Relion® 620 series

Transformer protection and control
RET620 ANSI
Product guide

Power and productivity
for a better world™

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1. Description

The RET620 is a dedicated transformer IED perfectly aligned for the protection, control, measurement and supervision of two- or three-winding power transformers and power generator-transformer blocks in utility and industry power distribution systems.

RET620 is a member of ABB's Relion® product family and a part of its 620 series products. The 620 series IEDs are characterized by flexibility and performance for demanding utility distribution and industrial applications. Engineered from the ground up, the 620 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability between substation automation devices.

Unique RET620 ANSI features:

- Six setting groups
- Drawout design
- Sensitive differential protection for turn-to-turn faults of two- or three windings
- Restricted earth fault (REF) protection
- Overexcitation (V/Hz) protection
- High-speed (< 1 ms) outputs
- Two RTD inputs and one mA input
- Arc flash detection (AFD)
- Thermal overload protection of transformer
- Ring-lug terminals for all inputs and outputs
- Large, easy to read LCD screen
- Programmable pushbuttons
- Environmentally friendly design with RoHS Compliance

The RET620 is the ultimate protection and control relay for two or three winding power transformers and power generator-transformer blocks. It can be applied for protection and control of the most commonly used power transformer combinations of delta and wye (grounded or ungrounded) windings. Flexible order coding allows for choosing configurations to best fit your transformer application needs.

The RET620 features three-phase, three restraint, multi-slope transformer differential protection with an unrestrained stage and a restrained stage to provide fast and selective protection for phase-to-phase winding interturn and bushing flash-over faults. Besides second harmonic restraint, an advanced waveform-based blocking algorithm ensures stability at transformer energization and a fifth harmonic restraint function ensures good protection stability at moderate overexcitation of power transformers. Sensitive restricted earth-fault protection (REF) completes the overall differential protection to detect even single phase-to-ground faults close to the grounded neutral of the transformer.

When the low-impedance REF protection is used, neither stabilizing resistors nor varistors are needed, and as a further benefit the ratio of the grounded neutral CT can differ from those of the phase current transformers. Due to its unit protection character and absolute selectivity the REF protection does not need time grading with other protection schemes, and therefore high-speed fault clearance can be achieved.

RET620 also incorporates a thermal overload protection function, which supervises the thermal stress of the transformer windings to prevent accelerated aging of the insulations. Multiple stages of phase and ground overcurrents are provided for both transformer windings plus optional voltage metering and protection for one transformer winding. Ground-fault protection based on the measured or calculated residual overvoltage is also available. Finally, RET620 also offers circuit breaker failure protection. Enhanced with an optional plug-in card, RET620 offers a fast three-channel arc fault protection system for arc flash supervision of the switchgear compartments.

RET620 also integrates control functionality, which facilitates the control of three circuit breakers via the front panel HMI or by means of remote controls. To protect the relay from unauthorized access and to maintain the integrity of information, the device has been provided with a four-level, role-based user authentication system. The access control system applies to the front panel HMI, the web browser based HMI and the PCM600 Protection and Control Relay Manager.

2. Standard configurations

The RET620 relay main application is protection, control, metering and monitoring of two- or three winding power transformers and offers two standard configurations whose relay functions and features are based on the analog inputs ordered for each configuration. See Tables 1 and 2 for details.

Configuration A comprises functionality for two- or three-winding power transformer protection, control and monitoring in industrial and utility applications. Two separate variants are available, where the voltage is measured (LV or HV side). Configuration B includes the addition of 2 RTD inputs and 1 mA input for temperature supervision.

Figures 1 and 2 below show the protection functions available for the two standard configurations and their available analog inputs for each configuration. See Selection and ordering data for details on the available analog inputs for each standard configuration.

Both configurations include standard features of metering, monitoring and control, plus sequence of event, fault and digital waveform recording.

Advanced Ethernet communications is included standard with parallel support of DNP3 Level 2+*, Modbus and IEC61850 and SNTP over TCP/IP. Optional RS-232 and RS-485 serial communication ports are available that support user programmable DNP3 Level 2+* or Modbus protocols. Included with the optional serial communication ports is IRIG-B time synchronization.

Fig 1: Functions included in RET620, VTs connected to the Bus 2

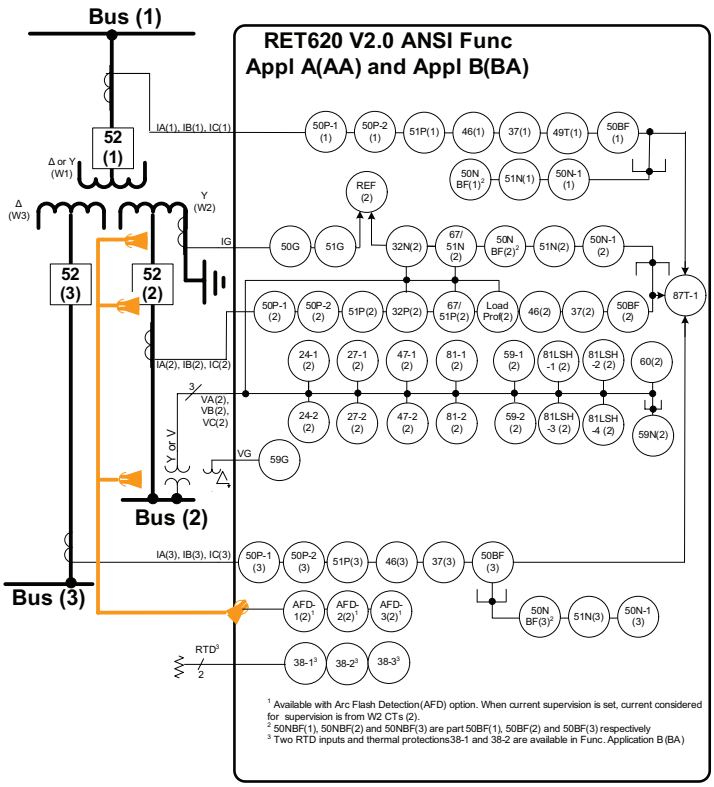


Fig. 2: Functions included in RET620, VTs connected to the Bus 1

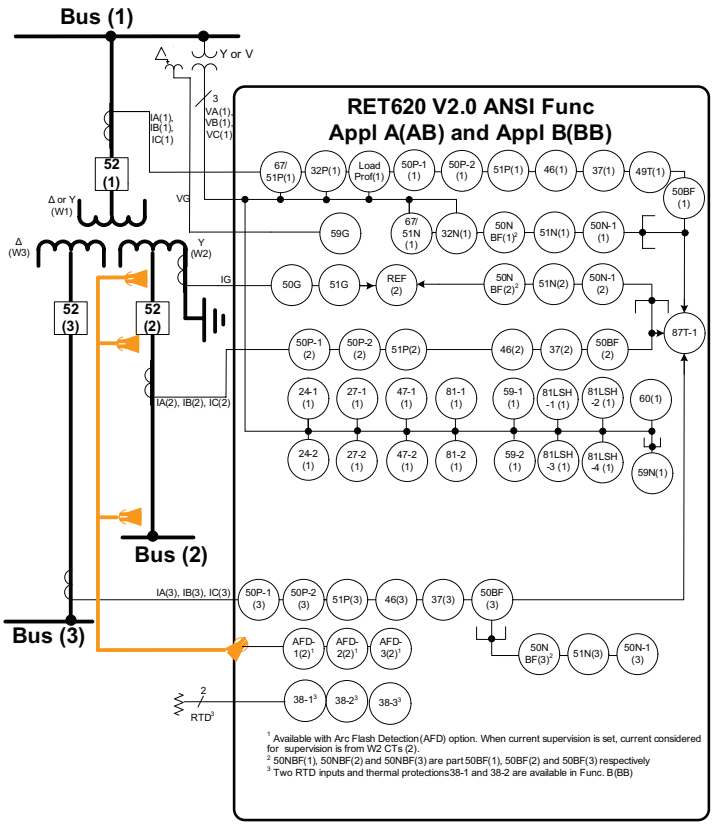


Table 1: Standard configurations (RET620)

Description	Functional application configuration
Differential, overexcitation, overcurrent, voltage (winding 2) and frequency protection and power system metering for two- or three-winding transformers	A (AA)
Differential, overexcitation, overcurrent, voltage (winding 1) and frequency protection and power system metering for two- or three-winding transformers	A (AB)
Differential, overexcitation, overcurrent, voltage (winding 2) and frequency and RTD protection and power system metering for two- or three-winding transformers	B (BA)
Differential, overexcitation, overcurrent, voltage (winding 1) and frequency and RTD protection and power system metering for two- or three-winding transformers	B (BB)

Table 2: Standard configurations

	Standard configuration		Standard configuration		ANSI/C37.2 - 2008
	AA	BA	AB	BB	RET
Protection					
Three-phase non-directional overcurrent protection, low stage, instance 1	●	●	●	●	51P(1)
Three-phase non-directional overcurrent protection, low stage, instance 2	●	●	●	●	51P(2)
Three-phase non-directional overcurrent protection, low stage, instance 3	●	●	●	●	51P(3)
Three-phase non-directional overcurrent protection, high stage, instance 1	●	●	●	●	50P-1(1)
Three-phase non-directional overcurrent protection, high stage, instance 2	●	●	●	●	50P-2(1)
Three-phase non-directional overcurrent protection, high stage, instance 3	●	●	●	●	50P-1(2)
Three-phase non-directional overcurrent protection, high stage, instance 4	●	●	●	●	50P-2(2)
Three-phase non-directional overcurrent protection, high stage, instance 5	●	●	●	●	50P-1(3)
Three-phase non-directional overcurrent protection, high stage, instance 6	●	●	●	●	50P-2(3)
Three-phase directional overcurrent protection, low stage, instance 1	-	-	●	●	67/51P(1)
Three-phase directional overcurrent protection, low stage, instance 2	●	●	-	-	67/51P(2)
Non-directional ground-fault protection, low stage, instance 1	●	●	●	●	51G
Non-directional ground-fault protection, low stage, instance 2	●	●	●	●	51N(1)
Non-directional ground-fault protection, low stage, instance 3	●	●	●	●	51N(2)
Non-directional ground-fault protection, low stage, instance 4	●	●	●	●	51N(3)
Non-directional ground-fault protection, high stage, instance 1	●	●	●	●	50G
Non-directional ground-fault protection, high stage, instance 3	●	●	●	●	50N-1(1)
Non-directional ground-fault protection, high stage, instance 4	●	●	●	●	50N-1(2)
Non-directional ground-fault protection, high stage, instance 5	●	●	●	●	50N-1(3)
Directional ground-fault protection, low stage, instance 1	-	-	●[1,3]	●[1,3]	67/51N(1)
Directional ground-fault protection, low stage, instance 2	●[1,3]	●[1,3]	-	-	67/51N(2)
Three phase directional power protection, instance 1	-	-	●	●	32P(1)
Three phase directional power protection, instance 2	●	●	-	-	32P(2)
Ground directional power protection, instance 1	-	-	●[1,3]	●[1,3]	32N(1)
Ground directional power protection, instance 2	●[1,3]	●[1,3]	-	-	32N(2)
Negative-sequence overcurrent protection, instance 1	●	●	●	●	46(1)
Negative-sequence overcurrent protection, instance 2	●	●	●	●	46(2)
Negative-sequence overcurrent protection, instance 3	●	●	●	●	46(3)
Residual overvoltage protection, instance 1	●	●	●	●	59G
Residual overvoltage protection, instance 2	-	-	●[4]	●[4]	59N(1)
Residual overvoltage protection, instance 3	●[4]	●[4]	-	-	59N(2)
Three-phase undervoltage protection, instance 1	-	-	●	●	27-1(1)
Three-phase undervoltage protection, instance 2	-	-	●	●	27-2(1)
Three-phase undervoltage protection, instance 3	●	●	-	-	27-1(2)
Three-phase undervoltage protection, instance 4	●	●	-	-	27-2(2)
Three-phase overvoltage protection, instance 1	-	-	●	●	59-1(1)
Three-phase overvoltage protection, instance 2	-	-	●	●	59-2(1)
Three-phase overvoltage protection, instance 3	●	●	-	-	59-1(2)
Three-phase overvoltage protection, instance 4	●	●	-	-	59-2(2)
Negative-sequence overvoltage protection, instance 1	-	-	●	●	47-1(1)

Table 2: Standard configurations (continued)

