BE1-11*d*

DC Power Protection System

Instruction Manual

12570 Route 143 • Highland, Illinois 62249-1074 USA
Tel +1 618.654.2341 • Fax +1 618.654.2351
www.basler.com • info@basler.com

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⚠ **WARNING:** California's Proposition 65 requires special warnings for products that may contain chemicals known to the state of California to cause cancer, birth defects, or other reproductive harm. Please note that by posting this Proposition 65 warning, we are notifying you that one or more of the Proposition 65 listed chemicals may be present in products we sell to you. For more information about the specific chemicals found in this product, please visit https://www.basler.com/Prop65.

Preface

This instruction manual provides information about the installation and operation of the BE1-11*d* DC Power Protection System. To accomplish this, the following information is provided:

- General information and a quick start guide
- Controls and indicators
- Inputs and outputs
- Protection and control functions
- Reporting and alarms information
- Mounting and connection diagrams
- BESTCOMS*Plus*® software
- Communication and security
- Testing and troubleshooting procedures
- Specifications
- IT-D Isolation Transducer

Optional instruction manuals for the BE1-11*d* include:

- Modbus® communication protocol (Basler Electric part number 9424200774)
- Distributed Network Protocol (DNP) (Basler Electric part number 9424200773)
- IEC 61850 communication protocol (Basler Electric part number 9424200892)

Conventions Used in this Manual

Important safety and procedural information is emphasized and presented in this manual through warning, caution, and note boxes. Each type is illustrated and defined as follows.

Warning!
Warning boxes call attention to conditions or actions that may cause personal injury or death.

Caution
Caution boxes call attention to operating conditions that may lead to equipment or property damage.

Note
Note boxes emphasize important information pertaining to installation or operation.

12570 State Route 143
Highland IL 62249-1074 USA
www.basler.com
info@basler.com
Tel: +1 618.654.2341
Fax: +1 618.654.2351

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Warning!

READ THIS MANUAL. Read this manual before installing, operating, or maintaining the BE1-11*d*. Note all warnings, cautions, and notes in this manual as well as on the product. Keep this manual with the product for reference. Only qualified personnel should install, operate, or service this system. Failure to follow warning and cautionary labels may result in personal injury or property damage. Exercise caution at all times.

Caution

Installing previous versions of firmware may result in compatibility issues causing the inability to operate properly and may not have the enhancements and resolutions to issues that more recent versions provide. Basler Electric highly recommends using the latest version of firmware at all times. Using previous versions of firmware is at the user's risk and may void the warranty of the unit.

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Over time, improvements and revisions may be made to this publication. Before performing any of the following procedures, contact Basler Electric for the latest revision of this manual.

The English-language version of this manual serves as the only approved manual version.

Revision History

A historical summary of the changes made to this instruction manual is provided below. Revisions are listed in reverse chronological order.

Visit www.basler.com to download the latest hardware, firmware, and BESTCOMS*Plus*® revision histories.

Instruction Manual Revision History

Manual Revision and Date	Change
H, Jun-25	• Updated China RoHS table • Changed mentions of BESTwave to BESTdata
G, Sep-24	• Removed references to the product CD • Removed language regarding plugin activation • Corrected path to Driver Installer location • Updated specifications • Updated BESTCOMS*Plus* system requirements
F, Dec-23	• Added China RoHS compliance
E, Feb-23	• Updated isolation specifications • Added a note about recommended wire size and earth ground • Updated procedure to download and install BESTCOMS*Plus*
D, Feb-22	• Added UKCA Compliance to the BE1-11*d* and RTD Module
C, Jul-21	• Removed the RTD Module's UL Recognition for use in Hazardous Locations • Minor text edits
B, Jun-21	• Added information on terminal strip kit to the *Mounting* chapter • Updated backup battery types • Minor text edits throughout manual
A, Sep-19	• Added support for BESTCOMS*Plus* version 4.00.00 • Removed Rev Letter from all pages • Changed sequential numbering to sectional numbering • Moved Instruction Manual Revision History into Preface • Removed standalone Revision History chapter • Minor text edits throughout manual
—, Feb-19	• Initial release

Contents

1 • Introduction

The BE1-11*d* DC Power Protection System provides flexible, reliable, and economical dc power protection, control, monitoring, and measurement functions. The capabilities of the BE1-11*d* make it well suited to provide comprehensive dc power protection. The BE1-11*d* offers dc overcurrent, over/undervoltage, rate of rise, power, and thermal overload protection functions as well as breaker reclosing and RTD (Resistance Temperature Detector) inputs with remote module. It offers breaker and trip-circuit monitoring, and oscillography and sequential events recording. Control features include virtual selector switches, circuit breaker control, virtual lockout, and variable-mode timers. System metering and status information are available at the BE1-11*d* front panel and through the BE1-11*d* communication ports. The system is suitable for mounting in OEM cubicle or retrofit switchgear applications.

A front-panel USB port or optional rear Ethernet port enables local communication between the BE1-11*d* and a PC operating with BESTCOMS*Plus*® software. BESTCOMS*Plus* software simplifies the commissioning process by providing a graphical interface for setting the BE1-11*d* and configuring a protection and control scheme for your application. Through BESTCOMS*Plus*, all BE1-11*d* settings and logic can be retained in a file for printing or uploading to other BE1-11*d* protection systems. Oscillography and sequential events records can be retrieved from a BE1-11*d*, viewed, and printed.

Front-panel features include a large, backlit alphanumeric display and LED indicators that display system parameters, BE1-11*d* settings, and BE1-11*d* status. Pushbuttons enable navigation through the display menu, changes to settings, resetting of targets (with password access), and direct access to virtual switches.

Applications

The capabilities of the BE1-11*d* make it ideally suited for applications with the following attributes:

- Isolation between the IT-D and the BE1-11*d* via fiber optic communications
- The flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit
- The economy provided by a multifunction unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required for typical applications.
- The small size and limited behind-panel projection facilitates modernizing protection and control systems in existing equipment
- Coordinated protection with other BE1-11 protection systems on both ac and dc sides of a rectifier
- High-speed Ethernet communications and protocol support
- The capabilities of a numeric multifunction relay
- IEC 61850 functionality

Features

The BE1-11*d* protection system includes many features for the protection, monitoring, and control of dc switchgear. These features include protection and control functions, metering functions, and reporting and alarm functions. A highly flexible programmable logic system called BESTlogic™*Plus* allows the user to apply the available functions with complete flexibility and customize the system to meet the requirements of the protected dc switchgear. Programmable I/O, extensive communication features, and an advanced user interface provide easy access to the features provided.

The following information summarizes the capabilities of this multifunction device. Each feature, along with its setup and use, is described in detail in the later chapters of this manual.

General Features

HMI (Human-Machine Interface)

Each BE1-11*d* has a front-panel display and 12 LED indicators: Power Supply Status, Relay Trouble Alarm, Minor Alarm, Major Alarm, Trip, and Indicator 1 through 7 (programmable in BESTlogic*Plus)*. The backlit, liquid crystal display (LCD) allows the BE1-11*d* to replace local indication and control functions such as panel metering, alarm annunciation, and control switches. Four scrolling pushbuttons enable navigation through the LCD menu tree. Parameters are changed using the Edit pushbutton. Targets, alarms, and other registers are cleared with the Reset pushbutton. In Edit mode, the scrolling pushbuttons provide data entry selections. Edit mode is indicated by an LED on the Edit pushbutton. Select Control Switch and Operate Control Switch pushbuttons provide a means to control the logic switches.

The LCD has automatic priority logic to govern which metering values are displayed on the screen so that when an operator approaches, the metering data of most interest is automatically displayed without having to navigate the menu structure. Scrollable metering parameters are selected on the General Settings, Front Panel HMI settings screen in BESTCOMS*Plus*.

Device Information

The version of the embedded software (firmware), serial number, and style number are available from the front panel or the communication ports.

Three free-form fields (Device ID, Station ID, and User ID) can be used to enter information to identify the BE1-11*d*. These fields are used by many of the reporting functions to identify the BE1-11*d* reporting the information. Examples of BE1-11*d* identification field uses include station name, circuit number, relay system, and purchase order.

Device Security

Security settings affect read and write access. Passwords provide access security for six distinct functional access areas: Read, Control, Operator, Settings, Design, and Administrator. Each username/password is assigned an access area with access to that area and each area below it. An administrator password provides access to all six of the functional areas.

A second dimension of security is provided by the ability to restrict access for any of the access areas to only specific communication ports. For example, you could set up security to deny access to control commands through the Ethernet port.

Setting Groups

Four setting groups allow adaptive relaying to be implemented to optimize BE1-11*d* settings for various operating conditions. Automatic and external logic can be employed to select the active setting group.

Clock

The clock is used by the logging functions to timestamp events. BE1-11*d* timekeeping can be self-managed by the internal clock or coordinated with an external source through a network or IRIG device.

A backup capacitor and additional battery backup are provided for the clock. During a loss of operating power, the backup capacitor maintains timekeeping for up to 24 hours depending on conditions. As the capacitor nears depletion, the backup battery takes over and maintains timekeeping. The backup battery has a life expectancy of greater than five years depending on conditions.

IRIG

A standard unmodulated IRIG-B input receives time synchronization signals from a master clock. Automatic daylight saving time compensation can be enabled and set for floating or fixed dates.

NTP (Network Time Protocol)

NTP synchronizes the real-time clock to network time servers through the Ethernet port. BESTCOMS*Plus* is used to establish the priority of time reference sources available to the BE1-11*d*, IRIG-B, NTP, DNP, and RTC (real-time clock). The NTP address is set using BESTCOMS*Plus*.

Communications

Three independent communication ports provide access to all BE1-11*d* functions. A USB (universal serial bus) port is located on the front panel, a two-wire RS-485 port is located on the rear panel, and an optional Ethernet port is located on the rear panel. The RS-485 and Ethernet ports are electrically isolated.

Modbus® and DNP3 protocols are optionally available for the RS-485 or Ethernet communication port. The IEC 61850 protocol is optionally available for the Ethernet port when RS-485 option is N (None). Separate instruction manuals cover each available protocol. Consult the product bulletin or Basler Electric for availability of these options and instruction manuals. Modbus sessions can be operated simultaneously over the Ethernet and RS-485 ports.

System Parameters

All sensing is performed using an IT-D isolation module. Each IT-D isolation module includes two channels that are capable of sensing either dc current or dc voltage. The dc system current is sensed using an appropriately scaled 25, 50, 75, or 100-millivolt nominal metering shunt. DC voltages are sensed by direct connection for nominal levels up to 1,500 Vdc. The BE1-11*d* can utilize two IT-D modules to sense a single dc current and up to three dc voltages.

The IT-D digitally samples the sensed inputs at a rate proportional to the rectification system nominal power input frequency. The sampling rate is established to maintain a high accuracy of the measurement for a dc signal with ripple content.

High-speed fiber optic communications between the IT-Ds and the BE1-11*d* transmit the magnitudes of the system measurement to the protection system.

Programmable Inputs and Outputs

Programmable contact inputs and outputs are described in the following paragraphs.

Programmable Inputs

Either seven or 10 programmable contact sensing inputs with programmable signal conditioning provide a binary logic interface to the protection and control system. Refer to the style chart for I/O options. Each input function and label is programmable using BESTlogic*Plus*. A user-meaningful label can be assigned to each input and to each state (energized and de-energized) for use in reporting functions. Board mounted jumpers support dual voltage ratings.

Programmable Outputs

Either eight or five programmable general-purpose contact outputs provide a binary logic interface to the protection and control system. Refer to the style chart for I/O options. One programmable, failsafe contact output serves as an alarm output. Each output function and label is programmable using BESTlogic*Plus*. A user-meaningful name can be assigned to each output and to each state (energized and de-energized) for use in reporting functions. Output logic can be overridden to open, close, or pulse each output contact for testing or control purposes. All output contacts are trip rated.

Reporting and Alarms

Several reporting and alarm functions provide fault reporting, demand, breaker, and trip circuit monitoring. Reporting of power quality and general status is also provided.

Alarms

Extensive self-diagnostics will trigger a fatal relay trouble alarm if any of the BE1-11*d* core functions are compromised. Fatal relay trouble alarms are not programmable and are dedicated to the Alarm output (OUTA) and the front panel Relay Trouble LED. Additional relay trouble alarms and all other alarm functions are programmable for major or minor priority. Programmed alarms are indicated by major or minor alarm LEDs on the front panel. Major and minor alarm points can also be programmed to any output contact including OUTA. Over 50 alarm conditions are available to be monitored including user-definable logic conditions using BESTlogic*Plus*.

Active alarms can be read and reset at the front panel or through the communication ports. A historical sequence of events report with time stamps lists when each alarm occurred and cleared. These reports are available through the communication ports.

Breaker Monitoring

Breaker statistics are recorded for a single breaker. They include the number of operations, fault current interruption duty, and breaker time to trip. Each of these conditions can be set to trigger an alarm.

Trip Circuit Monitor (72TCM)

The trip circuit of a breaker or lockout relay can be monitored for loss of continuity (trip coil open). Additional trip or close circuit monitors can be implemented in BESTlogic*Plus* using additional inputs, logic timers, and programmable logic alarms.

Demands

Demand values are continuously calculated for positive and negative current, and positive and negative power. Demand reporting records peak and present demand with time stamps for each register.

Power Quality

The BE1-11*d* offers power quality measurement performance. Power quality settings include dip hysteresis, dip ratio, swell hysteresis, and swell ratio.

Thermal Energy

Thermal energy is measured and reported by the BE1-11*d*.

General Status Reporting

The BE1-11*d* provides extensive general status reporting for monitoring, commissioning, and troubleshooting. Status reports are available from the front panel or communication ports.

Fault Reporting

Fault reports consist of simple target information, fault summary reports, and detailed oscillography records to enable the user to retrieve information about disturbances in as much detail as is desired. The BE1-11*d* records and reports oscillography data in industry-standard IEEE, COMTRADE format to allow using any fault analysis software. Basler Electric provides a Windows® based program called BESTdata that can read and plot binary or ASCII format files that are in the COMTRADE format. BESTdata software is free and available at www.basler.com.

Sequence of Events Recorder

A Sequence of Events Recorder (SER) records and time stamps all BE1-11*d* inputs and outputs as well as all alarm conditions monitored by the BE1-11*d*. I/O and Alarm reports can be extracted from the records as well as reports of events recorded during the time span associated with a specific fault report.

Protection and Control

The BE1-11*d* includes protection elements that monitor voltage, current, power, thermal overload, temperature, and more to provide protection against faults and abnormal operating conditions. Control elements make the BE1-11*d* capable of controlling complex distribution configurations. The following paragraphs describe each protection and control function.

Undervoltage (27) and Overvoltage (59) Protection

Four undervoltage and four overvoltage elements are included. The 27 elements are equipped with an undervoltage inhibit feature.

Rate of Rise Protection

Two rate of rise elements provide detection for remote faults often characterized by high fault resistance. Two parallel detection methods, Current Increment Detection and Time Delay Detection, are used for short-circuit current detection based on the defined parameters.

DC Overcurrent (76) Protection

Thirteen DC overcurrent elements can be set. DC overcurrent functions employ a dynamic integrating timing algorithm with selectable instantaneous or integrated reset characteristics. Inverse time overcurrent curves conform to IEEE Std C37.112-1996 - *IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays,* and include seven curves similar to Westinghouse/ABB CO curves, five curves similar to GE IAC curves, four table curves, a fixed time curve, and a user programmable curve.

Each inverse overcurrent element can be set separately for forward, reverse, or non-directional control.

Power (32) Protection

Two directional power elements can be set for forward or reverse, overpower or underpower protection. The element can be used for any application requiring directional power flow detection.

Thermal Overload (49) Protection

The thermal overload (49) element models the thermal capacity in the cables and catenary system in a transit application to provide thermal protection. It operates by simulating overheat temperature using load current and thermal time constant. The element trips when the simulated overheat temperature exceeds the defined trip level.

Resistance Temperature Detector (49RTD) Protection

Fourteen resistance temperature detector elements provide over/undertemperature protection in applications where a remote RTD module is connected to the BE1-11*d* via Ethernet or RS-485 cable. For more information, refer to the *RTD Module* chapter.

Recloser (82) Protection

The recloser element recloses the line circuit breaker automatically after a protective trip. Line test is used on a line circuit breaker before closing to prevent the line circuit breaker closing onto an overload or a short-circuit condition.

Analog Input Protection

Eight analog input protection elements monitor external analog input signals when two remote RTD modules are connected via an Ethernet or RS-485 cable. Four analog inputs are provided with each RTD module.

Breaker Control Switch (101)

Tripping and closing of a selected breaker can be controlled by the virtual breaker control switch. The virtual breaker control switch is accessed locally at the front panel or remotely through the communication ports.

Virtual Control Switches (43)

Five virtual control switches are accessed locally at the front panel or remotely through the communication ports. Virtual switches can be used to trip and close additional switches or breakers, or enable and disable certain functions.

Logic Timers (62)

Eight logic timers with six modes of operation emulate virtually any type of timer.

Lockout Functions (86)

Two lockout elements are provided.

BESTlogic™*Plus* Programmable Logic

Each BE1-11*d* protection and control function is implemented in an independent function element. Every function block is equivalent to its single function, discrete device counterpart so it is immediately familiar to the protection engineer. Each independent function block has all of the inputs and outputs that the discrete component counterpart may have. Programming with BESTlogic*Plus* is equivalent to choosing the devices required by your protection and control scheme and then drawing schematic diagrams to connect the inputs and outputs to obtain the desired operating logic.

Custom logic settings allow you to tailor the BE1-11*d* functionality to match the needs of your operation's practices and system requirements.

Metering Functions

Metering is provided for the following parameters:

- Voltages (V1, V2, V3)
- Current (I1)
- Power (P1)
- Energy
- Thermal capacity
- Analog input and output values
- RTD input temperatures

Model and Style Number Description

BE1-11*d* electrical characteristics and operational features are defined by a combination of letters and numbers that make up the style number. The style number describes the options included in a specific device and appears on labels located on the front panel and inside the case. Upon receipt of a BE1-11*d*, be sure to check the style number against the requisition and the packing list to ensure that they agree. The model number and style number are shown in Figure 1-1.

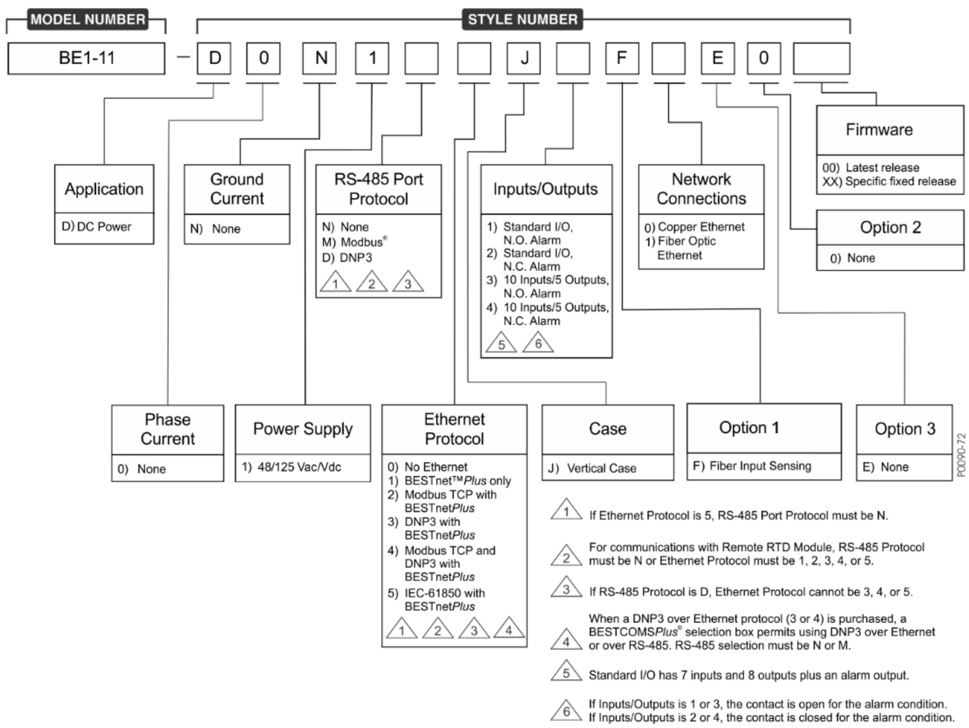


Figure 1-1. Style Chart

2 • Quick Start

This chapter provides basic installation and setup information about the BE1-11*d* DC Power Protection System. Upon receipt of the BE1-11*d*, check the model and style number against the requisition and packing list for agreement. If there is evidence of shipping damage, file a claim with the carrier, and notify the Basler Electric Regional Sales Office, your sales representative, or a sales representative at Basler Electric, Highland, Illinois.

If the BE1-11*d* is not installed immediately, store it in the original shipping carton in a moisture- and dust-free environment.

Note
Do not connect a USB cable between the PC and the BE1-11*d* until BESTCOMS*Plus* is installed. Connecting a USB cable before setup is complete may result in errors.

Maintenance

Preventive maintenance consists of periodic replacement of the backup battery and periodically checking that the connections between the BE1-11*d* and the system are clean and tight. The front cover should be removed only when replacing the backup battery for the real-time clock. Ensure that the BE1-11*d* is powered off and taken out of service before removing the front cover. BE1-11*d* units are manufactured using state-of-the-art, surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

Storage

This device contains long-life aluminum electrolytic capacitors. For devices that are not in service (spares in storage), the life of these capacitors can be maximized by energizing the device for 30 minutes once per year.

Install BESTCOMSPlus® Software

BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the BE1-11 plugin and the required version of .NET Framework (if not already installed). BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10, Windows 11. System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 2-1.

Table 2-1. System Recommendations for BESTCOMS*Plus* and the .NET Framework

System Type	Component	Recommendation
32/64 bit	Processor	2.0 GHz
32/64 bit	RAM	1 GB (minimum), 2 GB (recommended)
32 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)
64 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)

To install BESTCOMS*Plus*, a Windows user must have Administrator rights.

1. Download BESTCOMS*Plus* from www.basler.com.
2. Click the installation button for BESTCOMS*Plus*. The setup utility installs the BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the BE1-11 plugin for BESTCOMS*Plus* on your PC.

When BESTCOMS*Plus* installation is complete, a Basler Electric folder is added to the Windows programs menu. This folder is accessed by clicking the Windows Start button and then accessing the Basler Electric folder in the Programs menu. The Basler Electric folder contains an icon that starts BESTCOMS*Plus* when clicked.

Connect and Power Up the BE1-11 Plug-In

The BE1-11 plugin is a module that runs inside the BESTCOMS*Plus* shell. The BE1-11 plugin contains specific operational and logic settings for only BE1-11 protection systems.

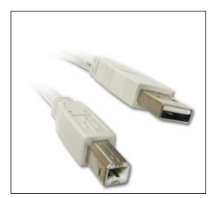
Note that if a BE1-11*d* is not connected, you will not be able to configure certain Ethernet settings. Ethernet settings can be changed only when an active USB or Ethernet connection is present. Refer to the *Communication* chapter for more information.

USB Connection

The USB driver was copied to your PC during BESTCOMS*Plus* installation and is installed automatically after powering the BE1-11*d*. USB driver installation progress is shown in the Windows Taskbar area. Windows will notify you when installation is complete.

Connect a USB cable between the PC and your BE1-11*d* protection system. A typical USB cable with a B-type connector is shown to the right.

Note
In some instances, the Found New Hardware Wizard will prompt you for the USB driver. If this happens, direct the wizard to the following folder: C:\Program Files\Basler Electric\USB Connect Driver\



If the USB driver does not install properly, refer to the *Troubleshooting* chapter.

Apply Operating Power

The nominal power supply values are listed on the front-panel label. See Figure 2-1 for an example.

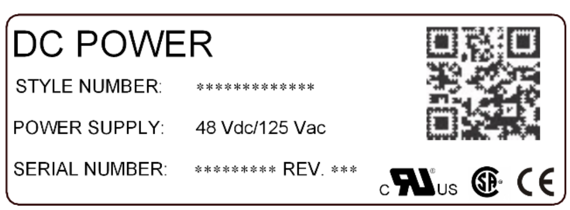


Figure 2-1. Front Panel Label Example

Connect rear terminals A6, A7, and A8 (ground) to a power supply. Figure 2-2 shows the rear terminals of the BE1-11*d* with standard I/O option. Apply operating power consistent with the nominal power supply values listed on the front-panel label. Wait until the boot sequence is complete.

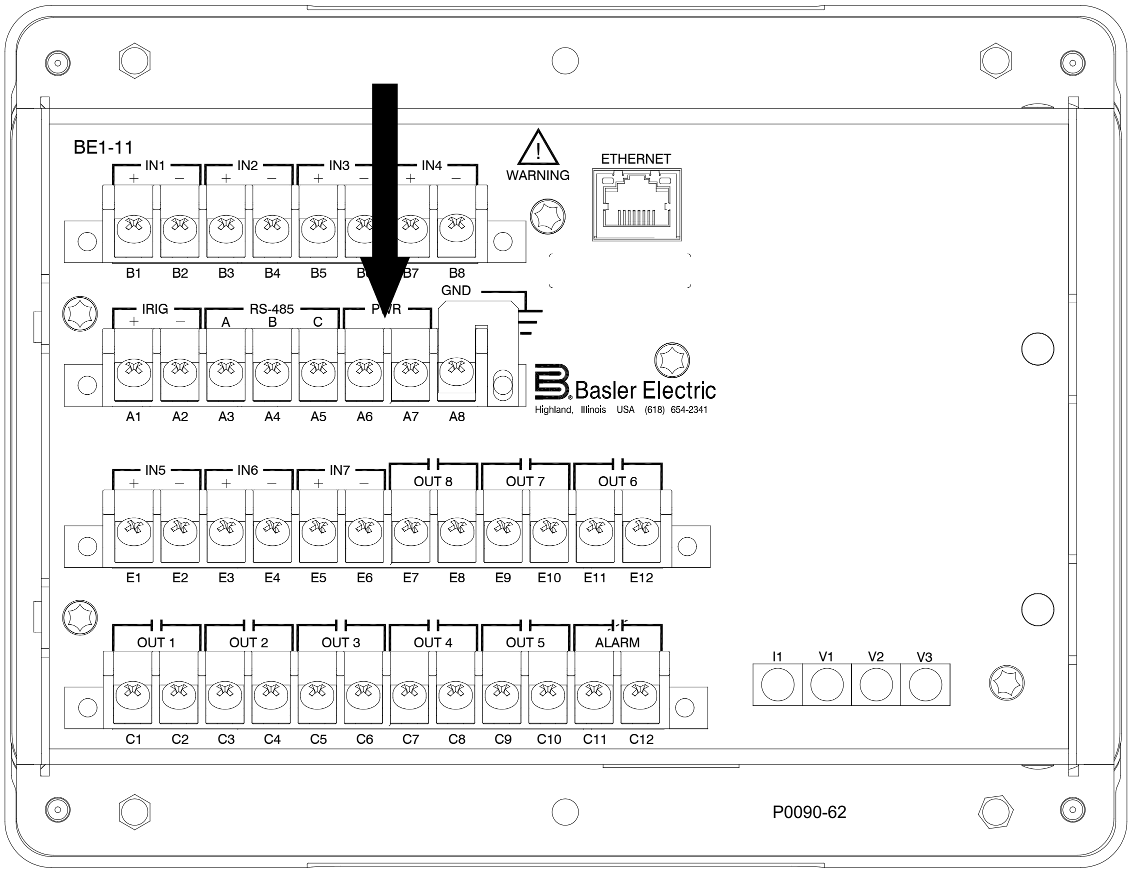


Figure 2-2. PWR Rear Terminals

Start BESTCOMS*Plus*®

To start BESTCOMS*Plus*, click the Start button, point to Programs, Basler Electric, and then click the BESTCOMS*Plus* icon. During initial startup, the BESTCOMS*Plus* Select Language screen is displayed (Figure 2-3). You can choose to have this screen displayed each time BESTCOMS*Plus* is started, or you can select a preferred language and this screen will be bypassed in the future. Click OK to continue. This screen can be accessed later by selecting Tools and Select Language from the menu bar.

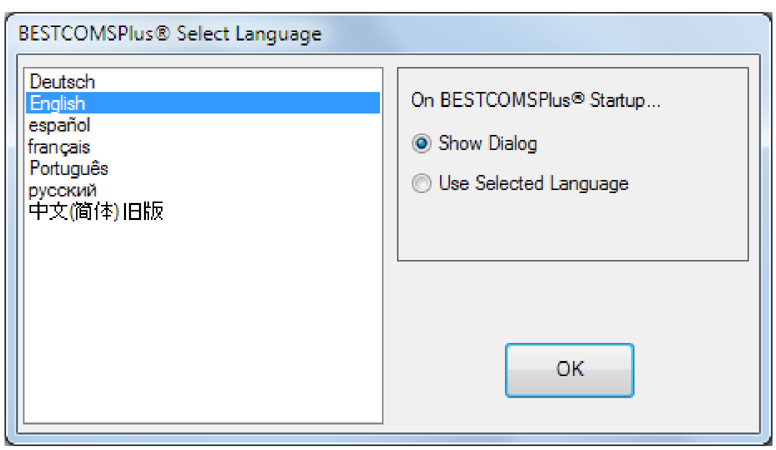


Figure 2-3. BESTCOMS*Plus* Select Language Screen

The BESTCOMS*Plus* splash screen is shown for a brief time. See Figure 2-4.

Figure 2-4. BESTCOMS*Plus* Splash Screen

The BESTCOMS*Plus* platform window opens. Select New Connection from the Communication pull-down menu and select BE1-11. See Figure 2-5.

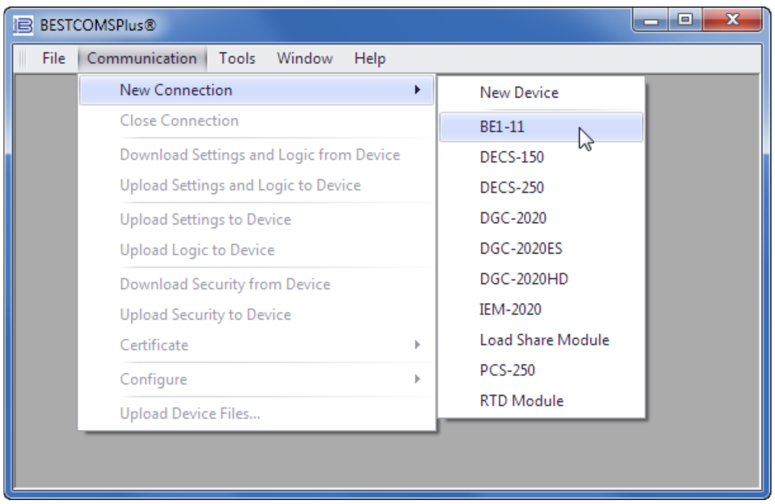


Figure 2-5. Communication Pull-Down Menu

The BE1-11 Connection screen shown in Figure 2-6 appears. Select USB Connection and then click the Connect button.

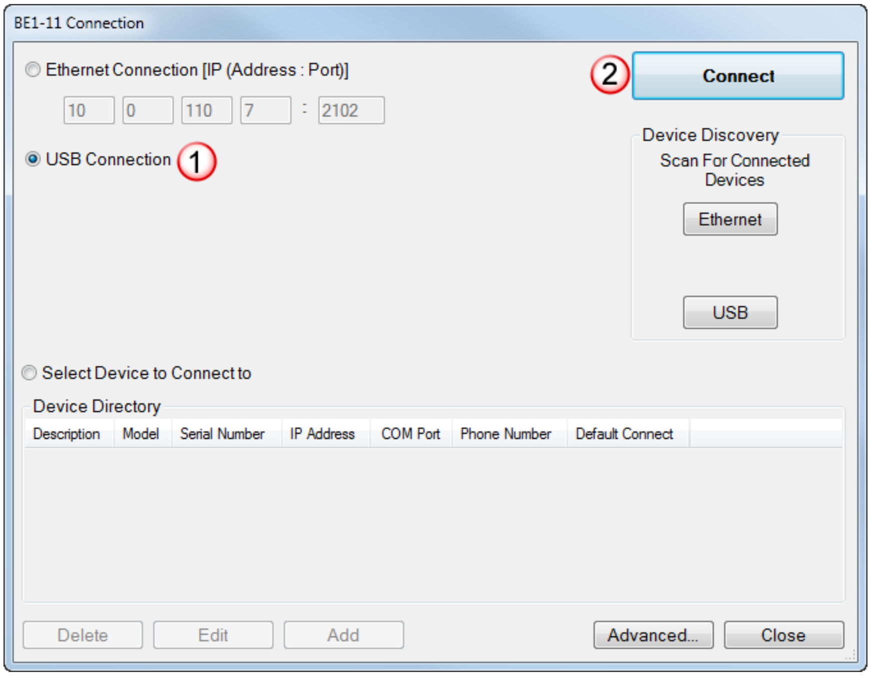


Figure 2-6. BE1-11 Connection Screen

Programming the BE1-11d

This section contains an introduction to BESTCOMS*Plus*, explains summary screens, and gives an example of settings elements and programming logic.

Introduction to BESTCOMS*Plus*®

BESTCOMS*Plus* is a Windows®-based, PC application that provides a user-friendly, graphical user interface (GUI) for use with Basler Electric communicating products. The name BESTCOMS*Plus* is an acronym that stands for Basler Electric Software Tool for Communications, Operations, Maintenance, and Settings.

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the BE1-11*d*. The capabilities of BESTCOMS*Plus* make the configuration of one or several BE1-11*d* DC Power Protection Systems fast and efficient. A primary advantage of BESTCOMS*Plus* is that a settings scheme can be created, saved as a file, and then uploaded to the BE1-11*d* at the user's convenience.

The BE1-11 plugin opens inside the BESTCOMS*Plus* main shell. The same default logic scheme that is shipped with the BE1-11*d* is brought into BESTCOMS*Plus* by downloading settings and logic from the BE1-11*d* or by selecting application type "D" on the Style Number screen. This gives the user the option of developing a custom setting file by modifying the default logic scheme or by building a unique scheme from scratch.

BESTlogic™*Plus* Programmable Logic is used to program BE1-11*d* logic for protection elements, inputs, outputs, alarms, etc. This is accomplished by the drag-and-drop method. The user can drag elements, components, inputs, and outputs onto the program grid and make connections between them to create the desired logic scheme.

BESTCOMS*Plus* also allows for downloading industry-standard COMTRADE files for analysis of stored oscillography data. Detailed analysis of the oscillography files can be accomplished using BESTdata software. BESTdata software is free and available at www.basler.com.

Figure 2-7 illustrates the typical user interface components of the BE1-11 plugin with BESTCOMS*Plus*.

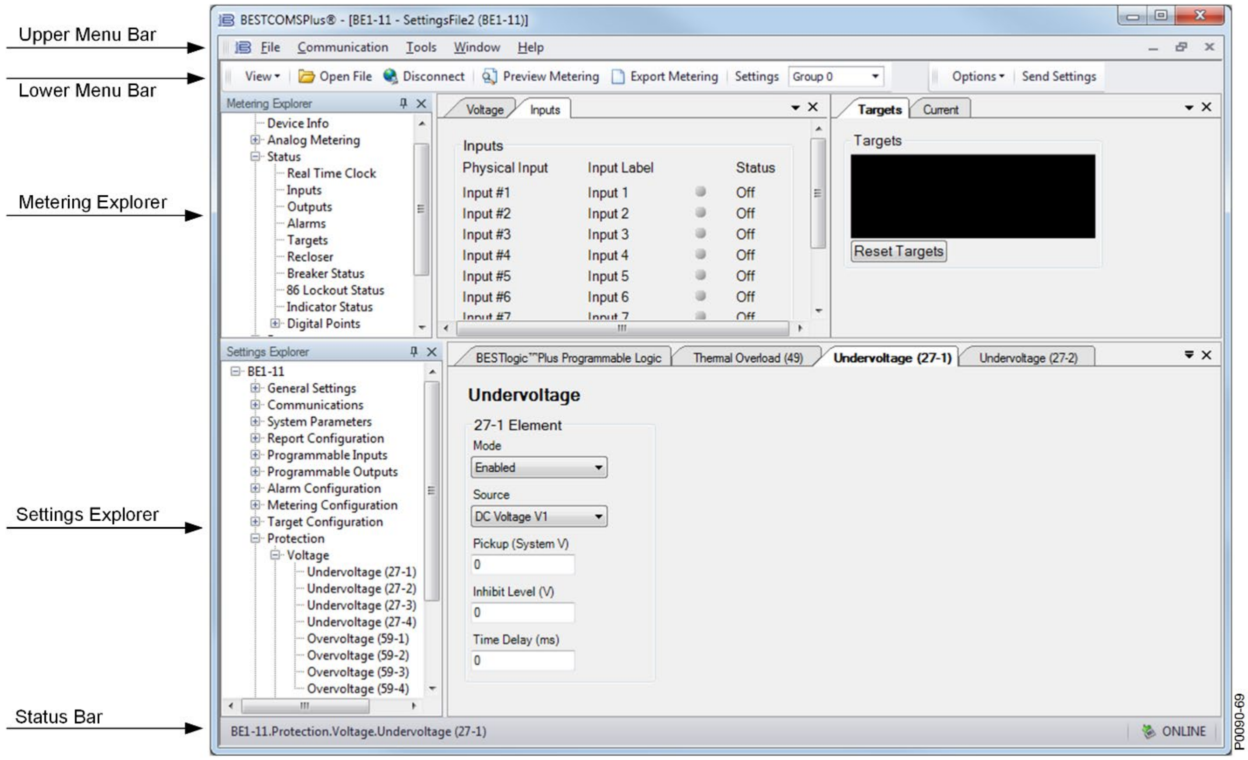


Figure 2-7. BESTCOMS*Plus* Typical User Interface Components

Click the View drop-down button to switch between the Settings Explorer and Metering Explorer or split the view between both. The Settings Info Panel displays settings ranges. A workspace can be opened, saved, or set as default. See Figure 2-8.

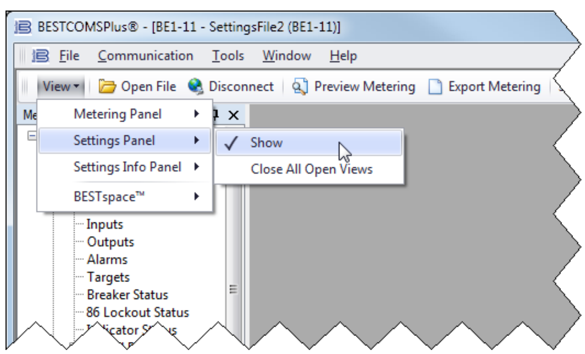


Figure 2-8. View Drop-Down Button

Summary Screens

Summary screens provide an overview of the system setup. The legend, located in the lower right-hand corner, provides interpretation for the various indicated colors. The current state of a protection and control function or element is indicated by the color of the adjacent indicator. If the function is enabled, the color is green. If the function is disabled only by a setting (such as zero), the color is yellow. If the function is disabled only by a mode, the color is blue. If the function is disabled by both a setting and mode, the color is gray. The Protection Summary screen is available by clicking Protection in the Settings Explorer as shown in Figure 2-9. Summary screens are also available for General Settings, Alarm Configuration, and Control.

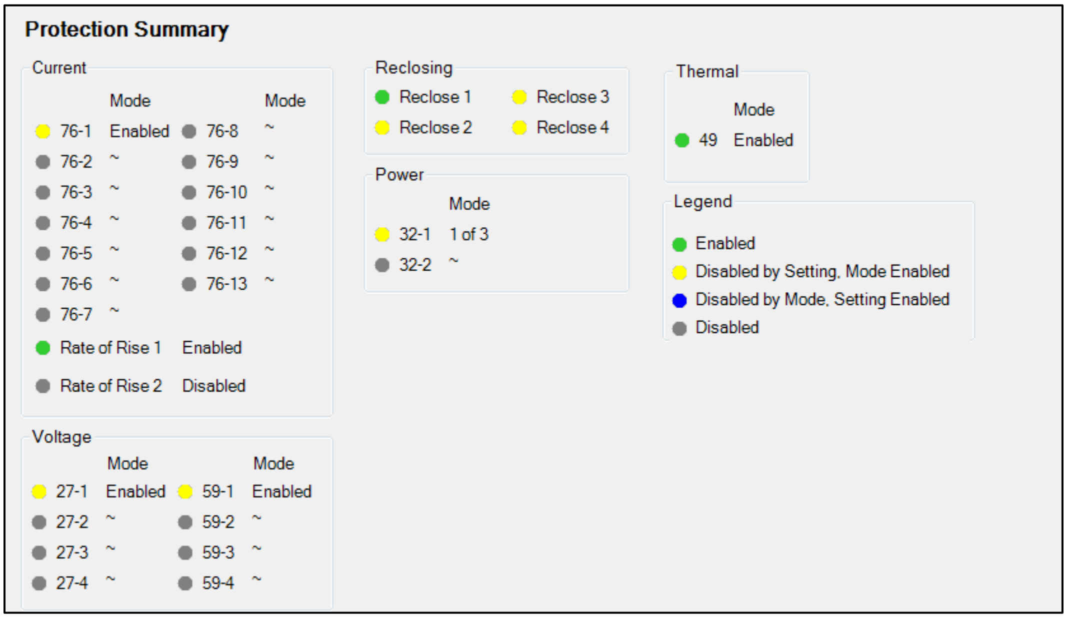


Figure 2-9. System Summary Screen

Programming Example

Changing default logic is sometimes required to match the protection requirements of the system. Additionally, elements must be enabled and operating settings set. This example demonstrates how to program the 59-1 overvoltage element. The 59-1 element is set for a 1,100 Vdc (Primary) pickup and a 30 second time delay. Additionally, the element pickup output is logically wired to output 4 and a user alarm.

Step 1: Start BESTCOMS*Plus* and select New Connection, BE1-11 from the Communication pull-down menu to connect to the BE1-11*d*. See Figure 2-5.

Step 2: The BE1-11 Connection screen appears. See Figure 2-6. Select USB Connection and click Connect.

Step 3: Select Download Settings and Logic from Device from the Communication pull-down menu. This copies all settings and logic from the BE1-11*d* to BESTCOMS*Plus*.

Step 4: Click on the View drop-down button and de-select Show Metering Panel and Show Setting Information. See Figure 2-8. This maximizes the settings workspace.

Step 5: In the Settings Explorer, expand Protection, Voltage and select the Overvoltage (59-1) screen. See Figure 2-10.

Step 6: Set the Mode to Enabled and enter settings for Pickup (310 Vdc) and Time Delay (50 ms).

Step 7: In the Settings Explorer, click BESTlogic*Plus* Programmable Logic to open the logic diagram. Click the Logic Page 1 tab. See Figure 2-11. Examine the 59-1 element. The Logic 0 connected to the Block input indicates that the 59-1 element is never blocked.

Off-Page Inputs/Outputs are used to make connections between logic pages and help keep logic diagrams free from clutter. The Trip output is connected to an Off-Page Output named 59-1 Trip. This 59-1 Trip Off-Page Output is carried over to Logic Page 2 (Figure 2-12) where it becomes an Off-Page Input. The 59-1 Trip Off-Page Input and several others are AND gated to the Trip Bus Off-Page Output, which is carried over to Logic Page 3 (Figure 2-13) where it becomes an Off-Page Input. The Trip Bus Off-Page Input in connected to physical Output 1 on the BE1-11*d*. Therefore, the OUT1 contacts operate when the 59-1 element is tripped.

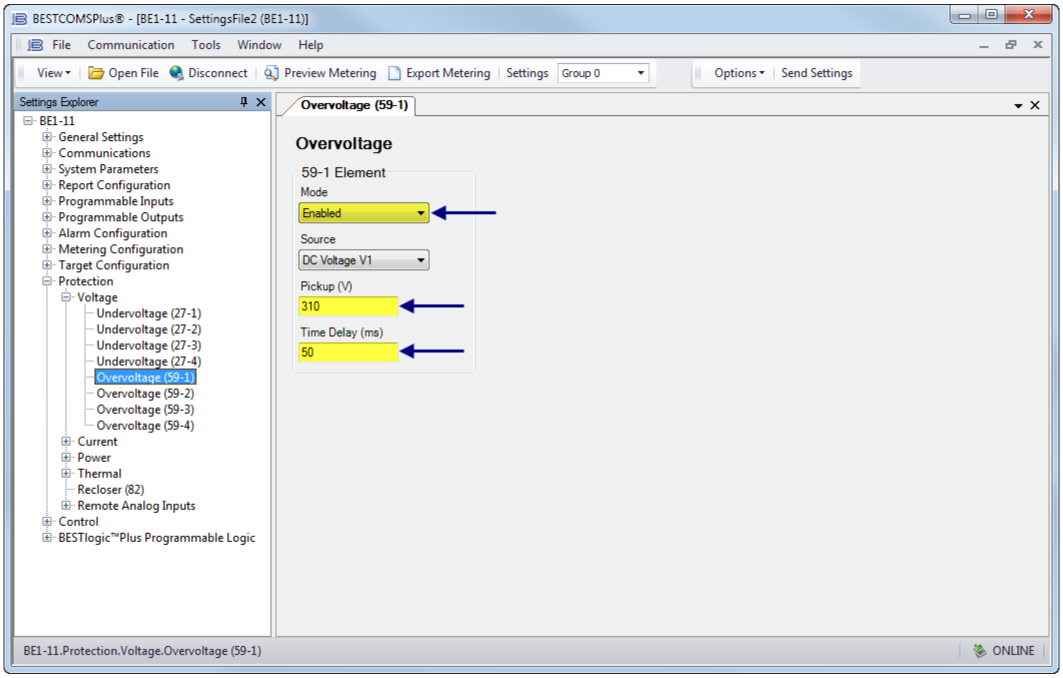


Figure 2-10. Overvoltage (59-1) Screen

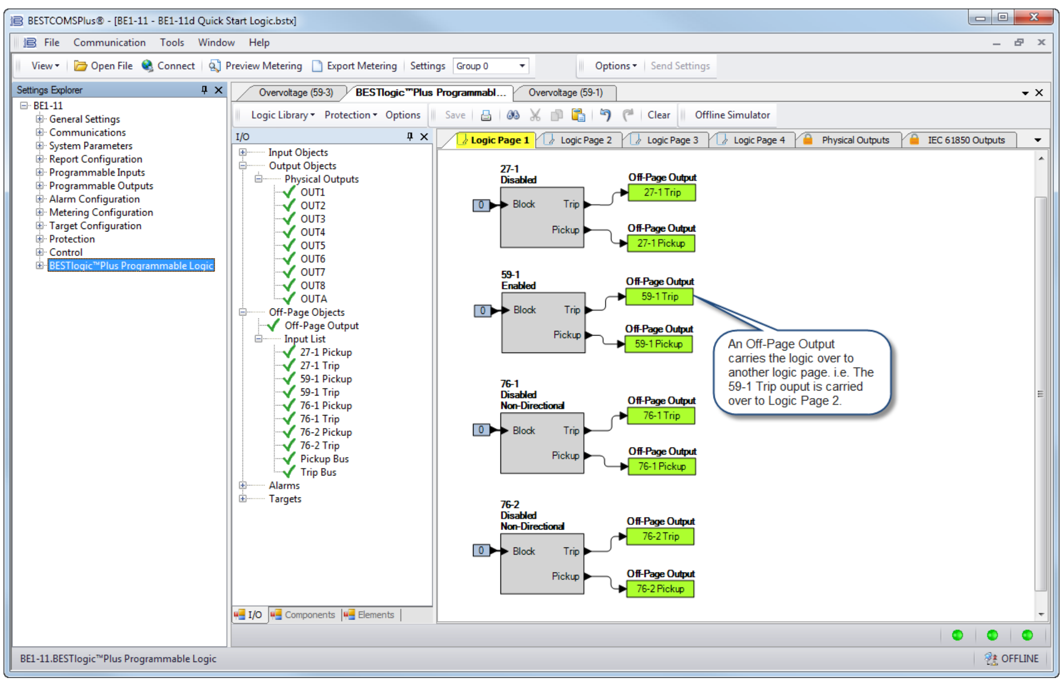


Figure 2-11. BESTlogic*Plus* Logic Page 1

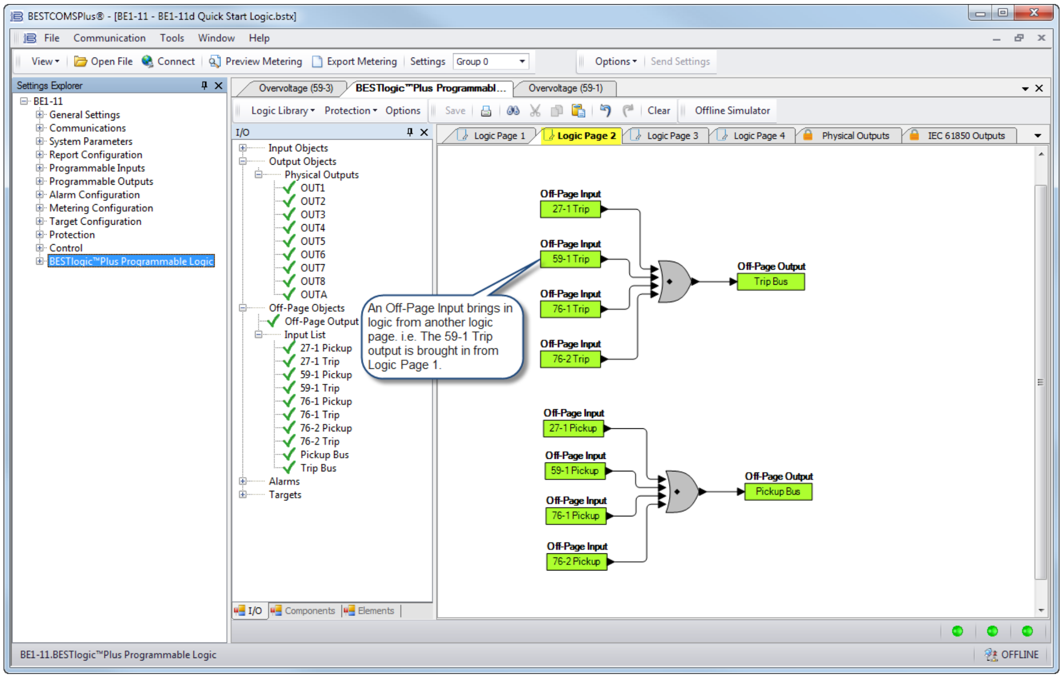


Figure 2-12. BESTlogic*Plus* Logic Page 2

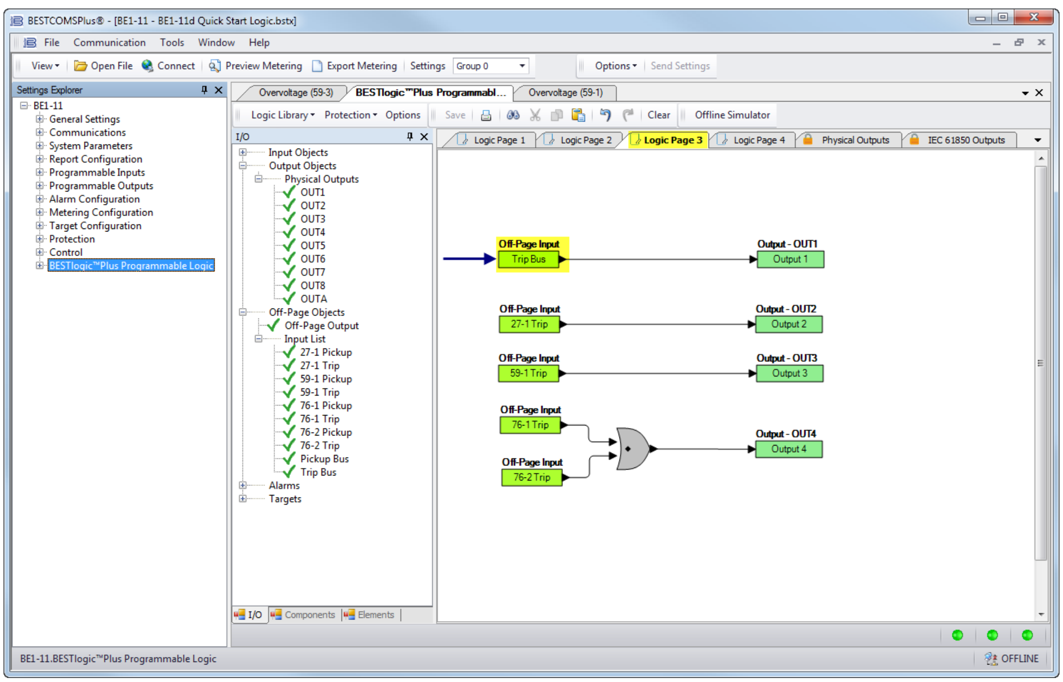


Figure 2-13. BESTlogic*Plus* Logic Page 3

Step 8: In this step, the Pickup output of the 59-1 element is connected to Output 4. When the Pickup output of the 59-1 element is true, the label of Output 4 is displayed in the fault report and/or sequence of events report. The label is named in Step 15. Click the Logic Page 1 tab and then click the I/O tab at the bottom. Expand Output Objects and then Physical Outputs. Click and drag OUT4 over to the logic diagram. Click on the Pickup output of the 59-1 element and drag it to the input of OUT4 to make a connection. Refer to Figure 2-14.

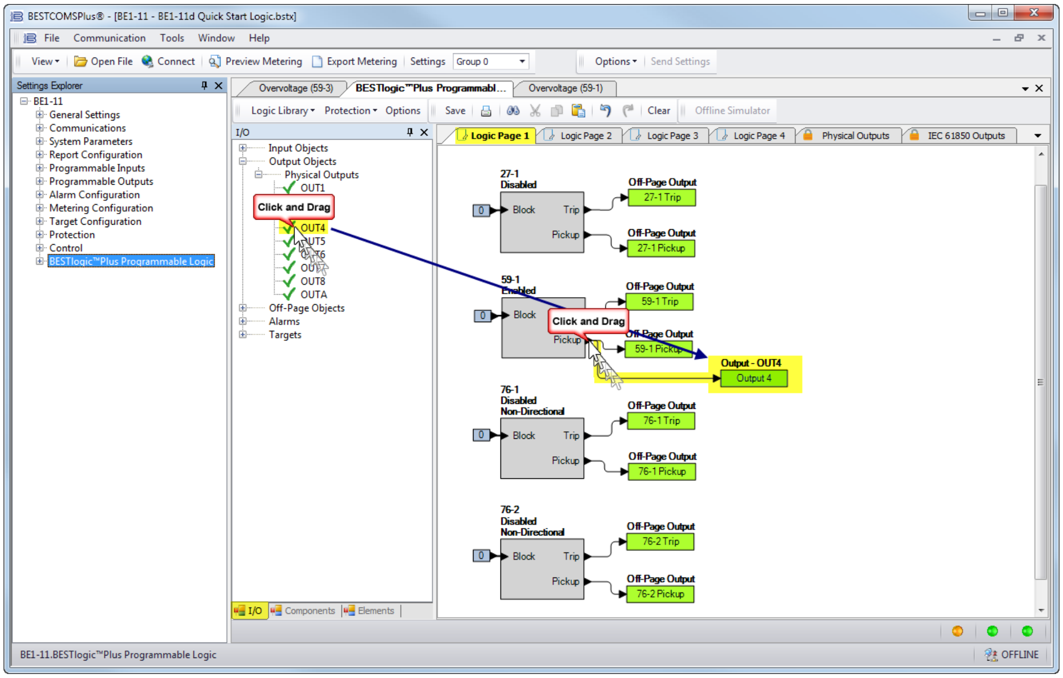


Figure 2-14. BESTlogic*Plus* Programming OUT4

Step 9: In this step, the Pickup output of the 59-1 element is connected to User Alarm 1. When the Pickup output of the 59-1 element is true, the label of the user alarm is displayed on the Alarms screen on the front-panel display and in the fault report and/or sequence of events report. The label is named in Step 12. Click the Logic Page 1 tab and then click the Elements tab at the bottom. Locate the User Alarm 1 element. Click and drag USERALM1 over to the logic diagram. Click on the Pickup output of the 59-1 element and drag to the input of USERALM1 to make a connection. Refer to Figure 2-15.

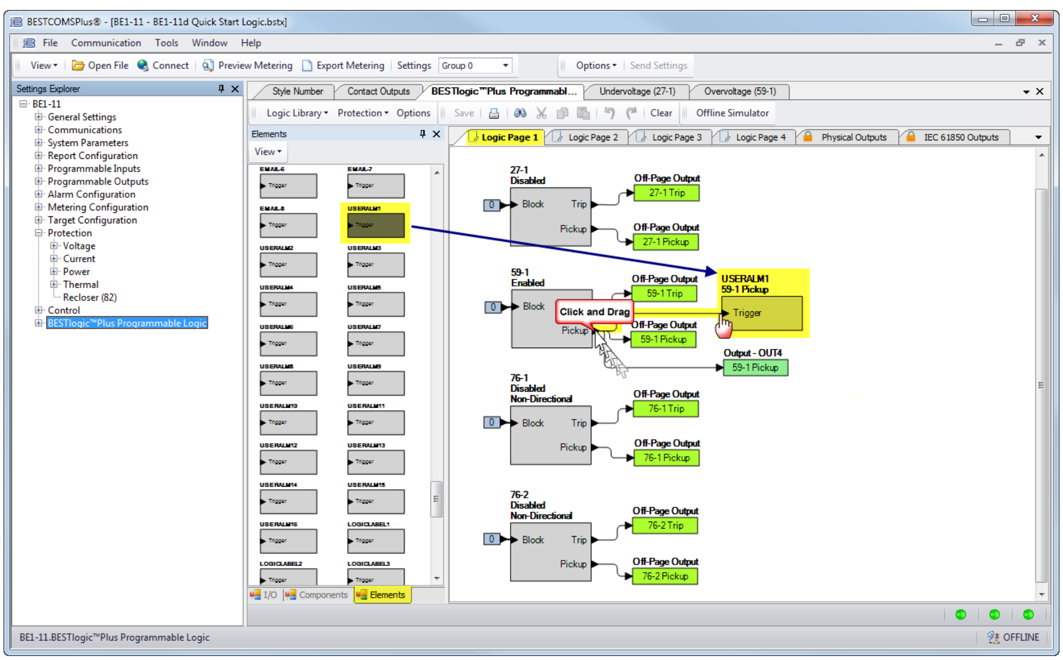


Figure 2-15. BESTlogic*Plus* Programming User Alarm 1

Step 10: Click the Save button to save the logic to BESTCOMS*Plus* memory for later inclusion in the settings file. See Figure 2-16.

Figure 2-16. BESTlogic*Plus* Toolbar

Step 11: In the Settings Explorer, expand Programmable Outputs, Contact Outputs, and name Output #4 (59-1 Pickup) as shown in Figure 2-17.

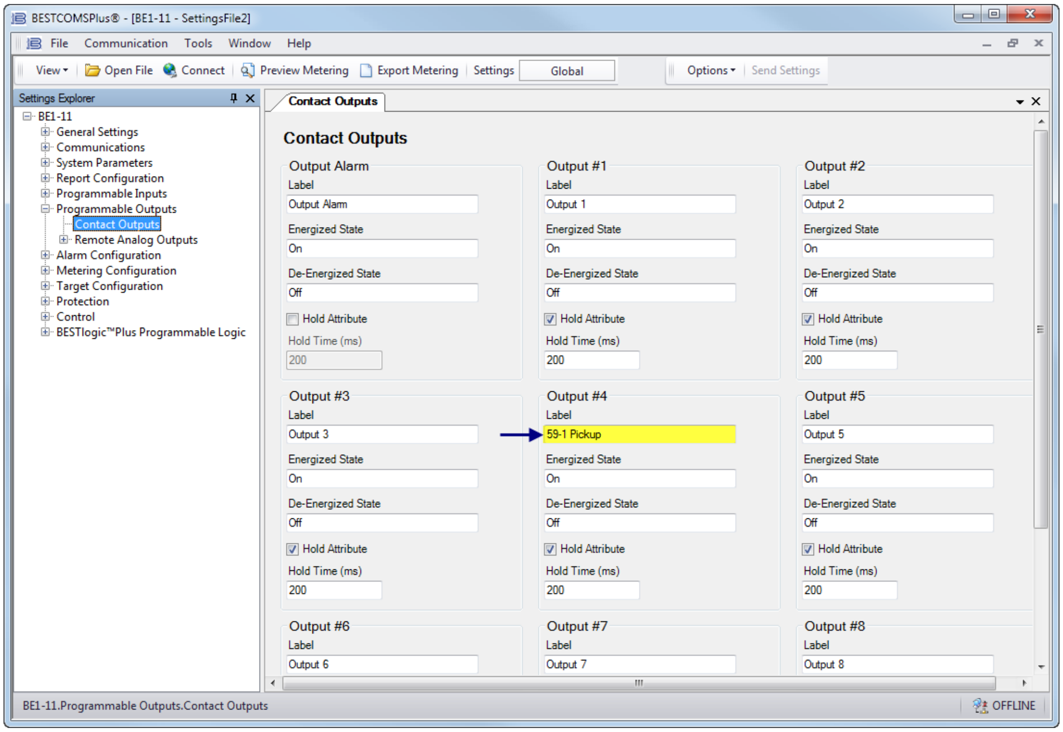


Figure 2-17. Contact Outputs Screen

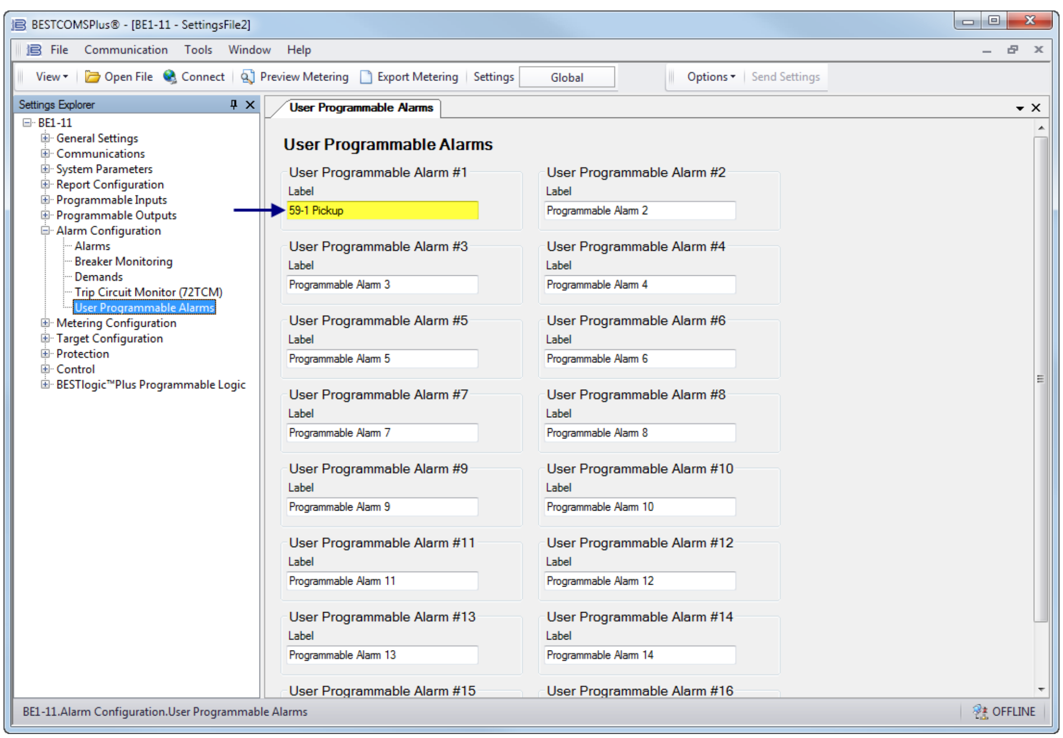


Figure 2-18. User Programmable Alarms Screen

Step 12: In the Settings Explorer, expand Alarm Configuration, User Programmable Alarms, and name User Programmable Alarm #1 (59-1 Pickup) as shown in Figure 2-18.

Step 13: Figure 2-19 shows the user-defined labels of OUT4 and USERALM1 that were named in Steps 11 and 12.

Step 14: Select Save from the File pull-down menu to save your new settings file.

Step 15: To make your new settings active in the BE1-11*d*, select Upload Settings and Logic to Device from the Communication pull-down menu. Enter the username and password.

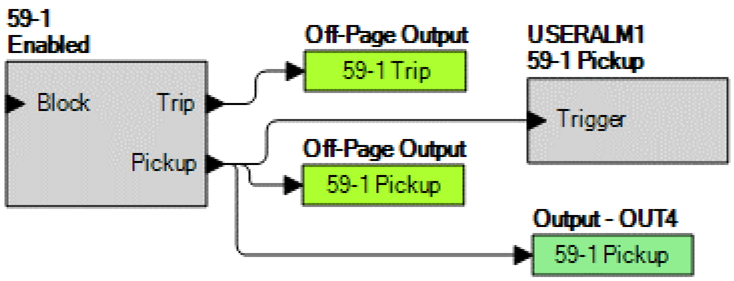


Figure 2-19. OUT4 and USERALM1 with User-Defined Labels

3 • Controls and Indicators

BE1-11*d* controls and indicators are located on the front panel and include sealed membrane switches, LED (light emitting diode) indicator lamps, and a multiple-line, alphanumeric LCD (liquid crystal display).

Illustrations and Descriptions

The HMI (Human-Machine Interface) is illustrated in Figure 3-1 and described in Table 3-1. The locators and descriptions of Table 3-1 correspond to the locators shown in Figure 3-1.

