Relion® 620 series

Motor protection and control REM620 ANSI Product guide

Power and productivity for a better world™

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1. Description

The REM620 is a dedicated motor IED perfectly aligned for the protection, control, measurement and supervision of asynchronous motors in manufacturing and process industry. REM620 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 REM620 ANSI features:

- Six setting groups
- Drawout design
- High-speed (< 1 ms) outputs
- Normally-closed output for motor contactors
- Dedicated machine-run-time timers
- Motor differential protection
- Up to 14 RTD inputs
- Up to 5 mA inputs
- Loss-of-load supervision
- Arc flash detection (AFD)
- Thermal overload protection of motor
- Ring-lug terminals for all inputs and outputs
- Large, easy to read LCD screen
- Programmable push-buttons
- Environmentally friendly design with RoHS compliance

The REM620 constitutes main protection for asynchronous motors and their drives in manufacturing and process industry. Typically, the motor relay is used with circuit breaker or contactor controlled HV motors, and contactor controlled medium sized and large LV motors in a variety of drives, such as pumps and conveyors, crushers and choppers, mixers and agitators, fans, and aerators. Flexible coding allows for choosing from different confi gurations to best fi t your motor application needs.

REM620 offers all the functionality needed to manage motor starts and normal drive operations, including protection and fault clearance in abnormal situations. The main features of the motor relay include thermal overload protection, motor start-up time supervision, locked rotor protection, and protection against too frequent motor starts. Additionally, differential protection can also be included. Furthermore, the relay offers negative phase sequence current unbalance protection, motor running stall protection, loss-of-load supervision, phase-reversal protection, and a provision to perform a forced emergency start.

REM620 also incorporates non-directional and directional ground-fault protection, back-up overcurrent protection, three phase undervoltage protection, negative phase sequence overvoltage, and positive sequence undervoltage protection. Enhanced with an optional plug-in card, REM620 offers a fast three channel arc-fault protection system for arc flash supervision of the switchgear compartments. REM620 also integrates basic control functionality, which facilitates the control of one circuit breaker via the front panel HMI or through remote controls.

To protect the relay from unauthorized access and to maintain the integrity of information, the relay has been provided with a four-level, role-based, user authentication system. The access control system applies to the front panel HMI, the embedded web browser based HMI, and the PCM600, Protection and Control IED Manager.

REM620 genuinely supports the new IEC 61850 standard for inter-device communication in substations. It also supports the industry standard Modbus® and DNP3 protocols. For accurate time stamping, REM620 supports synchronization over Ethernet using SNTP or over a separate bus using IRIG-B.

2. Standard configurations

The REM620 relay main application is protection, control, metering and monitoring of asynchronous motors and offers three standard confi gurations whose relay functions and features are based on the analog inputs for each confi guration. See Tables 1 and 2 for details.

Configuration A comprises analog inputs useful in cost effective motor protection, control and monitoring industrial and utility applications with up to 12 RTD inputs and up to 4 mA inputs.

Configuration B includes functionality for more comprehensive motor protection and control applications, e.g. motor differential protection.

Configuration C is a further enhancement of configuration B including up to 14 RTD inputs and up to 5 mA inputs.

Figures 1 through 2 show the protection functions available for the three standard confi gurations and their available analog inputs for each confi guration. See section 25. **Selection and ordering data** for details on the available analog inputs for each standard configuration.

Figure 1. REM620 ANSI Functional Application A

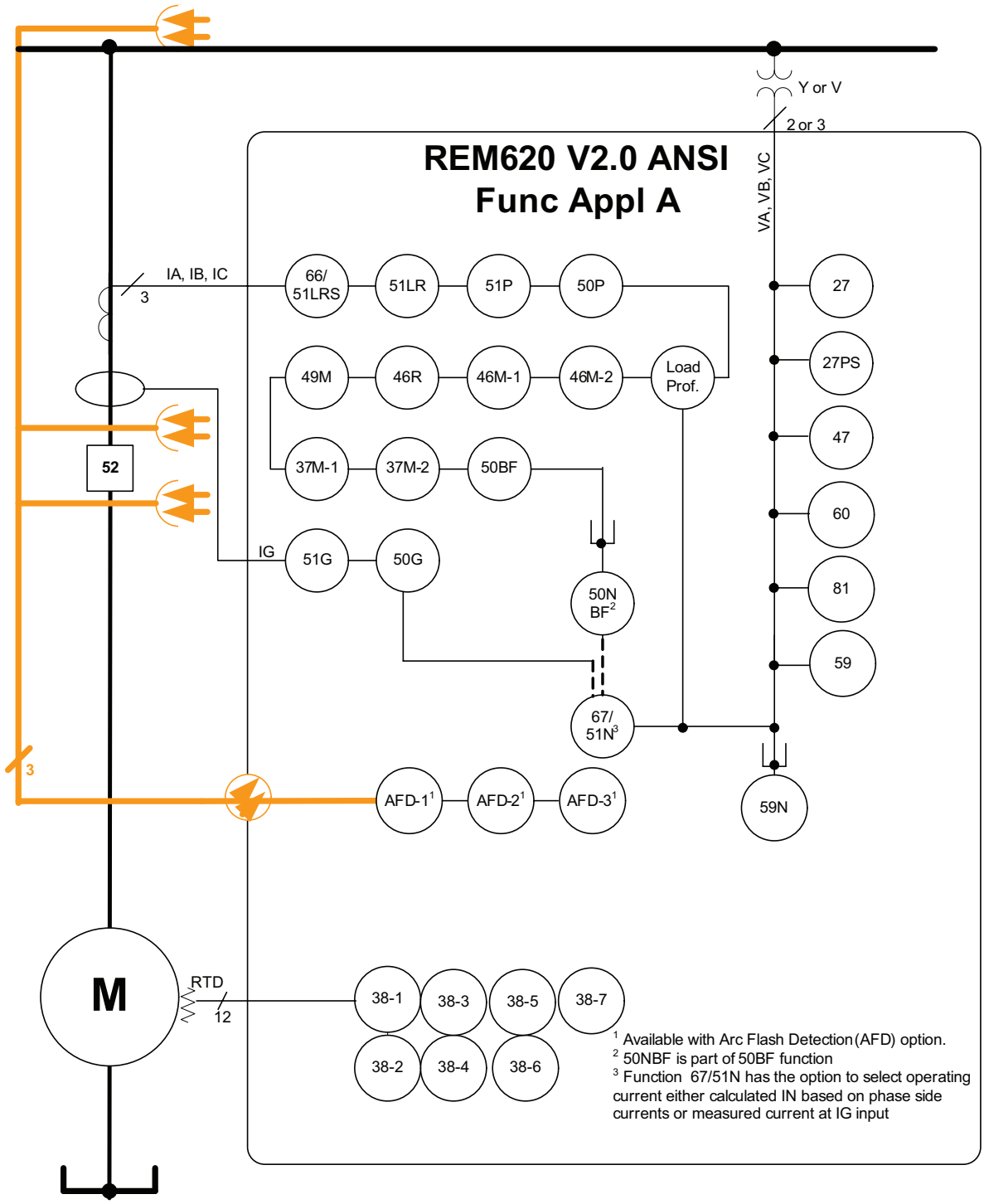
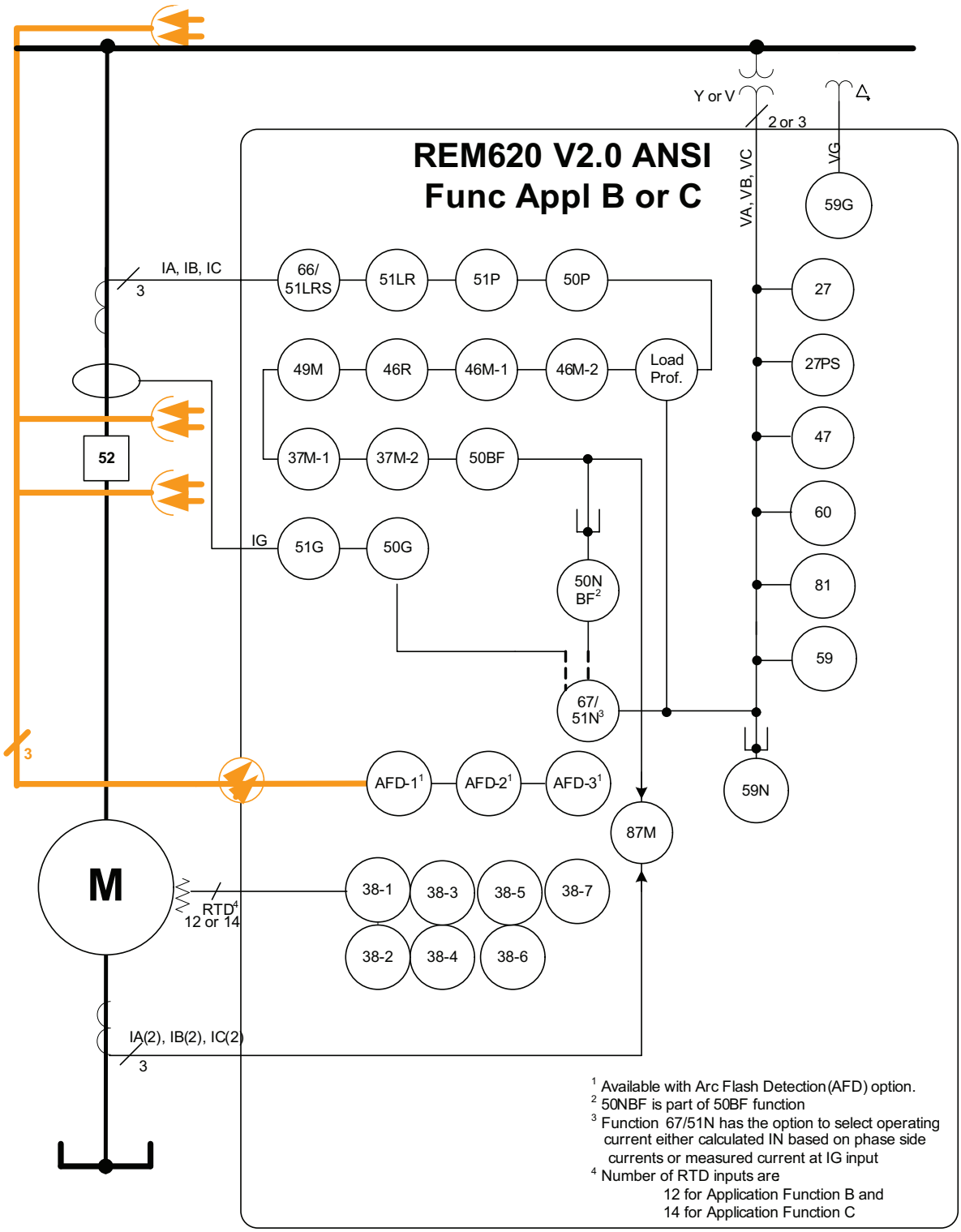


Figure 2. REM620 ANSI Functional Application B & C



All standard 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.

