PRODUCT GUIDE

RER620

Advanced recloser protection & control

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RER620

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1. Description

The RER620 is a dedicated recloser protection and control relay perfectly aligned for the protection, control, measurement and supervision of utility substations and industrial power systems including radial, looped and meshed distribution networks with or without distributed power generation. RER620 is a member of ABB's Relion® family and a part of its 620 protection and control product series. The 620 series protection and control relays are characterized by their compactness and withdraw-able unit design.

Re-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. The relay provides main protection for overhead lines and cable feeders in distribution networks. The relay is also used as back-up protection in applications, where an independent and redundant protection system is required.

Unique RER620 features

- Six setting groups
- Drawout design
- High impedance (HIZ) fault detection
- Integrated Loop Control
- Support both single and three phase tripping for improved feeder performance
- Easy integration of Distributed generation on already installed recloser
- Large, easy to read LCD screen "Quick" pushbuttons for easy operation
- Scalable hardware including binary inputs/outputs, different communication interfaces
- Integrated Web browser for easy setting and operation
- Use of IEC61850 and GOOSE messaging communications for high-speed protection, fault isolation and service restoration
- Easy integration into Ethernet or serial-based communication networks with DNP3 Level 2, Modbus, IEC 61850, IEC 60870-5-101/104 and PG&E 2179
- By using Application Configuration Tool – ACT of PCM600 tool, different applications such as recloser, switch, sectionalizer can be made easily
- Field data from recloser control, Sequence of Events, digital waveform recording, advanced metering, setting etc. can be achieved by using just simple Internet Explorer. No tool needs to be installed on field personnel's computer
- Environmentally friendly design with RoHS compliance

The RER620 provides main protection for overhead lines of distribution substations. It can be applied for protection and control of grounded and ungrounded distribution systems.

The RER620 is the most powerful, advanced recloser protection relay in its class, perfectly offering time and instantaneous overcurrent, negative sequence overcurrent, phase discontinuity, breaker failure, embedded loop control performing automatic loop restoration functions, commonly accepted as a means to significantly improve circuit reliability and to provide more effective system operation, and voltage metering and protection. The relay also features optional high impedance fault (HIZ) and sensitive earth fault (SEF) protection for grounded and ungrounded distribution systems. Also, the relay incorporates a flexible three and single-phase multi-shot auto-reclose function for automatic feeder restoration in temporary faults on overhead lines.

The RER620 also integrates basic control functionality, which facilitates the control of one circuit breaker or recloser via the relay's front panel human machine interface (HMI) or remote control system. To protect the relay from unauthorized access and to maintain the integrity of information, the re-

lay has been provided with a four-level, role-based user authentication system, with individual passwords for the viewer, operator, engineer, and administrator levels. The access control system applies to the front panel HMI, embedded web browser based HMI, and the PCM600 relay setting and configuration tool. RER620 supports the new IEC 61850 standard for inter-device communication in substations or along the feeder. The relay also supports the industry standard DNP3 level 2, Modbus, IEC 60870-5-101/104 and PG&E 2179 protocols.

2. Standard configurations

The RER620 relay's main application is feeder protection and control and offers one standard configuration whose relay functions and features are based on the ordering code. See Tables 1 for details. The standard signal configuration can be altered by means of the graphical signal matrix or the optional graphical application functionality of the Protection and Control protection and control relay Manager PCM600. Further, the application configuration functionality of PCM600 supports the creation of multi-layer logic functions utilizing various logical elements including timers and flip-flops. By combining protection functions with logic function blocks, the protection and control relay configuration can be adapted to user specific application requirements.

Configuration includes standard metering, monitoring and control features and sequence of event, fault and digital waveform recording. Advanced Ethernet communications included standard with parallel support of DNP3.0 Level 2+*, IEC 60870-5-104, Modbus and IEC61850 and SNTP over TCP/IP. Additional RS-232 and RS-485 serial communication ports are available as options that support DNP3 Level 2+*, IEC 60870-5-101, Modbus or PG&E 2179 protocols. Included with the optional serial communication ports is IRIG-B time synchronization.

*The DNP3.0 PG&E 2179 Level 2+ implementation includes some Level 3 functionality.

Table 1. Supported functions RER620

Functionality	
Protection	
Three-phase non-directional time overcurrent protection with single phase trip option, low stage	• 1)
Three-phase non-directional time overcurrent protection with single phase trip option, high stage 1	• 1)
Three-phase non-directional time overcurrent protection with single phase trip option, high stage 2	• 1)
Three-phase non-directional instantaneous overcurrent protection with single phase trip option	• 1)
Non-directional time overcurrent ground-fault protection, low stage	• 6)
Non-directional time overcurrent ground-fault protection, high stage 1	• 6)
Non-directional time overcurrent ground-fault protection, high stage 2	• 6)
Non-directional instantaneous time overcurrent ground-fault protection	• 6)
Non-directional sensitive earth-fault	• 7)
Negative sequence non-directional time overcurrent protection 1	•
Negative sequence non-directional time overcurrent protection 2	•
Phase discontinuity protection	•
Three-phase inrush detector	•
Three-phase directional overcurrent protection, low stage 1	• 4)
Three-phase directional overcurrent protection, low stage 2	• 4)
Directional ground-fault protection, low stage 1	•
Directional ground-fault protection, low stage 2	•
Three-phase overvoltage 1, source 1 low stage	• 2)
Three-phase overvoltage 2, source 1 high stage	•
Three-phase overvoltage 3, source 2 low stage	• 3)
Three-phase undervoltage 1, source 1 low stage	• 2)
Three-phase undervoltage 2, source 1 high stage	•
Three-phase undervoltage 3, source 2 low stage	• 3)
Positive sequence overvoltage protection, source 1	• 2)
Positive sequence overvoltage protection, source 2	• 3)
Negative sequence overvoltage protection, source 1	• 2)
Negative sequence overvoltage protection, source 2	• 3)
Zero sequence overvoltage protection, source 1	• 2)
Zero sequence overvoltage protection, source 2	• 3)

Table 1. Supported functions RER620 (continued)

Functionality	
Protection	
Underfrequency, overfrequency, frequency rate of change, source 1, stage 1	•
Underfrequency, overfrequency, frequency rate of change, source 1, stage 2	•
Load shed & restoration, source 1, stage 1	• 2)
Load shed & restoration, source 1, stage 2	• 3)
Circuit breaker failure protection	•
Circuit breaker close failure protection	•
Directional positive sequence power protection	• 4)
Directional negative/zero sequence power protection	•
High Impedance Fault Detector	• 7)
Cold load inrush detection, timer 1 Phase A (in seconds)	•
Cold load inrush detection timer 2 Phase A (in minutes)	
Cold load inrush detection timer 2 Phase C (in minutes)	•
Control	
Circuit Breaker 1 (3 state inputs / 3 control outputs)	•
Auto-reclosing, single phase and/or three phase	•
Synchronism and energizing check	•
Loop control	•
Condition monitoring	
Circuit-breaker condition monitoring	•
Fuse failure supervision, source 1	•
Measurement	
Digital fault (waveform) recorder	•
Three-phase current measurement	•
Sequence current measurement	•
Three-phase voltage measurement, source 1	•
Three-phase voltage measurement, source 2	•
Sequence voltage measurement, source 1	•
Sequence voltage measurement, source 2	•
Ground current	•
Single and three phase power, power factor and three phase energy, source 1	•
Frequency measurement, source 1	•
Demand metering, Max/Min metering	•
Sequence of events recorder (SER)	•
Fault Recorder	•
Fault Locator (FLOC)	•
Other functions	
Uninterruptable Power Supply (UPS) including: battery charger, heater control, auxiliary power for external modems, voltage boost	• 5)
Universal Power Driver (UPD) for ABB GridShield series of reclosers and others	•
Programmable buttons (16 buttons)	•
Move function block (8 outputs)	•
Pulse timer (8 timers)	•
Generic control points (16 outputs)	•
Set reset flip flops (8 outputs)	•
Time delay off timers (8 timers)	•
Time delay on timers (8 timers)	•
Move function block (8 outputs)	•
Pulse timer (8 timers)	•
Generic control points (16 outputs)	•
Set reset flip flops (8 outputs)	•

Table 1. Supported functions RER620 (continued)

Functionality	
Other functions	
Time delay off timers (8 timers)	•
Time delay on timers (8 timers)	•
Up/Down counters UDFCNT1...UDFCNT12 (12 counters)	•

1) Three phase tripping is always enabled when ordering RER620. Single phase tripping is optional
2) Voltages connected to X[130] terminals 1 - 9 are considered as Source 1
3) Voltages connected to X[130] terminals 11 - 18 are considered as Source 2
4) Polarizing voltage is taken from X[130] terminals 1 - 9
5) UPS is mandatory when using RER620 with either ABB Gridshield or G&W Viper recloser
6) I0 is calculated
7) IG is measured from the fourth CT (X[120], terminal 13-14) input of RER620

3. Protection functions

This protection and control relay provides non-directional three and single phase as well as ground overcurrent, phase unbalance and phase discontinuity protections with optional sensitive earth fault (SEF), high impedance fault detection (HIZ), directional phase, ground and neutral overcurrent and phase, ground (residual), positive sequence and negative sequence undervoltage and overvoltage protection. Also, the relay offers three and single-pole multishot autoreclose function for utility overhead and underground distribution feeders. Phase, ground and negative sequence protective elements can be set by selecting any curve according to the IEEE C37.112, IEC 60255-3. In addition, all traditional recloser curves are available.

Fast and delayed curves can be modified with the following curve modifiers:

- Time multiplier – shifts curve vertically
- Minimum trip time – holds off curve tripping
- Time adder – add time to curve

For phase, ground and negative sequence protective elements, instantaneous overcurrent , definite-time overcurrent and high-current lockout are also available.

RER620 offers different reset curves, including immediate, definite time and inverse time setting options.

RER620 offers a dedicated phase and ground directional protective elements. Phase directional elements provide a variety of different polarizing quantities such as Positive or Negative sequence voltage, self-polarizing (faulted) or cross-polarizing (healthy voltages). To secure a reliable and correct directional operation in case of close short circuits when polarizing quantity might be low, RER620 implements a memory function.

In the case of failure in the secondary circuits between the voltage transformers and RER620 to avoid misoperation of the voltage based functions, RER620 includes a Fuse failure/Loss-of potential functionality. Fuse failure/Loss-of potential functionality can detect failure in one, two or three phase failures in the secondary VT circuit.

