BE1-951 MULTIFUNCTION PROTECTION SYSTEM

DEVICE FUNCTIONS

24	25 Option	27	32
47	50	51	59
60	62	67	BF
79	81	DNP Option	Modbus RTU Option
		Ethernet Option	Modbus TCP Option

The BE1-951 is a multifunction numeric relay that provides three phase, ground, and negative sequence, directional or non-directional overcurrent protection with four shot recloser, forward or reverse power protection, breaker failure, over/underfrequency, over/undervoltage and overexcitation protection, sync check, breaker monitoring and control, sequence-of-events recording, fault reporting, and metering functions, all in an integrated system.

ADVANTAGES

- Each overcurrent element can be individually set for forward or reverse directional or non-directional control for maximum flexibility in any application.
- Includes a sensitive forward or reverse power element for dispersed storage and generation (DSG), dual bus sources with tie capability, or any application requiring reverse power protection.
- Includes distance to the fault to aid in timely fault location and service restoration.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make these relays completely self documenting.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Optional BESTNet Ethernet package provides metering and status web pages, settings and configuration via Ethernet and email notification of user-defined events. Modbus™/TCP also available.
- Provides optional separate ground current input for those applications where this is required.
- Includes frequency tracking and voltage restrained overcurrent for backup and cogeneration applications.
- Includes Real Time Clock with 8 hour capacitor ride through and optional battery backup.
- Available in fully drawout half rack case. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- Available in fully drawout S1 and S1 double-ended cases with test paddles for retrofit applications. The S1 case, with available adapter plates, fits cutout, drilling and behind panel projection dimensions for common Basler Electric, GE and Westinghouse unit case relays.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products

Request BESTCOMS for BE1-951 (includes "settings compare" feature)

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9328900990

MODBUS™ INSTRUCTION MANUAL

Request publication 9328900991

DNP 3.0 INSTRUCTION MANUAL

Request publication 9328900992

Basler Electric

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UHR-12
8-08

FEATURES

PROTECTION

- Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ
- Phase, Neutral, and Negative Sequence Time Overcurrent elements: 51P, 51N, 151N, 51Q (51P elements can have voltage restraint)
- Each overcurrent element can be set for forward, reverse, or nondirectional control (67P, 67N, 67Q). Directional control is by Positive (671), Negative (672), Zero Sequence Voltage (670V) and Zero Sequence Current (670I) polarized directional units.
- All U.S. and IEC timing curves plus user programmable curve
- Minimizes transient overreach and overtravel on overcurrent elements
- Optional separate ground current input provides zero sequence current polarization and/or ground overcurrent protection for a separate ground CT.
- Phase Undervoltage and Overvoltage elements: 27P, 59P. Elements use a 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 59X, 159X. Elements monitor either fundamental or third harmonic on the optional auxiliary 4th VT input, or fundamental phase residual, 3V0, of the phase inputs.
- Overexcitation, volts per Hertz element: 24
- Forward or Reverse Power: 32
- Negative Sequence Overvoltage element: 47
- Over/Under Frequency elements: 81, 181, 281, 381, 481, 581
- Each 81 element can be assigned to monitor 3 phase VT input (VP) or Auxiliary voltage input (Vx).
- Breaker Failure protection function: BF
- Two general purpose logic timers: 62, 162
- Programmable Logic using BESTlogic
- Four protection setting groups with external or automatic (cold load pickup, load, unbalance, recloser shot) selection modes
- Sync check with dead line/dead bus voltage monitor logic, 25, 25VM (Requires optional 4th VT sensing circuit)
- Fuse loss detection protects against false trip due to loss of voltage sensing: 60FL

CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions
- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Four virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343
- Virtual lockout latches: 86, 186. Status is stored in EEPROM.
- Communication port control of 101 and #43 switches allows for SCADA control of relay and breaker

INSTRUMENTATION

- Real time A, B, C phase current, voltage, and frequency and derived neutral and negative sequence current and voltage
- Real Time per phase and 3 phase Watts, Vars, and 3 phase Power Factor
- Enhanced Daylight Savings Time (DST) definitions.

REPORTS

- Current demands for phase, neutral, and negative sequence currents, and forward and reverse watts and vars—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset
- Optional 4000 point log of demand readings
- kWh and kvarh, forward and reverse
- Breaker operations counter and contact interruption duty

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report
- 16 fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- Total number of oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 12 samples/cycle
- COMTRADE format
- Load compensated distance to fault

COMMUNICATION PORTS

- Two independent general purpose communication ports
  - Front RS-232 ASCII communications
  - Rear RS-485 ASCII, Modbus™ and DNP® 3.0 protocols
- Optional rear RS-232 ASCII communications
- IRIG-B time sync (unmodulated)
- Optional 10 BaseT Ethernet port with BESTNet Easy Ethernet or with Modbus/TCP protocol

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact (closed or open) See style chart, page 12, for ordering information
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority
  Including:
  - Phase current, and forward and reverse watt and var demand alarm
  - Neutral and negative sequence unbalance demand alarms
  - Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter
  - Trip circuit voltage and continuity monitor
  - Close circuit monitor via BESTlogic

PROGRAMMABLE I/O

- Four programmable inputs
- Five programmable outputs and one dedicated programmable alarm output

FEATURES, continued

HARDWARE FEATURES

- Three case configurations
  - S1: Basler/GE style (with test plug)
  - S1: Double ended, Basler/GE style (with test plugs)
  - H1: Half Rack
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Real Time Clock with 8 hour capacitor ride through and optional battery backup
- Integral HMI with 2x16 character display
- Wide range ac/dc power supply options provide long holdup time to ride through dips on ac power source. (100 ms with 4 output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/dc) and 250Vac for Option 2 (125/250Vac/dc)).

