# BE1-11*i* INTERTIE PROTECTION SYSTEM

## DEVICE FUNCTIONS

| | | | |
|---|---|---|---|
| 24 | 25 | 27 | 32 |
| 43 | 46 | 47 | 50 |
| 51 | 59 | 60 | 62 |
| 67 | 79 | 81 | 101 |
| BF | Ethernet Option | Modbus Option | DNP 3 Option |

The BE1-11*i* Intertie Protection System is a multifunction numeric relay providing the protection and control requirements outlined in IEEE 1547-2003 Intertie Protection Standard for a majority of applications. The BE1-11*i* provides phase, ground, negative sequence, directional or non-directional time delays and instantaneous overcurrent, forward or reverse over and underpower, over and undervoltage, over, under and rate of change frequency, and overexcitation protection. These protective functions may be single or three phase. Sync check with conditional voltage supervision of reclosing is included. Breaker failure, trip circuit and contact monitoring, sequence-of-events and fault recording, metering functions, and distance to fault calculations are included in the integrated BE1-11*i* Intertie Protection System.

## ADVANTAGES

- All overcurrent elements may be individually set for forward, reverse, or nondirectional control for maximum flexibility in any application.
- Four "Tabular Definition" time curves create custom curve shapes for specific protection applications.
- Two sensitive over or underpower elements provide directional interconnection power flow and islanding detection.
- Five phase voltage elements available to provide over and undervoltage limits and islanding detection.
- Four single phase voltage elements available and may be used to provide $V_0$ measurement.
- Eight frequency elements provide over, under, and rate of change of frequency measurement for load shedding and islanding detection.
- Large high-contrast programmable 128x64 LCD display allows the relay to replace local indication, such as metering and alarm annunciation.
- Copper and fiber Ethernet communications are available for Modbus™ and DNP3.0 protocols.
- High-speed BESTCOMS*Plus* user interface via USB.
- Web page and user-selectable email triggers for remote alarm reporting.
- Power Quality reporting.
- Non-volatile event memory.

## WINDOWS® SOFTWARE
Interface for setting and communicating with Basler protection products
Request BESTCOMSPlus for BE1-11

| |
|---|
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| **APPLICATIONS** Page 3 |
| **FUNCTIONAL DESCRIPTION** Page 4 - 6 |
| **SPECIFICATIONS** Pages 7 - 9 |
| **ORDERING INFORMATION** Page 12 |

## ADDITIONAL INFORMATION

**INSTRUCTION MANUAL**
Request publication 9424200993

**MODBUS™ INSTRUCTION MANUAL**
Request publication 9424200991

**DNP 3.0 INSTRUCTION MANUAL**
Request publication 9424200992

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**Basler Electric**

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# FEATURES

## PROTECTION

- 6 each, Instantaneous Overcurrent (50) elements provide selection of single or three phase, neutral, zero and negative seuqence current measurement. Directional and non-directional operation is a selection Settable definite time delay is available.
- 7 each, Time Overcurrent (51) elements provide selection of single or three phase, neutral, zero and negative sequence current measurement. Voltage control or restraint characteristics may be selected. The reset characteristic may be instantaneous or have an inverse reset characteristic.
- Each Time Overcurrent element may be directional (67/67N) (forward or reverse) or non-directional. Directional control may be selected as Positive ($I_1$), Negative ($I_2$) or Zero ($I_0$) sequence current or zero sequence voltage ($V_0$).
- 24 industry standard timing curves are available, as well as a user programmable curve, and up to 4 user-defined tabular curves for use by any of the Time Overcurrent elements.
- Minimal transient overreach and overtravel is incorporated into the design of the overcurrent elements.
- An independent ground current input provides zero sequence current polarization and/or ground overcurrent protection.
- Negative sequence overcurrent is a selectable mode of operation for the Time Overcurrent elements.
- 5 Phase Undervoltage (27) and 4 Phase Overvoltage elements are available for measurement of phase-to-phase or phase-to-neutral voltage. Sensed voltage may be single or three phase. Undervoltage elements include an undervoltage inhibit setting to prevent erroneous operation.
- 4 Undervoltage (27) and 4 Overvoltage (59) elements are available to measure single phase inputs ($V_x$) or calculated sequence voltages ($3V_0$, $V_2$(47)). These undervoltage elements include an undervoltage inhibit setting to prevent erroneous operation.
- All voltage elements have a choice of definite or inverse time characteristics.
- Overexcitation, volts-per-Hertz (24) element provides a selection for definite or inverse timing characteristics.
- Sync check (25) with line and bus voltage monitoring logic (25VM).
- 2 directional power elements measure single or three phase power, in the forward or reverse direction, and compare the measurement to an over or under power user setting.
- Fuse loss detection protects against false tripping due to the loss of a sensing voltage (60FL).
- 8 frequency elements may be set individually for over, under, or rate-of-change of frequency. The rate-of-change can be set for positive, negative, or either. Each element can be assigned to either the three phase or single phase ($V_x$) voltage input. Each element includes an undervoltage inhibit setting.
- Breaker Failure (BF) protection functionality.
- 8 general purpose logic timers (62) and additional logic elements provide added functionality in the user designed BESTLogic*Plus* schemes.
- 4 protection setting groups with external or automatic selection modes.

## CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions.
- Five virtual selector switches (43) are controllabe from both the HMI and communication ports.
- Virtual lockout (86) latches. Status is stored in EEPROM.
- Virtual breaker control switch (101) is controllable from both the HMI and communication ports.
- Communication port control in the virtual switches provides SCADA control of the protective system and circuit breaker.

## INSTRUMENTATION

- Real time phase (A, B, C) currents, voltages, and frequency, as well as the calculated neutral current, and negative and zero sequence current and voltage.
- Real Time per phase and 3 phase Watts, Vars, and Power Factor.
- Auxiliary input fundamental and third harmonic voltage.
- Phase angle.
- Demand currents, watts, and vars.

## REPORTS

- Current demands for phase, neutral, negative sequence current, and forward and reverse watts and vars. Magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since last reset.
- 4000 point log of demand readings.
- kWh and kVarh, forward and reverse.
- Breaker operations counter and contact interruption duty

## FAULT RECORDING

- 1028 event sequence-of events report with I/O and alarm sub-reports.
- Fault Reporting - 1 or 2 oscillographic records per fault record.
- 16 fault summary reports. All Fault Summary Records saved in non-volatile memory
- Oscillographic memory will store up to 240 cycles of data @ 32 samples/cycle
- Oscillographic records are in the COMTRADE format.
- Distance-to-fault is calculated using a load compensated algorithm.

## COMMUNICATIONS PORTS

- Three independent general purpose communication ports and available protocols:
  - Front USB-B: BESTCOMS*Plus*
  - Rear RS-485: Modbus™ or DNP® 3.0
  - Rear Ethernet: BESTNet*Plus*, BESTCOMS*Plus*, Modbus™ and DNP® 3.0 protocols
  - IRIG-B time sync (unmodulated)

## SELF TEST and ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact (open or closed) *See style chart, page 12, for ordering information.*
- Extensive internal diagnostics monitor all internal functions of the relay.

# FEATURES, continued

- More than 20 additional alarm points, user programmable for major or minor priority. Including:
  - Phase current, forward and reverse Watt and Var demand alarm
  - Neutral and negative sequence unbalance demand
  - 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*Plus*