Standard configuration functionality	Standard configuration		Standard configuration		ANSI/C37.2 - 2008
	AA	BA	AB	BB	RET
Negative-sequence overvoltage protection, instance 2	-	-	●	●	47-2(1)
Negative-sequence overvoltage protection, instance 3	●	●	-	-	47-1(2)
Negative-sequence overvoltage protection, instance 4	●	●	-	-	47-2(2)
Frequency protection, instance 1	-	-	●	●	81-1(1)
Frequency protection, instance 2	-	-	●	●	81-2(1)
Frequency protection, instance 3	●	●	-	-	81-1(2)
Frequency protection, instance 4	●	●	-	-	81-2(2)
Voltage per hertz protection, instance 1	-	-	●	●	24-1(1)
Voltage per hertz protection, instance 2	-	-	●	●	24-2(1)
Voltage per hertz protection, instance 3	●	●	-	-	24-1(2)
Voltage per hertz protection, instance 4	●	●	-	-	24-2(2)
Three-phase thermal protection for power transformer, two time constants	●	●	●	●	49T
Stabilized and instantaneous differential protection for 3W-Transformers	●	●	●	●	87T
Numerical stabilized low impedance restricted ground-fault protection	●	●	●	●	87LOZREF(2)
Circuit breaker failure protection, instance 1	●	●	●	●	50BF(1)
Circuit breaker failure protection, instance 2	●	●	●	●	50BF(2)
Circuit breaker failure protection, instance 3	●	●	●	●	50BF(3)
Master trip, instance 1	●	●	●	●	86/94-1
Master trip, instance 2	●	●	●	●	86/94-2
Master trip, instance 3	●	●	●	●	86/94-3
Arc protection, instance 1	●	●	●	●	AFD-1(2)
Arc protection, instance 2	●	●	●	●	AFD-2(2)
Arc protection, instance 3	●	●	●	●	AFD-3(2)
Load shedding and restoration, instance 1	-	-	●	●	81LSH-1(1)
Load shedding and restoration, instance 2	-	-	●	●	81LSH-2(1)
Load shedding and restoration, instance 3	-	-	●	●	81LSH-3(1)
Load shedding and restoration, instance 4	-	-	●	●	81LSH-4(1)
Load shedding and restoration, instance 5	●	●	-	-	81LSH-1(2)
Load shedding and restoration, instance 6	●	●	-	-	81LSH-2(2)
Load shedding and restoration, instance 7	●	●	-	-	81LSH-3(2)
Load shedding and restoration, instance 8	●	●	-	-	81LSH-4(2)
Loss of phase, instance 1	●	●	●	●	37(1)
Loss of phase, instance 2	●	●	●	●	37(2)
Loss of phase, instance 3	●	●	●	●	37(3)
RTD based thermal protection, instance 1	●	●	●	●	38-1
RTD based thermal protection, instance 2	●	●	●	●	38-2
RTD based thermal protection, instance 3	●	●	●	●	38-3
Control					
Circuit-breaker control, instance 1	●	●	●	●	52(1)
Circuit-breaker control, instance 2	●	●	●	●	52(2)
Circuit-breaker control, instance 3	●	●	●	●	52(3)
Condition monitoring					
Circuit-breaker condition monitoring, instance 1	●	●	●	●	52CM(1)
Circuit-breaker condition monitoring, instance 2	●	●	●	●	52CM(2)
Circuit-breaker condition monitoring, instance 3	●	●	●	●	52CM(3)
Trip circuit supervision, instance 1	●	●	●	●	TCM-1
Trip circuit supervision, instance 2	●	●	●	●	TCM-2
Trip circuit supervision, instance 3	-	●	-	●	TCM-3
Advanced current circuit supervision for transformers	●	●	●	●	MCS, 3I, I2
Fuse failure supervision, instance 1	-	-	●	●	60(1)
Fuse failure supervision, instance 2	●	●	-	-	60(2)

Table 2: Standard configurations (continued)

Standard configuration functionality	Standard configuration		Standard configuration		ANSI/C37.2 - 2008
	AA	BA	AB	BB	RET
Measurement					
Three-phase current measurement, instance 1	●	●	●	●	IA, IB, IC (1)
Three-phase current measurement, instance 2	●	●	●	●	IA, IB, IC (2)
Three-phase current measurement, instance 3	●	●	●	●	IA, IB, IC (3)
Sequence current measurement, instance 1	●	●	●	●	I1, I2, I0(1)
Sequence current measurement, instance 2	●	●	●	●	I1, I2, I0(2)
Sequence current measurement, instance 3	●	●	●	●	I1, I2, I0(3)
Residual current measurement, instance 1	●	●	●	●	IG
Three-phase voltage measurement, instance 1	-	-	●	●	VA, VB, VC(1)
Three-phase voltage measurement, instance 2	●	●	-	-	VA, VB, VC (2)
Residual voltage measurement, instance 1	-	-	●	●	VG
Residual voltage measurement, instance 2	●	●	-	-	VG
Sequence voltage measurement, instance 1	-	-	●	●	V1, V2, V0(1)
Sequence voltage measurement, instance 2	●	●	-	-	V1, V2, V0(2)
Single-phase power and energy measurement, instance 1	-	-	●	●	SP, SE(1)
Single-phase power and energy measurement, instance 2	●	●	-	-	SP, SE(2)
Three-phase power and energy measurement, instance 1	-	-	●	●	P, E(1)
Three-phase power and energy measurement, instance 2	●	●	-	-	P, E(2)
Load profile	●	●	●	●	LoadProf
Frequency measurement, instance 1	-	-	●	●	f
Frequency measurement, instance 2	●	●	-	-	f
Tap changer position indication	●	●	●	●	84T
Other functions					
Minimum pulse timer (2 pcs), instance 1	●	●	●	●	TP-1
Minimum pulse timer (2 pcs), instance 2	●	●	●	●	TP-2
Minimum pulse timer (2 pcs), instance 3	●	●	●	●	TP-3
Minimum pulse timer (2 pcs), instance 4	●	●	●	●	TP-4
Pulse timer (8 pcs), instance 1	●	●	●	●	PT-1
Pulse timer (8 pcs), instance 2	●	●	●	●	PT-2
Time delay off (8 pcs), instance 1	●	●	●	●	TOF-1
Time delay off (8 pcs), instance 2	●	●	●	●	TOF-2
Time delay off (8 pcs), instance 3	●	●	●	●	TOF-3
Time delay off (8 pcs), instance 4	●	●	●	●	TOF-4
Time delay on (8 pcs), instance 1	●	●	●	●	TON-1
Time delay on (8 pcs), instance 2	●	●	●	●	TON-2
Time delay on (8 pcs), instance 3	●	●	●	●	TON-3
Time delay on (8 pcs), instance 4	●	●	●	●	TON-4
Set reset (8 pcs), instance 1	●	●	●	●	SR-1
Set reset (8 pcs), instance 2	●	●	●	●	SR-2
Set reset (8 pcs), instance 3	●	●	●	●	SR-3
Set reset (8 pcs), instance 4	●	●	●	●	SR-4
Move (8 pcs), instance 1	●	●	●	●	MV-1
Move (8 pcs), instance 2	●	●	●	●	MV-2
Move (8 pcs), instance 3	●	●	●	●	MV-3
Move (8 pcs), instance 4	●	●	●	●	MV-4
Move (8 pcs), instance 5	●	●	●	●	MV-5
Move (8 pcs), instance 6	●	●	●	●	MV-6
Move (8 pcs), instance 7	●	●	●	●	MV-7
Move (8 pcs), instance 8	●	●	●	●	MV-8
Generic control points, instance 1	●	●	●	●	CNTRL-1
Generic control points, instance 2	●	●	●	●	CNTRL-2
Generic control points, instance 3	●	●	●	●	CNTRL-3
Remote generic control points, instance 1	●	●	●	●	RCNTRL-1

Table 2: Standard configurations (continued)

Standard configuration functionality	Standard configuration		Standard configuration		ANSI/C37.2 - 2008
	AA	BA	AB	BB	RET
Local generic control points, instance 1	•	•	•	•	LCNTRL-1
Generic up-down counters, instance 1	•	•	•	•	CTR-1
Generic up-down counters, instance 2	•	•	•	•	CTR-2
Generic up-down counters, instance 3	•	•	•	•	CTR-3
Generic up-down counters, instance 4	•	•	•	•	CTR-4
Generic up-down counters, instance 5	•	•	•	•	CTR-5
Generic up-down counters, instance 6	•	•	•	•	CTR-6
Generic up-down counters, instance 7	•	•	•	•	CTR-7
Generic up-down counters, instance 8	•	•	•	•	CTR-8
Generic up-down counters, instance 9	•	•	•	•	CTR-9
Generic up-down counters, instance 10	•	•	•	•	CTR-10
Generic up-down counters, instance 11	•	•	•	•	CTR-11
Generic up-down counters, instance 12	•	•	•	•	CTR-12
Programmable buttons (16 buttons), instance 1	•	•	•	•	FKEY
Logging functions					
Disturbance recorder	•	•	•	•	DFR
Fault recorder	•	•	•	•	FR
Sequence event recorder	•	•	•	•	SER

1) Io selectable by parameter, I2 as default
2) Vo calculated and negative sequence voltage selectable by parameter, V2 as default
3) Vo calculated is always used

3. Protection functions

The RET620 relay features three-phase, three-restraint, multi-slope transformer differential protection with an instantaneous stage and a stabilized (biased) stage to provide fast and selective protection for phase-to-phase, winding interturn, and bushing flash-over faults. Besides second harmonic restraint, an advanced waveform-based blocking algorithm ensures stability at transformer energization and a fifth harmonic restraint function ensures good protection stability at moderate overexcitation of power transformers. Sensitive low impedance restricted earth-fault (REF) protection completes the overall differential protection detecting ground faults nearest the grounded neutral point of the transformer.

With the low-impedance REF protection, no external stabilizing resistors or varistors are needed and, for maximum flexibility, the grounded neutral CT is programmed independently of the phase CTs. Also, since the REF function does not require time-grading like other protection schemes, 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 that accelerate aging of the winding's insulation. Multiple stages of short-circuit, phase-overcurrent, negative-phase-sequence and ground fault back-up protection are available per winding. Ground fault protection based on the measured or calculated residual overvoltage is also available.

Finally, the RET620 also includes circuit breaker failure protection, and, with optional hardware and software, features three light detection channels for arc fault protection of the circuit breaker, busbar and cable compartment of metal-enclosed indoor switchgear. The arc-fault protection sensor interface is available on the optional communication module. Fast tripping increases personal safety and limits material damage within the switchgear in an arc fault situation.

4. Application

The RET620 provides main protection for two- or three-winding power transformers and power generator-transformer blocks. There are two standard configurations offering comprehensive protection functions for detection of faults within the transformer and within its zone of protection.

The voltage inputs, and therefore, the voltage protection and measurements, are pre-configured to the winding-1 or winding-2 inputs of the RET620, depending on the selected variant. In both configurations, the REF protective function is preconfigured to the RET620 winding-2 inputs thus making it applicable only to a wye-grounded power transformer's low voltage winding configuration.

Both standard configurations offer optional fiber Ethernet, serial and IRIG-B communications, and arc flash detection sensors. Table 3 shows the programmable transformer winding configuration available for each winding.

5. Supported ABB solutions

ABB's 620 series protection and control relays together with the COM600 Station Automation device constitute a genuine IEC 61850 solution for reliable power distribution in utility and industrial power systems. To facilitate and streamline the system engineering, ABB's relays are supplied with Connectivity Packages containing a compilation of software and relay-specific information including single-line diagram templates, a full relay data model including event and parameter lists. By utilizing the Connectivity Packages the relays can be readily configured via the PCM600 Protection and Control Relay Manager and integrated with the COM600 Station Automation device or the MicroSCADA Pro network control and management system.

The 620 series relays offer native support for the IEC 61850 standard also including horizontal GOOSE messaging. Compared with traditional hard-wired inter-device signaling, peer-to-peer communication over a switched Ethernet LAN offers an advanced and versatile platform for power system protection. Fast software-based communication, continuous supervision of the integrity of the protection and communication system, and inherent flexibility for reconfiguration and upgrades are among the distinctive features of the protection system approach enabled by the full implementation of the IEC 61850 substation automation standard.

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

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

Table 3: Supported ABB solutions

Product	Version
Station Automation COM600	3.5 or later
MicroSCADA Pro	9.3 or later

Figure 3. Utility distribution network example using 620 series relays, Station Automation COM600 and MicroSCADA Pro

