Power Electronics

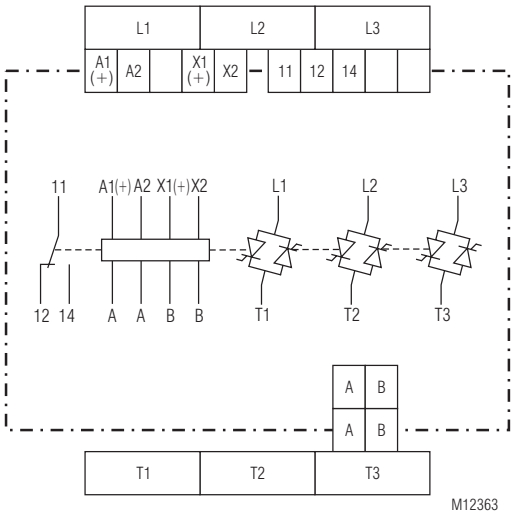
MINISTART
Softstarter, For Modbus
PF 9415

0280688

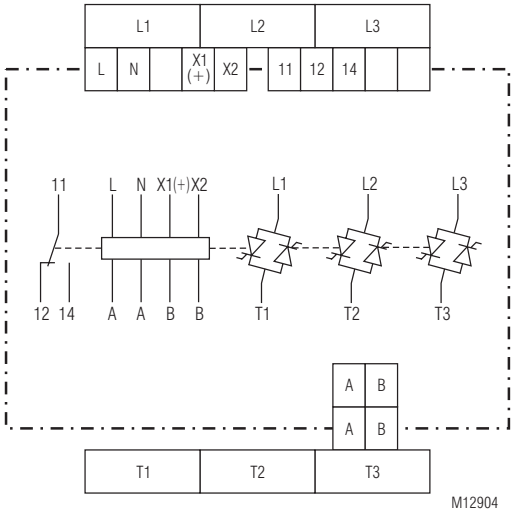
Product Description

The softstarter PF 9415 from the MINISTART family is a robust electronic control unit for ambitious start-up and deceleration 3-phase / asynchronous motors with integrated monitoring functions. After softstart the semiconductors are bridged by relay contacts to reduce the power dissipation in the unit. Motor start via control input or Modbus RTU, parameter dependent.

Circuit Diagrams



PF 9415 with UH = AC/DC 24 V



PF 9415 with UH = AC 230 V

Your Advantages

- For starting current limitation and soft start of asynchronous motors
- Only one small device 67.5 mm for softstart, softstop, motor protection, phase sequence, under- and overvoltage monitoring
- Simple and time-saving commissioning as well as user-friendly operation through parameterization via modbus
- Widely used measuring and automation protocol
- Soft start and minimized staring current
- Extended service life of AC - motors and mechanical drive system
- For motor currents up to 20 A (up to 40 A on request)
- Softstart, softstop 1 ... 20 s
- Energy saving by bridging of the semiconductors after softstart
- Symmetrical staring current

Features

- According IEC/EN 60947-4-2
- Modbus RTU interface
- Suitable for IE3-motors
- 3-phase controlled with integrated bypass relays
- Phase sequence, under- and 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
- Kickstart function
- Width: 67.5 mm