* The DNP3 Level 2+ implementation includes some Level 3 functionality.

Table 1. Standard configurations (REM620)

Description	Functional application configuration
Overcurrent, loadloss, phase and neutral voltage, frequency and RTD protection and power system metering for medium to large motors	A
Differential, overcurrent, loadloss, phase and neutral voltage, frequency and RTD protection and power system metering for medium to large motors	B
Differential, overcurrent, loadloss, phase and neutral voltage, frequency and extended RTD protection and power system metering for medium to large motors	C

Table 2. Supported functions

Standard configuration functionality	Configuration A	Configuration B	Configuration C	ANSI/C37.2 - 2008
	AA	BA	CA	REM
Protection				
Three-phase non-directional overcurrent protection, low stage, instance 1	●	●	●	51P
Three-phase non-directional overcurrent protection, high stage, instance 1	●	●	●	50P
Non-directional ground-fault protection, low stage, instance 1	●	●	●	51G
Non-directional ground-fault protection, high stage, instance 1	●	●	●	50G
Directional ground-fault protection, low stage, instance 1	● [1,3]	● [1,3]	● [1,3]	67/51N
Residual overvoltage protection, instance 1	-	●	●	59G
Residual overvoltage protection, instance 2	● [4]	● [4]	● [4]	59N
Three-phase undervoltage protection, instance 1	●	●	●	27
Three-phase overvoltage protection, instance 1	●	●	●	59
Positive-sequence undervoltage protection, instance 1	●	●	●	27PS
Negative-sequence overvoltage protection, instance 1	●	●	●	47
Frequency protection, instance 1	●	●	●	81
Negative-sequence overcurrent protection for motors, instance 1	●	●	●	46M-1
Negative-sequence overcurrent protection for motors, instance 2	●	●	●	46M-2
Loss of load supervision, instance 1	●	●	●	37M-1
Loss of load supervision, instance 2	●	●	●	37M-2
Motor load jam protection	●	●	●	51LR
Motor start-up supervision	●	●	●	66/51LRS
Phase reversal protection	●	●	●	46R
Thermal overload protection for motors	●	●	●	49M
Motor differential protection	-	●	●	87M
Circuit breaker failure protection, instance 1	●	●	●	50BF
Master trip, instance 1	●	●	●	86/94-1
Master trip, instance 2	●	●	●	86/94-2
Arc protection, instance 1	●	●	●	AFD-1
Arc protection, instance 2	●	●	●	AFD-2
Arc protection, instance 3	●	●	●	AFD-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
RTD based thermal protection, instance 4	●	●	●	38-4
RTD based thermal protection, instance 5	●	●	●	38-5

Table 2. Supported functions (continued)

Standard configuration functionality	Configuration A	Configuration B	Configuration C	ANSI/C37.2 - 2008
	AA	BA	CA	REM
Protection continued				
RTD based thermal protection, instance 6	●	●	●	38-6
RTD based thermal protection, instance 7	●	●	●	38-7
Control				
Circuit-breaker control, instance 1	●	●	●	52
Emergency startup	●	●	●	62EST
Condition Monitoring				
Circuit-breaker condition monitoring, instance 1	●	●	●	52CM
Trip circuit supervision, instance 1	●	●	●	TCM-1
Trip circuit supervision, instance 2	●	●	●	TCM-2
Current circuit supervision	●	●	●	CCM
Fuse failure supervision, instance 1	●	●	●	60
Runtime counter for machines and devices, instance 1	●	●	●	OPTM-1
Runtime counter for machines and devices, instance 2	●	●	●	OPTM-2
Measurement				
Three-phase current measurement, instance 1	●	●	●	IA, IB, IC
Three-phase current measurement, instance 2	-	●	●	IA, IB, IC(2)
Sequence current measurement, instance 1	●	●	●	I1, I2, I0
Sequence current measurement, instance 2	-	●	●	I1, I2, I0(2)
Residual current measurement, instance 1	●	●	●	IG
Three-phase voltage measurement, instance 1	●	●	●	VA, VB, VC
Residual voltage measurement, instance 1	-	●	●	VG
Sequence voltage measurement, instance 1	●	●	●	V1, V2, V0
Single-phase power and energy measurement, instance 1	●	●	●	SP, SE
Three-phase power and energy measurement, instance 1	●	●	●	P, E
Load profile	●	●	●	LoadProf
Frequency measurement, instance 1	●	●	●	f
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

Table 2 Supported functions (continued)

Standard configuration functionality	Configuration A	Configuration B	Configuration C	ANSI/C37.2 - 2008
	AA	BA	CA	REM
Other functions (continued)				
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
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
[3)] Vo calculated and negative sequence voltage selectable by parameter, V2 as default
[4)] Vo calculated is always used

3. Protection functions

The REM620 relay offers all the functionality needed to manage motor starts and normal drive operations also including protection and fault clearance in abnormal situations. The main features of this motor relay include thermal overload protection, motor start-up time supervision, locked rotor protection and protection against too frequent motor starts. Additionally, differential protection can also be included. Furthermore, the relay offers negative phase sequence current unbalance protection, motor running stall protection, loss-of-load supervision, phase-reversal protection and a provision to perform a forced emergency start.

The REM620 also incorporates non-directional and directional earth-fault protection, backup overcurrent protection, three phase undervoltage protection, and negative phase sequence overvoltage and positive sequence undervoltage protection.

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

The arc-fault protection sensor interface is available on the optional communication module. Fast tripping increases personal safety and limits material damage within the switchgear in an arc fault situation.

4. Application

The REM620 relay constitutes main protection for asynchronous motors and the associated drives. Typically, the motor relay is used with circuit-breaker or contactor controlled distribution motors and contactor-controlled medium sized and large low voltage motors in a variety of drives such as pumps and conveyors, crushers and choppers, mixers and agitators, fans and aerators.

The motor relay is thoroughly adapted for ground fault protection. Using cable current transformers, sensitive and reliable ground fault protection can be achieved. The ground fault protection can also utilize phase current transformers with a residual connection for the ground CT input. In this case, possible unwanted operations of the ground fault protection at motor start-up can be prevented using the relay's internal interlocking features or suitable stabilizing circuits. Figures 7 and 8 show typical REM620 application in substations with motor protection requirements.

More comprehensive protection of medium sized motors is possible with the VT inputs. Voltage, power and energy metering and phase, sequence and ground voltage protection are available with these additional voltage inputs.

5. Supported ABB solutions

ABB's 620 series protection and control IEDs together with the COM600 Station Automation device constitute a genuine IEC 61850 solution for reliable power distribution in utility and industrial power systems. To facilitate and streamline the system engineering ABB's IEDs are supplied with Connectivity Packages containing a compilation of software and relay-specific information including single-line diagram templates, a full relay data model including event and parameter lists. By utilizing the Connectivity Packages the IEDs 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 IEDs offer native support for the IEC 61850 standard also including horizontal GOOSE messaging. Compared with traditional hard-wired inter-device signaling, peer-to-peer communication over a switched Ethernet LAN offers an advanced and versatile platform for power system protection. Fast software-based communication, continuous supervision of the integrity of the protection and communication system, and inherent flexibility for reconfiguration and upgrades are among the distinctive features of the protection system approach enabled by the full implementation of the IEC 61850 substation automation standard.

At the substation level COM600 utilizes the data content of the design level IEDs to offer enhanced substation level functionality. COM600 features a web-browser based HMI providing a customizable graphical display for visualizing single line mimic diagrams for switchgear 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 IEDs. The collected network data facilitates extensive reporting and analyzing of network fault situations using the data historian and event handling features of COM600.

