

Rapid Link 4.0
RAMO
RASP



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Original Operating Instructions

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Danger! **Dangerous electrical voltage!**

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The applicable national accident prevention and safety regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
 - Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
 - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
 - Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

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0 About this manual

This manual describes types starting with Release 008 of the RAMO and Release 007 of the RASP.

The subsequent chapters provide special information needed to configure, install and operate these Rapid Link function modules.

0.1 List of revisions

The following significant amendments have been introduced since previous issues:

Publication date	Page	Subject	new	modified	omitted
04/16	17	UL Standards Compliance	✓		
10/15		UL approval	✓		
		EMC compliance for RASP units		✓	
		Comparison lists			✓
06/13	All	Complete revision	✓		
04/12	All	Complete revision	✓		
12/11	All	Complete revision	✓		
09/11	All	Complete revision	✓		
12/10		First version	–	–	–

0.2 Application notes

Please read this manual carefully, before you install the Rapid Link system and start using it.

We assume that you are familiar with basic physical concepts and are experienced in reading technical drawings and dealing with electrical equipment.



Incorporating RAMO and RASP units with version 4.0 into existing Rapid Link systems with version 3.0 or lower will require additional engineering and installation work. For more information, please consult this manual or contact your local sales office.

0.3 Reading conventions

The symbols used in this manual have the following meanings:

- ▶ Indicates instructions to be followed.

0.3.1 Hazard warnings of material damages

NOTICE

Warns about the possibility of material damage.

0.3.2 Hazard warnings of personal injury



CAUTION

Warns of the possibility of hazardous situations that may possibly cause slight injury.



WARNING

Warns of the possibility of hazardous situations that could result in serious injury or even death.



DANGER

Warns of hazardous situations that result in serious injury or death.

0.3.3 Tips



Indicates useful tips.



The housing, as well as other safety-relevant parts, has been left out in some of the figures in this manual in order to make the figures easier to understand. However, it is important to note that the components described in this manual must always be operated with their housing installed properly, as well as with all required safety-relevant parts.



Please follow the notes in the IL03406019Z and IL03406020Z instructional leaflets.

➔ All the specifications in this manual refer to the hardware and software versions documented in it.

➔ For more information on the series described in this manual, please visit:

www.eaton.de/EatonDE/ProdukteundLoesungen/Electrical/index.htm



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In the **Quick Search** box, enter a search term. Then click on **Search**.

Alternatively, you can use the list boxes to select the **Switching, Protecting and Driving Motors** ➔ **Rapid Link** options and then click on **Search** to access the information available on the subject of Rapid Link (instruction leaflets, software, manuals, catalogs, product information).

0.4 Abbreviations and symbols

The following symbols are used in this manual:

DIP	D ual i n-line p ackage (microswitch)
EMS	E lectronic M otor S tarter
EMC	E lectromagnetic c ompatibility
Fct No.	F unction n umber
FWD	Clockwise rotating field (F orward)
LCD	L iquid C rystal D isplay
LOS	L ist of o ffline s laves
PES	Functional earth, PE - positive earth cable s creen connection
PNU	P arameter N umber
REV	Anticlockwise rotating field (r everse)
DS	D efault s ettings
	The AS-Interface (A ctuator- S ensor-Interface) logo is used to indicate that the corresponding components comply with standards EN 50295 and IEC 6026-2.
	The DESINA logo (D Ecentralized and S tandardized I NstAllation technology) is applied here to components conforming to with the DESINA specification. Visit www.desina.de

0.5 Unit of measurement

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système International d'Unités) units. For the purpose of the equipment's UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

Table 1: Unit conversion examples

Designation	US-American designation	US-American value	SI value	Conversion value
Length	inch	1 inch (")	25.4 mm	0.0394
Power	horsepower	1 HP = 1.014 PS	0.7457 kW	1.341
Torque	pound-force inches	1 lbf in	0.113 Nm	8.851
Temperature	Fahrenheit	1 °F (T _F)	-17.222 °C (T _C)	$T_F = T_C \times 9/5 + 32$
Speed	Revolutions per minute	1 rpm	1 min ⁻¹	1
Weight	pound	1 lb	0.4536 kg	2.205

1 System Rapid Link 4.0

Rapid Link 4.0 is a modern, efficient drive and PLC.

Customer and sector-specific requirements for material handling systems are the main focus of the innovative Rapid Link Link 4.0 system's design. It is suitable for both simple and complex tasks in all material handling systems, but specially in horizontal conveying systems.

Because the Rapid Link 4.0 System can be fitted into a power and data bus, it allows electrical drives to be installed and taken into operation much more quickly and cost-efficiently than with conventional methods.

Thanks to a power bus and a data bus that are plugged into every Rapid Link 4.0 module, the system is quick and easy to install.

The version 4.0 Rapid Link modules provide tailored solutions with the following features:

- Degree of protection IP65,
- AS-Interface for communication and diagnostics,
- Plug-in terminal type to ISO 23570,
- Local operation/hand operation,
- Repair and maintenance switch (optional)
- Electronic DOL and reversing starter RAMO,
- RASP frequency controlled speed control.

1 System Rapid Link 4.0

1.1 System overview

1.1 System overview

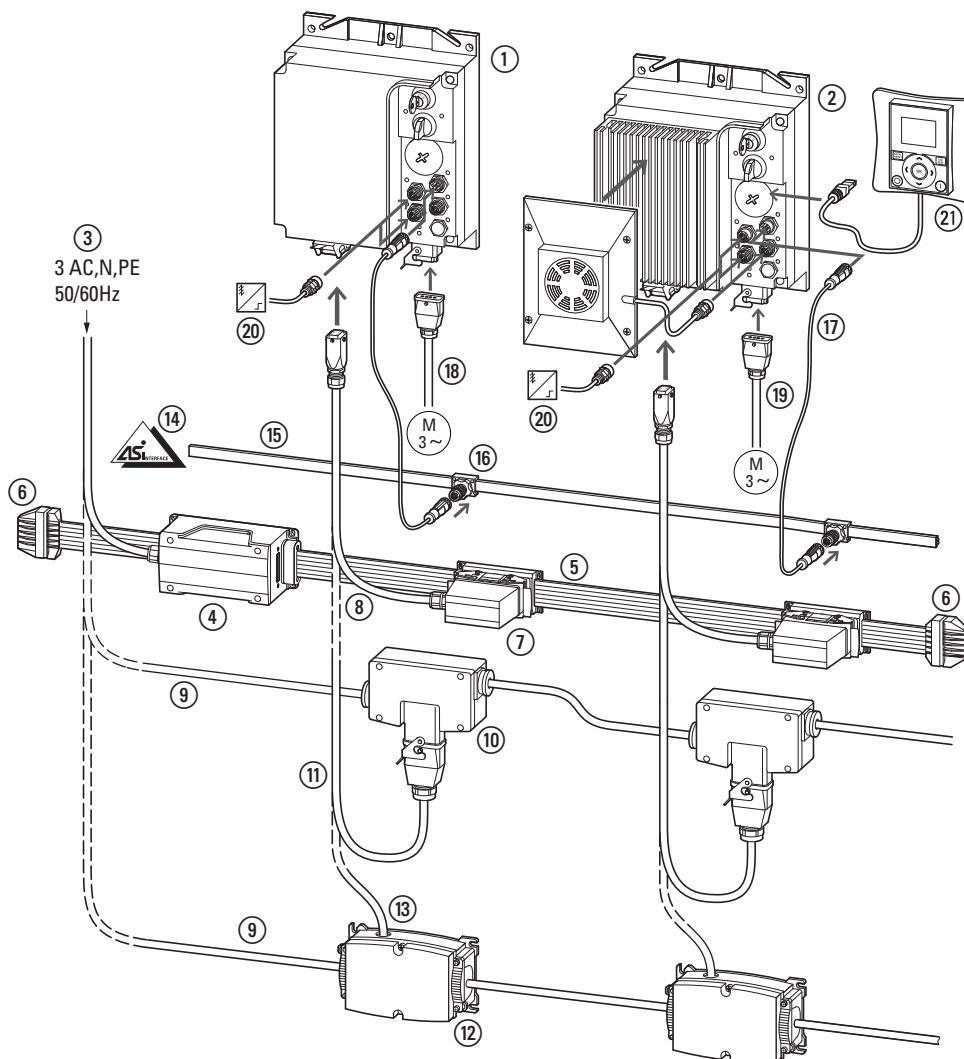


Figure 1: Overview Rapid Link Module RA 4.0

Function modules:

- ① RAMO motor starter (Motor Control Unit)
→ 3-phase electronic DOL starter or reversing starter
- ② RASP speed controller
→ 3-phase, frequency-controlled motor starter

Power bus:

- ③ Energy supply (3 AC N/PE 400/480 V, 50/60 Hz)
- ④ Incoming supply for ribbon cable
- ⑤ Ribbon cable for 400/480 V AC
- ⑥ End-piece for flat cable
- ⑦ Flexible busbar junction
- ⑧ Power adapter cable to flexible busbar junction
- ⑨ Round cable for 400/480 V AC

- ⑩ Plug-in link for round cable
- ⑪ Power adapter cable for pluggable round cable junction
- ⑫ Plug-in link for round cable (Powerbox)
- ⑬ Power adapter cable (round cable) to power box

Data bus:

- ⑭ AS-Interface supply via main cable
- ⑮ AS-Interface flat cable
- ⑯ Link for M12 connector cables
- ⑰ Extension cable with M12 plug

Motor connection:

- ⑱ Unshielded motor cable (for RAMO)
- ⑲ Screened motor cable (for RASP)

- ⑳ Sensor connection via M12 plug connector
- ㉑ External keypad (only RASP)

1.2 Checking the Delivery



Before opening the packaging go over the nameplate on the packaging and check for whether the delivered component is the same part no. as the one you ordered.

RAMO and RASP are packaged and dispatched carefully. The devices should be shipped only in their original packaging with suitable transportation materials. Please observe the labels and instructions on the packaging and for handling the unpacked device.

Open the packaging with adequate tools and inspect the contents immediately after receipt in order to ensure that they are complete and undamaged.

The packaging must contain the following parts:

- Motor Control Unit:
 - RAMO-D or RAMO-W,
 - the instructional leaflet IL03406019Z.

or

- Speed Control Unit:
 - RASP-2, RASP-3, RASP-4 or RASP-5,
 - the instructional leaflet IL03406020Z.

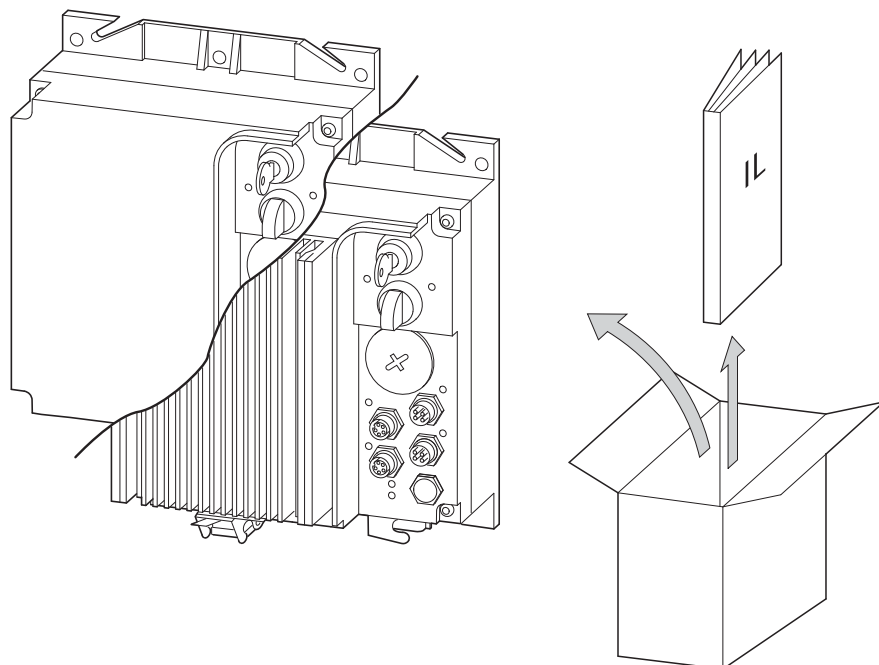


Figure 2: Equipment supplied (RAMO or RASP device plus instructional leaflet)

1 System Rapid Link 4.0

1.3 Ratings

1.3 Ratings

The device-specific rated operational data of RAMO or RASP are printed on the nameplate on the device's side.

1.3.1 Key to part numbers RAMO

The key to part numbers and the part no. of the motor starter RAMO are in the following order:

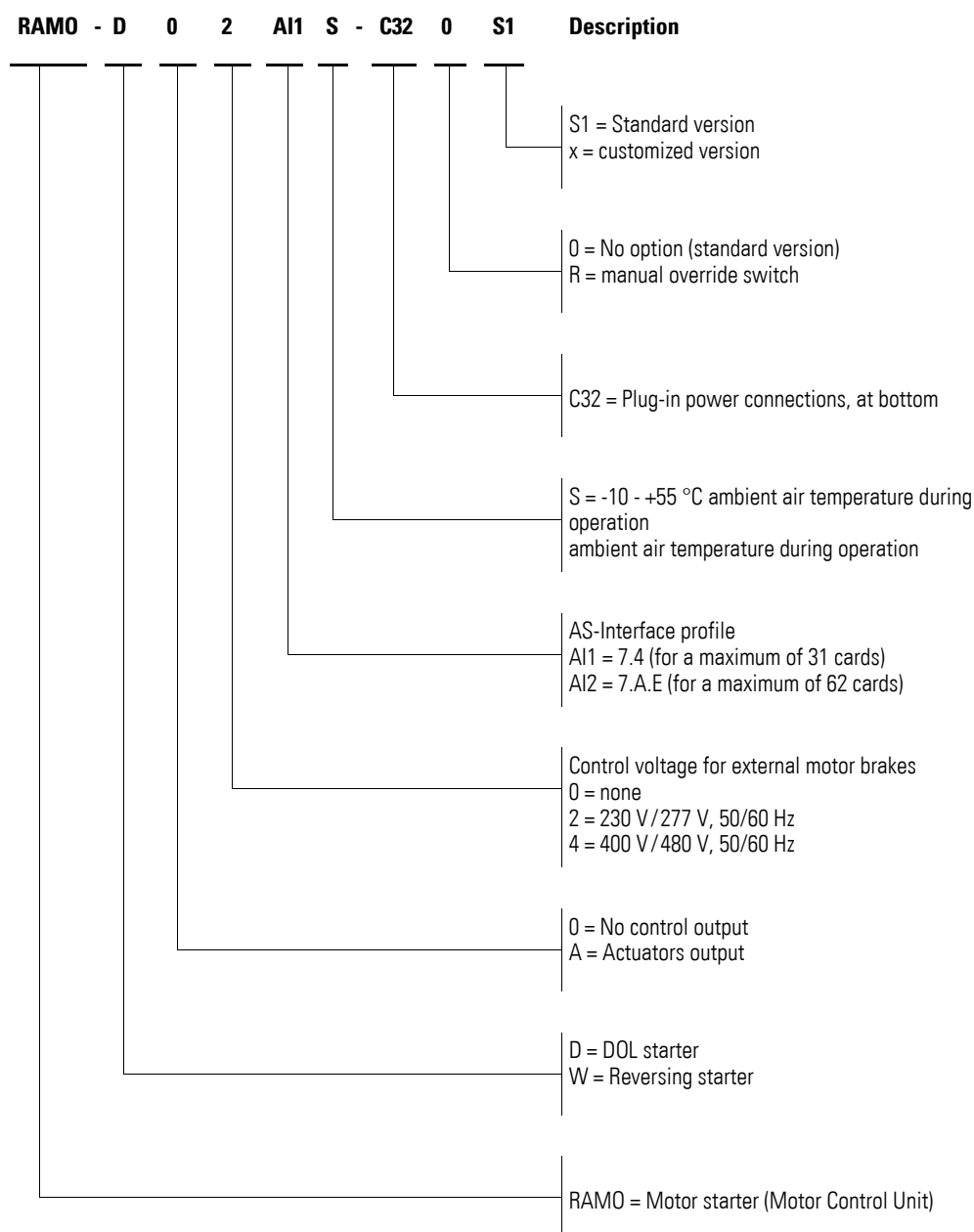


Figure 3: Key to part numbers of RAMO motor starter

1.3.2 Key to part numbers RASP

The key to part numbers and the part no. of the RASP speed controller are in the following order:

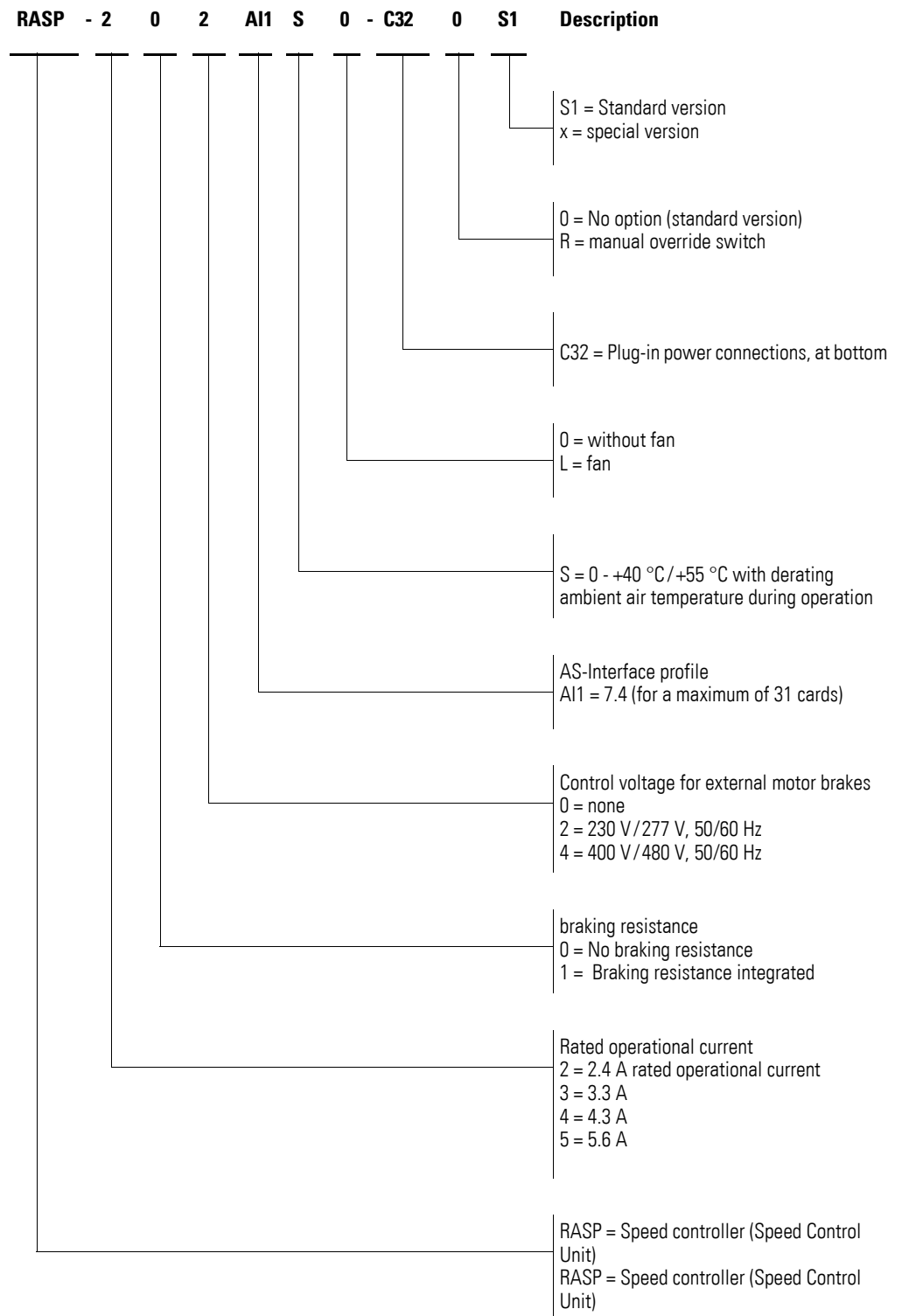


Figure 4: Key to parts numbers of the RASP speed controller

1 System Rapid Link 4.0

1.4 Technical data

1.4 Technical data

Table 2: General rated operational data (overview)

Technical Data	Formula sign	Unit	Value	
			RAMO	RASP
General				
Standards			IEC/EN 60947-4-2	IEC/EN 61800-3 IEC/EN 61800-5-1
Approvals, certificates			CE, CCC, UL	CE, UL
Production quality			Directive 2002/95/EC (RoHS), ISO 9001	Directive 2002/95/EC (RoHS), ISO 9001
Degree of protection			IP65, NEMA 12/NEMA 12K	IP65, NEMA 12/NEMA 12K
Mounting position			vertical (→ Page 57)	vertical (→ Page 57)
Ambient air temperature				
Operation	ϑ	°C	-10 - +55	0 - +40/+55 with fan for RASP-2, RASP-3 and RASP-4 or derating
Storage	ϑ	°C	-30 - +70	-30 - +70
Installation altitude	H	m	0 to 1000 a.s.l., above 1000 m with 1% derating per 100 m, up to 2000 m.	0 to 1000 a.s.l., above 1000 m with 1% derating per 100 m, up to 2000 m.
Humidity (IEC/EN 50178)	p_w	%	< 95 %, relative humidity, non-condensing	< 95 %, relative humidity, non-condensing
Vibration (IEC/EN 60068-2-6)				
Amplitude		Hz	3 - 15.8 Vibration amplitude: 0.15 mm	3 - 15.8 Vibration amplitude: 0.15 mm
Acceleration		Hz	15.8 - 150 constant acceleration 2 g	15.8 - 150 constant acceleration 2 g
Mechanical shock resistance (IEC/EN 60068-2-27)			1000 shocks per shaft, Semisinusoidal 15 g/11 ms	1000 shocks per shaft, Semisinusoidal 15 g/11 ms
MTBF			<ul style="list-style-type: none"> With an average device temperature of 40 °C: 29 years With an average device temperature of 55 °C: 16.6 years With an average device temperature of 70 °C: 9.2 years 	<ul style="list-style-type: none"> With an average device temperature of 40 °C: 16 years With an average device temperature of 55 °C: 8.5 years With an average device temperature of 70 °C: 4.9 years

Technical Data	Formula sign	Unit	Value	
			RAMO	RASP
Main circuit				
Feeder				
Rated operational voltage	U_e	V	3 AC 400/480	3 AC 400/480
Rated operating voltage for brake control	U_e	V	230/277 400/480	230/277 400/480
Voltage levels	U_{LN}	V	380 -10 % - 480 +10 %	380 -10 % - 480 +10 %
Frequency range	f_{LN}	Hz	50/60 (47 - 63 Hz \pm 0 %)	50/60 (45 - 66 Hz \pm 0 %)
System configuration			Alternating voltage, center-point-earthed star network (TN-S network) Alternating voltage, center-point-earthed star network (TN-S network) Phase-earthed AC supply systems are not permissible.	Alternating voltage, center-point-earthed star network (TN-S network) Phase-earthed AC supply systems are not permitted.
Mains switch-on frequency		Number	–	max. one time per minute
Mains current	THD	%	–	> 120
Short-circuit current	I_K	kA	< 10 (→ Section 1.5.1, „RAMO“, page 17)	< 10 (→ Section 1.5.2, „RASP“, page 18)
Short-circuit protection device (power bus supply) (Power bus incoming unit)			PKE3/XTUCP-36 FAZ-3-B20 or FAZ-3-C20	PKE3/XTUCP-36 FAZ-3-B20 or FAZ-3-C20
Overvoltage category/pollution degree (DIN/VDE 0110)			III/2	III
Rated impulse withstand voltage	U_{imp}	kV	4	–
Leakage current to PE earth (EN 50178)	I_{PE}	mA	–	> 3.5
Power section				
Instance			RAMO-D: DOL starter with thyristors and bypass contacts RAMO-W: Reversing starter with relays, thyristors and bypass contacts two-phase controlled	Variable frequency drive with DC link and IGBT inverter
Lifespan (AC3)		Number	> 10 millions connections	–
Output voltage	U_2	V AC	= U_{LN}	0 - U_{LN}
Output frequency	f_2	Hz	= f_{LN}	0 - 50 Hz, max. 320 Hz
rated operational current	I_e	A	6.6	2.4 - 3.3 - 4.3 - 5.6
Load current for the control unit for an external brake	I	A	\leq 0.6 max. 6 A for 120 ms	\leq 0.6 max. 6 A for 120 ms
Adjustable motor protection	I	A	0.3 - 6.6	0.48 - 11.2
Overload withstand capability				
for 60 s every 600 s at +40 °C	I_L	A	–	3.6 - 8.4
for 2 s every 20 s at +40 °C	I_L	A	–	4.8 - 11.2
Allocated motor output ¹⁾	P	kW		

1 System Rapid Link 4.0

1.4 Technical data

Technical Data	Formula sign	Unit	Value	
			RAMO	RASP
(with motor protection) with 400 V, 50 Hz	P	kW	0.09 - 3	0.18 - 2.2
at 440 V - 460 V, 60 Hz	P	HP	0.14 - 3	0.25 - 3
Control Voltage				
External control voltage	U	V	24, for actuators (O3), maximum load current 1 A	24, for quick stop function via AS-Interface plug
Tolerance		%	-15 - +20	
AS-Interface Specification				
Total power consumption from AS-Interface -power supply unit (30 V-)	I	mA	30 + 160 for sensors	30 + 160 for sensors
Specification			RAMO-...AI1: 7.4 RAMO-...AI2: 7.A.E	RASP-...AI1: 7.4
Station addresses		Number	RAMO-...AI1: 31 RAMO-...AI2: 62	RASP-...AI1: 31
I/O Code or I/O configuration			7 (hex)	7 (hex)
ID-code			4 (hex)	4 (hex)

1) Assigned motor rating for normal internally and externally ventilated three-phase asynchronous motors with 1500 rpm (at 50 Hz) or 1800 rpm (at 60 Hz).

1.5 UL Standards Compliance

1.5.1 RAMO

RAMO-... motor starters have been tested in accordance with UL 508 and are UL-listed.

Table 3: RAMO-D and RAMO-W

Property	Value
Input voltage	480 V AC
Output voltage	480 V AC
Rated operating voltage for brake control	277/480 V AC; 0.6 A
Input current, maximum	6.6A
Output current, maximum	6.6A
Stages	3
Frequency	50/60 Hz
Control voltage, external	24 V DC
Field bus input voltage	30 V DC
Motor protection	integrated
Thermistor monitoring	integrated
SCCR	→ Table 4
Degree of protection	NEMA 12 NEMA 12K (devices with built-in local disconnect switch)
Ambient temperature, maximum	55 °C

Table 4: Short circuit current rating for individual and group protection

	With fuse (UL listed)		Circuit-breakers (UL listed)	
	With built-in local disconnect switch	Without built-in local disconnect switch	With built-in local disconnect switch	Without built-in local disconnect switch
Voltage	480 V AC	480 V AC	480 V AC	480 V AC
Short-circuit current, maximum	30A	30A	32A	32A
Interrupting Rating	10 kA	65 kA	10 kA	65 kA



Devices with an integrated local disconnect switch (...-C32RS1) are listed for use as "motor disconnects" ("lockout/tagout").

1.5.2 RASP

RASP-... speed controllers have been tested in accordance with UL 61800-5 and are UL-listed.

Table 5: RASP-...

Property	RASP-2...	RASP-3...	RASP-4...	RASP-5...
Input voltage	480 V AC	480 V AC	480 V AC	480 V AC
Output voltage, maximum	480 V AC	480 V AC	480 V AC	480 V AC
Rated operating voltage for brake control	277/480 V AC; 0.6 A	277/480 V AC; 0.6 A	277/480 V AC; 0.6 A	277/480 V AC; 0.6 A
Input current, maximum	3.2A	4 A	5.6A	7.3A
Output current	2.1A	3A	3.4A	4.8A
Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Stages	3	3	3	3
Output frequency	0 - 320 Hz	0 - 320 Hz	0 - 320 Hz	0 - 320 Hz
Field bus input voltage	30 V DC	30 V DC	30 V DC	30 V DC
Motor protection	integrated, at 105% of full load	integrated, at 105% of full load	integrated, at 105% of full load	integrated, at 105% of full load
Thermistor monitoring	integrated	integrated	integrated	integrated
SCCR	→ Table 6	→ Table 6	→ Table 6	→ Table 6
Degree of protection	NEMA 12 / NEMA 12K	NEMA 12 / NEMA 12K	NEMA 12 / NEMA 12K	NEMA 12 / NEMA 12K
Ambient temperature, maximum	40 °C without fan; 55 °C with fan	40 °C without fan; 55 °C with fan	40 °C without fan; 55 °C with fan	40 °C with fan

Table 6: Short circuit current rating for individual and group protection

	With fuse (UL listed)		Circuit-breakers (UL listed)	
	With built-in local disconnect switch	Without built-in local disconnect switch	With built-in local disconnect switch	Without built-in local disconnect switch
Voltage	480 V AC	480 V AC	480 V AC	480 V AC
Short-circuit current, maximum	30A	30A	32A	32A
Interrupting Rating	10 kA	65 kA	10 kA	65 kA



Devices with an integrated local disconnect switch (...-C32RS1) are listed for use as "motor disconnects" ("lockout/tagout").

1.6 Selection criteria

The choice of RAMO/RASP unit ③ must be based on the supply system's ① supply voltage U_{LN} and the allocated motor's rated operational current ②. The circuit type (Δ / Y) of the motor must be selected according to the supply voltage ①. The RASP's rated output current I_e must be greater than or equal to the rated motor current. For RAMO, current monitoring must be set to the rated motor current.

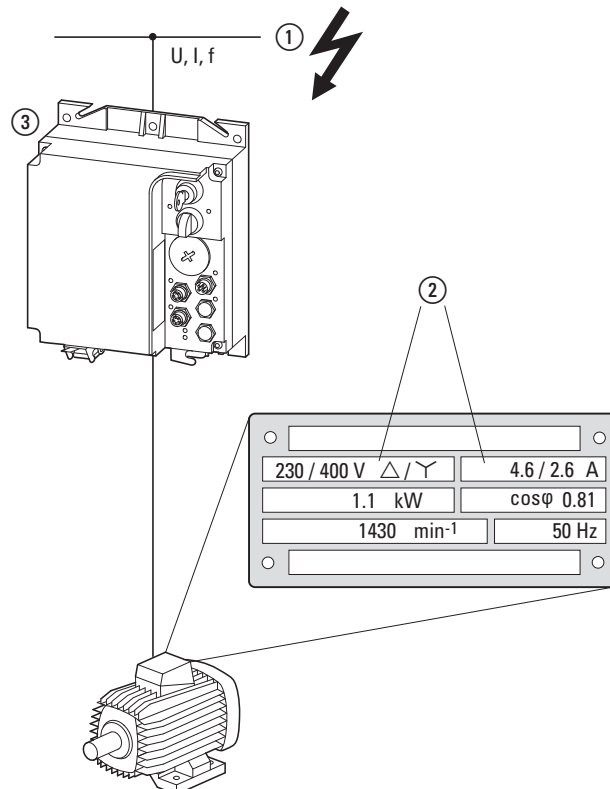


Figure 5: Selection criteria

When selecting the drive, the following criteria must be known:

- Type of motor (three-phase asynchronous motor)
- Mains voltage = rated operating voltage of the motor (e.g. 3 AC ~ 400 V),
- Rated motor current (recommended value, dependent on the circuit type and the supply power supply)
- Load Torque,
- Starting torque,
- Ambient air temperature (rated value +40 °C).

NOTICE

Do not connect or disconnect power connectors (mains, motor) while RAMO and RASP are operational.

1 System Rapid Link 4.0

1.7 Proper use



When connecting multiple motors in parallel to the output of the RAMO and RASP, the motor currents are added geometrically – separated by effective and idle current components. When you select a RAMO and RASP, make sure that they can supply the total resulting current. If necessary, for dampening and compensating the deviating current values, motor reactors or sine filters must be connected between RAMO or RASP and the motor.

For parallel operation of several motors on the output of a RASP or RAMO separate motor protection (e.g. a thermistor) is required.



RASP only

The paralleling link of multiple motors in the output of the RASP is only permitted with V/f characteristic control.

Speed control with slip compensation (P11.8) increases the drive dynamics and optimizes the output. With this function the frequency inverter calculates an electronic image of the motor. In this operating mode only one motor can be operated on an output of the RASP. The motor's rated current must be assigned to the rated operational current of the frequency inverter (same rating).

1.7 Proper use



DANGER

Incorrect engineering, installation, maintenance or operation of the entire plant or machine, non-observation of the instructions in this manual and modifications by insufficiently qualified persons can cause danger from connected actuators such as motors, hydraulic units etc.



RAMO and RASP are not devices for household use, and are designed exclusively for use in commercial applications. RAMO and RASP are electrical apparatus for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.



Rapid Link is intended only for switching, protecting, and controlling three-phase motors in machines and plants. Any other use is not proper use. The vendor does not accept liability for damage resulting from use other than the stated proper use.

1.7.1 Designated power supply systems

Observe the following instructions in this manual regarding mechanical and electrical layout, and commissioning and operation:

- The system must be connected to a three-phase power supply system with an earthed star point and separate N and PE conductors (TN-S grounding system). Unearthed configurations are not permissible.
- All Rapid Link function modules fulfil the safe isolation requirements of IEC/EN 60947-1, Annex N, between the AS-Interface voltage and the 24 V $\overline{\text{DC}}$ and 400/480 V \sim supplies.
- The thermistor circuits in RAMO and RASP units have double basic insulation.
- All devices am connected to the power and data bus must also meet the requirements for safe isolation according to IEC/EN 60947-1 Annex N or IEC/EN 60950. The 24 V DC power supply unit must be earthed on the secondary side. The 30 V DC PSU for the AS-Interface power supply (interface control unit) must meet the safe isolation requirements according to SELV.
- Emergency switching off devices (to IEC/EN 60204-1, corresponds to DIN VDE 0113, part 1) must be present. Their function must not be impaired in any way.
- Effective lightning protection measures must be implemented in the plant to prevent damage to electronic components.

Connecting the units to IT grounding systems (networks without a reference to ground potential) is not permitted, since the devices' internal filter capacitors connect the supply system to ground potential (enclosure).

1.7.2 Machinery Safety Directive and CE marking

After installation in a machine, the RAMO and RASP must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Safety Directive (MSD) 89/392/EEC (meets the requirements of EN 60204). The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings applied to RAMO and RASP units confirm that, when used in a typical drive configuration, the devices comply with the European Union's Low Voltage Directive and EMC Directive (Directive 73/23/EEC, amended by Directive 93/68/EEC, and Directive 89/336/EEC, amended by Directive 93/68/EEC).

1 System Rapid Link 4.0

1.8 Maintenance and inspection



At the output of RAMO and RASP (→ Section 3.6, „Motor feeder“, page 73) you must not:

- connect a voltage or capacitive loads (e.g. phase compensation capacitors),
- connect multiple RAMO and RASP in parallel,
- make a direct connection to the input (bypass).

The technical data and connection conditions must be observed. For additional information, see the nameplate of RAMO or RASP and the documentation.

Any other usage constitutes improper use.

1.8 Maintenance and inspection

RAMO and RASP are maintenance-free if the general rated operational data (Table 2, page 14) and the specific technical data and version particulars (→ Section 5.4, „Special technical data“, page 98 and page 114) are observed. External factors can, however, influence the components' lifespan and function. We therefore recommend that regular checks and the following general maintenance measures be performed at the specified intervals.

Table 7: Maintenance measures and maintenance intervals

Maintenance measures	Maintenance interval
Clean cooling vents (cooling slits) - RASP only	Please enquire
Check the fan function - RASP only	6 - 24 months (depending on the environment)
Check connectors (AS-Interface, sensors, mains, motor, etc.) and all metallic surfaces for corrosion	6 - 24 months (depending on the environment)
Charge capacitors, only for storage of RASP	12 months → Section 1.10, „Service and warranty“, page 23

There are no plans for replacing or repairing individual cards of RAMO or RASP.

Internal DC link capacitors in RASP

After long storage times or long down times without a power supply (> 12 months), the capacitors in the internal DC link must undergo controlled recharging, in order to avoid damage.

For this the RASP must be fed with a regulated DC power supply unit via two mains connection terminals (e.g. L1, L2). In order to prevent the capacitors from having eventual excessively high leakage currents, the inrush current should be limited to approximately 300 to 800 mA (depending on the relevant rating). In this case, the RASP must not be enabled (no start signal). The DC voltage must then be set to the values of the corresponding DC link voltage (U_{DC}) and fed for around two hours (regeneration time), about 565 V DC ($= 1.42 \times U_{LN}$) with three-phase line-to-line voltage (400 V).

1.9 Storage

Whenever RAMO or RASP devices are to be stored before use, it must be ensured that there are adequate ambient conditions at the site of storage:

- Storage temperature: -30 - +70 °C
- Relative average air humidity: < 95 %, non condensing (EN 50178)
- Store the devices only in closed original packaging.
- Degree of protection IP65 is obtained only with plug connectors.

RASP only:

- In order to prevent damage to the DC link capacitors in RASP devices, storage periods longer than 12 months should be avoided (see above: Section "Internal DC link capacitors in RASP").

1.10 Service and warranty

In the unlikely event that you have a problem with a RAMO or a RASP, please contact your local sales office.

When you call, have the following data ready:

- the exact part no.
(see nameplate),
- the date of purchase,
- a detailed description of the problem which has occurred with RAMO or RASP.

If some of the information printed on the rating plate is not legible, please state only the data which are clearly legible.

Information concerning the guarantee can be found in the Terms and Conditions Eaton Industries GmbH.

24-hour hotline: +49 (0)1805 223 822

Email: AfterSalesEGBonn@Eaton.com

1 System Rapid Link 4.0
1.10 Service and warranty

2 Engineering

2.1 Rapid Link modules

Rapid Link modules RAMO and RASP are installed in the direct vicinity of the drives. Their versions and mounting depend on the required specifications and the local conditions. They can be connected to the power and data bus at any point without having to interrupt the bus.

The below example with RAMO provides a simplified overview.

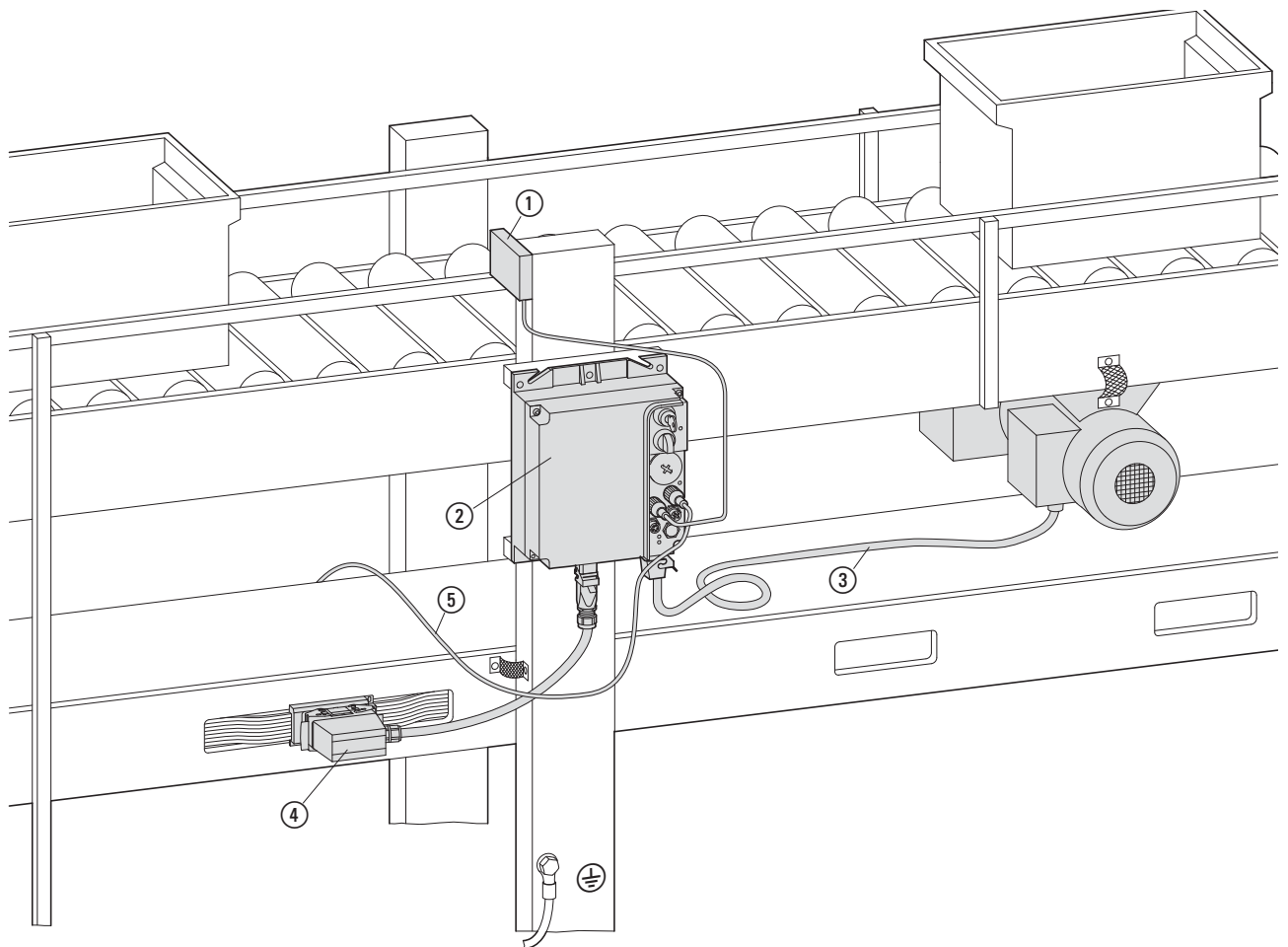
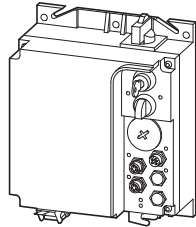


Figure 6: Example showing how to use a RAMO unit

- ① Sensor (light barriers)
- ② RAMO
- ③ Motor connection cable
- ④ Mains connection on power bus
- ⑤ AS-Interface

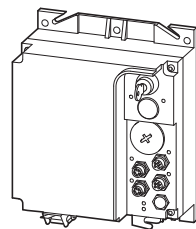
2.1.1 Instance

External appearance of various versions (→ Section 1.3.2, „Key to part numbers RASP“, page 13)



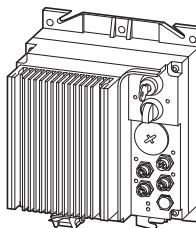
RAMO-W...-C32R...

- Reversing starter with Manual override switch,
- with plug-in power terminals



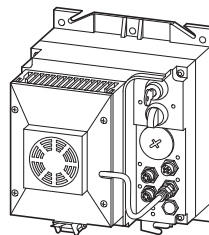
RAMO-DA...-C320...

- DOL starter
- with plug-in power terminals
- Actuator output 03



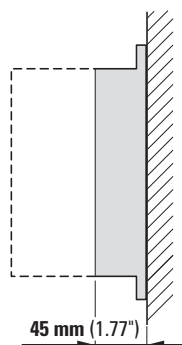
RASP-...0-C320...

- Open-loop speed control
- with plug-in power terminals

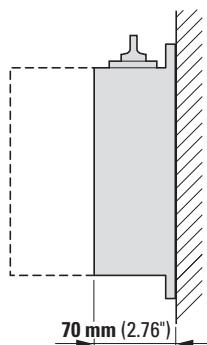


RASP-...L-C320...

- Open-loop speed control
- with plug-in power terminals
- with fan



Base without repair switch



Base with repair switch

2.1.2 Repair and maintenance switch

Versions RAMO-...C3xR... and RASP-...C3xR... feature a repair and maintenance switch ①, which isolates all three phases of the Rapid Link modules from the mains voltage.

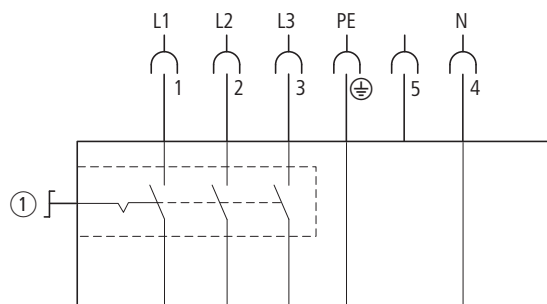
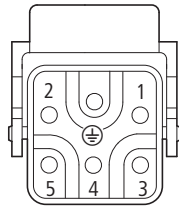


Figure 7: Repair and maintenance switch in position
0 = OFF



The motor must be stopped before the repair and maintenance switch is activated.



DANGER

Before performing maintenance or repair work on RASP units, make sure to wait until the the DC link voltage discharging time (at least five minutes) has passed. This also applies when handling the motor.

2 Engineering

2.1 Rapid Link modules

The figure below shows the contactor states for the repair and maintenance switch.

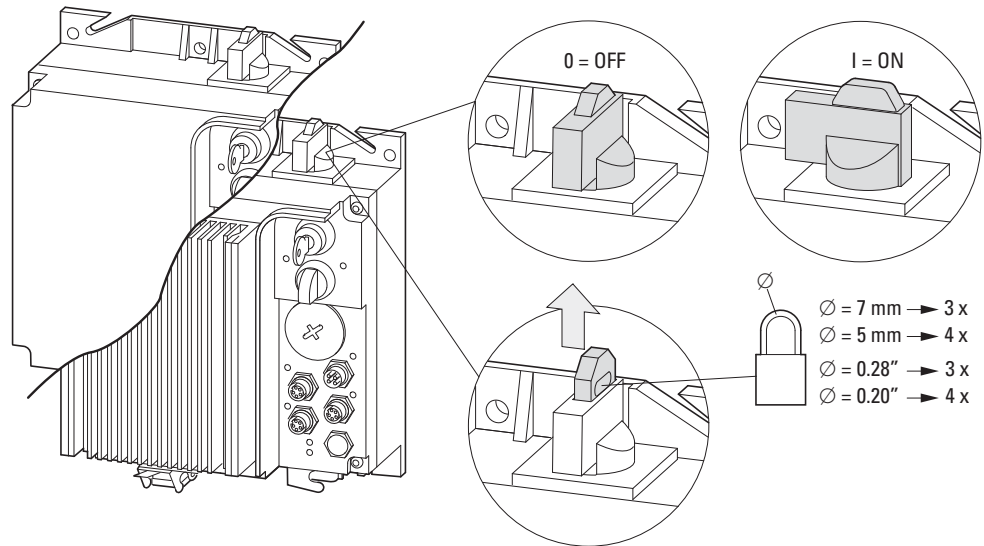


Figure 8: RAMO and RASP versions ...-C32R...

Contactor state 0 (= OFF) can be locked by pulling up the red locking collar padlocking facility. Please enquire up to three padlocks with a yoke diameter of 7 mm or up to four padlocks with a yoke diameter of 5 mm can be fitted.

After completion of maintenance or repair work, the switch can be released again and returned to position I (= ON). The motor can then be restarted with a start signal in manual or automatic mode.

2.1.3 Power terminals

Plug-in connections in power section for RAMO and RASP:

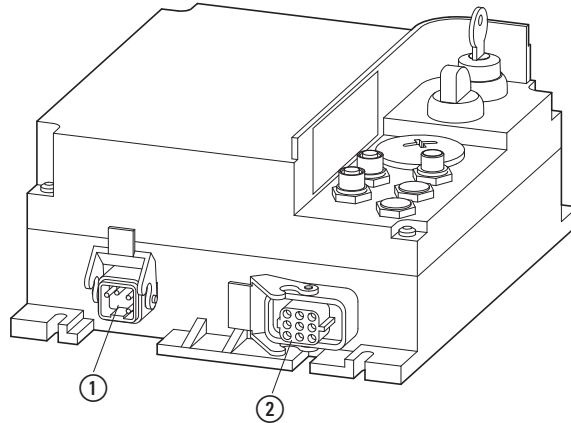


Figure 9: Connections in RAMO power section

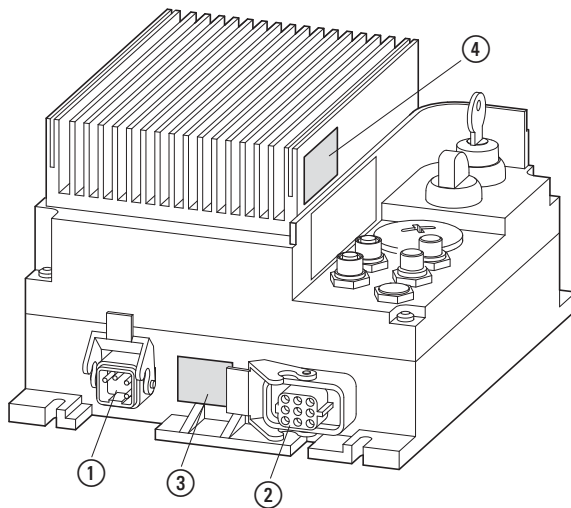
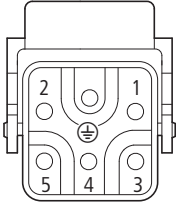


Figure 10: Connections in RASP power section

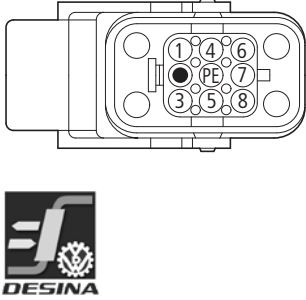
① 5 pole power plug (3 AC 400 V/480 V, N, PE)

PIN	Function
1	L1
2	L2
3	L3
4	N
5	-
PE	PE




② Motor feeder socket (DESINA)



PIN	Function
1	U1, motor
(2)	Coding
3	W1, motor
4	B2, brake
5	T1, thermistor
6	B1, brake
7	V1, motor
8	T2, thermistor
PE	PE



③ hazard warning, dangerous voltage - only with RASP


 **WARNING**

Dangerous voltage from internal DC link capacitors
(observe discharge time)
Dangerous voltage from internal DC link capacitors
(observe discharge time)
Pay attention to hazard warnings!





