ABB

RELION® 620 SERIES

Transformer Protection and Control RET620

Product Guide

Contents

1. Description

RET620 is a dedicated two-winding power transformer management relay perfectly aligned for the protection, control, measurement and supervision of both power and step-up transformers, including power generator-transformer blocks, in utility and industrial power distribution systems. RET620 is a member of ABB's Relion® protection and control product family and its 620 series. The 620 series relays are characterized by their functional scalability and withdrawable-unit design.
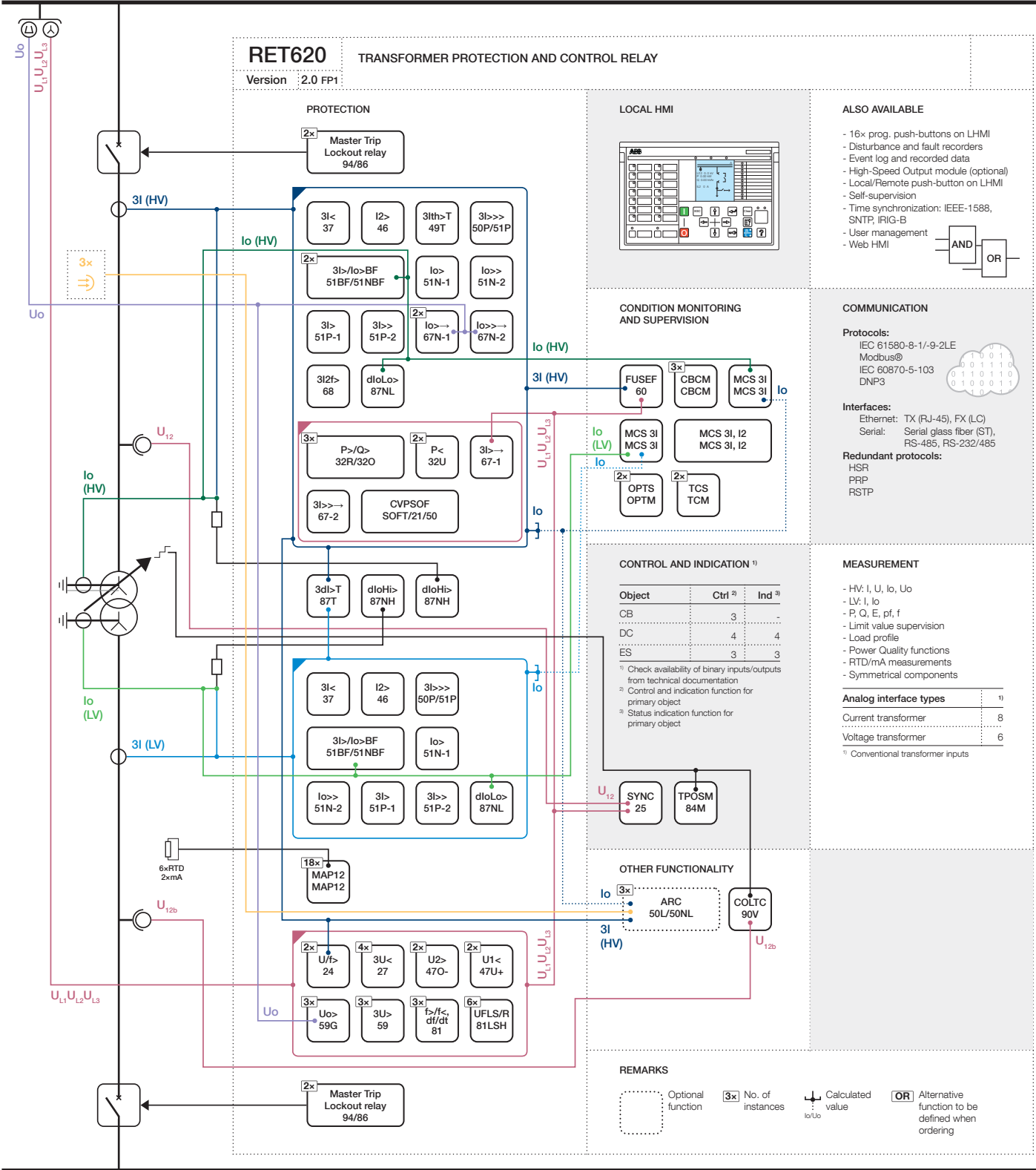
The 620 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability of substation automation devices.

The 620 series relays support a range of communication protocols including IEC 61850 with Edition 2 support, process bus according to IEC 61850-9-2 LE, IEC 60870-5-103, Modbus® and DNP3. Profibus DPV1 communication protocol is supported by using the protocol converter SPA-ZC 302.

2. Default configurations

The 620 series relays are configured with default configurations, which can be used as examples of the 620 series engineering with different function blocks. The default configurations are not aimed to be used as real end-user applications. The end-users always need to create their own application configuration with the configuration tool. However, the default configuration can be used as a starting point by modifying it according to the requirements.

RET620 is available with one default configuration. The default signal configuration can be altered by means of the graphical signal matrix or the graphical application functionality of the Protection and Control IED Manager PCM600. Furthermore, the application configuration functionality of PCM600 supports the creation of multi-layer logic functions utilizing various logical elements including timers and flip-flops. By combining protection functions with logic function blocks the relay configuration can be adapted to user specific application requirements.

ABB   3

RET620 TRANSFORMER PROTECTION AND CONTROL RELAY

Version 2.0 FP1

PROTECTION

| 2× Master Trip Lockout relay 94/86 |

3I (HV)

Io (HV)

3I< 37	I2> 46	3Ith>T 49T	3I>>> 50P/51P
2× 3I>/Io>BF 51BF/51NBF	Io> 51N-1	Io> 51N-2
3I> 51P-1	3I>> 51P-2	2× Io>→ 67N-1	Io>>→ 67N-2
3I2f> 68	dIoLo> 87NL

3I (HV)

| 3× P>/Q> 32R/32O | 2× P< 32U | 3I>→ 67-1 |
| 3I>>→ 67-2 | CVPSOF SOFT/21/50 |

3× ⟲

| 3dI>T 87T | dIoHi> 87NH | dIoHi> 87NH |

3I< 37	I2> 46	3I>>> 50P/51P
3I>/Io>BF 51BF/51NBF	Io> 51N-1
Io>> 51N-2	3I> 51P-1	3I>> 51P-2	dIoLo> 87NL

3I (LV)

Io (LV)

6×RTD 2×mA

| 18× MAP12 MAP12 |

| 2× U/f> 24 | 4× 3U< 27 | 2× U2> 47O- | 2× U1< 47U+ |
| 3× Uo> 59G | 3× 3U> 59 | 3× f>/f<, df/dt 81 | 6× UFLS/R 81LSH |

| 2× Master Trip Lockout relay 94/86 |

LOCAL HMI

ALSO AVAILABLE

- 16× prog. push-buttons on LHMI
- Disturbance and fault recorders
- Event log and recorded data
- High-Speed Output module (optional)
- Local/Remote push-button on LHMI
- Self-supervision
- Time synchronization: IEEE-1588, SNTP, IRIG-B
- User management
- Web HMI

AND OR

CONDITION MONITORING AND SUPERVISION

FUSEF 60	CBCM CBCM	3× MCS 3I MCS 3I
2× MCS 3I MCS 3I	MCS 3I, I2 MCS 3I, I2
2× OPTS OPTM	2× TCS TCM

Io (HV)

Io (LV)

Io

COMMUNICATION

Protocols:
IEC 61580-8-1/-9-2LE
Modbus®
IEC 60870-5-103
DNP3

Interfaces:
Ethernet: TX (RJ-45), FX (LC)
Serial: Serial glass fiber (ST), RS-485, RS-232/485

Redundant protocols:
HSR
PRP
RSTP

CONTROL AND INDICATION [1]

Object	Ctrl [2]	Ind [3]
CB	3	
DC	4	4
ES	3	3

[1] Check availability of binary inputs/outputs from technical documentation
[2] Control and indication function for primary object
[3] Status indication function for primary object

| SYNC 25 | TPOSM 84M |

MEASUREMENT

- HV: I, U, Io, Uo
- LV: I, Io
- P, Q, E, pf, f
- Limit value supervision
- Load profile
- Power Quality functions
- RTD/mA measurements
- Symmetrical components

Analog interface types		[1]
Current transformer		8
Voltage transformer		6

[1] Conventional transformer inputs

OTHER FUNCTIONALITY

Io
3× ARC 50L/50NL
3I (HV)
COLTC 90V

REMARKS

| ⌐ ¬ Optional function | 3× No. of instances | ⌐ Calculated value Io/Uo | OR Alternative function to be defined when ordering |

Figure 1.   Functionality overview of default configuration with conventional instrument transformer inputs

Table 1. Supported functions

Function	IEC 61850	A (CTs/VTs)
Protection		
Three-phase non-directional overcurrent protection, low stage	PHLPTOC1	1 HV
	PHLPTOC2	1 LV
Three-phase non-directional overcurrent protection, high stage	PHHPTOC1	1 HV
	PHHPTOC2	1 LV
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC1	1 HV
	PHIPTOC2	1 LV
Three-phase directional overcurrent protection, low stage	DPHLPDOC	1 HV
Three-phase directional overcurrent protection, high stage	DPHHPDOC	1 HV
Non-directional earth-fault protection, low stage	EFLPTOC1	1 HV1)
	EFLPTOC2	1 LV1)
Non-directional earth-fault protection, high stage	EFHPTOC1	1 HV1)
	EFHPTOC2	1 LV1)
Directional earth-fault protection, low stage	DEFLPDEF	2 HV1)
Directional earth-fault protection, high stage	DEFHPDEF	1 HV1)
Negative-sequence overcurrent protection	NSPTOC1	1 HV
	NSPTOC2	1 LV
Residual overvoltage protection	ROVPTOV	3 HV
Three-phase undervoltage protection	PHPTUV	4 HV
Three-phase overvoltage protection	PHPTOV	3 HV
Positive-sequence undervoltage protection	PSPTUV	2 HV
Negative-sequence overvoltage protection	NSPTOV	2 HV
Frequency protection	FRPFRQ	3 HV
Overexcitation protection	OEPVPH	2 HV
Three-phase thermal overload protection, two time constants	T2PTTR	1 HV
Loss of phase (undercurrent)	PHPTUC1	1 HV
	PHPTUC2	1 LV
Stabilized and instantaneous differential protection for two-winding transformers	TR2PTDF	1
Numerical stabilized low-impedance restricted earth-fault protection	LREFPNDF1	1 HV
	LREFPNDF2	1 LV
High-impedance based restricted earth-fault protection	HREFPDIF1	1 HV
	HREFPDIF2	1 LV

ABB | 5

Table 1. Supported functions, continued

Function	IEC 61850	A (CTs/VTs)
Circuit breaker failure protection	CCBRBRF1	1 HV
	CCBRBRF2	1 LV
	CCBRBRF3	1 HV
Three-phase inrush detector	INRPHAR	1 HV
Master trip	TRPPTRC	4
Arc protection	ARCSARC	(3)[2]
Load-shedding and restoration	LSHDPFRQ	6 HV
Multipurpose protection	MAPGAPC	18
Automatic switch-onto-fault logic (SOF)	CVPSOF	1 HV
Underpower protection	DUPPDPR	2 HV
Reverse power/directional overpower protection	DOPPDPR	3 HV
Control		
Circuit-breaker control	CBXCBR1	1 HV
	CBXCBR2	1 LV
	CBXCBR3	1 HV
Disconnector control	DCXSWI1	1 HV
	DCXSWI2	1 HV
	DCXSWI3	1 LV
	DCXSWI4	1 LV
Earthing switch control	ESXSWI1	1 HV
	ESXSWI2	1 LV
	ESXSWI3	1 HV
Disconnector position indication	DCSXSWI1	1 HV
	DCSXSWI2	1 HV
	DCSXSWI3	1 LV
	DCSXSWI4	1 LV
Earthing switch indication	ESSXSWI1	1 HV
	ESSXSWI2	1 LV
	ESSXSWI3	1 HV
Synchronism and energizing check	SECRSYN	1 HV
Tap changer position indication	TPOSYLTC	1
Tap changer control with voltage regulator	OLATCC	(1) LV
Condition monitoring and supervision		

Table 1. Supported functions, continued

Function	IEC 61850	A (CTs/VTs)
Circuit-breaker condition monitoring	SSCBR1	1 HV
	SSCBR2	1 LV
	SSCBR3	1 HV
Trip circuit supervision	TCSSCBR1	1 HV
	TCSSCBR2	1 LV
Current circuit supervision	CCSPVC1	1 HV
	CCSPVC2	1 LV
Advanced current circuit supervision for transformers	CTSRCTF	1
Fuse failure supervision	SEQSPVC	1 HV
Runtime counter for machines and devices	MDSOPT	2
Measurement		
Three-phase current measurement	CMMXU1	1 HV
	CMMXU2	1 LV
Sequence current measurement	CSMSQI1	1 HV
	CSMSQI2	1 LV
Residual current measurement	RESCMMXU1	1 HV
	RESCMMXU2	1 LV
Three-phase voltage measurement	VMMXU	1 HV
Single-phase voltage measurement	VAMMXU2	1 LV
	VAMMXU3	1 HV
Residual voltage measurement	RESVMMXU	1 HV
Sequence voltage measurement	VSMSQI	1 HV
Three-phase power and energy measurement	PEMMXU	1 HV
Load profile record	LDPRLRC	1 HV
Frequency measurement	FMMXU	1 HV
Power quality		
Current total demand distortion	CMHAI	1 HV
Voltage total harmonic distortion	VMHAI	1 HV
Voltage variation	PHQVVR	1 HV
Voltage unbalance	VSQVUB	1 HV
Other		
Minimum pulse timer (2 pcs)	TPGAPC	4
Minimum pulse timer (2 pcs, second resolution)	TPSGAPC	2
Minimum pulse timer (2 pcs, minute resolution)	TPMGAPC	2
Pulse timer (8 pcs)	PTGAPC	2

ABB

7

Table 1. Supported functions, continued

Function	IEC 61850	A (CTs/VTs)
Time delay off (8 pcs)	TOFGAPC	4
Time delay on (8 pcs)	TONGAPC	4
Set-reset (8 pcs)	SRGAPC	4
Move (8 pcs)	MVGAPC	4
Integer value move	MVI4GAPC	4
Analog value scaling	SCA4GAPC	4
Generic control point (16 pcs)	SPCGAPC	3
Remote generic control points	SPCRGAPC	1
Local generic control points	SPCLGAPC	1
Generic up-down counters	UDFCNT	12
Programmable buttons (16 buttons)	FKEYGGIO	1
Logging functions		
Disturbance recorder	RDRE	1
Fault recorder	FLTRFRC	1
Sequence event recorder	SER	1

1, 2, ... = Number of included instances. The instances of a protection function represent the number of identical protection function blocks available in the standard configuration.
() = optional
HV = The function block is to be used on the high-voltage side in the application.
LV = The function block is to be used on the low-voltage side in the application.

1) Function uses calculated value when the high-impedance based restricted earth-fault protection is used
2) Io is calculated from the measured phase currents

3. Protection functions

RET620 features a three-phase, multi-slope stabilized (biased) stage transformer differential protection and an instantaneous stage to provide fast and selective protection for phase-to-phase short circuit, winding interturn fault and bushing flash-over protection. Besides the second harmonic restraint, an advanced waveform-based blocking algorithm ensures stability at transformer energization and the fifth harmonic restraint function ensures good protection stability at moderate overexcitation of power transformers. The restricted earth-fault protection (REF) completes the overall differential protection providing detection of even single phase-to-earth faults close to the neutral earthing point of the transformer. Either the conventional high-impedance scheme or the numerical low-impedance scheme can be selected for the protection of the transformer 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 that of the phase current transformers. Due to its unit protection character and absolute selectivity, REF does not need to be time-graded with other

protection schemes, and therefore a high-speed fault clearance can be achieved.

The relay also incorporates a thermal overload protection function that supervises the thermal stress of the transformer windings to prevent the premature aging of the insulation of the windings. Multiple stages of short circuit, phase-overcurrent, negative-sequence and earth-fault backup protection are separately available for both sides of the power transformer. An earth-fault protection based on the measured or calculated residual voltage is also available. The relay also features three-phase overvoltage protection, three-phase undervoltage protection and residual overvoltage protection. Furthermore, the relay also offers circuit breaker failure protection and directional overpower protection and directional underpower protection.

