Relion® 615 series

Motor Protection and Control
REM615
Product Guide

Power and productivity
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Contents

1. Description

REM615 is a dedicated motor protection and control IED (intelligent electronic device) designed for the protection, control, measurement and supervision of asynchronous motors in manufacturing and process industry. REM615 is a member of ABB's Relion® product family and part of its 615 protection and control product series. The 615 series IEDs are characterized by their compactness and withdrawable-unit design.

Re-engineered from the ground up, the 615 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability between substation automation devices. Once the standard configuration IED has been given the application-specific settings, it can directly be put into service.

The 615 series IEDs support a range of communication protocols including IEC 61850 with GOOSE messaging, IEC 60870-5-103, Modbus® and DNP3.

2. Standard configuration

REM615 is available in three alternative standard configurations. The standard signal configuration can be altered by means of the graphical signal matrix or the optional graphical application functionality of the Protection and Control IED Manager PCM600. Further, the application configuration functionality of the IED supports the creation of multi-layer logic functions using various logical elements including timers and flip-flops. By combining protection functions with logic function blocks, the IED configuration can be adapted to user-specific application requirements.

Table 1. Standard configuration

Description	Std.conf.
Motor protection, optional RTD/mA inputs	A
Motor protection with current, voltage and frequency based protection and measurement functions, optional RTD/mA inputs	B
Motor protection with current, voltage and frequency based protection and measurements functions	C

Table 2. Supported functions

Functionality	A	B	C
Protection[1][2]			
Three-phase non-directional overcurrent protection, low stage, instance 1	●	●	●
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	●	●	●
Non-directional earth-fault protection, low stage, instance 1	●[3]	-	-
Non-directional earth-fault protection, high stage, instance 1	●[3]	●[4]	●[4]
Directional earth-fault protection, low stage, instance 1	-	●[3][5]	●[3][6]
Three-phase undervoltage protection, instance 1	-	●	●
Positive-sequence undervoltage protection, instance 1	-	●	●
Negative-sequence overvoltage protection, instance 1	-	●	●
Frequency protection, instance 1	-	●	●
Frequency protection, instance 2	-	●	●
Negative-sequence overcurrent protection for motors, instance 1	●	●	●
Negative-sequence overcurrent protection for motors, instance 2	●	●	●
Loss of load supervision	●	●	●
Motor load jam protection	●	●	●
Motor start-up supervision	●	●	●
Phase reversal protection	●	●	●
Thermal overload protection for motors	●	●	●
Circuit breaker failure protection	●	●	●
Master trip, instance 1	●	●	●
Master trip, instance 2	●	●	●
Arc protection, instance 1	o	o	o
Arc protection, instance 2	o	o	o
Arc protection, instance 3	o	o	o
Multi-purpose protection, instance 1[7]	o	o	-
Multi-purpose protection, instance 2[7]	o	o	-
Multi-purpose protection, instance 3[7]	o	o	-

Table 2. Supported functions, continued

Functionality	A	B	C
Control			
Circuit-breaker control	●	●	●
Disconnector position indication, instance 1	●	●	●
Disconnector position indication, instance 2	●	●	●
Disconnector position indication, instance 3	●	●	●
Earthing switch indication	●	●	●
Emergency startup	●	●	●
Condition Monitoring			
Circuit-breaker condition monitoring	●	●	●
Trip circuit supervision, instance 1	●	●	●
Trip circuit supervision, instance 2	●	●	●
Current circuit supervision	●	●	●
Fuse failure supervision	-	●	●
Runtime counter for machines and devices	●	●	●
Measurement			
Disturbance recorder	●	●	●
Three-phase current measurement, instance 1	●	●	●
Sequence current measurement	●	●	●
Residual current measurement, instance 1	●	●	●
Three-phase voltage measurement	-	●	●
Residual voltage measurement	-	-	●
Sequence voltage measurement	-	●	●
Three-phase power and energy measurement, including power factor	-	●	●
RTD/mA measurement	o	o	-
Frequency measurement	-	●	●

● = included, o = optional at the time of order

1) Note that all directional protection functions can also be used in non-directional mode.
2) The instances of a protection function represent the number of identical function blocks available in a standard configuration. By setting the application specific parameters of an instance, a protection function stage can be established.
3) Io selectable by parameter, Io measured as default.
4) Io selectable by parameter, Io calculated as default.
5) Uo calculated.

6) Uo selectable by parameter, Uo measured as default.
7) Multi-purpose protection is used for, for example, RTD/mA based protection.

3. Protections functions

The IED offers all the functionality needed to manage motor starts and normal operation, also including protection and fault clearance in abnormal situations. The main features of the IED include thermal overload protection, motor start-up time supervision, locked rotor protection and protection against too frequent motor starts. The IED also incorporates non-directional earth-fault protection, negative phase-sequence current unbalance protection and backup overcurrent protection. Furthermore, the IED offers motor running stall protection, loss-of-load supervision and phase-reversal protection.

Standard configurations B and C additionally offer directional earth-fault protection, three phase undervoltage protection, negative phase-sequence overvoltage and positive sequence undervoltage protection. Further, the B and C configurations offer frequency protection including overfrequency, underfrequency and rate-of-change frequency protection modes.

The RTD/mA module offered as an option for standard configurations A and B enable the use of the optional multipurpose protection function which can be used for tripping and alarm purposes using RTD/mA measuring data or analog values via GOOSE messages.

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. To enable an emergency hot start, REM615 offers a forced start execution feature.

Enhanced with optional hardware and software, the IED also features three light detection channels for arc fault protection of the circuit breaker, busbar and cable compartment of metal-enclosed indoor switchgear.

The arc-fault protection sensor interface is available on the optional communication module. Fast tripping increases personnel safety and limits switchgear damage, should an arc fault occur.

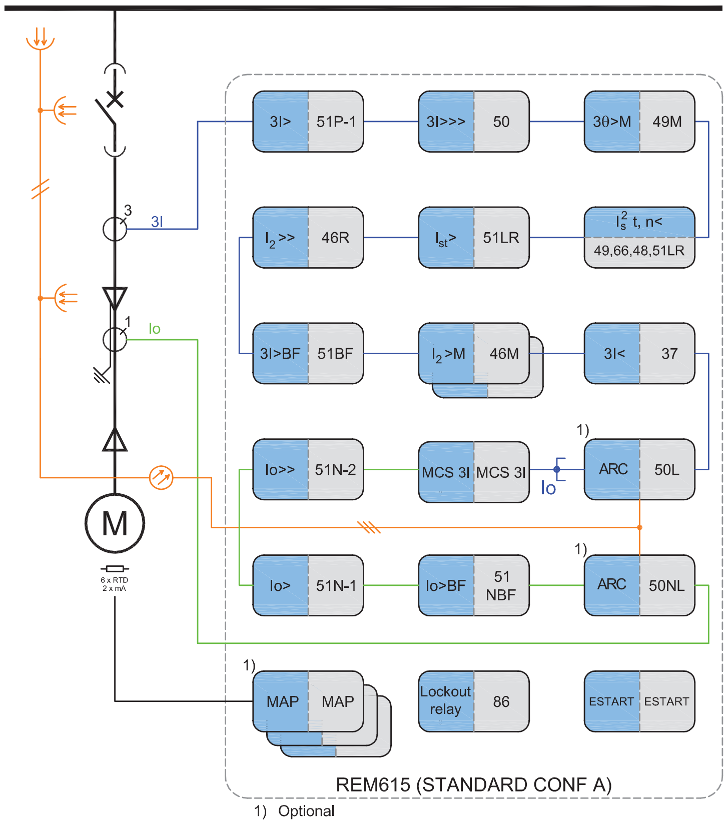

Figure 1. Protection function overview of standard configuration A

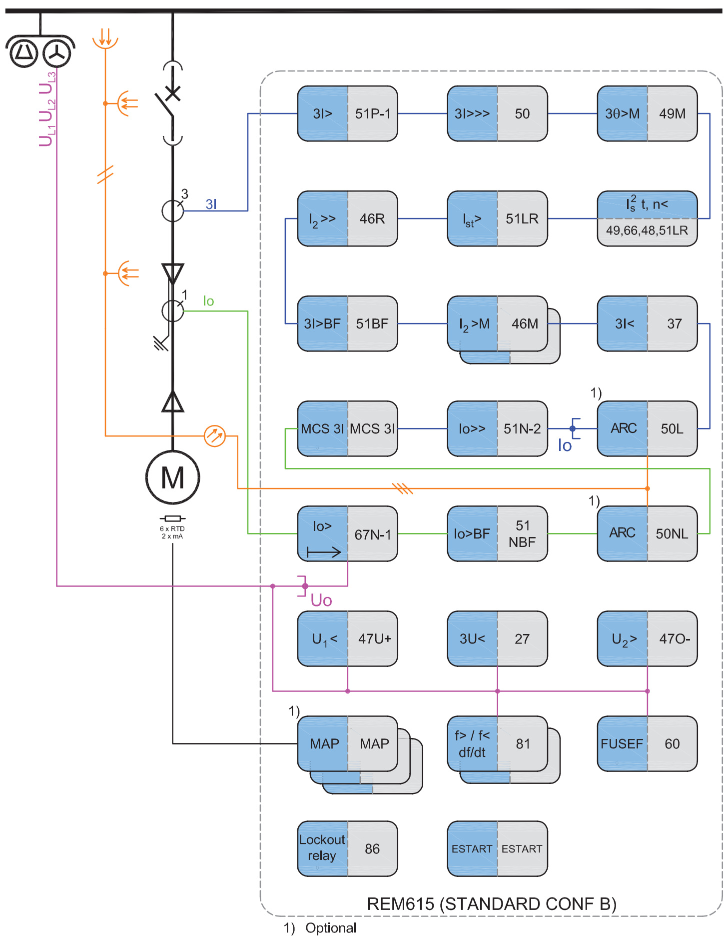

Figure 2. Protection function overview of standard configuration B

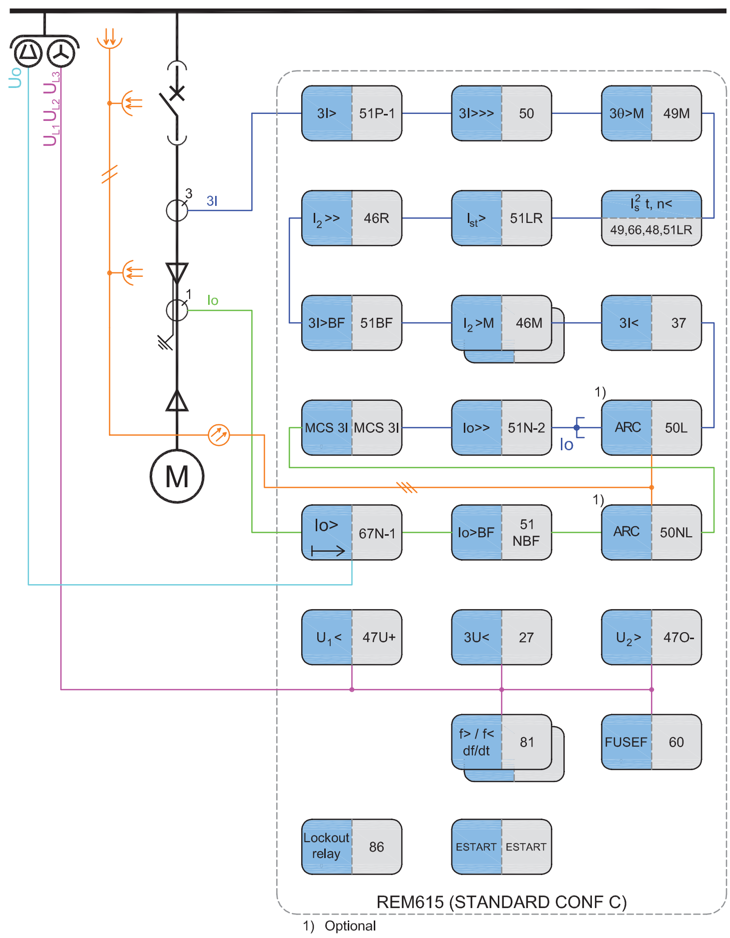

Figure 3. Protection function overview of standard configuration C

4. Application

REM615 constitutes main protection for asynchronous motors and the associated drives. Typically, the motor IED is used with circuit-breaker or contactor controlled HV motors, and contactor controlled medium sized and large LV motors in a variety of drives, such as pumps and conveyors, crushers and choppers, mixers and agitators, fans and aerators.

