

RELION® 630 SERIES

Motor Protection and Control

REM630

Product Guide



Motor Protection and Control	1MRS756977 H
REM630	
Product version: 1.3	

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1. Description

REM630 is a comprehensive motor management relay for protection, control, measuring and supervision of medium and large synchronous and asynchronous motors in medium voltage industrial power systems. REM630 is a member of ABB's Relion® product family and a part of its 630 series characterized by functional scalability and flexible configurability. REM630 also features necessary control functions required for the management of industrial motor feeder bays.

The supported communication protocols including IEC 61850 offer seamless connectivity to industrial automation systems.

2. Application

REM630 provides main protection for synchronous and asynchronous motors and the associated drives. The motor management protection relay is intended for circuit-breaker and contactor controlled medium sized and large synchronous and asynchronous motors in a variety of drive applications, such as motor drives for pumps, fans, compressors, mills, crushers, and so on.

The pre-defined configuration developed for REM630 can be used as such or easily customized or extended with add-on functions, by means of which the motor management protection relay can be fine-tuned to exactly satisfy the specific requirements of your present application.

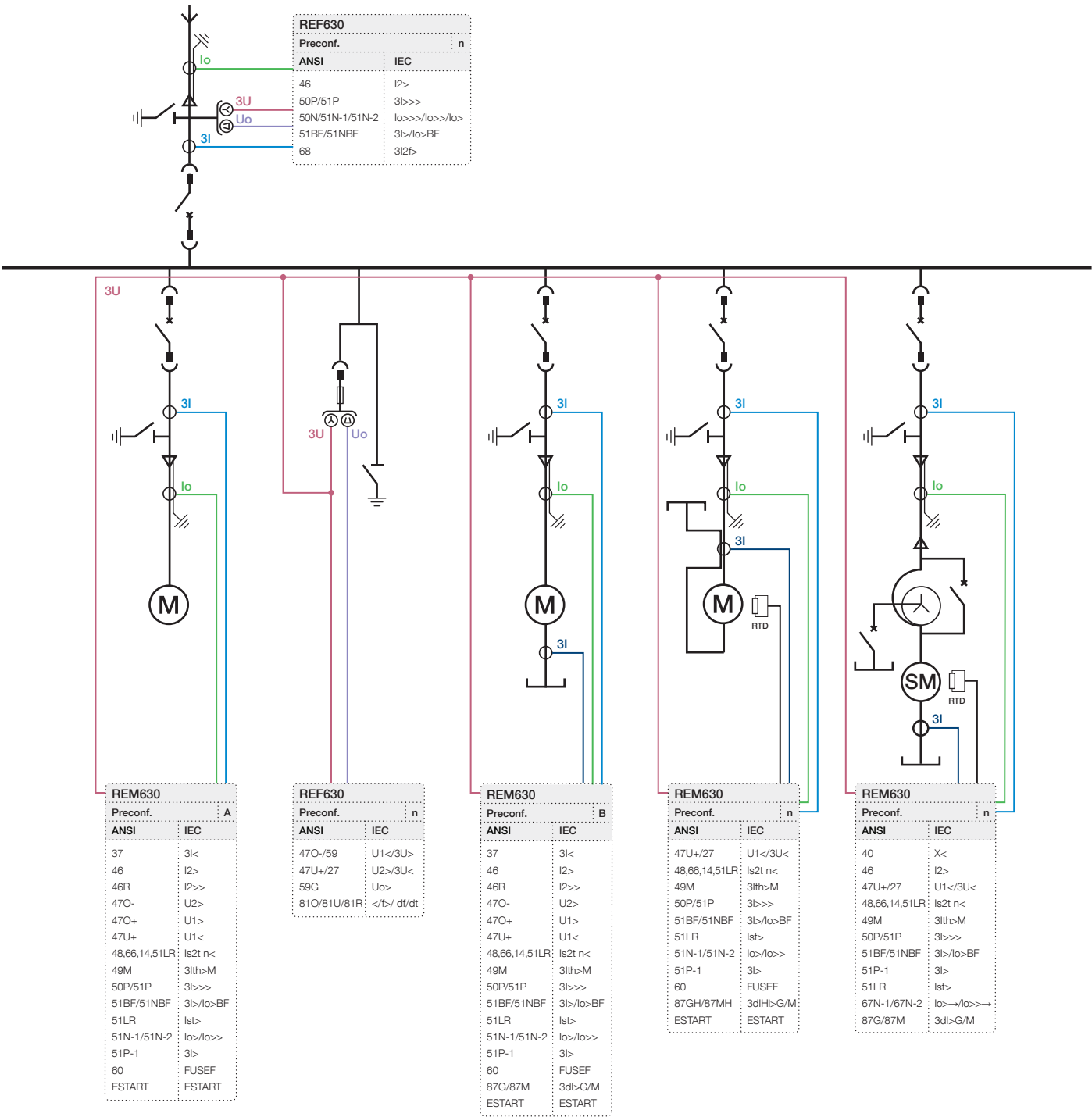


Figure 1. Example of a dedicated motor substation with the different motor starting methods combined in one medium voltage switchgear

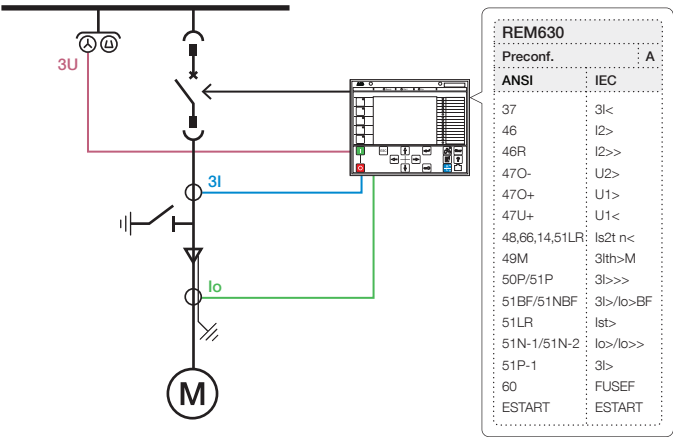


Figure 2. Application example for Direct-on-load started motor, with motor directly connected to medium-voltage network protected with preconfiguration A

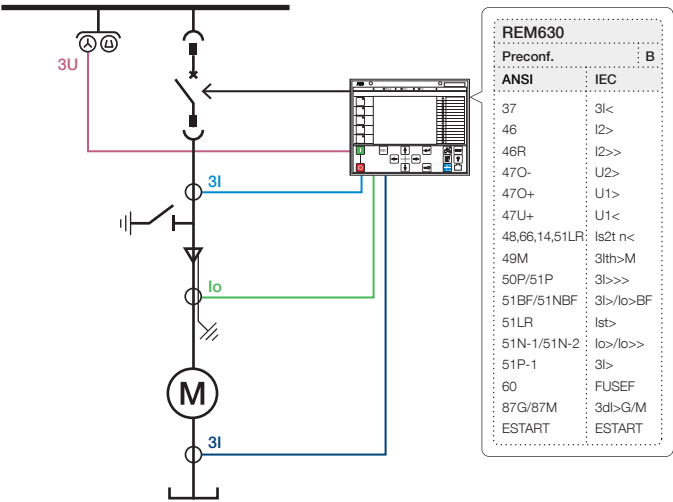


Figure 3. Application example for Direct-on-load started motor, with motor directly connected to medium-voltage network with Motor differential protection function enabled by default in preconfiguration B

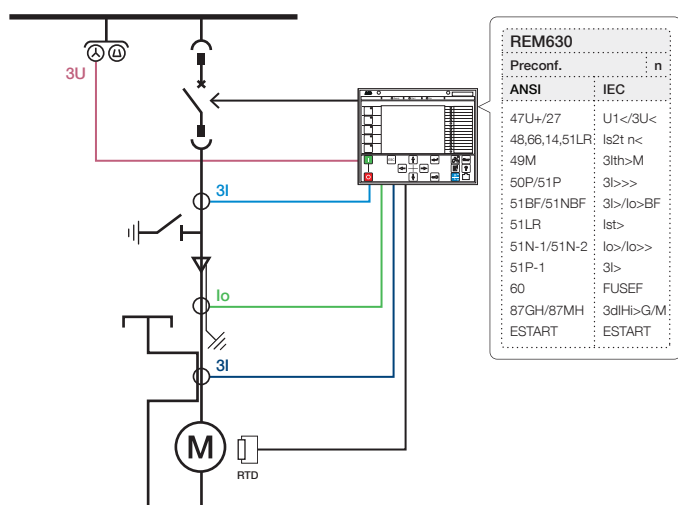


Figure 4. Application example for Direct-on-load started motor, with motor directly connected to medium-voltage network with flux-balance Motor differential protection function covered by preconfiguration n

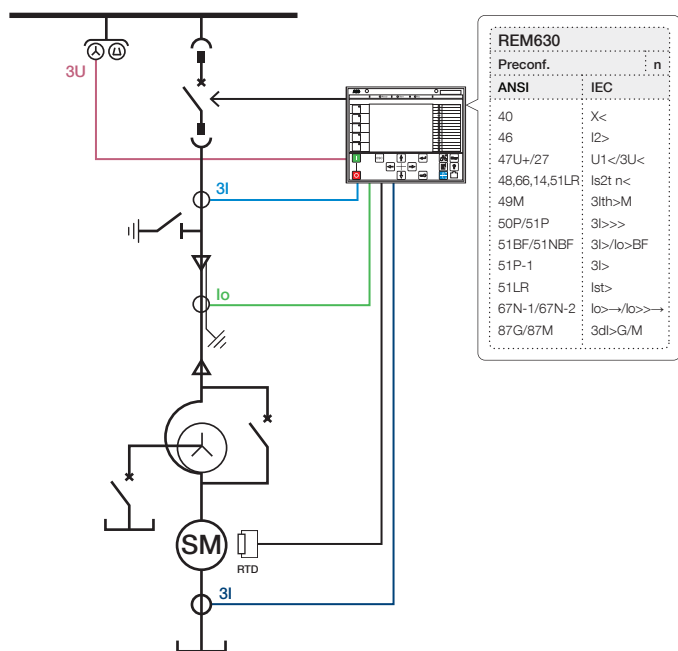


Figure 5. Application example for synchronous motor started with and autotransformer. Underexcitation protection function implemented with directional power functions

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3. Preconfigurations

The 630 series protection relays are offered with optional factory-made preconfigurations for various applications. The preconfigurations contribute to faster commissioning and less engineering of the protection relay. The preconfigurations include default functionality typically needed for a specific application. Each preconfiguration is adaptable using the Protection and Control IED Manager PCM600. By adapting the preconfiguration the protection relay can be configured to suit the particular application.

The adaptation of the preconfiguration may include adding or removing of protection, control and other functions according to the specific application, changing of the default parameter settings, configuration of the default alarms and event recorder

settings including the texts shown in the HMI, configuration of the LEDs and function buttons, and adaptation of the default single-line diagram.

In addition, the adaptation of the preconfiguration always includes communication engineering to configure the communication according to the functionality of the protection relay. The communication engineering is done using the communication configuration function of PCM600.

If none of the offered preconfigurations fulfill the needs of the intended area of application, 630 series protection relays can also be ordered without any preconfiguration. In this case the protection relay needs to be configured from the ground up.

