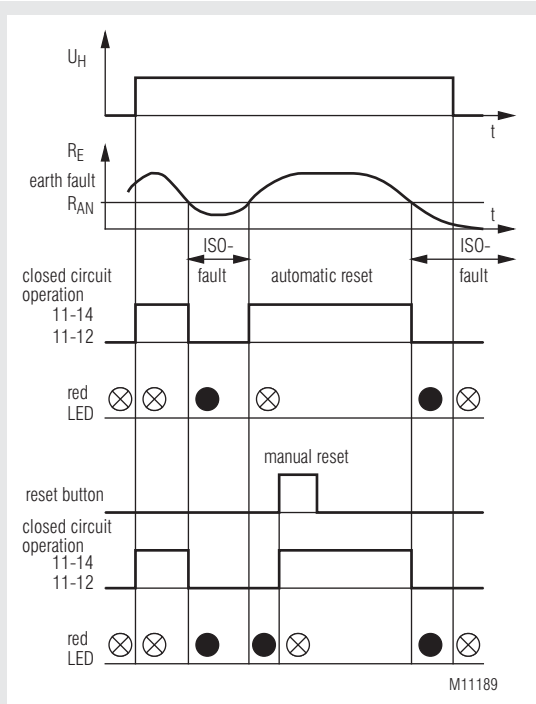
### Your Advantages

- Preventive fire and system protection
- Insulation monitoring of DC voltage systems up to 600 V nominal voltage
- No additional coupling device required
- Suitable for leakage capacitances up to 20  $\mu\text{F}$
- Monitoring also with voltage-free mains
- 2 wide voltage input ranges for auxiliary voltage

### Merkmale

- Insulation monitoring according to IEC/EN 61557-8
- Detection of symmetric and asymmetric insulation faults
- 1 changeover contact for alarm
- Fixed response value  $R_{AN}$ : 50  $\text{k}\Omega$ , other on request
- Internal reset and test pushbutton
- External test and reset pushbutton can be connected
- LED indicator for auxiliary voltage and alarm
- LED chain to indicate the current insulation resistance
- Automatic or manual reset, programmable
- Analogue output for insulating value
- External indicating instrument can be connected
- Closed circuit operation
- Open circuit operation on request
- With pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width 45 mm

### Function diagram



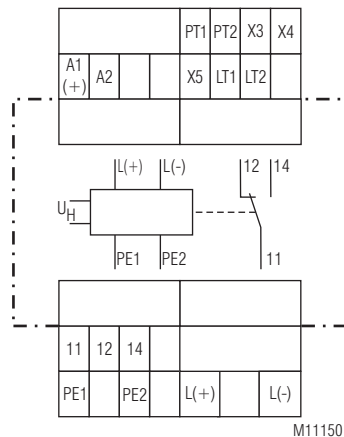
### Approvals and Markings



### Applications

Monitoring of the resistance to earth in ungrounded DC systems

### Circuit Diagram



Connection Terminals	
Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage $U_H$
L(+), L(-)	Connection for measuring circuit
PE1, PE2	Connection for protective conductor
X5(LT1)	Control input (manual/auto reset) X5/LT1 bridged: manual reset X5/LT1 not bridged: auto reset
PT1, PT2	connection option for external device test pushbutton
LT1, LT2	connection option for external reset pushbutton
X3, X4	Analogue output
11, 12, 14	Alarm signal relay (1 changeover contact)

### Function

The device is supplied with auxiliary voltage via terminals A1(+)/A2; ea green "ON" LED comes on. After connecting the auxiliary supply a 10 s start up delay is active allowing the measuring circuit to start. After this, measurement of the insulation resistance in the measuring circuits begins.

### Measuring circuit

(Insulation measurement between terminals L(+)/L(-) and PE1/PE2).

Terminals L(+) and L(-) are connected to the mains to be monitored. In addition, the two terminals PE1 and PE2 must be connected to the protective conductor system via separate lines. An active measuring voltage with alternating polarity is applied between L(+)/L(-) and PE1/PE2 to measure the insulation resistance.

The length of the positive and negative measuring phases has a fixed factory setting of 16 s (max. leakage capacitance of 20  $\mu$ F). The LED-chain and the analogue output show the actual determined insulating resistance, and the output relays witch according to the respective response values set. If the response thresholds has been undercut the red LED "Alarm" lights up.

### Indication

green LED "ON":	on, when auxiliary supply connected
red LED "Alarm":	on, when resistance is below the response value $R_{AN}$
LED-chain:	the approx. value of actual rsistance to ground (PE)

### Notes

The response value  $R_{AN}$  is fixed. An external indicator instrument can be connected.

The unit works de-energized on trip, that means, the output relay relase in position of rest at a insulation failures  $R_E < R_{AN}$ .

A bridge between X5 and LT1 allows to select auto or manual reset. The UH 5892 has a built in reset button on the front and allows connection of an external button at terminals LT1 and LT2 also.

For function test an external (terminals PT1-PT2) or built in push button can be used to simulate a ground fault. The push button has to be pressed for the length of a measuring period.

### Notes

The analogue output (terminals X3 and X4) provides a voltage signal proportional to the actual insulation resistance of the mains. The following formula describes the input to output ratio.:  
(0V at  $R_E = 0$  and 13.0 .... 13.5 V at  $R_E = \infty$ )

$$U_A = \frac{U_{max}}{\frac{180 \text{ k}\Omega}{R_E} + 1} ; U_{max} = 13.25 \text{ V} \pm 0.25 \text{ V}$$

These values are valid for  $C_E = 0$  (see diagram page 4). In practice it makes no sense to monitor values above 11 ... 12V as the tolerances increase, especially with mains capacity. On fluctuation of the mains voltage momentary false readings can occur. This is normal and caused by the cyclic measuring principle.

In one voltage system only one insulation monitor can be used. This has to be observed when interconnecting two separate systems.

### Technical Data

#### Auxiliary circuit

Auxiliary voltage $U_H$	Voltage range	Frequency range
AC/DC 24 ... 60V	AC 19 ... 68 V	45 ... 400 Hz; DC 48 % $W^*)$
	DC 18 ... 96 V	$W^*) \leq 5 \%$
AC/DC 85 ... 230 V	AC 65 ... 276 V	45 ... 400 Hz; DC 48 % $W^*)$
	DC 75 ... 300 V	$W^*) \leq 5 \%$
*) $W$ = permitted residual ripple of auxiliary supply		

Nominal consumption: max. 1.5 W

#### Measuring Circuit

<b>Nominal voltage <math>U_N</math>:</b>	DC 0 ... 600 V / AC 0 ... 400 V
<b>Voltage range:</b>	0 ... 1,15 $U_N$
<b>Frequency range:</b>	DC or 40 ... 60 Hz
<b>Response value <math>R_{AN}</math>:</b>	50 k $\Omega$ , 10 ... 440 k $\Omega$ on request
<b>Setting <math>R_{AN}</math>:</b>	fixed
<b>Internal AC resistance:</b>	> 120 k $\Omega$
<b>Internal DC resistance:</b>	> 150 k $\Omega$
<b>Messspannung:</b>	approx. $\pm 13$ V
<b>Max. measuring current (<math>R_E = 0</math>):</b>	< 0.3 mA
<b>Measuring cycle internally adjustable:</b>	2 ... 16 s
<b>Line capacitance <math>C_E</math> to ground:</b>	1 ... 20 $\mu$ F
<b>Factory setting:</b>	16 s (für $C_E = 20 \mu$ F)
<b>Operate delay at <math>R_{AN} = 50 \text{ k}\Omega</math>, <math>C_E = 20 \mu</math>F</b>	
$R_E$ from $\infty$ to 0,9 $R_{AN}$ :	< 100 s
$R_E$ from $\infty$ to 0 k $\Omega$ :	< 60 s
<b>Hysteresis at <math>R_{AN} = 50 \text{ k}\Omega</math>:</b>	approx. 5 %
<b>Response inaccuracy::</b>	$\pm 15\% \pm 1.5 \text{ k}\Omega$ IEC/EN 61557-8

#### Output

<b>Contacts:</b>	1 changeover contact
<b>Max. switching voltage:</b>	AC 250 V
<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity to AC 15:</b>	
NO contact:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	2 A / AC 230 V IEC/EN 60 947-5-1
<b>Short circuit strength max. fuse rating:</b>	6 A gL IEC/EN 60 947-5-1
<b>Electrical life at 5 A, AC 230 V:</b>	1 x 10 <sup>5</sup> switching cycles
<b>Mechanical life:</b>	> 50 x 10 <sup>6</sup> switching cycles

#### Analogue output

for actual insulating value, no galvanic separation  
Terminals X3-X4: typ. 0 ... 13.25 V /  $R_E$  approx. 50  $\Omega$   
(0 V at  $R_E = 0$  and 13.0 ... 13.5 V at  $R_E = \infty$ )  
X4 is internal connected with PE

## Technische Daten

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Permissible ambient and stocking temperature:</b>	- 20 ... + 60°C / - 25 ... + 70°C	
<b>Clearance and creepage distances</b>		
overvoltage category / pollution degree:	IEC 60 664-1	
meas. circuit to auxiliary voltage and relay contact:	6 kV/2	
auxiliary voltage to relay contact:	6 kV/2	
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	20 V / m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz	10 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltage		
between A1(+)/A2:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
HF-wire guided:	20 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4	

### Plug in with screw terminals

max. cross section for connection:	1 x 0.25 ... 2.5 mm <sup>2</sup> solid or stranded ferruled (isolated) or 2 x 0.25 ... 1.0 mm <sup>2</sup> solid or stranded ferruled (isolated)
------------------------------------	--

Insulation of wires or sleeve length:

7 mm

### Plug in with cage clamp terminals

max. cross section for connection:	1 x 0.25 ... 2.5 mm <sup>2</sup> solid or stranded ferruled (isolated) or 2 x 0.25 ... 1.5 mm <sup>2</sup> stranded twin ferruled (isolated)
------------------------------------	--

Insulation of wires or sleeve length:

10 mm

### Wire fixing:

captive slotted screw or cage clamp terminals

### Mounting:

DIN rail

IEC/EN 60 715

### Weight:

approx. 270 g

### Dimensions

**Width x height x depth:** 45 x 107 x 121 mm

### Classification to DIN EN 50155

### Vibration and shock resistance:

Category 1, Class B IEC/EN 61 373

### Protective coating of the PCB:

No

### Standard Types

UH 5892.11PS AC/DC 24 ... 60 V 50 kΩ

Article number:	0066309
• Output:	1 Wechsler
• Auxiliary voltage $U_H$ :	AC/DC 24 ... 60 V
• Response value $R_{AN}$ :	50 kΩ
• Line capacitance:	20 μF
• De-energized on trip	
• Width:	45 mm

UH 5892.11PS AC/DC 85 ... 230 V 50 kΩ

Article number:	0066946
• Output:	1 Wechsler
• Auxiliary voltage $U_H$ :	AC/DC 85 ... 230 V
• Response value $R_{AN}$ :	50 kΩ
• Line capacitance:	20 μF
• De-energized on trip	
• Width:	45 mm

## Options with Pluggable Terminal Blocks



Screw terminal (PS / plug in screw)



Cage clamp terminal (PC / plug in cage clamp)

## Accessories

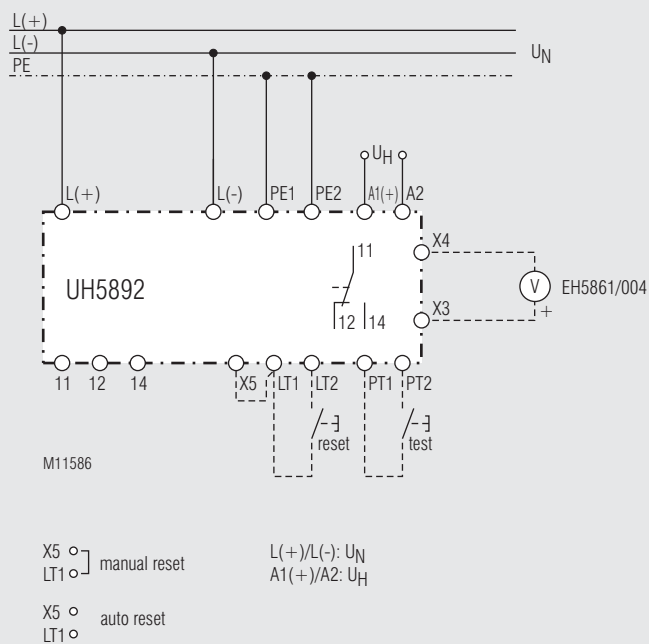
EH 5861/004:

indicating instrument, degree of protection: IP 52 Article number: 0030618



The indicating device EH 5861 is externally connected to the insulation monitor and shows the actual insulation resistance of the voltage system to ground. Dimensions: Width x height x depth 96 x 96 x 52 mm

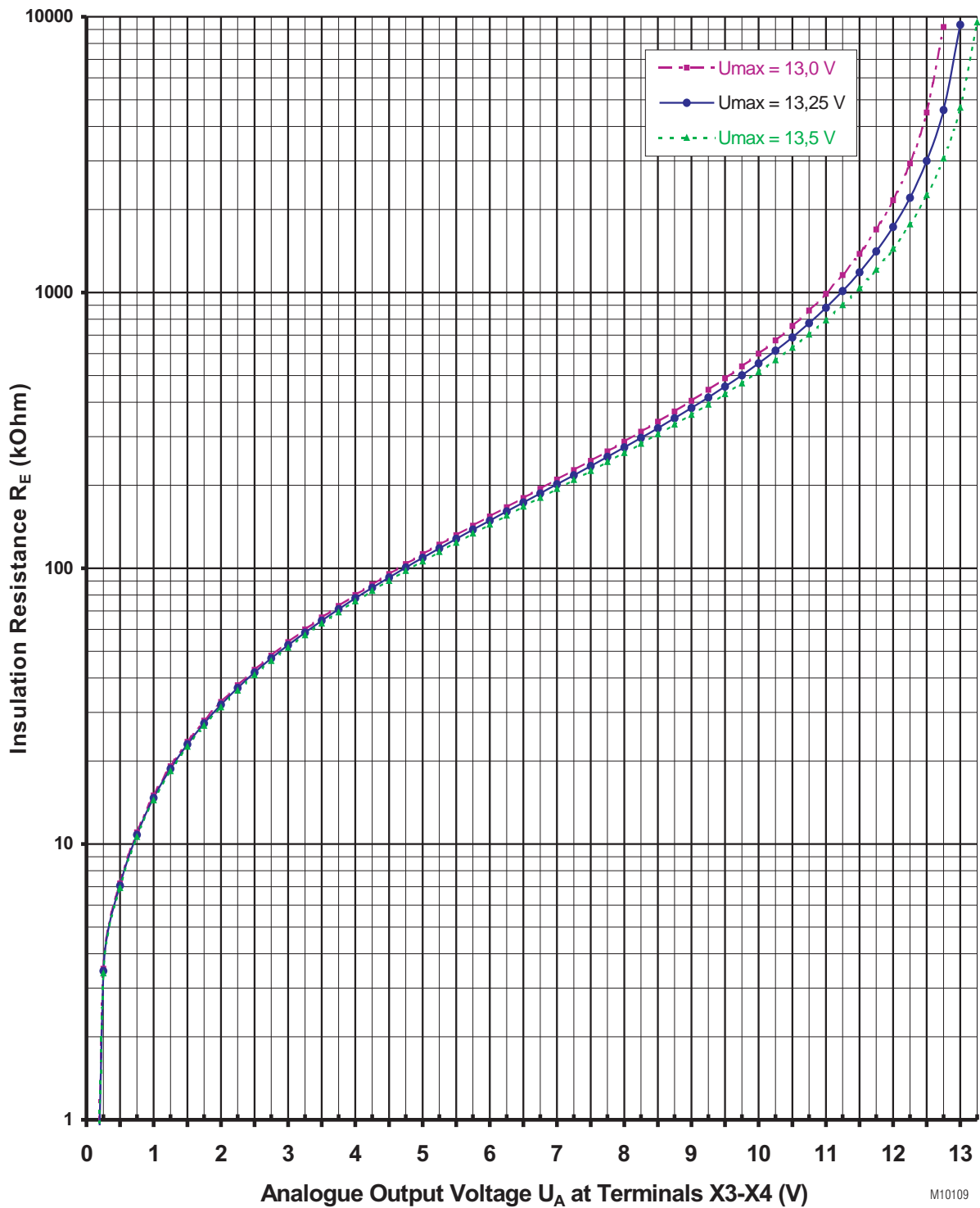
## Connection Example



### Analogue Output Voltage $U_A$ (Terminals X3-X4)

against Insulation Resistance  $R_E$  with  $C_E = 0$

Parameter: Max. Analogue Output Voltage  $U_{max}$  (at  $R_E = \infty$ )



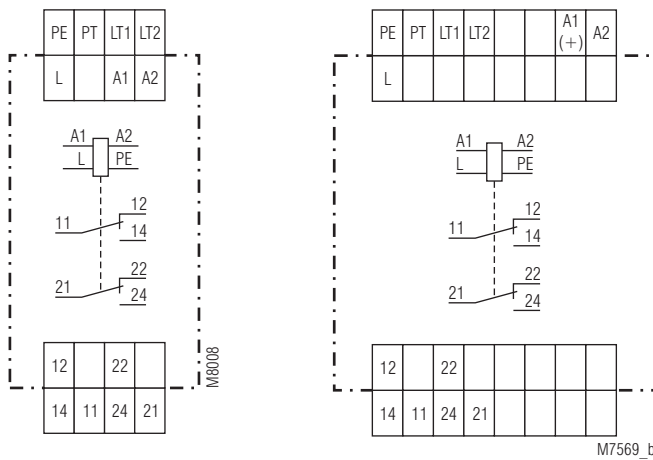
M10109

## VARIMETER IMD Insulation Monitor IL 5880, IP 5880, SL 5880, SP 5880



- According to IEC/EN 61 557-8
- For single and 3-phase AC-systems up to 0 ... 500 V and 10 ... 10000 Hz
- Adjustable tripping value  $R_{AL}$  of 5 ... 100 k $\Omega$
- Monitors also disconnected voltage systems
- De-energized on trip
- Auxiliary voltage Measuring Circuit and output contacts are galvanically separated
- Manual and auto reset
- With test and reset button
- Connections of external test and reset buttons possible
- LED indicators for operation and alarm
- 2 changeover contacts
- IL/SL 5880/200 with additional prewarning
  - adjustable prewarning value 10 k $\Omega$  ... 5 M $\Omega$
  - output function programmable
- Variant IL/SL 5880/300 according to DIN VDE 0100-551 for mobile generator sets available
- 4 models available:
  - IL 5880, IP 5880: 61 mm deep with terminals near to the bottom to be mounted in consumer units or industrial distribution systems according to DIN 43 880
  - SL 5880, SP 5880: 98 mm deep with terminals near to the top to be mounted in cabinets with mounting plate and cable ducts
- DIN rail or screw mounting
- 35 mm width

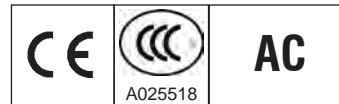
### Circuit Diagram



IL 5880, SL 5880

IP 5880, SP 5880

### Approvals and Markings



### Applications

- Monitoring of insulation resistance of ungrounded voltage systems to earth.
- IL/SL 5880/200 can also be used to monitor standby devices for earth fault, e.g. motor windings of devices that have to function in the case of emergency.
- IL/SL 5880/300 according to DIN VDE 0100-551 to monitor mobile generator systems
- Other resistance monitoring applications.
- For industrial and railway applications

### Function

The device is connected to the supply via terminals A1-A2. The unit can either be supplied from the monitored voltage system or from an separate auxiliary supply. Terminal L is connected to the monitored voltage and PE to earth. If the insulation resistance  $R_E$  drops below the adjusted alarm value  $R_{AL}$  the red LED goes on and the output relay switches off (de-energized on trip). If the unit is on auto reset (bridge between LT1-LT2) and the insulation resistance gets better ( $R_E$  rises), the insulation monitor switches on again with a certain hysteresis and the red LED goes off. Without the bridge between LT1-LT2 the Insulation monitor remains in faulty state even if the insulation resistance is back to normal. (In order to achieve failure storage, the voltage system showing a fault must not be switched off too fast after detection of the failure, see notes). The reset is done by pressing the internal or external reset button or by disconnecting the auxiliary supply. By activating the "Test" button an insulation failure can be simulated to test the function of the unit.

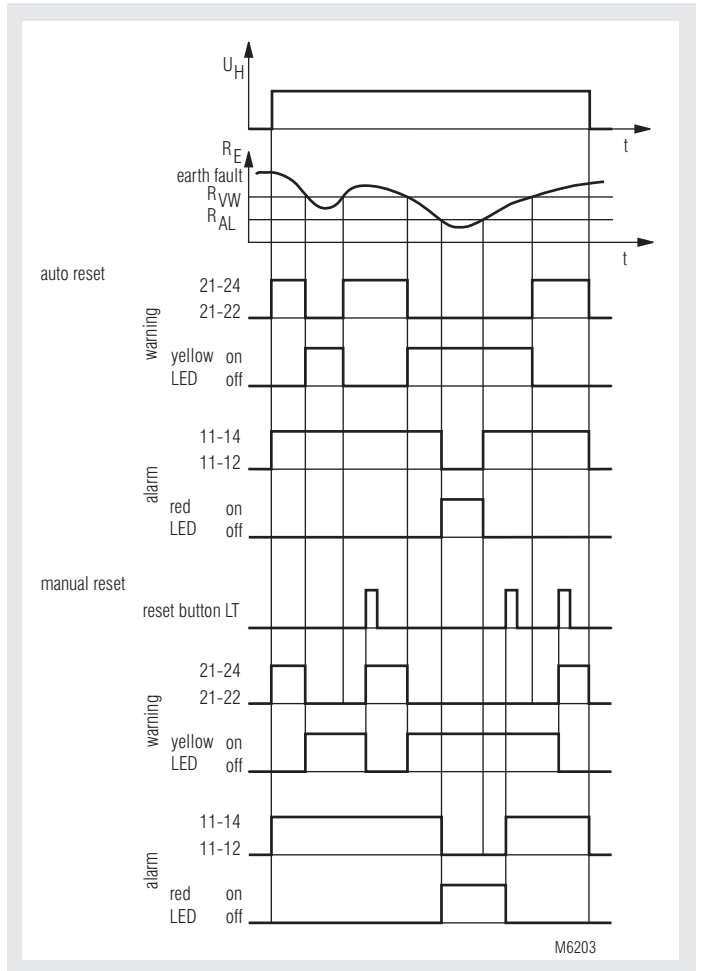
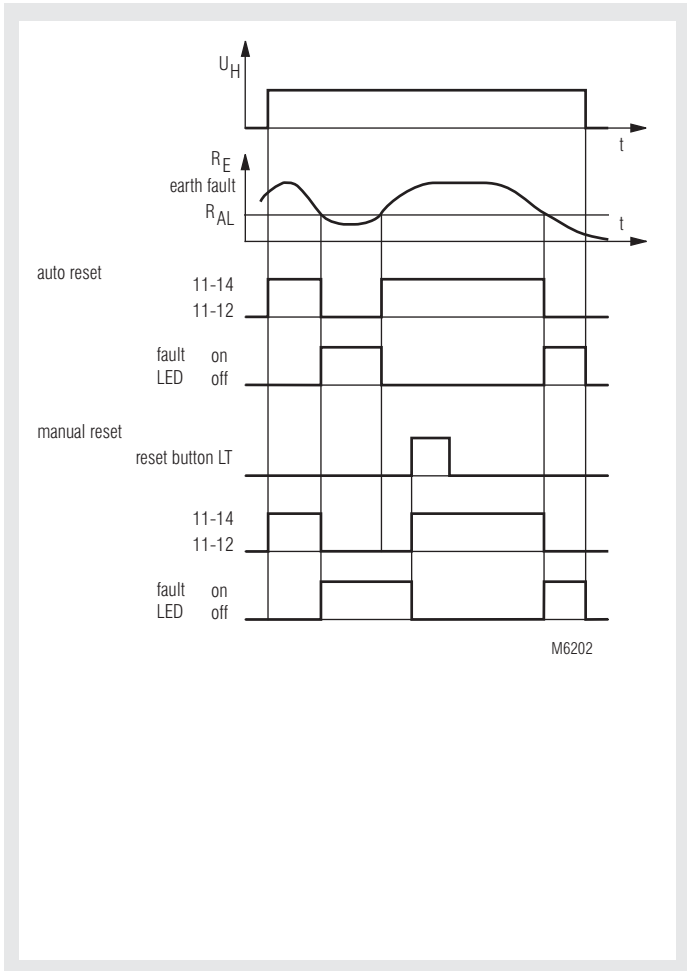
The variants IL/SL 5880.12/200 have a second setting range with a higher resistance up to 5 M $\Omega$  (Potentiometer  $R_{VW}$ ). This setting value can be used for pre-warning with relay output, by positioning the lower setting switch to "AL 11-12-14; VW 21-22-24".

If the higher setting range should be used only, the setting switch is put in position "VW 2u" and both contacts react only to the higher setting. If the lower setting range should be used only, the setting switch is put in position "AL 2u" and both contacts react only to the lower setting. When set to manual reset the latching is active on both settings  $R_{AL}$  and  $R_{VW}$ . Therefore it is possible in the case of a short insulation decrease (Switch position AL 11-12-14; VW 21-22-24), to pass the warning signal to a PLC while the main fault does not lead to a disconnection of the mains via the contacts 11-12-14.

### Connection Terminals

Terminal designation	Signal designation
A1	L / +
A2	N / -
L	Connection for monitored IT-systems
PE	Connection for protective conductor
PT	Connection for external test button
LT1, LT2	Connections for external reset or manual and auto reset: LT1/LT2 bridged: hysteresis function LT1/LT2 not bridged: manual reset
11, 12, 14 21, 22, 24	Changeover contact (each for switch in position VW or AL)

## Function Diagram



IL 5880, SL 5880, IP 5880, SP 5880

### Indicators

Green LED "ON":	On, when supply voltage connected
Red LED "AL":	On, when insulation fault detected, ( $R_E < R_{AL}$ )
Yellow LED "VW":	On, when insulation resistance is under prewarning value, $R_E < R_{VW}$ (only with variant IL/SL 5880.12/2__ and /300)

### Notes

#### Storing of insulation failures:

The storing of an insulation failure is delayed slightly longer the reaction of the output relay because of interference immunity. In cases where the defective voltage system is switched off immediately by the output of the insulation monitor it can happen that the fault is not stored (e. g. mobile generator sets).

For these applications we recommend the variant IL/SL 5880/300, where the output relay reacts only after the fault is stored. All other features of this variant are similar to IL/SL 5880/200.

The Insulation monitors IL/SL 5880 are designed to monitor AC-voltage systems. Overlaid DC voltage does not damage the instrument but may change the conditions in the Measuring Circuit.

IL 5880/200, SL 5880/200, IP 5880/200, SP 5880/200

### Notes

In one voltage system only one Insulation monitor must be connected. This has to be observed when coupling voltage system. Line capacitance  $C_E$  to ground does not influence the insulation measurement, as the measurement is made with DC-voltage. It is possible that the reaction time in the case of insulation time gets longer corresponding to the time constant  $R_E * C_E$ .

The model /200 can be used, because of its higher setting value, to monitor single or 3-phase loads for ground fault. If the load is operated from a grounded system the insulation resistance of the load can only be monitored when disconnected from the mains. This is normally the fact with loads which are operated seldom or only in the case of emergency but then must be function (see connection example).

The auxiliary supply can be connected to a separate auxiliary supply or to the monitored voltage system. The range of the auxiliary supply input has to be observed.

When monitoring 3-phase IT systems it is sufficient to connect the insulation monitor only to one phase. The 3-phases have a low resistive connection (approx. 3 - 5  $\Omega$ ) via the feeding transformer. So failures that occur in the non-connected phases will also be detected.



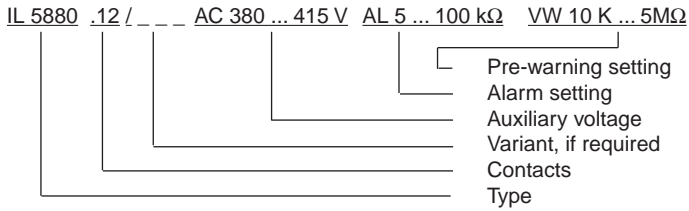
Technical Data	
<b>Auxiliary Circuit</b>	
<b>Nominal voltage <math>U_N</math></b> IL 5880, SL 5880:	AC 220 ... 240 V, AC 380 ... 415 V 0.8 ... 1.1 $U_N$ DC 12 V, DC 24 V
IP 5880, SP 5880:	AC / DC 110 ... 240 V 0.7 ... 1.25 $U_N$ 45 ... 400 Hz
<b>Frequency range (AC):</b>	
<b>Nominal consumption:</b>	
AC:	approx. 2 VA
DC:	approx. 1 W
<b>Measuring Circuit</b>	
<b>Nominal voltage <math>U_N</math>:</b>	AC 0 ... 500 V
<b>Voltage range:</b>	0 ... 1.1 $U_N$
<b>Frequency range:</b>	10 ... 10000 Hz
<b>Alarm value <math>R_{AL}</math>:</b>	5 ... 100 k $\Omega$
<b>Prewarning value <math>R_{VW}</math></b> <b>(only at IL/SL 5880/2... and IL/SL 5880/300):</b>	10 k $\Omega$ ... 5 M $\Omega$
<b>Setting <math>R_{AL}</math>, <math>R_{VW}</math>:</b>	infinite variable
<b>Internal test resistor:</b>	equivalent to earth resistance of < 5 k $\Omega$
<b>Internal AC resistance:</b>	> 250 k $\Omega$
<b>Internal DC resistance:</b>	> 250 k $\Omega$
<b>Measuring voltage:</b>	approx. DC 15 V, (internally generated)
<b>Max. measuring current (<math>R_E = 0</math>):</b>	< 0.1 mA
<b>Max. permissible noise DC voltage:</b>	DC 500 V
<b>Operate delay</b> at $R_{AL} = 50$ k $\Omega$ , CE = 1 $\mu$ F	
$R_E$ from $\infty$ to 0.9 $R_{AL}$ :	< 1.3 s
$R_E$ from $\infty$ to 0 k $\Omega$ :	< 0.7 s
<b>Response inaccuracy:</b>	$\pm 15\%$ + 1.5 k $\Omega$ IEC 61557-8
<b>Hysteresis</b> at $R_{AL} = 50$ k $\Omega$ :	approx. 15 %
<b>Output</b>	
<b>Contacts:</b>	
IL / SL 5880.12, IP / SP 5880.12:	2 changeover contacts
IL / SL 5880.12/2... IL / SL 5880.12/300, IP / SP 5880.12/2...:	2 x 1 changeover contact, programmable
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity</b> to AC 15	
NO:	5 A / AC 230 V IEC/EN 60 947-5-1
NC:	2 A / AC 230 V IEC/EN 60 947-5-1
to DC 13:	2 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V:	$\geq 5 \times 10^5$ switching cycles IEC/EN 60 947-5-1
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 30 \times 10^6$ switching cycles
<b>General Data</b>	
<b>Operating mode:</b>	Continuous operation
<b>Temperature range</b>	
Operation:	- 20 ... + 60°C
Storage:	- 20 ... + 70°C
<b>Altitude:</b>	< 2.000 m
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree	
between auxiliary supply connections (A1- A2):	4 kV / 2 at AC-auxiliary voltage IEC 60 664-1
between measuring input connections (L - PE):	4 kV / 2 IEC 60 664-1
between auxiliary supply and measuring input connections:	4 kV / 2 IEC 60 664-1
auxiliary supply connections and measuring input to relay contacts:	6 kV / 2 IEC 60 664-1
relay contact 11-12-14 to relay contact 21-22-24:	4 kV / 2 IEC 60 664-1
Insulation test voltage	
Routine test:	AC 4 kV; 1 s AC 2,5 kV; 1 s

Technical Data	
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 1 GHz:	10 V / m IEC/EN 61 000-4-3
1 GHz ... 2.5 GHz:	3 V / m IEC/EN 61 000-4-3
2.5 GHz ... 2.7 GHz:	1 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages	
between A1 - A2:	1 kV IEC/EN 61 000-4-5
between L - PE:	2 kV IEC/EN 61 000-4-5
HF-wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL Subjekt 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4
Cross section:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire
Stripping length:	10 mm
<b>Fixing torque:</b>	0.8 Nm
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail mounting (IEC/EN60715) or screw mounting M4, 90 mm hole pattern, with additional clip available as accessory
<b>Weight:</b>	
IL 5880:	160 g
SL 5880:	189 g
IP 5880:	250 g
SP 5880:	300 g
<b>Dimensions</b>	
<b>Width x height x depth:</b>	
IL 5880:	35 x 90 x 61 mm
SL 5880:	35 x 90 x 98 mm
IP 5880:	70 x 90 x 61 mm
SP 5880:	70 x 90 x 98 mm
<b>Classification to DIN EN 50155 for IL 5880</b>	
<b>Vibration and shock resistance:</b> Category 1, Class B IEC/EN 61 373	
<b>Ambient temperature:</b> T1 compliant	
T2, T3 and TX with operational limitations	
<b>Protective coating of the PCB:</b> No	
<b>Standard Types</b>	
IL 5880.12 AC 220 ... 240 V	
Article number:	0053378
• Auxiliary voltage $U_H$ :	AC 220 ... 240 V
• adjustable alarm value $R_{AL}$ :	5 ... 100 k $\Omega$
• Width:	35 mm
SL 5880.12 AC 220 ... 240 V	
Article number:	0055396
• Auxiliary voltage $U_H$ :	AC 220 ... 240 V
• adjustable alarm value $R_{AL}$ :	5 ... 100 k $\Omega$
• Width:	35 mm

## Variants

IL / SL 5880.12/200:	with pre-warning and programmable outputs
IL / SL 5880.12/201:	as version IL / SL 5880.12/200, but both output relays with energized on Trip principle
IL / SL 5880.12/300:	according to DIN VDE 0100-551 as version IL / SL 5880.12/200, but for use with mobile generator sets

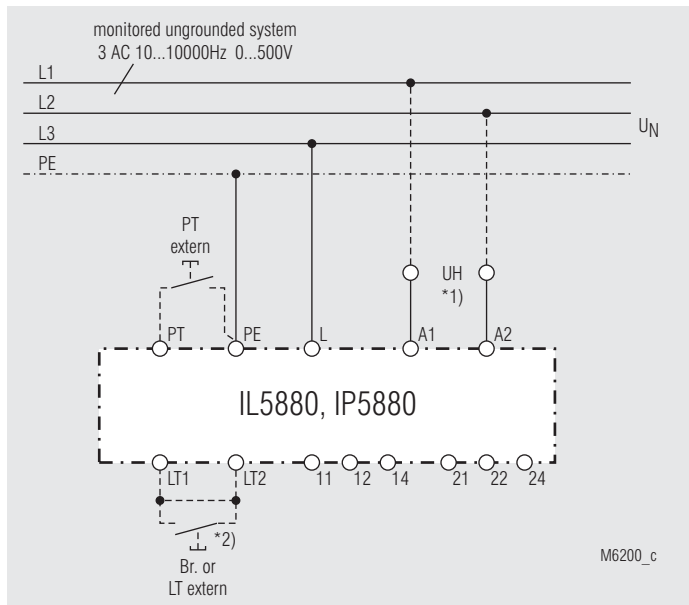
## Ordering example for variants



## Accessories

ET 4086-0-2:	Additional clip for screw mounting Article number: 0046578
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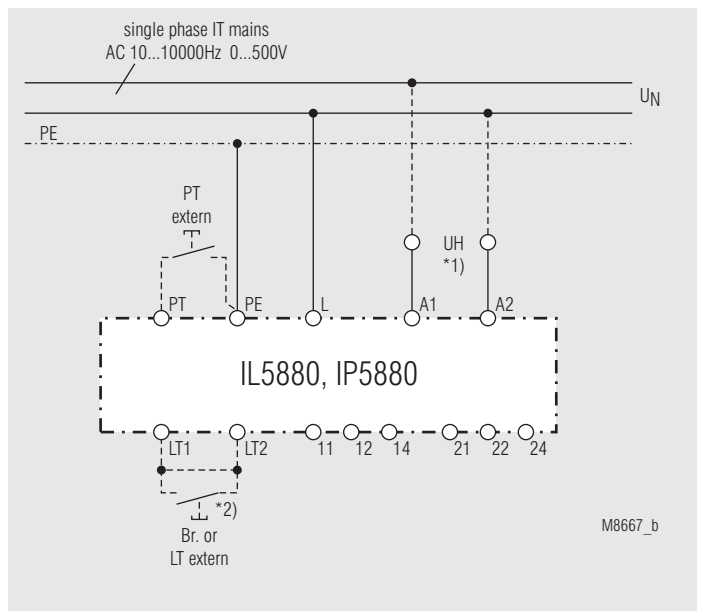
## Connection Example



Monitoring of an ungrounded voltage system.

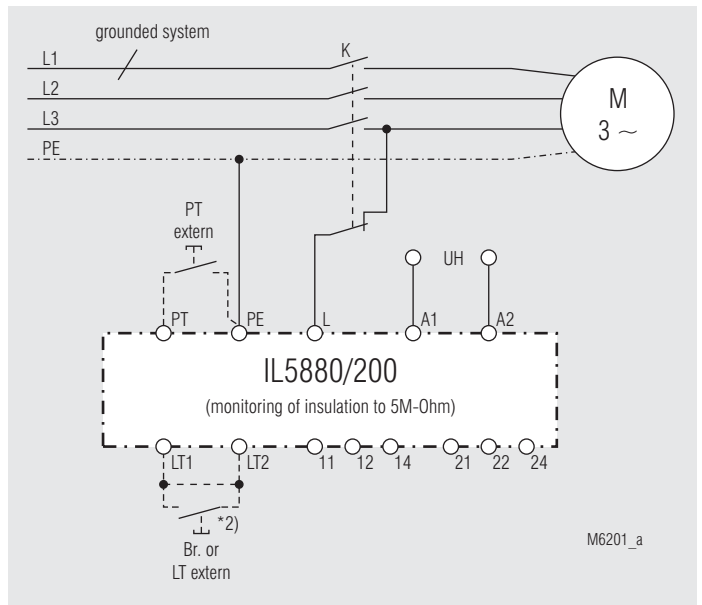
- \*1) Auxiliary supply  $U_H$  (A1 - A2) can be taken from the monitored voltage system. The voltage- and frequency range of the auxiliary supply input must be observed.
- \*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT

## Connection Example



Monitoring of an ungrounded voltage system.

- \*1) Auxiliary supply  $U_H$  (A1 - A2) can be taken from the monitored voltage system. The voltage- and frequency range of the auxiliary supply input must be observed.
- \*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT



Monitoring of motorwindings against ground.

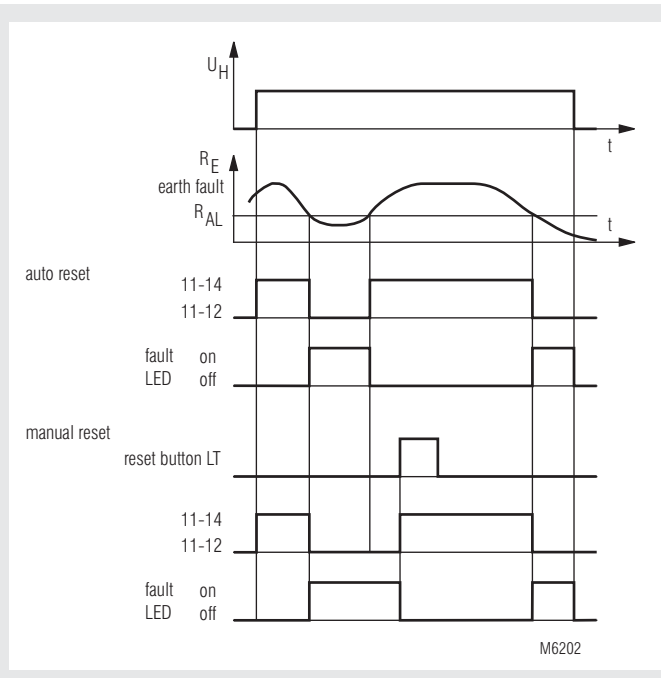
- The insulation of the motor to ground is monitored as long as contactor K does not activate the load.
- \*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT

## VARIMETER IMD Insulation Monitor MK 5880N, MH 5880



- According to IEC/EN 61 557-8
- For single and 3-phase AC-systems up to 0 ... 500 V and 10 ... 1000 Hz
- Monitors also disconnected voltage systems
- Adjustable tripping value  $R_{AL}$  of 5 ... 100 k $\Omega$
- De-energized on trip
- Auxiliary voltage, measuring circuit and output contacts are galvanically separated
- Manual and auto reset
- With test and reset button
- Connections for external test and reset buttons possible
- LED indicators for operation and alarm
- 2 changeover contacts
- MK 5880N/200 with additional prewarning
  - adjustable prewarning value 10 k $\Omega$  ... 5 M $\Omega$
  - 1 output relay for alarm and 1 for pre-warning
- MH 5880/500: similar to MK 5880N but with galvanic separated analogue output and 11 step LED chain for the actual insulation value
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled, or 2 x 2.5 mm<sup>2</sup> solid DIN 46 228-1/-2/-3/-4
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- MK 5880N: 22.5 mm width
- MH 5880: 45 mm width

### Function diagram



MK 5880N

### Approvals and Markings



<sup>1)</sup> only MK 5880N, see CCC-Data

### Applications

- Monitoring of insulation resistance of ungrounded voltage systems to earth
- MK 5880N/200 can also be used to monitor standby devices for earth fault, e. g. motor windings of devices that have to function in the case of emergency.
- Other resistance monitoring applications

### Notes

When monitoring 3-phase IT systems it is sufficient to connect the insulation monitor only to one phase. The 3-phases have a low resistive connection (approx. 3 - 5  $\Omega$ ) via the feeding transformer. So failures that occur in the non-connected phases will also be detected.

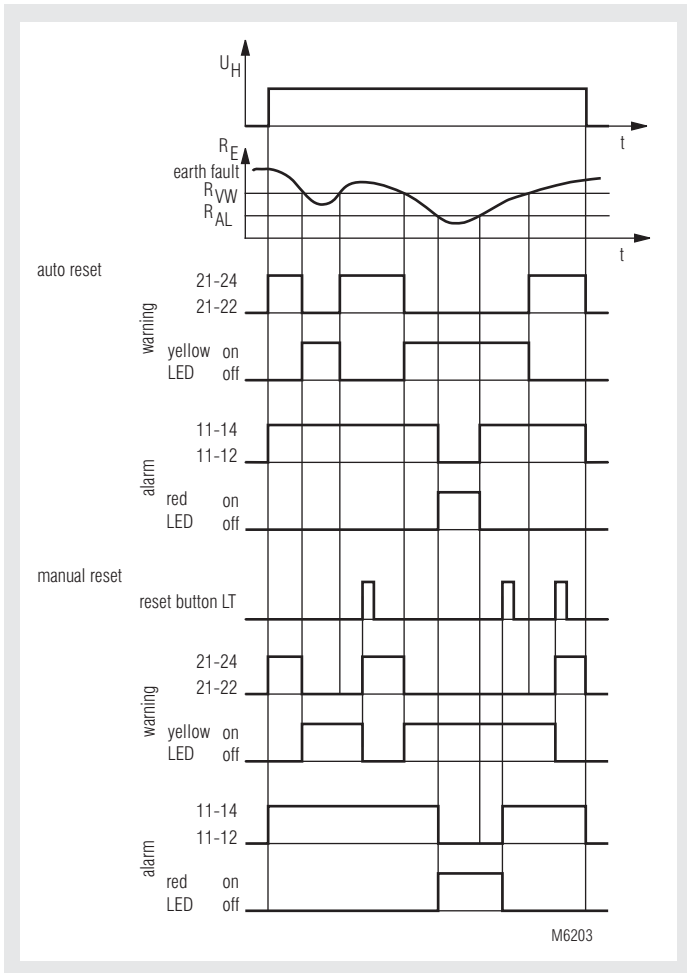
### Function

The device is connected to the supply via terminals A1-A2. The unit can either be supplied from the monitored voltage system or from a separate auxiliary supply. Terminal L is connected to the monitored voltage and PE to earth. If the insulation resistance  $R_E$  drops below the adjusted alarm value  $R_{AL}$  the red LED goes on and the output relay switches off (de-energized on trip). If the unit is on auto reset (bridge between LT1-LT2) and the insulation resistance gets better ( $R_E$  rises), the insulation monitor switches on again with a certain hysteresis and the red LED goes off. Without the bridge between LT1-LT2 the Insulation monitor remains in faulty state even if the insulation resistance is back to normal. The reset is done by pressing the internal or external reset button or by disconnecting the auxiliary supply. By activating the "Test" button an insulation failure can be simulated to test the function of the unit.

The variant MK 5880N.38/200 has a second setting range with a higher resistance up to 5 M $\Omega$  (Potentiometer  $R_{VV}$ ). This setting value can be used for pre-warning with relay output.

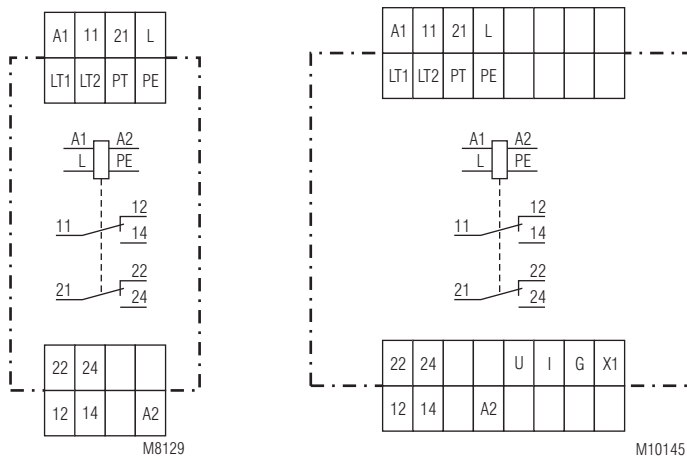
When set to manual reset the latching is active on both settings  $R_{AL}$  and  $R_{VV}$ . Therefore it is possible in the case of a short insulation decrease that the fault is stored and passed via contacts 21-22-24 to a PLC while the main fault does not lead to a disconnection of the mains via the contacts 11-12-14.

## Function diagramm



MK 5880N/200

## Circuit diagram



MK 5880N

MH 5880

## Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
L	Connection for measuring circuit
PE	Connection for protective conductor
PT/(PE)	Connection for external test button
LT1/LT2	Connection for external reset or control input for hysteresis function or manual reset LT1/LT2 bridged: Hysteresis function LT1/LT2 not bridged: Manual reset
11, 12, 14	Alarm signal relay (1 changeover contact)
21, 22, 24 <sup>1)</sup>	Prewarning signal relay (1 changeover contact)
U, I, G, X1 <sup>2)</sup>	Analogue output X1/G not bridged: U-G 0 ... 10V; I-G 0 ... 20mA X1/G bridged: U-G 2 ... 10V; I-G 4 ... 20mA

<sup>1)</sup> only MK 5880N/200 and MH 5880  
<sup>2)</sup> only MH 5880

## Indicators

green LED "ON":	On, when supply voltage connected
red LED "AL":	On, when insulation fault detected ( $R_E < R_{AL}$ )
yellow LED "VW":	On, when insulation resistance is under prewarning value, $R_E < R_{VW}$ (only with variant MK 5880N.38/200)

## Notes

The insulation monitor MK 5880N is designed to monitor AC-voltage systems. Overlaid DC voltage does not damage the instrument but may change the conditions in the measuring circuit.

In one voltage system only one Insulation monitor must be connected. This has to be observed when coupling voltage system.

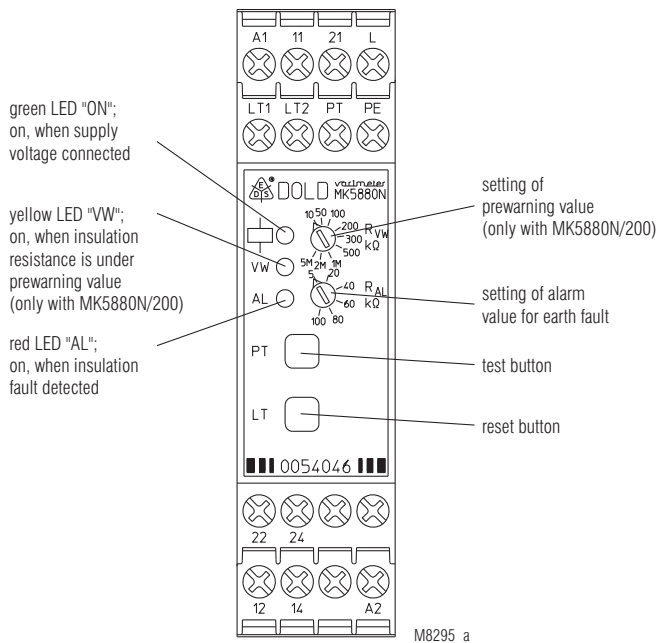
Line capacitance  $C_E$  to ground does not influence the insulation measurement, as the measurement is made with DC-voltage. It is possible that the reaction time in the case of insulation fault gets longer corresponding to the time constant  $R_E * C_E$ .

The model MK 5880N.38/200 can be used, because of its higher setting value up to 5 MΩ, to monitor single or 3-phase loads for ground fault. If the load is operated from a grounded system the insulation resistance of the load can only be monitored when disconnected from the mains. This is normally the fact with loads which are operated seldom or only in the case of emergency but then must be function (see connection example).

The auxiliary supply can be connected to a separate auxiliary supply or to the monitored voltage system. The range of the auxiliary supply input has to be observed.

The MH5880/500 has in addition to the prewarning function also a galvanic separated analogue output and an 11 step LED chain indicator, that displays the actual insulation value between 20 kΩ and 1 MΩ. On terminals U/G of the analogue output 0-10 V are provided, on terminals I/G 0-20 mA are available. By bridging terminals X1 and G the output can be switched over to 2-10 V and 4-20 mA. For the scaling of the analogue output see diagram M10142.

## Setting



## Technical Data

### Output

#### Contacts:

MK 5880N.12:	2 changeover contacts
MK 5880N.38/200:	2 x 1 changeover contact
	4 A

#### Thermal current $I_{th}$ : Switching capacity

to AC 15	3 A / AC 230 V	IEC/EN 60 947-5-1
NO contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V	IEC/EN 60 947-5-1
to DC 13:		IEC/EN 60 947-5-1

#### Electrical life

to AC 15 at 1 A, AC 230 V:  $\geq 3 \times 10^6$  switching cycles

#### Short circuit strength

max. fuse rating: 4 A gL IEC/EN 60 947-5-1

#### Mechanical life:

$\geq 30 \times 10^6$  switching cycles

### Analogue output with MH 5880/500

#### galvanic separation AC 3750V

#### to auxiliary supply, measuring circuit and relay output

terminal U(+) / G(-):	0 ... 10 V, max. 10 mA
terminal I (+) / G(-):	0 ... 20 mA, burden 500 Ohm
change to 2 ... 10 V or 4 ... 20 mA by bridging terminal X1 and G (see diagram M10142)	

## General Data

### Operating mode:

Continuous operation

### Temperature range:

- 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage / pollution degree		IEC 60 664-1
between auxiliary supply connections (A1- A2):	4 kV / 2 at AC-auxiliary voltage	IEC 60 664-1
between measuring input connections (L - PE):	4 kV / 2	IEC 60 664-1
between auxiliary supply and measuring input connections:	4 kV / 2 (3 kV at DC-auxiliary voltage)	IEC 60 664-1

### EMC

Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
Fast Transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages		
between A1 - A2:	1 kV	IEC/EN 61 000-4-5 (at AC-auxiliary voltage)
between L - PE:	1 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94  
Amplitude 0.35 mm  
frequency 10 ... 55 Hz IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

EN 50 005

### Terminal designation:

DIN 46 228-1/-2/-3/-4

### Wire connection

(integrated):  
1 x 4 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled or  
2 x 1.5 mm<sup>2</sup> stranded ferruled or  
2 x 2.5 mm<sup>2</sup> solid

### Insulation of wires

or sleeve length: 8 mm

### Plug in with screw terminals

max. cross section

for connection: 1 x 2.5 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled

### Insulation of wires

or sleeve length: 8 mm

## Technical Data

### Auxiliary circuit

Nominal voltage  $U_N$ : AC 220 ... 240 V, AC 380 ... 415 V  
DC 12 V, DC 24 V

### Voltage range

AC: 0.8 ... 1.1  $U_N$   
DC: 0.9 ... 1.25  $U_N$   
Frequency range (AC): 45 ... 400 Hz

### Nominal consumption:

AC: approx. 2 VA  
DC: approx. 1 W

### Measuring circuit

Nominal voltage  $U_N$ : AC 0 ... 500 V  
Voltage range: 0 ... 1.1  $U_N$   
Frequency range: 10 ... 1000 Hz  
Alarm value  $R_{AL}$ : 5 ... 100 k $\Omega$   
Prewarning value  $R_{VW}$  (only at MK 5880N/200): 10 k $\Omega$  ... 5 M $\Omega$   
Setting  $R_{AL}$ ,  $R_{VW}$ : infinite variable  
Internal test resistor: equivalent to earth resistance of < 5 k $\Omega$   
Internal AC resistance: > 250 k $\Omega$   
Internal DC resistance: > 250 k $\Omega$   
Measuring voltage: approx. DC 15 V, (internally generated)  
Max. measuring current ( $R_E = 0$ ): < 0.1 mA  
Max. permissible noise DC voltage: DC 500 V  
Operate delay at  $R_{AL} = 50$  k $\Omega$ ,  $C_E = 1$   $\mu$ F  
 $R_E$  from  $\infty$  to 0.9  $R_{AL}$ : approx. 1.3 s  
 $R_E$  from  $\infty$  to 0 k $\Omega$ : approx. 0.7 s  
Hysteresis at  $R_{AL} = 50$  k $\Omega$ : approx. 15 %

## Technical Data

### Plug in with cage clamp terminals

max. cross section for connection: 1 x 4 mm<sup>2</sup> solid or 1 x 2.5 mm<sup>2</sup> stranded ferruled

min. cross section for connection: 0.5 mm<sup>2</sup>

Insulation of wires or sleeve length: 12 ±0.5 mm

**Wire fixing:** Plus-minus terminal screws M 3.5 box terminals with wire protection or cage clamp terminals  
DIN rail IEC/EN 60 715

### Mounting:

**Weight**  
MK 5880N: approx. 180 g  
MH 5880: approx. 320 g

## Dimensions

### Width x height x depth

MK 5880N: 22.5 x 90 x 97 mm  
MK 5880N PC: 22.5 x 111 x 97 mm  
MK 5880N PS: 22.5 x 104 x 97 mm  
MH 5880: 45 x 90 x 97 mm

## CCC-Data

### Auxiliary circuit

**Nominal voltage  $U_N$ :** AC 220 ... 240 V  
DC 12 V, DC 24 V

### Switching capacity:

to AC 15  
NO contact: 1.5 A / AC 230 V



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard type

MK 5880N.12 AC 220 ... 240 V

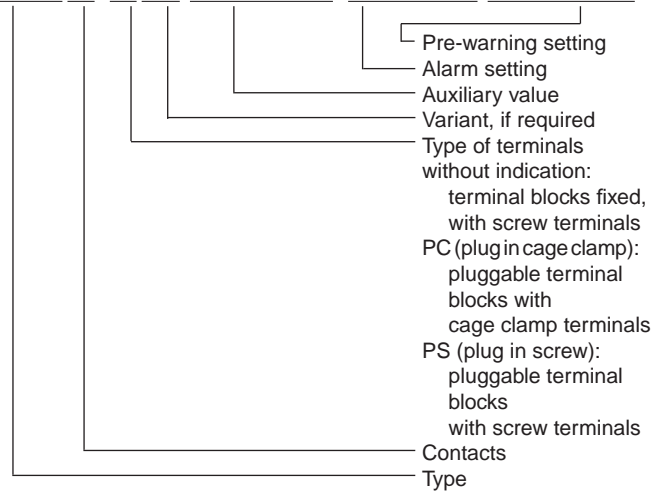
Article number: 0054044  
• Auxiliary voltage  $U_H$ : AC 220 ... 240 V  
• adjustable  
alarm value  $R_{AL}$ : 5 ... 100 k $\Omega$   
• Width: 22.5 mm

## Variants

MK 5880N.38/200: with pre-warning  
MH 5880.38/500: similar to MK 5880N but with galvanic separated analogue output (current/voltage) and 11 step LED chain for the actual insulation value  
Width: 45 mm

## Ordering example for variants

MK 5880N .38 PS /200 AC 380 ... 415 V AL 5 ... 100 k $\Omega$  VW 10 K ... 5M $\Omega$



## Options with Pluggable Terminal Blocks



Screw terminal (PS/plugin screw)

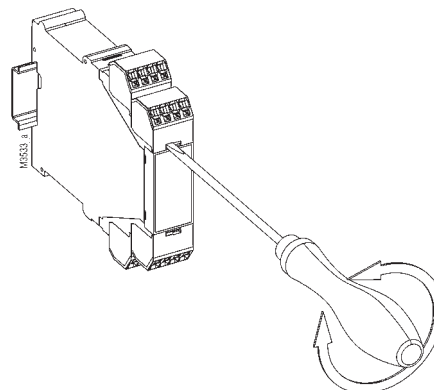


Cage clamp terminal (PC/plugin cage clamp)

## Notes

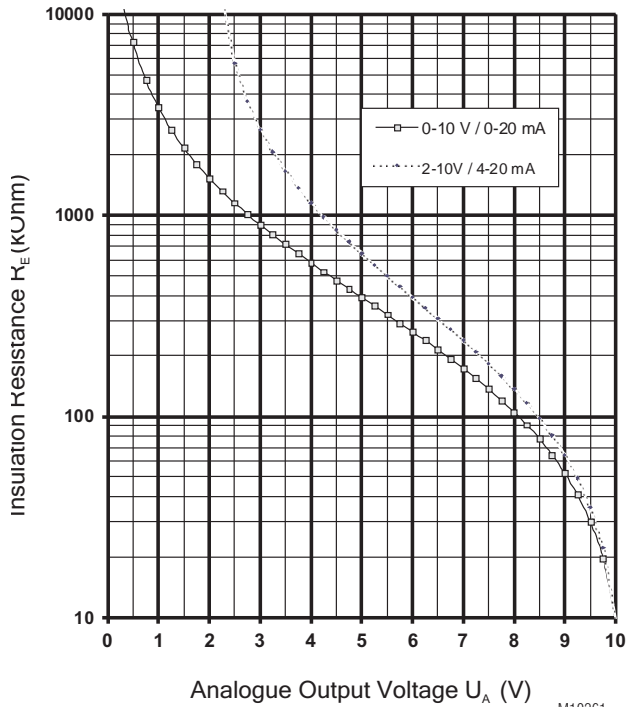
Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



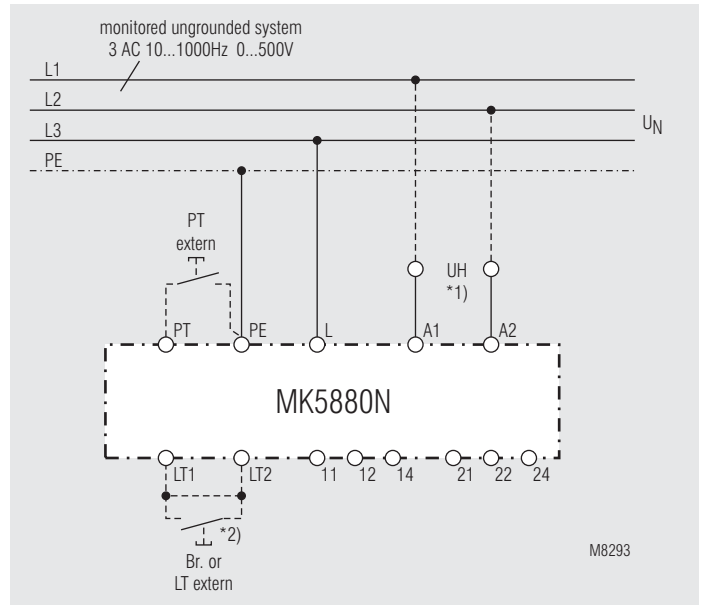
**MH5880**

Analogue Output Voltage  $U_A$   
against Insulation Resistance  $R_E$



M10261

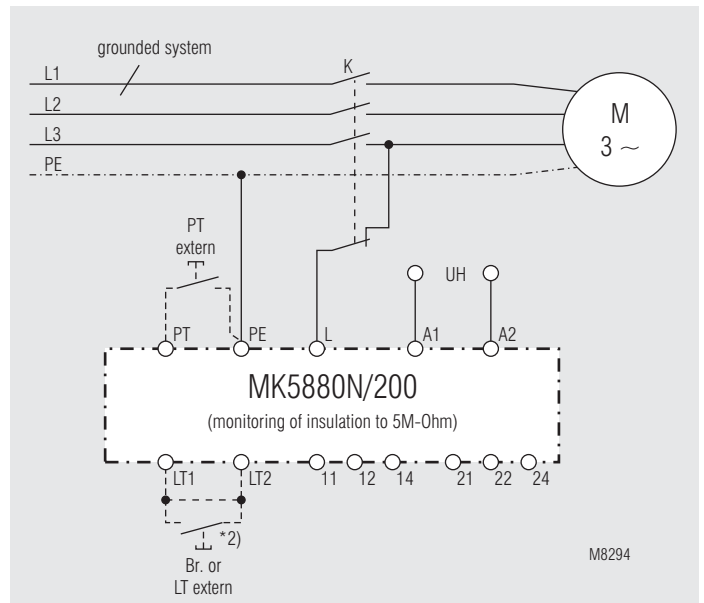
Analogue output voltage is proportional to the insulation resistance  $R_E$



Monitoring of an ungrounded voltage system.

\*1) Auxiliary supply  $U_H$  (A1 - A2) can be taken from the monitored voltage system. The range of the auxiliary supply input must be observed.

\*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT



Monitoring of motorwindings against ground

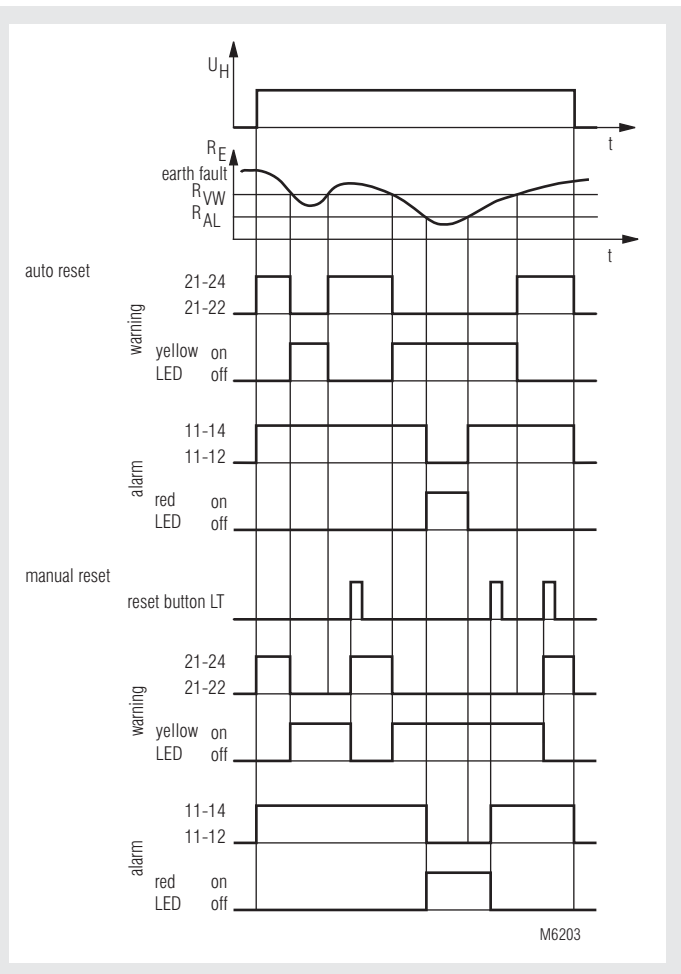
The insulation of the motor to ground is monitored as long as contactor K does not activate the load.

\*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT

**VARIMETER IMD**  
**Insulation Monitor**  
**RP 5888**



### Function Diagram



Function: de-energized on trip  
 With function energized on trip, the status of the relay contacts 11, 12, 14 and 21, 22, 24 is inverted

- Increasing the availability of machines and plants
- For preventive maintenance
- According to IEC/EN 61 557-8
- With configurable analogue output for insulating value
- For three-phase and A.C. power systems with 0 ... 500 V and 10 ... 1000 Hz
- Adjustable alarm value for ground fault  $R_{AL}$  of 5 k ... 5 M $\Omega$
- Monitors also disconnected voltage systems
- Energized / de-energized on trip settable
- Measuring circuit, auxiliary voltage, output contacts and analogue output are galvanically separated
- Programmable for manual reset or hysteresis function
- With test and reset button
- Connections for external test and reset buttons possible
- LED indicators for operation and alarm
- 2 changeover contacts
- Output function programmable
- Width: 70 mm

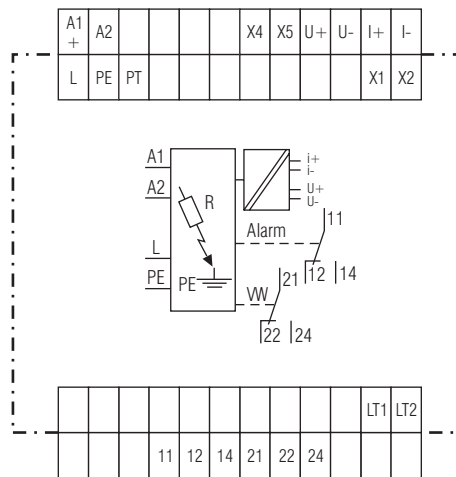
### Approvals and Markings



### Application

- Monitoring of insulation resistance of ungrounded voltage systems to earth
- Can also be used to monitor standby devices for earth fault, e.g. motor windings of devices that have to function in the case of emergency
- Other resistance monitoring applications

### Circuit Diagram



M9581\_c



## Function

The device is connected to the supply via terminals A1-A2. The unit can either be supplied from the monitored voltage system or from an separate auxiliary supply. Terminal L is connected to the monitored voltage and PE to earth. If the insulation resistance  $R_E$  drops below the adjusted alarm value  $R_{AL}$  the red LED goes on and the output relay switches off (de-energized on trip) or switches on (energized on trip). If the unit is on auto reset (bridge between LT1-LT2) and the insulation resistance gets better ( $R_E$  rises), the insulation monitor switches on (de-energized on trip) or switches off (energized on trip) again with a certain hysteresis and the red LED goes off. Without the bridge between LT1-LT2 the Insulation monitor remains in faulty state even if the insulation resistance is back to normal. The reset is done by pressing the internal or external reset button or by disconnecting the auxiliary supply. By activating the "Test" button an insulation failure can be simulated to test the function of the unit.

5 measuring ranges can be selected by rotary switch. 5 ... 50 kOhm; 10 ... 100 kOhm; 50 ... 500 kOhm; 100 K ... 1 MOhm and 0.5 M ... 5 MOhm. The fine tuning is done with potentiometer  $R_{AL}$  x Bereich. With the range selector also the relay function is set. The 5 ranges on the left are with function de-energized on trip, the 5 functions on the right with function energized on trip.

With the 4 smaller ranges up to max. 1 MOhm a pre-warning can be adjusted between setting value and 5 MOhms. On the range 0.5 ... 5 MOhm the pre-warning is adjustable between setting value and 10 MOhm. The pre-warning reacts on contact 21, 22, 24, the alarm value on contact 11, 12, 14. Turning  $R_{VW}$  fully anti clockwise contact 21, 22, 24 switches together with the alarm contact.

The pre-warning behaves similar as the alarm signal concerning manual reset. Hysteresis, energized or de-energized on trip

The devices have an analogue output that indicates the insulation resistance.

A Version with RS 485 interface is in preparation.

### Analogue output:

Output Terminal	Terminal X4-X5 bridged	Terminal X4-X5 open
u+ / u-	2 ... 10 V	0 ... 10 V
i+ / i-	4 ... 20 mA	0 ... 20 mA

### Terminal X1-X2, Analogue output:

X1-X2 open: Insulation value within the adjusted measuring range  $R_{AL}$  e. g. 50 ... 500 kOhm is proportional to 0 ... 10 V on terminals u+/u- (x4-X5 is open).  
The analogue value in relation to the insulation resistance can be seen in the diagrams M9605, M9606 (page 3 Setting aid).

X1-X2 bridged: Insulation value from 5 times the measuring range max 10 MOhm down to  $R_{AL}$  setting. e.g. range  $R_{AL} = 5 \text{ kOhm} \times 10$  (max fine tuning)  $\times 5 = 250 \text{ kOhm}$  setting value range  $5 \text{ kOhm} \times 4$  (fine tuning) = 20 kOhm  
Analogue output 4... 20 mA is proportional to 20 ... 250 kOhm

## Indication

green LED "ON":	On, when supply voltage connected (readiness for operation)
yellow LED "VW":	On, when insulation resistance is underprewarning value, $R_E < R_{VW}$
red LED "AL":	On, when insulation fault detected, $R_E < R_{AL}$ (value has fallen below alarm level)

## Notes

The Insulation monitor RP 5888 is designed to monitor AC-voltage systems. Overlaid DC voltage does not damage the instrument but may change the conditions in the Measuring Circuit. In one voltage system only one Insulation monitor must be connected. This has to be observed when coupling voltage system.

Line capacitance  $C_E$  to ground does not influence the insulation measurement, as the measurement is made with DC-voltage. It is possible that the reaction time in the case of insulation time gets longer corresponding to the time constant  $R_E * C_E$ .

The Insulation monitor can be used, because of it's higher setting value, to monitor single or 3-phase loads for ground fault.

If the load is operated from a grounded system the insulation resistance of the load can only be monitored when disconnected from the mains. This is normally the fact with loads which are operated seldom or only in the case of emergency but then must be function (see connection example).

The auxiliary supply can be connected to a separate auxiliary supply or to the monitored voltage system. The range of the auxiliary supply input has to be observed.

When monitoring 3-phase IT systems it is sufficient to connect the insulation monitor only to one phase. The 3-phases have a low resistive connection (approx. 3 - 5  $\Omega$ ) via the feeding transformer. So failures that occur in the non-connected phases will also be detected.

## Technical Data

### Auxiliary circuit

<b>Auxiliary voltage <math>U_H</math>:</b>	AC/DC 24 ... 80 V, AC/DC 80 ... 230 V
<b>Voltage range:</b>	DC 19 ... 110 V, AC 19 ... 90 V, DC 64 ... 300 V, AC 64 ... 265 V
<b>Nominal frequency:</b>	0.9 ... 1.25 $U_N$
<b>Nominal consumption</b>	AC 50 / 60 Hz

at AC:	5 VA
at DC:	2.5 W

### Measuring circuit

<b>Nominal voltage <math>U_N</math>:</b>	AC 0 ... 500 V
<b>Voltage range:</b>	0 ... 1.1 $U_N$
<b>Frequency range:</b>	10 ... 1000 Hz
<b>Alarm value <math>R_{AL}</math>:</b>	5 k ... 5 M $\Omega$
<b>Prewarning value <math>R_{VW}</math>:</b>	$R_{AL}$ ... 5 M $\Omega$
<b>Setting of ranges <math>R_{AL}</math> in 5 steps:</b>	5 ... 50 k $\Omega$ , 10 ... 100 k $\Omega$ , 50 ... 500 k $\Omega$ , 100 k ... 1 M $\Omega$ and 0.5 M ... 5 M $\Omega$
<b>Setting <math>R_{AL}</math>:</b>	infinite variable
<b>Setting <math>R_{VW}</math>:</b>	on relative scale related to $R_{AL}$ setting value
<b>Internal test resistor:</b>	equivalent to earth resistance of < 5 k $\Omega$
<b>Internal AC resistance:</b>	> 250 k $\Omega$
<b>Internal DC resistance:</b>	> 250 k $\Omega$
<b>Measuring voltage:</b>	approx. DC 15 V, (internally generated)
<b>Max. measuring current (<math>R_E = 0</math>):</b>	< 0.1 mA
<b>Max. permissible noise DC voltage:</b>	DC 500 V
<b>Operate delay</b>	
at $R_{AL} = 50$ k $\Omega$ , CE = 1 $\mu$ F	
$R_E$ from $\infty$ to 0.9 $R_{AL}$ :	< 2 s
$R_E$ from $\infty$ to 0 k $\Omega$ :	< 1.4 s
<b>Hysteresis</b>	
at $R_{AL} = 50$ k $\Omega$ :	approx. 15 %

### Output

<b>Contacts:</b>	1 changeover contact for alarm 1 changeover contact for prewarning 2 changeover contacts
at $R_{AL} = R_{VW}$ :	4 A
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity</b>	
to AC 15	
NO contacts:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contacts:	2 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V:	$\geq 5 \times 10^5$ switch. cycl. IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 30 \times 10^6$ switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated impuls voltage / pollution degree	IEC 60 664-1
auxiliary supply / measuring input / contacts:	6 kV / 2 IEC 60 664-1
measuring input / analogue output:	4 kV / 2 IEC 60 664-1
contacts 11,12,14 / 21,22,24:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge(ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages	
between A1 - A2:	1 kV IEC/EN 61 000-4-5
between L - PE:	1 kV IEC/EN 61 000-4-5
Interference supression:	EN 61 000-6-3
<b>Degree of protection:</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529

## Technical Data

<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	1 x 2.5 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded wire DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	box terminal with wire protection
<b>Fixing torque:</b>	0.4 Nm max.
<b>Stripping length:</b>	7.5 mm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	approx. 200 g

### Dimensions

<b>Width x height x depth:</b>	70 x 90 x 71 mm
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### Standard Type

RP 5888.12 AC/DC 80 ... 230 V

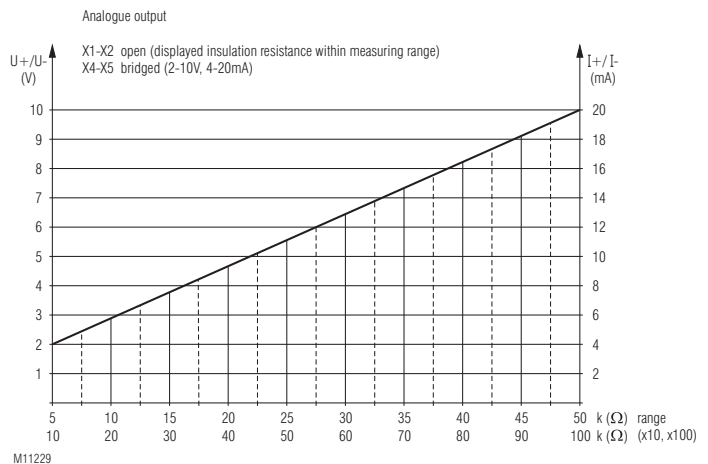
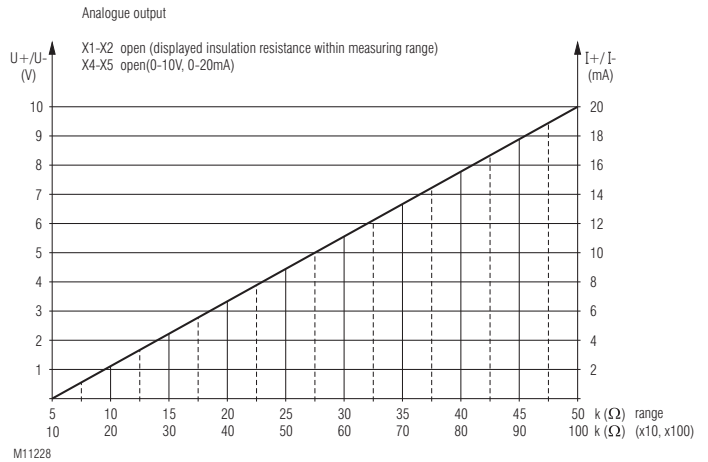
Article number:	0060868
• Auxiliary voltage $U_H$ :	AC/DC 80 ... 230 V
• Setting alarm value: $R_{AL}$ :	5 k ... 5 M $\Omega$
• Width:	70 mm

### Ordering Example

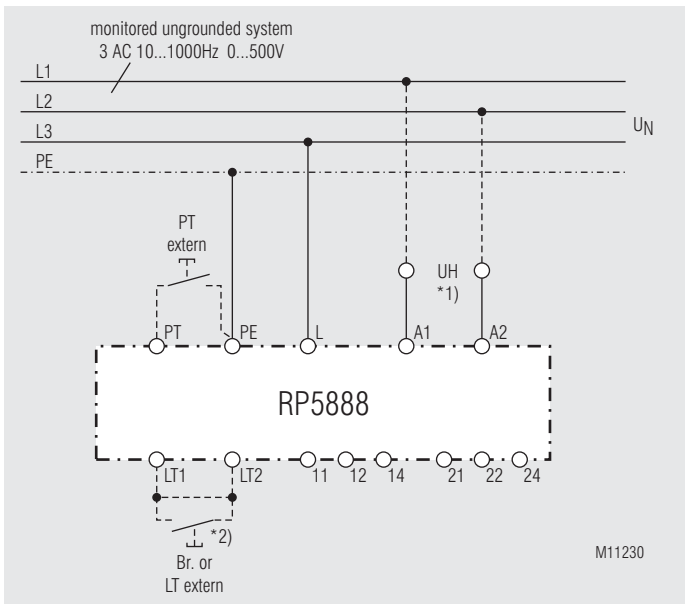
RP 5888 .12 AC/DC 80 ... 230 V  $R_{AL}$  5 k ... 5 M $\Omega$



### Setting Aid



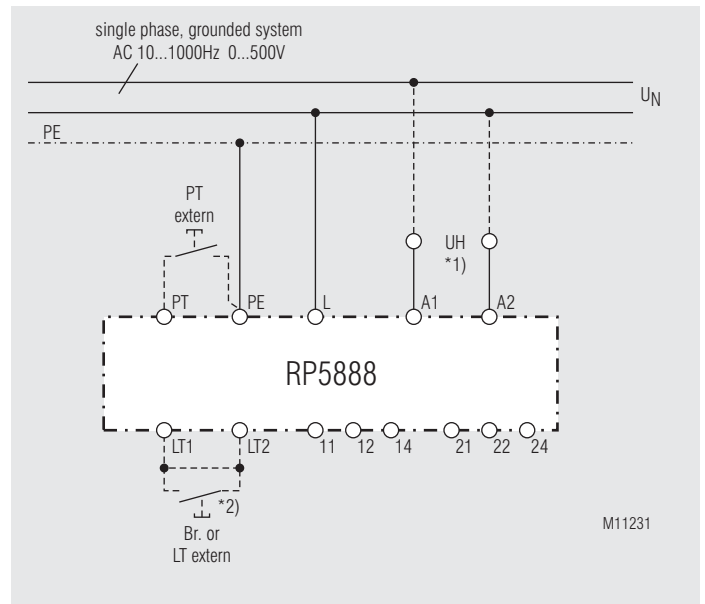
## Connection Examples



Monitoring of an ungrounded voltage system.

\*1) Auxiliary supply  $U_H$  (A1 - A2) can be taken from the monitored voltage system. The range of the auxiliary supply input must be observed.

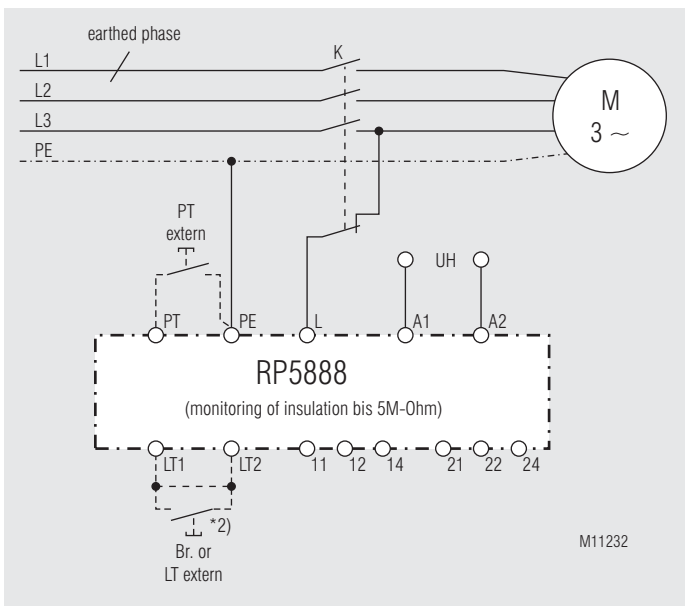
\*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT



Monitoring of an ungrounded voltage system.

\*1) Auxiliary supply  $U_H$  (A1 - A2) can be taken from the monitored voltage system. The range of the auxiliary supply input must be observed.

\*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT



Monitoring of motorwindings against ground.

The insulation of the motor to ground is monitored as long as contactor K does not activate the load.

\*2) with bridge LT1 - LT2: automatic reset  
without bridge LT1 - LT2: manual reset, reset with button LT

## VARIMETER IMD Insulation Monitor

IN 5880/710, IN 5880/711, IP 5880/711



0247384



- According to IEC/EN 60 255, DIN VDE 0435-303, IEC/EN 61 557-8
- For rooms used for medical purposes according to IEC 60364-7-710, DIN VDE 0100-710
- For three-phase and A.C. power systems with 0 ... 500 V and 10 ... 1000 Hz (IT power systems)
- Adjustable alarm value for ground fault  $R_{AL}$  of 50 ... 500 k $\Omega$
- Measuring circuit with broken wire protection
- As option, programmable for storing or non-storing of errors
- With reset and test button
- Additional external reset and test buttons can be connected
- LED indicators for operation, insulation fault, and interruption of Measuring circuit
- 2 changeover contacts
- As option, with LED chain for indication of the current insulation status
- 52.5 mm width

### Approvals and Markings



### Application

For insulation monitoring of the IT system of rooms used for medical purposes according to VDE 0100-710:

### Design and Method of Functioning

The terminals L/L' and PE/PE' are connected to the respective lines of the IT power system. If the IT transformer has a centre tapping or a star point, the terminals L / L' are preferably connected to this point. The terminals L' and PE' should be connected with separate lines and possibly not in the same place (at least not at the same terminal) of the IT power system to allow for safe recognition of an interruption in the measuring circle.

The insulation resistance of the IT power system against ground is measured between the terminals L / L' and PE / PE'. If the ground fault resistance  $R_E$  falls below the pickup value  $R_{AL}$  of the line isolation monitor, the red LED "AL" will be illuminated, and the two changeover contacts fall back into normal position. On interruption of the Measuring circuit, the two changeover contacts will likewise fall back into normal position, and the red LED "MK" will be illuminated.

After correction of the error ( $R_E > R_{AL}$ , Measuring circuit connected) and jumpered terminals LT1 – LT2 (= error not stored), the changeover contacts will change into work position (correct status), and the red error LEDs will stop lighting.

If you wish to store errors, remove the jumper LT1 – LT2. In this way, also short-lived errors as e.g. a temporary deterioration of insulation, for example by touching of a line or unreliable contact making in the Measuring circuit may trigger a stored alarm: The output contacts remain open also after the error has been corrected. The type of the error can be seen in retrospect from the illuminated error LED "AL" or "MK".

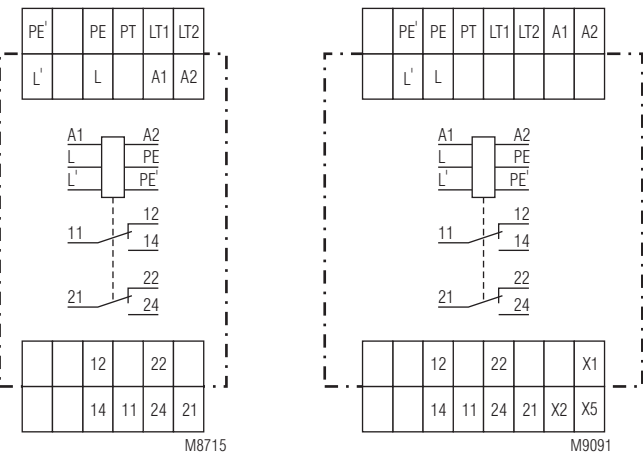
The error memory can be reset by pressing the internal or external reset key, or by switching off the auxiliary voltage.

By pressing the internal or external "Test" key, a deterioration of insulation is simulated in the Measuring circuit (=  $R_E$  approx. 40 k $\Omega$ ); thus, the correct response of the isolation monitor is checked.

The variant IN 5880/711 comprises an 11-stage LED chain for indication of the current insulation resistance of the power system. By means of differently colored LEDs, the insulation status in the range of 20 k $\Omega$  ... 1 M $\Omega$  is indicated. In this way, deterioration of insulation can be detected even before an alarm is triggered.

The variant IP 5880/711 includes a 11 step LED indicator to monitor the actual state of the insulation, an additional power supply and relays to connect a test and indicator unit UP 5862. The width is 70 mm.

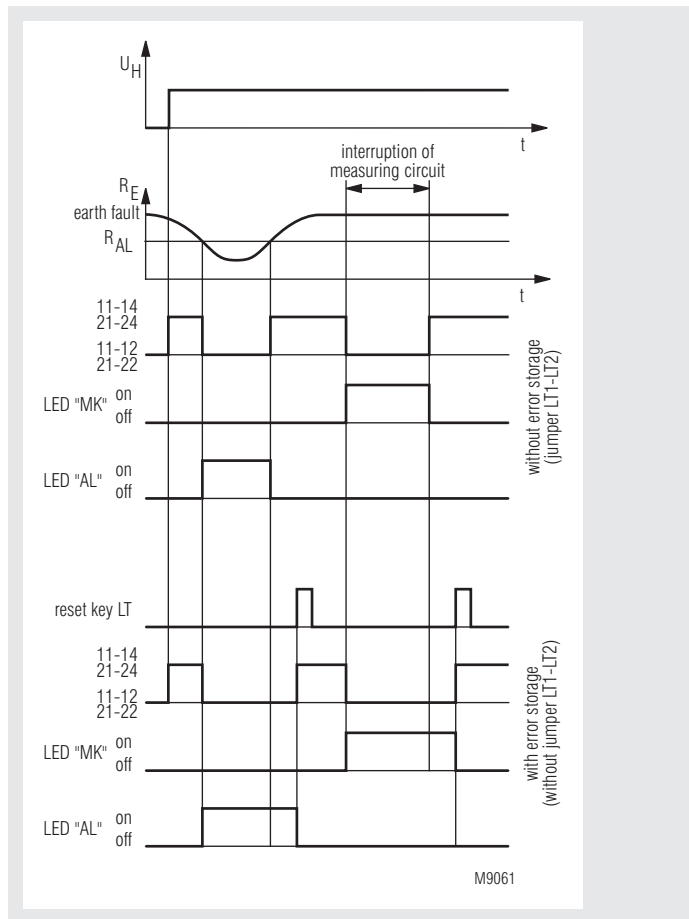
### Circuit Diagrams



IN 5880/710, IN 5880/711

IP 5880/711

## Function Diagram Insulation Monitoring System



### Notes

#### General

Before checking insulation and voltage of the system, disconnect the monitoring device IN 5880 from the power source.

#### Insulation monitoring system

The isolation monitor is designed to monitor straight AC power systems. Any interfering direct voltages getting into the Measuring circuit will not damage the device but will falsify the conditions in the Measuring circuit while they are affecting it. As insulation measuring is performed via direct current, it will not be falsified by system capacitances against protective ground  $C_E$ . However, the pickup time may be longer in case of insulation failure, in the order of the time constant  $R_E$  times  $C_E$ .

In every IT circuit, only one isolation monitor must be connected. This has to be observed when coupling voltage system.

### Indicators

- Green LED "ON": is illuminated when auxiliary voltage has been applied (operability)
- Red LED "AL": is illuminated when an insulation failure is present,  $R_e < R_{AL}$  (value has fallen below alarm level)
- Red LED "MK": is illuminated when one of the lines of the Measuring circuit is interrupted (L, L', PE, PE')

With IN 5880/711, additional 11-stage LED chain:

- Green LEDs: at  $\geq 1 \text{ M}\Omega$ , 750 k $\Omega$ , 550 k $\Omega$
- Yellow LEDs: at 400 k $\Omega$ , 300 k $\Omega$ , 220 k $\Omega$ , 160 k $\Omega$ , 110 k $\Omega$ , 75 k $\Omega$
- Red LEDs: at 40 k $\Omega$ ,  $\leq 20 \text{ k}\Omega$

## Technical Data

### Insulation Measuring Circuit

<b>Nominal voltage <math>U_N</math>:</b>	AC 0 ... 500 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Frequency range:</b>	10 ... 1000 Hz,
<b>Alarm value <math>R_{AL}</math>:</b>	Adjustable from 50 ... 500 k $\Omega$
<b>Internal testing resistor:</b>	corresponds to an $R_E$ of approx. 40 k $\Omega$
<b>AC internal resistance:</b>	> 250 k $\Omega$
<b>DC internal resistance:</b>	> 250 k $\Omega$
<b>Measuring voltage:</b>	approx. DC 15 V (generated internally)
<b>Max. measuring current (<math>R_E = 0</math>):</b>	< 50 $\mu\text{A}$
<b>Max. permissible interfering direct voltage:</b>	DC 500 V
<b>Operate delay:</b>	with $R_{AL} = 50 \text{ k}\Omega$ , $C_E = 1 \mu\text{F}$
$R_E$ of $\infty$ to 0.9 $R_{AL}$ :	< 1.3 s
$R_E$ of $\infty$ to 0 k $\Omega$ :	< 0.7 s
<b>Hysteresis:</b>	approx. 15 %

### Auxiliary Circuit

<b>Auxiliary voltage <math>U_H</math>:</b>	AC 220 ... 240 V
<b>Voltage range:</b>	0.85 ... 1.1 $U_H$
<b>Nominal consumption:</b>	approx. 2 VA
<b>Nominal frequency:</b>	45 ... 400 Hz

### Output

**Number of contacts provided:** 2 changeover contacts

<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity</b>	
acc. to AC 15	
NO contact:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	2 A / AC 230 V IEC/EN 60 947-5-1
<b>Contact life</b>	
to AC 15 with 1 A, AC 230V:	5 x 10 <sup>6</sup> operating cycles IEC/EN 60 947-5-1
<b>Short circuit strenght</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 30 x 10 <sup>6</sup> operating cycles

### General Data

<b>Nominal operation:</b>	Permanent operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
overvoltage category/ pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Static discharge (ESD):	8 kV (air discharge) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surges	
between supply lines:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Radio interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplast with V0 behavior according to UL Subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm Frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> massive, or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3
<b>Wire fixing:</b>	Screw terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Net weight</b>	
IN 5880/710:	approx. 190 g
IN 5880/711:	approx. 250 g
IP 5880/711:	approx. 350 g

### Dimensions

<b>Width x height x depth</b>	
IN 5880/710, IN 5880/711:	52.5 x 90 x 59 mm
IP 5880/711:	70 x 90 x 59 mm

### Standard Type

IN 5880.12/710 AC 220 – 240 V

- Article number: 0056739
- Output: 2 changeover contacts
  - Auxiliary voltage  $U_H$ : AC 220 ... 240 V
  - Overall width: 52.5 mm
  - Adjustable alarm value  $R_{AL}$ : 50 ... 500 k $\Omega$

### Variant

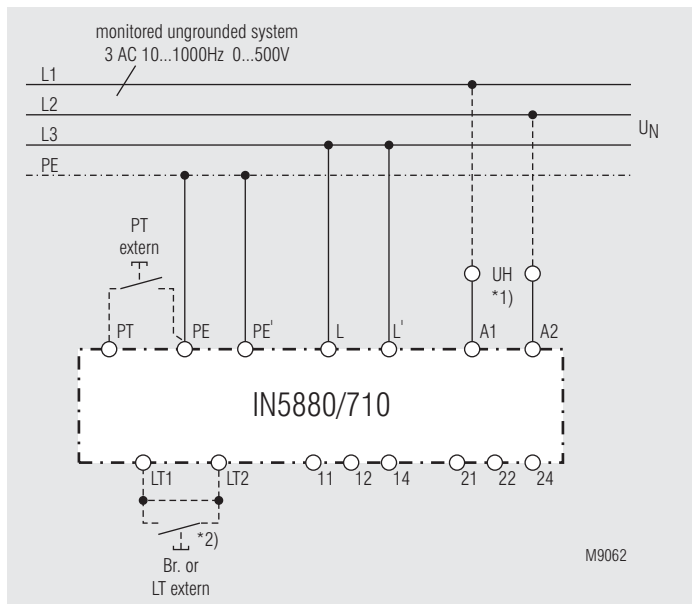
- IN 5880/711: with 11-stage LED chain for indication of the current insulation value
- IP 5880/711: with 11-stage LED chain for indication of the current insulation value, in addition with connection for test and indicator panel UP 5862

### Ordering Example

IN 5880.12/710 AC 220 ... 240 V 50 ... 500 k $\Omega$

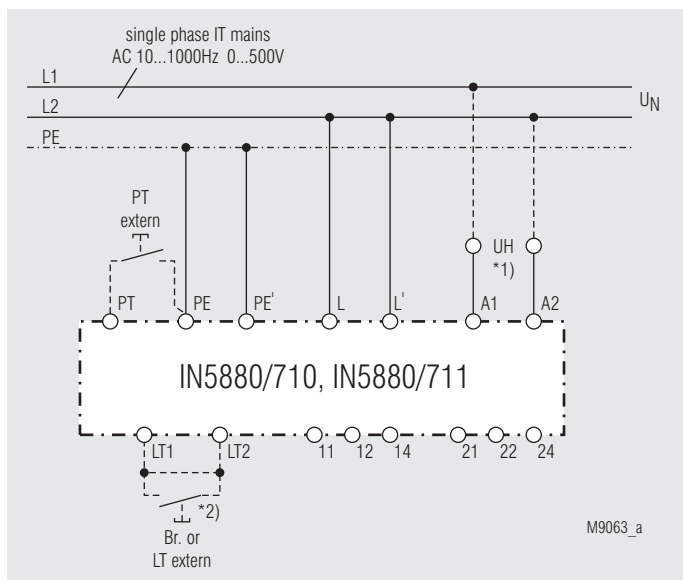
Alarm value  
Auxiliary voltage  
Type

### Connection Example



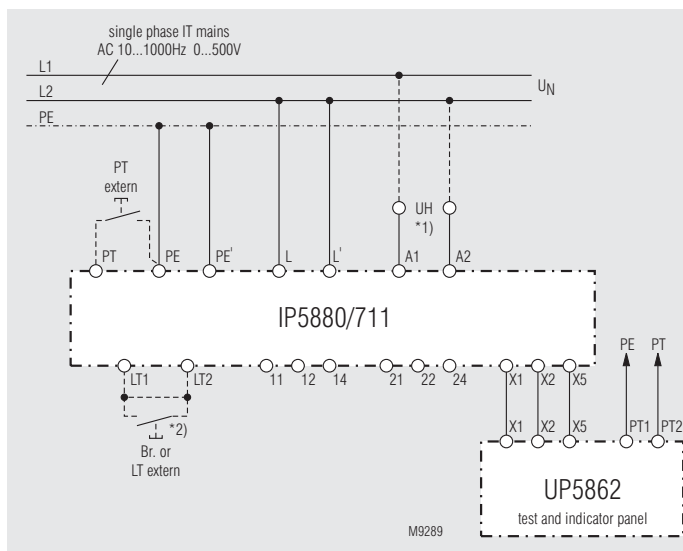
Monitoring of a 3-phase IT power system

### Connection Examples



Monitoring of a single phase IT power system

- \*1) The auxiliary voltage  $U_H$  (A1 – A2) can also be drawn from the power system to be monitored. However, the voltage range of the auxiliary voltage must be taken into consideration.
- \*2) With jumper LT1 – LT2: No storing of error message (hysteresis behavior)  
With jumper LT1 – LT2: Storing of error message; can be deleted by pressing the Delete (Reset) key LT



## Accessories

### Test and indicator panel UP 5862

For insulation monitors in medically used rooms according to IEC 60 364-7-710, DIN VDE 0100-710



- to mount in flush device boxes  
ø 60 mm, 35 mm deep;
- test button to check the function of the device
- with green LED to indicate operation
- reset button for audible alarm
- with yellow LED to monitor insulation failure

Max. wire length to IN / IP 5880

at wire cross section A = 0.5 mm<sup>2</sup>: 500 m

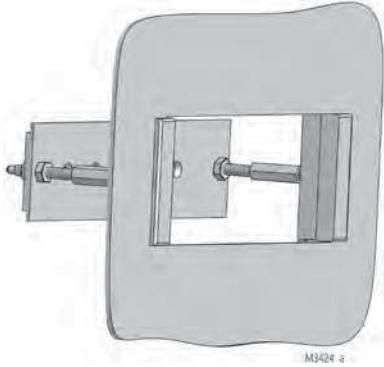
at wire cross section A = 1.5 mm<sup>2</sup>: 1000 m

Dimensions (width x height): 80 x 80 mm

Article number: 0041706

### Flush mounting kit

Order reference: KU 4087-150/005659



For universal use with:

- I-series devices of  
17,5 to 105 mm width
- easy mounting

### Mounting kit for surface mounting

KU 4087-100



Device of I-series	Width (mm)	Order reference
IK	17.5	KU4087-100/56763
IL	35.0	KU4088-100/56764
IN	52.5	KU4084-100/56765
IP	70.0	KU4089-100/56766
IR	105.0	KU4090-100/56767

## VARIMETER IMD Insulation Monitor IL 5881, SL 5881



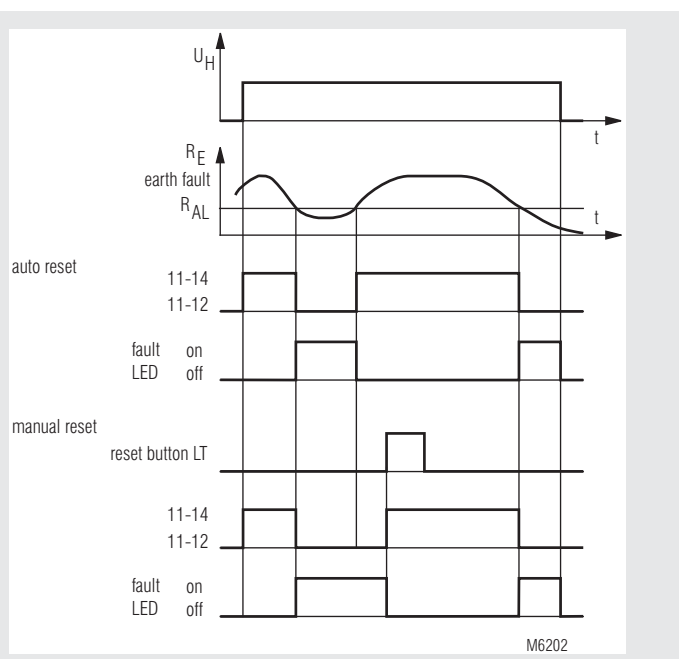
- According to IEC/EN 61 557-8
- For DC voltage systems up to 12 ... 280 V
- Wide voltage range of measuring input  $U_N$  DC 12 ... 280 V (on request DC 24 ... 500 V with separate auxiliary supply, Measuring range 20 ... 500 k $\Omega$ )
- Adjustable tripping value  $R_{AL}$  of 5 ... 200 k $\Omega$
- Selective ground fault indication for L+ and L- allows fast fault finding
- Without auxiliary supply
- De-energized on trip
- 2 changeover contacts
- Automatic or manual reset, programmable
- With test and reset buttons
- Connection for external test and reset button possible
- galvanic separated AC or DC auxiliary supply available as option
- adjustable time delay as option
- 2 models available:

IL 5881: 61 mm deep with terminals near to the bottom to be mounted in consumer units or industrial distribution systems according to DIN 43 880

SL 5881: 98 mm deep with terminals near to the top to be mounted in cabinets with mounting plate and cable ducts

- DIN rail or screw mounting
- 35 mm width

### Function Diagram



IL 5881/100, SL 5881/100; IL 5881, SL 5881

### Approvals and Markings



### Application

- Monitoring of insulation resistance of ungrounded DC-voltage systems to earth.
- For industrial and railway applications

### Function

If the insulation resistance  $R_E$  between L+ or L- to ground drops below the adjusted alarm value  $R_{AL}$  (insulation failure) the corresponding red LED goes on and the output relay switches off (de-energized on trip). If the unit is on auto reset (bridge between LT-X1) and the insulation resistance gets better ( $R_E$  rises), the insulation monitor switches on again with a certain hysteresis and the red LED goes off.

Without the bridge between LT-X1 the insulation monitor remains in faulty state even if the insulation resistance is back to normal. The location of the fault on L+ or L- is indicated on the corresponding LED (selective fault indication).

The reset is done by pressing the internal or external reset button or by disconnecting the auxiliary supply.

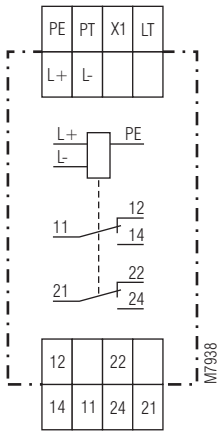
By activating the "Test" button internal or external an insulation failure can be simulated to test the function of the unit.

### Indicators

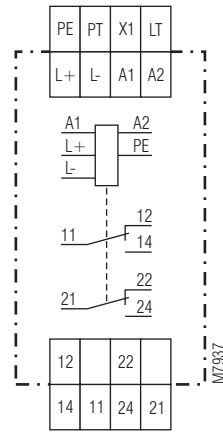
- |                 |  |
|-----------------|--|
| Green LED "ON": | On, when supply voltage connected                              |
| Red LED "RE+":  | On, when insulation fault detected ( $R_{E+} < R_{AL}$ ) on L+ |
| Red LED "RE-":  | On, when insulation fault detected ( $R_{E-} < R_{AL}$ ) on L- |



## Circuit Diagrams



IL 5881.12/100



IL 5881.12

## Connection Terminals

Terminal designation	Signal designation
A1	L / +
A2	N / -
L+, L-	Connection for monitored IT-systems
PE	Connection for protective conductor
PT, X1	Connection for external test button
LT, X1	Connections for external reset or manual and auto reset: LT/X1 bridged: hysteresis function LT/X1 not bridged: manual reset
11, 12, 14 21, 22, 24	Changeover contact (insulation failure)

## Notes

The IL/SL 5881 can be used in systems with high leakage capacity to ground. When the unit is adjusted to high alarm values a leakage capacity can create a pulse when switching the system on (short alarm pulse). This happens at the following values:

IL / SL 5881:  $R_{AL} = 200 \text{ k}\Omega$ ;  $C_E > 1 \mu\text{F}$   
 IL / SL 5881:  $R_{AL} = 50 \text{ k}\Omega$ ;  $C_E > 6 \mu\text{F}$   
 IL / SL 5881:  $R_{AL} = 20 \text{ k}\Omega$ ;  $C_E > 16 \mu\text{F}$

IL / SL 5881/100:  $R_{AL} = 500 \text{ k}\Omega$ ;  $C_E > 0.8 \mu\text{F}$   
 IL / SL 5881/100:  $R_{AL} = 200 \text{ k}\Omega$ ;  $C_E > 0.8 \mu\text{F}$   
 IL / SL 5881/100:  $R_{AL} = 50 \text{ k}\Omega$ ;  $C_E > 2.0 \mu\text{F}$   
 IL / SL 5881/100:  $R_{AL} = 20 \text{ k}\Omega$ ;  $C_E > 4.5 \mu\text{F}$

An optional time delay (on request) could suppress this pulse.

Because of the measuring principle with a resistor bridge (asymmetry principle) the insulation monitor IL/SL 5881 will not detect symmetric ground faults of L+ and L-. Also a voltfree (disconnected  $U_N = 0\text{V}$ ) system cannot be monitored.

## Notes

On models with separate auxiliary supply the alarm state is not defined when the voltage drops below 3 V. To avoid false alarm an additional auxiliary relay should be used which is connected to the monitored voltage or the variant IL 5881.12/010 is used.

On the models with galvanic separation between DC auxiliary supply and measuring input, the supply (A1/A2) can be connected to the monitored voltage system (L+/L-). The voltage range of the auxiliary input must be noticed which is only 1.25 of  $U_H$  while the measuring input always goes up to 280 V.

If no auxiliary supply is available the model IL/SL 5881/100 (without auxiliary supply) can be used which takes the auxiliary supply from the monitored system ( $U_H = U_N = \text{DC } 12 \dots 280 \text{ V}$ ).

In one isolated voltage system only one insulation monitor must be connected, because several units would influence each other (half response value if 2 devices are connected).

## Technical Data

### Auxiliary Circuit

(only at IL/SL 5881)

**Auxiliary voltage  $U_H$ :** AC 220 ... 240 V, 380 ... 415 V  
 DC 12 V, 24 V  
 DC 24 ... 60 V

### Voltage range:

AC: 0.8 ... 1.1  $U_H$   
 DC: 0.9 ... 1.25  $U_H$   
**Frequency range (AC):** 45 ... 400 Hz

### Nominal consumption

AC: approx. 2 VA  
 DC: approx. 1 W

## Measuring Circuit

	Standard	extended, on request
<b>Nominal voltage <math>U_N</math> at</b>		
$\leq 5 \%$ residual ripple:	DC 12 ... 280 V	DC 24 ... 500 V
$\leq 48 \%$ residual ripple:	DC 12 ... 220 V	
<b>Voltage range:</b>	0,9 ... 1,1 $U_N$	0,9 ... 1,1 $U_N$
<b>Alarm value <math>R_{AL}</math>:</b>	5 ... 200 k $\Omega$	20 ... 500 k $\Omega$
<b>Setting <math>R_{AL}</math>:</b>	infinite setting	infinite setting
<b>Internal AC resistance</b>	each approx.	each approx.
L+ and L- to PE:	75 k $\Omega$	190 k $\Omega$
<b>Max. Messstrom an PE (<math>R_E = 0</math>):</b>	$U_N / 75 \text{ k}\Omega$	$U_N / 190 \text{ k}\Omega$

### Operate delay

at  $R_{AL} = 50 \text{ k}\Omega$ ,  $C_E = 1 \mu\text{F}$

$R_E$  from  $\infty$  to  $0.9 R_{AL}$ :

approx. 0.8 s

$R_E$  from  $\infty$  to  $0 \text{ k}\Omega$ :

approx. 0.4 s

### Response inaccuracy:

$\pm 15 \%$  + 1.5 k $\Omega$

IEC 61557-8

### Hysteresis

at  $R_{AL} = 50 \text{ k}\Omega$ :

approx. 10 ... 15 %

### Time delay:

0.5 ... 20 s (variant)

## Output

### Contacts:

IL / SL 5881.12: 2 changeover contacts

**Thermal current  $I_{th}$ :** 4 A

### Switching capacity

to AC 15: 3 A / AC 230 V IEC/EN 60 947-5-1

### Switching capacity

to DC 13: 2 A / DC 24 V  
 0.2 A / DC 250 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 1 A, AC 230 V:  $\geq 2 \times 10^5$  switching cycles IEC/EN 60 947-5-1

### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

### Mechanical life:

$\geq 10 \times 10^6$  switching cycles

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range</b>		
Operation:	- 20 ... + 60°C	
Storage:	- 20 ... + 60°C	
<b>Altitude:</b>	< 2.000 m	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree		
between auxiliary supply connections(A1 / A2):	4 kV / 2 at AC-auxiliary voltage	IEC 60 664-1
between measuring input connections (L+ / L- / PE):	4 kV / 2	IEC 60 664-1
between auxiliary supply and measuring input connections:	4 kV / 2	IEC 60 664-1
Input to output(contacts):	6 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:		
80 MHz ... 1 GHz:	12 V / m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages		
between A1 - A2 and L+ - L-:	1 kV	IEC/EN 61 000-4-5
between A1, A2 - PE and L+, L- - PE:	2 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL Subjekt 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4	
Cross section:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire	
Stripping length:	10 mm	
<b>Fixing torque:</b>	0.8 Nm	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Mounting:</b>	DIN rail mounting (IEC/EN60715) or screw mounting M4, 90 mm hole pattern, with additional clip available as accessory	
<b>Weight</b>		
IL 5881:	approx. 170 g	
SL 5881:	approx. 200 g	

### Dimensions

#### Width x height x depth:

IL 5881:	35 x 90 x 61 mm
SL 5881:	35 x 90 x 98 mm

## Classification to DIN EN 50155 for IL 5881

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

**Ambient temperature:** T1 compliant  
T2, T3 and TX with operational limitations

**Protective coating of the PCB:** No

### Standard Types

IL 5881.12/100 DC 12 ... 280 V 5 ... 200 kΩ

Article number: 0053805

- Without auxiliary supply  $U_H$
- Nominal voltage  $U_N$ : DC 12 ... 280 V
- adjustable alarm value  $R_{AL}$ : 5 ... 200 kΩ
- Width: 35 mm

SL 5881.12/100 DC 12 ... 280 V 5 ... 200 kΩ

Article number: 0055168

- Without auxiliary supply  $U_H$
- Nominal voltage  $U_N$ : DC 12 ... 280 V
- adjustable alarm value  $R_{AL}$ : 5 ... 200 kΩ
- Width: 35 mm

### Variants

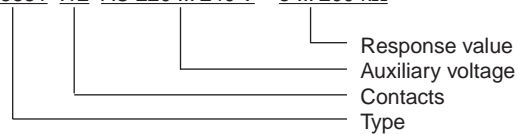
IL / SL 5881.12: with auxiliary supply

IL / SL 5881.12/010 with auxiliary supply  
no alarm at  $U_N < 3$  V

IL / SL 5881.12/300 without auxiliary supply  
Nominal voltage  $U_N$  DC 12 ... 280 V  
closed circuit operation  
Time delay 0.5 ... 20 s

### Ordering example for variants

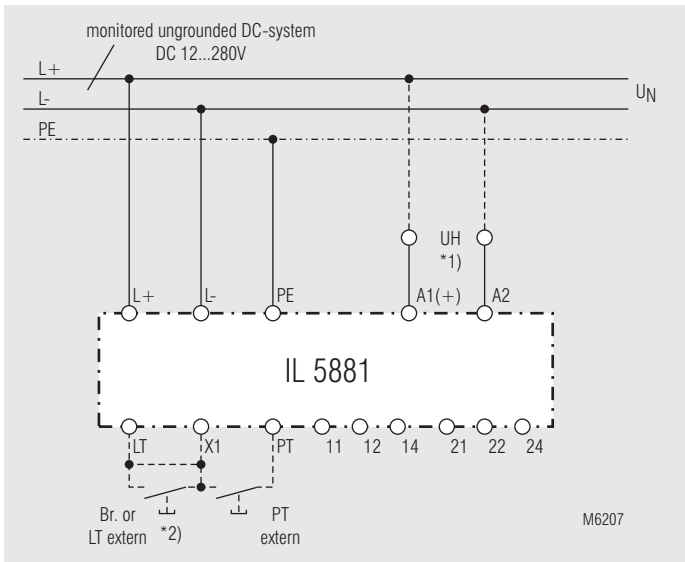
IL 5881 .12 AC 220 ... 240 V 5 ... 200 kΩ



### Accessories

ET 4086-0-2: Additional clip for screw mounting  
Article number: 0046578

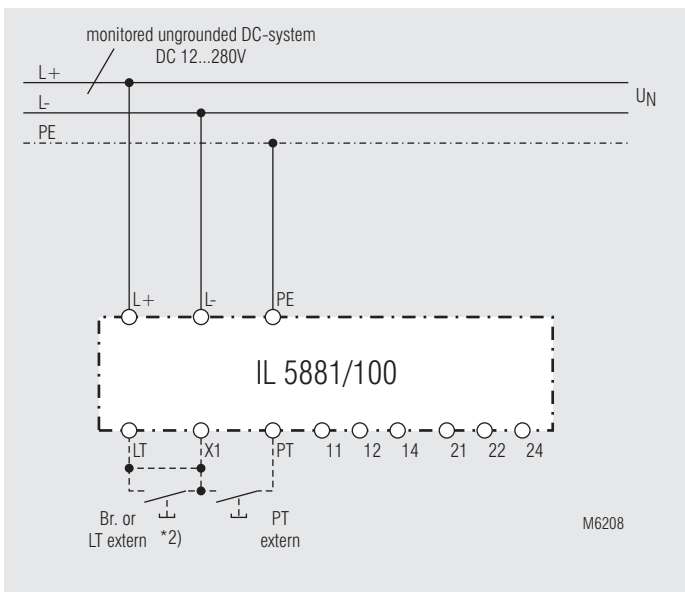
## Connections Examples



Monitoring of an ungrounded system.

\*1) Auxiliary supply U<sub>H</sub> (A1-A2) can be taken from monitored voltage system. The range of the auxiliary supply input must be observed.

\*2) with bridge LT - X1: automatic reset  
without bridge LT - X1: manual reset, reset with button LT



Monitoring of an ungrounded system without auxiliary supply.

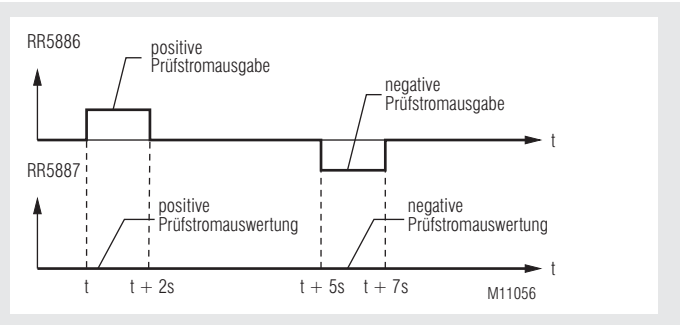
\*2) with bridge LT - X1: automatic reset  
without bridge LT - X1: manual reset, reset with button LT



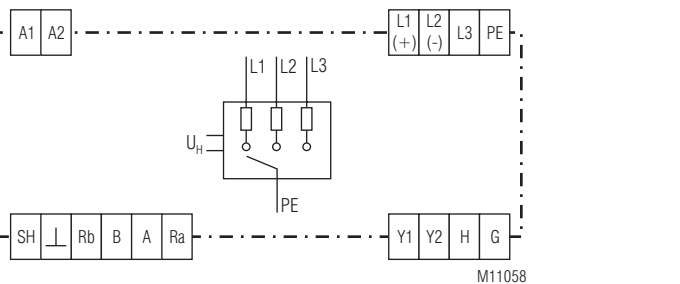
### Product description

The locating current injector RR 5886 in connection with the insulation fault locator RR 5887 monitors and localises insulation faults in complex AC/DC networks (IT systems). The external current transformers work independently of each other, calibrate themselves and are simply connected to the measuring channels of the insulation fault locator RR 5887. The number of measuring channels is increased by combining several insulation fault locators via a RS-485 bus connection. The search for insulation faults in extensive networks can be refined in this manner. Two different alarm levels facilitate the timely detection of a dangerous insulation state. The devices are operated easily and intuitively thanks to automatic balancing and a clear layout of the setting elements. The early detection and localisation of insulations faults permits their quick and targeted correction. As user you will benefit from the operating reliability and high availability of your system.

### Function Diagram



### Circuit Diagram



### Your Advantages

- Quick correction of insulation faults in complex power networks
- Universal auxiliary voltage range AC/DC 85 ... 265 V

### Features

- Insulation troubleshooting in DC, AC and mixed IT systems in connection with the insulation fault locator RR 5887 according to DIN EN 61557-9 (VDE 0413-9):2009 and DIN EN 61557-1 (VDE 0413-1)
- Insulation coordination according to IEC 60664-1
- External control via insulation monitor possible
- Positive and negative test current to monitor DC networks and networks with simultaneous alternating current and direct current portions present
- RS-485 bus connection to synchronise the test current analysis and optionally for the connection to the EDS measuring bus
- Control via insulation monitor via RS-485 bus or external control input possible
- Pushbutton for manual test current output
- Terminal connection for automatic test current output
- Status output of insulation fault detection via external switching output
- Width: 105 mm



### Approvals and Markings



### Application

- Insulation fault detection in complex AC/DC networks
- Industry, shipbuilding, plant engineering, PV systems
- Quick fault correction of insulation faults in medical facilities

### Indication

- green LED "ON": on, when supply connected
- yellow LED „“: Indicates the output of the positive test current pulse
- yellow LED „“: Indicates the output of the negative test current pulse
- yellow LED „RS485“: Indicates RS-485 bus activity and test current output

### Connection Terminals

Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage AC or DC
L1(+), L2(-), L3, PE	IT network voltage connections DC/ AC/3AC
SH, GND, Rb, B, A, Ra	RS-485 Bus (galvanic separation)
Y1, Y2	Switching input Test current output to control
G, H	Status switching output Test current output

## Notes



### Switching input



The test current output can be externally controlled via the switching input (terminals Y1, Y2). If the terminal connection is left open, the test current output can be controlled manually via the start/stop button. The test current output is started and stopped in alternating fashion with each push of the button.



When bridging terminals Y1-Y2, the test current is output automatically after switching on the device. The start-stop button is inactive at this time.

The switching input can also be selected directly via an external device, e.g. insulation monitoring device. The switching input is supplied as well via the electrically separated supply voltage. The switching input can therefore be switched via a transistor or a relay output.

Configuration options for the test current output:

Y1  *Automatic test current output*  
Y2 

Y1  *Release of the test current output through*  
Y2  *higher level control or external switch*

Y1  *Test current output controlled manually*  
Y2  *via device pushbutton*

### Switching output

The status of the test current output can be monitored via the switching output (terminals H, G). The switching output consists of a switching transistor, which is low-resistance at test current output and otherwise high-resistance. To generate digital output signals, the switching output must be connected to an external voltage source via a pull-up resistor.

### RS-485 bus connection

The locating current injector can be operated both in master mode and slave mode. The bus mode is set via a rotary switch.

The RS485 telegrams the locating current injector sends to synchronise the insulation fault measurement are identical in both bus modes.

While in the master mode the output of the telegrams occurs automatically every 12 seconds, in slave mode it occurs as response to a bus master request. A pending test current output is announced here in the user data range of the response telegram.

The insulation fault locators RR 5887, generally working in slave mode, synchronise themselves by monitoring the RS485 telegram network with manual test current output.

The RS-485 LED is permanently on during the test current output and bus activity and flashes when bus failures occur.

## Technical Data

### Auxiliary voltage

#### Nominal voltage range

A1(+)/A2: AC/DC 100 ... 230 V

Voltage range: AC/DC 85 ... 265 V

Nominal consumption: < 3 VA

### Monitored network

Nominal voltage: DC / AC / 3AC 24 ... 360 V

Voltage range AC / 3AC

L1/L2/L3: 21 ... 400 V, 40 ... 60 Hz

Voltage range DC

L1(+)/L2(-): 21 ... 400 V

Rated current range for

insulation test currents: 1 ... 5 mA

Maximum test current output: 6.5 mA

Test clock/test pause: 2 s / 3 s

Bus

(galvanic separation): RS-485

## Technical Data

### Switching input

Terminals: Y1, Y2

Connection (passive)

Low-signal: Bridge set / input low resistance

High-signal: Input open / input high resistance

Connection (active)

Voltage range (low/high): 0V / 12 ... 24 V

Max. switching current (24 V): 10 mA

### Switching output

Terminals: H(+), G(-)

Switching output (passive): transistor outputs

Test current output: Output low resistance  
(minimal 220 Ω via PTC)

No test current output: Output high resistance

Switching voltage max.: 24 V

Switching current max. (24 V): 10 mA

### RS-485 Bus

Terminals: SH, ⊥, Rb, B, A, Ra

Bus: galvanic separation

Geräte Mode

Bus-Master/Slave: adjustable via rotational switch

Transmission medium: twisted, shielded two-wire line (SH)

Data transmission rate: 115.2 kBit/s

Network termination: Bus termination via  
bridges Rb, B and Ra, A

### General Data

Nominal operating mode: continuous operation

Temperature range: -20 ... + 60 °C

Clearance and creepage distance

rated impulse voltage/  
pollution degree: 4 kV / 3 IEC 60 664-1

EMC

Electro static discharge (ESD): 8 kV (air) IEC/EN 61000-4-2

HF irradiation: 10 V / m IEC/EN 61000-4-3

Fast transients: 2 kV IEC/EN 61000-4-4

Surge voltage

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

Housing: thermoplastic with VO behaviour acc. to  
UL subject 94

Vibration resistance: Amplitude 0.35 mm  
frequency 10...55 Hz, IEC/EN 60 068-2-6

20 / 060 / 04

Climate resistance: EN 50 005

Terminal designation:

Wire connection

screw terminals: fixed  
max. 4 mm<sup>2</sup> solid or  
2.5 mm<sup>2</sup> stranded wire with sleeve

min. 0.20 mm<sup>2</sup>

clamping screw: M2.5

Mounting: DIN-rail IEC/EN 60 715

Weight: approx. 200 g

### Dimensions

Width x height x depth: 105 x 90 x 71 mm

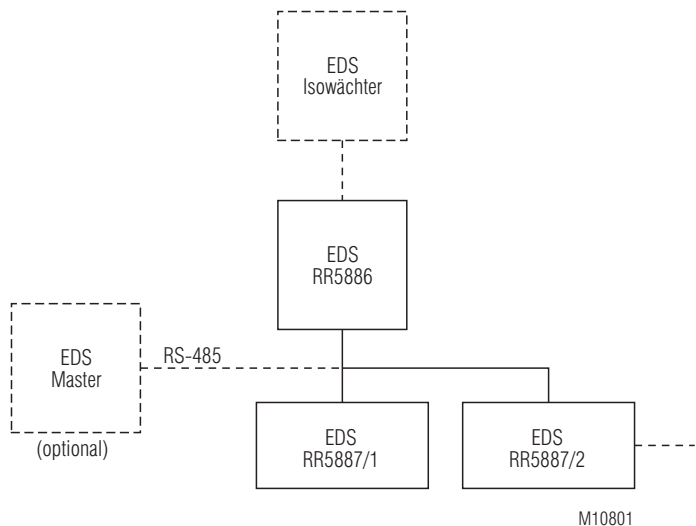
### Standard Type

RR 5886 AC/DC 85 ... 265 V

Article number: 0065011

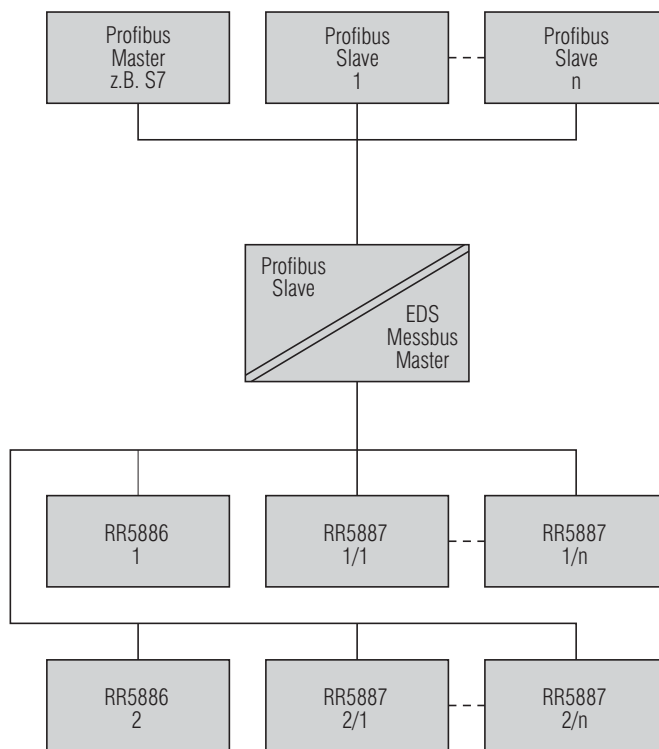
- Rated current range for insulation test currents: 1 ... 5 mA
- Maximum test current output: 6.5 mA
- Width: 105 mm

## System overview



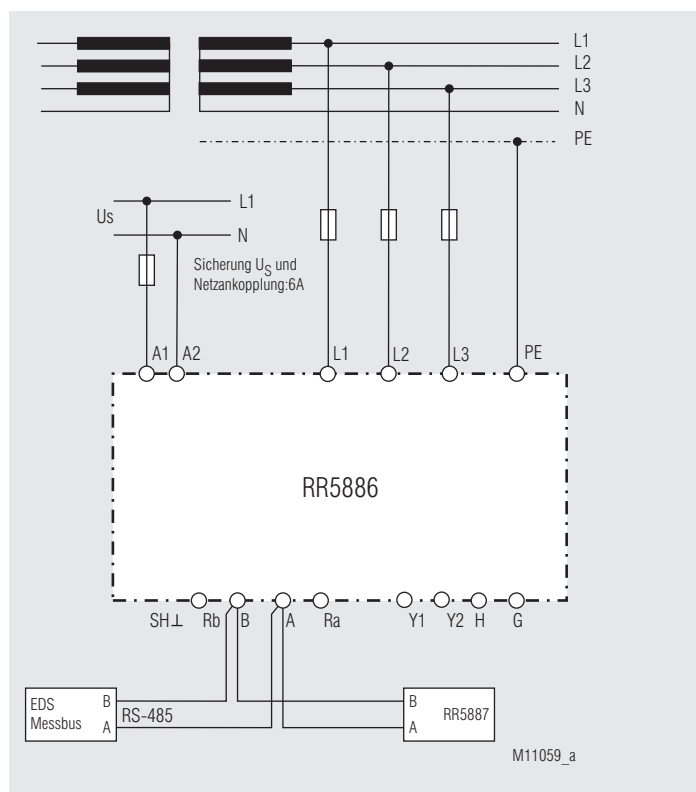
- Insulation fault detection in DC / AC / 3AC IT networks in connection with the insulation fault locator RR 5887
- External selection via an insulation monitoring device possible

## Connection to measuring bus /Profibus gateway

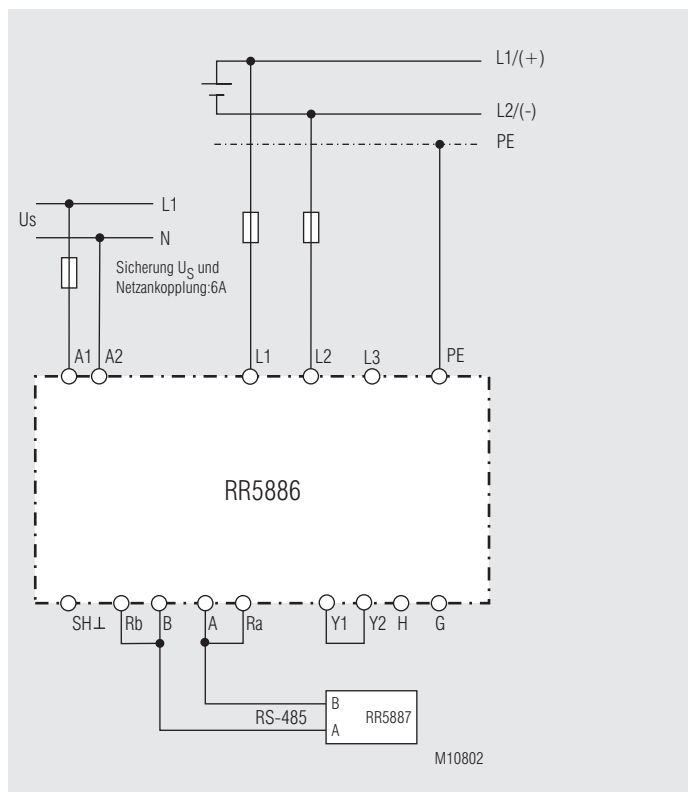


M11061

## Connection Examples

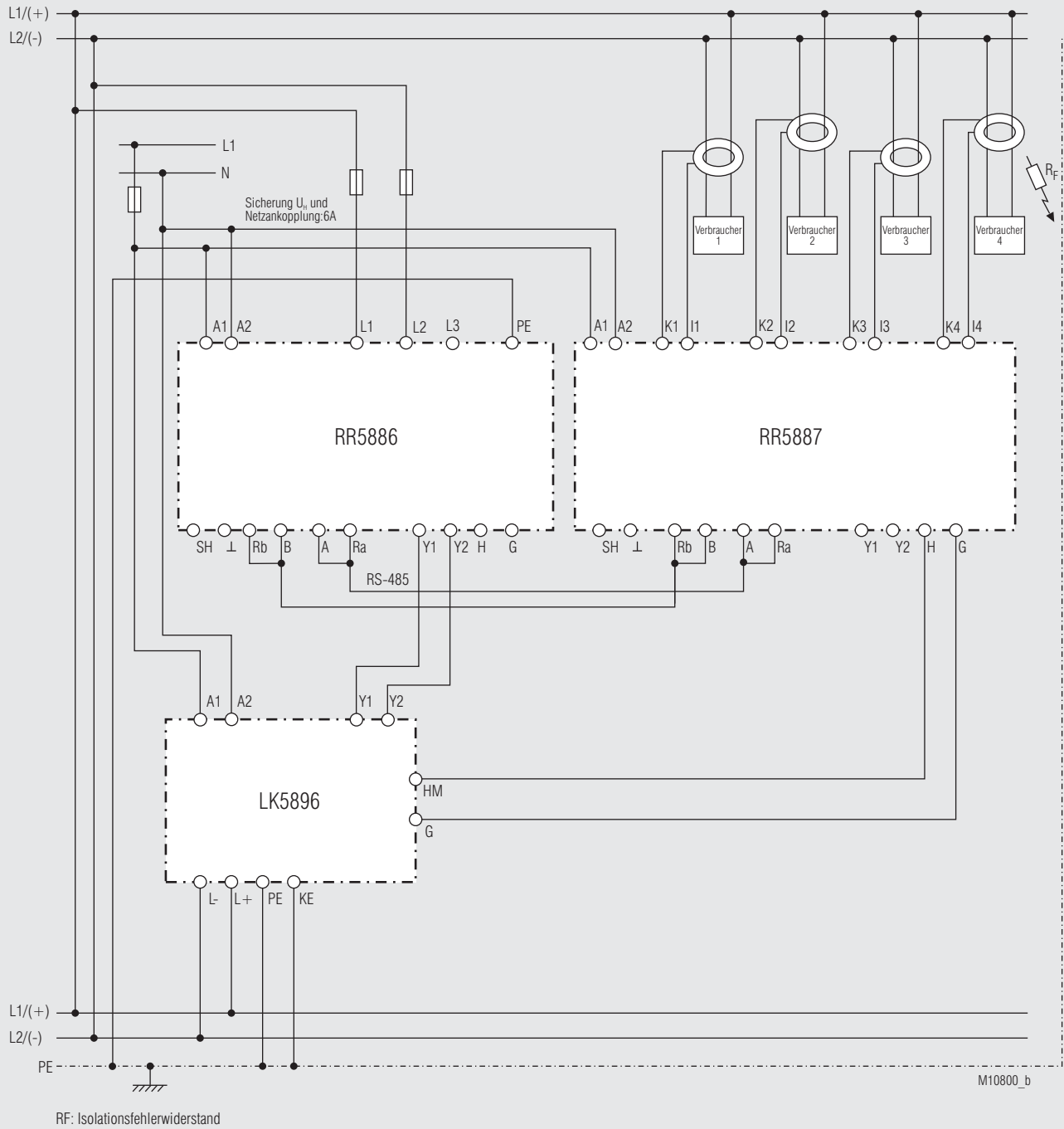


3AC network with manual test current output;  
EDS measuring bus connection without bus termination



AC (DC) network with automatic test current output;  
RR5886 is bus master; bus termination on the device

## Connection Example



Insulation monitoring and insulation fault detection with 4 connected current transformers in a DC/AC network with subdistribution - insulation fault detection can be controlled by the insulation monitor /LK 5896); ALARM MEMORY active, i.e. alarm states are stored; bus termination of the first and last device on the RS-485 bus.

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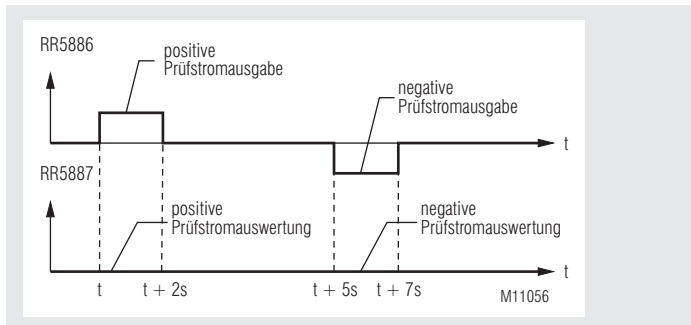


4-channel design

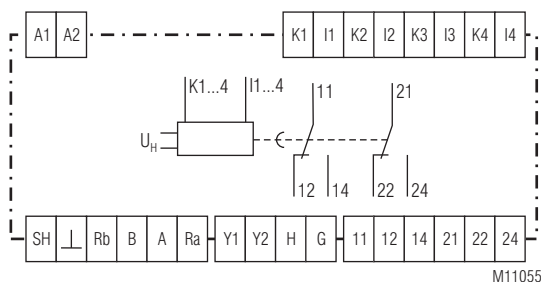
### Product Description

The locating current generator RR 5886 in connection with the insulation fault locator RR 5887 monitors and localises insulation faults in complex AC/DC networks (IT systems). The external current transformers work independently of each other, calibrate themselves and are simply connected to the measuring channels of the insulation fault locator RR 5887. The number of measuring channels is increased by combining several insulation fault locators via a RS-485 bus connection. The search for insulation faults in extensive networks can be refined in this manner. Two different alarm levels facilitate the timely detection of a dangerous insulation state. The devices are operated easily and intuitively thanks to automatic balancing and a clear layout of the setting elements. The early detection and localisation of insulations faults permits their quick and targeted correction. As user you will benefit from the operating reliability and high availability of your system.

### Function Diagram



### Circuit Diagram



### Your Advantages

- Quick correction of insulation faults in complex power networks
- Universal auxiliary voltage range AC/DC 85 ... 265 V
- Easy operation

### Features

- Insulation troubleshooting in DC, AC and mixed IT systems in connection with the locating current injector RR 5886 according to DIN EN 61557-9 (VDE 0413-9):2009 and DIN EN 61557-1 (VDE 0413-1)
- Insulation coordination according to IEC 60664-1
- Connection of max. 4 or 8 differential current transformers depending on the design
- RS-485 bus connection to synchronise the test current output and optionally for the connection to the EDS measuring bus for reading insulation fault currents
- Status output of insulation fault detection via external switching output
- Memory characteristics adjustable via bridge Y1-Y2
- Collective signalling relay to output preliminary warning and alarm states
- Pushbutton for manual reset of alarm states as well as testing of differential current transformers and their calibration
- Terminal connection for the storage of alarm states
- Width: 105 mm

### Approvals and Markings



### Application

- Insulation fault detection in complex AC/DC networks
- Industry, shipbuilding, plant engineering, PV systems
- Quick fault correction of insulation faults in medical facilities

### Indication

- green LED "ON": On, when supply connected
- yellow LED Kanal 1..4: Pre-warning: Display of an insulation fault current > 1 mA in the corresponding channel
- red LED Kanal 1..4: Alarm: Display of an insulation fault current > 5 mA in the corresponding channel
- yellow LED „RS-485“: Indicates RS-485 bus activity and active insulation fault detection

### Connection Terminals

Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage AC or DC
K1..K4/ I1..I4	Current transformer measur. channel
SH, GND, Rb, B, A, Ra	RS-485 Bus (galvanic separation)
Y1, Y2	Switching input Alarm storage
G, H	Status switching output Insulation fault detection
11, 12, 14	Indicator relay prewarning (changeover contact)
21, 22, 24	Indicator relay alarm (changeover contact)





## Notes



### Switching input

The device is equipped with a switching input (terminals Y1, Y2), which can be furnished either with a simple wire bridge or selected actively as digital control input from an external device with max. 24 V DC.

The input is low-active, i.e. when applying a low-level, the function "ALARM MEMORY" is active, otherwise it is inactive.

If the function is active, no prewarning/alarm states are reset following an insulation fault locating cycle. A reset takes place only after pushing the "Alarm reset/ Test/ Transformer calibration" button for at least 2 sec.

Y1  *ALARM MEMORY active*  
Y2  - Alarm states are preserved  
- Manually resettable via pushbutton

Y1  *ALARM MEMORY inactive*  
Y2  - Alarm states are updated after each measuring cycle

## Technical Data

### Auxiliary voltage

#### Nominal voltage range

A1(+) / A2: AC/DC 100 ... 230 V

Voltage range: AC/DC 85 ... 265 V

Nominal consumption: < 3 VA

### Monitored network

Nominal voltage: DC / AC / 3AC 24 ... 360 V

#### Voltage range AC / 3AC

L1/L2/L3: 21 ... 400 V, 40 ... 60 Hz

#### Voltage range DC

L1(+)/L2(-): 21 ... 400 V

#### Rated current range for

insulation test currents: 1 ... 5 mA

Maximum test current output: 6.5 mA

Response sensitivity: 0.5 mA

#### Bus

(galvanic separation): RS-485

### Differential current transformer

Terminals: K1, I1 ... K4, I4

Differential current transformer: ND 5017

Burden: 180 Ω

Rated voltage: 500 V

Rated frequency: 40 ... 60 Hz

Response sensitivity: 0.2 mA

Measuring range: 0.5 ... 10 mA

Number of measuring channel: 4

### Switching input

Terminals: Y1, Y2

Configuration (passive)

Low-level: Bridge set / input low resistance

High-level: Input open / input high-resistance

Configuration (active)

Voltage range (low/high): 0V / 12 ... 24 V

Max. switching current (24 V): 0.5 mA

### Switching output

Terminals: H(+), G(-)

Switching output (passive): transistor outputs

Test current output: Output low resistance  
(minimal 220 Ω via PTC)

No test current output: Output high resistance

Switching voltage max.: 24 V

Switching current max. (24 V): 10 mA

## Technical Data

### RS-485 Bus

Terminals: SH, ⊥, Rb, B, A, Ra

Bus: galvanic separation

Device mode

Bus-Master/Slave: adjustable via rotational switch

Transmission medium: twisted, shielded two-wire line (SH)

Data transmission rate: 115.2 kBit/s

Network termination: Bus termination via bridges Rb, B and Ra, A

### Connection alarm signalling relay

Output: 2 changeover contacts

Nominal voltage: AC/DC 24 ... 240 V

Limiting continuous current

(I<sub>th</sub> max): 2 x 5 A

Switching capacity

to AC 15

NO contact: 3 A / AC 230V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230V IEC/EN 60 947-5-1

Elektrical life

to AC 15

at 3 A, AC 230V: 2 x 10<sup>5</sup> switching cycl. IEC/EN 60 947-5-1

Short circuit strength

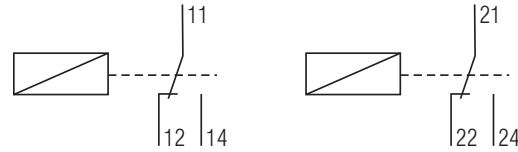
max. fuse rating: 6 A gL IEC/EN 60 947-5-1

Mechanical life: > 20 x 10<sup>6</sup> switching cycles

### Terminal designation relay:

Prewarning:

Alarm:



M11062

### General Data

Nominal operating mode: continuous operation

Temperature range: -20 ... + 60 °C

Clearance and creepage distance

rated impulse voltage/

pollution degree: 4 kV / 3 IEC 60 664-1

EMC

Electro static discharge (ESD): 8 kV (air) IEC/EN 61000-4-2

HF irradiation: 10 V / m IEC/EN 61000-4-3

Fast transients: 2 kV IEC/EN 61000-4-4

Surge voltage

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

Housing: thermoplastic with VO behaviour acc. to UL subject 94

Vibration resistance: Amplitude 0.35 mm

Frequenz 10...55 Hz, IEC/EN 60 068-2-6

20 / 060 / 04

EN 50 005

Wire connection

screw terminals:

fixed

max. 4 mm<sup>2</sup> solid or

2.5 mm<sup>2</sup> stranded wire with sleeve

min. 0.20 mm<sup>2</sup>

clamping screw:

M2.5

Mounting: DIN-rail IEC/EN 60 715

Weight: approx: ca. 225 g

### Dimensions

Width x height x depth: 105 x 90 x 71 mm

## Function

### Switching output

The device is equipped with a transistor switching output (terminals G, H), which is protected by a series-connected PTC (RN = 220 Ω).

In the idle state, the output is high-resistance. During insulation fault detection, the output is low-resistance (RN) and delivers a low-level in conjunction with a series resistor and an external voltage source.

### RS-485 bus connection

The insulation fault locator RR 5887 generally works in slave mode. It synchronises itself independently with the test current output by monitoring the RS485 telegram. All connected insulation fault locators RR 5887 work in parallel and independently from each other.

A bus address can be defined for the device via a rotary switch (RS-485 Bus). If the devices are integrated in an EDS measuring bus system for insulation fault detection, it must be remembered that each insulation fault locator receives its own channel number. An EDS measuring bus master can read insulation fault current values from the connected devices via this channel number.

The bus address of the associated locating current injector RR 5886 can be set via another rotary switch (RR 5886 Channel). A unique reference between a locating current injector and one or several insulation fault locators is established here. This way, several device combinations can be connected jointly to a RS-485 bus and monitor separate networks.

In the absence of an EDS measuring bus connection, the bus address does not have any special significance and be chosen arbitrarily.

The RS-485 LED is permanently on during the insulation fault detection and bus activity and flashes when bus failures occur.

### Influence of discharge capacities

The insulation fault locator is also able to perform reliable measurements under the influence of discharge capacities up to a certain size. The influence of discharge capacities depends on the insulation resistance and the mains voltage. Reliable detection of insulation resistance is ensured up to a discharge capacity of 1 µF.

The lower the mains voltage, the greater the permissible discharge capacity may be. For example, with mains voltages of 50 V, 20µF and more can also be processed without problem.

Insulation fault detection is no longer possible if the influence of the discharge capacities becomes too great. The measuring result may become poorer, in addition, when the discharge capacities are distributed unevenly in the network.

However, the symmetry relationships of the insulation fault resistances themselves do not affect the quality of the measurement.

If insulation faults are present between several conductors and PE, mains compensation currents flow through the insulation fault resistances overlaying the actual insulation fault currents. The measured insulation fault current can be reduced by half here in the extreme case.

### Current transformer calibration

Current transformer calibration is performed after switching on the device or after pushing the "Alarm reset/ Test/ Transformer calibration" push-button to compensate tolerances of the magnetic material of the current transformers and the resulting differences of the magnetic amplification.

### Insulation fault measurement in mixed networks

If an alternating current network, containing a downstream rectifier, is monitored, insulation fault detection can also be performed in the direct voltage circuit if the discharge capacities in this circuit are not too high. Because fault detection can be performed simultaneously in two different network forms – alternating current network and direct current network – the indications displayed for prewarning and alarm are quantitatively valid only for the network form set with the rotary switch. The network form not set will deliver results deviating by the factor 2. However, they can still be analysed in terms of their tendency, i.e. a potential insulation fault is still indicate.

### Insulation fault current display

The locating current injector takes the power for the test current from the monitored network itself. Insulation fault current measurements are nearly identical both for AC and DC networks. However, a difference in the level of the test current is obtained through the network form itself. With AC networks, the test current is only half the value as with DC networks. With 3AC networks, the factor is 0.67. These differences are taken into account when determining the level of the insulation fault current and with the display of the alarm values.

## Indication of alarm- and states

### Indication of alarm states

The display of an alarm state as well as the response of the corresponding common alarm signalling relay act at least for the duration of a measuring cycle (12 sec). The alarm state is cancelled again when the respective threshold of the insulation fault current, under consideration of a defined hysteresis, is fallen below again.

The switching terminal "ALARM MEMORY" must be equipped if the alarm state shall persist permanently.

The response threshold for the insulation fault current does not depend on the network form chosen.

### Prewarning

<b>Response threshold:</b>	1 mA
<b>Indication:</b>	yellow LED continuously on
<b>Common alarm relay:</b>	Collective signalling relay "Prewarning" responds
<b>Hysteresis for return:</b>	0.1 mA
<b>Duration of the alarm state:</b>	Until response threshold if fallen below

### Alarm

<b>Response threshold:</b>	5 mA
<b>Indication:</b>	rote LED leuchtet dauer-rot
<b>Common alarm relay:</b>	Collective signalling relay "Alarm" responds
<b>Hysteresis for return:</b>	0.5 mA
<b>Duration of the alarm state:</b>	Until response threshold if fallen below

### No insulation faults present

<b>Indication:</b>	The yellow LED briefly (200 ms) lights after the measuring cycle has been completed
--------------------	---

### Display of current transformer faults

The insulation fault locator does not feature any control elements for setting the completion of current transformers. For this reason, the device must detect the presence of transformers independently. This happens together with the transformer calibration after switching on the device or after pushing the "Alarm Rest/ Test/ Transformer calibration" button.

The device can detect both, a transformer short circuit and a broken supply line (open transformer contact) individually for each channel.

The check for transformer faults is cyclically repeated after an insulation fault measurement has been completed allowing a transformer fault to be detected also under ongoing operation.

### Short circuit at current transformer

<b>Indication:</b>	red LED flashes
<b>Duration of indication:</b>	Until the short circuit is resolved

Indication detected/interrupted differential current transformer

<b>Indication:</b>	yellow LED flashes
<b>Duration of indication:</b>	Until current transformer test is completed or open current transformer connection is closed again

### Indication of invalid insulation fault measurements

If the value determined for the insulation fault current is invalid, e.g. because of excessive discharge capacities, or the direction of line routing through the current transformer is wrong, this condition is also indicated.

<b>Indication:</b>	yellow LED flashes
<b>Duration of indication:</b>	Until a valid measured value is determined again or the line direction through the transformer was turned around

### Indication of alarm- and function states

#### Summary: Indication of alarm- and function states

Operation	State of transducer	Insulation failure current I <sub>fs</sub>	Indication
Measuring operation	Transducer connection ok	Prewarning: I <sub>fs</sub> > 1 mA	yellow LED continuously on
		Alarm: I <sub>fs</sub> > 5 mA	red LED continuously on
		no Insulation failure: I <sub>fs</sub> < 1 mA	yellow LED Briefly lights at the end of the measuring cycle
		Messwert ungültig	yellow LED flashes
	short circuit at transducer		red LED flashes
	breaking at transducer		yellow LED flashes
	Transducer not connected		No indication
Transducer Test/ calibration	Transducer connection		red LED flashes
	Transducer detected		yellow LED flashes

### Standard Type

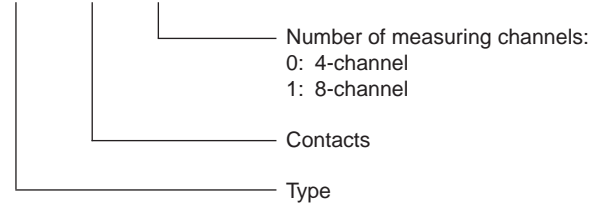
RR 5887.12 AC/DC 85 ... 265 V

Article number: 0065012

- Rated current range for insulation test currents: 1 ... 5 mA
- Maximum test current output: 6.5 mA
- Response sensitivity: 0.5 mA
- Prewarning Hysteresis: 0.1 mA): 1.0 mA
- Alarm (Hysteresis: 0.5 mA): 5.0 mA
- Width: 105 mm

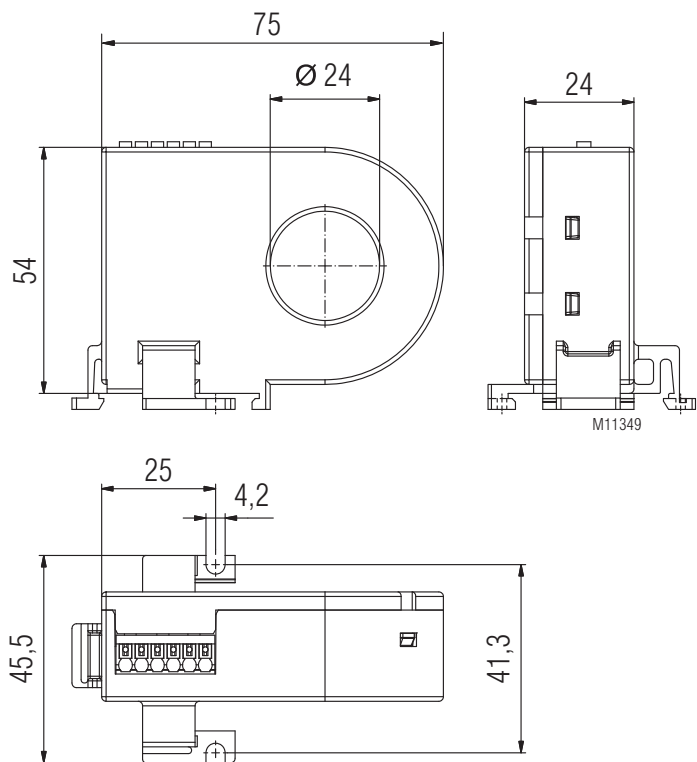
### Ordering example

RR 5887 .12 / 00\_

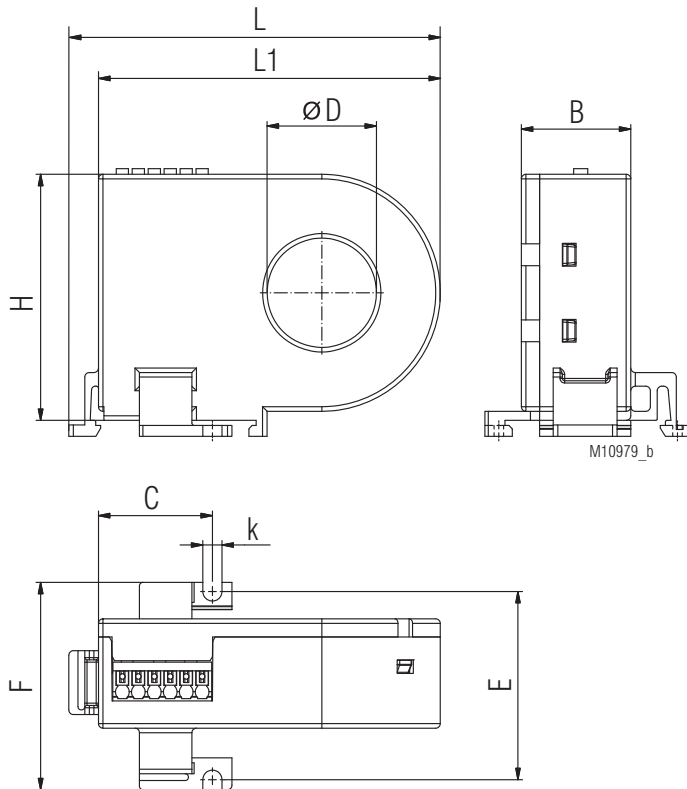


**Residual Current Monitor ND 5017/024**

- The differential current transformer ND5017/024 is designed for DIN rail mounting or screw-type mounting
- Mounting on the top-hat rail may be done horizontally or vertically



**Residual Current Monitor ND 5017/070 (on request)**



for DIN rail mounting or screw mounting

**Technical Data**

<b>Rated voltage:</b>	500 V
<b>Rated nominal voltage:</b>	1 A
<b>Rated transformation ratio:</b>	1 : 3000
<b>Burden:</b>	180 Ω
<b>Rated frequency:</b>	40 ... 65 Hz
<b>Temperature range:</b>	-20 ... + 60 °C
<b>Rated impulse voltage/ pollution degree:</b>	4 kV / 3
<b>Housing:</b>	thermoplastic with VO behaviour acc. to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10...55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04
<b>Climate resistance:</b>	
<b>Wire connection</b>	
Single wire	up to 1 m
≥ 0.75 mm <sup>2</sup> :	up to 10 m
≥ 0.75 mm <sup>2</sup> twisted:	up to 25 m
Cable shield ≥ 0.5 mm <sup>2</sup> :	(Shield on one side on I-conductor and not to be earthed)
<b>DIN rail mounting:</b>	integrated clips for vertical and horizontal mounting
<b>Screw fixing:</b>	M3 or M4
<b>Fixing torque:</b>	max. 0.8 Nm
<b>Weight:</b>	97 g

**Dimensions**

**Width x height x depth:** 105 x 90 x 71 mm

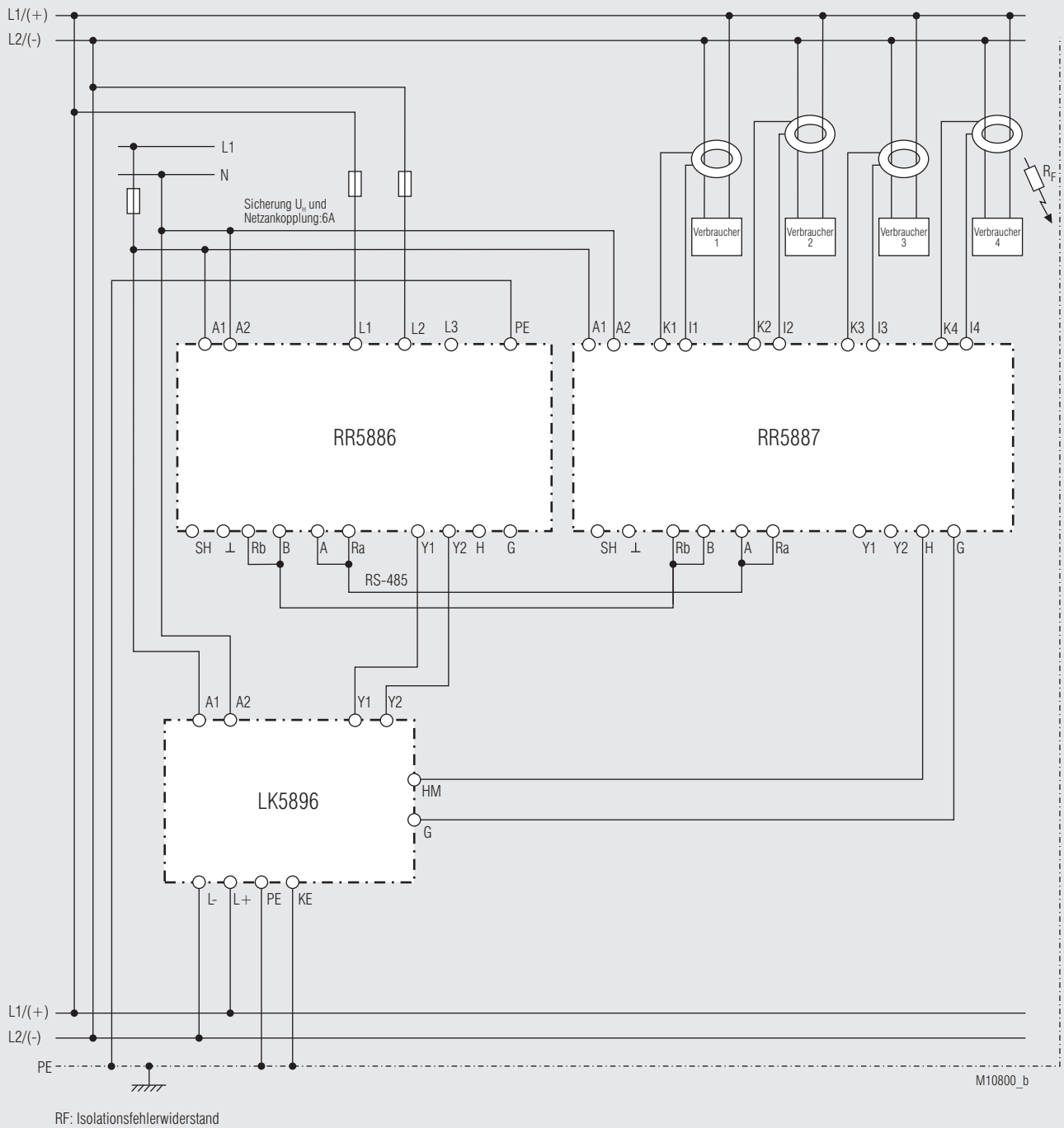
ND 5017/070	øD	L	H	H1	B	C	F	k	E	G
Dimensions/mm	70	111	110	115	32	37	55	4,2	50*	74*
Weight / g	approx. 220									

\*) Drill tolerance for screw mounting: ± 0.5 mm

**Mounting instructions for screw mounting**

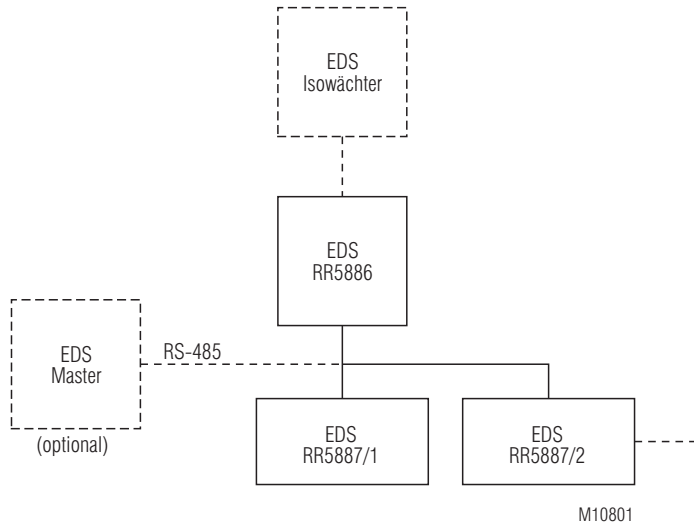
High forces when mounting may damage the current transformer fixtures. The fixing clips are designed to support the current transformer. Forces that are applied by the cable running through the current transformer can only be tolerated within limitations. During installation and afterwards please make sure that the wires are led through the current transformer without applying pressure and remain stable in that position.

## Connection Example



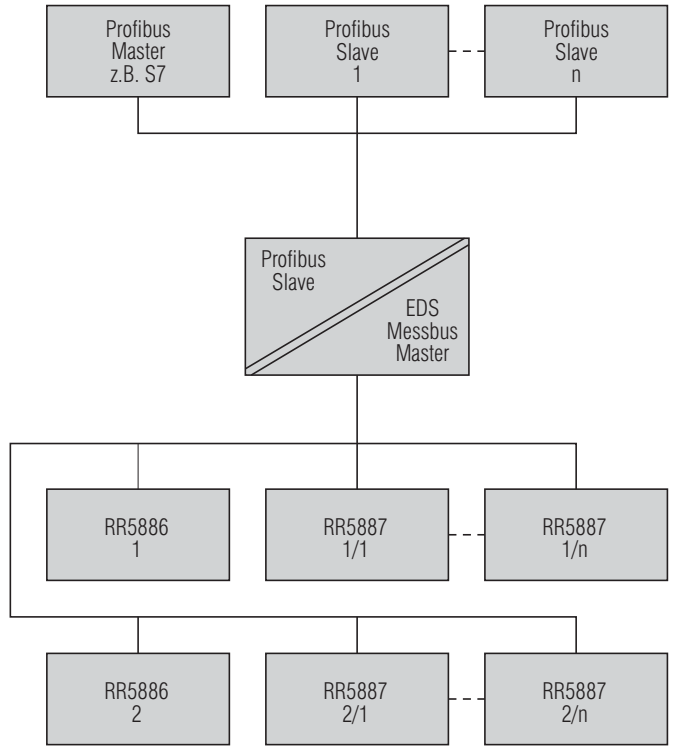
Insulation monitoring and insulation fault detection with 4 connected differential current transformers in a DC/AC network with subdistribution - insulation fault detection can be controlled by the insulation monitor /LK 5896); ALARM MEMORY active, i.e. alarm states are stored; bus termination of the first and last device on the RS-485 bus.

## System overview



- Insulation fault detection in DC / AC / 3AC IT networks in connection with the locating current injector RR 5886
- External selection via an insulation monitoring device possible

## Connection to measuring bus /Profibus gateway



## VARIMETER RCM Residual Current Monitor IL 5882, SL 5882, IR 5882



0239971



IL 5882



IR 5882  
with internal  
residual current transformer



ND 5016/024



ND 5016/035



ND 5016/070

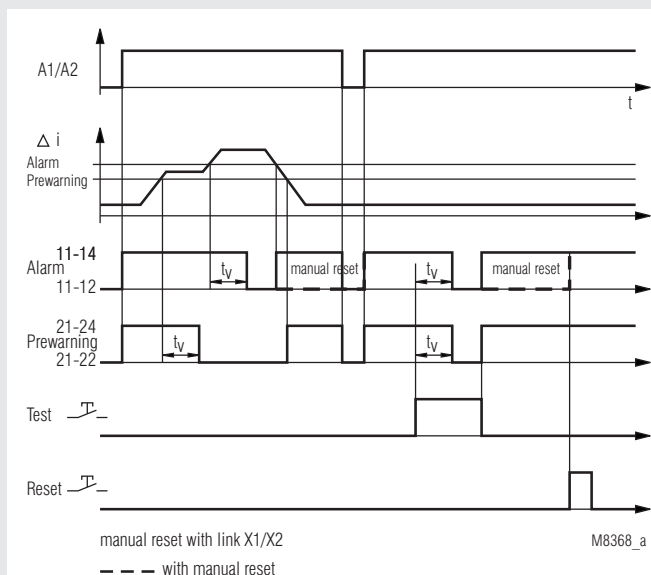
### Your advantages

- Preventive fire and system protection
- Increasing the availability of plants by early fault detection
- As option with external or internal residual current transformer
- Protection against manipulation by sealable transparent cover over setting switches

### Features

- According to IEC/EN 62 020
- for AC and pulsating DC currents Type A to IEC/TR 60755
- 9 tripping values from 10 mA to 10 A or from 10 mA ... 30 A
- Frequency range 20 ... 2000 Hz
- Selection of manual or automatic reset
- With prewarning
- With test and reset button
- Broken wire detection
- Short reaction time
- With adjustable delay  $t_d$
- De-energized on trip
- LED indication for auxiliary supply and state of contact
- 2 x 1 changeover contact
- Devices available in 3 enclosure versions:
  - IL 5882: 63 mm deep with terminals near to the bottom to be mounted in consumer units or industrial distribution systems according to DIN 43 880
    - width 35 mm
    - for connection of external residual current transformer, e. g. DOLD ND 5016, ND5019
  - SL 5882: 100 mm deep with terminals near to the top to be mounted in cabinets with mounting plate and cable ducts
    - width 35 mm
    - for connection of external residual current transformer, e. g. DOLD ND 5016, ND5019
  - IR 5882: 63 mm deep with terminals near to the bottom to be mounted in consumer units or industrial distribution systems according to DIN 43 88
    - width 105 mm
    - with internal residual current transformer

### Function Diagram



### Approvals and Markings



### Application

Detection of insulation faults in grounded voltage systems. The residual current relay is used to maintain electrical plants before faults occur. Decrease in insulation can be detected and indicated early without interruption of operation.

## Function

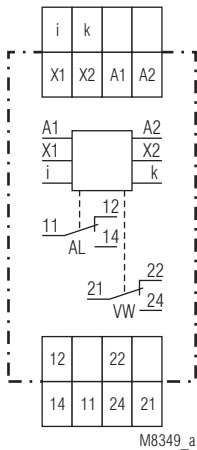
The function of the IL/SL 5882 and IR 5882 can be compared to a fault current circuit breaker unit. It detects and indicates residual currents, but does not disconnect.

The measurement is done by an external residual current transformer e.g. ND 5016 which is connected via terminals i and k to the IL/SL 5882. At the device IR 5882 the residual current transformer is integrated. All conductors of the voltage system to be monitored are run through the CT except the ground wire. In a fault free voltage system the sum of all current is 0 and the CT induces no secondary voltage. If due to an insulation fault a fault current flows to ground, the current difference in the CT creates a measuring current, which is detected and measured by the IL/SL 5882 or IR 5882. A broken wire in the sensing circuit would disable the measurement, therefore a special circuit detects broken wire and forces the unit to trip.

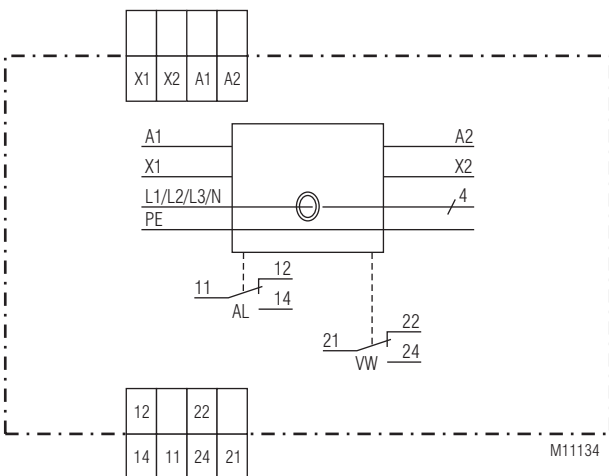
The unit has 2 x 1 changeover contacts. Contact 11-12-14 for alarm (AL) and 21-22-24 for prewarning (VW). Prewarning is detected at 70 % of the selected alarm value. With external bridge X1-X2 the alarm is stored and has to be reset by pressing the reset button or by disconnecting the auxiliary supply. Without bridge X1-X2 the unit works with auto-reset and the fault is not stored. With the button "Test" a fault can be simulated (Alarm). Each contact is delayed with an adjustable time delay  $t_v$  (same delay time for alarm and pre-warning).

To avoid unauthorised adjustment of the potentiometers the unit has a transparent cover that could be sealed with laquer. Two holes above the push buttons allow activation of test and reset.

## Circuit Diagrams



IL /SL 5882



IR 5882

## Connection terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
i, k (only at IL/SL 5882)	Conn. f. external current transformer ND5016, ND5019 ; terminals i, k
X1, X2	control input X1/X2 bridged: with manual reset of alarm X1/X2 not bridged: without manual reset of alarm (Hysteresis function)
11, 12, 14	1. C/O contact (Alarm)
21, 22, 24	1. C/O contact (Pre-warning)

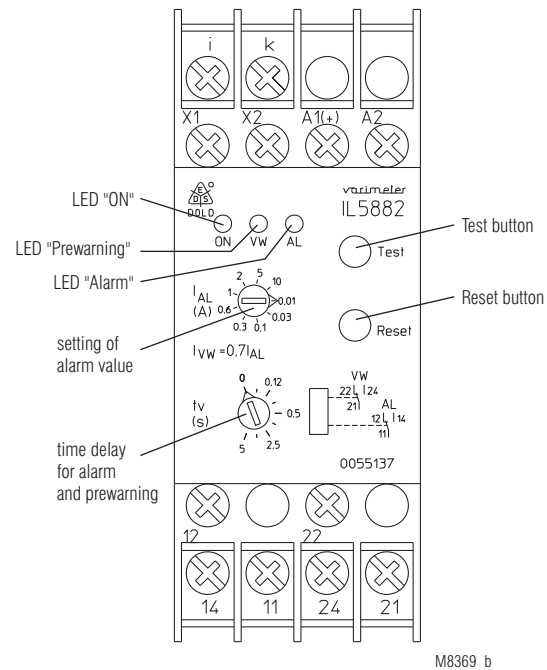
## Indication

green LED "ON": on, when supply connected  
red LEDs "VW", "AL": on, when insulation failure (prewarning and alarm)

## Note

If time is set to 0 and a pulsating fault current is flowing (e.g. 1-way rectified) the output relay may flicker because of the short reaction time. By increasing the time delay this effect can be avoided.

## Setting





## Technical Data

### Input

<b>Auxiliary voltage <math>U_H</math>:</b>	AC/DC 12 V, AC/DC 24 ... 230 V
<b>Voltage range:</b>	
AC:	0.8 ... 1.1 $U_N$
DC:	0.9 ... 1.25 $U_N$
<b>Nominal frequency <math>U_H</math>:</b>	50 ... 400 Hz
<b>Nominal consumption</b>	
AC 230 V:	4 VA
AC 24 V:	1.6 VA
DC 24 V:	1 W
<b>Measuring value adjustable via rotational switch:</b>	AC 0.01; 0.03 A; 0.1 A; 0.3 A; 0.6 A 1 A; 2 A; 5 A; 10 A or AC 0.01 A, 0.03 A; 0.1 A; 0.3 A; 0.6 A 1 A; 2 A; 7 A; 30 A
<b>Frequency range:</b>	20 Hz ... 2 kHz at failure current < 50 Hz and the function "auto reset", a time delay must be adjusted, so that the relay does not buzz before switching approx. 4% of trip value, fixed
<b>Hysteresis:</b>	$\leq 0$ ... -30 %
<b>Accuracy:</b>	$\leq \pm 1$ %
<b>Repeat accuracy:</b>	$\leq \pm 0.05$ % / K
<b>Temperature drift:</b>	10 ... 40 ms
<b>Reaction time:</b>	0 ... 5 s adjustable (logarithmic scale in order to allow also short time delay to be adjusted without problems)
<b>Response delay <math>t_v</math>:</b>	

### Output

<b>Contacts:</b>	
IL / SL / IR 5882.38:	1 changeover contact for Prewarning, 1 changeover contact for Alarm
<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity</b>	
to AC 15:	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
to DC 13:	
NO contact:	2 A / DC 24 V IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V:	3 x 10 <sup>5</sup> switching cycles EN 60 947-5-1
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 10^8$ switching cycles

### General Data

<b>Operating mode:</b>	Continuous
<b>Temperature range</b>	
Operation:	- 20 ... + 60°C
Storage:	- 25 ... + 70°C
<b>Altitude:</b>	< 2.000 m
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree supply / contacts:	4 kV / 2 IEC 60 664-1
supply / Measuring Circuit:	corresponding to CT
<b>EMC</b>	
Surge voltages:	class 3 (5 kV / 0.5 J) DIN VDE 0435-303
HF-interference:	class 3 (2.5 kV) DIN VDE 0435-303
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	IEC/EN 61 000-4-3, EN 50 121-3-2
80 MHz ... 1 GHz:	20 V / m
1 GHz ... 2,7 GHz:	10 V / m
Fast transients:	4 kV (class 4) IEC/EN 61 000-4-4
Surge voltages:	1 kV (class 3) IEC/EN 61 000-4-5
HF wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0-behaviour according UL subject 94

## Technical Data

<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6 20 / 060 / 03 IEC/EN 60 068-1 EN 50 005
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight</b>	
IL 5882:	approx. 125 g
SL 5882:	approx. 150 g
IR 5882:	approx. 300 g

### Dimensions

<b>Width x height x depth:</b>	
IL 5882:	35 x 90 x 63 mm
SL 5882:	35 x 90 x 100 mm
IR 5882:	105 x 90 x 63 mm (inner diameter current transformer: 21.5 mm or 28 mm)

### Standard Types

IL 5882.38 AC/DC 24 ... 230 V 50 / 60 Hz 10 A 5 s
Article number: 0055138
• De-energized on trip
• Auxiliary voltage $U_i$ : AC/DC 24 ... 230 V
• Measuring range: 10 A
• Response delay $t_v$ : 5 s
• Width: 35 mm

SL 5882.38 AC/DC 24 ... 230 V 50 / 60 Hz 10 A 5 s
Article number: 0055515
• De-energized on trip
• Auxiliary voltage $U_i$ : AC/DC 24 ... 230 V
• Measuring range: 10 A
• Response delay $t_v$ : 5 s
• Width: 35 mm

IR 5882.38 AC/DC 24 ... 230 V 50 / 60 Hz 10 A 5 s
Article number: 0066743
• Internal residual current transformer ( $\varnothing$ 28 mm)
• De-energized on trip
• Auxiliary voltage $U_i$ : AC/DC 24 ... 230 V
• Measuring range: 10 A
• Response delay $t_v$ : 5 s
• Width: 105 mm

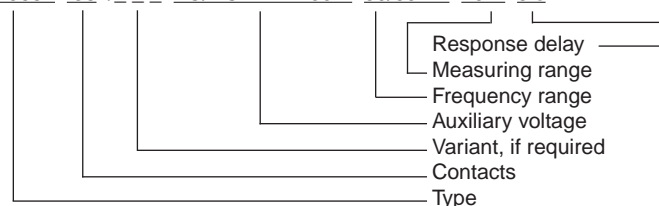
ND 5016/024
Article number: 0066009
• Residual current transformer for IL/SL 5882
• Diameter: 24 mm
• DIN-rail mounting: waagrecht oder senkrecht
• Screw mounting: M4

### Variant

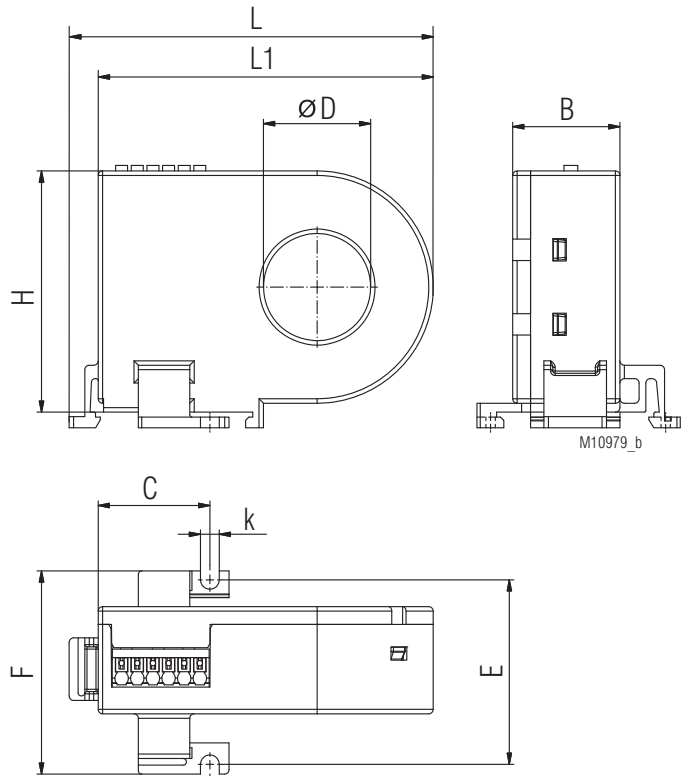
IL 5882.12/002:	with 2 changeover contacts for alarm and no pre-warning
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### Ordering example for variant

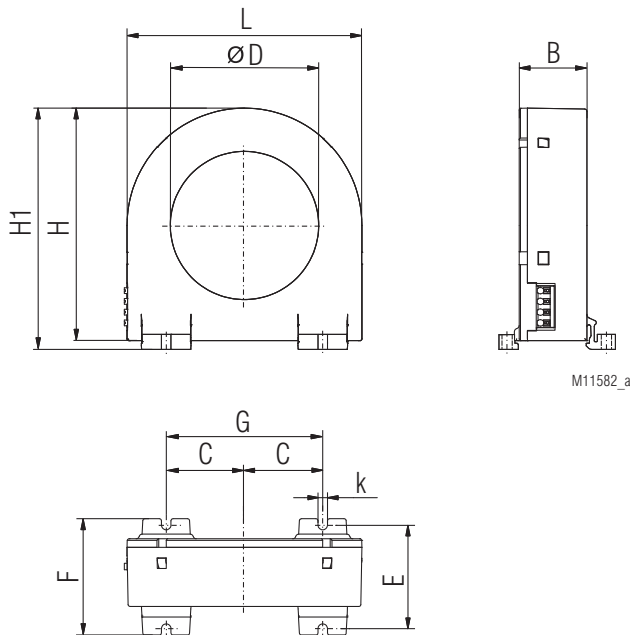
IL 5882 .38 / \_ \_ \_ AC/DC 24 ... 230 V 50/60 Hz 10 A 5 s



Residual Current Transformer ND 5016/024, ND 5016/035



Residual Current Transformer ND 5016/070



for DIN rail mounting or screw mounting

ND 5016/024	øD	L	L1	B	H	C	E	F	k
Dimension/mm	24	82	75	24	54	25	42*	46	4,2
Weight / g	approx. 80								

ND 5016/035	øD	L	L1	B	H	C	E	F	k
Dimension/mm	35	88	81	24	67	25	42*	46	4,2
Weight / g	approx. 90								

\*) Drill tolerance for screw mounting: ± 0.5 mm

for DIN rail mounting or screw mounting

ND 5016/070	øD	L	H	H1	B	C	F	k	E	G
Dimension/mm	70	111	110	115	32	37	55	4,2	50*	74*
Weight / g	approx. 220									

\*) Drill tolerance for screw mounting: ± 0.5 mm

Technical Data Residual Current Transformer ND 5016, ND 5018

Ambient temperature

ND 5016: - 20 ... + 60°C / 253 K ... 333 K  
 ND 5019: - 10 ... + 50°C / 263 K ... 323 K

Inflammability class:

V0 according to UL94

Nominal insulation voltage

acc. to IEC 60 664-1: AC 630 V

Rated impulse voltage /

pollution degree: 6 kV/3

Voltage test acc. to

IEC/EN 60 255: AC 3 kV

Transformation ratio:

500 /1

Length of connection wires

Type of wire:

Single wire: up to 1 m  
 Single wire Twisted pair: up to 10 m  
 Screened wire;  
 screen on terminal k: up to 25 m

Wire cross section

ND 5016: 0.2 ... 1.5 mm<sup>2</sup>  
 ND 5019: 0.75 mm<sup>2</sup>

Stripping length:

8 mm

Wire fixing

ND 5016: Terminals with spring connection and direct (Push in) technology  
 ND 5019: Box terminals

Screw connection:

ND 5016: M3 or M4  
 ND 5019: M5

Fixing torque:

0.8 Nm

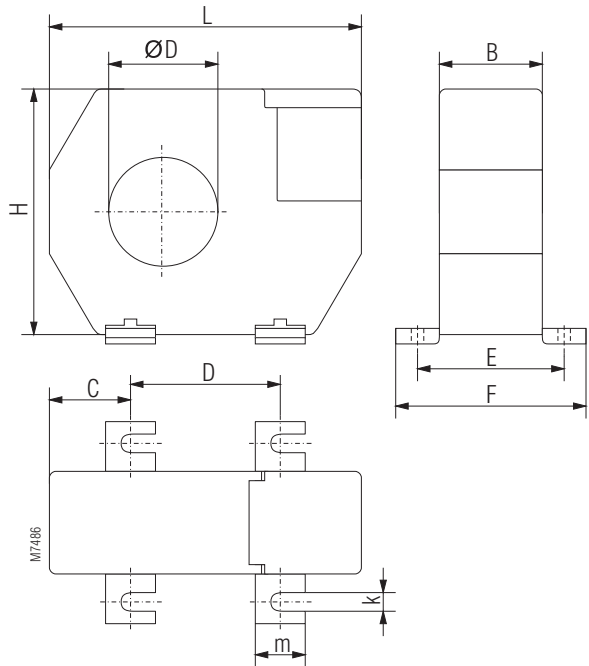
DIN rail mounting:

ND 5016/024, /035: integrated clips for vertical and horizontal mounting  
 ND 5016/070: integrated clips for horizontal mounting  
 ND 5019: using mounting adapter ET 5018

Mounting instructions for screw mounting

High forces when mounting may damage the current transformer fixtures. The fixing clips are designed to support the current transformer. Forces that are applied by the cable running through the current transformer can only be tolerated within limitations. During installation and afterwards please make sure that the wires are led through the current transformer without applying pressure and remain stable in that position.

Residual Current Transformer ND 5019

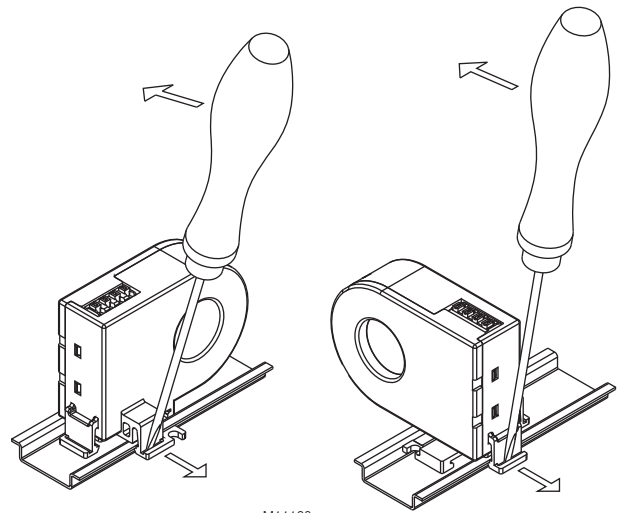
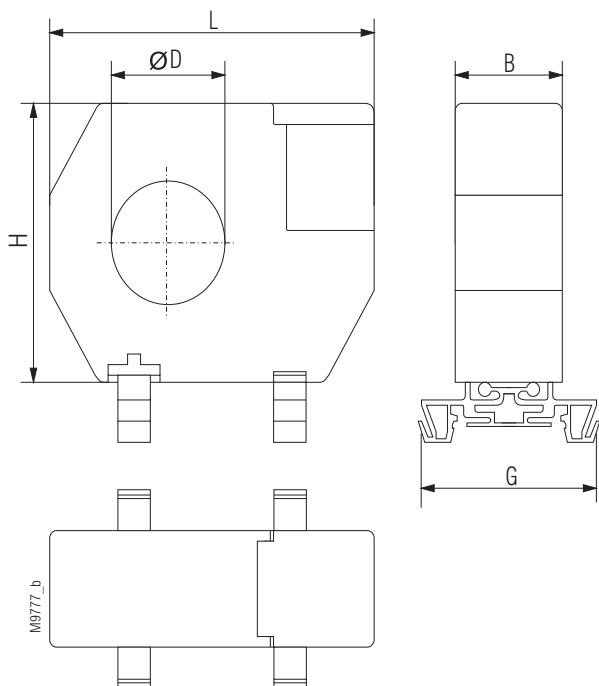


for Screw connection

Dimensions in mm	
	ND 5019/105
Art-Nr.	0055118
øD	105
L	170
B	33
H	146
C	38
D	94
E	46
F	61
k	6,5
m	16

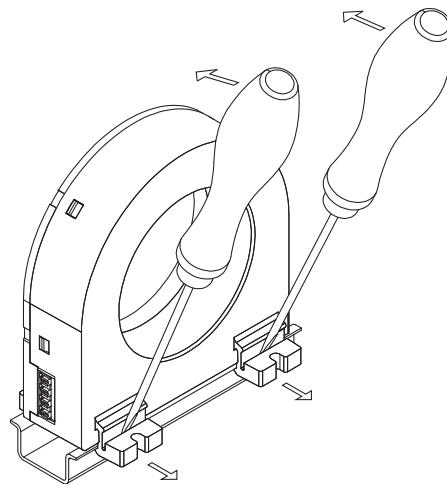
Weight	
	ND 5019/105
kg	0,5

The residual current transformer ND 5019/105 can also be mounted on DIN-rail. To do this the metal screw fixings have to be removed and have to be replaced by 2 mounting clips (ET5018: art.no. 0058754; set with 2 pcs)



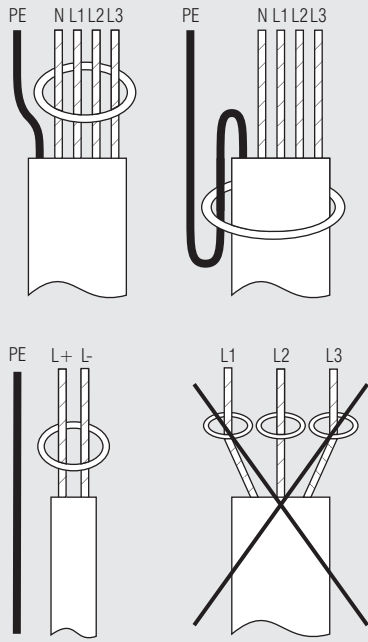
M11123

Disassembling ND 5016/070



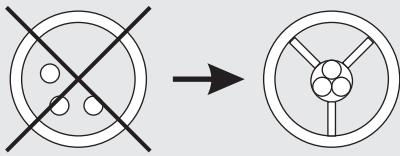
M11583

## Installation of Wires



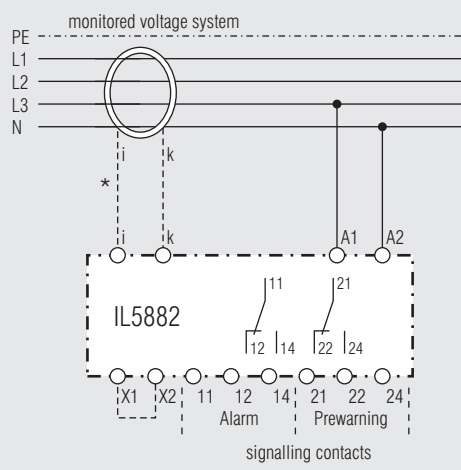
M8362\_a

## To Avoid Interference with High Starting Currents



M8363

## Connection Example



X1-X2 open : automatic reset  
X1-X2 closed : manual reset

M8370\_c

\* only IL5882, SL5882



### Attention:

As the auxiliary supply has no galvanic separation, the secondary circuit of the CT must not be connected to ground. A ground connection will lead to a damage of the unit!