The motor IED is thoroughly adapted for earth-fault protection. Using cable current transformers sensitive and reliable earth-fault protection can be achieved. Phase current transformers in Holmgreen (summation) connection can also be used for earth-fault protection. In that case possible unwanted operations of the earth-fault protection at motor start-up due to CT saturation can be prevented using the IED's internal interlocking features or a suitable stabilizing resistor in the common neutral return.

The optional RTD/mA module offered for standard configurations A and B facilitates the measurement of up to eight analog signals via the six RTD inputs or the two mA inputs using transducers. The RTD and mA inputs can be used for temperature monitoring of motor bearings and stator windings, thus expanding the functionality of the thermal overload protection and preventing premature aging of the motor.

Furthermore, the RTD/mA inputs can be used for measuring the ambient cooling air temperature. The analog temperature values can, if required, be sent to other IEDs using analog horizontal GOOSE messaging.

Temperature values can also, vice versa, be received from other IEDs over the station bus, thus increasing the extent of relevant information.

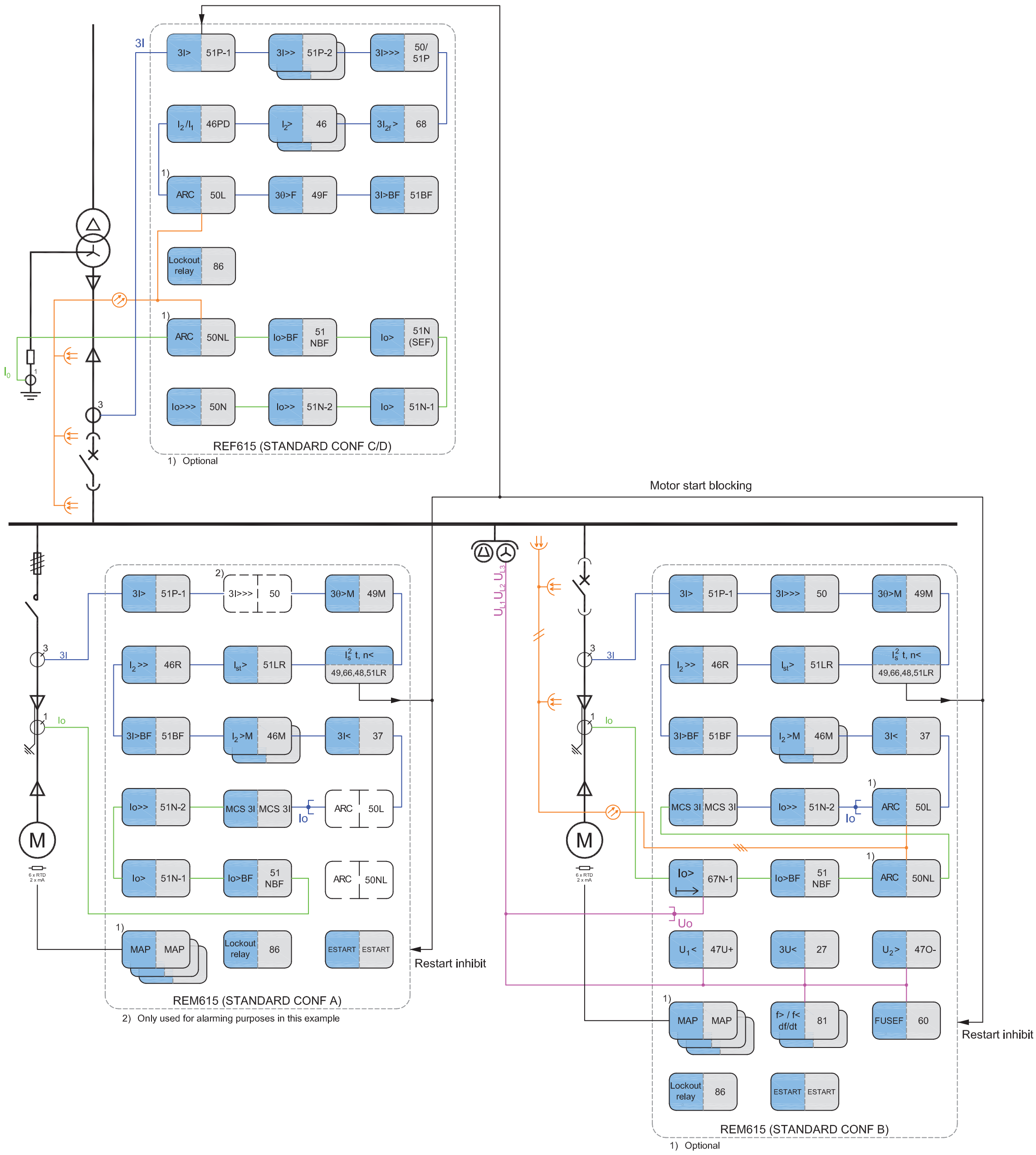

Figure 4. Motor protection and control of contactor and circuit-breaker controlled motors using REM615s with the standard configurations A and B. To prevent possible power system instability due to busbar voltage collapse, the simultaneous starting of several motors is inhibited. The motor start-up signal from each REM615 is connected to the "Restartinhibit" inputs of the other REM615s. Hence while one motor is starting-up, the starting of the other motors is inhibited. The same motor start-up signal is also used to dynamically increase the setting level of the lowest O/C protection stage of the REF615 on the incoming feeder. The optional RTD/mA inputs are utilized for motor winding and bearing temperature supervision.

5. Supported ABB solutions

ABB's 615 series protection and control IEDs together with the COM600 Station Automation device 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 IEDs are supplied with Connectivity Packages containing a compilation of software and IED-specific information including single-line diagram templates, a full IED data model including event and parameter lists. By utilizing the Connectivity Packages the IEDs can be readily configured via the PCM600 Protection and Control IED Manager and integrated with the COM600 Station Automation device or the MicroSCADA Pro network control and management system.

The 615 series IEDs offer native support for the IEC 61850 standard also including binary and analog horizontal GOOSE messaging. Compared with 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. Fast software-based communication, continuous supervision of the integrity of the protection and communication system, and inherent flexibility for reconfiguration and upgrades are among the distinctive features of the protection system approach enabled by the full implementation of the IEC 61850 substation automation standard.

At the substation level COM600 uses the data content of the bay level IEDs to offer enhanced substation level functionality. COM600 features a web-browser based HMI providing a customizable graphical display for visualizing single line mimic diagrams for switchgear bay solutions. The SLD feature is especially useful when 615 series IEDs without the optional single line diagram feature are used. Further, the web HMI of COM600 offers an overview of the whole substation, including IED-specific single line diagrams, thus enabling convenient information accessibility. 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 IEDs. The collected network data facilitates extensive reporting and analyzing of network fault situations using the data historian and event handling features of COM600. The data historian can be used for accurate process performance monitoring by following process and equipment performance calculations with real-time and history values. Better understanding of the process behaviour by joining time-based process measurements with production and maintenance events helps the user in understanding the process dynamics.

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

Table 3. Supported ABB solutions

Product	Version
Station Automation COM600	3.4 or later
MicroSCADA Pro	9.2 SP2 or later
System 800xA	5.0 Service Pack 2

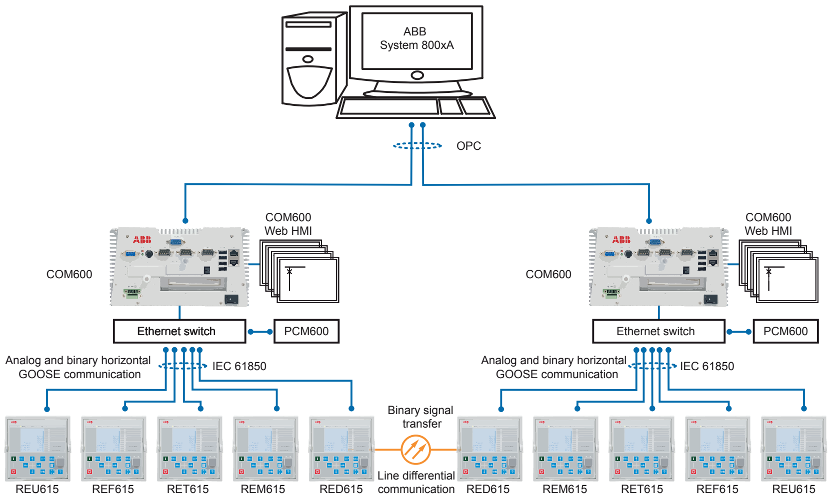

Figure 5. Industrial power system example using 615 series IEDs, Station Automation COM600 and System 800xA

6. Control

The IED offers control of one circuit breaker with dedicated push-buttons for circuit breaker opening and closing. Further, the optional large graphical LCD of the IED's HMI includes a single-line diagram (SLD) with position indication for the relevant circuit breaker. Interlocking schemes required by the application are configured using the signal matrix or the application configuration feature of PCM600.

7. Measurement

The IED continuously measures the phase currents and the neutral current. Further, the IED measures the phase voltages and the residual voltage. Depending on the standard configuration, the IED also offers frequency measurement. In addition, the IED calculates the symmetrical components of the currents and voltages, maximum current demand value over a user-selectable pre-set time frame, the active and reactive power, the power factor, and the active and reactive energy values. Calculated values are also obtained from the protection and condition monitoring functions of the IED.

For standard configuration A and B RTD/mA inputs are offered as an option. By means of the optional RTD/mA module the IED can measure up to eight analog signals such as stator winding and bearing temperatures via the six RTD inputs or the two mA inputs using transducers.

The values measured can be accessed locally via the user interface on the IED front panel or remotely via the communication interface of the IED. The values can also be accessed locally or remotely using the web-browser based user interface.

8. Disturbance recorder

The IED is provided with a disturbance recorder featuring up to 12 analog and 64 binary signal channels. The analog channels can be set to record either the waveform or the trend of the currents and voltage measured.

The analog channels can be set to trigger the recording function 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 or both.

By default, the binary channels are set to record external or internal IED signals, for example the start or trip signals of the IED stages, or external blocking or control signals. Binary IED signals such as a protection start or trip signal, or an external IED control signal over a binary input can be set to trigger the recording. The recorded information is stored in a non-volatile memory and can be uploaded for subsequent fault analysis.

9. Event log

To collect sequence-of-events (SoE) information, the IED incorporates a non-volatile memory with a capacity of storing 512 events with associated time stamps. The non-volatile memory retains its data also in case the IED temporarily loses its auxiliary supply. The event log facilitates detailed pre- and post-fault analyses of feeder faults and disturbances. The increased capacity to process and store data and events in the IED offers prerequisites to support the growing information demand of future network configurations.