Approvals and Markings

CE

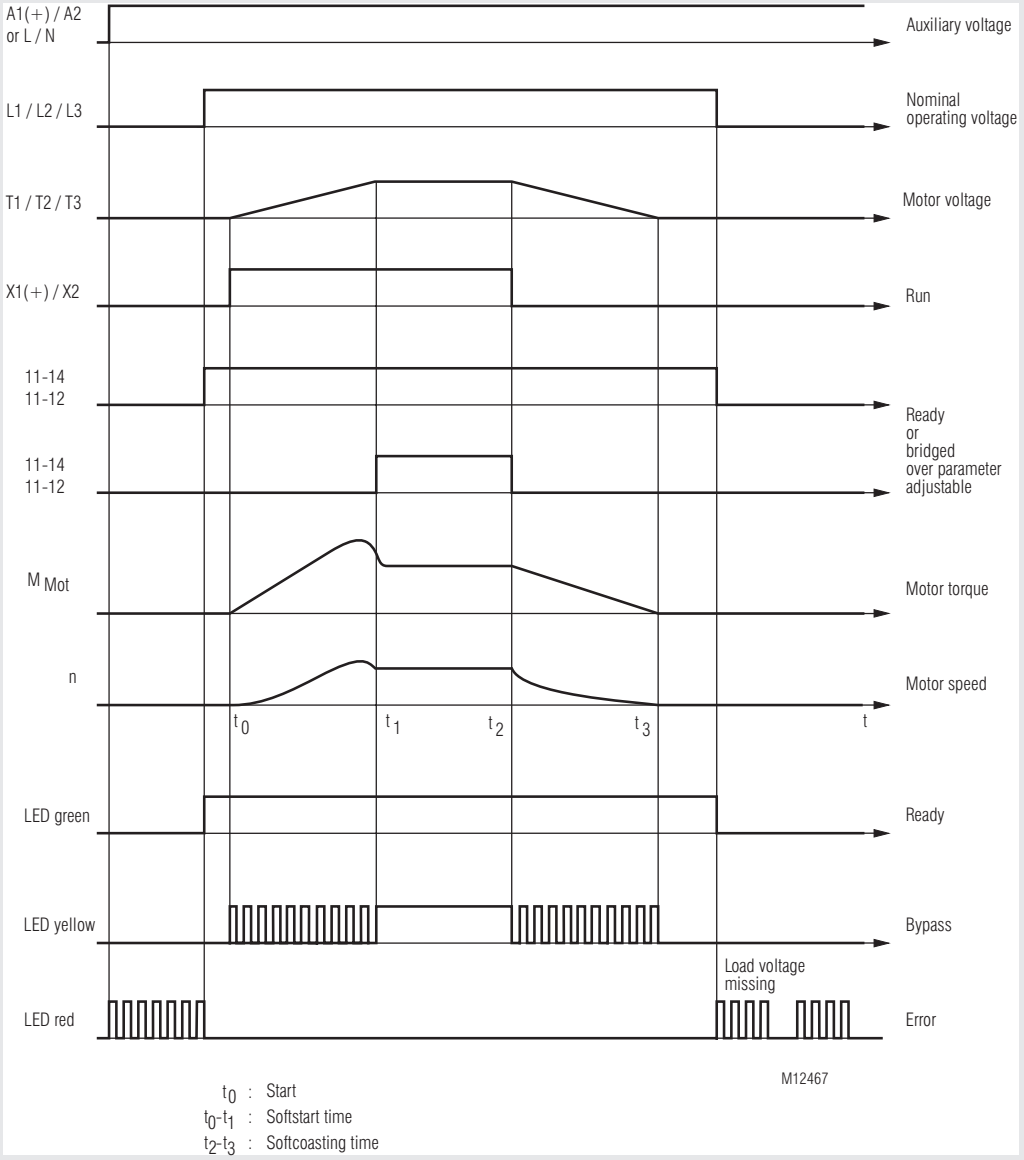
Applications

- Pumps
- Fans and ventilation systems
- Conveyor systems
- Compresseors
- Mills, crushers, presses
- ... and for other applications with ambitious start-up and deceleration

Terminal Connection

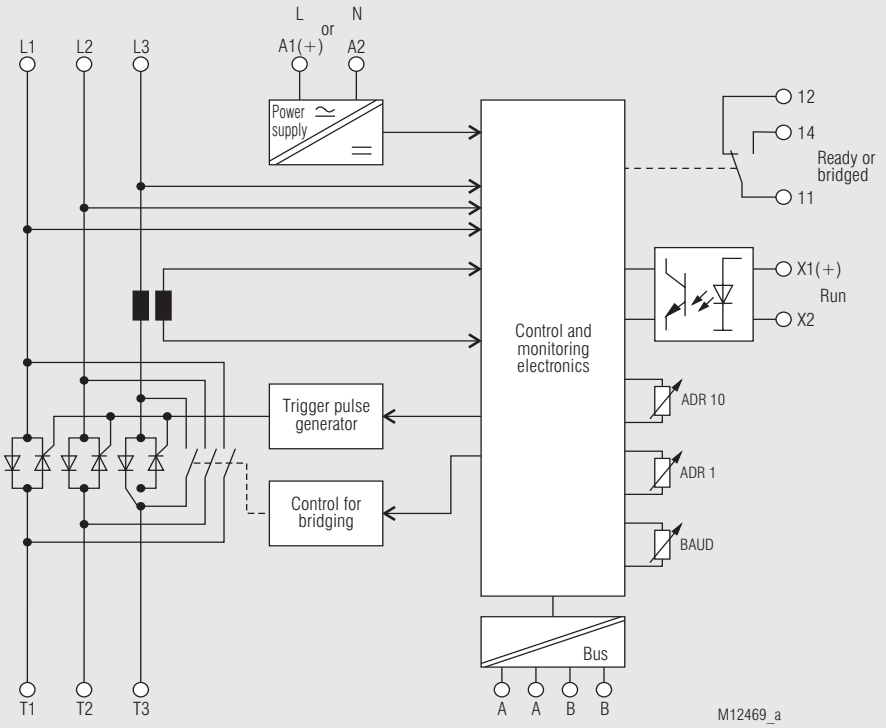
Terminal designation	Signal description
X1(+), X2	Control input Run
11, 12, 14	Indicator relay
A1(+), A2	Auxiliary voltage DC 24 V / AC 24 V
L, N	Auxiliary voltage AC 230 V
L1	Phase voltage L1
L2	Phase voltage L2
L3	Phase voltage L3
T1	Motor connection T1
T2	Motor connection T2
T3	Motor connection T3
A	Modbus signal A
B	Modbus signal B

Function Diagram



t_0 : Start
t_0-t_1 : Softstart time
t_2-t_3 : Softcoasting time

Block Diagram



Function Notes

Variation of speed is not possible with this device.

