GE Power Management

750/760

FEEDER MANAGEMENT RELAY®

Instruction Manual

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Manufactured under an
ISO9001 Registered system.

WARNING

These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

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A.1 FIGURES AND TABLES

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B.1 EU DECLARATION OF CONFORMITY

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C.1 WARRANTY INFORMATION

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1.1.1 DESCRIPTION

The 750 and 760 Feeder Management Relays® are microprocessor-based units intended for the management and primary protection of distribution feeders, as well as for the management and backup protection of buses, transformers, and transmission lines. The 760 relay is particularly suited to overhead feeders, where automatic reclosing is normally applied.

Each relay provides protection, control, and monitoring functions with both local and remote human interfaces. They also display the present trip/alarm conditions, and most of the more than 35 measured system parameters. Recording of past trip, alarm or control events, maximum demand levels, and energy consumption is also performed.

These relays contain many innovative features. To meet diverse utility standards and industry requirements, these features have the flexibility to be programmed to meet specific user needs. This flexibility will naturally make a piece of equipment difficult to learn. To aid new users in getting basic protection operating quickly, setpoints are set to typical default values and advanced features are disabled. These settings can be reprogrammed at any time.

Programming can be accomplished with the front panel keys and display. Due to the numerous settings, this manual method can be somewhat laborious. To simplify programming and to provide a more intuitive interface, programming can be accomplished with a personal computer running the 750/760 PC program provided with each relay. Even with minimal computer knowledge, this menu-driven program provides easy access to all front panel functions. Actual values can be displayed and setpoints can be displayed, altered, stored, and printed. If settings are stored in a setpoint file, they can be downloaded at any time to the front panel program port of the relay via a computer cable connected to the serial port of any personal computer.

A summary of the available functions is contained in the following list, and a one-line diagram of the most important protection and control features follows. For a complete understanding of each features operation, refer to the Chapter 7: SETPOINTS of this manual. The logic diagrams include a reference to every setpoint related to a feature and show all logic signals passed between individual features. Information related to the selection of settings for each setpoint is also provided.

PROTECTION

- Two Phase Time Overcurrent Elements with Voltage Restraint
- Two Phase Instantaneous Overcurrent Elements
- Two Neutral Time Overcurrent Elements
- Two Neutral Instantaneous Overcurrent Elements
- Ground Time and Instantaneous Overcurrent
- Sensitive Ground Time and Instantaneous Overcurrent
- Negative Sequence Time and Instantaneous Overcurrent
- Phase, Neutral, Ground, Sensitive Ground, and Negative Sequence Directional Control
- Negative Sequence Voltage
- Neutral Displacement
- Two Bus Undervoltage Elements
- Two Line Undervoltage Elements
- Two Overvoltage Elements
- Two Underfrequency Elements
- Frequency Decay
- Breaker Failure with Current Supervision

INPUTS

- 5 - AC Currents
- 4 - AC Voltages
- 20 Programmable Logic Inputs
  (14 contact and / or virtual)
  (6 virtual)
- 1 Analog Input

OUTPUTS

- 8 Electro-Mechanical Relays
- 1 Solid-State Trip
- 8 Analog Transducers

MONITORING

- Phase and Neutral Current Level
- Power Factor
  (Two Independent Stages)
- Fault Locator
- Demand
  (I_a, I_b, I_c, MW, Mvar, MVA)
- Analog Input
  (Two Threshold Stages)
  (Two Rate Stages)
- Overfrequency
- Trip Counter Limit
- Total Breaker Arcing Current
  (Per Phase)
- Breaker Operation Failure
- Trip and Close Coil Monitors
- VT Failure
- Pulsed Output

METERING

- Average Current
- Phase, Neutral, Ground, and Sensitive Ground Current Phasors
- Average Line and Phase Voltage
- Line and Phase Voltage Phasors
- Symmetrical Component Phasors
  (Current and Voltage)
- Frequency Magnitude and Rate
- Synchronizing Voltage Phasor
- Synchronizing Voltage Frequency
- Synchronizing $\Delta\Phi$, ΔkV, ΔHz
- Single and Three Phase Power
  (MW, Mvar, MVA, PF)
- Energy
  (MWh, Mvarh)
- Last and Maximum Demand
  (I_a, I_b, I_c, MW, Mvar, MVA)
- Analog Input Magnitude
- Analog Input Rate
  (per minute, per hour)

COMMUNICATIONS

- Front Panel RS232 Serial Port
- Two Rear Terminal Serial Ports
  (COM1 - RS485 or RS422)
  (COM2 - RS485 Only)
- Modbus or DNP 3.0 Protocol