DANGER
5 MIN

④ hazard warning, high temperature - only with RASP

 **CAUTION**

High heat sink temperature.
Do not touch!



ACHTUNG Hohe Temperatur
Kühlkörper nicht berühren
WARNING HOT SURFACE
Do not touch the heat sink

2.2 Electrical power network

2.2.1 Mains connection and configuration

The Rapid Link modules RAMO and RASP can be connected and operated with all control-point grounded AC power networks (see IEC 60364 for more information in this regard).

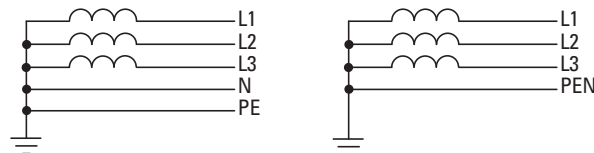


Figure 11: AC power networks with earthed center point (TN/TT networks)

The connection and operation of frequency inverters to asymmetrically grounded TN networks (phase-grounded Delta network "Grounded Delta", USA) or non-grounded or high-resistance grounded (over 30 Ω) IT networks is not permissible.



Measures for electromagnetic compatibility are mandatory in a magnet system, to meet the legal standards for EMC- and low-voltage regulations.

Good earthing measures are a prerequisite for the effective insert of further measures such as screen earth kit or filters here. Without respective grounding measures, further steps are superfluous.

2.2.2 Mains voltage and frequency

The standardized rated operating voltages (IEC 60038, VDE017-1) for power suppliers (EVU) guarantee the following conditions at the transition points:

- Deviation from the rated value of voltage:
maximum ± 10 %
- Deviation in voltage phase balance: maximum ± 3 %
- Deviation from rated value of the frequency:
maximum ± 4 %

The voltage value below also allows for the permitted voltage drop of 4 % in the consumer circuits, i.e. a total of $U_{LN} - 14$ %:

400 V -15 % - 400 V +10 % (380 V -10 % - 480 V +10 %)
(340 V -0 % - 440 V +0 %) (342 V - 520 V)

The permitted frequency range in all voltage ranges is 50/60 Hz here (45 Hz - 0 % - 66 Hz + 0 %).

2 Engineering

2.2 Electrical power network

2.2.3 Voltage balance

Because of the uneven loading on the conductor and with the direct connection of greater power ratings, deviations from the ideal voltage form and asymmetrical voltages can be caused in three-phase AC supply system. In consumers with a three-phase supply, these asymmetries in the mains voltage can result in uneven loading of the input phases and therefore to a premature failure of downstream semiconductors, such as diodes in mains rectifiers or thyristors EMS.



In the project planning consider only AC power networks that handle permitted asymmetric divergences in the mains voltage $\leq +3\%$.

If this condition is not fulfilled, or symmetry at the connection location is not known, the use of a main choke in the mains-side feeder unit of the power bus is recommended.

2.2.4 THD (total harmonic distortion) when using RASP units

The THD value (THD = Total Harmonic Distortion) is defined in standard IEC/EN 61800-3 as the ratio of the rms value of all harmonic components to the rms value of the fundamental frequency.



In order to reduce the THD value (up to 30%), it is recommended to use a DX-LN... mains choke (→ Section 2.2.6, "Mains chokes", page 33).

2.2.5 Idle power compensation devices

Compensation on the power supply side is not required for the RASP. It only take on very little reactive power of the fundamental harmonics ($\cos \varphi \sim 0.98$) from the AC power supply network.



In the AC supply system with non-choked reactive current compensation devices, current deviations can enable parallel resonance and undefinable circumstances. In the project planning for the connection of RASP to AC supply systems with undefined circumstances, consider using main chokes.

2.2.6 Mains chokes

A main choke (also called commutation choke) increases the reactor of the power supply line. This extends the current flow period and dampens mains deviations.

On RASP, a main choke limits the mains feedback to permissible values. The harmonic current emissions that are fed back into the mains network ("mains feedback") are reduced. This reduces the mains-side apparent current to about 30 %.

Main chokes attenuate interference from the supply system towards RAMO and RASP. This increases the electric strength of Rapid Link modules RAMO and RASP and extends their lifespan.

Mains chokes are designed based on the mains-side input current (I_{LN}) of Rapid Link power bus.



For the operation of RAMO and RASP, the application of main choke is not necessary.

We do recommend however that an upstream main choke is used since the network quality is not known in most cases. While planning the project, consider that a main choke is only assigned to a single Rapid Link power bus for decoupling. When using an adapting transformer a main choke is not necessary.

2.2.7 Mains contactor

The mains contactor enables an operational switching on and off of the supply voltage and switching off in case of a fault scenario.

Select the mains contactor according to the total mains-side current (I_{LN}) of a power bus (≤ 25 A) and utilization category AC-1 (IEC 60947).



In engineering take into account that jog operation of a Rapid link module must be carried out only through the module's AS-Interface control input and not through the mains contactor. The maximum permitted operating frequency of the mains voltage is one time per minute (normal operation).

2.3 Safety and protection

2.3.1 Fuses and cable cross-sections

The fuses and wire cross-sections allocated for power-side connections depend on the rated mains current ILN of the Rapid Link power bus (without mains reactor).

NOTICE

When selecting the cable cross-section, take into account the voltage drop under load.

The user is responsible for taking other applicable standards (e.g., IEC/EN 60204 and VDE 0289) into account.

The national and regional standards (for example VDE 0113, EN 60204) must be observed and the necessary approvals (for example UL) at the site of installation must be fulfilled.

When the device is operated in a UL-approved system, use only UL-approved fuses, fuse bases and cables.

The leakage currents to ground (to EN 50178) are greater than 3.5 mA. The connection terminals marked PE and the housing must be connected with the earth-current circuit.

NOTICE

The specified minimum PE conductor cross-sections (EN 50178, VDE 0160) must be maintained.



Choose the cross-section of the PE conductor in the motor lines at least as large as the cross-section of the phase lines (U, V, W).

The cross-sections of the cables and cable protection fuses used must correspond with local standards.

For an installation in accordance with UL Standards, the fuses and copper cable that are UL-approved and have a heat-resistance of +60/75 °C are to be used.

For a permanent installation with insulation, use power cables that are suitable for the specified mains voltages.

For RASP a fully (360°) shielded low-impedance-screened cable on the motor side is required. The length of the motor cable depends on the RFI class and must not exceed 10 m for RASP.

2.3.2 Tripping currents at short-circuit

The tripping current must also be reliably reached in the event of a short-circuit in 1 pole. Make sure that the total current of all motors (including starting currents) or the charging current of all connected speed control units RASP remains smaller than the tripping current when mains power is switched on.

Example: 3 pole miniature circuit-breaker.

	$I_n = 20 \text{ to } 25 \text{ A}^{1)}$	Miniature circuit-breaker 20 A, characteristic B	
Short-circuit tripping current	130 A (210 A)	60 - 100 A	100 - 200 A
Minimum current on short-circuit in one pole	150 A (250 A)	110 A	220 A
Maximum total current of all motors (including starting currents)	110 A (170 A)	55 A	90 A
Maximum total current of all motors (including starting currents)			

1) The values in brackets apply when the short-circuit instantaneous release is set to 210 A.

The following must be ensured when using a 3 pole miniature circuit-breaker with $I_n \leq 25 \text{ A}$ and trip characteristic B or C:

- The let-through energy I^2t in the event of a short-circuit must not exceed $29800 \text{ A}^2\text{s}$.
- Therefore the short-circuit current $I_{cc \text{ r.m.s.}}$ at the mounting location must not exceed 10 kA (a characteristic curve Figure 12).

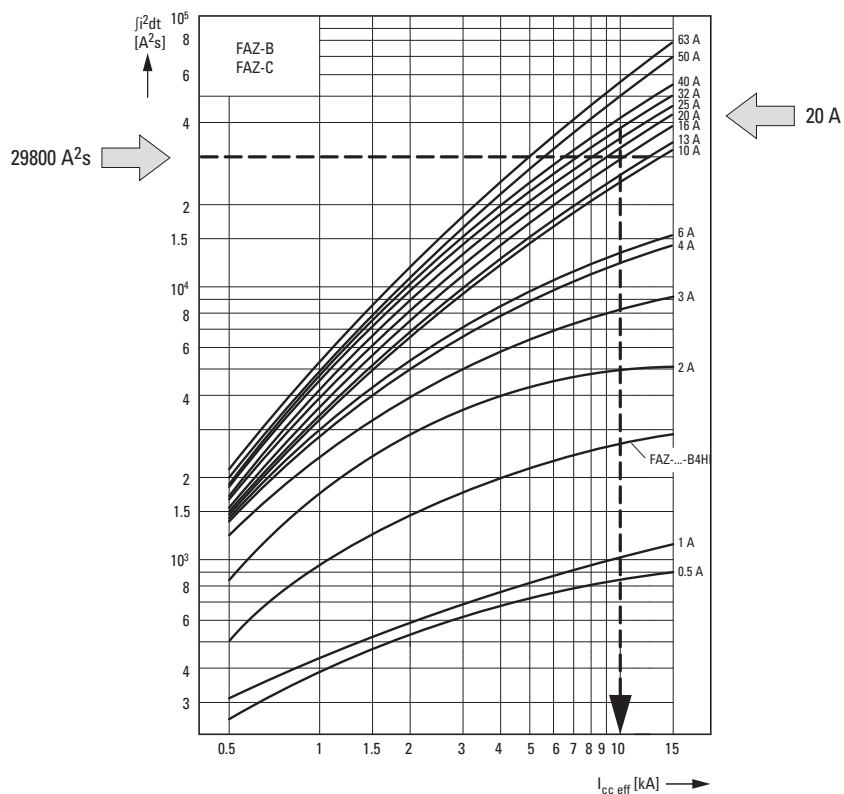


Figure 12: Cable protection with FAZ-3-B20

2.3.3 Residual current circuit-breaker (RCD)

RCD (Residual Current Device): Residual current device, residual current circuit breaker (FI circuit breaker).

Residual current circuit breakers protect persons and animals from the existence (not the origination) of impermissibly high touch voltages. They prevent dangerous, in cases deadly injuries caused by electrical accidents and also serve as fire prevention.

NOTICE

Residual current circuit breakers (RCD) are only to be installed between the AC power supply network and the Rapid Link modules RAMO and RASP.



WARNING

With RASP, only AC/DC sensitive residual current circuit breakers (RCD part no. B) are to be used (EN 50178, IEC 755).

Identification on the residual current circuit breaker

AC/DC sensitive (RCD, part no. B)



RASP work internally with rectified AC currents. If an error occurs, the DC currents can block an RCD circuit breaker of type A from triggering and therefore disable the protective functionality.

On RASP safety-relevant leakage currents can occur during operation when RASP is not earthed (due to a fault).

Leakage currents to ground are mainly caused by foreign capacities with RASP; between the motor phases and the shielding of the motor cable and via the star capacitors of the internal radio interference suppression filter.

The size of the leakage currents is mainly dependent upon the:

- length of the motor cable,
- shielding of the motor cable,
- height of the pulse frequency (switching frequency of the inverter),
- type of RFI filter,
- Grounding measures at the site of the motor.



The leakage current to ground is greater than 3.5 mA with a RASP. Based on the requirements of EN 50178, a larger earthing (PE) has to be connected. The cable cross-section must be at least 10 mm² or consist of two separately connected ground cables.

2.4 Power bus

The power bus supplies RAMO and RASP Rapid Link modules with power. Plug-in outgoers can be quickly and safely connected at any point along the bus. The power bus can consist either of a flexible busbar (ribbon cable) or standard round cables.

NOTICE

- All devices connected to the apparatus and data bus must also meet the requirements for safe isolation according to IEC/EN 60947-1 Annex N or IEC/EN 60950.
- Power supply units for the AS-Interface power supply must meet the safe isolation requirements according to SELV.

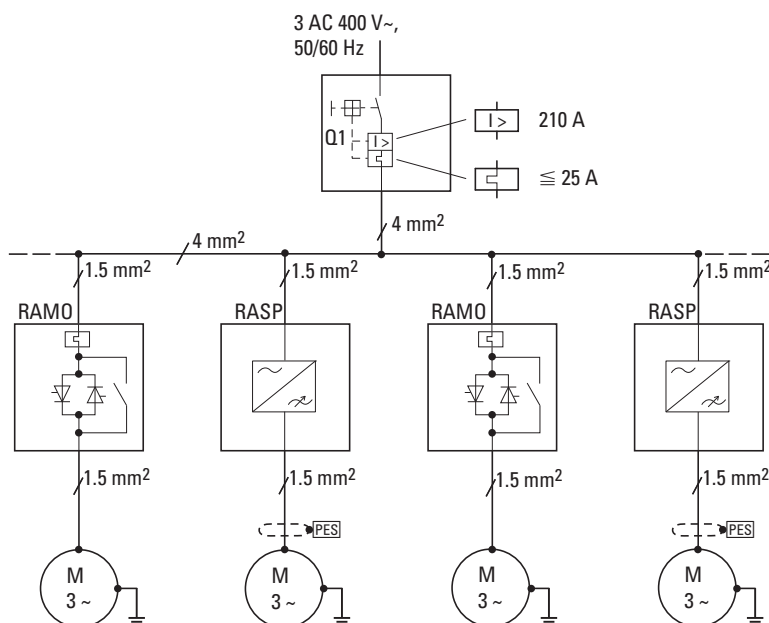


Figure 13: Sample configuration of a Rapid Link system with RAMO and RASP units

Observe the following when planning the lengths of the power bus cabling:

- On a short circuit in one pole at the end of the power bus, for example in the terminal board of the last consumer, the upstream safety device must trip. The level of short-circuit current depends on:
 - Cable length,
 - Conductor cross-section,
 - Short-circuit current at the incoming point
- The level of the application-specific voltage drop depends on:
 - Cable length,
 - Conductor cross-section,
 - Current consumption of motors

2 Engineering

2.4 Power bus

Calculate the short-circuit current and the voltage drop as specified in DIN VDE 0100 to make sure that the protection requirements are being met.

The power bus' cable length can be calculated as follows:

$$I = \frac{\frac{U_0 \times 1000}{I_{rm}} - Z_v - (Z_{Stich} \times l_{Stich})}{Z_{power\ bus}}$$

- l = Cable length (maximum: 100 m)
- U_0 = 230 V (single-phase no-load voltage)
- I_{rm} = Tripping current of short-circuit release
- z_v = External supply impedance (e.g., 100 mΩ)
- Z_{Stich} = 35.50 mΩ/m (stub line 1.5 mm²)
- $Z_{power\ bus}$ = 13.40 mΩ/m (power bus 4.0 mm²)
21.50 mΩ/m (power bus 2.5 mm²)

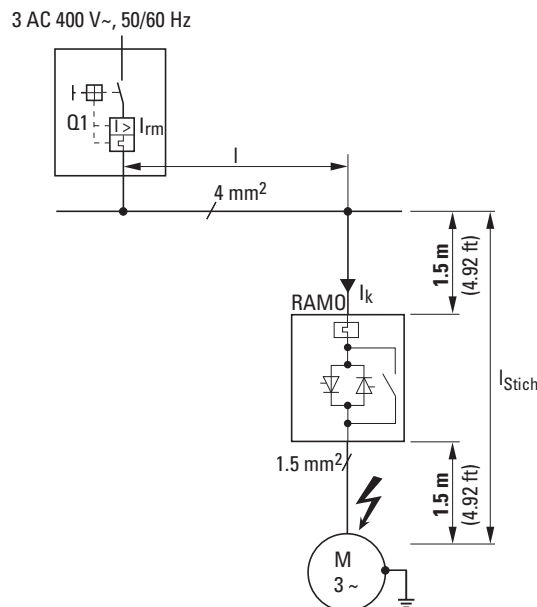


Figure 14: Example: RAMO

Requirements for the group protection device in the event of a short-circuit: Short-circuit current I_k must be greater than short-circuit release tripping current I_{rm} . The former depends on the impedance and length of the power bus and the branch line.



When selecting the cable cross-sectional area, take the voltage drop under load into account. The user is responsible for taking other applicable standards (e.g., VDE 0113, VDE 0289) into account.

Depending on the power bus' length and the configuration of the power branches, the total of all RAMO and RASP supply system currents during continuous operation must not exceed 25 A (4-mm² power bus).

2.5 How to install RASP units in such a way that they meet EMC requirements

2.5 How to install RASP units in such a way that they meet EMC requirements

The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is the responsibility of the end user or system operator. This operator must also take measures to minimize or remove emission in the environment concerned. He must also utilize means to increase the interference immunity of the devices of the system.



In a magnet system (PDS) with RASP, you should take measures for electromagnetic compatibility (EMC) while doing your engineering, since changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs as well.

The technology and system of a RASP device cause the flow of high frequency leakage current during operation. Because of this, all earthing elements must be low-impedance elements connected in such a way as to establish an electrical contact across a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 60335, either

- the cross-sectional area of the protective conductor must be $\geq 10 \text{ mm}^2$,
- The protective conductor must be open-circuit monitored, or
- the second protective conductor must be fitted.

For an EMC-compliant installation, we recommend the following measures:

- The unit should be installed in a conductive enclosure with a good connection to ground.
- Use screened motor cables (short cables).



Ground all conductive components and housings in a magnet system using as short a line as possible with the greatest possible cross-section (Cu-drain wire).

2.6 AS-i data bus

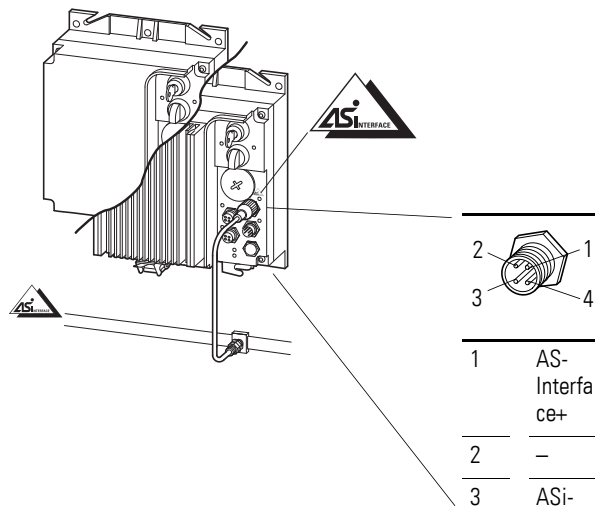


Figure 15:AS-i data bus

The AS-i data bus is a system solution that makes it possible to network various cards. AS-Interface networks are quick and easy to set up.

2.6.1 Data cable

AS-Interface uses a geometrically keyed, unscreened ribbon cable with a cross-sectional area of $2 \times 1.5 \text{ mm}^2$. It is used to transfer both power and all data traffic between the PLC and peripherals and also supplies the connected devices with power to a certain extent. The installation meets the usual requirements. Engineering is simplified by full flexibility in system layout and mounting.

When a link is connected to the flat cable, two metal pins pierce through the cable's jacket and into the two cores to establish a contact with the AS-Interface cable. There is no need to cut and strip cables, apply ferrules or connect individual cores.

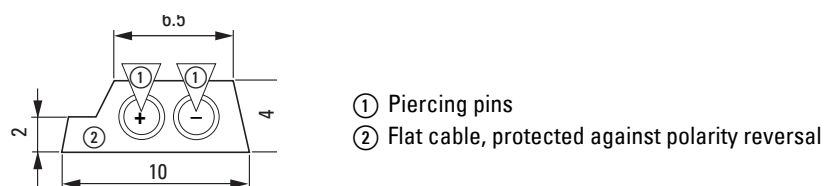


Figure 16: AS-i ribbon cable

Rapid Link function modules can be installed and removed any number of times at various locations. The AS-Interface ribbon cable is self-healing, dust-tight and resistant to spray-water. The network can have a star, linear or tree structure.

2.6.2 Data transfer

Data is modulated onto the supply voltage so that it can be transmitted. During this process, each card's transmitter injects data signals into the cable. This causes a change in the voltage induced in the data coupling coils. Finally, this change is detected by the receiver of each card along the AS-i cable.

2.6.2.1 Standard AS-i slaves

Standard AS-i slaves with AS-i profile S.7.4 (RASP-...AI1S... and RAMO-...AI1S... units) will take up one address per AS-i line. Up to 31 standard AS-i slaves can be connected to a single line.

2.6.2.2 AS-i slaves with expanded address range

When using AS-i slaves (A/B slaves) with an expanded address range with AS-i profile S-7.A.E (RAMO-...AI2S units), an address can be assigned to a maximum of 62 modules. In this case, an A or B suffix is added to the addresses so that, for example, addresses 1A and 1B can be assigned (maximum: 31A and 31B).



When using RASP units, a maximum of 31 modules can be connected to (assigned an address on) a single AS-i line.

The response time when a command is sent via an AS-Interface is 160 µs per card; this means that the response time when there are 31 cards is 5 ms.

2.6.3 Gateway

The gateway establishes the connection to the field bus (e.g., PROFIBUS-DP) and, in its function as the master, processes all communications on the AS-Interface line.

2.6.4 Cable length

The maximum cable length for all AS-i circuit segments is 100 m. The maximum distance between an AS-i gateway and an AS-i slave on the network can be increased to 300 m by using two repeaters, each extending the maximum distance by 100 m.

2.6.5 Accessing

Every slave must be assigned an address before data can be transmitted between the AS-i/DP gateway and the Rapid Link devices. Rapid Link devices have a default address of 0.

AS-i slaves can be assigned an address as follows:

- Offline: Address assigned with the manual address assignment device
- Online: Address assigned via the AS-i/DP gateway

The addresses that can be assigned are 1A to 31A and 1B to 31B (on AS-i version 2.1 and higher). The slaves' addresses do not have to be consecutive.



For information on how to assign addresses for and configure the AS-Interface, please consult the manual for the gateway you are using.

2.6.6 Replacing Rapid Link devices in the AS-i circuit

If a slave fails due to a fault, it can be replaced with an identical device with an address of 0. The gateway will detect the replacement and will automatically reassign the faulty slave's address to the new slave. It may be necessary to configure this feature on the gateway.

If the replacement device does not have a default address of 0, it will be necessary to program it with the faulty device's address.



You can use the AS-i gateway to delete the existing Rapid Link address and assign a new address.



For detailed information on assigning addresses and performing troubleshooting on the gateway, please consult the manufacturer's manual.

2.7 Sensor inputs I3 and I4

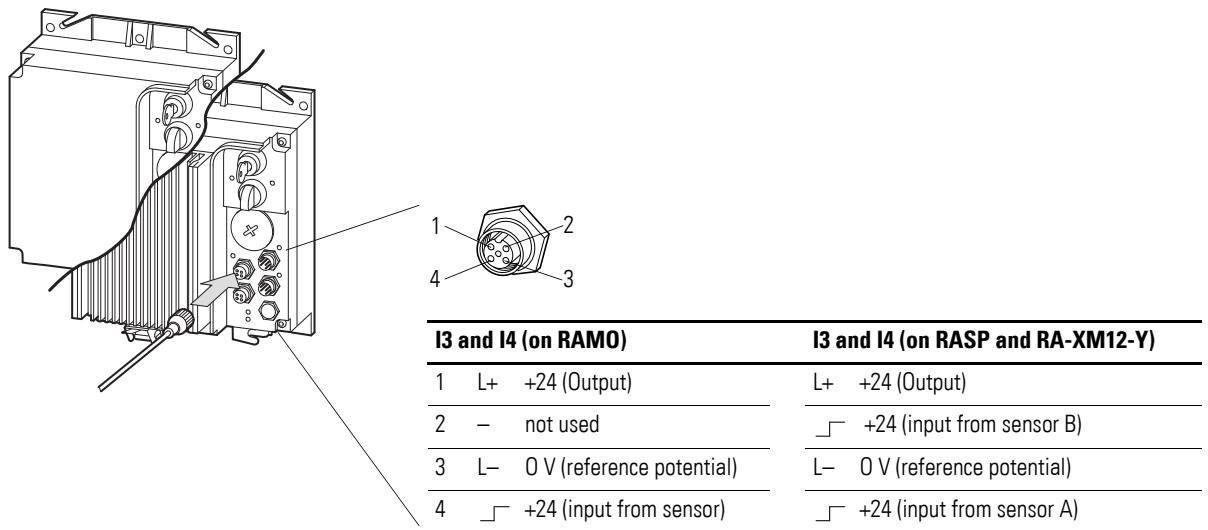
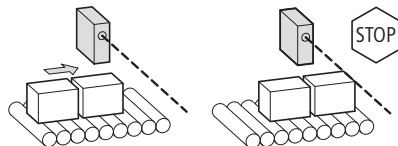


Figure 17: Terminal sockets for I3 and I4 sensor inputs

RAMO and RASP Rapid Link modules feature two M12 sockets (I3 and I4) that can be used to connect sensors directly. For example:

- Optical sensors (light barriers)
- Inductive sensors (proximity switches)
- Mechanical sensors (limit switches)



The length of the sensor connection cables for inputs I3 and I4 is limited to 20 m. The sensors are supplied with 24 V DC from Rapid Link modules RAMO and RASP (AS-Interface supply voltage). The total current of all sensors is limited to 160 mA.

The sensor supply is short-circuit proof. In the event of an overload or short-circuit, a group fault signal will be generated and the "Motor" LED will light up red to indicate this. As soon as the fault is fixed, the error message can be reset with the RESET command. In addition, the S1 bit will be set to high during a short-circuit (peripheral fault). It will be set back to low automatically once the short-circuit is eliminated.

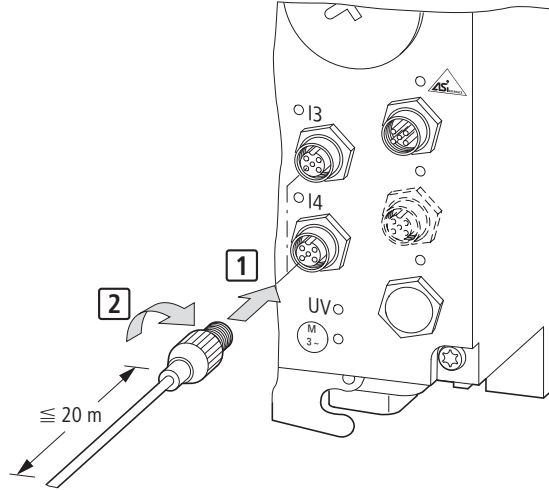


Capacitive sensors should not be connected to RASP units, as the latter's high-frequency output voltage to the motor may cause the sensor to switch incorrectly.

2 Engineering

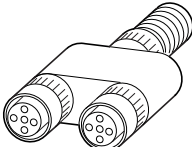
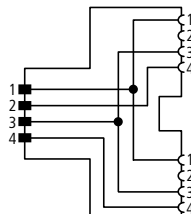
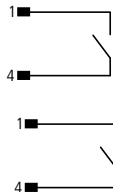
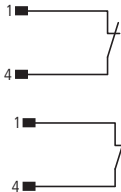
2.7 Sensor inputs I3 and I4

The input signals of the sensors at I3 and I4 are either incorporated directly in the internal controller of RAMO and RASP or transmitted to a higher-level PLC through AS-Interface. Signal conditioning and incorporation in the control sequence is made with a DIP switch (→ Section 5.6.2, “Adjust dip switch”, page 103, RASP: → Section 6.6.3, “Adjust dip switch”, page 122).



Only with RASP!

With optional Y-connector RA-XM12-Y up to four sensors can be connected to these two M12 sockets.

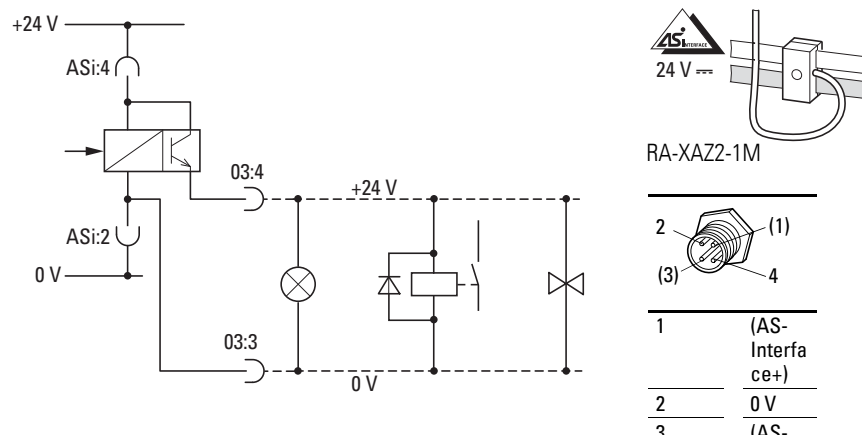
Y connector RA-XM12-Y	optical or inductive sensors $\Sigma I \leq 160\text{ mA}; 24\text{ V DC}$	N/O	NC	Sensor cable keying
		mechanical sensors		"A"-coded (IEC/EN 60947-5-2) 1 = brown 2 = white 3 = blue 4 = black
				

2.8 Actuator output O3



Only with RAMO-DA... and RAMO-WA...!
Actuator output O3

Actuator output O3 (M12 connectors → Figure 18) can be used to drive external indicator elements or relays. In this case, pin 4 on the AS-i connector must be powered with an external +24 VDC voltage. The corresponding reference point is pin 2 (0 V) on the AS-i connector. The actuator (indicator lamp, relay, valve) can be connected using O3 pin 4 (+24 V, max. 1 A). The corresponding reference point (0 V) is pin 3 on O3.



O3

1	-
2	-
3	0 V (actuator, connected to 0 V from AS-i:2)
4	┌ +24 V (output for actuator; maximum permissible load current: 1 A)



Figure 18: Connecting example actuator output O3

Actuator output O3 is switched directly through the AS-Interface (response time of up to 20 ms).

The connection cable's maximum permissible length is 20 m. The maximum permissible load current of 1 A must not be exceeded. Output O3 is short-circuit proof.

In the event of an overload or short-circuit, a group fault signal will be generated and the Motor LED will light up red to indicate this. The voltage at output O3 (24 V DC) is automatically switched off. As soon as the fault is fixed, the error message can be reset with the RESET command. In addition, the S1 bit will be set to high during a short-circuit (peripheral fault). It will be set back to low automatically once the short-circuit is eliminated.

2.9 Device fan connection F

➔ **RASP only!**
 Device fan connection F.

Device fan connection F (Fan) is featured only by RASP units; it is already connected at the factory in RASP-...SL-C... units.

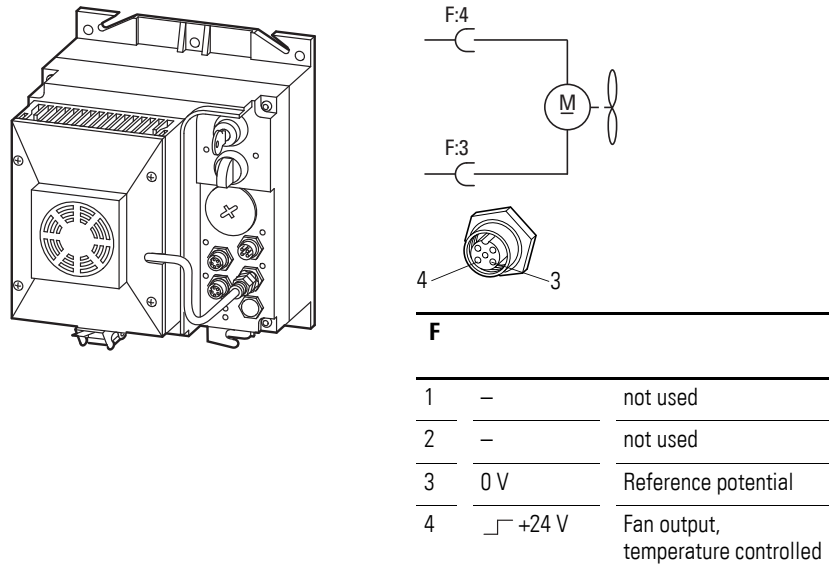


Figure 19: Device fan connection F

The output voltage on device fan connection F is 24 V DC and is controlled automatically by the RASP unit.

➔ Do not connect any loads other than the RASP unit's device fan to device fan connection F!
 Any other load connected here is considered contrary to intended use!

2.10 Motor and Application

2.10.1 Motor Selection

General recommendations for motor selection:

- To the output of Rapid Link modules RAMO and RASP three-phase AC motors with squirrel-cage rotor and surface-cooling can be connected; the output is also suitable for three-phase asynchronous motors. Other motor types, such as external-rotor motors, slip-ring motors, reluctance motors, or synchronous or servo motors can also be connected provided their electrical and connection characteristics are the same as those of asynchronous motors and their manufacturer has approved them for the application.
- To the frequency-controlled RASP only motors with at least temperature class F (155 °C max. steady state temperature) should be connected.
- Where possible, use 4 pole motors (synchronous speed: 1500 rpm at 50 Hz or 1800 rpm at 60 Hz).
- Operating conditions for S1 operation according to IEC 60034-1.
- When operating multiple motors in parallel on one RAMO and RASP, the motor output should not be more than three power classes apart.
- The rated operational current of motor and RAMO or RASP should be the same (avoid overdimensioning the motor!).

2.10.2 Motor and circuit type

The motor's stator winding can be connected in a star or delta circuit as per the rated operational data on the rating plate.

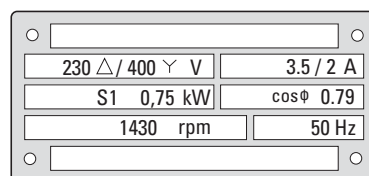


Figure 20: Example of a motor ratings plate

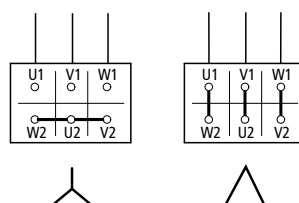


Figure 21: Configuration types:
Star-connected circuit (left), delta circuit (right)

A three-phase motor with the rating plate shown in Figure 20 can only be run in a star connection on the Rapid Link system ($U_{LN} = 400$ V).

The rated operational current of the motor with 2 A at 400 V requires a Rapid Link module (RAMO or RASP) with a rated operational current of at least 2 A.

Example

- RAMO-... max. output current 6.6 A, current limitation set to 2.1 A with DIP switch.
- RASP-2... Rated operational current 2.4 A.



Other operational characteristics and speeds are possible only with the frequency-controlled RASP Rapid Link module (see → Section 6.8.6.6, "V/f-characteristic curve (P11)", page 161).



Notes

- RAMO (→ Section 3.6, "Motor feeder", page 73)
- RASP (→ Section 3.6, "Motor feeder", page 73, → Section 3.6.3, "Motor feeder on RASP", page 76)

2.10.3 Automatic deceleration time extension on RASP

In a drive system with AC-supplied motors the energy always flows from the system with the higher frequency to the system with the lower frequency. The difference between the frequencies is the slip. Normally this means that the energy flows from a variable frequency drive to the motor.

If the deceleration time is set to short times on the variable frequency drive (→ Section , "P6.6", page 152), the motor may not be able to follow the deceleration ramp due to inertia, for example. The direction of energy flow then reverses and the motor's rotational energy is fed back into the variable frequency drive's internal DC link. This will result in an increased DC link voltage and, possibly, an overvoltage trip.

To ensure reliable operation without overvoltage tripping frequency-controlled drives RASP automatically adjust the deceleration time to motor and motor load. This prevents overvoltage tripping.

The RASP unit's automatic ramp extension function during regenerative operation can be disabled with the P6.34 parameter.

2.10.4 Change of rotation

Three-phase motors work with a clockwise rotating field (viewed from the motor shaft) when phase L1 is connected to U1, L2 to V1 and L3 to W1. This default operating direction can be reversed with gearboxes or different mounting positions. On RAMO-W... and RASP the operating direction can be reversed with DIP switch 7 without changing the wiring.

With the default settings (switch position Down) a clockwise rotating field is produced with control command FWD, and an anticlockwise rotating field with switch position Up. The LED indicates FWD for both directions.

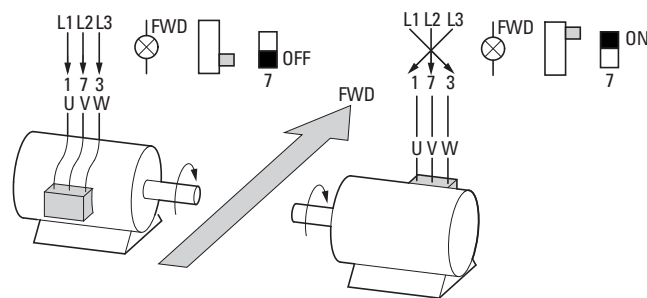


Figure 22: Example showing how to change the phase sequence

2.10.5 Quick stop

Quick stop is a motor stop function in automatic mode through pin 4 of the sensor inputs:

- I3/I4 on RAMO
- I3a/I4a on RASP

The input signals are processed directly in RAMO or RASP. PLC and bus cycle times have no influence on the switch-off time.

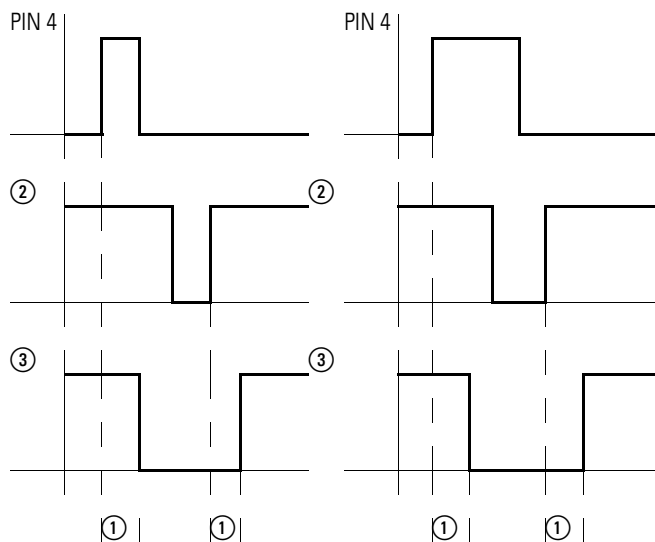


Figure 23: Examples: Edge-controlled quick stop in automatic mode (pin 4 = I3 or I3a)

- ① Internal response time
- ② Signal O1 from PLC through AS-Interface
- ③ Internal signal to motor output as response to the rising edge of the sensor at pin 4 (Stop) and to the subsequently rising edge of PLC O1 (Start)

The type of edge control (rising, falling) for the sensor inputs I3(a)/I4(a) is defined by DIP switches:

- DIP 5 on RAMO (→ Page 105)
- DIP 3 on RASP (→ Page 123)

The pin 4 input signal (rising edge) switches the motor output off. When the PLC output (O1) is reset (falling edge), the motor output can be switched back on. Whether or not the input signal is still being applied when the PLC output is reset or switched back on is irrelevant → Figure 23.

The FWD or REV LED flashes when the motor output is switched off by means of quick stop and the PLC continues to set the corresponding rotational direction bit.

During operation, the FWD or REV LED will light up as applicable if the PLC has set the corresponding operating direction bit.

Example of quick stop function

Vertical sorter with 360° eccentric drive:

The quick stop function makes it possible for the drive to stop at the exact point the limit switch is reached. The preprocessing in RAMO or RASP enables the the motor to switched off directly. PLC and bus cycle times have no influence on the switch-off time.

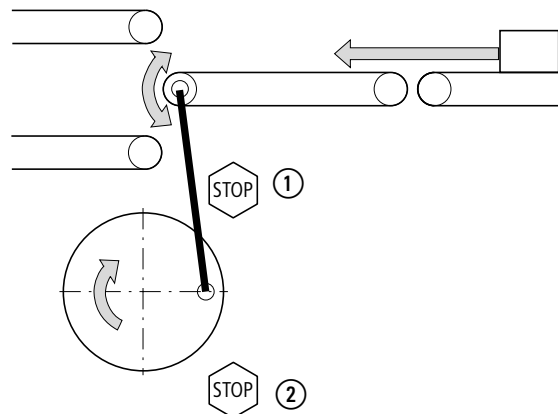


Figure 24: Example for eccentric drive

- ① upper break point
- ② lower break point

2.10.6 Interlocked manual operation

In interlocked manual operation damage to conveyed goods or plant through incorrect handling can be avoided. Limit switches connected to inputs I3 and I4, for example, can be used to reliably limit the travel path. This function also allows adjustment of, for example, light barriers before automatic control through a PLC (AS-Interface) is activated.

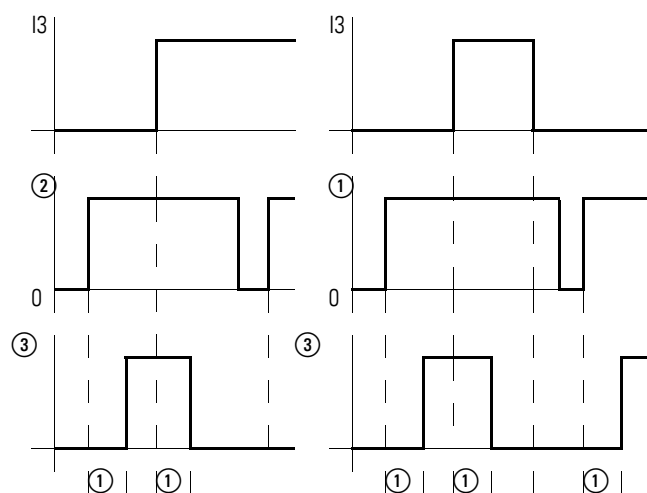


Figure 25: Interlocked manual operation
(example: I3 level-controlled clockwise operation)

- ① Internal response time
- ② Selector switch manual mode
- ③ Output signal

2 Engineering

2.10 Motor and Application

As shown in Figure 25, the FWD rotating field direction will be disabled in manual mode when the interlocked manual operation is activated after a rising edge (on I3, for example) or during a continuous signal. The motor can then only be operated in automatic mode on the RAMO-W, or in the opposite direction in manual mode on the RASP.

Rotating field direction FWD in manual mode is possible again only after a falling edge is registered at I3 or after a changeover to automatic mode and back again). This also applies for sensor input I4 and rotating field direction REV.

On RAMO-D... interlocked manual operation can be set to act only edge-controlled with switches DIP 6 and DIP 8 (→ Page 105). This allows continued manual operation in the same direction after a break point is reached by simply briefly switching over to Automatic and back again.

LED-signal under interlocked manual operation of RAMO-W and RASP:

- FWD or REV LED is lit when the associated operating direction is selected with the selector switch.
- FWD or REV LED flashes while the selector switch is operated but RAMO-W or RASP is switched off through interlocked manual operation. (For an example of interlocked manual operation with RASP → Page 126).

2.11 External brake

A mechanical spring-loaded brake fitted to the motor (disk or spring-applied brake) brakes the rotation of the motor shaft when the brake coil's supply voltage is switched off. If quick brake engagement times are required, DC air solenoids are used. In this case, the brake is supplied with AC power through a functional rectifier built into the motor.

RAMO and RASP Rapid Link modules feature a faster internal electronic switch for powering and actuating the external motor brake. It is connected using pins 4 and 6 of the motor feeder socket. The highest permissible continuous holding current is 0.6 A. For releasing the brake, up to 6 A are available for up to 120 ms.

RAMO-xx2; RASP-xx2

RAMO-xx4; RASP-xx4

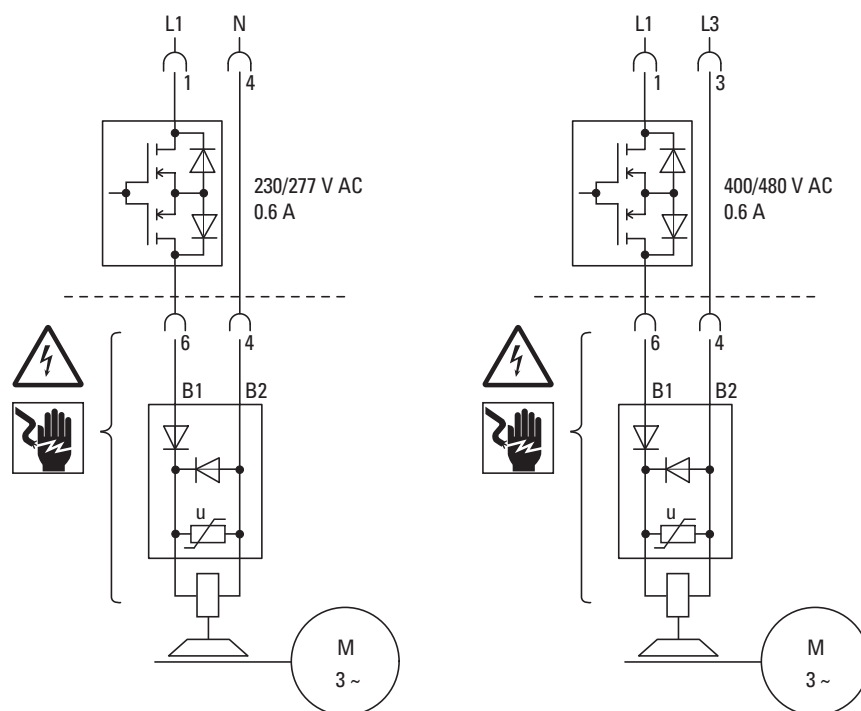


Figure 26: External brake control with 230 V/277 V (left) and 400 V/480 V (right)

The brake is actuated:

- With RAMO automatically with the start signal, in automatic and manual modes.
- Via the variable frequency drive in the case of RASP units (→ Section 6.8.6.8, "Braking (P12)", page 167).

2 Engineering

2.12 Thermistor and motor cable monitoring



DANGER

Dangerous touch voltage!

For RASP 4.0 use fully insulated plastic plugs in the motor feeder!

NOTICE

The motor's metal enclosure must always be earthed, irrespective of the type and version of motor cable used!

NOTICE

When using RAMO or RASP units, do **not** connect external brakes directly (to U, V, or W) inside the motor's terminal box!

2.12 Thermistor and motor cable monitoring

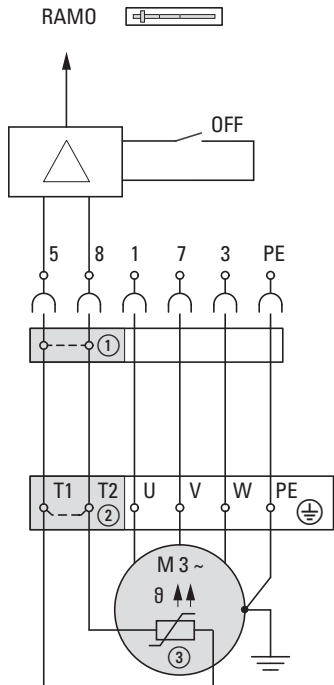
In RAMO and RASP units, a thermistor placed inside the motor, the motor cable, and the motor cable's plug-in connection are all monitored on pin 5 and pin 8 of the motor feeder socket .

For this purpose, the jumper on RAMO units (→ Figure 83, page 103), or DIP switch 1 on RASP units (→ Section 6.6.3.1, "DIP switch and motor cable monitoring (DIP 1)", page 123), must be open (default setting).

If the switch is closed, the fault signal will disable monitoring.

NOTICE

Only briefed qualified personnel should change the OFF position on DIP switch 1 (RASP) or on the jumper (RAMO)!



- ① Link in motor plug:
Only the plugged-in status of the motor connector is monitored.
- ② Link in motor terminal box:
The plugged-in status of the motor plug and the motor cable's connection are monitored.
- ③ Thermistor connection:
The plugged-in status of the motor plug, the motor cable's connection, and the thermistor (or thermostat, Thermo-Click) in the motor are monitored.

Figure 27: Monitoring with DIP and pressure switches

Jumper (RAMO) DIP 1 (RASP)	Description
OFF (default settings)	Pin 5 and pin 8 are monitored. The group fault indication will be enabled in the event of a discontinuity (the Motor LED will light up).
ON	Pin 5 and pin 8 are monitored. The group fault indication will be suppressed in the event of a discontinuity (no Motor LED group fault indication). In automatic mode, AS-i bit 1 at DIO is cleared.