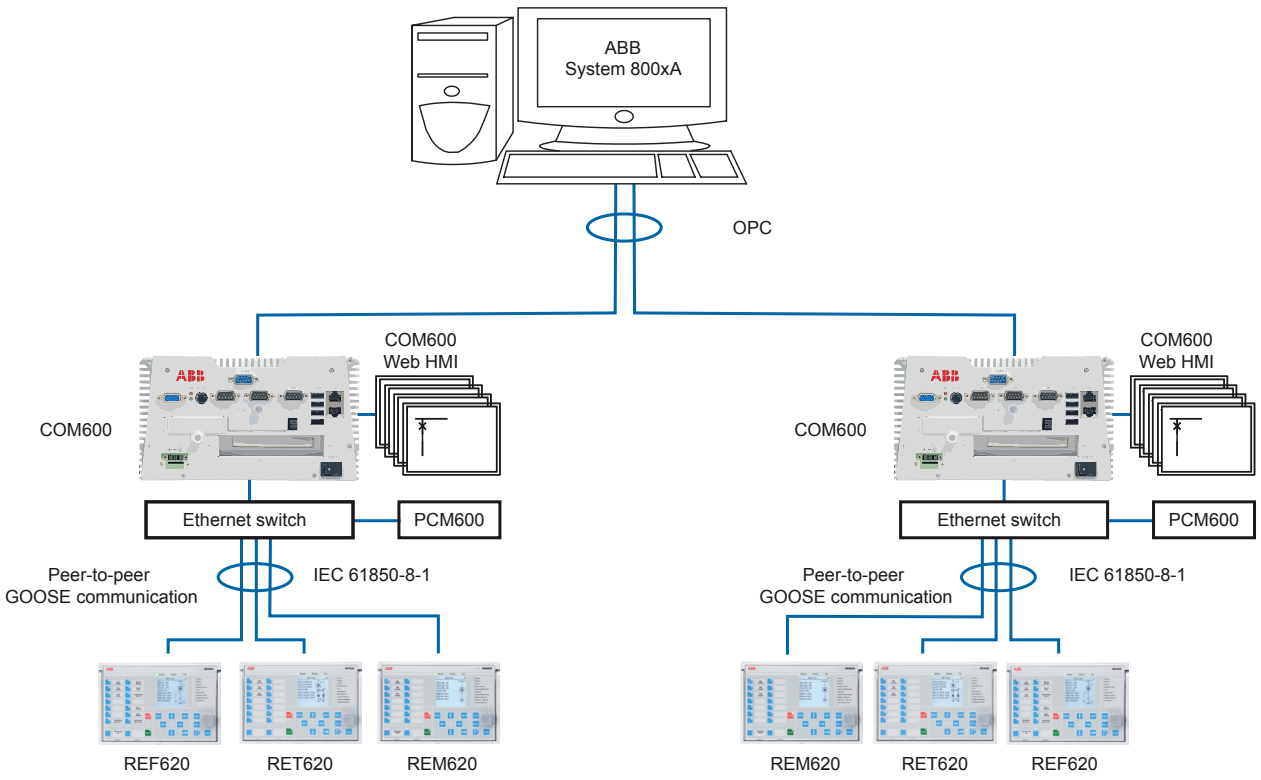
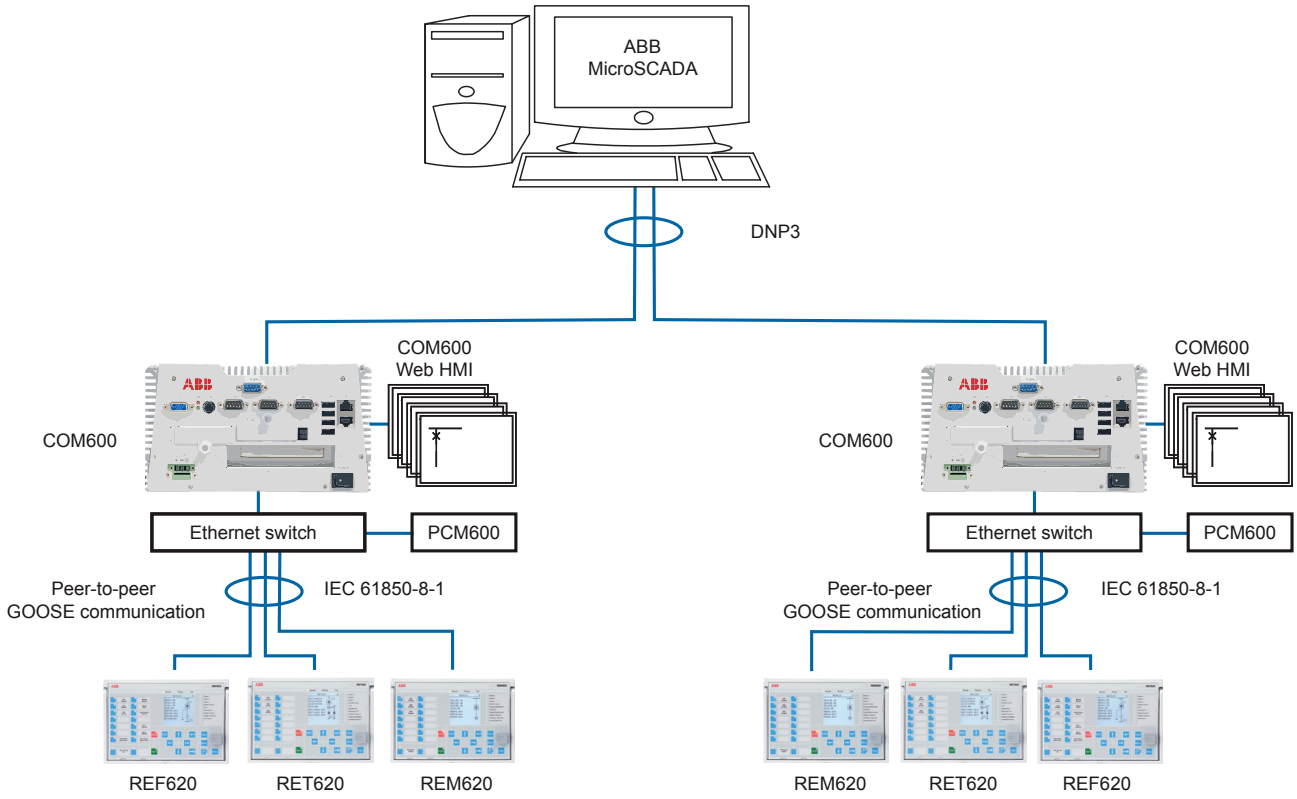


Figure 4. Industrial distribution network example using 620 series relays, Station Automation COM600 and System 800xA



6. Control

The relay offers status and control of up to three breakers with a set of push-buttons on the front panel local human machine interface (LHMI) for opening and closing a breaker. Flexible remote breaker control of select-before-trip (SBO) or direct trip is also available with each of the supported DNP3 Level 2+, Modbus and IEC 61850 communication Protocols. Interlocking schemes required by the application are configured with ACT in PCM600.

7. Measurements

The relay continuously measures the phase currents and voltages, the sequence components, the residual or ground current and the residual voltage VG. In addition, the relay calculates the demand and minimum and maximum demand currents over a user selectable pre-set time frame, the thermal overload of the protected object, and the phase unbalance value as a ratio between the negative sequence and positive sequence currents. Also voltage, power and energy (single-phase and three-phase quantities), power factor and frequency measurements and minimum and maximum demand watts and vars are available. The values measured can be accessed locally via the user interface on the relay front panel or remotely via the communication interface of the relay. The values can also be accessed locally or remotely using the web-browser based user interface.

8. Digital fault recorder

The relay is provided with a digital fault recorder (DFR) featuring up to 12 analog and 64 binary signal channels. The analog channels record either the waveform or the trend of the currents and voltages. The analog channels can be set to trigger the recording function when the measured value falls below or exceeds the set values. The binary signal channels can be set to start a recording on the rising or the falling edge of the binary signal or both. By default, the binary channels are set to record external or internal relay signals, e.g. the pickup or trip signals of the relay stages, or external blocking or control signals. Binary relay signals such as a protection pickup or trip signal, or an external relay control signal over a binary input can be set to trigger the recording.

9. Events recorder

The relay includes a sequence of events recorder (SER) that logs important event activity. The relay has the capacity to store in non-volatile memory the most recent 1024 events in a first-in-first-out (FIFO) buffer with each event date and time stamped to 1 ms resolution. The event log facilitates detailed pre- and post-fault analyses of feeder faults and disturbances.

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

10. Recorded data

The relay has the capacity to store in non-volatile memory the most recent 128 fault records for user post-fault analysis. Each record includes the current values, the Pickup times of the protection blocks, time stamp, etc. The fault recording can be triggered by the pickup signal or the trip signal of a protection block, or by both. The available measurement modes include DFT, RS, and peak-to-peak. All 128 fault records are retrievable and viewable via all protocols, the local HMI, web-based HMI and user tool PCM600. Demand and minimum and maximum demand currents, watts and vars with date and time stamp are stored as separate recorded data. The power demand values include single-phase and three-phase quantities with wye- connected VTs and three-phase quantities with delta-connected VTs.

Load Profile feature is included as standard. This feature records demand currents, watts and vars and bus voltage quantities, depending on the specific configuration, that present a clear view of bus stability and feeder loading. Such load profile is quite useful for system planners. The Load Profile data recording rate is set by the demand time interval setting and stored in non-volatile memory. For a demand time interval of 15 minutes, approximately 40 days of data is recordable in a first-in first-out (FIFO) buffer. The profile data is retrievable via the relay user tool PCM600 and viewable through its COMTRADE viewing tool Wavewin.

11. Circuit-breaker condition monitoring

For continuous knowledge of the operational availability of the REM620 features, a comprehensive set of monitoring functions to supervise the relay health, the trip circuit and the circuit breaker health is included. The breaker monitoring can include checking the wear and tear of the circuit breaker, the spring charging time of the breaker operating mechanism and the gas pressure of the breaker chambers. The relay also monitors the breaker travel time and the number of circuit breaker (CB) operations to provide basic information for scheduling CB maintenance. There is a condition monitoring feature for each of the breakers supported.

12. Trip-circuit monitoring

The trip-circuit monitoring continuously supervises 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. Local and remote indication are programmable to ensure immediate notification so the necessary steps can be established to correct before the next fault event occurs. There is a trip-circuit monitoring feature for each of the breakers supported.

13. Self diagnostics

The relay's built-in self-diagnostics system continuously monitors the state of the relay hardware and the operation of the relay software. Any fault or malfunction detected will be used for alerting the operator. A permanent relay fault will block the protection functions of the relay to prevent incorrect relay operation.

14. Fuse failure supervision

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

15. Current circuit supervision

The RET620 includes a unique current circuit supervision feature to monitor the health of the two sets of three-phase CT circuits. Current circuit supervision is used for detecting an open in the current transformer secondary circuits. On detecting an opening circuit, the current circuit supervision function activates an alarm LED and blocks certain protection functions to avoid unintended operation.

16. Load profile recording

The relay includes a load profile recording feature in all standard configurations. The load profile records, at least, stored demand current values and demand watts and vars values at a rate equal to the user-selected demand time interval. With a 15 minute demand time interval, load profile data comprising at least 40 days is possible. This profile data is most useful to distribution system capacity planners.

17. Single-line diagram (SLD)

The relay includes the ability for the user to design a unique single line diagram (SLD) view in the front panel LHMI LCD. An applicable default SLD view is provided for each standard confi guration. The SLD flexible programming allows for showing a one-line drawing of the relay application, metering values and text strings specifying, e.g., specific feeder and breaker information. Information can be split in two separate pages if needed. This reduces significantly time the substation personnel need to obtain this relevant information from smaller LCDs.

18. Access control

To protect the RET620 from unauthorized access and to maintain information integrity, the RET620 is provided with a four-level, role-based authentication system with administrator programmable individual passwords for the viewer, operator, engineer and administrator level. The access control applies to the frontpanel user interface, the web-browser based user interface and the PCM600 tool.

19. Inputs and outputs

The availability of analog and binary inputs depends upon the standard configuration ordered. Standard and optional binary inputs and outputs (I/O) also depend upon the selected IED configuration. Table xx (see comment 16) details the analog and binary inputs available for each standard configuration.

The phase-current inputs are user programmable for 5A or 1A ct secondary nominal rating. The ground ct option is programmable for 5/1A nominal rating, the SEF/HIZ ct option has a fixed 0.2A nominal rating. The sensitive earth fault ct option provides SEF protection and includes a separate, independent HIZ protective function for detecting downed conductors. The phase-current and ground current nominal rating of 5 A or 1 A are selected in the relay software. The nominal secondary voltage of the three-phase and ground VT inputs are user programmable. The binary input turn-on thresholds are programmable from 18…176 V DC by adjusting the relay's parameter settings.

Table 4: Analog IO

Functional application (order code character #4)	Analog inputs (order code characters #5 and #6)	No. of analog inputs			
		CT	VT	RTD	mA
A	AA	10[1]	4	0	0
A	AB	10[1]	4	0	0
B	BA	10[1]	4	2	1
B	BB	10[1]	4	2	1

[1]Ground CT (I_{nom} = 5/1A)

Table 5: Binary IO

Functional application (order code character #4)	Binary inputs and outputs (order code characters #7 and #8)	No. of binary inputs/binary outputs			
		Binary inputs	Signal outputs	Power outputs	High speed power outputs
A	AA	8	9	4	0
A	AB	16	13	4	0
A	A1	8	5	4	3
A	A2	16	5	4	6
A	A3	16	9	4	3
B	BA	8	9	4	0
B	BB	16	13	4	0
B	B1	8	5	4	3
B	B2	16	5	4	6
B	B3	16	9	4	3

20. Communications

The relay supports a range of communication protocols including IEC 61850, Modbus® and DNP3 Level 2. Operational information and controls are available through these protocols. Certain communication functionality, e.g., horizontal communication between relays, is only enabled by the IEC 61850 communication protocol.

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

The relay can send binary signals to other relays (so called horizontal communication) using the IEC 61850-8-1 GOOSE (Generic Object Oriented Substation Event) profile. Binary GOOSE messaging can, e.g., 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. Also, the relay supports the sending and receiving of analog values using GOOSE messaging. Analog GOOSE messaging enables fast transfer of analog measurement values over the network bus, thus facilitating, for example, sharing of RTD input values, such as surrounding temperature values, to other relay applications.

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

The self-healing Ethernet ring solution enables a cost-effective communication ring solution controlled by a managed switch with rapid spanning tree protocol (RSTP) support to be created. The managed switch controls the consistency of the loop, routes the data and corrects the data flow in case of a communication disturbance. The relays in the ring topology act as unmanaged switches forwarding unrelated data traffic. The Ethernet ring solution supports the connection of up to 30 ABB 615 or 620 series relays. If more than 30 relays are to be connected, it is recommended that the network is split into several rings with no more than 30 relays per ring.

The self-healing Ethernet ring solution avoids single point of failure concerns and improves the reliability of the communication. The solution can be applied for the Ethernet-based IEC 61850, Modbus and DNP3 Level 2 protocols.

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 connection to a serial bus is required, the 10-pin RS-485 screw-terminal or the fiber-optic ST connector can be used.

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.