Frequency protection including overfrequency, underfrequency and frequency rate-of-change protection is offered in RER620 with standard configuration. In addition, integrated load shedding and restoration function based on frequency and rate-of change is included. In the applications when closing of breakers between asynchronous networks is needed, energizing and synchronizing function is provided in the standard configuration. In the application when high sensitivity is required, positive and negative sequence directional power elements are included in the standard configuration. Recloser function in RER620 provides up to five programmable auto-reclose shots which can perform one to five successive auto-reclosings of desired type and duration, for instance one high-speed and one delayed auto-reclosing. Recloser function has the ability to operate on three poles independently. This feature allows it to be used in distribution networks, where the bulks of loads are single phase and it is not always necessary to operate all three poles in case of fault on one phase. Visual indication on programmable LED is provided when recloser is in the lockout. By using programmable push button, reclosing functionality can be disabled or enabled.

In several applications, such as fuse-saving applications involving down-stream fuses, tripping and initiation of shot 1 should be fast (instantaneous or short-time delayed). The tripping and initiation of shots 2, 3 and definite tripping time should be de-

layed. In such applications, RER620 includes a sequence coordination feature. Recloser feature in RER620 includes Switch Onto the Fault (SOTF) which prevents reclosing sequence when recloser/breaker is manually closed on forgotten grounding after a maintenance work along the power line. During the stormy weather, there might be many autoreclose shots within a few minutes. These types of faults can easily damage recloser/breaker if the reclose function is not blocked based on frequent operation counters.

Figure 1 shows the protection functions available for the standard configuration.

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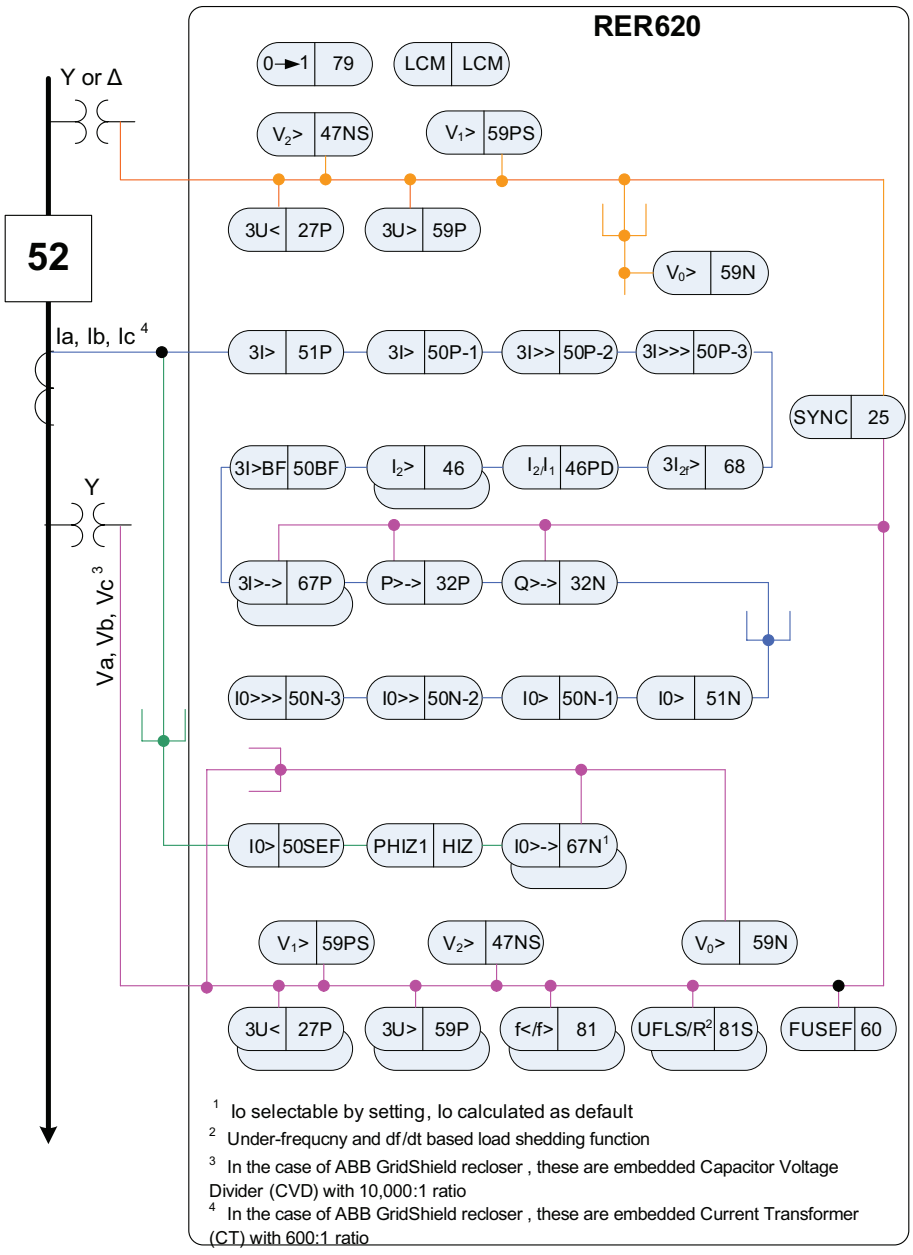
Figure 1. Protection function overview



4. Application

To make ordering simple, the RER620 always includes three phase CTs, sensitive earth fault (SEF)/ high impedance (HIZ) CT input and six VT inputs to perfectly match required distribution feeder protection, control and metering functionality. Customer programmable phase and ground CT and VT secondary nominal settings and wide protection setting ranges increase the RER620 flexibility of application. Directional ground-fault protection is mainly used in isolated neutral or compensated networks, whereas non-directional ground-fault protection is intended for directly or low impedance grounded networks. The protection and control relay can also be used for protection of ring-type and meshed distribution networks as well of radial networks containing distributed power generation.

Measured residual current from the fourth CT input (0.2/1A) is used by the Sensitive Earth Fault and High Impedance Detection. The residual current for the ground-fault protection derived from the phase currents is used by other time overcurrent and instantaneous ground protective elements. When applicable, the core-balance current transformers can be used for measuring the residual current, especially when sensitive ground-fault protection is required. In the case when high sensitivity is required to detect the fault in the range of 1A primary current, protection functions can be set to the fourth CT input with 0.2A nominal tap setting.

The standard configuration offers directional earth-fault protection with residual voltage calculated from the phase voltages. Furthermore, the standard configuration include fuse failure supervision. In addition standard configuration offers directional overcurrent protection, overvoltage and undervoltage protection, positive-sequence and negative-sequence overvoltage protection and residual voltage protection.
To perform automatic loop restoration functions, commonly accepted as a means to significantly improve circuit reliability and to provide more effective system operation, embedded Loop Control functionality is provided as a standard feature. In such applications there is no communication between the recloser control protection and control relays and automatic fault isolation and restoration is accomplished with Loop control functionality.

The loop control feature in RER620 supports (please refer to Figure 4):

Sectionalizing recloser:

Opens in response to a downstream fault or to a loss of phase voltage from an upstream circuit.

Midpoint recloser:
It supports loop control by automatically altering the RER620 settings in accordance with changing voltage conditions.

Tiepoint recloser:
It closes in response to a loss of all phase voltages from one source if the other source phase voltages are live.

In the case there is a communication (via fiber-optic or wireless) between recloser control relays, network reconfiguration can be accomplished by GOOSE messaging based on IEC61850, please refer to Figure 2.

To ensure that energization of Distributed generation interconnection transformer does not cause the protective elements at already installed recloser to operate (because of transformer inrush current), RER620 have built in logic to detect energization and consequently make necessary action such as desensitize or block protective elements. With this RER620 advanced feature, need for the external wireless communication as well as complex relay blocking logic and operational procedures are avoided, please refer to Figure 3.

Included is advanced Ethernet communications supporting the IEC61850-8 standard and DNP3 Level 2+, IEC 60870-5-104 and Modbus protocols over TCP/IP, and serial communications supporting DNP3 Level 2+, IEC 60870-5-101, Modbus and PG&E 2179 protocols.

The standard configuration includes six voltage sensing inputs. Each sensing input can accommodate conventional voltage sources as well as capacitive and resistive voltage dividers (sensors) that provide low level voltage magnitude.

Inaccuracy of the voltage sources (conventional and sensor type) can be compensated by setting in RER620.

Figure 2. Peer-to-peer relay Fault Detection Isolation and Restoration (FDIR) control using IEC61850 GOOSE messaging

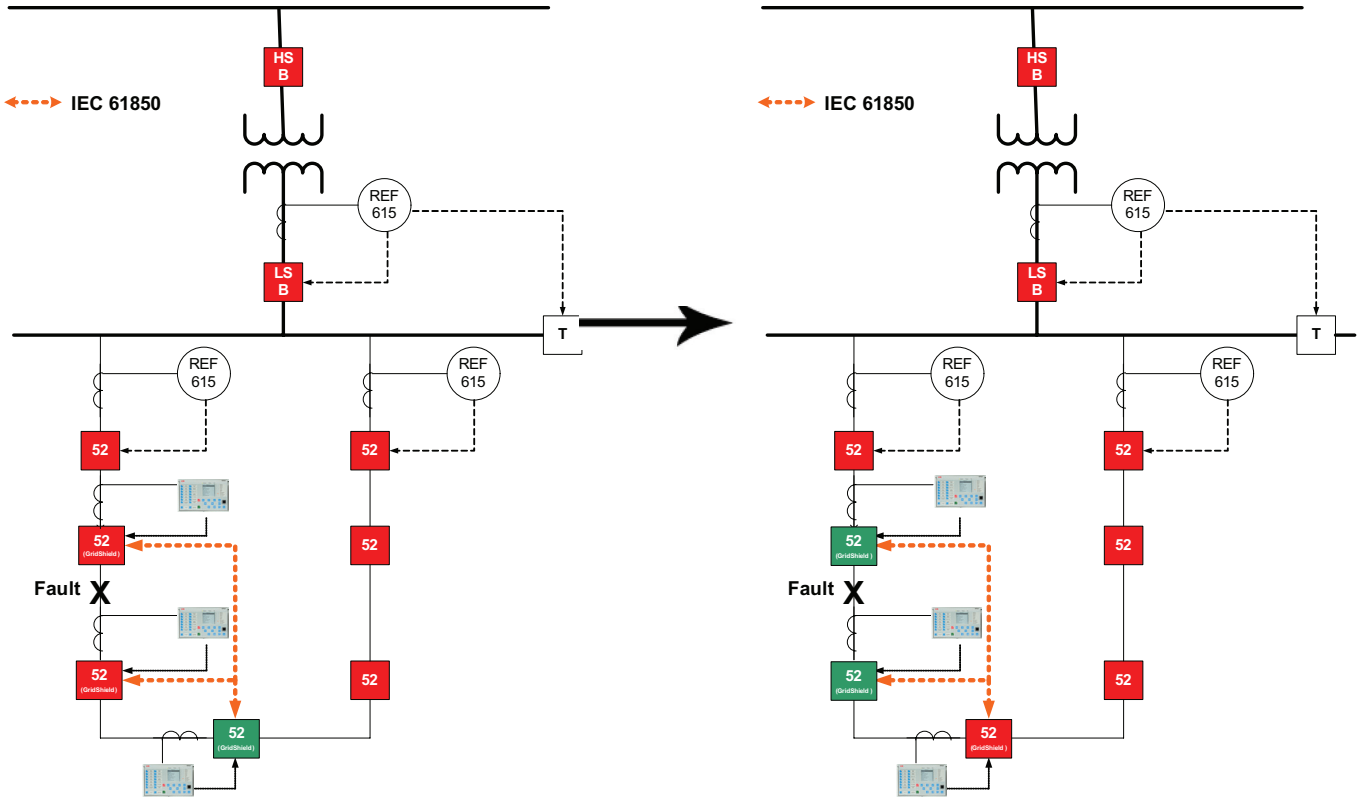


Figure 3. Recloser application with Distributed Energy Resources (DER)