### PROGRAMMABLE I/O
- Four programmable inputs
- Five programmable outputs and one dedicated programmable alarm output

### HARDWARE FEATURES
- Case configuration - H1: Half Rack
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming
- Real Time Clock with 8 hour capacitor ride through and battery backup
- Integral HMI with *128x64* 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)).
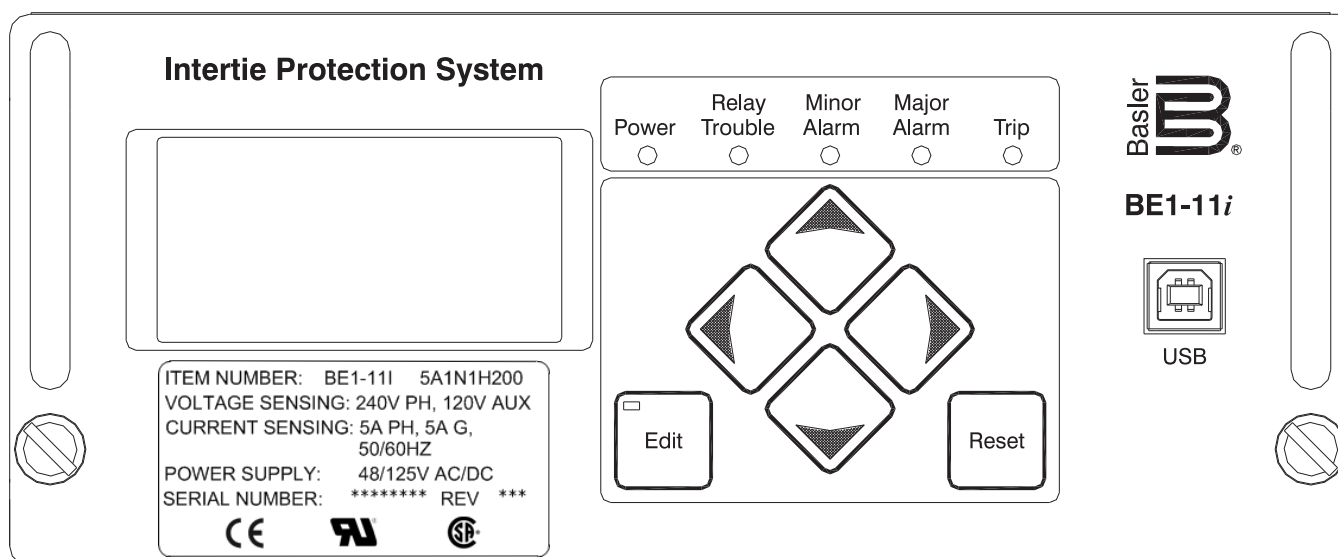
**Intertie Protection System**

Power | Relay Trouble | Minor Alarm | Major Alarm | Trip

Basler **B** ®

**BE1-11*i***

USB

ITEM NUMBER:   BE1-11I   5A1N1H200
VOLTAGE SENSING: 240V PH, 120V AUX
CURRENT SENSING: 5A PH, 5A G,
                50/60HZ
POWER SUPPLY:    48/125V AC/DC
SERIAL NUMBER:    ********  REV  ***

Edit          Reset

CE   UL   CSA

**Figure 1 - Advanced HMI (Human Machine Interface)**

# APPLICATIONS

The BE1-11*i* Intertie Protection System provides three phase, ground, and negative sequence overcurrent, voltage, frequency, and directional power functions for use in intertie applications as defined by IEEE 1547, or any directional or non-directional overcurrent application requiring frequency and overexcitation protection. The specialized capabilities of this protective system make it ideally suited for applications:

- Applications that require low burden to extend the linear range of CTs.
- 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 for typical applications.
- Applications that require directional control and fault locating.
- Applications that require communications and protocol support.
- Applications where the capabilities of a numeric multifunction relay are required.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection and control systems in existing equipment.

# FUNCTIONAL DESCRIPTION

The BE1-11*i* is a multifunction, numeric relay that provides a comprehensive mix of protective, control, and metering functions in an integrated package for interconnection appliations. Additional features included in this relay, such as forward/reverse power (32), synch check (25), over and undervoltage (27/59) and over and underfrequency (81O/U/ROC) make this system suitable for applications including feeder or bus protection, as well as load shedding.

With a sample rate of 32 samples per cycle, the digital signal processing with frequency compensation extracts the fundamental frequency 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.

In addition to the 3 phase CTs, the BE1-11*i* includes an 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.

A fourth Auxiliary Voltage (Vx) input also is available. This single phase 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.

All overcurrent elements can independently be set for forward, reverse, or nondirectional control. Directional control is obtained by positive, negative, and zero 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 an internal memory voltage to provide reliable directional control for close in balanced three phase faults.

Tripping by voltage dependent functions 27, 59, 32 will be blocked if a sensed voltage is lost (60FL).