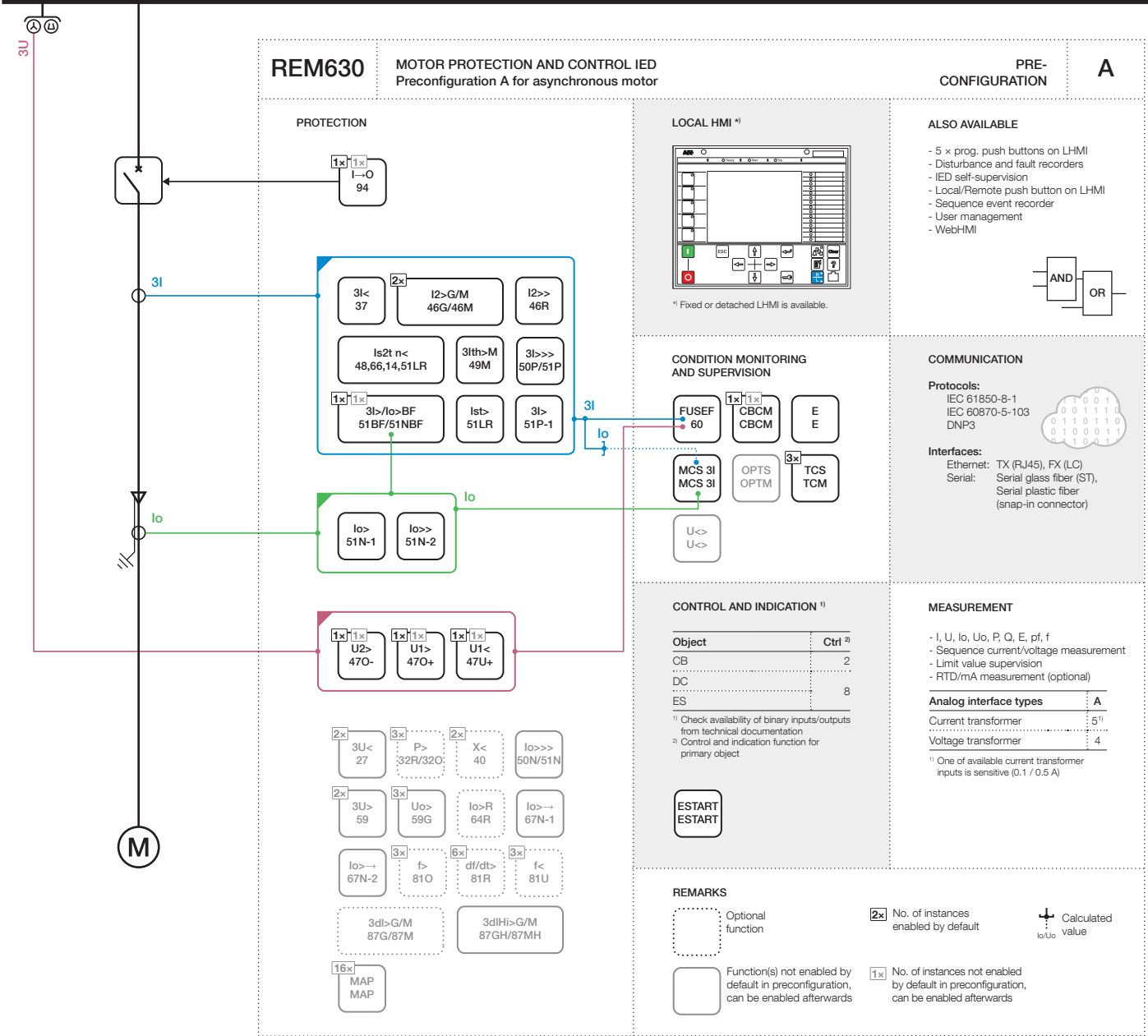


Figure 6. Functionality overview for preconfiguration A



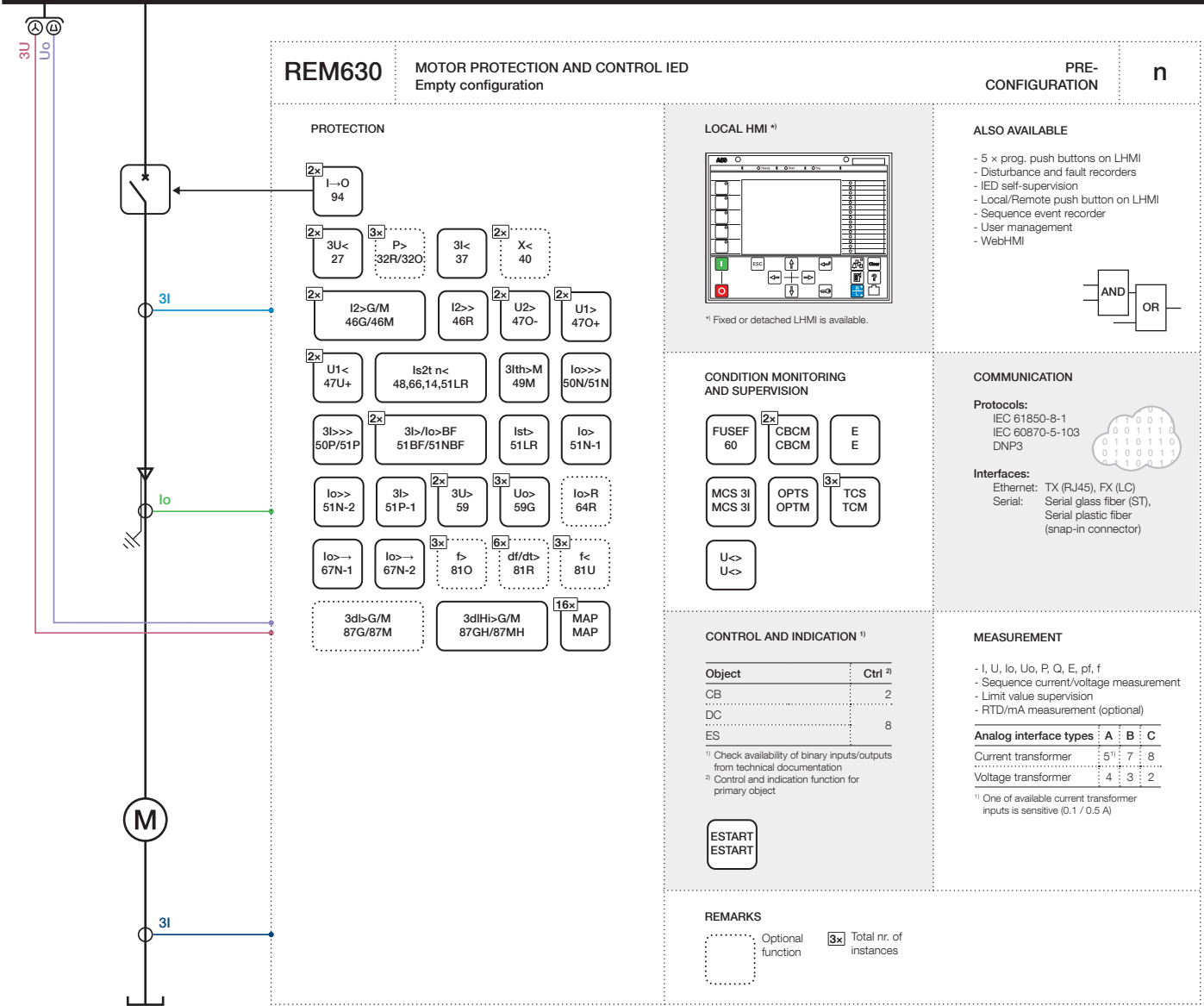


Figure 8. Functionality overview for preconfiguration n

Table 1. REM630 preconfiguration ordering options

Description	Preconfiguration		
Preconfiguration A for asynchronous motor	A		
Preconfiguration B for asynchronous motor including differential protection		B	
Number of instances available			n

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Table 2. Functions used in preconfigurations

Description	A	B	n
Protection			
Three-phase non-directional overcurrent protection, low stage	1	1	1
Three-phase non-directional overcurrent protection, instantaneous stage	1	1	1
Non-directional earth-fault protection, low stage	1	1	1
Non-directional earth-fault protection, high stage	1	1	1
Non-directional earth-fault protection, instantaneous stage	-	-	1
Directional earth-fault protection, low stage	-	-	1
Directional earth-fault protection, high stage	-	-	1
Rotor earth-fault protection	-	-	1
Negative-sequence overcurrent protection for machines	2	2	2
Phase-reversal protection	1	1	1
Three-phase thermal overload protection for motors	1	1	1
Motor startup supervision	1	1	1
Motor load jam protection	1	1	1
Emergency start	1	1	1
Loss of load supervision	1	1	1
High-impedance or flux-balance based differential protection for machines	-	-	1
Stabilized differential protection for machines	-	1	1
Three-phase overvoltage protection	-	-	2
Three-phase undervoltage protection	-	-	2
Positive-sequence overvoltage protection	1	1	2
Positive-sequence undervoltage protection	1	1	2
Negative-sequence overvoltage protection	1	1	2
Residual overvoltage protection	-	-	3
Reverse power/directional overpower protection	-	-	3
Frequency gradient protection	-	-	6
Overfrequency protection	-	-	3
Underfrequency protection	-	-	3
Three-phase underexcitation protection	-	-	2
Circuit breaker failure protection	1	1	2
Tripping logic	1	1	2
Multipurpose analog protection	-	-	16
Control			
Bay control	1	1	1
Interlocking interface	2	2	10
Circuit breaker/disconnector control	2	2	10
Circuit breaker	1	1	2

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Table 2. Functions used in preconfigurations, continued

Description	A	B	n
Disconnecter	1	1	8
Local/remote switch interface	-	-	1
Generic process I/O			
Single point control (8 signals)	-	-	5
Double point indication	-	-	15
Single point indication	-	-	64
Generic measured value	-	-	15
Logic Rotating Switch for function selection and LHMI presentation	-	-	10
Selector mini switch	-	-	10
Pulse counter for energy metering	-	-	4
Event counter	-	-	1
Supervision and monitoring			
Runtime counter for machines and devices	-	-	1
Circuit breaker condition monitoring	1	1	2
Fuse failure supervision	1	1	1
Current circuit supervision	1	1	1
Trip-circuit supervision	3	3	3
Station battery supervision	-	-	1
Energy monitoring	1	1	1
Measured value limit supervision	-	-	40
Measurement			
Three-phase current measurement	1	1	1
Three-phase voltage measurement (phase-to-earth)	-	-	1
Three-phase voltage measurement (phase-to-phase)	1	1	1
Residual current measurement	-	-	1
Residual voltage measurement	-	-	1
Power monitoring with P, Q, S, power factor, frequency	1	1	1
Sequence current measurement	1	1	1
Sequence voltage measurement	1	1	1
Disturbance recorder function			
Analog channels 1-10 (samples)	1	1	1
Analog channels 11-20 (samples)	-	-	1
Analog channels 21-30 (calc. val.)	-	-	1
Analog channels 31-40 (calc. val.)	-	-	1
Binary channels 1-16	1	1	1
Binary channels 17-32	1	1	1
Binary channels 33-48	1	1	1
Binary channels 49-64	1	1	1

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Table 2. Functions used in preconfigurations, continued

Description	A	B	n
Station communication (GOOSE)			
Binary receive	-	-	10
Double point receive	-	-	32
Interlock receive	-	-	59
Integer receive	-	-	32
Measured value receive	-	-	60
Single point receive	-	-	64
n = total number of available function instances regardless of the preconfiguration selected			
1, 2, ... = number of included instances			

4. Protection functions

REM630 offers all the functionality needed to manage motor starts and normal drive operations also including protection and fault clearance in abnormal situations. The motor management protection relay features motor run-up time supervision, locked rotor protection and protection against too frequent motor starts. Furthermore, the protection relay offers thermal overload protection, phase unbalance protection, stabilized differential protection for motors, high-impedance or flux-balance-based protection, three-phase directional overpower protection, underexcitation protection, load-based motor jam protection, loss of load supervision, and phase-reversal protection. REM630 also incorporates non-directional and directional earth-fault protection, rotor earth-fault protection and back-up overcurrent protection. The protection relay also offers optional negative and positive phase sequence overvoltage protection, positive phase sequence undervoltage protection, underfrequency and overfrequency protection.

In certain motor drives of special importance there must be a possibility to override the motor thermal overload protection to perform an emergency start of a hot motor.

5. Control

The protection relay incorporates local and remote control functions. The protection relay offers a number of freely assignable binary inputs/outputs and logic circuits for establishing bay control and interlocking functions for circuit breakers and motor operated switch-disconnectors. The protection relay supports both single and double busbar substation busbar layouts. The number of controllable primary apparatuses depends on the number of available inputs and outputs in the selected configuration. Besides conventional hardwired signaling also GOOSE messaging according to IEC 61850-8-1 can be used for signal interchange between protection relays to obtain required interlockings.

6. Measurement

The protection relay continuously measures the phase currents, the symmetrical components of the currents and the residual current. The protection relay also measures phase and phase-to-phase voltages, symmetrical components of the voltages and the residual voltage. In addition, the protection relay monitors active and reactive power, power demand value over a user-selectable pre-set time frames as well as cumulative active and reactive energy of both directions. Line frequency, the thermal overload of the protected object, and the phase unbalance value based on the ratio between the negative sequence and positive sequence current are also calculated. Cumulative and averaging calculations utilize the non-volatile memory available in the protection relay. Calculated values are also obtained from the protection and condition monitoring functions of the protection relay.

The values measured are accessed locally via the front-panel user interface of the protection relay or remotely via the communication interface of the protection relay. The values are also accessed locally or remotely using the Web-browser based user interface.

7. Disturbance recorder

The protection relay is provided with a disturbance recorder featuring up to 40 analog and 64 binary signal channels. The analog channels can be set to record the waveform of the currents and voltage measured. The analog channels can be set to trigger the recording when the measured value falls below or exceeds the set values. The binary signal channels can be set to start a recording on the rising or the falling edge of the binary signal. The binary channels are set to record external or internal relay signals, for example the start or operate signals of the protection functions, or external blocking or control signals. Binary relay signals such as a protection start or trip signal, or an external relay control signal over a binary input can be set to trigger the recording. In addition, the disturbance recorder settings include pre- and post triggering times.

The disturbance recorder can store up to 100 recordings. The number of recordings may vary depending on the length of the recording and the number of signals included. The disturbance recorder controls the Start and Trip LEDs on the front-panel user interface. The operation of the LEDs is fully configurable enabling activation when one or several criteria, that is, protection function starting or tripping, are fulfilled.

The recorded information is stored in a nonvolatile memory and can be uploaded for subsequent fault analysis.

8. Event log

The protection relay features an event log which enables logging of event information. The event log can be configured to log information according to user predefined criteria including relay signals. To collect sequence-of-events (SoE) information, the protection relay incorporates a nonvolatile memory with a capacity of storing 1000 events with associated time stamps and user definable event texts. The nonvolatile memory retains its data also in case the protection relay temporarily loses its auxiliary supply. The event log facilitates detailed pre- and post-fault analyses of faults and disturbances.

The SoE information can be accessed locally via the user interface on the protection relay's front panel or remotely via the communication interface of the protection relay. The information can further be accessed, either locally or remotely, using the web-browser based user interface.

The logging of communication events is determined by the used communication protocol and the communication engineering. The communication events are automatically sent to station automation and SCADA systems once the required communication engineering has been done.

9. Disturbance report

The disturbance report includes information collected during the fault situation. The report includes general information such as recording time, pre-fault time and post fault time. Further, the report includes pre-fault magnitude, pre-fault angle, fault magnitude and fault angle trip values. By default, the disturbance reports are stored in a nonvolatile memory. The numerical disturbance report can be accessed via the local front panel user interface. A more comprehensive disturbance report with waveforms is available using PCM600.

10. Circuit-breaker monitoring

The condition monitoring functions of the protection relay constantly monitors the performance and the condition of the circuit breaker. The monitoring comprises the spring charging time, SF6 gas pressure, the travel-time, operation counter, accumulated energy calculator, circuit-breaker life estimator and the inactivity time of the circuit breaker.

The monitoring functions provide operational circuit breaker history data, which can be used for scheduling preventive circuit-breaker maintenance.

