Relion® 615 series

Transformer Protection and Control RET615 Product Guide

Power and productivity
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Contents

1. Description

RET615 is a dedicated transformer protection and control IED (intelligent electronic device) for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industry power distribution systems. RET615 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 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 configurations

The transformer protection and control IED RET615 is available with four alternative standard configurations.

Table 1. Standard configurations

Description	Std.conf.
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the high-voltage (HV) side	A
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the low-voltage (LV) side	B
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the high-voltage (HV) side	C
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the low-voltage (LV) side	D

Table 2. Supported functions

Functionality	A	B	C	D
Protection[1)]				
Stabilized and instantaneous differential protection for two-winding transformers	●	●	●	●
Numerical stabilized low impedance restricted earth-fault protection	●	●	-	-
High impedance based restricted earth-fault protection	-	-	●	●
Master Trip, instance 1	●	●	●	●
Master Trip, instance 2	●	●	●	●
HV-side protection				
Three-phase non-directional overcurrent protection, low stage, instance 1	●	●	●	●
Three-phase non-directional overcurrent protection, high stage, instance 1	●	●	●	●
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	●	●	●	●
Non-directional earth-fault protection, low stage, instance 1	●	-	●	-
Non-directional earth-fault protection, high stage, instance 1	●	-	●	-
Negative-sequence overcurrent protection, instance 1	●	●	●	●
Three-phase thermal overload protection for power transformers, two time constants	●	●	●	●
Circuit breaker failure protection	●	●	●	●
LV-side protection				
Three-phase non-directional overcurrent protection, low stage, instance 2	●	●	●	●
Three-phase non-directional overcurrent protection, high stage, instance 2	●	●	●	●
Three-phase non-directional overcurrent protection, instantaneous stage, instance 2	●	●	●	●
Non-directional earth-fault protection, low stage, instance 2	-	●	-	●
Non-directional earth-fault protection, high stage, instance 2	-	●	-	●
Negative-sequence overcurrent protection, instance 2	●	●	●	●
Arc protection, instance 1	o	o	o	o
Arc protection, instance 2	o	o	o	o

Table 2. Supported functions, continued

Functionality	A	B	C	D
Arc protection, instance 3	o	o	o	o
Control				
Circuit-breaker control with interlocking	●	●	●	●
Disconnector position indication, instance 1	●	●	●	●
Disconnector position indication, instance 2	●	●	●	●
Disconnector position indication, instance 3	●	●	●	●
Earthing switch indication	●	●	●	●
Tap changer position indication	●	●	●	●
Condition monitoring				
Circuit-breaker condition monitoring	●	●	●	●
Trip circuit supervision, instance 1	●	●	●	●
Trip circuit supervision, instance 2	●	●	●	●
Measurement				
Disturbance recorder	●	●	●	●
Three-phase current measurement, instance 1 (HV side)	●	●	●	●
Three-phase current measurement, instance 2 (LV side)	●	●	●	●
Sequence current measurement (HV side)	●	●	●	●
Residual current measurement, instance 1 (HV side)	●	-	●	-
Residual current measurement, instance 2 (LV side)	-	●	-	●

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

1) Note that all directional protection functions can also be used in non-directional mode.

3. Protections functions

The IED features, three-phase, multi-slope transformer differential protection with an instantaneous stage and a stabilized (biased) stage to provide fast and selective protection for phase-to-phase, winding interturn and bushing flash-over faults. Besides second harmonic restraint an advanced waveform-based blocking algorithm ensures stability at transformer energization and a fifth harmonic restraint function ensures good protection stability at moderate overexcitation of power transformers. Sensitive restricted earth-fault protection (REF) completes the overall differential protection to detect even single phase-to-earth faults close to the neutral earthing point of the transformer. Either the conventional high-impedance scheme or a numerical low-impedance scheme can be selected for protection of the windings. When the low-impedance REF protection is used neither stabilizing resistors nor varistors are needed and as a further benefit the transforming ratio of the neutral earthing CTs can differ from those of the phase current transformers. Due to its unit protection character and absolute selectivity REF does not need time grading with other protection schemes, and therefore high-speed fault clearance can be achieved.

The IED also incorporates a thermal overload protection function, which supervises the thermal stress of the transformer windings to prevent an accelerated aging of the winding's insulation. Multiple stages of short-circuit, phase-overcurrent, negative-phase-sequence and earth-fault back-up protection are separately available for both windings. Earth-fault protection based on the measured or calculated residual overvoltage is also available. Finally, the IED also offers circuit-breaker failure protection.

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 personal safety and limits material damage within the switchgear in an arc fault situation.