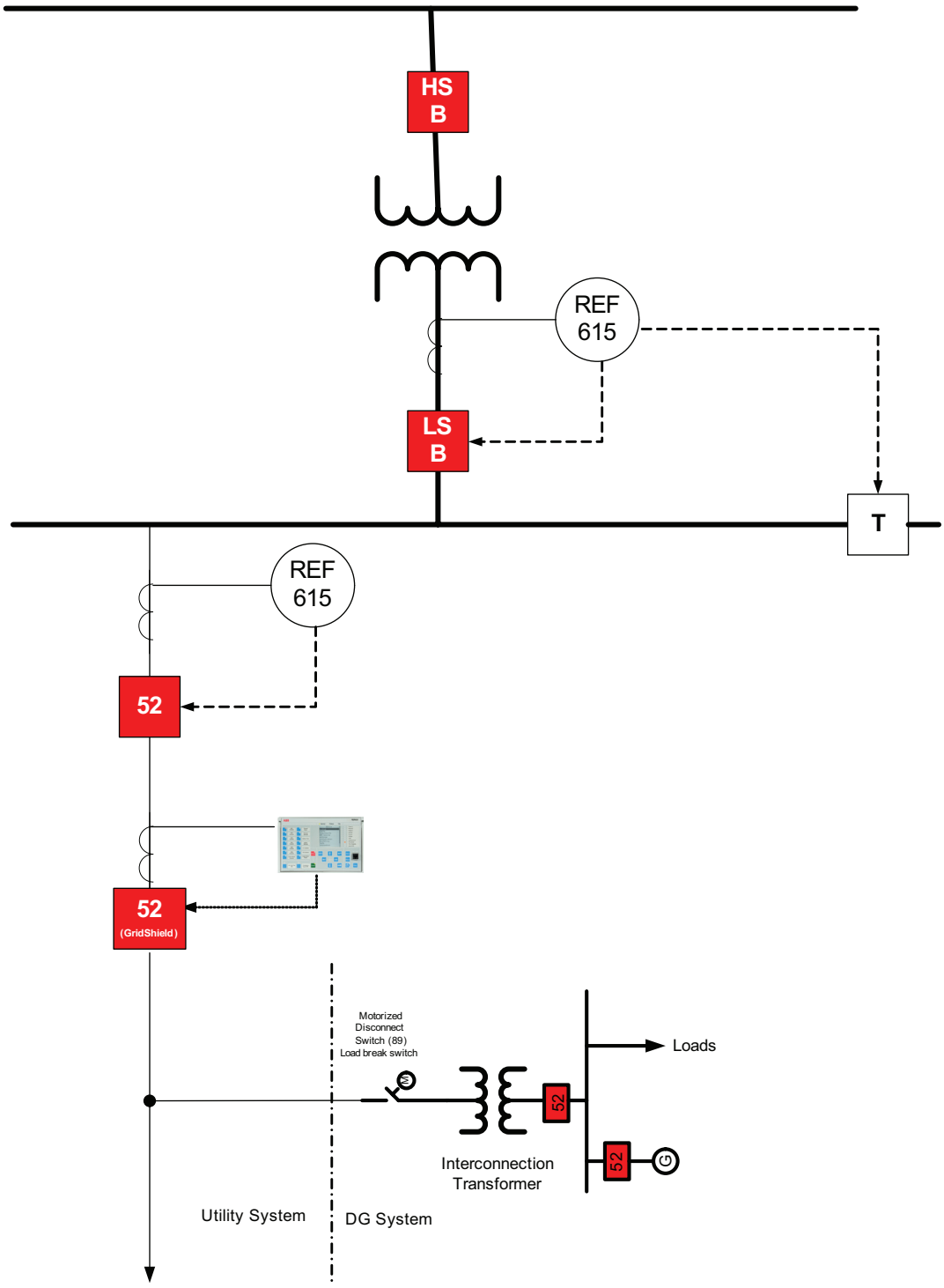
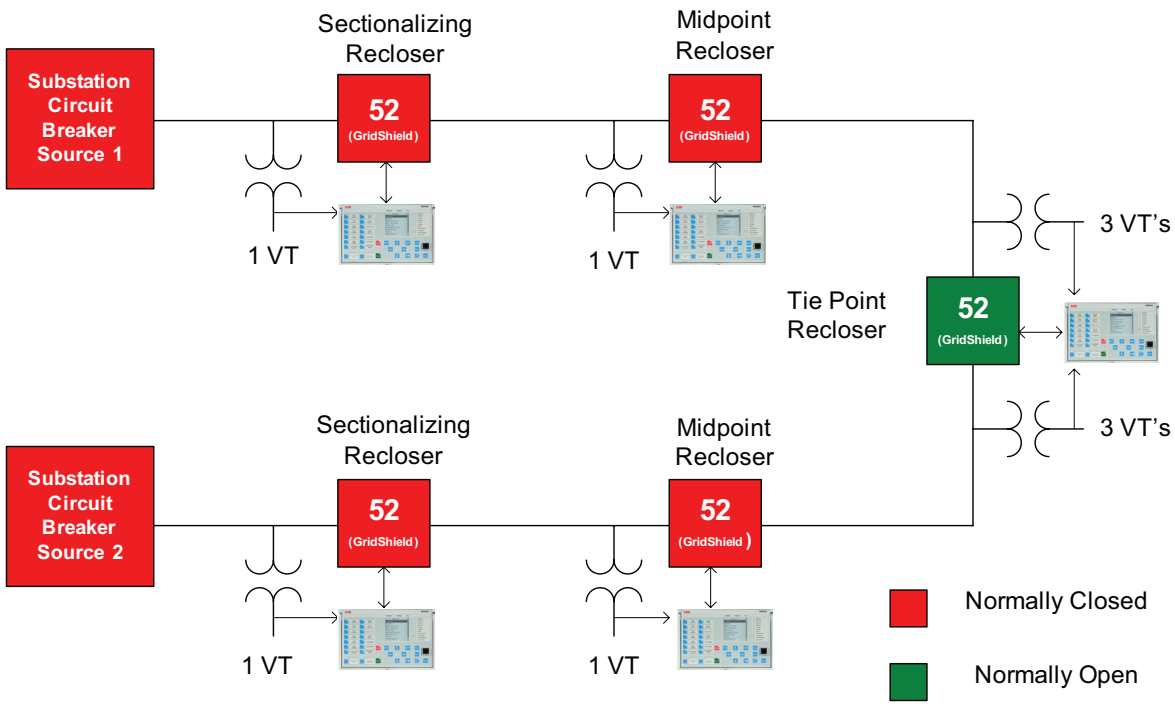


Figure 4. Recloser
Loop Control



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 protection and control 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 protection and control 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. Further, the web HMI of COM600 offers an overview of the whole substation and outgoing feeders with reclosers, including relay specific single line diagrams, thus enabling convenient information accessibility To enhance personnel safety, the web HMI also enables remote access to substation devices and processes. Furthermore, COM600 can be used as a local data warehouse for technical documentation of the substation and for network data collected by the protection and control relays. The collected network data facilitates extensive reporting and analyzing of network fault situations using the data historian and event handling features of COM600. The data historian can be used for accurate process performance monitoring by following process and equipment performance calculations with real-time and history values. Better understanding of the process behavior by joining time-based process measurements with production and maintenance events helps the user to understand the process dynamics.

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

Table 2. Supported ABB solutions

Product	Version
Station Automation COM600	3.5 or later
MicroSCADA Pro	9.2 SP2 or later
System 800xA	5.0 Service Pack 2

Figure 5. Utility distribution network example using 615, 620 series protection and control relays, Station Automation COM600 and MicroSCADA Pro