## VARIMETER RCM

Residual Current Monitor, Type B for AC and DC Systems  
RN 5883



0272374

### Your Advantage

- Preventive fire and system protection
- Increasing the availability of plants by early fault detection
- Universal usage at AC/DC mains
- Protection against manipulation by sealable transparent cover over setting switches

### Features

- According to IEC/EN 62 020, VDE 0663
- For AC and DC systems Type B, according to IEC/TR 60755
- To detect earth faults in grounded voltage systems
- 4 setting ranges from 10 mA to 3 A
- Manual reset, with alarm and pre-warning
- With adjustable switching delay
- Energized or de-energized on trip
- LED indicator for operation, pre-alarm and alarm
- With test function
- LED-chain indicates fault current
- As option with analogue output
- Broken wire detection
- Width: 52.5 mm

### Product Description

The AC/DC sensitive residual current monitor RN 5883 allows an early detection of insulation faults and detects differential currents with AC as well as DC components in grounded voltage systems (type B). The measurement takes place via an external current transformer.

Contrary to an RCD the residual current monitor RN 5883 does not disconnect the mains when detecting a fault but only indicates it. Besides the easy to read LED chain indicating the actual current several LEDs display operation, pre-alarm and alarm. The 4 measuring ranges cover 10 to 3 A. Additional features are broken wire detection, test function and adjustable pre-alarm.

The residual current monitor RN5883 provides early information for precise and cost effective maintenance before the plant stops.

### Approvals and Markings

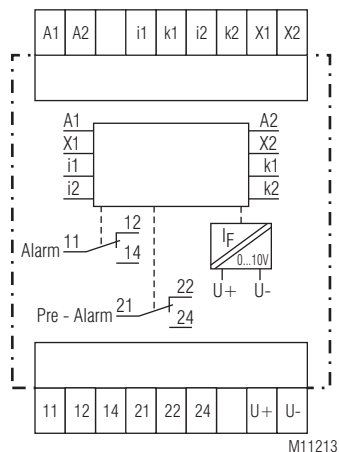


<sup>1)</sup> RN 5883 Variant /61; <sup>2)</sup> ND 5015

### Application

The residual current monitor type B is designed to monitor DC systems and AC systems up to 250 Hz.

### Circuit Diagram



M11213

### Indication

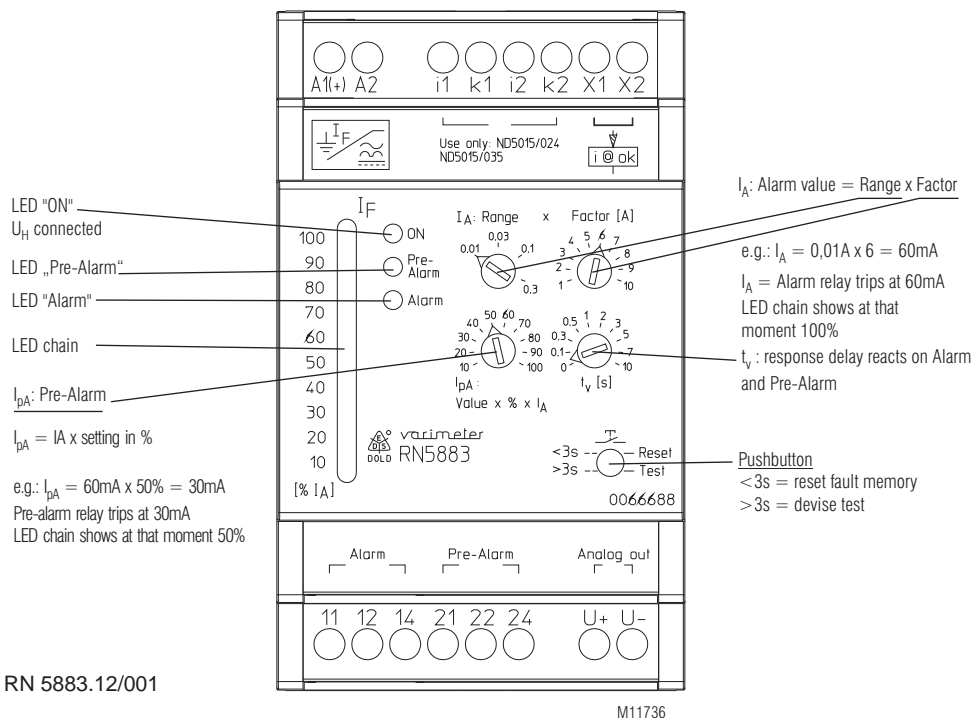
- green LED „ON“: On, when auxiliary supply connected
- yellow LED „Pre-Alarm“: Flashes during time delay  $t_v$   
On, when pre-alarm active
- red LED „Alarm“: Flashes during time delay  $t_v$   
On, when alarm active
- yellow and red LED: Flashes on broken wire or extremely high input signal
- yellow LED-chain: LED chain indicates fault current in % of adjusted alarm value

### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage $U_H$
i1, k1, i2, k2	Connection of an external residual current transformer
X1, X2	Parameterization input energized or de-energized on trip
11, 12, 14	Contacts alarm signal
21, 22, 24	Contacts pre-alarm signal
U-, U+	Analogue output (option)

### Notes

The devices measure AC and DC current (AC / DC sensitive). Due to the measurement principle they also detect magnetic fields in the next to the current transformer.  
When planning a panel with AC/DC sensitive residual current monitors please make sure that no components are placed next to the CT that create a magnetic field, e.g. contactors, transformers etc.  
If an influence is detected, also a rotation of the CT by 90° could positively reduce the influence.



It is of advantage to keep the range small and the Factor high.  
Example: Setting 300 mA: Range 0,1 x Factor 3 = 300 mA

### Function

The Measuring circuit includes an external residual current transformer. All conductors of a voltage system are fed through the transformer except the ground wire. In a healthy system the sum of all flowing currents is zero, so that no voltage is induced in the CT. If an earth fault occurs, sourcing a current flowing to ground, the current difference induces a current in the CT that is detected by the RN 5883.

If an earth fault occurs, sourcing a current flowing to ground, the current difference induces a current in the CT that is detected by the RP 5883.

On broken sensor wires and broken CT coils the unit goes into alarm state and the LEDs for pre-alarm (yellow) and alarm (red) flashes.

The unit has 2 changeover output contacts. One for alarm 11, 12, 14 and 21, 22, 24 and one for pre-alarm.

4 Setting Ranges can be selected from 10 mA to 3 A. The fine adjustment is made via potentiometer „Factor“  
Measuring range = Range x Factor.  
The alarm relay switches at 100 % of the adjusted response value.

The pre-alarm can be set in 10% steps between 10 and 100% of the alarm value.

Potentiometer t<sub>v</sub> sets the switching delay between 0 and 10 seconds. The delay reacts on pre-alarm and alarm.

The different CT sizes require a correct adaption of the residual current monitor. 3 models are available:

Type	Suitable residual current transformer	Frequeny range
RN 5883.12/61	ND 5015/024 ND 5015/035	DC + AC up to 250 Hz
RN 5883.12/010/61	ND 5015/070	DC + AC up to 180 Hz
RN 5883.12/020	ND 5018/105 ND 5018/140 ND 5018/210	DC + AC up to 60 Hz

An external link on X1-X2 allows the change between energized and de-energized on trip. A change of the function will only be valid after interruption of the supply voltage.

Terminal X1 / X2: external link = De-energized on trip,  
open = Energized on trip

De-energized on trip: In the case of groundfault or missing auxiliary supply the relays are de-energized, the NC contacts 11/12; 21/22 are closed

In fault free state the relays are energized, the NO contacts 11/14; 21/24 are closed

Energized on trip: In the case of groundfault the relays are energized, the NO contacts 11/14; 21/24 are closed  
in fault free state the relays are de-energized, the NC contacts 11/12; 21/22 are closed

If an adjusted value is reached on the measuring input (alarm or pre-warning) at the standard type RN 5883 the signal is stored. Reset is made by pressing the button „Test/Reset“ for < 3 s or by disconnecting the auxiliary supply (approx. 30 s).

If the „Test/Reset“ button is pressed for > 3 s, a test of the unit is made. The time delays run, the pre-warning and alarm is activated.

An LED chain shows the fault current between 10 and 100 % of the adjusted alarm value.

An analogue output 0 ... 10 V indicates also the fault current. 10 V corresponds to 100 % of the adjusted alarm value.

Technical Data	
<b>Input</b>	
<b>Auxiliary voltage <math>U_H</math>:</b>	AC/DC 24 ... 80 V, AC/DC 80 ... 230 V
<b>Voltage range</b>	
at $U_H = AC/DC 24 \dots 80 V$ :	DC 19 ... 110 V, AC 19 ... 90 V,
at $U_H = AC/DC 80 \dots 230 V$ :	DC 64 ... 300 V, AC 64 ... 265 V
<b>Nominal frequency <math>U_H</math>:</b>	AC 50 / 60 Hz
<b>Nominal consumption</b>	
at AC:	5 VA
at DC:	2.5 W
<b>Measuring range:</b>	10 ... 100 mA, 30 ... 300 mA, 100 ... 1000 mA, 300 ... 3000 mA (3 ... 30 mA on request)
<b>Measuring range fine adjustment:</b>	1 ... 10
<b>Überlastbarkeit:</b>	with overload protection
<b>Alarm:</b>	100 % of the adjusted measuring range
<b>Pre-alarm:</b>	10, 20, 30, 40, 50, 60, 70, 80, 90, 100 % of the adjusted alarm value
<b>Frequency range:</b>	DC and AC to 250 Hz
<b>Repeat accuracy:</b>	$\leq \pm 3 \%$
<b>Temperature drift:</b>	$\leq \pm 0.1 \%$ / K
<b>Reaction time:</b>	200 ms
<b>Switching delay</b>	
<b>Pre-alarm / alarm:</b>	0 ... 10 s

Output	
<b>Contacts:</b>	1 changeover contact for pre-alarm, 1 changeover contact for alarm
<b>Thermal current <math>I_{th}</math></b>	
up to 30 °C:	5 A
up to 40 °C:	4 A
up to 60 °C:	2 A
<b>Switching capacity</b>	
at AC 15:	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V:	3 x 10 <sup>6</sup> switch. cycl. IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 10^8$ switching cycles

Analogue Output (option)	
<b>Terminal <math>U_+</math> / <math>U_-</math>:</b>	0 ... 10 V; 5 mA variant RN 5883/_ _1 Screened wire; screen one end grounded at device to PE

General Data	
<b>Operating mode:</b>	Continuous
<b>Temperature range</b>	
Operation:	- 40 ... + 60°C - 20 ... + 60°C (variant /_1_ and /_2_)
Storage:	- 40 ... + 70°C
<b>Altitude:</b>	< 2,000 m
<b>Insulation coordination according to IEC 60664-1:</b>	
RN 5883 connected with current transformer ND 5015, ND 5018	
Rated impuls voltage / pollution degree:	
Auxiliary voltage / Meas. circuit:	6 kV / 2
Auxiliary voltage / Contacts:	6 kV / 2
Auxiliary voltage / Analoge output:	6 kV / 2
Contacts / Analoge output:	6 kV / 2
Meas. circuit / Analoge output:	6 kV / 2
Contacts 11,12,14 / 21, 22, 24:	4 kV / 2
<b>EMC</b>	
Surge voltages:	Class 3 (5 kV / 0.5 J) DIN VDE 0435-303
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 2,7 GHz:	20 V / m (class 3) IEC/EN 61 000-4-3
HF-wire guided:	10 V (class 3) IEC/EN 61 000-4-6
Fast transients:	2 kV (class 3) IEC/EN 61 000-4-4
Surge voltages:	1 kV class 3 IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011

Technical Data	
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0-behaviour according UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6 40 / 60 / 03 IEC/EN 60 068-1
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4
<b>Fixed screw terminals</b>	
Cross section:	0.5 ... 4 mm <sup>2</sup> (AWG 20 - 10) solid or 0.5 ... 4 mm <sup>2</sup> (AWG 20 - 10) stranded wire without ferrules 0.5 ... 2.5 mm <sup>2</sup> (AWG 20 - 10) stranded wire with ferrules
Stripping length:	6.5 mm
<b>Wire fixing:</b>	Cross-head screw / M3 box terminals
<b>Fixing torque:</b>	0.5 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	approx. 160 g
<b>Dimensions</b>	
<b>Width x height x depth:</b>	52.5 x 90 x 71 mm

### UL-Data RN 5883

These devices only monitor residual currents and are not intended to be used as Ground Fault Circuit Interrupter (GFCI) in accordance with UL1053 / UL943.

These devices have been investigated to be used with external differential current transformers manufactured by E. Dold & Söhne KG, Cat. Nos. ND5015/024/61, ND5015/035/61 or ND5015/070/61.

<b>Supply voltage <math>U_N</math>:</b>	AC/DC 24-80V single or double phase 50/60 Hz; AC/DC 80-230V single or double phase 50/60 Hz
---	--

<b>Switching capacity relays</b>	
Ambient temperature 30°C:	5A, 250Vac G.P. 250 Vac, 2A pilot duty 250 Vac, 1/2hp

Ambient temperature 40°C:	4A, 250Vac G.P. 250 Vac, 2A pilot duty 250 Vac, 1/2hp
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Ambient temperature 60°C:	2A, 250Vac G.P.
---------------------------	-----------------

<b>Analogue output</b> (only at variant/_1):	0 .. 10V, 5mA
---	---------------

Max. measuring frequency:	DC, AC (0 – 250Hz)
---------------------------	--------------------

<b>Wire connection:</b>	AWG 20 - 12 60°C / 75°C copper conductors only
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Technical data that is not stated in the UL-Data, can be found in the technical data section.

### Standard Type

RN 5883.12/61 AC/DC 80 ... 230 V 50 / 60 Hz

Article number: 0066451

- For residual current transformer ND 5015/024 and ND 5018/035
- Alarm und Pre-alarm
- Energized or de-energized on trip
- Without analogue output
- Auxiliary voltage  $U_{\text{A}}$ : AC/DC 80 ... 230 V
- Width: 52.5 mm

ND 5015/035/61

Article number: 0066841

- Residual current transformer for RN 5883
- Diameter: 35 mm

### Variants

**For residual current transformer ND5015/024 und ND5015/035:**

RN 5883.12/001/61: With analogue output 0 ... 10 V

RN 5883.12/800/61: Fixed values, without analogue output

RN 5883.12/802/61: Fixed values, without analogue output;  
with bridge on X1/X2:  
- Alarm: Energized on trip  
- Pre-alarm: De-energized on trip  
without bridge:  
- Alarm: De-energized on trip  
- Pre-alarm: Energized on trip

**Für residual current transformer ND5015/070:**

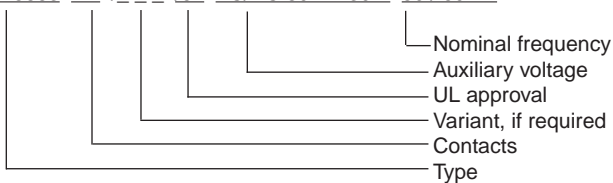
RN 5883.12/011/61: with analogue output 0 ... 10 V

**For residual current transformer ND5018/105, ND5018/140, ND5018/210:**

RN 5883.12/021: with analogue output 0 ... 10 V

### Ordering example for variants

RN 5883 .12 / \_ \_ \_ /61 AC/DC 80 ... 230 V 50 / 60 Hz



### UL-Daten ND 5015

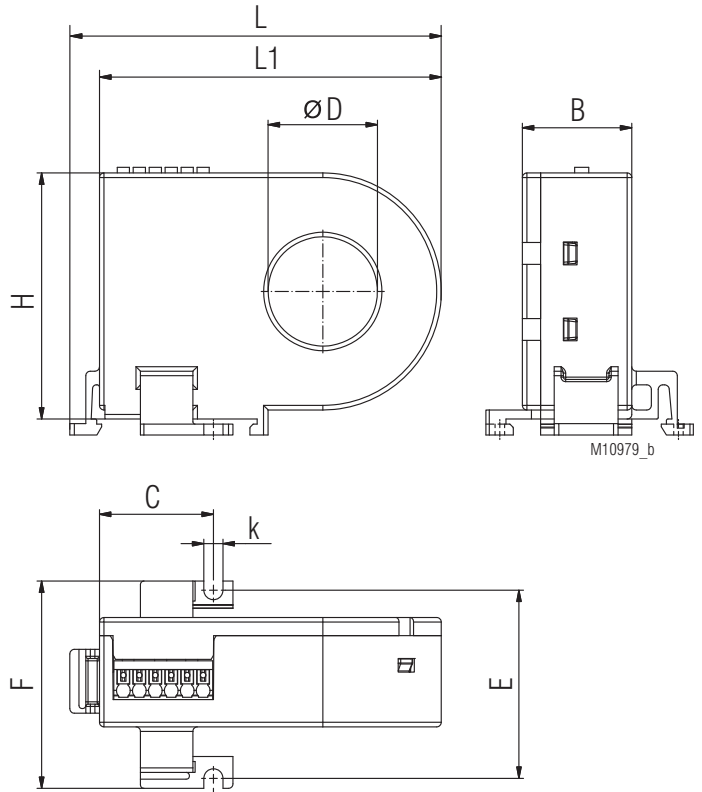
**Wire connection:** AWG 24 - 16  
60°C / 75°C copper conductors only



Technical data that is not stated in the UL-Data, can be found in the technical data section.

### Accessories

#### Residual Current Monitor ND 5015/024, ND 5015/035



for DIN rail mounting or screw mounting

ND 5015/024	øD	L	L1	B	H	C	E	F	k
Dimensions/mm	24	82	75	24	54	25	42*	46	4.2
Weight / g	approx. 80								

ND 5015/035	øD	L	L1	B	H	C	E	F	k
Dimensions/mm	35	88	81	24	67	25	42*	46	4.2
Weight / g	approx. 90								

\*) Drill tolerance for screw mounting: ± 0.5 mm

### Technical Data Residual Current Monitor ND 5015, ND 5018

**Ambient temperature:** - 40 ... + 60°C / 233 K ... 333 K  
**Inflammability class:** V0 according to UL94

#### Insulation coordination according to IEC 61869-1

Highest rated operating voltage  $U_m$ : AC 720 V  
Rated impulse voltage: 3 kV

Length of connection wires

Type of wire to CT, e.g.

Single wire:

up to 1 m

Single wire twisted pair (pair 1: i1 - k1; pair 2: i2 - k2):

up to 10 m

Screened wire; screen one end grounded at device to PE:

up to 25 m

Wire cross section:

0.2 ... 1.5 mm<sup>2</sup>

Stripping length:

8 mm

#### ND 5015:

Wire fixing:

Terminals with spring connection and direct (Push in) technology

Actuation power:

40 N max.

DIN rail mounting:

integrated clips for vertical and horizontal mounting

Screw fixing:

M3 or M4

Fixing torque:

max. 0.8 Nm

#### ND 5018:

Wire fixing:

Flat terminals with self-lifting clamping piece

DIN rail mounting:

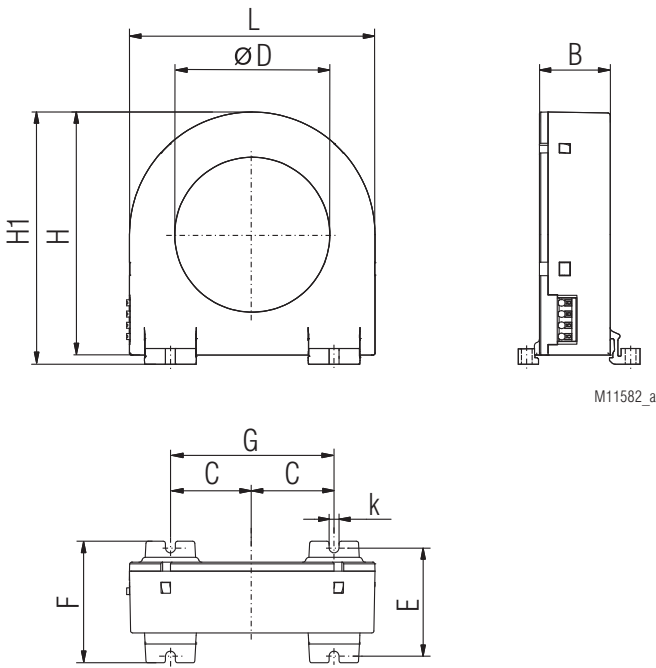
using mounting adapter ET 5018

Screw fastening:

(only at ND 5018/105, ND 5018/140, ND 5018/210) M 5



Residual Current Monitor ND 5015/070



for DIN rail mounting or screw mounting

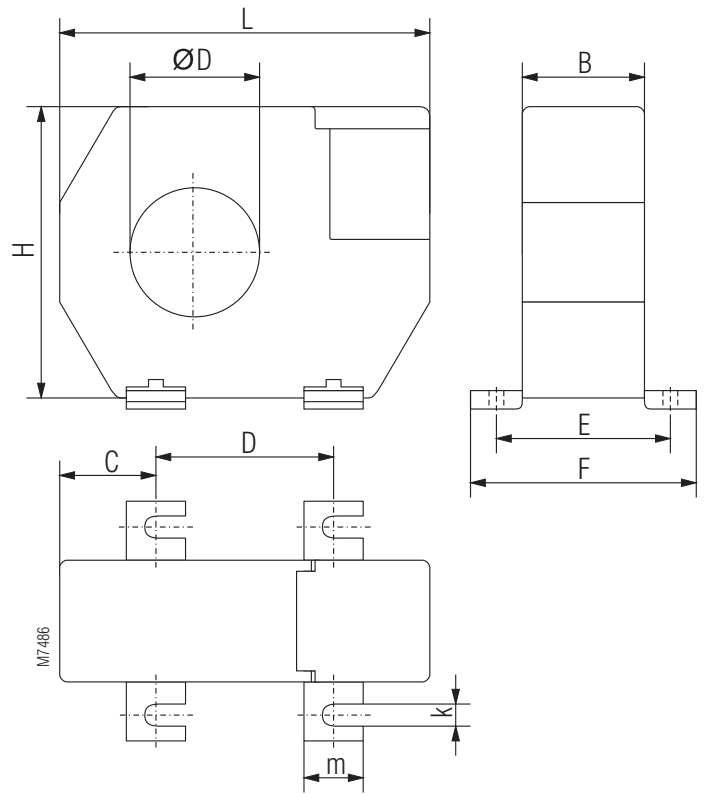
ND 5015/070	øD	L	H	H1	B	C	F	k	E	G
Dimensions/mm	70	111	110	115	32	37	55	4,2	50*	74*
Weight / g	approx. 220									

\*) Drill tolerance for screw mounting: ± 0.5 mm

**Mounting instructions for screw mounting**

High forces when mounting may damage the current transformer fixtures. The fixing clips are designed to support the current transformer. Forces that are applied by the cable running through the current transformer can only be tolerated within limitations. During installation and afterwards please make sure that the wires are led through the current transformer without applying pressure and remain stable in that position.

Residual Current Monitor ND 5018/105, ND 5018/140, ND 5018/210,

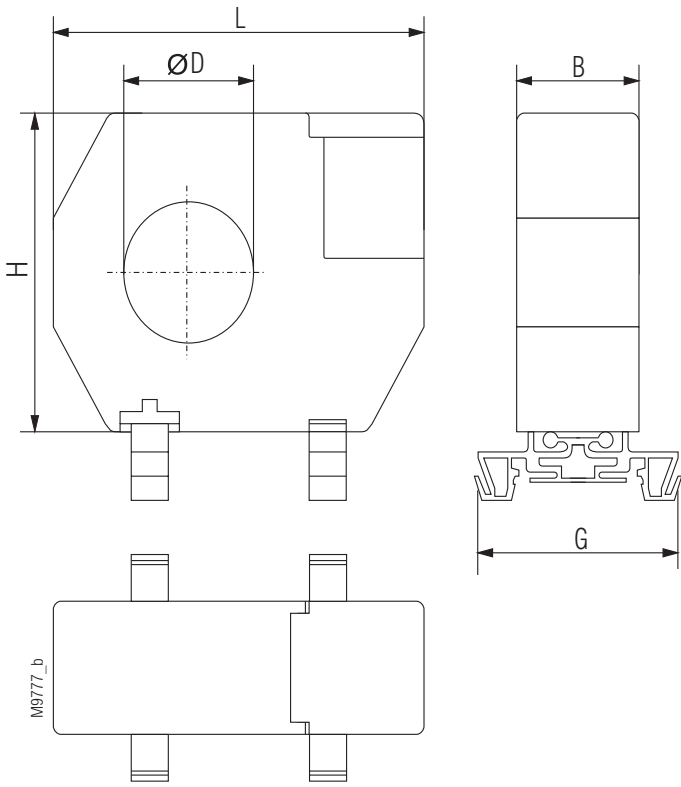


for screw mounting

ND 5018/105	øD	L	B	H	C	D	E	F	k	m
Dimensions/mm	105	170	33	146	38	94	46	61	6.5	16
Weight / g	530									
ND 5018/140	øD	L	B	H	C	D	E	F	k	m
Dimensions/mm	140	220	33	196	48.5	123	46	61	6.5	16
Weight / g	1250									
ND 5018/210	øD	L	B	H	C	D	E	F	k	m
Dimensions/mm	210	299	33	284	69	161	46	61	6.5	16
Weight / g	2100									

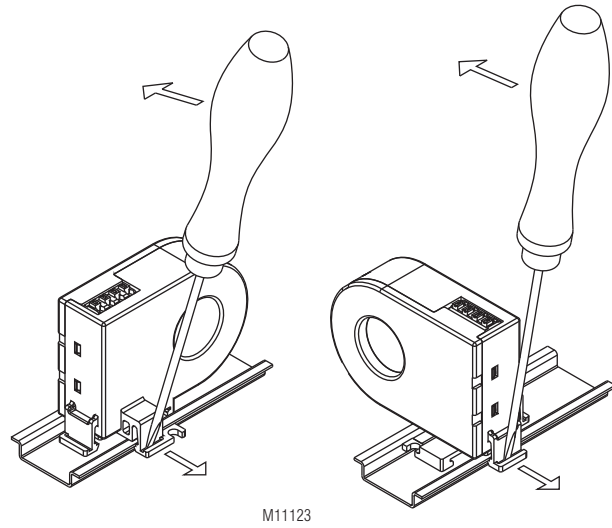
The residual current transformer ND 5018/105 can also be mounted on DIN-rail. To do this the metal screw fixings have to be removed and have to be replaced by 2 mounting clips (ET5018: art.no. 0058754; set with 2 pcs)

Residual Current Monitor ND 5018/105

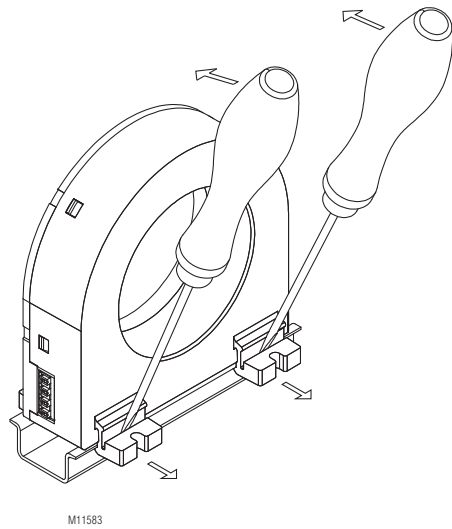


for DIN rail mounting

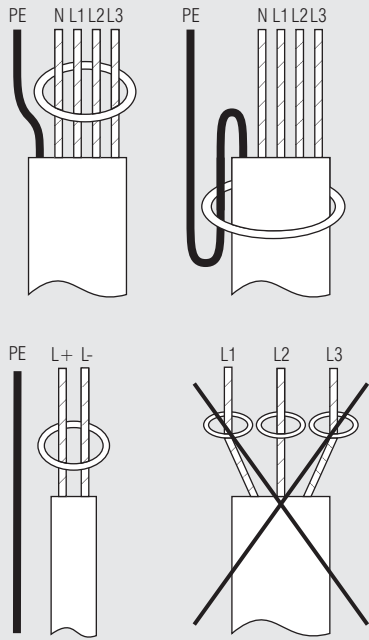
ND 5018/105	øD	L	B	H	G
Dimensions/mm	105	170	33	146	55
Weight / g	530				



Disassembling Residual Current Monitor ND 5015/070

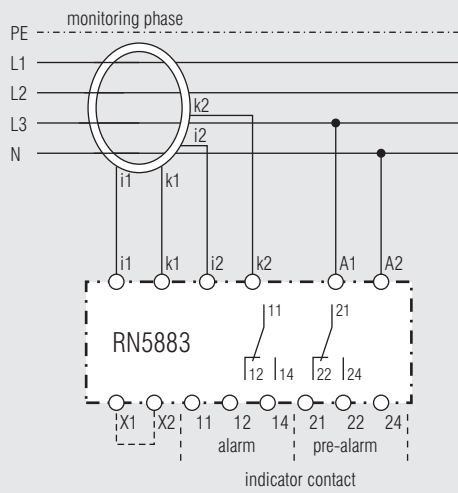


## Installation of Wires



M8362\_a

## Connection Example



X1-X2 open : operating current  
 X1-X2 bridged : de-energized

M11294

## VARIMETER PRO

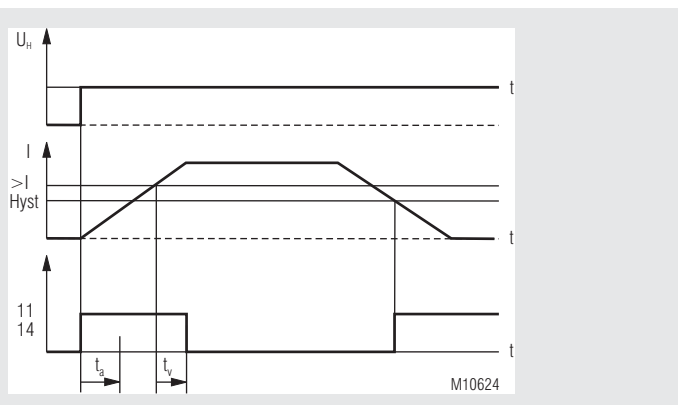
### Multifunction Measuring Relay MK 9300N, MH 9300



#### Product Description

The universal measuring relays MK 9300N / MH 9300 of the VARIMETER PRO series monitor up to 9 parameters simultaneously. These are under-voltage, over-voltage, voltage range, voltage asymmetry, under-, overcurrent, cos phi, effective-, apparent- and reactive power, frequency and phase sequence. The measurement in 3-phase or single-phase systems is very simple and without extensive wiring. Because of the menu structure the multifunctional measuring relays can be used easily and intuitively. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

#### Function Diagram



Example: overvoltage monitoring with closed circuit operation

#### Your Advantage

- Min-, Max. value or window monitoring
- Simultaneous monitoring of up to 9 different parameters
- Simple configuration and fault diagnostic
- Different fault indications
- Large measuring range 3 AC 24 ... 690 V
- Auxiliary voltage ranges DC 24 V, AC 230 V or AC/DC 110 ... 400 V
- Early detection of irregular states
- Space and cost saving
- Reduced wiring

#### Features

- Multifunction measuring relay acc. to EN 60255-1
- Voltage monitoring (1- and 3-phase)
- Current monitoring
- Frequency monitoring
- Power factor cos phi
- Phase sequence, phase failure, asymmetry
- Effective-, reactive- and apparent power
- Start up delay, on delay
- Adjustable hysteresis 0.2 ... 50 % of response value
- Manual reset
- LCD for indication of the measuring values
- Relay output
  - MK 9300N: 1 changeover contact
  - MH 9300: 2 x 1 changeover contacts
- Relay function selectable (energized/de-energized on trip)
- As option with plugable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- MK 9300N: Width 22,5 mm
- MH 9300: Width 45 mm

#### More Information

- **MK 9300N**  
The MK9300N has 1 relay output.  
Monitoring parameters can be set independently
- **MH 9300**  
The MH 9300 has 2 relay outputs.  
Monitoring parameters can be set independently  
Each monitoring function can be assigned to relay 1 and /or relay 2

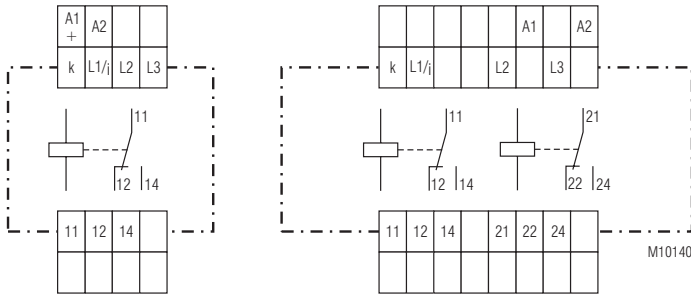
#### Approvals and Markings



#### Applications

- Monitoring of single and 3-phase loads
- Emergency power supplies
- Voltage dependent switching at under- or overvoltage
- Voltage monitoring of portable equipment
- Motor protection on Phase failure
- Transformer protection on asymmetric load
- Frequency monitoring on inverter outputs

## Circuit Diagrams



MK 9300N.11

MH 9300.12

## Connection Terminals

Terminal designation	Signal designation
A1 (+), A2	Auxiliary voltage AC or DC
L1/i, L2, L3	Voltage measuring input AC
L1/i, k	Current measuring path AC
11, 12, 14	Indicator relay (C/O contact)
21, 22, 24	Indicator relay (C/O contact)

## Function

After connecting the auxiliary supply to terminals A1-A2 the startup delay disables the monitoring function so that changes on the input have no influence on the relay output of the VARIMETER PRO. The device is in display (RUN) mode and continuously measures the actual values. The buttons and toggle between the different values. Pressing for more than 3 sec starts the input mode.

One or more measuring values can be assigned to the relay output. If the setting value of at least one function is exceeded the relay switches and the display indicates this state. The display is inverted, flashes and shows measuring function and fault.

The fault memory is selectable

With button the fault memory can be deleted.

On the unit MH 9300 it is possible to assign different values to the different relays so one can be used as pre-warning and the other as alarm output. Relay output 1 switches when actual value exceeds the pre-warning setting of at least one assigned measuring function.

If a second setting assigned to relay output 2 with the same measuring function the unit gives an Alarm signal.

## Remarks

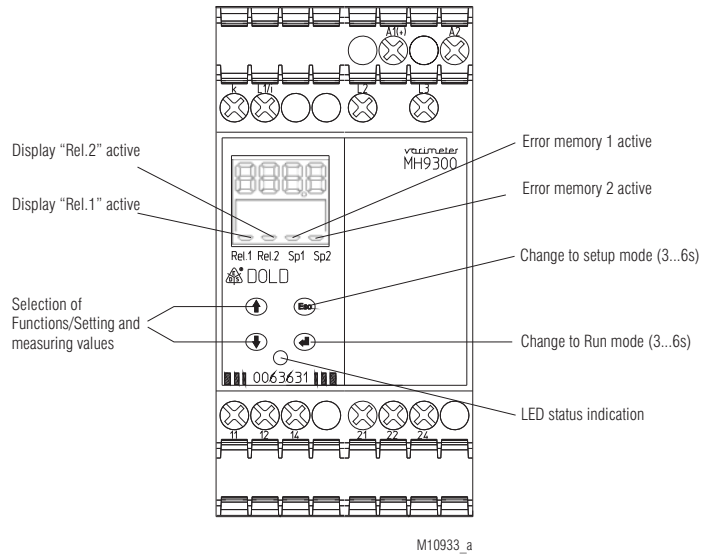
To provide correct function the measuring voltage on L1/L2 has to be at least 20 V.

Due to the measuring principle a symmetric load on all 3 phases as you have it usually with motors.

The unit can also be used for single phase monitoring by bridging terminals L2 and L3. The display shows U instead of  $U_{\min} / U_{\max}$ .

Overload within the current range is indicated by fast flashing of the LED.

## Setting



## Indicators

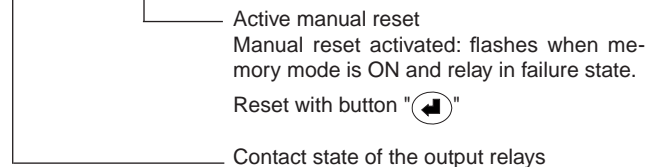
The LED indicate the state.

green LED  $U_N$  : on, when auxiliary voltage present

red LED (flashes) at overload at current path

orange LED: No measurement, unit in input mode

## Cursor LCD Display



## Operating

### UP / DOWN

#### Display (Run) - Mode

After power up the relay is in display (Run) mode.

Scrolls the display to show one of the 10 possible values.

If a values exceeds the setting, the values is indicated flashing on inverted display. In the case of a fault display the display always returns to the fault value after pressing **UP** **DOWN**. If voltage is missing on the measuring input some values cannot be calculated and a no value is shown.

#### Input-Mode

The measurement is interrupted, the relays are in failure state and the indicator LED has orange color

Selection of parameters and setting of thresholds.

### ENTER

#### Display (Run) - Mode:

Manual reset, when manual reset is selected for output relay  
Reset works only when fault is removed

#### Input-Mode:

- Shifts cursor to the right
- Saves the value no-voltage safe
- Pressing for more than 3 sec: Change to display (Run) mode.

### Esc

#### Display (Run) - Mode

- Pressing for more than 3 sec: Change to input mode

#### Input-Mode:

- Shifts cursor to the left
- Leave setting without saving

## LCD-Display



#### Setting of response values

- < Fault, when value drops under set point
- > Fault, when value exceeds set point
- OFF measurement disabled

If the adjusted threshold of at least one measuring function is exceeded, the corresponding relay output switches after the selected time delay  $t_v$  and the fault is indicated on the display.

Manual reset can be activated or de-activated and is operated with **ENTER** on the unit.

## Adjustable Parameter

Limit values for Rel.1 and Rel.2  
Selectable with buttons **UP** **DOWN**.

		Factory setting
$U_{min}$ :	Response value undervoltage, Lowest phase to phase voltage (Undervoltage relay)	OFF
$U_{max}$ :	Response value overvoltage, Highest phase to phase voltage L1, L2 or L3 (Overvoltage relay)	440 V
Asym:	Response value voltage asymmetry, Percentage of highest to lowest phase to phase voltage (Asymmetry relay)	20 %
I:	Response value current at current path L1 (< under- / > overcurrent)	> 8.00 A
Cos-φ:	Response value phase displacement between current and voltage (< under- / > overload monitor)	OFF
P:	Response value effective power 3-phase Independent of phase sequence switches at adjusted value also at reverse power (< under- / > overload)	OFF
S:	Response value apparent power 3-phase (< / >)	OFF
Q:	Response value reactive power (< / >)	OFF
f:	Response value frequency (range 1 ... 400 Hz) (< under / > overfrequency)	OFF
Hyst:	Hysteresis 0.2 ... 50 % of response value	4.0 %
$t_v$ :	On delay for relays ( 0 ... 10 sec )	0 s
Phseq:	Monitoring phase sequence (ON / OFF)	ON
A / R:	Setting open- / closed circuit operation	R
Sp:	Error storage ( ON / OFF )	OFF

Response values can be deactivated. (OFF)

## Further Setting Parameter

Selectable with buttons **UP** **DOWN**.

		Factory setting
$t_a$ :	Start up delay, when auxiliary voltage connected ( 0.2 ... 10 sec) in steps of 0.1 s	0.2 s

## Restore Factory Settings

(Restore factory settings)

Before auxiliary voltage connected press button **Esc**.  
During start press and hold.

## Indicator output

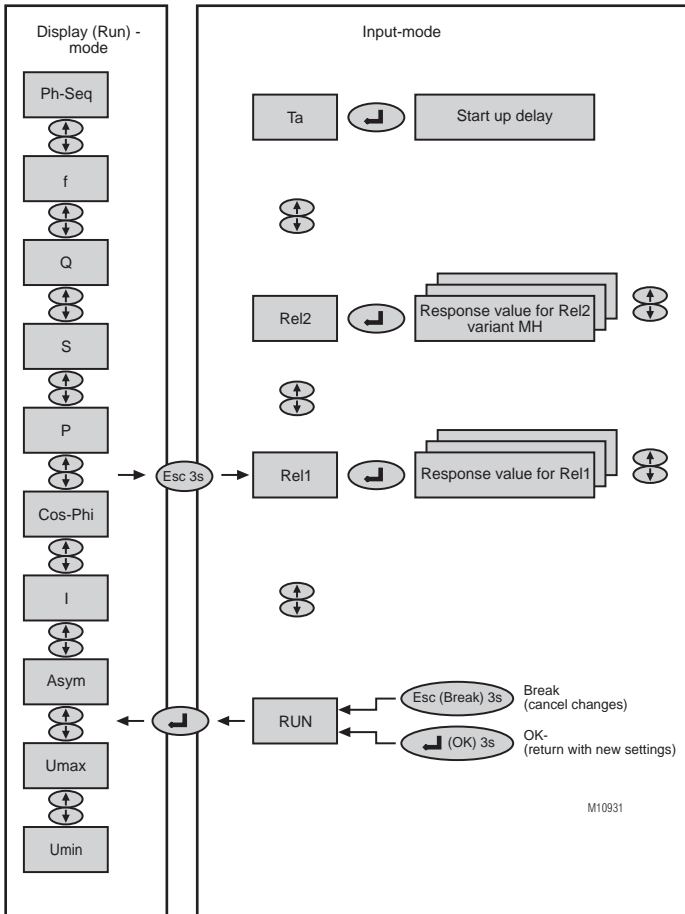
Monitoring parameters can be set independently.

The MK9300N has 1 relay output.

The MH 9300 has 2 relay outputs.

Each monitoring function can be assigned to Relay 1 and/or to Relay 2. The switching mode energized or de-energized on trip can be set in input mode.

## Operating



After connecting the auxiliary supply A1/A2 the unit is in display (Run) mode:

The display is inverted when a measured value exceeds the settings. With button the fault memory is reset.

The actual measured values can be toggled with the buttons.

Pressing button for more than 3 sec the unit changes to input mode.

In input mode the measurement is disabled, the relays are in failure mode and the indicator LED is orange.

With the buttons the different setting values can be chosen.

Move cursor position

One character to the right

One character to the left

### Back to the Display (Run)-Mode

Press button 3 s OK New values stored

or

Press button 3 s; Break Values unchanged

on the display confirm with to change to display (Run) mode.

Display (RUN) Mode	Input-Mode
Display inverted when the actual value is in failure state.	Measurement interrupted, relays are in failure state, indicator LED orange color
Scroll display between the 10 different measuring values.	Chose Rel1, Rel2, T <sub>a</sub> and RUN As option address for RS485 Bus
Reset fault memory:	Shift cursor to the left Shift cursor to the right
For more the 3 sec, change to input mode	For more than 3 sec, change to display mode

## Operating - Display - Menü (RUN) Mode

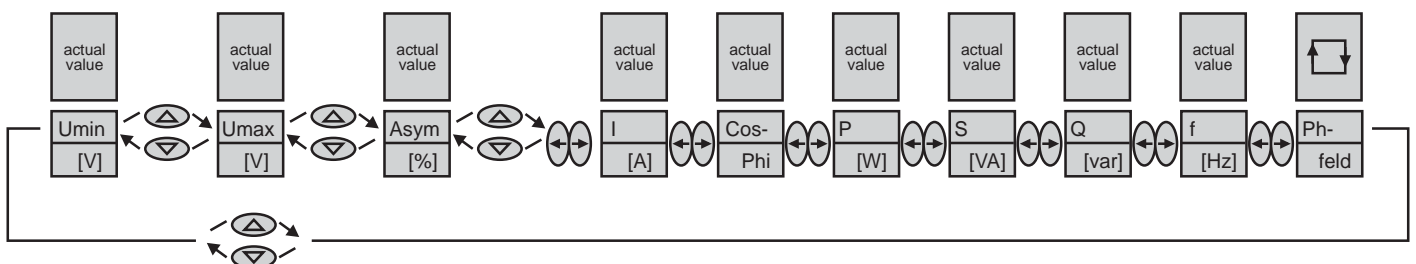
Cursor-display

relay 1 energized

relay 2 energized

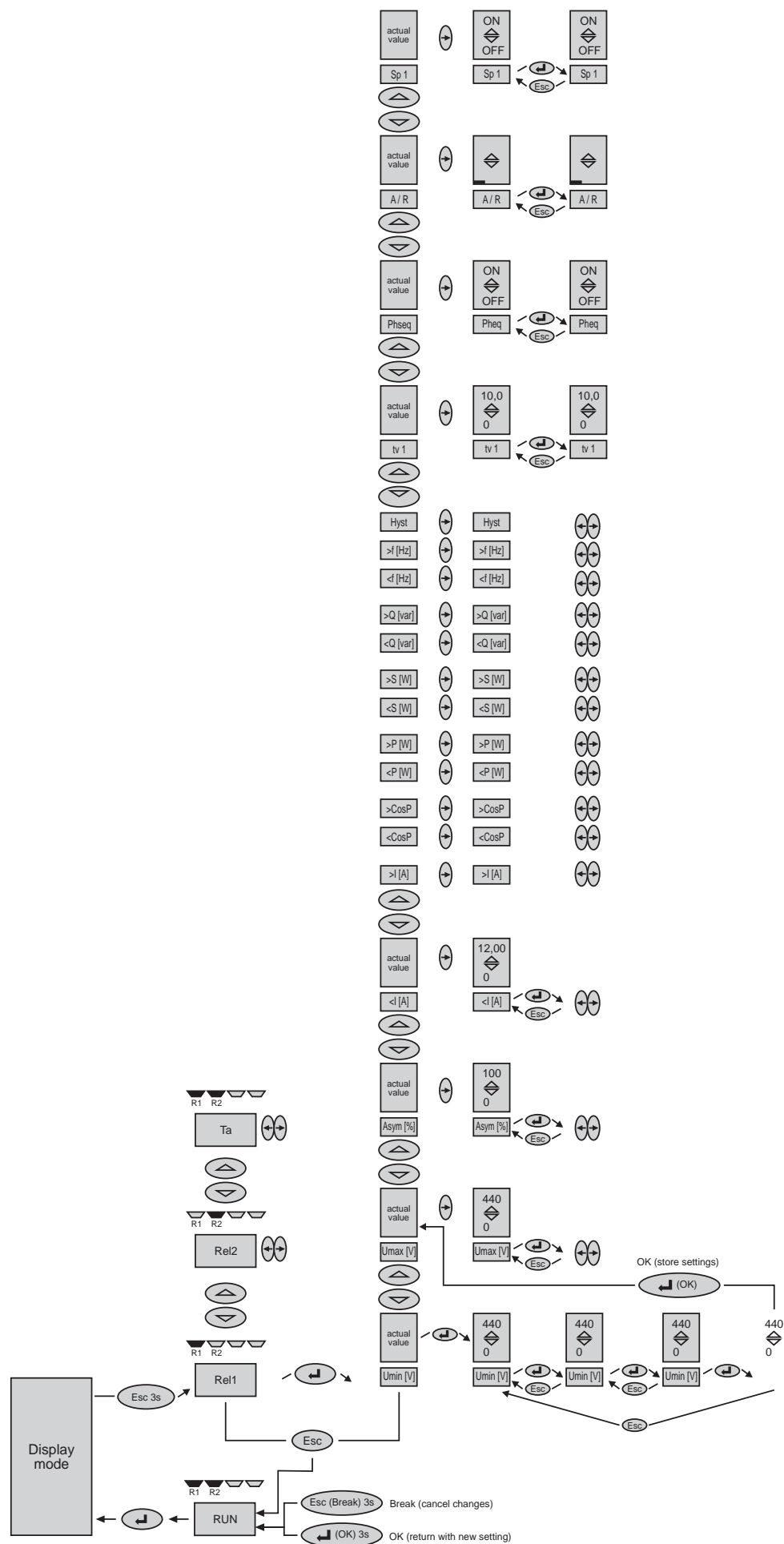
relay 1 and 2 energized

Cursor flashes during time delay tv



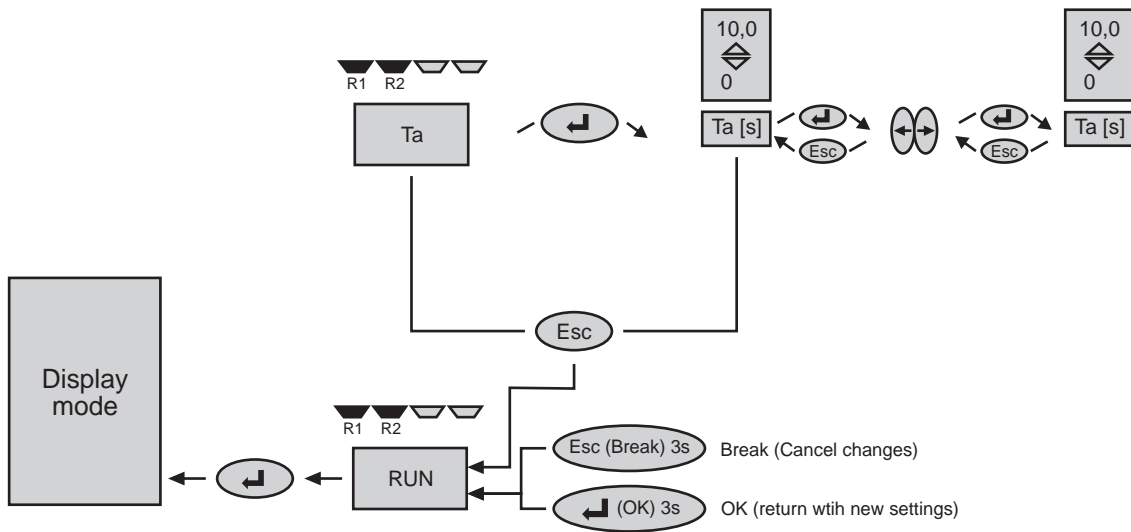
M11002

The menu for relay 2 is identically





Start up delay  $t_a$ : 0 ... 10 s in steps of 0.1 s



M11004\_a

**Technical Data**

**Auxiliary Voltage A1/A2**

**Nominal auxiliary voltage  $U_H$**   
 MK 9300N: DC 24 V (0.9 ... 1.1 x  $U_H$ )  
 MH 9300: AC 110, 230 V, 400 V (0.8 ... 1.1 x  $U_H$ )  
 AC/DC 110 ... 400 V (0.8 ... 1.1 x  $U_H$ )  
 DC 24 V (0.9 ... 1.1 x  $U_H$ )\*  
 \*) for measuring range 3 AC 24 ... 400 V

**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 400 Hz

**Input current**  
 at DC 24 V: 50 mA  
 at AC 230 V: 15 mA

**Voltage Measuring Input L1/L2/L3**

**MK 9300N:**  
**Nominal voltage:** 3 AC 400 V  
**Measuring range  $U_M$ :** 3 AC 24 ... 400 V  
 (0,8 ... 1,1 x  $U_M$ )

**MH 9300:**  
**Nominal voltage:** 3 AC 400 V / 690 V  
**Measuring range  $U_M$ :** 3 AC 24 ... 400 V, 24 ... 690 V  
 (0,8 ... 1,1 x  $U_M$ )

**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 1 ... 400 Hz

**Current Measuring Input i / k**

**Nominal current:** AC 12 A  
**Measuring range:** AC 100 mA ... 12 A  
**Max. overload**  
 continuously: 16 A  
 short time < 10 s: max. 25 A  
 If current range is overloaded, the LED flashes fast

**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 400 Hz

**Setting Range (absolute, via button and LCD-display)**

**Measuring accuracy at nominal frequency**  
 (in % of setting value):  $\pm 4 \%$

**Hysteresis**  
 (in % of setting value): 0.2 ... 50 % of response value

**Reaction time:** < 350 ms ( $f > 10$  Hz)

**Adjustable on delay  $t_v$ :** 0 ... 10 s (in steps of 0.1 s)  
**Adjustable start up delay  $t_a$ :** 0.2 ... 10 s (in steps of 0.1 s)

**Output Circuit (Rel1: 11/12/14; Rel2: 21/22/24)**

**Contacts:**  
 MK 9300N: 1 changeover contact  
 MH 9300: 1 changeover contact (Rel1) and 1 changeover contact (Rel2)  
 2 x 4 A

**Thermal current  $I_{th}$ :**  
**Switching capacity**  
 to AC 15:  
 NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1  
 NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1  
 to DC 13  
 NO contacts: 1 A / DC 24 V IEC/EN 60 947-5-1  
 NC contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life**  
 to AC 15 at 3 A, AC 230 V: 2 x 10<sup>5</sup> switch. cycl. IEC/EN 60 947-5-1

**Permissible switching frequency:** 1800 / h

**short circuit strength**  
**Max. fuse rating:** 4 A gG / gL IEC/EN 60 947-5-1

**Mechanical life:** 30 x 10<sup>6</sup> switching cycles

## Technical Data

### General Data

**Nominal operating mode:** continuous operation

### Temperature range

Operation: - 20... + 60 °C  
(at range 0 ... - 20 °C limited function of the LCD display)

Storage: - 20... + 60 °C

**Altitude:** < 2,000 m

### Clearance and creepage distance

#### rated impulse voltage /

#### pollution degree

Auxiliary voltage / meas. input: 6 kV / 2 IEC/EN 60 664-1

Auxiliary voltage / contacts: 6 kV / 2 IEC/EN 60 664-1

Measuring input / contacts: 6 kV / 2 IEC/EN 60 664-1

Contacts 11,12,14 / 21,22,24: 4 kV / 2 IEC/EN 60 664-1

Overvoltage category: III

### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation

80 MHz ... 2.7 GHz 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class A\*)

\*) The device is designed for the usage under industrial conditions (Class A, EN 55011).

When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

### Degree of protection

Housing: IP 40 DIN EN 60 529

Terminals: IP 20 DIN EN 60 529

**Housing:** thermoplastic with VO behaviour according to UL Subject 94

**Vibration resistance:** Amplitude 0.35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6  
20 / 060 / 04 EN 60 068-1

### Climate resistance:

**Wire connection** DIN 46 228-1/-2/-3/-4

### Screw terminal

**(fixed):** 1 x 4 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated) or  
2 x 1.5 mm<sup>2</sup> stranded ferruled (isolated) or  
2 x 2.5 mm<sup>2</sup> solid

Insulation of wires or sleeve length: 8 mm

### Terminal block

#### with screw terminals

Max. cross section: 1 x 2.5 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated)

Insulation of wires or sleeve length: 8 mm

### Terminal block

#### with cage clamp terminals

Max. cross section: 1 x 4 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated)  
0.5 mm<sup>2</sup>

Min. cross section:

Insulation of wires or sleeve length: 12 ±0.5 mm

### Wire fixing:

Plus-minus terminal screws M3,5 box terminals with wire protection or cage clamp terminals

**Fixing torque:** 0.8 Nm

**Mounting:** DIN rail IEC/EN 60 715

### Weight:

MK 9300N: approx. 140 g

MH 9300: approx. 250 g

## Dimensions

### Width x height x depth:

MK 9300N: 22.5 x 90 x 97 mm

MH 9300: 45 x 90 x 97 mm

## Standard Types

MK 9300N.11/022 3 AC 20 ... 440 V AC 12 A DC 24 V

Article number: 0063630

• Measuring voltage: 3 AC 20 ... 440 V

• Measuring current: AC 12 A

• Auxiliary voltage U<sub>H</sub>: DC 24 V

• Output: 1 changeover contact

• Width: 22,5 mm

MH 9300.12/022 3 AC 20 ... 440 V AC 12 A AC 230 V

Article number: 0063631

• Measuring voltage: 3 AC 20 ... 440 V

• Measuring current: AC 12 A

• Auxiliary voltage U<sub>H</sub>: AC 230 V

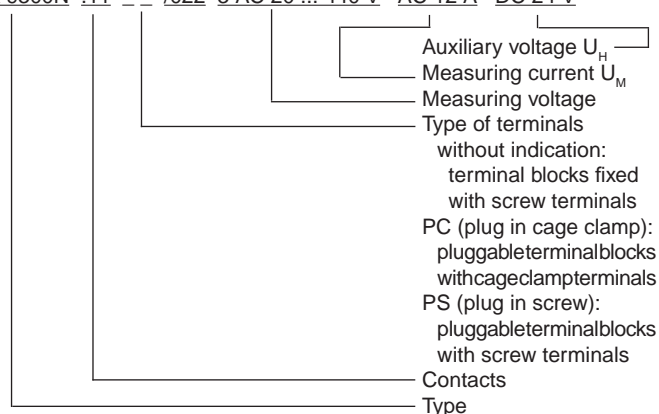
• Output: 1 changeover contact (Rel1) and

1 changeover contact (Rel2)

• Width: 45 mm

## Ordering Example

MK 9300N .11 \_ \_ /022 3 AC 20 ... 440 V AC 12 A DC 24 V



## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

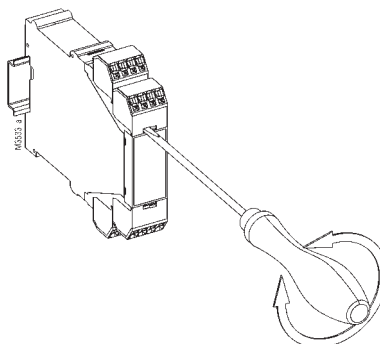


Cage clamp terminal  
(PC/plugin cage clamp)

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.





## Safety notes



### Dangerous voltage.

Electric shock will result in death or serious injury.



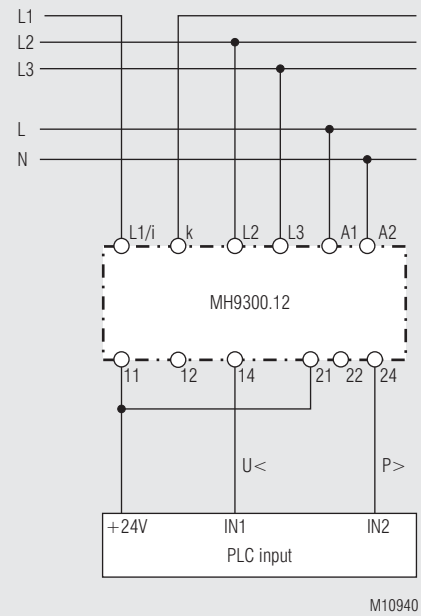
Disconnect all power supplies before servicing equipment.

- Faults must only be removed when the relay is disconnected
- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).
- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.
- Observe proper grounding of all components

## Set Up Procedure

The connection has to be made according to the connection examples. To connect the current of L1 the Terminals I and k are available. If the current to be measured exceeds the maximum continuous current of the input and external current transformer has to be used. If current is not measured input k remains unconnected.

## Connection Example



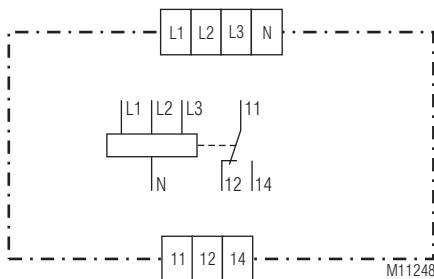
## VARIMETER PRO Phase monitor RL 9877, RN 9877



### Product Description

The measuring relays RN 9877 and RL 9877 of the VARIMETER series monitor overvoltage, undervoltage, voltage range, phase asymmetry and phase sequence in 3-phase or single-phase systems. The measurement is very simple and without extensive wiring as there is no auxiliary power supply necessary. The monitoring functions are easily selectable using a single turn switch without complex menu structure. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

### Circuit Diagram



### Connection Terminals

Terminal designation	Signal designation
L1	Phasen voltage L1
L2	Phasen voltage L2
L3	Phasen voltage L3
N	Neutral
11, 12, 14	Changeover contact (outputrelays)

### Your Advantages

- Preventive maintenance
- For better productivity
- Always right directions of motors and pumps
- Safe monitoring of motors and plants with phase failure detection
- High repeat accuracy
- Wide measuring voltage range
- Selectable monitoring function
- Easy setting

### Features

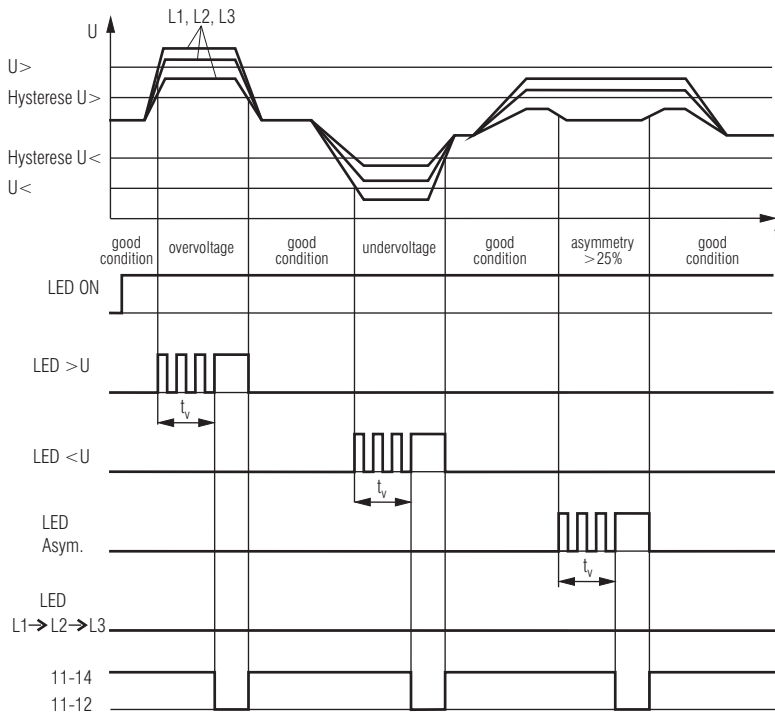
- According to IEC/EN 60 255-1
- For monitoring of AC 3- and single-phase with 50 /60 Hz
- Detection of
  - Overvoltage
  - Undervoltage
  - Voltage range excess
  - Phase failure
  - Phase asymmetry
  - missing neutral e.g. broken neutral wire
  - and phase sequence in 3-phase systems
- With or without neutral
- No separate auxiliary necessary
- Output: 1 changeover contact
- De-energized on trip
- Adjustable hysteresis for reset
- Adjustable switching delay
- Fast fault detection
- Width:
  - RL 9877: 35 mm
  - RN 9877: 52.5 mm

### Approvals and Markings



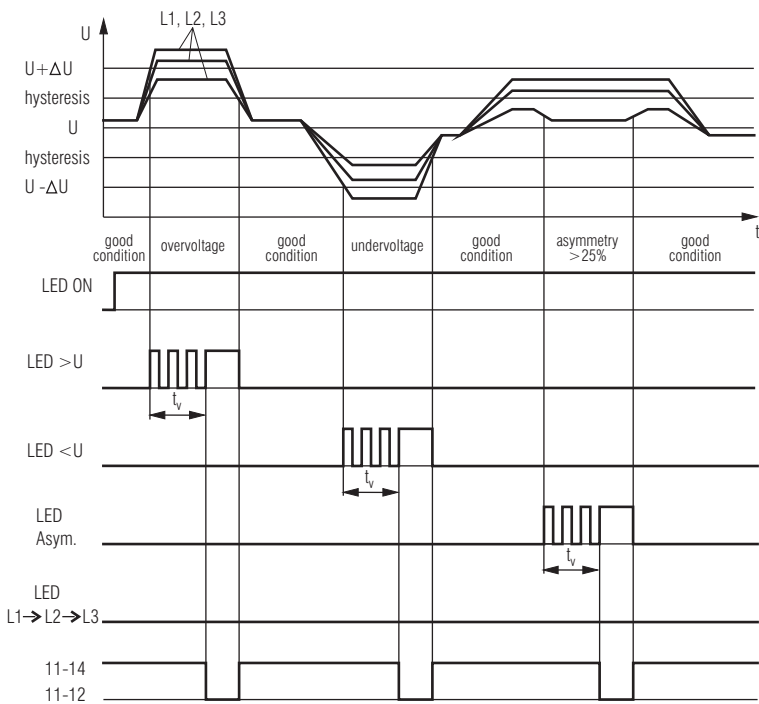
### Application

- Monitoring of three-phase voltage systems to identify overvoltage and undervoltage
- Indication of phase sequence in 3-phase systems, phase failure and voltage asymmetry
- Monitoring of voltage systems with motors
- Changeover to emergency supply after failure detection



M11480\_c

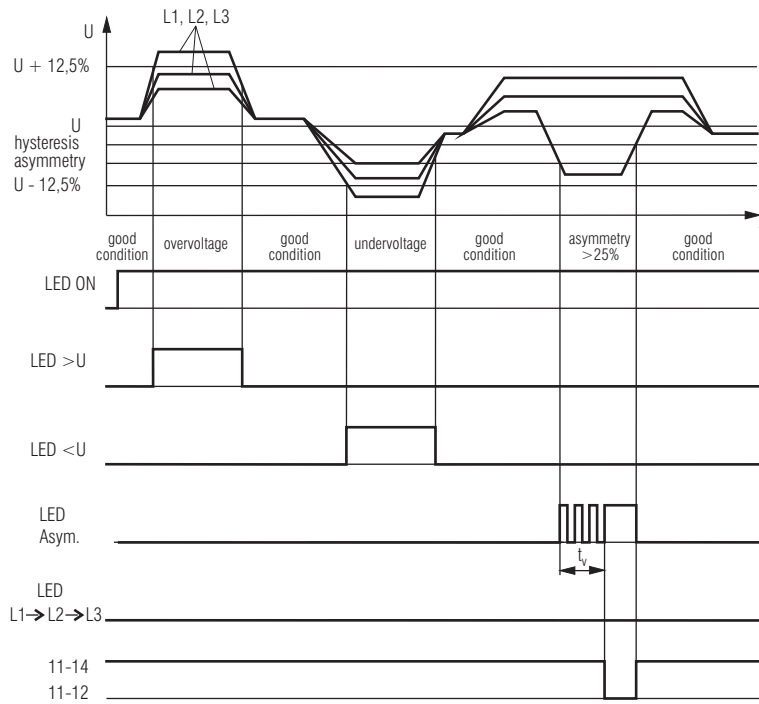
Monitoring function: 3 AC / 1 AC-overvoltage / undervoltage; rotary switch: „U>“ / „U<“



M11255\_c

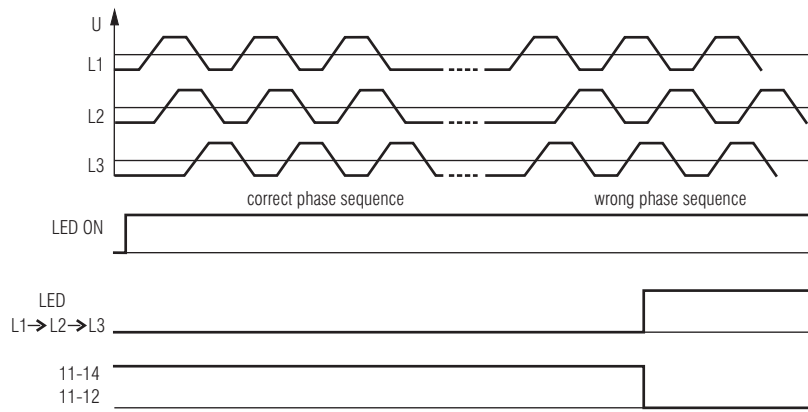
Monitoring function: 3 AC / 1 AC-voltage range; rotary switch: „U<>“

## Function Diagrams



M11404\_c

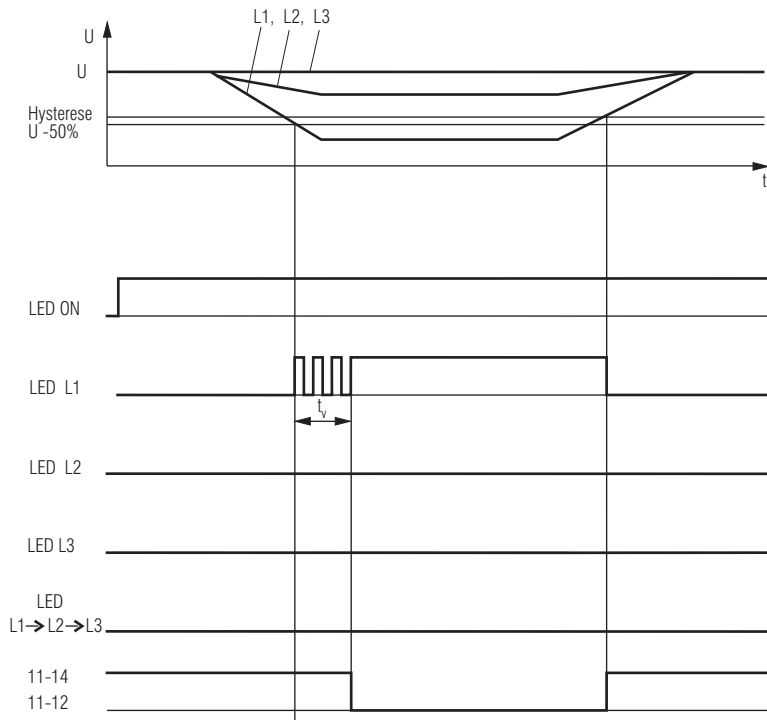
Monitoring function: 3 AC-Asymmetrie; rotary switch: „Asym.“



M11421

Monitoring function: 3 AC-phase sequence; rotary switch: any

## Function Diagrams



M11420\_b

only at variant RN9877/120 e.g. RL9877/120:  
Monitoring function: Phase failure

## Functions

In 3-phase systems all three phases are measured against neutral. In the monitoring modes overvoltage, undervoltage and voltage range the excess of the switching voltage U by one or more phase voltages is indicated by blinking of the corresponding LED. After the switching delay time has expired the voltage LED is on permanently and the output relay releases. If the phase voltage which has triggered the alarm falls below the nominal voltage U, the voltage LED switches off immediately whereas the output relay is energized.

The output relay operates in closed circuit mode i.e. in case of good condition the relay energized whereas in fault condition it is de-energized.

In the voltage range monitoring mode the nominal voltage range  $U \pm \Delta U$  is adjustable. An alarm is triggered in case a phase voltage leaves this monitoring range. The hysteresis for switching back into good condition is half the value set by the potentiometer  $\Delta U$ .

In the voltage monitoring operation modes an excess of the voltage asymmetry between the three phases of more than 25 % is indicated by the asymmetry LED turning on. In this terminology asymmetry means the relative difference of the maximum phase voltage and the minimum phase voltage. Fall back into good condition occurs with a hysteresis of ca. 6 %. In this case the asymmetry LED turns off and the output relay energizes.

In the asymmetry monitoring operation mode the trigger level for asymmetry excess in 3-phase systems is adjustable. The hysteresis for falling back into good condition is exactly half of the set value for asymmetry. In this monitoring mode activation and deactivation of the output relay is done using the same timing parameters as in the voltage monitoring mode except that the control is governed by asymmetry excess rather than voltage excess. In this function mode a difference of the phase voltage to the adjusted voltage value of more than 25% is indicated by the corresponding voltage LED. Again fall back into good condition is done with a hysteresis of approx. 6 %.

In all monitoring modes of a 3-phase system a correct phase sequence is monitored. In case of a wrong phase sequence the phase sequence LED turns on permanently and the output relay remains de-energized. This state is on hold until the unit is restarted with correct phase sequence. After the phase sequence is correct again the LED is turned off immediately.

A missing or broken neutral is indicated by the asymmetry LED and the phase sequence LED being switched on permanently.

In 3-phase systems without neutral the delta voltages UA, UB and UC are calculated via virtual star voltages by means of vector addition. The monitoring modes are the same as with devices with neutral. The following relationships between triangle voltages and device terminals are to be taken into account:

$$U_A = L_1 - L_2; \quad U_B = L_1 - L_3; \quad U_C = L_2 - L_3;$$

The variant RN9877/120 is especially suitable to detect phase failures.

While the neutral is connected and a phase drops under 50% of the phase voltage the corresponding LED signals the failure. The percentage between minimum and maximum phase voltage is measured.

When the neutral is missing, the phases are measured in relation to a virtual internal neutral.

After elaps of the switching delay the phase failure LED is continuously on and the output relay switches off (de-energised on trip). The reset takes place with a hysteresis of 6.25% then then LED goes off immediately and the output relay energises.

## Indicator

green LED „ON“:	on, when supply connected
red LED „U“:	on, when overvoltage
red LED „<U“:	on, when undervoltage
yellow LED „Asym.“:	indicates a voltage asymmetry in 3-phase systems or loss of neutral
yellow LED „L1→L2→L3“:	indicates wrong phase sequence in 3-phase systems or loss of neutral

### Variant /120:

green LED „ON“:	on, when supply connected
red LED „L1“:	on, when phase failure at phase 1
red LED „L2“:	on, when phase failure at phase 2
red LED „L3“:	on, when phase failure at phase 3
yellow LED „L1→L2→L3“:	indicates wrong phase sequence in 3-phase systems

## Notes

During initialisation the relay recognises automatic the mains frequency (50 Hz or 60 Hz) and Netzform (3AC- or 1AC- systems).

On 3-phase connection all 3-phase voltages are criteria to return into good state, therefore the hysteresis should be chosen as low as possible for undervoltage or overvoltage mode (max. 10%). For the voltage range mode a higher hysteresis should be selected (min.10%).

Depending on the voltage system different monitoring functions can be selectet on a selector switch:

Function select	Type of voltage	Monitoring
U>	3AC / 1AC	Overvoltage
U<	3AC / 1AC	Undervoltage
U<>	3AC / 1AC	Voltage range
Asym.	3AC	Phase asymmetry



## Technical Data

### Input

#### Operating voltage $U_b$ :

RL 9877:	3/N AC 80 ... 230 V / 45 ... 130 V 1- or 3-phase without / with neutral
RN 9877:	3/N AC 175 ... 525 V / 100 ... 300 V 1- or 3-phase without / with neutral

#### Voltage rated operating $U_e$ :

RL 9877:	3/N AC 94 ... 209 V / 53 ... 118 V
RN 9877:	3/N AC 205 ... 477 V / 118 ... 273 V

#### Operating voltage $U_g$ :

RL 9877:	3 AC 80 ... 230 V 3-phase without neutral
RN 9877:	3 AC 175 ... 525 V 3-phase without neutral

#### Voltage rated operating $U_e$ :

RL 9877:	3 AC 94 ... 209 V
RN 9877:	3 AC 205 ... 477 V

#### Nominal frequency:

50 / 60 Hz

#### Frequency range:

45 ... 65 Hz

#### Max. asymmetry:

50 %

#### Nominal consumption:

approx. 7 VA

### Output

**Contact:** 1 changeover contact

**Contact material:** AgNi

**Switching voltage:** AC 250 V

**Thermal current  $I_{th}$ :** 5 A

#### Switching capacity

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

#### Electrical life

to AC 15 at 1 A, AC 230 V: typ.  $3 \times 10^5$  switching cycles

**Short circuit strength** IEC/EN 60 947-5-1

max. fuse rating: 5 A gL

**Mechanical life:**  $> 30 \times 10^6$  switching cycles

### Measuring circuit

**Measuring voltage:** infinite adjustable

RL 9877: 3/N AC 80 ... 230 V / 45 ... 130 V

RN 9877: 3/N AC 175 ... 525 V / 100 ... 300 V

RL 9877: 3 AC 80 ... 230 V

RN 9877: 3 AC 175 ... 525 V

**Voltage range:**  $0.85 U_N$  ...  $1.1 U_N$

**Hysteresis:** infinite adjustable 4 ... 20 %

#### Response value for

**Phase asymmetry:** infinite adjustable 4 ... 20 %

**Switching delay  $t_v$ :** infinite adjustable

instantaneous, 2 ... 30 s

**Repeat accuracy:**  $\pm 2$  %

**Temperature influence:**  $\pm 1$  %

#### Attention:

**The combination of adjusted**

**switching voltage U and hysteresis  $\Delta U$**

**must be within the measuring range.**

### General Data

**Operating mode:** continuous operation

#### Temperature range

Operation: -20 ... +55 °C

Storage: -25 ... +65 °C

Relative air humidity: 93 % at 40 °C

**Altitude:**  $< 2,000$  m

#### Clearance and creepage

##### distances

Rated impulse voltage/ Pollution degree: 6 kV / 2 IEC 60 664-1

#### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 12 V / m IEC/EN 61 000-4-3

1 GHz ... 2,7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

## Technical Data

### Surge

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

#### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

#### Enclosure:

Thermoplastic with V0 behaviour

acc. to UL subject 94

Vibration resistance: Amplitude 0.35 mm

Class I IEC/EN 60 255-21

20 / 055 / 04 IEC/EN 60 068-1

EN 50 005

**Terminal designation:** EN 50 005

**Wire connection:** DIN 46 228-1/-2/-3/-4

#### Fixed screw terminals

Cross section: 0.2 ... 4 mm<sup>2</sup> (AWG 24 - 12) solid or

0.2 ... 2.5 mm<sup>2</sup> (AWG 24 - 12)

stranded wire with and without ferrules

7 mm

Stripping length: 7 mm

Fixing torque: 0.6 Nm EN 60 999-1

Wire fixing: Captive slotted screw / M2.5

#### Fixed

#### High-voltage terminals

Cross section: 0.2 ... 6 mm<sup>2</sup> (AWG 24 - 10) massiv oder

0.2 ... 4 mm<sup>2</sup> (AWG 24 - 10)

stranded wire without ferrules

0.25 ... 4 mm<sup>2</sup> (AWG 24 - 10)

stranded wire with ferrules

8 mm

Stripping length: 8 mm

Fixing torque: 0.7 Nm EN 60 999-1

Wire fixing: Captive slotted screw / M3

**Mounting:** DIN rail IEC/EN 60 715

#### Weight:

RL 9877: approx. 105 g

RN 9877: approx. 125 g

### Dimensions

**Width x height x depth:**

RL 9877: 35 x 90 x 71 mm

RN 9877: 52.5 x 90 x 71 mm

### UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition

ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition

CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

#### Switching capacity:

Pilot duty B300

5A 240Vac Resistive, G.P.

5A 30Vdc Resistive or G.P.

5A 250Vac G.P.

#### Wire connection:


60°C / 75°C copper conductors only

RL 9877: AWG 24 - 12 Sol/Str Torque 0.6 Nm

RN 9877

for terminals 11, 12, 14: AWG 24 - 12 Sol/Str Torque 0.6 Nm

for terminals L1, L2, L3, N: AWG 30 - 10 Sol/Str Torque 0.7 Nm

 **Technical data that is not stated in the UL-Data, can be found in the technical data section**

## Standard Types

RL 9877.11 3/N 80 ... 230 V / 45 ... 130 V 4 ... 20 % 0 ... 30 s

Article number: 0066426

- Output: 1 changeover contact
- Measuring voltage: 3/N AC 80 ... 230 V / 45 ... 130 V
- Hysteresis: 4 ... 20 %
- Switching delay: 0 ... 30 s
- Width: 35 mm

RN 9877.11 3/N 175 ... 525 V / 100 ... 300 V 4 ... 20 % 0 ... 30 s

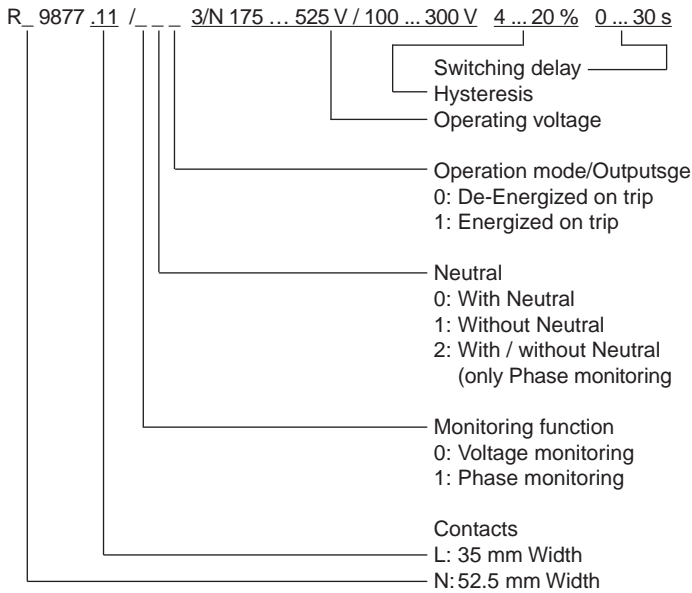
Article number: 0066425

- Output: 1 changeover contact
- Measuring voltage: 3/N AC 175 ... 525 V / 100 ... 300 V
- Hysteresis: 4 ... 20 %
- Switching delay: 0 ... 30 s
- Width: 52.5 mm

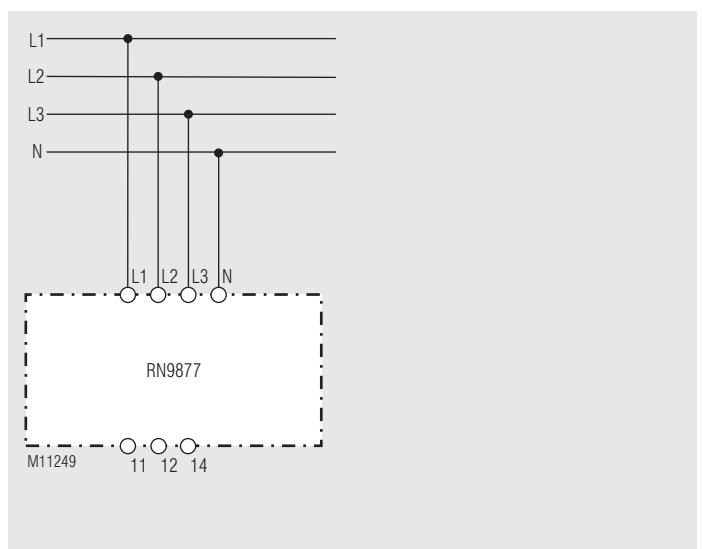
## Variant

RN 9877.11/120: to detect phase failure, indications of the missing phase via LED; can be used with or without neutral

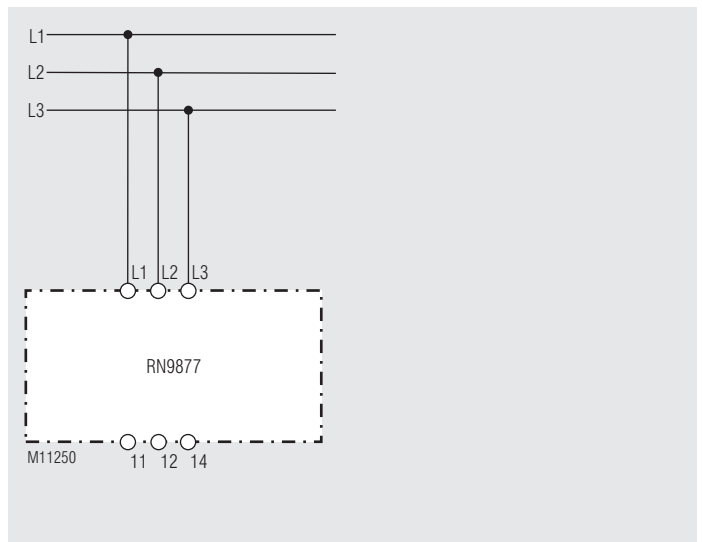
## Ordering example for variant



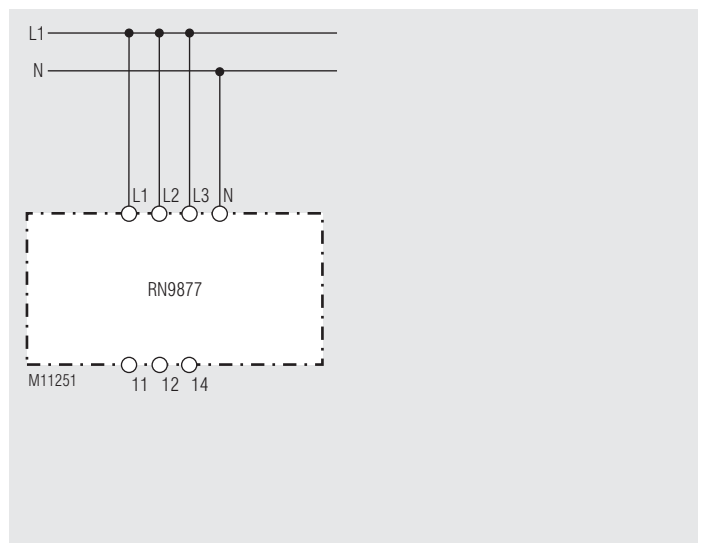
## Connection Examples



3-phase connection with neutral



3-phase connection without neutral



Single-phase connection

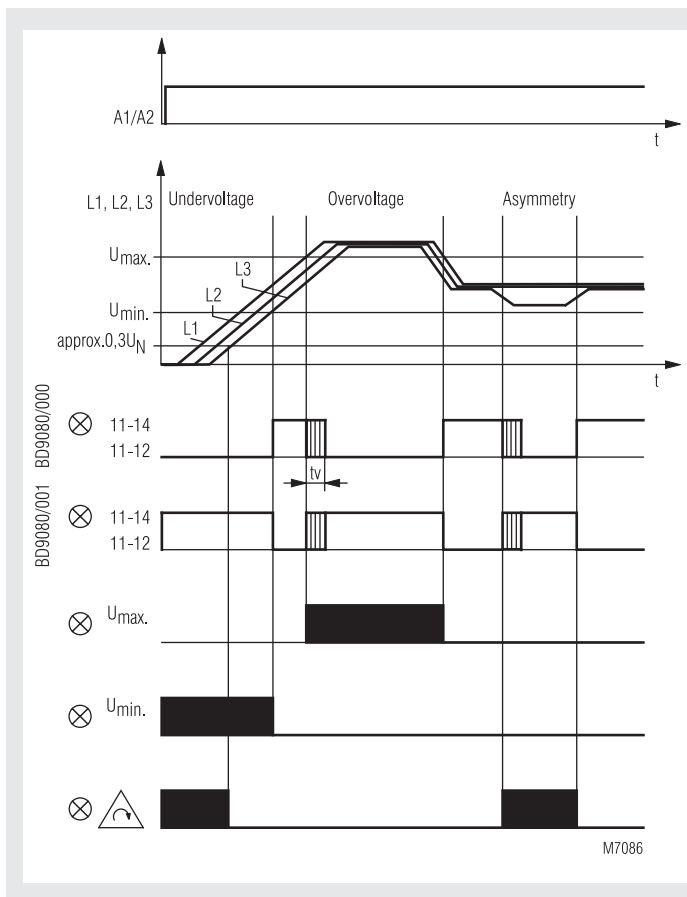
# Monitoring Technique

**VARIMETER PRO**  
Phase Monitor  
BD 9080



- According to IEC/EN 60255-1
- Monitoring of
  - Under- and overvoltage
  - Asymmetry
  - Phase failure
  - Phase sequence
- Adjustable time delay between 0.1 ... 5 s
- One LED in each case for:
  - Auxiliary voltage A1/A2
  - Overvoltage  $U_{max}$
  - Undervoltage  $U_{min}$
  - Asymmetry / Phase sequence / Power failure
  - Contact position
- Closed circuit operation
- 2 changeover contacts
- As option available with open circuit operation
- Width 45 mm

## Function Diagram



## Approvals and Markings



\*) see variants

## Applications

For monitoring three-phase networks for undervoltage, overvoltage, phase sequence, asymmetry, power failure.

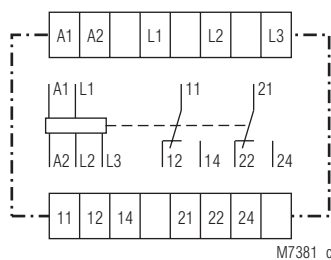
## Indication

- LED A1 / A2: on, when operating voltage present
- LED  $U_{max}$ : on, in event of overvoltage
- LED  $U_{min}$ : on, in event of undervoltage
- LED  $\Delta$ : on, in event of:
  - asymmetry
  - incorrect phase sequence
  - power failure
- LED: on, when output relay activated

## Notes

Measurement procedures: arithmetical mean value measurement over several half-waves of rectified phase voltages L1/L2 and L2/L3. Reference phase is L3. Networks with or without neutral can be monitored. The auxiliary voltage to be applied to A1/A2 can also be taken from the three-phase network which is to be monitored. This reduces to 0.8 - 1.1  $U_H$  the permitted range of voltage of the network to be monitored.

## Circuit Diagram



## Technical Data

### Input Circuit

<b>Nominal voltage <math>U_N</math></b>	3 AC 230, 400, 690 V
L1 / L2 / L3:	(other voltages on request)
<b>Setting range:</b>	0.7 ... 1.3 $U_N$
<b>Overload capacity of <math>U_N</math>:</b>	1.5 $U_N$ / 2 $U_N$ (10 s) max. 1 000 V
<b>Nominal frequency of <math>U_N</math>:</b>	50 / 60 Hz
<b>Frequency range of <math>U_N</math>:</b>	45 ... 65 Hz
<b>Accuracy:</b>	$\leq \pm 0.5\%$ of $U_N$
<b>Power consumption with <math>U_N</math>:</b>	L1 approx. 0.5 mA L2 approx. 0.5 mA L3 approx. 0.8 mA
<b>Hysteresis:</b>	$\leq 5\% \times U_A$ ( $U_A$ = response value)
<b>Asymmetry detection</b>	
Voltage:	$U_A \pm 8\% \dots 20\%$
<b>Fault angle:</b>	approx. $120^\circ \pm 15^\circ$
<b>Temperature influence:</b>	$\leq 0.08\%$ / K

### Auxiliary Circuit

<b>Auxiliary voltage <math>U_H</math></b>	AC 110, 230, 400 V
A1 / A2:	AC/DC 24 ... 80 V, AC/DC 80 ... 230 V (other voltages on request)
<b>Voltage range of <math>U_H</math>:</b>	0.8 ... 1.1 $U_H$
<b>Nominal frequency of <math>U_H</math>:</b>	50 / 60 Hz
<b>Frequency range of <math>U_H</math>:</b>	45 ... 500 Hz
<b>Nominal consumption:</b>	2.4 VA

### Output Circuit

<b>Contacts:</b>	2 changeover contacts
<b>Response-/Release time:</b>	approx. 900 / 150 ms
<b>Time delay <math>t_v</math>:</b>	0.1 ... 5 s
<b>Thermal current <math>I_{th}</math>:</b>	6 A (see continuous current limit curve)
<b>Switching capacity</b>	
to AC 15	
NO contact:	2 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
to DC 13	
NO contact:	1 A / DC 24 V IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical life:</b>	IEC/EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	
NO contact:	2.5 x 10 <sup>5</sup> switching cycles
<b>Permissible switching frequency:</b>	20 switching cycles / s
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 50 \times 10^6$ switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range</b>	
Operation:	- 20 ... + 60°C
Storage:	- 20 ... + 60°C
<b>Altitude:</b>	< 2,000 m
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree	
auxiliary voltage:	6 kV / 2 IEC 60 664-1
Contact / contact:	4 kV / 2 IEC 60 664-1
Overvoltage category:	III
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 2.7 GHz:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between	
wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
HF wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011

## Technical Data

### Degree of protection

Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz,
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4
<b>Fixed screw terminals</b>	
Cross section:	0.1 ... 4 mm <sup>2</sup> (AWG 28 - 12) solid or 0.1 ... 2.5 mm <sup>2</sup> (AWG 28 - 12) stranded wire with ferrules
Stripping length:	10 mm
<b>Fixing torque:</b>	0.8 Nm
<b>Wire fixing:</b>	Cross-head screw / M3,5 box terminals
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	325 g

### Dimensions

<b>Width x height x depth:</b>	45 x 74 x 133 mm
--------------------------------	------------------

### Classification to DIN EN 50155

<b>Vibration and shock resistance:</b>	Category 1, Class B IEC/EN 61 373
<b>Protective coating of the PCB:</b>	No

### UL-Data

<b>Switching capacity:</b>	Pilot duty B300
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Technical data that is not stated in the UL-Data, can be found in the technical data section.

### CCC-Data

<b>Thermal current <math>I_{th}</math>:</b>	5 A
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Technical data that is not stated in the CCC-Data, can be found in the technical data section.

### Standard Type

BD 9080.12	3 AC 400 V AC 230 V
Article number:	0045382
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3 AC 400 V
• Auxiliary voltage $U_H$ :	AC 230 V
• Closed circuit operation	
• Width:	45 mm

## Variants

BD 9080.12/61:

with UL-approval on request

BD 9080:

with CCC-approval on request

BD 9080.12/001:

open circuit operation

BD 9080.12/020:

output relay

BD 9080.12/200:

indicates only under- and overvoltage with extended temperature range of - 40 ... + 70 °C

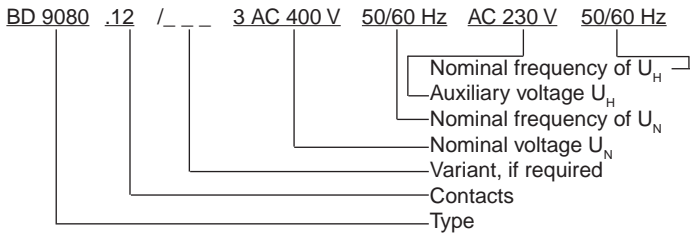
### Remark

At an ambient temperature of + 70°C the device has to be mounted with 2 cm space to the neighbour units and the necessary air circulation must be provided.

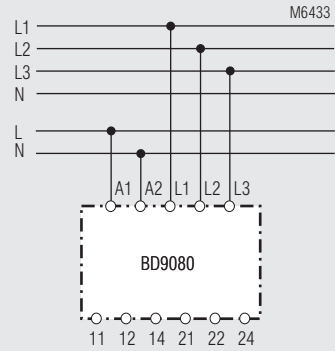
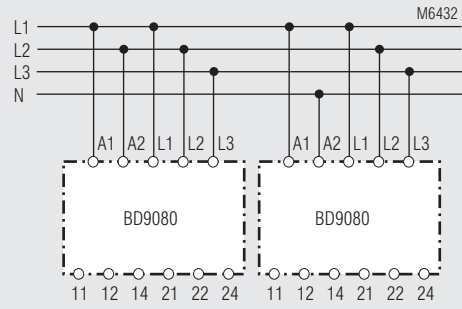
The contact current must not be more then 2 A.

The life of the product may be reduced by the higher ambient temperature!

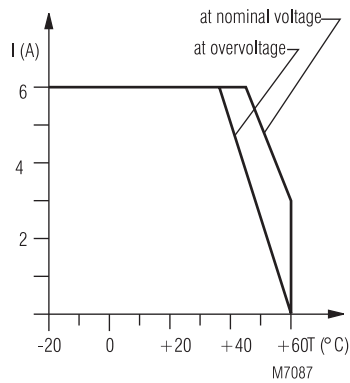
### Ordering example for variant



## Connection Examples



## Characteristic



Continuous current limit curve

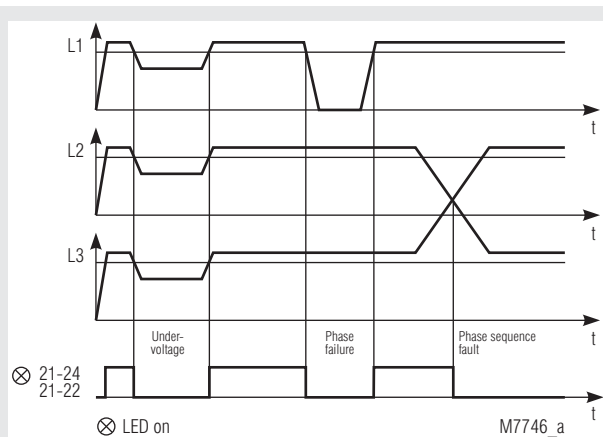
## VARIMETER PRO

Phase Monitor with thermistor motor protection  
IL 9086, SL 9086

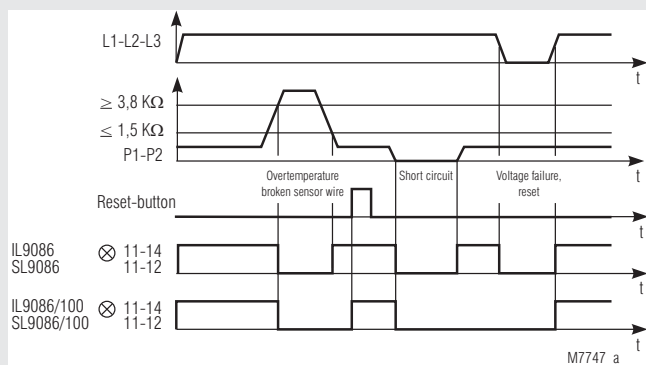


- According to IEC/EN 60 255-1, IEC/EN 60 947-8 (pr EN 60 947-8) and part 303
- Monitoring of
  - Undervoltage 3 phase
  - Phase failure
  - Phase sequence
  - Loss of neutral
  - Phase asymmetry
  - Overtemperature
  - Broken wire in thermistor circuit
  - Short circuit in thermistor circuit
- Without auxiliary supply
- 1 sensing input for 1 ... 6 thermistors
- LED indication
  - Supply voltage
  - Measuring voltage
  - Temperature
- As option with manual reset on temperature fault
- 2 x 1 changeover contact
- **Devices available in 2 enclosure versions:**
  - IL 9086:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9086:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

### Function Diagrams



### Voltage



### Temperature

### Approvals and Markings



### Applications

Monitoring of 3-phase Motor systems with temperature sensing of the Motor thermistors, e.g. for elevators.

### Function

When the voltage of the system and the temperature of the load is correct all three LED are on. The device has 2 separate relay outputs. If a temperature fault is detected relay 1 trips (deenergises on fault). If a voltage fault occurs relay 2 trips. The unit can be used for 3p 3w and 3p 4w systems. If connected to a 3 wire system the N-terminal remains unconnected.

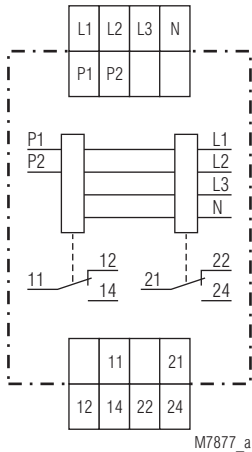
### Indicators

Left green LED:	on when supply connected
Right green LED:	on when measured voltage is correct
Middle green LED ∅:	on when temperature correct

### Notes

A short circuit between P1 - P2, i.e. between the sensor lines, will be detected. This is independent of the number of sensors. If more than one thermistors are connected in series, a short circuit across one sensor cannot be detected. The PTC input is galvanically separated from the supply and measuring voltage as well as from the output contacts.

## Circuit Diagram



## Connection Terminals

Terminal designation	Signal designation
L1, L2, L3, N	Measuring- or supply input
P1, P2	Thermistor input
11, 12, 14; 21, 22, 24	Changeover contacts

## Technical Data

### Measuring Input Voltage

#### Measuring voltage

L1 / L2 / L3 / N: 3 / N AC 400 / 230 V  
(other voltages on request)

**Voltage range:** 0.8 ... 1.1  $U_N$

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** 45 ... 65 Hz

**Undervoltage detection:** approx.  $0.7 \pm 0.15 \times U_N$

**Asymmetry detection:** approx. 20° angle asymmetrie

**Hysteresis:**  $\leq 6 \% \times U_N$

**Response delay:** 100 ... 300 ms

**Operate delay:** 15 ... 30 ms ( $0V \Rightarrow U_N$ )

### Measuring Input Thermistor (P1,P2)

**Temperature sensor:** PTC-sensor acc. to DIN 44 081/082

**Number of sensors:** 1 ... 6 piece in series

**Response value:** 3.2 ... 3.8 k $\Omega$

**Reset value:** 1.5 ... 1.8 k $\Omega$

**Short circuit in sensor line:** 10 ... 30  $\Omega$

**Load on sensor circuit:** < 5 mW (at R = 1.5 k $\Omega$ )

**Broken sensor circuit:** > 3.8 k $\Omega$

**Measuring voltage:**  $\leq 2$  V (at R = 1.5 k $\Omega$ )

**Measuring current:**  $\leq 1$  mA (at R = 1.5 k $\Omega$ )

**Voltage on P1,P2**

**on open sensor circuit:** approx. DC 12 V

**Short circuit current on sensor circuit:** approx. DC 1.5 mA

### Relay Output

#### Contacts

IL/SL 9086.38: 1 changeover contact  
(phase failure, contact 21-22-24)

1 changeover contact  
(temperature fault, contact 11-12-14)

**Contact material:** AgNi 0.15 + 0.3  $\mu$ m AU

**Thermal current  $I_{th}$ :** 2 x 4 A

#### Switching capacity

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

#### Electrical life:

to AC 15 at 1 A, AC 230 V: 6 x 10<sup>5</sup> switching cycles IEC/EN 60 947-5-1

**Switching voltage:** min. 10 V ; max. DC 120 V / AC 250 V

**Switching current:** min. 0.1 A ; max. 5 A

**Switching load:** min. 1 W, 1 VA; max. 120 W, 1250 VA

#### Short circuit strength

max. fuse rating: 4 A gG / gL IEC/EN 60947-5-1

**Mechanical life:** > 10<sup>8</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

### Temperature range

Operation: - 20 ... + 60 °C

Storage: - 25 ... + 60 °C

**Altitude:** < 2.000 m

### Input current

L1: approx. 7 mA

L2: approx. 7 mA

L3: approx. 1.5 mA

approx. 3.5 VA

### Nominal consumption:

### Clearance and creepage distances

Rated impulse voltage /

pollution degree

Input/Output: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation

80 MHz ... 2.7 GHz: 10 V/m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour  
according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

#### Wire connection

max. cross section: 2 x 2.5 mm<sup>2</sup> solid or

2 x 1.5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4

Stripping length: 10 mm

**Fixing torque:** 0,8 Nm

**Mounting:** DIN rail IEC/EN 60 715

**Weight**

IL 9086: 185 g

SL 9086: 230 g

### Dimensions

#### Width x height x depth

IL 9086: 35 x 90 x 59 mm

SL 9086: 35 x 90 x 98 mm

### Standard Type

IL 9086.38 3 AC 400 V and 3 / N AC 400 / 230 V  
 Article number: 0053087  
 • Output: 1 changeover contact (phase failure)  
 1 changeover contact (temperature fault)  
 • Nominal voltage  $U_N$ : 3 AC 400 V and 3 / N AC 400 / 230 V  
 • Width: 35 mm

SL 9086.38 3 AC 400 V and 3 / N AC 400 / 230 V  
 Article number: 0054751  
 • Output: 1 changeover contact (phase failure)  
 1 changeover contact (temperature fault)  
 • Nominal voltage  $U_N$ : 3 AC 400 V and 3 / N AC 400 / 230 V  
 • Width: 35 mm

### Variant

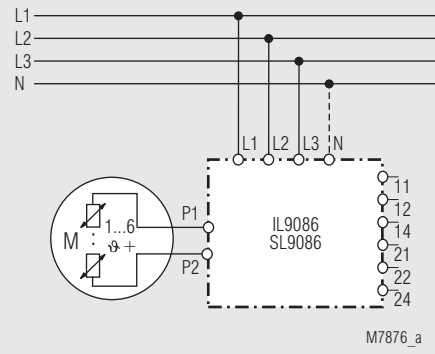
IL 9086.38/100 with manual reset after detection of overtemperature or short circuit in the sensor circuit. The output can be reset by pressing the reset button or by disconnecting the voltage for a short period after the temperature returned to good value.

### Ordering example vor variant

IL 9086 .38 / \_ 00 3/N AC 400/230 V 50/60 Hz

\_\_\_\_\_ Nominal frequency  
 \_\_\_\_\_ Measuring voltage  
 \_\_\_\_\_ 1 with manual reset  
 \_\_\_\_\_ Contacts  
 1 changeover contacts  
 phase failure  
 1 changeover contact  
 temperature fault  
 \_\_\_\_\_ Type

### Connection Examples





# Monitoring Technique

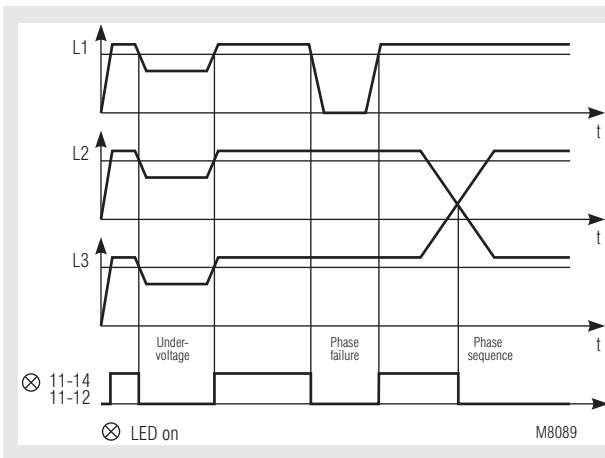
**VARIMETER PRO**  
**Phase Monitor**  
**IL 9087, SL 9087**



0237783

- According to IEC/EN 60 255-1
- Monitoring of phase failure
  - Undervoltage 3-phase 3 or 4 wire
  - Phase failure
  - Phase sequence
  - Loss of neutral
  - Phase asymmetry
- Without auxiliary supply
- De-energized on trip
- LED indication
  - Supply voltage
  - Phase failure
- 1 or 2 changeover contacts
- Devices available in 2 enclosure versions:
  - IL 9087: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9087: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

## Function Diagram



Voltage

## Approvals and Markings



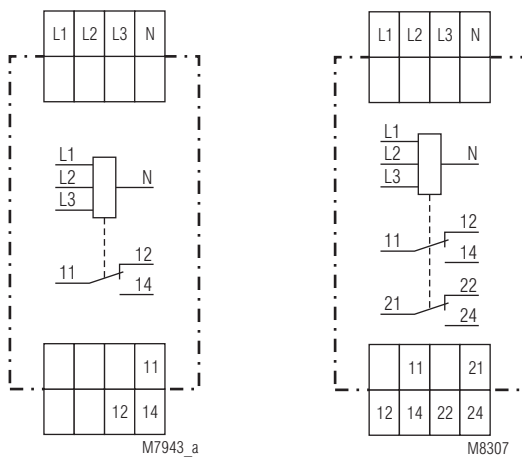
## Applications

Monitoring of 3-phase systems with motors, e. g. for elevators.

## Function

On a healthy voltage system both LEDs are on. If a voltage failure occurs the contact 11-14, 21-24 opens. In 3-phase voltage systems with unbalanced load the unit can also detect the loss of neutral on the input line of the system. If a neutral is not used the N-terminal remains unconnected.

## Circuit Diagrams



IL 9087.11,  
 SL 9087.11

IL 9087.12,  
 SL 9087.12

## Indicators

left green LED: on when voltage connected  
 right green LED: on when measuring voltage correct

## Connection Terminals

Terminal designation	Signal designation
L1, L2, L3, N	Measuring- or supply input
11, 12, 14; 21, 22, 24	Changeover contacts

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	3 / N AC 400 / 230 V (other voltages on request)
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	45 ... 65 Hz
<b>Undervoltage detection:</b>	approx. $0.7 \pm 0.15 \times U_N$
<b>Asymmetry detection:</b>	approx. 20° phase asymmetry
<b>Hysteresis:</b>	$\leq 6\% \times U_N$
<b>Response delay:</b>	100 ... 300 ms
<b>Operate delay:</b>	15 ... 30 ms ( $0V \Rightarrow U_N$ )

### Output

<b>Contacts</b>	
IL/SL 9087.11:	1 changeover contact
IL/SL 9087.12:	2 changeover contacts
<b>Contact material:</b>	AgNi 0.15 + 0.3 $\mu\text{m}$ AU
<b>Thermal current <math>I_{th}</math>:</b>	2 x 4 A
<b>Switching capacity</b> to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life:</b>	IEC/EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	6 x 10 <sup>5</sup> switching cycles
<b>Switching voltage:</b>	min. 10 V ; max. DC 120 V / AC 250 V
<b>Switching current:</b>	min. 0.1 A ; max. 5 A
<b>Switching capacity:</b>	min. 1 W, 1 VA; max. 120 W, 1250 VA
<b>Short circuit strength</b> max. fuse rating:	4 A gG / gL IEC/EN 60947-5-1
<b>Mechanical life:</b>	> 10 <sup>8</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range</b>	
Operation:	- 20 ... + 60 °C
Storage:	- 25 ... + 60 °C
<b>Altitude:</b>	< 2.000 m
<b>Input current</b>	
L1:	approx. 7 mA
L2:	approx. 7 mA
L3:	approx. 1.5 mA
<b>Nominal consumption:</b>	approx. 3.5 VA
<b>Clearance and creepage distances</b>	
Rated impulse voltage / pollution degree	
Input/Output:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF-irradiation	
80 MHz ... 2.7 GHz:	10 V/m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between	
wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
HF wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL Subj. 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Wire connection</b> max. cross section:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
Stripping length:	10 mm
<b>Fixing torque:</b>	0,8 Nm

## Technical Data

<b>Mounting:</b>	DIN-rail	IEC/EN 60 715
<b>Weight</b>		
IL 9087:	185 g	
SL 9087:	230 g	

### Dimensions

<b>Width x height x depth</b>	
IL 9087:	35 x 90 x 59 mm
SL 9087:	35 x 90 x 98 mm

### Classification to DIN EN 50155 for SL 9087

<b>Vibration and shock resistance:</b>	Category 1, Class B	IEC/EN 61 373
<b>Protective coating of the PCB:</b>	No	

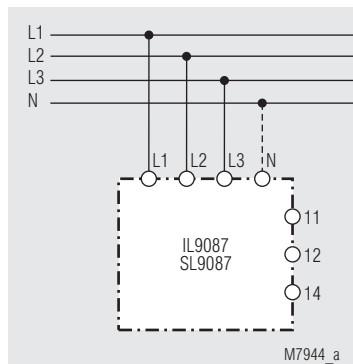
### Standard Types

<b>IL 9087.12</b>	3 AC 400 V and 3 / N AC 400 / 230 V
Article number:	0054502
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3 AC 400 V and 3 / N AC 400 / 230 V
• Width:	35 mm
<b>SL 9087.12</b>	3 AC 400 V and 3 / N AC 400 / 230 V
Article number:	
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3 AC 400 V and 3 / N AC 400 / 230 V
• Width:	35 mm

### Ordering Example

IL 9087	.11	3/N AC 400 / 230 V	50 / 60 Hz	
				Nominal frequency
				Measuring voltage
				Contacts
				Type

### Connection Examples



## VARIMETER PRO

### Over- and Undervoltage Relay

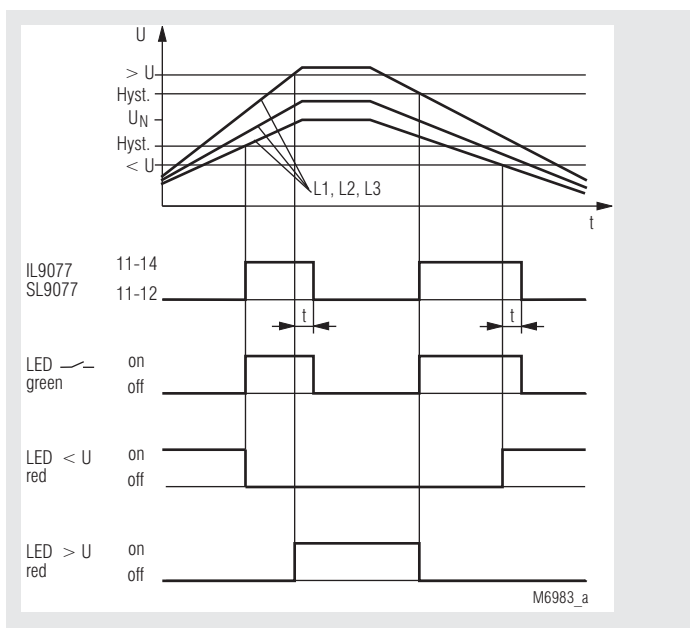
IL 9077, IP 9077, SL 9077, SP 9077



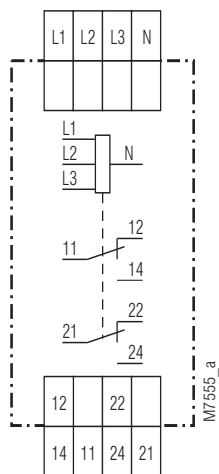
0222093

- According to IEC/EN 60 255-1
- Identification of overvoltage, undervoltage and phase failure
- With asymmetry identification as an option
- Mains fault diagnostics with a number of LEDs
- Setting values for overvoltage and undervoltage can be set separately
- Large Setting Ranges  $0.9 \dots 1.3 U_N$  and  $0.7 \dots 1.1 U_N$
- Time delay variable between  $0.1 \dots 20$  s
- Closed circuit operation
- No auxiliary voltage
- Independant of phase sequence
- As option with phase sequence detection
- Single-phase connection possible
- Optionally for 3P3W Systems
- 2 changeover contacts, at IP/SP 9077 2 x 2 changeover contacts
- Devices available in 2 enclosure versions:
  - I-model: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- IL 9077, SL 9077: width 35 mm
- IP 9077, SP 9077: width 70 mm

### Function Diagram IL 9077



### Circuit Diagram



IL 9077.12, SL 9077.12

### Approvals and Markings



\*) only IL 9077

### Applications

Monitoring of three-phase voltage systems to identify overvoltage and undervoltage, e.g. to monitor in-house generation equipment in accordance with VDE 0100.

### Function

All 3 phase voltages are measured with N (L1 and L2 are measured against L3 in the case of equipment without an N connection). If they are in the acceptable range, a green LED goes on and the output relay is activated. If at least one phase exceeds the setting value for overvoltage (variable between  $0.9 \dots 1.3 U_N$ ) or if at least one phase falls short of the setting value for undervoltage (variable between  $0.7 \dots 1.1 U_N$ ), the output relay releases after the set time delay and the green LED goes off (fault state). 2 red LEDs then indicate the cause of the fault:

- Undervoltage " $< U$ "
- Overvoltage " $> U$ "

When all 3 phase voltages are below the chosen setting value for overvoltage and above the chosen setting value for undervoltage again, the relevant red LED goes out, the output relay is activated again and the green LED goes on again (acceptable state).

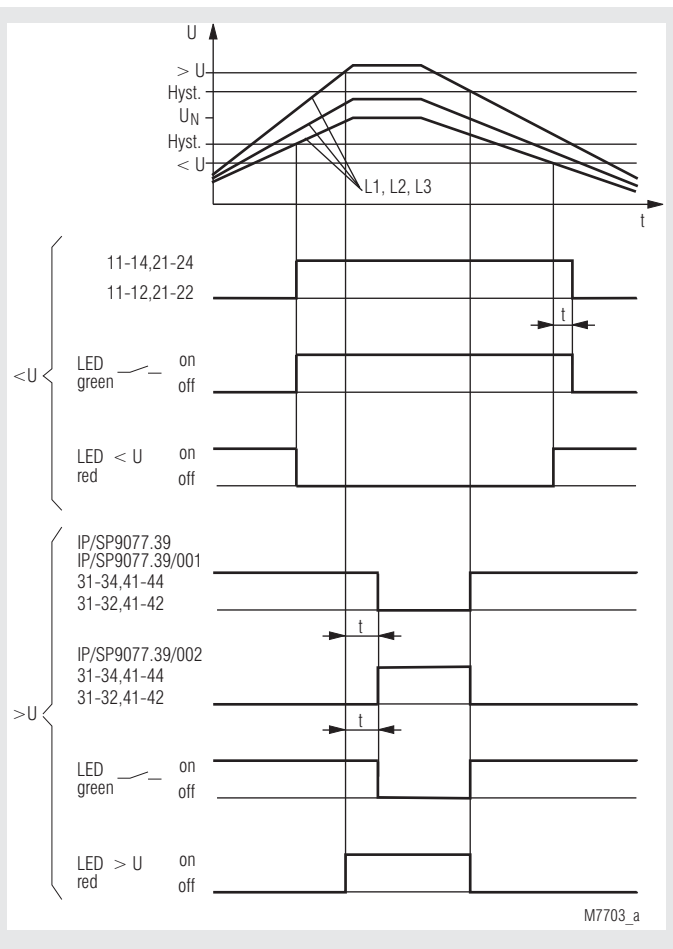
When the system returns to an acceptable state, there is a hysteresis of about 4 % of the set value with both the set voltage thresholds.

On the unit with phase sequence detection IL/SL 9077/003 (only available without neutral) the wrong phase sequence is handled like undervoltage: The red LED " $< U$ " is active and the output relay switches off.

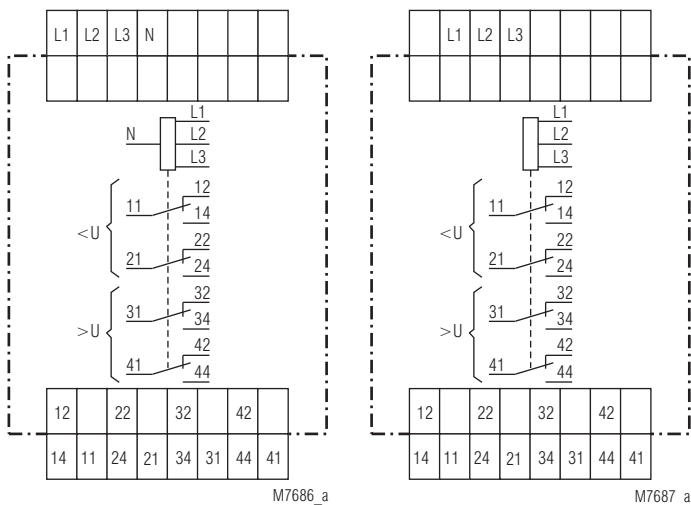
The model with asymmetry identification IL/SL 9077/010 monitors the symmetry of the three-phase voltage system as well. When all 3 voltages are in the acceptable range between the two setting values here, but there is voltage asymmetry of more than about 6 ... 8 %, the output relay releases after the set time delay and the LED that is green when the state is acceptable goes red. (This model can, for example, also be used for immediate identification of the regeneration of failed phases by feedback).

The IP/SP 9077.39 is an under- and overvoltage relay with separate output relays (each with 2 changeover contacts) for undervoltage and overvoltage monitoring. For every output a separate delay  $0.1 \dots 20$  s is adjustable.

## Function Diagram IP 9077



## Circuit Diagrams



IP 9077.39, SP 9077.39

IP 9077.39/001, SP 9077.39/001  
IP 9077.39/002, SP 9077.39/002

## Indicators

green LED  :	state
green LED goes red:	voltage asymmetry (only IL/SL 9077/010)
red LED "< U":	fault message / undervoltage
red LED "> U":	fault message / overvoltage

## Notes

The terminals L1, L2 and L3 have to be bridged if the relay is used in single phase systems. (For 3p3w units L1 and L2 have to be linked).  
The maximum fault delay amounts to only about 0.6 s if there is a total failure of phase L3.  
The overvoltage output on IP/SP 9077.39/002 can only switch if the voltage between L2 and L3 is  $> 0.7 U_N$  as the unit works without auxiliary supply.

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	
single-phase connection:	AC 100V , 115 V, 220 V, 230 V, AC 400 V, 415 V, 440 V, 500 V
3-phase without neutral connection:	3AC 100 V, 115 V, 220 V, 230 V, 3AC 400 V, 415 V, 440 V, 480 V, 500 V
3-phase with neutral connection:	3/N AC 100 V / 58 V; 3/N AC 110 V / 64 V; 3/N AC 200 V / 115 V; 3/N AC 220 V / 127 V; 3/N AC 230 V / 133 V; 3/N AC 400 V / 230 V; 3/N AC 415 V / 240 V; 3/N AC 440 V / 254 V; 3/N AC 480 V / 277 V; 3/N AC 500 V / 290 V
<b>Voltage range:</b>	$0.7 \dots 1.3 U_N$
<b>Maximum overload:</b>	$1.35 U_N$ , permanent
<b>Nominal consumption:</b>	approx. 8 VA (L3-N) (approx. 16 VA for IP 9077)
<b>Nominal frequency:</b>	50 / 60 Hz

### Setting Ranges

<b>Setting value for overvoltage "&gt; U":</b>	variable between $0.9 \dots 1.3 U_N$
<b>Setting value for undervoltage "&lt; U":</b>	variable between $0.7 \dots 1.1 U_N$
<b>Hysteresis:</b>	approx. 4 % of the set value in each case
<b>Time delay:</b>	variable between 0.1 ... 20 s
<b>Threshold for asymmetry identification</b> IL/SL 9077/010:	approx. 6 ... 8 % phase asymmetry

### Output

<b>Contacts</b>	
IL/SL 9077.12:	2 changeover contacts
IP/SP 9077.39:	2 x 2 changeover contacts
<b>Contact material:</b>	AgNi
<b>Switching voltage:</b>	AC 250 V
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity</b>	
to AC 15:	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	2 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life:</b>	IEC/EN 60 947- 5-1
to AC 15 at 1 A, AC 230 V:	$\geq 1.5 \times 10^5$ switching cycles
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$30 \times 10^6$ switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	
Operation:	- 20 ... + 60 °C
Storage:	- 25 ... + 60 °C
Relative air humidity:	93 % at 40 °C
<b>Altitude:</b>	< 2,000 m
<b>Clearance and creepage distances</b>	
rated rated impulse voltage voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 1 GHz:	10 V / m IEC/EN 61 000-4-3
1 GHz ... 2 GHz:	10 V / m IEC/EN 61 000-4-3
2 GHz ... 2.7 GHz:	10 V / m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between	
wires for power supply:	2 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011

## Technical Data

<b>Degree of protection:</b>	Housing: IP 40 IEC/EN 60 529 Terminals: IP 20 IEC/EN 60 529
<b>Housing:</b>	Highly non-flammable thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight</b>	
IL 9077:	110 g
SL 9077:	137 g
IP 9077:	210 g
SP 9077:	259 g

## Dimensions

### Width x height x depth

IL 9077:	35 x 90 x 59 mm
SL 9077:	35 x 90 x 98 mm
IP 9077:	70 x 90 x 59 mm
SP 9077:	70 x 90 x 98 mm

## Standard Types

IL 9077.12 3/N AC 400 / 230 V 0.1 ... 20 s

Article number:	0045788
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3/N AC 400/230 V
• De-energized on trip	
• Variable time delay	0.1 ... 20 s
• Width:	35 mm

SL 9077.12 3/N AC 400 / 230 V 0.1 ... 20 s

Article number:	0054758
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3/N AC 400/230 V
• De-energized on trip	
• Variable time delay	0.1 ... 20 s
• Width:	35 mm

## Variants

I_ 9077._._/001:	3p3w, de-energized on trip
IL 9077.12/003:	3p3w, de-energized on trip with phase sequence detection
IL 9077.12/010:	3p4w, de-energized on trip with asymmetry detection
IL 9077.12/011:	3p3w, de-energized on trip with asymmetry detection
IL 9077.12/800:	with fast response and high overload at overvoltage. See datasheet IL 9077/800.
IP 9077.39:	3p4w, de-energized on trip
IP 9077.39/002:	3p3w, undervoltage output de-energized on trip, overvoltage output energized on trip

## Ordering example for variants

IL 9077	.12	/	---	3/N AC 400/230 V	50 / 60 Hz	0.1 ... 20 s
						Time delay
						Nominal frequency
						Nominal voltage
						Variant, if required
						Contacts
						Type

## VARIMETER Voltage Relay RL 9836



0273490



### Your Advantages

- Preventive maintenance
- For better productivity
- High repeat accuracy
- Wide measuring voltage range
- Easy setting

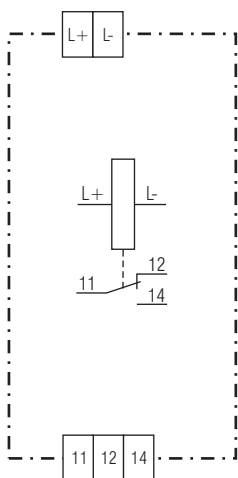
### Features

- According to IEC/EN 60 255-1
- For DC monitoring
- Detection of
  - Overvoltage
  - Undervoltage
  - Voltage range excess in single-phase AC voltage systems
- No separate auxiliary necessary
- Output: 1 changeover contact
- De-energized on trip
- Adjustable switching voltage
- Adjustable hysteresis for reset
- Adjustable switching delay
- Fast fault detection
- Width: 35 mm

### Product Description

The measuring relay RL 9836 of the VARIMETER series monitors over-voltage, undervoltage and voltage range in DC voltage systems. The measurement is very simple and without extensive wiring as there is no auxiliary power supply necessary. The monitoring functions are easily selectable using a single turn switch without complex menu structure. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

### Circuit Diagram



M11433

### Connection Terminals

Terminal designation	Signal designation
L +	Positiv voltage measuring input
L -	Negative voltage measuring input
11, 12, 14	Changeover contact (outputrelay)

### Approvals and Markings



### Application

- For monitoring direct current voltage supply systems to detect undervoltage, overvoltage
- Switch over to emergency supply after fault detection

### Function

When monitoring overvoltage, undervoltage and voltage range, the exceeding of the setting values above or below the thresholds is indicated by flashing of the voltage indicating LED. After the time delay the voltage indicating is continuously on and the relay de-energises. If the voltage returns to normal value, the LED goes immediately off and the output relay energises.

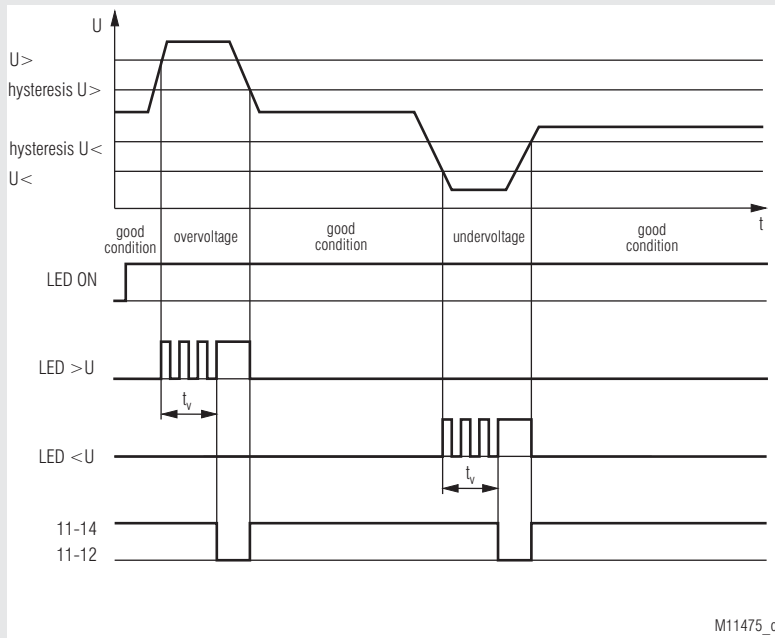
The output relay is de-energized on trip.

In the voltage range monitoring mode the nominal voltage range  $U \pm \Delta U$  is adjustable. An alarm is evoked in case the voltage leaves this monitoring range. The hysteresis for switching back into good condition is half the value set by the potentiometer  $\Delta U$ .

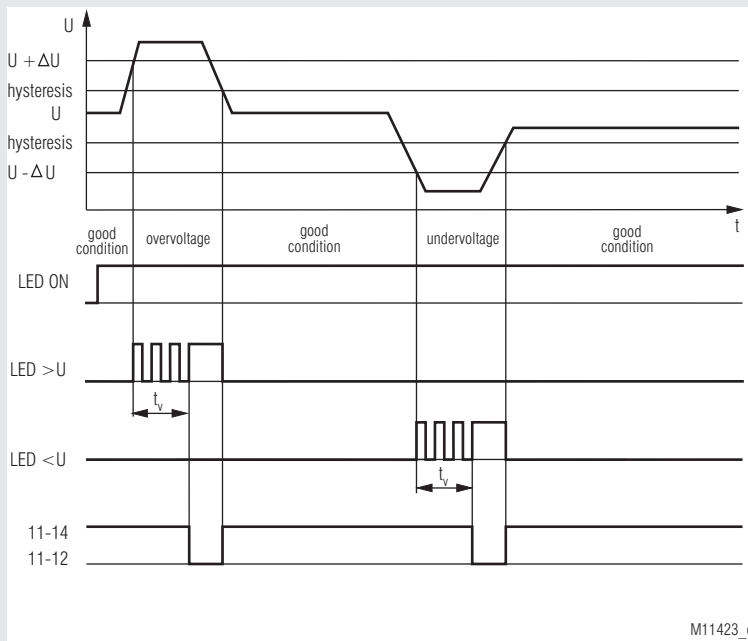
### Indicator

green LED „ON“:	on, when supply connected
red LED „>U“:	on, when overvoltage
red LED „<U“:	on, when undervoltage

## Function Diagrams



Monitoring function: overvoltage / undervoltage; rotary switch: „U>“ / „U<“



Monitoring function: voltage range; rotary switch: „U<>“

## Notes

The following monitoring functions are selectable using the 3-step function switch:

Function select	Monitoring function
U>	Overvoltage
U<	Undervoltage
U<>	Voltage range

## Technical Data

### Input

**Operating voltage  $U_b$ :** DC 24 ... 130 V; DC 50 ... 250 V  
**Voltage rated operating  $U_e$ :** DC 28 ... 118 V; DC 59 ... 227 V  
**Nominal consumption:** approx. 2 W

### Output

**Contacts:** 1 changeover contact  
**Contact material:** AgNi  
**Switching voltage:** AC 250 V  
**Thermal current  $I_{th}$ :** 5 A  
**Switching capacity to AC 15:**  
 NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical life to AC 15 at 1 A, AC 230 V:** typ.  $3 \times 10^5$  switching cycles  
**Short circuit strength max. fuse rating:** 5 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $> 30 \times 10^6$  switching cycles

### Measuring circuit

**Measuring voltage:** infinite adjustable  
 DC 24 ... 130 V; DC 50 ... 250 V  
**Hysteresis:** infinite adjustable 4 ... 20 %  
**Switching delay  $t_d$ :** infinite adjustable  
 instantaneous, 2 ... 30 s  
**Repeat accuracy:**  $\pm 2$  %  
**Temperature influence:**  $\pm 1$  %  
**Attention:**  
**The combination of adjusted switching voltage U and hysteresis  $\Delta U$  must be within the measuring range**

### General Data

**Operating mode:** continuous operation  
**Temperature range:**  
 Operation: - 20 ... + 55 °C  
 Storage: - 25 ... + 60 °C  
 Relative air humidity: 93 % at 40 °C  
**Altitude:** < 2,000 m  
**Clearance and creepage distances:**  
 Rated impuls voltage/ Pollution degree: 4 kV / 2 IEC 60 664-1  
**EMC:**  
 Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2  
 HF irradiation  
 80 MHz ... 1 GHz: 12 V / m IEC/EN 61 000-4-3  
 1 GHz ... 2,7 GHz: 10 V / m IEC/EN 61 000-4-3  
 Fast transients: 2 kV IEC/EN 61 000-4-4  
 Surge between wires for power supply: 2 kV IEC/EN 61 000-4-5  
 between wire and ground: 4 kV IEC/EN 61 000-4-5  
 HF wire guided: 10 V IEC/EN 61 000-4-6  
 Interference suppression: Limit value class B EN 55 011  
**Degree of protection:**  
 Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529  
**Enclosure:** Thermoplastic with V0 behaviour acc. to UL subject 94  
**Vibration resistance:** Amplitude 0.35 mm Class I IEC/EN 60 255-21  
**Climate resistance:** 20 / 055 / 04 IEC/EN 60 068-1  
**Terminal designation:** EN 50 005

## Technical Data

**Wire connection:** DIN 46 228-1/-2/-3/-4  
**Fixed screw terminals**  
 Cross section: 0.2 ... 4 mm<sup>2</sup> (AWG 24 - 12) solid or 0.2 ... 2.5 mm<sup>2</sup> (AWG 24 - 12) stranded wire with and without ferrules  
 Stripping length: 7 mm  
**Fixing torque:** 0.6 Nm EN 60 999-1  
**Wire fixing:** Captive slotted screw / M2.5  
**Mounting:** DIN rail IEC/EN 60 715  
**Nettogewicht:** approx. 105 g

## Dimensions

**Width x height x depth:** 35 x 90 x 71 mm

## UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition  
 ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition  
 CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

**Switching capacity:** Pilot duty B300  
 5A 240Vac Resistive, G.P.  
 5A 30Vdc Resistive or G.P.  
 5A 250Vac G.P.

**Wire connection:** 60°C / 75°C copper conductors only  
 AWG 24 - 12 Sol/Str Torque 0.6 Nm



Technical data that is not stated in the UL-Data, can be found in the technical data section

## Standard Type

RL 9836.11 DC 50 ... 250 V 4 ... 20 % 0 ... 30 s  
 Article number: 0066430  
 • Output: 1 Wechsler  
 • Operating voltage: DC 50 ... 250 V  
 • Hysteresis: 4 ... 20 %  
 • Switching delay: 0 ... 30 s  
 • Width: 35 mm

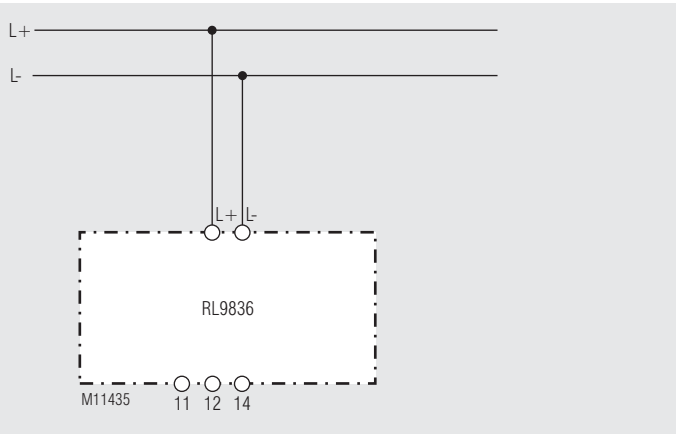
## Ordering example

RL 9836 .11 /00 DC 50 ... 250 V 4 ... 20 % 0 ... 30 s

Switching delay  
 Hysteresis  
 Operating voltage  
 DC 50 ... 250 V  
 DC 24 ... 130 V  
 Operation mode/Outputs  
 0: De-Energized on trip  
 1: Energized on trip  
 Contacts  
 Type



## Connection Example



Single-phase connection

## VARIMETER Voltage Relay RL 9854



0273496



### Your Advantages

- Preventive maintenance
- For better productivity
- High repeat accuracy
- Wide measuring voltage range
- Easy setting

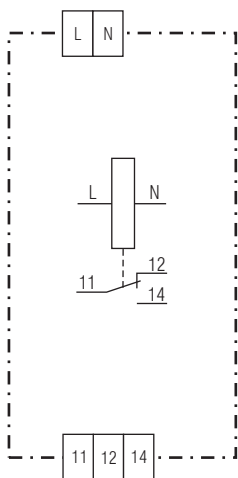
### Features

- According to IEC/EN 60 255-1
- For monitoring AC single phase with 50 /60 Hz
- Detection of
  - Overvoltage
  - Undervoltage
  - Voltage range excess in single-phase AC voltage systems
- No separate auxiliary necessary
- Output: changeover contact
- De-Energized on trip
- Adjustable switching voltage
- Adjustable hysteresis for reset
- Adjustable switching delay
- Fast fault detection
- Width: 35 mm

### Product Description

The measuring relay RL 9854 of the VARIMETER series monitors overvoltage, undervoltage and voltage range in single-phase systems. The measurement is very simple and without extensive wiring as there is no auxiliary power supply necessary. The monitoring functions are easily selectable using a single turn switch without complex menu structure. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

### Circuit Diagram



M11432

### Connection Terminals

Terminal designation	Signal designation
L	Phase voltage
N	Neutral
11, 12, 14	Changeover contact (outputrelays)

### Approvals and Markings



### Application

- Monitoring of voltage systems to detect over- and undervoltage
- Switch over to emergency supply after fault detection

### Function

When monitoring overvoltage, undervoltage and voltage range, the exceeding of the setting values above or below the thresholds is indicated by flashing of the voltage indicating LED. After the time delay the voltage indicating is continuously on and the relay de-energises. If the voltage returns to normal value, the LED goes immediately off and the output relay energises.

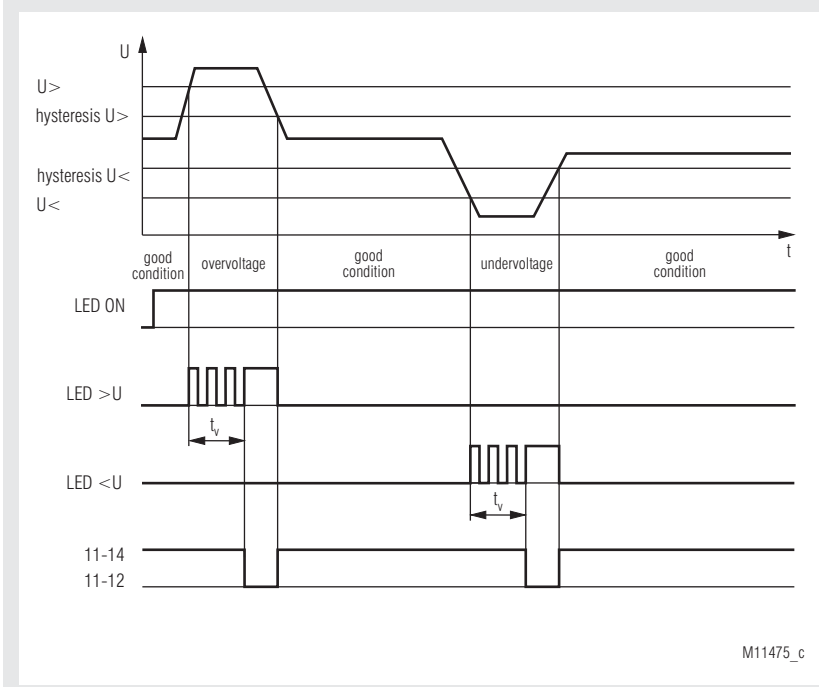
The output relay is de-energized on trip.

In the voltage range monitoring mode the nominal voltage range  $U \pm \Delta U$  is adjustable. An alarm is evoked in case the voltage leaves this monitoring range. The hysteresis for switching back into good condition is half the value set by the potentiometer  $\Delta U$ .

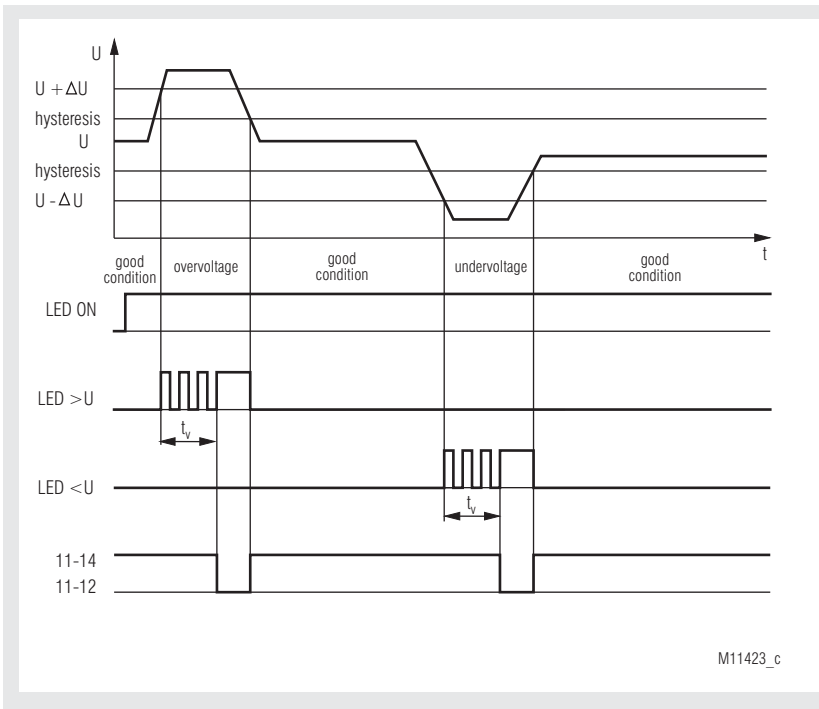
### Indicator

green LED „ON“:	on, when supply connected
red LED „>U“:	on, when overvoltage
red LED „<U“:	on, when undervoltage

Function Diagrams



Monitoring function: overvoltage / undervoltage; rotary switch: „U>“ / „U<“



Monitoring function: voltage range; rotary switch: „U<>“

## Notes

During initialisation the relay recognises the mains frequency (50 Hz or 60 Hz).

The following monitoring functions are selectable using the 3-step function switch:

Function select	Monitoring function
U>	Overvoltage
U<	Undervoltage
U<>	Voltage range

## Technical Data

### Input

<b>Operating voltage <math>U_b</math>:</b>	AC 100 ... 300 V, AC 45 ... 135 V single-phase with neutral
<b>Voltage rated operating <math>U_e</math>:</b>	AC 118 ... 273 V, AC 53 ... 123 V
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	45 ... 65 Hz
<b>Nominal consumption:</b>	approx. 7 VA

### Output

<b>Contact:</b>	1 changeover contact	
<b>Contact material:</b>	AgNi	
<b>Switching voltage:</b>	AC 250 V	
<b>Thermal current <math>I_{th}</math>:</b>	5 A	
<b>Switching capacity</b> to AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V:	typ. 3 x 10 <sup>6</sup> switching cycles	
<b>Short circuit strength</b> max. fuse rating:	5 A gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 30 x 10 <sup>6</sup> switching cycles	

### Measuring circuit

<b>Measuring voltage:</b>	infinite adjustable AC 100 ... 300 V, AC 45 ... 135 V
<b>Hysteresis:</b>	infinite adjustable 4 ... 20 %
<b>Switching delay <math>t_v</math>:</b>	infinite adjustable instantaneous, 2 ... 30 s
<b>Release delay:</b>	10 s
<b>Repeat accuracy:</b>	± 2 %
<b>Temperature influence:</b>	± 1 %
	<b>Attention:</b> <b>The combination of adjusted switching voltage U and hysteresis <math>\Delta U</math> must be within the measuring range.</b>

### General Data

<b>Operating mode:</b>	continuous operation	
<b>Temperature range</b>		
Operation:	- 20 ... + 55 °C	
Storage:	- 25 ... + 60 °C	
Relative air humidity:	93 % at 40 °C	
<b>Altitude:</b>	< 2,000 m	
<b>Clearance and creepage distances</b>		
Rated impuls voltage/ Pollution degree:	6 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge (ESD): HF irradiation	8 kV (air)	IEC/EN 61 000-4-2
80 MHz ... 1 GHz:	12 V / m	IEC/EN 61 000-4-3
1 GHz ... 2,7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge		
between		
wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011

## Technical Data

### Degree of protection:

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

### Enclosure:

Thermoplastic with V0 behaviour  
acc. to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm  
Class I IEC/EN 60 255-21  
20 / 055 / 04 IEC/EN 60 068-1  
EN 50 005

### Climate resistance:

### Terminal designation:

### Wire connection:

DIN 46 228-1/-2/-3/-4

### Fixed screw terminals

Cross section: 0.2 ... 4 mm<sup>2</sup> (AWG 24 - 12) solid or  
0.2 ... 2.5 mm<sup>2</sup> (AWG 24 - 12)  
stranded wire with and without ferrules

### Stripping length:

7 mm

### Fixing torque:

0.6 Nm EN 60 999-1

### Wire fixing:

Captive slotted screw / M2.5

### Mounting:

DIN rail IEC/EN 60 715

### Weight:

approx. 105 g

### Dimensions

**Width x height x depth:** 35 x 90 x 71 mm

## UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition  
ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition  
CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

### Switching capacity:

Pilot duty B300  
5A 240Vac Resistive, G.P.  
5A 30Vdc Resistive or G.P.  
5A 250Vac G.P.

### Wire connection:

60°C / 75°C copper conductors only  
AWG 24 - 12 Sol/Str Torque 0.6 Nm



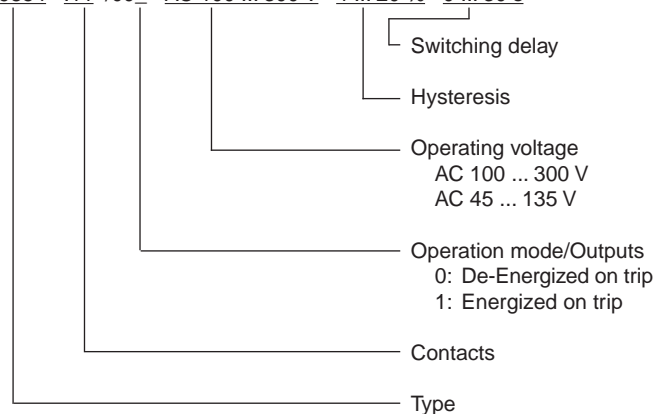
Technical data that is not stated in the UL-Data, can be found in the technical data section

## Standard Type

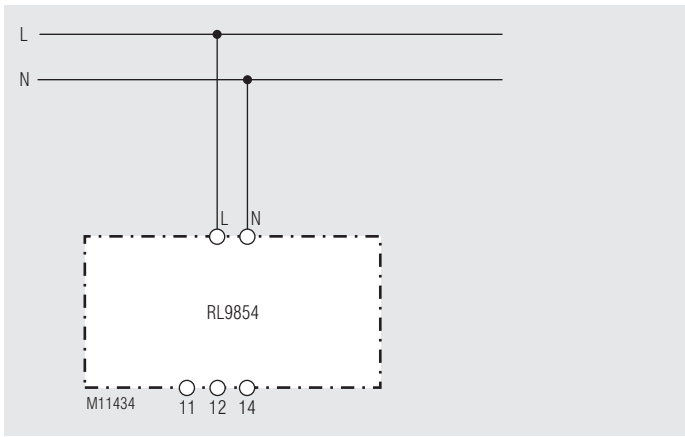
RL 9854.11	AC 100 ... 300 V	4 ... 20 %	0 ... 30 s
Article number: 0066429			
• Output:	1 changeover contact		
• Measuring voltage:	AC 100 ... 300 V		
• Hysteresis:	4 ... 20 %		
• Switching delay:	0 ... 30 s		
• Width:	35 mm		

## Ordering Example

RL 9854 .11 /00\_ AC 100 ... 300 V 4 ... 20 % 0 ... 30 s



## Connection Example



Single-phase connection

## VARIMETER

Voltage relay

MK 9064N, MH 9064



0269462



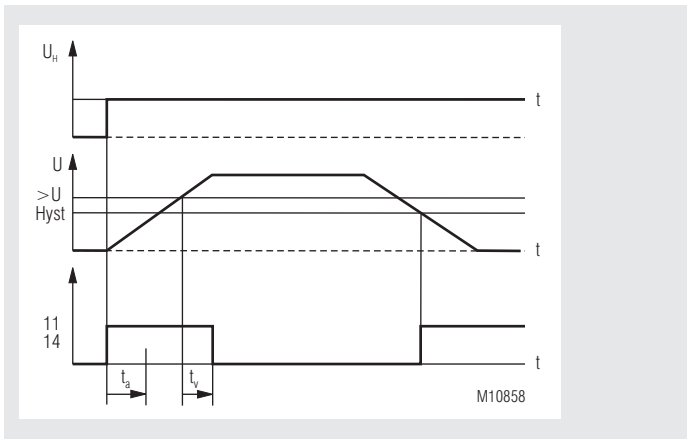
### Your Advantages

- Preventive maintenance
- For better productivity
- Quicker fault locating
- Precise and reliable
- Min-, Max. value or window monitoring
- Monitoring of AC/DC 0.2 ... 600 V
- Large measuring ranges
- Simple configuration and fault diagnostic
- Auxiliary voltage ranges DC 24 V, AC 230 V or AC/DC 110 ... 400 V
- Space and cost saving

### Features

- AC/DC voltage measuring (single-phase)
- Start up delay, on delay
- Manual reset
- LCD for indication of the measuring values
- Relay output
  - MK 9064N: 1 changeover contact
  - MH 9064: 2 x 1 changeover contacts
- Relay function selectable (energized/de-energized on trip)
- As option with plugable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- With RS485 (on request)
- Width MK 9064N: 22.5 mm
- Width MH 9064: 45.0 mm

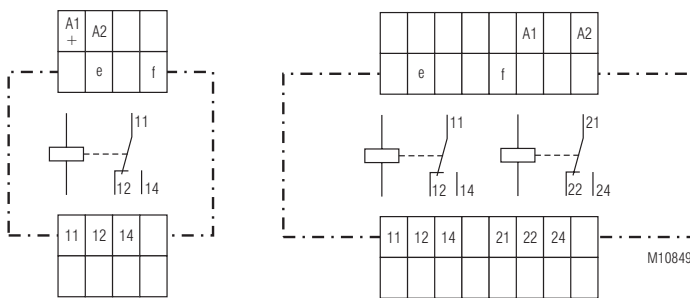
### Function Diagram



M10858

Example: overvoltage monitoring with closed circuit operation

### Circuit Diagrams



M10849

MK 9064N.11

M10848

MH 9064.12

### More Information

- **MH 9064**  
The MH 9064 has 2 relay outputs.  
The voltage monitoring can be assigned to relay 1 and /or relay 2

### Approvals and Markings



### Applications

- Voltage monitoring AC/DC single-phase
- Voltage dependent switching at under- or overvoltage

## Function

The Device is programmable for AC- or DC- measuring.  
 On AC-measurement the rectified mean value is measured.  
 On sinusoidal input signals the RMS value is displayed.

After connecting the auxiliary supply to terminals A1-A2 the startup delay disables the monitoring function so that changes on the input have no influence on the relay output of the VARIMETER.

The device is in display (RUN) mode and continuously measures the actual values. Pressing **(Esc)** for more than 3 sec starts the input mode.

If the setting value is exceeded the relay switches and the display indicates this state. The display is inverted, flashes and shows the error.

The fault memory is selectable

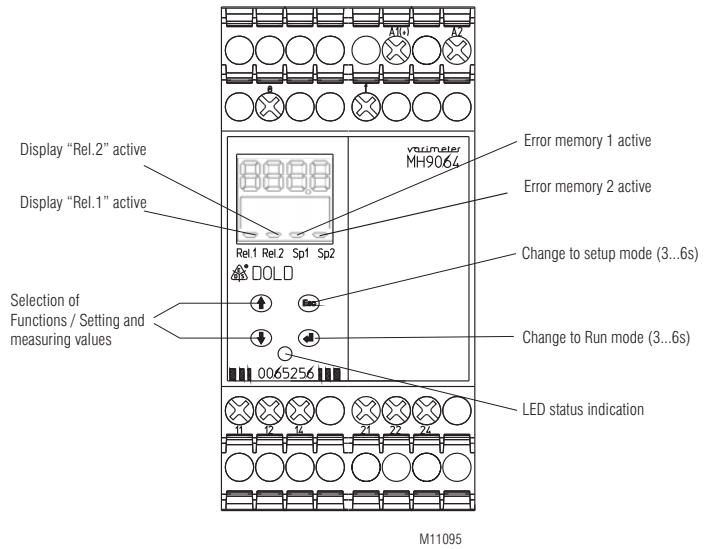
With button **(↵)** the fault memory can be deleted.

On the unit MH 9064 it is possible to assign different functions to the different relays so one can be used as pre-warning and the other as alarm output. Relay output 1 switches when actual value exceeds the pre-warning setting. If a second setting assigned to relay output 2 the unit gives an Alarm signal.

## Remarks

The unit needs a connected auxiliary supply.  
 It is designed for single phase AC/DC measurement.

## Setting



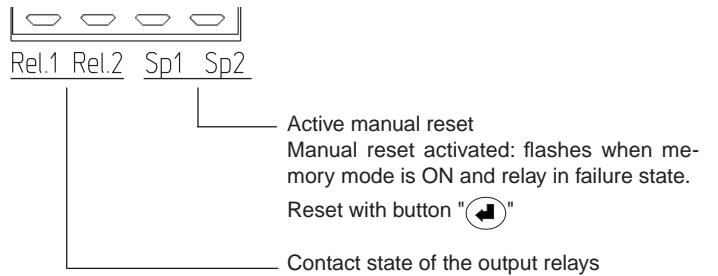
## Indication

The LED indicate the state.

green:	on, when auxiliary voltage present
orange (flashes):	No measurement; unit in input mode
red (short On, short Off):	Failure overvoltage

**If the measured value is higher then the upper end of scale value, the display shows the fault message "OL"**

## Cursor LCD Display



## Operating

### Display (Run) - Mode

### Input-Mode

#### ↑ UP / ↓ DOWN

After power up the relay is in display (Run) mode.

↑ ↓ buttons have no function

The measurement is interrupted, the relays are in failure state and the indicator LED has orange color

↑ ↓ Selection of parameters and setting of thresholds

#### ↵ ENTER

Manual reset, when manual reset is selected for output relay  
Reset works only when fault is removed

- Shifts cursor to the right  
- Saves the value no-voltage safe  
- Pressing for more than 3 sec: Change to display (Run) mode.

#### ⏏ Esc

- Pressing for more than 3 sec: Change to input mode

- Shifts cursor to the left  
- Leave setting without saving

## LCD-Display



## Setting Parameter

< U Fault, when value drops under set point  
> U Fault, when value exceeds set point  
OFF Measurement disabled

If the adjusted threshold of at least one measuring function is exceeded, the corresponding relay output switches after the selected time delay  $t_v$  and the fault is indicated on the display.

Manual reset can be activated or de-activated and is operated with ↵ on the unit.

### Adjustable Parameter

Limit values for Rel.1 and Rel.2 Selectable with buttons ↑ ↓.		Factory setting
<U:	Response value undervoltage (Undervoltage relay)	OFF
>U:	Response value overvoltage,, (Overvoltage relay)	*
Hyst:	response value hysteresis	5 %
$t_v$ :	On delay for relays ( 0 ... 10 sec )	0 s
A / R:	Setting open- / closed circuit operation	R
Sp:	Error storage ( ON / OFF )	OFF

Response values can be deactivated. (OFF)

\*) dependent to device-variant (measuring range)

### Further Setting Parameter

Selectable with buttons ↑ ↓.		Factory setting
$t_a$ :	Start up delay, when auxiliary voltage connected ( 0.2 ... 10 s )	0,2 s
AC/DC	Measuring voltage AC or DC	AC

### Restore Factory Settings

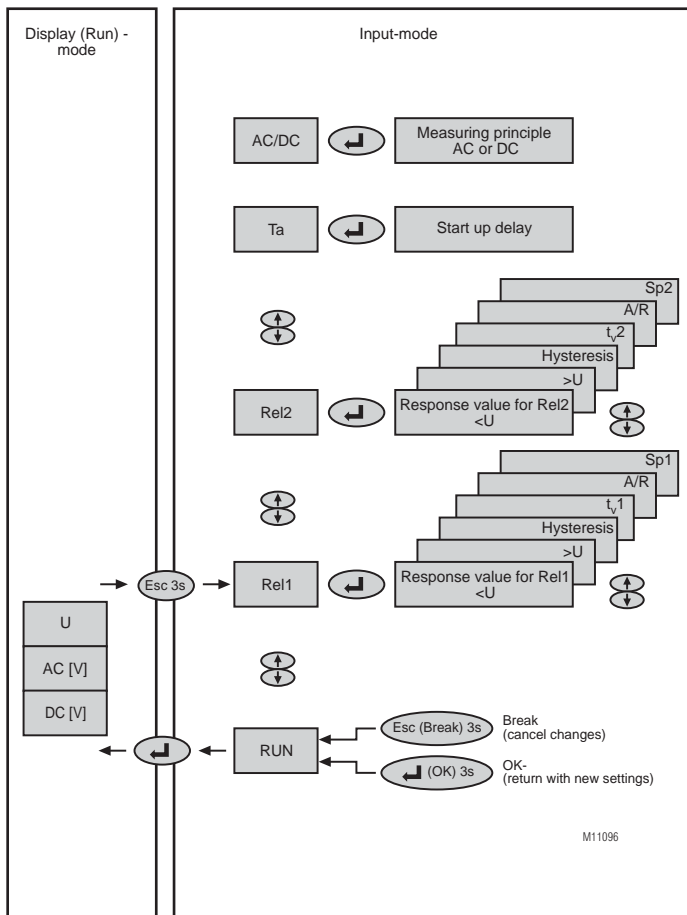
(Restore factory settings)  
Before auxiliary voltage connected press button ⏏ .  
During start press and hold.

### Indicator output

The switching mode energized or de-energized on trip can be set in input mode. The MH 9064 has 2 relay outputs. Monitoring function can be assigned to Relay 1 and/or to Relay 2.



## Operating



After connecting the auxiliary supply A1/A2 the unit is in display (Run) mode:

The actual measured value is displayed continuously (AC or DC)  
The display is inverted when a measured value is exceeds the settings..

With button the fault memory is reset.

Pressing button for more than 3 sec the unit changes to input mode.

In input mode the measurement is disabled, the relays are in failure mode and the indicator LED is orange.

With the buttons the different setting values can be chosen.

Move cursor position

One character to the right

One character to the left

### Back to the Display (Run)-Mode

Press button 3 s      OK      New values stored

or

Press button 3 s;      Break      Values unchanged

on the display confirm with to change to display (Run) mode.

Display (Run) - Modus	Input-Mode
Display inverted when the actual value is in failure state.	Measurement interrupted, relays are in failure state, indicator LED orange color
no function	Chose Rel1, Rel2, Ta, AC/DC and RUN As option address for RS485 Bus
Reset fault memory:	Shift cursor to the left Shift cursor to the right
For more the 3 sec, change to input mode	For more than 3 sec, change to display mode

## Technical Data

### Auxiliary voltage A1/A2

### Nominal auxiliary voltage $U_H$

MK 9064N:	DC 24 V	(0.9 ... 1.1 x $U_H$ )
MH 9064:	AC 230 V	(0.8 ... 1.1 x $U_H$ )
	AC/DC 110 ... 400 V	(0.8 ... 1.1 x $U_H$ )

### Nominal frequency:

50 / 60 Hz

### Frequency range:

45 ... 400 Hz

### Input current

at DC 24 V: 50 mA

at AC 230 V: 15 mA

## Voltage Measuring Input L+/L

### MK 9064N:

Nominal voltage: AC/DC 300 V, AC/DC 5 V

Measuring range  $U_M$ : AC/DC 12 ... 300 V, AC/DC 0.2 ... 5 V

(0.8 ... 1.1 x  $U_M$ )

### MH 9064:

Nominal voltage: AC/DC 600 V

Measuring range  $U_M$ : AC/DC 24 ... 600 V (0.8 ... 1.1 x  $U_M$ )

Nominal frequency:

50 / 60 Hz

Frequency range:

AC 10 ... 400 Hz

## Setting Range (absolute, via button and LCD-display)

### Measuring accuracy

at nominal frequency

(in % of setting value):  $\pm 2\% \pm 2$  Digit

### Hysteresis

(in % of setting value): 2 ... 50 %

### Reaction time:

< 150 ms

### Adjustable on delay ( $t_d$ ):

0 ... 10 s

Adjustable start up delay ( $t_s$ ): 0.2 ... 10 s

## Output Circuit (Rel1: 11/12/14; Rel2: 21/22/24)

### Contacts:

MK 9064N: 1 changeover contact

MH 9064: 1 changeover contact (Rel1) and 1 changeover contact (Rel2)

2 x 4 A

### Thermal current $I_{th}$ :

Switching capacity

to AC 15

NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1

to DC 13

NO contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

NC contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 3 A, AC 230 V: 2 x 10<sup>5</sup> switch. cycl. IEC/EN 60 947-5-1

### Permissible switching

frequency: 1800 / h

### Short circuit strength

Max. fuse rating: 4 A gI DIN VDE 0660

Mechanical life: 30 x 10<sup>6</sup> switching cycles

## General Data

### Nominal operating mode:

continuous operation

Temperature range: - 20... + 60°C

(at range 0 ... - 20°C limited function of the LCD display)

### Clearance and creepage distance

rated impulse voltage /

pollution degree: 4 kV / 2

high voltage test: IEC/EN 60 664-1

### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltage: 5 kV / 0.5J IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class A EN 61 000-6-4

### Degree of protection

Housing: IP 40 DIN EN 60 529

Terminals: IP 20 DIN EN 60 529

Housing: thermoplastic with VO behaviour

according to UL Subject 94

### Vibration resistance:

Amplitude 0.35 mm,

frequency 10 ... 55 Hz

## Technical Data

Climate resistance: 20 / 060 / 04 EN 60 068-1

Wire connection: DIN 46 228-1/-2/-3/-4

### Screw terminal

(fixed): 1 x 4 mm<sup>2</sup> solid or 1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm<sup>2</sup> stranded ferruled (isolated) or 2 x 2.5 mm<sup>2</sup> solid

Insulation of wires or sleeve length:

8 mm

### Terminal block

with screw terminals

Max. cross section: 1 x 2.5 mm<sup>2</sup> solid or 1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated)

Insulation of wires or sleeve length:

8 mm

### Terminal block

with cage clamp terminals

Max. cross section: 1 x 4 mm<sup>2</sup> solid or 1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated) 0.5 mm<sup>2</sup>

Min. cross section:

Insulation of wires or sleeve length:

12  $\pm 0.5$  mm

### Wire fixing:

Plus-minus terminal screws M3,5 box terminals with wire protection or cage clamp terminals

Fixing torque: 0.8 Nm

### Mounting:

DIN rail EN 60 715

### Weight:

MK 9064N: approx. 140 g

MH 9064: approx. 250 g

## Dimensions

### Width x height x depth:

MK 9064N: 22.5 x 90 x 99 mm

MH 9064: 45 x 90 x 99 mm

## Standard Types

MK 9064N.11 AC/DC 12 ... 300 V DC 24 V

Article number: 0065254

• Measuring range: AC/DC 12 ... 300 V

• Auxiliary voltage  $U_H$ : DC 24 V

• Output: 1 changeover contact

• Width: 22.5 mm

MH 9064.12 AC/DC 24 ... 600 V AC/DC 110 ... 400 V

Article number: 0065256

• Measuring range: AC/DC 24 ... 600 V

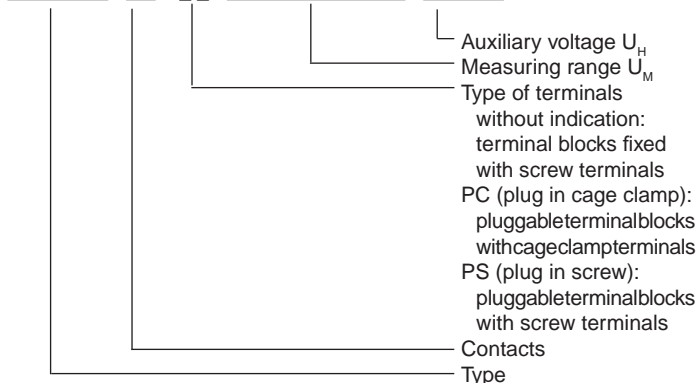
• Auxiliary voltage  $U_H$ : AC/DC 110 ... 400 V

• Output: 1 changeover contact (Rel1) and 1 changeover contact (Rel2)

• Width: 45 mm

## Ordering Example

MK 9064N .11 \_ \_ \_ AC/DC 12 ... 300 V DC 24 V



## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

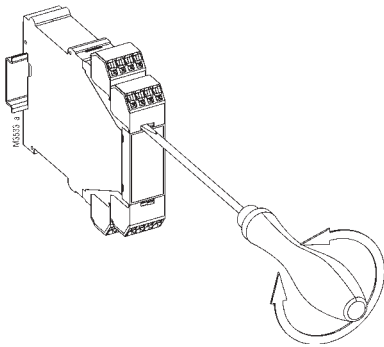


Cage clamp terminal  
(PC/plugin cage clamp)

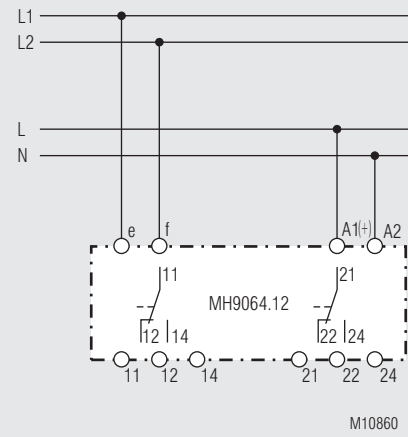
### Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Connection Example



### Safety notes



**Dangerous voltage.**  
Electric shock will result in death or serious injury.



Disconnect all power supplies before servicing equipment.

- Faults must only be removed when the relay is disconnected
- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).
- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.
- Observe proper grounding of all components

### Set Up Procedure

The connection has to be made according to the connection example.

# Monitoring Technique

## VARIMETER

### Voltage Relay

#### BA 9054, MK 9054N



0221541



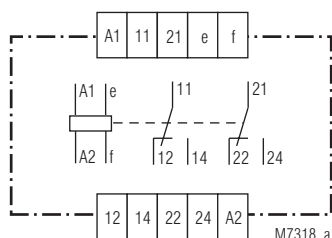
#### Your Advantages

- Protection against defect by overvoltage
- Preventive maintenance
- For better productivity
- Quicker fault locating
- Precise and reliable

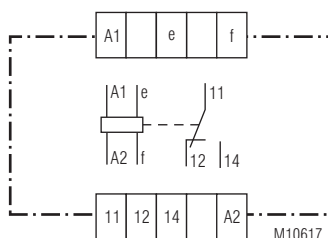
#### Features

- According to IEC/EN 60255-1, IEC/EN 60947-1
- to: monitor DC and AC
- BA 9054 with measuring ranges from 15 mV to 1000 V
- MK 9054N with measuring ranges from 15 mV to 500 V
- High overload possible
- Input frequency up to 5 kHz
- Galvanic separation between Auxiliary Circuit – measuring circuit
- Auxiliary supply AC/DC; BA 9054 with AC
- BA 9054 optionally with start-up delay (MK = standard)
- with time delay, up to max. 100 sec
- BA 9054 optionally with safe separation to IEC/EN 61140
- MK 9054N optionally with remote potentiometer
- As option with manual reset
- Option with fixed settings possible
- LED indicators for operation and contact position
- MK 9054N as option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width BA 9054: 45 mm
- Width MK 9054N: 22.5 mm

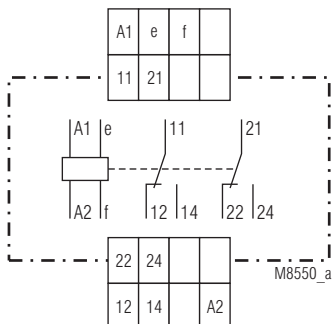
#### Circuit Diagrams



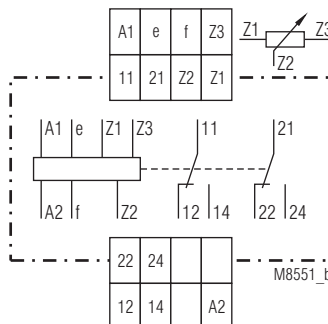
BA 9054



BA 9054/\_ 2 \_



MK 9054N



MK 9054N/1\_ \_

#### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
e, f	Voltage measuring input
11, 12, 14	1st changeover contact
21, 22, 24	2nd changeover contact
at MK 9054/1_ _: Z1, Z2, Z3	remote potentiometer for response value

#### Safety Notes

**Please observe when connecting a remote potentiometer to MK 9054N/1\_ \_:**



WARNING

Measuring circuit and remote potentiometer not galvanically separated. The remote potentiometer on terminals Z1, Z2, Z3 is related to terminal "e". Therefore "e" should be connected to "N", "-" or GND, so that the remote potentiometer is not connected to the Phase voltage. The remote potentiometer has to be connected volt- and ground-free.

#### Approvals and Markings



\* see variants

#### Applications

- Monitoring voltage in AC or DC systems
- For industrial and railway applications

#### Function

The relays measure the arithmetic mean value of the rectified measuring voltage. The AC units are adjusted to the r.m.s value. They have settings for response value and hysteresis. The units work as overvoltage relays but can also be used for undervoltage detection. The hysteresis is dependent on the response value.

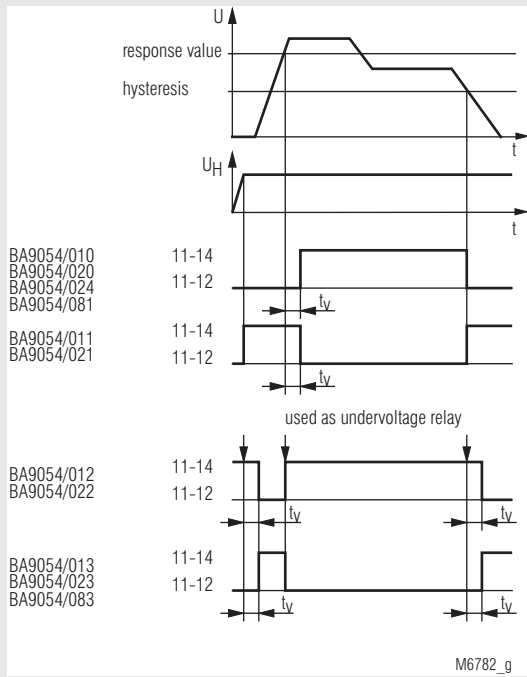
2 time delays are possible in different variants:

The start up delay  $t_a$  operates only when connecting the auxiliary supply. The response delay  $t_v$  is active after exceeding a response value. On overvoltage relays the delay is active when the voltage goes over the tripping value, on undervoltage relays when the voltage drops below the hysteresis value.

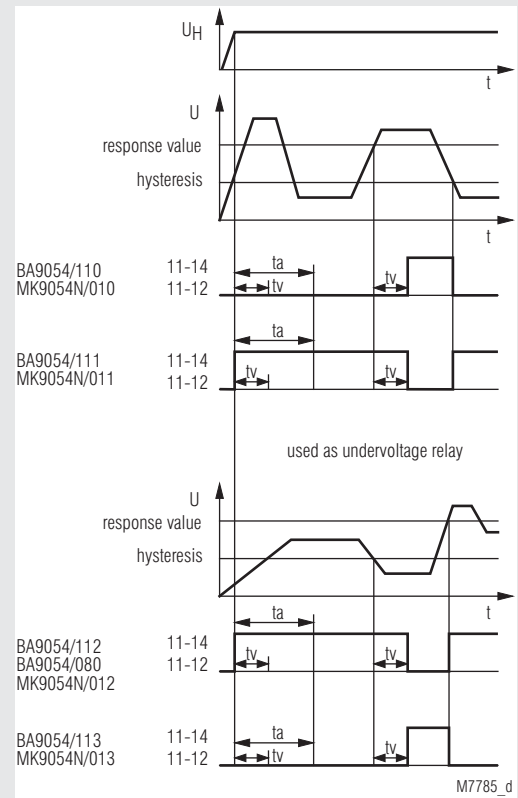
#### Indicators

green upper LED: on, when auxiliary supply connected  
yellow lower LED: on, when output relay activated

### Function Diagram without Start-up Delay



### Function Diagram with Start-up Delay



Version BA 9054/\_1\_: 2 changeover contacts

Version BA 9054/\_20, /\_21, /\_22, /\_23, /\_24: 1 changeover contact, measuring range  $\geq 70 \dots 700 \text{ V}$

At version BA 9054/6\_\_ with manual reset the contacts remain in the fault state after detecting a fault or after  $t_a$  has elapsed. The contacts are reset by disconnecting the supply voltage.

## Technical Data

### Input (e, f)

BA 9054 with 1 Measuring range for AC <b>and</b> DC			
Measuring range <sup>1)</sup>		internal resistance	max. permissible contin. voltage
AC	DC		
6 ... 60 mV	5.4 ... 54 mV	20 kΩ	10 V
15 ... 150 mV	13.5 ... 135 mV	40 kΩ	100 V
50 ... 500 mV	45 ... 450 mV	270 kΩ	250 V
0.5 ... 5 V	0.45 ... 4.5 V	500 kΩ	300 V
1 ... 10 V	0.9 ... 9.0 V	1 MΩ	300 V
5 ... 50 V	4.5 ... 45 V	2 MΩ	500 V <sup>2)</sup>
25 ... 250 V	22.5 ... 225 V	2 MΩ	500 V <sup>2)</sup>
50 ... 500 V	45 ... 450 V	2 MΩ	500 V <sup>2)</sup>
70 ... 700 V <sup>3)</sup>	63 ... 630 V	3 MΩ	700 V <sup>4)</sup>
100 ... 1000 V <sup>3)</sup>	90 ... 900 V	3 MΩ	1000 V <sup>4)</sup>

<sup>1)</sup> DC or AC voltage 50 ... 5000 Hz  
(Other frequency ranges of 10 ... 5000 Hz, e.g. 16 <sup>2</sup>/<sub>3</sub> Hz on request)

<sup>2)</sup> at Overvoltage category II: 600 V

<sup>3)</sup> only with BA 9054/\_20; /\_21; /\_22; /\_23; /\_24  
(Version: 1 changeover contact)

<sup>4)</sup> at overvoltage category II: 1000 V

#### Please note:

Measuring ranges 6 ... 60 mV only available at variant BA 9054/08\_  
(Using only for current sensing via shunt!)

MK 9054N with 1 Measuring range for AC <b>and</b> DC			
Measuring range <sup>1)</sup>		internal resistance	max. permissible contin. voltage
AC	DC		
6 ... 60 mV	5.4 ... 54 mV	20 kΩ	10 V
15 ... 150 mV	13.5 ... 135 mV	40 kΩ	100 V
50 ... 500 mV	45 ... 450 mV	270 kΩ	250 V
0.5 ... 5 V	0.45 ... 4.5 V	500 kΩ	300 V
1 ... 10 V	0.9 ... 9.0 V	1 MΩ	300 V
5 ... 50 V	4.5 ... 45 V	2 MΩ	500 V <sup>2)</sup>
25 ... 250 V	22.5 ... 225 V	2 MΩ	500 V <sup>2)</sup>
50 ... 500 V	45 ... 450 V	2 MΩ	500 V <sup>2)</sup>

<sup>1)</sup> DC or AC voltage 50 ... 5000 Hz  
(Other frequency ranges of 10 ... 5000 Hz, e.g. 16 <sup>2</sup>/<sub>3</sub> Hz on request)

<sup>2)</sup> Not suitable for 400 / 690 V-mains (systems)

#### Please note:

To avoid measuring mistakes, on units with mV input the input must always be terminated. In addition screened wires should be used..

Measuring ranges 6 ... 60 mV + 15 ... 150 mV  
(Using only for current sensing via shunt!)

#### Measuring principle:

arithmetic mean value

#### Adjustment:

The AC-devices can also monitor DC-voltage. The scale offset in this case is ( $\bar{U} = 0.90 U_{eff}$ )

#### Temperature influence:

< 0.05 % / K

## Technical Data

### Setting Ranges

#### Setting

Response value: infinite variable 0.1  $U_N$  ... 1  $U_N$   
relative scale

#### Hysteresis

at AC: infinite variable 0.5 ... 0.98 of setting value  
at DC: infinite variable 0.5 ... 0.96 of setting value

#### Accuracy:

Response value at  
Potentiometer right stop (max): 0 ... + 8 %  
Potentiometer left stop (min): - 10 ... + 8 %

#### Repeat accuracy:

≤ ± 0.5 %

#### Recovery time

at devices with manual reset  
(Reset by braking of the auxiliary voltage)  
BA 9054/6\_ \_; MK 9054N/6\_ \_: ≤ 1 s  
(dependent to function and auxiliary voltage)

#### Time delay $t_v$ :

infinite variable at logarithmic scale  
from 0 ... 20 s, 0 ... 30 s, 0 ... 60 s, 0 ... 100 s  
setting 0 s = without time delay

#### Start-up delay $t_a$ :

BA 9054/1\_ \_: 1 ... 20 s; 1 ... 60 s; 1 ... 100 s,  
adjustable on logarithmic scale.  
 $t_a$  is started when the supply voltage is connected. During elapse of time the output contact is in good state  
MK 9054N: 0.1 ... 20 s; 0.1 ... 60 s; 0.1 ... 100 s

### Auxiliary Circuit BA 9054 and MK 9054N

#### Auxiliary voltage $U_H$ (A1, A2)

BA 9054, Nominal voltage: AC 24, 42, 110, 127, 230, 400 V

**Voltage range:** 0.8 ... 1.1  $U_H$

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** ± 5 %

**Nominal consumption:** 2.5 VA

BA 9054, MK 9054N:		
Nominal voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W
	DC 18 ... 130 V	W ≤ 5 %
AC/DC 80 ... 230 V	AC 40 ... 265 V	45 ... 400 Hz; DC 48 % W
	DC 40 ... 300 V	W ≤ 5 %

BA 9054		
Nominal voltage	Voltage range	Frequency range
DC 12 V	DC 10 ... 18 V	battery voltage

#### Nominal consumption:

4 VA; 1.5 W at AC 230 V Rel. energized  
1 W at DC 80 V Rel. energized

### Output

#### Contacts

BA 9054: 2 changeover contacts

MK 9054N: 2 changeover contacts

#### Thermal current $I_{th}$

BA 9054: 2 x 5 A

MK 9054N: 2 x 4 A

#### Switching capacity

BA 9054

to AC 15: NO contact: 2 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

MK 9054N

to AC 15: 1.5 A / AC 230 V IEC/EN 60 947-5-1

BA 9054, MK 9054N

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1

IEC/EN 60 947-5-1

#### Electrical life

BA 9054

to AC 15 at 3 A, AC 230 V: 5 x 10<sup>5</sup> switching cycles

MK 9054N:

to AC 15 at 3 A, AC 230 V: 10<sup>5</sup> switching cycles

#### Short-circuit strength

**max. fuse rating:**

6A gG (gL) IEC/EN 60 947-5-1

#### Mechanical life

BA 9054:

50 x 10<sup>6</sup> switching cycles

MK 9054N:

30 x 10<sup>6</sup> switching cycles

**Technical Data****General Data**

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 40 ... + 60°C (higher temperature with limitations on request)	
Operation:	- 40 ... + 70°C (higher temperature with limitations on request)	
Storage:	- 40 ... + 70°C	
<b>Altitude:</b>	< 2.000 m	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree		
BA 9054:	6 kV / 2	IEC 60 664-1
MK 9054N	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	20 V/m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	40 / 060 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection</b>		
BA 9054:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve	
<b>MK 9054N</b>		
<b>Screw terminals (integrated):</b>	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 2.5 mm <sup>2</sup> solid	
Insulation of wires or sleeve length:	8 mm	
<b>Plug in with screw terminals</b>		
max. cross section for connection:	1 x 2.5 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)	
Insulation of wires or sleeve length:	8 mm	
<b>Plug in with cage clamp terminals</b>		
max. cross section for connection:	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)	
min. cross section for connection:	0.5 mm <sup>2</sup>	
Insulation of wires or sleeve length:	12 ±0.5 mm	
<b>Wire fixing</b>		
BA 9054:	Plus-minus terminal screws M3.5 with self-lifting clamping piece IEC/EN 60 999-1	
MK 9054N:	Plus-minus terminal screws M3.5 box terminals with wire protection or cage clamp terminals	
<b>Stripping length:</b>	10 mm	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN-rail IEC/EN 60 715	
<b>Weight</b>		
BA 9054:	AC-device: 280 g AC/DC-fdevice: 200 g	
MK 9054N:	150 g	

**Dimensions****Width x height x depth**

BA 9054:	45 x 75 x 120 mm
MK 9054N:	22.5 x 90 x 97 mm

**Classification to DIN EN 50155 for BA 9054**

<b>Vibration and shock resistance:</b>	Category 1, Class B	IEC/EN 61 373
<b>Ambient temperature:</b>	T1, T2 compliant	
	T3 and TX with operational limitations	
<b>Protective coating of the PCB:</b>	No	

**UL-Data**

<b>Auxiliary voltage U<sub>H</sub>(A1, A2)</b>		
BA 9054:	AC 24, 42, 48, 110, 115, 120 V	
<b>Thermal current I<sub>th</sub>:</b>		
BA 9054:	2 x 5 A	
MK 9054N:	2 x 4 A	
<b>Clearance and creepage distances</b>		
BA 9054, MK 9054N:	4 kV / 2	IEC 60 664-1
<b>HF irradiation</b>		
BA 9054 (80 MHz ... 2.7 GHz)	10 V/m	IEC/EN 61 000-4-3
<b>Switching capacity:</b>	Pilot duty B150	
<b>Ambient temperature:</b>	- 40 ... + 60°C	



Technical data that is not stated in the UL-Data, can be found in the technical data section.

**CCC-Data**

<b>Switching capacity</b>		
to AC 15:	1.5 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

**Standard Types**

BA 9054/010	AC 25 ... 250 V	AC 230 V
Article number:	0053639	
• for Overvoltage monitoring		
• Measuring range:	AC 25 ... 250 V	
• Auxiliary voltage U <sub>H</sub> :	AC 230 V	
• Time delay t <sub>v</sub> by U <sub>an</sub> :	0 ... 20 s	
• Width:	45 mm	
BA 9054/012	AC 25 ... 250 V	AC 230 V
Article number:	0053711	
• for Undervoltage monitoring		
• Measuring range:	AC 25 ... 250 V	
• Auxiliary voltage U <sub>H</sub> :	AC 230 V	
• Time delay t <sub>v</sub> by U <sub>ab</sub> :	0 ... 20 s	
• Width:	45 mm	
MK 9054N.12/010	AC 25 ... 250 V	AC/DC 80 ... 230 V
Article number:	t <sub>v</sub> 0 ... 20 s t <sub>a</sub> 0.1 ... 20 s	
• for Overvoltage monitoring		
• Measuring range:	AC 25 ... 250 V	
• Auxiliary voltage U <sub>H</sub> :	AC/DC 80 ... 230 V	
• Time delay t <sub>v</sub> by U <sub>an</sub> :	0 ... 20 s	
• Start up delay t <sub>a</sub> :	0.1 ... 20 s	
• Width:	22.5 mm	

**Ordering Example for Variants**

<p>BA 9054 / / /61 AC 25 ... 250V AC 230 V 0 ... 20 s 1 ... 20 s</p>	<p>MK 9054N / / AC 25 ... 250 V AC/DC 80 ... 230 V 0 ... 20 s 0,1 ... 20 s</p>
<p>Start up delay <math>t_a</math>  Time delay <math>t_v</math>  Auxiliary voltage  Measuring range  With UL-approval</p> <p>10 Overvoltage relay energized on trip time delay at setting value  11 Overvoltage relay de-energized on trip time delay at setting value  12 Undervoltage relay de-energized on trip time delay at hysteresis value  13 Undervoltage relay energized on trip time delay at hysteresis value  20 Same as BA 9054/024, but with additional moisture protection  21 Same as BA 9054/011, but with measuring range <math>\geq 70 \dots 700 \text{ V}</math>, 1 C/O contact  22 Same as BA 9054/012, but with measuring range <math>\geq 70 \dots 700 \text{ V}</math>, 1 C/O contact  23 Same as BA 9054/013, but with measuring range <math>\geq 70 \dots 700 \text{ V}</math>, 1 C/O contact  24 Same as BA 9054/010, but with measuring range <math>\geq 70 \dots 700 \text{ V}</math>, 1 C/O contact  46 Same as BA 9054/010, reduced reaction-time, measuring range DC 24 ... 35 V, it is necessary to connect power supply before measuring voltage  47 Same as 46, but with measuring range DC 60 ... 78 V</p> <p>0 Standard version  1 With start up delay <math>t_a</math>  2 With safe electrical separation of input- and output circuit according to DIN 61140  3 With 5 <math>\mu\text{m}</math> gold plated contacts  5 With forcibly guided contacts  6 With manual reset, resetting by disconnecting the power supply</p> <p>Type</p>	<p>Start up delay <math>t_a</math>  Time delay <math>t_v</math>  Auxiliary voltage  Measuring range</p> <p>10 Overvoltage relay energized on trip  11 Overvoltage relay de-energized on trip  12 Undervoltage relay de-energized on trip  13 Undervoltage relay energized on trip</p> <p>0 Standard version without remote potentiometer  1 Standard version with remote potentiometer (resp. value) Z1, Z2, Z3 for 470 k<math>\Omega</math>  <b>at this version there is no potentiometer for the response value</b>  6 General definition with manual reset function</p> <p>Type of terminals  Without indication:  terminal blocks fixed, with screw terminals  PC (plug in cage clamp):  pluggable terminal blocks with cage clamp terminals  PS (plug in screw):  pluggable terminal blocks with screw terminals</p> <p>Type</p>



## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

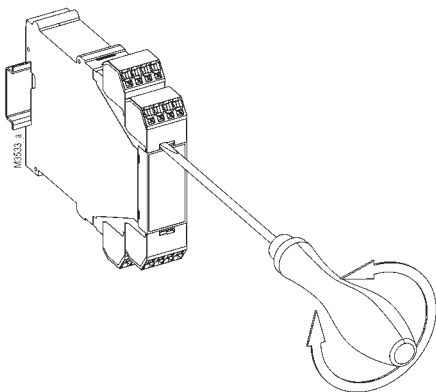


Cage clamp  
(PC/plugin cage clamp)

### Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



### Accessories

AD 3: Remote potentiometer 470 kW  
Article number: 0050174

### Setting

Example:  
Voltage relay BA 9054 / MK 9054N AC 25 ... 250 V

AC according to type plate:  
i.e. the unit is adjusted to AC voltage  
25 ... 250 V = measuring range

Response value AC 150 V  
Hysteresis AC 75 V

Settings:  
upper potentiometer: 0.6 (0.6 x 250 V = 150 V)  
lower potentiometer: 0.5 (0.5 x 150 V = 75 V)

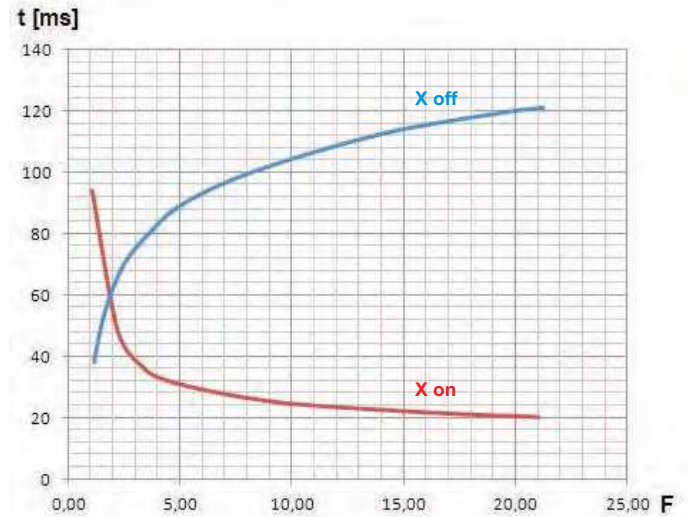
The AC-devices can also monitor DC voltage. The scale offset in this case is:  $\bar{U} = 0.9 \times U_{\text{eff}}$ .