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

Table 3. Supported ABB solutions

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

Figure 3. Utility distribution network example using 615 series IEDs, Station Automation COM600 and MicroSCADA Pro

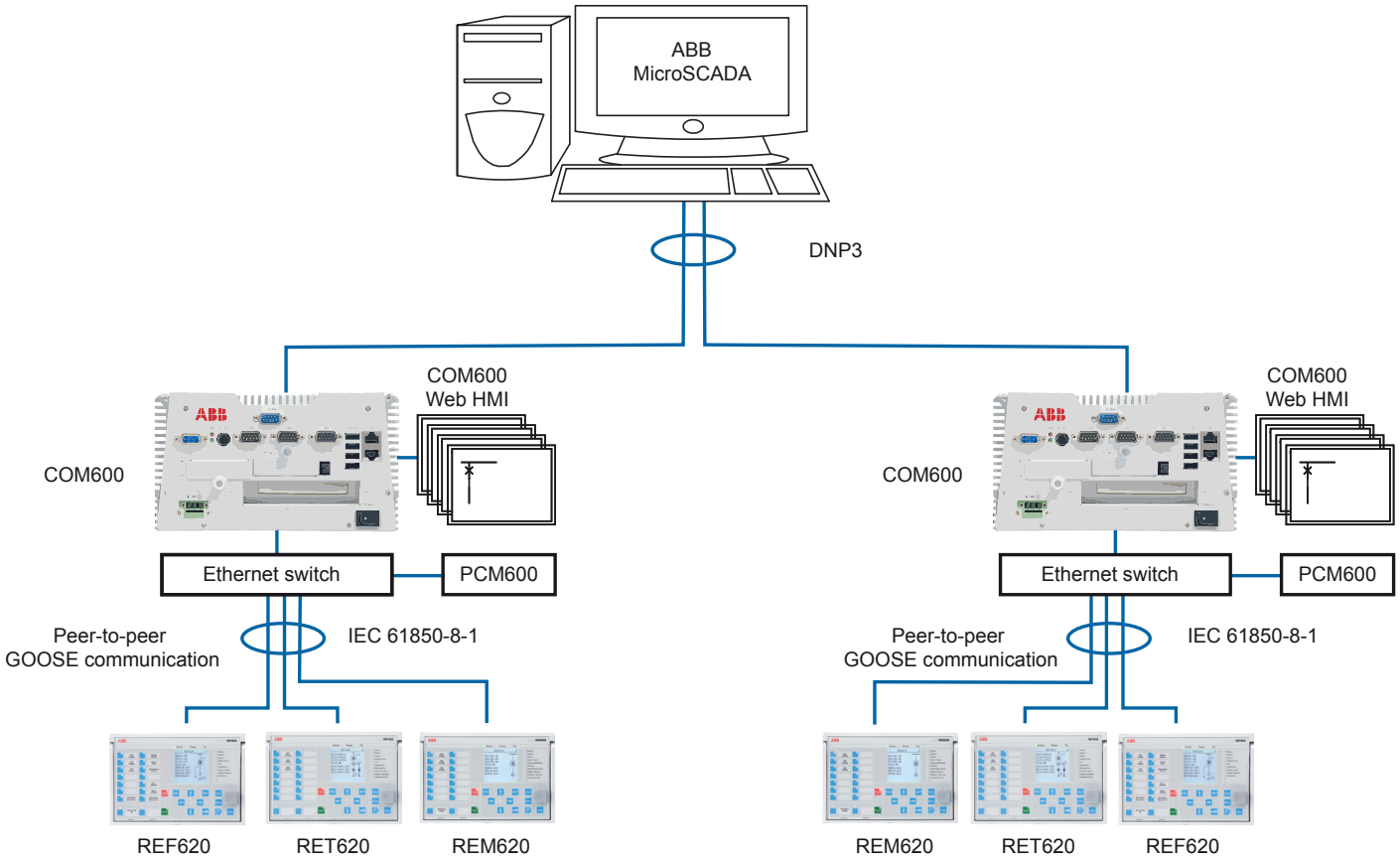
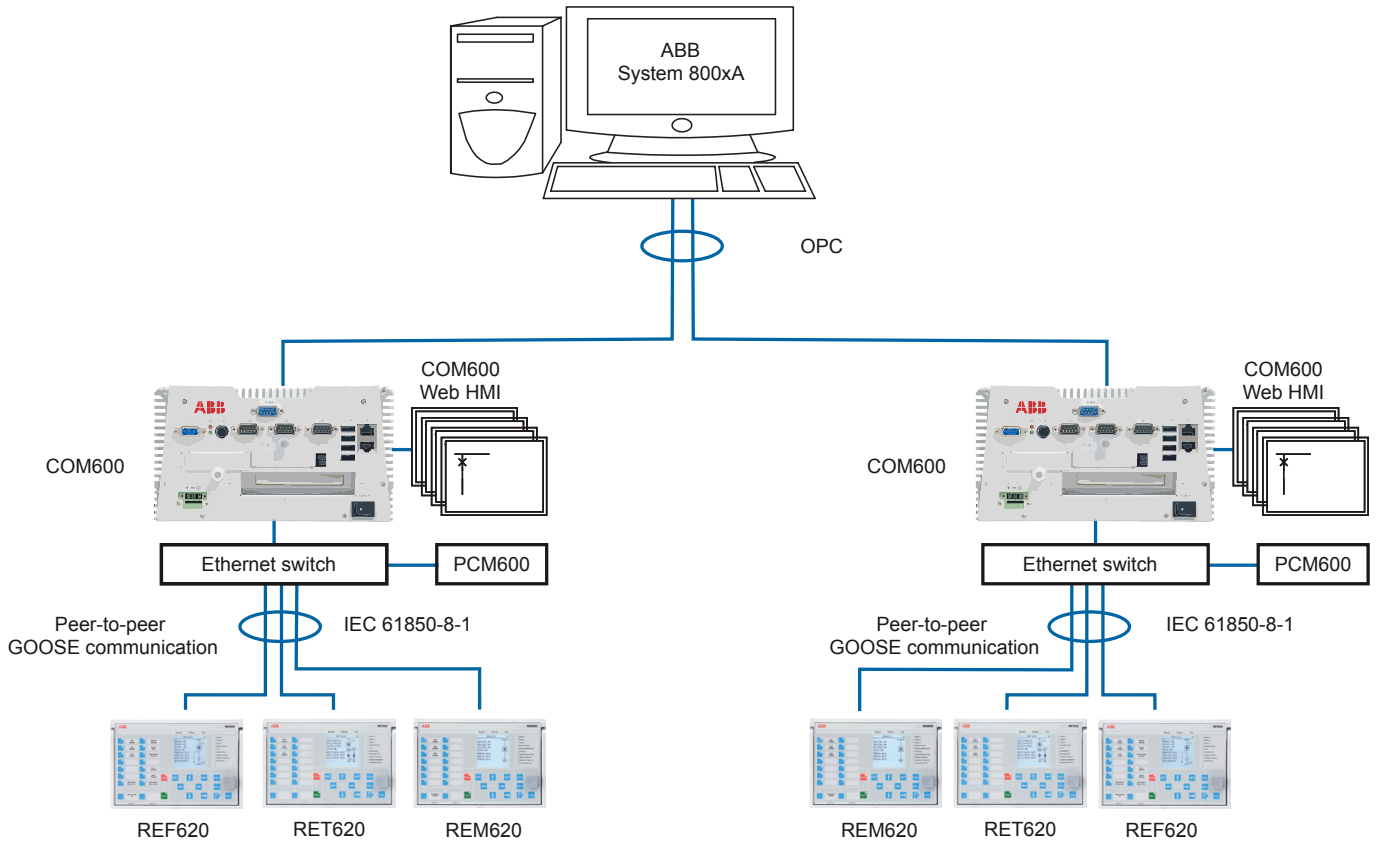


Figure 4. Industrial distribution network example using 615 series IEDs, Station Automation COM600 and System 800xA



6. Control

The relay offers status and control of one circuit breaker with dedicated push-buttons on the front panel local human machine interface (LHMI) for opening and closing of that breaker. Flexible remote breaker control of select-before-trip (SBO) or direct trip is also available witheach of the supported DNP3 Level 2+, Modbus and IEC 61850 communication protocols. Interlocking schemes required by the application can be configured with the application configuration tool in PCM600.

7. Measurements

The relay continuously measures the phase currents and voltages, the sequence components and the residual or ground current. If the relay includes the broken delta vt option, it also measures 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 theprotected 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, RMS 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) buff er. 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.

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.

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

Depending on the chosen standard configuration, the relay includes current circuit supervision. 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. The current circuit supervision function calculates the sum of the phase currents from the protection cores and compares the sum with the measured single reference current from a core balance current transformer or from separate cores in the phase current transformers.

16. 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. Motor run timers

The REM620 includes two motor run timers that enable user to optimize management of this asset by programming the timers to alarm at the recommended maintenance times based on actual use. This enhanced maintenance feature is an improvement over calendar driven maintenance schedules.

19. Access control

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

20. 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 5 A or 1 A ct secondary nominal rating. The ground ct option is programmable for 5/1 A nominal rating, the SEF/HIZ ct option has a fixed 0.2 A 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. Available analog inputs per REM620 configuration

		# of analog inputs			
Functional application (order code character #4)	Analog inputs (order code characters #5 and #6)	CT	VT	RTD	mA
A	AA	41	3	12	4
B	BA	71	4	12	4
C	CA	71	4	14	5

[1]Ground CT (Inom = 5/1A)

Table 5. Available binary inputs per REM620 configuration

		# of binary inputs/binary outputs			
Functional application (order code character #4)	Binary inputs and outputs (order code characters #7 and #8)	Binary inputs	Signal outputs	Power outputs	High speed power outputs
A	AA	8	6	4	0
A	AB	14	9	4	0
A	A1	8	2	4	3
A	A2	14	5	4	3
B	BA	12	6	4	0
B	B1	12	2	4	3
C	CA	12	6	4	0
C	C1	12	2	4	3

21. 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 IEDs (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 IEDs 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 IEDs 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 series relays. If more than 30 IEDs are to be connected, it is recommended that the network is split into several rings with no more than 30 IEDs per ring. The self-healing Ethernet ring solution avoids single point of failure concerns and improves the reliability of the communication. The solution can be applied for the Ethernet-based IEC 61850, Modbus and DNP3 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.

DNP3 Level 2 supports both serial and TCP modes for connection to one master. Additionally, changing of the active setting group is supported.