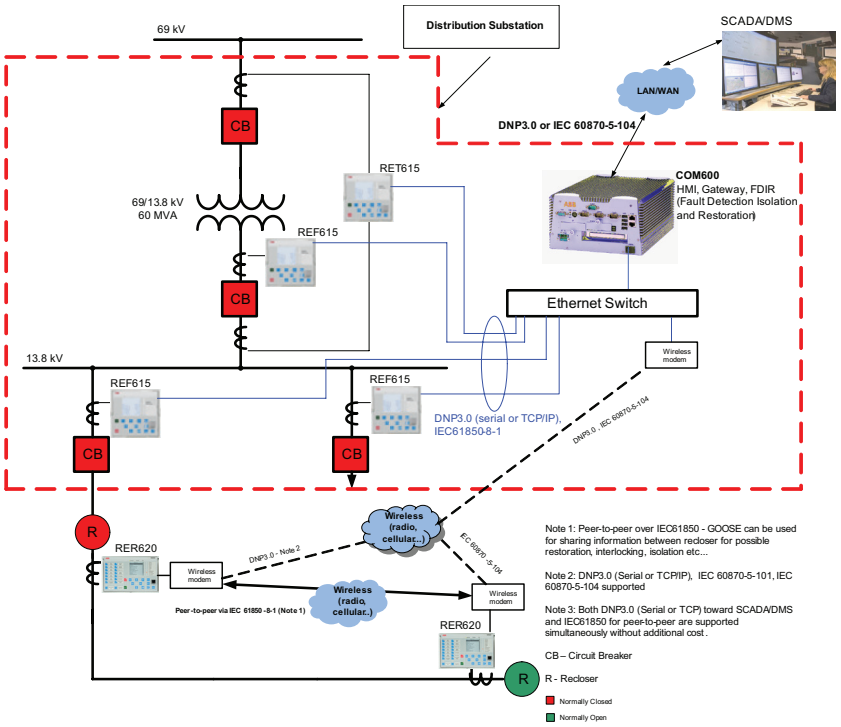
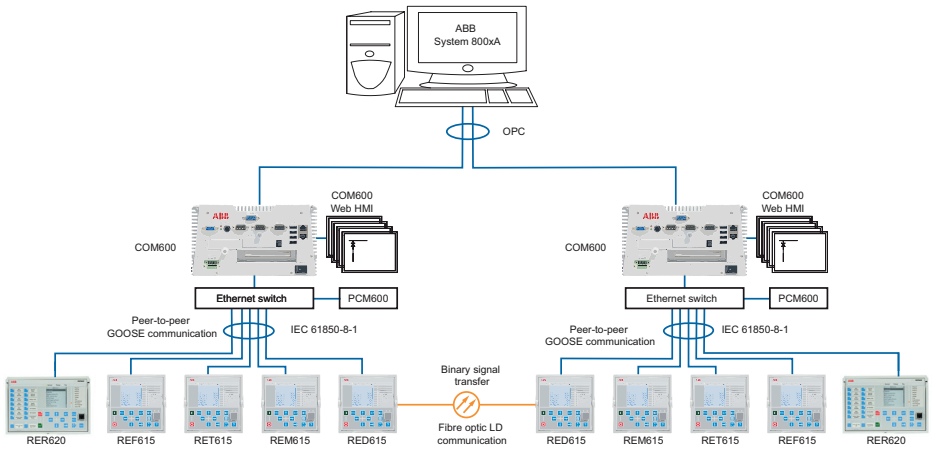


Figure 6. Industrial distribution network example using 615, 620 series protection and control relays, Station Automation COM600 and System 800xA



6. Control
The protection and control relay offers status and control of one recloser/circuit breaker with dedicated push-buttons on the front panel local human machine interface (LHMI) for opening and closing of that recloser/breaker.

Further, the large graphical LCD of the protection and control relay's HMI includes a single line diagram (SLD) with position indication for the relevant recloser/circuit breaker. Interlocking schemes required by the application are configured using the signal matrix or the application configuration feature of PCM600. The Protection and control relay also incorporates a synchro-check function to ensure that the voltage, phase angle and frequency on either side of an open recloser/circuit breaker satisfy the conditions for safe interconnection of two networks.

Flexible remote breaker control of select-before-trip (SBO) or direct trip is also available with each of the supported DNP3.0 Level 2+, Modbus, IEC 60870-5-101, IEC 60870-5-104, PG&E 2179 and IEC 61850 communication protocols. Interlocking schemes required by the application are configured with Signal Matrix Tool (SMT) or Application Configuration Tool (ACT) in PCM600 .

7. Measurements
The protection and control relay continuously measures the phase currents, the sequence components of the currents and the residual current . In addition, the relay calculates the demand phase currents over a user-selectable pre-set time frame, and the phase unbalance value as a ratio between the negative sequence and positive sequence currents. Phase, ground and sequence voltage measurements plus power, energy, frequency, and power factor measurements are included. The values measured can be accessed locally via the user interface on the protection and control 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 protection and control relay is provided with a digital fault recorder (DFR) featuring up to twelve analog and 64 binary signal channels. The analog channels record either the waveform or the trend of the currents and voltages measured.

The analog channels can be set to trigger the recording function when the measured value falls below or exceeds the set values. The binary signal channels can be set to start a recording 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. Phase and ground voltage waveforms would be available for inclusion in each digital recording. The recorded information is stored in a non-volatile memory and can be uploaded for subsequent fault analysis.

9. Event recorder
The protection and control relay includes a sequence of events recorder (SER) that logs important event activity. The non-volatile memory retains its data also in case the relay temporarily loses its auxiliary supply. The event log facilitates detailed pre and post-fault analyses of feeder faults and disturbances.

To collect sequence of events (SER) information, the relay incorporates a memory with a capacity of storing 512 event codes with associated date and time stamps. 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. Fault recorder
The protection and control relay has the capacity to store the records of 32 fault events. The records enable the user to analyze the most recent power system events. Each record includes the current, voltage and angle values, the Pickup times of the protection elements, time stamp, etc. The fault recording can be triggered by the pickup signal or the trip signal of a protection elements, or by both. The available measurement modes include DFT (Discrete Fourier Transform), RMS (Root-mean-square) and peak-to-peak.
All records are stored in a nonvolatile memory.

In addition, the maximum demand phase currents with date and time stamp are separately stored as recorded data. All 32 records are remotely retrievable via DNP3.0 Level 2+, IEC 60870-5-101, IEC 60870-5-104, and Modbus protocols and the 32 most recent fault records are retrievable and viewable using the front panel HMI, WMHI and PCM600 interfaces using the front panel HMI, web based WHMI and PCM600 interfaces.

11. Recloser/circuit-breaker condition monitoring
For continuous knowledge of the operational availability of recloser/circuit breaker, the RER620 features a comprehensive set of monitoring functions. Everytime the recloser/breaker operates, there will be electrical and mechanical wear. Thus, the life of the recloser/circuit breaker reduces due to wearing. The wearing in the recloser/breaker depends on the tripping current, and the remaining life of the recloser/breaker is estimated from the recloser/breaker trip curve provided by the manufacturer. The remaining life is calculated separately for each phase and it is available as a monitored data value.

The recloser/breaker monitoring can include checking the wear and tear of the recloser/circuit breaker, the spring charging time of the breaker operating mechanism and the gas pressure of the breaker chambers. The protection and control relay also monitors the breaker travel time and the number of circuit breaker (CB) operations to provide basic information for scheduling CB maintenance.

12. Trip-circuit monitoring
In the case RER620 is used with a breaker, 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.

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

14. Fuse failure protection
The protection and control relay includes fuse failure supervision functionality. The fuse failure supervision detects failures between the voltage measurement circuit and the relay. 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. Uninterruptable Power Supply (UPS)
The UPS unit is used in conjunction with RER620. Although the UPS is a physically separate unit, it is connected to and is controlled by the RER620. An external battery needs to be connected to the UPS, such that the UPS can draw power from the battery and make it available to the RER620, as well any other auxiliary devices, in the event the main power source is lost. The UPS charges the battery and also tests the battery to ensure its health and availability.

The UPS may be powered by AC or DC. There are two variants of the UPS. One variant covers the 125VDC and 120VAC range and another variant covers the 250VDC and 240VAC range. The UPS is equipped with the ability to monitor the availability of input voltage if powered by AC. In the case the main AC supply is lost, alarm is provided locally to the local HMI as well as remotely.

The UPS has an isolated Auxiliary Power Supply for auxiliary equipment such as radios, modems, etc. The Auxiliary Power Supply has two output voltage settings, 12VDC and 24VDC.

The UPS has an integrated battery charger that is a current regulated charger. The battery voltage determines when the charger is switched off. The switch off voltage is influenced by the temperature to some degree. The battery charger may charge as high as 50 W, but this is limited by the firmware and presently set to a value less than 50 W. The output wattage varies through different portions of the charge curve. If the battery to be charged is completely discharged or close to being completely dead then only a small amount of charge current is applied to the battery. As the battery starts charging, indicated by a voltage increase, the current is increased. This method is used to prevent battery charge failure due to trying to charge a defective battery or shorted battery circuit. The UPS has a circuit that switches in 1.5 ohms, 40 W of resistance across the battery. This load is applied to the battery for 0.1 seconds. The battery's voltage -is taken before and during this time. A comparison of the two measurements can be made and the health of the battery determined.

The UPS has embedded boost circuit for driving magnetic actuator of ABB GridShield reclosers. The output from this boost supply provides the power to operate the actuators for the GridShield family of reclosers.

The UPS makes use of its integrated temperature sensor to determine when the heater should engage. The UPS can also select to switch off the heater in the event there is no or limited input power. The heater will not be energized when operating off battery back up power. For example if a pole operation has just occurred the heater may be switch off so more available power can go into charging the boost capacitor. This circuit can conduct and switch 8 amps at 250VAC continuously.

16. Universal Power Driver (UPD)

The UPD is normally attached to three poles for control of a three-phase recloser in an electrical distribution system. Open and Close commands (local or remote) goes through six half-bridge drivers of UPD that are connected to form three independent full-bridge drive channels. The purpose of each channel is to allow current flow through magnetic actuator to be in the forward or reverse direction. The UPD is equipped with six binary inputs that are designed for reading switches (recloser and yellow handle position) located in the High Voltage Cabinet.

17. Access control

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

18. Inputs and outputs

Standard and optional binary inputs and outputs (I/O) also depend upon the selected protection and control relay configuration. Table 3 details the analog inputs and I/O available for each configuration. The phase current inputs are user programmable for 5 A or 1 A CT secondary nominal rating. The fourth CT is used by the SEF/HIZ and has a 0.2/1 A nominal rating. The sensitive earth fault CT provides SEF protection and includes a separate, independent HIZ protective function for detecting downed conductors.

The nominal secondary voltage of the six-phase VT inputs are user programmable. Both phase-to-phase (open delta) voltages and phase-to-ground (wye) voltages can be connected to protection and control relay. The binary input turn-on thresholds are programmable from 18…176 V DC by adjusting the relay's parameter settings. Besides the dedicated trip/close outputs that are mandatory to drive the magnetic actuators in reclosers, RER620 provides additional user programmable binary inputs and outputs.

All binary input and output contacts are freely programmable with the signal matrix tool in PCM600 software user tool.