AC 25 ... 250 V is equivalent to DC 22.5 ... 225 V

Response value DC 150 V  
Hysteresis DC 75 V

Settings:  
upper potentiometer: 0.66 (0.66 x 225 V = 150 V)  
lower potentiometer: 0.5 (0.5 x 150 V = 75 V)

## Characteristic



M11504 a

### Time delay of measuring circuit

X on: Measured value rises  $F = \frac{\text{Meas. value (after rise of meas. value)}}{\text{Setting value}}$

X off: Measured value drops  $F = \frac{\text{Meas. value (befor meas. value drops)}}{\text{Setting value (hysteresis)}}$

The diagram shows the typical delay of a standard devices depending on the measured values "X on and X off" at sudden rise or drop of the signal. At slow change of the measured value the delay is shorter. The total reaction time of the device results from the adjustable delay  $t_d$  and the delay created by the measuring circuit.

The diagram shows an average delay. The delay times could differ on the different variants.

### Example for "X on" (overvoltage detection with BA9054/010):

Adjusted setting value X on = 230 V.

Caused by a missing neutral the voltage rises suddenly to 400 V

$$F = \frac{\text{Measured value (after rise of meas. value)}}{\text{Setting value}} = \frac{400 \text{ V}}{230 \text{ V}} = 1,74$$

Reading from the diagram:

The output relay switches on after 64 ms at a setting  $t_d=0$ .

### Example for "X off" (undervoltage detection with BA9054/012):

Adjusted hysteresis setting value is 100 V.

Caused by a broken wire the voltage drops suddenly from 230 V to 0 V.

$$F = \frac{\text{Measured value (befor meas. value drops)}}{\text{Setting value (hysteresis)}} = \frac{230 \text{ V}}{100 \text{ V}} = 2,3$$

Reading from the diagram:

The output relay switches off after 70 ms at a setting  $t_d=0$ .

## VARIMETER Voltage Relay BA 9036

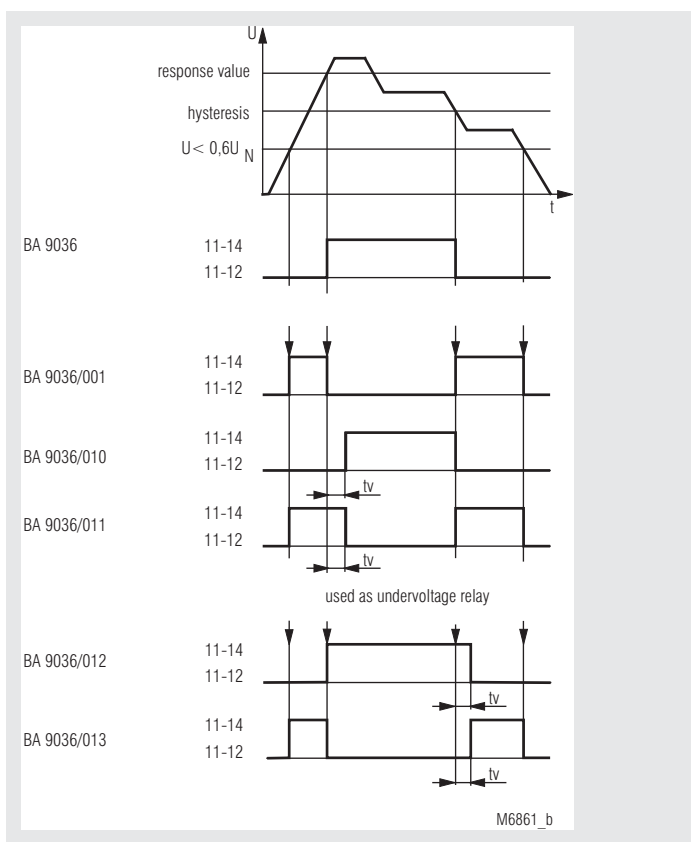


02/25114



- According to IEC/EN 60255-1, IEC/EN 60255-26
- Single-phase
- Measuring ranges from 24 to 400
- Settable response and release value
- Without auxiliary supply
- optionally available with adjustable time delay
- with LED indicators for operation and state of contacts
- 2 changeover contacts
- Width 45 mm

### Function Diagram



### Approvals and Markings



\* see variants

### Applications

Monitoring of voltage in DC and AC systems

### Indicators

upper LED: on, when voltage connected  
lower LED: on, when output contact activated

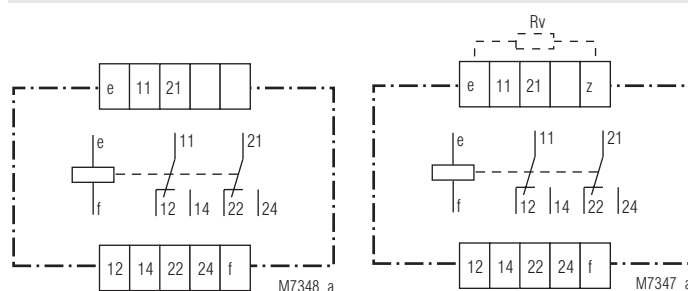
### Notes

#### Mounting instruction for units with external series resistor

The external resistor conducts mains voltage and heats up during operation. It has to be mounted at a suitable location in the cabinet so that touch protection is provided. Because of the heat dissipation a suitable distance to neighbour devices has to be kept.

When using a drop resistor the measuring has to be connected to e and f.

### Circuit Diagrams



BA 9036  
connection diagram for AC voltage

BA 9036  
connection diagram for DC voltage

### Connection Terminals

Terminal designation	Signal designation
e, f	Nominal voltage
e, z	Series resistor (DC)
11, 12, 14, 21, 22, 24	changeover contact

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	AC 42, 110, 127, 230, 240, 290, 400 V DC 24, 48, 60 V DC 110*, 127*, 220*, 240 V* *) with external drop resistor DC 110 V*: ZWS 20 SL1.5 k $\Omega$ 20 W DC 127 V*: ZWS 20 SL1.6 k $\Omega$ 20 W DC 220 V*: ZWS 35 SL 3.9 k $\Omega$ 35 W DC 240 V*: ZWS 35 SL4.7 k $\Omega$ 35 W *) Replacement RL 9836 without external drop resistor
<b>Nominal consumption:</b>	6 VA / 10 W
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	$\pm 5 \%$
<b>Temperature influence:</b>	$< 0.05 \%$ / K
<b>Max. overload:</b>	1.2 $U_N$ continuously

### Setting Ranges

<b>Setting:</b>	0.85 ... 1.05 $U_N$
<b>Hysteresis:</b>	0.75 ... 0.95 of setting value
<b>Setting accuracy:</b>	$\pm 5 \%$
<b>Repeat accuracy:</b>	$\pm 0.5 \%$
<b>Time delay <math>t_V</math>:</b>	0.5 ... 10 s adjustable ( $U > 0.6 \times U_N$ )

### Output

<b>Contacts:</b>	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>	6 A
<b>Switching capacity</b> to AC 15	
NO contact:	2 A / AC 230 V IEC/EN 60 947-5-1
NC contact: to DC 13	1 A / AC 230 V IEC/EN 60 947-5-1
NO contact:	1 A / DC 24 V IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical contact life</b> to AC 15 at 1 A, AC 230 V:	$\geq 2.5 \times 10^5$ switching cycles
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$30 \times 10^6$ switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b> rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	6 kV (air) IEC/EN 61 000-4-2
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply: between wire and ground:	1 kV IEC/EN 61 000-4-5 2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	310 g

### Dimensions

<b>Width x height x depth:</b>	45 x 73 x 132 mm
--------------------------------	------------------

## UL-Data

<b>Nominal voltage <math>U_N</math>:</b>	AC 120 V
<b>Switching capacity:</b>	Pilot duty B150



Technical data that is not stated in the UL-Data, can be found in the technical data section.

## CCC-Data

<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity</b> to AC 15	
NO contact:	2 A / AC 230 V IEC/EN 60 947-5-1
to DC 13	
NO contact:	1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

BA 9036 AC 230 V 50 Hz	
Article number:	0045288
• Nominal voltage $U_N$ :	AC 230 V
• Width:	45 mm

## Variants

BA 9036/61:	with UL approval on request
BA 9036:	with CCC approval on request
BA 9036/001:	overvoltage / closed circuit operation
BA 9036/010:	overvoltage / open circuit operation / time delay
BA 9036/011:	overvoltage / closed circuit operation / time delay
BA 9036/012:	undervoltage / closed circuit operation / time delay
BA 9036/013:	undervoltage / open circuit operation / time delay

## Ordering example for variants

BA 9036 / _ _ _ AC 230 V 50 Hz	
_____	Nominal frequency
_____	Nominal voltage
_____	Variant, if required
_____	Type

## Characteristic

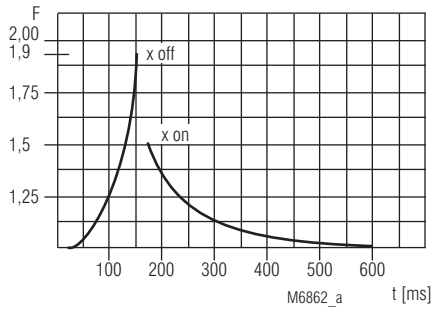


Diagram switching delay

Switching delay  $t_M$ :

The characteristic shows the switching delay depending on the values of  $X_{on}$  -  $X_{off}$  when switching the voltage on or off. A slow voltage change reduces the delay.

Example:

$$U_{\text{setting}} = 200 \text{ V} \quad F = \frac{230 \text{ V}}{200 \text{ V}} = 1.1$$

$$U_{\text{applied}} = 230 \text{ V}$$

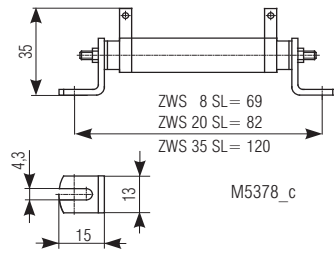
$$t_{M,\text{on}} = \text{approx. } 300 \text{ ms} \quad F = \frac{U_{\text{applied}}}{U_{\text{setting}}}$$

$$t_{M,\text{off}} = \text{approx. } 60 \text{ ms}$$

## Accessories

ZWS 20 SL, ZWS 35 SL

Drop resistor

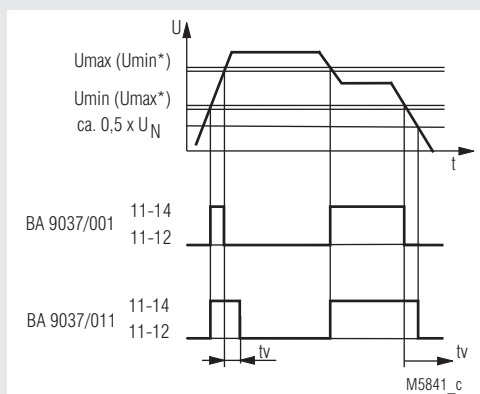


## VARIMETER Voltage Relay BA 9037



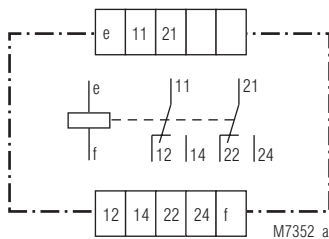
- According to IEC 255, EN 30 255, VDE 0435 part 303
- Single phase
- Measuring ranges from 24 to 660 V
- Response and release value adjustable independent of each other
- Under- and overvoltage detection
- Without auxiliary supply
- Large setting range
- With time delay
- Closed circuit operation
- Insensitive to harmonics
- LED indicators for operation and state of contacts
- Width 45 mm

### Function Diagram



\*  $U_{min}$  and  $U_{max}$  can also be exchanged. The hysteresis of the setting values is  $< 4\%$  of the response value

### Circuit Diagram



BA 9037.12

### Approvals and Markings



### Applications

Under- and overvoltage detection in AC or DC voltage systems

### Indicators

upper LED: on, when voltage connected  
lower LED: on, when output contact activated

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** DC 24, 42, 60 V (protected against wrong

polarity). These units are calibrated for DC voltage. When AC voltage is connected the setting has an offset of 11 %.

#### Measuring ranges:

#### Voltage range:

#### Nominal consumption:

AC 110, 127, 230, 240, 400, 660, 690 V  
0.7 ... 1.3  $U_N$   
0.6 ... 1.4  $U_N$   
DC 24 V 1 W  
AC 24 V 2 VA  
AC 230 V 5 VA  
AC 500 V 10 VA

#### Nominal frequency:

#### Frequency range:

#### Temperature influence:

50 / 60 Hz  
 $\pm 5\%$   
 $< 0.05\% / K$

### Setting Ranges

#### Response value:

$U_{min}$  infinite 0.7 ... 1.3  $U_N$

#### Hysteresis:

#### Setting accuracy:

#### Repeat accuracy:

$U_{max}$  infinite 0.7 ... 1.3  $U_N$   
at  $U_{min}$  bzw.  $U_{max} < 0.96$   
 $< \pm 5\%$   
 $< \pm 0.5\%$

## Technical Data

### Output

### Contacts

BA 9037.12: 2 changeover contacts

Release delay: 24 V < 20 ms

220 V < 150 ms

500 V < 150 ms

Thermal current  $I_{th}$ : 5 A

### Switching capacity

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

Electrical life IEC/EN 60 947-5-1

to AC 15 at 3 A, AC 230 V: 5 x 10<sup>5</sup> switching cycles

### Permissible switching frequency:

6000 switching cycles / h

### Short circuit strength

max. fuse rating: 4 AgL IEC/EN 60 947-5-1

Mechanical life: > 30 x 10<sup>6</sup> switching cycles

## General Data

Operating mode: Continuous operation

Temperature range: - 40 ... + 70°C

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation: 10 V/m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages: 1 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

Housing: Thermoplastic with V0 behaviour according to UL subject 94

Vibration resistance: Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz

Climate resistance: 20 / 060 / 04 IEC/EN 60 068-1

Terminal designation: EN 50 005

Wire connection: 2 x 2.5 mm<sup>2</sup> solid or 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4

Wire fixing: Flat terminals with self-lifting clamping piece IEC/EN 60 999-1

Fixing torque: 0.8 Nm

Mounting: DIN rail IEC/EN 60 715

Weight: 240 g

## Dimensions

Width x height x depth: 45 x 73 x 132 mm

## Classification to DIN EN 50155

### Vibration and

shock resistance: Category 1, Class B IEC/EN 61 373

Protective coating of the PCB: No

## Standard Type

BA 9037.12/001 AC / DC 24 V

Article number: 0030758

• without time delay

• Output: 2 changeover contacts

• Nominal voltage  $U_N$ : AC / DC 24 V

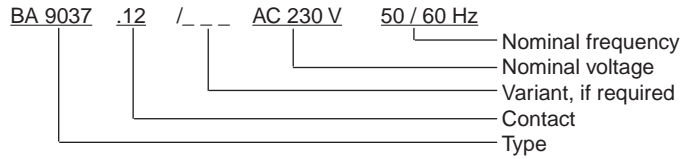
• Width: 45 mm

## Variant

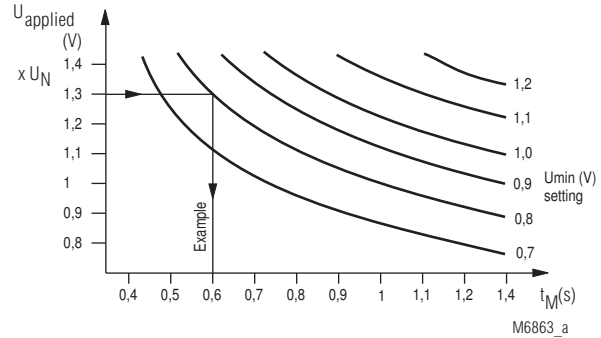
BA 9037.--/011:

adjustable time delay  $t_M$  1 ... 20 sec.  
If the voltage drops below 0.5  $U_N$  the time delay is inactive, and the contacts fall back immediately.

### Ordering example for variant



## Characteristics



### Operate delay $t_M$ :

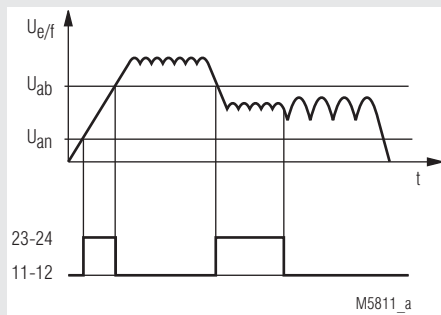
The diagram shows the relation of the operate delay to the applied measuring voltage  $U_{applied}$  and the setting of  $U_{min}$  when the voltage is switched on. A slow voltage change reduces the delay.

## VARIMETER Voltage Monitor IK 9044, IK 9046



- According to IEC/EN 60 255-1
- For monitoring direct current voltage supply systems to detect undervoltage, overvoltage and residual ripple
- For DC 24 V
- IK 9046 with adjustable residual ripple
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



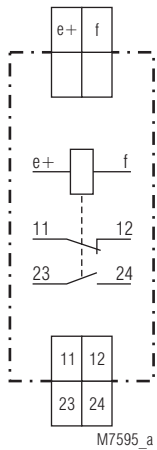
### Application

For monitoring direct current voltage supply systems, e.g. of PLC (three-phase bridges), automobile industry, welding.

### Indicator

Yellow LED: on, when there are no faults in the supply system

### Circuit Diagram



IK 9044

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** DC 24 V  
**Maximum overload:** DC 33 V permanent  
 DC 35 V 0.5 s  
 DC 45 V 10 ms  
**Nominal consumption:** 0.6 W

#### Nominal consumption:

**Overvoltage**  
 setting value:  $0.82 \times U_N$

**Undervoltage**  
 setting value:  $1.18 \times U_N$

**Hysteresis:**  $< 4\% \times U_N$

#### Residual ripple actuation

IK 9044: approx. 15 %  
 IK 9046: 0 ... 15 %, adjustable

#### Output

**Contacts:** 1 NC contact, 1 NO contact  
**Thermal current  $I_{th}$ :** 4 A

#### Switching capacity

to AC 15  
 NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life:** IEC/EN 60 947-5-1

AC 15 at 1 A, AC 230 V:  $5 \times 10^5$  switching cycles

#### Short circuit strength

**max. fuse rating:** 4 AgL IEC/EN 60 947-5-1

**Mechanical life:**  $30 \times 10^6$  switching cycles

### Connection Terminals

Terminal designation	Signal designation
e+, f	Measuring- and supply voltage DC 24 V
11, 12	NC contact
23, 24	NO contact

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range</b>		
Operation:	- 25 ... + 70°C	
Storage:	- 25 ... + 85 °C	
<b>Altitude:</b>	< 2,000 m	
<b>Clearance and creepage distances</b>		
rated impulse voltage/ pollution degree:	4 kV / 2 (basis insulation) IEC 60 664-1	
<b>EMC</b>		
Electrostatic discharge:	6 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages		
between wire and ground:	4 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	25 / 070 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>		
Cross section:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4	
Stripping length:	10 mm	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN rail IEC/EN 60 715 or screw attachment	
<b>Weight:</b>	67 g	

### Dimensions

**Width x height x depth:** 17.5 x 90 x 58 mm

### Standard Type

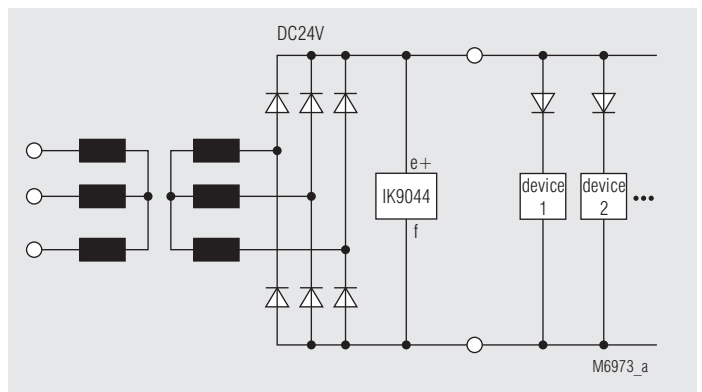
#### IK 9044 DC 24 V

Article number:	0027841
• Residual ripple actuation:	approx. 15 %
• Nominal voltage $U_N$ :	DC 24 V
• Width:	17.5 mm

#### IK 9046 DC 24 V

Article number:	0030027
• Residual ripple actuation:	0 ... 15 %, adjustable
• Nominal voltage $U_N$ :	DC 24 V
• Width:	17.5 mm

## Connection Example



M6973\_a



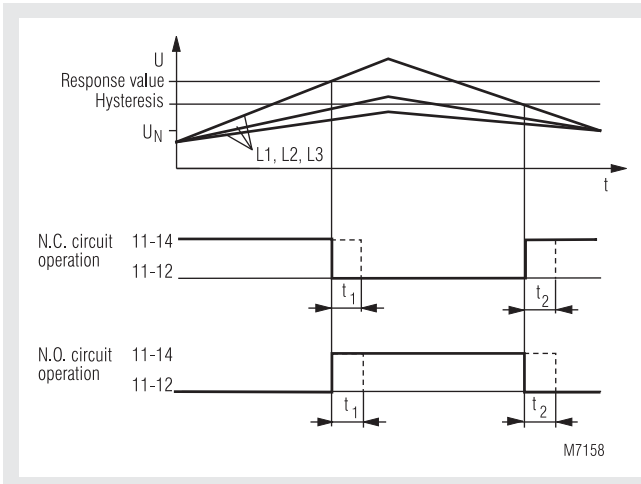
## VARIMETER

### Overvoltage Relay, 3-phase IK 9170, SK 9170



- According to IEC/EN 60 255, DIN VDE 0435-303
- Monitoring of overvoltage in 3-phase systems
- Also for single phase
- Without auxiliary supply
- Settable response value
- N.C. circuit operation (optionally N.O. circuit operation)
- Optionally with or without N
- Optionally with delay  $t_1$  on trip
- Optionally with delay  $t_2$  on reset
- LED indicator for state of output relay
- Independent of phase sequence
- 1 changeover contact
- Devices available in 2 enclosure versions:
  - IK 9170: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9170: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



### Applications

Monitors overvoltage, in 3-phase voltage systems

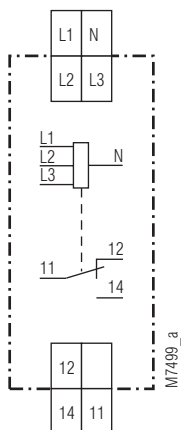
### Notes

The arithmetic mean value of each phase is measured against N. The variants without N measure  $L_1$  and  $L_3$  against  $L_2$ .

### Indicators

Yellow LED: output contact active (11-14 closed)

### Circuit Diagram



IK 9170.11, SK 9170.11

### Technical Data

#### Input Circuit

**Nominal voltage  $U_N$ :** 3/N AC 400/230 V (with neutral)  
3 AC 400 V (without neutral)  
**Voltage range:** 0.7 ... 1.3  $U_N$   
**Max. overload:** 1.35  $U_N$ , continuously  
**Nominal consumption:** approx. 4 VA  
**Frequency range:** 45 ... 65 Hz

#### Setting Ranges

**Response value:** adjustable: 0.9 ... 1.3  $U_N$   
**Hysteresis:** approx. 4 % of setting value  
**Time delay  $t_1 / t_2$ :** 0.5 ... 20 s

#### Output

##### Contacts

IK 9170.11, SK 9170.11: 1 changeover contact  
**Thermal current  $I_{th}$ :** 4 A

##### Switching capacity

to AC 15  
NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

##### Electrical contact life

at AC 230 V, 1 A ( $\cos \varphi = 0.5$ ):  $\geq 3 \times 10^5$  switching cycles

##### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage /  
pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 20 V / m IEC/EN 61 000-4-3

1 GHz ... 2 GHz: 20 V / m IEC/EN 61 000-4-3

2 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages  
between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour  
according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm,  
frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

**Climate resistance:** EN 50 005

**Terminal designation:**

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded ferruled  
DIN 46 228-1/-2/-3/-4

**Wire fixing:** Flat terminals with self-lifting  
clamping piece IEC/EN 60 999-1

**Mounting:** DIN rail IEC/EN 60 715

### Weight

IK 9170: 65 g

SK 9170: 83 g

### Dimensions

#### Width x height x depth

IK 9170: 17.5 x 90 x 59 mm

SK 9170: 17.5 x 90 x 98 mm

## Standard Types

IK 9170.11 3/N AC 400/230V 50/60 Hz 0.9 ... 1.3 U<sub>N</sub>

Article number: 0048645

SK 9170.11 3/N AC 400/230V 50/60Hz 0.9 ... 1.3 U<sub>N</sub>

Article number: 0054743

• Adjustable response value: 0.9 ... 1.3 U<sub>N</sub>

• Without time delay

• with N

• Closed circuit operation

• Output: 1 changeover contact

• Nominal voltage U<sub>N</sub>: 3/N AC 400/230 V

• Width: 17.5 mm

## Variants

IK 9170/001

0 N.C. circuit operation with N

1 N.C. circuit operation without N

2 N.O. circuit operation with N

3 N.O. circuit operation without N

0 without time delay

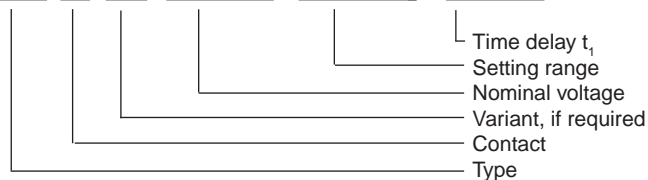
3 settable time delay t<sub>1</sub>

4 settable time delay t<sub>2</sub>

0 settable response value

## Ordering example for variants

IK 9170 .11 /031 3 AC 400 V 0.9 ... 1.3 U<sub>N</sub> 0.5 ... 20 s



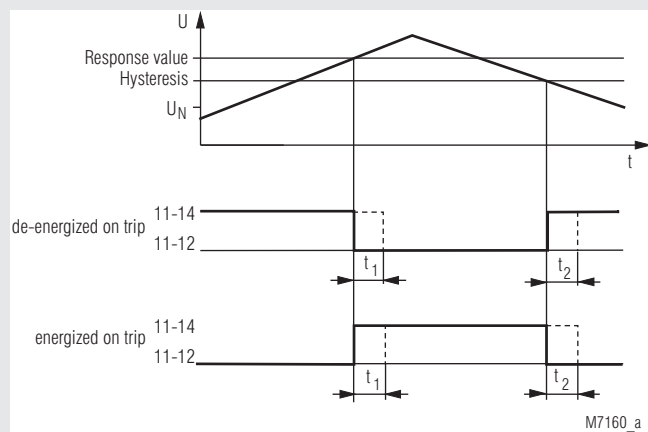
## VARIMETER

Overvoltage Relay, Single Phase  
IK 9172, SK 9172



- According to IEC/EN 60 255, DIN VDE 0435-303
- Monitoring of overvoltage
- Without auxiliary supply
- Settable response value
- De-energized on trip
- LED indicator for state of output relay
- 1 changeover contact
- As option energized on trip
- As option with delay t1 on trip
- As option with delay t2 on reset
- **Devices available in 2 enclosure versions:**
  - IK 9171:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9171:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



### Applications

Monitors overvoltage, in single-phase voltage systems

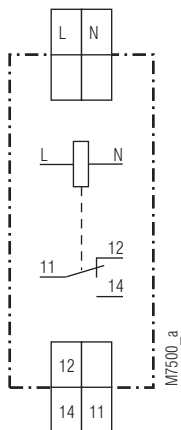
### Function

The arithmetic mean value of the voltage L-N ist measured.

### Indicators

Yellow LED: output contact active (11-14 closed)

### Circuit Diagram



IK 9172.11, SK 9172.11

### Technical Data

#### Input Circuit

**Nominal voltage  $U_N$ :** AC 24, 42, 110, 230 V  
DC 24, 48, 60, 110 V  
**Voltage range:** 0.7 ... 1.3  $U_N$   
**Max. overload:** 1.35  $U_N$  continuously  
**Nominal consumption:** max. 5 VA / DC 1 W  
**Frequency range:** 45 ... 65 Hz

#### Setting Ranges

**Response value:** adjustable: 0.9 ... 1.3  $U_N$   
**Hysteresis:** approx. 4 % of setting value  
**Time delay  $t_1 / t_2$ :** 0.5 ... 20 s

#### Output

#### Contacts

IK 9172.11, SK 9172.11: 1 changeover contact  
**Thermal current  $I_{th}$ :** 4 A  
**Switching capacity**  
to AC 15  
NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical contact life** IEC/EN 60 947-5-1  
at AC 230 V, 1 A ( $\cos \varphi = 0.5$ )  $\geq 3 \times 10^5$  switching cycles  
**Short circuit strength**  
**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation  
**Temperature range:** - 20 ... + 60 °C

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2  
 HF irradiation  
 80 MHz ... 1 GHz: 20 V / m IEC/EN 61 000-4-3  
 1 GHz ... 2 GHz: 20 V / m IEC/EN 61 000-4-3  
 2 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3  
 Fast transients: 4 kV IEC/EN 61 000-4-4

### Surge voltages between

wires for power supply: 1 kV IEC/EN 61 000-4-5  
 between wire and ground: 2 kV IEC/EN 61 000-4-5  
 Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
 20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

Terminal designation: EN 50 005

### Wire connection:

2 x 2.5 mm<sup>2</sup> solid or  
 2 x 1.5 mm<sup>2</sup> stranded ferruled  
 DIN 46 228-1/-2/-3/-4

### Wire fixing:

Flat terminals with self-lifting clamping piece IEC/EN 60 999-1  
 DIN rail IEC/EN 60 715

### Mounting:

**Weight**  
 IK 9171: 65 g  
 SK 9171: 83 g

## Dimensions

### Width x height x depth

IK 9172: 17.5 x 90 x 59 mm  
 SK 9172: 17.5 x 90 x 98 mm

## Standard Types

IK 9172.11 AC 230 V 50/60 Hz 0.9 ... 1.3 U<sub>N</sub>  
 Article number: 0048644  
 SK 9172.11 AC 230 V 50/60Hz 0.9 ... 1.3 U<sub>N</sub>  
 Article number: 0054745  
 • Adjustable response value: 0.9 ... 1.3 U<sub>N</sub>  
 • Without time delay  
 • De-energized on trip  
 • Output: 1 changeover contact  
 • Nominal voltage U<sub>N</sub>: AC 230 V  
 • Width: 17.5 mm

## Variants

IK 9172/001

- 0 De-energized on trip
- 1 Energized on trip
- 0 Without time delay
- 3 Settable time delay t<sub>1</sub>
- 4 Settable time delay t<sub>2</sub>
- 0 Settable response value

## Ordering example for variants

IK 9172 .11 / \_ \_ \_ AC 230 V 50/60 Hz 0.9 ... 1.3 U<sub>N</sub> 0.5 ... 20 s

- Time delay t<sub>1</sub>
- Setting range
- Nominal frequency
- Nominal voltage
- Variant, if required
- Contact
- Type

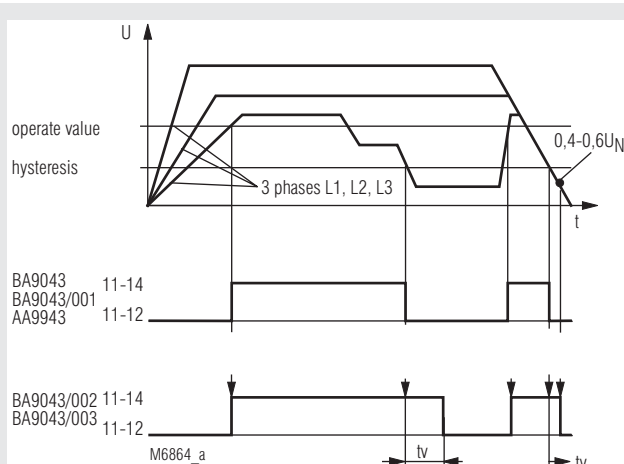
## VARIMETER

Undervoltage Relay  
BA 9043, AA 9943



- According to EC/EN 60255-1
- 3-phase
- For nominal voltage of 3 AC 100 / 57 to 690 / 400 V
- Measures arithmetic mean value
- Adjustable operate and release value
- For 3p3w or 3p4w systems
- BA 9043 with optionally adjustable time delay
- De-energized on trip operation
- LED indicator for operation and state of contact
- Insensitive to harmonics
- Frequency up to 400 Hz
- Width 45 mm

### Function Diagram



### Approvals and Markings



\*) see variants

### Application

- Undervoltage detection in 3 phase systems
- For industrial and railway applications

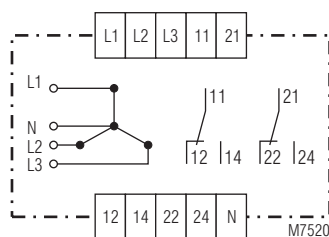
### Indicators

- upper LED (only BA 9043): on, when voltage connected
- lower LED: on, when output contact activated

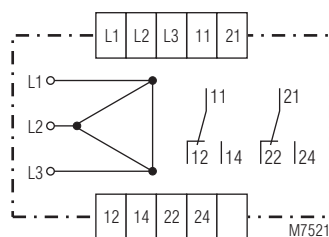
### Notes

For determination of the arithmetic mean value of the voltage the 3 phases are measured against N.  
The variants without N ( /001 and /003) measure L1 and L2 against L3.  
delay the delay is only active at  $U \geq 0,6 U_N$ . At  $< 0,4 U_N$  the relay switches off without delay.

### Circuit Diagrams



BA 9043, BA 9043/002  
AA 9943



BA 9043/001, BA 9043/003  
AA 9943/001

### Technical Data

#### Input

#### Nominal voltage U<sub>N</sub>

BA 9043, BA 9043/002 3/N AC 100/57 V; 220/127 V; 400/230 V  
AA 9943: 415/240 V; 440/254 V; 500/290 V  
BA 9043, BA9043/002: 3/N AC 690/400 V

BA 9043/001, BA 9043/003, AA 9943/001: 3 AC 100 V; 220 V; 400 V; 415 V, 440 V; 500 V  
BA 9043/001, BA 9043/003: 3 AC 690 V

#### Max. overload

BA 9043: 1.2 U<sub>N</sub> continuously  
AA 9943: 1.1 U<sub>N</sub> continuously

#### Nominal consumption:

AC 4 VA

#### Nominal frequency:

50 ... 400 Hz

#### Frequency range:

± 5 %

#### Temperature influence:

< 0.05 % / K

### Setting Ranges

- Response value:** 0.85 ... 1.05 U<sub>N</sub>, infinite variable with upper potentiometer
- Hysteresis:** 0.75 ... 0.95 of operate value
- Setting accuracy:** ≤ ± 10 %
- Switching delay t<sub>M</sub>:** see diagram switching delay
- Time delay t<sub>v</sub>:** infinite variable from 0.5 ... 10 sec for BA 9043/002, BA 9043/003  
Between 0.4 and 0.6 U<sub>N</sub> the contacts fall back according to the diagram without additional delay

## Technical Data

### Output

### Contacts

BA 9043:	2 changeover contacts
AA 9943.11:	1 changeover contact
AA 9943.12:	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>	6 A; see diagramm Continuous current limit curve

### Switching capacity

to AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13		
NO contact:	1 A / DC 24 V	IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V	IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 3 A, AC 230 V:	3 x 10 <sup>5</sup> switching cycles
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### Short circuit strength

<b>max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
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### Mechanical life:

> 30 x 10<sup>6</sup> switching cycles

## General Data

### Operating mode:

Continuous operation

### Temperature range

Operation: - 20 ... + 60°C

Storage: - 25 ... + 60°C

Altitude: < 2.000 m

### Clearance and creepage distances

rated impulse voltage / pollution degree:	4 kV / 2	IEC 60 664-1
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### EMC

Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
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### HF irradiation

80 MHz ... 1 GHz:	10 V/m	IEC/EN 61 000-4-3
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1 GHz ... 2.5 GHz:	3 V/m	IEC/EN 61 000-4-3
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2.5 GHz ... 2.7 GHz:	3 V/m	IEC/EN 61 000-4-3
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Fast transients:	2 kV	IEC/EN 61 000-4-4
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### Surge voltages

between

wires for power supply:	1 kV	IEC/EN 61 000-4-5
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between wire and ground:	2 kV	IEC/EN 61 000-4-5
--------------------------	------	-------------------

HF wire guided:	10 V	IEC/EN 61 000-4-6
-----------------	------	-------------------

Interference suppression:	Limit value class B	EN 55 011
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### Degree of protection

Housing:	IP 40	IEC/EN 60 529
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Terminals:	IP 20	IEC/EN 60 529
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### Housing:

Thermoplastic with V0 behaviour

according to UL subject 94

<b>Vibration resistance:</b>	Amplitude 0.35 mm	IEC/EN 60 068-2-6
------------------------------	-------------------	-------------------

frequency 10 ... 55 Hz

<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
----------------------------	---------------	-----------------

DIN EN 50 005

<b>Terminal designation:</b>	2 x 2.5 mm <sup>2</sup> solid or
------------------------------	----------------------------------

2 x 1.5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4

Flat terminals with self-lifting

<b>Wire fixing:</b>	clamping piece	IEC/EN 60 999-1
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0.8 Nm

<b>Fixing torque:</b>	DIN rail	IEC/EN 60 715
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### Mounting:

BA 9043: 310 g

AA 9943: 300 g

## Dimensions

### Width x height x depth

BA 9043: 45 x 73 x 132 mm

AA 9943: 45 x 77 x 127 mm

## CCC-Data

**Thermal current  $I_{th}$ :** 5 A

### Switching capacity

to AC 15: 2 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Classification to DIN EN 50155 for BA 9043

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

Ambient temperature: T1 compliant

T2, T3 and TX with operational limitations

**Protective coating of the PCB:** No

## Standard Type

BA 9043 3/N AC 400 / 230 V 50 ... 400 Hz

Article number: 0039676

- for 3p4w systems
- Nominal voltage  $U_N$ : 3/N AC 400 / 230 V
- Output: 2 changeover contacts
- Width: 45 mm

## Variants

AA 9943/001: without neutral  
AA 9943/175: for nuclear power plants  
BA 9043/001: without neutral  
BA 9043/002: with neutral, adjustable time delay

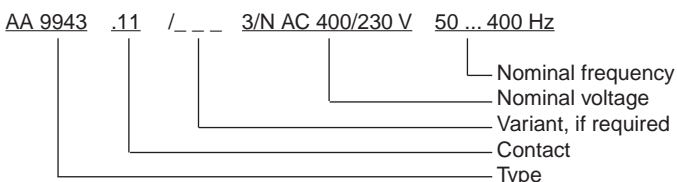
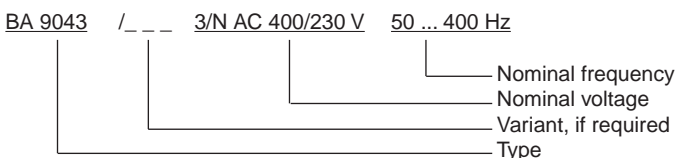
$t_v = 0.5 \dots 10$  sec

BA 9043/003: without neutral, adjustable time delay

$t_v = 0.5 \dots 10$  sec

BA 9043: with CCC-approval on request

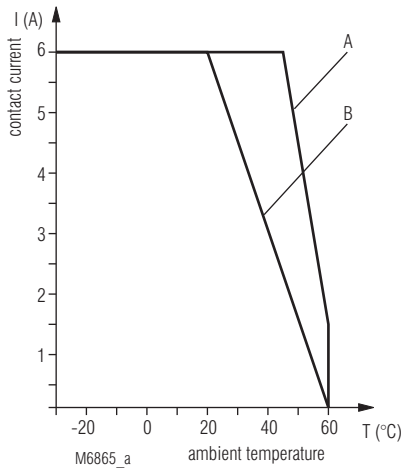
### Ordering example for variants



## Accessories

AA 9943: Cover  
K 70-34 Article number: 0011790

## Characteristics



Continuous current limit curve

A = Devices mounted with 2 cm distance

B = Devices mounted without distance

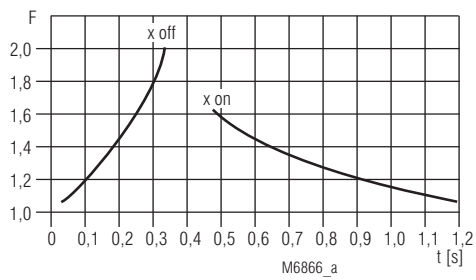


Diagram switching delay

Switching delay  $t_M$ :

When the voltage changes fast on the measuring input, the arithmetic mean value can only adjust after a short delay.

Example:

$$F = \frac{U_{\text{applied}}}{U_{\text{setting}}} \quad F = \frac{240 \text{ V}}{190 \text{ V}} = 1.26$$

U setting = 190 V

U applied = 240 V

according to diagram:

$t_{M, \text{on}}$  = approx. 800 ms

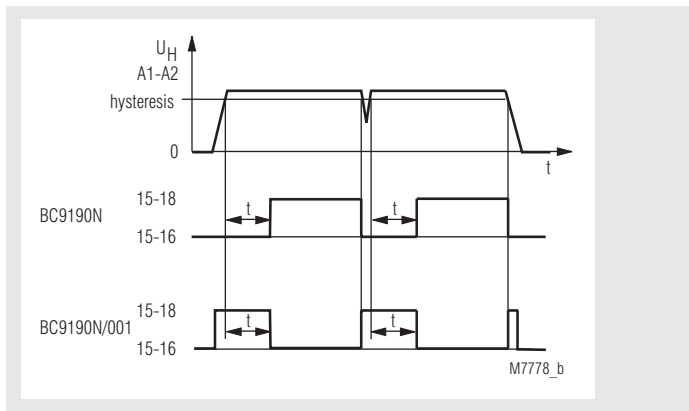
$t_{M, \text{off}}$  = approx. 100 ms

## VARIMETER Voltage Drop Detector BC 9190N

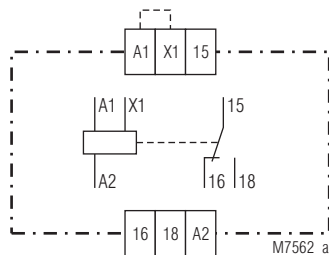


- According to IEC/EN 60 255, DIN VDE 0435-303
- Fast detection of undervoltage and phase failure in AC voltage systems
- Detects voltage drops (reaction time  $\leq 20$  ms)
- Response value 0.8 or 0.7  $U_N$  selectable by wire link
- Without auxiliary supply
- De-energized on trip
- LED indicator for contact position
- Adjustable operate delay after return of voltage
- As option adjustable fleeting on make pulse after return of voltage (variant BC 9190N.11/001)
- 1 changeover contact
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled (isolated), DIN 46 228-1/-2/-3/-4 or 2 x 2.5 mm<sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
- Width 22.5 mm

### Function Diagram



### Circuit Diagram



### Approvals and Markings



### Applications

Monitoring of voltage systems to detect auto reclosing as e.g. generated by the energy supplier in the case of flash-overs or switching procedures. It is possible that in control circuits some of the devices are reset during auto reclosing and some not. Because of this uncontrollable situations may occur.

By detecting these fast auto reclosings and addition of a certain time delay at reclosing the OFF-time is lengthened and every device has the time to reset. The circuit goes into a defined OFF-state and is automatically reset after the adjusted time delay or by manual reset if the automatic reset is disabled by an external circuit (see Connection Examples).

### Function

If the BC 9190N detects a voltage drop below 0.8 or 0.7 of  $U_N$  the yellow LED goes off and the relay de-energises (fault condition). The setting of the response value 0.7  $U_N$  is done by linking terminal X1 to A1. Without link the response value is 0.8  $U_N$ .

If the voltage returns to normal (2 % Hysteresis above response value) the output relay energises after the time delay  $t$  and the yellow LED switches on (good condition).

The BC 9190N.11/001 energises the output relay immediately after the voltage returns for an adjustable pulse time. After the time delay the relay is de-energized.

### Indication

LED: on when output relay activated (contacts 15-18 are closed)

### Notes

The BC 9190N is designed for mains frequency of 50 Hz. It can also be operated on 60 Hz but the response values are reduced to approx. 0.75 and 0.65  $U_N$ .



## Technical Data

### Time Circuit

<b>Time ranges:</b>	0.05 ... 1 s	15 ... 300 s
	0.15 ... 3 s	1.5 ... 30 min.
	0.5 ... 10 s	0.15 ... 3 h
	1.5 ... 60 s	0.5 ... 10 h
<b>Time setting:</b>	stepless 1:20	
<b>Recovery time:</b>	≤ 20 ms	
<b>Repeat accuracy:</b>	≤ 0.5 % + 10 ms	
<b>Voltage influence:</b>	≤ 1 %	
<b>Temperature influence:</b>	≤ 0.25 % / K	

### Input

<b>Nominal voltage <math>U_N</math>:</b>	AC 110 V, AC 230 V
<b>Overload:</b>	1.15 $U_N$
<b>Nominal consumption:</b>	2.5 VA
<b>Nominal frequency:</b>	50 Hz
<b>Frequency range:</b>	± 5 % $f_N$
<b>Response value</b>	
without bridge X1-A1:	0.8 $U_N$
with bridge X1-A1:	0.7 $U_N$
<b>Hysteresis:</b>	approx. 2 %

### Output

<b>Contacts:</b>	1 changeover contact
BC 9091N.11:	4 A
<b>Thermal current <math>I_{th}</math>:</b>	
<b>Switching capacity</b>	
to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	IEC/EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	1.5 x 10 <sup>5</sup> switching cycles
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	10 <sup>8</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 60°C	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between		
wires for power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) DIN 46 228-1/-2/-3/-4 or 2 x 2.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	

## Technical Data

<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight:</b>	80 g	

### Dimensions

<b>Width x height x depth:</b>	22.5 x 84 x 97 mm
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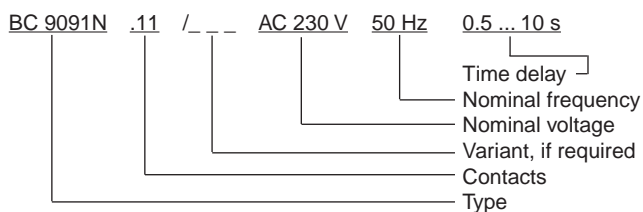
### Standard Type

BC 9190N.11	AC 230 V	0.5 ... 10 s
Article number:		
• Adjustable operate delay	0.5 ... 10 s	
• Output:	1 changeover contact	
• Nominal voltage $U_N$ :	AC 230 V	
• Time range:	0.5 ... 10 s	
• Width:	22.5 mm	

### Variant

BC 9190N.11/001	with fleeting on make function
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### Ordering example for variant



## VARIMETER

Undervoltage Relay, 3-phase

IK 9171, IL 9171, SK 9171, SL 9171

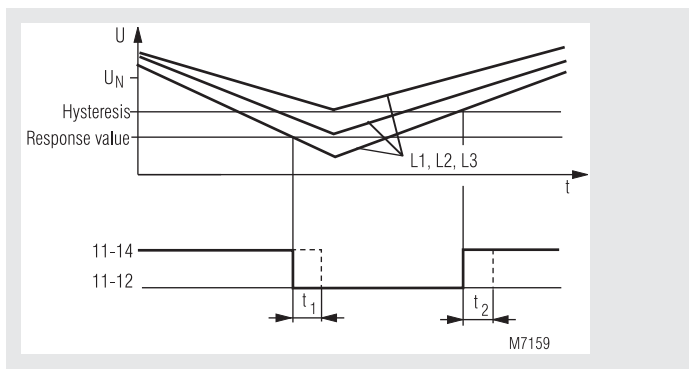


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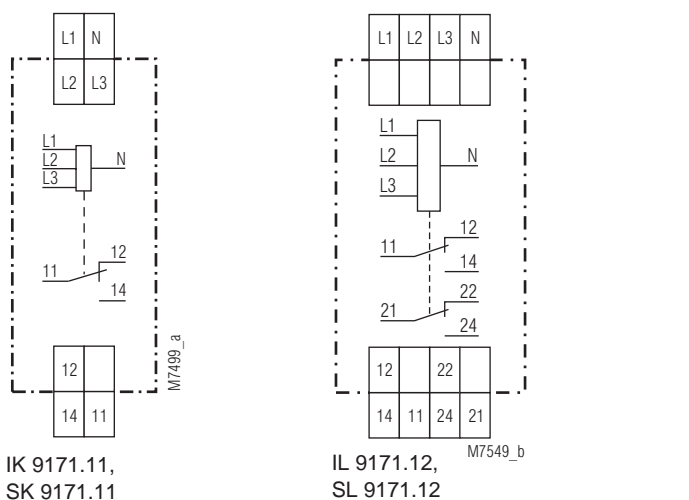


- According to IEC/EN 60 255-1
- Monitoring of undervoltage in 3-phase system
- Also for single phase
- Without auxiliary supply
- Optionally for 3p3w systems
- LED indicator for state of output relay
- Independent of phase sequence
- 1 or 2 changeover contacts
- Optionally fixed or settable response value
- As option with phase sequence detection
- Optionally with or without N
- Optionally with off-delay  $t_1$
- Optionally with on delay  $t_2$
- Devices available in 2 enclosure versions:
  - I-model: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width:
  - IK 9171, SK 9171: 17.5 mm
  - IL 9171, SL 9171: 35 mm

### Function Diagram



### Circuit Diagrams



### Approvals and Markings



### Application

Monitoring of voltage systems on undervoltage. Automatic switching to emergency supply or of emergency light in the case of phase loss according to DIN VDE 0100-710 or DIN VDE 0108.

Variant with  $t_2$  is used in unstable voltage systems, where after phase failure detection the consumers should be energized one after the other. This is done by setting the operate delay e.g. 0.1 ... 20 s of the different relays to different values. This variant is also used where a consumer after only short phase failure should not be started immediately (e.g. compressors).

### Function

The arithmetic mean value of each phase is measured against N. The variants without N measure L1 and L3 against L2 (IK/SK 9171) and L1 and L2 against L3 (IL/SL 9171).

### Indicators

Yellow LED: output contact active (11-14 closed)

### Notes

To measure single-phase voltage terminals L1, L2, L3 have to be linked together. The time delay  $t_1$  is only active if the voltage L1-N (IK/SK 9171) or L3-N (IL/SL 9171) is at least  $0,5 U_N$ .

Technical Data	
<b>Input Circuit</b>	
<b>Nominal voltage <math>U_N</math></b> 3-phase without neutral:	3 AC 100 V, 110 V, 127 V, 220 V, 230 V, 3 AC 240 V, 290 V, 400 V, 415 V, 440 V, 3 AC 480 V, 500 V
3-phase with neutral	3/N AC 100 V / 58 V; 3/N AC 110 V / 64 V; 3/N AC 220 V / 127 V; 3/N AC 230 V / 133 V; 3/N AC 380 V / 220 V; 3/N AC 400 V / 230 V; 3/N AC 415 V / 240 V; 3/N AC 440 V / 254 V; 3/N AC 480 V / 277 V; 3/N AC 500 V / 290 V 1.15 $U_N$ continuously
<b>Max overload:</b> <b>Nominal consumption</b> IK/SK 9171.11: IL/SL 9171.12: <b>Frequency range:</b>	approx. 6 VA approx. 8 VA 45 ... 65 Hz
<b>Setting ranges</b>	
<b>Response value:</b>	fixed: 0.7 or 0.85 $U_N$ adjustable: 0.55 ... 1.05 $U_N$ approx. 4 % of setting value
<b>Hysteresis:</b> <b>Time delay <math>t_1</math> / <math>t_2</math>:</b> <b>Reaction time:</b>	0.5 ... 20 s approx. 100 ms
<b>Output</b>	
<b>Contacts</b> IK/SK 9171.11: IL/SL 9171.12: <b>Contact material:</b> <b>Switching voltage:</b> <b>Thermal current <math>I_{th}</math>:</b> <b>Switching capacity</b> to AC 15 NO contact: NC contact: <b>Electrical life</b> to AC 15 at 1 A, AC 230 V: <b>Short circuit strength</b> <b>max. fuse rating:</b> <b>Mechanical life:</b>	1 changeover contact 2 changeover contacts AgNi AC 250 V 4 A 3 A / AC 230 V IEC/EN 60 947-5-1 1 A / AC 230 V IEC/EN 60 947-5-1 IEC/EN 60 947-5-1 $\geq 3 \times 10^5$ switching cycles 4 A gL IEC/EN 60 947-5-1 $\geq 30 \times 10^6$ switching cycles
<b>General Data</b>	
<b>Operating mode:</b> <b>Temperature range:</b> Operation: Storage: Relative air humidity: <b>Altitude:</b> <b>Clearance and creepage</b> <b>distances</b> rated impulse voltage / pollution degree: <b>EMC</b> Electrostatic discharge: HF irradiation 80 MHz ... 1 GHz: 1 GHz ... 2 GHz: 2 GHz ... 2.7 GHz: Fast transients: Surge voltages between wires for power supply: between wire and ground: HF-wire guided: Interference suppression: <b>Degree of protection</b> Housing: Terminals: <b>Housing:</b> <b>Vibration resistance:</b> <b>Climate resistance:</b> <b>Terminal designation:</b> <b>Wire connection:</b> <b>Wire fixing:</b> <b>Fixing torque:</b>	Continuous operation - 20 ... + 60 °C - 25 ... + 60 °C 93 % at 40 °C < 2,000 m 4 kV / 2 IEC 60 664-1 8 kV (air) IEC/EN 61 000-4-2 20 V / m IEC/EN 61 000-4-3 20 V / m IEC/EN 61 000-4-3 1 V / m IEC/EN 61 000-4-3 2 kV IEC/EN 61 000-4-4 2 kV IEC/EN 61 000-4-5 4 kV IEC/EN 61 000-4-5 30 V IEC/EN 61 000-4-6 Limit value class B EN 55 011 IP 40 IEC/EN 60 529 IP 20 IEC/EN 60 529 Thermoplastic with V0 behaviour according to UL subject 94 Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1 EN 50 005 2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4 Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 0.8 Nm

Technical Data		
<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight</b> IK 9171: SK 9171: IL 9171: SL 9171:	65 g 83 g 110 g 137 g	
<b>Dimensions</b>		
<b>Width x height x depth</b> IK 9171: 17.5 x 90 x 59 mm SK 9171: 17.5 x 90 x 98 mm IL 9171: 35 x 90 x 59 mm SL 9171: 35 x 90 x 98 mm		
<b>Classification to DIN EN 50155 for IK 9171</b>		
<b>Vibration and shock resistance:</b>	Category 1, Class B	IEC/EN 61 373
<b>Protective coating of the PCB:</b>	No	
<b>Standard Type</b>		
IK 9171.11/200 3/N AC 400/230 V 50/60 Hz 0.85 $U_N$ Article number: 0049292 SK 9171.11/200 3/N AC 400/230V 50/60Hz 0.85 $U_N$ Article number: 0054744	<ul style="list-style-type: none"> <li>• Output: 1 changeover contact</li> <li>• Nominal voltage <math>U_N</math>: 3/N AC 400/230 V</li> <li>• Detection of undervoltage at &lt; 0.85 <math>U_N</math></li> <li>• Fixed response value: 0.85 <math>U_N</math></li> <li>• No time delay</li> <li>• For 3p3w connection</li> <li>• Width: 17.5 mm</li> </ul>	
<b>Variants</b>		
I_ 9171/001	<ul style="list-style-type: none"> <li>0 NC circuit operation with N</li> <li>1 NC circuit operation without N</li> <li>0 without time delay</li> <li>3 settable time delay <math>t_1</math></li> <li>4 settable time delay <math>t_2</math></li> <li>0 settable response value</li> <li>2 fixed response value</li> <li>K width 17.5 mm</li> <li>L width 35 mm</li> </ul>	
IK 9171.11/034:	<ul style="list-style-type: none"> <li>- with settable time <math>t_1</math></li> <li>- NC circuit operation without N</li> <li>- detection of phase sequence</li> </ul>	
IL 9171.12/801:	as Standard Type /200 but output relay with 5 $\mu$ m goldplated contacts. This module is also suitable for switching small loads of 1 mVA ... 7 VA, 1 mW ... 7W in the range 0.1 ... 60 V, 1 ... 300 mA. The contacts also permit the maximum switching current (4 A). However, since the gold plating will be burnt off at this current level, the device is no longer suitable for switching small loads after this.	
<b>Ordering example for variants</b>		
IK 9171 .11 / _ _ _ 3 AC 400 V 50/60 Hz 0.55 ... 1.05 $U_N$ 0.5 ... 20 s		

## VARIMETER

Undervoltage Relay, Single-Phase

IK 9173, SK 9173

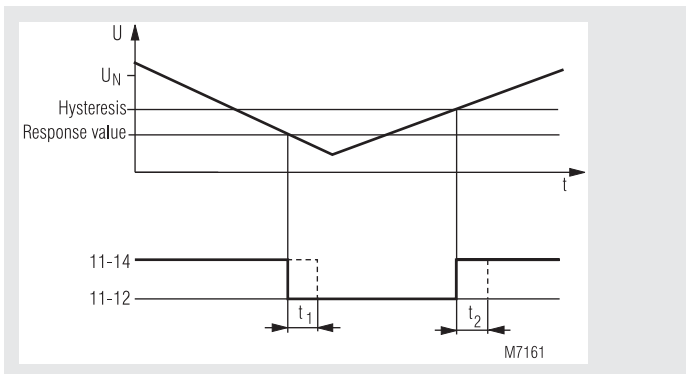


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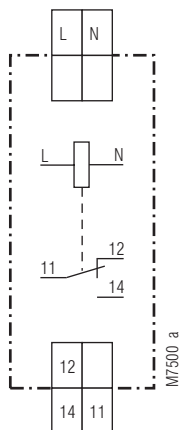


- According to IEC/EN 60 255, DIN VDE 0435-303
- Monitoring of undervoltage
- Without auxiliary supply
- Optionally fixed or settable response value
- N.C. circuit operation
- Optionally with off-delay  $t_1$
- Optionally with on-delay  $t_2$
- LED indicator for state of output relay
- 1 changeover contact
- Devices available in 2 enclosure versions:  
 IK 9173: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880  
 SK 9173: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Circuit Diagram



IK 9173.11, SK 9173.11

### Approvals and Markings



### Applications

Monitoring of voltage systems on undervoltage. Automatic switching to emergency supply or of emergency light in the case of phase loss according to DIN VDE 100-710, or DIN VDE 0108.

Variant with  $t_2$  is used in unstable voltage systems, where after phase failure detection the consumers should be energized one after the other. This is done by setting the operate delay of the different relays to different values. This variant is also used where a consumer after only short phase failure should not be started immediately (e.g. compressors).

Suitable for industrial and railway applications.

### Function

The arithmetic mean value of the voltage L-N is measured.

### Indication

yellow LED: output contact active (11-14 closed)

### Notes

The time delay for the models with delay  $t_1$  is only active as long as the phase voltage L-N is above  $0.5 U_N$ .

## Technical Data

### Input Circuit

<b>Nominal voltage <math>U_N</math>:</b>	AC 24, 42, 110, 230 V DC 24, 48, 60, 110, 125 V
<b>Max. overload:</b>	1.15 $U_N$ continuously
<b>Nominal consumption:</b>	approx. 6 VA / DC 1 W
<b>Frequency range:</b>	45 ... 65 Hz

### Setting Ranges

<b>Response value:</b>	fixed: 0.7 or 0.85 $U_N$ adjustable: 0.55 ... 1.05 $U_N$ (0.7 ... 1.0 $U_N$ at DC 24 V)
<b>Hysteresis:</b>	approx. 4 % of setting value
<b>Time delay <math>t_1</math> / <math>t_2</math>:</b>	0.5 ... 20 s

### Reaction time of the measuring input at phase failure:

approx. 100 ms

### Output

#### Contacts

IK 9173.11, SK 9173.11: 1 changeover contact

**Thermal current  $I_{th}$ :** 4 A

#### Switching capacity to AC 15:

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life** IEC/EN 60 947-5-1

at AC 230 V, 1 A ( $\cos \varphi = 0.5$ ):  $\geq 3 \times 10^5$  switching cycles

#### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

### General Data

**Operating mode:** Continuous operation

**Temperature range:** - 20 ... + 60 °C

#### Clearance and creepage distances

rated impulse voltage/  
pollution degree: 4 kV / 2 IEC 60 664-1

#### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 20 V / m IEC/EN 61 000-4-3

1 GHz ... 2 GHz: 20 V / m IEC/EN 61 000-4-3

2 GHz ... 2.7 GHz: 1 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

#### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

#### Housing:

Thermoplastic with V0 behaviour  
according to UL subject 94

#### Vibration resistance:

Amplitude 0.35 mm,  
frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

#### Climate resistance:

20 / 060 / 04 IEC/EN 60 068-1

#### Terminal designation:

EN 50 005

#### Wire connection:

2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded ferruled  
DIN 46 228-1/-2/-3/-4

#### Wire fixing:

Flat terminals with self-lifting  
clamping piece IEC/EN 60 999-1

#### Fixing torque:

0.8 Nm

#### Mounting:

DIN rail mounting (IEC/EN60715) or  
screw mounting M4, 90 mm hole pattern,  
with additional clip available as accessory

#### Weight

IK 9173: 65 g

SK 9173: 83 g

### Dimensions

#### Width x height x depth

IK 9173: 17.5 x 90 x 59 mm

SK 9173: 17.5 x 90 x 98 mm

## Classification to DIN EN 50155

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

**Protective coating of the PCB:** No

### Standard Types

IK 9173.11/200, AC 230 V, 0.7  $U_N$

Article number: 0049812

SK 9173.11/200, AC 230 V, 0.7  $U_N$

Article number: 0054746

- Detection of undervoltage at  $< 0.7 U_N$
- Fixed response value
- Without time delay
- Output: 1 changeover contact
- Nominal voltage  $U_N$ : AC 230 V
- Width: 17.5 mm

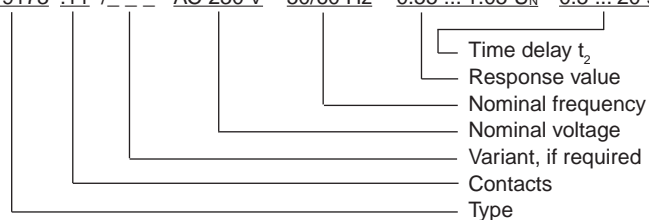
### Variants

IK 9173.11/000

- 0 NC circuit operation
- 0 without time delay
- 3 settable time delay  $t_1$
- 4 settable time delay  $t_2$
- 0 settable response value
- 2 fixed response value

### Ordering example for variants

IK 9173 .11 / \_ \_ \_ AC 230 V 50/60 Hz 0.55 ... 1.05  $U_N$  0.5 ... 20 s

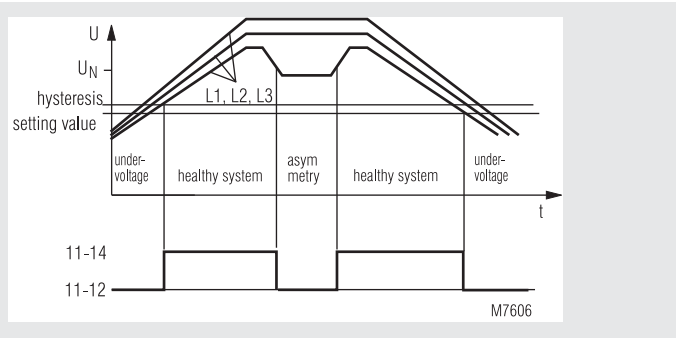


## VARIMETER Undervoltage Relay IL 9071, SL 9071

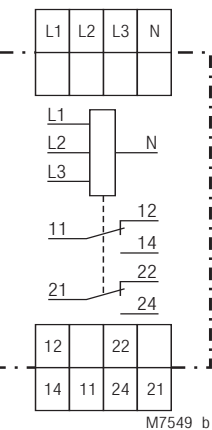


- According to IEC/EN 60 255-1
- Identification of
  - undervoltage
  - phase failure
  - asymmetry also with reverse voltage
  - missing neutral in the system
  - broken neutral on IL/SL 9071
  - neutral exchanged against phase
- Single phase connection possible
- According to DIN VDE 0100-710 (for rooms used for medical purposes) as an option
- Fixed setting value (variable as an option)
- De-energized on trip
- LED indicator
- With safe disconnection according to IEC/EN 61 140, IEC/EN 60 947-1 between the Measuring Circuit and the contacts
- Independant of phase sequence
- 2 changeover contacts
- Devices available in 2 enclosure version:
  - IL 9071: depth 61 mm with terminals at the bottom for installations systems and industrial distribution systems according to DIN 43 880
  - SL 9071: depth 98 mm with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

### Function Diagram



### Circuit Diagram



IL 9071.12, SL 9071.12

### Additional Information about this topic

- Datasheet undervoltage relay IK/IL 9171
- Relay workshop No. 15 and No. 16:  
The meaning of asymmetry in 3 phase systems (only in German)

### Approvals and Markings



\*) only IL 9071

### Applications

Monitoring of three-phase voltage systems to identify undervoltage, asymmetry or phase failure and switching-on of safety lighting in accordance with DIN VDE 0108.

Neutral monitoring in 3-phase systems. In 3-phase systems with neutral often also single phase load are connected between phase and neutral. If the neutral is missing in a system like this unsymmetric voltages occur that could damage single phase consumers if the voltage rises too high. Also consumers can stop to work if the phase-neutral voltage gets too low. The IL 9071 detects this problem and can switch of the system immediately.

### Indicators

green LED: on, when the mains system is working properly (contact 11-14 and 21-24 closed)

### Notes

For single phase operation the terminals L1, L2 and L3 have to be bridged

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b> single-phase connection:	AC 100 V, 115 V, 220 V, 230 V, AC 400 V, 415 V, 440 V, 500V
3-phase without neutral connection:	3AC 100 V, 115 V, 220 V, 230 V, 3AC 400 V, 415 V, 440 V, 500 V
3-phasisg with neutral connection:	3/N AC 100 V / 58 V; 3/N AC 110 V / 64 V; 3/N AC 200 V / 115 V; 3/N AC 220 V / 127 V; 3/N AC 230 V / 133 V; 3/N AC 400 V / 230 V; 3/N AC 415 V / 240 V; 3/N AC 440V / 254 V; 3/N AC 500 V / 290 V
<b>Overload:</b>	AC 440 V on all measuring inputs, for at least 1 h
<b>Voltage range:</b>	0.7 ... 1.1 $U_N$
<b>Nominal consumption</b>	approx. 6 VA (L3-N)
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	45 ... 65 Hz
<b>Input current at <math>U_N</math>:</b>	L1-N, L2-N: approx. 1.5 mA L3-N: approx. 25 mA

### Setting Ranges

<b>Setting value <math>U_{off}</math></b> IL 9071/010, SL 9071/010:	0.7 $U_N$ or 0.85 $U_N$ (hysteresis approx. 4 %)
IL 9071/117, SL 9071/117:	0.7 ... 0.95 $U_N$ (hysteresis approx. 4 %)
<b>Asymmetry identification</b> IL 9071/117, IL 9071/010, SL 9071/117, SL 9071/010:	approx. 5 ... 10 % phase asymmetry

### Output

<b>Contacts</b> IL 9071.12, SL 9071.12:	2 changeover contacts
<b>Contact material:</b>	AgNi
<b>Switching voltage:</b>	AC 250 V
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity</b> AC 15	IEC/EN 60 947-5-1
NO contact:	3 A / AC 230 V
NC contact:	2 A / AC 230 V
<b>Electrical life</b> AC 15 at 1 A, AC 230 V:	IEC/EN 60 947-5-1 5 x 10 <sup>5</sup> switching cycles
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>		
Operation:	- 20 ... + 60 °C	
Storage:	- 25 ... + 60 °C	
Relative air humidity:	93 % at 40 °C	
<b>Altitude:</b>	< 2,000 m	
<b>Clearance and creepage distances</b>		
rated rated impulse voltage voltage / pollution degree:	4 kV / 2	IEC 60 664-1
between Measuring Circuit and contacts	6 kV / 2	
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	10 V / m	IEC/EN 61 000-4-3
1 GHz ... 2 GHz:	10 V / m	IEC/EN 61 000-4-3
2 GHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between		
wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011

## Technical Data

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1	
<b>Climate resistance:</b>		
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight</b>		
IL 9071/010:	122 g	
SL 9071/010:	168 g	

### Dimensions

#### Width x height x depth

IL 9071:	35 x 90 x 61 mm
SL 9071:	35 x 90 x 98 mm

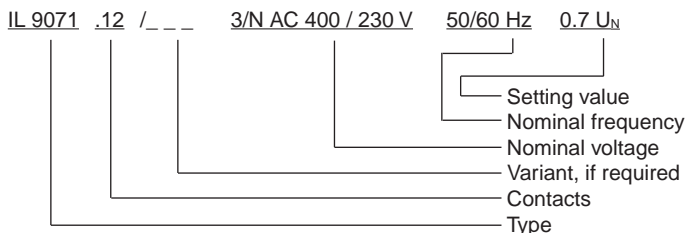
### Standard Types

IL 9071.12/010 3/N AC 400 / 230 V 0.85 $U_N$	
Article number:	0047074
SL 9071.12/010 3/N AC 400 / 230 V 0.85 $U_N$	
Article number:	0051006
• with asymmetry detection	
• 2 changeover contacts	
• Nominal voltage $U_N$ :	AC 230 / 3 AC 400 V
• Setting value:	0.85 $U_N$
• Width:	35 mm

### Variants

IL 9071/117, SL 9071/117:	according to DIN VDE 0100-710, rooms used for medical purposes, variable setting value
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### Ordering example for variants



## VARIMETER Undervoltage Relay RK 9871



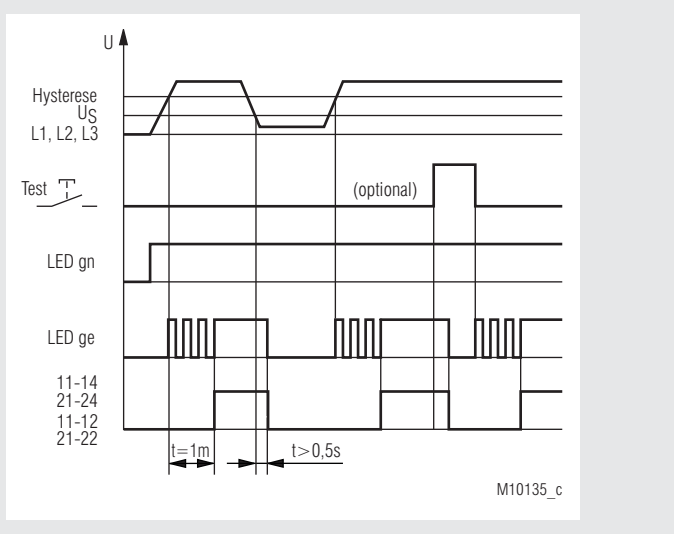
### Your Advantages

- Higher safety in buildings

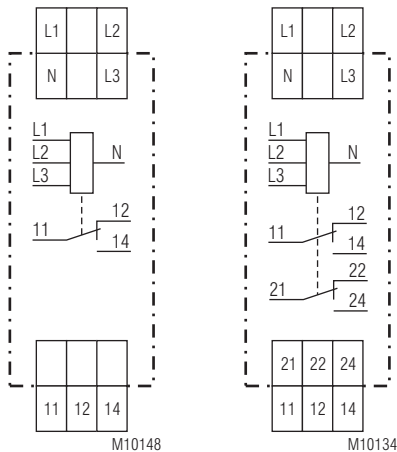
### Features

- According to IEC/EN 60255-1
- For installations according to DIN VDE 0100-718 and DIN VDE 0108-100 (replacement of DIN VDE 0108 )
- Detection of undervoltage in 3-phase systems
- Without separately auxiliary voltage (internal supply from all 3 phases)
- LED indication for für operation voltage and contact position
- De-energised on trip
- RK 9871.71: 1 changeover contact
- RK 9871.72: 2 changeover contacts
- With fixed time delay of 0.5s for fault indication
- With fixed time delay of 1min for reset
- With fixed response value at AC 195.5V
- As option with test-button for function control
- Width 17,5 mm

### Function Diagramm



### Circuit Diagrams



RK 9871.71

RK 9871.72

### Approvals and Markings



### Application

Monitoring of undervoltage in 3 phase voltage systems and switch over to emergency supply

For installations according to

- DIN VDE 0108-100 (emergency lightings)
- VDE 0100-718 (locations for a larger number of people)

### Function

When connecting the measuring voltage to the measuring inputs L1-L2-L3 at healthy voltage the output relay switches on after the voltage is healthy for at least 1 min.

During this time delay of 1 min the yellow led flashes. After detection of an undervoltage on one or several phases for at least 0.5 sec the output relay de-energises.

The undervoltage relay measures the arithmetic mean value of each of the three phases against neutral.

To measure single-phase voltage terminals L1, L2, L3 have to be linked together.

If a feed back voltage is generated by the load, that is higher then the setting value  $U_s$ , the unit will not detect phase failure.

### Indication

- LED green: on, when supply connected
- LED yellow: on, when the output relay is energized
- LED yellow: flashes during 1min reset delay time

### Safety Notes

- Never clear a fault when the device is switched on.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by instructed specialist staff, while the applicable safety rules must be observed.



## Technical Data

### Input

Measuring voltage =  
supply voltage

Nominal voltage $U_N$ :	3/N AC 400/230V
Max. overload:	1.15 $U_N$ continuous
Nominal consumption:	ca. 6 VA
Nominal frequency:	50 / 60Hz
Measuring frequency range:	45 ... 65 Hz
Response value:	195.5V fixed
Hysteresis:	approx. 5%
Overvoltage category:	III (according to IEC 60664-1)
Accuracy:	± 5%
Repeat accuracy:	< 2%
Temperature influence:	< 1%

### Output

#### Contacts

RK 9871.71:	1 changeover contact
RK 9871.72:	2 changeover contacts
Thermal current $I_{th}$ :	4 A
Switching capacity to AC 15:	
NO contact:	2 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
Electrical life to AC 15 at 1 A, AC 230 V:	1 x 10 <sup>5</sup> switching cycles IEC/EN 60 947-5-1
Short circuit strength max. fuse rating:	4 A gL IEC/EN 60 947-5-1
Mechanical life:	1 x 20 <sup>8</sup> switching cycles

## General Data

Nominal operating mode:	continuous operation
Temperature range:	
operation:	- 25 ... + 55°C
storage:	- 25 ... + 70°C
Clearance and creepage distance	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
EMC	
Electrostatic discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
HF-wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
Degree of protection	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
Housing:	thermoplastic with V0 behaviour acc. to UL subject 94
Vibration resistance:	Amplitude 0.35 mm, Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
Climate resistance:	25 / 060 / 04 IEC/EN 60 068-1
Terminal designation:	EN 50 005
Wire connection:	1 x 4 mm <sup>2</sup> solid or 1 x 2,5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
Wire fixing:	Plus-minus terminal screws M3,5 box terminals with wire protection
Mounting:	DIN-rail IEC/EN 60 715
Weight:	approx. 70 g

## Dimensions

Width x height x depth:	17.5 x 90 x 66 mm
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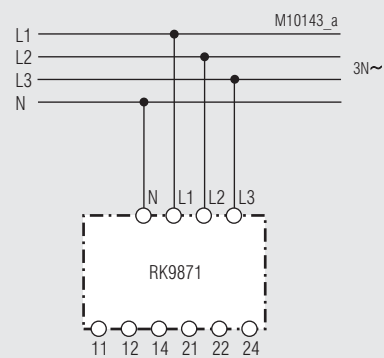
## Standard Type

RK 9871.72	3/N AC 400/230V	50 / 60 Hz
Article number:	0062759	
• Output:	2 changeover contact	
• Nominal voltage $U_N$ :	3/N AC 400/230V	
• Width:	17.5 mm	

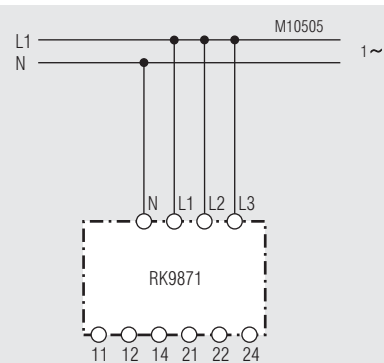
## Variant

RK 9871.72/100:	with test-button for simulation of undervoltage
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## Connection Examples



3-phase



1-phase

# Monitoring Technique

## VARIMETER

Battery Symmetry Monitor  
BA 9054/331, BA 9054/332



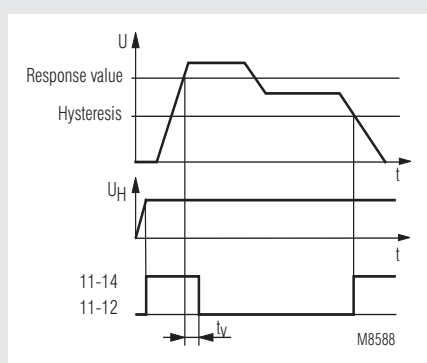
### BA 9054/331

- According to IEC/EN 60 255
- To monitor for battery systems (emergency power supply)
- Measuring rang DC 0.12 ... 1.2 V or 0.2 ... 2 V
- Without separately auxiliary voltage
- High overload possible
- With time delay 10 s
- LED indicators for operation and contact position
- Width: 45 mm

### BA 9054/332

- as BA 9054/331 but with
- battery voltages up to 500 V
  - separately auxiliary voltage

### Function Diagram



### Approvals and Markings



### Applications

Monitoring of battery systems to find voltage inversions of single cells, internal short circuits and sulphating

### Function

The middle connection of a Battery system is connected to terminal "M" of the BA 9054/331. If the two parts of the voltage differ more then the adjusted value for 10 s, the output relay trips. It trips also on broken wire on terminal "M".

The test button allows a test of the unit. It has to be pressed for at least 10 sec.

### Indicators

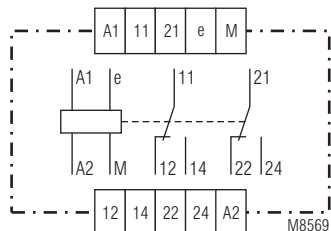
green upper LED: on, when auxiliary supply connected  
yellow lower LED: on, when output relay acitvated

### Remark

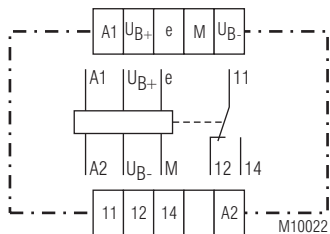
**Attention:** New batteries are not symmetric in the beginning. The battery monitor has to be readjusted after some time of operation. (see setting). The adjustment has to be verifi



### Circuit Diagram



BA 9054/331



BA 9054/332

## Technical Data

### Input

<b>Sensitivity of tripping:</b> <b>(Measuring range):</b>	DC 0.12 ... 1.2 V absolute scale or DC 0.2 ... 2 V absolute scale
<b>Resetting value:</b>	98% of operate value, fixed
<b>Repeat accuracy:</b>	± 0.5 %
<b>Time delay <math>t_v</math>:</b>	10 s
<b>Current middle connection</b> <b>(terminal M):</b>	max 12 $\mu$ A (bei 60 V bzw. 220 V)
<b>Principe de mesure:</b>	arithmetic mean value
<b>Temperature influence:</b>	< 0.05 % / K

### Auxiliary Circuit

<b>BA 9054/331:</b>	
<b>Battery voltage = auxiliary voltage:</b>	DC 24 ... 60 V / DC 110 ... 220 V
<b>Voltage range:</b>	DC 19 ... 80 V / DC 60 ... 300 V
<b>BA 9054/332:</b>	
<b>Battery voltage (<math>U_B</math>):</b>	DC 200 ... 500 V
<b>Auxiliary voltage (A1/A2):</b>	AC 230 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_H$
<b>Nominal consumption:</b>	approx. 2.5 VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	± 5 %

### Output

<b>Contacts:</b>	2 changeover contacts with 5 $\mu$ m gold contacts max. DC 60 V / 300 mA	
<b>Switching capacity</b> to AC 15:		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
to DC:	8 A / DC 24 V or 0.3 A / DC 220 V	
<b>Electrical life</b>		IEC/EN 60 947-5-1
to AC 15 at 3 A, AC 230 V:	5 x 10 <sup>5</sup> switching cycles	
<b>Short-circuit strength</b> <b>max. fuse rating:</b>	6 AgL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	50 x 10 <sup>6</sup> switching cycles	

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 40 ... + 60°C	
<b>Clearance and creepage distances</b> rated impulse voltage/ pollution degree		
In-/output:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply: between wire and ground:	2 kV 4 kV	IEC/EN 61 000-4-5 IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight:</b>	200 g	

### Dimensions

<b>Width x height x depth:</b>	45 x 75 x 120 mm
--------------------------------	------------------

## Standard Types

BA 9054/331	DC 0.12 ... 1.2 V	DC 24 ... 60 V	10 s
Article number:	0056172		
• Measuring range:	DC 0.12 ... 1.2 V		
• Auxiliary voltage:	DC 24 ... 60 V		
• Time delay:	10 s		
• Width:	45 mm		
BA 9054/331	DC 0.12 ... 1.2 V	DC 110 ... 220 V	10 s
Article number:	0056204		
• Measuring range:	DC 0.12 ... 1.2 V		
• Auxiliary voltage:	DC 110 ... 220 V		
• Time delay:	10 s		
• Width:	45 mm		
BA 9054/332	DC 0.12 ... 1.2 V	DC 200 ... 500 V	10 s
Article number:	0062251		
• Measuring range:	DC 0.12 ... 1.2 V		
• Auxiliary voltage:	AC 230 V		
• Battery voltage	DC 200 ... 500 V		
• Time delay:	10 s		
• Width:	45 mm		

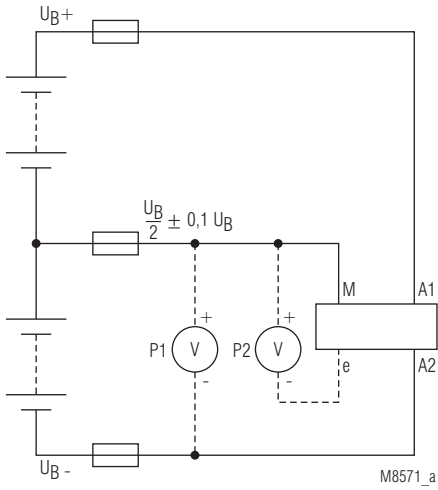
## Ordering example

BA 9054 /33_	DC 0.12...1.2 V	DC 24 ... 60 V	AC 230 V	10 s
				Time delay $t_v$
				Auxiliary voltage (only for /332) Battery-voltage
				Auxiliary voltage (/331)
				Measuring range
				Variant
				Type

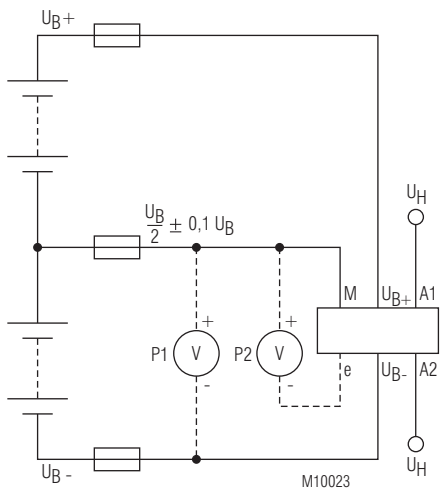
## Setting

- Connect the device as shown in application example
- Connect nominal voltage (battery voltage) to A1/A2 (/331 e.g.  $U_B$  /332).
- Set potentiometer for response value to min setting (0.12 V)
- Connect auxiliary  $U_H$  (/332) to A1, A2
- Find the middle of the battery voltage with the potentiometers for symmetry "grob" and "fein" (tuning and fine tuning). Differences of block batteries can be adjusted up to 12 V. The correct setting is indicated by a green LED.
- Adjust potentiometer for response value to the required value. The device is now ready to use.

## Application Example



BA 9054/331



BA 9054/332

## Set-up Procedure

### Example 1

Symmetric battery

$P1 = \frac{1}{2}$  battery voltage

Adjust P2 with tuning and fine tuning potentiometer to 0V

### Example 2

60 V battery set, combination of 12 V Block batteries

$P1 = 36$  V

Adjust P2 with tuning and fine tuning potentiometer to 0V

### Example 3

Non symmetric battery (compensation of battery tolerances)

$P1 = \frac{1}{2}$  battery voltage + 200 mV

Adjust P2 with tuning and fine tuning potentiometer to 200 mV

## VARIMETER

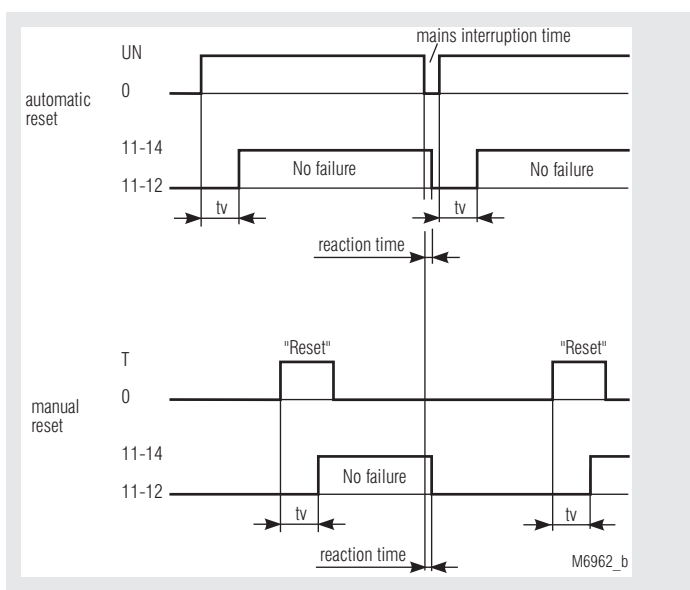
### Undervoltage Relay To Detect Auto-Reclosing IL 9079, SL 9079



0225283

- According to IEC/EN 60 255-1
- Fast detection of undervoltage or phase failure in three-phase voltage systems
- Detects auto reclosing of 20 ms
- Adjustable response value  $0.55 \dots 1.05 U_N$
- Operate delay to generate a defined reset signal
- Manual reset possible with external circuit
- Single-phase connection possible
- Optionally fixed response value  $0.8 U_N$
- De-energized on trip
- Green LED indicate for closed contact
- Independent of phase sequence
- 3p4w connection
- Optionally for 3p3w systems
- 2 changeover contacts
- Devices available in 2 enclosure versions:
  - IL 9079: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9079: depth 98 mm, with terminals at the top for cabinets for mounting plate and cable duct
- Width 35 mm

#### Function Diagram



#### Approvals and Markings



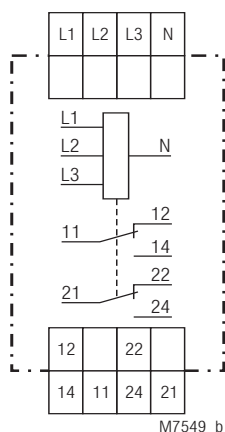
\*) nur IL 9079

#### Applications

Monitoring of voltage systems to detect auto reclosing as e.g. generated by the energy supplier in the case of flash-overs or switching procedures. It is possible that in control circuits some of the devices are reset during auto reclosing and some not. Because of this uncontrollable situations may occur.

By detecting these fast auto reclosings and addition of a certain time delay at reclosing the OFF-time is lengthened and every device has the time to reset. The circuit goes into a defined OFF state and is automatically reset after the adjusted time delay or by manual reset if the automatic reset is disabled by an external circuit (see connection examples).

#### Circuit Diagram



IL 9079.12, SL 9079.12

#### Function

The voltage of each phase is measured against N (with devices without N L1 and L2 are measured against L3). If at least 1 phase voltage goes under the response value (e.g.  $0.8 U_N$ ) the green LED goes off and the output relay deenergizes (fault condition). Only when all 3 phases go over the reset value (e.g.  $0.85 U_N$ ) again the output relay energizes after the adjustable operate delay  $t_v$  and the green LED comes on.

#### Indicators

green LED: on, when the mains system is working properly  
(contact 11-14 and 21-24 closed)

#### Notes

For single phase operation the terminals L1, L2 and L3 have to be bridged.

## Technical Data

### Input

#### Nominal voltage $U_N$ :

IL/SL 9079.12 and 002:	3/N AC 400 / 230 V
IL/SL 9079.12/001 and /003:	3 AC 400 V, 3 AC 500 V
SL 9079/103:	3 AC 400 V, 3 AC 500 V

**Maximum overload:** 1.1  $U_N$ , permanent

**Nominal consumption:** approx. 8 VA

**Nominal frequency:** 50 / 60 Hz

**Input resistance:** approx. 150 k $\Omega$

### Setting Ranges

#### Response / Reset value

IL/SL 9079.12 and /001:	0.8 $U_N$ / 0.85 $U_N$
IL/SL 9079/002 und /003:	adjustable 0.55 ... 1.05 $U_N$
SL 9079/103 3 AC 400 V:	adjustable 0.8 ... 1.05 $U_N$
SL 9079/103 3 AC 500 V:	adjustable 0.7 ... 1.05 $U_N$

hysteresis 4 %

**Detection of auto-reclosing:**  $\geq 20$  ms at response value 0.8  $U_N$

$\geq 35$  ms at response value 0.6  $U_N$

#### Reaction time on phase failure:

approx. 40 ms at response value 0.8  $U_N$

approx. 55 ms at response value 0.6  $U_N$

#### Reclosing delay:

adjustable, 0.2 ... 2 s

### Output

#### Contacts:

IL 9079.12, SL 9079.12: 2 changeover contacts

**Contact material:** AgNi

**Switching voltage:** AC 250 V

**Thermal current  $I_{th}$ :** 4 A

**Switching capacity**  
to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life** IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: 5 x 10<sup>5</sup> switching cycles

#### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** 30 x 10<sup>6</sup> switching cycles

### General Data

**Operating mode:** Continuous operation

#### Temperature range:

Operation: - 20 ... + 60 °C

Storage: - 25 ... + 60 °C

Relative air humidity: 93 % at 40 °C

**Altitude:** < 2,000 m

#### Clearance and creepage distances

rated rated impulse voltage /  
pollution degree: 4 kV / 2 IEC 60 664-1

#### EEMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

1 GHz ... 2 GHz: 10 V / m IEC/EN 61 000-4-3

2 GHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

#### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour  
according to UL subject 94

#### Vibration resistance:

Amplitude 0.35 mm,

frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** EN 50 005

## Technical Data

### Wire connection:

2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded ferruled  
DIN 46 228-1/-2/-3/-4

### Wire fixing:

Flat terminals with self-lifting  
clamping piece IEC/EN 60 999-1

### Fixing torque:

0.8 Nm

### Mounting:

DIN rail IEC/EN 60 715

### Weight

IL 9079: 110 g

SL 9079: 137 g

### Dimensions

#### Width x height x depth

IL 9079: 35 x 90 x 59 mm

SL 9079: 35 x 90 x 98 mm

### Standard Types

IL 9079.12/002 3/N AC 400 / 230 V 0.55 ... 1.05  $U_N$  0.2 ... 2 s

Article number: 0047842

SL 9079.12/002 3/N AC 400 / 230 V 0.55 ... 1.05  $U_N$  0.2 ... 2 s

Article number: 0054759

- 3p4w connection
- Output: 2 changeover contacts
- Nominal voltage  $U_N$ : 3/N AC 400 / 230 V
- Adjustable response value: 0.55 ... 1.05  $U_N$
- Adjustable reclosing delay: 0.2 ... 2 s
- Width: 35 mm

### Variants

IL 9079: for 3p4w systems, fixed response value 0.8  $U_N$

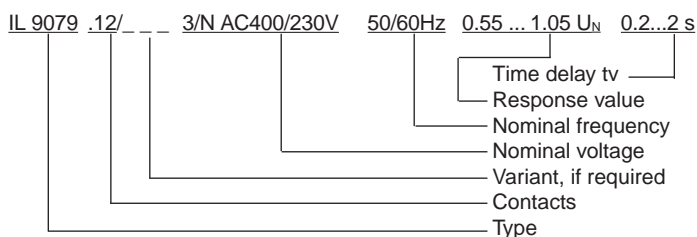
IL 9079/001: for 3p3w systems, fixed response value 0.8  $U_N$

IL 9079/002: for 3p4w systems,  
adjustable response value 0.55 ... 1.05  $U_N$

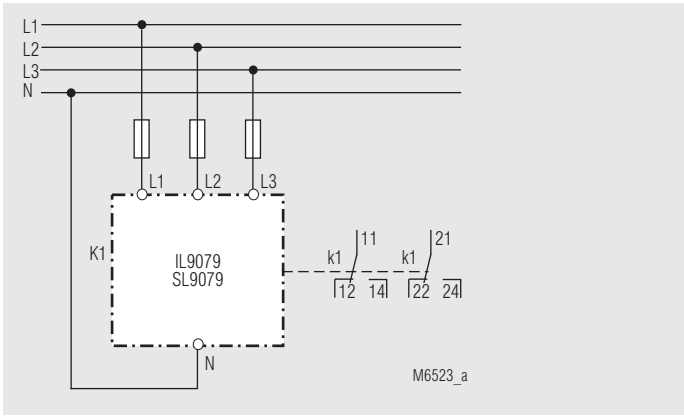
IL 9079/003: for 3p3w systems,  
adjustable response value 0.55 ... 1.05  $U_N$

IL 9079/103: for 3p3w systems,  
adjustable response value 0.8 ... 1.05  $U_N$   
adjustable response value 0.7 ... 1.05  $U_N$   
with transformer for mains with harmonic content

### Ordering example for variants

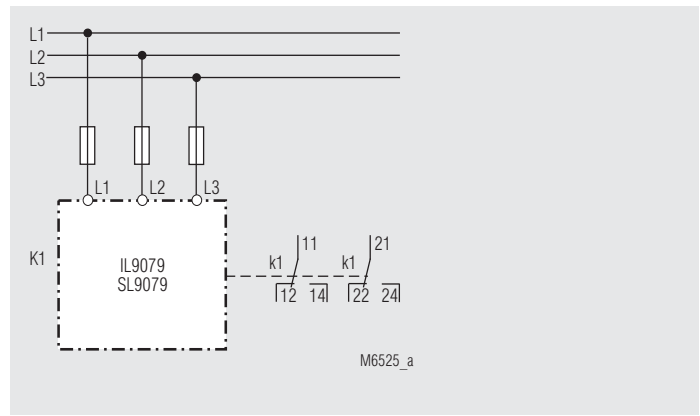


### Connection Examples

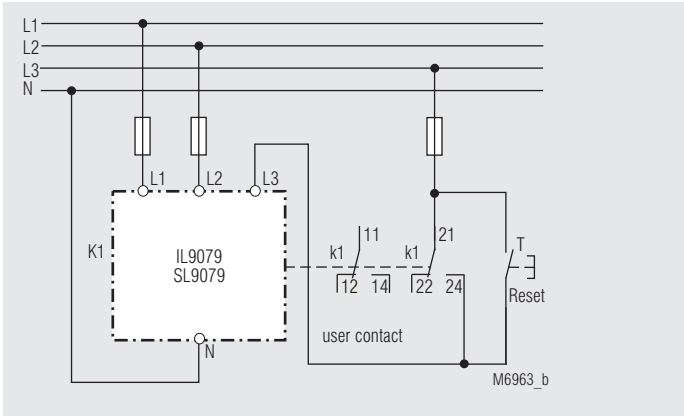


IL/SL 9079 and IL/SL 9079/002

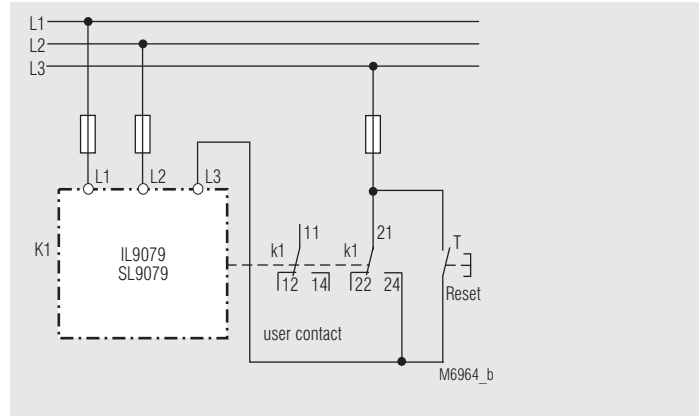
### Connection Examples



IL/SL 9079/001 and /003; SL 9079/103



IL/SL 9079 and IL/SL 9079/002



IL/SL 9079/001 and /003; SL 9079/103

## VARIMETER Current Relay RL 9853



### Your Advantages

- Preventive maintenance
- For better productivity
- High repeat accuracy
- Wide measuring voltage range
- Easy setting

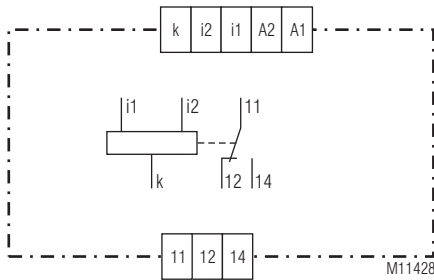
### Features

- According to IEC/EN 60 255-1
- For monitoring of current in DC and AC systems
- Detection of over- or undercurrent in AC- or DC mains
- Wide auxiliary range
- Output: 1 changeover contact
- De-Energized on trip
- Adjustable switching current
- Adjustable hysteresis for reset
- Adjustable switching delay
- Fast fault detection
- Width: 35 mm

### Product Description

The measuring relay RL 9853 of the VARIMETER series monitors overcurrent and undercurrent in AC or DC current systems. The monitoring functions are easily selectable using a single turn switch without complex menu structure. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

### Circuit Diagram



Terminals i1/k: 2 mA ... 11 mA; 0,1 A ... 1,1 A  
Terminals i2/k: 10 mA ... 110 mA; 1 A ... 10 A

### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
i1, i2, k	Current measuring input
11, 12, 14	Changeover contact (output relays)

### Approvals and Markings



### Application

- Monitoring of current in DC and AC systems to identify overcurrent and undercurrent
- Switch over to emergency supply after fault detection

### Indicator

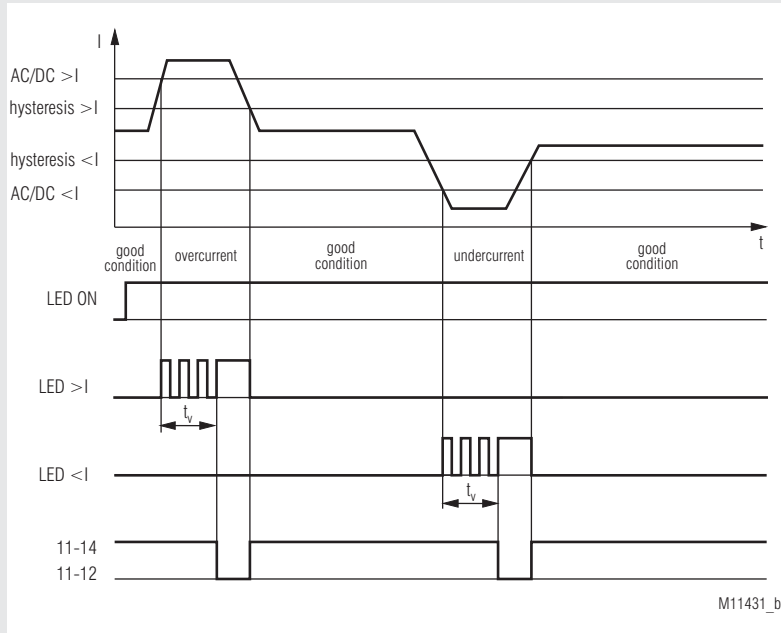
green LED „ON“:	on, when supply connected
red LED „>I <sub>N</sub> “:	on, when overcurrent
red LED „<I <sub>N</sub> “:	on, when undercurrent

### Function

When monitoring overcurrent or undercurrent the exceeding of the setting values above or below the thresholds is indicated by flashing of the current indicating LED. After the time delay the current indicating is continuously on and the relay de-energises. If the current returns to normal value, the LED goes immediately off and the output relay energises.



## Function Diagram



M11431\_b

## Notes

The current to be measured can also be sourced from the auxiliary supply. In this case the galvanic separation between auxiliary supply and measuring circuit is without effect. Depending on the required net form the following monitoring functions can be set using the function switch:

Function select	Type of current	Monitoring function
AC > $I_N$	AC	Overcurrent
AC < $I_N$	AC	Undercurrent
DC > $I_N$	DC	Overcurrent
DC < $I_N$	DC	Undercurrent

AC/DC measuring ranges (variant 100 mA)				
Terminals	Measuring range		Internal resistance	Max. therm.contin. current
i1/k	DC	2 mA ... 11 mA	10 $\Omega$	50 mA
	AC	2 mA ... 11 mA		
i2/k	DC	10 mA ... 110 mA	1,0 $\Omega$	200 mA
	AC	10 mA ... 110 mA		

AC/DC measuring ranges (variant 10 A)				
Terminals	Measuring range		Internal resistance	Max. therm.contin. current
i1/k	DC	0.1 A ... 1.1 A	40 m $\Omega$	2 A
	AC	0.1 A ... 1.1 A		
i2/k	DC	1 A ... 10 A	4 m $\Omega$	12 A
	AC	1 A ... 10 A		

## Technical Data

### Auxiliary circuit

<b>Auxiliary voltage <math>U_H</math>:</b>	DC 24 AC 110 ... 230 V 1-phase with neutral
<b>Voltage range:</b>	0.8 ... 1.1 $U_H$
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Nominal consumption:</b>	approx. 5 VA

### Input

<b>Operating current <math>I_B</math>:</b>	AC/DC 2 mA ... 100 mA, 100 mA ... 10 A
--	--

### Output

<b>Contact:</b>	1 changeover contact	
<b>Contact material:</b>	AgNi	
<b>Switching voltage:</b>	AC 250 V	
<b>Thermal current <math>I_{th}</math>:</b>	5 A	
<b>Switching capacity to AC 15</b>		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life to AC 15 at 1 A, AC 230 V:</b>	typ. 3 x 10 <sup>5</sup> switching cycles	
<b>Short circuit strength max. fuse rating:</b>	5 A gL IEC/EN 60 947-5-1	
<b>Mechanical life:</b>	> 30 x 10 <sup>6</sup> switching cycles	

### Measuring circuit

<b>Measuring current:</b>	infinite adjustable 10 % ... 110 % $I_B$
<b>Hysteresis:</b>	infinite adjustable 4 ... 20 %
<b>Switching delay <math>t_d</math>:</b>	infinite adjustable instantaneous, 2 ... 30 s
<b>Repeat accuracy:</b>	± 2 %
<b>Temperature influence:</b>	± 1 %
	<b>Attention:</b> <b>The combination of adjusted switching current I and hysteresis <math>\Delta I</math> must be within the measuring range.</b>

### General Data

<b>Operating mode:</b>	continuous operation	
<b>Temperature range</b>		
Operation:	- 20 ... + 55 °C	
Storage:	- 25 ... + 60 °C	
Relative air humidity:	93 % at 40 °C	
<b>Altitude:</b>	< 2,000 m	
<b>Clearance and creepage distances</b>		
Rated impulse voltage/ Pollution degree:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	12 V / m	IEC/EN 61 000-4-3
1 GHz ... 2,7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class A	EN 55 011
<b>Degree of protection:</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Enclosure:</b>	Thermoplastic with V0 behaviour acc. to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm Class I IEC/EN 60 255-21	
<b>Climate resistance:</b>	20 / 055 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	

## Technical Data

<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4	
<b>Fixed screw terminals</b>		
Cross section:	0.2 ... 4 mm <sup>2</sup> (AWG 24 - 12) solid or 0.2 ... 2.5 mm <sup>2</sup> (AWG 24 - 12) stranded wire with and without ferrules	
Stripping length:	7 mm	
<b>Fixing torque:</b>	0.6 Nm	EN 60 999-1
<b>Wire fixing:</b>	Captive slotted screw / M2.5	
<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight:</b>	approx. 105 g	

### Dimensions

<b>Width x height x depth:</b>	35 x 90 x 71 mm
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## UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition  
ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition  
CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

<b>Switching capacity:</b>	Pilot duty B300 5A 240Vac Resistive, G.P. 5A 30Vdc Resistive or G.P. 5A 250Vac G.P.
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<b>Wire connection:</b>	60°C / 75°C copper conductors only AWG 24 - 12 Sol/Str Torque 0.6 Nm
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Technical data that is not stated in the UL-Data, can be found in the technical data section

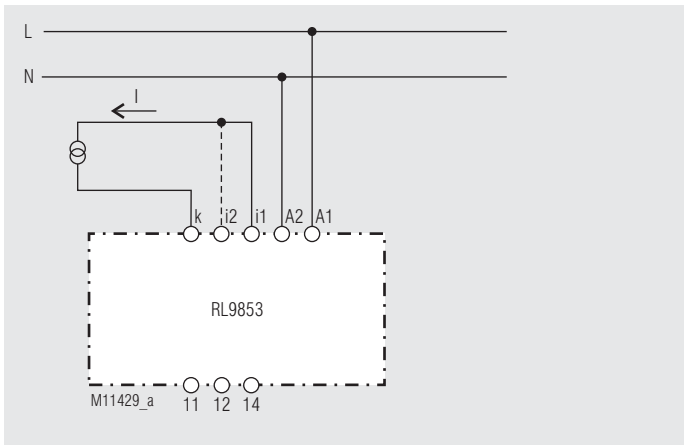
## Standard Type

RL 9853.11 AC/DC 0,1 ... 10 A AC 110 ... 230 V 4 ... 20 % 0 ... 30 s
Article number: 0066431
• Output: 1 Wechsler
• Operating current: AC/DC 0,1 ... 10 A
• Auxiliary voltage $U_H$ : AC 110 ... 230 V
• Hysteresis: 4 ... 20 %
• Switching delay: 0 ... 30 s
• Width: 35 mm

## Ordering Example

RL 9853 .11 /00 AC/DC 0,1 ... 10 A AC 110 ... 230 V 4 ... 20 % 0 ... 30 s	
	Switching delay
	Hysteresis
	Auxiliary voltage
	Operating current AC/DC 2 ... 100 mA AC/DC 0.1 ... 10 A
	Operation mode/Outputs 0: De-Energized on trip 1: Energized on trip
	Contacts
	Type

## Connection Example



## VARIMETER

### Current Relay

#### BA 9053, MK 9053N



0221540

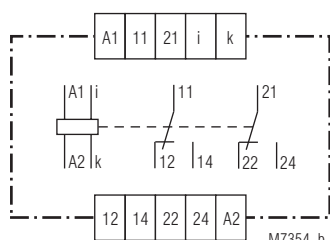


BA 9053

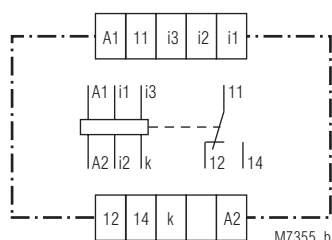


MK 9053N

### Circuit Diagrams



BA 9053

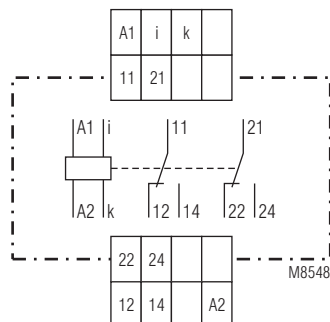


BA 9053/4 \_\_ z. B.:

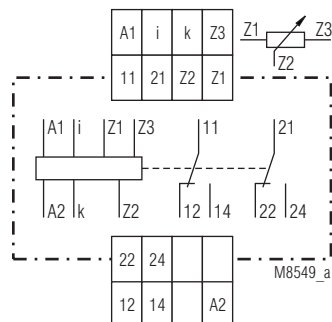
Terminals i1/k: 0.1 ... 1 A

Terminals i2/k: 0.5 ... 5 A

Terminals i3/k: 1 ... 10 A



MK 9053N



MK 9053N/1 \_\_

### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
i, k	Current measuring input
11, 12, 14	1st changeover contact
21, 22, 24	2nd changeover contact
at MK 9053/1 __ : Z1, Z2, Z3	Remote potentiometer for response value

### Safety Notes

#### Please observe when connecting a remote potentiometer to MK 9053N/1 \_\_:

Measuring circuit and remote potentiometer not galvanically separated. The voltage on on measuring circuit i, k / PE has connection to the remote potentiometer. The remote potentiometer has to be connected volt- and ground-free.

### Your Advantages

- Preventive maintenance
- For better productivity
- Quicker fault locating
- Precise and reliable

### Features

- According to IEC/EN 60 255-1, IEC/EN 60 947-1
- to: monitor DC and AC
- BA 9053 with measuring ranges from 2 mA to 25 A
- BA 9053 optionally with 3 measuring ranges 0.1 up to 25 A
- MK 9053N with measuring ranges from 2 mA up to 10 A
- High overload possible
- Input frequency up to 5 kHz
- Galvanic separation between auxiliary circuit - measuring circuit
- Auxiliary supply AC/DC; BA 9053 with AC
- BA 9053 optionally with start-up delay (MK = standard)
- with time delay, up to max. 100 sec
- BA 9053 optionally with safe separation to IEC/EN 61140
- MK 9053N optionally with remote potentiometer
- As option with manual reset
- Option with fixed settings possible
- LED indicators for operation and contact position
- MK 9053N as option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width BA 9053: 45 mm
- Width MK 9053N: 22.5 mm

### Approvals and Markings



\* see variants

### Applications

- Monitoring current in AC or DC systems
- For industrial and railway applications

### Function

The relays measure the arithmetic mean value of the rectified measuring current. The AC units are adjusted to the r.m.s. value. They have settings for response value and hysteresis. The units work as overcurrent relays but can also be used for undercurrent detection. The hysteresis is dependent on the response value.

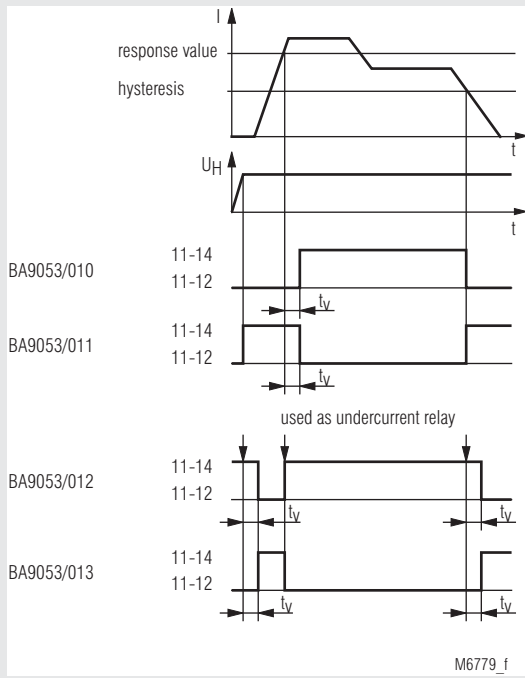
2 time delays are possible in different variants:

The start up delay  $t_a$  operates only when connecting the auxiliary supply. It disables tripping e.g. caused by an increased starting current of a motor. The response delay  $t_r$  is active after exceeding a response value. On overcurrent relays the delay is active when the current goes over the tripping value, on undercurrent relays when the current drops below the hysteresis value.

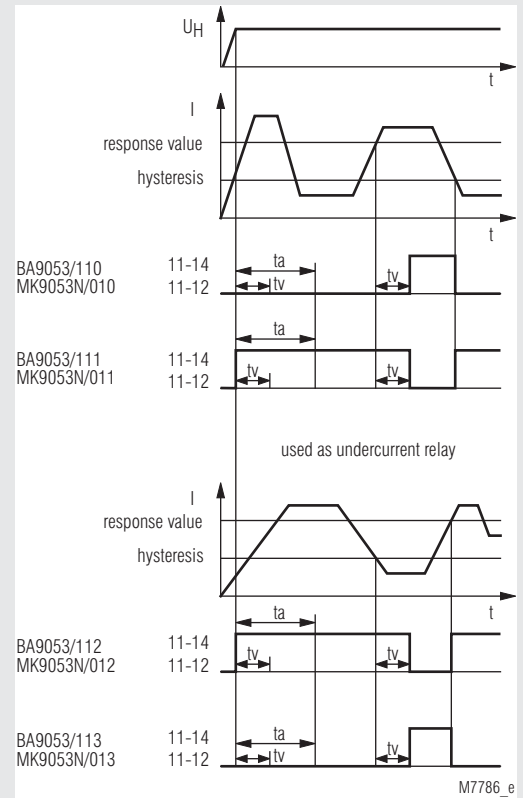
### Indicators

green LED: on, when auxiliary supply connected  
yellow LED: on, when output relay activated

### Function Diagram without Start-up Delay



### Function Diagram with Start-up Delay



On model BA 9053/6\_\_ with manual reset the contacts remain in the fault state after detecting a fault or after  $t_o$  has elapsed. The contacts are reset by disconnecting the supply voltage.

## Technical Data

### Input (i, k)

BA 9053 for AC <b>and</b> DC					
Measuring range*)		internal resistance	max. perm. cont. current		max. permiss. current 3 s On, 100 s Off
AC	DC		Device mounted without distance		
2 - 20 mA	1.8 - 18 mA	1.5 Ω	0.7 A		1 A
20 - 200 mA	18 - 180 mA	0.15 Ω	2 A		4 A
30 - 300 mA	27 - 270 mA	0.1 Ω	2.5 A		8 A
50 - 500 mA	45 - 450 mA	0.1 Ω	2.5 A		8 A
80 - 800 mA	72 - 720 mA	40 mΩ	4 A		12 A
0.1- 1 A	0.09- 0.9 A	30 mΩ	4 A		12 A
0.5- 5 A	0.45- 4.5 A	6 mΩ	10 A		30 A
1 - 10 A	0.9 - 9 A	3 mΩ	20 A		40 A
1.5- 15 A	1.35- 13.5 A	3 mΩ	25 A		40 A
2 - 20 A	1.8 - 18 A	3 mΩ	25 A		40 A
2.5 - 25 A	2.25- 22.5 A	3 mΩ	25 A		40 A

\* DC or AC current 50 ... 5000 Hz  
(other frequency ranges of 10 ... 5000 Hz, e.g. 16<sup>2/3</sup> Hz on request)

BA 9053/4_ _ with 3 measuring ranges:			
Range:	Terminals i1/k	Terminals i2/k	Terminals i3/k
AC 20 mA / 200 mA / 1A:	AC 2.0 ... 20 mA	AC 20 ... 200 mA	AC 0.1 ... 1 A
	DC 1.8 ... 18 mA	DC 18 ... 180 mA	DC 0.09 ... 0.9 A
AC 1 / 5 / 10A:	AC 0.1 ... 1 A	AC 0.5 ... 5 A	AC 1.0 ... 10 A
	DC 0.09 ... 0.9 A	DC 0.45 ... 4.5 A	DC 0.9 ... 9 A
AC 5 / 10 / 25A:	AC 0.5 ... 5 A	AC 1.0 ... 10 A	AC 2.5 ... 25 A
	DC 0.45 ... 4.5 A	DC 0.9 ... 9 A	DC 2.25 ... 22.5 A

MK 9053N with 1 Measuring range for AC <b>and</b> DC					
Measuring rang*)		internal resistance	max. perm. cont. current		max. permiss. current 3 s On, 100 s Off
AC	DC		Device mount. without distance		
			0.5 A	with 5 mm distance	
2 - 20 mA	1.8 - 18 mA	1.5 Ω	0.5 A	0.7 A	1 A
20 - 200 mA	18 - 180 mA	0.15 Ω	1.5 A	2 A	4 A
30 - 300 mA	27 - 270 mA	0.1 Ω	2 A	2.5 A	8 A
50 - 500 mA	45 - 450 mA	0.1 Ω	2 A	2.5 A	8 A
0.1- 1 A	0.09- 0.9 A	30 mΩ	3 A	4 A	8 A
0.5- 5 A	0.45- 4.5 A	6 mΩ	8 A	11 A	20 A
1 - 10 A	0.9 - 9 A	3 mΩ	12 A	15 A	20 A

\* DC or AC current 50 ... 5000 Hz  
(Other frequency ranges of 10 ... 5000 Hz, e.g. 16<sup>2/3</sup> Hz on request)

### Extending of measuring range:

For DC-current higher then the highest measuring range the voltage relay BA 9054 or MK 9054N measuring range 15 ... 150 mV or 6 ... 60 mV can be used with external Shunt.

For AC current higher then the highest measuring range can be used a current transformer e. g. with secondary winding of 1 A or 5 A together with BA 9053 or MK 9053N. The nominal load of the CT should be ≥ 0.5 VA.

### Measuring principle:

arithmetic mean value

### Adjustment:

The AC - devices can also monitor DC current. The scale offset in this case is:

$$(I = 0.90 I_{\text{eff}})$$

### Temperature influence::

< 0.05 % / K

## Technical Data

### Setting Ranges

#### Setting

Response value: infinite variable 0.1 I<sub>N</sub> ... 1 I<sub>N</sub>  
relative scale

#### Hysteresis

at AC: infinite variable 0.5 ... 0.98 of setting value  
at DC: infinite variable 0.5 ... 0.96 of setting value

#### Accuracy:

Response value at  
Potentiometer right stop (max): 0 ... + 8 %  
Potentiometer left stop (min): - 10 ... + 8 %  
Repeat accuracy: ± 0.5 %

#### Recovery time

at devices with manual reset

(Reset by braking of the auxiliary voltage)

BA 9053/6\_ \_; MK 9053N/6\_ \_: ≤ 1 s

(dependent to function and auxiliary voltage)

#### Time delay t<sub>v</sub>:

infinite variable at logarithmic scale  
from 0 ... 20 s, 0 ... 30 s, 0 ... 60 s, 0 ... 100 s  
setting 0 s = without time delay

#### Start-up delay t<sub>a</sub>:

BA 9053/1\_ \_:

1 ... 20 s; 1 ... 60 s; 1 ... 100 s,  
adjustable on logarithmic scale.

t<sub>a</sub> is started when the supply voltage is connected. During elapse of time

the output contact is in good state  
0.1 ... 20 s; 0.1 ... 60 s; 0.1 ... 100 s

MK 9053N:

### Auxiliary Circuit BA 9053 and MK 9053N

#### Auxiliary voltage U<sub>H</sub> (A1, A2)

BA 9053, Nominal voltages: AC 24, 42, 110, 127, 230, 400 V

**Voltage range:** 0.8 ... 1.1 U<sub>H</sub>

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** ± 5 %

**Nominal consumption:** 2.5 VA

BA 9053:		
Nominal voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W
	DC 18 ... 130 V	W ≤ 5 %
AC/DC 80 ... 230 V	AC 40 ... 265 V	45 ... 400 Hz; DC 48 % W
	DC 40 ... 300 V	W ≤ 5 %
DC 12 V	DC 10 ... 18 V	battery voltage

MK 9053N:		
Nominal voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W
	DC 18 ... 130 V	W ≤ 5 %
AC/DC 80 ... 230 V	AC 60 ... 265 V	45 ... 400 Hz; DC 48 % W
	DC 60 ... 300 V	W ≤ 5 %

#### Nominal consumption:

4 VA; 1.5 W at AC 230 V Rel. energized  
1 W at DC 80 V Rel. energized

Technical Data		
<b>Output</b>		
<b>Contacts</b>		
BA 9053:	2 changeover contacts	
MK 9053N:	2 changeover contacts	
<b>Thermal current <math>I_{th}</math>:</b>		
BA 9053:	2 x 5 A	
MK 9053N:	2 x 4 A	
<b>Switching capacity</b>		
BA 9053		
to AC 15:		
NO contact:	2 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
MK 9053N		
to AC 15:		
BA 9053, MK 9053N	1.5 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:		
BA 9053	1 A / DC 24 V	IEC/EN 60 947-5-1
<b>Electrical life</b>		
BA 9053		
to AC 15 at 3 A, AC 230 V:	5 x 10 <sup>5</sup> switch. cycl.	IEC/EN 60 947-5-1
MK 9053N		
to AC 15 at 3 A, AC 230 V:	10 <sup>5</sup> switching cycles	IEC/EN 60 947-5-1
<b>Short-circuit strength</b>		
<b>max. fuse rating:</b>	6 A gG (gL)	IEC/EN 60 947-5-1
<b>Mechanical life</b>		
BA 9053:	50 x 10 <sup>6</sup> switching cycles	
MK 9053N:	30 x 10 <sup>6</sup> switching cycles	
<b>General Data</b>		
<b>Operating mode:</b> Continuous operation		
<b>Temperature range:</b>		
BA 9053 (operation):		
≤ 10 A:	- 40 ... + 60°C	
≥ 15 A:	- 40 ... + 50°C (higher temperature with limitations on request)	
MK 9053N (operation):		
	- 20 ... + 50°C (higher temperature with limitations on request)	
BA 9053, MK 9053N (storage):		
	- 40 ... + 70°C	
<b>Altitude:</b> < 2,000 m		
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree		
BA 9053 meas. range ≤ 10 A:	6 kV / 2	IEC 60 664-1
BA 9053 meas. range ≥ 15 A:	4 kV / 2	IEC 60 664-1
MK 9053N:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 1 GHz:	20 V/m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between		
wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b> Thermoplastic with V0 behaviour according to UL subject 94		
<b>Vibration resistance:</b> Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz		
<b>Climate resistance</b>		
BA 9053		
≤ 10 A:	40 / 060 / 04	IEC/EN 60 068-1
≥ 15 A:	40 / 050 / 04	IEC/EN 60 068-1
MK 9053N:	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	

Technical Data	
<b>Wire connection</b>	
BA 9053:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve
MK 9053N:	
<b>Screw terminals (integrated):</b>	
	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 2.5 mm <sup>2</sup> solid
Insulation of wires or sleeve length:	
	8 mm
<b>Plug in with screw terminals</b>	
max. cross section for connection:	
	1 x 2.5 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)
Insulation of wires or sleeve length:	
	8 mm
<b>Plug in with cage clamp terminals</b>	
max. cross section for connection:	
	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated)
min. cross section for connection:	
	0.5 mm <sup>2</sup>
Insulation of wires or sleeve length:	
	12 ±0.5 mm
<b>Wire fixing:</b>	
BA 9053:	Plus-minus terminal screws M3.5 with self-lifting clamping piece IEC/EN 60 999-1
MK 9053N:	
	Plus-minus terminal screws M3.5 box terminals with wire protection or cage clamp terminals
<b>Stripping length:</b> 10 mm	
<b>Fixing torque:</b> 0.8 Nm	
<b>Mounting:</b> DIN-rail IEC/EN 60 715	
<b>Weight</b>	
BA 9053:	AC-device: 280 g AC/DC-device: 200 g
MK 9053N:	
	150 g
<b>Dimensions</b>	
<b>Width x height x depth</b>	
BA 9053:	45 x 75 x 120 mm
MK 9053N:	22.5 x 90 x 97 mm

## Classification to DIN EN 50155 for BA 9053

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

**Ambient temperature:** T1, T2 compliant  
T3 and TX with operational limitations

**Protective coating of the PCB:** No

## UL-Data

### Auxiliary voltage $U_H$ (A1, A2)

BA 9053: AC 24, 42, 48, 110, 115, 120 V

### Thermal current $I_{th}$ :

BA 9053: 2 x 5 A

MK 9053N: 2 x 4 A

### Clearance and creepage distances

BA 9053, MK 9053N: 4 kV / 2 IEC 60 664-1

### HF irradiation

BA 9053 (80 MHz ... 2.7 GHz) 10 V/m IEC/EN 61 000-4-3

**Switching capacity:** Pilot duty B150

**Ambient temperature:** - 40 ... + 60°C



Technical data that is not stated in the UL-Data, can be found in the technical data section.

## CCC-Data

### Switching capacity

to AC 15: 1.5 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

BA 9053/010 AC 0.5 ... 5 A AC 230 V

Article number: 0053128

• for Overcurrent monitoring

• Measuring range: AC 0.5 ... 5 A

• Auxiliary voltage  $U_H$ : AC 230 V

• Time delay by  $I_{an}$ : 0 ... 20 s

• Width: 45 mm

BA 9053/012 AC 0.5 ... 5 A AC 230 V

Article number: 0053192

• for Undercurrent monitoring

• Measuring range: AC 0.5 ... 5 A

• Auxiliary voltage  $U_H$ : AC 230 V

• Time delay by  $I_{ab}$ : 0 ... 20 s

• Width: 45 mm

MK 9053N.12/010 AC 0.5 ... 5 A AC/DC 80 ... 230 V  $t_v$  0 ... 20 s  $t_a$  0.1 ... 20 s

Article number: 0063176

• for Overcurrent monitoring

• Measuring range: AC 0.5 ... 5 A

• Auxiliary voltage  $U_H$ : AC/DC 80 ... 230 V

• Time delay by  $t_v$ : 0 ... 20 s

• Start up delay  $t_a$ : 0.1 ... 20 s

• Width: 22.5 mm



Ordering Example for Variants

BA 9053 / /61 AC 1 ... 10 A AC 24 V 0 ... 20 s 1 ... 100 s

Start up delay  $t_a$   
 Time delay  $t_v$   
 Auxiliary voltage  
 Measuring range

With UL-approval

10 Overcurrent relay energized on trip time delay at setting value  
 11 Overcurrent relay de-energized on trip time delay at setting value  
 12 Undercurrent relay de-energized on trip time delay at hysteresis value  
 13 Undercurrent relay energized on trip time delay at hysteresis value

0 Standard version  
 1 With start up delay  $t_a$   
 2 With safe electrical separation of input- and output circuit according to DIN 61140

Meas. range up to  $\leq 10$  A:  
 DIN EN 60947-1; 4 kV/2  
 in relation of overvoltage category III with basic insulation to DIN EN 60664-1 of 4 kV;  
 Meas. range up to  $\geq 15$  A:  
 overvoltage category II with basic insulation of 2.5 kV

3 With 5  $\mu$ m gold plated contacts  
 4 With 3 current ranges 1 C/O contact  
 431 With 3 current ranges 1 C/O contact, with safe separation up to 10 A  
 5 With forcibly guided contacts  
 6 With manual reset, resetting by disconnecting the power supply

Type

MK 9053N / AC 0,1 ... 1 A AC 230 V 0 ... 20 s 0,1 ... 20 s

Start up delay  $t_a$   
 Time delay  $t_v$   
 Auxiliary voltage  
 Measuring range

10 Overcurrent relay energized on trip  
 11 Overcurrent relay de-energized on trip  
 12 Undercurrent relay de-energized on trip  
 13 Undercurrent relay energized on trip

0 Standard version without remote potentiometer  
 1 Standard version with remote potentiometer (response-value) Z1, Z2, Z3 for 470 k $\Omega$   
**at this version there is no potentiometer for the response value**  
 6 With manual reset, resetting by disconnecting the power supply

Type of terminals  
 Without indication: terminal blocks fixed, with screw terminals  
 PC (plug in cage clamp): pluggable terminal blocks with cage clamp terminals  
 PS (plug in screw): pluggable terminal blocks with screw terminals

Type

## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

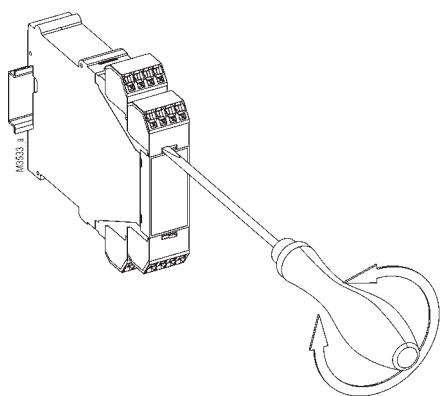


Cage clamp  
(PC/plugin cage clamp)

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Accessories

AD 3: Remote potentiometer 470 K $\Omega$   
Article number: 0050174

## Setting

Example:  
Current relay BA 9053 / MK 9053N AC 0.5 ... 5 A

AC according to type plate:  
i.e. the unit is calibrated for AC  
0.5 ... 5 A = measuring range

Response value AC 3 A  
Hysteresis AC 1.5 A

Settings:  
upper potentiometer: 0.6 (0.6 x 5 A = 3 A)  
lower potentiometer: 0.5 (0.5 x 3 A = 1.5 A)

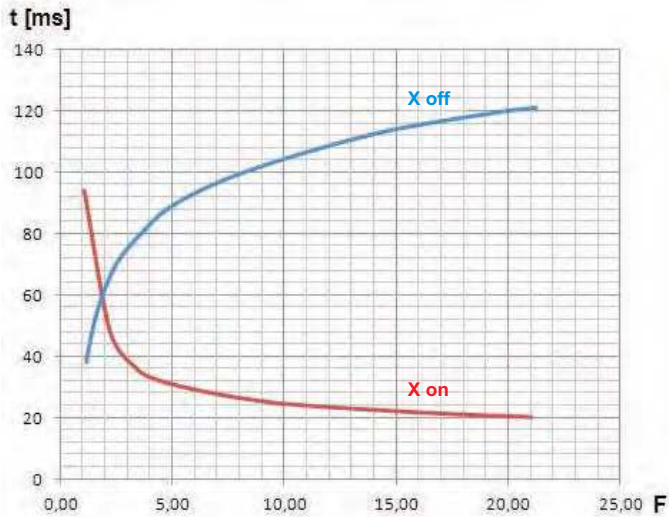
The AC - devices can also monitor DC current. The scale offset in this case is:  $\bar{I} = 0.90 \times I_{\text{eff}}$

AC 0.5 ... 5 A is equivalent to DC 0.45 ... 4.5 A

Response value DC 3 A  
Hysteresis DC 1.5 A

Settings:  
upper potentiometer: 0.66 (0.66 x 4.5 A = 3 A)  
lower potentiometer: 0.5 (0.5 x 3 A = 1.5 A)

## Characteristic



M11504 a

### Time delay of measuring circuit

X on: Measured value rise  $F = \frac{\text{Measured value (after rise of measured value)}}{\text{Setting value}}$

X off: Measured value drops  $F = \frac{\text{Measured value (before measured value drops)}}{\text{Setting value (hysteresis)}}$

The diagram shows the typical delay of a standard devices depending on the measured values "X on and X off" at sudden rise or drop of the signal. At slow change of the measured value the delay is shorter. The total reaction time of the device results from the adjustable delay  $t_v$  and the delay created by the measuring circuit.

The diagram shows an average delay. The delay times could differ on the different variants.

#### Example for "X on" (overcurrent detection with BA9053/010):

Adjusted setting value X on = 2 A.

Due to a stalled motor the current rises suddenly to 10 A.

$$F = \frac{\text{Measured value (after rise of measured value)}}{\text{Setting value}} = \frac{10 \text{ A}}{2 \text{ A}} = 5$$

Reading from the diagram:

The output relay switches on after 31 ms at a setting  $t_v=0$ .

#### Example for "X off" (undercurrent detection with BA9053/012):

Adjusted hysteresis setting value is 10 A.

The current drops suddenly from 23 A to 0 A.

$$F = \frac{\text{Measured value (before measured value drops)}}{\text{Setting value (hysteresis)}} = \frac{23 \text{ A}}{10 \text{ A}} = 2.3$$

Reading from the diagram:

The output relay switches off after 70 ms at a setting  $t_v=0$ .

## VARIMETER

### Overcurrent Relay

IK 9270, IL 9270, IP 9270, SK 9270, SL 9270, SP 9270



0224/259



IK 9270



IL 9270



IL 9270/5\_ \_



SL 9270/5\_ \_



SK 9270



IP 9270



SL 9270CT



SP 9270CT

- According to IEC/EN 60 255-1
- IP 9270, SP 9270CT: 3-phase  
IK 9270, SK 9270, IL 9270, SL 9270CT: single phase
- Measuring ranges from 0.1 ... 100 A
- Settable response value
- Fixed hysteresis
- Settable time delay
- De-energized on trip
- As option energized on trip
- LED indicators
- With auxiliary voltage
- Auxiliary supply and measuring input galvanic separated
- Devices available in 2 enclosure versions:
  - I-model, e.g. IK \_ \_ \_ \_ , depth 61 mm  
with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model, e.g. SK \_ \_ \_ \_ , depth 100 mm  
with terminals at the top for cabinets with mounting plate and cable duct
- Width IK 9270, SK 9270: 17.5 mm  
IL 9270, SL 9270CT: 35 mm  
IP 9270, SP 9270CT: 70 mm

#### Approvals and Markings



\*) only IL-devices

#### Applications

Overcurrent detection in single phase or 3-phase voltage systems

#### Indicators

IK 9270.11, SK 9270.11

IL 9270.11/5\_ \_ ,

SL 9270.11/5\_ \_ :

LED green:

aux. supply connected

LED yellow:

output contacts switched

IL 9270, SL 9270,

IP 9270, SP 9270:

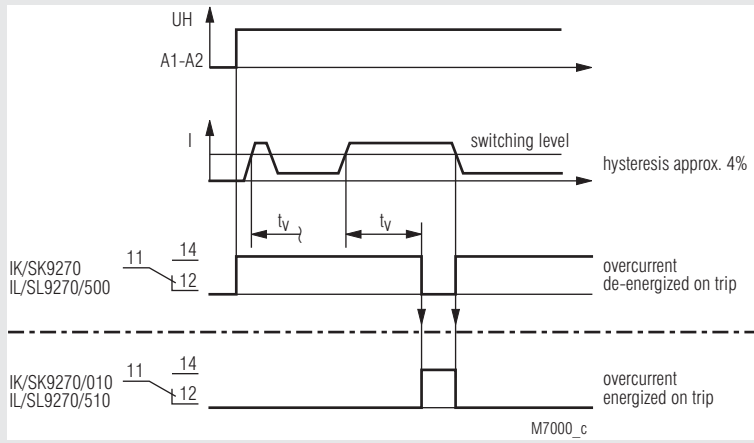
LED green:

current within limits

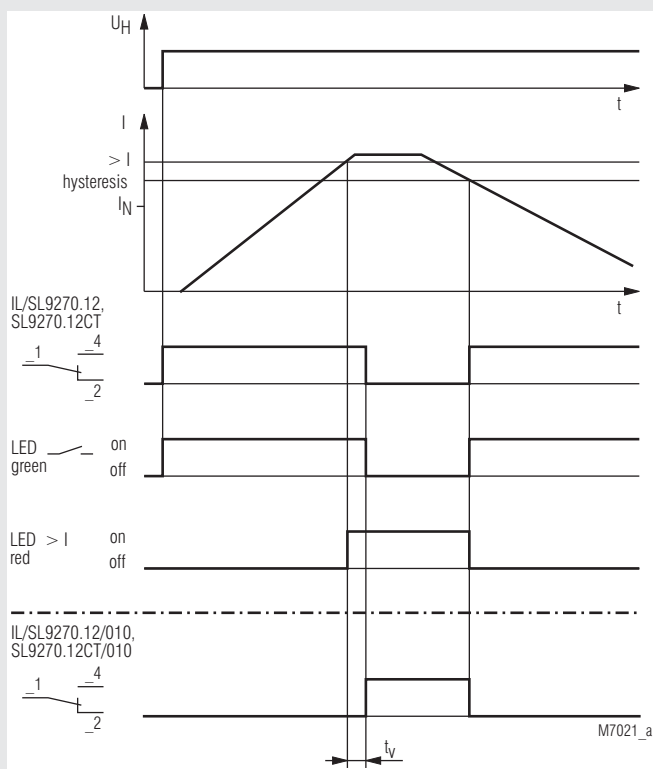
LED red  $I_{max}$ :

overcurrent

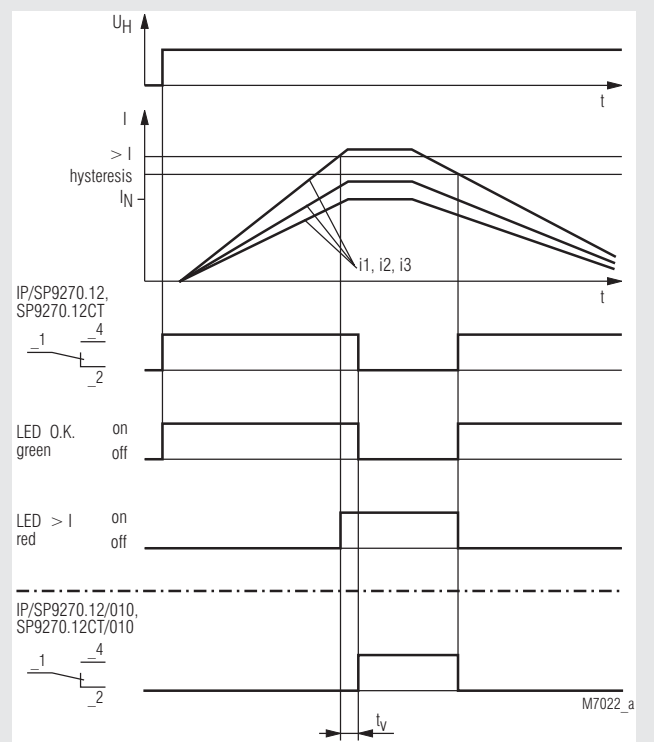
**Function Diagram IK/SK 9270, IL/SL 9270.11/500**



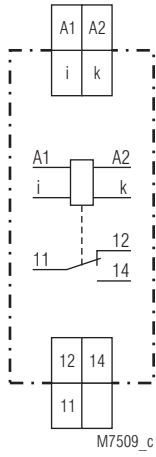
**Function Diagram IL 9270.12, SL 9270.12**



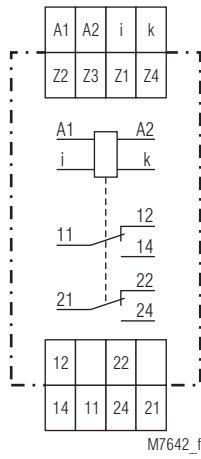
**Function Diagram IP 9270, SP 9270**



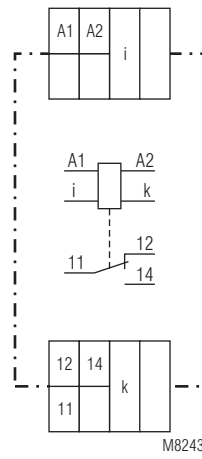
## Circuit Diagrams



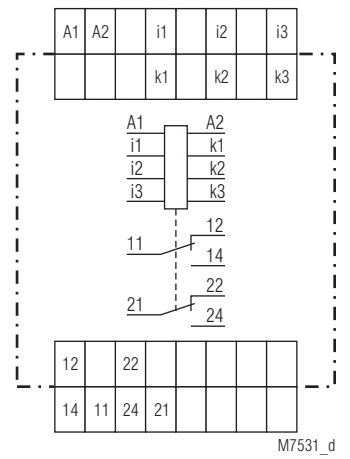
IK 9270.11, SK 9270.11



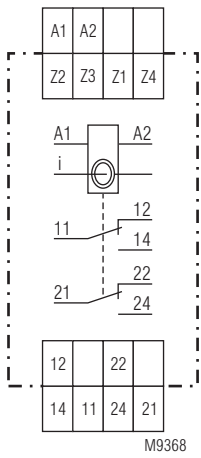
IL 9270.12, SL 9270.12



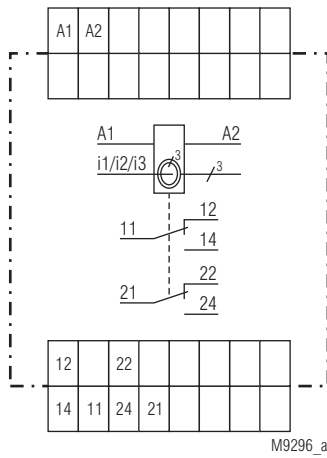
IL 9270.11/5\_



IP 9270.12, SP 9270.12



SL 9270.12CT









SP 9270.12CT

### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage AC or DC
i, k	Current measuring circuit AC or DC
i1, k1; i2, k2; i3, k3	Current measuring circuit phase 1; 2; 3
Z1 / Z2, Z3, Z4	Measuring ranges with bridges via terminals
11, 12, 14	Contacts Rel. 1
21, 22, 24	Contacts Rel. 2

**Technical Data**

Type						
	<b>IK 9270</b>	<b>SL 9270/5_ _</b>	<b>IL 9270</b>	<b>SL 9270CT</b>	<b>IP 9270</b>	<b>SP 9270CT</b>
Depth 61 mm	IK 9270.11	IL 9270.11/5_ _	IL 9270.12	-	IP 9270.12	-
Depth 100 mm	SK 9270.11	SL 9270.11/5_ _	SL 9270.12	SL 9270.12CT	SP 9270.12	SP 9270.12CT
Width	17.5 mm	35 mm	35 mm	35 mm	70 mm	70 mm
Measuring input	single-phase	single-phase	single-phase	single-phase	3-phase	3-phase
Measuring range (Nominal frequency 50 ... 400 Hz)	<b>0.1 ... 15 A</b>  4 part ranges settable with switch: 0.1 ... 1 A 0.5 ... 5 A 1 ... 10 A 1.5 ... 15 A  Max. thermal continuous current:  20 A at 50 °C 15 A at 60 °C	<b>0.1 ... 50 A</b>  5 part ranges settable with switch: 0.1 ... 1 A 0.5 ... 5 A 2.5 ... 25 A 3 ... 30 A 5 ... 50 A  Max. thermal continuous current:  50 A at 50 °C 60 A at 40 °C	<b>0.1 ... 15 A</b>  4 part ranges programmable with bridges: 0.1 ... 1 A (Z1-Z2) 0.5 ... 5 A (Z1-Z3) 1 ... 10 A (Z1-Z4) 1.5 ... 15 A (Z3-Z1-Z4)  Max. thermal continuous current:  20 A t 50 °C 15 A at 60 °C	<b>0.5 ... 100 A</b>  4 part ranges programmable with bridges: 0.5 ... 5 A (Z1-Z2) 2.5 ... 25 A (Z1-Z3) 7.5 ... 75 A (Z1-Z4) 10 ... 100 A (Z3-Z1-Z4)  Max. thermal continuous current:  limited only by diameter of cable 25 mm <sup>2</sup>	<b>0.1 ... 15 A</b>  1 fixed measuring range per unit 0.1 ... 1 A 0.5 ... 5 A 1 ... 10 A 1.5 ... 15 A  Max. thermal continuous current:  3 x 15 A t 50 °C 3 x 20 A at 45 °C	<b>0.5 ... 100 A</b>  1 fixed measuring range per unit 0.5 ... 5 A 2.5 ... 25 A 5 ... 50 A 7.5 ... 75 A 10 ... 100 A  Max. thermal continuous current:  limited only by diameter of cable 25 mm <sup>2</sup>
	<b>5 ... 750 mA<sup>*)</sup></b>  4 part ranges settable with switch: 5 ... 50 mA 25 ... 250 mA 50 ... 500 mA 75 ... 750 mA  Max. thermal continuous current: 5 A at 50 °C		<b>0.01 ... 1.5 A</b>  4 part ranges programmable with bridges: 0.01 ... 0.1 A (Z1-Z3) 0.5 ... 0.5 A (Z1-Z2) 0.1 ... 1 A (Z1-Z4) 0.15 ... 1.5 A (Z2-Z1-Z4)  Max. thermal continuous current: 20 A at 50 °C  15 A at 60 °C			
Max. current at 50 °C		all ranges 80 A / 3 s				
Wire current path Solid Stranded ferruled	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	1 x 10 mm <sup>2</sup> 1 x 6 mm <sup>2</sup>	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>
Contacts	1 changeover	1 changeover	2 changeover	2 changeover	2 changeover	2 changeover
Weight:	IK 9270: 70 g SK 9270: 90 g	IL 9270/5_ _: 125 g SL 9270/5_ _: 150 g	IL 9270: 125 g SL 9270: 150 g	approx. 230 g	IP 9270: 200 g SP 9270: 250 g	approx. 470 g

<sup>\*)</sup> Rated impulse voltage / pollution degree (auxiliary voltage - measuring circuit): 4 kV/2

## Technical Data

<b>Max. overload:</b>	see table
<b>Temperature influence:</b>	≤ 0.05 % / K
<b>Reaction time:</b>	see characteristic switching delay
<b>Internal resistor:</b>	< 5 mΩ

## Setting Ranges

<b>Response value:</b>	infinite variable within measuring range
<b>Hysteresis:</b>	approx. 4 % of setting value, fixed
<b>Repeat accuracy:</b>	≤ ± 1 %
<b>Switching delay:</b>	0.1 ... 20 sec settable

## Auxiliary Circuit

<b>Auxiliary voltage U<sub>H</sub>:</b>	AC/DC 24 V, AC 220 ... 240 V other voltages on request
---	---

## Voltage range

at AC:	0.8 ... 1.1 U <sub>H</sub>
at DC:	0.8 ... 1.25 U <sub>H</sub>

## Nominal consumption

at AC 230 V:	
IL/SL 9270, IP/SP 9270:	3.2 VA
IK/SK 9270, IL/SL 9270/500:	2.3 VA
at DC 24 V:	
IL/SL 9270, IP/SP 9270:	0.8 W
IK/SK 9270, IL/SL 9270/500:	0.4 W
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	± 5 %

## Output

### Contacts

IK 9270.11, SK 9270.11 IL/SL 9270.11/5_ _:	1 changeover contact
IL 9270.12, SL 9270.12 SL 9270.12CT:	2 changeover contacts
IP 9270.12, SP 9270.12 SP 9270.12CT:	2 changeover contacts
<b>Thermal current I<sub>th</sub>:</b>	5 A

### Switching capacity

to AC 15	
NO contact:	
IK 9270, IL 9270/5_ _:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
IL/SL 9270, IP/SP 9270, SL 9270CT, SP 9270CT:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	2 A / AC 230 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 bei 1 A, AC 230 V	
NO contact	
IK/SK 9270, IL/SL 9270/5_ _:	3 x 10 <sup>6</sup> switching cycles IEC/EN 60 947-5-1
to AC 15 at 2 A, AC 230 V	
IL/SL 9270, IP/SP 9270, SL 9270CT, SP 9270CT:	2 x 10 <sup>6</sup> switching cycles IEC/EN 60 947-5-1

### Short-circuit strength

<b>max. fuse rating:</b>	
IK/SK 9270, IL/SL 9270/5_ _:	4 A gL IEC/EN 60 947-5-1
IL/SL 9270, IP/SP 9270 SL 9270CT, SP 9270CT:	6 A gL IEC/EN 60 947-5-1

<b>Mechanical life:</b>	> 50 x 10 <sup>6</sup> switching cycles
-------------------------	---

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range</b>	
Operation:	- 20 ... + 60°C
Storage:	- 25 ... + 70°C
<b>Altitude:</b>	< 2.000 m

### Clearance and creepage distances

rated impulse voltage/ pollution degree:	IEC 60 664-1
---	--------------

	IP/SP	IK/SK IL/SL-devices/5_ _	IL/SL
Auxiliary voltage - Contacts	4 kV/2	4 kV/2	4 kV/2
Auxiliary voltage - Measuring circuit	6 kV/2	6 kV/2*)	4 kV/2
Measuring circuit - Contacts	6 kV/2	6 kV/2	4 kV/2
Measuring circuit-Measuring circuit	6 kV/2	-	-
Contacts-Contacts	4 kV/2	-	4 kV/2

The contacts are not designed for voltage systems with 400 / 690 V.

\*) 4 kV/2 at IK/SK 9270 with measuring range 5 ... 750 mA

### EMC

Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:		
IK/SK9270, IP/SP 9270, SL/SP 9270:		
80 MHz ... 1 GHz:	20 V / m	IEC/EN 61 000-4-3
1 GHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
SL/SP 9270CT, SL9270/5:		
80 MHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply		
IK/SK 9270, IL/SL 9270/5_ _:	2 kV	IEC/EN 61 000-4-5
IL/SL 9270, IP/SP 9270, SL/SP 9270CT:	1 kV	IEC/EN 61 000-4-5
between wire and ground:		
IK/SK 9270, IL/SL 9270/5_ _:	4 kV	IEC/EN 61 000-4-5
IL/SL 9270, IP/SP 9270, SL/SP 9270CT:	2 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94	
Amplitude 0.35 mm	
frequency 10 ... 55 Hz	IEC/EN 60 068-2-6
20 / 060 / 04	IEC/EN 60 068-1
EN 50 005	
2 x 2.5 mm <sup>2</sup> solid or	
2 x 1.5 mm <sup>2</sup> stranded ferruled	
DIN 46 228-1/-2/-3/-4	
0,6 mm <sup>2</sup>	

### Vibration resistance:

<b>Climate resistance:</b>	
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4 0,6 mm <sup>2</sup>
Min. cross section:	
Insulation of wires or sleeve length:	10 mm
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715

## Dimensions

### Width x height x depth

IK 9270:	17.5 x 90 x 61 mm
SK 9270:	17.5 x 90 x 100 mm
IL 9270:	35 x 90 x 61 mm
SL 9270, SL 9270CT:	35 x 90 x 100 mm
IP 9270:	70 x 90 x 61 mm
SP 9270, SP 9270CT:	70 x 90 x 100 mm



## CCC-Data

### Switching capacity

to AC 15: 5 A / AC 230 V IEC/EN 60 947-5-1  
 to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Types

IK 9270.11/010 AC 220 ... 240 V 50/60 Hz 0.1 ... 15 A

Article number: 0050330

SK 9270.11/010 AC 220 ... 240V 50/60Hz 0.1 ... 15 A

Article number: 0050736

- Single phase
- 4 programmable ranges up to 15 A
- Energized on trip
- Auxiliary voltage  $U_T$ : AC 220 ... 240 V
- 1 changeover contact
- Width: 17.5 mm

IP 9270.12/010 AC 220 ... 240 V 50/60 Hz 0.5 ... 5 A

Article number: 0049438

SP 9270.12/010 AC 220 ... 240 V 50/60 Hz 0.5 ... 5 A

Article number: 0050736

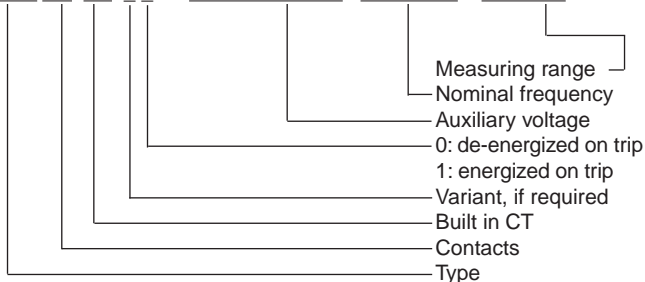
- 3-phase
- Range: 0.5 ... 5 A
- Energized on trip
- Auxiliary voltage  $U_T$ : AC 220 ... 240 V
- 2 changeover contacts
- Width: 70 mm

## Variants

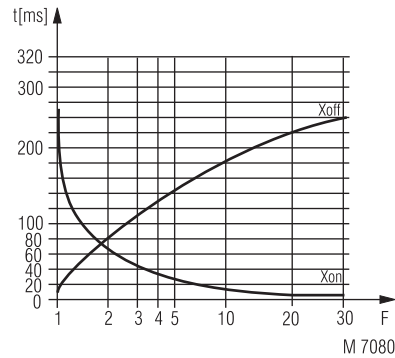
IK 9270.11, SK 9270.11:	Single phase current relay, de-energized on trip, 1 changeover contact
IL 9270.12, SL 9270.12:	Single phase current relay, de-energized on trip, 2 changeover contacts
IL 9270.12/010, SL 9270.12/010:	Single phase current relay, energized on trip, 2 changeover contacts
IL 9270.11/500, SL 9270.11/500:	Same as IK/SK 9270.11, except with 5 measuring ranges from 0.1 ... 50 A
IL 9270.11/510, SL 9270.11/510:	Same as IK/SK 9270.11/010, except with 5 measuring ranges from 0.1 ... 50 A
IP 9270.12, SP 9270.12:	3-phase current relay, de-energized on trip, 2 changeover contacts
SL 9270.12CT:	Single phase current relay with built in CT, de-energized on trip, 2 changeover contacts
SP 9270.12CT:	3-phase current relay with built in CT, energized on trip, 2 changeover contacts

### Ordering Example for variants

SP 9270 .12 CT / \_ 0 AC 220 ... 240 V 50 / 60 Hz 5 ... 50 A



## Characteristics



### Switching delay

The characteristic shows the switching delay depending on the values of  $X_{on}$  -  $X_{off}$  when switching the current on or off. A slow current change reduces the delay.

$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## VARIMETER

### Over- and Undercurrent Relay

IL 9277, IP 9277, SL 9277, SP 9277



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- According to IEC/EN 60 25-1
- IP 9277, SP 9277, SP 9277CT: 3-phase  
IL 9277, SL 9277, SL 9277CT: single phase
- Detects over- and undercurrent
- Measuring ranges from 0.1 ... 15 A
- With built in current transformer for 0.5 ... 100 A
- IL 9277, SL 9277 with 4 programmable ranges
- Settable 0.1 ... 1 s
- Separate setting for over- and undercurrent
- Fixed hysteresis approx. 4 %
- Settable time delay
- IP 9277, SP 9277 with separate settable time delay for over- and undercurrent
- De-energized on trip
- LED indicators for over-, under- and normal current
- Auxiliary supply and measuring input galvanic separated
- IL 9277, SL 9277 with one output relay for over- and undercurrent
- IP 9277, SP 9277 with separate output relays for over- and undercurrent
- Optionally energized on trip
- Devices available in 2 enclosure versions:
  - I-model, e.g. IL \_\_\_\_, depth 61 mm  
with terminals at the bottom for installations systems and industrial distribution systems according to DIN 43 880
  - S-model, e.g. SL \_\_\_\_, depth 100 mm  
with terminals at the top for cabinets with mounting plate and cable duct
- DIN rail or screw mounting
- Width IL 9277, SL 9277, SL 9277CT: 35 mm  
IP 9277, SP 9277, SP 9277CT: 70 mm

#### Approvals and Markings



\*) only IL-devices

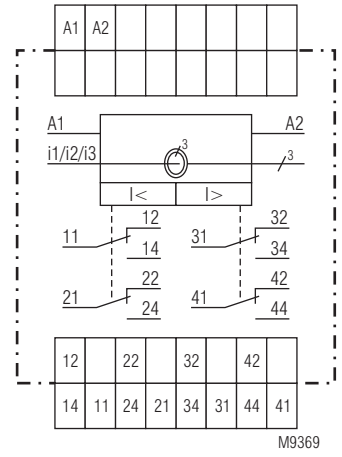
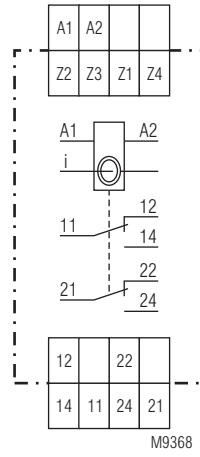
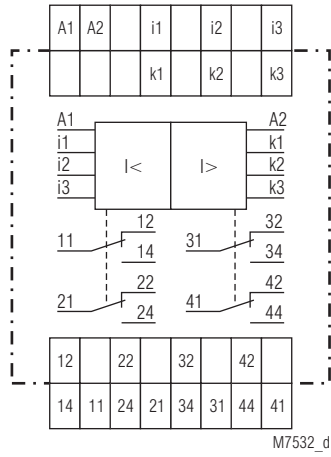
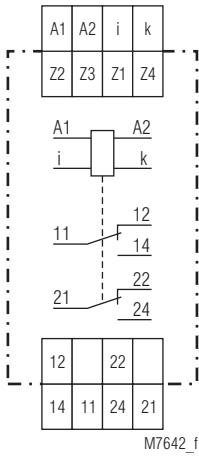
#### Applications

- Over- and undercurrent detection in single phase or 3-phase voltage systems
- For industrial and railway applications

#### Indicators

LED green:	current within limits
LED red $I_{max}$ :	overcurrent
LED red $I_{min}$ :	undercurrent

### Circuit Diagram



IL 9277.12, SL 9277.12

IP 9277.39, SP 9277.39

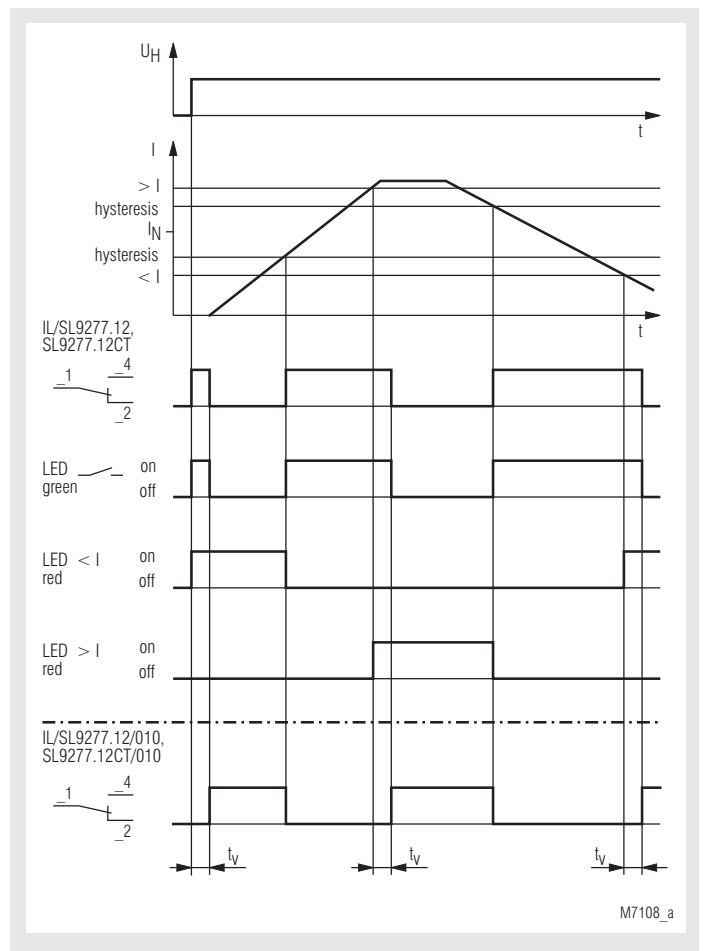
SL 9277.12CT

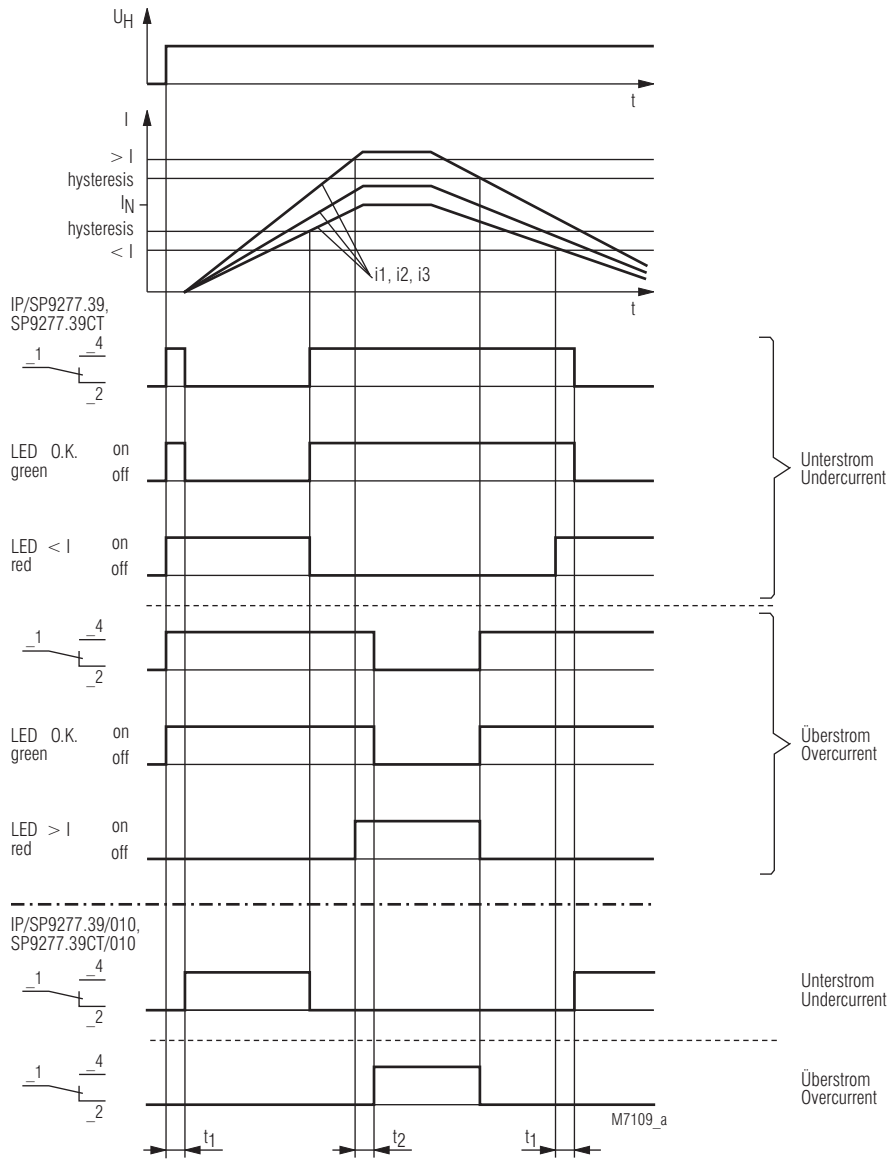
SP 9277.39CT

### Connection Terminals





Terminal designation	Signal designation
A1, A2	Auxiliary voltage AC or DC
i, k	Current measuring circuit AC or DC
i1, k1; i2, k2; i3, k3	Current measuring circuit phase 1; 2; 3
Z1 / Z2, Z3, Z4	Measuring ranges with bridges via terminals
IL-device: 11, 12, 14	Contacts Rel. 1 over- / undercurrent signal
IL-device: 21, 22, 24	Contacts Rel. 2 over- / undercurrent signal
IP-device: 11, 12, 14	Contacts Rel. 1 underrcurrent signal
IP-device: 21, 22, 24	Contacts Rel. 2 underrcurrent signal
IP-device: 31, 32, 34	Contacts Rel. 3 overcurrent signal
IP-device: 41, 42, 44	Contacts Rel. 4 overcurrent signal

### Function Diagram IL 9277, SL 9277, SL 9277CT





**Technical Data**

Type				
	<b>IL 9277</b>	<b>SL 9277CT</b>	<b>IP 9277</b>	<b>SP 9277CT</b>
Depth 61 mm	IL 9277.12		IP 9277.39	
Depth 100 mm	SL 9277.12	SL 9277.12CT	SP 9277.39	SP 9277.39CT
Width	35 mm	35 mm	70 mm	70 mm
Measuring input	single-phase	single-phase	3-phase	3-phase
Measuring range	0.1 ... 15 A settable with switch range / bridge	0.5 ... 100 A settable with bridges: range / bridge	1 Meas. range per unit	1 Meas. range per unit
Nominal frequency 50 ... 400 Hz	0.1 ... 1 A / Z1-Z2 0.5 ... 5 A / Z1-Z3 1 ... 10 A / Z1-Z4 1.5 ... 15 A / Z3-Z1-Z4  0.01 ... 1.5 A programmable with bridges: range / bridge 0.01 ... 0.1 A / Z1-Z3 0.05 ... 0.5 A / Z1-Z2 0.1 ... 1 A / Z1-Z4 0.15 ... 1.5 A / Z2-Z1-Z4	0.5 ... 5 A / Z1-Z2 2.5 ... 25 A / Z1-Z3 7.5 ... 75 A / Z1-Z4 10 ... 100 A / Z3-Z1-Z4	0.1 ... 1 A 0.5 ... 5 A 1 ... 10 A 1.5 ... 15 A	0.5 ... 5 A 2.5 ... 25 A 5 ... 50 A 7.5 ... 75 A 10 ... 100 A
Continuous current/ Max. ambient temperature	20 A / 50 °C 15 A / 60 °C	limited only by diameter of cable 25 mm <sup>2</sup>	3 x 15 A / 50 °C 3 x 20 A / 45 °C	limited only by diameter of cable 25 mm <sup>2</sup>
Wire current path Solid Stranded ferrule	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>
Contacts	2 C/O contacts	2 C/O contacts	2 x 2 C/O contacts *)	2 x 2 C/O contacts *)
Weight:	IL 9277: 125 g SL 9277: 150 g	approx. 230 g	IP 9277: 200 g SP 9277: 250 g	a<pprox. 470 g

\*) 2 changeover contacts for overcurrent, 2 changeover contacts for undercurrent

## Technical Data

**Max. overload:** see table  
**Temperature influence:**  $\leq 0.05\%$  / K  
**Reaction time:** see characteristic switching delay

## Setting Ranges

**Response value:** infinite variable within measuring range  
**Hysteresis:** approx. 4 % of setting value, fixed  
**Repeat accuracy:**  $\leq \pm 1\%$   
**Switching delay:** 0.1 ... 20 sec settable

## Auxiliary Circuit

### Auxiliary voltage $U_H$

IL 9277, SL 9277, SL 9277CT: AC/DC 24 V  
AC 115 ... 127 V, AC 220 ... 240 V,  
AC 400 ... 440 V

IP 9277, SP 9277, SP 9277CT: AC/DC 24 V  
AC 115, 127 V  
AC 220 ... 240 V, AC 400 ... 440 V

### Voltage range

at AC: 0.8 ... 1.1  $U_H$   
at DC: 0.8 ... 1.25  $U_H$

### Nominal consumption

IL 9277, SL 9277, SL 9277CT

at AC 230 V: 3.2 VA  
at DC 24 V: 0.8 W

IP 9277, SP 9277, SP 9277CT

at AC 230 V: 7.2 VA  
at DC 24 V: 1 W

**Nominal frequency:** 50 / 60 Hz

**Frequency range:**  $\pm 5\%$

## Output

### Contacts

IL 9277.12, SL 9277.12,  
SL 9277.12CT: 2 changeover contact

IP 9277.39, SP 9277.39,  
SP 9277.39CT: 2 x 2 changeover contact

**Thermal current  $I_{th}$ :** 5 A

**Switching capacity**  
to AC 15

NO contact: 5 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 2 A, AC 230 V

NO contact: 2 x 10<sup>5</sup> switch. cycles IEC/EN 60 947-5-1

### Short-circuit strength

**max. fuse rating:** 6 A gL IEC/EN 60 947-5-1

**Mechanical life:** > 50 x 10<sup>6</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

### Temperature range

Operation: - 20 ... + 60°C

Storage: - 25 ... + 70°C

**Altitude:** < 2.000 m

### Clearance and creepage distances

rated rated impulse voltage voltage/

pollution degree: IEC 60 664-1

	IP/SP-devices	IL/SL-devices
Supply - Contacts	4 kV/2	4 kV/2
Supply - Measuring Circuit	6 kV/2	4 kV/2
Measuring circuit-Measuring circuit	6 kV/2	-
Measuring Circuit - contacts	6 kV/2	4 kV/2
Contact-Contact	4 kV/2	4 kV/2
Measuring Circuit, max. voltage:	3 AC 400/690 V	AC 230 V/400
The contacts are not designed for voltage systems with 400 / 690 V		
contacts, max. voltage:	AC 230/400 V	AC 230/400 V

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

IL/SL 9277, IP/SP 9277

80 MHz ... 1 GHz: 20 V/m IEC/EN 61 000-4-3

1 GHz ... 2,7 GHz: 10 V/m IEC/EN 61 000-4-3

SL/SP 9277CT

80 MHz ... 1 GHz: 10 V/m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour  
according to UL subject 94  
Amplitude 0.35 mm

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

EN 50 005

2 x 2.5 mm<sup>2</sup> solid or

2 x 1.5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

0,6 mm<sup>2</sup>

Min. cross section:

Insulation of wires

or sleeve length:

10 mm

**Wire fixing:** Flat terminals with self-lifting

clamping piece IEC/EN 60 999-1

0.8 Nm

**Mounting:** DIN rail mounting (IEC/EN 60715) or

screw mounting M4, 90 mm hole pattern,

with additional clip available as accessory

## Dimensions

### Width x height x depth

IL 9277: 35 x 90 x 61 mm

SL 9277, SL 9277CT: 35 x 90 x 100 mm

IP 9277: 70 x 90 x 61 mm

SP 9277, SP 9277CT: 70 x 90 x 100 mm

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

Ambient temperature: T1 compliant

T2, T3 und TX with operational limitations

**Protective coating of the PCB:** No

## CCC-Data

### Switching capacity

to AC 15: 5 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Types

IL 9277.12 AC 220 ... 240 V

Article number: 0049306

SL 9277.12 AC 220 ... 240 V

Article number: 0054111

- Single phase
- 4 programmable ranges up to 15 A
- De-energized on trip
- Auxiliary voltage  $U_H$ : AC 220 ... 240 V
- 2 changeover contacts
- Width: 35 mm

IP 9277.39 0,5 ... 5 A AC 220 ... 240 V

Article number: 0049308

SP 9277.39 0,5 ... 5 A AC 220 ... 240 V

Article number: 0056075

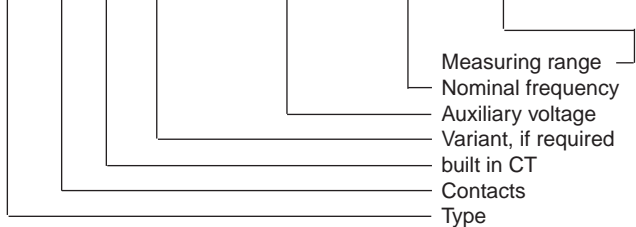
- 3-phase
- Range 0.5 ... 5 A
- De-energized on trip
- Auxiliary voltage  $U_H$ : AC 220 ... 240 V
- 2 changeover contacts each for over- and undercurrent
- Width: 70 mm

## Variants

IL 9277.12/010, SL 9277.12/010:	single phase current relay energized on trip
IP 9277.39/010, SP 9277.39/010:	3-phase current relay energized on trip
IP 9277.39/002, SP 9277.39/002:	3-phase current relay undercurrent de-energized on trip
SL 9277.12CT	overcurrent energized on trip single phase current relay with built in CT
SP 9277.39CT	3-phase current relay with built in CT

## Ordering example for variants

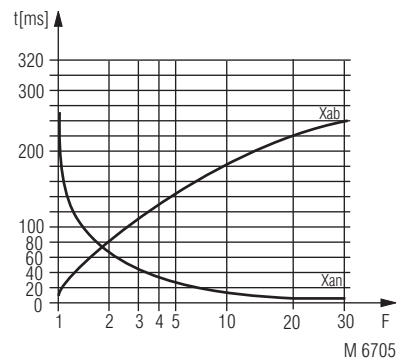
IP 9277 .39 CT / - - AC 220 ... 240 V 50 / 60 Hz 10 A



## Accessories

ET 4086-0-2:	Additional clip for screw mounting Article number: 0046578
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## Characteristics



### Switching delay

The characteristic shows the switching delay depending on the values of  $X_{an}$  -  $X_{ab}$  when switching the current on or off. A slow current change reduces the delay.

$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## VARIMETER

Overcurrent Relay  
IK 9272, SK 9272

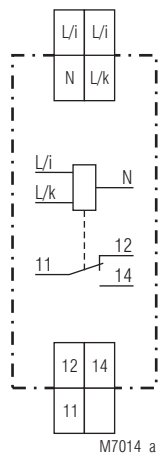


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- According to IEC/EN 60 255
- Single phase
- Measuring ranges from 0.05 ... 10 A
- Fixed hysteresis approx. 4 %
- Adjustable switching delay
- Closed circuit operation
- Optionally open circuit operation
- Automatic reset
- Optionally manual reset, reset button on the front
- LED indication for auxiliary voltage
- 1 changeover contact
- Devices available in 2 enclosure versions:  
 IK 9272: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880  
 SK 9272: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Circuit Diagram



### Approvals and Markings



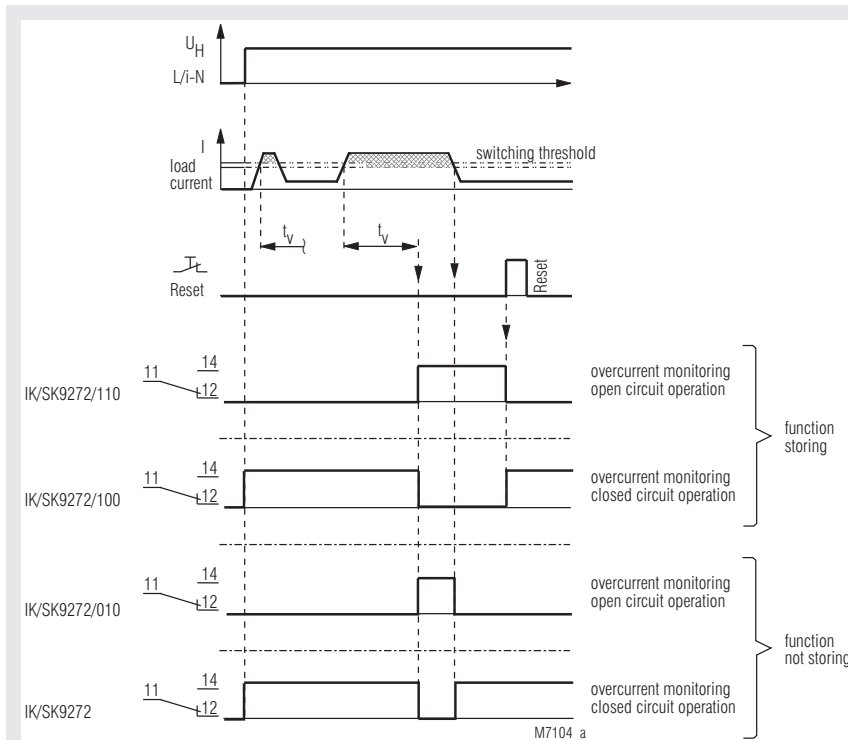
### Application

Overcurrent detection in AC power supplies

### Indication

green LED: on when auxiliary supply connected  
 yellow LED: on when output contacts switched

### Function Diagram





## Notes

Auxiliary voltage and measuring circuit are not galvanically separated. Thus they need the same reference potential "N", if there is no external separation, e.g. through a current transformer see Application Examples.

## Technical Data

### Input

<b>Measuring range:</b>	AC 50 ... 500 mA AC 0.1 ... 1 A AC 0.5 ... 5 A AC 1 ... 10 A higher currents via external current transformer (2.5 VA)
-------------------------	--

**Nominal frequency of measuring current:** 50 / 60 Hz

<b>Maximum continuous measuring current:</b>	
at AC 50 ... 500 mA:	2.5 A, at 50°C ambient temperature
at AC 0.1 ... 1 A:	5 A, at 50°C ambient temperature
at AC 0.5 ... 5 A:	11 A, at 50°C ambient temperature
at AC 1 ... 10 A:	15 A, at 50°C ambient temperature

<b>Maximum overload:</b>	
at AC 50 ... 500 mA:	8 A, max. 3 s
at AC 0.1 ... 1 A:	10 A, max. 3 s
at AC 0.5 ... 5 A:	20 A, max. 3 s
at AC 1 ... 10 A:	20 A, max. 3 s

<b>Temperature influence:</b>	≤ 0.2 % / K
<b>Reaction time:</b>	see characteristic switching delay

### Setting Ranges

<b>Response value:</b>	infinite variable within measuring range
<b>Hysteresis:</b>	approx. 0.96 of setting value, fixed approx. 4 % hysteresis
<b>Setting accuracy:</b>	≤ ± 10 % of setting value
<b>Repeat accuracy:</b>	≤ ± 1 %
<b>Time delay tv:</b>	0.1 ... 20 s adjustable

### Auxiliary Circuit

<b>Auxiliary voltage <math>U_H</math>:</b>	AC 115 ... 127 V, AC 220 ... 240 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_H$
<b>Nominal consumption</b> at AC 230 V:	5.5 VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	± 5 %

### Output

<b>Contacts</b> IK 9272.11, SK 9272.11:	1 changeover contact
<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity</b> to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V	IEC/EN 60 947-5-1
NO contact:	3 x 10 <sup>5</sup> switching cycles
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 10 <sup>8</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b> rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1

## Technical Data

### EMC

Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V/m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply: between wire and ground: HF wire guided:	1 kV IEC/EN 61 000-4-5 2 kV IEC/EN 61 000-4-5 10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	Housing: IP 40 IEC/EN 60 529 Terminals: IP 20 IEC/EN 60 529

<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1

<b>Climate resistance:</b>	EN 50 005
<b>Terminal designation:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled

<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4 Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 0.8 Nm IEC/EN 60 999-1
<b>Wire fixing:</b>	DIN rail IEC/EN 60 715

<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail

<b>Weight:</b>	
IK 9272:	65 g
SK 9272:	80 g

### Dimensions

<b>Width x height x depth:</b>	
IK 9272:	17.5 x 90 x 59 mm
SK 9272:	17.5 x 90 x 98 mm

### Classification to DIN EN 50155 for IK 9272

<b>Vibration and shock resistance:</b>	Category 1, Class B IEC/EN 61 373
<b>Protective coating of the PCB:</b>	No

### Standard Types

IK 9272.11/010	AC 220 ... 240 V	50/60 Hz	10 A
Article number:	0050068		
• Open circuit operation			
• Output:	1 changeover contact		
• Nominal voltage $U_N$ :	AC 220 ... 240 V		
• Measuring range:	1 ... 10 A		
• Width:	17.5 mm		

SK 9272.11/010	AC 220 ... 240 V	50/60Hz	10 A
Article number:	0050613		
• Open circuit operation			
• Output:	1 changeover contact		
• Nominal voltage $U_N$ :	AC 220 ... 240 V		
• Measuring range:	1 ... 10 A		
• Width:	17.5 mm		

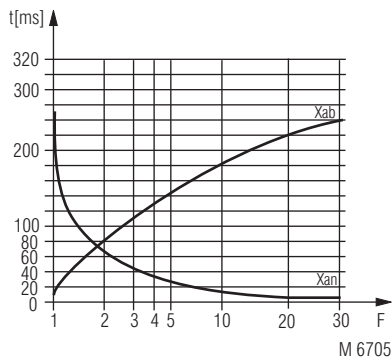
### Variants

IK 9272:	Closed circuit operation
IK 9272.11/100:	Manual reset, closed circuit operation
IK 9272.11/110:	Manual reset, open circuit operation

### Ordering example for variants

IK 9272	.11	/	---	AC 220 ... 240 V	50 / 60 Hz	10 A	
							Measuring range
							Nominal frequency
							Auxiliary voltage
							Variant, if required
							Contacts
							Type

## Characteristics

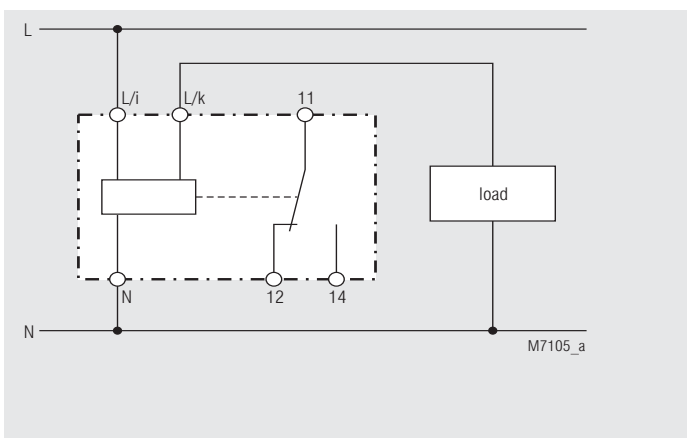


### Switching delay

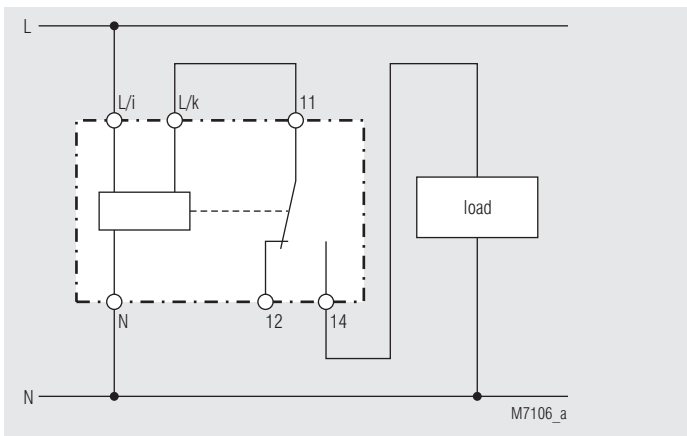
The characteristic shows the switching delay depending on the values of  $X_{an} - X_{ab}$  when switching the current on or off. A slow current change reduces the delay

$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## Connection Examples



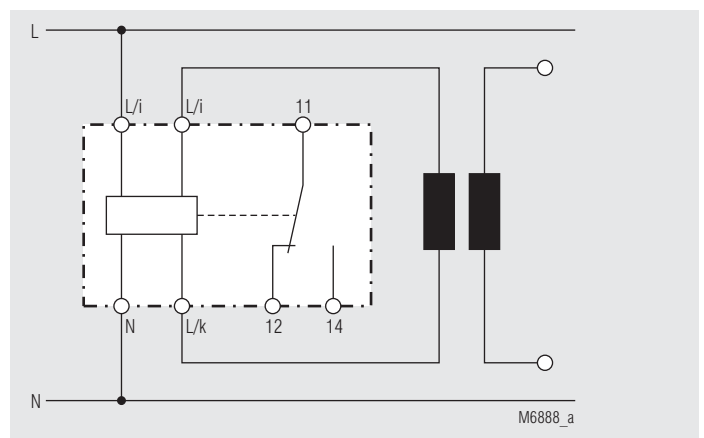
L/i - N auxiliary voltage  
L/i - L/k current input



### Connection Example for IK 9272/100

Load in series to the contact. When overcurrent the load is turned off. The fault is stored. New start by pressing reset button or auxiliary voltage off, on.

Maximum continuous measuring current for this application is 5 A:



Connection Example with external galvanical separation, e.g. via current transformer.

**Attention:** On the secondary side of the current transformer is the potential L.  
L/i is allowed to be changed, so that the secondary side of the current transformer has the potential N.