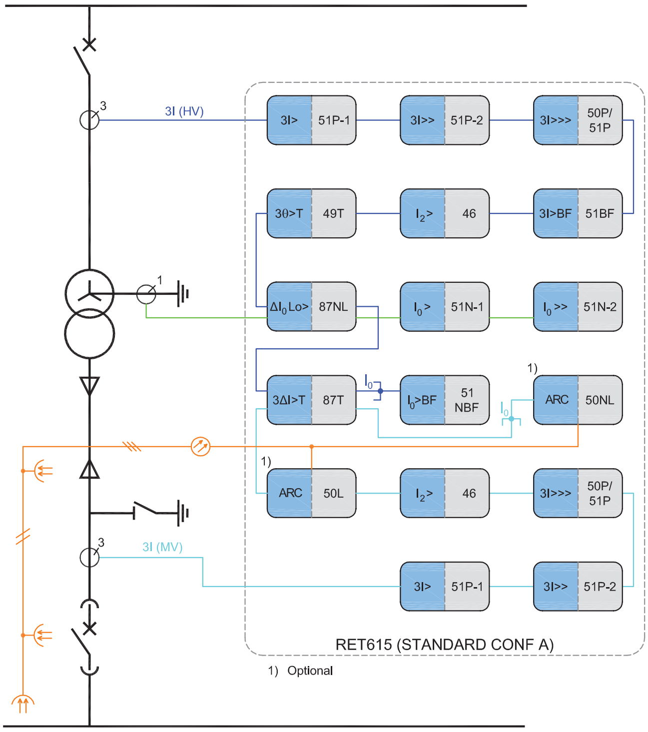

Figure 1. Protection function overview of standard configuration A

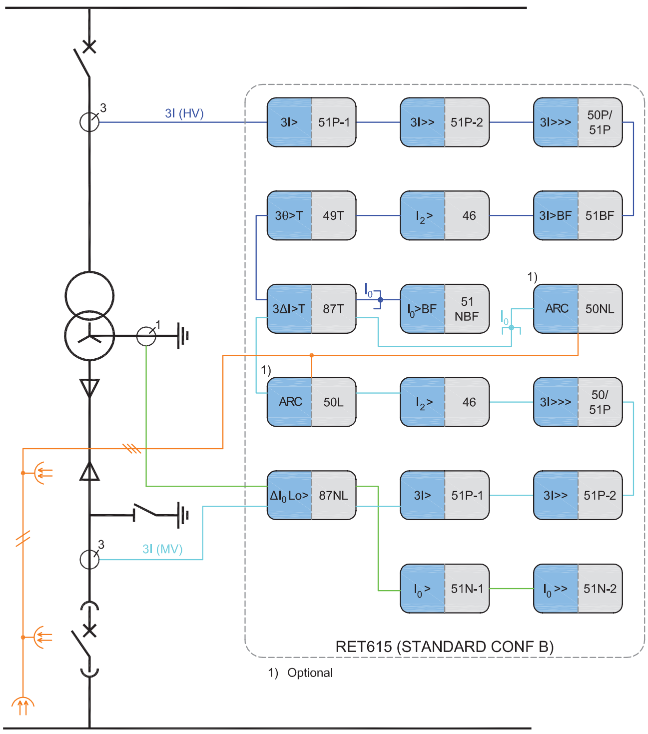

Figure 2. Protection function overview of standard configuration B

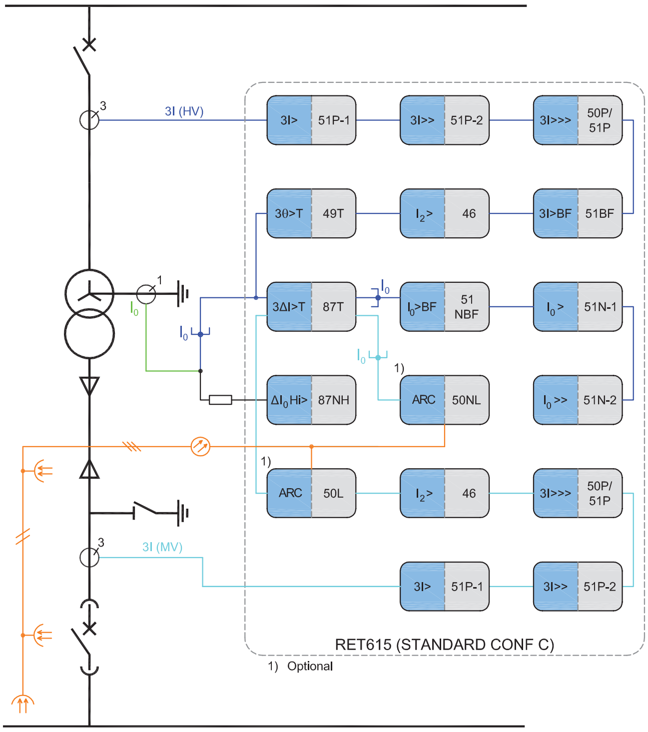

Figure 3. Protection function overview of standard configuration C

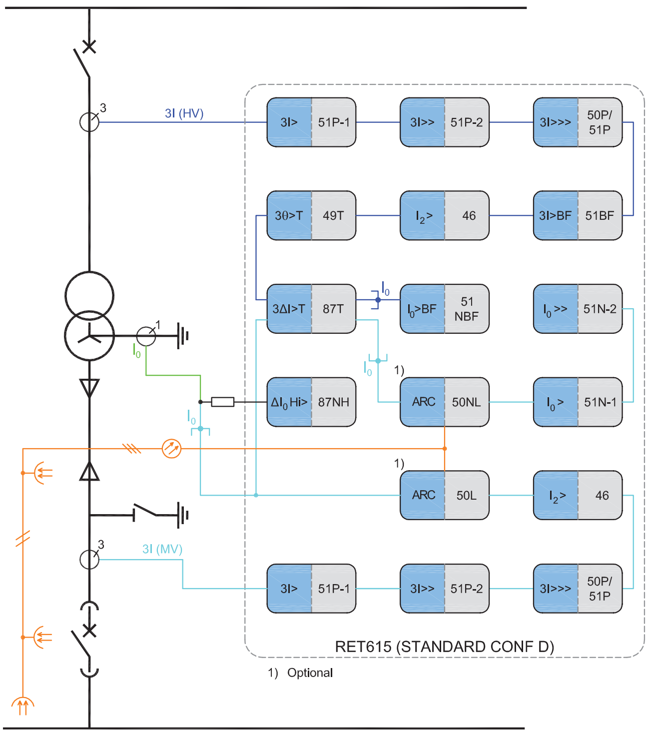

Figure 4. Protection function overview of standard configuration D

4. Application

RET615 provides main protection for two-winding power transformers and power generator-transformer blocks. As of now, there are four standard configurations offering comprehensive protection functions for detection and elimination of operational disturbance conditions and power transformer faults.