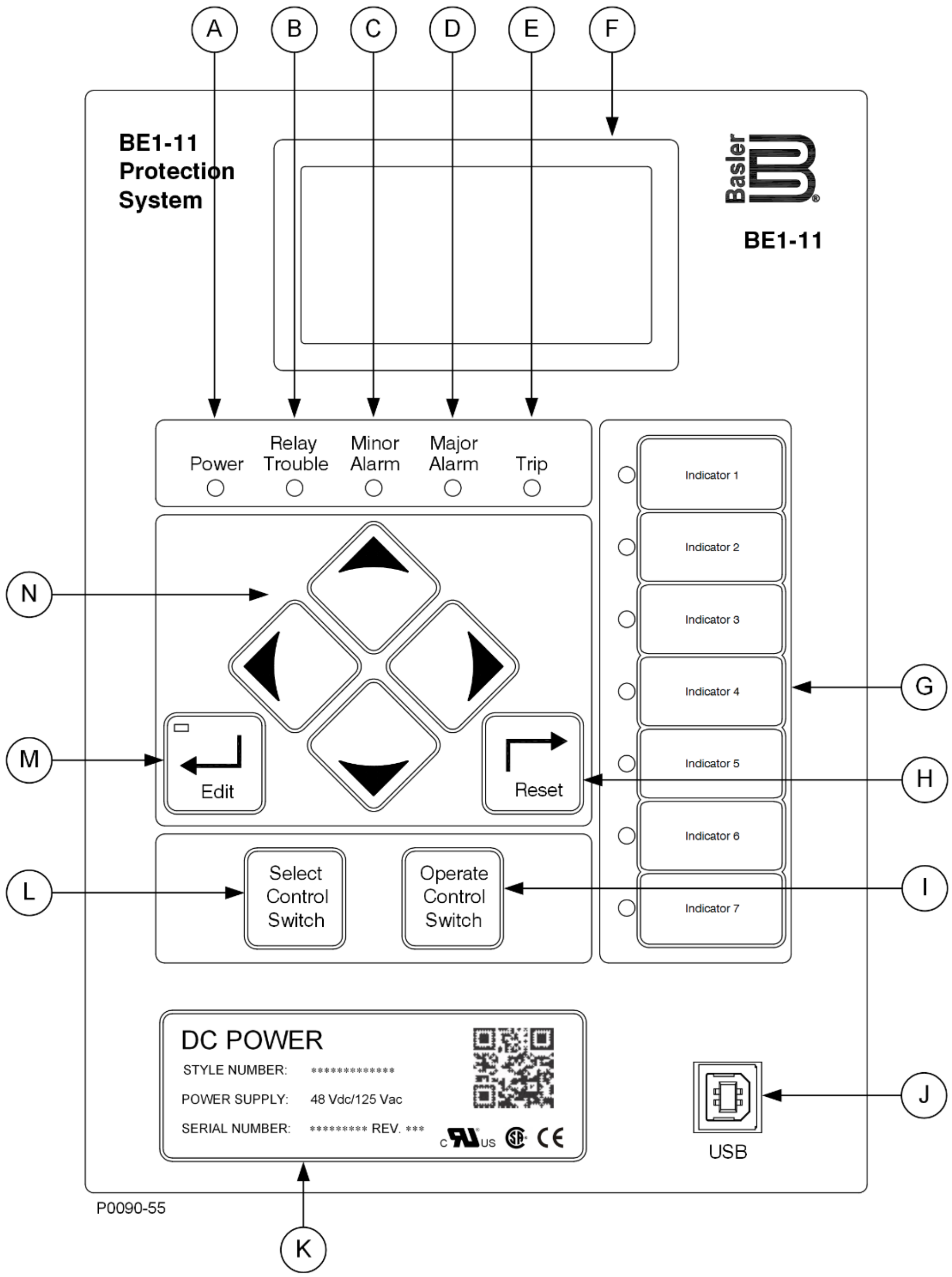


Figure 3-1. Front Panel

Table 3-1. Front Panel Descriptions

Locator	Description
A	Power Indicator – This green LED lights when operating power is applied to the BE1-11*d*.
B	Relay Trouble Indicator – This red LED lights momentarily during start-up and lights continuously when a BE1-11*d* failure is detected. The *Contact Inputs and Outputs* chapter provides a complete description of all BE1-11*d* failure alarm diagnostics.
C, D	Minor Alarm, Major Alarm Indicators – These red LEDs light to indicate that a programmable alarm has been set. Each indicator can be programmed to annunciate one or more conditions. The *Alarms* chapter provides detailed information about programming alarms.
E	Trip Indicator – A flashing red Trip LED indicates that a protective element is picked up. A continuously lit LED indicates that a trip output is closed. This red LED is sealed in if a protective trip has occurred and targets are displayed.
F	Display – 64 x 128 dot pixels liquid crystal display (LCD) with backlighting. The LCD is the primary source for obtaining information from the BE1-11*d* or when locally setting the BE1-11*d*. Information such as targets, metering values, demand values, communication parameters, and diagnostic information is provided by the LCD. Information and settings are displayed in a menu.
G	Indicators – These red LEDs are programmable through BESTlogic™*Plus*. An indicator label can be attached next to each LED. Labels of typical system conditions are provided. Refer to the *BESTlogicPlus* chapter for information on assigning logic elements to LED indicators. Indicator status is also available through the Metering Explorer in BESTCOMS*Plus*®.
H	Reset Pushbutton – Pressing this button resets the Trip LED, sealed-in Trip Targets, and Alarms.
I	Operate Control Switch – This pushbutton operates a 43 virtual control switch after it has been selected using the *Select Control Switch* (L). Refer to the *Virtual Control Switches (43)* chapter for more information about the control switches.
J	USB – This universal serial bus port is used to communicate with the BE1-11*d* using BESTCOMS*Plus*.
K	Identification Label – This label lists the style number, serial number, and power supply input voltages. The QR (Quick Response) code is read by an imaging device, such as a camera on a mobile phone or tablet. If an internet connection is available, you will be directed to the BE1-11*d* mobile web page where you can access this instruction manual, frequently asked questions, and a basic troubleshooting guide. You can also contact technical support and subscribe to Basler Electric product email announcements.
L	Select Control Switch – This pushbutton selects an enabled 43 virtual control switch. The *Operate Control Switch* (J) operates the switch after it has been selected. Refer to the *Virtual Control Switches (43)* chapter for more information about the control switches.
M	Edit Pushbutton – Settings changes are made at the front panel using this pushbutton. When pushed, this switch lights to indicate that Edit mode is active. When you are finished making settings changes (using the scrolling pushbuttons) and the Edit switch is pressed again, the switch light turns off to indicate that your settings changes have been saved. If changes are not completed and saved before the access timeout length setting expires, the BE1-11*d* will automatically exit the Edit mode without saving any changes and announce an Access Error.
N	Scrolling Pushbuttons – Use these four switches to navigate (UP/DOWN/LEFT/RIGHT) through the LCD menu tree. When in Edit mode, the LEFT and RIGHT scrolling pushbuttons select the variable to be changed. The UP and DOWN scrolling pushbuttons change the variable.

Menu Navigation

A menu tree with a Metering branch and a Settings branch can be accessed through the front-panel controls and display. A greater level of detail in a menu branch is accessed using the right scrolling pushbutton. The left scrolling pushbutton is used to return to the top of the menu branch.

Figure 3-2 illustrates the organization of the front-panel display menu tree structure.

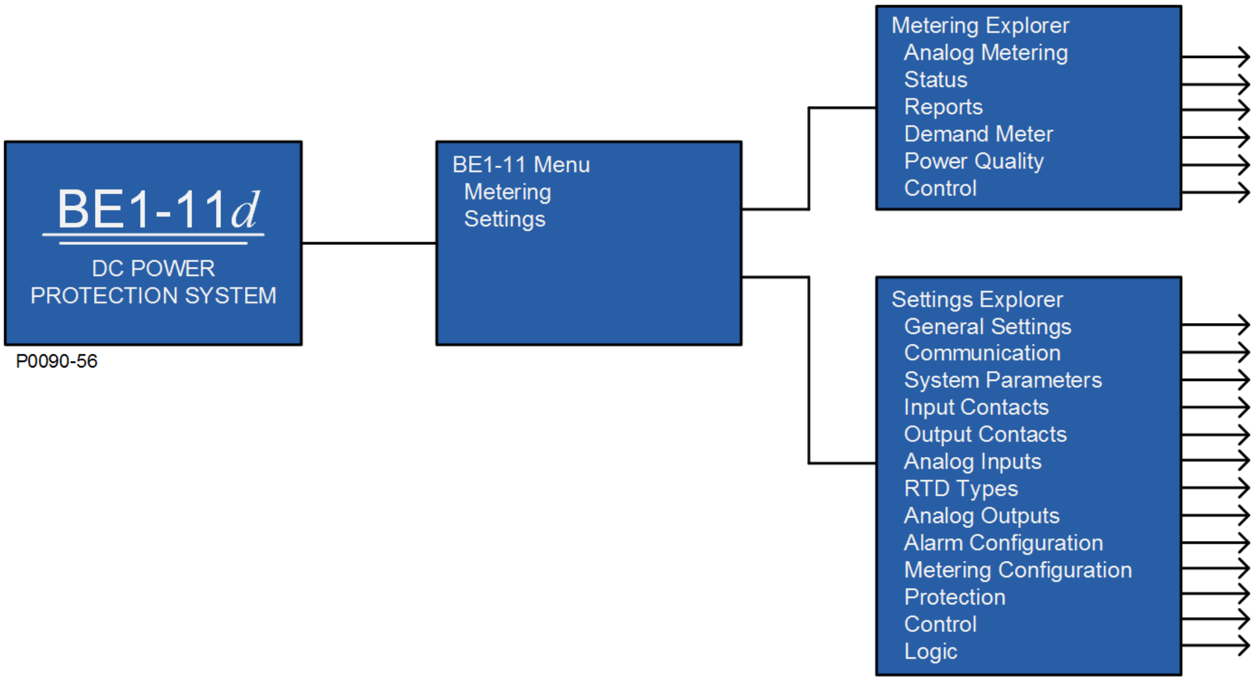


Figure 3-2. Front-Panel Display Menu Tree Layout

Front Panel Operations

The following paragraphs describe how the front-panel interface is used to set and control BE1-11*d* functions.

Entering Usernames and Passwords

If password security has been initiated for a function, the front-panel display will prompt you to enter a username and password when the Edit pushbutton is pressed. To gain access, you must enter the appropriate username and password. You can enter usernames and passwords by performing the following procedure:

1. Press the Edit pushbutton.
2. Enter the username by pressing the UP or DOWN scrolling pushbuttons until the proper first character of the username appears. Pressing the UP pushbutton scrolls through the alphabet and then the numbers in ascending order. Pressing DOWN scrolls through the numbers and then the alphabet in descending order.
3. Press the RIGHT scrolling pushbutton to move the cursor to the next character of the username and select the appropriate character.
4. Continue the process until the entire username has been spelled out. Press the Edit pushbutton when finished.
5. Repeat Steps 2 through 4 for the password.
6. Press the Edit pushbutton.

7. If the proper username and password have been entered, the screen will flash the type of access that has been granted. If an incorrect password has been entered, the screen will flash “Read Access”.
8. Once you gain access, it remains in effect until the access timeout length setting expires. As long as you continue to press the Edit key for a function for which you have gained access, the five-minute timer will be refreshed and you will not be prompted for a password.

To close access immediately, press the Reset button while any non-settings screen is displayed. The BE1-11*d* should flash “Read Only” on the LCD screen to indicate access through the front panel has been terminated.

Entering Settings

Settings for protection functions can be edited by using the RIGHT, LEFT, UP, and DOWN front-panel navigation keys. Navigate to Settings > Protection.

To edit a setting using the manual scrolling pushbuttons, perform the following procedures:

1. After scrolling to the desired settings group and element category, scroll to the screen that displays the function to be edited.
2. Press the Edit pushbutton to gain access. If password security has been initiated for settings, you will be prompted to enter the appropriate username and password. See the paragraphs, *Entering Usernames and Passwords*, for details on entering usernames and passwords from the front panel. Once access has been gained, the Edit LED will be lit and a cursor will appear in the first settings field on the screen.
3. Press the UP or DOWN scrolling key to select the desired setting. Some settings must be entered one character at a time. For example, to enter a 76-1 pickup as 7.3 amps, you would place the cursor in the Pickup field and press the UP pushbutton until the 7 is showing. Then press the RIGHT pushbutton to move the cursor over to the right side of the decimal and press the UP pushbutton until the 3 is showing. Other settings require scrolling through a list of selections. For example, you would move the cursor over to the Curve Index field and then scroll through a list of available time characteristic curves.
4. Once all of the settings on the screen have been entered, press the Edit pushbutton a second time and the settings will be validated. If the settings are in range, the Edit LED will go out. If you want to abort the edit session without changing any settings, press the Reset pushbutton before you press the Edit pushbutton the second time. The Edit LED will go out.

Performing Control Operations

Control operations can be executed by navigating to Metering, Control. These functions allow you to control the state of virtual switches, override logic, control the active setting group, and control the state of output contacts. All of these functions work similarly to the process of entering settings in that you press the Edit pushbutton for the action to be executed.

To operate the switch, use the following procedure:

1. Use the scrolling pushbuttons to scroll to Settings > Control > Virtual Switch 43 > 43-1 and verify that the 43-1 is set for Switch/Pulse mode.
2. Use the scrolling pushbuttons to scroll to Metering > Control > Virtual Switches > 43-1 > Operate.
3. Press the Edit pushbutton to gain access. If password security has been initiated for control functions, you will be prompted to enter the appropriate username and password. Once access is gained to the control function, press the Edit pushbutton and the Edit LED will light.
4. Press the UP or DOWN scrolling key to select the new state for the switch. The “Pulse” selection will pulse the state of the switch from its present state to the opposite state for approximately 200 milliseconds. The “Set” selection will set the state of the switch to true. The “Reset” selection will set the state of the switch to false. The allowable states are dependent upon the logic mode setting for the switch. If the switch is set to Switch mode, only the “Set” and “Reset” will function.

If the switch is set to Pulse mode, only the "Pulse" selection will function. If the switch is set to Switch/Pulse mode, any of the selections will function.

5. Press the Edit pushbutton a second time and the switch will change to the selected position and the Edit LED will go out. If you want to abort the editing session without changing any controls, press the Reset pushbutton before you press the Edit pushbutton the second time. The Edit LED will go out.

Resetting Functions

The Reset pushbutton is context sensitive. Its function is dependent upon the screen that is presently being displayed. For example, pressing the Reset key when Targets screen is displayed will reset the targets, but it will not reset the alarms, etc. It is necessary to scroll through the menu tree to the appropriate alarm screen to reset an alarm. You are prompted for a username and password when using the Reset key.

Display Setup

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Front Panel HMI

HMI Navigation Path: Settings Explorer, Control, General Settings, Front Panel HMI

Front-panel display settings are described in the following paragraphs. The BESTCOMS*Plus* Front Panel HMI screen is illustrated in Figure 3-3.

LCD Setup

The contrast of the front-panel LCD (liquid crystal display) can be adjusted to suit the viewing angle used or compensate for environmental conditions. When Invert Display is enabled, the display is inverted to have blue letters on a white background.

Sleep Mode Setup

A power saving feature, referred to as Sleep mode, will dim the front-panel LCD backlight when a front-panel key is not pressed for more than the user settable time delay. Normal display operation is resumed when any front-panel button is pressed. Sleep mode is enabled and disabled in BESTCOMS*Plus*.

Screen Scrolling Setup

When Screen Scrolling is enabled, the front-panel summary screen will scroll through the list of Scrolling Screen items. The Scroll Time Delay determines the scrolling speed. The Show Splash Screen setting allows the splash screen to be shown or hidden from screen scrolling. When screen scrolling is enabled and no screens are selected, the splash screen is displayed even if the Show Splash Screen setting is disabled. Scrolling screen items can only be selected in BESTCOMS*Plus*.

Targets and alarms are automatically displayed on the front-panel LCD when they become active if on the splash screen. After targets and alarms are reset, the BE1-11*d* returns to the main screen and begins scrolling if scrolling is enabled. Press the RIGHT navigation key to access the menu when targets and alarms are being displayed.

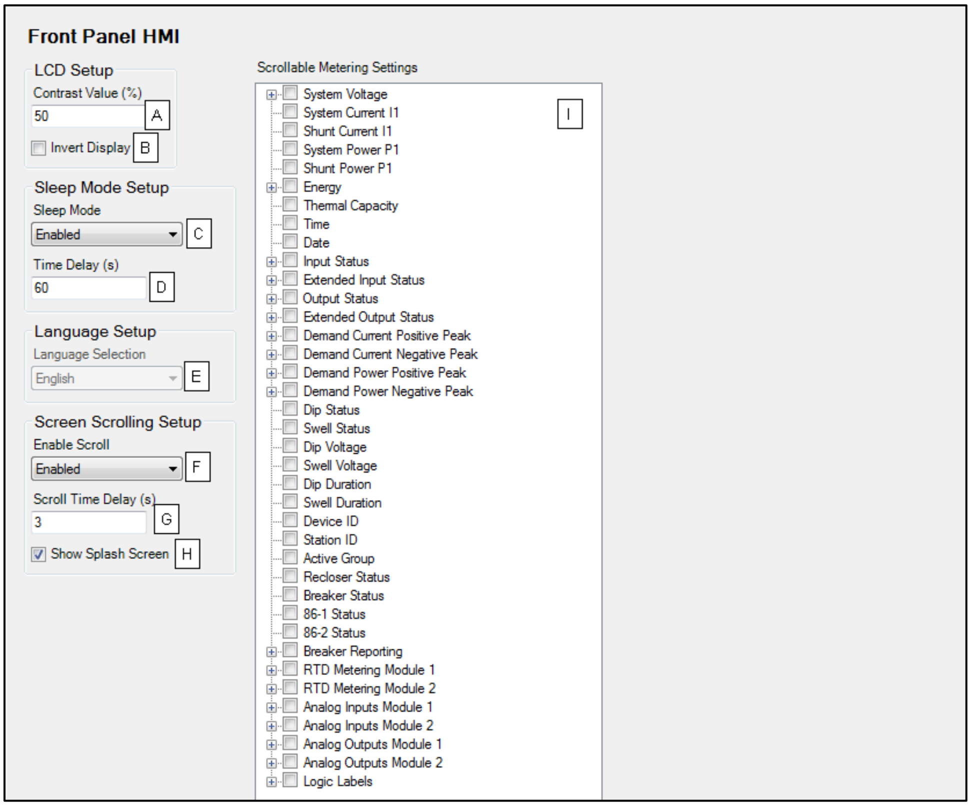


Figure 3-3. Front-Panel Display Setup Screen

4 • Contact Inputs and Outputs

BE1-11*d* DC Power Protection Systems provide contact inputs, general-purpose contact outputs, and one dedicated fail-safe alarm contact output. Each input and output is isolated and terminated at separate terminals. This chapter describes the function and setup of each input and output.

Contact-Sensing Inputs

Either 7 or 10 contact inputs are available to initiate BE1-11*d* protection system actions. Refer to the style chart for I/O options. Each isolated input requires an external wetting voltage. The nominal voltage(s) of the external dc source(s) must fall within the BE1-11*d* dc power supply input voltage range. To enhance user flexibility, the BE1-11*d* protection system uses a wide-range ac/dc power supply that covers several common control voltage ratings. To enhance flexibility, the input circuits are designed to respond to voltages at the lower end of the control voltage range while not overheating at the high end of the control voltage range.

The contact input circuits are polarity sensitive. When an ac wetting voltage is applied, the input signal is half-wave rectified by the opto-isolator diodes. The contact inputs drive BESTlogic™*Plus* variables IN1 through IN10. Each contact input is completely programmable so meaningful labels can be assigned to each input and the logic-high and logic-low states. The *BESTlogicPlus* chapter provides more information about using contact inputs in your programmable logic scheme.

Contact-Sensing Input Jumpers

Note
The BE1-11*d* protection system is delivered with the jumpers in the HIGH position. Read the following paragraphs before placing the BE1-11*d* in service.

Energizing levels for the contact-sensing inputs are jumper selectable for a minimum of approximately 26 Vdc for 48 Vdc nominal sensing voltages or 69 Vdc for 125 Vdc nominal sensing voltages. See Table 4-1 for the contact-sensing turn-on voltages.

Table 4-1. Contact-Sensing Turn-On Voltages

Nominal Input Voltage	Contact Sensing Turn-On Voltage *	
	Jumper Installed (Low Position)	Jumper Not Installed (High Position)
48 Vdc or 125 Vac/dc	26 to 38 Vdc	69 to 100 Vdc 56 to 97 Vac

* AC voltage ranges are calculated using the default recognition time (4 ms) and debounce time (16 ms).

Each BE1-11*d* is delivered with the contact-sensing jumpers disconnected for operation in the higher end of the control voltage range. If the contact-sensing inputs are to be operated at the lower end of the control voltage range, the jumpers must be installed.

The following paragraphs describe how to locate and remove/change the contact-sensing input jumpers:

1. Remove the BE1-11*d* from service and de-energize it.
2. The contact-sensing input jumpers are located behind the rear terminal blocks that are used for input connections. Using a 7/64” hex tool, remove the rear terminal block(s) associated with the input(s) that you want to configure. Observe all electrostatic discharge (ESD) precautions when handling the BE1-11*d*.
3. Using the input labels on the rear panel as a guide, locate the appropriate jumper terminal block that is mounted on the circuit board. Each terminal block has two sets of pins. With the jumper as

installed at the factory, one pin should be visible when viewed from the back of the unit. This configuration allows the inputs to operate at the higher end of the control voltage range. Figure 4-1 illustrates the location of the contact-sensing jumpers. The jumpers are shown in the HIGH position.

4. To select operation at the lower end of the control voltage range, install the jumper across the two pins using needle-nose pliers. Use care when removing and installing each jumper so that no components are damaged.
5. When all jumpers are positioned for operation in the desired control voltage range, reinstall the rear terminal block(s).
6. Using a 7/64” hex tool, tighten the screws to 10 in-lbs (1.12 N•m).

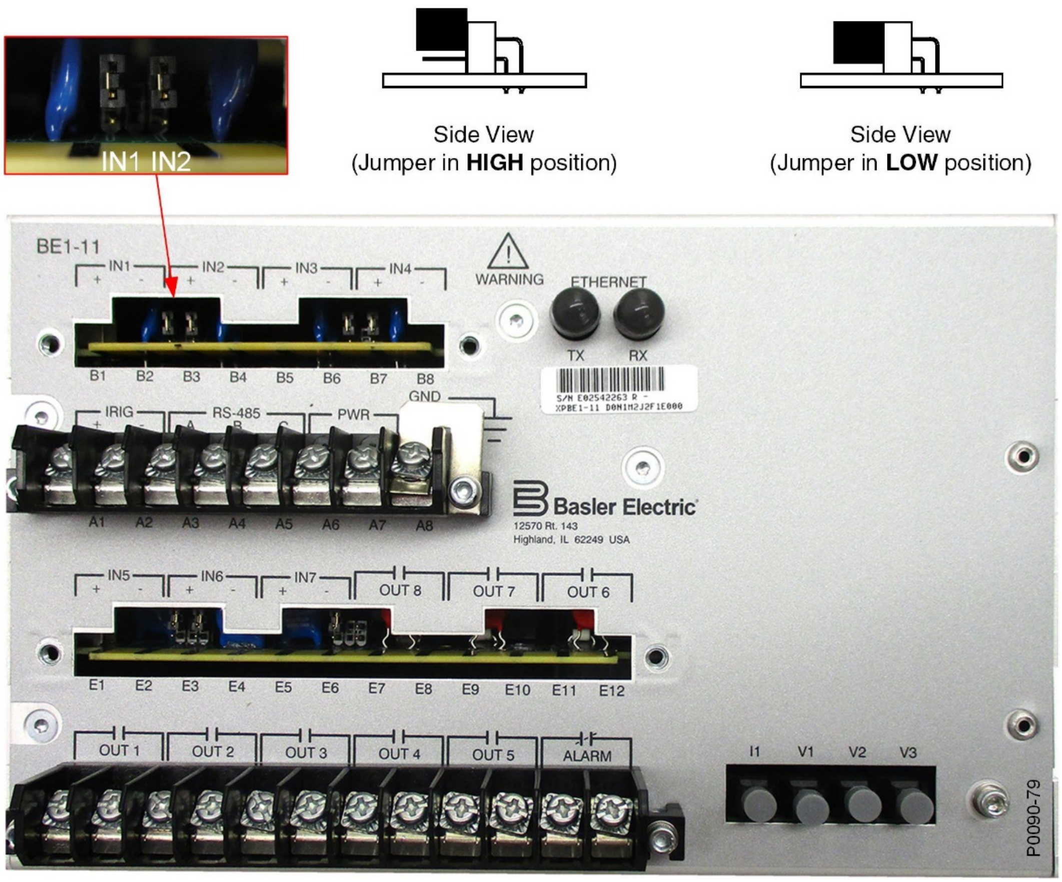


Figure 4-1. Contact-Sensing Jumper Locations (Standard I/O Option)

Digital Input Conditioning Function

Status of the contact-sensing inputs is checked every 1 millisecond. User-settable digital contact recognition and debounce timers condition the signals applied to the inputs. These parameters can be adjusted to obtain the optimum compromise between speed and security for a specific application. (See Figure 4-2.)

If the sampled status of a monitored contact is detected as energized for the recognition time, the logic variable changes from a de-energized (logic 0 or false) state to an energized (logic 1 or true) state. Once contact closure is recognized, the logic variable remains in the energized state until the sampled status of the monitored contact is detected to be de-energized for a period that is longer than the debounce time. At this point, the logic variable will change from an energized (logic 1 or true) state to a de-energized (logic 0 or false) state.

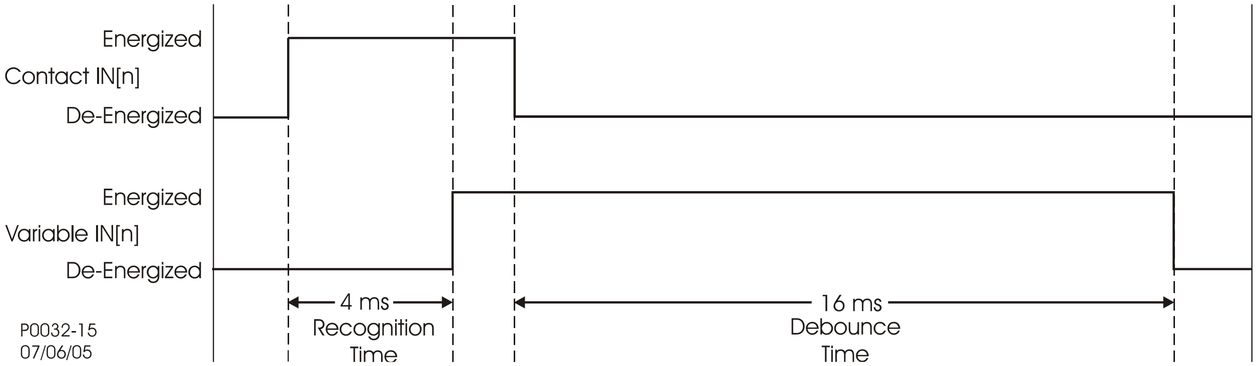


Figure 4-2. Digital Input Conditioning Timing Diagram

Setting the Contact Inputs

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Inputs, Contact Inputs

HMI Navigation Path: Settings Explorer, Contact Inputs

Settings and labels for the contact inputs are set using BESTCOMS*Plus*®.

Each of the inputs have two settings and three labels. The settings are Recognition Time and Debounce Time. The labels include a label to describe the input, a label to describe the Energized State, and a label to describe the De-Energized State. Labels are used by the BE1-11*d*'s reporting functions.

To edit the settings or labels, use the Settings Explorer to open the Programmable Inputs, Contact Inputs tree branch as shown in Figure 4-3.

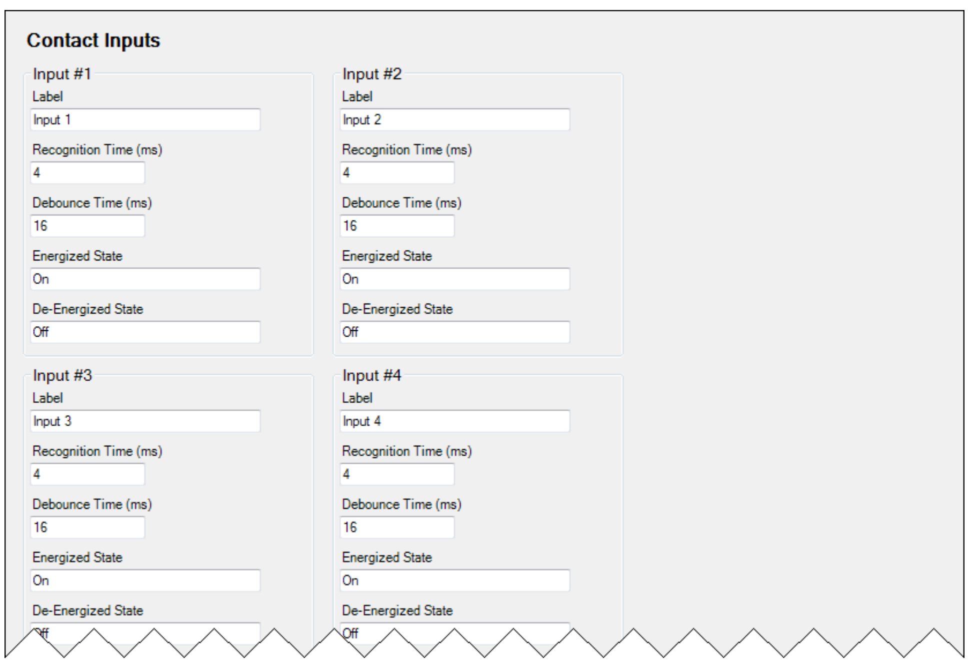


Figure 4-3. Contact Inputs Screen

See Table 4-2 for a list of settings and their defaults.

Table 4-2. Contact Input Settings

Setting	Range	Increment	Unit	Default
Label	User programmable label for the input contact. Used by the reporting function to give meaningful identification to the input contact. This label can be up to 64 characters long.			
Recognition Time	4 to 255	1 *	milliseconds	4
Debounce Time	4 to 255	1 *	milliseconds	16
Energized State	User programmable label for the energized state of the contact. Used by the reporting function to give meaningful identification to the state of the input contact. This label can be up to 64 characters long.			
De-Energized State	User programmable label for the de-energized state of the contact. Used by the reporting function to give meaningful identification to the state of the input contact. This label can be up to 64 characters long.			

* Since the input conditioning function is evaluated every quarter cycle, the setting is internally rounded to the nearest multiple of 4.16 milliseconds.

If you are concerned about ac voltage being coupled into the contact sensing circuits, the recognition time can be set higher than one-half of the power system cycle period. This will take advantage of the half-wave rectification provided by the input circuitry.

If an ac wetting voltage is used, the recognition time can be set to less than one-half of the power system cycle period and the debounce timer can be set to greater than one-half of the power system cycle period. The extended debounce time will keep the input energized during the negative half-cycle. The default settings of 4 and 16 milliseconds are compatible with ac wetting voltages.

Settings for contact inputs can also be entered through the front panel.

See the *Terminals and Connectors* chapter for an illustration of the programmable output terminals. Contact output electrical ratings are listed in the *Specifications* chapter.

Retrieving Contact-Sensing Input Status

Contact input status is determined through BESTCOMS*Plus* by using the Metering Explorer to open the Status, Inputs tree branch. BESTCOMS*Plus* must be online with the BE1-11*d* to view contact input status. Alternately, status can be determined through the front-panel display by navigating to Metering > Status > Inputs.

Contact Outputs

BE1-11*d* protection systems have either eight or five general-purpose contact outputs (OUT1 through OUT8/OUT5) and one failsafe, normally open or closed (when de-energized) alarm contact output (OUTA). Refer to the style chart for I/O options. Each output is isolated and rated for tripping duty. OUT1 through OUT8 are Form A (normally open), and OUTA is Form B (normally closed) or Form A (normally open).The style number determines the type of alarm contact output. A trip coil monitoring circuit is hardwired across OUT1. See the *Trip Circuit Monitor (72TCM)* chapter for details.

Contact outputs OUT1 through OUT8 and OUTA are driven by BESTlogic*Plus* expressions for OUT1 through OUT8 and OUTA. The use of each contact output is completely programmable so you can assign meaningful labels to each output and to the logic 0 and logic 1 states of each output. The *BESTlogicPlus* chapter has more information about programming output expressions in your programmable logic schemes.

BESTlogic*Plus* expressions for OUT1 through OUT8 and OUTA drive contact outputs OUT1 through OUT8 and OUTA. The state of the contact outputs can vary from the state of the output logic expressions for three reasons:

1. The relay trouble alarm disables all hardware outputs.
2. The programmable hold timer is active.
3. The select-before-operate function overrides a virtual output.

Figure 4-4 shows a diagram of the contact output logic for the general-purpose contact outputs. The OUT1 relay closes when the 76-1 element is in a trip condition.

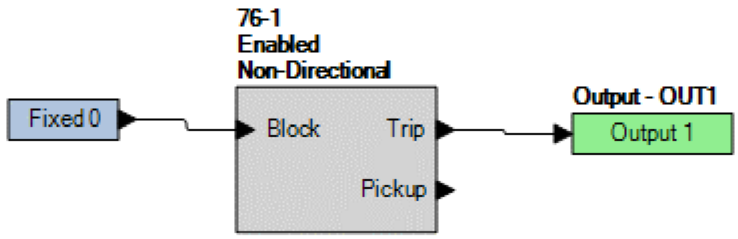


Figure 4-4. Output Logic, General Purpose Contact Outputs

Figure 4-5 illustrates the contact output logic for the failsafe alarm contact output when OUTA is normally closed (style xxxxxxx2xxxxxx). The OUTA relay closes when the 76-1 element is in a trip condition.

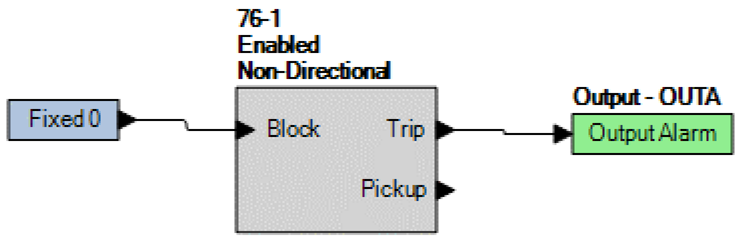


Figure 4-5. Output Logic, Failsafe Alarm Contact Output

Relay Trouble Alarm Disable

All internal circuitry and software that affects how the BE1-11*d* functions is monitored by the continuous self-test diagnostics function of the relay trouble alarms. A detailed list of relay trouble alarms is provided in Table 4-3. If any one of these points asserts, the failsafe alarm output relay de-energizes and closes/opens (depending on style number) the OUTA contact, the front-panel Relay Trouble LED lights, all output relays are disabled, logic OUTA is set, and the BE1-11*d* is taken offline. The relay trouble alarms function is not programmable.

Table 4-3. Relay Trouble Alarms

Name	Description
NVMH Settings File Not Opened	Error opening settings file
Update NVM Blocks Failed	Error writing settings file
NVMH Saving Blocks Error	Error writing settings file
NVMH Flash File Error	Error writing settings file
Flash Error	Flash file system error
uP Reset	Repetitive reboot
Cal Error	Calibration error
Cal Defaults Loaded	BE1-11*d* not calibrated
Defaults Loaded	Defaults have been loaded
uP Overload	Microprocessor is busy
Power Supply	Input power is too low/failed

Programmable Hold Timer—Hold Attribute

Historically, electromechanical relays have provided trip contact seal-in circuits. These seal-in circuits consisted of a dc coil in series with the relay trip contact and a seal-in contact in parallel with the trip contact. The seal-in feature serves several purposes for electromechanical relays. One purpose is to provide mechanical energy to drop the target. A second purpose is to carry the dc tripping current from the induction disk contact, which might not have significant closing torque for a low resistance connection. A third purpose is to prevent the relay contact from dropping out until the current has been interrupted by the 72a contacts in series with the trip coil. If the tripping contact opens before the dc current is interrupted, the contact might be damaged. Of the three items, only item three is an issue for electronic protection systems like the BE1-11*d*.

Contact Output Seal-In Logic

To prevent the output relay contacts from opening prematurely, a hold timer (200 to 2,000 ms) can be set with BESTCOMS*Plus*. If the protection engineer desires seal-in logic with feedback from the breaker position logic, he/she can provide this logic by modifying the logic for the tripping output. To do this, use one of the general purpose timers (62) and set it for Pickup/Dropout mode. Set the timer logic so that it is initiated by the breaker position input and set the timer for 32 ms pickup and 32 ms dropout. The same can be done for the closing output. Figure 4-6 provides a seal-in logic diagram.

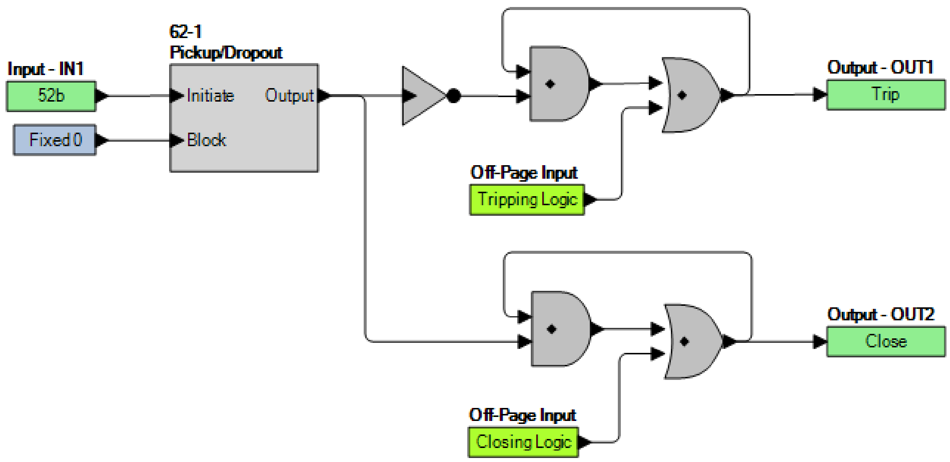


Figure 4-6. Contact Output Seal-In Logic Diagram

Setting the Contact Outputs

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Outputs, Contact Outputs

HMI Navigation Path: Not available through the front panel

Settings and labels for the contact outputs are set using BESTCOMS*Plus*.

Each of the eight outputs has one setting and three labels. The setting consists of a Hold Attribute. The labels include a label to describe the output, a label to describe the Energized State, and a label to describe the De-Energized State. Labels are used by the BE1-11*d*'s reporting functions.

To edit the settings or labels, use the Settings Explorer to open the Programmable Outputs, Contact Outputs tree branch as shown in Figure 4-7.

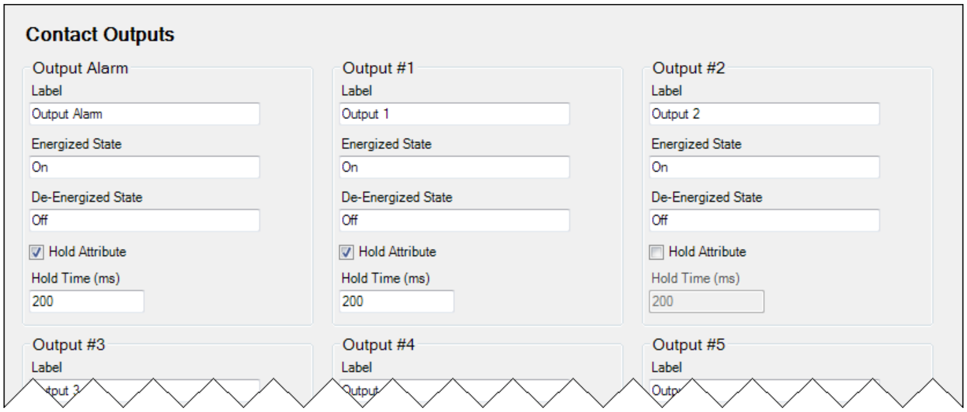


Figure 4-7. Contact Outputs Screen

Contact Output Logic Override Control

BESTCOMS*Plus* Navigation Path: Metering Explorer, Control, Output Override

HMI Navigation Path: Metering Explorer, Control, Output Override Contacts

Each contact output can be controlled directly using the select-before-operate output control function. The output logic expression that normally controls the state of an output can be overridden and the contact pulsed, held open, or held closed. This function is useful for testing purposes. An alarm point is available in the programmable alarm function for monitoring when the output logic has been overridden. See the *Alarms* chapter for more information about programmable alarms. Output logic override control is achieved using the front-panel interface or BESTCOMS*Plus*. Use the Metering Explorer to open the Control, Output Override screen. Refer to Figure 4-8.

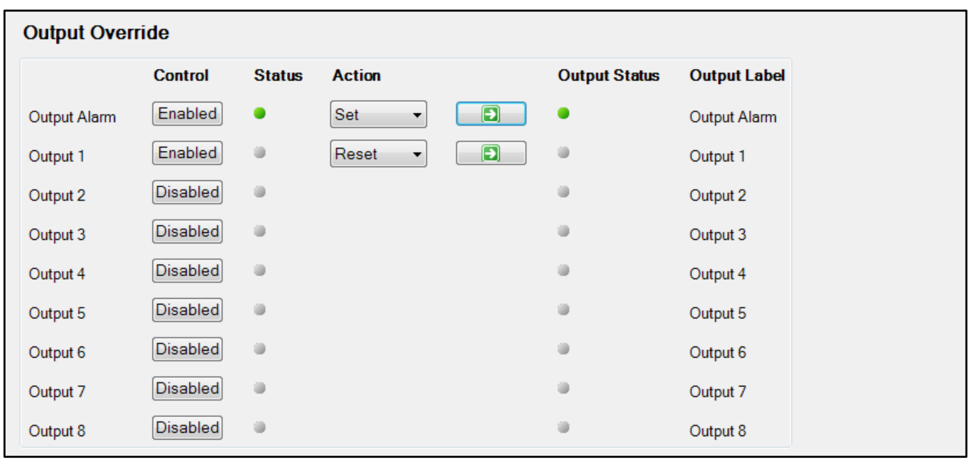


Figure 4-8. Output Override Screen

Enabling Logic Override Control

By default, logic override control is disabled. Output logic override must be enabled before the control can be used. Enabling of the output logic override control is not possible at the front panel. It can only be enabled through a communication port using BESTCOMS*Plus* (Figure 4-8). Click on the Disabled button next to the output you want to control. This button will change to Enabled and the following three action choices will appear to the right: Reset, Set, and Pulse.

Pulsing a Contact Output

Pulsing BE1-11*d* outputs provides the user the ability to test the operability of an output without energizing a measuring or timing element. This feature is useful when testing the protection and control system. When pulsed, an output changes from the current state (as determined by the virtual output logic expression) to the opposite state for 200 milliseconds. After 200 milliseconds, the output is returned automatically to logic control.

In the Action column, select Pulse from the drop-down menu and click on the green arrow to the right. Pulse override control can also be accessed at the Metering > Control > Override Output Contacts screen of the front-panel display by selecting PUL in the Override State field for the output contact to be pulsed.

Changing the State of a Contact Output

Outputs can be forced to an energized (logic 1 or true) state or to a de-energized (logic 0 or false) state. This feature can be used to disable a contact during testing.

In the Action column, select Set or Reset from the drop-down menu and click on the green arrow to the right. Contact output override control can also be accessed at the Metering > Control > Override Output Contacts screen of the front-panel display by entering a SET (logic 1 or true) or RST (logic 0 or false) in the Override State field for the contact output to be controlled.

Returning a Contact Output to Logic Control

When the output logic has been overridden and the contact is held in an energized or de-energized state, it is necessary to return the output to logic control.

Click on the Enabled button next to the output you want to change to logic control. This button changes to Disabled and the action choices disappear. Logic control can also be achieved at the Metering > Control > Override Output Contacts screen of the front-panel display by setting Override Enable to Disabled.

See the *Terminals and Connectors* chapter for an illustration of the programmable output terminals. Contact output electrical ratings are listed in the *Specifications* chapter.

Retrieving Contact Output Status

Output status is determined through BESTCOMS*Plus* by using the Metering Explorer to open the Status/Outputs tree branch. BESTCOMS*Plus* must be online with the BE1-11*d* to view contact output status. Alternately, status can be determined through the front-panel display by navigating to Metering > Status > Outputs.

5 • Undervoltage (27) Protection

Four undervoltage (27) elements monitor the voltage applied to the IT-D Isolation Transducer. This information is sent from the IT-D to the BE1-11*d* via the fiber-optic interface. An element can be configured to protect against undervoltage when the voltage decreases below a defined level.

The four, identical undervoltage protection elements are designated 27-1, 27-2, 27-3, and 27-4. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Undervoltage settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Voltage, Undervoltage (27)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Voltage Protection, Undervoltage 27

Element Operation

Undervoltage protection can be used to prevent damage to the train load in a transit application. For example, an undervoltage condition could occur when a faulty rectifier is producing less than nominal DC voltage output to the rail.

Source

The Source setting configures an undervoltage element to monitor V1, V2, or V3.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the measured voltage decreases below the voltage threshold established by the Pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay. A Time Delay setting of zero (0) makes the 27 element instantaneous with no intentional time delay.

If the pickup condition subsides before the element delay, the timer and Pickup output are reset, no corrective action is taken, and the element is rearmed for any other occurrences of undervoltage.

Trip

The Trip output becomes true when an undervoltage pickup condition persists for the duration of the element Time Delay setting. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Inhibit Level

The Inhibit Level setting impedes undervoltage element operation during undervoltage conditions that may occur during equipment startup.

Element Blocking

Block Logic Input

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Undervoltage element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The undervoltage element logic block is illustrated in Figure 5-1. Logic inputs and outputs are summarized in Table 5-1.

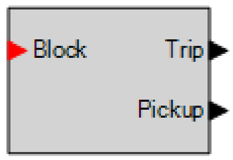


Figure 5-1. Undervoltage Element Logic Block

Table 5-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the 27 function when true
Trip	Output	True when the 27 element is in a trip condition
Pickup	Output	True when the 27 element is in a pickup condition

Operational Settings

Undervoltage element operational settings are configured on the Undervoltage (27) settings screen (Figure 5-2) in BESTCOMS*Plus*.

Figure 5-2. Undervoltage Settings Screen

6 • Overvoltage (59) Protection

Four overvoltage (59) elements monitor the sensing voltage applied to the IT-D Isolation Transducer. This information is sent from the IT-D to the BE1-11*d* via the fiber-optic interface. An element can be configured to protect against overvoltage when the voltage increases above a defined level.

The four, identical overvoltage protection elements are designated 59-1, 59-2, 59-3, and 59-4. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Overvoltage settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Voltage, Overvoltage (59)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Voltage Protection, Overvoltage 59

Element Operation

Overvoltage protection can be used to prevent damage to the train load in a transit application. For example, an overvoltage condition could occur due to a transient during rectifier switching.

Source

The Source setting configures an overvoltage element to monitor V1, V2, or V3.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the measured voltage increases above the voltage threshold established by the Pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay. A Time Delay setting of zero (0) makes the 59 element instantaneous with no intentional time delay.

If the pickup condition subsides before the element delay expires, the timer and Pickup output are reset, no corrective action is taken, and the element is rearmed for any other occurrences of overvoltage.

Trip

The Trip output becomes true if an overvoltage pickup condition persists for the duration of the element Time Delay setting. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Element Blocking

Block Logic Input

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Overvoltage element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The overvoltage element logic block is illustrated in Figure 6-1. Logic inputs and outputs are summarized in Table 6-1.

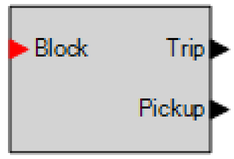


Figure 6-1. Overvoltage Element Logic Block

Table 6-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the 59 function when true
Trip	Output	True when the 59 element is in a trip condition
Pickup	Output	True when the 59 element is in a pickup condition

Operational Settings

Overvoltage element operational settings are configured on the Overvoltage settings screen (Figure 6-2) in BESTCOMS*Plus*.

Figure 6-2. Overvoltage Settings Screen

7 • Rate-of-Rise Protection

Two rate-of-rise elements provide detection for remote faults often characterized by high fault resistance. The rate-of-rise protection elements discriminate between low fault current conditions and normal, rolling stock-load fluctuations. Rate-of-rise protection monitors the feeder current step increase (ΔI) and its duration (ΔT) and activates whenever the current slope (di/dt) exceeds a specified rate-of-rise threshold. Fault current detection uses two parallel detection methods: Current Increment Detection (DDL+ ΔI) and Time Delay Detection (DDL+ ΔT).

The two, identical rate-of-rise protection elements are designated Rate of Rise 1 and Rate of Rise 2. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Rate of Rise settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Current, Rate of Rise

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Current Protection, Rate of Rise

Element Operation

Rate-of-rise protection can be used to protect trolley wires, third rails, feeders, and substations from remote overload conditions such as arcing faults, bolted faults, and severe overloads while allowing for normal train starts.

DDL (line fault detection) is based on the current rise rate (di/dt), the current increment (ΔI), and time delay parameters. ΔI provides the basis for short circuit current (SCC) discrimination with different time delays, whereas protective element enable criterion of the algorithms is based upon di/dt.

Two parallel detection methods, DDL+ΔI (Current Increment Detection) and DDL+ΔT (Time Delay Detection), are used for SCC detection based on the stated parameters. A protective trip is initiated by whichever detection method becomes true first.

Throughout the operation, di/dt, ΔI, and Δt are continuously measured. If di/dt is greater than the di/dt Trigger setting, then both parallel detection functions are initiated. The rate-of-rise of current is continuously monitored after the primary condition (di/dt > di/dt Trigger) is satisfied. The di/dt rate must remain higher than the di/dt Minimum setting when DDL+ΔI and DDL+ΔT are in process, otherwise the protection routine will be terminated and reset.

Pickup

The Pickup output becomes true when di/dt > di/dt Trigger. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates DDL+ΔI and DDL+ΔT detection. The pickup remains true until di/dt < di/dt Minimum.

If the pickup condition subsides before either DDL+ΔI or DDL+ΔT detect a trip, all timers and the Pickup output are reset, no corrective action is taken, and the element is rearmed.

DDL+ΔI Detection

This method is suitable for short-circuit faults at close distances because these types of faults exhibit a high rise rate and increment of SCC.

DDL+ΔI detection starts a timer when ΔI increases above the current threshold established by the Current Maximum setting. This timer begins timing to a trip. The duration of the timer is established by the Delta Current Timer Maximum setting. A setting of zero (0) makes the rate-of-rise element instantaneous with no intentional time delay.

Figure 7-1 illustrates the DDL+ΔI detection method.

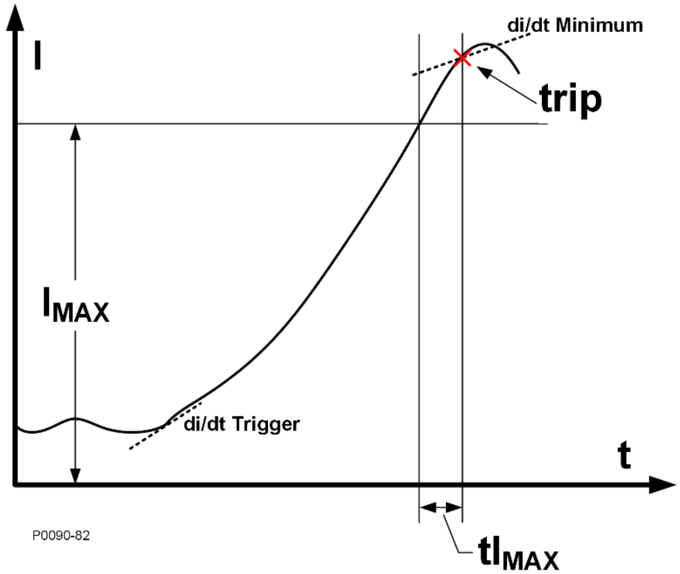


Figure 7-1. Current Increment Based Detection

Trip

The Trip output becomes true when the current amplitude remains greater than the Current Maximum setting for the duration of the element Delta Current Timer Maximum setting. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

DDL+ΔT Detection

This method is suitable for remote short-circuit faults because of their low rise-rate and longer duration of time to increment in value.

DDL+ΔT starts a timer Δt when initiated by di/dt > di/dt Trigger. If the timer Δt exceeds the time threshold established by the Delta Timer Maximum setting, the current input magnitude is compared to the Current Minimum setting.

Trip

The Trip output becomes true when Δt increases above the time threshold established by the Delta Timer Maximum setting and the current exceeds the Current Minimum setting. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Figure 7-2 illustrates the DDL+ΔT detection method.

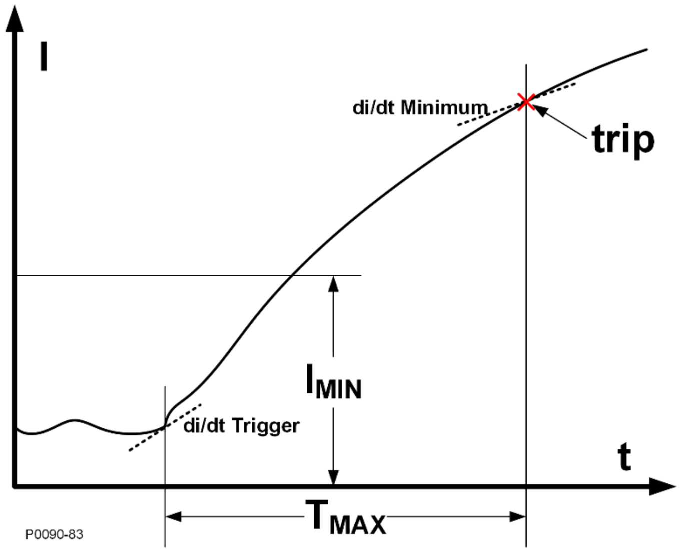


Figure 7-2. Time Delay Based Detection

Element Blocking

Block Logic Input

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Rate-of-rise element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The rate-of-rise element logic block is illustrated in Figure 7-3. Logic inputs and outputs are summarized in Table 7-1.

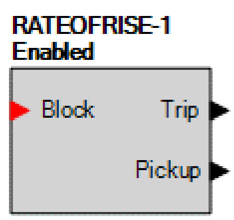


Figure 7-3. Rate of Rise Element Logic Block

Table 7-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the rate-of-rise function when true
Trip	Output	True when the rate-of-rise element is in a trip condition
Pickup	Output	True when the rate-of-rise element is in a pickup condition

Operational Settings

Rate-of-rise element operational settings are configured on the Rate of Rise settings screen (Figure 7-4) in BESTCOMS*Plus*.

Figure 7-4. Rate of Rise Settings Screen

8 • DC Overcurrent (76) Protection

Thirteen dc overcurrent (76) elements monitor the current applied to the IT-D Isolation Transducer. This information is sent from the IT-D to the BE1-11*d* via the fiber-optic interface.

The thirteen, identical overcurrent protection elements are designated 76-1 through 76-13. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the DC Overcurrent settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Current, DC Overcurrent (76)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Current Protection, Overcurrent 76

Element Operation

Overcurrent protection can be used to protect equipment from overload conditions such as bolted faults, arcing faults, and severe overloads in a transit application.

Direction

Overcurrent elements can be configured for forward or reverse tripping.

Timings

Each overcurrent element can be set for definite or inverse timing. When definite timing is selected, the Time Delay and Reset Delay settings are used. The Time Dial and Curve settings are used when inverse time is selected.

The following paragraphs describe the available timing curves. The user can select integrating reset timing to make the protective element use integrated reset and emulate an electromechanical induction disk reset characteristic.

Standard Curves

There are 22 standard curves available including standard inverse, short inverse, moderately inverse, long inverse, very inverse, and extremely inverse. Refer to the *Time Curve Characteristics* chapter for specific information on each curve.

Programmable Curves

An available programmable curve can be used to create a custom curve by selecting coefficients in the inverse time characteristic equation. When inverse time overcurrent characteristic curve P is selected, the coefficients used in the equation are those defined by the user. Inverse overcurrent characteristics for trip and reset programmable curves are defined by Equation 8-1 and Equation 8-2. These equations comply with IEEE Std C37.112-1996 - *IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays*. Definitions for these equations are provided in Table 8-1. The curve-specific coefficients are defined for the standard curves as listed in the *Time Curve Characteristics* chapter.

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

Equation 8-1. Time OC Characteristics for Trip

$$T_R = \frac{RD}{|M^2 - 1|}$$

Equation 8-2. Time OC Characteristics for Reset

Table 8-1. Definitions for Equation 8-1 and Equation 8-2

Parameter	Description	Explanation
T_T	Time to trip	Time that the 76-x function will take to time out and trip.
D	Time dial setting	Time dial setting for the 76-x function.

Parameter	Description	Explanation
M	Multiple of pickup	Measured current in multiples of pickup. The timing algorithm has a dynamic range of 1 to 40 times pickup.
A	Coefficient specific to selected curve	Affects the effective range of the time dial.
B	Coefficient specific to selected curve	Affects a constant term in the timing equation. Has greatest effect on curve shape at high multiples of tap.
C	Coefficient specific to selected curve	Affects the multiple of PU where the curve would approach infinity if allowed to continue below pickup. Has greatest effect on curve shape near pickup.
N	Exponent specific to selected curve	Affects how inverse the characteristics are. Has greatest effect on curve shape at low to medium multiples of tap.
K	Constant	Characteristic minimum delay term.
T_R	Time to reset	Relevant if 76-x function is set for integrating reset.
R	Coefficient specific to selected curve	Affects the speed of reset when integrating reset is selected.

Curve coefficients are entered on the DC Overcurrent (76) settings screen in BESTCOMS*Plus*. Programmable curve coefficients can be entered only when the P curve is chosen for the protection element from the Curve drop-down menu.

Table Curves

BESTCOMS*Plus* is used to set the 76 element Table Curves (T1, T2, T3, and T4). Using the Settings Explorer within BESTCOMS*Plus*, open the Protection, Current, Table Curve (1, 2, 3, or 4) tree branch and select the table curve to be modified. Refer to Figure 8-1. A minimum of 2 and maximum of 40 points can be entered for any one T curve. When you are satisfied with the values chosen, select Save Curve. Use the Settings Explorer to browse to the 76-x element you wish to program and use the drop-down menu under Curve to select T1, T2, T3, or T4.

Table curves can be entered regardless of the curve chosen for the protection element. However, the table curve will not be enabled until T1, T2, T3, or T4 is selected as the curve for the protective element.

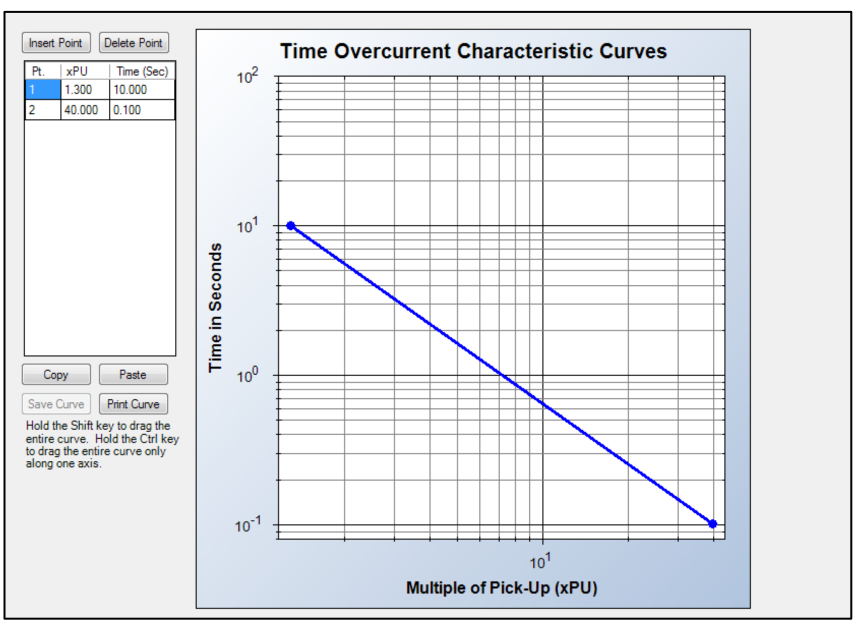


Figure 8-1. DC Overcurrent Table Curve

46 Curve

The 46 curve is an I^2t characteristic that emulates the melting, arcing, or clearing integral of a fuse.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the measured current increases above the current threshold established by the Pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, or start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay (definite time) or Time Dial and Curve settings (inverse time). A Time Delay or Time Dial setting of zero (0) makes the 76 element instantaneous with no intentional time delay.

If the pickup condition subsides before the calculated inverse time or definite time delay expires, the timer and Pickup outputs are reset, no corrective action is taken, and the element is rearmed for any other occurrences of overcurrent.

Trip

The Trip output becomes true if an overcurrent pickup condition persists for the duration of the definite time or calculated inverse time. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Element Blocking

Block Logic Input

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

DC overcurrent element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The dc overcurrent element logic block is illustrated in Figure 8-2. Logic inputs and outputs are summarized in Table 8-2.

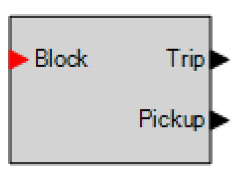


Figure 8-2. DC Overcurrent Element Logic Block

Table 8-2. Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the 76 function when true
Trip	Output	True when the 76 element is in a trip condition
Pickup	Output	True when the 76 element is in a pickup condition

Operational Settings

Inverse overcurrent element operational settings are configured on the DC Overcurrent (76) settings screen (Figure 8-3) in BESTCOMS*Plus*.

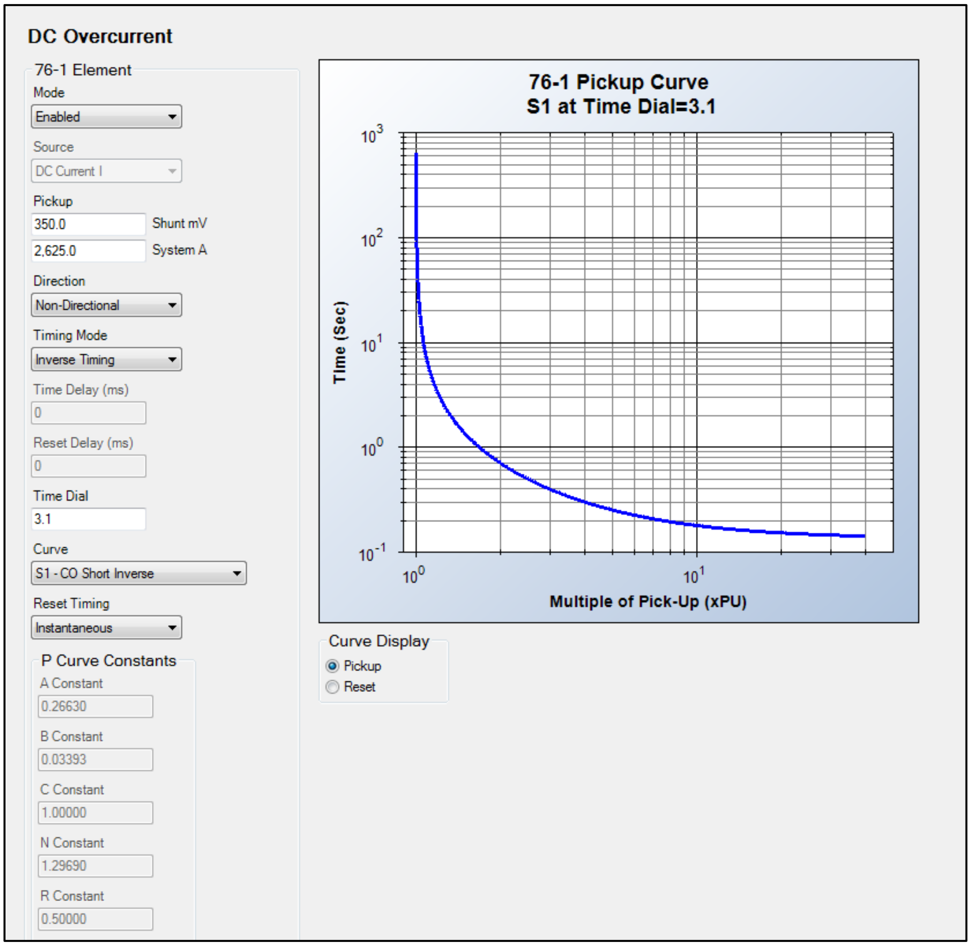


Figure 8-3. DC Overcurrent Settings Screen

9 • Power (32) Protection

Two power (32) elements monitor power (watts). An element can be configured to protect against overpower or underpower conditions.

The two, identical power protection elements are designated 32-1 and 32-2. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Power settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Power, Power (32)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Power Protection, Power 32

Element Operation

Power protection can be used in applications where excessive power flow in the tripping direction is undesirable. Directional power protection is desirable in applications where:

- Power flows into the secondary of a station distribution transformer, indicating an industrial or private customer is supplying power into the utility system.
- Excessive load has been connected to a system.
- Overload has been placed on a distribution system.
- An open breaker creates an overload on a local generation facility.

Over/Under

This setting configures the element to pick up for overpower or underpower.

Direction of Power Flow

In addition to exceeding the power pickup threshold, direction of power flow (forward or reverse) must match the directional setting for the 32 element to operate. In the BE1-11*d*, the forward and reverse directions are defined by the polarity voltage and current connections to the BE1-11*d* as shown in Figure 9-1. Based on IEEE polarity convention, forward power is defined as bus to line and reverse power is defined as line to bus.