Indication

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

LED - green "On": Device ready

LED - yellow "Bypass": On, when bridging relay active
Flashes, when softstart, softstop function active

LED - red "Error": Flashes if error (see flash codes)

LED - yellow "Bus": Flashes while receiving/sending a Modbus message

Outputs

One output relay is available.
Contact 11/14 is closed and contact 11/12 open if no device fault is present. Alternatively, the status of the bypass relay can be displayed with the signal relay via the "Signal relay" parameter. If bridging relays are switched on, contact 11/14 is closed and contact 11/12 is open.

Auxiliary Supply

An auxiliary voltage of optionally DC 24 V, AC 24 V or AC 230 V is required. This allows the failure of the nominal operating voltage to be signalled as an error.

Control Elements

Rotary switch

Rotary switch ADR10: - Module address x 10
Rotary switch ADR1: - Module address x 1
Rotary switch BAUD: - Baud rate

Note: The rotary switch setting is only accepted after the auxiliary voltage is applied.

Reset button: Reset of failure mode after failure is removed. The reset means that no Modbus messages can be received for approx. 50 ms.

Device Description

Softstart function
The parameters "M_{on}" and "T_{on}" are used to set the softstart torque and the softstart time.

Softstop function
The parameters "M_{off}" and "T_{off}" are used to set the softstop torque and the softstop time.

Voltage monitoring
Under and overvoltage on the load voltage is monitored. If the voltage is out of range this will lead to a motor stop and failure indication on the unit. The voltage values to be monitored can be set via parameters. The time up to the recognition of the voltage error can be set via the parameter “trigger time U error”.

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.

Device Description

Function kickstart
The kickstart function is switched on via the parameters “kickstart time” and “kickstart function”. The kickstart time indicates how long it takes to kickstart. The kickstart voltage indicates the voltage level. At the beginning of the soft start the kickstart voltage for the kickstart time is switched to the motor. This creates an increased break off torque and allows starting of motors with high holding force at standstill. After that the softstart follows with the adjusted starting ramp.

Shortcircuited Thyristor
Before each softstart the power-semiconductors are tested for short circuit. A detected short circuit forces the unit to failure mode. A thyristor short circuit switches the device to error mode.

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 50 Hz $\pm$ 5 Hz or 60 Hz $\pm$ 5 Hz the unit switches to failure mode.

Blocking protection
The function of a motor blockage detection in bypass operation is activated via the parameter “activation motor blockage protection”. If the motor current exceeds the current set via the parameter “trigger level motor blockage” for more than 1 s the device detects a motor blockage and switches to error 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 is adjusted to the rated motor current with the "I^e" parameter. When the I^2t value is overridden the unit switches into failure mode. The I^2t value is reset with the reset function.

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

Limitation of starting current
A current limitation can be activated via the parameter “soft start mode”. The level of the current limitation is set via the parameter “soft start current limit”. The time during which the soft start may be is within the current limitation is set via the parameter “max. current limitation time”. If the current limitation is not left within the preset time the device switches to error mode.

Failure mode
If a device or function failure is detected, the unit goes into failure mode. The motor is disconnected and the indicator relay drops out. Pressing the reset button exits the failure mode. Please make sure that when pressing the reset button, the start signal is disconnected to avoid unintentional starting. The reset means that no Modbus messages can be received for approx. 50 ms.

Control input X1(+), X2

The control input X1(+), X2 is used to start the motor.

The start of the motor can be switched from control input to the Modbus RTU via the parameter “function motor start”. A motor start can only be effected from one place.

After reset or application of auxiliary voltage the motor starts if a motor start command is applied at the control input or via the Modbus RTU.

Fault Indication by Flashing Code

During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the red LED oor can be read by Modbus RTU via input register “device errors”.

Flashes*)	**Fault**	**Possible cause**	**Troubleshooting**
1 x fast	Nominal operating voltage is missing	Defective fuse, faulty wiring Nominal operating voltage not yet applied	Check fuses and wiring Switch on nominal operating voltage
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	Nominal operating voltage incorrect. Clockwise phase sequence is mandatory for correct function	Check wiring, change 2 phases
4	Undervoltage	Undervoltage of nominal operating voltage	Check nominal operating voltage, check fuses, check threshold in holding register
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
8	Motor connected incorrectly	One or more wires to the motor are interrupted	Check wiring to motor
9	Communication fault Modbus	Broken wire, timeout set too short	Check wiring Increase timeout
10	Checksum failure	Checksum failure of the parameters in the EEprom	Restore parameters
11	Overvoltage	Overvoltage of nominal operating voltage	Check nominal operating voltage, check threshold in holding register
12	Current limitation period	Time during which currrent limitation is active in soft start	Increase ramp time, remove motor blocking, check motor on possible high friction
13	Temperature sensor	Faulty temperature sensor of power section	Device has to be repaired