The target reporting function in the BE1-11*f* automatically adapts the targets as appropriate. For example, if both the **50-2** and the **51-1** are set for directional control and trip for a fault involving a phase, they post targets for an A phase fault as "**50-2 67 A**" for the directional instantaneous trip or "**51-1 67 A**" for the directional time trip.

Three independent communications ports are available in the unit. The front panel USB port provides for BESTCOMS*Plus* communications with the relay. The rear panel RS-485 and optional Ethernet ports provide support for BESTCOMS*Plus*, BESTNet*Plus*, Modbus, and DNP 3.0 protocols. Modbus or DNP 3.0 are supported through the RS-485 port. The Ethernet port will support concurrent Modbus and DNP 3.0 or two concurrent sessions of DNP 3.0. The Ethernet port may be defined at the time of order to be either a copper (RJ-45) or multi-mode fiber optic connection. A standard IRIG-B port provides time synchronization from an external GPS clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, Voltage, Amp, and unbalance loading telemetry for the protected equipment. 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.

Figure 2 shows typical external connections, Figure 3 illustrates the functionality contained within this device, and Figure 5 shows rear panel connections.

# FUNCTIONAL DESCRIPTION, continued

**Figure 2 - Typical External Connections**

## BE1-11*i*

**Figure 3 - BE1-11*i* Intertie Application**

# FUNCTIONAL DESCRIPTION, continued

**BESTLogic*Plus***

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

Each of the protection and control functions in the BE1-11*i* is imple-mented 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. Figure 4 shows a sample BESTLogic*Plus* screen available in the BE1-11*i*. Programming BESTlogic+ is equivalent to choosing the functional 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 BE1-11*i* relay can store, as user settings, one user programmable, custom logic scheme. To save time, several preprogrammed logic schemes also are provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTLogic*Plus* settings.

BESTLogic*Plus* 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. In addition, these advanced logic features have been added: Edge triggers, XOR gates, logic timers, counters, and latches.
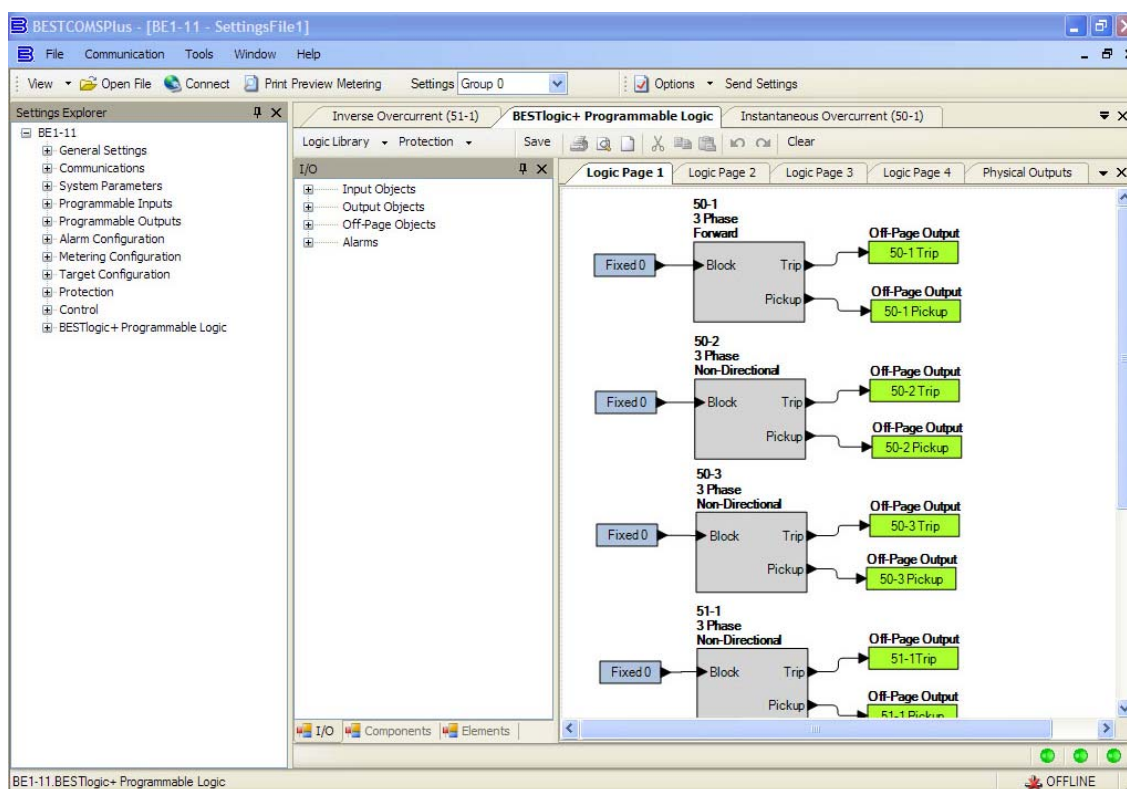