CONTROL

- Four Protection Setpoint Groups
- Synchrocheck
  (With Dead-Source Bypassing)
- Manual Close Blocking
- Cold Load Pickup Blocking
- Automatic Restoration after Undervoltage Tripping
- Automatic Restoration after Underfrequency Tripping
- Transfer
- Automatic Reclosing (760 Only)
  (Up To 4 Shots)
  (With Protection Modification and Current Supervision and Zone Coordination)
- Breaker Open & Close

OTHER

- Data Logger (8 Channels)
- Event Recorder (128 Events)
- Waveform Capture
  (16 Samples Per Cycle)
- Real Time Clock
- IRIG-B Time Synchronization

USER INTERFACE

- 40 Character Vacuum Fluorescent Display
- LED Indicators On Faceplate
- Clear English Language Messages
- Context-Sensitive Help Messages
- Intuitive Message Structure
- Full Numeric Keypad
- Faceplate Breaker Control Keys
- Access Security
  (Keyswitch and Passcode)
- Prefault, Fault and Postfault Simulation
- Product Firmware in Flash Memory
  (Upgrades via RS232 Port)

1

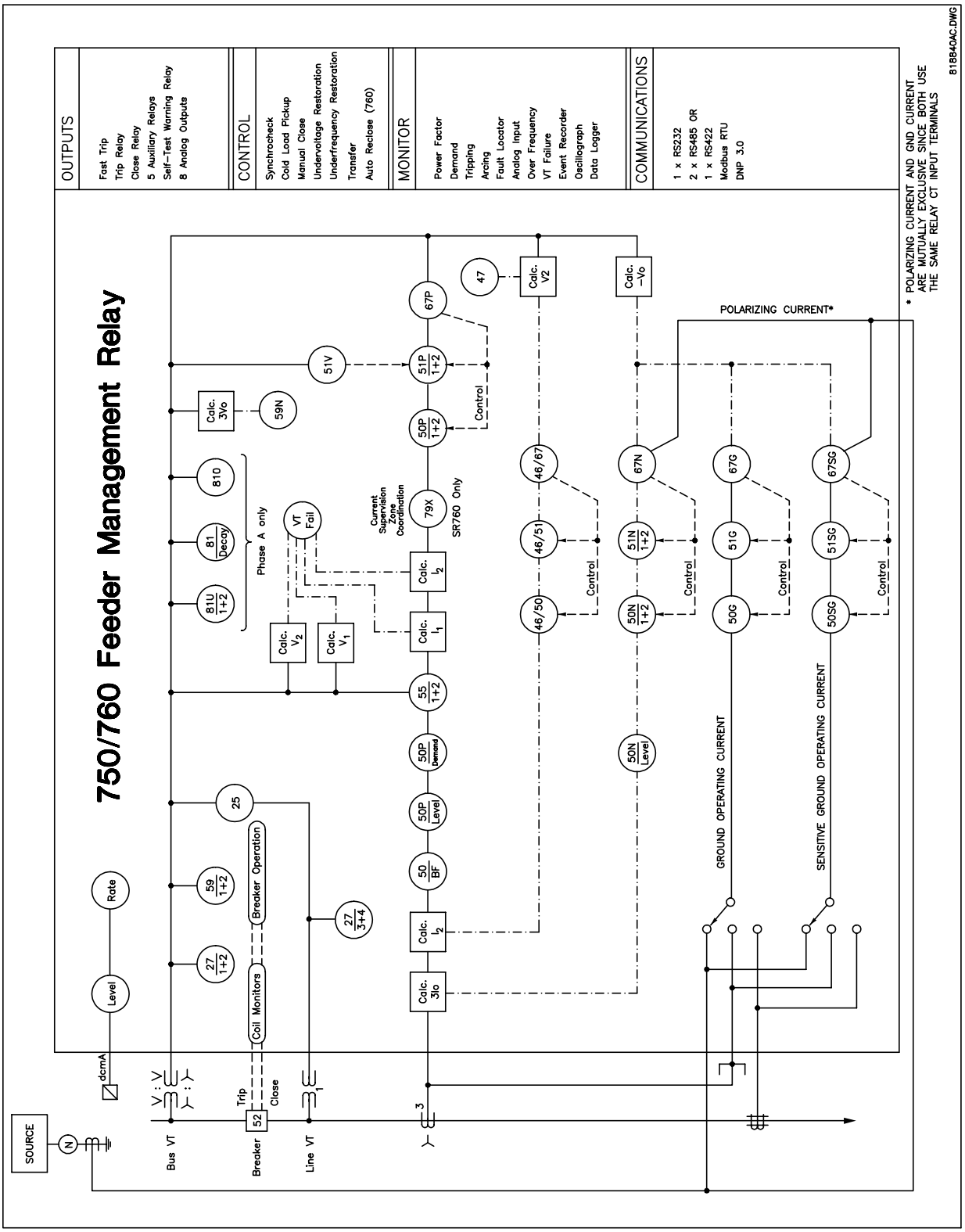

Figure 1–1: PROTECTION ONE LINE DIAGRAM

1.1.3 USING THIS MANUAL

Reading a lengthy instruction manual on a new product is not a task most people enjoy. To speed things up, Chapter 2: GETTING STARTED provides a step-by-step tutorial for a simple feeder application. Important wiring considerations and precautions discussed in Chapter 3: INSTALLATION should be observed for reliable operation. Detailed information regarding accuracy, output relay contact ratings, and so forth are detailed in Section 1.2: TECHNICAL SPECIFICATIONS of this chapter. The remainder of this manual should be read and kept for reference to ensure maximum benefit from the 750 and 760. For further information, please consult your local sales representative or the factory. Comments about new features or modifications for your specific requirements are welcome.