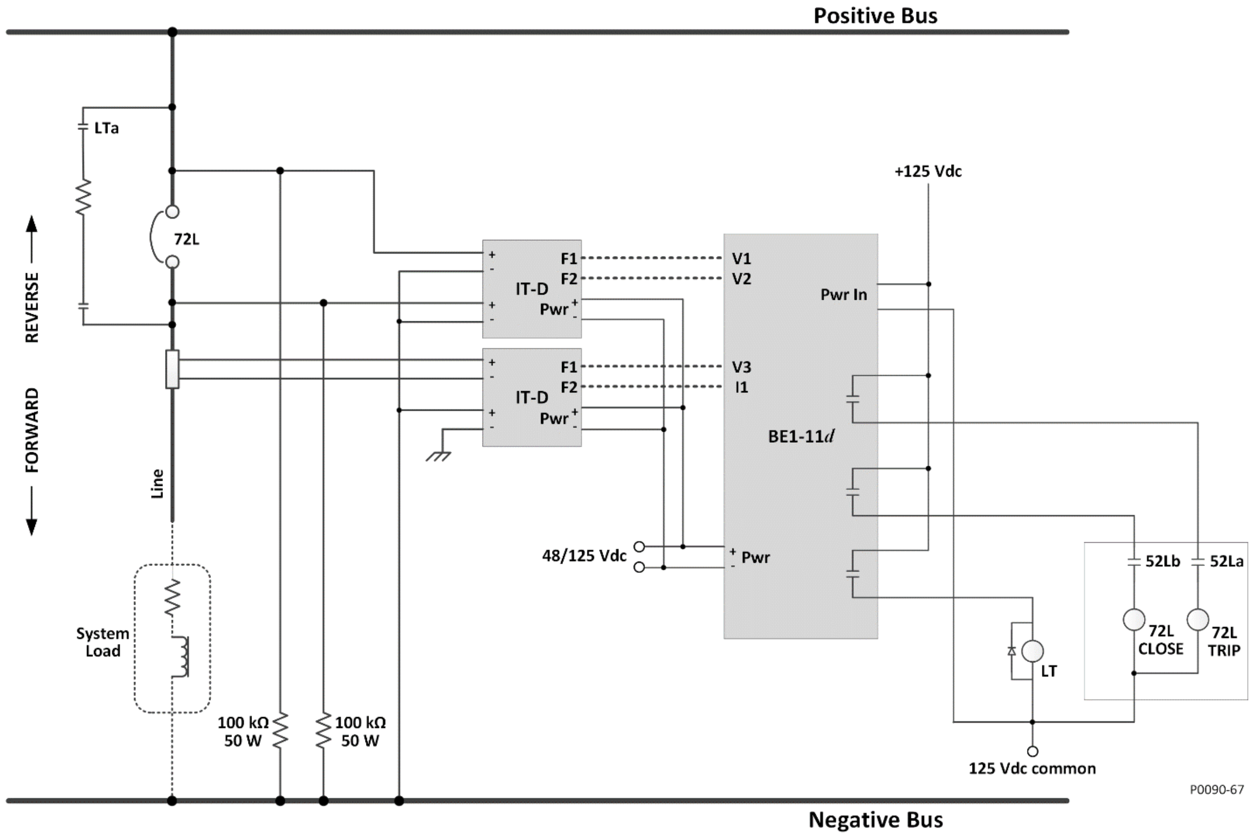


Figure 9-1. Direction of Power Flow Defined by the Polarity of Voltage and Current Connections

Establishing Forward and Reverse Pickup Values

Power pickup settings for the power elements are always positive regardless of the directional setting. However, it is useful in understanding the element response to visualize the forward direction as positive power and the reverse direction as negative power. If we think in terms of a forward and reverse scale with zero (0) in the middle as shown in Figure 9-2, positive and negative power flows relative to the forward and reverse directional setting. For example, assume an intertie application where the Area EPS (electric utility) requires the Local EPS (source of non-utility generation) to separate from the Area EPS (trip the intertie breaker) if any power flows towards the Area EPS. For illustrative purposes, assume that the BUS in Figure 9-1 is the Local EPS, 72 is the intertie breaker, and LINE is the Area EPS. Normal power flow is from the Area EPS to the Local EPS, which happens to be an industrial facility with local generation used for peak shaving.

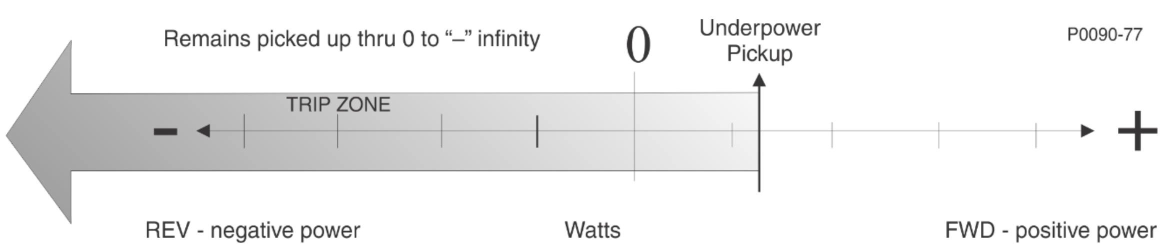


Figure 9-2. Forward and Reverse Pickup Values

Assuming polarity current and voltage connections as shown in Figure 9-1, forward power is defined as flowing into the Area EPS and reverse power is defined as flowing into the Local EPS. For this application, the 32 element should be set to trip for minimum underpower in the reverse direction (to the Local EPS). Therefore, the settings would be Reverse, Under, and 1 watt. Assume that normal power absorbed by the load is 4 kW in the reverse or negative direction on our scale. If load is suddenly lost at the industrial plant while the peak shaving generation is running, power may flow towards the Area EPS depending on the load to generation ratio. What was a negative 4 kW passes through 0 watts on its way to some positive power level. However, in doing so, passes through the negative underpower trip threshold of Reverse, Under, 1 watt, resulting in a 32 trip and opening of the intertie circuit breaker. From negative 1 to positive infinity, the 32 element remains in a picked up condition as shown in Figure 9-2. A trip time delay should be included to ensure that the 32 element does not operate for a transient power condition.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the calculated real power increases above or decreases below the threshold established by the Pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay setting. A Time Delay setting of zero (0) makes the 32 element instantaneous with no intentional time delay.

If the pickup condition subsides before the element delay expires, the timer and Pickup output are reset, no corrective action is taken, and the element is rearmed for any other occurrences of over/under power.

Trip

The Trip output becomes true if a power pickup condition exists for the duration of the element Time Delay. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Element Blocking

Block Logic Input

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Power element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The power element logic block is illustrated in Figure 9-3. Logic inputs and outputs are summarized in Table 9-1.

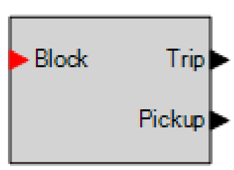


Figure 9-3. Power Element Logic Block

Table 9-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the 32 function when true
Trip	Output	True when the 32 element is in a trip condition
Pickup	Output	True when the 32 element is in a pickup condition

Operational Settings

Power element operational settings are configured on the Power (32) settings screen (Figure 9-4) in BESTCOMS*Plus*.

Figure 9-4. Power Settings Screen

10 • Thermal Overload (49) Protection

The thermal overload (49) element models the thermal capacity in the cables and catenary system in a transit application to provide thermal protection. It operates by simulating overheat temperature using load current and thermal time constant.

Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Thermal Overload (49) settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Thermal, Thermal Overload (49)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Thermal Protection, Thermal Overload 49

Element Operation

The thermal overload (49) element corresponds to the IEC-60255-8 standard. The cold curve characteristic is applied when the estimated current prior to the overload (I_P) is less than 10% of the base value of current, where base value is the specified shunt-rated value. If I_P current is greater or equal to 10% of the base value, then the hot curve characteristic is applied. I_P is estimated based upon a 2-second average measurement of the measured current prior to exceeding the overload setpoint. The hot curve, cold curve, and reset time equations are defined below.

$$t_{op} = t_{trip} \times ln\left(\frac{I^2 - I_P^2}{I^2 - I_{OL}^2}\right)$$

Equation 10-1. Hot Curve

$$t_{op} = t_{trip} \times ln\left(\frac{I^2}{I^2 - I_{OL}^2}\right)$$

Equation 10-2. Cold Curve

$$t_{rst} = t_{reset} \times ln\left(\frac{I_{OL}^2}{|I^2 - I_{OL}^2|}\right) + t_{min}$$

Equation 10-3. Reset Time

Where:

I = per unit current measured
I_{OL} = per unit overload setting
I_P = 2-second average measurement of current prior to exceeding the overload setpoint
t_{op} = thermal protection time to operate
t_{trip} = thermal protection trip time constant (time dial)
t_{rst} = thermal protection time to reset
t_{reset} = thermal protection reset time constant (time dial)
T_{min} = minimum reset time setting
$\ln$ = natural log

Accumulated Thermal Capacity

The thermal overload (49) element estimates accumulated thermal capacity using the following equations:

$$E_n = E_{n-1} + \frac{\Delta t}{t_{op}}$$

Equation 10-4. Accumulated Thermal Energy for Above Pickup (Trip)

$$E_n = E_{n-1} + \frac{\Delta t}{t_{rst}}$$

Equation 10-5. Accumulated Thermal Energy for Below Pickup (Reset)

Overload and Trip

The Overload output occurs first, followed by the Trip output.

Overload

The Overload output becomes true when the accumulated thermal capacity reaches a value of 1. In BESTlogic*Plus*, the Overload output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Reset

The thermal overload element resets when E < 0.05. In case of emergency, the thermal memory, I_P average current, and the Overload output will be reset when the Reset input is true.

Trip

The Trip output becomes true when the simulated overheat temperature exceeds the trip level. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Alarm

The Alarm output is true when the thermal capacity rises above the the trip value as indicated by the Alarm Level setting. This provides an indication that thermal capacity is being accumulated prior to the protection element tripping.

Element Blocking

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Overloaded outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Thermal overload element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The thermal overload element logic block is illustrated in Figure 10-1. Logic inputs and outputs are summarized in Table 10-1.

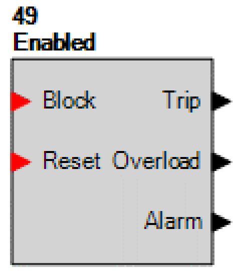


Figure 10-1. Thermal Overload Element Logic Block

Table 10-1. Logic Inputs and Outputs

Name	Function	Purpose
Block	Input	Disables the 49 function when true
Reset	Input	Resets the thermal memory, I_P average current, and Overload output
Trip	Output	True when the 49 element is in trip condition
Overload	Output	True when the 49 element is in overload condition
Alarm	Output	True when the 49 element is in alarm condition

Operational Settings

Thermal overload operational settings are configured on the Thermal Overload (49) settings screen (Figure 10-2) in BESTCOMS*Plus*.

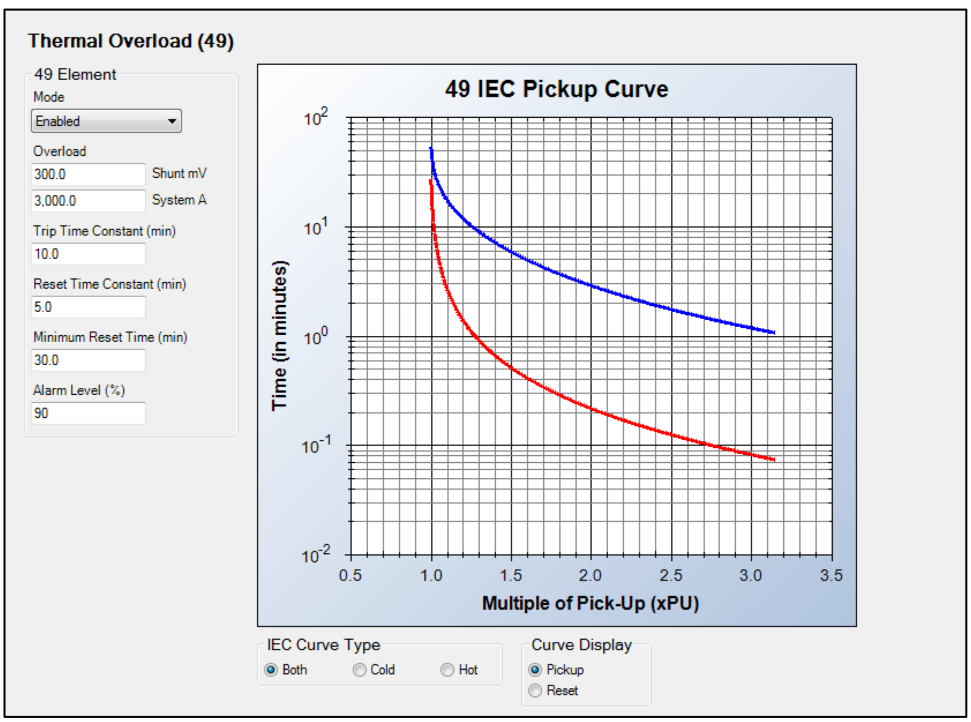


Figure 10-2. Thermal Overload Settings Screen

11 • Resistance Temperature Detector (49RTD) Protection

Fourteen resistance temperature detector (49RTD) elements provide over/undertemperature protection in applications when a remote RTD module is connected via Ethernet or RS-485. There are 12 physical RTD sensors per RTD module. Each element can be set to monitor a single physical RTD sensor or a group of them. Refer to the *RTD Module* chapter for information on mounting, connections, communication setup, and specifications.

The fourteen, identical remote RTD protection elements are designated 49RTD-1 through 49RTD-14. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Remote RTD (49RTD) settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Thermal, Resistance Temperature Detector (49RTD)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Thermal Protection, Resistance Temp 49RTD

Element Operation

Each RTD input can be configured to protect against high, low, or both temperature conditions.

Modes of Protection

Three modes of protection are available: Over, Under, and Over/Under.

In Over mode, if the temperature of the RTD is above the Over Pickup setting, the element will pick up. In Under mode, if the temperature of the RTD is below the Under Pickup setting, the element will pick up. In Over/Under mode, if the temperature of the RTD is above the Over Pickup setting or below the Under Pickup setting, the element will pick up. The element will remain in the picked-up condition and continue timing towards a trip unless the temperature falls below the Over Pickup setting or rises above the Under Pickup setting.

Source

The Source setting selects which RTD input to monitor. Refer to the *RTD Module* chapter for more information.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the measured remote RTD input value increases above (Over mode) or decreases below (Under mode) the pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay setting. A Time Delay setting of zero (0) makes the element instantaneous with no intentional time delay.

If the pickup condition subsides before the element delay expires, the timer and Pickup output are reset and no corrective action is taken.

Trip

The Trip output becomes true if a pickup condition persists for the duration of the element Time Delay. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Voting

The Voting parameter defines the number of RTDs in the group that must exceed the pickup setting to cause a trip. For example, if the 49RTD-1 Voting setting is three, then at least 3 RTDs in the selected group must exceed the pickup setting to cause a trip.

Element Blocking

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Remote RTD input element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The remote RTD input element logic block is illustrated in Figure 11-1. Logic inputs and outputs are summarized in Table 11-1.

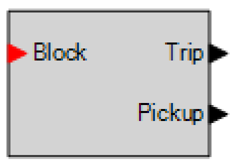


Figure 11-1. Remote RTD Input Element Logic Block

Table 11-1. Logic Inputs and Outputs

Name	Function	Purpose
Block	Input	Disables the 49RTD function when true
Trip	Output	True when the 49RTD element is in trip condition
Pickup	Output	True when the 49RTD element is in pickup condition

Operational Settings

Remote RTD input element operational settings are configured on the Resistance Temperature Detector settings screen (Figure 11-2) in BESTCOMS*Plus*.

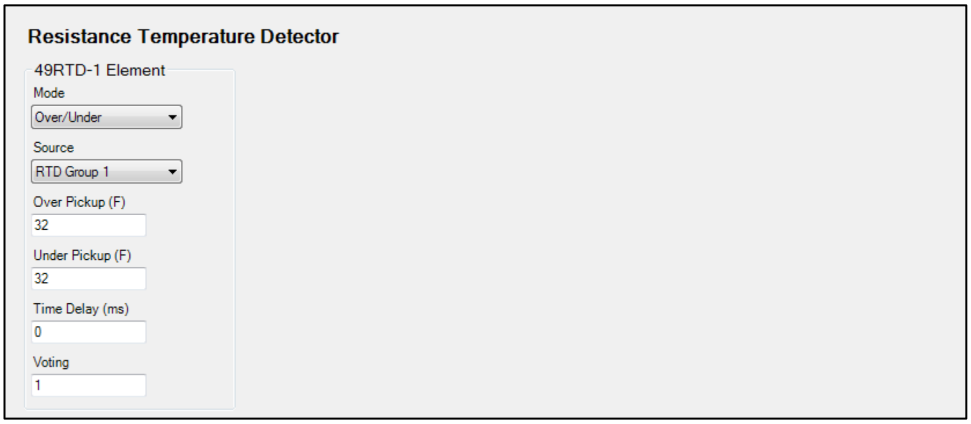


Figure 11-2. Resistance Temperature Detector Settings Screen

Remote RTD Metering

RTD metering values are obtained through BESTCOMS*Plus* by using the Metering Explorer to open the Analog Metering, RTD Meter tree branch. BESTCOMS*Plus* must be online with the BE1-11*d* to view RTD metering. Alternately, values can be obtained through the front-panel display by navigating to the Metering, Analog Metering, RTD Meter Input screen.

12 • Recloser (82) Protection

The recloser (82) element automatically recloses the line DC circuit breaker (72L), which has been tripped by a protective relay or other device in DC power systems.

Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Recloser (82) screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs, operational settings, and an overall logic diagram appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Recloser (82)

HMI Navigation Path: Settings Explorer, Protection, Settings Group x (where x = 0 to 3), Reclosing 82

Element Operation

The recloser protection (82) element provides up to four reclosing attempts. The reclosers allow supervisory control and coordination of tripping and reclosing with other system devices. A line test can be performed on line DC circuit breaker (72L) before closing to prevent the line DC circuit breaker closing onto an overload or a short-circuit condition.

Line Test

A line test is initiated by inserting a resistor (R_{Sense}), by means of a suitably rated line measurement contactor (LM), between the bus and line. An auxiliary supply can alternatively be used as the test voltage. The load impedance acts as a dividing resistance to the inserted resistor and, by measuring the voltage between feeder and return circuit, a determination can be made to allow/inhibit a reclose signal.

When the calculated load resistance (R_{Load}) is below the predefined R Limit setting, an overload exists on the line and the reclose is inhibited. The line test function will continue to run until the Load Measurement timer expires. Once the Load Measurement timer expires, the LM contact will open and the 82 element will proceed to the next reclose cycle or go into lockout.

If the calculated load resistance is above the predefined R Limit setting, a reclose is enabled.

Line test device systems may be either of the low resistance or the high resistance type. An issue with line testing measurements is the effect of the negative voltage drop, which may appear on the return circuit due to currents in the return circuit from loads external to the line test device zone. This can give misleading interpretation of the line testing measurements.

Where negative voltage drop in the return circuit can give this effect, it can be minimized by using the low resistance system, which tends to minimize this effect. The line test device can be bypassed if the line is already live from the line circuit breaker at the remote end.

A typical line test circuit is shown in Figure 12-1. Load resistance is calculated using Equation 12-1.

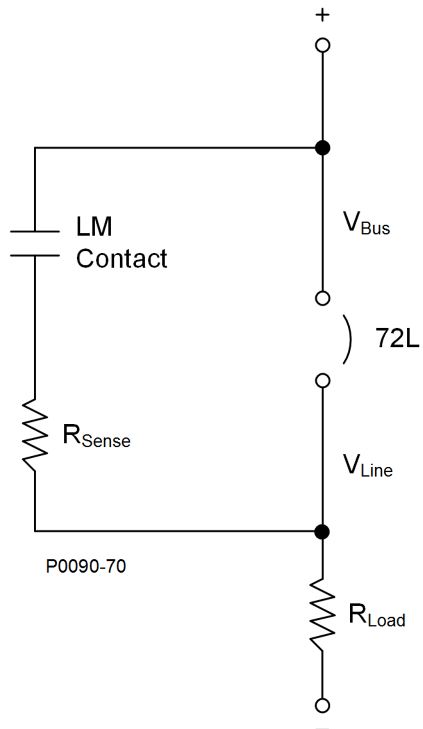


Figure 12-1. Typical Line Test Circuit

$$\frac{R_{Load}}{R_{Sense} + R_{Load}} \times V_{Bus} = V_{Line}$$

$$R_{Load} = \frac{V_{Line} \times R_{Sense}}{(V_{Bus} - V_{Line})}$$

Equation 12-1. Load Resistance Calculation

Modes of Operation

Two modes of operation are available: Power Up to Lockout and Power Up to Reclose.

Power Up to Lockout

When power is lost during a reset condition, the BE1-11*d* goes to lockout after power is restored if the Bypass input of the 82 element is true. If the Bypass input is false and the Enable input is true, a line test will be initiated.

Power Up to Reclose

When power is lost during a reset condition, the BE1-11*d* initiates a first programmed reclose after power is restored if the breaker (72L) is open, the Bypass input of the 82 element is true, and the Initiate input of the 82 element is true.

Inputs

Recloser element logic inputs are described in the following paragraphs.

Initiate

The Initiate input is used with the Breaker Status (BRKSTAT) logic element to start the reclose timers at each step of the reclosing sequence. To start the automatic reclose timers, the Initiate and Bypass inputs must be true and BRKSTAT must be false. To ensure that the Initiate input is recognized, a recognition dropout timer holds the Initiate input true for approximately 225 milliseconds after it goes to a false state.

This situation may occur if the Initiate is driven by the trip output of a protective function. As soon as the breaker opens, the protective function will drop out. The recognition dropout timer ensures that the Initiate signal will be recognized as true even if the breaker status input is slow in indicating breaker opening. Information on setting up the breaker status logic can be found in the *Breaker Monitoring* chapter. Figure 12-2 illustrates the recognition dropout logic and timing relationship.

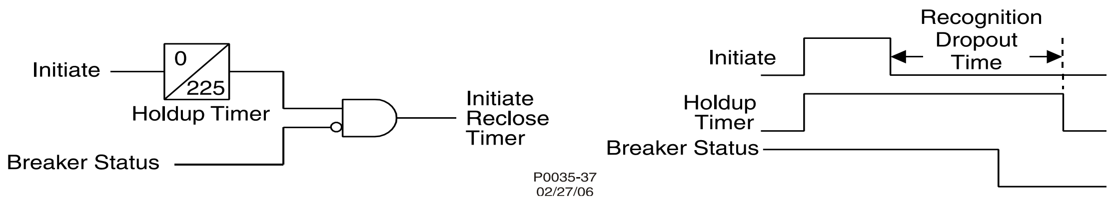


Figure 12-2. Recognition Dropout Timing

Wait

A true signal at the Wait input disables the reclosing function. In this condition, recloser timing is interrupted. When this input returns to a false state, reclosing is enabled and recloser timing resumes.

DTL (Drive to Lockout)

When true, the DTL input forces the reclosing function into the Lockout position. Lockout persists for the period defined by the Reset Time after the DTL input becomes false and the breaker is closed.

Enable

When the Enable input is true and the Bypass input is false, a line test will be initiated.

Bypass

When the Bypass input is true, a line test will not be performed. A line test should not be performed in a Live Bus/Live Line condition. The Bypass input of the 82 element can be connected to the LB/LL output of the Voltage Monitor element.

Outputs

Recloser element logic outputs are described in the following paragraphs.

Close

The Close output becomes true at the end of each reclose time delay and remains true until the breaker closes. Any of the following conditions will cause the Close output to become false (before the breaker close signal (72L) becomes true):

- The reclose fail timer times out.
- The recloser goes to lockout.
- The Wait logic is asserted.

LM Contact

The Line Measurement (LM) contact output is true when the Bypass input is false and the Enable input is true. The LM Contact output can be connected in BESTlogic*Plus* Programmable Logic to close the physical LM contact in the line test circuit.

Lockout

The Lockout output is true when the recloser is in the Lockout state. It remains true until the recloser goes to the Reset state. The recloser will go to lockout if any of the following conditions exist:

- More than the maximum number of programmed recloses is initiated before the recloser returns to the Reset state.
- The DTL input is true.
- The Reclose Fail is true.
- The maximum reclose cycle time is exceeded.

Running

The Running output is true when the recloser is running (i.e., not in reset or lockout). This output is available to block the operation of a load tap changer on a substation transformer or voltage regulator during the fault clearing and restoration process.

Reset

The Reset output provides reset indication and is true when the recloser is in the Reset position.

Reclose Fail Timer

This timer begins when the Close output becomes true and continues counting until the Breaker Status becomes true. If the reclose fail timer times out, the recloser function is driven to lockout and the Lockout output becomes true. The BE1-11*d* remains in lockout until the breaker is manually closed and the Breaker Status remains true for the reset time. The reset time is set on the Recloser screen in BESTCOMS*Plus*.

Maximum Cycle Timer (MAX Cycle)

Max Cycle is the reclose maximum operation time. If a reclose operation is not completed before the maximum operate time expires, the recloser goes to lockout. This timer limits the total fault clearing and restoration sequence to a definable period. The Max Cycle timer stops when the recloser is reset. If the total reclosing time between Reset states exceeds the maximum reclose cycle timer setting, the recloser will go to lockout. If not desired, the Max Cycle timer can be disabled by setting it at zero (0). The Wait input does not pause the Max Cycle timer. The maximum cycle time is set on the Recloser screen in BESTCOMS*Plus*.

Setting Group Selection

Any of the four recloser shots can be used to select a different setting group when the appropriate shot is reached in a reclosing sequence. This change in setting groups allows changing protection coordination during the reclosing sequence. Detailed information about BE1-11*d* setting groups can be found in the *Setting Groups* chapter.

Logic Connections

82 Recloser Element

Recloser element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The recloser element logic block is illustrated in Figure 12-3. Logic inputs and outputs are summarized in Table 12-1.

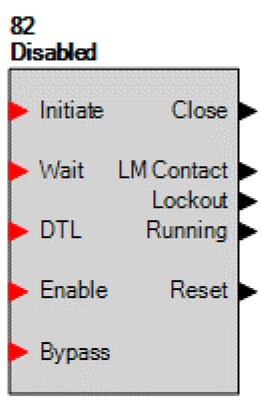


Figure 12-3. Recloser Element Logic Block

Table 12-1. Recloser Logic Inputs and Outputs

Name	Logic Function	Purpose
Initiate	Input	Initiates the operation of the reclosing function
Wait	Input	Momentarily disables, but does not reset the recloser
DTL	Input	Disables the recloser (Drive To Lockout)
Enable	Input	Enables the line test function
Bypass	Input	Disables (bypasses) the line test function
Close	Output	True at the end of each reclose time delay and remains true until the breaker closes
LM Contact	Output	True when the Bypass input is false and the Enable input is true. Connect to a physical output in BESTlogic*Plus* to close the LM contact
Lockout	Output	True when the recloser is in the Lockout state
Running	Output	True when the reclose is running
Reset	Output	True when the recloser is in the Reset position

Voltage Monitor Element

Voltage Monitor element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The voltage monitor element logic block is illustrated in Figure 12-4. Logic inputs and outputs are summarized in Table 12-2.

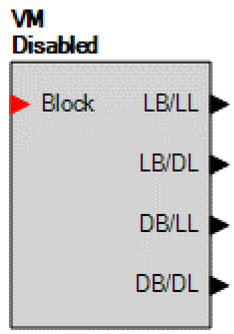


Figure 12-4. Voltage Monitor Element Logic Block

Table 12-2. Voltage Monitor Logic Inputs and Outputs

Name	Logic Function	Purpose
Block	Input	Disables the voltage monitor function when true
LB/LL	Output	True when the Bus and Line are both live
LB/DL	Output	True when the Bus is live and the Line is dead
DB/LL	Output	True when the Bus is dead and the Line is live
DB/DL	Output	True when the Bus and Line are both dead

Typical Line Test Logic

Typical line test logic is shown in Figure 12-5.

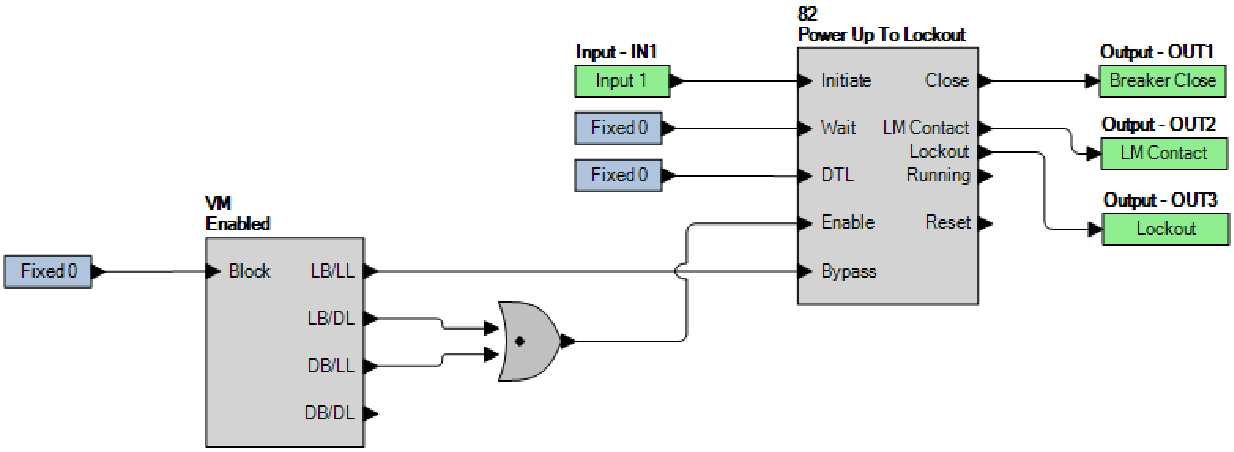


Figure 12-5. Typical Line Test Logic

Operational Settings

Recloser element operational settings are configured on the Recloser (82) settings screen (Figure 12-6) in BESTCOMS*Plus*.

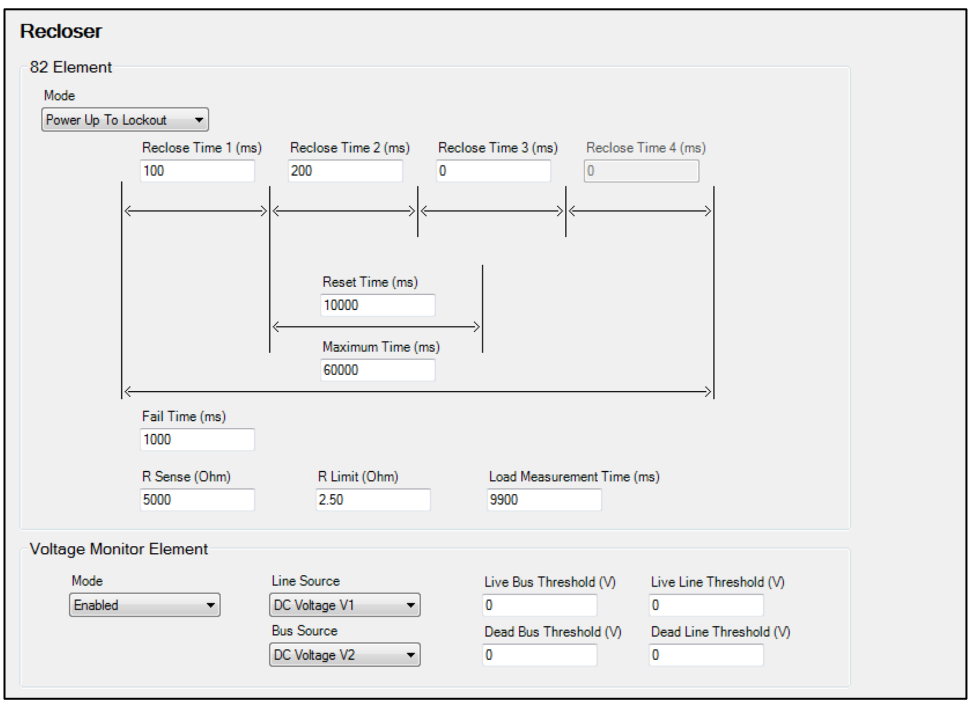


Figure 12-6. Recloser Settings Screen

Logic Diagram

Figure 12-7 illustrates an overall logic diagram for the recloser element.

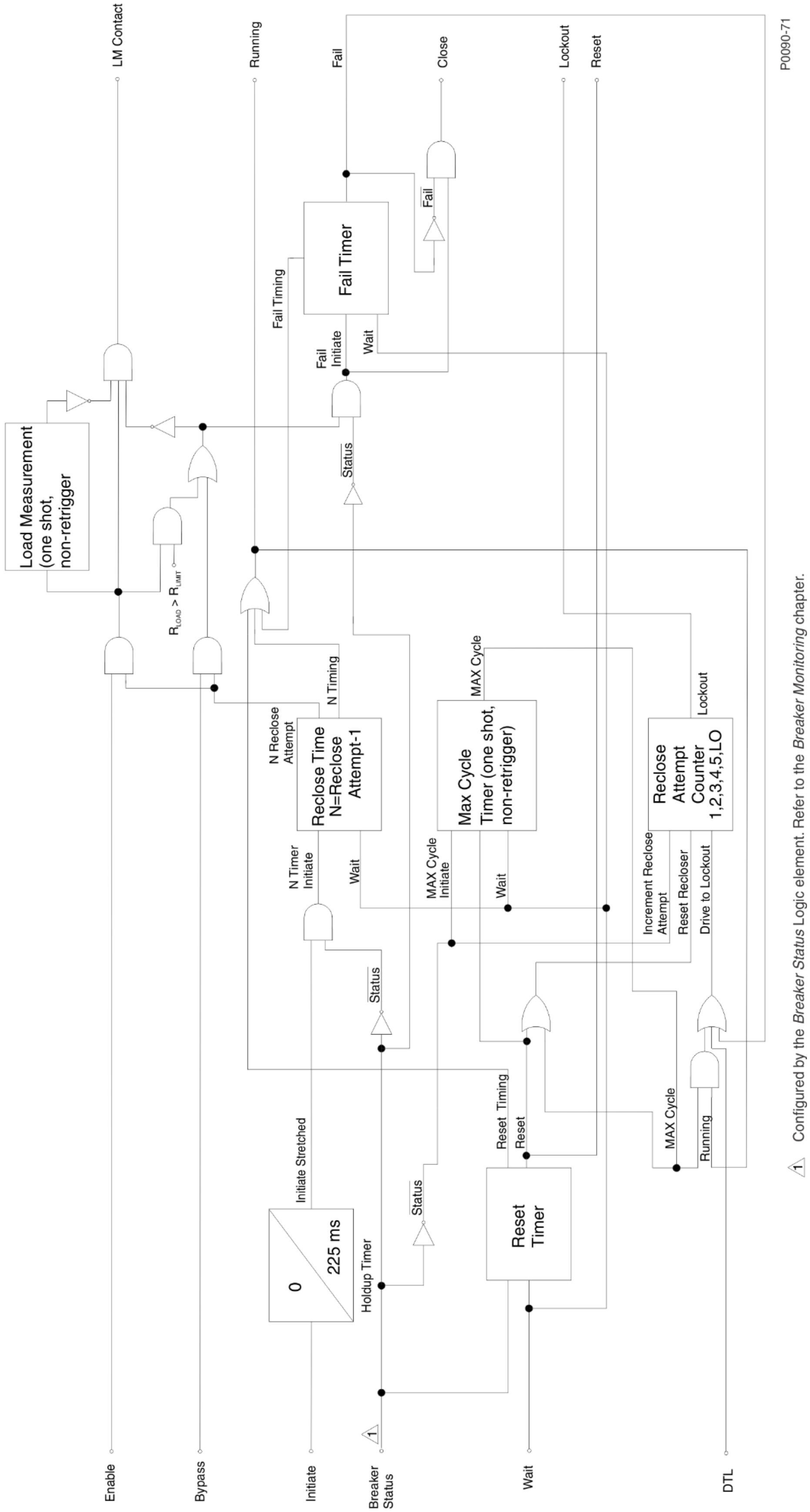


Figure 12-7. Overall Logic Diagram for Reclosing

13 • Analog Input Protection

Eight analog input elements monitor external analog input signals when two remote RTD modules are connected via Ethernet or RS-485. Four analog inputs are provided with each RTD module. Refer to the *RTD Module* chapter for information on mounting, connections, communication setup, and specifications.

The eight, identical remote analog input protection elements are designated ANALOG-1, ANALOG-2, ANALOG-3, ANALOG-4, ANALOG-5, ANALOG-6, ANALOG-7, and ANALOG-8. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Remote Analog Input settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Remote Analog Inputs

HMI Navigation Path: Settings Explorer, Protection, Analog Protection

Element Operation

Modes of Protection

Two modes of protection are available: Over and Under.

In Over mode, if the analog input value is above the Over Pickup setting, the element will pick up. In Under mode, if the analog input value is below the Under Pickup setting, the element will pick up.

Source

The *Source* setting selects which analog input to monitor. Refer to the *RTD Module* chapter for more information.

Pickup and Trip

The Pickup output occurs first, followed by the Trip output.

Pickup

The Pickup output becomes true when the measured remote analog input value increases above (Over mode) or decreases below (Under mode) the pickup setting. In BESTlogic*Plus*, the Pickup output can be connected to other logic elements to annunciate the condition, control other elements in logic, and start the fault recorder (logic element FAULTTRIG).

Assertion of the Pickup output initiates a timer that begins timing to a trip. The duration of the timer is established by the Time Delay setting. A Time Delay setting of zero (0) makes the element instantaneous with no intentional time delay.

If the pickup condition subsides before the element delay expires, the timer and Pickup output are reset and no corrective action is taken.

Trip

The Trip output becomes true if a pickup condition persists for the duration of the element Time Delay setting. In BESTlogic*Plus*, the Trip output can be connected to other logic elements and to a physical relay output to annunciate the condition and to initiate corrective action. If a target is enabled for the element, the BE1-11*d* will record a target when the Trip output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Inhibit

When enabled, remote analog input protection is inhibited when the monitored analog input value decreases below the Inhibit Level setting. This setting is available only in the Under protection mode.

Element Blocking

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the Trip and Pickup outputs to logic 0 and resetting the element timer. Connect the element Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Remote analog input element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The remote analog input element logic block is illustrated in Figure 13-1. Logic inputs and outputs are summarized in Table 13-1.

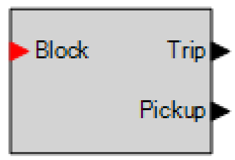


Figure 13-1. Remote Analog Input Element Logic Block

Table 13-1. Logic Inputs and Outputs

Name	Function	Purpose
Block	Input	Disables the analog input element when true
Trip	Output	True when the analog input element is in trip condition
Pickup	Output	True when the analog input element is in pickup condition

Operational Settings

Remote analog input element operational settings are configured on the Remote Analog Input settings screen (Figure 13-2) in BESTCOMS*Plus*.

Figure 13-2. Remote Analog Input Settings Screen

Remote Analog Input Metering

Analog input metering values are obtained through BESTCOMS*Plus* by using the Metering Explorer to open the Analog Metering, Analog Inputs tree branch. BESTCOMS*Plus* must be online with the BE1-11*d* to view analog input metering. Alternately, values can be obtained through the front-panel display by navigating to the Metering, Analog Metering, Analog Input screen.

14 • Virtual Control Switches (43)

Five virtual control switch (43) elements provide manual control, locally and remotely, without using physical switches and/or interposing relays.

The five, identical virtual control switch elements are designated 43-1, 43-2, 43-3, 43-4, and 43-5. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Virtual Control Switches (43) settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Settings Navigation Path: Settings Explorer, Control, Virtual Control Switches (43)

HMI Settings Navigation Path: Settings Explorer, Control, Virtual Switch 43

BESTCOMS*Plus* Control Navigation Path: Metering Explorer, Control, Virtual Switches

HMI Control Navigation Path: Metering Explorer, Control, Virtual Switches

Element Operation

Virtual control switches can emulate virtually any type of binary (two-position) switch. An example would be an application that requires a ground cutoff switch. The traditional approach might be to install a switch on the panel and wire the output to a contact sensing input on the BE1-11*d* or in series with the ground trip output of the BE1-11*d*. Instead, a virtual control switch can be used to reduce costs with the added benefit of being able to operate the switch both locally through the front panel and remotely from a substation computer or through an Ethernet connection to a remote operator's console.

Mode

Three modes of operation are available: Switch/Pulse, Switch, and Pulse. Because switch status information is saved in nonvolatile memory, the BE1-11*d* powers up with the switches in the same state as when the BE1-11*d* was powered down.

Switch/Pulse Mode

In Switch/Pulse mode, each switch can be controlled to reset, set, or pulse. Assertion of the Set input forces the output to set (logic 1). Assertion of the Reset input forces the output to reset (logic 0). Assertion of the Pulse input toggles the virtual output from its current state to the opposite state for 200 ms then back to the original state. An additional Hold Time can be set when the virtual output is connected to a physical output in BESTlogic*Plus*. See the *Contact Inputs and Outputs* chapter for more information.

Switch Mode

In Switch mode, the switch emulates a two-position selector switch, and only set and reset commands are accepted. Assertion of the Set input forces the output to set (logic 1). Assertion of the Reset input forces the output to reset (logic 0).

Pulse Mode

In Pulse mode, a momentary close, spring-return switch is emulated and only the pulse command is accepted. Assertion of the Pulse input toggles the virtual output from its current state to the opposite state for 200 ms and then back to the original state. An additional Hold Time can be set when the virtual output is connected to a physical output in BESTlogic*Plus*. See the *Contact Inputs and Outputs* chapter for more information.

Customized Labels

User specified labels can be assigned to each virtual switch and to both states of each switch. The labels can be up to 64 characters long. In the previous ground cutoff switch example, you may enable one of the switches in the Switch mode and connect the output of that switch to the blocking input of a 59 protection element. This would disable the ground overvoltage protection when the switch is closed (logic 1) and enable it when the switch is open (logic 0). For the application, you may set the switch label to be GROUND PROTECTION CUTOFF. The closed position of the switch may be labeled DISABLD and the open position may be labeled NORMAL.

Control of Virtual Control Switches

The state of the virtual control switches can be controlled using the Select/Operate Control Switch buttons on the front panel or through BESTCOMS*Plus* when the connection state is active. Using select-before-operate, perform the following steps to control a switch using BESTCOMS*Plus*:

1. Use the Metering Explorer to open the Control/Virtual Switches tree branch (Figure 14-1).
2. If Switch/Pulse mode is selected on the Virtual Control Switches (43) settings screen in BESTCOMS*Plus*, use the drop-down box to select either Switch or Pulse.
3. Click the 43-# button to **select** it. Login may be required. The On or Off indicator (current state) will begin to flash.
4. Click on the 43-# button a second time to **operate** it. The On or Off indicator (previous state) will stop flashing and the Off or On indicator (current/new state) will light.

Note
If Step 4 is not performed within 30 seconds of Step 3, the LED will stop flashing and the 43-# button will have to be selected again.

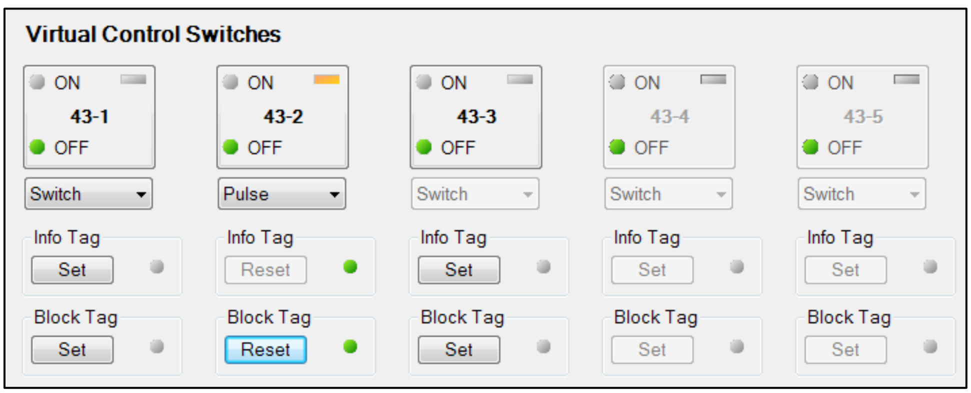


Figure 14-1. Virtual Switches Control Screen

Tagging of Virtual Control Switches

Virtual control switches provide tagging for each switch to indicate that the switch function is, or may be, under revision. Each switch has two tagging modes, Informational and Blocking. When in Informational mode, the switch is still operational when tagged. When in the Blocking mode, the switch is not operational when tagged.

Tagging of virtual control switches can be accomplished through the front panel and through BESTCOMS*Plus*. Use the Metering Explorer in BESTCOMS*Plus* to open the Control/Virtual Switches tree branch. Click on the Set button for Info Tag or Block Tag. If tagging is successful, the indicator to the right of the Set button will turn green. A tagged switch is indicated by an amber indicator in the upper right corner of the element button. Click on the Reset button to clear a tag. Refer to Figure 14-1.

The Block Tag has priority over the Informational Tag. Once the Block Tag has been placed, the Informational Tag cannot be changed until the Block Tag is removed. In other words, you must choose to place the Informational Tag before placing the Block Tag.

Each tag is placed with an "owner". A tag must be removed by the same "owner" that placed it. For example, if a tag is placed through BESTCOMS*Plus*, it can be removed only through BESTCOMS*Plus*. It cannot be removed through the front panel. If a tag is placed through the front panel, it can be removed only through the front panel. This applies for all other forms of communication when placing tags.

A Block Tag alarm indicates when a block tag is in place. Refer to the *Alarms* chapter for information on how to program alarms.

Logic Connections

Virtual control switch element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The virtual control switch element logic block is illustrated in Figure 14-2. Logic inputs and outputs are summarized in Table 14-1.

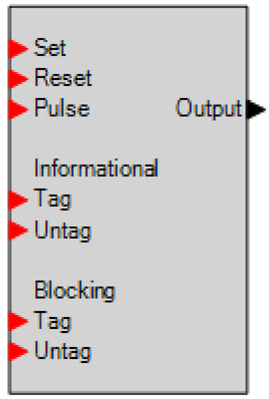


Figure 14-2. Virtual Control Switch Element Logic Block

Table 14-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Set	Input	Sets the state of the output to true
Reset	Input	Sets the state of the output to false
Pulse	Input	Momentarily changes state of the output
Informational Tag	Input	Sets an informational tag on the 43 element
Informational Untag	Input	Removes the informational tag from the 43 element
Blocking Tag	Input	Sets a blocking tag on the 43 element
Blocking Untag	Input	Removes the blocking tag from the 43 element
Output	Output	True when the 43 element is set

Operational Settings

Virtual control switch element operational settings are configured on the Virtual Control Switches (43) settings screen (Figure 14-3) in BESTCOMS*Plus*.

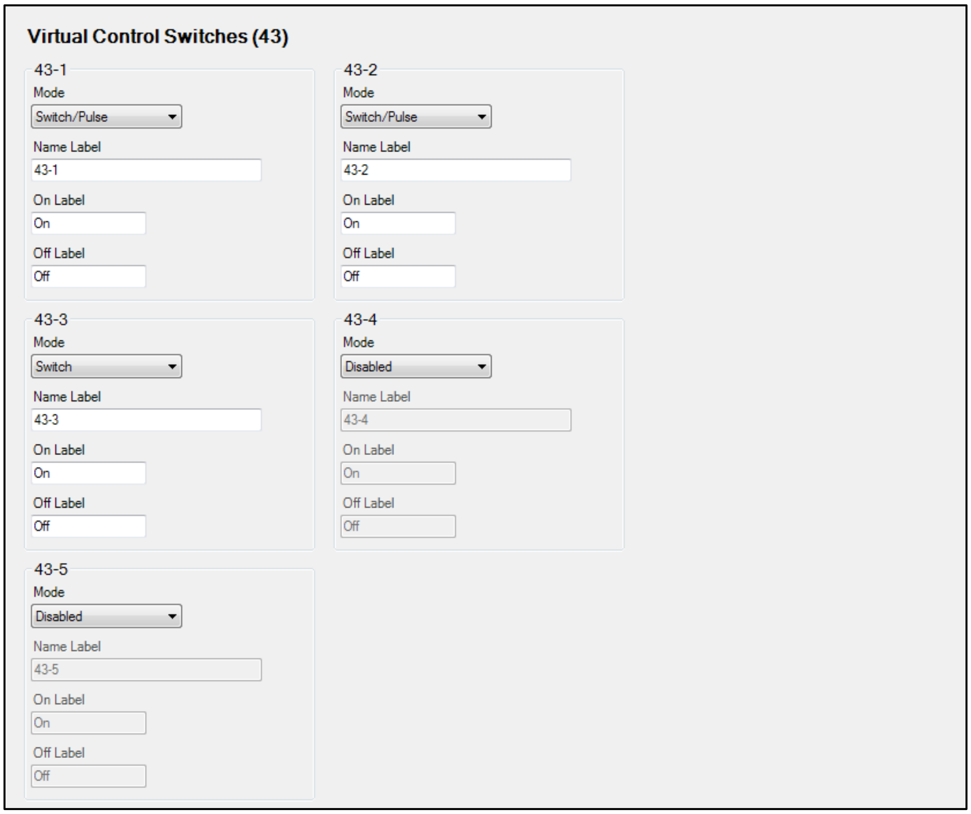


Figure 14-3. Virtual Control Switches Settings Screen

15 • Logic Timers (62)

Eight logic timer (62) elements emulate virtually any type of timer used in power system applications.

The eight, identical logic timer elements are designated 62-1, 62-2, 62-3, 62-4, 62-5, 62-6, 62-7, and 62-8. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Logic Timers (62) settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Control, Logic Timers (62)

HMI Navigation Path: Settings Explorer, Control, Timer Setup 62, Settings Group x (x = 0 to 3)

Element Operation

Each timer has two time delay settings. The duration of the timers is established by the Time Delay 1 (T1) setting and the Time Delay 2 (T2) setting. Assertion of the Initiate input starts the timing sequence.

The functioning of the output is dependent upon the type of timer as specified by the mode setting. In BESTlogic*Plus*, the output can be connected to other logic elements or a physical relay output to alert the operator of a condition. If a target is enabled for the element, the BE1-11*d* will record a target when the output becomes true. See the *Fault Reporting* chapter for more information about target reporting.

Mode

Six operating modes are available: Pickup/Dropout, One-Shot/Non-Retriggerable, One-Shot/Retriggerable, Oscillator, Integrating Timer, and Latched.

<u>*Pickup/Dropout Mode*</u>

The output changes to logic true if the Initiate input is true for the duration of Time Delay 1 (T1). See Figure 15-1. If the Initiate input toggles to false before time T1, the T1 timer is reset. Once the output of the timer toggles to true, the Initiate input must be false for the duration of Time Delay 2 (T2). If the Initiate input toggles to true before time T2, the output stays true and the T2 timer is reset.

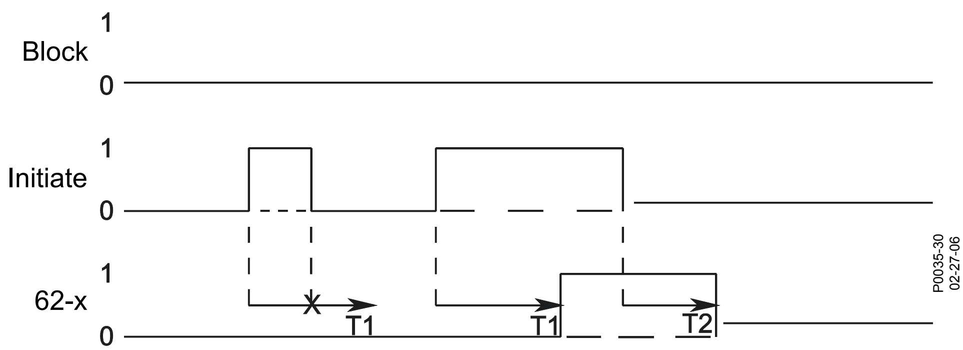


Figure 15-1. Pickup/Dropout Mode

<u>*One-Shot/Non-Retriggerable Mode*</u>

The one-shot, non-retriggerable timer starts its timing sequence when the Initiate input changes from false to true. See Figure 15-2. The timer will time for the duration of Time Delay 1 (T1) and then the output will toggle to true for the duration of Time Delay 2 (T2). Additional initiate input changes of state are ignored until the timing sequence is completed. If the T2 timer is set to 0, this timer will not function. The timer will return to false if the Block input becomes true.

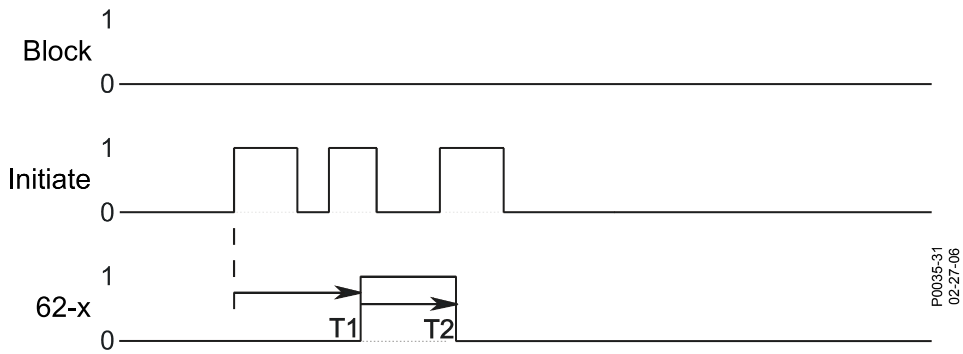


Figure 15-2. One-Shot/Non-Retriggerable Mode

One-Shot/Retriggerable Mode

The one-shot retriggerable timer starts its timing sequence when the Initiate input changes from false to true. See Figure 15-3. The timer will time for the duration of Time Delay 1 (T1) and then the output will toggle to true for the duration of Time Delay 2 (T2). Additional initiate input changes of state are ignored until the timing sequence has been completed. If a new false-to-true transition occurs on the Initiate input, the output is forced to logic false and the timing sequence is restarted. If the T2 timer is set to 0, this timer will not function. The timer will return to false if the Block input becomes true.

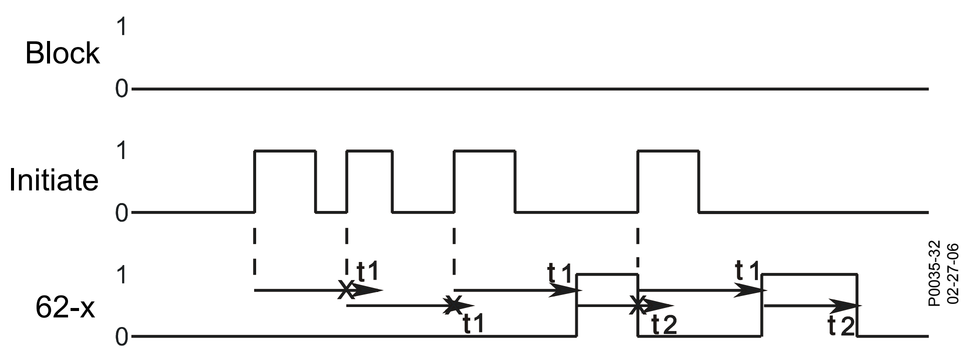


Figure 15-3. One-Shot/Retriggerable Mode

Oscillator Mode

In this mode, the Initiate input is ignored. See Figure 15-4. If the Block input is false, the output oscillates with an ON time (T1) and an OFF time (T2). When the Block input is held true, the oscillator stops, and the output is held off.

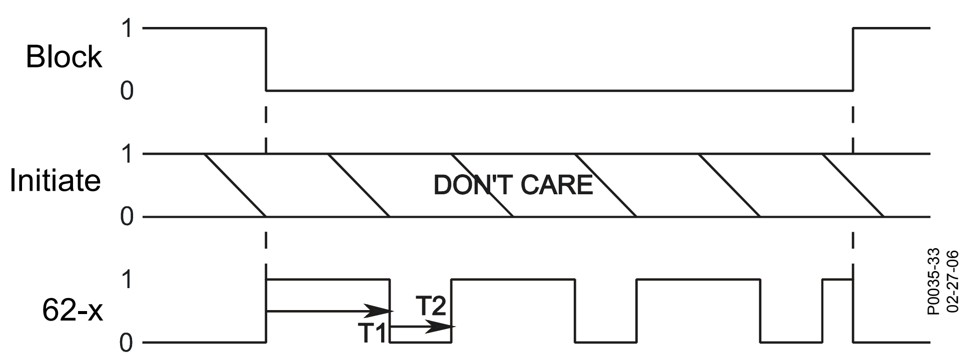


Figure 15-4. Oscillator Mode

Integrating Timer Mode

An integrating timer is similar to a pickup/dropout timer except that the Time Delay 1 (T1) setting defines the rate that the timer integrates toward timing out and setting the output to true. Conversely, the Time Delay 2 (T2) setting defines the rate that the timer integrates toward dropout and resetting the output to false. T1 defines the time delay for the output to change to true if the initiate input becomes true and stays true. T2 defines the time delay for the output to change to false if it is presently true and the initiate input becomes false and stays false.

In the example shown in Figure 15-5, T2 is set to half of the T1 setting. The initiate input becomes true and the timer starts integrating toward pickup. Prior to timing out, the Initiate input toggles to false and the timer starts resetting at twice the rate as it was integrating toward time out. It stays false long enough for the integrating timer to reset completely but then toggles back to true and stays true for the entire duration of time T1. At that point, the timer's output is toggled to true. Then later, the initiate Input becomes false and stays false for the duration of T2. At that point, the output of the timer is toggled to false.

This type of timer is useful in applications where a monitored signal might be hovering at its threshold between on and off. For example, it is desired to take some action when current is above a certain level for a certain period. A DC Overcurrent (76) element could be used to monitor the current level. Thus, if the current level is near the threshold so that the Initiate input toggles between true and false from time to time, the function will still time out as long as the time that it is true is longer than the time that it is false. With a simple pickup/dropout timer, the timing function would reset to zero and start over each time the Initiate input became false.

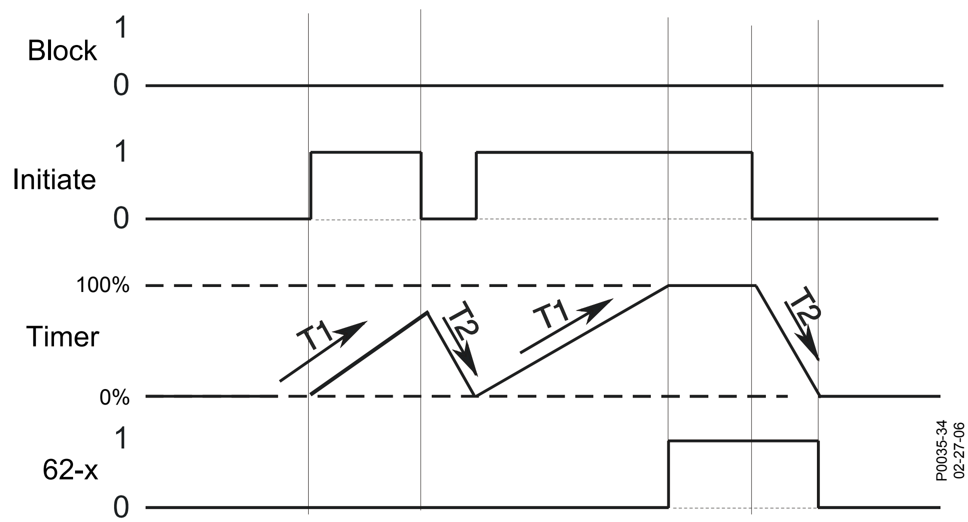


Figure 15-5. Integrating Timer Mode

Latched Mode

A one shot timer starts its timing sequence when the Initiate input changes from false to true. The timer will operate for Delay Time (T1) and then the output will latch true. Additional Initiate input changes of state are ignored. Time (T2) is ignored. Refer to Figure 15-6.

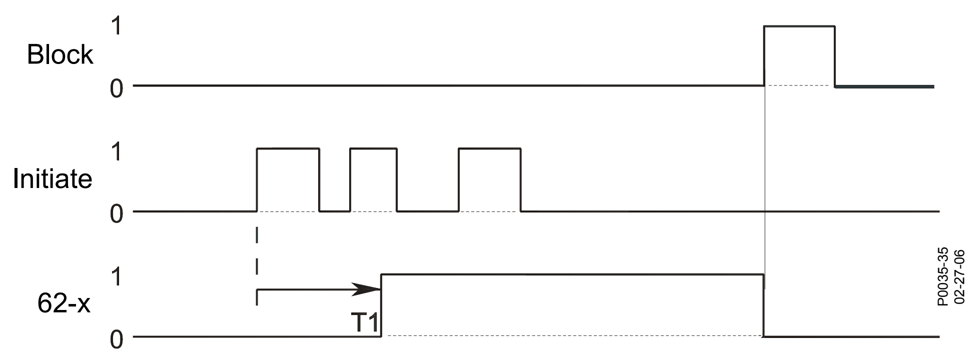


Figure 15-6. Latched Mode

Element Blocking

The Block input provides logic-supervision control of the element. When true, the Block input disables the element by forcing the element output to logic 0 and resetting the element timer. Connect the element

Block input to the desired logic in BESTlogic*Plus*. When the element is initially selected from the Elements view, the default condition of the Block input is a logic 0.

Logic Connections

Logic timer element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The logic timer element logic block is illustrated in Figure 15-7. Logic inputs and outputs are summarized in Table 15-1.

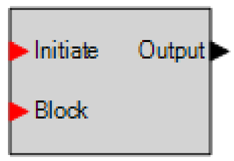


Figure 15-7. Logic Timer Element Logic Block

Table 15-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Initiate	Input	Starts the 62 timing sequence
Block	Input	Disables the 62 function when true
Output	Output	True when 62 timing criteria have been met according to mode

Operational Settings

Logic timer element operational settings are configured on the Logic Timers (62) settings screen (Figure 15-8) in BESTCOMS*Plus*.

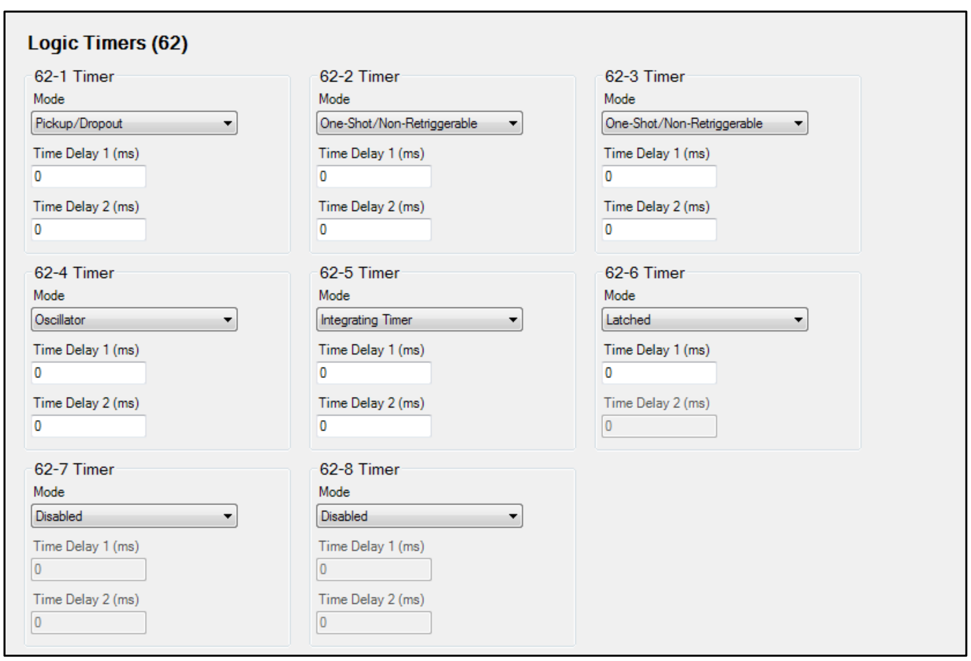


Figure 15-8. Logic Timers Settings Screen

16 • Lockout Functions (86)

Two lockout function (86) elements can be used to prevent operation of circuit breakers or other devices until the condition causing lockout is eliminated.

The two, identical lockout function elements are designated 86-1 and 86-2. Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Lockout Functions screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Control, Lockout Functions (86)

HMI Navigation Path: Settings Explorer, Control, Lockout 86

Element Operation

When the Set input is asserted, the output of the function becomes TRUE (breaker opens). When the Reset input is asserted, the output becomes FALSE (breaker closes). If both inputs are asserted at the same time, the Set input will have priority and drive the output to TRUE. The state of the function is stored in nonvolatile memory.

Logic Connections

Lockout function element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The lockout function element logic block is illustrated in Figure 16-1. Logic inputs and outputs are summarized in Table 16-1.

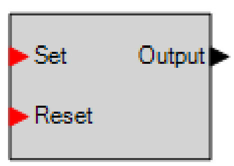


Figure 16-1. Lockout Function Element Logic Block

Table 16-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Set	Input	Sets the state of the output to TRUE
Reset	Input	Sets the state of the output to FALSE
Output	Output	True when the Set input is asserted

Operational Settings

Lockout function element operational settings are configured on the Lockout Functions (86) settings screen (Figure 16-2) in BESTCOMS*Plus*.