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

10. Recorded data

The IED has the capacity to store the records of 32 latest fault events. The records enable the user to analyze the power system events. Each record includes current, voltage and angle values, time stamp, etc. The fault recording can be triggered by the start signal or the trip signal of a protection block, or by both. The available measurement modes include DFT, RMS and peak-to-peak. In addition, the maximum demand current with time stamp is separately recorded. By default, the records are stored in a non-volatile memory.

11. Condition monitoring

The condition monitoring functions of the IED constantly monitors the performance and the condition of the circuit breaker. The monitoring comprises the spring charging time, SF6 gas pressure, the travel-time and the inactivity time of the circuit breaker.

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

In addition, the IED includes a running time counter for monitoring of how many hours the motor has been in operation thus enabling scheduling of time-based preventive maintenance of the motor.

12. 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.

13. Self-supervision

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

A permanent IED fault will block the protection functions to prevent incorrect operation.

14. Fuse failure supervision

The IED includes fuse failure supervision functionality. The fuse failure supervision detects failures between the voltage measurement circuit and the IED. The failures are detected 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.

15. Current circuit supervision

The IED includes 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 activates an alarm LED and blocks certain protection functions to avoid unintended operation. The current circuit supervision function calculates the sum of the phase currents from the protection cores and compares the sum with the measured single reference current from a core balance current transformer or from separate cores in the phase current transformers.

16. Access control

To protect the IED from unauthorized access and to maintain information integrity, the IED is provided with a four-level, role-based authentication system with administrator-programmable individual passwords for the viewer, operator, engineer and administrator level. The access control applies to the front-panel user interface, the web-browser based user interface and the PCM600 tool.

17. Inputs and outputs

The IED is equipped with three phase-current inputs, one residual-current input, three phase-voltage inputs and one residual voltage input. The phase-current inputs and the residual current inputs are rated 1/5 A, that is, the inputs allow connection of either 1 A or 5 A secondary current transformers. The optional residual-current input 0.2/1 A is normally used in applications requiring sensitive earth-fault protection and featuring core-balance current transformers. The three phase-voltage inputs and the residual-voltage input covers the rated voltages 60-210 V. Both phase-to-phase voltages and phase-to-earth voltages can be connected.

The rated values of the current and voltage inputs are settable parameters of the IED. In addition, the binary input thresholds are selectable within the range of 18…176 V DC by adjusting the IED’s parameter settings.

All binary inputs and outputs contacts are freely configurable with the signal matrix or application configuration functionality of PCM600.

As an option for standard configurations A and B, the IED offers six RTD inputs and two mA inputs. By means of the optional RTD/mA module the IED can measure up to eight analog signals such as temperature, pressure and tap changer position values via the six RTD inputs or the two mA inputs using transducers. The values can, apart from measuring and monitoring purposes, be used for tripping and alarm purposes using the offered optional multipurpose protection functions.

Please refer to the Input/output overview table and the terminal diagrams for more detailed information about the inputs and outputs.

Table 4. Input/output overview

Standard configuration	Analog inputs				Binary inputs/outputs	
	CT	VT	RTD inputs	mA inputs	BI	BO
A	4	-	6[1)]	2[1)]	4 (12)[2)]	6 (10)[2)]
B[3)]	4	3	6[1)]	2[1)]	8 (14)[2)]	10 (13)[2)]
C	4	5[4)]	-	-	16	10

1) With optional RTD/mA module.
2) With optional binary I/O module.
3) The optional I/O module and the optional RTD/mA modules are mutually exclusive.
4) One of the five inputs is reserved for future applications.

18. Communication

The IED supports a range of communication protocols including IEC 61850, IEC 60870-5-103, Modbus® and DNP3. Operational information and controls are available through these protocols. However, some communication functionality, for example, horizontal communication between the IEDs, is only enabled by the IEC 61850 communication protocol.

The IEC 61850 communication implementation supports all monitoring and control functions. Additionally, parameter settings, disturbance recordings and fault records can be accessed using the IEC 61850 protocol. Disturbance recordings are available to any Ethernet-based application in the standard COMTRADE file format. The IED supports simultaneous event reporting to five different clients on the station bus.

The IED can send binary signals to other IEDs (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 IED meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard. Further, the IED 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 IED applications.

The IED offers an optional second Ethernet bus to enable the creation of a self-healing Ethernet ring topology. The IED communication module options include both galvanic and fibre-optic Ethernet combinations. The communication module including one fibre-optic LC port and two galvanic RJ-45 ports is used when the ring between the IEDs is built using CAT5 STP cables. The LC port can in this case be used for connecting the IED to communication ports outside the switchgear. The communication module including three RJ-45 ports is used when the whole substation bus is based on CAT5 STP cabling.

The self-healing Ethernet ring solution enables a cost efficient communication ring controlled by a managed switch with rapid spanning tree protocol (RSTP) support to be created. The managed switch controls the consistency of the loop, routes the data and corrects the data flow in case of a communication disturbance. The IEDs in the ring topology act as unmanaged switches forwarding unrelated data traffic. The Ethernet ring solution supports the connection of up to thirty 615 series IEDs. If more than 30 IEDs are to be connected, it is recommended that the network is split into several rings with no more than 30 IEDs per ring. The self-healing Ethernet ring solution avoids single point of failure concerns and improves the reliability of the communication. The solution can be applied for the Ethernet-based IEC 61850, Modbus and DNP3 protocols.

All communication connectors, except for the front port connector, are placed on integrated optional communication modules. The IED can be connected to Ethernet-based communication systems via the RJ-45 connector (100Base-TX) or the fibre-optic LC connector (100Base-FX). If connection to a serial bus is required, the 10-pin RS-485 screw-terminal or the fibre-optic ST connector can be used.

Modbus implementation supports RTU, ASCII and TCP modes. Besides standard Modbus functionality, the IED supports retrieval of time-stamped events, changing the active setting group and uploading of the latest fault records. If a Modbus TCP connection is used, five clients can be connected to the IED simultaneously. Further, Modbus serial and Modbus TCP can be used in parallel, and if required both IEC 61850 and Modbus protocols can be run simultaneously.

The IEC 60870-5-103 implementation supports two parallel serial bus connections to two different masters. Besides basic standard functionality, the IED supports changing of the active setting group and uploading of disturbance recordings in IEC 60870-5-103 format.

DNP3 supports both serial and TCP modes for connection to one master. Further, changing of the active setting group is supported.

When the IED uses the RS-485 bus for the serial communication, both two- and four wire connections are supported. Termination and pull-up/down resistors can be configured with jumpers on the communication card so external resistors are not needed.

The IED supports the following time synchronization methods with a time-stamping resolution of 1 ms:

Ethernet-based:

- SNTP (Simple Network Time Protocol)

With special time synchronization wiring:

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

In addition, the IED supports time synchronization via the following serial communication protocols:

- Modbus
- DNP3
- IEC 60870-5-103

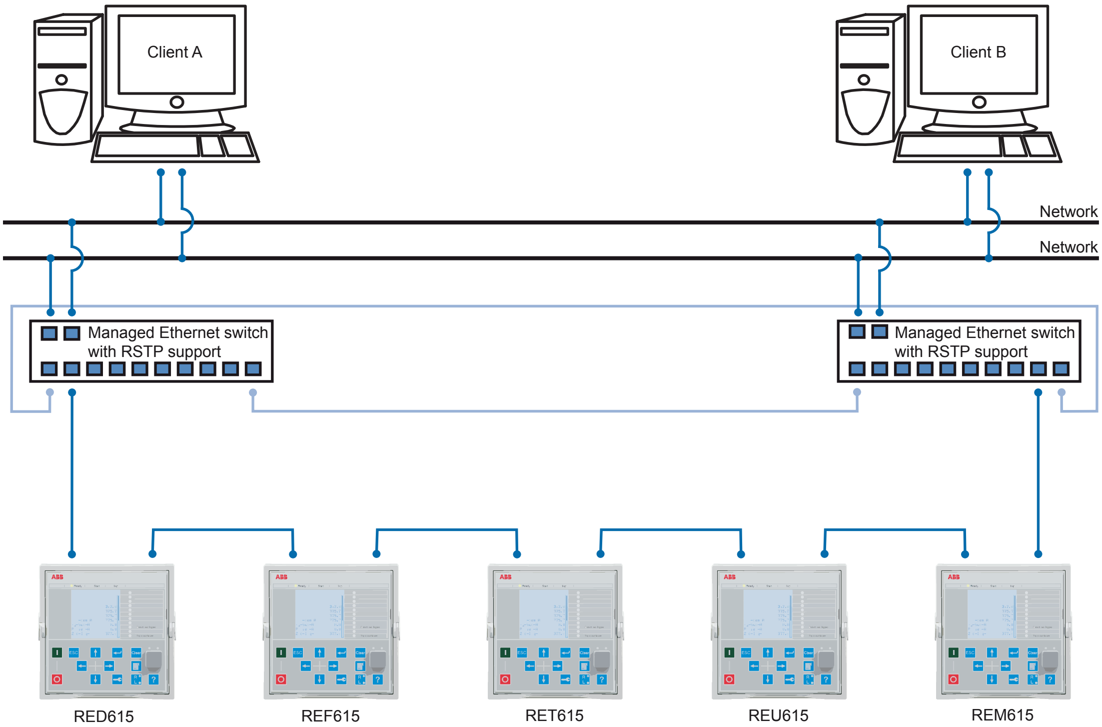

Figure 6. Self-healing Ethernet ring solution

Table 5. Supported station communication interfaces and protocols

Interfaces/ Protocols	Ethernet		Serial	
	100BASE-TX RJ-45	100BASE-FX LC	RS-232/RS-485	Fibre-optic ST
IEC 61850	●	●	-	-
MODBUS RTU/ ASCII	-	-	●	●
MODBUS TCP/ IP	●	●	-	-
DNP3 (serial)	-	-	●	●
DNP3 TCP/IP	●	●	-	-
IEC 60870-5-103	-	-	●	●

● = Supported

19. Technical data

Table 6. Dimensions

Description	Value	
Width	frame	177 mm
	case	164 mm
Height	frame	177 mm (4U)
	case	160 mm
Depth		201 mm (153 + 48 mm)
Weight	complete IED	4.1 kg
	plug-in unit only	2.1 kg

Table 7. Power supply

Description	Type 1	Type 2
U_{aux}nominal	100, 110, 120, 220, 240 V AC, 50 and 60 Hz	24, 30, 48, 60 V DC
	48, 60, 110, 125, 220, 250 V DC	
U_{aux}variation	38...110% of U_n (38...264 V AC)	50...120% of U_n (12...72 V DC)
	80...120% of U_n (38.4...300 V DC)	
Start-up threshold		19.2 V DC (24 V DC * 80%)
Burden of auxiliary voltage supply under quiescent (P_q)/operating condition	DC < 12.0 W (nominal)/< 18.0 W (max) AC< 16.0 W (nominal)/< 21.0W (max)	DC < 12.0 W (nominal)/< 18.0 W (max)
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 IED	30 ms at $V_n$rated	
Fuse type	T4A/250 V	

Table 8. Energizing inputs

Description		Value	
Rated frequency		50/60 Hz	
Current inputs	Rated current, I_n	0.2/1 A[1]	1/5 A[2]
	Thermal withstand capability: • Continuously • For 1 s	 4 A 100 A	 20 A 500 A
	Dynamic current withstand: • Half-wave value	 250 A	 1250 A
	Input impedance	<100 mΩ	<20 mΩ
Voltage inputs	Rated voltage	60...210 V AC	
	Voltage withstand: • Continuous • For 10 s	 2 x U_n (240 V AC) 3 x U_n (360 V AC)	
	Burden at rated voltage	<0.05 VA	