2 Engineering

2.12 Thermistor and motor cable monitoring

3 Installation

3.1 Introduction

This chapter describes the mounting and electrical connection of Rapid Link modules RAMO and RASP.

- ➔ During installation and mounting, cover the operator control and display elements and the plug connectors in the control and power sections, either with a cover or with masking tape, in order to prevent foreign bodies from entering them. On RASP it is also advisable to protect the cooling fins and, if fitted, the fan from ingress of foreign bodies.
- ➔ Perform all installation work with the specified tools and without the use of excessive force.

3.2 Installation instructions

The mounting instructions in this manual apply to RAMO and RASP with standard equipment and IP65 degree of protection.

For installation instructions, see instructional leaflet IL03406019Z for RAMO or IL03406020Z for RASP

3.2.1 Mounting position

Rapid Link modules RAMO and RASP are preferably installed vertically.

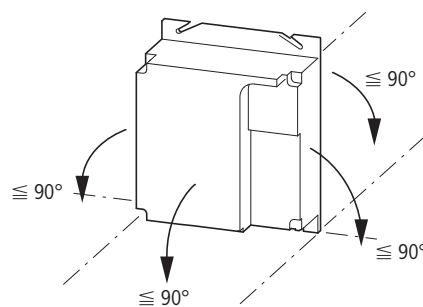


Figure 28: Mounting position of RAMO
Maximum inclination in all directions
90°, do not rotate by 180°.

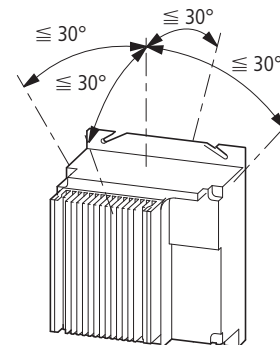


Figure 29: Mounting position of RASP
Maximum inclination in all directions
30°, do not rotate by 180°.

3 Installation

3.2 Installation instructions

3.2.2 Free space

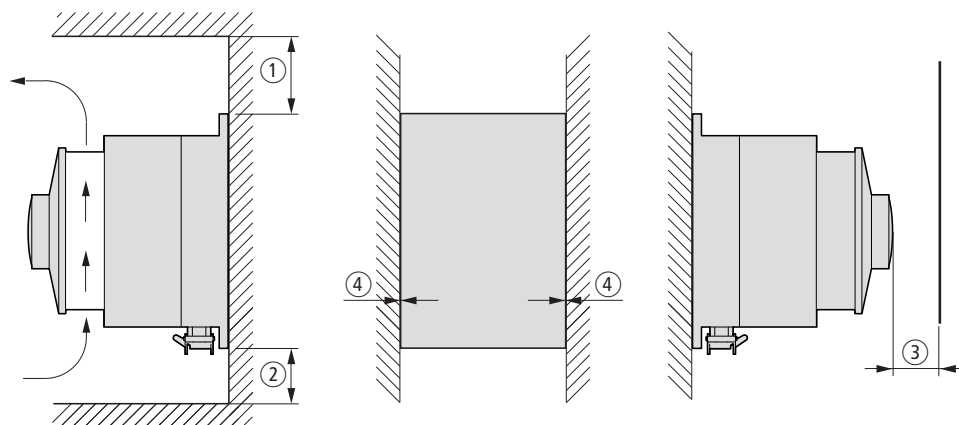


Figure 30: Clearances for thermal air cooling
(Example: RASP)

Depending on version, thermal clearances must be provided around the RAMO and RASP Rapid Link modules. On versions with a repair and maintenance switch (RAMO-...R... and RASP-...R...) or in the area of the pluggable cable connections (2), these must also provide unobstructed handling.

The table below lists the recommended minimum clearances.

Position	Instance	Clear Zone [mm]	
		RAMO	RASP
① top	• without repair and maintenance switch	25	100
	• with repair and maintenance switch	~150	~150
② bottom	• without power connection	25	100
	• with power connection	~100	~100
③ front	• without fan	15	25
	• with fan	—	50
④ lateral	• without repair and maintenance switch	~0 ¹⁾	~0 ¹⁾
	• with repair and maintenance switch	~150	~150
	• without power connection	~0 ¹⁾	~0 ¹⁾
	• with power connection	~100	~100

1) At an installation altitude up to 1000 m and at an ambient temperature of up to +40 °C no clearance is required to the sides. Higher ambient temperatures (up to a maximum of +50 °C), pulse frequencies f_{PWM} (up to maximum 16 kHz) and set-up heights (up to 2000 m) require space on the sides of at least 20 mm.



Devices with high magnetic fields (e. g. reactors or transformers) should not be mounted close to the RAMO or RASP.

3.2.3 Fixing

Rapid Link modules RAMO and RASP are mounted with screws.



Install RAMO and RASP units on a non-flammable mounting base only (e.g., on a metal plate).



For RAMO and RASP unit weights and dimensions, please refer to the corresponding technical data (see page (→) Section 7.1, „Dimensions“, page 181).

3.2.3.1 Fixing with screws

The permitted maximum tightening torque for the fixing screws is 1.3 Nm (11.5 lb-in).



Washer and split washer provide a firm seat during fixing.



2x/4x

2x/4x

2x/4x

M6

DIN 127, M6

DIN 125, M6

3 Installation

3.2 Installation instructions

Vertical arrangement

RA...-C32...

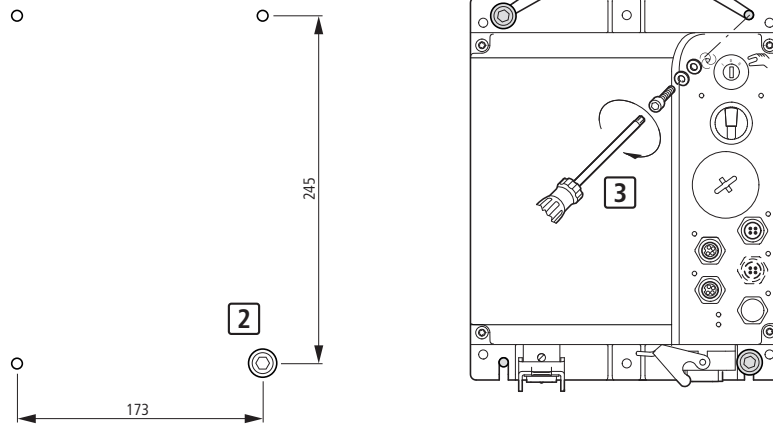
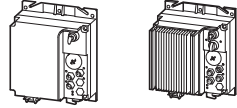


Figure 31: Fixing dimensions (standard) and mounting

- 1** 4 x Drill hole with thread for M6 screw.
- 2** Where screws are prefitted, a clearance of about 12 mm should be provided between mounting surface and washer.
- 3** Tighten the screws to a torque of 1.3 Nm.

Vertical arrangement, center fixing

RA...-C32...

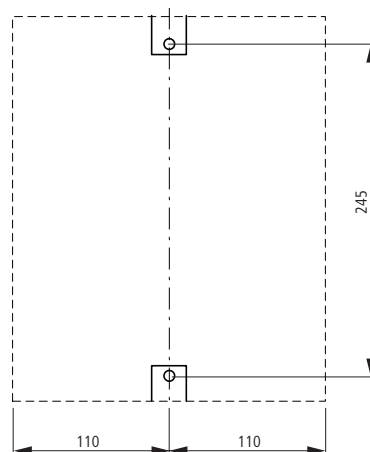


Figure 32: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

Horizontal arrangement

(base rotated by 90 °)

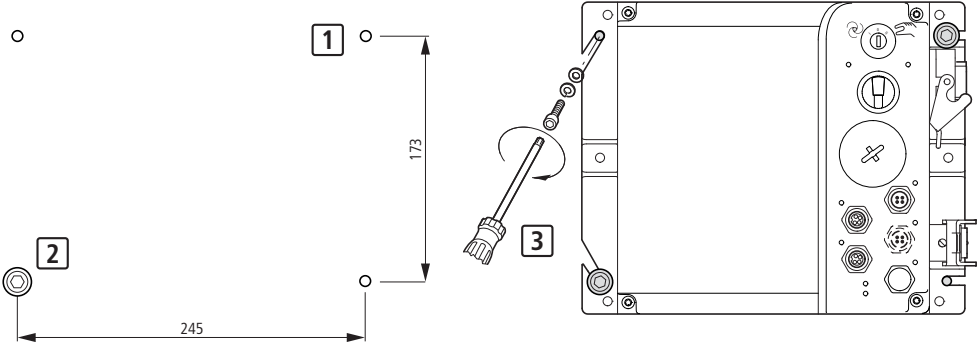
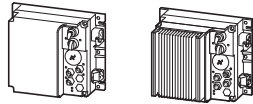


Figure 33: Fixing dimensions (standard) and mounting

- 1** Drill hole with thread for M6 screw.
- 2** Where screws are prefitted, a clearance of about 12 mm should be provided between mounting surface and washer.
- 3** Tighten the screws to a torque of 1.3 Nm.

Horizontal arrangement, center fixing

(base rotated by 90 °)

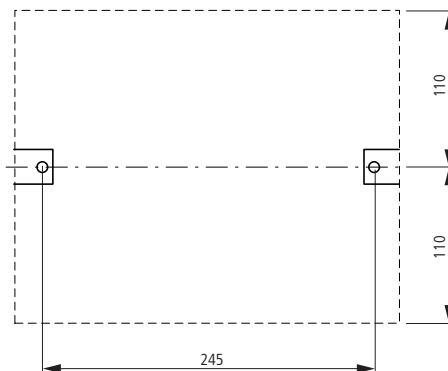


Figure 34: Fixing dimensions (center)

Two M6 screws, tightening torque 1.3 Nm.

3 Installation

3.2 Installation instructions

3.2.4 Position of the power terminals

The standard arrangement of power terminals is vertical at the bottom on versions RAMO-...-C32... and RASP-...-C32...

A horizontal arrangement can be implemented by qualified specialists by turning the black enclosure base 90° to the left or right. To do this, remove the four screws in the enclosure cover.

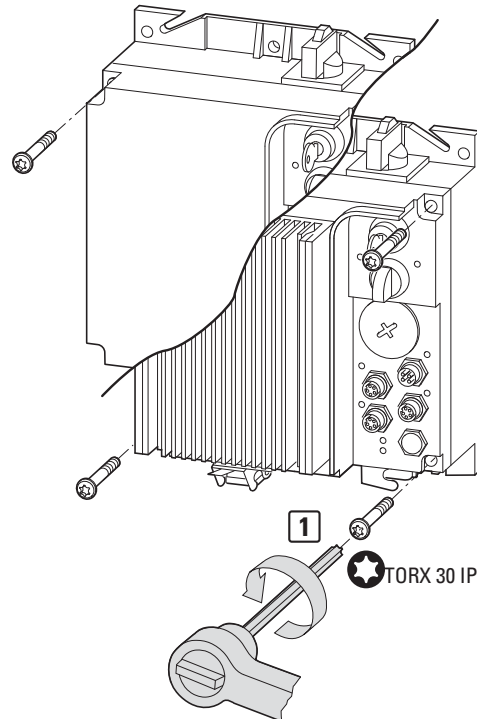


Figure 35:Dismantling the enclosure cover

- ▶ Fix the enclosure cover at the side and lift off carefully.

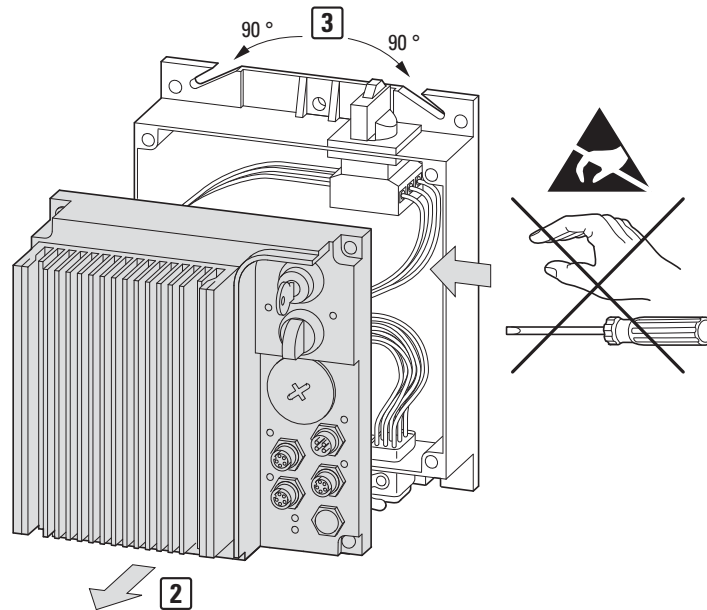


Figure 36: Example: Lifting off enclosure cover on a RASP

NOTICE

Do not reach into the opened base or the enclosure cover! as this can damage assemblies and connections and impair the device's function.

The enclosure base can now be rotated, for example by 90 ° counterclockwise (to the left). The power terminals now point to the right. Finally carefully refit the enclosure cover.



When assembling, make sure that the rubber seals are seated correctly (degree of protection IP65).

With the four screws secure the enclosure cover on the base. Tighten the screws in two passes, always tightening two diagonally opposite screws at a time. For example, tighten all four screws to about 2 Nm and then to 5 Nm, always working in a crosswise pattern.

3 Installation

3.2 Installation instructions



Use a suitable tool (Torx 30 IP) to tighten the screws to a torque of 5 Nm.

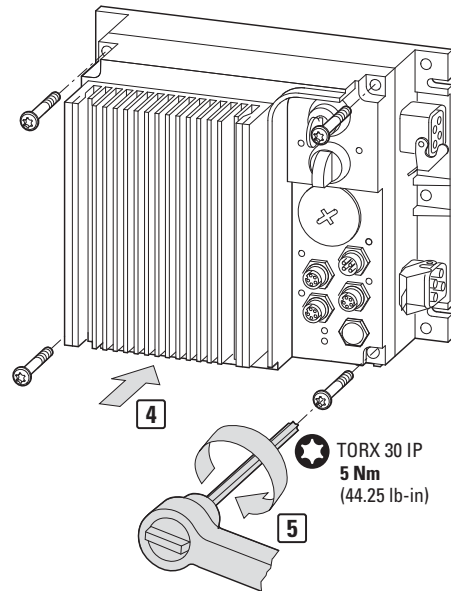


Figure 37: Mounting the enclosure cover

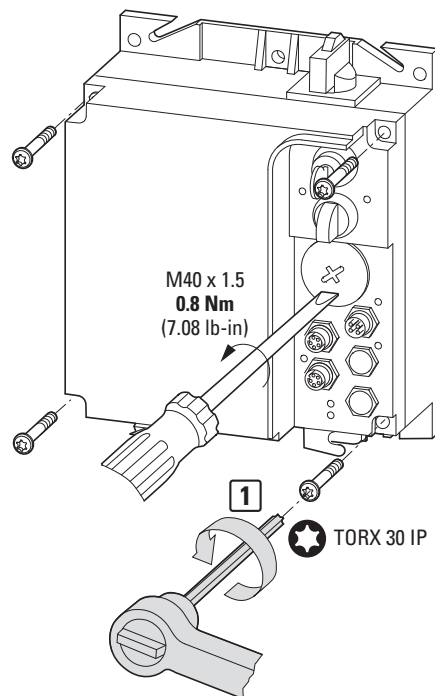


Figure 38: Fastening the M40 screw-on cover



Tighten the M40 screw-on cover with the required tool using a torque of 0.8 Nm.

3.3 Electrical Installation



DANGER

Electric shock hazard - risk of injuries!
Carry out wiring work only if the unit is de-energized.

NOTICE

Fire hazard!

Only use cables, protective switches, and contactors that feature the indicated permissible nominal current value.



WARNING

With RASP earth leakage currents are greater than 3.5 mA (AC). According to product standard IEC/EN 61800-5-1 an additional protective conductor must therefore be connected to the RASP's heat sink.



DANGER

The components in the RASP power section remain energized up to five (5) minutes after the supply voltage has been switched off (internal DC link capacitor discharging time). On RASP the motor feeder cable must be disconnected or work on the motor terminal box performed only after the discharging time.



Complete the following steps with the specified tools and without using force.

3.4 Power bus

The Rapid Link system can have one of two types of power bus:

- Flexible (RA-C1-7...) busbar,
- Round conductor (standard cable).

3.4.1 Flexible (RA-C1-7...) busbar

The RA-C1-7... flexible busbar is keyed in order to prevent it from being connected the wrong way around. More specifically, one of the busbar edges has a tapered shape. The cable connector in all system components (ribbon cable outgoers) will be shaped accordingly. In other words, the flexible busbar needs to be inserted in such a way that the tapered side will be on the opposite side of the hinge of the opened cable connector.

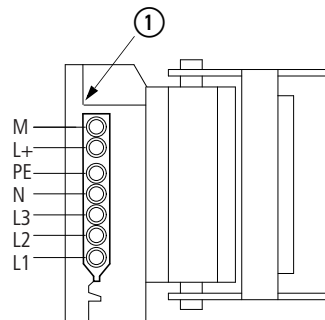


Figure 39:Keying on RA-C1-7... flexible busbar

① Hinge



L+ and M are not used on Rapid Link modules RAMO and RASP.



RAMO and RASP must always be connected with five conductors: L1, L2, L3, N, PE.

3.4.1.1 Laying the flexible busbar

Unwind the flexible busbar, cut it to length, and route it as necessary. There is an inscription on one side of the busbar that is designed to work as a keying guide. A metric marker on the jacket aids with cutting to length.

NOTICE

The flexible busbar is not suitable for drawing in and must not be used as trailing cable!

Where the flexible busbar is not laid within cable ducts, secure it to the ground with cable binders or cable clamps.



In areas in which mechanical damage is likely to occur, we recommend laying the busbar in cable ducting for protection.

3.4.1.2 End-pieces and lead-throughs

Once the flexible busbar has been routed, all free busbar ends must be safely terminated and sealed as required to achieve an IP65 degree of protection. To do this, use cable end pieces (RA-C1-END1) and bushings (RA-C1-DF) as necessary.

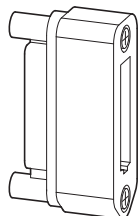


Figure 40: Bushing RA-C1-DF for ribbon cable

With bushing RA-C1-DF the flexible busbar can be fed into distribution module RA-C1-VM-7 or a control panel.

- ▶ Cut the busbar to the required length.

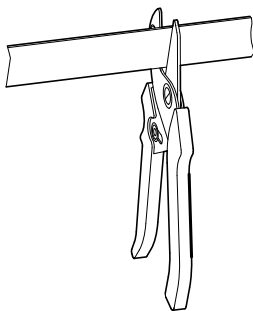


Figure 41: RA-C1-CUT, hand ribbon cable cutter



For cutting to length we recommend tool RA-C1-CUT.

- ▶ Strip the flexible busbar to the required length:
 - for cable end piece to 19 mm,
 - for distributor module to 50 mm,
 - for control panel as required.



Tool RA-C1-AZ-4 is recommended for stripping 7 x 4 mm² flexible bus bar.

If using a standard cable stripping knife, make sure not to cut into the rubber jacket by more than 0.7 mm in order to avoid damaging the conductor's insulation.

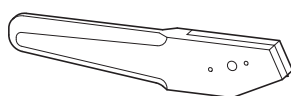


Figure 42: RA-C1-AZ-4
tool for stripping the cable jacket

3 Installation

3.4 Power bus

3.4.1.3 End-piece mounting

- ▶ First slide the lower (shorter) part of busbar end piece RA-C1-END1 onto the prepared flexible busbar.
- ▶ Slot the individual conductors into the insulation channels in the busbar end piece up to the stop.
- ▶ Join the upper and lower sections with the two screws.
Installed correctly, the flexible busbar offers degree of protection IP65.



3.4.1.4 Connections, flexible busbar junction

The supply and outgoer modules can be installed at any point along the flexible busbar without interrupting the busbar's conductors. The connection is made with contact screws.

PIN	Function	Conductor number 7 x 4 mm ²
1	L1	1
2	L2	2
3	L3	3
4	N	4
5	+24 V ¹⁾	5
6	0 V ¹⁾	6
PE	PE	yellow/green

1) Not used for RAMO and RASP.

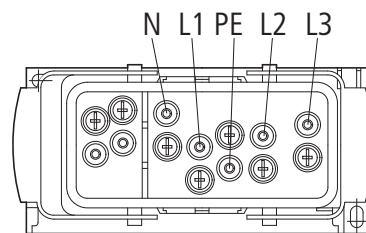


Figure 43: Pin assignment for RA-C1-PLF1 ribbon cable outgoer

3.4.2 Round conductor

3.4.2.1 Round cable junction RA-C2-S1-4

Round cable junction RA-C2-S1-4 is a T connector for the RA-C3/C2-1.5HF plug-in power adapter cable. It makes it possible to connect a Rapid Link module (RAMO / RASP) directly.

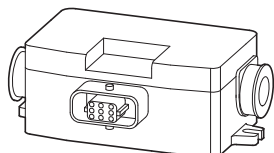


Figure 44: Round cable junction RA-C2-S1-4

Insulation piercing terminals are used for conductor contacting in the power bus. The bushings are dimensioned for a conductor with an outer diameter from 10 to 16 mm.

Accessories (seal insert, locking clip, the fully wired bushing insert, etc.) is included as standard.

- ▶ For mounting the round cable junction is secured to the substrate with suitable screws (M5).
- ▶ Strip the round cables to a length of 130 mm (two radial cuts, one longitudinal cut) - for example with wire stripper AM16 from Weidmüller.



To strip the cable, position the blade in such a way that the conductor insulation will not be damaged.

- ▶ Make a radial cut in the gaskets, lay the seals around the cable jacket and insert it in the provided U-shaped contour in the cable junction.



The supplied equipment includes two pairs of seals for cable outer diameters from 10 to 13 mm and from 13 to 16 mm. Only these matched gasket inserts guarantee degree of protection IP65 when used correctly.



The round cable must be laid without tension. Install only one conductor per terminal.

3 Installation

3.4 Power bus

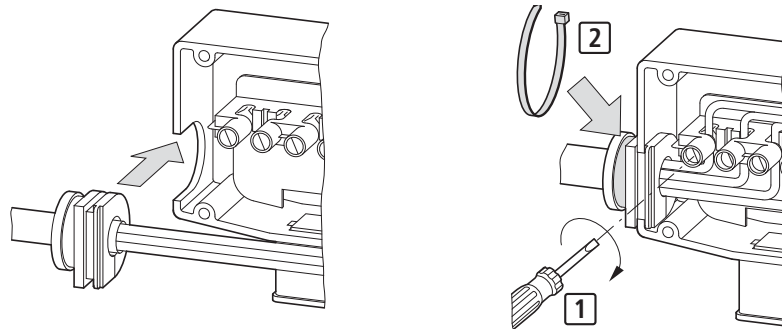


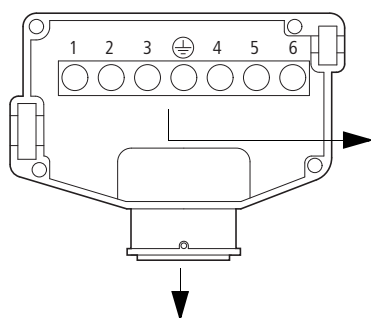
Figure 45: Round cable connection

- ▶ Insert the individual wires into the insulation piercing terminals and secure them with the screws one at a time.
- ▶ Turn in the screws [1] all the way to the stop (tightening torque of 0.5 to 1 Nm).
- ▶ Place the cover on the base so that it rests fully on the base. All screws must be turned in all the way.
- ▶ Fasten the cover with the four screws (Pozidriv 2 size; 1.5 to 2 Nm).
- ▶ In order to ensure that an IP65 degree of protection is maintained, firmly tighten a cable binder [2] around each outer gasket.
- ▶ Slot the attached locking clip for the outgoer plug onto the two studs of the bushing housing.



The open end of the last round cable junction (at the end of the power bus) must be sealed off with an RA-C2-SBL end-piece.

3.4.2.2 Assignment of terminals and conductors



PIN	Function
1	L1
2	L2
3	L3
⊕	⊕
4	N
5	24 V ¹⁾
6	0 V ¹⁾

PIN	Function
1	N
2	L2
3	n. c.
4	+24 V ¹⁾
5	0 V ¹⁾
6	L3
7	–
8	L1
PE	PE



1) Not used for RAMO and RASP

3.4.2.3 Round cable junction RA-C4-PB65

The RA-C4-PB65 round cable junction (power box) is a contact unit for uncut round cables with a cross-sectional area of 2.5 to 6 mm² that has an IP65 degree of protection.

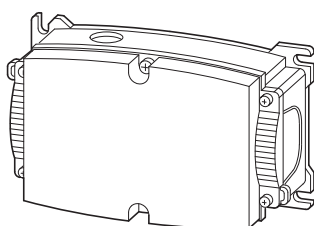


Figure 46: RA-C4-PB65 round cable junction (power box)



The power box's IP65 enclosure is supplied without gaskets (RA-C4-D... or RA-CU-PB65 required).

Gaskets RA-C4-D...

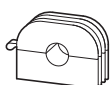


Figure 47: Enclosure bushing seal



Figure 48: Blanking plug (RA-C4-D0)

3 Installation

3.5 Power plug RA...C3...

3.5 Power plug RA...C3...

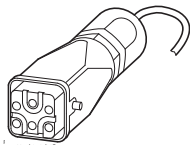


Figure 49: Power plug RA...C3...

The RA...C3... power plug (Type: HAN Q5/0) has the following PIN assignment:

PIN	Function	Power plug
1	L1	
2	L2	
3	L3	
4	N	
5	-	
PE	PE	

After installing the power bus outgoing (RA-C1-PLF1, RA-C2-S1-4, RA-C4-PB65) you can connect the Rapid Link module (RAMO / RASP) to the power plug using the assigned power adapter cables.

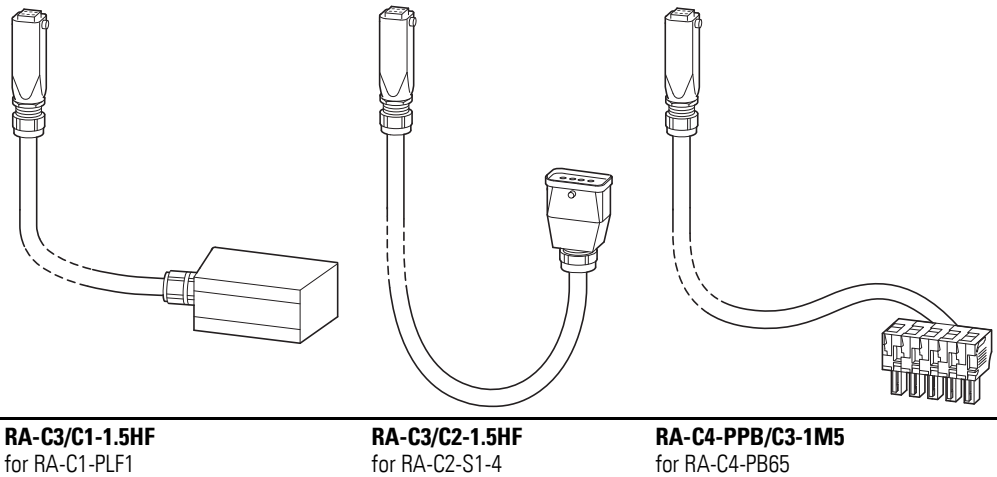


Figure 50: Power plug with adapter cable (Eaton)

NOTICE


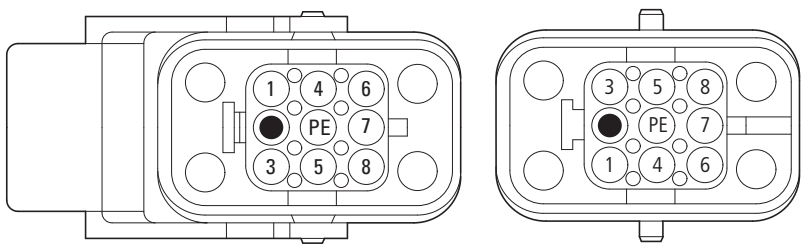
Compatibility with cables from other manufacturers cannot be guaranteed!

3.6 Motor feeder

3.6.1 Motor feeder plug

RAMO and RASP are connected to the motor through a socket connector. The pin assignment of this motor feeder socket complies with the DESINA specification for:

- Three-phase motor (U1, V1, W1)
- Temperature sensor (T1, T2)
- Motor brake (B1, B2)

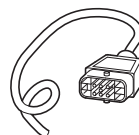
PIN	Function	Arrangement of pins
		
		Motor outgoing socket
		Plug connectors
1	U1 Motor	
2	Coding	
3	W 1 Motor	
4	B2 brake	
5	T1 Thermistor	
6	B1 brake	
7	V1 Motor	
8	T2 Thermistor	
PE	PE	

3.6.2 Motor feeder connecting examples

The following examples show preferred connections for the motor feeder plug in the Rapid Link System.



The PE connection of the motor feeder socket is always connected directly with the PE connection of the power plug.



RAMO-CM1-2MO for RAMO...

RASP-CM1-2MO for RASP...

Figure 51: Motor cable for connecting the motor starter to the motor

NOTICE

Compatibility with cables from other manufacturers cannot be guaranteed!

3 Installation

3.6 Motor feeder

3.6.2.1 Motor cable monitoring

Pin 5 and pin 8 of the motor feeder socket are used to monitor the motor cable's motor feeder plug and for thermistor protection.

The way monitoring is performed will depend on the jumper ② in RAMO units (→ Page 55) and DIP switch 1 on RASP units (→ Page 123).

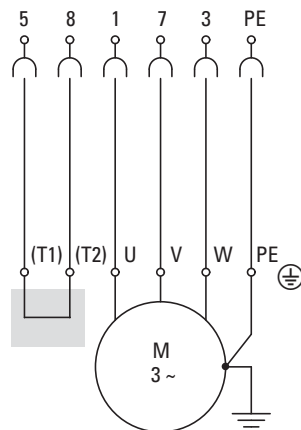


Figure 52: General motor connection with motor feeder plug and motor cable monitoring



For motor cable monitoring and operation without a thermistor, the cable ends of PIN 5 and PIN 8 must be bridged in the terminal box of the motor (cable monitoring T1 - T2).

3.6.2.2 Motor cable with thermistor connection

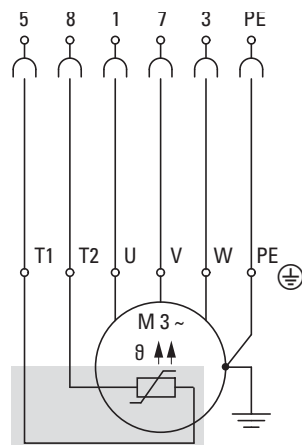


Figure 53: General motor connection with thermistor, motor feeder plug and motor cable monitoring

The cable ends (PIN 5 and PIN 8) on motors with thermistors or thermostats (thermoclick) must be connected in the terminal box of the motor (T1 - T2).

On motor cables without the conductors for pins 5 and 8 (e.g., 4-core motor cables) the pin 5 and pin 8 connections must be connected directly in the motor plug. In this case, T1 and T2 in the motor terminal box are connected with a separate cable and connected to an external monitoring device (e.g., EMT6).

The monitoring is implemented according to the setting of jumper ② for RAMO (→ Page 55) or DIP switch 1 for RASP (→ Page 123).

3.6.2.3 Motor cable with connection for motor brake

On motors with an attached mechanical spring-pressure brake, the control device for this brake can be actuated by RAMO-..2... or RASP-..2... with 277 V AC or by RAMO-...4 or RASP-...4... with 480 V AC. The connection is implemented via PIN 4 and PIN 6 in the motor plug (→ Page 73)

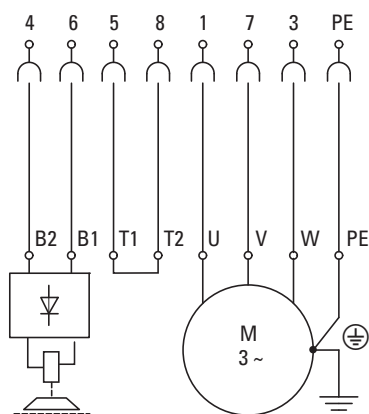


Figure 54: General connection with brake

3 Installation

3.6 Motor feeder

3.6.3 Motor feeder on RASP

The RASP speed control unit is frequency-controlled (with a built-in variable frequency drive) and requires screened motor cables in the motor feeder.

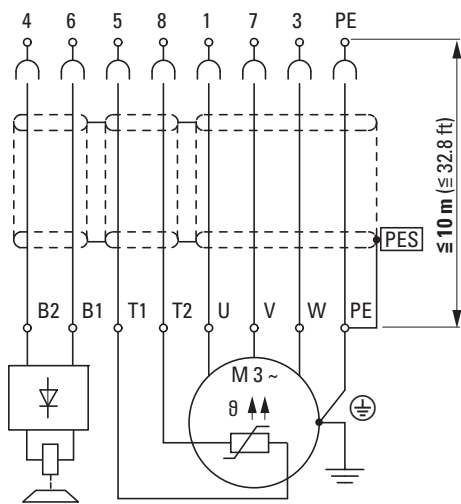


Figure 55: Screened motor cable for RASP.
Longest permissible length of motor cable: 10 m



On operation without thermistor the cable ends of pins 5 and PIN 8 must be bridged in the terminal box (→ Section 3.6.2.1, „Motor cable monitoring“, page 74).



For RASP 4.0 the motor cable's screen braid has to be earthed only at the motor (PES).



DANGER

Dangerous touch voltage

For RASP 4.0, use fully insulated plastic plugs in the motor feeder!

NOTICE

The motor's metal enclosure must always be earthed - irrespective of the type and version of motor cable used!

3.6.4 Screened motor cable for RASP.

3.6.4.1 General notes

The following information uses the example of a DESINA MOTORFLEX cable with 4G1.0 2 x (2 x 0.75), to describe the steps required for the EMC connection of a mains cable to the RASP.

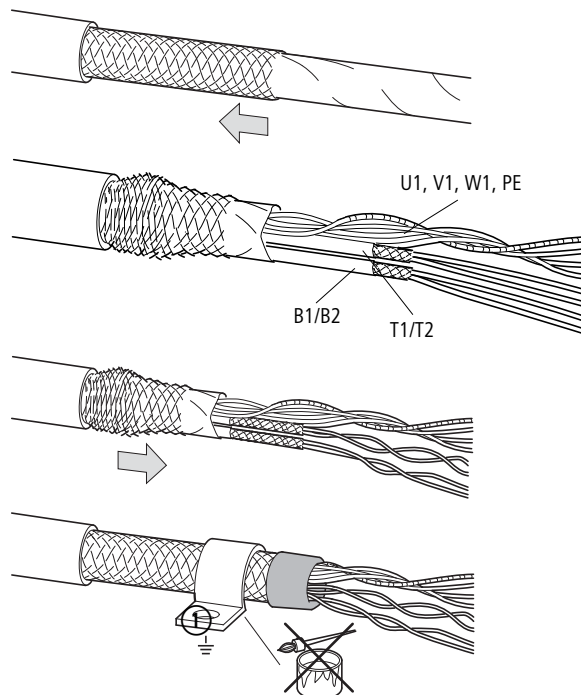


Figure 56: EMC-compliant connection of the screened motor cable

① 360° contact clamp Δ PES

- ▶ Stripping the motor cable ends (radial and longitudinal cut).



To strip the cable, position the blade in such a way that the conductor insulation and the braid will not be damaged.

- ▶ Push the screen braid back to reveal the individual conductors.
- ▶ The conductors B1 (= N) and B2 (= L) for the external brake as well as T1 and T2 for the thermistor have a sheath and a separate screen braid. These conductors must be stripped separately.
- ▶ Then slide the outer screen braid of the motor cable back towards the cable end far enough that conductors B1/B2 and T1/T2 are covered over a large area and connected with each other.



Wrap insulating or textile tape or slide a rubber grommet around the screen ends to prevent the screen braid from splicing.

3 Installation

3.6 Motor feeder

- ▶ At the motor's terminal box, connect the motor cable's braid to ground potential (PES).

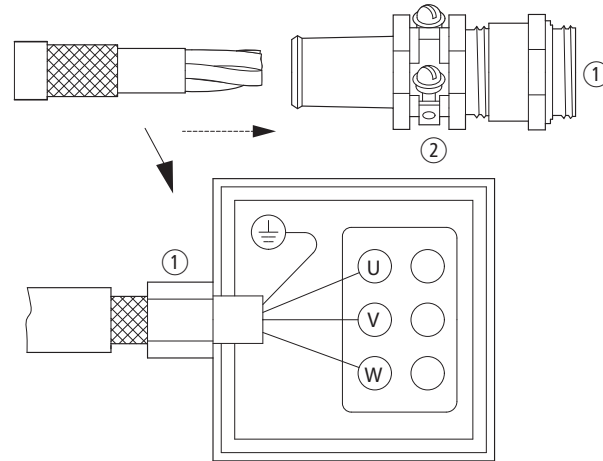


Figure 57:360° screen contact at the motor terminal box

- ① 360° contact screen for the motor cable
- ② Clamp strap with screw for the screen braid

- ▶ Connect the jointly twisted strands (U, V, W, and PE) and separately twisted strands B1/B2 and T1/T2 to the corresponding terminals in the motor or in the connector.

The substrate must be free from varnish (direct contacting). The screen clamp shown in the illustration is an example of a large-area earth connection (PES).

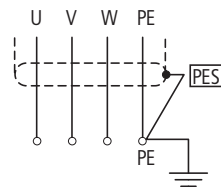


Figure 58:Connecting a screen braid (PES) to the motor terminal box

3.6.4.2 Notes on replacing devices

In applications in which RASP 4.0 replaces older versions (RA-SP.../C1, RA-SP.../C2, RA-SP...-HE.../C3A) with metal motor feeder plugs, these metal plugs must be replaced with insulated (plastic) motor plugs:
For example: Replace the motor cable and connector with RASP-C...

➔ On motor cables shorter than 5 m the metal motor plug (SET-M4/...-HF) does not have to be replaced.

If the existing motor cable will or can not be replaced in existing applications, safe operation can be ensured with the following measures:

- Strip the screen braid of the motor cable close to the metal plug and create a large area connection to the PE (PES → ① page 77)
Disadvantage:
The high degree of protection of the motor cable and thus the high degree of protection of the Rapid Link System (IP65) is thus removed at this point.
- Replace the metal motor plug with an insulated motor plug. Insulate the motor cable's screen in the plug.

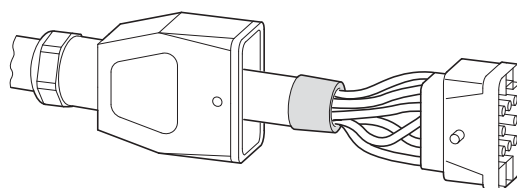


Figure 59: Motor cable in insulating plug

- Replace the metal plug with a plug with an internal PE connection for the cable screen.

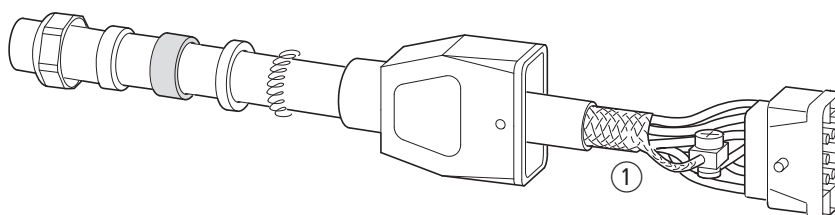


Figure 60: Motor cable with space unit connection Δ PES

- ① 360° contact screen for the motor cable

3 Installation
 3.6 Motor feeder

3.6.4.3 Functional earth on RASP

With the RASP speed control unit, leakage currents to earth (I_{PE}) can exceed 3.5 mA. According to EN 50178 the PE connection must be made with two PE conductors or with one PE conductor with a cross section of at least 10 mm². The detachable power plug in the Rapid Link system means that the heat sink for RASP must be permanently connected to earth with a second PE cable. Connect the PE cable at the screw labeled with the earth symbol (⊕).

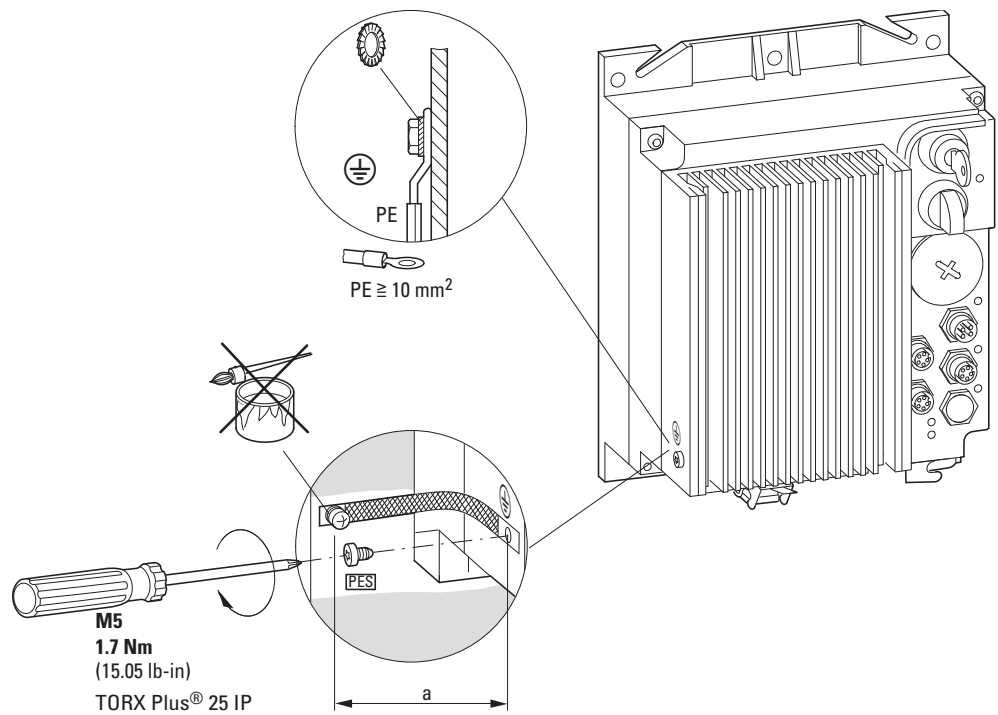


Figure 61: Functional earth (drain wire or round cable)

	a (drain wire)	a (round cable in conjunction with ferrite cores)
RASP without repair and maintenance switch	≥ 155 mm	~ 300 mm
RASP with repair and maintenance switch	≥ 180 mm	~ 300 mm



The earth connection contact surfaces of the heat sink must be free from paint.

3.6.4.4 Operational safety of plug connectors



To increase the operational safety of the plug-in connection (inadvertent loosening of the locking clips) we recommend securing the plug-in connections with a cable binder at the locking clip.

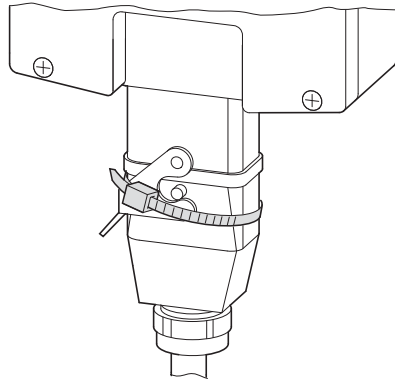


Figure 62: Securing the motor feeder plug with a cable binder

3 Installation

3.7 Data bus

3.7 Data bus

You can place M12 branches (ZB2-100-AZ1) at any point along the AS-i ribbon cable.

Fitting provides the mechanical and electrical connection at the same time:

- ▶ Release the black union nut until the contact tips no longer protrude.
- ▶ Insert the two-wire profile ribbon cable and clip the junction shut.
- ▶ Retighten the black union nut.

The device or module is now ready for operation.

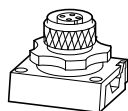


Figure 63: Junction M12 (order no.: ZB2-100-AZ1)

The Rapid Link function modules have an AS-i M12 plug-in connector that matches the M12 branch.

PIN	Function
1	AS-Interface+
2	–
3	AS-Interface -
4	–



RASP... offers the option of using AS-i interface pins 2 and 4 to activate a second STOP function with an external control voltage (24 VDC) (→ Page 127).

This requires a second AS-i ribbon cable and connector RA-XAZ2-1M.

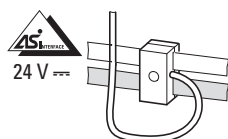


Figure 64: RA-XAZ2-1M, AS-i branch

PIN	Function
1	AS-Interface+
2	0 V
3	AS-Interface -
4	+24V

3.7.1 Extension circuit

For connecting the M12 junction ZB2-100-A21 with Rapid Link modules RAMO or RASP, extension cable RA-XM12-1M can be used. This 1 m long connection cable is prefabricated with an M12 socket (connection to RAMO or RASP) and an M12 plug (M12 junction).

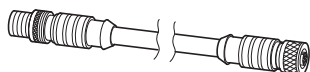


Figure 65: Extension cable RA-XM12-1M

3.7.2 Cable routing

➔ Always lay the control and signal cables separately from the mains and motor cables.

Do not lay the data bus (AS-Interface) and the sensor and actuator cables directly parallel with the power bus (mains cable), to a power adapter cable or to a motor cable. Avoid laying them in a common cable duct or conduit or tying them together with cable binders. Signal and power cables should, as far as possible, cross at right angles. This increases their interference immunity (EMC) and therefore operational reliability. On the frequency-controlled RASP further measures are necessary to ensure an EMC-compliant installation (➔ Page 77).

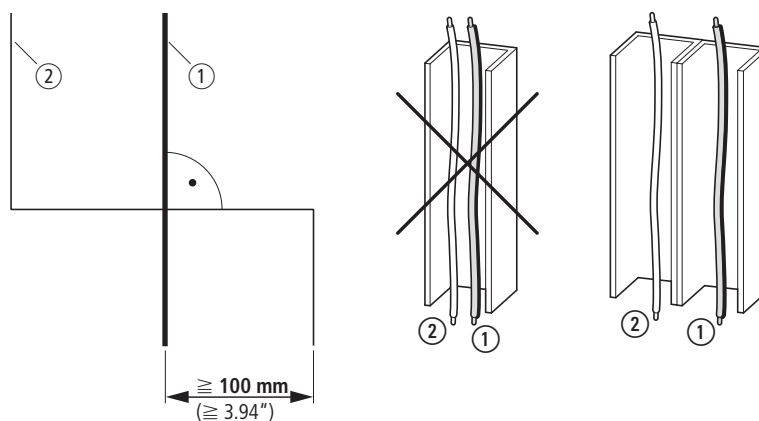


Figure 66: Laying of signal and power cables

- ① Power cables, mains connection, (power bus, adapter cable) motor cable
- ② Control cables: AS-Interface (data bus), sensor-/actuator connection

3.8 Insulation test

The Rapid Link modules RAMO and RASP are tested, delivered and require no additional testing.



DANGER

Do not perform insulation resistance tests with an insulation tester at the control terminals (I3, I4, AS-Interface, O3, F) and power terminals (power plug and motor feeder plug).

If insulation testing is required in the power circuit of the PDS, you must consider the following measures.

Rapid Link modules

Disconnect all plug-in connections in the control and power sections.



DANGER

With RASP, wait at least five minutes after switching off the supply voltage before disconnecting a cable connection.

Testing the motor cable insulation

Always disconnect the motor feeder plug before disconnecting RAMO and RASP Rapid Link modules. Measure the insulation resistance of the motor cable between the individual phase conductors and between the phase conductor and the protective conductor.

The insulation resistance must be greater than 1 M Ω .

Testing the mains cable insulation

Always disconnect the power plug from Rapid Link modules RAMO and RASP. Measure the insulation resistance of the mains cable between the individual phase conductors and between each phase conductor and the protective conductor.

The insulation resistance must be greater than 1 M Ω .

Testing the motor insulation

The motor cable must be disconnected at all terminals (U, V, W, B1, B2, T1, T2, PE) and the bridge circuits (star or delta) open. Measure the insulation resistance between the individual motor windings. The measurement voltage must at least match the rated operating voltage of the motor but is not to exceed 1000 V.

The insulation resistance must be greater than 1 M Ω .



Consider the notes from the motor manufacturer in testing the insulation resistance.