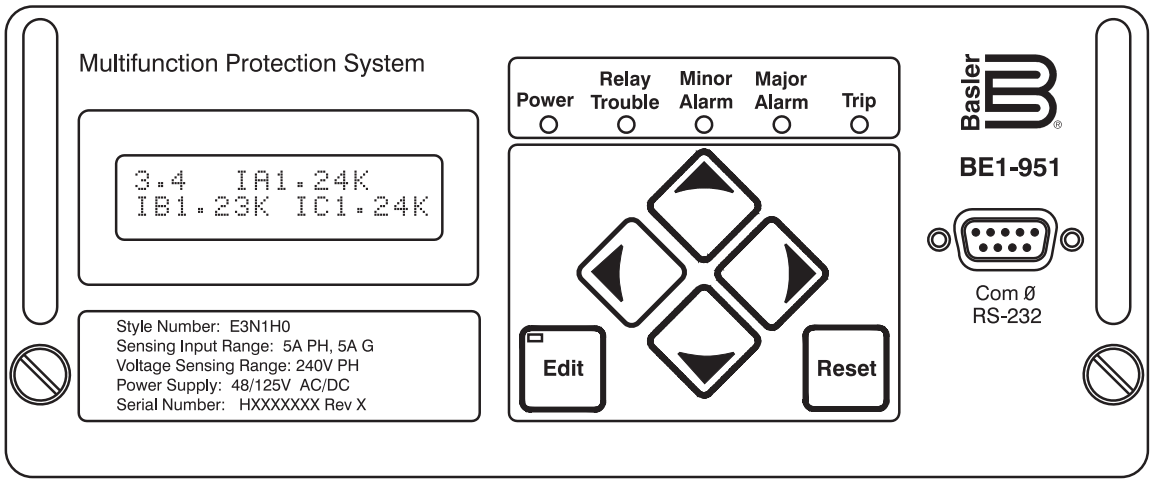


Figure 1 - Advanced HMI (Human Machine Interface)

APPLICATIONS

The BE1-951 Multifunction Protection System provides three phase, ground, and negative sequence overcurrent, voltage and frequency protection and is intended for use in any directional or non-directional overcurrent protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require low burden to extend the linear range of CTs.
- Applications that require high accuracy across a wide frequency range such as for motor, generator, and generator step-up transformer protection or in cogeneration facilities.
- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required on a typical circuit.
- Applications that require directional control and fault locating.
- Applications requiring protection of the intertie between dispersed storage and generation facilities (DSG) and a utility.
- Transformer backup applications where overexcitation protection is required.
- Applications that require communications and protocol support.
- Applications where the capabilities of a multifunction relay are required, yet drawout construction also is desired.
- Applications where bus protection is provided by a high speed overcurrent blocking scheme on the transformer bus mains instead of a dedicated bus differential circuit.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection and control systems in existing substations.
- Applications using Ethernet communication, programmable email notifications, and live metering information via an embedded web server (with BESTNet option).
- Applications requiring Modbus/TCP Ethernet communications (with Modbus/TCP option).

FUNCTIONAL DESCRIPTION

The BE1-951 is a multifunction, numeric relay that provides a comprehensive mix of protective functions to detect faults and abnormal operating conditions in substations and on feeders, along with control and metering functions in an integrated system. Additional features included in this relay such as voltage restrained overcurrent (51V), overexcitation (24), forward/reverse power (32), synch check (25), over and undervoltage (27/59) and over and underfrequency (81O/U) make this system suitable for any directional or non-directional overcurrent and over/underpower applications including feeder, transformer, generator, intertie, bus, and load shedding applications. Twelve sample per cycle digital signal processing with frequency compensation extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common protective functions for substation and feeder applications. The voltage sensing circuits automatically configure themselves internally for 1 phase, 3 phase 3 wire, or 3 phase 4 wire VT circuits.

The BE1-951 also can be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT, or to provide ground backup protection for the neutral or tertiary of a transformer.

An optional fourth Auxiliary Voltage input is also available. This voltage input can be connected to line side potential for sync check (25) and dead line (25VM) closing supervision or to a ground sensing VT connection for ground fault protection on the delta side of a cogeneration intertie transformer.

For directional applications, all overcurrent elements can be independently set for forward, reverse, or non-directional control. The target reporting function in the BE1-951 automatically adapts the targets as appropriate. For example, if the 150TP and the 51P functions are set for directional control, they post targets for an A phase fault as “167A” for directional instantaneous trip or "67TA" for directional time trip respectively. Directional control is by sequence directional elements. The zero sequence current polarized element uses the optional independent ground input for its polarization signal. The zero sequence voltage polarized element requires that the VT connection be 4W. The positive sequence directional element has memory voltage to provide reliable directional control for close in balanced three phase faults.

Three independent communications ports provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. COM1 is front RS-232 ASCII; COM2 is RS-485 with Modbus™ or DNP; COM3 is RS-232 or ethernet with BESTNet or Modbus™/TCP. The standard IRIG-B port can provide time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-951 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 8A and 8B show each of the independent function blocks available for use in the BE1-951. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-951 relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 2A, 2B, 2C and 3 show typical external connections, and Figures 5, 6, and 7 show rear panel connections.

FUNCTIONAL DESCRIPTION, continued

Instead of the BESTNet option, the BE1-951 can be ordered with the Modbus/TCP option. With Modbus/TCP, your BE1-951 relay offers a true Modbus/TCP protocol connection via an internal 10 BaseT port. No clumsy external adaptors are required! Simply plug in an Ethernet cable and your BE1-951 is part of your Modbus network.