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

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

Ethernet-based:
- SNTP (Simple Network Time Protocol) – primary and secondary SNTP servers supported

With special time synchronization wiring:
- IRIG-B (Inter-Range Instrumentation Group - Time Code Format B)

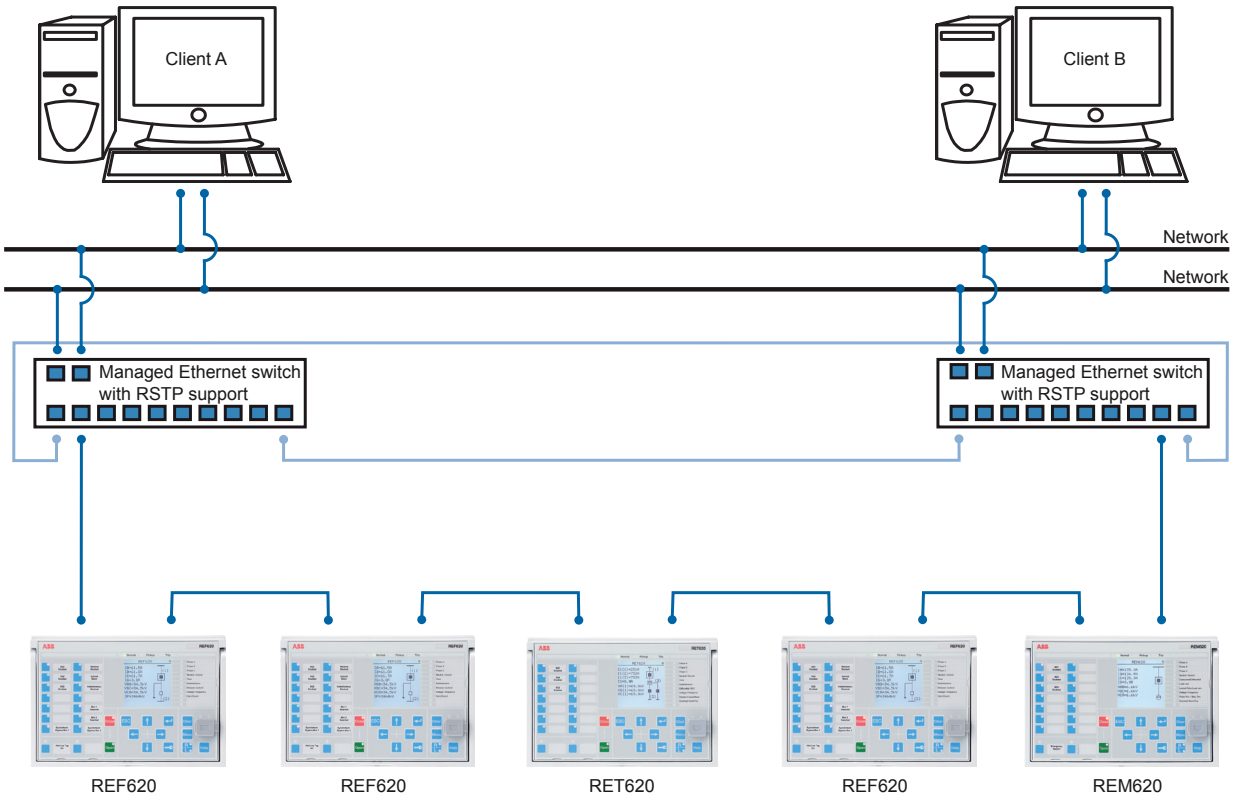
In addition, the relay supports time synchronization via the following serial communication protocols:
- Modbus
- DNP3 Level 2

Table 6. Supported station communication interfaces and protocols

Interfaces/Protocols	Ethernet		Serial	
	100BASE-TX (RJ-45)	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	-	-	•	•
IRIG-B time synchronization	-	-	•	•

• = supported

Figure 5. Communication ring application



22. 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 (Vn)	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
Vn variation	38…110% of Vn (38…264 V AC) 80…120% of Vn (38.4…300 V DC)	50…120% of Vn (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, In	5/1 A[1)]	0.2 A[2)]
	Thermal withstand capability: • Continuously • For 1 s	 20 A 500 A	 4 A 100 A
	Dynamic current withstand: • Half-wave value	 1250 A	 250 A
	Input impedance	<20 mΩ	<100 mΩ
Voltage inputs	Rated voltage Vn	60…210 V AC (Parametrization)	
	Voltage withstand: • Continuous • For 10 s	 2 × Vn (240 V AC) 3 × Vn (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 × In
Ground current as a multiple of the rated current of the analog input	0…50 × In

Table 11. RTD/mA inputs

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

Table 12. 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 14. 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 15. 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
Trip-circuit monitoring (TCM):	
• Control voltage range	20…250 V AC/DC
• Current drain through the monitoring circuit	~1.5 mA
• Minimum voltage over the TCM contact	20 V AC/DC (15…20 V)

Table 16. 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 17. 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 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 18. High-speed output (HSO) devices [Typical operation time: 1 ms]

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 19. Ethernet and seriel 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	115200bits/s

[1] Depending on the optional communication module.

Table 20. 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 21. IRIG-B

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

[1)] According to 200-04 IRIG standard

Table 22. 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 23. Degree of protection of flush-mounted relay

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

Table 24. Environmental 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 25. 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 26. 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
• Communication	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:		EN 55011, class A
• Conducted		IEC60255-25
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 27. Insulation tests

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

Table 28. Mechanical tests

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

Table 29. Product safety

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

Table 30. EMC compliance

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

Table 31. RoHS compliance

Complies with the RoHS directive 2002/95/EC

Protection functions

Table 32. Motor phase-current differential protection (87M)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the current measured: fn ±2Hz		
Trip time		Minimum	Typical	Maximum
	Low stage	36 ms	40 ms	42 ms
	High stage	12 ms	17 ms	22 ms
Reset time		< 40 ms		
Reset ratio		Typical 0.95		
Retardation time		< 20 ms		

Table 33. Motor phase-current differential protection (87M) main settings

Parameter	Function	Value (Range)	Step
Low trip value	87M	5…30%	1%
Curve slope	87M	10…50	1
High trip value	87M	100…1000	10
DC restrain	87M	Enable or disable	-

Table 34. RTD/mA measurement (38)

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

Table 35. Multipurpose analog protection (MAP)

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

Table 36. 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
Pickup mode	MAP	Over	-
		Under	

Table 37. 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 38. 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 x F_n	0.001
Pickup value 81U	81	0.800...1.100 x F_n	0.001
Pickup value df/dt	81	-0.200...0.200 x F_n /s	0.005
Trip time 81O/81U	81	80...200000 ms	10
Trip time df/dt	81	120...200000 ms	10

Table 39. Three-phase non-directional overcurrent protection (50P, 51P)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the current measured: f_n ±2Hz		
	51P	±1.5% of the set value or ±0.002 × I_n		
	50P	±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
	50P and 51P: 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 P-to-P+backup: No suppression		

[1)] Set Trip delay time = 0,02 s, Operate curve type = ANSI 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 × In, Pickup range multiples in range of 1.5 to 20

Table 40. Three-phase non-directional overcurrent protection (50P, 51P) main settings

Parameter	Function	Value (Range)	Step
Pickup range	51P	0.05…5.00 × I_n	0.01
	50P	0.10…40.00 × I_n	0.01
Time multiplier	51P	0.8…10.0	0.05
	50P	0.05…15.00	0.05
Definite time delay	51P	40…200000 ms	10
	50P	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	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 41. Ground non-directional overcurrent protection (50G, 51G)

Characteristic		Value		
Pickup accuracy	51G	Depending on the frequency of the current measured: fn ±2Hz		
		±1.5% of the set value or ±0.002 × I_n		
	50G	±1.5% of the set value or ±0.002 × I_n (at currents in the range of 0.10…10 × I_n)		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	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 P-to-P+backup: 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 42. Ground non-directional overcurrent protection (50G, 51G) main settings

Parameter	Function	Value (Range)	Step
Pickup range	51G	0.05…5.00 × I_n	0.01
	50G	0.10…40.00 × I_n	0.01
Time multiplier	51G	0.8…10.0	0.05
	50G	0.05…15.00	0.05
Definite time delay	51G	40…200000 ms	10
	50G	40…200000 ms	10
Operating curve type [1)]	51G	Definite or inverse time Curve type: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19	
	50G	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 43. Directional ground overcurrent protection (67/51N)

Characteristic		Value		
Pickup accuracy	w	Depending on the frequency of the current measured: f_n ±2Hz		
	67/51N	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 44. Directional ground overcurrent 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	
Operation mode	67/51N	1=Phase angle 2=I_0Sin 3=I_0Cos 4=Phase angle 80 5=Phase angle 88	

Table 45. 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 46. 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	

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

Table 47. 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 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 × 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 48. 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 49. Positive sequence undervoltage protection (27PS)

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} = 0.99 × set Pickup value	52 ms	55 ms	57 ms
	V_{Fault} = 0.9 × set Pickup value	44 ms	46 ms	49 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		
Suppression of harmonics		DFT: -50dB at f = n × f_n, where n = 2, 3, 4, 5,…		

[1] Pickup range = 1.0 × V_n, Positive sequence voltage before fault 1.1 × V_n, f_n = 50 Hz, positive sequence undervoltage 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 50. Positive sequence undervoltage protection (27PS) main settings

Parameter	Function	Value (Range)	Step
Pickup range	27PS	0.010…1.200 × Vn	0.001
Definite time delay	27PS	40…120000 ms	10
Voltage block value	27PS	0.01…1.0 × Vn	0.01

Table 51. Negative sequence overvoltage protection (47)

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	33 ms	35 ms	37 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 × fn, where n = 2, 3, 4, 5,…		

[1)] Negative sequence voltage before fault 0.0 × Vn, fn = 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 52. Negative sequence overvoltage protection (47) main settings