4 Operation

4.1 Checklist for commissioning

Before commissioning Rapid Link Modules RAMO and RASP, check the following points (checklist):

No.	Activity	Note
1	Mounting and wiring completed in accordance with the applicable instructional leaflets (→ IL3406019Z and IL3406020Z).	
2	All wiring and line section leftovers, as well as all the tools used, have been removed from the RAMO, RASP, motor's and drive unit's proximity.	
3	All plug connectors in the power section are made as described in this manual. → The AS-i bus must be plugged in and powered in manual mode as well.	
4	The cables connected to Rapid Link cards RAMO and RASP are not short-circuited and not connected to earth (PE), except for the PE cable.	
5	On speed control unit RASP the heat sink is correctly earthed (PE).	
6	All electrical connections on the motor are established correctly. → On RASP, metal motor plugs are permissible only with a motor cable length of up to 5 m!	
7	Each single phase of the supply voltage (power bus L1, L2, L3) is protected with a fuse.	
8	The Rapid Link modules RAMO, RASP and the motor are adapted to the mains voltage. → Section 1.3, "Ratings", page12, connection type (star, delta) of the motor tested.	
9	The quality and volume of cooling air are in line with the environmental conditions required for the RAMO, RASP and the motor.	
10	All connected control cables (I3, I4, and AS-i) ensure the corresponding stop conditions.	
11	The parameters that were preset at the factory have been checked with the list of parameters.	
12	The effective direction of a coupled machine will allow the motor to start.	
13	All emergency switching off functions and safety functions are in an appropriate condition.	

4 Operation

4.2 Operational hazard warnings

4.2 Operational hazard warnings

Please observe the following notes.

**DANGER**

Commissioning is only to be completed by qualified technicians.

**DANGER**

Hazardous voltage!

The safety instructions on pages I and II must be followed.

NOTICE

Before switching on the supply voltage (400 V AC) for the first time, check that all wires are connected to the correct terminals and that all PE and earth connections have been made.

**DANGER**

The motor outgoing sockets are live when the supply (mains) voltage is connected.

The control signal terminals are isolated from the line power potential.

**DANGER**

RAMO unit outputs carry a dangerous voltage whenever the supply voltage is switched on - even if the unit is in the OFF/ STOP state!

**DANGER**

Do not remove the motor and power plug when the system is live.

**DANGER**

The output to the brake carries a dangerous voltage whenever the supply voltage is switched on - even if in the Off state!

4.2.1 Specific hazard warnings for RAMO

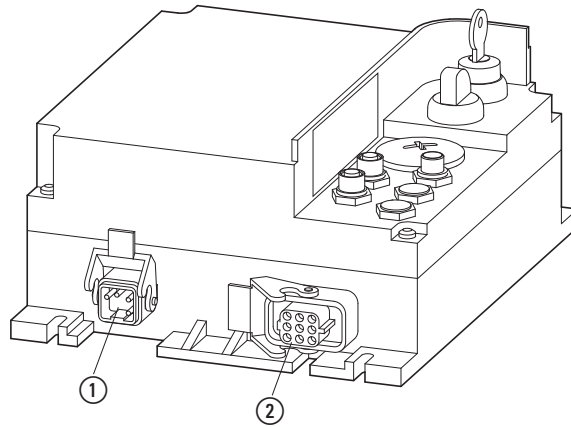


Figure 67:Connections in RAMO power section

- ① Power plug
- ② Motor outgoing socket

Examples of hazard warnings on motor control unit RAMO

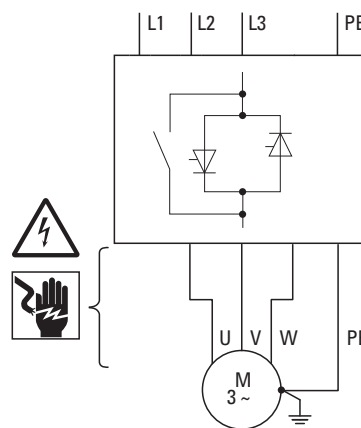


Figure 68:RAMO-Dx0...-C3... DOL starter

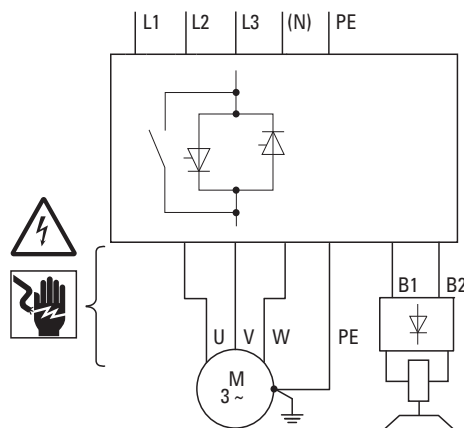


Figure 69:DOL starter with braking control RAMO-Dx2...-C3...

4 Operation

4.2 Operational hazard warnings

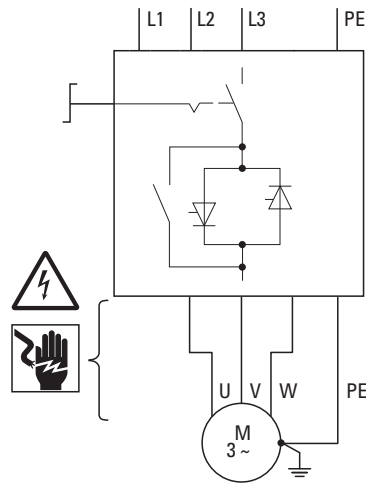


Figure 70: DOL starter with repair and maintenance switch RAMO-Dx0...-C3xR...

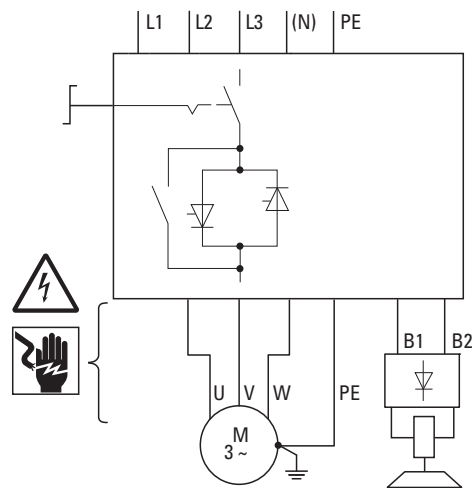


Figure 71: DOL starter with repair and maintenance switch and brake control RAMO-Dx2...-C3xR...

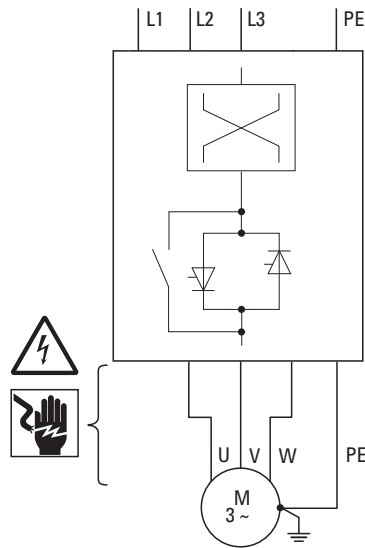


Figure 72:RAMO-Wx0...-C3...reversing starter

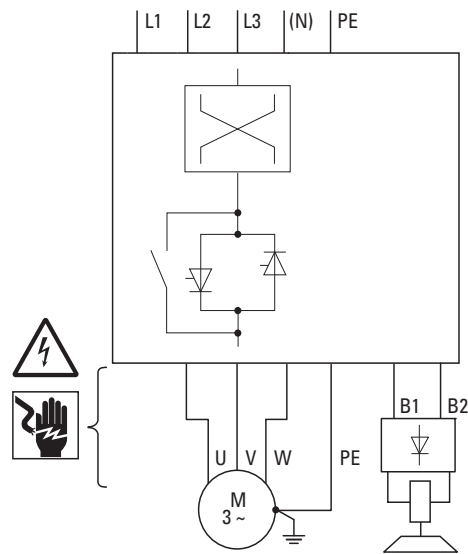


Figure 73:Reversing starter with braking control RAMO-Wx2...-C3...

4 Operation

4.2 Operational hazard warnings

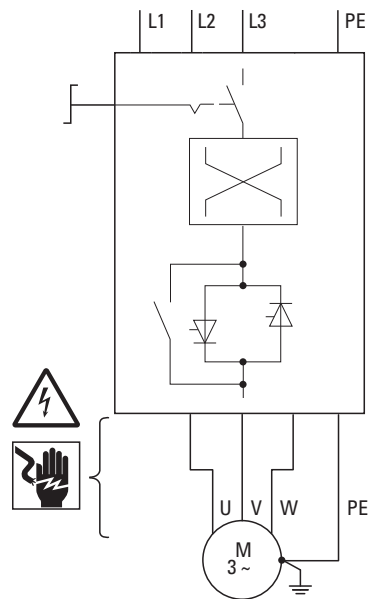


Figure 74: Reversing starter with repair and maintenance switch RAMO-Wx0...-C3xR...

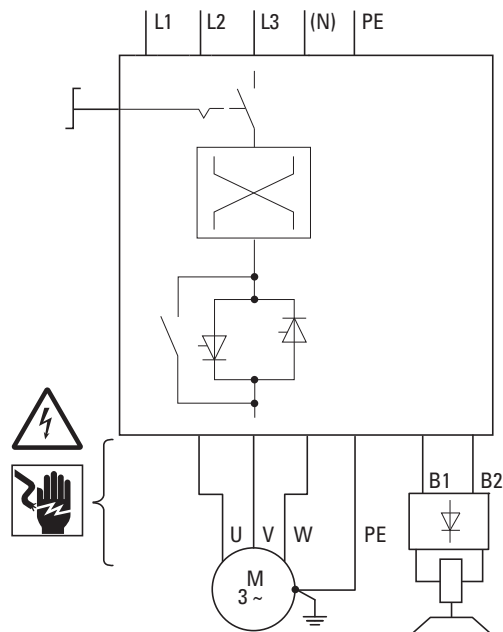


Figure 75: Reversing starter with repair and maintenance switch and brake control RAMO-Wx2...-C3xR...

4.2.2 Specific hazard warnings for RASP

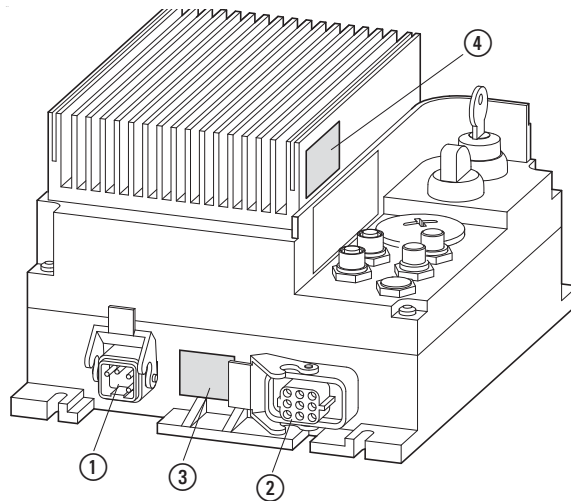


Figure 76: Connections in RASP power section and hazard warnings

- ① Power plug
- ② Motor outgoer socket
- ③ Hazard warning (discharge time of internal DC link capacitors)
- ④ Hazard warning (heat sink overtemperature)

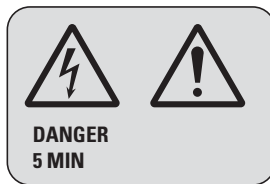
for ③



DANGER

The components and connections in the power section (power plug, motor outgoer) remain energized up to five minutes after the supply voltage has been switched off (internal DC link capacitor discharging time).

Pay attention to hazard warnings!



4 Operation

4.2 Operational hazard warnings

for ④



DANGER

High temperatures may occur on the heat sink of the RASP during operation.

Do not touch the heat sink!



NOTICE

Make sure that there is no danger in starting the motor. Disconnect the driven machine if there is a danger in an incorrect operating state.



If motors are to be operated with frequencies higher than the standard 50 or 60 Hz, then these operating ranges must be approved by the motor manufacturer. The motors could be damaged otherwise.

4.3 Operator control and display elements

4.3.1 Manual control

RAMO and RASP Rapid Link modules come with a manual controller (local controller) as standard. This controller is made up of a key switch and, in the case of RAMO-W and RASP, of a direction selector switch.

The manual control allows:

- a simple commissioning
- local operation during setup and maintenance,
- manual operation of a single drive unit with the overall system in automatic mode,
- secure (interlocked) manual operation within an area secured with limit switches (→ Section 2.7, "Sensor inputs I3 and I4", page43).

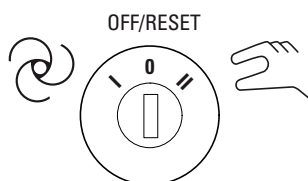





Figure 77:Key-switches



The key is maintained in all switch positions and can be inserted and removed in all positions.

The key switch has three positions.

Position	Function	Description
	Auto operation	Automatic operation through AS-Interface through the master controller (PLC)
	Manual mode	Local operation, even without AS-Interface parameters. The AS-Interface voltage must be present (LED  lit up). Start enable is issued with the direction selector switch (FWD, REV) on RAMO-W und RASP. In the case of RAMO-D, the start enable signal is sent using the key switch ("Manual" position).
OFF/RESET	Off Reset command	In this position RAMO and RASP do not issue control signals, irrespective of the control source. Fault signals, Motor LED lights up: <ul style="list-style-type: none"> • red → Fault present, reset not executed. • red flashing → Fault rectified, reset can be executed. For the Reset command, this position must be held for about one second. On RASP a Reset signal is issued to the frequency inverter (DI5) in this position.

4 Operation

4.3 Operator control and display elements

On Rapid Link modules RAMO-W... (reversing switch) and RASP (speed controller) the required rotating field direction can be selected with the selector switch in manual mode:

- FWD = Forward. Enable clockwise rotation (L1 → U, L2 → V, L3 → W).
- REV = Reverse. Enable Counterclockwise rotation (L1 → W, L2 → V, L3 → U).

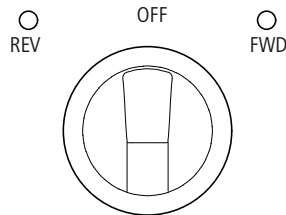


Figure 78: Direction of rotating field

The selected and enabled rotating field direction is indicated by the green FWD and REV LEDs. The selector switch for the rotating field direction has three positions. In switch position OFF the Rapid Link modules are inhibited in manual mode.









The selector switch for the direction of rotating field maintained in all positions.

4.3.2 LED indicators

The LEDs used in the Rapid Link system are multicolored and make it possible to indicate various operating states. The following table shows the possible states:

Table 8: LED indicators (using the AS-i LED as an example)

AS-i-LED	view	Description
		
	off (no indication)	No supply voltage connected.
	Green	Data communication active.
	red	<ul style="list-style-type: none"> • Data exchange interrupted and communication via the data interface blocked. • The processor for the communication <ul style="list-style-type: none"> • is waiting for a request, or • was reset by the communication watchdog. • The device address has not been configured.
	Flashing red/yellow	<ul style="list-style-type: none"> • The module is waiting for the address assignment. • Data exchange not possible.
	red/green flashing	Peripheral fault (signal generated at FID input)

5 Motor starter RAMO

5.1 Description

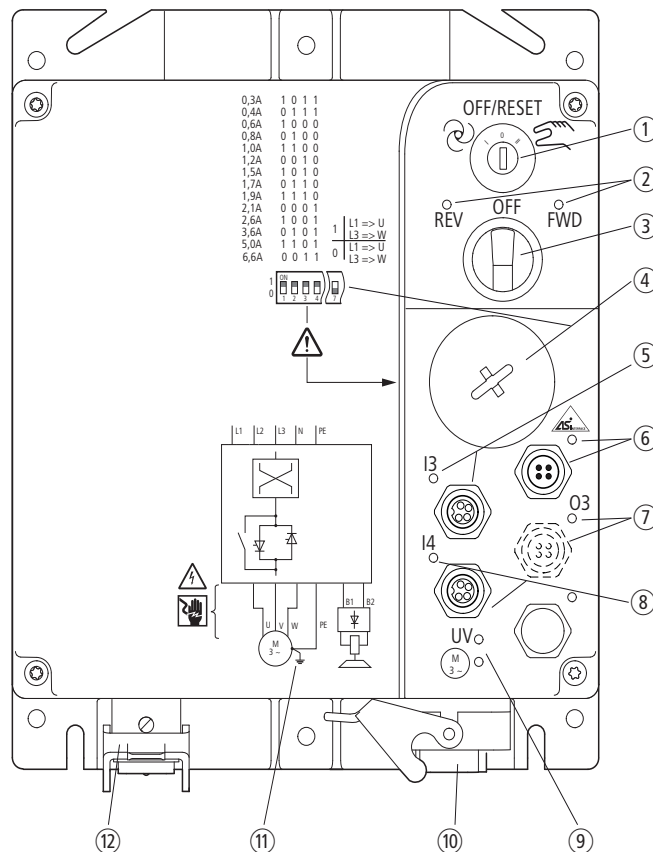


Figure 79: Overview RAMO

- ① Key-switch for manual and automatic mode and Reset
- ② LED for indicating motor voltage rotating field
 - FWD = Clockwise rotating field (Forward Run)
 - REV = Counterclockwise rotating field (Reverse Run)
- ③ Selector switch for rotating field direction (FWD, REV) in manual mode, RAMO-W... only
- ④ Inscription: Assignment of DIP switch positions to motor current protection value, under sealing screw
- ⑤ Sensor input I3 (M12 socket)
- ⑥ Connection AS-Interface (M12 plug) with LED
- ⑦ Actuator output O3 (M12 plug) with LED display - versions RAMO-DA... and RAMO-WA... only
- ⑧ Sensor input I4 (M12 socket) with LED
- ⑨ Status indicator (LED):
 - UV = Lights up with a green light if the supply voltage (400 VAC) and the AS-Interface voltage (24 V DC) are present
 - Motor = lit red when RAMO has detected a fault
- ⑩ Motor feeder plug
- ⑪ Block diagram power terminals RAMO-W...
- ⑫ Power plug, (supply voltage 3 AC 400 V, N, PE)

5 Motor starter RAMO

5.2 Features

5.2 Features

RAMO (Motor Control Unit) units are electronic motor starters (EMS) that can be used to directly start three-phase motors with a current of up to 6.6 A (Δ 3 kW with 400 V). RAMO switches with thyristors and relays in the energy branch. This makes it possible for the units to have a lifespan of more than 10 million switching cycles.

RAMO is available in two versions:

- RAMO-**D**... = DOL starter for one operating direction
- RAMO-**W**... = Reversing starter for two operating directions (FWD, REV)

The speed of the controlled motors is constant after run-up and is determined by the frequency of the supply voltage (energy bus, 50/60 Hz). The three-phase motor protection allows protected operation of three-phase motors in the range from 0.3 A (Δ 90 W at 400 V) to 6.6 A (Δ 3 kW at 400 V). This enables the so-called thermistor motor protection to be implemented in conjunction with the integrated thermistor monitoring.

The built-in transistor switch allows actuation of spring-loaded brakes with DC air solenoid valve. A controlled supply voltage of 230 V AC or 400 V AC is output for the brake rectifier (→ Figure 52, page 74).



DANGER

RAMO is not intended to be opened by the user. Open only in voltage-free state!

5.3 Connections

Motor control unit RAMO is supplied ready for installation.
All connections are via plug-in connectors.

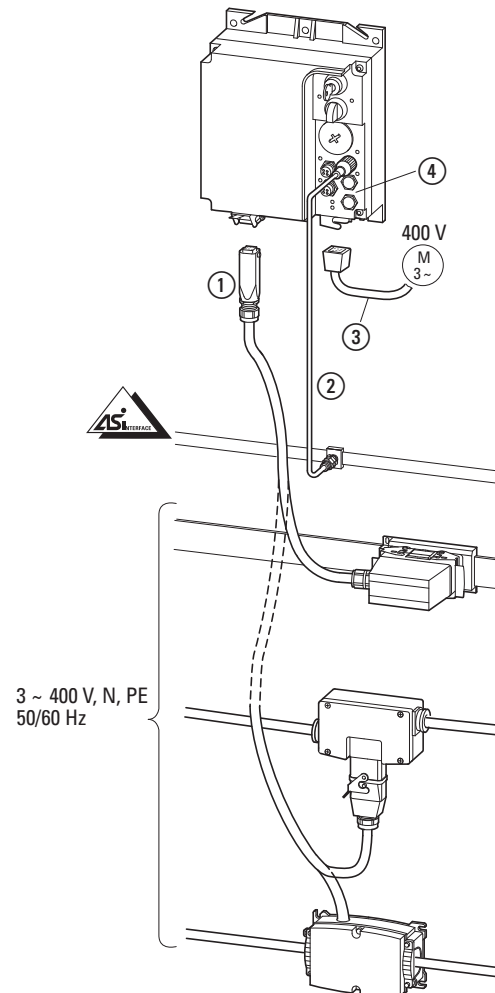


Figure 80: Connections on the RAMO

- ① Power plug, power supply (3 AC 400 V, N, PE) through an power adapter cable
(→ Section 3.5, „Power plug RA...C3...“, page 72)
- ② AS-Interface, data bus for controlling the RAMO unit in automatic mode
- ③ Motor connection: Motor outgoer socket according to DESINA specifications
- ④ Sensor (I3 + I4) and actuator connections (O3)

5 Motor starter RAMO

5.4 Special technical data

5.4 Special technical data

The following tables show the technical data of the Motor Control Unit (RAMO) in the individual power classes with the allocated motor output.



The motor output allocation is based on the rated operational current.



The motor output designates the respective active power output to the drive shaft of a normal, four pole, internally or externally ventilated three-phase asynchronous motor with 1500 rpm at 50 Hz or 1800 rpm at 60 Hz.

	Formula sign	Unit	RAMO-D	RAMO-W
Instance			DOL starter L1 → U, L2 → V, L3 → W	Reversing starter FWD: L1 → U, L2 → V, L3 → W REV: L1 → W, L2 → V, L3 → U
Block diagram			→ Page 99	→ Page 100
Rated operational current (I_e)	I_e	A	6.6	
Adjustable motor protection		A	0.3 - 6.6	
Assigned motor output at 440 - 480 V, 60 Hz	P	kW	0.09 - 3	
	P	HP	0.14 - 3	
Power side (Primary side)				
Number of phases			3	
Rated operating voltage	U_{LN}	V	400 V - 15 % - 480 V + 10 %, 45 - 66 Hz	
Input current	I_{LN}	A	0.3 - 6.6	
Braking				
Control voltage (external brake)	U	V	RAMO-Dx2...: 230/277 (50/60 Hz) RAMO-Dx4...: 400/480 (50/60 Hz)	RAMO-Wx2...: 230/277 (50/60 Hz) RAMO-Wx4...: 400/480 (50/60 Hz)
Load current (external brake)	I	A	≤ 0.6 A, max. ≤ 6 A for 120 ms	
Heat dissipation at rated operational current (I_e)	P_v	W	max. 8 W, depending on motor current, brake and output O3	
Weight (without repair and maintenance switch)	m	kg	1.5/1.7	1.6/1.8
Response time				
Motor On (automatic) ¹⁾	t_{ON}	ms	Motor 20-35, brake 20-35	
Motor Off (automatic) ¹⁾	t_{OFF}	ms	Motor 20-35, brake 20-35	
Switch off the motor (quick stop)	t_{off}	ms	Motor 20-35, brake 20-35	
Switch on O3	t_{ON}	ms	2 - 20	
Switch off O3	t_{OFF}	ms	2 - 20	
Minimum pulse duration I3/I4	t_{ON}	ms	5	

1) without bus runtime, depending on PLC

5.5 Block diagrams

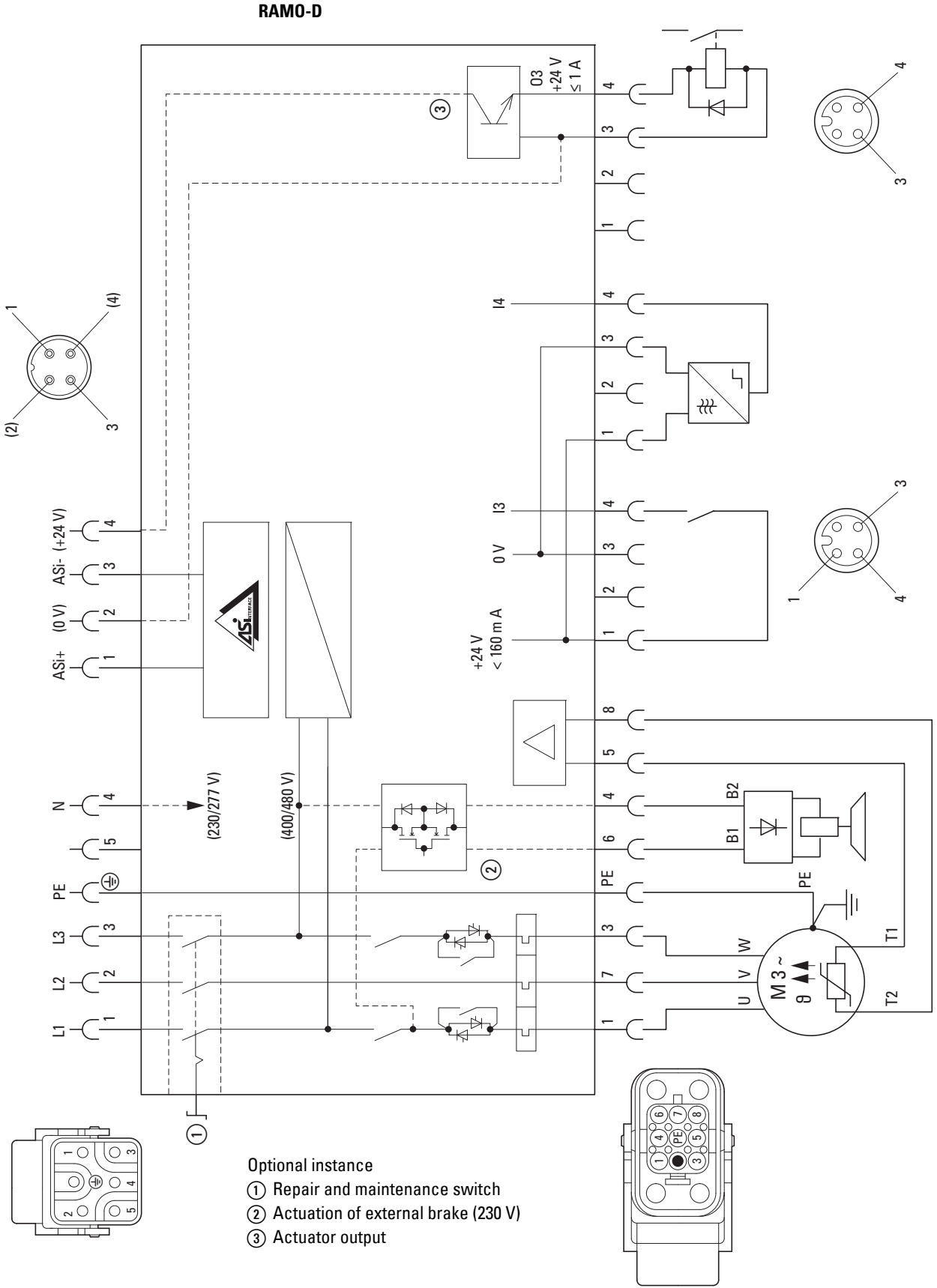


Figure 81:Block diagram RAMO-D...

5 Motor starter RAMO

5.5 Block diagrams

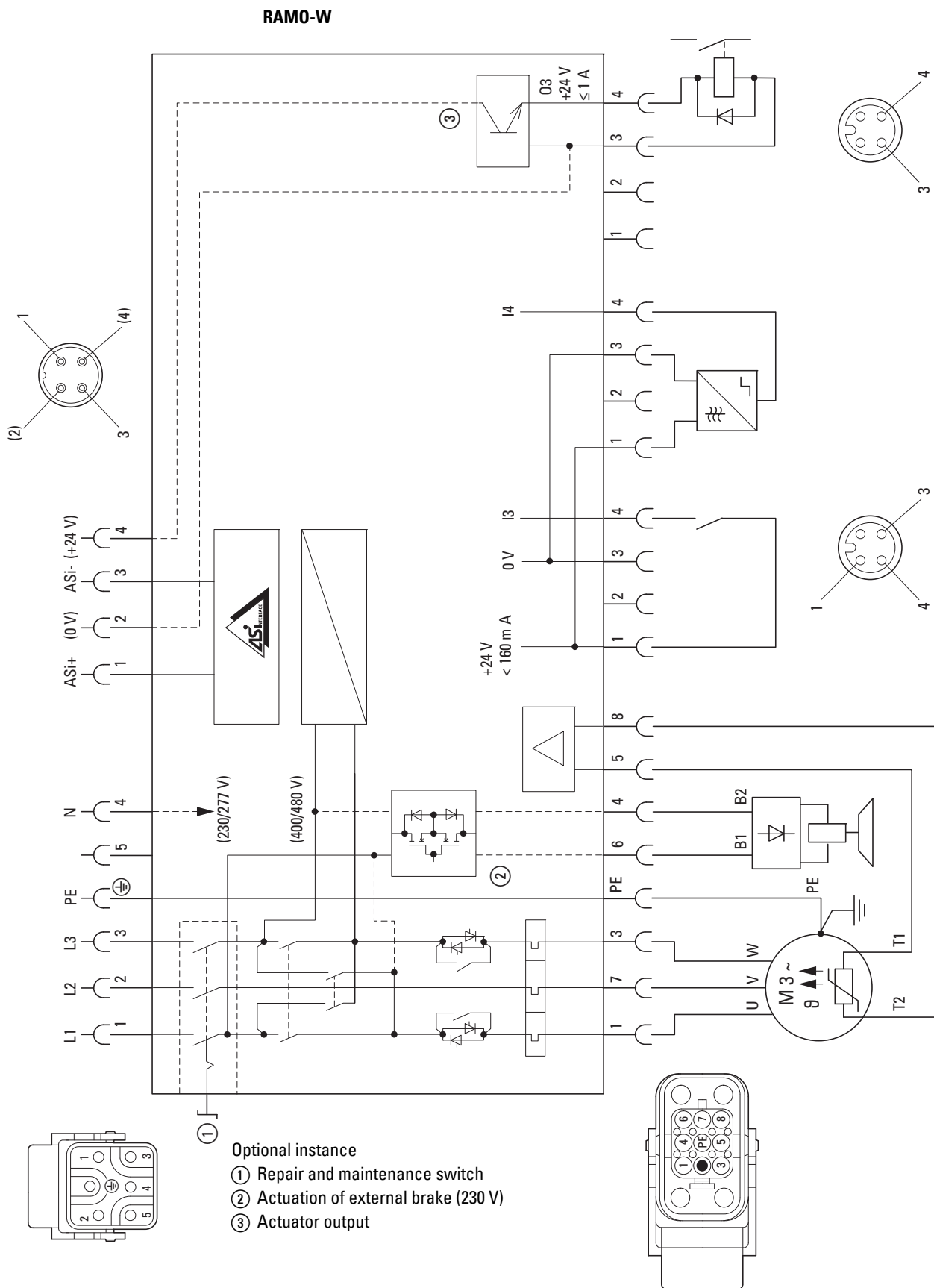
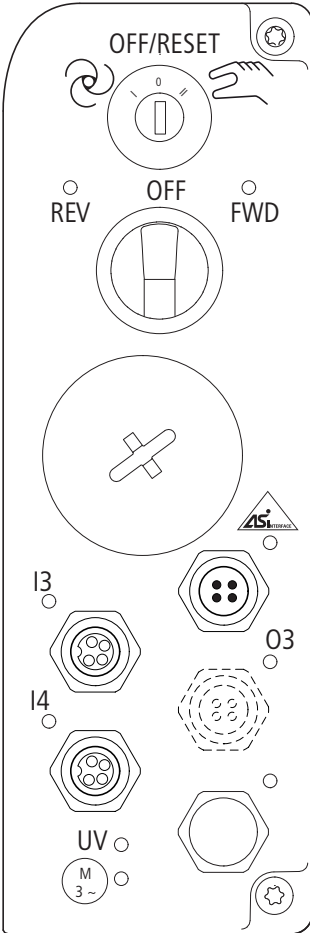




Figure 82:Block diagram RAMO-W...

5.6 Operation


5.6.1 LED indicators

The LEDs of RAMO motor control unit indicate the operating states and allow a quick diagnosis.

LED	State	Description
	FWD	Clockwise rotating field of motor voltage (U-V-W)
	Off	Not actuated
	green	enabled (RUN-Mode)
	Flashing (green)	controlled: <ul style="list-style-type: none"> • but inhibited through quick stop function of sensor inputs (I3, I4). • but inhibited because the key switch was in the MANUAL position when the supply voltage (400 V or AS-i) was switched on. → A Reset command required.
	REV	Counterclockwise rotating field of motor voltage (W-V-U) RAMO-W...only!
	Off	Not actuated
	green	enabled (RUN-Mode)
	Flashing (green)	controlled: <ul style="list-style-type: none"> • but inhibited through quick stop function of sensor inputs (I3, I4) • but inhibited because the key switch was in the MANUAL position when the supply voltage (400 V or AS-i) was switched on. → A Reset command required.
	AS-Interface	
	Off	No supply voltage in the AS-i electronics: Check the AS-i connection cables Check the AS-i power supply unit (head-end controller)
	green	Communication active, normal operation
	Red	No communication: <ul style="list-style-type: none"> • Head-end controller (master) in STOP mode. • RAMO not entered or entered with the wrong address (ID). • RAMO in Reset mode.
	Flashing red/yellow	AS-i address = 0 → Configure the AS-i address
	Flashing red/green	Peripheral error (→ Section 4.3.2, „LED indicators“, page 94)
	I3	Sensor input I3
Off	<ul style="list-style-type: none"> • not connected • Not triggered (no input signal) 	
green	I3 triggered (input signal)	

5 Motor starter RAMO

5.6 Operation

LED	State	Description
I4	Off	Sensor input I4 <ul style="list-style-type: none"> not connected Not triggered (no input signal)
	green	I4 triggered (input signal)
O3		Actuator output O3 RAMO-DA.../ RAMO-WA... only!
	Off	<ul style="list-style-type: none"> Not actuated
	green	O3 triggered (output signal)
UV	Off	The 400 V supply voltage and/or the AS-i voltage (30 V DC) is missing or the repair switch is switched off.
	green	The 400 V supply voltage and the AS-i voltage (30 V DC) are switched on.
		RAMO group fault indication
	Off	No fault message
	Red	Fault message: A fault has been detected and is permanently active. <ul style="list-style-type: none"> Motor overload (overcurrent) → Check motor and drive unit (reset when motor has cooled) → Short circuit in motor cable → Check DIP switch (DIP 1- DIP 4) Thermistor/cable monitoring → Check motor and drive unit (reset when motor has cooled down) → No motor cable connected (motor outgoer socket) → Jumper T1/T2 in motor terminal box missing on motors without temperature sensor → Wire jumper (②, Figure 83, page 103) not closed with motor cable disconnected (→ for servicing only) DIP switch (under screw plug) with invalid settings (→ Page 104) Overload/short circuit on sensor inputs I3/I4 or actuator output O3 Current lower limit undershot (→ Page 107) On a temporary or rectified fault this LED flashes until the Reset → Page 107 command is issued (key switch).
	Flashing (red)	The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged with key switch OFF/RESET (→ The Motor LED goes out).

5.6.2 Adjust dip switch

Before commissioning the motor control unit (RAMO), the current monitoring function must be set to the rated motor current. This function is disabled by default and would trigger a fault signal as soon as mains power is switched on (Motor LED lights up). To set the DIP switches, open the screw plug (M40 × 1.5)

NOTICE

Do not move the DIP and wire jumper switches under the screw plug unless the key switch is in the OFF/RESET position. Switching during operation may cause an accidental motor start.

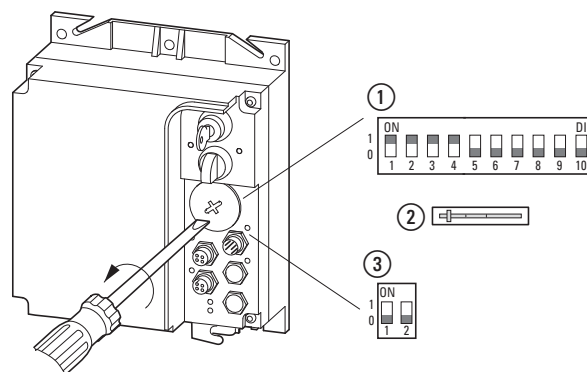


Figure 83: DIP switches underneath screw plug

RAMO plug for cable screw gland

- ① Current limit values and functions, dip switches
- ② Thermistor and motor cable monitoring (wire jumper)
- ③ Quick stop (→ Section 5.6.2.7, „Bit DQ3 – Quick stop“, page 107)



When configured with its default settings, the device will have the jumper (DIP switch, ②) open. Closing the jumper will disable the fault signal for thermistor and motor cable monitoring.

(→ Section 2.12, „Thermistor and motor cable monitoring“, page 54)

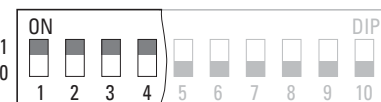
5 Motor starter RAMO

5.6 Operation

5.6.2.1 Current monitoring (DIP 1 - DIP 4)

The motor current monitoring limit values are set with DIP switches 1 to 4.

Table 9: Setting current values with the DIP switches



Switch position	Motor current	Assigned motor rating at 400 V, 50 Hz	Assigned motor rating at 440 V - 480 V, 60 Hz
1 1 1 1	No function (state of delivery) ¹⁾	–	–
1 0 1 1	0.3A	90 W	0.14 HP
0 1 1 1	0.4A	120 W	0.16 HP
1 0 0 0	0.6A	180 W	0.25 HP
0 1 0 0	0.8A	250 W	0.33 HP
1 1 0 0	1.0A	370 W	0.5 HP
0 0 1 0	1.2A	370 W	0.5 HP
1 0 1 0	1.5A	550 W	0.75 HP
0 1 1 0	1.7A	550 W	0.75 HP
1 1 1 0	1.9A	750 W	1 HP
0 0 0 1	2.1A	750 W	1 HP
1 0 0 1	2.6A	1.1 kW	1.2 HP
0 1 0 1	3.6A	1.5 kW	2 HP
1 1 0 1	5.0A	2.2 kW	3 HP
0 0 1 1	6.6A	3 kW	3 HP
0 0 0 0	no function ¹⁾	–	–

1) Current monitoring disabled.
RAMO cannot be operated. The red LED in the motor symbol is lit. A group fault is pending.

5.6.2.2 Sensor inputs I3 and I4 (DIP 5)

Sensor inputs I3 and I4 are laid out for rising-edge input signals (N/O, fail-safe). By default, DIP switch 5 is in position 0 (= OFF). The sensor signal is processed unmodified in the RAMO and in AS-Interface.

When sensors that switch to zero (N/C) are used, DIP switch 5 must be set to position 1 (= ON). The signal is then inverted for the RAMO's internal processing. The original signal is transmitted via the AS-Interface. Please enquire, it can be inverted in the higher-level master control system.

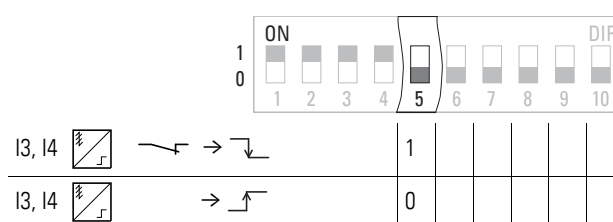


Figure 84: Configuring the sensors inputs I3 and I4

5.6.2.3 Quick stop and interlocked manual operation (DIP 6 and DIP 8)



RAMO-D DOL starters

DIP Switch	Configuration		
6	8	Functions of I3 and I4	Restart conditions in manual mode
			Restart conditions in automatic mode
0	0	No function (as supplied)	–
1	0	I3 and I4 stop the motor in automatic and manual mode	Key switch reset
0	1	I3 stops the motor in automatic mode	–
1	1	I3 stops the motor in automatic and manual mode	Key-operated switch reset and I3 no longer active

RAMO-W reversing starters

DIP Switch		Configuration	Restart conditions in manual mode	Restart conditions in automatic mode
6	8	Functions of I3 and I4		
0	0	No function	–	–
1	0	I3 stops the motor in both rotation directions in automatic mode	–	Command change through AS-i
0	1	I3 stops the motor in FWD in automatic mode	–	Command change through AS-i
		I4 stops the motor in REV in automatic mode	–	–
1	1	I3 stops the motor during FWD in automatic and manual mode	REV: Rotation direction change to FWD FWD: from REV and reset I3 FWD: Key switch reset and I3 no longer active	Command change through AS-i
		I4 stops the motor in REV in automatic and manual mode	FWD: Rotation direction change to REV REV: from FWD and reset I4 REV: Key switch reset and I4 no longer active	–

5.6.2.4 Phase reversal switch (DIP 7)

DIP switch 7 changes the rotating field on the RAMO-W output from FWD to REV (→ Figure 17, page 43). The control logic and the LED indication remain in the FWD function.



In the case of RAMO-W... units, the setting of DIP switch 7 should be changed only by qualified users as per the instructions in this manual.

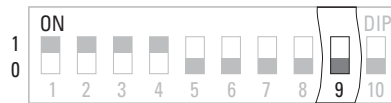


With RAMO-D... the contactor state of DIP 7 (down, 0 = OFF) should not be changed (no fault message, no function).



DIP 7	Configuration (only with RAMO-W)
1	Changing phase sequence (L1 → W and L3 → U = REV, counterclockwise rotation)
0	State of delivery FWD (clockwise rotation) in FWD operating mode

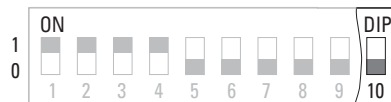
5.6.2.5 Monitoring the current lower limit (DIP 9)



DIP 9	Configuration
1	Monitoring the current lower limit enabled.
0	Monitoring the current lower limit disabled (as supplied)

When DIP 9 = 1 (= ON), an error message (the Motor LED will light up red) will be output when a phase (L1, L2, L3) carries less than 25 % of rated operational current I_e.

5.6.2.6 AS-interface diagnostics (DIP 10)



Diagnostic status via the AS-Interface parameter channel and periphery.

DIP 10	Configuration
1	Diagnostic status through AS-Interface parameter channel and peripheral error message ¹⁾ enabled.
0	Diagnostic status through AS-Interface parameter channel and peripheral error message ¹⁾ disabled (as supplied).

1) Example of a peripheral fault: relay contact in power section fused together

5.6.2.7 Bit DQ3 – Quick stop

On the UL version with profile AS-i 7.4, “quick stop suppression” is enabled with DQ3.

To do this (i.e., to disable the quick stop function), DIP switch 1 on the left of section ③ in → Figure 83, page 103 must be ON.

DIP 3.1	DQ3	Function	Description
ON	0	Quick stop ON	Response to sensors
ON	1	Quick stop OFF	No response to sensors
OFF	0	none	DQ3 signals will not be transmitted
OFF	1	none	DQ3 signals will not be transmitted

5 Motor starter RAMO

5.6 Operation

5.6.3 AS-i control

Table 10: Actuation motor starter RAMO

Function	Signal at RAMO							
	AS-Interface outputs				AS-Interface inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	DI3
Zero Speed	0	0						
Anticlockwise rotating field (REV)	0	1						
Clockwise rotating field (FWD)	1	0						
Zero Speed/reset	1	1						
Actuator output O3 = High			1					
Actuator output O3 = Low			0					
Quick stop ON				0				
Quick stop OFF				1				
Automatic mode					1			
No automatic mode					0			
Accumulative error						0		
No accumulative error						1		
external input I3 via M12 socket								
no signal							0	
Signal available							1	
external input I4 via M12 socket								
no signal								0
Signal available								1

- The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV).
- DQ2 can be used to switch output O3 to HIGH or LOW.

5.7 Diagnostics and error handling

All faults identified by the power module (DQL) are internally transmitted to the AS-Interface card as group fault messages: DI1 (fault). The red LED in the motor symbol lights up.

- ▶ Turn the key switch to the OFF position to reset the error message. Hold the switch in this position for at least one second so that the RAMO unit will detect the command.

The Reset signal via AS-i provides an additional reset option for RAMO units in case the latter cannot be locally reset due to accessibility issues. The local reset with the key switch remains the main reset function, since it is necessary for analyzing and eliminating fault causes locally.

Table 11: RAMO internal diagnostic status (for briefed service personnel only)

Diagnostics-status	Status				group errors	Peripheral error (FID)	Description
	P1	P2	P3	P4 ¹⁾	DI1		
Thyristor/bypass contact defective	0	0	1	0	1	1	Output switched through (On position) without actuation signal Possible causes: <ul style="list-style-type: none"> • Thyristor failed • Bypass contact welded • I3/I4 sensor short-circuit • O3 actuator short-circuit
Overload trip	0	1	0	0	1	0	Triggering at 110 % of the thermal motor simulation value
Thermistortripping	0	1	1	0	1	0	Possible causes: Motor plug not plugged <ul style="list-style-type: none"> • Thermistor in motor not connected • Jumper in terminal box of motor or in motor feeder plug missing (T1 = Pin 5, T2 = Pin 8). • Tripping due to excessive resistance in thermistor sensor circuit (e.g. overtemperature)
No diagnostic message	1	1	1	0	1	0	Possible causes: <ul style="list-style-type: none"> • Overload or short-circuit of external inputs I3, I4 • Overload or short-circuit of external output O3 • Incorrect DIP switch setting • 400 V supply voltage absent • Trip in event of undershooting current lower limit
Manual mode (status_local_operation)	1	0	0	0	0	0	Key-switch in MANUAL (HAND) position
Load signal 1 (status_overload_warning)	1	0	1	0	0	0	Message at 90 % of thermal motor simulation value (preventive maintenance, message reset automatically).
Load message 2 (status_load_indication)	1	1	0	1	0	0	Message at 70 % of thermal motor simulation value (preventive maintenance; message will be reset automatically).

1) P4 diagnostics possible only with standard slave profile (S-7.4)

The unit can be switched back on after approximately one minute. If the fault continues to be present, the motor LED will show a solid red light. If the fault is eliminated at this point, the red motor LED will start flashing, in which case the unit will need to be reset with the key switch.

5 Motor starter RAMO

5.7 Diagnostics and error handling

6 RASP speed controllers

6.1 Description

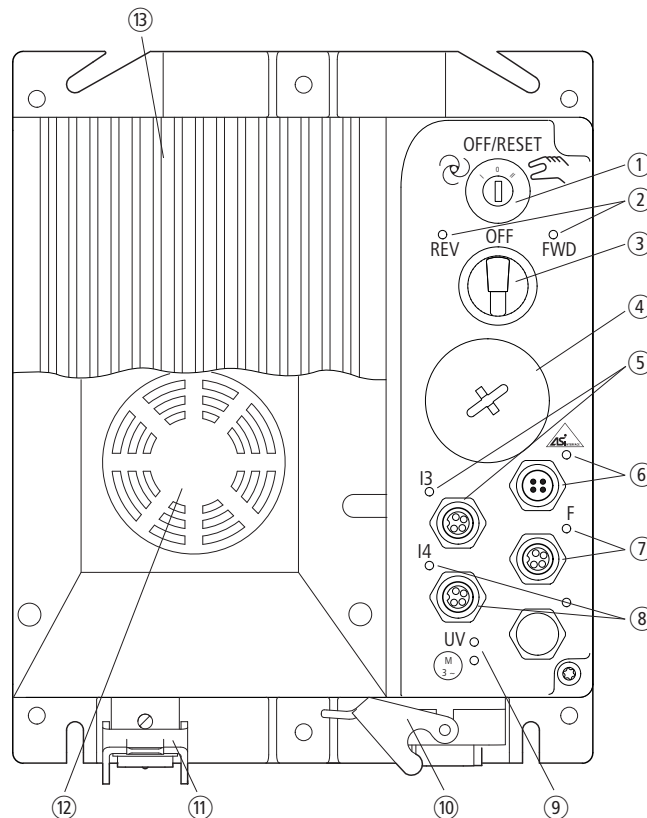


Figure 85: RASP overview

- ① Key-switch for manual and automatic mode and Reset
- ② LED for indicating motor voltage rotating field
 - FWD = Clockwise rotating field (Forward Run)
 - REV = Counterclockwise rotating field (Reverse Run)
- ③ Selector switch for rotating field direction (FWD, REV) in manual mode
- ④ Sealing screw with DIP switch and serial interface (RJ 45 socket)
- ⑤ Sensor input I3 (M12 plug) with LED
- ⑥ With AS-Interface/M12 plug with LED
- ⑦ Fan connection F (M12 socket) with LED
- ⑧ Sensor input I4 (M12 socket) with LED
- ⑨ Status LEDs:
 - UV = lit green when supply voltage (480 V AC) present
 - Motor = lit red when RASP has detected a fault
- ⑩ Motor- outgoer plug
- ⑪ Power plug, supply voltage (480 V AC)
- ⑫ Device fan (optional), on RASP-5... (2.2 kW) fitted ex-factory
- ⑬ Heat sink

6 RASP speed controllers

6.2 Features

6.2 Features

RASP (Speed Control Unit) units are electronic speed controllers used for the frequency-controlled start and operation of three-phase motors with currents of up to 5.6 A (\triangleq 2.2 kW with 400 V). RASP supplies a constant torque across the entire frequency/speed range and is popular for hoist and rotary drives. The fixed speed values (standard: four, maximum: eight) allow for process-controlled speeds. The frequency control (soft starting) is gentle on motor, mechanics and energy supply (no current peaks).