1) Ordering option for residual current input
2) Residual current and/or phase current

Table 9. Binary inputs

Description	Value
Operating range	±20% of the rated voltage
Rated voltage	24...250 V DC
Current drain	1.6...1.9 mA
Power consumption	31.0...570.0 mW
Threshold voltage	18...176 V DC
Reaction time	3 ms

Table 10. RTD/mA measurement (XRGGIO130)

Description		Value	
RTD inputs	Supported RTD sensors	100 Ω platinum 250 Ω platinum 100 Ω nickel 120 Ω nickel 250 Ω nickel 10 Ω copper	TCR 0.00385 (DIN 43760) TCR 0.00385 TCR 0.00618 (DIN 43760) TCR 0.00618 TCR 0.00618 TCR 0.00427
	Supported resistance range	0...2 kΩ	
	Maximum lead resistance (three-wire measurement)	25 Ω per lead	
	Isolation	2 kV (inputs to protective earth)	
	Response time	<4 s	
	RTD/resistance sensing current	Maximum 0.33 mA rms	
	Operation accuracy	Resistance	Temperature
		± 2.0% or ±1 Ω	±1°C 10 Ω copper: ±2°C
mA inputs	Supported current range	0…20 mA	
	Current input impedance	44 Ω ± 0.1%	
	Operation accuracy	Resistance	
		±0.5% or ±0.01 mA	

Table 11. Signal outputs and IRF output

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 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

Table 12. Double-pole power output relays with 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 48/110/220 V DC (two contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC
Trip-circuit supervision (TCS):	
• Control voltage range	20...250 V AC/DC
• Current drain through the supervision circuit	~1.5 mA
• Minimum voltage over the TCS contact	20 V AC/DC (15...20 V)

Table 13. Single-pole power output relays

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 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 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

Table 14. Front port Ethernet interfaces

Ethernet interface	Protocol	Cable	Data transfer rate
Front	TCP/IP protocol	Standard Ethernet CAT 5 cable with RJ-45 connector	10 MBits/s

Table 15. Station communication link, fibre-optic

Connector	Fibre type1)	Wave length	Max. distance	Permitted path attenuation2)
LC	MM 62.5/125 μm glass fibre core	1300 nm	2 km	<8 dB
LC	SM 9/125 μm	1300 nm	2-20 km	<8 dB
ST	MM 62.5/125 μm glass fibre core	820-900 nm	1 km	<11 dB

1) (MM) multi-mode fibre, (SM) single-mode fibre
2) Maximum allowed attenuation caused by connectors and cable together

Table 16. IRIG-B

Description	Value
IRIG time code format	B004, B005[1)]
Isolation	500V 1 min.
Modulation	Unmodulated
Logic level	TTL Level
Current consumption	2...4 mA
Power consumption	10...20 mW

1) According to 200-04 IRIG -standard

Table 17. Lens sensor and optical fibre for arc protection

Description	Value
Fibre-optic cable including lens	1.5 m, 3.0 m or 5.0 m
Normal service temperature range of the lens	-40...+100°C
Maximum service temperature range of the lens, max 1 h	+140°C
Minimum permissible bending radius of the connection fibre	100 mm

Table 18. Degree of protection of flush-mounted IED

Description	Value
Front side	IP 54
Rear side, connection terminals	IP 20

Table 19. Environmental conditions

Description	Value
Operating temperature range	-25...+55°C (continuous)
Short-time service temperature range	-40...+85°C (<16h)[1)2)]
Relative humidity	<93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	Up to 2000 m
Transport and storage temperature range	-40...+85°C

1) Degradation in MTBF and HMI performance outside the temperature range of -25...+55 °C
2) For IEDs with an LC communication interface the maximum operating temperature is +70 °C

Table 20. Environmental tests

Description	Type test value	Reference
Dry heat test (humidity <50%)	• 96 h at +55°C • 16 h at +85°C[1)]	IEC 60068-2-2
Dry cold test	• 96 h at -25°C • 16 h at -40°C	IEC 60068-2-1
Damp heat test, cyclic	• 6 cycles (12 h + 12 h) at +25°C…+55°C, humidity >93%	IEC 60068-2-30
Storage test	• 96 h at -40°C • 96 h at +85°C	IEC 60068-2-48

1) For IEDs with an LC communication interface the maximum operating temperature is +70°C

Table 21. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz/100 kHz burst disturbance test: • Common mode • Differential mode	 2.5 kV 2.5 kV	IEC 61000-4-18 IEC 60255-22-1, class III IEEE C37.90.1-2002
Electrostatic discharge test: • Contact discharge • Air discharge	 8 kV 15 kV	IEC 61000-4-2 IEC 60255-22-2 IEEE C37.90.3-2001
Radio frequency interference tests:	10 V (rms) f=150 kHz-80 MHz 10 V/m (rms) f=80-2700 MHz 10 V/m f=900 MHz 20 V/m (rms) f=80-1000 MHz	IEC 61000-4-6 IEC 60255-22-6, class III IEC 61000-4-3 IEC 60255-22-3, class III ENV 50204 IEC 60255-22-3, class III IEEE C37.90.2-2004
Fast transient disturbance tests: • All ports	 4 kV	IEC 61000-4-4 IEC 60255-22-4 IEEE C37.90.1-2002
Surge immunity test: • Communication • Other ports	 1 kV, line-to-earth 4 kV, line-to-earth 2 kV, line-to-line	IEC 61000-4-5 IEC 60255-22-5
Power frequency (50 Hz) magnetic field: • Continuous • 1-3 s	 300 A/m 1000 A/m	IEC 61000-4-8

Table 21. 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
Power frequency immunity test: • Common mode • Differential mode	Binary inputs only 300 V rms 150 V rms	IEC 61000-4-16 IEC 60255-22-7, class A
Emission tests: • Conducted 0.15-0.50 MHz 0.5-30 MHz • Radiated 30-230 MHz 230-1000 MHz	 < 79 dB(µV) quasi peak < 66 dB(µV) average < 73 dB(µV) quasi peak < 60 dB(µV) average < 40 dB(µV/m) quasi peak, measured at 10 m distance < 47 dB(µV/m) quasi peak, measured at 10 m distance	EN 55011, class A IEC 60255-25

Table 22. Insulation tests

Description	Type test value	Reference
Dielectric tests • Test voltage	2 kV, 50 Hz, 1 min 500 V, 50 Hz, 1 min, communication	IEC 60255-5 and IEC 60255-27
Impulse voltage test • Test voltage	5 kV, 1.2/50 μs, 0.5 J 1 kV, 1.2/50 μs, 0.5 J, communication	IEC 60255-5 and IEC 60255-27
Insulation resistance measurements • Isolation resistance	>100 MΩ, 500 V DC	IEC 60255-5 and IEC 60255-27
Protective bonding resistance • Resistance	<0.1 Ω, 4 A, 60 s	IEC 60255-27

Table 23. Mechanical tests

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

Table 24. Product safety

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

Table 25. EMC compliance

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

Table 26. RoHS compliance

Description
Complies with RoHS directive 2002/95/EC

Protection functions

Table 27. Three-phase non-directional overcurrent protection (PHxPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
	PHLPTOC	±1.5% of the set value or ±0.002 x I_n		
	PHHPTOC[1) and PHIPTOC	±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of the set value (at currents in the range of 10…40 x I_n)		
Start time [2)3)		Minimum	Typical	Maximum
	PHIPTOC: I_{Fault} = 2 x set *Start value* I_{Fault} = 10 x set *Start value*	16 ms 11 ms	19 ms 12 ms	23 ms 14 ms
	PHHPTOC[1) and PHLPTOC: I_{Fault} = 2 x set *Start value*	22 ms	24 ms	25 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 30 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Operate time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms [4)		
Suppression of harmonics		RMS: No suppression DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … Peak-to-Peak: No suppression P-to-P+backup: No suppression		

1) Not included in REM615
2) Set *Operate delay time* = 0,02 s, *Operate curve type* = IEC definite time, *Measurement mode* = default (depends on stage), current before fault = 0.0 x In, fn = 50 Hz, fault current in one phase with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
3) Includes the delay of the signal output contact
4) Includes the delay of the heavy-duty output contact

Table 28. Three-phase non-directional overcurrent protection (PHxPTOC) main settings

Parameter	Function	Value (Range)	Step
Start Value	PHLPTOC	0.05...5.00 x I_n	0.01
	PHHPTOC[1)]	0.10...40.00 x I_n	0.01
	PHIPTOC	1.00...40.00 x I_n	0.01
Time multiplier	PHLPTOC	0.05...15.00	0.05
	PHHPTOC[1)]	0.05...15.00	0.05
Operate delay time	PHLPTOC	40...200000 ms	10
	PHHPTOC[1)]	40...200000 ms	10
	PHIPTOC	20...200000 ms	10
Operating curve type[2)]	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[1)]	Definite or inverse time Curve type: 1, 3, 5, 9, 10, 12, 15, 17	
	PHIPTOC	Definite time	

1) Not included in REM615
2) For further reference please refer to the Operating characteristics table

Table 29. Directional earth-fault protection (DEFxPDEF)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
	DEFLPDEF	Current: ±1.5% of the set value or ±0.002 x I_n Voltage ±1.5% of the set value or ±0.002 x U_n Phase angle: ±2°		
	DEFHPDEF[1)]	Current: ±1.5% of the set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of the set value (at currents in the range of 10…40 x I_n) Voltage: ±1.5% of the set value or ±0.002 x U_n Phase angle: ±2°		
Start time [2)3)]		Minimum	Typical	Maximum
	DEFHPDEF[1)] I_{Fault} = 2 x set *Start value*	42 ms	44 ms	46 ms
	DEFLPDEF I_{Fault} = 2 x set *Start value*	61ms	64 ms	66 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 30 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Operate time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms [4)]		
Suppression of harmonics		RMS: No suppression DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … Peak-to-Peak: No suppression		

1) Not included in REM615
2) Set *Operate delay time* = 0.06 s,*Operate curve type* = IEC definite time, *Measurement mode* = default (depends on stage), current before fault = 0.0 x 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
3) Includes the delay of the signal output contact
4) Maximum *Start value* = 2.5 x I_n, *Start value* multiples in range of 1.5 to 20

Table 30. Directional earth-fault protection (DEFxPDEF) main settings

Parameter	Function	Value (Range)	Step
Start Value	DEFLPDEF	0.010...5.000 x I_n	0.005
	DEFHPDEF[1)]	0.10...40.00 x I_n	0.01
Directional mode	DEFLPDEF and DEFHPDEF	1=Non-directional 2=Forward 3=Reverse	
Time multiplier	DEFLPDEF	0.05...15.00	0.05
	DEFHPDEF[1)]	0.05...15.00	0.05
Operate delay time	DEFLPDEF	60...200000 ms	10
	DEFHPDEF[1)]	40...200000 ms	10
Operating curve type[2)]	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[1)]	Definite or inverse time Curve type: 1, 3, 5, 15, 17	
Operation mode	DEFLPDEF and DEFHPDEF[1)]	1=Phase angle 2=IoSin 3=IoCos 4=Phase angle 80 5=Phase angle 88	

1) Not included in REM615
2) For further reference, refer to the Operating characteristics table

Table 31. Non-directional earth-fault protection (EFxPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
	EFLPTOC	±1.5% of the set value or ±0.002 x I_n		
	EFHPTOC and EFIPTOC[1]	±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of the set value (at currents in the range of 10…40 x I_n)		
Start time [2)3)]		Minimum	Typical	Maximum
	EFIPTOC[1]: I_{Fault} = 2 x set *Start value* I_{Fault} = 10 x set *Start value*	16 ms 11 ms	19 ms 12 ms	23 ms 14 ms
	EFHPTOC and EFLPTOC: I_{Fault} = 2 x set *Start value*	22 ms	24 ms	25 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 30 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Operate time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms [4]		
Suppression of harmonics		RMS: No suppression DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … Peak-to-Peak: No suppression		