The standard configurations A and C are intended for power transformers with earthed HV side neutrals. The A configuration features low impedance REF protection while the C configuration offers high impedance REF protection. The B and D configurations fit transformers with a solidly earthed LV side neutral or their LV side neutral earthed over a resistor. The B and D configurations fit also applications including a separate earthing transformer located within the area of protection. The A and B configurations also suit applications, where the turns ratio of the CT of the neutral earthing circuit differs from turns ratio of the line CTs. The C and D configurations require that the turns ratios of the CTs are equal.

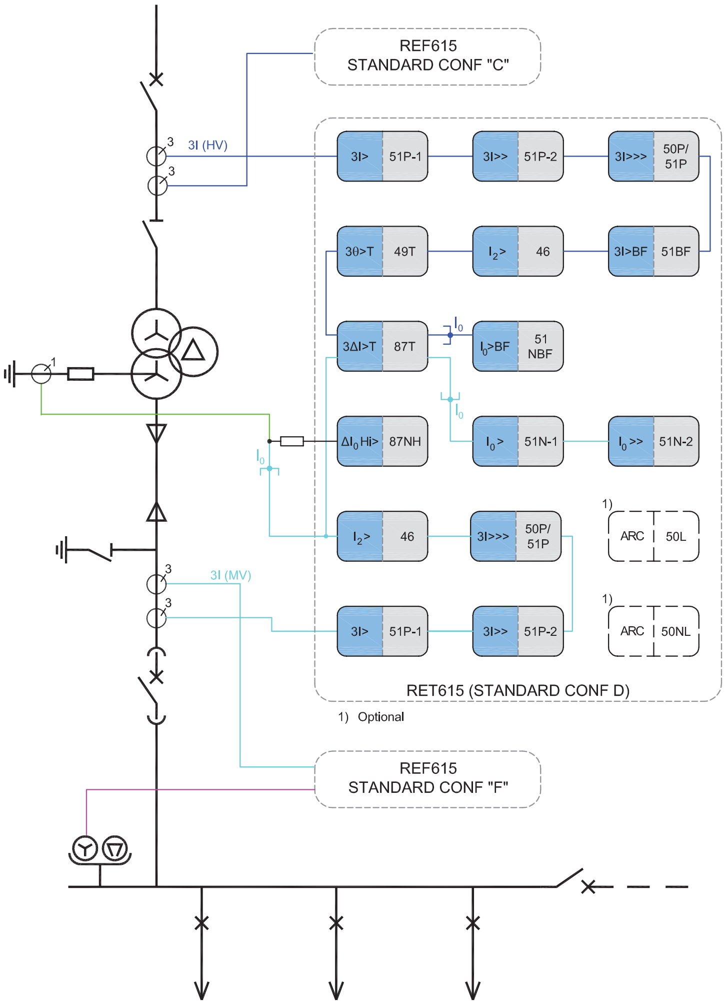

Figure 5. Main protection of a Yyn(d) connected power transformer and control of the HV side circuit breaker using a RET615 with the standard configuration D. Restricted E/F protection with a high impedance scheme is applied on the transformer MV side. A REF615 with the standard configuration C is used as redundant back-up protection on the HV side. In addition, a REF615 with the standard configuration F is used on the MV side to provide, besides O/C and E/F back-up protection, busbar overvoltage and undervoltage protection. Further, the REF615 with the standard configuration F enables local/remote control of the circuit breaker on the MV side.

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 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 utilizes 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. 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.

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	3.3 or later
MicroSCADA Pro	9.2 SP1 or later

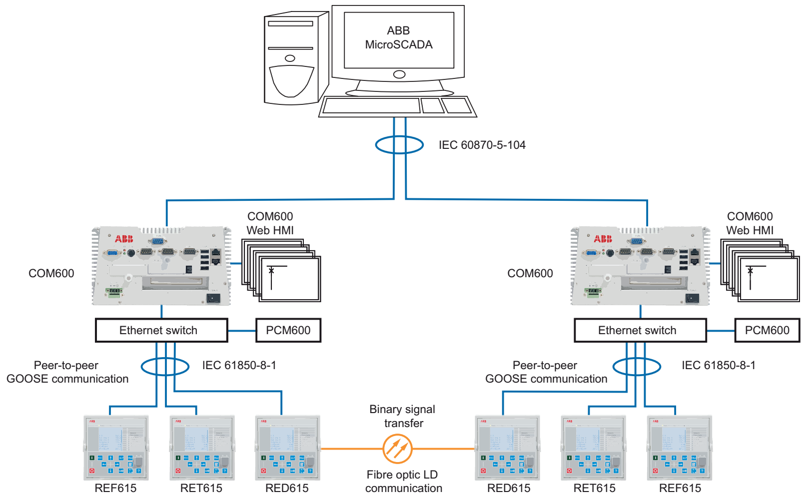

Figure 6. Utility power distribution network example using 615 series IEDs, Station Automation COM600 and MicroSCADA Pro