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

Table 53. Ground overvoltage protection (59G)

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	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 × fn, where n = 2, 3, 4, 5,…		

[1)] Residual voltage before fault 0.0 × Vn, fn = 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 54. Ground overvoltage protection (59G) main settings

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

Table 55. Negative phase-sequence current protection (46M)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the current measured: f_n = ±2Hz		
		±1.5% of the set value or ±0.002 × In		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	I_{Fault} = 2 × set Pickup value	22 ms	25 ms	27 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 current before fault = 0.0, f_n = 50 Hz, results based on statistical distribution of 1000 measurements
[2)] Includes the delay of the signal output contact
[3)] Pickup value multiples in range of 1.10 to 5.00

Table 56. Negative phase-sequence current protection (46M) main settings

Parameter	Function	Value (Range)	Step
Pickup value	46M	0.01…0.50 × In	0.01
Operating curve type	46M	ANSI Def. Time IEC Def. Time Inv. Curve A Inv. Curve B	-
Trip delay time	46M	100…120000 ms	10
Cooling time	46M	5…7200 s	1
Operation	46M	Off On	-

Table 57. Loss of load supervision (37)

Characteristic	Value
Pickup accuracy	Depending on the frequency of the current measured: fn ±2Hz
	±1.5% of the set value or ±0.002 × In
Pickup time	Typical 300 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

Table 58. Loss of load supervision (37) main settings

Parameter	Function	Value (Range)	Step
Pickup value	37	0.01…1.00 × In	0.01
Current block value	37	0.01…0.50 × In	0.01
Trip delay time	37	40…600000 ms	10
Operation	37	Off On	-

Table 59. Motor load jam protection (51LR)

Characteristic	Value
Pickup accuracy	Depending on the frequency of the current measured: fn ±2Hz
	±1.5% of the set value or ±0.002 × In
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

Table 60. Motor load jam protection (51LR) main settings

Parameter	Function	Value (Range)	Step
Operation	51LR	Off On	-
Pickup value	51LR	0.01…10.00 × In	0.01
Trip delay time	51LR	100…120000 ms	10

Table 61. Motor start-up supervision (66/51LRS)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the voltage measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 × Vn		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	I_{Fault} = 1.1 × set Start detection A	29 ms	31 ms	34 ms
Trip time accuracy		±1.0% of the set value or ±20 ms		
Suppression of harmonics		Typical 0.90		

Table 62. Motor start-up supervision (66/51LRS) main settings

Parameter	Function	Value (Range)	Step
Motor start-up A	66/51LRS	1.0…10.00 × In	0.1
Motor start-up time	66/51LRS	1…80.0 s	1
Locked rotor time	66/51LRS	2…120 s	1
Operation	66/51LRS	Off On	-
Operation mode	66/51LRS	Ilt Ilt, CB Ilt & stall Ilt & stall, CB	-
Restart inhibit time	66/51LRS	0…250 min	1

Table 63. Phase reversal protection (46R)

Characteristic		Value		
Pickup accuracy		Depending on the frequency of the voltage measured: f_n ±2Hz		
		±1.5% of the set value or ±0.002 × Vn		
Pickup time [1) 2)]		Minimum	Typical	Maximum
	I_{Fault} = 2.0 × set Pickup value	22 ms	25 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: -50 dB at f = n × f_n, where n = 2, 3, 4, 5,…		

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

Table 64. Phase reversal protection (46R) main settings

Parameter	Function	Value (Range)	Step
Pickup value	46R	0.05…1.00 × In	0.01
Trip delay time	46R	100…60000 ms	10
Operation	46R	Off On	-

Table 65. Three-phase thermal overload protection for motors (49M)

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 × In (at currents in the range of 0.01…4.00 × In)
Trip time accuracy	±2.0% of the theoretical value or ±0.50 s

1) Overload current > 1.2 × Operate level temperature

Table 66. Thermal overload protection for motors (49M) main settings

Parameter	Function	Value (Range)	Step
Env temperature mode	49M	FLC Only Use RTD Set Amb Temp	-
Env temperature set	49M	-20.0…70.0 °C	0.1
Alarm thermal value	49M	50.0…100.0 %	0.1
Restart thermal value	49M	20.0…80.0 %	0.1
Overload factor	49M	1.00…1.20	0.01
Weighting factor p	49M	20.0…100.0	0.1
Time constant normal	49M	80…4000 s	1
Time constant start	49M	80…4000 s	1
Operation	49M	Off	-

Table 67. 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 × In
Trip time accuracy	±1.0% of the set value or ±20 ms

Table 68. Circuit breaker failure protection (50BF/50NBF) main settings

Parameter	Function	Value (Range)	Step
Current value (Operating phase current)	50BF/50NBF	0.05…1.00 × In	0.05
Current value Res (Operating residual current)	50BF/50NBF	0.05…1.00 × In	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 69. Arc protection (AFD)

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

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

Table 70. Arc protection (AFD) main settings

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

Control functions

Table 71. Emergency startup (62EST) main settings

Parameter	Function	Value (Range)	Step
Operation	62EST	Off On	-
Motor stand still A	62EST	0.05…0.20 × In	0.01

Measurement functions

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

Characteristic	Value
Measurement accuracy	Depending on the frequency of the current measured: fn ± 2 Hz at currents in the range of 0.01…40 × In)
	Current: ±0.5% or ±0.002 × In
	Phase angle: ±2.5°
Suppression of harmonics	DFT: -50dB at f = n × fn, 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 = ±2 Hz
	Voltage: ±0.5% or ±0.002 × Vn
	Phase angle: ±2.5°
Suppression of harmonics	DFT: -50 dB at f = n × fn, 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: fn ± 2 Hz
	(at voltages in range 0.01…1.15 × Vn)
	±0.5% or ±0.002 × Vn
Suppression of harmonics	DFT: -50 dB at f = n × fn, where n = 2, 3, 4, 5,…
	RMS: No suppression

Table 75. Voltage sequence components (V1, V2, V0)

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

Table 76. Ground current measurement (IG)

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

Table 77. Ground voltage measurement (VG)

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

Table 78. 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 × In At all three voltages in range 0.50…1.15 × Vn At the frequency fn ±1 Hz Active power and energy in range |PF| > 0.71 Reactive power and energy in range |PF| < 0.71
	±1.5% for power (S,P and Q) ±0.015 for power factor ±1.5% for energy
Suppression of harmonics	DFT: -50 dB at f = n × fn, where n = 2, 3, 4, 5,…

Table 79. Frequence measurement (f)

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

Supervision functions

Table 80. Current circuit supervision (CCM)

Characteristic	Value
Trip time [1)]	< 30 ms

1) Including the delay of the output contact

Table 81. Current circuit supervision (CCM) main settings

Parameter	Values (Range)	Unit	Description
Pickup range	0.05…0.20	× In	Minimum trip current differential level
Maximum trip current	1.00…5.00	× In	Block of the function at high phase current

Table 82. Fuse failure supervision (60)

Characteristic	Value	
Trip time [1)]	NPS function:	
	VFault = 1.1 × set Neg Seq voltage Lev	< 33 ms
	VFault = 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, fn = 50 Hz, fault voltage with nominal frequency injected from random phase angle, results based on statistical distribution of 1000 measurements

Table 83. Motor run time counter (OPTM)

Description	Value
Motor run-time measurement accuracy	±0.5%

23. 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.

Table 84. Large display

Character size	Rows in the view	Characters per row
Large, variable width (13x14 pixels)	10	20 or more

24. 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 indication color, red or green, for each LED can be selected individually with PCM 600. The indication color, red or green, for each LED can be selected individually with 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.

25. 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-fl ush mounting
- Wall mounting
- Mounting to a 19" equipment frame
- Mounting with Flexitest (FT) test switches to a
- 19"rack

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

26. 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.

27. Selection and ordering data

The relay type and serial number label identifies the prote ction 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 in Fig. xx 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: NAMAAAABNBE1BNN1XF	N	A	M	A	A	A	A	B	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	Motor protection and control																		
4) Configuration	A: Overcurrent, load loss, phase and neutral voltage, frequency and RTD protection and power system metering for medium to large motors				A														
	B: Differential, overcurrent, load loss, phase and neutral voltage, frequency and RTD protection and power system metering for medium to large motors				B														
	C: Differential, overcurrent, load loss, phase and neutral voltage, frequency and extended RTD protection and power system metering for medium to large motors				C														
5-6) Analog Inputs	3 CT + Ground CT + 3 VT + 12 RTD					A	A												
	6 CT + Ground CT + 4 VT + 12 RTD					B	A												
	6 CT + Ground CT + 4 VT + 14 RTD					C	A												
7-8) Binary I/O	8 BI + 6 BO + 3 HSO							A	1										
	8 BI + 10 BO							A	A										
	14 BI + 9 BO + 3 HSO							A	2										
	14 BI + 13 BO							A	B										
	12 BI + 6 BO + 3 HSO							B	1										
	12 BI + 10 BO							B	A										
	8 BI + 6 BO + 3 HSO							C	1										
	8 BI + 10 BO							C	A										
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								

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Ex: NAMAAAABNBE1BNN1XF	N	A	M	A	A	A	A	B	N	B	E	1	B	N	N	1	X	F
Digit	**Description**																		
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								
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

28. Accessories 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 software modules of the relay. Use the ordering key information in Fig. xx to generate the order number when ordering complete protection relays. Add the figure based on the Excel table for order codes. ordering data for details on the available analog inputs for each standard configuration.

Table 86. 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

29. 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).