Table 6: Supported station communication interfaces and protocols

	Ethernet		Serial	
Interfaces/protocols	**100BASE-TX (RJ45)**	**100BASE-FX (LC)**	**RS-232/RS-485**	**Fiber-optic (ST)**
DNP3.0 Level 2+ over TCP/IP	●	●	-	-
Modbus over TCP/IP	●	●	-	-
IEC 61850-8-1	●	●	-	-
SNTP	●	●	-	-
FTP	●	●	-	-
DNP3.0 Level 2+ serial	-	-	●	●
Modbus RTU/ASCII	-	-	●	●

21. Technical data

Table 7: Dimensions

Description	Value	
Width	Frame	10.32 inches (262.2 mm)
	Case	9.69 inches (246 mm)
Height	Frame	6.97 inches (177 mm), 4U
	Case	6.30 inches (160 mm)
Depth		7.91 inches (201 mm)
Weight	Complete IED	10.5 lbs (4.8 kg)
	Plug-in unit only	6.0 lbs (2.8 kg)

Table 8: Power supply

Description	Type 1	Type 2
V nominal (V_n)	100, 110, 120, 220, 240 V AC, 60 and 50 Hz 48, 60, 110, 125, 220, 250 V DC	24, 30, 48, 60 V DC
V_n variation	38…110% of V_n (38…264 V AC) 80…120% of V_n (38.4…300 V DC)	50…120% of V_n (12…72 V DC)
Start-up threshold		19.2 V DC (24 V DC × 80%)
Burden of auxiliary voltage supply under quiescent (Pq)/operating condition	DC < 12.0 W (nominal) / < 18.0 W (max), AC < 16.0 W (nominal) / < 21.0W (max)	DC < 12.0 W (nominal) / < 18.0 W (max
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz	
Maximum interruption time in the auxiliary DC voltage without resetting the relay	50 ms at nominal voltage	50 ms at nominal voltage
Fuse type	T4A/250 V	

Table 9: Analog inputs

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

[1)] Phase and ground current inputs
[2)] Sensitive earth fault (SEF)/high impedance (HIZ) detection current input

Table 10: Measuring range

Description	Value
Measured currents on phases IA, IB and IC as multiples of the rated currents of the analog inputs	0…50 × I_n
Ground current as a multiple of the rated current of the analog input	0…50 × I_n

Table 11: 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 mW
Threshold voltage	18…176 V DC
Reaction time	3 ms

Table 12: Signal outputs and IRF output

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	10 A
Make and carry 0.5 s	15 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	10 mA at 5 V AC/DC

Table 13: Double-pole power output (PO) relays with TCM [typical operation time: 8...11 ms]

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 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC (two contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC

Table 14: Single-pole power output (PO) relays [typical operation time: 8...11 ms]

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 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: Double-pole signal outputs with higher make and carry capabilities (typical operation time: 8...11 ms)

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

Table 16: High-speed output (HSO) devices [typical operation time: 1ms]

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	6 A
Make and carry for 3.0 s	15 A
Make and carry 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

Table 17: Ethernet and serial interfaces

Ethernet interface	Protocol	Cable	Data transfer rate
Front RJ-45	TCP/IP	Standard Ethernet CAT5 cable with RJ-45 connector	10 MBits/s
Rear RJ-45 or LC	TCP/IP	Shielded twisted pair CAT 5e cable with RJ-45 connector or fiber-optic cable with LC connector	100 MBits/s
X5	Serial	10-pin counter connector Weidmuller BL 3.5/10/180F AU OR BEDR (or 9-pin counter connector Weidmuller BL 3.5/9/180F AU OR BEDR1)[1]	115200 bits/s
X16	Serial	9-pin D-sub connector DE-9	115200 bits/s
X12	Serial	Optical ST-connector	115200 bits/s

Table 18: Network ethernet ports specifications

Connector	Fiber type[1]	Wavelength	Max. distance	Permitted path attenuation[2]
LC	MM 62.5/125 µm glass fiber core	1300 nm	2 km	<8 dB
ST	MM 62.5/125 µm glass fiber core	820-900 nm	1 km	<11 dB

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

Table 19: IRIG-B

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

[1] According to 200-04 IRIG standard

Table 20: Lens sensor and optical fiber for arc flash detection (AFD)

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…+212 °F (-40…100 °C)
Maximum service temperature range of the lens, max 1 h	+284 °F (+140 °C)
Minimum permissible bending radius of the connection fiber	3.94" (100 mm)

Table 21: Degree of protection of flush-mounted relay

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

Table 22: Environment conditions

Description	Value
Continuous operating temperature range	-25…+55 °C
Short-term operating temperature range	-40…+85 °C (<16 h) [1, 2]
Relative humidity	<93%, non-condensing
Atmospheric pressure	12.47 - 15.37 psi (86 - 106 kPa)
Altitude	Up to 6561 ft. (2000 m)
Transport and storage temperature range	-40…+85 °C

[1] Degradation in MTBF and HMI performance outside the continuous operating temperature range.
[2] For relays with an LC communications interface, the maximum operating temperature is +70 °C .

Table 23: Environmental tests

Description	Type test value	Reference
Dry heat test (humidity <50%)	– 96 h at +55° C	IEC 60068-2-2
	– 16 h at +85° C [1]	
	– 12 h at +85 °C [1]	IEEE C37.90-2005
Dry cold test	– 96 h at -25° C	IEC 60068-2-1
	– 16 h at -40° C	
	– 12 h at -40° C	IEEE C37.90-2005
Damp heat test, cyclic	– 6 cycles (12 h + 12 h) at +25…+55 °C, humidity >93%	IEC 60068-2-30
	– +25° C, Rh = 95%, 96h	IEEE C37.90-2005
Storage test	– 96 h at 40° C	IEC 60068-2-48
	– 96 h at +85° C	IEEE C37.90-2005

[1)] For relays with an LC communication interface the maximum operating temperature is +70 °C.

Table 24: Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz burst disturbance test:		IEC 61000-4-18
– Common mode	2.5 kV	IEC 60255-22-1, class III
– Differential mode	2.5 kV	IEEE C37.90.1-2002
Electrostatic discharge test:		IEC 61000-4-2
– Contact discharge	8 kV	IEC 60255-22-2
– Air discharge	15 kV	IEEE C37.90.3-2001
Radio frequency interference tests:	10 V (emf)	IEC 61000-4-6
	f = 150 kHz…80 MHz	IEC 60255-22-6, class III
	10 V/m (rms)	IEC 61000-4-3
	f=80…2700 MHz	IEC 60255-22-3, class III
	10 V/m	ENV 50204
	f=900 MHz	IEC 60255-22-3, class III
	20 V/m (rms)	IEEE C37.90.2-2004
	f=80…1000 MHz	
Fast transient disturbance tests:		IEC 61000-4-4
– All ports	4 kV	IEC 60255-22-4
		IEEE C37.90.1-2002
Surge immunity test:		IEC 61000-4-5
– Communications	1 kV, line-to-earth	IEC 60255-22-5
– Other ports	4 kV, line-to-earth	
	2 kV, line-to-line	
Power frequency (50 Hz) magnetic field:		IEC 61000-4-8
– Continuous	300 A/m	
– 1-3 s	1000 A/m	
Voltage dips and short interruptions	30%/10 ms	IEC 61000-4-11
	60%/100 ms	
	60%/1000 ms	
	>95%/5000 ms	
Power frequency immunity test:	Binary inputs only	IEC 61000-4-16
– Common mode	300 V rms	IEC 60255-22-7, class A
– Differential mode	150 V rms	
Emission tests:		ENV 55011, class A
– Conducted		IEC 60255-25
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	

Table 25: Insulation tests

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

Table 26: Mechanical tests

Description	Reference	Requirement
Vibration tests (sinusoidal)	IEC 60068-2-6 (test Fc)	Class 2
	IEC 60255-21-1	
Shock and bump test	IEC 60068-2-27 (test Ea shock)	Class 2
	IEC 60068-2-29 (test Eb bump)	
	IEC 60255-21-2	
Mechanical durability	IEEE C37.90-2005	– 200 withdrawals and insertions of the plug-in unit
	IEC 602556-6	– 200 adjustments of relay setting controls

Table 27: Product safety

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

Table 28: EMC compliance

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

Table 29: RoHS compliance

Description
Complies with the RoHS directive 2002/95/EC

Protection functions

Table 30: Three-phase non-directional overcurrent protection (51P, 50P)

Characteristic		Value		
Pickup accuracy	51P	Depending on the frequency of the current measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 × I_n		
	50P-1, 50P-2	±1.5% of set value or ±0.002 × I_n		
		(at currents in the range of 0.1…10 × I_n)		
		±5.0% of set value		
		(at currents in the range of 10…40 × I_n)		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	51P, 50P-1, and 50P-2:	23 ms	25 ms	28 ms
	I_{Fault} = 2 × set Pickup value			
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 30 ms		
Trip time accuracy in definite time mode		±1.0% of the set value or 20 ms		
Trip time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms [3)]		
Suppression of harmonics		RMS: No suppression		
		DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		
		Peak-to-Peak: No suppression		
		P-to-P+backup: No suppression		

[1)] Set trip delay time = 0.02 s, Operate curve type = IEC definite time, Measurement mode = default (depends on stage), current before fault = 0.0 × I_n, f_n = 50 Hz, fault current in one phase with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
[2)] Includes the delay of the signal output contact
[3)] Maximum Pickup range = 2.5 × I_n, Pickup range multiples in range of 1.5 to 20

Table 31: Three-phase non-directional overcurrent protection (51P, 50P) main settings

Parameter	Function	Value (range)	Step
Pickup range	51P	0.05…5.00 × I_n	0.01
	50P-1. 50P-2	0.10…40.00 × I_n	0.01
Time multiplier	51P	0.05…15.00	0.05
	50P-1. 50P-2	0.05…15.00	0.05
Definite time delay	51P	40…200000 ms	10
	50P-1. 50P-2	40…200000 ms	10
Operating curve type [1)]	51P	Definite or inverse time	
		Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,	
		11, 12, 13, 14, 15, 17, 18, 19	
	50P-1. 50P-2	Definite or inverse time	
		Curve type: 1, 3, 5, 9, 10, 12, 15, 17	

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

Table 32: Three-phase non-directional overcurrent protection (51P, 50P) main settings

Parameter	Function	Value (range)	Step
Pickup range	51P	0.05…5.00 × I_n	0.01
	50P-1. 50P-2	0.10…40.00 × I_n	0.01
Time multiplier	51P	0.05…15.00	0.05
	50P-1. 50P-2	0.05…15.00	0.05
Definite time delay	51P	40…200000 ms	10
	50P-1. 50P-2	40…200000 ms	10
Operating curve type [1]	51P	Definite or inverse time	
		Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	50P-1. 50P-2	Definite or inverse time	
		Curve type: 1, 3, 5, 9, 10, 12, 15, 17	

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

Table 33: Three-phase directional overcurrent protection (67/51P)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the current/voltage measured: f_n ±2Hz		
	Current:		
	±1.5% of the set value or ±0.002 × I_n		
	Voltage:		
	±1.5% of the set value or ±0.002 × V_n		
	Phase angle:		
	±2°		
Pickup time [1] [2]	Minimum	Typical	Maximum
I_{Fault} = 2.0 × set Pickup value	38 ms	43 ms	46 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode	±5.0% of the theoretical value or ±20 ms [3]		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1] Measurement mode and PoI quantity = default, current before fault = 0.0 × I_n, voltage before fault 1.0 × V_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 Pickup range = 2.5 × I_n, Pickup range multiples in range of 1.5 to 20

Table 34: Three-phase directional overcurrent protection (67/51P) main settings

Parameter	Function	Value (range)	Step
Pickup range	67/51P	0.05…5.00 × I_n	0.01
Time multiplier	67/51P	0.05…15.00	0.05
Definite time delay	67/51P	40…200000 ms	10
Directional mode	67/51P	1 = Non-directional	
		2 = Forward	
		3 = Reverse	
Characteristic angle	67/51P	-179…180 degrees	1
Operating curve type [1]	67/51P	Definite or inverse time	
		Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	

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

Table 35: Non-directional neutral, ground fault protection (51N, 51G, 50N, 50G)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
	51N, 51G	±1.5% of the set value or ±0.002 × I_n		
	50N, 50G	±1.5% of set value or ±0.002 × I_n (at currents in the range of 0.1…10 × I_n)		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	51N, 51G, and 50N-1, 50N-2, 50G-1, 50G-2: I_{Fault} = 2 × set Pickup value	23 ms	25 ms	28 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		
Retardation time		< 30 ms		
Trip time accuracy in definite time mode		±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode		±5.0% of the theoretical value or ±20 ms [3)]		
Suppression of harmonics		RMS: No suppression DFT: -50dB at f = n × 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 × 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 Pickup range = 2.5 × I_n, Pickup range multiples in range of 1.5 to 20

Table 36: Non-directional neutral, ground fault protection (51N, 51G, 50N, 50G) main settings

Parameter	Function	Value (range)	Step
Pickup range	51N, 51G	0.05…5.00 × I_n	0.01
	50N-1, 50N-2, 50G-1, 50G-2	0.10…40.00 × I_n	0.01
Time multiplier	51N, 51G	0.05…15.00	0.05
	50N-1, 50N-2, 50G-1, 50G-2	0.05…15.00	0.05
Definite time delay	51N, 51G	40…200000 ms	10
	50N-1, 50N-2, 50G-1, 50G-2	40…200000 ms	10
Operating curve type [1)]		Definite or inverse time	
	51N, 51G	Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	50N-1, 50N-2, 50G-1, 50G-2	Definite or inverse time Curve type: 1, 3, 5, 9, 10, 12, 15, 17	

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

Table 37: Directional neutral fault protection (67/51N)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the current measured: f_n ±2Hz		
	Current:		
	±1.5% of the set value or ±0.002 × I_n		
	Voltage:		
	±1.5% of the set value or ±0.002 × V_n		
	Phase angle:		
	±2°		
Pickup time [1) 2)]	Minimum	Typical	Maximum
67/51N: I_{Fault} = 2 × set Pickup value	62 ms	65 ms	69 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 30 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode	±5.0% of the theoretical value or ±20 ms [3)]		
Suppression of harmonics	RMS: No suppression		
	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		
	Peak-to-Peak: No suppression		

[1)] Set Definite time delay = 0,06 s, Inverse-time (IDMT) and definite-time (DT) curves = 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 Pickup range = 2.5 × I_n, Pickup range multiples in range of 1.5 to 20