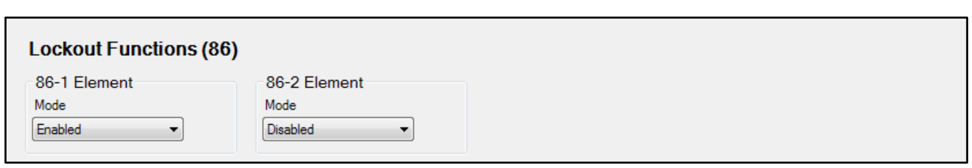


Figure 16-2. Lockout Functions Settings Screen

Retrieving Lockout Status from the BE1-11*d*

Lockout status can be viewed through BESTCOMS*Plus*, the front-panel display, and the web page interface.

To view 86 lockout status using BESTCOMS*Plus*, use the Metering Explorer to open the Status, 86 Lockout Status screen shown in Figure 16-3. To view lockout status from the front-panel display, navigate to Metering Explorer, Status, 86 Lockout Status.

Figure 16-3. 86 Lockout Status Screen

17 • Breaker Control Switch (101)

The breaker control switch (101) element provides manual control of a circuit breaker or switch without using physical switches or interposing relays. Both local and remote control is possible. A virtual switch can be used instead of a physical switch to reduce costs with the added benefit that the virtual switch can be operated both locally from the front panel and remotely from a substation computer or Ethernet connection to an operator's console.

Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Breaker Control Switch settings screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Settings Navigation Path: Settings Explorer, Control, Breaker Control Switch (101)

HMI Settings Navigation Path: Settings Explorer, Control, Breaker Switch 101

BESTCOMS*Plus* Control Navigation Path: Metering Explorer, Control, Breaker Control Switch

HMI Control Navigation Path: Metering Explorer, Control, 101 Breaker Control SW

Element Operation

The breaker control switch emulates a typical breaker control switch with a momentary close, spring return, trip contact output (Trip), a momentary close, spring return, close contact output (Close), a trip slip contact output (TSC), and a close slip contact output (CSC). The trip slip contact output retains the status of the last trip control action. That is, it is TRUE (closed) in the after-trip state and FALSE (open) in the after-close state. The close slip contact output retains the status of the last close control action. It is FALSE (open) in the after-trip state and TRUE (closed) in the after-close state. Figure 17-1 shows the state of the TSC and CSC logic outputs with respect to the state of the Trip and Close outputs.

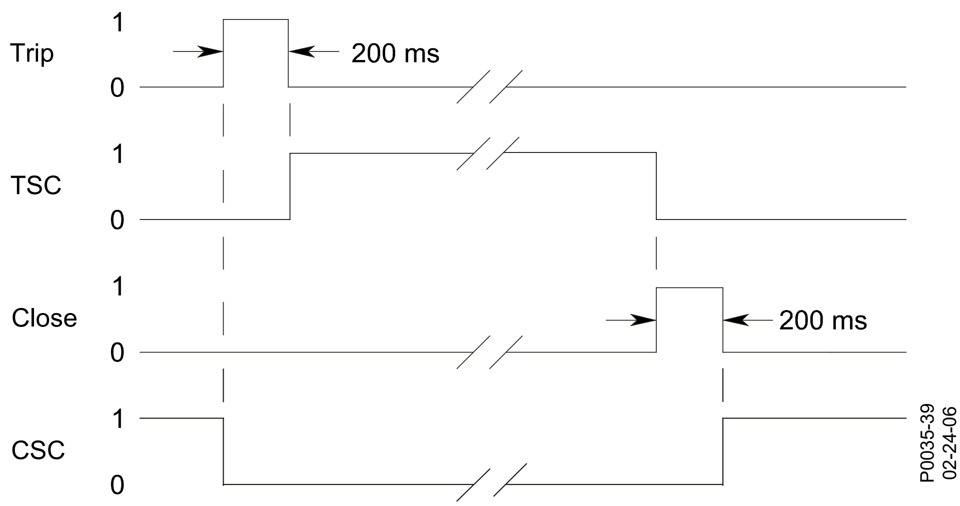


Figure 17-1. Breaker Control Switch State Diagram

When the breaker control switch is controlled to trip, the Trip output pulses TRUE (closed) for approximately 200 milliseconds and then the TSC output goes TRUE (closed). When the breaker control switch is controlled to close, the CSC output pulses TRUE (closed) and the TSC goes FALSE (open). The status of the slip contact outputs is saved to nonvolatile memory so that the BE1-11*d* will power up with the contact in the same state as when the BE1-11*d* was powered down.

Control of Breaker Control Switch

The state of virtual control switches can be controlled using the front-panel interface or through BESTCOMS*Plus* when the connection state is active. Using select-before-operate, perform the following steps to control the switch using BESTCOMS*Plus*:

1. Use the Metering Explorer to open the Control/Breaker Control Switch tree branch (Figure 17-2).
2. Click on either the TRIP or CLOSE button to **select** it. Login may be required. The green selection indicator will begin to flash.
3. Click on the TRIP or CLOSE button a second time to **operate** it. The green selection indicator will stop flashing and the proper status indicator will light.

Note
If Step 3 is not performed within 25 seconds of Step 2, the button will stop flashing and either the TRIP or CLOSE button will have to be re-selected.

Figure 17-2. Breaker Control Switch Control Screen

Tagging of Breaker Control Switch

The breaker control switch provides tagging to indicate that the switch function is, or may be, under revision. There are two tagging modes, Informational and Blocking. When in Informational mode, the switch will still be operational when tagged. When in the Blocking mode, the switch will not be operational while tagged. A tagged switch is indicated by an amber indicator on this screen.

Tagging of the breaker control switch can be accomplished through the front panel and through BESTCOMS*Plus*. Use the Metering Explorer in BESTCOMS*Plus* to open the Control/Breaker Control Switch tree branch. Click on the Set button for Informational Tag, Blocking Tag, or both. If tagging is successful, a green indicator to the right of the Set button will light.

The Blocking Tag has priority over the Informational Tag. Once the Blocking Tag has been placed, the Informational Tag cannot be changed until the Blocking Tag is removed. In other words, you must choose to place the Informational Tag before placing the Blocking Tag.

Each tag is placed with an “owner”. A tag must be removed by the same “owner” that placed it. For example, if a tag is placed through BESTCOMS*Plus*, it can be removed only through BESTCOMS*Plus*. It cannot be removed through the front panel. If a tag is placed through the front panel, it can be removed only through the front panel. This applies for all other forms of communication when placing tags.

A 101 Tag alarm is also provided to indicate that the 101 is tagged. Refer to the *Alarms* chapter for information on how to program alarms.

Logic Connections

Breaker control element logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The breaker control element logic block is illustrated in Figure 17-3. All logic inputs use rising-edge detection for recognition. Logic inputs and outputs are summarized in Table 17-1.

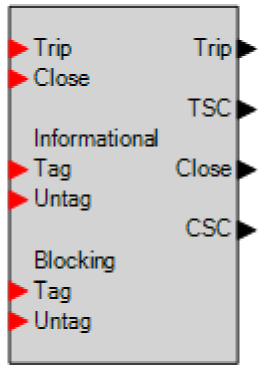


Figure 17-3. Breaker Control Element Logic Block

Table 17-1. Logic Inputs and Outputs

Name	Logic Function	Purpose
Trip	Input	Sets the state of the 101 element to Trip
Close	Input	Sets the state of the 101 element to Close
Informational Tag	Input	Sets an informational tag on the 101 element
Informational Untag	Input	Removes the informational tag from the 101 element
Blocking Tag	Input	Sets a blocking tag on the 101 element
Blocking Untag	Input	Removes the blocking tag from the 101 element
Trip	Output	True if the 101 element is in the Trip state
TSC	Output	True after the Trip output momentarily closes
Close	Output	True if the 101 element is in the Close state
CSC	Output	True after the Close output momentarily closes

Operational Settings

Breaker control element operational settings are configured on the Breaker Control Switch (101) settings screen (Figure 17-4) in BESTCOMS*Plus*.

Figure 17-4. Breaker Control Switch Settings Screen

18 • Setting Groups

Four setting groups allow for adapting the coordination settings to optimize them for a predictable situation. Sensitivity and time coordination settings can be adjusted to optimize sensitivity or clearing time based upon source conditions or to improve security during overload conditions. The possibilities for improving protection by eliminating compromises in coordination settings with adaptive setting groups are endless.

The four setting groups are designated Setting Group 0, Setting Group 1, Setting Group 2, and Setting Group 3. Setting group logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and setting group operational settings are configured on the Setting Group Setup screen in BESTCOMS*Plus*. A summary of the logic inputs and outputs and operational settings appears at the end of this chapter.

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Setting Group Setup

HMI Navigation Path: Settings Explorer, General Settings, Settings Group

Setting Group Functions

The group of settings that is active at any point in time is controlled by the setting group selection logic. This function logic allows for manual (logic) selection.

Logic Inputs

The function monitors logic inputs D0 through D3 and changes the active setting group according to the status of these inputs. These inputs can be connected to logic expressions such as contact sensing outputs.

Logic Outputs

The function logic has four logic variable outputs, SG0 through SG3. The appropriate variable is asserted when each setting group is active. These logic variables can be used in programmable logic to modify the logic based upon which setting group is active.

The SGCACTIVE logic output is asserted when setting group control is active. The SGCLOVRD logic output is asserted when setting group control is overridden by logic.

Changing Setting Groups

When the BE1-11*d* switches to a new setting group, all functions are reset and initialized with the new operating parameters. The settings change occurs instantaneously so at no time is the BE1-11*d* off line. When a setting group changes according to current level and the 82 recloser is not in reset, the 82 element settings will not change to the new settings until the 82 element returns to reset. The active setting group is saved in nonvolatile memory so that the BE1-11*d* will power up using the same setting group that was active when it was powered down. To prevent the BE1-11*d* from changing settings while a fault condition is in process, setting group changes are blocked when the BE1-11*d* is in a picked-up state. Since the BE1-11*d* is completely programmable, the fault condition is defined by the pickup logic expression in the fault reporting functions. See the *Fault Reporting* chapter for more information.

Setting Group Selection

Selection of the active setting group provided by this function logic can also be overridden. When logic override is used, a setting group is made active and the BE1-11*d* stays in that group regardless of the state of the manual logic control conditions.

Manual (logic) selection reads the status of the logic inputs to the setting group selection function block to determine what setting group should be active. **For the logic inputs to determine which setting group should be active, the AUTOMATIC input must be logic 0.** The function block operational mode setting determines how it reads these logic inputs. There are two possible logic modes as shown in Table 18-3.

Discrete Inputs

When the setting group selection function block is enabled for Discrete Inputs, there is a direct correlation between each discrete logic input and the setting group that will be selected. That is, asserting input D0 selects SG0 and asserting input D1 selects SG1, etc. The active setting group latches-in after the input is read. It is not necessary that the input be maintained. If one or more inputs are asserted at the same time, the numerically higher setting group will be activated. A pulse must be present for approximately one second for the setting group change to occur. After a setting group change occurs, no setting group change can occur within two times the SGC alarm on time. Any pulses to the inputs will be ignored during that period.

Figure 18-1 shows an example of how the inputs are read when the setting group selection function mode is enabled for Discrete Inputs. Note that a pulse on the D3 input while D0 is also active does not cause a setting group change to SG3 because the AUTOMATIC input is active.

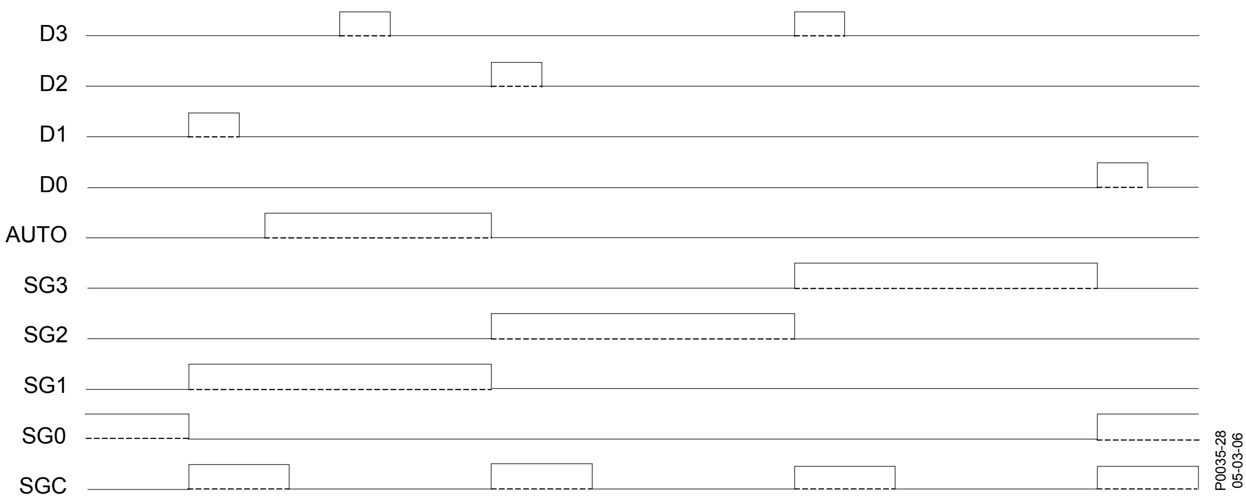


Figure 18-1. Input Control Discrete Inputs

Binary Inputs

When the setting group selection function block is enabled for Binary Inputs, the inputs on D0 and D1 are read as binary encoded (Table 18-1). Inputs D2 and D3 are ignored. A new coded input must be stable for approximately one second for the setting group change to occur. After a setting group change occurs, no setting group change can occur within two times the SGC alarm on time.

Table 18-1. Setting Group Binary Codes

Binary Code		Setting Group
D1	D0	
0	0	SG0
0	1	SG1
1	0	SG2
1	1	SG3

The active setting group is controlled by a binary signal applied to discrete inputs D0 and D1. This requires separate logic equations for only D0 and D1 if all setting groups are to be used. Figure 18-2 shows how the active setting group follows the binary sum of the D0 and D1 inputs except when blocked by the AUTOMATIC input. Note that a pulse on the D1 input while D0 is also active does not cause a setting change to SG3 because the AUTOMATIC input is active.

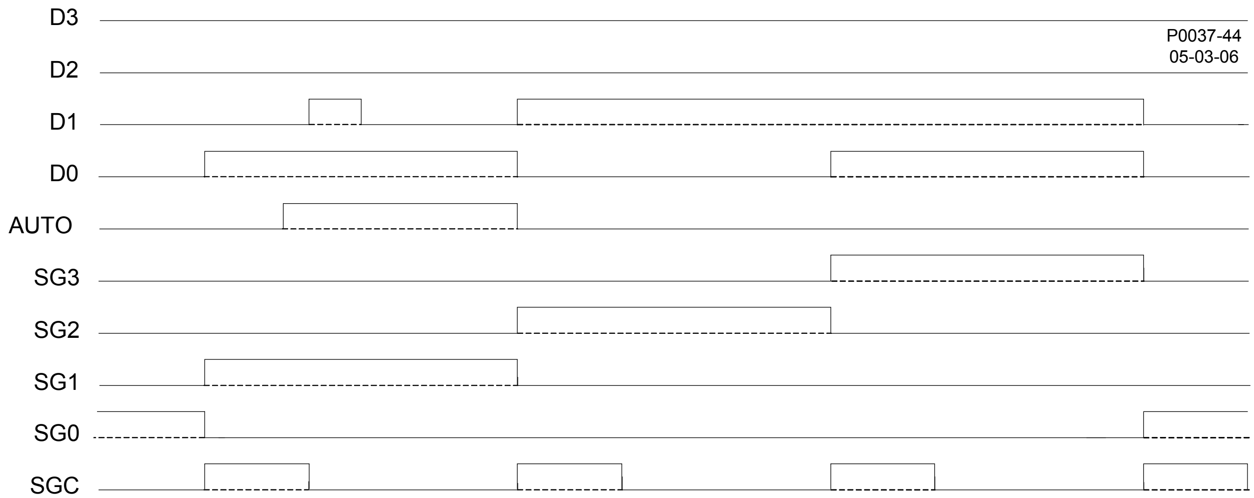


Figure 18-2. Input Control Binary Inputs

Alarm and Timer

The setting group selection function logic also has an alarm output variable called Setting Change (Setting Group Changed). This output is asserted whenever the BE1-11*d* switches from one setting group to another. The Setting Change alarm bit is asserted for the SGC Alarm Timer setting. This output can be used in the programmable alarms function if it is desired to monitor when the BE1-11*d* changes to a new setting group. See the *Alarms* chapter for more information on setting up alarms.

The SGC Alarm Timer setting also serves to provide anti-pump protection to prevent excessive changing between groups. Once a change in the active group has been made, another change cannot take place for two times the SGC Alarm Timer setting.

The SGC Active (Setting Group Change Active) alarm output is typically used to provide an external acknowledgment that a setting group change has occurred. If SCADA (Supervisory Control and Data Acquisition) is used to change the active group, then this signal could be monitored to verify that the operation occurred. The SGC Active alarm output ON time is user programmable and should be set greater than the SCADA scan rate. This can be set through BESTCOMS*Plus*®.

Automatic Setting Group Selection

The setting group element has the built-in ability to automatically change setting groups. One method is based on the history of the current sensed by the BE1-11*d*. Another method is based upon the status of the reclose function (82). To enable automatic change of setting groups, setting group selection must be enabled and the AUTOMATIC input must be logic 1.

When automatic selection is enabled, it holds precedence over all manual logic control.

The automatic setting group selection can be used to force the BE1-11*d* to change to settings that will automatically compensate for cold-load pickup conditions. For instance, if the BE1-11*d* senses current drop below a very small threshold for a period of time indicating an open breaker, then the BE1-11*d* will move to an alternate setting group that will allow for the large inrush of current the next time the load is energized. After current has returned to measurable levels for some period of time, the BE1-11*d* returns to the normal settings. Another application is to prevent the BE1-11*d* from seeing an overload condition as a fault. If the BE1-11*d* sees sustained high level current that is encroaching on normal trip levels (indicative of an overload rather than a fault), the BE1-11*d* will move to an alternate setting group that can accommodate the condition. The BE1-11*d* can be set to alarm for this condition using the programmable logic alarms.

The BE1-11*d* has the logic to automatically change setting groups based upon the status of the reclose function (82). This scheme allows the BE1-11*d* to have fast and slow curves, for instance, when the user is applying automatic reclosing into a fault. On the first trip of a fault, the BE1-11*d* can use a setting group with a fast overcurrent curve and/or a low set instantaneous setting, with the intent of tripping faster than downstream fuses. On subsequent trips, by monitoring the reclose step, the BE1-11*d* would be in an alternate setting group with a slower overcurrent response and/or a higher or no instantaneous trip with the intent of operating slower than downstream fuses.

Automatic Control by Monitoring Line Current

The setting group Switch Threshold and Return Threshold settings determine how the function selects the active setting group when automatic selection is enabled.

Automatic control of the active setting group allows the BE1-11*d* to automatically change configuration for optimum protection based on the current system conditions. For example, in locations where seasonal changes can cause large variations in loading, the overcurrent protection can be set with sensitive settings during the majority of the time and switch to a setting group with lower sensitivity (higher pickups) during the few days of the year when the loading is at peak.

The BE1-11*d* will switch to a setting group when current rises above the "switch threshold" for the "switch time" and will return from the setting group when current falls below the "return threshold" for the "return time." However, if the Switch Threshold is 0 and a nonzero switch-to time is entered, the BE1-11*d* will change to the indicated setting group after the switch-to time.

If the monitored element is first, second, third, or fourth reclose, the switch time, switch threshold, return time, and return threshold are ignored and the setting group is based upon the status for the reclose step. This method of controlling setting groups will be covered further in the following paragraphs.

If a group's switch threshold is zero, the group’s switch time delay is zero, and current is being monitored, then the BE1-11*d* will never automatically switch to that setting group.

Five settings for each group are used for automatic control. Each group has a Switch Threshold and Switch Time, a Return Threshold and Return Time, and a Monitor Setting. The Switch and Return thresholds are set in amps.

This function can also be used to automatically change the active setting group for cold load pickup conditions. If the Switch Threshold for a group is set to 0 amps, the function will switch to that group when there is no current flow for the time delay period, indicating that the breaker is open or the circuit source is out of service.

Note the difference in operation when a switch threshold of 0.5 amps is used. For this setting, the group is selected when current rises above 0.5 amps.

When the Switch criteria are met for more than one setting group at a time, the function will use the numerically higher of the enabled setting groups. If the switch-to time delay setting is set to 0 for a setting group, automatic control for that group is disabled. If the return time delay setting is set to 0 for a setting group, automatic return for that group is disabled and the BE1-11*d* will remain in that setting group until returned manually by logic override control.

Group Control by Monitoring Reclose Status

The active setting group can also be controlled by the status of the reclose (82) function. Upon entering a reclose operation, as the BE1-11*d* steps through an automatic reclose operation, the BE1-11*d* can be instructed to change to an appropriate setting group. If the monitored element is 1st reclose, 2nd reclose, 3rd reclose, or 4th reclose, the switch time, switch threshold, return time, and return threshold are ignored.

When setting group changes are made, the BE1-11*d* will stay in the last group selected until the BE1-11*d* returns to a reset condition. Upon the return to a reset condition, the BE1-11*d* restores Setting Group 1.

The points in the reclose process that the first, second, third, and fourth reclose setting causes a change to the desired setting group is when A, the referenced reclose occurs and B, after the breaker closes.

Example:

In most common practices, two setting groups are used for emulating a circuit recloser in a fuse-saving scheme (a "fast" curve and a "slow" curve). The settings below call for using Setting Group 0 during normal operation, Setting Group 1 after reclose 2 and remain in Setting Group 1 until the breaker closes from lockout. The active group would return to group 0 when the recloser resets if any of the close operations prior to lockout was successful. Setting Groups 2 and 3 are not used. Refer to Figure 18-3.

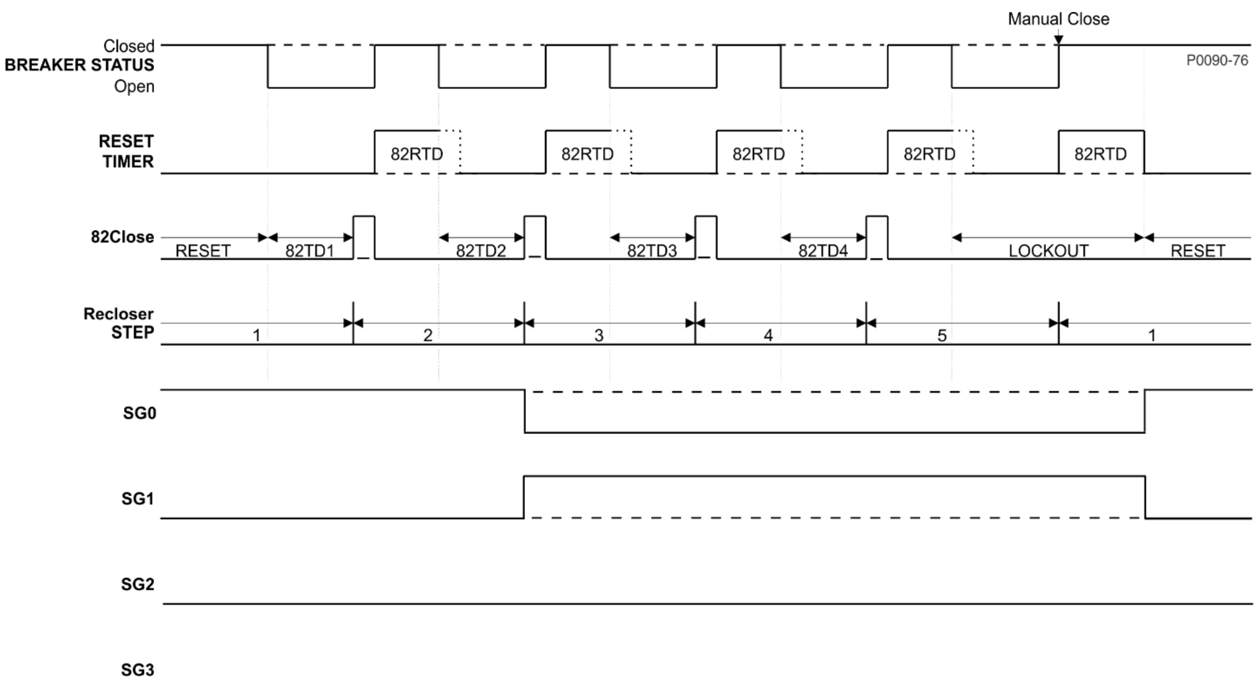


Figure 18-3. Change Group on Recloser Shot

Logic Connections

Setting group logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The setting group logic block is illustrated in Figure 18-4. Logic inputs and outputs are summarized in Table 18-2.

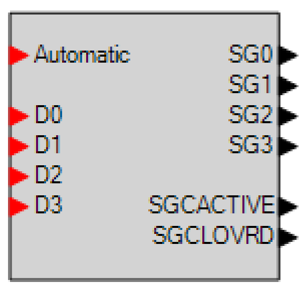


Figure 18-4. Setting Group Logic Block

Table 18-2. Logic Inputs and Outputs

Name	Logic Function	Purpose
Automatic	Input	True when automatic control is enabled and false when logic control is enabled
D0, D1, D2, D3	Inputs	Meaning depends upon the Mode setting
SG0, SG1, SG2, SG3	Outputs	True for the active setting group
SGCACTIVE	Output	True when Setting Group Control is Active
SGCLOVRD	Output	True when Setting Group Control is overridden by logic

Operational Settings

Setting group operational settings are configured on the Setting Group Setup screen (Figure 18-5) in BESTCOMS*Plus*. Setting ranges and defaults are summarized in Table 18-3.

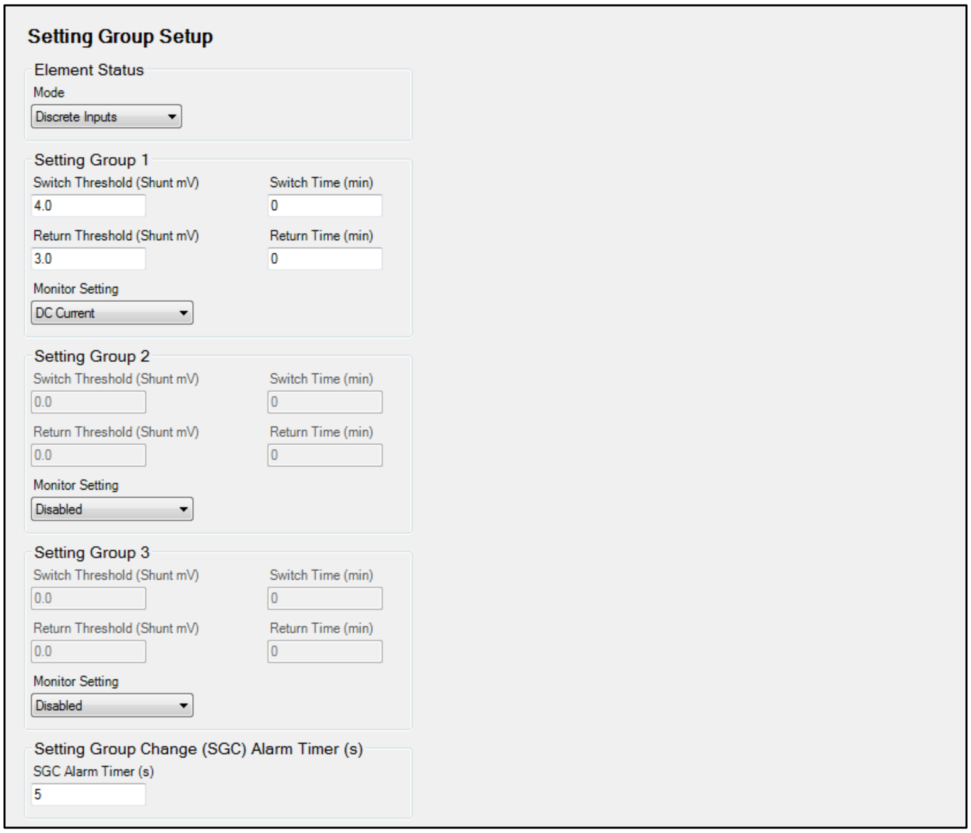


Figure 18-5. Setting Group Setup Screen

Table 18-3. Operational Settings

Setting	Range	Purpose	Default
Mode	Disabled, Discrete Inputs, or Binary Inputs	Sets the mode of the setting group selection function. (If Auto mode is desired, logic mode must be either 1 or 2.)	Disabled
Switch Threshold	0 to 500 mV	Measured current of the SG0 Monitor Setting that must be exceeded for a setting group change to occur. (Set in increments of 1 mV.)	0
Switch Time	0 = Disabled 1 to 60 minutes	Time, in minutes, that determines when a setting change occurs once the Switch Threshold setting is exceeded.	0
Return Threshold	0 to 500 mV	Measured current of the SG0 Monitor Setting that the monitored current must decrease below in order for a return to SG0. (Set in increments of 1 mV.)	0
Return Time	0 = Disabled 1 to 60 minutes	Time, in minutes, that determines when a return to SG0 will occur once the monitored current has decreased below the Return Threshold setting.	0
Monitor Setting	Disable, First to Fourth Recloser Shot, or DC Current	Determines when automatic setting group changes occur. DC Current can be selected so that setting group changes are based on load current. If First to Fourth Recloser Shot is entered as the Monitor Setting, the Switch Time, Switch Threshold, Return Time, and Return Threshold parameters are not required.	Disable

Setting	Range	Purpose	Default
Setting Group Change (SGC) Alarm Timer	0 = Disabled 1 to 10 seconds	Measured in seconds, the SGC alarm timer sets the amount of time the alarm is on.	5

Logic Override of the Setting Group Selection Function

Setting group control can be overridden to allow manual setting group control.

BESTCOMS*Plus* Navigation Path: Metering Explorer, Control, Setting Group Control

HMI Navigation Path: Metering Explorer, Control, Settings Group Control

Use the Metering Explorer in BESTCOMS*Plus* to open the Control, Setting Group Control tree branch as shown in Figure 18-6. Select a setting group to change to or return to logic control. The Active Setting Group is also displayed on this screen.

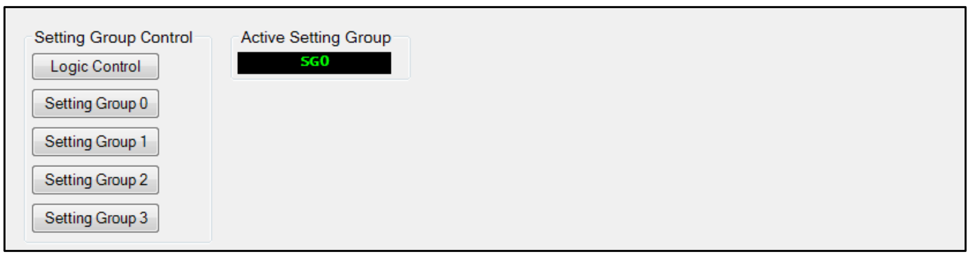


Figure 18-6. Setting Group Control Screen

Manual setting group control can also be achieved by navigating to the Metering > Control > Settings Group Control screen on the front-panel display.

19 • Metering

The BE1-11*d* measures the voltage and current inputs, displays those values in real time, records those values every quarter-second, and calculates other quantities from the measured inputs.

Metering Explorer

The Metering Explorer is a convenient tool within BESTCOMS*Plus*® that contains analog metering, status, reports, demand, power quality, and control. Control screens include virtual switches, breaker control switch, output override, and setting group control. Details of the Analog Metering branch are described in this chapter. Refer to the appropriate chapters in this manual for information on status, reports, demand, power quality, and control. Metering values can be exported to a *.csv (comma-separated values) file.

The Metering Explorer has a “docking” feature allowing the user to arrange and dock metering screens. A blue transparent square representing the screen being moved, seven arrow buttons, and a tabs button appear when holding down the left mouse button on a metering tab and dragging it to an arrow box used for docking.

Holding the left mouse button down on a metering tab and dragging it anywhere other than an arrow box will place it as a floating metering screen. This floating screen can later be closed by clicking on the in the upper right corner.

See Figure 19-1. Table 19-1 explains the call-outs in Figure 19-1.

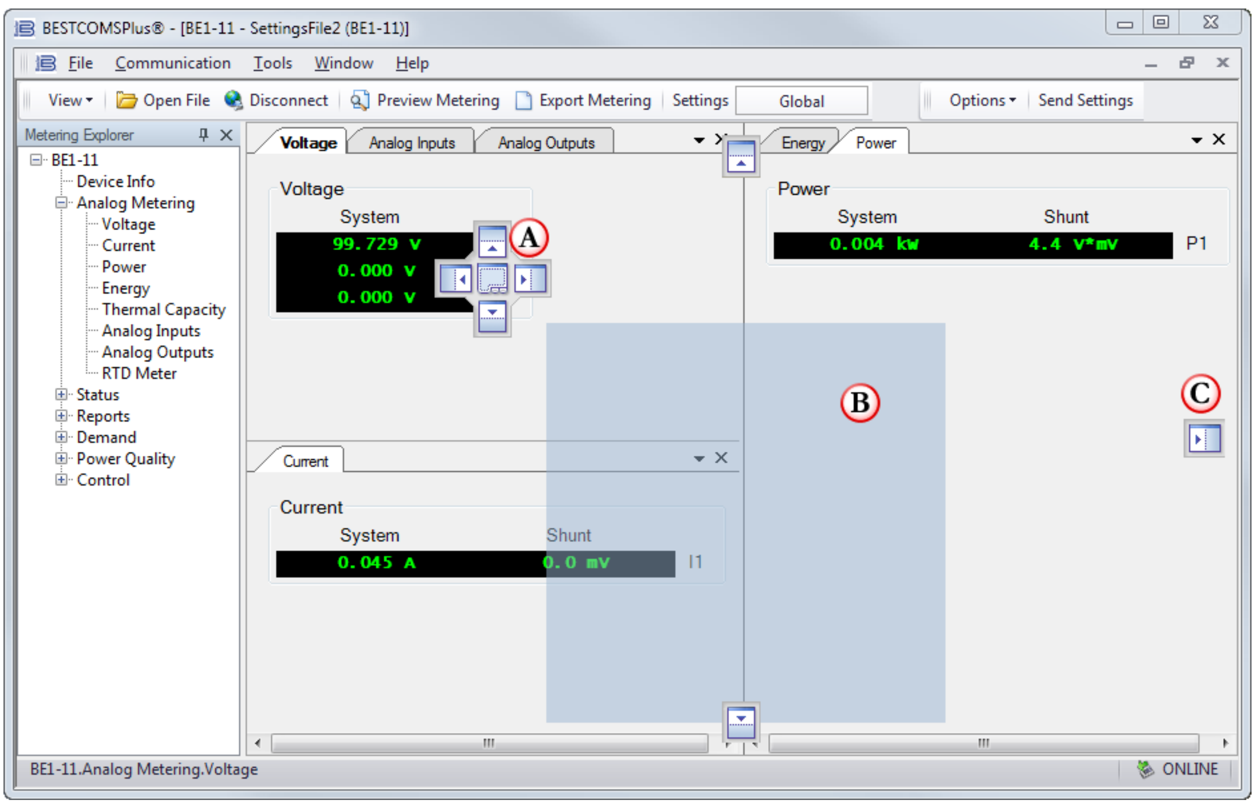


Figure 19-1. Metering, Docking Options

Table 19-1. Explanation of Figure 19-1 Call-Outs

Call-Out	Explanation
A	Holding the left mouse button down on a metering tab and dragging it to one of the four arrow boxes will place it inside the selected window on the location selected. To place the metering tab as a tab inside the selected window, drop it on the tabs button in the center of the arrow buttons.
B	This blue transparent square represents the screen being moved.
C	Holding the left mouse button down on a metering tab and dragging it to the right, down, left, or up arrow box will place it across the side/bottom/top of the screen. Click on the (thumbtack) to dock it on the side bar. To display a screen that is docked, simply use the mouse to hover the pointer over the tab on the side bar.

Analog Metering Functions

BE1-11*d* analog metering functions include voltage, current, power, energy, thermal capacity, analog inputs, analog outputs, and RTD meter. Metered values are viewed through the Metering Explorer in BESTCOMS*Plus*, the front-panel display, or the web page interface on Ethernet equipped protection systems. Refer to the *BESTnet™Plus* chapter for more information. Metering functions are summarized in the following paragraphs. For information on watts calculations, refer to the *Configuration* chapter.

Voltage

System and shunt voltage metering data is found in BESTCOMS*Plus* (Figure 19-2) and on the Metering > Analog Metering > Voltage screen of the front-panel display.

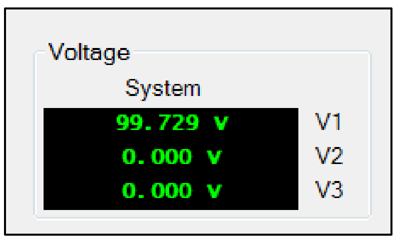


Figure 19-2. Analog Metering, Voltage Screen

Current

System and shunt current metering data is found in BESTCOMS*Plus* (Figure 19-3) and on the Metering > Analog Metering > Current screen of the front-panel display.

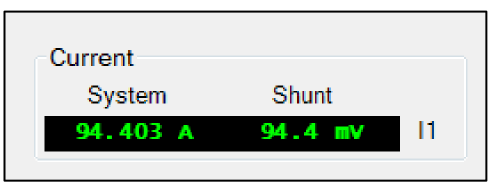


Figure 19-3. Analog Metering, Current Screen

Power

Power metering data is found in BESTCOMS*Plus* (Figure 19-4) and on the Metering > Analog Metering > Power screen of the front-panel display.

The measured current and voltage are used to calculate the power. The Power Voltage Source setting in the Settings Explorer defines which voltage source the BE1-11*d* uses to calculate power.

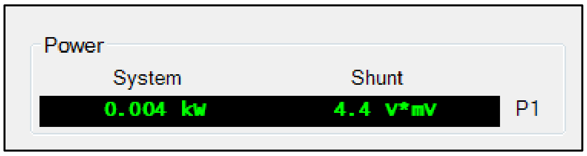


Figure 19-4. Analog Metering, Power Screen

Energy

Energy is metered for positive and negative watthours. Watthour values are calculated per minute as shown in Equation 19-1.

$$60 \text{ Minutes} \times \text{ Watts}$$

Equation 19-1. Power Energy Data Equation

Watt values are updated every 250 milliseconds and watthour values are logged once every minute. Power Energy registers are stored in nonvolatile memory at 15-minute intervals.

Watthour values can be read, reset, or changed through the front panel or communication ports. A lagging power factor load will report positive watts.

Power Energy metering data is found in BESTCOMS*Plus* (Figure 19-5) and on the Metering > Analog Metering > Energy screen of the front-panel display.

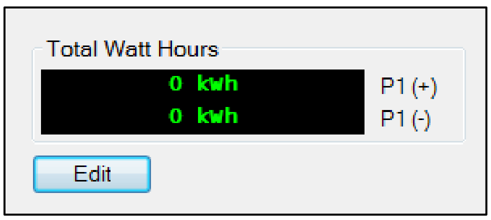


Figure 19-5. Analog Metering, Power Energy Screen

Click the Edit button to change the values. The Meter Energy Editor screen appears as shown in Figure 19-6. Make the desired changes and then click Upload Data to Device. A username and password are required to upload data. Click Close when finished.

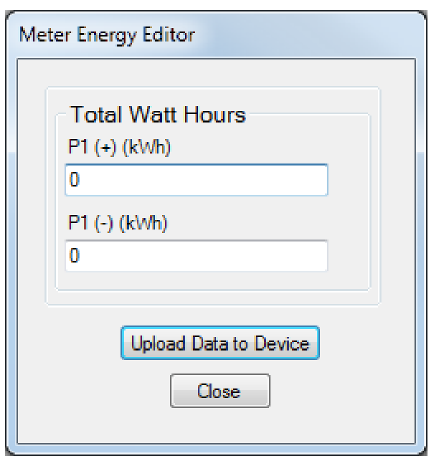


Figure 19-6. Meter Energy Editor Screen

Thermal Capacity

Thermal capacity metering data is found in BESTCOMS*Plus* (Figure 19-7) and on the Metering > Analog Metering > Thermal Capacity screen of the front-panel display.

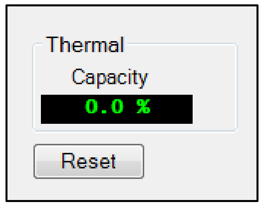


Figure 19-7. Analog Metering, Thermal Capacity Screen

Analog Inputs and Outputs

The following screens are used when an optional RTD module is connected to the BE1-11*d*. For more information, refer to the *RTD Module* chapter.

The Analog Inputs screen is shown in Figure 19-8 and the Analog Outputs screen is shown in Figure 19-9. These values are also available under Metering > Analog Metering on the front-panel display

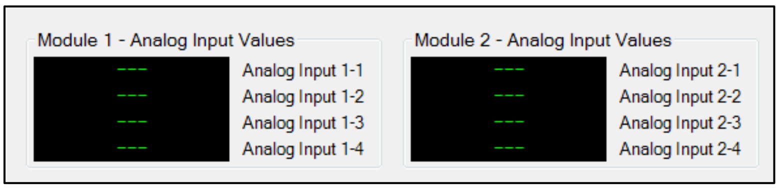


Figure 19-8. Analog Metering, Analog Inputs Screen

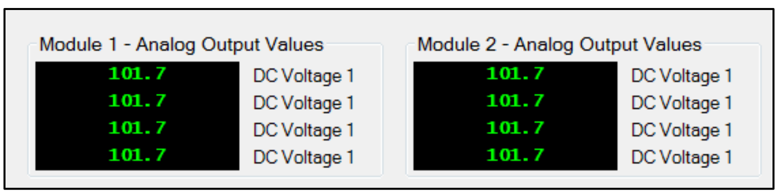


Figure 19-9. Analog Metering, Analog Outputs Screen

RTD Meter

RTD metering data is found in BESTCOMS*Plus* (Figure 19-10) and on the Metering > Analog Metering > RTD Meter screen of the front-panel display. Temperatures are displayed from the optional RTD modules.

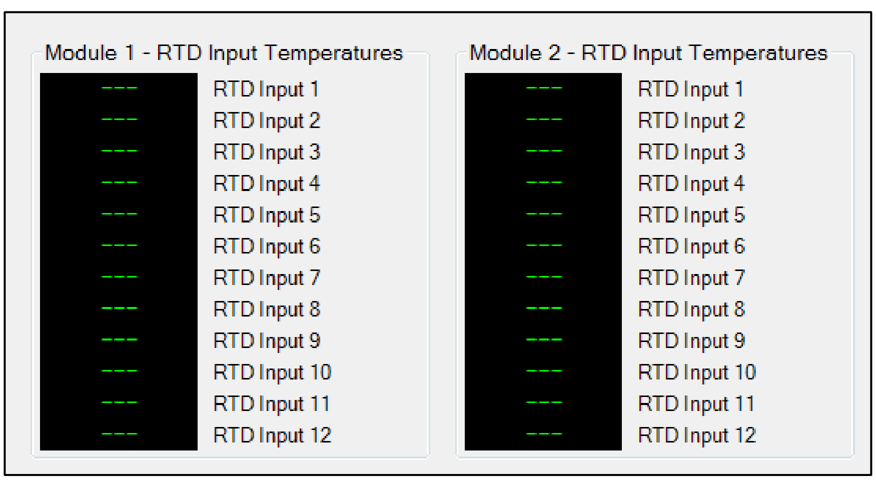


Figure 19-10. RTD Meter Screen

20 • Digital Points

BE1-11*d* digital points are shown in BESTCOMS*Plus* under *Metering Explorer, Status, Digital Points*. The user can search for points by scrolling through a grid of all points or by entering the point name in the top filter row. Clicking on the point name will open the corresponding monitor screen. The Search screen is available by clicking the Digital Points tree as shown in Figure 20-1. One of the digital points monitor screens is shown in Figure 20-2.

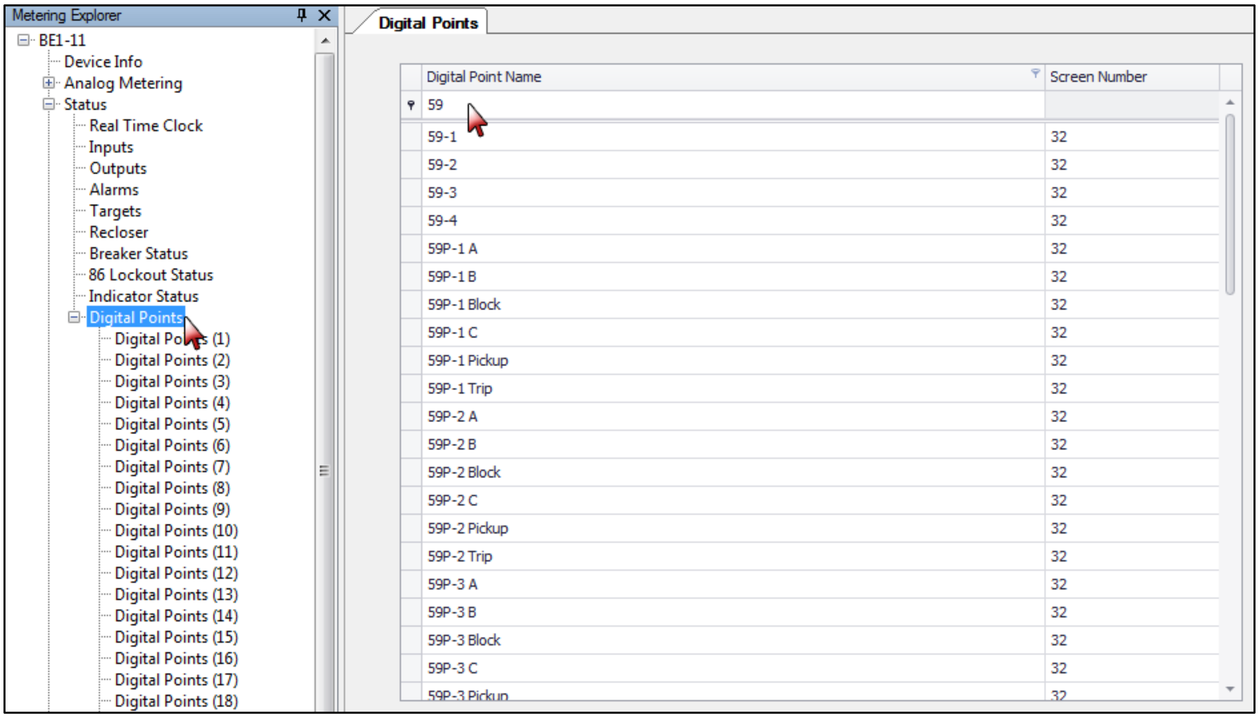


Figure 20-1. Digital Points – Search Screen

Figure 20-2. Digital Points – Monitor Screen

21 • Sequence of Events

A sequence of events recorder (SER) report is very useful in reconstructing the exact sequence and timing of events during a power disturbance or even normal system operations. The SER tracks over 700 data points by monitoring the internal and external status of the BE1-11*d*. All changes of state that occur during each scan are time tagged to 1 millisecond resolution. Over 1,000 records are stored in nonvolatile memory; when the SER memory becomes full, the oldest record is replaced by the latest one acquired.

The SER monitors the following points and conditions:

- Single-state events such as resetting demands or targets, changing settings, etc.
- Programmable logic variables
- Targets
- Relay trouble alarm variables
- Programmable alarm variables
- Output contact status
- Fault reporting trigger expressions

BE1-11*d* protection systems have three identification fields: Device ID, Station ID, and User ID. These fields are used in the header information lines of the sequence of events records. Refer to the *BESTCOMSPlus® Software* chapter for information on BE1-11*d* identification settings.

For user-programmable logic variables (contact sensing inputs, contact outputs, and virtual control switches), the user-programmed variable name, and state names are logged in the SER report instead of the generic variable name and state names.

When a monitored event occurs or a monitored variable changes state, the SER logs all event data listed in Table 21-1.

Table 21-1. Event Data Recorded

Event Data Recorded	Description
TIME STAMP	Date of change in format YYYY-MM-DD
	Time of change in 24 hour format HH:MM:SS.mmm
SYNC	Time Sync Status, one of: IRIGB, DNP, NTP, RTC, NO_SYNC
DEVICE ID	User entered device name string
TYPE	Point Type, one of: ALRM (alarm), CONF (configurable), LGIC (logic), PROT (protection), STAT (status), TRBL (trouble), TRGT (target), USER (user)
NUM	Basler Point Name (not localized to local language)
DESCRIPTION	Localized or user entered string description of point
STATUS	Localized or user entered string status of point (Open, Closed, Trip, etc.)

Sequence of Events Setup

BESTCOMS*Plus* Navigation Path: Settings Explorer, Report Configuration, Sequence of Events Setup

HMI Navigation Path: Not available through the front panel

The Sequence of Events Setup screen is shown in Figure 21-1. Select events to be recorded in the Sequence of Events Log. All events are enabled by default.

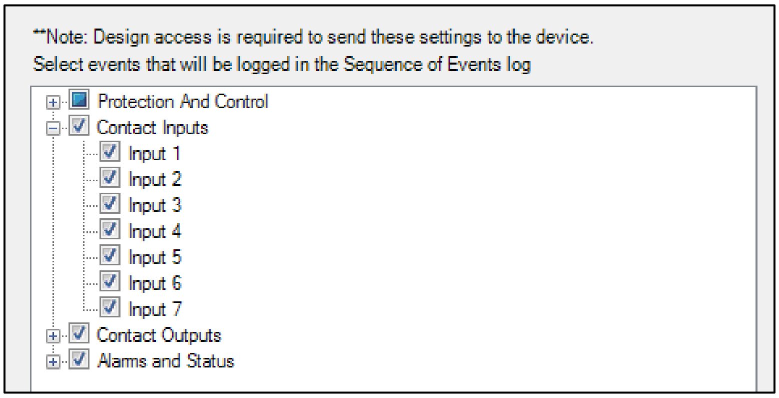


Figure 21-1. Sequence of Events Setup Screen

Retrieving SER Information

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Sequence of Events

HMI Navigation Path: Not available through the front panel

Sequence of events data can be obtained through BESTCOMS*Plus* and the web page interface.

Viewing and Downloading SER Data through BESTCOMS*Plus*®

Use the Metering Explorer to open the Reports, Sequence of Events screen. If an active connection to a BE1-11*d* is present, the sequence of events will automatically download. Using the Options button, you can copy, print, or save the Sequence of Events. The Refresh button is used to refresh/update the list of events. The Clear button will clear all events. The Toggle Sorting button enables sorting. Click on a column header to sort. See Figure 21-2.

Time Stamp	Sync	Device ID	Type	Num	Description	Status
2018-09-06 12:03:08.863	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:03:15.308	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:03:15.679	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:03:15.846	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:17:22.079	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:17:26.711	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:17:27.023	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:17:27.181	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:17:48.568	RTC	BE1-11_1	PROT	1539	43-1	On
2018-09-06 12:17:55.269	RTC	BE1-11_1	PROT	1539	43-1	Off
2018-09-06 12:18:20.968	RTC	BE1-11_1	PROT	1539	43-1	On
2018-09-06 12:18:21.167	RTC	BE1-11_1	PROT	1539	43-1	Off
2018-09-06 12:18:46.085	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:18:53.154	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:18:53.555	RTC	BE1-11_1	ALRM	2391	Setting Change	Off
2018-09-06 12:18:53.726	RTC	BE1-11_1	ALRM	2391	Setting Change	On
2018-09-06 12:19:05.693	RTC	BE1-11_1	PROT	1571	43-2	On
2018-09-06 12:19:12.649	RTC	BE1-11_1	PROT	1571	43-2	Off
2018-09-06 12:19:15.434	RTC	BE1-11_1	PROT	1578	43-2-Tagl Status	On

Figure 21-2. Sequence of Events Screen

Viewing SER Data through the Web Page Interface

Sequence of events summary can be viewed through the web page interface. Refer to the *BESTnet™Plus* chapter.

22 • Fault Reporting

Information about faults detected by the BE1-11*d* is recorded and reported. Fault reporting includes fault summary reports, oscillographic records, and targets.

Fault Reporting Trigger Logic

Logic expressions are used to define the three conditions for fault reporting. These conditions are Trip, Picked Up, and Logic trigger. An oscillographic record is triggered when either the Pickup or Logic input is true. You can also force a trigger using BESTCOMS*Plus*®.

Figure 22-8 illustrates how each of these logic expressions is used by the various BE1-11*d* functions. Fault trigger logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*. The *BESTlogicPlus* chapter provides information about using BESTlogic*Plus* to program the BE1-11*d*. Figure 22-1 illustrates the fault reporting trigger logic block.

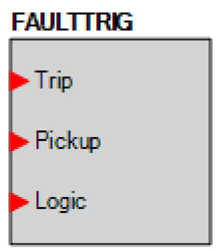


Figure 22-1. Fault Reporting Trigger Logic Block

Trip

Trip expressions are used by the fault reporting function to start logging targets for an event and to record fault current magnitudes at the time of trip. The trip expression is used to light the Trip LED on the front panel. The Trip LED will turn on and remain on as long as the trip expression is true. The Trip LED will remain on (or "sealed-in") after the trip expression becomes false if targets are associated with the trip. The breaker monitoring function uses the trip expression to start counting the breaker operate time.

Pickup

Pickup expressions are used by the fault reporting function to time-stamp the fault summary record, time the length of the fault from pickup to dropout (fault clearing time), and to control the recording of oscillographic data. The pickup expression is used to flash the Trip LED on the front panel. The Trip LED will continue to flash on and off as long as the pickup expression is true and the trip expression is not true. A pickup expression is also used by the setting group selection function to prevent a setting group change during a fault.

Logic

Logic trigger expressions allow the fault reporting function to be triggered even though the BE1-11*d* is not picked up. A logic trigger expression provides an input to the fault reporting function much as the pickup expression does. This logic expression is not used by the setting group selection or the front panel.

Targets

Each protective function logs target information to the fault reporting function when a trip condition occurs and the trip output of the logic block becomes true (refer to Figure 22-8 and Table 22-1, call-out B). Table 22-1 lists targets as displayed. All targets are enabled by default.

Table 22-1. Targets as Displayed

Target	Description
27-#	Undervoltage
32-# DC Over	Overpower
32-# DC Under	Underpower
49	Thermal Overload
49RTD-# RTD-#-#	Over/Undertemperature
59-#	Overvoltage
76-#	Overcurrent
ROR-#	Rate of Rise
Analog In #	Remote Analog Input
86-#	Lockout Function
62-#	Timer Output
“User Defined Label”	User Programmable Target

Target logging for a protective function can be disabled if the function is used in a supervisory or monitoring capacity. The following paragraphs describe how the BE1-11*d* is programmed to define which protective functions log targets.

Target Settings

Targets are enabled using BESTCOMS*Plus*. Use the Settings Explorer to open the Target Configuration tree branch. You can select which protective elements trigger a target by selecting Enabled or Disabled from the Mode drop-down menu next to the targets. See Figure 22-2.

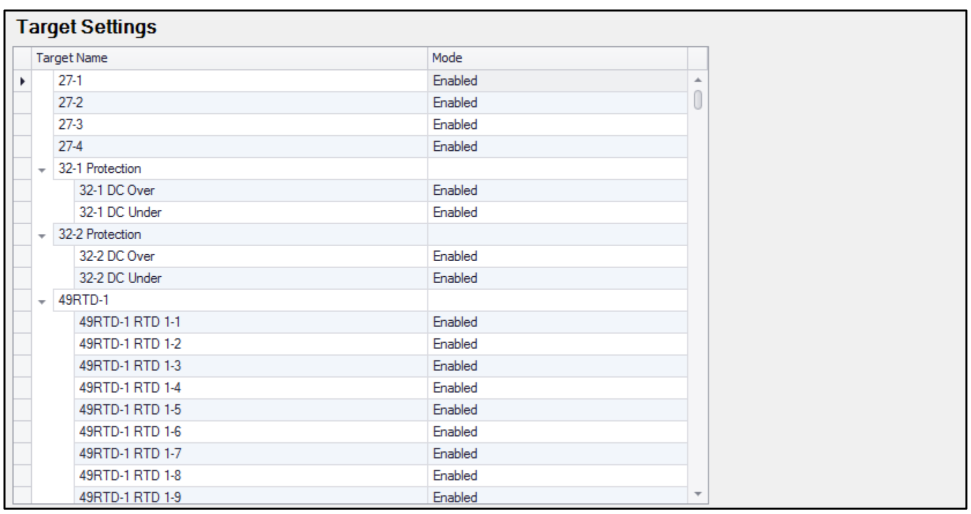


Figure 22-2. Target Settings Screen

User Programmable Targets

BESTCOMS*Plus* Navigation Path: Settings Explorer, Target Configuration, User Programmable Targets

HMI Navigation Path: Not available through the front panel

Twelve user programmable targets are available. BESTlogic*Plus* Programmable Logic is used to set up target logic. User target labels are programmed on the User Programmable Targets screen (Figure 22-3) under Target Configuration. When active, the label of a user target is displayed on the front-panel display, in the fault report, and in the sequence of events report.

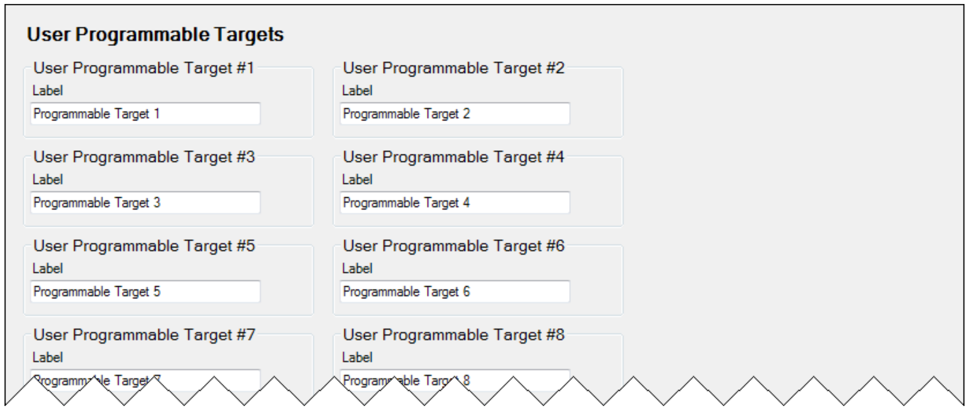


Figure 22-3. User Programmable Targets Screen

Retrieving Target Information and Resetting Targets

To view targets at the front-panel display, navigate to Metering > Status > Targets. The BE1-11*d* provides target information from the most recent trip event. Target information is specific to an event; it is not cumulative. Targets for previous events are recorded in the fault summary reports, which are described in *Fault Reports.*

When a protective trip occurs and targets are logged, the front-panel Trip LED seals-in. The target can be viewed on the front-panel display by navigating to Metering > Status > Targets.

To view target status using BESTCOMS*Plus*, use the Metering Explorer to open the Status, Targets screen shown in Figure 22-4.

Targets can also be viewed through the web page interface. Refer to the *BESTnetPlus* chapter*.*

Targets can be cleared through BESTCOMS*Plus* or by pressing the front-panel Reset button while viewing the Targets screen. Targets cannot be reset through the web page interface.

Figure 22-4. Targets Screen

A BESTlogic*Plus* expression can be used to reset the targets. Use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic tree branch. Select the Target Reset logic block from the list of Elements. Use the drag and drop method to connect a variable or series of variables to the Reset input. The target reset logic block is shown in Figure 22-5.

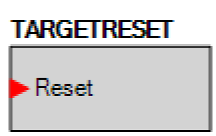


Figure 22-5. Target Reset Logic Block

Pressing the front-panel Reset key clears the targets and the Trip LED. Depending on device security setup, a username and password may be required to reset targets at the front panel. Logging in is not required if the Unsecured Access Level is set to Operator or higher. Target reset can also be set outside of security control, allowing reset without logging in. Refer to the *Security* chapter for more information.

A target reset key is available as a status input in BESTlogic*Plus*. Refer to the *BESTlogicPlus* chapter for more information.

Fault Reports

The BE1-11*d* records information about faults and creates fault summary reports. A maximum of 255 fault summary reports are stored in nonvolatile memory. When a new fault summary report is generated, the BE1-11*d* discards the oldest of the 255 events and replaces it with a new one. Each fault summary report is assigned a sequential number (from 1 to 255) by the BE1-11*d*. After event number 255 has been assigned, the numbering starts over at 1.

Five different event types are generated by the BE1-11*d*: Trip, Pickup, Logic, Breaker Failure, and Forced Trigger.

BE1-11*d* protection systems have three identification fields: Device ID, Station ID, and User ID. These fields are used in the header information lines of the fault reports. Refer to the *BESTCOMSPlus Software* chapter for information on BE1-11*d* identification settings.

Viewing and Downloading Fault Data through BESTCOMS*Plus*®

To view fault summary reports using BESTCOMS*Plus*, use the Metering Explorer to open the Reports, Fault Records screen shown in Figure 22-6. This screen shows a list of faults along with number, date, time, event type, and number of oscillographic records for each fault.

From this screen, you can choose to View All or View New fault reports. Then select View Fault Details or View Fault Sequence of Events by selecting your choice at the top of the screen and then highlighting the fault to be displayed.

The Download button allows you to download and save all files associated with the selected fault. These files include oscillographic records. The Refresh button refreshes the list of fault reports on the screen (Figure 22-6) that are available to view/download. The Reset button resets new faults. The Trigger button manually triggers a fault.

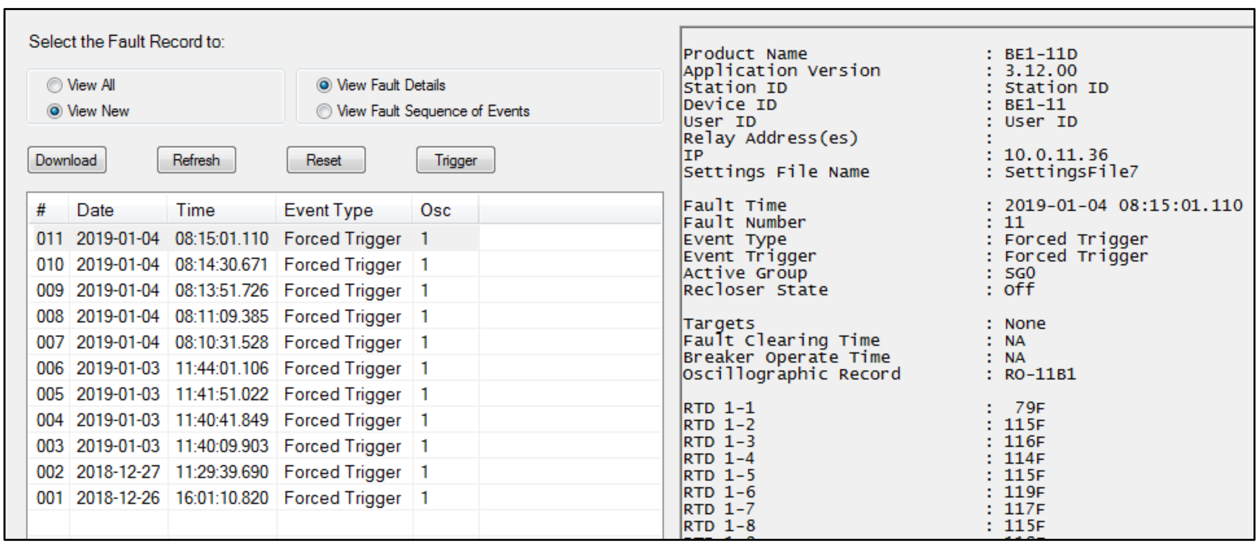


Figure 22-6. Fault Reports Screen

Viewing and Downloading Fault Data through the Web Page Interface

Fault report data can be viewed through the web page interface. For more information, refer to the *BESTnetPlus* chapter.

Viewing Fault Data through the Front-Panel Display

Fault report data for the last 10 faults can be viewed through the front-panel display by navigating to Metering, Reports, Fault Reports.

Fault Summary Report Items

A fault summary report collects several items of information about a fault that can aid in determining why a fault occurred without having to sort through all of the detailed information available. The following items are contained in a typical fault summary report.

Product Name

This line reports the product name.

Application Version

This line reports the version of firmware inside the BE1-11*d*.

Station ID, Device ID, and User ID

These lines report station, device, and user information as defined by *BESTCOMSPlus* on the Device Info screen.

Relay Address

This line reports the communications port address(es) that the report was requested from. The addresses are assigned using BESTCOMS*Plus* or the front-panel interface.

Settings File Name

This line reports the name of the settings file that was active at the time of the fault.

Fault Time

This line reports the time and date of the initial trigger of the event. This is based on either the pickup logic expression or the logic trigger expression becoming true as defined by the Fault Trigger logic. Refer to Figure 22-8 and Table 22-2, call-out A.

Fault Number

This line reports the sequential number (from 1 to 255) assigned to the report by the BE1-11*d*.

Event Type

This line reports the type of event that occurred. There are five event categories:

1. Trip: A fault was detected as defined by the pickup expression and the BE1-11*d* tripped to clear the fault.
2. Pickup: A fault was detected as defined by the pickup expression but the BE1-11*d* never tripped indicating that the fault was cleared by another device.
3. Logic: A fault report was recorded by the logic trigger expression but no fault was detected as defined by the pickup expression.
4. Breaker Failure: A fault was detected as defined by the pickup expression and the breaker failure trip became true before the fault was cleared.
5. Forced Trigger: A fault report was triggered through the BESTCOMS*Plus* interface.