## VARIMETER

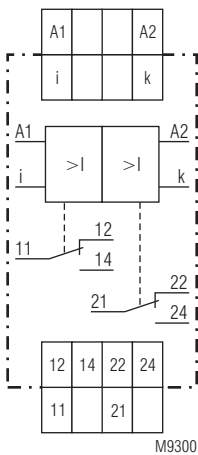
### Overcurrent Relay

IL 5201/20007, SL 5201/20007CT



- According to IEC/EN 60 255, DIN VDE 0435-303
- 2 independent relays in once enclosure
- 2 measuring ranges from 0.5 to 5 A
- Adjustable response values
- Fixed hysteresis
- Adjustable switching delay
- Closed circuit operation
- LED indicators
- with auxiliary voltage
- galvanic separation between Auxiliary Circuit and Measuring Circuit
- **2 models available:**
  - IL 5201:** 63 mm deep with terminals near to the bottom to be mounted in consumer units or industrial distribution systems according to DIN 43 880
  - SL 5201:** 100 mm deep with terminals near to the top to be mounted in cabinets with mounting plate and cable ducts
- Width: 35 mm

### Circuit Diagram



### Approvals and Markings



### Application

Overcurrent detection in single phase or 3-phase voltage systems

### Indicators

LEDs green: on, when supply voltage connected  
 LEDs yellow: on, when output relay active

### Technical Data

#### Measuring Circuit

**Measuring ranges**  
 IL 5201/20007: 2 separate Measuring Circuits 0.5 ... 5 A adjustable  
 SL 5201/20007CT: 2 separate Measuring Circuits 5 ... 50 A adjustable

**Nominal frequency:** 50 ... 400 Hz  
**Thermal continuous current ambient-temperature:** 20 A / 50°C  
 15 A / 60°C

**Temperature influence:** ≤ 0.05 % / K  
**Reaction time:** see characteristic switching delay  
**Internal resistance:** < 5 mΩ

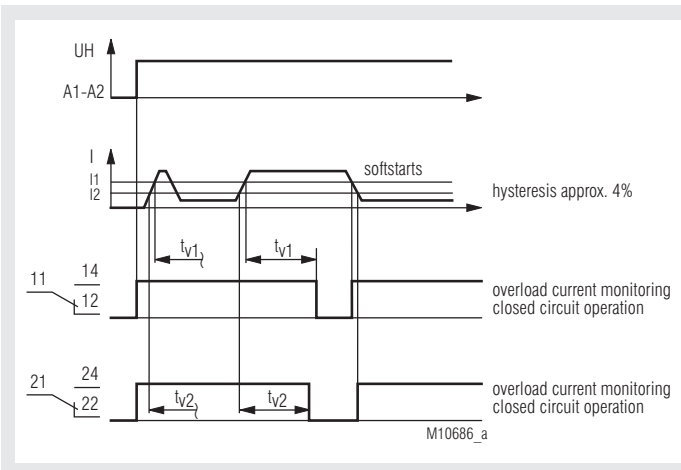
#### Setting Ranges

**Setting of response value:** infinitely variable at measuring range  
**Hysteresis:** approx. 4 % of setting range, factory set fixed value  
**Repeat accuracy:** ≤ ± 1 %  
**Time delay tv:** 0.1 ... 20 s adjustable

#### Auxiliary Circuit

**Auxiliary voltage U<sub>H</sub>:** AC 220 ... 240 V  
**Voltage range:** 0.8 ... 1.1 U<sub>H</sub>  
**Nominal consumption:** 2 x 2.3 VA  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** ± 5 %

### Function Diagram



## Technical Data

### Output

<b>Contacts:</b>	2 x 1 changeover contacts	
<b>thermal current <math>I_{th}</math>:</b>	2 x 5 A	
<b>Switching capacity</b> to AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V		
NO contact:	3 x 10 <sup>5</sup> switch. cycl.	IEC/EN 60 947-5-1
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 50 x 10 <sup>6</sup> switching cycles	

### General Data

<b>Nominal operating mode:</b>	continuous operation	
<b>Temperature range:</b>	- 20 ... + 60°C	
<b>Clearance and creepage distance</b> rated impulse voltage / pollution degree:		IEC 60 664-1
Auxiliary voltage-contacts:	4 kV/2	
Auxiliary voltage-measur. circuit:	6 kV/2	
Measuring circuit-contacts:	6 kV/2	
The contacts are not designed for voltage systems with 400 / 690 V		
<b>EMC</b>		
Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltage between		
wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection:</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	thermoplastic with VO behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1	
<b>Climate resistance:</b>	EN 50 005	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 DIN rail IEC/EN 60 715	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight</b>		
IL 5201/20007:	approx. 124 g	
SL 5201/20007CT:	approx. 245 g	

### Dimensions

IL 5201/20007:	35 x 90 x 63 mm
SL 5201/20007CT:	35 x 90 x 100 mm

## Standard Types

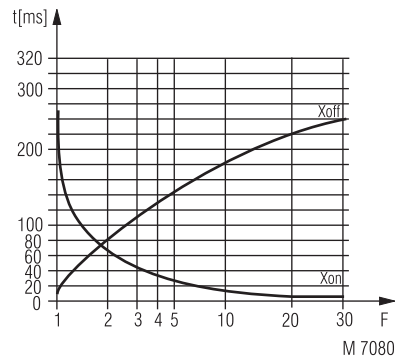
IL 5201/20007 AC 220 ... 240 V 50/60 Hz 0,5 ... 5 A

Article number:	0059589
• single phase	
• 2 adjustable measuring ranges up to 5 A	
• Closed circuit operation	
• Auxiliary voltage $U_H$	AC 220 ... 240 V
• 2 x 1 changeover contacts	
• Width: 35 mm	

SL 5201/20007CT AC 220 ... 240 V 50/60 Hz 5 ... 50 A

Article number:	0059807
• single phase	
• 2 adjustable measuring ranges up to 50 A	
• Closed circuit operation	
• Auxiliary voltage $U_H$	AC 220 ... 240 V
• 2 x 1 changeover contacts	
• Width: 35 mm	

## Characteristic



### Switching delay

The characteristic shows the switching delay depending on the values of  $X_{on}$  -  $X_{off}$  when switching the current on or off. A slow current change reduces the delay.

$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## VARIMETER

### Undercurrent Relay

IK 9271, IL 9271, IP 9271, SK 9271, SL 9271, SP 9271



02244263



IK 9271



IL 9271



IL 9271/5\_ \_



SL 9271/5\_ \_



SK 9271



IP 9271



SL 9271CT



SP 9271CT

- According to IEC/EN 60 255-1
- IP 9271, SP 9271, SP 9271CT: 3-phase  
IK 9271, IL 9271, SK 9271, SL 9271, SL 9271CT: single phase
- Measuring ranges from 0.1 ... 100 A
- IK 9271, SK 9271:  
with 4 ranges settable by rotational switch, 1 changeover contact
- IL 9271, SL 9271:  
with 5 ranges settable by rotational switch, 1 changeover contact  
with 4 ranges programmable by bridges, 2 changeover contacts
- IP 9271, SP 9271: with 1 range, 2 changeover contacts
- Settable response value
- Fixed hysteresis
- Settable time delay
- De-energized on trip
- Optionally energized on trip
- LED indicators
- With auxiliary voltage
- Auxiliary supply and measuring input galvanic separated
- Devices available in 2 enclosure versions:
  - I-model, e.g. IK \_ \_ \_ \_ , depth 61 mm  
with terminals at the bottom for installations systems  
and industrial distribution systems according to DIN 43 880
  - S-model, e.g. SK \_ \_ \_ \_ , depth 100 mm  
with terminals at the top for cabinets with mounting plate  
and cable duct
- Width IK 9271, SK 9271: 17.5 mm  
IL 9271, SL 9271, SL 9271CT: 35 mm  
IP 9271, SP 9271, SP 9271CT: 70 mm

#### Approvals and Markings



\*) only IL-devices

#### Applications

Undercurrent detection in single phase or 3-phase voltage systems

#### Indicators

IK 9271.11, SK 9271.11

IL 9271.11/5\_ \_

SL 9271.11/5\_ \_:

green LED:

on when aux. supply connected

yellow LED:

on when output contacts switched

IL 9271, SL 9271,

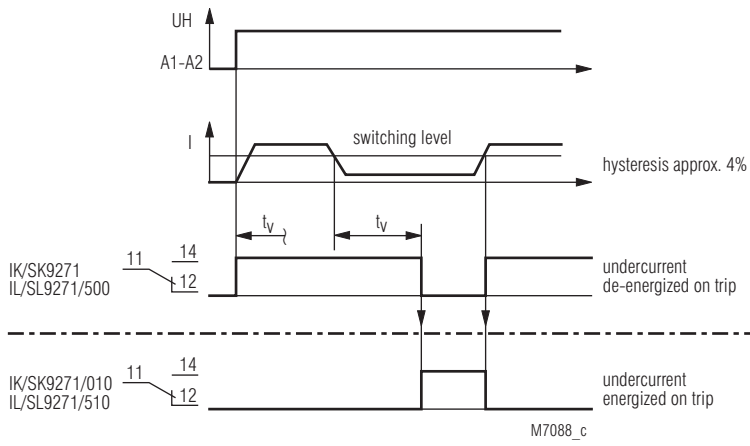
IP 9271, SP 9271:

green LED:

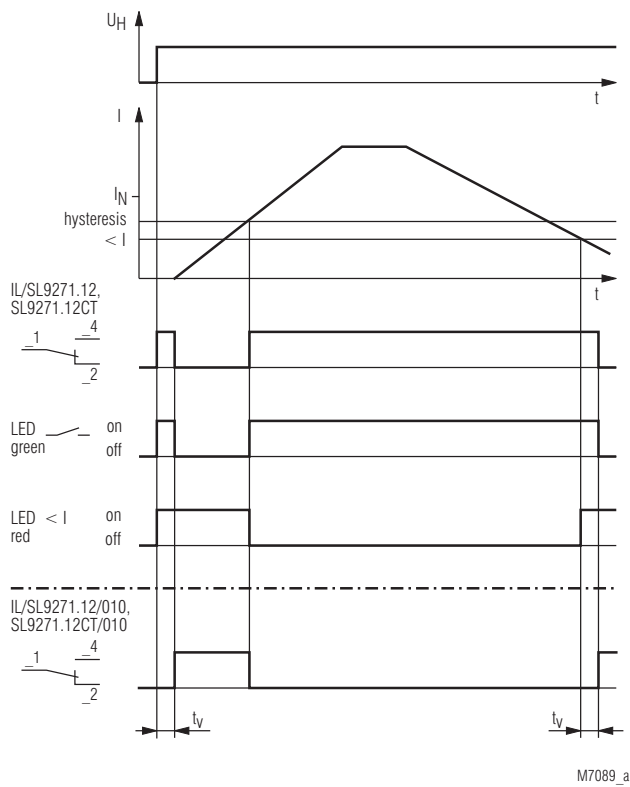
on when current within limits

red LED I<sub>max</sub>:

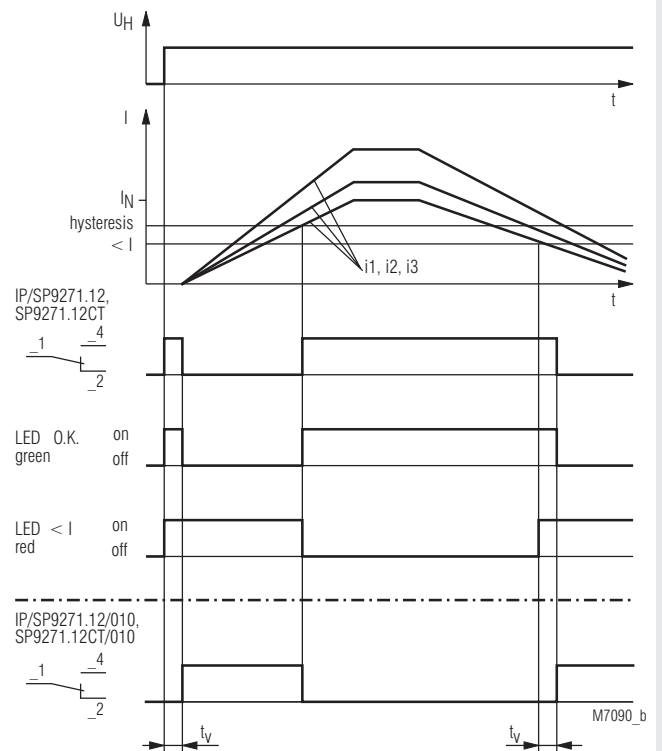
on when undercurrent



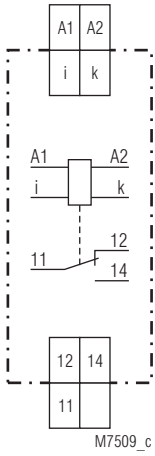
Function Diagram IL 9271.12, SL 9271.12



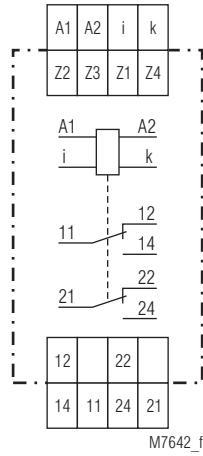
Function Diagram IP 9271, SP 9271



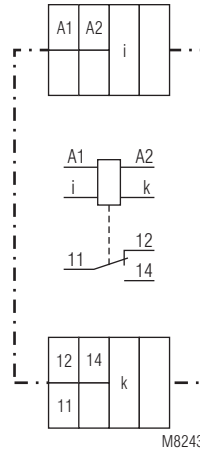
Circuit Diagrams



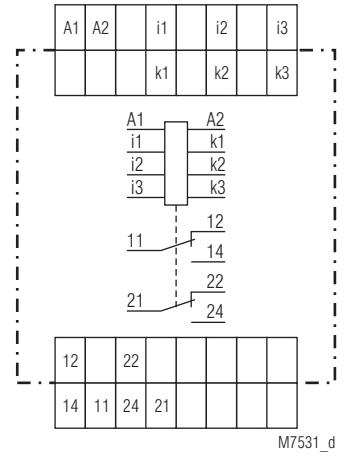
IK 9271.11, SK 9271.11



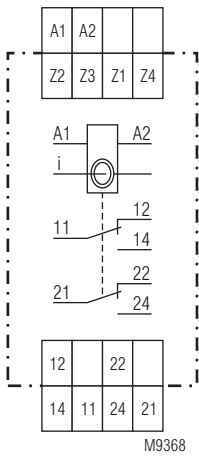
IL 9271.12, SL 9271.12



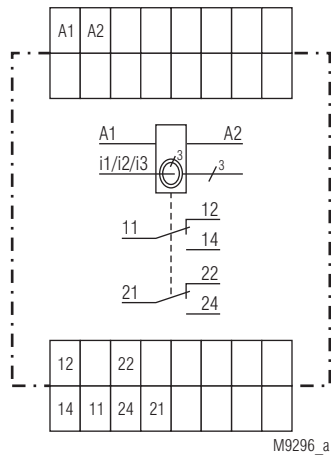
IL 9271.11/5\_



IP 9271.12, SP 9271.12









SL 9271.12CT



SP 9271.12CT

**Technical Data**

Type						
	<b>IK 9271</b>	<b>SL 9271/5_ _</b>	<b>IL 9271</b>	<b>SL 9271CT</b>	<b>IP 9271</b>	<b>SP 9271CT</b>
Depth 61 mm	IK 9271.11	IL 9271.11/5_ _	IL 9271.12	-	IP 9271.12	-
Depth 100 mm	SK 9271.11	SL 9271.11/5_ _	SL 9271.12	SL 9271.12CT	SP 9271.12	SP 9271.12CT
Width	17.5 mm	35 mm	35 mm	35 mm	70 mm	70 mm
Measuring input	single-phase	single-phase	single-phase	single-phase	3-phase	3-phase
Measuring range (Nominal frequency 50 ... 400 Hz)	<b>0.1 ... 15 A</b>  4 part ranges settable with switch: 0.1 ... 1 A 0.5 ... 5 A 1 ... 10 A 1.5 ... 15 A  Max. thermal continuous current:  20 A at 50 °C 15 A at 60 °C	<b>0.1 ... 50 A</b>  5 part ranges settable with switch: 0.1 ... 1 A 0.5 ... 5 A 2.5 ... 25 A 3 ... 30 A 5 ... 50 A  Max. thermal continuous current:  50 A at 50 °C 60 A at 40 °C	<b>0.1 ... 15 A</b>  4 part ranges programmable with bridges: 0.1 ... 1 A (Z1-Z2) 0.5 ... 5 A (Z1-Z3) 1 ... 10 A (Z1-Z4) 1.5 ... 15 A (Z3-Z1-Z4)  Max. thermal continuous current:  20 A at 50 °C 15 A at 60 °C	<b>0.5 ... 100 A</b>  4 part ranges programmable with bridges: 0.5 ... 5 A (Z1-Z2) 2.5 ... 25 A (Z1-Z3) 7.5 ... 75 A (Z1-Z4) 10 ... 100 A (Z3-Z1-Z4)  Max. thermal continuous current:  limited only by diameter of cable 25 mm <sup>2</sup>	<b>0.1 ... 15 A</b>  1 fixed measuring range per unit 0.1 ... 1 A 0.5 ... 5 A 1 ... 10 A 1.5 ... 15 A  Max. thermal continuous current:  3 x 15 A at 50 °C 3 x 20 A at 45 °C	<b>0.5 ... 100 A</b>  1 fixed measuring range per unit 0.5 ... 5 A 2.5 ... 25 A 5 ... 50 A 7.5 ... 75 A 10 ... 100 A  Max. thermal continuous current:  limited only by diameter of cable 25 mm <sup>2</sup>
	<b>5 ... 750 mA<sup>*)</sup></b>  4 part ranges settable with switch: 5 ... 50 mA 25 ... 250 mA 50 ... 500 mA 75 ... 750 mA  Max. thermal continuous current: 5 A at 50 °C		<b>0.01 ... 1.5 A</b>  4 part ranges programmable with bridges: 0.01 ... 0.1 A (Z1-Z3) 0.5 ... 0.5 A (Z1-Z2) 0.1 ... 1 A (Z1-Z4) 0.15 ... 1.5 A (Z2-Z1-Z4)  Max. thermal continuous current: 20 A at 50 °C  15 A at 60 °C			
Max. current at 50 °C		all ranges 80 A / 3 s				
Wire current path Solid Stranded ferruled	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	1 x 10 mm <sup>2</sup> 1 x 6 mm <sup>2</sup>	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>	2 x 2.5 mm <sup>2</sup> 2 x 1.5 mm <sup>2</sup>	CT-diameter = 10 mm 25 mm <sup>2</sup>
Contacts	1 changeover	1 changeover	2 changeover	2 changeover	2 changeover	2 changeover
Weight:	IK 9271: 70 g SK 9271: 90 g	IL 9271/5_ _: 125 g SL 9271/5_ _: 150 g	IL 9271: 125 g SL 9271: 150 g	approx. 230 g	IP 9271: 200 g SP 9271: 250 g	approx. 470 g

<sup>\*)</sup> Rated impulse voltage / pollution degree (auxiliary voltage - measuring circuit): 4 kV/2



## Technical Data

**Max. overload:** see table  
**Temperature influence:**  $\leq 0.05\%$  / K  
**Reaction time:** see characteristic switching delay

### Setting Ranges

**Response value:** infinite variable within measuring range  
**Hysteresis:** approx. 4% of setting value, fixed  
**Repeat accuracy:**  $\leq \pm 1\%$   
**Switching delay:** 0.1 ... 20 sec settable

### Auxiliary Circuit

**Auxiliary voltage  $U_H$ :** AC/DC 24 V, AC 220 ... 240 V  
other voltages on request

#### Voltage range

at AC: 0.8 ... 1.1  $U_H$   
at DC: 0.8 ... 1.25  $U_H$

#### Nominal consumption

at AC 230 V:  
IL/SL 9271, IP/SP 9271: 3.2 VA  
IK/SK 9271, IL/SL 9271/500: 2.3 VA  
at DC 24 V:  
IL/SL 9271, IP/SP 9271: 0.8 W  
IK/SK 9271, IL/SL 9271/500: 0.4 W  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:**  $\pm 5\%$

### Output

#### Contacts

IK 9271.11, SK 9271.11  
IL/SL 9271.11/5\_\_ : 1 changeover contact  
IL 9271.12, SL 9271.12  
SL 9271.12CT: 2 changeover contacts  
IP 9271.12, SP 9271.12  
SP 9271.12CT: 2 changeover contacts  
**Thermal current  $I_{th}$ :** 5 A  
**Switching capacity**  
to AC 15  
NO contact:  
IK 9271, IL 9271/5\_\_ : 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
IL/SL 9271, IP/SP 9271,  
SL 9271CT, SP 9271CT: 5 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical life**  
to AC 15 bei 1 A, AC 230 V  
NO contact  
IK/SK 9271, IL/SL 9271/5\_\_ : 3 x 10<sup>6</sup> switching cycles IEC/EN 60 947-5-1  
to AC 15 at 2 A, AC 230 V  
IL/SL 9271, IP/SP 9271,  
SL 9271CT, SP 9271CT: 2 x 10<sup>5</sup> switching cycles IEC/EN 60 947-5-1  
**Short-circuit strength**  
**max. fuse rating:**  
IK/SK 9271, IL/SL 9271/5\_\_ : 4 A gL IEC/EN 60 947-5-1  
IL/SL 9271, IP/SP 9271  
SL 9271CT, SP 9271CT: 10 A gL IEC/EN 60 947-5-1  
**Mechanical life:** > 50 x 10<sup>6</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

#### Temperature range

Operation: - 20 ... + 60°C

Storage: - 25 ... + 70°C

**Altitude:** < 2.000 m

#### Clearance and creepage distances

rated impulse voltage/

pollution degree:

IEC 60 664-1

	IP/SP	IK/SK IL/SL-devices/5__	IL/SL
Auxiliary voltage - Contacts	4 kV/2	4 kV/2	4 kV/2
Auxiliary voltage - Measuring circuit	6 kV/2	6 kV/2 <sup>*)</sup>	4 kV/2
Measuring circuit - Contacts	6 kV/2	6 kV/2	4 kV/2
Measuring circuit-Measuring circuit	6 kV/2	-	-
Contacts-Contacts	4 kV/2	-	4 kV/2

The contacts are not designed for voltage systems with 400 / 690 V.

<sup>\*)</sup> 4 kV/2 at IK/SK 9271 with measuring range 5 ... 750 mA  
and IK 9271.11/800

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation:

IK/SK9271, IP/SP 9271,

SL/SP 9271:

80 MHz ... 1 GHz: 20 V / m IEC/EN 61 000-4-3

1 GHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3

SL/SP 9271CT, SL9271/5:

80 MHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages between

wires for power supply

IK/SK 9271, IL/SL 9271/5\_\_ : 2 kV IEC/EN 61 000-4-5

IL/SL 9271, IP/SP 9271,  
SL/SP 9271CT: 1 kV IEC/EN 61 000-4-5

between wire and ground:  
IK/SK 9271, IL/SL 9271/5\_\_ : 4 kV IEC/EN 61 000-4-5

IL/SL 9271, IP/SP 9271,  
SL/SP 9271CT: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

#### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour

according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

**Climate resistance:** EN 50 005

**Terminal designation:** EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or

2 x 1.5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

0,6 mm<sup>2</sup>

Min. cross section:

Insulation of wires

or sleeve length: 10 mm

**Wire fixing:** Flat terminals with self-lifting

clamping piece IEC/EN 60 999-1

0.8 Nm

**Fixing torque:** 0.8 Nm

**Mounting:** DIN rail IEC/EN 60 715

### Dimensions

#### Width x height x depth

IK 9271: 17.5 x 90 x 61 mm

SK 9271: 17.5 x 90 x 100 mm

IL 9271: 35 x 90 x 61 mm

SL 9271, SL 9271CT: 35 x 90 x 100 mm

IP 9271: 70 x 90 x 61 mm

SP 9271, SP 9271CT: 70 x 90 x 100 mm

## CCC-Data

### Switching capacity

to AC 15:	5 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	2 A / DC 24 V	IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Types

IK 9271.11	AC 220 ... 240 V	50/60 Hz	0.1 ... 15 A
Article number:	0050331		
SK 9271.11	AC 220 ... 240 V	50/60 Hz	0.1 ... 15 A
Article number:	0050647		
• Single phase			
• 4 programmable ranges up to 15 A			
• energized on trip			
• Auxiliary voltage $U_H$ :	AC 220 ... 240 V		
• 1 changeover contact			
• Width:	17.5 mm		
IP 9271.12	AC 220 ... 240 V	50/60 Hz	0.5 ... 5 A
Article number:	0049961		
SP 9271.12	AC 220 ... 240 V	50/60 Hz	0.5 ... 5 A
Article number:	0050648		
• 3-phase			
• Range:	0.5 ... 5 A		
• de-energized on trip			
• Auxiliary voltage $U_H$ :	AC 220 ... 240 V		
• 2 changeover contacts			
• Width:	70 mm		

## Variants

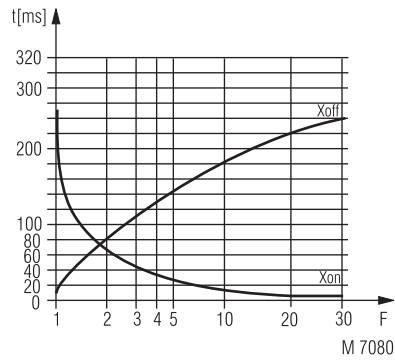
IK 9271.11/010, SK 9271.11/010:	single phase current relay energized on trip, 1 changeover contact
IK 9271.11/800:	single phase current relay energized on trip, except with 1 measuring ranges from 10 ... 100 mA, 1 changeover contact
IL 9271.12/010, SL 9271.12/010:	single phase current relay energized on trip, 2 changeover contacts
IL 9271.11/500, SL 9271.11/500:	same as IK/SK 9271.11, except with 5 measuring ranges from 0.1 ... 50 A
IL 9271.11/510, SL 9271.11/510:	same as IK/SK 9271.11/010, except with 5 measuring ranges from 0.1 ... 50 A
IP 9271.12/010, SP 9271.12/010:	3-phase current relay energized on trip, 2 changeover contacts
SL 9271.12CT:	single phase current relay with built in CT, de-energized on trip, 2 changeover contacts
SP 9271.12CT:	3-phase current relay with built in CT, de-energized on trip, 2 changeover contacts

### Ordering example for variants

SP 9271 .12 CT / \_ 0 AC 220 ... 240 V 50 / 60 Hz 5 ... 50 A

SP	Type
9271	Contacts
.12	Built in CT
CT	Variant, if required
/	1: energized on trip
_	0: de-energized on trip
0	Auxiliary voltage
AC 220 ... 240 V	Nominal frequency
50 / 60 Hz	Measuring range
5 ... 50 A	

## Characteristics



### Switching delay

The characteristic shows the switching delay depending on the values of  $X_{on}$  -  $X_{off}$  when switching the current on or off. A slow current change reduces the delay.

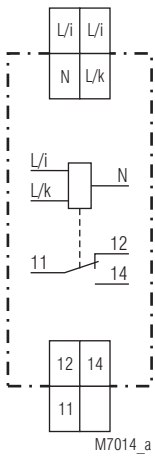
$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## VARIMETER Undercurrent Relay IK 9273, SK 9273



- According to IEC/EN 60 255
- Single phase
- Measuring ranges from 0.05 ... 10 A
- Setting value adjustable from 0.1 ... 1 A
- Fixed hysteresis approx. 4 %
- Settable switching delay
- Closed circuit operation
- Optionally open circuit operation
- Automatic reset
- Optionally manual reset, reset button on the front
- LED indication for auxiliary voltage and contact position
- 1 changeover contact
- Devices available in 2 enclosure versions:  
 IK 9273: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880  
 SK 9273: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Circuit Diagram



IK 9273.11, SK 9273.11

M7014\_a

### Approvals and Markings



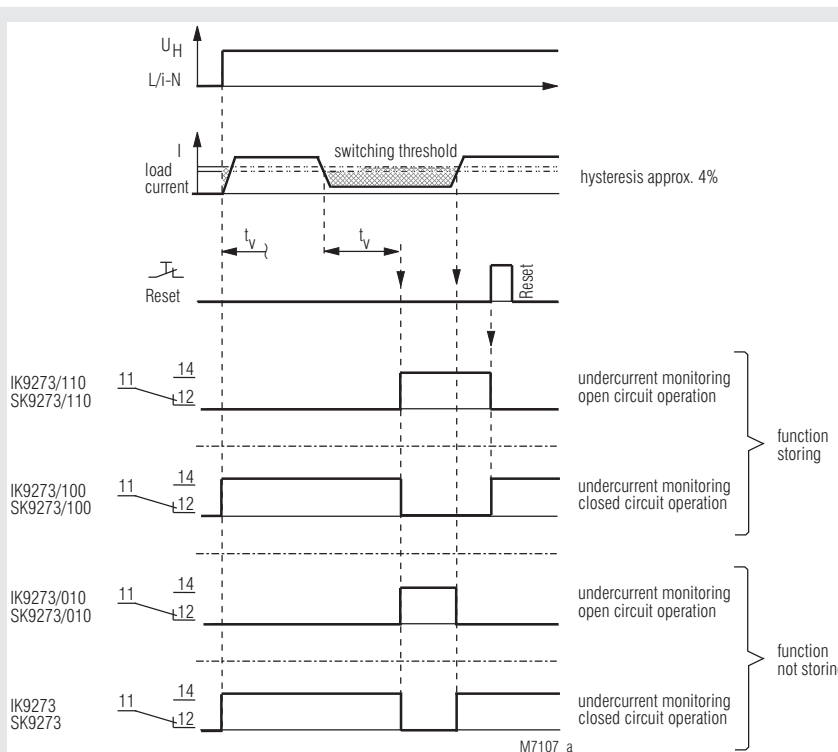
### Application

Undercurrent monitoring in AC voltage power supplies

### Indication

green LED: on when auxiliary supply connected  
 yellow LED: on when output contacts switched

### Function Diagram



M7107\_a

## Notes

Auxiliary voltage and measuring circuit are not galvanically separated. Thus they need, the same reference potential "N" if there is no external galvanic separation, e.g. through a current transformer see Application Examples.

## Technical Data

### Input

<b>Measuring ranges:</b>	AC 50 ... 500 mA AC 0.1 ... 1 A AC 0.5 ... 5 A AC 1 ... 10 A higher currents via external current transformer (2.5 VA)
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### Nominal frequency of measuring current: Maximum continuous measuring current:

at AC 50 ... 500 mA:	2.5 A, at 50°C ambient temperature
at AC 0.1 ... 1 A:	5 A, at 50°C ambient temperature
at AC 0.5 ... 5 A:	11 A, at 50°C ambient temperature
at AC 1 ... 10 A:	15 A, at 50°C ambient temperature

### Max. overload:

at AC 50 ... 500 mA:	8 A, max. 3 s
at AC 0.1 ... 1 A:	10 A, max. 3 s
at AC 0.5 ... 5 A:	20 A, max. 3 s
at AC 1 ... 10 A:	20 A, max. 3 s

### Temperature influence:

<b>Reaction time:</b>	see characteristics, switching delay
-----------------------	--------------------------------------

### Setting Ranges

<b>Response value:</b>	infinite variable within measuring range
<b>Hysteresis:</b>	approx. 0.96 of setting value, fixed approx. 4 % hysteresis
<b>Setting accuracy:</b>	≤ ± 10 % of setting value
<b>Repeat accuracy:</b>	≤ ± 1 %
<b>Switching delay tv:</b>	0.1 ... 20 s adjustable

### Auxiliary Circuit

<b>Auxiliary voltage U<sub>H</sub>:</b>	AC 115 ... 127 V, AC 220 ... 240 V
<b>Voltage range:</b>	0.8 ... 1.1 U <sub>H</sub>
<b>Nominal consumption</b> at AC 230 V:	5.5 VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	± 5 %

### Output

#### Contacts

IK 9273.11, SK 9273.11:	1 changeover contact
<b>Thermal current I<sub>th</sub>:</b>	5 A
<b>Switching capacity</b> to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V	
NO contact:	3 x 10 <sup>5</sup> switching cycles
<b>Short circuit strength</b> <b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 10 <sup>8</sup> Schaltspiele

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b> rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1

## Technical Data

### EMC

Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V/m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
HF wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	Housing: IP 40 IEC/EN 60 529
	Terminals: IP 20 IEC/EN 60 529

### Housing:

	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
	20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

### Terminal designation:

### Wire connection:

	EN 50 005
	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled
	DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
	0.8 Nm IEC/EN 60 999-1
<b>Fixing torque:</b>	
<b>Mounting:</b>	DIN rail IEC/EN 60 715

### Weight

IK 9273:	65 g
SK 9273:	84 g

### Dimensions

#### Width x height x depth

IK 9273:	17.5 x 90 x 59 mm
SK 9273:	17.5 x 90 x 98 mm

## Standard Types

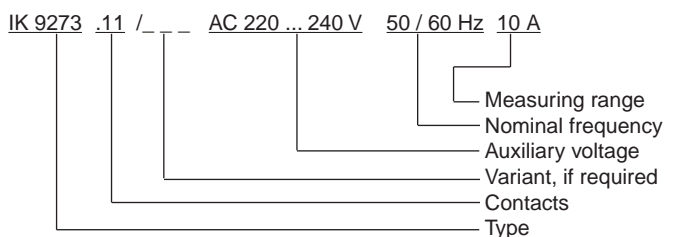
IK 9273.11 AC 220 ... 240 V	50/60 Hz	10 A
Article number:	0050544	
• Closed circuit operation		
• Output:	1 changeover contact	
• Nominal voltage U <sub>N</sub> :	AC 220 ... 240 V	
• Measuring range:	1 ... 10 A	
• Width:	17.5 mm	

SK 9273.11 AC 220 ... 240 V	50/60 Hz	10 A
Article number:	0054747	
• Closed circuit operation		
• Output:	1 changeover contact	
• Nominal voltage U <sub>N</sub> :	AC 220 ... 240 V	
• Measuring range:	1 ... 10 A	
• Width:	17.5 mm	

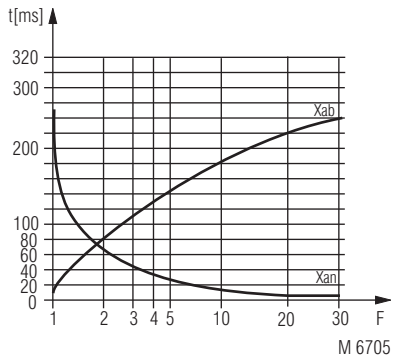
## Variants

IK 9273.11/010:	Open circuit operation
IK 9273.11/100:	Manual reset, closed circuit operation
IK 9273.11/110:	Manual reset, open circuit operation

### Ordering example for variants



## Characteristics

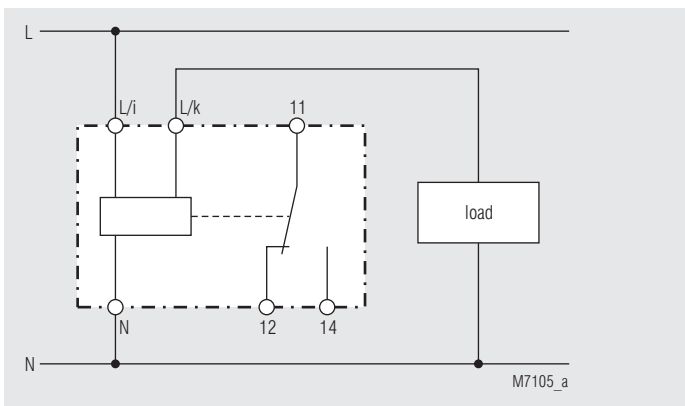


### Switching delay

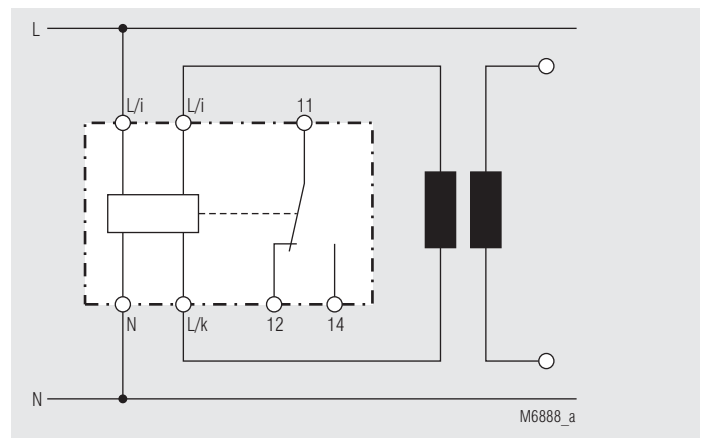
The characteristic shows the switching delay depending on the values of  $X_{an}$  -  $X_{ab}$  when switching the current on or off. A slow current change reduces the delay.

$$F = \frac{I_{\text{applied}}}{I_{\text{setting}}}$$

## Application Examples

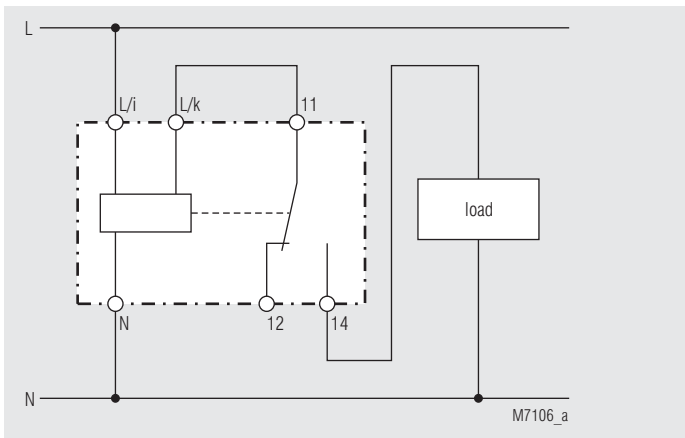


L/i - N auxiliary voltage  
L/i - L/k current input



Connection Example with external galvanic separation, e.g. by current transformer

**Attention:** On the secondary side of the current transformer is the potential L.  
L/i is allowed to be exchanged, so that the secondary side of the current transformer has the potential N.



### Connection Example for IK 9273/100 + IK 9273

Load in series to the contact. When undercurrent the load is turned on. The fault is stored. New start by pressing reset button or auxiliary voltage off, on. Maximum continuous measuring current for this application is 5 A.

## VARIMETER Current Monitor IK 8839, IL 8839

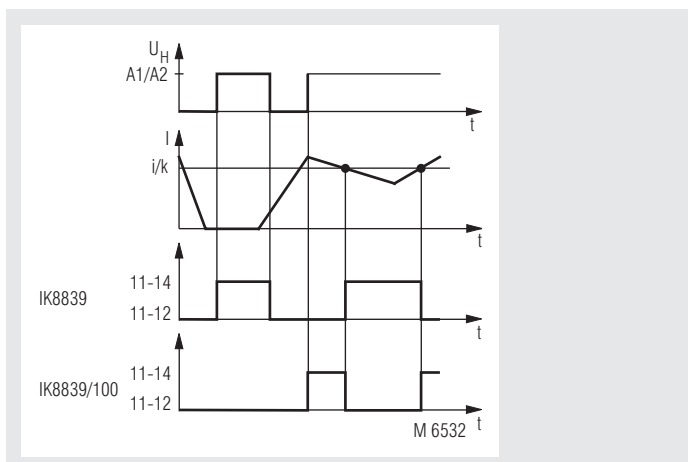


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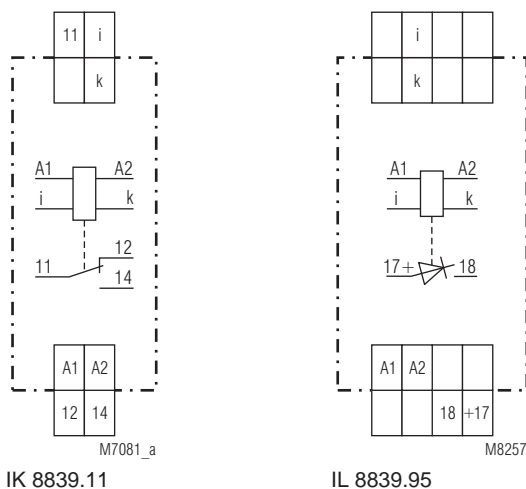


- According to IEC/EN 60 255, DIN VDE 0435-303
- Measuring range 0.175 ... 1 A
- Fixed switching point setting
- High maximum load
- As option with semiconductor output
- Width  
IK 8839: 17.5 mm  
IL 8839: 35 mm

### Function Diagram



### Circuit Diagram



### Approvals and Markings



### Application

For monitoring the operation of consumers that are primarily electrothermal in nature, e.g. heating spirals, supplementary tubular heaters. The current monitor checks whether the operating current is flowing when the consumer is switched on.

### Technical Data

#### Input

<b>Switching point, fixed:</b>	Permanent maximum load	2 s
AC 0.175 A:	AC 5 A	AC 16 A
AC 0.75 A:	AC 20 A	AC 150 A
AC 1.0 A:	AC 20 A	AC 150 A
<b>Switching tolerance:</b>	± 15 %	
<b>Frequency influence:</b>	48 ... 52 Hz / - 8 % ... + 3 %	
<b>Auxiliary voltage U<sub>H</sub>:</b>	AC/DC 24 V, AC/DC 48 V	
	AC 110 ... 127 V, AC 220 ... 230 V	
	0.8 ... 1.1 U <sub>N</sub>	

#### Voltage range:

**Nominal consumption at AC 230 V:**

apparent power:	50 / 60 Hz
active power:	2.2 VA
<b>Nominal frequency:</b>	0.5 W
<b>Nominal consumption:</b>	50 Hz
	± 5 %

#### Output

#### Contacts

IK 8839.11:	1 changeover contact
<b>Operate time:</b>	approx. 60 ms
<b>Thermal current I<sub>th</sub>:</b>	5 A

#### Switching capacity to AC 15

NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b>		IEC/EN 60 947-5-1

to AC 15 at 5 A, AC 230 V: approx. 10<sup>5</sup> switching cycles  
to AC 15 at 8 A, AC 230 V: approx. 5 x 10<sup>4</sup> switching cycles

#### Permissible switching frequency:

3000 / h

#### Short circuit strength

**max. fuse rating:**

4 AgL IEC/EN 60 947-5-1

#### Mechanical life:

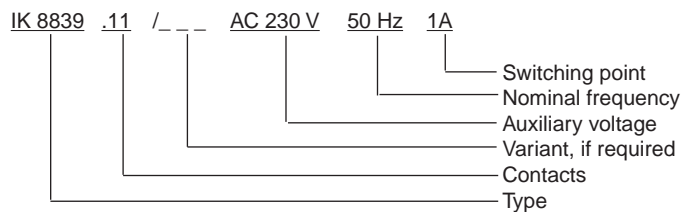
20 x 10<sup>6</sup> switching cycles

Technical Data	
<b>General Data</b>	
<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>Semiconductor Output</b>	
<b>Output</b>	
IL 8839.95:	Transistor
<b>Output voltage:</b>	DC 24 V (0 ... 30 V)
<b>Min. output voltage U<sub>ON</sub>:</b>	< 0.3 V
<b>Clearance and creepage distances</b>	
I <sub>max.</sub>	5 A
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	
between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	
Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	
Amplitude 0.35 mm IEC/EN 60 068-2-6	
Frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	
20 / 060 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	
EN 50 005	
<b>Wire connection:</b>	
2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled	
DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	
Terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Mounting:</b>	
DIN rail IEC/EN 60 715	
<b>Weight:</b>	
70 g	
<b>Dimensions</b>	
<b>Width x height x depth:</b>	17.5 x 89 x 58 mm

Standard Type	
IK 8839.11 AC 230 V 50 Hz 1 A	
Article number:	0054134 stock item
• Output:	1 changeover contact
• Auxiliary voltage U <sub>H</sub> :	AC 230 V
• Switching point:	1 A
• Width:	17.5 mm

Variants	
IK 8839.11/100:	with an inverted output
IK 8839.11/001:	with a fixed operate delay 180 ... 300 ms
IK 8839.01/150, IK 8839.05/150	with High current terminals max. 16 mm <sup>2</sup> solid max. 6 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
IK 8839.01/250, IK 8839.05/250:	with High current terminals max. 16 mm <sup>2</sup> solid max. 6 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
IK 8839.01/150:	with a fixed switching point AC 1.0 A, permanent maximum load: 40 A, 1 NO contact
IK 8839.05/150:	same as IK 8839.01/150, but with 1 NC contact
IK 8839.01/250:	same as IK 8839.01/150, but with an inverted output
IK 8839.05/250:	same as IK 8839.05/150, but with an inverted output

#### Ordering example for variants



#### Specification for Tender for IK 8839

Current monitor according to IEC/EN 60 255, DIN VDE 0435-303 to be built in consumer units. Switching point AC 0.175 A ... 5 A permanent, can be overloaded for a short time for 2 s ... 16 A. 1 changeover contact. Width 17.5 mm Type IK 8839 Manufactured by E. DOLD & SÖHNE KG

Current monitor according to IEC/EN 60 255, DIN VDE 0435-303 to be built in consumer units. Switching point AC 0.175 A ... 20 A permanent, can be overloaded for a short time for 2 s ... 150 A. 1 changeover contact. Width 17.5 mm Type IK 8839 Manufactured by E. DOLD & SÖHNE KG

Current monitor according to IEC/EN 60 255, DIN VDE 0435-303 to be built in consumer units. Switching point AC 1.0 A ... 20 A permanent, can be overloaded for a short time for 2 s ... 150 A. 1 changeover contact. Width 17.5 mm Type IK 8839 Manufactured by E. DOLD & SÖHNE KG

# Monitoring Technique

## VARIMETER

Current Asymmetry Relay with integrated current transformer up to 100 A - IP 9278, SP 9278CT

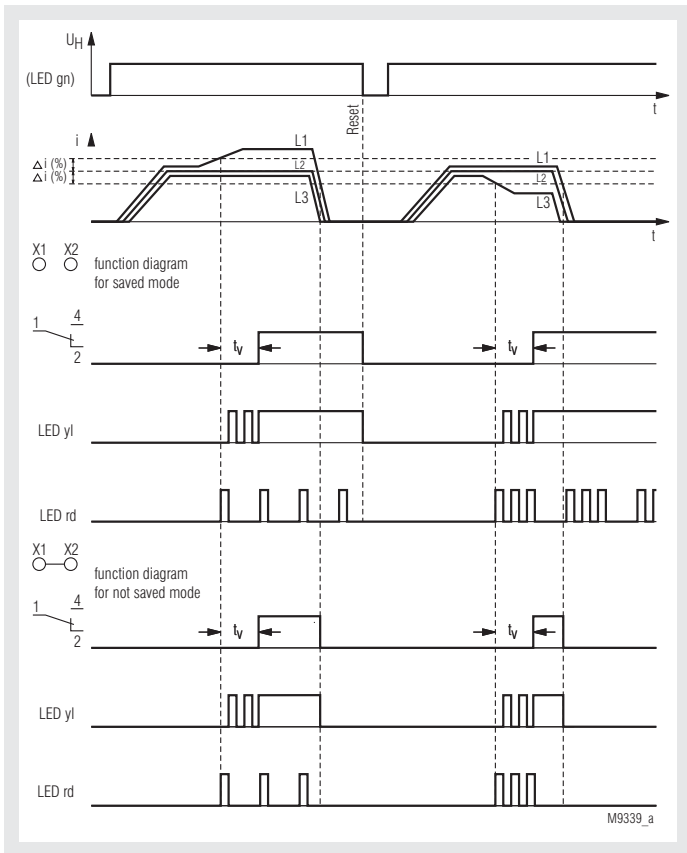


02541039



- According to IEC/EN 60 255, DIN VDE 0435-303
- IP 9278, SP 9278: 3-phase
- Measuring range IP 9278, SP 9278: up to 15 A  
SP 9278CT: up to 100 A
- 2 changeover contacts
- Adjustable asymmetry
- Settable time delay
- Open circuit operation
- LED indicators
- With auxiliary voltage
- Auxiliary supply and measuring input galvanic separated
- As option with external remote reset
- Width 70 mm

### Function Diagram



### Approvals and Markings



### Applications

Monitoring of current asymmetry in 3-phase systems e.g. monitoring of heating elements, heating and load circuits

### Indicators

- LED green: on when aux. supply connected  
 LED yellow: on when output contacts switched, flashes during timing  
 LED red: Failure code:  
 1 short pulse, followed by longer space = failure in current path i1/k1  
 2 short pulses, followed by longer space = failure in current path i2/k2  
 3 short pulses, followed by longer space = failure in current path i3/k3  
 4 short pulses, followed by longer space = current is out of operating range

### Function

The IP 9278 monitors 3 currents (phases) on asymmetry. Within the operating range the device searches continuously for the 2 currents with the smallest current difference in %. The currents in these 2 paths are the reference for the asymmetry calculation of the third current path. The asymmetry is adjustable within 10 ... 40%.

If asymmetry is detected, the fault is indicated after an adjustable time delay  $t_v$  by 2 changeover contacts. Without bridge the fault is stored, with bridge it auto resets.

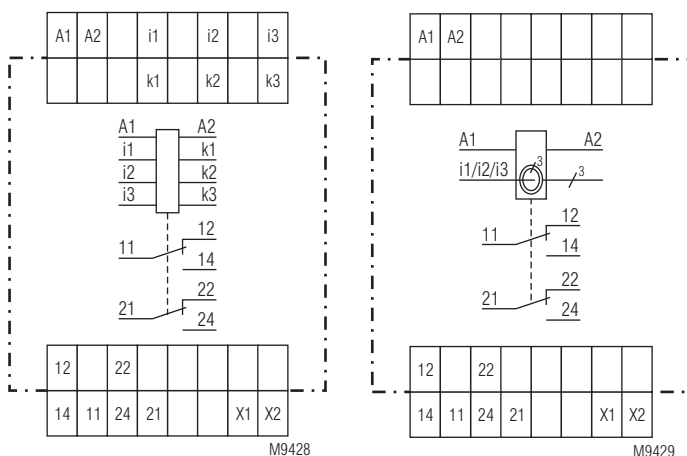
The flashing code on the red LED indicates in which current path the failure occurred.

The reset is made by disconnecting the auxiliary voltage. On request the unit is also available with remote reset.

### Notes

For small currents at the bottom end of the operating range it is recommended to adjust the asymmetry value slightly higher to reduce the response sensitivity.

### Circuit Diagrams



IP 9278.12

SP 9278.12CT



## Technical Data

### Input

#### Measuring Ranges

	IP 9278	SP 9278CT
Measuring range:	1 ... 15 A	4 ... 50 A 8 ... 100 A other ranges on request
Operating range (asymmetry ± 10 %):	0.9 ... 16.5 A	3.5 ... 55 A 9 ... 110 A
Asymmetry ± 20 %:	1.2 ... 13.7 A	4.5 ... 45 A 9 ... 90 A
Asymmetry ± 40 %:	1.5 ... 11.5 A	6 ... 39 A 12 ... 78 A

When the current falls below or rises above the operating range a fault is indicated by the output relay and the red LED gives the flash code 4 (Out of range).

The current transformers are mounted in the base of the SP 9278, the wires are lead through the CTs (no terminals).

#### Measuring Circuit

Frequency range of measuring current:	50 ... 400 Hz
Max. permitted continuous current of the current paths	
IP 9278:	20 A at 45°C ambient temperature 15 A bei 50°C ambient temperature
SP 9278CT:	100 A
Temperature influence:	≤ 0.05 % / K
Reaction time:	approx. 500 ms

#### Setting Ranges

Response value of asymmetry:	adjustable within the operating range 10 ... 40 % compared to the mean value of the 2 current paths with the lowest difference.
Repeat accuracy:	≤ ± 1 %
Time delay $t_d$ :	0.1 ... 20 s settable (logarithmic scale)

#### Auxiliary Circuit

Auxiliary voltage $U_H$ :	AC/DC 24 V, AC 220 ... 240 V others on request
Voltage range	
at AC:	0.8 ... 1.1 $U_H$
at DC:	0.8 ... 1.25 $U_H$
Nominal consumption	
at AC 230 V:	3.2 VA
at DC 24 V:	1 W
Nominal frequency:	50 / 60 Hz
Frequency range:	± 5 %

#### Output

Contacts	
IP 9278.12, SP 9278.12CT:	2 changeover contacts
Thermal current $I_{th}$ :	5 A
Switching capacity	
to AC 15	
NO contact:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
Electrical life	
to AC 15 at 1 A, AC 230 V	
NO contact:	2 x 10 <sup>6</sup> switch. cycl. IEC/EN 60 947-5-1
Short-circuit strength	
max. fuse rating:	10 A gL IEC/EN 60 947-5-1
Mechanical life:	> 50 x 10 <sup>6</sup> switching cycles

## Technical Data

### General Data

Operating mode:	Continuous operation
Temperature range:	- 20 ... + 60°C
Clearance and creepage distances	
rated rated impulse voltage voltage/	
pollution degree:	IEC 60 664-1
Supply - contacts:	4 kV/2
Supply - Measuring circuit:	6 kV/2
Measuring circuit - contacts:	6 kV/2
Measuring circuit -	
Measuring circuit -	6 kV/2
The contacts are not designed for voltage systems with 400 / 690 V	
EMC	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
Degree of protection	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
Housing:	Thermoplastic with V0 behaviour according to UL subject 94
Vibration resistance:	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1
Climate resistance:	
Terminal designation:	EN 50 005
Wire connection:	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4

Current path i/k	
on SP 9278CT:	3 x 25 mm <sup>2</sup> with insulation max. 10 mm Ø DIN 46 228-1/-2/-3/-4
Wire fixing:	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 DIN rail IEC/EN 60 715
Mounting:	
Weight	
IP 9278:	200 g
SP 9278CT:	300 g

#### Dimensions

Width x height x depth	
IP 9278:	70 x 90 x 61 mm
SP 9278CT:	70 x 90 x 100 mm

#### Standard Type

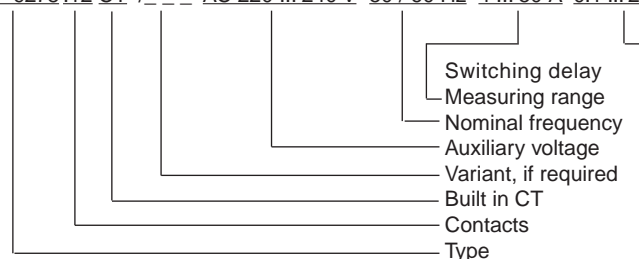
IP 9278.12 AC/DC 24 V	1 ... 15 A	0.1 ... 20 s
Article number:	0057915	
• Measuring range:	1 ... 15 A	
• 2 changover contacts		
• Auxiliary voltage $U_H$ :	AC/DC 24 V	
• Time delay:	0.1 ... 20 s	

#### Variants

IP 9278.12/100:	Variant with external remote reset control voltage on terminals X1-X2 AC/DC 10 ... 265 V for reset
-----------------	--

#### Ordering example for variants

SP 9278.12 CT / \_ \_ \_ AC 220 ... 240 V 50 / 60 Hz 4 ... 50 A 0.1 ... 20 s



## VARIMETER

Motor Load Monitor  
MK 9397N, MH 9397



MK 9397N

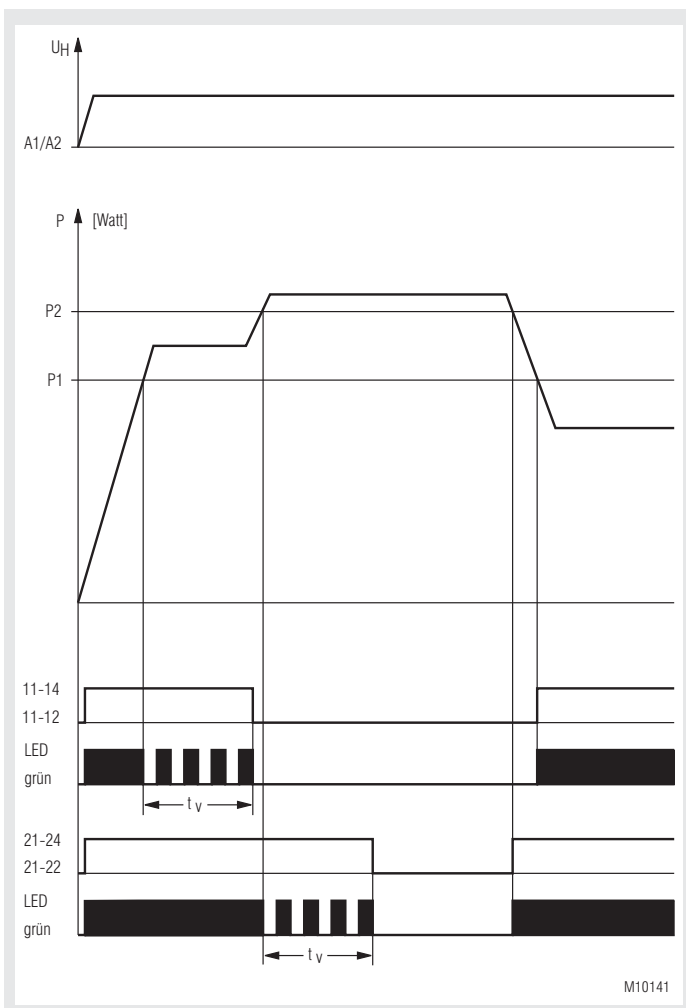
MH 9397

### Product description

The Load monitor MK9397 and MH9397 of the varimeter family monitor reliably the load of motors as well as the function of 3 phase electrical users.

If the measured value falls under or goes over the adjusted settings the corresponding output relay is energised. To avoid unnecessary tripping a response delay  $t_v$  can be adjusted between 0 and 10 s. LEDs show the status of the output relays.

### Function Diagram



M10141

### Your Advantage

- Preventive maintenance
- For a evaluate time
- Quicker fault locating
- Precise and reliable
- Overload detection, as option also with prewarning
- Can also be used for underload monitoring
- Simple adjustment and fault diagnostics
- Space and cost saving

### Features

- According to EN 60255-1
- Active power measuring
- Relay output
- MK 9397N: 1 changeover contact
- MH 9397: 1 changeover contact each for overload and prewarning
- On delay
- Closed circuit operation
- As option open circuit operation
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- MK 9397N: Width 22,5 mm
- MH 9397: Width 45 mm

### Approvals and Markings



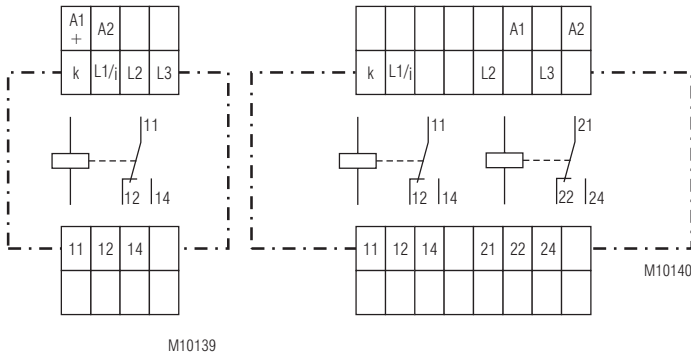
### Application

The load monitor is suitable to monitor industrial motors with variable load as well as to monitor the correct function of electrical users. The units can detect in time wearing or failures on machines and tools. So maintenance can be carried out before a plant stops.

### Function

The load monitor monitors the effective power of electrical consumers. As the current is only measured in one phase a symmetric load in a 3 phases is assumed. as it is usual with motors. The setting value is adjusted with potentiometers, the range selection by rotational switches. The MH 9397 has 2 response values (e.g. for prewarning).

## Circuit Diagrams



MK 9397N

MH 9397

## Connection Terminals

Terminal designation	Signal designation
A1 / A2	Auxiliary voltage
K / L1/i	Current path (current at phase L1)
L1 / L2 / L3	Supply
11 / 12 / 14	Contacts relay 1
21 / 22 / 24	Contacts relay 2 (only at MH 9397)

## Connection notes

The unit can also be used on single phase loads. the terminals L2 and L3 have to be bridged in this case. The device also switches at the set points in the case of reverse power. Overload in the current path is indicated by fast flashing of the LEDs.

## Geräteanschluss

The connection has to be done according to the connection diagrams. To connect the motor current of L1 the terminals i and k are used.. For current exceeding the limits of the device an additional current transformer has to be used.

## Setting

2 rotational switches for P<sub>1</sub>

rotary switch 1:

rotary switch 2:

fine adjustment

8 ranges adjustable:

0 ... 1 kW

1 ... 2 kW

2 ... 3 kW

⋮

7 ... 8 kW

2 rotational switches for P<sub>2</sub>

rotary switch 3:

rotary switch 4:

fine adjustment

8 ranges adjustable:

0 ... 1 kW

1 ... 2 kW

2 ... 3 kW

⋮

7 ... 8 kW

rotary switch t<sub>v</sub>:

0 ... 10 s

## Example

Response value: 5.2 kW

fine adjustment

(upper rotary switch):

0,2 kW



## Bereichswahl

(lower rotary switch):

5 ... 6 kW



## Indication

The LED indicate the state.

green LED, UN: on, when auxiliary voltage present

green LED, P1: flashes: during time delay  
permanently on: Relay 1 active

(only at MH 9397)

green LED, P2: flashes: during time delay  
permanently on: Relais 2 active

Overload within the current range is indicated by fast flashing of the LED.

**Technical Data****Auxiliary Voltage A1 / A2****Nominal auxiliary voltage  $U_H$ :**

MK 9397N: DC 24 V (0.9 ... 1.1 x  $U_H$ )  
 MH 9397: AC 230V (0.8 ... 1.1 x  $U_H$ )

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** 45 ... 400 Hz

**Input current:**

at DC 24V: 50 mA

at AC 230V: 15 mA

**Voltage Measuring Input L1 / L2 / L3**

**Nominal voltage  $U_N$ :** 3 AC 400 V

**Measuring range:** 3 AC 12 ... 400 V

Variants without auxiliary supply get their power from the measuring input. The Voltage range of the Measuring voltage is then identical with the range of the auxiliary supply.

**Current Measuring Input i / k**

**Nominal current  $I_N$ :** AC 12 A

**Measuring range:** AC 100 mA ... 12 A

**Max. overload**

continuously: 16 A

short time < 10 s: max. 25 A

Overload within the current range is indicated by fast flashing of the LED.

**Nominal frequency:** 50 / 60 Hz

**Frequency range:** 45 ... 400 Hz

**Setting range (at absolute scale)**

**Rel 1:** fine adjustment

**Range:** 8 ranges 0 ... 8 kW

**Rel 2:** fine adjustment

**Range:** 8 ranges 0 ... 8 kW

**Measuring accuracy**

**at nominal frequency**  
(in % of setting value):  $\pm 4\%$

**Hysteresis**  
(in % of setting value): < 5 %

**Reaction time:** < 150 ms

**Time delay  $t_d$ :** 0 ... 10 s adjustable

**Start up delay:** 500 ms fixed

**Output Circuit (Rel1: 11/12/14; Rel2: 21/22/24)****Contacts**

MK 9397N: 1 changeover contact for P1

MH 9397: 1 changeover contact for P1 and

1 changeover contact for P2

**Thermal current  $I_{th}$ :** 2 x 4 A

**Switching capacity**

to AC 15:

NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life**

to AC 15 at 3 A, AC 230 V: 2 x 10<sup>5</sup> switch. cycl. IEC/EN 60 947-5-1

**Permissible switching**

**frequency:** 1800 switching cycles / h

**Short circuit strength**

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** 30 x 10<sup>6</sup> switching cycles

**Technical Data****General Data**

**Nominal operating mode:** continuous operation

**Temperature range:** - 20 ... + 60°C

**Clearance and creepage distance**

**rated impulse voltage /**

**pollution degree:** 4 kV / 2

**high voltage test:** IEC/EN 60 664-1

**EMC**

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF irradiation: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class A EN 55 011

**Degree of protection:**

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** thermoplastic with VO behaviour

according to UL Subject 94

Amplitude 0,35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

**Wire connection** DIN 46 228-1/-2/-3/-4

**Screw terminal****(fixed):**

1 x 4 mm<sup>2</sup> solid or

1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated) or

2 x 1.5 mm<sup>2</sup> stranded ferruled (isolated) or

2 x 2.5 mm<sup>2</sup> solid

Insulation of wires or

sleeve length: 8 mm

**Terminal block****with screw terminals**

Max. cross section: 1 x 2.5 mm<sup>2</sup> solid or

1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated)

Insulation of wires or

sleeve length: 8 mm

**Terminal block****with cage clamp terminals**

Max. cross section: 1 x 4 mm<sup>2</sup> solid or

1 x 2.5 mm<sup>2</sup> stranded ferruled (isolated)

Min. cross section: 0.5 mm<sup>2</sup>

Insulation of wires or

sleeve length: 12  $\pm 0.5$  mm

**Wire fixing:** Plus-minus terminal screws M3,5 box

terminals with wire protection

or cage clamp terminals

0.8 Nm

**Fixing torque:** DIN rail IEC/EN 60 715

**Mounting:**

**Weight:** 360 g

**Dimensions**

**Width x height x depth:**

MK 9397N: 22.5 x 90 x 99 mm

MH 9397: 45 x 90 x 99 mm

## Standard Types

MK 9397N.11/010 3 AC 24 ... 400 V AC 12 A DC 24 V 10 s

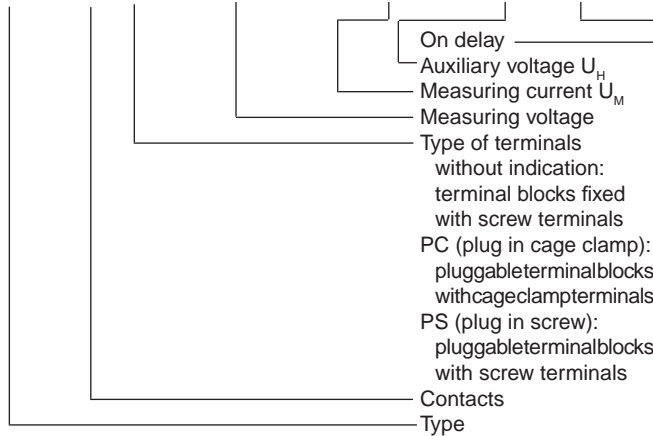
- Article number: 0062043
- Measuring voltage: 3 AC 24 ... 400 V
  - Measuring current: AC 12 A
  - Auxiliary voltage  $U_H$ : DC 24 V
  - On delay: up to 10 s
  - Output: 1 changeover contact
  - Width: 22,5 mm

MH 9397.12/010 3 AC 24 ... 400 V AC 12 A AC 230 V 10 s

- Article number: 0062046
- Measuring voltage: 3 AC 24 ... 400 V
  - Measuring current: AC 12 A
  - Auxiliary voltage  $U_H$ : AC 230 V
  - On delay: up to 10 s
  - Output: 1 changeover contact (Rel1) and 1 changeover contact (Rel2)
  - Width: 45 mm

## Ordering Example

MK 9397N .11 /010 3 AC 24... 400 V AC 12 A DC 24 V 10 s



## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)

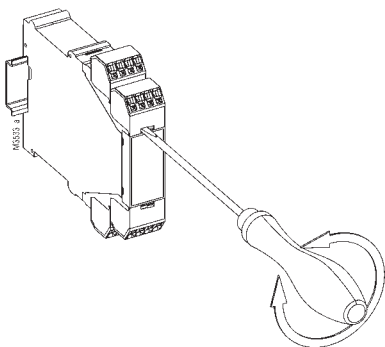


Cage clamp terminal  
(PC/plugin cage clamp)

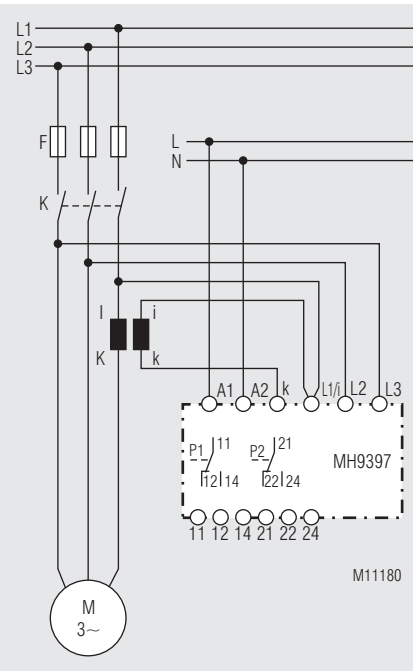
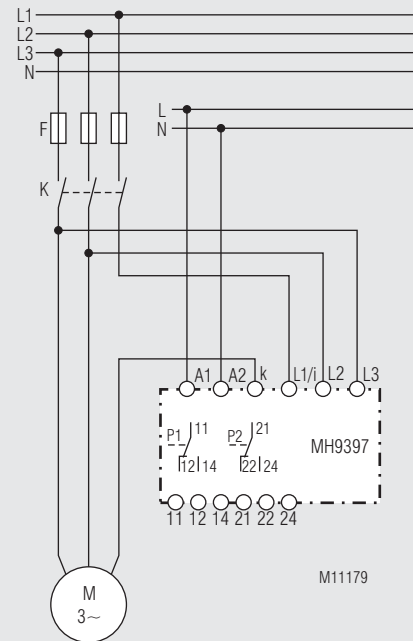
## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Connection Example



## Remark:

When using external current transformers the setting values have to be multiplied with the transmission ratio  $\ddot{u}$  of the current transformer.

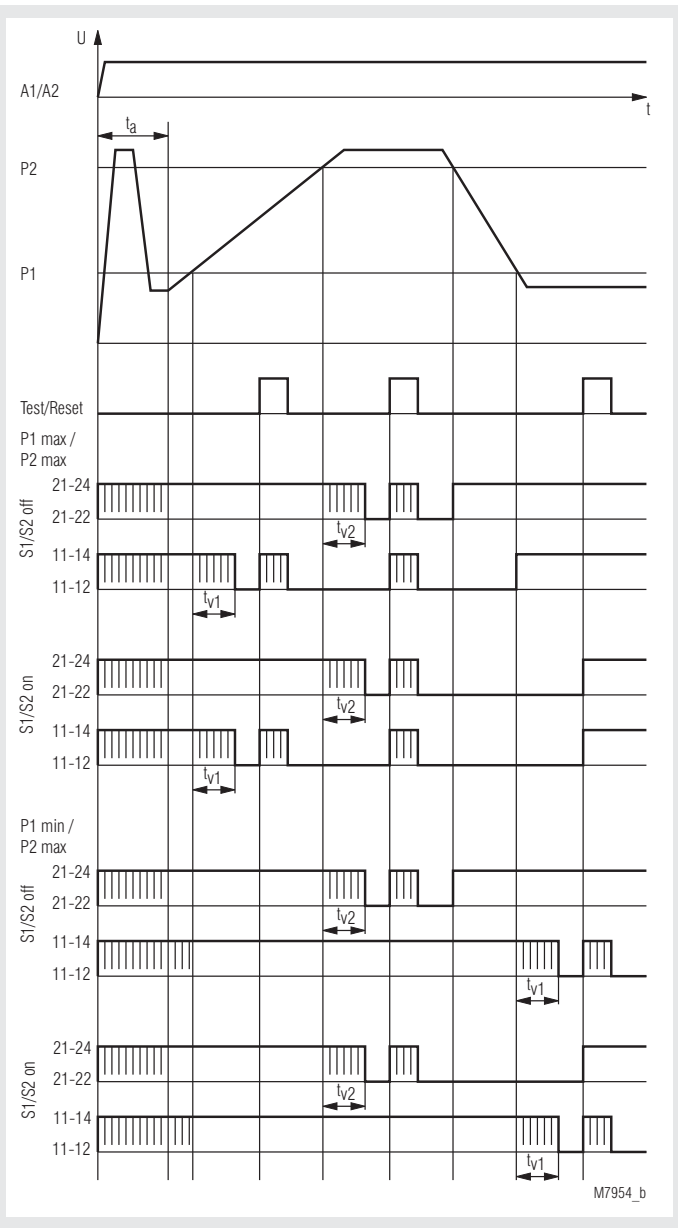
Example: response value = setting value (P1/P2) x  $\ddot{u}$

## VARIMETER Motor Load Monitor BH 9097



- According to IEC/EN 60255-1, IEC/EN 60255-26, DIN/VDE 0435-303
- Identification of
  - Underload  $P_1$  and Overload  $P_2$
  - Overload  $P_1$  (prewarning) and Overload  $P_2$  programmable
- Adjustment of  $P_1$  and  $P_2$  on absolute scale
- For motors up to 22 kW / 400 V; 37 kW / 600 V
- Measurement: effective power
- Large current range because of automatic range selection
- 1 changeover contact for  $P_1$  and 1 changeover contact for  $P_2$
- Adjustable start-up delay  $t_a$
- Adjustable switching delay  $t_v$
- With automatic or manual reset, programmable
- Test / Reset button for easy setup
- Up to 40 A without external current transformer
- De-energized or energized on fault, programmable
- Also for single-phase operation
- LED indicators
- Width 45 mm

### Function Diagram for Setting De-energized on Fault\*)



**P1max/P2max:** Overload monitoring with prewarning  
**P1min/P2max:** Under- and overload monitoring  
**S1/S2 ON:** manual reset  
**S1/S2 OFF:** automatic reset  
**IIIII:** corresponding LED is flashing

\*) when set to energized on fault the function of LEDs and output relays are inverted.

### Approvals and Markings



\* see variants

### Applications

The BH 9097 is used to monitor variable loads on industrial motors.

### Function

The motor load monitor BH 9097 checks the active power consumption of electrical consumers. As the measuring principle is only single phase correct measurement of 3-phase load is only possible when all three phases have the same load which is normal with motors. Using DIP-switches the unit can be set up to act as under- and overload relay  $P_{1min}/P_{2max}$  or as overload relay with pre-warning  $P_{1max}/P_{2max}$ . The settings of  $P_1$  and  $P_2$  are absolute values and calibrated in Watts adjustable via rotational switches. 2 LEDs show the state of the corresponding output relays. The unit can be configured to energise or to de-energise on fault. Every output relay is fitted with it's own time delay  $t_v$ . A start-up delay  $t_a$  acts on both outputs.

### Indication

green LED, $U_N$ :	flashing:	during Start-up delay $t_a$
	continuous:	supply connected
yellow LED, $P_1$ :	flashing:	during time delay $t_{v1}$ and for set up assistance
	continuous:	when relay $P_1$ active (contact 11-14)
yellow LED, $P_2$ :	flashing:	during time delay $t_{v2}$ and for set up assistance
	continuous:	when relay $P_2$ active (contact 21-24)

### Fault indication

2 different faults are displayed with the LEDs.

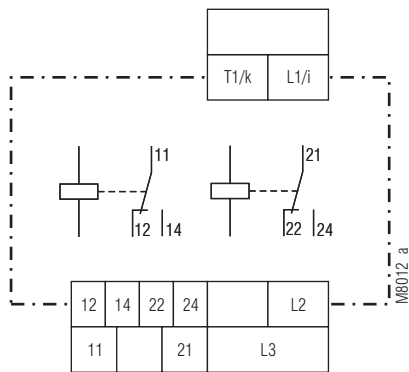
#### 1.) No measurement:

Without measuring voltage measurement is not possible  
 - All 3 LEDs flash in sequence one after the other.  
 The output contacts are in failure state.

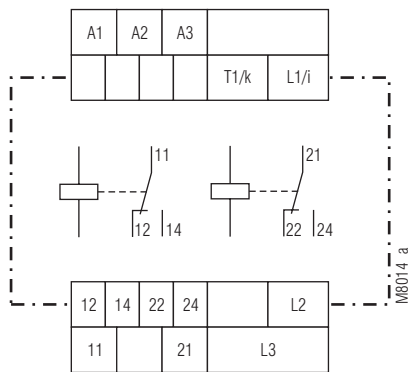
#### 2.) The BH 9097 measures negative load:

Possible reason: The unit measures reverse power or the current connections are connected wrong.  
 - All 3 LEDs flash simultaneously.

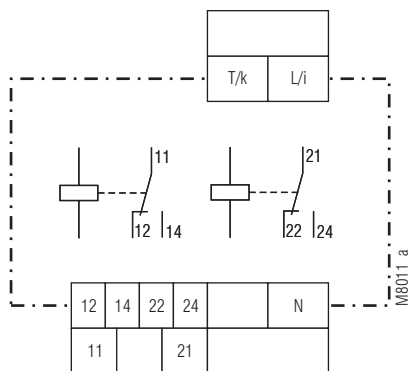
## Connection Diagrams



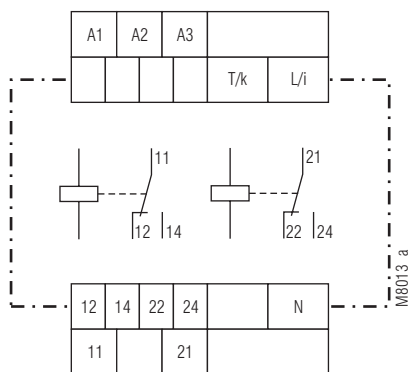
BH 9097.38/001



BH 9097.38/011



BH 9097.38



BH 9097.38/010

## Technical Data

### Input

#### Measuring voltage

Voltage range: without auxiliary voltage  $0.8 \dots 1.1 \times U_N$   
with auxiliary voltage, see setting ranges  
300 k $\Omega$  ... 500 k $\Omega$

#### Input resistance:

#### Measuring current

Measuring range: see setting ranges

Nominal current [A]	40	24	8	2.4	0.8	0.24
Permissible current range (overload) [A]						
continuously:	0 ... 40	0 ... 40	0 ... 16	0 ... 8	0 ... 2,4	0 ... 1
1 min. (10 min. break):	150	150	20	16	3	1,5
20 s (10 min. break):	200	200	25	20	4	2
Input res. of current on i-k [m $\Omega$ ]:	$\leq 1$	$\leq 1$	7	14	830	830

#### Frequency range:

10 ... 400 Hz  
(please see characteristics M7953)

### Setting Ranges

#### P<sub>1</sub> und P<sub>2</sub> on absolute scale

Switch

load range

for P<sub>1</sub> and P<sub>2</sub>:

lower range

upper range

Measuring accuracy (in % of setting value):

$\pm 4 \%$  (2 % on request)

Hysteresis

(in % of setting value):

< 5 %

Harmonic distortion

< 40 %

Reaction time:

< 50 ms

Switching delay  $t_{v1}/t_{v2}$ :

0 ... 10 s (infinite variable)

Start-up delay  $t_a$ :

0 ... 30 s (infinite variable)

### Setting Ranges

Available variants	Measuring voltage $U_N$	Measuring current $I_N$ [A]	selection of load range
<b>1-phase</b>			
without auxiliary voltage			
BH 9097.38/000	AC 230 V	0.0024 ... 0.24	0.1 ... 60 W
	AC 230 V	0.024 ... 2.4	1 ... 600 W
	AC 230 V	0.24 ... 24	10 ... 6000 W
with auxiliary voltage			
BH 9097.38/010	AC 35...250 V	0.0024 ... 0,24	0.1 ... 60 W
	AC 35...250 V	0.024 ... 2,4	1 ... 600 W
	AC 35...250 V	0.24 ... 24	10 ... 6000 W
<b>3-phase</b>			
without auxiliary voltage			
BH 9097.38/001	3 AC 400 V	0.008 ... 0,8	0.1 ... 60 W
	3 AC 400 V	0.08 ... 8	10 ... 6000 W
	3 AC 400 V	0.4 ... 40	0.1 ... 30 kW
with auxiliary voltage			
BH 9097.38/011	3 AC 60 ... 440 V	0.008 ... 0,8	1 ... 600 W
	3 AC 60 ... 440 V	0.08 ... 8	10 ... 6000 W
	3 AC 100 ... 760 V	0.4 ... 40	0.1 ... 52 kW

### Auxiliary Circuit

#### Auxiliary voltage $U_H$

only for BH 9097.38/010,

BH 9097.38/011:

AC 110 V (Klemmen A 1 - A 2),  
AC 230 V (Klemmen A 1 - A 3),  
DC 24 V

Voltage range:

$0.8 \dots 1.1 U_H$

Frequency range of  $U_H$ :

45 ... 400 Hz

#### Input current

AC 110 V:

approx. 30 mA

AC 230 V:

approx. 15 mA

DC 24 V:

approx.. 50 mA

## Technical Data

### Output

**Contacts:** 1 changeover contact for P1  
1 changeover contact for P2  
2 x 5 A

### Thermal current $I_{th}$ : Switching capacity to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 3 A, AC 230 V: 2 x 10<sup>6</sup> switching cycles IEC/EN 60 947-5-1

### Permissible switching frequency:

1800 switching cycles / h

### Short circuit strength

max. fuse rating: 4 A gl IEC/EN 60 947-5-1

### Mechanical life:

30 x 10<sup>6</sup> switching cycles

## General Data

### Operating mode:

continuous

### Temperature range:

- 20 ... + 55°C

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

### Surge voltages

between wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94

Amplitude 0,35 mm

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 055 / 04 IEC/EN 60 068-1

EN 50 005

### Wire connection

Load terminals: 1 x 10 mm<sup>2</sup> solid or 1 x 6 mm<sup>2</sup> stranded wire with sleeve

Control terminals: 1 x 4 mm<sup>2</sup> solid or 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve

or 1 x 2,5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4

Box terminals with self-lifting wire protection and Plus-minus terminal screws M3.5

DIN rail IEC/EN 60 715

Weight: 430 g

### Dimensions

### Width x height x depth:

45 x 84 x 121 mm

## CCC-Data

**Thermal current  $I_{th}$ :** 4 A

### Switching capacity

to AC 15: 3 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

BH 9097.38/001 3 AC 400 V 50 / 60 Hz  $t_a$  30 s  $t_r$  10 s

Article number: 0053944

• 3-phase, without auxiliary supply

• Output: 1 changeover contact for P1 and 1 changeover contact for P2

• Nominal voltage  $U_N$ : 3 AC 400 V

• Width: 45 mm

## Variants

BH 9097:

with CCC-approval on request

BH 9097.38/001: 3-phase without auxiliary supply

BH 9097.38/011: 3-phase with auxiliary supply

BH 9097.38/000: 1-phase without auxiliary supply

BH 9097.38/010: 1-phase with auxiliary supply

BH 9097.38/1\_\_ : With galvanically separated current path.

For applications with current transformers

grounded on the secondary side,

current range limited to 25 A

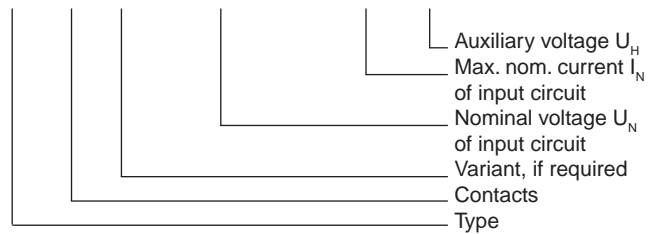
same as BH 9097.38/001, but with

start up delay  $t_a = 0 \dots 10$  s

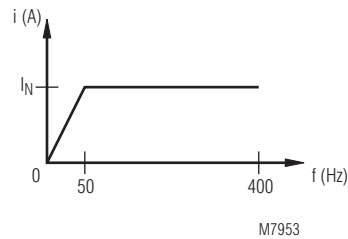
BH 9097.38/801:

## Ordering example for variants

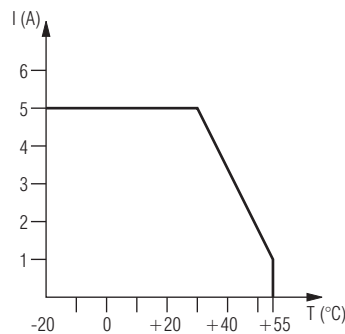
BH 9097 .38 / \_ \_ \_ 3 AC 100...760 V AC 40 A AC 230/110 V



## Characteristics



Max. input current curve in relation to input frequency



continuous current limit curve  
(current over 2 contacts)

M8367



## Settings

2 rotational switches for P<sub>1</sub>: Value P<sub>1</sub> (2 decades)  
 2 rotational switches for P<sub>2</sub>: Value P<sub>2</sub> (2 decades)  
 Potentiometer t<sub>v1</sub>: time delay for value P<sub>1</sub>  
 Potentiometer t<sub>v2</sub>: time delay for value P<sub>2</sub>  
 Potentiometer t<sub>a</sub>: start-up delay after connection voltage  
 Test/Reset-Taste: Test function as setting assistance  
 Reset function when manual reset is selected

Dip-switches:



x10 | x1  
 A | R

selection of upper / lower load range  
 selection of closed or open circuit  
 operation for output relays

P<sub>2</sub> max. | P<sub>2</sub> max.  
 P<sub>1</sub> max. | P<sub>1</sub> min.

2 MAX switching values (Overload with  
 Pre-warning) or MAX and MIN switching  
 value (Overload / Underload monitoring)

S1 ON | OFF:

manual / automatic reset for P<sub>1</sub>

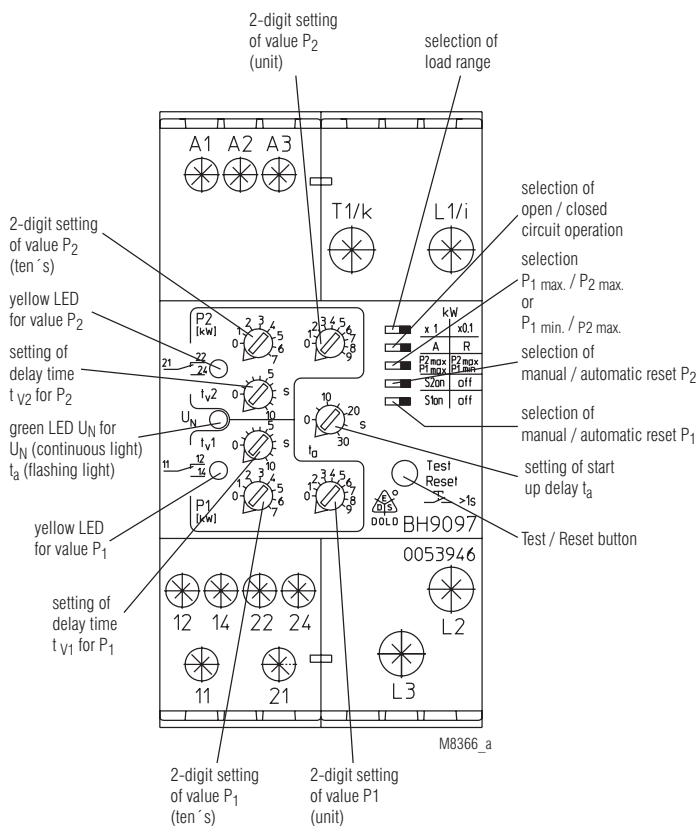
S2 ON | OFF:

manual / automatic reset for P<sub>2</sub>

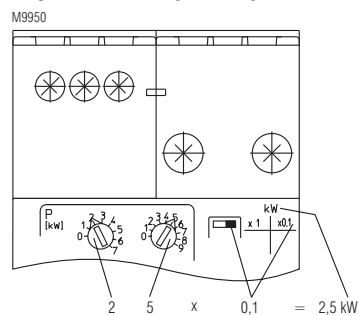
## Connection

The device has to be connected according to the connection diagrams. The motor is connected to terminals L/i and T/k or L1/i and T1/k. The flow direction of the current has to be observed. On reverse power the unit gives a fault signal. The max continuous motor current is 40 A limited by the terminals. With higher currents a current transformer with 2,5 VA has to be used.

## Set-up Procedure and Setting Instructions



## Adjustment example: response value: 2,5 kW



Response value = 25 x 0,1 = 2,5 kW

The adjustment of the unit can be made without additional measuring equipment and calculations. Please make sure that the load values are in the permitted operating range of the unit. Based on the max permitted values the BH 9097 can be used for 48 kW 3-phase motors at 3 AC 690 V and 5.8 kW single phase motors at AC 230 V.

There are three methods to set up the unit:

### Method 1:

If the absolute values of the actual required tripping points P<sub>1</sub> and P<sub>2</sub> are known, they can be set directly on the unit (2-digit setting of P<sub>1</sub> and P<sub>2</sub>).

### Method 2:

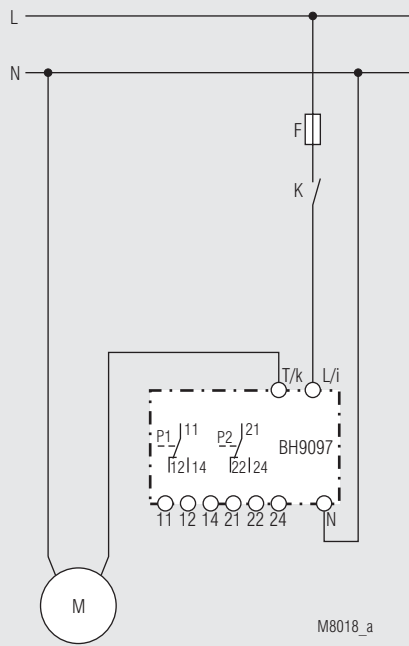
This method is recommended when it is possible to simulate the different load situations during set-up. In this case nothing has to be calculated. Turn the delay time for P<sub>1</sub> and P<sub>2</sub> to min. The motor runs in underload while the Pot 1 is turned until the output relay switches. The same has to be done for overload. Now the unit is set accurately. Now adjust the operate delay and the start-up delay to the required values.

Pressing the test / reset button during setup disables the switching of the output relays. The LEDs of P<sub>1</sub> and P<sub>2</sub> flash.

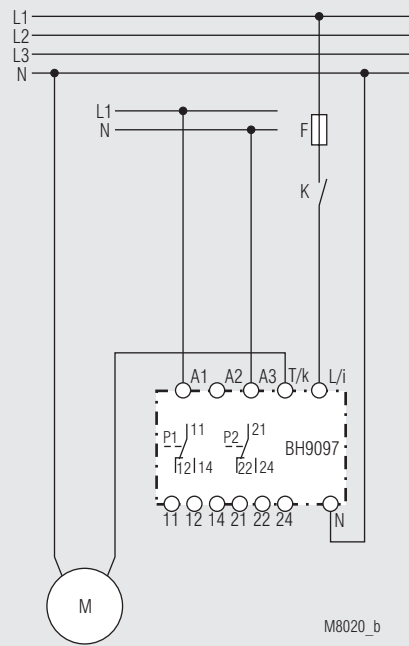
### Method 3:

This method is the most simple one but not the most accurate. The operate delay is set to min. The motor is switched on and runs on nominal load. With both potentiometers the set points are searched by slowly turning the max. Pot from high to low value and the min. Pot from low to high value until the corresponding output relays switch. After that turn the Pot P<sub>2</sub> to the right (e.g. + 10 %) side and the Pot P<sub>1</sub> to the left (e.g. - 10 %) until the output relays reset. The unit is now set and responds if the load differs from the nominal value. Finally set the operate delay and start-up delay to the required values. The DIP switch should be set to P<sub>1</sub> min / P<sub>2</sub> max.

single phase

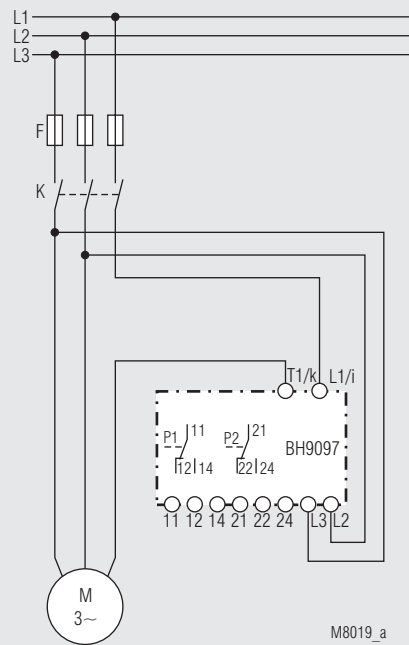


BH 9097.38

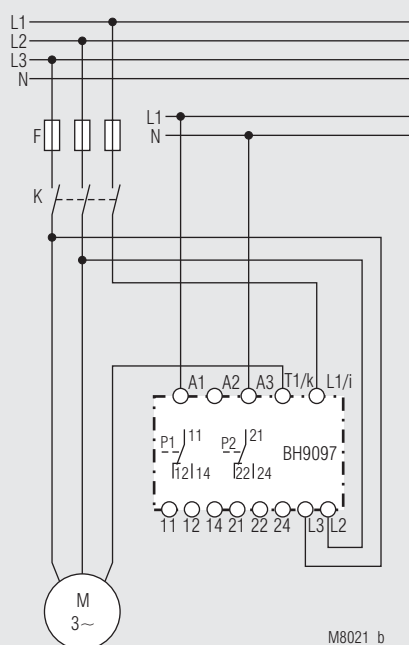


BH 9097.38/010

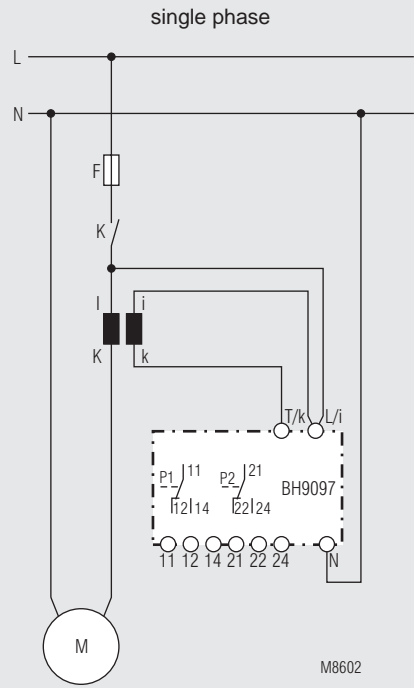
3-phase



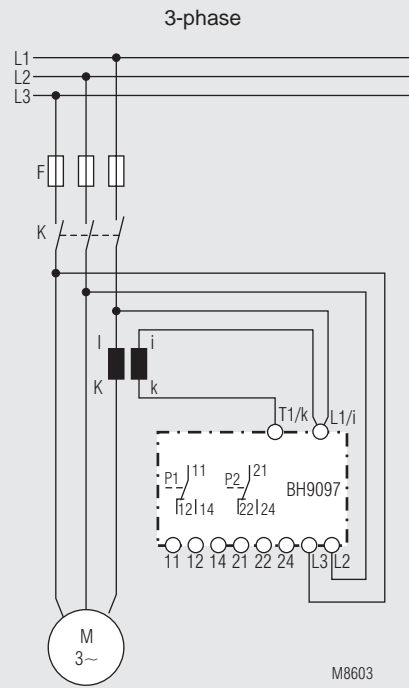
BH 9097.38/001



BH 9097.38/011



BH 9097.38



BH 9097.38/001

**Note:** When using external CTs the adjusted value has to be multiplied with the transmission ratio ( $\ddot{u}$ ) of the CT.  
**Example:** Switching value = Setting value (P1/P2) x  $\ddot{u}$

## VARIMETER

Motor Load Transmitter  
BH 9098



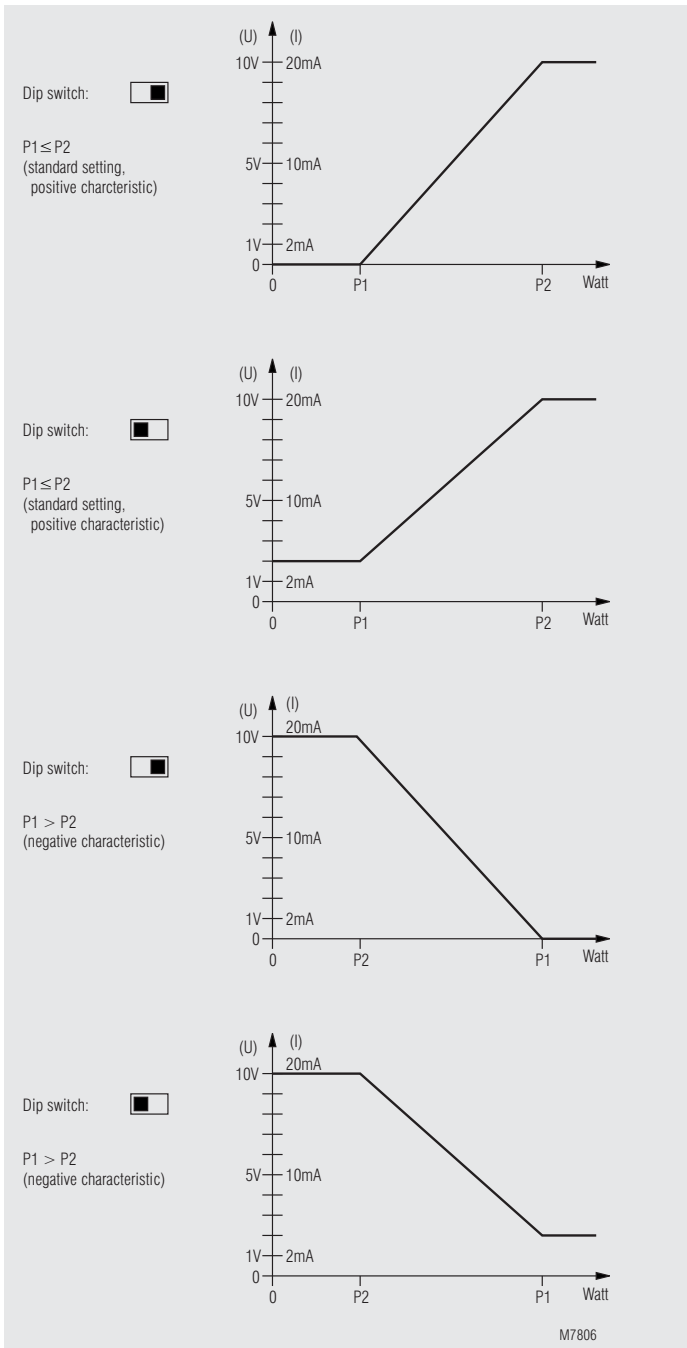
0240708



- According to IEC/EN 60 255, DIN VDE 0435-303
- As load depending output signals are available
  - 0 ... 20 mA and 0 ... 10 V or
  - 4 ... 20 mA and 2 ... 10 V
- Measures effective load
- Adjustment of  $P_1$  and  $P_2$  on absolute scale
- For motors up to 22 kW / 400 V bzw. 37 kW / 690 V
- Adjustable start up delay  $t_a$
- Up to 40 A without external current transformer
- As option for single phase loads
- LED indicators
- Width 45 mm

### Load Characteristics

4 different types of load characteristics can be selected via  $P_1$ ,  $P_2$  and a DIP switch.



### Approvals and Markings



### Application

The motor load transmitter is suitable to monitor motors with variable load.

### Function

The motor load transmitter BH9098 monitors the effective load of motors and balanced three phase and single phase systems. Due to the single phase current measuring system, the unit assumes the load is balanced on all phases, as is the norm for motors. The power consumption of the load is continuously monitored and converted into a standard dc current or voltage signal. Two pairs of rotary switches,  $P_1$  and  $P_2$  set the lower and upper end of the measured range in Watts. When the monitored load is between these set values a proportional output signal is produced. If the monitored load is outside the set range the output signal will remain at minimum or maximum.

### Indicators

green LED,  $U_N$ : flashing: start up delay  $t_a$   
Continuous light: voltage connected

### Failure Indication

Two different failure states are displayed by LEDs.

#### 1.) No measuring voltage:

- If the measuring voltage is missing, measurement is not possible.
- The LED flashes fast in intervals.
- The output signals are on min. value.

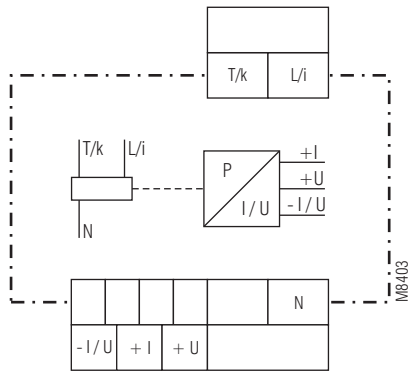
#### 2.) Reverse power:

- The calculated power value is negative.
- The LED flashes fast.
- The output signals are on min. value.

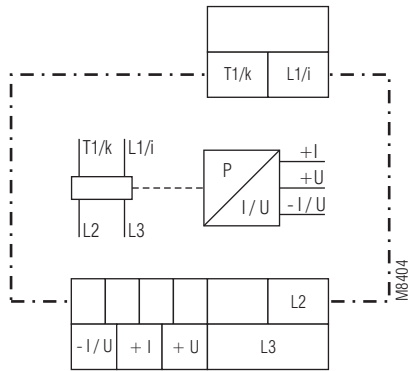
Possible reason:

The unit detects reverse power or the current connections are inverted.

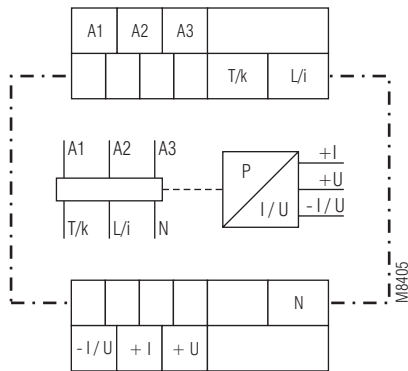
## Circuit Diagrams



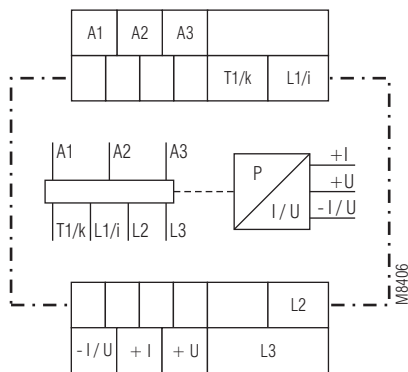
BH 9098.90



BH 9098.90/001

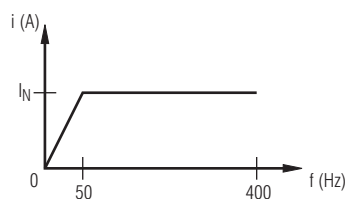


BH 9098.90/010



BH 9098.90/011

## Characteristics



M7953

Max. input current curve in relation to input frequency

## Technical Data

### Input

#### Measuring voltage

Voltage range: without auxiliary voltage  $0.8 \dots 1.1 \times U_N$   
with auxiliary voltage, see setting ranges

#### Input resistance:

300 k $\Omega$  ... 500 k $\Omega$

#### Measured current

Measuring range: see setting ranges

Rated current [A]	40	24	8	2.4	0.8	0.24
Permissible current range (overload) [A]						
continuously:	0 ... 40	0 ... 40	0 ... 16	0 ... 8	0 ... 4	0 ... 1
1 min. (10 min. break):	150	150	20	16	3	1,5
20 s (10 min. break):	200	200	25	20	4	2
Input resistance of current i-k [m $\Omega$ ]:	$\leq 1$	$\leq 1$	7	14	150	500

#### Frequency range:

10 ... 400 Hz (see characteristics M7953)

### Setting Ranges

#### P<sub>1</sub> and P<sub>2</sub> on absolute scale:

Upper Switch

load range

for P1 and P2:

lower range



upper range



#### Measuring accuracy

(in % at nominal load):

$\pm 5$  %

#### Harmonic distortion:

< 40 %

#### Start-up delay t<sub>s</sub>:

0 ... 30 s (infinitely variable)

### Analogue Output for Current 0 / +I

#### Galvanically isolated

to measuring input and

auxiliary voltage:

4 kV eff.

#### Output current:

DC 0 ... 20 mA

DC 4 ... 20 mA

(selectable via DIP switch)

#### Output impedance (Load):

max. 500  $\Omega$

### Analogue Output for Voltage 0 / +U

#### Galvanically isolated

to measuring input and

auxiliary voltage:

4 kV eff.

#### Output voltage:

DC 0 ... 10 V

DC 2 ... 10 V

(selectable via DIP switch)

#### Output impedance (Load):

min. 5000  $\Omega$

### Setting Ranges

Available variants	Measuring voltage U <sub>N</sub>	Measuring current I <sub>N</sub> [A]	selection of load range resistive
<b>1-phase</b>			
without auxiliary voltage			
BH 9098.90/000	AC 230 V	0.0024 ... 0.24	0.1 ... 60 W
	AC 230 V	0.024 ... 2.4	1 ... 600 W
	AC 230 V	0.24 ... 24	10 ... 6000 W
with auxiliary voltage			
BH 9098.90/010	AC 35...250 V	0.0024 ... 0.24	0.1 ... 60 W
	AC 35...250 V	0.024 ... 2.4	1 ... 600 W
	AC 35...250 V	0.24 ... 24	10 ... 6000 W
<b>3-phase</b>			
without auxiliary voltage			
BH 9098.90/001	3 AC 400 V	0.008 ... 0,8	0.1 ... 60 W
	3 AC 400 V	0.08 ... 8	10 ... 6000 W
	3 AC 400 V	0.4 ... 40	0.1 ... 30 kW
with auxiliary voltage			
BH 9098.90/011	3 AC 60 ... 440 V	0.008 ... 0.8	1 ... 600 W
	3 AC 60 ... 440 V	0.08 ... 8	10 ... 6000 W
	3 AC 100 ... 760 V	0.4 ... 40	0.1 ... 52 kW

## Technical Data

### Auxiliary Circuit

#### Auxiliary voltage $U_H$

only for BH 9098.90/010 and BH 9098.90/011:

AC 110 V (terminals A 1 - A 2),  
AC 230 V (terminals A 1 - A 3),  
DC 24 V

#### Voltage range:

0.8 ... 1.1  $U_H$

#### Frequency range of $U_H$ :

45 ... 400 Hz

#### Input current

AC 110 V:

approx. 30 mA

AC 230 V:

approx. 15 mA

DC 24 V:

approx. 50 mA

## General Data

#### Operating mode:

Continuous operation

#### Temperature range:

- 20 ... + 55°C

#### Clearance and creepage distances

rated impulse voltage /  
pollution degree:

4 kV / 2

IEC 60 664-1

#### EMC

Electrostatic discharge:

8 kV (air)

IEC/EN 61 000-4-2

HF-irradiation:

10 V / m

IEC/EN 61 000-4-3

Fast transients:

2 kV

IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply:

1 kV

IEC/EN 61 000-4-5

between wire and ground:

2 kV

IEC/EN 61 000-4-5

HF-wire guided:

10 V

IEC/EN 61 000-4-6

Interference suppression:

Limit value class B

EN 55 011

#### Degree of protection

Housing:

IP 40

IEC/EN 60 529

Terminals:

IP 20

IEC/EN 60 529

#### Housing:

Thermoplast with V0-behaviour  
according to UL subject 94

#### Vibration resistance:

amplitude 0.35 mm

#### Climate resistance:

#### Terminal designation:

20 / 055 / 04

IEC/EN 60 068-1

#### Wire connection

Load terminals:

1 x 10 mm<sup>2</sup> solid or

1 x 6 mm<sup>2</sup> stranded ferruled

Control terminals:

1 x 4 mm<sup>2</sup> solid or

2 x 1.5 mm<sup>2</sup> stranded ferruled or

1 x 2.5 mm<sup>2</sup> stranded ferruled or

DIN 46 228-1/-2/-3/-4

#### Wire connection:

Box terminals with self-lifting  
wire protection and plus-minus  
terminal screws M3.5

#### Mounting:

DIN rail

IEC/EN 60 715

#### Weight:

430 g

## Dimensions

#### Width x height x depth:

45 x 84 x 121 mm

## Standard Type

BH 9098.90/001 3 AC 400 V AC 40 A

Article number:

- 3-phase, without auxiliary voltage

- Output: analogue

- Nominal voltage  $U_N$ : 3 AC 400 V

- Width: 45 mm

## Variants

BH 9098.90/1\_\_:

3-phase without auxiliary voltage with galvanically separated current path. For applications with current transformers grounded on the secondary side, current range limited to 25 A

BH 9098.90/011:

3-phase with auxiliary voltage

BH 9098.90/000:

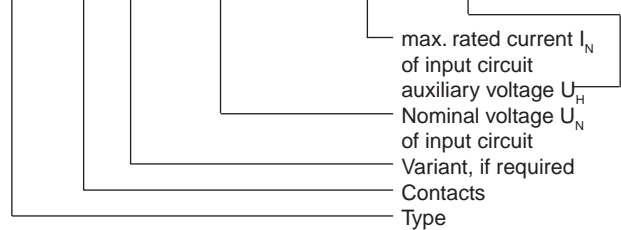
1-phase without auxiliary voltage

BH 9098.90/010:

1-phase with auxiliary voltage

## Ordering example for variants

BH 9098 .90 /011 3 AC 100...760 V AC 40 A AC 230/110 V



## Settings

### Rotational switches $P_1$ and $P_2$ (2 digits) (calculation for resistive load) 48 kW

The switches are used to set the minimum and maximum load values  $P_1$  and  $P_2$  of the load characteristics. The scale shows the absolute value. On the 3-phase variant the max. possible power setting value is 52 kW (760 V x 40 A x 1.732). The setting resolution is 1 kW and the load range can be selected by DIP-switches. If the load range is reduced by factor 10 the setting resolution is 100 W.

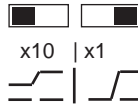
### Potentiometer $t_a$

A start-up delay can be adjusted between 0 ... 30 s.

After mains voltage is connected the start-up delay begins. During this time the measurement is disabled and the LED flashes (see indicators).

Independent of the settings the analogue output is on min. value.

### DIP-switches:



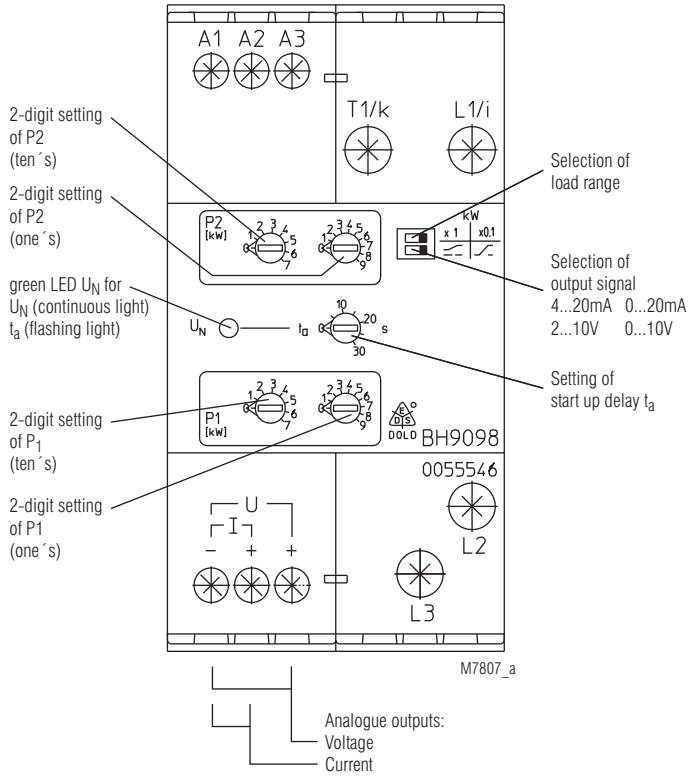
reduction of load range  $P_1$  and  $P_2$  by factor 10

Selection of output signal:

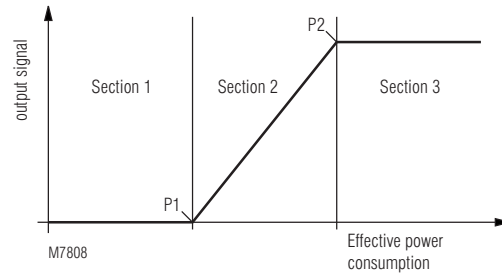
4 ... 20 mA	to	0 ... 20 mA
2 ... 10 V	to	0 ... 10 V

## Connection

The connection has to be made according to the application drawings. The measuring current has to be connected to terminals L/i and T/k or L1/i and T1/k. The flow direction of the current must be correct. On reverse power the unit gives a failure indication. The maximum nominal motor current flowing directly through the load transmitter is 40 A. On higher current a current transformer with 2,5 VA burden capacity has to be used.



The load characteristic shows 3 sections:



**Example 1**

The smaller value is adjusted on P<sub>1</sub>  
 The higher value is adjusted on P<sub>2</sub>  
 Standard setting: positive characteristic

- If the effective power consumption of the load is in section 1 between 0 W and P<sub>1</sub> setting the analogue output signal is on minimum value.
- If the effective power consumption of the load is in section 2 between P<sub>1</sub> and P<sub>2</sub> setting the analogue output signal is proportional to the effective load following a **positive characteristic**.
- If the effective power consumption of the load is in section 3 between P<sub>2</sub> setting and P<sub>max</sub> the analogue output signal is on maximum value.

**Example 2**

P<sub>1</sub> = 0 and P<sub>2</sub> = P<sub>max</sub>

- Selection of the maximum possible load range span. The whole load range of the unit is converted into a proportional output signal. Section 1 and 3 are missing.

**Example 3**

P<sub>1</sub> = P<sub>2</sub>

- If the **same** value is adjusted for P<sub>1</sub> and P<sub>2</sub> section 2 is missing, i.e. the output signal is either on minimum or maximum value. The unit works as limit switch.

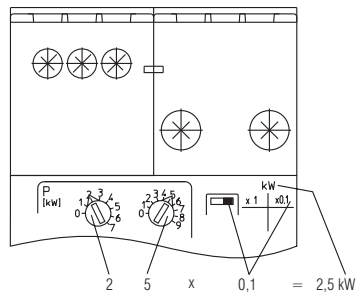
**Example 4**

On P<sub>1</sub> the higher value is adjusted.  
 On P<sub>2</sub> the lower value is adjusted.

- Inverted output, negative characteristic

**Adjustment example: response value: 2,5 kW**

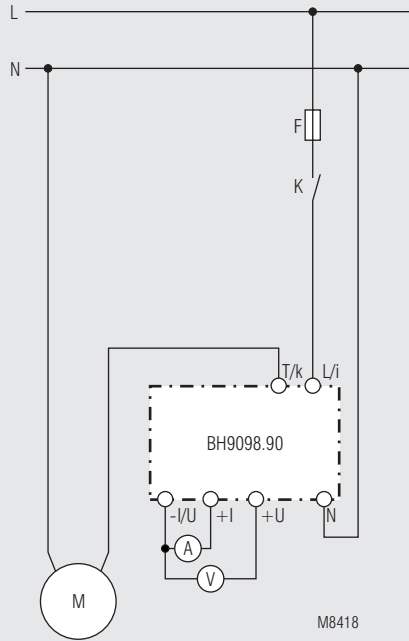
M9950



Response value = 25 x 0,1 = 2,5 kW

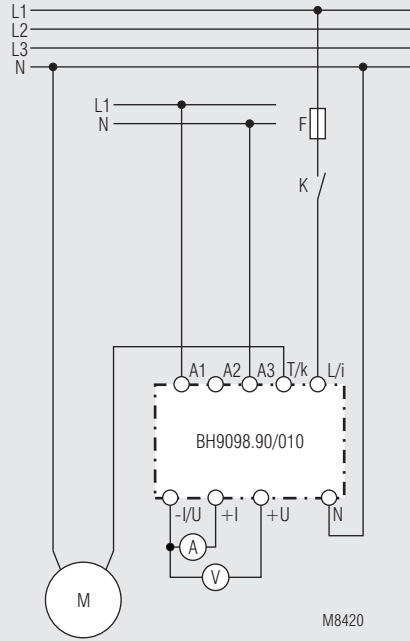
Connection Example

1-phase



BH 9098.90

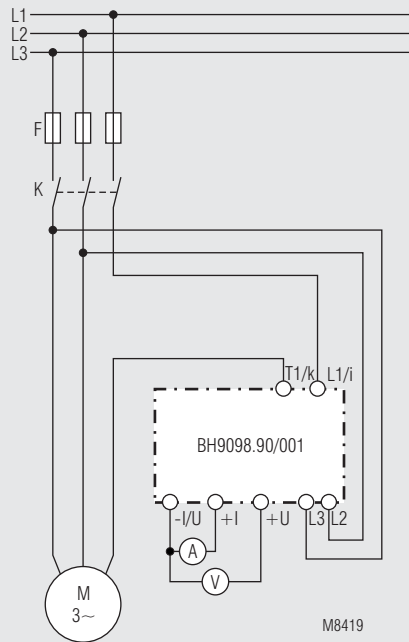
M8418



BH 9098.90/010

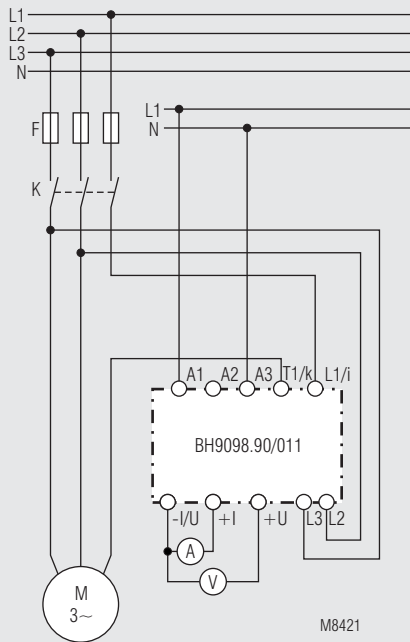
M8420

3-phase



BH 9098.90/001

M8419

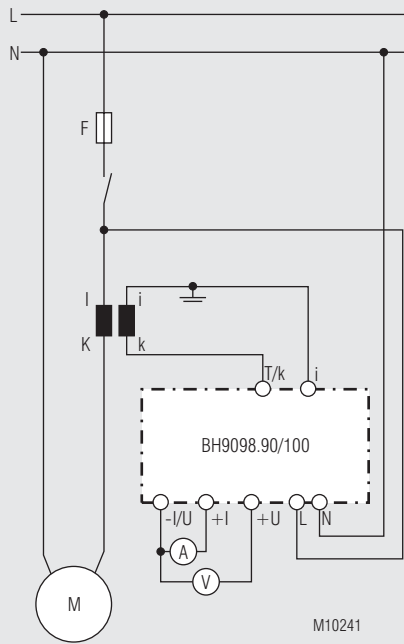


BH 9098.90/011

M8421

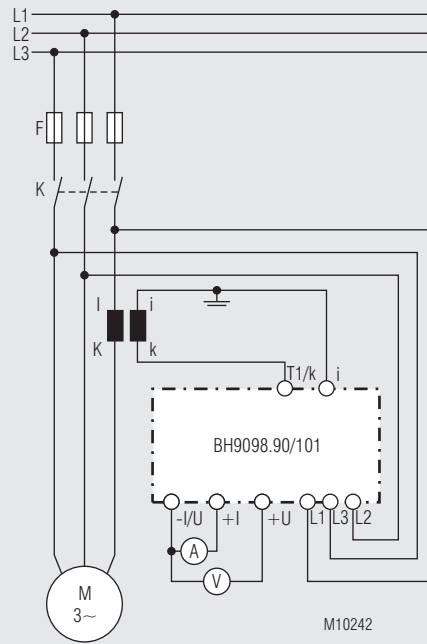


Connection Examples with external current transformer



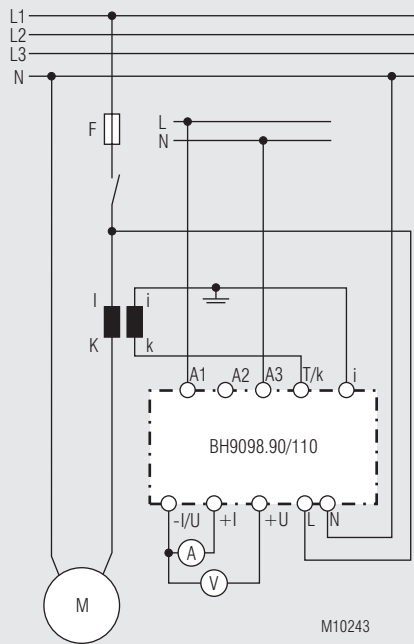
BH 9098.90/100

M10241



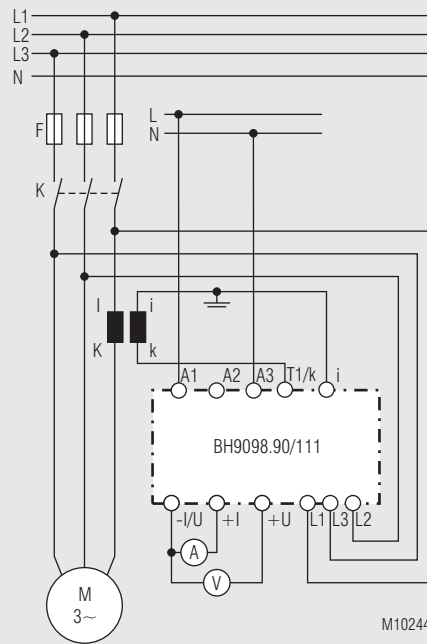
BH 9098.90/101

M10242



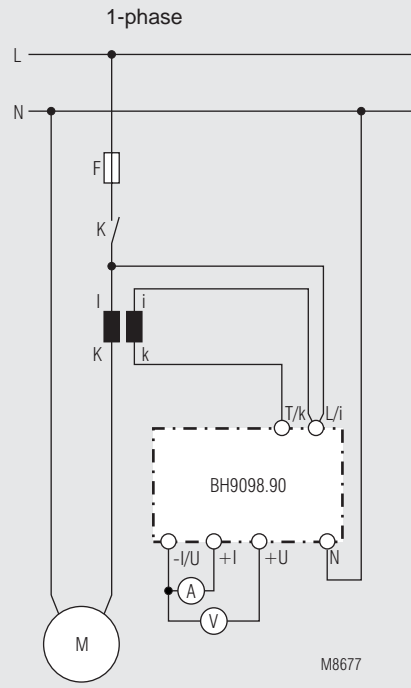
BH 9098.90/110

M10243

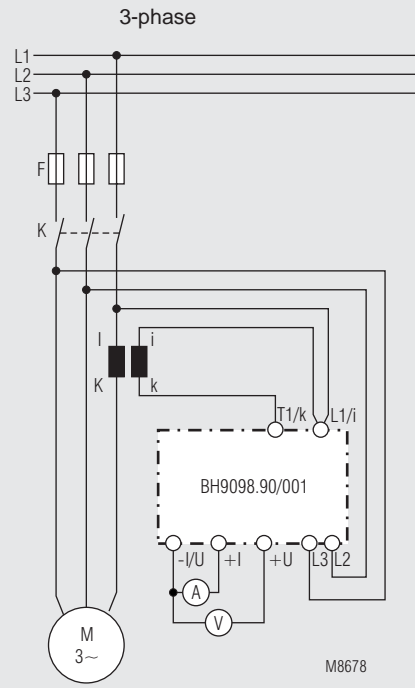


BH 9098.90/111

M10244



BH 9098.90



BH 9098.90/001

**Note:** When using external CTs the adjusted value has to be multiplied with the transmission ratio ( $\ddot{u}$ ) of the CT.

**Example:** Switching value = Setting value (P1/P2) x  $\ddot{u}$  e.g. for 100/5A C/T  $\ddot{u}=20$  (100 divided by 5)

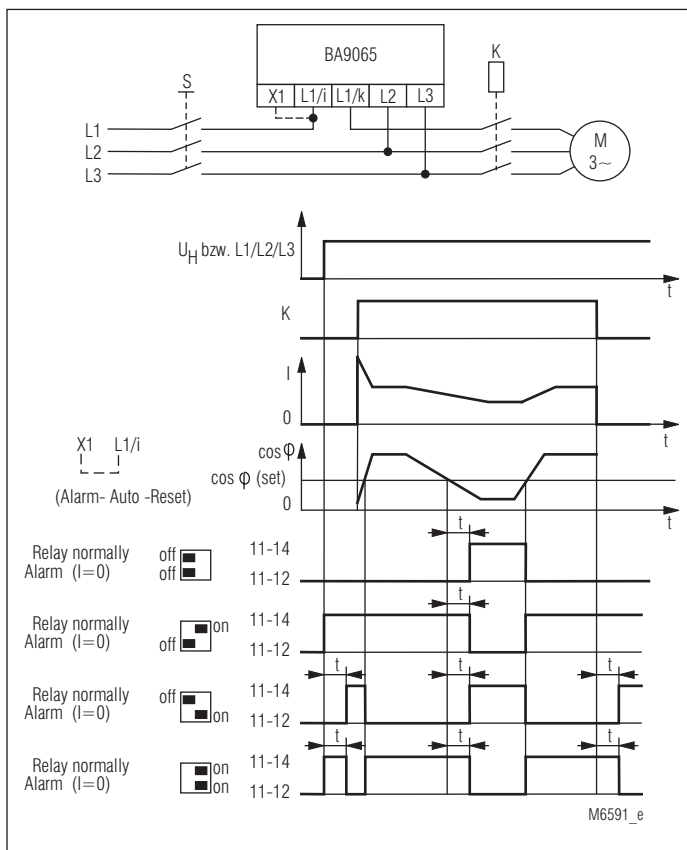
# Monitoring Technique

## VARIMETER Underload Monitor (cos φ) BA 9065



- According to IEC/EN 60 255, VDE 0435
- Detection of underload (cos φ)
- Current ranges up to 10 A, for higher values a CT must be used
- Adjustable response value
- Programmable functions:
  - alarm when I = 0
  - automatic or manual reset
  - closed or open circuit operation
- Manual remote reset
- Adjustable operate delay
- Independent of phase sequence
- Also for 400 Hz systems
- Optionally for motors with frequency converters (10 ... 100 Hz) (see notes)
- Width 45 mm

### Function Diagram



### Approvals and Markings



### Applications

- Monitors underload and no load on squirrel cage motors e.g.
- fan monitoring (broken belt)
  - filter monitoring (blocked filter)
  - pump monitoring (blocked valve, dry running)

### Function

The underload monitor BA 9065 measures the phase shift between voltage and current. The phase angle changes with changing load. This measuring method is suitable to monitor asynchronous motors on underload and no load independent of motor size. The change of cos φ has to be bigger than the hysteresis of the monitor (see diagram). In some cases the cos φ does not change much with load change on the motor, e.g.:

- small load change on oversized motor
  - single phase shaded-pole and collector motors
- In these cases we recommend the use of our motor load monitors BA 9067 or BH 9067.
- The BA 9065 can also be used on systems with variable frequency because of its frequency independent measuring principle. The BA 9065.20 does not need a separate auxiliary supply as it takes the required energy from the monitored mains.
- A yellow LED indicates operation. If the cos φ goes under the setting value the device reacts after a settable time delay. A green LED shows the state of the output relay.

Functions programmable with DIP-switches:

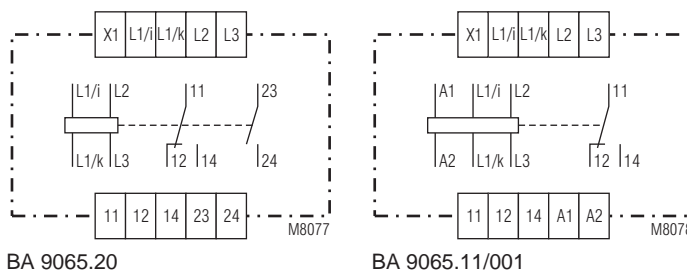
- open circuit operation (relay normally off)
- alarm when no current is flowing (Alarm at I = 0 on)
- closed circuit operation (relay normally on)
- no alarm when no current is flowing (Alarm at I = 0 off)

Function programmable with bridge X1-L1/i:

bridge  
X1-L1/i

- manual reset, reset with built-in reset button or remote reset with button connected to X1-L1/i
- Automatic reset when system returns to correct load (cos φ)

### Circuit Diagram



BA 9065.20

BA 9065.11/001

## Notes

To terminal X1 only the potential of L1/i must be connected.  
When setting the response value on BA 9065 with frequency converters please note that the  $\cos \varphi$  of the motor changes with the frequency.  
The measurement of the  $\cos \varphi$  is made by detecting the phase angle between current and voltage by monitoring the shift of the zero passage of current and voltage. Therefore the measurement is independent of frequency and voltage amplitude.  
When using the model BA 9065.11/001 with separate auxiliary supply, the measuring circuit (L1/i-L1/k; L2-L3) can also monitor variable frequencies and voltages on the output of a frequency converter. As the  $\cos \varphi$  of squirrel cage motors varies with the frequency and with the load, it must be checked for each application if the BA 9065 is suitable. When a current transformer is used with variable frequency, this must also be a special one, that can transmit also low frequencies.

Please note when using a current transformer:

- the phase position must be correct (see Connection Examples), if not there will be no or permanent alarm
- there must be a connection from L1 to the secondary side of the CT (see Connection Examples)

## Technical Data

### Input Circuit

<b>Nominal voltage <math>U_N</math>:</b>	AC / 3 AC 220 ... 254 V, 380 ... 440 V, 480 ... 550 V, 600 ... 690 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency of <math>U_N</math>:</b>	45 ... 400 Hz
<b>Nominal consumption:</b>	2.5 VA (terminals L1/i-L2, A1-A2)
<b>Current range (L1/i-L1/k):</b>	0.1 ... 2 A      0.5 ... 10 A *
<b>Internal resistance L1/i-L1/k:</b>	approx. 30 m $\Omega$ approx. 10 m $\Omega$
<b>Consumption L1/i-L1/k:</b>	max. 0.12 VA      max. 1.1 VA * (higher currents using external current transformers, see connection examples)
<b>Short time overload: Usable current transformers:</b>	see diagram short time overload 1 A or 5 A type Class 3 or better with necessary power
<b>Setting range <math>\cos \varphi</math>:</b>	0 ... 0.9 ; infinite variable
<b>Operate delay <math>t_r</math>:</b>	1 ... 40 s; infinite variable

### Output

<b>Contacts</b>	
BA 9065.20:	1 changeover contact, 1 NO contact
BA 9065.11/001:	1 changeover contact
<b>Thermal current <math>I_{th}</math>:</b>	6 A (up to 25°C, see also derating curve)
<b>Switching capacity to AC 15</b>	
NC contact:	1 A / AC 230 V      IEC/EN 60 947-5-1
NO contact:	3 A / AC 230 V      IEC/EN 60 947-5-1
<b>Electrical life</b>	IEC/EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	1.5 x 10 <sup>5</sup> switching cycles
<b>Short-circuit strength max. fuse rating:</b>	4 A gL      IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2      IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air)      IEC/EN 61 000-4-2
HF irradiation:	10 V / m      IEC/EN 61 000-4-3
Fast transients:	2 kV      IEC/EN 61 000-4-4
Surge voltages between	
wires for power supply:	1 kV      IEC/EN 61 000-4-5
between wire and ground:	2 kV      IEC/EN 61 000-4-5
Interference suppression:	Limit value class B      EN 55 011

## Technical Data

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm,  
frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
20 / 060 / 04      IEC/EN 60 068-1

### Climate resistance:

### Terminal designation:

EN 50 005

### Wire connection:

2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228-1/-2/-3/-4

### Wire fixing:

Flat terminals with self-lifting  
clamping piece      IEC/EN 60 999-1

### Mounting:

DIN rail

IEC/EN 60 715

### Weight:

270 g

### Dimensions

**Width x height x depth:** 45 x 74 x 124 mm

### Standard Type

BA 9065.20	3 AC 380 ... 440 V	0.5 ... 10 A	
Article number:	0039727		stock item
• Output:	1 changeover contact, 1 NO contact		
• Nominal voltage $U_N$ :	3 AC 380 ... 440 V		
• Current range:	0.5 ... 10 A		
• Width:	45 mm		

### Variants

BA 9065.11/001:  
for motors with frequency converters, separate auxiliary supply is necessary

### Auxiliary voltage $U_H$ :

AC 220 ... 254 V  
AC 380 ... 440 V

### Nominal frequency of $U_H$ :

45 ... 400 Hz

### Motorvoltage $U_N$ :

3 AC 40 ... 660 V  
without neutral

### Nominal frequency of $U_N$ :

10 ... 100 Hz

### Contacts:

1 changeover contact

### Ordering example for variants

BA 9065	.20	AC / 3 AC 380 ... 440 V	0.5 ... 10 A	45 ... 400 Hz	
					Nominal frequency
					Current range
					Nominal voltage
					Contacts
					Type

### Accessories

ET 4762-5:	Adapter for screw fixing Article number: 0023119
------------	---

## Characteristics

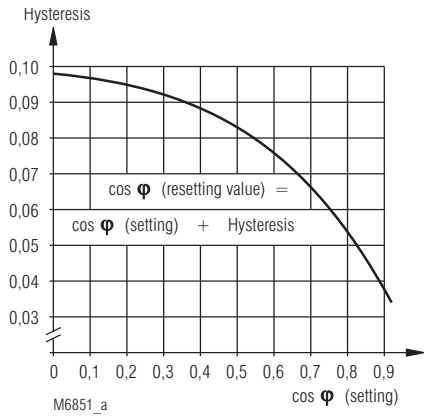


Diagram for hysteresis

Hysteresis depending on adjusted  $\cos \varphi$  setpoint. The hysteresis is the switching difference between alarm on ( $\cos \varphi$  setting) and alarm off ( $\cos \varphi$  reset value).

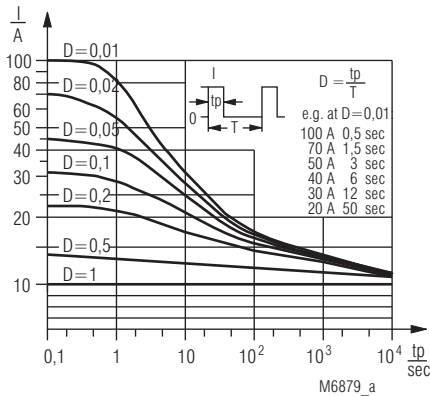
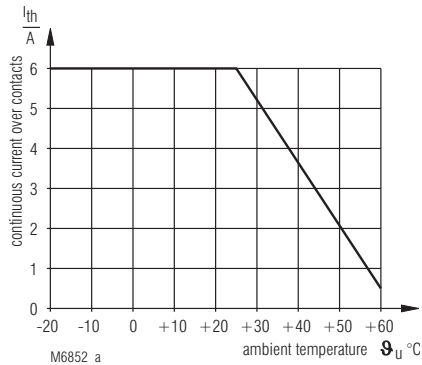


Diagram for short-time overload of the current input L1/i-L1/k (0.5 ... 10 A)



Continuous current limit curve for contacts

## Operating Instructions

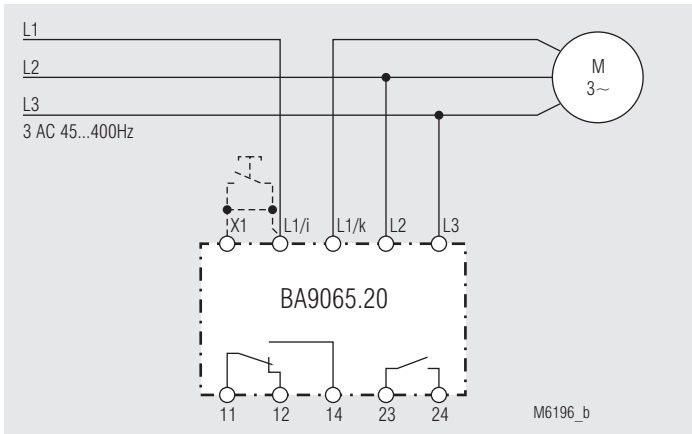
The example of a frequency controlled fan motor shows how to set up the unit.

- 1) Setting on BA 9065
  - set BA 9065 to automatic restart (bridge X1-L/i; or while doing below mentioned tests press the reset button continuously)
  - adjust time delay to minimum (left position)
  - adjust  $\cos \varphi$  potentiometer to 0 (left position)
- 2) Setting on Motor:
  - simulate broken belt (motor runs without load)
  - run motor on lowest frequency

When the motor runs without load and lowest possible frequency, this is the worst case to detect broken belt.
- 3) Keep the conditions of 2) and turn the  $\cos \varphi$  potentiometer slowly (because of time delay) to the right (to higher value) until the contact switches. Please note this setting and keep it.
- 4) - remount the belt (normal working condition)
  - at the lowest frequency and automatic reset or pressed reset button the monitor should show "good" condition, because the  $\cos \varphi$  rises.

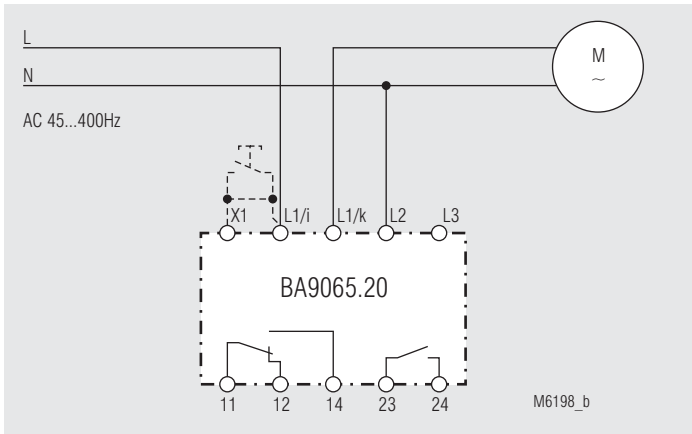
If the Monitor does not show "good" condition the change of  $\cos \varphi$  is obviously smaller than the hysteresis. Now set potentiometer back to 0 again and turn it slowly to higher values to check the alarm value. Finally turn the potentiometer again to 0 and then set it to the value found under 3) as this is the optimum setting.
- 5) Rise the frequency under normal conditions to maximum. The Alarm state should reset. Lower the frequency to minimum, no alarm should occur. At last set the time delay to a higher value, because the motor runs as generator for a short time when the frequency is lowered and the BA 9065 would react immediately.

**Connection Examples**

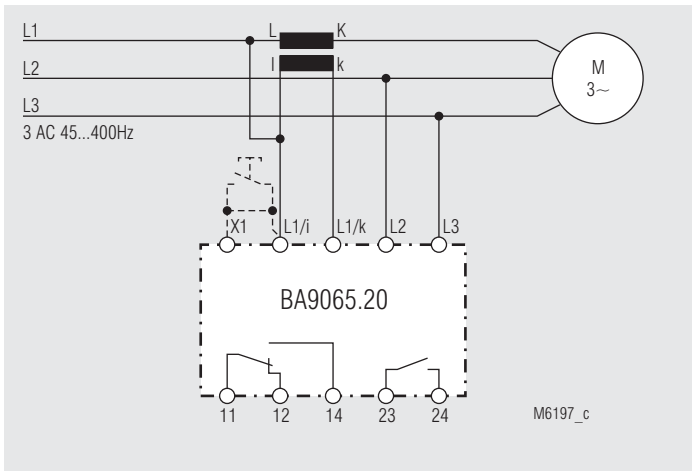


Without current transformer ( $I_{Mot} = 0.5 \dots 10 \text{ A}$ )  
 Please note:  
 The nominal voltage is the phase to phase voltage

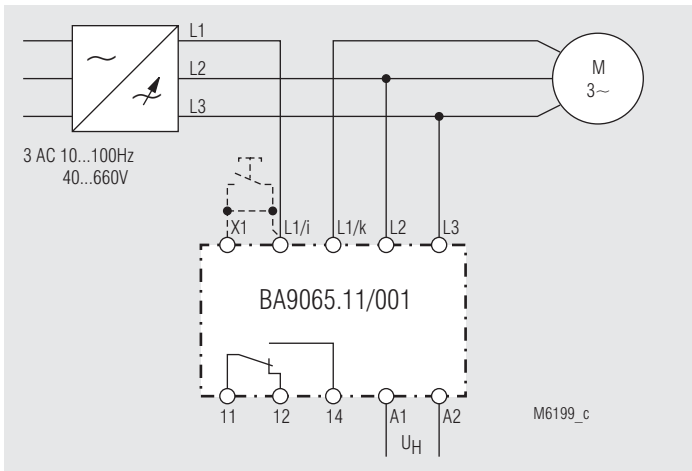
**Connection Examples**



Single phase connection  
 Please note:  
 The nominal voltage is the phase to neutral voltage



With current transformer ( $I_{Mot} > 10 \text{ A}$ )  
 Please note:  
 The nominal voltage is the phase to phase voltage.  
 The sens of winding of the CT is of importance!



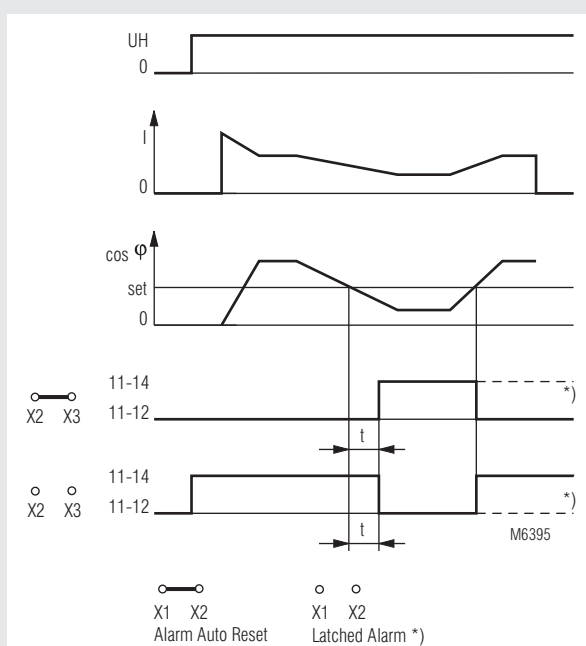
Connection with CT or single phase see BA 9065.20

## VARIMETER Underload Monitor MK 9065



- According to IEC/EN 60 255, DIN VDE 0435-303
- Detection of underload ( $\cos \varphi$ )
- Current ranges up to 10 A
- Adjustable response value
- Programmable functions:
  - automatic or manual reset
  - closed or open circuit operation
- Manual remote reset
- Adjustable operate delay up to 100 s
- For single and 3-phase AC-systems without neutral
- Independent of phase sequence
- Also for 400 Hz systems
- MK 9065.11 can be used for motors with frequency converters (2 ... 200 Hz)
- Optionally with sealable cover
- Green indicator LED for operational mode
- Red indicator LED for underload monitoring
- Width 22.5 mm

### Function Diagram



### Approvals and Markings



### Applications

- Monitors underload and no load on squirrel cage motors e.g.
- fan monitoring (broken belt)
  - filter monitoring (blocked filter)
  - pump monitoring (blocked valve, dry running)

### Indicators

- green LED: on, when supply connected  
red LED: on, when underload detected

### Function

The underload monitor MK 9065 measures the phase shift between voltage and current. The phase angle changes with changing load. This measuring method is suitable to monitor asynchronous motors on underload and no load independent of motor size. In some cases the  $\cos \varphi$  does not change much with load change on the motor, e.g.:

- small load change on oversized motor
- single phase chaded-pole and collector motors

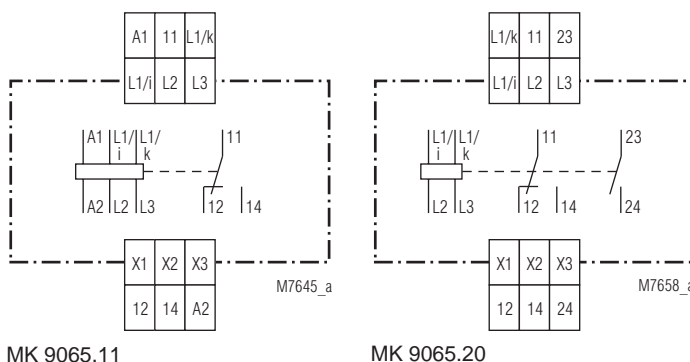
In these cases we recommend the use of motor load monitor BA 9067.

Programmable by bridging terminals:

- X1 - X2 bridged: alarm not stored (auto reset)
- X1 - X2 open: stored alarm: reset by external or internal reset button
- X2 - X3 bridged: open circuit operation (relay energized on underload)
- X2 - X3 open: closed circuit operation (relay de-energized on underload)

When setting the MK 9065 in a system with frequency converters please note that the  $\cos \varphi$  varies with the frequency.

### Circuit Diagrams



MK 9065.11

MK 9065.20

## Technical Data

### Input (L1-L2-L3)

<b>Nominal voltage <math>U_N</math>:</b>	(= Motor voltage)
MK 9065.11:	AC or 3 AC 15 ... 690 V
MK 9065.20:	AC or 3 AC 110 ... 127 V, 220 ... 240 V, 380 ... 415 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency of <math>U_N</math>:</b>	
MK 9065.11:	2 ... 200 Hz
MK 9065.20:	45 ... 400 Hz
<b>Nominal consumption:</b>	2 VA
<b>Current range (L1/i-L1/k):</b>	0.1 ... 2 A      0.5 ... 10 A*
<b>Internal resistance (L1/i-L1/k):</b>	approx. 30 m $\Omega$ approx. 10 m $\Omega$
<b>Consumption (L1/i-L1/k):</b>	max. 0.12 VA      max. 1.1 VA
<b>Short time overload:</b>	see diagram (for 2 A range reduced) * for higher currents use external current transformer (see connection diagram) Suitable current transformers: 1 A or 5 A types, class 3, with necessary load capacity

### Setting Ranges

<b>Setting range <math>\cos \varphi</math>:</b>	0 ... 0.97 infinite variable
<b>Operate delay <math>t_r</math>:</b>	approx. 1 ... 100 s infinite variable

### Auxiliary circuit

#### Auxiliary voltage $U_H$ (A1 - A2)

MK 9065.11:	AC 110 ... 127 V, 220 ... 240 V, 380 ... 415 V
MK 9065.20:	$U_H = U_N$
<b>Voltage range:</b>	0.8 ... 1.1 $U_H$
<b>Frequency range:</b>	45 ... 400 Hz

### Output

#### Contacts

MK 9065.11:	1 changeover contact
MK 9065.20:	1 changeover contact, 1 NO contact
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity to AC 15</b>	
NO contact:	3 A / AC 230 V      IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V      IEC/EN 60 947-5-1
<b>Electrical life to AC 15 at 3 A, AC 230 V:</b>	5 x 10 <sup>5</sup> switching cycles
<b>Short-circuit strength max. fuse rating:</b>	4 A gL      IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 50°C with a distance of $\geq 10$ mm to the next units a max. ambient temperature of 60°C is possible
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2      IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	4 kV (air)      IEC/EN 61 000-4-2
Fast transients:	4 kV      IEC/EN 61 000-4-4
Surge voltages between	
wires for power supply:	2 kV      IEC/EN 61 000-4-5
between wire and ground:	4 kV      IEC/EN 61 000-4-5
Interference suppression:	Limit value class B      EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40      IEC/EN 60 529
Terminals:	IP 20      IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6

## Technical Data

<b>Climate resistance:</b>	20 / 050 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 1.5 mm <sup>2</sup> solid or 2 x 1.0 mm <sup>2</sup> stranded wire with sleeve	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece	IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight:</b>	155 g	

### Dimensions

<b>Width x height x depth:</b>	22.5 x 82 x 99 mm
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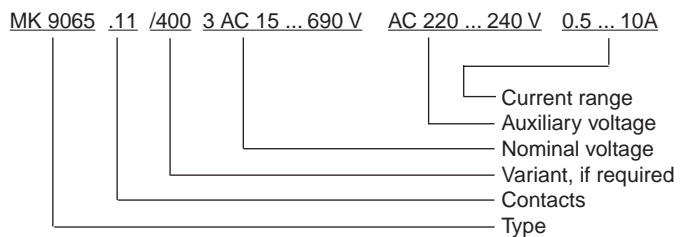
### Standard Type

MK 9065.20	3 AC 380 ... 415 V	0.5 ... 10 A	1 ... 100 s
Article number:	0045108		
• Output:	1 changeover contact, 1 NO contact		
• Nominal voltage $U_N$ :	3 AC 380 ... 415 V		
• Current range:	0.5 ... 10 A		
• Width:	22.5 mm		

### Variants

MK 9065.11:	Output 1 changeover contact, auxiliary supply separated from measuring input, standard unit can be used also with frequency converters
MK 9065.20:	Model with 1 changeover contact and 1 separate NO contact, auxiliary supply is taken from measuring input, cannot be used with frequency converters
MK 9065. __ /400:	with transparent sealable cover

### Ordering example for variants



### Characteristics

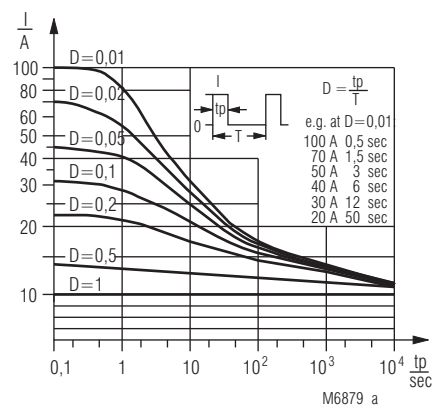
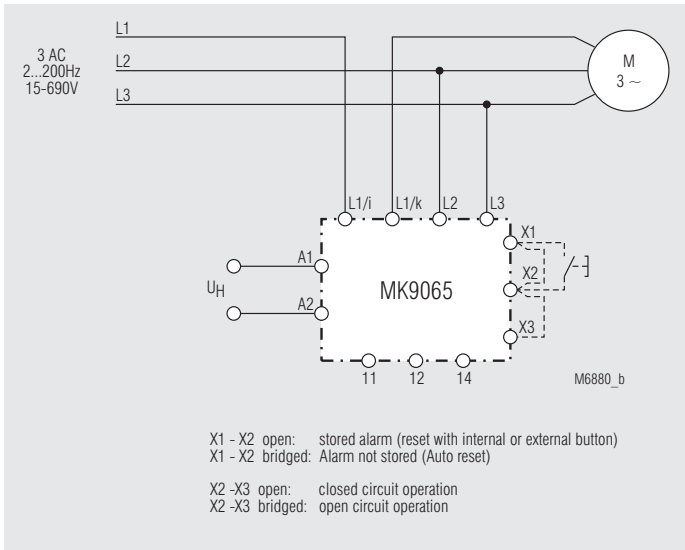


diagram for short-time overload of the current input L1/i-L1/k (0.5 ... 10 A)

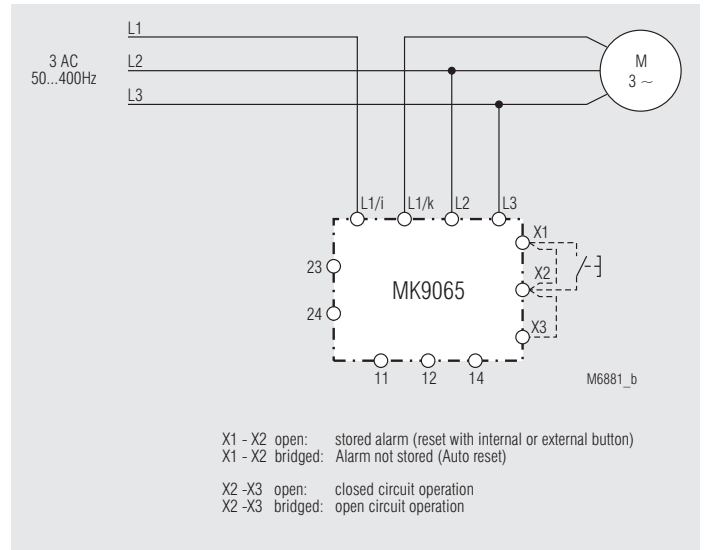


### Connection Examples

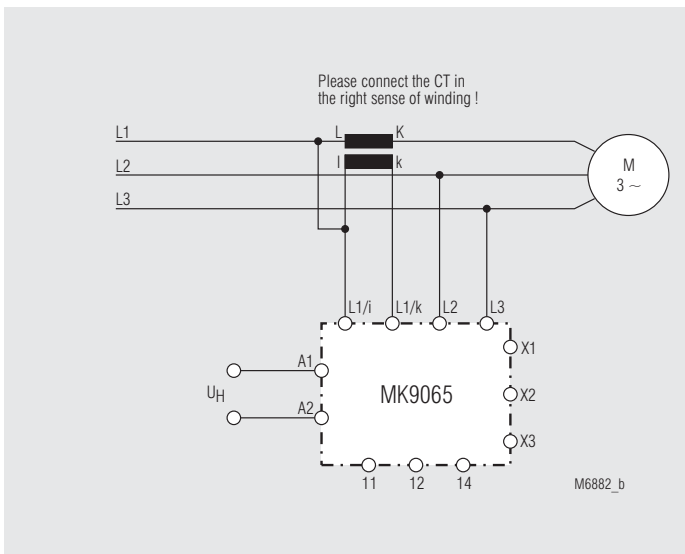


Standard circuit with MK 9065.11

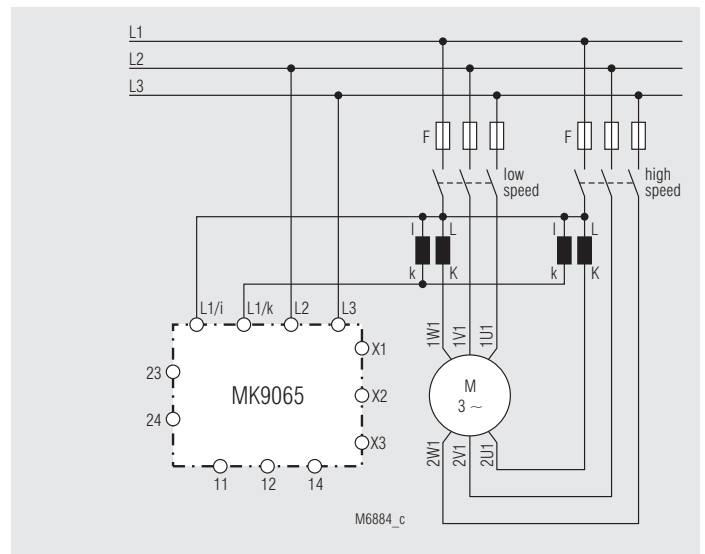
### Connection Examples



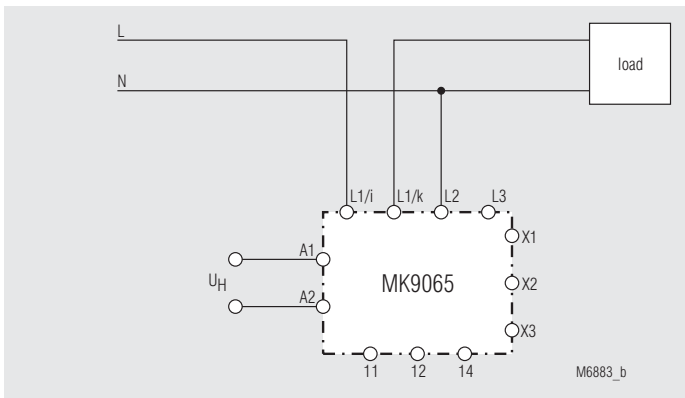
Standard circuit with MK 9065.20



Connection Example for MK 9065.11 with current transformer



Connection Example for MK 9065.20 for motors with separate windings



Connection Example for MK 9065.11 with single phase connection

# Monitoring Technique

## VARIMETER

Underload Monitor (cos φ Monitor)

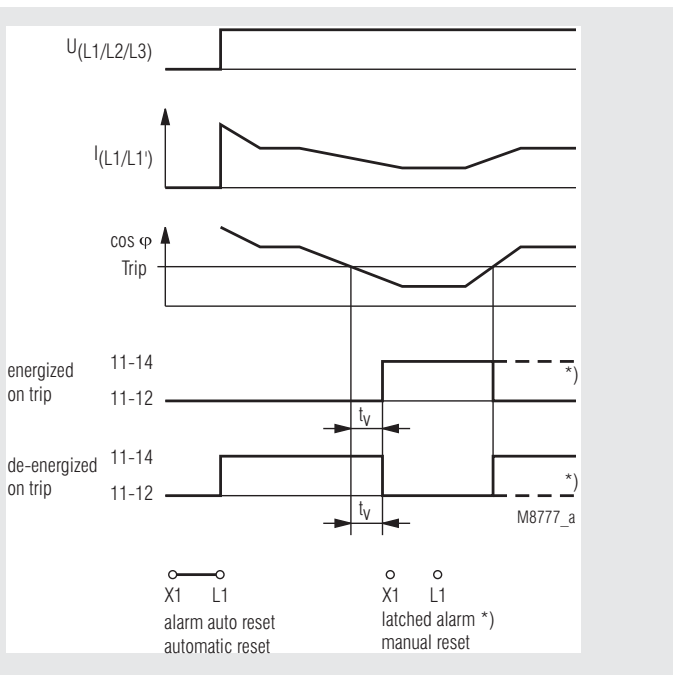
IK 9065, SK 9065, SL 9065CT



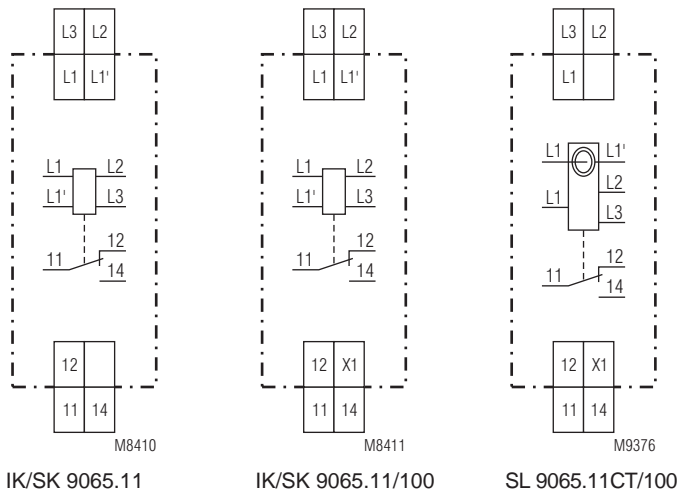
0246036



### Function Diagram



### Circuit Diagrams



- According to EN 60 255-1
- Detection of underload (cos φ)
- Without auxiliary supply
- Current up to 8 A
- Motors up to 5 A nominal current can be connected directly
- Higher currents via current transformer
- SL 9065CT with integrated current transformer for currents up to 100 A
- Adjustable response value
- Automatic reset (Alarm auto reset)
- Adjustable operate delay up to 100 s
- De-energized on trip
- For single and 3-phase loads e.g. motors
- Independent of phase sequence
- 1 changeover contact
- LED indicator voltage supply and alarm
- DIN rail or screw mounting
- Devices available in 2 enclosure versions:
  - IK 9065: depth 58 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9065, SL 9065CT: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- IK 9065, SK 9065 width 17.5 mm
- SL 9065CT width 35 mm

IK/SK 9065/100: as IK/SK 9065 but:

- programmable for
  - automatic reset or manual reset (latched alarm)
  - energized or de-energized on trip
- With reset button
- Remote reset

### Approvals and Markings



### Applications

- Monitors underload and no load on squirrel cage motors e.g.
- fan monitoring (broken belt)
  - filter monitoring (blocked filter)
  - pump monitoring (blocked valve, dry running)
  - general cos phi monitoring
  - for industrial and railway applications

### Function

The underload monitor IK/SK/SL 9065 measures the phase shift between voltage and current. The phase angle changes with changing load. This measuring method is suitable to monitor asynchronous motors on underload and no load independent of motor size. In some cases the cos φ does not change much with load change on the motor, e.g.:

- small load change on oversized motor
- single phase shaded-pole and collector motors

For these cases we recommend the use of our motor load monitor BH 9097.

If a cos phi value lower then the adjusted value is detected the output relay changes into alarm state after the adjusted time delay  $t_v$  and the red LED "Alarm" lights up. If the underload monitor is in auto reset mode it changes back to normal state without delay when the cos phi rises above the adjusted cos phi value.

### Indicators

- green LED: on, when supply connected to L1-L2
- red LED: on, when underload detected (Alarm)

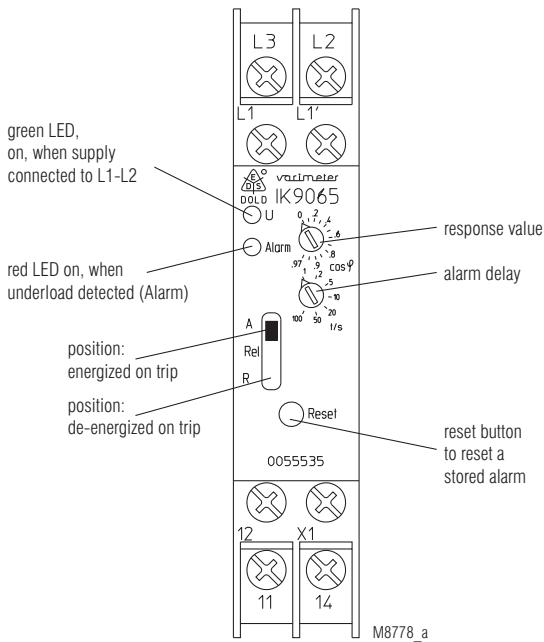
## Connection Terminals

Terminal designation	Signal designation
L1, L2, L3	Connection for 3-phase systems
L1', L1 <sup>1)</sup>	Current measuring circuit, connection for external current transformer possible <sup>1)</sup>
X1, L1 <sup>2)</sup>	Control input (manual reset / auto-Reset) <sup>2)</sup> X1/L1 not bridged: manual reset X1/L1 bridged: auto-reset
11, 12, 14	Changeover contact

<sup>1)</sup> Only at IK/SK 9065

<sup>2)</sup> Only at IK/SK/SL 9065.11/100

## Setting



## Notes

Monitoring of single phase load is also possible. The terminal L3 is not connected in this case (see connection diagram). The underload monitor must be ordered for the right voltage e.g. a unit for 3 AC 230 V for a single phase 230 V application.

When the underload monitor IK/SK 9065 is connected to the supply voltage L1-L2-L3 and no current is flowing in the current path L1-L1' the unit changes also in alarm state.

The current path L1-L1' allows to connect currents up to 8 A directly at IK/SK 9065. When connecting asynchronous motors not only the nominal current is important, but also the much higher starting current. The overload characteristic of the current input allows to connect motors with nominal current up to 4..5 A depending on the starting conditions. This is at 3 AC 400 V a motor load of 1.5 ... 2.2 kW.

It is important that the motor is connected to L1' and **not** to L1. On wrong connection the phase angle will be measured in a wrong way and the underload monitor IK/SK 9065 will not work.

For higher currents over 8 A (nominal motor current over 5 A) external current transformers can be used ( see Connection Examples). Also here the current transformers have to be connected with the right polarity. All standard current transformers of class 3 or better can be used (1 A or 5 A types). The integrated current transformer at SL 9065CT allows to connect currents up to 100 A directly.

The variant IK/SK/SL 9065.11/100 allows the following settings:

Bridge

X1-L1

- Automatic restart (Alarm auto reset)
- ● Manual restart (Latched Alarm), reset with built in push button, external push button on X1-L1 or by disconnecting the supply voltage.

Switch "REL" on front side

- Position "A": energized on trip (relay energizes on underload-alarm)
- Position "R": de-energized on trip (relay de-energizes on underload-alarm)

## Technical Data

<b>Input</b>	
<b>Nominal voltage <math>U_N</math>:</b>	(= Motor voltage) 3 AC (or AC) 110, 230, 400 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency of <math>U_N</math>:</b>	45 ... 65 Hz
<b>Nominal consumption (L1-L2):</b>	max. approx. 11 VA

## Current Path

<b>Current range IK 9065, SK 9065:</b>	0.1 ... 2 A	0.5 ... 8 A*
Internal resistance:	approx. 30 m $\Omega$	approx. 10 m $\Omega$
Consumption:	max. 0.14 VA	max. 0.7 VA
	* (for higher currents use external current transformer see connection diagram)	

Short time overload:	2.5 x $I_{max}$ for 2 s, 5 x $I_{max}$ for 0.5 s
Suitable current transformers:	1 A or 5 A types, class 3, with necessary load capacity

<b>Current range SL 9065CT:</b>	5 ... 100 A via integrated current transformer in the base (max. wire-diameter: 10 mm)
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<b>Setting range <math>\cos \varphi</math>:</b>	0 ... 0.97 infinite variable
<b>Operate delay <math>t_v</math>:</b>	1 ... 100 s infinite variable

## Output

<b>Contacts:</b>	1 changeover contact
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity to AC 15</b>	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
to DC 13 at 0.1 Hz:	1 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical life to AC 15 at 1 A, AC 230 V:</b>	1.5 x 10 <sup>5</sup> switching cycles IEC/EC 60 947-5-1

<b>Short-circuit strength max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles

## General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range</b>	
Operation:	- 25 ... + 60°C
Storage:	- 25 ... + 60°C
<b>Altitude:</b>	< 2,000 m
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF-irradiation:	
80 MHz ... 1 GHz:	20 V / m IEC/EN 61 000-4-3
1.4 GHz ... 2 GHz:	20 V / m IEC/EN 61 000-4-3
2 GHz ... 2.5 GHz:	10 V / m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV IEC/EN 61 000-4-5
HF-wire guided:	10 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class A*) *) The device is designed for the usage under industrial conditions (Class A, EN 55011). When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	40 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	
Cross section:	2 x 2.5 mm <sup>2</sup> solid or 1 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
Stripping length:	10 mm

## Technical Data

<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 0,8 Nm
<b>Fixing torque:</b>	
<b>Mounting:</b>	DIN rail mounting (IEC/EN 60715) or screw mounting M4, 90 mm hole pattern, with additional clip available as accessory
<b>Weight:</b>	
IK 9065:	approx 65 g
SK 9065:	approx 84 g
SL 9065CT:	approx. 195 g

## Dimensions

<b>Width x height x depth:</b>	
IK 9065:	17.5 x 90 x 58 mm
SK 9065:	17.5 x 90 x 98 mm
SL 9065CT:	35 x 90 x 98 mm

## Classification to DIN EN 50155 for IK 9065 and SK 9065

<b>Vibration and shock resistance:</b>	Category 1, Class B IEC/EN 61 373
<b>Ambient temperature:</b>	T1, T2 compliant T3 and TX with operational limitations
<b>Protective coating of the PCB:</b>	No

## Standard Types

IK 9065.11	3 AC 400 V	0.4 ... 8 A	1 ... 100 s
Article number:	0055534		
• Output:	1 changeover contact		
• De-energized on trip:			
• Nominal voltage $U_N$ :	3 AC 400 V		
• Current range:	0.4 ... 8 A		
• Operate delay:	1 ... 100 s		
• Width:	17.5 mm		

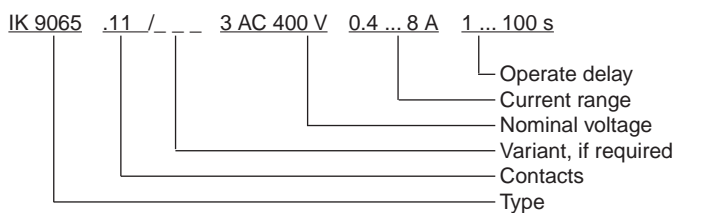
SK 9065.11	3 AC 400 V	0.4 ... 8 A	1 ... 100 s
Article number:	0055816		
• Output:	1 changeover contact		
• De-energized on trip:			
• Nominal voltage $U_N$ :	3 AC 400 V		
• Current range:	0.4 ... 8 A		
• Operate delay:	1 ... 100 s		
• Width:	17.5 mm		

SL 9065.11CT/100	3 AC 400 V	5 ... 100 A	1 ... 100 s
Article number:	0059410		
• Output:	1 changeover contact		
• Nominal voltage $U_N$ :	3 AC 400 V		
• Current range:	5 ... 100 A		
• Operate delay:	1 ... 100 s		
• programmable for: manual reset with built in or external push button, energized or de-energized on trip, selection via switch on the front			
• Width:	35 mm		

## Variants

IK 9065.11/100, SK 9065.11/100:	programmable for: manual reset with built in or external push button, energized or de-energized on trip, selection via switch on the front
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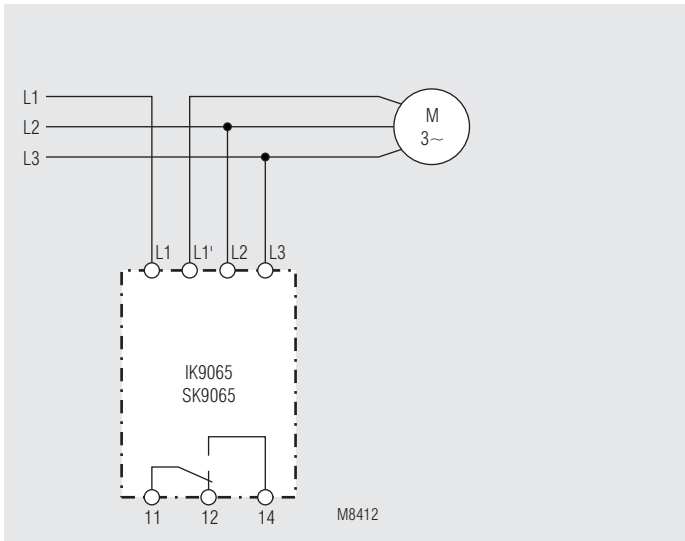
## Ordering example for variants



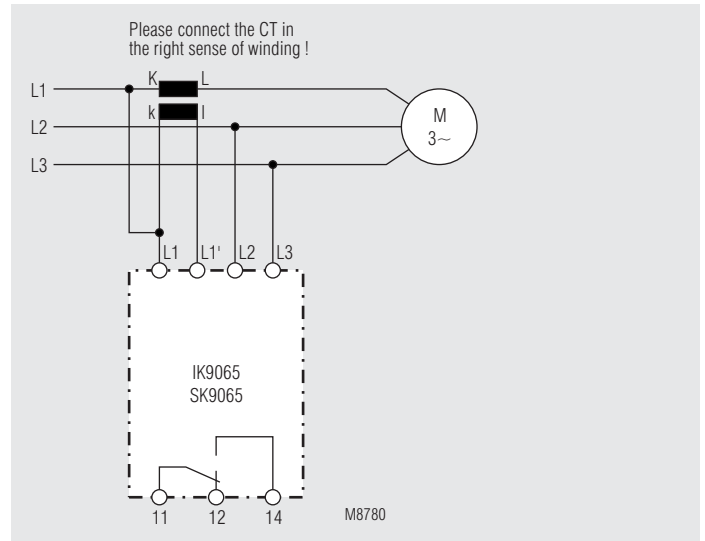
## Accessories

ET 4086-0-2:	Additional clip for screw mounting Article number: 0046578
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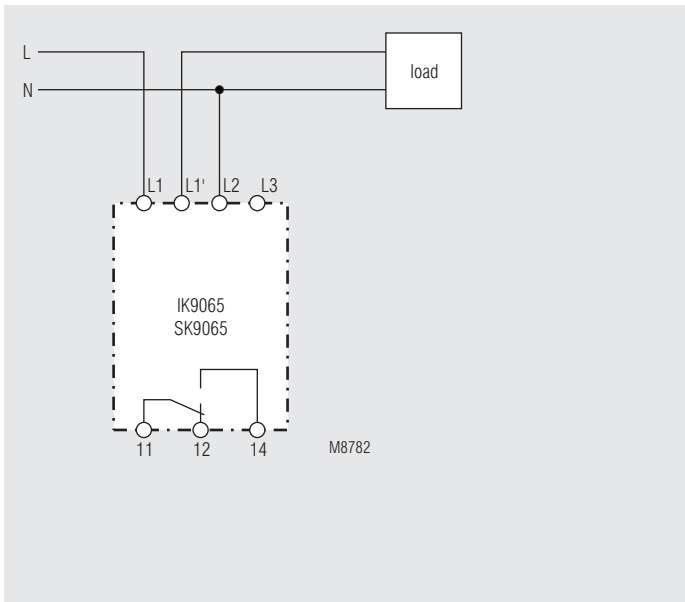
## Connection Examples



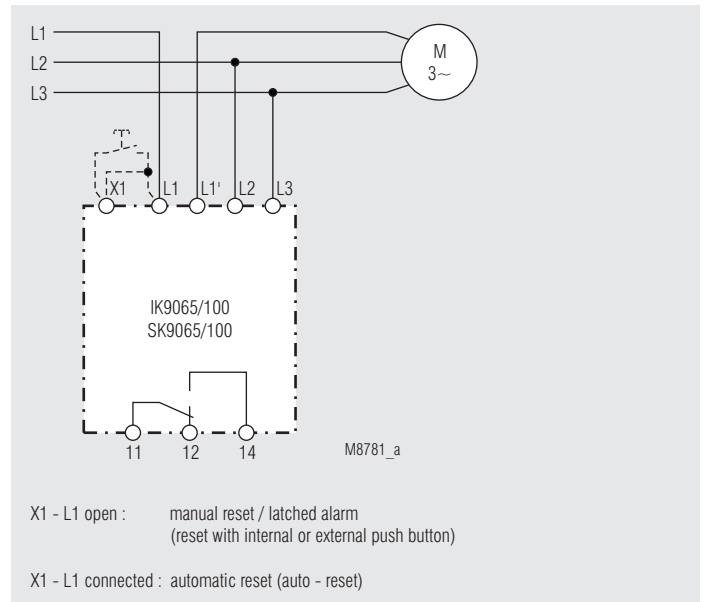
IK 9065.11 with 3-phase load



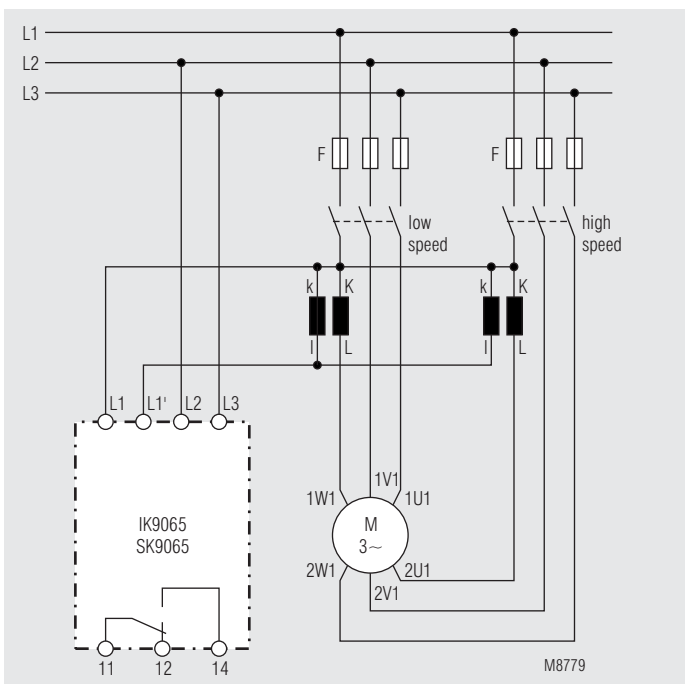
IK/SK 9065.11 with 3-phase load and external current transformer



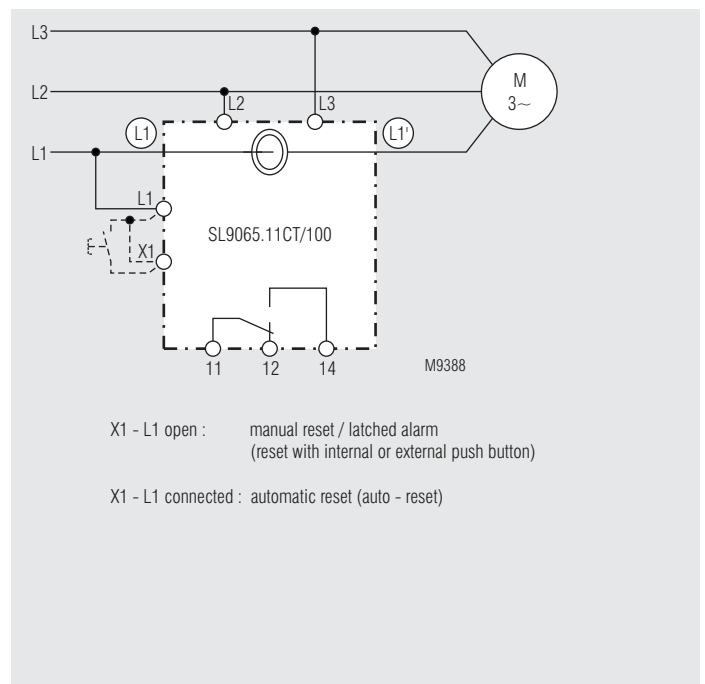
IK 9065.11 with single-phase load



IK/SK 9065.11/100 with 3-phase load



IK/SK 9065.11 for motors with separate windings



SL 9065.11CT/100

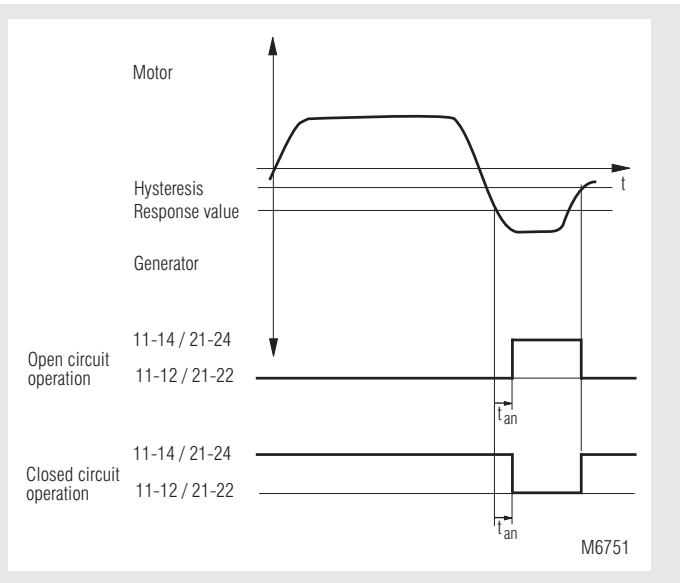
## VARIMETER

### Reverse Power Monitoring BH 9140, RP 9140



- According to IEC/EN 60 255, DIN VDE 0435-303
- Effective power measuring
- For single and 3-phases
- Adjustable response value 2 ... 20 % reverse power
- Hysteresis 12.5 %
- Rated current BH 9140: 5 A or 40 A  
Rated current RP 9140: 5 A
- Adjustable on delay
- Open circuit operation
- LED indication for voltage supply and contact position
- 2 changeover contacts
- As option closed circuit operation
- Width:  
BH 9140: 45 mm  
RP 9140: 70 mm

### Function Diagram



### Approvals and Markings



### Application

The reverse power relays BH 9140 and RP 9140 monitor the direction of the energy transport in an electrical system. This could be necessary at connection points between public supply and industrial mains e. g. when operating emergency power supplies, to avoid taht generators run as motors.

### Function

The response value can be adjusted on  $P_R$  from 2 ... 20 %. The reverse power is calculated for 3p4w and 3p3w units according to the formula:

$$U_{star} \times I_u \times \cos \varphi \times \text{response value (\%)}$$

At a setting of 20 % and  $\cos \varphi = 1$  this is for BH 9140 max.:

$$230 \text{ V} \times 5 \text{ A} \times 0.2 = 230 \text{ W}$$

$$230 \text{ V} \times 40 \text{ A} \times 0.2 = 1840 \text{ W}$$

and for RP 9140 max. :

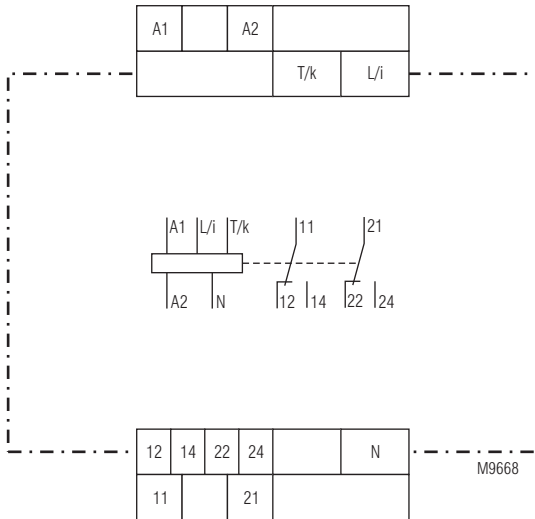
$$230 \text{ V} \times 5 \text{ A} \times 0.2 = 230 \text{ W}$$

### Indication

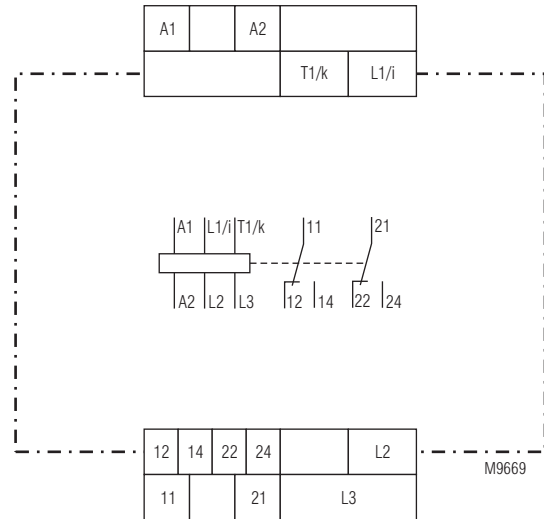
LED green: on, when auxiliary supply connected  
LED green/red: on, when corresponding output relay is active

### Notes

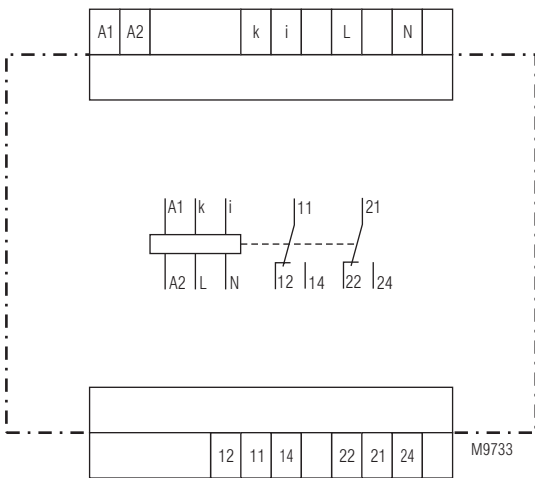
If the current is higher than the nominal current of the device an external current transformer can be used with min. 2.5 VA. The direction of the current has to be observed.