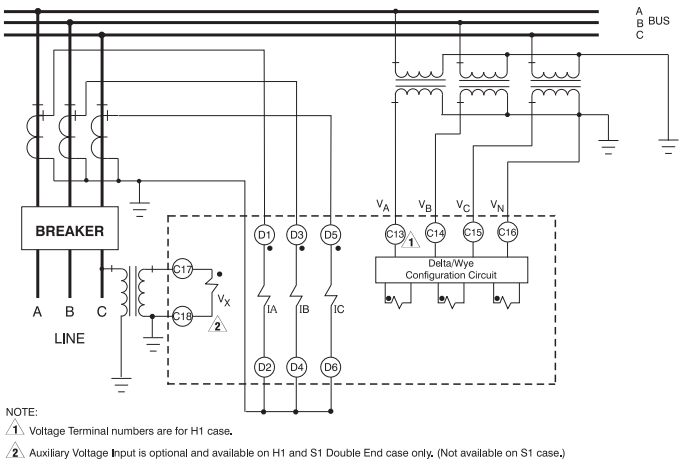


Figure 2A - Typical External Sensing Connections - Feeder Breaker Application

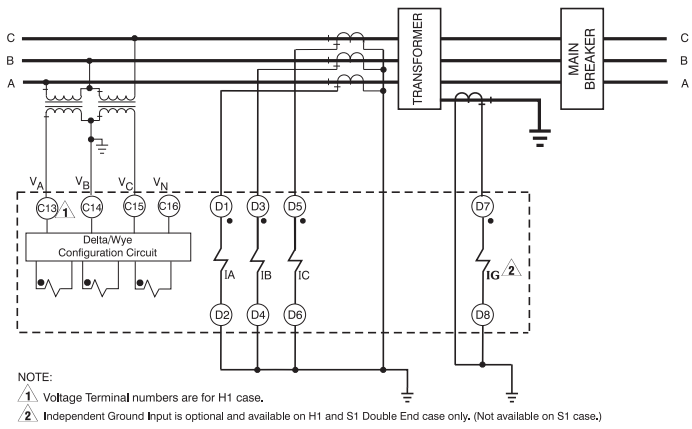


Figure 2B - Typical External Sensing Connections - Transformer Backup Application

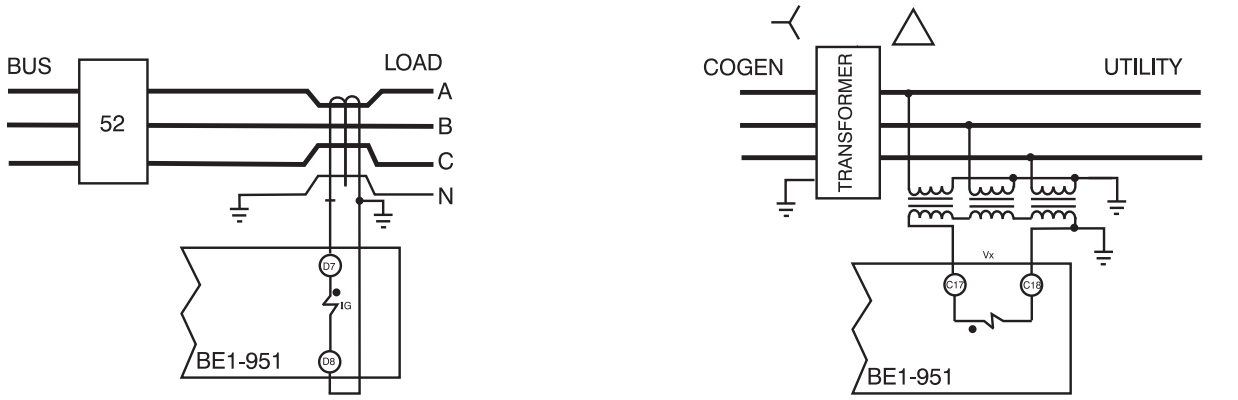
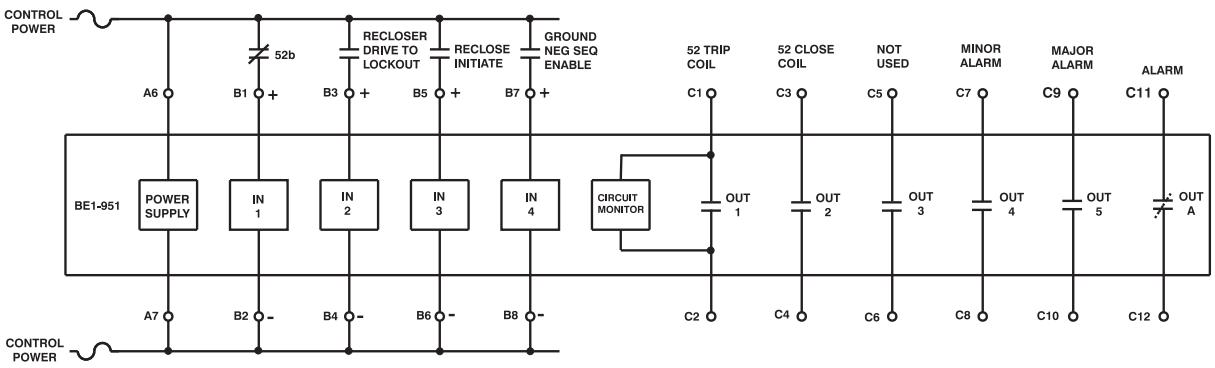


