

## MINISTART Softstarter For Heating Pumps PF 9029



02.69343

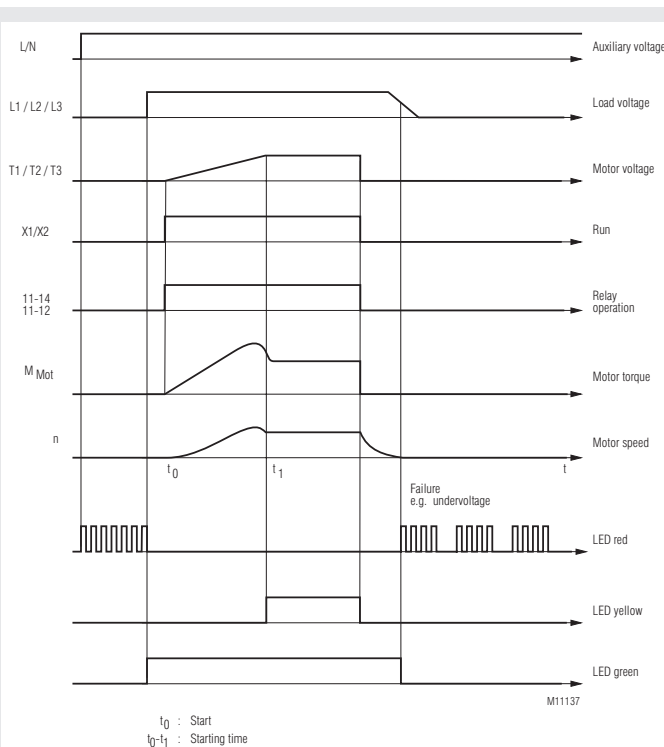
### Your Advantages

- For starting current limitation in heat pumps to provide stable mains conditions
- Only one small device 67.5 mm for softstart, motor protection, voltage- and phase sequence monitoring
- Soft start and minimized starting current
- Extended service life of AC - motors and mechanical drive system
- Motor power up to 18,5 kW
- Short ramp up time: < 200 ms
- Energy saving by bridging of the semiconductors after softstart
- Symmetrical starting current

### Features

- According to IEC/EN 60 947-4-2
- 3-phase controlled with integrated bypass relays
- Phase sequence monitoring
- Undervoltage monitoring
- Overvoltage monitoring
- Blocked motor monitoring in bypass mode
- Integrated motor protection to class 10 acc. to IEC/EN 60947-4-2
- Starting current limitation
- Thyristor monitoring
- Detection of missing load
- Automatic frequency detection of supply voltage
- Temperature monitoring of power semiconductors

### Function diagram



### Approvals and Markings



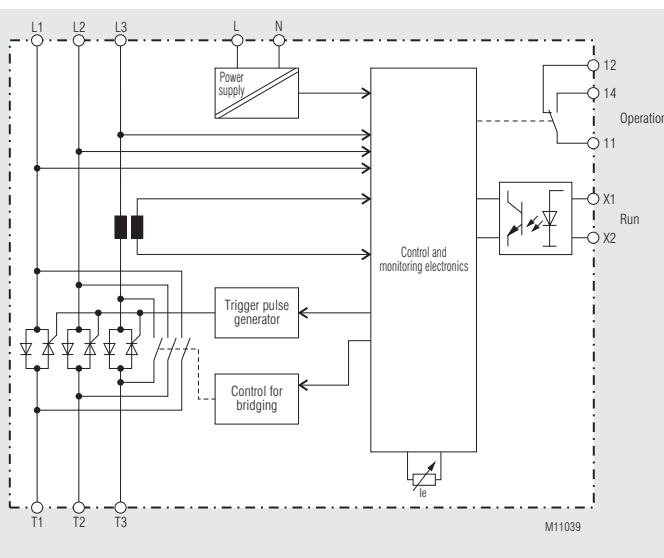
### Applications

- Softstarter for compressor motors

### Product Description

The PF 9029 from the MINISTART-family is a robust electronic control unit for soft starting of compressor motors with integrated monitoring functions. After successful starting the semiconductors are bridged by relays to minimize the power dissipation of the units.

### Block Diagram



### Function Notes

Variation of speed is not possible with this device.