1) Not included in REM615
2) *Measurement mode* = default (depends on stage), current before fault = 0.0 x 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
3) Includes the delay of the signal output contact
4) Maximum *Start value* = 2.5 x I_n, *Start value* multiples in range of 1.5 to 20

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

Parameter	Function	Value (Range)	Step
Start value	EFLPTOC	0.010...5.000 x I_n	0.005
	EFHPTOC	0.10...40.00 x I_n	0.01
	EFIPTOC [1]	1.00...40.00 x I_n	0.01
Time multiplier	EFLPTOC	0.05...15.00	0.05
	EFHPTOC	0.05...15.00	0.05
Operate delay time	EFLPTOC	40...200000 ms	10
	EFHPTOC	40...200000 ms	10
	EFIPTOC[1]	20...200000 ms	10
Operating curve type[2]	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[1]	Definite time	

1) Not included in REM615
2) For further reference please refer to the Operating characteristics table

Table 33. Three phase undervoltage protection (PHPTUV)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the voltage measured: fn ±2 Hz		
		±1.5% of the set value or ±0.002 x U_n		
Start time[1)2)]		Minimum	Typical	Maximum
	U_{Fault} = 0.9 x set *Start value*	62 ms	64 ms	66 ms
Reset time		< 40 ms		
Reset ratio		Depends on the set *Relative hysteresis*		
Retardation time		< 35 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Operate time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms[3)]		
Suppression of harmonics		DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) *Start value* = 1.0 x U_n, Voltage before fault = 1.1 x U_n, f_n = 50 Hz, undervoltage in one phase-to-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) Minimum *Start value* = 0.50, *Start value* multiples in range of 0.90 to 0.20

Table 34. Three-phase undervoltage protection (PHPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PHPTUV	0.05...1.20 x U_n	0.01
Time multiplier	PHPTUV	0.05...15.00	0.05
Operate delay time	PHPTUV	60...300000 ms	10
Operating curve type[1)]	PHPTUV	Definite or inverse time Curve type: 5, 15, 21, 22, 23	

1) For further reference please refer to the Operating characteristics table

Table 35. Positive sequence undervoltage protection (PSPTUV)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the voltage measured: f_n ±2 Hz		
		±1.5% of the set value or ±0.002 x U_n		
Start time[1)2)]		Minimum	Typical	Maximum
	U_{Fault} = 0.99 x set *Start value*	51 ms	53 ms	54 ms
	U_{Fault} = 0.9 x set *Start value*	43 ms	45 ms	46 ms
Reset time		< 40 ms		
Reset ratio		Depends of the set *Relative hysteresis*		
Retardation time		< 35 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Suppression of harmonics		DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) *Start value* = 1.0 x U_n, Positive sequence voltage before fault = 1.1 x U_n, f_n = 50 Hz, positive sequence undervoltage 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 36. Positive sequence undervoltage protection (PSPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PSPTUV	0.010...1.200 x U_n	0.001
Operate delay time	PSPTUV	40...120000 ms	10
Voltage block value	PSPTUV	0.01...1.0 x U_n	0.01

Table 37. Frequency protection (FRPFRQ)

Characteristic		Value
Operation accuracy	f>/f<	±10 mHz
	df/dt	±100 mHz/s (in range |df/dt| < 5 Hz/s) ± 2.0% of the set value (in range 5 Hz/s < |df/dt| < 15 Hz/s)
Start time	f>/f<	< 80 ms
	df/dt	< 120 ms
Reset time		< 150 ms
Operate time accuracy		±1.0% of the set value or ±30 ms

Table 38. Frequency protection (FRPFRQ) main settings

Parameter	Values (Range)	Unit	Step	Default	Description
Operation mode	1=Freq< 2=Freq> 3=df/dt 4=Freq< + df/dt 5=Freq> + df/dt 6=Freq< OR df/dt 7=Freq> OR df/dt			1=Freq<	Frequency protection operation mode selection
Start value Freq>	0.900...1.200	xFn	0.001	1.050	Frequency start value overfrequency
Start value Freq<	0.800...1.100	xFn	0.001	0.950	Frequency start value underfrequency
Start value df/dt	-0.200...0.200	xFn /s	0.005	0.010	Frequency start value rate of change
Operate Tm Freq	80...200000	ms	10	200	Operate delay time for frequency
Operate Tm df/dt	120...200000	ms	10	400	Operate delay time for frequency rate of change

Table 39. Negative sequence overvoltage protection (NSPTOV)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the voltage measured: f_n ±2 Hz		
		±1.5% of the set value or ±0.002 × U_n		
Start time[1)2)]		Minimum	Typical	Maximum
	U_{Fault} = 1.1 × set *Start value*	33 ms	35 ms	37 ms
	U_{Fault} = 2.0 × set *Start value*	24 ms	26 ms	28 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 35 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Suppression of harmonics		DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5, …		

1) Negative-sequence voltage before fault = 0.0 × U_n, f_n = 50 Hz, negative-sequence overvoltage 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 40. Negative sequence overvoltage protection (NSPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	NSPTOV	0.010...1.000 x U_n	0.001
Operate delay time	NSPTOV	40...120000 ms	1

Table 41. Negative phase-sequence overcurrent protection for motors (MNSPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: fn ±2 Hz		
		±1.5% of the set value or ±0.002 x I_n		
Start time[1)2)]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 x set *Start value*	22 ms	24 ms	25 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 35 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Operate time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms[3)]		
Suppression of harmonics		DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) Negative-sequence current before = 0.0, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact
3) *Start value* multiples in range of 1.10 to 5.00

Table 42. Negative phase-sequence overcurrent protection for motors (MNSPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	MNSPTOC	0.01...0.50 x I_n	0.01
Operating curve type	MNSPTOC	ANSI Def. Time IEC Def. Time Inv. Curve A Inv. Curve B	-
Operate delay time	MNSPTOC	100...120000 ms	10
Cooling time	MNSPTOC	5...7200 s	1
Operation	MNSPTOC	Off On	-

Table 43. Loss of load supervision (LOFLPTUC)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2 Hz
	±1.5% of the set value or ±0.002 x I_n
Start time	Typical 300 ms
Reset time	< 40 ms
Reset ratio	Typical 0.96
Retardation time	< 35 ms
Operate time accuracy in definite time mode	±1.0% of the set value or ±20 ms

Table 44. Loss of load supervision (LOFLPTUC) main settings

Parameter	Function	Value (Range)	Step
Start value high	LOFLPTUC	0.01...1.00 x I_n	0.01
Start value low	LOFLPTUC	0.01...0.50 x I_n	0.01
Operate delay time	LOFLPTUC	400...600000 ms	10
Operation	LOFLPTUC	Off On	-

Table 45. Motor load jam protection (JAMPTOC)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2 Hz
	±1.5% of the set value or ±0.002 x I_n
Reset time	< 40 ms
Reset ratio	Typical 0.96
Retardation time	< 35 ms
Operate time accuracy in definite time mode	±1.0% of the set value or ±20 ms

Table 46. Motor load jam protection (JAMPTOC) main settings

Parameter	Function	Value (Range)	Step
Operation	JAMPTOC	Off On	-
Start value	JAMPTOC	0.10...10.00 x I_n	0.01
Operate delay time	JAMPTOC	100...120000 ms	10

Table 47. Motor start-up supervision (STTPMSU)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
		±1.5% of the set value or ±0.002 x I_n		
Start time[1)2)]		Minimum	Typical	Maximum
	I_{Fault} = 1.1 x set *Start detection A*	27 ms	30 ms	34 ms
Operate time accuracy		±1.0% of the set value or ±20 ms		
Reset ratio		Typical 0.90		

1) Current before = 0.0 x I_n, f_n = 50 Hz, overcurrent in one phase, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact

Table 48. Motor start-up supervision (STTPMSU) main settings

Parameter	Function	Value (Range)	Step
Motor start-up A	STTPMSU	1.0...10.0 x I_n	0.1
Motor start-up time	STTPMSU	1...80.0 s	1
Lock rotor time	STTPMSU	2...120 s	1
Operation	STTPMSU	Off On	-
Operation mode	STTPMSU	IIt IIt, CB IIt & stall IIt & stall, CB	-
Restart inhibit time	STTPMSU	0...250 min	1

Table 49. Phase reversal protection (PREVPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
		±1.5% of the set value or ±0.002 x I_n		
Start time[1)2)]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 x set *Start value*	22 ms	24 ms	25 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 35 ms		
Operate time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Suppression of harmonics		DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) Negative-sequence current before = 0.0, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact

Table 50. Phase reversal protection (PREVPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	PREVPTOC	0.05...1.00 x I_n	0.01
Operate delay time	PREVPTOC	100...60000 ms	10
Operation	PREVPTOC	Off On	-

Table 51. Three-phase thermal overload protection for motors (MPTTR)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2 Hz
	Current measurement: ±1.5% of the set value or ±0.002 x I_n (at currents in the range of 0.01...4.00 x I_n)
Operate time accuracy[1)]	±2.0% of the theoretical value or ±0.50 s

1) Overload current > 1.2 x Operate level temperature

Table 52. 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...70.0 °C	0.1
Alarm thermal value	MPTTR	50.0...100.0 %	0.1
Restart thermal value	MPTTR	20.0...80.0 %	0.1
Overload factor	MPTTR	1.00...1.20	0.01
Weighting factor p	MPTTR	20.0...100.0	0.1
Time constant normal	MPTTR	80...4000 s	1
Time constant start	MPTTR	80...4000 s	1
Operation	MPTTR	Off On	-

Table 53. Circuit breaker failure protection (CCBRBRF)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2 Hz
	±1.5% of the set value or ±0.002 x I_n
Operate time accuracy	±1.0% of the set value or ±20 ms

Table 54. Circuit breaker failure protection (CCBRBRF) main settings

Parameter	Function	Value (Range)	Step
Current value (Operating phase current)	CCBRBRF	0.05...1.00 x I_n	0.05
Current value Res (Operating residual current)	CCBRBRF	0.05...1.00 x I_n	0.05
CB failure mode (Operating mode of function)	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...60000 ms	10
CB failure delay	CCBRBRF	0...60000 ms	10
CB fault delay	CCBRBRF	0...60000 ms	10

Table 55. Arc protection (ARCSARC)

Characteristic		Value		
Operation accuracy		±3% of the set value or ±0.01 x I_n		
Operate time		Minimum	Typical	Maximum
	Operation mode = "Light+current"[1)2)]	9 ms	12 ms	15 ms
	Operation mode = "Light only"[2)]	9 ms	10 ms	12 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		

1) *Phase start value* = 1.0 x I_n, current before fault = 2.0 x set *Phase start value*, f_n = 50 Hz, fault with nominal frequency, results based on statistical distribution of 200 measurements
2) Includes the delay of the heavy-duty output contact

Table 56. Arc protection (ARCSARC) main settings

Parameter	Function	Value (Range)	Step
Phase start value (Operating phase current)	ARCSARC	0.50...40.00 x I_n	0.01
Ground start value (Operating residual current)	ARCSARC	0.05...8.00 x I_n	0.01
Operation mode	ARCSARC	1=Light+current 2=Light only 3=BI controlled	

Table 57. Multipurpose protection (MAPGAPC)