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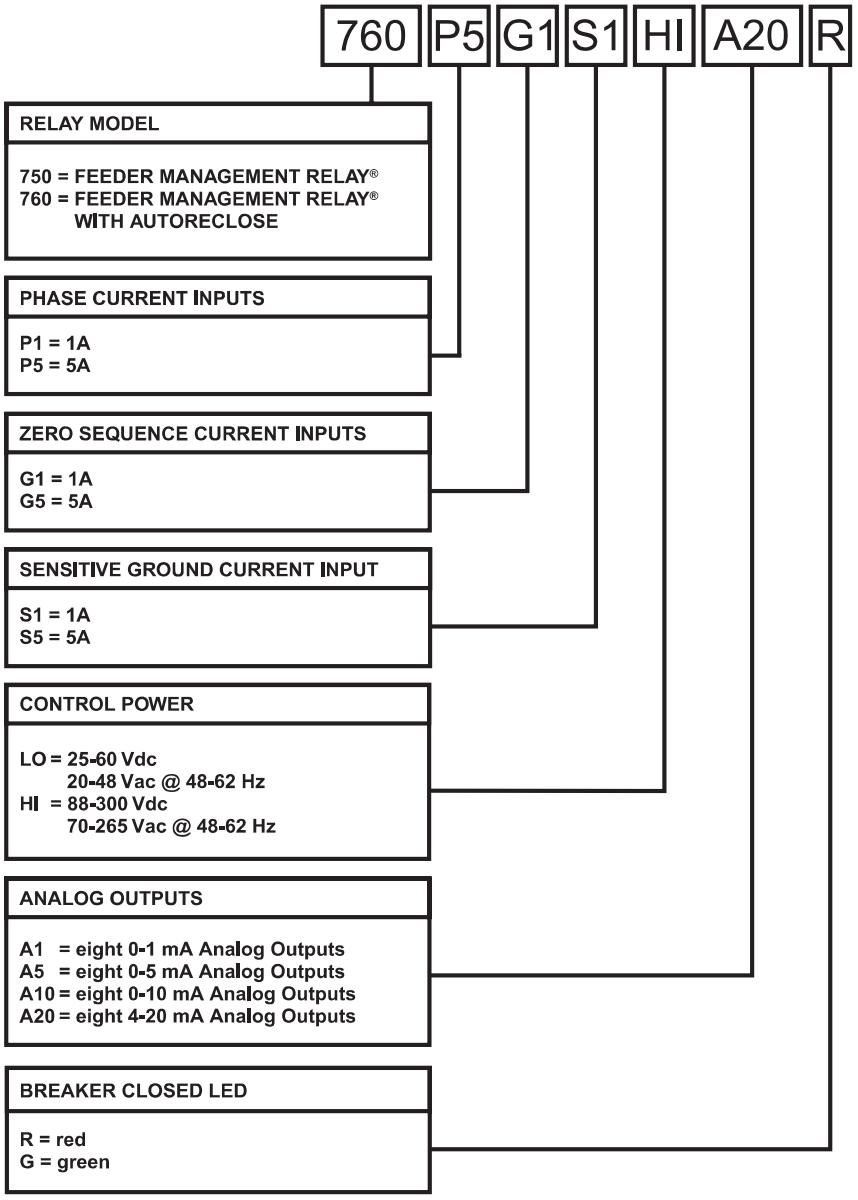
1.1.4 SHIPPING CONTENTS

- 750 Feeder Management Relay® or 760 Feeder Management Relay® with autoreclosure.
- 750/760 Instruction Manual with Warranty Card.
- 750/760 PC program and Firmware on CD, Service Sticker, and GE Power Management Screwdriver.

1.1.5 ORDER CODE

The relay model number will be indicated on the side of the drawout unit. This identification label can be interpreted with the following order code.