Table 38: Directional neutral fault protection (67/51N) main settings

Parameter	Function	Value (range)	Step
Pickup range	67/51N	0.05…5.00 × I_n	0.01
Directional mode	67/51N	1=Non-directional	
		2=Forward	
		3=Reverse	
Time multiplier	67/51N	0.05…15.00	0.05
Definite time delay	67/51N	60…200000 ms	10
Operating curve type [1]	67/51N	Definite or inverse time	
		Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
Opeation mode	67/51N	1=Phase angle	
		2=I_0Sin	
		3=I_0Cos	
		4=Phase angle 80	
		5=Phase angle 88	

Table 39: Three-phase overvoltage protection (59)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz		
	±1.5% of the set value or ±0.002 × V_n		
Pickup time [1) 2)]	Minimum	Typical	Maximum
V_{Fault} = 1.1 × set pickup value	23 ms	27 ms	30 ms
Reset time	< 40 ms		
Reset ratio	Depends on the Relative hysteresis		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode	±5.0% of the theoretical value or ±20 ms [3)]		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1)] Pickup range = 1.0 × V_n, Voltage before fault 0.9 × V_n, f_n = 50 Hz, overvoltage in one phase-to-phase with nominal frequence injected from random phase angle, results based on statistical distribution of 1000 measurements.
[2)] Includes the delay of the signal output contact
[3)] Maximum pickup range = 1.20 × V_n, Pickup range multiples in range of 1.10 to 2.00

Table 40: Three-phase overvoltage protection (59) main settings

Parameter	Function	Value (range)	Step
Pickup range	59	0.05…1.60 × V_n	0.01
Time multiplier	59	0.05…15.00	0.05
Definite time delay	59	40…300000 ms	10
Operating curve type [1]	59	Definite or inverse time Curve type: 5, 15, 17, 18, 19, 20	

Table 41: Three-phase undervoltage protection (27)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz		
	±1.5% of the set value or ±0.002 × V_n		
Pickup time [1] [2]	Minimum	Typical	Maximum
V_{Fault} = 0.9 × set pickup value	62 ms	66 ms	69 ms
Reset time	< 40 ms		
Reset ratio	Depends on the Relative hysteresis		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode	±5.0% of the theoretical value or ±20 ms [3]		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1] Pickup range = 1.0 × V_n, Voltage before fault 1.1 × V_n, f_n = 50 Hz, undervoltage in one phase-to-phase with nominal frequence injected from random phase angle, results based on statistical distribution of 1000 measurements
[2] Includes the delay of the signal output contact
[3] Minimum Pickup range = 0.50, Pickup range multiples in range of 0.90 to 0.20

Table 42: Three-phase undervoltage protection (27) main settings

Parameter	Function	Value (range)	Step
Pickup range	27	0.05…1.20 × V_n	0.01
Time multiplier	27	0.05…15.00	0.05
Definite time delay	27	60…300000 ms	10
Operating curve type [1]	27	Definite or inverse time Curve type: 5, 15, 21, 22, 23	

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

Table 43: Negative sequence overvoltage protection (47)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the current measured: f_n ±2 Hz		
	±1.5% of the set value or ±0.002 × I_n		
Pickup time [1] [2]	Minimum	Typical	Maximum
V_{fault} = 1.1 × set Pickup value	33 ms	35 ms	38 ms
V_{fault} = 2.0 × set Pickup value	25 ms	27 ms	30 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1] Negative sequence voltage before fault 0.0 × V_n, f_n = 50 Hz, negative sequence overvoltage with nominal frequence injected from random phase angle, results based on statistical distribution of 1000 measurements
[2] Includes the delay of the signal output contact

Table 44: Negative sequence overvoltage protection (47) main settings

Parameter	Function	Value (range)	Step
Pickup range	47	0.010…1.000 × V_n	0.001
Definite time delay	47	40…120000 ms	1

Table 45: Ground overvoltage protection (59G)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the voltage measured: f_n ±2 Hz		
	±1.5% of the set value or ±0.002 × V_n		
Pickup time [1) 2)]	Minimum	Typical	Maximum
V_{fault} = 1.1 × set Pickup value	55 ms	57 ms	60 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1)] Residual voltage before fault 0.0 × V_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 46: Ground overvoltage protection (59G) main settings

Parameter	Function	Value (range)	Step
Pickup range	59G	0.010…1.000 × V_n	0.001
Definite time delay	59G	40…300000 ms	1

Table 47: Negative sequence overcurrent protection (46)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the current measured: f_n ±2 Hz		
	±1.5% of the set value or ±0.002 × I_n		
Pickup time [1) 2)]	Minimum	Typical	Maximum
I_{Fault} = 2 × set Pickup value	22 ms	25 ms	27 ms
I_{Fault} = 10 × set Pickup value	14 ms	17 ms	19 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Trip time accuracy in inverse time mode	±5.0% of the theoretical value or ±20 ms [3)]		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1)] Negative sequence voltage before fault 0.0 × V_n, f_n = 50 Hz, negative sequence overvoltage with nominal frequence 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 (46) main settings

Parameter	Function	Value (range)	Step
Pickup range	46	0.01…5.00 × I_n	0.01
Time multiplier	46	0.05…15.00	0.05
Definite time delay	46	40…200000 ms	10
Operating curve type [1)]	46	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	

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

Table 49: Thermal overload protection, two time constants (49T)

Characteristic	Value
Pickup accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz
	Current measurement: ±1.5% of the set value or ±0.002 × I_n (at currents in the range of 0.01…4.00 × I_n)
Trip time accuracy[1]	±2.0% of the theoretical value or ±0.50 s

[1] Overload current > 1.2 × Operate level temperature

Table 50: Thermal overload for protection, two time constants (49T) main settings

Parameter	Function	Value (range)	Step
Temperature rise	49T	0.0…200.0 °C	0.1
Max temperature	49T	0.0…200.0 °C	0.1
Operate temperature	49T	80.0…120.0 %	0.1
Weighting factor p	49T	0.00…1.00	0.01
Short time constant	49T	6…60000 s	1
Current reference	49T	0.05…4.00 × I_n	0.01
Operation	49T	Off	-
		On	

Table 51: Stabilized and instantaneous differential protection for 3-winding transformers (87T3)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the current measured: f_n ±2 Hz		
		±3.0% of the set value or ±0.002 × I_n		
Trip time [1] [2]		Minimum	Typical	Maximum
	Low stage	34 ms	39 ms	44 ms
	High stage	19 ms	21 ms	22 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.96		

[1] Current before fault = 0.0 x I_n, f_n = 60 Hz. Injected differential current = 2.0 x set trip value.
[2] Includes the delay of the output contact value. f_n = 60 Hz.

Table 52: Stabilized and instantaneous differential protection for 3-winding transformers (87T3) main settings

Parameter	Function	Value (range)	Step
Restraint mode	87T3	"2.h + 5.h + wav Wavefrom 2.h + wavefrom 5.h + wavefrom"	
Instantaneous stage setting	87T3	500...3000 %Ir	10
Basic setting for biased operation	87T3	5…50 %	1
Slope of the second line of the operating characteristics	87T3	10…50 %	1
Turn point between the second and the third line of the operating characteristics	87T3	100…500 %Ir	1
Resistive reach for load discrimination, PSL	87T3	7…20 %	1
Load discrimination angle, PSL	87T3	10…50 %	1
Type of the third set/group of current inputs	87T3	Not in use Winding 3 Wnd 1 restraint Wnd 2 restraint	
CT connection type consideration between current gropus 1 and 2	87T3	Type 1 Type 2	
CT connection type consideration between current gropus 1 and 3	87T3	Type 1 Type 2	
Reference winding for vector group matching	87T3	Winding 1 Winding 2 Winding 3	
Elimination of the zero-sequence current	87T3	Not eliminated Winding 1 Winding 2 Winding 1 and 2 Winding 3 Winding 1 and 3 Winding 2 and 3 Winding 1,2,3	
Setting the phase shift between winding 1 and 2	87T3	0.0…359.9 deg	0.1
Setting the phase shift between winding 1 and 3	87T3	0.0…359.9 deg	0.1

Table 53: Three-phase inrush current detection (INR)

Characteristic	Value
Pickup accuracy	At the frequency f=f_n
	Current measurement:
	±1.5% of the set value or ±0.002 × I_n
	Ratio I2f/I1f measurement: ±5.0% of set value
Reset time	+35 ms / -0 ms
Reset ratio	Typical 0.96
Trip time accuracy	+20 ms / -10 ms

Table 54: Three-phase inrush current detection (INR) main settings

Parameter	Function	Value (range)	Step
Pickup range (Ratio of the 2nd to the 1st harmonic leading to restraint)	INR	5…100%	1
Definite time delay	INR	20…60000 ms	1

Table 55: Circuit breaker failure protection (50BF, 50NBF)

Characteristic	Value
Pickup accuracy	Depending on the frequency of the current measured: fn ±2Hz ±1.5% of the set value or ±0.002 × I_n
Trip time accuracy	±1.0% of the set value or ±20 ms

Table 56: Circuit breaker failur protection (50BF, 50NBF) main settings

Parameter	Function	Value (range)	Step
Current value (Operating phase current)	50BF, 50NBF	0.05…1.00 × I_n	0.05
Current value Res (Operating residual current)	50BF, 50NBF	0.05…1.00 × I_n	0.05
CB failure mode (Operating mode of function)	50BF, 50NBF	1=Current 2=Breaker status 3=Both	
CB fail trip mode	50BF, 50NBF	1=Off 2=Without check 3=Current check	
Retrip time	50BF, 50NBF	0…60000 ms	10
CB failure delay	50BF, 50NBF	0…60000 ms	10
CB fault delay	50BF, 50NBF	0…60000 ms	10

Table 57: Arc protection (AFD)

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

[1)] Phase Pickup range = 1.0 × I_n, current before fault = 2.0 × set Phase Pickup range, fn = 50Hz, fault with nominal frequency, results based on statistical distribution 200 measurements
[2)] Includes the delay of the heavy-duty output contact

Table 58: Arc protection (AFD) main settings

Parameter	Function	Value (range)	Step
Phase pickup range (Operating phase current)	AFD	0.50…40.00 × I_n	0.01
Ground pickup range (Operating residual current)	AFD	0.05…8.00 × I_n	0.01
Operation mode	AFD	1=Light+current 2=Light only 3=BI controlled	

Table 59: Operating characteristics

Parameter	Values (range)
Inverse-time and definite-time curve types (overcurrent protection)	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
Inverse-time and definite-time curve types (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

Table 60: Restricted earth fault, low impedance (REF)

Characteristic	Value		
Pickup accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz		
	±2.5% of the set value or ±0.002 × I_n		
Pickup time [1) 2)]	Minimum	Typical	Maximum
I_{Fault} = 2.0 × set Trip value	37 ms	40 ms	45 ms
Reset time	< 40 ms		
Reset ratio	Typical 0.96		
Retardation time	< 35 ms		
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms		
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1)] Pickup range = 1.0 × V_n, Voltage before fault 0.9 × V_n, f_n = 50 Hz, overvoltage in one phase-to-phase with nominal frequence injected from random phase angle, results based on statistical distribution of 1000 measurements.

[2)] Includes the delay of the signal output contact

Table 61: Restricted earth fault, low impedance (REF) main settings

Parameter	Function	Value (range)	Step
Trip value	REF	5…50 %	1
Restraint mode	REF	None	
		2nd harmonic	-
Pickup range 2.H	REF	10…50 %	1
Minimum trip time	REF	40…300000 ms	1
Operation	REF	Off	
		On	

Table 62: Single-phase undercurrent protection (37)

Characteristic	Value
Pickup accuracy	Depending on the frequency of the current measured: f_n ±2Hz ±1.5% of the set value or ±0.002 × I_n
Pickup time	Typical < 55 ms
Reset time	< 40 ms
Reset ratio	Typical 1.04
Retardation time	< 35 ms
Trip time accuracy in definite time mode	±1.0% of the set value or ±20 ms

Table 63: Single-phase undercurrent protection (37) main settings

Parameter	Function	Value (range)	Step
Pickup value	37	0.01…1.00 × I_n	0.01
Current book value	37	0.01…0.50 × I_n	0.01
Definite time delay	37	400…600000 ms	10
Operation	37	Off	
		On	

Table 64: Overexcitation protection (24)

Characteristic	Value
Pickup accuracy	±3.0% of the set value
Pickup time[1), 2)]	Frequency change: Typical 200 ms Voltage change: Typical < 40 ms
Reset time	< 50 ms
Reset ratio	Typical 0.96
Retardation time	< 35 ms
Pickup time accuracy in definite-time mode	±1.0% of the set value or ±20 ms
Pickup 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 65: Overexcitation protection (24) main settings

Parameter	Function	Value (range)	Step
Pickup value	24	100…200%	1
Curve type	24	Definite-time or inverse-time curves	-
Time multiplier	24	0.1…100.0	0.1
Trip delay time	24	200…200000 ms	10

Table 66: Frequency protection (81)

Characteristic		Value
Pickup accuracy	81O/81U	±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)
Pickup time	81O/81U	< 80 ms
	df/dt	< 120 ms
Reset time		< 150 ms
Trip time accuracy		±1.0% of the set value or ±30 ms

Table 67: Frequency protection (81) main settings

Parameter	Function	Value (range)	Step
Operation mode	81	1=81U	
		2=81O	
		3=df/dt	
		4=81U + df/dt	
		5=81O + df/dt	
		6=81U or df/dt	
		7=81O or df/dt	
Pickup value 81O	81	0.900…1.200 × F_n	0.001
Pickup value 81U	81	0.800…1.100 × F_n	0.001
Pickup value df/dt	81	-0.200…0.200 × F_n/s	0.005
Trip time 81O/81U	81	80…200000 ms	10
Trip time df/dt	81	120...200000 ms	10

Table 68: Load shed and restoration (81LSH)