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Table 3. Input/output overview

Standard configuration	Analog inputs		Binary inputs/ outputs	
	CT	VT	BI	BO
Basic	4	6	4[1)]	6[1)]
Full with optional I/O	4	6	20[2)]	14[2)]

1) In addition to the 4 Binary Inputs and 6 Binary Outputs, UPD (Universal Power Driver) has a 3 Binary Outputs to drive recloser (Open/ Close) and 4 Binary Inputs. Three binary inputs are connected to the GridShield position indication (52b contact), one input is reserved for 69 switch (optional in GridShield assembly).
2) Two Optional Binary I/O cards need to be installed in slot X[105] and X[110]

19. Communications

The protection and control relay supports a range of different communication protocols: IEC 61850, DNP3 Level 2+, IEC 60870-5-101, IEC 60870-5-104, Modbus and PG&E 2179. Operational information and controls are available through these protocols. Unique communication functionality, for example, peer-to-peer communication between relays is available via the IEC 61850 communication protocol. The IEC 61850 communication implementation supports all monitoring and control functions. Additionally, parameter setting and disturbance file records can be accessed using the IEC 61850-8-1 protocol. Disturbance files are available to any Ethernet-based application in the standard COMTRADE format. Further, the relay can send and receive binary signals from other Protection and control relay (peer-to-peer communication) using the IEC61850-8-1 GOOSE profile. The relay meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard. The relay can simultaneously report events to five different clients - maximum five IEC 61850-8-1 clients, maximum five Modbus clients, maximum two clients in total for IEC 60870-5 -101 and/or IEC 60870-5-104 and maximum one DNP3.0 Level 2+client with total number not exceeding five.

All communication connectors, except for the front RJ45 connector, are located in the back of the unit on the left most card slot. This slot remains in the case when the draw out unit is removed eliminating the need to disconnect communication connections.

The relay can be connected to an Ethernet-based communications network via a copper RJ45 (100Base TX) or fiber optic LC (100Base FX) connector or serial network via the RS-485 option that provides one 4-wire or two 2-wire ports. When the protection and control relay uses the RS-485 bus for the serial communication, both two- and four wire connections are supported. Termination and pull-up/down resistors can be configured with jumpers on the communication card so external resistors are not needed.

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.

Modbus over TCP/IP is supported with the Ethernet communications option selected. Besides standard Modbus functionality such as status and control operations, the relay supports retrieval of time-stamped events, uploading of disturbance files and storing of the latest fault records. For the Modbus TCP connection, a maximum of five clients can be connected to the relay simultaneously.

DNP3.0 Level 2+ over TCP/IP is also supported with the Ethernet communications card option. Another serial communications option offers programmable RS-232 or RS-485 and fiber-optic (ST) serial ports. Communication channel redundancy is supported for DNP3. RER620 listens the DNP master on both channels - serial and TCP/IP - simultaneously and responds on both ports. One DNP master is supported. Status and control, including recloser/breaker trip/close control, operations are supported in the Level 2+ implementation. Optional serial (RS-232/RS-485) communication interfaces are available that support user programmable protocols of DNP3.0 Level 2+, IEC 60870-5-101, PG&E 2179 , and Modbus RTU/ ASCII. Another serial communications option offers programmable RS-232 or RS-485 and fiber-optic (ST) serial ports. All serial communication card options include an Ethernet communications port and an IRIG-B port for dedicated time synchronization network connections. The companion standards IEC 60870-5-101 (for serial line) and IEC 60870-5-104 (for Ethernet) are derived from the IEC 60870-5 protocol standard definition. It specifies a functional profile for basic telecontrol tasks. The protection and control relay supports both balanced and unbalanced link mode.

The relay supports the time synchronization with a time-stamping resolution of +/-1 ms:

Ethernet based:
- SNTP (primary and secondary server support)

With special time synchronization wiring:
- IRIG-B (Inter-Range Instrumentation Group - Time Code Format B)
- In addition, the protection and control relay supports time synchronization via the following serial communication protocols:
- Modbus
- DNP3
- IEC 60870-5-103

Table 4. Supported station communication interfaces and protocols

Interfaces/protocols	Ethernet		Serial	
	100BASE-TX (RJ45)	100BASE-FX (LC)	RS-232/RS-485	Fiber-optic (ST)
DNP3 Level 2+ over TCP/IP	•	•	-	-
Modbus over TCP/IP	•	•	-	-
IEC 61850-8-1	•	•	-	-
SNTP	•	•	-	-
FTP	•	•	-	-
IEC 60870-5-104	•	•	-	-
DNP3 Level 2+ serial	-	-	•	•
Modbus RTU/ASCII	-	-	•	•
IRIG-B time synchronization	-	-	•	•
IEC 60870-5-101	-	-	•	•
PG&E 2179 protocol	-	-	•	•

• = supported

20. Technical data

Table 5. Dimensions

Description	Value	
Width	frame case	10.32" (262.2 mm) 9.69" (246 mm)
Height	frame case	6.97" (177 mm), 4U 6.30" (160 mm)
Depth	case	7.91" (201 mm)
Weight	complete protection and control relay plug-in unit only	10.5 lbs (4.8 kg) 6.0 lbs (2.8 kg)

Table 6. Power supply (RER620)

Description	Type 2
V nominal (V_n)	60 V DC
V_n variation	50 to 120% of V_n (30 to 72 V DC)
Start-up threshold	48 V DC (60 V DC × 80%)
Burden of auxiliary voltage supply under quiescent (Pq)/operating condition	DC < 6.9 W (nominal)/ 13.3 W (max)
Ripple in the DC auxiliary voltage	Max 12% of the DC value (at frequency of 2 x f_n Hz)
Maximum interruption time in the auxiliary DC voltage without resetting the protection and control relay	50 ms at 60 V DC
Fuse type	T4A/250 V

Table 7. Uninterruptable Power Supply (UPS) tests

Test	Type test value	Reference
Control voltage (IEEE C37.90-2005) - UPS0001 - UPS0002	 90 to 150 V AC 180 to 280V AC	 No influence No influence
Control power interruptions (IEC 60255-11-2008) - UPS0001 and UPS0002	 60 VDC	 2 seconds (no battery)
IEEE C37.60 - 2003 UPS0001 and UPS0002	15 kV, 27 kV, 38 kV reclosers	No influence
Power consumption (IEEE C37.90-2005) - UPS0001 - UPS0002	 90 to 150 VAC 180 to 280 VAC	 25 W (nominal)/~120 W (max)
Auxiliary Power Supply	12 VDC & 24 VDC	20 W (nominal)/~24 W (max)
Battery Charger	48 VDC	35 W max
Battery Run Time	38 hr	48 VDC 12 amp hr. battery with standard load (15 W)
Boost Supply	Programmable 61-250 VDC	80 W max

—

Table 8. Energizing inputs

Description		Value	
Rated frequency		50/60 Hz ± 5 Hz	
Current inputs	Rated current, I_n	0.2/1 A[1)]	1/5 A[2)]
	Thermal withstand capability: - Continuously - For 1 s	 4 A 100 A	 20 A 500 A
	Dynamic current withstand: - Half-wave value	 250 A	 1250 A
	Input impedance	<100 mΩ	<20 mΩ
Voltage input	Rated voltage	100 V AC/ 110 V AC/ 115 V AC/120 V AC (Parametrization)	
	Voltage withstand: - Continuous - For 10 s	 2 x Vn (240 V) 3 x Vn (360 V)	
	Burden at rated voltage	<0.05 VA	

1) Ordering option for ground current input
2) Ground current and/or phase current

—

Table 9. Binary inputs

Description	Value
Rated voltage	24 to 250 V DC
Operating range	±20 % of the rated voltage
Current drain	1.6 to 1.9 mA
Power consumption	31.0 to 570 mW
Threshold voltage	18 to 176 V DC
Reaction time	3 ms

—

Table 10. Signal outputs and IRF output

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	5 A
Make and carry for 3.0 s	10 A
Make and carry 0.5 s	15 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

—

Table 11. Double-pole power output relays with TCM function

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry 0.5 s	30 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 48/110/220 V DC (two contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC
Trip-circuit monitoring (TCM): - Control voltage range - Current drain through the monitoring circuit - Minimum voltage over the TCM contact	 20...250 V AC/DC ~1.5 mA 20 V AC/DC (15 to 20 V)

—
Table 12. Single-pole power output relays

Description	Value
Rated voltage	250 V AC/DC
Continuous contact carry	8 A
Make and carry for 3.0 s	15 A
Make and carry 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 13. Universal Power Driver (UPD) tests

Test	Description	Result
Binary inputs - Operational range - Current drain - Power consumption	 250 VDC (max) 0.10 mA (max) 250 mW (max) 10mW (nominal)	 No influence
IEEE C37.60 - 2003	15 kV, 27 kV, 38 kV reclosers	No influence
Output voltage range for 6 channels, half bridge drivers	High and low side drives, per channel	250 VDC
Switching capacity 6 channels, half bridge drivers	 High and low side drives, per channel	 22 Amp (nominal)/~30 Amp (max)

—
Table 14. Ethernet interfaces

Ethernet interface	Protocol	Cable	Data transfer rate
Front	TCP/IP protocol	Standard Ethernet CAT 5 cable with RJ-45 connector	10 MBits/s
Rear	TCP/IP protocol	Shielded twisted pair CAT 5e cable with RJ-45 connector or fiber-optic cable with LC connector	100 MBits/s

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Table 15. Serial rear interface

Type	Counter connector
Serial port (X5)	10-pin counter connector[1] Weidmuller BL 3.5/10/180F AU or BEDR or 9-pin counter connector[1] Weidmuller BL 3.5/9/180F AU or BEDR1
Serial port (X16)	9-pin D-sub conenctor DE-9
Serial port (X12)	Optical ST-connector

[1] Depending on the optional communication module

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Table 16. Network Ethernet ports specifications

Connector	Fiber type[2]	Wave length	Maximum distance	Permitted path attenuation[1]
LC	MM 62.5/125 μm glass fiber core	1300 nm	2 km	<8 dB
Serial port (X16)	MM 62.5/125 μm glass fiber core	820-900 nm	1 km	<11 dB

[1] Maximum allowed attenuation caused by connectors and cable together
[2] (MM) - Multi-mode fiber

—
Table 17. Degree of protection of flush-mounted protection and control relay

Description	Value
Front side	IP 54
Rear side	IP 20

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Table 18. Environmental conditions

Description	Value
Continuous operating temperature range	-25 C to +55° C
Short-term operating temperature range	-40 C to +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...+85ºC

[1)] Degradation in MTBF and LHMI performance outside the temperature range of -25 to +55° C
[2)] For protection and control relays with an LC communications interface, the maximum operating temperature is +70° C

—

Table 19. Climatic environmental tests

Description	Reference	Requirement
Dry heat test	IEEE C37.90-2005	+85°C 12h[1) 2)]
Dry cold test		-40°C 12h[2) 3)]
Damp heat test		+25°C, Rh = 95%, 96h
Storage test		+85°C 96h -40°C 96h

*Unless otherwise specified, tests are applicable to both RER620 and UPS.
[1)] For protection and control relays with an LC communication interface, the maximum operating temperature +70°C.
[2)] LCD may be unreadable, but protection and control relay is operational.
[3)] For PS_L (24-60Vdc), the minimum start up voltage is 48Vdc at -40°C.