Enhanced with optional hardware and software, the relay also features three light detection point-to-point lens sensors 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 staff safety and security and limits material damage in an arc fault situation. A binary input and output module can be selected as an option - having three high speed binary outputs (HSO) it further decreases the total operate time with typically 4...6 ms compared to the normal power outputs.

4. Application

RET620 has been designed to be the main protection for two-winding power transformers and power generator-transformer blocks. The relay also includes an optional voltage regulation function.

RET620 can be used with either single- or double-busbar configurations with one or two breakers, and with numerous switching device configurations. The relay supports a substantial number of both manually and motor-operated disconnectors and earthing switches, and it is capable of running large configurations. The number of controllable devices depends on the number of inputs and outputs left free from other application needs. The number of available I/Os can be increased with the RIO600 Remote I/O device.

The relay offers extensive possibilities to tailor the configurations to end application requirements. The tool suite for all Relion relays is Protection and Control IED Manager PCM600, which contains all the necessary tools for configuring the device, including functionality, parameterization, the HMI and communication.

RET620 provides both transformer protection and control and voltage regulator control at the same time. The voltage regulation capability is targeted for the automatic and manual voltage regulation of power transformers equipped with a motor-driven on-load tap changer. The automatic voltage regulation can be applied both with a single transformer as well as with up to four transformers running in parallel. The relay also supports both traditional resistor connection-based and numerically calculated high-impedance earth-fault protection. To further improve the arc protection and minimize the effects of an arc fault, the 620 series relays ordered with the arc protection option can be equipped with an I/O card featuring high-speed outputs.
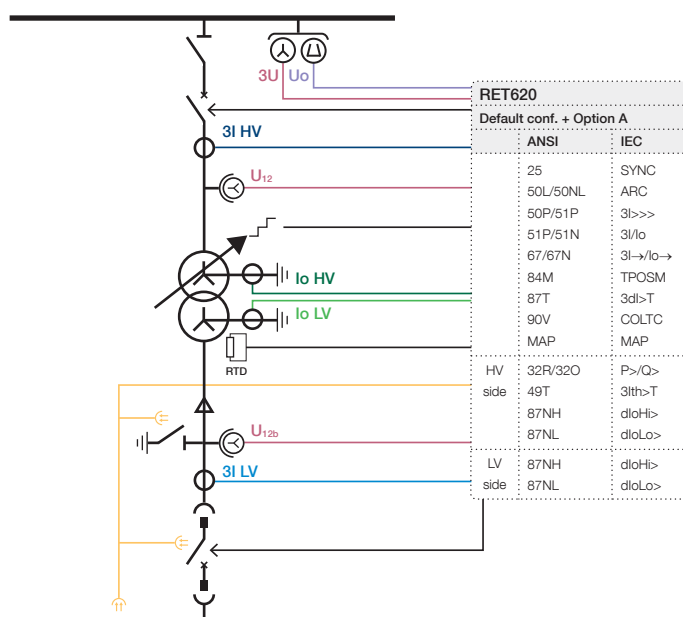

Figure 2. The protection of HV/MV, or an MV/MV transformer with low-impedance earth-fault protection on both sides of the transformer
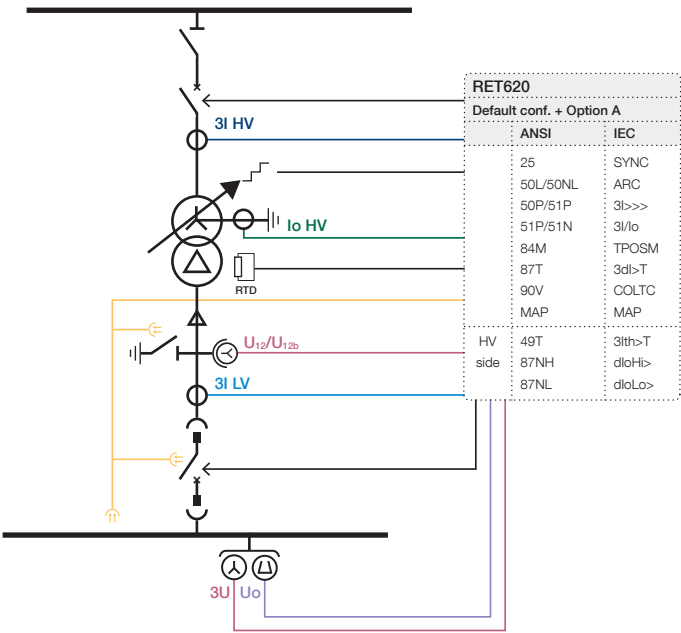
ABB | 9

Figure 3. Protection of HV/MV transformer with restricted earth-fault protection on the upper side of the transformer

5. Supported ABB solutions

The 620 series protection relays together with the Substation Management Unit COM600S constitute a genuine IEC 61850 solution for reliable power distribution in utility and industrial power systems. To facilitate the system engineering, ABB's relays are supplied with connectivity packages. The connectivity packages include a compilation of software and relay-specific information, including single-line diagram templates and a full relay data model. The data model includes event and parameter lists. With the connectivity packages, the relays can be readily configured using PCM600 and integrated with COM600S or the network control and management system MicroSCADA Pro.

The 620 series relays offer native support for IEC 61850 Edition 2 also including binary and analog horizontal GOOSE messaging. In addition, process bus with the sending of sampled values of analog currents and voltages and the receiving of sampled values of voltages is supported. Compared to traditional hard-wired, inter-device signaling, peer-to-peer communication over a switched Ethernet LAN offers an advanced and versatile platform for power system protection. Among the distinctive features of the protection system approach, enabled by the full implementation of the IEC 61850 substation automation standard, are fast communication capability, continuous supervision of the protection and communication system's integrity, and an inherent flexibility regarding reconfiguration and upgrades.This protection relay series is able to optimally utilize interoperability provided by the IEC 61850 Edition 2 features.

At substation level, COM600S uses the data content of the bay-level devices to enhance substation level functionality. COM600S features a Web browser-based HMI, which provides a customizable graphical display for visualizing single-line mimic diagrams for switchgear bay solutions. The Web HMI of COM600S also provides an overview of the whole substation, including relay-specific single-line diagrams, which makes information easily accessible. Substation devices and processes can also be remotely accessed through the Web HMI, which improves personnel safety.

In addition, COM600S can be used as a local data warehouse for the substation's technical documentation and for the network data collected by the devices. The collected network data facilitates extensive reporting and analyzing of network fault situations by using the data historian and event handling features of COM600S. The historical data can be used for accurate monitoring of process and equipment performance, using calculations based on both real-time and historical values. A better understanding of the process dynamics is achieved by combining time-based process measurements with production and maintenance events.

COM600S can also function as a gateway and provide seamless connectivity between the substation devices and network-level control and management systems, such as MicroSCADA Pro and System 800xA.

Table 2. Supported ABB solutions

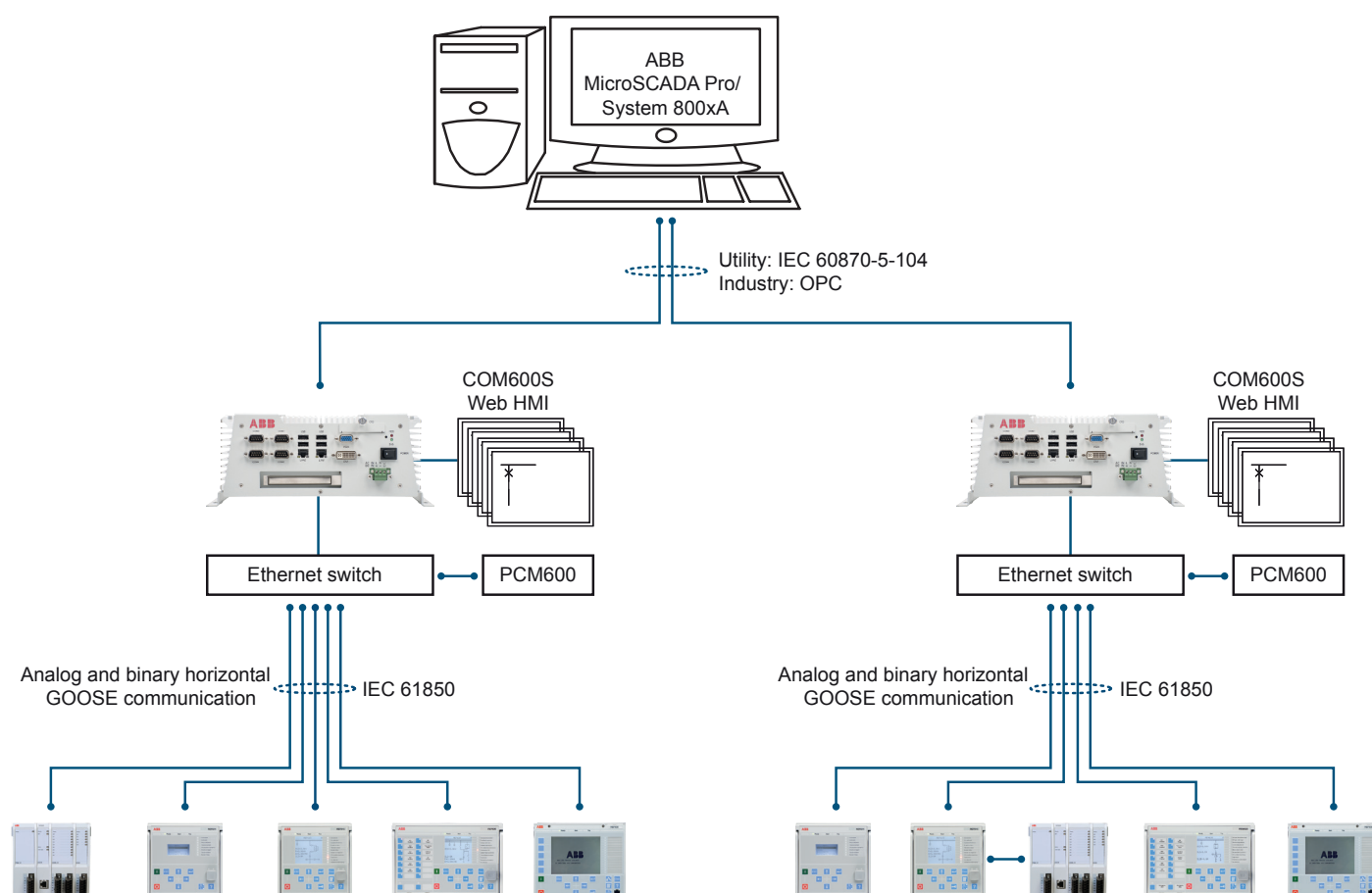| Product	Version
Substation Management Unit COM600S	4.0 SP1 or later
	4.1 or later (Edition 2)
MicroSCADA Pro SYS 600	9.3 FP2 or later
	9.4 or later (Edition 2)
System 800xA	5.1 or later

Figure 4.   ABB power system example using Relion relays, COM600S and MicroSCADA Pro/System 800xA

6. Control

RET620 integrates functionality for the control of circuit breakers, disconnectors and earthing switches via the front panel HMI or by means of remote controls. The relay includes three circuit breaker control blocks. In addition to the circuit breaker control, the relay features four disconnector control blocks intended for the motor-operated control of disconnectors or circuit breaker truck. Furthermore, the relay offers three control blocks intended for the motor-operated control of earthing switch. On top of that, the relay includes

additional four disconnector position indication blocks and three earthing switch position indication blocks usable with manually-only controlled disconnectors and earthing switches.

Two physical binary inputs and two physical binary outputs are needed in the relay for each controllable primary device taken into use. Depending on the chosen hardware configuration of the relay, the number of binary inputs and binary outputs varies. In case the amount of available binary inputs or outputs of the chosen hardware configuration is not sufficient, connecting an

ABB   11

external input or output module, for example RIO600, to the relay can extend binary inputs and outputs utilizable in the relay configuration. The binary inputs and outputs of the external I/O module can be used for the less time-critical binary signals of the application. The integration enables releasing of some initially reserved binary inputs and outputs of the relay.

The suitability of the binary outputs of the relay which have been selected for the controlling of primary devices should be carefully verified, for example, the make and carry as well as the breaking capacity. In case the requirements for the control circuit of the primary device are not met, the use of external auxiliary relays should be considered.

The graphical LCD of the relay's HMI includes a single-line diagram (SLD) with position indication for the relevant primary devices. Interlocking schemes required by the application are configured using the Signal Matrix or the Application Configuration tools in PCM600.

A synchrocheck function is incorporated to ensure that the voltage, phase angle and frequency on either side of an open circuit breaker satisfy the conditions for a safe interconnection of two networks.

A functionality is included optionally for controlling the voltage on the load side of the power transformer. Based on the measured values, the relay sends control commands to the tap changer, thus enabling the optional automatic voltage regulation.

7. Measurement

The relay continuously measures the phase currents and the neutral current. Furthermore, the relay measures the phase voltages and the residual voltage. In addition, the relay calculates the symmetrical components of the currents and voltages, the system frequency, the active and reactive power, the power factor, the active and reactive energy values as well as the demand value of current and power over a user-selectable preset time frame. Calculated values are also obtained from the protections and condition monitoring functions of the relay.

The relay can measure analog signals such as temperature, pressure and tap changer position values via the RTD inputs or the mA inputs using transducers. Besides the RTD module within the basic HW combination, it is also possible to add one more optional RTD/mA module.

The measured values can be accessed via the local HMI or remotely via the communication interface of the relay. The values can also be accessed locally or remotely using the Web HMI.

The relay is provided with a load profile recorder. The load profile feature stores the historical load data captured at a periodical time interval (demand interval). The records are in COMTRADE format.

8. Power quality

In the EN standards, power quality is defined through the characteristics of the supply voltage. Transients, short-duration and long-duration voltage variations and unbalance and waveform distortions are the key characteristics describing power quality. The distortion monitoring functions are used for monitoring the current total demand distortion and the voltage total harmonic distortion.

Power quality monitoring is an essential service that utilities can provide for their industrial and key customers. A monitoring system can provide information about system disturbances and their possible causes. It can also detect problem conditions throughout the system before they cause customer complaints, equipment malfunctions and even equipment damage or failure. Power quality problems are not limited to the utility side of the system. In fact, the majority of power quality problems are localized within customer facilities. Thus, power quality monitoring is not only an effective customer service strategy but also a way to protect a utility's reputation for quality power and service.

The protection relay has the following power quality monitoring functions.

- Voltage variation
- Voltage unbalance
- Current harmonics
- Voltage harmonics

The voltage unbalance and voltage variation functions are used for measuring short-duration voltage variations and monitoring voltage unbalance conditions in power transmission and distribution networks.

The voltage and current harmonics functions provide a method for monitoring the power quality by means of the current waveform distortion and voltage waveform distortion. The functions provides a short-term three-second average and a long-term demand for total demand distortion TDD and total harmonic distortion THD.

9. Disturbance recorder

The relay 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 voltages 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 either on the rising or the falling edge of the binary signal or on both.

By default, the binary channels are set to record external or internal relay signals, for example, the start or trip signals of the relay stages, or external blocking or control signals. Binary relay signals, such as protection start and trip signals, or an external relay control signal via a binary input, can be set to trigger the

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

10. Event log

To collect sequence-of-events information, the relay has a nonvolatile memory capable of storing 1024 events with the associated time stamps. The nonvolatile memory retains its data even if the relay temporarily loses its auxiliary supply. The event log facilitates detailed pre- and post-fault analyses of feeder faults and disturbances. The considerable capacity to process and store data and events in the relay facilitates meeting the growing information demand of future network configurations.

The sequence-of-events information can be accessed either via local HMI or remotely via the communication interface of the relay. The information can also be accessed locally or remotely using the Web HMI.

11. Recorded data

The relay has the capacity to store the records of the 128 latest fault events. The records can be used to analyze the power system events. Each record includes, for example, current, voltage and angle values and a time stamp. The fault recording can be triggered by the start or the trip signal of a protection block, or by both. The available measurement modes include DFT, RMS and peak-to-peak. Fault records store relay measurement values at the moment when any protection function starts. In addition, the maximum demand current with time stamp is separately recorded. The records are stored in the nonvolatile memory.