Characteristic		Value
Pickup accuracy	81U	±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)
Pickup time	81U	< 80 ms
	df/dt	< 120 ms
Reset time		< 150 ms
Trip time accuracy		±1.0% of the set value or ±30 ms

Table 69: Load shed and restoration (81LSH) main settings

Parameter	Function	Value (range)	Step
Load shed mode	81LSH	81U	
		81U and df/dt	
		81U or df/dt	-
Restore mode		Disabled	
	81LSH	Auto	
		Manual	-
Pickup value 81U	81LSH	0.800…1.200 × F_n	0.001
Pickup value df/dt	81LSH	-0.200…-0.005 × F_n/ds	0.005
Trip time 81U	81LSH	80…200000 ms	10
Trip time df/dt	81LSH	120…200000 ms	10
Restore pickup val	81LSH	0.800…1.200 × F_n	0.001
Restore delay time	81LSH	80…200000 ms	10

Table 70: Multipurpose analog protection (MAP)

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

Table 71: Multipurpose analog protection (MAP) main settings

Parameter	Function	Value (range)	Step
Pickup value	MAP	-10000.0…10000.0	0.1
Trip delay time	MAP	0…200000 ms	100
Operation mode	MAP	Over	-
		Under	

Measurement functions

Table 72: Three-phase current measurements (IA, IB, IC)

Characteristic	Value
Measurement accuracy	Depending on the frequency of the current measured: f_n±2 Hz at currents in the range of 0.01…40 × I_n)
	Current: ±0.5% or ±0.002 × I_n
	Phase angle: ±2.5°
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…
	RMS: No suppression

Table 73: Current sequence components (I1, I2, I0)

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

Table 74: Three-phase voltage measurements (VA, VB, VC)

Characteristic	Value
Measurement accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz (at voltages in range 0.01…1.15 × V_n)
	Voltage: ±0.5% or ±0.002 × V_n
	Phase angle: ±2.5°
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…
	RMS: No suppression

Table 75: Three-phase voltage measurements (VA, VB, VC)

Characteristic	Value
Measurement accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz (at voltages in range 0.01…1.15 × V_n)
	Voltage: ±0.5% or ±0.002 × V_n
	Phase angle: ±2.5°
Suppression of harmonics	DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…
	RMS: No suppression

Table 76: Voltage sequence components (V1, V2, V0)

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

Table 77: Ground current measurement (IG)

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

Table 78: Ground voltage measurement VG)

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

Table 79: Frequency measurement (f)

Characteristic	Value
Measurement accuracy	±10 mHz (in measurement range 35…75 Hz)

Table 80: Three-phase and single-phase power and energy (P, SP, E, SE)

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

Supervision functions

Table 81: Fuse failure supervision (60)

Characteristic	Value	
Trip time [1]	NPS function:	
	V_{Fault} = 1.1 × set Neg Seq voltage Lev	< 33 ms
	V_{Fault} = 5.0 × set Neg Seq voltage Lev	< 18 ms
	Delta function:	
	ΔV = 1.1 × set Voltage change rate	<30 ms
	ΔV = 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

22. Display

The relay's local HMI includes a large LCD screen standard. The large LCD display offers full front-panel user-interface functionality with menu navigation and menu views.

The large display offers increased front-panel usability with less menu scrolling and improved information overview than with smaller LCD screens. The large display is well-suited for all relay installations providing an easy viewing interface.

23. Local HMI

The IED's local HMI includes a large LCD screen standard. The large LCD display offers full front-panel user-interface functionality with menu navigation and menu views. The large display offers increased front-panel usability with less menu scrolling and improved information overview than with smaller LCD screens. In addition, the large display includes a user configurable single line diagram (SLD) with position indication for the associated primary equipment. The standard configuration of the IED displays, apart from the primary equipment position, the related measuring values. Thus all necessary measurement can be viewed without scrolling through the IED menu. The SLD view can also be accessed using the web-browser based user interface. The default SLD can be modified according to user requirements using the graphical display editor in PCM600.

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

The large display is well-suited for all IED's installations providing an easy viewing interface.

The IED provides sixteen user configurable push buttons that are used for easy and quick operations, thus eliminating need for traditional external control switches. These pushbuttons are accessible in the IED for making any user defined logic. For each push button different operation modes such as pulsed, toggled are available. Each push button includes imbedded LED and configuration labels template is provided.

By eleven user configurable LEDs, traditional annunciation panel can be replaced. The input signal for each LED is selected individually with the PCM 600 Signal Matrix Tool (SMT). **The indication color, red or green, for each LED can be selected individually wiht the PCM 600.** Each indication LED on the IED can be set individually to operate in four different sequences (based on application): two as follow type and two as latch type. The light from the LEDs can be steady or flickering. LED label template is provided to suit your protection and control scheme.

24. Mounting methods

By means of appropriate mounting accessories the standard relay case for the 620 series relays can be flush mounted, semi-fl ush 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-out for one relay. For the routine testing purposes, the relay cases can be equipped with Flexitest (FT) test switches, type FT-1 or FT-19R, which can be mounted side by side or below the relay cases.

Mounting methods:
- Flush mounting
- Semi-flush mounting
- Wall mounting
- Mounting to a 19" equipment frame
- Mounting with Flexitest (FT) test switches to a 19" rack

Panel cut-out for flush mounting:
- Height: 9.76" (248 mm)
- Width: 6.38" (162 mm)

25. Relay case and drawout unit

For safety reasons, the relay cases 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 current measuring relay units from being inserted into a relay case for a voltage measuring relay unit and vice versa, i.e. the relay cases are assigned to a certain type of relay draw-out unit.

26. Selection and ordering data

The relay type and serial number label identifies the protection relay. The label is placed above the HMI on the upper part of the drawout unit. An order number label is placed on the side of the draw-out unit as well as inside the case. The order number consists of a string of alphanumeric characters generated from the hardware and soft ware modules of the relay.

Use the ordering key information below to generate the order number when ordering complete protection relays.

		1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Ex: NATBBABANBE1BNN1XF	N	A	T	B		B	A	B	A	N	B	E	1	B	N	N	1	X	F
Digit	Description																			
1) Product Series	620 series (Includes case)																			
2) Standard	ANSI																			
3) Main Appl	Transformer protection and control																			
4) Configuration	A: Differential, overexcitation, overcurrent, voltage (winding 1 or 2) and frequency protection and power system metering for two- or three-winding transformers				A															
	B: Differential, overexcitation overcurrent, voltage (winding 1 or 2), frequency and RTD protection and power system metering for two- or three-winding transformers					B														
5-6) Analog Inputs	10 CT + 4 VT [W2]						A	A												
	10 CT + 4 VT [W1]						A	B												
	10 CT + 4 VT [W2] + 2 RTD						B	A												
	10 CT + 4 VT [W1] + 2 RTD						B	B												
7-8) Binary I/O	8 BI + 9 BO + 3 HSO								A	1										
	8 BI + 13 BO								A	A										
	16 BI + 9 BO + 6 HSO								A	2										
	16 BI + 13 BO + 3 HSO								A	3										
	16 BI + 17 BO								A	B										
	8 BI + 9 BO + 3 HSO								B	1										
	8 BI + 13 BO								B	A										
	16 BI + 9 BO + 6 HSO								B	2										
	16 BI + 13 BO + 3 HSO								B	3										
	16 BI + 17 BO								B	B										
9-10) Communication Ports[1]	One port: Ethernet 100FX (LC)										N	A								
	One port: Ethernet 10/100BaseT (RJ45)										N	B								
	Two/three ports: [Ethernet 100 FX (LC) + RS-485 (1x4-wire or 2x2-wire)] + IRIG-B										A	A								
	Two/three ports: [Ethernet 10/100BaseT (RJ45) + RS-485 (1x4-wire or 2x2-wire)] + IRIG-B										A	B								
	Four ports: [Ethernet 100FX (LC) + 2 * Ethernet 10/100BaseT (RJ45) + serial glass fiber (ST)]										A	K								
	Four ports: [Ethernet 3 * 10/100BaseT (RJ45) + serial glass fiber (ST)]										A	L								
	Three ports: Ethernet 10/100BaseT (RJ45) + configurable RS232/RS485 + [RS485 or serial glass fiber (ST)] + IRIG-B										3	3								
Includes Arc Flash Detection	One port: Ethernet 100FX (LC) + Arc Flash Detection										N	F								
	One port: Ethernet 10/100BaseT (RJ45) + Arc Flash Detection										N	G								
	Two/three ports: [Ethernet 100 FX (LC) + RS-485 (1x4-wire or 2x2-wire)] + IRIG-B + Arc Flash Detection										F	F								
	Two/three ports: [Ethernet 10/100BaseT (RJ45) + RS-485 (1x4-wire or 2x2-wire)] + IRIG-B + Arc Flash Detection										F	G								
	Four ports: [Ethernet 100FX (LC) + 2 * Ethernet 10/100BaseT (RJ45) + serial glass fiber (ST)] + Arc Flash Detection										F	K								
	Four ports: [Ethernet 3 * 10/100BaseT (RJ45) + serial glass fiber (ST)] + Arc Flash Detection										F	L								

	Ex: NATBBABANBE1BNN1XF	N	A	T	B	B	A	B	A	N	B	E	1	B	N	N	1	X	F
Digit	Description																		
11) Protocols	IEC61850 + DNP3.0 L2 + Modbus											E							
12) Language	English												1						
	English + Spanish												5						
	English + Portuguese												8						
13) Front Panel	Large LCD (standard)													B					
14) Option 1	None														N				
15) Option 2	None															N			
16) Power Supply	48-250 Vdc; 100-240 Vac																1		
	24-60 Vdc																2		
17) SW Version	SW Version 2.0																	X	
18) HW Version	HW Version																		F

* Note: All communication options with RS-485 include IRIG-B connections.
1) SNTP is available for time-sync with all Ethernet options. IRIG-B is available for time-sync with all RS-485 options.
Both SNTP and IRIG-B are available for time-sync when both Ethernet and RS-485 options are available.
2) Version is F as product is based on M9.1
3) RET620 has a different case, the back terminal needs to support two current input modules

27. Accessories and ordering data

Table 82: Accessories and ordering data

Item	Order Number
Tools	
PCM600 user tool	PCM600-24
Cables	
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
Mounting accessories	
Semi-flush mounting kit	2RCA030573A0001
Wall mounting kit	2RCA030894A0001
19” mounting panel kit	2RCA031135A0001
Protection cover kit	2RCA030963A0001
Test switches	
FT-1, FT-14, and FT-19 Flexitest switches	See Descriptive bulletins DB 41-077 and DB 41-078 on www.abb.com/substationautomation

28. Tools

The relay is delivered as a pre-configured unit. The default parameter setting values can be changed from the front-panel user interface, the web-browser based user interface (WHMI) or the PCM600 tool in combination with the relay specific connectivity package (CP).

PCM600 offers extensive relay configuration functions such as application configuration, signal matrix, communication management, graphical display editor, and IEC 61850 communication configuration including horizontal relay-to-relay communication, GOOSE.

When the web-browser based user interface is used, the relay can be accessed either locally or remotely using a web browser (IE 7.0 or later). For security reasons, the web-browser based user interface is disabled by default. The interface can be enabled with the PCM600 tool or from the front panel user interface. The functionality of the interface can be limited to read-only access by means of PCM600.

Table 83: Tools

Configuration, setting and SA system tools	Version
PCM600	2.4.1 or later
Web-browser based user interface	IE 7.0 or later
RET620 Connectivity Package	2.0 ANSI or later
COM600 substation product	V3.5 or later
MicroSCADA Pro Substation Automation system	9.3 or later