Event Trigger

This line reports the logic variables in the picked up or logic trigger expressions that became true to trigger the recording of the event.

Active Group

This line reports what setting group was active at the time that the fault occurred.

Recloser State

This line reports the state of the recloser shot counter prior to the fault that triggered the report.

Targets

This line reports the targets that were logged to the fault report between the time that the trip expression became true until the end of the fault. Refer to Figure 22-8 and Table 22-2, call-out B.

Fault Clearing Time

This line reports the time from when the BE1-11*d* detected the fault until the BE1-11*d* detected that the fault had cleared. Refer to Figure 22-8 and Table 22-2, call-out C.

- If the fault report was triggered through the BESTCOMS*Plus* interface, the recording of the report was terminated after 60 seconds and this line is reported as n/a.
- If the pickup or logic expressions stay true for more than 60 seconds, an alarm bit in the programmable alarm function is set and this line is reported as n/a. In this situation, the fault reporting functions (including targets) will not operate again until the pickup and logic trigger expressions return to a false state to enable another trigger.

Breaker Operate Time

This line reports the breaker trip time from the breaker monitoring and alarm function. This is the time measured from when the breaker is trigged until the fast current detector function detects that the arc has been extinguished.

Oscillographic Record

This line reports the number of oscillographic records that are stored in memory for this fault report. Refer to Figure 22-8 and Table 22-2, call-out E. Recording of oscillographic records is described later in this chapter.

I1, V1, V2, V3

These lines report the voltage and current magnitudes measured two power system cycles immediately following the trip trigger. If the fault is cleared prior to the BE1-11*d* tripping, the recorded fault voltages and current are for the power system cycle two cycles prior to the end of the fault. Refer to Figure 22-8 and Table 22-2, call-out F.

Thermal Capacity

This line reports the thermal energy measured during the two power system cycles immediately following the trip trigger. If the fault is cleared prior to the BE1-11*d* tripping, the recorded fault thermal energy is for the power system cycle two cycles prior to the end of the fault. Refer to Figure 22-8 and Table 22-2, call-out F.

RTD

These lines report the values of the RTDs when an optional remote RTD module is connected.

Analog Inputs

These lines report the values of the analog inputs when an optional remote RTD module is connected.

Oscillographic Records

Recording Oscillographic Records

Each time the fault reporting function starts recording, it freezes a user-defined cycle pre-fault buffer. If the fault is not cleared within that time, the fault reporting function records a second oscillographic record. This second record captures the end of the fault. Oscillographic records are stored in nonvolatile memory. As additional faults are recorded, the oldest records are overwritten. The fault reporting function can record up to 32 oscillographic records based on IEEE Std C37.111-1999 - *IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems*. The number of records to store is selectable by the user. Maximum data capture resolution is 32 samples per cycle and is user selectable. The BE1-11*d* can store up to 2,048 cycles of data at 8 samples per cycle or 512 cycles of data at 32 samples per cycle. Refer to **Error! Reference source not found.** for Oscillographic Records Settings.

All channels are recorded (I1, V1, V2, V3, Analog Inputs, and RTDs) as they happen in real time.

A settings snapshot is taken and recorded with each event. This snapshot will be stored in a file that can later be uploaded to the device to return it to the settings that were active at the time of the recording.

BE1-11*d* protection systems have three identification fields: Device ID, Station ID, and User ID. These fields are used in the header information lines of the oscillographic records. Refer to the *BESTCOMSPlus Software* chapter for information on BE1-11*d* identification settings.

Oscillographic Records Settings

The oscillographic records settings are programmed through BESTCOMS*Plus*. Use the Settings Explorer to open the Metering Configuration, Fault Records screen as shown in Figure 22-7. Enter the values for Sample Resolution, Number of Records to Store, and Prefault Cycles.

Figure 22-7. Fault Records Screen

Retrieving Oscillographic Records

Oscillographic records can be downloaded through the Reports, Fault Reports screen in BESTCOMS*Plus* (Figure 22-6). See *Fault Reports* earlier in this chapter. Oscillographic records can also be downloaded through the web page interface. For more information, refer to the *BESTnetPlus* chapter.

Protective Fault Analysis

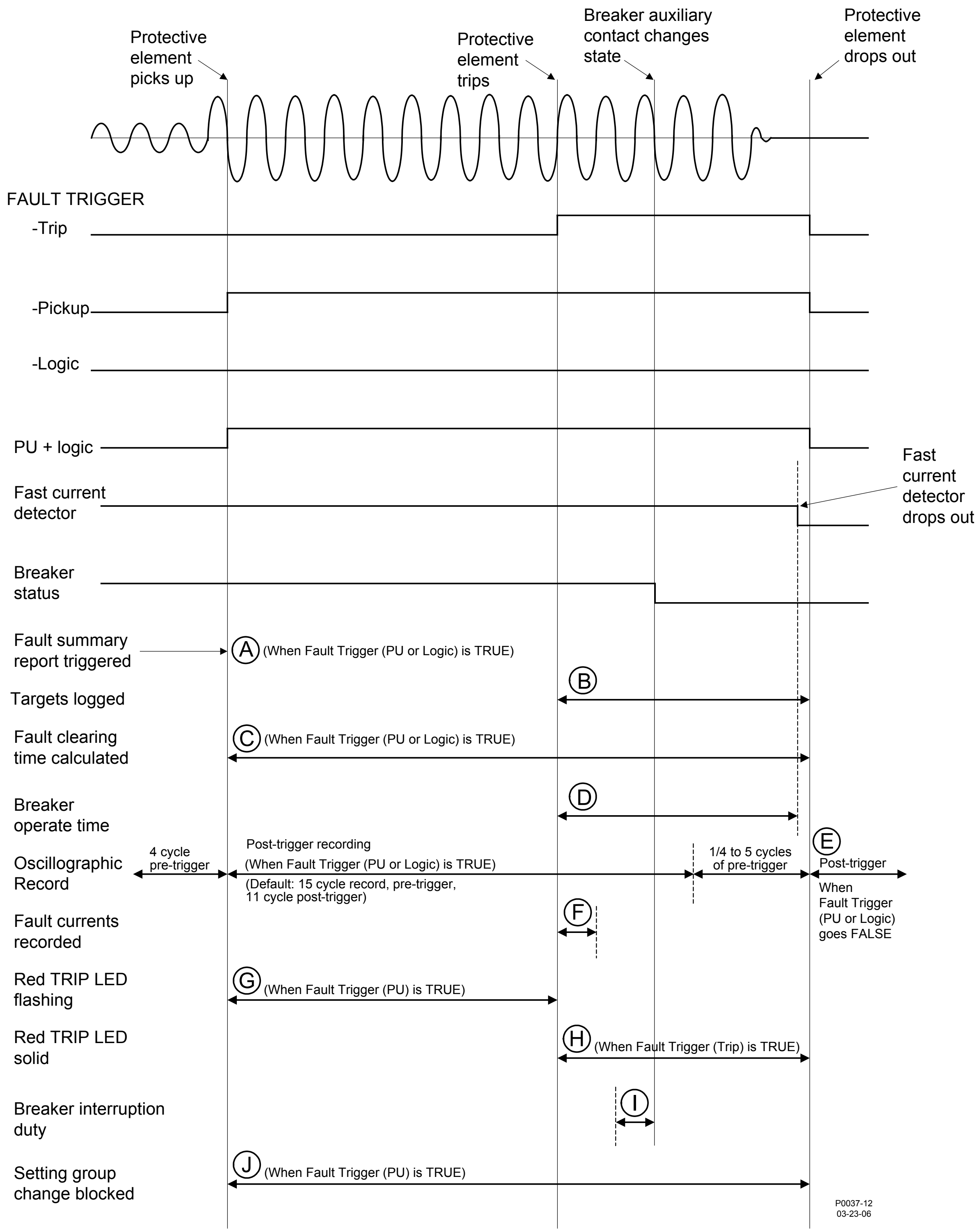


Figure 22-8. Protective Fault Analysis

Table 22-2. Legend for Figure 22-8

Locator	Description
A	A fault summary report and an oscillograph record are triggered when the Pickup logic expression becomes true.
B	During the time that the Trip expression is true, targets are logged from each of the protective functions that reach a trip state. If a protective function is not being used for tripping purposes, the associated target function can be disabled through BESTCOMS*Plus*.
C	Fault clearing time is calculated as the duration of the time that the Pickup logic expression is true.
D	Breaker operate time is calculated as the time from when the Trip logic expression becomes true until the fast current detector senses that the breaker has successfully interrupted the current in all poles of the breaker.
E	A second oscillographic record is triggered to record the end of the fault if the Pickup logic expression remains in the true state at the time that the first oscillographic record ends. This second record will have from ¼ to five cycles of pre-trigger data depending upon when the Pickup logic expression becomes false.
F	Recorded fault current and voltage are displayed on the Targets screen of the front-panel display. The same information is recorded in the fault summary report. The magnitude results are based on data captured two cycles after the trip output goes true. This two-cycle delay allows the line transients to settle to provide data that is more accurate. If the Trip expression does not become true, the fault was cleared by a down-stream device. For these pickup-only events, fault current and voltage recorded in the fault summary report will be for the power system cycle ending two cycles prior to the end of the fault record. This is also the case if the fault record was triggered through BESTCOMS*Plus*.
G	During the time that the Pickup expression is true, the red Trip LED on the front panel flashes indicating that the BE1-11*d* is picked up.
H	During the time the Trip expression is true, the red Trip LED on the front panel lights steadily indicating that the BE1-11*d* is in a tripped state. If targets have been logged for the fault, the Trip LED is sealed in until the targets have been reset.
I	Breaker operations and interruption duty functions are driven by the breaker status function. The operations counter is incremented on breaker opening. The magnitude of the current that is used for accumulating breaker duty is recorded for the power system cycle ending when the breaker status changes state. Thus, breaker duty is accumulated every time that the breaker opens even if it is not opening under fault.
J	Setting group changes are blocked when the Pickup expression is true to prevent protective functions from being reinitialized with new operating parameters while a fault is occurring.

23 • Alarms

The BE1-11*d* monitors internal systems, external interfaces, and power system equipment and annunciates an alarm when one of these components fails. An alarm can be configured as latching or non-latching with a status of major or minor. It can also be used as an input to other logic blocks in BESTlogic™*Plus*. Latching alarms are stored in nonvolatile memory and are retained even when BE1-11*d* operating power is lost. Active alarms are displayed on the front-panel display, web page interface, and through BESTCOMS*Plus*® until they are cleared. Non-latching alarms are cleared when BE1-11*d* operating power is lost.

If an alarm is configured as Major, a front-panel Major Alarm LED lights when the alarm is active. The front-panel Minor Alarm LED operates in a similar manner. Each alarm provides a logic output that can be connected to a physical output or other logic input using BESTlogic*Plus* Programmable Logic.

The ability to program the reporting and display of alarms along with the automatic display priority feature of the front-panel display gives the BE1-11*d* the functionality of a local and remote alarm annunciator. See the *Controls and Indicators* chapter for more information on the automatic display priority logic.

A detailed list of alarms is provided in Table 23-1.

Table 23-1. Available Alarms

Name	Description
43-1 Blocking Tag Status	43-1 virtual switch block tag set
43-2 Blocking Tag Status	43-2 virtual switch block tag set
43-3 Blocking Tag Status	43-3 virtual switch block tag set
43-4 Blocking Tag Status	43-4 virtual switch block tag set
43-5 Blocking Tag Status	43-5 virtual switch block tag set
49 Alarm	True when the thermal capacity rises above the trip value as indicated by the Alarm Level setting. This provides an indication that thermal capacity is being accumulated prior to the protection element tripping.
72 Trip Coil Monitor	Monitored trip circuit open
82 Recloser Fail	Reclose fail timer timed out before breaker closed
82 Recloser Lockout	Recloser went through sequence without success
101 Blocking Tag Status	101 breaker control switch block tag is set
Analog	Analog-to-digital converter error
Breaker Monitor 1	Breaker alarm 1 threshold exceeded
Breaker Monitor 2	Breaker alarm 2 threshold exceeded
Breaker Monitor 3	Breaker alarm 3 threshold exceeded
Changes Lost	Password access lost. Read only
Date Time Set	The date/time was set by the user
Default Cal Loaded	Error reading the RTD module nonvolatile calibration settings which forces default calibration settings to be loaded. This alarm is set by the remote RTD module.
Defaults Loaded	Error reading the RTD module nonvolatile settings which forces default settings to be loaded. This alarm is set by the remote RTD module.
DNP Polls Error	DNP polling failure
Ethernet Excess Traffic	Local network overloaded

Name	Description
Ethernet Link Lost	Ethernet communication lost
Fault Report Timeout	True if fault event trigger lasts longer than 60 seconds
Firmware Change	Firmware has been changed
Flash Failure	Error reading the RTD module nonvolatile settings (FLASH READ FAIL) or error writing the RTD module nonvolatile settings (FLASH WRITE FAIL). This alarm is set by the remote RTD module.
I1 DC Positive Demand	Positive DC overcurrent demand maximum exceeded
I1 DC Negative Demand	Negative DC overcurrent demand maximum exceeded
IRIG Sync Lost	IRIG failed to synchronize
IT-D I1 Frequency Mismatch	Frequency style of the connected IT-D does not match the Power Source Frequency setting on the BE1-11*d*
IT-D V1 Frequency Mismatch	Frequency style of the connected IT-D does not match the Power Source Frequency setting on the BE1-11*d*
IT-D V2 Frequency Mismatch	Frequency style of the connected IT-D does not match the Power Source Frequency setting on the BE1-11*d*
IT-D V3 Frequency Mismatch	Frequency style of the connected IT-D does not match the Power Source Frequency setting on the BE1-11*d*
Logic Equal None	Active logic = NONE
No IT-D Connection Input I1	Fiber input I1 of the BE1-11*d* is not connected to the IT-D.
No IT-D Connection Input V1	Fiber input V1 of the BE1-11*d* is not connected to the IT-D.
No IT-D Connection Input V2	Fiber input V2 of the BE1-11*d* is not connected to the IT-D.
No IT-D Connection Input V3	Fiber input V3 of the BE1-11*d* is not connected to the IT-D.
No User Setting	User settings do not exist
NTP Sync Lost	Network Time Protocol (NTP) sync lost
Output 1 Override Control	Override enabled on Output 1
Output 2 Override Control	Override enabled on Output 2
Output 3 Override Control	Override enabled on Output 3
Output 4 Override Control	Override enabled on Output 4
Output 5 Override Control	Override enabled on Output 5
Output 6 Override Control	Override enabled on Output 6
Output 7 Override Control	Override enabled on Output 7
Output 8 Override Control	Override enabled on Output 8
Output Alarm Override Control	Override enabled on Output Alarm
Output Override	One or more output contacts have logic output override condition
P1 DC Positive Demand	Positive watt demand maximum exceeded
P1 DC Negative Demand	Negative watt demand maximum exceeded
Power Loss Alarm	Operating power lost
Programmable Alarm 1	Programmable alarm 1 is true
Programmable Alarm 10	Programmable alarm 10 is true
Programmable Alarm 11	Programmable alarm 11 is true
Programmable Alarm 12	Programmable alarm 12 is true

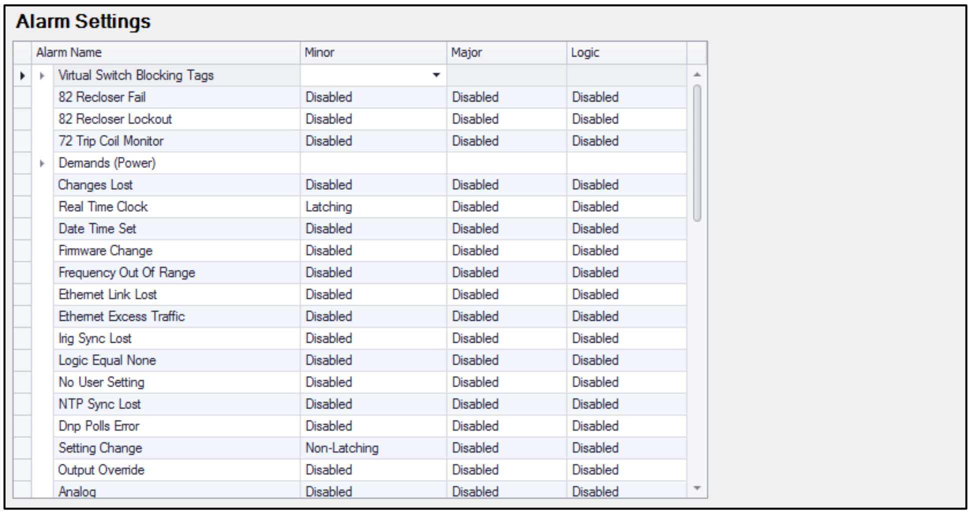
Name	Description
Programmable Alarm 13	Programmable alarm 13 is true
Programmable Alarm 14	Programmable alarm 14 is true
Programmable Alarm 15	Programmable alarm 15 is true
Programmable Alarm 16	Programmable alarm 16 is true
Programmable Alarm 2	Programmable alarm 2 is true
Programmable Alarm 3	Programmable alarm 3 is true
Programmable Alarm 4	Programmable alarm 4 is true
Programmable Alarm 5	Programmable alarm 5 is true
Programmable Alarm 6	Programmable alarm 6 is true
Programmable Alarm 7	Programmable alarm 7 is true
Programmable Alarm 8	Programmable alarm 8 is true
Programmable Alarm 9	Programmable alarm 9 is true
Real Time Clock	Real-time clock not set
RTD Comm Receive Fail	BE1-11*d* cannot communicate with the RTD module. This alarm is set by the BE1-11*d*.
RTD Comm Send Fail	RTD module cannot communicate with the BE1-11*d*. This alarm is set by the remote RTD module.
RTD Out of Range	RTD out of range. See the *RTD Module* chapter for acceptable range.
Setting Change	Setting change made by user
Settings Group 0	Setting group 0 is active
Settings Group 1	Setting group 1 is active
Settings Group 2	Setting group 2 is active
Settings Group 3	Setting group 3 is active
SGC Active	Active setting group changed
SGC Logic Override	Setting group control was overridden by logic
uP Reset Alarm	Microprocessor watchdog circuit timed out

Alarm Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, Alarms

HMI Navigation Path: Not available through the front panel

Alarms are enabled using BESTCOMS*Plus*. Use the Settings Explorer to open the Alarm Configuration, Alarms tree branch. Configure alarms by selecting Disabled, Latching, or Non-Latching from the Minor, Major, and Logic drop-down menus next to the alarms. Refer to Figure 23-1.



Alarm Settings

Alarm Name	Minor	Major	Logic
Virtual Switch Blocking Tags			
82 Recloser Fail	Disabled	Disabled	Disabled
82 Recloser Lockout	Disabled	Disabled	Disabled
72 Trip Coil Monitor	Disabled	Disabled	Disabled
Demands (Power)			
Changes Lost	Disabled	Disabled	Disabled
Real Time Clock	Latching	Disabled	Disabled
Date Time Set	Disabled	Disabled	Disabled
Firmware Change	Disabled	Disabled	Disabled
Frequency Out Of Range	Disabled	Disabled	Disabled
Ethernet Link Lost	Disabled	Disabled	Disabled
Ethernet Excess Traffic	Disabled	Disabled	Disabled
Irig Sync Lost	Disabled	Disabled	Disabled
Logic Equal None	Disabled	Disabled	Disabled
No User Setting	Disabled	Disabled	Disabled
NTP Sync Lost	Disabled	Disabled	Disabled
Dnp Polls Error	Disabled	Disabled	Disabled
Setting Change	Non-Latching	Disabled	Disabled
Output Override	Disabled	Disabled	Disabled
Analog	Disabled	Disabled	Disabled

Figure 23-1. Alarm Settings Screen

User Programmable Alarms

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, User Programmable Alarms

HMI Navigation Path: Not available through the front panel

Sixteen user programmable alarms are available. BESTlogic*Plus* Programmable Logic is used to set up alarm logic. User alarm labels are programmed on the User Programmable Alarms screen (Figure 23-2) under Alarm Configuration. When active, the label of a user alarm is displayed on the Alarms screen on the front-panel display and in the fault report and/or sequence of events report.

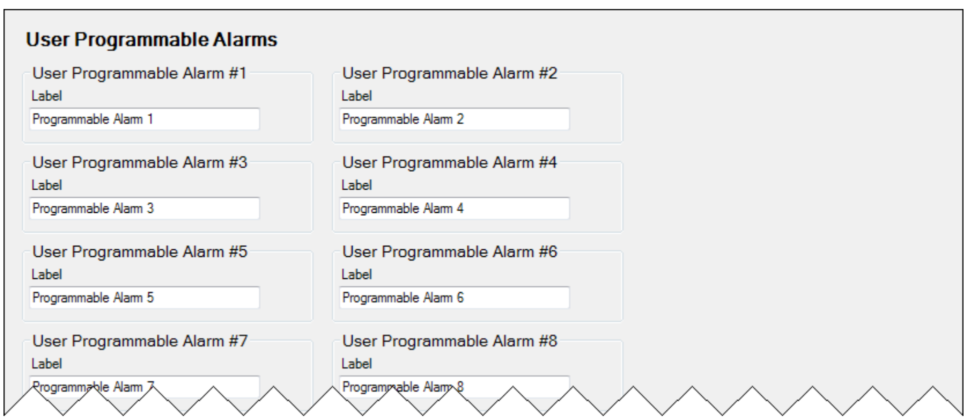


Figure 23-2. User Programmable Alarms Screen

Retrieving Alarm Information

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Alarms

HMI Navigation Path: Metering Explorer, Status, Alarms

Major and Minor alarms can be viewed through BESTCOMS*Plus*, the front-panel display and LED indicators, and the web page interface. Alarms are displayed in the fault reports and sequence of events reports.

To view alarms at the front-panel display, navigate to Metering > Status > Alarms. All active alarms will be shown on this screen. The front-panel navigation keys can be used to scroll through the list of active alarms.

To view alarm status using BESTCOMS*Plus*, use the Metering Explorer to open the Status, Alarms screen shown in Figure 23-3. Alarms can be reset by clicking the Reset Alarms button under the appropriate column.

Figure 23-3. Alarms Screen

Resetting Alarms

A BESTlogic*Plus* expression can be used to reset the alarms. Use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic tree branch. Select the Major Alarm Reset, Minor Alarm Reset, or Logic Alarm Reset logic block from the list of Elements. The Major Alarm Reset will reset all major alarms. The Minor Alarm Reset will reset all minor alarms. The Logic Alarm Reset will reset all logic alarms. Use the drag-and-drop method to connect a variable or series of variables to the Reset input. The alarm reset logic blocks are shown in Figure 23-4.

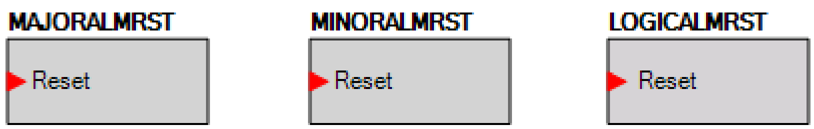


Figure 23-4. Alarm Reset Logic Block

Major and Minor alarms can be cleared by pressing the Reset button on the front-panel interface while the Alarms screen is being displayed or through BESTCOMS*Plus*. Alarms cannot be reset through the web page interface.

Pressing the front-panel Reset key clears the alarms and the Major Alarm or Minor Alarm LED. Depending on device security setup, a username and password may be required to reset alarms at the front panel. Logging in is not required if the Unsecured Access Level is set to Operator or higher, as long as no other port has access above Read. Alarm reset can also be set outside of security control, allowing reset without logging in. Refer to the *Security* chapter for more information.

An alarm reset is available as a status input in BESTlogic*Plus*. Refer to the *BESTlogicPlus* chapter for more information.

24 • Breaker Monitoring

Breaker monitoring helps manage equipment inspection and maintenance expenses by providing extensive monitoring and alarms for the circuit breaker. Breaker monitoring functions include breaker status and operations counter reporting, fault current interruption duty monitoring and trip-speed monitoring. Each function can be set up as a programmable alarm. The *Alarms* chapter has more information about the use of programmable alarms. The breaker trip circuit voltage and continuity monitor is a related function and is described in the *Trip Circuit Monitor (72TCM)* chapter.

Breaker Status Reporting

The breaker status monitoring function monitors the position of the breaker for reporting purposes. Opening breaker strokes are also counted and recorded in the breaker operations counter register. Circuit breaker status is also used by the 82 function and the 72TCM function. The breaker status logic block is shown in Figure 24-1.

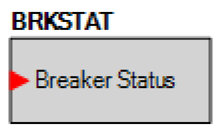


Figure 24-1. Breaker Status Logic Block

BESTlogic™*Plus* Settings for Breaker Status

Since the BE1-11*d* is completely programmable, it is necessary to program which logic variable will monitor breaker status. Breaker status is programmed using BESTCOMS*Plus*®*.* Use the Settings Explorer to open the BESTlogic*Plus* Programmable Logic tree branch and select the Breaker Status logic block from the list of Elements. Use the drag and drop method to connect a variable or group of variables to the input. Refer to the *BESTlogicPlus* chapter for more information on setting BESTlogic*Plus* programmable logic.

Table 24-1 summarizes the BESTlogic*Plus* settings for Breaker Status.

Table 24-1. BESTlogic*Plus* Settings for Breaker Status

Setting	Range/Purpose	Default
Breaker Status	True when the breaker is closed (e.g., 72L logic).	0

Retrieving Breaker Status and Operation Counter Information

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Breaker Status

HMI Navigation Path: Metering Explorer, Status, Breaker Status

Breaker status can be viewed through BESTCOMS*Plus*, the front-panel display, and the web page interface.

To view breaker status using BESTCOMS*Plus*, use the Metering Explorer to open the Status, Breaker Status screen shown in Figure 24-2. To view breaker status at the front-panel display, navigate to Metering Explorer, Status, Breaker Status.

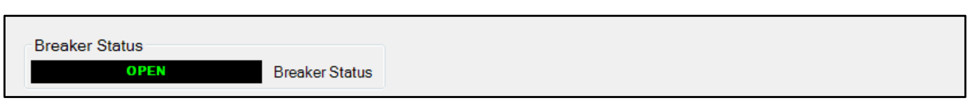


Figure 24-2. Breaker Status Screen

The number of breaker operations can be read at the front-panel display. The counter value can be adjusted using the Edit key. This allows the BE1-11*d* counter value to be matched to an existing mechanical cyclometer on a breaker mechanism. Write access to the reports functions must be gained to edit this value at the front-panel display. To view the breaker status using BESTCOMS*Plus*, use the Metering Explorer to open the Control, Breaker Control Switch tree branch.

The breaker operations counter can be monitored to give an alarm when the value exceeds a threshold. See *Breaker Alarms* in this chapter for more information about this feature.

Breaker duty monitoring is discussed in the following paragraphs.

Breaker Duty Monitoring

When the breaker opens, the current interrupted in the circuit breaker is accumulated by the breaker duty monitor. Breaker opening is defined by the breaker status monitoring function (Breaker Status). Figure 24-3 illustrates breaker status during a fault and protective trip. Table 24-2 serves as a legend for the call-outs of Figure 24-3.

Each time the breaker trips, the breaker duty monitor updates two sets of registers of the breaker. In the Accumulated I Duty registers, the breaker duty monitor adds the measured current in primary amperes. In the Accumulated I^2 Duty registers, the function adds the measured current in primary amperes squared. The user selects which of the two sets of duty registers are reported and monitored when setting up the breaker duty monitor.

Even though duty register values are calculated and stored in primary amperes or primary amperes-squared, the duty value is reported as a percent of maximum. The user sets the value that the BE1-11*d* will use for 100 percent duty (D_{MAX}). The value set for maximum duty is used directly for reporting the accumulated I Duty. The square of the value set for maximum duty is used for reporting the accumulated I^2 duty.

Since the true measure of contact wear includes a factor for arcing time (t), an assumed arcing time for the breaker should be included when choosing the setting for 100 percent interruption duty (D_{MAX}).

When testing the BE1-11*d* by injecting currents, the values in the duty registers should be read and recorded prior to the start of testing. Once testing is complete and the BE1-11*d* is returned to service, the registers should be reset to the original pre-test values. A block accumulation logic input can be used when testing so that simulated breaker duty is not added to the duty registers. The Block logic input of the breaker duty function is an OR logic term (e.g., IN1 or OUT5) which blocks the breaker monitoring logic when true (1). Block is set to zero to disable blocking. When breaker monitoring is blocked (logic expression equals 1), breaker duty is not accumulated.

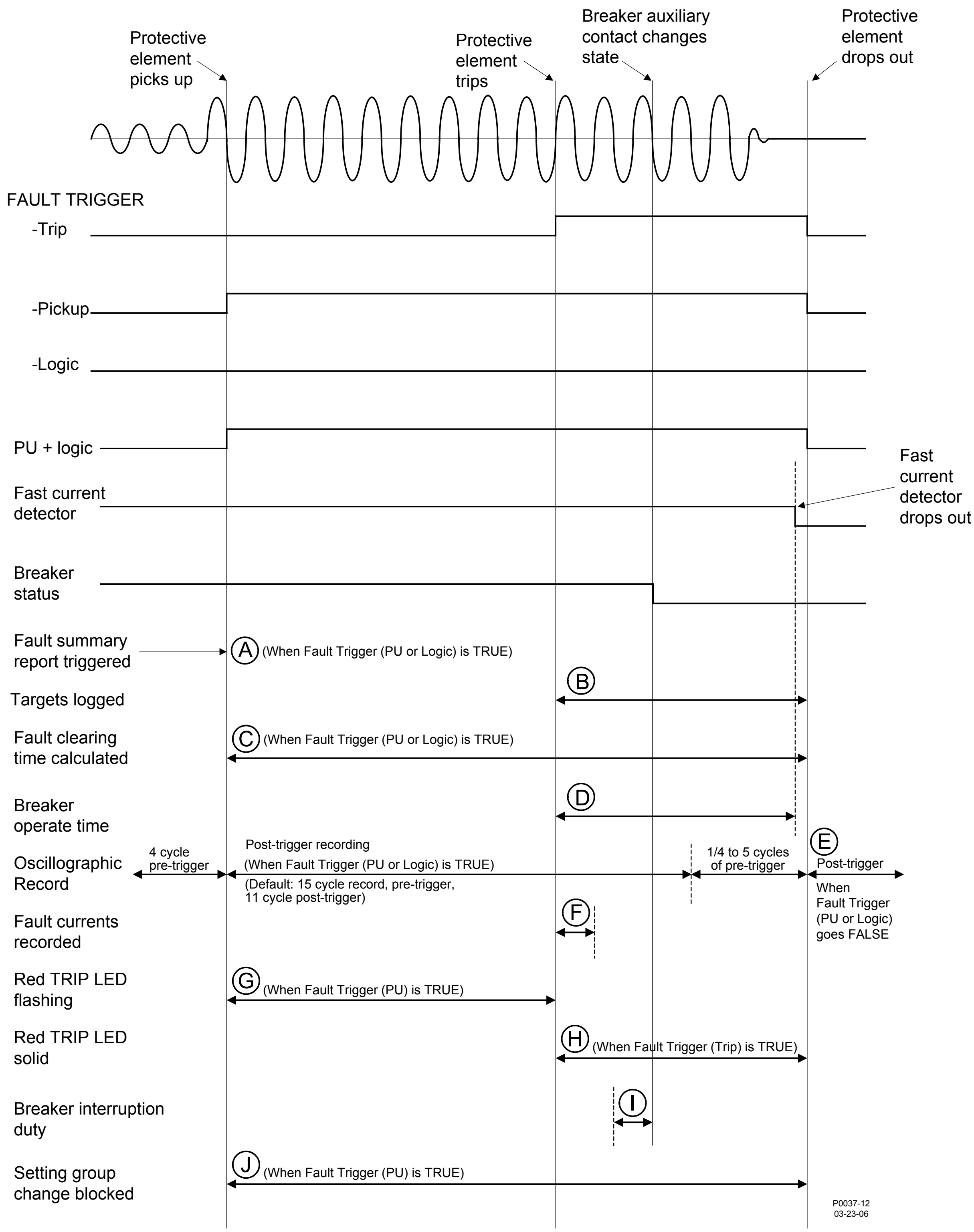


Figure 24-3. Protective Fault Analysis

Table 24-2. Legend for Figure 24-3

Locator	Description
A	A fault summary report and an oscillograph record are triggered when the Pickup logic expression becomes true.
B	During the time that the Trip expression is true, targets are logged from each of the protective functions that reach a trip state. If a protective function is not being used for tripping purposes, the associated target function can be disabled through BESTCOMS*Plus*.
C	Fault clearing time is calculated as the duration of the time that the Pickup logic expression is true.
D	Breaker operate time is calculated as the time from when the Trip logic expression becomes true until the fast current detector senses that the breaker has successfully interrupted the current in the breaker.
E	A second oscillographic record is triggered to record the end of the fault if the Pickup logic expression remains in the true state at the time that the first oscillographic record ends. This second record will have from ¼ to five cycles of pre-trigger data depending upon when the Pickup logic expression becomes false.
F	Recorded fault current, voltage, and distance magnitudes are displayed on the Targets screen of the front-panel display. The same information including phase voltage frequency, auxiliary voltage frequency, and voltage and current angles are recorded in the fault summary report. The magnitude, angle, and distance results are based on data captured two cycles after the trip output goes true. This two-cycle delay allows the line transients to settle to provide data that is more accurate. The post fault current vectors are compared to pre-fault current vectors captured three cycles prior to protective pickup to perform distance calculations. If the Trip expression does not become true, the fault was cleared by a down-stream device. For these pickup-only events, fault current, voltage, angle, and distance recorded in the fault summary report will be for the power system cycle ending two cycles prior to the end of the fault record. This is also the case if the fault record was triggered through BESTCOMS*Plus*.
G	During the time that the Pickup expression is true, the red Trip LED on the front panel flashes indicating that the BE1-11*d* is picked up.
H	During the time the Trip expression is true, the red Trip LED on the front panel lights steadily indicating that the BE1-11*d* is in a tripped state. If targets have been logged for the fault, the Trip LED is sealed in until the targets have been reset.
I	Breaker operations and interruption duty functions are driven by the breaker status function. The operations counter is incremented on breaker opening. The magnitudes of the currents that are used for accumulating breaker duty are recorded for the power system cycle ending when the breaker status changes state. Thus, breaker duty is accumulated every time that the breaker opens even if it is not opening under fault.
J	Setting group changes are blocked when the Pickup expression is true to prevent protective functions from being reinitialized with new operating parameters while a fault is occurring.

Setting the Breaker Duty Monitoring Function

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, Breaker Monitoring

HMI Navigation Path: Settings Explorer, Alarm Configuration, Breaker Monitor

Breaker Duty Monitoring settings are made using BESTCOMS*Plus*. Use the Settings Explorer to open the Alarm Configuration, Breaker Monitoring tree branch shown in Figure 24-4.

Using the pull-down menus and settings boxes, make the application-appropriate settings to the breaker duty monitoring function.

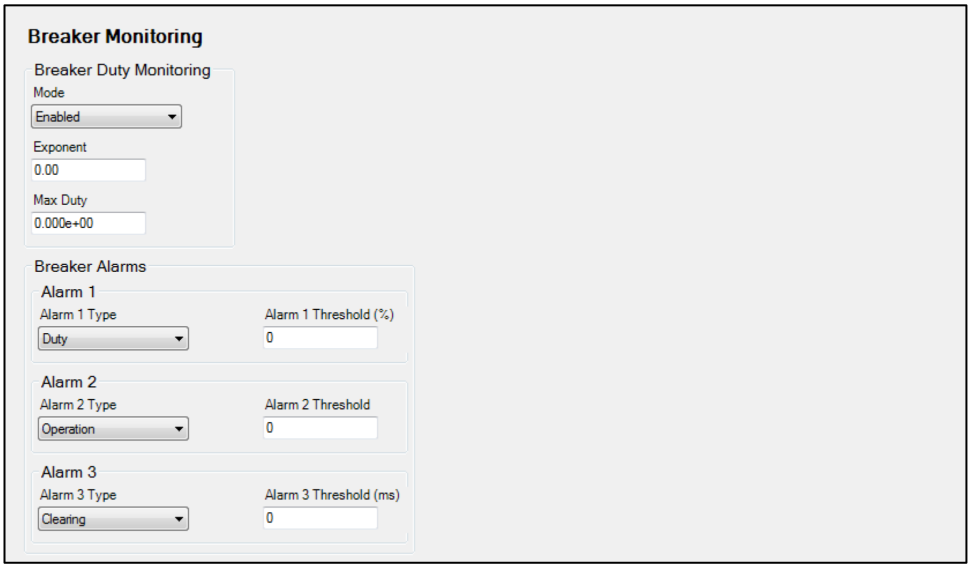


Figure 24-4. Breaker Monitoring Settings Screen

To connect the Block logic input, use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic tree branch and select the breaker monitor logic block from the list of *Elements*. Use the drag and drop method to connect a variable or series of variables to the input. Refer to the *BESTlogicPlus* chapter for more information on setting BESTlogic*Plus* programmable logic.

The breaker monitor logic block is shown in Figure 24-5.

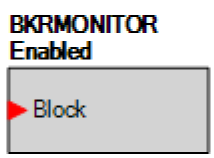


Figure 24-5. Breaker Monitor Logic Block

Table 24-3 summarizes the Breaker Duty Monitoring settings.

Table 24-3. Breaker Duty Monitoring Settings

Function	Range/Purpose	Default
Mode	Disabled or Enabled	Disabled
Exponent	1 to 3 in increments of 0.01	0
Max Duty	0 to 42,000,000 in increments of 1 The Max Duty parameter represents the maximum duty that the breaker contacts can withstand before needing service. Max Duty is programmed in primary amperes using exponential floating-point format.	0.000e+00
Block	Logic input that blocks the breaker monitoring logic when true. When true, breaker operations are not counted.	0

Retrieving Breaker Duty Information

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Breaker Monitor

HMI Navigation Path: Metering Explorer, Reports, Breaker Report

Breaker duty values can be read at the front-panel display. Duty values can be changed by using the front-panel Edit key. Write access to reports is required to edit breaker duty values. Duty values can also be read or changed through the communication ports using BESTCOMS*Plus*. Use the Metering Explorer to open the Reports, Breaker Monitor screen shown in Figure 24-6.

Figure 24-6. Breaker Report Screen

Breaker Operate Time Monitoring

The breaker operate time monitor tracks the time from when a trip output occurs (defined by the Trip logic expression) to when the fast current detector observes that current is zero. This time is reported as a line in the fault summary reports. See the *Fault Reporting* chapter for more information about the Trip logic expression and fault summary reports.

Breaker operate time can be monitored to give an alarm when the value exceeds a threshold. *Breaker Alarms* provides more information about this feature.

Breaker Alarms

Three alarm points are included in the programmable alarms for checking breaker monitoring functions. Each alarm point can be programmed to monitor any of the three breaker monitoring functions, operations counter, interruption duty, or clearing time. An alarm threshold can be programmed to monitor each function. Alternately, three different thresholds can be programmed to monitor one of the monitored functions.

Breaker Alarms Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, Breaker Monitoring

HMI Navigation Path: Settings Explorer, Alarm Configuration, Breaker Monitor

Settings are made using BESTCOMS*Plus*. Use the Settings Explorer to open the Alarm Configuration, Breaker Monitoring tree branch shown in Figure 24-4.

Using the pull-down menus and settings boxes, make the application-appropriate settings to the breaker alarms.

25 • Demands

Demand recording promotes the ability of an electric power provider to plan for future upgrades. For example, increasing load, over time, at a substation will be reflected in the demand values. This growing demand can be addressed through additional capacity before the increasing load becomes an issue.

The BE1-11*d* continuously calculates demand values for current and watts. Demand values are recorded with timestamps for peak demands and present demands. Programmable alarm points can be set to alarm if thresholds are exceeded for overload. For information on enabling alarms, refer to the *Alarms* chapter.

Current and Watts

Demand values are continuously calculated for positive and negative demand current and watts.

Demand Reporting Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, Demands

HMI Navigation Path: Settings Explorer, Alarm Configuration, Demands

Settings are made using BESTCOMS*Plus*®. Use the Settings Explorer to open the Alarm Configuration, Demands tree branch. Enter the appropriate demand reporting settings. Refer to Figure 25-1.

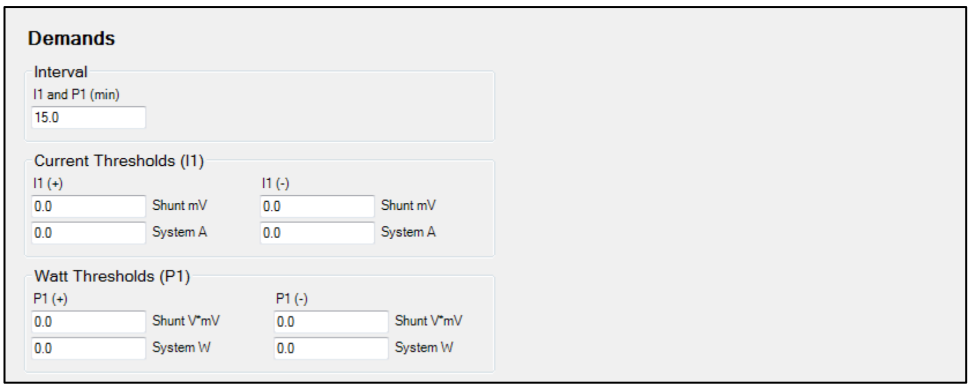


Figure 25-1. Demands Screen

Retrieving Demand Reporting Information

BESTCOMS*Plus* Navigation Path: Metering Explorer, Demand

HMI Navigation Path: Metering Explorer, Demand Meter

Values and timestamps in the demand registers are reported in system values. They can be read at the front-panel display, through BESTCOMS*Plus*, and through the web page interface.

Peak demand values can be preset by pressing the Edit key and changing the value. Write access to the Reports functional area is required to preset values at the front panel.

To access demand data through BESTCOMS*Plus*, use the Metering Explorer to open the Demand tree branch and select Demand Current (Figure 25-2) or Demand Watts (Figure 25-3).

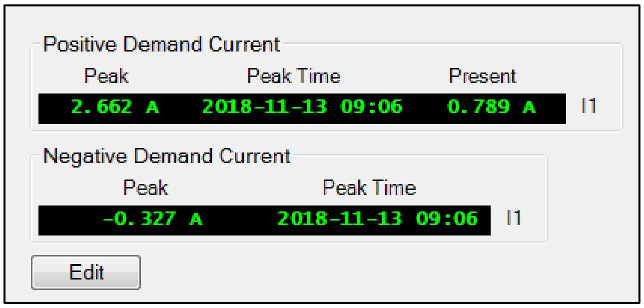


Figure 25-2. Demand Current Screen

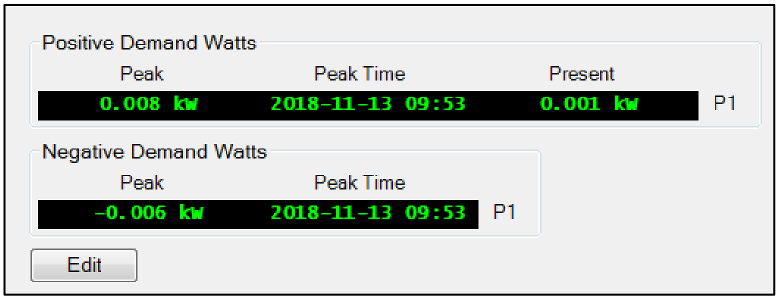


Figure 25-3. Demand Watts Screen

Refer to the *BESTnet™Plus* chapter for information on viewing the demands through the web page interface.

26 • Load Profile

Load profile recording provides a running average of the demand and is used to determine system loads during certain times of the day, week, or month. The load profile recording function uses a 4,000-point data array for data storage of current (I1) and power (P1) demand readings.

At the specified (programmed) interval, the load profile function takes the data from the demand calculation register and places it in a data array. If the programmed interval is set at 15 minutes, four entries would be generated in one hour, 96 entries per day. Load profile data is smoothed by the demand calculation function. If a step change is made in current, with the demand interval set for fifteen minutes, and the load profile recording interval set for one minute, it would take approximately 15 minutes for the load (step change) to reach 90% of the final level.

Setting the Load Profile Recording Function

BESTCOMS*Plus* Navigation Path: Settings Explorer, Metering Configuration, Load Profile

HMI Navigation Path: Settings Explorer, Metering Configuration, Data Log Settings

For load profile recording to log data, you must enable the function and set the demand logging interval. This can be done through BESTCOMS*Plus*®. Use the Settings Explorer to open the Load Profile screen under Metering Configuration.

The BESTCOMS*Plus* Load Profile screen is illustrated in Figure 26-1.

Figure 26-1. Load Profile Screen

Retrieving Load Profile Recorded Data

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Load Profile

HMI Navigation Path: Not available through the front panel

Recorded load profile data can be downloaded through BESTCOMS*Plus* on the Load Profile screen under Reports of the Metering Explorer.

27 • Power Quality

The BE1-11*d* offers class B power quality measurement performance as defined by IEC 610004-30. Power quality data consists of voltage and dips/swells. Power quality is reported through BESTCOMS*Plus*®, the front-panel interface, and the web page interface. Refer to the *BESTnet™Plus* chapter for information on viewing the demands through the web page interface.

Operation

A dip event begins when V1, V2, or V3 decreases below the dip threshold and ends when V1, V2, or V3 returns above the dip threshold and dip hysteresis. A swell event begins when V1, V2, or V3 increases above the swell threshold and ends when V1, V2, or V3 returns below the swell threshold and swell hysteresis. A dip event reports dip duration and the minimum voltage measured during the dip event. A swell event reports swell duration and the maximum voltage measured during the swell event.

Reference Voltage

This is the nominal system voltage ($V_{reference}$). Dip and swell thresholds are calculated based on this nominal system voltage.

Dip Hysteresis

This setting determines the hysteresis of the dip threshold. For example, a value of 1.02 sets the hysteresis to 2% of the dip threshold.

Dip Ratio

This setting determines the dip threshold. For example, a value of 0.90 sets the dip threshold to 90% of the reference voltage.

Swell Hysteresis

This setting determines the hysteresis of the swell threshold. For example, a value of 0.98 sets the hysteresis to 2% of the swell threshold.

Swell Ratio

This setting determines the swell threshold. For example, a value of 1.10 sets the swell threshold to 110% of the reference voltage.

Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Metering Configuration, Power Quality

HMI Navigation Path: Settings Explorer, Metering Configuration, Power Quality

Settings are made using BESTCOMS*Plus*. Use the Settings Explorer to open the Metering Configuration, Power Quality tree branch. The Power Quality screen is illustrated in Figure 27-1.

Figure 27-1. Metering Configuration, Power Quality Screen

Metering

BESTCOMS*Plus* Navigation Path: Metering Explorer, Power Quality

HMI Navigation Path: Metering Explorer, Power Quality

Power quality data can be viewed using BESTCOMS*Plus*, through the front-panel interface, and through the web page interface. To view data using BESTCOMS*Plus*, use the Metering Explorer to open the Power Quality tree branch.

Voltage

Figure 27-2 illustrates the Power Quality, Voltage screen.

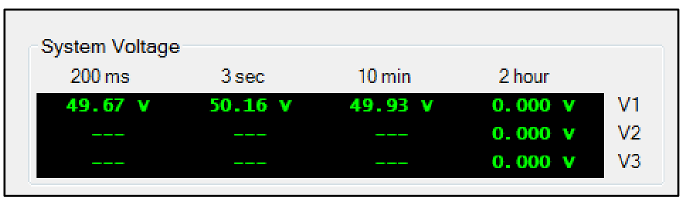


Figure 27-2. Power Quality, Voltage Screen

Dip/Swell

Figure 27-3 illustrates the Power Quality, Dip/Swell screen. The red indicator changes to green when the threshold specified in Power Quality Settings has been exceeded.

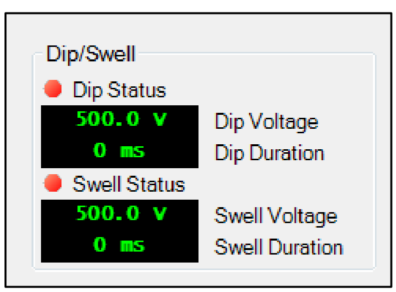


Figure 27-3. Power Quality, Dip/Swell Screen

Refer to the *BESTnetPlus* chapter for information on viewing power quality data through the web page interface.

28 • Trip Circuit Monitor (72TCM)

A trip circuit monitor (72TCM) element continually monitors the circuit breaker trip circuit for voltage and continuity.

Element logic connections are made on the BESTlogic™*Plus* screen in BESTCOMS*Plus*® and element operational settings are configured on the Trip Circuit Monitor (72TCM) settings screen in BESTCOMS*Plus*. A summary of the logic output and operational settings appears at the end of this chapter.

Element Operation

A closed breaker with no voltage detected across the trip contacts can indicate that a trip circuit fuse is open or there is a loss of continuity in the trip coil circuit. The 72TCM element detects this condition and signals an alarm. In BESTlogic*Plus*, the Alarm output can be connected to other logic elements or a physical relay output to annunciate the condition and initiate corrective action.

Breaker Status

Breaker status (open or closed) is obtained through the breaker status reporting function (configured by the Breaker Status logic block). Refer to the *Breaker Monitoring* chapter for more information.

Programmable Alarm

A 72 Trip Coil Monitor alarm occurs when the breaker status reporting function detects a closed breaker and no trip circuit voltage for the duration of a 500 millisecond coordination delay. The alarm appears on the front-panel display, web page interface, and on the Alarms metering screen in BESTCOMS*Plus*. Refer to the *Alarms* chapter for information on how to program alarms.

Detector Circuit

The detector circuit used by the 72TCM element is placed in parallel with the OUT1 contact when the TCM jumper is installed. This contact is used in all of the preprogrammed logic schemes as the main trip output. The detector circuit across OUT1 is not polarity sensitive because the optical isolator used for detecting continuity is connected across a full wave bridge. See Figure 28-1.

The amount of current drawn through the optical isolator circuit depends on the total input impedance for the power supply voltage rating (see Table 28-1).

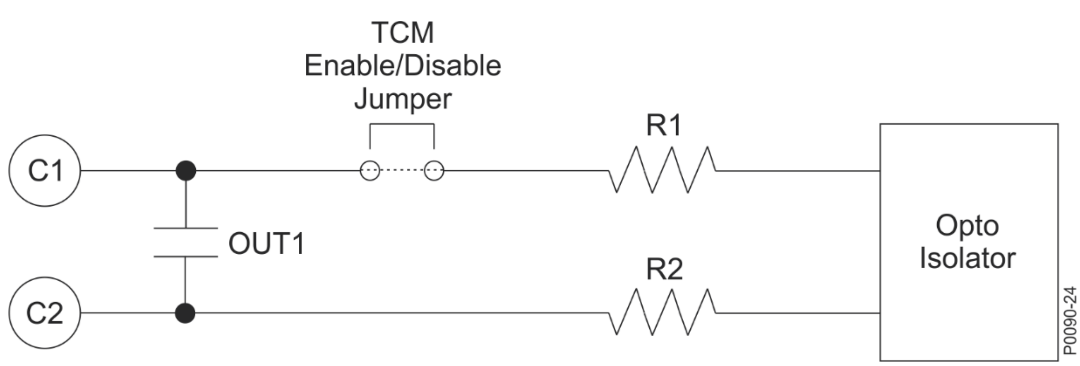


Figure 28-1. Trip Detector Circuit

Table 28-1. Current Draw for each Power Supply Voltage Rating

Power Supply Voltage Rating	R1	R2	R Total	Optical Isolator	
				Off (25% V)	On (80% V)
48/125 Vdc	9.4 kΩ	24 kΩ	33.4 kΩ	12.0 V (0.359 mA)	38.4 V (1.15 mA)

Figure 28-2 illustrates typical trip circuit monitor connections for the BE1-11*d*.

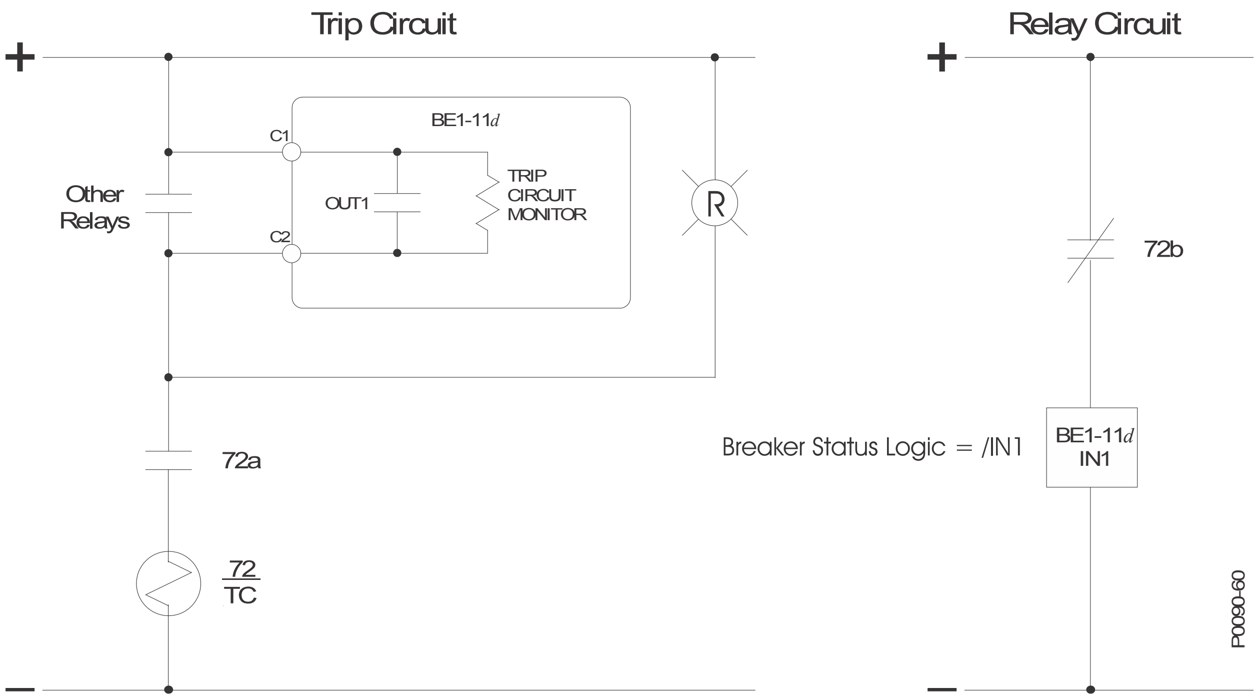


Figure 28-2. Trip Circuit Voltage and Continuity Monitor

> **Caution**
>
> Applications that place other device inputs in parallel with the breaker trip coil may not perform as desired. The connection of other devices in parallel with the trip coil causes a voltage divider to occur when the breaker or trip circuit is open. This may cause false tripping of the other devices and prevent the BE1-11*d* trip circuit monitor from reliably detecting an open circuit. Contact Basler Electric for advice on this application.
>
> The circuit monitor sensing element has the same rating as the power supply voltage. If the trip circuit voltage is significantly greater than the power supply voltage (for example, when using a capacitor trip device), the user should program the BE1-11*d* to use one of the other output relays for tripping. In this situation, the trip circuit monitor function will not be available.

In Figure 28-3, a 62X auxiliary relay is shown. In this case, the impedance of the 62X coil is small compared to the impedance of the TCM circuit so the TCM optical isolator is always on and the TCM is always at logic 1. This prevents the TCM logic from working even if the trip coil is open. To prevent this problem, a diode was added as shown in Figure 28-3 to isolate the TCM circuit from the effects of 62X.

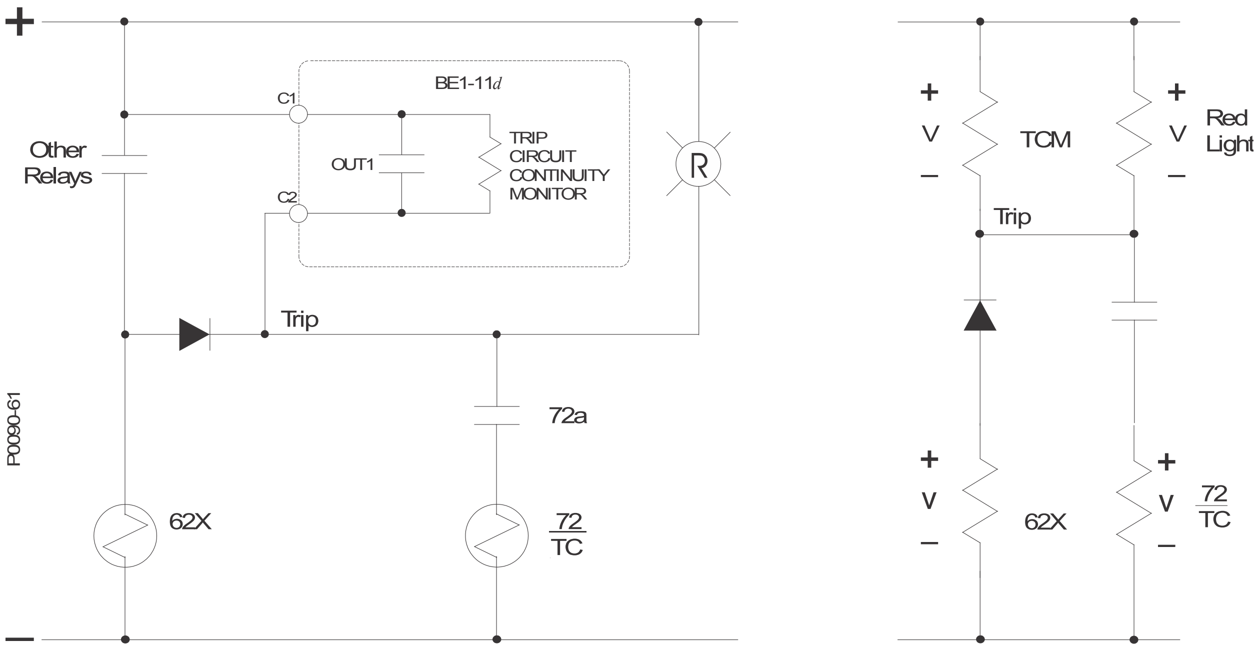


Figure 28-3. TCM with Other Devices

Trip Circuit Monitor (72TCM) Enable/Disable Jumper

Note
A BE1-11*d* is delivered with the trip circuit monitor enabled (TCM jumper connected). Read the following paragraphs before placing the BE1-11*d* in service.

The trip circuit monitor draws a small amount of current, even when the contact is open. See Table 28-1 for actual values. If the output is connected to light loads or digital inputs, it may be necessary to remove the jumper to prevent the trip circuit monitor from activating those inputs.

The following paragraphs describe how to locate and connect/remove the trip circuit monitor jumper:

1. The trip circuit monitor jumper is located behind the rear terminal block that is used for OUT1 through OUTA connections. Using a 7/64" hex tool, remove the rear terminal block. Observe all electrostatic discharge (ESD) precautions when handling the BE1-11*d*.
2. Locate the jumper terminal block that is mounted on the left side of the circuit board. The terminal block has four pins. With the jumper as installed at the factory, the jumper should be connected across pins 1 and 2 (left side) when viewed from the back of the unit. This jumper configuration enables the trip circuit monitor. Figure 28-4 illustrates the location of the jumper terminal block as well as the position of the jumper connected.
3. To disable the trip circuit monitor, remove the jumper from the two pins using needle-nose pliers. Use care when removing the jumper so that no components are damaged. Retain the jumper for enabling the trip circuit monitor in the future.
4. After removing the jumper to disable the trip circuit monitor, reinstall the rear terminal block.
5. Tighten the screws using a 7/64" hex tool. A torque of 10 in-lbs (1.12 N•m) is recommended.

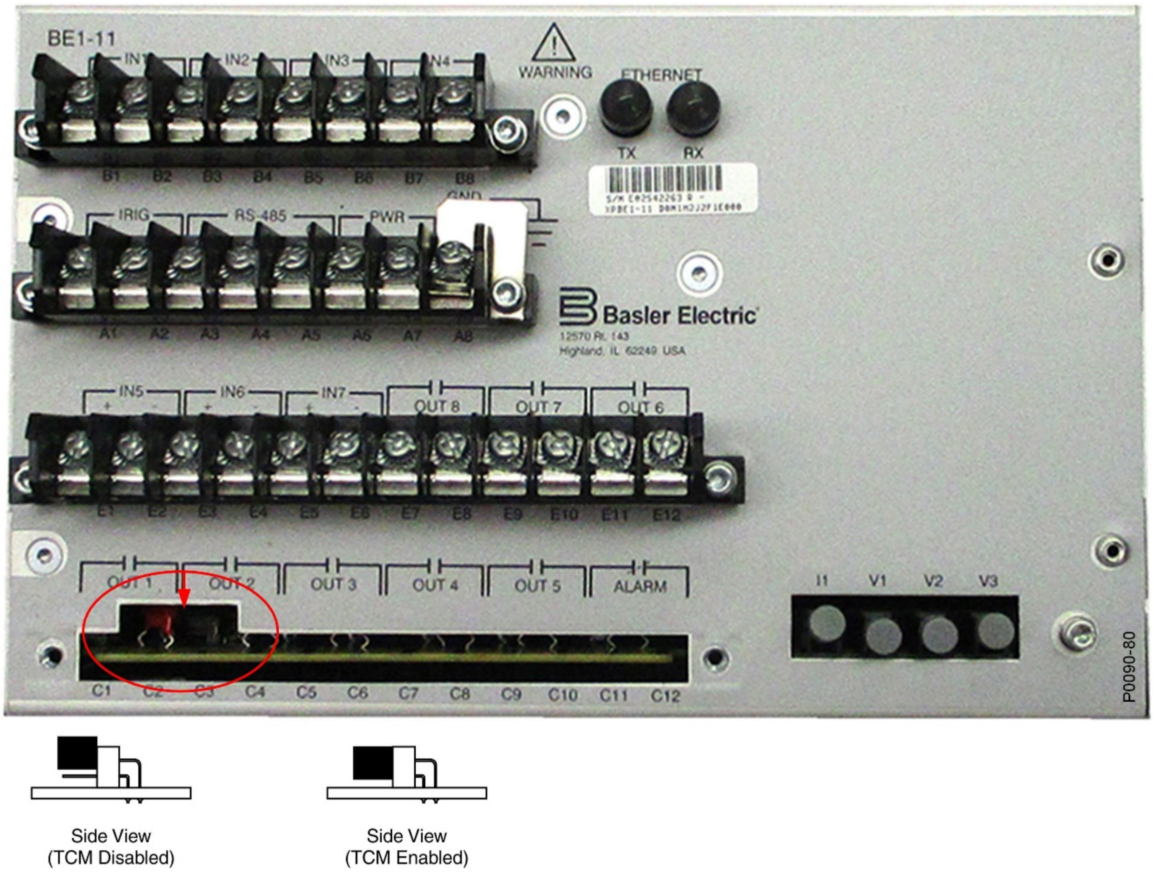


Figure 28-4. Trip Circuit Monitor Enable/Disable Jumper Location

Logic Connections

Trip circuit monitor logic connections are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The trip circuit monitor element logic block is illustrated in Figure 28-5. The logic output is summarized in Table 28-2.

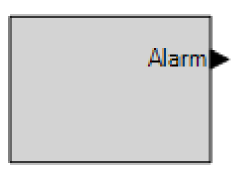


Figure 28-5. Trip Circuit Monitor Element Logic Block

Table 28-2. Logic Output

Name	Logic Function	Purpose
Alarm	Output	True when voltage is not detected in the trip circuit

Operational Settings

Trip circuit monitor element operational settings are configured on the Trip Circuit Monitor (72TCM) settings screen (Figure 28-6) in BESTCOMS*Plus*.

Figure 28-6. Trip Circuit Monitor Settings Screen

29 • BESTnet™*Plus*

BE1-11*d* DC Power Protection Systems with an Ethernet port have a web page interface that can be used to view BE1-11*d* status, real-time data, demand data, faults, sequence of events, and power quality. Refer to the *Communication* chapter for information about configuring the BE1-11*d* to communicate through the Ethernet port. Verify that Enable Web Pages is selected on the Settings, Communications, Ethernet screen in the Settings Explorer of BESTCOMS*Plus*® or on the Settings > Communication > Ethernet screen of the front-panel display. Using a web browser, enter the IP Address of your BE1-11*d* in the address bar. The protection system's IP address is found on the front-panel display under Settings > Communication > Ethernet. Figure 29-1 shows an example for a BE1-11*d* with an IP address of 10.0.129.101.

Figure 29-1. Address Bar of Web Browser

Status Page

Figure 29-2 illustrates the Status (home) page. Device information, firmware version, breaker status, lockout status, recloser status, alarm status, targets, local inputs status, and local outputs status are shown on this page. A green indicator lights to indicate an energized state for inputs and outputs.