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Table 20. Electromagnetic compatibility tests*

The EMC immunity test level meets the requirements listed below		
Description	**Type test value**	**Reference**
1 MHz burst disturbance test, class III:		
- Common mode - Differential mode	2.5 kV 2.5 kV	IEEE C37.90.1-2002
Electrostatic discharge test		
- Contact discharge - Air discharge	± 8 kV ± 15 kV	IEEE C37.90.3.-2001
Radio frequency interference tests:	20 V/m (rms), f=80 to 1000 MHz (sweep and keying test)	IEEE C37.90.2-2004
Fast transient disturbance tests:		
- Fast transient disturbance tests:	± 4 kV common mode/ differential mode	IEEE C37.90.1-2002

*Unless otherwise specified, tests are applicable to both RER620 and UPS.

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Table 21. Insulation tests

Description	Type test value	Reference
Dielectric tests:		IEEE C37.90-2005
- Test voltage	2.8 kV DC, 1 min 700 V, DC, 1 min for communication	
Impulse voltage test:		
- Test voltage	5 kV, unipolar impulses, waveform 1.2/50 μs, source energy 0.5 J 1 kV, unipolar impulses, waveform 1.2/50 μs, source energy 0.5 J, communication	

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Table 22. Mechanical tests

Description		Value
Vibration tests (sinusoidal)	IEC 60255-21-1-1988	Class 2
Shock and bump test	IEC 60255-21-2-1988	Class 2
Mechanical durability	IEEE C37.90-2005	- 200 withdrawals and insertions of the plug-in unit - 200 adjustments of protection and control relay setting controls

Protection functions

Table 23. 51P/50P technical data

Description		Value		
	Depending on the frequency of the current measured: f_n ±2Hz			
Operation accuracy	51P	±1.5% of the set value or ±0.002 x I_n		
	50P-1, 50P-2 and 50P-3	±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of the set value (at currents in the range of 10…40 x I_n)		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	50P-3: I_{Fault} = 2 x set Pickup value	16 ms	19 ms	23 ms
	I_{Fault} = 10 x set Pickup value	11 ms	12 ms	14 ms
	51P and 50P-1/2: I_{Fault} = 2 x set Pickup range	22ms	24 ms	25 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 x f_n, where n = 2, 3, 4, 5,… Peak-to-Peak: No suppression P-to-P+backup: No suppression		

[1)] Set Operate delay time = 0,02 s, Operate curve type = ANSI definite time, Measurement mode = default (depends on stage), current before fault = 0.0 x 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 x I_n, Pickup range multiples in range of 1.5 to 20

—

Table 24. 67/51P and 67/50P technical data

Description		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
	67/51P, 67/50P-1	Current: ±1.5% of the set value or ±0.002 x I_n Voltage: ±1.5% of the set value or ±0.002 x U_n Phase angle: ±2°		
	67/50P-2	Current: ±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of set value (at currents in the range of 10…40 x I_n) Voltage: ±1.5% of the set value or ±0.002 x U_n Phase angle: ±2°		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 x set Pickup value	37 ms	40 ms	42 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 x f_n, where n = 2, 3, 4, 5,…-		

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

—

Table 25. 51N/G, 50N/G-1/2 & 50N/G-3 technical data

Description		Value		
	Depending on the frequency of the current measured: f_n ±2Hz			
Operation accuracy	51N/51G	±1.5% of the set value or ±0.002 x I_n		
	50N-1/2, 50G-1/2 and 50N/G3	±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of the set value (at currents in the range of 10…40 x I_n)		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	50N-3, 50G-3: I_{Fault} = 2 x set Pickup value I_{Fault} = 10 x set Pickup value	 16 ms 11 ms	 19 ms 12 ms	 23 ms 14 ms
	50N-1, 50N-2, 50G-1, 50G-2 and 51N/51G: I_{Fault} = 2 x set Pickup range	22 ms	24 ms	25 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 x f_n, where n = 2, 3, 4, 5,… Peak-to-Peak: No suppression		

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

—

Table 26. 67/51N and 67/50N technical data

Description		Value		
Operation accuracy	67/51N, 67/50N-1	Depending on the frequency of the current measured: f_n ±2Hz Current: ±1.5% of the set value or ±0.002 x I_n Voltage: ±1.5% of the set value or ±0.002 x V_n Phase angle: ±2°		
	67N/50N-2	Current: ±1.5% of set value or ±0.002 x I_n (at currents in the range of 0.1…10 x I_n) ±5.0% of set value (at currents in the range of 10…40 x I_n) Voltage: ±1.5% of the set value or ±0.002 x U_n Phase angle: ±2°		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	67N/51N, 67N/50N-1 and 67N/50N-2: I_{Fault} = 2 x set Pickup range	61 ms	64 ms	66 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 = DFT: -50dB at f = n x f_n, where n = 2, 3, 4, 5,…-		

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

—

Table 27. 46 technical data

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

[1)] Negative sequence voltage before fault 0.0 x U_n, f_n = 50 Hz, negative sequence overvoltage with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements
[2)] Includes the delay of the signal output contact
[3)] Maximum Pickup value = 2.5 x I_n, Pickup value multiples in range of 1.5 to 20

—

Table 28. 46PD technical data

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	±2% of the set value
Pickup time	< 70 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 x f_n, where n = 2, 3, 4, 5,…

—

Table 29. Three-phase inrush current detection (INR)

Characteristic	Value
	At the frequency f=f_n
Pickup accuracy	Current measurement: ±1.5% of set value or ±0.002 x 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	+35 ms / -0 ms

—

Table 30. 59 technical data

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 x V_n		
		Minimum	Typical	Maximum
Pickup time [1) 2)]	V_{Fault} = 1.1 x set Pickup value	22 ms	24 ms	26 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 x f_n, where n = 2, 3, 4, 5,…-		

[1)] Pickup value = 1.0 x V_n, Voltage before fault 0.9 x V_n, f_n = 60 Hz, overvoltage in one phase-to-phase with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

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

[3)] Maximum Pickup value = 1.20 x V_n, Pickup range multiples in range of 1.10 to 2.00

—

Table 31. 27 technical data

Characterstic		Value		
		Depending on the frequency of the current measured: f_n ±2Hz		
Operation accuracy		±1.5% of the set value or ±0.002 x V_n		
Pickup time [1) 2)]	V_{Fault} = 0.9 x set Pickup value	Minimum	Typical	Maximum
		62 ms	64 ms	66 ms
Reset time		< 40 ms		
Reset ratio		Depends on the set 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 x f_n, where n = 2, 3, 4, 5,...-		

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

—

Table 32. 59G technical data

Characteristic		Value		
		Depending on the frequency of the current measured: f_n ±2Hz		
Operation accuracy		±1.5% of the set value or ±0.002 x V_n		
		Minimum	Typical	Maximum
Pickup time [1) 2)]	V_{Fault} = 1.1 x set Pickup value	29 ms	31 ms	32 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 x f_n, where n = 2, 3, 4, 5,...-		

[1)] Ground voltage before fault 0.0 x V_n, f_n = 50 Hz, residual voltage with nominal frequency injected from radom phase angle, results based on statistical distribution of 1000 measurements
[2)] Includes the delay of the signal output contact

—

Table 33. 47 technical data

Characteristic		Value		
		Depending on the frequency of the current measured: f_n ±2Hz		
Operation accuracy		±1.5% of the set value or ±0.002 x V_n		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	V_{Fault} = 1.1 x set Pickup value	29 ms	31 ms	32 ms
	V_{Fault} = 2.0 x set Pickup value	24 ms	26 ms	28 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 x f_n, where n = 2, 3, 4, 5,...-		

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

—

Table 34. FRPFRQ technical data

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

—

Table 35. 81S technical data

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

—

Table 36. 50BF technical data

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

Protection functions

—

Table 37. IA, IB, IC technical data

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±2Hz
	±0.5% or ±0.002 x I_n (at currents in the range of 0.01 to 4.00 x I_n) Note: The protection and control relay may indicate non-zero phase current measurements in the range of 0.003...0.01 x In when the recloser is in the open state.
Suppression of harmonics	DFT: -50dB at f = n x f_n, where n = 2, 3, 4, 5,... RMS: No suppression

—

Table 38. VA, VB, VC

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

—

Table 39. IG technical data

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

—

Table 40. VN technical data

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

—

Table 41. I1, I2, I0 technical data

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

—

Table 42. V1, V2, V0 technical data

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

—

Table 43. P, E technical data

Characteristic	Value
Operation accuracy	At all three currents in range 0.10 to 1.20 x I_n At all three voltages in range 0.50 to 1.15 x 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 x f_n, where n = 2, 3, 4, 5,...

—

Table 44. FMMXU technical data

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

Control functions

—

Table 45. 79 technical data

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

—

Table 46. 25 technical data

Characteristic	Value
Operation accuracy	Depending on the frequency of the voltage measured: f_n ±1 Hz
	Voltage: ±3.0% of set value or ±0.01 x V_n Fequency: ±10 mHz Phase angle: ±3°
Reset time	< 50 ms
Reset ratio	Typical 0.96
Trip time accuracy	±1.0% of the set value or ±20 ms

Condition monitoring functions

—

Table 47. 52CM technical data

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

—

Table 48. Fuse failure/Loss-of potential technical data

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

[1] Includes the delay of the signal output contact, f_n = 60 Hz, fault voltage with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

—

Table 49. 59N technical data

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 x V_n		
		Minimum	Typical	Maximum
Pickup time [1] [2]	V_{Fault} = 1.1 x set Pickup value	29 ms	31 ms	32 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 x f_n, where n = 2, 3, 4, 5,...-		

[1] Zero sequence voltage before fault = 0.0 x Vn, fn = 60 Hz, zero sequence 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 50. 59PS technical data

Characteristic		Value		
Operation accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 x V_n		
		Minimum	Typical	Maximum
Pickup time [1) 2)]	V_{Fault} = 1.1 x set Pickup value	29 ms	31 ms	32 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 x f_n, where n = 2, 3, 4, 5,...-		

[1)] Positive sequence voltage before fault = 0.0 x Vn, fn = 60 Hz, positive sequence 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 51. 32P technical data

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	±1.5% of the current or ±0.01A ±1.5% of the voltage or ±1V ±3.0% of the characteristic angle or ±4 Deg

—

Table 52. 32N technical data

Characteristic	Value
Operation accuracy	Depending on the frequency of the current measured: f_n ±2Hz
	±1.5% of the current or ±0.01A ±1.5% of the voltage or ±1V ±3.0% of the characteristic angle or ±4 Deg

21. Display

The relay's local HMI includes a large LCD screen as a 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.