12. Condition monitoring

The condition monitoring functions of the relay constantly monitor 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 circuit breaker history data, which can be used for scheduling preventive circuit breaker maintenance.

In addition, the relay includes a runtime counter for monitoring of how many hours a protected device has been in operation thus enabling scheduling of time-based preventive maintenance of the device.

13. 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.

14. Self-supervision

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

A permanent relay fault blocks the protection functions to prevent incorrect operation.

15. Fuse failure supervision

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

16. 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.

17. Access control

To protect the relay from unauthorized access and to maintain information integrity, the relay is provided with a four-level, role-based authentication system with administrator-programmable individual passwords for the viewer, operator, engineer and administrator levels. The access control applies to the local HMI, the Web HMI and PCM600.

18. Inputs and outputs

The relay is equipped with six phase current inputs, two residual-current inputs, three phase voltage inputs, one residual-voltage input, one phase-to-phase voltage for syncrocheck input and one phase-to-phase voltage for automatic voltage regulator via online tap change input. In addition to current and voltage measurements, the relay's basic configuration includes eight binary inputs and 13 binary outputs. Additionally, basic configuration offers two RTD inputs and one mA input. The phase current inputs and the residual-current inputs are rated 1/5 A, that is, the inputs allow the connection of either 1 A or 5 A secondary 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.

As an optional addition, the relay's basic configuration includes one empty slot which can be equipped with one of the following

ABB   13

optional modules. The first option, additional binary inputs and outputs module, adds eight binary inputs and four binary outputs to the relay. This option is especially needed when connecting the relay to several controllable objects. The second option, an additional RTD/mA input module, increases the relay with six RTD inputs and two mA inputs when additional sensor measurements for example for temperatures, pressures, levels and so on are of interest. The third option is a high-speed output board including eight binary inputs and three high-speed outputs. The high-speed outputs have a shorter activation time compared to the conventional mechanical output relays, shortening the overall relay operation time by 4...6 ms with very time-critical applications like arc protection. The high-speed outputs are freely configurable in the relay application and not limited to arc protection only.

The rated values of the current and voltage inputs are settable parameters of the relay. In addition, the binary input thresholds are selectable within the range of 16...176 V DC by adjusting the relay's parameter settings.

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

See the Input/output overview table and the terminal diagrams for more information about the inputs and outputs.

If the number of the relay's own inputs and outputs does not cover all the intended purposes, connecting to an external input or output module, for example RIO600, increases the number of binary inputs and outputs utilizable in the relay configuration. In this case, the external inputs and outputs are connected to the relay via IEC 61850 GOOSE to reach fast reaction times between the relay and RIO600 information. The needed binary input and output connections between the relay and RIO600 units can be configured in a PCM600 tool and then utilized in the relay configuration.

Table 3. Input/output overview

Default conf.	Order code digit		Analog channels		Binary channels			
	5-6	7-8	CT	VT	BI	BO	RTD	mA
A	AA	AA	8	6	16	4 PO + 13 SO	2	1
		AB			8	4 PO + 9 SO	8	3
		AC			16	4 PO + 9 SO + 3 HSO	2	1
		NN			8	4 PO + 9 SO	2	1

19. Station communication

The relay supports a range of communication protocols including IEC 61850 Edition 1 and Edition 2, IEC 61850-9-2 LE, IEC 60870-5-103, Modbus® and DNP3. Profibus DPV1 communication protocol is supported with using the protocol converter SPA-ZC 302. Operational information and controls are available through these protocols. However, some communication functionality, for example, horizontal communication between the relays, is only enabled by the IEC 61850 communication protocol.

The IEC 61850 protocol is a core part of the relay as the protection and control application is fully based on standard modelling. The relay supports Edition 2 and Edition 1 versions of the standard. With Edition 2 support, the relay has the latest functionality modelling for substation applications and the best interoperability for modern substations. It incorporates also the full support of standard device mode functionality supporting different test applications. Control applications can utilize the new safe and advanced station control authority feature.

The IEC 61850 communication implementation supports 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 relay supports simultaneous event reporting to five different clients on the station bus. The relay can exchange data with other devices using the IEC 61850 protocol.

The relay can send binary and analog signals to other devices 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 relay meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard (<10 ms data exchange between the devices). The relay also supports the sending and receiving of analog values using GOOSE messaging. Analog GOOSE messaging enables easy transfer of analog measurement values over the station bus, thus facilitating for example the sending of measurement values

between the relays when controlling parallel running transformers.

The relay also supports IEC 61850 process bus by sending sampled values of analog currents and voltages and by receiving sampled values of voltages. With this functionality the galvanic interpanel wiring can be replaced with Ethernet communication. The measured values are transferred as sampled values using IEC 61850-9-2 LE protocol. The intended application for sampled values shares the voltages to other 620 series relays, having voltage based functions and 9-2 support. 620 relays with process bus based applications use IEEE 1588 for high accuracy time synchronization.

For redundant Ethernet communication, the relay offers either two optical or two galvanic Ethernet network interfaces. A third port with galvanic Ethernet network interface is also available. The third Ethernet interface provides connectivity for any other Ethernet device to an IEC 61850 station bus inside a switchgear bay, for example connection of a Remote I/O. Ethernet network redundancy can be achieved using the high-availability seamless redundancy (HSR) protocol or the parallel redundancy protocol (PRP) or a with self-healing ring using RSTP in managed switches. Ethernet redundancy can be applied to Ethernet-based IEC 61850, Modbus and DNP3 protocols.

The IEC 61850 standard specifies network redundancy which improves the system availability for the substation communication. The network redundancy is based on two complementary protocols defined in the IEC 62439-3 standard: PRP and HSR protocols. Both protocols are able to overcome a failure of a link or switch with a zero switch-over time. In both protocols, each network node has two identical Ethernet ports dedicated for one network connection. The protocols rely on the duplication of all transmitted information and provide a zero switch-over time if the links or switches fail, thus fulfilling all the stringent real-time requirements of substation automation.

In PRP, each network node is attached to two independent networks operated in parallel. The networks are completely separated to ensure failure independence and can have different topologies. The networks operate in parallel, thus providing zero-time recovery and continuous checking of redundancy to avoid failures.
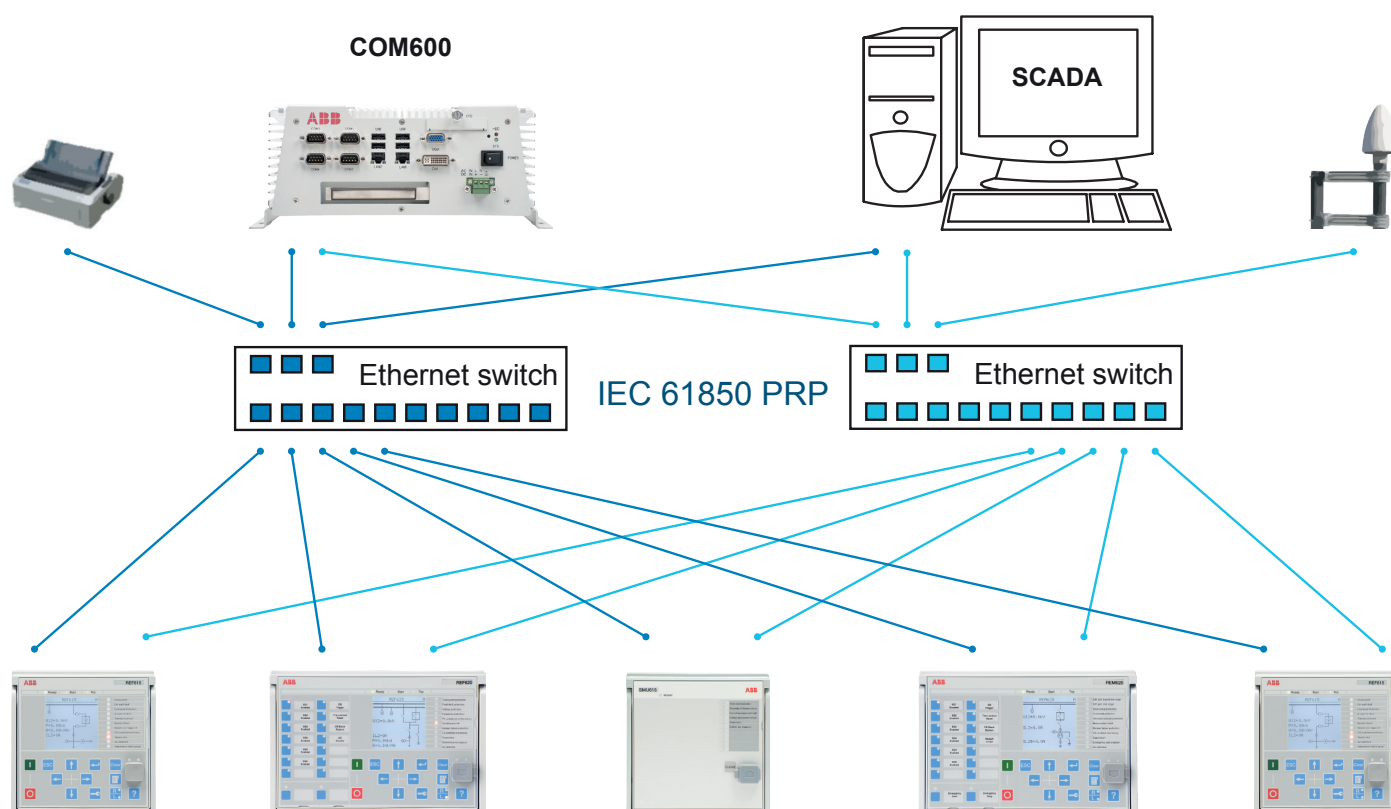

Figure 5.   Parallel redundancy protocol (PRP) solution

HSR applies the PRP principle of parallel operation to a single ring. For each message sent, the node sends two frames, one through each port. Both frames circulate in opposite directions over the ring. Every node forwards the frames it receives from one port to another to reach the next node. When the originating sender node receives the frame it sent, the sender node discards the frame to avoid loops. The HSR ring with 620 series relays supports the connection of up to 30 relays. If more

ABB

15

than 30 relays are connected, it is recommended to split the network into several rings to guarantee the performance for real-time applications.
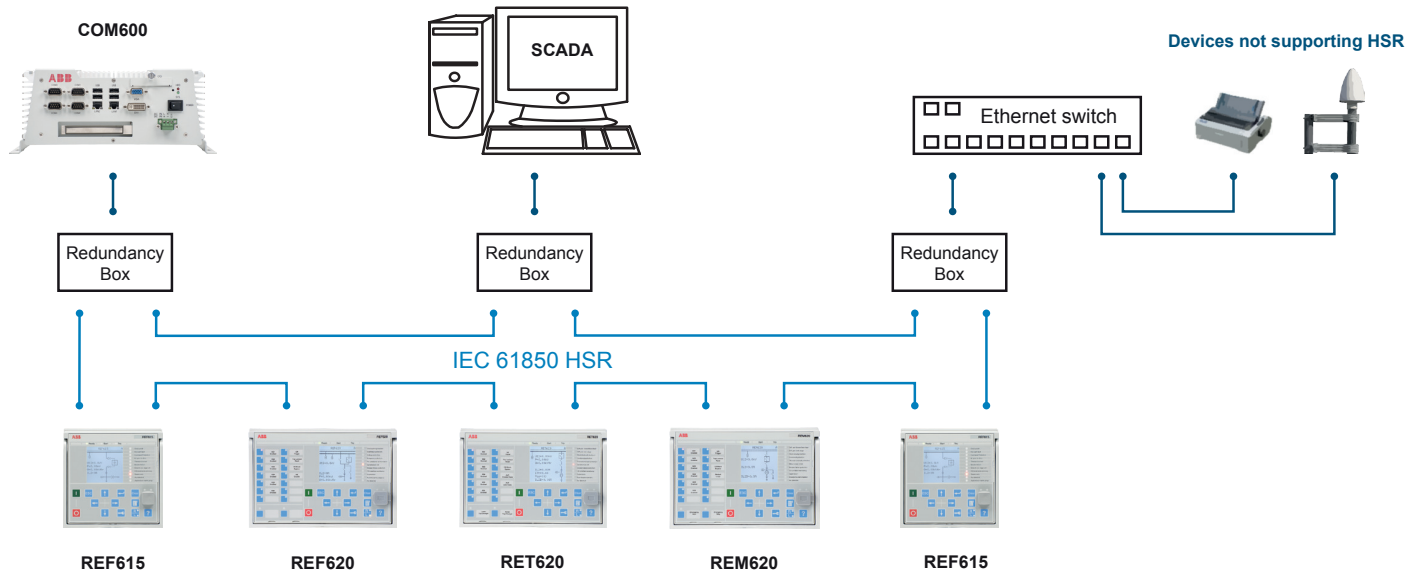

Figure 6.   High availability seamless redundancy (HSR) solution

The choice between the HSR and PRP redundancy protocols depends on the required functionality, cost and complexity.

The self-healing Ethernet ring solution enables a cost-efficient communication ring controlled by a managed switch with standard Rapid Spanning Tree l Protocol (RSTP) support. The managed switch controls the consistency of the loop, routes the data and corrects the data flow in case of a communication switch-over. The relays in the ring topology act as unmanaged switches forwarding unrelated data traffic. The Ethernet ring solution supports the connection of up to thirty 620 series relays. If more than 30 relays are connected, it is recommended to split the network into several rings. The self-healing Ethernet ring solution avoids single point of failure concerns and improves the reliability of the communication.
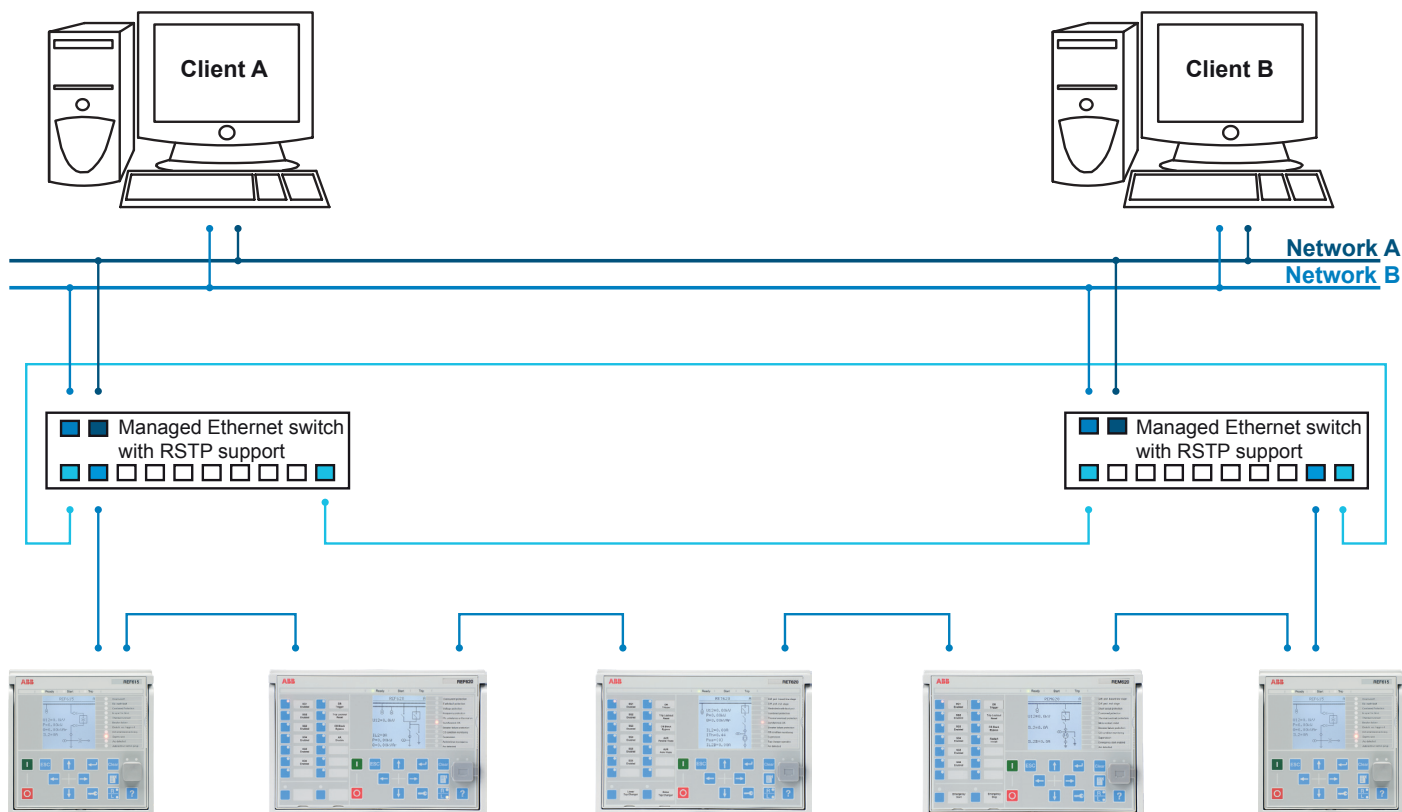
Figure 7.   Self-healing Ethernet ring solution

All communication connectors, except for the front port connector, are placed on integrated optional communication modules. The relay can be connected to Ethernet-based communication systems via the RJ-45 connector (100Base-TX) or the fiber-optic LC connector (100Base-FX). If a connection to the serial bus is required, the 9-pin RS-485 screw-terminal can be used. An optional serial interface is available for RS-232 communication.