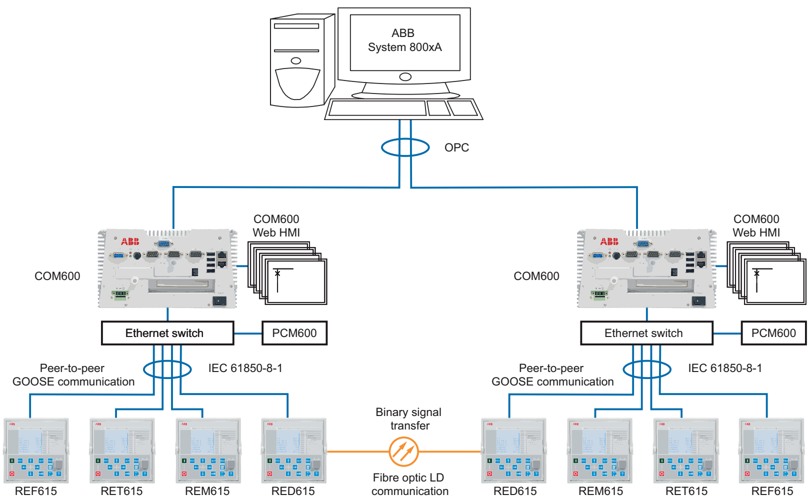

Figure 7. Industrial power system example using 615 series IEDs, Station Automation COM600 and System 800xA

6. Control

The IED offers control of one circuit breaker (by default HV side circuit breaker) with dedicated push-buttons for opening and closing. Interlocking schemes required by the application are configured with the signal matrix in PCM600.

7. Measurement

The IED continuously measures the high voltage (HV) side and the low-voltage (LV) side phase currents and the neutral current of the protected transformer. In addition, the IED calculates the maximum current demand value over a user-selectable pre-set time frame and the symmetrical components of the currents. Calculated values are also obtained from the protection and condition monitoring functions of the IED.

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 50 event codes 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 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 four latest fault events. The records enable the user to analyze the four most recent power system events. 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. Circuit-breaker 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.

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. 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.

15. Inputs and outputs

The IED is equipped with six phase-current inputs and one neutral-current input. The rated level of the current inputs is 1/5 A and selectable in the IED software. In addition, the binary input thresholds 18…176 V DC are selected by adjusting the IED's parameter settings.

All binary input and output contacts are freely configurable with the signal matrix in PCM600.

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	BI	BO
A, B, C, D	7	-	8 (14) [1)]	10 (13) [1)]

1) With optional binary I/O module ( )

16. 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.

The IEC 61850 communication implementation supports all monitoring and control functions. Additionally, parameter setting and disturbance file records can be accessed using the IEC 61850 protocol. Disturbance files are available to any Ethernet-based application in the standard COMTRADE format. Further, the IED can send and receive binary signals from other IEDs (so called horizontal communication) using the IEC61850-8-1 GOOSE profile. The IED meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard. The IED can simultaneously report events to five different clients on the station bus.

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).

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. If required, both IEC 61850 and serial 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 files in IEC 60870-5-103 format.

DNP3 supports both serial and TCP modes for connection to one master.

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

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

17. Technical data

Table 6. Dimensions

Description	Value	
Width	frame	179.8 mm
	case	164 mm
Height	frame	177 mm (4U)
	case	160 mm
Depth		194 mm (153 + 41 mm)
Weight	IED	3.5 kg
	spare unit	1.8 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	250 V DC ~ 5.9 W (nominal)/~ 11.9 W (max) 240 V AC ~ 7.4 W (nominal)/~ 13.6 W(max)	60 V DC ~ 5.6 W (nominal)/~ 11.0 W (max)
Ripple in the DC auxiliary voltage	Max 12% of the DC value (at frequency of 100 Hz)	
Maximum interruption time in the auxiliary DC voltage without resetting the IED	• 110 V DC: 106 ms • 110 V AC: 166 ms	48 V DC: 74 ms
Fuse type	T4A/250 V	

Table 8. Energizing inputs

Description		Value
Rated frequency		50/60 Hz ± 5 Hz
Current inputs	Rated current, I_n	1/5 A[1)]
	Thermal withstand capability:	
	• Continuously	20 A
	• For 1 s	500 A
	Dynamic current withstand:	
	• Half-wave value	1250 A
	Input impedance	<20 mΩ

1) 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. 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 11. 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 • Current drain through the supervision circuit • Minimum voltage over the TCS contact	 20...250 V AC/DC ~1.5 mA 20 V AC/DC (15...20 V)

Table 12. Single-pole power output relays

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, at 48/110/220 V DC	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC

Table 13. 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 14. Degree of protection of flush-mounted IED

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

Table 15. Environmental conditions

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

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

Table 16. 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 17. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz burst disturbance test:		IEC 61000-4-18 and IEC 60255-22-1, level 3
• Common mode	2.5 kV	
• Differential mode	1.0 kV	
Electrostatic discharge test:		IEC 61000-4-2, IEC 60255-22-2 and IEEE C37.90.3.2001
• Contact discharge	8 kV	
• Air discharge	15 kV	
Radio frequency interference tests:		IEC 61000-4-6 and IEC 60255-22-6, level 3
• Conducted, common mode	10 V (rms), f=150 kHz...80 MHz	
• Radiated, amplitude-modulated	10 V/m (rms), f=80...2700 MHz	IEC 61000-4-3 and IEC 60255-22-3, level 3
• Radiated, pulse-modulated	10 V/m, f=900 MHz	ENV 50204 and IEC 60255-22-3, level 3
Fast transient disturbance tests:		IEC 61000-4-4 and IEC 60255-22-4, class A
• All ports	4kV	
Surge immunity test:		IEC 61000-4-5 and IEC 60255-22-5, level 4/3
• Binary inputs	4 kV, line-to-earth 2 kV, line-to-line	
• Communication	1 kV, line-to-earth	
• Other ports	4 kV, line-to-earth 2 kV, line-to-line	
Power frequency (50 Hz) magnetic field:		IEC 61000-4-8, level 5
• Continuous	300 A/m	