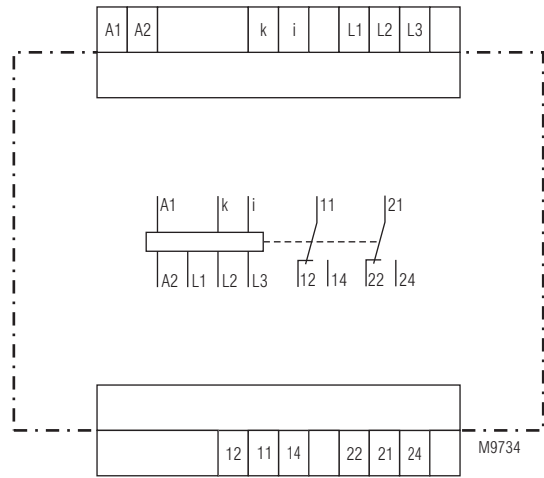
BH 9140: Version for single- and 3-phase connection with N



BH 9140: Version for 3-phase connection without N



RP 9140: Version for single- and 3-phase connection with N



RP 9140: Version for 3-phase connection without N

## Technical Data

### Measuring Circuit

#### Voltage

Nominal voltage $U_N$	
L1-N:	AC 110, 230 V
L1-L2-L3:	3 AC 110, 230, 400, 440 V
max. overload:	1.1 $U_N$

#### Current

Nominal current:	5 A / (40 A only for BH 9140)
max. overload:	15 A

#### Power

Response value:	2 ... 20 % reverse power
Hysteresis:	12.5 % of set response value
Frequency range:	45 ... 65 Hz
On delay $t_{an}$ :	adjustable 0.2 ... 10 s

### Auxiliary Circuit

<b>Auxiliary voltage A1, A2:</b>	AC 110, 230, 400, 440 V, DC 24 V*)
	*) only for BH 9140

<b>Voltage range:</b>	0.8 ... 1.1 $U_H$
-----------------------	-------------------

<b>Frequency range:</b>	45 ... 65 Hz
-------------------------	--------------

<b>Nominal consumption:</b>	< 4 VA
-----------------------------	--------

### Output

<b>Contacts:</b>	2 changeover contacts
------------------	-----------------------

<b>Thermal current <math>I_{th}</math>:</b>	2 x 5 A
---	---------

#### Switching capacity

according to AC 15

NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
-------------	----------------	-------------------

NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
-------------	----------------	-------------------

according to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1
---------------------	---------------	-------------------

<b>Electrical life</b>		IEC/EN 60 947-5-1
------------------------	--	-------------------

acc. to AC 15 at 3 A, AC 230 V: 2 x 10<sup>5</sup> switching cycles

#### Permissible

<b>switching frequency:</b>	1800 switching cycle/H
-----------------------------	------------------------

#### Short circuit strength

<b>max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
--------------------------	--------	-------------------

<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles
-------------------------	---------------------------------------

### General Data

<b>Nominal operating mode:</b>	continuous operation
--------------------------------	----------------------

#### Permissible ambient-/

<b>storage temperature:</b>	- 20 ... + 60°C
-----------------------------	-----------------

#### Clearance and creepage distance

rated impulse voltage /		
pollution degree:	4 kV / 2	IEC 60 664-1

#### EMC

Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
--------------------------------	------------	-------------------

Fast transients:	2 kV	IEC/EN 61 000-4-4
------------------	------	-------------------

#### Surge

between		
wires for power supply:	1 kV	IEC/EN 61 000-4-5

between wire and ground:	2 kV	IEC/EN 61 000-4-5
--------------------------	------	-------------------

interference suppression:	Limit value class B	EN 55 011
---------------------------	---------------------	-----------

#### Degree of protection:

Housing:	IP 40	IEC/EN 60 529
----------	-------	---------------

Terminals:	IP 20	IEC/EN 60 529
------------	-------	---------------

#### Housing:

Thermoplastic with V0 behaviour

according to UL subject 94

<b>Vibration resistance:</b>	Amplitude 0.35 mm	
------------------------------	-------------------	--

	Frequency 10 ... 55 Hz	IEC/EN 60 068-2-6
--	------------------------	-------------------

	20 / 060 / 04	IEC/EN 60 068-1
--	---------------	-----------------

	EN 50 005	
--	-----------	--

#### Wire connection BH 9140

load terminals:	1 x 10 mm <sup>2</sup> solid or
-----------------	---------------------------------

	1 x 6 mm <sup>2</sup> stranded wire with sleeve
--	---

control terminal:	1 x 4 mm <sup>2</sup> solid or
-------------------	--------------------------------

	2 x 1.5 mm <sup>2</sup> stranded wire with sleeve or
--	--

	1 x 2.5 mm <sup>2</sup> stranded wire with sleeve
--	---

	DIN 46 228-1/-2/-3/-4
--	-----------------------

<b>Wire fixing BH 9140:</b>	Box terminals with self-lifting wire protection and Plus-minus terminal screws M3.5
-----------------------------	---

## Technical Data

### Wire connection RP 9140:

fixed screw terminal (S):	0.2 ... 4 mm <sup>2</sup> solid or
	0.2 ... 1.5 mm <sup>2</sup> stranded wire with sleeve

### Wire fixing RP 9140:

	Flat screws M 2,5
	box terminals with wire protection
	DIN rail IEC/EN 60 715

### Mounting:

<b>Weight:</b>	
----------------	--

BH 9140:	430 g
----------	-------

RP 9140:	250 g
----------	-------

### Dimensions

#### Width x height x depth:

BH 9140:	45 x 84 x 121 mm
----------	------------------

RP 9140:	70 x 90 x 71 mm
----------	-----------------

## Standard Types

BH 9140.12/001	3 AC 400 V	5 A	AC 230 V	10 s
----------------	------------	-----	----------	------

Article number:	0060919
-----------------	---------

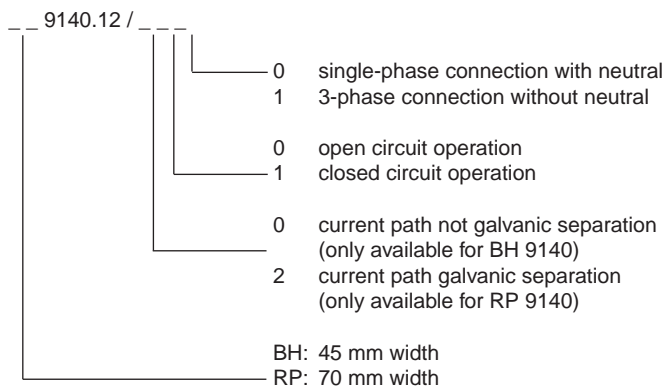
- open circuit operation
- 3-phase connection without neutral
- Response value: 2 ... 20 %
- Nominal voltage  $U_N$ : 3 AC 400 V
- Nominal current: 5 A
- Auxiliary voltage  $U_H$ : AC 230 V
- On delay: 0.2 ... 10 s
- Width: 45 mm

RP 9140.12/201	3 AC 400 V	5 A	AC 230 V	10 s
----------------	------------	-----	----------	------

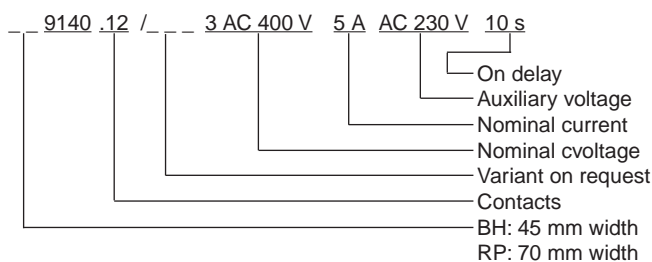
Article number:	0061258
-----------------	---------

- Open circuit operation
- 3-phase connection without neutral
- Response value: 2 ... 20 %
- Nominal voltage  $U_N$ : 3 AC 400 V
- Nominal current: 5 A
- Auxiliary voltage  $U_H$ : AC 230 V
- On delay: 0.2 ... 10 s
- Width: 70 mm

## Variants



## Ordering example for variants

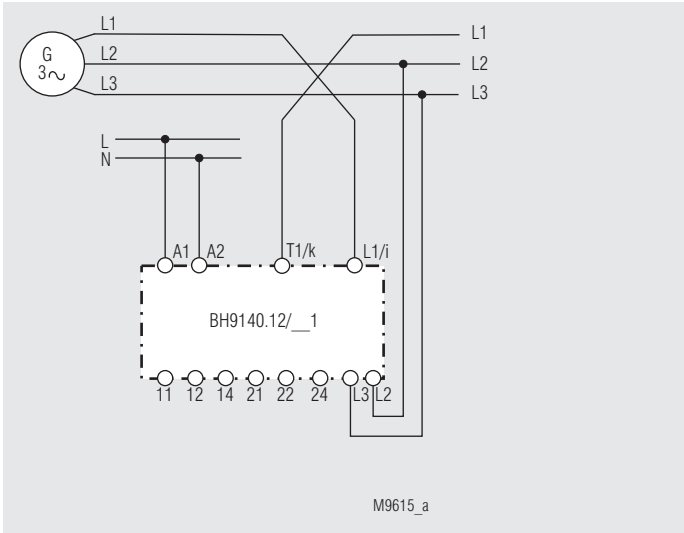


## Setting Facilities

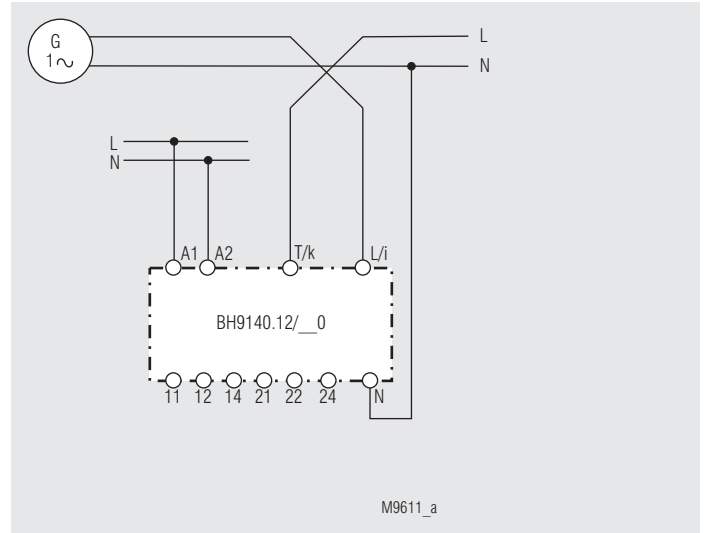
Response value	
Reverse power:	2 ... 20 %
On delay:	0.2 ... 10 s



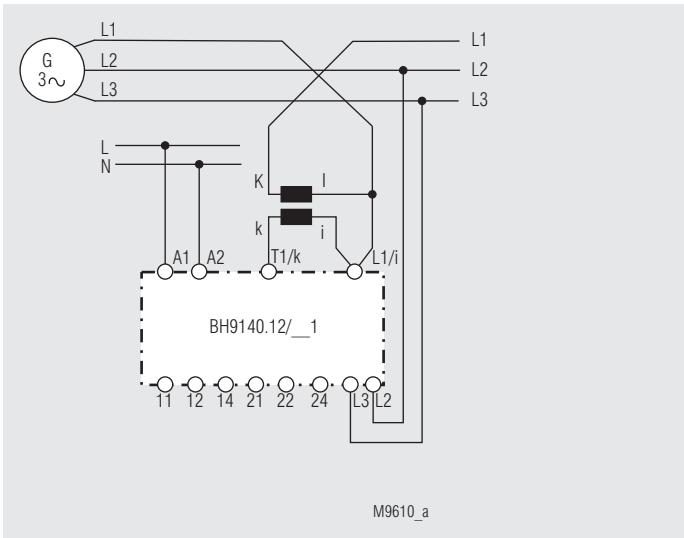
Connection Examples BH 9140



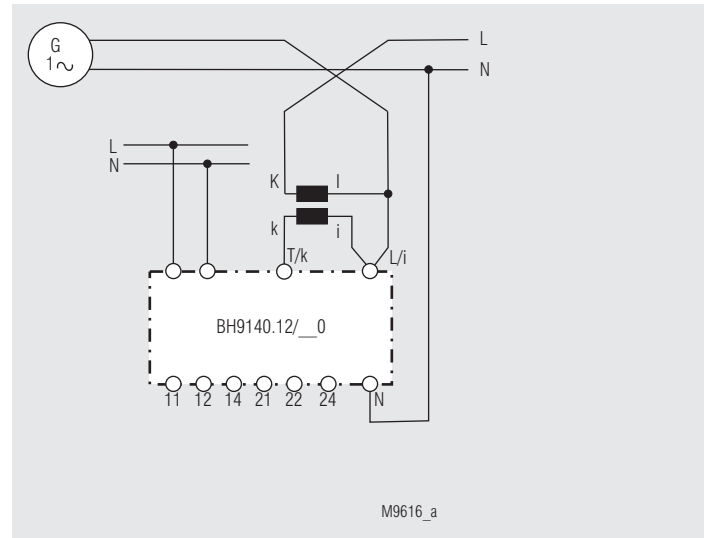
For 3-phase connection without N



For single or 3-phase connection with N

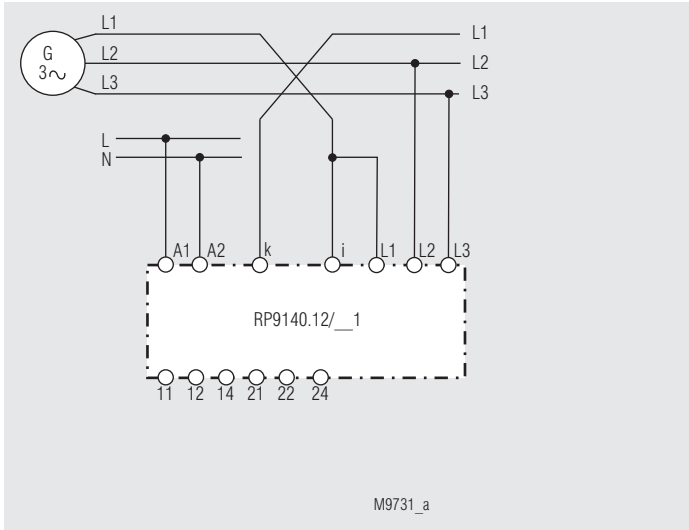


For 3-phase connections with current transformer (external).

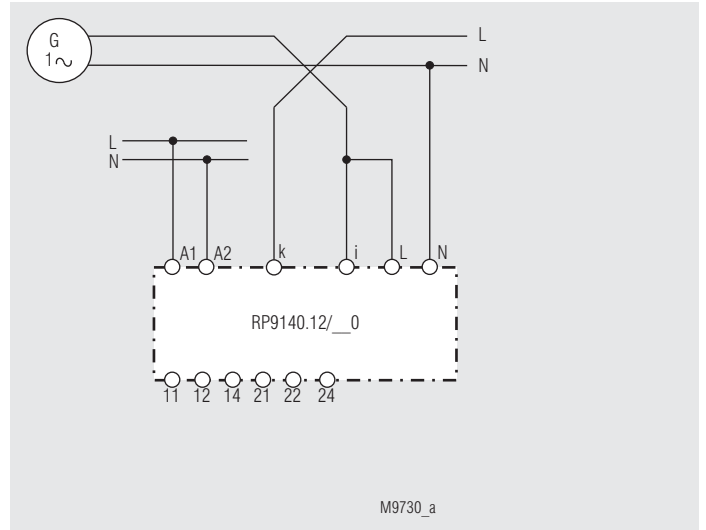


For single or 3-phase connections with current transformer (external)

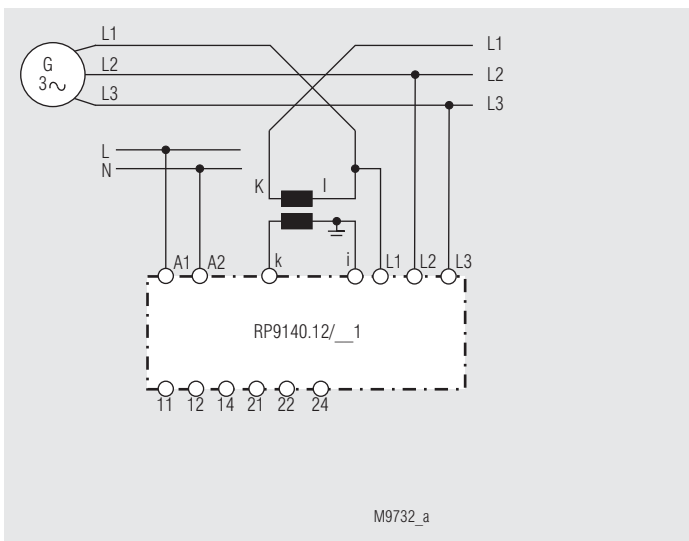
Connection Examples RP 9140



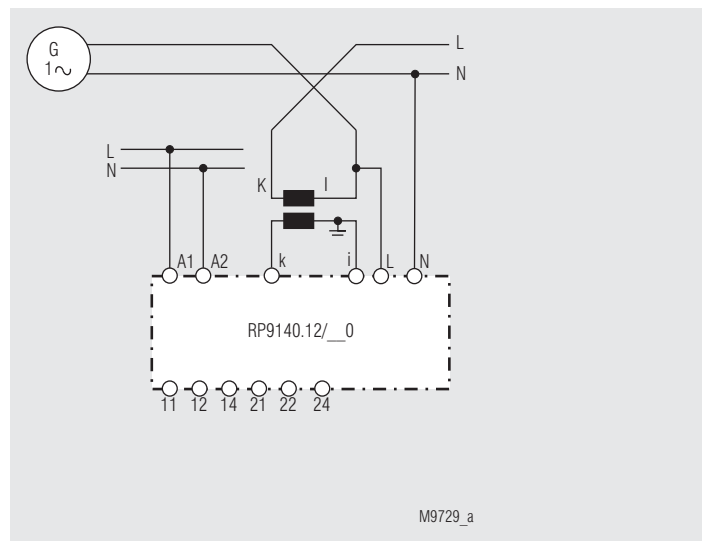
For 3-phase connection without N



For single or 3-phase connection without N



For 3-phase connections with current transformer (external).



For single or 3-phase connections with current transformer (external)

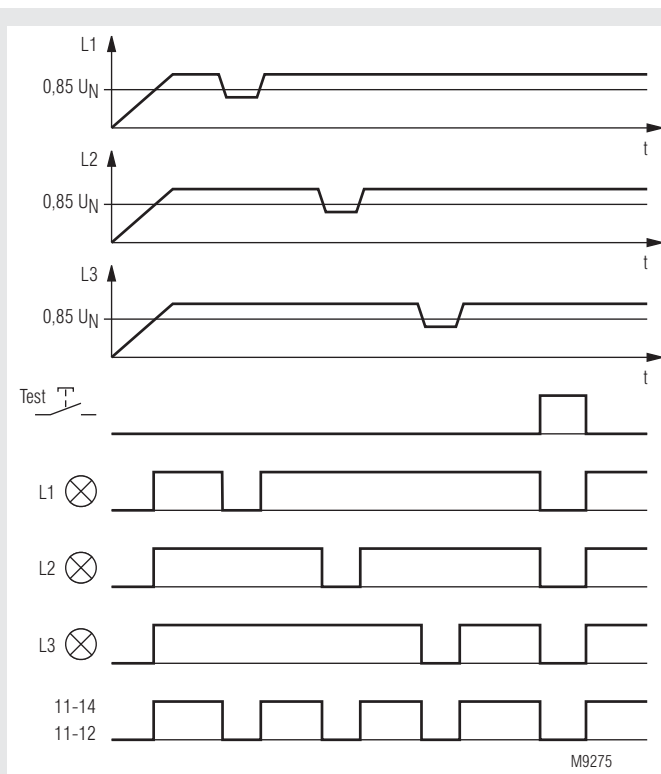
## VARIMETER

Undervoltage Relay, 3-Phase With Test Key  
IL 9176

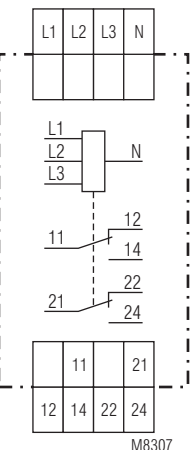


- According to IEC/EN 60 255
- Detection of
  - undervoltage 1 up to 3-phase,  $0.85 \times U_N$
  - phase failure
- Without auxiliary voltage
- De-energized on trip
- LED indicator for L1, L2, L3 with test key to simulate failure
- 2 changeover contacts
- Width 35 mm

### Function Diagram



### Circuit Diagram



### Approvals and Markings



### Application

Voltage monitoring of 3-phase systems  
IL 9176.12/108 for installations according to DIN VDE 0108

### Function

On a healthy voltage system all 3 LEDs are on. The output contacts 11-14 and 21-24 are closed. By pressing the test button a failure is simulated and the relay contacts de-energise. This allows to test the circuit. When having asymmetric loads in the circuit the unit detects also a broken neutral wire. If the voltage drops below  $0.85 \times U_N$  in one phase, the corresponding LED and the relay contacts switch off.

### Indication

- L1: phase voltage L1 present
- L2: phase voltage L2 present
- L3: phase voltage L3 present

### Technical Data

#### Input (L1, L2, L3, N)

**Nominal voltage  $U_N$ :** 3/N AC 400 / 230 V  
**Max. overload:**  $1.1 U_N$ , continuously  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz

#### Input current

**L1:** 25 mA / AC 230 V  
**L2:** 1 mA / AC 230 V  
**L3:** 1 mA / AC 230 V

#### Nominal consumption:

**Response value:**  $0.85 U_N$ , fixed  
**Hysteresis:** approx. 5 %  $U_N$

#### Start up delay

( $0_V \rightarrow U_N$ ): approx. 500 ms

#### Release delay

( $U_N \rightarrow 0_V$ ): approx. 70 ms

### Output

**Contact:** 2 changeover contacts  
**Thermal current  $I_{th}$ :** 2 x 4 A

**switching capacity**  
 according to AC 15:

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1

#### Electrical life

acc.to AC 15 bei 1 A / AC 230 V:  $5 \times 10^6$  switching cycles IEC/EN 60 947-5-1

## Technical Data

### Short circuit strength

<b>Max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>8</sup> switching cycles	

## General Data

**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distance

rated impulse voltage / pollution degree:	4 kV / 2	IEC 60 664-1
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### Test voltage

Input / output	AC 2.5 kV	IEC/EN 61 810-4-2
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### EMC

Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
--------------------------------	------------	-------------------

Fast transients:	4 kV	IEC/EN 61 000-4-4
------------------	------	-------------------

### Surge voltage

between

wires for power supply:	1 kV	IEC/EN 61 000-4-5
-------------------------	------	-------------------

between wire and ground:	2 kV	IEC/EN 61 000-4-5
--------------------------	------	-------------------

Interference suppression:	Limit value class B	EN 55 011
---------------------------	---------------------	-----------

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
----------	-------	---------------

Terminals:	IP 20	IEC/EN 60 529
------------	-------	---------------

**Housing:** thermoplastic with VO behaviour  
according to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm,  
Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

**Leiteranschluß:** 2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228-1/-2/-3/-4

### Wire connection:

Flat terminals with self-lifting  
clamping piece IEC/EN 60 999-1

<b>Mounting:</b>	DIN-rail	IEC/EN 60 715
------------------	----------	---------------

<b>Weight:</b>	105 g	
----------------	-------	--

## Dimensions

<b>Width x height x depth:</b>	35 x 90 x 59 mm
--------------------------------	-----------------

## Standard Type

IL 9176.12 3/N AC 400/230V	50/60 Hz
Article number:	0059134
• Nominal voltage U <sub>N</sub> :	3/N AC 400/230 V
• Output:	2 changeover contacts
• Width:	35 mm

## Variant

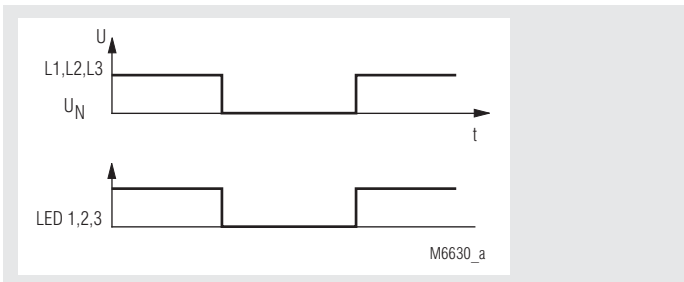
IL 9176.12/108:	with Marking „Für Anlagen nach DIN VDE 0108“ (for systems according to DIN VDE 0108)
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## VARIMETER Phase Indicator IK 9168, SK 9168



- According to IEC/EN 60 255, DIN VDE 0435-303
- Indication of phase failure in 3-phase systems
- Single phase connection possible
- Independent of phase sequence
- LED indicator for each phase
- **Devices available in 2 enclosure versions:**
  - IK 9168:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9168:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



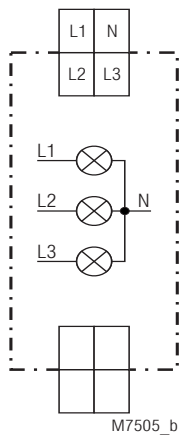
### Applications

Indication of phase failure in 3-phase systems

### Indicators

LED L1, L2, L3: on when corresponding phase is present

### Circuit Diagram



IK 9168, SK 9168

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3/N AC 400 / 230 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Input current at  $U_N$ :** 0.2 mA  
**Nominal consumption:** 0.5 VA per input  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz  
**Operate value:** 0.5  $U_N \pm 10\%$

#### General Data

**Operating mode:** Continuous operation  
**Temperature range:** - 20 ... + 60°C  
**Clearance and creepage distances**  
 rated impulse voltage / pollution degree (between L1-L2-L3-N): 4 kV / 2 IEC 60 664-1  
**EMC**  
 Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2  
 HF irradiation: 10 V/m IEC/EN 61 000-4-3  
 Fast transients: 2 kV IEC/EN 61 000-4-4  
 Surge voltages between wires for power supply: 2 kV IEC/EN 61 000-4-5  
 between wire and ground: 4 kV IEC/EN 61 000-4-5  
 Interference suppression: Limit value class B EN 55 011  
**Degree of protection**  
 Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529  
**Housing:** Thermoplastic with V0 behaviour according to UL subject 94  
**Vibration resistance:** Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz  
**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1  
**Terminal designation:** EN 50 005

## Technical Data

<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight</b>	
IK 9168:	50 g
SK 9168:	70 g

## Dimensions

### Width x height x depth

IK 9168:	17.5 x 90 x 59 mm
SK 9168:	17.5 x 90 x 98 mm

## Standard Type

IK 9168	3/N AC 400 / 230 V	50/60 Hz	
Article number:	0049174		stock item
• Nominal voltage $U_N$ :	3/N AC 400 / 230 V		
• Width:	17.5 mm		
SK 9168	3/N AC 400 / 230 V	50/60Hz	
Article number:	0054712		
• Nominal voltage $U_N$ :	3/N AC 400 / 230 V		

## Ordering example

IK 9168	3/N AC 400/230 V	50/60 Hz	
			Nominal frequency
			Nominal voltage
			Type

## VARIMETER Phase Monitor RK 9872



### Your Advantages

- Reliability monitoring of 3- or 1-phase voltage systems on:
  - Undervoltage
  - Overvoltage
  - Phase sequence (at 3-phase voltage system)
- Fast fault location
- Preventive maintenance
- Space saving

### Features

- According to IEC/EN 60255-1
- Detection of under-/overvoltage and phase sequence in 3-phase voltage systems
- Without separate auxiliary voltage
- LED-Indication for operation voltage and contact position
- De-energized on trip
- With fixed response value for undervoltage
- With fixed response value for overvoltage
- Width: 17,5 mm

### Product Description

The space saving phase monitor RK9872/800 from the Varimeter family monitors under- and overvoltage as well as phase sequence in 3-phase systems.

The response values are fixed. When connecting the measuring voltage to the inputs L1-L2-L3 and fault free system the relay switches on.

When the measuring voltage is connected the unit checks a clockwise phase sequence. If this is not the case the yellow LED flashes. The output relay will not energise. After detection of under- or overvoltage on one or more phases for more than 5 sec. the relay switches off. The relay stays off for at least 2 seconds. The phase monitor measures the arithmetic mean value of the 3 phases against neutral.

### Approvals and Markings



### Application

Monitoring of voltage systems on undervoltage, overvoltage and phase sequence, e. g. for applications with squirrel cage motors and -machines, cranes, elevator, escalator, pumps, aircondition.

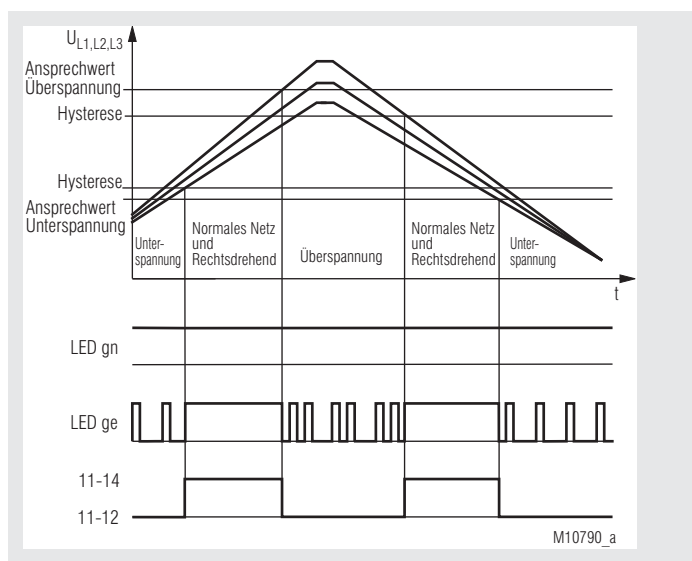
### Indicators

- |             |   |
|-------------|---|
| green LED:  | on, when nominal voltage connected            |
| yellow LED: | on, when corresponding output relay is active |
| yellow LED: | flashes at failure with code:                 |
|             | 1 x at undervoltage                           |
|             | 2 x at overvoltage                            |
|             | 3 x at phase reversal                         |

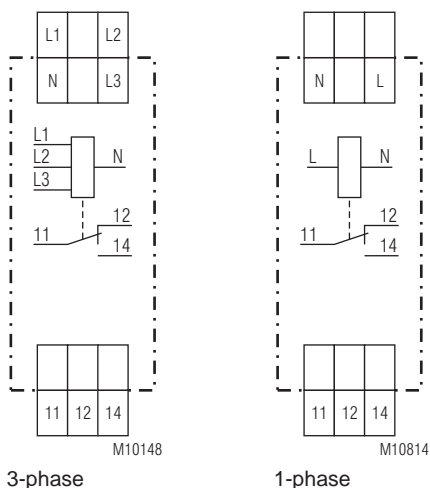
### Safety Notes

- Faults must only be removed when the relay is disconnected.
- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).
- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.
- If the connected system creates a reverse voltage above the undervoltage response value the failure cannot be detected.

### Function Diagramm



## Circuit Diagram



## Connection Terminals

Terminal designation	Signal designation
L1	Phase voltage L1
L2	Phase voltage L2
L3	Phase voltage L3
L	Phase voltage L
N	Neutral
11, 12, 14	Changeover contact (output relay)

## Technical Data

### Input

Measuring voltage = supply voltage

Nominal voltage $U_N$ :	3/N AC 400/230V
Max. overload:	1.15 $U_N$ continuously
Nominal consumption:	approx. 6 VA
Nominal frequency:	50 / 60 Hz
Measuring frequency range:	45 ... 65 Hz

Response value*):	3-phase		1-phase	
	3N AC 400 / 230 V	AC 400 V	AC 110 V	
Undervoltage:	195.5 V	360 V	99 V	
Overvoltage:	253 V	440 V	121 V	
Hysteresis:	2.5 %	1.5 %	2.0 %	
Accuracy:				± 3%
Repeat accuracy:				< 2%
Temperature influence:				< 1%

\*) the response values are fixed and measured against N

Reaction time:	≤ 50 ms
Overvoltage category:	III (according to IEC 60664-1)

### Output

Contacts:	1 changeover contact	
Thermal current $I_{th}$ :	4 A	
Switching capacity to AC 15:		
NO contacts:	2 A / AC 230 V	IEC/EN 60 947-5-1
NC contacts:	1 A / AC 230 V	IEC/EN 60 947-5-1
Electrical life to AC 15 at 1 A, AC 230 V:	1 x 10 <sup>5</sup> switch. cycl. IEC/EN 60 947-5-1	
Mechanical life:	1 x 10 <sup>6</sup> switching cycles	

## Technical Data

### General Data

Nominal operating mode:	continuous operation
Temperature range:	
Operation:	- 25 ... + 60°C
Storage:	- 25 ... + 70°C

### Clearance and creepage distance

contact / measuring voltage		
rated impuls voltage / pollution degree:	6 kV / 2	IEC 60 664-1

### EMC

Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages		
between power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011

### Degree of protection

Enclosure:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

### Housing:

thermoplastic with VO behaviour acc. to UL subject 94	
Vibration resistance:	Amplitude 0.35 mm, Frequency 10 ... 55 Hz IEC/EN 60 068-2-6 25 / 060 / 04 IEC/EN 60 068-1 EN 50 005
Climate resistance:	
Terminal designation:	
Wire connection:	DIN 46 228-1/-2/-3/-4

### Fixed screw terminals

Cross section:	0.34 ... 2.5 mm <sup>2</sup> (AWG 22 - 14) solid or 0.34 ... 2.5 mm <sup>2</sup> (AWG 22 - 14) stranded wire with and without ferrules
Stripping length:	7 mm

Fixing torque:	0.5 Nm	EN 60 999-1
Wire fixing:	Captive slotted screw / M2.5	
Mounting:	DIN-rail	IEC/EN 60 715
Weight:	approx. 70 g	

### Dimensions

Width x height x depth:	17.5 x 90 x 66 mm
-------------------------	-------------------

## Standard Type

RK 9872.11	3/N AC 400/230 V	50 / 60 Hz
Article number::	0065075	
• Output:	1 changeover contact	
• Nominal voltage $U_N$ :	3/N AC 400/230 V	
• Width:	17.5 mm	

## Variant

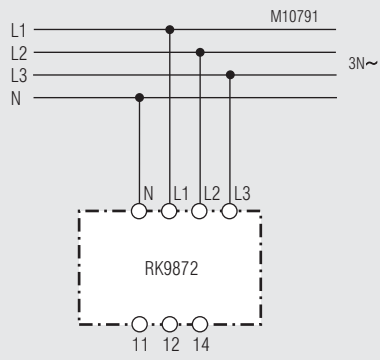
RK 9872.11/100:	Undervoltage / overvoltage monitoring
-----------------	---------------------------------------

## Ordering example for variant

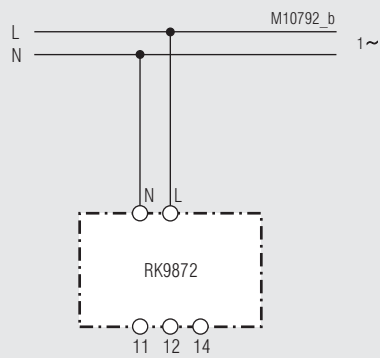
RK 9872 / _ _ 0	
	0 Standard
	0 without time delay
	1 with time delay 0.5 s
	0 Function undervoltage overvoltage phase sequence
	1 Function undervoltage overvoltage



## Connection Examples



3-phase



1-phase

## VARIMETER Phase Monitor IK 9169, RK 9169, SK 9169

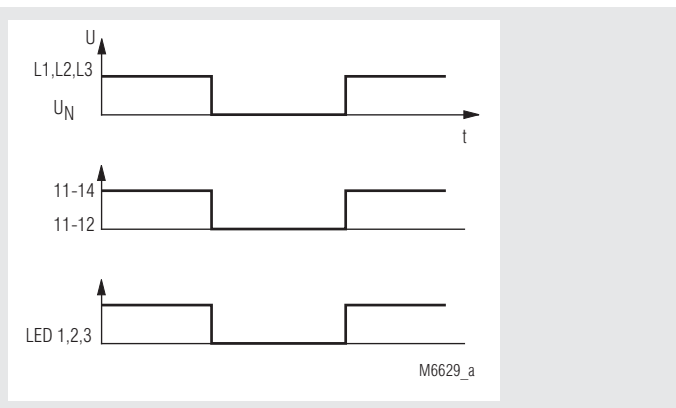


0225117



- According to IEC/EN 60 255-1
- Detection of phase failure in 3-phase systems
- Single phase connection possible
- Closed circuit operation
- Independent of phase sequence
- LED indicator for each phase
- Output 1 changeover contact
- Devices available in 2 enclosure versions:
  - I- and R-versions, e.g. IK 9169 with depth 61 mm or RK 9169 with depth 71 mm with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43880
  - S-version, e.g. SK 9169: depth 100 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



### Applications

Detection of phase failure in 3-phase systems

### Indicators

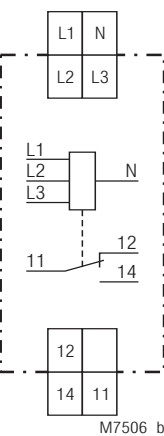
LED L1, L2, L3: on, when phase is present

### Notes

On broken or disconnected neutral the LEDs are off although the 3 phases are present.

In this case measurement is necessary to prove that no voltage is present.

### Circuit Diagram



IK 9169, RK 9169, SK 9169

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3/N AC 380 ... 415 / 220 ... 240 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz  
**Response value:** 0.7  $U_N \pm 10\%$

#### Output

##### Contact

IK 9169, RK 9169, SK 9169: 1 changeover contact  
**Thermal current  $I_{th}$ :** 4 A

##### Switching capacity

to AC 15  
 NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
 NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical life** IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: typ. 300 000 switching cycles

##### Short-circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

### Connection Terminals

Terminal designation	Signal designation
L1, L2, L3, N	Measuring input or. supply voltage
11, 12, 14	Changeover contact

**Technical Data****General Data****Operating mode:** Continuous operation**Temperature range:**

Operation: - 20 ... + 60°C

Storage: - 25 ... + 60°C

**Altitude:** < 2.000 m**Clearance and creepage distances**

rated impulse voltage /

pollution degree

(between L1-L2-L3-N): 4 kV / 2 IEC 60 664-1

input / output: 4 kV / 2 IEC 60 664-1

**EMC**

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 2.7 GHz: 10 V/m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

**Degree of protection**

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:**Thermoplastic with V0 behaviour  
according to UL subject 94**Vibration resistance:**Amplitude 0.35 mm  
frequency 10 ... 55 Hz IEC/EN 60 068-2-6The 1 MHz slow damped oscillator test according to IEC/EN 60255-1  
has not been made.**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1**Terminal designation:** EN 50 005**Wire connection:** DIN 46 228-1/-2/-3/-4**IK 9169, SK 9169**Cross section: 2 x 0,6 ... 2,5 mm<sup>2</sup> solid or  
2 x 0,28 ... 1,5 mm<sup>2</sup> stranded wire with  
and without ferrules

Stripping length: 10 mm

Leiterbefestigung: Plus-Minus-terminal screws M3,5 with  
self-lifting clamping piece**RK 9169**Cross section: 0,5 ... 10 mm<sup>2</sup> solid or  
0,5 ... 6 mm<sup>2</sup> mm<sup>2</sup> stranded wire with  
and without ferrules

Stripping length: 10 mm

**Wire fixing:** Captive slotted screw / M3,5**Fixing torque:** 0.8 Nm**Mounting:** DIN rail IEC/EN 60 715**Weight**

IK 9169: 60 g

RK 9169: 75 g

SK 9169: 80 g

**Dimensions****Width x height x depth**

IK 9169: 17.5 x 90 x 59 mm

RK 9169: 17.5 x 90 x 71 mm

SK 9169: 17.5 x 90 x 98 mm

**Standard Types**

IK 9169.11 3/N AC 380 ... 415 / 220 ... 240 V 50/60 Hz

Article number: 0049177

RK 9169.11 3/N AC 380 ... 415 / 220 ... 240 V 50/60 Hz

Article number: 0060316

SK 9169.11 3/N AC 380 ... 415 / 220 ... 240 V 50/60Hz

Article number: 0054713

- Output: 1 changeover contact
- Nominal voltage  $U_N$ : 3/N AC 380 ... 415 / 220 ... 240 V
- Width: 17.5 mm

## VARIMETER

Phase Sequence Module  
IL 9059, SL 9059, OA 9059



0269442



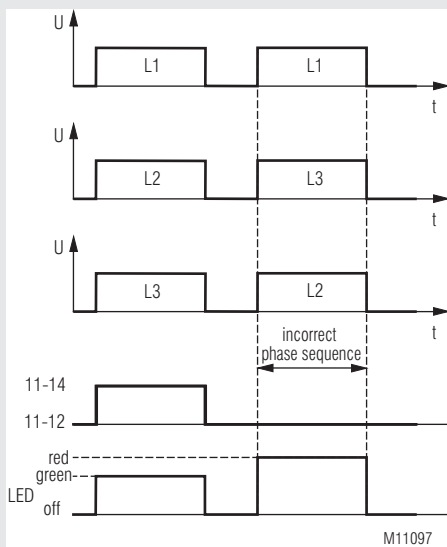
### Your Advantages

- Protects mobile equipment against damage or destruction coming from wrong phase sequence
- OA 9059: reduced wiring by mounting directly in the motor connection box

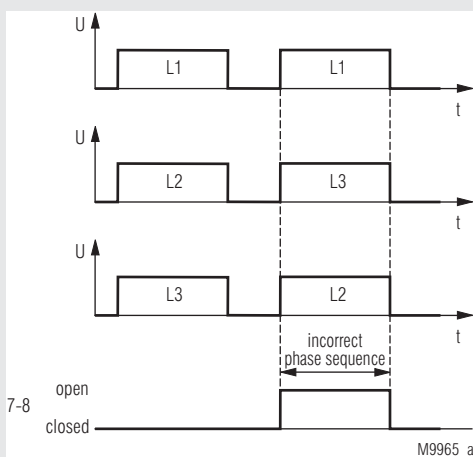
### Features

- According to IEC/EN 60255-1
- Detection of incorrect phase sequence
- No separately auxiliary voltage necessary
- Nominal voltage range 3 AC 380 ... 690 V
- Suitable for operation with inverters (f = 40 ... 80 Hz)
- Relay output:
  - IL/SL 9059: 1 changeover contact
  - OA 9059: 1 NC contact
- Extended temperature range
- Devices available in 3 enclosure versions:
  - IL 9059: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9059: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
  - OA 9059: sealed modul with stranded wire connection suitable for mounting in terminal box
- Width
  - IL/SL 9059: 35 mm
  - OA 9059: 62 mm

### Function Diagrams



IL 9059, SL 9059



OA 9059/001

### Approvals and Markings



\*) only IL 9059

### Applications

In many application with pumps, conveyors and fans efficient monitoring systems should help to detect failures and misfunctions in time, to avoid damage and long times of non-operation.

Besides speed and frequency the monitoring of phase sequence is very important.

The phase sequence relay with it's wide voltage range of 3AC380-690V detects a wrong phase sequence and signals via a galvanically separated relay contact the wrong rotation of a motor.

By integrating the relay output into the enabling circuit of a plant, the unit disables the start of the plant in the case of wrong phase sequence. especially portable equipment can be protected in this way.

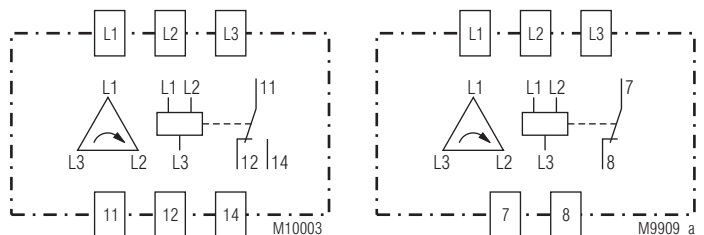
### Indicators

2-colour LED at IL/SL 9059

green: correct phase sequence  
contacts 11-14 closed

red: incorrect phase sequence  
contacts 11-12 closed

### Circuit Diagrams



IL 9059, SL 9059

OA 9059

Connection Terminals	
Terminal designation	Signal designation
L1, L2, L3	Input circuit OA 9059: L1 (red), L2 (blue), L3 (grey)
7, 8 (OA 9059)	NO contact: 7 (yellow), 8 (green)
11,12,14 (IL/SL 9059)	Changeover contact

### Technical Data

#### Input circuit

<b>Nominal voltage <math>U_N</math>:</b>	3 AC 380 ... 690 V
<b>Voltage range:</b>	0.85 ... 1.1 $U_N$ (3 AC 320 ... 760 V)
<b>Nominal frequency:</b>	ca. 3 VA
<b>Frequency range:</b>	40 ... 80 Hz (main frequency); suitable for operation with inverters with independant pulse frequency

#### Output

##### Contact

IL/SL 9059:	1 changeover contacts
OA 9059:	1 NC contact
<b>Contact material:</b>	AgNi 0.15 gold plated
<b>Switching voltage:</b>	AC 250 V
<b>Response time:</b>	After connection of all 3 phase with incorrect phase sequence until NC contact at OA 9059/001 opens: approx. 100 ms

##### Thermal current $I_{th}$ :

IL/SL 9059:	5 A
OA 9059:	2 A

##### Switching capacity IL/SL 9059

to AC 15:	2 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	2 A / DC 24 V	IEC/EN 60 947-5-1

##### Switching capacity OA 9059

to AC 15:	1 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1

##### Electrical life:

1.5 x 10<sup>5</sup> switching cycles

##### Short circuit strength

##### max. fuse rating:

IL/SL 9059:	4 A gL	IEC/EN 60 947-5-1
OA 9059:	2 A gL	IEC/EN 60 947-5-1

##### Mechanical life:

≥ 30 x 10<sup>6</sup> switching cycles

### General Data

**Operating mode:** Continuous operation

#### Temperature range

##### Operation

IL/SL 9059:	- 30 ... + 70°C
OA 9059:	- 30 ... + 75°C

##### Storage

IL/SL 9059:	- 40 ... + 70°C
OA 9059:	- 45 ... + 75°C

Relative air humidity: 93 % at 40 °C

##### Altitude:

< 2,000 m

#### Clearance and creepage distances

rated rated impulse voltage voltage /

pollution degree;

Output to Input:	6 kV / 3	IEC 60 664-1
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#### EMC

Statische Entladung (ESD): 8 kV (Luftentladung) IEC/EN 61 000-4-2

##### HF irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

##### IL/SL 9059:

1 GHz ... 2 GHz: 3 V / m IEC/EN 61 000-4-3

2 GHz ... 2.7 GHz: 3 V / m IEC/EN 61 000-4-3

##### OA 9059:

1 GHz ... 2 GHz: 10 V / m IEC/EN 61 000-4-3

2 GHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

##### HF-wire guided

IL/SL 9059: 30 V / m IEC/EN 61 000-4-6

OA 9059: 10 V / m IEC/EN 61 000-4-6

Surge voltages: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Technical Data

#### Degree of protection:

IL/SL 9059: Housing: IP 40 EN 60 529

Terminals: IP 20 EN 60 529

Module is completed sealed-in

OA 9059:

#### Housing:

IL/SL 9059: Thermoplastic with V0 behaviour  
according to UL subject 94

OA 9059: Potting compound UL approval

**Vibration resistance:** Amplitude 0.35 mm,  
frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

#### Climate resistance:

IL/SL 9059: 30 / 070 / 04 IEC/EN 60 068-1

OA 9059: 30 / 075 / 04 IEC/EN 60 068-1

#### Wire connection:

IL/SL 9059: 2 x 2.5 mm<sup>2</sup> solid DIN 46 228  
2 x 1.5 mm<sup>2</sup> stranded ferruled  
DIN 46 228-1 /-2 /-3

OA 9059:

L1; L2; L3: 0.5 mm<sup>2</sup>, double insulation

7; 8: 0.25 mm<sup>2</sup>, double insulation

wire length: 25 cm

**Wire fixing IL/SL 9059:** Flat terminals with self-lifting clamping  
piece EN 60 999

#### Fixing torque:

IL/SL 9059: 0.8 Nm

#### Mounting

IL/SL 9059: DIN rail IEC/EN 60 715

OA 9059

Mounting screws: M4 x 25 mm

Mounting torque: 1.2 Nm

#### Weight:

IL 9059: approx. 215 g

SL 9059: approx. 245 g

OA 9059: approx. 180 g

### Dimensions

#### Width x height x depth:

IL 9059: 35 x 90 x 59 mm

SL 9059: 35 x 90 x 98 mm

OA 9059: 62 x 62 x 25 mm

## Standard Type

IL 9059.11 3 AC 380 ... 690 V 40 ... 80 Hz  
for mounting in consumer units or industrial distribution systems

- Article number: 0062239
- Output: 1 changeover contact
  - Nominal voltage  $U_N$ : 3 AC 380 ... 690 V
  - Frequency range: 40 ... 80 Hz
  - De-energized on trip
  - Width: 35 mm

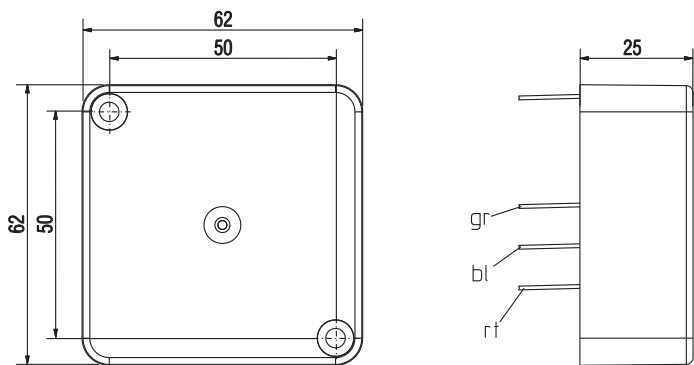
SL 9059.11 3 AC 380 ... 690 V 40 ... 80 Hz  
for cabinets with mounting plate

- Article number: 0065771
- Output: 1 changeover contact
  - Nominal voltage  $U_N$ : 3 AC 380 ... 690 V
  - Frequency range: 40 ... 80 Hz
  - De-energized on trip
  - Width: 35 mm

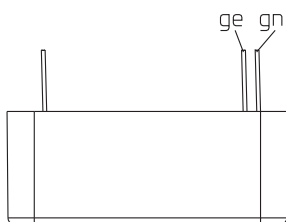
OA 9059.05/001 3 AC 380 ... 690 V 40 ... 80 Hz  
for mounting in terminal box

- Article number: 0065777
- Output: 1 NC contact
  - Nominal voltage  $U_N$ : 3 AC 380 ... 690 V
  - Frequency range: 40 ... 80 Hz
  - Energized on trip
  - Width: 62 mm

## Dimension OA 9059



M10799



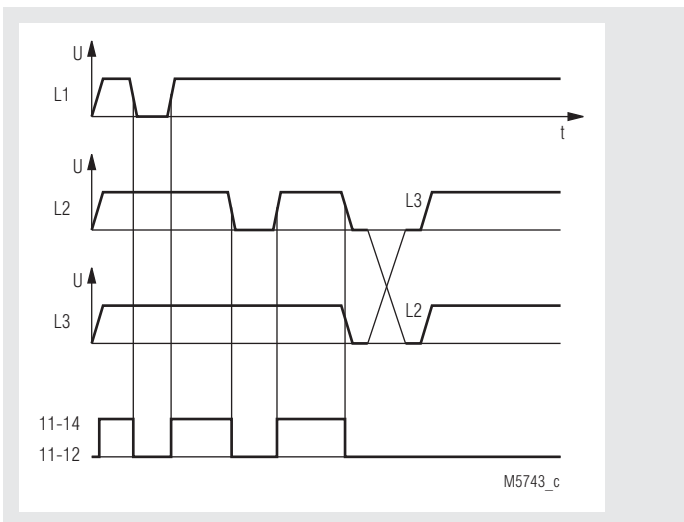
## VARIMETER

Phase Sequence Relay  
BA 9041, AI 941 N



- According to IEC 255, EN 60 255, VDE 0435 part 303
- Detection of wrong phase sequence
- 1 or 2 changeover contacts
- Width 45 mm

### Function Diagram



### Approvals and Markings



### Application

Monitoring three-phase mains for incorrect phase sequence

### Function

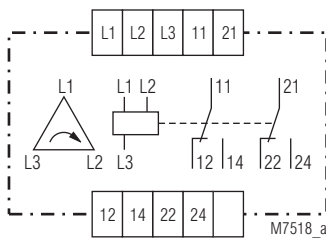
The phase sequence relays BA 9041 and AI 941N monitor the right order of the phases in a 3-phase system. When all 3 phases are connected to the device and the phase sequence is correct the output contacts are activated, 11-14 and 21-24 close and a green LED comes on.

When the voltage in one phase drops below 60 % of the nominal voltage the relay is de-energized. If a load feeds back a voltage that is higher than 60 %  $U_N$ , the fault is not detected. To avoid this problem an asymmetry relay BA 9040 should be used.

In systems with commutation peaks (thyristor controlled drives) the device can falsely detect a phase failure.

In this case it is helpful to know as much as possible about the actual conditions in the system.

### Circuit Diagram



BA 9041, AI 941 N.002

### Technical Data

#### Input

<b>Nominal voltage <math>U_N</math>:</b>	3 AC 190, 230, 400, 415, 440, 500 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency of <math>U_N</math>:</b>	50 Hz (60 Hz on request)
<b>Frequency range:</b>	$\pm 5 \%$
<b>Nominal consumption:</b>	< 3.5 VA

#### Output

#### Contacts

AI 941 N.001:	1 changeover contact
AI 941 N.002, BA 9041:	2 changeover contacts
<b>Operate-/release delay:</b>	< 100 / < 50 ms
<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity</b>	
to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	IEC/EN 60 947-5-1
to AC 15 at 3 A, AC 230 V:	2.5 x 10 <sup>5</sup> switching cycles
<b>Short-circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	50 x 10 <sup>6</sup> switching cycles

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 60°C	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection:</b>	Housing: IP 40	IEC/EN 60 529
	Terminals: IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm, IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Screw mounting:</b>	AI 941 N: 35 x 50 mm and 35 x 60 mm	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight:</b>		
BA 9041:	310 g	
AI 941 N:	300 g	

### Dimensions

#### Width x height x depth

BA 9041:	45 x 74 x 124 mm
AI 941 N:	45 x 77 x 127 mm

### Standard Types

BA 9041 AC 400 V 50 Hz		
Article number:	0041732	stock item
• Output:	2 changeover contacts	
• Nominal voltage $U_N$ :	AC 400 V	
• Width:	45 mm	
AI 941N.001 AC 400 V 50 Hz		
Article number:	0040771	stock item
• Output:	1 changeover contact	
• Nominal voltage $U_N$ :	AC 400 V	
• Width:	45 mm	

### Variant

AI 941 N. ___ /03:	Nominal frequency 50 ... 60 Hz, phase failure cannot be detected with this unit
--------------------	---

### Ordering example for variants

BA 9041	AC 400 V	50 Hz	
			Nominal frequency
			Nominal voltage
			Type

AI 941 N	.001	/ _ _	AC 400 V	50 Hz	
					Nominal frequency
					Nominal voltage
					Variant, if required
					Contacts
					Type



## VARIMETER Phase Sequence Relay MK 9056N



0275083

### Your Advantage

- Correct sense of rotation of motors
- Simple wiring

### Features

- According to IEC/EN 60 255-1
- Detection of wrong phase sequence
- LED indication of rotation
- 2 changeover contacts
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled, or 2 x 2.5 mm<sup>2</sup> solid DIN 46 228-1/-2/-3/-4
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width 22.5 mm

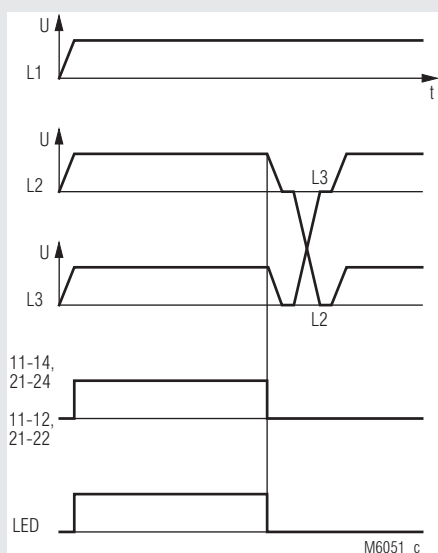
### Product Description

The MK 9056N detect wrong phase sequence in 3-phase systems. To monitor phase failure it is more suitable to use an Asymmetry relay e.g. MK 9040N.

### Approvals and Markings

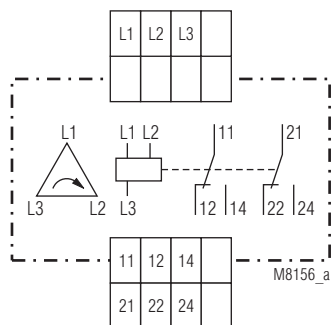


### Function Diagram



M6051\_c

### Circuit Diagram



### Connection Terminals

Terminal designation	Signal designation
L1, L2, L3	Connection of the monitoring 3-phase system
11, 12, 14, 21, 22, 24	"incorrect phase sequence-signaling relays (2 changeover contacts)"

### Indicators

green LED: on, when corresponding output relay is active

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3 AC 42 ... 60 V, 100 ... 127 V  
3 AC 220 ... 240, 380 ... 500 V  
**Voltage range:** 0.9 ... 1.1  $U_N$   
**Nominal frequency of  $U_N$ :** 50 / 60 Hz  
**Nominal consumption:** approx. 2 W

#### Output

**Contact:** 2 changeover contacts  
**Operate / release delay:** < 100 / 50 ms  
**Thermal current  $I_{th}$ :** 5 A  
**Switching capacity**  
to AC 15  
NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
to DC 13  
NO contact: 1 A / DC 24 V IEC/EN 60 947-5-1  
NC contact: 1 A / DC 24 V IEC/EN 60 947-5-1  
**Electrical life**  
to AC 15 at 3 A, AC 230 V: 5 x 10<sup>5</sup> switch. cycles IEC/EN 60 947-5-1  
**Short circuit strength**  
**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:** > 20 x 10<sup>6</sup> switching cycles

### General Data

**Operating mode:** Continuous operation  
**Temperature range:**  
Operation: - 20 ... + 60°C  
Storage: - 20 ... + 60°C  
**Altitude:** < 2.000 m

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

## Technical Data

<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>		
	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>		
	Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1 EN 50 005	
<b>Climate resistance:</b>		
<b>Terminal designation:</b>		
<b>Wire connection</b>		
<b>Screw terminals (integrated):</b>		
	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled or 2 x 1.5 mm <sup>2</sup> stranded ferruled or 2 x 2.5 mm <sup>2</sup> solid	

Insulation of wires or sleeve length:	8 mm
<b>Plug in with screw terminals</b>	
max. cross section for connection:	1 x 2.5 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled

Insulation of wires or sleeve length:	8 mm
<b>Plug in with cage clamp terminals</b>	
max. cross section for connection:	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled

min. cross section for connection:	0.5 mm <sup>2</sup>
Insulation of wires or sleeve length:	12 <sup>+0.5</sup> mm
<b>Wire fixing:</b>	
	Plus-minus terminal screws M 3.5 box terminals with wire protection or cage clamp terminals
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	approx. 140 g

## Dimensions

<b>Width x height x depth:</b>	
MK 9056N:	22.5 x 90 x 97 mm
MK 9056N PC:	22.5 x 111 x 97 mm
MK 9056N PS:	22.5 x 104 x 97 mm

## CCC-Data

<b>Auxiliary voltage U<sub>N</sub>:</b>	3 AC 42-60 V, 3 AC 100-127V, 3 AC 220-240 V
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<b>Switching capacity</b>	
to AC 15	
NO contact:	1,5 A / AC 230 V IEC/EN 60 947-5-1



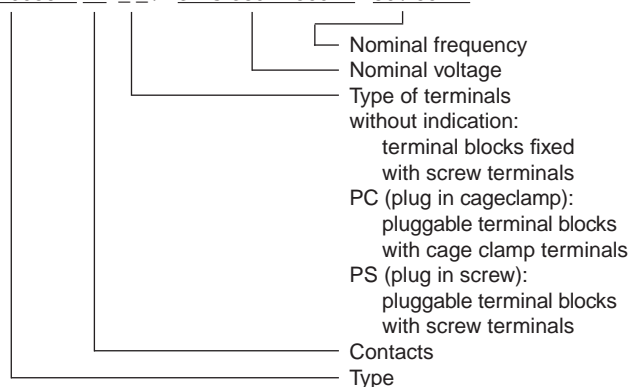
Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Types

MK 9056N.12	AC 380 ... 500 V	50 / 60 Hz
Article number:	0054183	
• Output:	2 changeover contacts	
• Nominal voltage U <sub>N</sub> :	AC 380 ... 500 V	
• Width:	22.5 mm	

## Ordering Example

MK 9056N. 12 \_ \_ / 3 AC 380 ... 500 V 50 / 60 Hz



## Options with Pluggable Terminal Blocks



Screw terminal (PS/plugin screw)

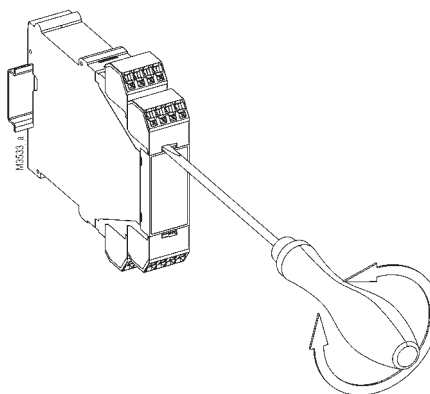


Cage clamp (PC/plugin cage clamp)

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.

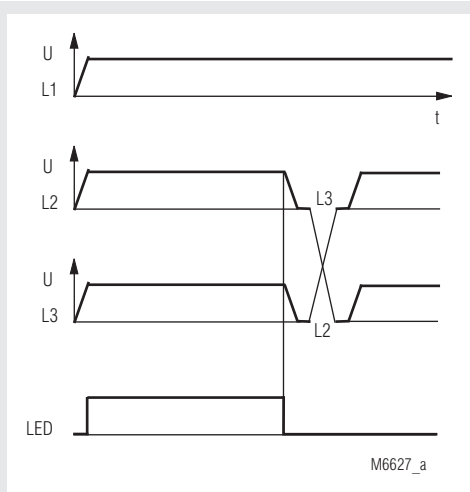


## VARIMETER Phase Sequence Indicator IK 9178, SK 9178



- According to IEC/EN 60 255, DIN VDE 0435-303
- Indication of phase sequence in 3-phase systems
- Without auxiliary supply
- LED indicator for phase sequence
- **Devices available in 2 enclosure versions:**
  - IK 9178:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9178:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



### Applications

Indication of phase sequence in 3-phase systems

### Indicators

LED: on when phase sequence is right

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3 AC 400 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz

#### General Data

**Operating mode:** Continuous operation  
**Temperature range:** - 20 ... + 60°C

**Clearance and creepage distances**  
 rated impulse voltage / pollution degree  
 (between L1-L2-L3): 4 kV / 2 IEC 60 664-1

**EMC**  
 Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2  
 HF irradiation: 10 V/m IEC/EN 61 000-4-3  
 Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages between wires for power supply: 1 kV IEC/EN 61 000-4-5  
 between wire and ground: 2 kV IEC/EN 61 000-4-5  
 Interference suppression: Limit value class B EN 55 011

**Degree of protection**  
 Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94  
 Amplitude 0.35 mm IEC/EN 60 068-2-6  
 frequency 10 ... 55 Hz

**Vibration resistance:** 20 / 060 / 04 IEC/EN 60 068-1  
 frequency 10 ... 55 Hz

**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1

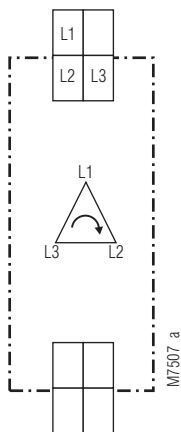
**Terminal designation:** EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or 2 x 1.5 mm<sup>2</sup> stranded ferruled  
 DIN 46 228-1/-2/-3/-4

**Wire fixing:** Flat terminals with self-lifting clamping piece IEC/EN 60 999-1

**Mounting:** DIN rail IEC/EN 60 715

### Circuit Diagram



IK 9178, SK 9178

## Technical Data

### Weight

IK 9178:	50 g
SK 9178:	69 g

### Dimensions

#### Width x height x depth

IK 9178:	17.5 x 90 x 59 mm
SK 9178:	17.5 x 90 x 98 mm

## Standard Types

IK 9178 3 AC 400 V 50/60 Hz

Article number: 0049102 stock item

- Nominal voltage  $U_N$ : 3 AC 400 V
- Width: 17.5 mm

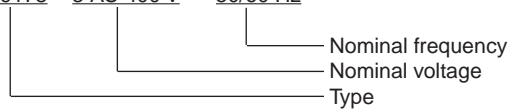
SK 9178 3 AC 400 V 50/60 Hz

Article number: 0054760

- Nominal voltage  $U_N$ : 3 AC 400 V
- Width: 17.5 mm

## Ordering example

IK 9178 3 AC 400 V 50/60 Hz



## VARIMETER

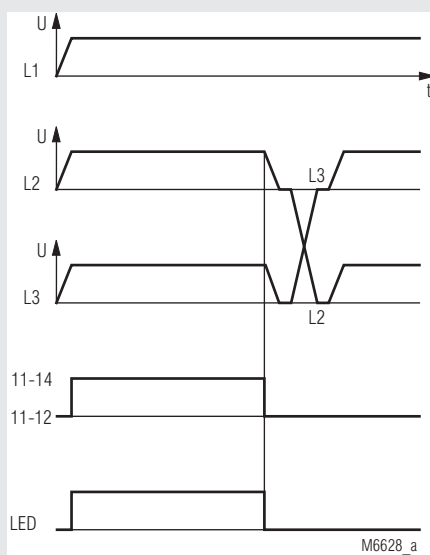
### Phase Sequence Monitor (Phase Sequence Relay)

IK 9179, RK 9179, SK 9179



- According to IEC/EN 60255-1
- Detection of phase sequence in 3-phase systems
- Without auxiliary voltage
- Closed circuit operation
- LED indicator for phase sequence
- Output 1 changeover contact
- Devices available in 2 enclosure versions:
  - I- and R-model, e.g. IK 9169 with depth 61 mm or RK 9169 with depth 71 mm with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model, e.g. SK 9169 depth 100 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Approvals and Markings



### Applications

Detection of phase sequence in 3-phase systems. Disable start of motors with fixed direction of rotation in the case of wrong phase sequence

### Indicators

LED: on, when output relay active (contact 11-14 closed)

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3 AC 400 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz

#### Output

#### Contact:

IK 9179.11, RK 9169, SK 9179: 1 changeover contact

**Thermal current  $I_{th}$ :** 4 A

#### Switching capacity

to AC 15:

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life** IEC/EN 60 947-5-1

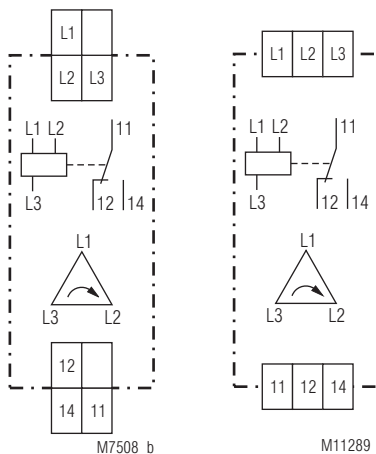
to AC 15 at 1 A, AC 230 V: typ. 300 000 switching cycles

#### Short-circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

### Circuit Diagram



IK 9179, SK 9179

RK 9179

### Connection Terminals

Terminal designation	Signal designation
L1, L2, L3	Measuring input or. supply voltage
11, 12, 14	Changeover contact

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 60°C	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree		
(between L1-L2-L3):	4 kV / 2	IEC 60 664-1
input/output:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation		
80 MHz ... 2,7 GHz:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF wire guided:	20 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	

The 1 MHz slow damped oscillator test according to IEC/EN 60255-1 has not been made.

<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4	
<b>IK 9179, SK 9179</b>		
Cross section:	2 x 0,6 ... 2,5 mm <sup>2</sup> solid or 2 x 0,28 ... 1,5 mm <sup>2</sup> stranded wire with and without ferrules	
Stripping length:	10 mm	
Leiterbefestigung:	Plus-Minus-terminal screws M3,5 with self-lifting clamping piece	
Fixing torque:	0.8 Nm	
<b>RK 9179</b>		
Cross section:	0,34 ... 2,5 mm <sup>2</sup> solid or 0,34 ... 2,5 mm <sup>2</sup> stranded wire with and without ferrules	
Stripping length:	7 mm	
<b>Wire fixing:</b>	Captive slotted screw / M2,5	
<b>Fixing torque:</b>	0.5 Nm	
<b>Mounting:</b>	DIN rail	IEC/EN 60 715
<b>Weight</b>		
IK 9179:	60 g	
RK 9179:	74 g	
SK 9179:	77 g	

## Dimensions

### Width x height x depth

IK 9179:	17.5 x 90 x 61 mm
RK 9179:	17.5 x 90 x 71 mm
SK 9179:	17.5 x 90 x 100 mm

## Standard Types

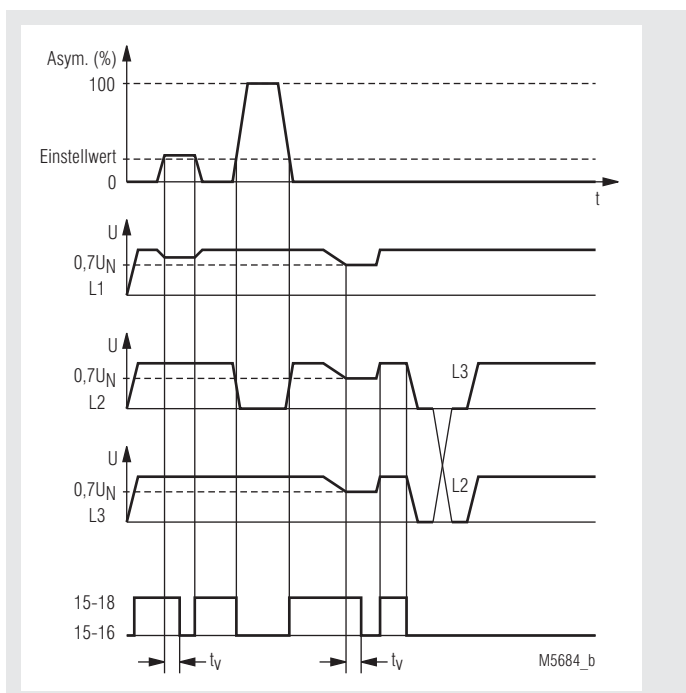
IK 9179.11	3 AC 400 V	50/60 Hz
Article number:	0049182	
RK 9179.11	3 AC 400 V	50/60 Hz
Article number:	0060282	
SK 9179.11	3 AC 400 V	50/60 Hz
Article number:	0051576	
• Output:	1 changeover contact	
• Nominal voltage U <sub>N</sub> :	3 AC 400 V	
• Width:	17.5 mm	

## VARIMETER Asymmetry Relay AK 9840

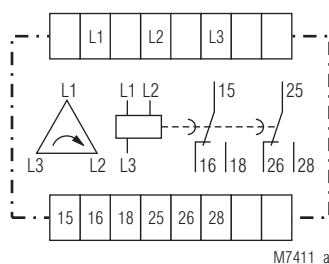


- According to EN 60 255-1
- For nominal voltages from 3 AC 230 up to 500 V
- Detection of
  - voltage asymmetry
  - incorrect phase sequence
  - phase failure
  - undervoltage
- Voltage feedback recognition
- Also suitable for harmonic industrial mains
- Closed circuit operation
- Contact position indication
- With adjustable delay
- 2 C/O contacts
- Width: 75 mm

### Function Diagram



### Circuit Diagram



AK 9840.82

### Approvals and Markings



### Application

Monitoring three-phase mains for voltage asymmetry, phase failure or incorrect phase sequence.

### Function

The AK 9840 asymmetry relay monitors the voltage symmetry of the phase voltages, the undervoltage and the correct phase sequence L1-L2-L3. Voltage asymmetry and undervoltage are determined by measuring the arithmetic average between the three phases.

If there is no fault in the system being monitored the output relay is energized (closed circuit principle), contact 15-18, 25-28 is closed, and this is indicated by a green LED. The instrument responds to asymmetrical voltage changes caused by unequal mains loading or failure of an outer conductor due to the melting of a fuse. An asymmetry relay always only detects the difference between two voltages, and hence does not react to symmetric voltage falls in the mains supply unless the voltage drops below the undervoltage recognition value set at  $0.7 U_N$ . If the set asymmetry is exceeded positively or negatively or if there is undervoltage, the output relay is deenergized after the set response delay. If the phase sequence is incorrect, the output relay responds without delay. The LED indicator is extinguished. Thanks to the special circuitry which evaluates the phase angle, a fault condition, the relay will not be affected by any voltage feedback. Depending on the mains conditions, the feedback is identified as asymmetry - delayed - or as incorrect phase sequence - non-delayed.

Mains supplies with a mid-point conductor can also be monitored with the Instrument. It is not necessary to connect the neutral. The nominal voltage for this application must be converted to delta voltage when placing an order.

Industrial mains with thyristors, with automatic reactive current compensating plant and with emergency power generators have a high harmonic content. With the AK 9840 the measuring principle employed ensures that no errors occur in the response values. Also suitable for automatic changeover to battery-powered operation of emergency lightings when the supply voltage drops by 30 % (to VDE 0108).

### Indication

LED: on, when output relay active

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	3 AC 400 V additional voltages for ranges 3 AC 100 ... 690 V are also available
<b>Voltage range:</b>	0.7 ... 1.1 $U_N$ / 0.7 ... 1.2 $U_N$ to 1.5 s
<b>Nominal consumption:</b>	$\leq 7.1$ VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	$\pm 5\%$ / 10 % to 1.5 s
<b>Max. harmonics level:</b>	distortion factor $K \leq 12\%$

### Setting Ranges

<b>Setting range:</b>	5 ... 20 % $U_N$ voltage asymmetry settable
<b>Hysteresis:</b>	0.98 fixed
<b>Voltage feedback recognition:</b>	up to 100 % - setting value, e.g. when setting value = 5 % asymmetry, 100 % - 5 % = 95 % Recognition of voltage feedback up to 95 %
<b>Undervoltage setting:</b>	0.7 $U_N$
<b>Delay:</b>	0.5 ... 5 s infinite variable

### Output

<b>Contacts</b>	AK 9840.82:	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>		6 A
<b>Switching capacity</b>		
to AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b>		
to AC 15 at 1 A, AC 230 V:	$\geq 2.5 \times 10^5$ switch. cycl.	IEC/EN 60 947-5-1
<b>Short-circuit strength</b>		
<b>max. fuse rating:</b>	4 AgL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$> 30 \times 10^6$ switching cycles	

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 60°C	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree:		
Measuring input to contacts:	6 kV / 2	IEC 60 664-1
Relay contact to relay contact:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	3 V/m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between		
wire for powers supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz	
<b>Climate resistance:</b>	20 / 060 / 04	IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight:</b>	300 g	

### Dimensions

<b>Width x height x depth:</b>	75 x 78 x 119 mm
--------------------------------	------------------

## Standard Type

AK 9840.82	3 AC 400 V	50 / 60 Hz
Article number:	0040621	
• Output:	2 changeover contacts	
• Nominal voltage $U_N$ :	3 AC 400 V	
• Width:	75 mm	

## Characteristic

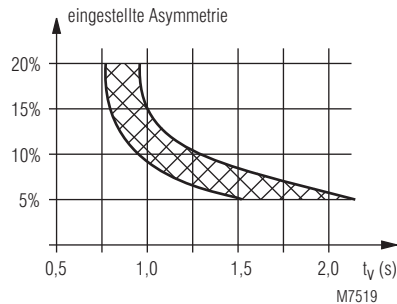


Diagramm Start up delay

The diagram shows the start delay in relation of the adjusted asymmetry when the unit is switched to the symmetric mains.



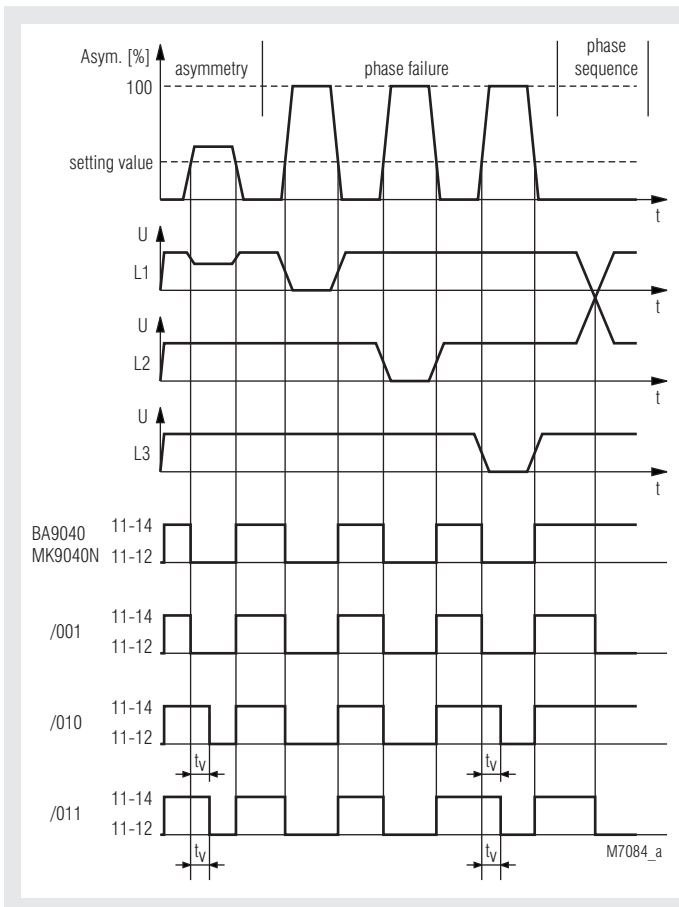
## VARIMETER

Asymmetry Relay  
BA 9040, MK 9040N



- According to IEC 255, EN 60 255, VDE 0435 part 303
- Recognition of
  - voltage asymmetry
  - phase failure
  - voltage feedback
  - optionally with phase sequence recognition
- Optionally with adjustable response delay
- 2 LED displays for power supply and state of contact
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled, or 2 x 2.5 mm<sup>2</sup> solid DIN 46 228-1/-2/-3/-4
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- BA 9040: width 45 mm
- MK 9040N: width 22.5 mm

### Function Diagram



### Approvals and Markings



\* see variants

### Applications

Monitoring three-phase mains for voltage asymmetry, phase failure or incorrect phase sequence, e.g. in elevators, escalators, crane systems etc.

### Indications

upper LED: on when supply voltage connected  
lower LED: on when output relay energized

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3 AC 400 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Nominal consumption:**  
 BA 9040: approx. 4.8 VA  
 MK 9040N: 7 VA  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz  
**Temperature influence:** < 0.05 % / K  
**Frequency influence:** < 0.02 % / Hz

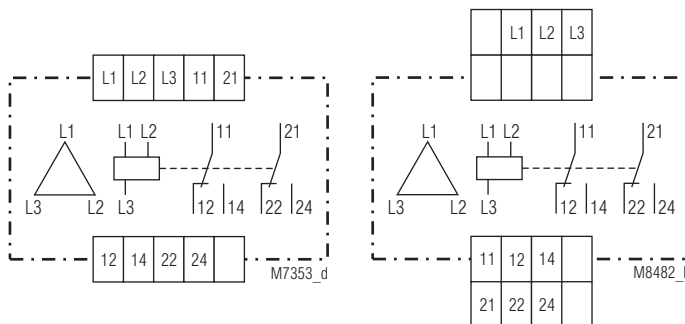
#### Setting Ranges

**Setting range:** 5 ... 15 % voltage asymmetry  
**Repeat accuracy:** ≤ 0.5 %  
**Release ratio:** < 4 %  $U_N$   
**Voltage feedback recognition:** up to 100 % - setting value, e.g. when setting value = 5 % asymmetry, 100 % - 5 % = 95 %  
 Recognition of voltage feedback up to 95 %

#### Time delay $t_v$

BA 9040: 0.5 ... 5 s  
 MK 9040N: 0.5 ... 10 s

### Circuit Diagrams



BA 9040.12

MK 9040N.12

## Technical Data

### Output

<b>Contacts</b>	2 changeover contacts	
<b>Response/release time:</b>		
BA 9040:	≤ 1 s / ≤ 250 ms	
MK 9040N:	≤ 1.5 s / ≤ 250 ms	
<b>Thermal current I<sub>th</sub>:</b>	6 A (see continuous current limit curve)	
<b>Switching capacity to AC 15</b>		
NO contact:	2 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13		
NO contact:	1 A / DC 24 V	IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V	IEC/EN 60 947-5-1
<b>Electrical life:</b>		
to AC 15 at 3 A, AC 230 V:	10 <sup>5</sup> switching cycles	IEC/EN 60 947-5-1
<b>Permissible switching frequency:</b>	6 000 switching cycles / h	
<b>Short circuit strength max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1

## General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 60 °C	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplast with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Frequency 10 ... 55 Hz, Amplitude 0.35 mm IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>		
BA 9040:	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
MK 9040N:	Box terminal with wire protection	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight:</b>	325 g	

## Dimensions

<b>Width x height x depth:</b>	
BA 9040:	45 x 74 x 133 mm
MK 9040N:	22.5 x 90 x 100 mm

## CSA-Data

<b>Switching capacity:</b>	3A 230Vac
<b>Wire connection:</b>	60°C / 75°C copper conductors only AWG 20 - 14 Sol Torque 0.8 Nm AWG 20 - 16 Str Torque 0.8 Nm



Technical data that is not stated in the CSA-Data, can be found in the technical data section.

## CCC-Data

<b>Thermal current I<sub>th</sub>:</b>	5 A
<b>Switching capacity to AC 15:</b>	2 A / AC 230 V IEC/EN 60 947-5-1
to DC 13:	1 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

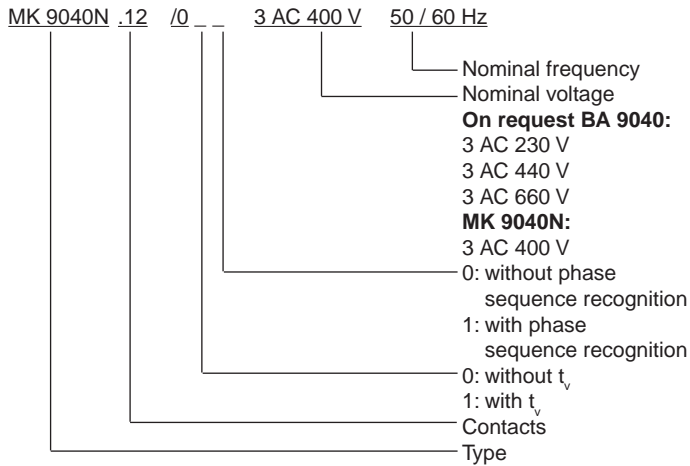
## Standard Types

BA 9040.12/001	3 AC 400 V	50/60 Hz	
Article number:	0043764		stock item
• With phase sequence detection			
• Without operate delay			
• Output:	2 changeover contacts		
• Nominal voltage U <sub>N</sub> :	3 AC 400 V		
• Width:	45 mm		
MK 9040N.12/001	3AC 400 V	50/60 Hz	
Article number:	0055712		stock item
• With phase sequence detection			
• Without operate delay			
• Output:	2 changeover contacts		
• Nominal voltage U <sub>N</sub> :	3 AC 400 V		
• Width:	22.5 mm		

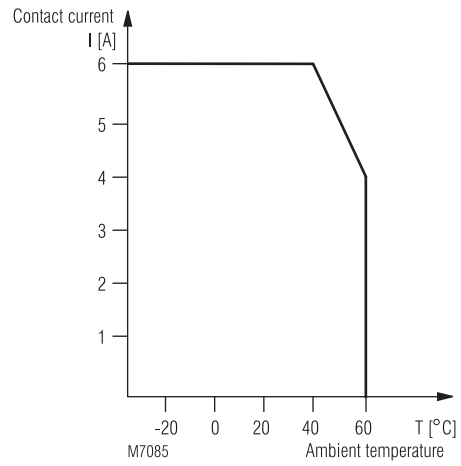
## Variants

BA 9040.12/60:	with CSA approval on request
BA 9040:	with CCC approval on request
BA 9040.12/0_0:	without phase sequence detection
BA 9040.12/0_1:	with phase sequence detection
BA 9040.12/00_:	without time delay
BA 9040.12/01_:	with adjustable time delay
	$t_v$ : 0 ... 5 s
MK 9040N.12/0_0:	without phase sequence detection
MK 9040N.12/0_1:	with phase sequence detection
MK 9040N.12/00_:	without time delay
MK 9040N.12/01_:	with adjustable time delay
	$t_v$ : 0 ... 10 s

## Ordering example for variants



## Characteristics



Continuous current limit curve

## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)



Cage clamp  
(PC/plugin cage clamp)

## VARIMETER Asymmetry Relay BA 9042, AI 942

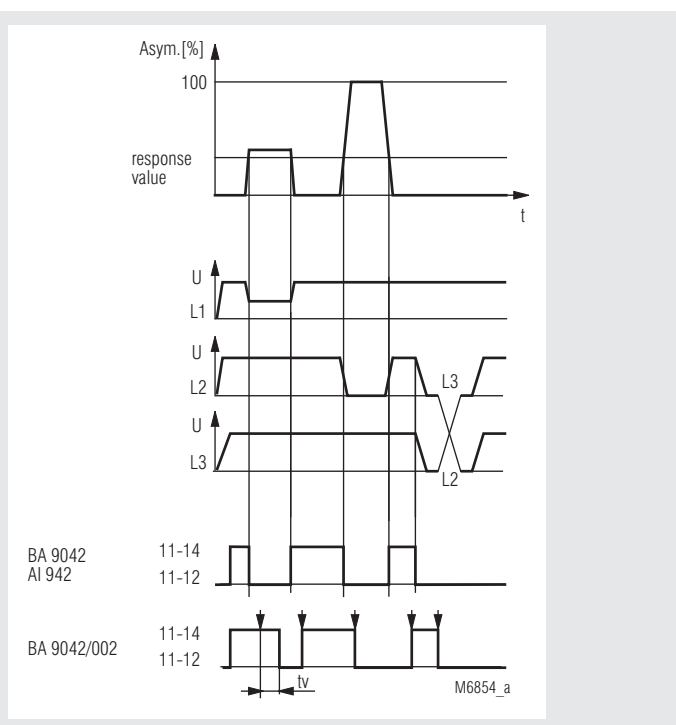


0225/073



- According to IEC 255, EN 60 255, VDE 0435 part 303
- For nominal voltage from 3 AC 230 V to 500 V
- Detection of
  - voltage asymmetry
  - wrong phase sequence
  - phase failure
- Detection of feedback voltage
- BA 9042 optionally with adjustable time delay
- Closed circuit operation
- BA 9042 LED indicators for operation and state of contacts
- Width 45 mm

### Function Diagram



### Approvals and Markings



### Application

Monitoring three-phase mains for voltage asymmetry, phase failure or incorrect phase sequence.

### Function

The device responds to unsymmetric voltage changes, which can occur because of unbalanced load or phase failure (blown fuse). An asymmetry relay detects only the voltage difference between 2 phases and does not react on symmetric undervoltage.

### Indicators

BA 9042  
red LED: on, when supply voltage connected  
green LED: on, when output relay energized

### Notes

On ambient temperature > 20 °C overvoltage together with max. thermal current is not allowed. In industrial voltage systems with high harmonic content (content > 2 %) measuring faults can occur. Harmonics in industrial systems are caused by thyristor controls, emergency power supplies, reactive current compensators, etc.

Normally the harmonic content of a voltage system is unknown. We recommend therefore to test a sample in the actual circuit which we can provide with the right to return. If problems occur during the test we are able to offer other solutions.

### Technical Data

#### Input

**Nominal voltage  $U_N$ :** 3 AC 230, 240, 400, 415, 440, 500 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Nominal consumption:** ≤ 3.8 VA  
**Nominal frequency:** 50 or 60 Hz  
**Frequency range:** ± 5 %

#### Setting ranges

**Setting range:** 5 ... 15 % voltage asymmetry, settable

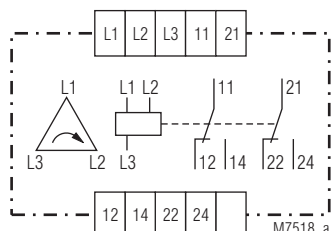
#### Hysteresis

BA 9042 : > 0.98

#### Voltage feedback recognition:

up to 100 % - setting value, e.g. when setting value = 5 % asymmetry, 100 % - 5 % = 95 %  
 Recognition of voltage feedback up to 95 %

### Circuit Diagram



BA 9042 / AI 942

## Technical Data

### Output

### Contacts

BA 9042:	2 changeover contacts
AI 942.001:	1 changeover contact
AI 942.002:	2 changeover contacts

### Release delay:

(at phase failure or asymmetry)

≤ 150 ms  
If the voltage system becomes again symmetric before 150 ms the contacts may switch

### Operate delay:

(delay of the contacts when switching on)

≤ 500 ms

### Thermal current $I_{th}$ :

6 A

### Switching capacity

to AC 15

NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 3 A, AC 230 V IEC/EN 60 947-5-1

AI 942.001: ≥ 5 × 10<sup>5</sup> switching cycles

to AC 15 at 1 A, AC 230 V IEC/EN 60 947-5-1

BA 9042.12, AI 942.002: ≥ 2.5 × 10<sup>5</sup> switching cycles

### Short-circuit strength

max. fuse rating: 4 AgL IEC/EN 60 947-5-1

Mechanical life: > 30 × 10<sup>6</sup> switching cycles

## General Data

Operating mode: Continuous operation

Temperature range: - 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage / pollution degree 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages between

wire for powers supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour according to UL subject 94

Vibration resistance: Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz

Climate resistance: 20 / 060 / 04 IEC/EN 60 068-1

Terminal designation: EN 50 005

### Wire connection:

2 × 2.5 mm<sup>2</sup> solid or  
2 × 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228-1/-2/-3/-4

### Wire fixing:

Flat terminals with self-lifting clamping piece IEC/EN 60 999-1  
DIN rail IEC/EN 60 715

### Mounting:

### Weight

BA 9042: 310 g

AI 942: 300 g

## Dimensions

### Width x height x depth

BA 9042: 45 x 73 x 132 mm

AI 942: 45 x 77 x 127 mm

## Standard Type

BA 9042 3 AC 400 V 50 Hz

Article number: 0040770 stock item

• Output: 2 changeover contacts

• Nominal voltage  $U_N$ : 3 AC 400 V

• Width: 45 mm

## Variant

BA 9042/002: with time delay  $t_v = 0.5 \dots 10$  s on asymmetry detection

## Ordering example for variant

BA 9042 /002 3 AC 400 V 50 Hz  
Nominal frequency  
Nominal voltage  
Variant, if required  
Type

AI 942 .001 3 AC 400 V 50 Hz  
Nominal frequency  
Nominal voltage  
Contacts  
Type

## Accessories

AI 942:

K 70-34:

Cover

Article number: 0011790

## VARIMETER

### Frequency Relay

BA 9837, AA 9837, AA 9838



0225154



BA 9837



AA 9837



AA 9838

- According IEC/EN 60255-1
- Detection of under- or overfrequency
- Adjustable response value
- Optionally 1 or 2 changeover contacts
- Width 45 mm

#### Approvals and Markings



#### Application

The frequency relay can be used especially in applications where the rotor frequency of a slip-ring motor must be measured. The rotor frequency is reciprocal proportional to the speed (see diagram rotor frequency at contercurrent braking).

This behaviour allows to find speed depending switching values and can be used for start up and contercurrent braking of motors on cranes.

#### Function

The device compares 2 frequencies. The measuring frequency is compared to an internally generated, settable frequency reference.

With bridge on X1-X2 the output relay deenergises when the measuring frequency is higher then the setted frequency. The relay energises again when the measuring frequency drops under the setted frequency x hysteresis.

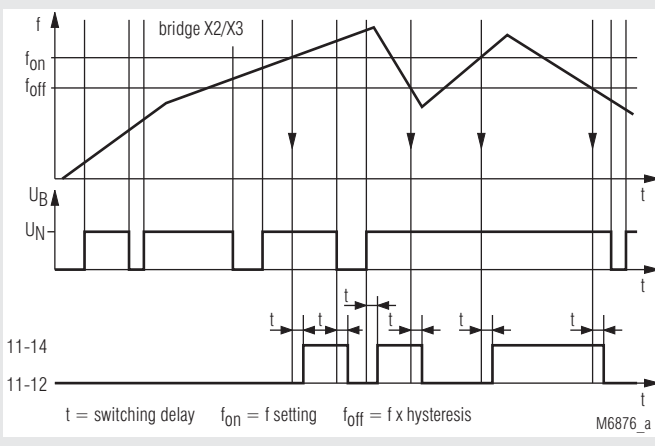
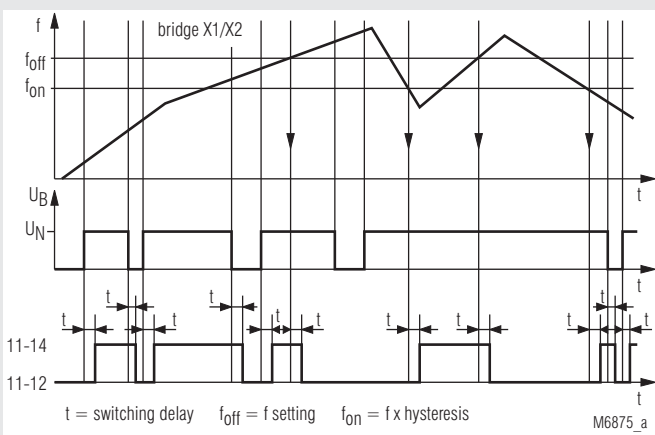
With bridge on X2-X3 the output relay energises when the measuring frequency is higher then the setted frequency. The relay deenergises again when the measuring frequency drops under the setted frequency x hysteresis.

An indicating LED shows that the frequency signal is connected. At low frequency the LED flashes. A second LED indicates the state of the output relay.

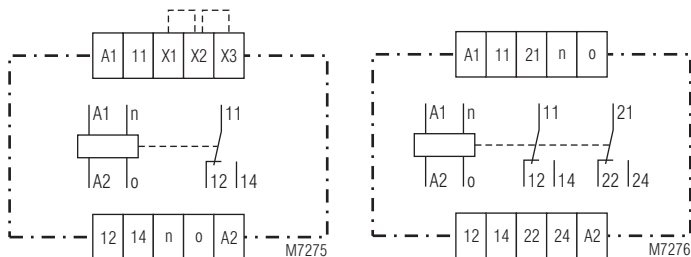
#### Notes

Terminals X1, X2, X3 should only be connected together with the corresponding wire links. Do not connect external voltage, neutral or ground. The measuring input is designed for an amplitude of AC 8...500 V. Higher values AC 12...800 V can be achieved by connecting a series resistor, type IK 5110 into the measuring circuit either to terminal n or o.

#### Function Diagram



## Circuit Diagrams



BA 9837.11,  
AA 9837.11, AA 9838.11

BA 9837.12,  
AA 9837.12

## Connection Terminals

Terminal designation	Signal designation
A1	+ / L
A2	- / N
n, o	Measuring input
X1, X3	Control input
X2	Control output
11, 12, 14, 21, 22, 24	Changeover contacts

## Technical Data

### Input

**Measuring input:** AC Amplitude AC 8 ... 500 V r.m.s  
internal resistance: > 400 kΩ

**Setting range:**  
BA 9837, AA 9837: 5 ... 15 Hz      40 ... 120 Hz  
10 ... 30 Hz      100 ... 300 Hz  
20 ... 60 Hz      200 ... 600 Hz  
30 ... 90 Hz

AA 9838: 20 ... 80 Hz  
**Setting:** infinite on absolute scale  
**Response value:** ≥ setting value

**Hysteresis:**  
BA 9837, AA 9837: 0.8 ... 0.97 of response value  
AA 9838: 0.96 of response value

**Accuracy:** < ± 1 %  
**Temperature influence:** < ± 0.15 % / °C

**Influence of auxiliary supply:** < ± 0.5 % at 0.8 ... 1.1 U<sub>H</sub>

### Auxiliary Circuit

**Auxiliary voltage U<sub>H</sub>:**  
BA 9837, AA 9837: AC 24, 42, 110, 127, 230, 240 V  
AA 9838: AC 48, 110, 230 V

**Voltage range of U<sub>H</sub>:** 0.8 ... 1.1 U<sub>H</sub>

**Nominal consumption U<sub>H</sub>:** < 3 VA

**Nominal frequency of U<sub>H</sub>:** 50 / 60 Hz ± 5 %

### Output

#### Contacts

BA 9837.11, AA 9837.11,  
AA 9838.11: 1 changeover contact  
BA 9837.12, AA 9837.12: 2 changeover contacts

**Switching delay:**  
setting range (Hz)      bridge X1-X2      bridge X2-X3  
5 - 15      500 - 800      650 - 1 000  
10 - 30      250 - 300      600 - 800  
20 - 60      120 - 150      300 - 430  
20 - 80      100 - 120      290 - 430  
30 - 90      90 - 120      280 - 400  
40 - 120      60 - 80      140 - 210  
100 - 300      25 - 45      70 - 120  
200 - 600      15 - 25      70 - 100  
switching delay in ms

## Technical Data

**Thermal current I<sub>th</sub>:** 6 A  
**Switching capacity** to AC 15, AC 230 V: 3 A / AC 230 V IEC/EN 60 947-5-1  
**Electrical life** to AC 15, at 3 A, AC 230 V: 2.5 x 10<sup>5</sup> switching cycles IEC/EN 60 947-5-1  
**Short circuit strength max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:** > 30 x 10<sup>6</sup> switching cycles

## General Data

**Operating mode:** Continuous operation

**Temperature range:**  
Operation: - 20 ... + 60 °C  
Storage: - 20 ... + 70 °C

**Altitude:** < 2.000 m

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation 80 MHz ... 2,7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages between wires for power supply: 2 kV IEC/EN 61 000-4-5  
between wire and ground: 4 kV IEC/EN 61 000-4-5  
Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529  
Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

**Climate resistance:**  
**Terminal designation:** EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228-1/-2/-3/-4

**Wire fixing:** Flat terminals with self-lifting clamping piece IEC/EN 60 999-1

**Screw mounting:** 35 x 50 mm and 35 x 60 mm

**Fixing torque:** 0.8 Nm  
**Mounting:** DIN rail IEC/EN 60 715

**Weight:** 250 g

## Dimensions

**Width x height x depth:** 45 x 77 x 127 mm

## Standard Type

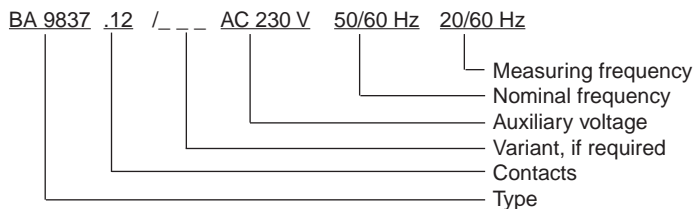
BA 9837.11 30 / 90 Hz AC 230 V AC 50 / 60 HZ

Article number: 0050216  
• Output: 1 changeover contact  
• Measuring frequency: 30 / 90 Hz  
• Auxiliary voltage U<sub>H</sub>: 230 V  
• Width: 45 mm

## Variants

	Frequency relay with 2 changeover contacts and internal bridges (X1, X2, X3)
BA 9837.12/010:	with internal bridge X1 - X2
BA 9837.12/020:	with internal bridge X2 - X3
AA 9837.12/010:	with internal bridge X1 - X2
AA 9837.12/020:	with internal bridge X2 - X3

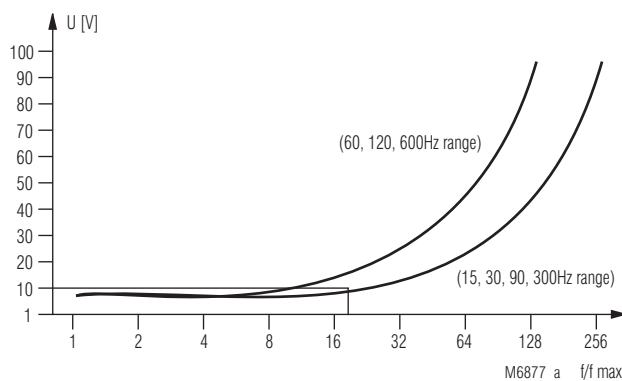
## Ordering example for variants



## Accessories

IK 5110:	Series resist or for higher measuring voltage AC 12 ... 800 V eff. Article number: 0015751
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## Characteristics



## Measuring sensitivity

The diagram shows the sensitivity of the input of the frequency relay AA 9837. If the measuring voltage is lower than the curve values the frequency cannot be measured anymore. Please note.

Superimposed interference voltages on the measuring input with a ration.

$$\frac{f}{f_{\max}}$$

above the curve values can influence the measuring results.

$f$  - frequency on input

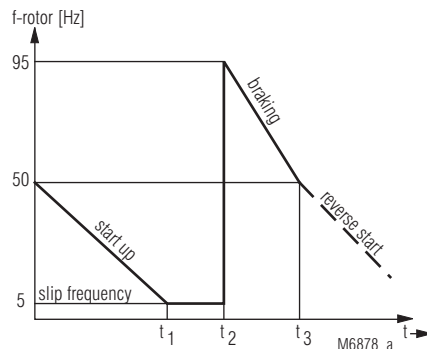
$f_{\max}$  - highest value of the actual frequency range

Example:

$U_{\text{meB}}$ : 10 V; measuring frequency:  $f = 4\,800$  Hz  
chosen frequency range: 100 - 300 Hz,  $f_{\max} = 300$  Hz

$$\frac{f}{f_{\max}} = \frac{4\,800 \text{ Hz}}{300 \text{ Hz}} = 16$$

The measuring frequency is detected, as the measuring voltage is above the response curve.



$t_1$  nominal speed reached  
 $t_2$  start braking  
 $t_3$  standstill (end of braking to avoid reverse start)

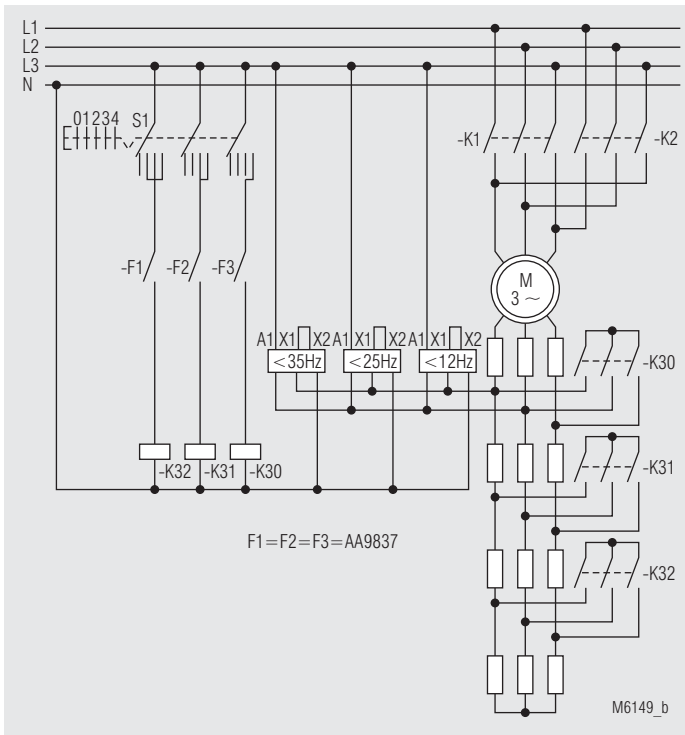
## Rotor frequency at countercurrent braking

Braking:

When reversing the phases for braking the rotor frequency changes and drops proportional to the speed to mains frequency. E.g. when the rotor frequency is 5 Hz at nominal speed, it to 95 Hz. When the motor is at stand still the rotor frequency is nominal frequency. At this point the frequency relay has to give the signal to stop braking, before the motor starts up in the opposite direction.



## Connection Example



Motor control with starting resistance

### Start:

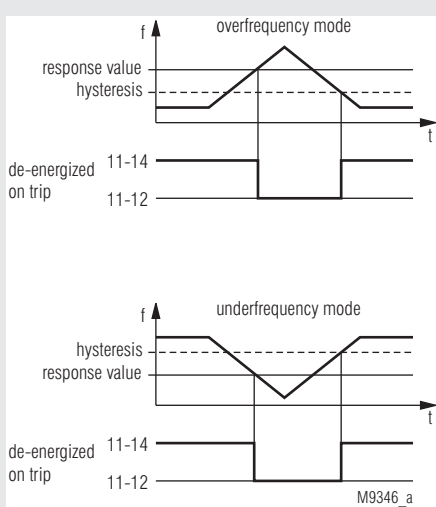
To achieve an optimum speed depending starting inertia, different starting resistors are switched into the rotor circuit, when certain speed values are reached. Often this procedure is controlled with timers, but with small loads the motor reaches the speed to switch over much faster than with high loads and the motor still runs on the lower stage. When the switching of the resistors is controlled speed depending by frequency relays, the start up cycles can be shortened and the plant can be used more effective.

## VARIMETER Frequency Relay IL 9837, SL 9837

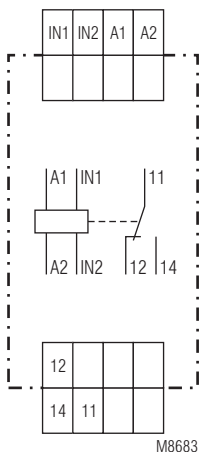


- According to IEC/EN 60 255-1
- Overfrequency or underfrequency monitoring of AC voltages
- Adjustable response value  $f_{min}$  or  $f_{max}$  5 ... 200 Hz or 15 ... 600 Hz
- Adjustable hysteresis
- Large voltage range of the measuring input (nominal voltage AC 24 ... 440 V)
- De-energized on trip
- LED indication for auxiliary voltage, measuring voltage and contact position
- 1 changeover contact
- As option for frequency inverters with a range of 1 ... 300 Hz
- 2 changeover contacts available on request
- As option adjustable start-up delay available
- Energized on trip function available on request
- Devices available in 2 enclosure versions:
  - IL 9837: depth 58 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9837: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- 35 mm width

### Function Diagram



### Circuit Diagram



IL 9837, SL 9837

### Approvals and Markings



\* only for IL 9837

### Application

- Frequency monitoring of A.C. voltages
- Monitoring of the rotor frequency of slipping motors
- Control / monitoring of drives in crane systems
- Frequency monitoring in frequency inverters (IL 9837.11/500)

### Function

The frequency to be monitored is applied to measuring input IN1-IN2. The measuring circuit is electrically separated from the auxiliary voltage input A1-A2, to which the supply voltage of the frequency relay is connected.

The measured frequency is compared to a response value to be set at the unit.

In overfrequency mode, the output relay switches into alarm position when the preset response value is exceeded. When the system frequency once more falls below the response value minus the preset hysteresis, the output relay will switch back into normal position.

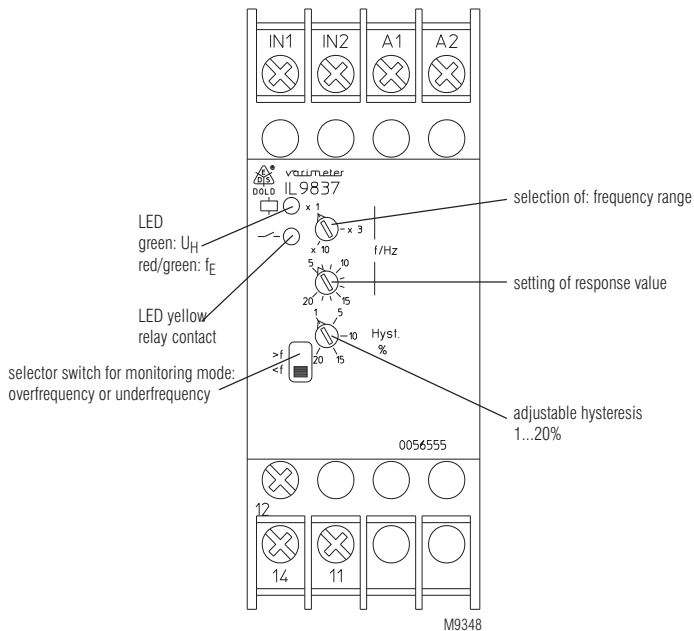
In underfrequency mode, the output relay switches into alarm position when the actual value falls below the preset response value. When the system frequency once more exceeds the response value plus hysteresis, the output relay will switch back into normal position.

If de-energized on trip is selected, the output relay is energized (11-14 closed) in normal status. If energized on trip is selected, the output relay is energized (11-14 closed) in alarm status.

### Indicators

- Upper LED: green light is permanently on, when only the auxiliary voltage has been applied to A1-A2, green-red alternating light, when measuring frequency has also been applied to IN1-IN2
- Yellow LED: is on, when the output relay is energized (contacts 11-14 closed)

## Setting



## Notes

**Monitoring mode underfrequency or overfrequency**  
The mode can be selected by means of the slide switch at the front of the unit. The operating mode de-energized or energized on trip as well as the response value do not change.

**Setting of the hysteresis**  
With input frequencies < 15 Hz (4 Hz with variant IL 9837.11/500), the hysteresis should not be set to minimum values to avoid cycling of the output relay.

In the "underfrequency" monitoring mode (" $< f$ "), with input frequencies close to the end of the respective range, hysteresis can only be set to a maximum of 4 ... 10% for proper resetting; this is due to reasons of the switching operation. If applicable, select the next higher frequency range.

**Variant IL 9837.11/500 for frequency inverter**  
This variant can be used with frequency inverter to monitor the frequency of 1 ... 300 Hz generated by the frequency inverter. It has a specifically dimensioned measuring input with low pass character to suppress the cycle frequency of the inverter. Simultaneously, the input sensitivity is adjusted to the voltage/frequency characteristic of the inverter.

## Technical Data

### Measuring Circuit

**Measuring input:** IN1-IN2  
**Nominal voltage  $U_N$ :** AC 24 ... 440 V  
**Voltage range:** 0.8 ... 1.1  $U_N$   
**Input resistance:** approx. 1 M $\Omega$   
**Frequency range:** 5 ... 20 Hz, 15 ... 60 Hz, 50 ... 200 Hz or 15 ... 60 Hz, 45 ... 180 Hz, 150 ... 600 Hz selected with rotary switch

**Response value**  
infinitely adjustable: 1 : 4 in each frequency range  
**Hysteresis**  
infinitely adjustable: 1 ... 20 % of the set response value

**Measuring input:** IL 9837.11/500  
**Max. input voltage:** AC 500 V  
**Min. measuring voltage:** approx. AC 10 V with 1 Hz ... AC 220 V with 300 Hz, see diagramm M8681  
**Input resistance:** approx. 700 k $\Omega$   
**Frequency range:** 1 ... 10 Hz, 5 ... 50 Hz, 30 ... 300 Hz selected with rotary switch

**Response value**  
infinitely adjustable: 1 : 10 in each frequency range  
**Hysteresis**  
infinitely adjustable: 1 ... 20 % of the set response value

## Technical Data

### Auxiliary Circuit

**Nominal voltage  $U_H$ :** AC 24, 42, 115, 127, 230, 240, 400 V  
DC 12, 24, 48 V

**Voltage range**  
AC: 0.8 ... 1.1  $U_H$   
DC: 0.9 ... 1.25  $U_H$

**Nominal consumption**  
AC: approx. 1.5 VA  
DC: approx. 1 Watt

**Frequency range**  
AC: 45 ... 400 Hz

### Output

**Contacts:** 1 changeover contact  
**Thermal current  $I_{th}$ :** 4 A  
**Switching capacity**  
to AC 15  
NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
to DC 13:  
NO contact: 1 A / DC 24 V IEC/EN 60 947-5-1  
NC contact: 1 A / DC 24 V IEC/EN 60 947-5-1  
**Contact life:**  
to AC 15 at 1 A, AC 230V: 1.5 x 10<sup>5</sup> switch. cycles IEC/EN 60 947-5-1  
**Short circuit strenght**  
**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

### General Data

**Nominal operation:** Continous  
**Temperature range:** - 20 ... + 60°C  
**Clearance and creepage distances**  
Rated rated impulse voltage voltage /  
Pollution degree: 4 kV / 2  
**EMC**  
Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2  
Fast transients: 2 kV IEC/EN 61 000-4-4  
Surge  
between  
supply lines: 1 kV IEC/EN 61 000-4-5  
HF voltage driven: 10 V IEC/EN 61 000-4-5  
Interference suppression: Limit value class B EN 55 011  
**Degree of protection**  
Housing: IP 40 IEC/EN 60 529  
Terminals: IP 20 IEC/EN 60 529  
**Housing:** Thermoplast with V0 behavior according to UL Subject 94  
**Vibration resistance:** Amplitude 0.35 mm  
Frequency 10 ... 55 Hz IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1  
**Climate resistance:**  
**Terminal designation:** DIN EN 50 005  
**Wire connection:** 2 x 2.5 mm<sup>2</sup> massive, or 2 x 1.5 mm<sup>2</sup> stranded wire ferruled  
DIN 46 228-1/-2/-3  
**Wire fixing:** Screw terminals with self-lifting clamping piece IEC/EN 60 999-1  
DIN rail IEC/EN 60 715  
**Mounting:**  
**Net weight**  
IL 9837: approx. 137 g  
SL 9837: approx. 164 g

### Dimensions

**Width x height x depth**  
IL 9837: 35 x 90 x 59 mm  
SL 9837: 35 x 90 x 98 mm

### CCC-Data for IL 9837

Thermal current  $I_{th}$ : 4 A

Switching capacity  
 to AC 15: 5 A / AC 230 V IEC/EN 60 947-5-1  
 to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

### Standard Type

IL 9837.11 5 ... 200 Hz  $U_n$  AC 230 V Hyst. 1 ... 20 %  
 Article number: 0056555

- De-energized on trip
- Selection of overvoltage or undervoltage
- Selectable frequency range: 5 ... 20 Hz, 15 ... 60 Hz, 50 ... 200 Hz
- Response value: Infinitely adjustable 1:4
- Auxiliary voltage  $U_H$ : AC 230 V
- Hysteresis: 1 ... 20 % adjustable
- Output contact: 1 changeover contact
- Width: 35 mm

### Varianten

IL 9837.11/500: Input designed for frequency inverters  
 Selection of overfrequency or underfrequency  
 Selectable frequency range  
 1 ... 10 Hz, 5 ... 50 Hz, 30 ... 300 Hz  
 Response value infinitely adjustable 1:10  
 Auxiliary voltage  $U_H$  AC 230 V  
 De-energized on trip

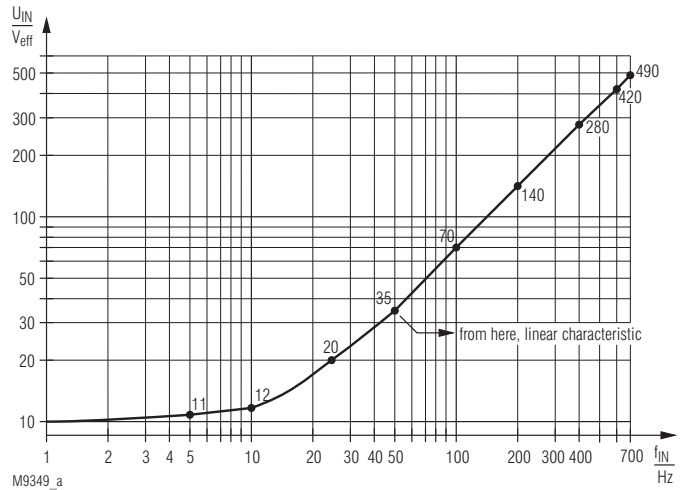
IL 9837.11/\_ \_4: Output contact 1 changeover contact  
 with adjustable start-up delay  
 0.1 ... 20 s

### Ordering example for variants

IL 9837 .11 / \_ \_ \_ 5 ... 200 Hz  $U_n$  AC 230 V 1 ... 20 %

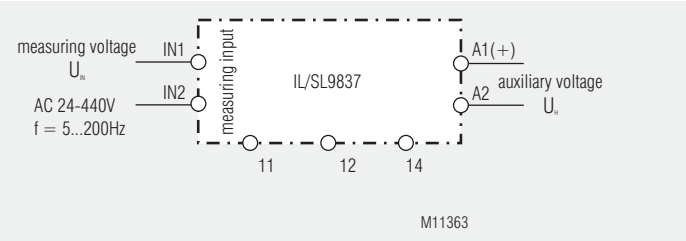
\_\_\_\_\_ Hysteresis  
 \_\_\_\_\_ Auxiliary voltage  
 \_\_\_\_\_ Frequency range  
 \_\_\_\_\_ Variant, if required  
 \_\_\_\_\_ Contacts  
 \_\_\_\_\_ Type

### Characteristic



Typical input sensitivity of the measuring input with variant IL 9837.11/500

### Connection Example

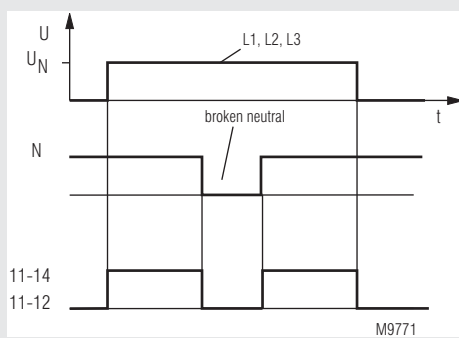


## VARIMETER Neutral Monitor IL 9069, SL 9069



- According to IEC/EN 60 255-1
- Detection of
  - missing neutral in the system
  - broken neutral on IL/SL 9069
  - neutral exchanged against phase
- Detection of phase failure also with disconnected load
- For 3-phase systems
- De-energized on trip
- LED indicator for operation/state of output contacts
- Single phase connection possible
- Without auxiliary voltage
- 2 changeover contacts
- Optionally with adjustable asymmetry detection and on delay
- Devices available in 2 enclosure version:
  - IL 9069: depth 59 mm with terminals at the bottom for installations systems and industrial distribution systems according to DIN 43 880
  - SL 9069: depth 98 mm with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

### Function Diagram



### Approval and Markings



\* only for IL 9069

### Application

#### Neutral monitoring in 3-phase systems

In 3-phase systems with neutral often also single phase loads are connected between phase and neutral. If the neutral is missing in a system like this, unsymmetric voltages occur, that could damage single phase consumers, if the voltage rises to high. Also consumers can stop to work if the phase-neutral voltage gets too low. The IL 9069 detects this problem and can switch off the system immediately.

To monitor mobile systems that are connected via plug connectors. On mobile systems that are connected by a very long cable, voltage drop can cause a significant asymmetry also during normal operation. For this case we recommend the variant IL/SL 9069.12/500 with an adjustable asymmetry setting (approx. 5 ...15%) and an additional response delay.

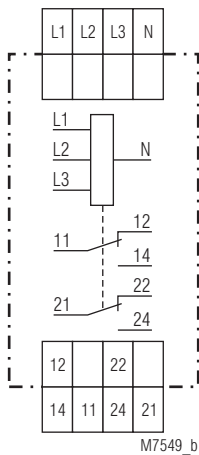
### Function

All 3 phase voltages are measured between phase input L1, L2, L3 and the neutral N. If all 3 phases and the neutral are connected correctly and the asymmetry in good state, the green LED is on and the output relay is energized. If the neutral or one phase is missing or the neutral is exchanged with a phase or the asymmetry exceeds the setting value, the output relay de-energises immediately or after the adjusted time delay (with IL/SL 9069.12/500) and the green LED goes off. The time delay on IL/SL 9069.12/500 is only active when the voltage on terminals L3-N is at least  $0,7 U_N$  as the unit is supplied from these terminals.

### Indication

LED green: on when output relay activated (contact 11-14 and 21-24 are closed)

### Circuit Diagram



IL 9069.12, SL 9069.12

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	3/N AC 400 / 230 V
<b>Max. overload:</b>	AC 440 V on all measuring inputs
<b>Voltage range:</b>	0.7 ... 1.1 $U_N$
<b>Permissible asymmetry of the phase</b>	
IL/SL 9069.12:	max. 5 %
IL/SL 9069.12/500:	adjustable approx. 5 ... 15 %
<b>Nominal consumption</b>	approx. 6 VA (L3-N)
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	45 ... 65 Hz
<b>Input current at <math>U_N</math>:</b>	L1-N, L2-N: approx. 1.5 mA L3-N: approx. 25 mA
<b>On delay</b>	
IL/SL 9069.12:	approx. 100 ms
IL/SL 9069.12/500:	approx. 0.1 ... 20 s, adjustable

### Output

<b>Contact</b>	
IL 9069.12, SL 9069.12:	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>	4 A
<b>Switching capacity</b>	
according to AC 15:	3 A / AC 230 V IEC/EN 60 947-5-1
according to DC 13:	2 A / DC 24 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V:	$\geq 5 \times 10^5$ switch. cycl. IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>max. fuse:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 30 \times 10^6$ switch. cycles

## General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	-20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages	
between	
wires for power supply:	2 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight</b>	
IL 9069:	110 g
SL 9069:	137 g

## Dimensions

<b>Width x height x depth</b>	
IL 9069:	35 x 90 x 59 mm
SL 9069:	35 x 90 x 98 mm

## Standard Type

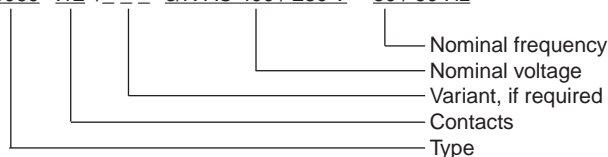
IL 9069.12, 3/N AC 400 / 230 V, 50 / 60 Hz	
Article number:	0048730
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3/N AC 400 / 230 V
• Width:	35 mm
SL 9069.12, 3/N AC 400 / 230 V, 50 / 60 Hz	
Article number:	0054750
• Output:	2 changeover contacts
• Nominal voltage $U_N$ :	3/N AC 400 / 230 V
• Width:	35 mm

## Variant

IL/SL 9069.12/500:	with adjustable asymmetry detection and adjustable on delay
--------------------	---

## Order example for variant

IL 9069 .12 / \_ \_ \_ 3/N AC 400 / 230 V 50 / 60 Hz



## VARIMETER Fuse Monitor RL 9075, RN 9075



0273-488

### Your Advantages

- Increasing the availability of plants by early detection of blown fuses, that may cause damage if undetected
- Fast detection of blown fuses also with disconnected load availability of your plant on request
- Reliable detection of blown fuses inspite of:
  - asymmetric mains
  - harmonic content

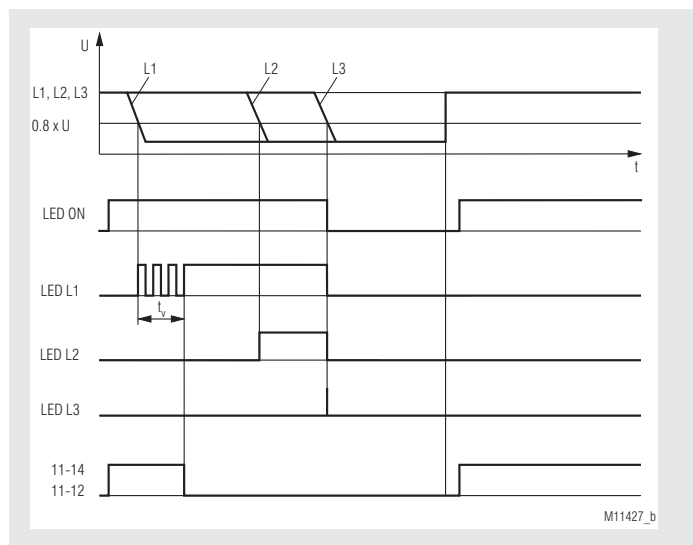
### Features

- According to IEC/EN 60 255-1
- To monitor fuses in single and 3-phase AC voltage systems with neutral
- Adjustable operating voltages: 400 V / 230 V and 230 V / 130 V and 110 V / 64V
- Undervoltage detection below  $0.8 \times U_b$
- Fast detection of a blown fuse
- No separate auxiliary necessary
- Output: 1 changeover contact
- De-energized on trip
- Adjustable switching delay
- Width:
  - RL 9075: 35 mm
  - RN 9075: 52.5 mm

### Product Description

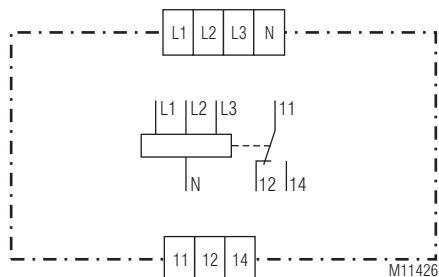
The fuse monitors RL 9075 and RN 9075 of the varimeter series monitor up to 3 fuses. The measurement is very simple and without extensive wiring, as no separate auxiliary supply is necessary. The fast detection of a defective fuse protects against expensive damages and the user has the benefit of high operational performance and availability of the plant.

### Function Diagram



3-phase connetion to monitor 3 fuses

### Circuit Diagram



### Approvals and Markings



### Application

Monitors the state of 1-3 fuses in single- or 3-phase voltage systems with neutral, e.g. for automatic disconnection and lockout in the case of a fuse failure.

### Indication

green LED „ON“: on, when supply connected  
 red LED „L1, L2, L3“: shows that the voltage is dropped under  $0.8 \times U_b$  after the fuse which indicates a blown fuse

### Connection Terminals

Terminal designation	Signal designation
L1	Phase voltage L1
L2	Phase voltage L2
L3	Phase voltage L3
N	Neutral
11, 12, 14	Changeover contacts (outputrelays)

## Function

When monitoring fuses in a 3-phase system all the phases are measured against N. The recognition of a blown fuse is done by monitoring the voltage at the fuse input terminals L1, L2 and L3. A voltage drop on one of these input terminals below  $0.8 \times U_B$  is an indication for a blown fuse. In case an undervoltage condition on any of the three terminals has been recognized the LED of the corresponding terminal starts blinking red. After the switching delay time has expired, the LED switches on red continuously. At the same time the relay, which works in open circuit alarm mode, switches its state. After the terminal voltage exceeds the switching level again e.g. by replacing the blown fuse, the corresponding LED immediately turns off and at the same time the relay switches back into idle mode.

When monitoring fuses in a 1-phase system, up to 3 fuses can be connected to the same phase and being monitored.

If less than 3 fuses are monitored at 3- or single-phase monitoring, the unused terminals LX have to be bridged (see connection examples).

Via rotary switch the both operating ranges 400 V / 230 V or 230 V / 130 V at RN 9075 can be selected. At RL 9075 the operating voltage is fixed.

## Notes

During initialisation the fuse monitor recognises the mains frequency (50 Hz or 60 Hz).

For reliable detection of fuse failure with large inductive loads we recommend to have symmetric loads.

When using the fuse monitor with motor loads it could happen, due to feedback voltage, that the failed fuse is only detected after the motor is switched off.

Adjustable operating voltages via rotary switch:

Device	Function Lx/N	Voltages 0.8 x Lx/N
RN 9075	230 V	184 V
	130 V	104 V
RL 9075	-	51 V

## Technical Data

### Input

#### Operating voltage $U_B$ :

RL 9075: 3/N AC 77 ... 121 V / 44 ... 70 V  
1- or 3-phase without / with neutral  
RN 9075: 3/N AC 138 ... 440 V / 78 ... 253 V  
1- or 3-phase without / with neutral

#### Voltage rated operating $U_o$ :

RL 9075: 3/N AC 90 ... 110 V / 52 ... 64 V  
RN 9075: 3/N AC 162 ... 400 V / 92 ... 230 V

#### Voltage range:

RL 9075: 0.7 ... 1.1  $U_B$   
RN 9075: 0.6 ... 1.1  $U_B$

#### Nominal frequency:

50 / 60 Hz

#### Frequency range:

45 ... 65 Hz

#### Nominal consumption:

approx. 7 VA

### Output

#### Contacts:

1 changeover contact

#### Contact material:

AgNi

#### Switching voltage:

AC 250 V

#### Thermal current $I_{th}$ :

5 A

#### Switching capacity

to AC 15

NO contact:

3 A / AC 230 V IEC/EN 60 947-5-1

NC contact:

1 A / AC 230 V IEC/EN 60 947-5-1

#### Electrical life

to AC 15 at 1 A, AC 230 V: typ.  $\times 10^5$  switching cycles

short circuit strength IEC/EN 60 947-5-1

max. fuse rating:

5 A gL

#### Mechanical life:

$> 30 \times 10^6$  switching cycles

## Technical Data

### Measuring circuit

#### Monitoring voltage

RL 9075:  $Lx/N = 51 \text{ V} (0.8 \times 64 \text{ V})$   
RN 9075:  $Lx/N = 184 \text{ V} (0.8 \times 230 \text{ V}) +$   
 $Lx/N = 104 \text{ V} (0.8 \times 130 \text{ V})$

#### Monitoring range:

RL 9075: 0.7 ... 1.1  $U_B$   
RN 9075: 0.6 ... 1.1  $U_B$

#### Number of monitored fuse:

1 ... 3

#### Switching delay $t_v$ :

infinite adjustable  
instantaneous, 2 ... 30 s

#### Repeat accuracy:

$\pm 2 \%$

#### Temperature influence:

$\pm 1 \%$

### General Data

#### Operating mode:

continuous operation

#### Temperature range

Operation: - 20 ... + 55 °C

Storage: - 25 ... + 60 °C

Relative air humidity: 93 % at 40 °C

Altitude: < 2,000 m

#### Clearance and creepage distances

Rated impuls voltage/

Pollution degree: 6 kV / 2 IEC 60 664-1

#### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 12 V / m IEC/EN 61 000-4-3

1 GHz ... 2,7 GHz: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

#### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

Enclosure: Thermoplastic with V0 behaviour

acc. to UL subject 94

Vibration resistance: Amplitude 0,35 mm

Class I IEC/EN 60 255-21

20 / 055 / 04 IEC/EN 60 068-1

EN 50 005 DIN 46 228-1/-2/-3/-4

#### Climate resistance:

#### Terminal designation:

#### Wire connection:

#### Fixed screw terminals

Cross section: 0.2 ... 4 mm<sup>2</sup> (AWG 24 - 12) solid or

0.2 ... 2.5 mm<sup>2</sup> (AWG 24 - 12)

stranded wire with and without ferrules

7 mm

Stripping length: 7 mm

Fixing torque: 0.6 Nm EN 60 999-1

Wire fixing: Captive slotted screw / M2.5

#### Fixed

#### High-voltage terminals

Cross section: 0.2 ... 6 mm<sup>2</sup> (AWG 24 - 10) massiv oder

0.2 ... 4 mm<sup>2</sup> (AWG 24 - 10)

stranded wire without ferrules

0.25 ... 4 mm<sup>2</sup> (AWG 24 - 10)

stranded wire with ferrules

8 mm

Stripping length: 8 mm

Fixing torque: 0.7 Nm EN 60 999-1

Wire fixing: Captive slotted screw / M3

Mounting: DIN rail IEC/EN 60 715

#### Weight:

RL 9075: approx. 105 g

RN 9075: approx. 125 g

### Dimensions

#### Width x height x depth:

RL 9075: 35 x 90 x 71 mm

RN 9075: 52.5 x 90 x 71 mm



## UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition  
ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition  
CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

**Switching capacity:** Pilot duty B300  
5A 240Vac Resistive, G.P.  
5A 30Vdc Resistive or G.P.  
5A 250Vac G.P.

**Wire connection:** 60°C / 75°C copper conductors only  
RL 9075: AWG 24 - 12 Sol/Str Torque 0.6 Nm  
RN 9075  
for terminals 11, 12, 14: AWG 24 - 12 Sol/Str Torque 0.6 Nm  
for terminals L1, L2, L3, N: AWG 30 - 10 Sol/Str Torque 0.7 Nm



Technical data that is not stated in the UL-Data, can be found in the technical data section

## Standard Types

RL 9075.11 3/N AC 110 V / 64 V 0 ... 30 s

- Article number: 0066880
- Output: 1 changeover contact
  - Operating voltage: 3/N AC 110 V / 64 V
  - Switching delay: 0 ... 30 s
  - Width: 35 mm

RN 9075.11 3/N AC 230 V / 130 V + 3/N AC 400 V / 230 V 0 ... 30 s

- Article number: 0066928
- Output: 1 changeover contact
  - Operating voltage: 3/N AC 230 V / 130 V + 3/N AC 400 V / 230 V
  - Switching delay: 0 ... 30 s
  - Width: 52,5 mm

## Ordering Examples

R\_9075 .11 /00\_ 3/N AC 110 V / 64 V 0 ... 30 s

Switching delay

Operating voltage

RL 9075:

3/N AC 110 V / 64 V

RN 9075:

3/N AC 400 V / 230 V +

3/N AC 230 V / 130 V

Operation mode/Outputs

0: De-Energized on trip

1: Energized on trip

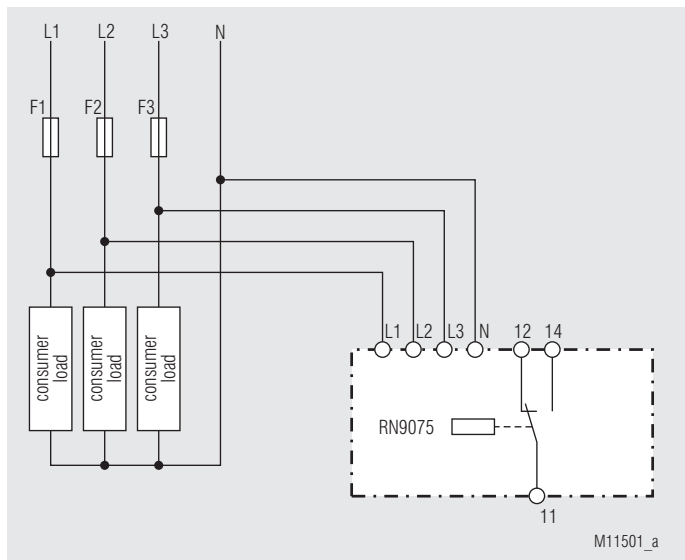
Contacts

Type

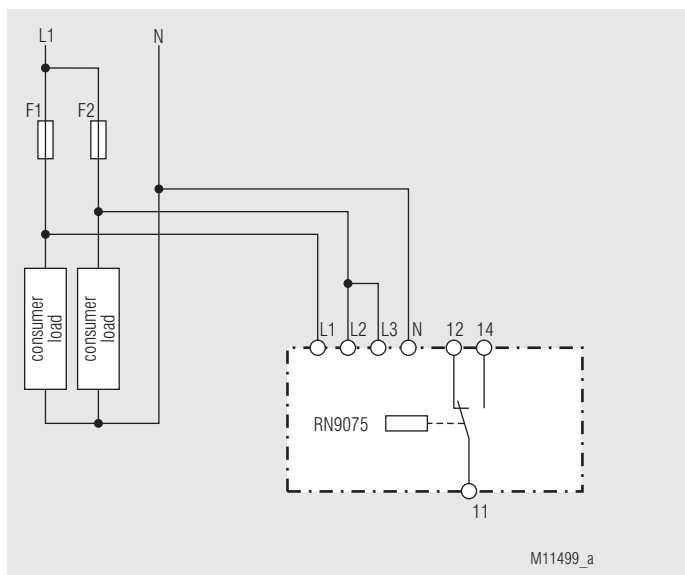
L: 35 mm Width

N: 52.5 mm Width

## Connection Examples



3-phase connection to monitor 3 fuses



1-phase connection to monitor 2 fuses

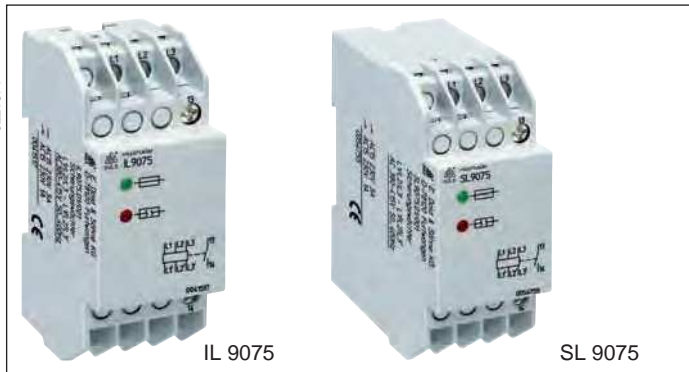
## VARIMETER

### Fuse Monitor

IL 9075, IP 9075, SL 9075, SP 9075

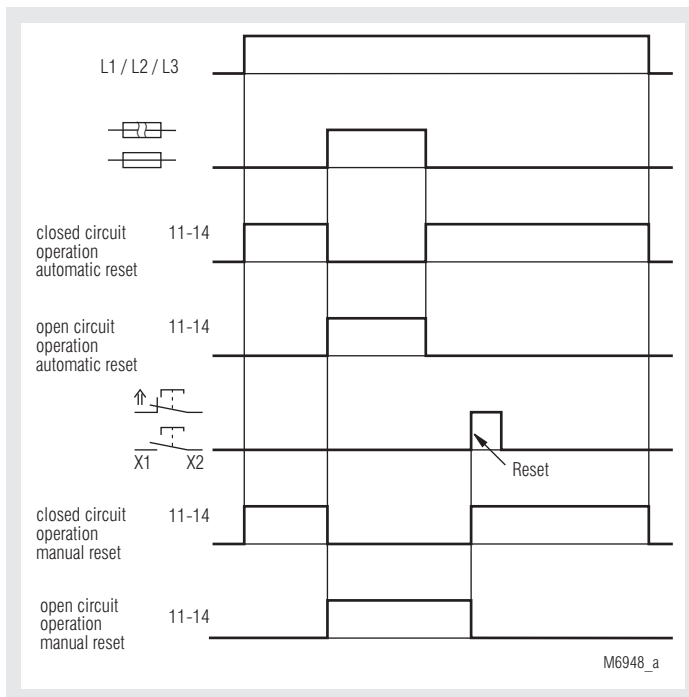


0221571



- According to IEC/EN 60 255-1
- Recognizes fuse failures in three-phase mains up to 3 AC 690 V
- Can be used for all types and sizes of fuses
- Independent of phase sequence
- Signals even if loads are switched off
- No malfunction on
  - asymmetrical mains
  - mains with harmonic waves
  - motors producing feedback
- Shorter response time than with motor circuit-breakers
- Green LED for intact fuses
- Red LED for fuse failure
- As option: energized / de-energized on trip in the case of IP 9075 programmable via X4-X5 or X3-X4
- As option: with manual reset function and remote reset, programmable via X1-X2
- As option: 1 NO contact or 2 changeover contacts
- Devices available in 2 enclosure versions:
  - I-model: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- IL 9075, SL 9075: width 35 mm
- IP 9075, SP 9075: width 70 mm

### Function Diagram



### Approvals and Markings



<sup>1)</sup> only IL 9075

### Applications

Fuse monitoring in the three-phase mains, e.g. for automatic switching-off and switch-on blockage of three-phase motors in the event of one or more phase fuses failing.

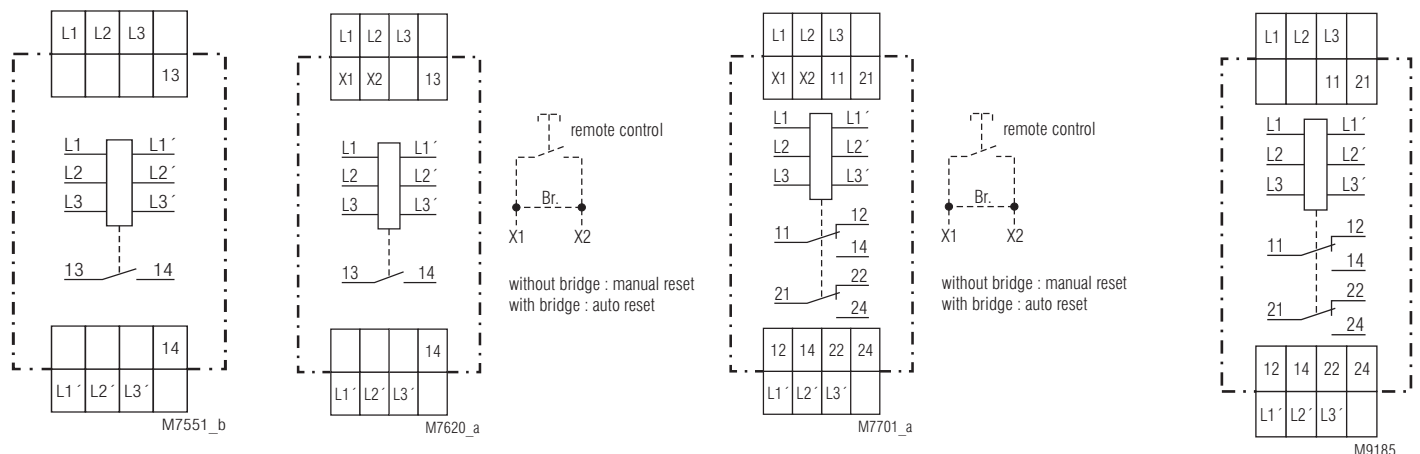
### Indicators

green LED: for healthy fuse  
red LED: for blown fuse

### Notes

The internal resistance of the fuse monitor's measuring path is in the MOhm range, meaning that the regulations as regards touch voltage are fulfilled if a fuse is not present or if it is faulty (IEC 974-1, internal resistance > 2000 Ohm/V).

### Circuit Diagrams



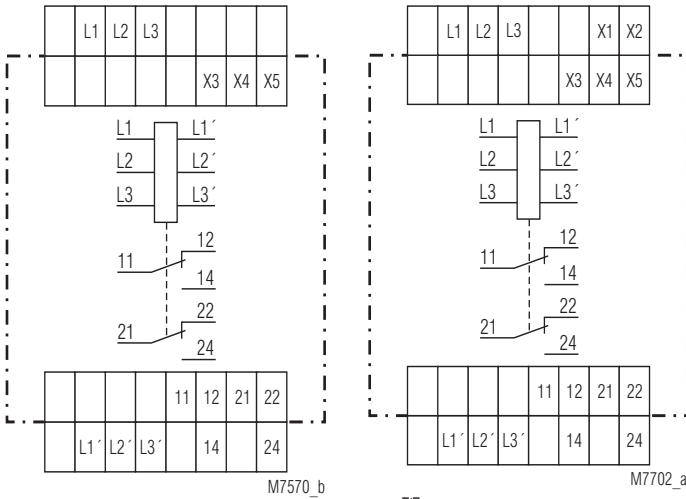
IL 9075.01,  
SL 9075.01

IL 9075.01/01\_  
SL 9075.01/01\_

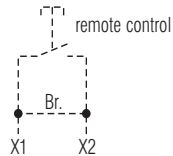
IL 9075.12/01\_  
SL 9075.12/01\_

IL 9075.12/001,  
SL 9075.12/001

## Circuit Diagrams



IP 9075.12, SP 9075.12



without bridge : manual reset  
with bridge : auto reset

IP 9075.12/010, SP 9075.12/010

## Connection Terminals

Terminal designation	Signal designation
L1, L2, L3	Voltage before the fuses
L1', L2', L3'	Voltage after the fuses
X1, X2	Programming manual reset / reset
X3, X4, X5	Programming input energized / de-energized on trip
__ 9075.01: 11, 13	NO contact Rel. 1
__ 9075.12: 11, 12, 14	C/O contact Rel. 1
__ 9075.12: 21, 22, 24	C/O contact Rel. 2

## Technical Data

### Input

#### Nominal voltage $U_N$ :

IL/SL 9075.01/\_\_\_:

3 AC 110 ... 127 V  
3 AC 220 ... 240 V  
3 AC 380 ... 415 V  
3 AC 400 ... 440 V

IL/SL 9075.12/\_\_\_:

3 AC 110 V  
3 AC 230 V  
3 AC 400 V

IP 9075, SP 9075:

3 AC 480 ... 550 V, 600 ... 690 V

#### Voltage range:

0.8 ... 1.1  $U_N$

#### Nominal consumption:

IL 9075, SL 9075:

2.0 VA (on L2 / L3)

IP 9075, SP 9075:

3.0 VA (on L1 / L2)

#### Nominal frequency:

50 ... 400 Hz

#### Internal resistance of the measuring paths:

> 2000  $\Omega/V$

#### Permissible feedback:

max. 90 %

### Output

#### Contacts

IL/SL 9075.01/\_\_\_:

1 NO contact

IL/SL 9075.12/\_\_\_:

2 changeover contacts

IP/SP 9075.12/\_\_\_:

2 changeover contacts

#### Response/release time:

de-energized on trip

IL/SL 9075. \_\_/001:

< 50 ms

IL/SL 9075. \_\_/011:

< 50 ms

IP/SP 9075:

< 50 ms

energized on trip

IL/SL 9075. \_\_:

< 500 ms

IL/SL 9075. \_\_/010:

< 500 ms

IP/SP 9075:

< 500 ms

#### Output nominal voltage:

max. AC 250 V

#### Thermal current $I_{th}$ :

4 A

#### Switching capacity

to AC 15

IL/SL 9075:

NO contact:

3 A / AC 230 V

IEC/EN 60 947-5-1

NC contact:

1 A / AC 230 V

IEC/EN 60 947-5-1

to DC 13:

1 A / DC 24 V

IEC/EN 60 947-5-1

IP/SP 9075:

Schließer:

3 A / AC 230 V

IEC/EN 60 947-5-1

Öffner:

1 A / AC 230 V

IEC/EN 60 947-5-1

#### Electrical life

to AC 15 at 1 A, AC 230 V

IL/SL 9075:

1.5 x 10<sup>5</sup> switching cycles

IP/SP 9075:

2.5 x 10<sup>5</sup> switching cycles

#### Short circuit strength

##### max. fuse rating:

4 A gL

IEC/EN 60 947-5-1

##### Mechanical life:

> 10<sup>8</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

### Temperature range:

Operation: - 20 ... + 60 °C

Storage: - 25 ... + 70 °C

**Altitude:** < 2.000 m

### Clearance and creepage distances

rated impulse voltage /

pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

1 GHz ... 2.7 GHz: 3 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0 behaviour

according to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm,

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

### Terminal designation:

2 x 2.5 mm<sup>2</sup> solid or

2 x 1.5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

Min. cross section:

0,6 mm

Insulation of wires

or sleeve length:

10 mm

### Wire fixing:

Flat terminals with self-lifting

clamping piece IEC/EN 60 999-1

### Fixing torque:

0.8 Nm

### Mounting:

DIN rail IEC/EN 60 715

(also available for screw mounting)

### Weight:

IL 9075: 130 g

SL 9075: 157 g

IP 9075: 255 g

SP 9075: 304 g

## Dimensions

### Width x height x depth

IL 9075: 35 x 90 x 59 mm

SL 9075: 35 x 90 x 98 mm

IP 9075: 70 x 90 x 59 mm

SP 9075: 70 x 90 x 98 mm

## Standard Types

IL 9075.01/001 AC 380 ... 415 V 50 ... 400 Hz

Article number: 0041517

SL 9075.01/001 AC 380 ... 415 V 50 ... 400 Hz

Article number: 0054755

• De-energized on trip

• Automatic reset

• 1 NO contact

• Nominal voltage  $U_N$ : AC 380 ... 415 V

• Width: 35 mm

## Variants

For rated voltages up to 3 AC 400 resp. 440 V:

IL 9075. \_\_ : energized on trip, automatic reset

IL 9075. \_\_ /001 : de-energized on trip, automatic reset

IL 9075. \_\_ /010 : energized on trip, manual reset

IL 9075. \_\_ /011 : de-energized on trip, manual reset

For rated voltages up to 3 AC 690 V,

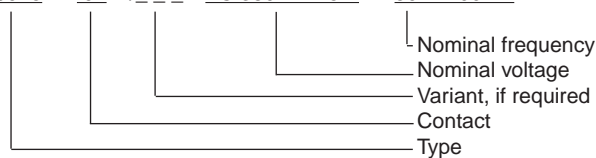
open/de-energized on trip, settable:

IP 9075.12 : automatic reset

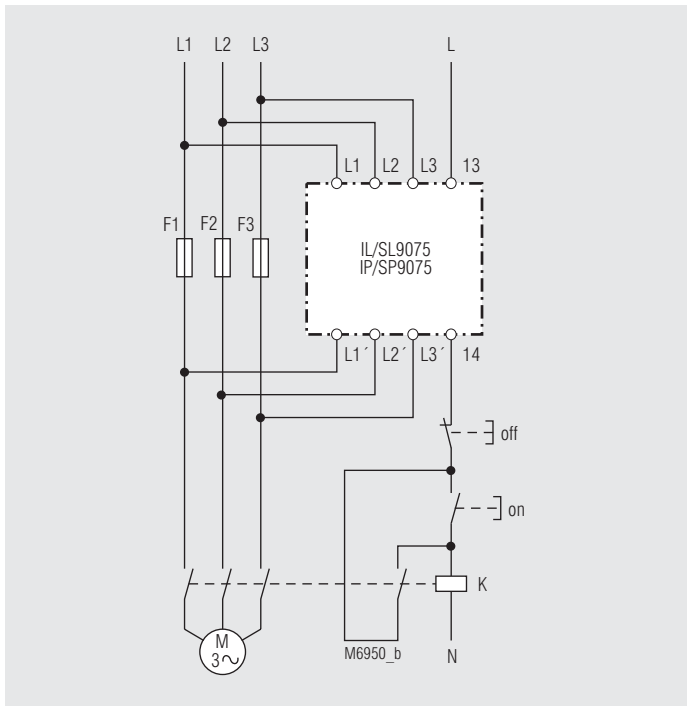
IP 9075.12/010 : manual reset or automatic reset settable

## Ordering example for variants

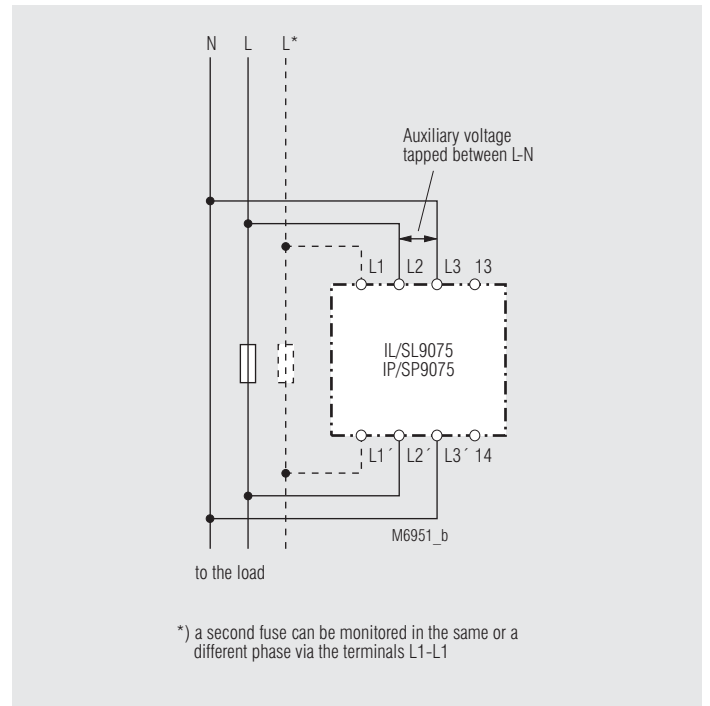
IL 9075 .01 / \_ \_ \_ AC 380 ... 415 V 50 ... 400 Hz



## Connection Examples



Fuse monitoring in the 2-phase mains, e.g. for motor protection with IL 9075/001 or with IP 9075, de-energized on trip, jumper X3-X4



Fuse monitoring in the alternating current mains

\*) a second fuse can be monitored in the same or a different phase via the terminals L1-L1

## VARIMETER Fuse monitor UG 9075



0268831



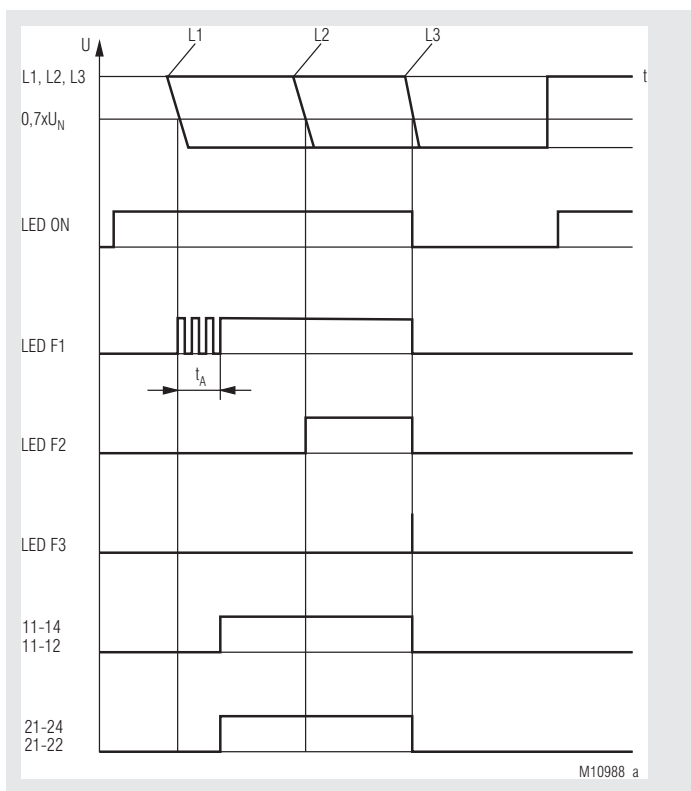
### Your advantages

- increasing the availability of plants by early detection of blown fuses, that may cause damage if undetected
- fast detection of blown fuses also with disconnected load availability of your plant on request
- reliable detection of blown fuses inspite of:
  - asymmetric mains
  - harmonic content

### Features

- According to IEC/EN 60 255-1
- To monitor fuses in single and 3-phase AC voltage systems
- Undervoltage detection below  $0.7 \times U_N$
- No separate auxiliary necessary
- 2 changeover contacts
- 2 nominal voltages adjustable:  
3/N AC 240 V / 140 V or 3/N AC 400 V / 230 V or  
fixed nominal voltage: 3/N AC 110 V / 64 V
- Adjustable operate delay
- Energized on trip
- Automatic adjustment to 50 Hz and 60 Hz mains frequency
- Width 22.5 mm

### Function Diagram



### Approvals and Markings



### Application

Monitors the state of 1-3 fuses in single- or 3-phase voltage systems. e.g. for automatic disconnection and lockout of a 3 phase motor in the case of a fuse failure.

### Function

During initialisation the fuse monitor recognises the mains frequency (50 Hz or 60 Hz). When monitoring fuses in a 3-phase system all the phases are measured against N. The recognition of a blown fuse is done by monitoring the voltage at the fuse input terminals F1, F2 and F3. A voltage drop on one of these input terminals below  $0.7 \times U_N$  is an indication for a blown fuse. In case an undervoltage condition on any of the three terminals has been recognized the LED of the corresponding terminal starts blinking red. After the adjusted response time has expired, the LED switches on red continuously. At the same time the relay, which works in open circuit alarm mode, switches its state. After the terminal voltage exceeds the switching level again e.g. by replacing the blown fuse, the corresponding LED immediately turns off and at the same time the relay switches back into idle mode.

When monitoring fuses in a 1-phase system, up to 3 fuses can be connected to the same phase and being monitored.

At Variant for 3/N AC 240 V / 140 V and 3/N AC 400 V / 230 V are both voltage ranges via potentiometer settable.

### Notes

For reliable detection of fuse failure with large inductive loads we recommend to have symmetric loads.

When using the fuse monitor with motor loads it could happen, due to feedback voltage, that the failed fuse is only detected after the motor is switched off.

### 3-phase connection to monitor 3 fuses

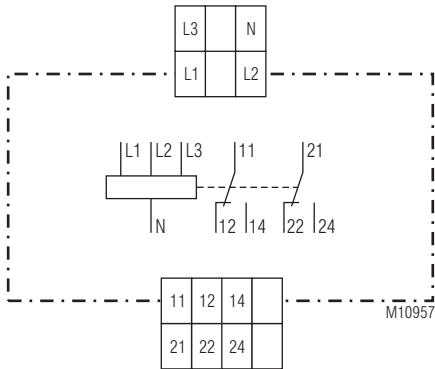
LED F1	LED F2	LED F3	Relay output
1	1	1	off
0	1	1	on
1	0	1	on
1	1	0	on
0	0	1	on
0	1	0	on
1	0	0	on
0	0	0	off

Logic table for 3 fuses  
1: fuse OK, 0: fuse blown

LED F1	LED F2	LED F3	Relay output
1	1	1	off
0	1	1	on
1	0	0	on
0	0	0	off

Logic table for monitoring of 2 fuses  
in a single-phase a.c. system  
1: fuse OK, 0: fuse blown

## Circuit Diagrams



## Connection Terminals

Terminal designation	Signal designation
L1, L2, L3, N	Connection for fuses
11, 12, 14, 21, 22, 24	Blown fuse-indicator relay (2 changeover contacts)

## Indicators

green LED "ON"	on when supply connected
red LED "F1, F2, F3"	shows that the voltage is dropped under $0.7 U_N$ after the fuse which indicates a blown fuse

## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	3/N AC 240 V / 140 V 3/N AC 400 V / 230 V 3/N AC 110 V / 64 V
<b>Voltage range:</b>	0.7 ... 1.1 $U_N$
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Nominal consumption:</b>	approx. 2 W

### Measuring circuit

<b>Monitoring voltage <math>U_N</math>:</b>	3/N AC 240 V / 140 V 3/N AC 400 V / 230 V 3/N AC 110 V / 64 V
<b>Monitoring range:</b>	0.7 ... 1.1 $U_N$
<b>Response value:</b>	0.7 x $U_N$
<b>Hysteresis:</b>	10 %
<b>Number of monitored fuse:</b>	1 ... 3
<b>On delay:</b>	infinite adjustable instantaneous (< 200 ms), 2 ... 25 s
<b>Release delay:</b>	instantaneous
<b>Accuracy:</b>	± 3 %
<b>Repeat accuracy:</b>	± 1 %

### Output

<b>Contacts:</b>	2 changeover contacts
<b>Switching capacity</b> to AC 15	
NO contact:	3 A / AC 120 V IEC/EN 60 947-5-1
NC contact:	1.5 A / AC 240 V IEC/EN 60 947-5-1
to DC 13	
NO contact:	0.22 A / DC 120 V IEC/EN 60 947-5-1
NC contact:	0.1 A / DC 250 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 1 at 8 A, AC 250 V:	> 10 <sup>5</sup> switching cycles IEC/EN 60 947-5-1
<b>Shortcircuit protection</b> <b>max. fuse:</b>	3 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 3 x 10 <sup>7</sup> switching cycles

## Technical Data

### General Data

<b>Operating mode:</b>	continuous operation
<b>Temperature range</b>	
Operation:	0 ... + 55 °C
Storage:	- 25 ... + 60 °C
<b>Relative air humidity:</b>	93 % at 40 °C
<b>Altitude:</b>	< 2.000 m
Rated impulse voltage/ Pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge (ESD):	8 kV (Luftentladung) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 2,7 GHz:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge between wires for power supply: between wire and ground: HF-wire bound: Interference suppression:	1 kV IEC/EN 61 000-4-5 2 kV IEC/EN 61 000-4-5 10 V IEC/EN 61 000-4-6 Limit value class B EN 55 011
<b>Protection degree:</b>	
Enclosure:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Enclosure:</b>	Thermoplastic with V0 behaviour acc. to UL Subj. 94 Amplitude 0.35 mm, Frequency 10 .. 55 Hz IEC/EN 60 068-2-6 0 / 055 / 04 IEC/EN 60 068-1 EN 50 005
<b>Vibration resistance:</b>	
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	
<b>Wire connection:</b>	DIN 46 228-1/-2/-3/-4
<b>Plugin with screw terminals (PS)</b> max. cross section for connection:	1 x 0,25 ... 2,5 mm <sup>2</sup> solid or stranded ferruled (isolated) or 2 x 0,25 ... 1,0 mm <sup>2</sup> solid or stranded ferruled (isolated)
Insulation of wires or sleeve length:	7 mm
<b>Wire fixing:</b>	captive slotted screw
<b>Fixing torque:</b>	0,5 ... 0,6 Nm
<b>Mounting:</b>	DIN rail
<b>Weight:</b>	approx. 190 g

### Dimensions

<b>Width x height x depth:</b>	22.5 x 109 x 120.3 mm
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## Standard Types

UG 9075.12 PS 3/N AC 240 / 140 V + 3/N AC 400 / 230 V

Article number: 0065531

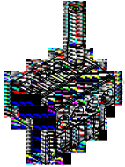
- 2 nominal voltages adjustable:  
3/N AC 240 / 140 V + 3/N AC 400 / 230 V
- Output: 2 changeover contacts
- Width: 22,5 mm

UG 9075.12PS 3/N AC 110 / 64 V

Article number: 0065532

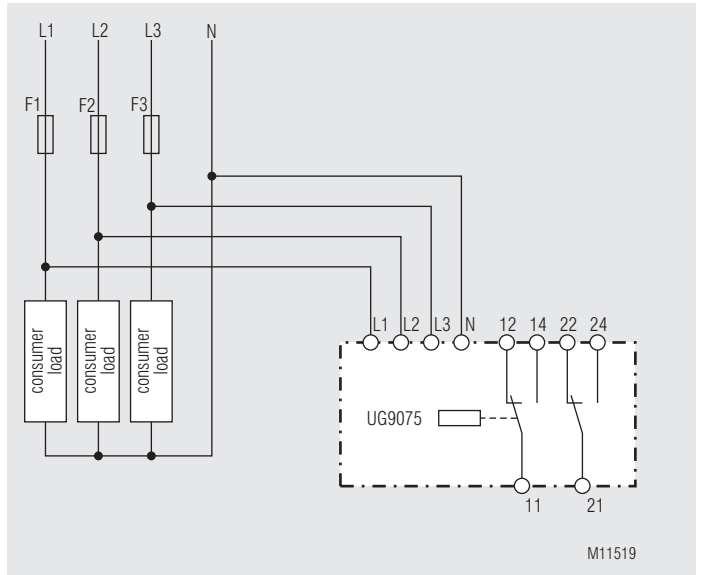
- fixed nominal voltage: 3/N AC 110 / 64 V
- Output: 2 changeover contacts
- Width: 22,5 mm

## Options with Pluggable Terminal Blocks

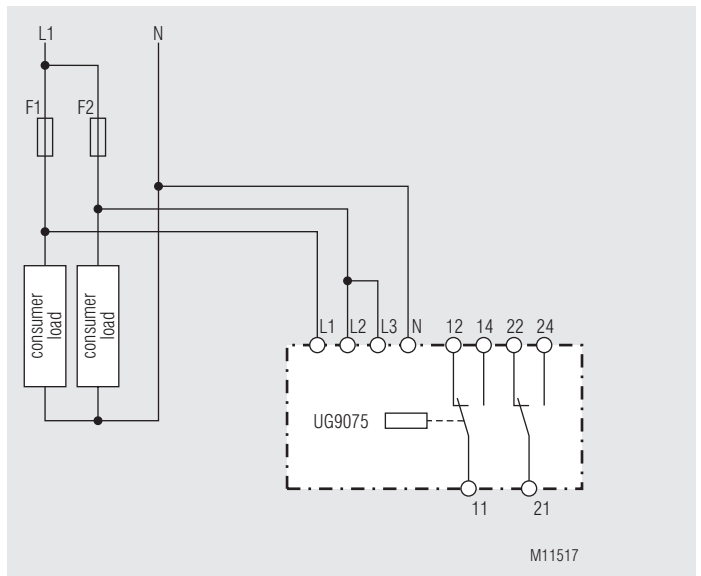


Screw terminal  
(PS/plugin screw)

## Application Examples



3-phase connection to monitor 3 fuses



1-phase connection to monitor 2 fuses

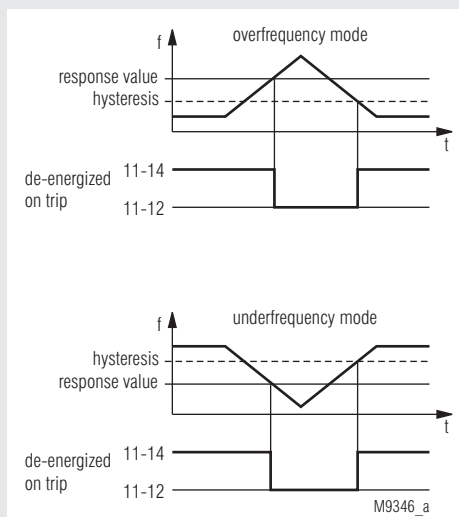


## VARIMETER Frequency Relay IK 9143, SK 9143



- According to IEC/EN 60 255, DIN VDE 0435-303
- Monitoring of overfrequency and underfrequency (selectable) in A.C. power systems
- Without auxiliary voltage
- Selection of frequency range for 50 or 60 Hz systems
- Adjustable response value
- Adjustable hysteresis
- De-energized on trip (output relay not activated in case of error)
- LED indicators for measuring voltage and contact position
- 1 changeover contact
- As option energized on trip (output relay activated in case of error)
- **Devices available in 2 enclosure versions:**
  - IK 9143:** depth 58 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9143:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- 17.5 mm width

### Function Diagram



### Approvals and Markings



### Application

Frequency monitoring function in in-plant generation units and local power supply systems

### Function

The system to be monitored is connected to the terminals A1-A2. Its internal supply voltage is also taken from these terminals. The input frequency is compared to response value to be set at the unit.

In overfrequency mode, the output relay switches into alarm position when the preset response value is exceeded. When the system frequency once more falls below the response value minus the preset hysteresis, the output relay will switch back into normal position.

In underfrequency mode, the output relay switches into alarm position when the actual value falls below the preset response value. When the system frequency once more exceeds the response value plus hysteresis, the output relay will switch back into normal position.

If de-energized on trip is selected, the output relay is energized (11-14 closed) in normal status.

If energized on trip is selected, the output relay is energized (11-14 closed) in alarm status.

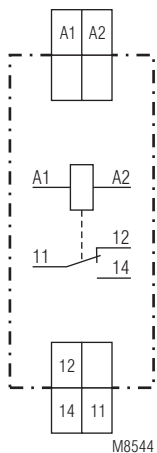
### Indicators

- |              |  |
|--------------|--|
| Green LED:   | On, when measuring voltage is connected to A1 - A2             |
| Yellow LEDs: | On, when the output relay is energized (contacts 11-14 closed) |

### Notes

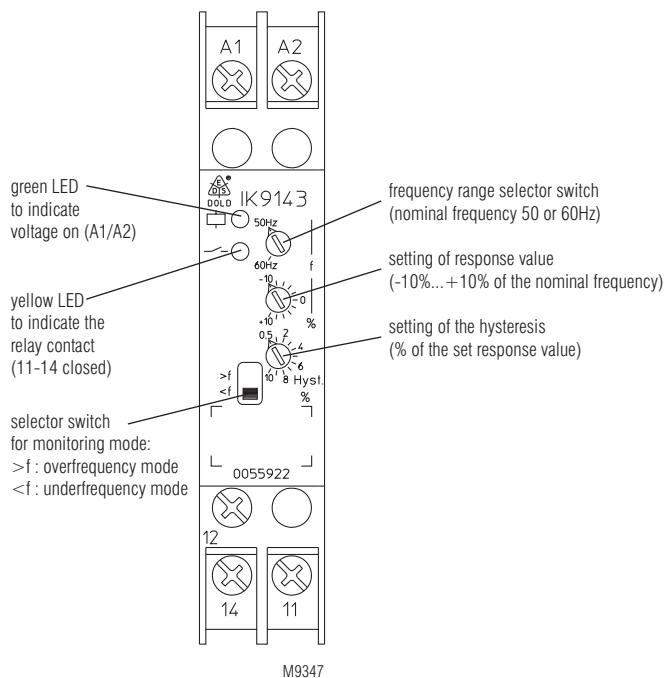
Monitoring mode underfrequency or overfrequency  
The mode can be selected by means of the slide switch at the front of the unit. The operating mode de-energized or energized on trip as well as the response value do not change.

### Circuit Diagram



IK 9143, SK 9143

## Setting



## Technical Data

### Input

**Nominal voltage  $U_n$ :** AC 110, 230, 400 V

**Voltage range:** 0.8 ... 1.1  $U_n$

**Nominal consumption:**

AC 110 V: approx. 3 VA

AC 230 V: approx. 5 VA

AC 400 V: approx. 8 VA

**Frequency range:** 50/60 Hz, selectable with rotary switch

**Response value**  
infinitely adjustable: -10 ... +10% of the selected frequency range

**Hysteresis**  
infinitely adjustable: 0.5 ... 10% of the set response value

### Output

**Contacts:** 1 changeover contact

**Thermal current  $I_t$ :** 4 A

**Switching capacity**

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

to DC 13

NO contact: 1 A / DC 24 V IEC/EN 60 947-5-1

NC contact: 1 A / DC 24 V IEC/EN 60 947-5-1

**Contact life:**

to AC 15 with 1 A, AC 230V:  $> 1.5 \times 10^5$  operating cycles IEC/EN 60 947-5-1

**Short circuit strength**

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  operating cycles

## General Data

**Nominal operation:** Continuous  
**Temperature range:** -20 ... +60°C

**Clearance and creepage distances**

Rated impulse voltage /

Pollution degree: 4 kV / 2 IEC 60 664-1

## Technical Data

### EMC

Electrostatic discharge (ESD): 8 kV (air discharge) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge between supply lines: 1 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplast with V0 behavior according to UL Subject 94  
Amplitude 0.35 mm

**Vibration resistance:** Frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

### Terminal designation:

### Wire connection:

2 x 2.5 mm<sup>2</sup> massive, or  
2 x 1.5 mm<sup>2</sup> stranded ferruled  
DIN 46 228-1/-2/-3

**Wire fixing:** Screw terminals with self-lifting clamping piece IEC/EN 60 999-1  
DIN rail IEC/EN 60 715

### Mounting:

### Net weight

IK 9143: approx. 65 g

SK 9143: approx. 83 g

## Dimensions

### Width x height x depth

IK 9143: 17.5 x 90 x 58 mm

SK 9143: 17.5 x 90 x 98 mm

## Standard Type

IK 9143.11 50 / 60 Hz  $\pm 10\%$  AC 230 V Hyst. 0.5 ... 10 %

Article number: 0055922

- De-energized on trip
- Selection of overvoltage or undervoltage
- Selectable frequency range: 50 or 60 Hz
- Response value:  $\pm 10\%$  adjustable
- Nominal voltage  $U_n$ : AC 230 V
- Hysteresis: 0.5 ...  $\pm 10\%$  adjustable
- Width: 17.5 mm

## Variants:

IK 9143.11/001,

SK 9143.11/001: energized on trip

## Ordering example for variants

IK 9143 .11 / \_ \_ \_ 50 / 60 Hz  $\pm 10\%$  AC 230 V 0.5 ... 10 %

Hysteresis  
 Nominal voltage  
 Response value  
 Frequency range  
 Variant, if required  
 Contacts  
 Type

## VARIMETER Frequency Relay MK 9837N, MH 9837



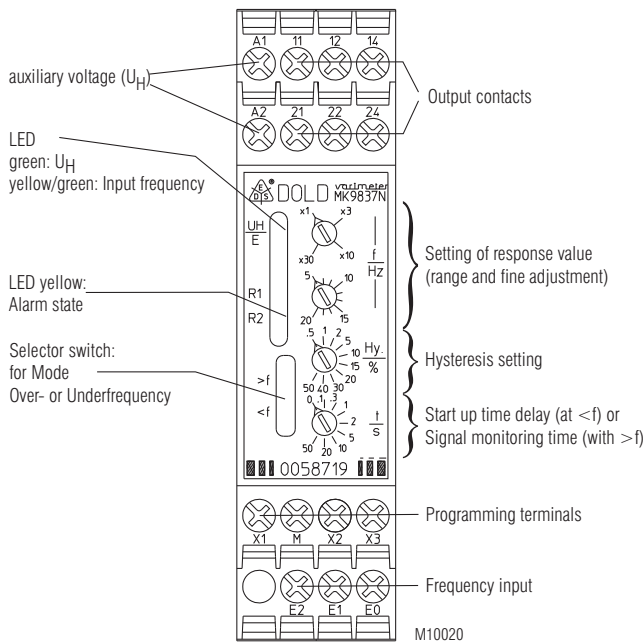
### Your Advantages

- Universal usage
- Easy handling

### Features

- According to IEC/EN 60 255-1
- Detection of over- or underfrequency of alternating voltage (adjustable function)
- Fast reaction time by measuring duration of cycle of input frequency
- Universal measuring input for AC-voltages of 15 ... 280 V as well as 30 ... 550 V
- As option with measuring input for inverters
- 4 ranges adjustable response value 1,5 ... 200 Hz or 5 ... 600 Hz
- Adjustable hysteresis
- Adjustable start up time delay 0 ... 50 s at function underfrequency
- Adjustable monitoring time for missing input signal at function overfrequency
- Response delay programmable via terminals 0 ... 100 s
- Alarm storing or auto-reset programmable via terminals
- Galvanic separation between measuring input, auxiliary voltage and output contacts
- MH 9837 available with wide input range for auxiliary supply (AC/DC 24 ... 60 V or AC/DC 110 ... 230 V)
- 2 changeover contacts, closed circuit operation
- Open circuit operation on request
- LED indication for auxiliary voltage, measuring voltage and alarm status
- MH 9837.12/008: with galvanic separated analogue output (current/voltage) and 11 step LED chain for the actual frequency
- Device available with 2 response values and separately controlled outputrelays for under- and overfrequency see MK 9837N/500
- 2 possible compact designs:  
MK 9837N: Width 22,5 mm  
MH 9837: Width 45 mm

### Setting



### Approvals and Markings

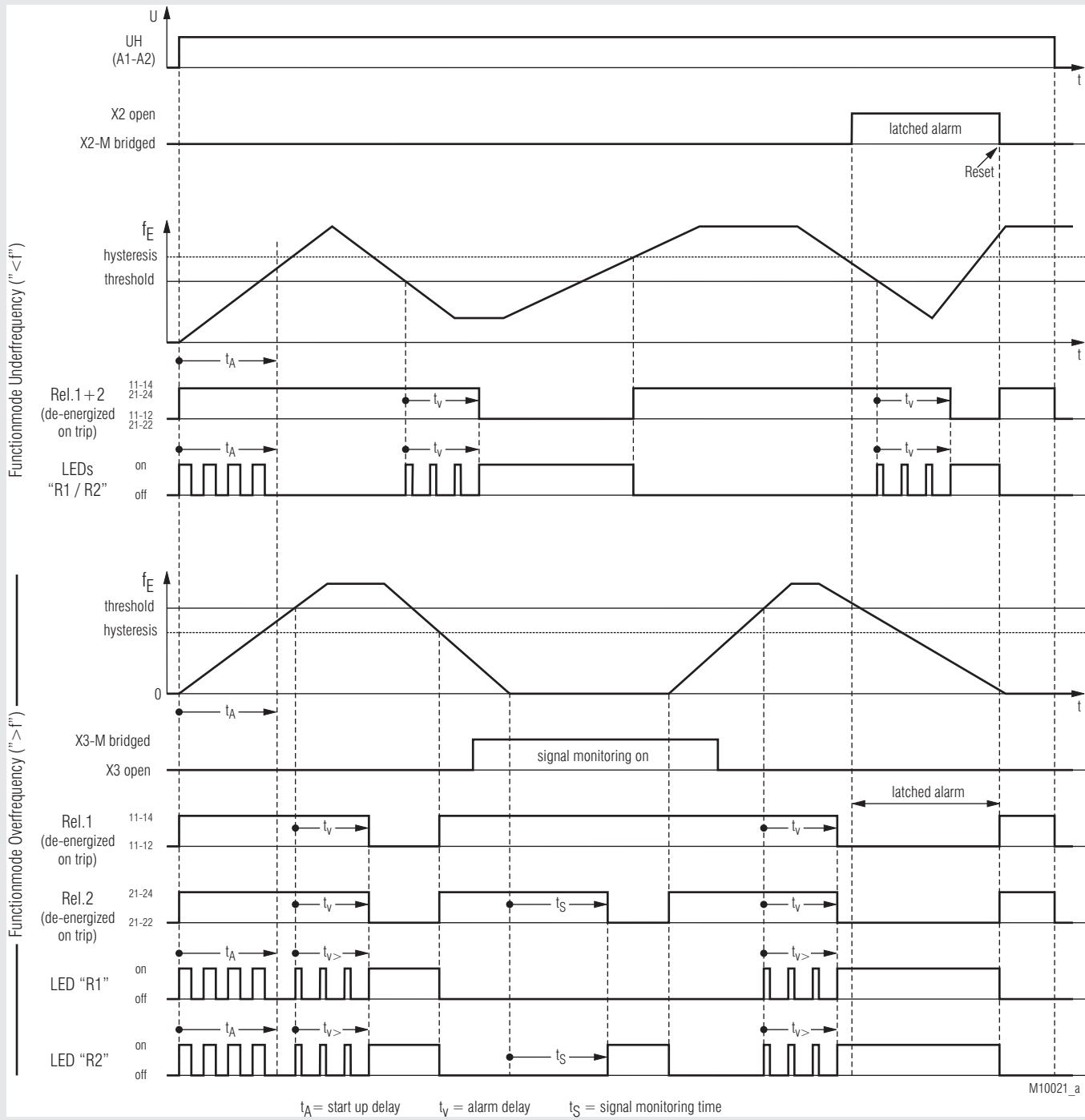


\*) only MK 9837N

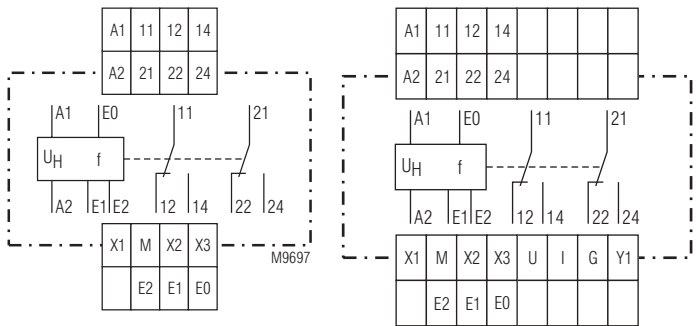
### Applications

- Monitoring of frequency in AC systems
- Monitoring of rotor frequency on slip ring motors
- Control and monitoring of motors in sewage water treatment plants
- Monitoring of output voltage on inverters (variant /050)
- Monitoring of supply voltage frequency on railway rolling stock

# Function Diagram



## Circuit Diagrams



MK 9837N

MH 9837/008

## Connection Terminals

Terminal designation	Signal designation
A1+, A1	+ / L
A2	- / N
E0, E1, E2	Frequency input
X1, X2, X3	Programming terminals
M	Reference for programming terminals
U	Analogue output voltage
I	Analogue output current
G	Reference for analogue output
Y1	Range selection for analogue output
11, 12, 14, 21, 22, 24	"monitoring output frequency failure (2 changeover contacts)"

## Functions

The auxiliary supply is connected to terminals A1-A2.

Terminals E0-E1-E2 form the measuring input. For low voltages the measuring voltage is connected to E1-E0 and for higher voltages to E2-E0 (see section technical data).

The input frequency is compared to the setting value (response value = fine tunig x range).

As the device measures the cycle duration the fastest frequency measurement is possible (reaction time = cycle time + 10 ms).

In overfrequency mode (switch on front in pos. ">f") the output relay switches to alarm state if the input frequency rises above the response value for a longer time then selected on the terminals. If the measuring frequency drops again under the hysteresis value, the output relay switches back to good state without delay.

In underfrequency mode (switch on front in pos. "<f") the output relay switches to alarm state, if the input frequency drops below the response value for a longer time then selected on the terminals. If the measuring frequency rises again above the hysteresis value, the output relay switches back to good state without delay.

If manual reset is chosen, the output relay stays in tripped position, even if the frequency is back to normal. The reset is made by bridging terminals X2-M or by disconnecting the auxiliary supply.

In alarm state the yellow LEDs „R1“ / „R2“ are continuously on, during time delay they flash with short pulse.

In de-energized on trip mode the output relay is energized in good state (contacts 11-14 etc. closed).

In energized on trip mode the output relay is energized in alarm state (contacts 11-14 etc. closed).

If start up delay is selected a timer is started after connection of auxiliary supply that disables the measuring circuit for the adjusted time. This start up delay avoids an alarm e.g. when starting a generator or motor.

When measuring overfrequency, monitoring of the signal on E0-E1-E2 can be selected. If the signal is missing longer then the selected monitoring time, relay 2 (contacts 21-22-24) and LED "R2" indicate alarm.

## Indicators

- Upper LED „UH/E“:
- green, when only auxiliary voltage connected to A1 - A2
  - yellow/green, when measuring frequency is detected on E0-E1-E2
- Lower LED „R1“ (yellow):
- On, when alarm state (under- / overfrequency) flashes (with short pulse) when time delay is active
- Lower LED „R2“ (yellow):
- On, when alarm state (under- / overfrequency) flashes (with short pulse) when time delay is active
  - additional flashes at signal monitoring alarm LEDs "R1" and "R2" flash together during start up delay

## Notes

### Frequency measuring input

The standard measuring input is divided up in to voltage ranges (E1-E0 AC 15... 280 V and E2-E0 AC 30 ... 550 V). If the measuring voltage is always higher then AC 30 V, the higher range should be used. To measure the output frequency on inverters the variant /\_5\_ has to be used. A special dimensioned measuring input with low pass characteristic avoids the measuring of the pulse frequency. In addition the input sensitivity is adapted to the voltage-/frequency-characteristic of inverters (see diagram in technical data).

Visual indication of measuring voltage: If the voltage on the measuring input is to low for correct function on inputs E0-E1-E2 the upper 2-colour LED "UH/E" shows green continuous light. If underfrequency is selected the unit indicates underfrequency alarm, if overfrequency is selected together with measuring signal monitoring the unit indicates measuring signal alarm. If the voltage on the measuring input is high enough the LED "UH/E" flashes yellow/green.

## Notes

### Start up delay / monitoring of measuring signal.

The start up time delay (tA) can be adjusted with the lowest potentiometer on the front side of the unit and is activated when connecting the auxiliary supply.

In underfrequency mode ("<f") the start up delay can be extended/restarted at any time with a control contact between terminals X3-M. As long as X3-M is bridged the start up delay is continuously on and the frequency is not measured. When the link on X3-M is opened the start up delay time restarts.

In overfrequency mode (">f") with a bridge on X3-M, the lowest potentiometer sets the measuring signal monitoring time (tS) (The adjusted time values tA/tS are identically).

When signal monitoring in mode ">f" is selected by bridging X3-M the measuring input is monitored as follows: If during the adjusted monitoring time interval no measuring signal is detected, measuring signal alarm is indicated. As soon as the measuring signal returns the alarm status is reset (auto reset selected) and the monitoring interval tS starts again.

The alarm status is indicated on relay 2 (contacts 21-22-24) and LED "R2" and can be easily differentiated from under/over frequency alarm where both relays (contacts 11-12-14and 21-22-24) and LEDs "R1"and "R2") are active.

The detection of missing measuring signal can increase the safety in critical applications on overfrequency. It detects if the measuring signal is connected to the input of the device and works correctly

### Programming terminals (M-X1-X2-X3):

**Attention!** The terminals M-X1-X2-X3 have no galvanic separation to the measuring circuit, and must be operated potential free.

- M: Common connection (Ground) of the programming terminals
- X1: A response delay of 0...100 s after connection of auxiliary supply is achieved by connecting a X1 to M with a potentiometer or fixed resistor (see technical data). The delay can be stopped by bridging X1 to M at any time.
- X2: Manual reset with NO contact push button on X2-M, auto reset with terminals X2-M bridged.
- X3: When X3-M is bridged in mode "underfrequency" the start up delay is continuously active or the time is restarted. In mode overfrequency the monitoring of the measuring signal is switched on by bridging X3-M.

### Adjustment aid for start up delay and alarm delay

During the elapse of start up delay and alarm delay the yellow LED „R1“ and „R2“ is flashing with a frequency of 2 Hz. To set a specific time value in seconds the number of flash pulses can be used to check the setting: Number of flash pulses divided by 2 = time delay in seconds.

### Variant MH 9837.12/008: 45 mm width

Identically to MK 9837N.12, but with 11 step LED chain indicator and galvanic separated analogue output to display the actual measured frequency.

On terminals U/G of the analogue output 0-10 V are provided, on terminals I/G 0-20 mA are available. By bridging terminals Y1 and G the output can be switched over to 2-10 V and 4-20 mA. The max. value of the analogue output is indicating 2 times of the max. value of the selected range this allows also to indicate overfrequency values. The scaling is linear to the input frequency (lowest analogue value is 0 Hz). The LED chain indicator shows on 10 LEDs the actual frequency ( ≤ 10% ... 100% of the setting range). If the frequency exceeds the maximum value of the range the indicator is switched over to 2 x max value and the top LED (red) is on.