Modbus implementation supports RTU, ASCII and TCP modes. Besides standard Modbus functionality, the relay 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 relay 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 relay supports changing of the active setting group and uploading of disturbance recordings in IEC 60870-5-103 format. Further, IEC 60870-5-103 can be used at the same time with the IEC 61850 protocol.

DNP3 supports both serial and TCP modes for connection up to five masters. Changing of the active setting and reading fault

records are supported. DNP serial and DNP TCP can be used in parallel. If required, both IEC 61850 and DNP protocols can be run simultaneously.

620 series supports Profibus DPV1 with support of SPA-ZC 302 Profibus adapter. If Profibus is required the relay must be ordered with Modbus serial options. Modbus implementation includes SPA-protocol emulation functionality. This functionality enables connection to SPA-ZC 302.

When the relay 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 relay 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)

ABB   17

The relay supports the following high accuracy time synchronization method with a time-stamping resolution of 4 μs required especially in process bus applications.
• PTP (IEEE 1588) v2 with Power Profile

The IEEE 1588 support is included in all variants having a redundant Ethernet communication module.

IEEE 1588 v2 features
• Ordinary Clock with Best Master Clock algorithm
• One-step Transparent Clock for Ethernet ring topology
• 1588 v2 Power Profile
• Receive (slave): 1-step/2-step
• Transmit (master): 1-step

• Layer 2 mapping
• Peer to peer delay calculation
• Multicast operation

Required accuracy of grandmaster clock is +/-1 μs. The relay can work as a master clock per BMC algorithm if the external grandmaster clock is not available for short term.

The IEEE 1588 support is included in all variants having a redundant Ethernet communication module.

In addition, the relay supports time synchronization via Modbus, DNP3 and IEC 60870-5-103 serial communication protocols.

Table 4. Supported station communication interfaces and protocols

Interfaces/Protocols	Ethernet		Serial	
	100BASE-TX RJ-45	100BASE-FX LC	RS-232/RS-485	Fiber-optic ST
IEC 61850-8-1	●	●	-	-
IEC 61850-9-2 LE	●	●	-	-
MODBUS RTU/ASCII	-	-	●	●
MODBUS TCP/IP	●	●	-	-
DNP3 (serial)	-	-	●	●
DNP3 TCP/IP	●	●	-	-
IEC 60870-5-103	-	-	●	●

● = Supported

20. Technical data

Table 5. Dimensions

Description	Value	
Width	Frame	262.2 mm
	Case	246 mm
Height	Frame	177 mm, 4U
	Case	160 mm
Depth		201 mm
Weight	Complete protection relay	max. 5.5 kg
	Plug-in unit only	max. 3.0 kg

Table 6. 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	
Maximum interruption time in the auxiliary DC voltage without resetting the relay	50 ms at U_n rated	
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 <18.0 W (nominal[1])/<22.5 W (max[2])	DC <18.5 W (nominal[1])/<22.5 W (max[2])
	AC <19.0 W (nominal[1])/<23.0 W (max[2])	
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz)	
Fuse type	T4A/250 V	

1) During the power consumption measurement, the relay is powered at rated auxiliary energizing voltage and the energizing quantities are energized without any binary output being active
2) During the power consumption measurement, the relay is powered at rated auxiliary energizing voltage and the energizing quantities are energized to activate at least half of the binary outputs

ABB

19

Table 7. 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
Voltage inputs	Rated voltage	60...210 V AC
	Voltage withstand:	
	• Continuous	240 V AC
	• For 10 s	360 V AC
	Burden at rated voltage	<0.05 VA

1)   Residual current and/or phase current

Table 8. 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	16...176 V DC
Reaction time	<3 ms

Table 9. RTD/mA measurement

Description		Value	
RTD inputs	Supported RTD sensors	100 Ω platinum	TCR 0.00385 (DIN 43760)
		250 Ω platinum	TCR 0.00385
		100 Ω nickel	TCR 0.00618 (DIN 43760)
		120 Ω nickel	TCR 0.00618
		250 Ω nickel	TCR 0.00618
		10 Ω copper	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	±0.5% or ±0.01 mA	

Table 10. Signal output with high make and carry

Description	Value [1]
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	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

1) X100: SO1
X105: SO1, SO2, when any of the protection relays is equipped with BIO0005.
X110: SO1, SO2 when REF620 or RET620 is equipped with BIO0005

Table 11. Signal outputs and IRF output

Description	Value [1]
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	10 mA at 5 V AC/DC

1) X100: IRF,SO2
X105: SO3, SO4, when any of the protection relays is equipped with BIO0005
X110: SO3, SO4, when REF620 or RET620 is equipped with BIO0005
X130: SO1, SO2, when RET620 is equipped with RTD0002

ABB   21

Table 12. Double-pole power outputs with TCS function X100: PO3 and PO4

Description	Value [1]
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 a series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC
Trip-circuit monitoring (TCS)	
• Control voltage range	20...250 V AC/DC
• Current drain through the monitoring circuit	~1.5 mA
• Minimum voltage over the TCS contact	20 V AC/DC (15...20 V)

1) PSM0003: PO3, PSM0004: PO3, PSM0003: PO4 and PSM0004: PO4.

Table 13. Signal/trip output with high make and carry and with TCS function

Description	Value [1]
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 (two contacts connected in series)	1A/0.25A/0.15A
Minimum contact load	100 mA at 24 V AC/DC

1) X130: SO3 of RET620 equipped with RTD0002

Table 14. Single-pole power output relays X100: PO1 and PO2

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	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC

Table 15. High-speed output HSO

Description	Value [1]
Rated voltage	250 V AC/DC
Continuous contact carry	6 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	5 A/3 A/1 A
Operate time	<1 ms
Reset	<20 ms, resistive load

1) X105: HSO1, HSO2 HSO3, when any of the protection relays is equipped with BIO0007

Table 16. 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 17. Station communication link, fiber optic

Connector	Fiber type[1]	Wave length	Typical max. length[2]	Permitted path attenuation[3]
LC	MM 62.5/125 or 50/125 µm glass fiber core	1300 nm	2 km	<8 dB
ST	MM 62.5/125 or 50/125 µm glass fiber core	820...900 nm	1 km	<11 dB

1) (MM) multi-mode fiber, (SM) single-mode fiber
2) Maximum length depends on the cable attenuation and quality, the amount of splices and connectors in the path.
3) Maximum allowed attenuation caused by connectors and cable together

Table 18. IRIG-B

Description	Value
IRIG time code format	B004, B005[1]
Isolation	500V 1 min
Modulation	Unmodulated
Logic level	5 V TTL
Current consumption	<4 mA
Power consumption	<20 mW

1) According to the 200-04 IRIG standard

Table 19. Lens sensor and optical fiber for arc protection

Description	Value
Fiber 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 fiber	100 mm

ABB

23

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

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

Table 21. 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 relays with an LC communication interface the maximum operating temperature is +70 ºC

Table 22. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz/100 kHz burst disturbance test		IEC 61000-4-18 IEC 60255-26, class III IEEE C37.90.1-2002
• Common mode	2.5 kV	
• Differential mode	2.5 kV	
3 MHz, 10 MHz and 30 MHz burst disturbance test		IEC 61000-4-18 IEC 60255-26, class III
• Common mode	2.5 kV	
Electrostatic discharge test		IEC 61000-4-2 IEC 60255-26 IEEE C37.90.3-2001
• Contact discharge	8 kV	
• Air discharge	15 kV	
Radio frequency interference test		
	10 V (rms) f = 150 kHz...80 MHz	IEC 61000-4-6 IEC 60255-26, class III
	10 V/m (rms) f = 80...2700 MHz	IEC 61000-4-3 IEC 60255-26, class III
	10 V/m f = 900 MHz	ENV 50204 IEC 60255-26, class III
Fast transient disturbance test		IEC 61000-4-4 IEC 60255-26 IEEE C37.90.1-2002
• All ports	4 kV	
Surge immunity test		IEC 61000-4-5 IEC 60255-26
• Communication	1 kV, line-to-earth	
• Other ports	4 kV, line-to-earth 2 kV, line-to-line	
Power frequency (50 Hz) magnetic field immunity test		IEC 61000-4-8
• Continuous • 1...3 s	300 A/m 1000 A/m	
Pulse magnetic field immunity test	1000 A/m 6.4/16 µs	IEC 61000-4-9
Damped oscillatory magnetic field immunity test		IEC 61000-4-10
• 2 s	100 A/m	
• 1 MHz	400 transients/s	
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	Binary inputs only	IEC 61000-4-16 IEC 60255-26, class A
• Common mode	300 V rms	

ABB   25

Table 22. Electromagnetic compatibility tests, continued

Description	Type test value	Reference
• Differential mode	150 V rms	
Conducted common mode disturbances	15 Hz...150 kHz Test level 3 (10/1/10 V rms)	IEC 61000-4-16
Emission tests		EN 55011, class A IEC 60255-26 CISPR 11 CISPR 12
• Conducted		
0.15...0.50 MHz	<79 dB (µV) quasi peak <66 dB (µV) average	
0.5...30 MHz	<73 dB (µV) quasi peak <60 dB (µV) average	
• Radiated		
30...230 MHz	<40 dB (µV/m) quasi peak, measured at 10 m distance	
230...1000 MHz	<47 dB (µV/m) quasi peak, measured at 10 m distance	
1…3 GHz	<76 dB (µV/m) peak <56 dB (µV/m) average, measured at 3 m distance	
3…6 GHz	<80 dB (µV/m) peak <60 dB (µV/m) average, measured at 3 m distance	

Table 23. Insulation tests

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

Table 24. Mechanical tests

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

Table 25. Environmental tests

Description	Type test value	Reference
Dry heat test	• 96 h at +55ºC • 16 h at +85ºC[1]	IEC 60068-2-2
Dry cold test	• 96 h at -25ºC • 16 h at -40ºC	IEC 60068-2-1
Damp heat test	• 6 cycles (12 h + 12 h) at +25°C…+55°C, humidity >93%	IEC 60068-2-30
Change of temperature test	• 5 cycles (3 h + 3 h) at -25°C...+55°C	IEC60068-2-14
Storage test	• 96 h at -40ºC • 96 h at +85ºC	IEC 60068-2-1 IEC 60068-2-2

[1] For relays with an LC communication interface the maximum operating temperature is +70ºC

Table 26. Product safety

Description	Reference
LV directive	2006/95/EC
Standard	EN 60255-27 (2013) EN 60255-1 (2009)

Table 27. EMC compliance

Description	Reference
EMC directive	2004/108/EC
Standard	EN 60255-26 (2013)

Table 28. RoHS compliance

Description
Complies with RoHS directive 2002/95/EC

ABB   27

Protection functions

Table 29. Three-phase non-directional overcurrent protection (PHxPTOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the measured current: f_n ±2 Hz		
	PHLPTOC	±1.5% of the set value or ±0.002 × I_n		
	PHHPTOC and PHIPTOC	±1.5% of set value or ±0.002 × I_n (at currents in the range of 0.1…10 × I_n) ±5.0% of the set value (at currents in the range of 10…40 × I_n)		
Start time [1][2]		Minimum	Typical	Maximum
	PHIPTOC: I_{Fault} = 2 × set *Start value* I_{Fault} = 10 × set *Start value*	16 ms 11 ms	19 ms 12 ms	23 ms 14 ms
	PHHPTOC and PHLPTOC: I_{Fault} = 2 × set *Start value*	23 ms	26 ms	29 ms
Reset time		Typically 40 ms		
Reset ratio		Typically 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: -50 dB at f = n × 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 × 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 30. Three-phase non-directional overcurrent protection (PHxPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	PHLPTOC	$0.05...5.00 \times I_n$	0.01
	PHHPTOC	$0.10...40.00 \times I_n$	0.01
	PHIPTOC	$1.00...40.00 \times I_n$	0.01
Time multiplier	PHLPTOC	0.05...15.00	0.01
	PHHPTOC	0.05...15.00	0.01
Operate delay time	PHLPTOC	40...200000 ms	10
	PHHPTOC	40...200000 ms	10
	PHIPTOC	40...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, see the Operation characteristics table

Table 31. Three-phase directional overcurrent protection (DPHxPDOC)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current/voltage measured: $f_n \pm 2$ Hz		
	DPHLPDOC	Current: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ Voltage: $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$ Phase angle: $\pm 2°$		
	DPHHPDOC	Current: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.1...10 \times I_n$) $\pm 5.0\%$ of the set value (at currents in the range of $10...40 \times I_n$) Voltage: $\pm 1.5\%$ of the set value or $\pm 0.002 \times U_n$ Phase angle: $\pm 2°$		
Start time[1][2]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 × set *Start value*	39 ms	43 ms	47 ms
Reset time		Typically 40 ms		
Reset ratio		Typically 0.96		
Retardation time		<35 ms		
Operate time accuracy in definite time mode		$\pm 1.0\%$ of the set value or ± 20 ms		
Operate time accuracy in inverse time mode		$\pm 5.0\%$ of the theoretical value or ± 20 ms[3]		
Suppression of harmonics		DFT: -50 dB at $f = n \times f_n$, where n = 2, 3, 4, 5,…		

1) *Measurement mode* and *Pol quantity* = default, current before fault = $0.0 \times I_n$, voltage before fault = $1.0 \times U_n$, f_n = 50 Hz, fault current in one phase with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact
3) Maximum *Start value* = $2.5 \times I_n$, *Start value* multiples in range of 1.5...20

ABB

29

Table 32. Three-phase directional overcurrent protection (DPHxPDOC) main settings

Parameter	Function	Value (Range)	Step
Start value	DPHLPDOC	$0.05...5.00 \times I_n$	0.01
	DPHHPDOC	$0.10...40.00 \times I_n$	0.01
Time multiplier	DPHxPDOC	0.05...15.00	0.01
Operate delay time	DPHxPDOC	40...200000 ms	10
Operating curve type[1]	DPHLPDOC	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	DPHHPDOC	Definite or inverse time Curve type: 1, 3, 5, 9, 10, 12, 15, 17	
Directional mode	DPHxPDOC	1 = Non-directional 2 = Forward 3 = Reverse	-
Characteristic angle	DPHxPDOC	-179...180°	1

1) For further reference, see the Operating characteristics table

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

Characteristic		Value		
Operation accuracy		Depending on the frequency of the measured current: $f_n \pm 2$ Hz		
	EFLPTOC	$\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$		
	EFHPTOC and EFIPTOC	$\pm 1.5\%$ of set value or $\pm 0.002 \times I_n$ (at currents in the range of $0.1...10 \times I_n$) $\pm 5.0\%$ of the set value (at currents in the range of $10...40 \times I_n$)		
Start time [1][2]		Minimum	Typical	Maximum
	EFIPTOC: $I_{Fault} = 2 \times$ set *Start value* $I_{Fault} = 10 \times$ set *Start value*	16 ms 11 ms	19 ms 12 ms	23 ms 14 ms
	EFHPTOC and EFLPTOC: $I_{Fault} = 2 \times$ set *Start value*	23 ms	26 ms	29 ms
Reset time		Typically 40 ms		
Reset ratio		Typically 0.96		
Retardation time		<30 ms		
Operate time accuracy in definite time mode		$\pm 1.0\%$ of the set value or ± 20 ms		
Operate time accuracy in inverse time mode		$\pm 5.0\%$ of the theoretical value or ± 20 ms [3]		
Suppression of harmonics		RMS: No suppression DFT: -50 dB at $f = n \times f_n$, where n = 2, 3, 4, 5,… Peak-to-Peak: No suppression		