Table 17. Electromagnetic compatibility tests, continued

Description	Type test value	Reference
Power frequency immunity test: • Common mode • Differential mode	Binary inputs only 300 V rms 150 V rms	IEC 61000-4-16 and IEC 60255-22-7, class A
Voltage dips and short interruptions	30%/10 ms 60%/100 ms 60%/1000 ms >95%/5000 ms	IEC 61000-4-11
Electromagnetic emission tests: • Conducted, RF-emission (mains terminal) 0.15...0.50 MHz 0.5...30 MHz • Radiated RF -emission 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 and IEC 60255-25

Table 18. Insulation tests

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

Table 19. 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

Table 20. EMC compliance

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

Table 21. Product safety

Description	Reference
LV directive	2006/95/EC
Standard	EN 60255-27 (2005) EN 60255-6 (1994)

Table 22. RoHS compliance

Description
Complies with RoHS directive 2002/95/EC

Table 23. 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

Protection functions

Table 24. Three-phase non-directional overcurrent protection (PHxPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
	PHLPTOC	±1.5% of the set value or ±0.002 x I_n		
	PHHPTOC 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 [1)2)]		Minimum	Typical	Maximum
	PHIPTOC: I_{Fault} = 2 x set *Start value*	16 ms	19 ms	23 ms
	I_{Fault} = 10 x set *Start value*	11 ms	12 ms	14 ms
	PHHPTOC 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 [3)]		
Suppression of harmonics		RMS: No suppression DFT: -50dB at f = n x f_n, where n = 2, 3, 4, 5, … 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 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
2) Includes the delay of the signal output contact
3) Includes the delay of the heavy-duty output contact

Table 25. 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	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	0.05...15.00	0.05
Operate delay time	PHLPTOC	40...200000 ms	10
	PHHPTOC	40...200000 ms	10
	PHIPTOC	20...200000 ms	10
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 please refer to the Operating characteristics table at the end of the Technical data chapter

Table 26. Non-directional EF protection (EFxPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
	EFLPTOC	±1.5% of the set value or ±0.002 x I_n		
	EFHPTOC and EFIPTOC	±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 [1)2)]		Minimum	Typical	Maximum
	EFIPTOC: 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 [3)]		
Suppression of harmonics		RMS: No suppression DFT: -50dB at f = n x f_n, where n = 2, 3, 4, 5, … Peak-to-Peak: No suppression		

1) *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
2) Includes the delay of the signal output contact
3) Maximum *Start value* = 2.5 x I_n, *Start value* multiples in range of 1.5 to 20

Table 27. Non-directional EF 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	1.00...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	20...200000 ms	10
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 please refer to the Operating characteristics table at the end of the Technical data chapter

Table 28. Negative phase-sequence overcurrent protection (NSPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 x I_n		
Start time [1)2)]		Minimum	Typical	Maximum
	I_{Fault} = 2 x set *Start value* I_{Fault} = 10 x set *Start value*	22 ms 14 ms	24 ms 16 ms	25 ms 17 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: -50dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) Negative sequence current before fault = 0.0, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact
3) Maximum *Start value* = 2.5 x I_n, *Start value* multiples in range of 1.5 to 20

Table 29. Negative phase-sequence overcurrent protection (NSPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	NSPTOC	0.01...5.00 x I_n	0.01
Time multiplier	NSPTOC	0.05...15.00	0.05
Operate delay time	NSPTOC	40...200000 ms	10
Operating curve type[1)]	NSPTOC	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	

1) For further reference please refer to the Operating characteristics table at the end of the Technical data chapter

Table 30. Thermal overload protection, two time constants (T2PTTR)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	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 31. Thermal overload for protection, two time constants (T2PTTR) main settings

Parameter	Function	Value (Range)	Step
Temperature rise	T2PTTR	0.0...200.0°C	0.1
Max temperature	T2PTTR	0.0...200.0°C	0.1
Operate temperature	T2PTTR	80.0...120.0 %	0.1
Weighting factor p	T2PTTR	0.00...1.00	0.01
Short time constant	T2PTTR	60...60000 s	1
Current reference	T2PTTR	0.05...4.00 pu	0.01
Operation	T2PTTR	Off On	-

Table 32. Transformer differential protection of two winding transformers (TR2PTDF)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±3.0% of the set value or ±0.002 x I_n		
Operate time[1)2)]		Minimum	Typical	Maximum
	Low stage High stage	34 ms 21 ms	40 ms 22 ms	44 ms 24 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Suppression of harmonics		DFT: -50dB at f = n x f_n, where n = 2, 3, 4, 5, …		

1) Current before fault = 0.0, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
2) Includes the delay of the output contact. When differential current = 2 x set operate value and f_n = 50 Hz.

Table 33. Stabilized differential protection for two winding transformers (TR2PTDF) main settings

Parameter	Function	Value (Range)	Step
Restraint mode	TR2PTDF	2.h & 5.h & wav Waveform 2.h & waveform 5.h & waveform	-
High operate value	TR2PTDF	500...3000 %	10
Low operate value	TR2PTDF	5...50 %	1
Slope section 2	TR2PTDF	10...50 %	1
End section 2	TR2PTDF	100...500 %	1
Start value 2.H	TR2PTDF	7...20 %	1
Start value 5.H	TR2PTDF	10...50 %	1
Operation	TR2PTDF	Off On	-
Winding 1 type	TR2PTDF	Y YN D Z ZN	-
Winding 2 type	TR2PTDF	Y YN D Z ZN	-
Zro A elimination	TR2PTDF	Not eliminated Winding 1 Winding 2 Winding 1 and 2	-