RASP units are available in four ratings: from 2.4 to 5.6 A.

The internal electronic motor protection (I^2t controller) allows for the protected operation of three-phase motors within a range of 0.48 (\triangleq 180 W with 400 V) to 5.6 A (\triangleq 2.2 kW with 400 V). The motor's starting current, and accordingly and almost proportionately the motor's starting torque, enable values of up to 200% for 2 s every 20 s and 150% for 60 s every 600 s. Together with the integrated thermistor monitoring function, what is referred to as "full motor protection" can be ensured.

The built-in transistor switch allows actuation of spring-loaded brakes with DC air solenoid valve.

For the brake rectifier a controlled supply voltage of 230 V/277 V AC or 400 V/480 V AC is output. In addition versions of RASP with built-in braking resistance also allow dynamic braking.



DANGER

RASP is not intended to be opened by the user. Open only in voltage-free state!

6.3 Connections

Speed control unit RASP is supplied ready for connection. All connections are via plug-in connectors.

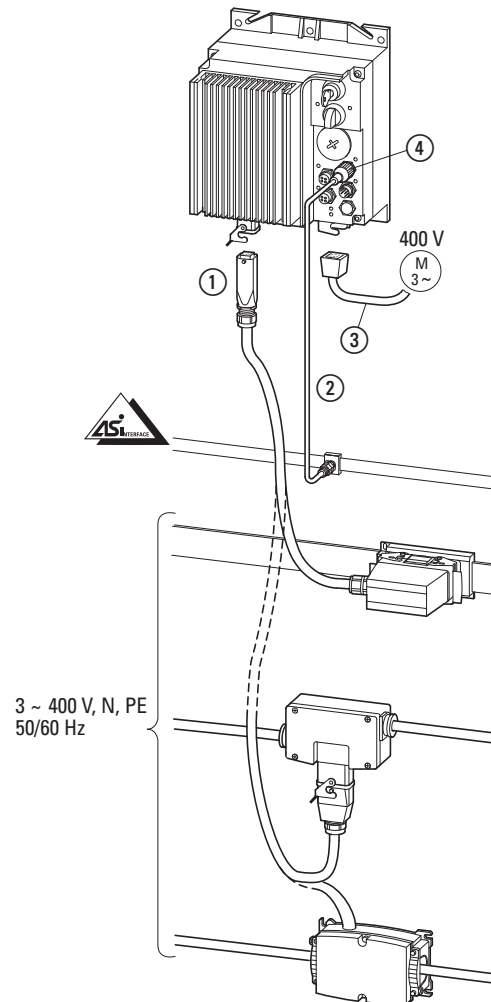


Figure 86: Connections on the RASP

- ① Power supply (3 AC 400 V, N, PE) through a power adapter cable
(→ Section 3.5, "Power plug RA...C3...", page 72)
- ② AS-Interface, data bus for controlling the RASP in automatic mode
- ③ Motor connection according DESINA specification
- ④ Sensor and fan connections

6 RASP speed controllers

6.4 Special technical data

6.4 Special technical data

The following tables show the technical data of the Speed Control Unit RASP in the individual power classes with the allocated motor output.



The motor output allocation is based on the rated operational current.



The motor output designates the respective active power output to the drive shaft of a normal, four pole, internally or externally ventilated three-phase asynchronous motor with 1.500 rpm at 50 Hz or 1.800 rpm at 60 Hz.

	Formula sign	Unit	RASP-2...	RASP-3...	RASP-4...	RASP-5...
Rated operational current (I_e)	I_e	A	2.4	3.3	4.3	5.6
Overload current for 60 s every 600 s at 40 °C	I_L	A	3.6	5	6.5	8.4
Starting current for 2 s every 20 s at 40 °C	I_L	A	4.8	6.6	8.6	11.2
Apparent power at 400 V rated operation	S	kVA	1.66	2.29	2.98	3.88
Assigned motor rating at 440 - 480 V, 60 Hz						
	P	kW	0.75	1.1	1.5	2.2
	P	HP	1	1.5	2	3
Setting range Setting range current limitation (P7.2)	I_2	A	0.48 - 4.8	0.66 - 6.6	0.86 - 8.6	1.12 - 11.2
Power side (Primary side)						
Number of phases			3	3	3	3
Rated voltage	U_{LN}	V	380 V - 15 % - 480 V + 10 %, 50/60 Hz (380 - 480 V \pm 0 %, 45 - 66 Hz \pm 0 %)			
Input current	I_{LN}	A	3.2	4	5.6	7.3
Leakage current to ground (PE) without motor (typical values)						
In normal operation	I_{PE}	mA	75	75	75	75
On interruption of a mains phase	I_{PE}	mA	70	70	70	70
On interruption of two mains phases	I_{PE}	mA	35	35	35	35
Braking						
Braking value	I/I_e	%	\leq 30	\leq 30	\leq 30	\leq 30
On threshold for brake transistor	U_{DC}	V DC	765	765	765	765

6 RASP speed controllers

6.4 Special technical data

	Formula sign	Unit	RASP-2...	RASP-3...	RASP-4...	RASP-5...
DC braking	I/I_e	%	≤ 100, adjustable	≤ 100, adjustable	≤ 100, adjustable	≤ 100, adjustable
Rated operating voltage for brake control	U	V AC	RASP-xx2...: 230/277 RASP-xx4...: 400/480			
Pulse frequency	f_{PWM}	kHz	6 (adjustable 1.5 – 16)			
V/f characteristic			linear	linear	linear	linear
Heat dissipation at rated operational current (I_e) and a pulse frequency (f_{PWM}) of 6 kHz	P_V	W	39	49	63	83
Heat dissipation during no-load operation (standby) with AS-i supply voltage	P_V	W	< 12	< 12	< 12	< 12
Efficiency	η		0.95	0.95	0.96	0.96
Fan						
internal			temperature controlled			
Device fans on heat sink			–	–	–	Fan
Output frequency	f_z	Hz	50/60 Hz, adjustable 0 - 320 Hz			
1. Fixed frequency (p10.2)	f_z	Hz	30	30	30	30
2. Fixed frequency (P10.3)	f_z	Hz	40	40	40	40
3. Fixed frequency (P10.4)	f_z	Hz	50	50	50	50
"n0" potentiometer frequency	f_z	Hz	~ 5 - 10; (WE: max. 50/60)			
Factory set response time						
Motor On (automatic) ¹⁾	t_{ON}	ms	30 - 50	30 - 50	30 - 50	30 - 50
Motor Off (automatic) ¹⁾	t_{OFF}	ms	15 - 35	15 - 35	15 - 35	15 - 35
Switch off the motor (quick stop)	t_{OFF}	ms	15 - 35	15 - 35	15 - 35	15 - 35
Minimum pulse duration I3/I4	t_{ON}	ms	5	5	5	5
Longest permissible length of motor cable (EMC, 2nd environment, C3)	l	m A	10	10	10	10
Weight (without/with repair and maintenance switch)	m	kg	4.2/4.4	4.2/4.4	4.2/4.4	4.4/4.6
Acceleration time	t	s	5	5	5	5
Deceleration time	t	s	2	2	2	2

1) without bus runtime, depending on PLC.

6.4.1 Overload

The variable frequency drive modules in the RASP speed control unit allow for an overload cycle of 150% I_e for 60 s every 600 s of operation.

After the overload phase (150 % I_e for 60 s or 200 % I_e for 2 s) a 100 % rated operational current (I_e) can be drawn.

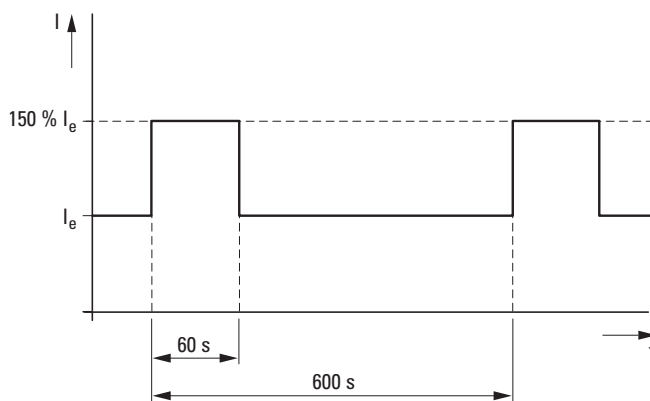


Figure 87: Overload cycle in operation

6.4.2 Derating curves

Although high pulse frequencies allow for low running noise and shorter response times, they also produce higher losses at the power output stages, as well as greater interference in the mains and motor cables. Because of this, the pulse frequency should be set to the lowest possible value.

The default switching frequency (pulse frequency) f_{PWM} is 6 kHz. In Expert mode (P1.1 = 0), the switching frequency can be changed via parameter P11.9.

The temperature of the RASP increases with higher pulse frequencies. The output current (I_{2N}) should therefore be reduced (derating) according to the ambient air temperature, when higher pulse frequencies are used.

If higher switching frequencies are required (> 6 kHz), the load (output current) and/or the ambient temperature must be reduced or the cooling increased (fan, RASP-FAN-S1).

Part no.	Rated operational current I_e at 40 °C	Fan
RASP-2...	2.4 A	–
RASP-3...	3.3 A	–
RASP-4...	4.3 A	–
RASP-5...	5.6 A	✓

The fan makes it possible to run the unit at higher ambient temperatures.

The following derating curves show the output current during continuous operation ($I_{2N} = I_e$) as a function of carrier frequency (f_{PWM}) and ambient temperature (ϑ) with and without an RASP-FAN-S1 fan (→ Section 7.2.1, “Device fan RASP-FAN-S1”).

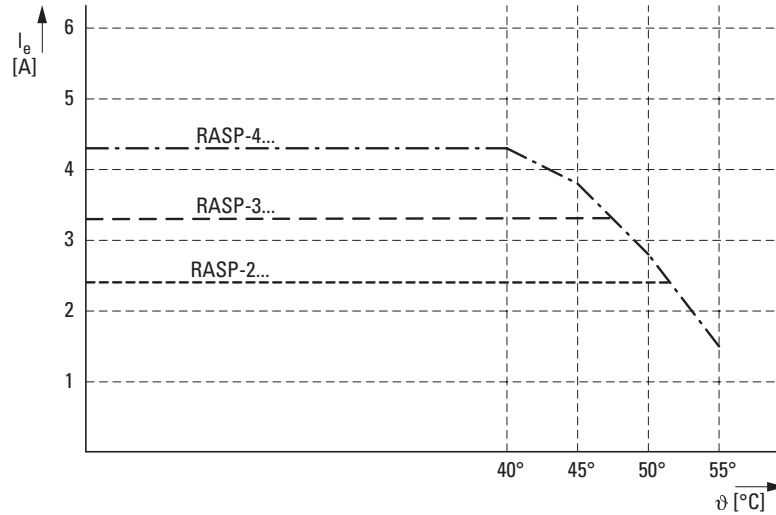


Figure 88: $f_{PWM} = 6$ Hz, RASP without fan

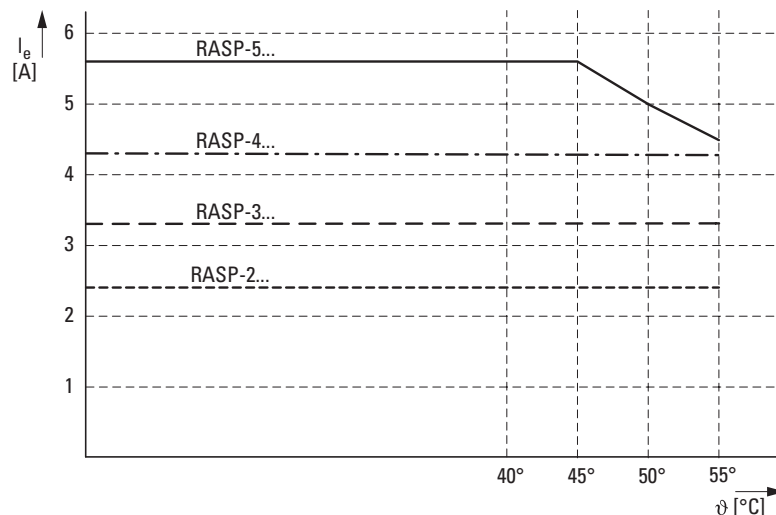


Figure 89: $f_{PWM} = 6$ Hz, RASP with RASP-FAN-S1 fan

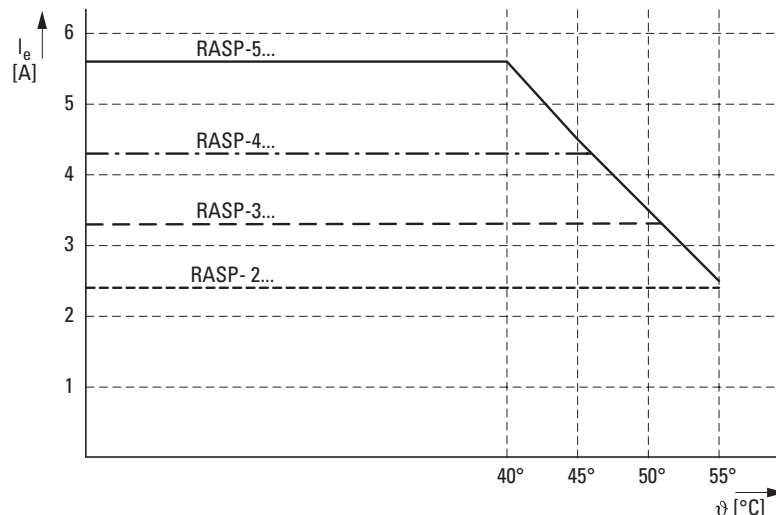


Figure 90: $f_{PWM} = 16$ Hz, RASP with RASP-FAN-S1 fan

6 RASP speed controllers

6.5 Block flow diagram

6.5 Block flow diagram

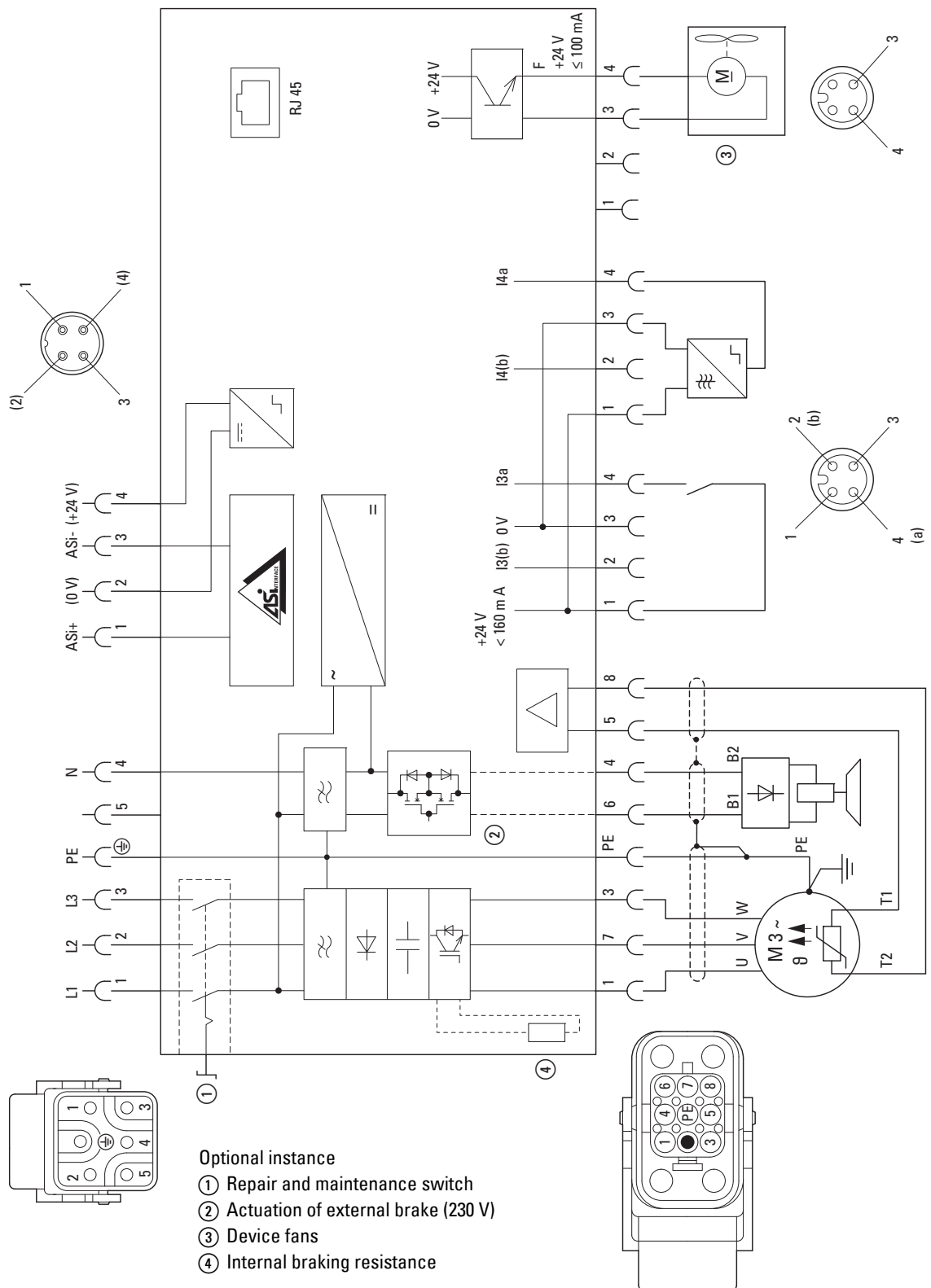
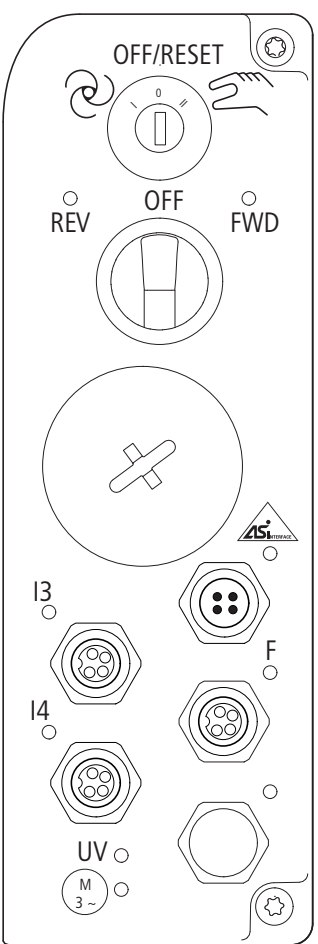




Figure 91:Block diagram RASP...

6.6 Operation


6.6.1 LED indicators

The motor control unit's LEDs indicate the operating states and allow a quick diagnosis.

	LED	Indicator	Description	
	FWD		Clockwise rotating field of motor voltage (U-V-W)	
		Off	Not actuated	
		green	enabled (RUN-Mode)	
		Flashing (green)	controlled: <ul style="list-style-type: none"> • but inhibited through quick stop function of sensor inputs (I3, I4) • but inhibited because the key-operated switch was in the MANUAL position when the supply voltage (400 V or AS-i) was switched on. → A Reset command required. 	
	REV		Counterclockwise rotating field of motor voltage (W-V-U)	
		Off	Not actuated	
		green	enabled (RUN-Mode)	
		Flashing (green)	controlled: <ul style="list-style-type: none"> • but inhibited through quick stop function of sensor inputs (I3, I4) • but inhibited because the key-operated switch was in the MANUAL position when the supply voltage (400 V or AS-i) was switched on. → Reset command required. 	
				AS-Interface
			Off	No supply voltage in the AS-i electronics: → Check the AS-i connection cables → Check the AS-i power supply unit (head-end controller)
green			Communication active, normal operation	
Red			No communication: <ul style="list-style-type: none"> • RASP not entered or entered with the wrong address (ID). 	
Flashing red/yellow			AS-i address = 0: → Configure the AS-i address	
Flashing red/green			→ Peripheral error (→ Section 4.3.2, "LED indicators", page 94)	
I3		Sensor input I3		
	Off	<ul style="list-style-type: none"> • not connected • Not triggered (no input signal) 		
	green	I3 actuated (input signal) through pin 4		
	Red	I3 actuated (input signal) through pin 2		
	yellow	I3 actuated (input signal) through pins 2 and 4		

6 RASP speed controllers

6.6 Operation

LED	Indicator	Description
I4		Sensor input I4
	Off	<ul style="list-style-type: none"> not connected Not triggered (no input signal)
	green	I4 actuated (input signal) through pin 4
	Red	I4 actuated (input signal) through pin 2
	yellow	I4 actuated (input signal) through pins 2 and 4
F		Device fan (output F = Fan)
	Off	<ul style="list-style-type: none"> not connected Not actuated
	green	Output signal (24 V DC) for device fan. Temperature-controlled by the RASP.
UV	Off	The 400 V supply voltage is missing or the repair switch is switched off.
	green	400 v supply voltage switched on.
		RASP group fault indication
	Off	No fault message
	Red	<p>Fault message: A fault has been detected and is permanently active. → Check the motor and the drive unit</p> <ul style="list-style-type: none"> Fault signal from internal variable frequency drive → Fault code (F...) can be read out with MaxConnect parameter configuration software Thermistor/cable monitoring → Check motor and drive unit (reset when motor has cooled down) → No motor cable connected (motor feeder socket) → Jumper T1/T2 in motor terminal box missing on motors without temperature sensor Overload / short-circuit on sensor inputs I3 and I4 <p>On a temporary or rectified fault this LED flashes until the Reset command is issued (key switch).</p>
	Flashing (red)	<p>The detected fault (the fault signal's cause) has been fixed. The fault signal can now be acknowledged with key switch OFF/RESET (→ The Motor LED goes out).</p>

6.6.2 RASP actuation

Table 12: Actuation of speed control unit RASP

Function	Signal to RASP							
	Outputs				Inputs			
	DQ0	DQ1	DQ2	DQ3	DI0	DI1	DI2	DI3
No controller enable	0	0						
Anticlockwise rotating field (REV)	0	1						
Clockwise rotating field (FWD)	1	0						
No controller enable	1	1						
f_0 = Analog value via potentiometer or FF0 (P10.1), if P6.2 = 0			0	0				
FF1 (P10.2) = 30 Hz			1	0				
FF2 (P10.3) = 40 Hz			0	1				
FF3 (P10.4) = 50 Hz			1	1				
Automatic mode					1			
No automatic mode					0			
Accumulative error						0		
No accumulative error						1		
external input I3a via M12 socket								
no signal							0	
Signal available							1	
external input I4a via M12 socket								
no signal								0
Signal available								1

The START signal or enable for the requested operating direction is issued through DQ0 (FWD) or DQ1 (REV). Through outputs DQ2 and DQ3 fixed frequencies FF1 to FF3 (digital setpoint value memory) are called up in binary code. If DQ2 and DQ3 are not actuated, the frequency value (f_0) set at spindle potentiometer n_0 is issued (analog setpoint value memory, 0 to 50 Hz).

6 RASP speed controllers

6.6 Operation

6.6.3 Adjust dip switch

Before taking speed control unit RASP into operation, the functions must be set with the DIP switches.

To set the DIP switches, open the locking screw.

NOTICE

The DIP switches under the screw plug must be set only before the AS-Interface (M12 plug) is connected and before the AS-i voltage is applied.

Switching during operation may cause an accidental motor start.

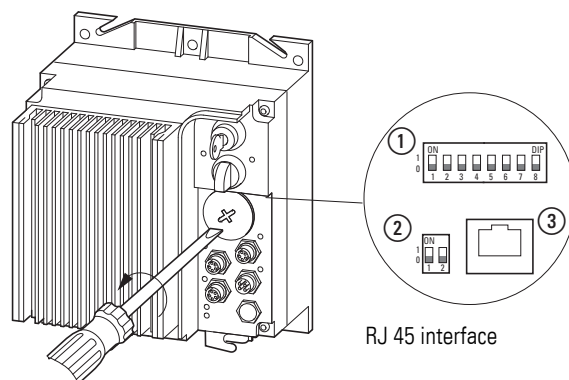


Figure 92: DIP switches and interface underneath screw plug

RASP plug for cable screw gland:

- ① Functions, dip switch
- ② dip switch (currently without function)
- ③ Serial interface (RJ 45)



Do not change the position of the two DIP switches ② (in the OFF position)!

NOTICE

The RJ45 interface is not designed for Ethernet communication.

6.6.3.1 DIP switch and motor cable monitoring (DIP 1)



DIP switch 1 will be in the OFF position by default. When it is in the ON position, the thermistor and motor cable monitoring fault signal will be disabled (→ Page 55).

6.6.3.2 AS-interface diagnostics (DIP 2)



No function.
DIP 2 must always be in the OFF switch position.



6.6.3.3 Sensor inputs I3 and I4 (DIP 3)

Sensor inputs I3 and I4 are laid out for rising-edge input signals (N/O, fail-safe). By default, DIP switch 3 is in position 0 (= OFF). The sensor signal is processed unmodified in the RASP and in AS-Interface.

When sensors that switch to zero (N/C) are used, DIP switch 3 must be set to position 1 (= ON). For the RASP's internal processing the signal is then inverted. The original signal is transmitted via the AS-Interface. If required, it can be inverted in the higher-level master control system.

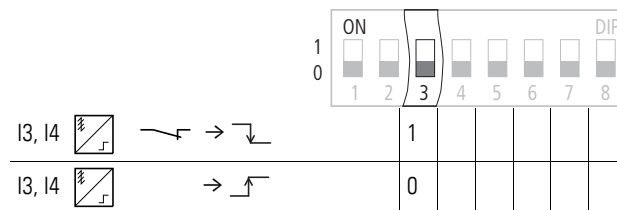
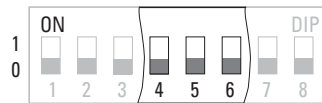


Figure 93:Configuring the sensors inputs I3 and I4

6 RASP speed controllers

6.6 Operation

6.6.3.4 Quick stop and interlocked manual operation (DIP 4 to DIP 6)



DIP switch			Add-on function RASP...
4	5	6	
0	0	0	No add-on functions (as supplied)
0	0	1	Quick stop: I3a and I4a activated. I3a is assigned to operating direction "right", I4a is assigned to operating direction "left"; Application example: vertical sorter < 360° eccentric press
0	1	0	Quick stop: I3a is activated. I3a is assigned to both operating directions. I4a has no add-on function; Application example: chain discharger
0	1	1	Quick stop and interlocked manual mode (edge- and signal-controlled): I3a and I4a activated. I3a is assigned to operating direction "right", I4a is assigned to operating direction "left"; Application example: vertical sorter < 360° eccentric press
1	0	0	Quick stop and interlocked manual mode (only edge controlled): I3a and I4a activated. I3a and I4a are assigned to operating direction "right". The operating direction "left" is blocked: Application example vertical sorter > 360° eccentric press and > 360° rotary table
1	0	1	Quick stop and creep speed: I3a/b and I4a/b activated. I3a/b are assigned to operating direction Clockwise, I4a/b to operating direction Counterclockwise. When I3b/I4b is reached, RASP... switches to creep speed FF 1. When I3a/I4a is reached, the drive switches off. Application example: rotary table Note: I3a/b and I4a/b require the RA-XM12-Y Y connector (→ Page 44).
1	1	0	Invalid switch setting/error message at DI1
1	1	1	Quick stop and interlocked manual mode (edge- and signal-controlled) and creep speed: I3a/b and I4a/b activated. I3a/b are assigned to operating direction Clockwise, I4a/b to operating direction Counterclockwise. When I3b/I4b is reached, RASP... switches to creep speed FF 1. When I3a/I4a is reached, the drive switches off. Application example: rotary table Note: Note: I3a/b and I4a/b require the RA-XM12-Y Y connector (→ Page 44).

6 RASP speed controllers

6.6 Operation

Example: rotary table

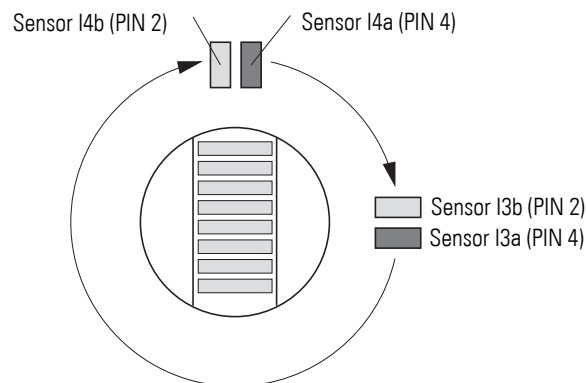


Figure 94: Example of turntable control with clockwise rotation
 Pin 2: creep speed
 Pin 4: Stop

If there is an input signal on pin 2 (I3b/I4b) (rising edge or continuous signal), the RASP unit will switch the drive from potentiometer frequency n_0 to fixed frequency 1 (FF1). The input signal should be applied for at least 18.5 ms. The creep speed will remain active until the limit switch (pin 4 of M12 sockets I3 and I4) is reached and the drive stops. If the key switch is switched from manual mode to automatic mode and back, fixed frequency 1 (FF1) will continue to be used if the signal on PIN 2 (I3b/I4b) is still being applied. Otherwise, potentiometer frequency n_0 will be applied.

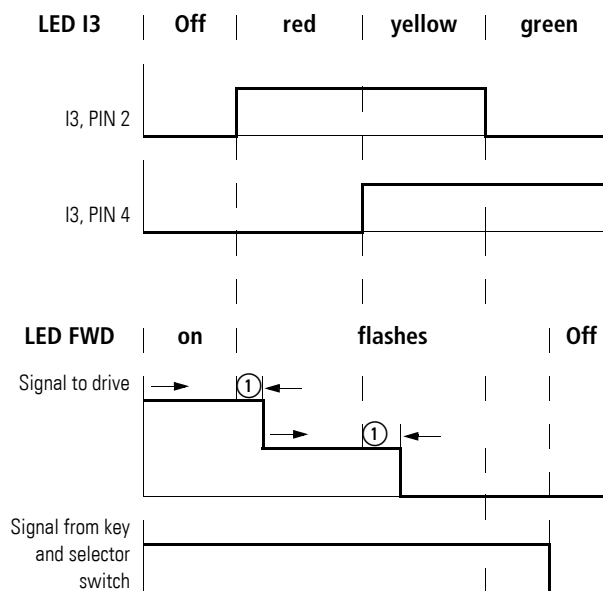


Figure 95: Interlocked manual operation with creep speed
 (example: sensor input I3 and clockwise motion)

① 13.5 ms \pm 5 ms

6.6.3.5 Phase reversal switch (DIP 7)

DIP 7 switch on RASP changes the rotation field at the output from FWD to REV (→ Figure 22, page 49). The control logic and the LED signals stay in the FWD function.



The setting of DIP switch 7 should be changed only by qualified users as per the instructions in this manual.



DIP 7	Configuration
1	Change phase sequence (L1 → W and L3 → U = REV, counterclockwise rotation) in the FWD operating mode
0	State of delivery FWD (clockwise rotation) in FWD operating mode

6.6.3.6 Stop behavior (DIP 8)



DIP 8	Configuration
1	Switch off with second ramp (dec 2) when the external 24 VDC control voltage is switched off
0	No response to external 24 V DC control voltage (state of delivery).

RASP units do not require an external 24 VDC control voltage. However, with their AS-Interface connection, they can be used to decelerate the motor to a controlled stop with the second ramp in the event that the connection's external 24 V DC voltage drops out. For this purpose, this 24 VDC voltage needs to be fed using the M12 AS-Interface connector (→ Figure 115, page 170). If the supply voltage is switched off, the internal variable frequency drive's digital inputs will be set as follows: DI1 - DI4 = 0, DI6 = 1.



The second deceleration time can be set with parameter P6.20 (→ Page 154).

6 RASP speed controllers

6.6 Operation

Internal link

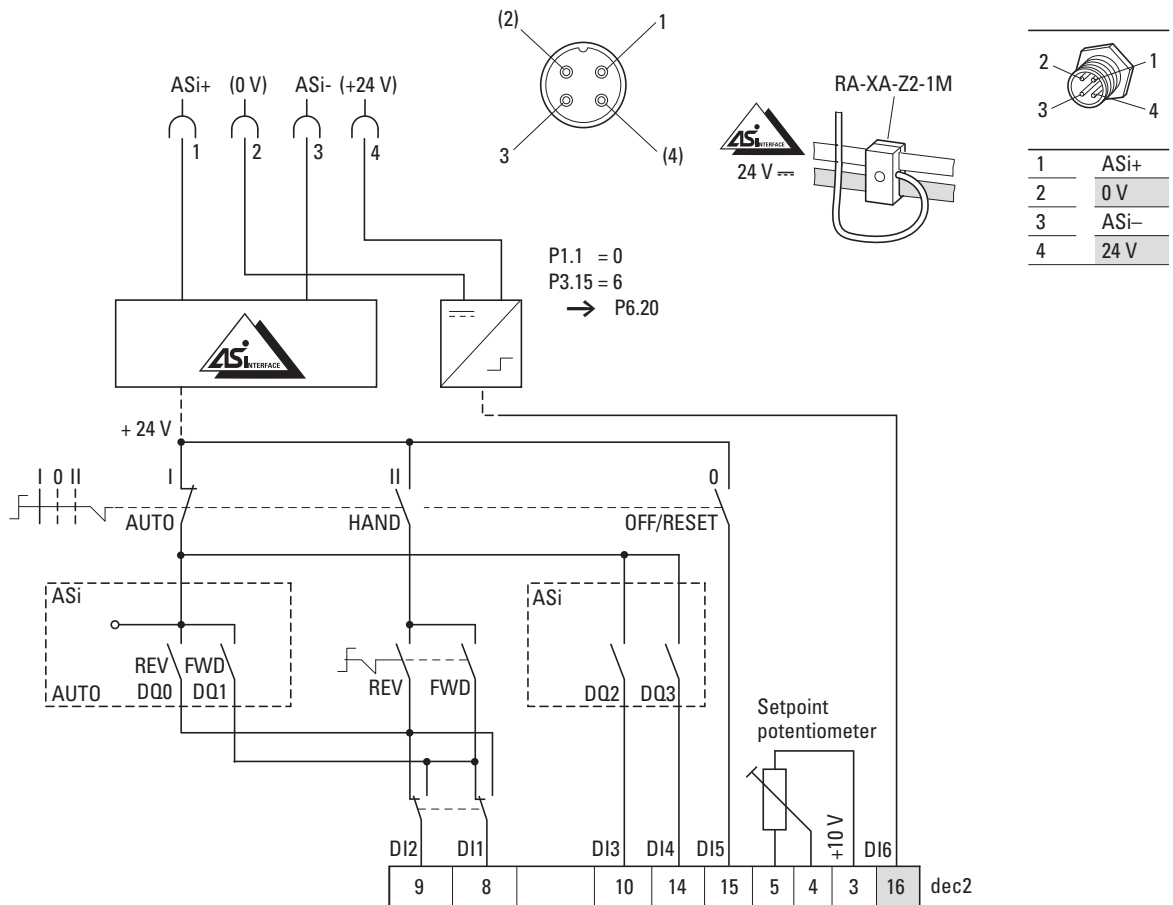


Figure 96: Actuation of speed control unit RASP

- ① Switch for setting phase reversal DIP 7
- ② AUTO - OFF/RESET - HAND key switches
- ③ Selector switch REV - OFF - FWD
- ④ Potentiometer n_0
- ⑤ Variable frequency drive module
- ⑥ Second ramp time (dec2)

6.7 Diagnostics and error handling

All faults identified by the power module are internally transmitted to the AS-Interface card as group fault messages: DI1 (fault). The red LED in the motor symbol lights up. The connected motor coasts to a halt when the fault signal is received. In the event of a thermistor fault (also thermoclick, interruption of motor cable) the motor stops with the delay time set with parameter P6.6 (default settings: 2 s).

Error messages are reset when the key switch is switched to the OFF/Reset position. RASP units require for the switch to be held in this position for about 0.5 seconds so that the Reset command can be detected.

The Reset command via AS-i provides an additional reset option for RASP units, i.e., in addition to the local reset option. The local reset via the key switch remains the main application, as the cause must be analyzed and rectified locally.

In automatic mode the RASP interprets simultaneous setting of the outputs for clockwise and counterclockwise rotation (data bits DO0 and DO1) as Reset. Before a Reset data bits DO0 and DO1 must be Low for at least 18.5 ms. The reset is performed only when the data bits are then High for at least 18.5 ms. AN internal logic prevents error states.

When mains power is switched on, the built-in variable frequency drive performs a self test.

The power module can detect the following errors and output them through the the serial interface.

- Mains overvoltage, mains undervoltage,
- Overvoltage in internal DC link,
- Overcurrent (overload, short-circuit, earth fault),
- EEPROM and microprocessor error,
- Overtemperature in power module,
- Motor overtemperature (thermistor and thermoclick only) or motor cable open circuit. The power module does not detect this error message. It is available as diagnostic status through the parameter channel.

There will be no separate indication if the device's internal fuses for the DC air solenoids blow. A voltage measurement between pin 4 and pin 6 is required in order to check whether the fuses have blown. This check must be performed by a briefed, qualified person.

In general, errors can be acknowledged as follows:

- With fault diagnostics, using diagnostic parameters
- With LED indicators

6 RASP speed controllers

6.7 Diagnostics and error handling

Automatic configuration for servicing

If you replace an RASP unit with an identical device with an address of 0, the corresponding AS-Interface address will be assigned immediately.

Procedure:

- ▶ Establish the plugged connection to the new RASP....

The key-switch is in its Off position. After no more than 0.5 seconds all error LEDs must have gone out.

- ▶ Switch to manual or automatic mode.

Troubleshooting using diagnostic parameters

The control system sets the diagnostic parameters listed below. This applies to Rapid Link devices that communicate via AS-i. The PLC program contains four diagnostic bits.

Diagnostic bit	Rapid Link → PLC	PLC → Rapid Link
F0	Config error	Offline
F1	AS-i fail	LOS Master Bit
F2	Periphery error	Activate project mode
F3	Project mode active	Activate normal operation

The following program excerpt shows an example of bus diagnostics.

```
0001 (*Control ASi*)
0002
0003 (*PLC→ASi*)
0004 %QX100.4:=xOffline;
0005 %QX100.5:=xLosMasterBit;
0006 %QX100.6:= xProjectMode;
0007 %QX100.7:=xOperationMode;
0008 (*ASi→PLC*)
0009 xConfigError:=%IX100.4;
0010 xASiFail:=%IX100.5;
0011 xBusFail:=%IX100.6;
0012 xProjectModeActive:=%IX100.7;
0013 (*****)
```

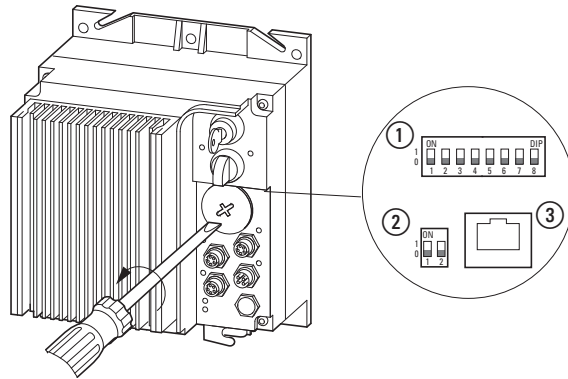
LED indicators

The LEDs in Rapid Link devices are used to indicate operating states (→ Section 7.4, "Error handling and diagnostics"), making quick diagnostics possible.

6.8 Parameters

Speed control unit RASP is configured for direct operation in the Rapid Link system by default. Parameterization is not required for general operation of the speed control.

6.8.1 Parameter setting



A change of the parameter values in the RASP requires a connection with the RJ45 socket (3). This is provided under the front locking screw.



The RASP speed control unit's parameters can only be viewed and edited using either an external LCD keypad (RASP-KEY-S1) or the MaxConnect parameter configuration software program. The connection between the RASP unit and an external LCD keypad is made using a patch cable with an RJ45 plug; the connection to the PC is made using connection cable XMX-CBL-3M4-USB.

The components listed here are not supplied as standard with RASP units (optional accessories). The corresponding accessories are listed and described in the appendix to the manual.

NOTICE

Do not connect or disconnect the connection cable between the RASP unit and the external LCD keypad or computer, as this may cause an undefined drive response during data transfers!



The RASP speed control unit has a factory set basic parameter set (FS: P1.1 = 1).

For briefed qualified personnel, changing the parameter range to P1.1 = 0 will allow access to an extended parameter set.

6 RASP speed controllers

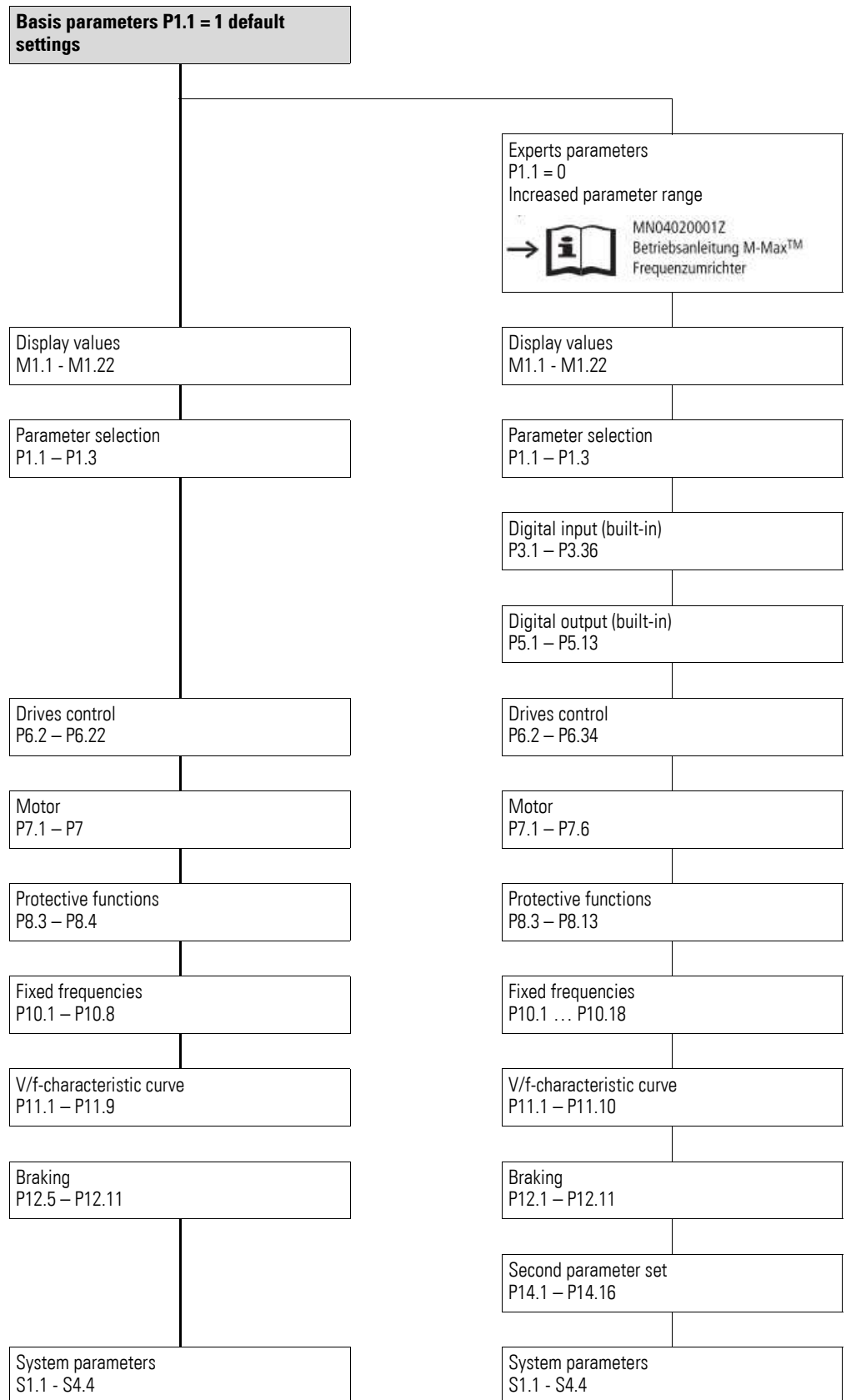
6.8 Parameters

NOTICE

Changing the parameter range to P1.1 = 0 will require additional engineering and careful parameter configuration. The operation and function of the RASP unit may considerably deviate from the settings in the Rapid Link system and lead to different operating states.

6.8.2 Parameter structure

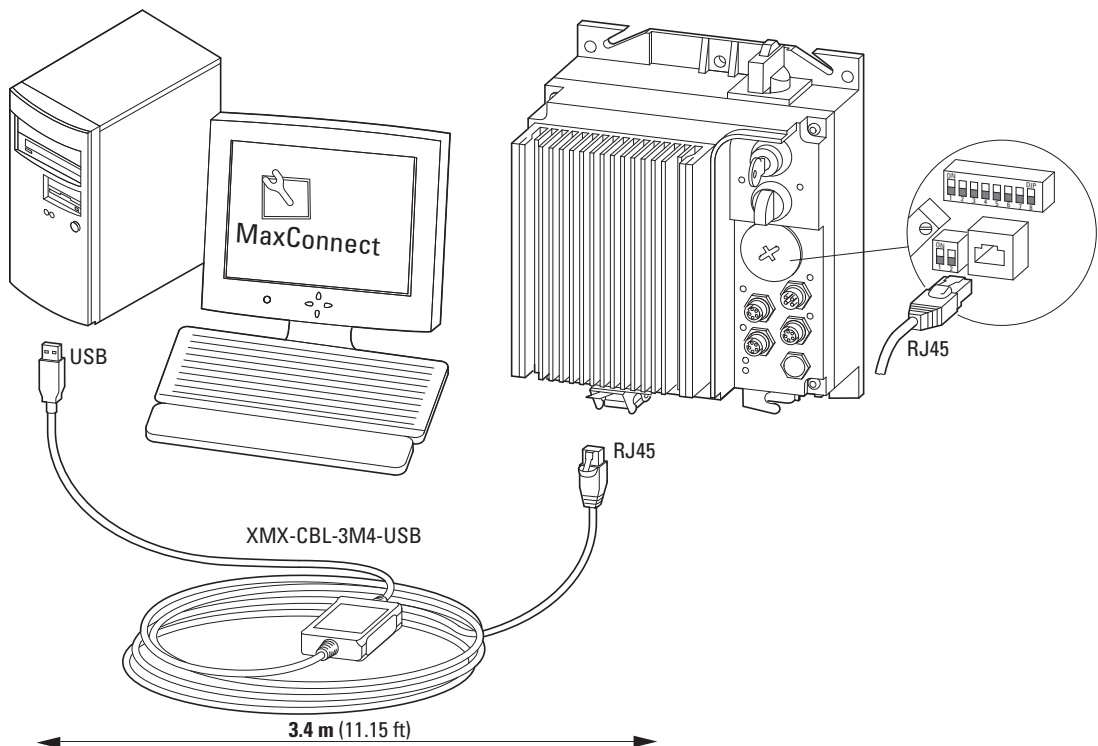
The diagram below shows a simplified version of the parameter structure in RASP units. The basic parameter settings are described in detail on the following pages. The expert parameters are only listed in table format in this manual.



6 RASP speed controllers

6.8 Parameters

6.8.3 Configuring parameters with a PC and the MaxConnect program



The optionally available XMx-CBL-3M4-USB communication cable is needed in order to connect the unit to the PC. This cable features a galvanically isolated interface converter that makes it possible to connect the RASP unit's RJ45 connector to a USB port on a computer.

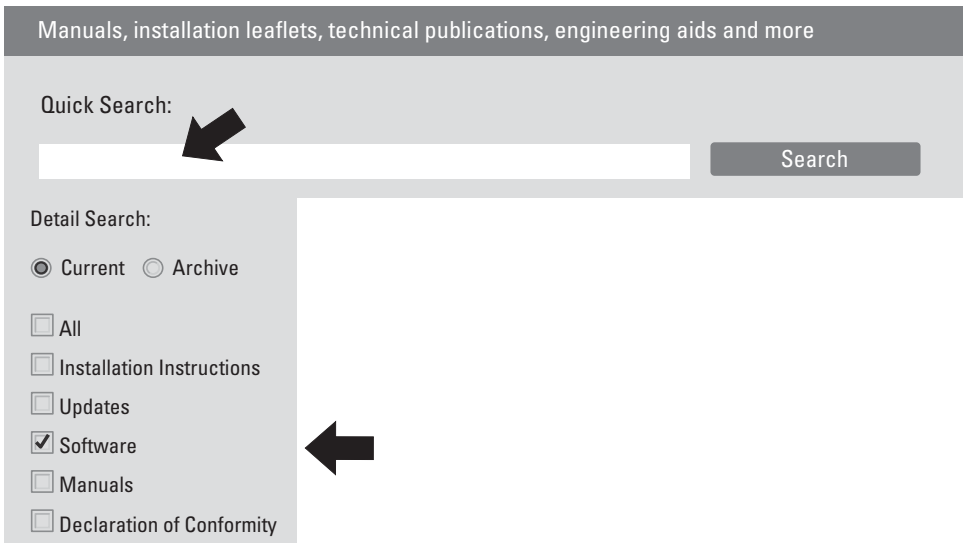
The following example (screenshots) shows some of the required installation steps.

www.Eaton.net

Connect to the Internet (www.eaton.net).