1) *Measurement mode* = default (depends on stage), current before fault = $0.0 \times I_n$, f_n = 50 Hz, earth-fault current with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact
3) Maximum *Start value* = $2.5 \times I_n$, *Start value* multiples in range of 1.5...20

Table 34. Non-directional earth-fault protection (EFxPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	EFLPTOC	$0.010...5.000 \times I_n$	0.005
	EFHPTOC	$0.10...40.00 \times I_n$	0.01
	EFIPTOC	$1.00...40.00 \times I_n$	0.01
Time multiplier	EFLPTOC and EFHPTOC	0.05...15.00	0.01
Operate delay time	EFLPTOC and 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, see the Operation characteristics table

ABB 31

Table 35. Directional earth-fault protection (DEFxPDEF)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the measured current: f_n ±2 Hz		
	DEFLPDEF	Current: ±1.5% of the set value or ±0.002 × I_n Voltage ±1.5% of the set value or ±0.002 × U_n Phase angle: ±2°		
	DEFHPDEF	Current: ±1.5% of the set value or ±0.002 × I_n (at currents in the range of 0.1…10 × I_n) ±5.0% of the set value (at currents in the range of 10…40 × I_n) Voltage: ±1.5% of the set value or ±0.002 × U_n Phase angle: ±2°		
Start time [1][2]		Minimum	Typical	Maximum
	DEFHPDEF I_{Fault} = 2 × set *Start value*	42 ms	46 ms	49 ms
	DEFLPDEF I_{Fault} = 2 × set *Start value*	58 ms	62 ms	66 ms
Reset time		Typically 40 ms		
Reset ratio		Typically 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: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,… Peak-to-Peak: No suppression		

1) Set *Operate delay time* = 0.06 s, *Operate curve type* = IEC definite time, *Measurement mode* = default (depends on stage), current before fault = 0.0 × 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 × I_n, *Start value* multiples in range of 1.5...20

Table 36. Directional earth-fault protection (DEFxPDEF) main settings

Parameter	Function	Value (Range)	Step
Start value	DEFLPDEF	$0.010...5.000 \times I_n$	0.005
	DEFHPDEF	$0.10...40.00 \times I_n$	0.01
Directional mode	DEFxPDEF	1 = Non-directional 2 = Forward 3 = Reverse	-
Time multiplier	DEFLPDEF	0.05...15.00	0.01
	DEFHPDEF	0.05...15.00	0.01
Operate delay time	DEFLPDEF	60...200000 ms	10
	DEFHPDEF	40...200000 ms	10
Operating curve type[1]	DEFLPDEF	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	DEFHPDEF	Definite or inverse time Curve type: 1, 3, 5, 15, 17	
Operation mode	DEFxPDEF	1 = Phase angle 2 = IoSin 3 = IoCos 4 = Phase angle 80 5 = Phase angle 88	-

1) For further reference, see the Operating characteristics table

Table 37. Negative-sequence overcurrent protection (NSPTOC)

Characteristic	Value		
Operation accuracy	Depending on the frequency of the measured current: $f_n \pm 2$ Hz		
	$\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$		
Start time [1][2]		Minimum	Typical	Maximum
	$I_{Fault} = 2 \times$ set *Start value* $I_{Fault} = 10 \times$ set *Start value*	23 ms 15 ms	26 ms 18 ms	28 ms 20 ms
Reset time	Typically 40 ms		
Reset ratio	Typically 0.96		
Retardation time	<35 ms		
Operate time accuracy in definite time mode	$\pm 1.0\%$ of the set value or ± 20 ms		
Operate time accuracy in inverse time mode	$\pm 5.0\%$ of the theoretical value or ± 20 ms [3]		
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where n = 2, 3, 4, 5,...		

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

ABB

33

Table 38. Negative-sequence overcurrent protection (NSPTOC) main settings

Parameter	Function	Value (Range)	Step
Start value	NSPTOC	$0.01...5.00 \times I_n$	0.01
Time multiplier	NSPTOC	0.05...15.00	0.01
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, see the Operation characteristics table

Table 39. Residual overvoltage protection (ROVPTOV)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the measured voltage: f_n ±2 Hz		
		±1.5% of the set value or $±0.002 \times U_n$		
Start time[1][2]		Minimum	Typical	Maximum
	U_{Fault} = 2 × set *Start value*	48 ms	51 ms	54 ms
Reset time		Typically 40 ms		
Reset ratio		Typically 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 $f = n \times f_n$, where n = 2, 3, 4, 5,…		

1) Residual voltage before fault = $0.0 \times U_n$, f_n = 50 Hz, residual voltage 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. Residual overvoltage protection (ROVPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	ROVPTOV	$0.010...1.000 \times U_n$	0.001
Operate delay time	ROVPTOV	40...300000 ms	1

Table 41. Three-phase undervoltage protection (PHPTUV)

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} = 0.9 × set *Start value*		62 ms	66 ms	70 ms
Reset time	Typically 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 × f_n, where n = 2, 3, 4, 5,…		

1) *Start value* = 1.0 × U_n, Voltage before fault = 1.1 × 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...0.20

Table 42. Three-phase undervoltage protection (PHPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PHPTUV	0.05...1.20 × U_n	0.01
Time multiplier	PHPTUV	0.05...15.00	0.01
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, see the Operation characteristics table

Table 43. Three-phase overvoltage protection (PHPTOV)

Characteristic	Value		
Operation accuracy	Depending on the frequency of the measured voltage: 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*		23 ms	27 ms	31 ms
Reset time	Typically 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 × f_n, where n = 2, 3, 4, 5,…		

1) *Start value* = 1.0 × U_n, Voltage before fault = 0.9 × U_n, f_n = 50 Hz, overvoltage 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) Maximum *Start value* = 1.20 × U_n, *Start value* multiples in range of 1.10...2.00

ABB   35

Table 44. Three-phase overvoltage protection (PHPTOV) main settings

Parameter	Function	Value (Range)	Step
Start value	PHPTOV	$0.05...1.60 \times U_n$	0.01
Time multiplier	PHPTOV	0.05...15.00	0.01
Operate delay time	PHPTOV	40...300000 ms	10
Operating curve type[1]	PHPTOV	Definite or inverse time Curve type: 5, 15, 17, 18, 19, 20	

1) For further reference, see the Operation characteristics table

Table 45. Positive-sequence undervoltage protection (PSPTUV)

Characteristic		Value		
Operation accuracy		Depending on the frequency of the measured voltage: f_n ±2 Hz		
		±1.5% of the set value or $±0.002 \times U_n$		
Start time[1][2]		Minimum	Typical	Maximum
	U_{Fault} = 0.99 × set *Start value*	52 ms	55 ms	58 ms
	U_{Fault} = 0.9 × set *Start value*	44 ms	47 ms	50 ms
Reset time		Typically 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		
Suppression of harmonics		DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…		

1) *Start value* = 1.0 × U_n, positive-sequence voltage before fault = 1.1 × 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 46. Positive-sequence undervoltage protection (PSPTUV) main settings

Parameter	Function	Value (Range)	Step
Start value	PSPTUV	$0.010...1.200 \times U_n$	0.001
Operate delay time	PSPTUV	40...120000 ms	10
Voltage block value	PSPTUV	$0.01...1.00 \times U_n$	0.01

Table 47. Negative-sequence overvoltage protection (NSPTOV)

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

1)   Negative-sequence voltage before fault = $0.0 \times U_n$, 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 48. Negative-sequence overvoltage protection (NSPTOV) main settings

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

Table 49. Frequency protection (FRPFRQ)

Characteristic		Value
Operation accuracy	f>/f<	± 5 mHz
	df/dt	± 50 mHz/s (in range |df/dt| <5 Hz/s)
		$\pm 2.0\%$ 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		$\pm 1.0\%$ of the set value or ± 30 ms

ABB

37

Table 50. Frequency protection (FRPFRQ) main settings

Parameter	Function	Value (Range)	Step
Operation mode	FRPFRQ	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	-
Start value Freq>	FRPFRQ	$0.9000...1.2000 \times F_n$	0.0001
Start value Freq<	FRPFRQ	$0.8000...1.1000 \times F_n$	0.0001
Start value df/dt	FRPFRQ	$-0.2000...0.2000 \times F_n/s$	0.0025
Operate Tm Freq	FRPFRQ	80...200000 ms	10
Operate Tm df/dt	FRPFRQ	120...200000 ms	10

Table 51. Overexcitation protection (OEPVPH)

Characteristic	Value	
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz	
	±2.5% of the set value or 0.01 × Ub/f	
Start time [1][2]	Frequency change	Typically 200 ms (±20 ms)
	Voltage change	Typically 100 ms (±20 ms)
Reset time	<60 ms	
Reset ratio	Typically 0.96	
Retardation time	<45 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 ±50 ms	

1) Results based on statistical distribution of 1000 measurements
2) Includes the delay of the signal output contact

Table 52. Overexcitation protection (OEPVPH) main settings

Parameter	Function	Value (Range)	Step
Start value	OEPVPH	100...200%	1
Operating curve type	OEPVPH	Definite or inverse time Curve type: 5, 15, 17, 18, 19, 20	
Time multiplier	OEPVPH	0.1...100.0	0.1
Operate delay time	OEPVPH	200...200000 ms	10
Cooling time	OEPVPH	5...10000 s	1

Table 53. Three-phase thermal overload protection, two time constants (T2PTTR)

Characteristic	Value
Operation accuracy	Depending on the frequency of the measured current: 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 54. Three-phase thermal overload 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
Short time constant	T2PTTR	6...60000 s	1
Weighting factor p	T2PTTR	0.00...1.00	0.01
Current reference	T2PTTR	0.05...4.00 × I_n	0.01
Operation	T2PTTR	1 = on 5 = off	-

Table 55. Loss of phase, undercurrent (PHPTUC)

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 × I_n
Start time	Typically <55 ms
Reset time	<40 ms
Reset ratio	Typically 1.04
Retardation time	<35 ms
Operate time accuracy in definite time mode	mode ±1.0% of the set value or ±20 ms

Table 56. Phase undercurrent protection (PHPTUC) main settings

Parameter	Function	Value (Range)	Step
Current block value	PHPTUC	0.00...0.50 × I_n	0.01
Start value	PHPTUC	0.01...1.00 × I_n	0.01
Operate delay time	PHPTUC	50...200000 ms	10

ABB | 39

Table 57. Stabilized and instantaneous differential protection for two-winding transformers (TR2PTDF)

Characteristic	Value		
Operation accuracy	Depending on the frequency of the measured current: f_n ±2 Hz		
	±3.0% of the set value or ±0.002 × I_n		
Start time[1][2]		Minimum	Typical	Maximum
	Low stage	36 ms	41 ms	46 ms
	High stage	21 ms	22 ms	24 ms
Reset time	Typically 40 ms		
Reset ratio	Typically 0.96		
Suppression of harmonics	DFT: -50 dB at f = n × 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 × set operate value and f_n = 50 Hz.

Table 58. Stabilized differential protection for two-winding transformers (TR2PTDF) main settings

Parameter	Function	Value (Range)	Step
High operate value	TR2PTDF	500...3000 %I_r	10
Low operate value	TR2PTDF	5...50 %I_r	1
Slope section 2	TR2PTDF	10...50%	1
End section 2	TR2PTDF	100...500 %I_r	1
Restraint mode	TR2PTDF	5 = Waveform 6 = 2.h + waveform 8 = 5.h + waveform 9 = 2.h + 5.h + wav	-
Start value 2.H	TR2PTDF	7...20%	1
Start value 5.H	TR2PTDF	10...50%	1
Operation	TR2PTDF	1 = on 5 = off	-
Winding 1 type	TR2PTDF	1 = Y 2 = YN 3 = D 4 = Z 5 = ZN	-
Winding 2 type	TR2PTDF	1 = y 2 = yn 3 = d 4 = z 5 = zn	-
Zro A elimination	TR2PTDF	1 = Not eliminated 2 = Winding 1 3 = Winding 2 4 = Winding 1 and 2	-

ABB

Table 59. Numerical stabilized low-impedance restricted earth-fault protection (LREFPNDF)

Characteristic	Value		
Operation accuracy	Depending on the frequency of the measured current: f_n ±2 Hz		
	±2.5% of the set value or ±0.002 x I_n		
Start time[1][2]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 × set *Operate value*	37 ms	41 ms	45 ms
Reset time	Typically 40 ms		
Reset ratio	Typically 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)   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 60. Numerical stabilized low-impedance restricted earth-fault protection (LREFPNDF) main settings

Parameter	Function	Value (Range)	Step
Operate value	LREFPNDF	5...50 %I_n	1
Minimum operate time	LREFPNDF	40...300000 ms	1
Restraint mode	LREFPNDF	1 = None 2 = Harmonic2	-
Start value 2.H	LREFPNDF	10...50%	1
Operation	LREFPNDF	1 = on 5 = off	-

Table 61. High-impedance based restricted earth-fault protection (HREFPDIF)

Characteristic	Value		
Operation accuracy	Depending on the frequency of the measured current: f_n ±2 Hz		
	±1.5% of the set value or ±0.002 × I_n		
Start time[1][2]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 × set *Operate value*	16 ms	21 ms	23 ms
	I_{Fault} = 10.0 × set *Operate value*	11 ms	13 ms	14 ms
Reset time	Typically 40 ms		
Reset ratio	Typically 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 62. High-impedance based restricted earth-fault protection (HREFPDIF) main settings

Parameter	Function	Value (Range)	Step
Operate value	HREFPDIF	$1.0...50.0\%I_n$	0.1
Minimum operate time	HREFPDIF	40...300000 ms	1
Operation	HREFPDIF	1 = on 5 = off	-

Table 63. Circuit breaker failure protection (CCBRBRF)

Characteristic	Value
Operation accuracy	Depending on the frequency of the measured current: $f_n \pm 2$ Hz
	$\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$
Operate time accuracy	$\pm 1.0\%$ of the set value or ± 20 ms
Reset time[1]	Typically 40 ms
Retardation time	<20 ms

1) Trip pulse time defines the minimum pulse length

Table 64. Circuit breaker failure protection (CCBRBRF) main settings

Parameter	Function	Value (Range)	Step
Current value	CCBRBRF	$0.05...2.00 \times I_n$	0.01
Current value Res	CCBRBRF	$0.05...2.00 \times I_n$	0.01
CB failure mode	CCBRBRF	1 = Current 2 = Breaker status 3 = Both	-
CB fail retrip 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 65. Three-phase inrush detector (INRPHAR)

Characteristic	Value
Operation accuracy	At the frequency $f = f_n$
	Current measurement: $\pm 1.5\%$ of the set value or $\pm 0.002 \times I_n$ Ratio I2f/I1f measurement: $\pm 5.0\%$ of the set value
Reset time	+35 ms / -0 ms
Reset ratio	Typically 0.96
Operate time accuracy	+35 ms / -0 ms

ABB

Table 66. Three-phase inrush detector (INRPHAR) main settings

Parameter	Function	Value (Range)	Step
Start value	INRPHAR	5...100%	1
Operate delay time	INRPHAR	20...60000 ms	1

Table 67. Arc protection (ARCSARC)

Characteristic		Value		
Operation accuracy		±3% of the set value or ±0.01 × I_n		
Operate time		Minimum	Typical	Maximum
	Operation mode = "Light +current"[1][2]	9 ms[3] 4 ms[4]	12 ms[3] 6 ms[4]	15 ms[3] 9 ms[4]
	Operation mode = "Light only"[2]	9 ms[3] 4 ms[4]	10 ms[3] 6 ms[4]	12 ms[3] 7 ms[4]
Reset time		Typically 40 ms[3] <55 ms[4]		
Reset ratio		Typically 0.96		

[1] Phase start value = 1.0 × I_n, current before fault = 2.0 × 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
[3] Normal power output
[4] High-speed output

Table 68. Arc protection (ARCSARC) main settings

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

Table 69. Load-shedding and restoration (LSHDPFRQ)