**Figure 4 - BESTLogic*Plus* Programmable Logic, Sample Screen**
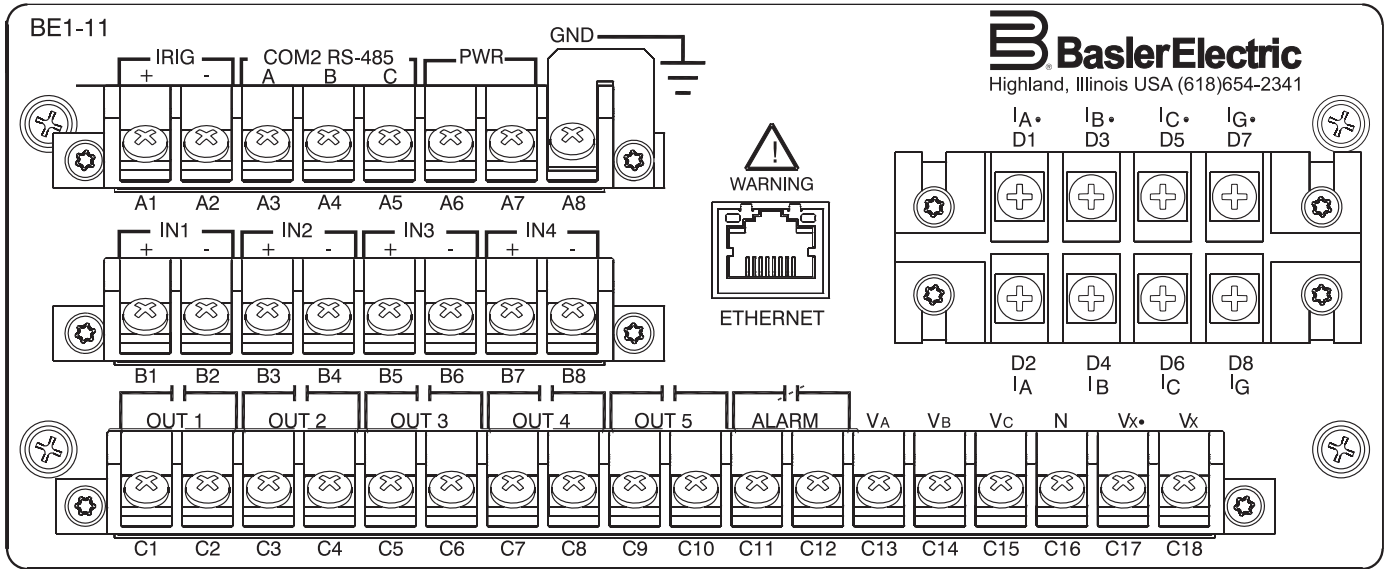
# FUNCTIONAL DESCRIPTION, continued