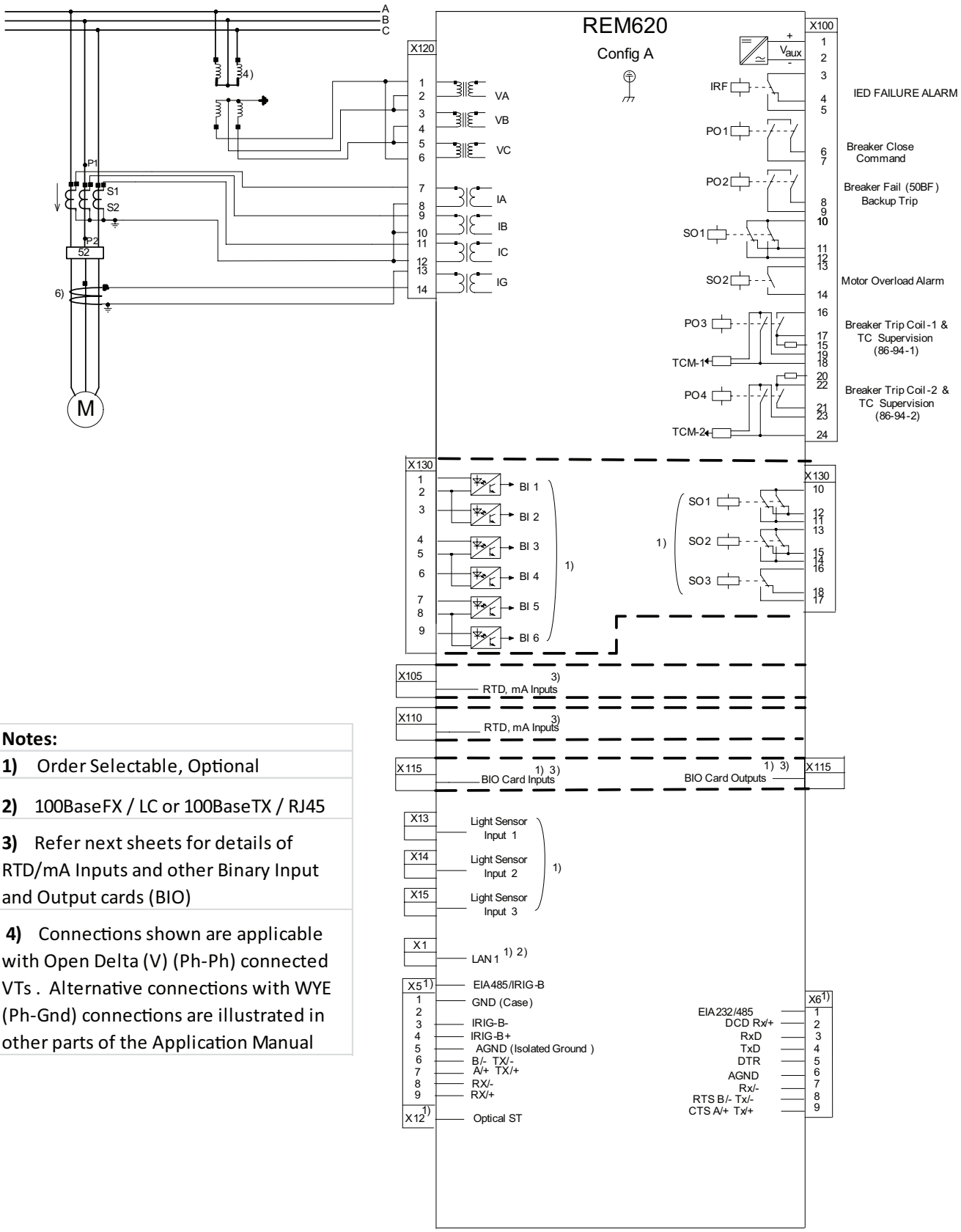
PCM600 offers extensive relay configuration functions such as application configuration, signal matrix, communication management, graphical display editor, and IEC 61850 communication configuration including horizontal relay-to-relay communication, GOOSE.

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 87. Tools

Configuration, setting and SA system tools	Version
PCM600	2.4.1 or later
Web-browser based user interface	IE 7.0 or later
REM620 Connectivity Package	2.0 ANSI or later
COM600 substation product	V3.5 or later
MicroSCADA Pro Substation Automation system	9.3 or later

Figure 6. REM620 Connection Diagram Config A



Notes:

1) Order Selectable, Optional

2) 100BaseFX / LC or 100BaseTX / RJ45

3) Refer next sheets for details of RTD/mA Inputs and other 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) connections are illustrated in other parts of the Application Manual

Figure 7. REM620 Connection Diagram Config A

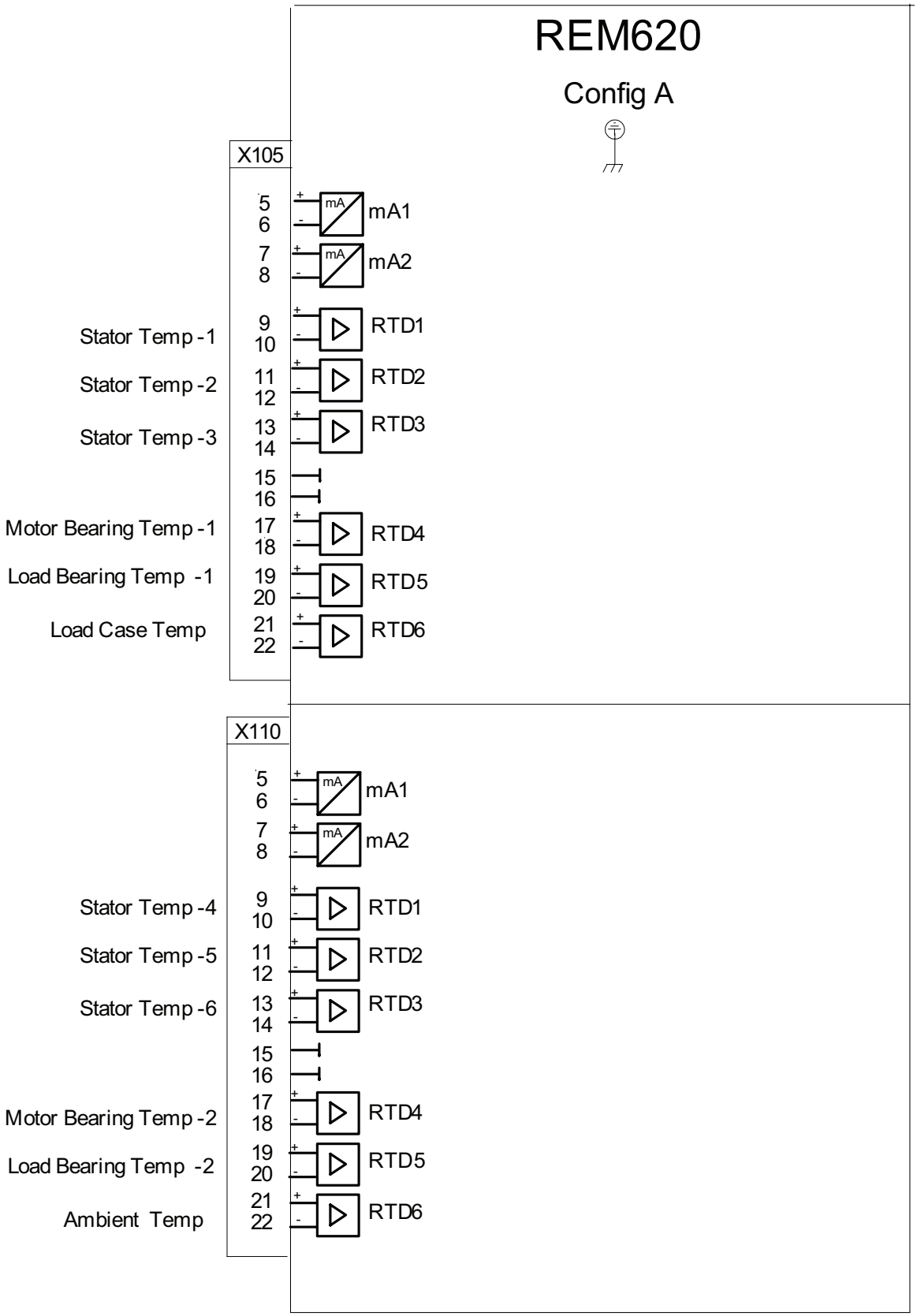
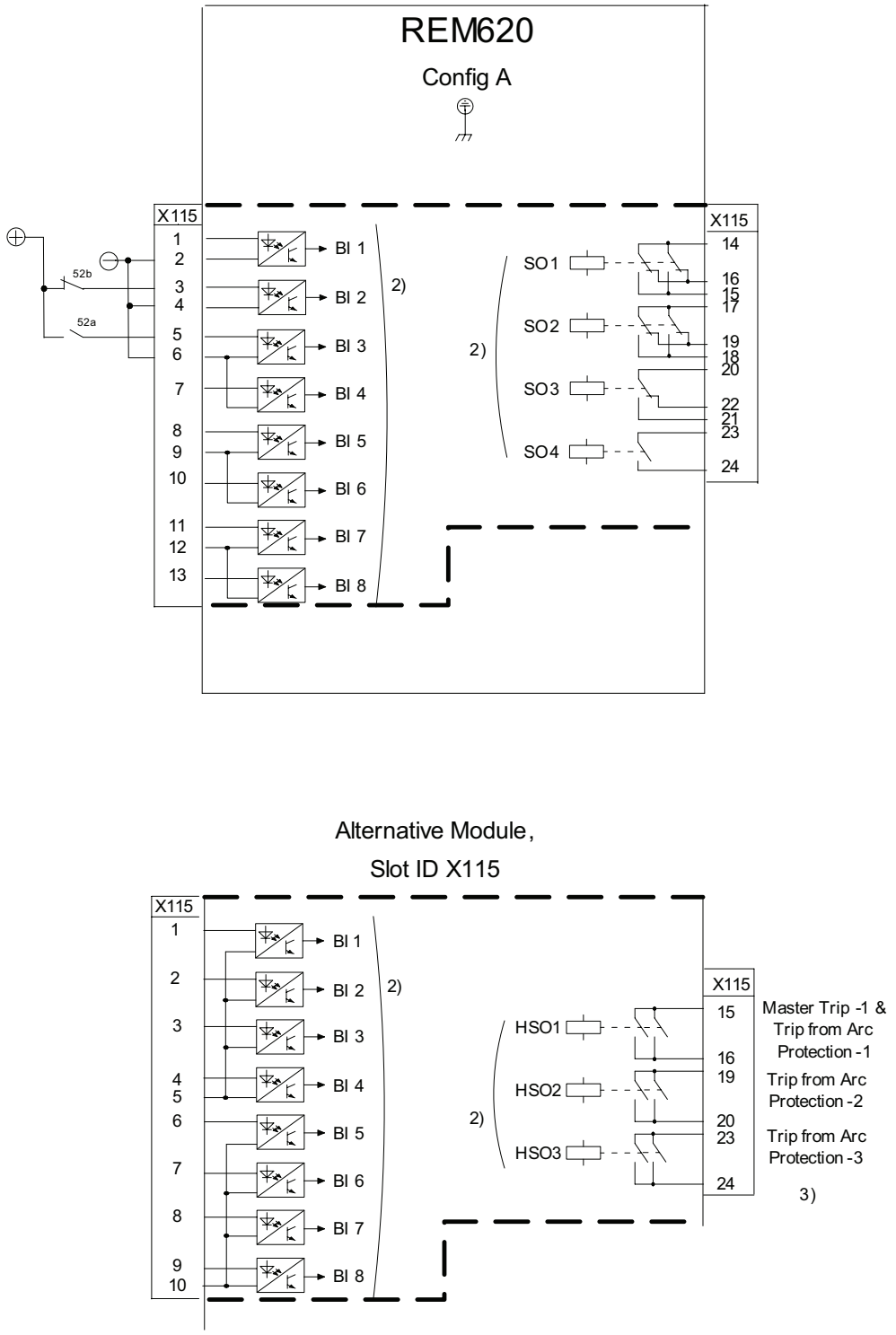