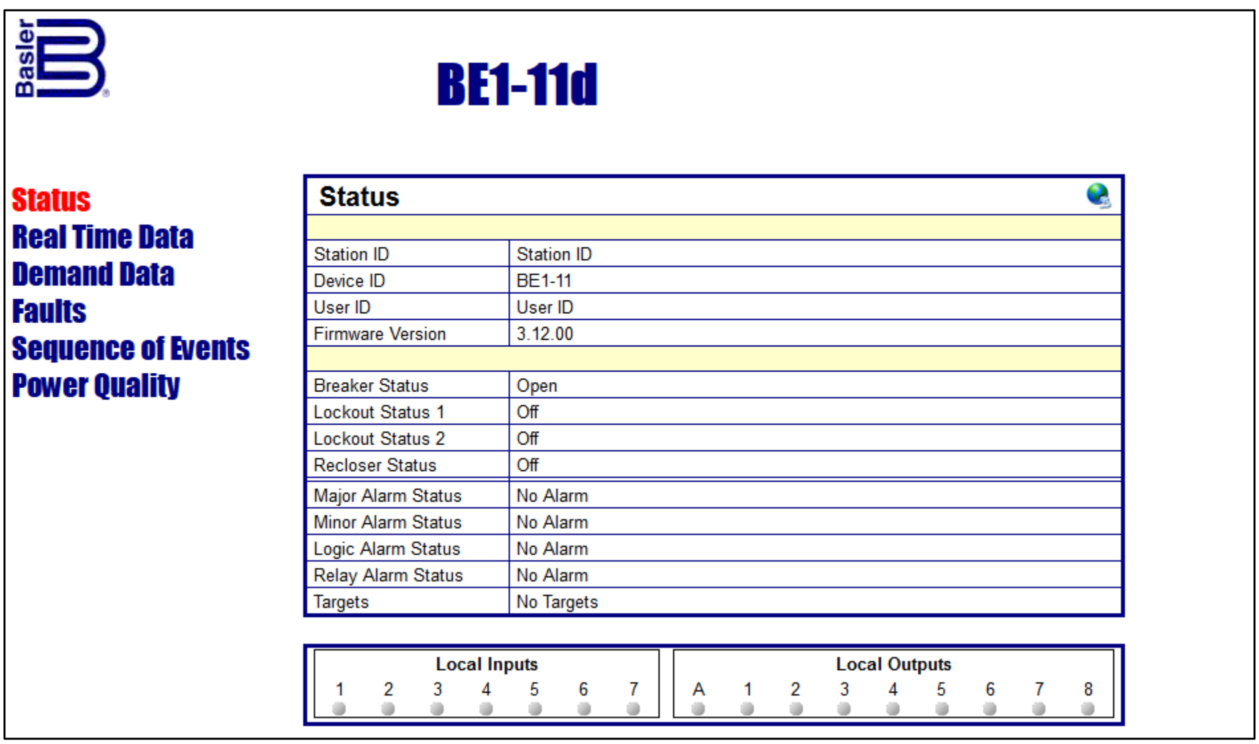
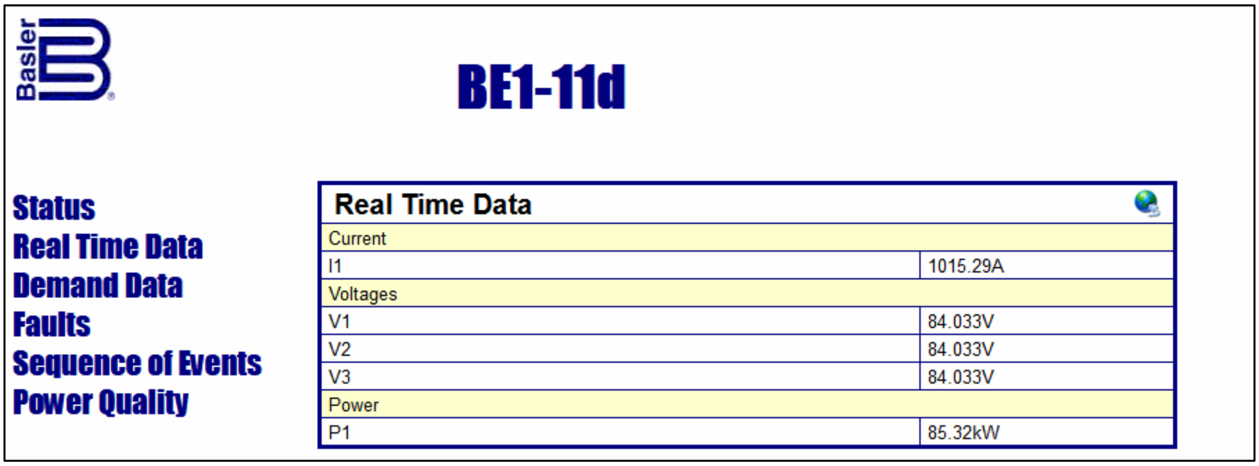


Figure 29-2. Status Page (Home Page)

Real Time Data

Figure 29-3 illustrates the Real Time Data page. Values for current, voltages, and power are shown on this page.

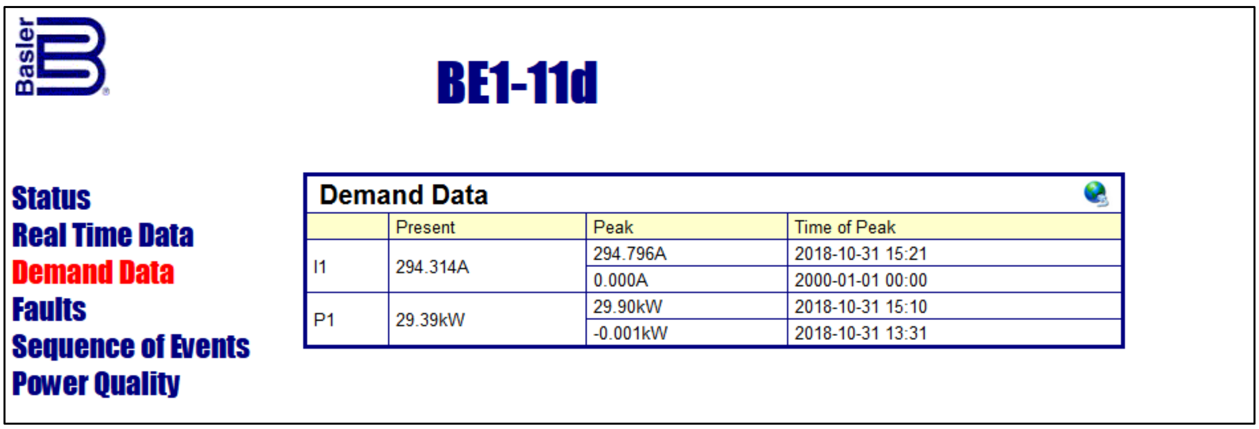


Current	
I1	1015.29A
Voltages	
V1	84.033V
V2	84.033V
V3	84.033V
Power	
P1	85.32kW

Figure 29-3. Real Time Data Page

Demand Data

Figure 29-4 illustrates the Demand Data page. Present and peak demand values are shown on this page.



	Present	Peak	Time of Peak
I1	294.314A	294.796A	2018-10-31 15:21
		0.000A	2000-01-01 00:00
P1	29.39kW	29.90kW	2018-10-31 15:10
		-0.001kW	2018-10-31 13:31

Figure 29-4. Demand Data Page

Faults

Fault Summary

Figure 29-5 illustrates the Fault Summary page. To view fault details and download oscillography files, click on a fault in the fault summary list.

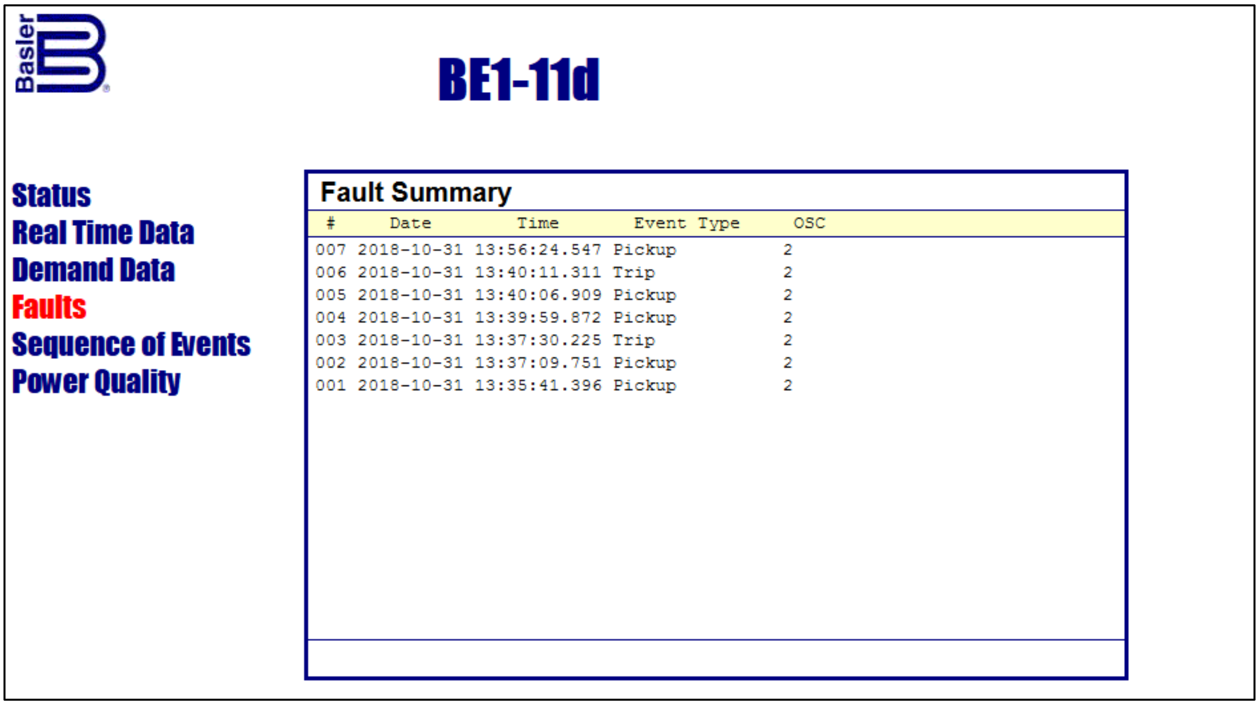


Figure 29-5. Fault Summary Page

Fault Details

Figure 29-6 illustrates the Fault Details page. Use the buttons to download oscillography files.

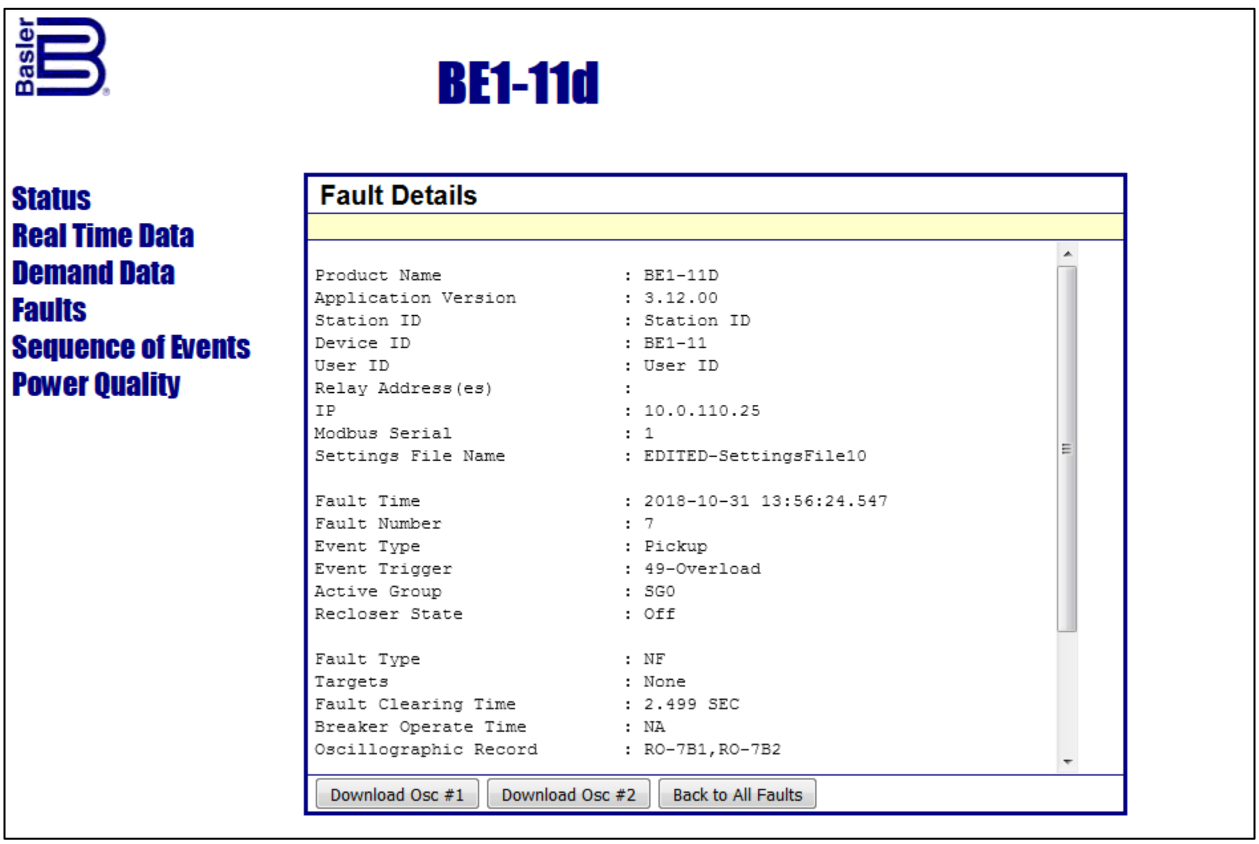


Figure 29-6. Fault Details Page

Sequence of Events

Figure 29-7 illustrates the Sequence of Events Summary page. A summary of the sequence of events is shown on this screen. The view can be customized by clicking on View New, View Protection, View Alarms, or View Targets. A selected subset of event data can be downloaded as a *.csv (comma-separated values) file.

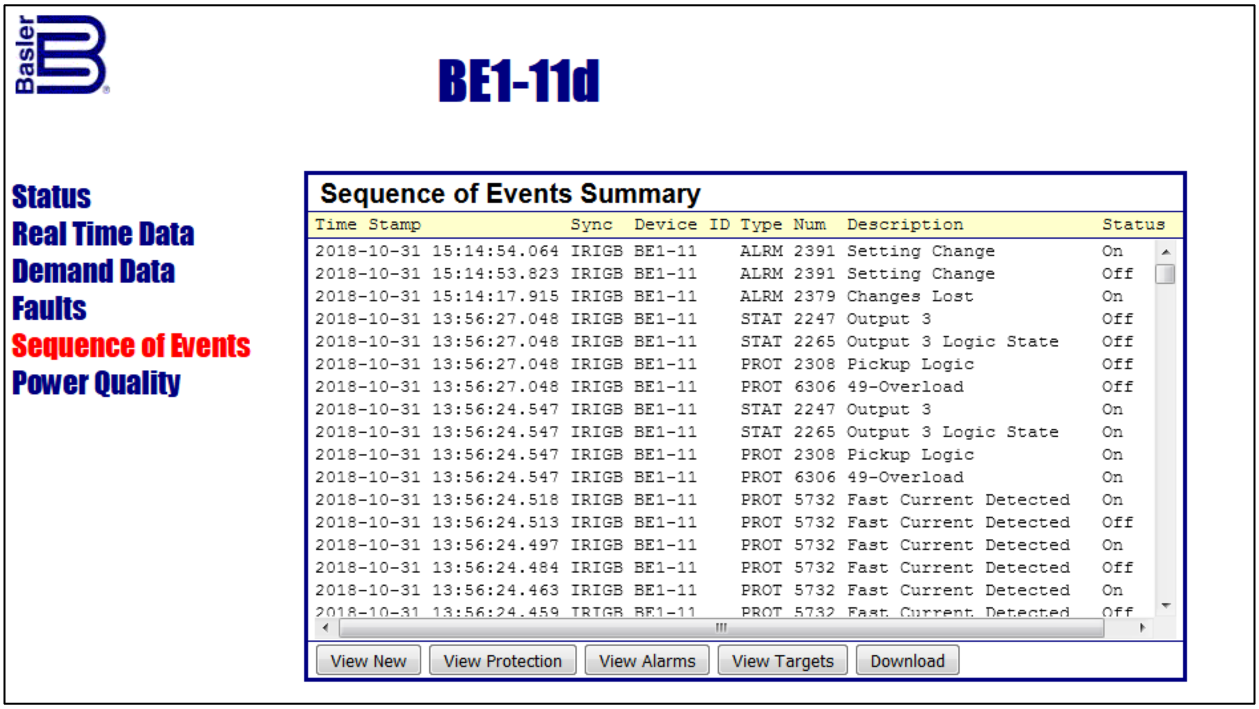


Figure 29-7. Sequence of Events Summary Page

Power Quality

Figure 29-8 illustrates the Power Quality page.

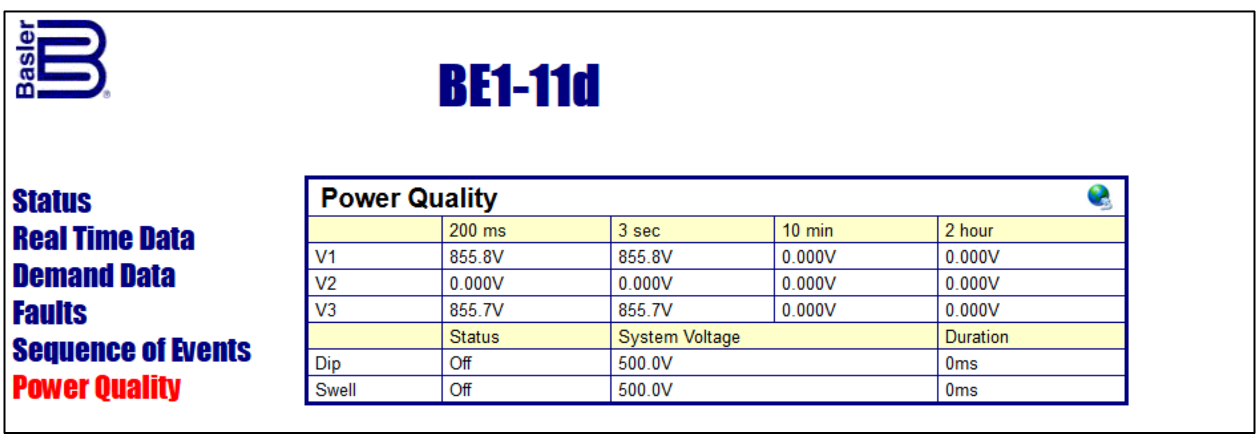


Figure 29-8. Power Quality Page

30 • Mounting

BE1-11*d* protection systems are supplied in a non-drawout, J case that fits in a standard electro-mechanical relay case opening. J case terminal strips are removable via two 7/64” hex screws. Extra terminal strip kits (Figure 30-1) are available as part number 9424226100. Note that some terminal strips provided in the kit will not be used for your product. Adapter plates are sold separately. A BE1-11*d* can be mounted at any convenient angle.

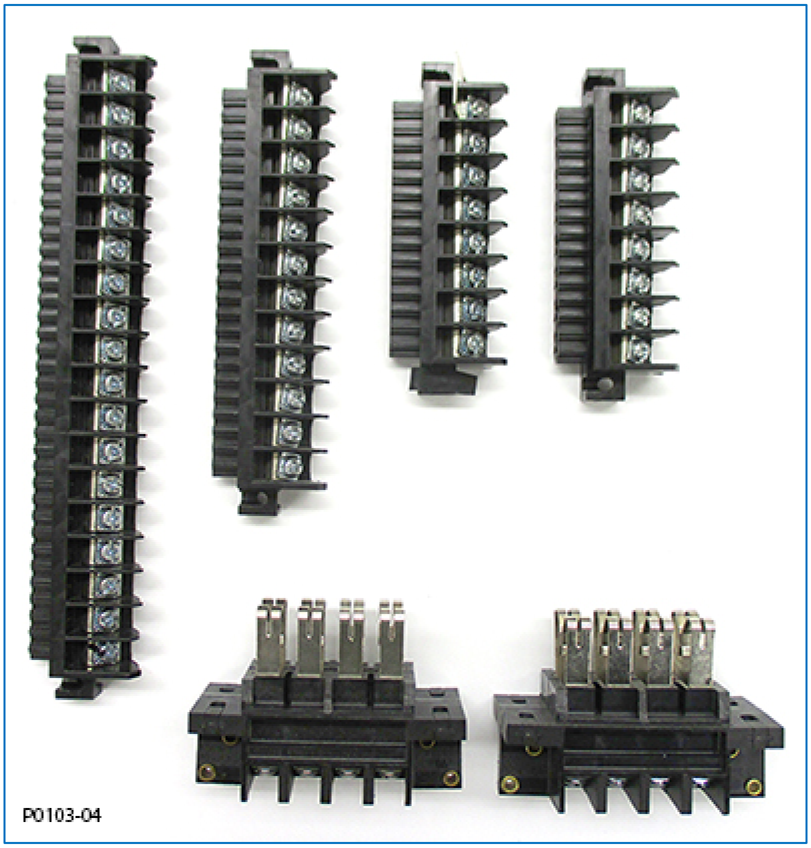


Figure 30-1. J Case Terminal Strip Kit, Part Number 9424226100

Note
Case mounting studs are carbon steel #10-32. The torque applied to the provided nuts should be 25 to 35 inch-pounds (2.82 to 3.95 N•m).

Case Dimensions

Front dimensions are shown in Figure 30-2 and side dimensions are shown in Figure 30-3. Dimensions are shown in inches [millimeters].

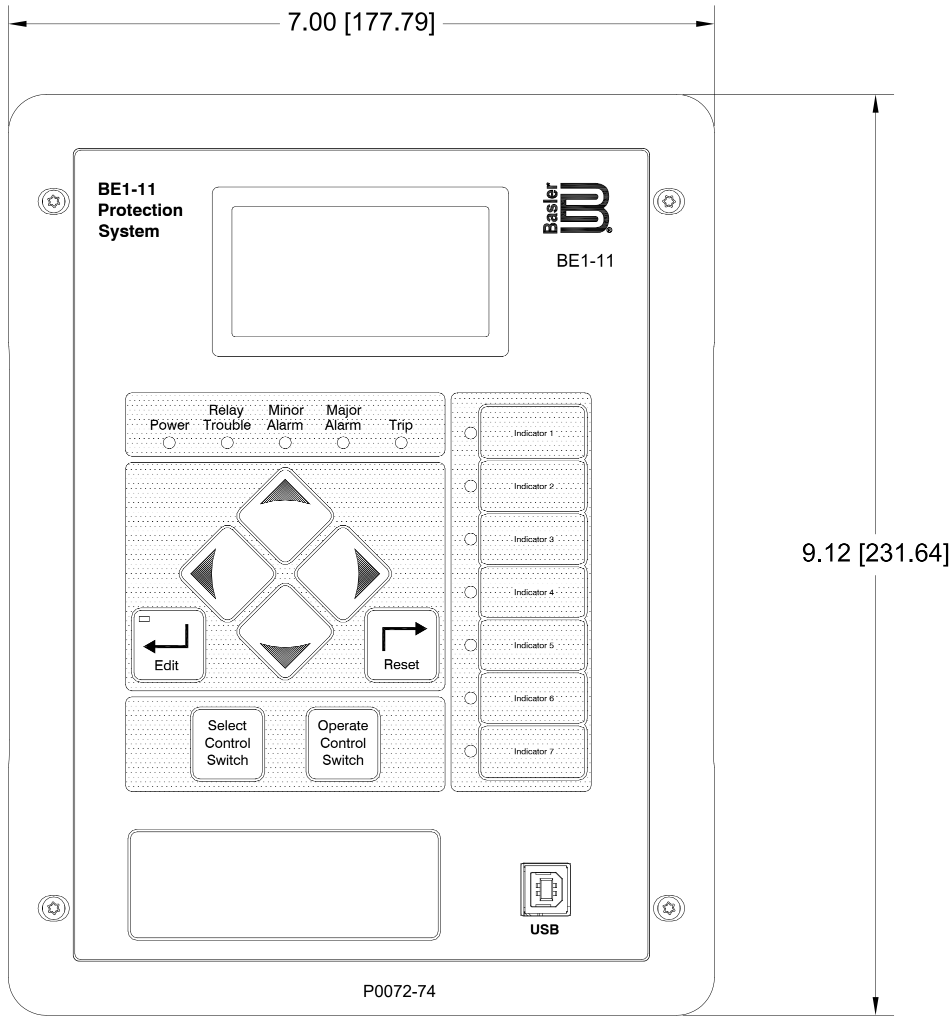


Figure 30-2. Case Front Dimensions

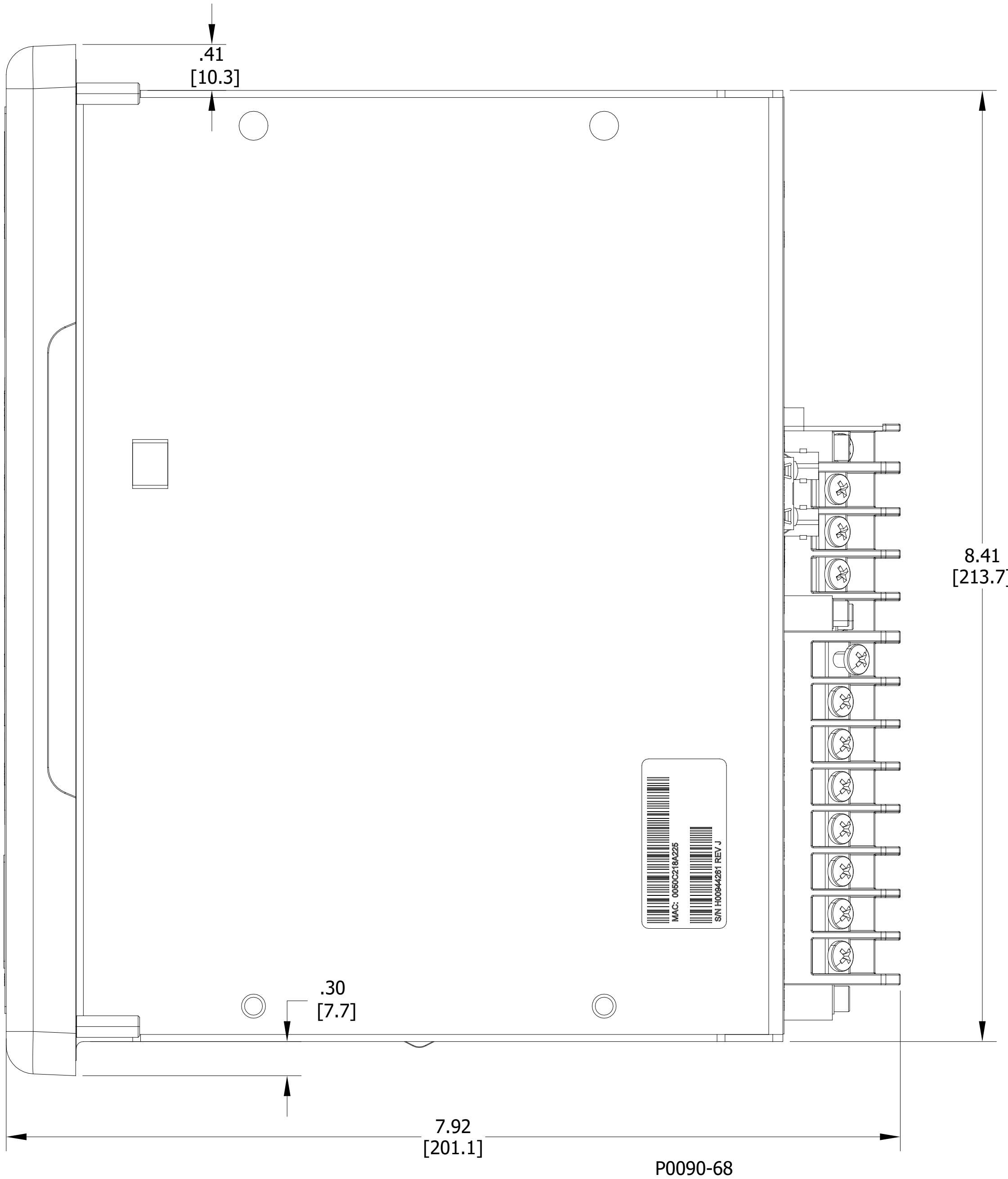


Figure 30-3. Case Side Dimensions

Panel Cutting and Drilling Dimensions

Panel cutting and drilling dimensions are shown in Figure 30-4.

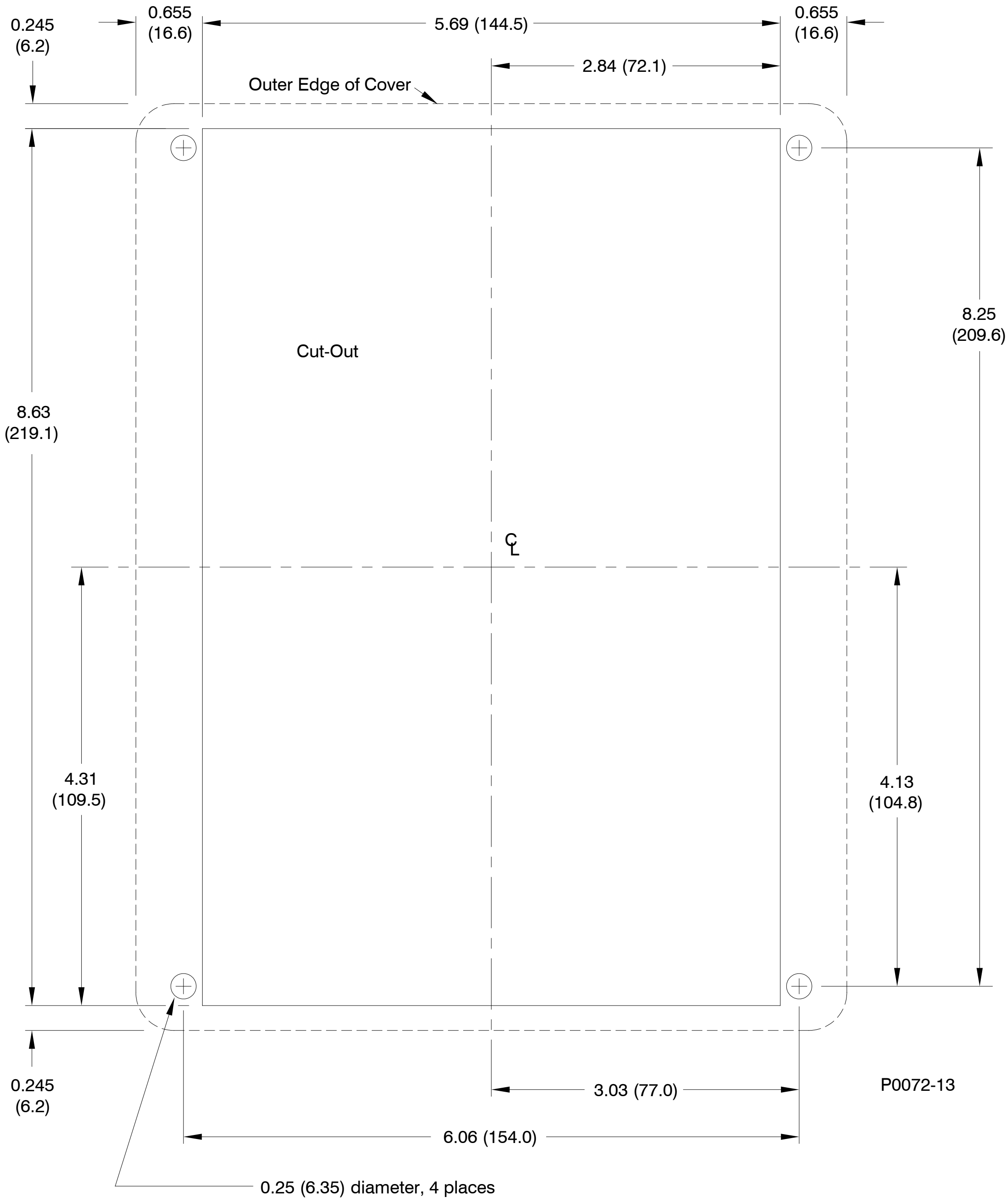


Figure 30-4. Case Cutout and Drilling Dimensions

GE S2 and ABB FT-21 Adapter Plate

An adapter plate to mount a J case in a GE S2 or ABB FT-21 cutout is shown in Figure 30-5. Order Basler part number 9108551021.

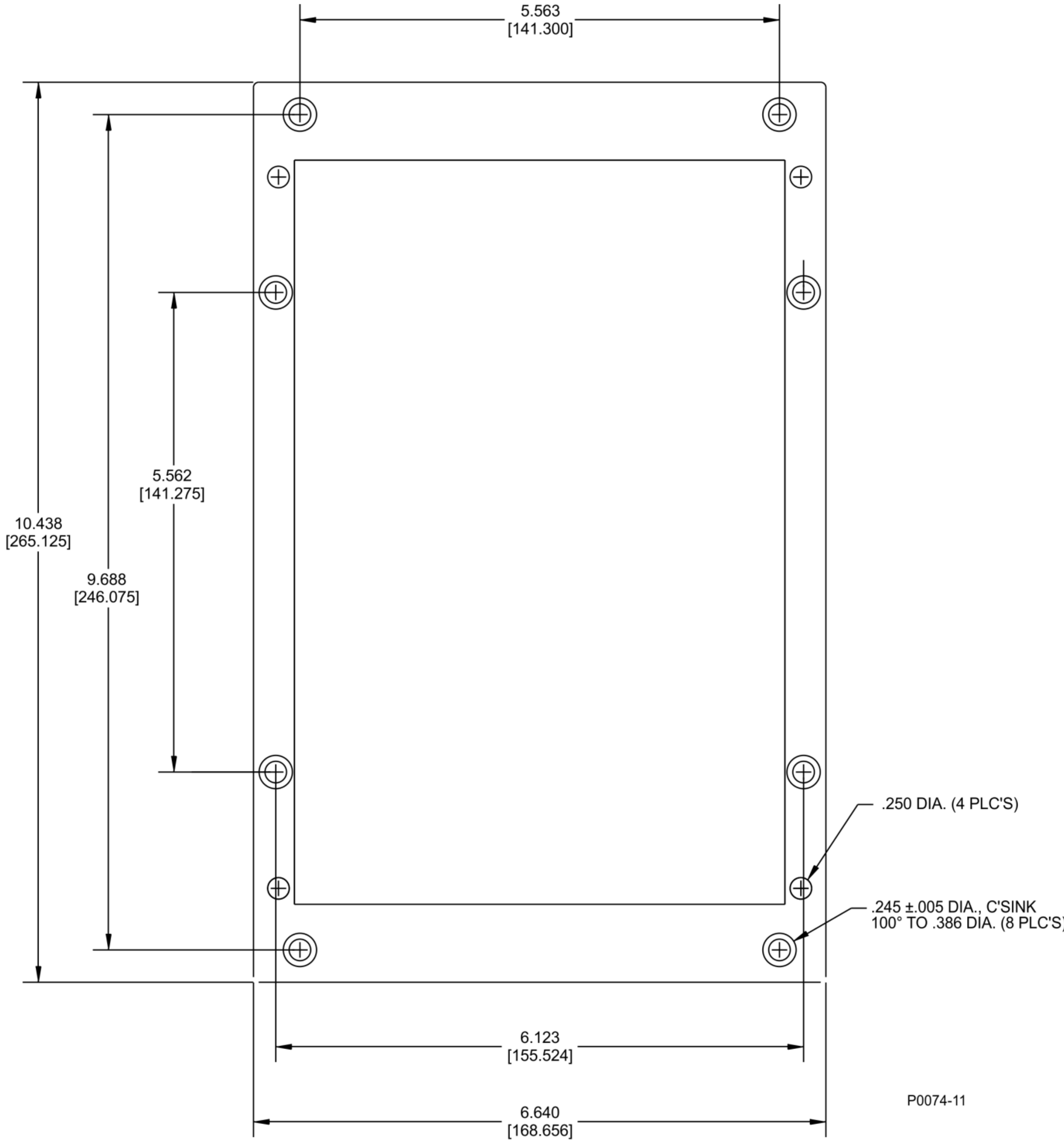


Figure 30-5. Adapter Plate (Basler P/N: 9108551021)

ABB FT-31/FT-32 Adapter Plate

An adapter plate to mount a J case in a ABB FT-31/FT-32 cutout is shown in Figure 30-6. Order Basler part number 9108551022.

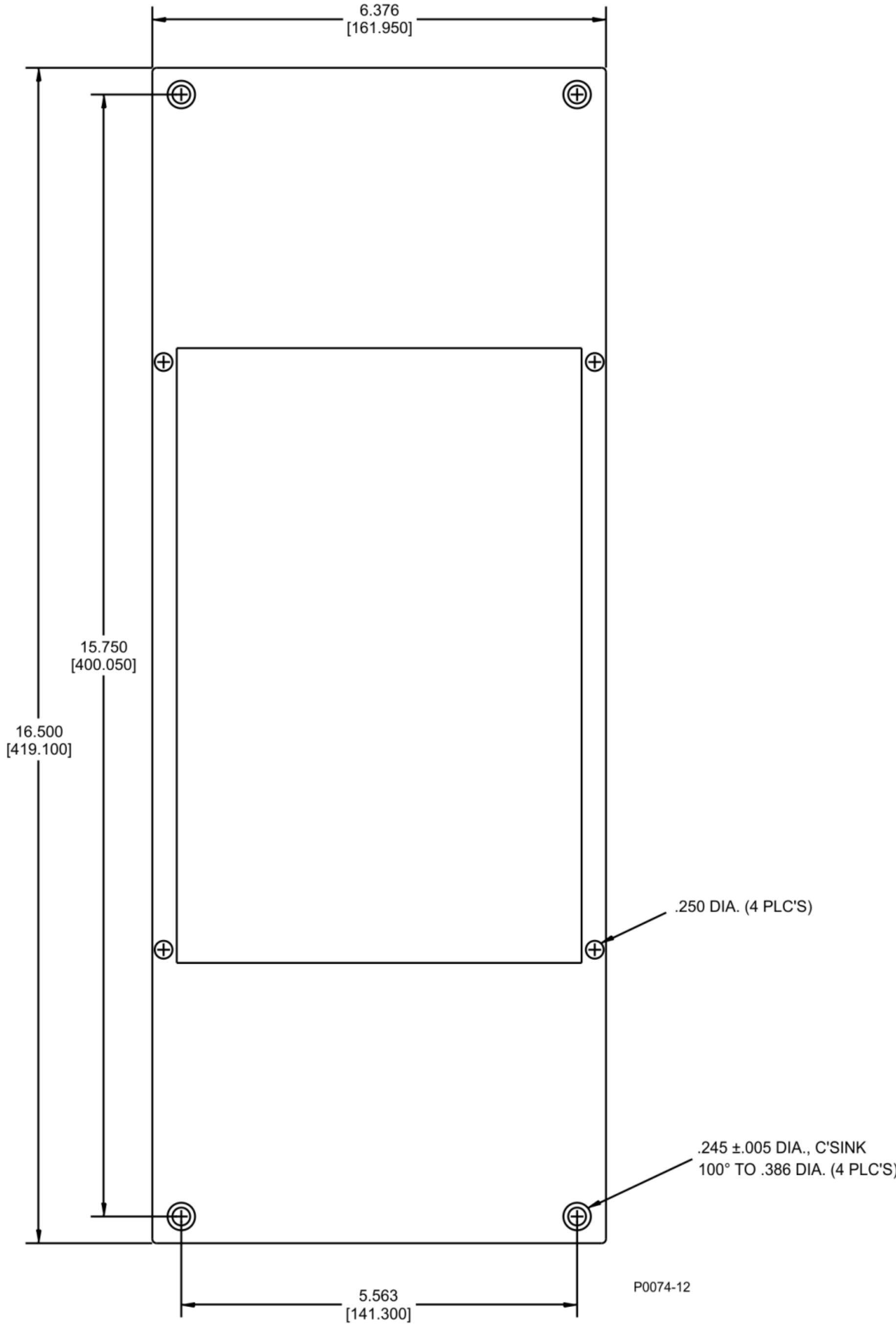


Figure 30-6. Adapter Plate (Basler P/N: 9108551022)

GE M1/M2 Adapter

An adapter plate to mount a J case in a GE M1/M2 cutout or Basler M1 cutout is shown in Figure 30-7. Order Basler part number 9108551029.

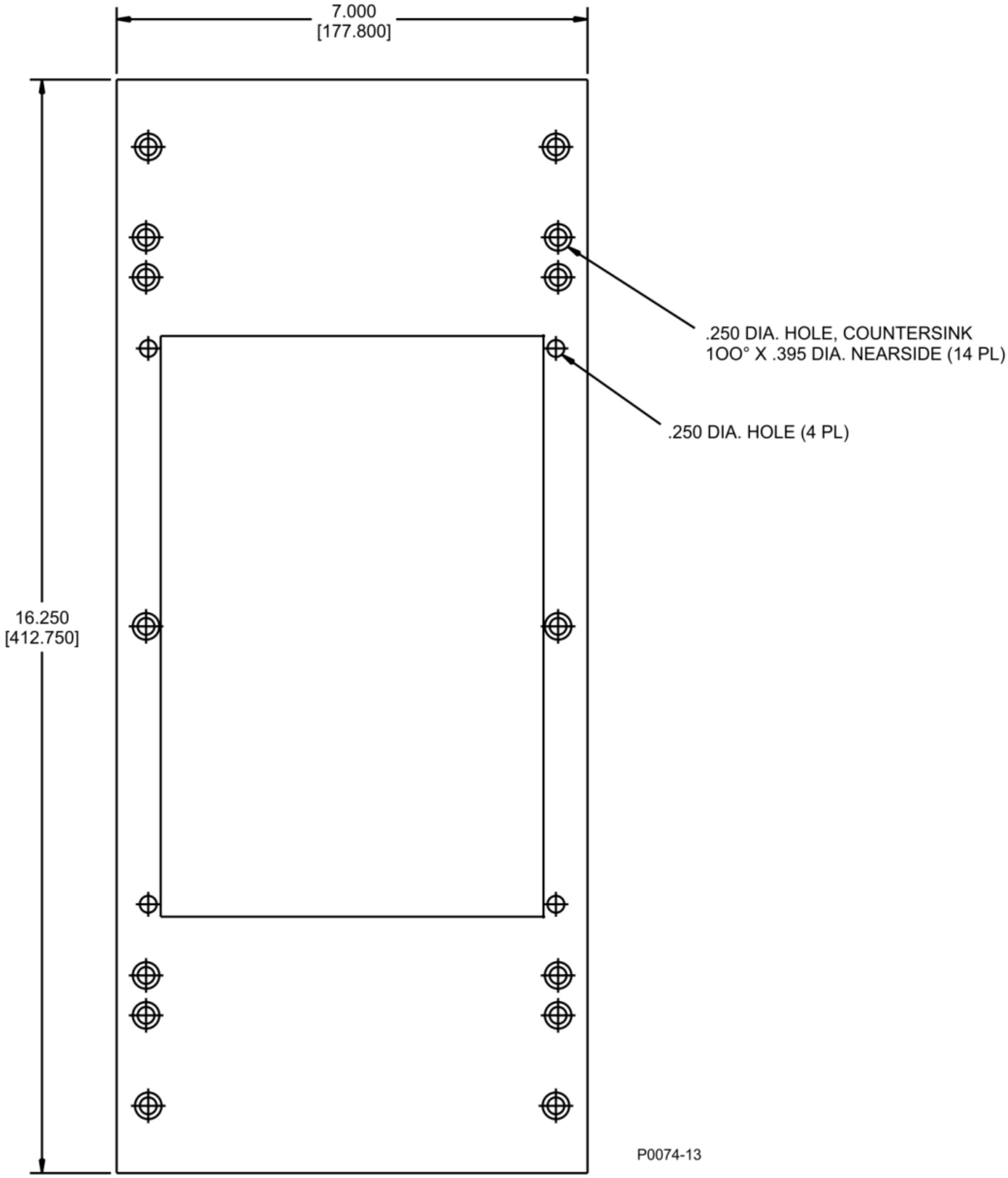


Figure 30-7. Adapter Plate (Basler P/N: 9108551029)

Multilin 345/745 Retrofit Mounting Plate

A J case retrofit mounting plate for the Multilin 345/745 consists of two parts. See Figure 30-8 and Figure 30-9. Order Basler part number 9424200073.

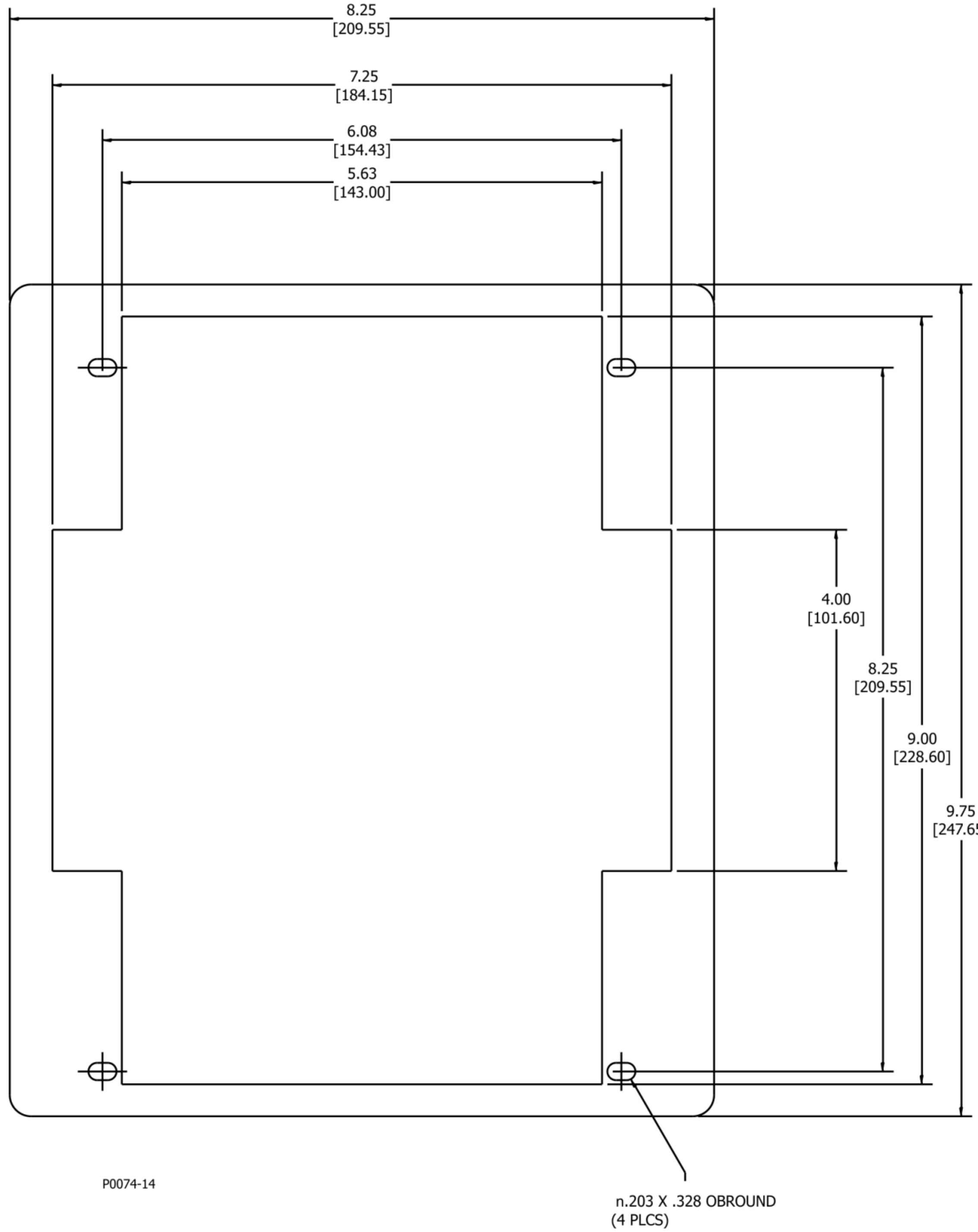


Figure 30-8. Retrofit Mounting Plate (Basler P/N: 9424200073) – Part 1

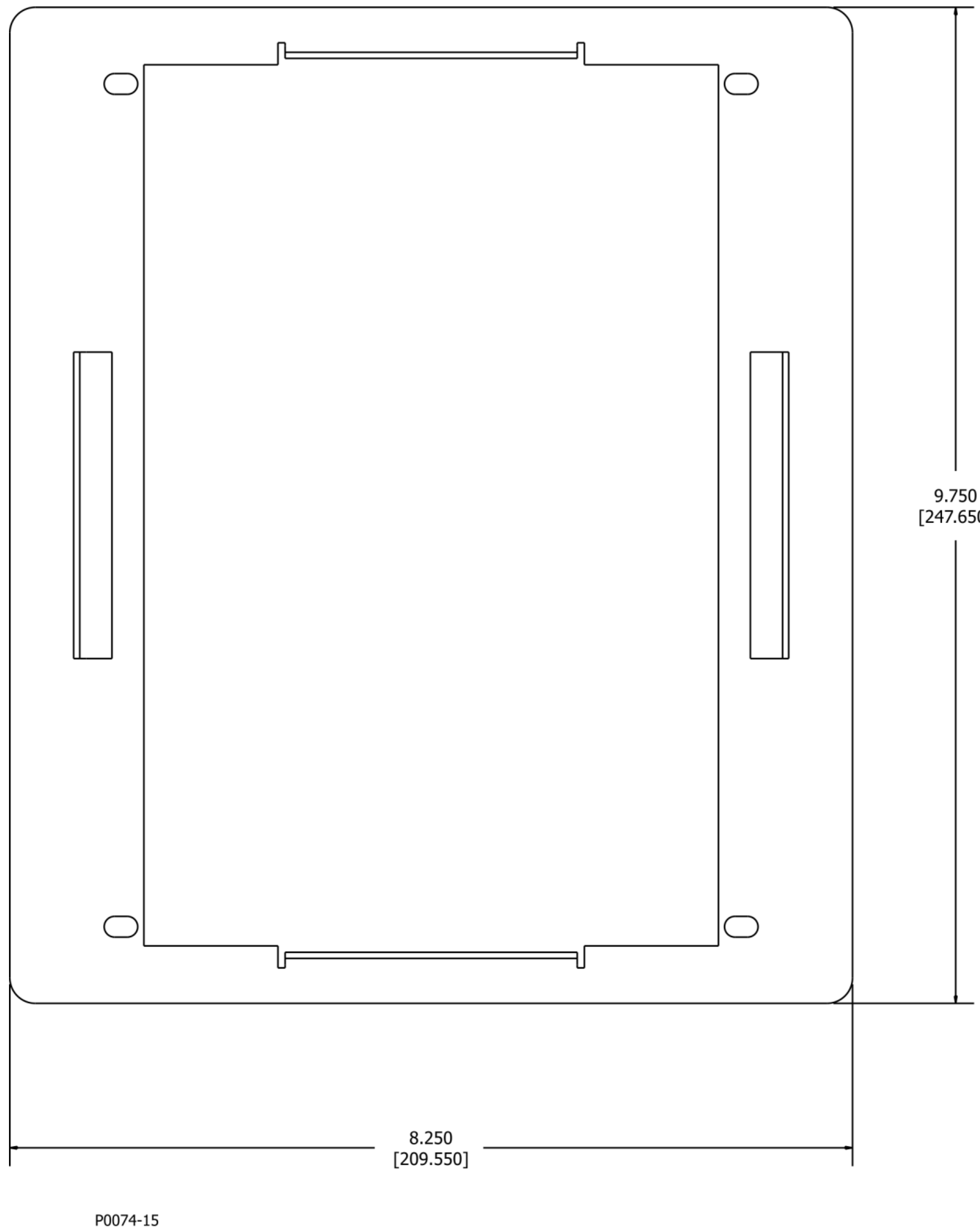
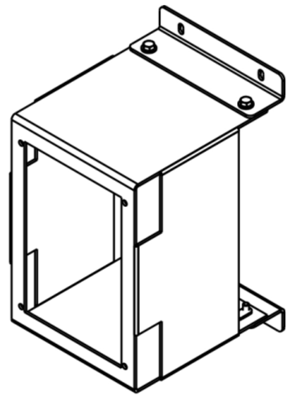


Figure 30-9. Retrofit Mounting Plate (Basler P/N: 9424200073) – Part 2

Pivoting Projection-Mounting Kit

A pivoting projection-mounting kit for a J case is shown in Figure 30-10. When installed, this kit provides rear access to connections by allowing the BE1-11*d* to swing left or right. Order Basler part number 9424226101.



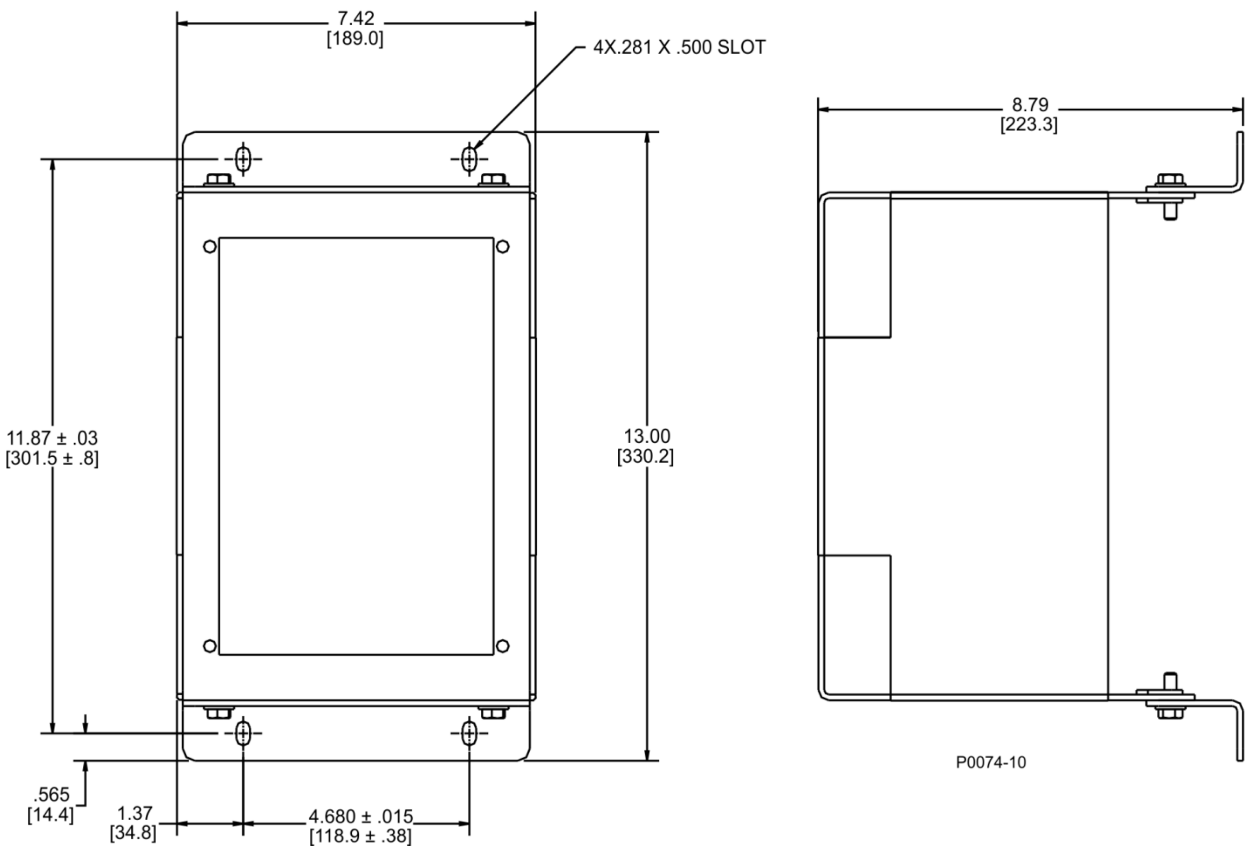


Figure 30-10. Pivoting Projection-Mounting Kit (Basler P/N: 9424226101)

31 • Terminals and Connectors

Connections to the BE1-11*d* are dependent on the application and logic scheme selected by the user. As a result, some BE1-11*d* inputs and outputs may not be used for a given application. Before energizing a BE1-11*d*, make sure the connections match the options associated with the model and style number found on the BE1-11*d* nameplate. Refer to the style chart in the *Introduction* chapter for available options. Be sure to use the correct input power for the specified power supply. Incorrect wiring may result in damage to the BE1-11*d*.

Notes

Connections to the BE1-11*d* contact inputs, power supply inputs, and contact outputs should be made with a minimum wire size of 14 AWG (2.08 mm^2).

Connections to the BE1-11*d* ground terminal should be made with a minimum wire size of 12 AWG (3.31 mm^2).

When the BE1-11*d* is configured in a system with other protective devices, a separate ground bus lead is recommended for each BE1-11*d*.

It is recommended in all applications where contact outputs drive relay coils that a reverse biased diode be implemented in parallel with the relay coil for EMI suppression.

Rear panel connections are shown in Figures 31-1 through 31-4.

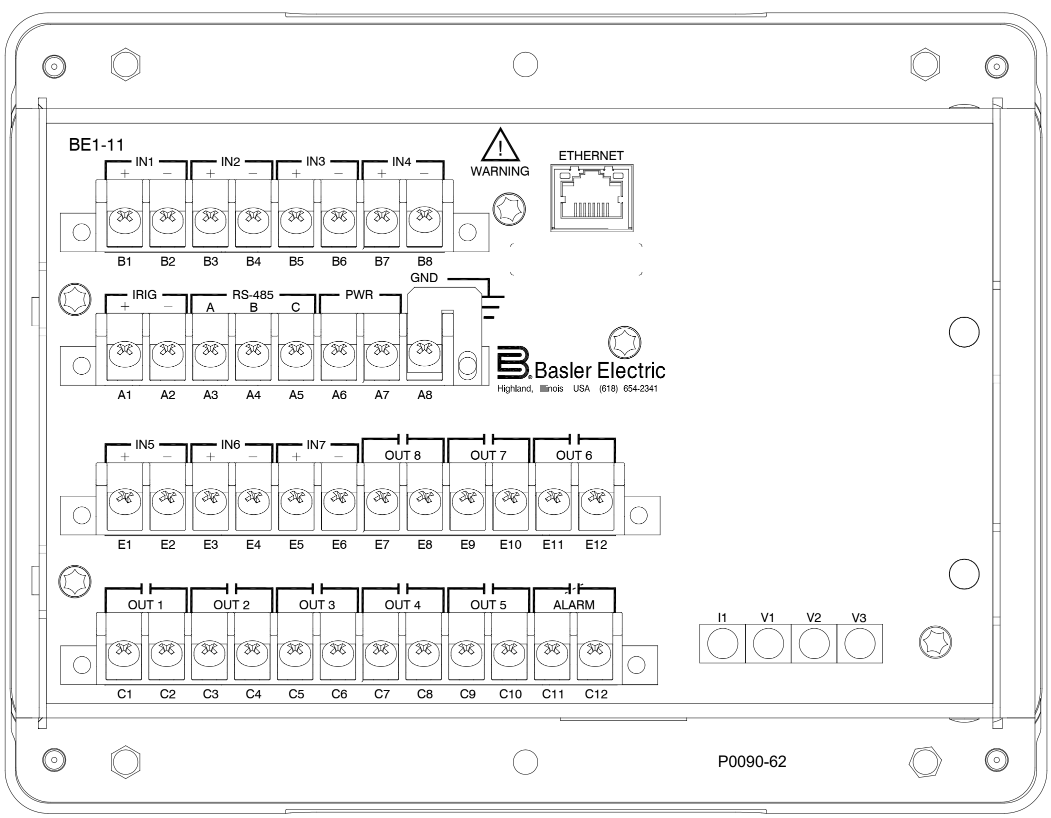


Figure 31-1. Rear Panel Connections with RJ45 Ethernet (7 Inputs and 8 Outputs Option)

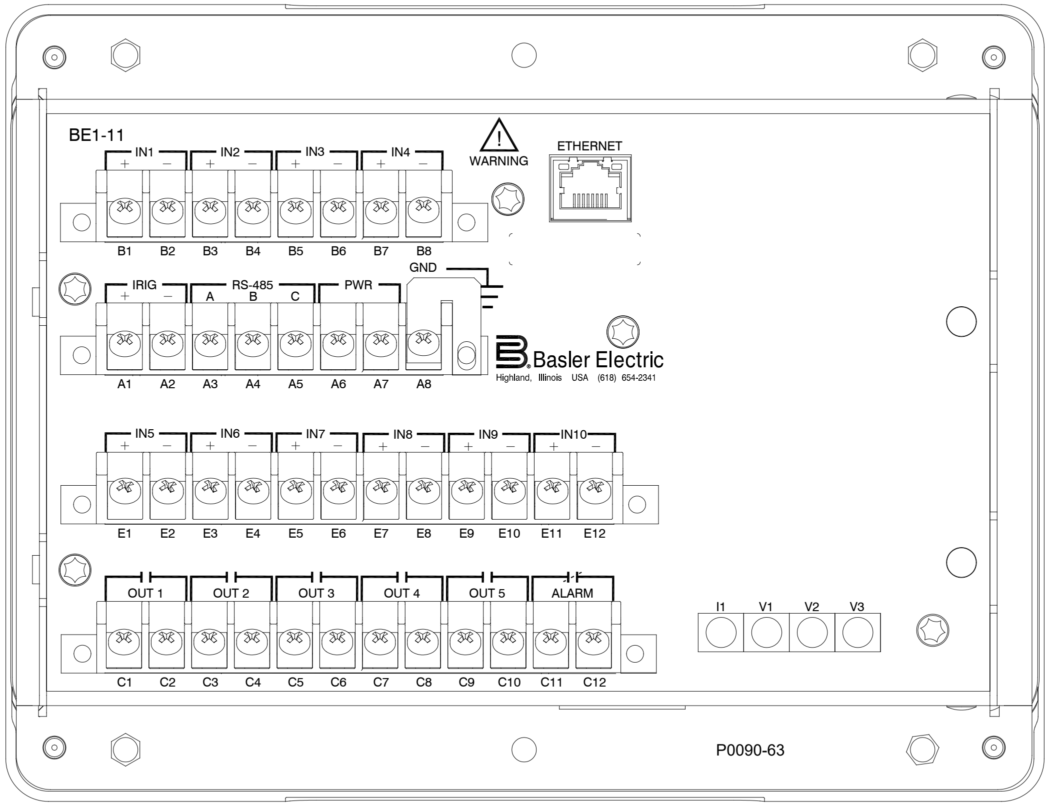


Figure 31-2. Rear Panel Connections with RJ45 Ethernet (10 Inputs and 5 Outputs Option)

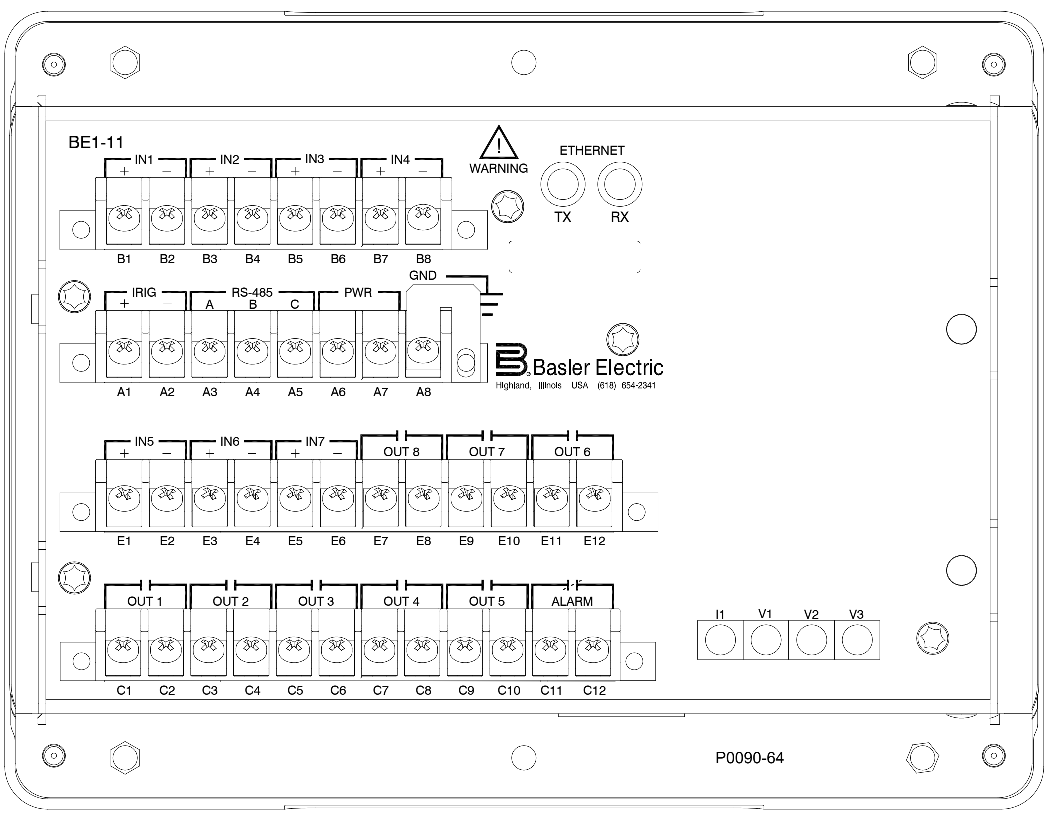


Figure 31-3. Rear Panel Connections with Fiber Optic Ethernet (7 Inputs and 8 Outputs Option)

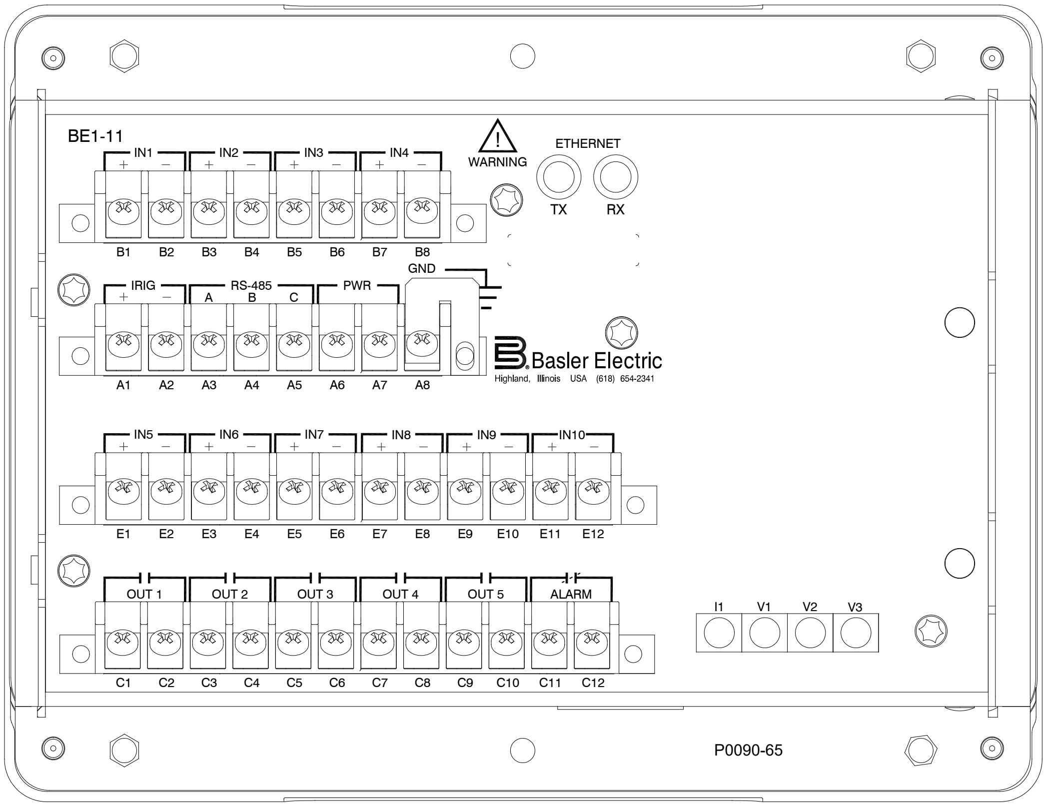


Figure 31-4. Rear Panel Connections with Fiber Optic Ethernet (10 Inputs and 5 Outputs Option)

Terminal Blocks

Terminal blocks use #6-32 screws. The torque applied to these screws should not exceed 12 inch-pounds (1.35 N•m). Each terminal block screw accommodates a lug no wider than 0.320 inches (8.1 millimeters).