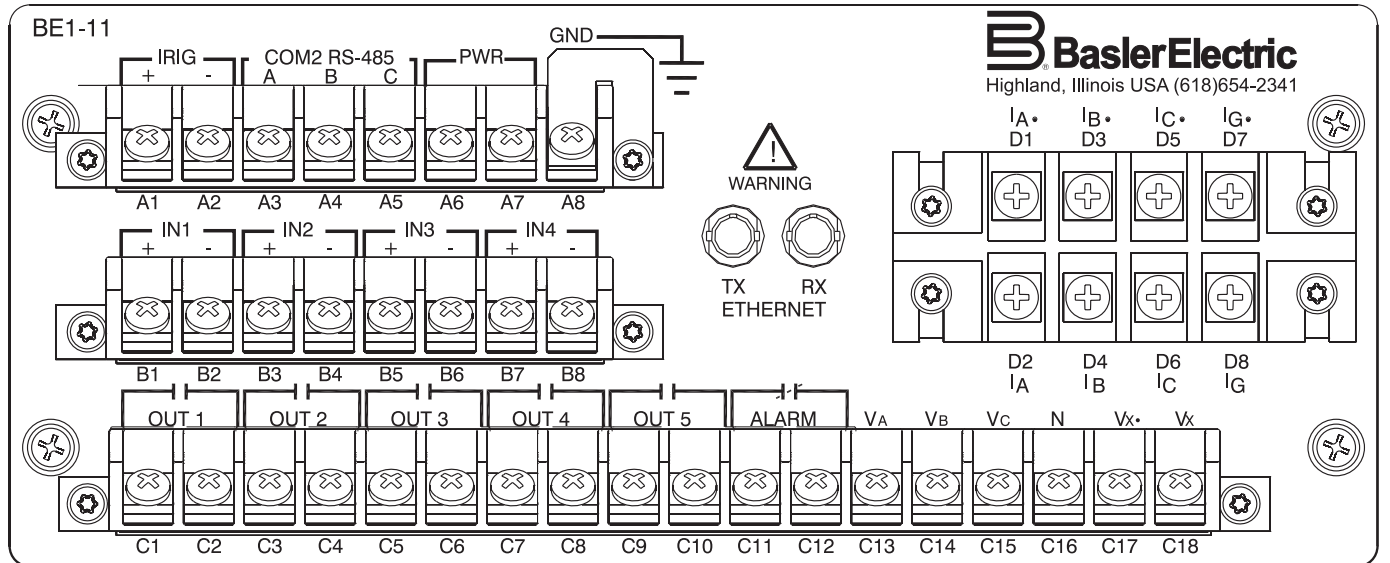**Figure 5 - BE1-11*i*  H1 Rear Panel Connections (shown with optional copper Ethernet port)**



**Figure 6 - BE1-11*i*  H1 Rear Panel Connections (shown with optional Fiber optic 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: | 80A |
| 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 ($V_x$)**

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

**A/D CONVERTER**

| | |
|---|---|
| Sampling Rate: | 32/cycle, adjusted to input frequency 10-75Hz |

**POWER SUPPLY**

| | | |
|---|---|---|
| Option 1: 48/125Vac/dc | DC range 35-150V | |
| | AC range 55-135V | |
| Option 2: 125/250Vac/dc | DC range 90 - 300V | |
| | AC range 90 - 270V | |
| Option 3: 24Vdc | DC range 17 - 32V | |
| | (down to 8V for momentary dips) | |
| Burden: | 10 Watts continuous, 12 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:

| | Low Range | | High Range | |
|---|---|---|---|---|
| Power Supply Option | 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: | Up to 115,200 |

**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 per Standard 508, File E97033
CSA certified per Standard CAN/CSA-C22-2
Gost R certified per relevant standards of Gosstandart of Russia
CE qualified - meets or exceeds standards for distribution in the European Community

**CASE SIZE**

10.50"W x 3.47"H x 9.10"D with mounting flanges (8.5"W without mounting flanges)

**SHIPPING WEIGHT**

Approx. 12 pounds (5.4 kg)

**WARRANTY**

7 years

# PERFORMANCE SPECIFICATIONS

## INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50)

| | | |
|---|---|---|
| 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 (51)

| | | |
|---|---|---|
| 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.

## CURRENT PICKUP ACCURACY (All 50 and 51)

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

## NEGATIVE SEQUENCE OVERCURRENT (46)

| | | |
|---|---|---|
| Pickup: | 5A CT | 0.1-16.0A |
| | 1A CT | 0.02-3.20A |
| Time dial: | TD=K=0-99 for 46 curve | |
| | TD=0.00-9.9 for all other curves | |
| Time-Current Characteristics: | Same curves as 51 elements | |