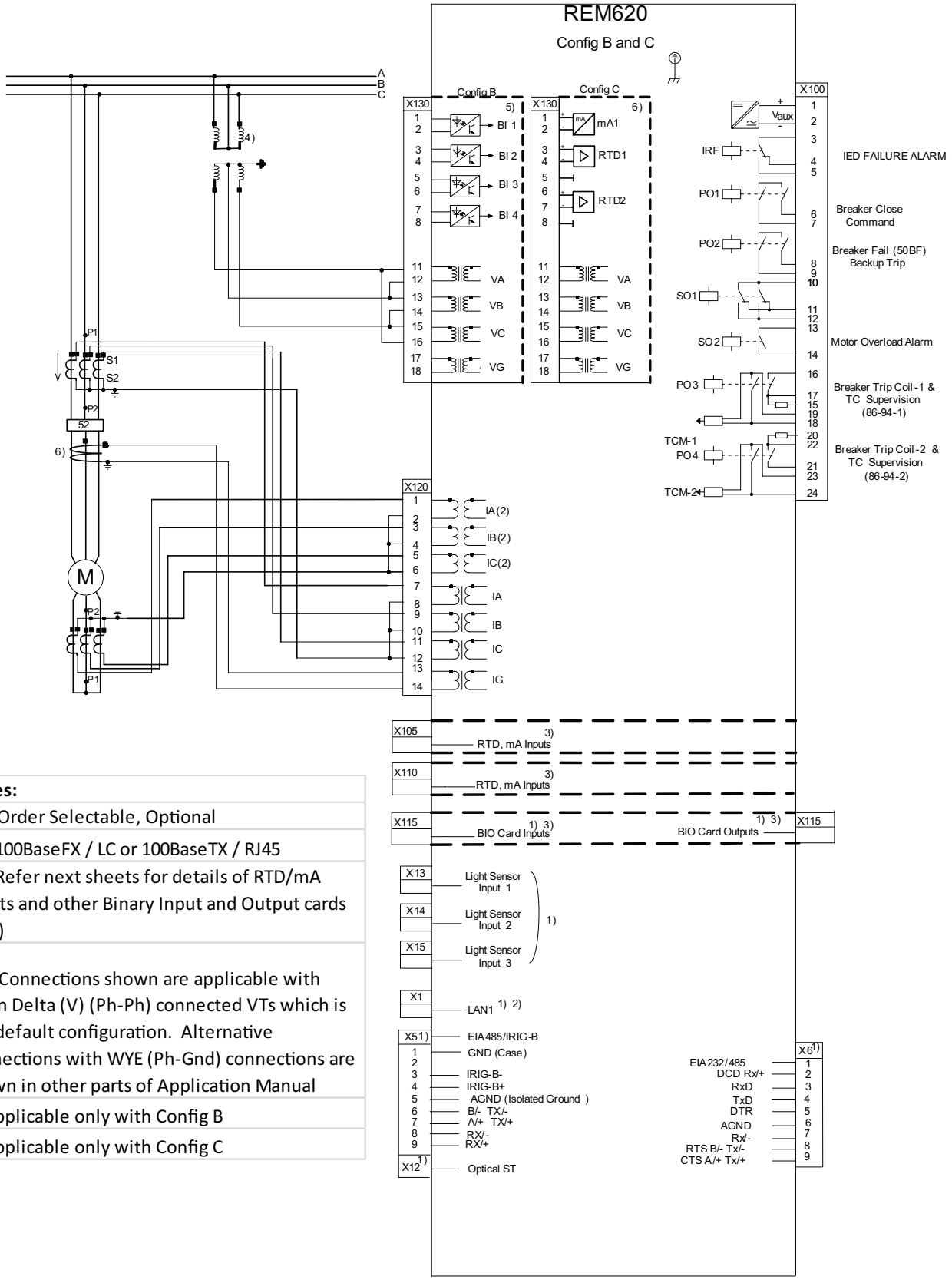
Figure 8. REM620 Connection Diagram Config A



2) Order Selectable, Optional alternatives

3) Default outputs configured with High Speed Outputs when Arc protection option is chosen

Figure 9. REM620 Connection Diagram Config B and C



Notes:
1) Order Selectable, Optional
2) 100BaseFX / LC or 100BaseTX / RJ45
3) Refer next sheets for details of RTD/mA Inputs and other Binary Input and Output cards (BIO)
4) Connections shown are applicable with Open Delta (V) (Ph-Ph) connected VTs which is the default configuration. Alternative connections with WYE (Ph-Gnd) connections are shown in other parts of Application Manual
5) Applicable only with Config B
6) Applicable only with Config C