11. Trip-circuit supervision

The trip-circuit supervision continuously monitors the availability and operability of the trip circuit. It provides open-circuit monitoring both when the circuit breaker is in its closed and in its open position. It also detects loss of circuit-breaker control voltage.

12. Self-supervision

The relay's built-in self-supervision system continuously monitors the state of the relay hardware and the operation of the relay software. Any fault or malfunction detected is used for alerting the operator.

Self-supervision events are saved into an internal event list which can be accessed locally via the user interface on the protection relay's front panel. The event list can also be accessed using the Web HMI or PCM600.

13. Fuse failure supervision

The fuse failure supervision detects failures between the voltage measurement circuit and the relay. The failures are detected either by the negative sequence-based algorithm or by the delta voltage and delta current algorithm. Upon the detection of a failure, the fuse failure supervision function activates an alarm and blocks voltage-dependent protection functions from unintended operation.

14. Current circuit supervision

Current circuit supervision is used for detecting faults in the current transformer secondary circuits. On detecting of a fault the current circuit supervision function can also activate an alarm LED and block certain protection functions to avoid unintended operation. The current circuit supervision function calculates the sum of the phase currents and compares the sum with the measured single reference current from a core balance current transformer or from another set of phase current transformers.

15. Access control

To protect the protection relay from unauthorized access and to maintain information integrity, the protection relay is provided with an authentication system including user management. Using the IED User Management tool in the Protection and Control IED Manager PCM600, an individual password is assigned to each user by the administrator. Further, the user name is associated to one or more of the four available user groups: System Operator, Protection Engineer, Design Engineer and User Administrator. The user group association for each individual user enables the use of the protection relay according to the profile of the user group.

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16. Inputs and outputs

The protection relay is equipped with three phase-current inputs and two residual-current inputs for earth-fault protection. The protection relay always includes one residual voltage input for directional earth-fault protection or residual voltage protection. Further, the protection relay includes three phase-voltage inputs for overvoltage, undervoltage and directional overcurrent protection and other voltage based protection functions.

The phase-current inputs are rated 1/5 A. The protection relay is equipped with two alternative residual-current inputs, that is 1/5 A or 0.1/0.5 A. The 0.1/0.5 A input is normally used in applications requiring sensitive earth-fault protection and featuring a core-balance current transformer.

The three phase-voltage inputs, for either phase-to-phase voltages or phase-to-earth voltages, and the residual-voltage input cover the rated voltages 100 V, 110 V, 115 V and 120 V. The rated values of the current and voltage inputs are selected in the relay software.

In addition, the binary input thresholds are selected by adjusting the protection relay's parameter settings. The threshold voltage can be set separately for each binary input.

The optional RTD/mA module facilitates the measurement of up to eight analog signals via the RTD/mA inputs and provides four mA outputs. With RTD sensors the RTD/mA inputs can for

instance be used for temperature measurement stator windings, thus extending the functionality of the thermal overload protection and preventing premature aging of the windings. Furthermore, the RTD/mA inputs can be used for measuring the ambient air or cooling media temperature, or bearing temperatures. The RTD/mA inputs can be used for supervision of analog mA signals provided by external transducers. The RTD/mA inputs can be alternatively used also as resistance input or as an input for voltage transducer. The RTD/mA module enables the use of the multipurpose analog protection functions. These protection functions can be used for tripping and alarm purposes based on RTD/mA measuring data, or analog values communicated via GOOSE messaging. The mA outputs can be used for transferring freely selectable measured or calculated analog values to devices provided with mA input capabilities.

The enhanced scalability of the 6U variant protection relays are intended for optimized medium voltage metal-clad switchgear applications where additional binary inputs and outputs are often required.

All binary input and output contacts are freely configurable using the signal matrix of the application configuration function in PCM600.

See the Input/output overview tables, the selection and ordering data and the terminal diagrams for more information about the inputs and outputs.

Table 3. Analog input configuration

Analog input configuration	CT (1/5 A)	CT sensitive (0.1/0.5 A)	VT	RTD/mA inputs	mA outputs
AA	4	1	4	-	-
AB	7	-	3	-	-
AC	8	-	2	-	-
BA	4	1	4	8	4
BB	7	-	3	8	4
BC	8	-	2	8	4

Table 4. Binary input/output options for 4U variants

Binary I/O options	Binary input configuration	BI	BO
Default	AA	14	9
With one optional binary I/O module	AB	23	18
With two optional binary I/O modules ¹⁾	AC	32	27

1) Not possible if RTD/mA module is selected.

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Table 5. Binary input/output options for 6U variants

Binary I/O options	Binary input configuration	BI	BO
Default	AA	14	9
With one optional binary I/O module	AB	23	18
With two optional binary I/O modules	AC	32	27
With three optional binary I/O modules	AD	41	36
With four optional binary I/O modules ¹⁾	AE	50	45

1) Not possible if RTD/mA module is selected.

17. Communication

The protection relay supports the IEC 61850 substation automation standard including horizontal GOOSE communication as well as the well-established DNP3 (TCP/IP) and IEC 60870-5-103 protocols. All operational information and controls are available through these protocols.

Seamless connectivity to industrial automation systems is achieved with the Station Automation COM600 device using the OPC Server/Client technology. COM600 works as a gateway between the Distributed Control System (DCS) and the bay level protection relays enabling sending of monitoring data and receiving of power distribution process control commands.

Disturbance files are accessed using the IEC 61850 or IEC 60870-5-103 protocols. Disturbance files are also available to any Ethernet based application in the standard COMTRADE format. The protection relay can send binary signals to other protection relays (so called horizontal communication) using the IEC 61850-8-1 GOOSE (Generic Object Oriented Substation Event) profile. Binary GOOSE messaging can, for example, be employed for protection and interlocking-based protection schemes. The protection relay meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard. Further, the protection relay supports the sending and receiving of analog values using GOOSE messaging. Analog GOOSE messaging enables fast transfer of analog measurement values over the station bus, thus facilitating for example sharing of RTD input values, such as surrounding temperature values, to other relay applications. The protection relay interoperates with other IEC 61850 compliant devices, tools and systems and

simultaneously reports events to five different clients on the IEC 61850 station bus. For a system using DNP3 over TCP/IP, events can be sent to four different masters. For systems using IEC 60870-5-103, the protection relay can be connected to one master in a station bus with star-topology.

All communication connectors, except for the front port connector, are placed on integrated communication modules. The protection relay is connected to Ethernet-based communication systems via the RJ-45 connector (10/100BASE-TX) or the fibre-optic multimode LC connector (100BASE-FX).

IEC 60870-5-103 is available from optical serial port where it is possible to use serial glass fibre (ST connector) or serial plastic fibre (snap-in connector).

The protection relay supports the following time synchronization methods with a timestamping resolution of 1 ms.

Ethernet communication based

- SNTP (simple network time protocol)
- DNP3

With special time synchronization wiring

- IRIG-B (Inter-Range Instrumentation Group - Time Code Format B)

IEC 60870-5-103 serial communication has a time-stamping resolution of 10 ms.

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Table 6. Supported communication interface and protocol alternatives

Interfaces/protocols ¹⁾	Ethernet 100BASE-TX RJ-45	Ethernet 100BASE-FX LC	Serial snap-in	Serial ST
IEC 61850	•	•		
DNP3	•	•		
IEC 60870-5-103			•	•
• = Supported				

1) Please refer to the Selection and ordering data chapter for more information

18. Technical data

Table 7. Dimensions

Description	Value
Width	220 mm
Height	177 mm (4U) 265.9 mm (6U)
Depth	249.5 mm
Weight box	6.2 kg (4U) 5.5 kg (6U) ¹⁾
Weight LHMI	1.0 kg (4U)

1) Without LHMI

Table 8. Power supply

Description	600PSM03	600PSM02
U _{aux} nominal	100, 110, 120, 220, 240 V AC, 50 and 60 Hz	48, 60, 110, 125 V DC
	110, 125, 220, 250 V DC	
U _{aux} variation	85...110% of U _n (85...264 V AC)	80...120% of U _n (38.4...150 V DC)
	80...120% of U _n (88...300 V DC)	
Maximum load of auxiliary voltage supply	35 W	
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz)	
Maximum interruption time in the auxiliary DC voltage without resetting the protection relay	50 ms at U _{aux}	
Power supply input must be protected by an external miniature circuit breaker	For example, type S282 UC-K. The rated maximum load of aux voltage which is given as 35 watts. Depending on the voltage used, select a suitable MCB based on the respective current. Type S282 UC-K has a rated current of 0.75 A at 400 V AC.	

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Table 9. Energizing inputs

Description		Value	
Rated frequency		50/60 Hz	
Operating range		Rated frequency ± 5 Hz	
Current inputs	Rated current, I_n	0.1/0.5 A ¹⁾	1/5 A ²⁾
	Thermal withstand capability:		
	• Continuously	4 A	20 A
	• For 1 s	100 A	500 A
	• For 10 s	25 A	100 A
	Dynamic current withstand:		
Voltage inputs	• Half-wave value	250 A	1250 A
	Input impedance	<100 m Ω	<20 m Ω
	Rated voltage, U_n	100 V AC/ 110 V AC/ 115 V AC/ 120 V AC	
	Voltage withstand:		
	• Continuous	425 V AC	
	• For 10 s	450 V AC	
	Burden at rated voltage	<0.05 VA	

1) Residual current

2) Phase currents or residual current

Table 10. Binary inputs

Description	Value
Operating range	Maximum input voltage 300 V DC
Rated voltage	24...250 V DC
Current drain	1.6...1.8 mA
Power consumption/input	<0.3 W
Threshold voltage	15...221 V DC (parametrizable in the range in steps of 1% of the rated voltage)
Threshold voltage accuracy	$\pm 3.0\%$
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz)

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Table 11. RTD inputs

Description		Value	
RTD inputs	Supported RTD sensor	100 Ω platinum	TCR 0.00385 (DIN 43760)
		250 Ω platinum	TCR 0.00385
		100 Ω nickel	TCR 0.00618 (DIN 43760)
		120 Ω nickel	TCR 0.00618
		10 Ω copper	TCR 0.00427
	Supported resistance range	0...10 k Ω	
	Maximum leadresistance (three-wire measurement)	100 Ω platinum	25 Ω per lead
		250 Ω platinum	25 Ω per lead
		100 Ω nickel	25 Ω per lead
		120 Ω nickel	25 Ω per lead
		10 Ω copper	2.5 Ω per lead
		Resistance	25 Ω per lead
	Isolation	4 kV	Inputs to all outputs and protective earth
	RTD / resistance sensing current	Maximum 0.275 mA rms	
	Operation accuracy / temperature	• $\pm 1^{\circ}\text{C}$	Pt and Ni sensors for measuring range -40°C ... 200°C and -40°C ... 70°C ambient temperature
		• $\pm 2^{\circ}\text{C}$	CU sensor for measuring range -40°C ... 200°C in room temperature
		• $\pm 4^{\circ}\text{C}$	CU sensors -40°C ... 70°C ambient temperature
		• $\pm 5^{\circ}\text{C}$	From -40°C ... 100°C of measurement range
	Operation accuracy / Resistance	$\pm 2.5 \Omega$	0...400 Ω range
		$\pm 1.25\%$	400 Ω ...10K Ω ohms range
	Response time	< Filter time +350 ms	
mA inputs	Supported current range	-20 ... $+20$ mA	
	Current input impedance	100 $\Omega \pm 0.1\%$	
	Operation accuracy	$\pm 0.1\% \pm 20$ ppm per $^{\circ}\text{C}$ of full-scale	Ambient temperature -40°C ... 70°C
Voltage inputs	Supported voltage range	-10 V DC... $+10$ V DC	
	Operation accuracy	$\pm 0.1\% \pm 40$ ppm per $^{\circ}\text{C}$ of full-scale	Ambient temperature -40°C ... 70°C

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Table 12. Signal output and IRF output

IRF relay change over - type signal output relay	
Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	10 A
Make and carry 0.5 s	15 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at U < 48/110/220 V DC	≤0.5 A/≤0.1 A/≤0.04 A
Minimum contact load	100 mA at 24 V AC/DC

Table 13. Power output relays without TCS function

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at U< 48/110/220 V DC	≤1 A/≤0.3 A/≤0.1 A
Minimum contact load	100 mA at 24 V AC/DC

Table 14. Power output relays with TCS function

Description	Value
Rated voltage	250 V DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at U < 48/110/220 V DC	≤1 A/≤0.3 A/≤0.1 A
Minimum contact load	100 mA at 24 V DC
Control voltage range	20...250 V DC
Current drain through the supervision circuit	~1.0 mA
Minimum voltage over the TCS contact	20 V DC

Table 15. mA outputs

Description	Value
mA outputs	Output range
	Output range
	Operation accuracy
	Maximum load (including wiring resistance)
	Hardware response time
	Isolation level

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Table 16. Ethernet interfaces

Ethernet interface	Protocol	Cable	Data transfer rate
LAN1 (X1)	TCP/IP protocol	Fibre-optic cable with LC connector or shielded twisted pair CAT 5e cable or better	100 MBits/s

Table 17. LAN (X1) fibre-optic communication link

Wave length	Fibre type	Connector	Permitted path attenuation ¹⁾	Distance
1300 nm	MM 62.5/125 µm or MM 50/125 µm glass fibre core	LC	<7.5 dB	2 km

1) Maximum allowed attenuation caused by connectors and cable together

Table 18. X4/IRIG-B interface

Type	Protocol	Cable
Screw terminal, pin row header	IRIG-B	Shielded twisted pair cable Recommended: CAT 5, Belden RS-485 (9841- 9844) or Alpha Wire (Alpha 6222-6230)