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

Table 58. Multipurpose analog protection (MAPGAPC) main settings

Parameter	Function	Value (Range)	Step
Start value	MAPGAPC	-10000.0...10000.0	0.1
Operate delay time	MAPGAPC	0...200000 ms	100
Operation mode	MAPGAPC	Over Under	-

Control functions

Table 59. Emergency startup (ESMGAPC) main settings

Parameter	Function	Value (Range)	Step
Operation	ESMGAPC	Off On	-
Motor stand still A	ESMGAPC	0.05...0.20 x I_n	0.01

Measurement functions

Table 60. Three-phase current measurement (CMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2 Hz
	±0.5% or ±0.002 x I_n (at currents in the range of 0.01...4.00 x I_n)
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … RMS: No suppression

Table 61. Residual current measurement (RESCMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f/f_n = ±2 Hz
	±0.5% or ±0.002 x I_n at currents in the range of 0.01...4.00 x I_n
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … RMS: No suppression

Table 62. Three-phase voltage measurement (VMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz At voltages in range 0.01…1.15 x U_n
	±0.5% or ±0.002 x U_n
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … RMS: No suppression

Table 63. Residual voltage measurement (RESVMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f/f_n = ±2 Hz
	±0.5% or ±0.002 x U_n
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, … RMS: No suppression

Table 64. Voltage sequence components (VSMSQI)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz At voltages in range 0.01…1.15 x U_n
	±1.0% or ±0.002 x U_n
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …

Table 65. Three-phase power and energy (PEMMXU)

Characteristic	Value
Operation accuracy	At all three currents in range 0.10…1.20 x I_n At all three voltages in range 0.50…1.15 x U_n At the frequency f_n ±1 Hz Active power and energy in range $\|PF\| > 0.71$ Reactive power and energy in range $\|PF\| < 0.71$
	±1.5% for power (S, P and Q) ±0.015 for power factor ±1.5% for energy
Suppression of harmonics	DFT: -50 dB at f = n x f_n, where n = 2, 3, 4, 5, …

Table 66. RTD/mA measurement (XRGGIO130)

Description		Value	
RTD inputs	Supported RTD sensors	100 Ω platinum 250 Ω platinum 100 Ω nickel 120 Ω nickel 250 Ω nickel 10 Ω copper	TCR 0.00385 (DIN 43760) TCR 0.00385 TCR 0.00618 (DIN 43760) TCR 0.00618 TCR 0.00618 TCR 0.00427
	Supported resistance range	0...2 kΩ	
	Maximum lead resistance (three-wire measurement)	25 Ω per lead	
	Isolation	2 kV (inputs to protective earth)	
	Response time	<4 s	
	RTD/resistance sensing current	Maximum 0.33 mA rms	
	Operation accuracy	Resistance	Temperature
		± 2.0% or ±1 Ω	±1°C 10 Ω copper: ±2°C
mA inputs	Supported current range	0…20 mA	
	Current input impedance	44 Ω ± 0.1%	
	Operation accuracy	Resistance	
		±0.5% or ±0.01 mA	

Table 67. Frequency measurement (FMMXU)

Characteristic	Value
Operation accuracy	±10 mHz (in measurement range 35 - 75 Hz)

Supervision functions

Table 68. Current circuit supervision (CCRDIF)

Characteristic	Value
Operate time[1]	< 30 ms

1) Including the delay of the output contact.

Table 69. Current circuit supervision (CCRDIF) main settings

Parameter	Values (Range)	Unit	Description
Start value	0.05...0.20	x I_n	Minimum operate current differential level
Maximum operate current	1.00...5.00	x I_n	Block of the function at high phase current

Table 70. Fuse failure supervision (SEQRFUF)

Characteristic	Value	
Operate time[1]		
• NPS function	U_{Fault} = 1.1 x set *Neg Seq voltage Lev*	< 33 ms
	U_{Fault} = 5.0 x set *Neg Seq voltage Lev*	< 18 ms
• Delta function	ΔU = 1.1 x set *Voltage change rate*	< 30 ms
	ΔU = 2.0 x set *Voltage change rate*	< 24 ms

1) Includes the delay of the signal output contact, f_n = 50 Hz, fault voltage with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

Table 71. Motor run time counter (MDSOPT)

Description	Value
Motor run-time measurement accuracy[1]	±0.5%

1) Of the reading, for a stand-alone IED, without time synchronization.

20. Local HMI

The IED is available with two optional displays, a large one and a small one. The large display is suited for IED installations where the front panel user interface is frequently used and a single line diagram is required. The small display is suited for remotely controlled substations where the IED is only occasionally accessed locally via the front panel user interface.

Both LCD displays offer front-panel user interface functionality with menu navigation and menu views. However, the large display offers increased front-panel usability with less menu scrolling and improved information overview. In addition, the large display includes a user-configurable single line diagram (SLD) with position indication for the associated primary equipment. Depending on the chosen standard configuration, the IED displays the related measuring values, apart from the default single line diagram. The SLD view can also be accessed using the web-browser based user interface. The default SLD can be modified according to user requirements by using the graphical display editor in PCM600.

The local HMI includes a push button (L/R) for local/remote operation of the IED. When the IED is in the local mode, the IED can be operated only by using the local front panel user interface. When the IED is in the remote mode, the IED can execute commands sent from a remote location. The IED supports the remote selection of local/remote mode via a binary input. This feature facilitates, for example, the use of an external switch at the substation to ensure that all IEDs are in the local mode during maintenance work and that the circuit breakers cannot be operated remotely from the network control centre.

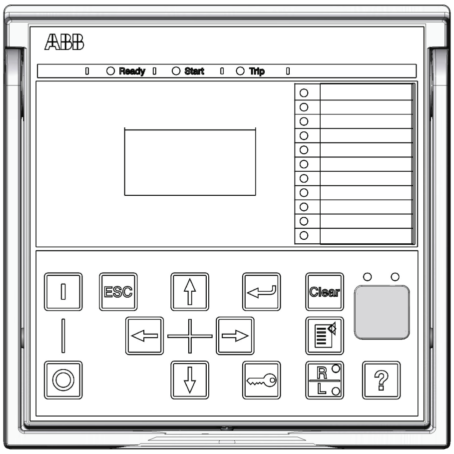

Figure 7. Small display

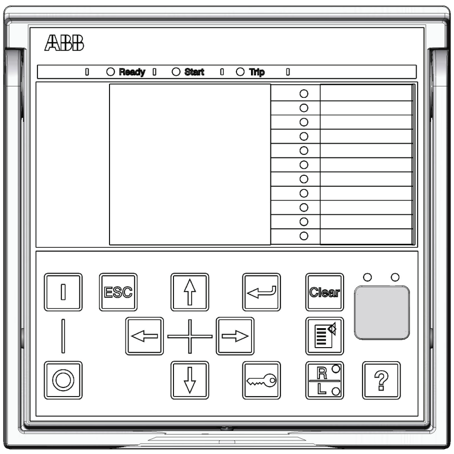

Figure 8. Large display

Table 72. Small display

Character size[1]	Rows in the view	Characters per row
Small, mono-spaced (6x12 pixels)	5	20
Large, variable width (13x14 pixels)	4	8 or more

1) Depending on the selected language

Table 73. Large display

Character size[1]	Rows in the view	Characters per row
Small, mono-spaced (6x12 pixels)	10	20
Large, variable width (13x14 pixels)	8	8 or more

1) Depending on the selected language

21. Mounting methods

By means of appropriate mounting accessories the standard IED case for the 615 series IED can be flush mounted, semi-flush mounted or wall mounted. The flush mounted and wall mounted IED cases can also be mounted in a tilted position (25°) using special accessories.

Further, the IEDs can be mounted in any standard 19” instrument cabinet by means of 19” mounting panels available with cut-outs for one or two IEDs. Alternatively, the IED can be mounted in 19” instrument cabinets by means of 4U Combiflex equipment frames.

For the routine testing purposes, the IED cases can be equipped with test switches, type RTXP 18, which can be mounted side by side with the IED cases.

Mounting methods:

- Flush mounting
- Semi-flush mounting
- Semi-flush mounting in a 25° tilt
- Rack mounting
- Wall mounting
- Mounting to a 19" equipment frame
- Mounting with a RTXP 18 test switch to a 19" rack

Panel cut-out for flush mounting:

- Height: 161.5±1 mm
- Width: 165.5±1 mm

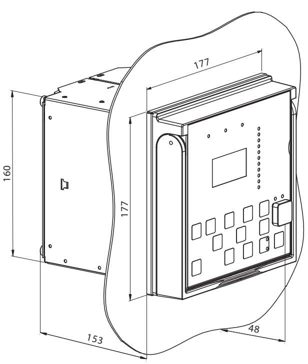

Figure 9. Flush mounting

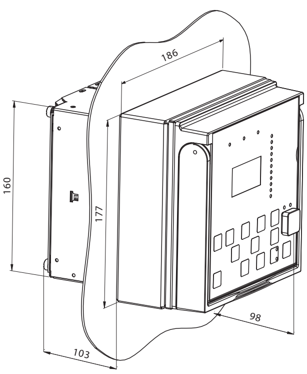

Figure 10. Semi-flush mounting

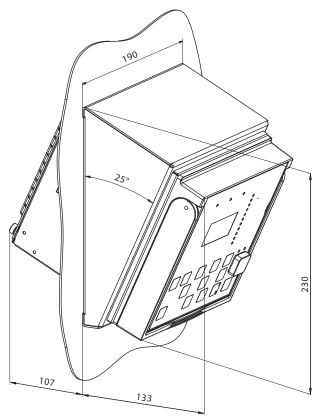

Figure 11. Semi-flush with a 25° tilt

22. IED case and IED plug-in unit

For safety reasons, the IED cases for current measuring IEDs are provided with automatically operating contacts for short-circuiting the CT secondary circuits when a IED unit is withdrawn from its case. The IED case is further provided with a mechanical coding system preventing current measuring IED units from being inserted into a IED case for a voltage measuring IED unit and vice versa, i.e. the IED cases are assigned to a certain type of IED plug-in unit.

23. Selection and ordering data

The IED type and serial number label identifies the protection IED. The label is placed above the HMI on the upper part of the plug-in-unit. An order number label is placed on the side of the plug-in unit as well as inside the case. The order number consists of a string of codes generated from the IED's hardware and software modules.

Use the ordering key information to generate the order number when ordering complete IEDs.

H B M B C C A H B C C 1 B B N 1 X D

#	DESCRIPTION	
1	**IED**	
	615 series IED (including case)	H
	615 series IED (including case) with test switch, wired and installed in a 19” equipment panel	K
	615 series IED (including case) with test switch, wired and installed in a mounting bracket for CombiFlex rack mounting (RGHT 19” 4U variant C)	L
2	**Standard**	
	IEC	B
3	**Main application**	
	Motor protection and control	M

The standard configuration determines the I/O hardware and available options.
The example below shows standard configuration "B" with chosen options.