## Device Description

### Failure Mode

The softstarter is monitoring different parameters. If failure is detected the unit switches off. In failure mode a red LED with flash code signals the fault. The failure mode can be reset by pressing the reset button or by disconnecting the power supply.

### Undervoltage monitoring

To make sure the motor is operated with the correct voltage the voltage is monitored. The voltage is not monitored in ramp up mode. If the voltage drops below 330 V for longer than 1 s the unit switches to failure mode.

### Overvoltage detection

To make sure the motor is operated with the correct voltage the voltage is monitored. The voltage is not monitored in ramp up mode. If the voltage rises above 470 V for longer than 1 s the unit switches to failure mode.

### Phase sequence monitoring

The phase sequence monitoring function monitors clockwise phase sequence of the 3-phase system. An anti-clockwise sequence forces the unit to failure mode.

### Shortcircuited Thyristor

Before each softstart the power-semiconductors are tested for short circuit. A detected short circuit forces the unit to failure mode. For short circuit test the motor must be connected.

### Motor not connected

Before each softstart it is tested that the motor is correctly connected to the unit. This test avoids that the motor starts on 2 phases and gets faulty. Wrong connection forces the unit to failure mode.

### Overtemperature

The temperature of the semiconductors is measured by NTC sensor. Overtemperature forces the unit into failure mode.

### Frequency detection

To achieve a correct function the actual frequency has to be known. The frequency is monitored after power on or reset. If the frequency is outside the limits 50Hz  $\pm$  5 Hz or 60 Hz  $\pm$  5 Hz the unit switches to failure mode.

### Blocking protection

In Bypass mode a blocking of the motor is detected by current monitoring. If the current exceeds 4 times the nominal current of the motor, the unit recognizes motor blocking. The unit switches to failure mode.

### Overload protection

The unit incorporates an electronic overload protection, which is realized by monitoring the current in one phase. Overload protection class 10 is a fix setting. The response current can be adjusted with a potentiometer by adjusting the motor rated current. When the I<sub>2t</sub> value is overridden the unit switches into failure mode. The I<sup>2t</sup> value is reset with the reset function.



**Note:** At loss of the auxiliary supply the actual I<sup>2t</sup>-value is stored. At restart the I<sup>2t</sup>-value is recalled and used for operation independent how long the motor was cooling down.

### Limitation of starting current

By starting current limitation the peak current can be limited. The load on the supply network is lower. The time limit of the current is monitored and if the starting time exceeds the limit of 5 s a failure signal is indicated. The current limit is fixed to 2.5 times the motor nominal current.

## Indication

The device status is indicated with different coloured LEDs and flash code

LED green:	Device ready
LED yellow:	On, when bridging relay active
LED red:	Flashes if error (see flash codes)

## Control Elements

**Potentiometer I<sub>e</sub>:** Nominal current for overload protection and starting current limitation.



**Note:** The potentiometer setting is only read when connecting the power supply or on reset at failure mode.

**Reset-button:** Reset of failure mode after failure is removed and confirming potentiometer setting.

## Control Circuit

The control input works with a voltage of AC/DC 20 ... 300 V.



After reset or disconnecting the power supply the unit initiates a softstart, if voltage is connected to control input.

## Outputs

One output relay is available. The monitoring contact "operation" closes when the start signal is connected. It opens after the signal is disconnected or when an error occurs.

## Auxiliary Supply

To monitor phase failure on all 3 phases an external auxiliary supply of AC 230 V is necessary.

## Fault Indication by Flashing Code

During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the red LED0

Flashes *)	Fault	Possible cause	Troubleshooting
1 x fast	Motor voltage is missing	Defective fuse, faulty wiring	Check fuses and wiring
1	Device temperature to high	Duty cycle exceeded	Reduce operating time, use heat sink if possible
2	Mains frequency out of tolerance	Wrong frequency	Device is not suitable for actual frequency. Contact manufacturer
3	Phase sequence incorrect	Load voltage incorrect. Clockwise phase sequence is mandatory for correct function	Check wiring, change 2 phases
4	Undervoltage detected	Load voltage under 330V	Check load voltage
5	Overload detected	Motor overloaded	Reduce operating time, Motor rough-running? Adjust nominal current
6	Motor blocked in Bypass-Mode	Motor stalled in operation	Check motor
7	Thyristor short-circuit	Faulty thyristor detected	Device has to be repaired
9	Motor connected incorrectly	One or more wires to the motor are interrupted	Check wiring to motor
10	Temperature sensor defective	Interruption or short circuit in temperature sensor of power semiconductors	Device has to be repaired
*) No.: Number of flash pulses in a series			