Table 19. X9 Optical serial interface characteristics

Wave length	Fibre type	Connector	Permitted path attenuation	Distance
820 nm	MM 62.5/125	ST	4 dB/km	1000 m
820 nm	MM 50/125	ST	4 dB/km	400 m
660 nm	1 mm	Snap-in		10 m

Table 20. Degree of protection of flush-mounted protection relay

Description	Value
Front side	IP 40
Rear side, connection terminals	IP 20

Table 21. Degree of protection of the LHMI

Description	Value
Front and side	IP 42

Table 22. Environmental conditions

Description	Value
Operating temperature range	-25...+55°C (continuous)
Short-time service temperature range	-40...+70°C (<16h) Note: Degradation in MTBF and HMI performance outside the temperature range of -25...+55°C
Relative humidity	<93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	up to 2000 m
Transport and storage temperature range	-40...+85°C

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Table 23. Environmental tests

Description	Type test value	Reference
Dry heat test (humidity <50%)	<ul style="list-style-type: none"> • 96 h at +55°C • 16 h at +85°C 	IEC 60068-2-2
Cold test	<ul style="list-style-type: none"> • 96 h at -25°C • 16 h at -40°C 	IEC 60068-2-1
Damp heat test, cyclic	<ul style="list-style-type: none"> • 6 cycles at +25...55°C, Rh >93% 	IEC 60068-2-30
Storage test	<ul style="list-style-type: none"> • 96 h at -40°C • 96 h at +85°C 	IEC 60068-2-1 IEC 60068-2-2

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Table 24. Electromagnetic compatibility tests

Description	Type test value	Reference
100 kHz and 1 MHz burst disturbance test		IEC 61000-4-18, level 3 IEC 60255-22-1
<ul style="list-style-type: none"> Common mode Differential mode 	2.5 kV 1.0 kV	
3 MHz, 10 MHz and 30 MHz burst disturbance test		IEC 61000-4-18 IEC 60255-22-1, class III
<ul style="list-style-type: none"> Common mode 	2.5 kV	
Electrostatic discharge test		IEC 61000-4-2, level 4 IEC 60255-22-2 IEEE C37.90.3.2001
<ul style="list-style-type: none"> Contact discharge Air discharge 	8 kV 15 kV	
Radio frequency interference tests		
<ul style="list-style-type: none"> Conducted, common mode 	10 V (rms), f=150 kHz...80 MHz	IEC 61000-4-6 , level 3 IEC 60255-22-6
<ul style="list-style-type: none"> Radiated, pulse-modulated 	10 V/m (rms), f=900 MHz	ENV 50204 IEC 60255-22-3
<ul style="list-style-type: none"> Radiated, amplitude-modulated 	10 V/m (rms), f=80...2700 MHz	IEC 61000-4-3, level 3 IEC 60255-22-3
Fast transient disturbance tests		IEC 61000-4-4 IEC 60255-22-4, class A
<ul style="list-style-type: none"> All ports 	4 kV	
Surge immunity test		IEC 61000-4-5, level 3/2 IEC 60255-22-5
<ul style="list-style-type: none"> Communication Binary inputs, voltage inputs Other ports 	1 kV line-to-earth 2 kV line-to-earth 1 kV line-to-line 4 kV line-to-earth, 2 kV line-to-line	
Power frequency (50 Hz) magnetic field		IEC 61000-4-8
<ul style="list-style-type: none"> 1...3 s Continuous 	1000 A/m 300 A/m	
Pulse magnetic field immunity test	1000 A/m 6.4/16 µs	IEC 61000-4-9
Damped oscillatory magnetic field immunity test		IEC 61000-4-10
<ul style="list-style-type: none"> 2 s 1 MHz 	100 A/m 400 transients/s	
Power frequency immunity test	Binary inputs only	IEC 60255-22-7, class A IEC 61000-4-16
<ul style="list-style-type: none"> Common mode Differential mode 	300 V rms 150 V rms	
Conducted common mode disturbances	15 Hz...150 kHz Test level 3 (10/1/10 V rms)	IEC 61000-4-16

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Table 24. Electromagnetic compatibility tests, continued

Description	Type test value	Reference
Voltage dips and short interruptions	30%/10 ms 60%/100 ms 60%/1000 ms >95%/5000 ms	IEC 61000-4-11
Electromagnetic emission tests		EN 55011, class A IEC 60255-25
<ul style="list-style-type: none"> Conducted, RF-emission (mains terminal) 		
0.15...0.50 MHz	<79 dB(μV) quasi peak <66 dB(μV) average	
0.5...30 MHz	<73 dB(μV) quasi peak <60 dB(μV) average	
<ul style="list-style-type: none"> Radiated RF-emission 		
30...230 MHz	<40 dB(μV/m) quasi peak, measured at 10 m distance	
230...1000 MHz	<47 dB(μV/m) quasi peak, measured at 10 m distance	

Table 25. Insulation tests

Description	Type test value	Reference
Dielectric tests		IEC 60255-5 IEC 60255-27
<ul style="list-style-type: none"> Test voltage 	2 kV, 50 Hz, 1 min 500 V, 50 Hz, 1 min, communication	
Impulse voltage test		IEC 60255-5 IEC 60255-27
<ul style="list-style-type: none"> Test voltage 	5 kV, 1.2/50 μs, 0.5 J 1 kV, 1.2/50 μs, 0.5 J, communication	
Insulation resistance measurements		IEC 60255-5 IEC 60255-27
<ul style="list-style-type: none"> Isolation resistance 	>100 MΩ, 500 V DC	
Protective bonding resistance		IEC 60255-27
<ul style="list-style-type: none"> Resistance 	<0.1Ω, 4 A, 60 s	

Table 26. Mechanical tests

Description	Reference	Requirement
Vibration tests (sinusoidal)	IEC 60068-2-6 (test Fc) IEC 60255-21-1	Class 1
Shock and bump test	IEC 60068-2-27 (test Ea shock) IEC 60068-2-29 (test Eb bump) IEC 60255-21-2	Class 1
Seismic test	IEC 60255-21-3 (method A)	Class 1

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Table 27. Product safety

Description	Reference
LV directive	2006/95/EC
Standard	EN 60255-27 (2005) EN 60255-1 (2009)

Table 28. EMC compliance

Description	Reference
EMC directive	2004/108/EC
Standard	EN 50263 (2000) EN 60255-26 (2007)

Table 29. RoHS compliance

Description
Complies with RoHS directive 2002/95/EC

Protection functions

Table 30. Three-phase non-directional overcurrent protection (PHxPTOC)

Characteristic		Value
Operation accuracy		At the frequency $f = f_n$
	PHLPTOC	$\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
	PHHPTOC and PHIPTOC	$\pm 1.5\%$ of set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.1 \dots 10 \times I_n$) $\pm 5.0\%$ of the set value (at currents in the range of $10 \dots 40 \times I_n$)
Start time ¹⁾²⁾	PHIPTOC: $I_{Fault} = 2 \times \text{set Start value}$ $I_{Fault} = 10 \times \text{set Start value}$	Typically 17 ms (± 5 ms) Typically 10 ms (± 5 ms)
	PHHPTOC: $I_{Fault} = 2 \times \text{set Start value}$	Typically 19 ms (± 5 ms)
	PHLPTOC: $I_{Fault} = 2 \times \text{set Start value}$	Typically 23 ms (± 15 ms)
Reset time		<45 ms
Reset ratio		Typically 0.96
Retardation time		<30 ms
Operate time accuracy in definite time mode		$\pm 1.0\%$ of the set value or ± 20 ms
Operate time accuracy in inverse time mode		$\pm 5.0\%$ of the theoretical value or ± 20 ms ³⁾
Suppression of harmonics		RMS: No suppression DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ Peak-to-Peak: No suppression P-to-P+backup: No suppression

1) Set *Operate delay time* = 0.02 s, *Operate curve type* = IEC definite time, *Measurement mode* = default (depends on stage), current before fault = $0.0 \times I_n$, $f_n = 50$ Hz, fault current in one phase with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

2) Includes the delay of the signal output contact

3) Includes the delay of the heavy-duty output contact

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Table 31. Three-phase non-directional overcurrent protection (PHxPTOC) main settings

Parameter	Function	Value (Range)	Step
Start Value	PHLPTOC	0.05...5.00 pu	0.01
	PHHPTOC	0.10...40.00 pu	0.01
	PHIPTOC	0.10...40.00 pu	0.01
Time multiplier	PHLPTOC	0.05...15.00	0.01
	PHHPTOC	0.05...15.00	0.01
Operate delay time	PHLPTOC	0.04...200.00 s	0.01
	PHHPTOC	0.02...200.00 s	0.01
	PHIPTOC	0.02...200.00 s	0.01
Operating curve type ¹⁾	PHLPTOC	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	PHHPTOC	Definite or inverse time Curve type: 1, 3, 5, 9, 10, 12, 15, 17	
	PHIPTOC	Definite time	

1) For further reference, see the Operation characteristics table

Table 32. Non-directional earth-fault protection (EFxPTOC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$
	EFLPTOC $\pm 1.5\%$ of the set value or $\pm 0.001 \times I_n$
	EFHPTOC and EFIPPTOC $\pm 1.5\%$ of set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.1...10 \times I_n$) $\pm 5.0\%$ of the set value (at currents in the range of $10...40 \times I_n$)
Start time ¹⁾²⁾	EFIPPTOC: $I_{Fault} = 2 \times \text{set Start value}$ Typically 12 ms (± 5 ms)
	EFHPTOC: $I_{Fault} = 2 \times \text{set Start value}$ Typically 19 ms (± 5 ms)
	EFLPTOC: $I_{Fault} = 2 \times \text{set Start value}$ Typically 23 ms (± 15 ms)
Reset time	<45 ms
Reset ratio	Typically 0.96
Retardation time	<30 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 20 ms ³⁾
Suppression of harmonics	RMS: No suppression DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ Peak-to-Peak: No suppression

1) Operate curve type = IEC definite time, Measurement mode = default (depends on stage), current before fault = $0.0 \times I_n$, $f_n = 50$ Hz, earth-fault current with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

2) Includes the delay of the signal output contact

3) Maximum Start value = $2.5 \times I_n$, Start value multiples in range of 1.5...20

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Table 33. Non-directional earth-fault protection (EFxPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	EFLPTOC	0.010...5.000 pu	0.005
	EFHPTOC	0.10...40.00 pu	0.01
	EFIPTOC	0.10...40.00 pu	0.01
Time multiplier	EFLPTOC	0.05...15.00	0.01
	EFHPTOC	0.05...15.00	0.01
Operate delay time	EFLPTOC	0.04...200.00 s	0.01
	EFHPTOC	0.02...200.00 s	0.01
	EFIPTOC	0.02...200.00 s	0.01
Operating curve type ¹⁾	EFLPTOC	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	EFHPTOC	Definite or inverse time Curve type: 1, 3, 5, 9, 10, 12, 15, 17	
	EFIPTOC	Definite time	

1) For further reference, see the Operation characteristics table

Table 34. Directional earth-fault protection (DEFxPDEF)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$
	Current: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ Voltage $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$ Phase angle: $\pm 2^\circ$
	Current: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.1 \dots 10 \times I_n$) $\pm 5.0\%$ of the set value (at currents in the range of $10 \dots 40 \times I_n$) Voltage: $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$ Phase angle: $\pm 2^\circ$
Start time ¹⁾²⁾	DEFHPDEF and DEFLPTDEF: $I_{\text{Fault}} = 2 \times \text{set Start value}$ Typically 54 ms (± 15 ms)
Reset time	Typically 40 ms
Reset ratio	Typically 0.96
Retardation time	<30 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 20 ms ³⁾
Suppression of harmonics	RMS: No suppression DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ Peak-to-Peak: No suppression

1) Set *Operate delay time* = 0.06 s, *Operate curve type* = IEC definite time, *Measurement mode* = default (depends on stage), current before fault = $0.0 \times I_n$, $f_n = 50$ Hz, earth-fault current with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

2) Includes the delay of the signal output contact

3) Maximum *Start value* = $2.5 \times I_n$, *Start value* multiples in range of 1.5 to 20

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Table 35. Directional earth-fault protection (DEFxPDEF) main settings

Parameter	Function	Value (Range)	Step
Start Value	DEFLPDEF	0.010...5.000 pu	0.005
	DEFHPDEF	0.10...40.00 pu	0.01
Directional mode	DEFLPDEF and DEFHPDEF	1=Non-directional 2=Forward 3=Reverse	
Time multiplier	DEFLPDEF	0.05...15.00	0.01
	DEFHPDEF	0.05...15.00	0.01
Operate delay time	DEFLPDEF	0.06...200.00 s	0.01
	DEFHPDEF	0.06...200.00 s	0.01
Operating curve type ¹⁾	DEFLPDEF	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	DEFHPDEF	Definite or inverse time Curve type: 1, 3, 5, 15, 17	
Operation mode	DEFLPDEF and DEFHPDEF	1=Phase angle 2=IoSin 3=IoCos 4=Phase angle 80 5=Phase angle 88	

1) For further reference, refer to the Operation characteristics table

Table 36. Rotor earth-fault protection (MREFPTOC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾²⁾	Typically 25 ms (± 15 ms)
Reset time	<50 ms
Reset ratio	Typically 0.96
Retardation time	<50 ms
Operate time accuracy	$\pm 1.0\%$ of the set value of ± 20 ms
Suppression of harmonics	-50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Current before fault = $0.0 \times I_n$, $f_n = 50$ Hz, earth-fault current with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

2) Includes the delay of the signal output contact

Table 37. Rotor earth-fault protection (MREFPTOC) main settings

Parameter	Function	Value (Range)	Step
Alarm start value	MREFPTOC	0.010...2.000 pu	0.001
Operate start value	MREFPTOC	0.010...2.000 pu	0.001
Alarm delay time	MREFPTOC	0.04...200.00 s	0.01
Operate delay time	MREFPTOC	0.04...200.00 s	0.01