OTHER ACCESSORIES

DEMO:	Metal carry case in which 750/760 unit may be mounted.
SR 19-1 PANEL:	Single cutout 19" panel.
SR 19-2 PANEL:	Dual cutout 19" panel.
RS-232/485:	RS232 to RS485 converter box for harsh industrial environments.
5A PHASE CT:	50, 75, 100, 150, 200, 250, 300, 350, 400, 500, 600, 750,1000.
1A PHASE CT:	50, 75, 100, 150, 200, 250, 300, 350, 400, 500, 600, 750,1000.
SR 1 3/8" COLLAR:	For shallow switchgear, reduces the depth of the relay by 1 3/8".
SR 3" COLLAR:	For shallow switchgear, reduces the depth of the relay by 3".

760ORDER.CDR

1.2.1 APPLICABILITY

Systems:	3 or 4 wire, 600 kV maximum, 5000 Amp maximum
Frequency:	25 to 60 Hz nominal (frequency tracking allows operation from 16-65 Hz)

1.2.2 INPUTS

CONTROL POWER

Options:	LO/HI (specified when ordering)
LO Range:	DC = 20 to 60 V AC = 20 to 48 V @ 48 to 62 Hz.
HI Range:	DC = 88 to 300 V AC = 70 to 265 V @ 48 to 62 Hz.
Power:	25 VA nominal, 35 VA maximum
Voltage Loss Hold-Up Time:	30 ms

PHASE CURRENT INPUT

Source CT:	1 to 50000 A primary, 1 or 5 A secondary
Relay Input:	1 A or 5 A (specified when ordering)
Burden:	Less than 0.2 VA at 1 or 5 A
Conversion Range:	0.01 to 20 x CT (fundamental frequency only)
Accuracy:	at < 2 x CT: ± 0.5% of 2 x CT at ≥ 2 x CT: ± 1% of 20 x CT
Overload Withstand:	1 second @ 80 times rated current continuous @ 3 times rated current
Calculated Neutral Current Errors:	3 x phase inputs

GROUND CURRENT INPUT

Source CT:	1 to 50000 A primary, 1 or 5 A secondary
Relay Input:	1 A or 5 A (specified when ordering)
Burden:	Less than 0.2 VA at 1 or 5 A
Conversion Range:	0.01 to 20 x CT (fundamental frequency only)
Accuracy:	at < 2 x CT: ± 0.5% of 2 x CT at ≥ 2 x CT: ± 1% of 20 x CT
Overload Withstand:	1 second @ 80 times rated current continuous @ 3 times rated current

SENSITIVE GROUND CURRENT INPUT

Source CT:	1 to 50000 A primary, 1 or 5 A secondary
Relay Input:	1 A or 5 A (specified when ordering)
Burden:	Less than 0.2 VA at 1 or 5 A
Conversion Range:	Low End: 0.005 x CT Maximum: 500 A primary (fundamental frequency only)
Accuracy:	at < 0.1 x CT: ± 0.2% of 1 x CT at ≥ 0.1 x CT: ± 1% of 1 x CT
Overload Withstand:	1 second @ 80 times rated current continuous @ 3 times rated current

BUS AND LINE VOLTAGE INPUTS

Source VT:	0.12 to 600 kV / 50 to 240 V
Source VT Ratio:	1 to 5000 in steps of 0.1
Relay Input:	50 V to 240 V phase-neutral
Burden:	Less than 0.025 VA at 120 V or > 576 KΩ
Max. Continuous:	273 V phase-neutral (Full Scale) CT (fundamental frequency only)
Accuracy (0°-40°C):	± 0.25% of full scale (10 to 130 V); ± 0.8% of full scale (130 to 273 V) *(for open delta, the calculated phase has errors 2 times those shown above)*

LOGIC INPUTS

Inputs:	14 contact and / or virtual, 6 virtual only (Functions assigned to logic inputs)
Dry Contacts:	1000 Ω maximum ON resistance (32 V DC @ 2 mA provided by relay)
Wet Contacts:	30 to 300 V DC @ 2.0 mA (External DC voltage only)

ANALOG INPUT

Current Input:	0-1 mA, 0-5 mA, 0-10 mA, 0-20 mA, or 4-20 mA (programmable)
Input Impedance:	375 Ω ± 10%
Conversion Range:	0 to 21 mA
Accuracy:	± 1% of full scale

TRIP AND CLOSE COIL MONITORING INPUTS

Acceptable Voltage Range:	20 to 250 V DC
Trickle Current:	2 mA to 5 mA

IRIG-B INPUT

Amplitude-Modulated:	2.5 to 6 Vp-p @ 3:1 signal ratio
DC Shift:	TTL
Input Impedance:	20 kΩ ±10%

(Accuracies based on less than 2 x CT and 50 to 130 V inputs)

* Full Scale = 2 x CT @ 1 x VT Full Scale x √3

GENERAL

The harmonic components of current and voltage are removed from the input voltage and current parameters, so all relay measurements based on these quantities respond to the fundamental component only. To minimize errors, the A/D process utilizes a sampling rate that is automatically adjusted to be 16 samples per power frequency cycle when a measurable voltage is available. To prevent overreaching of overcurrent elements, a digital filter removes the transient DC component of currents.