Characteristic		Value
Operation accuracy	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<	<80 ms
	df/dt	<120 ms
Reset time		<150 ms
Operate time accuracy		±1.0% of the set value or ±30 ms

ABB | 43

Table 70. Load-shedding and restoration (LSHDPFRQ) main settings

Parameter	Function	Value (Range)	Step
Load shed mode	LSHDPFRQ	1 = Freq< 6 = Freq< OR df/dt 8 = Freq< AND df/dt	-
Restore mode	LSHDPFRQ	1 = Disabled 2 = Auto 3 = Manual	-
Start value Freq	LSHDPFRQ	$0.800...1.200 \times f_n$	0.001
Start value df/dt	LSHDPFRQ	$-0.200...-0.005 \times f_n/s$	0.005
Operate Tm Freq	LSHDPFRQ	80...200000 ms	10
Operate Tm df/dt	LSHDPFRQ	120...200000 ms	10
Restore start Val	LSHDPFRQ	$0.800...1.200 \times f_n$	0.001
Restore delay time	LSHDPFRQ	80...200000 ms	10

Table 71. Multipurpose protection (MAPGAPC)

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

Table 72. Multipurpose 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	1 = Over 2 = Under	-

Table 73. Automatic switch-onto-fault (CVPSOF)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz
	Current: ±1.5% of the set value or $±0.002 \times I_n$ Voltage: ±1.5% of the set value or $±0.002 \times U_n$
Operate time accuracy	±1.0% of the set value or ±20 ms
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where n = 2, 3, 4, 5,…

Table 74. Automatic switch-onto-fault logic (CVPSOF) main settings

Parameter	Function	Value (Range)	Step
SOTF reset time	CVPSOF	0...60000 ms	10

Table 75. Underpower protection (DUPPDPR)

Characteristic	Value
Operation accuracy [1]	Depending on the frequency of the measured current and voltage: f_n ±2 Hz
	Power measurement accuracy ±3% of the set value or ±0.002 × S_n Phase angle: ±2°
Start time [2][3]	Typically 45 ms
Reset time	Typically 30 ms
Reset ratio	Typically 1.04
Operate time accuracy	±1.0% of the set value of ±20 ms
Suppression of harmonics	-50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

1) *Measurement mode* = "Pos Seq" (default)
2) U = U_n, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
3) Includes the delay of the signal output contact

Table 76. Underpower protection (DUPPDPR) main settings

Parameter	Function	Value (Range)	Step
Start value	DUPPDPR	0.01...2.00 × S_n	0.01
Operate delay time	DUPPDPR	40...300000 ms	10
Pol reversal	DUPPDPR	0 = False 1 = True	-
Disable time	DUPPDPR	0...60000 ms	1000

Table 77. Reverse power/directional overpower protection (DOPPDPR)

Characteristic	Value
Operation accuracy [1]	Depending on the frequency of the measured current and voltage: f = f_n ±2 Hz
	Power measurement accuracy ±3% of the set value or ±0.002 × S_n Phase angle: ±2°
Start time [2][3]	Typically 45 ms
Reset time	Typically 30 ms
Reset ratio	Typically 0.94
Operate time accuracy	±1.0% of the set value of ±20 ms
Suppression of harmonics	-50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

1) *Measurement mode* = "Pos Seq" (default)
2) U = U_n, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
3) Includes the delay of the signal output contact

ABB

45

Table 78. Reverse power/directional overpower protection (DOPPDPR) main settings

Parameter	Function	Value (Range)	Step
Start value	DOPPDPR	$0.01...2.00 \times S_n$	0.01
Operate delay time	DOPPDPR	40...300000 ms	10
Directional mode	DOPPDPR	2 = Forward 3 = Reverse	-
Power angle	DOPPDPR	-90...90°	1

Table 79. Operation characteristics

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

Control functions

Table 80. Synchronism and energizing check (SECRSYN)

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±1 Hz
	Voltage: ±3.0% of the set value or ±0.01 × U_n Frequency: ±10 mHz Phase angle: ±3°
Reset time	<50 ms
Reset ratio	Typically 0.96
Operate time accuracy in definite time mode	±1.0% of the set value or ±20 ms

Table 81. Synchronism and energizing check (SECRSYN) main settings

Parameter	Function	Value (Range)	Step
Live dead mode	SECRSYN	-1 = Off 1 = Both Dead 2 = Live L, Dead B 3 = Dead L, Live B 4 = Dead Bus, L Any 5 = Dead L, Bus Any 6 = One Live, Dead 7 = Not Both Live	-
Difference voltage	SECRSYN	0.01...0.50 × U_n	0.01
Difference frequency	SECRSYN	0.001...0.100 × f_n	0.001
Difference angle	SECRSYN	5...90°	1
Synchrocheck mode	SECRSYN	1 = Off 2 = Synchronous 3 = Asynchronous	-
Dead line value	SECRSYN	0.1...0.8 × U_n	0.1
Live line value	SECRSYN	0.2...1.0 × U_n	0.1
Close pulse	SECRSYN	200...60000 ms	10
Max energizing V	SECRSYN	0.50...1.15 × U_n	0.01
Control mode	SECRSYN	1 = Continuous 2 = Command	-
Phase shift	SECRSYN	-180...180°	1
Minimum Syn time	SECRSYN	0...60000 ms	10
Maximum Syn time	SECRSYN	100...6000000 ms	10
Energizing time	SECRSYN	100...60000 ms	10
Closing time of CB	SECRSYN	40...250 ms	10

Table 82. Tap changer position indication (TPOSYLTC)

Descrpition	Value
Response time for binary inputs	Typically 100 ms

ABB   47

Table 83. Tap changer control with voltage regulator (OLATCC)

Characteristic	Value
Operation accuracy[1]	Depending on the frequency of the measured current: f_n ±2 Hz
	Differential voltage U_d = ±0.5% of the measured value or ±0.005 × U_n (in measured voltages <2.0 × U_n) Operation value = ±1.5% of the U_d for Us = 1.0 × U_n
Operate time accuracy in definite time mode[2]	+4.0%/-0% of the set value
Operate time accuracy in inverse time mode[2]	+8.5%/-0% of the set value (at theoretical B in range of 1.1…5.0) Also note fixed minimum operate time (IDMT) 1 s.
Reset ratio for control operation Reset ratio for analogue based blockings (except run back raise voltage blocking)	Typically 0.80 (1.20) Typically 0.96 (1.04)

1)   Default setting values used
2)   Voltage before deviation = set *Band center voltage*

ABB

Table 84. Tap changer control with voltage regulator (OLATCC) main settings

Parameter	Function	Value (Range)	Step
Auto parallel mode	OLATCC	2 = Auto master 3 = Auto follower 5 = NRP 7 = MCC	-
Band center voltage	OLATCC	$0.000...2.000 \times U_n$	0.001
Line drop V Ris	OLATCC	0.0...25.0%	0.1
Line drop V React	OLATCC	0.0...25.0%	0.1
Stability factor	OLATCC	0.0...70.0%	0.1
Load phase angle	OLATCC	-89...89°	1
Control delay time 1	OLATCC	1000...300000 ms	100
Control delay time 2	OLATCC	1000...300000 ms	100
Operation mode	OLATCC	1 = Manual 2 = Auto single 3 = Auto parallel 4 = Input control 5 = Command	-
Custom Man blocking	OLATCC	1 = Custom disabled 2 = OC 3 = UV 4 = OC, UV 5 = EXT 6 = OC, EXT 7 = UV, EXT 8 = OC, UV, EXT	-
Delay characteristics	OLATCC	0 = Inverse time 1 = Definite time	-
Band width voltage	OLATCC	$1.20...18.00 \ \%U_n$	0.01
Load current limit	OLATCC	$0.10...5.00 \times I_n$	0.01
Block lower voltage	OLATCC	$0.10...1.20 \times U_n$	0.01
Runback raise V	OLATCC	$0.80...2.40 \times U_n$	0.01
Cir current limit	OLATCC	$0.10...5.00 \times I_n$	0.01
LDC limit	OLATCC	$0.00...2.00 \times U_n$	0.01
Lower block tap	OLATCC	-36...36	-
Raise block tap	OLATCC	-36...36	-
LCT pulse time	OLATCC	500...10000 ms	100
LDC enable	OLATCC	0 = False 1 = True	-
Follower delay time	OLATTC	6...20 s	-

ABB   49

Condition monitoring and supervision functions

Table 85. Circuit-breaker condition monitoring (SSCBR)

Characteristic	Value
Current measuring accuracy	±1.5% or ±0.002 × I_n (at currents in the range of 0.1…10 × I_n) ±5.0% (at currents in the range of 10…40 × I_n)
Operate time accuracy	±1.0% of the set value or ±20 ms
Travelling time measurement	+10 ms / -0 ms

Table 86. Current circuit supervision (CCSPVC)

Characteristic	Value
Operate time [1]	<30 ms

1)   Including the delay of the output contact

Table 87. Current circuit supervision (CCSPVC) main settings

Parameter	Function	Value (Range)	Step
Start value	CCSPVC	0.05...0.20 × I_n	0.01
Max operate current	CCSPVC	1.00...5.00 × I_n	0.01

Table 88. Advanced current circuit supervision for transformers (CTSRCTF)

Characteristic	Value
Operate time [1]	<30 ms

1)   Including the delay of the output contact

Table 89. Advanced current circuit supervision for transformers (CTSRCTF) main settings

Parameter	Function	Value (Range)	Step
Min operate current	CTSRCTF	0.01...0.50 × I_n	0.01
Max operate current	CTSRCTF	1.00...5.00 × I_n	0.01
Max Ng Seq current	CTSRCTF	0.01...1.00 × I_n	0.01

Table 90. Fuse failure supervision (SEQSPVC)

Characteristic		Value	
Operate time [1]	NPS function	U_{Fault} = 1.1 × set *Neg Seq voltage Lev*	<33 ms
		U_{Fault} = 5.0 × set *Neg Seq voltage Lev*	<18 ms
	Delta function	ΔU = 1.1 × set *Voltage change rate*	<30 ms
		ΔU = 2.0 × 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 91. Runtime counter for machines and devices (MDSOPT)

Description	Value
Motor runtime measurement accuracy[1]	±0.5%

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

ABB   51

Measurement functions

Table 92. Three-phase current measurement (CMMXU)

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

Table 93. Sequence current measurement (CSMSQI)

Characteristic	Value
Operation accuracy	Depending on the frequency of the measured current: f/f_n = ±2 Hz
	±1.0% or ±0.002 × I_n at currents in the range of 0.01...4.00 × I_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…

Table 94. 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 × I_n at currents in the range of 0.01...4.00 × I_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,… RMS: No suppression

Table 95. 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 × U_n
	±0.5% or ±0.002 × U_n
Suppression of harmonics	DFT: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,… RMS: No suppression

Table 96. Single-phase voltage measurement (VAMMXU)

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

Table 97. Residual voltage measurement (RESVMMXU)

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

Table 98. Sequence voltage measurement (VSMSQI)

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

Table 99. Three-phase power and energy measurement (PEMMXU)

Characteristic	Value
Operation accuracy	At all three currents in range $0.10…1.20 \times I_n$
	At all three voltages in range $0.50…1.15 \times U_n$
	At the frequency $f_n \pm 1$ Hz
	$\pm 1.5\%$ for apparent power S
	$\pm 1.5\%$ for active power P and active energy[1]
	$\pm 1.5\%$ for reactive power Q and reactive energy[2]
	± 0.015 for power factor
Suppression of harmonics	DFT: -50 dB at $f = n \times f_n$, where n = 2, 3, 4, 5,…

1) |PF| >0.5 which equals |cosφ| >0.5
2) |PF| <0.86 which equals |sinφ| >0.5

Table 100. Frequency measurement (FMMXU)

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

ABB   53

Power quality functions

Table 101. Voltage variation (PHQVVR)

Characteristic	Value
Operation accuracy	±1.5% of the set value or ±0.2% of reference voltage
Reset ratio	Typically 0.96 (Swell), 1.04 (Dip, Interruption)

Table 102. Voltage variation (PHQVVR) main settings

Parameter	Function	Value (Range)	Step
Voltage dip set 1	PHQVVR	10.0...100.0%	0.1
Voltage dip set 2	PHQVVR	10.0...100.0%	0.1
Voltage dip set 3	PHQVVR	10.0...100.0%	0.1
Voltage swell set 1	PHQVVR	100.0...140.0%	0.1
Voltage swell set 2	PHQVVR	100.0...140.0%	0.1
Voltage swell set 3	PHQVVR	100.0...140.0%	0.1
Voltage Int set	PHQVVR	0.0...100.0%	0.1
VVa Dur Max	PHQVVR	100...3600000 ms	100

Table 103. Voltage unbalance (VSQVUB)

Characteristic	Value
Operation accuracy	±1.5% of the set value or ±0.002 × U_n
Reset ratio	Typically 0.96

Table 104. Voltage unbalance (VSQVUB) main settings

Parameter	Function	Value (Range)	Step
Operation	VSQVUB	1 = on 5 = off	-
Unb detection method	VSQVUB	1 = Neg Seq 2 = Zero Seq 3 = Neg to Pos Seq 4 = Zero to Pos Seq 5 = Ph vectors Comp	-

Other functions

Table 105. Pulse timer (PTGAPC)

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

Table 106. Time delay off (8 pcs) (TOFPAGC)

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

Table 107. Time delay on (8 pcs) (TONGAPC)

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

ABB   55

21. Local HMI

The relay supports process information and status monitoring from the relay's local HMI via its display and indication/alarm LEDs. The local LHMI also enables control operations for the equipment connected and controlled by the relay, either via display or via manual push buttons available on the local HMI.

LCD display offers front-panel user interface functionality with menu navigation and menu views. In addition, the display includes a user-configurable two-page single-line diagram (SLD) with a position indication for the associated primary equipment and primary measurements from the process. The SLD can be modified according to user requirements by using Graphical Display Editor in PCM600.

The local HMI also includes 11 programmable LEDs. These LEDs can be configured to show alarms and indications as needed by PCM600 graphical configuration tool. The LEDs include two separately controllable colors, red and green, making one LED able to indicate better the different states of the monitored object.

The relay also includes 16 configurable manual push buttons, which can freely be configured by the PCM600 graphical configuration tool. These buttons can be configured to control the relay's internal features for example changing setting group, triggering disturbance recordings or changing operation modes for functions or to control relay external equipment, for example lowering or raising tap changer, via relay binary outputs. These buttons also include a small indication LED for each button. This LED is freely configurable, making it possible to use push button LEDs to indicate button activities or as additional indication/alarm LEDs in addition to the 11 programmable LEDs.

The local HMI includes a push button (L/R) for the local/remote operation of the relay. When the relay is in the local mode, the relay can be operated only by using the local front-panel user interface. When the relay is in the remote mode, the relay can execute commands sent remotely. The relay 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 the relays are in the local mode during maintenance work and that the circuit breakers cannot be operated remotely from the network control center.
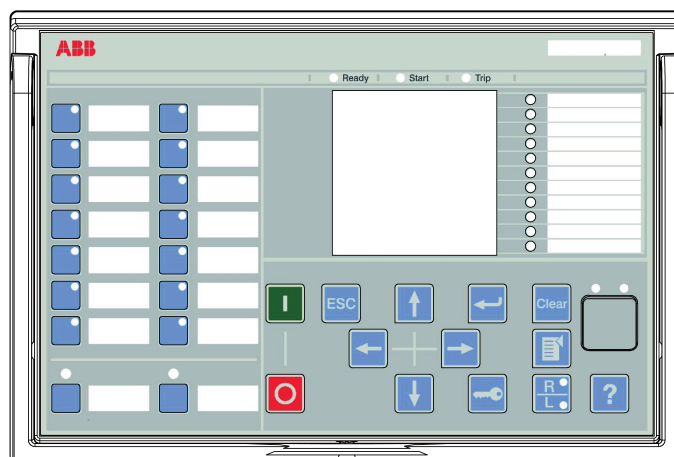
Figure 8. Example of the LHMI

22. Mounting methods

By means of appropriate mounting accessories, the standard relay case can be flush mounted, semi-flush mounted or wall mounted.

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

For routine testing purposes, the relay cases can be equipped with test switches, type RTXP 24, which can be mounted side by side with the relay cases.