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Table 38. Negative-sequence overcurrent protection for machines (MNSPTOC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾²⁾	$I_{\text{Fault}} = 5.0 \times \text{set Start value}$ Typically 43 ms (± 15 ms)
Reset time	<70 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 35 ms
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 30 ms ³⁾
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Negative-sequence current before = $0.0 \times I_n$, $f_n = 50$ Hz

2) Includes the delay of the signal output contact

3) Start value multiples in range of 1.10...5.00

Table 39. Negative-sequence overcurrent protection for machines (MNSPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	MNSPTOC	0.01...0.50 pu	0.01
Operating curve type	MNSPTOC	ANSI Def. Time IEC Def. Time Inv. Curve A Inv. Curve B	-
Operate delay time	MNSPTOC	0.10...120.00 s	0.01
Cooling time	MNSPTOC	5...7200 s	1

Table 40. Phase-reversal protection (PREVPTOC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾²⁾	$I_{\text{Fault}} = 2.0 \times \text{set Start value}$ Typically 25 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Negative-sequence current before = $0.0 \times I_n$, $f_n = 50$ Hz

2) Includes the delay of the signal output contact

Table 41. Phase-reversal protection (PREVPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	PREVPTOC	0.05...1.00 pu	0.01
Operate delay time	PREVPTOC	0.100...30.000 s	0.001

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Table 42. Three-phase thermal overload protection for motors (MPTTR)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ Current measurement: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.01 \dots 4.00 \times I_n$)
Operate time accuracy ¹⁾	$\pm 2.0\%$ or ± 0.050 s

1) Overload current $> 1.2 \times$ Operate level temperature

Table 43. Three-phase thermal overload protection for motors (MPTTR) main settings

Parameter	Function	Value (Range)	Step
Env temperature mode	MPTTR	FLC Only Use RTD Set Amb Temp	-
Env temperature set	MPTTR	$-20.0 \dots 70.0^\circ$	0.1
Alarm thermal value	MPTTR	$50.0 \dots 100.0\%$	0.1
Restart thermal value	MPTTR	$20.0 \dots 80.0\%$	0.1
Overload factor	MPTTR	$1.00 \dots 1.20$	0.01
Weighting factor p	MPTTR	$20.0 \dots 100.0$	0.1
Time constant normal	MPTTR	$80 \dots 4000$ s	1
Time constant start	MPTTR	$80 \dots 4000$ s	1

Table 44. Motor startup supervision (STTPMSU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾²⁾	$I_{\text{Fault}} = 1.1 \times \text{set Start detection A}$ Typically 25 ms (± 15 ms)
Operate time accuracy	$\pm 1.0\%$ of the set value or ± 20 ms
Reset ratio	Typically 0.90

1) Current before $= 0.0 \times I_n$, $f_n = 50$ Hz, overcurrent in one phase

2) Includes the delay of the signal output contact

Table 45. Motor startup supervision (STTPMSU) main settings

Parameter	Function	Value (Range)	Step
Motor start-up A	STTPMSU	$1.0 \dots 10.0$ pu	0.1
Motor start-up time	STTPMSU	$0.3 \dots 80.0$ s	0.1
Lock rotor time	STTPMSU	$2.0 \dots 120.0$ s	0.1
Operation mode	STTPMSU	II _t II _t , CB II _t & stall II _t & stall, CB	-
Restart inhibit time	STTPMSU	$0 \dots 250$ min	1

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Table 46. Motor load jam protection (JAMPTOC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾²⁾	$I_{\text{Fault}} = 2.0 \times \text{set Start value}$ Typically 25 ms ($\pm 15\text{ms}$)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms

1) Current before = $0.0 \times I_n$, $f_n = 50$ Hz

2) Includes the delay of the signal output contact

Table 47. Motor load jam protection (JAMPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	JAMPTOC	0.10...10.00 pu	0.01
Operate delay time	JAMPTOC	0.10...120.00 s	0.01

Table 48. Emergency start (ESMGAPC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$

Table 49. Emergency start (ESMGAPC) main settings

Parameter	Function	Value (Range)	Step
Motor stand still A	ESMGAPC	0.05...0.20 pu	0.01

Table 50. Loss of load supervision (LOFLPTUC)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Start time ¹⁾	Typically <330 ms
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms

1) Includes the delay of the signal output contact

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Table 51. Loss of load supervision (LOFLPTUC) main settings

Parameter	Function	Value (Range)	Step
Start value high	LOFLPTUC	0.01...1.00 pu	0.01
Start value low	LOFLPTUC	0.01...0.50 pu	0.01
Operate delay time	LOFLPTUC	0.40...600.00 s	0.01

Table 52. High-impedance or flux-balance based differential protection for machines (MHZPDIF)

Characteristic	Value
Operation accuracy	$\pm 1.5\%$ of the set value or $0.002 \times I_n$
Start time ¹⁾²⁾	Typically 15 ms (± 10 ms)
Reset time	<65 ms
Reset ratio	Typically 0.96
Retardation time	<50 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value of ± 20 ms

1) $F_n = 50$ Hz, results based on statistical distribution of 1000 measurements

2) Includes the delay of the signal output contact

Table 53. High-impedance or flux-balance based differential protection for machines (MHZPDIF) main settings

Parameter	Function	Value (Range)	Step
Operate value	MHZPDIF	0.5...50.0%	0.1
Minimum operate time	MHZPDIF	0.02...300.00 s	0.01

Table 54. Stabilized differential protection for machines (MPDIF)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 3\%$ of the set value or $\pm 0.002 \times I_n$
Operate time ¹⁾²⁾	Biased low stage Instantaneous high stage ³⁾ Typically 40 ms (± 10 ms) Typically 15 ms (± 10 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<20 ms

1) $F_n = 50$ Hz, results based on statistical distribution of 1000 measurements

2) Includes the delay of the high speed power output contact

3) $I_{\text{fault}} = 2 \times \text{High operate value}$

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Table 55. Stabilized differential protection for machines (MPDIF) main settings

Parameter	Function	Value (Range)	Step
CT connection type	MPDIF	1...2	1
High operate value	MPDIF	100...1000%	1
Low operate value	MPDIF	5...30%	1
Slope section 2	MPDIF	10.0...50.0%	0.1
End section 1	MPDIF	0...100%	1
End section 2	MPDIF	100...300%	1

Table 56. Three-phase overvoltage protection (PHPTOV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{Fault} = 2.0 \times \text{set } Start \text{ value}$ Typically 17 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Depends of the set <i>Relative hysteresis</i>
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 20 ms ³⁾
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) *Start value* = $1.0 \times U_n$, Voltage before fault = $0.9 \times U_n$, $f_n = 50$ Hz, overvoltage in one phase-to-phase with nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

3) Maximum *Start value* = $1.20 \times U_n$, *Start value* multiples in range of 1.10...2.00

Table 57. Three-phase overvoltage protection (PHPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	PHPTOV	0.05...1.60 pu	0.01
Time multiplier	PHPTOV	0.05...15.00	0.01
Operate delay time	PHPTOV	0.40...300.000 s	0.10
Operating curve type ¹⁾	PHPTOV	Definite or inverse time Curve type: 5, 15, 17, 18, 19, 20	

1) For further reference, see the Operation characteristics table

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Table 58. Three-phase undervoltage protection (PHPTUV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{\text{Fault}} = 0.9 \times \text{set Start value}$ Typically 24 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Depends of the set <i>Relative hysteresis</i>
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 20 ms ³⁾
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) *Start value* = $1.0 \times U_n$, Voltage before fault = $1.1 \times U_n$, $f_n = 50$ Hz, undervoltage in one phase-to-phase with nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

3) Minimum *Start value* = $0.50 \times U_n$, *Start value* multiples in range of 0.90...0.20

Table 59. Three-phase undervoltage protection (PHPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PHPTUV	0.05...1.20 pu	0.01
Time multiplier	PHPTUV	0.05...15.00	0.01
Operate delay time	PHPTUV	0.040...300.000 s	0.010
Operating curve type ¹⁾	PHPTUV	Definite or inverse time Curve type: 5, 15, 21, 22, 23	

1) For further reference, see the Operation characteristics table

Table 60. Positive-sequence overvoltage protection (PSPTOV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{\text{Fault}} = 1.1 \times \text{set Start value}$ $U_{\text{Fault}} = 2.0 \times \text{set Start value}$ Typically 29 ms (± 15 ms) Typically 24 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Positive-sequence voltage before fault = $0.0 \times U_n$, $f_n = 50$ Hz, positive-sequence overvoltage of nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

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Table 61. Positive-sequence overvoltage protection (PSPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	PSPTOV	0.800...1.600 pu	0.001
Operate delay time	PSPTOV	0.040...120.000 s	0.001

Table 62. Positive-sequence undervoltage protection (PSPTUV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{Fault} = 0.9 \times \text{set Start value}$ Typically 28 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Positive-sequence voltage before fault = $1.1 \times U_n$, $f_n = 50$ Hz, positive-sequence undervoltage of nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

Table 63. Positive-sequence undervoltage protection (PSPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PSPTUV	0.010...1.200 pu	0.001
Operate delay time	PSPTUV	0.040...120.000 s	0.001
Voltage block value	PSPTUV	0.01...1.0 pu	0.01

Table 64. Negative-sequence overvoltage protection (NSPTOV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{Fault} = 1.1 \times \text{set Start value}$ $U_{Fault} = 2.0 \times \text{set Start value}$ Typically 29 ms (± 15 ms) Typically 24 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Negative-sequence voltage before fault = $0.0 \times U_n$, $f_n = 50$ Hz, negative-sequence overvoltage of nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

Table 65. Negative-sequence overvoltage protection (NSPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	NSPTOV	0.010...1.000 pu	0.001
Operate delay time	NSPTOV	0.040...120.000 s	0.001

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Table 66. Residual overvoltage protection (ROVPTOV)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$
Start time ¹⁾²⁾	$U_{\text{Fault}} = 1.1 \times \text{set Start value}$ Typically 27 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.96
Retardation time	<35 ms
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

1) Residual voltage before fault = $0.0 \times U_n$, $f_n = 50$ Hz, residual voltage with nominal frequency injected from random phase angle

2) Includes the delay of the signal output contact

Table 67. Residual overvoltage protection (ROVPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	ROVPTOV	0.010...1.000 pu	0.001
Operate delay time	ROVPTOV	0.040...300.000 s	0.001

Table 68. Reverse power/directional overpower protection (DOPPDPR)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 3\%$ of the set value or $\pm 0.002 \times S_n$
Start time ¹⁾²⁾	Typically 20 ms (± 15 ms)
Reset time	<40 ms
Reset ratio	Typically 0.94
Retardation time	<45 ms
Operate time accuracy	$\pm 1.0\%$ of the set value of ± 20 ms

1) $U = U_n$, $F_n = 50$ Hz, results based on statistical distribution of 1000 measurements.

2) Includes the delay of the signal output contact.

Table 69. Reverse power/directional overpower protection (DOPPDPR) main settings

Parameter	Function	Value (Range)	Step
Directional mode	DOPPDPR	Forward Reverse	-
Start value	DOPPDPR	0.01...2.00 pu	0.01
Power angle	DOPPDPR	-90.00...90.00°	0.01
Operate delay time	DOPPDPR	0.04...300.00 s	0.01

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Table 70. Frequency gradient protection (DAPFRC)

Characteristic	Value
Operation accuracy	df/dt < ±10 Hz/s: ±10 mHz/s Undervoltage blocking: ±1.5% of the set value or ±0.002 × U _n
Start time ¹⁾²⁾	<i>Start value</i> = 0.05 Hz/s df/dt _{FAULT} = ±1.0 Hz/s Typically 110 ms (±15 ms)
Reset time	<150 ms
Operate time accuracy in definite time mode	±1.0% of the set value or ±30 ms
Suppression of harmonics	DFT: -50 dB at f = n × f _n , where n = 2, 3, 4, 5,...

1) Frequency before fault = 1.0 × f_n, f_n = 50 Hz

2) Includes the delay of the signal output contact

Table 71. Frequency gradient protection (DAPFRC) main settings

Parameter	Function	Value (Range)	Step
Start value	DAPFRC	-10.00...10.00 Hz/s	0.01
Operate delay time	DAPFRC	0.120...60.000 s	0.001

Table 72. Overfrequency protection (DAPTOF)

Characteristic	Value
Operation accuracy	At the frequency f = 35...66 Hz ±0.003 Hz
Start time ¹⁾²⁾	f _{Fault} = 1.01 × set <i>Start value</i> Typically <190 ms
Reset time	<190 ms
Operate time accuracy in definite time mode	±1.0% of the set value or ±30 ms
Suppression of harmonics	DFT: -50 dB at f = n × f _n , where n = 2, 3, 4, 5,...

1) Frequency before fault = 0.99 × f_n, f_n = 50 Hz

2) Includes the delay of the signal output contact

Table 73. Overfrequency protection (DAPTOF) main settings

Parameter	Function	Value (Range)	Step
Start value	DAPTOF	35.0...64.0 Hz	0.1
Operate delay time	DAPTOF	0.170...60.000 s	0.001

Table 74. Underfrequency protection (DAPTUF)

Characteristic	Value
Operation accuracy	At the frequency f = 35...66 Hz ±0.003 Hz
Start time ¹⁾²⁾	f _{Fault} = 0.99 × set <i>Start value</i> Typically <190 ms
Reset time	<190 ms
Operate time accuracy in definite time mode	±1.0% of the set value or ±30 ms
Suppression of harmonics	DFT: -50 dB at f = n × f _n , where n = 2, 3, 4, 5,...