32 • Typical Connections

Note
The relay should be hard-wired to earth ground with no smaller than 12 AWG (4 mm^2) copper wire attached to the rear ground terminal of the relay case. When the relay is configured in a system with other protective devices, a separate ground bus lead is recommended for each relay.

Typical input and output connections for the BE1-11*d* are shown in Figure 32-1.

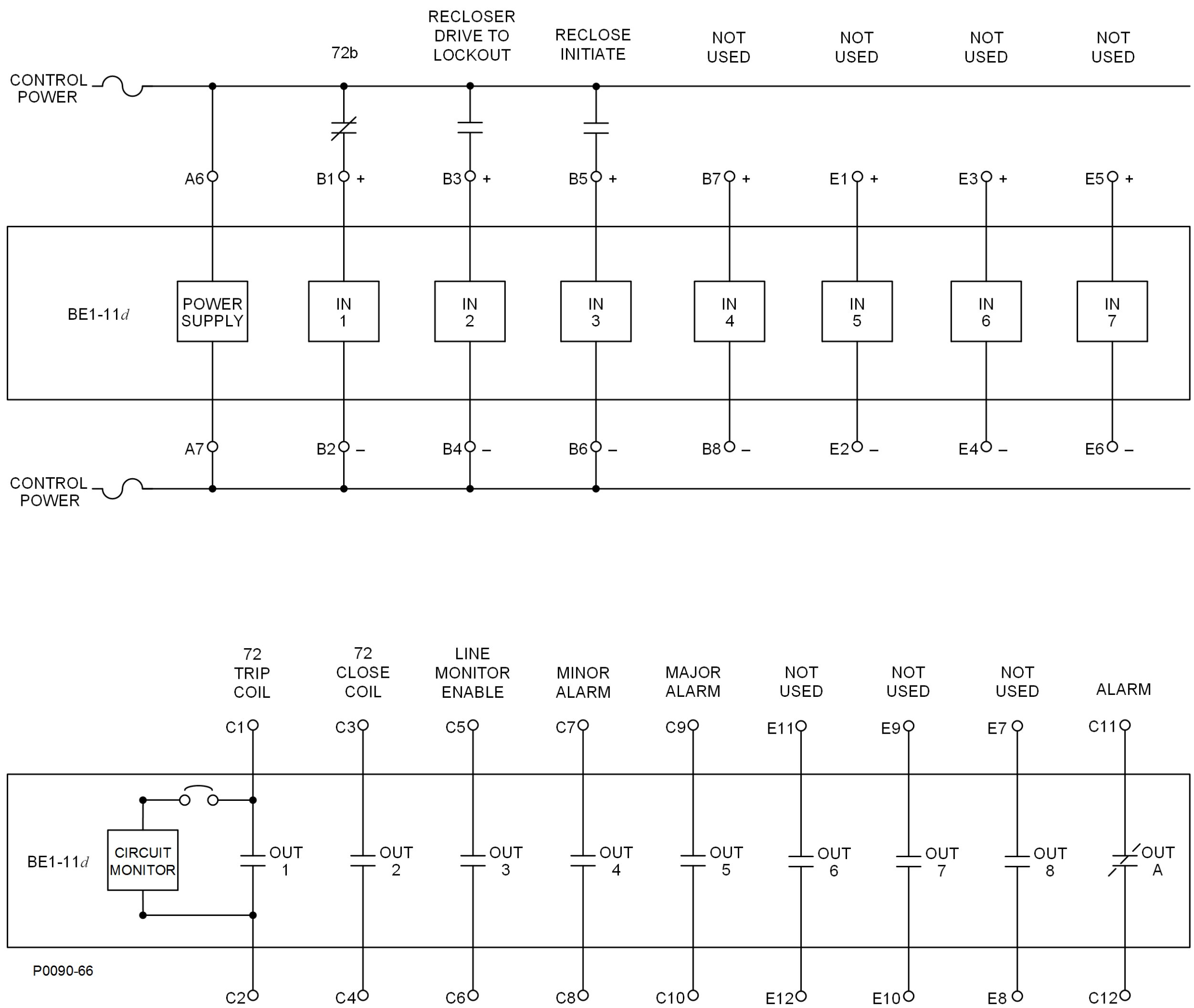


Figure 32-1. Typical Inputs and Outputs Connections

Typical DC transit application connections are shown in Figure 32-2.

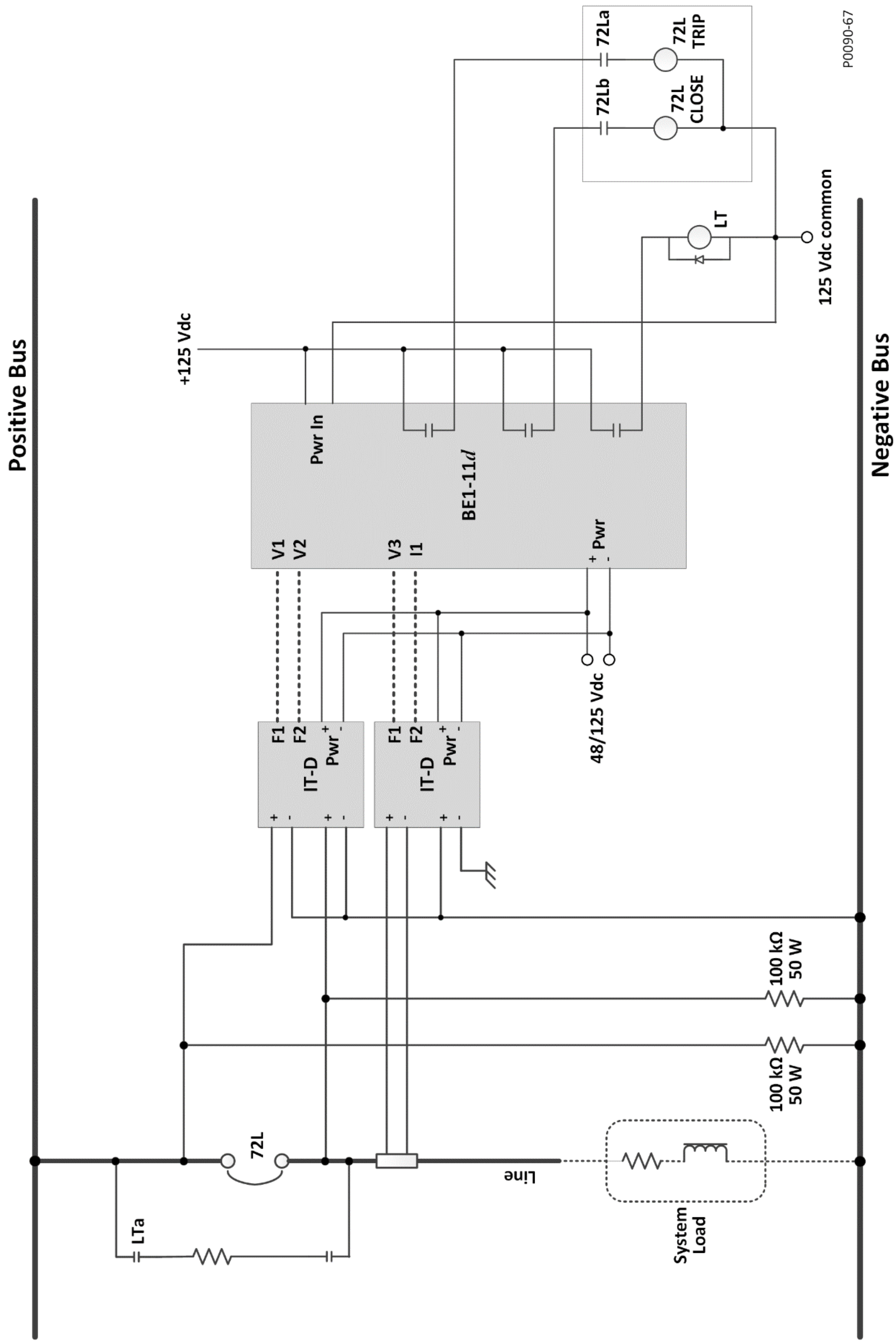


Figure 32-2. Typical DC Transit Application

33 • BESTCOMS*Plus*® Software

BESTCOMS*Plus* is a Windows®-based, PC application that provides a user-friendly, graphical user interface (GUI) for use with Basler Electric communicating products. The name BESTCOMS*Plus* is an acronym that stands for Basler Electric Software Tool for Communications, Operations, Maintenance, and Settings.

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the BE1-11*d*. The capabilities of BESTCOMS*Plus* make the configuration of one or several BE1-11*d* DC Power Protection Systems fast and efficient. A primary advantage of BESTCOMS*Plus* is that a settings scheme can be created, saved as a file, and then uploaded to the BE1-11*d* at the user's convenience.

BESTCOMS*Plus* uses plugins allowing the user to manage several different Basler Electric products. The BE1-11 plugin opens inside the BESTCOMS*Plus* main shell. The same default logic scheme that is shipped with the BE1-11*d* is brought into BESTCOMS*Plus* by downloading settings and logic from the BE1-11*d* or by selecting application type "D" on the Style Number screen. This gives the user the option of developing a custom setting file by modifying the default logic scheme or by building a unique scheme from scratch.

BESTlogic™*Plus* Programmable Logic is used to program BE1-11*d* logic for protection elements, inputs, outputs, alarms, etc. This is accomplished by the drag-and-drop method. The user can drag elements, components, inputs, and outputs onto the program grid and make connections between them to create the desired logic scheme.

BESTCOMS*Plus* also allows for downloading industry-standard COMTRADE files for analysis of stored oscillography data. Detailed analysis of the oscillography files can be accomplished using BESTdata software. BESTdata software is free and available at www.basler.com.

Figure 33-1 illustrates the typical user interface components of the BE1-11 plugin with BESTCOMS*Plus*.

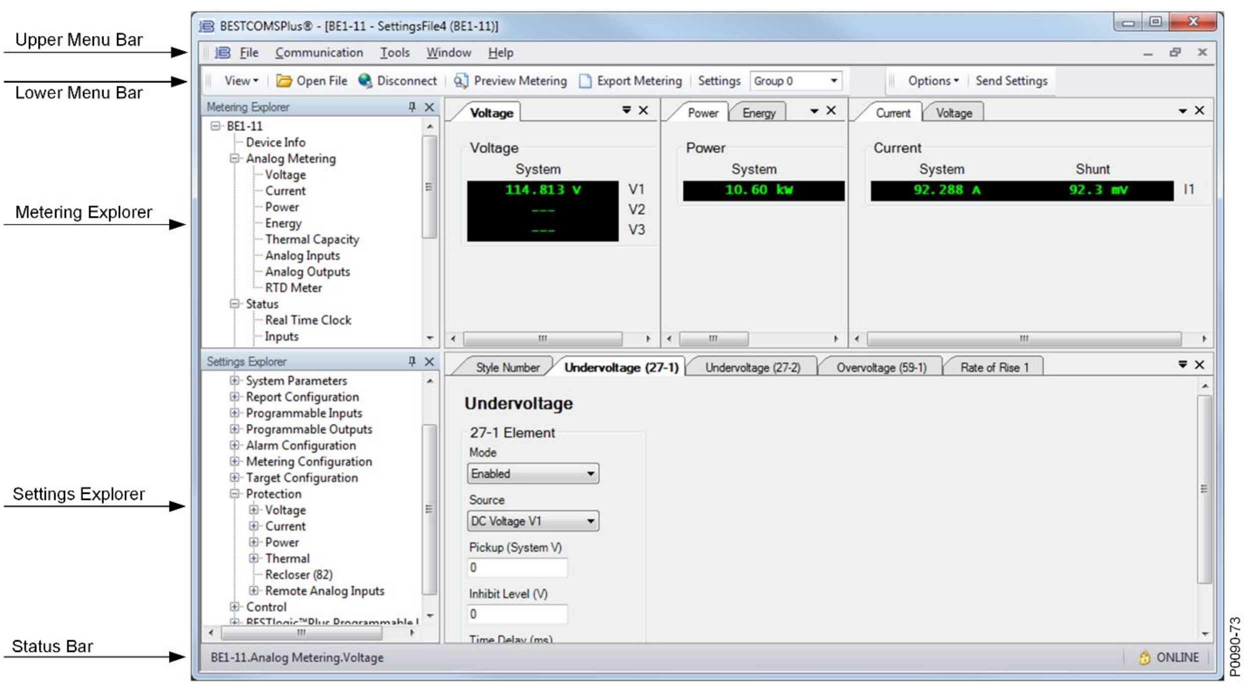


Figure 33-1. Typical User Interface Components

System Recommendations

BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the BE1-11 plugin and the required version of .NET Framework (if not already installed). BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10, and Windows 11. System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 33-1.

Table 33-1. System Recommendations for BESTCOMS*Plus* and the .NET Framework

System Type	Component	Recommendation
32/64 bit	Processor	2.0 GHz
32/64 bit	RAM	1 GB (minimum), 2 GB (recommended)
32 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)
64 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)

To install BESTCOMS*Plus*, a Windows user must have Administrator rights.

Installation

Note

Do not connect a USB cable until setup completes successfully. Connecting a USB cable before setup is complete may result in unwanted or unexpected errors.

Run the setup file for the BESTCOMS*Plus* application. The setup utility installs BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the BE1-11 plugin for BESTCOMS*Plus* on your PC.

When BESTCOMS*Plus* installation is complete, a Basler Electric folder is added to the Windows programs menu. This folder is accessed by clicking the Windows Start button and then accessing the Basler Electric folder in the Programs menu. The Basler Electric folder contains an icon that starts BESTCOMS*Plus* when clicked.

Connect the BE1-11 and Start BESTCOMSPlus®

The BE1-11 plugin is a module that runs inside the BESTCOMS*Plus* shell. The BE1-11 plugin contains specific operational and logic settings for only the BE1-11*d*.

Connect a USB Cable

The USB driver was copied to your PC during BESTCOMS*Plus* installation and is installed automatically after powering the BE1-11*d*. USB driver installation progress is shown in the Windows taskbar area. Windows will notify you when installation is complete.

Connect a USB cable between the PC and your BE1-11*d*. Apply operating power (per style chart in the *Introduction* chapter) to the BE1-11*d* at rear terminals A6 and A7. Wait until the boot sequence is complete.

Note

In some instances, the Found New Hardware Wizard will prompt you for the USB driver. If this happens, direct the wizard to the following folder:

C:\Program Files\Basler Electric\USB Connect Driver\

If the USB driver does not install properly, refer to the *Troubleshooting* chapter.

Start BESTCOMS*Plus*®

To start BESTCOMS*Plus*, click the Start button, point to Programs, Basler Electric, and then click the BESTCOMS*Plus* icon. During initial startup, the BESTCOMS*Plus* Select Language screen is displayed (Figure 33-2). You can choose to have this screen displayed each time BESTCOMS*Plus* is started, or you can select a preferred language and this screen will be bypassed in the future. Click OK to continue. This screen can be accessed later by selecting Tools and Select Language from the menu bar.

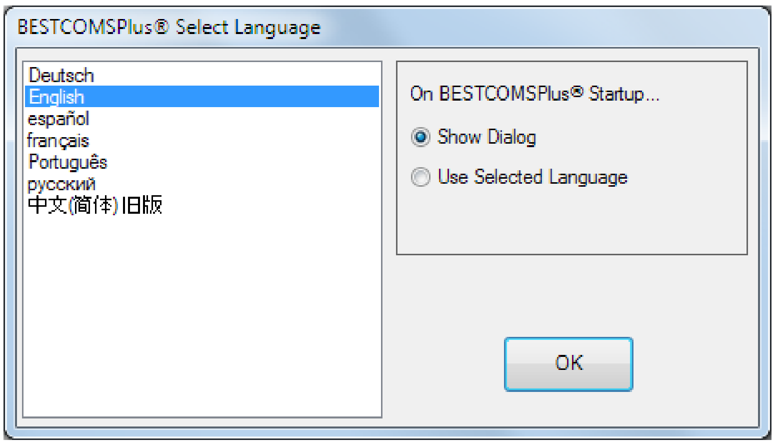


Figure 33-2. BESTCOMS*Plus* Select Language Screen

The BESTCOMS*Plus* splash screen is shown for a brief time. See Figure 33-3.

Figure 33-3. BESTCOMS*Plus* Splash Screen

The BESTCOMS*Plus* platform window opens. Select New Connection from the Communication pull-down menu and select BE1-11. See Figure 33-4.

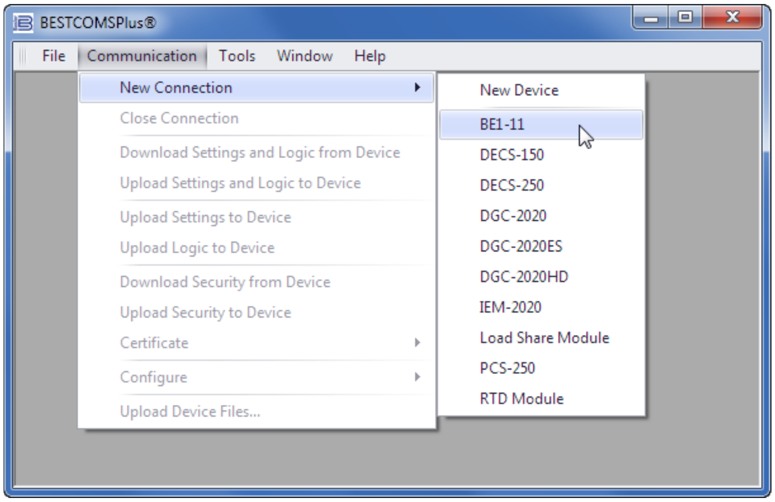


Figure 33-4. Communication Pull-Down Menu

The BE1-11 Connection screen shown in Figure 33-5 appears. Select USB Connection and then click the Connect button.

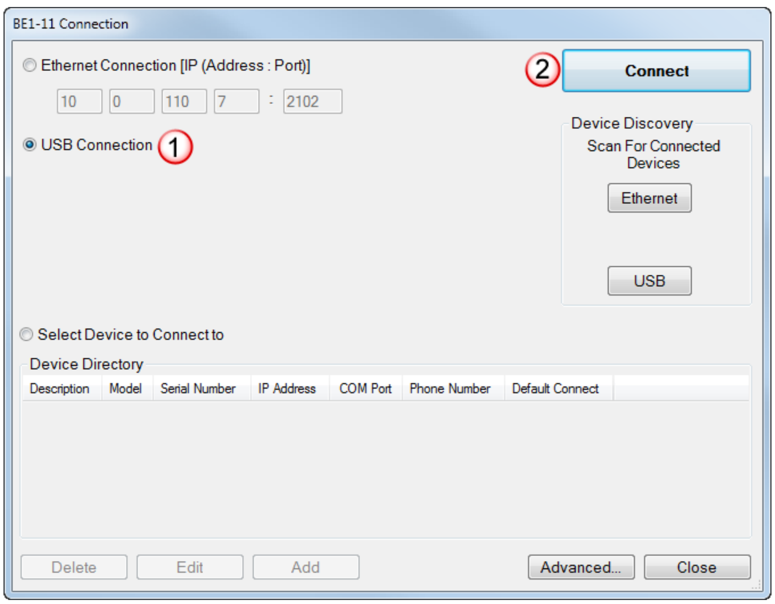


Figure 33-5. BE1-11 Connection Screen

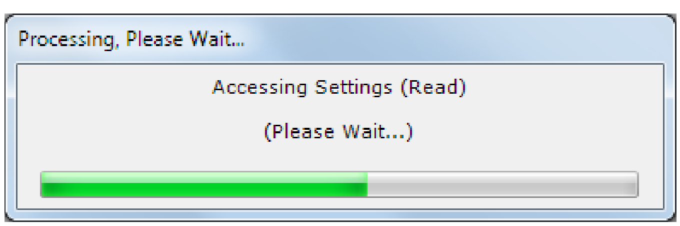


Figure 33-6. Processing, Please Wait…

Advanced Properties

Click the Advanced button on the Connection screen to display the Advanced Properties dialog. Default settings are shown in Figure 33-7.

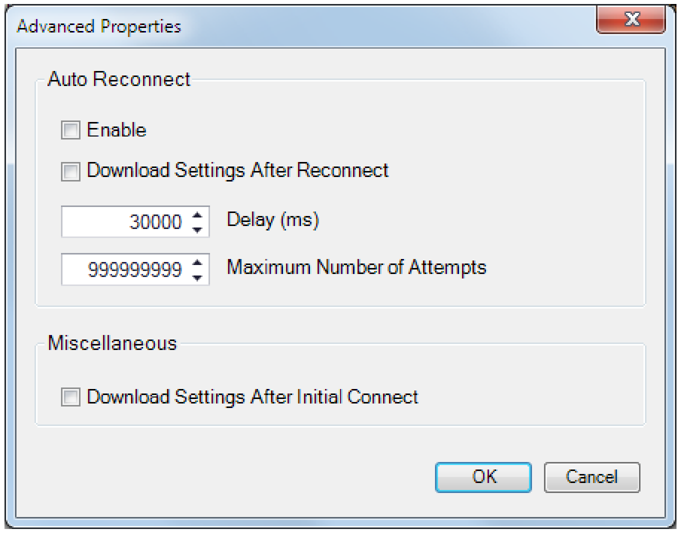


Figure 33-7. Advanced Properties Dialog

Menu Bars

The menu bars are located near the top of the BESTCOMS*Plus* screen (see Figure 33-1). The upper menu bar has five pull-down menus. With the upper menu bar, it is possible to manage settings files, configure communication settings, upload and download settings/security files, and compare settings files. The lower menu bar consists of clickable icons. The lower menu bar is used to change BESTCOMS*Plus* views, open a settings file, connect/disconnect, preview metering printout, export metering, switch to live mode, and send settings after a change is made when not in live mode.

Upper Menu Bar (BESTCOMS*Plus*® Shell)

Upper menu bar functions are listed and described in Table 33-2.

Table 33-2. Upper Menu Bar (BESTCOMS*Plus*® Shell)

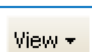
Menu Item	Description
File	
New	Create a new settings file
Open	Open an existing settings file
Close	Close settings file
Save	Save settings file
Save As	Save settings file with a different name
Export To File	Save settings as a *.csv file
Print	Print, export, or send a settings file
Properties	View properties of a settings file
History	View history of a settings file
Recent Files	Open a previously opened file
Exit	Close BESTCOMS*Plus* program
Communication	
New Connection	Choose new device or BE1-11
Close Connection	Close communication between BESTCOMS*Plus* and BE1-11
Download Settings and Logic from Device	Download operational and logic settings from the device
Upload Settings and Logic to Device	Upload operational and logic settings to the device

Menu Item	Description
Upload Settings to Device	Upload operational settings to the device
Upload Logic to Device	Upload logic settings to the device
Download Security from Device	Download security settings from the device
Upload Security to Device	Upload security settings to the device
Certificate - Upload Certificate to Device	Upload certificate to the device
Certificate - Remove Certificate from Device	Remove certificate from the device
Reset to Factory Defaults	Reset factory defaults in the BE1-11*d* (Available only when the device does not contain default settings. Administrator access level required.)
Upload Settings, Logic and Security	Upload operational, logic, and security settings to the device (Available only when the device contains default settings. No password required.)
Configure	Ethernet settings
Upload Device Files	Upload firmware to the device
Upgrade Style Number	Upload a style upgrade file supplied by Basler Electric
Tools	
Select Language	Select BESTCOMS*Plus* language
Set File Password	Password protect a settings file
Compare Settings Files	Compare two settings files
Copy Settings Group	Copy Settings from Group to Group
Auto Export Metering	Exports metering data at a user-defined interval
Launch BEST61850	Opens BEST61850 (if installed)
Event Log - View	View the BESTCOMS*Plus* event log
Event Log - Verbose Logging	Enable/disable verbose logging
Event Log - Verbose Communication Logging	Enable/disable verbose communication logging
Set Default Shell	Select the default shell for BESTCOMS*Plus*
Generate Certificate	Generate a certificate
Accepted Devices	View and delete accepted devices
Help	
Check for Updates	Check for BESTCOMS*Plus* updates via the internet
Check for Update Settings	Enable or change automatic checking for updates
About	View general, detailed build, and system information

Lower Menu Bar (BE1-11 Plugin)

Lower menu bar functions are listed and described in Table 33-3.

Table 33-3. Lower Menu Bar (BE1-11 Plugin)

Menu Button	Description
	Enables you to show/hide the Metering Panel, Settings Panel, or Settings Info Panel. Opens and saves workspaces. Customized workspaces make switching between tasks easier and more efficient.
	Opens a saved settings file.

Menu Button	Description
Connect	Opens the BE1-11 Connection screen, which enables you to connect to the BE1-11*d* via USB or Ethernet. This button appears only when a BE1-11*d* is not connected.
Disconnect	Used to disconnect a connected BE1-11*d*. This button appears only when a BE1-11*d* is connected.
Preview Metering	Displays the Print Preview screen where a preview of the Metering printout is shown. Click on the printer button to send to a printer.
Export Metering	Enables all metering values to be exported into a *.csv (comma-separated values) file.
Settings Group 0 Settings Global	A pull-down menu allowing group selection is available when making protection settings. The settings can be applied to Group 0, 1, 2, or 3. If a global setting is being changed, Global will appear in place of the drop-down menu.
Options ▾	Displays a drop-down list entitled Live Mode Settings, which enables Live mode where settings are automatically sent to the device in real time as they are changed. The changed device settings are saved to non-volatile memory by clicking on the Save button.
Save LIVE MODE	Saves all device settings to non-volatile memory. This button appears only when operating in Live mode.
Send Settings	Sends settings to the BE1-11 when BESTCOMS*Plus* is not operating in Live Mode. Click this button after making a setting change to send the modified setting to the BE1-11*d*.

Settings Explorer

The Settings Explorer is a convenient tool within BESTCOMS*Plus* used to navigate through the various settings screens of the BE1-11 plugin. Descriptions of these configuration settings are organized as follows:

- General Settings
- Communications
- System Parameters
- Report Configuration
- Programmable Inputs
- Programmable Outputs
- Alarm Configuration
- Metering Configuration
- Target Configuration
- Protection
- Control
- BESTlogic*Plus* Programmable Logic

Logic setup will be necessary after making certain setting changes. For more information, refer to the *BESTlogicPlus* chapter.

Settings Entry

When entering settings in BESTCOMS*Plus*, each setting is validated against prescribed limits. Entered settings that do not conform with the prescribed limits are accepted but flagged as noncompliant. Figure 33-8 illustrates an example of flagged, noncompliant settings (locator A) and the Setting Validation window (locator B) used to diagnose faulty settings.

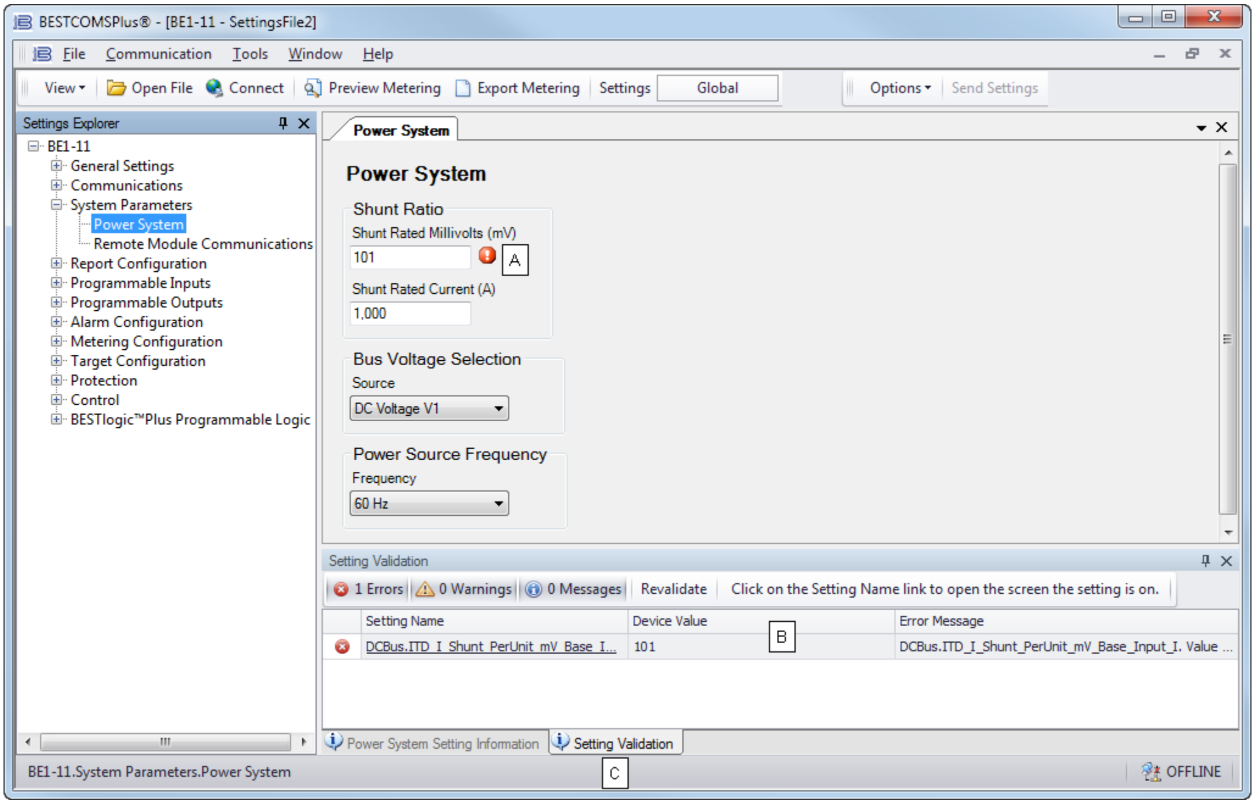


Figure 33-8. Flagged, Noncompliant Settings and the Seting Validation Window

The Setting Validation window, viewed by selecting the Setting Validation tab (locator C), displays three types of annunciations: errors, warnings, and messages. An error describes a problem such as a setting that is out of range. A warning describes a condition where supporting settings are invalid, causing other settings to be noncompliant with the prescribed limits. A message describes a minor setting issue that was automatically resolved by BESTCOMS*Plus*. An example of a condition triggering a message is entry of a settings value with a resolution that exceeds the limit imposed by BESTCOMS*Plus*. In this situation, the value is automatically rounded and a message is triggered. Each annunciation lists a hyperlinked name for the noncompliant setting and an error message describing the issue. Clicking the hyperlinked setting name takes you to the setting screen with the offending setting. Right-clicking the hyperlinked setting name will restore the setting to its default value.

Note
It is possible to save a BE1-11 settings file in BESTCOMS*Plus* with noncompliant settings. However, it is not possible to upload noncompliant settings to the BE1-11.

Metering Explorer

The Metering Explorer is described in the *Metering* chapter.

Settings File Management

A settings file contains all BE1-11*d* settings including logic.

A settings file created in BESTCOMS*Plus* will have one of two file extensions. Settings files created in version 4.00.00 and later are given an extension of “bst4”. Settings files created in versions prior to 4.00.00 will have an extension of “bstx”.

It is possible to save only the BE1-11*d* logic displayed on the BESTlogic*Plus* Programmable Logic screen as a separate logic library file. This ability is helpful when similar logic is required for several BE1-11*d* systems. The file extension of a logic file created in BESTCOMS*Plus* will be either “bsl4” (version 4.00.00 and later) or “bslx” (versions prior to 4.00.00).

It is important to note that settings and logic can be uploaded to the device separately or together, but are always downloaded together. For more information on logic files, refer to the *BESTlogicPlus* chapter.

Opening a Settings File

To open a BE1-11*d* settings file with BESTCOMS*Plus*, pull down the File menu and choose Open. The Open dialog box appears. This dialog box allows you to use normal Windows techniques to select the file that you want to open. Select the file and choose Open. You can also open a file by clicking on the Open File button on the lower menu bar. If connected to a device, you will be asked to upload the settings and logic from the file to the current device. If you choose Yes, the settings displayed in BESTCOMS*Plus* instance will be overwritten with the settings of the opened file.

Saving a Settings File

Select Save or Save As from the File pull-down menu. A dialog box pops up allowing you to enter a filename and location to save the file. Select the Save button to complete the save.

Upload Settings and/or Logic to Device

To upload a settings file to the BE1-11*d*, open the file or create a new file through BESTCOMS*Plus*. Then pull down the Communication menu and select Upload Settings and Logic to Device. If you want to upload operational settings without logic, select Upload Settings to Device. If you want to upload logic without operational settings, select Upload Logic to Device. You are prompted to enter the username and password. The default username is “**A**” and the default password is “**A**”. If the username and password are correct, the upload begins and the progress bar is shown.

Upload Settings, Logic, and Security to Device

This function is available only when the device contains default settings. A password is not required. To upload settings, logic, and security to the BE1-11*d*, pull down the Communication menu and select Upload Settings, Logic, and Security.

Download Settings and Logic from Device

To download settings and logic from the BE1-11*d*, pull down the Communication menu and select Download Settings and Logic from Device. If the settings in BESTCOMS*Plus* have changed, a dialog box will open asking if you want to save the current settings changes. You can choose Yes or No. After you have taken the required action to save or discard the current settings, downloading begins. BESTCOMS*Plus* reads all settings and logic from the BE1-11*d* and loads them into BESTCOMS*Plus* memory. See Figure 33-9.

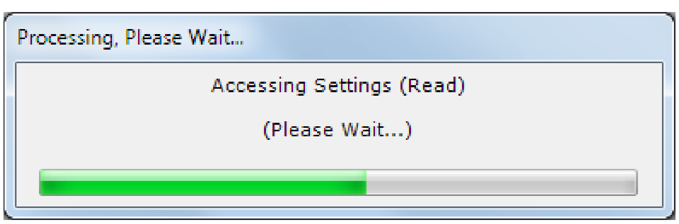


Figure 33-9. Processing, Please Wait…

Printing a Settings File

To view a preview of the settings printout, select Print Preview from the File pull-down menu. To print the settings, select the printer icon in the upper left corner of the Print Preview screen.

You can skip the print preview and go directly to print by pulling down the File menu and selecting Print. A Print dialog box opens with the typical Windows choice to setup the properties of printer. Execute this command, as necessary, and then select Print.

Comparing Settings Files

BESTCOMS*Plus* has the ability to compare two settings files. To compare files, pull down the Tools menu and select Compare Settings Files. The BESTCOMS*Plus* Settings Compare Setup dialog box appears (Figure 33-10). Select the location of the first file under Left Settings Source and select the location of the second file under Right Settings Source. If you are comparing a settings file located on your PC hard drive or portable media, click the folder button and navigate to the file. If you want to compare settings from a unit, click the Download settings from unit button to set up the communication port. Click the Compare button to compare the selected settings files.

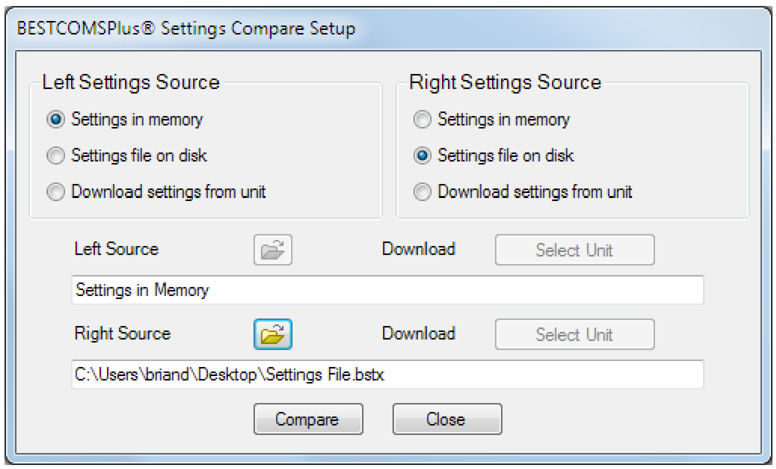


Figure 33-10. BESTCOMS*Plus* Settings Compare Setup

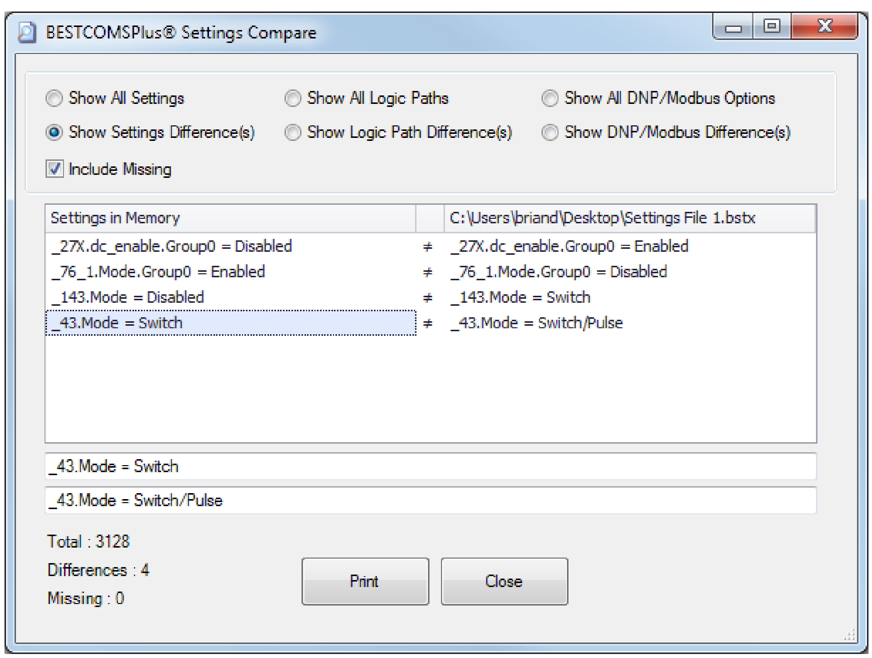


Figure 33-11. BESTCOMS*Plus* Settings Compare

A dialog box will appear and notify you if any differences were found. The BESTCOMS*Plus* Settings Compare dialog box (Figure 33-11) is displayed where you can select to view all settings, settings differences, all logic paths, logic path differences, all DNP/Modbus options, or DNP/Modbus differences. If a settings file based on an older version of firmware was uploaded into the BE1-11*d*, the BE1-11*d* could contain additional settings that did not exist when the original settings file was created. The settings compare function detects these differences and displays them when the Include Missing box is checked. Uncheck this box to ignore differences due to the additional settings. Click Print to print a report or click Close to close the window.

Auto Export Metering

The auto export metering function automatically exports metering data over a user-defined period. The user specifies the Number of Exports and the Interval between each export. Enter a filename for the metering data and a folder in which to save. The first export is performed immediately after clicking the Start button. Click the Filter button to select specific metering screens. Figure 33-12 illustrates the Auto Export Metering screen.

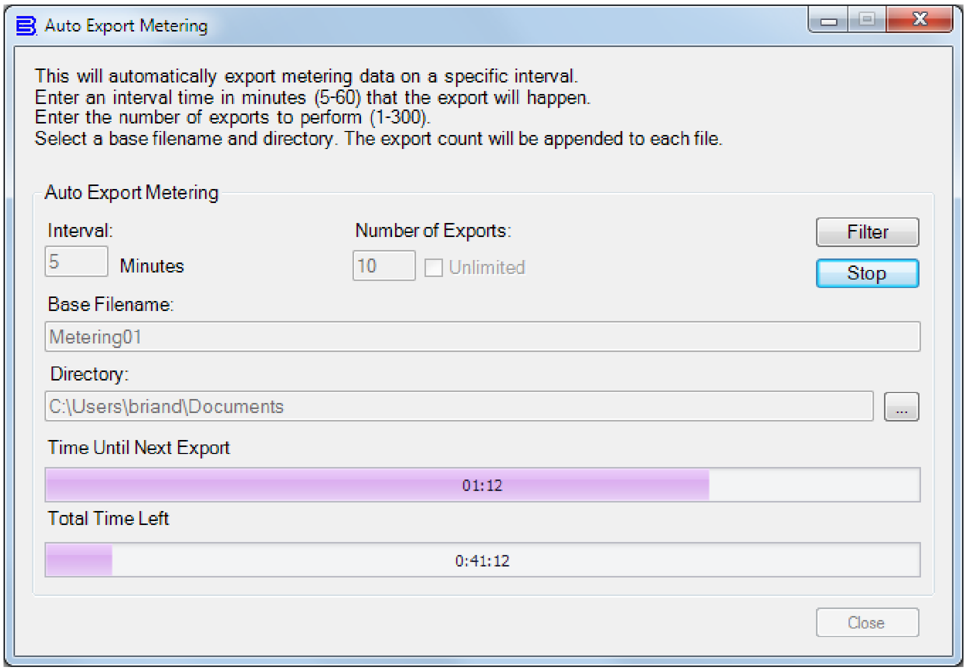


Figure 33-12. Auto Export Metering

BESTCOMS*Plus*® Updates

Ongoing BE1-11*d* functionality enhancements may make future BE1-11*d* firmware updates desirable. Enhancements to BE1-11*d* firmware typically coincide with enhancements to the BE1-11 plugin for BESTCOMS*Plus*. When a BE1-11*d* is updated with the latest version of firmware, the latest version of BESTCOMS*Plus* should also be obtained.

- You can download the latest version of BESTCOMS*Plus* by visiting www.basler.com.
- BESTCOMS*Plus* automatically checks for updates when Check Automatically is selected on the Check for Updates User Settings screen. This screen is accessed under the Help drop-down menu. (An internet connection is required.)
- You can use the manual "check for updates" function in BESTCOMS*Plus* to ensure that the latest version is installed by selecting Check for Updates in the Help drop-down menu. (An internet connection is required.)

Firmware Updates

For information on updating firmware, refer to the *Device Information* chapter.

34 • BESTlogic™*Plus*

BESTlogic*Plus* Programmable Logic is a programming method used for managing the input, output, protection, control, monitoring, and reporting capabilities of Basler Electric's BE1-11*d* DC Power Protection System. Each BE1-11*d* has multiple, self-contained logic blocks that have all of the inputs and outputs of its discrete component counterpart. Each independent logic block interacts with control inputs and hardware outputs based on logic variables defined with BESTlogic*Plus*. BESTlogic*Plus* equations entered and saved in the BE1-11*d* system's nonvolatile memory integrate (electronically wire) the selected or enabled protection and control blocks with control inputs and hardware outputs. A group of logic equations defining the logic of the BE1-11*d* is called a logic scheme.

One default active logic scheme is preloaded into the BE1-11*d*. This scheme provides protection functions common in DC feeder applications and virtually eliminates the need for "start-from-scratch" programming. Other logic schemes are available at www.basler.com. BESTCOMS*Plus*® can be used to open a logic scheme that was previously saved as a file and upload it to the BE1-11*d*. The default logic scheme can also be customized to suit your application.

BESTlogic*Plus* is not used to define the operating settings (modes, pickup thresholds, and time delays) of the individual protection and control functions. Operating settings and logic settings are interdependent but separately programmed functions. Changing logic settings is similar to rewiring a panel and is separate and distinct from making the operating settings that control the pickup thresholds and time delays of a BE1-11*d*. Detailed information about operating settings is provided in each chapter of the various protection and control functions.

Caution
This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

Overview of BESTlogic™Plus

BESTlogic*Plus* settings are made through BESTCOMS*Plus*. Use the Settings Explorer to open the BESTlogic*Plus* Programmable Logic tree branch as shown in Figure 34-1.

The BESTlogic*Plus* Programmable Logic screen contains a logic library for opening and saving logic files, tools for creating and editing logic documents, and protection settings.

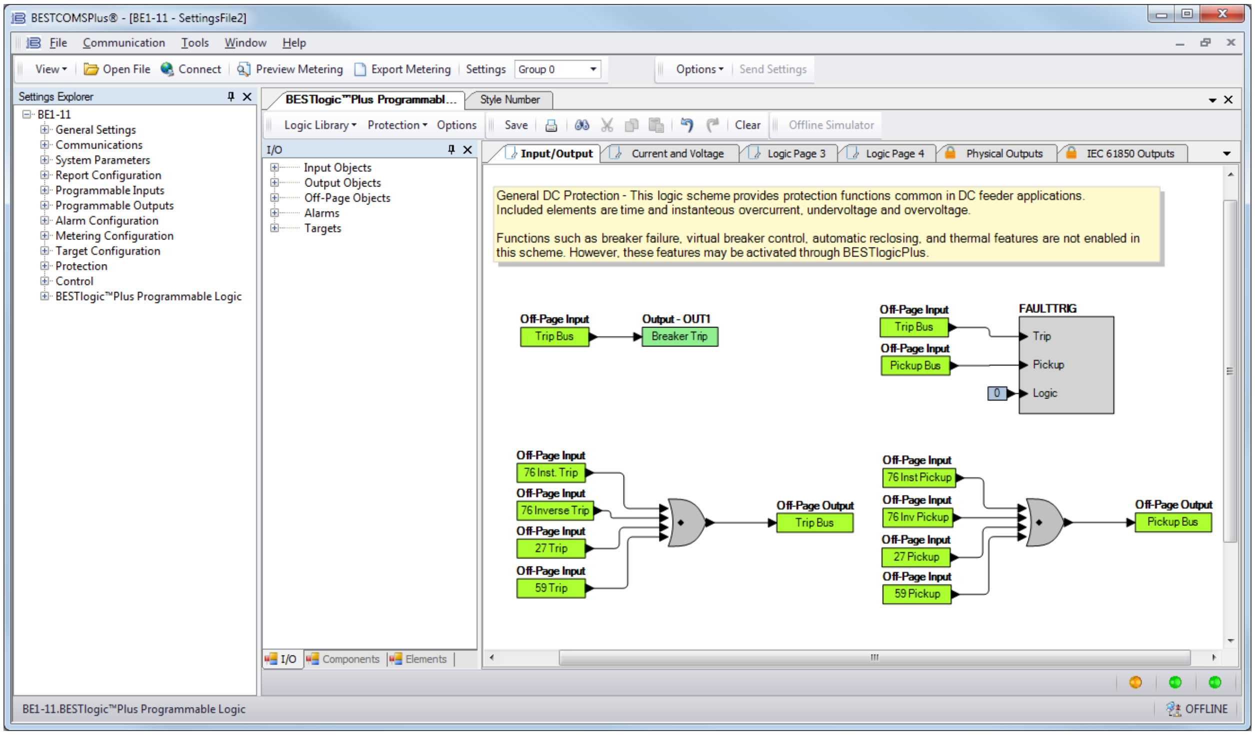


Figure 34-1. BESTlogic*Plus* Programmable Logic Tree Branch

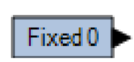
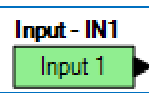
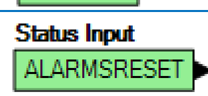
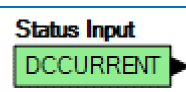
BESTlogic™*Plus* Composition

There are three main groups of objects used for programming BESTlogic*Plus*. These groups are I/O, Components, and Elements. For details on how these objects are used to program BESTlogic*Plus*, see the paragraphs on *Programming BESTlogicPlus.*

I/O

This group contains Input Objects, Output Objects, Off-Page Objects, Alarms, and Targets. Input objects can be logically connected to any logic block input. Output objects can be logically connected to any logic block output. Table 34-1 lists the names and descriptions of the objects in the I/O group.

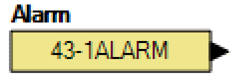
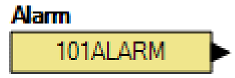
Table 34-1. I/O Group, Names and Descriptions

Name	Description	Symbol
Input Objects		
Logic 0	Always false (Low). Double-click or right-click on the object to change the fixed state from 0 to 1.	
Logic 1	Always true (High). Double-click or right-click on the object to change the fixed state from 1 to 0.	
Physical Inputs IN1–IN10	True when Physical Input x is active.	
Status Inputs Alarms Reset	The Alarm Reset status input goes momentarily high when the Major, Minor, and Logic alarms are cleared.	
Status Inputs DC Current Detected	The DC Current Detected status input goes high when the DC current is greater than 5% of the current shunt setting as determined by the fast current detector.	

Name	Description	Symbol
Status Inputs Targets Reset	The Target Reset status input goes momentarily high when the targets are cleared.	Status Input TARGETSRESET
Output Objects		
Physical Outputs OUT1–OUT8 and OUTA	Physical Outputs 1 through 8 and A.	Output - OUT1 Output 1
Off-Page Objects		
Off-Page Output	Used in conjunction with the Off-Page Input to transform an output on one logic page into an input on another logic page. Outputs can be renamed by right-clicking and selecting Rename Output. Right-clicking will also show pages that the corresponding inputs can be found on. Selecting the page will take you to that page.	Off-Page Output Test
Off-Page Input	Used in conjunction with the Off-Page Output to transform an output on one logic page into an input on another logic page. Inputs can be renamed by right-clicking and selecting Rename Input. Right-clicking will also show pages that the corresponding outputs can be found on. Selecting the page will take you to that page.	Off-Page Input Test
Alarms		
Logic Alarm	True when the Logic Alarm is true. Refer to the *Alarms* chapter for more information.	Alarm LOGICALARM
Major Alarm	True when the Major Alarm is true. Refer to the *Alarms* chapter for more information.	Alarm MAJORALARM
Minor Alarm	True when the Minor Alarm is true. Refer to the *Alarms* chapter for more information.	Alarm MINORALARM
Relay Trouble Alarm	True when a Relay Trouble alarm is active. Refer to the *Alarms* chapter for more information.	Alarm RELAYTROUBLE
Targets	True when targets are active. Refer to the *Fault Reporting* chapter for more information.	Alarm TARGETSALARM
Individual Alarms 49 Alarm	True when the thermal capacity rises above the trip value as indicated by the Alarm Level setting. This provides an indication that thermal capacity is being accumulated prior to the protection element tripping.	Alarm 49Alarm
Individual Alarms 72 Trip Coil Monitor	True when the monitored trip circuit is open.	Alarm 72TCMALARM
Individual Alarms 82 Recloser Fail	True when the reclose fail timer timed out before the breaker closed.	Alarm 82FALARM
Individual Alarms 82 Recloser Lockout	True when the recloser went through a sequence without success.	Alarm 82LOALARM

Name	Description	Symbol
Individual Alarms Analog	True when there is an analog-to-digital converter error.	Alarm ANALOGALARM
Individual Alarms Breaker Monitor 1–3	True when breaker alarm threshold has been exceeded.	Alarm BRKMON1ALARM
Individual Alarms Changes Lost	True when password access has been lost before saving settings. Device returns to “Read Only”.	Alarm CHANGESLOSTALM
Individual Alarms Date Time Set	True when the date/time was set by the user.	Alarm DATETIMESETALM
Individual Alarms *Demands* I1 Negative Demand	True when the I1 Negative Demand Threshold has been exceeded.	Alarm I1DCNEGDMDALM
Individual Alarms *Demands* I1 Positive Demand	True when the I1 Positive Demand Threshold has been exceeded.	Alarm I1DCPOSDMDALM
Individual Alarms *Demands* P1 Negative Demand	True when the P1 Negative Demand Threshold has been exceeded.	Alarm P1DCNEGDMDALM
Individual Alarms *Demands* P1 Positive Demand	True when the P1 Positive Demand Threshold has been exceeded.	Alarm P1DCPOSDMDALM
Individual Alarms DNP Polls Error	True when there is a DNP polling failure.	Alarm DNPPOLLSERRORALM
Individual Alarms Ethernet Excess Traffic	True when the local network is overloaded.	Alarm ETHEXCESSTRAFFICALM
Individual Alarms Ethernet Link Lost	True when Ethernet communication is lost.	Alarm ETHLINKLOSTALM
Individual Alarms Fault Report Timeout	True when the fault event trigger lasts 60 seconds.	Alarm FAULTRPTTIMEOUTALM
Individual Alarms *Fiber Input Alarms* No IT-D Connection Input I1	True when fiber input I1 of the BE1-11*d* is not connected to the IT-D.	Alarm I1NOITDALARM
Individual Alarms *Fiber Input Alarms* No IT-D Connection Input V1–V3	True when fiber input Vx of the BE1-11*d* is not connected to the IT-D.	Alarm V1NOITDALARM
Individual Alarms Firmware Change	True when firmware has been changed.	Alarm FIRMWARECHANGEALM
Individual Alarms IRIG Sync Lost	True when IRIG failed to synchronize.	Alarm IRIGSYNCLOSTALM
Individual Alarms Logic Equal None	True when there is no logic programmed in the BE1-11*d*.	Alarm LOGICEQUALNONEALM
Individual Alarms Microprocessor Reset Alarm	True when the microprocessor watchdog circuit timed out.	Alarm UPRESETALARM

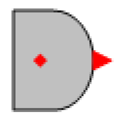
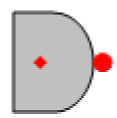
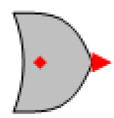
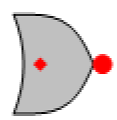
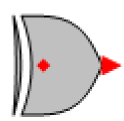
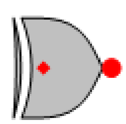
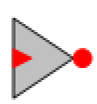
Name	Description	Symbol
Individual Alarms No User Setting	True when user settings do not exist.	Alarm NOUSERSETTINGALARM
Individual Alarms NTP Sync Lost	True when Network Time Protocol sync is lost.	Alarm NTPSYNCLOSTALM
Individual Alarms Output Override	True when one or more output contacts have a logic output override condition.	Alarm OUTPUTOVERRIDEALM
Individual Alarms *Output Override Enabled Alarms* Output 1–8 and Output A Override Enabled	True when override is enabled on Output x.	Alarm OUT1OVERRIDEALM
Individual Alarms Power Loss	True when operating power is lost.	Alarm POWERLOSSALARM
Individual Alarms Real Time Clock	True when the Real-Time Clock is not set.	Alarm RTCALARM
Individual Alarms *Remote Module 1–2* Default Cal Loaded	True when there is an error reading the RTD module nonvolatile calibration settings which forces default calibration settings to be loaded. This alarm is set by the remote RTD module.	Alarm RM1DEFAULTCALLOADEDALM
Individual Alarms *Remote Module 1–2* Defaults Loaded	True when there is an error reading the RTD module nonvolatile settings which forces default settings to be loaded. This alarm is set by the remote RTD module.	Alarm RM1DEFAULTSLOADEDALM
Individual Alarms *Remote Module 1–2* Flash Failure	True when there is an error reading the RTD module nonvolatile settings (FLASH READ FAIL) or error writing the RTD module nonvolatile settings (FLASH WRITE FAIL). This alarm is set by the remote RTD module.	Alarm RM1FLASHFAILUREALM
Individual Alarms *Remote Module 1–2* RTD Comm Recv Fail	True when the BE1-11*d* cannot communicate with the RTD module. This alarm is set by the BE1-11*d*.	Alarm RM1RTDCOMMRECEICVEFAILALM
Individual Alarms *Remote Module 1–2* RTD Comm Send Fail	True when the RTD module cannot communicate with the BE1-11*d*. This alarm is set by the remote RTD module.	Alarm RM1RTDCOMMSENDFAILALM
Individual Alarms *Remote Module 1–2* RTD Out of Range	True when the RTD is out of range. See the *RTD Module* chapter for acceptable range.	Alarm RM1RTDOUTOFRANGEALM
Individual Alarms Setting Change	True when a setting change is made by the user.	Alarm SETTINGCHANGEALM
Individual Alarms Settings Group 0–3	True when Setting Group x is active.	Alarm SG0ALARM
Individual Alarms SGC Active	True when the active setting group changed.	Alarm SGCACTIVEALM
Individual Alarms SGC Logic Override	True when setting group control was overridden by logic.	Alarm SGCLOGICOVERRIDEALM

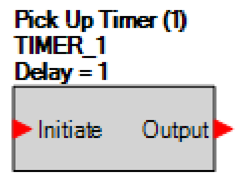
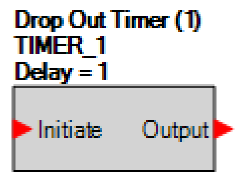
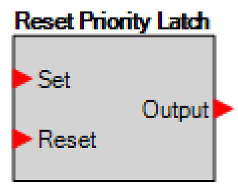
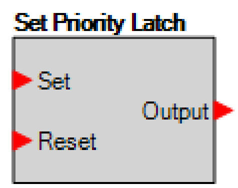
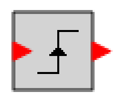
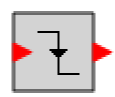
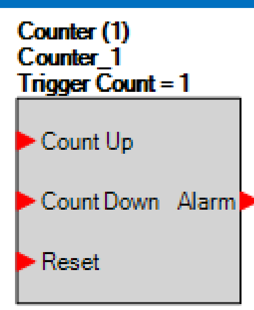
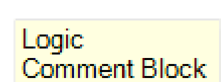
Name	Description	Symbol
Individual Alarms Virtual Switch Blocking Tags 43-1 – 43-5 Blocking Tag Status	True when a 43-x Block Tag is set. Refer to the *Virtual Control Switches (43)* chapter for more information.	
Individual Alarms Virtual Switch Blocking Tags 101 Blocking Tag Status	True when a 101 Block Tag is set. Refer to the *Breaker Control Switch (101)* chapter for more information.	

Components

This group contains Logic Gates, Pickup and Dropout Timers, Latches, Logic Counters, and Comment Blocks. Double-click or right-click on a gate to change the type. Table 34-2 lists the names and descriptions of the objects in the Components group.

Table 34-2. Components Group, Names and Descriptions

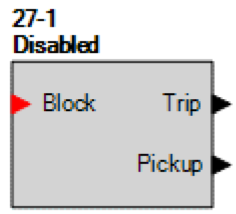
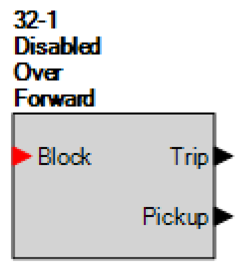
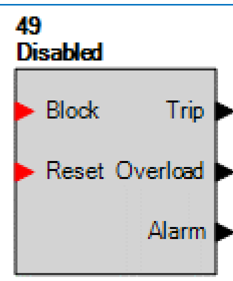
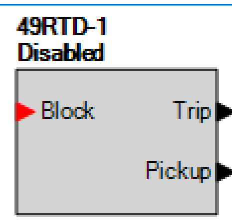
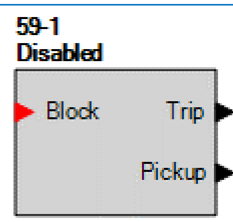
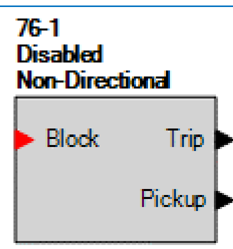
Name	Description	Symbol
	Logic Gates	
AND	Input Output 0 0 0 0 1 0 1 0 0 1 1 1	
NAND	Input Output 0 0 1 0 1 1 1 0 1 1 1 0	
OR	Input Output 0 0 0 0 1 1 1 0 1 1 1 1	
NOR	Input Output 0 0 1 0 1 0 1 0 0 1 1 0	
XOR	Input Output 0 0 0 0 1 1 1 0 1 1 1 0	
XNOR	Input Output 0 0 1 0 1 0 1 0 0 1 1 1	
NOT (INVERTER)	Input Output 0 1 1 0	

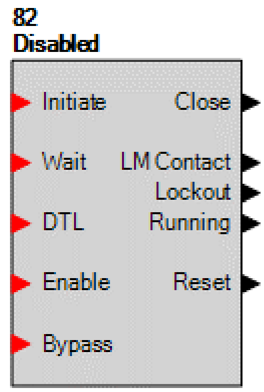
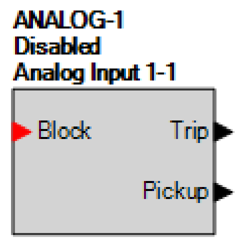
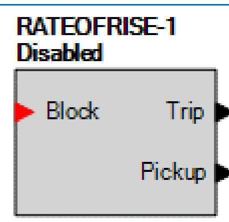
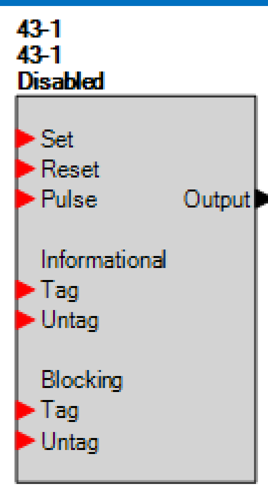
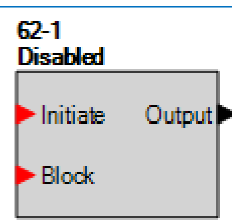
Name	Description	Symbol
Pickup and Dropout Timers		
Pick Up Timer	A pickup timer produces a true output when the elapsed time is greater than or equal to the Pickup Time setting after a false to true transition occurs on the Initiate input from the connected logic. Whenever the Initiate input status transitions to false, the output transitions to false immediately. Refer to *Programming BESTlogicPlus, Pickup and Dropout Timers*. Double-click or right-click on the logic timer to select from timers 1 through 16.	
Drop Out Timer	A drop out timer produces a true output when the elapsed time is greater than or equal to the Dropout Time setting after a true to false transition occurs on the Initiate input from the connected logic. Whenever the Initiate input transitions to true, the output transitions to false immediately. Refer to *Programming BESTlogicPlus, Pickup and Dropout Timers*. Double-click or right-click on the logic timer to select from timers 1 through 16.	
Latches		
Reset Priority Latch	The latch is set when the Set input is true and the Reset input is false. The latch is cleared when the Reset input is true.	
Set Priority Latch	The latch is set when the Set input is true. The latch is cleared when the Set input is false and the Reset input is true.	
Triggers		
Rising Edge	The output of a rising edge trigger pulses true when the input goes from logic 0 to logic 1. Double-click or right-click on the logic trigger to change the type.	
Falling Edge	The output of a falling edge trigger pulses true when the input goes from logic 1 to logic 0. Double-click or right-click on the logic trigger to change the type.	
Logic Counters		
Logic Counters	A logic counter produces a true Alarm output when the elapsed count is greater than or equal to the Trigger Count setting after a false to true transition occurs on the Count Up input from the connected logic. A positive going edge on the Reset input will reset the counter. The count will be reduced by 1 each time a false to true transition occurs on the Count Down input. Double-click or right-click on the logic counter to select from counters 1 through 8.	
Other		
Logic Comment Block	The logic comment block is used to place notes on the logic.	