**Technical Data****Frequency Measuring Input (E0-E1-E2)****Standard-frequency measuring****Voltage range**

E0-E1: AC 15 ... 280 V,  
E0-E2: AC 30 ... 550 V

**Input resistance**

E0-E1: approx. 300 kΩ  
E0-E2: approx. 850 kΩ

**Frequency Measuring Input for Inverters (variant / 5\_)**

**Max. input voltage:** AC 550 V  
**Min. measuring voltage:** see characteristic M9349  
**Input resistance:** approx. 900 kΩ

**Common Data for Both Measuring Inputs**

**Galvanic separation:** Frequency measuring input to auxiliary voltage and output contacts

**Frequency ranges:**

1,5 ... 6 Hz	5 ... 20 Hz	15 ... 60 Hz	50 ... 200 Hz or
5 ... 20 Hz	15 ... 60 Hz	50 ... 200 Hz	150 ... 600 Hz 4 ranges selectable

**Response time**

(response value): continuously variable;  
1:4 in each response value

**Tolerances of the adjusted tripping values at variation of auxiliary supply and temperature:**

**Hysteresis:** better than ± 1 %  
continuously variable: 0,5 ... 50 %  
of adjustable response value

**Reaction time of**

**Frequency monitoring:** (Alarm delay set to 0)  
Duration of 1 cycle (inverse value of adjusted frequency) + 10 ms  
adjustable 0 ... 100 s with resistor/potentiometer across terminals X1-M:

**Response delay:**

R / kΩ:	0	15	22	33	47	68	100	150	220	470	∞
t <sub>r</sub> / s:	0	0.3	0.7	1.3	2.3	5	9	15	25	50	100

**Time between connection of auxiliary supply and ready to measure:**

approx. 0,4 s (with start up delay is 0)

**Start up time delay /**

**Signal monitoring time:** 20 ms ... 50 s continuously variable  
on logarithmic scale

**Auxiliary Circuit (A1-A2)****Auxiliary voltage U<sub>H</sub>**  
(galvanic separation):

AC 115, 230, 400 V  
DC 12, 24, 48 V  
AC/DC 24 ... 60, 110 ... 230 V (only for MH-version possible)

**Voltage range**

AC: 0,8 ... 1,1 U<sub>H</sub>  
DC: 0,9 ... 1,2 U<sub>H</sub>  
AC/DC: 0,75 ... 1,2 U<sub>H</sub>

**Frequency range**

AC: 45 ... 440 Hz

**Nominal consumption:**

AC: approx. 4 VA  
DC: approx. 2 W

**Output (11-12-14, 21-22-24)**

**Contacts:** 2 changeover contacts  
**Thermal current I<sub>th</sub>:** 4 A

**Switching capacity**

according to AC 15  
NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1  
according to DC 13  
NO contact: 1 A / DC 24 V IEC/EN 60 947-5-1  
NC contact: 1 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life**

acc. to AC 15 at 1 A, AC 230 V: 1,5 x 10<sup>5</sup> switching cycles IEC/EN 60 947-5-1

**Short circuit strength**

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** ≥ 30 x 10<sup>6</sup> switching cycles

**Technical Data****Analogue Output with MH 9837.12/008****galvanic separation AC 3750V****to auxiliary supply, measuring circuit and relay outputs**

terminal U(+) / G(-): 0 ... 10 V, max. 10 mA  
terminal I (+) / G(-): 0 ... 20 mA, max. burden 500 Ohm  
change to 2 ... 10 V or 4 ... 20 mA by bridging terminal Y1 and G.  
scaling is linear with frequency (lowest value at f = 0, highest value at 2 x max setting value)

**General Data**

**Nominal operating mode:** continuous operation

**Temperature range**

Operation: - 20 ... + 60°C  
(higher temperature with limitations on request)

Storage: - 25 ... + 60°C

**Altitude:** < 2,000 m

**Clearance and creepage distance**

rated impulse voltage /

pollution degree:

output to measuring circuit: 4 kV / 2 IEC 60 664-1

output to auxiliary circuit: 4 kV / 2 IEC 60 664-1

output to output: 4 kV / 2 IEC 60 664-1

auxiliary circuit to measuring input: 4 kV / 2 IEC 60 664-1

Programming terminals

M-X1-X2-X3: without galv. separation to measuring circuit

**EMV**

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation

80 MHz ... 1 GHz: 20 V/m IEC/EN 61 000-4-3

1 GHz ... 2,5 GHz: 10 V/m IEC/EN 61 000-4-3

2,4 GHz ... 2,7 GHz: 1 V/m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

**Degree of protection:**

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:**

thermoplastic with V0 behaviour

according to UL subject 94

**Vibration resistance:** Amplitude 0,35 mm IEC/EN 60 068-2-6

Frequency 10 ... 55 Hz IEC/EN 60 068-1

20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** EN 50 005

**Wire connection:** 1 x 4 mm<sup>2</sup> solid or

2 x 1,5 mm<sup>2</sup> solid or

1 x 2,5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4 or

2 x 1,5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/

Plus-minus terminal screws

M3,5 box terminals with wire protection

0,8 Nm IEC/EN 60 715

**Mounting:** DIN rail

**Weight:** MK 9837N: approx. 210 g

MH 9837: approx. 350 g

**Dimensions****Width x height x depth:**

MK 9837N: 22,5 x 90 x 97 mm

MH 9837: 45 x 90 x 97 mm

## Classification to DIN EN 50155

**Vibration and shock resistance:** Category 1, Class B IEC/EN 61 373  
**Ambient temperature:** T1 compliant  
 T2, T3 and TX with operational limitations  
**Protective coating of the PCB:** No

## CCC-Data

**Auxiliary voltage  $U_N$ :**  
 MK 9837N: AC 115, 230 V  
 DC 12, 24, 48 V

**Switching capacity**  
 to AC 15  
 NO contact: 1,5 A / AC 230 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Types

MK 9837N.12 5 ... 600 Hz  $U_H$  AC 230 V  
 Article number: 0058719

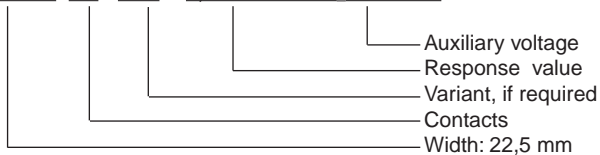
- Switchable monitoring modus: over- or underfrequency
- Closed circuit operation
- Mode overfrequency with selectable signal monitoring
- 4 settable frequency ranges are possible:  
 5 ... 20 Hz, 15 ... 60 Hz, 50 ... 200 Hz, 150 ... 600 Hz
- Settable hysteresis of 0,5 ... 50 %
- Start up time delay / signal monitoring time:  
 settable to 0 ... 50 s
- Response delay: settable with external resistor to 0 ... 100 s
- Alarm storing or auto-reset selectable
- Frequency measuring input: AC 15 ... 280 V / AC 30 ... 550 V
- Auxiliary voltage  $U_H$ : AC 230 V
- Output: 2 changeover contacts
- Width: 22,5 mm

## Variants

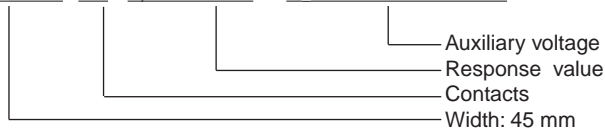
MK 9837N.12/050: as MK 9837N.12, but with measuring input for inverters  
 MH 9837.12: as MK 9837N.12, but for variants with wide auxiliary voltage range  
 Width: 45 mm  
 MH 9837.12/008: similar to MK 9837N.12, but with galvanic separated analogue output (current/voltage) and 11 step LED chain.  
 Width: 45 mm

## Ordering example for variants

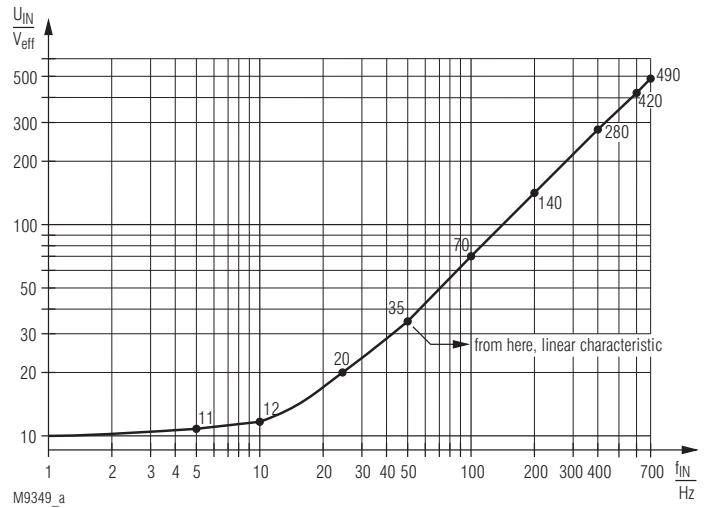
MK 9837N .12 /050 1,5 ... 200 Hz  $U_H$  AC 230 V



MH 9837 .12 1,5 ... 200 Hz  $U_H$  AC/DC 110 ... 230 V



## Characteristic



Typical sensitivity of the measuring input at variant MK 9837N.12/\_5\_

## VARIMETER

### Frequency Relay

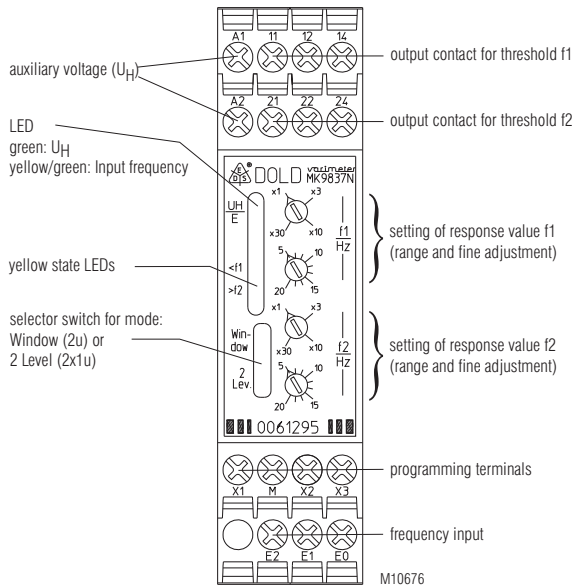
MK 9837N/5\_0, MH 9837/5\_0



MK 9837N/500

MH 9837/500

### Setting



### Your Advantages

- Separate output signals for under and over frequency
- Simple wiring
- Easy handling

### Features

- According to IEC / EN 60 255, VDE 0435 Teil 303
- Monitoring of AC voltage for under and overfrequency, can be used also for pre-warning
- Separate relay outputs for over- or underfrequency (1 or 2 changeover contacts each)
- Alternative usage for monitoring of a frequency window
- Separate adjustment of response value for over- or underfrequency at 4 ranges each, 1.5 ... 200 Hz or 5 ... 600 Hz
- Second response value for prewarning possible
- Fast reaction time by measuring duration of cycle of input frequency
- Universal measuring input for AC-voltages of 15 ... 280 V as well as 30 ... 550 V
- As option with measuring input for inverters
- Programmable hysteresis of response value: 2 ... 10 %
- Start up time delay programmable via terminals from 0 ... 50 s e.g. continuously
- Manual or auto-reset programmable via terminals
- Galvanic separation between measuring input, auxiliary voltage and output contacts
- MH 9837/508: with galvanic separated analogue output (current/voltage) and 11 step LED chain for the actual frequency
- MH 9837/5\_0: with wide input range for auxiliary voltage available (AC/DC 24 ... 60 V or AC/DC 110 ... 230 V)
- Closed circuit operation (de-energized on trip)
- LED indication for auxiliary voltage, measuring voltage and alarm status
- Device available with 2 contacts  
MK 9837N/5\_0: 2 x 1 changeover contact  
MH 9837/5\_0: 2 x 2 changeover contacts or wide auxiliary voltage range
- 2 possible compact designs:  
MK 9837N/5\_0: Width 22,5 mm  
MH 9837/5\_0: Width 45 mm

### Approvals and Markings



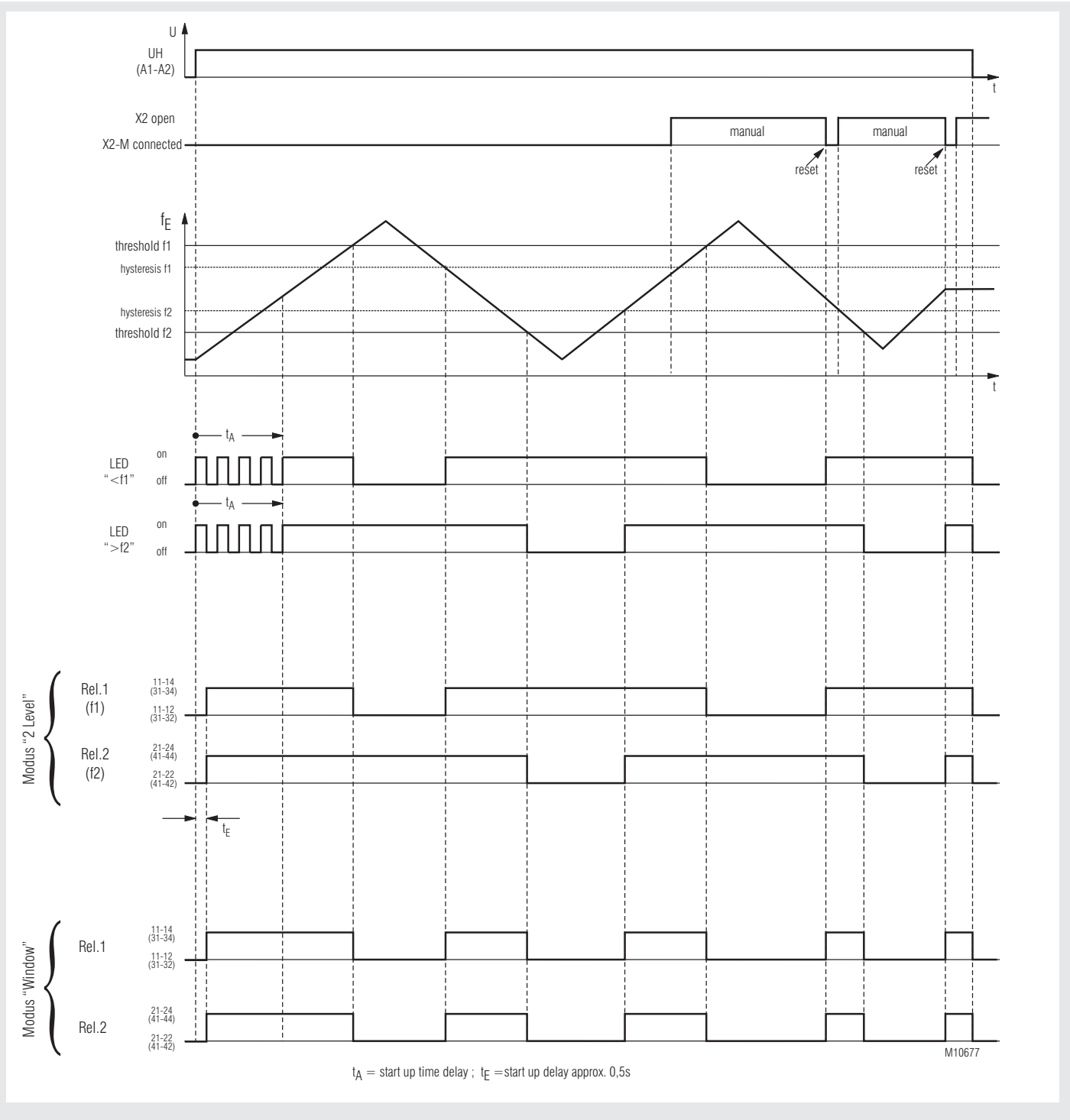
\*) only MK 9837N/5\_0

### Application

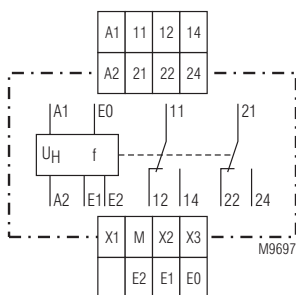
- Monitoring of frequency in AC systems
- Monitoring of rotor frequency on slip ring motors
- Control and monitoring of motors in sewage water treatment plants
- Monitoring of output frequency on inverters (variant /550)



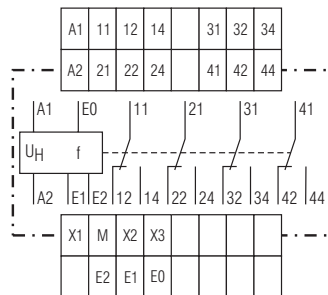
## Function Diagram



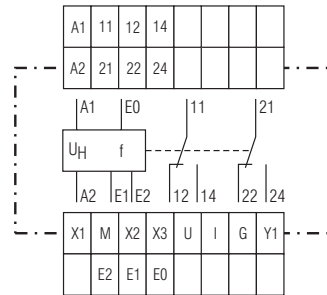
## Circuit Diagrams



MK 9837N/500



MH 9837/500



MH 9837/508

## Connection Terminals

Terminal designation	Signal designation
A1+, A1	+ / L
A2	- / N
E0, E1, E2	Frequency input
X1, X2, X3	Programming terminals
M	Reference for programming terminals
U	Analogue output voltage
I	Analogue output current
G	Reference for analogue output
Y1	Range selection for analogue output
11, 12, 14, 21, 22, 24, 31, 32, 34, 41, 42, 44	"monitoring output frequency failure (2 or 4 changeover contacts)"

## Functions

The auxiliary supply is connected to terminals A1-A2. Terminals E0-E1-E2 form the measuring input. For low voltages the measuring voltage is connected to E1-E0 and for higher voltages to E2-E0 (see section technical data).

The input frequency is compared to the setting value for over- and underfrequency (response value f1 e.g. f2 = fine tuning x range). As the device measures the cycle duration the fastest frequency measurement is possible (reaction time = cycle time + 10 ms).

If the input frequency on the measuring input E0-E1-E2 is under the response value f1 less hysteresis (both upper potentiometers) and over the response value f2 (both lower potentiometers) plus hysteresis then the output relays are energized and the yellow LEDs "<f1" and ">f2" are on.

If the frequency rises above the value of f1, the relay 1 de-energizes (contacts 11-12 close) in "2 level mode", in "window mode" also relay 2 de-energizes (contacts 21-22 close). The yellow LED "<f1" goes off. Only when the input frequency drops under the level f1 minus hysteresis, the output relay (both relays in window mode) energize again and the yellow LED "<f1" is on.

If the frequency drops below the value of f2, the relay 2 de-energizes (contacts 21-22 close) in "2 level mode", in "window mode" also relay 1 de-energizes (contacts 11-12 close). The yellow LED "<f2" goes off. Only when the input frequency rises above the level f2 plus hysteresis, the output relay (both relays in window mode) energize again and the yellow LED "<f2" is on.

If manual reset is active (terminal x2 not connected) and the frequency returns to good state the relay (relays) remain in alarm position (de-energized) and the corresponding LED is off. To reset the alarm terminals X2-M must be bridged, or the auxiliary supply has to be switched off and on again.

If a start-up delay is adjusted, this delay starts with the connection of the auxiliary supply. During this time the frequency is not detection is off, the yellow LEDs "<f1" and ">f2" flash and the output relays are in good state (energized). The start-up delay allows to avoid alarms during the starting period of a generator or motor.

Using the sliding switch on the front of the unit the user can chose between the two function modes "2-level mode" and "window mode".

„2 level-mode“: 2x1 c/o contacts; the output relays 1 and 2 switch separately at the corresponding response value f1 and f2.

„window-mode“: 2 c/o contacts; the output relays switch together at the response values for f1 and f2 (where f1>f2); i.e. the relays switch off together the frequency rises over f1 or drops under f2.

## Indicators

Upper LED „UH/E“: - green, when only auxiliary voltage connected to A1 - A2  
 - yellow/green, when measuring frequency is detected on E0-E1-E2

Lower LED „<f1“ (yellow): - On, input frequency is lower than response value f1 (= relay 1 energized in "2-level mode")

Lower LED „>f2“ (yellow): - On, when input frequency is higher than response level f2 (= relay 2 energized in "2-level mode")  
 LEDs "<f1" and ">f2" flashes during start up delay

## Notes

### Setting of response values f1 and f2 / function energized on trip for output relays

Normally the response value f1 is used for overfrequency and f2 for underfrequency the hysteresis works accordingly to these settings. Both relays operate de-energized on trip. In "2-level-mode" the frequency detection and the control of the corresponding relays at the response values f1 and f2 work completely independent. So it is possible to adjust f2 higher than f1 if auto reset is selected. If f2 is used for overfrequency, the unit works energized on trip, as the relay 2 (21-22-24) always energizes when the frequency rises above response value + hysteresis. In the same way the response value f1 - hysteresis can be used for underfrequency so that relay 1 (11-12-14) is energized on trip.

When using manual reset in "window mode" the response value f1 (minus hysteresis) must always be higher than f2 (plus hysteresis) to avoid that the output relays do not switch anymore and the yellow LEDs "<f1" and ">f2" remain dark.

### Frequency measuring input

The standard measuring input is divided up in to voltage ranges (E1-E0 AC 15... 280 V and E2-E0 AC 30 ... 550 V). If the measuring voltage is always higher then AC 30 V, the higher range should be used.

To measure the output frequency on inverters the variant /550 has to be used. A special dimensioned measuring input with low pass characteristic avoids the measuring of the pulse frequency. In addition the input sensitivity is adapted to the voltage-/frequency-characteristic of inverters (see diagram in technical data).

Visual indication of measuring voltage:

If the voltage on the frequency measuring input is high enough for monitoring the upper dual color LED "UH/E" is ON yellow/green. If the voltage on the input is to low, the LED "UH/E" shows only green color.

**Attention:** If the measuring voltage is to low the unit reacts as on underfrequency!

### Programming terminals (M-X1-X2-X3):

**Attention!** The terminals M-X1-X2-X3 have no galvanic separation to the measuring circuit (E0-E1-E2), and must be operated potential free.

- M: Common connection (Ground) of the programming terminals
- X1: start up delay at range of 0...50 s is achieved by connecting a X1 to M with a potentiometer (0.25 W) or fixed resistor (see technical data). If no start up delay is required the terminals X1-M must be linked.
- X2: Manual reset with NO contact push button on X2-M, auto reset with terminals X2-M bridged.
- X3: Hysteresis setting at range of 2...10 % is achieved by connecting the terminal X3 to M with a potentiometer (0.25 W) or fixed resistor (see technical data).  
 For a hysteresis of 2 % the terminal X3 remains open;  
 for a hysteresis of 10 % s the terminals X3-M must be linked.

### Start up delay

A start up delay ( $t_A = 0 \dots 50$  s) adjusted by connecting a resistor 0 ... 500kOhm to the terminals X1 and M see technical data. This start up delay is started when connecting the auxiliary supply. During this time monitoring is disabled and both output relays are energized. If the connection between X1 and M is open circuit (resistance > 500 kOhm), the startup delay is continuously on. With this possibility the frequency monitoring can be disabled by an external contact until e.g. a system reaches its normal operation status. When the circuit X1 - M closes the time delay set by a resistor in this circuit runs down before the monitoring starts.

If no start up delay is required, the terminals X1-M must be linked. There must be a connection between X1-M when the frequency should be monitored. While the start up delay is active, the yellow LEDs "<f1" and ">f2" flash with 2 Hz. To adjust a specific time the number of flashing cycles can be counted. Number of cycles divided by 2 = start up time in seconds.

**Notes****Manual / automatic reset**

To enable manual reset the connection X2-M remains open. Storing of the alarm influences the output relays and the corresponding LEDs. Reset is made by closing the connection between X2 and M or by disconnecting the auxiliary supply.

**Setting of hysteresis**

Connecting terminal X3 via a resistor to M adjusts the hysteresis. Both response values (f1 and f2) have the same hysteresis in percentage of the adjusted response values. So the absolute value of the hysteresis is higher on the higher response value than on the lower response value.

**Variant MH 9837.38/508: (45 mm width)**

Identically to MK 9837N.12, but with 11 step LED chain indicator and galvanic separated analogue output to display the actual measured frequency. On terminals U/G of the analogue output 0-10 V are provided, on terminals I/G 0 ... 20 mA are available. By bridging terminals Y1 and G the output can be switched over to 2 ... 10 V and 4 ... 20 mA. The max. value of the analogue output is indicating 2 times of the max. value of the selected range this allows also to indicate overfrequency values. The scaling is linear to the input frequency (lowest analogue value is 0 Hz). The LED chain indicator shows on 10 LEDs the actual frequency ( $\leq 10\% \dots 100\%$  of the setting range). If the frequency exceeds the maximum value of the range the indicator is switched over to 2 x max value and the top LED (red) is on.

**Technical Data****Frequency Measuring Input (E0-E1-E2)****Standard-frequency measuring****Voltage range**

E0-E1: AC 15 ... 280 V,  
E0-E2: AC 30 ... 550 V

**Input resistance**

E0-E1: approx. 300 k $\Omega$   
E0-E2: approx. 850 k $\Omega$

**Frequency measuring input for inverters (variant /550)**

**Max. input voltage:** AC 550 V  
**Min. measuring voltage:** approx. AC 10 V (at 1 Hz) ... AC 150 V (at 200 Hz); (see characteristic M8681)  
**Input resistance:** approx. 900 k $\Omega$

**Common Data for Both Measuring Inputs**

**Galvanic separation:** Frequency measuring input to auxiliary voltage and output contacts

**Frequency ranges: (separately selectable for f1 and f2)**

1.5 ... 6 Hz	5 ... 20 Hz	15 ... 60 Hz	50 ... 200 Hz or
5 ... 20 Hz	15 ... 60 Hz	50 ... 200 Hz	150 ... 600 Hz 4 ranges selectable each

**Response time f1, f2**

(response value): separately adjustable at absolute scale

**Tolerances of the adjusted tripping values at variation of auxiliary supply and temperature:**

**Hysteresis:** approx.  $\pm 1\%$   
adjustable from 2 ... 10 % with resistor/potentiometer across terminals X3-M

Resistance:	0	15 k $\Omega$	39 k $\Omega$	120 k $\Omega$	$\infty$
Hysteresis:	10 %	8 %	6 %	4 %	2 %

**Reaction time of**

**Frequency monitoring:** Duration of 1 cycle (inverse value of adjusted frequency) + 10 ms adjustable from 0 ... 50 s with resistor/potentiometer across terminals X1-M:

R / k $\Omega$ :	0	15	22	33	47	68	100	150	220	470	$\infty$
t <sub>v</sub> / s:	0	0,3	0,7	1,3	2,3	5	9	15	25	50	$\infty$

**Time between connection of auxiliary supply and ready to measure:**

approx. 0.5 s (with start up delay is 0)

**Technical Data****Auxiliary Circuit (A1-A2)****Auxiliary voltage U<sub>H</sub>**

(galvanic separation): AC 115, 230, 400 V  
DC 12, 24, 48 V  
AC/DC 24 ... 60, 110 ... 230 V (only for MH-version possible)

**Voltage range**

AC: 0.8 ... 1.1 U<sub>H</sub>  
DC: 0.9 ... 1.2 U<sub>H</sub>  
AC/DC: 0.75 ... 1.2 U<sub>H</sub>

**Frequency range**

AC: 45 ... 440 Hz

**Nominal consumption:**

AC: approx. 4 VA  
DC: approx. 2 W

**Output (11-12-14, 21-22-24 + 31-32-34, 41-42-44 at MH 9837.39/5\_0)****Contacts:**

MK 9837N.38/5\_0: 2 x 1 changeover contact  
(1 each for over- and underfrequency alarm)  
MH 9837.39/5\_0: 2 x 2 changeover contacts  
(2 each for over- and underfrequency alarm)  
4 A

**Thermal current I<sub>th</sub>:****Switching capacity**

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

to DC 13

NO contact: 1 A / DC 24 V IEC/EN 60 947-5-1

NC contact: 1 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life**

to AC 15 at 1 A, AC 230 V: 1,5 x 10<sup>6</sup> switching cycles IEC/EN 60 947-5-1

**Short circuit strength**

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1  
**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

**Analogue Output with MH 9837.38/508****galvanic separation AC 3750V****to auxiliary supply, measuring circuit and relay outputs**

terminal U(+) / G(-): 0 ... 10 V, max. 10 mA  
terminal I (+) / G(-): 0 ... 20 mA, max. burden 500 Ohm  
change to 2 ... 10 V or 4 ... 20 mA by bridging terminal Y1 and G.  
scaling is linear with frequency (lowest value at f = 0, highest value at 2 x max setting value)

**General Data**

**Nominal operating mode:** continuous operation

**Temperature range:** - 20 ... + 60°C

**Clearance and creepage distance**

rated impulse voltage /

pollution degree:

output to measuring circuit: 4 kV / 2 IEC 60 664-1

output to auxiliary circuit: 4 kV / 2 IEC 60 664-1

output to output: 4 kV / 2 IEC 60 664-1

auxiliary circuit to

measuring input: 4 kV / 2 IEC 60 664-1

Programming terminals

M-X1-X2-X3: without galv. separation to measuring circuit

**EMV**

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

## Technical Data

### Degree of protection:

Housing: IP 40 IEC/EN 60 529  
 Terminals: IP 20 IEC/EN 60 529

**Housing:** thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm  
 Frequency 10 ... 55 Hz IEC/EN 60 068-2-6  
 20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

**Terminal designation:** EN 50 005

**Wire connection:** 1 x 4 mm<sup>2</sup> solid or  
 2 x 1.5 mm<sup>2</sup> solid or  
 1 x 2.5 mm<sup>2</sup> stranded wire with sleeve  
 DIN 46 228-1/-2/-3/-4 or  
 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
 DIN 46 228-1/-2/-3/

**Wire fixing:** Plus-minus terminal screws  
 M3.5 box terminals with wire protection  
 DIN rail IEC/EN 60 715

### Mounting:

**Weight:**  
 MK 9837N/5\_0: approx. 210 g  
 MH 9837/5\_0: approx. 295 g  
 MH 9837/508: approx. 350 g

## Dimensions

### Width x height x depth:

MK 9837N/5\_0: 22.5 x 90 x 97 mm  
 MH 9837/5\_0: 45 x 90 x 97 mm

## CCC-Data

### Auxiliary voltage $U_N$ :

MK9837N/5\_0: AC 115, 230 V  
 DC 12, 24, 48 V

### Switching capacity

to AC 15  
 NO contact: 1,5 A / AC 230 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

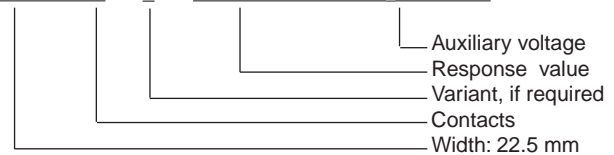
MK 9837N.38/500 2 x 5 ... 600 Hz  $U_H$  AC 230 V  
 Article number: 0061295  
 • 2 adjustable response values at 4 ranges each:  
 5 ... 20 Hz, 15 ... 60 Hz, 50 ... 200 Hz, 150 ... 600 Hz  
 • Switchable monitoring mode: „2 Level“ or „Window“  
 • Hysteresis: programmable via terminal: 2 ... 10 %  
 • start up time delay: settable with external resistor 0 ... 50 s  
 • Alarm storing or auto-reset selectable  
 • Frequency input AC 15...280 V / AC 30...550 V  
 • Closed circuit operation  
 • Auxiliary voltage  $U_H$ : AC 230 V  
 • Output: 2 changeover contacts  
 • Width: 22,5 mm

## Variants

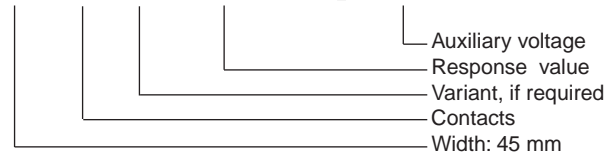
MK 9837N.38/550: as MK 9837N.38/500, but with but with measuring input for inverters  
 MH 9837.38/5\_0: as MK 9837N.38/5\_0, but for variants with wide auxiliary voltage range  
 Width: 45 mm  
 MH 9837.38/508: as MK 9837N.38/500, but with galvanic separated analogue output (current/voltage) and 11 step LED chain.  
 Width: 45 mm  
 MH 9837.39/5\_0: as MK 9837N.38/5\_0, jedoch mit 2 x 2 Wechslern  
 Width: 45 mm

## Ordering example for variants

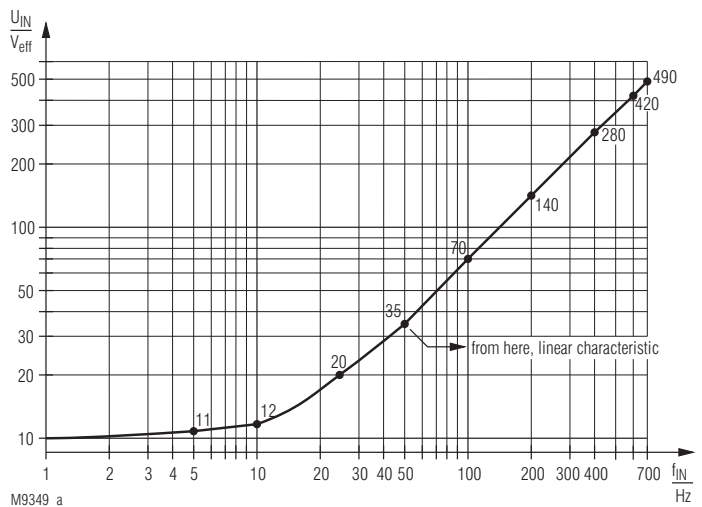
MK 9837N .38 /5\_0 2 x 5 ... 600 Hz  $U_H$  AC 230 V



MH 9837 .38 /5\_0 2 x 5 ... 600 Hz  $U_H$  AC/DC 110 ... 230 V



## Characteristics



Typical sensitivity of the measuring input at variant  
 MK 9837N.12/\_5\_

## VARIMETER

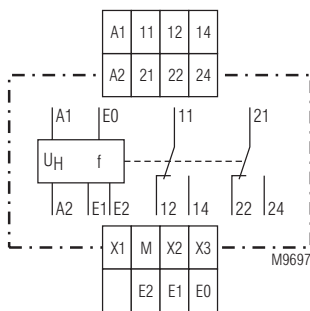
Mains Frequency Monitor  
MK 9143N, MH 9143



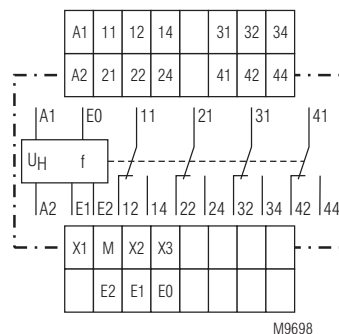
0257/047

- According to IEC / EN 60 255-1
- Monitoring of 50 - and 60 Hz-current supply on over- and underfrequency
- Monitoring of local generator sets and voltage supplies
- For precise frequency measuring with fast response time
- High disturbance immunity
- Separately adjustable trip points and separate outputs for over- and underfrequency (1 or 2 c/o each)
- **MK 9143N / MH 9143:**
  - Trip points adjustable precisely and reproducible on 10 step rotational switch in the range of  $\pm 0,1$  Hz to  $\pm 5$  Hz related to 50 or 60 Hz
  - Nominal frequency 50 or 60 Hz selectable
  - Fixed hysteresis optimised for trip point
  - Time delay for over and underfrequency each adjustable from 0 to 20 s
  - As option one common output for under and overfrequency "Window"-mode (MK 9143N/400 / MH 9143/400)

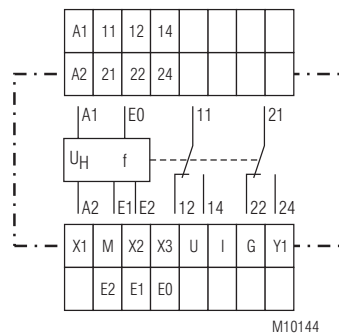
### Circuit Diagrams



MK 9143N.38



MH 9143.39



MH 9143.38/008

- **MH 9143.38/008:** with galvanic separated analogue output (current/voltage) and 11 step LED chain for the actual frequency
- **MK 9143N/600 / MH 9143/600:**
  - Variable alarm value in the range of 45 to 65 Hz
  - Hysteresis adjustable for under- and overfrequency separately adjustable 0 ... 20%
  - Common output for under and overfrequency "Window"-mode can be selected
- Start up delay 0...30 s selectable
- Manual or auto reset selectable
- Output relay energized or de-energized on trip selectable for overfrequency
- Output relay de-energized on trip for underfrequency
- Universal frequency measuring input for AC 40 ... 550V
- Several options for auxiliary supply
- As option without aux. supply for voltage range AC 18 ... 70 V or 70 ... 275V
- LED indicators for auxiliary supply, input frequency, over and under frequency alarm
- 2 possible contact arrangements  
MK 9143N and MK 9143N/600: 2 x 1 C/O contacts, width 22,5 mm  
MH 9143 and MH 9143/600: 2 x 2 C/O contacts, width 45 mm

### Approvals and Markings

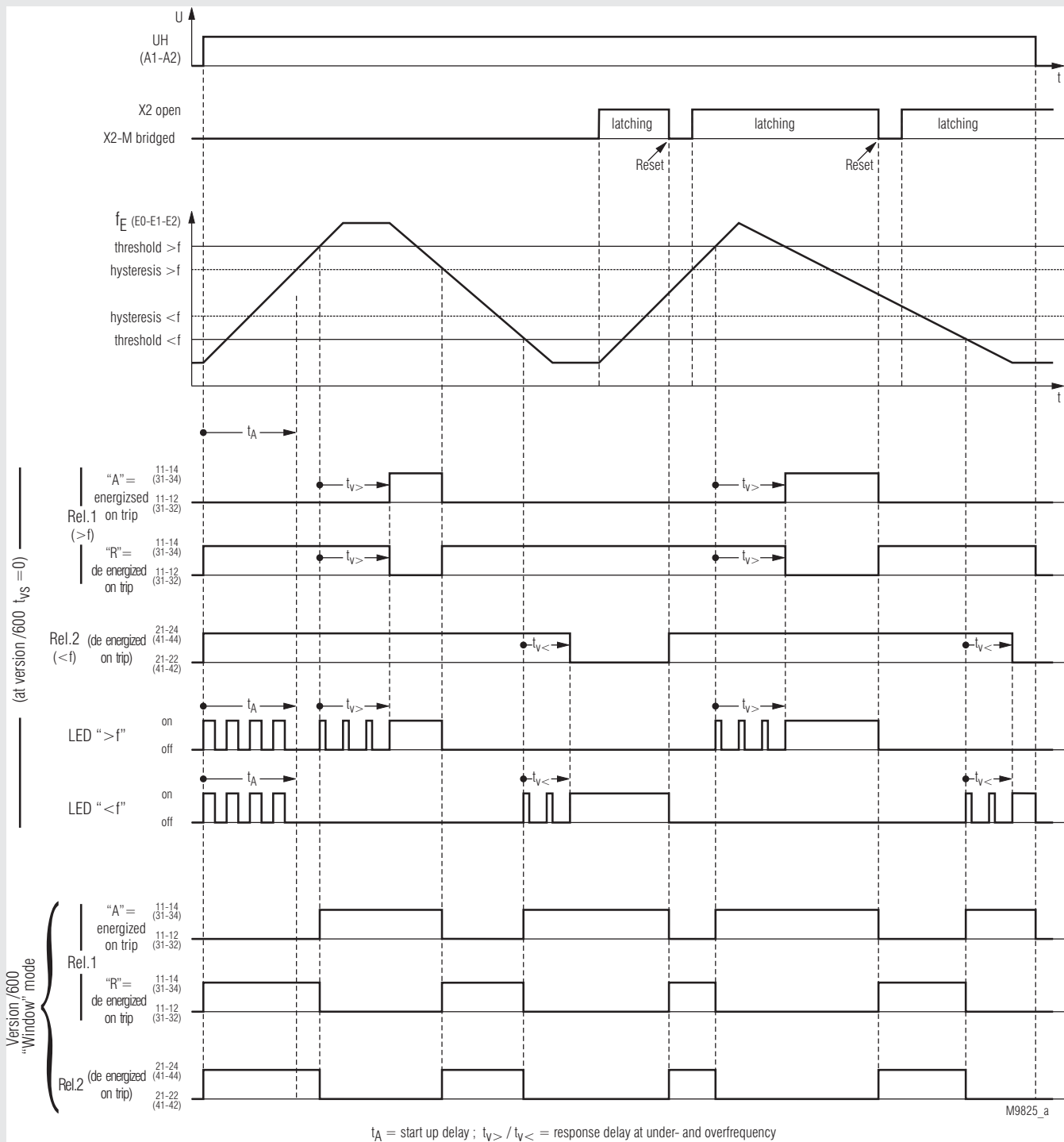


### Connection Terminals

Terminal designation	Signal designation
A1+, A1	+ / L
A2	- / N
E0, E1, E2	Frequency input
X1, X2, X3	Programming terminals
M	Reference for programming terminals
U	Analogue output voltage
I	Analogue output current
G	Reference for analogue output
Y1	Range selection for analogue output
11, 12, 14, 21, 22, 24	"monitoring output frequency failure (2 changeover contacts)"

### Application

Monitoring of local generator sets and voltage supplies



## Function

The auxiliary supply is connected to terminals A1-A2.

(If the measuring voltage is within the tolerances of the auxiliary supply the terminals A1-A2 can also be supplied from the Measuring voltage.)

The measuring input is on terminals E0-E1-E2 with low voltages on E1-E0 and high voltages on E2-E0 (see technical data). The input frequency is compared to the values set on the device.

If the input frequency falls below or rises above the tripping value, the corresponding output relay goes in alarm state (with time delay if adjusted) and the LED  $>f$  or  $<f$  lights up. When the frequency returns to good state the relays the hysteresis is active before the relays return to good state and the corresponding LED goes off.

If manual reset is selected the relay and the LED remain in alarm state when the frequency returns to good state.

Manual reset is made by bridging terminals X2-M or by disconnecting the auxiliary supply.

In de-energized on trip mode the output relay is energized in good state (contacts 11-14 etc. closed).

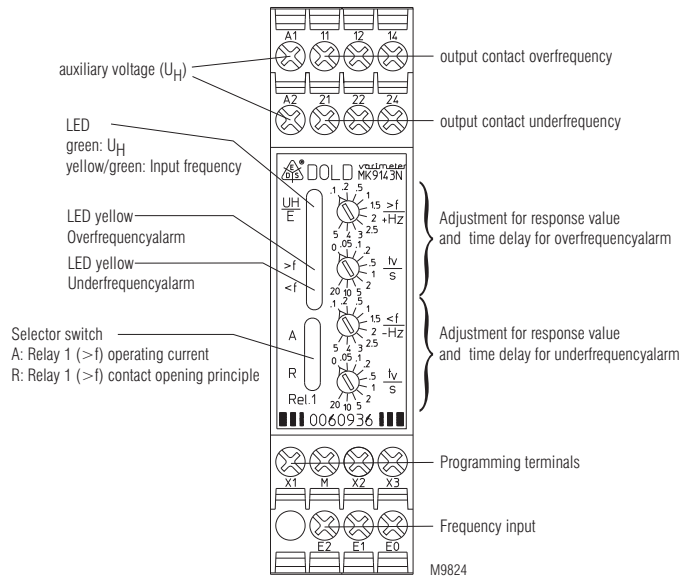
In energized on trip mode the output relay is energized in alarm state (contacts 11-14 etc. closed).

If start up delay is selected a timer is started after connection of auxiliary supply that disables the measuring circuit for the adjusted time. Both LEDs  $<f$  and  $>f$  flash together and the relays are in non tripped state (Good state). Using the start up delay an alarm can be avoided during start up of a generator.

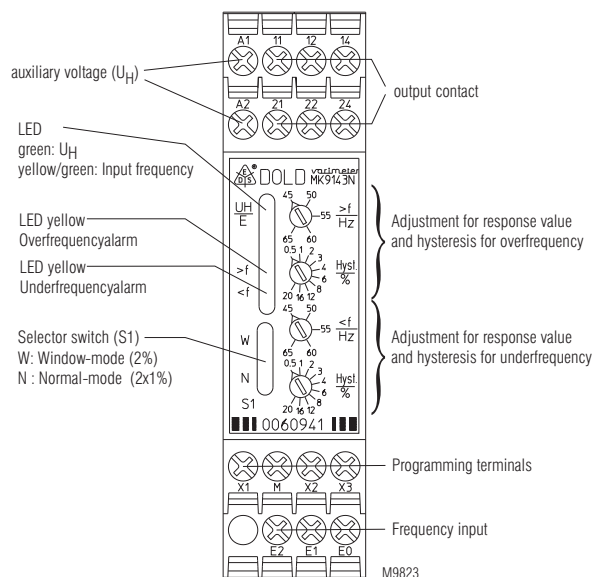
## Indicators

- Upper LED „UH/E“:
- green, when only auxiliary voltage connected to A1 - A2
  - yellow/green, when measuring frequency is detected on input
- Lower LED „ $>f$ “ (yellow):
- On, when overfrequency is detected, flashes (with short pulse) when time delay is active
- Lower LED „ $<f$ “ (yellow):
- On, when underfrequency is detected, flashes (with short pulse) when time delay is active
- LEDs „ $>f$ “ and „ $<f$ “:
- flash together during start up delay.

## Settings



MK 9143N



MK 9143N/600

## Notes

### Frequency measuring input

The standard frequency measuring input for AC voltages AC 40...550V is divided in 2 ranges (40...150 V on E1-E0 and 150-550 V on E2-E0) to achieve a higher immunity against Harmonics and disturbance. If the measuring voltage is around 150 V the smaller range should be used, as it can be overloaded continuously up to 250 V. In the case of lower measuring voltages an input for AC 10-280 V E1-E0 and 20 to 550 V E2-E0 is available with slightly lower disturbance immunity. If the measuring signal is missing or if it is too low on E0-E1-E2 the upper 2 colour LED UH/E lights green. The underfrequency output is tripped in this case as well. When the input voltage is high enough on the measuring input this LED light yellow-green.

### Output contacts

Relay 1 (11-12-14, and 31-32-34 on MH 9143.39) is tripped on overfrequency. Relay 2 (21-22-24, and 41-42-44 on MH 9143.39) is tripped on underfrequency.

On the variant /600 the slide switch on the front can be switched to position W (window mode) in that position both relays switch on under- and overfrequency.

Relay 1 can be switched over from energized to de-energized on trip, relay 2 only operates de-energized on trip.

The model /400 operates always window mode. Both relays switch on over- and underfrequency. On this variant both relays can be switched over together between energized and de-energized on trip

### Programming terminals (M – X1 – X2 – X3):

**Attention!** The terminals M-X1-X2-X3 have no galvanic separation to the measuring circuit, and must be operated potential free.



M: Common connection (Ground) of the programming terminals  
 X1: A start up delay of 0...30 s after connection of auxiliary supply is achieved by connecting a X1 to M with a potentiometer or fixed resistor (see technical data). The start up delay can be stopped by bridging X1 to M at any time.  
 If no start up delay is required the terminals X1-M must be linked.

X2: Manual reset with NO contact push button on X2-M, auto reset with terminals X2-M bridged.

X3: selection of nominal frequency 50 or 60 Hz with MK 9143N and MH 9143;  
 selection of relay mode energized or de-energized on trip for relay 1 with MK 9143N/600 and MH 9143/600

### Model MK 9143N and MH 9143:

This variant offers a very accurate frequency setting that is required e.g. for small generator sets which feed the public mains:

- the adjustment of the tripping values for over and underfrequency is accurate and reproducible in 10 steps from +/- 0,1 Hz to +/- 5 Hz
- the hysteresis is always 1/8 of the adjusted tripping value, i. e., at setting + or -0,1 Hz it is 0,012 Hz and at setting + or -4 Hz it is approx. 0,5 Hz
- the tripping delay is separately adjustable for over and underfrequency with a range of 20 s.
- switching between energized and de-energized on trip of relay 1 by slide switch Rel.1 on the front
- programming of mains frequency 50 or 60 Hz with terminal X3:  
 X3 open: Frequency 50 Hz  
 X3 linked to M: Frequency 60 Hz

## Notes

### Variant MH 9143.38/008: 45 mm width

Identically to MK 9143N, but with 11 step LED chain indicator and galvanic separated analogue output to display the difference between measured frequency and the mains frequency (50 or 60 Hz).  
 On terminals U/G of the analogue output 0-10 V are provided, on terminals I/G 0-20 mA are available. By bridging terminals Y1 and G the output can be switched over to 2-10 V and 4-20 mA. The middle value of the analogue output indicates nominal frequency, the display and analogue output shows ± 10% difference to the nominal frequency.

### Model MK 9143N/400 and MH 9143/400

Identical with MK 9143N and MH 9143 but both output relays switch together (Window mode) and both can be switched over together via slide switch from energized to de-energized on trip.

### Model MK 9143N/600 and MH 9143/600

To be used on local generator sets and other equipment where larger frequency tolerances are necessary:

- Adjustment of the tripping values for over and underfrequency individual between 45 and 65 Hz
- Separate adjustable hysteresis for over and underfrequency in a range of 0,5 ... 20% of the tripping value
- Output function can be changed with slide switch (S1) on the front:  
 Position „N“: Normal mode: relay 1 for overfrequency, relay 2 for underfrequency  
 Position „W“: Window mode: relay 1+2 switch together at over and underfrequency
- Switching between energized and de-energized on trip of relay 1 by terminal X3:  
 X3 open: de-energized on trip for relay 1  
 X3 linked to M: energized on trip for relay 1

### Adjustment aid for start up delay and alarm delay

During the elapse of start up delay and alarm delay on MK 9143N and MH 9143) the yellow LED <f or >f is flashing with a frequency of 2 Hz. To set a specific time value in seconds the number of flash pulses can be used to check the setting: Number of flash pulses divided by 2 = time delay in seconds.

## Technical Data

### Measuring Input (E0-E1-E2)

#### Voltage range

E0-E1: AC 40 ... 150 V,  
 E0-E2: AC 150 ... 550 V

#### Input resistance

E0-E1: approx. 170 kΩ  
 E0-E2: approx. 640 kΩ

#### Galvanic separation:

Frequency measuring input to auxiliary voltage and output contacts

#### Response time of

**Frequency monitoring:** typ. 60 ms  
 (when alarm delay is 0)

#### Time between connection of auxiliary supply and ready to measure:

approx. 0,4 s (with start up delay is 0)  
 adjustable from 0 ... 30 s with resistor/potentiometer between terminals X1 and M:

R / kΩ:	0	4,7	12	22	39	56	100	180	390	∞
t <sub>Act</sub> / s:	0	0,5	1	2	4	6	10	15	20	100

#### Adjustment of the response values (frequency threshold for alarm)

**MK 9143N, MH 9143:** 10 individual step as deviation from nominal frequency.

Overfrequency:	+0,1	+0,2	+0,5	+1	+1,5	+2	+2,5	+3	+4	+5	Hz
Underfrequency:	-0,1	-0,2	-0,5	-1	-1,5	-2	-2,5	-3	-4	-5	Hz

#### Setpoint frequency:

50 or 60 Hz, selectable via connection of terminal X3

#### Accuracy of the

**frequency threshold:** better than 200 ppm (0,02 %)



## Technical Data

<b>Auxiliary voltage- and temperature influence:</b>	less than 200 ppm (< 0,02 %)
<b>Hysteresis:</b>	1/8 of adjusted deviation value of nominal frequency
<b>Time delay:</b>	separately adjustable for over- and under frequency alarm: 0 ... 20 s adjustable on logarithmic scale.
<b>Adjustment of response value (frequency threshold for alarm)</b>	
<b>MK 9143N/600, MH 9143/600:</b>	continuously variable, separately for over- and underfrequency alarm: each 45 ... 65 Hz approx. 1 Hz
<b>Setting accuracy:</b>	continuously variable, separately for over- and underfrequency alarm: each 0,5 ... 20 % of the setting alarm threshold
<b>Hysteresis:</b>	
<b>Tolerances of the adjusted tripping values at variation of auxiliary supply and temperature:</b>	± 0,2 Hz

## Auxiliary Circuit

<b>Auxiliary voltage <math>U_H</math></b> (galvanic separation):	AC 115, 230, 400 V DC 12, 24, 48 V AC/DC 24 ... 60, 110 ... 230 V (only for MH-version possible)
<b>Voltage range:</b>	
AC:	0,8 ... 1,1 $U_H$
DC:	0,9 ... 1,2 $U_H$
AC/DC:	0,75 ... 1,2 $U_H$
<b>Frequency range</b>	
AC:	45 ... 440 Hz
<b>Nominal consumption:</b>	
AC:	approx. 4 VA
DC:	approx. 2 W

## Output 11-12-14, 21-22-24; + 31-32-34, 41-42-44 at MH 9143.39

### Contacts

MK 9143N.38, MK 9143.38/600:	2 x 1 C/O contacts, each 1 for over- and underfrequency alarm
MH 9143.39, MH 9143.39/600:	2 x 2 C/O contacts, each 2 for over- and underfrequency alarm

### Thermal current $I_{th}$ :

### Switching capacity

according to AC 15

NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
according to DC 13		
NO contact:	1 A / DC 24 V	IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V	IEC/EN 60 947-5-1

### Elektrical life

acc. to AC 15 at 1 A, AC 230 V: 1,5 x 10<sup>6</sup> switching cycles IEC/EN 60 947-5-1

### Short circuit strength

<b>max. fuse rating:</b>	4 A gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	30 x 10 <sup>6</sup> switching cycles	

## Analogue Output with MH 9143.38/008

### galvanic separation AC 3750V

### to auxiliary supply, measuring circuit and relay outputs.

terminal U(+) / G(-):	0 ... 5 ... 10 V, max. 10 mA
terminal I (+) / G(-):	0 ... 10 ... 20 mA, max. burden 500 Ohm
change to 2 ... 10 V or 4 ... 20 mA by bridging terminal Y1 and G	
Analogue output:	± 10% difference to the nominal frequency

## Technical Data

### General Data

**Nominal operating mode:** continuous operation

### Temperature range:

Operation: - 20 ... + 60°C

Storage: - 25 ... + 60°C

**Altitude:** < 2.000 m

### Clearance and creepage distance

rated impulse voltage /

pollution degree:

output to measuring circuit: 4 kV / 2 IEC 60 664-1

output to auxiliary circuit: 4 kV / 2 IEC 60 664-1

output to output to: 4 kV / 2 IEC 60 664-1

auxiliary circuit to measuring input: 4 kV / 2 IEC 60 664-1

Programming terminals

M-X1-X2-X3: without galv. separation to

measuring circuit

### EMC

Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

1 GHz ... 2.7 GHz: 3 V / m IEC/EN 61 000-4-3

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF-wire guided: 30 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

### Housing:

thermoplastic with V0 behaviour

according to UL subject 94

Amplitude 0,35 mm

Frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

EN 50 005

### Vibration resistance:

### Climate resistance:

### Terminal designation:

### Wire connection

Cross section:

1 x 4 mm<sup>2</sup> solid or

2 x 1,5 mm<sup>2</sup> solid or

1 x 2,5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4 or

2 x 1,5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/

8 mm

Stripping length:

### Wire fixing:

Plus-minus terminal screws

M4 box terminals with wire protection

0.8 Nm

### Fixing torque:

### Mounting:

DIN rail

IEC/EN 60 715

### Weight:

MK 9143N, MK 9143/600:

approx. 210 g

MH 9143, MH 9143/600:

approx. 295 g

MH 9143.38/008:

approx. 350 g

### Dimensions

### Width x heigh x depth:

MK 9143N, MK 9143/600: 22,5 x 90 x 97 mm

MH 9143, MH 9143/600: 45 x 90 x 97 mm

### Standard Type

MK 9143N.38 +/- 5 Hz U<sub>H</sub> AC 230 V

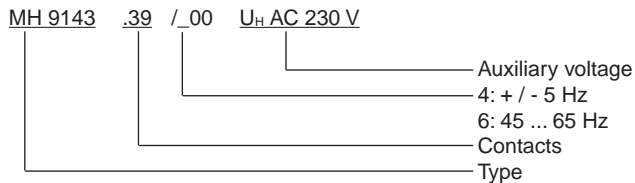
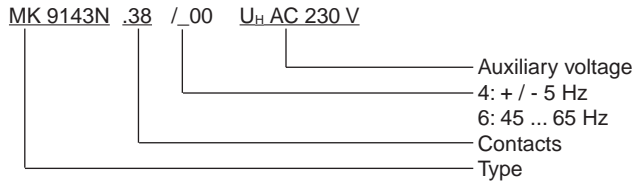
Article number: 0060936

- Each 1 C/O contact for over- and underfrequency
- Auxiliary voltage U<sub>H</sub>: AC 230 V
- Frequency measuring input: AC 40 ... 150 / 150 ... 550 V
- Trip points adjustable precisely and reproducible on 10 step rotational switch in the range of ± 0.1 Hz to ± 5 Hz related to 50 or 60 Hz
- Switching setpoint frequency: 50 / 60 Hz
- Time delay for over and underfrequency each adjustable from 0 ... 20 s
- Start up delay: 0 ... 30 s selectable
- Manual or auto reset selectable
- Width: 22.5 mm

### Variants

- MK 9143N.38/400: Same as MK 9143N.38, but with output relay in "Window"-Mode
- MK 9143N.38/600: - over- and underfrequency threshold each continuously variable of 45 ... 65 Hz  
- without time delay  
- Hysteresis at over- and underfrequency each continuously variable of 0.5 ... 20 %  
- Funktion mode of the outputrelay switchable on "Window"
- MK 9143N.38/801: Same as /600, but with fixed time delay for over- and underfrequency of 100 ms
- MH 9143.38/008: Same as MK 9143N.38, but with galvanic separated analogue output (current/voltage) and 11 step LED chain.  
Width: 45 mm
- MH 9143.39: Same as MK 9143N.38, but with each 2 C/O contacts for over- and underfrequency  
width: 45 mm
- MH 9143.39/400: Same as MK 9143N.38/400, but with each 2 C/O contacts for over- and underfrequency  
Width: 45 mm
- MH 9143.39/600: Same as MK 9143N.38/600, but with 2 C/O contacts for over- and underfrequency  
Width: 45 mm

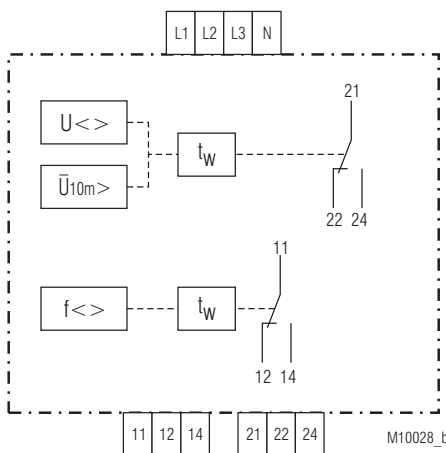
### Ordering example for variants





- According to DIN EN 60255-1, DIN EN 60947-1
- Voltage and frequency monitoring for generator sets >30 kVA on public grid, according to VDEW directive
- RP 9800: 3-phase voltage measurement to neutral
- Disconnection on rise and drop of voltage
- Disconnection on rise and drop of frequency
- Disconnection when 10 minute mean value differs to nominal voltage (overvoltage)
- Frequency and voltage are indicated by separate output relays
- Permits connection or re-connection after adjustable time delay  $t_w$
- Protection against manipulation by sealable transparent cover over setting switches
- Precise adjustment and indication of setting values according to the directive
- High measuring accuracy
- Width 70 mm

### Circuit Diagram



### Approvals and Markings



### Application

Monitoring of voltage and frequency for generator set >30 kVA connected to the public grid according to VDEW directive  
As alternative to disconnector switches in plants with <30 kVA, when a manual isolator switch is used.

### Function

The RP 9800 monitors the voltage of the 3 phases against neutral indicating over and undervoltage. The phase with the highest voltage (overvoltage) and the phase with the lowest voltage (undervoltage) will cause the relay to switch. The unit is calibrated to the mean RMS value.

The frequency is measured single phase in phase L1. (Reference N).

The voltage and frequency monitoring operate 2 separate output relays. When exceeding the setting values the output relays switch into de-energized state.

If the measured values are within or return to the adjusted ranges the activation or reset takes place after an adjustable time delay  $t_w$ .

### Note

**When using the variant RP 9800.12 N-terminal for 3-phase 4 wire connection, the neutral has to be connected.**

### Indication

- green LED ON On, when auxiliary supply connected.
- red LED f<> On, when frequency out of range.
- red LED U<> On, when voltage out of range,  
Flashes, when 10 min mean value is higher than setting.
- yellow LED f<> On, when relay f<> is energized, flashes during time delay  $t_w$ -relay f<>.
- yellow LED U<> On, when relay Rel. U<> s energized, flashes during time delay  $t_w$  - Rel. U<>.

## Adjustment Facilities

Adjustment with 8-or 10 step rotary switches:

- Poti  $f >$  (Hz): - overfrequency (variant /500: 2 potentiometers)  
Poti  $f <$  (Hz): - underfrequency  
Poti  $U >$  (%): - overvoltage  
Poti  $U <$  (%): - undervoltage (variant /500: not available)  
Poti  $\bar{U}$  10 min: - overvoltage, 10 min mean value  
Poti  $t_w$  (s): - time delay for activation or reset

### Standard factory settings according to VDE 0126

(not for time delay for activation):

- Response value for: - overfrequency  $f > = 50,2$  Hz  
Response value for: - underfrequency  $f < = 47,5$  Hz  
Response value for: - overvoltage  $U > = 115$  %  
Response value for: - undervoltage  $U < = 80$  %  
Response value for: - overvoltage, 10 min mean value  $\bar{U}_{10m} = 110$  %  
Time delay for: - activation  $t_w = 40$  s

## Technical Data

### Overfrequency:

- RP 9800: 50.2 ... 52 Hz  
setting via 8 step rotary switch  
50.2; 50.3; 50.4; 50.6; 50.8; 51.0;  
51.5; 52 Hz  
RP 9800/500: 50.2 ... 51.5 Hz  
Adjustment on 2 Pots each with 8 steps in  
steps of 0.1 Hz  
Pot. 2 min. + Pot. 1 50.2 ... 50.8 Hz and  
Pot. 1 max. + Pot. 2 50.9 ... 51.5 Hz

### Underfrequency:

- 47 ... 49.8 Hz  
setting via 8 step rotary switch  
47; 47.5; 47.8; 48.2; 48.6; 49.0; 49.4;  
49.8 Hz

### Overvoltage:

- 197 ... 218 V (L - N) (182 V)  
248 ... 276 V (L - N) (230 V)  
setting via 8 step rotary switch  
108%, 110%, 112%, 114%, 115%,  
116%, 118%, 120% of  $U_N$

### Undervoltage

- RP 9800: 131 ... 164 V (L - N) (182 V)  
166 ... 207 V (L - N) (230 V)  
setting via 8 step rotary switch  
72%, 74%, 76%, 78%, 80%, 82%, 86%,  
90% of  $U_N$   
RP 9800/500: 80% of  $U_N$  fixed

### Overvoltage, 10 minute mean value:

- 189 ... 211 V (L - N) (182 V)  
239 ... 267 V (L - N) (230 V)  
setting via 8 step rotary switch  
104%, 106%, 108%, 110%, 112%,  
114% 115% 116% von  $U_N$

### Time delay for activation or reset:

- setting via 10 step rotary switch  
5, 10, 20, 30, 40, 50, 60, 70, 80, 90 s

### Repeat accuracy:

- Voltage measuring  $\leq \pm 1$  %  
Frequency measuring  $\leq \pm 0.02$  %

### Hysteresis:

- Voltage measuring  $\leq 2.5$  %  
Frequency measuring 0.05 Hz

### Response time (disconnection):

- < 100 ms (typ. 75 ms)

## Output

**Thermal current  $I_{th}$ :** 5 A

### Switching capacity

according to AC 15

- NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1  
NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 1 A, AC 230 V

- NO contacts:  $3 \times 10^5$  switching cycles IEC/EN 60 947-5-1

**Max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:**  $> 50 \times 10^6$  switching cycles

## Technical Data

### General Data

- De-energized on trip:** are switched off when failure indicated or  
voltage is switched off  
2 relays with C/O contact each  
1. Rel. for  $f <$ , 2. Rel. for  $U <$   
**Voltage range:** 3 x AC 85 V ... 280 V  
( $U_H$  of all 3-phases to neutral)  
box terminal with cross recess screw  
solid / stranded 0,5 - 4 mm<sup>2</sup>

### Terminals:

### Cross section:

### Flexible with

### multicore cable ends:

### Multiple wire connection:

### Temperature range:

### Clearance and creepage distance

rated impulse voltage /

pollution degree:

6 kV / 2

IEC 60 664-1

### EMC

Electrostatic discharge (ESD):

8 kV (air)

IEC/EN 61 000-4-2

HF irradiation:

10 V/m

IEC/EN 61 000-4-3

Fast transients:

4 kV

IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply:

2 kV

IEC/EN 61 000-4-5

between wire and ground:

4 kV

IEC/EN 61 000-4-5

Interference suppression:

Limit value class B

EN 55 011

### Degree of protection

Housing:

IP 40

IEC/EN 60 529

Terminals:

IP 20

IEC/EN 60 529

Housing:

Thermoplastic with VO behaviour

according to UL subject 94

### Vibration resistance:

Amplitude 0.35 mm

frequency 10...55 Hz,

IEC/EN 60 068-2-6

### Climate resistance:

### Terminal designation:

### Wire connection

Cross section:

solid/stranded 0.5 ... 4 mm<sup>2</sup>

Stranded ferruled:

0,5 ... 2,5 mm<sup>2</sup>

Multiple wire connection:

0,5 ... 1,5 mm<sup>2</sup> (2 wires with same  
cross section)

### Wire fixing:

### Mounting:

### Weight:

box terminal with cross recess screw  
DIN rail  
175 g

## Dimensions

**Width x height x depth:** 70 x 90 x 71 mm

## Standard Types

RP 9800.12 3/N AC 400/230V

Article number: 0062263

RP 9800.12 3/N AC 315/182 V

Article number: 0063103

RP 9800.12/200 3/N AC 690/400 V

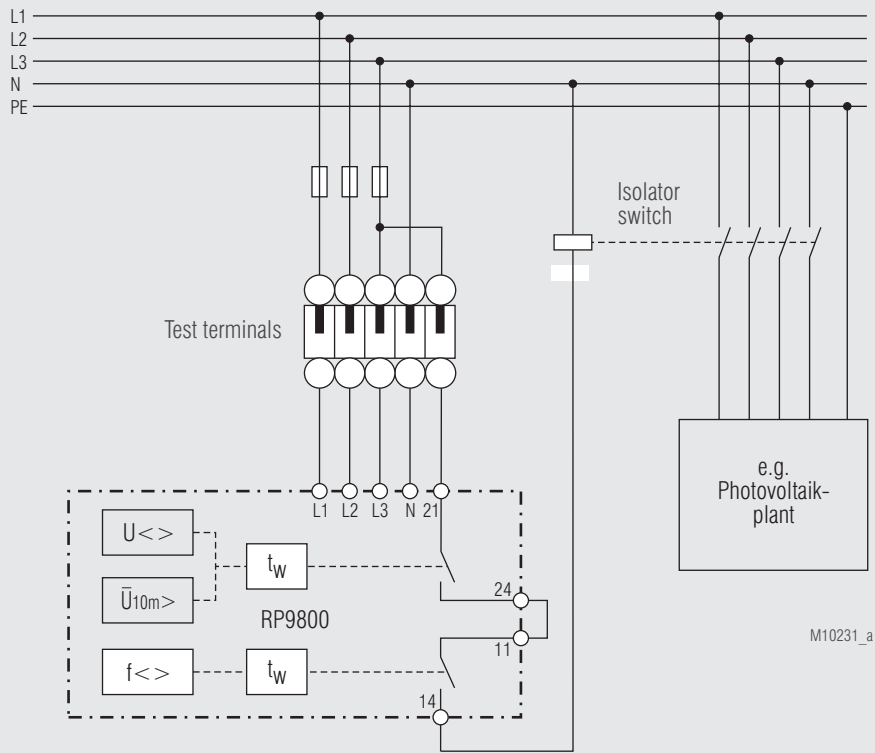
Auxiliary voltage  $U_H$ : AC/DC 24 ... 80 V

Article number: 0063268

RP 9800.12/500 3/N AC 400/230V

Article number: 0064515

## Application Example



## VARIMETER NA

Voltage- and Frequency Monitor acc. to VDE-AR-N 4105  
RP 9810



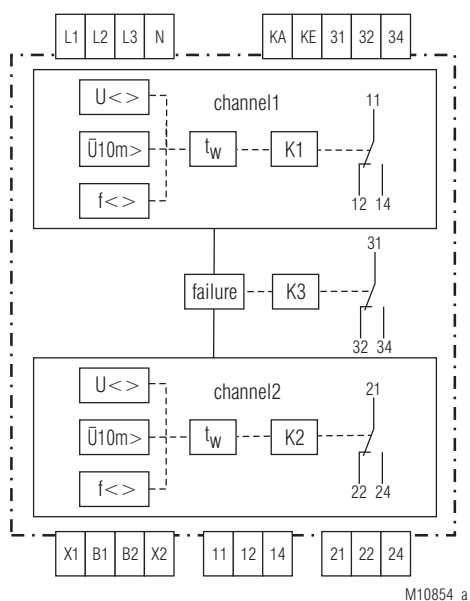
### Your Advantages

- Easy adjustment via rotational switch
- Precise adjustment and indication of setting values
- Indication, diagnostics and fault presentation via display
- Protection against manipulation by sealable transparent cover over setting switches
- Mains and system protection for your generator set

### Features

- Certificate of conformity (test certificate) of the BG ETEM acc. to VDE-AR-N 4105
- Following DIN V VDE V 0126-1-1
- According to DIN EN 60 255-1
- Can be used according to EEG 2012 and SysStabV
- Voltage and frequency monitoring for generator sets >30 kVA on public grid, as option also for ≤ 30kVA
- Fail-safe because of 2-channel structure
- Certificate of conformity (test certificate) of the BG ETEM
- Monitoring of the section switches with measuring of response time
- System test via test button
- Isolated grid detection
- Manual reset
- With additional enabling input, e.g. for ripple control receiver
- Connection or re-connection after adjustable delay time  $t_w$
- Factory setting according to VDE-AR-N 4105
- Random controlled disconnection in the range of 50.2 Hz and 51.5 Hz for non-regulated power generation systems
- Protection against manipulation by sealable transparent cover over setting switches
- Additional fault signalling relay output
- High measuring accuracy
- Installation type enclosure 4TE (width x height x depth: 70 x 90 x 71 mm)

### Circuit Diagram



### Connection Terminals

Terminal designation	Signal designation
L1, L2, L3 / N	Auxiliary voltage and measuring inputs
11, 12, 14	Control of section switch 1
21, 22, 24	Control of section switch 2
31, 32, 34	Contacts fault signalling relay
X1, B1 / X2, B2	Enabling inputs
KA, KE	Feedback circuit of section switch

### Approvals and Markings



### Applications

- Photovoltaic, wind power
- Combined heat and power stations, water power
- Monitoring of voltage and frequency for generator set connected to the public grid according to VDE-AR-N 4105 directive

### Functions

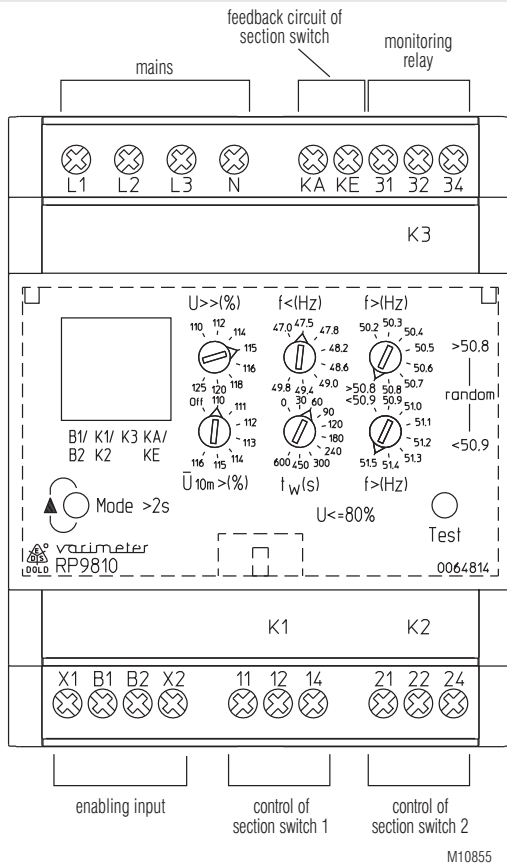
The voltage and frequency module RP 9810 monitors in domestic generator sets the mains of the energy supplier. It is built up in a redundant way and each of the 2 channels act on a separate output relay. The adjustment is made via rotational switches. The factory default setting is according to the description in VDE-AR-N 4105. The limit value for undervoltage is fixed at 80% of  $U_n$ . After setup the settings may be sealed with a transparent front cover.

Measured values above or below the limits will lead to a disconnection of the generator system from the mains. The reconnection of the generator system to the mains is only enabled, when the frequency and the voltage are within the limits for the adjusted time  $t_w$  without interruption. After a disconnection because of a short interruption, the reconnection is made when the frequency and the voltage are within the limits for 5 s without interruption. When the supply voltage has failed the conditions for the short interruption are not valid.

The voltage frequency monitor measures the voltage in all 3 phases between phase and neutral. In addition the phase-to-phase voltages are calculated and monitored. The frequency is measured single phase in both models in L1.

The indication of the operating status, the measured values and the fault memory is done on an LCD display. The value to be displayed is selected by pressing a pushbutton.

## Indication



M10855

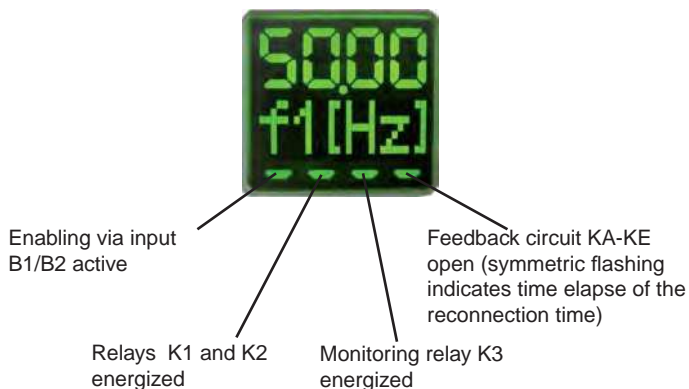
The colour of the backlight indicates the operating status of the device

- Off:** No supply voltage connected
- Green:** Normal operation.
- Red:** Failure status.
- Yellow:** Warning (failure message not acknowledged or test button pressed).

2 display modes can be selected, the actual value display and the failure memory display. Pressing the button "Mode" (>2s) toggles between both display modes.

### Actual value display

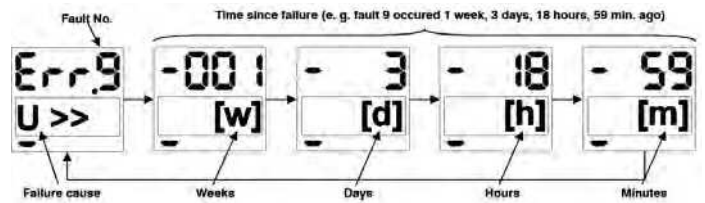
Displays the actual frequency and the voltage. Short activation of the button "mode" displays the next value.



## Indication

### Display of failure memory

In failure display mode the failure entries with failure cause and relative time to event are shown. Short activation of the button "mode" displays the next failure message. If no entries are stored, the display shows "NoErr".

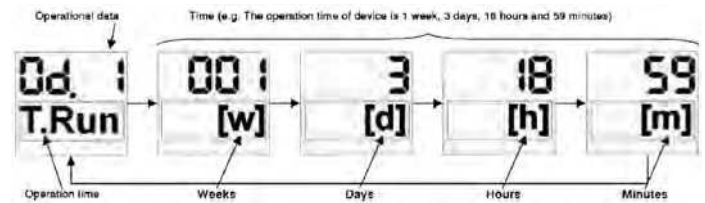


### Display of operating data (variant /\_02)

This variant displays additionally to the actual value and failure memory, the operating time or the disconnection time. Pressing the button "Mode" for more than 2 s toggles the display between actual value, failure memory and operating data.

Within this display mode the following operating data (Operational data can be selected by short actuation of the "Mode" button:

- Od.1: „T.Run“:  $\Sigma$  Operating time (powersupply connected)
- Od.2: „t.Err“:  $\Sigma$  Alarm-/ Failure duration
- Od.3: „t.Xof“:  $\Sigma$  Duration of external disconnection (via input B1/B2)



All operational data is deleted by pressing "Mode" and "Test" for more than 2 seconds in operational data display mode. The reset is confirmed on the display "ResOd" (Reset operational data).

## Error Indication

The failure status of the unit is indicated by a red backlight. If a failure is detected the unit automatically changes to failure memory display. The last 9 failures are stored, where failure 1 is the newest and failure 9 the oldest. The failures are displayed as follows

„U<“:	undervoltage
„U10m>“:	overvoltage, 10 min mean value
„U>>“:	overvoltage
„f1<“:	underfrequency
„f1>“:	overfrequency
„KS“:	failure section switch (broken wire in feedback circuit KA/KE or section switch contacts welded)
„KS??“:	Warning section switch K1 and K2 energized but feedback circuit KA/KE indicates open section switch
„Setup“:	Setting of the 2 overfrequency potentiometers (f>) is not plausible
„Sys.X“:	System error
„Int.X“:	Internal error

When leaving the failure state, the backlight changes from red to yellow in the first step. Only when the failures are acknowledged, either by deleting the failure memory or by changing into display mode actual value, the backlight changes to green. The entries of the failure memory stay valid when resetting a failure message (pressing the pushbutton “Mode” for >2s).

The failure memory is deleted by pressing the buttons “Mode” and “Test” simultaneously for more than 2 seconds in display mode failure or by disconnecting the supply L1/L2/L3/N for a longer period.

## Fault Signalling Relay

A third output relay K3 indicates the disconnection of the generator system in the case of a failure (contact 31-32).

## Isolated Grid Detection

The RP9810 includes a passive procedure to detect an isolated network according to chapter 6.5.3 and annex D2 of VDE-AR-N 4105. The 3-phase voltage monitoring allows this isolated network detection.

## System Test

With the pushbutton „Test“ the contacts of the section switch can be tested for correct function. Pressing the test button disconnects the generator system from the mains. When testing the release time of the section switch is monitored via the feedback circuit. The measured time is shown on the LCD display. To determine the full disconnection time the measuring and evaluation time is added to the release time of the section switch. According to VDE-AR-N 4105 200 ms must not be exceeded.

## Monitoring of Section Switches

Via the 2 contacts 11-14 and 21-24 the 2 section switches are controlled. The monitoring of the section switches is made by the feedback circuit (terminals KA-KE) to which the NC contacts of the section switches are connected (see connection diagrams).

The voltage and frequency monitor only connects the generator system to the mains when in disconnected state the feedback circuit KA-KE is closed, i.e. the section switches are de-energised (NC contacts are closed). As long as the section switch is not energized the feedback circuit KA-KE must be closed if not the failure “KS” is displayed.

## Random Switch Off at Overfrequency

In VDE-AR-N 4105 a frequency range between 50.2 Hz and 51.5 Hz was defined. In this range a step less reduction of the generated power can be made if the generator is controllable.

Non controllable generator systems can alternatively disconnect themselves in the frequency range of 50.2 Hz and 51.5 Hz from the mains. In this case a symmetric distribution within this range of the disconnection frequency for each plant has to be observed. The RP9810 has a random setting facility within this range, by turning both related switches into position “random”. With this setting also the connection and reconnection time is automatically selected within a range of 1 ...10 minutes.

## Adjustment Facilities

Adjustment with 8-or 10 step rotary switches:

Poti 1+2 f>(Hz):	- overfrequency
Poti f<(Hz):	- underfrequency
Poti U>>(%):	- overvoltage
Poti U10m>(%):	- overvoltage, 10 min mean value
Poti t <sub>w</sub> (s):	- time delay for activation or reset
fixed:	- undervoltage

## Standard factory settings according to VDE-AR-N 4105

(not for time delay for activation):

Response value for:	- overfrequency f> = 51.5 Hz
Response value for:	- underfrequency f< = 47.5 Hz
Response value for:	- overvoltage U>> = 115 %
Response value for:	- undervoltage U< = 80 %
Response value for:	- overvoltage, 10 min mean value U10m> = 110 %
Time delay for:	- time delay for activation or reset t <sub>w</sub> = 60 s

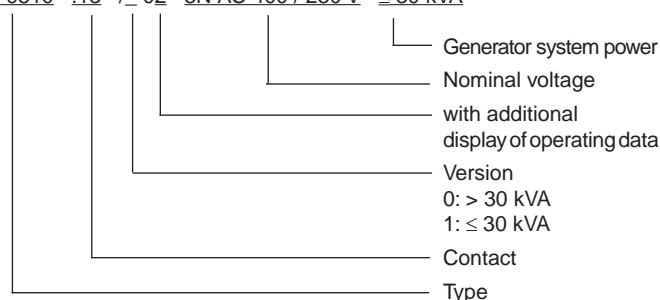


Technical Data	
<b>Overfrequency:</b>	50.2 ... 51.5 Hz Adjustment on 2 Potis each with 8 steps in steps of 0.1 Hz Poti 2 min. + Poti 1 50.2 ... 50.8 Hz or Poti 1 max. + Poti 2 50.9 ... 51.5 Hz
<b>Random disconnection:</b>	50.2 ... 51.5 Hz setting f> "random"
<b>Underfrequency:</b>	47.0 ... 49.8 Hz setting via 8 step rotary switch 47.0; 47.5; 47.8; 48.2; 48.6; 49.0; 49.4; 49.8 Hz
<b>Overvoltage</b> at version ≤ 30 kVA: at version > 30 kVA: both versions are setting via 8 step rotary switch:	253 ... 288 V (L - N) 253 ... 288 V (L - N) + 438 ... 498 V (L - L) 110%, 112%, 114%, 115%, 116%, 118%, 120%, 125 % von U <sub>N</sub>
<b>Undervoltage</b> at version ≤ 30 kVA: at version > 30 kVA: both versions:	184V (L - N) 184V (L - N) + 319 V (L - L) 80% von U <sub>N</sub> fixed
<b>Overvoltage, 10 minute mean value:</b> at version ≤ 30 kVA: at version > 30 kVA: both versions are setting via 8 step rotary switch:	253 ... 267 V (L - N) 253 ... 267 V (L - N) + 438... 462 V (L - L) Off, 110%, 111%, 112%, 113%, 114%, 115%, 116% von U <sub>N</sub>
<b>Time delay for activation or reset:</b>	0 ... 600s setting via 10 step rotary switch 0, 30, 60, 90, 120, 180, 240, 300, 450, 600 s
<b>Random Random reconnection:</b>	60 ... 600 s setting f> "random"
Reconnecting conditions voltage: frequency: Repeat accuracy:	5% hysteresis 47.5 Hz ... 50.05 Hz Voltage measuring ≤ ± 1 % ± 1 digit Frequency measuring ≤ ± 0.02 % ± 1 digit
Response time (disconnection):	< 100 ms

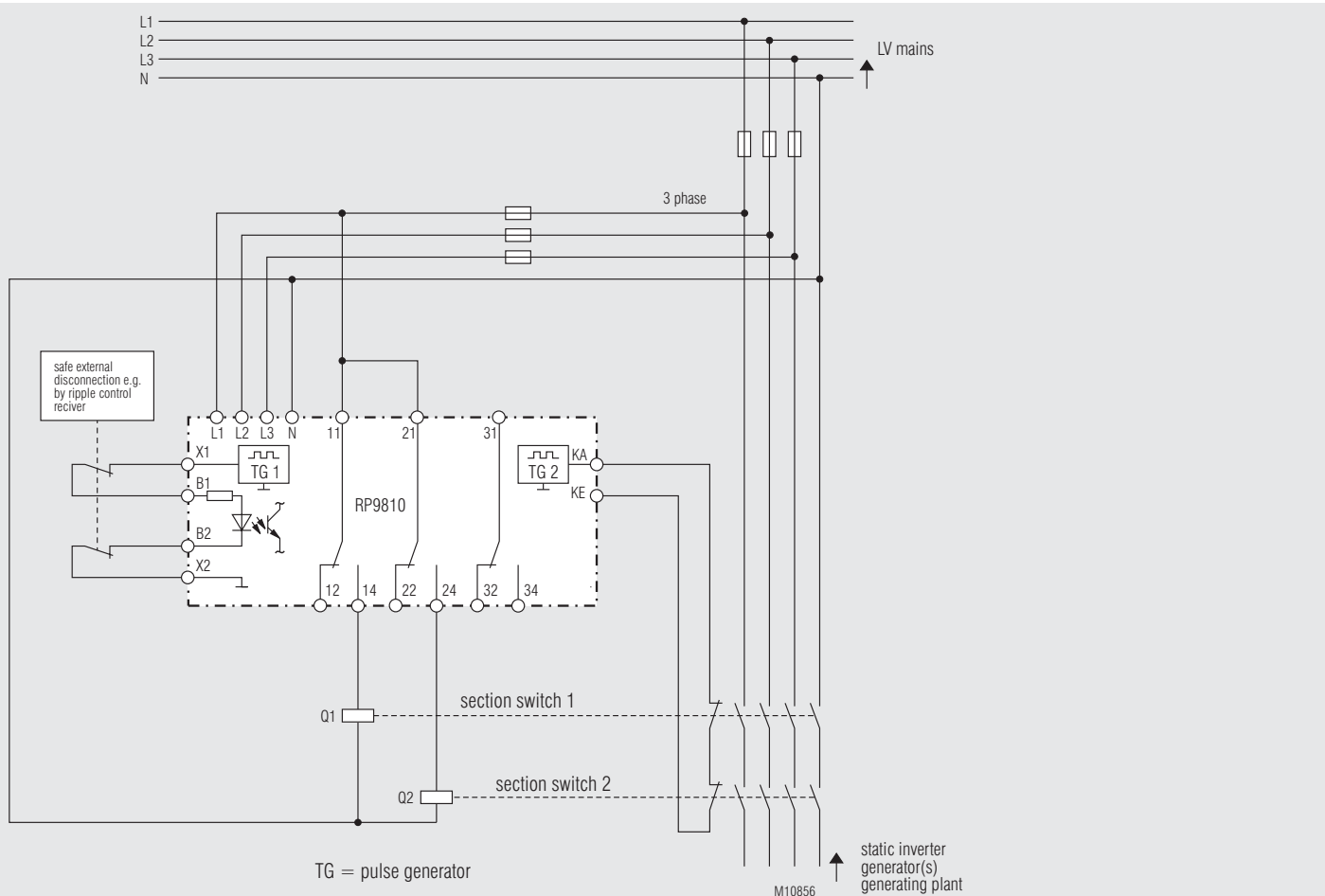
### Output

<b>Relay K1 and K2:</b>	1 changeover contact each
<b>relay K3:</b>	1 changeover contact
The 3 Output relays are de-energized on trip, after disconnection or failure	
<b>Thermal current I<sub>th</sub>:</b>	5 A
<b>Switching capacity</b> according to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V	
NO contact:	3 x 10 <sup>5</sup> switch. cycles IEC/EN 60 947-5-1
<b>Short circuit strength max. fuse rating:</b>	6 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 50 x 10 <sup>6</sup> switching cycles

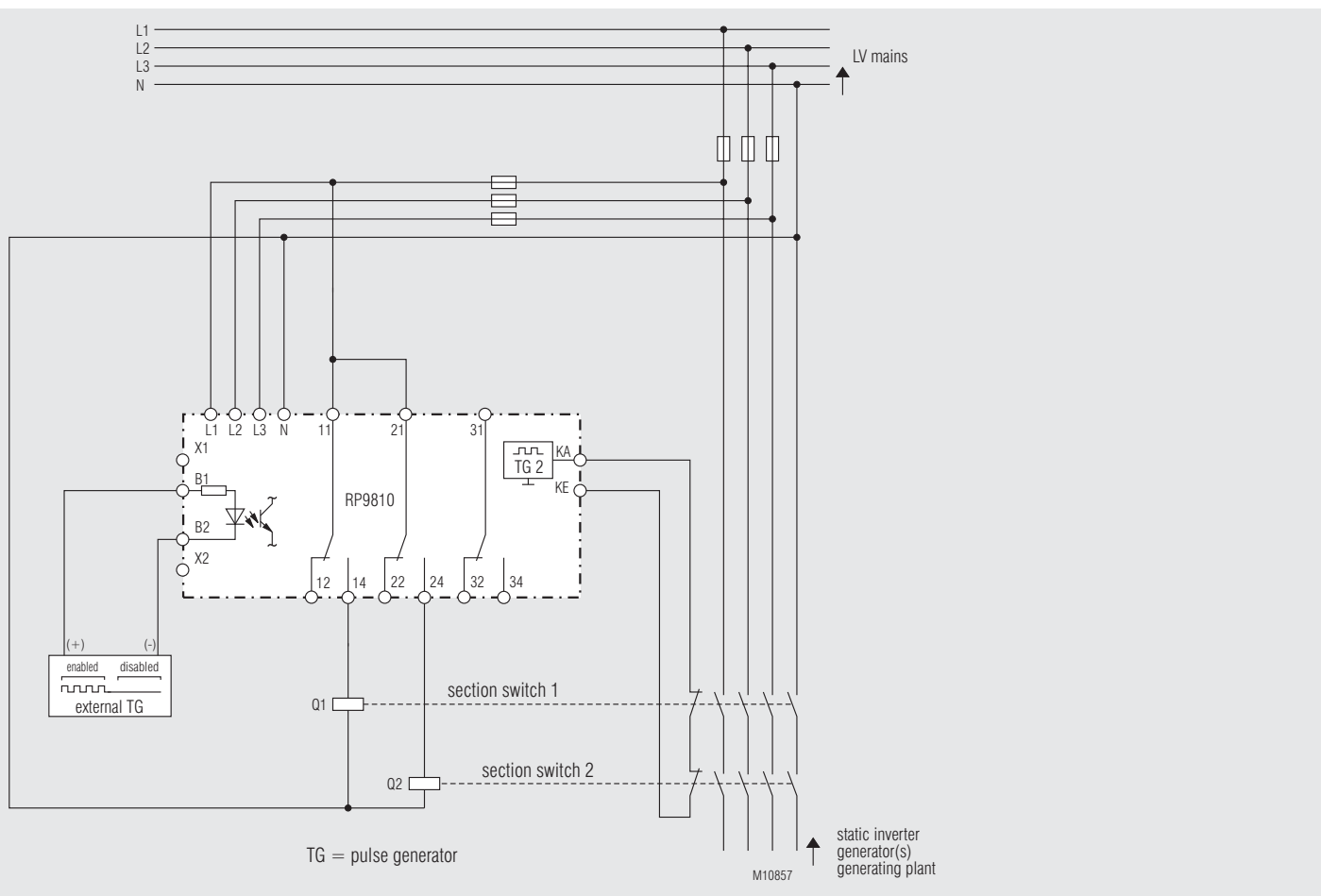
Technical Data	
<b>General Data</b>	
<b>Voltage range:</b>	3 x AC 85 V ... 288 V (U <sub>H</sub> of all 3-phases to neutral) AC 24V, 40 ... 400Hz
<b>Enabling inputs B1/B2:</b>	
<b>Temperature range:</b> Operation:	- 20 ... 60 °C (At an ambient temperature below 0°C the LCD display may have restricted function.)
Storage:	- 25 ... 70 °C
<b>Altitude:</b>	< 2.000 m
<b>Clearance and creepage distance</b>	
rated impulse voltage/ pollution degree:	
Measuring circuit / 11, 12, 14 / 21, 22, 24:	6 kV / 2 IEC 60 664-1
Measuring circuit / B1, B2 / 31, 32, 34:	4 kV / 2 IEC 60 664-1
the Measuring circuit are:	L1, L2, L3, N, KA, KE, X1, X2
<b>EMC</b>	
Electro static discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation	
80 MHz ... 2,7 GHz:	10 V/m IEC/EN 61 000-4-3
Fast transients:	4 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply: between wire and ground:	2 kV IEC/EN 61 000-4-5 4 kV IEC/EN 61 000-4-5
HF wire guided: interference suppression:	10 V IEC/EN 61 000-4-6 Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
Housing:	thermoplastic with VO behaviour acc. to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm Frequenz 10...55 Hz, IEC/EN 60 068-2-6 20 / 060 / 04 IEC/EN 60 068-1 EN 50 005
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	
<b>Wire connection</b>	
Cross section:	solid/stranded 0.5 ... 4 mm <sup>2</sup>
Stranded ferruled:	0.5 ... 4 mm <sup>2</sup>
Stripping length:	6.5 mm
<b>Wire fixing:</b>	Plus-minus terminal screws M3.5 box terminals
<b>Fixing torque:</b>	0.5 Nm
<b>Mounting:</b>	DIN-rail
<b>Weight:</b>	215 g
<b>Recommend fuse protection measuring inputs:</b>	gG / gL 6A
<b>Dimensions</b>	
<b>Width x height x depth:</b>	70 x 90 x 71 mm
<b>Standard Type</b>	
RP 9810.13 3/N AC 400/230V > 30 kVA	
Article number:	0064814
RP 9810.13/100 3/N AC 400/230V ≤ 30 kVA	
Article number:	0064860
<b>Variant</b>	
RP 9810.13/_ 02:	with additional display of operating data
<b>Ordering example for variant</b>	
RP 9810 .13 /_ 02 3N AC 400 / 230 V ≤ 30 kVA	



Application Examples



enable via external contact



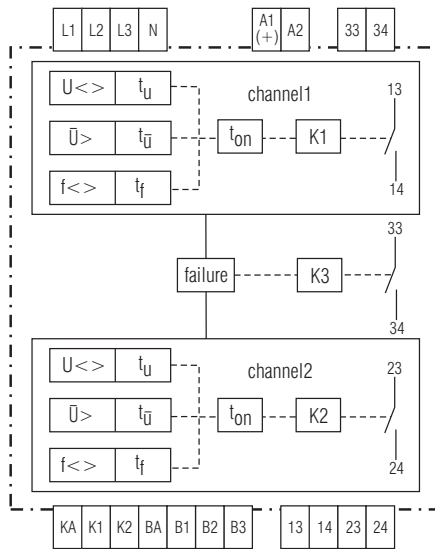
enable via external power AC 24V 40 ... 400Hz



### Product Description

The voltage and frequency monitor RP 9811 represents a safe solution to monitor and optimize mains supply when feeding power to a public grid that conforms with various national standards. User-friendly: The unit can be adjusted quickly and simply with only two rotary switches. Use the first rotary switch to select one of the already preset standards according to your national requirements. Use the second rotary switch to set the type of system, quickly and simply, on the unit. You can adjust each parameter individually with menu-guidance in case of different requirements. All measuring variables required are constantly determined by the unit. If incorrect voltage or frequency values occur, the RP 9811 disconnects the distributed power generation system securely from the mains.

### Circuit Diagram



M10900\_e

### Connection Terminals

Terminal designation	Signal designation
A1(+), A2	Auxiliary voltage AC or DC
L1, L2, L3, N	Connections for measuring circuit
KA, K1, K2	Feedback circuit of external section switch KA / K1: section switch 1 KA / K2: section switch 2
BA; B1, B2, B3	Enabling of monitoring function: BA / B1 + BA / B2 bridged) + BA / B3 open With setting standard CEI 0-21: BA / B2 - function selection
K1 (13, 14)	Connection section switch 1 - NO contact
K2 (23, 24)	Connection section switch 2 - NO contact
K3 (33, 34)	Fault indicating relay - NO contact (open NO: indicates fault)

### Your Advantages

- Mains and system protection for your generator set
- Can be used in several countries
  - DIN VDE 0126-1-1 (generator sets on public grid)
  - VDE-AR-N 4105 (generator sets on public grid)
  - BDEW-directive (generator sets on medium voltage grid)
  - CEI 0-21 (generator sets in Italy)
  - ÖVE/ÖNORM E8001-4-712 (generator sets in Austria)
  - G59/3 (generator sets in UK)
- Easy adjustment via rotational switch and menu display
- Indication, diagnostics and fault presentation via display and LEDs
- Password protected
- Protection against manipulation by sealable transparent cover over setting switches
- CRC-value for parameter testing
- Adjustment of the voltage for nominal voltage will change the limit values accordingly
- Mains synchronization on generator operation

### Features

- Certificate of conformity (test certificate) of the BG ETEM
- Acc. to VDE-AR-N 4105, DIN VDE 0126-1-1, BDEW-directive, CEI-0-21
- Acc. to DIN EN 60 255-1
- Can be used according to EEG 2012 and SysStabV
- Voltage and frequency monitoring for generator sets
- Fail-safe 2-channel structure
- Monitoring of the section switches by measuring the response time
- System test via test button
- Enabling inputs allow integration into various ripple control and plant concepts
- Isolated grid detection
- Manual reset
- Memorising of disconnection time
- Connection or re-connection after adjustable delay time  $t_{on}$
- Factory setting according to:
  - VDE-AR-N 4105, DIN VDE 0126-1-1, BDEW-directive, CEI 0-21, ÖVE/ÖNORM, G59/3 LV
- Random controlled disconnection in the range of 50.2 Hz and 51.5 Hz for non-regulated power generation systems
- Random operated connection time ( $t_{on}$ ) setting range 60...600 s
- Additional fault signalling relay output
- High measuring accuracy
- Installation type enclosure 4TE (width x height x depth: 70 x 90 x 71 mm)

### Approvals and Markings



### Applications

- Monitoring of voltage and frequency for generator sets e.g.:
- Photovoltaic
  - Wind power
  - Water power
  - Combined heat and power stations

## Functions

The voltage and frequency module RP 9811 monitors the domestic generator set and the mains of the energy supplier. It is built up in a redundant way and each of the 2 channels act on a separate output relay. The adjustment is made via menu and rotational switches. The factory default setting is set by rotational switch and can be set via menu. After setup the settings can be sealed with a transparent front cover or alternatively protected by password.

Measured values above or below the limits will lead to a disconnection of the generator system from the mains. The reconnection of the generator system to the mains is only enabled, when the frequency and the voltage are within the limits for the adjusted time  $t_{on}$  without interruption.

The voltage frequency monitor RP 9811 measures the voltage in all 3 phases between phase and neutral. Depending on the rotary switch setting the phase-to-phase voltages are calculated and monitored. The frequency is measured single phase in both models on L1.

The operating state, measured values, error memory and the parameters are viewed via LCD display. The measured value, operating data or scan of the error memory is selected via the "Mode" button, the parameters are selected via the "RUN/SET" button. Status LEDs are available also.

### Parameter No. 25 short interruption ( $t_{onShort}$ ) = on:

After the disconnection due to a short interruption  $< 3$  s, reconnection automatically occurs if the mains frequency and voltage have been continuously within the tolerance range for 5 s. A short term interruption does not register as a hard failure of the operating voltage.

### Changing the mains rated voltage – limit values adjust automatically

If the mains voltage must be adjusted because of the requirements of the power supply utility or if the operation of the voltage and frequency monitor takes place on a medium-voltage grid, parameter 1 (rated voltage  $U_N$ ) must be adjusted accordingly. With a medium-voltage grid, this is due to the transformation ratio of the voltage measuring transducer used through which the device is connected to the grid.

The voltage-related monitoring parameters are set as percentage deviation of the mains rated voltage. When the mains rated voltage changes, the absolute limits adjust automatically to the changed mains rated voltage.

## Functions

### Function RoCoF (df/dt)

RoCoF „Rate of Change of Frequency“ (rate of Change of Frequency)

Parameter:

Parameter table

	Display	Value	
1)	RoCoF	0,10 ... 5 Hz /s / off	df / dt
2)	T_df/dt	0,05 ... 10 s / off	off delay
3)	Perio	4 ... 50	Number of cycles for measurement
Default- setting: 4 cycles			

### Description

The voltage and frequency monitor RP 9811 is able to measure the rate of change of frequency df/dt (frequency gradient). If the frequency gradient rises for an adjustable time over an adjustable value the RP 9811 switches off after an adjustable time.

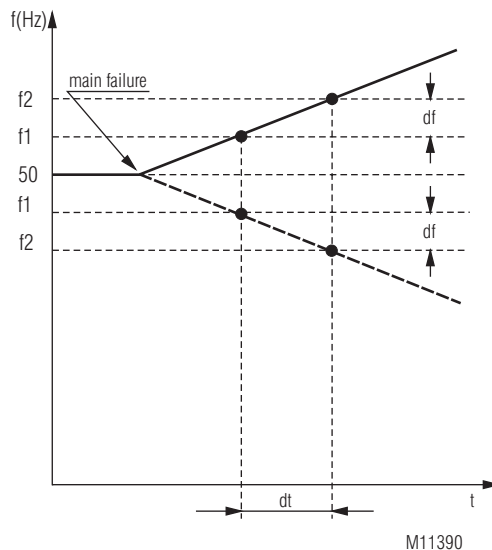
The frequency gradient can be positive or negative, i.e. rising frequency as well as dropping frequency can be detected.

### Response

If for the duration of the selected number of cycles the frequency gradient is exceeded, the adjusted time delay „T\_df/dt“ is started, the display shows the failure message „RoCoF“ and the fault signaling relay switches.

If the failure gradient goes under the response value minus hysteresis of 5% within the selected number of cycles or the direction of change of frequency changes the monitoring cycle starts again from the beginning.

Only when the time delay „T\_df/dt“ is finished the RP 9811 switches off. If „T\_df/dt“ = off the RP9811 switches off immediately.



**Function Vector shift**

Parameter:

Parameter table

1)	VecSh	2 ... 20° / off	(Vector shift)
2)	Phase	1 / 3	(single- oder 3-phase)

**Description**

The add-on fast disconnection on vector shift detects phase jumps in all 3 phases simultaneously. Independent of this the unit can be set to react on single phase vector shift (sensitive measurement).

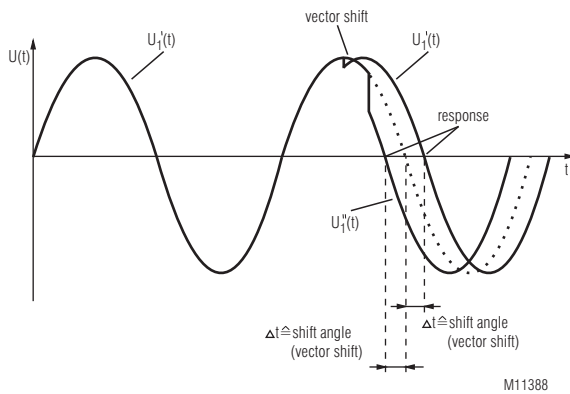
The selection is done with parameter "Phase" number of phases 1 or 3 phases. When selecting 3 phases the vector shift response takes only place when the adjusted vector shift angle is exceeded in all 3 phases.

The shift angle can be adjusted between 2 and 20%. The value could be positive or negative. The actual frequency is continuously measured in all 3 phases. The measurement is based on time measurements of full frequency cycles and is calculated as mean value of 8 cycles before a vector shift. To detect a vector shift the sum of two cycles is relevant.

After each cycle a new sum is calculated. A angle shift that has the length of 2 cycles is reliably detected.

**Response**

When detecting a vector shift the RP 9811 disconnects within <50 ms.



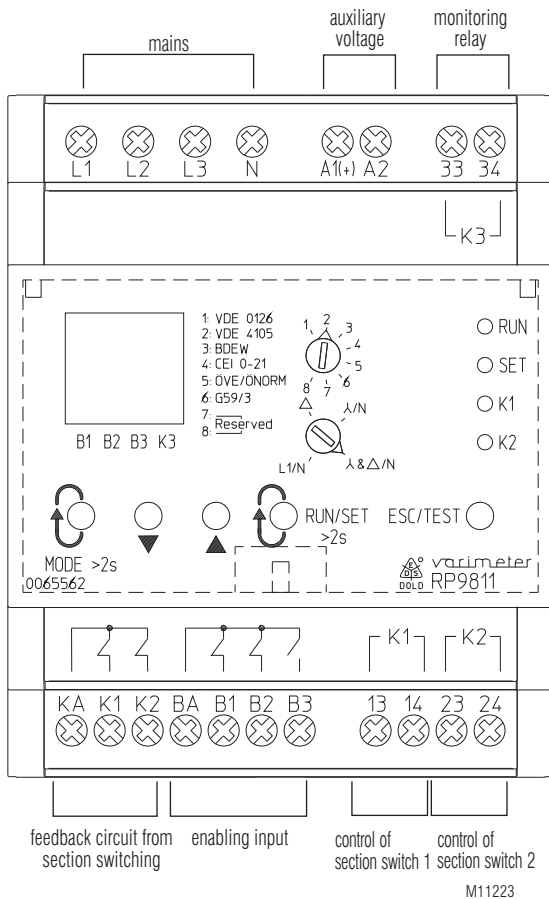
**Reset**

If a disconnection was caused by the functions „vector shift“ or „RoCoF“ the reset is started after a delay of 5 seconds. The adjustable reset time “tON” elapses. To start the reset the mains must be without fault and the monitoring function is enabled (inputs BA/B1, B2, B3).

**Application**

The functions „RoCoF“ and vector shift are mainly used in generator operation. See also Application example „Generator operation with mains synchronization,“ in the data sheet.

## Indicators



The colour of the backlight indicates the operating status of the device

- Off:** No supply voltage connected
- Green:** Normal operation.
- Red:** Failure status.
- Yellow:** Warning (failure message not acknowledged or test button pressed).

Four display modes can be selected: the measured value display, operating data display, error memory display and the display of the set parameters. Switching between the display modes is done by pressing the "Mode" button long (> 2 s). Switching to the display of the parameters set is done by pressing the RUN/SET button long (> 2s). When in the display mode of the parameters set, switch to the input mode for parameters to change the settings. This is done by pressing the ▼ ▲ button

### Actual value display

Displays the actual frequency and the voltage. Short activation of the button "mode" displays the next value



State control input B1, B2 and B3 — Monitoring relay K3

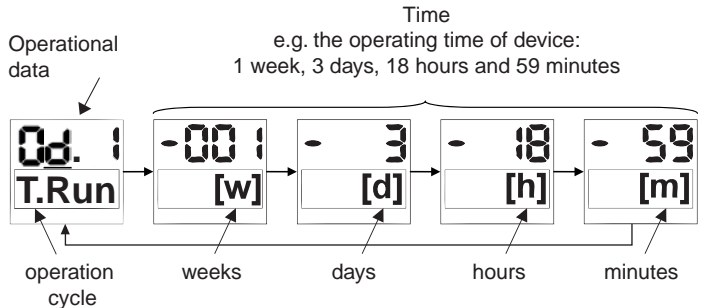
## Indicators

### Display of the operating data

If the operating voltage is present, various operating data, e.g. the operating duration of the device or the disconnect time, is recorded and added.

Within this display mode the following operating data can be selected by short actuation of the "Mode" button:

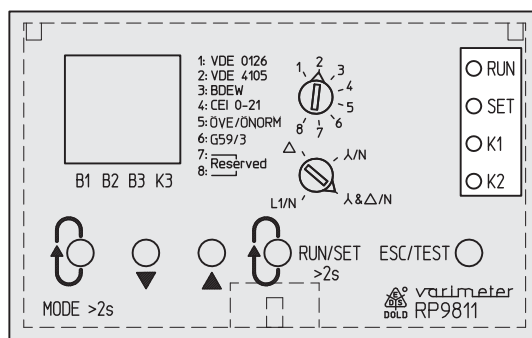
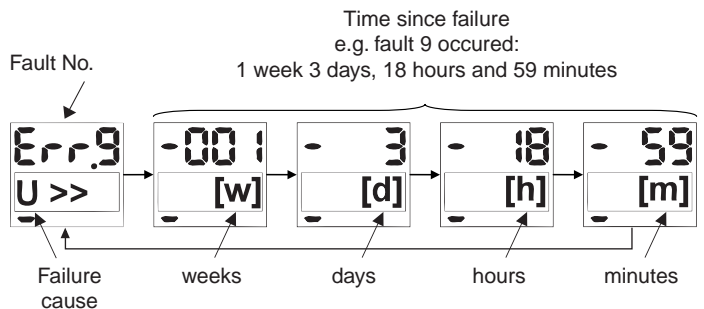
- Od.1: „T.Run“:  $\Sigma$  Operating time (powersupply connected)
- Od.2: „t.Err“:  $\Sigma$  Alarm-/ Failure duration
- Od.3: „t.Xof“:  $\Sigma$  Duration of external disconnection (via input B1/B2/B3)



All operational data is deleted by pressing "Mode" and "Test" for more than 2 seconds in operational data display mode. The reset is confirmed on the display "ResOd" (Reset operational data).

### Display of failure memory

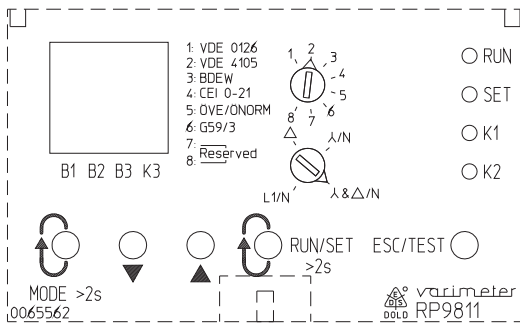
In failure display mode the failure entries with failure cause and relative time to event are shown. Short activation of the button "mode" displays the next failure message. If no entries are stored, the display shows "NoErr".



### Indication LED

- RUN:** Unit in RUN-Mode
- SET:** Unit in Input-Mode
- RUN+SET simultaneously on:** Adjusted parameters are displayed
- K1 on:** Section switch K1 energized
- K1 flashing:** Connecting delay is running
- K2 on:** Section switch K2 energized
- K2 flashing:** Connecting delay is running

## Adjustment Facilities



### Operating element

<b>MODE</b>	Press the button > 2 s: Device switches to the display mode (measured value, operating data, error memory)
<b>RUN/SET &gt; 2 s:</b>	Device switches to the parameter mode or also back to the display mode. In the parameter mode: Scroll through the parameters stored by briefly pressing the button. They are shown on the display. Press the button in the input mode > 2 s: Save parameters, switch to the RUN mode.
<b>▲ Up</b>	If the device is in the parameter mode, pressing these buttons switches to the input (SET) mode of the parameters.
<b>▼ Down</b>	The values are changed in the input mode.
<b>ESC/TEST</b>	Switch to the display mode without saving changed values. The device switches to the display (RUN) mode without saving the changed values. In the RUN and parameter mode: Test function is triggered; the disconnect time of the section switches is measured here and shown on the display in (ms).

### Adjustment by rotational switch

#### Rotary switch Standard selection:

Device works according to

- 1: DIN V VDE V 0126-1-1
- 2: VDE-AR-N 4105 (rotary switch network connection:  $\lambda$  &  $\Delta$ /N !)
- 3: BDEW-directive
- 4: CEI 0-21
- 5: ÖVE/ÖNORM
- 6: G59/3
- 7 ... 8: Reserved

#### Rotary switch network connection:

- $\Delta$ : Delta voltage  
 $\lambda$ /N: Star voltage  
 $\lambda$  &  $\Delta$ /N: Delta- and star-voltage  
 L1/N: Voltage L1-N

#### Example:

##### Standard factory settings according to VDE-AR-N 4105

(not for time delay for activation):

- Response value for: - overfrequency  $f > = 51,5$  Hz  
 Response value for: - underfrequency  $f < = 47,5$  Hz  
 Response value for: - overvoltage  $V > > = 115$  % of  $U_N$   
 Response value for: - undervoltage  $V < = 80$  % of  $U_N$   
 Response value for: - overvoltage, 10 min mean value  $\sqrt{10m} > = 110$  %  
 Time delay for: - reactivation  $t_{on} = 60$  s

## Adjustment Facilities

**Remark to standard G59/3** (rotary switch for standard selection position 6)  
The parameters for G59/3 LV (Low Voltage Grid) are preset.

If the RP9811 should operate according to G59/3 HV (High Voltage Grid) the following settings have to be changed:

**e.g. for 110 V L-L:** (rotary switch for standard selection position 6)

- rotary switch network connection: Delta voltage
- Parameter Nr. 1: Nominal voltage (Phase to Phase) change from 400V to 110V.
- Parameter Nr. 2:  $U >$  change from 114% to 110% (acc. to standard)
- Parameter Nr. 6:  $U >>$  change from 119% to 113% (acc. to standard)
- Parameter Nr. 20:  $U >$  On change from 114% to 110%

No.	Parameter	VDE 0126		VDE-AR-N 4105		BDEW- medium voltage		Italy CEI0-21		ÖVE/ÖNORM E 8001-4-712		Großbritannien G59/3 Low Voltage Grid	
		Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range
<b>Monitoring-/ disconnection parameters:</b>													
1	Nominal voltage $U_N$ (Delta- or star-voltage depending on rotary switch setting)	230V (400V)	50-230V (87-400V) Step 1V	230V (400V)	50-230V (87-400V) Step 1V	230V (400V)	50-230V (87-400V) Step 1V	230V (400V)	50-230V (87-400V) Step 1V	230V (400V)	50-230V (87-400V) Step 1V	230V (400V)	50-230V (87-400V) Step 1V
2	Oversvoltage $U >$	off	100-130% / off Step 1%	off	100-130% / off Step 1%	108%	100-130% / off Step 1%	off	100-130% / off Step 1%	off	100-130% / off Step 1%	114%	100-130% / off Step 1%
3	Time delay oversvoltage $t U >$	off	0-60s / off Step 0,1s	off	0-60s / off Step 0,1s	60s	0-60s / off Step 0,1s	off	0-60s / off Step 0,1s	off	0-60s / off Step 0,1s	1s	0-60s / off Step 0,1s
4	Oversvoltage, 10 min mean value $\bar{U} >$	110%	100-120% / off Step 1%	110%	100-120% / off Step 1%	off	100-120% / off Step 1%	110%	100-120% / off Step 1%	112%	110-115% / off Step 1%	off	100-120% / off Step 1%
5	time delay Oversvoltage, 10 min mean value $t \bar{U} >$	3s	0,2-10s / off Step 0,1s	3s	0,2-10s / off Step 0,1s	off	0,2-10s / off Step 0,1s	3s	0,05-10s / off Step 0,05s	off	0,2-10s / off Step 0,1s	off	0,2-10s / off Step 0,1s
6	Oversvoltage 2 $U >>$	115%	100-130% Step 1%	115%	100-130% Step 1%	120%	100-130% Step 1%	115%	100-130% Step 1%	115%	100-130% Step 1%	119%	100-130% Step 1%
7	Time delay oversvoltage 2 $t U >>$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,2s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,5s	0,05-10s / off Step 0,05s
8	Undersvoltage $U <$	80%	10-100% Step 1%	80%	10-100% Step 1%	80%	10-100% Step 1%	85%	20-100% Step 1%	80%	10-100% Step 1%	87%	10-100% Step 1%
9	Time delay undersvoltage $t U <$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	2,7s	0,05-10s / off Step 0,05s	0,4s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	2,5s	0,05-10s / off Step 0,05s
10	Undersvoltage 2 $U <<$	off	10-100% / off Step 1%	off	10-100% / off Step 1%	45%	10-100% / off Step 1%	40%	20-100% / off Step 1%	off	10-100% / off Step 1%	80%	10-100% / off Step 1%
11	Time delay undersvoltage 2 $t U <<$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,3s	0,05-10s / off Step 0,05s	0,2s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,5s	0,05-10s / off Step 0,05s
12	Overfrequency $f >$	50,2 Hz	50-52Hz / off Step 0,05Hz Random 50,2...51,5Hz	51,5 Hz	50-52Hz / off Step 0,05Hz Random 50,2...51,5Hz	51,5 Hz	50-52Hz / off Step 0,05Hz Random 50,2...51,5Hz	50,5 Hz	50-52Hz Step 0,05Hz Random 50,2...51,5Hz	51,0	50-52Hz Step 0,05Hz	51,5Hz	50-52Hz / off Step 0,05Hz
13	Time delay overfrequency $t f >$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,1s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	90s	0-99s / off Step 0,1s
14	Overfrequency 2 $f >>$	off	50-52Hz / off Step 0,05Hz	off	50-52Hz / off Step 0,05Hz	off	50-52Hz / off Step 0,05Hz	51,5 Hz	50-52Hz Step 0,05Hz	off	50-52Hz / off Step 0,05Hz	52,0Hz	50-52Hz / off Step 0,05Hz
15	Time delay overfrequency 2 $t f >>$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,1s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,5s	0,05-10s / off Step 0,05s
16	Underfrequency $f <$	47,5 Hz	47-50Hz Step 0,05Hz	47,5 Hz	47-50Hz Step 0,05Hz	47,5 Hz	47-50Hz / off Step 0,05Hz	49,5 Hz	47-50Hz Step 0,05Hz	47,0Hz	47-50Hz Step 0,05Hz	47,5Hz	47-50Hz Step 0,05Hz
17	Time delay underfrequency $t f <$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,1s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	20s	0-99s / off Step 0,1s
18	Underfrequency 2 $f <<$	off	47-50Hz / off Step 0,05Hz	off	47-50Hz / off Step 0,05Hz	off	47-50Hz / off Step 0,05Hz	47,5 Hz	47-50Hz Step 0,05Hz	off	47-50Hz / off Step 0,05Hz	47,0Hz	47-50Hz / off Step 0,05Hz
19	Time delay underfrequency 2 $t f <<$	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,1s	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	0,5s	0,05-10s / off Step 0,05s



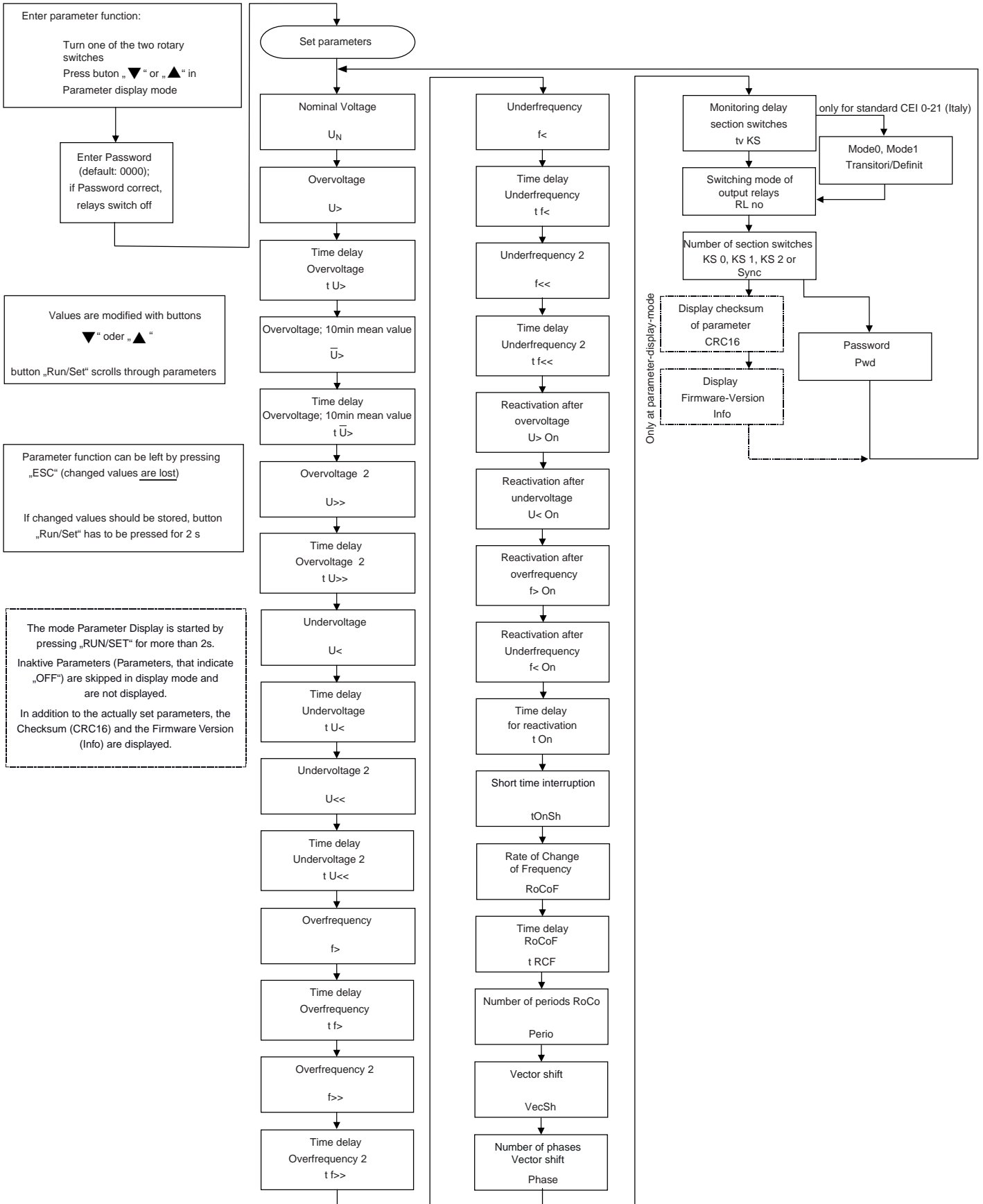
No.	Parameter	VDE 0126		VDE-AR-N 4105		BDEW- medium voltage		Italy CEI0-21		ÖVE/ÖNORM E 8001-4-712		Großbritannien G59/3 Low Voltage Grid	
		Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range	Default	Setting range
<b>Connection parameters:</b>													
20	Reactivation after overvoltage U > On	110%	100-120% / off Step 1%	110%	100-120% / off Step 1%	off	100-120% / off Step 1%	110%	100-120% / off Step 1%	112%	100-120% / off Step 1%	114%	100-120% / off Step 1%
21	Reactivation after undervoltage U < On	85%	20-100% Step 1%	85%	20-100% Step 1%	95%	20-100% Step 1%	85%	20-100% Step 1%	80%	20-100% Step 1%	87%	20-100% Step 1%
22	Reactivation after overfrequency f > On	50,05 Hz	50-52Hz Step 0,05Hz	50,05 Hz	50-52Hz Step 0,05Hz	50,05 Hz	50-52Hz Step 0,05Hz	50,10 Hz	50-52Hz Step 0,05Hz	51,0Hz	50-52Hz Step 0,05Hz	51,5Hz	50-52Hz Step 0,05Hz
23	Reactivation after underfrequency f < On	47,5 Hz	47-50Hz Step 0,05Hz	47,5 Hz	47-50Hz Step 0,05Hz	47,5 Hz	47-50Hz Step 0,05Hz	49,9 Hz	47-50Hz Step 0,05Hz	47,0Hz	47-50Hz Step 0,05Hz	47,5Hz	47-50Hz Step 0,05Hz
24	Time delay for reactivation t On	60s	1-600s Step 1s Random 60...600s	60s	1-600s Step 1s Random 60...600s	1s	1-600s Step 1s Random 60...600s	300s	1-600s Step 1s Random 60...600s	30s	1-600s Step 1s	20s	1-600s Step 1s
25	Short time interruption tOnSh	off	on / off	on	on / off	off	on / off	off	on / off	on	on / off	on	on / off
<b>RoCoF/Vector shift:</b>													
26	Rate of Change of Frequency RoCoF	off	0,10-5Hz/s / off Step 0,01Hz/s	off	0,10-5Hz/s / off Step 0,01Hz/s	off	0,10-5Hz/s / off Step 0,01Hz/s	off	0,10-5Hz/s / off Step 0,01Hz/s	off	0,10-5Hz/s / off Step 0,01Hz/s	off	0,10-5Hz/s / off Step 0,01Hz/s
27	Time delay RoCoF t RCF	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s	off	0,05-10s / off Step 0,05s
28	Number of periods RoCoF Perio	10	4-50 Step 1	10	4-50 Step 1	10	4-50 Step 1	10	4-50 Step 1	10	4-50 Step 1	10	4-50 Step 1
29	Vector shift VecSh	off	2-20° / off Step 1°	off	2-20° / off Step 1°	off	2-20° / off Step 1°	off	2-20° / off Step 1°	off	2-20° / off Step 1°	off	2-20° / off Step 1°
30	Number of phases vector shift Phase	1	1 / 3	1	1 / 3	1	1 / 3	1	1 / 3	1	1 / 3	1	1 / 3
<b>General parameters:</b>													
31	Monitoring delay section switches tv KS	0,25s	0,05-10s Step 0,05s	0,25s	0,05-10s Step 0,05s	0,25s	0,05-10s Step 0,05s	0,25s	0,05-10s Step 0,05s	0,25s	0,05-10s Step 0,05s	0,25s	0,05-10s Step 0,05s
32	Mode (only at CEI0-21 Italy)	---	---	---	---	---	---	Mode0	Mode0: Tran- sitori Mode1: Definit	---	---	---	---
33	Switching mode of output relays	RL no	RL no: normal- ly open	RL no	RL no: normal- ly open	RL no	RL no: normal- ly open	RL no	RL no: normal- ly open	RL no	RL no: normal- ly open	RL no	RL no: normal- ly open
34	Number of section switch (only at CEI0-21 Italy)	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>	KS 2	KS 0: <sup>1)</sup> KS 1: <sup>2)</sup> KS 2: <sup>3)</sup> Sync: <sup>4)</sup>
35	Password Pwd	0000	0000-9999 Step 1	0000	0000-9999 Step 1	0000	0000-9999 Step 1	0000	0000-9999 Step 1	0000	0000-9999 Step 1	0000	0000-9999 Step 1

<sup>1)</sup> KS 0: No section switch    <sup>2)</sup> KS 1: 1 section switch    <sup>3)</sup> KS 2: 2 section switches    <sup>4)</sup> Sync: Mains synchronization

**Comment on parameter no. 31:**

The scan delay of the section switches (tv KS) must be greater than the actual time of the section switches. The adjustable delay is active when the section switches close. (Motor driven sector switches have longer connection times). The monitoring delay when disconnecting is fixed at 250 ms.

# Running chart parametrisation



### CRC16-value (Test value of parameter setting)

Below, the CRC16 values for the different positions of the two rotary switches are listed for standard and system configuration. The CRC16 values listed are obtained from the standard set, the system configuration and the associated default values of the parameter setting. If different parameters are selected than the default settings, different CRC16 values are obtained. They are not listed here.

Standard	Mains form	CRC16- value *)
VDE 0126	Y & Δ / N	ddcA
VDE 0126	Y / N	d85F
VDE 4105	Y & Δ / N	3b56
BDEW	Y & Δ / N	18b5
BDEW	Y / N	1d20
BDEW	Δ	1E53
CEI 0-21	Y & Δ / N	3bc4
CEI 0-21	Y / N	3E51
ÖVE/ÖNORM	Y & Δ / N	cb04
G59/3 LV	Y & Δ / N	5dE8
G59/3 LV	Y / N	587d
G59/3 HV 110V	Δ	47d3

\*) Firmware-Version ≥ 04.00

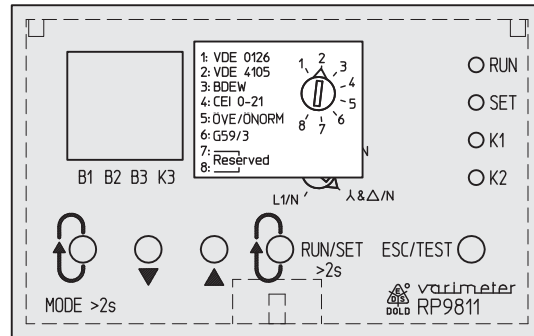
### Set parameters

#### Input-Mode

Via rotary switch the default settings for 6 standards can be adjusted quickly:

- 1: VDE 0126
- 2: VDE-AR-N 4105
- 3: BDEW-Mittelspannung
- 4: Italien CEI0-21
- 5: ÖVE/ÖNORM
- 6: G59/3
- 7: Reserved
- 8: Reserved

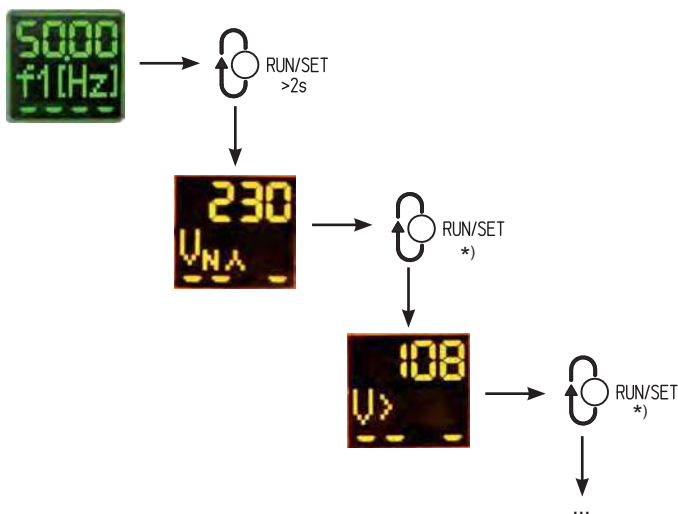
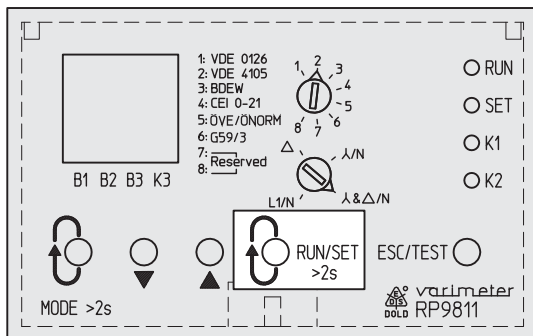
The default settings can be selected via the rotary switch thereby accepting the default settings of the parameter table. The individual parameters can be changed manually if needed.



### Set parameters

#### Display mode

All parameters currently set to "active" are shown in the display mode. Scrolling between the different "active" parameters is possible with the RUN/SET button.



To change the parameters manually, the RUN/SET button must be pressed longer than two seconds. The display mode is accessed. The input mode is accessed when subsequently pressing "▼▲". The input mode is also accessed by turning one of the two rotary switches.

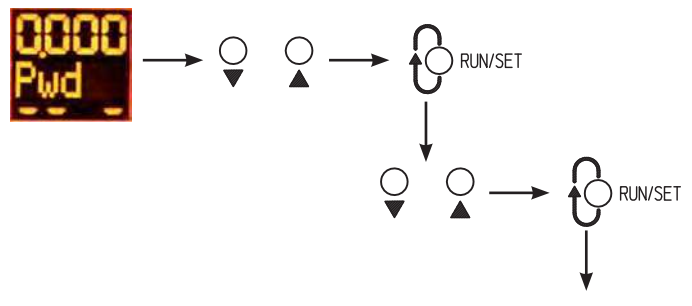
Before the values of a parameter can be modified, the password has to be entered correctly, or the default password (factory set) has to be acknowledged by pressing the RUN/SET button 4 times. The display then shows OK !

The password consists of four numbers from 0000-9999

#### Change of password:

To avoid unintended modifications the following sequence has to be followed:

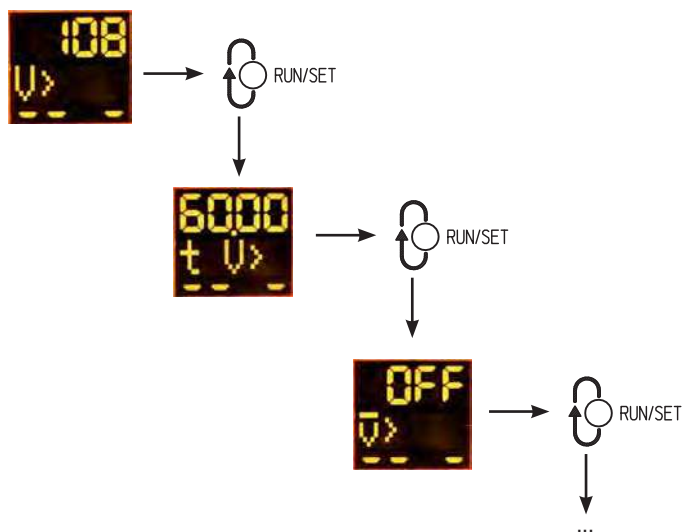
1. Use RUN/SET button to select parameter no. 35 select "Password PWD"
2. Enter password with buttons ▼▲
3. Acknowledge password by pressing RUN/SET button, the display now shows "Pwd 2"
4. Repeat step 2. And 3. until display changes to parameter no. 1
5. Other parameter changes can be made. By pressing RUN/SET button for longer than 2 sec the changes are stored. The device changes to RUN mode display.



\*) briefly pressing the button is sufficient for scrolling

### Set parameters

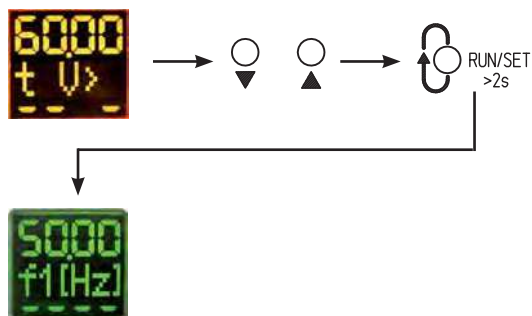
If the password is correct, the different parameters can be changed or parameters can be set to "active" or "inactive". Changing the different parameters is done analogue to the display mode by using the RUN/SET button.



The default values set in the parameters (see parameter table) can be individually adjusted with the ▼▲ buttons; however, they must be within the respective setting ranges. The next parameter can be selected with the RUN/SET button and also be adjusted with the ▼▲ buttons.

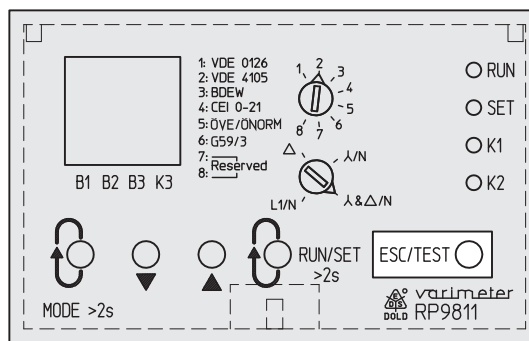


After the desired changes have been made, the new values are saved by pressing the RUN/SET button (> 2 s).

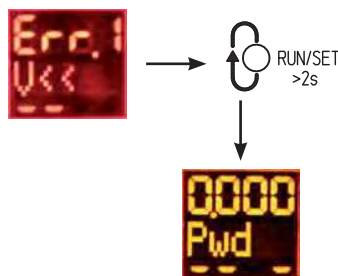


### Set parameters

Jumping back to the display mode is possible at any time by pressing the ESC/TEST button without saving the changed parameters.



Wrong or contradictory entries of parameter values are recognised and displayed by the device as errors (setup errors). The error status can be exited by pressing the RUN/SET button longer than two seconds. The faulty parameters can be corrected back in the input mode.



## Error Indication

The failure status of the unit is indicated by a red backlight. If a failure is detected the unit automatically changes to failure memory display. The last 9 failures are stored, where failure 1 is the newest and failure 9 the oldest. The failures are displayed as follows

Failure indication; Failure cause		
Parameter Nr.	Display	Failure
2	V>	overvoltage
4	$\bar{V}$ >	overvoltage, 10 min mean value
6	V>>	overvoltage 2
8	V<	undervoltage
10	V<<	undervoltage 2
12	f1>	overfrequency
14	f1>>	overfrequency 2
16	f1<	underfrequency
18	f1<<	underfrequency 2
26	RoCoF	Frequency change df/dt (Rate of Change of Frequency)
29	VecSh	Vector shift detected (Vector Shift)
	KS1, KS2	failure section switch (broken wire in feedback circuit or section switch contacts welded)
	Sys.5	Measured value deviation between channel 1 and channel 2 too large; locks the memory, cancelling the lock: Switch off auxiliary voltage longer than 30 s.
	Int.8	Failure during system test KS1 and KS2 have not been disconnected from grid
	Setup	The setting of the two potentiometers (standard and mains) is not correct, set values are not plausible (e.g. connection and disconnection value).

When leaving the failure state, the backlight changes from red to yellow in the first step. Only when the failures are acknowledged, either by deleting the failure memory or by changes to the actual value in the display mode, the backlight changes to green. The entries in the failure memory stay valid when resetting a failure message (pressing the pushbutton "Mode" for >2s).

The failure memory is deleted by pressing the buttons "Mode" and "Test" simultaneously for more than 2 seconds in display mode failure or by disconnecting the supply L1/L2/L3/N for a longer period.

## Fault Signalling Relay

A third output relay K3 indicates the disconnection of the generator system in the case of a failure (contact 33-34).

## Isolated Grid Detection

The RP 9811 includes a passive procedure to detect an isolated network according to chapter 6.5.3 and annex D2 of VDE-AR-N 4105 and chapter A.3.5.3 of ÖVE/ÖNORM E8001-4-712. The 3-phase voltage monitoring allows an isolated network to be detected.

## Random Switch Off at Overfrequency

In VDE-AR-N 4105 a frequency range between 50.2 Hz and 51.5 Hz was defined. In this range a step less reduction of the generated power can be made if the generator is controllable.

Non controllable generator systems can alternatively disconnect themselves from the mains in the frequency range of 50.2 Hz and 51.5 Hz. In this case a symmetric distribution within this range of the disconnection frequency for each plant has to be observed. The RP 9811 has a random setting facility within this range, by turning both related switches into position "random". With this setting the connection and reconnection time is automatically selected within a range of 1 ...10 minutes.

## Random Controlled Connection $T_{on}$

The device offers the possibility to use a random control for connection with a delay between 60 and 600 s. Parameter  $T_{on}$ : "random"

## System Test

When operating the pushbutton „Test“ the states of the section switch can be tested for correct function. Pressing the test button disconnects the generator system from the mains.

### Evaluation of disconnection time:

When the test function is operated the release time of the section switch is monitored via the feedback circuit. The measured time is shown on the LCD display.

To determine the full disconnection time the measuring and evaluation time is added to the release time of the section switch.

## Control inputs B1, B2, B3

### Power up conditions (release)

The distributed power generation system is connected to the grid when the following conditions are met at the control inputs B1, B2, B3.

1. Inputs BA-B1 and BA-B2 are bridged
2. Input BA-B3 is open (operates inverted)
3. Both section switches are switched off. KA-K1 and KA-K2 are closed.


KA-K1 and KA-K2 are open after the connection.

If this is not the case, error KS1 or KS2 is indicated on the display.

If both section switches fail, KS1 and KS2 are entered in the error memory. The error message relay K3 releases in case of error.

## Function control input B2 at adjustable standard CEI 0-21

### Mode Transitori (default):

BA-B2 closed  : monitoring of tight frequency window [ f>, f< ]

BA-B2 open  : monitoring of wide frequency window [ f>>, f<< ]

### Mode Definit:

BA-B2 no function: monitoring of wide frequency window [ f>>, f<< ]

Required parameter setting for Mode Definit:

Parameter No. 15 [ t f>>]: 1 s  
Parameter No. 19 [ t f<<]: 4 s

## Monitoring of Section Switches at mains synchronization

Via the 2 contacts 13-14 and 23-24 the 2 section switches are controlled. The monitoring of the section switches is made by the feedback circuit (terminals KA-K1, KA-K2), to which the NC contacts of the section switches are connected (see connection diagrams).

The voltage and frequency monitor RP 9811 only connects the generator system to the mains when in disconnected state the feedback circuits KA-K1, KA-K2 are closed, i.e. the section switches are de-energised (NC contacts are closed). As long as the section switch is not energized the feedback circuits KA-K1, KA-K2 must be closed if not the failure "KS" is displayed.

The feedback loops KA-K1, KA-K2 must be open after the section switch is selected, otherwise device 2 performs additional connection attempts. If the connection was not successful after the 3rd attempt, the error "KS" is reported and the error message relay switches to the normal position.

### Parameter number of section switches = 0:

Only for simplifying the set-up procedure the monitoring of the feedback circuit can be disabled.

To fulfil the starting conditions, K1 and K2 has to be bridged with KA.

If only one section switch is installed, K1 and K2 are connected in parallel.

### Function Mains synchronization on generator operation:

Parameter number of section switches = „Sync“

This function is available in units with firmware 02.00 and higher.

See relevant application example.

The monitoring of the Feedback contacts can be disabled with the enabling input BA/B3.

BA/B3 closed = feedback contact section switch 2 is disabled

BA/B3 open = both feedback contacts channel 1 and channel 2 are monitored.

Starting condition: BA/B1-B2-B3 bridged, or with standard CEI 0-21 BA/B1-B3 bridged.

### According to the Italian standard CEI 0-21 (< 20 kW)

Using only one section switch is possible. This is permissible for systems < 20 kW.

Coupling switch K1 is connected to terminals 13/14. The feedback contacts terminal K1/K2 of the two section switches must be switched in parallel (bridge between terminal K1 and K2). Setting the number of section switches: Parameter [34] = KS 1 (1 section switch).

Even if only one section switch is connected, monitoring by the RP 9811.03 takes place via two channels.

### Note:

If the feedback contacts terminal K1/K2 are bridged. LED K2 indicates the status of channel 2 and is on corresponding to LED K1 of channel 1. The connection condition is identical with systems > 20 kW.



## Safety notes



### Dangerous voltage.

Electric shock will result in death or serious injury.



Disconnect all power supplies before servicing equipment.

- Faults must only be removed when the relay is disconnected
- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).
- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.
- Observe proper grounding of all components

## Set Up Procedure

The connection has to be made according to the connection examples.

Technical Data	
<b>Reactivation:</b>	see parameter table "Connection parameters"
<b>Disconnection:</b>	see parameter table "Monitoring-/ disconnection parameters"
<b>Accuracy:</b>	
voltage measurement:	$\leq \pm 1\%$ $\pm 1$ digit (at AC 230 V)
Frequency measurement:	$\leq \pm 0,02\%$ $\pm 1$ digit
Reaction time (Disconnection):	< 100 ms
Disconnection by vector shift:	< 50 ms

#### Auxiliary Voltage

Auxiliary Voltage	Voltage range	Frequency range
AC/DC 24 ... 80 V	AC 18 ... 100 V	45 ... 400 Hz; DC 48 % W <sup>*)</sup>
	DC 18 ... 130 V	W $\leq$ 5 %
AC/DC 80 ... 230 V	AC 60 ... 276 V	45 ... 400 Hz; DC 48 % W <sup>*)</sup>
	DC 50 ... 300 V	W $\leq$ 5 %

<sup>\*)</sup> W = permitted residual ripple of auxiliary supply

#### Nominal consumption

DC 24, 48 V:	1.5 W
AC 230 V:	4.2 VA

#### Output

<b>Relay K1 and K2:</b>	1 NO contact each
<b>Relay K3:</b>	1 NO contact
	The 3 Output relays are de-energized on trip, after disconnection or failure
	5 A
<b>Thermal current I<sub>th</sub>:</b>	
<b>Switching capacity</b>	
according to AC 15	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V	
NO contact:	3 x 10 <sup>5</sup> switch. cycles IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	6 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 50 x 10 <sup>6</sup> switching cycles

#### General Data

<b>Measuring voltage range:</b>	AC 15 ... 300 V (Phase-N) AC 26 ... 520 V (Phase-Phase)
<b>Frequency range:</b>	46...54 Hz
<b>Enabling inputs</b>	
<b>BA / B1, B2, B3:</b>	DC 12 V (Ground- and volt-free contact)
<b>Temperature range:</b>	
Operation:	- 30 ... + 60 °C
Storage:	- 40 ... + 70 °C
<b>Altitude:</b>	up to 4,000 m IEC 60 664-1
<b>Clearance and creepage distance</b>	
Rated impulse voltage /	
Pollution degree:	
auxiliary circuit / measuring circuit /	
contacts:	5 kV / 2 IEC 60 664-1
13-14 / 23-24:	4 kV / 2 IEC 60 664-1
	(at altitude > 2.000 m the contacts
	13-14 / 23-24 must be connectet on the
	same phase!)
The measuring circuit includes:	L1, L2, L3, N, KA, K1, K2, BA, B1, B2, B3
<b>EMC</b>	
Electrostatic discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V/m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge	
between	
wires for power supply:	2 kV IEC/EN 61 000-4-5
between wire and ground:	4 kV IEC/EN 61 000-4-5
HF wire guided:	20 V IEC/EN 61 000-4-6
Interference suppression:	Limit value class B EN 55 011

Technical Data	
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	thermoplastic with VO behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0,35 mm frequency 10...55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	30 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection</b>	
Cross section:	solid, stranded 0.5 ... 4 mm <sup>2</sup>
Flexible with plastic sleeve:	0.5 ... 4 mm <sup>2</sup>
Multi-wire connection:	0.5 ... 1.5 mm <sup>2</sup> (2 wires with the same diameter)
Stripping length:	6.5 mm
max. fixing torque:	0.5 Nm
<b>Wire fixing:</b>	Plus-minus terminal screws / M3 box terminals
<b>Mounting:</b>	DIN-rail
<b>Weight:</b>	215 g
<b>Recommended fuse for measuring inputs:</b>	gG / gL 6A

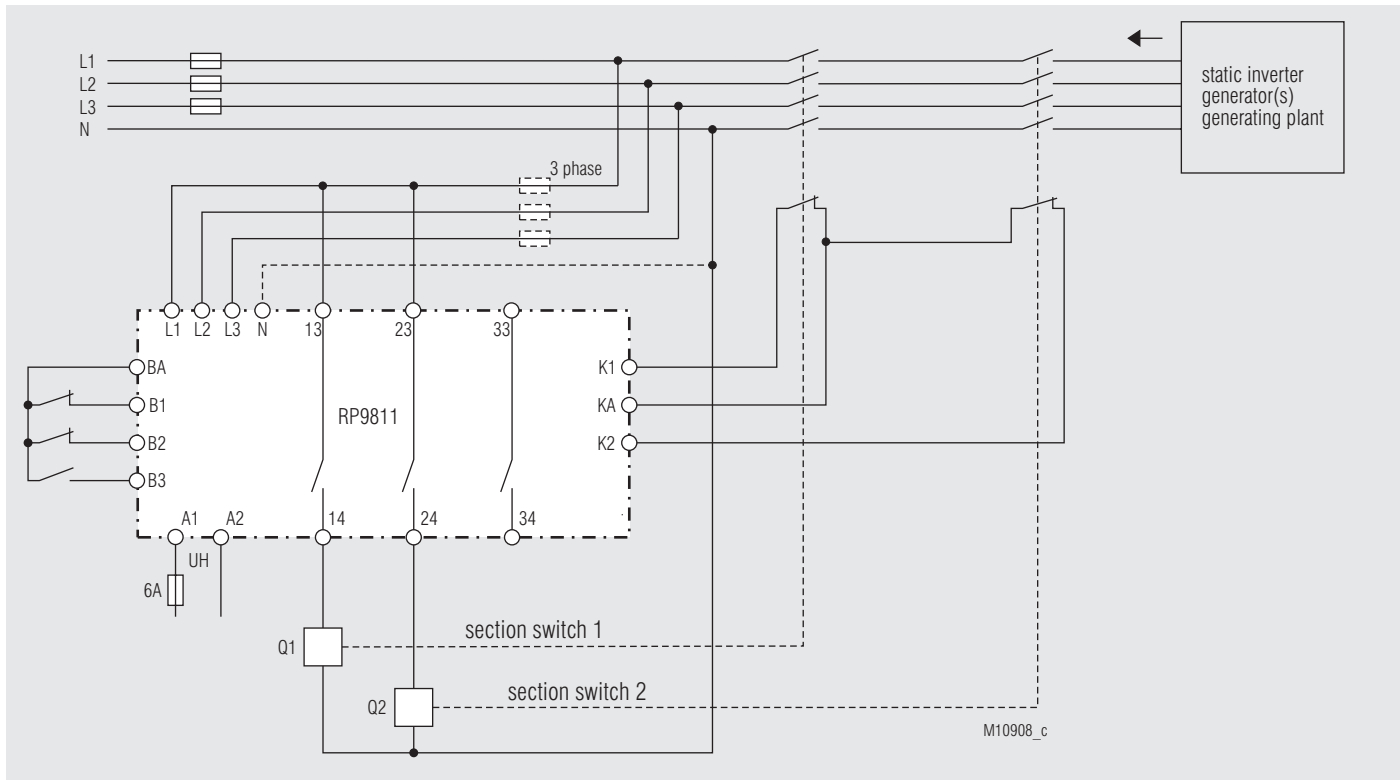
#### Dimensions

<b>Width x height x depth:</b>	70 x 90 x 71 mm
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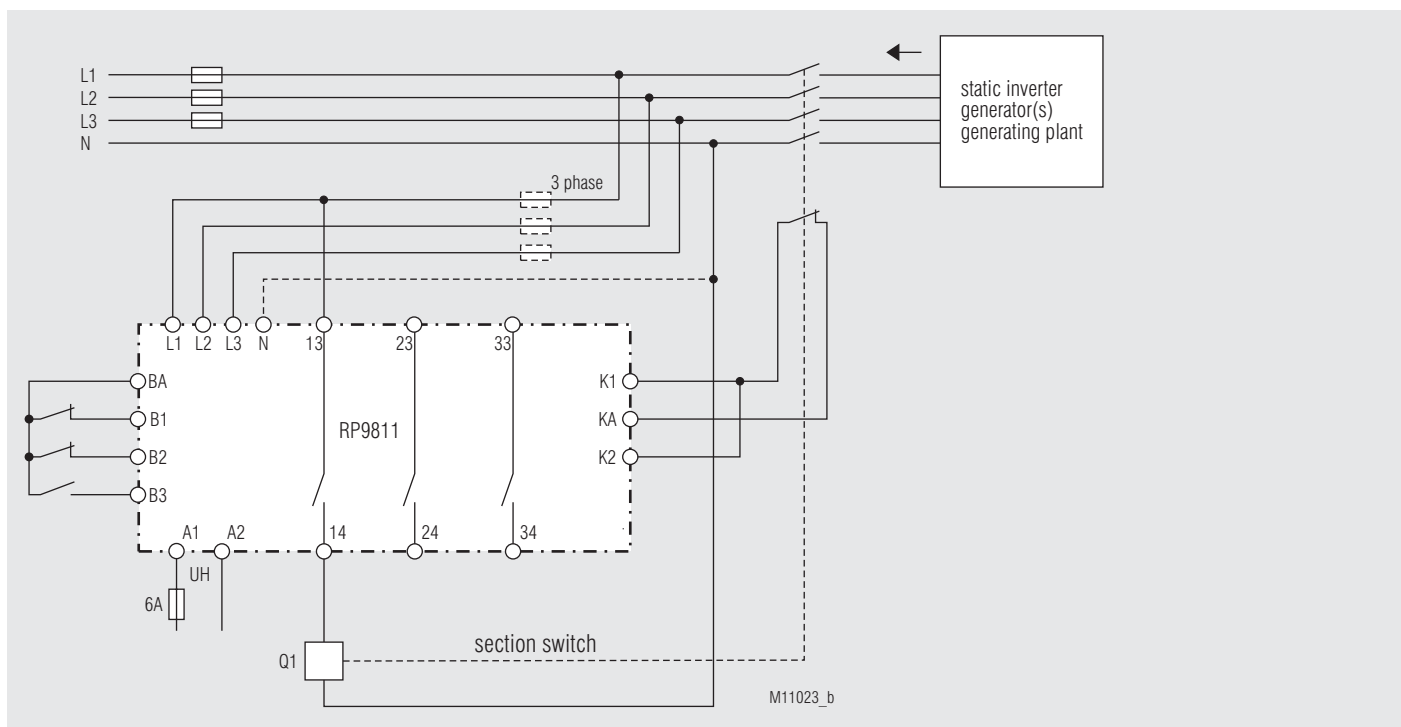
#### Standard Types

RP 9811.03 3/N AC 400 / 230 V	
Article number:	0065562
• Auxiliary voltage U <sub>H</sub> :	AC/DC 80...230 V
RP 9811.03 3/N AC 400 / 230 V	
Article number:	0065698
• Auxiliary voltage U <sub>H</sub> :	AC/DC 24...80 V

Application Examples



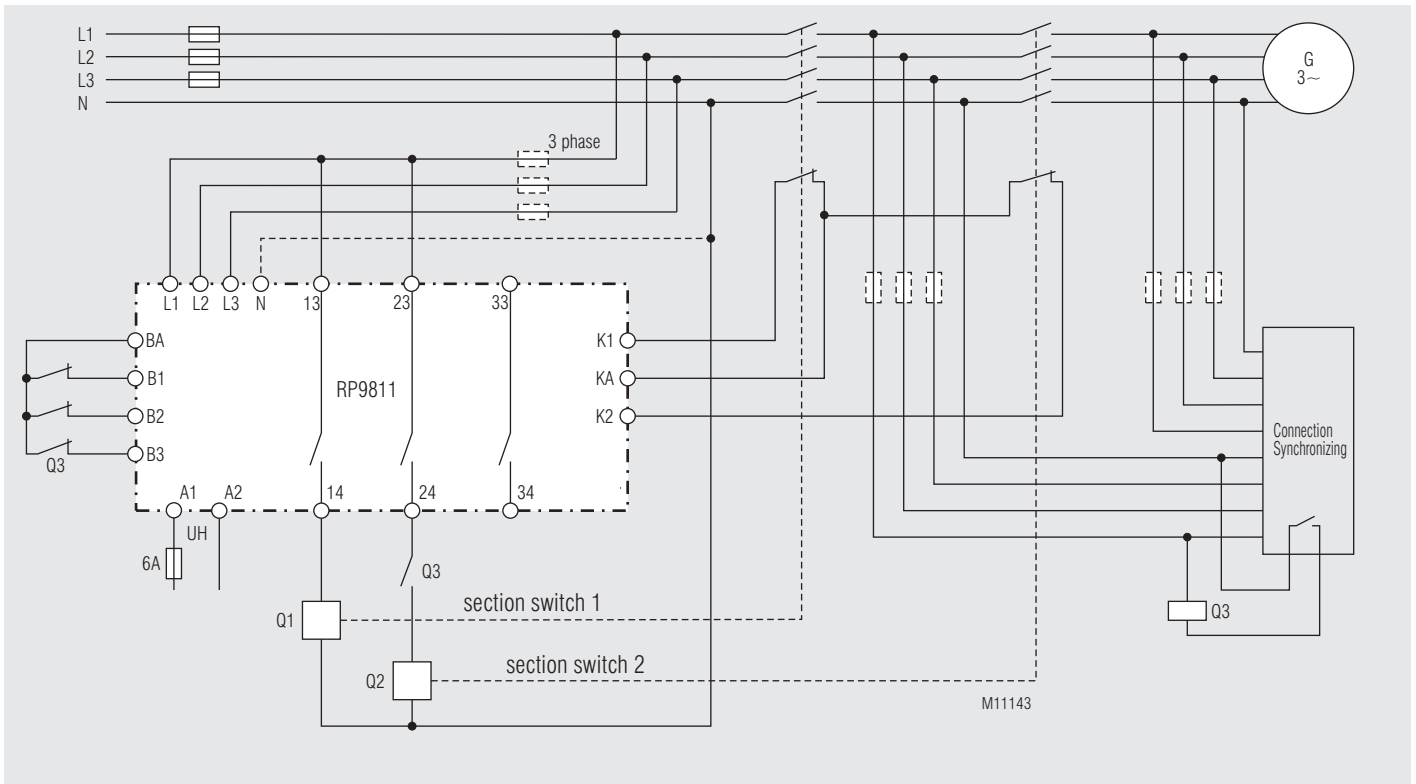
Application example according to DIN VDE-AR-N 4105 (from 30 kW); CEI 0-21 (from 20 kW); BDEW-directive; DIN V VDE V 0126-1-1  
2 section switches



Application example according to CEI 0-21 (< 20 kW)  
1 section switch



# Application Example



Generator operation with mains synchronisation

## VARIMETER Valve Monitor IK 9076, SK 9076

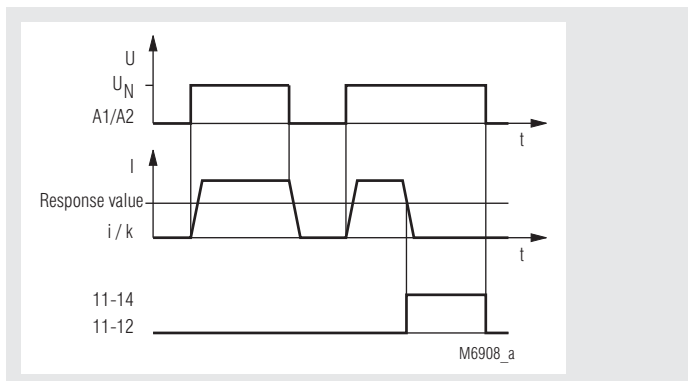


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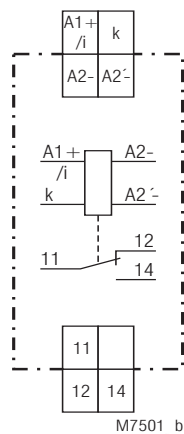


- According to IEC/EN 60 255, DIN VDE 0435-303
- Current monitor
- Detection of wire breakage
- Fixed switching points
- For DC 24 V
- Energized on trip
- Green LED display for operating voltage
- Red LED display for contact position
- **Devices available in 2 enclosure versions:**
  - IK 9076:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK 9076:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 17.5 mm

### Function Diagram



### Circuit Diagram



IK 9076.11, SK 9076.11

### Approvals and Markings



### Application

For monitoring valves.

### Indicators:

Upper LED: on, when operating voltage is supplied  
Lower LED: on, when the output relay is activated

### Note

IK/SK 9076 has no polarity safeguard!

### Technical Data

#### Input

<b>Nominal voltage <math>U_N</math>:</b>	DC 24 V
<b>Voltage range:</b>	0.85 ... 1.2 $U_N$
<b>Nominal consumption:</b>	0.35 W
<b>Switching points (fixed):</b>	Setting value    max. continuous current
	0.3 ... 0.7 A *    1.5 A
	0.2 ... 0.4 A    0.9 A
	0.15 ... 0.3 A    0.5 A
	0.05 ... 0.1 A    0.25 A
	* Suitable e.g. for 24 W / 1 A valves

#### Permissible measuring current:

1.5 A at an ambient temperature of 55°C  
2.2 A at an ambient temperature of 35°C  
8 A, up to 3 s

#### Maximum overload:

#### Output

#### Contacts

IK 9076.11, SK 9076.11: 1 changeover contact

**Operate/release time:** 100 ms / 20 ms

**Thermal current  $I_{th}$ :** 4 A

#### Switching capacity

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

**Electrical life:** IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: 1.5 x 10<sup>5</sup> switching cycles

#### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** ≥ 10<sup>8</sup> switching cycles

## Technical Data

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 20 ... + 55°C	
<b>Clearance and creepage distances</b>		
rated impulse voltage/ pollution degree:	4 kV / 2	IEC 60 664-1
<b>EMC</b>		
Electrostatic discharge:	6 kV (contact)	IEC/EN 61 000-4-2
HF irradiation:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	20 / 055 / 04 IEC/EN 60 068-1	
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4	
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1 DIN rail IEC/EN 60 715	
<b>Mounting:</b>		
<b>Weight</b>		
IK 9076:	56 g	
SK 9076:	75 g	

### Dimensions

#### Width x height x depth

IK 9076:	17.5 x 90 x 59 mm
SK 9076:	17.5 x 90 x 98 mm

## Standard Types

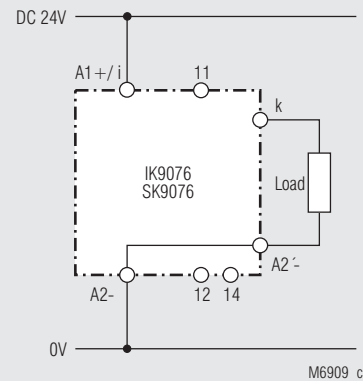
IK 9076.11 DC 24 V < 0.3 A

Article number:	0051708
• Output:	1 changeover contact
• Nominal voltage $U_N$ :	DC 24 V
• Operate time:	< 0.3 A
• Width:	17.5 mm

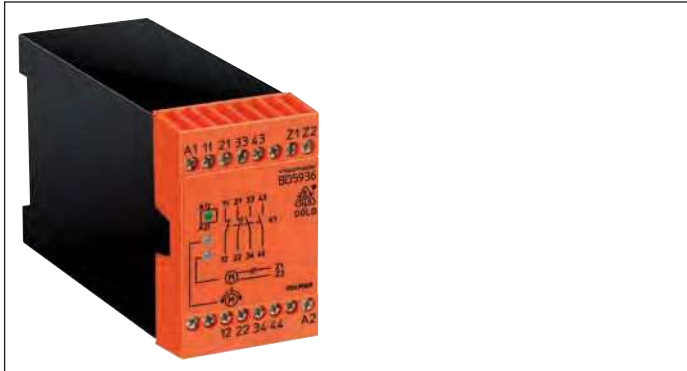
SK 9076.11 DC 24 V < 0.3 A

Article number:	0054742
• Output:	1 changeover contact
• Nominal voltage $U_N$ :	DC 24 V
• Operate time:	< 0.3 A
• Width:	17.5 mm

## Connection Example



## VARIMETER Standstill Monitor BD 5936



### Your Advantage

- Standstill monitoring without sensor

### Features

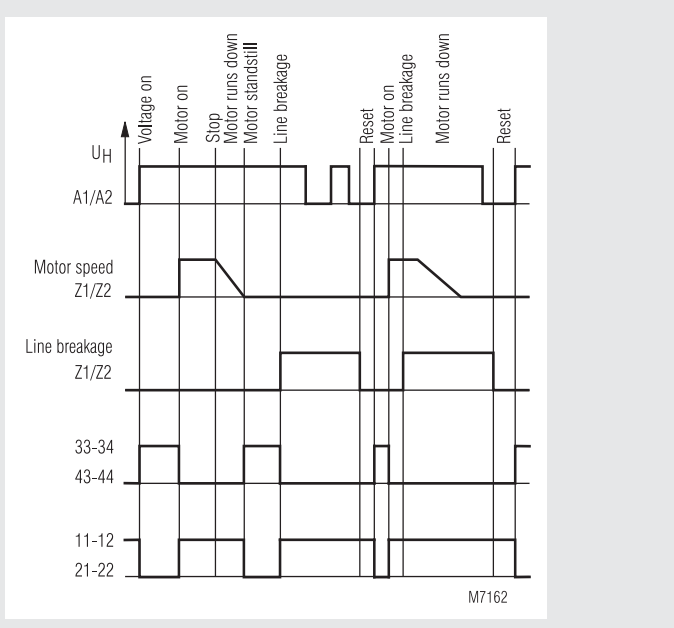
- According to IEC/EN 60255-1, IEC/EN 60255-26
- For standstill monitoring of 3- and 1-phase asynchronous motors
- Line breakage detection in the measurement circuit
- Forcibly guided output contacts:  
2 NO, 2 NC contacts for 250 V AC
- LED indicators for motor standstill, line breakage, and operating voltage
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled (isolated), DIN 46 228/-1/-2/-3/-4 or 2 x 2.5 mm<sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3
- Width 45 mm

### Product Description

The BD 5936 detecting standstills of 3- and 1-phase asynchronous motors. At 2 terminals of the stator winding the BD 5936 measures the voltage of the slowing motor which has been induced. If the induction voltage approaches 0 this indicates that the device is at a standstill and the output relay is activated.

Additional the monitor detects strand breaks between measurement inputs Z1 / Z2. If a line breakage is detected, the output relay goes into the normal position (as when the motor is running). This state is saved and can only be cleared by (briefly) switching off the auxiliary voltage.

### Function Diagram



### Approvals and Markings



\* see variants

### Applications

For detecting standstills of 3- and 1-phase asynchronous motors, for example, for releasing protective door interlocks of machine tools or for activating stopping brakes.

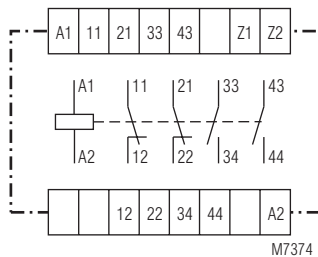
### Notes

In the case on the motor wires the Z1 / Z2 connection wire should be installed separately from the motor supply and connected directly to the motor terminals. For longer distances please use twisted pair wires.

### Indicators

- 1st green LED: comes on when operating voltage present
- 2nd green LED: comes on when motor at a standstill
- Red LED: comes on in event of line breakage between Z1 and Z2

### Circuit Diagram



### Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage $U_H$
Z1, Z2	Measuring input (connection on motor)
11, 12, 21, 22	Forcibly guided NC contacts
33, 34, 43, 44	Forcibly guided NO contacts

## Technical Data

### Input

<b>Auxiliary voltage <math>U_H</math>:</b>	AC 24, 48, 110, 120, 230 V, AC/DC 24 ... 60 V, 110 ... 230 V (other voltages on request)
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal consumption:</b>	approx. 3 VA, 3 W
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Measurement/motor voltage:</b>	AC 690 V
<b>Response value:</b>	approx. 20 mV
<b>Release value:</b>	approx. 40 mV

### Output

<b>Contacts</b>	BD 5936.17:	2 NO, 2 NC contacts
<b>Contact type:</b>		relay, forcibly guided
<b>Output rated voltage:</b>		250 V AC
<b>Thermal current <math>I_{th}</math>:</b>		5 A
<b>Switching capacity</b>		IEC/EN 60 947-5-1
to AC 15:		
NO contact:		3 A / AC 230 V
NC contact:		2 A / AC 230 V
<b>Electrical life</b>		IEC/EN 60 947-5-1
to AC 15 at 2 A, AC 230 V:		10 <sup>5</sup> switching cycles
<b>Short circuit strength</b>		
<b>max. fuse rating:</b>		6 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>		10 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range:</b>	- 15 ... + 55 °C at max. 90 % air humidity	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree, Terminals Z1/Z2:	IEC 60 664-1	
at AC-Auxiliary voltage $U_H$ :	6 kV / 2 (Overvoltage category III)	
at AC/DC-Auxiliary voltage $U_H$ :	4 kV / 2 (Overvoltage category II)	
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV	IEC/EN 61 000-4-5
between wire and ground:	4 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection:</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour to UL Subj. 94	
<b>Vibration resistance:</b>	Amplitude 0,35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	15 / 055 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>	1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) DIN 46 228-1/-2/-3/-4 or 2 x 2.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3	
<b>Line attachment:</b>	Plus-minus terminal screws M 3,5 box terminal with wire protection	
<b>Mounting:</b>	DIN rail IEC/EN 60 715	
<b>Weight:</b>	325 g	

### Dimensions

<b>Width x height x depth:</b>	45 x 74 x 121 mm
--------------------------------	------------------

## UL-Data

<b>Switching capacity:</b>		
<b>NO contacts:</b>	Pilot duty A300	
	10A 250Vac G.P.	
	10A 24Vdc	
<b>NC contacts:</b>	10A 250Vac G.P.	
	10A 24Vdc	



Technical data that is not stated in the UL-Data, can be found in the technical data section.

## CCC-Data

<b>Thermal current <math>I_{th}</math>:</b>	5 A	
<b>Switching capacity</b>		
to AC 15:	2 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

BD 5936.17/001	AC 230 V	50/60 Hz
Article number:	0049069	
• Output:	2 NO, 2 NC contacts	
• Auxiliary voltage $U_H$ :	AC 230 V	
• With automatic reset for broken wire detection		
• Width:	45 mm	

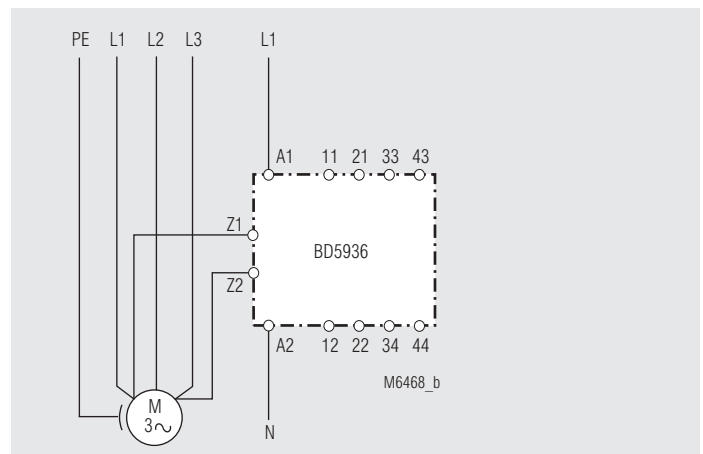
## Variants

BD 5936.17:	without automatic reset for broken wire detection
BD 5936.17/61:	with UL-approval (Canada/USA)
BD 5936:	with CCC-approval on request

## Ordering example for variants

BD 5936	.17	/	AC 230 V	50 / 60 Hz	
					Nominal frequency
					Auxiliary voltage
					Variant, if required
					Contacts
					Type

## Connection Example



## VARIMETER

### Standstill Monitor

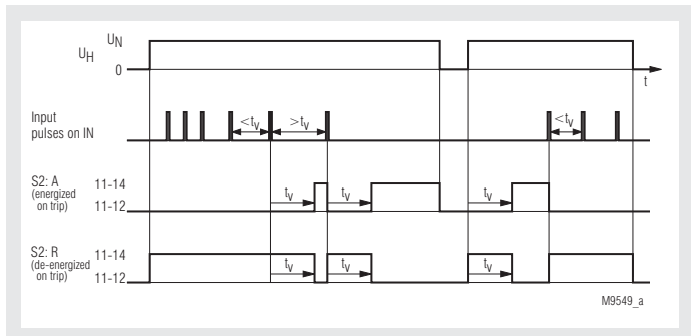
IK 9144, IL 9144, SK 9144, SL 9144



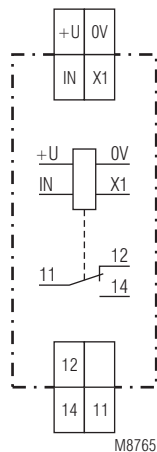
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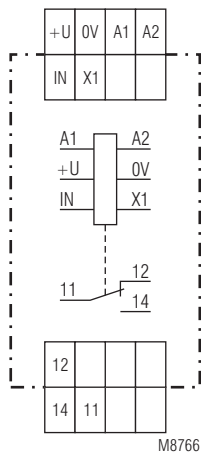
### Function Diagram



### Circuit Diagrams



IK 9144, SK 9144



IL 9144, SL 9144

- According to IEC/EN 60 255, DIN VDE 0435-303
- Detection of standstill of rotating machine parts and cyclic pulses
- Detection of blocking or missing pulses
- Monitoring time adjustable between 0.1 ... 20 s (others on request)
- Energized or de-energized on trip
- For input frequency up to 5 kHz ( $\approx$  300000 ipm)
- Universal input, suitable for a variety of sensors (PNP, NPN, 2-wire, contact, voltage)
- Input also suitable for SKF sensor bearings
- As option for Namur sensors
- On request with manual reset
- IK 9144 and SK 9144: compact version for DC 24V auxiliary supply
- IL 9144 and SL 9144: for auxiliary supply up to AC 400V with galvanic separation to sensor input
- LED indicators for auxiliary supply, sensor pulses and contact position
- 1 changeover contact (2 changeover on request)
- **Devices available in 2 enclosure versions:**
  - IK/IL 9144:** depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK/SL 9144:** depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- IK 9144, SK 9144: width 17.5 mm
- IL 9144, SL 9144: width 35 mm

### Approvals and Markings



### Applications

Speed monitoring on rotating machine parts, monitoring of cyclic movements, general monitoring of pulse sequences (transportation, conveyors production systems), monitoring of pulse frequency (e.g. flow sensors, anemometers), watchdog function for controllers and PLCs.

### Function

The frequency to be monitored is connected to the input terminal IN.

If the time between 2 pulses exceeds the adjusted monitoring time  $t_v$  the output relay changes state.

In energized on trip mode (slide switch in position A), the output relay is de-energized when connecting the supply (contacts 11-14 open). It energises (contacts 11-14 closed) when during the monitoring time  $t_v$  no pulses are detected on input IN. With a new pulse the relay de-energises immediately and the monitoring time  $t_v$  is started again.

In de-energized on trip mode (slide switch in position R), the output relay is energized when connecting the supply (contacts 11-14 closed). It de-energized (contacts 11-14 open), when during the monitoring time  $t_v$  no pulses are detected on input IN. With a new pulse the relay energized immediately and the monitoring time  $t_v$  is started again.

### Indicators

- Green LED: On, when only auxiliary voltage connected to A1 - A2, intermittent red/green flashing when pulses are on the input IN
- Yellow LED: On, when the output relay is energized (contacts 11-14 closed)

## Notes

To the universal input of the speed monitor (terminals +U, X1, IN, 0V) a wide range of different sensors can be connected (capacitive, inductive, ultrasonic, hall effect, optical, reed, etc.) The input is suitable for proximity sensors according to IEC/EN 60 947-5-2 (VDE 0660 part 208)

Depending on the type of sensor (3-wire PNP or NPN, 2-wire, contact, voltage) the connection is made to different terminals (see Connection Examples).

The models IL and SL 9144 have a galvanic separation between Input Circuit (+U, X1, IN, 0V) and auxiliary supply (A1, A2 e.g. 230VAC). 24V DC with up to 20mA is provided on the terminals U+/0V for the supply of the sensor. If sensors with higher power consumption are used, the model IK and SK 9144 is suitable, where the sensors and the speed monitor is supplied by DC 24V from an external power supply.

The speed monitors can be operated with SKF sensor bearings. Sensor bearings include ball bearing and speed sensor in a compact way. The actual sensors are hall effect sensors with NPN output. The connection is made as with NPN proximity sensors.

The model /200 is optimised for Namur proximity sensors according to IEC/EN 60 947-5-6 (VDE 0660 part 212). Namur sensors are 2-wire sensors with defined current in on and off state.

### Monitoring indicator of sensor input

The upper 2-coloured LED shows indicates the connected supply voltage and the status of the sensor:

Green: input IN on LOW level  
Red: input IN on HIGH level  
Green/Red: pulses on input IN

### Several devices on one sensor

A parallel connection of several monitors to one sensor is possible without problems on the universal input, when several tripping values are required or a range between to limits should be monitored. The corresponding terminals are connected in parallel.

### Reaction time

The reaction time is equal to the adjusted monitoring time  $t_r$ . To shorten the reaction time the number of incoming pulses should be increased, e. g. by adding sensing points to a rotating part. The monitoring time then can be adjusted shorter.

### Maximum input frequency, minimum pulse and space time

Every frequency measuring device detects input pulses only up to a certain maximum input frequency. (This is also a result of a proper interference suppression). If the input frequency is higher then the maximum value, the input pulses are not longer detected, i.e. the monitor detects frequency 0. The maximum frequency is always much higher then the maximum setting value of the highest setting range

Also the maximum switching frequency of the sensors must be observed. In addition every frequency input needs a certain minimum pulse and space duration of the connected sensor to react properly. This is very important with high frequency and a low or high pulse/space ratio (e. g. a small active area on big diameter or a small gap on big diameter at high rotation speed). The minimum pulse or space times are very short on these modules, so that most applications are uncritical (see technical data).

## Technical Data

### Input Circuit

**Universal input:** for PNP-, NPN-, 2-wire sensors, contacts and voltage suitable for proximity sensors according to IEC/EN 60 947-5-2 (VDE 0660 part 208)

**IK 9144, SK 9144:** sensor supply by external auxiliary voltage DC 24 V

**IL 9144, SL 9144:** built in power supply approx. DC 24 V, max. 20 mA

**Max. residual current** of 2-wire sensors: 2 mA (OFF)

**Max. voltage drop** of 2-wire sensors: 8 V (ON)

**Voltage drive** input resistance: approx. 17 k $\Omega$

Threshold Low  
IK 9055, SK 9055: approx. 9.2 V  
IL 9055, SL 9055: approx. 8.4 V

Threshold High  
IK 9055, SK 9055: approx. 11 V  
IL 9055, SL 9055: approx. 10.3 V

### NAMUR Input

IK 9144/200, SK 9144/200, IL 9144/200, SL 9144/200: für NAMUR-sensors according to IEC/EN 60 947-5-6 (VDE 0660 part 212) (previously EN 50227/DIN 19234)

**No-load operation voltage:** approx. 8.2 V

**Input resistance:** 1 k $\Omega$

**Short circuit current:** approx. 8 mA

**Switching thresholds:**

Low: approx. 1.5 mA  
High: approx. 1.8 mA

**Response value:** Monitoring time  $t_v$  adjustable 0.1 ... 20 s (others on request)

**Max. input frequency:** 5 kHz

**Minimum pulse and space time:** 100  $\mu$ s

### Auxiliary Circuit

#### IK 9144, SK 9144

(terminal connection +U/0V):

**Nominal voltage  $U_H$ :** DC 24 V

**Voltage range:** 19.2 ... 30 V

**Nominal consumption:** max. approx. 0.8 W

#### IL 9144, SL 9144

(terminal connection A1/A2):

**Nominal voltage  $U_H$ :** AC 24 V, 42 V, 115 V, 127 V, 230 V, 400 V

**Voltage range:** 0.8 ... 1.1  $U_H$

**Nominal consumption:** approx. 4 VA

**Frequency range:** 45 ... 400 Hz

### Output

**Contacts:** 1 changeover contact

**Thermal current  $I_{th}$ :** 4 A

**Switching capacity** to AC 15

NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1

**Switching capacity** to DC 13

NO/NC contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life** to AC 15 at 1 A / 230 V: 1.5 x 10<sup>5</sup> switching cycles IEC/EN 60 947-5-1

**Short circuit strength** max. fuse rating: 4 A gL IEC/EN 60 941-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

### Temperature range

(operation): -20 ... +60 °C

### Clearance and creepage distances

rated impulse voltage/  
pollution degree 4 kV/2

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 1 kV IEC/EN 61 000-4-4

Surge voltages: 1 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour

according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm,  
frequency 10...55Hz, IEC/EN 60 068-2-6

**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** DIN EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or DIN 46 228

2 x 1.5 mm<sup>2</sup> stranded wire

with sleeve DIN 46 228-1/-2/-3

**Wire fixing:** Flat terminals with self-lifting

clamping piece IEC/EN 60 999

DIN rail IEC/EN 60 715

### Mounting:

**Weight**

IK 9144: approx. 65 g

SK 9144: approx. 85 g

IL 9144: approx. 140 g

SL 9144: approx. 160 g

### Dimensions

width x height x depth

IK 9144: 17.5 x 90 x 59 mm

SK 9144: 17.5 x 90 x 98 mm

IL 9144: 35 x 90 x 59 mm

SL 9144: 35 x 90 x 98 mm

## Standard types

IK 9144.11 0.1 ... 20 s  $U_H$  DC 24 V

Article number: 0057162

- Universal input, suitable for a variety of sensors (PNP,NPN,2-wire, contact, voltage)
- Energized or de-energized on trip
- Monitoring time adjustable between 0.1 ... 20 s
- Auxiliary voltage  $U_H$ : DC 24 V
- Output: 1 changeover contact

IL 9144.11 0.1 ... 20 s  $U_H$  AC 230 V

Article number: 0057161

- Universal input, suitable for a variety of sensors (PNP,NPN,2-wire, contact, voltage)
- Energized or de-energized on trip
- Monitoring time adjustable between 0.1 ... 20 s
- Auxiliary voltage  $U_H$ : AC 230 V
- Output: 1 changeover contact

## Variants

IK 9144.11/200,

SK 9144.11/200,

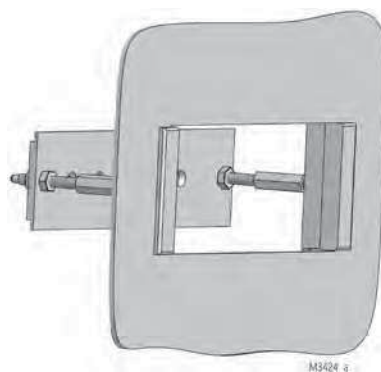
IL 9144.11/200,

SL 9144.11/200: Input for NAMUR sensors

## Accessoires

### Flush mounting kit

Order reference: KU 4087-150/0056598



For universal use with:

- I-series devices of 17.5 to 105 mm width
- easy mounting

### Mounting kit for surface mounting

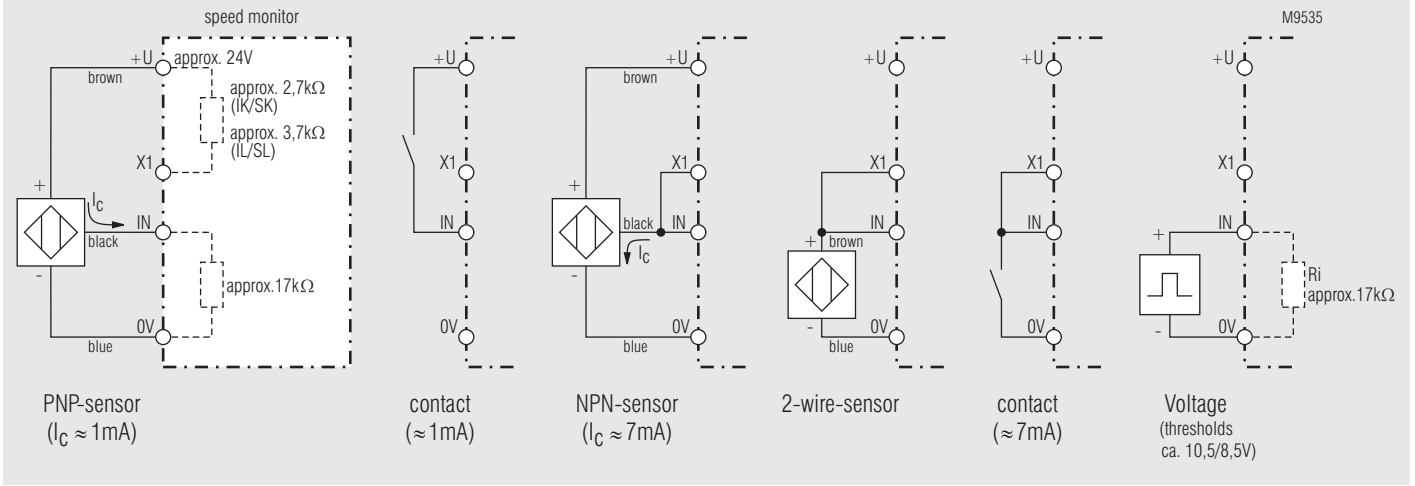
KU 4087-100



Types of I-series	Width (mm)	Order reference
IK	17.5	KU4087-100/56763
IL	35.0	KU4088-100/56764
IN	52.5	KU4084-100/56765
IP	70.0	KU4089-100/56766
IR	105.0	KU4090-100/56767



## Application Example Universal Input



Note: For IK-models the auxiliary voltage (DC 24 V) must be additionally connected to terminals +U/0V

## Monitoring Technique

**VARIMETER**  
Speed Monitor  
BA 9055, AA 9050

Replacements:  
MK 9055N, MH 9055

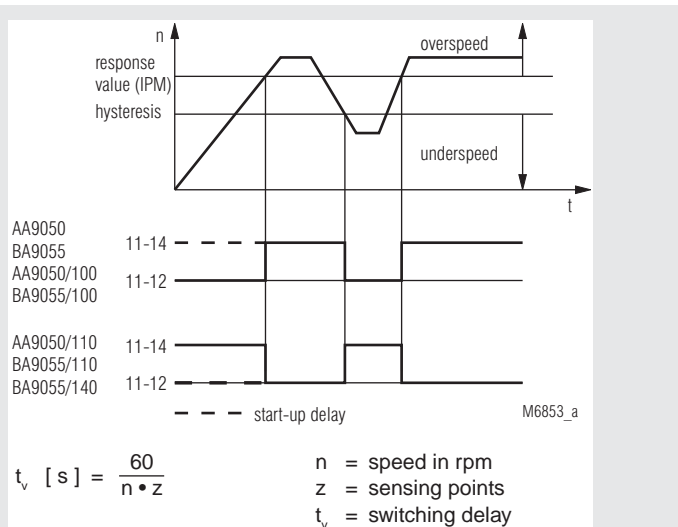
**DOLD** 

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- According to IEC/EN 60 255-1
- Detection of
  - underspeed
  - overspeed
  - standstill
- Adjustable response value
- BA 9055 with adjustable start-up delay
- AA 9050 with adjustable hysteresis
- Width 45 mm

### Function Diagram



### Approvals and Markings



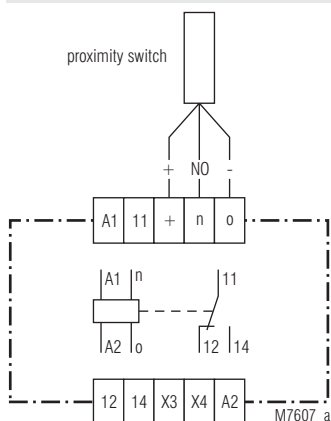
### Applications

Speed monitors are used in case where it is necessary not to exceed certain speed limits in order to protect people plants and products against damage. The Speed monitors are used on escalators, conveyors, transfer lines, elevators as well as plants where several drives with a certain speed have to work together.

### Function

The measuring principle is to compare frequencies. With a proximity sensor the speed is converted to a speed proportional frequency. This frequency is compared to an internal adjustable frequency reference. If the measured frequency is higher then the reference the output relay is energized on an underspeed monitor or de-energized on an overspeed monitor. The output relay deenergises on an underspeed monitor if the speed goes under the setted hysteresis value. On the overspeed monitor the relay is energized. The reaction time is rather short, as the unit has no intergrating function. To calculate refer to formula in Function Diagram. The power supply for the proximity sensor is built into the unit. **The input is designed for pnp sensors.** The speed monitor has an integrated start-up delay. The unit is delivered with a bridge between terminals X3-X4. The start-up delay is activated when the power supply is connected to A1-A2. For the start-up the output relay is energized. If no start-up delay is required, the bridge must be removed. The start-up delay can be activated also by external contacts connected to X3-X4. The start-up delay normally is not required with overspeed monitoring. An LED indicates the connected power supply. A second LED indicates the state of the output relay.