—

Table 53. Large display

Character size	Rows in the view	Characters per row
Large, variable width (13x14pixels)	10	20 or more

22. Local HMI

The protection and control 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. 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 relay displays, apart from the primary equipment position, the related measuring values. Thus all necessary measurement can be viewed without scrolling through the relay 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 protection and control relay. When the relay is in local mode the relay can only be operated using the local front panel user interface. When the relay is in remote mode, the relay can execute commands sent from a remote location. The relay supports the remote selection of local/remote mode via a binary input. This feature facilitates, for example, the use of an external switch at the substation to ensure that all relays are in local mode during maintenance work and that the recloser/circuit breakers cannot be operated remotely from the network control center.

The large display is well-suited for all protection and control relay installations providing an easy viewing interface.

The protection and control relay 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 RER620 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). Each indication LED on the protection and control relay 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 control scheme.

23. Mounting methods

The RER620 can be installed as flush mounted. Further, the relays can be mounted in any standard 19" instrument cabinet by means of 19” mounting panels available with cut-outs for one or two relays. For the routine testing purposes, the relay cases can be equipped with ABB 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
- Mounting with Flexitest (FT) test switches to a 19" rack

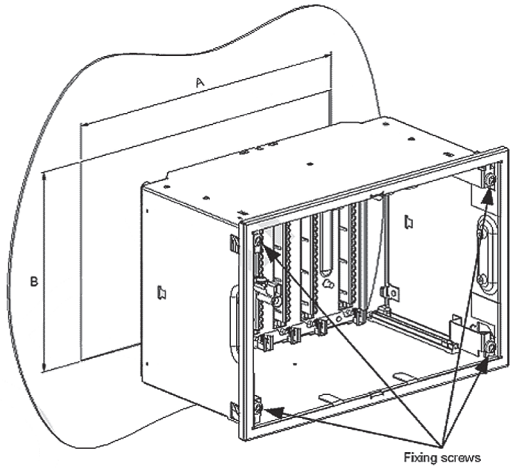
Requirements for installation:

- Panel cut-out of 9.76 x 6.38 inches (248 x 162 mm)
- Depth behind the panel 6.02 inches (153 mm)

24. protection and control relay case and drawout unit

For safety reasons, the protection and control relay cases are provided with automatically operating contacts for short-circuiting the CT secondary circuits when a Protection and control 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.

Figure 8: Flush mounting a case into a panel cut-out



A	9.76 inches (248±1 mm)
B	6.38 inches (162±1 mm)

25. Selection and ordering data

The relay type and serial number label identifies the protection and control relay . The label is placed above the HMI on the upper part of the draw-out 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 software modules of the relay.

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

The order number consists of a string of alphanumeric characters generated from the hardware and software modules of the relay.

Use the ordering key information below.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Ex: NARAAAABNBE1B1NUXD	**N**	**A**	**R**	**A**	**A**	**A**	**A**	**B**	**N**	**B**	**E**	**1**	**B**	**1**	**N**	**U**	**X**	**D**
Digit	**Description**																		
1) Product Series	N: 620 series (Includes case)																		
2) Standard	A: ANSI		A																
	B: IEC		B																
3) Main Appl	R:Feeder protection and recloser control																		
4) Functional Appl[5]	A: Single and Dual Source (6 VT inputs)				A														
	B: Single and Dual Source (6 VT inputs) - G&W / others				B														
5-6) Analog Inputs	3 CT (1A/5A) + 1 CT (0.2A/1A) + 6 VT (1-240 VAC)					A	A												
7-8) Binary I/O	4 BI + 6 BO							A	A										
	12 BI + 10 BO							A	B										
	20 BI + 14 BO							A	C										
9-10) Communication Ports[1), 3)]	One port: Ethernet 100FX (LC)									N	A								
	One port: Ethernet 10/100BaseT (RJ45)									N	B								
	Two ports: Ethernet 10/100BaseT (RJ45) + configurable RS232/RS485 + IRIG-B									2	3								
	Three ports: [Ethernet 10/100BaseT (RJ45) + configurable RS232/RS485 + RS485 or serial glass fiber (ST) + IRIG-B]									3	3								
11) Protocols[3)]	IEC61850 + DNP3.0 L2 + Modbus											E							
	IEC61850 + IEC101 + IEC104											F							
	IEC61850 + DNP3.0 L2 + Modbus + PG&E 2179											G							
12) Language	English												1						
	English + Spanish												5						
13) Front Panel	Large LCD (standard)													B					
14) Recloser Tripping	Single Phase														1				
	Three Phase														3				
15) Option 2	None															N			
16) Power Supply[2)]	Power Supply 24 - 60 VDC+ Ext UPS																U		
17) SW Version	SW Version 1.3																	3	
	SW Version 1.2																	2	
	SW Version 1.1																	1	
18) HW Version	HW Version																		D

Notes:
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) Ordering code for UPS:
UPS120A 90...150 V AC
UPS240A 180...280 V AC
602236-UPS Please order always with UPS module and Functional Appl Opt B
3) When option G is selected, COM0022 or COM0023 is required.
4) Option G is not offered for Functional Appl option B
5) Option B (RA02) only available for SW 1.3 or later

26. Accessories and ordering data

Table 54. Accessories and ordering data

Item	Order number
Tools	
PCM600 V2.4 (or later)	See PCM600 product guide (document number 1MRS756448)
Test switches	
FT-1, FT-14, and FT-19 Flexitest switches	See FT switch product guide (document number 1VAC394641-PG)

27. Tools

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

When the web-browser based user interface is used, the protection and control 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 55. Tools

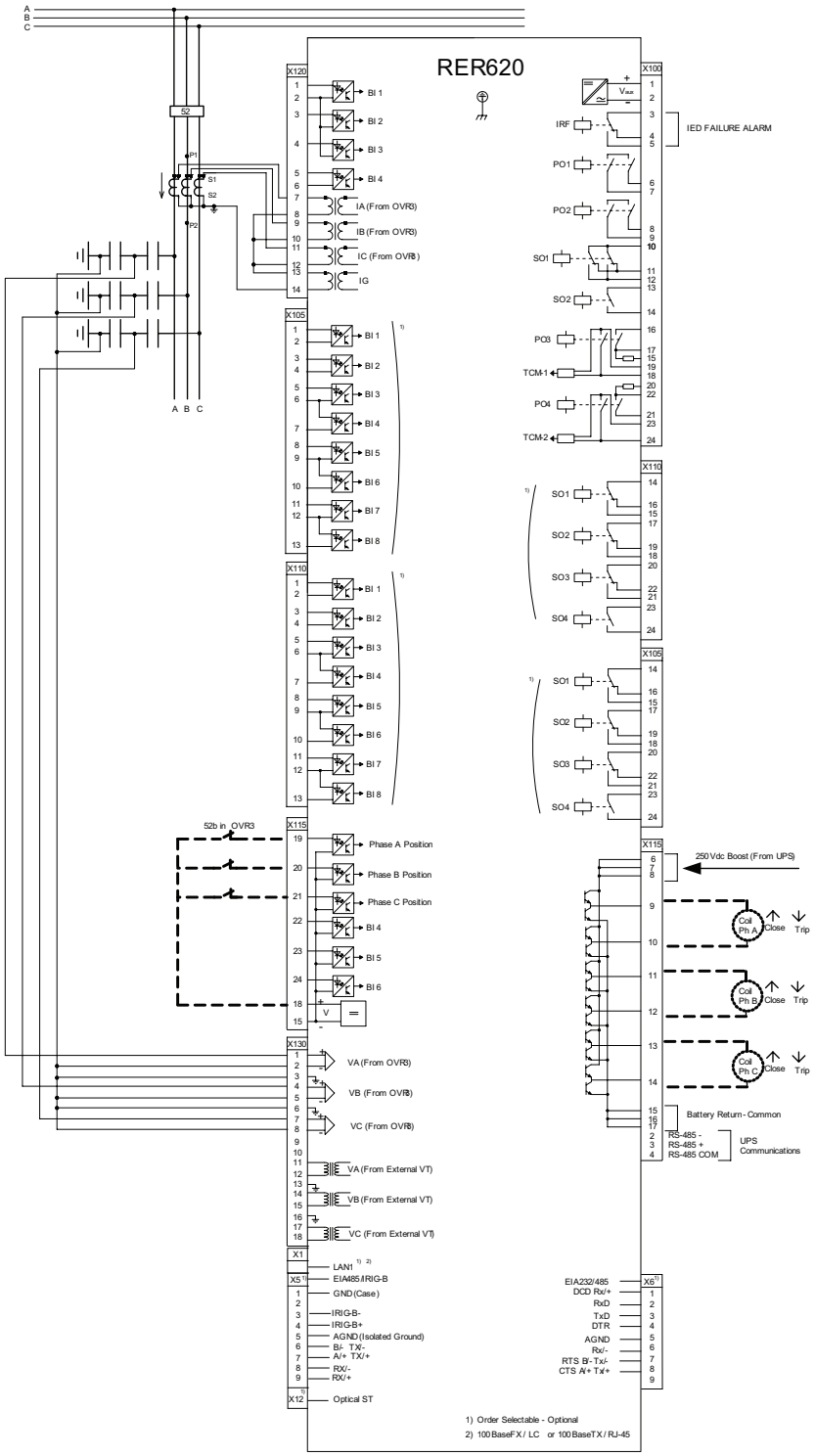
Item	Order number
PCM600	2.6 FP1 or later
Web-browser based user interface	IE 9.0 or later
RER620 Connectivity Package	1.2 or later
COM600 substation product	3.5 or later
MicroSCADA Pro Substation Automation system	9.3.2 HF2 or later

Table 56. Supported functions

Function	WebHMI	PCM600	PCM Engineering	PCM Engineering Pro
Protection and control relay parameter setting	•	•	•	•
Saving of protection and control relay parameter settings in the relay	•	•	•	•
Signal monitoring	•	•	•	•
Disturbance recorder handling	•	•	•	•
Alarm LED viewing	•	•	•	•
Access control management	•	•	•	•
Protection and control relay signal configuration (signal matrix)	-	•	•	•
Modbus® communication configuration (communication management)	-	•	•	•
DNP3 communication configuration (communication management)	-	•	•	•
(communication management)	-	•	•	•
Saving of protection and control relay parameter settings in the tool	-	•	•	•
Disturbance record analysis	-	•	•	•
XRIO parameter export/import	-	•	•	•
Graphical display configuration	-	•	•	•
Application configuration	-	•	•	•
IEC 61850 communication configuration, GOOSE (communication configuration)	-	-	-	•
Phasor diagram viewing	•	-	-	-
Event viewing	•	-	-	-
Saving of event data on the user's PC	•	-	-	-

28. Terminal diagrams

Figure 9. RER620 standard configuration A with options



29. Certificates

All type test certificates are available upon request.