Mounting methods
• Flush mounting
• Semi-flush mounting
• Rack mounting
• Wall mounting
• Mounting to a 19" equipment frame
• Mounting with an RTXP 24 test switch to a 19" rack

Panel cut-out for flush mounting
• Height: 162 ±1 mm
• Width: 248 ±1 mm
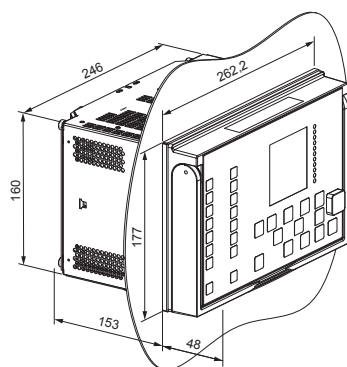
Figure 9.   Flush mounting
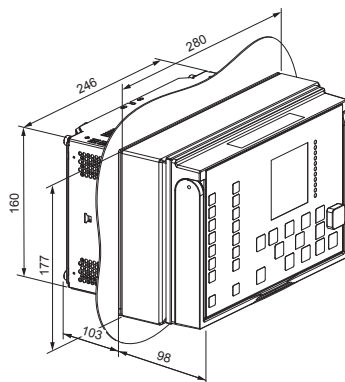
Figure 10.   Semi-flush mounting
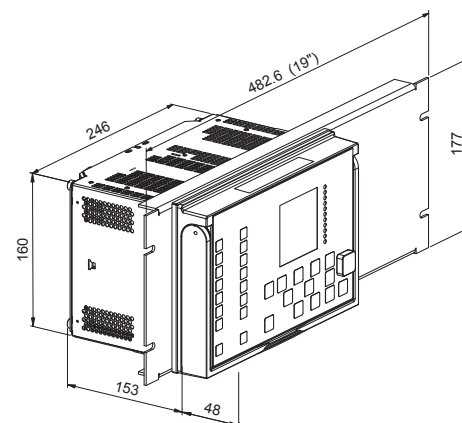
Figure 11.   Rack mounting
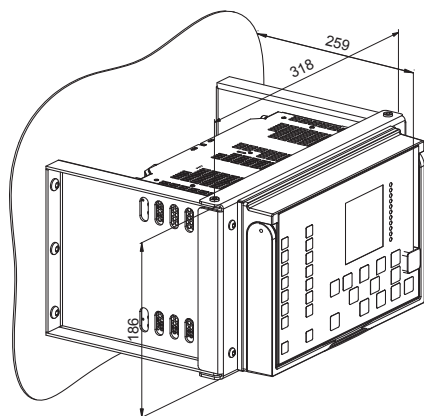
Figure 12.   Wall mounting

23. Relay case and plug-in unit

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

ABB   57

24. Selection and ordering data

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

Use ABB Library to access the selection and ordering information and to generate the order number.

Product Selection Tool (PST), a Next-Generation Order Number Tool, supports order code creation for ABB Distribution Automation IEC products with emphasis on, but not exclusively for, the Relion product family. PST is an easy-to-use, online tool always containing the latest product information. The complete order code can be created with detailed specification and the result can be printed and mailed. Registration is required.

N B T N A A N N A B C 1 B N N 1 1 G

#	Description	
1	**IED**	
	620 series IED (including case)	N
	Complete Relay with conformal coating	5
2	**Standard**	
	IEC	B
	CN	C
3	**Main application**	
	Transformer protection and control	T
4	**Functional application**	
	Example configuration	N
5-6	**Analog inputs and outputs**	
	8I (I_0 1/5 A) + 6U + 8BI + 13BO + 2RTD in + 1mA in	AA
7-8	**Optional board**	
	Optional I/Os 8BI+ 4BO	AA
	Optional RTDs 6RTD in + 2mA in	AB
	Optional Fast I/Os 8BI + 3HSO	AC
	No optional board	NN

N B T N A A N N **A B** C 1 B N N 1 1 G

9 - 10	Communication (Serial/Ethernet)	
	Serial RS 485, incl. an input for IRIG-B + Ethernet 100Base FX (1xLC)	AA
	Serial RS 485, incl. an input for IRIG-B + Ethernet 100Base TX (1xRJ45)	AB
	Serial RS 485, incl. an input for IRIG-B	AN
	Serial glass fibre (ST) + Ethernet 100Base TX (1xRJ45) + 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 and FX (1xLC, 2xRJ45) with HSR/PRP	BC
	Serial glass fibre (ST) + Ethernet 100Base TX (3xRJ45) with HSR/PRP	BD
	Serial glass fibre (ST) + Ethernet 100Base TX and FX (2xLC, 1xRJ45) with HSR/PRP	BE
	Serial glass fibre (ST) + Ethernet 100Base TX and FX (1xLC, 2xRJ45) with HSR/PRP and IEC61850-9-2LE	BF
	Serial glass fibre (ST) + Ethernet 100Base TX (3xRJ45) with HSR/PRP and IEC61850-9-2LE	BG
	Serial glass fibre (ST) + Ethernet 100Base TX and FX (2xLC, 1xRJ45) with HSR/PRP and IEC61850-9-2LE	BH
	Serial glass fibre (ST) + Serial RS 485 connector, RS 232/485 D-Sub 9 connector + input for IRIG-B (cannot be combined with arc protection)	BN
	RS 232/485 (including IRIG-B) + Ethernet 100Base TX (1xRJ45) (cannot be combined with arc protection)	CB
	RS 232/485 + RS 485/ Glassfiber ST (including IRIG-B) (cannot be combined with arc protection)	CN
	Ethernet 100Base FX (1xLC)	NA
	Ethernet 100Base TX (1xRJ45)	NB
	Ethernet 100Base TX and FX (1xLC, 2xRJ45) with HSR/PRP	NC
	Ethernet 100Base TX (3xRJ45) with HSR/PRP	ND
	Ethernet 100Base TX and FX (2xLC, 1xRJ45) with HSR/PRP	NE
	Ethernet 100Base TX and FX (1xLC, 2xRJ45) with HSR/PRP and IEC61850-9-2LE	NF
	Ethernet 100Base TX (3xRJ45) with HSR/PRP and IEC61850-9-2LE	NG
	Ethernet 100Base TX and FX (2xLC, 1xRJ45) with HSR/PRP and IEC61850-9-2LE	NH
	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.

ABB   59

N B T N A A N N A B **C 1 B** N N **1 1 G**

#	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
	IEC 61850 + IEC 60870-5-103 (for serial + Ethernet communication modules)	G
	IEC 61850 + DNP3 (for Ethernet or serial + Ethernet communication modules)	H
12	**Language**	
	English	1
	English and Chinese	2
13	**Front panel**	
	Large LCD with Single Line Diagram - IEC	B
	Large LCD with Single Line Diagram - CN	D
14	**Option 1**	
	Arc protection (requires a communication module, cannot be combined with com. module options BB, BN, CB and CN)	B
	None	N
15	**Option 2**	
	Automatic voltage regulator	A
	None	N
16	**Power supply**	
	Power supply 48-250 VDC, 100-240 VAC	1
	Power supply 24-60 VDC	2
17 - 18	**Reserved**	
	Product version 2.0 FP1	1G

Example code: N B T N A A N N A B C 1 B N N 1 1 G

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 relays

25. Accessories and ordering data

Table 108. 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 109. Mounting accessories

Item	Order number
Semi-flush mounting kit	2RCA030573A0001
Wall mounting kit	2RCA030894A0001
19" rack mounting kit with cut-out for one relay	2RCA031135A0001
19" rack mounting kit for one relay and one RTXP24 test switch (the test switch and wire harness are not included in the delivery)	2RCA032818A0001
Mounting bracket for one relay with test switch RTXP in 4U Combiflex (RHGT 19" variant C) (the test switch, wire harness and Combiflex RGHT 19" variant C are not included in the delivery)	2RCA032826A0001
Functional earthing flange for RTD modules	2RCA036978A0001[1]

1)   Cannot be used when the IED is mounted with the Combiflex 19" equipment frame (2RCA032826A0001).

26. Tools

The protection relay is delivered as a preconfigured unit including the example configuration. The default parameter setting values can be changed from the front-panel user interface (local HMI), the Web browser-based user interface (Web HMI) or Protection and Control IED Manager PCM600 in combination with the relay-specific connectivity package.

PCM600 offers extensive relay configuration functions. For example, depending on the protection relay, the relay signals, application, graphical display and single-line diagram, and IEC 61850 communication, including horizontal GOOSE communication, can be modified with PCM600.

When the Web HMI is used, the protection relay can be accessed either locally or remotely using a Web browser (Internet Explorer). For security reasons, the Web HMI is disabled by default but it can be enabled via the local HMI. The Web HMI functionality can be limited to read-only access.

The relay connectivity package is a collection of software and specific relay information, which enables system products and tools to connect and interact with the protection relay. The connectivity packages reduce the risk of errors in system integration, minimizing device configuration and setup times. Further, the connectivity packages for protection relays of this product series include a flexible update tool for adding one additional local HMI language to the protection relay. The update tool is activated using PCM600, and it enables multiple updates of the additional HMI language, thus offering flexible means for possible future language updates.

Table 110. Tools

Description	Version
PCM600	2.6 (Rollup 20150626) or later
Web browser	IE 8.0, IE 9.0, IE 10.0 or IE 11.0
RET620 Connectivity Package	2.1 or later

ABB   61

Table 111. Supported functions

Function	Web HMI	PCM600
Relay parameter setting	●	●
Saving of relay parameter settings in the relay	●	●
Signal monitoring	●	●
Disturbance recorder handling	●	●
Alarm LED viewing	●	●
Access control management	●	●
Relay signal configuration (Signal Matrix)	-	●
Modbus® communication configuration (communication management)	-	●
DNP3 communication configuration (communication management)	-	●
IEC 60870-5-103 communication configuration (communication management)	-	●
Saving of relay parameter settings in the tool	-	●
Disturbance record analysis	-	●
XRIO parameter export/import	-	●
Graphical display configuration	-	●
Application configuration	-	●
IEC 61850 communication configuration, GOOSE (communication configuration)	-	●
Phasor diagram viewing	●	-
Event viewing	●	●
Saving of event data on the user's PC	●	●
Online monitoring	-	●

● = Supported

27. Cyber security

The relay supports role based user authentication and authorization. It can store 2048 audit trail events to a nonvolatile memory. The nonvolatile memory is based on a memory type which does not need battery backup or regular component exchange to maintain the memory storage. FTP and Web HMI use TLS encryption with a minimum of 128 bit key length protecting the data in transit. In this case the used communication protocols are FTPS and HTTPS. All rear communication ports and optional protocol services can be deactivated according to the required system setup.
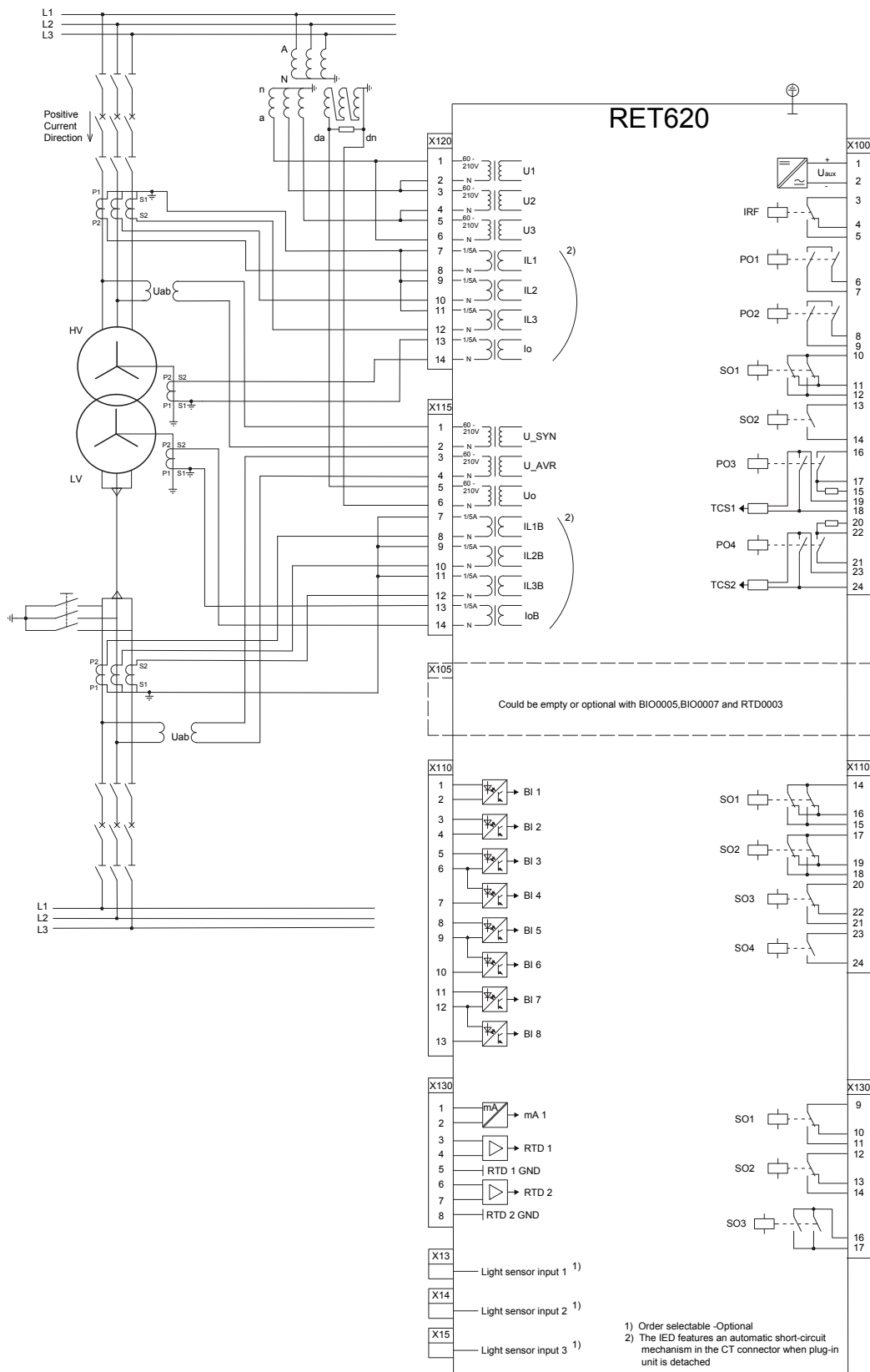
28. Connection diagrams

Figure: RET620 TE201 Connection diagram for standard modules

1) Order selectable -Optional
2) The IED features an automatic short-circuit mechanism in the CT connector when plug-in unit is detached

Figure 14.   Connection for the A configuration
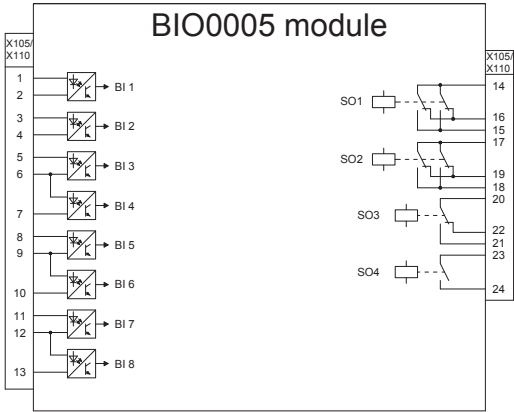
ABB

63

Figure 15.   Optional BIO0005 module (slot X105)
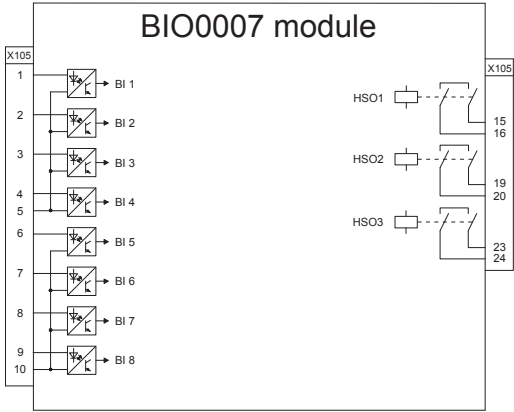
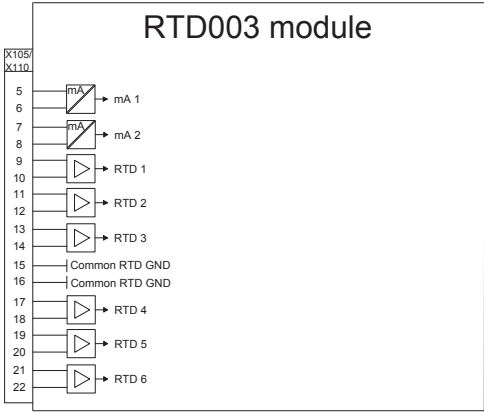Figure 16.   Optional BIO0007 module for fast outputs (slot X105)

Figure 17.   Optional RTD0003 module (slot X105)

29. Certificates

DNV GL has issued an IEC 61850 Edition 2 Certificate Level A1 for Relion® 620 series. Certificate number: 74108008-OPE/INC 15-2319.