1) Frequency before fault = 1.01 × f_n, f_n = 50 Hz

2) Includes the delay of the signal output contact

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Table 75. Underfrequency protection (DAPTUF) main settings

Parameter	Function	Value (Range)	Step
Start value	DAPTUF	35.0...64.0 Hz	0.1
Operate delay time	DAPTUF	0.170...60.000 s	0.001

Table 76. Three-phase underexcitation protection (UEXPDIS)

Characteristic	Value
Operation accuracy ¹⁾	At the frequency $f = f_n$ $\pm 3.0\%$ of the set value or $\pm 0.2\%$ Zb
Start time ²⁾³⁾	Typically 45 ms (± 15 ms)
Reset time	<50 ms
Reset ratio	Typically 1.04
Retardation time	Total retardation time when the impedance returns from the operating circle <40 ms
Operate time accuracy in definite-time mode	$\pm 1.0\%$ of the set value of ± 20 ms

1) Adaptive DFT measurement used

2) $f_n = 50$ Hz, results based on statistical distribution of 1000 measurements

3) Includes the delay of the signal output contact

Table 77. Three-phase underexcitation protection (UEXPDIS) main settings

Parameter	Function	Value (Range)	Step
External Los Det Ena	UEXPDIS	0...1	1
Diameter	UEXPDIS	1...6000 %Zb	1
Offset	UEXPDIS	-1000...1000 %Zb	1
Displacement	UEXPDIS	-1000...1000 %Zb	1
Operate delay time	UEXPDIS	0.06...200.00 s	0.01

Table 78. Circuit breaker failure protection (CCBRBRF)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Operate time accuracy	$\pm 1.0\%$ of the set value or ± 30 ms

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Table 79. Circuit breaker failure protection (CCBRBRF) main settings

Parameter	Function	Value (Range)	Step
Current value	CCBRBRF	0.05...1.00 pu	0.01
Current value Res	CCBRBRF	0.05...1.00 pu	0.01
CB failure mode	CCBRBRF	1 = Current 2 = Breaker status 3 = Both	-
CB fail trip mode	CCBRBRF	1 = Off 2 = Without check 3 = Current check	-
Retrip time	CCBRBRF	0.00...60.00 s	0.01
CB failure delay	CCBRBRF	0.00...60.00 s	0.01
CB fault delay	CCBRBRF	0.00...60.00 s	0.01

Table 80. Multipurpose analog protection (MAPGAPC)

Characteristic	Value
Operate time accuracy	±1.0% of the set value or ±20 ms

Table 81. Multipurpose analog protection (MAPGAPC) main settings

Parameter	Function	Value (Range)	Step
Operation mode	MAPGAPC	Over Under	-
Start value	MAPGAPC	-10000.0...10000.0	0.1
Start value Add	MAPGAPC	-100.0...100.0	0.1
Operate delay time	MAPGAPC	0.00...200.00 s	0.01

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Table 82. Operation characteristics

Parameter	Value (Range)
Operating curve type	1 = ANSI Ext. inv. 2 = ANSI Very. inv. 3 = ANSI Norm. inv. 4 = ANSI Mod inv. 5 = ANSI Def. Time 6 = L.T.E. inv. 7 = L.T.V. inv. 8 = L.T. inv. 9 = IEC Norm. inv. 10 = IEC Very inv. 11 = IEC inv. 12 = IEC Ext. inv. 13 = IEC S.T. inv. 14 = IEC L.T. inv 15 = IEC Def. Time 17 = Programmable 18 = RI type 19 = RD type
Operating curve type (voltage protection)	5 = ANSI Def. Time 15 = IEC Def. Time 17 = Inv. Curve A 18 = Inv. Curve B 19 = Inv. Curve C 20 = Programmable 21 = Inv. Curve A 22 = Inv. Curve B 23 = Programmable

Supervision and monitoring functions

Table 83. Runtime counter for machines and devices (MDSOPT)

Characteristic	Value
Motor run-time measurement accuracy ¹⁾	±0.5%

1) Of the reading, for a stand-alone protection relay without time synchronization

Table 84. Runtime counter for machines and devices (MDSOPT) main settings

Parameter	Function	Value (Range)	Step
Warning value	MDSOPT	0...299999 h	1
Alarm value	MDSOPT	0...299999 h	1
Initial value	MDSOPT	0...299999 h	1
Operating time hour	MDSOPT	0...23 h	1
Operating time mode	MDSOPT	Immediate Timed Warn Timed Warn Alm	-

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Table 85. Circuit breaker condition monitoring (SSCBR)

Characteristic	Value
Current measuring accuracy	At the frequency $f = f_n$ $\pm 1.5\%$ or $\pm 0.002 \times I_n$ (at currents in the range of $0.1 \dots 10 \times I_n$) $\pm 5.0\%$ (at currents in the range of $10 \dots 40 \times I_n$)
Operate time accuracy	$\pm 1.0\%$ of the set value or ± 20 ms
Traveling time measurement	± 10 ms

Table 86. Fuse failure supervision (SEQRFUF)

Characteristic		Value	
Operation accuracy		At the frequency $f = f_n$	
		Current: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ Voltage: $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$	
Operate time ¹⁾	• NPS function	$U_{Fault} = 1.1 \times \text{set } Neg \text{ Seq voltage } Lev$ $U_{Fault} = 5.0 \times \text{set } Neg \text{ Seq voltage } Lev$	Typically 35 ms (± 15 ms) Typically 25 ms (± 15 ms)
	• Delta function	$\Delta U = 1.1 \times \text{set } Voltage \text{ change rate}$ $\Delta U = 2.0 \times \text{set } Voltage \text{ change rate}$	Typically 35 ms (± 15 ms) Typically 28 ms (± 15 ms)

1) Includes the delay of the signal output contact, $f_n = 50$ Hz, fault voltage with nominal frequency injected from random phase angle

Table 87. Current circuit supervision (CCRDIF)

Characteristic	Value
Operate time ¹⁾	<30 ms

1) Including the delay of the output contact

Table 88. Current circuit supervision (CCRDIF) main settings

Parameter	Function	Value (Range)	Step
Start value	CCRDIF	0.05...2.00 pu	0.01
Maximum operate current	CCRDIF	0.05...5.00 pu	0.01

Table 89. Trip-circuit supervision (TCSSCBR)

Characteristic	Value
Time accuracy	$\pm 1.0\%$ of the set value or ± 40 ms

Table 90. Station battery supervision (SPVNZBAT)

Characteristic	Value
Operation accuracy	$\pm 1.0\%$ of the set value
Operate time accuracy	$\pm 1.0\%$ of the set value or ± 40 ms

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Table 91. Energy monitoring (EPDMMTR)

Characteristic	Value
Operation accuracy	At all three currents in range $0.10 \dots 1.20 \times I_n$ At all three voltages in range $0.50 \dots 1.15 \times U_n$ At the frequency $f = f_n$ Active power and energy in range $ PF > 0.71$ Reactive power and energy in range $ PF < 0.71$ $\pm 1.5\%$ for energy
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

Measurement functions

Table 92. Three-phase current measurement (CMMXU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 0.5\%$ or $\pm 0.002 \times I_n$ (at currents in the range of $0.01 \dots 4.00 \times I_n$)
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ RMS: No suppression

Table 93. Three-phase voltage measurement (phase-to-earth) (VPHMMXU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 0.5\%$ or $\pm 0.002 \times U_n$ (at voltages in the range of $0.01 \dots 1.15 \times U_n$)
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ RMS: No suppression

Table 94. Three-phase voltage measurement (phase-to-phase) (VPPMMXU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 0.5\%$ or $\pm 0.002 \times U_n$ (at voltages in the range of $0.01 \dots 1.15 \times U_n$)
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ RMS: No suppression

Table 95. Residual current measurement (RESCMMXU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 0.5\%$ or $\pm 0.002 \times I_n$ (at currents in the range of $0.01 \dots 4.00 \times I_n$)
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ RMS: No suppression

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Table 96. Residual voltage measurement (RESVMMXU)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 0.5\%$ or $\pm 0.002 \times U_n$
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$ RMS: No suppression

Table 97. Power monitoring with P, Q, S, power factor, frequency (PWRMMXU)

Characteristic	Value
Operation accuracy	At all three currents in range $0.10 \dots 1.20 \times I_n$ At all three voltages in range $0.50 \dots 1.15 \times U_n$ At the frequency $f = f_n$ Active power and energy in range $ \text{PF} > 0.71$ Reactive power and energy in range $ \text{PF} < 0.71$ $\pm 1.5\%$ for power (S, P and Q) ± 0.015 for power factor
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

Table 98. Sequence current measurement (CSMSQI)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.0\%$ or $\pm 0.002 \times I_n$ at currents in the range of $0.01 \dots 4.00 \times I_n$
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

Table 99. Sequence voltage measurement (VSMSQI)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$ $\pm 1.0\%$ or $\pm 0.002 \times U_n$ At voltages in range of $0.01 \dots 1.15 \times U_n$
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where $n = 2, 3, 4, 5, \dots$

19. Front panel user interface

The 630 series protection relays can be ordered with a detached front-panel user interface (HMI). An integrated HMI is available for 4U high housing. The local HMI includes a large graphical monochrome LCD with a resolution of 320 x 240 pixels (width x height). The amount of characters and rows fitting the view depends on the character size as the characters' width and height may vary.

In addition, the local HMI includes dedicated open/close operating buttons and five programmable function buttons with

LED indicators. The 15 programmable alarm LEDs can indicate a total of 45 alarms. The local HMI offers full front-panel user-interface functionality with menu navigation, menu views and operational data. In addition, the local HMI can, using PCM600, be configured to show a single-line diagram (SLD). The SLD view displays the status of the primary apparatus such as circuit breakers and disconnectors, selected measurement values and busbar arrangements.

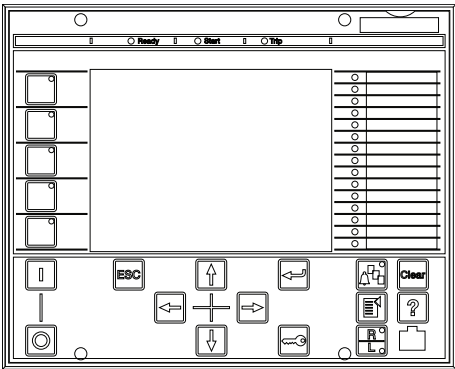


Figure 9. Local user interface

20. Mounting methods

By means of appropriate mounting accessories the standard relay case for the 630 series protection relays can be flush mounted, semi-flush mounted or wall mounted. Detachable HMI is intended for optimized mounting in medium voltage metal-clad switchgear, thus reducing wiring between the low-voltage compartment and the panel door. Further, the protection relays can be mounted in any standard 19" instrument cabinet by means of 19" rack mounting accessories.

For the routine testing purposes, the relay cases can be installed with RTXP test switches (RTXP8, RTXP18 or RTXP24) which can be mounted side by side with the relay case in a 19" rack.

Mounting methods:

- Flush mounting
- Semi-flush mounting
- Overhead/ceiling mounting

- 19" rack mounting
- Wall mounting
- Mounting with a RTXP8, RTXP18 or RTXP24 test switch to a 19"rack
- Door mounting of the local HMI, relay case mounted in the low-voltage compartment of the switchgear

To ensure grounding of the RTD channels, a separate cable shield rail is included in the protection relay delivery when the optional RTD/mA module is ordered.

For further information regarding different mounting options see the installation manual.

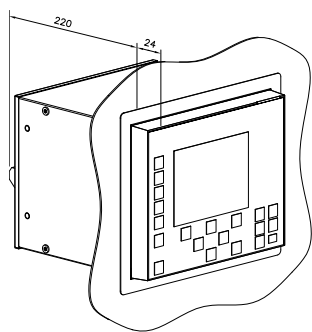


Figure 10. Flush mounting

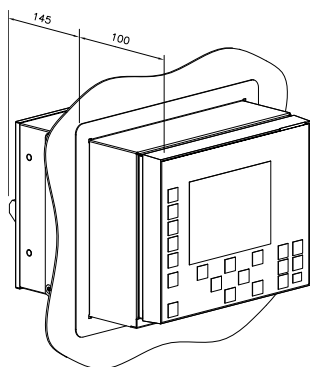


Figure 11. Semi-flush mounting

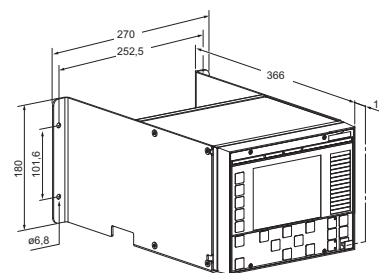


Figure 12. Wall mounting

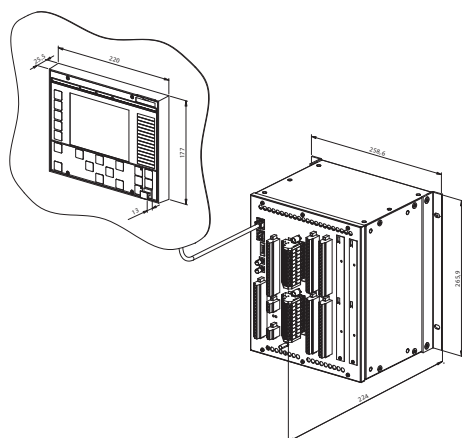


Figure 13. 6U half 19" unit wall mounted with two mounting brackets and detached LHMI

21. Selection and ordering data

The IED type and serial number label identifies the protection and control relay. The label placed is on the side of the protection relay's case. The labels include a set of smaller size labels, one label for each module in the protection relay. The module labels state the type and serial number of each module.

The order code consists of a string of letters and digits generated from the hardware and software modules of the protection relay. Use the ordering key information in tables to generate the order code when ordering protection and control relays.