Figure 2C - Typical Alternate Connections for V_x and I_G

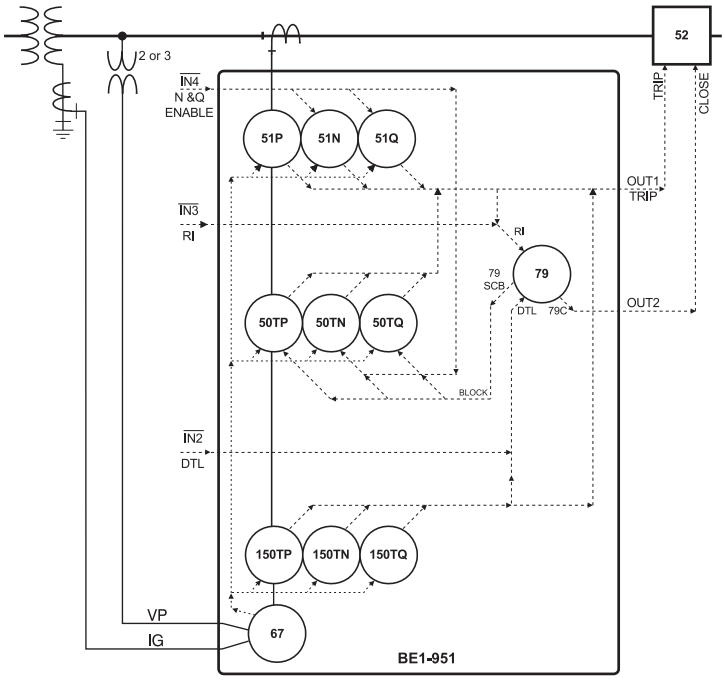


NOTES:

1.) CONNECTIONS SHOWN ARE FOR USE WITH PRE-PROGRAMMED LOGIC SCHEME OC-W-79. OC-W-79 PROVIDES OVERCURRENT PROTECTION WITH RECLOSING CAPABILITIES. ALL INPUTS AND OUTPUTS ARE FULLY PROGRAMMABLE USING BESTlogic.

Figure 3 - Typical External Connections

FUNCTIONAL DESCRIPTION, continued



Based upon pre-programmed logic OC-W-79.
Not all available protection and control functions are shown.

Figure 4 - Typical Application Single Line

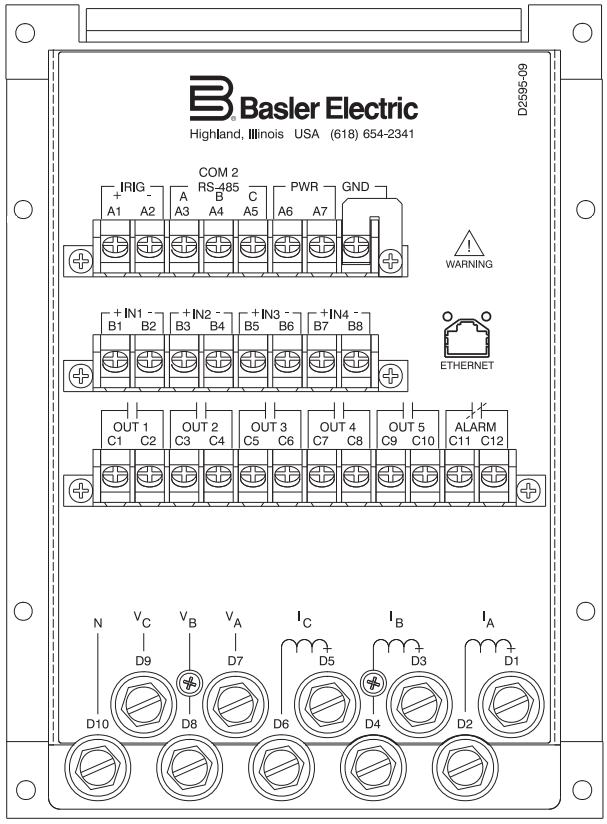


Figure 5 - BE1-951 S1 Rear Panel Connections (shown with Ethernet port)

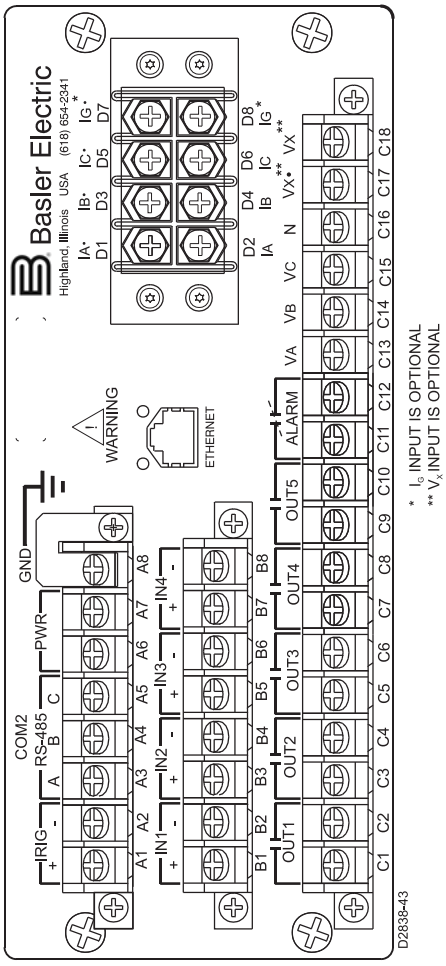


Figure 6 - BE1-951 H1 Rear Panel Connections (shown with Ethernet port)

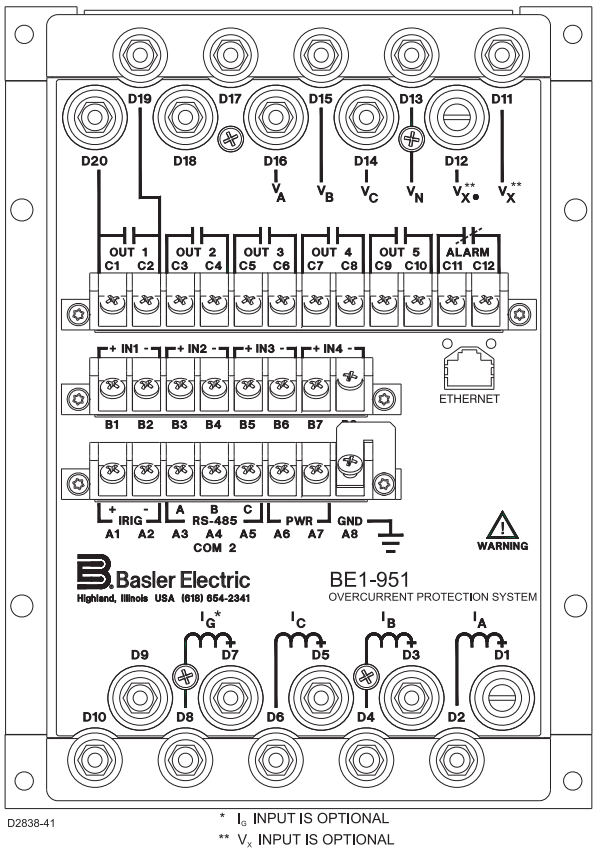


Figure 7 - BE1-951 S1 Double-Ended Rear Panel Connections (shown with Ethernet port)