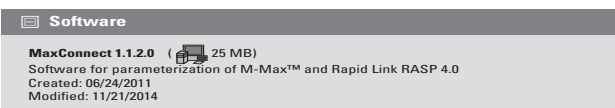


Click on **Customer Support**.



Select **Software** and **Rapid Link**.

Select **Download MaxConnect 1.1.2.0** or a later version with current date.



Click on **Open** when the download prompt appears.



6 RASP speed controllers

6.8 Parameters



Double-click

Eaton_MaxConnect_..._install.exe to run it.

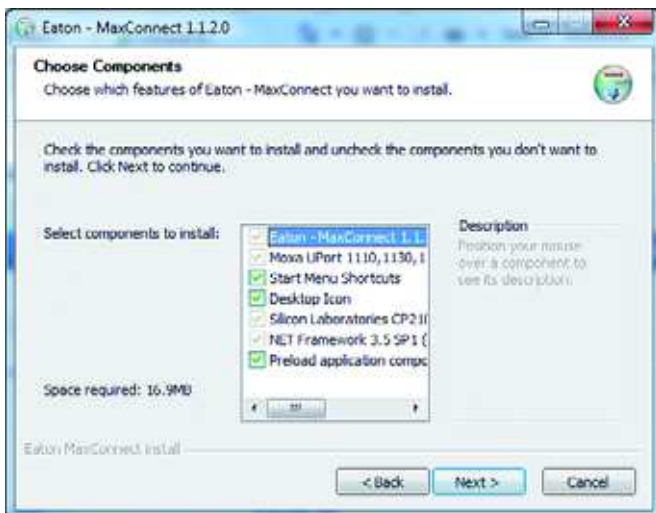
Eaton_MaxLoader_... is not required here; it is needed only for software updates.

Start the MaxConnect Setup Wizard by clicking on **Next**.



In this Setup Wizard, confirm each input field to complete automatic installation.

Individual setting options are not described here.



Click **Next** to confirm the files selected for installation.

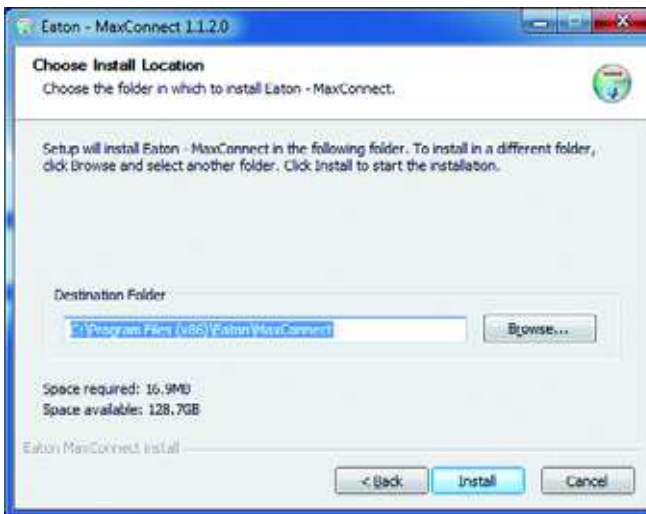


Required interface drivers not installed on the PC are selected automatically here (highlighted green).

For example CP210x (Silcon Laboratories) for the interface converter of the XMx-CBL-3M4-USB.

6 RASP speed controllers

6.8 Parameters



With the **Browse...** button you can specify a different location of folder name in which to install MaxConnect.

Click on **Install** to start the installation process.

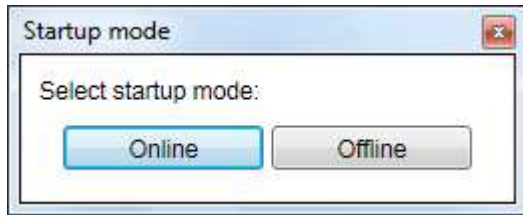


The installation has been completed successfully.

Click on **Finish** to complete the installation process and run the MaxConnect program.

6 RASP speed controllers

6.8 Parameters



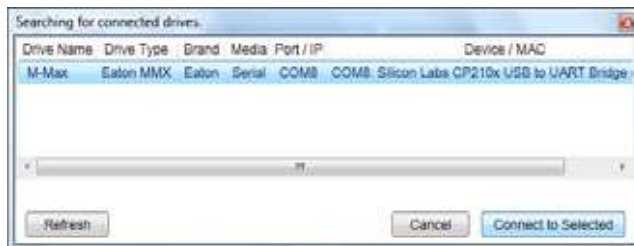
Function **Startup mode** requires a connection between RASP and PC. Use only XMX-CBL-3M4-USB connection cable.



When the RASP unit is powered with mains voltage (400 V) (the UV LED lights up green), the **Online** button can be used to activate Startup mode.



The **Offline** function can be used only when data sets for RASP have already been saved on the PC.



The automatic search for the connected drive is indicated by the "Searching for connected device..." message.

To confirm identified the drive, click "Select devices" (blue highlight). This activates button **Connect to Selected**.

Activate the connection to the RASP with button **Connect to Selected**.



Do not switch off the RASP unit or disconnect it from the PC while data is being transferred. Doing so may cause parameters and settings that have not been saved to be lost.

NOTICE

Do not use any cable other than the XMX-CBL-3M4-USB connection cable to connect the RASP unit and the PC.

Do not attempt to use an Ethernet connection!

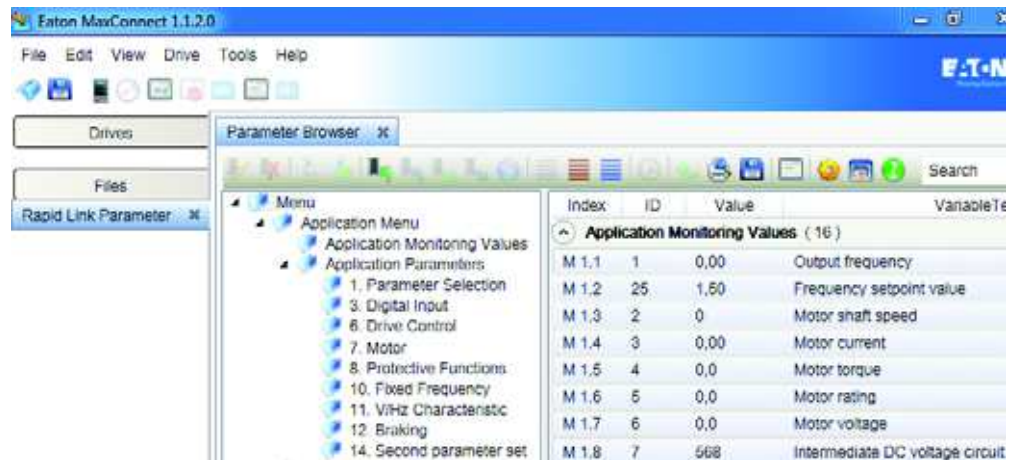


Figure 97:Parameter structure with MaxConnect

The parameters from the RASP are read out automatically. Loading is indicated by an orange bar (lower left, Uploading tree). The progress and the loaded parameter areas are indicated by folder icons highlighted blue in the middle field. The right field lists the associated parameters.

After loading, you can activate the general PC functions in the toolbar (top left). With the **File** button, for example, you can save the parameter set uploaded from the RASP on the PC or print the parameter list. Under **Tools** you can select the desired language, for example with **option** Language; German - Germany (or with F4 on the keypad). Then click **OK** to activate the selected language.



Languages for which a language file is not available will be shown partially or completely in English. The parameter names and tooltips shown refer to M-Max™ variable frequency drives. Some of them may deviate from the following parameter descriptions (see page 88)!

The RASP-specific language files are:

- German - Germany Rapid Link,
- English - United States Rapid Link.

6 RASP speed controllers

6.8 Parameters

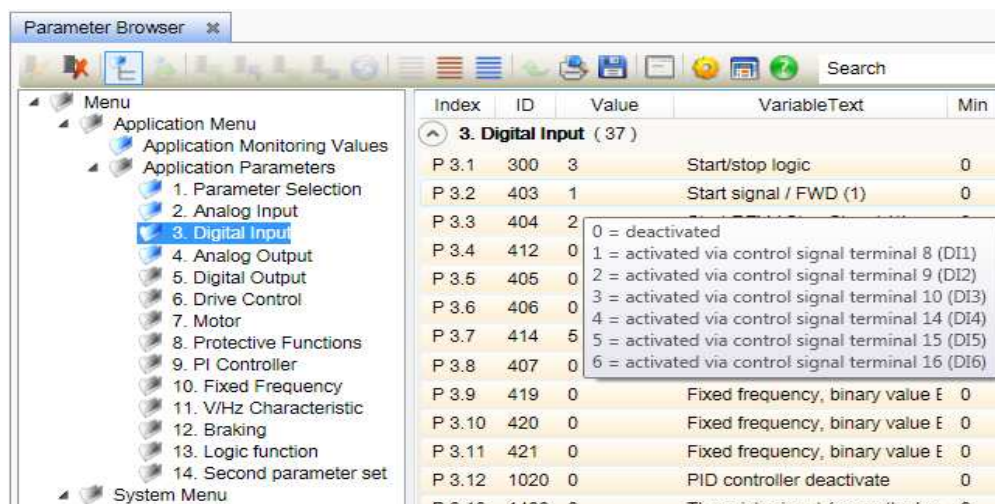


Figure 98:Parameter selection

The function or value of a parameter can be changed in column **Value**. You can activate the input field with the mouse. A field showing the possible settings and functions appears. This field disappears again after a while and can be called up again by moving the mouse.

To save a changed parameter value in the RASP, press Enter on the keyboard or select another parameter with the mouse.

A description of the parameters and their settings and functions can be found in → Section 6.8.6, "Basis parameters".



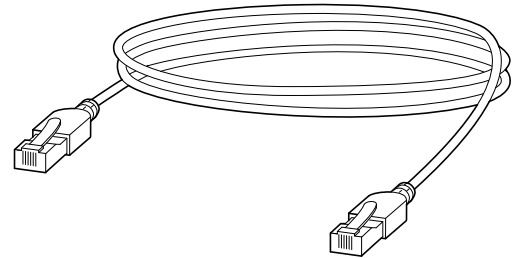
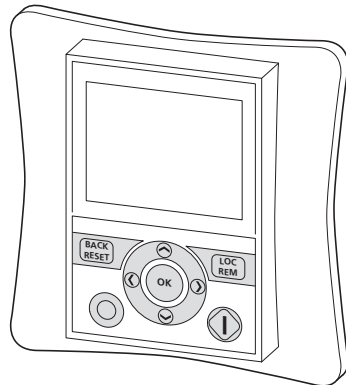
RASP speed control units cannot be controlled using the MaxConnect computer program!
The start/stop functions can only be used directly through the RASP unit, both in manual and automatic modes.
With MaxConnect you can configure parameters, back up your data and print out parameter data simply and easily. The **View, Operational Data** (Ctrl + 2) option can be used to display the RASP unit's operational data graphically as well (oscilloscope).



During the installation process, a shortcut to the MaxConnect program will be created on the desktop so that MaxConnect can be started quickly.

The program will always start in Startup mode.

6.8.4 Parameterization with LCD keypad RASP-KEY-S1



To connect the optional RASP-KEY-S1 LCD keypad, you will need a standard connection cable with RJ45 plugs on both ends (patch cable).

The equipment supplied with RASP-KEY-S1 includes a 1-m long connection cable.

6 RASP speed controllers

6.8 Parameters

6.8.5 Operating unit elements

The following figure shows and designates the elements found on the optional RASP-KEY-S1 LCD keypad for RASP units.



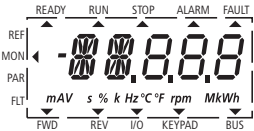









Figure 99:View of RASP-KEY-S LCD keypad with LCD display and function buttons



The RASP-KEY-S1 keypad can display measured values (MON), set parameters (PAR) and indicate the operating states of the RASP.

RASP units cannot be operated or controlled using RASP-KEY-S1!

Table 13: Operating unit elements

Operating unit element	Explanation
	<ul style="list-style-type: none"> • Backlit liquid crystal display (LCD) • Plain text with alphanumeric characters
	<ul style="list-style-type: none"> • Acknowledge error message (Reset) • Activates the selection for the menu levels (◀ flashes).
	<p>No function with RASP</p>
	<ul style="list-style-type: none"> • Select function and parameter • Increase numerical value
	<ul style="list-style-type: none"> • Confirm and activate selection (store) • Lock display
	<ul style="list-style-type: none"> • Select function and parameter • Reduce numerical value
	<ul style="list-style-type: none"> • Move to the individual parameter groups (... S4.1 - P1.1 - P2.1 - P3.1 ...) • In displays with several digits move between the individual digits (Cursor)
	
	<p>No function with RASP</p>
	<p>No function with RASP</p>



Actuating the arrow keys increases or decreases the active value, the parameter or function by one unit. Holding down the arrow key makes the change automatically.



6 RASP speed controllers

6.8 Parameters

6.8.5.1 Display unit

Following is a figure showing the display unit (LCD display) and its indication elements.

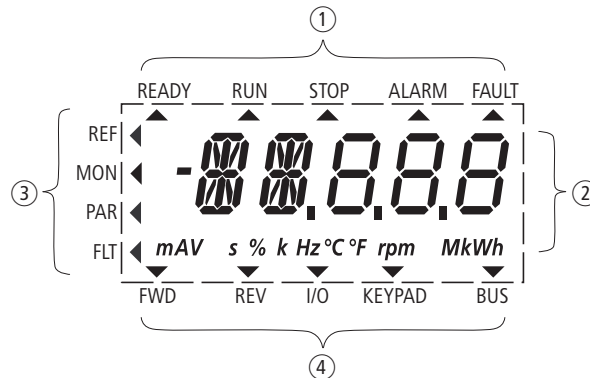


Figure 100:LCD display (areas)

The display unit consists of a backlit liquid crystal display (LCD). It is subdivided into four areas (see the following table).

Table 14: Areas of the LCD display

Context	Description
① Status display	The arrowheads ▲ on the top border show information regarding the drive. <ul style="list-style-type: none"> • READY = Ready to start • RUN = operating signal • STOP = Stop, stop command activated • ALARM = alarm message activated • FAULT = The drive has been stopped due to an error message.
② Plain text display	Two 14- and three 7-segment blocks for displaying: <ul style="list-style-type: none"> • AL = Alarm message • F = Error messages • M = Measurement value (operating data) • P = Parameter numbers • S = System parameter • - = Anticlockwise field of rotation (REV). The respective units of measurement are displayed in the bottom line.
③ Menu level	The arrow ◀ shows the selected main menu: <ul style="list-style-type: none"> • REF = (not activated) • MON = Operational data indicator (Monitor) • PAR = Parameter levels • FLT = Fault log (Fault).
④ Control commands	The arrowhead ▼ points to the selected rotating field direction and the active control level: <ul style="list-style-type: none"> • FWD = Clockwise rotating field (Forward Run) • REV = Counterclockwise rotating field (Reverse Run) • I/O = Via control terminals (Input/Output) • KEYPAD = Via control unit • BUS = Via field bus (interface)

6.8.5.2 General information on menu navigation

When you switch on the supply voltage for RASP (400 V), the built-in variable frequency drive runs the following functions:

- The lighting of the LCD display is switched on and the display briefly shows 0 – 0.
- After the self-test, the top status line of the LCD display indicates that the device is ready to start and proper operation by an arrow ▲ under READY.
The arrow ▲ under STOP indicates that there is no start command (FWD or REV).
- The arrow ▼ on the status line points to I/O (control input/output) to indicate actuation through the built-in control signal terminals.
The arrow ▼ over FWD (Forward) indicates the basic rotational direction (phase sequence for a clockwise rotating field) on the output terminals U/T1, V/T2 and W/T3).
- The M1.1 and 0.00 Hz (output frequency) operational data is automatically shown alternately. The arrow ◀ in the left-hand status line indicates menu mode MON (Monitor = Operating data display).



Display in automatic alternation



Figure 101:Operational data indicator (operational)



By pressing the OK button, you can change the alternating display mode so that it will stay on the output frequency (0.00 Hz).

The variable frequency drive is now ready for operation in the RASP unit and can be started with the specified default settings when the assigned motor output is connected.

6 RASP speed controllers

6.8 Parameters




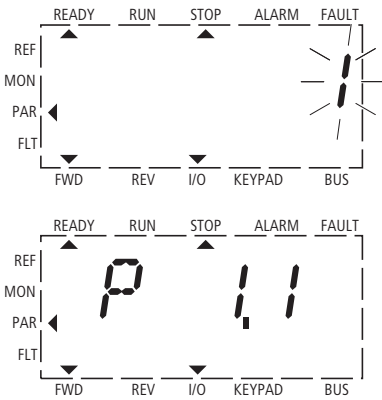



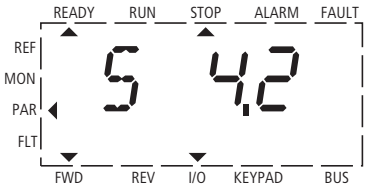

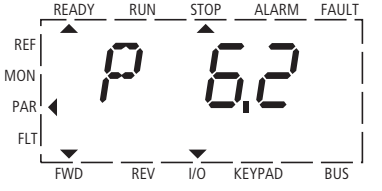

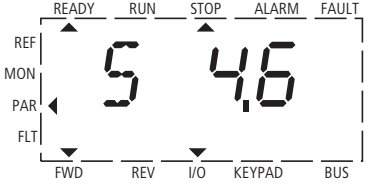

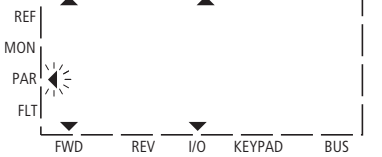
6.8.5.3 Select parameters

The table below outlines the general controls and indications for selecting and setting parameters (→ Page 135).



Functions, parameters, and values are activated and stored by pressing the OK button.

Sequence	Commands	View	Description
0			<p>Measured value 1.1</p> <p>This indicator alternates automatically with the value for the 0.00 Hz output frequency (during STOP).</p>
1	 		<p>Actuating the BACK/RESET button activates the menu level (arrow flashes).</p> <p>The two arrow keys enable you to select the individual main menus:</p> <ul style="list-style-type: none"> • REF = Setpoint input (Reference) • MON = Operational data indicator (Monitor) • PAR =Parameter levels • FLT = Fault log (Fault). <p>Use the OK button to open the selected main menu.</p>
2		 <p style="text-align: center;">↓</p> <p style="text-align: center;">Display in automatic alternation</p> <p style="text-align: center;">↑</p>	<p>The numerical first value is always shown from the selected main menu.</p> <p>Example: Main menu PAR, Parameter P1.1</p> <p>The display automatically switches between the parameter number and the defined value.</p> <p>P1.1 =1 is displayed at the first switch on and after the default settings have been activated.</p> <p>Use the OK button to activate the selected parameter. The value (1) flashes.</p>

Sequence	Commands	View	Description
3	  		<p>If the parameter value is flashing, you can use the two arrow keys to change the value within the permitted range.</p> <ul style="list-style-type: none"> • P1.1 = Basis parameters • P1.0 = Expert parameters <p>The selected value is confirmed with the OK button. The display now changes automatically between the new value and the respective parameter number.</p>
4a			<p>To show the parameter with the next higher number (P1.1 → P1.2 → P1.3...), use arrow key ^</p>
4b			<p>To show the first parameter of the last parameter group (P1.1 → S4.2 → S5.3...), use arrow key <</p>
4c			<p>To show the first parameter of the group with the next higher number (P1.1 → P6.2 → P7.1...), use arrow key ></p>
4 d			<p>To show the last parameter value (P1.1 → S4.6 → S4.5...), use arrow key v.</p>
5			<p>By actuating the BACK/RESET pushbutton, you exit main menu PAR (arrow flashes). To change to a different menu level, use arrow keys ^ or v.</p>

6 RASP speed controllers

6.8 Parameters

6.8.6 Basis parameters

The abbreviations used in the parameter lists have the following meaning:

PNU	Parameter number
ID	Identification number of the parameter
RUN	Access rights to the parameters during operation (RUN): ✓ = Modification permissible, - = Modification only possible in STOP
ro/rw	Parameter read and write permissions via a fieldbus connection (BUS): ro = read only rw = read and write
Value	Setting of the parameters
DS	Default settings: WE (P1.1 = 1) Basis parameters

The figure below shows the list of parameters in this manual and in the MaxConnect program.



Parameters marked in column **Access right RUN** with ✓, can be changed during operation (RUN mode). Access rights are not shown in MaxConnect.



The number and order of displayed columns can be changed in MaxConnect (similar columns in Excel or under Tools – Options – Parameter/value).

PNU	ID	Access right		Value	Description	DS			
		RUN	ro/rw						
Index	ID	Value			Variable Text	Min	Max	Unit	Default



The following parameters are only relevant for RASP.

6.8.6.1 Parameter selection (P1)

Under Parameter selection (P1) you can select the basic RASP settings.

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P1.1	115	✓	rw		Parameter ranges	1
				0	Expert (extended parameter set) Caution: Activation of P1.1 = 0 requires extended engineering and parameterization, since operating principle and function of RASP can differ in the Rapid Link system.	
				1	Base Standard parameters for RASP in the Rapid Link system	
P1.2	540	–	rw		Applications Note: These default settings can be changed only when DIP switches 4 to 6 are set to zero.	0
				0	Two operating directions with three fixed frequencies FWD/REV/B0/B1 (AS-i outputs DQ0 - DQ3) DQ0 = FWD (clockwise rotating field) DQ1 = REV (anticlockwise rotating field) DQ0 + DQ1 = Reset DQ2 = FF1 (P10.2 = 30 Hz) DQ3 = FF2 (P10.3 = 40 Hz) DQ2 + DQ3 = FF3 (P10.4 = 50 Hz)	
				1	One operating direction with 7 fixed frequencies FWD/B0/B1/B2 (AS-i outputs DQ0 - DQ3) DQ0 = FWD (clockwise rotating field) DQ1 = FF1 (P10.2 = 30 Hz) DQ2 + FF2 (P10.3 = 40 Hz) DQ1 + DQ2 = FF3 (P10.4 = 50 Hz) DQ3 = FF4 (P10.5 = 10 Hz) DQ1 + DQ3 = FF5 (P10.6 = 15 Hz) DQ2 + DQ3 = FF6 (P10.7 = 20 Hz) DQ1 + DQ2 + DQ3 = FF7 (P10.8 = 25 Hz)	
				2	2 = PM-Motor (not activated; intended for permanent motors)	

6 RASP speed controllers

6.8 Parameters

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)																																				
		RUN	rw/ ro																																							
P1.3	1472	–	rw		Default settings (FS), country specific	0																																				
				0	EU (Europe, 50 Hz networks)																																					
				1	USA (North America, 60 Hz networks)																																					
				The country-specific default setting takes into account the frequency-based parameters that change depending on whether a 50 Hz or a 60 Hz supply system is being used:																																						
		<table border="1"> <thead> <tr> <th>PNU</th> <th>Designation</th> <th>P1.3 = 0</th> <th>P1.3 = 1</th> </tr> </thead> <tbody> <tr> <td>P6.4</td> <td>Maximum frequency</td> <td>50 Hz</td> <td>60 Hz</td> </tr> <tr> <td>P7.3</td> <td>Motor, rated speed</td> <td>1440 rpm</td> <td>1720 rpm</td> </tr> <tr> <td>P7.6</td> <td>Motor, rated frequency</td> <td>50 Hz</td> <td>60 Hz</td> </tr> <tr> <td>P11.2</td> <td>Cut-off frequency</td> <td>50 Hz</td> <td>60 Hz</td> </tr> <tr> <td>P11.4</td> <td>V/f characteristic curve, mean frequency value</td> <td>25 Hz</td> <td>30 Hz</td> </tr> <tr> <td>P14.3</td> <td>Motor rated speed (2PS)</td> <td>1440 rpm</td> <td>1720 rpm</td> </tr> <tr> <td>P14.6</td> <td>Motor rated frequency (2PS)</td> <td>50 Hz</td> <td>60 Hz</td> </tr> <tr> <td>P14.8</td> <td>Maximum frequency (2PS)</td> <td>50 Hz</td> <td>60 Hz</td> </tr> </tbody> </table>				PNU	Designation	P1.3 = 0	P1.3 = 1	P6.4	Maximum frequency	50 Hz	60 Hz	P7.3	Motor, rated speed	1440 rpm	1720 rpm	P7.6	Motor, rated frequency	50 Hz	60 Hz	P11.2	Cut-off frequency	50 Hz	60 Hz	P11.4	V/f characteristic curve, mean frequency value	25 Hz	30 Hz	P14.3	Motor rated speed (2PS)	1440 rpm	1720 rpm	P14.6	Motor rated frequency (2PS)	50 Hz	60 Hz	P14.8	Maximum frequency (2PS)	50 Hz	60 Hz	
PNU	Designation	P1.3 = 0	P1.3 = 1																																							
P6.4	Maximum frequency	50 Hz	60 Hz																																							
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P7.6	Motor, rated frequency	50 Hz	60 Hz																																							
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P11.4	V/f characteristic curve, mean frequency value	25 Hz	30 Hz																																							
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P14.6	Motor rated frequency (2PS)	50 Hz	60 Hz																																							
P14.8	Maximum frequency (2PS)	50 Hz	60 Hz																																							

6.8.6.2 Drives control (P6)

In parameter group P6 the operating conditions for the RASP's variable frequency drive are defined.

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P6.2	117	✓	rw		Setpoint input	3
				0	FF0 (Fixed frequency) The value can be set in parameter P10.1.	
				1	REF (external keypad RASP-KEY-S1) This setting causes the setpoint value defined at REF to be read. It can be set via the keypad with the arrow keys.	
				2	Deactivated	
				3	Potentiometer n_0 (→ Figure 102, internal input AI1 of the variable frequency drive)	

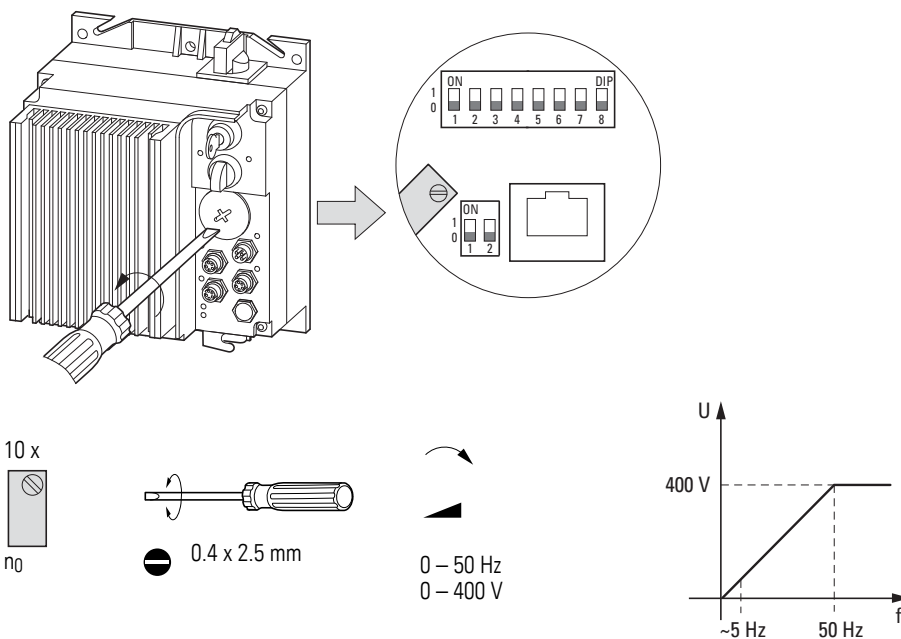


Figure 102: 10-turn spindle potentiometer:
Set to approximately 5 - 10 Hz by default.

6 RASP speed controllers

6.8 Parameters

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ro			
P6.3	101	–	rw		Minimum frequency 0.00 - P6.4 [Hz]	0.00
P6.4	102	–	rw		Maximum frequency P6.3 - 320 Hz	50.00
P6.5	103	✓	rw		Acceleration time (acc1) 0.1 - 3000.0 s (→ Figure 103 below)	5.0
P6.6	104	✓	rw		Deceleration time (dec1) 0.1 – 3000.0 s (see Figure 103 below)	2.0

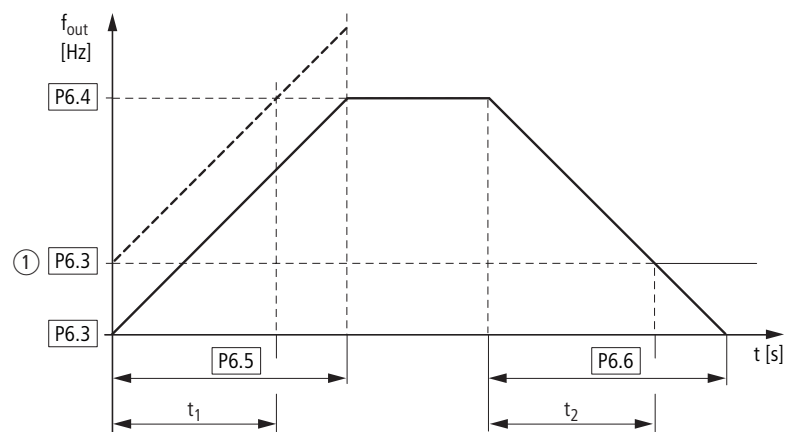


Figure 103: Acceleration and deceleration time

Reference points for the acceleration and deceleration times set in parameters P6.5 and P6.6 are always 0 Hz (P6.3) and the maximum output frequency f_{max} (P6.4).

① When setting a minimum output frequency (P6.3 greater than 0 Hz), the acceleration and deceleration time of the drive are reduced to t_1 and t_2 .

The values for the acceleration time t_1 and the deceleration time t_2 are calculated as follows:

$$t_1 = \frac{(P6.4 - P6.3) \times P6.5}{P6.4}$$

$$t_2 = \frac{(P6.4 - P6.3) \times P6.6}{P6.4}$$



The defined acceleration (P6.5) and deceleration times (P6.6) apply for all changes to the frequency reference value. When parameter P6.8 = 1 (WE), the motor will always be brought to a controlled run-down (brake ramp P6.6). Starting friction and load inertia can lead to longer acceleration times for the drive than are set in P6.5. Large centrifugal masses or if driven by the load, the deceleration time of the drive can be greater than is set in P6.6.

PNU	ID	Access right		Value	Description	WE (P1.1 = 1)
		RUN	rw/ro			
P6.7	505	–	rw		Start function	0
				0	Ramp (acceleration) The acceleration time with the value set at parameter P6.5.	
				1	Flying restart circuit Starting on a running motor. By switching on a small current value, a small torque is created. With a frequency search (beginning with the maximum frequency P6.4), the correct rotational field frequency is determined. The output frequency is then adapted to the specified setpoint frequency based on the defined acceleration (P6.5) and deceleration (P6.6) times.	
P6.8	506	–	rw		Stop function	1
				0	Free coasting The motor runs down uncontrolled after switching the start-release off (FWD/REV).	
				1	Ramp (deceleration) = dynamic braking. Deceleration time with the value set under P6.6. If the energy that is fed back by the motor during the dynamic braking is too high, the deceleration time has to be extended. RASPs with built-in braking resistance can dissipate excess energy (P12.5 and P12.6 → Page 169).	
P6.9	500	–	rw		Wave form, time-based S-form	0.0
				0.0	Linear acceleration and deceleration time based on P6.5 and P6.6.	
				0.1 - 10.0 s	Time-graded transition to start and end of the acceleration ramp (P6.5) and deceleration ramp (P6.6). The time set here applies for both ramps (see Figure 104).	

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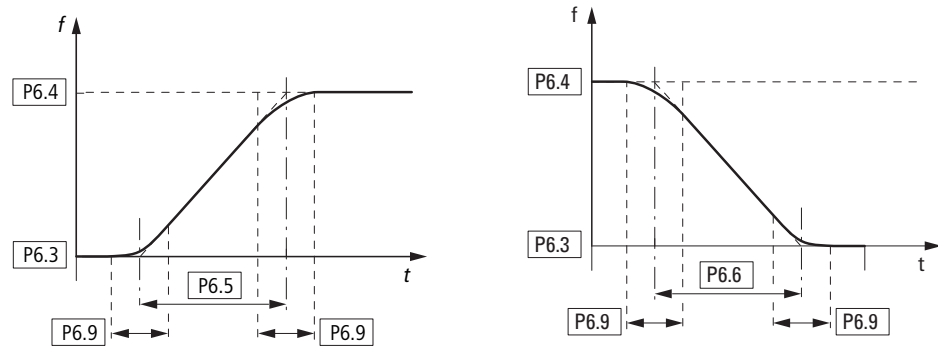


Figure 104: S-formed curve for acceleration and deceleration ramps

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ro			
P6.19	502	✓	rw		Second acceleration time (acc2) 0.1 - 3000.0 s (see P6.5). Activation takes place at the frequency set under P6.21	10.0
P6.20	503	✓	rw		Second deceleration time (dec2) 0.1 - 3000.0 s (see P6.6). Activation takes place at the frequency set under P6.22	10.0
P6.21	526	–	rw		Transition frequency (acc1 - acc2) 0.00 Hz = deactivated 0.01 - P6.4 Hz If the output frequency set here is exceeded, the acceleration time is switched automatically from acc1 (P6.5) to acc2 (P6.19).	0.00
P6.22	1334	–	rw		Transition frequency (dec1 - dec2) 0.00 Hz = deactivated 0.01 - P6.4 Hz If the output frequency set here is exceeded, the deceleration time is switched automatically from dec1 (P6.6) to dec2 (P6.20).	0.00

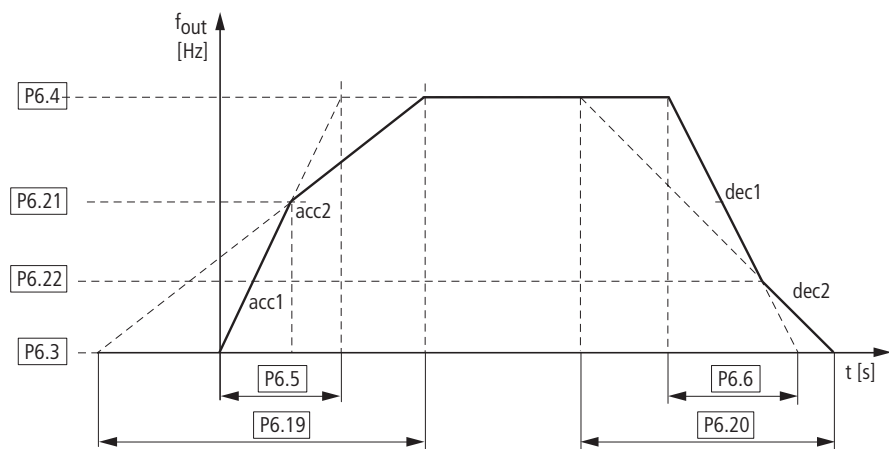


Figure 105: Ramp time changeover

Automatically adjusting the deceleration time

➔ RASP release 005 and higher – only adjustable in expert mode (P1.1 = 1).

Excessively short deceleration ramps or high-inertia loads can cause oversynchronous operation during deceleration. The motor then works regeneratively and charges up the internal DC link. Excessive voltage results in fault signal F 02 (overvoltage).

With parameter P6.34 you can automatically stop the deceleration ramp if the DC link voltage reaches an excessive value during deceleration. The deceleration time of the drive (to Stop) is thus automatically extended. The value for the ramp time set under P6.6 is not changed. Select this function if short deceleration times (P6.6) are required but changing loads necessitate a longer deceleration time.

Alternatively: RASP-1... with internal braking resistance (➔ Section , "Regenerative braking", page 168)

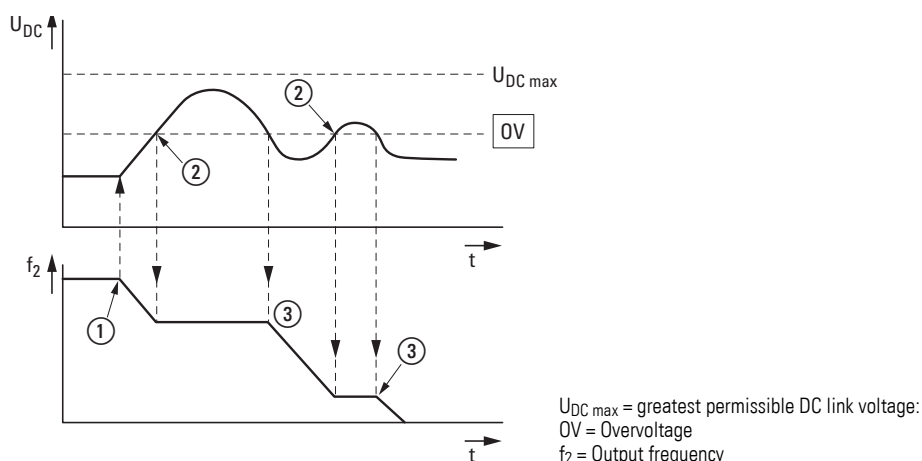


Figure 106: Time delay of the output frequency

When deceleration starts (STOP signal), ① the output frequency f_2 of the RASP is reduced. If the motor speed is higher than the variable frequency drive's output, the motor operates regeneratively and feeds its surplus energy into the internal DC link. This increases the DC link voltage. If the DC link voltage exceeds the internal limit value (OV) ②, the reduction of the output frequency is f_2 stopped. The deceleration can resume only when the motor no longer operates regeneratively and the DC link voltage has dropped below the value of OV value ③.

PNU	ID	Access right		Value	Description	WE (P1.1 = 0)
		RUN	rw/ro			
P6.34	1998	-	rw		Overvoltage controller	1
				0	ON, Automatic stopping of the deceleration time (output frequency)	
				1	OFF, no monitoring	

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6.8 Parameters

6.8.6.3 Motor (P7)

For optimal operation, you should enter the ratings plate information for the motor here. This information makes up the base values for the motor controller (electrical reproduction).

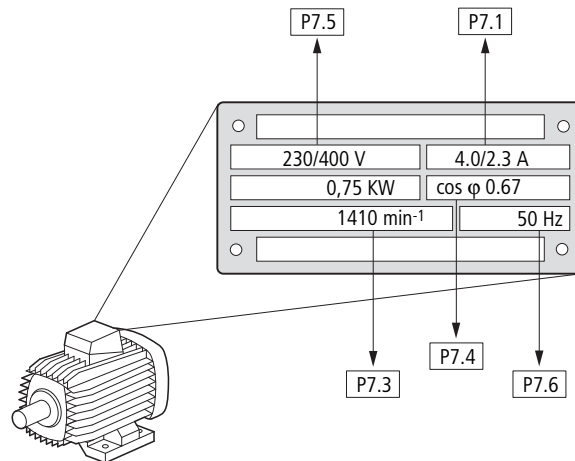


Figure 107: Motor parameters from ratings plate

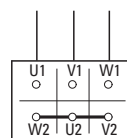


By default, the motor data is set to the RASP unit's rated operational data and depends on the performance variables.

Switching type for stator windings of the motor

Example taking into account mains voltage and motor according to (→ Figure 107):

400 V (P7.5) → star-connected circuit → P7.1 = 2.3 A



$U_{LN} = 400 \text{ V}$

Figure 108: Star circuit for RASP at $U_{LN} = 400 \text{ V}$

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6.8 Parameters

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ro			
P7.1	113	–	rw		Motor, rated operational current	2.4 ¹⁾
					Setting range: $0.2 \times I_e - 2 \times I_e$ [A] I_e = variable frequency drive's rated operational current in the RASP (→ motor rating plate)	
P7.2	107	–	rw		Current limitation	3.6 ¹⁾
					Setting range: $0.2 \times I_e - 2 \times I_e$ [A] Default setting: $1.5 \times I_e$	
P7.3	112	–	rw		Motor, rated speed	1440 ¹⁾ 1720
					Setting range: 300 – 20000 rpm (min ⁻¹) (→ Motor rating plate).	
P7.4	120	–	rw		Motor, power factor (cos φ)	0.85 ¹⁾
					Setting range: 0.30 – 1.00 (→ Motor ratings plate)	
P7.5	110	–	rw		Motor, rated operating voltage	400 ¹⁾
					Setting range: 180 – 500 V (→ Motor ratings plate). Pay attention to the mains voltage and the type of circuit in the stator winding!	
P7.6	111	–	rw		Motor, rated frequency	50.00 ¹⁾ 60.00
					Setting range: 30 - 320 Hz (→ Motor rating plate)	

- 1) Example: Default settings for RASP-2...
For the ratings on the rating plate in Figure 107 the parameters must be set as follows: P7.1 = 2.3, P7.3 = 1410, P7.4 = 0.67.

6 RASP speed controllers

6.8 Parameters

6.8.6.4 Protective functions (P8)

In parameter group P8 the response of the RASP's built-in variable frequency drive to external influences can be adjusted:

- 0 = deactivated, no reaction
- 1 = Warning (e.g. Warning message AL 50)
- 2 = Error (stop mode after error message based on parameters P6.8, e.g. F...50)

The error - (FAULT) and warning messages (ALARM) are described in chapter 5.

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ro			
P8.3	703	-	rw		Earth-fault protection	2
					Earth-fault protection checks the currents in the motor phases against ground (PE) at startup and is also active in operation.	
				0	Deactivated If the monitoring is deactivated, the response time is shortened to a start signal. Caution: When the monitoring is deactivated, a ground fault can cause damage to the inverter. Caution: When the monitoring is deactivated, a ground fault can cause damage to the inverter.	
				1	Warning (AL 03)	
				2	Error (F... 03), stop function according to P6.8	
P8.4	709	-	-		Blocking protection mechanism	2
					The blocking protection is functions as an overload protection. It protects the motor from brief overloads (e. g. blocked motor shaft) and is set with parameter P7.2.	
					Note: In the case of long motor cable lengths and low motor outputs (poor efficiency $\cos \varphi$), a higher (capacitive) motor current may flow, causing premature tripping. Solution: Motor choke or sinusoidal filter	
				0	Deactivated	
				1	Warning (AL 15)	
				2	Error (F... 15), stop function according to P6.8.	

6.8.6.5 Fixed frequency setpoint value (P10)

Up to seven fixed frequencies can be activated in the RASP unit, depending on the value set for parameter 1.2.



The maximum permitted set value for a fixed frequency is limited by parameter P6.4 (maximum frequency). A fixed frequency value can go below a minimum limit frequency set at parameter P6.3.



The fixed frequency values can be changed during operation (RUN).

Fixed frequency

Binary code table showing how to activate the fixed frequencies

Input (binary)			Fixed frequency
B0	b1	m2	(Default setting)
			FF0, P10.1 = 5 Hz, only if P6.2 = 0
X			FF1, P10.2 = 30 Hz
	X		FF2, P10.3 = 40 Hz
X	X		FF3, P10.4 = 50 Hz
		X	FF4, P10.5 = 10 Hz
X		X	FF5, P10.6 = 15 Hz
	X	X	FF6, P10.7 = 20 Hz
X	X	X	FF7, P10.8 = 25 Hz

Designation	PNU	Digital input (built-in)	Parameter Definition	AS-Interface				Manual mode
				DQ0	DQ1	DQ2	DQ3	
0	–	–	Spindle potentiometer n_0 (→ Figure 102, page 151)	–	–	0	0	Selector switch (HAND, FWD, REV) Selector switch (HAND, FWD, REV)
FF1	P10.1	DI3	WE = 30 Hz	–	–	1	0	–
FF2	P10.2	DI4	WE = 40 Hz	–	–	0	1	–
FF3	P10.3	DI3 + DI4	WE = 50 Hz	–	–	1	1	–
FWD	–	DI1	–	1	0	–	–	FWD, HAND
REV	–	DI2	–	0	1	–	–	REV, HAND

6 RASP speed controllers

6.8 Parameters

The change between the individual fixed frequencies is done with the acceleration times and deceleration times set at P6.5 and P6.6. When FWD or REV enable is revoked, the output frequency is inhibited directly (coasting to halt). When P6.8 = 1 the controlled deceleration of the drive is executed ① (→ Figure 109).



In → Figure 96, page 128, DI1, DI3, and DI4 refer to the digital inputs of the variable frequency drive in the RASP unit. In automatic mode, these inputs are switched using AS-i outputs DQ0 to DQ3.

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ro			
P10.1	124	✓	rw		Fixed frequency FF0	5.00 6.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4). This value is only active if for the setpoint input has been set the parameter P6.2 = 0.	
P10.2	105	✓	rw		Fixed frequency FF1	30.00 36.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4) (activated internally through DI3)	
P10.3	106	✓	rw		Fixed frequency FF2	40.00 48.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4) (activated internally through DI4)	
P10.4	126	✓	rw		Fixed frequency FF3	50.00 60.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4) (internal through DI3 and DI4 only with P1.2 = 1 activated)	
P10.5	127	✓	rw		Fixed frequency FF4	10.00 12.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4)	
P10.6	128	✓	rw		Fixed frequency FF5	15.00 18.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4)	
P10.7	129	✓	rw		Fixed frequency FF6	20.00 24.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4)	
P10.8	130	✓	rw		Fixed frequency FF7	25.00 30.00 ¹⁾
					0.00 Hz up to the maximum frequency value (P6.4)	

1) Value at P1.3 = 1

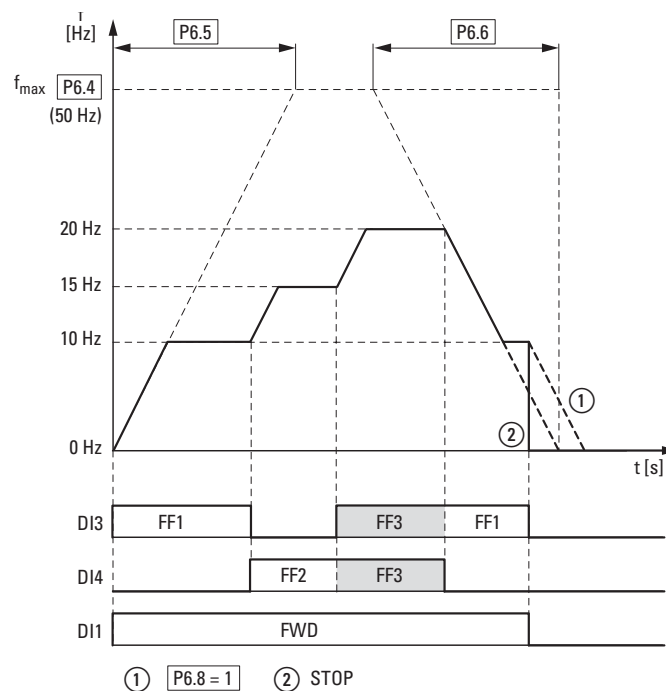


Figure 109: Example, activation of fixed frequencies with acceleration and deceleration ramps

DQ2 → DI3 = FF1 (P10.2)
 DQ3 → DI4 = FF2 (P10.3)
 DQ2 + DQ3 → DI3 + DI4 = FF1 FF3 (P10.2)

6.8.6.6 V/f-characteristic curve (P11)

The RASP's variable frequency drive controls its inverters with sinusoidal pulse width modulation (PWM). The IGBTs are actuated here by two V/f-based control procedures, which are set in parameter P11.8.

P11.8 = 0:

- Frequency control (Hz),
- Parallel connection of several motors,
- Large power difference ($P_{FU} \gg P_{Motor}$),
- Switching in the output,
- low heat dissipation.

P11.8 = 1:

- Speed control (rpm, min^{-1}) with slip compensation,
- Standalone operation (only one motor), no more than one power rating less,
- High torque (requirement: exact motor data for the motor calculation model, parameter group 7).

6 RASP speed controllers

6.8 Parameters

The V/f characteristic curve (voltage/frequency characteristic curve) represents a control procedure of the variable frequency drive in which the motor voltage is controlled in a specific ratio to the frequency. If the voltage/frequency ratio is constant (linear characteristic curve), the magnetizing flux and the torque curve of the connected motor is virtually constant.

In the standard application, the benchmark values for the V/f-characteristic curve correspond with the rated operational data of the connected motor (see ratings plate for the motor):

- Cut-off frequency P11.2 = Rated motor frequency P7.6 = Maximum frequency P6.4.
- Output voltage P11.3 = Nominal motor voltage P7.5.



The rating data of the V/f-characteristic curve is assigned automatically and corresponds with the values of parameter P7.5 (nominal motor voltage) and P7.6 (rated motor frequency). For other values of the V/f characteristic curve P7.5 and P7.6 must be set before the V/f characteristic curve listed here can be changed.