CURRENT

Phase A RMS Current Phasor

Phase B RMS Current Phasor

Phase C RMS Current Phasor

% of Load-To-Trip

Accuracy: ± 0.5% of full scale

VOLTAGE

A–N (A–B) RMS Voltage Phasor

B–N (B–C) RMS Voltage Phasor

C–N (C–A) RMS Voltage Phasor

Accuracy: ± 0.25% of full scale

FREQUENCY

A-N (A-B) Bus & Line Voltage

Range: 16 to 90 Hz

Accuracy: ± 0.02 Hz

SYMMETRICAL COMPONENTS

Current Level Accuracy: ± 1.5% of full scale

Voltage Level Accuracy: ± 0.75% of full scale

Current & Voltage

Angle Accuracy: ± 2°

3Φ POWER FACTOR

Range: 0.00 Lag to 1.00 to 0.00 Lead

Accuracy: ± 0.02

3Φ REAL POWER

Range: –3000.0 to 3000.0 MW

Accuracy: ± 1% of full scale

3Φ REACTIVE POWER

Range: –3000.0 to 3000.0 Mvar

Accuracy: ± 1% of full scale *

3Φ APPARENT POWER

Range: –3000.0 to 3000.0 MVA

Accuracy: ± 1% of full scale *

WATT-HOURS

Range: -2.1×10^8 to 2.1×10^8 MWh

Accuracy: ± 2% of full scale * per hour

VAR-HOURS

Range: -2.1×10^8 to 2.1×10^8 MVar

Accuracy: ± 2% of full scale * per hour

DEMAND

Phase A/B/C Current

Range: 0 to 65535 A

3Φ Real Power

Range: –3000.0 to 3000.0 MW

3Φ Reactive Power

Range: –3000.0 to 3000.0 Mvar

3Φ Apparent Power

Range: –3000.0 to 3000.0 MVA

Measurement Type: Thermal Exponential, 90% response time (programmed): 5, 10, 15, 20, 30, or 60 min.
Block Interval / Rolling Demand, time interval (programmed): 5, 10, 15, 20, 30, or 60 min.

Accuracy: ± 2% of full scale *

PHASE / NEUTRAL / GROUND / NEGATIVE SEQUENCE TIME OVERCURRENT PROTECTION

Pickup Level:	0.05 to 20.00 in steps of 0.01 x CT
Dropout Level:	97 to 98% of Pickup
Curve Shape:	ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C and Short FlexCurve™ A/B (programmable curves) IAC Extreme/Very/Inverse/Short
Curve Multiplier:	0.00 to 100.00 in steps of 0.01
Reset Type:	Instantaneous/Linear
Level Accuracy:	Per current input (I_2 is 3 x input error)
Timing Accuracy:	at ≥ 1.03 x PU: ± 3% of trip time or ± 20 ms (whichever is greater)

SENSITIVE GROUND TIME OVERCURRENT PROTECTION

Pickup Level:	0.005 to 1.000 in steps of 0.001 x CT
Dropout Level:	97 to 98% of Pickup
Curve Shape:	ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C and Short FlexCurve™ A/B (programmable curves) IAC Extreme/Very/Inverse/Short
Curve Multiplier:	0.00 to 100.00 in steps of 0.01
Reset Type:	Instantaneous/Linear
Level Accuracy:	Per current input (I_2 is 3 x input error)
Timing Accuracy:	at ≥ 1.03 x PU: ± 3% of trip time or ± 20 ms (whichever is greater)

PHASE TIME OVERCURRENT VOLTAGE RESTRAINT

Pickup Adjustment:	Modifies pickup from 0.10 to 0.90 x VT nominal in a fixed line relationship

PHASE / NEUTRAL / GROUND / NEGATIVE SEQUENCE INSTANTANEOUS OVERCURRENT PROTECTION

Pickup Level:	0.05 to 20.00 in steps of 0.01 x CT
Dropout Level:	97 to 98% of Pickup
Time Delay:	0.00 to 600.00 in steps of 0.01s
Level Accuracy:	Per phase / neutral / ground current input (I_2 is 3 x phase input error)
Timing Accuracy:	at 0 ms time delay (no intentional delay): relay contacts = 50 ms max; solid state output = 45 ms max at non-zero time delay: delay accuracy = 0 to +20 ms
Phases:	Any One/Any Two/All Three (programmable) phases have to operate for output (Not for I_2)

SENSITIVE GROUND INSTANTANEOUS OVERCURRENT PROTECTION

Pickup Level:	0.005 to 1.000 in steps of 0.001 x CT
Dropout Level:	97 to 98% of Pickup
Time Delay:	0.00 to 600.00 in steps of 0.01s
Level Accuracy:	Per phase / neutral / ground current input (I_2 is 3 x phase input error)
Timing Accuracy:	at 0 ms time delay (no intentional delay): relay contacts = 50 ms max; solid state output = 45 ms max at non-zero time delay: delay accuracy = 0 to +20 ms
Phases:	Any One/Any Two/All Three (programmable) phases have to operate for output (Not for I_2)