30. References

The download area on the right hand side of the web page (www.abb.com/substationautomation) contains the latest product documentation, such as technical Reference manual, installation manual, operators manual, etc. The selection tool on the web page helps you find the documents by the document category and language.

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

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 RER620 protection relay on the product page.

31. Functions, codes, and symbols

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Table 57. RER620 1.1 Function List

Function name				Configuration
IEC61850	**IEC60617**	**ANSI/C37.2**	**Description**	**RA01 and RA02**
Current protection				
SPHLPTOC1	3I>(1)	51P	Three-phase non-directional time overcurrent protection with 1-ph trip option, low stage	Y
SPHLPTOC2	3I>(2)	50P-1	Three-phase non-directional time overcurrent protection with 1-ph trip option, high stage 1	Y
SPHHPTOC1	3I>>(1)	50P-2	Three-phase non-directional time overcurrent protection with 1-ph trip option, high stage 2	Y
SPHIPTOC1	3I>>>(1)	50P-3	Three-phase non-directional instantneous overcurrent protection with 1-ph trip option	Y
XEFLPTOC2	Io>(2)	51N	Non-directional time overcurrent ground-fault protection, low stage	Y
XEFLPTOC3	Io>(3)	50N-1	Non-directional time overcurrent ground-fault protection, high stage 1	Y
XEFHPTOC3	Io>>(3)	50N-2	Non-directional time overcurrent ground-fault protection, high stage 2	Y
XEFIPTOC2	Io>>>(2)	50N-3	Non-directional instantaneous time overcurrent ground-fault protection	Y
EFLPTOC3	Io>(3)	50SEF	Non-directional sensitive earth-fault	Y
XNSPTOC1	I2 >(1)	46-1	Negative sequence non-directional time overcurrent protection 1	Y
XNSPTOC2	I2 >(2)	46-2	Negative sequence non-directional time overcurrent protection 2	Y
PDNSPTOC1	I2/I1>	46PD	Phase discontinuity protection	Y
INPHAR	3I2f >	INR	Three-phase inrush detector	**Y**
SDPHLPDOC1	3I >->(1)	67/51P-1	Three-phase directional overcurrent protection, low stage 1	Y
SDPHLPDOC2	3I >->(2)	67/51P-2	Three-phase directional overcurrent protection, low stage 2	Y
XDEFLPDEF1	Io>->(1)	67/51N-1	Directional ground-fault protection, low stage 1	Y
XDEFLPDEF2	Io>->(1)	67/51N-2	Directional ground-fault protection, low stage 2	Y
SDPHLPDOC1	3I >->(1)	67/51P-1	Three-phase directional overcurrent protection, low stage 1	Y
SDPHLPDOC2	3I >->(2)	67/51P-2	Three-phase directional overcurrent protection, low stage 2	Y
XDEFLPDEF1	Io>->(1)	67/51N-1	Directional ground-fault protection, low stage 1	Y
XDEFLPDEF2	Io>->(1)	67/51N-2	Directional ground-fault protection, low stage 2	Y
Total current protection functions included				**17**
Cold load timers				
TPSGAPC1	TPS(1)	62CLD-1	Cold load timer 1 Phase A (in seconds)	Y
TPMGAPC1	TPM(1)	62CLD-2	Cold load timer 2 Phase A (in minutes)	Y
TPSGAPC2	TPS(2)	62CLD-3	Cold load timer 1 Phase B (in seconds)	Y
TPMGAPC2	TPM(2)	62CLD-4	Cold load timer 2 Phase B (in minutes)	Y
TPSGAPC3	TPS(3)	62CLD-5	Cold load timer 1 Phase C (in seconds)	Y
TPMGAPC3	TPM(3)	62CLD-6	Cold load timer 2 Phase C (in minutes)	Y
Total cold load timers				6

Function name				Configuration
IEC61850	**IEC60617**	**ANSI/C37.2**	**Description**	**RA01 and RA02**
Voltage protection				
SPHPTOV1	3U >(1)	59-1	Three-phase overvoltage 1, source 1 low stage	Y
SPHPTOV2	3U >(2)	59-2	Three-phase overvoltage 2, source 1 high stage	Y
SPHPTOV3	3U >(3)	59-3	Three-phase overvoltage 3, source 2 low stage	Y
SPHPTUV1	3U <(1)	27-1	Three-phase undervoltage 1, source 1 low stage	Y
SPHPTUV2	3U <(2)	27-2	Three-phase undervoltage 2, source 1 high stage	Y
SPHPTUV3	3U <(3)	27-3	Three-phase undervoltage 3, source 2 low stage	Y
PSPTOV1	U1>(1)	59PS-1	Positive sequence overvoltage protection, source1	Y
PSPTOV2	U1>(2)	59PS-2	Positive sequence overvoltage protection, source 2	Y
NSPTOV1	U2>(1)	47-1	Negative sequence overvoltage protection, source1	Y
NSPTOV2	U2>(2)	47-2	Negative sequence overvoltage protection, source 2	Y
ROVPTOV1	Uo>(1)	59N-1	Zero sequence overvoltage protection, source1	Y
ROVPTOV2	Uo>(2)	59N-2	Zero sequence overvoltage protection, source 2	Y
Total voltage protection functions included				12
Frequency protection				
FRPFRQ1	f</f>,df/dt(1)	81-1	Underfrequency, overfrequency, frequency rate of change, source 1, stage 1	Y
FRPFRQ2	f</f>,df/dt(2)	81-2	Underfrequency, overfrequency, frequency rate of change, source 1, stage 2	Y
LSHDPFRQ1	UFLS/R(1)	81S-1	Load shed & restoration, source 1, stage 1	Y
LSHDPFRQ2	UFLS/R(2)	81S-2	Load shed & restoration, source 1, stage 2	Y
Total frequency protections included				4
Other protection				
PHIZ1	PHIZ1	HIZ	High Impedance Fault Detector	Y
SCCBRBRF1	3I>/Io>BF	50BFT	Circuit breaker failure protection	Y
SCCBRBCF1	SCCBRBCF1	50BFC	Circuit breaker close failure protection	Y
DRFLO1	FLO	FLO	Fault Locator (FLOC)	Y
DPSRDIR1	P>->	32P	Directional positive sequence power protection	Y
DNZSRDIR1	Q>->	32N	Directional negative/zero sequence power protection	Y
DLCM1	LCM	LCM	Loop control	Y
Total other protection functions included				7
Control				
SDARREC1	O -> I	79	Autoreclosing, 1ph and/or 3-ph	
SECRSYN1	SYNC	25	Synchro-check/voltage check	
SCBXCBR1	I<->O CB	52	Circuit Breaker 1 (3 state inputs / 3 control outputs)	
Total control functions included				3
Condition monitoring				
SPSCBR1	CBCM	52CM	CB condition monitoring	Y
SEQRFUF1	FUSEF	60	Fuse failure supervision, source 1	Y
Total cond. monitoring functions				2
Measurements				
CMMXU1	3I	IA,IB,IC	Three-phase current	Y
CSMTA1			Demand metering, Max/Min metering	Y
CSMSQI1	I1,I2,I0	I1, I2, I0	Sequence current	Y
RESCMMXU1	Io	IG	Ground current	Y
VMMXU1	3U	VA,VB,VC	Three-phase voltage measurement, source 1	Y
VMMXU2	3U(B)	VA,VB,VC(2)	Three-phase voltage measurement, source 2	Y
VSMSQI1	U1,U2,U0	V1,V2,V0	Sequence voltage measurement, source 1	Y
VSMSQI2	U1,U2,U0(B)	V1,V2,V0(2)	Sequence voltage measurement, source 2	Y
APEMMXU1	P,E	P,E	Single and three phase power, power factor and three phase energy, source 1	Y
FMMXU1	f	f	Frequency measurement, source 1	Y
Total meas. functions				10

Function name				**Configuration**
IEC61850	**IEC60617**	**ANSI/C37.2**	**Description**	**RA01 and RA02**
Trip logic				
Total trip logic functions				
Recorders				
RDRE1	DR	DFR	Disturbance recorder	Y
SER	SER	SER	Sequence of Events (SER)	Y
FLTMSTA	FLTMSTA	FLTMSTA	Fault Recorder	Y
Total recorder functions				3
Other functions				
ZBAT1	UPS	UPS	Battery voltage, current. Test the battery	Y
XGGIO115	X115(UPD)	X115(UPD)	Universal Power Drive	Y
FKEYGGIO1	FKEYGGIO1	FKEYGGIO1	Programmable buttons (16 buttons)	Y
MVGAPC1	MVGAPC1	MVGAPC1	Move function block (8 outputs)	Y
PTGAPC1	PTGAPC1	PTGAPC1	Pulse timer (8 timers)	Y
SPCGGIO1	SPCGGIO1	SPCGGIO1	Generic control points (16 outputs)	Y
SRGAPC1	SRGAPC1	SRGAPC1	Set reset flip flops (8 outputs)	Y
TOFGAPC1	TOFGAPC1	TOFGAPC1	Time delay off timers (8 timers)	Y
TONGAPC1	TONGAPC1	TONGAPC1	Time delay on timers (8 timers)	Y
MVGAPC2	MVGAPC2	MVGAPC2	Move function block (8 outputs)	Y
PTGAPC2	PTGAPC2	PTGAPC2	Pulse timer (8 timers)	Y
SPCGGIO2	SPCGGIO2	SPCGGIO2	Generic control points (16 outputs)	Y
SRGAPC2	SRGAPC2	SRGAPC2	Set reset flip flops (8 outputs)	Y
TOFGAPC2	TOFGAPC2	TOFGAPC2	Time delay off timers (8 timers)	Y
TONGAPC2	TONGAPC2	TONGAPC2	Time delay on timers (8 timers)	Y
UDFCNT1-12	UDFCNT1-12	UDFCNT1-12	Up/Down Counters (12 counters)	Y
Total other functions				16
Total functions included				80

32. Document revision history

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Table 58. Document revision history

Revision & date	Version	Update
A / December 2010	V1.1	Initial product version release
B / November 2011	V1.1	PG&E Protocol, counters added
C / August 2014	V1.2	Ability to read low currents added
D/ July 2017	V1.2	Updated ordering aid

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