DNV GL has issued an IEC 61850 Edition 1 Certificate Level A1 for Relion® 620 series. Certificate number: 74108008-OPE/INC 15-2323.

Additional certificates can be found on the product page.

30. References

The www.abb.com/substationautomation portal provides information on the entire range of distribution automation products and services.

The latest relevant information on the RET620 protection and control relay is found on the product page. Scroll down the page to find and download the related documentation.

ABB   65

31. Functions, codes and symbols

Table 112. Functions included in the relay

Function	IEC 61850	IEC 60617	ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage	PHLPTOC1	3I> (1)	51P-1 (1)
	PHLPTOC2	3I> (2)	51P-1 (2)
Three-phase non-directional overcurrent protection, high stage	PHHPTOC1	3I>> (1)	51P-2 (1)
	PHHPTOC2	3I>> (2)	51P-2 (2)
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC1	3I>>> (1)	50P/51P (1)
	PHIPTOC2	3I>>> (2)	50P/51P (2)
Three-phase directional overcurrent protection, low stage	DPHLPDOC1	3I> -> (1)	67-1 (1)
Three-phase directional overcurrent protection, high stage	DPHHPDOC1	3I>> -> (1)	67-2 (1)
Non-directional earth-fault protection, low stage	EFLPTOC1	Io> (1)	51N-1 (1)
	EFLPTOC2	Io> (2)	51N-1 (2)
Non-directional earth-fault protection, high stage	EFHPTOC1	Io>> (1)	51N-2 (1)
	EFHPTOC2	Io>> (2)	51N-2 (2)
Directional earth-fault protection, low stage	DEFLPDEF1	Io> -> (1)	67N-1 (1)
	DEFLPDEF2	Io> -> (2)	67N-1 (2)
Directional earth-fault protection, high stage	DEFHPDEF1	Io>> -> (1)	67N-2 (1)
Negative-sequence overcurrent protection	NSPTOC1	I2> (1)	46 (1)
	NSPTOC2	I2> (2)	46 (2)
Residual overvoltage protection	ROVPTOV1	Uo> (1)	59G (1)
	ROVPTOV2	Uo> (2)	59G (2)
	ROVPTOV3	Uo> (3)	59G (3)
Three-phase undervoltage protection	PHPTUV1	3U< (1)	27 (1)
	PHPTUV2	3U< (2)	27 (2)
	PHPTUV3	3U< (3)	27 (3)
	PHPTUV4	3U< (4)	27 (4)
Three-phase overvoltage protection	PHPTOV1	3U> (1)	59 (1)
	PHPTOV2	3U> (2)	59 (2)
	PHPTOV3	3U> (3)	59 (3)
Positive-sequence undervoltage protection	PSPTUV1	U1< (1)	47U+ (1)
	PSPTUV2	U1< (2)	47U+ (2)
Negative-sequence overvoltage protection	NSPTOV1	U2> (1)	47O- (1)
	NSPTOV2	U2> (2)	47O- (2)
Frequency protection	FRPFRQ1	f>/f<,df/dt (1)	81 (1)
	FRPFRQ2	f>/f<,df/dt (2)	81 (2)
	FRPFRQ3	f>/f<,df/dt (3)	81 (3)

Table 112. Functions included in the relay, continued

Function	IEC 61850	IEC 60617	ANSI
Overexcitation protection	OEPVPH1	U/f> (1)	24 (1)
	OEPVPH2	U/f> (2)	24 (2)
Three-phase thermal overload protection, two time constants	T2PTTR1	3Ith>T/G/C (1)	49T/G/C (1)
Loss of phase (undercurrent)	PHPTUC1	3I< (1)	37 (1)
	PHPTUC2	3I< (2)	37 (2)
Stabilized and instantaneous differential protection for two-winding transformers	TR2PTDF1	3dI>T (1)	87T (1)
Numerical stabilized low-impedance restricted earth-fault protection	LREFPNDF1	dIoLo> (1)	87NL (1)
	LREFPNDF2	dIoLo> (2)	87NL (2)
High-impedance based restricted earth-fault protection	HREFPDIF1	dIoHi> (1)	87NH (1)
	HREFPDIF2	dIoHi> (2)	87NH (2)
Circuit breaker failure protection	CCBRBRF1	3I>/Io>BF (1)	51BF/51NBF (1)
	CCBRBRF2	3I>/Io>BF (2)	51BF/51NBF (2)
	CCBRBRF3	3I>/Io>BF (3)	51BF/51NBF (3)
Three-phase inrush detector	INRPHAR1	3I2f> (1)	68 (1)
Master trip	TRPPTRC1	Master Trip (1)	94/86 (1)
	TRPPTRC2	Master Trip (2)	94/86 (2)
	TRPPTRC3	Master Trip (3)	94/86 (3)
	TRPPTRC4	Master Trip (4)	94/86 (4)
Arc protection	ARCSARC1	ARC (1)	50L/50NL (1)
	ARCSARC2	ARC (2)	50L/50NL (2)
	ARCSARC3	ARC (3)	50L/50NL (3)
Load-shedding and restoration	LSHDPFRQ1	UFLS/R (1)	81LSH (1)
	LSHDPFRQ2	UFLS/R (2)	81LSH (2)
	LSHDPFRQ3	UFLS/R (3)	81LSH (3)
	LSHDPFRQ4	UFLS/R (4)	81LSH (4)
	LSHDPFRQ5	UFLS/R (5)	81LSH (5)
	LSHDPFRQ6	UFLS/R (6)	81LSH (6)

ABB   67

Table 112. Functions included in the relay, continued

Function	IEC 61850	IEC 60617	ANSI
Multipurpose protection	MAPGAPC1	MAP (1)	MAP (1)
	MAPGAPC2	MAP (2)	MAP (2)
	MAPGAPC3	MAP (3)	MAP (3)
	MAPGAPC4	MAP (4)	MAP (4)
	MAPGAPC5	MAP (5)	MAP (5)
	MAPGAPC6	MAP (6)	MAP (6)
	MAPGAPC7	MAP (7)	MAP (7)
	MAPGAPC8	MAP (8)	MAP (8)
	MAPGAPC9	MAP (9)	MAP (9)
	MAPGAPC10	MAP (10)	MAP (10)
	MAPGAPC11	MAP (11)	MAP (11)
	MAPGAPC12	MAP (12)	MAP (12)
	MAPGAPC13	MAP (13)	MAP (13)
	MAPGAPC14	MAP (14)	MAP (14)
	MAPGAPC15	MAP (15)	MAP (15)
	MAPGAPC16	MAP (16)	MAP (16)
	MAPGAPC17	MAP (17)	MAP (17)
	MAPGAPC18	MAP (18)	MAP (18)
Automatic switch-onto-fault logic (SOF)	CVPSOF1	CVPSOF (1)	SOFT/21/50 (1)
Underpower protection	DUPPDPR1	P< (1)	32U (1)
	DUPPDPR2	P< (2)	32U (2)
Reverse power/directional overpower protection	DOPPDPR1	P>/Q> (1)	32R/32O (1)
	DOPPDPR2	P>/Q> (2)	32R/32O (2)
	DOPPDPR3	P>/Q> (3)	32R/32O (3)
Control			
Circuit-breaker control	CBXCBR1	I <-> O CB (1)	I <-> O CB (1)
	CBXCBR2	I <-> O CB (2)	I <-> O CB (2)
	CBXCBR3	I <-> O CB (3)	I <-> O CB (3)
Disconnector control	DCXSWI1	I <-> O DCC (1)	I <-> O DCC (1)
	DCXSWI2	I <-> O DCC (2)	I <-> O DCC (2)
	DCXSWI3	I <-> O DCC (3)	I <-> O DCC (3)
	DCXSWI4	I <-> O DCC (4)	I <-> O DCC (4)
Earthing switch control	ESXSWI1	I <-> O ESC (1)	I <-> O ESC (1)
	ESXSWI2	I <-> O ESC (2)	I <-> O ESC (2)
	ESXSWI3	I <-> O ESC (3)	I <-> O ESC (3)

Table 112. Functions included in the relay, continued

Function	IEC 61850	IEC 60617	ANSI
Disconnector position indication	DCSXSWI1	I <-> O DC (1)	I <-> O DC (1)
	DCSXSWI2	I <-> O DC (2)	I <-> O DC (2)
	DCSXSWI3	I <-> O DC (3)	I <-> O DC (3)
	DCSXSWI4	I <-> O DC (4)	I <-> O DC (4)
Earthing switch indication	ESSXSWI1	I <-> O ES (1)	I <-> O ES (1)
	ESSXSWI2	I <-> O ES (2)	I <-> O ES (2)
	ESSXSWI3	I <-> O ES (3)	I <-> O ES (3)
Synchronism and energizing check	SECRSYN1	SYNC (1)	25 (1)
Tap changer position indication	TPOSYLTC1	TPOSM (1)	84M (1)
Tap changer control with voltage regulator	OLATCC1	COLTC (1)	90V (1)
Condition monitoring and supervision			
Circuit-breaker condition monitoring	SSCBR1	CBCM (1)	CBCM (1)
	SSCBR2	CBCM (2)	CBCM (2)
	SSCBR3	CBCM (3)	CBCM (3)
Trip circuit supervision	TCSSCBR1	TCS (1)	TCM (1)
	TCSSCBR2	TCS (2)	TCM (2)
Current circuit supervision	CCSPVC1	MCS 3I (1)	MCS 3I (1)
	CCSPVC2	MCS 3I (2)	MCS 3I (2)
Advanced current circuit supervision for transformers	CTSRCTF1	MCS 3I,I2 (1)	MCS 3I,I2 (1)
Fuse failure supervision	SEQSPVC1	FUSEF (1)	60 (1)
Runtime counter for machines and devices	MDSOPT1	OPTS (1)	OPTM (1)
	MDSOPT2	OPTS (2)	OPTM (2)
Measurement			
Three-phase current measurement	CMMXU1	3I (1)	3I (1)
	CMMXU2	3I (2)	3I (2)
Sequence current measurement	CSMSQI1	I1, I2, I0 (1)	I1, I2, I0 (1)
	CSMSQI2	I1, I2, I0 (B) (1)	I1, I2, I0 (B) (1)
Residual current measurement	RESCMMXU1	Io (1)	In (1)
	RESCMMXU2	Io (2)	In (2)
Three-phase voltage measurement	VMMXU1	3U (1)	3V (1)
Single-phase voltage measurement	VAMMXU2	U_A (2)	V_A (2)
	VAMMXU3	U_A (3)	V_A (3)
Residual voltage measurement	RESVMMXU1	Uo (1)	Vn (1)
Sequence voltage measurement	VSMSQI1	U1, U2, U0 (1)	V1, V2, V0 (1)
Three-phase power and energy measurement	PEMMXU1	P, E (1)	P, E (1)
Load profile record	LDPRLRC1	LOADPROF (1)	LOADPROF (1)
Frequency measurement	FMMXU1	f (1)	f (1)
Power quality			

ABB   69

Table 112. Functions included in the relay, continued

Function	IEC 61850	IEC 60617	ANSI
Current total demand distortion	CMHAI1	PQM3I (1)	PQM3I (1)
Voltage total harmonic distortion	VMHAI1	PQM3U (1)	PQM3V (1)
Voltage variation	PHQVVR1	PQMU (1)	PQMV (1)
Voltage unbalance	VSQVUB1	PQUUB (1)	PQVUB (1)
Other			
Minimum pulse timer (2 pcs)	TPGAPC1	TP (1)	TP (1)
	TPGAPC2	TP (2)	TP (2)
	TPGAPC3	TP (3)	TP (3)
	TPGAPC4	TP (4)	TP (4)
Minimum pulse timer (2 pcs, second resolution)	TPSGAPC1	TPS (1)	TPS (1)
	TPSGAPC2	TPS (2)	TPS (2)
Minimum pulse timer (2 pcs, minute resolution)	TPMGAPC1	TPM (1)	TPM (1)
	TPMGAPC2	TPM (2)	TPM (2)
Pulse timer (8 pcs)	PTGAPC1	PT (1)	PT (1)
	PTGAPC2	PT (2)	PT (2)
Time delay off (8 pcs)	TOFGAPC1	TOF (1)	TOF (1)
	TOFGAPC2	TOF (2)	TOF (2)
	TOFGAPC3	TOF (3)	TOF (3)
	TOFGAPC4	TOF (4)	TOF (4)
Time delay on (8 pcs)	TONGAPC1	TON (1)	TON (1)
	TONGAPC2	TON (2)	TON (2)
	TONGAPC3	TON (3)	TON (3)
	TONGAPC4	TON (4)	TON (4)
Set-reset (8 pcs)	SRGAPC1	SR (1)	SR (1)
	SRGAPC2	SR (2)	SR (2)
	SRGAPC3	SR (3)	SR (3)
	SRGAPC4	SR (4)	SR (4)
Move (8 pcs)	MVGAPC1	MV (1)	MV (1)
	MVGAPC2	MV (2)	MV (2)
	MVGAPC3	MV (3)	MV (3)
	MVGAPC4	MV (4)	MV (4)
Integer value move	MVI4GAPC1	MVI4 (1)	MVI4 (1)
	MVI4GAPC2	MVI4 (2)	MVI4 (2)
	MVI4GAPC3	MVI4 (3)	MVI4 (3)
	MVI4GAPC4	MVI4 (4)	MVI4 (4)

ABB

Table 112. Functions included in the relay, continued

Function	IEC 61850	IEC 60617	ANSI
Analog value scaling	SCA4GAPC1	SCA4 (1)	SCA4 (1)
	SCA4GAPC2	SCA4 (2)	SCA4 (2)
	SCA4GAPC3	SCA4 (3)	SCA4 (3)
	SCA4GAPC4	SCA4 (4)	SCA4 (4)
Generic control point (16 pcs)	SPCGAPC1	SPC (1)	SPC (1)
	SPCGAPC2	SPC (2)	SPC (2)
	SPCGAPC3	SPC (3)	SPC (3)
Remote generic control points	SPCRGAPC1	SPCR (1)	SPCR (1)
Local generic control points	SPCLGAPC1	SPCL (1)	SPCL (1)
Generic up-down counters	UDFCNT1	UDCNT (1)	UDCNT (1)
	UDFCNT2	UDCNT (2)	UDCNT (2)
	UDFCNT3	UDCNT (3)	UDCNT (3)
	UDFCNT4	UDCNT (4)	UDCNT (4)
	UDFCNT5	UDCNT (5)	UDCNT (5)
	UDFCNT6	UDCNT (6)	UDCNT (6)
	UDFCNT7	UDCNT (7)	UDCNT (7)
	UDFCNT8	UDCNT (8)	UDCNT (8)
	UDFCNT9	UDCNT (9)	UDCNT (9)
	UDFCNT10	UDCNT (10)	UDCNT (10)
	UDFCNT11	UDCNT (11)	UDCNT (11)
	UDFCNT12	UDCNT (12)	UDCNT (12)
Programmable buttons (16 buttons)	FKEYGGIO1	FKEY (1)	FKEY (1)
Logging functions			
Disturbance recorder	RDRE1	DR (1)	DFR (1)
Fault recorder	FLTRFRC1	FAULTREC (1)	FAULTREC (1)
Sequence event recorder	SER1	SER (1)	SER (1)

32. Document revision history

Document revision/date	Product version	History
A/2013-05-07	2.0	First release
B/2013-07-01	2.0	Content updated
C/2014-07-01	2.0	Content updated
D/2014-09-11	2.0	Content updated
E/2015-12-11	2.0 FP1	Content updated to correspond to the product version
F/2019-06-19	2.0 FP1	Content updated

ABB   71

1MRS757846 F