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P11.1	108	-	rw		V/f characteristic curve	0
				0	linear The output voltage changes linearly with the output frequency; from zero to voltage P11.3 with the cut-off frequency P11.2. By defining a minimum frequency (P6.3), a voltage corresponding with one of the linear characteristic curves is output. The V/f ratio running linearly between zero and the cut-off frequency remains constant. With parameter P11.6, the voltage value can be raised by percentages in a linear V/f/f-ratio over the entire manipulating range.	
				1	quadratic The output voltage changes quadratically with the output frequency; from zero to voltage P11.3 with the cut-off frequency P11.2. By defining a minimum frequency P6.3, a voltage corresponding with one of the quadratic characteristic curves is output. The V/f ratio running quadratically between zero and the cut-off frequency remains constant. With parameter P11.6, the voltage value can be raised as a percentage by a quadratic V/f ratio over the entire manipulating range.	
				2	Parameterizable In connection with parameters P11.4, P11.5 and P11.6, the V/f ratio and therefore the parameters for characteristic curve progress can be defined as required.	

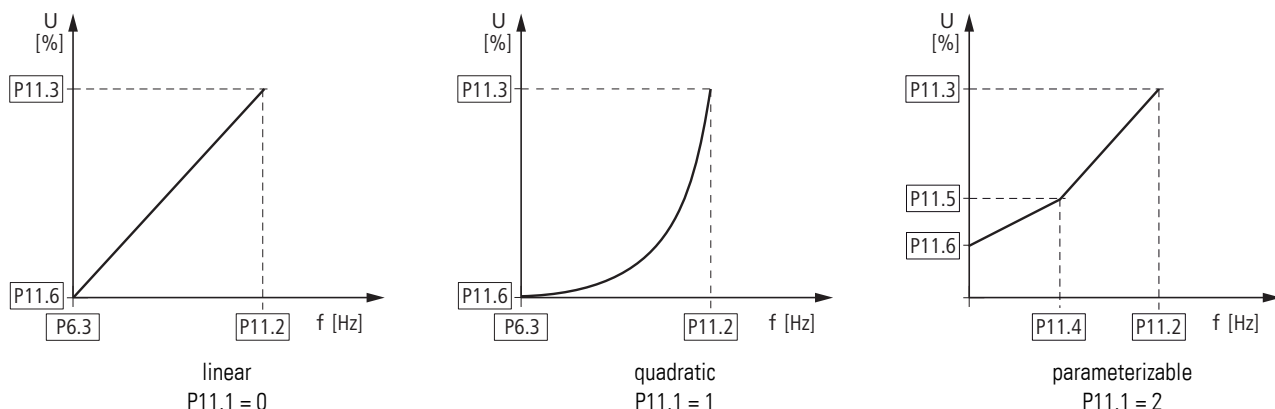


Figure 110: V/f-characteristic curve (P11.1)

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P11.2	602	–	rw		<p>Cut-off frequency</p> <p>30.00 - 320.00 Hz</p> <p>The output voltage reaches its maximum rated value P11.3 with the cut-off frequency. For example: 400 V at 50 Hz.</p> <p>If the maximum output frequency (P6.4) is set to higher values, the output voltage will remain constant starting from the cut-off frequency defined here.</p> <p>As of this cut-off frequency, the voltage/frequency ratio is no longer constant. The magnetization of the connected motor is reduced with increasing frequency (field weakening range).</p> <p>The graph shows a linear increase from (P6.3, P11.6) to (P11.2, P11.3), followed by a constant voltage level until P6.4, and then a drop to zero.</p> <p>Example: linear V/f characteristic curve with cut-off frequency and field weakening range.</p>	50.00 60.00
P11.3	603	–	rw		<p>Output voltage</p> <p>10.00 – 200.00 % of mains voltage</p> <p>In the standard application, the value set here is equal to 100 % of the mains voltage supply and corresponding with the nominal motor voltage set under P7.5 (→ rating plate motor).</p>	100.00
P11.4	604	–	rw		<p>V/f characteristic curve, mean frequency value</p> <p>0.00 - P11.2 [Hz]</p> <p>Definition of a frequency value for the voltage value set under P11.5</p> <p>Defined ratio (break-point) for the defined V/f-characteristic curve (P11.1 = 2, see characteristic P11.1 = 2)</p>	50.00 60.00

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6.8 Parameters

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P11.5	605	–	rw		V/f characteristic curve, mean voltage value	100.00
					0.00 - P11.3 % Definition of a voltage value for the frequency value set under P11.4 Defined ratio (break-point) for the defined V/f-characteristic curve (P11.1 = 2, see characteristic P11.1 = 2)	
P11.6	606	–	rw		Output voltage at 0 Hz	0.00
					0.00 - 40.00 % Definition of a start voltage at 0 Hz (zero frequency voltage) Note: A high start voltage enables a high torque at the start. Notice: A high torque at low speed causes a high thermal load on the motor. If temperatures are too high, the motor should be equipped with an external fan.	
P11.7	109	–	rw		Torque increase	0
				0	Deactivated	
				1	activated Automatic increase of the output voltage (boost) with an increased load and low speed (e.g. heavy starting duty). Notice: A high torque at low speed causes a high thermal load on the motor. Note: If the temperatures are too high, the motor should be equipped with an external fan.	
P11.8	600	–	rw		Control mode	0
				0	Frequency control (V/f-characteristic curve) The setpoint entry controls the output frequency of the variable frequency drive (resolution of the output frequency = 0.01 Hz). Note: In this mode, multiple motors, with varying outputs, can be connected in parallel in the output of the variable frequency drive.	
				1	Speed control with slip compensation, The setpoint entry controls the motor speed depending on the load torque (calculation by motor model). Note: In this mode, only one motor with the assigned power (current) may be connected in the output of the variable frequency drive. Note: Speed control requires a precise electrical map of the connected motor. The ratings plate information for the motor must be set in the parameter group P7 in this case.	

On the constant three-phase AC supply system, the three-phase asynchronous motor has a constant rotor speed (n_1 , P7.3, rating plate specifications) according to the number of pole pairs and mains frequency. The slip here represents the difference between the rotating field of the stator and that of the rotor.

In static operation, the slip is constant. Load changes (①) at the motor shaft cause a larger slip (Δn) and thus a reduced rotor speed (②). In controlled operation (V/F characteristic curve), the variable frequency drive cannot compensate this load-related speed difference. The speed behavior of the motor is even, as in a constant AC supply system.

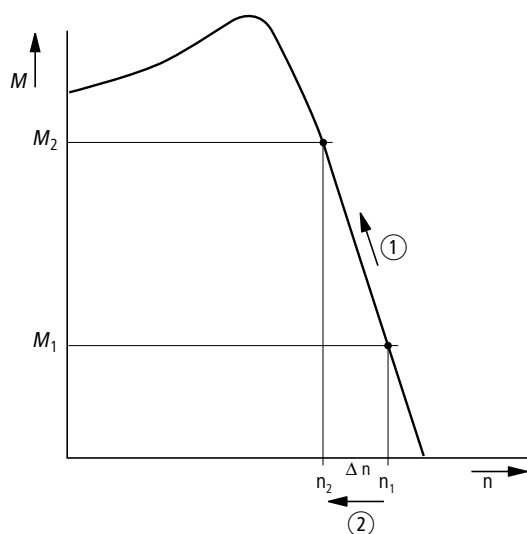


Figure 111: Speed behavior without slip compensation

In "speed control" mode (P11.8 = 1), the variable frequency drive can compensate for these load-based fluctuations. From the measured voltage and current values of the stator winding (u_1 , i_1) the internal motor model calculates the required manipulated variables for the flux variable i_μ and the torque variable i_w . In the equivalent circuit diagram of the three-phase motor, the load-related slip is shown as the resistance R'_2/s . During no-load operation, this resistance approaches infinity, and approaches zero as the load increases.

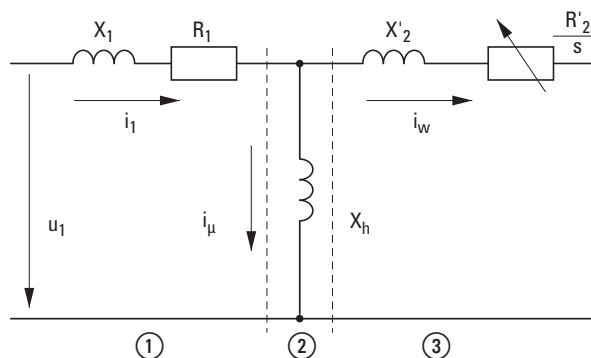


Figure 112: Equivalent circuit diagram for three-phase asynchronous motor

- ① Stator winding
- ② Air gap
- ③ Transformed rotor winding

6 RASP speed controllers

6.8 Parameters

An exact calculation requires the precise rating specifications of the motor (parameter group 7). The speed control (P11.8 = 1) can then compensate the load-related slip deviations. The simple illustration shows that, as the load torque increases (①), the resulting speed reduction is compensated by an increase in the output frequency (②) (see figure).

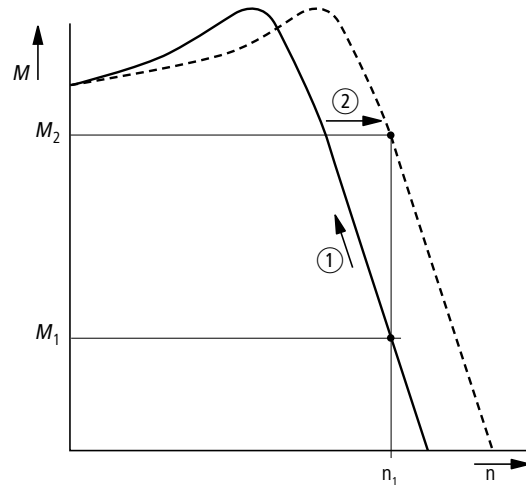


Figure 113: Speed behavior with slip compensation

6.8.6.7 Switching frequency/Pulse frequency

Only adjustable in Expert mode.

PNU	ID	Access right		Value	Description	DS (P1.1 = 0)
		RUN	rw/ro			
P11.9	601	–	rw		Pulse frequency (f_{PWM}) 1.5 - 16.0 kHz Using a high switching frequency can reduce the magnetization noise in the motor. The heat dissipation in the inverter (IGBT) increases with higher switching frequencies. With motor frequencies < 5 Hz a higher speed stability can be achieved at low switching frequencies. Note: For protection against thermal overload, the variable frequency drive will reduce the switching frequency automatically if, for example: <ul style="list-style-type: none"> • too high values are set • The ambient air temperatures are high • high load currents. Parameter P11.10 must be set to 1 for operation at a constant pulse frequency.	6.0
P11.10	522	–	rw		Pulse frequency, stabilizer (sinusoidal filter)	0
				0	Deactivated	
				1	activated The switching frequency set at P11.9 (f_{PWM}) is kept constant. Note: When using a sinusoidal filter, the pulse frequency must be constant. If this setting is active (P11.10 = 1), excessively high ambient temperatures or load currents can cause an automatic disconnection with the error message F14 (→ Section 6.7, "Diagnostics and error handling", page 129).	

6.8.6.8 Braking (P12)

RASP versions with braking resistance and activated brake chopper:

- RASP-21...
- RASP-31...
- RASP-41...
- RASP-51...



Parameters P12.5 and P12.6 are shown only when the RASP contains a braking resistance. The internal braking resistance ($R_B = 1500 \Omega$) has a continuous braking power of 460 W.

In parameter group P12 you can set different brake functions of the RASP:

- Generative braking (brake chopper with braking resistance),
- mechanical braking (actuation).

The brake functions make it possible to reduce undesired coasting and long decelerations. Mechanical braking also ensures safe operating states.

6 RASP speed controllers

6.8 Parameters

Regenerative braking

If the rotor of an asynchronous motor is driven oversynchronously in the operating direction of the rotating field, it generates electric power via its stator windings. This turns the motor into a generator. In the variable frequency drive, this generative energy causes an increase in the DC link voltage.

Oversynchronous speeds occur, for example, when the output frequency in variable frequency drive operation is reduced with short deceleration times, the connected machine has a large flywheel mass or when the flowing medium in pumps and fans works against the speed reduction.

The increase in the DC link voltage is monitored by the variable frequency drive and always enables a braking torque of about 30% of the motor's rated torque. A higher braking torque can be achieved by selecting a more powerful RASP variable frequency drive. RASP units have an internal braking chopper with a high-capacity resistor.

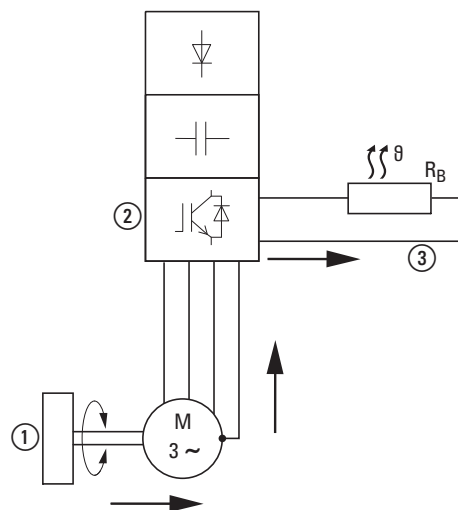


Figure 114: Regenerative braking with external braking resistance

- ① Machine flywheel mass
- ② Inverter with brake chopper (brake transistor)
- ③ Braking resistance (R_B)
- Energy flow (braking torque)

PNU	ID	Access right		Value	Description	DS (P1.1 = 1)
		RUN	rw/ ro			
P12.5	504	–	rw		Brake chopper	2
				0	Brake-chopper deactivated	
				1	Automatic activation in operation (RUN); dynamic intermediate brake	
				2	Automatic activation in operation (RUN) and on STOP. Dynamic intermediate brake in operation and during deceleration ramp after a Stop signal.	
P12.6	1447	–	rw		Brake chopper, switching threshold	765
				Setting range: 0 - 911 V		
				→ The switching threshold for the brake transistor should always be above the maximum DC link voltage.		
				For example, allowing for the maximum permissible excess supply system voltage of +10%: $U_{LN} = 400 \text{ V AC}$ $U_{LN} + 10 \% = 400 \text{ V AC} = 440 \text{ V AC}$ $U_{DC} = 1.42 \times U_{LNmax} = 1.42 \times 440 \text{ V} = 625 \text{ V DC}$ (maximum permissible DC link voltage in motor operation). Allowing for an energy absorption from the DC link of around 30% during braking, the on threshold here for the braking transistor should be set to around 780 V.		
				Note: If the ON switching threshold is set to lower values, the braking resistance will be switched on earlier, i.e., it will be subjected to a greater load. The magnitude of the DC link voltage is shown under M1.8. In practice, the DC link voltage will be around 565 V when $U_{LN} = 400 \text{ V}$.		

Mechanical brake (actuation)

→ The actuation of an external mechanical brake can only be set in expert mode (P1.1 = 0) if parameter P5.3 = 29 is activated.

If the variable frequency drive module's output frequency (F2) exceeds the value set with P5.5, the assigned digital output (P5.3 → DO) is activated and the motor's external, mechanical brake is actuated. The brake releases. If the output frequency drops under the value set with P5.7, the digital output is switched off again. The mechanical brake engages.

6 RASP speed controllers

6.8 Parameters

In practice you can select the following settings:

- P6.8 = 0: Digital output and brake are switched off directly with the Stop signal, regardless of the output frequency.
- P5.5 = P5.7: Same On and Off frequency, e.g. for holding brakes
- P5.5 > P5.7: The output frequency must have exceeded the value of P5.5 before the brake engages again when the value drops below that of P5.7.
- P5.5 < P5.7 (→ Figure 115): After the value of P5.5 is exceeded, the digital output will remain active (= brake vented) until the output frequency has exceeded the value of P5.7 as well. Once the value falls below the value of P5.7, the digital output can be activated again as soon as the value also falls below the value of P5.5.

The on/off-delay for digital output DO, and therefore the brake's venting and engagement, can be influenced by using parameters P5.12 (DO on-delay) and P5.13 (DO off-delay).

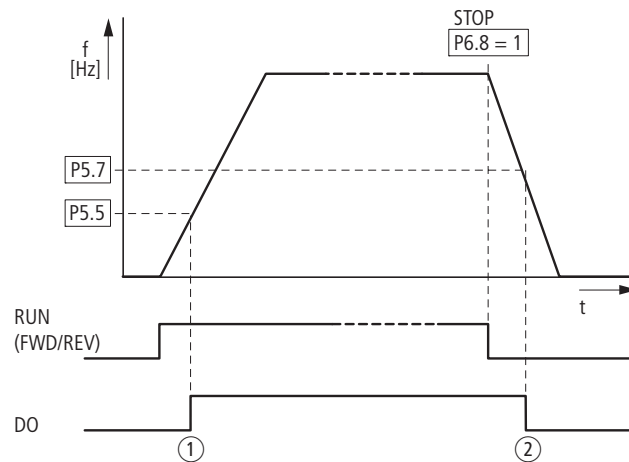


Figure 115: Mechanical brake actuation

- ① Brake, released
- ② Brake activates and brakes the drive mechanically.

6 RASP speed controllers

6.8 Parameters

PNU	ID	Access right		Value	Description	DS (P1.1 = 0)
		RUN	rw/ro			
P12.7	1448	–	rw		<p>Open external brake, deceleration time</p> <p>Setting range: 0.00 - 320.00 s Condition: RUN (Start enable) If the frequency set here is exceeded, value 26 will be used to switch the assigned digital output (P5...) and actuate (vent) the brake.</p>	0.2
P12.8	1449	–	rw		<p>Open external brake, frequency limit value</p> <p>Setting range: 0.00 - P6.4 Hz Condition: RUN (Start enable) After the time set here has elapsed, the value 26 is switched to the assigned digital output (P5...) (brake actuated).</p>	1.50
P12.9	1450	–	rw		<p>Close external brake, frequency limit value</p> <p>Setting range: 0.00 - P6.4 Hz If the frequency goes below the value set here, the value 26 deactivates the assigned digital output (P5...). The brake closes again.</p>	1.00
P12.10	1451	–	rw		<p>Close external brake, frequency limit value on reversing (REV)</p> <p>Setting range: 0.00 - P6.4 Hz</p>	1.50
P12.11	1452	–	rw		<p>Open external brake, current limit value</p> <p>Setting range: 0.00 - P7.2 A Condition: RUN (Start enable) On reaching the current value set here, the value 26 is switched to the assigned digital output (P5...) (brake actuated).</p>	0.00

6 RASP speed controllers

6.8 Parameters

6.8.6.9 System parameter

The system parameters (S parameters) inform the user of device-specific settings.



With the exception of group S4, the system parameters are set to the ro (= read-only) status and cannot be modified!

PNU	ID	Access right		Value	Description	Factory setting
		RUN	rw/ro			
Hard- and Software Information						
S1.1	2314	–	ro	xx	API SW ID: control section, software identification	0
S1.2	835	–	ro	xxxxx	API SW Version: Control section, software version	0
S1.3	2315	–	ro	x	Power SW ID: power section, software identification	0
S1.4	834	–	ro	xxx	Power SW Version: Power section, software version	0
S1.5	837	–	ro	90xx	Application ID	0
S1.6	838	–	ro	xxx.xx	Application revision	0.00
S1.7	839	–	ro	xx	System load	0
					Load as percentage [%].	
Communication (for internal communication only)						
S2.1 ¹⁾	808	–	ro	xx.yyy	Communication status	0.00
					xx = Number of error messages (0 to 64) yyy = Number of correct messages (0 to 999)	
S2.2 ¹⁾	809	✓	rw		Field bus protocol	1
				0	Field bus deactivated	
				1	Modbus RTU	
S2.3 ¹⁾	810	✓	rw		Station address	1
					Station address 1 to 255.	
S2.4 ¹⁾	811	✓	rw		Baud rate	5
					Transfer rate (1 Baud = 1 symbol per second) The baud rate must be equal on the send and receive sides.	
				0	= 300 Baud	
				1	= 600 Baud	
				2	= 1200 baud (1.2 kBaud)	
				3	= 2400 baud (2.4 kBaud)	
				4	= 4800 baud (4.8 kBaud)	
				5	= 9600 baud (9.6 kBaud)	
				6	= 19200 baud (19.2 kBaud)	
				7	= 38400 baud (38.4 kBaud)	
8	= 57600 baud (57.6 kBaud)					

1) Parameters S2.1 to S2.4 are used only for internal communication of the RASP's variable frequency drive module and re overwritten with specific parameter values.

6 RASP speed controllers

6.8 Parameters

PNU	ID	Access right		Value	Description	Default settings
		RUN	rw/ro			
S2.6	813	–	ro		Parity type	0
				0	= No function (inaccessible)	
S2.7	814	–	ro		Communication timeout	0
				0	= Not used	
				1	= 1 s	
				2	= 2 s	
				...255	= up to 255 s	
S2.8	815	–	ro		Reset communication status	0
				0	= Not used	
				1	= Resets parameter S2.1	
Unit counter						
S3.1	827	–	ro	-	MWh counter	0.00
S3.2	828	–	ro	-	Operating days [d]	0
S3.3	829	–	ro	-	Operating hours [h]	0
S3.4	840	–	ro	0 - 0000	RUN counter, days	0
S3.5	841	–	ro	0 - 24	RUN counter, hours	0
S3.6	842	–	ro	0 - 0000	FLT counter: Error counter	0
S3.7 ¹⁾		–	ro	0 - ...	Parameter set status (RASP-KEY-S1 only)	5
User Set						
S4.2	831	–	rw		Default settings (WE)	0
				0	= Factory setting or changed value (user setting for parameter)	
				1	= Restores default settings for all parameters.	
S4.3	832	✓	rw		Password	0000
					The password protection applies to all parameters. Password forgotten (→ Service and warranty, page 22)	
				0000	Deactivated	
S4.4	833	✓	rw		Backlight (RASP-KEY-S1 only)	5
				0	deactivated, always OFF	
				1 - 60	activated. set value 1 to 60 minutes	
S4.5		–	rw		Save parameter set (RASP-KEY-S1 only)	0
				0	Deactivated	
				1	Activated, save parameter set in RASP-KEY-S1	
S4.6		–	rw		Write back parameter set (RASP-KEY-S1 only)	0
				0	Deactivated	
				1	Activated, save parameter set from RASP-KEY-S1 to speed control unit RASP	

6 RASP speed controllers

6.8 Parameters

6.8.7 Operational data indicator (MON) on external keypad

When the specified supply voltage (L1, L2, L3, N) is applied, the LCD display will be illuminated (= Power ON) and all segments will be shown briefly.

After this, the parameter number (M1.1) and the corresponding display value (0.00) will automatically be shown in alternating sequence.

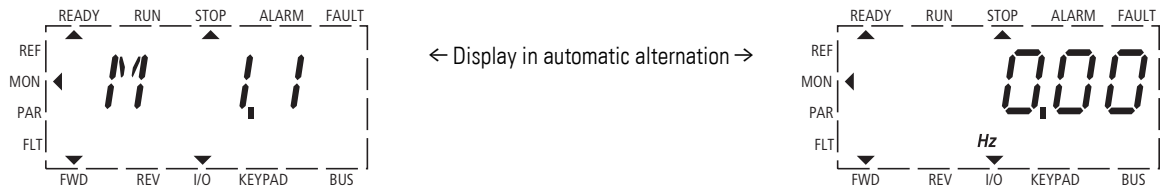


Figure 116: Operational data indicator

The \wedge and \vee arrow keys can be used in the MON (monitor) menu mode to show the desired operational data (parameter number M...). The parameter number and the display value are shown in alternation automatically, and the display can be fixed on the selected display value with the OK button. If you wish to access a different operational data indicator, press the OK button once again. Then use the \wedge and \vee arrow keys to make your selection and confirm with the OK button like you did previously. The appropriate unit is shown under the respective operational data indicator.



The values of the operating data display cannot be changed by hand (i. e. by value entry)!



You can select operational data indicators during operation (RUN).

PNU	ID	Designation	Display value	Unit	Description
M1.1	1	Output frequency	0.00	Hz	Frequency to motor
M1.2	25	Frequency reference value	0.00	Hz	Frequency reference value
M1.3	2	Motor shaft speed	0	rpm	Calculated speed of the motor (rpm) ¹⁾
M1.4	3	Motor current	0.00	A	Measured motor current
M1.5	4	Motor torque	0.0	%	Calculated ratio of torque to rated torque of the motor ¹⁾ .
M1.6	5	Motor Power	0.0	%	Calculated ratio of actual output power to rated motor output ¹⁾ .
M1.7	6	Motor voltage	0.0	V	Measured output voltage to motor.
M1.8	7	DC link voltage	000	V	Measured intermediate circuit voltage (depending on the supply voltage).
M1.9	8	Unit temperature	00	°C	Measured heat sink temperature.
M1.10	9	Motor temperature	0	%	% (calculated value)
M1.11	13	Analog input 1	0.0	%	Value on AI1
M1.14	15	Digital input	0	–	DI1, DI2, DI3 state (see example below)
M1.15	16	Digital input	0	–	DI4, DI5, DI6 state (see example below)
M1.16	17	Digital output	1	–	RO1, RO2, DO state (see example below)
M1.21	1480	Counter, digital input	0	–	Number of control sections of a digital input (DI1 to DI6) assigned to P3.23. The counter reset command is set with P3.24.
M1.22	1999	RASP device unit temperature	0	°C	Measured temperature in the RASP enclosure.

1) The calculated motor data (M1.3, M1.5 and M1.6) is based on the values entered in parameter group P7
(→ Section 6.8.6.3, "Motor (P7)", page 156).

2) The calculated motor temperature (M1.10) considers the temperature model of the protection function in parameter group P8
(→ Section 6.8.6.4, "Protective functions (P8)", page 158)

6 RASP speed controllers

6.8 Parameters

Example: Status displays

The status displays of the digital inputs and outputs are equivalent. They make it possible to check whether a control signal that is output (e.g., from an external controller) will activate the variable frequency drive's inputs (DI1 to DI6). This provides you with an easy way to check the wiring (wire breakage).

The following table shows a few examples.

Display value:

- 1 = activated = High
- 0 = not activated = Low

PNU	ID	Display value	Description
M1.14	15	0	No digital input (DI1, DI2, DI3) is actuated.
		1	Control signal terminal 10 is actuated (DI3) = AS-Interface : DQ2 (FF1).
		10	Control signal terminal 9 is actuated (DI2) = AS-Interface : DQ1 (REV).
		100	Control signal terminal 8 is actuated (DI1) = AS-Interface : DQ0 (FWD).
		101	Control signal terminals 10 and 8 are actuated (DI3 + DI1) = AS-Interface : DQ2 + DQ0.
		111	Control signal terminals 10, 9 and 8 are actuated (DI3 + DI2 + DI1) = AS-Interface : DQ2 + DQ1 + DQ0.
M1.15	16	1	Control signal terminal 14 is actuated (DI14) = AS-Interface : DQ3 (FF2).
		10	Control signal terminal 15 is actuated (DI15) = RESET.
		100	Control signal terminal 16 is actuated (DI16) = QUICK STOP
M1.16	17	1	Transistor DO is actuated. The transistor switches the voltage connected at control signal terminal 20 (DO+) to control signal terminal 13 (DO-) = Fault → error message through AS-Interface.
		10	Relay R02 is actuated. Control signal terminals 25 (R21) and 26 (R24) are connected (closed changeover contact). Switches output F for the device fan.
		100	Relay R01 is actuated. N/O contact, control signal terminals 22 (R13) and 23 (R14) are closed. Controls the electronic circuit-breaker for the external brake.

6.8.8 Error and Warning messages (FLT)

6.8.8.1 Introduction

On speed control unit RASP all errors are indicated by the group fault (motor LED lit red). When a deviation from the correct operating state is detected, the built-in frequency inverter module can distinguish between fault (FAULT) and alarm messages (ALARM).

Through the serial interface (RJ 45 plug under the locking screw, → Section 6.6.3, "Adjust dip switch", page 122) detailed information about a fault signal can be viewed with the MaxConnect PC software or with optional LED keypad RASP-KEY-S1.

6.8.8.2 Error Messages

Faults can cause malfunctions and technical defects. The inverter (variable frequency drive's output) is automatically disabled if a fault is detected. The connected motor then runs down freely to a stop.

On the display of optional LCD keypad RASP-KEY-S1 the error messages are displayed with an arrow head ▲ under FAULT and failure code F.... The current (last) error is always labeled F1 and flashes; the last but one is labeled F2, etc.



Figure 117: Example of an error message (undervoltage)

6.8.8.3 Acknowledge error message (Reset)

Error messages are normally acknowledged by turning the key switch to position OFF/RESET. On the display of LCD keypad RASP-KEY-S1 the error message stops flashing. The arrow point ▲ underneath FAULT disappears. BACK/RESET key, although this resets only the error message in the variable frequency drive module.

In conjunction with the RASP-KEY-S1 keypad, a reset command can be output automatically every 5 seconds. If the LED flashes at the Motor symbol, the fault message can be acknowledged.

➔ The fault signal (error message) in the RASP can be acknowledged only with the key switch in position OFF/RESET.

The current fault message indication (F1...) in RASP-KEY-S1 is cleared when the supply voltage is interrupted or when you press the BACK/RESET key and then the OK key (indication d...) and then the BACK/RESET key again. The fault message is cleared from the display and the arrow point ◀ flashes at menu mode MON. To select the Monitor menu, use the OK key.

➔ When in the error register (display F...), it is only possible to return to the menu mode (arrow point ◀ FLT flashes) from display F... .

6 RASP speed controllers

6.8 Parameters

6.8.8.4 Fault log (FLT)

The faults in the fault memory (FLT) can only be read out with the optional RASP-KEY-S1 LCD keypad. The nine most recent faults will be listed.

In menu mode FLT (◀), the ^ and ∨ arrow keys can be used to open faults F1 to F9 individually. Every error message is stored with the time of the error occurrence under d (day), H (hour) and m (minute). The call is made with the OK button, and the selection with ^ and ∨ arrow buttons.

The fault memory will be cleared when you load the default settings.



Activating the default settings will reset all parameters!

6.8.8.5 Alarm messages

An alarm message gives warning of possible damage and indicates impending errors that can still be prevented, such as an excessively high temperature rise. Warning messages appear on the display of optional LCD keypad RASP-KEY-S1 with an arrow point ▲ under ALARM and AL with the associated code number. The code numbers for faults and warning messages are identical.



Figure 118: Example of an alarm message



If a warning message occurs, the variable frequency drive in RASP remains active (READY, RUN).

The alarm message (AL) is displayed alternating with the active operational display value.

Table 15 shows the failure codes, their possible causes and indicates correction measures.

Table 15: List of fault messages (F) and warning messages (AL)

Display	Designation	Possible cause	Notes
01	Overcurrent	<ul style="list-style-type: none"> The variable frequency drive has detected an excessive current ($> 4 \times I_N$) in the motor cable. Sudden load increase. Short-circuit in motor cable. inadequate motor. 	<ul style="list-style-type: none"> Check the load Check the motor size Check the cable (→ parameter P6.6)
02	OverVoltage	<ul style="list-style-type: none"> The DC link voltage has exceeded the internal safety limit. the delay time is too short. high overvoltage peaks in supply system 	increase braking time
03	Ground fault	<ul style="list-style-type: none"> An additional leakage current was detected when starting by means of a current measurement. Insulation fault in the cables or in the motor 	Check the motor cable and the motor
08	System fault	<ul style="list-style-type: none"> Central processing unit error message Internal communication fault. 	Reset error: Switch mains voltage off and on (Restart). If the fault occurs again, please contact your closest Eaton representative.
09	Undervoltage	<p>The DC link voltage has exceeded the internal safety limit.</p> <p>Probable cause:</p> <ul style="list-style-type: none"> the supply voltage is too low, internal device fault, Power failure. 	<ul style="list-style-type: none"> If a brief power failure takes place, reset the fault and restart the variable frequency drive. Check the supply voltage. If it is OK, there is an internal fault. If this is the case, please contact your closest Eaton representative.
11	Phase failure Motor cable	<p>Cable break in:</p> <ul style="list-style-type: none"> Motor feeder plug Motor cable Terminal box of the motor 	<p>This error message is also output in no load operation or when a zero setpoint value is active.</p> <p>Remedy: replace motor cable with the plug</p> <p>Note: Error message implemented from Release 007.</p>
13	Under-temperature	The IGBT switch temperature is below -10 °C.	Check the ambient air temperature
14	Overtemperature	The IGBT switch temperature is above 120 °C. An excessive temperature warning is issued if the IGBT switch temperature goes above 110 °C.	<ul style="list-style-type: none"> Make sure that there is an unobstructed flow of cooling air Check the ambient air temperature Make sure that the switching frequency (→ Parameter P11.9) is not too high in relation to the ambient air temperature and to the motor load:
15	Motor blocked	The motor blocking protection mechanism has been triggered.	Check the motor
16	Motor overtemperature	The variable frequency drive's motor temperature model has detected motor overheating. The motor is overloaded.	Decrease the motor load. If the motor is not overloaded, check the temperature model parameter.
17	Motor underload	Motor idle, connection to load machine interrupted (e.g. torn drive belt).	This function must be activated under P8.5. The underload message is set with P8.12 and P8.13.
22	EEPROM checksum error	<ul style="list-style-type: none"> Error when storing parameters. Malfunction, Component fault, Error in microprocessor monitoring. 	Please contact your closest Eaton representative.
25	Watchdog	<ul style="list-style-type: none"> Error in microprocessor monitoring. Malfunction, Component fault. 	Reset the fault and restart If the fault occurs again, please contact your closest Eaton representative.
27	Back EMF	<p>Electromotive force</p> <p>The voltage induced in the motor with the rotation is greater than the output voltage of the variable frequency drive.</p>	<ul style="list-style-type: none"> The rotation energy is greater than the braking energy. Lengthen deceleration times. Switch on brake chopper and braking resistance. Use higher rated variable frequency drives.

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6.8 Parameters

Display	Designation	Possible cause	Notes
30	Internal error	Internal error message. No function with RASP.	The fault cannot be reset. Please contact your closest Eaton representative.
35	Application error	The application is not working.	Please contact your closest Eaton representative.
50	Live zero error (Analog input)	Internally monitored zero point (4 mA, 2 V → parameter P2.1) for analog input (AO1)	Please contact your closest Eaton representative.
51	External fault	Error message on a digital input (DI1 to DI6) that is programmed as an input for an external error message.	<ul style="list-style-type: none">• Check the programming (P3.5, P3.6) and check the device indicated by the error message.• Check the cabling for the respective device as well.
53	Field bus error	The internal communication connection is interrupted. No function with RASP.	Please contact your closest Eaton representative.
54	Field bus interface error	The field bus connection is interrupted. No function with RASP.	Please contact your closest Eaton representative.
55	(Reserve)	–	–

6.8.9 Setpoint input (REF)



This function is not enabled in RASP units!

7 Appendix

7.1 Dimensions

RAMO motor starter

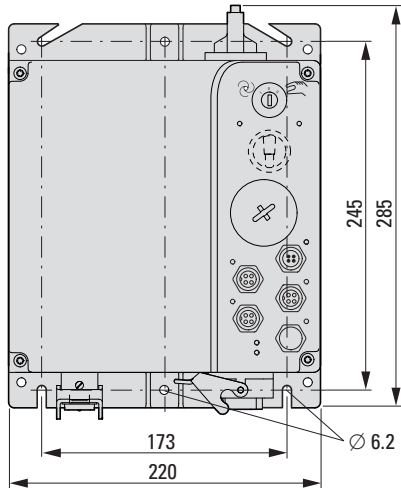
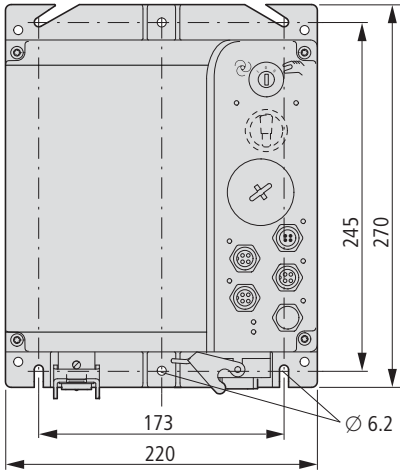
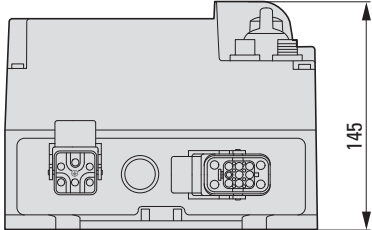
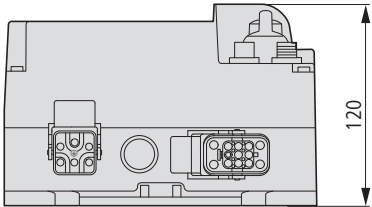


Figure 119:RAMO-D, RAMO-W

Figure 120:RAMO-D, RAMO-W
 with repair and maintenance switch

RASP speed controllers

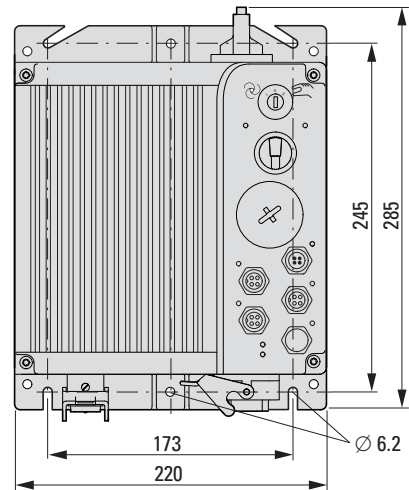
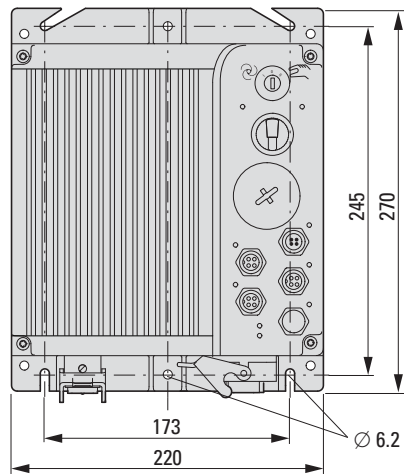
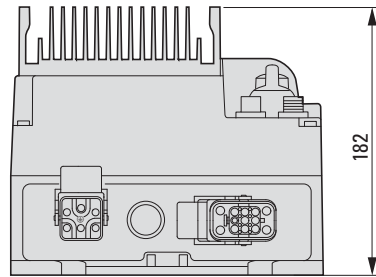
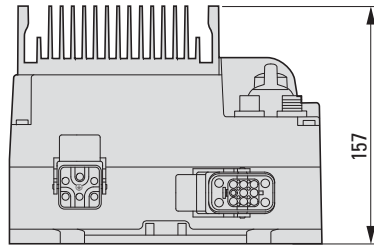


Figure 121: RASP-2, RASP-3, RASP-4

Figure 122: RASP-2, RASP-3, RASP-4 with repair and maintenance switch

RASP speed controllers

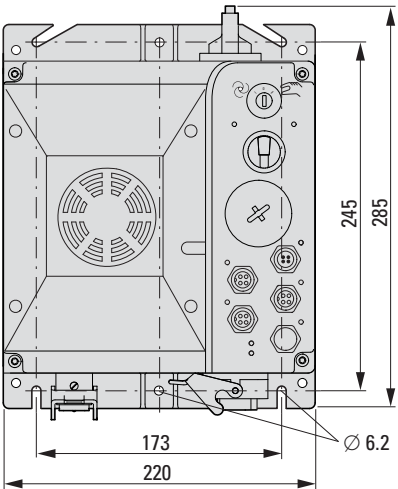
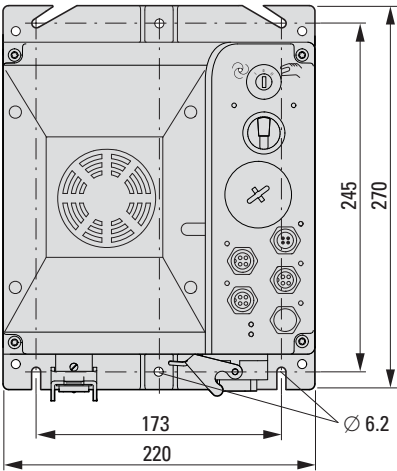
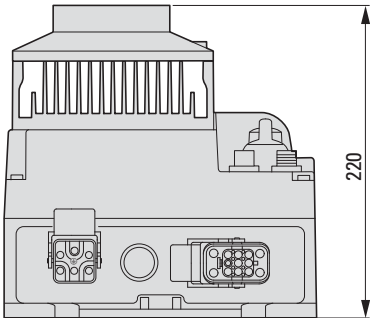
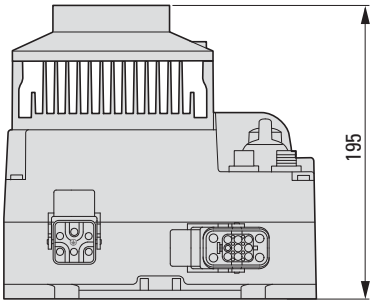


Figure 123:RASP-5
(2.2 kW with device fan)

Figure 124:RASP-5 (2.2 kW with device fan)
with maintenance and repair switch

7.2 Accessories

7.2.1 Device fan RASP-FAN-S1

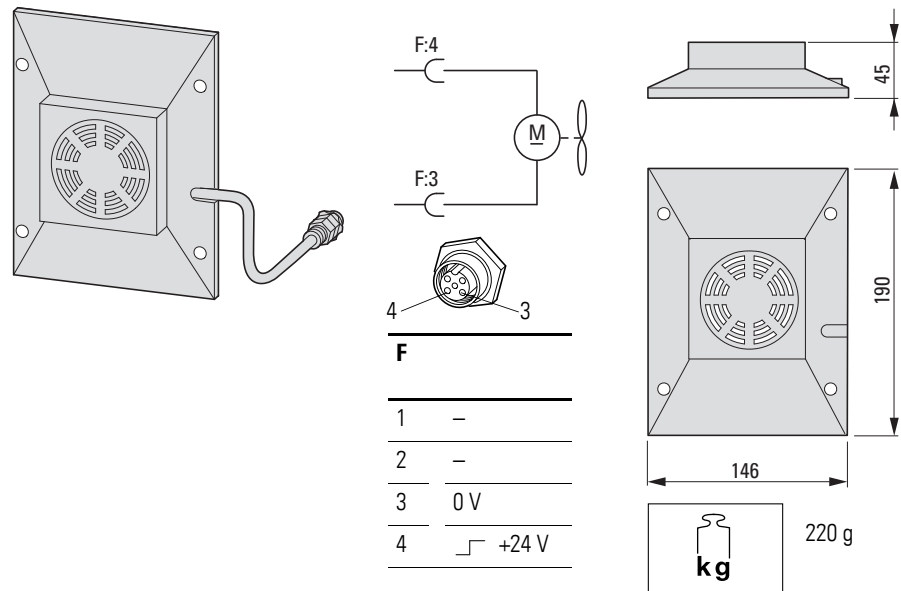


Figure 125:RASP-FAN-S1
(article no.: 156643)

Figure 126:Device fan dimensions



Device fan RASP-FAN-S1 is not supplied with the RASP.
The device fan is an integral part of RASP-5... (2.2 kW) devices.

Device fan RASP-FAN-S1 can be fitted for increased cooling on versions RASP-2... (0.75 kW), RASP-3... (1.1 kW) and RASP-4... (1.5 kW). It increases the highest permissible ambient air temperature from +40 °C to +55 °C.

On RASP-5... (2.2 kW) units, the device fan that already comes installed is part of the required cooling equipment. The maximum permissible ambient air temperature for RASP-5... (2.2 kW) units is +40 °C / +55 °C with derating.

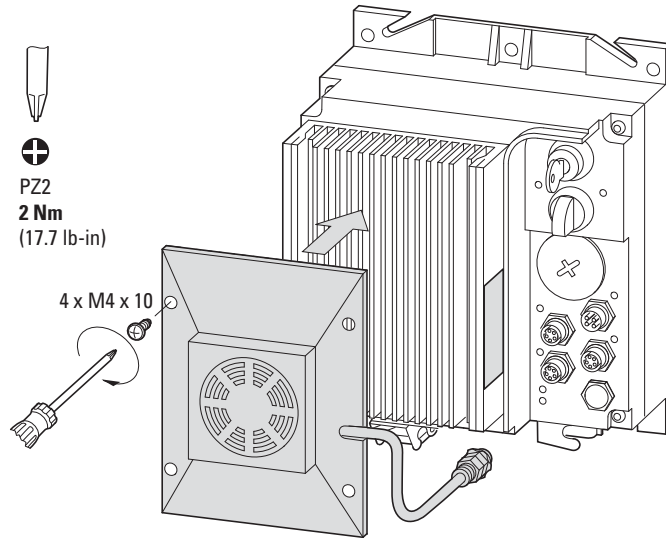


Figure 127: Mounting the RASP-FAN-S1 device fan

The device fan is fitted to the heat sink with the four supplied screws. The device fan is temperature-controlled by the RASP through the M12 socket.

7.2.2 XMX-CBL-3M4-USB communication cable

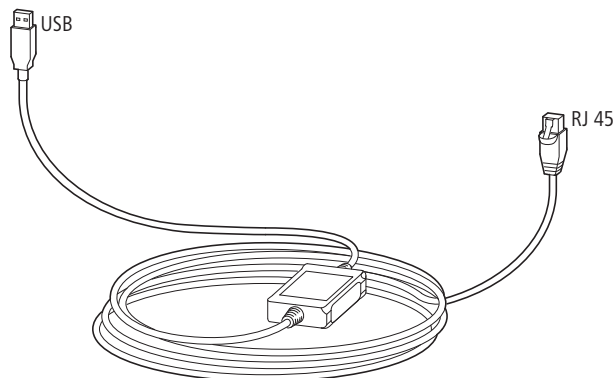


Figure 128: XMX-CBL-3M4-USB communication cable (article no.: 153448)



XMX-CBL-3M4-USB connection cable is not supplied with the RASP.

Connection cable XMX-CBL-3M4-USB allows communication and data exchange between RASP and a PC. The cable has a length of about 3.4 m, an interface converter with potential isolation, an RJ45 plug and a USB port.

Connect RJ45 plug to the serial interface ③, under the sealing screw of the RASP. Connect the USB plug to a free USB port on the PC.

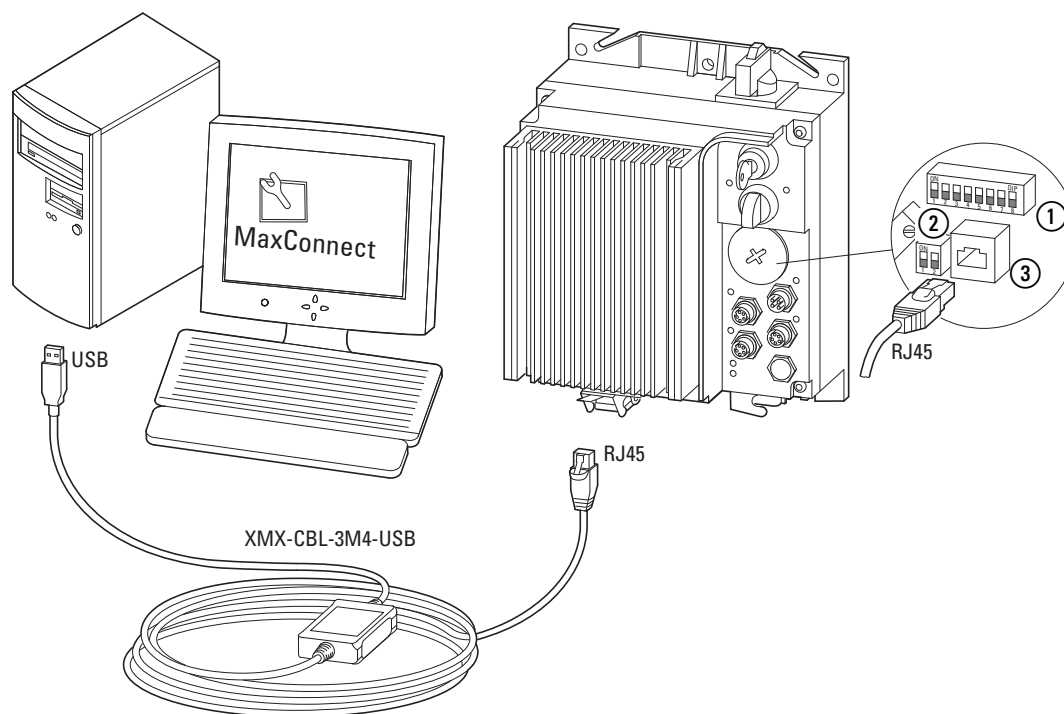


Figure 129: Communication cable between PC and RASP unit

RASP plug for cable screw gland

- ① Functions, dip switch
- ② dip switch (currently without function)
- ③ Serial interface (RJ 45)

For data-exchange between PC and RASP the RASP must be supplied with mains voltage.

- ▶ Go to the **Support** area.
 - ▶ Under **Download Center**, check the **Software** check box.
 - ▶ Select **Rapid Link** from the "By Applications" drop-down menu.
 - ▶ Download the **MaxConnect** program.
- RASP units require version V 1.1.2.0 or higher.