Table 34. Numerical stabilized low impedance restricted earth-fault protection (LREFPNDF)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±2.5% of the set value or ±0.002 x I_n		
Start time[1)2)]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 x set *Operate value*	38 ms	40 ms	43 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: -50dB at f = n x f_n, where n = 2, 3, 4, 5, …		

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

Table 35. Numerical stabilized low impedance restricted earth-fault protection (LREFPNDF) main settings

Parameter	Function	Value (Range)	Step
Operate value	LREFPNDF	5...50 %	1
Restraint mode	LREFPNDF	None 2nd harmonic	-
Start value 2.H	LREFPNDF	10...50 %	1
Minimum operate time	LREFPNDF	0.040...300.000 s	0.001
Operation	LREFPNDF	Off On	-

Table 36. High-impedance based restricted earth-fault protection (HREFPDIF)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±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 *Operate value*	16 ms	21 ms	23 ms
	I_{Fault} = 10.0 x set *Operate value*	11 ms	13 ms	14 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		

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

Table 37. High-impedance based restricted earth-fault protection (HREFPDIF) main settings

Parameter	Function	Value (Range)	Step
Operate value	HREFPDIF	0.5...50.0 %	0.1
Minimum operate time	HREFPDIF	0.020...300.000 s	0.001
Operation	HREFPDIF	Off On	-

Table 38. Circuit breaker failure protection (CCBRBRF)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	±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 39. 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 40. 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 41. 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 42. Operation characteristics

Parameter	Values (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

Measurement functions

Table 43. Three-phase current measurement (CMMXU)

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	±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: -50dB at f = n x f_n, where n = 2, 3, 4, 5, … RMS: No suppression

Table 44. Residual current measurement (RESCMMXU)

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

18. Display options

The IED is available with two optional displays, a large one and a small one. Both LCD displays offer full front-panel user-interface functionality with menu navigation and menu views.

The large display offers increased front-panel usability with less menu scrolling and improved information overview. The large display is suited for IED installations where the front panel user interface is frequently used, whereas the small display is suited for remotely controlled substations where the IED is only occasionally accessed locally via the front panel user interface.

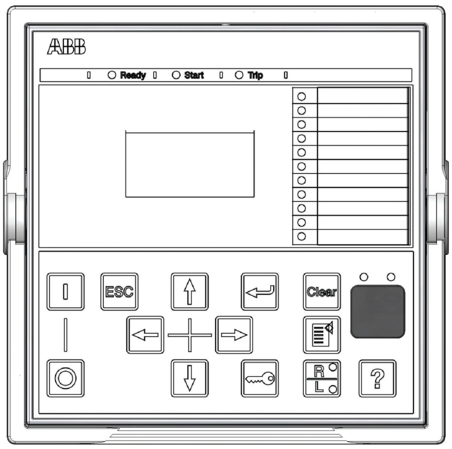

Figure 8. Small display

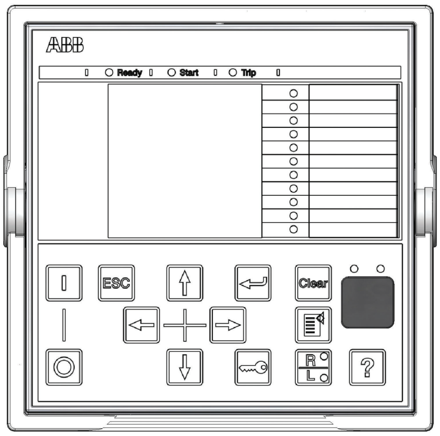

Figure 9. Large display

Table 45. 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 46. 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

19. 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

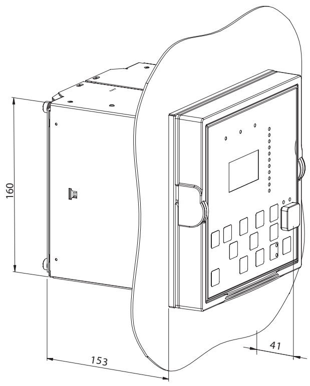

Figure 10. Flush mounting

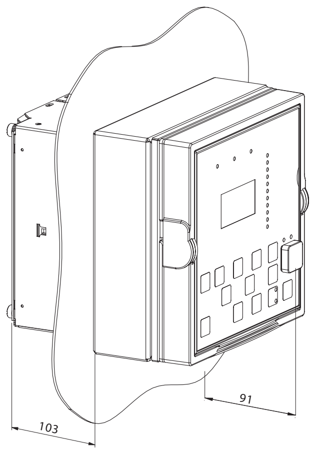

Figure 11. Semi-flush mounting

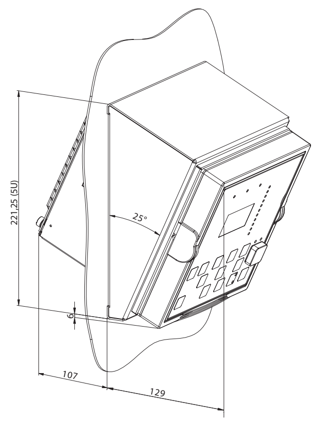

Figure 12. Semi-flush with a 25° tilt

20. 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.

21. 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 T A B A B A N B B 1 A B N 1 X C

#	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**	
	Transformer protection and control	T

The standard configuration determines the I/O hardware and available options. Choose the digits from one of the blue standard configuration rows below to define the corect digits for # 4-8. The example below shows standard configuration "A" with chosen options.