PHASE DIRECTIONAL CONTROL

Relay Connection:	90° (quadrature)
Polarizing Voltage:	Phase A: Vbc Phase B: Vca Phase C: Vab
MTA:	0 to 359° in steps of 1°
Angle Accuracy:	± 2°
Operation Delay:	25 to 40 ms

NEUTRAL DIRECTIONAL CONTROL

Polarized by voltage, current or both voltage and current (For voltage element polarizing, the source VTs must be connected in Wye).

Polarizing Voltage:	–Vo
Polarizing Current:	Ig
MTA:	0 to 359° in steps of 1°
Angle Accuracy:	± 2°
Operation Delay:	25 to 40 ms

GROUND / SENSITIVE GROUND DIRECTIONAL CONTROL

Polarized by voltage, current or both voltage and current (For voltage element polarizing, the source VTs must be connected in Wye).

Polarizing Voltage:	-Vo
Polarizing Current:	Ig
MTA:	0 to 359° in steps of 1°
Angle Accuracy:	± 2°
Operation Delay:	25 to 40 ms

BUS UNDERVOLTAGE 1 / 2 AND LINE UNDERVOLTAGE 3 / 4

Minimum Voltage:	> programmable threshold from 0.00 to 1.25 x VT in steps of 0.01
Pickup Level:	0.00 to 1.25 in steps of 0.01 x VT
Dropout Level:	102 to 103% of Pickup
Curve:	definite time or inverse time
Time Delay:	0.0 to 6000.0 in steps of 0.1 s
Phases:	Any One/Any Two/All Three (programmed) to operate for output (bus undervoltage only)
Level Accuracy:	Per voltage input
Timing Accuracy:	± 100 ms

OVERVOLTAGE 1 / 2

Pickup Level:	0.00 to 1.25 in steps of 0.01 x VT
Dropout Level:	97 to 98% of Pickup
Time Delay:	0.0 to 6000.0 in steps of 0.1 s (definite time)
Phases:	Any One/Any Two/All Three (programmable) phases have to operate for output
Level Accuracy:	Per voltage input
Timing Accuracy:	± 100 ms

NEGATIVE SEQUENCE VOLTAGE

Pickup Level:	0.00 to 1.25 in steps of 0.01 x VT
Dropout Level:	97 to 98% of Pickup
Time Delay:	0.0 to 6000.0 in steps of 0.1 (definite or inverse time)
Level Accuracy:	3 x voltage input error
Timing Accuracy:	± 100 ms

UNDERFREQUENCY 1 / 2

Minimum Voltage:	0.00 to 1.25 in steps of 0.01 x VT in Phase A
Pickup Level:	20.00 to 65.00 in steps of 0.01 Hz
Dropout Level:	Pickup + 0.03 Hz
Time Delay:	0.00 to 600.00 in steps of 0.01 s (definite time)
Level Accuracy:	± 0.02 Hz
Timing Accuracy:	at 60 Hz: ± 25 ms at 50 Hz: ± 30 ms

BREAKER FAILURE

Pickup Level:	0.05 to 20.0 x CT in steps of 0.01
Dropout Level:	97 to 98% of Pickup
Time Delay:	0.03 to 1.00 s in steps of 10
Timing Accuracy:	± 20 ms error
Level Accuracy:	per CT input

NEUTRAL DISPLACEMENT

Pickup Level:	0.00 to 1.25 in steps of 0.01 x VT
Dropout Level:	97 to 98% of Pickup
Curve Shape:	ANSI Extremely/Very/Moderately/Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C and Short FlexCurve™ A/B (programmable curves) IAC Extreme/Very/Inverse/Short
Curve Multiplier:	0.00 to 100.00 in steps of 0.01
Reset Type:	Instantaneous/Linear
Level Accuracy:	3 x voltage input error
Timing Accuracy:	±50 ms

PHASE / NEUTRAL CURRENT

Pickup Level:	0.05 to 20.00 in steps of 0.01 x CT
Dropout Level:	97 to 98% of Pickup
Time Delay:	0 to 60000 in steps of 1 s (definite time)
Level Accuracy:	Per current input
Timing Accuracy:	± 100 ms

POWER FACTOR 1 / 2

Required Voltage:	> 30% of nominal in all phases
Pickup Level:	0.50 Lag to 0.50 Lead in steps of 0.01
Dropout Level:	0.50 Lag to 0.50 Lead in steps of 0.01
Time Delay:	0 to 60 000 in steps of 1 s (definite time)
Level Accuracy:	± 0.02
Timing Accuracy:	± 100 ms