### Circuit Diagram



BA 9055.11, AA 9050.11

### Connection Terminals

Terminal designation	Signal description
A1	L / +
A2	N / -
+, o	Current supply proximity sensors
n	Measuring input
X3, X4	Programming terminals
11, 12, 14	Speed indicator relay (two-way contact)

## Technical Data

### Input Circuit

<b>Input:</b>	for proximity sensors, built in power supply DC 24 V, max. 40 mA
<b>Setting range:</b>	0.05 ... 0.5 lpm    10 ...    100 lpm 0.1 ... 1 lpm    50 ...    500 lpm 0.5 ... 5 lpm    100 ... 1 000 lpm 1 ... 10 lpm    500 ... 5 000 lpm 5 ... 50 lpm    1000 ... 10 000 lpm lpm = Impuls per minute
<b>Min. pulse length:</b>	1 ms
<b>Max. frequency:</b>	30 000 lpm
<b>Setting:</b>	infinite on relative scale
<b>Setting accuracy:</b>	≤ ± 3 %
<b>Response value:</b>	0.1 ... 1 of end of scale value
<b>Hysteresis:</b>	
BA 9055:	2 % of response value
AA 9050:	2 ... 30 % of response value
<b>Accuracy:</b>	≤ ± 1 %
<b>Temperature influence:</b>	≤ ± 0.1 % /°C
<b>Influence of auxiliary supply:</b>	< ± 0.5 % at 0.9 ... 1.1 U <sub>N</sub>
<b>Start up delay</b>	
BA 9055:	1 ... 20 s
AA 9050:	10 s (up to 60 min. available)

### Auxiliary Circuit

<b>Auxiliary voltage U<sub>H</sub>:</b>	AC 24, 42, 110, 127, 230, 240 V DC 24 V
<b>Voltage range of U<sub>H</sub>:</b>	
AC:	0.8 ... 1.1 U <sub>H</sub>
DC:	0.9 ... 1.2 U <sub>H</sub>
<b>Nominal consumption:</b>	< 4 VA
<b>Nominal frequency of U<sub>H</sub>:</b>	50 / 60 Hz

### Output Circuit

<b>Contacts:</b>	1 changeover contact
<b>Thermal current I<sub>th</sub>:</b>	6 A
<b>Switching capacity</b> to AC 15:	5 A / AC 230 V    IEC/EN 60 947-5-1
<b>Permissible switching frequency:</b>	6 000 switching cycles / h
<b>Short circuit strength</b>	
<b>max. fuse rating:</b>	4 A gL    IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 30 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2    IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air)    IEC/EN 61 000-4-2
HF-irradiation:	
80 MHz ... 1 GHz:	10 V/m    IEC/EN 61 000-4-3
1 GHz ... 2,5 GHz:	3 V/m    IEC/EN 61 000-4-3
2,5 GHz ... 2,7 GHz:	3 V/m    IEC/EN 61 000-4-3
Fast transients:	2 kV    IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV    IEC/EN 61 000-4-5
between wire and ground:	4 kV    IEC/EN 61 000-4-5
HF-irradiation:	10 V    IEC/EN 61 000-4-6
Interference suppression:	Limit value class B    EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40    IEC/EN 60 529
Terminals:	IP 20    IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10...55Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04    IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005

## Technical Data

<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1,5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece    IEC/EN 60 999-1
<b>Screw mounting</b>	
AA 9050:	35 x 50 mm and 35 x 60 mm
<b>Mounting:</b>	DIN rail    IEC/EN 60 715
<b>Weight:</b>	
BA 9055:	410 g
AA 9050:	400 g

### Dimensions

#### Width x height x depth

BA 9055:	45 x 74 x 124 mm
AA 9050:	45 x 77 x 127 mm

### Standard Type

BA 9055 AC 230 V 50/60 Hz 10 ... 100 lpm 1 ... 20 s	
Article number:	0030731
• Output:	1 changeover contact
• Nominal voltage U <sub>N</sub> :	AC 230 V
• Setting range:	10 ... 100 lpm
• Width:	45 mm

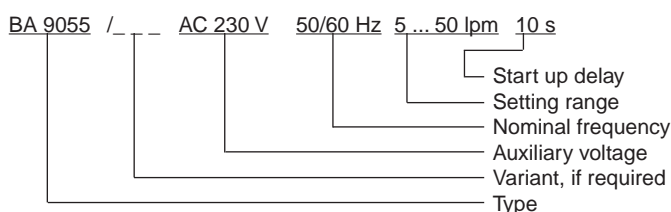
### Classification to DIN EN 50155 for BA 9055

<b>Vibration and shock resistance:</b>	Category 1, Class B    IEC/EN 61 373
<b>Protective coating of the PCB:</b>	No

### Variants

BA 9055, AA 9050:	Standstill and underspeed monitoring with start up delay, closed circuit operation overspeed monitoring with start up delay, open circuit operation with UL-approval
BA 9055/61: BA 9055/100, AA 9050/100:	Standstill and underspeed monitoring without start up delay, closed circuit operation overspeed monitoring without start up delay, open circuit operation
BA 9055/110, AA 9050/110:	Standstill and underspeed monitoring without start up delay, open circuit operation overspeed monitoring without start up delay, closed circuit operation
BA 9055/140:	Standstill and underspeed monitoring with start up delay, open circuit operation overspeed monitoring with start up delay, closed circuit operation

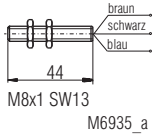
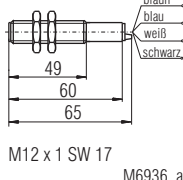
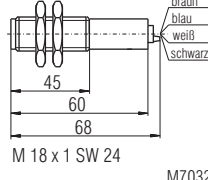
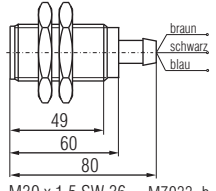
### Ordering example for variants



### Accessories

K 70-34:	Cover for AA 9050 Article number: 0011790
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**Initiators (proximity sensors), induktive**

Type	NA 5001.01.10 pnp NA 5001.01.20 npn	NA 5002.01.34 pnp/npn	NA 5005.01.34 pnp/npn	NA 5010.01.10 pnp NA 5010.01.20 npn
Dimensions	 M8x1 SW13 M6935_a	 M12 x 1 SW 17 M6936_a	 M 18 x 1 SW 24 M7032_a	 M30 x 1,5 SW 36 M7033_b
Enclosure	Metal	Metal	Metal	Metal
Switching distance $S_n$	1 mm	2 mm	5 mm	10 mm
Switching frequency	5 000 Hz	1 000 Hz	300 Hz	200 Hz
Hysteresis	2 ... 10 %			
Repeat accuracy	5 %			
Voltage range	10 ... 30 V			
Residual ripple	< 10 %			
Continuous current	≤ 200 mA	≤ 100 mA	≤ 100 mA	≤ 400 mA
Output	.10 pnp NO 20 npn NO	.34 pnp NO + npn NO	.34 pnp NO + npn NO	.10 pnp NO .20 npn NO
Indication of output state	LED			
Ambient temperature	- 25 ... 70°C			
Temperature influence	10 %			
Degree of protection	IP 67			
Connection wire	2 m			
Fixing torque	4 Nm	15 Nm	40 Nm	100 Nm
Weight	45 g	70 g	120 g	270 g

**Connection Table BA 9055, AA 9050**

Type	Wire	Terminal on AA 9050 / BA 9055
NA 5001.01.10	brown +	+
	blue -	0
	black NO	n
NA 5002.01.34 NA 5005.01.34	brown +	+
	white +	+
	blue -	0
NA 5010.01.10	black NO	n
	brown +	+
	blue -	0
	black NO	n

**Connection Table BA 9055 / \_ \_ 5**

Type	Wire	Terminal on BA 9055
NA 5001.01.10	brown +	+
	blue -	0
	black NO	n
NA 5002.01.34 NA 5005.01.34	brown +	+
	white NO	n
	blue -	0
	black -	0
NA 5010.01.10	brown +	+
	blue -	0
	black NO	n

**Initiatoren NA 5002.01.34 and NA 5005.01.34 only usable for units without initiator-detection!**

## VARIMETER

### Speed Monitor

IK 9055, IL 9055, SK 9055, SL 9055



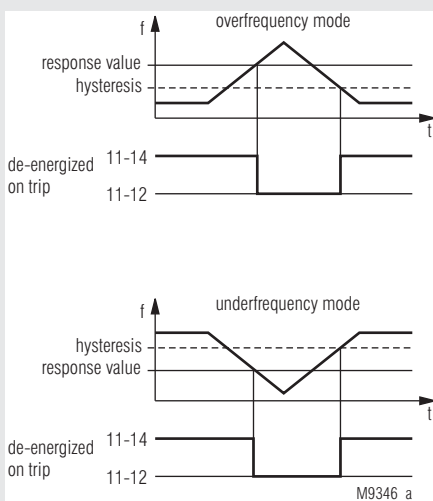
#### Your Advantage

- Protection of persons, machines and products
- Easy setting
- Universal input, for configuration of different sensors (PNP, NPN, 2-wire, contact, voltage)

#### Features

- According to IEC/EN 60 255-1
- Detection of over- or underspeed or frequency, function selectable
- 3 selectable ranges for frequency or speed, adjustable tripping value
- Ranges up to 10 kHz ( $\approx$  600.000 ipm) available, therefore suitable for turbines, centrifuges and similar applications
- Adjustable hysteresis
- Input also suitable for SKF sensor bearings
- As option for Namur sensors
- As option for permanent magnet sensors
- As option with adjustable switching delay/start up delay
- On request with manual reset
- IK 9055 and SK 9055: compact version for DC 24 V auxiliary supply
- IL 9055 and SL 9055: for auxiliary supply up to AC 400 V with galvanic separation to sensor input
- De-energized on trip (Energized on trip on request)
- LED indicators for auxiliary supply, sensor pulses and contact position
- 1 changeover contact (2 changeover on request)
- Devices available in 2 enclosure versions:
  - IK/IL 9055: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SK/SL 9055: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- DIN rail or screw mounting
- IK 9055, SK 9055: width 17.5 mm
- IL 9055, SL 9055: width 35 mm

#### Function Diagram



#### Approvals and Markings



#### Applications

Speed monitoring on rotating machine parts, monitoring of cyclic movements, general monitoring of pulse sequences (transportation, conveyors production systems), monitoring of pulse frequency (e.g. flow sensors, anemometers), pulse monitoring on railway rolling stock

#### Function

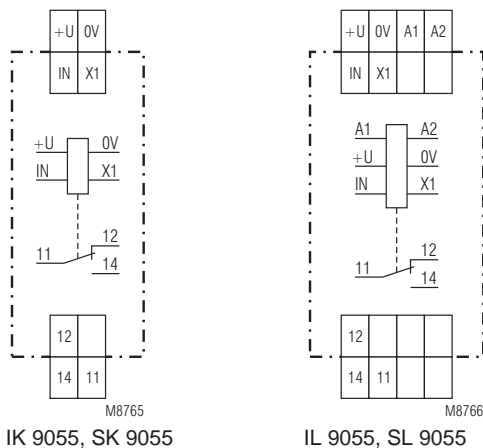
The frequency to be monitored is connected to the input terminal IN. It is compared to the adjusted tripping value.

In overfrequency mode, the output relay switches into alarm position when the preset response value is exceeded. When the system frequency once more falls below the response value minus the preset hysteresis, the output relay will switch back into normal position.

In underfrequency mode, the output relay switches into alarm position when the actual value falls below the preset response value. When the system frequency once more exceeds the response value plus hysteresis, the output relay will switch back into normal position.

If de-energized on trip is selected, the output relay is energized (11-14 closed) in normal status. If energized on trip is selected, the output relay is energized (11-14 closed) in alarm status.

## Circuit Diagrams



IK 9055, SK 9055

IL 9055, SL 9055

## Connection Terminals

Terminal designation	Signal designation
U+, 0V	Supply voltage device and sensor
A1, A2 (only at IL/SL)	Auxiliary voltage input
X1, IN	Connection sensor (see application example)
11, 12, 14	Changeover contact

## Indicators

Green LED:	On, when only auxiliary voltage connected to A1-A2, intermittent red/green flashing when pulses are on the input IN
Yellow LED:	On, when the output relay is energized (contacts 11-14 closed)

## Notes

To the universal input of the speed monitor (terminals +U, X1, IN, 0V) a wide range of different sensors can be connected (capacitive, inductive, ultrasonic, hall effect, optical, reed, etc.) The input is suitable for proximity sensors according to IEC/EN 60 947-5-2 (VDE 0660, part 208).

Depending on the type of sensor (3-wire PNP or NPN, 2-wire, contact, voltage) the connection is made to different terminals (see Connection Examples). The models IL and SL 9055 have a galvanic separation between Input Circuit (+U, X1, IN, 0V) and auxiliary supply (A1, A2 e.g. 230 V AC).

24 V DC with up to 20 mA is provided on the terminals U+/0V for the supply of the sensor.

If sensors with higher power consumption are used, the model IK and SK 9055 is suitable, where the sensors and the speed monitor are supplied by DC 24 V from an external power supply.

The speed monitors can be operated with SKF sensor bearings. Sensor bearings include ball bearing and speed sensor in a compact way. The actual sensors are hall effect sensors with NPN output. The connection is made as with NPN proximity sensors.

The model /200 is optimised for Namur proximity sensors according to IEC 60 947-5-6 (VDE 0660 part 212, previously EN 50 227/ DIN 19 234). Namur sensors are 2-wire sensors with defined current in on and off state.

The model /300 is designed to connect permanent magnet sensors. Permanent sensors are simple, robust 2-wire sensors without voltage supply and electronic circuits. They generate an induced voltage while the permanent magnet passes. They are very cost effective and can be used also with high temperature and hard ambient conditions.

## Monitoring indicator of sensor input

The upper 2-coloure LED shows the connected supply voltage and the status of the sensor:

Green:	input IN on LOW level
Red:	input IN on HIGH level
Green/Red:	pulses on input IN

## Several devices on one sensor

A parallel connection of several monitors to one sensor is possible without problems on the universal input, when several tripping values are required or a range between two limits should be monitored. The corresponding terminals are connected in parallel.

## Monitoring function over- or underfrequency

The function can be changed by a slide switch on the front of the unit. Energized on trip or de-energized on trip remains the same when changing the function, also the tripping value remains unchanged. No calculations with hysteresis are necessary.

## Hysteresis setting

When the setting value is very low in the lowest range, the hysteresis should not be adjusted to the minimum in order to avoid cycling of the output relay.

In the operating mode underfrequency (<f) at setting values near to the end of the range the hysteresis can only be set to 4 ... 10 % due to the internal circuit. When there are problems, the next higher range should be selected.

## Reaction time

The unit work with an integrating measuring principle, where the mean value of several input pulse periods is calculated. This avoids problems with interference pulses, but the reaction time gets longer. The reaction time relates to the lowest adjustable frequency on the actual unit.

An approximate calculation is: Time constant ( $\tau$ )  $\approx \frac{2.5}{f_{\min}}$

The time constant ( $\tau$ ) is the time after which a change of the input frequency with 63 % influences the calculation. If the input frequency before the change is near to the switching value or the change of the frequency is very low, the reaction time can be shorter than the time constant. The technical data will show always the time constant.

Special models with shorter time constant (limited frequency range) on request.

#### Maximum input frequency, minimum pulse and space time

Every frequency measuring device detects input pulses only up to a certain maximum input frequency. (This is also a result of a proper interference suppression.) If the input frequency is higher than the maximum value, the input pulses are not longer detected. The monitor detects frequency 0.

The maximum frequency is always much higher than the maximum setting value of the highest setting range (see technical data).

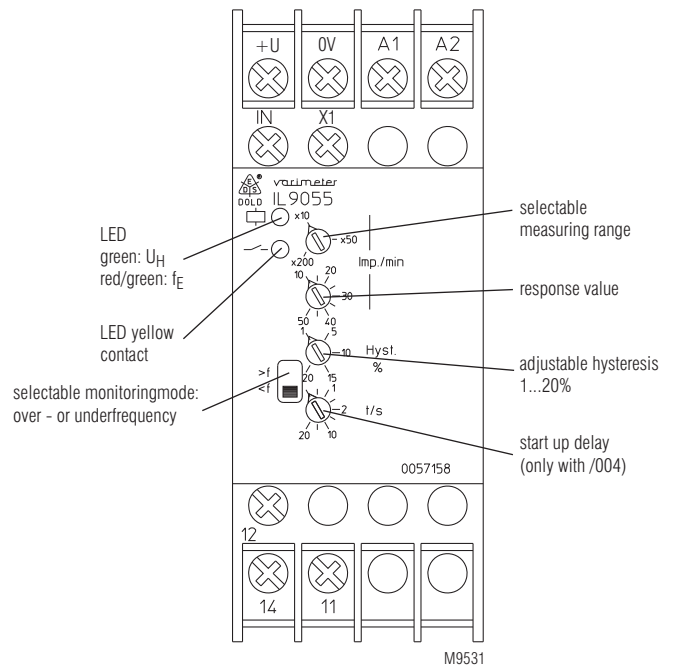
Also the maximum switching frequency of the sensors must be observed. In addition every frequency input needs a certain minimum pulse and space duration of the connected sensor to react properly. This is very important with high frequency and a low or high pulse/space ratio (e.g. a small active area on big diameter or a small gap on big diameter at high rotation speed). If a frequency near to the maximum speed should be detected a pulse/space ratio of 1:1 should be provided by designing the rotating part accordingly. Pulse time is the time the high signal is present at the IN terminal, space time is the time the low signal is present on the IN terminal.

When using PNP sensors or contacts connected to +U the pulse time is identically with the on time of the sensor or contact.

The minimum pulse or space time are very short on these modules, so that most applications are uncritical (see technical data).

#### Variants with delay or start up delay

Devices with adjustable switching delay or start up delay can be made. The start up delay is started when connecting the auxiliary supply, during this time no frequency measurement is done. This may be useful in application for underspeed monitoring when the speed monitor is started up with the motor which needs some time to get on operation speed. Without start up delay there would be an alarm when before the motor is on speed. Compared with the standard switching delay a start up delay has the advantage that it only works one time on start up, but after that a change is detected immediately. If the start up delay is not required, (e.g. on function overspeed), the potentiometer "t/s" is set to left end (minimum).



## Technical Data

### Input Circuit

<b>Universal input:</b>	for PNP-, NPN-, 2-wire sensors, contacts and voltage suitable for proximity sensors according to IEC/EN 60 947-5-2 (VDE 0660 part 208)
<b>IK 9055, SK 9055:</b>	sensor supply by external auxiliary voltage DC 24 V
<b>IL 9055, SL 9055:</b>	built in power supply approx. DC 24 V, max. 20 mA
<b>Max. residual current</b> of 2-wire sensors:	2 mA (OFF)
<b>Max. voltage drop</b> of 2-wire sensors:	8 V (ON)
<b>Voltage drive</b> input resistance:	approx. 17 k $\Omega$
Threshold Low	
IK 9055, SK 9055:	approx. 9.2 V
IL 9055, SL 9055:	approx. 8.4 V
Threshold High	
IK 9055, SK 9055:	approx. 11 V
IL 9055, SL 9055:	approx. 10.2 V
<b>NAMUR Input</b>	
IK 9055/200, SK 9055/200, IL 9055/200, SL 9055/200:	für NAMUR-sensors according to IEC/EN 60 947-5-6 (VDE 0660 part 212) (previously EN 50227/DIN 19234)
<b>No-load operation voltage:</b>	approx. 8.2 V
<b>Input resistance:</b>	1 k $\Omega$
<b>Short circuit current:</b>	approx. 8 mA
<b>Switching thresholds:</b>	Low approx. 1.5 mA High approx. 1.8 mA
<b>Input</b>	
IK 9055/300, SK 9055/300, IL 9055/300, SL 9055/300:	for permanent magnet sensors
<b>Input resistance</b> at f < 100 Hz:	approx. 50 k $\Omega$
at f = 2 kHz:	approx. k $\Omega$
<b>Input sensitivity</b> standard:	approx. 50 mV <sub>eff.</sub> (at f < 500 Hz)
high:	approx. 20 mV <sub>eff.</sub> (at f < 250 Hz)
<b>Max. input voltage:</b>	80 V <sub>eff.</sub>
<b>Monitoring mode:</b>	overfrequency („>f“) or underfrequency („<f“) selectable via slide switch
<b>Response value:</b>	frequency ranges each 3-fold, selectable via rotary switch

## Technical Data

### Frequency range:

100 ... 500	50 ... 500	2 ... 20	10 ... 100
500 ... 2500	500 ... 5000	20 ... 200	100 ... 1000
2000 ... 10000	5000 ... 50000	200 ... 2000	1000 ... 10000
Impulse/min	Impulse/min	Hz	Hz

### Fineadjustment range:

infinitely 1:5	infinitely 1:10	infinitely 1:10	infinitely 1:10
----------------	-----------------	-----------------	-----------------

### Max. input frequency

(Pulse: break = 1:1):

5 kHz	5 kHz	5 kHz	15 kHz
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### Min. pulse- and breaktime:

150 $\mu$ s	150 $\mu$ s	150 $\mu$ s	50 $\mu$ s
-------------	-------------	-------------	------------

### Time constant $\tau$ measuring circuit:

approx. 1.4 s	approx. 3 s	approx. 1.4 s	approx. 0.2 s
---------------	-------------	---------------	---------------

### Hysteresis

adjustable infinitely: 1... 20 % of the adjusted response

value

### Start up delay

IK 9055/004, SK 9055/004,

IL 9055/004, SL 9055/004

adjustable logarithmically:

0.1 ... 20 s

### Auxiliary Circuit

#### IK 9055, SK 9055

(terminal connection +U/0V):

**Nominal voltage  $U_H$ :**

DC 24 V

**Voltage range:**

19.2 ... 30 V

**Nominal consumption:**

max. approx. 0.5 W

#### IL 9055, SL 9055

(terminal connection A1/A2):

**Nominal voltage  $U_H$ :**

AC 24 V, 48 V, 230 V (others on request)

**Voltage range:**

0.8 ... 1.1  $U_H$

**Nominal consumption:**

approx. 4 VA

**Frequency range:**

45 ... 400 Hz

### Output

#### Contacts:

1 changeover contact

**Thermal current  $I_{th}$ :**

4 A

**Switching capacity**

to AC 15

NO contacts:

3 A / AC 230 V

IEC/EN 60 947-5-1

NC contacts:

1 A / AC 230 V

IEC/EN 60 947-5-1

nach DC 13

NO contacts:

1 A / DC 24 V

IEC/EN 60 947-5-1

NC contacts:

1 A / DC 24 V

IEC/EN 60 947-5-1

#### Electrical life

to AC 15 at 1 A / 230 V:

1.5 x 10<sup>6</sup> switching cycles IEC/EN 60 947-5-1

#### Short circuit strength

max. fuse rating:

4 A gL

IEC/EN 60 941-5-1

#### Mechanical life:

≥ 30 x 10<sup>6</sup> switching cycles

### General Data

#### Operating mode:

Continuous operation

#### Temperature range

Operation:

- 20 ... + 60°C

Storage:

- 20 ... + 60°C

#### Altitude:

< 2.000 m

#### Clearance and creepage distances

rated impulse voltage/

pollution degree:

4 kV / 2

IEC 60 664-1

#### EMC

Electrostatic discharge:

8 kV (air)

IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz:

20 V/m

IEC/EN 61000-4-3

1 GHz ... 2 GHz:

10 V/m

IEC/EN 61000-4-3

2 GHz ... 2.7 GHz:

1 V/m

IEC/EN 61000-4-3

Fast transients:

4 kV

IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply:

1 kV

IEC/EN 61 000-4-5

between wire and ground:

2 kV

IEC/EN 61 000-4-5

HF-wire guided:

10 V

IEC/EN 61 000-4-6

Interference suppression:

Limit value class B

EN 55 011



## Technical Data

### Degree of protection

Housing: IP 40  
Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm,  
Frequency 10...55Hz, IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

**Climate resistance:** IEC/EN 60 068-1

**Terminal designation:** DIN EN 50 005

**Wire connection:** DIN 46 228-1/-2/-3/-4

Cross section: 2 x 0.6 ... 2.5 mm<sup>2</sup> solid or  
2 x 0.28 ... 1,5 mm<sup>2</sup> stranded wire with  
and without ferrules

Stripping length: 10 mm

**Wire fixing:** Plus-Minus-terminal screws M3,5 with  
self-lifting clamping piece

**Fixing torque:** 0.8 Nm

**Mounting:** DIN rail mounting (IEC/EN60715) or  
screw mounting M4, 90 mm hole pattern,  
with additional clip available as accessory

### Weight

IK 9055: approx. 65 g

SK 9055: approx. 85 g

IL 9055: approx. 140 g

SL 9055: approx. 160 g

## Dimensions

### Width x height x depth

IK 9055: 17.5 x 90 x 59 mm

SK 9055: 17.5 x 90 x 98 mm

IL 9055: 35 x 90 x 59 mm

SL 9055: 35 x 90 x 98 mm

## CSA-Data

### Nominal voltage $U_N$ :

IK 9055, SK 9055: DC 24 V

IL 9055, SL 9055: AC 24 V, AC 48 V, AC 230 V

**Ambient temperature:** -20 ... +60°C

**Switching capacity:** 3A 240Vac

**Wire connection:** 60°C / 75°C copper conductors only  
AWG 20 - 14 Sol Torque 0.6 Nm  
AWG 20 - 16 Str Torque 0.6 Nm



Technical data that is not stated in the CSA-Data, can be found in the technical data section.

## Classification to DIN EN 50155 for IK 9055

### Vibration and

**shock resistance:** Category 1, Class B IEC/EN 61 373

**Ambient temperature:** T1 compliant  
T2, T3 and TX with operational limitations

**Protective coating of the PCB:** No

## Standard Types

IK 9055.11/60 50 ... 50000 lpm  $U_H$  DC 24 V Hysteresis 1 ... 20 %

Article number: 0059786

- Universal input for PNP-, NPN-, 2-wire sensors, contacts, voltage
- Selectable function: over- or underfrequency
- 3-fold selectable ranges 50 ... 500 lpm, 500 ... 5000 lpm, 5000 ... 50000 lpm
- Response value infinitely adjustable 1:10
- Hysteresis adjustable: 1 ... 20 %
- Auxiliary voltage  $U_H$ : DC 24 V
- De-energized on trip
- Output: 1 changeover contact

IL 9055.11/60 2 ... 2000 Hz  $U_H$  AC 230 V Hysteresis 1 ... 20 %

Article number: 0057157

- Universal input for PNP-, NPN-, 2-wire sensors, contacts, voltage
- Selectable function: over- or underfrequency
- 3-fold selectable ranges 2 ... 20 Hz, 20 ... 200 Hz, 200 ... 2000 Hz
- Response value infinitely adjustable 1:10
- Hysteresis adjustable: 1 ... 20 %
- Auxiliary voltage  $U_H$ : AC 230 V
- De-energized on trip
- Output: 1 changeover contact

## Variants

IK 9055. \_\_ /60,

SK 9055. \_\_ /60,

IL 9055. \_\_ /60,

SL 9055. \_\_ /60:

with CSA-approval

IK 9055.11/004,

SK 9055.11/004,

IL 9055.11/004,

SL 9055.11/004:

with adjustable start up delay  
0.1 ... 20 s

IK 9055.11/200,

SK 9055.11/200,

IL 9055.11/200,

SL 9055.11/200:

input for NAMUR sensors

IK 9055.11/300,

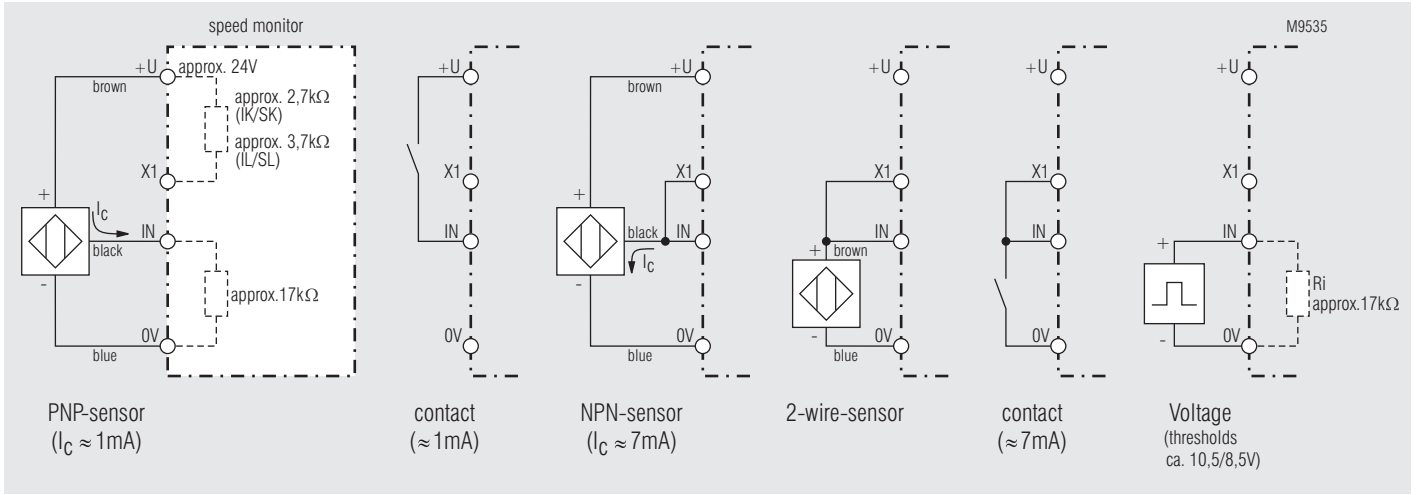
SK 9055.11/300,

IL 9055.11/300,

SL 9055.11/300:

input for permanent magnet sensors

## Application Example Universal Input



Note: For IK-models the auxiliary voltage (DC 24 V) must be additionally connected to terminals +U/0V

## VARIMETER Speed Monitor MK 9055N, MH 9055



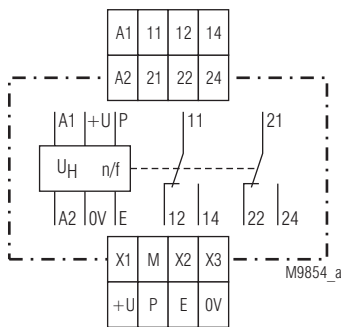
### Your Advantage

- Protection of persons, machines and products
- Easy setting
- Universal input, for configuration of different sensors (PNP, NPN, 2-wire, contact, voltage)
- with fast reaction at low speed

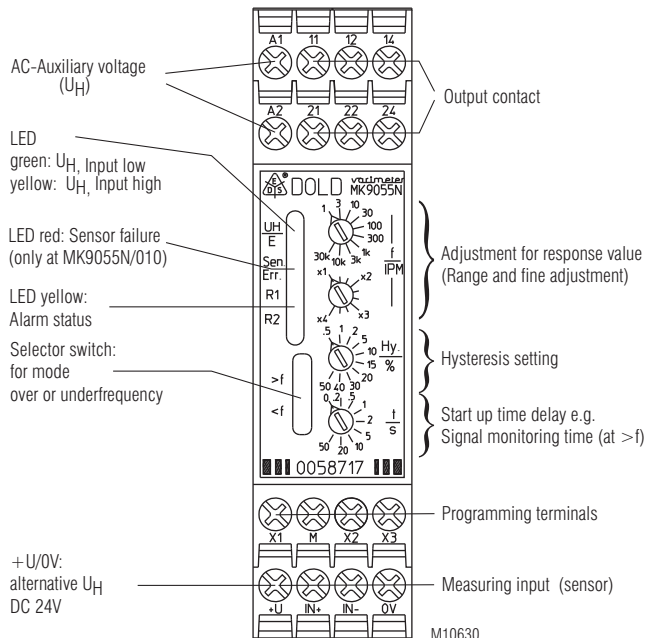
### Features

- According to IEC/EN 60 255-1, VDE 0435 part 303
- Detection of high or low-rpm / stand still (adjustable function)
- Large setting range 1 ... 120.000 IPM or 0.15 ... 20.000 Hz (10 ranges each)
- As option with input for NAMUR-sensors with sensor and wire protection against interruption and short circuit
- Adjustable hysteresis 0.5 ... 50 %
- Adjustable start up time delay 0 ... 50 s, control with external contact
- Adjustable monitoring time for missing input signal at function overfrequency; additional using as standstill level
- Programmable via terminals:
  - Alarm delay of 0 ... 100 s
  - with manual reset or auto reset
- LED-indication for auxiliary voltage, measuring input and output relay; additional LED for indication of wire- / sensor failure at NAMUR-input
- Auxiliary voltages AC 230 V and DC 24 V in one unit
- 2 changeover contacts, closed circuit operation
- Open circuit operation on request
- As option with analogue output, proportionally to speed
- Device available with 2 response values and separately controlled output relays for under- and overfrequency see MK 9055N/5\_ \_
- MH 9055 with wide input range for auxiliary voltage (AC/DC 24 ... 60 V or AC/DC 110 ... 230 V)
- 2 possible compact designs
  - MK 9055N: Width 22,5 mm
  - MH 9055: Width 45 mm

### Circuit Diagram



### Setting

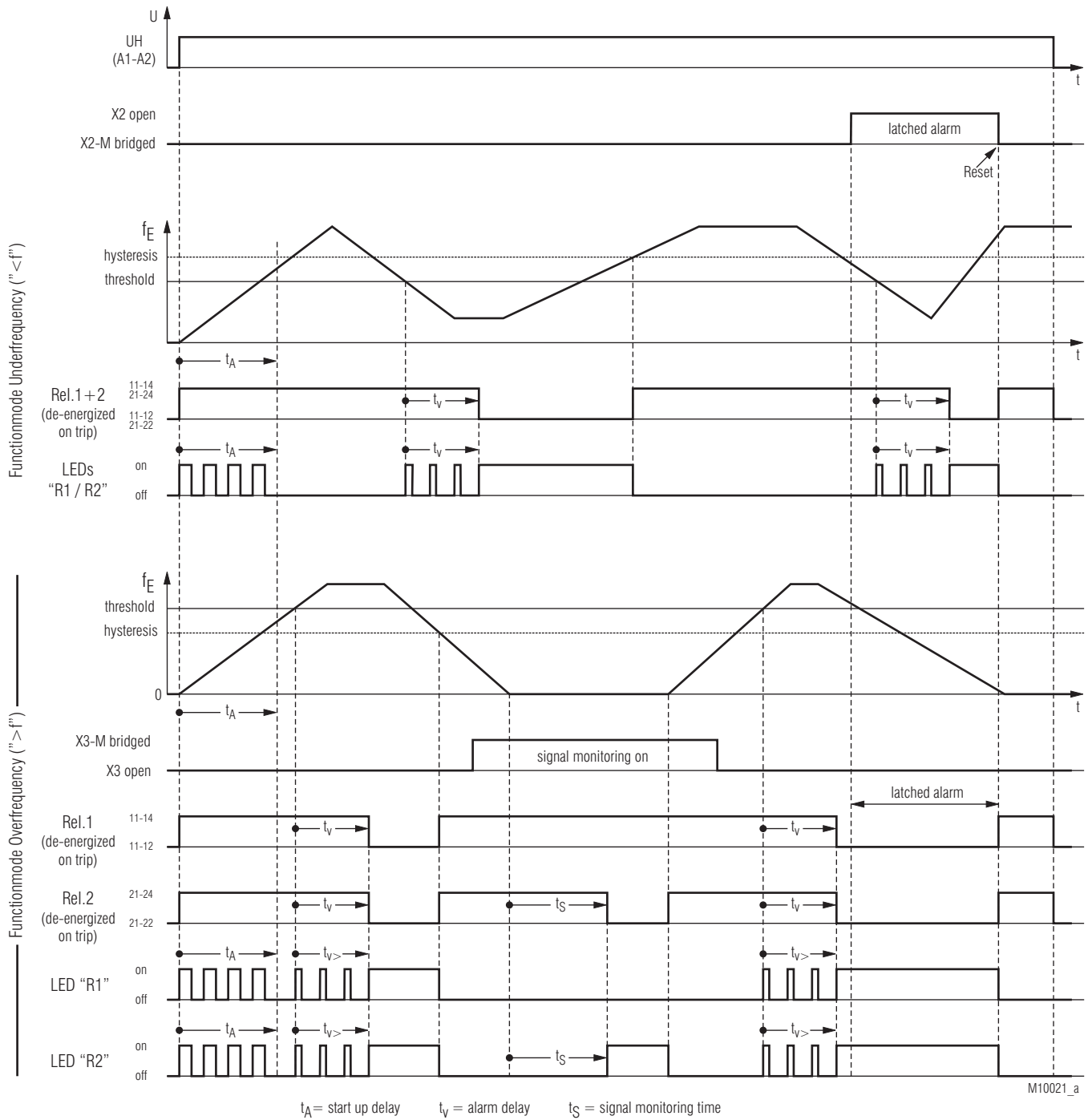


### Approvals and Markings



### Application

- Speed monitoring on rotating machine parts
- monitoring of cyclic movements
- general monitoring of pulse sequences (transportation, conveyors, production systems),
- monitoring of pulse frequency (e.g. flow sensors, anemometers)



## Function

The auxiliary supply is connected to terminals A1-A2. An operation with alternatively DC 24 V is possible via terminals +U / 0V.

Different sensors can be connected to the measuring input that detects the speed pulses.

The input frequency is compared to the setting value (response value = fine tuning x range).

As the device measures the periods duration the fastest frequency measurement is possible.

In overfrequency mode (switch on front in pos. ">f") the output relays switches to alarm state if the input frequency rises above the response value for a longer time then selected on the terminals. If the measuring frequency drops again under the hysteresis value, the output relay switches back to good state without delay.

In underfrequency mode (switch on front in pos. "<f") the output relays switches to alarm state, if the input frequency drops below the response value for a longer time then selected on the terminals. If the measuring frequency rises again above the hysteresis value, the output relay switches back to good state without delay.

If manual reset is chosen, the output relay stays in tripped position, even if the frequency is back to normal. The reset is made by bridging terminals X2-M or by disconnecting the auxiliary supply.

In alarm state the yellow LEDs „R1“ / „R2“ are continuously on, during time delay they flash with short pulse.

In de-energized on trip mode the output relay is energized in good state (contacts 11-14, 21-24 etc. closed).

In energized on trip mode the output relay is energized in alarm state (contacts 11-14, 21-24 etc. closed).

If start up delay is selected a timer is started after connection of auxiliary supply that disables the measuring circuit for the adjusted time on terminal X3. During this time the frequency measurement is disabled, the yellow LEDs "R1" and "R2" flash symmetrically and the output relays remain in "good" position.

This start up delay avoids an alarm e.g. when starting a generator or motor.

In overfrequency mode missing input signal can be monitored as option: If the signal is missing longer then the selected monitoring time, relay 2 (contacts 21-22-24) and LED "R2" indicate alarm.

The variant /010 (NAMUR sensor input) includes broken wire and short circuit monitoring of the sensor and connection wire. A red LED indicates this failure and the output relays switch off.

## Indicators

Upper LED "UH/E":	- green:	Auxiliary supply is present, measuring input is Low
	- yellow:	Auxiliary supply is present, measuring input is High
	- intermittent red/green flashing if U <sub>H</sub> and impuls sequence present	
Red LED "Sen.Err": (only at NAMUR input)	- on, when broken wire or interruption at sensor circuit detected	
Lower LED „R1“ (yellow):	- on, when alarm state (under- / overfrequency) flashes (with short pulse) when time delay is active	
Lower LED „R2“ (yellow):	- on, when alarm state (under- / overfrequency) flashes (with short pulse) when time delay is active	
	- additional flashes at signal monitoring alarm LEDs "R1" and "R2" flash together during start up delay	

## Notes

### Universal measuring input

The universal input of the speed monitor (terminals +U, P, E, 0V) can handle a large variety of sensors (inductive or capacitive proximity sensors, ultra sonic, halleffect, optical sensors, light barriers, reed contacts etc.). The input is suitable for all sensors according to IEC / EN 60947-5-2 (VDE 0660 part 208).

Depending on the sensor that is used (3-wire PNP or NPN, 2-wire, contact) the connection to the input terminals could be different (see Connection Examples).

As the speed monitor is suitable for a very high maximum frequency, RC-elements need to be installed to suppress bouncing of contact sensors (see Connection Examples). It is possible to use standard RC-elements suitable for contact protection or RF interference protection.

### NAMUR input

The Variant M\_9055N/010 is optimized for the connection of NAMUR sensors according to IEC / EN 60947-5-6 (VDE 0660 Teil 212; former EN 50227 / DIN 19234). These 2-wire-sensors are connected to terminals IN+ / IN- (see application example).

Namur sensors have a defined current in ON as well as in OFF state. This allows to detect short circuits and broken wire on sensor and connection wires with this variant. Together with the upper green/yellow LED the type of failure is indicated:

Red LED "Sen..Err" ON and upper LED "UH/E" lights up green:

Broken wire at input circuit

Red LED "Sen..Err" ON and upper LED "UH/E" lights up yellow:

Short circuit at input circuit

Instead of a NAMUR sensor also a contact sensor with correspondent resistor circuit can be used (see Connection Examples). The suggested resistors are necessary to avoid broken wire or short circuit detection alarm. If the resistors are connected directly on the sensor side, the wiring still is monitored. Because of contact bouncing of mechanical contacts a capacitor has to be connected on the measuring input terminals.

### Sensor supply, 24V DC auxiliary supply as alternative

The input circuit (+U, P, E, 0V) is galvanic separated to the auxiliary supply A1, A2 (eg. AC 230V). By connecting AC 230V auxiliary voltage on terminals A1-A2 the unit provides a voltage of approx. 24 V max 20mA to supply external sensors. If the auxiliary supply is DC 24V or sensors with higher power consumption are used, the DC 24V auxiliary supply is connected to terminals +U / 0V. The sensors are also supplied from this source. (In this case there is no galvanic separation between auxiliary supply and measuring input).

### Monitoring indicator of sensor input

The upper 2-coloure LED shows the connected supply voltage and the electrical state of the measuring input:

Green: input E ist on LOW level

Yellow: input E ion HIGH level

Depending on the type of sensor (PNP, NPN, 2-wire, NO or NC contact) the actual state (active or inactive) is indicated.

Green / yellow: input pulses from sensor present

### Several speed monitors on one sensor

Parallel operation of several speed monitors on one sensor is possible the universal input e.g. to monitor several speed levels. The corresponding terminals are all connected in parallel.

### Start up delay / monitoring of measuring signal.

The start up time delay ( $t_A$ ) can be adjusted with the lowest potentiometer on the front side of the unit and is activated when connecting the auxiliary supply. If no start-up delay is required the potentiometer is turned fully antic-clockwise ( $t=0$ ).

In underfrequency mode (" $<f$ ") the start up delay can be extended/restarted at any time with a control contact between terminals X3-M. As long as X3-M is bridged the start up delay is continuously on and the frequency is not measured. When the link on X3-M is opened the start up delay time restarts.

In overfrequency mode (" $>f$ ") with a bridge on X3-M, the lowest potentiometer sets the measuring signal monitoring time ( $t_S$ ) (The adjusted time values  $t_A / t_S$  are identically).

When signal monitoring in mode ">f" is selected by bridging X3-M the measuring input is monitored as follows:

If during the adjusted monitoring time interval no measuring signal is detected, measuring signal alarm is indicated. As soon as the measuring signal returns the alarm status is reset (auto reset selected) and the monitoring interval  $t_S$  starts again.

The alarm status is indicated on relay 2 (contacts 21-22-24) and LED "R2" and can be easily differentiated from under/over frequency alarm where

**Notes**

both relays (contacts 11-12-14 and 21-22-24) and LEDs "R1" and "R2" are active.  
 The detection of missing measuring signal can increase the safety in critical applications on overfrequency. It detects if the measuring signal is connected to the input of the device and works correctly: It can be checked if the frequency input still delivers pulses. If a Namur sensor is used with variant /010 higher safety can be achieved by the integrated short circuit and broken wire detection.

**Second speed level / detection of overspeed and standstill**  
 The signal monitoring time setting in the overfrequency mode can also be used as second speed level, e.g. to detect standstill in addition to overspeed. To achieve this, the monitoring time is adjusted on the lower potentiometer to the reverse value of the pulse frequency that indicates standstill.

**Programming terminals (M-X1-X2-X3):**

**Attention!** The terminals M-X1-X2-X3 have no galvanic separation to the measuring circuit (+U / P / E / 0V) e.g. auxiliary voltage DC 24 V

- M: Common connection (Ground) of the programming terminals (identically with 0V)
- X1: A response delay of 0...100 s after connection of auxiliary supply is achieved by connecting a X1 to M with a potentiometer or fixed resistor (0.25 W) see technical data. The delay can be stopped by bridging X1 to M at any time. If no start up delay is required the terminals X1-M must be linked.
- X2: Manual reset with NO contact push button on X2-M, auto reset with terminals X2-M bridged.
- X3: When X3-M is bridged in mode "underfrequency" the start up delay is continuously active or the time is restarted. In mode overfrequency the monitoring of the measuring signal is switched on by bridging X3-M.

**Adjustment aid for start up delay and alarm delay**  
 During the elapse of start up delay and alarm delay the yellow LED „R1“ and „R2“ is flashing with a frequency of 2 Hz. To set a specific time value in seconds the number of flash pulses can be used to check the setting: Number of flash pulses divided by 2 = time delay in seconds.

**Variants with Analogue Output Indicating the Actual Speed / Frequency**

With this variant the programming terminal X3 is replaced by terminal UA or IA, that provides an analogue signal proportional to the speed with reference to terminal 0V. This signal is either 0 ... 10 V or 0 ... 20 mA or 4 ... 20 mA. As the X3 terminal is not available, these variants do not offer indication of missing speed signal in overfrequency mode and the start up delay can only be initiated when the auxiliary supply is switched on.  
 With the variant /017 (NAMUR sensor input with analogue output 4 ... 20 mA) the analogue output also indicates a sensor or wiring failure by switching the output to 0 mA.  
 The analogue output has no galvanic separation to measuring input and the alternative auxiliary supply on terminals +U/0V

**Technical Data**

**Frequency Measuring Input**

**Universal Input (+U / P / E 0V)**

for PNP-, NPN-, 2-wire sensors, contacts and voltages, connection see application examples;  
 suitable for all proximity sensors according to IEC / EN 60947-5-2 (VDE 0660 part 208)  
 built in power supply approx. DC 24 V / max. 20 mA on terminals +U / 0V;  
 Alternatively external auxiliary voltage supply DC 24 V via terminals +U/0V

- Max. residual current**  
 at 2-wire sensors: 2 mA (OFF state)
- Max. voltage drops**  
 at 2-wire sensors: 8 V (ON state)
- Voltage control**  
 Input resistance: approx. 17 kΩ  
 Low-capability: ≤ 8 V  
 High-capability: ≥ 11 V

**NAMUR Input (Variant /010) IN+ / IN-**

- for NAMUR sensors according to IEC/EN 60947-5-6 (VDE 0660 part 212)
- No-load voltage:** approx. 8.2 V
- Input resistance:** approx. 1 kΩ
- Short circuit current:** approx. 8 mA
- response value**  
 Low: typ. 1.55 mA  
 High: typ. 1.75 mA
- Broken wire threshold: ≤ 0,15 mA
- short circuit threshold: ≥ 6 mA

Alternatively external auxiliary voltage supply DC 24 V via terminals +U/0V

**Common Data for Inputs**

**response value**  
 10 ranges: 1 ... 120.000 IPM

range	1	2	3	4	5	6	7	8	9	10
Imp. / min	1 to 4	3 to 12	10 to 40	30 to 120	100 to 400	300 to 1.200	1.000 to 4.000	3.000 to 12.000	10.000 to 40.000	30.000 to 120.000

or 0.15 ... 20.000 Hz

range	1	2	3	4	5	6	7	8	9	10
Hz	0.15 to 0.6	0,5 to 2	1,5 to 6	5 to 20	15 to 60	50 to 200	150 to 600	500 to 2.000	1.500 to 6.000	5.000 to 20.000

- Fine adjustment: infinite 1:4
- Max. input frequency**  
 (Impuls : Pause = 1 : 1)  
 Range 1 ... 4: 1.5 kHz  
 Range 5 ... 7: 5 kHz  
 Range 8 ... 10: 25 kHz
- Min. pulse- and breaktime**  
 Range 1 ... 4: 350 µs  
 Range 5 ... 7: 100 µs  
 Range 8 ... 10: 20 µs
- Stability of the setting threshold at variation of auxiliary voltage and temperature:** 2 %
- Hysteresis:** infinitely variable: 0.5 ... 50 % of the setting response value
- Reaction time of Frequency monitoring:** (Alarm delay set to 0)  
 Duration of 1 cycle (inverse value of adjusted frequency) + 10 ms  
 (at over frequency: inverse value of signal frequency + 10 ms)
- Response delay:** adjustable 0 ... 100 s with resistor/potentiometer across terminals X1-M:

R / kΩ:	0	15	22	33	47	68	100	150	220	470	∞
t <sub>v</sub> / s:	0	0.3	0.7	1.3	2.3	5	9	15	25	50	100

## Technical Data

### Time between connection

#### of auxiliary supply and

#### ready to measure:

approx. 0.4 s (with start up delay is 0)

#### Start up time delay /

#### signal monitoring time:

continuously variable on logarithmic scale;  
 $t_A$ : 0 ... 50 s,  $t_S$ : 0,1 ... 50 s

### Auxiliary Voltage (A1-A2; e.g. +U / 0V)

**Auxiliary voltage  $U_H$ :** AC 115, 230, 400 V + DC 24 V each  
(via terminals +U / 0V)  
(Terminals +U / 0V has no galvanic  
separation to measuring input)

AC/DC 24 ... 60, 110 ... 230 V (only for  
MH-version possible)

### Voltage range

AC: 0.8 ... 1.1  $U_H$

DC: 0.85 ... 1.2  $U_H$

AC/DC: 0.75 ... 1.2  $U_H$

### Frequency range

AC: 45 ... 440 Hz

### Nominal consumption:

AC: approx. 4 VA

DC: approx. 2 W

### Contact Output (11-12-14, 21-22-24)

**Contacts:** 2 changeover contacts

**Thermal current  $I_{th}$ :** 4 A

### Switching capacity

to AC 15

NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1

to DC 13

NO contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

NC contacts: 1 A / DC 24 V IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 1 A, AC 230 V: 1,5 x 10<sup>5</sup> switch.cycl. IEC/EN 60 947-5-1

### short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

### Analogue Voltage Output (variant /0\_5, terminal "UA" against "0V")

**Nominal output voltage:** 0 ... 10 V, linear proportional to the  
speed / frequency, without galvanic  
separation to measuring input and  
DC 24 V-supply

**Load:** max. 10 mA

**Scale:** 0 V at 0 IPM / Hz  
5 V at setting end of scale value of  
speed / frequency  
10 V at input frequency = 2 x end of  
scale value

**Accuracy:** 3 %

### Analogue Output (variant /0\_6, e.g. 0\_7; terminal "IA" against "0V")

**Output:** 0 ... 20 mA bzw. 4 ... 20 mA, linear  
proportional to the speed / frequency,  
without galvanic separation to measuring  
input and DC 24 V-supply

**Max. burden:** 500  $\Omega$

**Scale:** 0 mA e.g. 4 mA at 0 IPM / Hz  
10 mA e.g. 12 mA at setting end of  
scale value  
20 mA at input frequency = 2 x end of  
scale value

### Fault signal at

**NAMUR input:** at output 4 ... 20 mA (variant /017)  
on sensor failure current drops to 0

**Accuracy:** 3 %

## Technical Data

### General Data

**Nominal operating mode:** continuous operation

**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distance

rated impulse voltage /

pollution degree:

Contact to measuring input: 4 kV / 2 IEC 60 664-1

Contact to auxiliary circuit: 4 kV / 2 IEC 60 664-1

Contact to Contact: 4 kV / 2 IEC 60 664-1

Auxiliary circuit A1-A2 to  
measuring input: 4 kV / 2 IEC 60 664-1

Programming terminals  
M-X1-X2-X3: without galv. separat. to measuring input

Auxiliary voltage DC 24 V  
(an +U / 0V): without galv. separat. to measuring input

Analogue output, optional  
(UA / IA): without galv. separat. to measuring input

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltage

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

HF-wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

### Degree of protection:

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** thermoplastic with VO behaviour

acc. to UL subject 94

Amplitude 0.35 mm

frequency 10 ... 55 Hz IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

EN 50 005

**Wire connection:** 1 x 4 mm<sup>2</sup> solid or

2 x 2.5 mm<sup>2</sup> solid or

1 x 2.5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/-4 oder

2 x 1.5 mm<sup>2</sup> stranded wire with sleeve

DIN 46 228-1/-2/-3/

Plus-minus terminal screws M3,5 box

terminals with wire protection

0.8 Nm

**Mounting:** DIN-rail IEC/EN 60 715

**Weight:** approx. 210 g

### Dimensions

#### Width x height x depth:

MK 9055N: 22.5 x 90 x 97 mm

MH 9055: 45 x 90 x 97 mm

### Standard Type

MK 9055N.12 1 ... 120.000 IPM  $U_H$  AC 230 V

Article number: 0058715

• Universal input for PNP-, NPN-, 2-wire-sensors, contacts, voltage

• Selectable function: over- or underfrequency

• Selectable signal monitoring at overfrequency mode

• 10-fold selectable ranges: 1 ... 120.000 IPM

• Response value infinitely adjustable 1:4

• Hysteresis: adjustable from 0.5...50 %

• Start up time delay /

signal monitoring time: adjustable from 0 ... 50 s

• Response delay: settable with external resistor to 0...100 s

• Alarm storing or auto-reset selectable

• Auxiliary voltage  $U_H$ : AC 230 V + DC 24 V

• Closed circuit operation

• Output: 2 changeover contacts

• Width: 22.5 mm

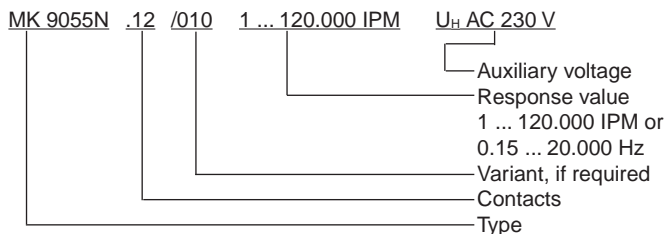
### Standard Type

- MK 9055N.12 0,15 ... 20.000 Hz  $U_H$  AC 230 V  
 Article number: 0058716
- Universal input for PNP-, NPN-, 2-wire-sensors, contacts, voltage
  - Selectable function: over- or underfrequency
  - Selectable signal monitoring at overfrequency mode
  - 10-fold selectable ranges: 0,15 ... 20.000 Hz
  - Response value infinitely adjustable 1:4
  - Hysteresis: adjustable from 0.5...50 %
  - Start up time delay / signal monitoring time: adjustable from 0 ... 50 s
  - Response delay: settable with external resistor to 0...100 s
  - Alarm storing or auto-reset selectable
  - Auxiliary voltage  $U_H$ : AC 230 V + DC 24 V
  - Closed circuit operation
  - Output: 2 changeover contacts
  - Width: 22.5 mm

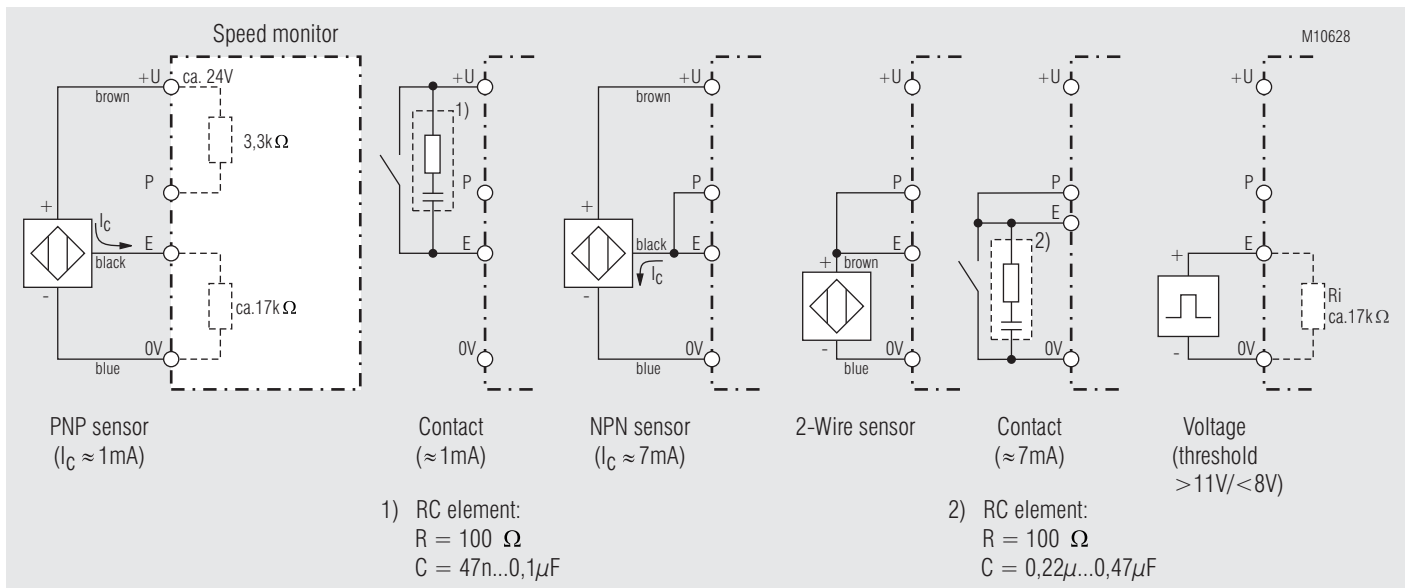
### Variants

- M\_ 9055\_ .12/0\_
- 0 Standard
  - 5 Analogue output 0 ... 10 V (instead of terminal X3)
  - 6 Analogue output 0 ... 20 mA (instead of terminal X3)
  - 7 Analogue output 4 ... 20 mA (instead of terminal X3)
  - 0 Universal input (standard)
  - 1 NAMUR input with sensor monitoring

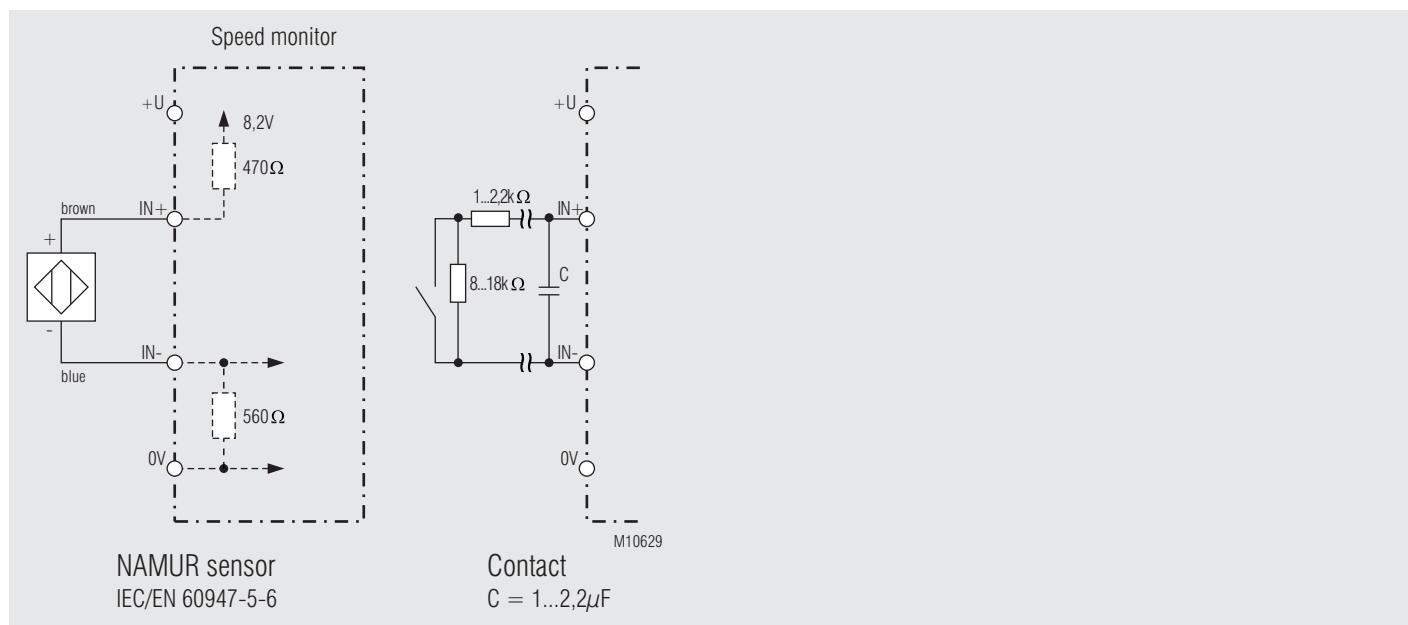
### Ordering example for variants



### Application Examples



### Universal input



NAMUR input only at M\_ 9055.12/01\_



## VARIMETER

### Level Sensing Relay

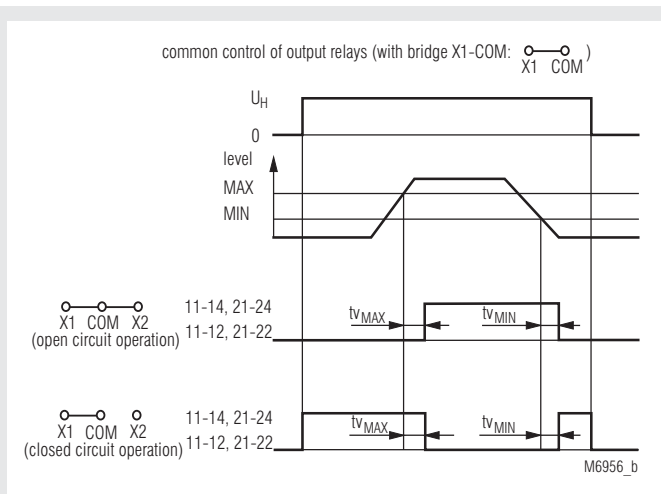
IL 9151, SL 9151, MK 9151N



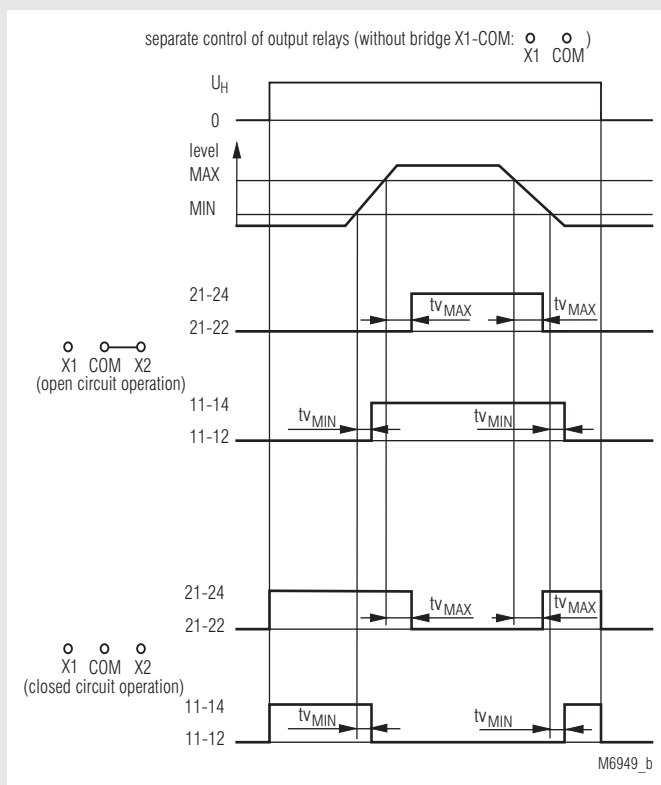
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- According to IEC/EN 60 255-1
- 3 probe connections for 2-point and 1-point level control
- Also for use as moisture detector
- High interference resistance of the Measuring Circuit, which is isolated from the mains
- Max. wire length to the probes: 1500 m
- Large setting range: 2 ... 450 kΩ  
this permits differentiation between fluid and foam
- Separately adjustable response and release time delay 0.2 ... 20 s for MIN- and MAX-level
- Programmable for:
  - 2 separate controllable output relays for MIN and MAX level
  - common controlled output relays for 2-point hysteresis level control
  - open circuit operation
  - closed circuit operation
- Measuring Circuit for probes works with internally generated AC voltage (approx. 30 Hz), electrolytic behaviour does not occur in the liquid
- For auxiliary voltages of 24 ... 415 V AC or 24 V DC
- LEDs for operation and state of contact
- 2 changeover relays with 1 changeover contact each
- IL 9151 and SL 9151 with safe separation according to IEC/EN 61 140, IEC/EN 60 947-1
- Devices available in 3 enclosure versions:
  - IL 9151: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9151, MK 9151N: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- IL/SL 9151: 35 mm width
- MK 9151N: 22.5 mm width

### Function Diagrams



common control of output relays



separate control of output relay

### Approvals and Markings



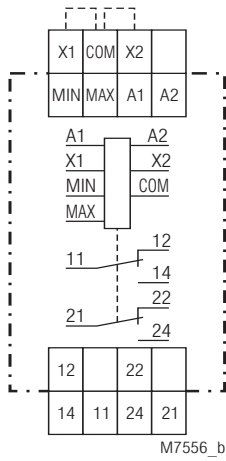
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<sup>1)</sup> only IL 9151, MK 9151N

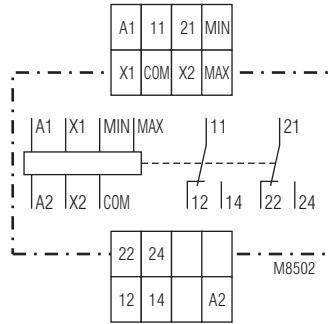
### Application

- Level monitoring and control for conductive liquids and powders, e.g. maximum and minimum filling levels, overfilling and protection against dry running
- Monitoring and control of the mixing ratio of conductive liquids
- General resistance monitoring tasks, e.g. limit temperature detection with PTC
- Contact protection relay with time delay

## Circuit Diagrams



IL 9151.12, SL 9151.12



MK 9151N.12

## Connection Terminals

Terminal designation	Signal designation
A1, A2	Auxiliary voltage AC oder DC
MIN, MAX, COM	Electrode connection
X1 - COM	Selection operating mode via bridge
X2 - COM	Selection de-energized or energized via bridge
11, 12, 14	Contacts Rel. 1
21, 22, 24	Contacts Rel. 2

## Indicators

### IL/SL 9151

green LED:	on, when auxiliary supply connected
yellow LED:	on, when relay MIN active
red LED:	on, when relay MAX active

### MK 9151N

green LED:	on, when auxiliary supply connected
yellow LED "MIN":	on, when relay MIN active
red LED "MAX":	on, when relay MAX active

## Notes

All commercially available probes are suitable. The reference probe for level measurement is generally located at the lowest point of the container and must always be connected to the "COM" terminal. The container itself can be used as a reference probe if it consists of conductive material.

On the level "MIN" and "MAX" the other probes are installed and connected to the corresponding inputs of IL 9151. It is also possible to connect only one probe.

### 2-point level control

The 2-point control is selected when a liquid should be kept between "MIN" and "MAX" level. 2 operation modes can be selected:

without bridge X1 - COM:	separate control of output relays for "MIN" and "MAX" level
with bridge X1 - COM:	common control of both output relays

When the relays are separately controlled each output relay is operated by the corresponding probe circuit. For each level the time delay can be set separately ( $t_{v_{MIN}}$  and  $t_{v_{MAX}}$ ).

When the relays are controlled together, these work like a relay with 2 changeover contacts as follows:

If the liquid rises above the "MAX" level the output relays switch over after the delay time of  $t_{v_{MAX}}$  and start e.g. a pump to sink the liquid. If the level goes under the "MAX" level the output relays remain activated until the "MIN" level is reached. Now the output relays switch back after the time delay of  $t_{v_{MIN}}$  and stop the pump. The whole process starts again when the level reaches the "MAX" probe.

## Notes

### 1-point level control

1-point level control (see Figure) is especially suitable for protection against overfilling and dry running on containers with a free inlet/outlet. In this configuration, all that is required besides the reference probe "COM" is the "MAX", which must be located at the desired limit level. The output relay switches over after the set delay time if the fluid level exceeds or falls below the limit level, which permits fluid to be pumped out or added.

Without bridge X1 - COM only relay "MAX" (contacts 21-22-24) switch, with bridge X1 - COM both relays switch together. If for each output relay a separate time delay is necessary, the unit has to be set to separate control of the outputs and the "MIN" and "MAX" inputs are connected to the same probe. Please note that the resistance of the liquid is divided up on both input circuits. Therefore the response value must be set to the double value.

If separate output control is selected with 1-point control for each output relay the time delay can be set separately.

Because of the settable time delay of 0.2 to 20 sec for each probe circuit, it is possible to suppress early switching caused by waves on the liquid. Also time depending level control can be realised. The delay works integrating and is active when the liquid goes over as well as under the probe level.

The wide setting range allows easily an optimum setting so that the unit can differentiate between foam and liquid. The response value must be set to a value high enough, that the unit reacts when the liquid, but not when the foam reaches the probe (for setting procedure the time delay is set to min. value).

## Technical Data

### Input

**Setting range of the fluid resistance:** 2 ... 450 kΩ (response value)  
**Setting:** on logarithmically divided absolute scale  
**Switching point hysteresis:** approx. 4 % (at 450 kΩ)  
 ... 15 % (at 2 kΩ) of the set value

**Voltage and temperature influence:** < 2 % of the set value

**Max. cable length to the probes:**

Set value	Cable length (at 100 nF/km)
450 kΩ	50 m
100 kΩ	200 m
35 kΩ	500 m
10 kΩ	1500 m
5 kΩ	3000 m

**Max. sensing voltage:** approx. AC 10 V  
(internally generated)

**Max. sensing current:** approx. AC 1.5 mA  
(internally generated)

**Response and release times**  
 $t_{V_{MIN}}$ ,  $t_{V_{MAX}}$ : 0.2 ... 20 s for both output relays  
 separate settable  
 Setting on logarithmically-divided  
 absolute scale

### Auxiliary Circuit

**Auxiliary voltage  $U_H$ :** AC 24, 42, 110, 230 V  
 DC 24 V

**Voltage range of  $U_H$**   
 AC: 0.8 ... 1.1  $U_N$   
 DC: 0.85 ... 1.25  $U_N$

**Nominal power consumption**  
 AC: approx. 2 VA  
 DC: approx. 1 W

**Frequency range:** 45 ... 400 Hz

### Output

#### Contacts

IL/SL 9151.12, MK 9151N.12: 2 x 1 changeover contact

**Thermal current  $I_{th}$ :** 4 A

#### Switching capacity

IL/SL 9151:

to AC 15

NO contact: 5 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 2 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1

MK 9151N:

to AC 15

NO contact: 3 A / AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A / AC 230 V IEC/EN 60 947-5-1

to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1

#### Electrical life

IL/SL 9151: IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: 2 x 10<sup>5</sup> switching cycles

MK 9151N: IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: 1.5 x 10<sup>5</sup> switching cycles

#### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** ≥ 30 x 10<sup>6</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation

#### Temperature range:

Operation: - 20 ... + 60°C

Storage: - 25 ... + 70°C

**Altitude:** < 2.000 m

#### Clearance and creepage distances

rated impulse voltage /

pollution degree

IEC 60 664-1

IL/SL 9151:

input / Auxiliary Circuit: 6 kV / 2 (at  $U_H$  = DC 24 V: 1 kV)

input / output circuit: 6 kV / 2

MK 9151N:

input / Auxiliary Circuit: 4 kV / 2 (at  $U_H$  = DC 24 V: 1 kV)

input / output circuit: 4 kV / 2

auxiliary / output circuit

A1-A2 (AC): 4 kV / 2

#### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

1 GHz ... 2.7 GHz: 3 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

HF wire guided: 10 V IEC/EN 61 000-4-6

Interference suppression: Limit value class B EN 55 011

#### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour

according to UL subject 94

Amplitude 0.35 mm,

frequency 10 ... 55 Hz, IEC/EN 60 068-2-6

20 / 060 / 04 IEC/EN 60 068-1

EN 50 005

#### Climate resistance:

#### Terminal designation:

#### Wire connection:

IL/SL 9151: 2 x 2.5 mm<sup>2</sup> solid or  
 2 x 1.5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

0,6 mm

10 mm

1 x 4 mm<sup>2</sup> solid or

1 x 2.5 mm<sup>2</sup> stranded ferruled or

2 x 1.5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

0.5 mm<sup>2</sup>

8 mm

Min. cross section:

Abisolierlänge der Leiter:

#### Wire fixing:

IL/SL 9151: Flat terminals with self-lifting

clamping piece IEC/EN 60 999-1

Box terminal with wire protection

0.8 Nm

DIN rail IEC/EN 60 715

**Weight**

IL 9151: approx. 165 g

SL 9151: approx. 192 g

MK 9151N: approx. 180 g

### Dimensions

#### Width x height x depth

IL 9151: 35 x 90 x 59 mm

SL 9151: 35 x 90 x 98 mm

MK 9151N: 22.5 x 90 x 98 mm

### CCC-Data

#### Nominal voltage $U_N$ :

MK 9151N: AC 24, 42, 110, 230 V

DC 24 V

#### Switching capacity

to AC 15

NO contact: 1.5 A / AC 230 V IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Standard Type

IL 9151.12 2 ... 450 kΩ AC 230 V 0.2 ... 20 s

- Article number: 0049135
- Settable response value: 2 ... 450 kΩ
  - Auxiliary voltage  $U_H$ : AC 230 V
  - Response and release delay: 0.2 ... 20 s
  - 2 output relays with 1 changeover contact each
  - With safe separation
  - Width: 35 mm

SL 9151.12 2 ... 450 kΩ AC 230 V 0.2 ... 20 s

- Article number: 0051552
- Settable response value: 2 ... 450 kΩ
  - Auxiliary voltage  $U_H$ : AC 230 V
  - Response and release delay: 0.2 ... 20 s
  - 2 output relays with 1 changeover contact each
  - With safe separation
  - Width: 35 mm

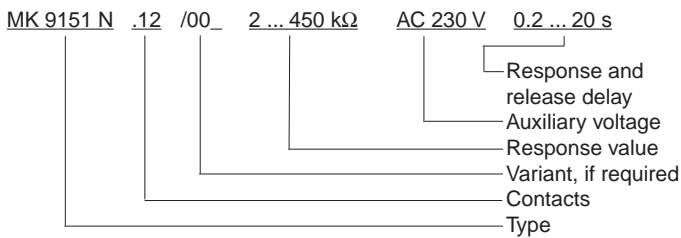
MK 9151N.12 2 ... 450 kΩ AC 230 V 0.2 ... 20 s

- Article number: 0054100
- Settable response value: 2 ... 450 kΩ
  - Auxiliary voltage  $U_H$ : AC 230 V
  - Response and release delay: 0.2 ... 20 s
  - 2 output relays with 1 changeover contact each
  - Width: 22.5 mm

## Variants

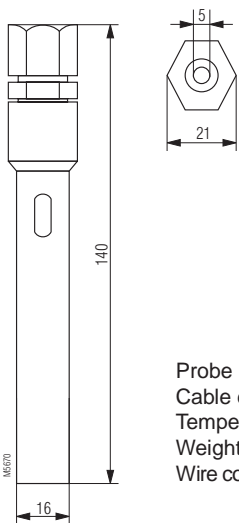
- MK 9151N.12/001: time delay, when level drops under setting value
- MK 9151N.12/002: time delay, when level rises over setting value

## Ordering example for variants



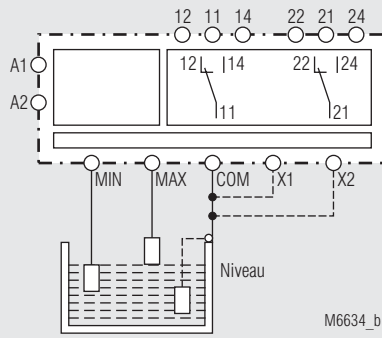
## Accessories

- OA 5640: Standard probe  
Article number: 0016045

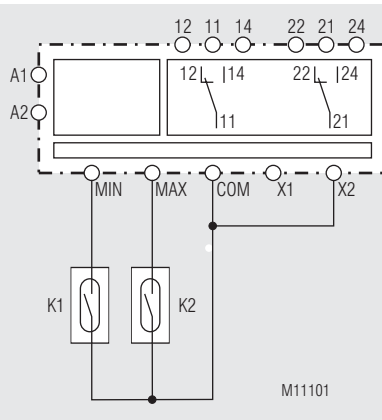


Probe made of stainless steel,  
Cable entry PG 9,  
Temperature range 0 ... +60°C,  
Weight approx. 0.1 kg  
Wire connection 2.5 mm<sup>2</sup> stranded wire with sleeve

## Application Example



IL 9151, SL 9151 with safe separation according to IEC/EN 61 140, IEC/EN 60 947-1



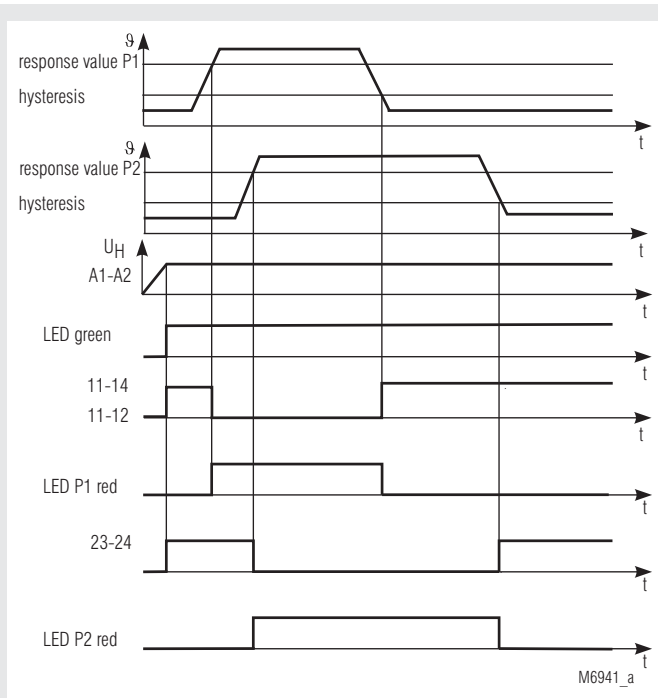
Application as contact protection relay, e.g. for two reed contact switches (K1, K2).

## VARIMETER Temperature Monitoring Relay BA 9094

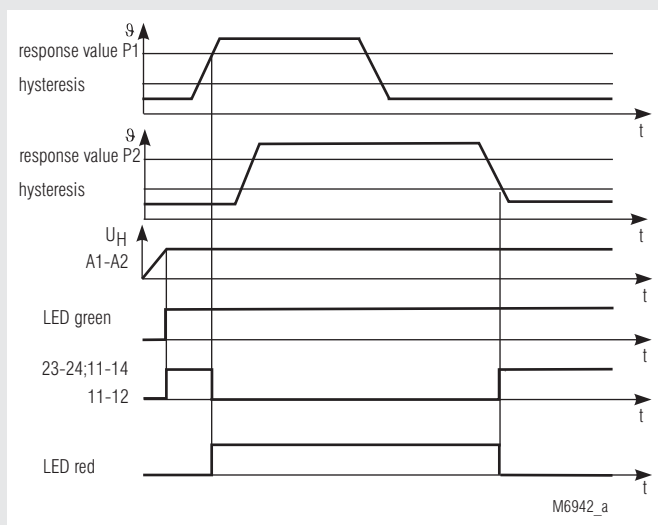


- According to IEC/EN 60 255, VDE 0435
- 2 PT 100 inputs with separate outputs or alternatively common output
- Optionally 1 PT 100 input with 2 separate outputs for 2 different response values
- Separate adjustable response and release values for each input
- Optionally with fixed response and release values
- Broken wire detection in sensor circuit
- Closed circuit operation
- 2 wire connection
- Width 45 mm

### Function Diagrams



BA 9094.28, BA 9094.28/100



BA 9094.20

### Approvals and Markings



### Applications

Monitoring of temperature e.g. Motors, ball bearings, etc.

### Function

On overtemperature and broken wire the output relay deenergises

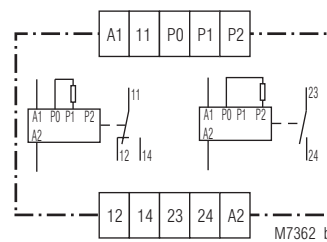
### Indicator

green LED: on, when auxiliary supply connected  
red LED P1, P2: on, when overtemperature

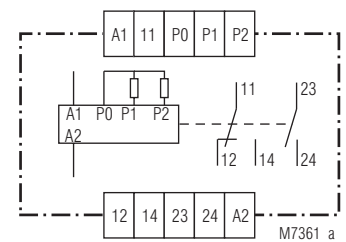
### Notes

An input which is not used must be bridged

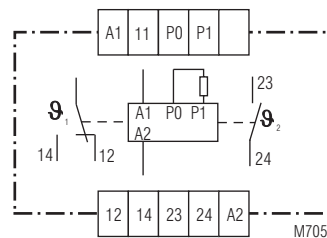
### Circuit Diagrams



BA 9094.28



BA 9094.20



BA 9094.28/100

## Technical Data

### Input

<b>Inputs:</b>	2 PT 100 inputs
<b>Setting range response value:</b>	20°C ... 100°C other ranges on request
<b>Hysteresis:</b>	85 % ... 95 % of response value

### Auxiliary Circuit

<b>Auxiliary voltage U<sub>H</sub>:</b>	AC 24, 42, 110, 127, 230 V DC 24 V
<b>Voltage range:</b>	0,8 ... 1,1 U <sub>H</sub>
<b>Nominal consumption:</b>	3,4 VA
<b>Nominal frequency:</b>	50/60 Hz

### Output

<b>Contacts:</b>	
BA 9094.28:	1 changeover contact for P1 1 NO contact for P2
BA 9094.20:	1 changeover, 1 NO contact for P1, P2
<b>Thermal current I<sub>th</sub> :</b>	6 A
<b>Switching capacity to AC15:</b>	
BA 9094.28:	5 A / AC 230 V IEC/EN 60 947-5-1
BA 9094.20:	1 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	IEC/EN 60 947-5-1
BA 9094.28:	
to AC 15 at 5 A, AC 230 V:	> 0,1 x 10 <sup>6</sup> switching cycles
BA 9094.20:	
to AC 15 at 1 A, AC 230 V:	> 0,1 x 10 <sup>6</sup> switching cycles
<b>Short-circuit strength max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	> 30 x 10 <sup>6</sup> switching cycles

### General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60 °C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppressions:	Limit value class B EN 55 011
<b>Degree of protection:</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0,35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2,5 mm <sup>2</sup> solid or 2 x 1,5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	320 g

### Dimensions

<b>Width x height x depth:</b>	45 x 74 x 132 mm
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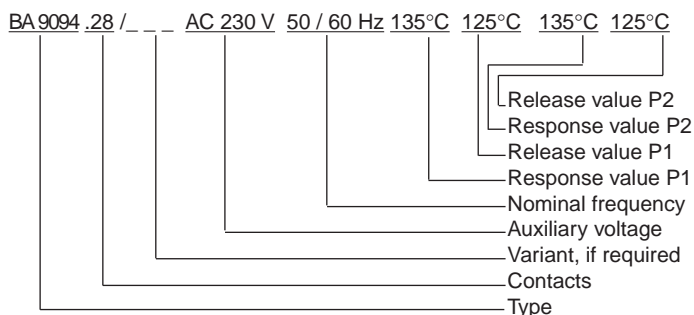
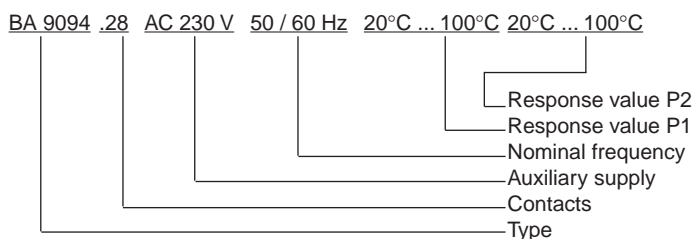
## Standard Type

BA 9094.28 AC 230 V 50/60 Hz 2 x 20 ... 100°C	
Article number:	0048194 stock item
• Output:	1 changeover contact for P1 1 NO contact for P2
• Nominal voltage U <sub>N</sub> :	AC 230 V
• Response value:	2 x 20 ... 100°C
• Width:	45 mm

## Variants

BA 9094. __ _ /001:	with fixed response and release value <b>Response value:</b> 135°C ± 2°C other values on request <b>Release value:</b> 125°C ± 2°C other values on request
BA 9094.28/100:	only 1 PT 100 input with 2 separate outputs for 2 different response values

## Ordering example for variants



## VARIMETER

### Temperature Monitoring Relay

IK 9094, IL 9094, SK 9094, SL 9094

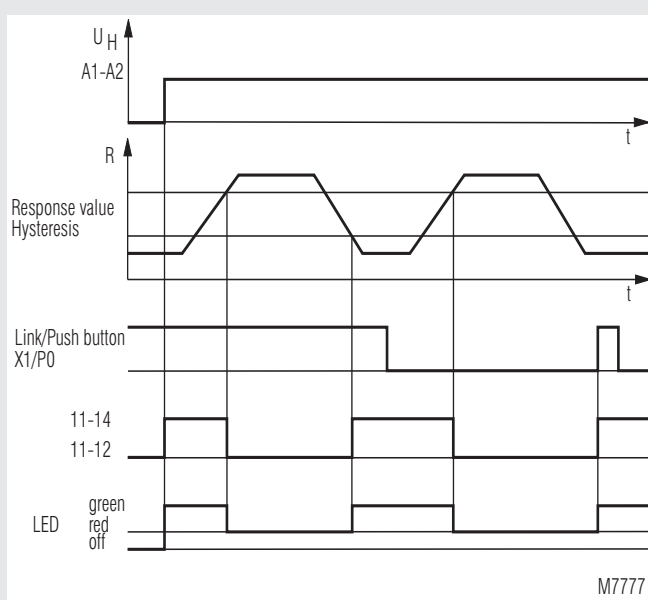


- According to IEC/EN 60 255-1
- 1 PT100 input, 2-wire connection
- 3 temperature ranges
- Adjustable response value
- Adjustable Hysteresis with wide range 3 ... 30 °C or 1 ... 15°C
- Broken wire detection in sensor circuit
- Programmable hysteresis or latching function via terminal X1
- IK 9094 no galvanic separation between measuring and Auxiliary Circuit
- Closed circuit operation
- LED indicator for operation and state of output relay
- 1 changeover contact
- As option with response value up to - 50°C, e.g. for refrigeration plants
- As option with galvanic separation between measuring and Auxiliary Circuit
- Devices available in 2 enclosure versions:
  - I-model: depth 59 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - S-model: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- DIN rail or screw mounting
- IK 9094, SK 9094: 17.5 mm width
- IL 9094, SL 9094: 35 mm width

#### Approvals and Markings



#### Function Diagram



#### Applications

- Monitoring of temperature e.g. Motors, ball bearings, rooms, refrigeration plants, etc.
- Temperature control
- Monitoring of humidity, see relay workshop no. 19
- For industrial and railway applications

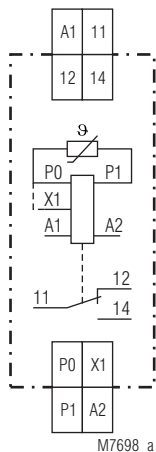
#### Function

On terminals P0 - P1 the resistance of the PT 100 is measured. On overtemperature and broken wire the output relay deenergises

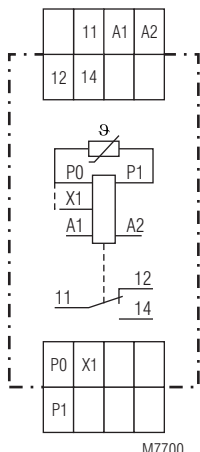
#### Indicators

LED: green, when auxiliary supply connected  
 LED: red, when overtemperature

## Circuit Diagrams



IK 9094.11, SK 9094.11



IL 9094.11, SL 9094.11

## Connection Terminal

Terminal designation	Signal designation
A1, A2	Auxiliary voltage
P0, P1	Connection for resistance thermometer PT100
X1, P0	Control input (manual reset / hysteresis function) X1/P0 nicht gebrückt: manual reset X1/P0 gebrückt: Hysteresis function
11, 12, 14	Changeover contact

## Notes

Setting  
Easy to set the temperature in °C:  
Response value: Upper switch sets range (3 positions)  
+ Middle potentiometer sets response value in °C

Release value: Lower potentiometer sets Hysteresis in °C

To operate the unit as temperature controller it has to be set to hysteresis function and to a small hysteresis (e.g. 3 °C).

With link X1-P0: Hysteresis function  
Without link X1-P0: Latching function (the relay stays in off position even if the temperature is correct again.

The latching can be reset by bridging X1-P0 for a short time (Push button) or by disconnecting the auxiliary supply.

The IK/SK 9094 is designed to operate 2 wire PT 100 sensors. Therefore the setting must be corrected when using longer wires with about 2.6 °C per Ω of the connection wires (e.g. 2 pole cable 2 x 1.5 mm<sup>2</sup> of 40 m length has about 1Ω).

A temperature sensor with insulation must be used (AC 300 V).

## Technical Data

### Input

**Inputs :** P0 and P1 for PT100 sensors according to DIN 43 760 / DIN IEC 751  
X1 to set hysteresis or latching function:  
hysteresis function  
latching function (Fault signal remains stored when temperature goes over set point)

- with bridge X1-P0:  
- without bridge X1-P0:

### Setting range of response value:

0 ... 150°C in 3 ranges  
( 0 ... 50°C, 50 ... 100°C, 100 ... 150°C)  
(on request 100 ... 250°C in 3 ranges of 50°C)  
IL/SL 9094.11/010:  
- 50 ... +25°C in 3 ranges  
(- 50 ... -25°C, -25 ... 0°C, 0 ... +25°C)

### Release value:

IL/SL 9094.11/010:  
Adjustable hysteresis on absolute scale 3 ... 30°C,  
Hysteresis 1 ... 15°C adjustable  
(Release value = response value minus hysteresis)

### Voltage and temperature influence:

< 1 % of setting value  
**Measuring current:** approx. 2.5 mA  
**Dissipation of PT 100:** approx 0.6 mW

### Voltage on open terminals

#### P0-P1:

#### Broken wire detection:

approx. 6 V  
A broken wire in the PT 100 sensor wires is detected as fault (over-temperatur)

## Auxiliary Circuit (A1-A2)

### Auxiliary voltage U<sub>H</sub>

IK/SK 9094: AC/DC 24 V  
IL/SL 9094: AC 230 V ( galvanic separation to measuring circuit)

### Voltage range

at AC: 0.8 ... 1.1 U<sub>N</sub>  
at DC: 0.9 ... 1.25 U<sub>N</sub>

### Nominal consumption

IK/SK 9094.11  
at AC: approx. 1 VA  
at DC: approx. 0.6 W

### IK/SK 9094.11/001

at AC: approx. 1.2 VA  
at DC: approx. 0.7 W  
IL/SL 9094.11: approx. 2 VA

### Nominal frequency (AC):

50/60 Hz

### Galvanic isolation between measuring and auxiliary inputs

IK/SK 9094.11/001 DC 1000 V  
IL/SL 9094.11: 4 kV / 2

## Output

### Contacts

IK/SK 9094.11, IL/SL 9094.11: 1 changeover contact

**Thermal current I<sub>th</sub> :** 4 A

### Switching capacity

to AC 15

NO contact: 3 A, AC 230 V IEC/EN 60 947-5-1

NC contact: 1 A, AC 230 V IEC/EN 60 947-5-1

to DC 13 at 0.1 Hz: 1 A / DC 24 V IEC/EN 60 947-5-1

**Electrical life** IEC/EN 60 947-5-1

to AC 15 at 1 A, AC 230 V: ≥ 3 x 10<sup>5</sup> Switching cycles

### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** ≥ 30 x 10<sup>6</sup> Switching cycles



**Technical Data****General Data**

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range</b>		
Operation:	- 20 ... + 60 °C	
Storage:	- 25 ... + 60 °C	
<b>Relative air humidity:</b>	max. 95 %	
<b>Altitude:</b>	< 2,000 m	
<b>Clearance and creepage distances</b>		
rated impulse voltage / pollution degree		
IK/SK 9094.11:		
Between A1-A2 auxiliary supply:	0.5 kV / 2	IEC 60 664-1
IK/SK 9094.11/001:		
Between measuring input P0-P1 (-X1) and auxiliary supply:	1 kV / 2	IEC 60 664-1
IL/SL 9094.11:	4 kV / 2	IEC 60 664-1
Between input and output contacts:	4 kV / 2 (basis insulation)	IEC 60 664-1
Airgap:	≥ 3 mm	
Creepage distance on PCB:	≥ 3 mm,	
Inside enclosure:	≥ 5.5 mm	
Outside enclosure:	≥ 5.5 mm	
Overvoltage category:	III	
<b>EMC</b>		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF-irradiation		
80 MHz ... 1 GHz:	10 V / m	IEC/EN 61 000-4-3
1 GHz ... 2 GHz:	10 V / m	IEC/EN 61 000-4-3
2 GHz ... 2.7 GHz:	10 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply		
IK/SK 9094:	0.5 kV	IEC/EN 61 000-4-5
IL/SL 9094:	2 kV	IEC/EN 61 000-4-5
HF wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
<b>Degree of protection</b>		
Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz IEC/EN 60 068-2-6	
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1	
<b>Terminal designation:</b>	EN 50 005	
<b>Wire connection:</b>		
Cross section:	2 x 2.5 mm <sup>2</sup> solid 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4	
Stripping length:	10 mm	
<b>Wire connection:</b>	Flat terminals with self-lifting clamping piece IEC/EN 60 999-1	
<b>Fixing torque:</b>	0.8 Nm	
<b>Mounting:</b>	DIN rail mounting (IEC/EN 60715) or screw mounting M4, 90 mm hole pattern, with additional clip available as accessory	
<b>Weight</b>		
IK 9094:	65 g	
SK 9094:	83 g	
IL 9094:	137 g	
SL 9094:	164 g	

**Dimensions****Width x height x depth**

IK 9094:	17.5 x 90 x 59 mm
SK 9094:	17.5 x 90 x 98 mm
IL 9094:	35 x 90 x 59 mm
SL 9094:	35 x 90 x 98 mm

**Classification to DIN EN 50155 for IK 9094****Vibration and**

<b>shock resistance:</b>	Category 1, Class B	IEC/EN 61 373
Ambient temperature:	T1 compliant	
	T2, T3 and TX with operational limitations	

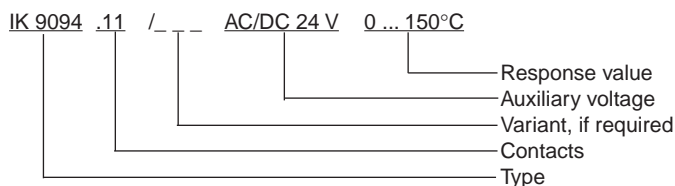
**Protective coating of the PCB:** No**Standard Types**

IK 9094.11 AC/DC 24 V 0 ... 150°C	
Article number:	0051642
SK 9094.11 AC/DC 24 V 0 ... 150°C	
Article number:	0054753
• Output:	1 changeover contact
• Auxiliary voltage U <sub>H</sub> :	AC/DC 24 V
• Response value:	0 ... 150°C
• Width:	17.5 mm

IL 9094.11 AC 230 V 0 ... 150°C	
Article number:	0056024
SL 9094.11 AC 230 V 0 ... 150°C	
Article number:	0056100
• Output:	1 changeover contact
• Auxiliary voltage U <sub>H</sub> :	AC 230 V
• Response value:	0 ... 150°C
• Width:	35 mm

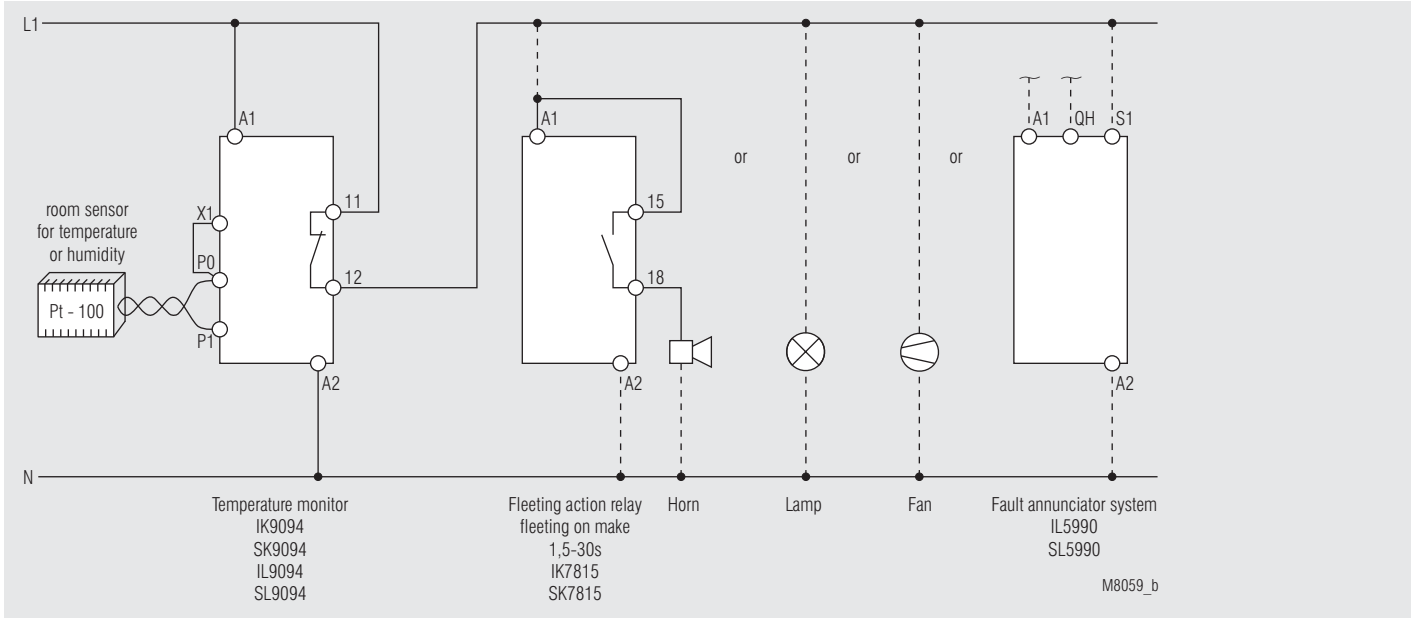
**Variants**

IK 9094.11 /001:	with galvanic isolation between measuring and Auxiliary Circuit
IL 9094.11/010:	for refrigeration plants Art.-no.: 0056080

**Ordering example for variants****Accessories**

ET 4086-0-2:	Additional clip for screw mounting Article number: 0046578
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# Application Examples



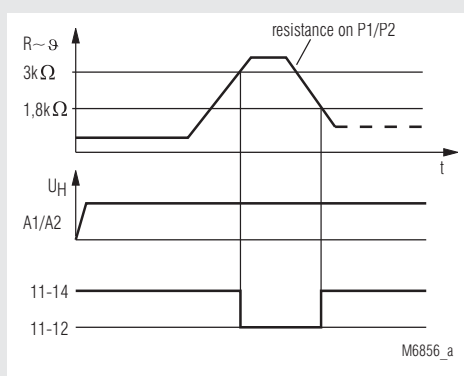
## VARIMETER

Thermistor Motor Protection Relay  
BA 9038, AI 938

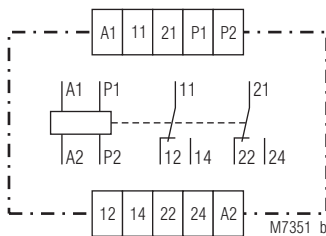


- According to DIN VDE 0660 part 302 (pr EN 60 947-8) and part 303
- 1 input for PTC-resistors or bimetal contacts
- Broken wire detection in sensor circuit
- Optionally with no voltage reclosing interlock
- Closed circuit operation
- 1 or 2 changeover contacts
- Width 45 mm

### Function Diagram



### Circuit Diagram



BA 9038.12, AI 938.002,

### Approvals and Markings



### Applications

To protect against thermal overload of motors caused by high switching frequency, heavy duty starting, phase failure on one phase, bad cooling, high ambient temperature.

### Function

As sensors special PTC-resistors are use, which are normally built into the motor windings. Up to 6 PTC resistors can be connected in series. When the resistance reaches a certain value, the output relay deenergizes. An LED comes on. The thermistor motor protection relay works with closed circuit operation and also detects broken wire on the sensor circuit. Please note, that contact 11-12 and 21-22 may be closed for a short moment while the voltage is switched on.

The models AI 938.001/03 and BA 9038.11/003 include a thermal reclosing interlock. When the response temperature is reached the output relay deenergizes and the push button on the relay front comes out after approx. 1 s. This unit has no indicator LED.

The model BA 9038.\_\_/100 includes an electromagnetic reclosing interlock. When the response temperature is reached the output relay deenergizes and the push button on the relay front comes out immediately. This model has 2 LEDs. One indicates connected auxiliary supply, the other one overtemperature.

The output relay of the units with reclosing interlock remains deenergized, also when the temperature goes back to normal. The interlock is no voltage safe, so also on loss of voltage its actual state is stored (VDE 0113 § 5.4.2). By pressing the button on the front the module can be reset again.

### Notes

The wires of the sensor circuit must not be influenced by other voltages therefore they should be routed separately or screened and earthed at one end only. The total resistance of the wiring should not exceed 100 Ω.

## Technical Data

### Input Circuit

<b>Response value:</b>	≥ 3 kΩ
<b>Release value:</b>	≤ 1.8 kΩ
<b>Number of sensors:</b>	1 ... 6 pcs
<b>Operate delay:</b>	≤ 20 ms
<b>Release delay:</b>	≤ 15 ms

### Auxiliary Circuit

<b>Auxiliary voltage <math>U_H</math>:</b>	AC 24, 42, 110, 127, 230, 240 V
<b>Voltage range of <math>U_H</math>:</b>	0.8 ... 1.1 $U_N$
<b>Nominal consumption:</b>	2.2 VA
<b>Nominal frequency of <math>U_H</math>:</b>	50 / 60 Hz

### Output

#### Contacts

BA 9038.11:	1 changeover contact
AI 938.001:	1 changeover contact
BA 9038.12:	2 changeover contacts
AI 938.002:	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>	5 A

#### Switching capacity

to AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life</b>		IEC/EN 60 947-5-1

to AC 15 at 3 A, AC 230 V

2 changeover contacts: 0.5 x 10<sup>5</sup> switching cycles

1 changeover contact: 2.5 x 10<sup>5</sup> switching cycles

at 0.05 A:

2 changeover contacts: 10 x 10<sup>6</sup> switching cycles

1 changeover contact: 30 x 10<sup>6</sup> switching cycles

#### Short-circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** > 30 x 10<sup>6</sup> switching cycles

## General Data

**Operating mode:** Continuous operation

**Temperature range:** - 20 ... + 60°C

#### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

#### EMC

Electrostatic discharge: 6 kV (air) IEC/EN 61 000-4-2

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wired and ground: 2 kV IEC/EN 61 000-4-5

Interference suppressions: Limit value class B EN 55 011

#### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm, IEC/EN 60 068-2-6 frequency 10 ... 55 Hz

**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4

**Wire fixing:** Flat terminals with self-lifting clamping piece IEC/EN 60 999-1

#### Screw fixing:

AI 938: 35 x 50 mm and

35 x 60 mm

**Mounting:** DIN rail IEC/EN 60 715

#### Weight:

BA 9038: 250 g

AI 938: 240 g

## Dimensions

#### Width x height x depth:

BA 9038: 45 x 74 x 124 mm

AI 938: 45 x 77 x 127 mm

## Standard Types

BA 9038.11/003 AC 230 V 50 / 60 Hz

Article number: 0028829

• Output: 1 changeover contact

• Auxiliary voltage  $U_H$ : AC 230 V

• with thermal reclosing interlock (manual reset)

• Width: 45 mm

## Variants

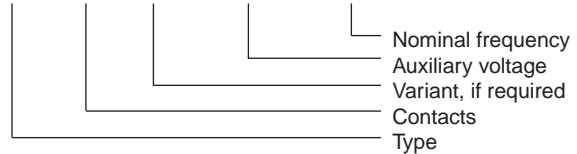
BA 9038.11: without thermal reclosing interlock (manual reset function)

BA 9038. \_\_ /100: with electro magnetic reclosing interlock (manual reset function)

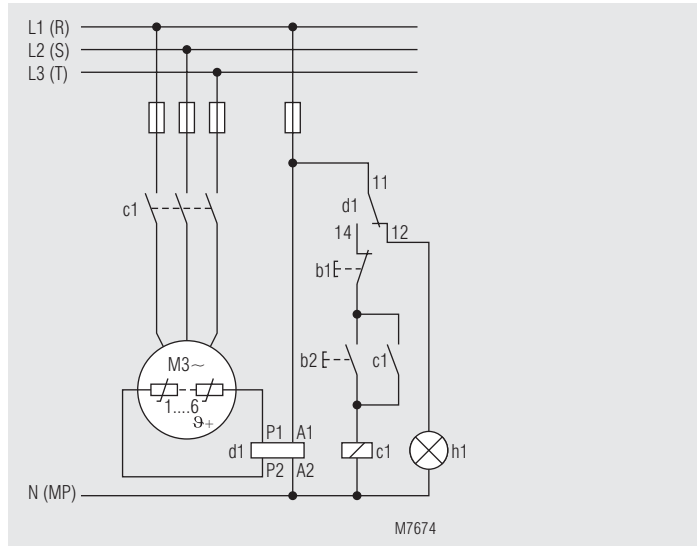
AI 938.001: without thermal reclosing interlock (manual reset function)

## Ordering example for variants

BA 9038 . . . / . . . AC 230 V 50/60 Hz



## Application Example

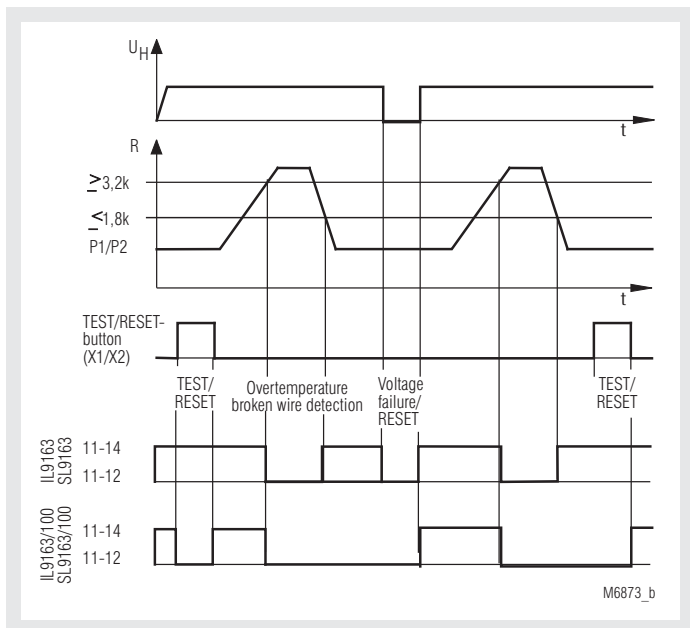


## VARIMETER Thermistor Motor Protection Relay IL 9163, SL 9163



- According to IEC/EN 60 255-1
- Monitoring of:
  - overtemperature
  - broken wire detection in sensor circuit
- 1 input for 1 to 6 PTC-resistors
- With manual reset variant /100
- Optionally with button for reset and test function
- Remote reset on A1/A2 (NC contact) or X1/X2 (NO contact)
- Closed circuit operation
- LED indicator for
  - auxiliary supply
  - state of contact
- 2 changover contacts
- Devices available in 2 enclosure versions:
  - IL 9163: depth 58 mm, with terminals at the bottom for installation systems and industrial distribution systems according to DIN 43 880
  - SL 9163: depth 98 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

### Function Diagram



### Approvals and Markings



### Applications

To protect against thermal overload of motors caused by high switching frequency, heavy duty starting, phase failure on one phase, bad cooling, high ambient temperature.

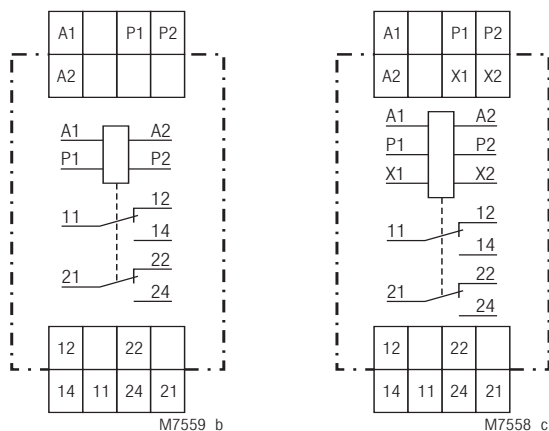
### Function

If one of the sensors in the Measuring Circuit reaches the response temperature (or broken wire is detected), the device indicates failure. This failure is stored in the device /100 even if the temperature goes back to normal. The unit can be resetted by pressing the Test/Reset button, by bridging X1/X2 for a short moment or by disconnecting the auxiliary supply for a short time.

#### Test/Reset button:

Besides the reset function this button provides in normal operation a test facility. The unit indicates fault as long as the button is activated.

### Circuit Diagram



IL 9163.12,  
SL 9163.12

IL 9163.12/100,  
SL 9163.12/100

### Indicators

- green LED: on, when auxiliary supply connected
- red LED: on, when overtemperature or broken wire is detected

### Notes

The unit with AC/DC 24 V has no galvanic separation between auxiliary supply (A1/A2) and measuring input (P1, P2), and therefore it should only be used for battery powered systems or with safety transformers according to IEC/EN 60 742.

Technical Data	
<b>Measuring Circuit</b>	
<b>Temperature sensors:</b>	PTC-Resistor according to DIN 44081/082
<b>No. of sensors:</b>	1 ... 6 in series
<b>Response value:</b>	3.2 ... 3.8 k $\Omega$
<b>Release value:</b>	1.5 ... 1.8 k $\Omega$
<b>Loading of measuring circuit:</b>	< 5 mW (at R = 1.5 k $\Omega$ )
<b>Broken wire detection:</b>	> 3.1 k $\Omega$
<b>Measuring voltage:</b>	$\leq$ 2 V (at R = 1.5 k $\Omega$ )
<b>Measuring current:</b>	$\leq$ 1 mA (at R = 1.5 k $\Omega$ )
<b>Voltage at broken wire:</b>	DC approx. 9 V
<b>Current when short circuit on input:</b>	DC approx. 1.1 mA

Auxiliary Circuit	
<b>Auxiliary voltage <math>U_H</math>:</b>	AC/DC 24 V AC 110, 230, 400 V    50 / 60 Hz
<b>Voltage range:</b>	AC 0.9 ... 1.1 $U_H$ DC 0.9 ... 1.25 $U_H$
<b>at 10 % residual ripple:</b>	DC 0.9 ... 1.1 $U_H$
<b>at 48 % residual ripple:</b>	DC 0.9 ... 1.1 $U_H$
<b>Nominal consumption:</b>	AC: 1.5 VA DC: 0.85 W
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Frequency range:</b>	45 ... 65 Hz
<b>Max. bridging time on failure of aux. supply:</b>	approx. 70 ms
<b>Operate delay:</b>	< 40 ms
<b>Release delay:</b>	< 100 ms
<b>Control input (X1/X2)</b>	
<b>Function:</b>	Remote reset with NO contact (voltage free)
<b>Remark:</b>	This input is not galvanic separated from measuring input P1/P2

Output	
<b>Contacts</b>	
IL/SL 9163.12:	2 changeover contacts
<b>Thermal current <math>I_{th}</math>:</b>	5 A
<b>Switching capacity to AC 15</b>	
NO contact:	3 A / AC 230 V    IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V    IEC/EN 60 947-5-1
<b>Electrical life</b>	IEC/EN 60 947-5-1
to AC 15 at 1 A, AC 230 V:	$\geq 5 \times 10^5$ switching cycles
to AC 15 at 5 A, AC 230 V:	$\geq 1.5 \times 10^5$ switching cycles
<b>Short-circuit strength max. fuse rating:</b>	4 AgL    IEC/EN 60 947-5-1
<b>Mechanical life:</b>	$\geq 1 \times 10^8$ switching cycles

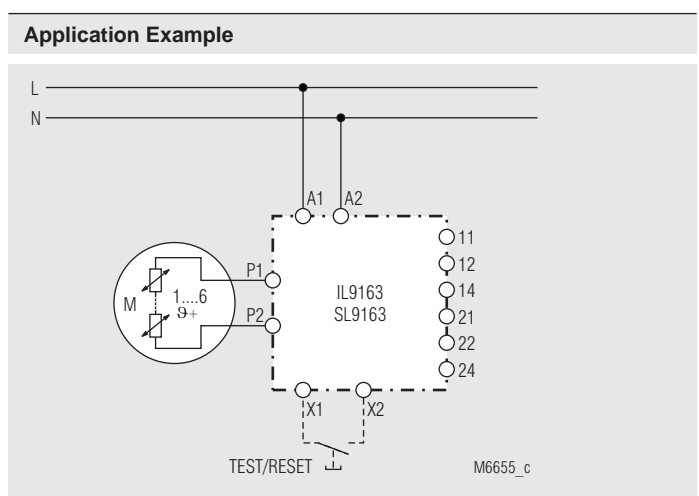
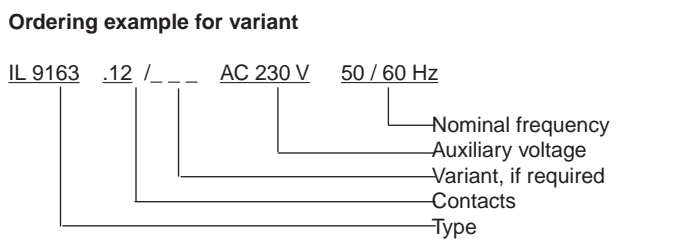
General Data	
<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated rated impulse voltage / pollution degree:	4 kV / 2    IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	8 kV (air)    IEC/EN 61 000-4-2
HF irradiation:	10 V / m    IEC/EN 61 000-4-3
Fast transients:	4 kV    IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV    IEC/EN 61 000-4-5
between wire and ground:	4 kV    IEC/EN 61 000-4-5
HF-wire guided	10 V    IEC/EN 16 000-4-6
Interference suppressions:	Limit value class B    EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40    IEC/EN 60 529
Terminals:	IP 20    IEC/EN 60 529

Technical Data	
<b>Housing:</b>	Thermoplastic with V0 behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04    IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self-lifting clamping piece    IEC/EN 60 999-1
<b>Fixing torque:</b>	0.8 Nm
<b>Mounting:</b>	DIN rail    IEC/EN 60 715
<b>Weight</b>	
IL 9163:	150 g
SL 9163:	200 g

Dimensions	
<b>Width x height x depth</b>	
IL 9163:	35 x 90 x 58 mm
SL 9163:	35 x 90 x 98 mm

Standard Type	
IL 9163.12 AC 230 V 50 / 60 Hz	
Article number:	0049222
• Auxiliary voltage $U_H$ :	AC 230 V
• Automatic reset	
• Width:	35 mm
SL 9163.12 AC 230 V 50 / 60 Hz	
Article number:	0054752
• Auxiliary voltage $U_H$ :	AC 230 V
• Automatic reset	
• Width:	35 mm

Variant	
IL 9163.12/100:	2 changeover contacts with manual reset



## VARIMETER EX Thermistor Motor Protection Relay MK 9163N, MK 9163N-ATEX



MK 9163N

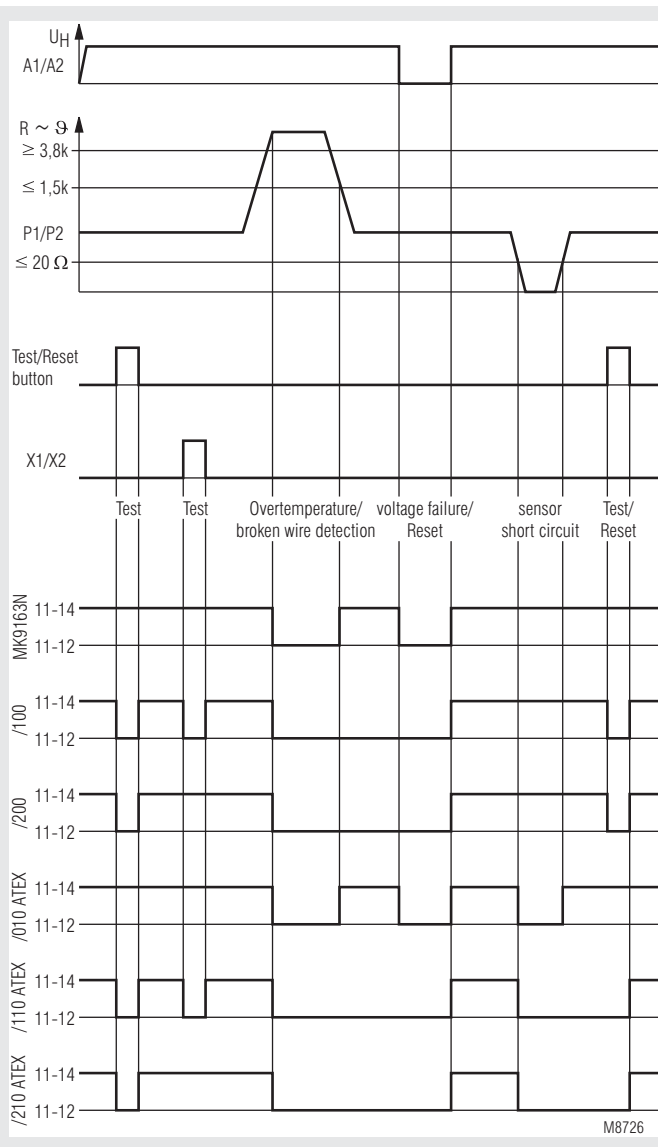
### Your advantages

- Reliable temperature monitoring of motors
- Rapid fault location

### Features

- According to DIN EN 60947-5-1, DIN EN 60947-8, DIN EN 60079-14, DIN EN 61508, DIN EN 50495, DIN EN 13849
- Monitoring of
  - overtemperature
  - broken wire detection in sensor circuit
  - short circuit detection in sensor circuit
- 1 input for 1 to 6 PTC-resistors
- De-energized on trip
- LED-indicator for
  - auxiliary supply
  - state of contact
- Output with 2 changeover contacts
- As option with manual reset, internal reset button and external remote reset X1/X2
- Wire connection: also 2 x 1.5 mm<sup>2</sup> stranded ferruled, or 2 x 2.5 mm<sup>2</sup> solid DIN 46 228-1/-2/-3/-4
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width 22.5 mm

### Function Diagram



### Approvals and Markings



<sup>1)</sup> For devices with ATEX-approval

Directive 94/9/EG

EU-Test certificate no.

03 ATEX 3117 II (2) G [Ex e] [Ex d] [Ex px] [Ex n]  
II (2) D [Ex tb] [Ex tc]

<sup>2)</sup> Approval not for all variants; on request

### Applications

- To protect against thermal overload of motors caused by high switching frequency, heavy duty starting, phase failure on one phase, bad cooling, high ambient temperature
- Temperature monitoring of bearings, transmissions, oil and cooling liquids.

### Devices with ATEX-approval:

Temperature monitoring of explosion protected Motors by „extended safety“ EX e DIN EN 60079-7, „pressure proof enclosure“ EX d DIN EN 60079-1 or „overpressure enclosure“ Ex px in gas containing atmosphere as well as „protection by enclosures“ Ex t DIN EN 60079-31 in dust containing atmosphere. The thermistor Motor protection relay protects Standard and Explosion proof Motor against overheating due to overload according to DIN EN 60079-14 and DIN EN 60079-0.

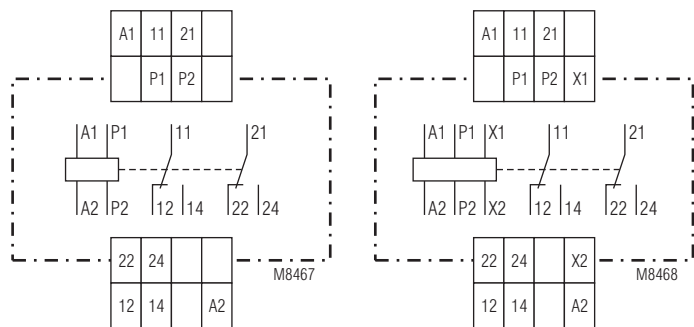
### Function

If one of the sensors in the measuring circuit reaches the response temperature (or broken wire is detected), the device indicates failure. This failure is stored in the device with manual reset, even if the temperature goes back to normal. The unit can be reset by pressing the Test/Reset button, by bridging X1/X2 for a short moment or by disconnecting the auxiliary supply for a short time.

Test/Reset button:

Besides the reset function this button provides in normal operation a test facility. The unit indicates fault as long as the button is activated (see also under "Variants").

## Circuit Diagrams



MK 9163N.12,  
MK 9163N.12/010-ATEX

MK 9163N.12/100, MK 9163N.12/200,  
MK 9163N.12/110-ATEX,  
MK 9163N.12/210-ATEX

## Indicators

green LED: on, when auxiliary supply connected  
red LED: on, when overtemperature or broken wire, short circuit is detected

## Technical Data

### Input Circuit

**Response value:** 3.2 ... 3.8 k $\Omega$   
**Release value:** 1.5 ... 1.8 k $\Omega$   
**Broken wire detection:** > 3.8 k $\Omega$   
**Short circuit on measuring circuit:** < 20  $\Omega$   
**Loading of measuring circuit:** < 5 mW (bei R = 1.5 k $\Omega$ )  
**Measuring voltage:**  $\leq$  2 V (bei R = 1.5 k $\Omega$ )

### Auxiliary Circuit

**Auxiliary voltage  $U_H$ :** AC/DC 24 V  
AC 110, 230, 400 V 50 / 60 Hz  
**Voltage range:** AC 0.8 ... 1.1  $U_H$   
at 10 % residual ripple: DC 0.9 ... 1.25  $U_H$   
at 48 % residual ripple: DC 0.8 ... 1.1  $U_H$   
**Nominal consumption:** AC: 1.5 VA  
DC: 0.85 W  
**Nominal frequency:** 50 / 60 Hz  
**Frequency range:** 45 ... 65 Hz  
**Max. bridging time on failure of aux. supply:** 20 ms  
**Operate delay:** < 40 ms  
**Release delay:** < 100 ms

### External Remote Reset X1/X2

**Function:** External remote reset X1/X2 with NO contact (voltage free)  
**Remark:** This input is not galvanic separated from measuring input P1/P2

### Output

**Contacts:** MK 9163N, MK 9163N-ATEX: 2 changeover contacts  
**Thermal current  $I_{th}$ :** 5 A

### Switching capacity MK 9163N

to AC 15  
NO contacts: 2 A / AC 230 V IEC/EN 60 947-5-1  
NC contacts: 1 A / AC 230 V IEC/EN 60 947-5-1  
to DC 13: 1 A / DC 24 V IEC/EN 60 947-5-1

### Switching capacity MK 9163N-ATEX

to AC 15: 3 A / AC 230 V IEC/EN 60 947-5-1  
to DC 13: 2 A / DC 24 V IEC/EN 60 947-5-1

### Electrical life

at 4 A, AC 230 V,  $\cos\varphi = 0.6$ : 1.5 x 10<sup>6</sup> switching cycles

### Short-circuit strength

max. line circuit breaker: C 16 A DIN EN 60 947-5-1

### Mechanical life:

$\geq$  30 x 10<sup>6</sup> switching cycles

## Technical Data

### General Data

**Operating mode:** Continuous operation  
**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC/EN 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2  
HF-irradiation: 10 V / m IEC/EN 61 000-4-3  
Fast transients: 4 kV IEC/EN 61 000-4-4

### Surge voltages between wires for power supply

at AC 230 V: 2 kV IEC/EN 61 000-4-5  
at DC 24 V: 1 kV IEC/EN 61 000-4-5  
between wire and ground: 4 kV IEC/EN 61 000-4-5  
Interference suppressions: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529  
Terminals: IP 20 IEC/EN 60 529

### Housing:

Thermoplastic with V0-behaviour according to UL subject 94

### Vibration resistance:

Amplitude 0.2 mm, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

### Climate resistance:

20 / 060 / 04 IEC/EN 60 068-1

### Terminal designation:

EN 50 005

### Wire connection

**Screw terminals (integrated):** 1 x 4 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled or  
2 x 1.5 mm<sup>2</sup> stranded ferruled or  
2 x 2.5 mm<sup>2</sup> solid

### Insulation of wires or sleeve length:

8 mm

### Plug in with screw terminals

#### max. cross section for connection:

1 x 2.5 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled

### Insulation of wires or sleeve length:

8 mm

### Plug in with cage clamp terminals

#### max. cross section for connection:

1 x 4 mm<sup>2</sup> solid or  
1 x 2.5 mm<sup>2</sup> stranded ferruled

#### min. cross section for connection:

0.5 mm<sup>2</sup>

### Insulation of wires or sleeve length:

12  $\pm$ 0.5 mm

### Wire fixing:

Plus-minus terminal screws M 3.5  
box terminals with wire protection or  
cage clamp terminals

max. 0.8 Nm

### Fixing torque:

DIN rail IEC/EN 60 715

### Weight:

160 g

## Dimensions

### Width x height x depth

MK 9163N: 22.5 x 90 x 102 mm  
MK 9163N PC: 22.5 x 111 x 102 mm  
MK 9163N PS: 22.5 x 104 x 102 mm



## Technical Data

### Safety Related Data

#### Values according to EN 61508 / EN 50495

SIL:	1 (Typ B)	
T <sub>1</sub> (Proof Test Intervall):	2	a
HFT:	0	
SFF:	36,6	%
PFD <sub>0</sub> :	7,83 x 10 <sup>-3</sup>	
λ <sub>du</sub> [FIT]:	894	
λ <sub>dd</sub> [FIT]:	0	
λ <sub>su</sub> [FIT]:	516	
λ <sub>sd</sub> [FIT]:	0	
Mode of operation:	low demand mode	
Architecture:	1001	

#### Values according to EN 13849:

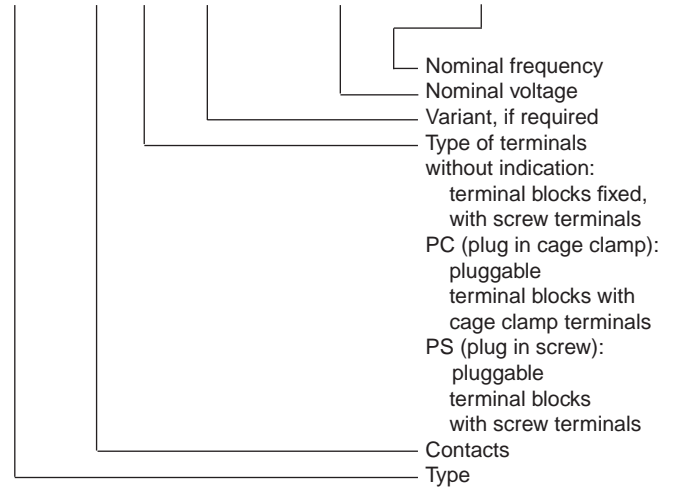
Category:	1	
PL:	c	
MTBF:	81	a
MTTF <sub>d</sub> :	63,8	a
DC <sub>avg</sub> :	0	%



The a.m. data for functional safety is valid for an ambient temperature of 40°C respecting also selfheating.  
Data for other ambient temperatures are available on request.

## Ordering example for variants

MK 9163N .12 / / ATEX AC/DC 230 V 50/60 Hz



## CCC-Data

Thermal current I<sub>th</sub>: 4 A

### Switching capacity

to AC 15:	1,5 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13:	1 A / DC 24 V	IEC/EN 60 947-5-1



Technical data that is not stated in the CCC-Data, can be found in the technical data section.

## Options with Pluggable Terminal Blocks



Screw terminal  
(PS/plugin screw)



Cage clamp terminal  
(PC/plugin cage clamp)

## Standard Type

MK 9163N.12/110-ATEX	AC 230 V	50/60 Hz
Article number:	0056453	
• with Test/Reset button		
• Output:	2 changeover contacts	
• Nominal voltage U <sub>N</sub> :	AC 230 V	
• Width:	22.5 mm	

## Variant

MK 9163N.12 /	
	ATEX with approval
	0 free
	0 without short circuit detection
	1 with short circuit detection (ATEX)
	0 without RESET
	1 with RESET and test function via built in button and X1/X2
	2 with RESET and test function via built in button, at X1/X2 RESET function only

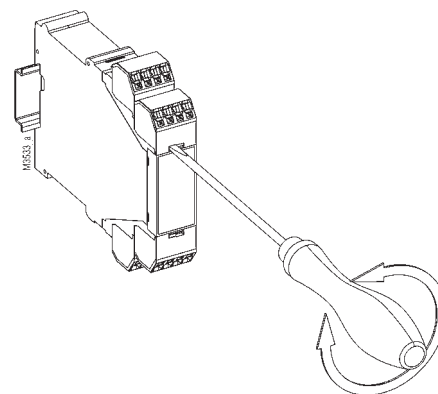
### Available variants

MK 9163N.12  
MK 9163N.12/100  
MK 9163N.12/200  
MK 9163N.12/010 ATEX  
MK 9163N.12/110 ATEX  
MK 9163N.12/210 ATEX

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Manufacturing Data

Each unit is marked with the manufacturing date e.g. "Bj. KW 49/02". The unit had been produced in week 49 – 2002.

## Additional Remarks and Safety Instructions

### Use on motors in explosion hazardous areas

Thermal protection on motors that are equipped with PTC sensors according to DIN 44 081 or DIN 44 082 or DIN EN 60034-11 type A (DIN EN 60947-8). When used on motors of protection degree EX and EX d only the sensor wire leads through the Ex-area. The motor protection relay has to be mounted outside the Ex-area, but monitors devices operated in the Ex-area.

### Safety integrity level SIL 1

To fulfil SIL 1 a cyclic function test of the protection device has to be provided. This can be done manually during maintenance (see below).

### The function test must be carried out all 2 years.

### Test facilities for set-up and maintenance

A test of the unit can be made by simulating the resistance on the sensor input. During maintenance these tests can also be made.

- Test of short circuit detection: Bridge sensor input (this test is possible without disconnection of the sensor).
- Test of broken wire detection: Disconnect sensor wire.
- Test of overtemperature function: Change resistance on input from low 50 ... 1500  $\Omega$  to 4 k $\Omega$ .

The RESET button can also be used for test purpose (see Function Diagram)

### Installation

The DC 24 V version has no galvanic separation between auxiliary supply (A1, A2) and the sensor circuit (P<sub>1</sub>, P<sub>2</sub>). These units are only allowed to be connected to transformers according to DIN EN 61 558 or to battery supply.

### Wiring

The sensor and control wires have to be installed separately from the motor wires. When strong inductive or capacitive influence is expected from parallel installed high current wires, screened wire should be used.

### Wire length

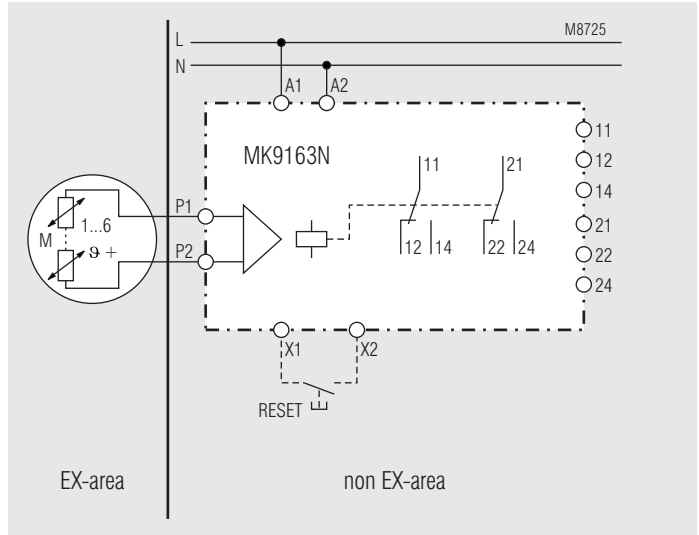
The max. wire length of the sensor circuit is:

Diameter (mm <sup>2</sup> ):	4	2.5	1.5	0.5
max. wire length (m):	2 x 550	2 x 250	2 x 150	2 x 50

### Safety instructions

- Installation, test and replacement may only be carried out by qualified specialist staff and the applicable safety rules must be observed. The data for functional safety in explosion hazardous areas have to be respected.
- Details of the motor supplier and the details about the explosion protection from the EC-type examination certificates for explosion proof motors have to be respected.
- For the test and the maintenance of motor protection devices for explosion proof machines, the EN 60079-17 and the safety rules that result from the motor application and the corresponding type of protection have to be respected (EC ATEX Directive 94/9/EC and DIN EN 60079-14).
- The motor protection relay has to switch off the motor immediately also when it is controlled by an inverter. The control circuit must allow this. In this case the sensor wires must be lead separately. The use of wires inside the motor connection cable is not allowed.
- If variants are used that have no no-voltage safe reset function additional measures have to be applied in order to disable safely the restart of the motor until the fault is removed if this leads to a dangerous situation.
- The relay must only be opened by the manufacturer.
- The relay must only be replaced by equivalent devices marked according to the relevant safety rules.
- The permitted ambient conditions must be observed.
- Devices that show obvious transportation damage must not be used in safety relevant applications.

## Application Example



## VARIMETER EX Thermistor Motor Protection Relay MK 9003 ATEX



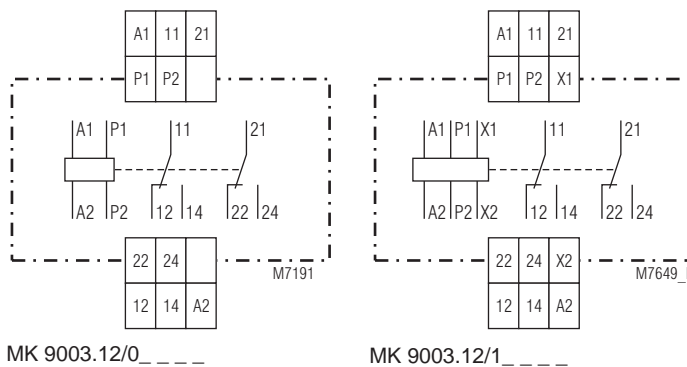
### Your advantages

- Reliable temperature monitoring of motors
- Rapid fault location

### Features

- According to pr EN 60 947-8, EN 60 079-14
- Detection of
  - overtemperature
  - broken wire in sensor circuit
  - short circuit in sensor circuit
- 1 input for 1 to 6 PTC-reistors
- Functions as options or settable with DIP-switches:
  - automatic reset (fault is not stored)
  - manual reset (fault is stored)
  - manual reset only on start-up
  - manual reset on and also after start-up
- No voltage safe manual reset
- Closed circuit operation
- LED indicators for
  - auxiliary supply
  - contact position
  - overtemperature, broken wire or short-circuit in sensor circuit
- 2 changeover contacts
- Button for reset function
- Remote reset via terminals X1 / X2 (NO contact)
- Optionally safe separation according to IEC/EN 61 140, IEC/EN 60 947-1, 6 kV/2 between:
  - auxiliary voltage and measuring circuit
  - auxiliary voltage and output contacts
  - measuring circuit and output contacts
  - the 2 changeover contacts (only with 2 changeover contacts)
- Width 22.5 mm

### Circuit Diagrams



### Approvals and Markings



<sup>1)</sup> Directive 94/9/EG

EG type test no.

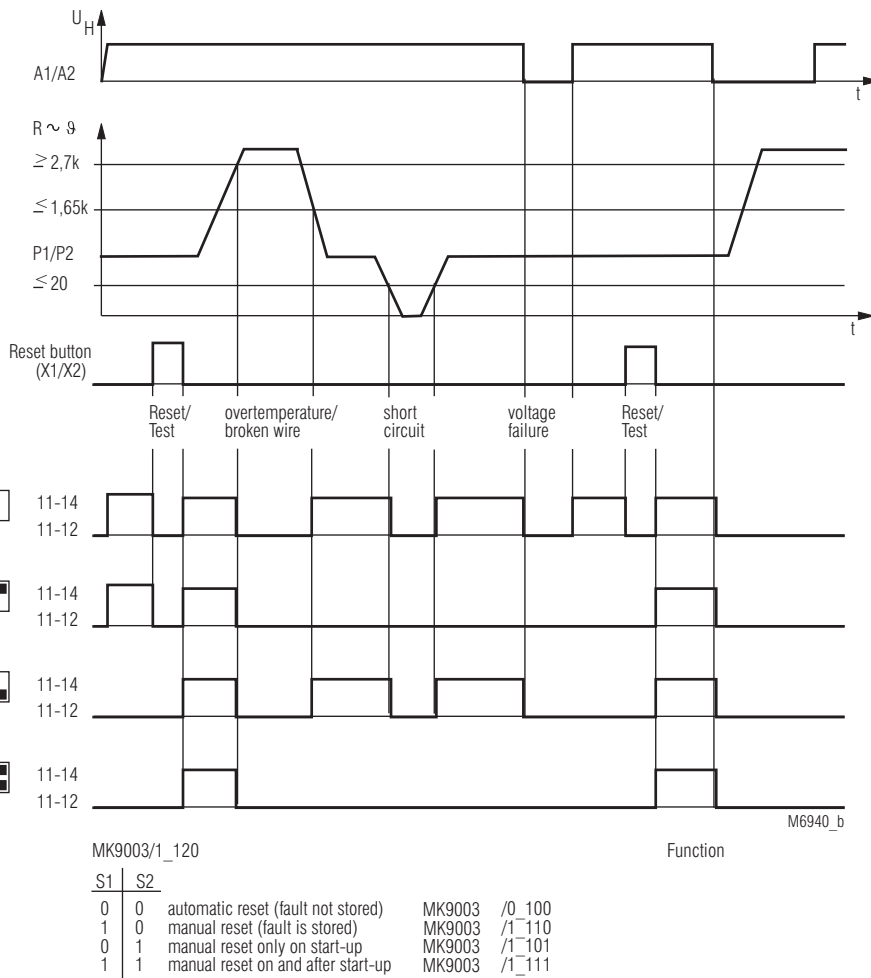
02 ATEX 3057 II (2) G [Ex e] [Ex d] [Ex px] [Ex n]  
II (2) D [Ex tb] [Ex tc]

### Application

Temperature monitoring of explosion protected Motors by „extended safety“ EX e DIN EN 60079-7, „pressure proof enclosure“ EX d DIN EN 60079-1 or „overpressure enclosure“ Ex px in gas containing atmosphere as well as „protection by enclosures“ Ex t DIN EN 60079-31 in dust containing atmosphere. The thermistor Motor protection relay protects Standard and Explosion proof Motor against overheating due to overload according to DIN EN 60079-14 and DIN EN 60079-0.

### Indicators

green LED:	on, when supply voltage connected
red LED:	on, when output contact de-energized
yellow LED:	on, when overtemperature of failure in sensor circuit



**With manual reset, also after voltage failure (no start-up reset)**

After the failure is gone manual reset must be made (reset button on unit or remote reset X1-X2) to bring the unit in operating mode (no voltage safe).

After voltage failure manual reset must always be made.

**Activation after power on (start-up reset)**

After the failure is removed the contacts switch back automatically to active condition. After voltage failure manual reset must always be made.

**With manual reset (fault is stored)**

After the failure is gone manual reset must be made (reset button on unit or remote reset X1-X2) to bring the unit in operating mode (no voltage safe).

**Automatic reset**

After the failure is removed the contacts switch back automatically to active condition.

## Technical Data

### Input

Response value:	2.7 ... 3.1 k $\Omega$
Release value:	1.5 ... 1.65 k $\Omega$
Broken wire on meas. circuit:	> 3.1 k $\Omega$
Short circuit on meas. circuit:	< 20 $\Omega$
Loading of measuring circuit:	< 2.5 mW (at R = 1.5 k $\Omega$ )
Voltage on measuring circuit:	$\leq$ 2 V (at R = 1.5 k $\Omega$ )

### Auxiliary Circuit

Auxiliary voltage $U_H$ :	AC 24, 110, 230, 400 V 50 / 60 Hz DC 24 V
---------------------------	--

Voltage range:	0.85 ... 1.1 $U_H$
Nominal consumption	
AC:	1.5 VA, $\cos \varphi = 0.95$
Nominal frequency:	50 / 60 Hz
Frequency range:	45 ... 65 Hz
Max. bridging time on voltage failure:	20 ms
Operate delay:	approx. 18 ms
Release delay:	approx. 12 ms

### Remote Reset on MK 9003/1 \_ \_ \_

Function:	remote reset X1 / X2 with voltage free NO contact
Remark:	input X1 / X2 has no galvanic separation to measuring input P1 / P2

### Output

Contacts	
MK 9003.12:	2 changeover contacts
Thermal current $I_{th}$ :	4 A
Switching capacity	
to AC 15:	
NO contact:	3 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	1 A / AC 230 V IEC/EN 60 947-5-1
to DC 13:	
NO contact:	1 A / DC 24 V IEC/EN 60 947-5-1
NC contact:	1 A / DC 24 V IEC/EN 60 947-5-1
Electrical life	
to AC 15 at 5 A, AC 230 V:	1 x 10 <sup>6</sup> switching cycles IEC/EN 60 947-5-1
Short circuit strength	
max. fuse rating:	6 A gL IEC/EN 60 947-5-1
Mechanical life:	$\geq$ 50 x 10 <sup>6</sup> switching cycles

### General Data

Operating mode:	Continuous operation
Temperature range:	- 20 ... + 55°C
Storage temperature:	- 40 ... + 85°C
Clearance and creepage distances	
rated impulse voltage / pollution degree:	6 kV / 2 IEC 60 664-1
EMC	
Electrostatic discharge:	8 kV (air) IEC/EN 61000-4-2
Fast transient:	4 kV IEC/EN 61000-4-4
Interference suppression:	Limit value class B EN 55 011
Degree of protection	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
Housing:	Thermoplastic with V0-behaviour according to UL subject 94
Vibration resistance:	amplitude 0.35 mm frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 055 / 04 IEC/EN 60 068-1
Climate resistance:	
Terminal designation:	EN 50 005
Wire connection	
max. cross section	2 x 2,5 mm <sup>2</sup> solid or 2 x 0,75 mm <sup>2</sup> stranded wire with sleeve DIN 46228-1/-2/-3/-4 or 2 x 1,5 mm <sup>2</sup> strand.wire w. sl. DIN 46228-4
min. cross section:	0,5 mm <sup>2</sup> solid or stranded wire with sleeve
Insulation of wires or sleeve length:	8 mm
Wire fixing:	Plus-Minus-terminal screws M3,5 with self-lifting clamping piece IEC/EN 60 999-1
Fixing torque:	0.8 Nm
Mounting:	DIN rail IEC/EN 60 715
Weight:	162 g

### Dimensions

Width x height x depth:	22.5 x 82 x 99 mm
-------------------------	-------------------

## Technical Data

### Safety Related Data

#### Values according to EN 61508 / EN 50495:

SIL:	1 (Type B)	
T <sub>1</sub> (Proof Test Intervall):	2	a
HFT:	0	
SFF:	45,67	%
PFD <sub>G</sub> :	9,94 x 10 <sup>-3</sup>	
$\lambda_{du}$ :	1135	FIT
$\lambda_{dd}$ :	0	FIT
$\lambda_{su}$ :	945	FIT
$\lambda_{sd}$ :	0	FIT
Mode of operation:	low demand mode	
Architecture:	1001	

#### Values according to EN 13849:

Category:	1	
PL:	c	
MTBF:	55	a
MTTF <sub>d</sub> :	50,5	a
DC <sub>avg</sub> :	0	%



The a.m. data for functional safety is valid for an ambient temperature of 40°C respecting also selfheating. Data for other ambient temperatures are available on request.

### Standard Type

MK 9003.12/11120 ATEX	AC 230 V	
Article number:	0055727	stock item
• Output:	2 changeover contacts	
• Function programmable on S1 and S2		
• With short circuit detection		
• With safe separation according to IEC/EN 61 140, IEC/EN 60 947-1		
• Auxiliary voltage $U_H$ :	AC 230 V	
• Width:	22.5 mm	

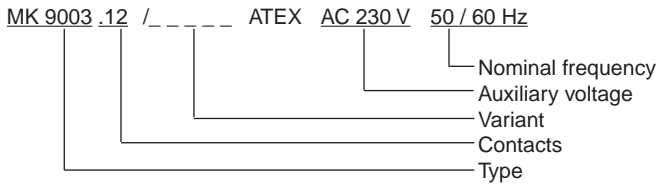
### Variants

MK 9003.12 / _ _ _ _ ATEX	
00	automatic reset
10	manual reset
01	manual reset only on start-up
11	manual reset on and also after start up
20	function programmable on S1 and S2
1	with short circuit detection
0	without safe separation
1	with safe separation (see Application example)
0	without RESET-function (only with MK 9003._ /1_100)
1	with RESET-function with MK 9003._ /1_110 MK 9003._ /1_101 MK 9003._ /1_111 MK 9003._ /1_120

available variants (others with short circuit detection on request)

MK 9003/00100 ATEX
MK 9003/01100 ATEX
MK 9003/10110 ATEX
MK 9003/11110 ATEX
MK 9003/11120 ATEX

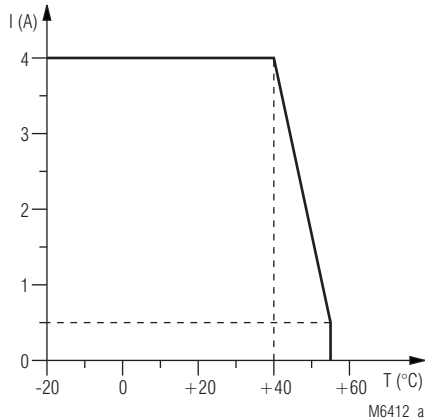
## Ordering example for variants



## Accessories

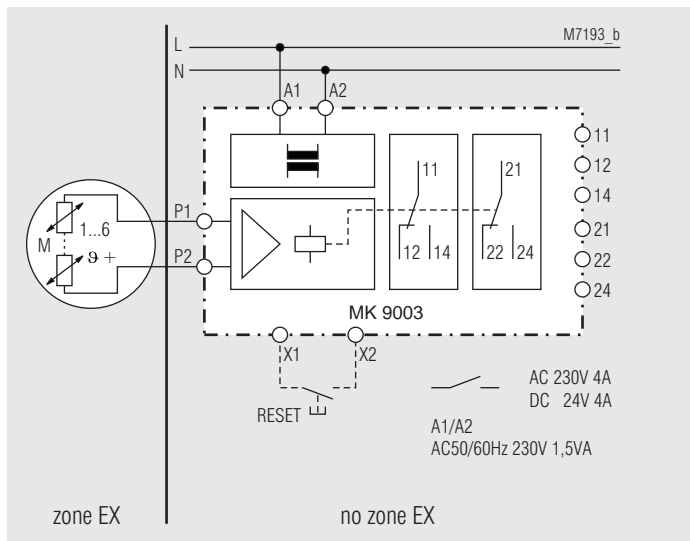
ET 4752-143: Marking plate  
Article number: 0043203

## Characteristic



Continuous current limit curve

## Application Example



Thermistor motor protection relay shown as variant MK 9003/\_1\_ \_ \_ \_ , with safe separation according to IEC/EN 61 140, IEC/EN 60 947-1, 6 kV/2 between:

- Auxiliary voltage and measuring circuit
- Auxiliary voltage and output contacts
- Measuring circuit and output contacts
- the 2 changeover contacts (only with 2 changeover contacts)

Note: See also **Installation**

## Production Date

Every unit is labelled with the production date e.g. "Bj. KW 49/02".  
The device was produced in week 49, 2002.

## Additional Information and Safety Instructions

### Use on motors in explosion hazardous areas

Thermal protection on motors that are equipped with PTC sensors according to DIN 44 081 or DIN 44 082 or DIN EN 60034-11 type A (DIN EN 60947-8). In applications with motors of the explosion protection class Ex e and Ex d only the sensor with its connection wire leads into the Ex area. The motor protection relay has to be mounted outside the Ex-area, but monitors devices operated in the Ex-area.

### Safety integrity level SIL 1

To fulfil SIL 1 a cyclic function test of the protection device has to be provided. This can be done manually during maintenance (see below).

### The function test must be carried out all 2 years.

### Test facilities for set-up and maintenance

A test of the unit can be made by simulating the resistance on the sensor input. During maintenance these tests can also be made.

- Test of short circuit detection: Bridge sensor input (this test is possible without disconnection of the sensor).
- Test of broken wire detection: Disconnect sensor wire.
- Test of overtemperature function: Change resistance on input from low 50 ... 1500  $\Omega$  to 4 k $\Omega$ .

The RESET button can also be used for test purpose (see Function Diagram)

### Installation

The DC 24 V version has no galvanic separation between auxiliary supply (A1, A2) and the sensor circuit (P<sub>1</sub>, P<sub>2</sub>). These units are only allowed to be connected to transformers according to DIN EN 61 558 or to battery supply.

### Wiring

The sensor and control wires have to be installed separately from the motor wires. When strong inductive or capacitive influence is expected from parallel installed high current wires, screened wire should be used.

### Wire length

The max. wire length of the sensor circuit is:

Diameter (mm <sup>2</sup> ):	4	2.5	1.5	0.5
max. wire length (m):	2 x 550	2 x 250	2 x 150	2 x 50

### Safety instructions

- Installation, test and replacement may only be carried out by qualified specialist staff and the applicable safety rules must be observed. The data for functional safety in explosion hazardous areas have to be respected.
- Details of the motor supplier and the details about the explosion protection from the EC-type examination certificates for explosion proof motors have to be respected.
- For the test and the maintenance of motor protection devices for explosion proof machines, the EN 60079-17 and the safety rules that result from the motor application and the corresponding type of protection have to be respected (EC ATEX Directive 94/9/EC and DIN EN 60079-14).
- The motor protection relay has to switch off the motor immediately also when it is controlled by an inverter. The control circuit must allow this. In this case the sensor wires must be lead separately. The use of wires inside the motor connection cable is not allowed.
- If variants are used that have no no-voltage safe reset function additional measures have to be applied in order to disable safely the restart of the motor until the fault is removed if this leads to a dangerous situation.
- The relay must only be opened by the manufacturer.
- The relay must only be replaced by equivalent devices marked according to the relevant safety rules.
- The permitted ambient conditions must be observed.
- Devices that show obvious transportation damage must not be used in safety relevant applications.

## Noise Filter MK 5130N, LG 5130



0272373

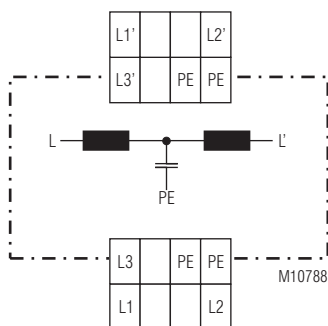
### Your Advantages

- Reliable operation of measuring relays and other low consumption loads in systems with high frequency noise
- Protection of measuring inputs / measuring relays by reduction of noise
- More precise and constant measuring results
- Increasing the availability of plants

### Features

- 3-phase noise filter for measuring relays
- Noise suppression of wire bound interference
- Broadband suppression of high frequencies
- For nominal voltages up to 3 AC 1000 V
- PE connection for increased suppression level
- 2 models available:  
MK 5130N: depth 97 mm  
LG 5130: depth 121 mm
- Width: 22.5 mm

### Circuit Diagram



### Approvals and Markings



### Applications

- Operation of measuring relays on inverters and equipment with high frequency noise voltage
- Noise suppression for circuits and loads up to 50 mA per phase
- Reduction of noise created by electric tools, contactors and luminescent lamps

### Connection Terminals

Terminal designation	Signal designation
L1, L2, L3	Input phase voltages
L1', L2', L3'	Output phase voltages
PE	Connection for protective conductor

### Notes

The noise filter is connected with its input terminals L1/L2/L3 to the inverter output and the measuring relay or device to be protected to the filter outputs L1'/L2'/L3'.

It is not mandatory to connect the PE to the corresponding device terminals but it increases the filter effect.

The maximum current in each filter path is 50 mA. So this filter can also be used in the auxiliary supply of low consumption equipment.

If only one line should be filtered, the 3 paths could be connected in series increasing the filter effect, or in parallel increasing the current capacity to 150 mA.

### Function

Increased numbers of inverters create on their outputs steep commutation edges that create noise and high frequency leaking currents on direct connected equipment. Devices that are connected to inverters can be disturbed or damaged. The HF components can be conducted to other parts of the system e.g. via the DC 24 V supply.

This could happen on measuring relays that are connected to the inverter output. The auxiliary supply of the measuring relay has a galvanic separation from the measuring input, but coupling capacitances in the power supply can create a high frequency connection to the measuring input. Certain frequencies will then create leakage currents from inverter to auxiliary supply.

In principle all monitoring devices connected to inverter outputs may be subject to interference. It is also possible that these devices conduct the interference to other parts of the system.

The noise filter MK 5130N / LG 5130 have in each path for the 3 phases (input L1/L2/L3 - output L1'/L2'/L3') 4 inductances connected in series to provide broad band filtering up to very high frequencies. If also PE is connected, a Y-capacitor connected to PE gets active and provides increased filtering. (T-filter).

By connecting the MK 5130N / LG 5130 between inverter and measuring relay / device to be protected, the current flowing via coupling capacitances is extremely reduced, as the filter elements create a rising impedance with rising frequency. This avoids disturbance or damage on connected devices.

## Technical Data

### Nominal voltage $U_N$

without PE connection: max. 3 AC 1000 V  
with PE connection: max. 3/N AC 860 / 500 V

### Current carrying capacity

per path: max. 50 mA

### Ohmic resistance

per path: approx. 140  $\Omega$

### Impedance per path (approximate values):

f / Hz	10 k	20 k	50 k	100 k	200 k	300 k	500 k	1 M	2 M	3 M	5 M ... 30 M
without PE:	2.5 k $\Omega$	4.5 k $\Omega$	10 k $\Omega$	16 k $\Omega$	20 k $\Omega$	23 k $\Omega$	30 k $\Omega$	30 k $\Omega$	30 k $\Omega$	25 k $\Omega$	22 k $\Omega$
with PE:	2.5 k $\Omega$	4.5 k $\Omega$	10 k $\Omega$	10 k $\Omega$	18 k $\Omega$	55 k $\Omega$	160 k $\Omega$	300 k $\Omega$	770 k $\Omega$	1 M $\Omega$	1 M $\Omega$

## General Data

**Nominal operating mode:** Continuous operation

### Temperature range

Operation and storage: - 40 ... + 70°C

**Relative air humidity:** 93% at 40°C

**Altitude:** < 2,000 m

### EMC

Electrostatic discharge: 8kV (air) IEC/EN 61 000-4-2

Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages between

power supply L/N: 2 kV IEC/EN 61 000-4-5

between wire and ground: 4 kV IEC/EN 61 000-4-5

HF wire guided: 20 V IEC/EN 61 000-4-6

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplastic with V0 behaviour according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm frequency 10 ... 55 Hz IEC/EN 60 068-2-6

**Climate resistance:** 40 / 070 / 04 IEC/EN 60 068-1

**Wire connection:** 1 x 4 mm<sup>2</sup> solid or 2 x 2.5 mm<sup>2</sup> solid or 1 x 2.5 mm<sup>2</sup> stranded wire with sleeve or 2 x 1.5 mm<sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2-3/-4 or 2 x 2.5 mm<sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2-3/

**Wire fixing:** Plus-minus terminal screws M 3.5 box terminals with wire protection

**Fixing torque:** 0.4 Nm

**Mounting:** DIN rail IEC/EN 60 715

### Weight:

MK 5130N: approx. 130 g

LG 5130: approx. 140 g

## Dimensions

### Width x height x depth:

MK 5130N: 22.5 x 90 x 97 mm

LG 5130: 22.5 x 90 x 121 mm

## Standard Types

### MK 5130N

Article number: 0065014

• Width: 22.5 mm

• Depth: 97 mm

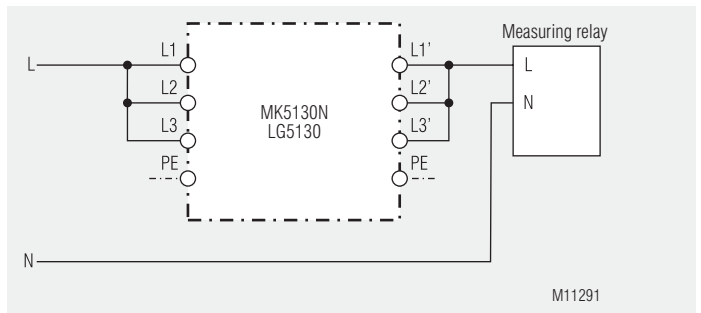
### LG 5130

Article number: 0065015

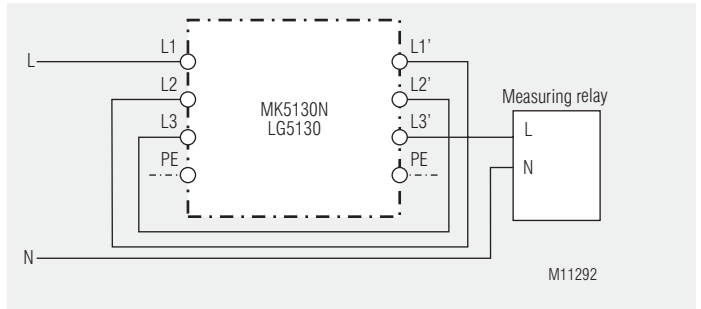
• Width: 22,5 mm

• Depth: 121 mm

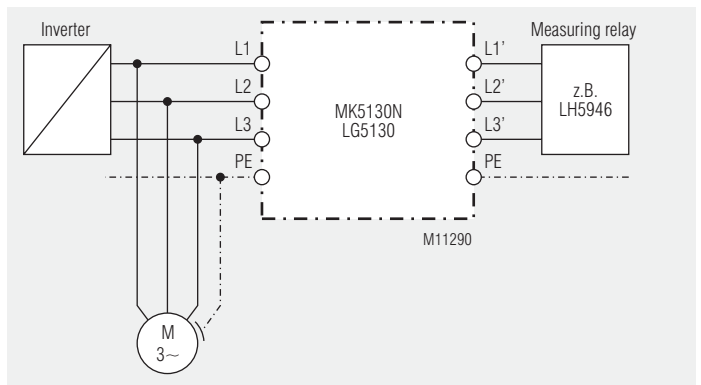
## Connection Examples



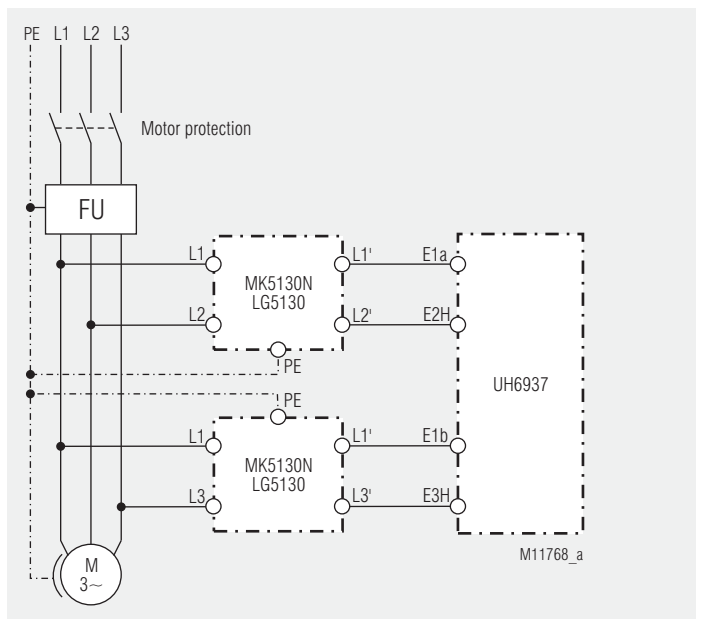
Noise filtering in a single wire with max. current capacity 150 mA



Noise filtering in a single wire with max. current capacity 50 mA



Noise filtering between the 3 phases of an inverter and a measuring relay



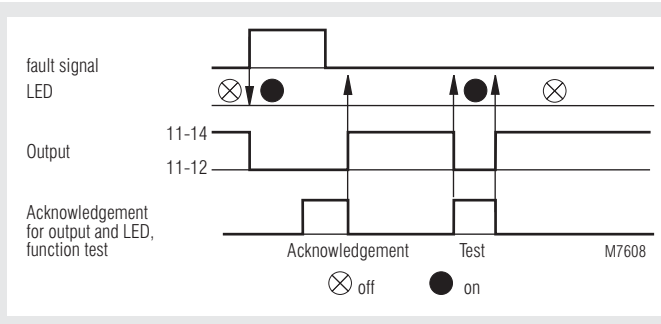
Inverter monitoring function, 3-phase with frequency monitor UH 6937





- Common alarm annunciator for 6 signals
- Optionally for up to 8 signals
- Closed circuit operation
- Optionally with open circuit operation
- With LED for each fault signal
- Inputs up to AC/DC 300 V
- With relay output for common signal
- Pushbutton for fault signal acknowledgement and function test
- Front surface 96 x 96 mm

### Function Diagram



### Approvals and Markings



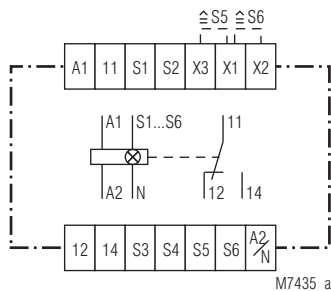
### Application

Monitoring of industrial plants and buildings

### Indication

LEDs for each fault signal  
Continuous light when fault signal applied

### Circuit diagram



EH 9997.11

### Notes

It must be observed, that the fault inputs are not separated from the supply voltage (common terminal A2/N). In case of DC-signals the minus-pole always to be connected to A2.  
By removing the bridges X1/X3 - X1/X2 on the backside, the function of the fault signal can be changed, so that the faults 5 and 6 will only be indicated optically and the output relay will not be influenced.

The EH 9997 will be supplied unlabeled.  
Individual lable on demand.

### Technical Data

#### Input

<b>Inputs:</b>	between AC/DC 12 and 300 V in 3 sectors;
	AC/DC 12 ... 70 V, AC/DC 70 ... 160 V, AC/DC 160 ... 300 V
<b>Nominal voltage <math>U_N</math>:</b>	AC/DC 24, 42, 48 V AC 110 ... 127, 220 ... 240 V
<b>Special voltage:</b>	
external resistor	
DC 60 V:	820 $\Omega$ ZWS 8 SL
DC 110 V:	2.2 k $\Omega$ ZWS 20 SL
DC 220 V:	4.7 k $\Omega$ ZWS 20 SL
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal consumption:</b>	AC 230 V, 9 VA
	DC 24    60    110    220 V
	1    2.5    5    10 W
<b>Nominal frequency:</b>	50 / 60 Hz

## Technical Data

### Output

### Contacts

EH 9997.11: 1 changeover contact  
6 A

### Thermal current $I_{th}$ : Switching capacity

to AC 15  
NO contact: 3 A / 230 V IEC/EN 60 947-5-1  
NC contact: 1 A / 230 V IEC/EN 60 947-5-1

**Electrical life**  
to AC 15 at 3 A, AC 230 V: 0.1 x 10<sup>6</sup> switching cycles

**Short circuit strength**  
**max. fuse rating:** 6 AgL IEC/EN 60 947-5-1

**Mechanical life:** > 30 x 10<sup>6</sup> switching cycles

## General Data

**Operating mode:** Continuous operation  
**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage /  
pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2  
HF-irradiation: 10 V / m IEC/EN 61 000-4-3  
Fast transients: 4 kV IEC/EN 61 000-4-4

Surge voltages  
between  
wires for power supply: 2 kV IEC/EN 61 000-4-5  
between wire and ground: 4 kV IEC/EN 61 000-4-5  
Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529  
Terminals: IP 20 IEC/EN 60 529

### Housing

Thermoplast with V0 behaviour  
according to UL subject 94  
**Vibration resistance:**  
Amplitude 0.35 mm,  
frequency 10 ... 55 Hz IEC/EN 60 068-2-6  
**Climate resistance:**  
humid heat IEC/EN 60 068-2-30

### Terminal designation:

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228-1/-2/-3/-4

**Wire fixing:** Flat terminals with self lifting  
clamping piece IEC/EN 60 999-1

**Mounting:** 2 clamps with screws

**Weight:** 300 g

## Dimensions

Width x height x depth: 96 x 96 x 129 mm  
Front panel cut-out: Diameter 91<sup>+1</sup> mm

## Standard Type

EH 9997.11 AC 220 ... 240 V 50/60 Hz AC/DC 160 ... 300 V  
Article number: 0013214 stock item  
• Output: 1 changeover contact  
• Nominal voltage  $U_N$ : AC 220 ... 240 V  
• Inputs: AC/DC 160 ... 300 V

## Variants

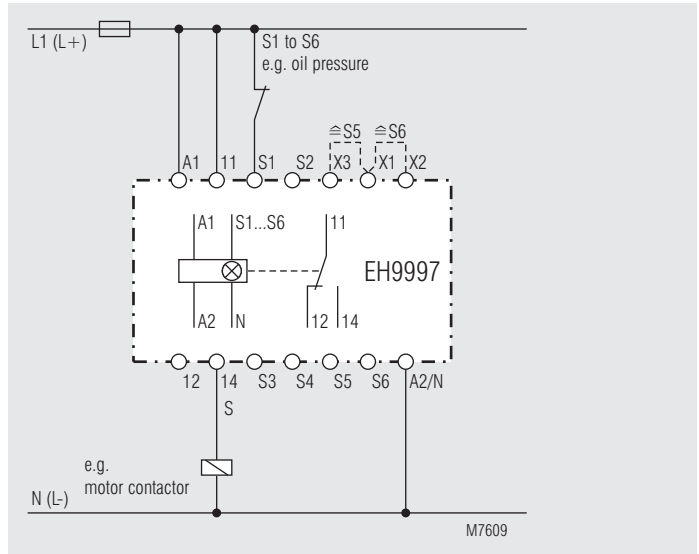
EH 9997/013: During function test, common signal  
will not be operated  
EH 9997/074: Open circuit operation  
EH 9997/075: 8 signals; all stored, indicated and  
switching common output

## Ordering example for variants

EH 9997 .11 / - - - AC 230 ... 240 V AC/DC 160 ... 300 V 50/60 Hz

Nominal frequency  
Inputs  
Nominal voltage  
Variant, if required  
Contacts  
Type

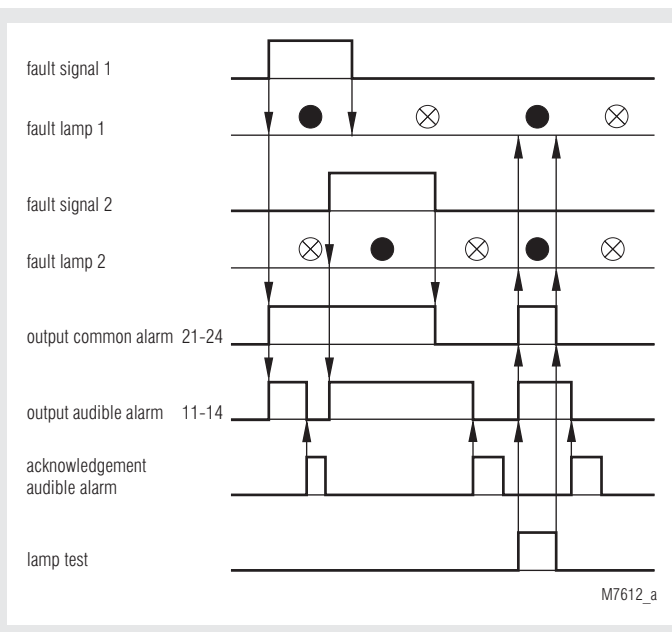
## Connection Example





- According to IEC/EN 60 255, DIN VDE 0435-303
- Common alarm annunciator for 12 signals
- 1 relay for common signal and horn
- Inputs up to AC/DC 230 V
- 1 connection for acknowledgement button of horn and lamp test
- Width: 45 mm

### Function Diagram



### Approvals and Markings



### Application

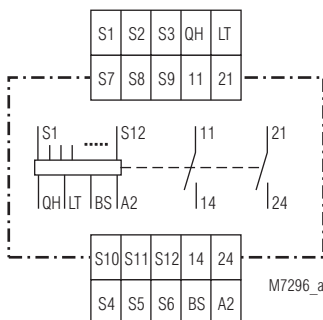
Monitoring of industrial plants and buildings

### Notes

The inputs and the lamp test input "LT" are to be controlled with the same phase voltage. In case of connection of different phases the fault annunciator can be destroyed. The fault annunciator AD 5960 is not suitable for the use of lamps with transformers. If the fault annunciator lamps should be controlled with another voltage than that of the inputs, we recommend our fault annunciators AN 5969 or EP 9969, which have relay outputs.

By shock or vibration during transportation the relay contacts may switch to the wrong state. This is typical when bistable relays are used. By connecting nominal voltage to one of the inputs the contacts are brought into right state to achieve a safe switching, the inputs  $S_1 \dots S_{12}$  have to be activated at least 60 ms.

### Circuit Diagram



## Technical Data

### Input

<b>Nominal voltage <math>U_N</math>:</b>	AC/DC 24, 42, 110, 230 V
<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Fault signal current per input</b>	
Voltage AC/DC:	24 42 110 230 V
Current $\hat{I}_s$ :	440 280 180 150 mA
<b>Input current load* at input of lamp test</b>	
Voltage AC/DC:	24 42 110 230 V
Current $\hat{I}$ :	5.3 3.4 2.2 1.8 A
	Current shape see characteristic
	* without connection of the external signal lamp

### Output

**Contacts:** 1 NO contact each for common alarm and audible alarm

**Operate time of Relay "Horn":** approx. 20 ms  
**Recovery time "Horn":** approx. 5 s  
 (min. necessary time between the occurrence of a fault and the acknowledgement of the audible alarm)

**Operate time of common alarm relay:**  $\leq 1$  s

**Actuation time for lamp test input:**  $\geq 2$  s

**Switching capacity:** AC 250 V / 5 A

**Loading:** 1 A per external signal lamp, however totally max. 5 A

**Thermal current  $I_{th}$ :** 8 A

## General Data

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
HF-irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV IEC/EN 61 000-4-5
between wire and ground:	4 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplast with V0-behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm frequency 10...55Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 2.5 mm <sup>2</sup> solid or 2 x 1.5 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminal with self-lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	200 g

## Dimensions

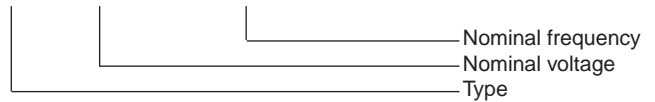
**Width x height x depth:** 45 x 77 x 127 mm

## Standard Type

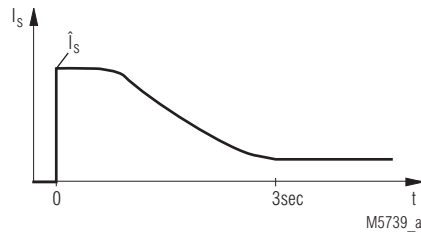
AD 5960 AC/DC 230 V 50/60 Hz	
Article number:	0028134 stock item
• Output:	1 NO contact each for common alarm and audible alarm
• Auxiliary voltage $U_H$ :	AC/DC 230 V
• Inputs:	AC/DC 230 V

## Ordering Example

AD 5960 AC/DC 230 V 50 / 60 Hz

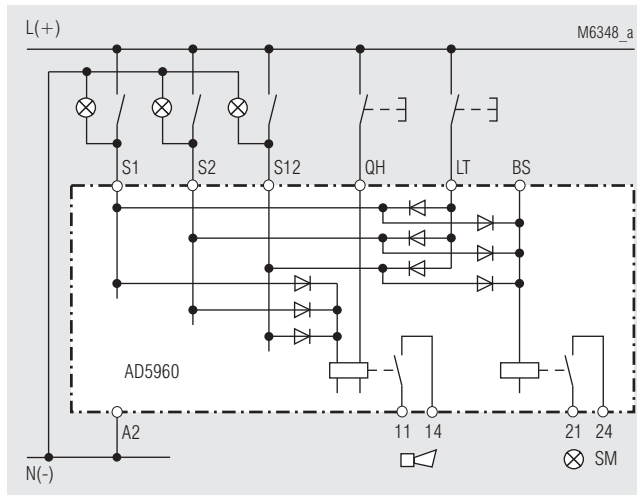


## Characteristic



Current curve of the inputs and of the lamp test inputs

## Connection Example



## INFOMASTER Fault Annunciator System IL 5990, IL 5991, SL 5990, SL 5991



- According to DIN 19235
- Common alarm annunciator
- Expandable from 4 up to 160 inputs
- Open circuit inputs / closed circuit inputs selectable via bridges X1-X2
- Delayed inputs up to 10 s
- Acknowledgement push button QH for external buzzer built in
- Accessories: Buzzer IK 8832, SK 8832
- Devices available in 2 enclosure versions:
  - I-model: depth 61 mm, with terminals at the bottom for installations systems and industrial distribution systems according to DIN 43 880
  - S-model: depth 100 mm, with terminals at the top for cabinets with mounting plate and cable duct
- Width 35 mm

### Fault annunciator IL 5990, SL 5990:

- 4 inputs with LED on control unit
- 1 output for common signal and 1 output for audible alarm

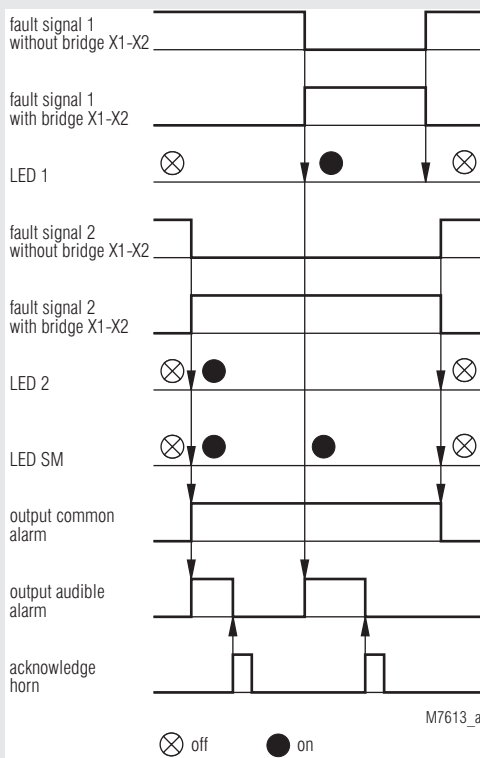
### Extension unit IL 5991, SL 5991:

- 4 inputs with LED on control unit

### Approvals and Markings



### Function Diagram



### Application

For monitoring of industrial plants and buildings

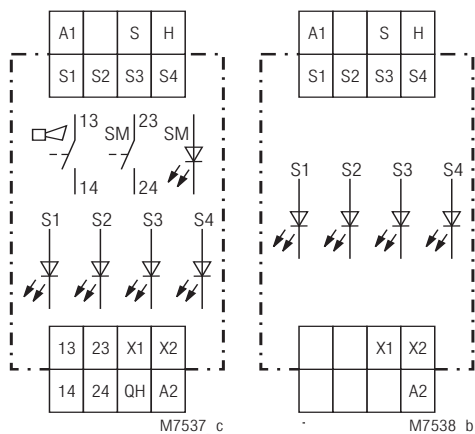
### Notes

The terminals A1, inputs S1 - S4 and the acknowledgement input Q<sub>H</sub> have to be connected at the same phase. The NO contacts 13 - 14 , 23 - 24 have to be connected to the same phase. The bus-circuits H and S have a low voltage and are not allowed to be connected to any external voltage. If inductive or capacitive superimposed voltages are expected from power cables, it is recommended, to use screened cables for these lines. The screen is to be connected to ground.

Bridge X1 - X2 = open circuit operation

A different setting of the fault annunciator IL 5990 and the extension unit IL 5991 is possible.

## Circuit Diagrams



IL 5990, SL 5990

IL 5991, SL 5991

## Connection Terminals

Terminal designation	Signal designation
A1	+ / L
A2	- / N
S1, S2, S3, S4	Measuring input for alarm
X1, X2	Control input for closed - / open circuit operation
QH	Control input for acknowledgement audible alarm
13, 14	Relay output for audible alarm
23, 24	Relay output for common alarm
H	Bus leads audible alarm
S	Bus leads common signal

## Technical Data

### Input

<b>Nominal voltage A1-A2 and inputs S1-S4:</b>	AC 230 V, AC/DC 24 V
<b>Voltage range:</b>	0,8 ... 1,1 U <sub>N</sub>
<b>Nominal consumption:</b>	8 VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Min. time for input signal:</b>	≥ 100 ms
<b>Min. time for acknowledgement:</b>	≥ 200 ms
<b>Operate delay:</b>	1 s, 3 s, 10 s

### Output

**Contacts:** 1 NO contact for common signal and audible alarm

**Thermal current I<sub>th</sub>:** 5 A

### Switching capacity

to AC 15: 1 A / 230 V IEC/EN 60 947-5-1  
to AC 15 at 1 A, AC 230 V: IEC/EN 60 947-5-1

### Electrical life

to AC 15 at 1 A, AC 230 V: ≥ 1,5 x 10<sup>6</sup> switching cycles

### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

**Mechanical life:** ≥ 30 x 10<sup>6</sup> switching cycles

### General Data

**Operating mode:** Continuous operation

**Temperature range:** - 20 ... + 60°C

### Clearance and creepage distances

rated impulse voltage / pollution degree: 4 kV / 2 IEC 60 664-1

### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF-irradiation

80 MHz ... 1 GHz: 10 V / m IEC/EN 61 000-4-3

1 GHz ... 2.7 GHz: 3 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

### Surge voltages

between

wires for power supply: 1 kV IEC/EN 61 000-4-5

between wire and ground: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

### Degree of protection

Housing: IP 40 IEC/EN 60 529

Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplast with V0 behaviour according to UL subject 94

**Vibration resistance:** 0,35 mm Amplitude, frequency 10 ... 55 Hz IEC/EN 60 068-2-6

**Climate resistance:** 20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** EN 50 005

**Terminal designation:** 2 x 2,5 mm<sup>2</sup> solid or

2 x 1,5 mm<sup>2</sup> stranded ferruled

DIN 46 228-1/-2/-3/-4

**Wire connection:** Flat terminals with self-lifting

clamping piece IEC/EN 60 999-1

**Fixing torque:** 0,8 Nm IEC/EN 60 999-1

**Mounting:** DIN rail IEC/EN 60 715

**Weight**

IL 5990: approx. 140 g

IL 5991: approx. 120 g

SL 5990: approx. 170 g

SL 5991: approx. 150 g

### Dimensions

#### Width x height x depth

IL 5990, IL 5991: 35 x 90 x 61 mm

SL 5990, SL 5991: 35 x 90 x 100 mm

## Standard Types

IL 5990 AC 230 V 50 / 60 Hz 1 s  
Article number: 0049188  
SL 5990 AC 230 V 50 / 60 Hz 1 s  
Article number: 0051721  
• Nominal voltage  $U_N$ : AC 230 V  
• Operate delay: 1 s  
• Width: 35 mm

IL 5991 AC 230 V 50 / 60 Hz 1 s  
Article number: 0049189  
SL 5991 AC 230 V 50 / 60 Hz 1 s  
Article number: 0050615  
• Nominal voltage  $U_N$ : AC 230 V  
• Operate delay: 1 s  
• Width: 35 mm

## Ordering example

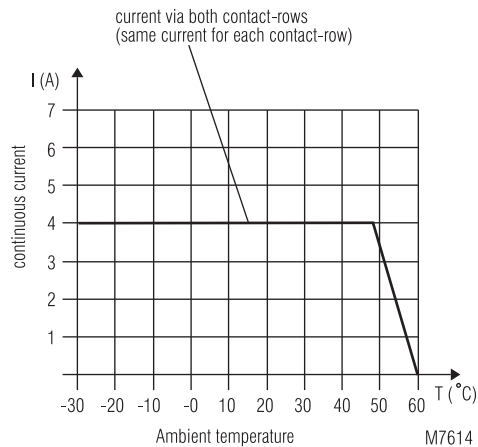
IL 5990 AC 230 V 50 / 60 Hz 1 s

Operate delay  
Nominal frequency  
Nominal voltage  
Type

## Accessories

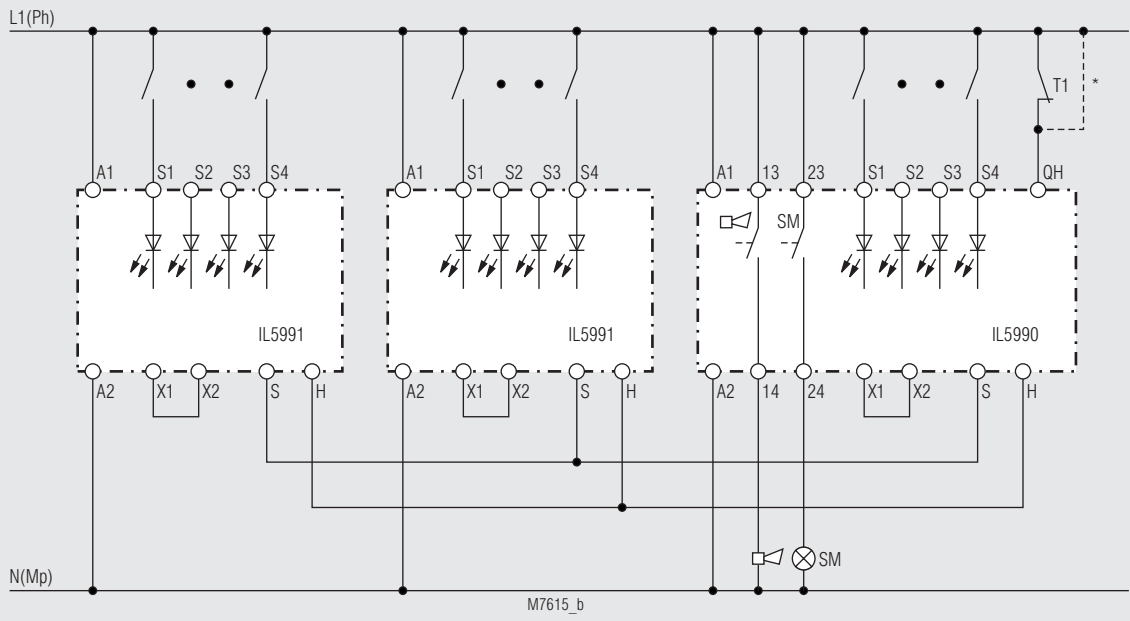
Buzzer IK 8832, SK 8832: Article number: 0049528

## Characteristics



Continuous current-limit curve

## Connection Example



with bridge X1/X2 open circuit operation  
without bridge X1/X2 closed circuit operation

T1 external acknowledgement push button for audible alarm  
\* without external acknowledgement push button has to be replaced by a bridge



0262840



**Compact fault monitoring system with bus**  
for intelligent, fast and cost saving failure diagnostics.

Available as **common alarm system** or system with programmable function **new signal -**, **first signal -**, and **common alarm annunciator**

#### Your Advantage

- **cost saving:** Reduction of standstill times in production
- **expandable:** up to 88 inputs decentralised via bus
- **flexible:** usage as new- / first- / common signal annunciator
- **all in one:** external buzzer and display units are available as accessoires
- **Far away but easy to reach:** with the GSM-Module you receive fault messages and acknowledge them by SMS using your mobile phone.

#### Additional Information about this topic

- Informations about the additional Base module, Extension module and Display unit see datasheet RP 5990, RP 5991 and RP 5994, RP 5995
- Information about the additional text display unit see data sheet EH 5996
- Informations about the additional GSM-module for alarm and reset via SMS see datasheet RP 5810

#### Approvals and Markings



#### Application

- In building applications, e.g. heating, air conditioning, elevators, escalators, doors, Gates, etc.
- In machines and plants, e.g. process monitoring, emergency power supplies, pumping stations, water treatment, sewage water treatment

#### Description

The main feature of the modular fault annunciator system INFOMASTER B is the bus structure. It allows easy expansion of the system and adoption to new application requirements.

If INFOMASTER B is used only as common alarm annunciator system the RP 5990 is the base unit.

For flexible use with first-, new signal or common alarm monitoring the RP 5994 is the base unit.