H B T A B A B A N B B 1 A B N 1 X C

#	DESCRIPTION		
4-8	**Standard configuration descriptions in short:** **A** = Transformer differential prot. with numerical restricted E/F protection for the HV side **B** = Transformer differential prot. with numerical restricted E/F protection for the LV side **C** = Transformer differential prot. with high imp. restricted E/F protection for the HV side **D** = Transformer differential prot. with high imp. restricted E/F protection for the LV side		
	Std. conf. # 4	**Available analog inputs options** # 5-6	**Available binary inputs/output options** # 7-8
	A	**BA** = (7 I (I_0 1/5 A))	**BA** = 8 BI + 10 BO or **BB** = 14 BI + 13 BO
	B	**BA** = (7 I (I_0 1/5 A))	**BA** = 8 BI + 10 BO or **BB** = 14 BI + 13 BO
	C	**BA** = (7 I (I_0 1/5 A))	**BA** = 8 BI + 10 BO or **BB** = 14 BI + 13 BO
	D	**BA** = (7 I (I_0 1/5 A))	**BA** = 8 BI + 10 BO or **BB** = 14 BI + 13 BO

The communication module harware determines the available communication protocols. Choose the digits from one of the blue communication rows below to define the corect digits for digits 9-11. Note that the communication options are not dependant on the chosen standard configuration.

H B T A B A B A N B B 1 A B N 1 X C

#	DESCRIPTION		
9 - 11	**Communication descriptions in short:** Serial communication options digit #9 Ethernet communication options digit #10 Communication protocol options #11		
	Serial options # 9	**Ethernet options # 10**	**Protocol options # 11**
	A = RS-485 (incl. IRIG-B)	**A** = Ethernet 100BaseFX (LC) or **B** = Ethernet 100BaseTX (RJ-45)	**B** = Modbus or **C** = IEC 61850 and Modbus or **D** = IEC 60870-5-103 or **E** = DNP3
	A = RS-485 (incl. IRIG-B)	**N** = None	**B** = Modbus or **D** = IEC 60870-5-103 or **E** = DNP3
	B = Glass fibre (ST) [1) 2)]	**B** = Ethernet 100BaseTX (RJ-45)	**B** = Modbus or **C** = IEC 61850 and Modbus or **D** = IEC 60870-5-103 or **E** = DNP3
	B = Glass fibre (ST) [1) 2)]	**N** = None	**B** = Modbus or **D** = IEC 60870-5-103 or **E** = DNP3
	N = None	**A** = Ethernet 100BaseFX (LC) or **B** = Ethernet 100BaseTX (RJ-45)	**A** = IEC 61850 or **B** = Modbus or **C** = IEC 61850 and Modbus or **E** = DNP3
	N = None	**N** = None	**A** = IEC 61850

[1)] Serial communication using glass fibre (ST) cannot be combined with arc protection.

[2)] The communication card includes an RS-485 connector and an input for IRIG-B.

In addition to a serial communication option for station bus communication to gateways and SCADA systems, an Ethernet communication option can be chosen. This enables the use of an Ethernet based service bus for PCM600 and the WebHMI. However, this requires that an Ethernet communication option is chosen in addition to the serial communication (digit #10 = RJ-45 or LC).

H B T A B A B A N B B 1 A B N 1 X C

#	DESCRIPTION	
12	**Language**	
	English	1
	English and German	3
	English and Spanish	5
	English and Russian	6
	English and Portugese (Brasilian)	8
13	**Front panel**	
	Small LCD	A
	Large LCD	B
14	**Option 1**	
	Arc protection [1)]	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 2.0	C

[1)] The arc protection hardware is located on the communication module (digit 9-10). Thus a communication module is always required to enable arc protection. Note that arc protection cannot be combined with serial communication using glass fibre (ST).

Example code: H B T A B A B A N B B 1 A B N 1 X C

Your ordering code:

Digit (#)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Code																		

Figure 13. Ordering key for complete IEDs

22. Accessories and ordering data

Table 47. 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 48. 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

23. 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.

PCM600 offers extensive IED configuration functions such as IED signal configuration using the signal matrix, and IEC 61850 communication configuration including horizontal peer-to-peer communication, GOOSE.

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.

Table 49. Tools

Configuration and setting tools	Version
PCM600	2.0 SP2 or later
Web-browser based user interface	IE 7.0 or later
RET615 Connectivity Package	2.5 or later

Table 50. Supported functions

Function	WebHMI	PCM600
IED signal configuration (signal matrix)	-	●
IEC 61850 communication configuration, GOOSE (communication configuration)	-	●
Modbus® communication configuration (communication management)	-	●
DNP3 communication configuration (communication management)	-	●
IEC 60870-5-103 communication configuration (communication management)	-	●
IED parameter setting	●	●
Saving of IED parameter settings in the IED	●	●
Saving of IED parameter settings in the tool	-	●
Signal monitoring	●	●
Disturbance recorder handling	●	●
Disturbance record analysis	-	●
Event viewing	●	-
Saving of event data on the user's PC	●	-
Alarm LED viewing	●	●
Phasor diagram viewing	●	-
Access control management	●	●