H B M **B C C A H** B C C 1 B B N 1 X D

#	DESCRIPTION	
4-8	**Standard configurations, analog and binary I/O options**	
	Standard configuration descriptions in short: **A** = Motor protection, optional RTD/mA inputs **B** = Motor protection with current, voltage and frequency based protection and measurement functions, optional RTD/mA inputs **C** = Motor protection with current and voltage based protection and measurement functions	
	Std conf **A:** 4I (Io 1/5 A) + 4 BI + 6 BO	**AACAB**
	Std conf **A:** 4I (Io 1/5 A) + 12 BI + 10 BO	**AACAD**
	Std conf **A:** 4I (Io 0.2/1 A) + 4 BI + 6 BO	**AADAB**
	Std conf **A:** 4I (Io 0.2/1 A) + 12 BI + 10 BO	**AADAD**
	Std conf **A:** 4I (Io 1/5 A) + 6 RTD + 2 mA+ 4 BI + 6 BO	**AAGAB**
	Std conf **A:** 4I (Io 0.2/1 A) + 6 RTD + 2 mA+ 4 BI + 6 BO	**AAHAB**
	Std conf **A:** 4I(Io 1/5 A) + 6 RTD + 2mA+ 12 BI + 10 BO	**AAGAD**
	Std conf **A:** 4I(Io 0.2/1 A) + 6 RTD + 2mA+ 12 BI + 10 BO	**AAHAD**
	Std conf **B:** 4I (Io 1/5 A) + 3U + 8 BI + 10 BO	**BCAAH**
	Std conf **B:** 4I (Io 1/5 A) + 3U + 14 BI + 13 BO	**BCAAJ**
	Std conf **B:** 4I (Io 0.2/1 A) + 3U + 8 BI + 10 BO	**BCBAH**
	Std conf **B:** 4I (Io 0.2/1 A) + 3U + 14 BI + 13 BO	**BCBAJ**
	Std conf **B:** 4I (Io 1/5 A) + 3U + 6 RTD + 2 mA + 8 BI + 10 BO	**BCCAH**
	Std conf **B:** 4I (Io 0.2/1 A) + 3U + 6 RTD + 2 mA + 8 BI + 10 BO	**BCDAH**
	Std conf **C:** 4I (Io 1/5 A) + 5U + 16 BI + 10 BO	**CAEAG**
	Std conf **C:** 4I (Io 0.2/1 A) + 5U + 16 BI + 10 BO	**CAFAG**

**The communication module hardware determines the available communication protocols.
Choose the hardware from one of the rows below to define the digits # 9-10.**

H B M B C C A H **B C** C 1 B B N 1 X D

#	DESCRIPTION	
9 - 10	**Communication modules (Serial/Ethernet)**	
	Serial RS-485, incl. an input for IRIG-B + Ethernet 100Base-FX (1 x LC)	**AA**
	Serial RS-485, incl. an input for IRIG-B + Ethernet 100Base-TX (1 x RJ-45)	**AB**
	Serial RS-485, incl. an input for IRIG-B	**AN**
	Serial glass fibre (ST), incl. an RS-485 connector and an input for IRIG-B (cannot be combined with arc protection)	**BN**
	Serial glass fibre (ST) + Ethernet 100Base-TX (1 x RJ-45) + Serial RS-485 connector, RS-232/485 D-Sub 9 connector + input for IRIG-B (cannot be combined with arc protection)	**BB**
	Serial glass fibre (ST) + Ethernet 100Base-TX (3 x RJ-45)	**BD**
	Serial glass fibre (ST) + Ethernet 100Base-TX and -FX (2 x RJ-45 + 1 x LC)	**BC**
	Ethernet 100Base-FX (1 x LC)	**NA**
	Ethernet 100Base-TX (1 x RJ-45)	**NB**
	Ethernet 100Base-TX (2 x RJ-45 + 1 x LC)	**NC**
	Ethernet 100Base-TX (3 x RJ-45)	**ND**
	No communication module	**NN**

If serial communication is chosen, please choose a serial communication module including Ethernet (for example "BC") if a service bus for PCM600 or the WebHMI is required.

H B M B C C A H B C C 1 B B N 1 X D

#	DESCRIPTION	
11	**Communication protocols**	
	IEC 61850 (for Ethernet communication modules and IEDs without a communication module)	A
	Modbus (for Ethernet/serial **or** Ethernet + serial communication modules)	B
	IEC 61850 + Modbus (for Ethernet **or** serial + Ethernet communication modules)	C
	IEC 60870-5-103 (for serial **or** Ethernet + serial communication modules)	D
	DNP3 (for Ethernet/serial **or** Ethernet + serial communication modules)	E

H B M B C C A H B C C 1 B B N 1 X D

#	DESCRIPTION	
12	**Language**	
	English	1
	English and German	3
	English and Swedish	4
	English and Spanish	5
	English and Russian	6
	English and Portuguese (Brazilian)	8
13	**Front panel**	
	Small LCD	A
	Large LCD with single line diagram (SLD)	B
14	**Option 1**	
	Arc protection (requires a communication module, cannot be combined with communication modules BN or BB)	B
	None	N
15	**Option 2**	
	None	N
16	**Power supply**	
	48...250 V DC, 100...240 V AC	1
	24...60 V DC	2
17	**Vacant digit**	
	Vacant	X
18	**Version**	
	Version 3.0	D

Example code: H B M B C C A H B C C 1 B B N 1 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																		

Figure 12. Ordering key for complete IEDs

24. Accessories and ordering data

Table 74. Cables

Item	Order number
Cable for optical sensors for arc protection 1.5 m	1MRS120534-1.5
Cable for optical sensors for arc protection 3.0 m	1MRS120534-3.0
Cable for optical sensors for arc protection 5.0 m	1MRS120534-5.0

Table 75. Mounting accessories

Item	Order number
Semi-flush mounting kit	1MRS050696
Wall mounting kit	1MRS050697
Inclined semi-flush mounting kit	1MRS050831
19” rack mounting kit with cut-out for one IED	1MRS050694
19” rack mounting kit with cut-out for two IEDs	1MRS050695
Mounting bracket for one IED with test switch RTXP in 4U Combiflex (RHGT 19” variant C)	2RCA022642P0001
Mounting bracket for one IED in 4U Combiflex (RHGT 19” variant C)	2RCA022643P0001
19” rack mounting kit for one IED and one RTXP18 test switch (the test switch is not included in the delivery)	2RCA021952A0003
19” rack mounting kit for one IED and one RTXP24 test switch (the test switch is not included in the delivery)	2RCA022561A0003

25. Tools

The IED is delivered as a pre-configured unit. 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 IED-specific connectivity package.

The Protection and Control IED Manager PCM600 is available in three different variants, that is PCM600, PCM600 Engineering and PCM600 Engineering Pro. Depending on the chosen variant, PCM600 offers extensive IED configuration functions such as IED signal configuration, application configuration, graphical display configuration including single line diagram configuration, and IEC 61850 communication configuration including horizontal GOOSE communication.

When the web-browser based user interface is used, the IED 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 can be limited to read-only access by means of PCM600.

The IED connectivity package is a collection of software and specific IED information, which enable system products and tools to connect and interact with the IED. The connectivity packages reduce the risk of errors in system integration, minimizing device configuration and set-up times. Further, the Connectivity Packages for the 615 series IEDs include a flexible update tool for adding one additional local HMI language to the IED. The update tool is activated using PCM600 and enables multiple updates of the additional HMI language, thus offering flexible means for possible future language updates.

Table 76. Tools

Configuration and setting tools	Version
PCM600	2.3 or later
Web-browser based user interface	IE 7.0 or later
REM615 Connectivity Package	3.0.2 or later

Table 77. Supported functions

Function	WebHMI	PCM600	PCM600 Engineering	PCM600 Engineering Pro
IED parameter setting	●	●	●	●
Saving of IED parameter settings in the IED	●	●	●	●
Signal monitoring	●	●	●	●
Disturbance recorder handling	●	●	●	●
Alarm LED viewing	●	●	●	●
Access control management	●	●	●	●
IED signal configuration (signal matrix)	-	●	●	●
Modbus® communication configuration (communication management)	-	●	●	●
DNP3 communication configuration (communication management)	-	●	●	●
IEC 60870-5-103 communication configuration (communication management)	-	●	●	●
Saving of IED parameter settings in the tool	-	●	●	●
Disturbance record analysis	-	●	●	●
XRIO parameter export/import	-	●	●	●
Graphical display configuration	-	●	●	●

Table 77. Supported functions, continued

Function	WebHMI	PCM600	PCM600 Engineering	PCM600 Engineering Pro
Application configuration	-	-	●	●
IEC 61850 communication configuration, GOOSE (communication configuration)	-	-	-	●
Phasor diagram viewing	●	-	-	-
Event viewing	●	-	-	-
Saving of event data on the user's PC	●	-	-	-