## BREAKER FAILURE (50BF)

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

| 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 | 1.0000 | 0.028 | 29.0000 |
| F | 0.0000 | 1.00000 | 0.000 | 0.0000 | 0.028 | 1.0000 |
| 46 | * | 0.00000 | 0.000 | 2.0000 | 0.028 | 100.0000 |
| A1 | 0.1400 | 0.00000 | 1.000 | 0.0200 | 0.000 | 2.0000 |
| B1 | 13.5000 | 0.00000 | 1.000 | 1.0000 | 0.000 | 3.2500 |
| C1 | 80.0000 | 0.00000 | 1.000 | 2.0000 | 0.000 | 8.0000 |
| D1 | 0.0515 | 0.11400 | 1.000 | 0.0200 | 0.000 | 4.8500 |
| E3 | 19.6100 | 0.49100 | 1.000 | 2.0000 | 0.000 | 21.6000 |
| F1 | 28.2000 | 0.12170 | 1.000 | 2.0000 | 0.000 | 29.1000 |
| P | 0 to 600 | 0 to 25 | 0 to 1 | .5 to 2.5 | 0.028 | 0 to 30 |
| T | User defined currents and time delays. | | | | | |

**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 Overcurrent
**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
**P** = Programmable
**T\*\*** = Table Lookup (T1 through T4)

\*  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.

\*\* Tabular curve definition may include up to 40 points for each of 4 user-defined curves.

## DIRECTIONAL CONTROL (ALL OVERCURRENT)

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

# PERFORMANCE SPECIFICATIONS, continued

**VOLTS/HZ (24)**

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

$$T_T = \frac{D_T}{(M-1)^2} \qquad T_R = D_R \times \frac{ET}{FST} \times 100$$

$T_T$ = Time to Trip
$T_R$ = Time to Reset
$D_T$ = Time Dial, Trip
$D_R$ = Time Dial, Reset

$M = \dfrac{\text{Actual V/Hz}}{\text{Pickup V/Hz}}$

ET = Elapsed Time
FST = Full Scale Trip Time ($T_T$)

**SYNC CHECK (25)**

| | |
|---|---|
| Delta Phase Angle: | 1 - 99 degrees |
| Delta Voltage Magnitude: | 1 - 20V |
| Delta Frequency: | 0.01 - 0.50Hz |
| Phase Shift CompensatioN: | 0 - 359 degrees |

**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: | 10.0-300$V_{L-L}$ or 10.0-300$V_{L-N}$ |
| Delay Time: | 0.050 - 600sec. |

Inverse delay equations:

For overvoltage protection  $t(G) = \dfrac{TD}{(G/G_s)-1}$

For undervoltage protection  $t(G) = \dfrac{TD}{1-(G/G_s)}$

where
$t(G)$ = operating time with constant value of $G$ *(seconds)*
$TD$ = time multiplier setting
$G$ = measured value of the characteristic quantity
$G_s$ = setting (pickup) value of the characteristic quantity

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

| | |
|---|---|
| Mode: | Fundamental $V_X$, |
| | 3 phase Residual (3V0), |
| | 3rd Harmonic $V_X$ |
| Pickup: | 1.0 - 150V |
| Delay Time: | 0.050 - 600 Sec. |
| Inverse Delay: | ±5% or 2 cycles |

**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 (All 27, 47 and 59)**

| | |
|---|---|
| Definite Time Accuracy: | ±0.5% or ±1 cyc |

**NEGATIVE SEQUENCE OVERVOLTAGE (47)**

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

**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)**

| | |
|---|---|
| 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) | |
| Mode: | Rate of Change (ROC) |
| Pickup: | 0.2-20Hz/sec |
| Accuracy: | 0.1 Hz/sec or 2% |