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10milliohms

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	250A
Saturation limit:	30A
Burden:	<22milliohms

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	12/cycle, adjusted to input frequency 10-75Hz

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V (down to 8V for momentary dips)
Burden:	6 watts continuous, 8 watts maximum with all outputs energized

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range:

Power Supply Option	Low Range		High Range	
	Turn-on Voltage Range	Burden	Turn-on Voltage Range	Burden
1) 48/125Vac/Vdc	26-38V	123.76k ohms	69-100V	66.49k ohms
2) 125/250Vac/Vdc	69-100V	53.65k ohms	138-200V	21.15k ohms
3) 24Vdc	5-8Vdc	6.15k ohms	N/A	N/A

Control inputs recognize both DC and AC voltages.

COMMUNICATION PORTS

Response time:	<100mSec for metering and control functions
Baud rate:	300 - 19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electromagnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
  *LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
Gost R Certified, #POCC US.ME05.B03391
DNP 3.0 IED Certified, Subset Level 2, 6/20/00, by SUBNET Solutions, Inc.

CASE SIZE

H1: 10.50"W x 3.47"H x 9.10"D with mounting flanges (8.5"W without mounting flanges)
S1: 6.65"W x 9.32"H x 9.51"D (includes relay cover)
S1 Double-ended: 6.65"W x 9.32"H x 9.51"D (includes relay cover)

SHIPPING WEIGHT

H1: Approx. 10 pounds (4.54 kg)
S1: Approx. 11.2 pounds (5.08 kg)
S1 double-ended: 12.8 pounds (5.81 kg)