ANALOG IN THRESHOLD 1 / 2

Pickup Level:	0 to 65535 in steps of 1 unit
Dropout Level:	Programmable from 2 to 20% of Pickup (under or over)
Time Delay:	0 to 60000 in steps of 1 s
Level Accuracy:	± 1%
Timing Accuracy:	± 100 ms

ANALOG IN RATE 1 / 2

Pickup Level:	–1000 to 1000 µA/hr. in steps of 0.1
Dropout Level:	97 to 98% of Pickup
Time Delay:	0 to 60000.0 in steps of 1 s
Level Accuracy:	± 1%
Timing Accuracy:	± 100 ms

OVERFREQUENCY

Required Voltage:	> 30% of nominal in phase A
Pickup Level:	20.01 to 65.00 in steps of 0.01 Hz
Dropout Level:	Pickup - 0.03 Hz
Time Delay:	0.0 to 6000.0 in steps of 0.1 s
Level Accuracy:	± 0.02 Hz
Timing Accuracy:	at 60 Hz: ± 34 ms at 50 Hz: ± 40 ms

FAULT LOCATOR

Range:	–327.68 to 327.66 km/miles 0 to 65534 Ohms
Memory:	stores the 10 most recent faults

DEMAND

(accuracies based on less than 2 x CT and 50 to 130 V inputs)

Measured Values:	Phase A/B/C Current (A) 3Φ Real Power (MW) 3Φ Reactive Power (Mvar) 3Φ Apparent Power (MVA)
Measurement Type:	Thermal Exponential, 90% response time (programmed): 5, 10, 15, 20, 30, or 60 min. Block Interval / Rolling Demand, time interval (programmed): 5, 10, 15, 20, 30, or 60 min. Block Interval with Start Demand Interval Logic Input pulses
A Pickup Level:	10 to 10000 in steps of 1
MW Pickup Level:	0.1 to 3000.0 in steps of 0.1
Mvar Pickup Level:	0.1 to 3000.0 in steps of 0.1
MVA Pickup Level:	0.1 to 3000.0 in steps of 0.1
Level Accuracy:	± 2%

VT FAILURE

Programmable to inhibit dependent features.

BREAKER FAILURE TO OPERATE

Time Delay:	30 to 1000 ms in steps of 10
Timing Accuracy:	0 to +20 ms error

ACCUMULATED ARCING CURRENT

Pickup Level:	1 to 50 000 kA^2-seconds in steps of 1
Start Delay:	0 to 100 ms in steps of 1

TRIP / CLOSE COIL MONITORS

Detect open trip and close circuits.

PULSE OUTPUT

Pulse output is 1 second on time and one second off time after the programmed interval.

SYNCHROCHECK

Voltage Difference: 0.01 to 100.00 kV in steps of 0.01

Phase Difference: 0 to 100° in steps of 2°

Frequency Difference: 0.00 to 5.00 Hz in steps of 0.02

Bypass Permissives: DB & DL (Dead Bus and Dead Line)
LL & DB (Live Line and Dead Bus)
DL & LB (Dead Line and Live Bus)
DL | DB (Dead Line or Dead Bus)
DL X DB (Dead Line or Dead Bus, but not both)

FOUR SETPOINT GROUPS

Can be changed from logic input or communications

Include protection features: Time O/C Curves, Phase O/C, Neutral O/C, Ground O/C, Negative Sequence O/C & Voltage, Phase Directional Control, Ground Directional Control, Over & Undervoltage, Underfrequency and Breaker Failure

UNDERVOLTAGE RESTORATION

Initiated By: Trip from Undervoltage 1, 2, 3 or 4

Minimum Voltage Level: 0.00 to 1.25 x VT in steps of 0.01

Time Delay: 0.1 to 100.0 in steps of 0.1 s

Incomplete Sequence Time: 1 to 10000 in steps of 1 min.

Phases: Any One/Any Two/All Three (programmable) phases have to operate for output

Level Accuracy: Per voltage input

Timing Accuracy: ± 100 ms

UNDERFREQUENCY RESTORATION

Initiated By: Trip from Underfrequency 1 or 2

Minimum Voltage Level: 0.00 to 1.25 x VT in steps of 0.01

Minimum Frequency Level: 20.00 to 60.00 in steps of 0.01 Hz.

Time Delay: 0.1 to 100.0 in steps of 0.1 s

Incomplete Sequence Time: 1 to 10000 in steps of 1 min.

Level Accuracy: Per voltage and frequency input

Timing Accuracy: ± 100 ms

MANUAL CLOSE FEATURE BLOCKING

Set to operate by a manual close command.

Programmable to block instantaneous overcurrent elements for a selectable period.

Programmable to raise pickup of time overcurrent elements for a selectable period.

COLD LOAD PICKUP FEATURE BLOCKING

Set to operate automatically or by a logic input command.