● = Supported

24. Terminal diagrams

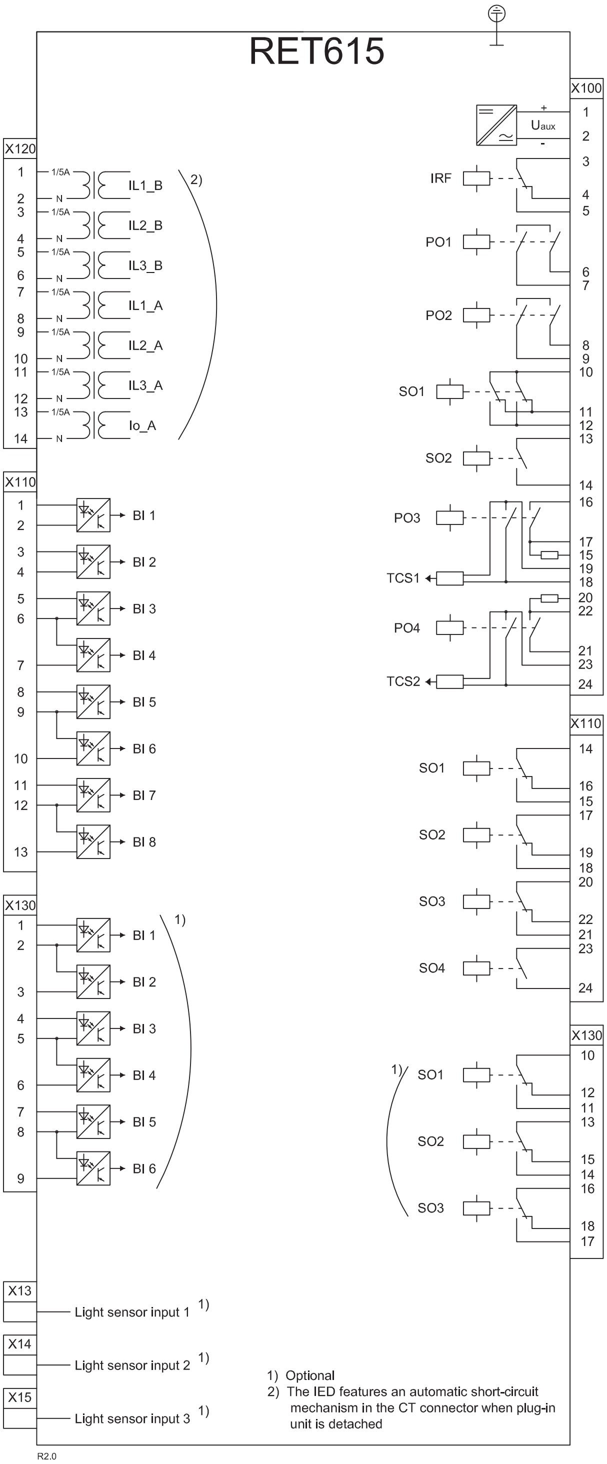

Figure 14. Terminal diagram of standard configurations A-D

25. 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 RET615 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.

26. Functions, codes and symbols

Table 51. RET615 Functions, codes and symbols

Functionality	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, low stage, instance 2	PHLPTOC2	3I> (2)	51P-1 (2)
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	3I>> (1)	51P-2 (1)
Three-phase non-directional overcurrent protection, high stage, instance 2	PHHPTOC2	3I>> (2)	51P-2 (2)
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	PHIPTOC1	3I>>> (1)	50P/51P (1)
Three-phase non-directional overcurrent protection, instantaneous stage, instance 2	PHIPTOC2	3I>>> (2)	50P/51P (2)
Non-directional earth-fault protection, low stage, instance 1	EFLPTOC1	I_0> (1)	51N-1 (1)
Non-directional earth-fault protection, low stage, instance 2	EFLPTOC2	I_0> (2)	51N-1 (2)
Non-directional earth-fault protection, high stage, instance 1	EFHPTOC1	I_0>> (1)	51N-2 (1)
Non-directional earth-fault protection, high stage, instance 2	EFHPTOC2	I_0>> (2)	51N-2 (2)
Negative-sequence overcurrent protection, instance 1	NSPTOC1	I_2> (1)	46 (1)
Negative-sequence overcurrent protection, instance 2	NSPTOC2	I_2> (2)	46 (2)

Table 51. RET615 Functions, codes and symbols, continued

Functionality	IEC 61850	IEC 60617	IEC-ANSI
Three-phase thermal overload protection for power transformers, two time constants	T2PTTR1	3Ith>T	49T
Stabilized and instantaneous differential protection for 2W – transformers	TR2PTDF1	3dI>T	87T
Numerical stabilized low impedance restricted earth-fault protection	LREFPNDF1	dI$_0$Lo>	87NL
High impedance based restricted earth-fault protection	HREFPDIF1	dI$_0$Hi>	87NH
Circuit breaker failure protection	CCBRBRF1	3I>/I$_0$>BF	51BF/51NBF
Master trip, instance 1	TRPPTRC1	Master Trip (1)	94/86 (1)
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)
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
Tap changer position indication	TPOSSLTC1	TPOSM	84M
Condition Monitoring			
Circuit-breaker condition monitoring	SSCBR1	CBCM	CBCM
Trip circuit supervision, instance 1	TCSSCBR1	TCS (1)	TCM (1)

Table 51. RET615 Functions, codes and symbols, continued

Functionality	IEC 61850	IEC 60617	IEC-ANSI
Trip circuit supervision, instance 2	TCSSCBR2	TCS (2)	TCM (2)
Measurement			
Disturbance recorder	RDRE1	-	-
Three-phase current measurement, instance 1	CMMXU1	3I	3I
Three-phase current measurement, instance 2	CMMXU2	3I(B)	3I(B)
Sequence current measurement	CSMSQI1	I_1, I_2, I_0	I_1, I_2, I_0
Residual current measurement, instance 1	RESCMMXU1	I_0	I_n
Residual current measurement, instance 2	RESCMMXU2	I_0(B)	I_n(B)

27. Document revision history

Document revision/ date	Product version	History
A/03.07.2009	2.0	First release

Contact us

ABB Oy
Distribution Automation
P.O. Box 699
FI-65101 VAASA, Finland
Phone +358 10 22 11
Fax +358 10 22 41094

www.abb.com/substationautomation