WARRANTY

7 years

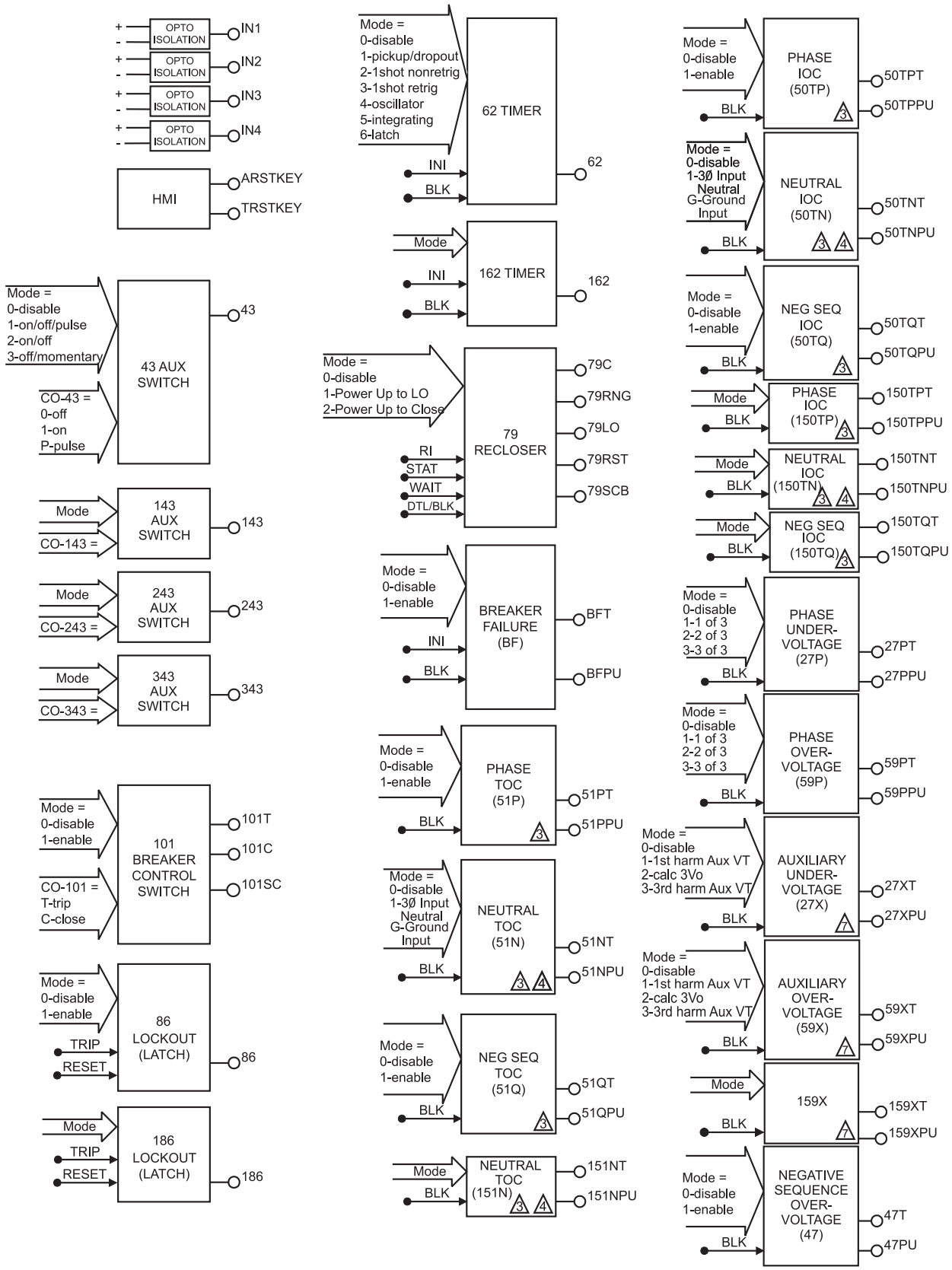
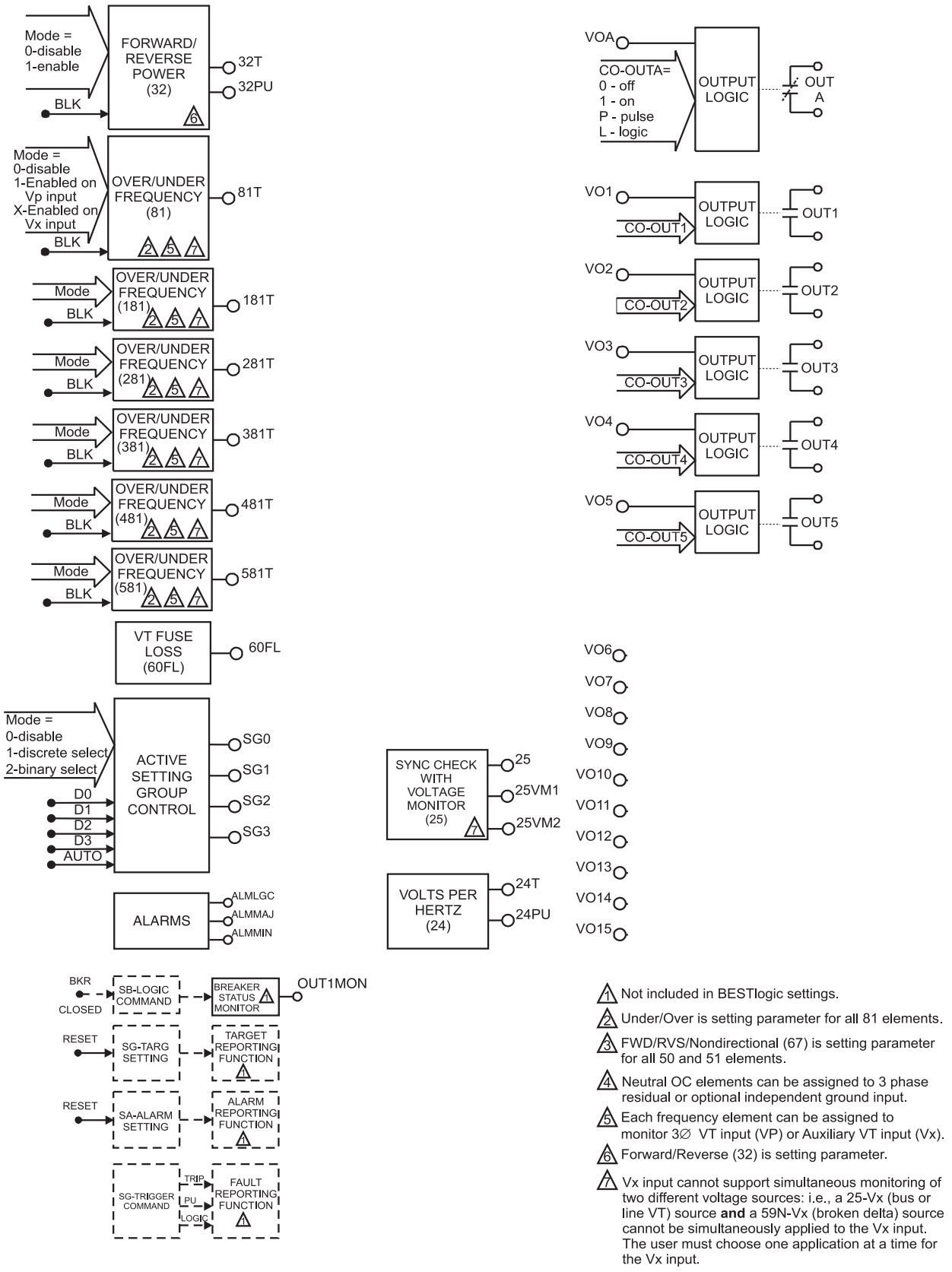


Figure 8A - BESTlogic Function Blocks



1. Not included in BESTlogic settings.
2. Under/Over is setting parameter for all 81 elements.
3. FWD/RVS/Nondirectional (67) is setting parameter for all 50 and 51 elements.
4. Neutral OC elements can be assigned to 3 phase residual or optional independent ground input.
5. Each frequency element can be assigned to monitor 3∅ VT input (VP) or Auxiliary VT input (Vx).
6. Forward/Reverse (32) is setting parameter.
7. Vx input cannot support simultaneous monitoring of two different voltage sources: i.e., a 25-Vx (bus or line VT) source **and** a 59N-Vx (broken delta) source cannot be simultaneously applied to the Vx input. The user must choose one application at a time for the Vx input.

Figure 8B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ)

Pickup: 5A CT 0.5 - 150.0A
1A CT 0.1 - 30.0A
PU time with TD=0.000 Sec
2 cyc for P, N &G @ 5 x PU
3 cyc for Q @ 5 x PU
Delay time: 0.000 - 60 sec
Time Accuracy: ±0.5% or ±½ cyc for P and N
±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 51N, 151N, 51Q)

Pickup: 5A CT 0.5 - 16.0A
1A CT 0.1 - 3.20A
Time dial: TD=K=0 - 99 for 46 curve
TD=0.0 - 9.9 for all other curves
Time-Current Characteristics:
The following expression describes the inverse time current characteristic for each curve:

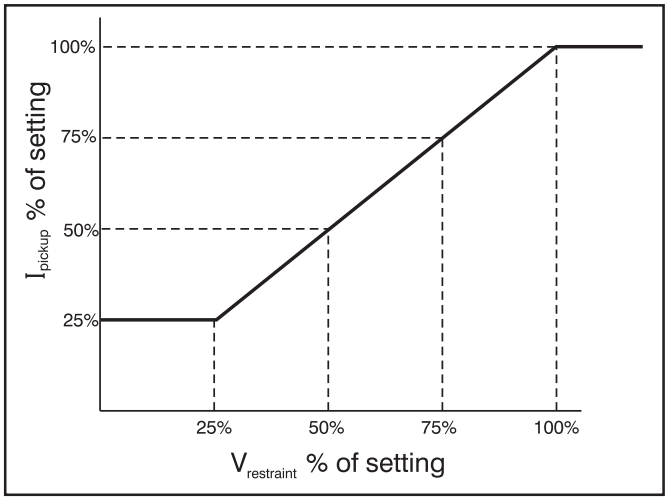
$$T_T = \frac{AD}{M^N - C} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2 - 1} = \text{Time for decaying reset}$$

where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.
Control/Restraint Range: 30 - 250V
Restrained Mode Characteristic: (see below)



Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.0000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
L1, L2 = CO Long Inv, IAC Long Inv
D = CO Definite Time
M = CO Moderately Inverse
I1, I2 = CO Inverse, IAC Inverse
V1, V2 = CO Very Inv, IAC Very Inv
E1, E2 = CO Ext Inverse, IAC Ext. Inverse
A = IEC Standard Inverse
B = IEC Very Inverse
C = IEC Extremely Inverse
G = IEC Long Time Inverse
F = Fixed Time
46 = Negative Sequence Overcurrent
P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on system full load current setting, minimum pickup, and K factor settings.

DIRECTIONAL CONTROL (ALL OVERCURRENT)

Mode: Forward, Reverse, Nondirectional
67P Polarization: Positive Sequence w/Memory
Negative Sequence
67Q Polarization: Negative Sequence
67N Polarization: Selectable any combination
Zero Sequence Voltage (Requires 4W VT)
Zero Sequence Current (Requires IG)
Negative Sequence

BREAKER FAILURE (BF)

Time: 50 - 999mSec
Dropout: 5A CT 0.5A
1A CT 0.1A
Time Accuracy: ±0.5% or +1¼ cyc / - ½ cyc

VOLTS/HZ (24)

Pickup: 0.5 - 6V/Hz
Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2}$$

T_T = Time to Trip
D_T = Time Dial, Trip
M = Pickup V/Hz

$$T_R = D_R \times \frac{ET}{FST} \times 100$$

T_R = Time to Reset
D_R = Time Dial, Reset
ET = Elapsed Time
FST = Full Scale Trip Time (T_T)

PERFORMANCE SPECIFICATIONS, continued

SYNC CHECK (25)

Delta Phase Angle:	1 - 99 degrees
Delta Voltage Magnitude:	1 - 20V
Delta Frequency:	0.01 - 0.50Hz

SYNC CHECK, VOLTAGE MONITOR (25VM)

Dead Threshold:	10 - 150V
Live Threshold:	10 - 150V
Dropout Time Delay:	0.050 - 60.0sec
Logic:	Dead Phase/Dead Aux. Dead Phase/Live Aux. Live Phase/Dead Aux.
Two Independent outputs:	25VM1 and 25VM2

PHASE OVER/UNDERVOLTAGE (27P, 59P)

Mode:	1 of 3; 2 of 3; 3 of 3
Pickup:	10.0-300V_{L-L} or 10.0-300V_{L-N}
Delay Time:	0.050 - 600sec.

NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup:	1.0 - 300V_{L-N}
Delay Time:	0.050 - 600sec.

AUXILIARY / 3V0 OVER/UNDERVOLTAGE (27X, 59X, 159X)

Mode:	Fundamental V_X , 3 phase Residual (3V0), 3rd Harmonic V_X
Pickup:	1.0 - 150V
Delay Time:	0.050 - 600 Sec.

POWER (32)

Mode:	Forward, Reverse
Pickup:	5A: 1.0 - 6000 Watts, 3 ph 1A: 1.0 - 1200 Watts, 3 ph
Pickup Accuracy:	±3%
Delay Time:	0.050 - 600 Sec.

FREQUENCY (81, 181, 281, 381, 481, 581)

Mode:	Over, Under
Pickup:	20.00 - 70.00 Hz
Delay Time:	0.000 - 600 Sec.
Time Accuracy:	±0.5% or +1 cyc / -0 cyc

(Min. trip time affected by min. 3 cyc security count)

GENERAL PURPOSE LOGIC TIMERS (62, 162)

Mode:	PU/DO 1 Shot, Non-Retrig. 1 Shot, Retrig. Integrating Latch
T1 and T2 Delay Time:	0.000 - 9999 Sec.
Time Accuracy:	±0.5% or ±¾ cyc

RECLOSER (79)

Mode:	Power up to close, Power up to lockout
Reclose Shots:	0 - 4
Reclose, Reset, Fail, Max. Cycle Timers:	0.100 - 600 Sec.
Time Accuracy:	±0.5% or +1¾ cyc/-0 cyc

CURRENT PICKUP ACCURACY (All 50 and 51)

Phase and Ground:	5A	2% or 50mA
	1A	2% or 10mA
Neutral and Negative Sequence:	5A	3% or 75mA
	1A	3% or 75mA

VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

Phase (V_{L-L} or V_{L-N}):	±2% or ±0.5V
Phase 3V0 and V2:	±2% or ±0.5V

DEFINITE TIME ACCURACY UNLESS OTHERWISE STATED (All 27, 47 and 59)

Definite Time Accuracy:	±0.5% or ±1 cyc

SETTING GROUPS

Setting Groups:	4
Control Modes:	Automatic: CLP; Recloser shot; Dynamic load or unbalance External: Discrete input logic; Binary: Input Logic