*): Number of flash pulses in a series

Technical Data

Auxiliary supply:	AC/DC 24 V	I AC 230 V
Overvoltage protection:	Varistor AC 30 V	I AC 275 V
Ramp up / deceleration time:	1 ... 20 s	
Starting / deceleration torque:	30 ... 80 % of nom. operating voltage	
Kickstart voltage:	50 ... 100 % of nom. operating voltage	
Kickstart time:	100 ... 2000 ms	
Consumption:	2.4 VA	I 3.2 VA

Control Input Run X1(+), X2

Control voltage:	AC/DC 12 ... 30 V	I AC/DC 20 ... 300 V
Control input current:	2 ... 3.1 mA	
Start up delay:	60 ms	
Release delay:	320 ms	

Indicator Output Ready 11, 12, 14

Contacts:	1 changeover contact	
Switching capacity		
to AC 15		
NO contacts:	3 A / AC 230 V	IEC/EN 60947-5-1
NC contacts:	1 A / AC 230 V	IEC/EN 60947-5-1
Electrical life		
to AC 15 at 3 A, AC 230 V:	2 x 10^5 switching cycles	
Permissible switching frequency:	Max. 1800 switching cycles / h	
Short circuit strength max. fuse rating:	4 A gG / gL	IEC/EN 60947-5-1
Mechanical life:	≥ 10^8 switching cycles	

Output / Load Circuit

Load circuit	
Nominal operating voltage:	3 AC 200 ... 480 V
Making voltage:	3 AC 110 V ... 3 AC 510 V
Undervoltage:	3 AC 100 V ... 500 V
Overvoltage:	3 AC 200 V ... 600 V
Peak reverse voltage:	1200 V
Overvoltage protection:	Varistor 510 V
Nominal frequency:	50 Hz ± 5 Hz or 60 Hz ± 5 Hz
Nominal operating current I_e:	20 A
Setting range I_e:	5 ... 20 A
Standard value for rated motor power at 400 V:	10 kW
Surge current:	1050 A (tp = 10 ms)
Load limit integral:	5500 A^2s
Resolution current measurement:	0.1 A
Usage category:	20A: AC-53a: 4 - 20: 100-20
Number of starts per hour:	20
Overload protection:	Class 10
Blocking protection, response value:	200 ... 800 % of I_e, longer than 1 s at Bypass-Mode
Current limiting:	200 ... 600 % of I_e, during ramp up
Short circuit detection	
Mode 1:	35 A gG / gL
Mode 2:	5500 A^2s

Coordination Type!
Coordination type 1 according to IEC 60947-4-1: The engine control unit is defective following a short circuit and must be replaced.
Coordination type 2 according to IEC 60947-4-1: The engine control unit is still suitable for continued use following a short circuit.

Technical Data

General Data

Temperature range

Operation:	- 20 ... + 50 °C At an altitude of > 1000 m the maximum permissible temperature reduces by 0.5 °C / 100 m	
Storage:	- 20 ... + 75 °C	
Relative air humidity:	< 95 %, no condensation at 40 °C	
Altitude:	≤ 2000 m	
Overvoltage category:	III	
Clearance and Creepage distances rated impulse voltage / pollution degree		
Nom. operating voltage / heat sink:	6 kV / 2	IEC/EN 60947-4-2
Nom. operating voltage / auxiliary voltage:	6 kV / 2	IEC/EN 60947-4-2
Nom. operating voltage / indicator relay:	6 kV / 2	IEC/EN 60947-4-2
Auxiliary voltage / indicator relay:	6 kV / 2	IEC/EN 60947-4-2
Nom. operating voltage / control input:	6 kV / 2	IEC/EN 60947-4-2
Auxiliary voltage / control input:	6 kV / 2	IEC/EN 60947-4-2
Indicator relay / control input:	6 kV / 2	IEC/EN 60947-4-2
Nom. operating volt. / Modbus:	6 kV / 2	IEC/EN 60947-4-2
Auxiliary voltage / Modbus:	6 kV / 2	IEC/EN 60947-4-2
Control input / Modbus:	6 kV / 2	IEC/EN 60947-4-2
Electrostatic discharge:	8 kV (air) 4 kV (contact)	IEC/EN 61000-4-2 IEC/EN 61000-4-2

EMC

HF-irradiation		
80 MHz ... 1.0 GHz:	10 V / m	IEC/EN 61000-4-3
1.0 GHz ... 6.0 GHz:	3 V / m	IEC/EN 61000-4-3
Fast transients:	2 kV	IEC/EN 61000-4-4
Surge voltage between		
wires for power supply:	1 kV	IEC/EN 61000-4-5
Between wire and ground:	2 kV	IEC/EN 61000-4-5
HF-wire guided:	10 V	IEC/EN 61000-4-6
Voltage dips:		IEC/EN 61000-4-11
Interference emission wire guided:	Limit value class B	IEC/EN 60947-4-2
Interference emission during operation with UH 24 V:	Limit value class A	IEC/EN 60947-4-2

Danger of emitted interference!
May cause property damage.
The device is designed for use in an industrial environment (class A, EN 55011) when operated with UH 24 V. Connecting the device to a low voltage supply grid (class B, EN 55011) may cause radio frequency interference when operating with UH 24 V. Take suitable measures to avoid this.