**GENERAL PURPOSE LOGIC TIMERS (62)**

| | |
|---|---|
| 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 |

**SETTING GROUPS**

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

# PERFORMANCE SPECIFICATIONS, continued

**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**

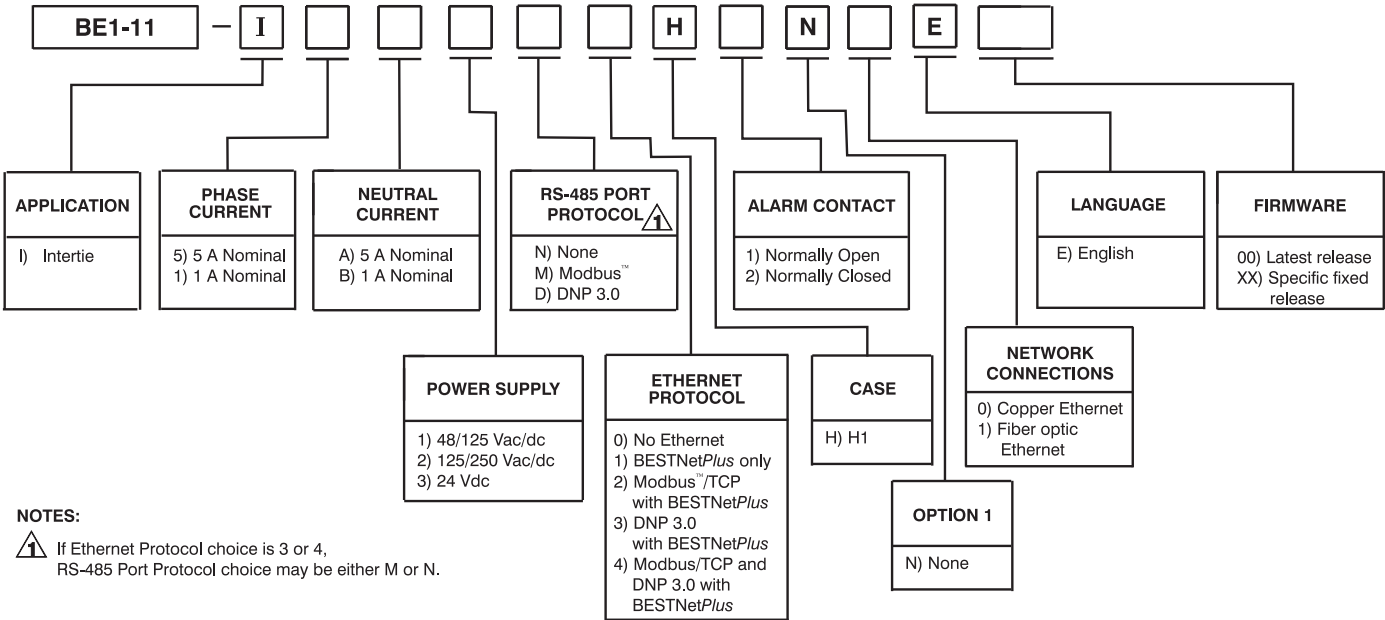| | |
|---|---|
| Duty Mode: | I or $I^2$ |
| Duty Alarm Range: | 0 - to 100% |
| Op Counter Alarm Range: | 0 - 99999 |
| Trip Time Alarm Range: | 20 - 1000mSec |

# ORDERING

## SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-11 relays. For example, if the style number were BE1-11 **I5A1M2H2N1E00**, the device would have the following:

BE1-11

| | | |
|---|---|---|
| **(I)** | - | Intertie Application |
| **(5)** | - | 5 Amp Phase nominal current |
| **(A)** | - | 5 Amp Neutral nominal current |
| **(1)** | - | 48/125 Vac/Vdc power supply |
| **(M)** | - | Modbus protocol |
| **(2)** | - | Modbus/TCP with BESTNet*Plus* |
| **(H)** | - | Half Rack Case |
| **(2)** | - | Normally Closed Alarm |
| **(N)** | | |
| **(1)** | - | Fiber optic Ethernet |
| **(E)** | - | English language |
| **(00)** | - | Latest release of firmware |



**NOTES:**

⚠1 If Ethernet Protocol choice is 3 or 4, RS-485 Port Protocol choice may be either M or N.

## STANDARD ACCESSORIES

| | |
|---|---|
| 9289900016 | Escutcheon plate to panel mount two dovetailed H1 relays. |
| 9289900017 | Escutcheon plate to panel mount one H1 relay. |
| 9289924100 | Adapter bracket to mount single H1 case in 19" rack. |
| 9289929100 | Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack. |

ISO9001-2000
Highland, IL USA    Taylor, TX USA
Wasselonne, France  Suzhou, China

**Basler Electric**

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