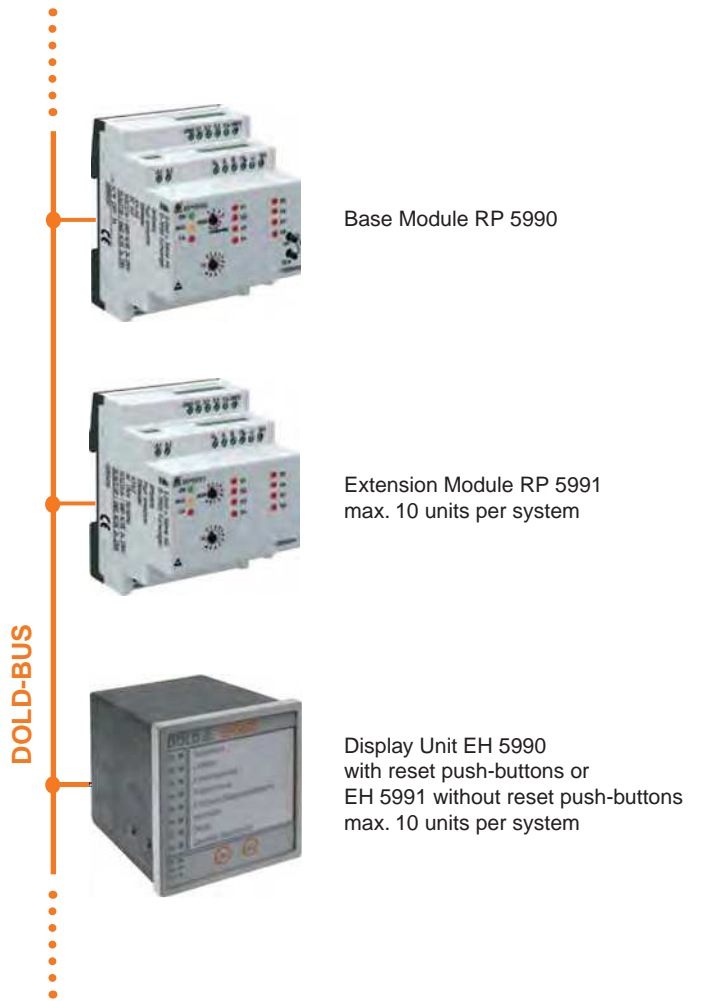
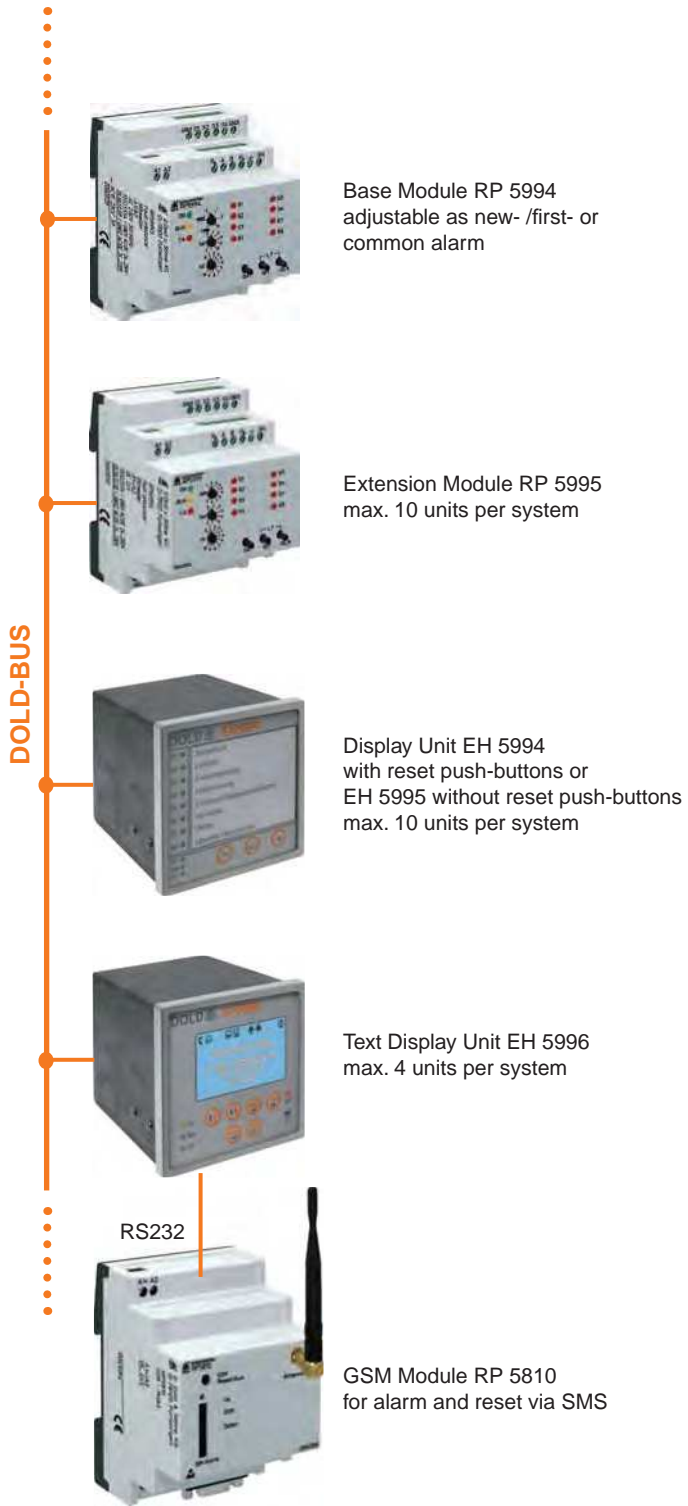
On both modules the number of inputs can be expanded by adding up to 10 extension modules and up to 10 indicator modules.

When using the base module RP 5994 4 text display modules EH5996 can be integrated.

The EH 5996 includes a RS232 interface to connect a GSM module RP 5810. This allows to communicate coming and going fault signal messages to predefined receivers.

for new- /first- and common alarm

only for common alarm





### Common Alarm Annunciator RP 5990, RP 5991

- Fast localisation of failures and their causes
- Reduction of standstill times in production
- Common alarm annunciator with manual or auto reset of faults
- Expandable from 8 to 88 fault signals
- Open or closed circuit operation settable with rotational switch on base unit and with link X1/X2 on extension units
- Adjustable on delay for input signals 0 to 10 sec
- Reset buttons for audible alarm and common alarm on front side
- Connection for external reset of audible alarm
- Galvanic separation to bus RS485 (optional)
- Accessories: buzzer RK 8832, display unit EH 5990, EH 5991
- Width: 70 mm

### • Base Module RP 5990:

- 8 fault signal inputs with indicator LED on the unit
- One relay output each for audible alarm and common alarm
- Reset buttons for audible alarm and common alarm
- Connection for external reset of audible alarm

### • Extension Module RP 5991:

- 8 fault signal inputs with indicator LED on the unit
- As option one relay output each for audible alarm and common alarm
- As option reset buttons for audible alarm and common alarm

### Display Unit EH 5990, EH 5991

- Exchangable front label for individual legending
- As option galvanic separated RS485 bus
- Protection degree for front side IP64
- Enclosure for flush mounting 96 x 96 mm

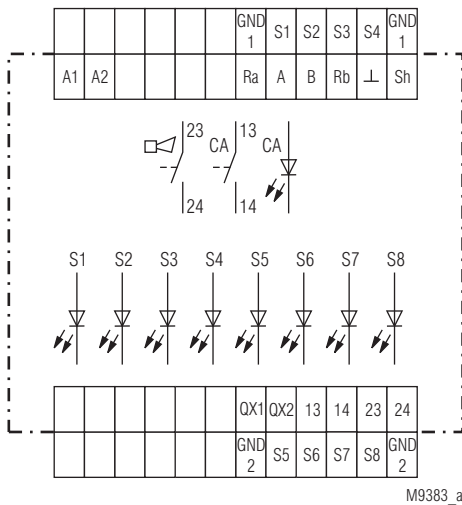
### • Display Unit EH 5990:

- 8 fault signal LEDs on the unit
- Reset buttons for audible alarm and common alarm

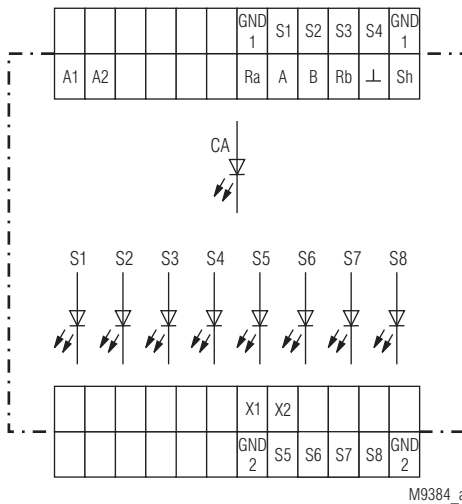
### • Display Unit EH 5991:

- 8 fault signal LEDs on the unit
- Without reset buttons

### Circuit Diagrams



RP 5990



RP 5991

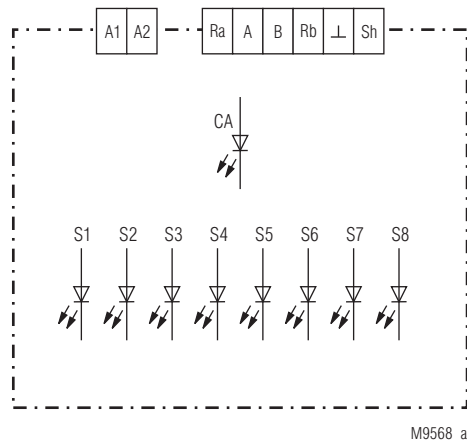
### Additional Information about this topic

General Information for INFOMASTER B see data sheet INFOMASTER B, Systemoverview

### Approvals and Markings

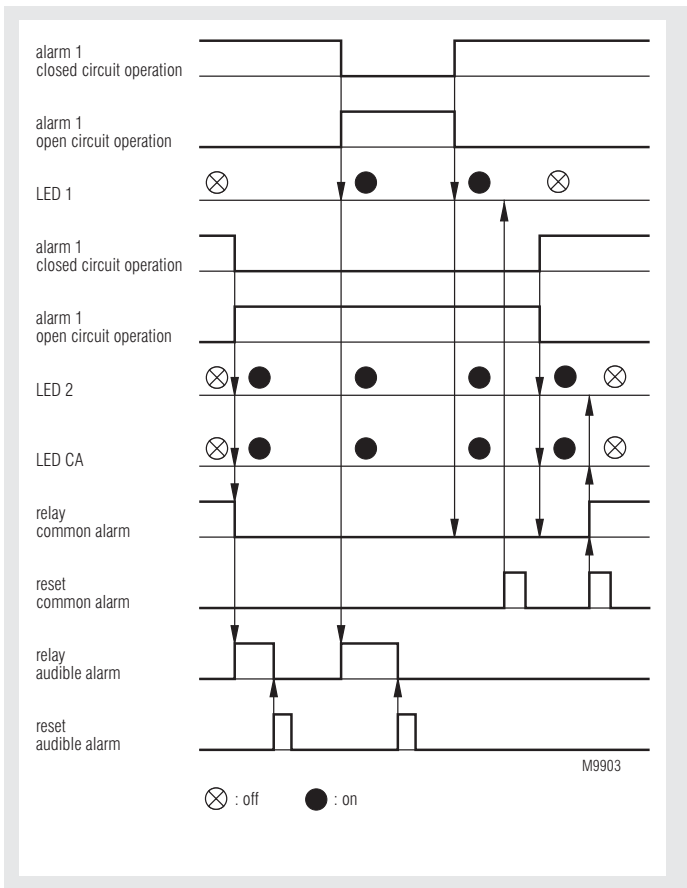


### Circuit Diagram

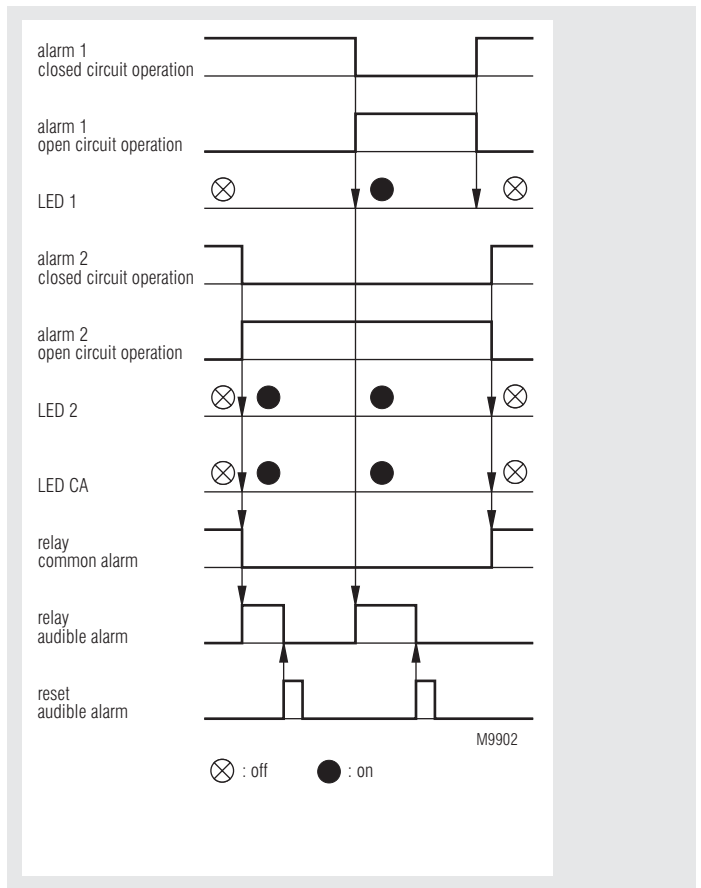


EH 5990, EH 5991

## Function Diagram (Faults with Manual Reset)



## Function Diagram (Faults with Auto Reset)



### Indication

LED green „ON“:	on when supply connected
LED red „CA“:	on when output common alarm active
LED yellow „BUS“:	on when bus active
LEDs red S1 ... S8	on when fault annunciator active

### Setting and Adjustment

#### Wiring

Devices with DC 24V auxiliary supply have to be operated on a galvanic separated power supply.

#### Configuration Cycle

- 1.) Wire the system
- 2.) Adjust module address on extension modules with switch "ADR" (different addresses for all modules)
- 2.1) When display units are integrated into the annunciator system the address setting of each display unit has to be done as follows
  - if the display unit should display the state of the base module (RP 5990) set "MODE" switch on back of the unit to position "Basismodul" and adjust an address that is not used by any other display unit.
  - if the display unit should display the state of an extension module (RP 5991) set "MODE" switch on back of the unit to position "Erw.modul" and adjust the same address as on the extension module (RP 5991) of which the status should be displayed.
- 3.) Set "MODE" switch on base module to position "Config"
- 4.) Choose input mode on extension modules:  
Terminals X1/X2 open = open circuit operation  
Terminals X1/X2 linked = closed circuit operation
- 5.) Set delay on switch, „td“ 0 ... 10 s
- 6.) Power up the system
- 7.) Fault signal LEDs of the base module are flashing for some time
- 8.) On the detected extension modules the fault signal LEDs are now flashing
- 9.) Fault signal LEDs change to continuous state and indicate number of detected extension modules in binary code
- 10.) The detected modules are stored no voltage safe in the base module memory. The fault annunciator only works with the detected modules. If a new module is added, the configuration cycle has to be run again.
- 11.) Select the required alarm function with switch "MODE" on the base module
- 12.) Press push buttons QH and QHC to leave the configuration mode.

## Setting and Adjustment

### Functions of Switch „MODE“

switch „MODE“	description
0	Common alarm annunciator alarm manual reset, inputs open circuit operation
1	Common alarm annunciator alarm auto reset, inputs open circuit operation
2	Common alarm annunciator alarm manual reset, inputs closed circuit operation
3	Common alarm annunciator alarm auto reset, inputs closed circuit operation
Configuration	Configuration


### Lamp Test


Pressing the pushbuttons QH and QCA simultaneously during normal operation will force a lamp test function (LT). During lamp test all fault signal LEDs are switched on.


### Fault Diagnostics


To indicate failures of the system the unit generates a flash code on the Bus LED. When a failure code 1 to 3 is displayed, the contacts of the common alarm relay switch off.


LED continuously on: System has no failure

Failure 1  : Configuration failure. One or more extension modules, that have been detected during configuration do not exist anymore. The address of the first missing extension module is displayed as binary code on the fault signal LEDs.

Failure 2  : The base module cannot communicate with the extension modules. The address of the first extension module that cannot communicate with the base module is displayed as binary code on the fault signal LEDs.

Failure 3  : The bus wire is interrupted or the bus is not terminated correctly. The base module does not find any extension modules to communicate with.

Failure 4  : In normal operation: the configuration data has been found faulty. A new configuration cycles has to be run.  
During configuration: the detected configuration data could not be stored.

Failure 5  : New modules unknown to the device software of the base module have to be implemented by a firmware update of the base module.

**Remark:** Different types of devices (device classes) can be connected to the annunciator bus e.g. extension modules RP 5990, display units EH 5990, EH 5991 etc. The base module detects the different module types and adds a device specific number to the adjusted bus module address (address offset). In the case of failure this added number is indicated as binary code on the LEDs of the base module.

Device class	address offset	modules
Extension modules	+ 0	RP 5991
Display unit	+ 10	EH 5990, EH 5991

## Technical Data

### Input

<b>Nominal voltage A1-A2:</b>	AC 230 V, DC 24 V
<b>Voltage range:</b>	0.8 ... 1.1 U <sub>N</sub>
<b>Nominal consumption A1-A2</b>	
at AC 230 V:	3.4 VA
at DC 24 V:	1.1 W
<b>Nominal frequency A1-A2</b>	
at AC 230 V:	50 Hz

### Fault Signal Inputs (only for RP 5990, RP 5991)

<b>Fault signal inputs S1...S8:</b>	AC/DC 24 ... 230 V
<b>Min. time for input signal:</b>	≥ 70 ms
<b>Min. time for acknowledgement:</b>	≥ 70 ms
<b>Operate delay</b>	setting with potentiometer 0 ... 10 s

### Output (only for RP 5990, RP 5991)

<b>Contacts:</b>	1 NO contact each for output common alarm and horn
<b>Thermal current I<sub>th</sub>:</b>	2 A
<b>Switching capacity</b>	
according to AC 15:	3 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b>	
to AC 15 at 1 A, AC 230 V:	≥ 1.5 x 10 <sup>5</sup> sw. cycles IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>Max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	≥ 30 x 10 <sup>6</sup> switching cycles

### RS485 Bus

RP 599_, EH 599_:	not isolated
RP 599_/1_ __, EH 599/1_ __:	isolated (1KV)
<b>Bus wire:</b>	screened twisted pair
<b>Data transmission rate:</b>	115.2 KB/s
<b>Attention: both ends of the twisted pair have to be terminated by inserting the links A/Ra and B/Rb!</b>	

### General Data

<b>Nominal operating mode:</b>	continuous operation
<b>Temperature range:</b>	- 20 ... + 55°C
<b>clearance and creepage distance</b>	
rated impulse voltage / pollution degree	
relay output:	4 kV / 2 IEC 60 664-1
input:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltage between	
wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection RP 5990, RP 5991</b>	IEC/EN 60 529
Housing	
Cover:	IP 40
Base:	IP 30
Terminals:	IP 20
<b>Degree of protection EH 5990, EH 5991</b>	IEC/EN 60 529
Front:	IP 67
Enclosure:	IP 20
<b>Enclosure:</b>	thermoplastic with VO behaviour according to UL Subject 94
<b>Vibration resistance:</b>	0.35 mm amplitude, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 055 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005

## Technical Data

<b>Wire connection</b>	DIN 46 228/1-/2-/3-/4
fixed screw terminal (S):	0.2 ... 4 mm <sup>2</sup> solid or 0.2 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
plug-in screw terminal (PS):	0.1 ... 2.5 mm <sup>2</sup> solid or 0.1 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
plug-in cage clamp terminals (PC):	0.2 ... 2.5 mm <sup>2</sup> solid or 0.2 ... 1.5 mm <sup>2</sup> stranded wire with sleeve

### Wire fixing

fixed screw terminals (S),  
plug-in screw terminals (PS): Captive plus-minus-terminal screws  
M2.5 with self raising terminal box

plug-in cage clamp terminals (PC): cage clamp terminals for directly  
plug-in of conductors  
Screwdriver 0.6 x 3.5 for removing  
of the cage-clamp

**Mounting:** DIN-rail IEC/EN 60 715

### Weight

RP 5990 S:	260 g
RP 5991 S:	240 g
EH 5990, EH 5991	
AC 230 V-version:	285 g
DC 24 V-version:	210 g

### Dimensions

#### Width x height x depth:

RP 5990, RP 5991:	70 x 90 x 71 mm
EH 5990, EH 5991:	96 x 96 x 60.5 mm

### Standard Types

RP 5990 S AC 230 V 50 Hz

Article number: 0059452

RP 5991 S AC 230 V 50 Hz

Article number: 0059456

- Nominal voltage  $U_N$ : AC 230 V
- fixed screw terminals
- Width: 70 mm

EH 5990 AC 230 V 50 Hz

Article number: 0060581

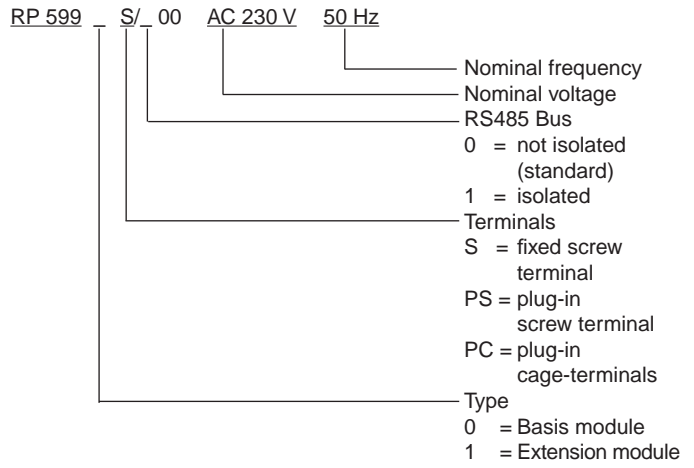
- Nominal voltage  $U_N$ : AC 230 V
- Reset buttons for audible alarm and common alarm on front side
- Width: 96 mm

EH 5991 AC 230 V 50 Hz

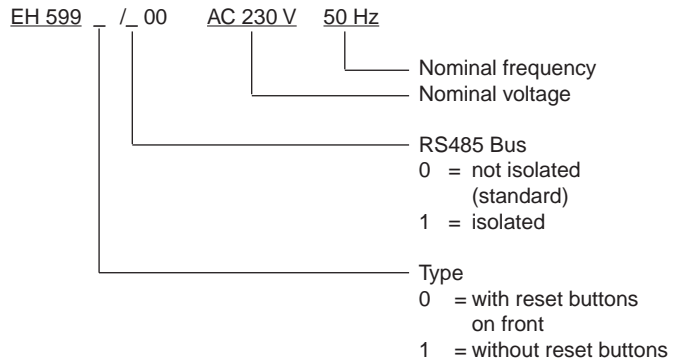
Article number: 0060585

- Nominal voltage  $U_N$ : AC 230 V
- Without reset buttons
- Width: 96 mm

### Ordering Example for RP 599\_



### Ordering Example for EH 599\_

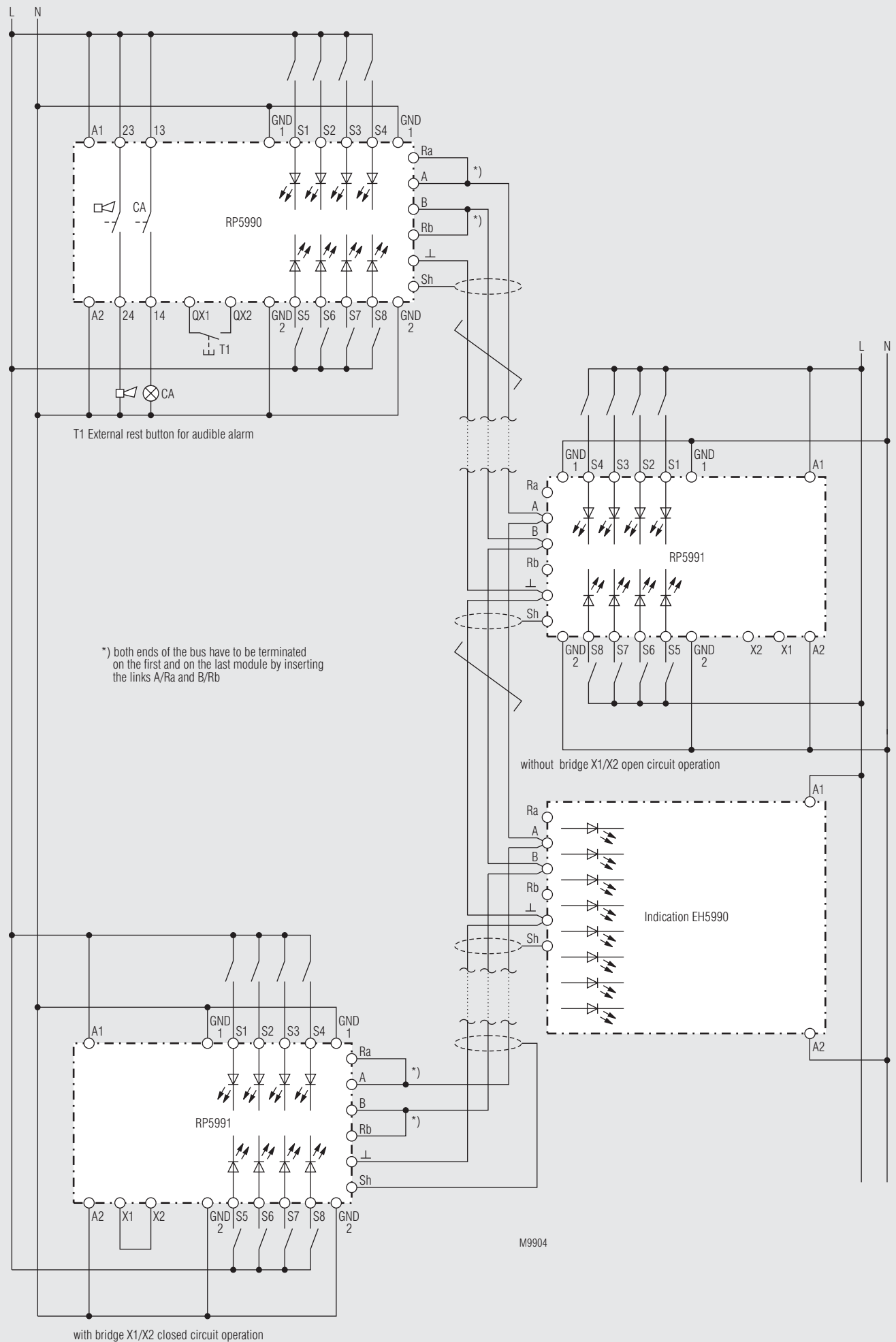


### Accessories

Buzzer RK 8832

Article number: 0059906

# Connection Example





### New- / First- /Common Signal Annunciator RP 5994, RP 5995

- Fast localisation of failures and their causes
- Reduction of standstill times in production
- Adjustable operating modes:  
New- / First signal annunciator according to DIN 19 235,  
common alarm annunciator manual reset / auto reset settable
- Expandable from 8 to 88 fault signals
- Open or closed circuit operation settable
- Adjustable on delay for input signals 0 to 10 sec
- Reset buttons for audible alarm and common alarm on front side
- Connection for external reset of audible alarm, common alarm and single alarm according to setting
- Galvanic separation to bus RS485 (optional)
- Accessories: buzzer RK 8832, display unit EH 5994, EH 5995  
text display unit EH 5996, GSM-module RP 5810
- Width: 70 mm

### Base module RP 5994:

- 8 fault signal inputs with indicator LED on the unit
- One relay output each for audible alarm and common alarm
- Reset buttons for audible alarm, common alarm, and single alarm
- Connection of remote reset button. Function according to setting

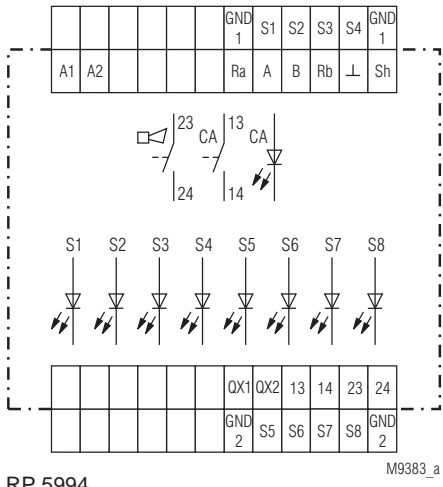
### Extension module RP 5995:

- 8 fault signal inputs with indicator LED on the unit
- One relay output each for audible alarm and common alarm (on request)
- Reset buttons for audible alarm, common alarm, and single alarm
- Connection of remote reset button. Function according to setting

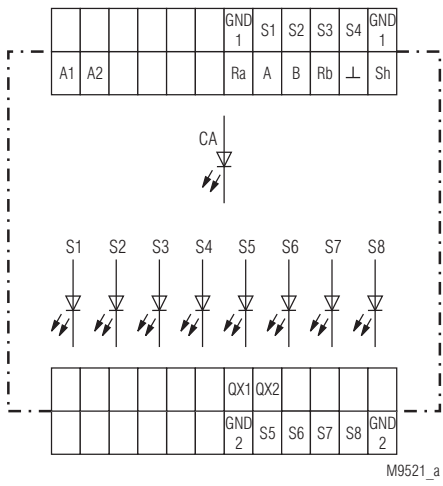
### Display unit EH 5994, EH 5995

- Exchangable front label for individual legending
- As option galvanic separated RS458 bus
- Protection degree for front side IP 64
- Enclosure for flush mounting 96 x 96 mm
- **Display unit EH 5994:**
  - 8 fault signal LEDs on the unit
  - Reset buttons for audible alarm, common alarm and alarm signal
- **Display unit EH 5995:**
  - 8 fault signal LEDs on the unit
  - Without reset buttons

### Circuit Diagrams



RP 5994 M9383\_a



RP 5995 M9521\_a

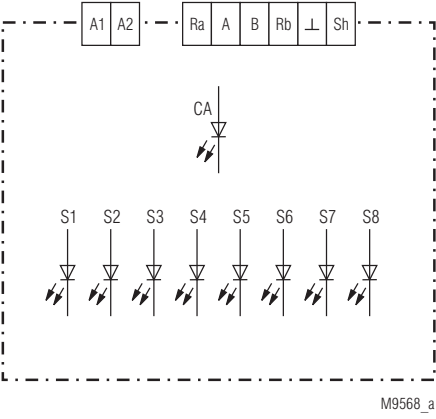
### Additional Information about this topic

- General information for INFOMASTER B see data sheet INFOMASTER B, System overview
- Information about the additional text display unit see data sheet EH 5996
- Information about the additional GSM-module for alarm and acknowledgement per SMS see data sheet RP 5810

### Approvals and Markings



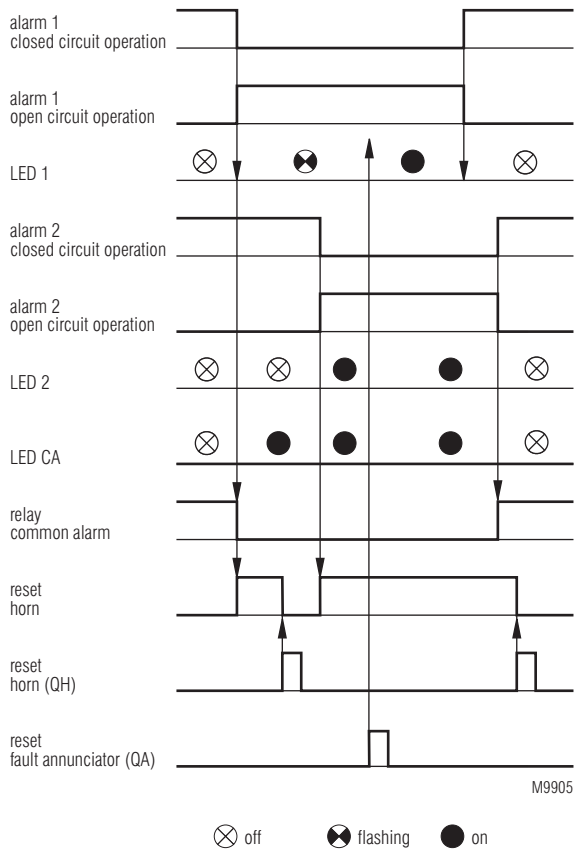
### Circuit Diagram



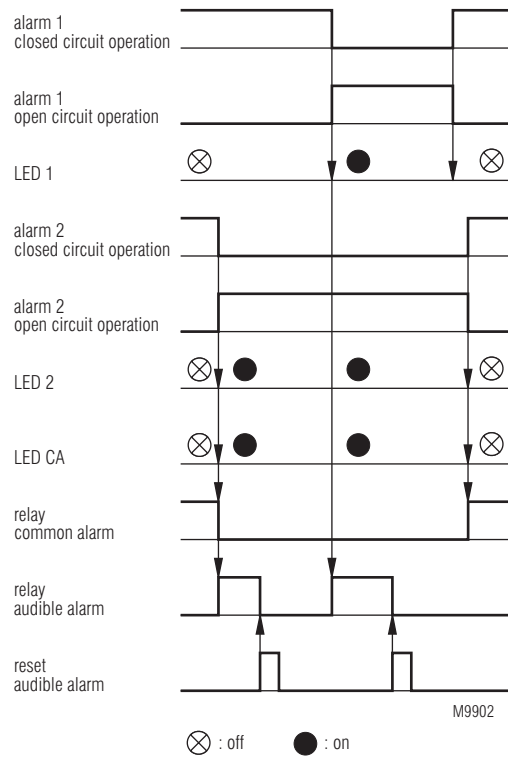
EH 5994, EH 5995 M9568\_a



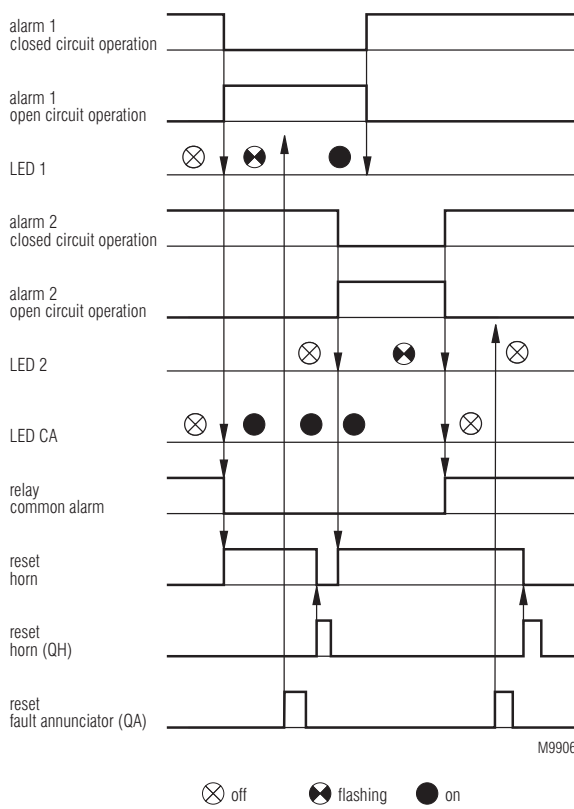
**Function Diagram (First Signal Annunciator)**



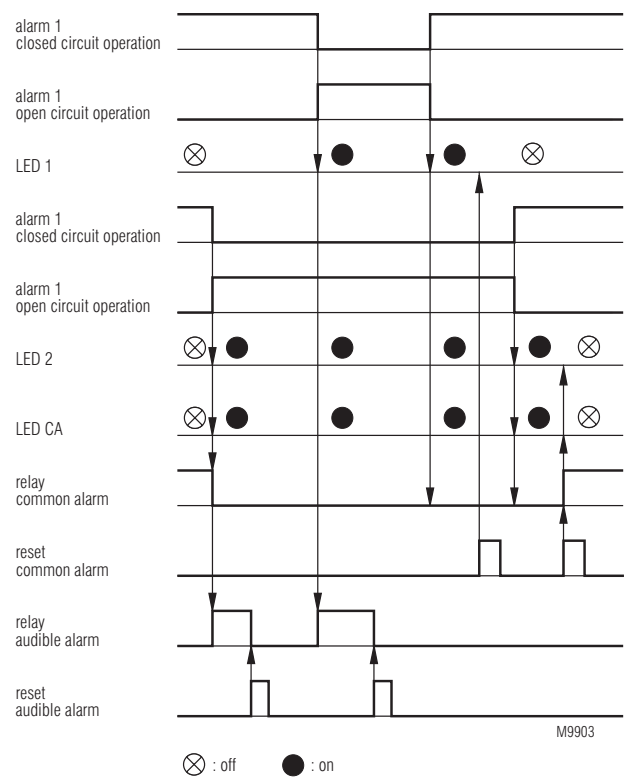
**Function Diagram (Common Alarm Annunciator, Auto Reset)**



**Function Diagram (New Signal Alarm Annunciator)**



**Function Diagram (Common Alarm Annunciator Manual Reset)**



## Setting and Adjustment

### Wiring

Devices with DC 24V auxiliary supply have to be operated on a galvanic separated power supply.

### Configuration Cycle

- 1.) Wire the system
- 2.) Adjust module address on extension modules with switch "ADR" (different addresses for all modules)
- 2.1) When display units are integrated into the annunciator system the address setting of each display unit has to be done as follows
  - if the display unit should display the state of the base module (RP 5994) set "MODE" switch on back of the unit to position "Basismodul" and adjust an address that is not used by any other display unit.
  - if the display unit should display the state of an extension module (RP 5995) set "MODE" switch on back of the unit to position "Erw.modul" and adjust the same address as on the extension module (RP 5995) of which the status should be displayed.
- 3.) Set "MODE" switch on base module to position "Config"
- 4.) Choose input mode on extension modules:  
Terminals X1/X2 open = open circuit operation  
Terminals X1/X2 linked = closed circuit operation
- 5.) Set delay on switch, „td“ 0 ... 10 s
- 6.) Power up the system
- 7.) Fault signal LEDs of the base module are flashing for some time
- 8.) On the detected extension modules the fault signal LEDs are now flashing
- 9.) Fault signal LEDs change to continuous state and indicate number of detected extension modules in binary code
- 10.) The detected modules are stored no voltage safe in the base module memory. The fault annunciator only works with the detected modules. If a new module is added, the configuration cycle has to be run again.
- 11.) Select the required alarm function with switch "MODE" on the base module
- 12.) Press push buttons QH and QHC to leave the configuration mode.

### Function Switch „MODE“

switch „MODE“	description
0	First fault signal
1	New fault signal
2	Common alarm manual reset
3	Common alarm auto reset
Config.	Configuration

### Function Switch „Set“

Switch „Set“	Function of QX1 / QX2				Function principle of fault signal inputs	
	Alarm reset QA	Audible alarm reset QH	Common alarm reset QCA	Lamp test LT	open circuit operation	closed circuit operation
0	✓	-	-	-	✓	-
1	-	✓	-	-	✓	-
2	-	-	✓	-	✓	-
3	-	-	-	✓	✓	-
4	✓	-	-	-	-	✓
5	-	✓	-	-	-	✓
6	-	-	✓	-	-	✓
7	-	-	-	✓	-	✓

## Setting and Adjustment

### Possible Alarm Modes:

Alarm annunciator	Alarm reset QA	Audible alarm reset QH	Common alarm reset QCA
New signal alarm annunciator	✓	✓	-
First signal annunciator	✓	✓	-
Common alarm annunciator manual reset	✓	✓	✓
Common alarm annunciator auto reset	-	✓	-

- : this setting ist not supported by the module

### Lamp Test


Pressing the pushbuttons QH and QCA simultaneously during normal operation will force a lamp test function (LT). During lamp test all fault signal LEDs are switched on.


The lamp test function can also be operated by bridging the terminal QX1/QX2 (connection remote reset) if this function is selected on switch "Set" for QX1/QX2


### Fault Diagnostics


To indicate failures of the system the unit generates a flash code on the Bus LED. When a failure code 1 to 3 is displayed, the contacts of the common alarm relay switch off.


LED continuously on: System has no failure

Failure 1  : Configuration failure. One ore more extension modules, that have been detected during configuration do not exist anymore. The address of the first missing extension module is displayed as binary code on the fault signal LEDs.

Failure 2  : The base module cannot communicate with the extension modules. The address of the first extension module that cannot communicate with the base module is displayed as binary code on the fault signal LEDs.

Failure 3  : The bus wire is interrupted or the bus is not terminated correctly. The base module does not find any extension modules to communicate with.

Failure 4  : In normal operation: the configuration data has been found faulty. A new configuration cycles has to be run. During configuration: the detected configuration data could not be stored.

Failure 5  : New modules unknown to the device software of the base module have to be implemented by a firmware update of the base module.



**Remark:** Different types of devices (device classes) can be connected to the annunciator bus e.g. extension modules RP 5995, display units EH 5994, EH 5995 etc. The base module detects the different module types and adds a device specific number to the adjusted bus module address (address offset). In the case of failure this added number is indicated as binary code on the LEDs of the base module.

Max. 4 text display units EH 5996 can be connected to the Base module RP 5994.

These 4 units has to be designation by adresse 0 up to 3

Device class	adress offset	modules
Extension modules	+ 0	RP 5995
Display unit	+ 10	EH 5994, EH 5995
Textdisplay unit	+ 20	EH 5996

## Technical Data

### Input

<b>Nominal voltage A1-A2:</b>	AC 230 V, DC 24 V
<b>Voltage range:</b>	0.8 ... 1.1 U <sub>N</sub>
<b>Nominal consumption A1-A2</b>	
at AC 230 V:	3.4 VA
at DC 24 V:	1.1 W
<b>Nominal frequency A1-A2</b>	
at AC 230 V:	50 Hz

### Fault Signal Inputs (only for RP 5994, RP 5995)

<b>Fault signal inputs S1...S8:</b>	AC/DC 24 ... 230 V
<b>Min. time for input signal:</b>	≥ 70 ms
<b>Min. time for acknowledgement:</b>	≥ 70 ms
<b>Operate delay</b>	setting with poti 0 ... 10 s

### Output (only for RP 5994, RP 5995)

<b>Contacts:</b>	1 NO contact each for output common alarm and horn
<b>Thermal current I<sub>th</sub>:</b>	2 A
<b>Switching capacity</b> according to AC 15:	3 A / AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 1 A, AC 230 V:	≥ 1.5 x 10 <sup>5</sup> sw. cycles IEC/EN 60 947-5-1
<b>Short circuit strength</b>	
<b>Max. fuse rating:</b>	4 A gL IEC/EN 60 947-5-1
<b>Mechanical life:</b>	≥ 30 x 10 <sup>6</sup> switching cycles

### RS485 Bus

RP 599_, EH 599_:	not isolated
RP 599_/1_-, EH 599/1_-:	isolated (1KV)
<b>Bus wire:</b>	screened twisted pair
<b>Data transmission rate:</b>	115.2 KB/s
<b>Attention: both ends of the twisted pair have to be terminated by inserting the links A/Ra and B/Rb!</b>	

### General Data

<b>Nominal operating mode:</b>	continuous operation
<b>Temperature range:</b>	- 20 ... + 55°C
<b>clearance and creepage distance</b>	
rated impulse voltage / pollution degree	
relay output:	4 kV / 2 IEC 60 664-1
input:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection RP 5994, RP 5995:</b>	IEC/EN 60 529
Housing	
Cover:	IP 40
Base:	IP 30
Terminals:	IP 20
<b>Degree of protection EH 5994, EH 5995:</b>	IEC/EN 60 529
Front:	IP 64
Enclosure:	IP 20
<b>Enclosure:</b>	thermoplastic with VO behaviour according to UL Subjekt 94
<b>Vibration resistance:</b>	0.35 mm amplitude, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6 20 / 055 / 04 IEC/EN 60 068-1
<b>Climate resistance:</b>	
<b>Terminal designation:</b>	EN 50 005 DIN 46 228/1-/-2/-3/-4
<b>Wire connection</b>	
fixed screw terminal (S):	0.2 ... 4 mm <sup>2</sup> solid or 0.2 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
plug-in screw terminal (PS):	0.1 ... 2.5 mm <sup>2</sup> solid or 0.1 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
plug-in cage clamp terminals (PC):	0.2 ... 2.5 mm <sup>2</sup> solid or 0.2 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
<b>Wire fixing</b>	
fixed screw terminals (S), plug-in screw terminals (PS):	Captive plus-minus-terminal screws M2.5 with self raising terminal box

## Technical Data

plug-in cage clamp terminals (PC):

cage clamp terminals for directly plug-in of conductors  
Screwdriver 0.6 x 3.5 for removing of the cage-clamp  
DIN-rail IEC/EN 60 715

### Mounting:

<b>Weight</b>	
RP 5994 S:	260 g
RP 5995 S:	240 g
EH 5994, EH 5995	
AC 230 V-versions:	285 g
DC 24 V-versions:	210 g

### Dimensions

<b>Width x height x depth:</b>	
RP 5994, RP 5995:	70 x 90 x 71 mm
EH 5994, EH 5995:	96 x 96 x 60.5 mm

### Standard Types

RP 5994 S AC 230 V 50 Hz	
Article number:	0060029
RP 5995 S AC 230 V 50 Hz	
Artikelnummer:	0060034
• Nominal voltage U <sub>N</sub> :	AC 230 V
• fixed screw terminals	
• Width:	70 mm
EH 5994 AC 230 V 50 Hz	
Article number:	0060589
• Nominal voltage U <sub>N</sub> :	AC 230 V
• Reset buttons for audible alarm and common alarm on front side	
• Width:	96 mm
EH 5995 AC 230 V 50 Hz	
Article number:	0060593
• Nominal voltage U <sub>N</sub> :	AC 230 V
• Without reset buttons	
• Width:	96 mm

### Ordering Example for RP 599\_

RP 599	S/	00	AC 230 V	50 Hz	
					Nominal frequency
					Nominal voltage
					RS485 Bus
					0 = not isolated (standard)
					1 = isolated
					Terminals
					S = fixed screw terminal
					PS = plug-in screw terminal
					PC = plug-in cage-terminals
					Type
					4 = Basis module
					5 = Extension module

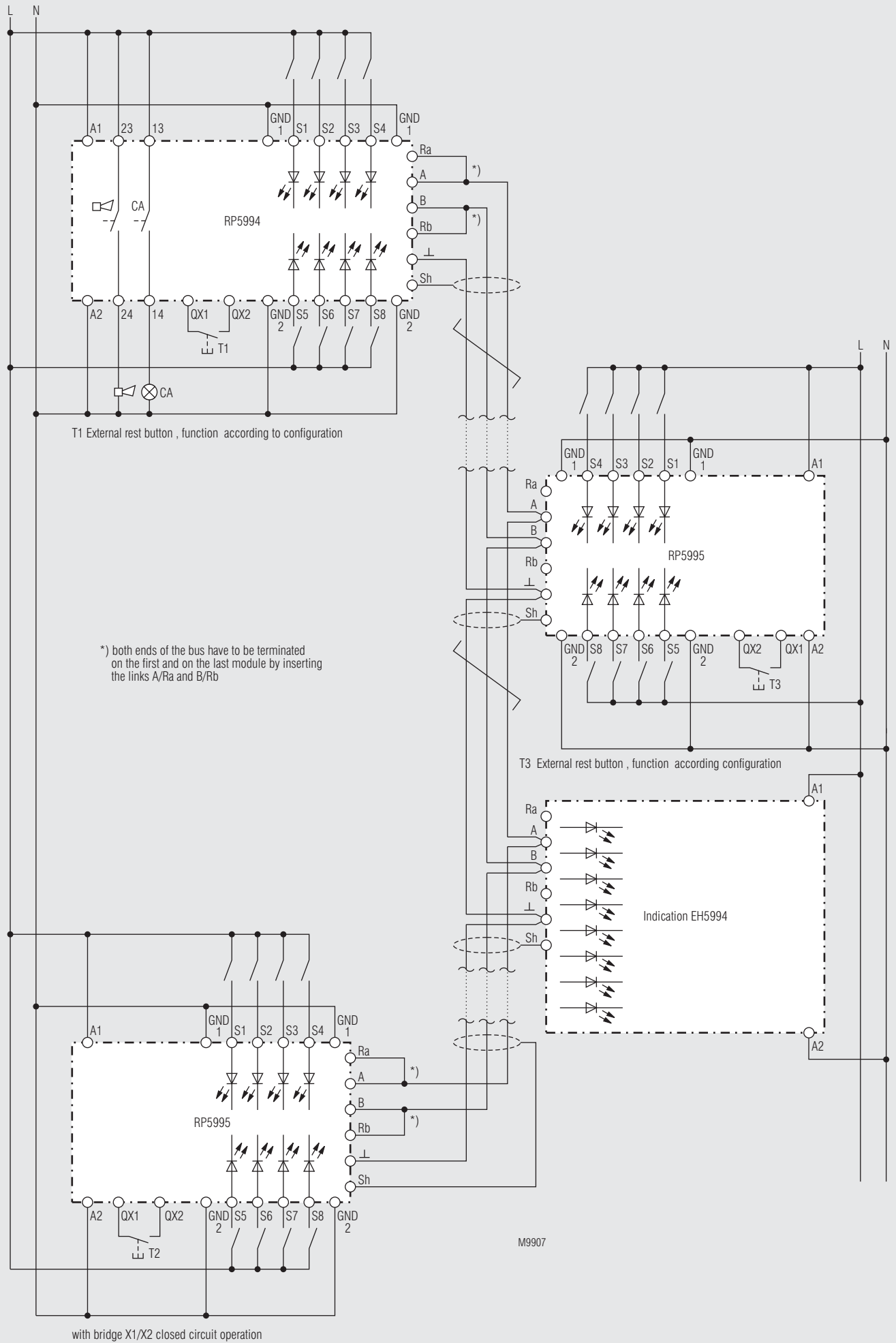
### Ordering Example for EH 599\_

EH 599	/	00	AC 230 V	50 Hz	
					Nominal frequency
					Nominal voltage
					RS485 Bus
					0 = not isolated (standard)
					1 = isolated
					Type
					4 = with reset buttons on front
					5 = without reset buttons

### Accessories

Buzzer RK 8832:	Article number: 0059906
Text Display Unit EH 5996	Article number: 0061784

# Connection Example



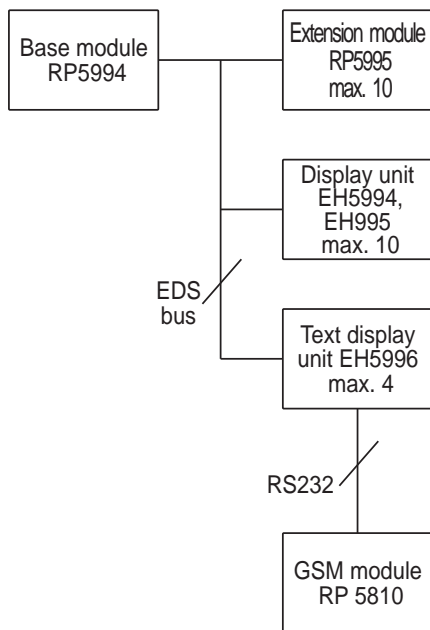
\*) both ends of the bus have to be terminated on the first and on the last module by inserting the links A/Ra and B/Rb



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### System Overview

In one fault monitoring system INFOMASTER B with one base module RP 5994 up to 4 text displays EH 5996 can be operated. In addition it is possible to connect 10 extension modules RP 5995 and 10 Display units EH 5994 or EH 5995. Via the RS232 interface on EH 5996 a GSM Module RP 5810 can be controlled, that transfers SMS on coming or going fault signals to pre-defined receivers.



M9915\_a

### Your Advantages

- Easy to extend up to 10 displays because of bus connection
- Easy to change the operating language for menus and failure text

### Features

- Text display for DOLD fault annunciator system INFOMASTER B with base module RP 5994
- To display up to 88 fault messages with 80, 40 or 20 characters each
- Operating mode adjustable on base module RP 5994 for new, first or common alarm
- Reset buttons for individual alarm signal, audible alarm and common alarm on front side
- RS 485 bus connection, as option with galvanic separation
- Alarms and resets can be transmitted by SMS via GSM module RP 5810
- SMS communication is possible with up to 16 receivers
- Configuration of the text display via USB-Stick (accessories OA 5996 Article-No. 0065659), therefore no laptop on site is necessary
- Real time clock
- Operating language for menus and failure text in English, German and French
- Up to 3 variable parameters in one message text
- 2 password levels for device configuration

### Approvals and Markings



### Additional Information about this topic

- General information for INFOMASTER B see datasheet INFOMASTER B, systemoverview
- Informations about the additional Base module, Extension module and Display unit see datasheet RP 5994, RP 5995
- Informations about the additional GSM-module for alarm and reset via SMS see datasheet RP 5810

### Application

- To monitor industrial plants and buildings
- For fast localisation of failures and their causes
- For reduction of standstill times in production

### Indication

green LED „ON“:	on when supply connected
red LED „CA“:	on, when output common alarm is active
yellow LED „BUS“:	on, when bus is active

## Setting and Adjustment

### Wiring






Devices with DC 24V auxiliary supply have to be operated on a galvanic separated power supply.

### Configuration cycle

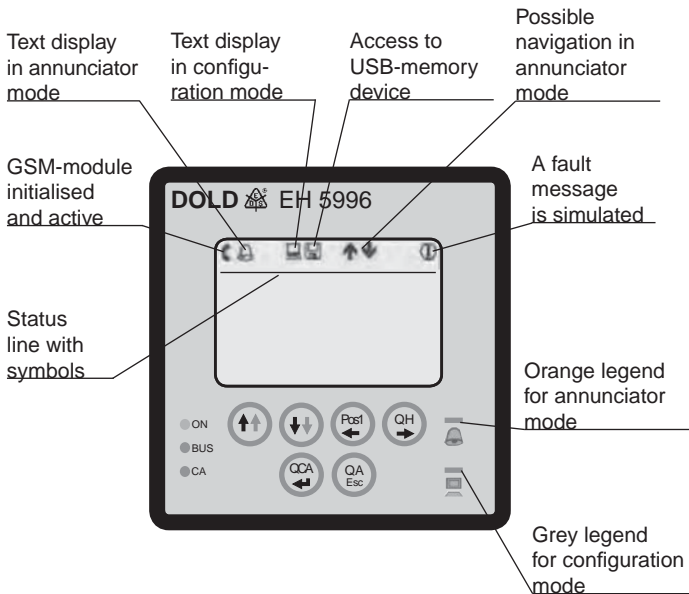
- 1.) Wire the system
- 2.) Adjust module address on all connected modules with switch "ADR" (different addresses for all modules)
- 3.) Set "MODE" switch on base module to position "Config"
- 4.) Power up the system
- 5.) While fault signal LEDs of the base module are flashing
- 6.) the text display Eh 5996 detected by the base module RP 5994 shows the following text:  
„**System is in configuration mode module has been detected on bus**“
- 7.) Fault signal LEDs change to continuous state and indicate number of detected extension modules in binary code
- 8.) The detected modules are stored no voltage safe in the base module memory. The fault annunciator only works with the detected modules. If a new module is added, the configuration cycle has to be run again.
- 9.) Configuration of the text display unit (see user manual)

## Operation of Text Display Unit

The text display is either in annunciator or configuration mode. A symbol in the status line of the display indicates the mode (see table and drawing below). Depending on the actual mode the pushbuttons on the front have a different function. In annunciator mode the orange legend is valid and in configuration the grey legend.








	Symbols in status line
	GSM module is initialised and ready
	Annunciator mode
	Configuration mode
	Reading from or writing to USB-memory device
	Simulation mode

### Description text display unit EH 5996



## Operation of Text Display Unit

### Function of Push Buttons

	Annunciator mode	Configuration mode
	Previous active fault message	one menu item up or increase value in data entry field
	Next active fault message	one menu item down or decrease value in data entry field
	Beginning of active messages list	one character to the left in data entry field
	Acknowledging the audible alarm	one character to the right in data entry field
	Acknowledging the common alarm	select menu item or confirm entered data
	Acknowledging alarm message	cancel changes and leave data entry field
	Change into configuration mode	

### SMS Function

In conjunction with the GSM module RP 5810 the text display can transmit SMS on coming and going alarm messages. For each alarm message an SMS text each for coming and going can be defined together with max. 16 possible receivers. Also it is possible to enable receivers out of the possible 16 to acknowledge alarms.

## Technical Data

### Input

<b>Nominal voltage A1-A2:</b>	AC 230 V, DC 24 V
<b>Voltage range:</b>	0.8 ... 1.1 U <sub>N</sub>
<b>Nominal consumption A1-A2</b>	
at AC 230 V:	2.5 VA
at DC 24 V:	1.9 W
<b>Nominal frequency A1-A2</b>	
at AC 230 V:	50 Hz

### Output

#### RS485 Bus

EH 5996:	not isolated
EH 5996/1_ _:	isolated (1KV)
<b>Bus wire:</b>	screened twisted pair
<b>Data transmission rate:</b>	115.2 KB/s
<b>Attention: both ends of the twisted pair have to be terminated by inserting the links A/Ra and B/Rb!</b>	

### General Data

<b>Nominal operating mode:</b>	continuous operation
<b>Temperature range:</b>	- 20 ... + 55°C
<b>Clearance and creepage distance</b>	
rated impulse voltage / pollution degree	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge (ESD):	8 kV (air) IEC/EN 61 000-4-2
HF irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltage between wires for power supply:	1 kV IEC/EN 61 000-4-5
between wire and ground:	2 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection:</b>	IEC/EN 60 529
Front:	IP 64
Enclosure:	IP 20
<b>Enclosure:</b>	thermoplastic with VO behaviour according to UL Subjekt 94

## Technical Data

<b>Vibration resistance:</b>	0.35 mm amplitude, frequency 10 ... 55 Hz, IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 055 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection</b>	DIN 46 228/1-/-2/-3/-4
plug-in screw terminal:	0.1 ... 2.5 mm <sup>2</sup> solid or 0.1 ... 1.5 mm <sup>2</sup> stranded wire with sleeve
<b>Wire fixing:</b>	Captive plus-minus-terminal screws M2.5 with self raising terminal box
<b>Mounting:</b>	DIN-rail IEC/EN 60 715
<b>Weight:</b>	260 g

## Dimensions

**Width x height x depth:** 96 x 96 x 123 mm

## Standard Types

EH 5996 AC 230 V 50 Hz	
Article number:	0061784
EH 5996 DC 24 V	
Article number:	0061813
• Nominal voltage $U_N$ :	AC 230 V or DC 24 V
• fixed screw terminals	
• Width:	96 mm

## Ordering example

EH 5996	/	00	AC 230 V	50 Hz	
					Nominal frequency
					Nominal voltage
					RS485 Bus
					0 = not isolated (standard)
					1 = isolated
					Type

## Accessories

Base module RP 5994	Article number: 0060029
Extension module RP 5995	Article number: 0060034
Display unit EH 5994	Article number: 0060589
Display unit EH 5995	Article number: 0060593
Buzzer RK 8832	Article number: 0059906
GSM-Module RP 5810	Article number: 0065146
USB-Stick OA 5996 (FAT 16 formatted):	Article number: 0065659

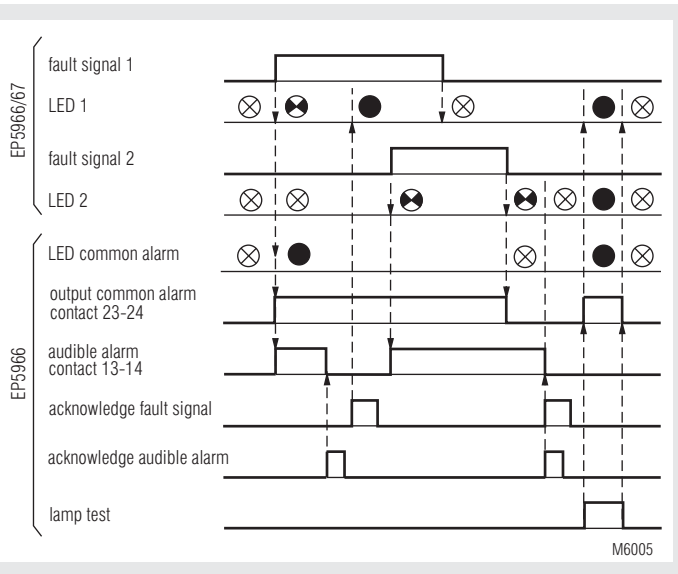


- New fault annunciation with single frequency flashlight according to DIN 19 235
- Expandable from 16 up to 160 inputs
- in 2 groups of 8 inputs selectable:
  - open circuit operation
  - closed circuit operation
- Input voltage up to max. AC/DC 240 V
- Delayed inputs
- Exchangable front for individual scale
- Removable terminals
- Flush mounting
- Frame 72 x 144 mm

### EP 5966:

- 16 inputs in control unit
- Output relay for common signal and audible alarm
- Built in and external connected pushbuttons for lamp test (LT), acknowledgement of horn (QH) and of alarm (QS)
- Extension module with 16 inputs

### Function Diagram



### Approvals and Markings



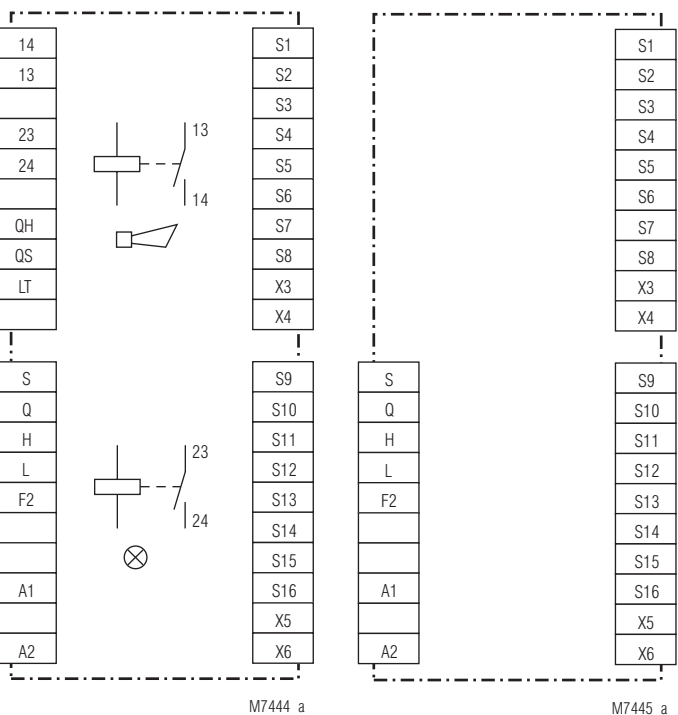
### Applications

Monitoring of industrial plants and buildings

### Function

The unit EP 5966 controls the system and includes the common alarm output for all connected extension modules EP 5967. For audible alarm as well as for common alarm 2 relay outputs (NO) are available. The acknowledgement (QH and QS), as well as the lamp test (LT) can be effected through built in and external pushbuttons. The pushbutton lamp test (LT) is for the checking of the LED's in the control unit and the subsequent extension modules. The associated common alarm output contact 23-24 will be closed.

### Circuit Diagrams



On EP 5966 and 5967 open circuit operation or closed circuit operation can be selected by bridging terminals X3/X4 or X5/X6 for 2 groups of 8 inputs. To avoid unnecessary fault signalling an operate delay of 1 s, 3 s or 10 s to the inputs is available.

The fault annunciator lamps can be marked by the customer on an attached label. Spare labels for EP 5966 and EP 5967 are available. Extension modules can be mounted in neighbour cabinets. The distances of the panels should not be bigger than 10 m. In this case the connection cable must be screened. The screen has to be grounded on both sides.

### Indication

One LED for each signal  
EP 5966 with additional LED for common alarm

### Notes

The inputs for the control signals as well as the inputs for programming (open circuit / closed circuit) are **not** protected against false connection to mains voltage.

The inputs are not galvanic separated from the supply voltage. At DC units 0 V must always be connected to A2.

When configured for NC signal inputs, the inputs not used, must be connected to high level.



**Technical Data****Input****Auxiliary voltage  $U_H$  (A1, A2):** AC 24, 42, 110, 127, 230 V

Special voltages <sup>1)</sup> :	EP 5966	EP 5967
DC 48 V:	270 $\Omega$ / 8 W	330 $\Omega$ / 8 W
DC 60 V:	390 $\Omega$ / 8 W	510 $\Omega$ / 8 W
DC 110 V:	1.0 k $\Omega$ / 20 W	1.2 k $\Omega$ / 20 W
DC 127 V:	1.2 k $\Omega$ / 20 W	1.5 k $\Omega$ / 20 W
DC 220 V:	2.4 k $\Omega$ / 35 W	2.7 k $\Omega$ / 35 W

<sup>1)</sup> Special voltages with series dropresistor (5%) on terminal A1. The fault annunciators are made for the special voltage and cannot be adapted to other voltages by changing series resistors.

<b>Voltage range:</b>	0.8 ... 1.1 $U_N$
<b>Nominal consumptions</b>	
EP 5966:	approx. 5 VA
EP 5967:	approx. 5 VA
<b>Nominal frequency:</b>	50 / 60 Hz
<b>Min. time for input signal:</b>	$\geq 100$ ms + operate delay
<b>Min. time for acknowledgement:</b>	$\geq 200$ ms
<b>Input voltage (S1 ... S16):</b>	AC/DC 24 ... 60 V AC/DC 110 ... 240 V AC/DC 12 ... 30 V (only at $U_H = DC 12$ V)

**Output**

<b>Operate delay <math>t_v</math>:</b>	1 s, 3 s, 10 s
<b>Thermal current <math>I_{th}</math>:</b>	3 A
<b>Switching capacity</b> to AC 15:	3 A; AC 230 V IEC/EN 60 947-5-1
<b>Electrical life</b> to AC 15 at 3 A, AC 230 V:	5 x 10 <sup>5</sup> switching cycles IEC/EN 60 947-5-1

**General Data**

<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 50°C
<b>Clearance and creepage distances</b>	
rated impulse voltage / pollution degree:	4 kV / 2 IEC 60 664-1
<b>EMC</b>	
Electrostatic discharge:	4 kV (air) IEC/EN 61 000-4-2
HF-irradiation:	10 V / m IEC/EN 61 000-4-3
Fast transients:	2 kV IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	2 kV IEC/EN 61 000-4-5
between wire and ground:	4 kV IEC/EN 61 000-4-5
Interference suppression:	Limit value class B EN 55 011
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0-behaviour according to UL subject 94
<b>Vibration resistance:</b>	Amplitude 0.35 mm IEC/EN 60 068-2-6 frequency 10 ... 55 Hz
<b>Climate resistance:</b>	20 / 050 / 04 IEC/EN 60 068-1
<b>Wire connection:</b>	2 x 1.5 mm <sup>2</sup> solid DIN 46 228-1/-2/-3/-4 1 x 1.5 mm <sup>2</sup> or 2 x 0.75 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Box terminals with self-lifting wire protection, removable flush mounting
<b>Mounting:</b>	
<b>Weight</b>	
EP 5966:	520 g
EP 5967:	approx. 480 g

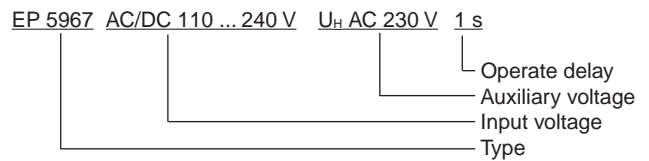
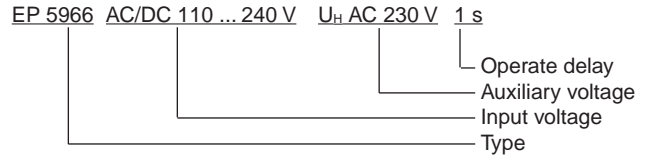
**Dimensions**

<b>Width x height x depth:</b>	72 x 144 x 134 mm
<b>Front panel cut-out:</b>	66 <sup>+0.7</sup> x 138 <sup>+1</sup> mm

**Standard Types**

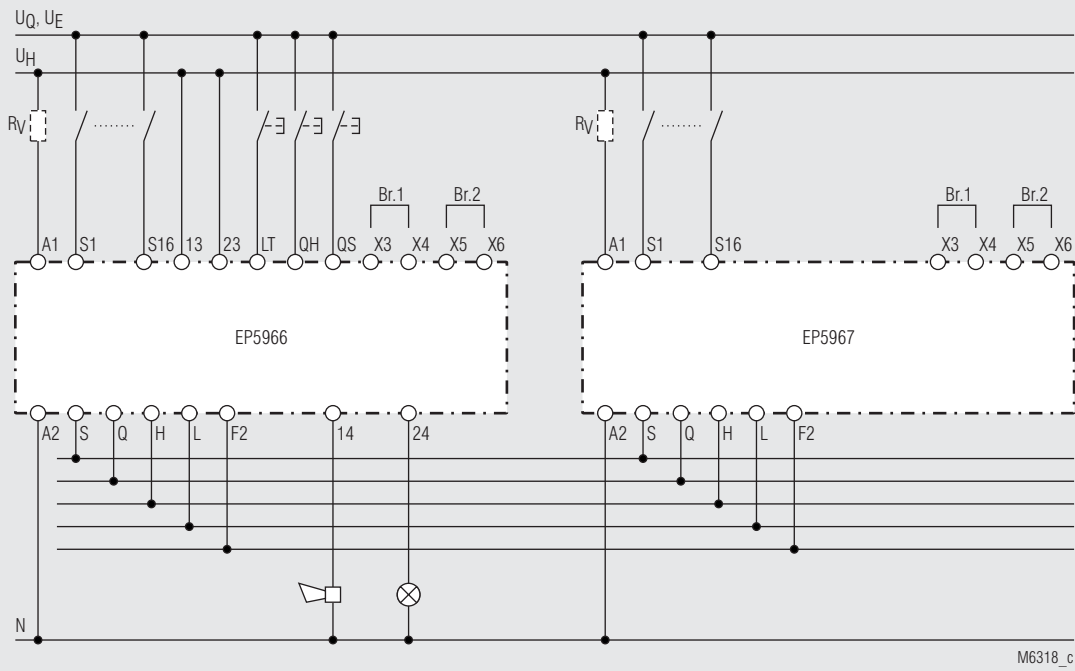
EP 5966 AC/DC 24 ... 60 V $U_H$ DC 24 V 1 s	
Article number:	0041660
• Input voltage:	AC/DC 24 ... 60 V
• Auxiliary voltage $U_H$ :	DC 24 V
• Operate delay:	1 s
• Frame:	72 x 144 mm

EP 5967 AC/DC 24 ... 60 V $U_H$ DC 24 V 1 s	
Article number:	0041662
• Input voltage:	AC/DC 24 ... 60 V
• Auxiliary voltage $U_H$ :	DC 24 V
• Operate delay:	1 s
• Frame:	72 x 144 mm

**Ordering examples****Accessories**

Spare indication label:	EP 5966-0-1, Art.-No.: 0048909
	EP 5967-0-1, Art.-No.: 0050771
Spare transparent front sheet:	EP 5966-10, Art.-No.: 0048738

## Connection Example



M6318\_c

S1 - S16	Inputs
LT	Lamp test
QH	Acknowledge audible alarm
QS	Acknowledge fault signal
13/14	Relay contact audible alarm
23/24	Relay contact common alarm
UQ	Control voltage of the acknowledge inputs
UE	Control voltage of the inputs

with bridge X3 / X4 or X5 / X6 n.o. circuit operation  
 without bridge X3 / X4 or X5 / X6 n.c. circuit operation



- New fault annunciation according to DIN 19235
- Expandable from 3 up to 303 inputs
- Width 45 mm

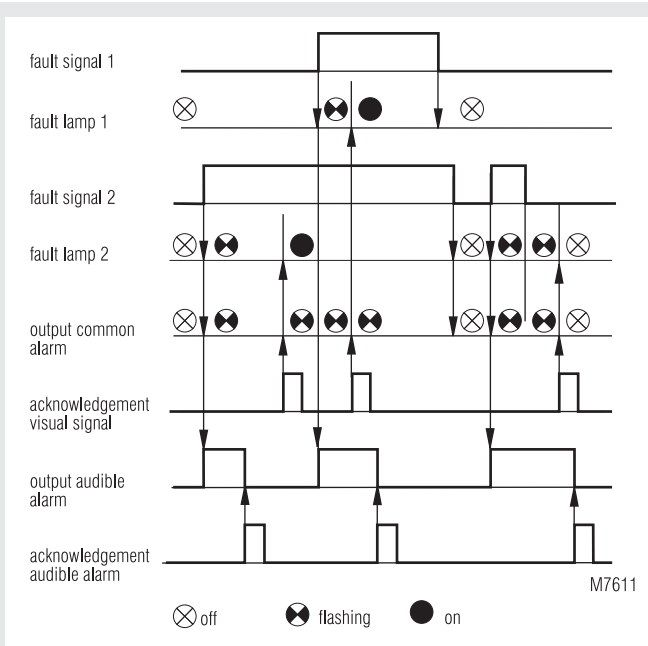
**Fault annunciator AD 5998:**

- 3 inputs
- Pushbutton connection possible for light signal acknowledgement, horn acknowledgement and lamp test
- 1 relay for common alarm and 1 for horn

**Extension unit AD 5992:**

- 6 inputs

**Function Diagram**



**Approvals and Markings**



**Application**

Monitoring of industrial plants and buildings

**Notes**

The connections A1, inputs S1-S3 and S1-S6, lamp test input LT and acknowledgement input Q have to be connected to the same phase.

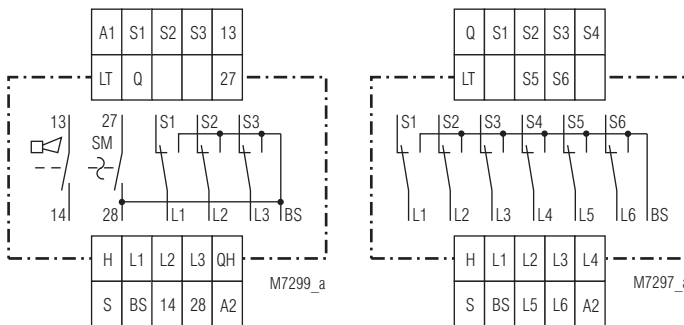
Even if no common signal light will be connected, the nominal voltage is to be connected to terminal 27.

The bus-lines H and S have a low voltage and are not allowed to be connected to any external voltage. If inductive or capacitive superimposed voltages are expected, it is recommended to use screened cables for these lines.

The flash impulse via flash line BS will be generated by an internal contact. The maximum load of this contact must be observed (technical data).

It is not allowed to connect lamps with transformers on the outputs. This would cause unintentional fault signals at the lamp test.

**Circuit Diagrams**



AD 5998

AD 5992

In case of units with AC-voltage, the signal lights during the lamp test are lighting dim, as the test will be effected only with a half-wave. The half-wave voltage is also applied at terminals S1-S3 and S1-S6 during the lamp test.

If other lamps, except for the fault signal lamps, should be tested via the lamp test pushbutton T1, it is necessary to use a lamp tester, whose diode configuration is identically to the diode configuration of the fault annunciator. In case of AC-voltage operation this is the lamp tester AI 990/04, in case of DC-voltage operation the lamp tester AI 990 or AI 990.10.

## Technical Data

### Input

**Nominal voltage  $U_N$ :** AC 24, 230, 240 V,  
DC 24 V with polarity protection  
AC 42, 110, 127 V on demand

**Special voltages:** with additional resistors  
(see connection example)

	AD 5998		AD 5992
	RV	R1	R2
DC 48 V:	ZWS 8 sl 390 $\Omega$	ZWS 8 sl 2.7 k $\Omega$	ZWS 8 sl 430 $\Omega$
DC 60 V:	ZWS 8 sl 640 $\Omega$	ZWS 20 sl 4.7 k $\Omega$	ZWS 8 sl 640 $\Omega$
DC 110 V:	ZWS 20 sl 1.5 k $\Omega$	ZWS 20 sl 10 k $\Omega$	ZWS 20 sl 1.5 k $\Omega$
DC 125 V:	ZWS 20 sl 1.8 k $\Omega$	ZWS 20 sl 12 k $\Omega$	ZWS 20 sl 1.8 k $\Omega$
DC 230 V:	ZWS 20 sl 3.3 k $\Omega$	ZWS 20 sl 24 k $\Omega$	ZWS 20 sl 3.3 k $\Omega$

**Voltage range:** 0.8 ... 1.1  $U_N$

**Nominal consumption:** AC 230 V 6 VA DC 24 V 1.5 W

**Nominal frequency:** 50 / 60 Hz

**Fault impulse time:**  $\geq$  100 ms

**Acknowledgement impulse time:**  $>$  200 ms

### Output

#### Loading:

AD 5992 / AD 5998  
signal light each:  
(terminals L1, L2, L3, L4,  
L5, L6 bzw. L1, L2, L3)

AC 230 V 1 A max.

AD 5998  
Audible-alarm output  
(terminal 14): AC 230 V 3 A max.

Common alarm output  
(terminal 28) and lamp signal  
via flash line BS totally: AC 230 V 3 A max.  
DC 24 V 2 A max.  
for higher switching capacity  
a contactor is to be inserted

Lamp test (pushbutton 1): Sum of the currents of all lamp signals L

## General Data

**Operation mode:** Continuous operation

**Temperature range:** - 20 ... + 60°C

**Clearance and creepage distances**

rated impulse voltage /  
pollution degree: 4 kV / 2 IEC 60 664-1

**EMC**

Electrostatic discharge: 6 kV (contact) IEC/EN 61 000-4-2

HF-irradiation: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

Surge voltages: 1 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55 011

**Degree of protection:** Housing: IP 40 IEC/EN 60 529  
Terminals: IP 20 IEC/EN 60 529

**Housing:** Thermoplast with V0 behaviour  
according to UL subject 94

**Vibration resistance:** Amplitude 0.35 mm,  
frequency 10...55Hz IEC/EN 60 068-2-6  
20 / 060 / 04 IEC/EN 60 068-1

**Climate resistance:**

**Terminal designation:** EN 50 005

**Wire connection:** 2 x 2.5 mm<sup>2</sup> solid or  
2 x 1.5 mm<sup>2</sup> stranded wire with sleeve  
DIN 46 228

**Wire fixing:** Flat terminals with self lifting  
clamping piede IEC/EN 60 999-1  
DIN rail IEC/EN 60 715

**Mounting:**

**Weight**

AD 5998: AC 230 V 380 g DC 24 V 250 g

AD 5992: AC 230 V 360 g DC 24 V 220 g

## Dimensions

**Width x height x depth:** 45 x 77 x 127 mm

## Standard Types

AD 5998 AC 230 V 50/60 Hz  
Article number: 0032367 stock item

- Nominal voltage  $U_N$ : AC 230 V
- Width: 45 mm

AD 5992 AC 230 V 50/60 Hz  
Article number: 0032361 stock item

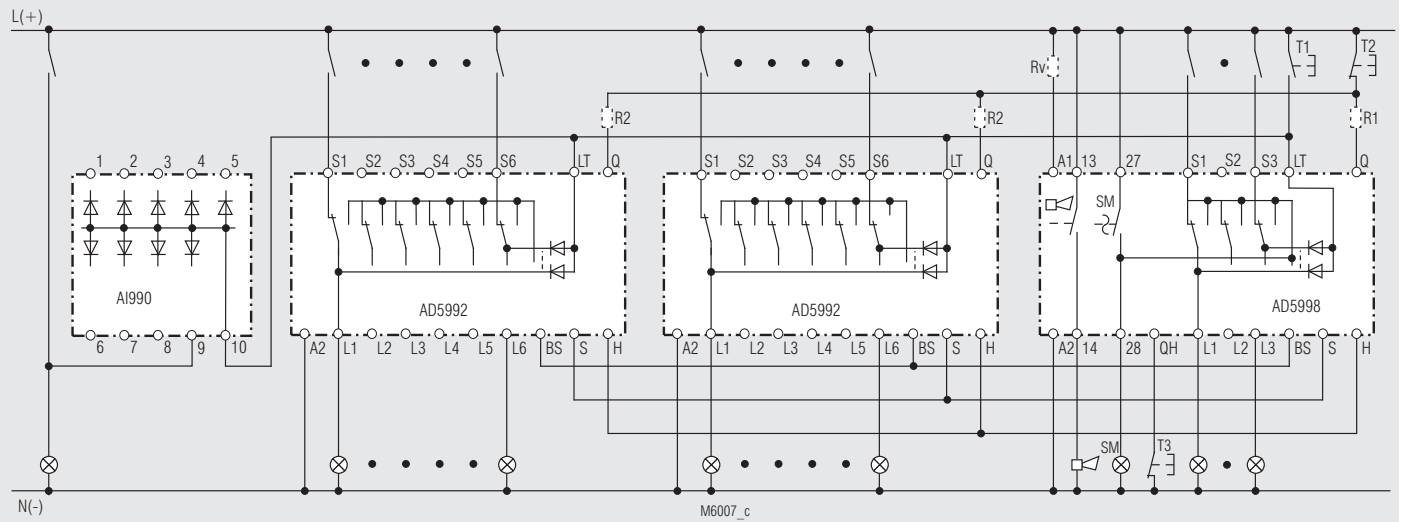
- Nominal voltage  $U_N$ : AC 230 V
- Width: 45 mm

## Ordering Example

AD 5998 AC 230 V 50/60 Hz

Nominal frequency  
Nominal voltage  
Type

## Connection Examples

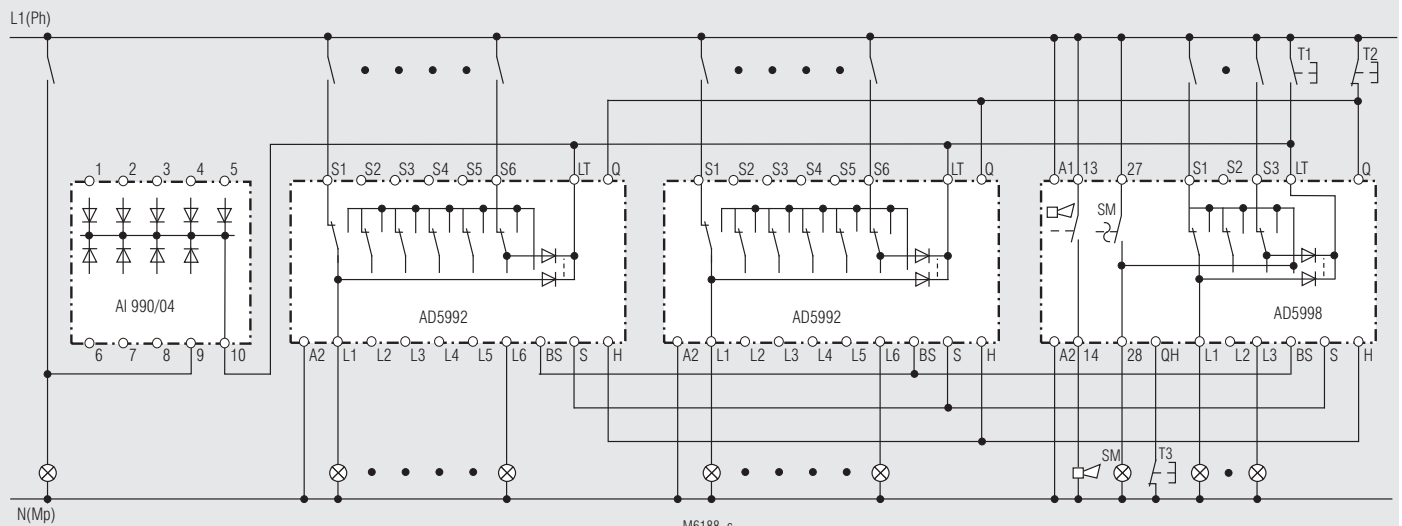


T1 external pushbutton for lamp test  
T2 external acknowledgement pushbutton for lamp signal

T3 external acknowledgement pushbutton for audible alarm  
 $R_{V,r}$  R1, R2 > DC 30 V

Connection diagram AD 5998 - AD 5992 for operation at DC-voltage with additional lamp tester AI 990 or AI 990.10  
Lamp tester AI 990 is only required if additional lamps in the system need to be tested.

## Connection Examples



T1 external pushbutton for lamp test  
T2 external acknowledgement pushbutton for lamp signal

T3 external acknowledgement pushbutton for audible alarm

Connection diagram AD 5998 - AD 5992 for operation at AC-voltage with additional lamp tester AI 990.04 or AI 990.12  
Lamp tester AI 990 is only required if additional lamps in the system need to be tested.



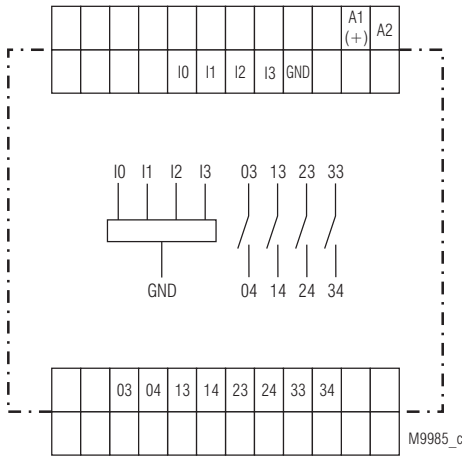
**Your Advantage**

- Easy remote control of unit via mobile phone
- Easy configuration of unit via mobile phone
- SMS-status request of all i/p's - and o/p's via configurable shortcuts
- SMS text messages via customers SIM card
- Cyclic SMS message with configurable time interval (watchdog function)

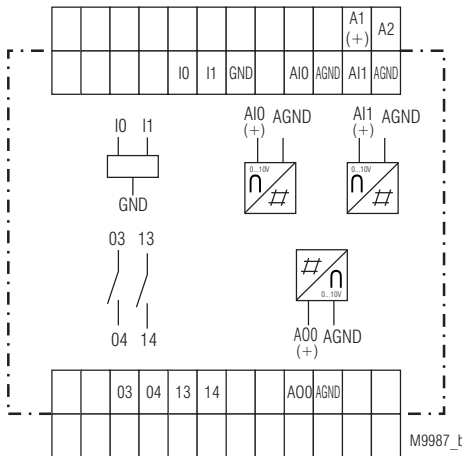
**Features**

- According to directive 1999/5/EC (RTTE) for radio equipment and telecommunications terminal equipment
- 4 digital inputs and 4 relay outputs
- Variant RP 5812/001 with 2 digital and 2 analogue inputs and 1 analogue - and 2 relay outputs
- Auxiliary voltage DC 24 V
- DC 24 V digital inputs
- Automatic SMS messages for status changes
- Quad-Band GSM-Module for 850, 900, 1800 and 1900 MHz (GSM = Global System for Mobile)
- Pin protection of SIM card
- Caller password protection against unauthorised access
- User Dialogue language for: German, English or French
- Configurable authorization levels for up to 16 users
- Assignment of different I/O's to different users
- Automatic sending of SMS when digital inputs change state i.e. come on or go off or both (on rising edge or falling edge)
- Automatic sending of SMS when analogue inputs
  - exceed preset lower and upper limits or
  - when signal is within the preset window
  - and when the signal returns to good state
- Adjustable
  - Hysteresis for analogue inputs
  - Time delay for each input
  - Repeat time for SMS-transmitting
  - Time delay for output status after starting the unit
  - Time delay for activation of the output
- SMS for device status to the system administrators
- SMS-counter to monitor the remaining account
- No interruption of operation after Voltage failure due to integrated Li-Ion battery backup 24Hours
- Compact width: 70 mm

**Circuit Diagrams**



RP 5812S, RP 5812PS, RP 5812PC



RP 5812S/001, RP 5812PS/001, RP 5812PC/001

**Approvals and Markings**



**Application**

- Remote monitoring control and operation of
  - Machinery and installations for industry and building automation.
  - Small power plants
  - Remote buildings
  - Unmanned production plants
  - Air-conditioning and refrigeration systems
  - Heating systems
  - Elevators and escalators
  - Alarm systems, burglar alarms
  - Smoke, fire and gas warning systems
  - Doors, gates and windows
  - Flood warning systems
- Level alarm in pumping stations
- Remote shut down of rental equipment when payment overdue
- Level monitoring in silos, tanks, etc.

## Indication

green LED „U <sub>H</sub> “:	on when supply connected
yellow LED „GSM“ off:	SMS-Telecontrol module is off
flashes 600ms on / 600 ms off:	SMS-Telecontrol module searches for available network and logs on
flashes 75ms on / 3s off:	SMS-Telecontrol module is registered on GSM network.
on:	Data transmission in GSM network is taking place
yellow LED „Status“ off:	Configuration correct, SMS-Telecontrol module is working correctly
flashes:	Indication of failure code, see table “Fault indication by flashing code”
on:	SMS transmission take place

## Settings



### Safety remarks

- The SMS-Telecontrol module must not be used for safety relevant control functions due to signal availability.
- The use of the SMS-Telecontrol module in medical rooms must be evaluated thoroughly as medical equipment such as pacemakers etc may react to the radiofrequency of the SMS-Telecontrol module. Also be aware that the radio frequency of the SMS-Telecontrol module may disturb the function of insufficiently protected PCs, monitors and other electronic equipment.
- Delays in the transmission of I/O status may take place due to network problems.

### General settings

- If the SMS-Telecontrol module is disconnected for a long period, (e.g. as when delivered) the battery must be charged. To do this the SMS-Telecontrol module needs to be connected to the supply Voltage for up to 6 h. Only after this time is correct operation is possible.

### Attention



On delivery the battery is disconnected. Before the batteries can be charged the connection has to be made by changing the slide switch at the bottom edge of the unit to the ON position.

- On first activation a SIM card with a pin code of 1234 has to be inserted. This pin can then be changed by an SMS command. After pin change only the SIM card with the changed pin can be used. If the pin number on the SIM card is different to the one in the configuration the SIM card may be locked when connecting to the GSM network. A locked SIM card can be unlocked by placing it in a mobile Phone and entering the PUK or Master pin.
- If the Reset/Default Konf. button on the front of the unit is pressed for 3-4 seconds while the unit is powered up, the SMS-Telecontrol module is reset. This means, that the any connection to an SMS network is disconnected and reconnected. If the reset button is pressed for more than 5 sec the configuration is reset to default and the unit makes a factory reset.
- Due to the internal battery back up, the function of the SMS-Telecontrol module is still available even if the power supply is disconnected for up to 24 hours.



### Attention

It is your responsibility as an end user to dispose old batteries correctly. Of course, you may return replaced batteries to us.

## Settings

### Set up procedure of SMS-Telecontrol module

- Wire the i/p's- o/p's and the auxiliary supply connections
- Press the SIM eject button (use pen tip), insert the SIM-card with the Preconfigured pin 1234 into the SMS-Telecontrol module
- Power up the SMS-Telecontrol module
- Send the necessary configuration commands via text to the SMS-Telecontrol module (see manual)

### Examples for configuration and communication of the SMS module via SMS:

#### Demand:

The SMS module located in the pump station, should be named “Pump station” and then answer with this name.

The following SMS is created and sent:  
CFGDN\$Pump station#

#### Demand:

Input I0 shall send an SMS on the negative edge (turning off) of the input signal

The following SMS is created and sent:

DISEND\$0\$FE#

#### Demand:

Input I0 shall be named „ Pump“

The following SMS is created and sent:  
DISYMB\$0\$Pump#

#### Demand:

The status „0“ of input I0 shall be named „ Pump stopped“

The following SMS is created and sent:  
DITXTLO\$0\$Pump stopped#

An SMS is generated and sent by the SMS module caused by a defective Pump, it appears as follows:

Answer: „Pump station:Pump stopped“

#### Demand:

The current status of the (2 or 4) digital inputs can be called up.

The following SMS is created and sent:

?DIALL#

Answer: „Pump station:Pump stopped; Level to high“

and for the 2 analogue inputs:

and to call up the 2 analogue inputs if previously configured for level and motor temperature

?AIALL#

Answer: „Pump station: Level:180cm; pump temp: 85°C“

## Safety notes

- **Attention:** It is important, that the connected voltage of the analogue inputs and the analogue outputs of the variant /001 are no larger than are specified in the Technical Data.



- The Li-Ion battery can not be changed by the user. Is there a need to replace the battery please send the device back to the manufacturer.
- Please note, before using, the other safety instructions of the manual INFOMASTER SMS-Telecontrol module RP 5812.

## Technical Data

### Input

**Auxiliary Voltage A1-A2 (U<sub>H</sub>):** DC 24 V,

**Nominal consumption A1-A2:** max. 4.5 W at DC 24V

#### Inputs (digital)

RP 5812: 4 x i/p; I0 ... I3  
DC 24 V with galvanic separation

RP 5812/001: 2 x i/p; I0 ... I1  
DC 24 V with galvanic separation

#### Inputs (analogue)

RP 5812/001: 2 x i/p; AI0 ... AI1  
DC 0 .. 10 V resolution 100 mV

## Technical Data

### Outputs

#### Contacts:

RP 5812: 4 N/O contacts  
RP 5812/001: 2 N/O contacts

**Thermal current  $I_{th}$ :** 2A

**Switching capacity to AC 15:** IEC/EN 60947-5-1  
3 A / AC 230 V (secondary voltage)

#### Electrical life

**to AC15 at 1A / 230V:**  $\geq 1,5 \times 10^6$  switch. cycl. IEC/EN 60 947-5-1

**Max. fuse rating:** 4A gL IEC/EN 60947-5-1

**Mechanical life:**  $\geq 30 \times 10^6$  switching cycles

#### Output (analogue)

RP 5812/001: AO0  
DC 0..10V resolution 100 mV

## GSM

Frequency band: 850 / 900 / 1800 / 1900 MHz  
Power class: GSM 850 / 900 MHz: 4 (2 W)  
GSM 1800 / 1900 MHz: 1 (1 W)  
SIM-card: 1.8V and 3 V SIM cards are supported  
Aerial jack: SMA (male)

## General Data

**Nominal operating mode:** continuous operation

**Temperature range:** 0 ... + 40°C

#### Clearance and creepage distance:

Rated impulse Voltage / pollution degree: 4 kV / 2 IEC 60 664-1

#### EMC

Electrostatic discharge: 8 kV (air) IEC/EN 61 000-4-2

HF irradiation: 10 V / m IEC/EN 61 000-4-3

Fast transients: 2 kV IEC/EN 61 000-4-4

#### Surge

between wires for power supply: 1 kV IEC/EN 61 000-4-5

wire and ground: 2 kV IEC/EN 61 000-4-5

Interference suppression: Limit value class B EN 55011

#### Degree of protection:

Housing, Cover IP 30 IEC/EN 60 529

Terminals IP 20 IEC/EN 60 529

#### Housing:

thermoplastic with VO behaviour acc. to

UL subject 94

#### Vibration resistance:

Amplitude 0,35 mm

Frequency 10 ... 55 Hz IEC/EN 60 068-2-6

00 / 040 / 04 IEC/EN 60 068-1

#### Climate resistance:

**Terminal designation:** EN 50 005

**Wire connection:** DIN 46 228/-1/-2/-3/-4

fixed screw terminal (S): 0,2 ... 4 mm<sup>2</sup> solid or

0,2 ... 1,5 mm<sup>2</sup> stranded wire with sleeve

plug in screw terminal (PS): 0,1 .. 2,5 mm<sup>2</sup> solid or

0,1 .. 1,5 mm<sup>2</sup> stranded wire with sleeve

plug in cage clamp terminals (PC): 0,2 .. 2,5 mm<sup>2</sup> solid or

0,2 .. 1,5 mm<sup>2</sup> stranded wire with sleeve

**Wire fixing:**

fixed screw terminal (S),

plug in screw terminal (PS): Captive plus-minus-terminal screws M2,5

with self raising terminal box

plug in cage clamp terminals (PC): spring terminal for direct

plug in of wires,

screw driver 0,6 x 3,5 for

spring releasing

**Mounting:** DIN rail IEC/EN 60175

**Weight:** 216 g

## Dimensions

Width x height x depth: 70 x 95 x 80 mm

## Standard Types

RP 5812S DC 24 V

Article number: 0065147

• Auxiliary Voltage  $U_H$ : DC 24 V

• Inputs: 4 digital inputs DC 24 V

• Outputs: 4 relay outputs N/O contacts

• Width: 70 mm

RP 5812S/001 DC 24 V

Article number: 0065148

• Auxiliary voltage  $U_H$ : DC 24 V

• Inputs: 2 digital inputs DC 24 V

2 analogue inputs 0 ... 10 V

• Outputs: 2 relay outputs N/O contacts

1 analogue output 0 ... 10 V

• Width: 70 mm

## Ordering Example

RP 5812 / 0 0 AC/DC 19 ... 30 V

Auxiliary Voltage

Inputs / Outputs

0: 4 digital inputs,

4 relay outputs

1: 2 digital inputs,

2 analogue inputs

2 relay outputs,

1 analogue outputs

Type of Terminals

S: Terminal blocks fixed,

with screw terminals

PC (plug in cage clamp):

Plug in terminal blocks with

cage clamp terminals

PS (plug in screw):

Plug in terminal blocks with

screw terminals

Type



## Accessories

OA 5810/900:	GSM-aerial, 90° angle Article number: 0062212
OA 5810/901:	GSM magnetic foot areal with 2,5 m connecting lead Article number: 0062213

## Fault indicated by Flashing Code

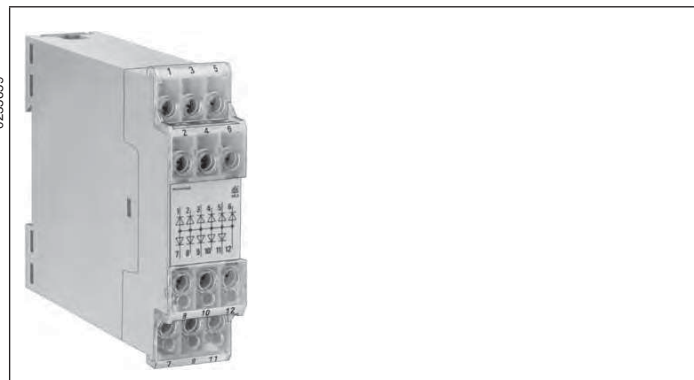
The current state of the SMS-Telecontrol module is indicated by the flashing code on the status LED. The number of flashing pulses followed by a longer space relates to the failure code in the following table. After the longer space the flashing cycle is repeated until the state on the unit changes.

State LED	Description
OFF	No status for indication, normal operation
ON	SMS transmission
2 * flashes	Internal system failure, please contact the manufacturer
3 * flashes	Invalid configuration. When this failure occurs, the unit tries to reset the configuration to factory settings followed by a device test. If the failure remains, please contact manufacturer.
4 * flashes	No access on SIM-card <b>Cause:</b> no SIM-card inserted or invalid PIN for inserted SIM card
5 * flashes	No GSM network available <b>Cause:</b> insufficient radio signal, aerial placed in a poor location.
6 * flashes	In the configuration, the service centre for SMS transmission is not yet defined. <b>Cause:</b> The CFGINT command sequence SMS has not been sent to the module
7 * flashes	No administrator for using are defined. No user administrator is defined <b>Cause:</b> The CFGINT command sequence SMS has not been sent to the module

LEDs for each I/O on the front of the unit indicate the status of the in- and outputs.

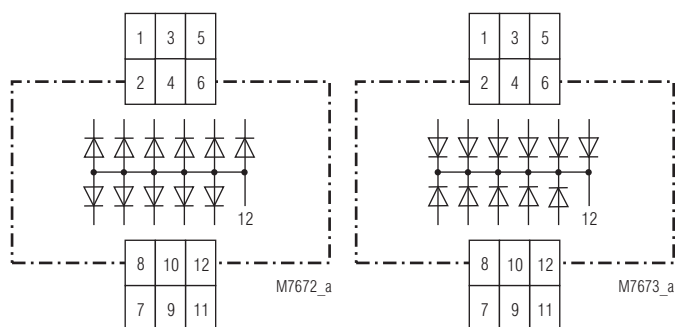
# Monitoring Technique

**INFOMASTER**  
**Lamp Tester**  
**MK 9994, MK 9995**



- For max. 11 indicator lamps
- Width 22.5 mm

## Circuit Diagrams



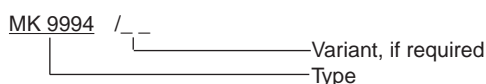
MK 9994

MK 9995

## Standard Types

MK 9994	
Article number:	0012938
MK 9995	
Article number:	0015889
• Width:	22.5 mm

## Ordering example for variants



## Approvals and Markings



## Application

The lamp tester contains a diode group with either common anode or cathode. It blocks one lamp from the other in order to avoid influence. On AC-operation the lamps are only half illuminated.

## Technical Data

**Nominal voltage:** AC 250 V

### Data of diodes

Current per output:	0.6 A at 100 % ED 1 A max. 3 min.
Periodical peak reverse voltage:	1 000 V
Peak surge voltage:	1 200 V
Peak surge voltage power dissipation:	1.0 kW for 10 μs
Max. peak current:	50 A for 10 ms
Periodical peak voltage:	1 100 V

## General Data

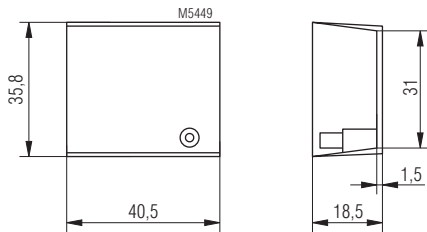
<b>Operating mode:</b>	Continuous operation
<b>Temperature range:</b>	- 20 ... + 60°C
<b>Degree of protection</b>	
Housing:	IP 40 IEC/EN 60 529
Terminals:	IP 20 IEC/EN 60 529
<b>Housing:</b>	Thermoplastic with V0 behaviour to UL subject 94
<b>Vibration resistance:</b>	0,35 mm Amplitude, frequency 10 ... 55 Hz IEC/EN 60 068-2-6
<b>Climate resistance:</b>	20 / 060 / 04 IEC/EN 60 068-1
<b>Terminal designation:</b>	EN 50 005
<b>Wire connection:</b>	2 x 1.5 mm <sup>2</sup> solid or 2 x 1.0 mm <sup>2</sup> stranded wire with sleeve DIN 46 228-1/-2/-3/-4
<b>Wire fixing:</b>	Flat terminals with self lifting clamping piece IEC/EN 60 999-1
<b>Mounting:</b>	DIN rail IEC/EN 60 715
<b>Weight:</b>	80 g

## Dimensions

**Width x height x depth:** 22.5 x 82 x 99 mm

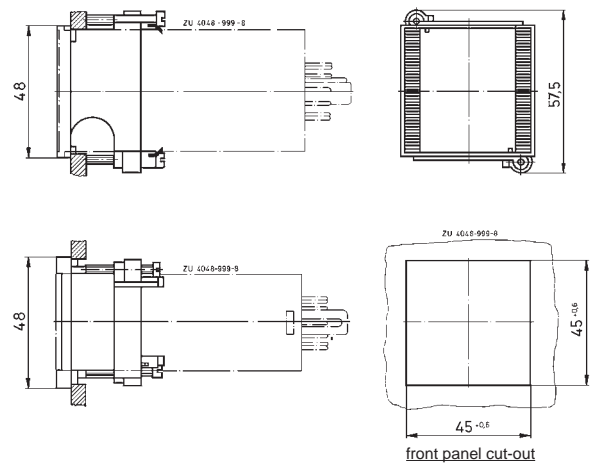
### Cover K 70-34

For Timers: AA 9943, AA 9050, AI 942,



### Front frame ET 4048-3

48 x 48 with clamp screws.



### Mounting kit for surface mounting KU 4087-100

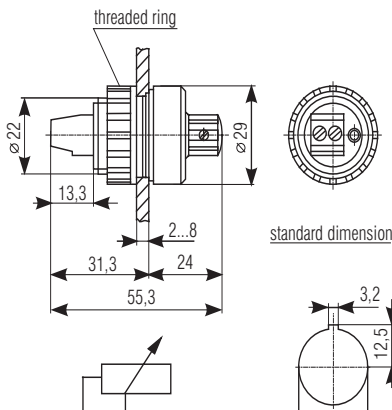


Types of I-series	Width (mm)	Order reference
IK	17,5	KU4087-100/56763
IL	35,0	KU4088-100/56764
IN	52,5	KU4084-100/56765
IP	70,0	KU4089-100/56766
IR	105,0	KU4090-100/56767

### External potentiometer AD 3

The external potentiometer is used for remote setting of the time delay. The internal potentiometer of the timer must be set to min. time delay.

Degree of protection front side: IP 60



### Test and indicator panel UP 5862

For insulation monitors in medically used rooms according to IEC 60 364-7-710, DIN VDE 0100-710

- to mount in flush device boxes  $\varnothing$  60 mm, 35 mm deep;
- test button to check the function of the device
- with green LED to indicate operation
- reset button for audible alarm
- with yellow LED to monitor insulation failure

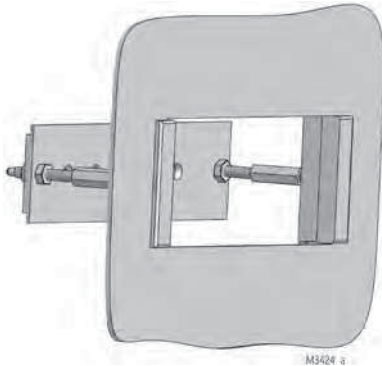


Max. wire length to IN / IP 5880  
 at wire cross section A = 0.5 mm<sup>2</sup>: 500 m  
 at wire cross section A = 1.5 mm<sup>2</sup>: 1000 m

Dimensions (width x height): 80 x 80 mm  
 Article number: 0041706

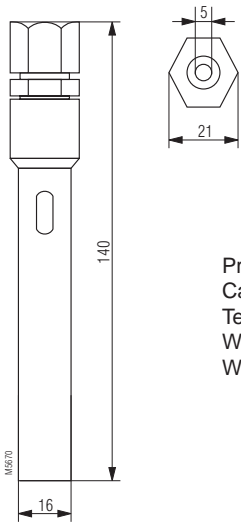
### Flush mounting kit

Order reference: KU 4087-150/0056598



- For universal use with:
- I-series devices of 17.5 to 105 mm width
  - easy mounting

### Standard probe OA 5640

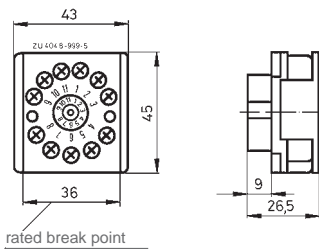


Probe made of stainless steel,  
Cable entry PG 9,  
Temperature range 0 ... +60°C,  
Weight approx. 0.1 kg  
Wire connection 2.5 mm<sup>2</sup> stranded wire with sleeve

### Plug in adaptor ET 4048-13

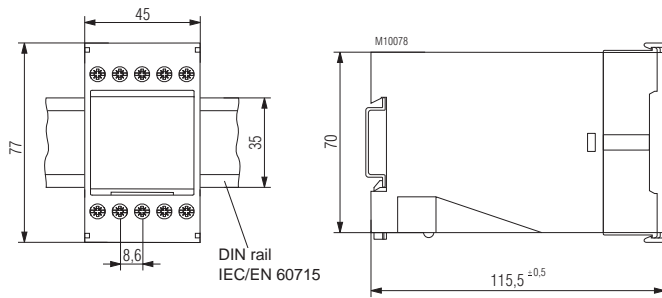
11-pole, from PC

For installation into control panel.

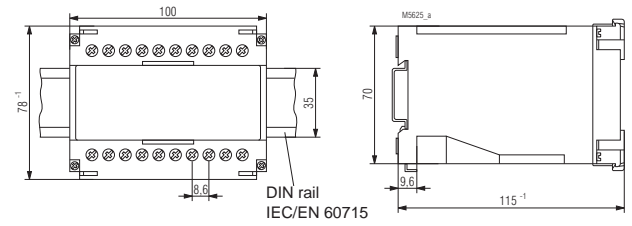


Version with flat-pin plug on request.

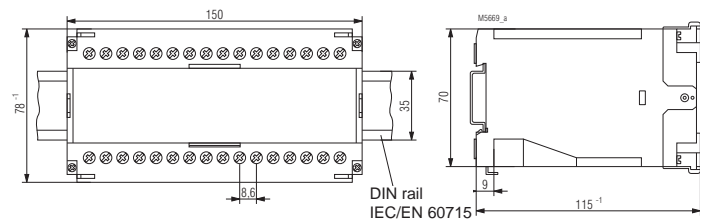
## AA / AI - Enclosure



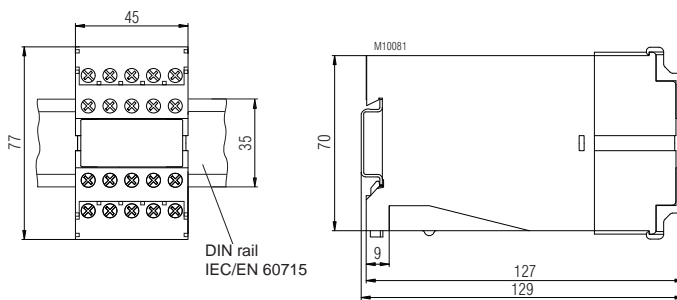
## AN - Enclosure



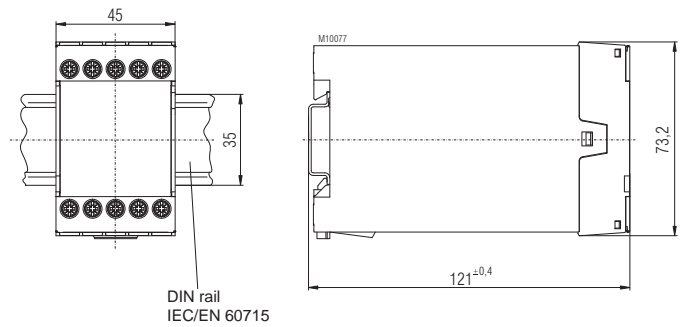
## AR - Enclosure



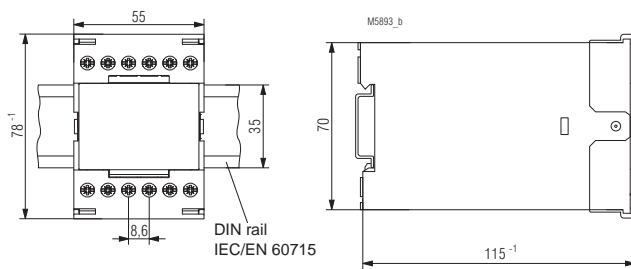
## AD - Enclosure



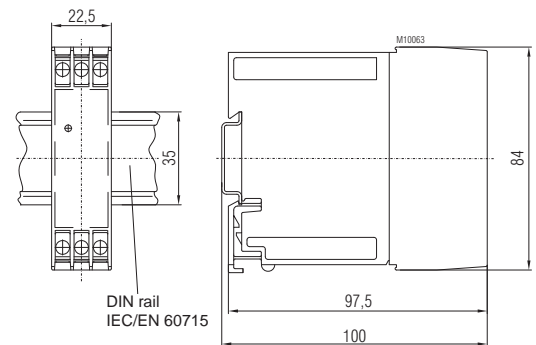
## BA - Enclosure



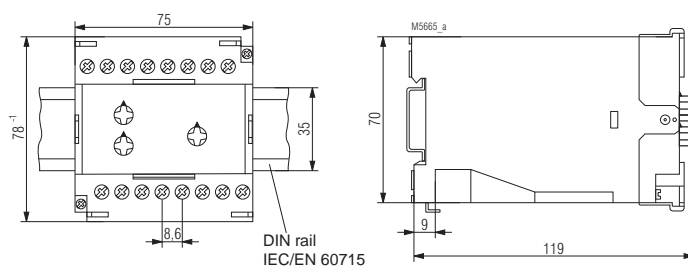
## AG - Enclosure



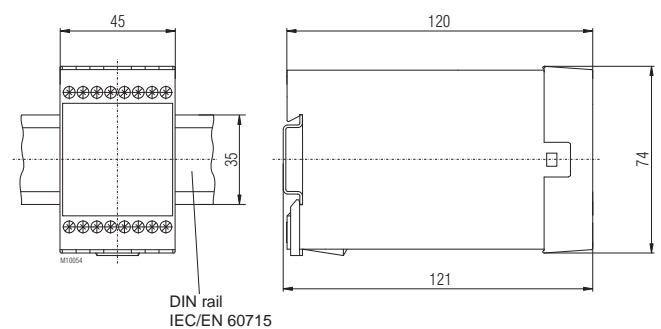
## BA - Enclosure



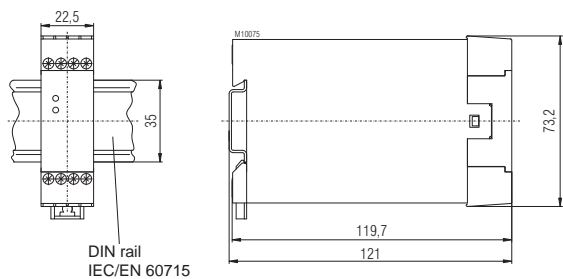
## AK - Enclosure



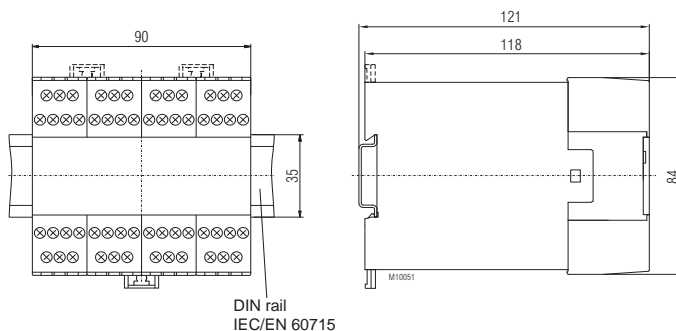
## BD - Enclosure



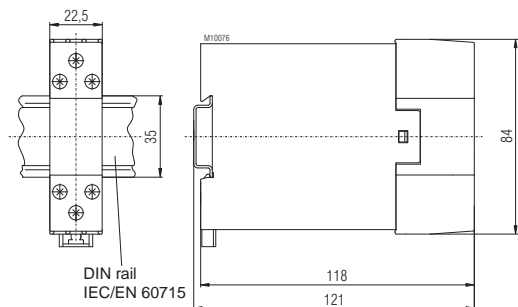
**BE - Enclosure**



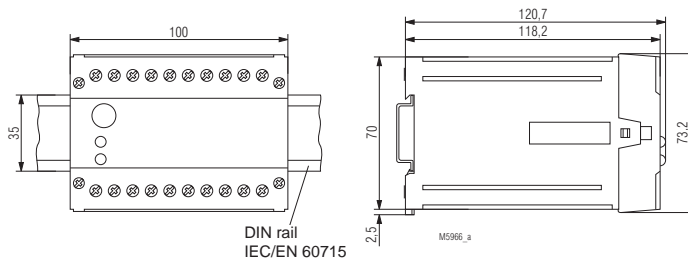
**BL - Enclosure**



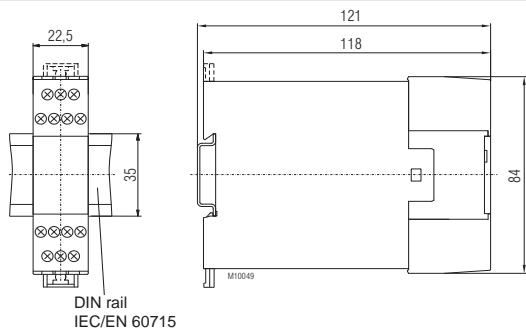
**BF - Enclosure**



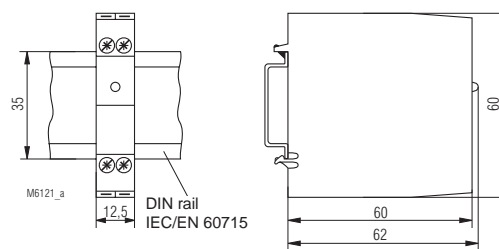
**BN / BO - Enclosure**



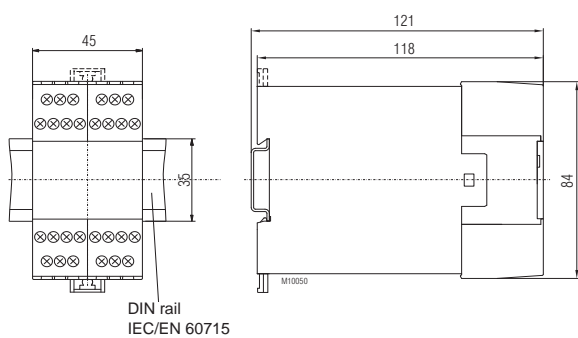
**BG - Enclosure BA - Enclosure**



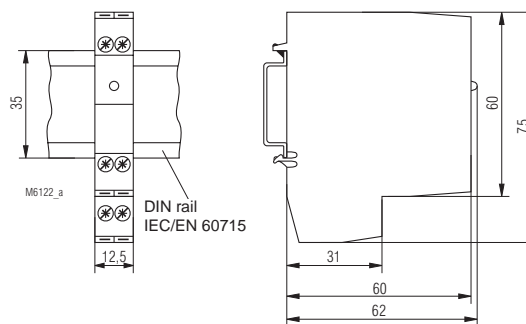
**CA - Enclosure BA - Enclosure**



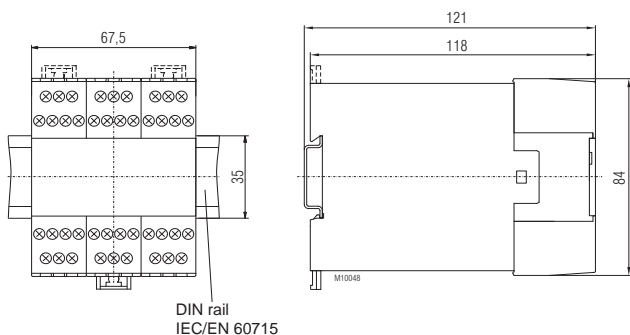
**BH - Enclosure**



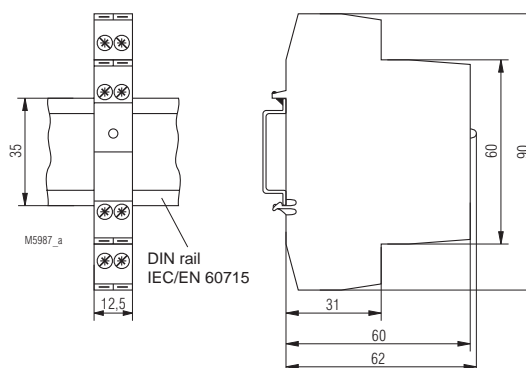
**CB - Enclosure**



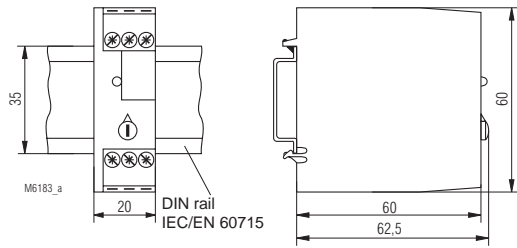
**BI - Enclosure**



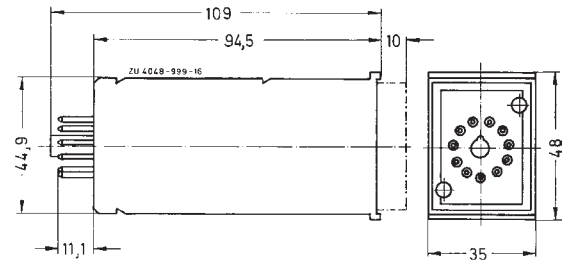
**CC - Enclosure**



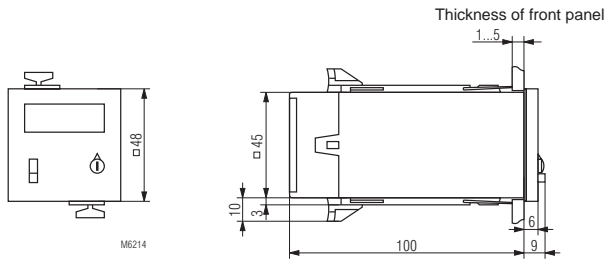
### CD - Enclosure



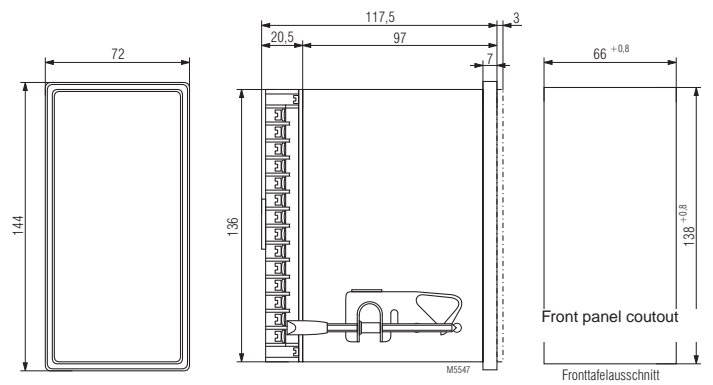
### EO - Enclosure



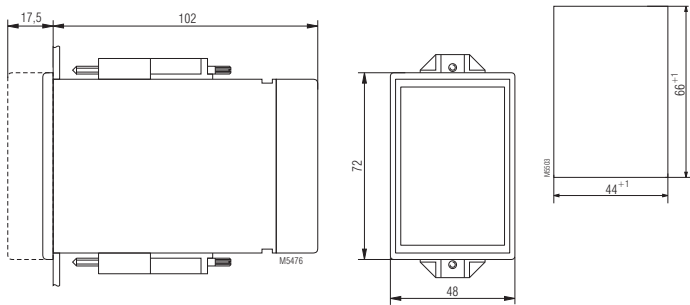
### EB - Enclosure



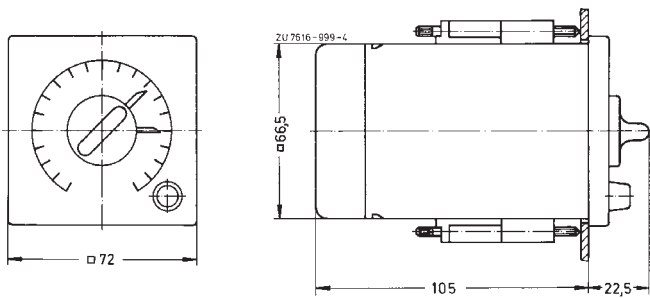
### EP - Enclosure



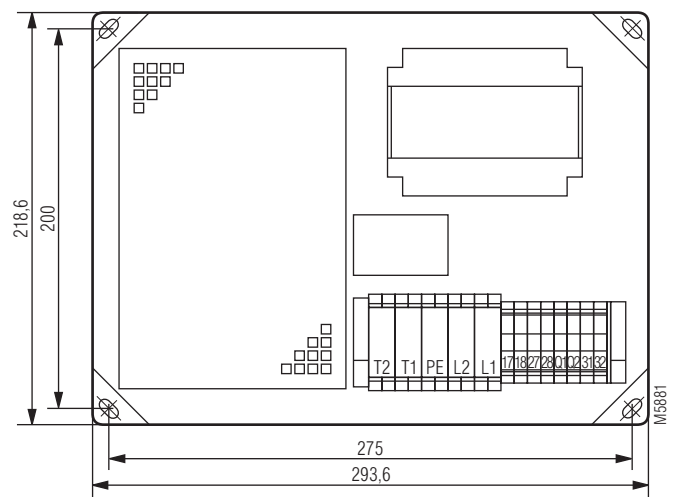
### EC - Enclosure BA - Enclosure



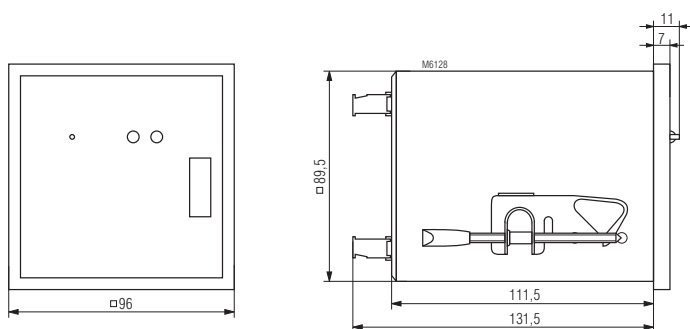
### EF - Enclosure



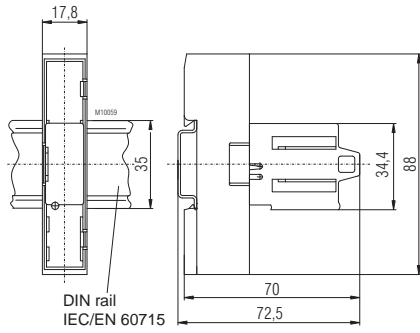
### GA - Enclosure



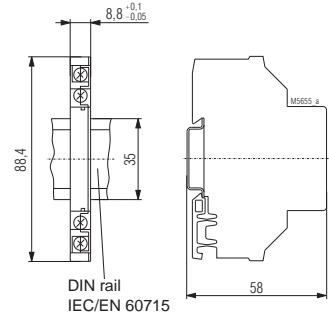
### EH - Enclosure



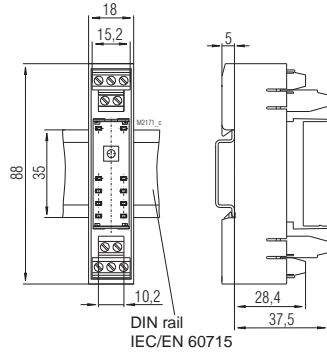
### HA / HC - Enclosure



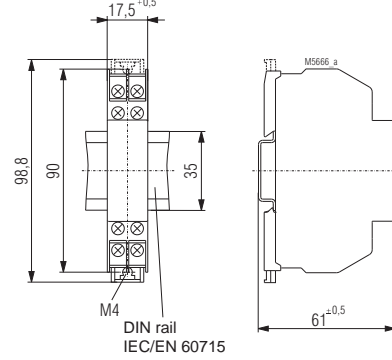
### IG - Enclosure



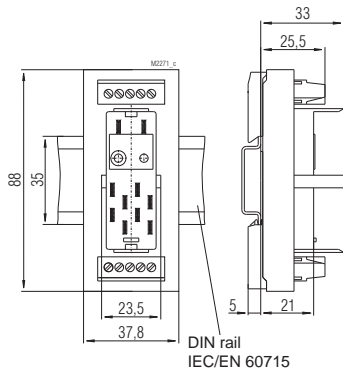
### HC - Enclosure



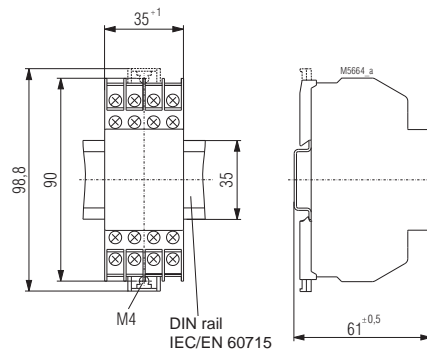
### IK - Enclosure



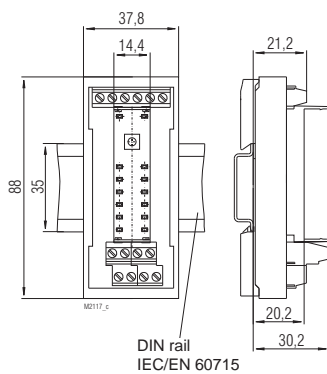
### HL - Plug-in base



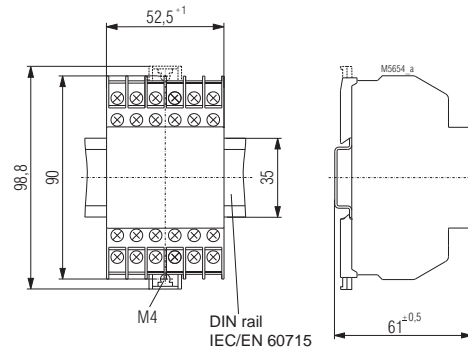
### IL - Enclosure



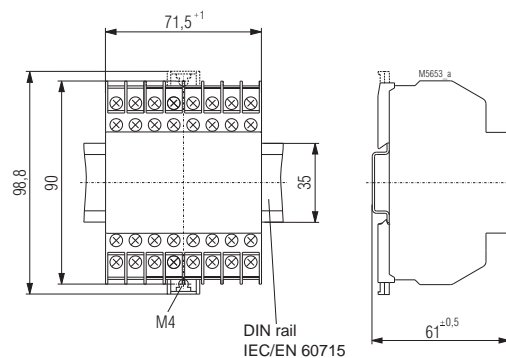
### HL 3094 - Plug-in base



### IN - Enclosure



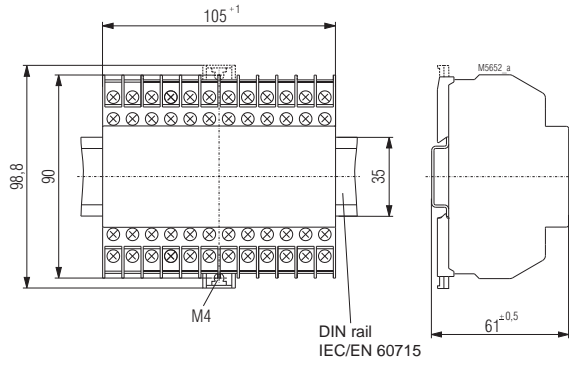
### HL 3096 - Plug-in base



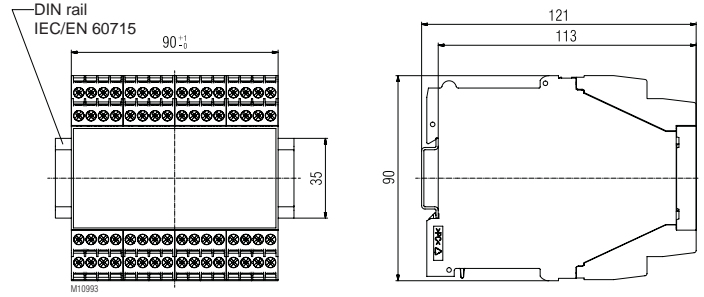
### IP - Enclosure



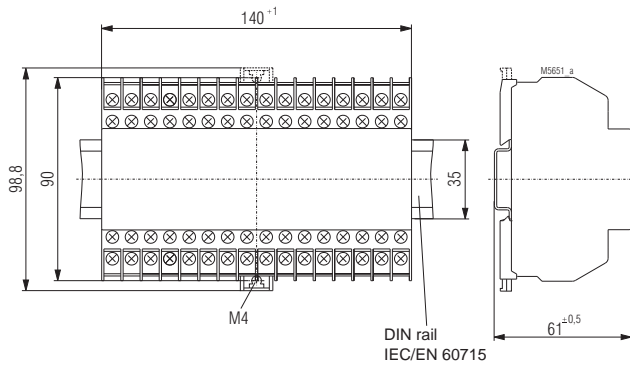
### IR - Enclosure



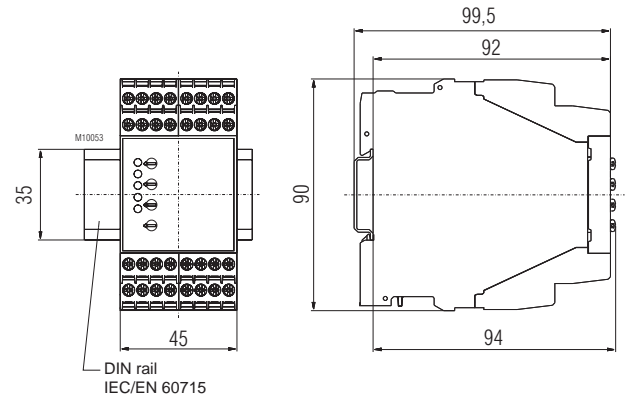
### LK - Enclosure



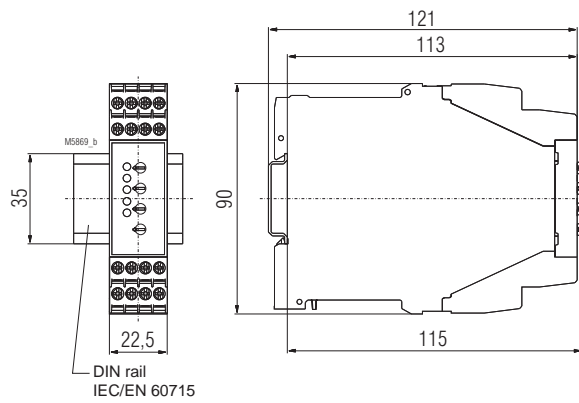
### IS - Enclosure



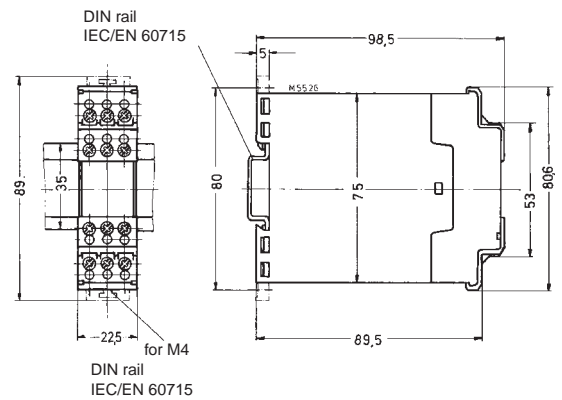
### MH - Enclosure



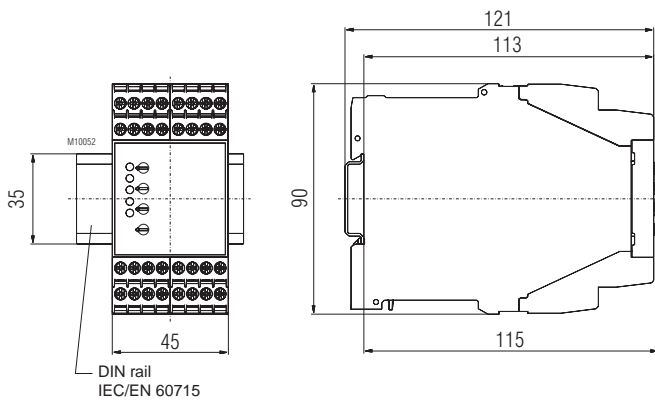
### LG - Enclosure



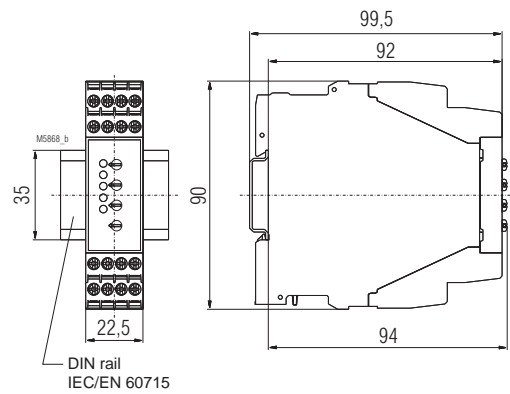
### MK - Enclosure



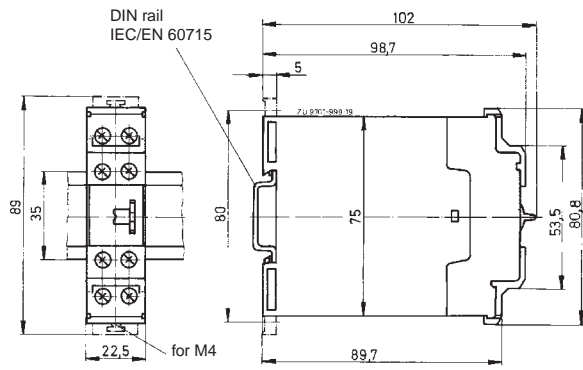
### LN - Enclosure



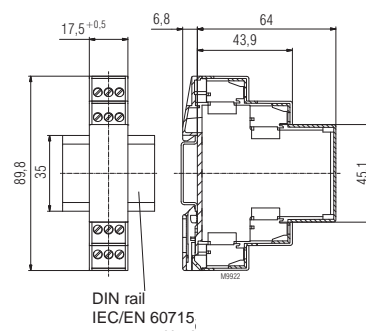
### MKN - Enclosure



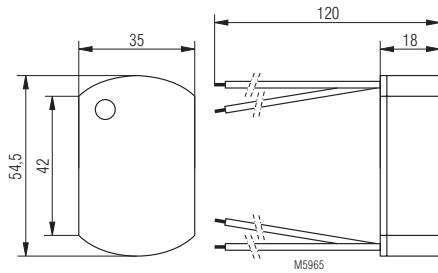
**ML - Enclosure**



**RK - Enclosure**

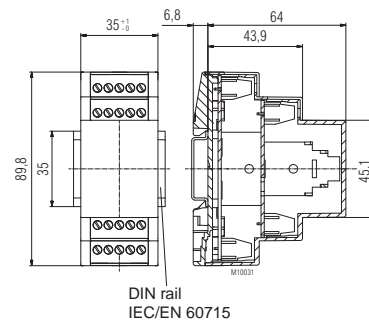


**OA - Enclosure**

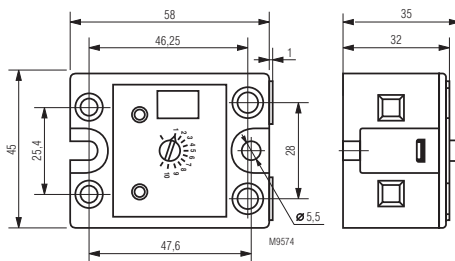


Enclosure OA 8823 / 8824

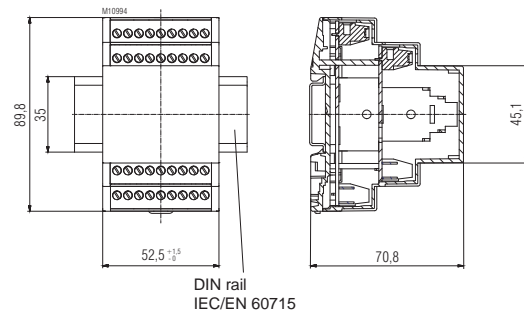
**RL - Enclosure**



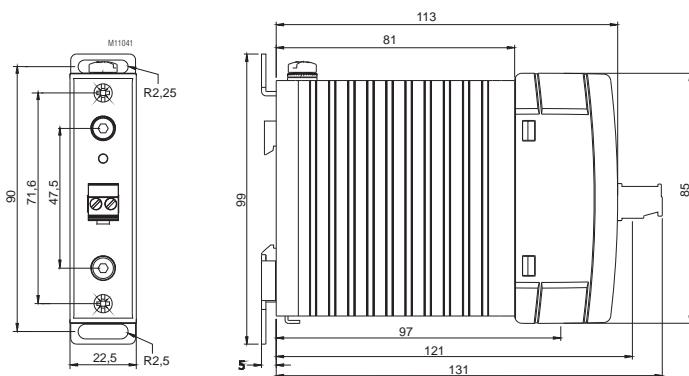
**PH - Enclosure**



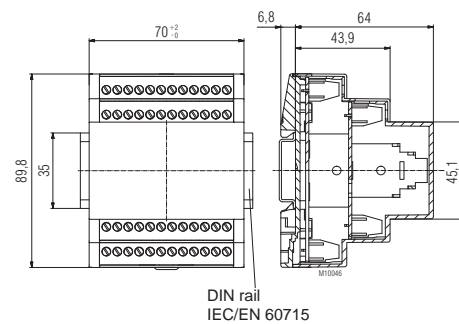
**RN - Enclosure**



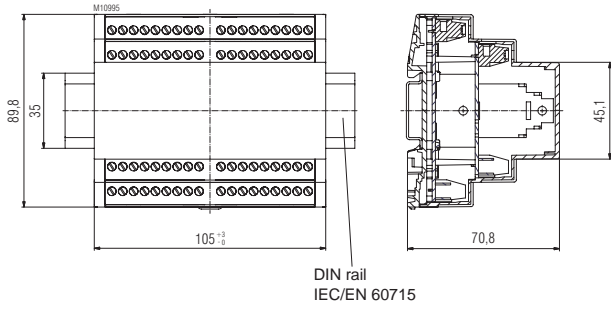
**PK - Enclosure**



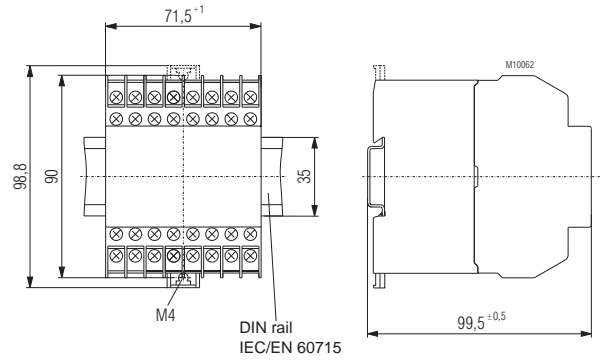
**RP - Enclosure**



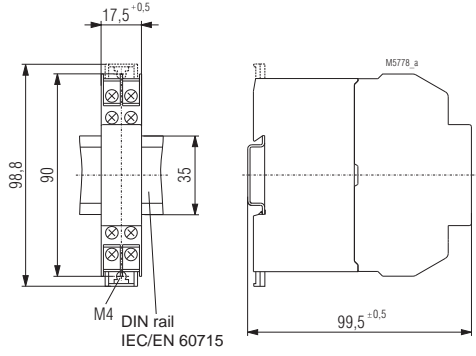
### RR - Enclosure



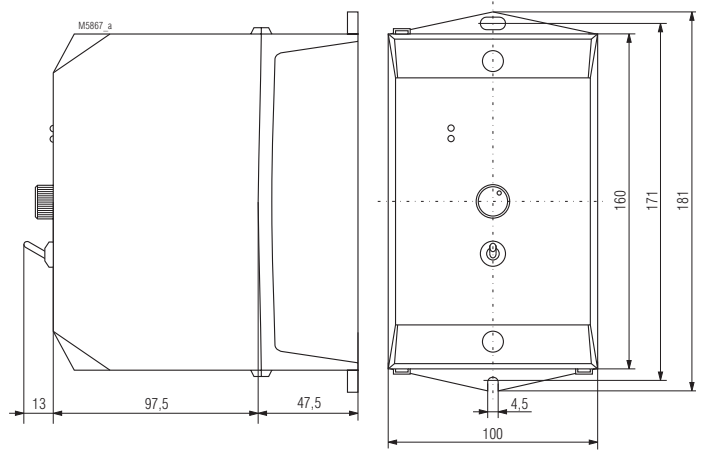
### SP - Enclosure



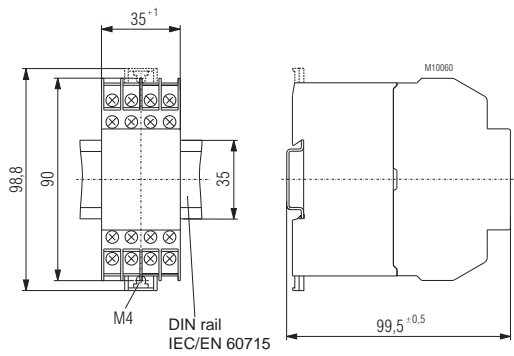
### SK - Enclosure



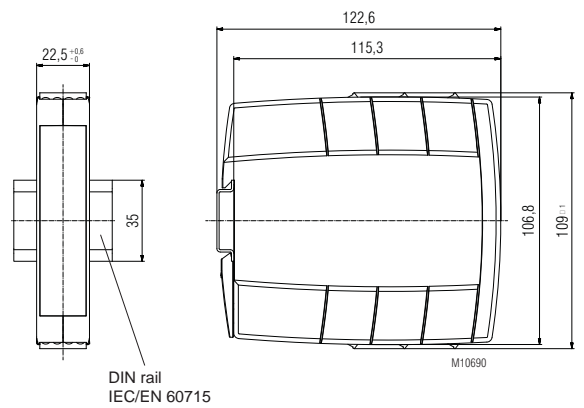
### SX - Enclosure



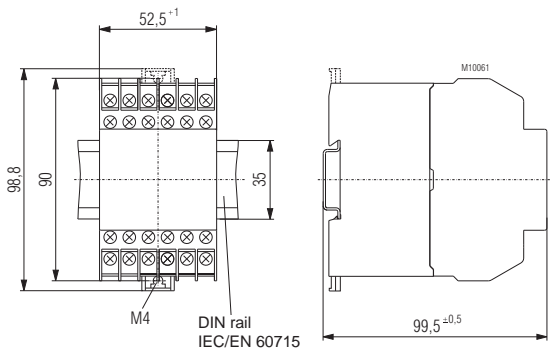
### SL - Enclosure



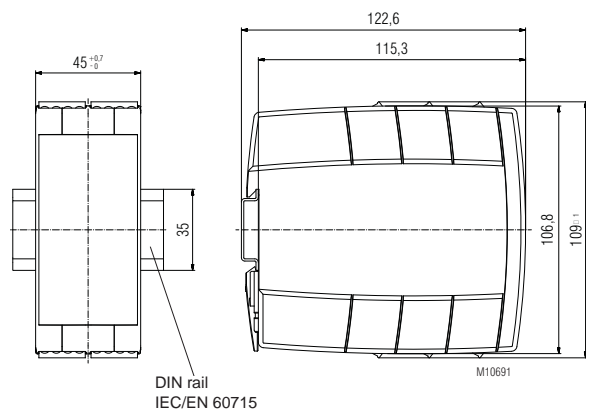
### UG - Enclosure



### SN - Enclosure



### UH - Enclosure



## General technical definitions

### Open-circuit mode (normally de-energized mode)

Contact switches to operated condition when the operate condition is met.

### Limiting continuous current $I_{th}$

This is the current that a relay contact may permanently carry without exceeding its permissible heating related to defined environmental conditions.

### Accuracy (repeat accuracy)

This is the difference between the smallest and largest measured values of constant influence quantities related to the max. value (full scale value).

### Equipment service life

Mechanical service life indicating the permissible number of operations for de-energized relay contacts.

### Hysteresis

Hysteresis is generally known as maintaining an effect although the physical quantity that has caused it is no longer effective. For relays, magnetic hysteresis causes the difference between pick-up and drop-out values. In case of measuring relays the drop-out value is determined by an adjustable hysteresis.

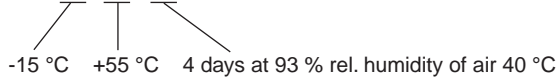
### Climate resistance / humidity class

Electromechanical equipment:

The standard DIN EN 60068-2-78 describes the tests for the environmental conditions of steady state damp heat, for example.

Electronic equipment:

The indication of climate resistance for electronic equipment is given as follows: Climate resistance: 15 / 55 / 04 IEC/EN 60068-1



### Contact service life

Electrical service life indicating the number of operating cycles to be expected at a defined load, e.g. AC 15 (see the definition for switching capacity).

### Creeping distance

This is the shortest distance along the surface of an insulating material between two conductive parts.

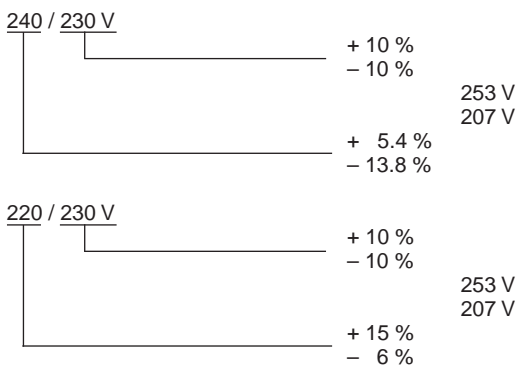
### Clearance in air

This is the shortest distance in air between two conductive parts.

### Nominal voltage

The nominal voltage of a relay is that voltage for which the winding including additional built-in components is designed and to which other characteristics are related to.

Devices that are rated for 230 V  $\pm$  10 % can only be operated on a 220 V or 240 V system with restricted tolerances. For these devices, the restricted tolerance is indicated on the nameplate.



### Protective separation

A protective separation of circuits is present when a single fault does not cause the voltage from being transferred to another circuit. The definition of "protective separation" is based on the standards DIN EN 61140, DIN EN 60947-1 in conjunction with the standard DIN EN 60664-1 and is specified as rated impulse withstand voltage related to the pollution severity. The rated impulse withstand voltage is the voltage level according to which clearance and creeping distances are rated. It is determined as a function of the overvoltage category to which the electrical equipment is to be assigned to.

A specification of 4 kV/2 means: Rated impulse withstand voltage 4 kV related to the pollution severity 2.

### Test voltage

The test voltage specifies the dielectric strength between coil and contact, e.g. 4 kV.

### Closed-circuit mode (normally energized mode)

With the closed-circuit principle, the contact falls back in its normal position when the operate condition is met.

### Degree of protection

Standardized classification of the protection of equipment against accidental contact, foreign bodies and water. According to IEC/EN 60529, the degree of protection is indicated by the code letters IP and two code numbers. The first code number describes the protection against accidental contact and foreign bodies, the second number the protection against water.

#### Degrees of protection against solid foreign bodies designated by the first code number.

First code no.	Short description	Degree of protection Definition
0	Not protected	–
1	Protected against solid foreign objects, diameter 50 mm and larger	The object probe, a ball with a diameter of 50 mm, must not enter fully.)*
2	Protected against solid foreign objects, diameter 12.5 mm and larger	The object probe, a ball with a diameter of 12.5 mm, must not enter fully.)*
3	Protected against solid foreign objects, diameter 2.5 mm and larger	The object probe with a diameter of 2.5 mm must not penetrate at all.)*
4	Protected against solid foreign objects, diameter 1.0 mm and larger	The object probe with a diameter of 1.0 mm must not penetrate at all.)*
5	Protected against dust	The penetration of dust is not completely prevented, but dust must not enter in an amount that impairs the satisfactory functioning of the equipment or the safety.
6	Dust-proof	No penetration of dust is allowed.

\*) Note: The full diameter of the object probe must not fit through any opening of the enclosure.

#### Degrees of protection against water designated by the second code number

Second code no.	Short description	Degree of protection Definition
0	Not protected	–
1	Protected from drip water.	Drops which fall vertically must not have any harmful effect.
2	Protected against drip water when the enclosure is inclined at an angle up to 15 %.	Drops which fall vertically must not have any harmful effect when the enclosure is inclined at an angle up to 15 % of either side of the vertical.
3	Protected against spray water.	Water which is sprayed at an angle of up to 60 % of either side of the perpendicular must not have any harmful effects.
4	Protected against spray water	Water splashing against the enclosure from all directions must not have any harmful effects.
5	Protected against water jets.	Water jets against the enclosure from all directions must not have any harmful effects.
6	Protected against strong jets of water.	Strong water jets against the enclosure from all directions must not have any harmful effects.
7	Protected against the effects of temporary flooding.	Water must not enter the enclosure in any harmful quantity when the enclosure is temporarily submerged in water under standard conditions of pressure and time.
8	Protected against the effects of permanent flooding.	Water must not enter the enclosure in any harmful quantity when the enclosure is permanently submerged in water under conditions to be agreed between manufacturer and user. However, the conditions must be more stringent than those for code number 7.

# General technical definitions

## Switching capacity

Unaffected electric current a switching device or fuse can make/interrupt at a defined voltage under specified conditions.

Extract from IEC/EN 60 947-5-1

**Table 1: Utilization categories for switching elements**

Type of current	Utilization category	Typical applications
Alternating voltage	AC-12	Control of ohmic and semiconductor loads in input circuits of optocouplers
	AC-13	Control of semiconductor loads with transformer separation
	AC-14	Control of small electromagnetic loads (max. 72 VA)
	AC-15	Control of electromagnetic loads (larger than 72 VA)
Direct voltage	DC-12	Control of ohmic and semiconductor loads in input circuits of optocouplers
	DC-13	Control of electromagnetic loads
	DC-14	Control of electromagnetic loads with auto-resistors in the circuit

The rated operational current and the rated operational voltage are determined according to the values defined in the tables 2 and 3 for usual and unusual conditions depending on the utilization category.

**Table 2: Proof of the making and breaking capacity of switching elements under usual conditions by utilization categories**

Utilization category	Making			Breaking			Min. ON-duration	Number of making and breaking operations and switching rate		
	I/I <sub>e</sub>	U/U <sub>e</sub>		I/I <sub>e</sub>	U/U <sub>e</sub>			Se-quence <sup>2)</sup>	Num-ber	Cycles per min.
AC			cos φ			cos φ	Cycles (at 50 Hz or 60 Hz)			
AC-12	1	1	0,9	1	1	0,9	2	1	50 <sup>4)</sup>	6
AC-13	2	1	0,65	1	1	0,65	2 <sup>3)</sup>	2	10	fast <sup>5)</sup>
AC-14	6	1	0,3	1	1	0,3	2 <sup>3)</sup>	3	990	60
AC-15	10	1	0,3	1	1	0,3	2 <sup>3)</sup>	4	5000	6
DC			T0,95 ms			T0,95 ms	Time ms			
DC-12	1	1	1	1	1	1	25			
DC-13	1	1	6xP <sup>6)</sup>	1	1	6xP <sup>6)</sup>	T0,95			
DC-14	10	1	15	1	1	15	25 <sup>3)</sup>			

I <sub>e</sub>	Rated operational current	I	Making or breaking current
U <sub>e</sub>	Rated operational voltage	U	Voltage before making
P = U <sub>e</sub> x I <sub>e</sub>	Steady-state power in Watt	T0.95	Time until 95 % of the steady-state current is reached
3) Both ON-duration values (for I <sub>making</sub> and for I <sub>breaking</sub> ) must be at least 2 cycles (or 25 ms for DC-14).			
4) The first 50 switching cycles must be carried out with test voltage U <sub>e</sub> x 1.1, with the test current I <sub>e</sub> is firstly set at U <sub>e</sub> .			
5) As fast as possible, but full closing and opening of the contacts must be ensured.			
6) The value "6 x P" results from an empirical ratio that corresponds to most d.c. magnet loads up to an upper limit P = 50 W, with 6 x P = 300 ms. Loads with a rated power above 50 W are composed from small parallel loads. Therefore, 300 ms is an upper limit independent of the power magnitude.			
7) For all utilization categories the test sequences must be performed in the specified order.			

**Table 3: Proof of the making and breaking capacity of switching elements under unusual conditions by utilization categories<sup>1)</sup>**

Utilization category	Making			Breaking			Min. ON-duration	Making and breaking	
	I/I <sub>e</sub>	U/U <sub>e</sub>		I/I <sub>e</sub>	U/U <sub>e</sub>			Number	switching cycles/min.
AC			cos φ			cos φ	Cycles (at 50 Hz or 60 Hz)		
AC-12	–	–	–	–	–	–	–	–	–
AC-13 <sup>3)</sup>	10	1,1	0,65	1,1	1,1	0,65	2 <sup>4)</sup>	10	6
AC-14	6	1,1	0,7	6	1,1	0,7	2	10	6
AC-15	10	1,1	0,3	10	1,1	0,3	2	10	6
DC			T0,95 ms			T0,95 ms	Time ms		
DC-12	–	–	–	–	–	–	–	–	–
DC-13 <sup>3)</sup>	1,1	1,1	6xP <sup>6)</sup>	1,1	1,1	6xP <sup>6)</sup>	T0,95	10	6
DC-14	10	1,1	15	10	1,1	15	25 <sup>4)</sup>	10	6

I<sub>e</sub> Rated operational current  
U<sub>e</sub> Rated operational voltage  
P = U<sub>e</sub> x I<sub>e</sub> Steady-state power in Watt

I Making or breaking current  
U Voltage before making  
T0.95 Time until 95 % of the steady-state current is reached

- 1) The unusual condition must simulate an electromagnet blocked in open position.
- 3) For semiconductor switching elements an overload protection specified by the manufacturer should be used for testing under unusual conditions.
- 4) Both ON-duration values (for I<sub>making</sub> and for I<sub>breaking</sub>) must be at least 2 cycles (or 25 ms for DC-14).
- 5) The value "6 x P" results from an empirical ratio that corresponds to most d.c. magnet loads up to an upper limit P = 50 W, with 6 x P = 300 ms. Loads having a rated power above 50 W are composed of small parallel loads. Therefore, 300 ms is an upper limit independent of the power magnitude. For semiconductor switching elements the largest time constant must be 60 ms so that T0.95 = 180 ms (3 x time constant).

## Electrical life

The electrical life of a control unit is defined by the number of switching cycles under load that is reached or exceeded by 90 % of all devices under test without any repair or replacement of any part.

Extract from IEC/EN 60 947-5-1

**Table 4: Making and breaking capacity for testing the electrical service life**

Type of current	Utilization category	Making			Breaking		
Alternating current	AC-15	I	U	cos φ	I	U	cos φ
		10 I <sub>e</sub>	U <sub>e</sub>	0,7 <sup>1)</sup>	I <sub>e</sub>	U <sub>e</sub>	0,4 <sup>1)</sup>
Direct current	AC-15	I	U	T0,95	I	U	T0,95
		I <sub>e</sub>	U <sub>e</sub>	6 x P <sup>3)</sup>	I <sub>e</sub>	U <sub>e</sub>	6 x P <sup>3)</sup>

I<sub>e</sub> Rated operational current  
U<sub>e</sub> Rated operational voltage  
P = U<sub>e</sub> x I<sub>e</sub> Steady-state power in Watt

I Making or breaking current  
U Voltage before making  
T0.95 Time until 95 % of the steady-state current is reached (in ms)

- 1) The indicated power factors are conventional values and are only indicated for test circuits where electrical characteristics of coils are simulated. It is pointed out that for circuits with a power factor 0.4 shunt resistors are used in the test circuit to simulate the dampening effect by eddy-current losses.
- 2) In case of magnetic loads for direct current that are equipped with switching devices for starting an auto-resistor the rated operational current must be at least the highest inrush current.
- 3) The value "6 x P" results from an empirical ratio that corresponds to most d.c. magnet loads up to an upper limit P = 50 W. Loads having a power above 50 W are composed of small parallel loads. Therefore, 300 ms is an upper limit independent of the power.

## Further available devices

Function	Type
Current relay .....	ML 9701
Insulation monitor .....	AI 897
Insulation monitor .....	AI 898
Insulation monitor .....	EH 5878
Lamp tester .....	AI 990
line breakage relay .....	AI 940
Overvoltage relay .....	IL 9070
Test and indication panel .....	UP 5864

The data sheets are available at [www.dold.com](http://www.dold.com)

Function	Type	Page	Function	Type	Page
<b>A</b>					
Accessories .....		443	Insulation monitor .....	IN 5880/710, IN 5880/711 IP 5880/711 .....	94
Alphabetical index .....		16	Insulation monitor .....	MK 5880N, MH 5880 .....	85
Asymmetry relay .....	AK 9840 .....	297	Insulation monitor .....	LK 5894 .....	71
Asymmetry relay .....	BA 9040, MK 9040N .....	299	Insulation monitor .....	LK 5895 .....	66
Asymmetry relay .....	BA 9042, AI 942 .....	302	Insulation monitor .....	LK 5896 .....	59
<b>B</b>					
Battery symmetry monitor .....	BA 9054/331, BA 9054/332 .....	196	Insulation monitor .....	RN 5897/010 .....	39
<b>C</b>					
Common alarm system, bus connection .....	RP 5990, RP 5991 .....	421	Insulation monitor .....	RN 5897/300 .....	51
Current asymmetry relay .....	IP 9278, SP 9278CT .....	242	Insulation monitor .....	UH 5892 .....	77
Current monitor .....	IK 8839, IL 8839 .....	240	Insulation monitor .....	RP 5888 .....	90
Current relay .....	BA 9053, MK 9053N .....	206	<b>L</b>		
<b>D</b>					
Dimensions .....		447	Lamp tester .....	MK 9994, MK 9995 .....	444
Display unit with bus connection for fault annunciator system .....	EH 5990, EH 5991 .....	421	Level sensing relay .....	IL 9151, SL 9151, MK 9151N .....	387
Display unit with bus connection for fault annunciator system .....	EH 5994, EH 5995 .....	426	Locating current injector .....	RR 5886 .....	102
<b>F</b>			<b>M</b>		
Fault annunciator system .....	AD 5960 .....	413	Mains frequency monitor .....	MK 9143N, MH 9143 .....	335
Fault annunciator system .....	AD 5998, AD 5992 .....	437	Motor load monitor .....	BH 9097 .....	248
Fault annunciator system .....	EH 9997 .....	411	Motor load monitor .....	MK 9397N, MH 9837 .....	244
Fault annunciator system .....	EP 5966, EP 5967 .....	434	Motor load transmitter .....	BH 9098 .....	254
Fault annunciator system .....	IL 5990, IL 5991, SL 5990, SL 5991 .....	415	Multifunction measuring relay .....	MK 9300N, MH 9300 .....	126
Frequency relay .....	BA 9837, AA 9837, AA 9838 .....	304	<b>N</b>		
Frequency relay .....	IK 9143, SK 9143 .....	323	Neutral monitor .....	IL 9069, SL 9069 .....	311
Frequency relay .....	IL 9837, SL 9837 .....	308	New-/ First signal annunciator ...	RP 5994, RP 5995 .....	426
Frequency relay .....	MK 9837N, MH 9837 .....	325	Noise Filter .....	MK 5130N, LG 5130 .....	409
Frequency relay .....	MK 9837N/500, MH 9837/500 .....	330	<b>O</b>		
Further available devices .....		456	Overcurrent relay .....	IK 9270, IL 9270, IP 9270, SK 9270, SL 9270, SP 9270 .....	220
Fuse monitor .....	IL 9075, IP 9075, SL 9075, SP 9075 .....	316	Overcurrent relay .....	IK 9272, SK 9272 .....	226
Fuse monitor .....	UG 9075 .....	320	Overcurrent relay .....	IL 5201/20007, SL 5201/20007CT .....	229
<b>G</b>					
General conditions .....		459	Over- and undercurrent relay .....	IL 9277, IP 9277, SL 9277, SP 9277 .....	214
General technical definitions .....		454	Overvoltage relay .....	IK 9170, SK 9170 .....	179
<b>I</b>					
INFOMASTER_B, System Overview .....		419	Overvoltage relay .....	IK 9172, SK 9172 .....	181
Insulation fault locator .....	RR 5887 .....	106	Over- and undervoltage relay ...	IL 9077, IP 9077, SL 9077, SP 9077 .....	149
Insulation monitor .....	IL 5880, IP 5880, SL 5880, SP 5880 .....	81	<b>P</b>		
Insulation monitor .....	IL 5881, SL 5881 .....	98	Phase indicator .....	IK 9168, SK 9168 .....	279
			Phase monitor .....	BD 9080 .....	141
			Phase monitor .....	IK 9169, RK 9169, SK 9169 .....	284
			Phase monitor .....	IL 9086, SL 9086 .....	144
			Phase monitor .....	IL 9087, SL 9087 .....	147
			Phase monitor .....	RK 9872 .....	281

Function	Type	Page	Function	Type	Page
Phase sequence indicator	IK 9178, SK 9178	293	Underload monitor	MK 9065	265
Phase sequence monitor /-relay	IK 9179, RK 9179, SK 9179	295	Undervoltage relay	BA 9043, AA 9943	183
Phase sequence relay	BA 9041, AI941N	289	Undervoltage relay	BC 9190N	186
Phase sequence module	IL 9059, OA 9059, SL 9059	286	Undervoltage relay	IK 9173, SK 9173	190
Phase sequence relay	MK 9056N	291	Undervoltage relay	IK 9171, IL 9171, SK 9171, SL 9171	188
<b>R</b>			Undervoltage relay	IL 9071, SL 9071	192
Residual current monitor	IL 5882, SL 5882, IR 5882	113	Undervoltage relay	IL 9079, SL 9079	199
Residual current monitor Type A, with forcibly guidet indicator contacts	IP 5882.48	*	Undervoltage relay	IL 9176	277
Residual current monitor, Type B for AC and DC Systems	RN 5883	119	Undervoltage relay	IP 9109.17/107	*
Residual current transformer	ND 5015	122	Undervoltage relay	IP 9109.27/107	*
Residual current transformer	ND 5016	116	Undervoltage relay	IP 9110/107	*
Residual current transformer	ND 5017	110	Undervoltage relay	RK 9871	194
Residual current transformer	ND 5018	123	<b>V</b>		
Residual current transformer	ND 5019	117	Valve monitor	IK 9076, SK 9076	364
Reverse power monitoring	BH 9140, RP 9140	272	Voltage and frequency monitor	RP 9800	341
<b>S</b>			Voltage and frequency monitor acc. to VDE-AR-N 4105	RP 9810	344
SMS Telecontrol module	RP 5812	440	Voltage and frequency monitor	RP 9811	349
Speed monitor	BA 9055, AA 9050	372	Voltage drop detector	BC 9190N	186
Speed monitor	IK 9055, IL 9055 SK 9055, SL 9055	375	Voltage monitor	IK 9044, IK 9046	177
Speed monitor	MK 9055N, MH 9055	381	Voltage relay	BA 9036	172
Standstill monitor	BD 5936	366	Voltage relay	BA 9037	175
Standstill monitor	IK 9144, IL 9144 SK 9144, SL 9144	368	Voltage relay	BA 9054, MK 9054N	166
<b>T</b>			Voltage relay	MK 9064N, MH 9064	160
Temperature monitoring relay	BA 9094	391	* Data sheet on request		
Temperature monitoring relay	IK 9094, IL 9094, SK 9094, SL 9094	393			
Text display unit with bus connection infomaster B	EH 5996	431			
Thermistor motor protection relay	BA 9038, AI 938	397			
Thermistor motor protection relay	IL 9163, SL 9163	399			
Thermistor motor protection relay	MK 9003-ATEX	405			
Thermistor motor protection relay	MK 9163N, MK 9163-ATEX	401			
Transformer protection	IP 9111/107	*			
<b>U</b>					
Undercurrent relay	IK 9271, IL 9271, IP 9271, SK 9271, SL 9271, SP 9271	231			
Undercurrent relay	IK 9273, SK 9273	237			
Underload monitor	BA 9065	261			
Underload monitor	IK 9065, SK 9065, SL 9065CT	268			



# General Conditions

## for the Supply of Products and Services of the Electrical and Electronics Industry ("Grüne Lieferbedingungen" – GL)\*



### for commercial transactions between businesses

recommended by ZVEI-Zentralverband Elektrotechnik- und Elektronikindustrie e. V.

as of June 2011

#### Article I: General Provisions

1. Legal relations between Supplier and Purchaser in connection with supplies and/or services of the Supplier (hereinafter referred to as "Supplies") shall be solely governed by the present GL. The Purchaser's general terms and conditions shall apply only if expressly accepted by the Supplier in writing. The scope of delivery shall be determined by the congruent mutual written declarations.
2. The Supplier herewith reserves any industrial property rights and/or copyrights pertaining to its cost estimates, drawings and other documents (hereinafter referred to as "Documents"). The Documents shall not be made accessible to third parties without the Supplier's prior consent and shall, upon request, be returned without undue delay to the Supplier if the contract is not awarded to the Supplier. Sentences 1 and 2 shall apply mutatis mutandis to the Purchaser's Documents; these may, however, be made accessible to those third parties to whom the Supplier has rightfully subcontracted Supplies.
3. The Purchaser has the non-exclusive right to use standard software and firmware, provided that it remains unchanged, is used within the agreed performance parameters, and on the agreed equipment. Without express agreement the Purchaser may make one back-up copy of standard software.
4. Partial deliveries are allowed, unless they are unreasonable to accept for the Purchaser.
5. The term „claim for damages" used in the present GL also includes claims for indemnification for useless expenditure.

#### Article II: Prices, Terms of Payment, and Set-Off

1. Prices are ex works and excluding packaging; value added tax shall be added at the then applicable rate.
2. If the Supplier is also responsible for assembly or erection and unless otherwise agreed, the Purchaser shall pay the agreed remuneration and any incidental costs required, e. g. for traveling and transport as well as allowances.
3. Payments shall be made free Supplier's paying office.
4. The Purchaser may set off only those claims which are undisputed or non-appealable.

#### Article III: Retention of Title

1. The items pertaining to the Supplies ("Retained Goods") shall remain the Supplier's property until each and every claim the Supplier has against the Purchaser on account of the business relationship has been fulfilled. If the combined value of the Supplier's security interests exceeds the value of all secured claims by more than 20 %, the Supplier shall release a corresponding part of the security interest if so requested by the Purchaser; the Supplier shall be entitled to choose which security interest it wishes to release.
2. For the duration of the retention of title, the Purchaser may not pledge the Retained Goods or use them as security, and resale shall be possible only for resellers in the ordinary

course of their business and only on condition that the reseller receives payment from its customer or makes the transfer of property to the customer dependent upon the customer fulfilling its obligation to effect payment.

3. Should Purchaser resell Retained Goods, it assigns to the Supplier, already today, all claims it will have against its customers out of the resale, including any collateral rights and all balance claims, as security, without any subsequent declarations to this effect being necessary. If the Retained Goods are sold on together with other items and no individual price has been agreed with respect to the Retained Goods, Purchaser shall assign to the Supplier such fraction of the total price claim as is attributable to the price of the Retained Goods invoiced by Supplier.
4. (a) Purchaser may process, amalgamate or combine Retained Goods with other items. Processing is made for Supplier. Purchaser shall store the new item thus created for Supplier, exercising the due care of a diligent business person. The new items are considered as Retained Goods.  
(b) Already today, Supplier and Purchaser agree that if Retained Goods are combined or amalgamated with other items that are not the property of Supplier, Supplier shall acquire co-ownership in the new item in proportion of the value of the Retained Goods combined or amalgamated to the other items at the time of combination or amalgamation. In this respect, the new items are considered as Retained Goods.  
(c) The provisions on the assignment of claims according to No. 3 above shall also apply to the new item. The assignment, however, shall only apply to the amount corresponding to the value invoiced by Supplier for the Retained Goods that have been processed, combined or amalgamated.  
(d) Where Purchaser combines Retained Goods with real estate or movable goods, it shall, without any further declaration being necessary to this effect, also assign to Supplier as security its claim to consideration for the combination, including all collateral rights for the pro-rata amount of the value the combined Retained Goods have on the other combined items at the time of the combination.
5. Until further notice, Purchaser may collect assigned claims relating to the resale. Supplier is entitled to withdraw Purchaser's permission to collect funds for good reason, including, but not limited to delayed payment, suspension of payments, start of insolvency proceedings, protest or justified indications for overindebtedness or pending insolvency of Purchaser. In addition, Supplier may, upon expiry of an adequate period of notice disclose the assignment, realize the claims assigned and demand that Purchaser informs its customer of the assignment.
6. The Purchaser shall inform the Supplier forthwith of any seizure or other act of intervention by third parties. If a reasonable interest can be proven, Purchaser shall, without undue delay, provide Supplier with the information and/or Documents necessary to assert the claims it has against its customers.

\* The original German text shall be the governing version.

7. Where the Purchaser fails to fulfill its duties, fails to make payment due, or otherwise violates its obligations the Supplier shall be entitled to rescind the contract and take back the Retained Goods in the case of continued failure following expiry of a reasonable remedy period set by the Supplier; the statutory provisions providing that a remedy period is not needed shall be unaffected. The Purchaser shall be obliged to return the Retained Goods. The fact that the Supplier takes back Retained Goods and/or exercises the retention of title, or has the Retained Goods seized, shall not be construed to constitute a rescission of the contract, unless the Supplier so expressly declares.

#### **Article IV: Time for Supplies; Delay**

1. Times set for Supplies shall only be binding if all Documents to be furnished by the Purchaser, necessary permits and approvals, especially concerning plans, are received in time and if agreed terms of payment and other obligations of the Purchaser are fulfilled. If these conditions are not fulfilled in time, times set shall be extended reasonably; this shall not apply if the Supplier is responsible for the delay.
2. If non-observance of the times set is due to:
  - (a) force majeure, such as mobilization, war, terror attacks, rebellion or similar events (e. g. strike or lockout);
  - (b) virus attacks or other attacks on the Supplier's IT systems occurring despite protective measures were in place that complied with the principles of proper care;
  - (c) hindrances attributable to German, US or otherwise applicable national, EU or international rules of foreign trade law or to other circumstances for which Supplier is not responsible; or
  - (d) the fact that Supplier does not receive its own supplies in due time or in due formsuch times shall be extended accordingly.
3. If the Supplier is responsible for the delay (hereinafter referred to as "Delay") and the Purchaser has demonstrably suffered a loss therefrom, the Purchaser may claim a compensation as liquidated damages of 0.5 % for every completed week of Delay, but in no case more than a total of 5 % of the price of that part of the Supplies which due to the Delay could not be put to the intended use.
4. Purchaser's claims for damages due to delayed Supplies as well as claims for damages in lieu of performance exceeding the limits specified in No. 3 above are excluded in all cases of delayed Supplies, even upon expiry of a time set to the Supplier to effect the Supplies. This shall not apply in cases of liability based on intent, gross negligence, or due to loss of life, bodily injury or damage to health. Rescission of the contract by the Purchaser based on statute is limited to cases where the Supplier is responsible for the delay. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser.
5. At the Supplier's request, the Purchaser shall declare within a reasonable period of time whether it, due to the delayed Supplies, rescinds the contract or insists on the delivery of the Supplies.
6. If dispatch or delivery, due to Purchaser's request, is delayed by more than one month after notification of the readiness for dispatch was given, the Purchaser may be charged, for every additional month commenced, storage costs of 0.5 %

of the price of the items of the Supplies, but in no case more than a total of 5 %. The parties to the contract may prove that higher or, as the case may be, lower storage costs have been incurred.

#### **Article V: Passing of Risk**

1. Even where delivery has been agreed freight free, the risk shall pass to the Purchaser as follows:
  - (a) if the delivery does not include assembly or erection, at the time when it is shipped or picked up by the carrier. Upon the Purchaser's request, the Supplier shall insure the delivery against the usual risks of transport at the Purchaser's expense;
  - (b) if the delivery includes assembly or erection, at the day of taking over in the Purchaser's own works or, if so agreed, after a successful trial run.
2. The risk shall pass to the Purchaser if dispatch, delivery, the start or performance of assembly or erection, the taking over in the Purchaser's own works, or the trial run is delayed for reasons for which the Purchaser is responsible or if the Purchaser has otherwise failed to accept the Supplies.

#### **Article VI: Assembly and Erection**

Unless otherwise agreed in written form, assembly and erection shall be subject to the following provisions:

1. Purchaser shall provide at its own expense and in due time:
  - (a) all earth and construction work and other ancillary work outside the Supplier's scope, including the necessary skilled and unskilled labor, construction materials and tools;
  - (b) the equipment and materials necessary for assembly and commissioning such as scaffolds, lifting equipment and other devices as well as fuels and lubricants;
  - (c) energy and water at the point of use including connections, heating and lighting;
  - (d) suitable dry and lockable rooms of sufficient size adjacent to the site for the storage of machine parts, apparatus, materials, tools, etc. and adequate working and recreation rooms for the erection personnel, including sanitary facilities as are appropriate in the specific circumstances; furthermore, the Purchaser shall take all measures it would take for the protection of its own possessions to protect the possessions of the Supplier and of the erection personnel at the site;
  - (e) protective clothing and protective devices needed due to particular conditions prevailing on the specific site.
2. Before the erection work starts, the Purchaser shall unsolicitedly make available any information required concerning the location of concealed electric power, gas and water lines or of similar installations as well as the necessary structural data.
3. Prior to assembly or erection, the materials and equipment necessary for the work to start must be available on the site of assembly or erection and any preparatory work must have advanced to such a degree that assembly or erection can be started as agreed and carried out without interruption. Access roads and the site of assembly or erection must be level and clear.

4. If assembly, erection or commissioning is delayed due to circumstances for which the Supplier is not responsible, the Purchaser shall bear the reasonable costs incurred for idle times and any additional traveling expenditure of the Supplier or the erection personnel.
5. The Purchaser shall attest to the hours worked by the erection personnel towards the Supplier at weekly intervals and the Purchaser shall immediately confirm in written form if assembly, erection or commissioning has been completed.
6. If, after completion, the Supplier demands acceptance of the Supplies, the Purchaser shall comply therewith within a period of two weeks. The same consequences as upon acceptance arise if and when the Purchaser lets the two-week period expire or the Supplies are put to use after completion of agreed test phases, if any.
7. There shall be no claims based on Defect in cases of insignificant deviations from the agreed quality, of only minor impairment of usability, of natural wear and tear, or damage arising after the passing of risk from faulty or negligent handling, excessive strain, unsuitable equipment, defective civil works, inappropriate foundation soil, or claims based on particular external influences not assumed under the contract, or from non-reproducible software errors. Claims based on defects attributable to improper modifications or repair work carried out by the Purchaser or third parties and the consequences thereof are likewise excluded.
8. The Purchaser shall have no claim with respect to expenses incurred in the course of supplementary performance, including costs of travel, transport, labor, and material, to the extent that expenses are increased because the subject-matter of the Supplies has subsequently been brought to another location than the Purchaser's branch office, unless doing so complies with the normal use of the Supplies.

#### **Article VII: Receiving Supplies**

The Purchaser shall not refuse to receive Supplies due to minor defects.

#### **Article VIII: Defects as to Quality**

The Supplier shall be liable for defects as to quality ("Sachmängel", hereinafter referred to as "Defects",) as follows:

1. Defective parts or defective services shall be, at the Supplier's discretion, repaired, replaced or provided again free of charge, provided that the reason for the Defect had already existed at the time when the risk passed.
2. Claims for repair or replacement are subject to a statute of limitations of 12 months calculated from the start of the statutory statute of limitations; the same shall apply mutatis mutandis in the case of rescission and reduction. This shall not apply where longer periods are prescribed by law according to Sec. 438 para. 1 No. 2 (buildings and things used for a building), Sec. 479 para. 1 (right of recourse), and Sec. 634a para. 1 No. 2 (defects of a building) German Civil Code ("Bürgerliches Gesetzbuch"), in the case of intent, fraudulent concealment of the Defect or non-compliance with guaranteed characteristics ("Beschaffenheitsgarantie"). The legal provisions regarding suspension of the statute of limitations ("Ablaufhemmung", "Hemmung") and recommencement of limitation periods shall be unaffected.
3. Notifications of Defect by the Purchaser shall be given in written form without undue delay.
4. In the case of notification of a Defect, the Purchaser may withhold payments to an amount that is in a reasonable proportion to the Defect. The Purchaser, however, may withhold payments only if the subject-matter of the notification of the Defect involved is justified and incontestable. The Purchaser has no right to withhold payments to the extent that its claim of a Defect is time-barred. Unjustified notifications of Defect shall entitle the Supplier to demand reimbursement of its expenses by the Purchaser.
5. The Supplier shall be given the opportunity to repair or to replace the defective good ("Nacherfüllung") within a reasonable period of time.
6. If repair or replacement is unsuccessful, the Purchaser is entitled to rescind the contract or reduce the remuneration; any claims for damages the Purchaser may have according to No. 10 shall be unaffected.
9. The Purchaser's right of recourse against the Supplier pursuant to Sec. 478 BGB is limited to cases where the Purchaser has not concluded an agreement with its customers exceeding the scope of the statutory provisions governing claims based on Defects. Moreover, No. 8 above shall apply mutatis mutandis to the scope of the right of recourse the Purchaser has against the Supplier pursuant to Sec. 478 para. 2 BGB.
10. The Purchaser shall have no claim for damages based on Defects. This shall not apply to the extent that a Defect has been fraudulently concealed, the guaranteed characteristics are not complied with, in the case of loss of life, bodily injury or damage to health, and/or intentionally or grossly negligent breach of contract on the part of the Supplier. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser. Any other or additional claims of the Purchaser exceeding the claims provided for in this Article VIII, based on a Defect, are excluded.

#### **Article IX: Industrial Property Rights and Copyrights; Defects in Title**

1. Unless otherwise agreed, the Supplier shall provide the Supplies free from third parties' industrial property rights and copyrights (hereinafter referred to as "IPR") with respect to the country of the place of delivery only. If a third party asserts a justified claim against the Purchaser based on an infringement of an IPR by the Supplies made by the Supplier and used in conformity with the contract, the Supplier shall be liable to the Purchaser within the time period stipulated in Article VIII No. 2 as follows:
  - (a) The Supplier shall choose whether to acquire, at its own expense, the right to use the IPR with respect to the Supplies concerned or whether to modify the Supplies such that they no longer infringe the IPR or replace them. If this would be impossible for the Supplier under reasonable conditions, the Purchaser may rescind the contract or reduce the remuneration pursuant to the applicable statutory provisions;
  - (b) The Supplier's liability to pay damages is governed by Article XII;
  - (c) The above obligations of the Supplier shall apply only if the Purchaser (i) immediately notifies the Supplier of any such claim asserted by the third party in written form, (ii) does not concede the existence of an infringement and (iii) leaves any protective measures and settlement negotiations to the Supplier's discretion. If the Purchaser

stops using the Supplies in order to reduce the damage or for other good reason, it shall be obliged to point out to the third party that no acknowledgement of the alleged infringement may be inferred from the fact that the use has been discontinued.

2. Claims of the Purchaser shall be excluded if it is responsible for the infringement of an IPR.
3. Claims of the Purchaser are also excluded if the infringement of the IPR is caused by specifications made by the Purchaser, by a type of use not foreseeable by the Supplier or by the Supplies being modified by the Purchaser or being used together with products not provided by the Supplier.
4. In addition, with respect to claims by the Purchaser pursuant to No. 1 a) above, Article VIII Nos. 4, 5, and 9 shall apply mutatis mutandis in the event of an infringement of an IPR.
5. Where other defects in title occur, Article VIII shall apply mutatis mutandis.
6. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Article IX, based on a defect in title, are excluded.

#### **Article X: Conditional Performance**

1. The performance of this contract is conditional upon that no hindrances attributable to German, US or otherwise applicable national, EU or international rules of foreign trade law or any embargos or other sanctions exist.
2. The Purchaser shall provide any information and Documents required for export, transport and import purposes.

#### **Article XI: Impossibility of Performance; Adaptation of Contract**

1. To the extent that delivery is impossible, the Purchaser is entitled to claim damages, unless the Supplier is not responsible for the impossibility. The Purchaser's claim for damages is, however, limited to an amount of 10 % of the value of the part of the Supplies which, owing to the impossibility, cannot be put to the intended use. This limitation shall not apply in the case of liability based on intent, gross negligence or loss of life, bodily injury or damage to health; this does not imply a change in the burden of proof to the detriment of the Purchaser. The Purchaser's right to rescind the contract shall be unaffected.
2. Where events within the meaning of Article IV No. 2 (a) to (c) substantially change the economic importance or the contents of the Supplies or considerably affect the Supplier's business, the contract shall be adapted taking into account the principles of reasonableness and good faith. To the extent this is not justifiable for economic reasons, the Supplier shall have the right to rescind the contract. The same applies if required export permits are not granted or cannot be used. If the Supplier intends to exercise its right to rescind the contract, it shall notify the Purchaser thereof without undue

delay after having realized the repercussions of the event; this shall also apply even where an extension of the delivery period has previously been agreed with the Purchaser.

#### **Article XII: Other Claims for Damages**

1. Unless otherwise provided for in the present GL, the Purchaser has no claim for damages based on whatever legal reason, including infringement of duties arising in connection with the contract or tort.
2. This does not apply if liability is based on:
  - (a) the German Product Liability Act ("Produkthaftungsgesetz");
  - (b) intent;
  - (c) gross negligence on the part of the owners, legal representatives or executives;
  - (d) fraud;
  - (e) failure to comply with a guarantee granted;
  - (f) negligent injury to life, limb or health; or
  - (g) negligent breach of a fundamental condition of contract ("wesentliche Vertragspflichten").

However, claims for damages arising from a breach of a fundamental condition of contract shall be limited to the foreseeable damage which is intrinsic to the contract, provided that no other of the above case applies.

3. The above provision does not imply a change in the burden of proof to the detriment of the Purchaser.

#### **Artikel XIII: Venue and Applicable law**

1. If the Purchaser is a businessman, sole venue for all disputes arising directly or indirectly out of the contract shall be the Supplier's place of business. However, the Supplier may also bring an action at the Purchaser's place of business.
2. This contract and its interpretation shall be governed by German law, to the exclusion of the United Nations Convention on contracts for the International Sale of Goods (CISG).

#### **Article XIV: Severability Clause**

The legal invalidity of one or more provisions of this Agreement in no way affects the validity of the remaining provisions. This shall not apply if it would be unreasonably onerous for one of the parties to be obligated to continue the contract.