Radio irradiation:	Limit value class B	IEC/EN 60947-4-2
Harmonics in bypass mode:		IEC/EN 61000-3-11
Degree of Protection		
Enclosure:	IP 40	IEC/EN 60529
Terminals:	IP 20	IEC/EN 60529
Housing:	Thermoplastic with V0 behaviour acc. to UL subject 94	
Vibrations:	Frequency 10 ... 150 Hz Amplitude 0.35 mm constant, from 10 ... 60 Hz Constant acceleration 5 g, from 60 ... 150 Hz	IEC/EN 60068-2-6
Climate resistance:	20 / 050 / 04	IEC/EN 60068-1

Technical Data

Wire connections
Load terminals: Box terminals with self-lifting wire protection
Captive M4 Pozidriv-terminal screws
0.5 ... 16 mm² solid
0.5 ... 16 mm² stranded wire with sleeve DIN 46228/1
0.5 ... 16 mm² stranded ferruled (isolated) DIN 46228/4
21 - 6 AWG

Insulation of wires or sleeve length: 12 mm - 13 mm
Mounting torque: 2.5 Nm
Control terminals: Pluggable terminal blocks with cage clamp terminals
0.2 - 2.5 mm² solid
0.2 - 2.5 mm² ferruled
0.2 - 2.5 mm² stranded wire with sleeve DIN 46228/1
0.2 - 2.5 mm² stranded ferruled (isolated)
26 - 12 AWG

Insulation of wires or sleeve length: 8 mm
Bus terminals: Pluggable terminal blocks with cage clamp terminals
0.2 - 1.5 mm² solid
0.2 - 1.5 mm² fine stranded
0.2 - 1.5 mm² ferruled DIN 46228/1
0.2 - 1.5 mm² stranded wire with sleeve
26 - 16 AWG
0.2 - 1.5 mm² solid

Insulation of wires or sleeve length: 10 mm
Weight
with DIN rail mounting: 960 g

Dimensions

Width x height x depth: 67.5 mm x 122.4 mm x 122.1 mm
with fixing plate
with heat sink

Standard Type

PF 9415.11 3 AC 200 ... 480 V U_H DC 24 V 20 A

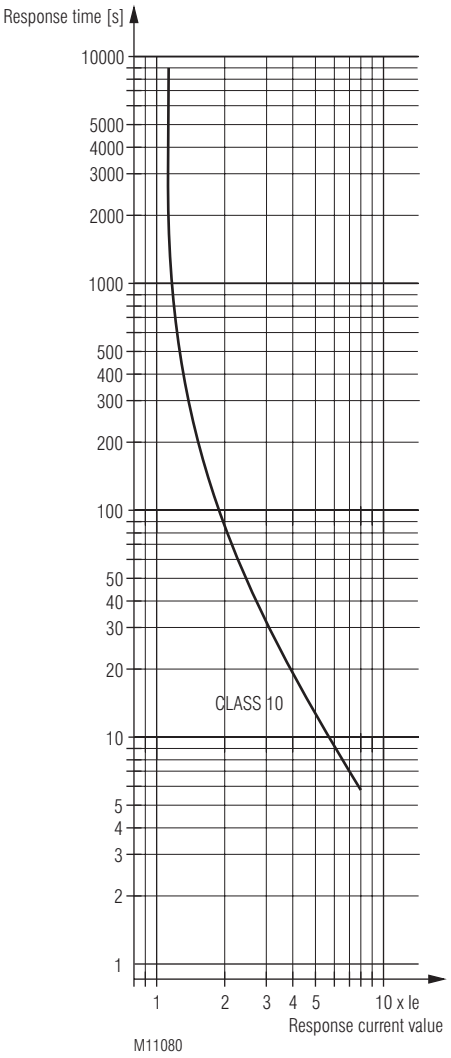
Article number:	0069251
• Load voltage:	3 AC 200 ... 480 V
• Auxiliary voltage U_H:	AC 230 V
• Nominal operating current I_e:	20 A
• Setting range I_e:	5 A ... 20 A
• Width:	67,5 mm

Ordering Example

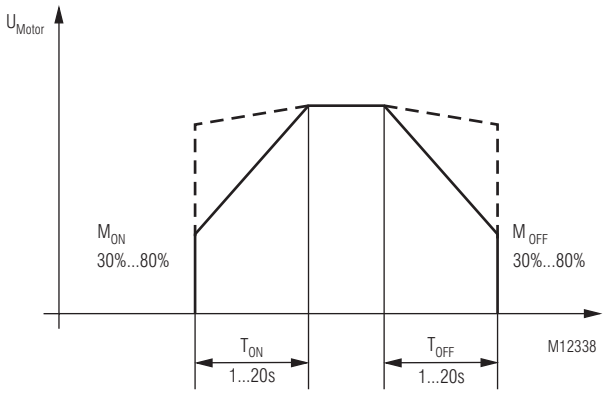
PF 9415 .11 3 AC 200 ... 480 V U_H 230 V 20 A