The MaxConnect parameter configuration software program can be downloaded for free from Eaton's website:

www.eaton.de/EatonDE/ProdukteundLoesungen/Electrical/index.htm
→ **Customer support** → **Download Center** – **Software**

7.2.3 Optional keypad RASP-KEY-S1

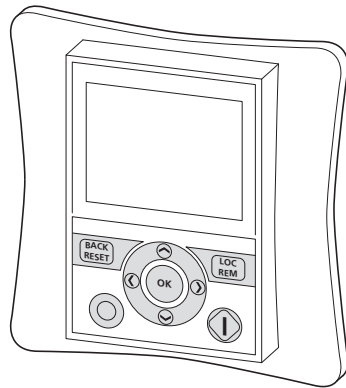


Figure 130:RASP-KEY-S1
(article no.: 156644)

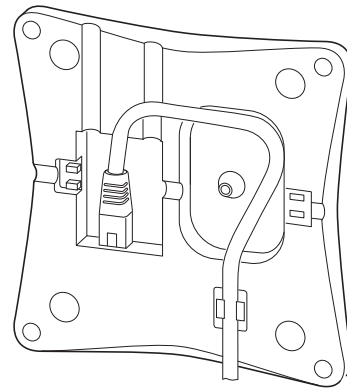


Figure 131:RJ45 socket at the back of LCD
keypad RASP-KEY-S1



RASP-KEY-S1 optional LCD keypad is not supplied with the RASP.

The optional RASP-KEY-S1 keypad enables you to configure the RASP's parameters and view operational data. The Start and Stop keys and the setpoint input have no function. The connection to the RASP requires a patch cable with an RJ45 plug.



The RASP-KEY-S1 keypad is supplied with a 1 m long patch cord.

7.2.3.1 AS-i-profile

RASP

RASP... units have AS-i profile S-7.E.0 (old) and AS-i profile S-7.4 (new).

Due to the expanded AS-i profile, the master (gateway) needs to carry out a new initialization process if new RASP devices with profile S-7.4 are used as a replacement. To do this, the AS-i master needs to be switched to configuration mode. In this mode, the AS-i master will recognize the type and profile of the AS-i slaves connected to the AS-i cable.

The profile is hard-coded into the slave modules during production and cannot be changed. On PROFIBUS/AS-i gateways, this configuration mode can usually only be activated if there are no ongoing communications with the PROFIBUS.

The assignment of Rapid Link inputs/outputs and the data bits remain the same. The PLC programs do not have to be modified.

RAMO

RAMO-...AI1S devices have AS-i profile S-7.4 (old); RAMO-...AI2S devices have AS-i profile S-7.A.E (new).

Due to the expanded AS-i profile, the system needs to be reinitialized if new RAMO devices with profile S-7.4 are replaced with RAMO devices with profile S-7.4.A.E. To do this, the AS-i master needs to be switched to configuration mode. In this mode, the AS-i master will recognize the type and profile of the AS-i slaves connected to the AS-i cable.

The profile is hard-coded into the slave modules during production and cannot be changed. On PROFIBUS/AS-i gateways, this configuration mode can usually only be activated if there are no ongoing communications with the PROFIBUS.

The assignment of Rapid Link inputs/outputs and the data bits remain the same. The PLC programs do not have to be modified.

7.2.4 lock shackle SET-M-LOCK

For cases in which the system user requires a disconnect and locking facilities for padlocks on every motor, the SET-M-LOCK locking clip can be used. This locking clip can be used to safely de-energize and lock and tag out SET-M3... and SET-M4... motor cables with one or two padlocks with a shackle diameter of up to 8 mm.

The locking clip fulfils the requirements of IEC/EN 60204-1 in combination with RAMO motor starters and RASP speed controllers:

- For supply disconnecting mains isolating devices for up to 16 A as per section 5.3
- for circuit breaking equipment for preventing unexpected starting according to section 5.4,
- For devices for disconnecting electrical equipment as per section 5.5
- for protection against unauthorized, unintentional and / or erroneous closing according to section 5.6.

The locking clip can be mounted next to any RAMO motor starter and RASP speed controller with one or two 90° M5 countersunk head screws (e.g. according to ISO 2009 or ISO 7046). Alternatively, the locking clip can be given to specialist maintenance engineers as an aid for the toolkit.

Procedure

- ▶ Set the key switch of the motor control unit (RAMO or RASP) to its OFF position.
- ▶ Wait until the motor comes to a stop and the DC link voltage is discharged (at least 5 minutes).
- ▶ Unclamp the locking clip from the motor feeder and pull the motor plug out of the socket on the drive motor control device.
- ▶ Join the motor plug in the locking clip and secure it in place with your padlock.

7 Appendix
7.2 Accessories

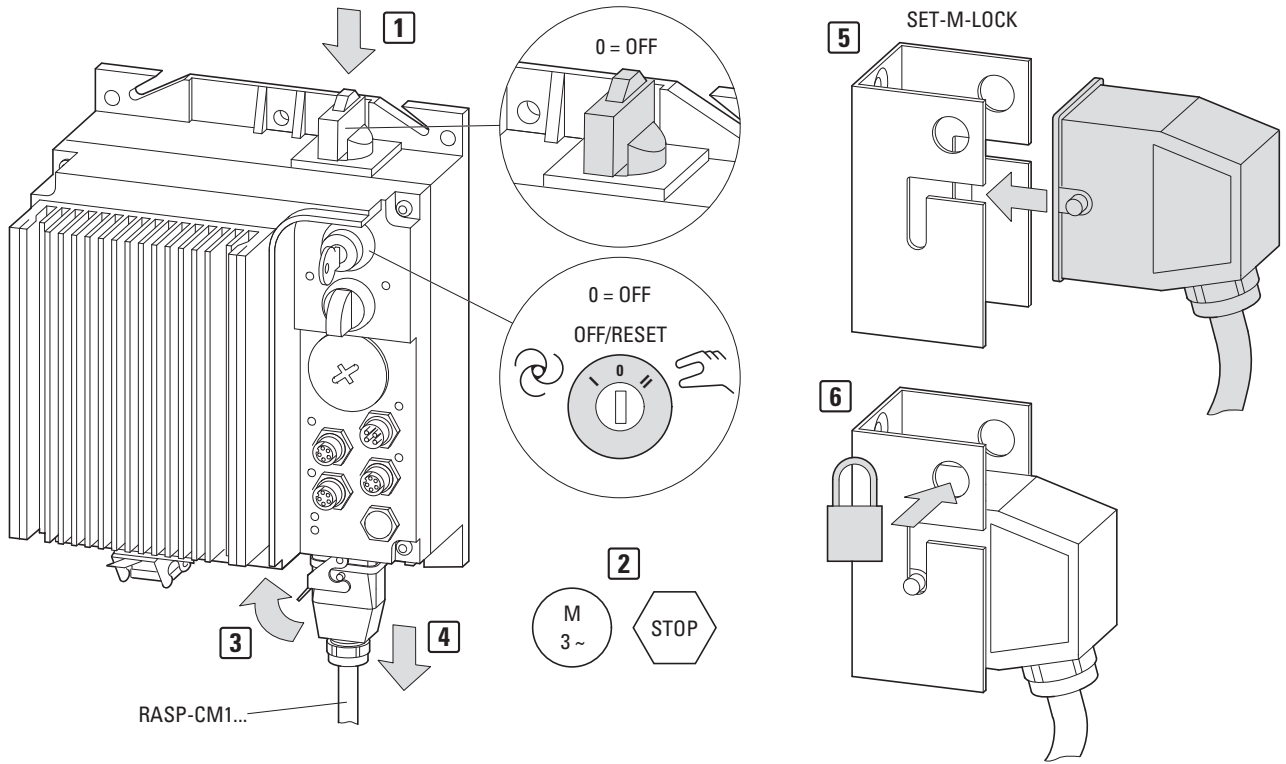


Figure 132: Installing the locking clip

7.2.5 Motor cable

RAMO (RAMO-CM1-...)

The motor needs to be connected using an unshielded, DESINA-compliant RAMO-CM1-... (8 x 1.5 mm²) motor cable.

Table 16: Pin assignment



1	1	U1		
	–			
3	3	W1		
4	5			m2
5	6		T1	
6	4			B1
7	2	V1		
8	7		T2	
PE (polyethylene)	PE (polyethylene)	PE (polyethylene)		

RASP (RASP-CM1-...)

The motor needs to be connected using an unshielded, DESINA-compliant RASP-CM1-... (4 x 1.5 mm² + 2 x (2 x 0.75) mm²) motor cable.

Table 17: Pin assignment



1	1	U1		
	–			
3	3	W1		
4	5			m2
5	7		T1	
6	6			B1
7	2	V1		
8	8		T2	
PE (polyethylene)	PE (polyethylene)	PE (polyethylene)		

7 Appendix

7.3 Parameter lists for RASP

7.3 Parameter lists for RASP

The abbreviations used in the parameter lists have the following meaning:

PNU	Parameter number
ID	Identification number of the parameter
RUN	Access rights to the parameters during operation (RUN): ✓ = Modification permissible, - = Modification only possible in STOP
ro/rw	Parameter read and write permissions via a fieldbus connection (BUS) ro = read only rw = read and write
Page	Page reference for parameter description in this manual.
DS	Default settings: <ul style="list-style-type: none">• WE (P1.1 = 1) Basis parameters
User setting	User setting of the parameters

7.3.1 Basis parameters (P1.1 = 1)



The table below lists all parameter in the RASP's default (P1.1 = 1) basic setting.

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					
Parameter selection								
P1.1	115	✓	rw	Parameter range	0 = Expert (extended parameter set)	149	1	
					Note: This manual only describes these parameters in part and in direct relation to Rapid Link. The general description of these parameters is provided in the manual MN04020001Z (M-Max variable frequency drive). 1 = Basis (standard parameters)			
P1.2	540	–	rw	Application	0 = FWD/REV/FF1/FF2	149	0	
					1 = FWD/FF1/FF2/FF3			
					2 = PM-Motor (not activated)			
P1.3	1472	–	rw	Default settings (FS), country specific	0 = EU	150	0	
					1 = USA			

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					
Drives control								
P6.2	117	✓	rw	Setpoint input	0 = FF0 (Fixed frequency) 1 = REF (operating unit) 3 = Potentiometer n0 (AI1, control signal terminal 2)	149	3	
P6.3	101	–	rw	Minimum frequency	0.00 - P6.4 Hz	151	0.00	
P6.4	102	–	rw	Maximum frequency	P6.3 - 320.00 Hz	152	50.00	
P6.5	103	–	rw	Acceleration time (acc1)	0.1 - 3000.0 s	152	5.0	
P6.6	104	–	rw	Deceleration time (dec1)	0.1 - 3000.0 s	152	2.0	
P6.7	505	–	rw	Start Function	0 = Acceleration time (ramp) 1 = Flying restart circuit	153	0	
P6.8	506	–	rw	Stop Function	0 = Free coasting 1 = Deceleration time (ramp)	153	1	
P6.9	500	–	rw	S ramp, time-based waveform	0.00 = linear 0.1 - 10.0 s = S-shaped	153	0.0	
P6.19	502	✓	rw	Acceleration time (acc2)	0.1 - 3000.0 s	154	10.0	
P6.20	503	✓	rw	Deceleration time (dec2)	0.1 - 3000.0 s	154	10.0	
P6.21	526	–	rw	Transition frequency (acc1 - acc2)	0.00 = deactivated 0.01 - P6.4 Hz	154	0.00	
P6.22	1334	–	rw	Transition frequency (dec1 - dec2)	0.00 = deactivated 0.01 - P6.4 Hz	154	0.00	
Motor								
P7.1	113	–	rw	Motor, rated operational current	0.2x I _e ... 2 x I _e (→ motor rating plate)	157	I _e	
P7.2	107	–	rw	current limitation	0.2 x I _e - 2 x I _e	157	1.5 x I _e	
P7.3	112	–	rw	Motor, rated speed	300 ... 20000 min-1 (→ motor rating plate)	157	1440	
P7.4	120	–	rw	Motor, power factor (cos φ)	0.3 - 1.00 (→ motor rating plate)	157	0.85	
P7.5	110	–	rw	Motor, rated operating voltage	180 - 500 V (→ Motor rating plate)	157	400	
P7.6	111	–	rw	Motor, rated frequency	30 - 320 Hz (→ Motor rating plate)	157	50.00	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					
Protective functions								
P8.3	703	–	rw	earth fault monitoring		158	2	
					0 = Deactivated			
					1 = Danger			
P8.4	709	–	rw	Stall protection	2 = Error, stop according to P6.8	158	2	
					0 = Deactivated			
					1 = Danger			
					2 = Error, stop according to P6.8			
Fixed frequencies								
P10.1	124	✓	rw	Fixed frequency FF0	0.00 - P6.4 Hz	160	5.00	
P10.2	105	✓	rw	Fixed frequency FF1	0.00 - P6.4 Hz	160	30.00	
P10.3	106	✓	rw	Fixed frequency FF2	0.00 - P6.4 Hz	160	40.00	
P10.4	126	✓	rw	Fixed frequency FF3	0.00 - P6.4 Hz	160	50.00	
P10.5	127	✓	rw	Fixed frequency FF4	0.00 - P6.4 Hz	160	10.00	
P10.6	128	✓	rw	Fixed frequency FF5	0.00 - P6.4 Hz	160	15.00	
P10.7	129	✓	rw	Fixed frequency FF6	0.00 - P6.4 Hz	160	20.00	
P10.8	130	✓	rw	Fixed frequency FF7	0.00 - P6.4 Hz	160	25.00	
V/f characteristic curve								
P11.1	108	–	rw	V/f characteristic curve, characteristic curve		162	0	
					0 = linear			
					1 = squared			
					2 = parameterizable			
P11.2	602	–	rw	Cut-off frequency	30.00 - 320.00 Hz	163	50.00	
P11.3	603	–	rw	Output voltage	10.00 - 200.00 % of nominal motor voltage (P6.5)	163	100.00	
P11.4	604	–	rw	V/f characteristic curve, mean frequency value	0.00 - P11.2 Hz	163	50.00	
P11.5	605	–	rw	V/f characteristic curve, mean voltage value	0.00 - P11.3 Hz	164	100.00	
P11.6	606	–	rw	Output voltage at zero frequency	0.00 - 40.00 %	164	0.00	
P11.7	109	–	rw	Torque increase		164	0	
					0 = Deactivated			
					1 = active			
P11.8	600	–	rw	Control Mode		164	0	
					0 = Frequency control (V/f)			
					1 = Speed control (vector)			

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					
Braking								
P12.5	504	–	rw	Brake chopper	Parameter indication only for RASP with braking resistance 0 = Deactivated 1 = Active in RUN 2 = Active in RUN and STOP	169	2	
P12.6	1447	–	rw	Brake chopper, switching threshold	Parameter indication only for RASP with braking resistance 0 - 911 V	169	765	
P12.7	1448	–	rw	Open external brake, deceleration time	0.00 - 320 s	171	0.20	
P12.8	1449	–	rw	Open external brake, frequency limit value	0.00 - 320.00 Hz	171	1.50	
P12.9	1450	–	rw	Close external brake, frequency limit value	0.00 - 320.00 Hz	171	1.00	
P12.10	1451	–	rw	Close external brake, frequency limit value on reversing (REV)	0.00 - 320.00 Hz	171	1.50	
P12.11	1452	–	rw	Open external brake, current limit value	0.00 - P7.2 A	171	0.00	
System parameters								
Hard- and Software Information								
S1.1	2314	–	ro	API SW ID	(144) ¹⁾	172	0	
S1.2	835	–	ro	API SW Version	(3) ¹⁾	172	0	
S1.3	2315	–	ro	Power SW ID	(1) ¹⁾	172	0	
S1.4	834	–	ro	Power SW Version	(113) ¹⁾	172	0	
S1.5	837	–	ro	Application ID	(9002)	172	0	
S1.6	838	–	ro	Application, revision	(102.33) ¹⁾	172	0.00	
S1.7	839	–	ro	System load	(80 %) ¹⁾	172	0	

1) Example: Display values dependent on version and performance class

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					

Communication

S2.1 ¹⁾	808	–	ro	Communication status	In xx.yyy format xx = Number of error messages (0 - 64) yyy = number of correct messages (0 - 999)	172	0.00	
S2.2 ¹⁾	809	✓	rw	Field bus protocol	0 = FB disabled 1 = Modbus RTU	172	1	
S2.3 ¹⁾	810	✓	rw	Station address	1 - 255	172	1	
S2.4 ¹⁾	811	✓	rw	Baud Rate	0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400 8 = 57600	172	5	

1) For RASP internal communication only.

S2.6	813	✓	rw	Parity type	0 = None, no → 2 Stop bits 1 = Even, → 1 Stop bit 2 = Odd → 1 Stop bit	173	0	
S2.7	814	✓	rw	communication Timeout	0 = not used 1 = 1 s 2 = 2 s ...255 = to 255 s	173	0	
S2.8	815	✓	rw	Reset communication status	0 = not used 1 = resets parameter S2.1	173	0	

Unit counter

S3.1	827	–	ro	MWh counter	MWh	173	0.00	
S3.2	828	–	ro	Operating days	d	173	0	
S3.3	829	–	ro	Operating hours	H	173	0	
S3.4	840	–	ro	RUN counter, days	d	173	0	
S3.5	841	–	ro	RUN counter, hours	H	173	0	
S3.6	842	–	ro	FLT counter		173	0	

User Set

S4.1	830	✓	rw	Display contrast (external keypad)	0 - 15	173	7	
S4.2	831	–	rw	Default settings (WE)	0 = keep current settings 1 = clears all values and default settings	173	0	
S4.3	832	✓	rw	Password	0000 = Deactivated 0001 - 9999 = Password	173	0000	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 1)	User setting
		RUN	ro/rw					
Display values								
M1.1	1	–	ro	Output Frequency	Hz	175	0.00	
M1.2	25	–	ro	Frequency setpoint value	Hz	175	0.00	
M1.3	2	–	ro	Motor shaft speed	rpm (calculated value, rpm)	175	0	
M1.4	3	–	ro	Motor current	A	175	0.00	
M1.5	4	–	ro	Motor Torque	% (calculated value)	175	0.0	
M1.6	5	–	ro	Motor rating	% (calculated value)	175	0.0	
M1.7	6	–	ro	Motor Voltage	V	175	0.0	
M1.8	7	–	ro	Intermediate DC voltage circuit	V	175	0	
M1.9	8	–	ro	Unit Temperature	°C	175	0	
M1.10	9	–	ro	Motor temperature	°C (calculated value)	175	0	
M1.11	13	–	ro	Analog input AI1	% (Potentiometer n_0)	175	0.0	
M1.14	15	–	ro	Digital inputs DI1, DI2, DI3 (AS-i outputs DQ0-DQ1)	DI1 = 100, DI2 = 10, DI3 = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.15	16	–	ro	Digital inputs DI4, DI5, DI6 (AS-i outputs DQ2-DQ3)	DI4 = 100, DI5 = 10, DI6 = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.16	17	–	ro	Digital outputs RO1, RO2, DO (AS-i inputs DI0-DI1)	RO1 = 100, RO2 = 10, DO = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.21	1480	–	ro	Counter, digital output	n	175	0	
M1.22	1999	–	ro	RASP device unit temperature	°C	175	0	

7.3.2 Experts parameters (P1.1 = 0)

PNU	Parameter number
ID	Identification number of the parameter
RUN	Access rights to the parameters during operation (RUN): ✓ = Modification permissible, - = Modification only possible in STOP
ro/rw	Parameter read and write permissions via a fieldbus connection (BUS) ro = read only rw = read and write
Page	Page reference for parameter description in this manual.
DS	Default setting: WE (P1.1 = 0) Expert parameters
→ i	Cross-reference to the parameter description in manual MN04020001Z for M-Max™ variable frequency drives.
User setting	User setting of the parameters



The table below lists all parameters of the RASP. This parameter list is intended only for trained specialists. The RASP Expert operation parameters in the default setting are listed in the following sections.

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Parameter selection								
P1.1	115	✓	rw	Parameter range	0 = Expert (extended parameter set) 1 = Basic (Standard parameter) Note: This manual only describes these parameters in part and in direct relation to Rapid Link. A general description of these parameters is provided in manual MN04020001Z ("M-Max variable frequency drives").	149	1 → 0	
P1.2	540	–	rw	Application	0 = FWD/REV/FF1/FF2 1 = FWD/FF1/FF2/FF3 2 = PM-Motor (not activated)	149	0	
P1.3	1472	–	rw	Default settings (FS), country specific	0 = EU 1 = USA	150	0	
Digital input								
P3.1	300	✓	rw	Start/stop logic	0 = DI1 (FWD), DI2 (REV), REAF 1 = DI1 (FWD) + DI2 = REV 2 = DI1 (Start pulse), DI2 (Stop pulse) 3 = DI1 (FWD), DI2 (REV)	→ i	3	
P3.2	403	✓	rw	Start signal (FWD)	0 = Deactivated 1 = activated via DQ1 (=DI1) 2 = activated via DQ2 (= DI2) 3 = activated via DQ3 (= DI3) 4 = activated via DQ4 (= DI4) 5 = Do not use. (Reset) 6 = 24 DC monitoring of the AS-Interface (M12 plug)	→ i	1	
P3.3	404	✓	rw	Start signal (REV)	like P3.2	→ i	2	
P3.4	412	✓	rw	Reversing (change of direction of the field of rotation)	like P3.2	→ i	0	
P3.5	405	✓	rw	External fault (N/O)	like P3.2	→ i	0	
P3.6	406	✓	rw	External fault (N/C)	like P3.2	→ i	0	
P3.8	407	✓	rw	Start enable (RUN)	like P3.2	→ i	0	
P3.9	419	✓	rw	Fixed frequency, binary value B0	like P3.2	→ i	3	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
P3.10	420	✓	rw	Fixed frequency, binary value B1	like P3.2	→ i	4	
P3.11	421	✓	rw	Fixed frequency, binary value B2	like P3.2	→ i	0	
P3.15	1402	✓	rw	Acceleration-/ Switch deceleration time	like P3.2	128	0	
P3.16	1403	✓	rw	Acceleration-/ Stop deceleration time	like P3.2	→ i	0	
P3.17	1404	✓	rw	Block parameters	like P3.2	→ i	0	
P3.21	1408	✓	rw	Sequence control, Program start	like P3.2	→ i	0	
P3.22	1409	✓	rw	Sequence control, Program pause	like P3.2	→ i	0	
P3.23	1410	✓	rw	Counter, digital input	like P3.2	→ i	0	
P3.24	1411	✓	rw	Counter, reset	like P3.2	→ i	0	
P3.25	1412	✓	rw	Change control level	like P3.2	→ i	0	
P3.26	1413	✓	rw	Change setpoint source (I/O)	like P3.2	→ i	0	
P3.27	1414	✓	rw	Second parameter set	like P3.2	→ i	0	
P3.29	1416	✓	rw	Meter, output signal 1	0 - 65535	→ i	0	
P3.30	1417	✓	rw	Meter, output signal 2	0 - 65535	→ i	0	
P3.31	1418	✓	rw	DI1 Logic (Actuation DQ1)	0 = N/O 1 = N/C Note: Change only active after POWER ON/OFF	→ i	0	
P3.32	1419	✓	rw	DI2 Logic (Actuation DQ2)	Like P3.31	→ i	0	
P3.33	1420	✓	rw	DI3 Logic (Actuation DQ3)	Like P3.31	→ i	0	
P3.34	1421	✓	rw	DI4 Logic (Actuation DQ4)	Like P3.31	→ i	0	
P3.35	1422	✓	rw	DI5 logic (Reset)	do not change	→ i	0	
P3.36	1423	✓	rw	DI6-logic (without function)	do not use	→ i	0	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Digital output								
P5.1	313	✓	rw	R01 Signal (not used)	0 = Deactivated	→ i	0	
P5.2	314	✓	rw	R02 Signal (reserved for heating)	0 = Deactivated	→ i	30	
P5.3	312	✓	rw	DO signal (Digital Output)	0 = Deactivated 1 = Ready to start (READY) 2 = Operation (RUN) 3 = Error message (FAULT) 4 = Error message inverted 5 = Warning (ALARM) 6 = Reversing (FWD ↔ REV) 7 = Frequency reference value reached 8 = Motor controller active 9 = Zero frequency 10 = Frequency monitoring 1 11 = Frequency monitoring 2 12 = overtemperature control 13 = Overcurrent control active 14 = Overvoltage control active 15 = Sequence control active 16 = Sequence control, single step completed 17 = Sequence control, program cycle completed 18 = Sequence control, pause 19 = Counter, value 1 reached 20 = Counter, value 2 reached 21 = RUN message active 22 = External brake actuated 23 = Deactivated 24 = Deactivated 25 = Deactivated 26 = External brake actuated 27 = Current monitoring 28 = Deactivated 29 = Frequency Special Monitor 30 = Reserve	170	26	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
P5.4	315	✓	rw	Frequency monitoring	0 = Deactivated 1 = Minimum 2 = Maximum	→ i	0	
P5.5	316	✓	rw	Frequency monitoring, setpoint value	0.00 - 320.00 Hz	170	0.00	
P5.6	346	✓	rw	Frequency monitoring	0 = Deactivated 1 = minimum value 2 = maximum value	→ i	0	
P5.7	347	✓	rw	Frequency monitoring, setpoint value (2PS)	0.00 - 320.00 Hz	170	0.00	
P5.8	1457	✓	rw	Current monitoring, Setpoint	0.00 - 1e A	→ i	0.00	
P5.9	1458	✓	rw	DO Logic	0 = N/O 1 = N/C	→ i	0	
P5.12	1459	✓	rw	DO switch-on delay	0.00 - 320.00 s	170	0.00	
P5.13	1460	✓	rw	DO off-delay	0.00 - 320.00 s	170	0.00	

Drives control

P6.2	117	✓	rw	Setpoint input	0 = FFO (Fixed frequency) 1 = REF (operating unit) (A11, control signal terminal 2) 3 = Potentiometer n ₀	151	3	
P6.3	101	–	rw	Minimum frequency	0.00 - P6.4 Hz	152	0.00	
P6.4	102	–	rw	Maximum frequency	P6.3 - 320.00 Hz	152	50.00	
P6.5	103	–	rw	Acceleration time (acc1)	0.1 - 3000.0 s	152	5.0	
P6.6	104	–	rw	Deceleration time (dec1)	0.1 - 3000.0 s	152	2.0	
P6.7	505	–	rw	Start Function	0 = Acceleration time (ramp) 1 = Flying restart circuit	153	0	
P6.8	506	–	rw	Stop Function	0 = Fee coasting 1 = Deceleration time (ramp)	153	1	
P6.9	500	–	rw	S ramp, time-based waveform	0.00 = linear 0.1 - 10.0 s (S-shaped)	153	0.0	
P6.10	717	–	rw	REAF, wait time over three automatic restarts.	0.10 - 10.00 s	→ i	0.50	
P6.11	718	–	rw	REAF, Test time before an automatic restart	0.00 - 60.00 s	→ i	30.00	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
P6.12	719	–	rw	REAF, Start function in the event of an automatic restart	0 = Acceleration time (ramp) 1 = Flying restart circuit 2 = according to P6.7	→ i	0	
P6.13	731	–	rw	REAF, automatic restart after an error message	0 = Deactivated 1 = active	→ i	0	
P6.15	184	–	rw	REF Setpoint input, external operating unit (KEYPAD)	-P6.4 - P6.4 Hz	→ i	0.00	
P6.18	1428	–	rw	Setpoint input (2PS)	Like P6.2	→ i	2	
P6.19	502	✓	rw	Acceleration time (acc2)	0.1 - 3000.0 s	154	10.0	
P6.20	503	✓	rw	Deceleration time (dec2)	0.1 - 3000.0 s	154	10.0	
P6.21	526	–	rw	Transition frequency (acc1 - acc2)	0.00 = Deactivated 0.01 - P6.4 Hz	154	0.00	
P6.22	1334	–	rw	Transition frequency (dec1 - dec2)	0.00 = Deactivated 0.01 - P6.4 Hz	154	0.00	
P6.23	1429	–	rw	REV blocked	0 = Deactivated 1 = active	→ i	0	
P6.24	509	–	rw	frequency jump 1, Lower value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.25	510	–	rw	frequency jump 1, Upper value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.26	511	–	rw	Frequency jump 2, Lower value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.27	512	–	rw	Frequency jump 2, Upper value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.28	513	–	rw	Frequency jump 3, Lower value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.29	514	–	rw	Frequency jump 3, Upper value	0.00 = Deactivated 0.01 - P6.4 Hz	→ i	0.00	
P6.30	759	–	rw	REAF, number of automatic restarts	1 - 10	→ i	3	
P6.34	1998	–	rw	Overvoltage controller	0 = ON 1 = OFF	155	1	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Motor								
P7.1	113	–	rw	Motor, rated operational current	0.2x I _e - 2 x I _e (→ Motor rating plate)	157	I _e	
P7.2	107	–	rw	current limitation	0.2x I _e - 2 x I _e	157	1.5 x I _e	
P7.3	112	–	rw	Motor, rated speed	300 ... 20000 min ⁻¹ (→ Motor rating plate)	157	1440	
P7.4	120	–	rw	Motor, power factor (cos φ)	0.3 - 1.00 (→ Motor rating plate)	157	0.85	
P7.5	110	–	rw	Motor, rated operating voltage	180 - 500 V (→ Motor rating plate)	157	400	
P7.6	111	–	rw	Motor, rated frequency	30 - 320 Hz (→ Motor rating plate)	157	50.00	
Protective functions								
P8.3	703	–	rw	earth fault monitoring	0 = Deactivated 1 = Danger 2 = Error, stop according to P6.8	158	2	
P8.4	709	–	rw	Stall protection	0 = Deactivated 1 = Danger 2 = Error, stop according to P6.8	158	2	
P8.5	713	–	rw	Underload protection	0 = Deactivated 1 = Danger 2 = Error, stop according to P6.8	→ i	2	
P8.6	704	–	rw	Motor, temperature protection	0 = Deactivated 1 = Danger 2 = Error, stop according to P6.8	→ i	2	
P8.7	705	–	rw	Motor, ambient air temperature	-20 - +100 °C	→ i	40	
P8.8	706	–	rw	Motor, cooling factor at zero frequency	0.0 - 150 %	→ i	40	
P8.9	707	–	rw	Motor, thermal time constant	1 - 200 min	→ i	45	
P8.12	714	–	rw	Underload, load curve at rated frequency	10.0 - 150.0 %	→ i	50.0	
P8.13	715	–	rw	Underload, load curve at frequency = 0	10.0 - 150.0 %	→ i	10.0	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Fixed frequencies								
P10.1	124	✓	rw	Fixed frequency FF0	0.00 - P6.4 Hz	160	5.00	
P10.2	105	✓	rw	Fixed frequency FF1	0.00 - P6.4 Hz	160	30.00	
P10.3	106	✓	rw	Fixed frequency FF2	0.00 - P6.4 Hz	160	40.00	
P10.4	126	✓	rw	Fixed frequency FF3	0.00 - P6.4 Hz	160	50.00	
P10.5	127	✓	rw	Fixed frequency FF4	0.00 - P6.4 Hz	160	10.00	
P10.6	128	✓	rw	Fixed frequency FF5	0.00 - P6.4 Hz	160	15.00	
P10.7	129	✓	rw	Fixed frequency FF6	0.00 - P6.4 Hz	160	20.00	
P10.8	130	✓	rw	Fixed frequency FF7	0.00 - P6.4 Hz	160	25.00	
P10.9	1436	✓	rw	Sequence control		→ i	0	
					0 = Deactivated 1 = Program cycle, once 2 = Program cycle, continuous 3 = Program cycle, step by step 4 = Program cycle, continuous and step by step			
P10.10	1437	✓	rw	Sequence control, Program FWD/REV	0 - 255	→ i	0	
P10.11	1438	✓	rw	Set time for FF0	0 - 10000 s	→ i	0	
P10.12	1439	✓	rw	Set time for FF1	0 - 10000 s	→ i	0	
P10.13	1440	✓	rw	Set time for FF2	0 - 10000 s	→ i	0	
P10.14	1441	✓	rw	Set time for FF3	0 - 10000 s	→ i	0	
P10.15	1442	✓	rw	Set time for FF4	0 - 10000 s	→ i	0	
P10.16	1443	✓	rw	Set time for FF5	0 - 10000 s	→ i	0	
P10.17	1444	✓	rw	Set time for FF6	0 - 10000 s	→ i	0	
P10.18	1445	✓	rw	Set time for FF7	0 - 10000 s	→ i	0	
V/f characteristic curve								
P11.1	108	-	rw	V/f-characteristic curve Characteristic		162	0	
					0 = linear 1 = squared 2 = parameterizable			
P11.2	602	-	rw	Cut-off frequency	30.00 - 320.00 Hz	163	50.00	
P11.3	603	-	rw	Output voltage	10.00 - 200.00 % of nominal motor voltage (P6.5)	163	100.00	
P11.4	604	-	rw	V/f-characteristic curve Mean frequency value	0.00 - P11.2 Hz	163	50.00	
P11.5	605	-	rw	V/f-characteristic curve Mean voltage value	0.00 - P11.3 Hz	164	100.00	
P11.6	606	-	rw	Output voltage at zero frequency	0.00 - 40.00 %	164	0.00	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
P11.7	109	–	rw	Torque increase	0 = Deactivated 1 = active	164	0	
P11.8	600	–	rw	Control Mode	0 = Frequency control (V/f) 1 = Speed control (vector)	164	0	
P11.9	601	–	rw	Pulse frequency	1.5 - 16.0 kHz	167	6.0	
P11.10	522	–	rw	Pulse frequency, stabilizer (sinusoidal filter)	0 = Deactivated 1 = active		0	

Braking

P12.1	507	–	rw	DC braking, current	A, dependent on I _e	→ i	I _e	
P12.2	516	–	rw	DC braking, Braking time at start	0.00 - 600.00 s	→ i	0.00	
P12.3	515	–	rw	DC braking, start frequency during delay ramp	0.00 - 10.00 Hz	→ i	1.50	
P12.4	508	–	rw	DC braking, Braking time in case of STOP	0.00 - 600.00 s	→ i	0.00	
P12.5	504	–	rw	Brake chopper	Parameter display only RASP with braking resistance 0 = Deactivated 1 = Active in RUN 2 = Active in RUN and STOP	169	2	
P12.6	1447	–	rw	Brake chopper Switching threshold	Parameter display only RASP with braking resistance 0 - 911 V	169	765	
P12.7	1448	–	rw	Open external brake, deceleration time	0.00 - 320 s	171	0.20	
P12.8	1449	–	rw	Open external brake, frequency limit value	0.00 - 320.00 Hz	171	1.50	
P12.9	1450	–	rw	Close external brake, frequency limit value	0.00 - 320.00 Hz	171	1.00	
P12.10	1451	–	rw	Close external brake, frequency limit value on reversing (REV)	0.00 - 320.00 Hz	171	1.50	
P12.11	1452	–	rw	Open external brake, current limit value	0.00 - P7.2 A	171	0.00	

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PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Second parameter set								
P14.1	1347	–	rw	Motor (2PS), rated operational current	$0.2 \times I_e - 2 \times I_e$ A (→ Motor rating plate)	→ i	I_e	
P14.2	1352	–	rw	Current limit (2PS)	$0.2 \times I_e - 2 \times I_e$ A	→ i	$1.5 \times I_e$	
P14.3	1350	–	rw	Motor (2PS) nominal speed	300 - 20000 rpm (min ⁻¹) (→ Motor rating plate)	→ i	1440	
P14.4	1351	–	rw	Motor (2PS), power factor (cos φ)	0.3 - 1.00 (→ Motor rating plate)	→ i	0.85	
P14.5	1348	–	rw	Motor (2PS), rated operating voltage	180 - 500 V (→ Motor rating plate)	→ i	400	
P14.6	1349	–	rw	Motor (2PS), rated frequency	30 - 320 Hz (→ Motor rating plate)	→ i	50.00	
P14.7	1343	–	rw	Minimum frequency (2PS)	0.00 - P14.8 Hz	→ i	0.00	
P14.8	1344	–	rw	Maximum frequency (2PS)	P14.7 - 320 Hz	→ i	50.00	
P14.9	1345	–	rw	Acceleration time (2PS, acc3)	0.1 - 3000 s	→ i	3.0	
P14.10	1346	–	rw	Deceleration time (2PS, dec3)	0.1 - 3000 s	→ i	3.0	
P14.11	1355	–	rw	V/f characteristic curve (2PS), Characteristic	0 = linear 1 = squared 2 = parameterizable	→ i	0	
P14.12	1354	–	rw	Torque increase (2PS)	0 = Deactivated 1 = activated	→ i	0	
P14.13	1353	–	rw	Motor (2PS), temperature protection	Like P8.1	→ i	0	
P14.14	1469	–	rw	Motor (2PS), ambient air temperature	-20 - +100 °C	→ i	40	
P14.15	1470	–	rw	Motor (2PS), cooling factor at zero frequency	0.0 - 150 %	→ i	40.0	
P14.16	1471	–	rw	Motor (2PS), thermal time constant	1 - 200 min	→ i	45	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					

System parameters

Hard- and Software Information

S1.1	2314	–	ro	API SW ID	62	172	0	
S1.2	835	–	ro	API SW Version	65534	172	0	
S1.3	2315	–	ro	Power SW ID	0	172	0	
S1.4	834	–	ro	Power SW Version	253	172	0	
S1.5	837	–	ro	Application ID	9002	172	0	
S1.6	838	–	ro	Application, revision	655.33	172	0.00	
S1.7	839	–	ro	System load	80 %	172	0	

Communication

S2.1 ¹⁾	808	–	ro	Communication status	In xx.yyy format xx = Number of error messages (0 - 64) yyy = number of correct messages (0 - 999)	172	0.00	
S2.2 ¹⁾	809	✓	rw	Field bus protocol	0 = FB disabled 1 = Modbus RTU	172	1	
S2.3 ¹⁾	810	✓	rw	Station address	1 - 255	172	1	
S2.4 ¹⁾	811	✓	rw	Baud Rate	0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400 8 = 57600	172	5	

1) For RASP internal communication only.

S2.6	813	✓	rw	Parity type	0 = None, no → 2 Stop bits 1 = Even, → 1 Stop bit 2 = Odd → 1 Stop bit	173	0	
S2.7	814	✓	rw	communication Timeout	0 = not used 1 = 1 s 2 = 2 s ...255 = to 255 s	173	0	
S2.8	815	✓	rw	Reset communication status	0 = not used 1 = resets parameter S2.1	173	0	

Unit counter

S3.1	827	–	ro	MWh counter	MWh	173	0.00	
S3.2	828	–	ro	Operating days	d	173	0	
S3.3	829	–	ro	Operating hours	H	173	0	
S3.4	840	–	ro	RUN counter, days	d	173	0	
S3.5	841	–	ro	RUN counter, hours	H	173	0	
S3.6	842	–	ro	FLT counter		173	0	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
User Set								
S4.1	830	✓	rw	Display contrast (external keypad)	0 - 15	173	7	
S4.2	831	–	rw	Default settings (WE)	0 = keep current settings 1 = clears all values and default settings	173	0	
S4.3	832	✓	rw	Password	0000 = Deactivated 0001 - 9999 = Password	173	0000	
S4.4	833	–	ro	Software package	0 - 61 min	173	5	

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7.3 Parameter lists for RASP

PNU	ID	Access right		Designation	Value Range	Page	DS (P1.1 = 0)	User setting
		RUN	ro/rw					
Display values								
M1.1	1	–	ro	Output Frequency	Hz	175	0.00	
M1.2	25	–	ro	Frequency setpoint value	Hz	175	0.00	
M1.3	2	–	ro	Motor shaft speed	rpm (calculated value, rpm)	175	0	
M1.4	3	–	ro	Motor current	A	175	0.00	
M1.5	4	–	ro	Motor Torque	% (calculated value)	175	0.0	
M1.6	5	–	ro	Motor rating	% (calculated value)	175	0.0	
M1.7	6	–	ro	Motor Voltage	V	175	0.0	
M1.8	7	–	ro	Intermediate DC voltage circuit	V	175	0	
M1.9	8	–	ro	Unit Temperature	°C	175	0	
M1.10	9	–	ro	Motor temperature	°C (calculated value)	175	0	
M1.11	13	–	ro	Analog input AI1	% (Potentiometer n ₀)	175	0.0	
M1.14	15	–	ro	Digital input DI1, DI2, DI3 (AS-i outputs DQ0-DQ1)	DI1 = 100, DI2 = 10, DI3 = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.15	16	–	ro	Digital input DI4, DI5, DI6 (AS-i outputs DQ2-DQ3)	DI4 = 100, DI5 = 10, DI6 = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.16	17	–	ro	Digital output RO1, RO2, DO (AS-i inputs DI0-DI1)	RO1 = 100, RO2 = 10, DO = 1 (0-1-10-11-100-101-110-111)	175	0	
M1.21	1480	–	ro	Counter, digital output	n	175	0	
M1.22	1999	–	ro	RASP device unit temperature	?°C	175	0	

7 Appendix

7.4 Error handling and diagnostics

7.4 Error handling and diagnostics

The LEDs in Rapid Link devices are used to indicate operating states, making quick diagnostics possible. The following two tables show the corresponding LED states and examples of faults, as well as troubleshooting measures. The information on these tables rests on the assumption that all other cards are error-free and can be controlled through the PLC.

Table 18: LEDs and possible faults (measures)

	LED status	Fault	Testing	Measures	AS-i gateway	PLC(S)
 AS-i	Green	none	None	None	Data communications with Rapid Link established.	Can communicate with all Rapid Link devices and control them
	off	U _B missing. The supply voltage is switched off.	<ul style="list-style-type: none"> Are any AS-i connections loose? The internal electronics are malfunctioning. The AS-i power supply is malfunctioning. 	Check all plugs, cables, and the AS-i power supply.	Missing slave Config Error	Cannot communicate with Rapid Link devices and cannot control them
	red	No data communications with the gateway	<ul style="list-style-type: none"> Were any new addresses assigned to the Rapid Link system? Is the master in Stop mode? 	Delete the Rapid Link address and assign a new address.	Unknown Slave Config Error	Can only control Rapid Link after a new address has been assigned to Rapid Link and Rapid Link has been reprogrammed
	Flashing red/yellow	Data cannot be exchanged	Is the Rapid Link address 0? Is the Rapid Link device new?	Assign a new address to Rapid Link.	Unknown Slave Config Error	Can only control Rapid Link after a new address has been assigned to Rapid Link
	Red/green	Internal AS-i error; peripheral fault	None	Reset the fault and restart. If the fault occurs again, please contact your closest Eaton representative.	Periphery Fault	Cannot communicate with Rapid Link devices and cannot control them
 Group fault indication	off	none	None	None	None	Can communicate with all Rapid Link devices and control them
	red	→ Page 102, → Page 109, → Page 120	→ Page 102, → Page 109, → Page 120	→ Page 102, → Page 109, → Page 120	None	Can communicate with all Rapid Link devices, but cannot control them
	Flashing (red)	none	Has there been a Rapid Link reset?	Acknowledge the fault signal with OFF/RESET	None	Can communicate with all Rapid Link devices, but cannot control them
UV Supply voltage	off	No supply voltage	<ul style="list-style-type: none"> Is the 5-pin power plug connected? Is there any voltage at the input terminals? 	Check the main supply and the cables	None	Can communicate with all Rapid Link devices, but cannot control them
	Green	none	None	None	None	Can communicate with all Rapid Link devices and control them

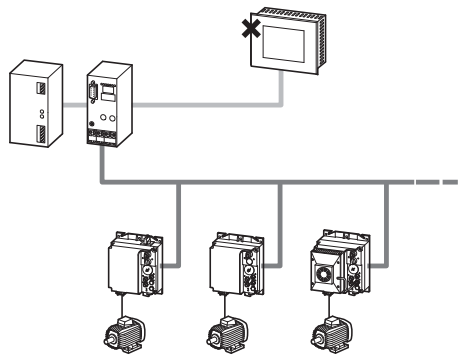
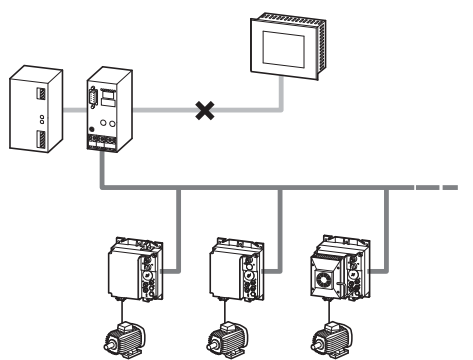
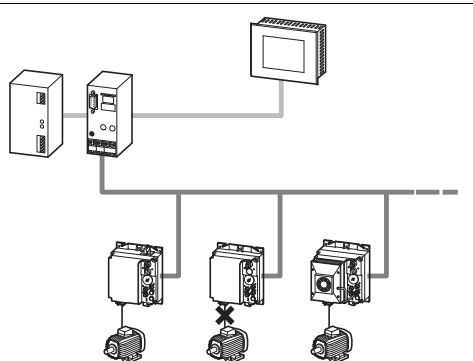
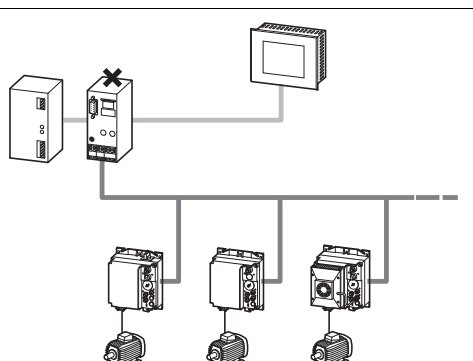
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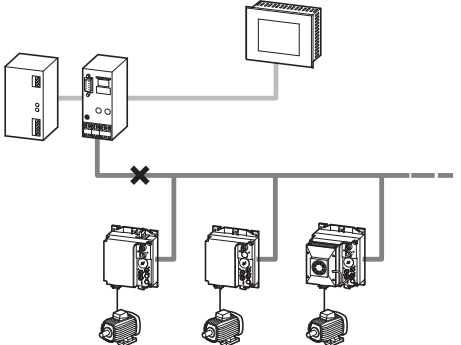
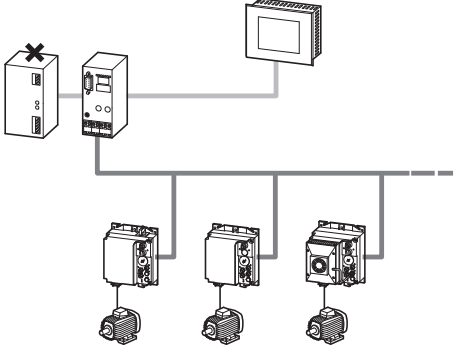
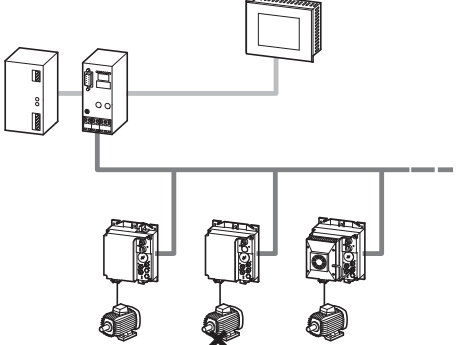
7.4 Error handling and diagnostics

7.4.1 Fault Diagnostics

The following table shows potential points of failure.

Table 19: Troubleshooting and points of failure

Error	Measures	Error Location
Faulty PLC	<p>All motors stop.</p> <p>Replace the PLC and configure the new PLC. The gateway displays "Bus Fault" (bF).</p>	
Faulty or disconnected PROFIBUS cable	<p>All motors stop.</p> <p>The gateway displays bF.</p> <p>As soon as a connection is established again, all the motors start running again automatically.</p>	
Faulty or disconnected motor cable	<p>The connected motor stops.</p> <p>The group fault LED lights up red. After the connection is restored, the motor does not start automatically.</p> <p>→ RESET the motor</p>	
Faulty AS-i gateway	<p>All motors stop.</p> <p>As soon as a connection is established again, all the motors start running again automatically.</p> <p>→ Replace the gateway!</p>	

Error	Measures	Error Location
<p>Faulty or disconnected AS-i data bus</p>	<p>None of the Rapid Link devices have a control voltage; all motors stop.</p> <p>The AS-i gateway shows the missing addresses in succession.</p> <p>As soon as a connection is established again, all the motors start running again automatically.</p>	
<p>Faulty power supply</p>	<p>None of the Rapid Link devices have a control voltage; all motors stop.</p> <p>The gateway is off.</p> <p>→ Replace the power supply.</p> <p>As soon as a connection is established again, all the motors start running again automatically.</p>	
<p>Malfunctioning or defective motor</p>	<p>→ Repair or replace the motor.</p> <p>The group fault LED lights up red.</p> <p>→ Reset required.</p>	

7 Appendix

7.4 Error handling and diagnostics

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