● = Supported

26. Terminal diagrams

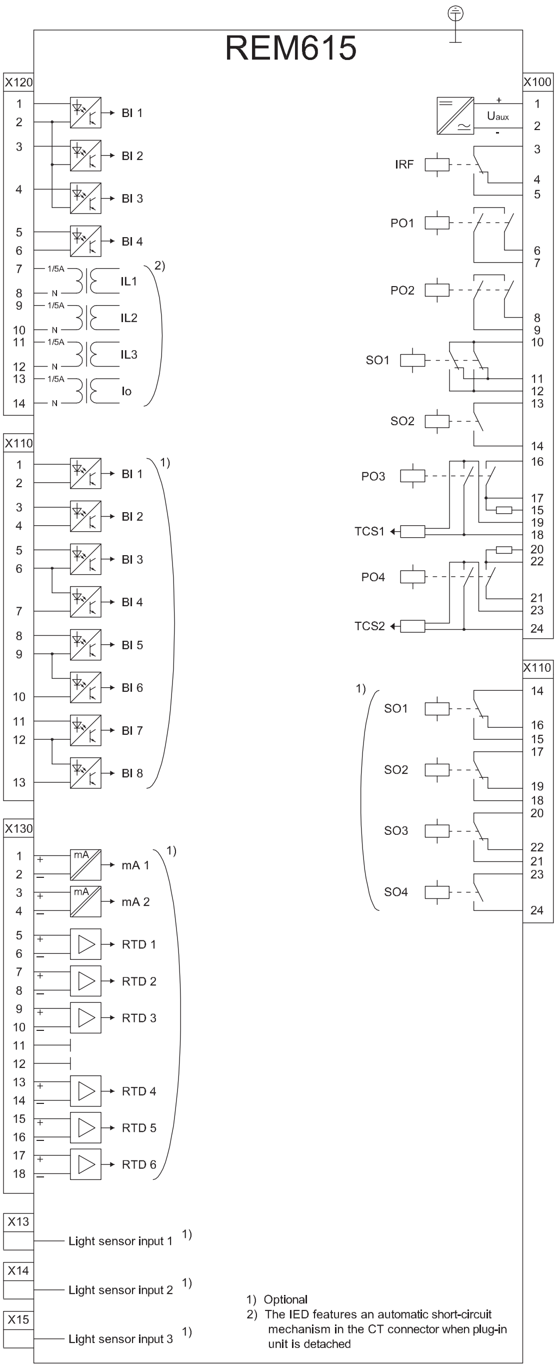

Figure 13. Terminal diagram of standard configuration A

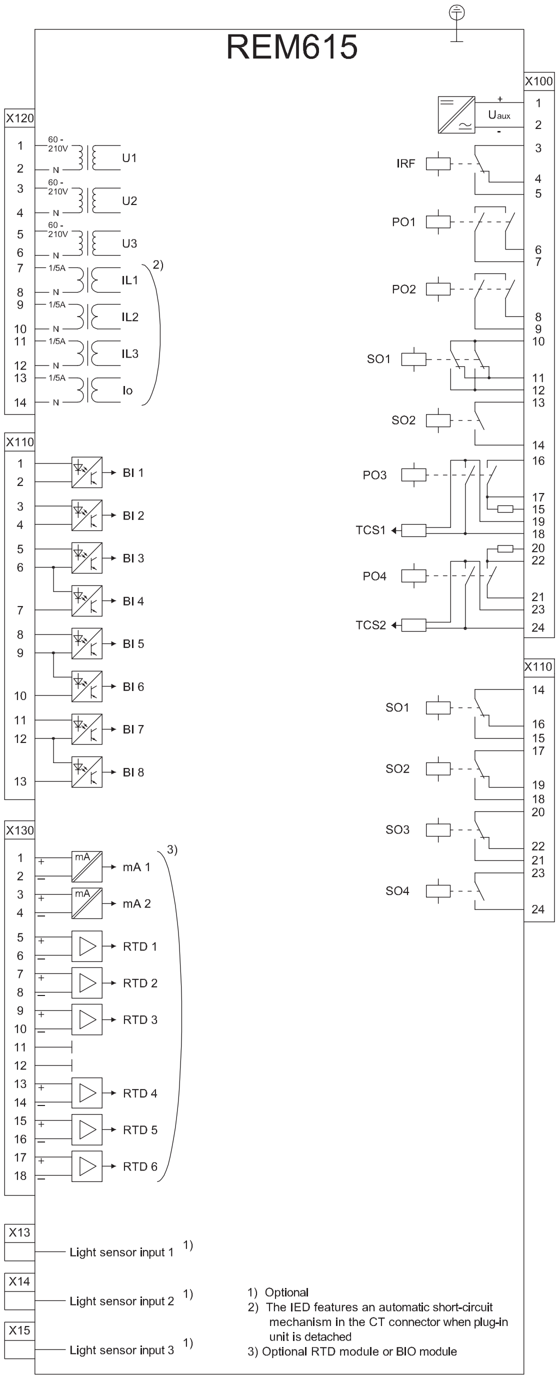

Figure 14. Terminal diagram of standard configuration B

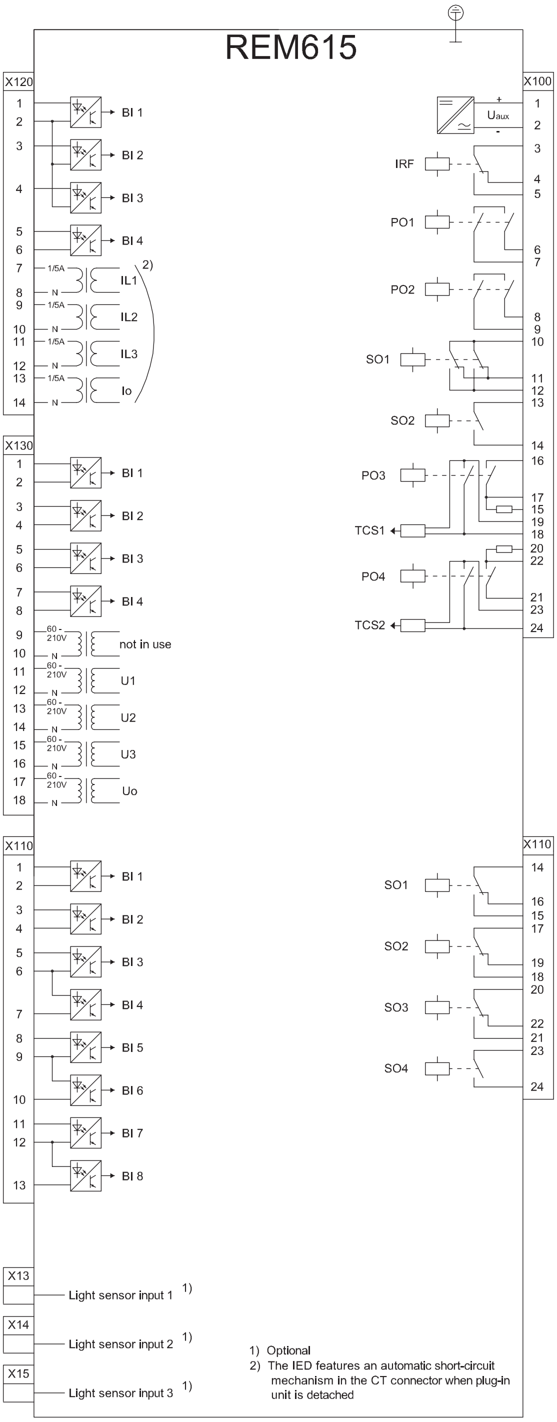

Figure 15. Terminal diagram of standard configuration C

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 REM615 protection IED on the product page.

The download area on the right hand side of the web page contains the latest product documentation, such as technical reference manual, installation manual, operators manual, etc. The selection tool on the web page helps you find the documents by the document category and language.

The Features and Application tabs contain product related information in a compact format.

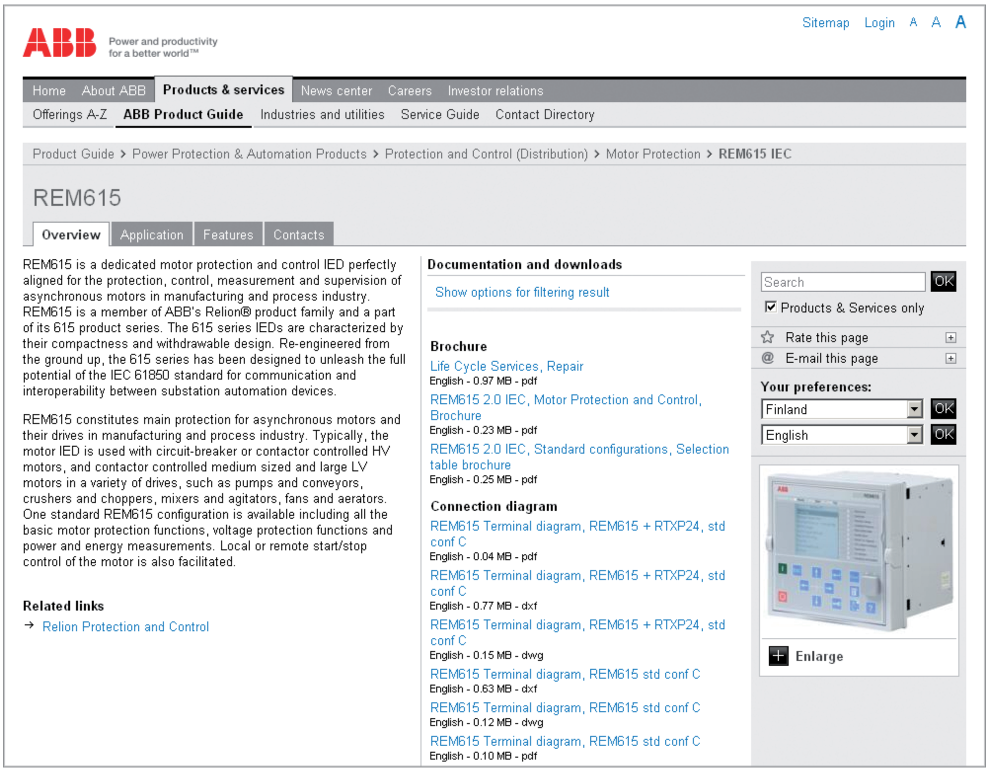

Figure 16. Product page

28. Functions, codes and symbols

Table 78. REM615 Functions, codes and symbols

Function	IEC 61850	IEC 60617	IEC-ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	3I> (1)	51P-1 (1)
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	PHIPTOC1	3I>>> (1)	50P/51P (1)
Non-directional earth-fault protection, low stage, instance 1	EFLPTOC1	Io> (1)	51N-1 (1)
Non-directional earth-fault protection, high stage, instance 1	EFHPTOC1	Io>> (1)	51N-2 (1)
Directional earth-fault protection, low stage, instance 1	DEFLPDEF1	Io> -> (1)	67N-1 (1)
Three-phase undervoltage protection, instance 1	PHPTUV1	3U< (1)	27 (1)
Positive-sequence undervoltage protection, instance 1	PSPTUV1	U1< (1)	47U+ (1)
Negative-sequence overvoltage protection, instance 1	NSPTOV1	U2> (1)	47O- (1)
Frequency protection, instance 1	FRPFRQ1	f>/f<,df/dt (1)	81 (1)
Frequency protection, instance 2	FRPFRQ2	f>/f<,df/dt (2)	81 (2)
Negative-sequence overcurrent protection for motors, instance 1	MNSPTOC1	I2>M (1)	46M (1)
Negative-sequence overcurrent protection for motors, instance 2	MNSPTOC2	I2>M (2)	46M (2)
Loss of load supervision	LOFLPTUC1	3I<	37
Motor load jam protection	JAMPTOC1	Ist>	51LR
Motor start-up supervision	STTPMSU1	Is2t n<	49,66,48,51LR
Phase reversal protection	PREVPTOC1	I2>>	46R
Thermal overload protection for motors	MPTTR1	3Ith>M	49M
Circuit breaker failure protection	CCBRBRF1	3I>/Io>BF	51BF/51NBF
Master trip, instance 1	TRPPTRC1	Master Trip (1)	94/86 (1)

Table 78. REM615 Functions, codes and symbols, continued

Function	IEC 61850	IEC 60617	IEC-ANSI
Master trip, instance 2	TRPPTRC2	Master Trip (2)	94/86 (2)
Arc protection, instance 1	ARCSARC1	ARC (1)	50L/50NL (1)
Arc protection, instance 2	ARCSARC2	ARC (2)	50L/50NL (2)
Arc protection, instance 3	ARCSARC3	ARC (3)	50L/50NL (3)
Multi-purpose protection, instance 1[1)]	MAPGAPC1	MAP (1)	MAP (1)
Multi-purpose protection, instance 2[1)]	MAPGAPC2	MAP (2)	MAP (2)
Multi-purpose protection, instance 3[1)]	MAPGAPC3	MAP (3)	MAP (3)
Control			
Circuit-breaker control	CBXCBR1	I <-> O CB	I <-> O CB
Disconnector position indication, instance 1	DCSXSWI1	I <-> O DC (1)	I <-> O DC (1)
Disconnector position indication, instance 2	DCSXSWI2	I <-> O DC (2)	I <-> O DC (2)
Disconnector position indication, instance 3	DCSXSWI3	I <-> O DC (3)	I <-> O DC (3)
Earthing switch indication	ESSXSWI1	I <-> O ES	I <-> O ES
Emergency startup	ESMGAPC1	ESTART	ESTART
Condition monitoring			
Circuit-breaker condition monitoring	SSCBR1	CBCM	CBCM
Trip circuit supervision, instance 1	TCSSCBR1	TCS (1)	TCM (1)
Trip circuit supervision, instance 2	TCSSCBR2	TCS (2)	TCM (2)
Current circuit supervision	CCRDIF1	MCS 3I	MCS 3I
Fuse failure supervision	SEQRFUF1	FUSEF	60
Runtime counter for machines and devices	MDSOPT1	OPTS	OPTM
Measurement			
Disturbance recorder	RDRE1	-	-
Three-phase current measurement, instance 1	CMMXU1	3I	3I

Table 78. REM615 Functions, codes and symbols, continued

Function	IEC 61850	IEC 60617	IEC-ANSI
Sequence current measurement	CSMSQI1	I1, I2, I0	I1, I2, I0
Residual current measurement, instance 1	RESCMMXU1	Io	In
Three-phase voltage measurement	VMMXU1	3U	3U
Residual voltage measurement	RESVMMXU1	Uo	Vn
Sequence voltage measurement	VSMSQI1	U1, U2, U0	U1, U2, U0
Three-phase power and energy measurement, including power factor	PEMMXU1	P, E	P, E
RTD/mA measurement	XRGGIO130	X130 (RTD)	X130 (RTD)
Frequency measurement	FMMXU1	f	f

1) Multi-purpose protection is used for, for example, RTD/mA based protection.

29. Document revision history

Document revision/ date	Product version	History
A/2009-07-03	2.0	First release
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