- 20 A: Nominal operating current
- U_H 230 V: Auxiliary voltage U_H
- 3 AC 200 ... 480 V: Load voltage
- .11: Contacts
- PF 9415: Type

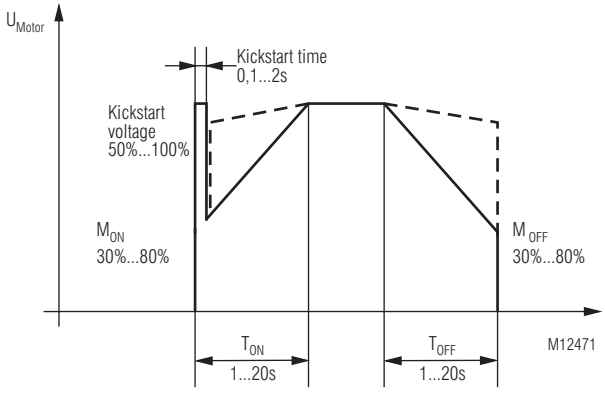
Characteristics



Trigger characteristics



Characteristic without kickstart function



Characteristic with kickstart function

Set-up procedure

Parametrization via Modbus

Softstart:

1. Start the device and motor via control input Run X1(+), X2 e.g start motor via Modbus-RTU.
   Turn potentiometer "M_{on}" up until the motor starts to turn without excessive humming.
2. Adjust potentiometer "T_{on}" to give desired ramp time.

Softstop:

- During softstop the device has to be connected to the voltage.
- Initiate softstop by opening control input Run X1(+), X2 e.g via Modbus-RTU.
- The softstop time is identical with the softstart time "T_{off}".

Safety Instructions

Installation Error!

- For engine control units, the minimum loads indicated in the data sheet must be observed.
- The use of capacitive loads can lead to the destruction of switching components of the motor control unit. Do not operate capacitive loads on the motor control unit.

To switch off the motor in case of failure of Modbus communication the communication must be monitored by the timeout function.

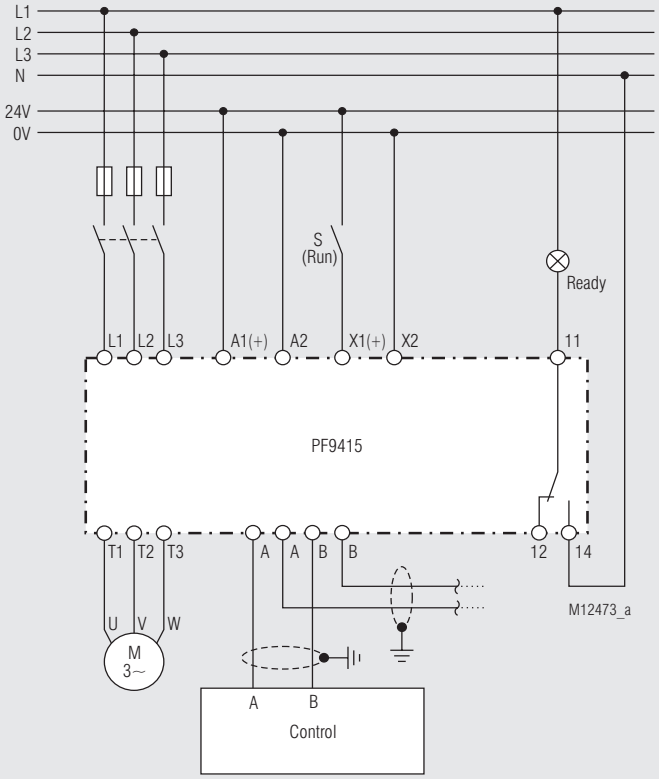
WARNUNG **Functional error!**
Danger to life or risk of serious injuries.

- Voltage is present at the output terminals when the motor control unit is in the OFF state.

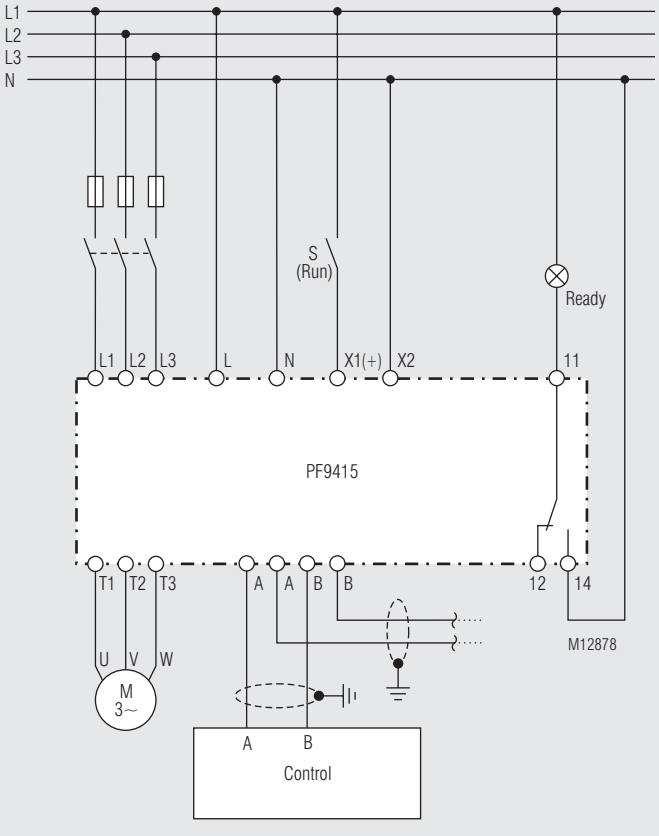
WARNING **Functional error!**
Danger to life, risk of serious injuries or property damage.