## Technical Data

<b>Auxiliary supply:</b>	AC 230 V ± 10%	
<b>Overvoltage protection:</b>	Varistor AC 275 V	
<b>Starting voltage:</b>	3 AC 220 V	
<b>Ramp up time:</b>	0.2 s	
<b>Undervoltage protection:</b>	3 AC 330 V, for more than 1s	
<b>Overvoltage protection:</b>	3 AC 470 V, for more than 1s	
<b>Resolution of voltage measurement:</b>	AC 1.5 V	
<b>Nominal consumption:</b>	4 VA	
<b>Short circuit detection</b>	5 ... 25 A	10 ... 36 A
Mode 1:	35 A gL / gG	50 A gG / gL
Mode 2:	5510 A <sup>2</sup> s	5500 A <sup>2</sup> s

## Control Input

<b>Control voltage:</b>	AC/DC 20 ... 300 V
<b>Control input current:</b>	0.2 mA ... 3.1 mA
<b>Start up delay:</b>	10 ... 50 ms
<b>Release delay:</b>	200 ms

## Indicator output

<b>Contacts:</b>	1 changeover contact	
<b>Switching capacity to AC 15</b>		
NO contacts:	3 A / AC 230 V	IEC/EN 60 947-5-1
NC contacts:	1 A / AC 230 V	IEC/EN 60 947-5-1
<b>Electrical life to AC 15 at 3 A, AC 230 V:</b>	2 x 10 <sup>5</sup> switching cycles	
<b>Permissible switching frequency:</b>	max. 1 800 switching cycles / h	
<b>Short circuit strength</b>		
max. fuse rating:	4 A gG / gL	IEC/EN 60 947-5-1
<b>Mechanical life:</b>	≥ 10 <sup>8</sup> switching cycle	

## Output / Load Circuit

<b>Load circuit</b>		
<b>Nominal operating voltage L1-L3:</b>	3 AC 340 ... 460 V	
<b>Peak reverse voltage:</b>	1200 V	
<b>Overvoltage protection:</b>	Varistor 510 V	
<b>Nominal frequency:</b>	50 Hz ± 5 Hz or 60 Hz ± 5Hz	
<b>Nominal operating current I<sub>e</sub>:</b>	25 A (AC-53b)	36 A
<b>Setting range I<sub>e</sub>:</b>	5 A ... 25 A	10 A ... 36 A
<b>Stoßstrom:</b>	1050 A (tp = 10 ms)	
<b>Load limit integral:</b>	5500 A <sup>2</sup> s	
<b>Resolution current measurement:</b>	0.1 A	0.2 A
<b>Usage category</b>	I <sub>e</sub> : AC-53b: 2.5 - 0.2: 60	
<b>Number of starts per hour:</b>	10	
<b>Overload protection:</b>	Class 10	
<b>Blocking protection, response value:</b>	4 x I <sub>e</sub> , for longer than 1 s in bypass mode	
<b>Current limiting:</b>	2.5 x I <sub>e</sub> ± 10% during ramp up	

## General Data

<b>Temperature range</b>		
operation:	0 ... + 50 °C	
storage:	- 20 °C ... +75 °C	
Relative air humidity:	< 95%, no condensation at 40°C	
<b>Altitude:</b>	< 1.000 m	

## EMC

### Clearance and Creepage distances

<b>rated impulse voltage / pollution degree</b>		
Overvoltage category:	III	
Mains-/Motor voltage-heat sink:	6 kV / 2	IEC/EN 60 947-4-2
Mains-/Motor voltage - control voltage:	6 kV / 2	IEC/EN 60 947-4-2
Mains-/Motor voltage-indicator relay:	6 kV / 2	IEC/EN 60 947-4-2
Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61 000-4-2
Fast transients	2 kV	IEC/EN 61 000-4-4
Surge between		
Wires for power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6

## Technical Data

Voltage dips:	IEC/EN 61 000-4-11
Wire guided HF irradiation in bypass mode:	IEC/EN 60 947-4-2
Radio HF irradiation in bypass mode:	IEC/EN 60 947-4-2
Harmonics in bypass mode:	IEC/EN 61 000-3-11