Table 84: Supported functions

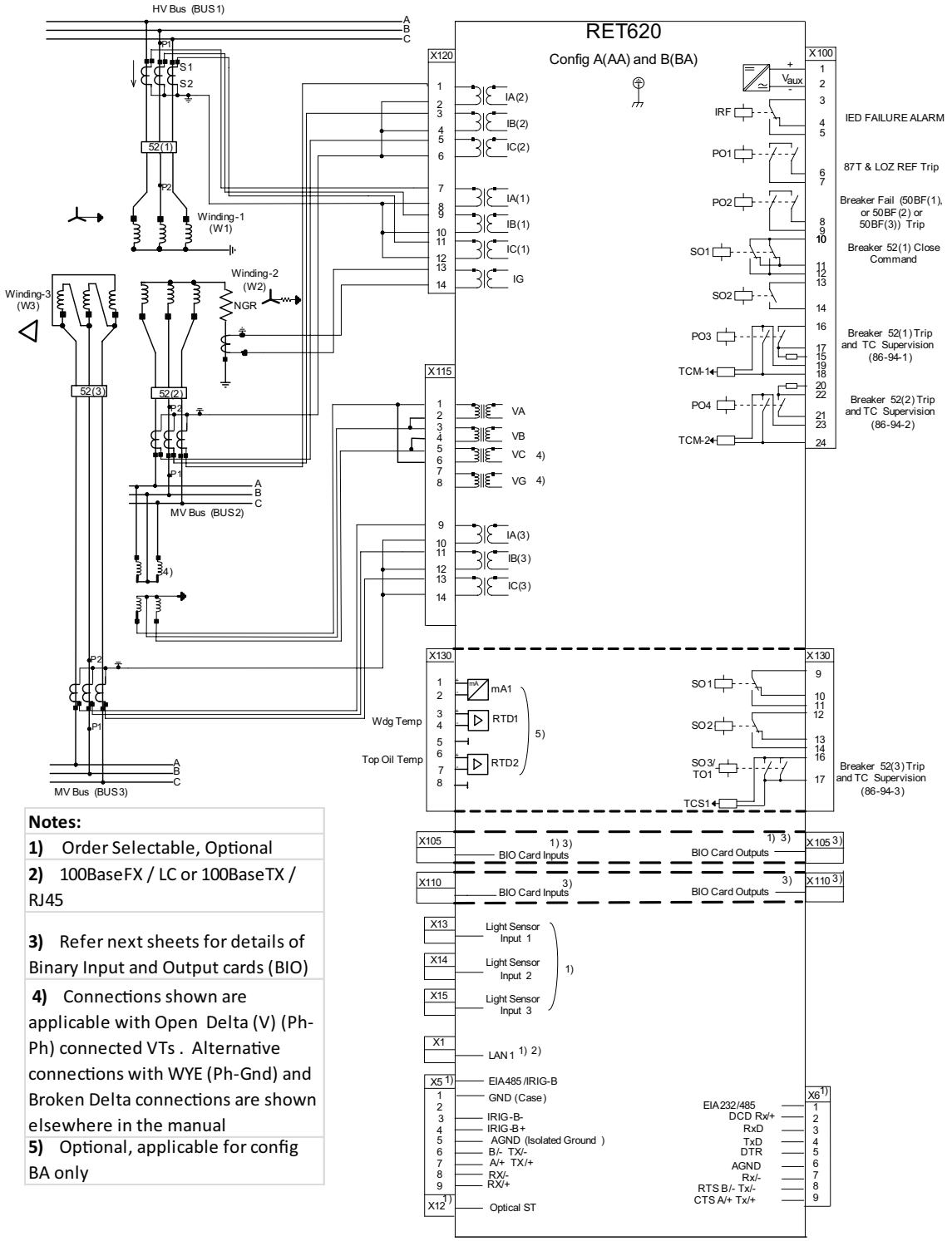
Functions	Web HMI	PCM600
Relay signal configuration (signal matrix tool)	–	•
IEC 61850 communication configuration, GOOSE (communication configuration tool)	–	•
Modbus® communication configuration (communication management tool)	–	–[1)]
DNP3.0 Level 2+ communication configuration (communication management tool)	–	•
IEC 60870-5-103 communication configuration (communication management tool)	–	•
Relay parameter setting	•	•
Saving of relay parameter settings in the relay	•	•
Saving of relay parameter settings in the tool	–	•
Signal monitoring	•	•
Digital fault recorder (DFR) handling	•	•
Digital fault record analysis	–	•
Event viewing	•	–
Saving of event data on the user's PC	•	–
Alarm LED viewing	•	•
Phasor diagram viewing	•	–
Access control management	•	•
Single-line diagram	• (view)	• (edit)

• = Supported

[1)] Analog and digital values pre-mapped to registers for easy individual or grouped register retrieval by Modbus driver

29. Terminal diagrams

Figure 5. RET620 Connection Diagram Config AA and BA



Notes:

1) Order Selectable, Optional

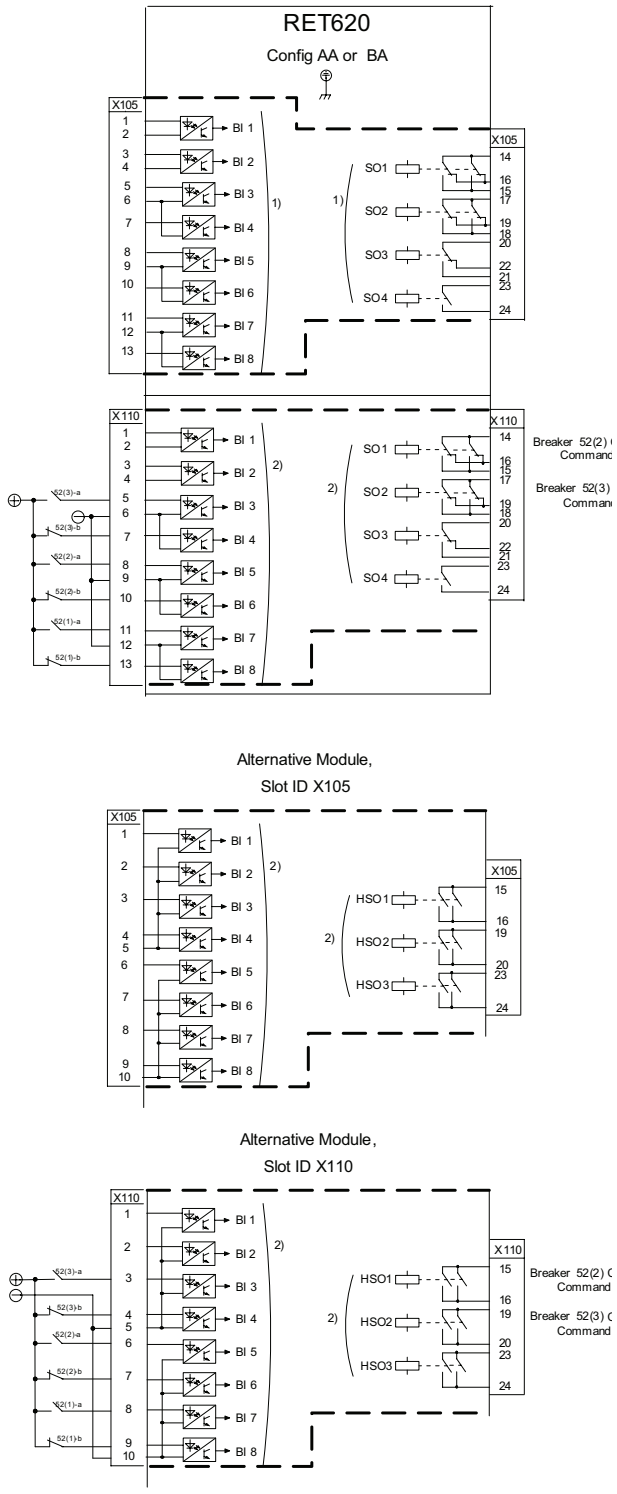
2) 100BaseFX / LC or 100BaseTX / RJ45

3) Refer next sheets for details of Binary Input and Output cards (BIO)

4) Connections shown are applicable with Open Delta (V) (Ph-Ph) connected VTs . Alternative connections with WYE (Ph-Gnd) and Broken Delta connections are shown elsewhere in the manual

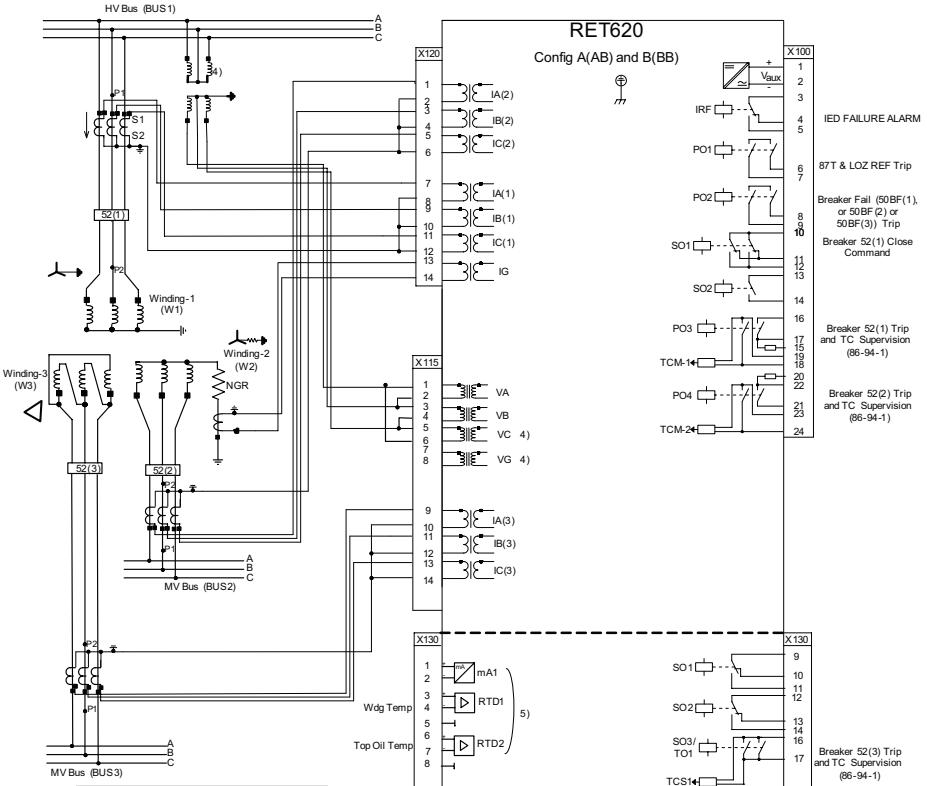
5) Optional, applicable for config BA only

Figure 6. RET620 Connection Diagram Config AA and BA



1) Order Selectable, Optional
2) Order Selectable, Optional alternatives

Figure 7. RET620 Connection Diagram Config AB and BB



Notes:

1) Order Selectable, Optional

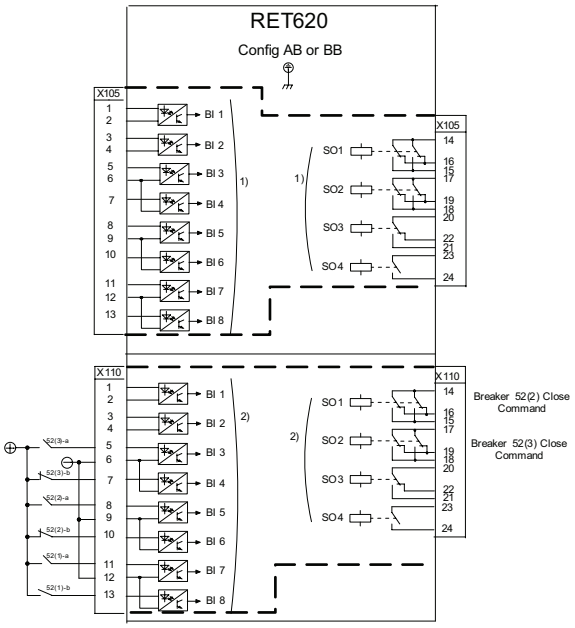
2) 100BaseFX / LC or 100BaseTX / RJ45

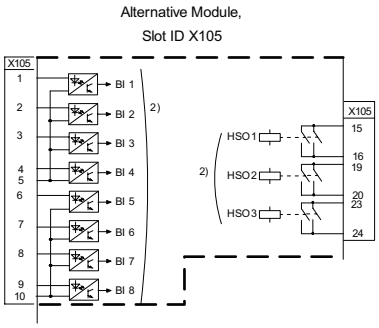
3) Refer next sheets for details of Binary Input and Output cards (BIO)

4) Connections shown are applicable with Open Delta (V) (Ph-Ph) connected VTs. Alternative connections with WYE (Ph-Gnd) and Broken Delta connections are shown elsewhere in the manual

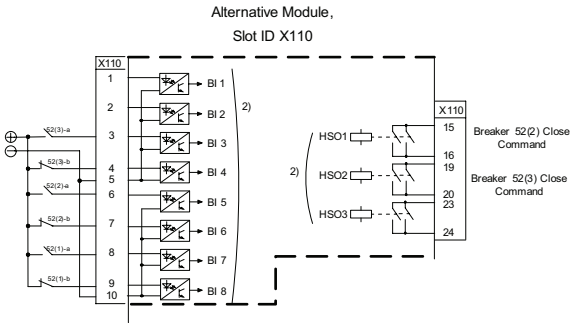
5) Optional, applicable for config BB only

Figure 8. RET620 Connection Diagram Config AB and BB





1) Order Selectable, Optional
2) Order Selectable, Optional alternatives



30. Certificates

The REM620 is a UL Listed product, UL File/Sec. E103204

31. References

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

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

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

You will find the latest relevant information on the feeder protection and control RET620 ANSI on the product web page.