- Make sure that the motor start signal is removed before resetting, otherwise the motor will start again.

Connection Example

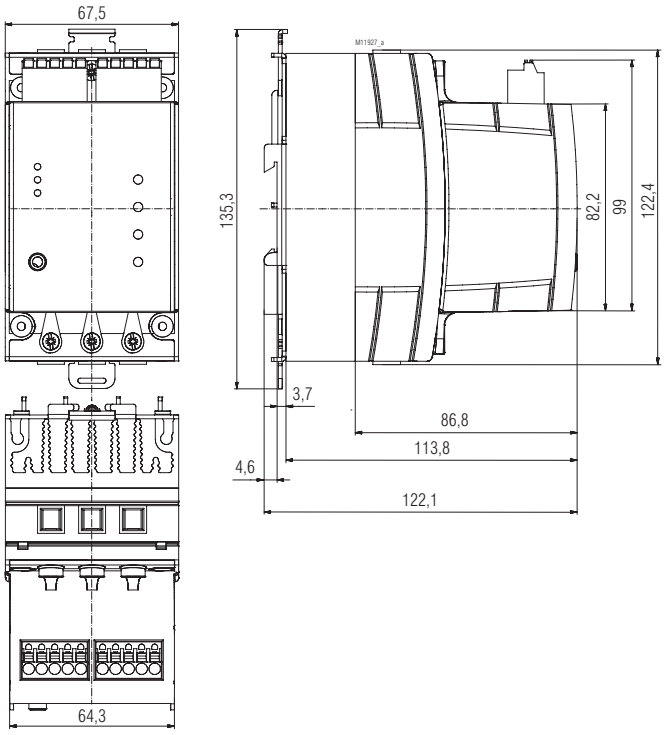


PF 9415 with UH = AC/DC 24 V



PF 9415 with UH = AC 230 V

Dimensions



With heat sink

Bus Interface

Protocol	Modbus Seriell RTU
Adress	1 to 99
Baud rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Bit/s
Data bit	8
Stop bit	2
Parity	None

The bus parameters are set via rotary switch.
The bus parameters are only taken over upon application of auxiliary voltage.

More information about the interface, wiring rules, device identification and communication monitoring can be found in the Modbus user manual.

Function-Codes

At PF 9415 the following function codes are implemented:

Function-Code	Name	Description
0x03	Read Holding Register	Device parameter read word by word
0x04	Read Input Register	Device actual value, Device state value, Device ident value read word by word
0x05	Write Single Coil	Outputs write individually
0x06	Write Single Register	Device parameter write word by word
0x10	Write Multiple Register	Device parameter write in blocks

Device configuration

If required the device configuration data can be saved permanently by setting the the Bit "Write configuration to EEPROM". The data is copied from the EEPROM to the relevant register when connecting the auxiliary voltage. As the numbers of write cycles of an EEPROM are limited, the writing must not be done in cycles. Writing the EEPROM is only possible while the motor is not controlled. If a command is sent to write the configuration data to the EEPROM, it will only be processed once the motor is no longer controlled.
It should also be noted that no Modbus telegrams can be received for approx. 50 ms when writing the EEPROM.

Reset Function

By sending a reset command a reset can be operated via Modbus. The reset means that no Modbus messages can be received for approx. 50 ms.

Modbus RTU

For communication between softstarter and a supervising control the Modbus RTU protocol according to Specification V 1.1b3 is used.

Parameter Table

Every slave owns an output- configuration- and actual value table. In these tables it is defined under which address the parameters, state values, control values and measuring values can be found.