## Degree of Protection

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

## Housing:

## Vibration resistance

## Climate resistance:

## Wire connections

## Load terminals:

Box terminals with self-lifting wire protection	
Captive M4 Pozidriv-terminal screws	
0,5 ... 16 mm <sup>2</sup> solid	
0,5 ... 16 mm <sup>2</sup> mit stranded wire with sleeve	
DIN 46228/1	
0,5 ... 16 mm <sup>2</sup> stranded ferruled (isolated)	
DIN 46228/4	
21 - 6 AWG	

## Insulation of wires

## or sleeve length:

## Mounting torque:

## Control terminals

12 mm - 13 mm	
2.5 Nm	
pluggable terminal blocks with cage clamp terminals	
0.2 - 2.5 mm <sup>2</sup> solid	
0.2 - 2.5 mm <sup>2</sup> ferruled	
0.2 - 2.5 mm <sup>2</sup> stranded wire with sleeve	
DIN 46228/1	
0.2 - 2.5 mm <sup>2</sup> stranded ferruled (isolated)	
26 - 12 AWG	

## Insulation of wires

## or sleeve length:

## Weight

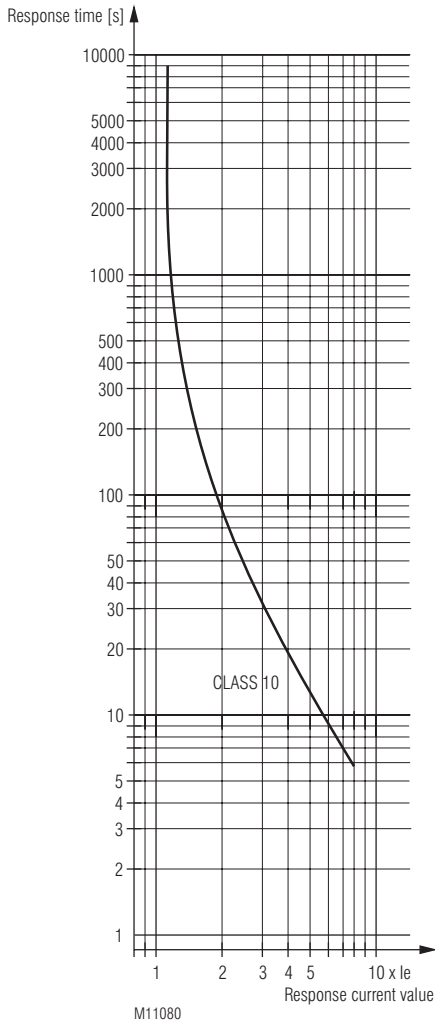
without DIN rail mounting:	500g
with DIN rail mounting:	600g

## Dimensions

## Width x height x depth

without DIN rail mounting:	67.5 mm x 122.5 mm x 86.5 mm
with DIN rail mounting:	67.5 mm x 140 mm x 95.5 mm

## Characteristics



## Trigger characteristics

### Standard Type

PF 9029.11 3 AC 400 V 50 Hz  $U_H$  230 V Hz 25 A

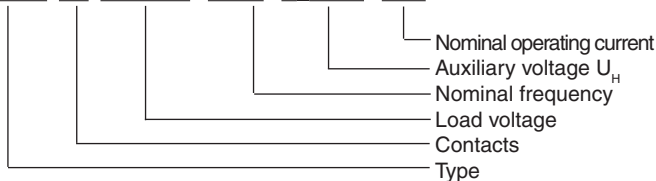
- Article number: 0065815
- Load voltage: 3 AC 400 V
  - Auxiliary voltage  $U_H$ : 230 V
  - Nominal operating current  $I_e$ : 25 A
  - Setting range  $I_e$ : 5 A ... 25 A
  - Width: 67.5 mm

PF 9029.11 3 AC 400 V 50 Hz  $U_H$  230 V Hz 36 A

- Article number: 0067298
- Load voltage: 3 AC 400 V
  - Auxiliary voltage  $U_H$ : 230 V
  - Nominal operating current  $I_e$ : 36 A
  - Setting range  $I_e$ : 10 A ... 36 A
  - Width: 67.5 mm