#	Description	
1	IED	
	630 series, 4U half 19" housing	S
	630 series, 6U half 19" housing	T
	630 series, 4U half 19" housing & connector set	U
	630 series, 6U half 19" housing & connector set	V
2	Standard	
	IEC	B
3	Main application	
	Motor protection and control	M

SBMAAAAABBAZAADBXD

The preconfiguration determines the analog input and binary I/O options.
The example below shows standard configuration "A" with chosen options.

SBMAAAABBAZAADB XD

#	Description
4-8	Functional application, preconfigurations: A = Preconfiguration A for asynchronous motors B = Preconfiguration B for asynchronous motors including differential protection ¹⁾ N = None
Pre-conf.	Available analog input options
A	$AA = 4I (I_0 1/5 A) + 1I (I_0 0.1/0.5 A) + 4U$ $BA = 4I (I_0 1/5 A) + 1I (I_0 0.1/0.5 A) + 4U + 8mA/RTD \text{ in} + 4mA \text{ out}$
B ¹⁾	$AB = 7I (I_0 1/5 A) + 3U$ $BB = 7I (I_0 1/5 A) + 3U + 8mA/RTD \text{ in} + 4mA \text{ out}$
N	$AA = 4I (I_0 1/5 A) + 1I (I_0 0.1/0.5 A) + 4U$ $AB = 7I (I_0 1/5 A) + 3U$ $AC = 8I (I_0 1/5 A) + 2U$ $BA = 4I (I_0 1/5 A) + 1I (I_0 0.1/0.5 A) + 4U + 8mA/RTD \text{ in} + 4mA \text{ out}$ $BB = 7I (I_0 1/5 A) + 3U + 8mA/RTD \text{ in} + 4mA \text{ out}$ $BC = 8I (I_0 1/5 A) + 2U + 8mA/RTD \text{ in} + 4mA \text{ out}$
Pre-conf.	Available binary input/output options
A	$AA = 14 \text{ BI} + 9 \text{ BO}$ $AB = 23 \text{ BI} + 18 \text{ BO}$ $AC^{3)} = 32 \text{ BI} + 27 \text{ BO}$ $AD^{2)} = 41 \text{ BI} + 36 \text{ BO}$ $AE^{2,4)} = 50 \text{ BI} + 45 \text{ BO}$
B ¹⁾	$AA = 14 \text{ BI} + 9 \text{ BO}$ $AB = 23 \text{ BI} + 18 \text{ BO}$ $AC^{3)} = 32 \text{ BI} + 27 \text{ BO}$ $AD^{2)} = 41 \text{ BI} + 36 \text{ BO}$ $AE^{2,4)} = 50 \text{ BI} + 45 \text{ BO}$
N	$AA = 14 \text{ BI} + 9 \text{ BO}$ $AB = 23 \text{ BI} + 18 \text{ BO}$ $AC^{3)} = 32 \text{ BI} + 27 \text{ BO}$ $AD^{2)} = 41 \text{ BI} + 36 \text{ BO}$ $AE^{2,4)} = 50 \text{ BI} + 45 \text{ BO}$

1) Preconfiguration B requires that the stabilized differential protection option is chosen for digit #14 or digit #15

2) Binary input/output options AD and AE require 6U half 19" IED housing (digit #1 = T or V)

3) Binary input/output option AC is not available for 4U high variant (digit #1 = S or U) with RTD card options (digit #5-6 = BA, BB or BC)

4) Binary input/output option AE is not available for 6U high variant (digit #1 = T or V) with RTD card options (digit #5-6 = BA, BB or BC)

SBMAAAABBAZAADB XD

#	Description
9	Communication modules (Serial) Serial glass fibre (ST connector) A Serial plastic fibre (Snap-in connector) B
10	Communication modules (Ethernet) Ethernet 100Base-FX (LC connector) A Ethernet 100Base-TX (RJ-45 connector) B
11	Communication (Protocol) IEC 61850 protocol A IEC 61850 and DNP3 TCP/IP protocols B IEC 61850 and IEC 60870-103 protocols C

S B M A A A A B B A Z A A D B X D

#	Description	
12	Language	
	Language package	Z
13	Front panel	
	Integrated LHM ¹⁾	A
	Detached LHMI + 1 m cable	B
	Detached LHMI + 2 m cable	C
	Detached LHMI + 3 m cable	D
	Detached LHMI + 4 m cable	E
	Detached LHMI + 5 m cable	F
	No LHMI ²⁾	N
14	Option 1 ³⁾	
	Under- / overfrequency protection including rate of change and Stabilized differential protection ⁴⁾	A
	Under- / overfrequency protection including rate of change and additional functions for synchronous motor ⁵⁾	B
	Stabilized differential protection and additional functions for synchronous motor ^{4,5)}	C
	All options	Z
	None	N
15	Option 2 ³⁾	
	Underfrequency and overfrequency protection (including rate of change)	B
	Stabilized differential protection ⁴⁾	C
	Additional functions for synchronous motor ⁵⁾	D
	None	N
16	Power supply	
	Power supply 48-125 VDC	A
	Power supply 110-250 VDC, 100-240 VAC	B
17	Reserved	
	Undefined	X
18	Version	
	Version 1.3	D

1) Integrated HMI is not available for 6 U high variant (digit #1 = T or V)

2) Preconfiguration requires HMI, so option N is not valid if preconfiguration is selected. A detached LHMI cannot be used if No LHMI configuration has been chosen

3) Any optional function can be chosen only once. Due to this, the option 2 (digit 15) has limitations based on the selection in option 1 (digit 14).

4) Preconfiguration B requires that the stabilized differential protection option is chosen for digit #14 or #15

5) Synchronous motor protections: three-phase underexcitation protection, reverse power / directional overpower protection and rotor earth-fault protection (rotor earth-fault protection requires separate fundamental frequency voltage injection device)

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Example code: **S B M A A A A A B B A Z A A D B X D**

Your ordering code:

Digit (#)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Code	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure 14. Ordering key for complete protection relays

22. Accessories

Table 100. Mounting accessories

Item	Order number
Flush mounting kit for one 4U half 19" housing the protection relay	1KHL400040R0001
Semi-flush mounting kit for one 4U half 19" housing the protection relay	1KHL400444R0001
Wall-mounting kit (cabling towards the mounting wall) for one 4U half 19" housing the protection relay	1KHL400067R0001
Wall-mounting kit (cabling to the front) for one 4U half 19" housing the protection relay	1KHL400449R0001
19" rack mounting kit for one 4U half 19" housing the protection relay	1KHL400236R0001
19" rack mounting kit for two 4U half 19" housing the protection relays	1KHL400237R0001
Overhead/ceiling mounting kit (with cable space) for one 4U half 19" housing the protection relay	1KHL400450R0001
Wall-mounting kit for direct rear wall mounting (with cabling to the front) of one 6U half 19" housing the protection relay	1KHL400452R0001
Wall-mounting kit (with cabling towards the mounting wall) for one 6U half 19" housing the protection relay	1KHL400200R0001
Overhead/ceiling mounting kit (with cable space) for one 6U half 19" housing the protection relay	1KHL400464R0001

Table 101. Test switch mounting accessories

Item	Order number
19" rack mounting kit for one RTXP8 test switch (the test switch is not included in the delivery)	1KHL400465R0001
19" rack mounting kit for one RTXP18 test switch (the test switch is not included in the delivery)	1KHL400467R0001
19" rack mounting kit for one RTXP24 test switch (the test switch is not included in the delivery)	1KHL400469R0001

Table 102. Connector sets

Item	Order number
Connector set for one 4U housing the protection relay including analog input variant 4I + 5U or 5I + 4U	2RCA021735
Connector set for one 6U housing the protection relay including analog input variant 4I + 5U or 5I + 4U	2RCA021736
Connector set for one 4U housing the protection relay including analog input variant 7I + 3U	2RCA023041
Connector set for one 6U housing the protection relay including analog input variant 7I + 3U	2RCA023042
Connector set for one 4U housing the protection relay including analog input variant 8I + 2U	2RCA023039
Connector set for one 6U housing the protection relay including analog input variant 8I + 2U	2RCA023040

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Table 103. Optional cables for external display module

Items	Order number
LHMI cable (1 m)	2RCA025073P0001
LHMI cable (2 m)	2RCA025073P0002
LHMI cable (3 m)	2RCA025073P0003
LHMI cable (4 m)	2RCA025073P0004
LHMI cable (5 m)	2RCA025073P0005

24. Tools

The protection relay is delivered either with or without an optional factory made preconfiguration. The default parameter setting values can be changed from the front-panel user interface, the web-browser based user interface (WebHMI) or the PCM600 tool in combination with the relay-specific connectivity package.

PCM600 offers extensive relay configuration functions such as relay application configuration, signal configuration, DNP3 communication configuration and IEC 61850 communication configuration including horizontal communication, GOOSE.

When the web-browser based user interface is used, the protection relay can be accessed either locally or remotely

using a web browser (IE 7.0 or later). For security reasons, the web-browser based user interface is disabled by default. The interface can be enabled with the PCM600 tool or from the front panel user interface. The functionality of the interface is by default limited to read-only, but can be configured to enable read and write access by means of PCM600 or the local HMI.

The relay connectivity package is a collection of software and specific protection relay information, which enable system products and tools to connect and interact with the protection relay. The connectivity packages reduce the risk of errors in system integration, minimizing device configuration and set-up times.

Table 104. Tools

Description	Version
PCM600	2.5 or later
Web browser	IE 8.0, IE 9.0 or IE 10.0
REM630 Connectivity Package	1.3 or later

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Table 105. Supported functions

Function	WebHMI	PCM600
Parameter setting	•	•
Disturbance handling	•	•
Signal monitoring	•	•
Event viewer	•	•
Alarm LED viewing	•	•
Hardware configuration	-	•
Signal matrix	-	•
Graphical display editor	-	•
IED configuration templates	-	•
Communication management	-	•
Disturbance record analysis	-	•
IED user management	-	•
User management	-	•
Creating/handling projects	-	•
Graphical application configuration	-	•
IEC 61850 communication configuration, including GOOSE	-	•
IED Compare	-	•

25. Supported ABB solutions

ABB's 630 series protection and control protection relays together with the Grid Automation controller COM600 constitute a genuine IEC 61850 solution for reliable power distribution in utility and industrial power systems. To facilitate and streamline the system engineering ABB's relays are supplied with connectivity packages. The connectivity packages include a compilation of software and relay-specific information such as single-line diagram templates, manuals and a full relay data model including event and parameter lists. With the connectivity packages, the relays can be readily configured via the PCM600 Protection and Control IED Manager and integrated with the Grid Automation controller COM600 or the MicroSCADA Pro network control and management system.

The 630 series relays offer support for the IEC 61850 standard including horizontal GOOSE messaging. Compared to traditional hard-wired, inter-device signaling, peer-to-peer communication over a switched Ethernet LAN offers an advanced and versatile platform for power system protection. Among the distinctive features of the protection system approach, enabled by the full implementation of the IEC 61850

substation automation standard, are fast communication capability, continuous supervision of the protection and communication system's integrity, and an inherent flexibility regarding reconfiguration and upgrades

At substation level, COM600 uses the logic processor and data content of the bay level devices to enhance substation level functionality. COM600 features a Web-browser based HMI which provides a customizable graphical display for visualizing single line mimic diagrams for switchgear bay solutions. To enhance personnel safety, the Web HMI also enables remote access to substation devices and processes. Furthermore, COM600 can be used as a local data warehouse for technical documentation of the substation and for network data collected by the devices. The collected network data facilitates extensive reporting and analyzing of network fault situations using the data historian and event handling features of COM600.

COM600 also features gateway functionality providing seamless connectivity between the substation devices and network-level control and management systems such as MicroSCADA Pro and System 800xA.

Table 106. Supported ABB solutions

Product	Version
Grid Automation Controller COM600	3.5 or later
MicroSCADA Pro SYS 600	9.3 FP1 or later
System 800xA	5.1 or later