32. Functions, codes and symbols

Table 85: Functions included in standard configurations, RET620

Function	IEC61850	ANSI/C37.2	IEC60617
Protection			
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	51P(1)	3I> (1)
Three-phase non-directional overcurrent protection, low stage, instance 2	PHLPTOC2	51P(2)	3I> (2)
Three-phase non-directional overcurrent protection, low stage, instance 3	PHLPTOC3	51P(3)	3I> (3)
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	50P-1(1)	3I>> (1)
Three-phase non-directional overcurrent protection, high stage, instance 2	PHHPTOC2	50P-2(1)	3I>> (2)
Three-phase non-directional overcurrent protection, high stage, instance 3	PHHPTOC3	50P-1(2)	3I>> (3)
Three-phase non-directional overcurrent protection, high stage, instance 4	PHHPTOC4	50P-2(2)	3I>> (4)
Three-phase non-directional overcurrent protection, high stage, instance 5	PHHPTOC5	50P-1(3)	3I>> (5)
Three-phase non-directional overcurrent protection, high stage, instance 6	PHHPTOC6	50P-2(3)	3I>> (6)
Three-phase directional overcurrent protection, low stage, instance 1	DPHLPDOC1	67/51P(1)	3I> -> (1)
Three-phase directional overcurrent protection, low stage, instance 2	DPHLPDOC2	67/51P(2)	3I> -> (2)
Non-directional ground-fault protection, low stage, instance 1	EFLPTOC1	51G	Io> (1)
Non-directional ground-fault protection, low stage, instance 2	EFLPTOC2	51N(1)	Io> (2)
Non-directional ground-fault protection, low stage, instance 3	EFLPTOC3	51N(2)	Io> (3)
Non-directional ground-fault protection, low stage, instance 4	EFLPTOC4	51N(3)	Io> (4)
Non-directional ground-fault protection, high stage, instance 1	EFHPTOC1	50G	Io>> (1)
Non-directional ground-fault protection, high stage, instance 3	EFHPTOC3	50N-1(1)	Io>> (3)
Non-directional ground-fault protection, high stage, instance 4	EFHPTOC4	50N-1(2)	Io>> (4)
Non-directional ground-fault protection, high stage, instance 5	EFHPTOC5	50N-1(3)	Io>> (5)
Directional ground-fault protection, low stage, instance 1	DEFLPDEF1	67/51N(1)	Io> -> (1)
Directional ground-fault protection, low stage, instance 2	DEFLPDEF2	67/51N(2)	Io> -> (2)
Three phase directional power protection, instance 1	DPSRDIR1	32P(1)	I1-> (1)
Three phase directional power protection, instance 2	DPSRDIR2	32P(2)	I1-> (2)
Ground directional power protection, instance 1	DNZSRDIR1	32N(1)	I2 ->, Io-> (1)
Ground directional power protection, instance 2	DNZSRDIR2	32N(2)	I2 ->, Io-> (2)
Negative-sequence overcurrent protection, instance 1	NSPTOC1	46(1)	I2> (1)
Negative-sequence overcurrent protection, instance 2	NSPTOC2	46(2)	I2> (2)
Negative-sequence overcurrent protection, instance 3	NSPTOC3	46(3)	I2> (3)
Residual overvoltage protection, instance 1	ROVPTOV1	59G	Uo> (1)
Residual overvoltage protection, instance 2	ROVPTOV2	59N (1)	Uo> (2)

Table 85: Functions included in standard configurations, RET620 (cont'd)

Function	IEC61850	ANSI/C37.2	IEC60617
Residual overvoltage protection, instance 3	ROVPTOV3	59N (2)	Uo> (3)
Three-phase undervoltage protection, instance 1	PHPTUV1	27-1(1)	3U< (1)
Three-phase undervoltage protection, instance 2	PHPTUV2	27-2(1)	3U< (2)
Three-phase undervoltage protection, instance 3	PHPTUV3	27-1(2)	3U< (3)
Three-phase undervoltage protection, instance 4	PHPTUV4	27-2(2)	3U< (4)
Three-phase overvoltage protection, instance 1	PHPTOV1	59-1(1)	3U> (1)
Three-phase overvoltage protection, instance 2	PHPTOV2	59-2(1)	3U> (2)
Three-phase overvoltage protection, instance 3	PHPTOV3	59-1(2)	3U> (3)
Three-phase overvoltage protection, instance 4	PHPTOV4	59-2(2)	3U> (4)
Negative-sequence overvoltage protection, instance 1	NSPTOV1	47-1(1)	U2> (1)
Negative-sequence overvoltage protection, instance 2	NSPTOV2	47-2(1)	U2> (2)
Negative-sequence overvoltage protection, instance 3	NSPTOV3	47-1(2)	U2> (3)
Negative-sequence overvoltage protection, instance 4	NSPTOV4	47-2(2)	U2> (4)
Frequency protection, instance 1 (1)	FRPFRQ1	81-1(1)	f>/f<,df/dt
Frequency protection, instance 2 (2)	FRPFRQ2	81-2(1)	f>/f<,df/dt
Frequency protection, instance 3 (3)	FRPFRQ3	81-1(2)	f>/f<,df/dt
Frequency protection, instance 4 (4)	FRPFRQ4	81-2(2)	f>/f<,df/dt
Voltage per hertz protection, instance 1	OEPVPH1	24-1(1)	U/f> (1)
Voltage per hertz protection, instance 2	OEPVPH2	24-2(1)	U/f> (2)
Voltage per hertz protection, instance 3	OEPVPH3	24-1(2)	U/f> (3)
Voltage per hertz protection, instance 4	OEPVPH4	24-2(2)	U/f> (4)
Three-phase thermal overload protection for power transformers, two time constants	T2PTTR1	49T(1)	3Ith>T
Stabilized and instantaneous differential protection for 3W -Transformers	TR3PTDF1	87T	3dI>T
Numerical stabilized low impedance restricted ground-fault protection	LREFPNDF1	87LOZREF(2)	dIoLo>
Circuit breaker failure protection, instance 1	CCBRBRF1	50BF(1)	3I>/Io>BF (1)
Circuit breaker failure protection, instance 2	CCBRBRF2	50BF(2)	3I>/Io>BF (2)
Circuit breaker failure protection, instance 3	CCBRBRF3	50BF(3)	3I>/Io>BF (3)
Master trip, instance 1 (1)	TRPPTRC1	86/94-1	Master Trip
Master trip, instance 2 (2)	TRPPTRC2	86/94-2	Master Trip
Master trip, instance 3 (3)	TRPPTRC3	86/94-3	Master Trip
Arc protection, instance 1	ARCSARC1	AFD-1(2)	ARC (1)
Arc protection, instance 2	ARCSARC2	AFD-2(2)	ARC (2)
Arc protection, instance 3	ARCSARC3	AFD-3(2)	ARC (3)
Load shedding and restoration, instance 1	LSHDPFRQ1	81LSH-1(1)	UFLS/R (1)
Load shedding and restoration, instance 2	LSHDPFRQ2	81LSH-2(1)	UFLS/R (2)
Load shedding and restoration, instance 3	LSHDPFRQ3	81LSH-3(1)	UFLS/R (3)
Load shedding and restoration, instance 4	LSHDPFRQ4	81LSH-4(1)	UFLS/R (4)
Load shedding and restoration, instance 5	LSHDPFRQ5	81LSH-1(2)	UFLS/R (5)
Load shedding and restoration, instance 6	LSHDPFRQ6	81LSH-2(2)	UFLS/R (6)
Load shedding and restoration, instance 7	LSHDPFRQ7	81LSH-3(2)	UFLS/R (7)
Load shedding and restoration, instance 8	LSHDPFRQ8	81LSH-4(2)	UFLS/R (8)
RTD based thermal protection, instance 1	MAPGAPC1	38-1	ThA> ThB>
RTD based thermal protection, instance 2	MAPGAPC2	38-2	ThA> ThB>
RTD based thermal protection, instance 3	MAPGAPC3	38-3	ThA> ThB>
Loss of phase, instance 1	PHPTUC1	37(1)	3I< (1)
Loss of phase, instance 2	PHPTUC2	37(2)	3I< (2)
Loss of phase, instance 3	PHPTUC3	37(3)	3I< (3)
Control			
Circuit-breaker control, instance 1	CBXCBR1	52(1)	I <-> O CB (1)
Circuit-breaker control, instance 2	CBXCBR2	52(2)	I <-> O CB (2)
Circuit-breaker control, instance 3	CBXCBR3	52(3)	I <-> O CB (3)
Condition monitoring			
Circuit-breaker condition monitoring, instance 1	SSCBR1	52CM(1)	CBCM (1)
Circuit-breaker condition monitoring, instance 2	SSCBR2	52CM(2)	CBCM (2)

Table 85: Functions included in standard configurations, RET620 (cont'd)

Function	IEC61850	ANSI/C37.2	IEC60617
Circuit-breaker condition monitoring, instance 3	SSCBR3	52CM(3)	CBCM (3)
Trip circuit supervision, instance 1	TCSSCBR1	TCM-1	TCS (1)
Trip circuit supervision, instance 2	TCSSCBR2	TCM-2	TCS (2)
Trip circuit supervision, instance 3	TCSSCBR3	TCM-3	TCS (3)
Advanced current circuit supervision for transformers	CTSRCTF1	MCS 3I, I2	MCS 3I, I2
Fuse failure supervision, instance 1	SEQRFUF1	60(1)	FUSEF (1)
Fuse failure supervision, instance 2	SEQRFUF2	60(2)	FUSEF (2)
Measurement			
Three-phase current measurement, instance 1	CMMXU1	IA, IB, IC(1)	3I
Three-phase current measurement, instance 2	CMMXU2	IA, IB, IC(2)	3I(B)
Three-phase current measurement, instance 3	CMMXU3	IA, IB, IC(3)	3I(C)
Sequence current measurement, instance 1	CSMSQI1	I1, I2, I0(1)	I1, I2, I0
Sequence current measurement, instance 2	CSMSQI2	I1, I2, I0(2)	I1, I2, I0(B)
Sequence current measurement, instance 3	CSMSQI3	I1, I2, I0(3)	I1, I2, I0(C)
Residual current measurement, instance 1	RESCMMXU1	IG	Io
Three-phase voltage measurement, instance 1	VMMXU1	VA, VB, VC(1)	3U
Three-phase voltage measurement, instance 2	VMMXU2	VA, VB, VC (2)	3U(B)
Residual voltage measurement, instance 1	RESVMMXU1	VG	Uo
Residual voltage measurement, instance 2	RESVMMXU2	VG	Uo(B)
Sequence voltage measurement, instance 1	VSMSQI1	V1, V2, V0(1)	U1, U2, U0
Sequence voltage measurement, instance 2	VSMSQI2	V1, V2, V0 (2)	U1, U2, U0(B)
Single-phase power and energy measurement, instance 1	SPEMMXU1	SP, SE(1)	SP, SE
Single-phase power and energy measurement, instance 2	SPEMMXU2	SP, SE(2)	SP, SE(B)
Three-phase power and energy measurement, instance 1	PEMMXU1	P, E(1)	P, E
Three-phase power and energy measurement, instance 2	PEMMXU2	P, E(2)	P, E(B)
Load profile	LDPMSTA1	LoadProf	-
Frequency measurement, instance 1	FMMXU1	f	f
Frequency measurement, instance 2	FMMXU2	f	f
Tap changer position indication	TPOSSLTC1	84T	TPOSM
Recorder			
Disturbance recorder	RDRE1	DFR	DR
Fault recorder	FLTMSTA1	FR	FR
Sequence event recorder	SER	SER	SER
Other functions			
Minimum pulse timer (2 pcs), instance 1	TPGAPC1	TP-1	TP (1)
Minimum pulse timer (2 pcs), instance 2	TPGAPC2	TP-2	TP (2)
Minimum pulse timer (2 pcs), instance 3	TPGAPC3	TP-3	TP (3)
Minimum pulse timer (2 pcs), instance 4	TPGAPC4	TP-4	TP (4)
Pulse timer (8 pcs), instance 1	PTGAPC1	PT-1	PT (1)
Pulse timer (8 pcs), instance 2	PTGAPC2	PT-2	PT (2)
Time delay off (8 pcs), instance 1	TOFGAPC1	TOF-1	TOF (1)
Time delay off (8 pcs), instance 2	TOFGAPC2	TOF-2	TOF (2)
Time delay off (8 pcs), instance 3	TOFGAPC3	TOF-3	TOF (3)
Time delay off (8 pcs), instance 4	TOFGAPC4	TOF-4	TOF (4)
Time delay on (8 pcs), instance 1	TONGAPC1	TON -1	TON (1)
Time delay on (8 pcs), instance 2	TONGAPC2	TON -2	TON (2)
Time delay on (8 pcs), instance 3	TONGAPC3	TON -3	TON (3)
Time delay on (8 pcs), instance 4	TONGAPC4	TON -4	TON (4)
Set reset (8 pcs), instance 1	SRGAPC1	SR-1	SR (1)
Set reset (8 pcs), instance 2	SRGAPC2	SR-2	SR (2)
Set reset (8 pcs), instance 3	SRGAPC3	SR-3	SR (3)
Set reset (8 pcs), instance 4	SRGAPC4	SR-4	SR (4)
Move (8 pcs), instance 1	MVGAPC1	MV-1	MV (1)

Table 85: Functions included in standard configurations, RET620 (cont'd)

Function	IEC61850	ANSI/C37.2	IEC60617
Move (8 pcs), instance 2	MVGAPC2	MV-2	MV (2)
Move (8 pcs), instance 3	MVGAPC3	MV-3	MV (3)
Move (8 pcs), instance 4	MVGAPC4	MV-4	MV (4)
Move (8 pcs), instance 5	MVGAPC5	MV-5	MV (5)
Move (8 pcs), instance 6	MVGAPC6	MV-6	MV (6)
Move (8 pcs), instance 7	MVGAPC7	MV-7	MV (7)
Move (8 pcs), instance 8	MVGAPC8	MV-8	MV (8)
Generic control points, instance 1	SPCGGIO1	CNTRL-1	SPC(1)
Generic control points, instance 2	SPCGGIO2	CNTRL-2	SPC(2)
Generic control points, instance 3	SPCGGIO3	CNTRL-3	SPC(3)
Remote Generic control points, instance 1	SPCRGGIO1	RCNTRL-1	SPCR(1)
Local Generic control points, instance 1	SPCLGGIO1	LCNTRL-1	SPCL(1)
Generic Up-Down Counters, instance 1	UDFCNT1	CTR-1	CTR(1)
Generic Up-Down Counters, instance 2	UDFCNT2	CTR-2	CTR(2)
Generic Up-Down Counters, instance 3	UDFCNT3	CTR-3	CTR(3)
Generic Up-Down Counters, instance 4	UDFCNT4	CTR-4	CTR(4)
Generic Up-Down Counters, instance 5	UDFCNT5	CTR-5	CTR(5)
Generic Up-Down Counters, instance 6	UDFCNT6	CTR-6	CTR(6)
Generic Up-Down Counters, instance 7	UDFCNT7	CTR-7	CTR(7)
Generic Up-Down Counters, instance 8	UDFCNT8	CTR-8	CTR(8)
Generic Up-Down Counters, instance 9	UDFCNT9	CTR-9	CTR(9)
Generic Up-Down Counters, instance 10	UDFCNT10	CTR-10	CTR(10)
Generic Up-Down Counters, instance 11	UDFCNT11	CTR-11	CTR(11)
Generic Up-Down Counters, instance 12	UDFCNT12	CTR-12	CTR(12)
Programmable buttons (16 buttons), instance 1	FKEYGGIO1	FKEY	FKEY

33. Document revision history

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34. Notes

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