### Ordering Example

PF 9029 .11 AC 400 V 50 Hz  $U_H$  230 V 25 A



## Accessories

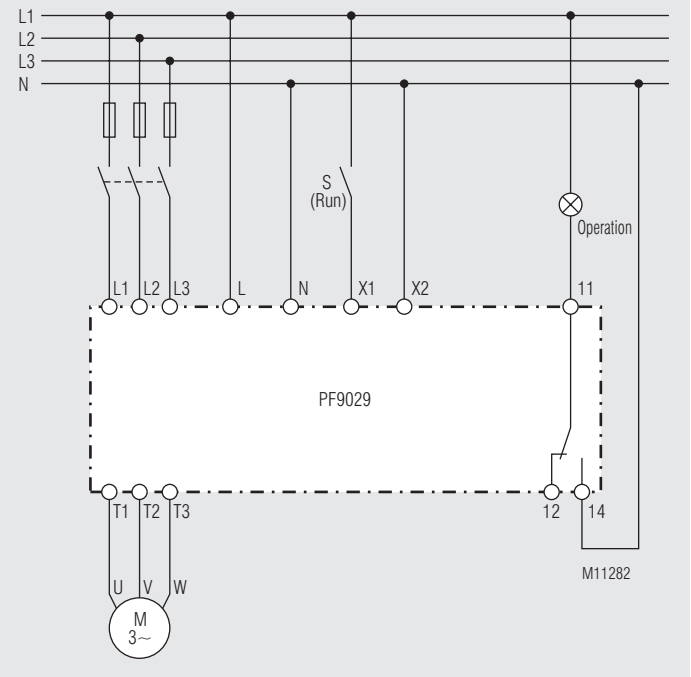
The devices can be mounted on DIN-rail according to IEC/EN 60715 with a fixing plate.

Type: KX4840-20  
Article number: 0066204

## Operation

1. Connect unit as shown in wiring example
2. Adjust Potentiometer setting „ $I_e$ “ to nominal motor current.

## Connection Example



## Safety Instruction



### Dangerous voltage.

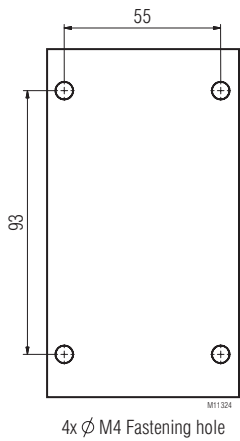
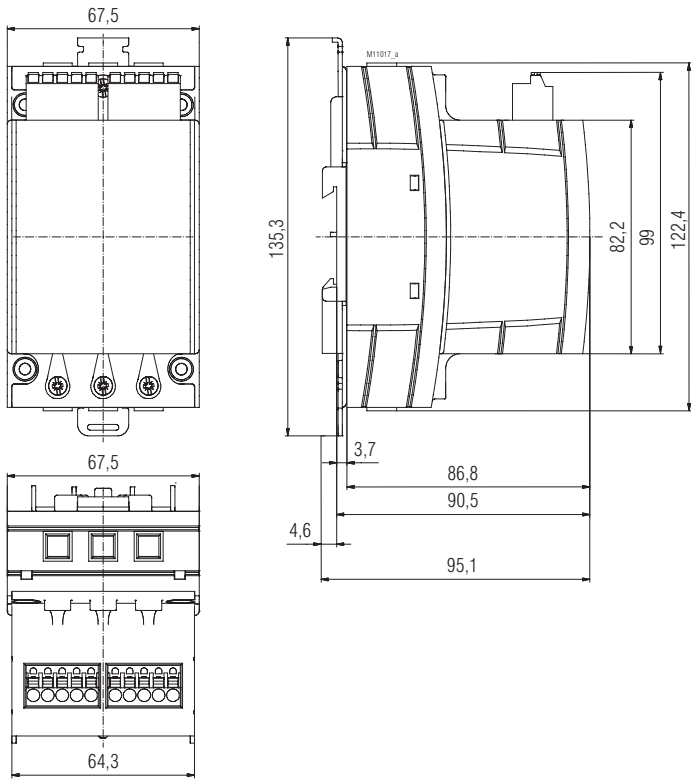
Electric shock will result in death or serious injury.



Disconnect all power supplies before servicing equipment.

- Never clear a fault when the device is switched on
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.
- Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor must be disconnected from the mains.

## Dimensions



Drilling pattern