26. Terminal diagrams

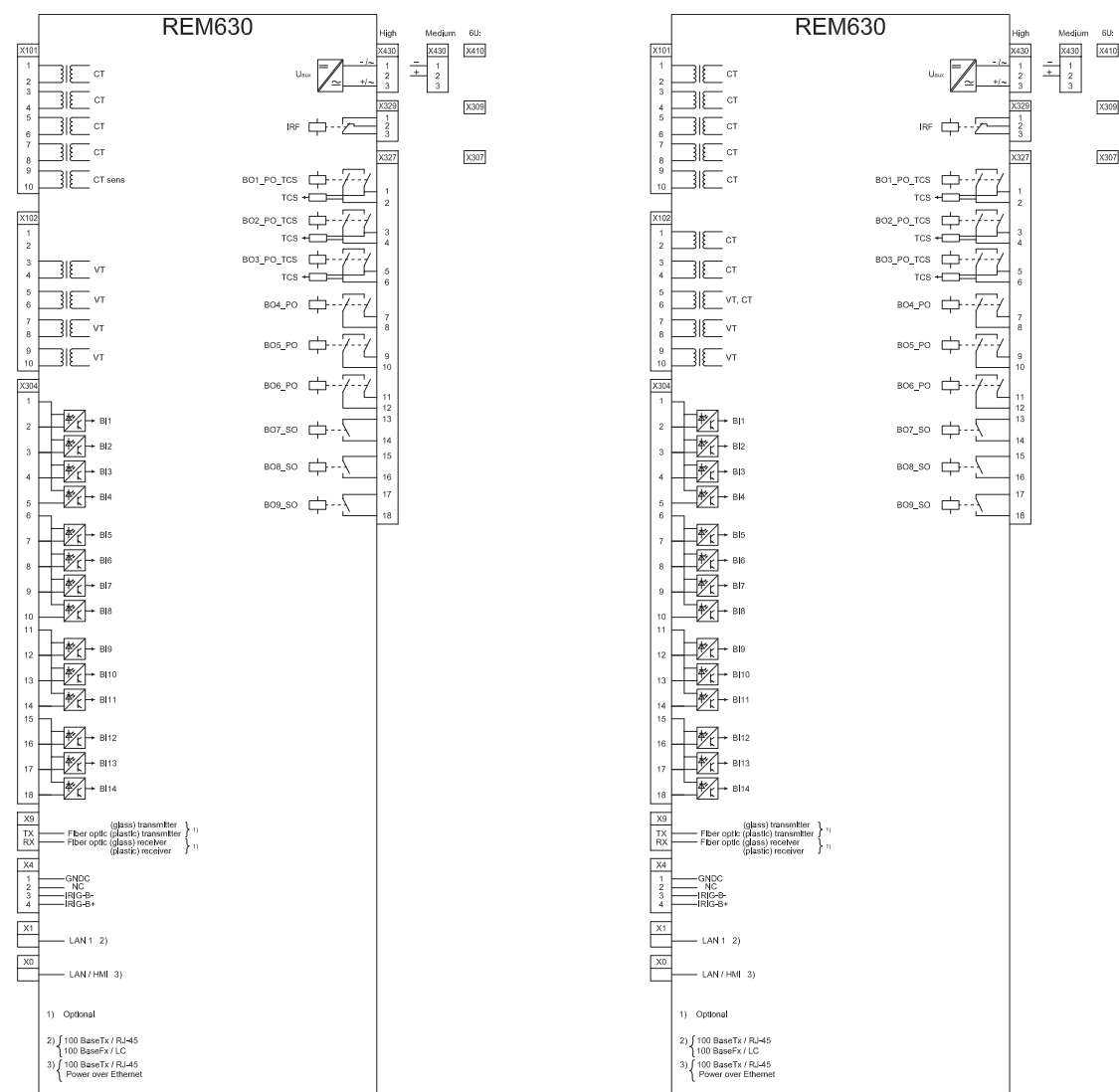


Figure 15. Terminal diagram for REM630

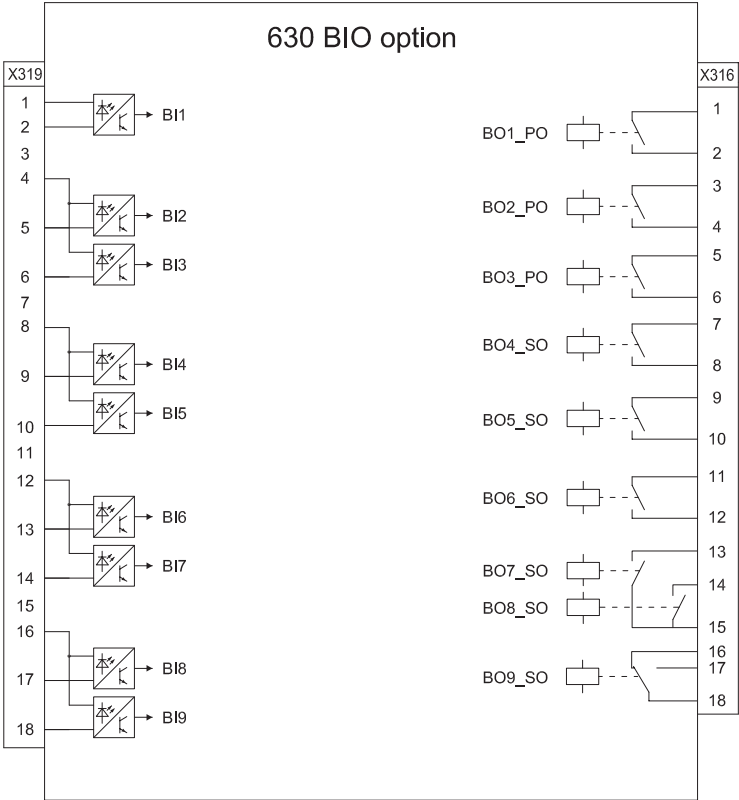


Figure 16. 630 series BIO module option

Table 107. BIO options

Unit	BI/BO
4U	X319 + X316 ¹⁾
	X324 + X321
6U	X324 + X321 ¹⁾
	X329 + X326
	X334 + X331
	X339 + X336

1) Occupied by RTD module when ordered

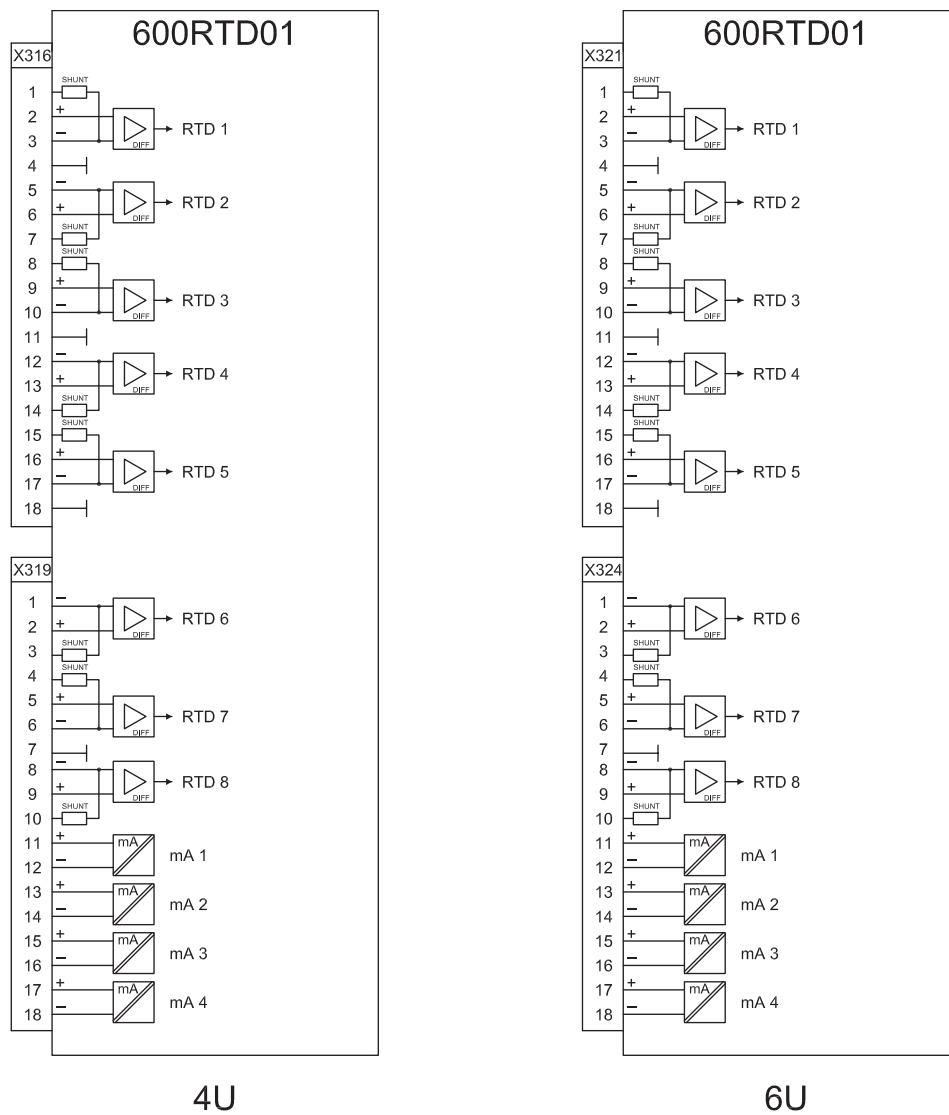


Figure 17. 630 series RTD module option

27. References

The www.abb.com/substationautomation portal offers you information about the distribution automation product and service range.

You will find the latest relevant information on the REM630 protection relay on the [product page](#). Scroll down the page to find and download the related documentation.

28. Functions, codes and symbols

Table 108. Functions included in the relay

Description	IEC 61850	IEC 60617	ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage	PHLPTOC	3I>	51P-1
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC	3I>>>	50P/51P
Non-directional earth-fault protection, low stage	EFLPTOC	I0>	51N-1
Non-directional earth-fault protection, high stage	EFHPTOC	I0>>	51N-2
Non-directional earth-fault protection, instantaneous stage	EFIPTOC	I0>>>	50N/51N
Directional earth-fault protection, low stage	DEFLPDEF	I0> ->	67N-1
Directional earth-fault protection, high stage	DEFHPDEF	I0>> ->	67N-2
Rotor earth-fault protection	MREFPTOC	Io>R	64R
Negative-sequence overcurrent protection for machines	MNSPTOC	I2>G/M	46G/46M
Phase-reversal protection	PREVPTOC	I2>>	46R
Three-phase thermal overload protection for motors	MPTTR	3Ith>M	49M
Motor startup supervision	STTPMSU	Is2t n<	48,66,14,51LR
Motor load jam protection	JAMPTOC	Ist>	51LR
Emergency start	ESMGAPC	ESTART	ESTART
Loss of load supervision	LOFLPTUC	3I<	37
High-impedance or flux-balance based differential protection for machines	MHZPDIF	3dIHi>G/M	87GH/87MH
Stabilized differential protection for machines	MPDIF	3dI>G/M	87G/87M
Three-phase overvoltage protection	PHPTOV	3U>	59
Three-phase undervoltage protection	PHPTUV	3U<	27
Positive-sequence overvoltage protection	PSPTOV	U1>	47O+
Positive-sequence undervoltage protection	PSPTUV	U1<	47U+
Negative-sequence overvoltage protection	NSPTOV	U2>	47O-
Residual overvoltage protection	ROVPTOV	U0>	59G
Reverse power/directional overpower protection	DOPDPDR	P>	32R/32O
Frequency gradient protection	DAPFRC	df/dt>	81R
Overfrequency protection	DAPTOF	f>	81O
Underfrequency protection	DAPTUF	f<	81U
Three-phase underexcitation protection	UEXPDIS	X<	40
Circuit breaker failure protection	CCBRBRF	3I>/I0>BF	51BF/51NBF
Tripping logic	TRPPTRC	I -> O	94
Multipurpose analog protection	MAPGAPC	MAP	MAP
Control			
Bay control	QCCBAY	CBAY	CBAY

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Table 108. Functions included in the relay, continued

Description	IEC 61850	IEC 60617	ANSI
Interlocking interface	SCILO	3	3
Circuit breaker/disconnector control	GNRLCSWI	I <-> O CB/DC	I <-> O CB/DC
Circuit breaker	DAXCBR	I <-> O CB	I <-> O CB
Disconnector	DAXSWI	I <-> O DC	I <-> O DC
Local/remote switch interface	LOCREM	R/L	R/L
Generic process I/O			
Single point control (8 signals)	SPC8GGIO	-	-
Double point indication	DPGGIO	-	-
Single point indication	SPGGIO	-	-
Generic measured value	MVGGIO	-	-
Logic Rotating Switch for function selection and LHMI presentation	SLGGIO	-	-
Selector mini switch	VSGGIO	-	-
Pulse counter for energy metering	PCGGIO	-	-
Event counter	CNTGGIO	-	-
Supervision and monitoring			
Runtime counter for machines and devices	MDSOPT	OPTS	OPTM
Circuit breaker condition monitoring	SSCBR	CBCM	CBCM
Fuse failure supervision	SEQRFUF	FUSEF	60
Current circuit supervision	CCRDIF	MCS 3I	MCS 3I
Trip-circuit supervision	TCSSCBR	TCS	TCM
Station battery supervision	SPVNZBAT	U<>	U<>
Energy monitoring	EPDMMTR	E	E
Measured value limit supervision	MVEXP	-	-
Measurement			
Three-phase current measurement	CMMXU	3I	3I
Three-phase voltage measurement (phase-to-earth)	VPHMMXU	3Upe	3Upe
Three-phase voltage measurement (phase-to-phase)	VPPMMXU	3Upp	3Upp
Residual current measurement	RESCMMXU	I0	I0
Residual voltage measurement	RESVMMXU	U0	U0
Power monitoring with P, Q, S, power factor, frequency	PWRMMXU	PQf	PQf
Sequence current measurement	CSMSQI	I1, I2	I1, I2
Sequence voltage measurement	VSMSQI	U1, U2	V1, V2
Analog channels 1-10 (samples)	A1RADR	ACH1	ACH1
Analog channels 11-20 (samples)	A2RADR	ACH2	ACH2
Analog channels 21-30 (calc. val.)	A3RADR	ACH3	ACH3
Analog channels 31-40 (calc. val.)	A4RADR	ACH4	ACH4
Binary channels 1-16	B1RBDR	BCH1	BCH1

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Table 108. Functions included in the relay, continued

Description	IEC 61850	IEC 60617	ANSI
Binary channels 17 -32	B2RBDR	BCH2	BCH2
Binary channels 33 -48	B3RBDR	BCH3	BCH3
Binary channels 49 -64	B4RBDR	BCH4	BCH4
Station communication (GOOSE)			
Binary receive	GOOSEBINRCV	-	-
Double point receive	GOOSEDPRCV	-	-
Interlock receive	GOOSEINTLKRCV	-	-
Integer receive	GOOSEINTRCV	-	-
Measured value receive	GOOSEMVRCV	-	-
Single point receive	GOOSESPRCV	-	-

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29. Document revision history

Document revision/date	Product version	History
A/2009-10-26	1.0	First release
B/2009-12-23	1.0	Content updated
C/2011-02-23	1.1	Content updated to correspond to the product version
D/2011-05-18	1.1	Content updated
E/2012-08-29	1.2	Content updated to correspond to the product version
F/2014-12-03	1.3	Content updated to correspond to the product version
G/2016-01-15	1.3	Content updated
H/2019-02-25	1.3	Content updated



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