Programmable to block instantaneous overcurrent elements for a selectable period.

Programmable to raise pickup of time overcurrent elements for a selectable period.

TRANSFER SCHEME

Used for double-bus system with two normally-closed incoming and one normally-open bus tie circuit breaker.

Provides automatic closing of the bus tie breaker after a loss of one source, with bus decayed voltage permissive.

Provides trip of a pre-selected breaker after the third breaker is manually closed (prevent-parallel operation).

AUTORECLOSE (760 ONLY)

Up to four reclose attempts before lockout.

Each reclose shot can block instantaneous overcurrent, and raise pickup of time overcurrent elements.

Current supervision can adjust the maximum number of shots to be attempted.

IRIG-B TIME SYNCHRONIZATION

Error: ± 1.0 millisecond

LAST TRIP DATA

Records cause of most recent trip, 4 RMS currents, and 3 RMS voltages with a 1 ms time stamp.

TRIP COUNTERS

Accumulates all ground, sensitive ground, neutral, negative sequence, and phase overcurrent trips.

EVENT RECORDER (128 EVENTS)

Records event cause, 3 phase current phasors, 1 ground current phasor, sensitive ground current phasors, 3 voltage phasors, system frequency, synchronizing voltage, synchronizing frequency, and analog input level with a 1 ms time stamp.

WAVEFORM CAPTURE

Data Channels:	4 currents, 3 voltages, 14 logic input states and 8 output relays
Sample Rate:	16 per cycle
Trigger Source:	Element pickup/trip/dropout, control/alarm event, logic input or manual command
Trigger Position:	0 to 100%
Storage capacity:	2 to 16 events with 2048 to 256 samples of data respectively

DATA LOGGER

Data Channels:	8 channels; same parameters as for analog outputs available
Sample Rate:	Per Cycle / Per second / Per Minute / Every 5,10,15, 20, 30, or 60 min.
Trigger Source:	Pickup/trip/dropout, control/alarm event, logic input, manual command, or continuous
Trigger Position:	0 to 100%
Storage capacity:	2 to 16 events with 2048 to 256 samples of data respectively (4096 if continuous)

SIMULATION

Programmable prefault, fault, and postfault parameters. Simulation of circuit breaker and selection of whether or not to operate outputs relays.

1.2.8 OUTPUTS

ANALOG OUTPUTS

Type: Active

Outputs: 8 Channels; specify one of the following output ranges when ordering:

Output Range	Maximum Load
0-1 mA:	12 kΩ
0-5 mA:	2.4 kΩ
0-10 mA:	1.2 kΩ
4-20 mA:	600 Ω

Isolation: Fully isolated

Accuracy: ± 1% of full scale

Response Time: 100% indication in less than 6 power system cycles (100 ms @ 60 Hz)

SOLID STATE TRIP

Make and Carry 15 A @ 250 V DC for 500 ms

OUTPUT RELAYS

Configuration: 1 TRIP: Form A
2 CLOSE: Form A
3-7 AUXILIARY: Form C
8 SELF-TEST WARNING: Form C

Contact Material: silver alloy

Contact Ratings:

1 TRIP / 2 CLOSE:

- Make: 30 A (per ANSI/IEEE C37.90)
- Carry: 20 A continuous
- Break: DC 300 W resistive
  DC 150 W inductive (L/R = 40 ms)
  AC 5000 VA resistive
  AC 5000 VA inductive (PF = 0.4)

3-7 AUXILIARY / 8 SELF-TEST WARNING

- Make: 30 A (per ANSI/IEEE C37.90)
- Carry: 10 A continuous for 15 sec.
  5 A continuous
- Break: DC 150 W resistive
  DC 90 W inductive (L/R = 40 ms)
  AC 1250 VA resistive
  AC 500 VA inductive (PF = 0.4)

Contact Durability: 100 000 operations (at 1800 operations/hour) at Rated Load

1.2.9 COMMUNICATIONS

ALL PORTS

300-19200 baud, programmable parity, Modbus RTU or DNP 3.0 protocol

1.2.10 CLOCK

Resolution: 1 ms

Accuracy with IRIG-B: ± 1 ms

Accuracy without IRIG-B: ± 1 minute/month

Backup Battery Life: 10 years continuous use

1.2.11 PHYSICAL SPECIFICATIONS

ENVIRONMENT

Operating Temperature Range: –40 °C to +60 °C

Ambient Storage Temperature: –40 °C to +80 °C

Ambient Shipping Temperature: -40 °C to +80 °C

Humidity: up to 90% noncondensing

Pollution Degree: 2

IP Rating: 40-X

CASE

Fully drawout unit (automatic CT shorts)

Meets CE drawout specifications

Seal provision

Dust tight door

Panel or 19" rack mount

Weight (Case and Relay): 7.9 kg

Shipping Weight: 9.4 kg