METERING

Current Range:	5A	0.5 to 15.0
	1A	0.1 to 3.0
Current Accuracy:	±1%	
Phase Voltage Range:	3W	0 - 300 V_{L-L}
	4W	0 - 300 V_{L-L}
Phase Voltage Accuracy:	±0.5% for 50V<V_{L-L}<300V	
Watt/VAR:	5A	0 to ±7500
	1A	0 to ±1500
Watt Accuracy:	1% @ Unity PF	
VAR Accuracy:	1% @ Zero PF	
Energy:	0 to ±1.0E12 (F/R registers)	
Frequency:	10 - 75Hz	
Frequency Accuracy:	0.01Hz	

DEMANDS (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval:	1 - 60 min.
Demand Mode:	Thermal

BREAKER MONITORING

Duty Mode:	I or I^2
Duty Alarm Range:	0 - to 100%
Op Counter Alarm Range:	0 - 99999
Trip Time Alarm Range:	20 - 1000mSec

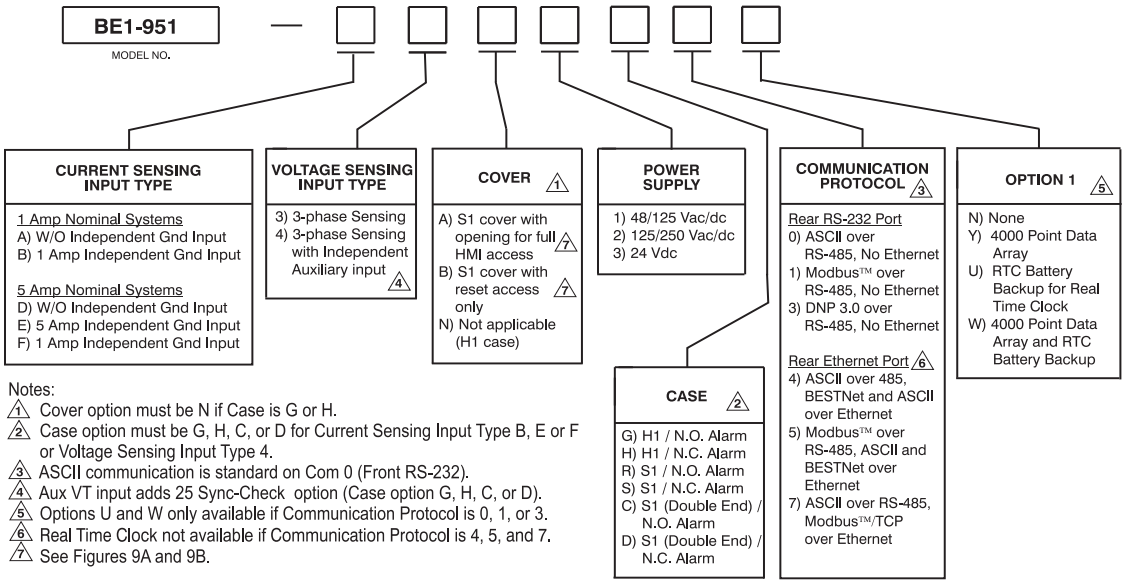
ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-951 relays. For example, if the style number were BE1-951 **E3N1H0Y**, the device would have the following:

BE1-951

- **(E)** - 5 Amp nominal system with 5 Amp Independent Ground Input
- **(3)** - Three phase voltage sensing
- **(N)** - Not applicable
- **(1)** - 48/125 Vac/Vdc power supply
- **(H)** - Half Rack Case, Normally Closed alarm output
- **(0)** - ASCII over RS-485, no Ethernet
- **(Y)** - 4000 point Data Array



Notes:
1. Cover option must be N if Case is G or H.
2. Case option must be G, H, C, or D for Current Sensing Input Type B, E or F or Voltage Sensing Input Type 4.
3. ASCII communication is standard on Com 0 (Front RS-232).
4. Aux VT input adds 25 Sync-Check option (Case option G, H, C, or D).
5. Options U and W only available if Communication Protocol is 0, 1, or 3.
6. Real Time Clock not available if Communication Protocol is 4, 5, and 7.
7. See Figures 9A and 9B.

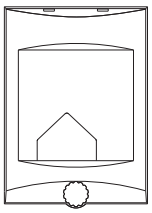


Figure 9A Cover option A.

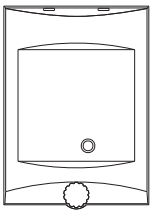
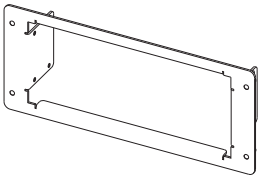


Figure 9B Cover option B.

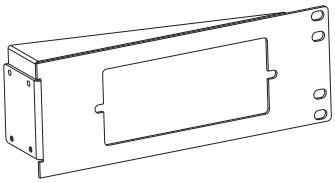
STANDARD ACCESSORIES

9334818100 Battery Backup Replacement Kit (if "U" or "W" is chosen for Option 1)
9108551021 Adapter plate to mount an S1 case in a GE S2 or Westinghouse FT-21 cutout.
9108551022 Adapter plate to mount an S1 case in a Westinghouse FT-32 cutout.

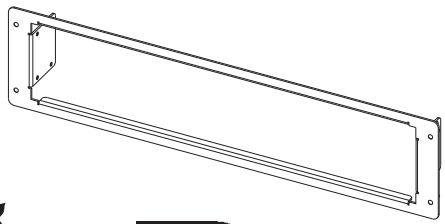
9289900017
Escutcheon plate to panel mount one H1 relay.



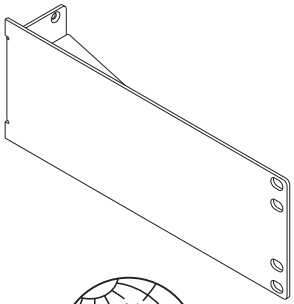
9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.



9289924100
Adapter bracket to mount single H1 case in 19" rack.



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