Write Single Coils (control signals) FC0x05

Register-adress	Protocol-adress	Name	Value range	Description	Data type	Access rights
1	0	Reset	0x0000 0xFF00	No function Acknowledgement error	BIT	Write
2	1	Reserved	0x0000 0xFF00	Not used	BIT	Write
3	2	Write configuration to EEPROM	0x0000 0xFF00	No function Save parameters	BIT	Write
4	3	Reserved	0x0000 0xFF00	Not used	BIT	Write
5	4	Reserved	0x0000 0xFF00	Not used	BIT	Write
49	48	Run	0x0000 0xFF00	Motor OFF Motor ON	BIT	Write

Parameter Table

Read Input Registers (State signals and measuring values) FC0x04:

Register-adress	Protocol-adress	Name	Value range	Description	Data type	Access rights
30001	0	Device failure	0 ... 14	0: No failure 1: Overtemperature LT 2: Wrong freqency 3: Phase reversal 4: Undervoltage 5: Motor protection has responded 6: Motor blocked 7: Thyristor short-circuit 8: Motor not properly connected 9: Communication fault Modbus 10: Checksum failure EEPROM 11: Overvoltage 12: Current limitation period exceeded 13: Temperature sensor defective	UINT16	Read
30002	1	State of device	0 … 10	0: Device initialize 1: Ready, wait for start 2: Device in error mode 3: Wait for nominal operating voltage 4: Frequency measurement 5: Thyristor test 6: Line test 7: Kickstart 8: Softstart 9: Power semiconductor bridged 10: Softstop	UINT16	Read
32001	2000	Actual motor current	0 … 500	In 1/10 A (Current values less than 2 A are displayed as 0)	UINT16	Read
32002	2001	Motor load	0 … 100	In %	UINT16	Read
32003	2002	Phase voltage L1/L2	0 … 600	In V	UINT16	Read
32004	2003	Phase voltage L2/L3	0 … 600	In V	UINT16	Read
32005	2004	Phase voltage L1/L3	0 … 600	In V	UINT16	Read
32006	2005	Mains frequency	50/60	In Hz	UINT16	Read

Parameter Table

Read Holding Registers (Device configuration, control signals) FC0x03:
Write Holding Register (Device configuration, control signals) FC0x06:
WriteMultiple Registers (Device configuration, control signals) FC0x10:

Register-adress	Protocol-adress	Name	Value range	Initial value	Description	Data type	Access rights
40001	0	State word 1	0, 1, 4	0	Bit 0 = Reset Bit 2 = Write configuration to EEPROM	UINT16	Write / read
40002	1	Timeout release	0 … 1	0	0 = Disable 1 = Enable	UINT16	Write / read
40003	2	Timeout	100 … 10000	1000	Timeout value in ms	UINT16	Write / read
40004	3	State word 2	0 … 1	0	0 = Motor OFF 1 = Motor ON	UINT16	Write / read
42001	2000	I_e	5000 … 20000	5000	Nominal motor current in mA	UINT16	Write / read
42002	2001	M_{on}	30 … 80	30	Softstart voltage in % from nominal voltage	UINT16	Write / read
42003	2002	T_{on}	1000 … 20000	10000	Softstart ramp time in s	UINT16	Write / read
42004	2003	M_{off}	30 … 80	80	Softstop voltage in % from nominal voltage	UINT16	Write / read
42005	2004	T_{off}	1000 … 20000	10000	Softstop ramp time in ms	UINT16	Write / read
42006	2005	Undervoltage	100 … 500	100	Threshold for undervoltage monitoring in V	UINT16	Write / read
42007	2006	Overvoltage	200 … 600	440	Threshold for overvoltage monitoring in V	UINT16	Write / read
42008	2007	Trigger time U error	100 … 5000	500	Trigger time voltage error in ms	UINT16	Write / read
42009	2008	Kickstart time	0, 100 … 2000	0	Kickstart time in ms 0 = Without kickstart	UINT16	Write / read
42010	2009	Kickstart voltage	50 … 100	50	Kickstart voltage in % of nom. operation voltage	UINT16	Write / read
42011	2010	Soft start mode	1 … 2	1	1 = Without current limiting 2 = With current limiting	UINT16	Write / read
42012	2011	Soft start current limit	200 … 600	400	Soft start current limit in % of I_e	UINT16	Write / read
42013	2012	Max. current limitation time	500 … 50000	10000	Termination of soft start after this time has elapsed in current limit (in ms)	UINT16	Write / read
42014	2013	Trigger threshold motor blockage	200 … 800	400	Trigger threshold for motor blockage in % of I_e	UINT16	Write / read
42015	2014	Activation motor blockage protection	0 … 1	0	0 = Motor blockage protect. OFF 1 = Motor blockage protect. ON	UINT16	Write / read
42016	2015	Function signalling relay	0 … 1	0	0 = Message ready 1 = Message bridged	UINT16	Write / read
42017	2016	Function motor start	0 … 1	0	0 = Via Control input 1 = Via Modbus-RTU	UINT16	Write / read

Parameters from Adress 2000 can be stored permanently in the EEPROM by setting the Bit "Write configuration to EEPROM"

Writing the EEPROM is only possible while the motor is not controlled. If a command to write the configuration data to the EEPROM is sent, it will only be processed as soon as the motor is no longer controlled.
It should also be noted that no Modbus telegrams can be received for approx. 50 ms when writing the EEPROM.

If the value ranges are exceeded, the corresponding holding register is set to its initial value and the error code 0x04 SERVER DEVICE FAILURE is returned.