Figure 10. REM620 Connection Diagram Config B and C

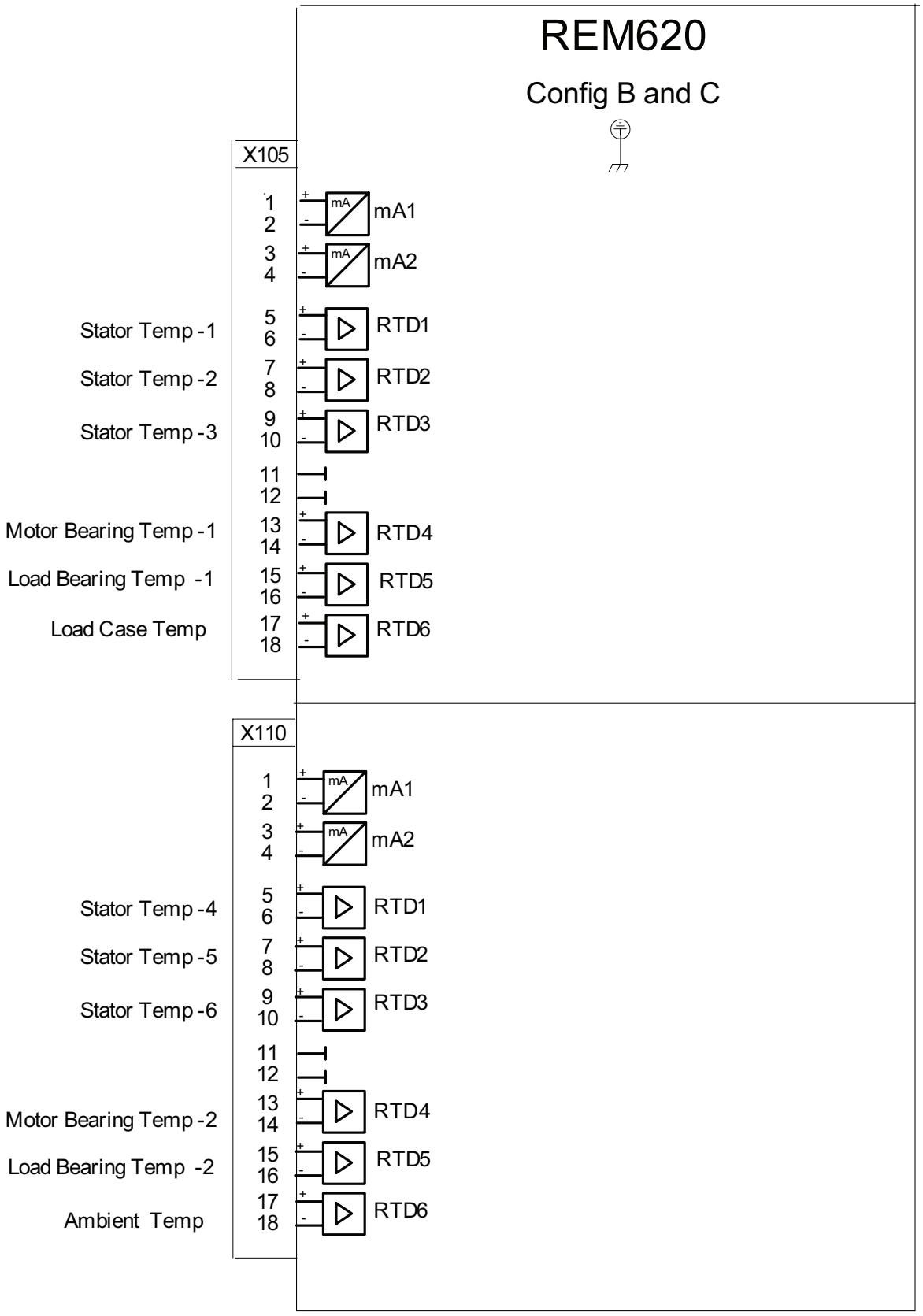
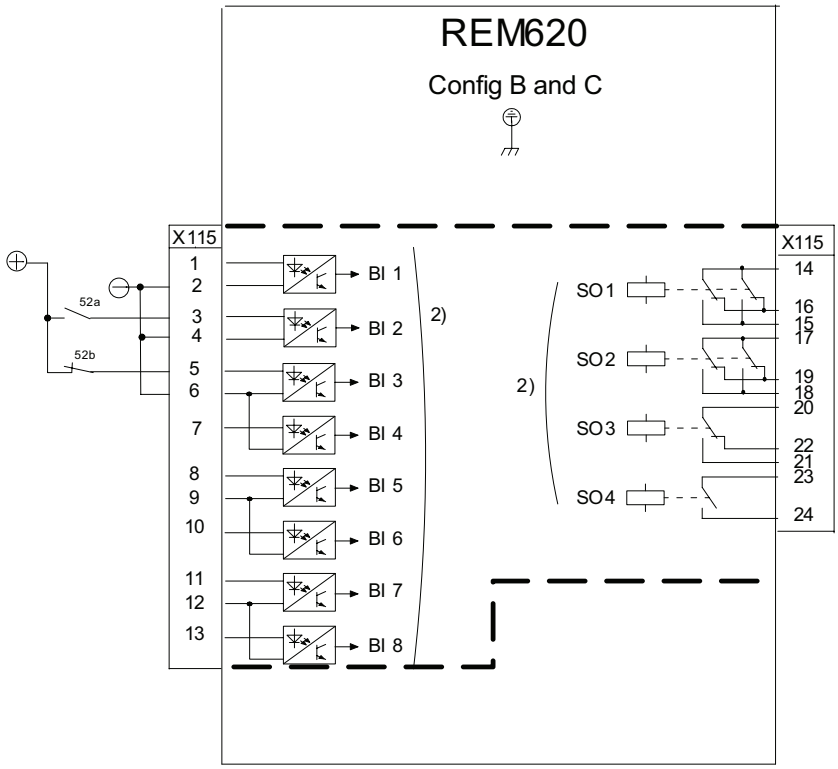
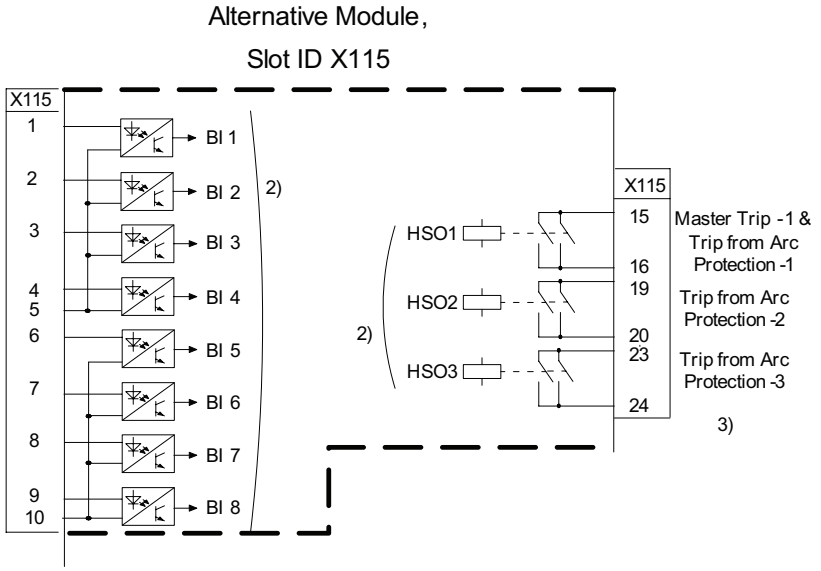


Figure 11. REM620 Connection Diagram Config B and C





2) Order Selectable, Optional alternatives

3) Default outputs configured with High Speed Outputs when Arc protection option is chosen

31. Certificates

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

32. 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 REM620 ANSI on the product web page.

33. Functions, codes and symbols

Table 86. Functions included in standard configurations, REM620

Function	IEC61850	ANSI/C37.2	IEC60617
Protection			
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	51P	3I> (1)
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	50P	3I>> (1)
Non-directional ground-fault protection, low stage, instance 1	EFLPTOC1	51G	Io> (1)
Non-directional ground-fault protection, high stage, instance 1	EFHPTOC1	50G	Io>> (1)
Directional ground-fault protection, low stage, instance 1	DEFLPDEF1	67/51N	Io> -> (1)
Residual overvoltage protection, instance 1	ROVPTOV1	59G	Uo> (1)
Residual overvoltage protection, instance 2	ROVPTOV2	59N	Uo> (2)
Three-phase undervoltage protection, instance 1	PHPTUV1	27	3U< (1)
Three-phase overvoltage protection, instance 1	PHPTOV1	59	3U> (1)
Positive-sequence undervoltage protection, instance 1	PSPTUV1	27PS	U1<(1)
Negative-sequence overvoltage protection, instance 1	NSPTOV1	47	U2> (1)
Frequency protection, instance 1	FRPFRQ1	81	f>/f<,df/dt -1
Negative-sequence overcurrent protection for motors, Instance 1	MNSPTOC1	46M-1	I2>M(1)
Negative-sequence overcurrent protection for motors, Instance 2	MNSPTOC2	46M-2	I2>M(2)
Loss of load supervision, instance 1	LOFLPTUC1	37M-1	3I<(1)
Loss of load supervision, instance 2	LOFLPTUC2	37M-2	3I<(2)
Motor load jam protection	JAMPTOC1	51LR	Ist>
Motor start-up supervision	STTPMSU1	66/51LRS	Is2t n<
Phase reversal protection	PREVPTOC1	46R	I2>>
Thermal overload protection for motors	MPTTR1	49M	3Ith>M
Motor differential protection	MPDIF1	87M	3dI>M
Circuit breaker failure protection, instance 1	CCBRBRF1	50BF	3I>/Io>BF (1)
Master trip, instance 1	TRPPTRC1	86/94-1	Master Trip -1
Master trip, instance 2	TRPPTRC2	86/94-2	Master Trip -2
Arc protection, instance 1	ARCSARC1	AFD-1	ARC (1)
Arc protection, instance 2	ARCSARC2	AFD-2	ARC (2)
Arc protection, instance 3	ARCSARC3	AFD-3	ARC (3)
RTD based thermal protection, instance 1	MAPGAPC1	38-1	MAP(1)
RTD based thermal protection, instance 2	MAPGAPC2	38-2	MAP(2)
RTD based thermal protection, instance 3	MAPGAPC3	38-3	MAP(3)
RTD based thermal protection, instance 4	MAPGAPC4	38-4	MAP(4)
RTD based thermal protection, instance 5	MAPGAPC5	38-5	MAP(5)
RTD based thermal protection, instance 6	MAPGAPC6	38-6	MAP(6)
RTD based thermal protection, instance 7	MAPGAPC7	38-7	MAP(7)
Control			
Circuit-breaker control, instance 1	CBXCBR1	52	I <-> O CB (1)
Emergency startup	ESMGAPC1	62EST	ESTART
Condition Monitoring			
Circuit-breaker condition monitoring, instance 1	SSCBR1	52CM	CBCM (1)
Trip circuit supervision, instance 1	TCSSCBR1	TCM-1	TCS (1)

Trip circuit supervision, instance 2	TCSSCBR2	TCM-2	TCS (2)
Current circuit supervision	CCRDIF1	CCM	MCS 3I
Fuse failure supervision, instance 1	SEQRFUF1	60	FUSEF (1)
Runtime counter for machines and devices, instance 1	MDSOPT1	OPTM-1	OPTS(1)
Runtime counter for machines and devices, instance 2	MDSOPT2	OPTM-2	OPTS(2)
Measurement			
Three-phase current measurement, instance 1	CMMXU1	IA, IB, IC	3I
Three-phase current measurement, instance 2	CMMXU2	IA, IB, IC(2)	3I(B)
Sequence current measurement, instance 1	CSMSQI1	I1, I2, I0	I1, I2, I0
Sequence current measurement, instance 2	CSMSQI2	I1,I2,I0(2)	I1, I2, I0(B)
Residual current measurement, instance 1	RESCMMXU1	IG	Io
Three-phase voltage measurement, instance 1	VMMXU1	VA, VB, VC	3U
Residual voltage measurement	RESVMMXU1	VG	Uo
Sequence voltage measurement, instance 1	VSMSQI1	V1, V2, V0	U1, U2, U0
Single-phase power and energy measurement, instance 1	SPEMMXU1	SP, SE	SP, SE
Three-phase power and energy measurement, instance 1	PEMMXU1	P, E	P, E
Load profile	LDPMSTA1	LoadProf	LoadProf
Frequency measurement	FMMXU1	f	f
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)
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

34. Document revision history

Rev. A, V2.0

Notes

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