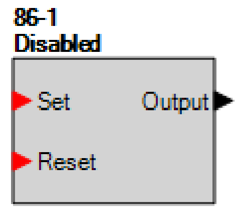
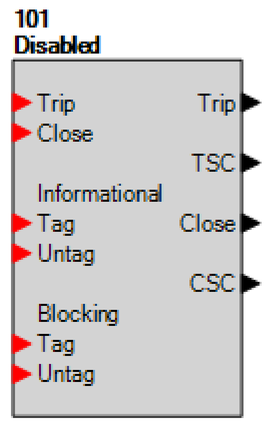
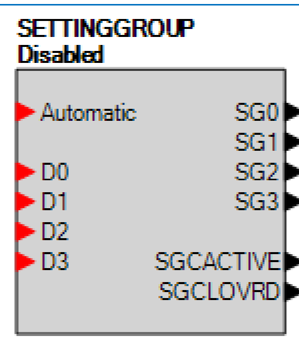
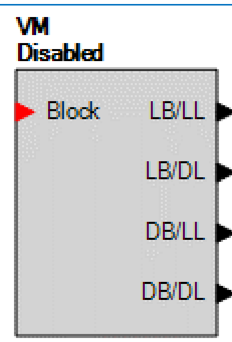
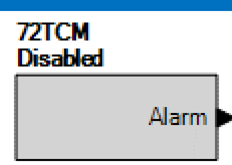
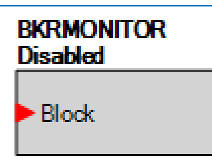
Elements

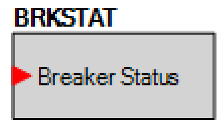
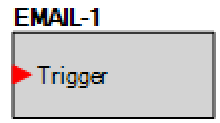
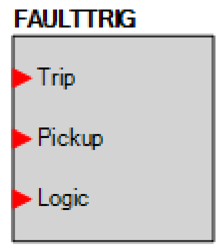
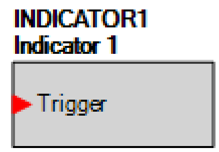
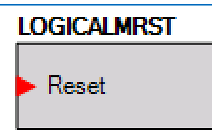
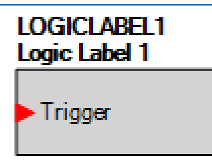
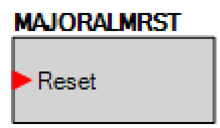
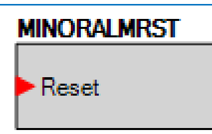
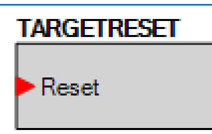
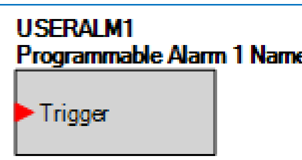
This group contains protection, control, reporting, and alarms elements. Table 34-3 lists the names and descriptions of the elements in the Elements group.

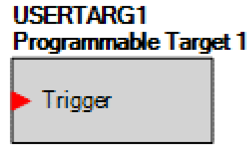
Table 34-3. Elements Group, Names and Descriptions

Name	Description	Symbol
Protection		
27-x	Undervoltage Protection. Refer to the *Undervoltage (27) Protection* chapter.	
32-x	Power Protection. Refer to the *Power (32) Protection* chapter.	
49	Thermal Overload Protection. Refer to the *Thermal Overload (49) Protection* chapter.	
49RTD-x	Resistance Temperature Detector Protection. For use when an optional RTD module is connected. Refer to the *Resistance Temperature Detector (49RTD) Protection* chapter.	
59-x	Overvoltage Protection. Refer to the *Overvoltage (59) Protection* chapter.	
76-x	Overcurrent Protection. Refer to the *Overcurrent (76) Protection* chapter.	

Name	Description	Symbol
82	Recloser Protection. Refer to the *Recloser (82) Protection* chapter.	
ANALOG-x	Analog Input. Refer to the *RTD Module* chapter.	
RATEOFRISE-x	Rate of Rise Protection. Refer to the *Rate of Rise (ROR) Protection* chapter.	
Control		
43-x	Virtual Control Switch. Refer to the *Virtual Control Switches (43)* chapter.	
62-x	Logic Timer. Refer to the *Logic Timers (62)* chapter.	

Name	Description	Symbol
86-x	Lockout Function. Refer to the *Lockout Functions (86)* chapter.	
101	Breaker Control Switch. Refer to the *Breaker Control Switch (101)* chapter.	
SETTINGGROUP	Setting Group Control. Refer to the *Setting Groups* chapter.	
VM	Voltage Monitor. Refer to the *Recloser (82) Protection* chapter.	
Reporting and Alarms		
72TCM	Trip Circuit Monitor. Refer to the *Trip Circuit Monitor (72TCM)* chapter.	
BKRMONITOR	Breaker Monitor. Refer to the *Breaker Monitoring* chapter.	

Name	Description	Symbol
BRKSTAT	Breaker Status. Refer to the *Breaker Monitoring* chapter.	
EMAIL-x	Email Trigger. Refer to the *Communication* chapter.	
FAULTTRIG	Fault Trigger. Refer to the *Fault Reporting* chapter.	
INDICATORx	Indicator. Refer to the *Controls and Indicators* chapter. The indicator is displayed in the sequence of events and the corresponding indicator on the front panel is lit when the Trigger input is true. To name indicators, use the Settings Explorer in BESTCOMS*Plus* to expand the BESTlogic*Plus* Programmable Logic tree branch and select Front Panel Indicator Labels.	
LOGICALMRST	Logic Alarm Reset. The Reset input is positive-edge triggered. Refer to the *Alarms* chapter.	
LOGICLABELx	Logic Label. The logic label is displayed in the sequence of events when the Trigger input is true. To name logic labels, use the Settings Explorer in BESTCOMS*Plus* to expand the BESTlogic*Plus* Programmable Logic tree branch and select Logic Labels.	
MAJORALMRST	Major Alarm Reset. The Reset input is positive-edge triggered. Refer to the *Alarms* chapter.	
MINORALMRST	Minor Alarm Reset. The Reset input is positive-edge triggered. Refer to the *Alarms* chapter.	
TARGETRESET	Target Reset. The Reset input is positive-edge triggered. Refer to the *Fault Reporting* chapter.	
USERALARMx	User Programmable Alarm. Refer to the *Alarms* chapter.	

Name	Description	Symbol
USERTARGx	User Programmable Target. Refer to the *Targets* chapter.	

Logic Schemes

A logic scheme is a group of logic variables that defines the operation of a BE1-11*d*. One logic scheme is configured for basic DC feeder applications and is the default active logic scheme. Only one logic scheme can be active at a given time. In most applications, preprogrammed logic schemes eliminate the need for custom programming. Preprogrammed logic schemes can provide more inputs, outputs, or features than are needed for a particular application. This is because a preprogrammed scheme is designed for a large number of applications with no special programming required. Unneeded logic block outputs can be left open to disable a function or a function block can be disabled through operating settings.

When a custom logic scheme is required, programming time is reduced by modifying the default logic scheme. Other logic schemes are available at www.basler.com.

Default Logic Scheme

All BE1-11*d* protection systems are delivered with the default logic scheme pre-loaded in memory. If the function block configuration and output logic of the default logic scheme meets the requirements of your application, then only the operating settings (system parameters and threshold settings) need to be adjusted before placing the BE1-11*d* in service.

Details of Default Logic Scheme describes the characteristics of the logic scheme and how it combines to create a basic DC protection system. A detailed description of the default scheme is also provided.

The default logic scheme is designed to accommodate most common DC feeder schemes. The protection engineer can adapt it by changing the function block operation and settings. This eliminates the need to create a custom logic scheme.

It should be noted that the default logic scheme also illustrates typical ways of using or controlling various functions. The user can choose to create a custom logic scheme by mixing the logic from the default scheme. The flexibility of BESTlogic*Plus* allows the protection engineer to create a custom scheme that exactly meets the requirements of the application.

Caution
Always remove the BE1-11*d* from service prior to changing or modifying the active logic scheme. Attempting to modify a logic scheme while the BE1-11*d* is in service could generate unexpected or unwanted outputs. Modifying a logic scheme in BESTCOMS*Plus* does not automatically make that scheme active in the BE1-11*d*. The modified scheme must be uploaded into the BE1-11*d*. See the paragraphs on *Sending and Retrieving Logic Schemes.* Operational settings are not included in the default logic scheme. Each element, target, pickup setting, timing setting, etc. will have to be enabled and programmed separately using the Settings Explorer in BESTCOMS*Plus*.

Overview of Default Logic Scheme

The default logic scheme provides basic DC protection. Included protective elements are 76-1, 76-2, 27-1, and 59-1. Functions such as breaker failure, virtual breaker control, automatic reclosing, and thermal features are not enabled in this scheme. However, these features can be activated through BESTCOMS*Plus*.

Details of Default Logic Scheme

The following paragraphs describe the default logic scheme in detail. Operation of the protection and control logic under normal conditions is described. The features of the logic scheme are broken down into functional groups and described in detail.

The default logic scheme is intended for applications requiring basic DC protection. This logic scheme provides an excellent base on which to create a custom scheme for a specific application.

The components of the default logic are summarized in Table 34-4 and Table 34-5. Figure 34-2 shows a one-line drawing for the default logic scheme. A diagram of the default logic is shown in Figure 34-3.

Operation - Protection

The DC overcurrent elements (76-1 and 76-2) are activated to provide timed and instantaneous overcurrent protection in this scheme. The undervoltage (27-1) and overvoltage (59-1) elements are activated to provide basic timed undervoltage and overvoltage protection. A function block is disabled by setting the pickup setpoint at zero in each of the four setting groups. OUT1 will operate and trip the breaker. All contact-sensing inputs are unassigned.

Operation - Setting Group Selection

A setting group can be selected automatically or by using the communication ports or the front-panel interface. Automatic setting group changes are based on current level and duration. Automatic setting group changes for cold load pickup and/or dynamic setting adjustments are enabled by using BESTCOMS*Plus*. Setting group changes are not accommodated in this scheme.

Operation - Alarms

If the continuous self-test diagnostics of the BE1-11*d* detect an error, failsafe output contact OUTA will close and the Relay Trouble LED on the front panel will light. OUTA will also close if BE1-11*d* operating power is lost. More information about alarms is provided in the *Alarms* chapter.

Table 34-4. Default Function Block Logic

Function	Purpose	BESTlogic*Plus* Inputs
76-1	Used for instantaneous DC overcurrent protection	0
76-2	Used for inverse DC overcurrent protection	0
27-1	Used for undervoltage protection	0
59-1	Used for overvoltage protection	0
FAULT TRIGGER	Trip	Trip Bus
	Picked Up	Pickup Bus
	Logic	0

Table 34-5. Default Output Logic

Output	Purpose	Description	Label	State Labels	
				Energized	De-Energized
OUTA	Alarm Output Contact	Alarm contact closes/opens (refer to style number) automatically when relay trouble alarm occurs.	Output Alarm	On	Off
OUT1	Breaker Trip Output	Contact closes when protective trip expression is true.	Breaker Trip	On	Off

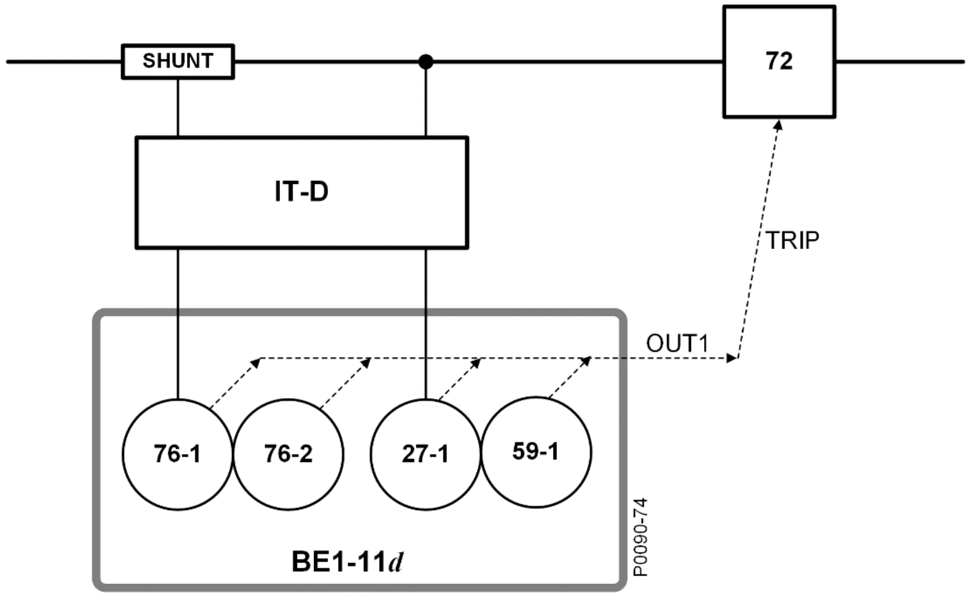


Figure 34-2. One-Line Drawing for Default Logic

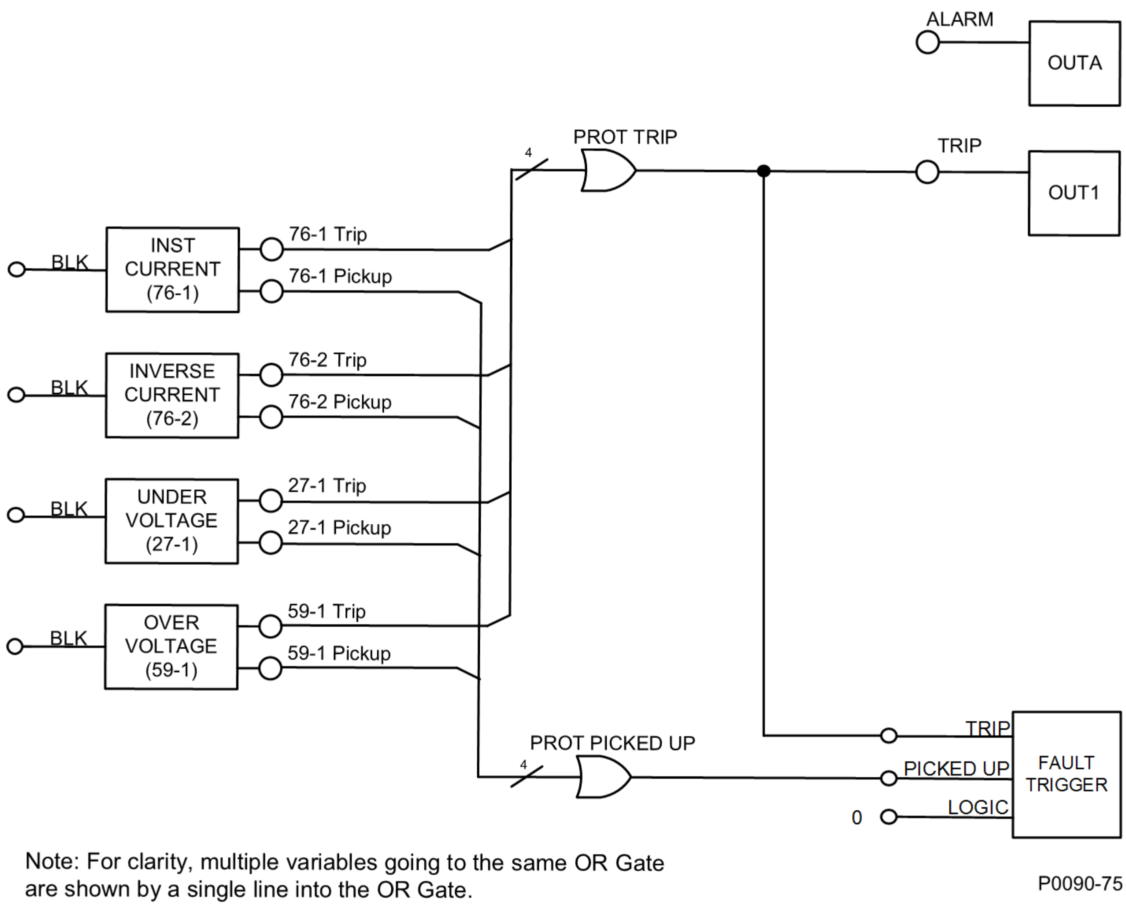


Figure 34-3. Logic Diagram for Default Logic

Copying and Renaming Preprogrammed Logic Schemes

Copying a saved logic scheme to the active logic is accomplished by loading the saved logic scheme into BESTCOMS*Plus* and then uploading to the device.

Retrieving a Logic Scheme from the BE1-11*d*

To retrieve settings from the BE1-11*d*, the BE1-11*d* must be connected to a computer through a communications port. Once the necessary connections are made, settings can be downloaded from the BE1-11*d* by selecting Download Settings and Logic from Device on the Communication pull-down menu.

Sending a Logic Scheme to the BE1-11*d*

To send settings to the BE1-11*d*, the BE1-11*d* must be connected to a computer through a communications port. Once the necessary connections are made, settings can be uploaded to the BE1-11*d* by selecting Upload Settings and Logic to Device or Upload Logic to Device on the Communication pull-down menu.

Programming BESTlogicPlus

BESTCOMS*Plus* is used to program BESTlogic*Plus*. Using BESTCOMS*Plus* is analogous to physically attaching wire between discrete BE1-11*d* terminals. To program BESTlogic*Plus*, use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic tree branch as shown in Figure 34-1.

The drag-and-drop method is used to connect a variable or series of variables to the logic inputs, outputs, components, and elements. To draw a wire/link from port to port (triangles), use the primary mouse button to click on a port, pull the wire onto another port, and release the left mouse button. A red port indicates that a connection to the port is required or missing. A black port indicates that a connection to the port is not required. Drawing wires/links from input to input or output to output is not allowed. Only one wire/link can be connected to any one output. If the proximity of the endpoint of the wire/link is not exact, it may attach to an unintended port.

If an element is disabled by the style number, it will have a red X on it. To enable the element, configure the style number to include the element. Refer to the *Device Information* chapter for more details.

The view of Logic Page 1 through 4 and Physical Outputs can be automatically arranged by clicking the right mouse button on the window and selecting Auto-Layout.

Logic tabs can be renamed by clicking the right mouse button in the logic drawing area and selecting Rename Logic Tabs.

The following must be met before BESTCOMS*Plus* will allow logic to be uploaded to the BE1-11*d*:

- A minimum of two inputs and a maximum of 32 inputs on any multi-port (AND, OR, NAND, NOR, XOR, and XNOR) gate.
- A maximum of 32 logic elements in series.
- A maximum of 256 logic elements per diagram.

Three status indicators are located in the lower right corner of the BESTlogic*Plus* window. These indicators show the Logic Save Status, Logic Diagram Status, and Logic Layer Status. Table 34-6 defines the colors for each indicator.

Table 34-6. Status Indicators

Indicator	Color	Definition
Logic Save Status (Left Indicator)	Amber	Logic has changed since last save
	Green	Logic has NOT changed since last save
Logic Diagram Status (Center Indicator)	Red	Requirements NOT met as listed above
	Green	Requirements met as listed above
Logic Layer Status (Right Indicator)	Red	Requirements NOT met as listed above
	Green	Requirements met as listed above

Pickup and Dropout Timers

Pickup and dropout timer logic blocks are shown in Figure 34-4.

To program logic timer settings, use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic, Logic Timers tree branch. Enter a Name label that you want to appear on the timer logic block. The Time Delay value range is 0.0 to 1800.0 seconds in 0.1-second increments.

Next, open the Components tab inside the BESTlogic*Plus* window and drag a timer onto the program grid. Right click on the timer to select the timer you want to use that was previously set on the Logic Timers tree branch. The Logic Timer Properties Dialog Box will appear. Select the timer you want to use.

Timing accuracy is ±15 milliseconds.

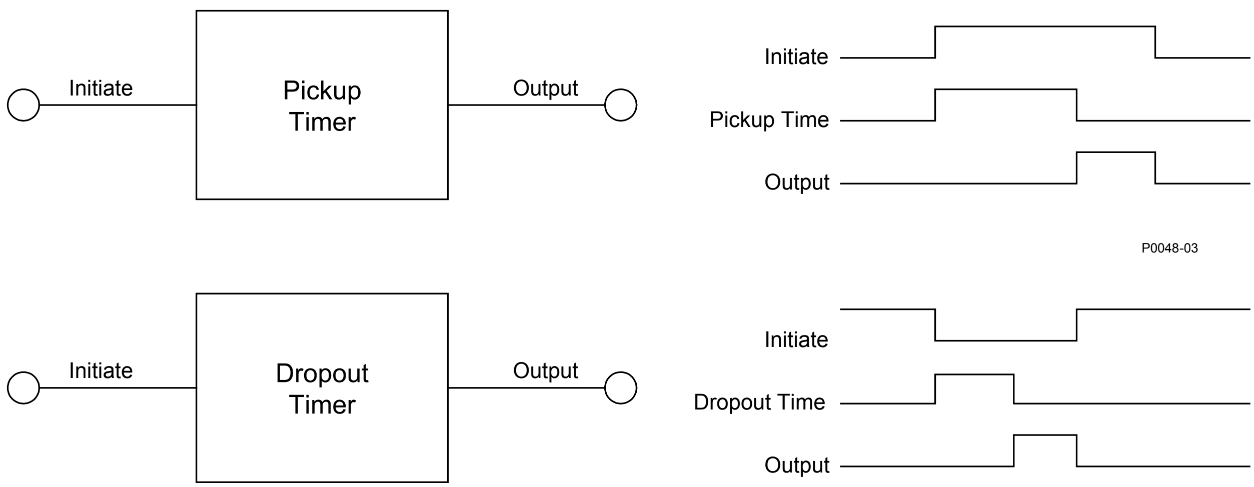


Figure 34-4. Pickup and Dropout Timer Logic Blocks

Offline Logic Simulator

You can use the offline logic simulator to test your custom logic before placing it in operation. The state of various logic elements can be toggled to verify that the logic states travel through the system as expected.

Before running the logic simulator, you must click the Save button on the BESTlogic*Plus* toolbar to save the logic to memory. Changes to the logic (other than changing the state) are disabled when the simulator is enabled. Colors are selected by clicking the Options button on the BESTlogic*Plus* toolbar. By default, Logic 0 is red and Logic 1 is green. Using your mouse, double-click on a logic element output to change its state.

An example of the offline logic simulator is shown in Figure 34-5. Output 1 is Logic 1 (green) when Output 2 is Logic 0 (red).

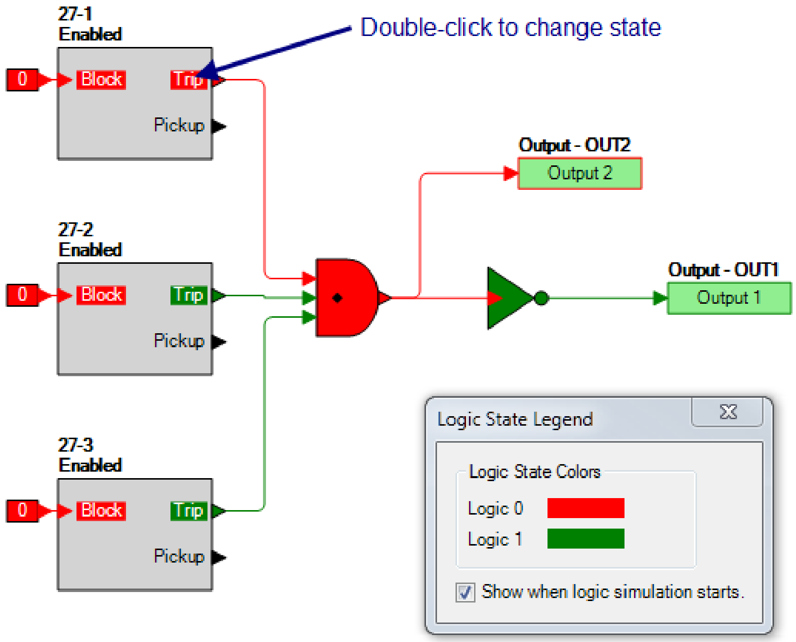


Figure 34-5. Offline Logic Simulator Example

BESTlogic™Plus File Management

To manage BESTlogic*Plus* files, use the Settings Explorer to open the BESTlogic*Plus* Programmable Logic tree branch. The BESTlogic*Plus* Programmable Logic toolbar is used to manage BESTlogic*Plus* files. Refer to Figure 34-6. For information on Settings Files management, refer the *BESTCOMSPlus Software* chapter.

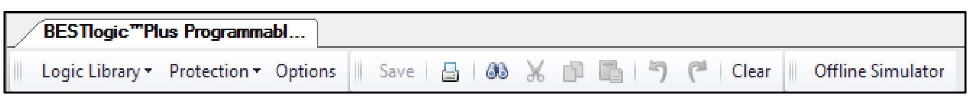


Figure 34-6. BESTlogic*Plus* Programmable Logic Toolbar

Saving a BESTlogic™*Plus* File

After programming BESTlogic*Plus* settings, click on the Save button to save the settings to memory.

Before the new BESTlogic*Plus* settings can be uploaded to the BE1-11*d*, you must select Save from the File pull-down menu located at the top of the BESTCOMS*Plus* main shell. This step will save both the BESTlogic*Plus* settings and the operating settings to a file.

The user also has the option to save the BESTlogic*Plus* settings to a unique file that contains only BESTlogic*Plus* settings. Click on the Logic Library drop-down button and select Save Logic Library File*.* Use normal Windows® techniques to browse to the folder where you want to save the file and enter a filename to save as.

Opening a BESTlogic™*Plus* File

To open a saved BESTlogic*Plus* file, click on the Logic Library drop-down button on the BESTlogic*Plus* Programmable Logic toolbar and select Open Logic Library File*.* Use normal Windows techniques to browse to the folder where the file is located.

Protecting a BESTlogic™*Plus* File

Objects in a logic diagram can be locked so that when the logic document is protected these objects cannot be changed. Locking and protecting is useful when sending logic files to be modified by other personnel. The locked object(s) cannot be changed. To view the lock status of the object(s), select Show Lock Status from the Protection drop-down menu. To lock object(s), use the mouse to select object(s) to be locked. Right click on the selected object(s) and select Lock Object(s). The gold colored padlock next to the object(s) will change from an open to a locked state. To protect a logic document, select Protect Logic Document from the Protection drop-down button. A password is optional.

Uploading a BESTlogic™*Plus* File

To upload a BESTlogic*Plus* file to the BE1-11*d*, you must first open the file through BESTCOMS*Plus* or create the file using BESTCOMS*Plus*. Then pull down the Communication menu and select Upload Logic to Device.

Downloading a BESTlogic™*Plus* File

To download a BESTlogic*Plus* file from the BE1-11*d*, you must pull down the Communication menu and select Download Settings and Logic from Device. If the logic in your BESTCOMS*Plus* has changed, a dialog box will open asking you if want to save the current logic changes. You can choose Yes or No. After you have taken the required action to save or not save the current logic, the downloading is executed.

Printing a BESTlogic™*Plus* File

To view a preview of the printout, click on the Print Preview icon located on the BESTlogic*Plus* Programmable Logic toolbar. If you wish to print, select the printer icon in the upper left corner of the Print Preview screen.

You can skip the print preview and go directly to print by clicking on the Printer icon on the BESTlogic*Plus* Programmable Logic toolbar. A dialog box, Select Views to Print opens allowing you to check which views you would like to print. Next, the Print dialog box opens with the typical Windows choice to setup the properties of printer. Execute this command, as necessary, and then select Print.

A Page Setup icon is also provided on the BESTlogic*Plus* Programmable Logic toolbar allowing you to select Paper Size, Paper Source, Orientation, and Margins.

Clearing the On-Screen Logic Diagram

Click the Clear button to clear the on-screen logic diagram on all logic pages and start over.

BESTlogic™Plus Examples

Example 1 - OR Gate Connections

Figure 34-7 illustrates a typical OR gate connection. In this example, OUT5 will become active when either the Major Alarm OR the Minor Alarm OR both is true.

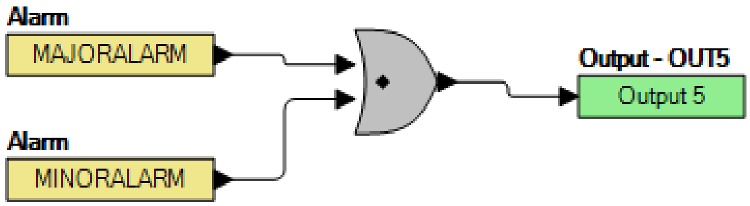


Figure 34-7. Example 1 - OR Gate Connections

Example 2 - Overvoltage Logic Diagram

Figure 34-8 illustrates a typical logic diagram of two overvoltage elements set up to trip outputs and trigger fault reports. The 59-1 function is blocked when IN1 is true. The 59-2 function is blocked when IN2 is true. OUT1 is true when either the 59-1 or 59-2 is in a trip condition. OUT2 is true when either the 59-1 or 59-2 is in a pickup condition. The fault trigger logic block ensures that faults are recorded.

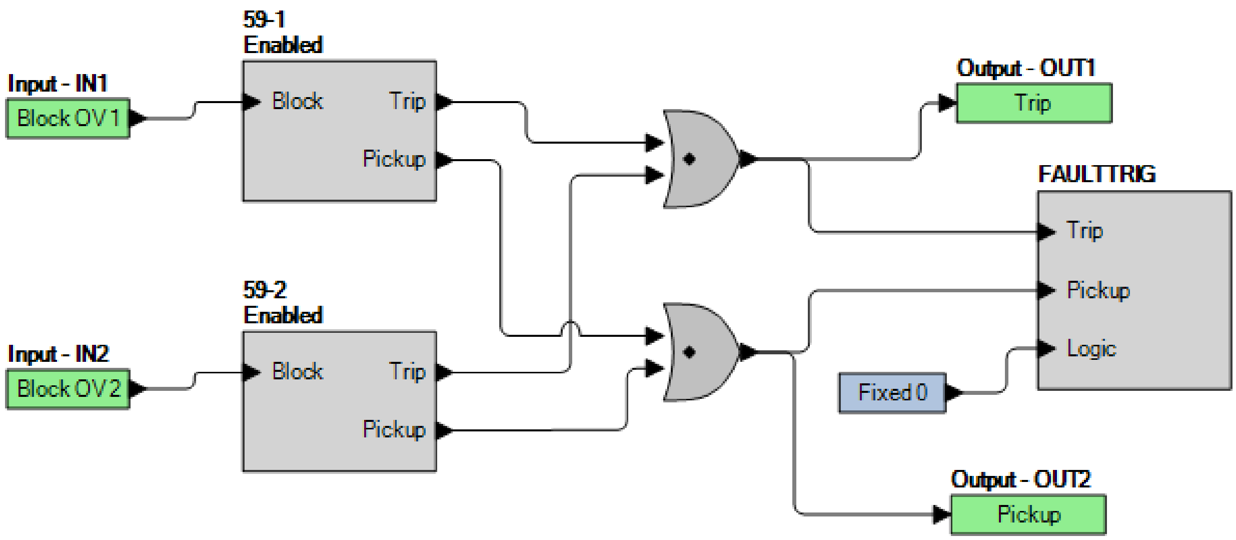


Figure 34-8. Example 2 - Overvoltage Logic Diagram

35 • Communication

This chapter describes the connections and settings for BE1-11*d* communication. In addition to standard USB, RS-485, and optional Ethernet communication, the BE1-11*d* is capable of sending email messages to a selected recipient with details about a user-selected condition. The configuration of email notifications is described later in this chapter.

Available ports for communicating with the BE1-11*d* include USB, RS-485, and Ethernet. DHCP (Dynamic Host Configuration Protocol) is enabled by default allowing the BE1-11*d* to send a broadcast request for configuration information. The DHCP server receives the request and responds with configuration information. Settings for Ethernet must be made through the front-panel USB port if not using DHCP.

Connections

The following paragraphs describe the communication connections for the BE1-11*d*. Refer to the *Terminals and Connectors* chapter for views of the communication ports.

USB Connection

A front-panel B-type USB connector provides local communication with a PC operating BESTCOMS*Plus*® software.

Ethernet Connection

BE1-11*d* protection systems with style numbers xxxxx1xxxxxxxx, xxxxx2xxxxxxxx, xxxxx3xxxxxxxx, xxxxx4xxxxxxxx, and xxxxx5xxxxxxxx have a rear-panel Ethernet port. For style number xxxxxxxxx0xxxx (Copper Ethernet Connection), a 10BASE-T/100BASE-TX port is an eight-pin RJ45 connector that connects to shielded, twisted-pair, Category 5 copper wire media. For style number xxxxxxxxx1xxxx (Fiber Optic Ethernet Connection), a 100BASE-FX ST type connector port uses a 1300 nanometer near-infrared (NIR) light wavelength transmitted via two strands of multimode optical fiber, one for receive (RX) and the other for transmit (TX).

RS-485 Connections

RS-485 connections are made at a three-position terminal block connector that mates with a standard communication cable. A twisted-pair cable is recommended. Shield and ground on both ends to common ground potential as recommended by industry standards. Connector pin numbers, functions, names, and signal directions are shown in Table 35-1. An RS-485 connection diagram is provided in Figure 35-1.

Table 35-1. RS-485 Pinouts

Terminal	Function	Name	Direction
A	Send/Receive A	(SDA/RDA)	In/Out
B	Send/Receive B	(SDB/RDB)	In/Out
C	Signal Ground	(GND)	n/a

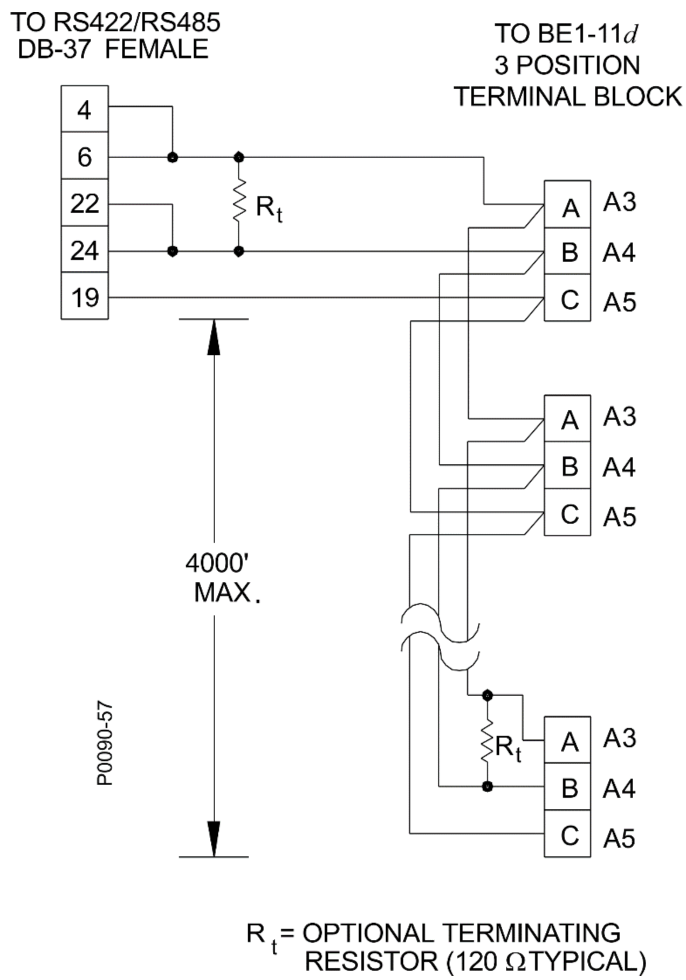


Figure 35-1. RS-485 DB-37 to BE1-11*d*

Ethernet Setup

Located on the rear panel, the optional Ethernet communication port provides dynamic addressing (DHCP), Web pages (HTTP), email alerts (SMTP), as well as communication with a PC running BESTCOMS*Plus*, Modbus®, or DNP software. Additional Ethernet settings are illustrated in Figure 35-2.

The Enable Web Pages box must be checked to enable viewing of BE1-11*d* web pages. Refer to the *BESTnet™Plus* chapter for more information on viewing web pages.

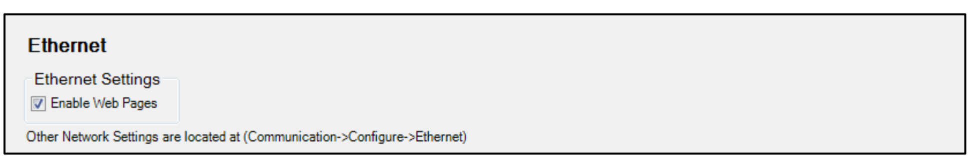


Figure 35-2. Ethernet Screen

Ethernet Port Configuration

Initially you must use a USB connection on the front panel to configure communications.

1. Connect an Ethernet cable between the BE1-11*d* and your network.
2. Connect a USB cable between the BE1-11*d* and your PC.
3. Apply operating power to the BE1-11*d* and wait until the boot sequence is complete.
4. Use BESTCOMS*Plus* to connect to the BE1-11*d* through the USB port.

5. Select Configure, Ethernet from the Communication pull-down menu. If the BE1-11*d* is connected properly, the Configure Ethernet Port screen shown in Figure 35-3 will appear.

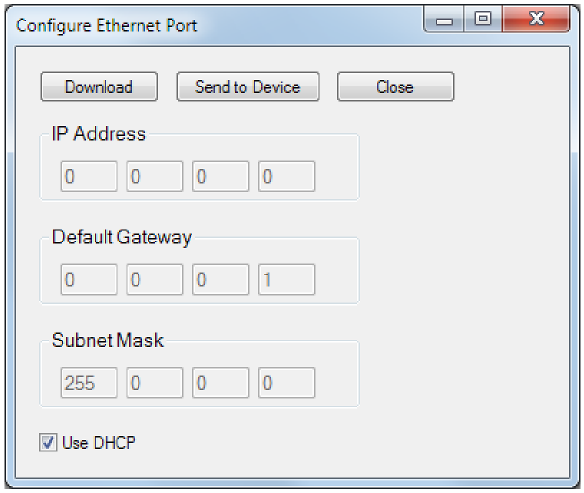


Figure 35-3. Configure Ethernet Port

DHCP (Dynamic Host Configuration Protocol) is enabled by default and allows the BE1-11*d* to send a broadcast request for configuration information. The DHCP server receives the request and responds with configuration information. Use one of the following methods to locate the Active IP address of the BE1-11*d*:

- Use the Device Discovery function on the BE1-11 Connection screen in BESTCOMS*Plus*.
- Navigate to Settings > Communication > Ethernet on the front panel of the BE1-11*d*.

If DHCP is not being used, use BESTCOMS*Plus* to configure the Ethernet port as described in the following paragraphs.

Configurable Ethernet options include:

IP Address:	Internet Protocol Address to be used by the BE1-11*d*.
Default Gateway:	Default host to send data destined for a host not on the network subnet.
Subnet Mask:	Mask used to determine the range of the current network subnet.
Use DHCP:	When this box is checked, the IP Address, Default Gateway, and Subnet Mask are automatically configured via DHCP. This can be used only if the Ethernet network has a properly configured DHCP server running. The BE1-11*d* does not act as a DHCP server.

6. Obtain the values for these options from the site administrator if the BE1-11*d* is intended to share the network with other devices.
7. If the BE1-11*d* is operating on an isolated network, the IP address can be chosen from one of the following ranges as listed in IETF publication RFC 1918, *Address Allocation for Private Networks.*
   - 10.0.0.0 - 10.255.255.255
   - 172.16.0.0 - 172.31.255.255
   - 192.168.0.0 - 192.168.255.255

   If the BE1-11*d* is operating on an isolated network, the Subnet Mask can be left at 0.0.0.0 and the Default Gateway can be chosen as any valid IP address from the same range as the BE1-11*d* IP address.

Note

The PC running BESTCOMS*Plus* software must be configured correctly to communicate with the BE1-11*d*. The PC must have an IP address in the same subnet range as the BE1-11*d* if the BE1-11*d* is operating on a private, local network.

Otherwise, the PC must have a valid IP address with access to the network and the BE1-11*d* must be connected to a properly configured router. The network settings of the PC depend on the operating system installed. Refer to the operating system manual for instructions.

On most Microsoft Windows based PCs, the network settings can be accessed through the Network Connections icon located inside the Control Panel.

8. Click the Send to Device button located on the Configure Ethernet Port screen. A confirmation pop-up will indicate that the BE1-11*d* will reboot after settings are sent. Click the *Yes* button to allow settings to be sent. After the unit has rebooted and the power-up sequence is complete, the BE1-11*d* is ready to be used on a network.
9. If desired, BE1-11*d* settings can be verified by selecting Download Settings and Logic from Device from the Communication pull-down menu. Active settings will be downloaded from the BE1-11*d*. Verify that the downloaded settings match the previously sent settings.

Email Setup

The BE1-11*d* is capable of sending email alerts when triggered by chosen logic. A maximum of eight circumstances can be established for sending email alerts. Setup of email notifications is made on the BESTCOMS*Plus* Email Setup screen (Settings Explorer, Communications, Email Setup) illustrated in Figure 35-4. A notification is configured by entering the SMTP email server address, mail from domain, and the email address of the intended recipients. One email address can be entered in the “To” field and one email address can be entered in the “Cc” field. The “Subject” field accepts up to 64 characters for describing the condition triggering the notification email.

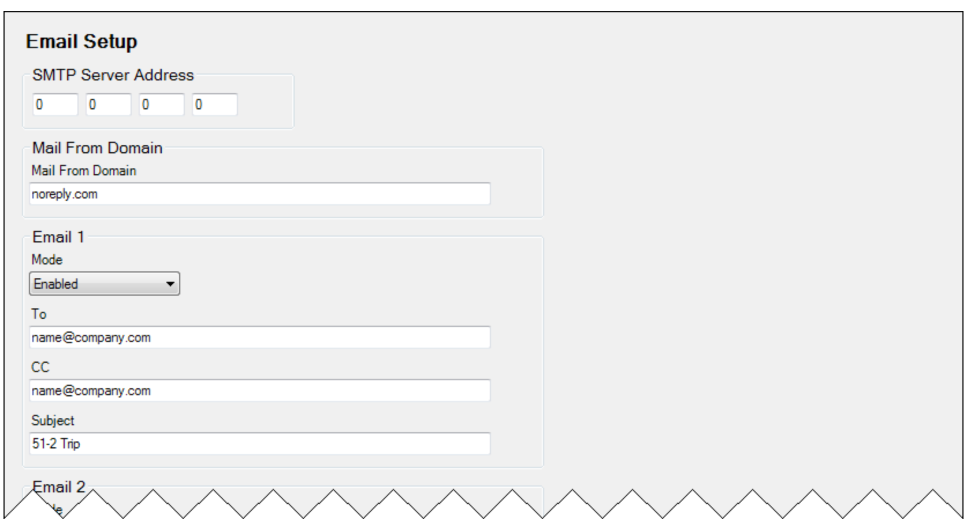


Figure 35-4. Email Setup Screen

BESTlogic™*Plus* Settings for Email

BESTlogic*Plus* settings are made using BESTCOMS*Plus*. To program the BESTlogic*Plus* settings, use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* Programmable Logic tree branch and select the email logic block from the list of Elements. The email logic block is shown in Figure

35-5. Use the drag-and-drop method to connect a variable or series of variables to the input. Refer to the *BESTlogicPlus* chapter for more information on setting BESTlogic*Plus* programmable logic.

Figure 35-5. Email Logic Block

Table 35-2 lists the BESTlogic*Plus* settings for email.

Table 35-2. BESTlogic*Plus* Settings for Email

Name	Function	Purpose	Default
Trigger	Input	Triggers an email message.	0

RS-485 Setup

The RS-485 communication port is located on the rear panel and provides communication with a PC operating Modbus® or DNP software. The Baud Rate is the rate at which the BE1-11*d* will communicate. Bits Per Character can be 8 Bits or 7 Bits. Parity can be None, Odd, or Even. Stop Bits can be set to 1 or 2. The BESTCOMS*Plus* RS485 Setup screen is illustrated in Figure 35-6.

Figure 35-6. RS485 Setup Screen

DNP Setup

Settings for DNP are made by using the Settings Explorer to open the Communications, DNP tree branch. Settings can be made for DNP Analog Points Mapping, DNP Binary Points Mapping, DNP Analog Input Scaling, and DNP Analog Output Scaling. A list of DNP data objects accessible by a master station can be found in Basler Electric publication 9424200773, *Distributed Network Protocol (DNP3) Instruction Manual.*

DNP Settings

The Communications, DNP, DNP Settings tree branch contains screens for miscellaneous DNP settings, unsolicited response support, and default variations.

Miscellaneous Settings

The Miscellaneous Settings screen (Figure 35-7) is used to configure the physical port, type of Ethernet endpoint, local Ethernet port number, client IP address, UDP endpoint, listening end point, link layer, time sync support, application layer, alarm mask, and DNP time in UTC.

Alarm Mask

The Alarm Mask setting allows active alarms that are not enabled in an alarm list to be annunciated in DNP.

DNP Time in UTC

The DNP Time in UTC setting, when enabled, sets the DNP time base to UTC.

Note

Physical Port Selection (Ethernet or RS-485) is available only for Ethernet Protocol options 3 and 4 and only when RS-485 port protocol option is N (None). RTD module communication over RS-485 is not available when the physical port for DNP communication is RS-485.

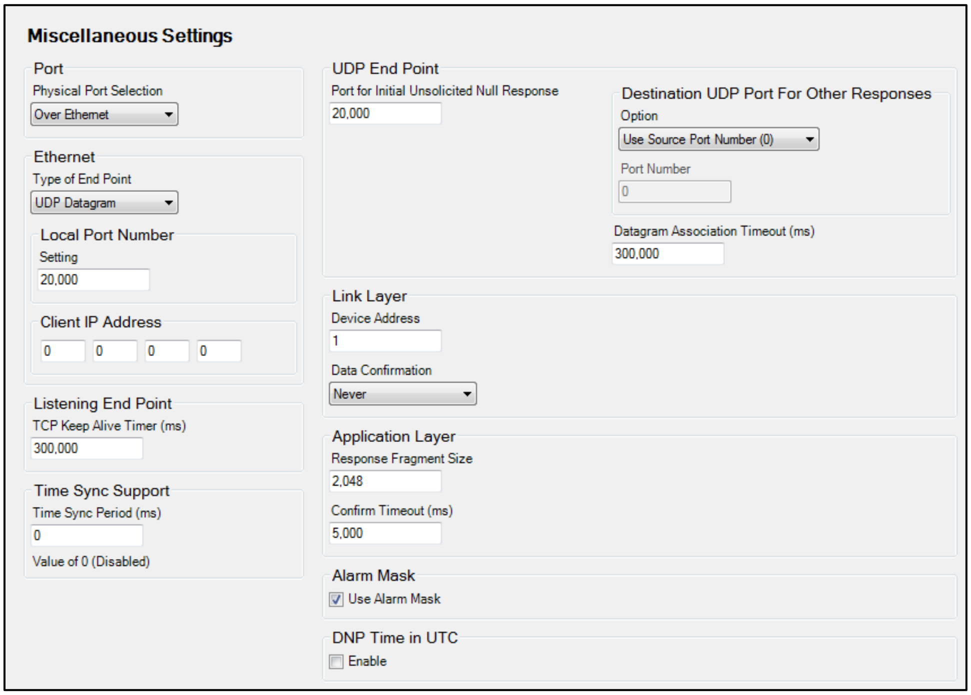


Figure 35-7. DNP Settings, Miscellaneous Settings Screen

Unsolicited Response Support

The Unsolicited Response Support screen (Figure 35-8) configures BE1-11*d* unsolicited responses over a DNP network and selects the classes of events that trigger the responses.

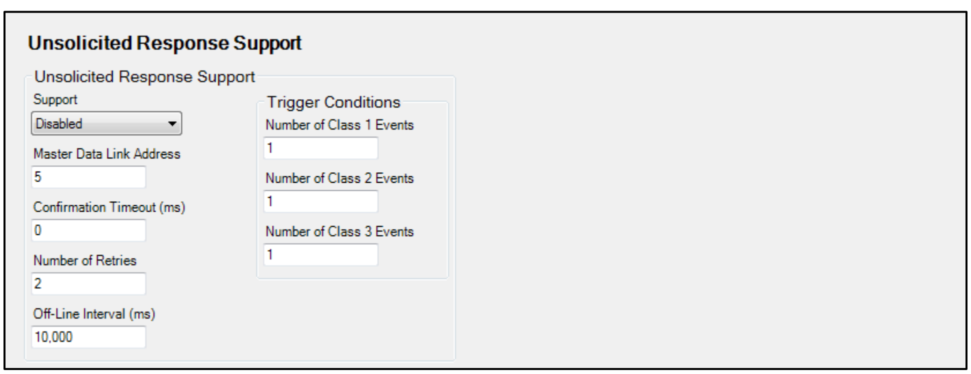


Figure 35-8. DNP Settings, Unsolicited Response Support Screen

Default Variations

The Default Variations screen (Figure 35-9) is used to configure the binary and analog inputs and analog output status.

Figure 35-9. Default Variations Screen

DNP Analog Points Mapping

Analog points can be mapped to any of the available analog user map registers. Use the Settings Explorer in BESTCOMS*Plus* to open the Communications, DNP, DNP Analog Points Mapping tree branch as shown in Figure 35-10.

To map an Analog Point to the Analog User Map:

1. Select an analog point in the left-hand column.
2. Click on the Add >> button to add the analog point to the analog user map list.
3. Use the Move Up or Move Down buttons above the analog user map list to arrange the analog user maps.
4. Click on the orange Save button to save the settings to BESTCOMS*Plus* memory. This button changes to white indicating that the settings have been saved to BESTCOMS*Plus* memory.

Upload settings to the device by selecting Communication from the top pull-down menu and then Upload Settings to Device.

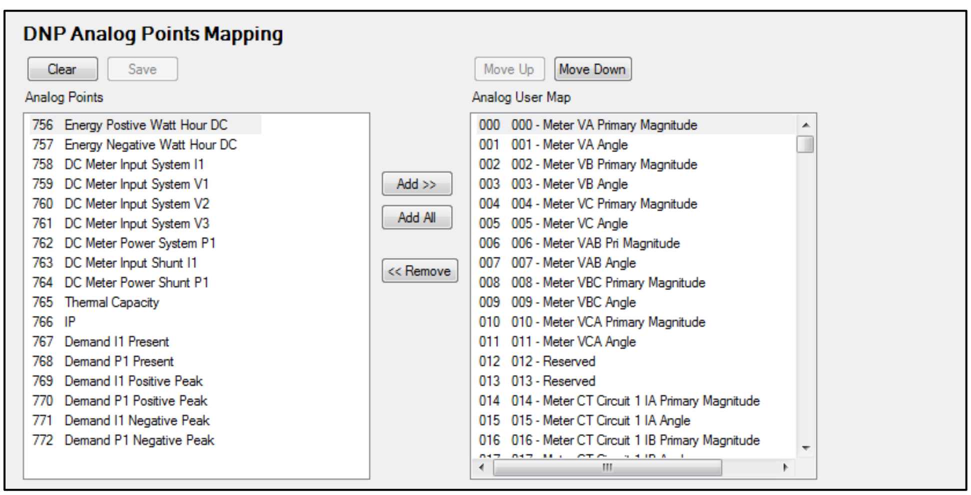


Figure 35-10. DNP Analog Points Mapping Screen

DNP Binary Points Mapping

Binary points can be mapped to any of the available binary user map registers. Use the Settings Explorer in BESTCOMS*Plus* to open the Communications, DNP, DNP Binary Points Mapping tree branch as shown in Figure 35-11.

To map a Binary Point to the Binary User Map:

1. Select a binary point in the left-hand column.
2. Click on the Add >> button to add the binary point to the binary user map list.
3. Use the Move Up or Move Down buttons above the binary user map list to arrange the binary user maps.
4. Click on the orange Save button to save the settings to BESTCOMS*Plus* memory. This button changes to white indicating that the settings have been saved to BESTCOMS*Plus* memory.
5. Upload settings to the device by selecting Communication from the top pull-down menu and then Upload Settings to Device.

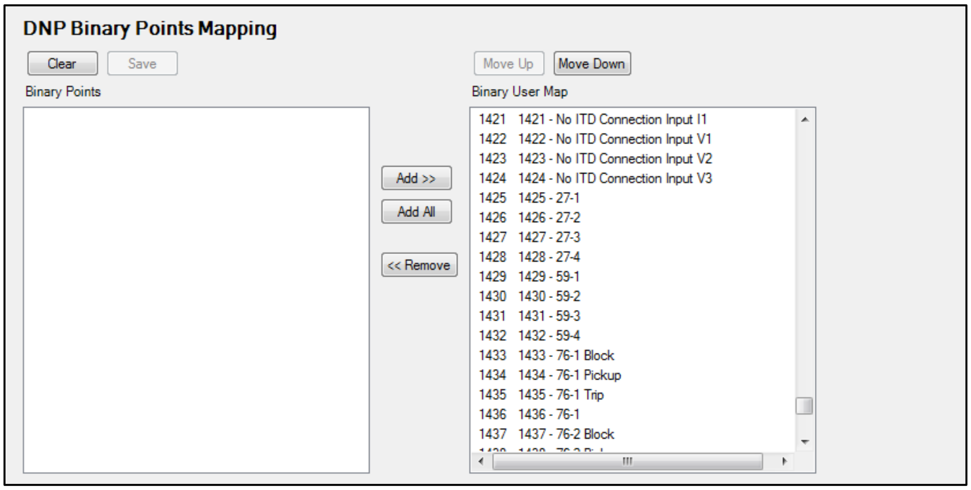


Figure 35-11. DNP Binary Points Mapping Screen

DNP Analog Input and Output Scaling

Individual BE1-11*d* analog inputs and outputs can be scaled to maintain value readability and resolution. Analog input point scaling is adjusted on the DNP Analog Input Scaling screen (shown in Figure 35-12) and analog output point scaling is adjusted on the DNP Analog Output Scaling screen. On each screen, individual points can be selected and assigned a scaling factor of 0.001 to 1,000,000,000. A scaling factor of 1.000 is the default value for all analog input and output points.

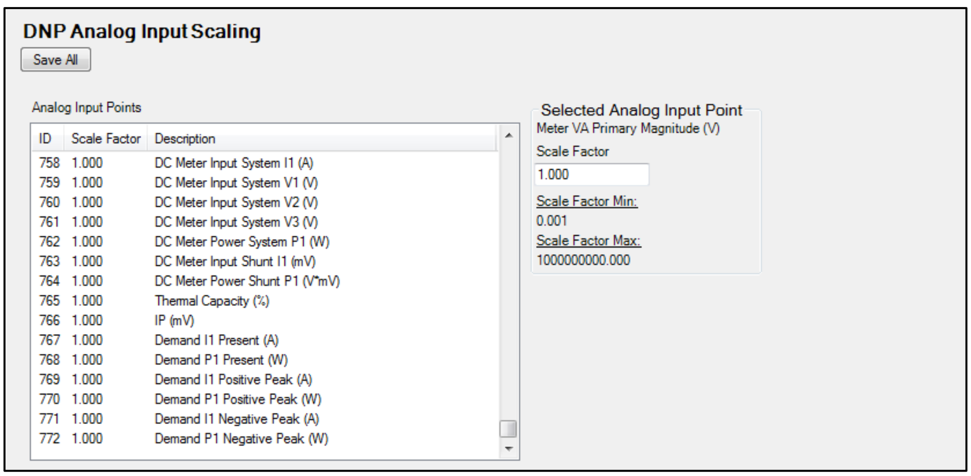


Figure 35-12. DNP Analog Input Scaling Screen

Modbus® Setup

Settings for Modbus are made by using the Settings Explorer to open the Communications, Modbus tree branch. Settings can be made for Modbus mapping. A list of Modbus registers can be found in Basler Electric publication 9424200774, *Modbus Protocol Instruction Manual.*

Miscellaneous Modbus® Settings

The Miscellaneous Modbus Settings screen is shown in Figure 35-13. Settings are provided for Modbus over RS485 and Ethernet. When Auto Save is enabled, group saves are performed to reduce write times.

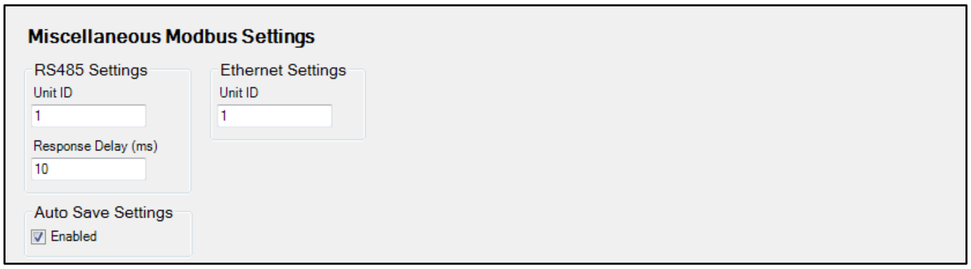


Figure 35-13. Miscellaneous Modbus Settings

Modbus® Mapping

Source registers can be mapped to any of 125 available poll block registers ranging from 9875 to 9999. Use the Settings Explorer in BESTCOMS*Plus* to open the Communications, Modbus, Modbus Mapping tree branch as shown in Figure 35-14.

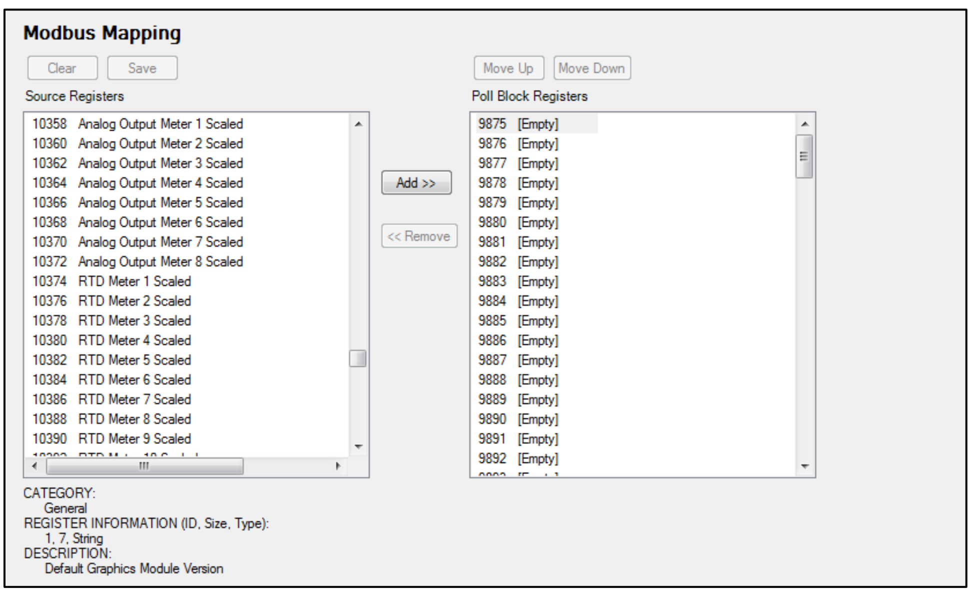


Figure 35-14. Modbus Mapping Screen

To map a Source Register to Poll Block Registers:

1. Select a source register in the left-hand column. The category, register information, and description of the selected source register are shown in the lower left-hand corner of the screen.
2. Click the Add >> button to add the source register to the poll block register list.
3. Use the Move Up or Move Down buttons above the poll block register list to arrange the poll block registers.
4. Click on the orange Save button to save the settings to BESTCOMS*Plus* memory. This button changes to white indicating that the settings have been saved to BESTCOMS*Plus* memory.

5. Upload settings to the device by selecting Communication from the top pull-down menu and then Upload Settings to Device.

36 • Security

Multiple levels of BE1-11*d* security give personnel the level of access appropriate for the tasks they routinely perform while securing critical settings from unauthorized access.

Note
The BE1-11*d* does not support factory password reset in the field and will need to be returned to Basler Electric for service if all Admin passwords are lost or expired.

Access Levels

Passwords provide access security for six distinct functional access areas: Read, Control, Operator, Settings, Design, and Administrator (Admin). Each functional area can be assigned a unique password or one password can be assigned to multiple areas. Functional areas are not independent of one another. For example, an Admin password is used to access levels 6, 5, 4, 3, 2, and 1; a Design password is used to access levels 5, 4, 3, 2, and 1. Table 36-1 lists the access levels and descriptions.

Table 36-1. Access Levels and Descriptions

Access Level	Description
6 - Admin (highest)	Create, edit, and delete users and device security.
5 - Design	Create or change programmable logic and reboot device.
4 - Settings	Change all settings values. Logic equations cannot be created or changed.
3 - Operator	Set date and time, reset accumulated metering values, and erase event data.
2 - Control	Operate real-time controls.
1 - Read	Read all system parameters. No changes or operation allowed.
0 - None	All access denied.

Additional security is provided by controlling the functional areas that can be accessed through a particular communication port. For example, security can be configured so that front panel access is permitted at a lower access level than BESTCOMS*Plus*® or Modbus access.

The communication ports and password parameters act as a two-dimensional control to limit changes. The entered password must be correct and the command must be entered through a valid port. Only one port at a time can be in use with higher than Read access. For example, if a user gains Settings access at the front-panel USB port, users at other areas (rear Ethernet and front panel) will be able to gain Read access only after the user with Settings access at the front-panel USB port disconnects from the device. Read access is always allowed for all simultaneous users with access level 1 or higher.

If a port holding higher than Read access sees no activity for the duration of the Access Timeout setting, access privileges will automatically be lowered to Read access. This feature ensures that password protection cannot be accidentally left in a state where access privileges are enabled for one area and other areas locked out for an indefinite period.

Username Setup

1. Use the Settings Explorer in BESTCOMS*Plus* to select Username Setup under General Settings, Device Security Setup. The Login dialog box appears. See Figure 36-1. An administrator access level is required to set up usernames and passwords.

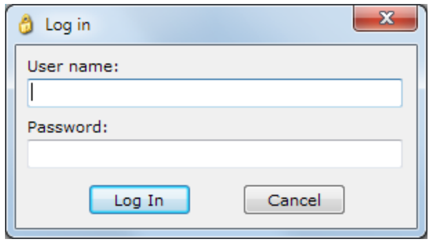


Figure 36-1. Login Screen

2. Enter the username and password of the administrator and then click the Log In button. The default Administrator username is “**A**” and the default Password is “**A**”.
3. Only an administrator can modify usernames and passwords on the Username Setup screen (Figure 36-2). Complex usernames and passwords up to 16 characters in length are accepted. Acceptable characters include uppercase letters, lowercase letters, numbers, and certain special characters.

Note

The BE1-11*d* supports at least this set of characters in passwords:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h I j k l m n o p q r s t u v w x y z

0 1 2 3 4 5 6 7 8 9

` ~ ! @ # $ % ^ & ( ) _ + - = { } [ ] \ : " ; ' < > ? . / ,

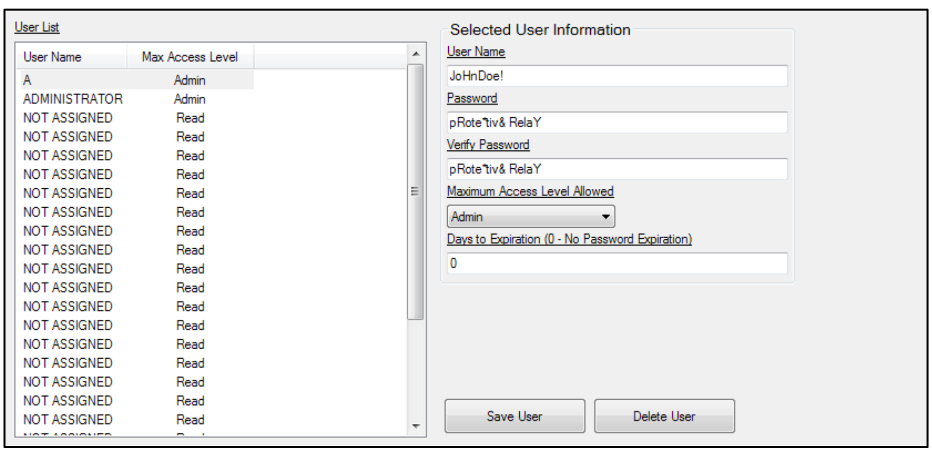


Figure 36-2. Username Setup Screen

4. In the left-hand column, highlight any username labeled NOT ASSIGNED or highlight a specific username to change it.
5. On the right side of the screen, enter a username.
6. Enter a password for the user.
7. Re-enter the password to verify it.
8. Using Table 36-1 as a reference, enter the maximum access level allowed for the user.
9. Enter the number of days to expiration of the password or leave at default (0) for no expiration.
10. Click the Save User button to save to the settings to BESTCOMS*Plus* memory.
11. Pull down the Communication menu and select Upload Security to Device. The Login dialog box pops up. An administrator level is required to upload security settings to the device.

12. Enter the username and password of the administrator and then click the Log In button. The default administrator username is “**A**” and the default password is “**A**”. BESTCOMS*Plus* notifies you when the upload is successful.

Port Access Setup

1. Use the Settings Explorer in BESTCOMS*Plus* to select Port Access Setup under General Settings, Device Security Setup. The Port List screen is shown in Figure 36-3.

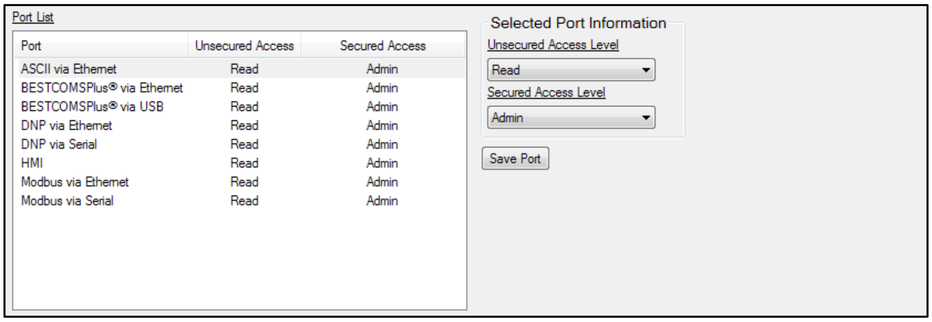


Figure 36-3. Port List Screen

2. The Login dialog box pops up. See Figure 36-1. An administrator access level is required to set up port access. Enter the username and password of the administrator and then click the Log In button. The default administrator username is “**A**” and the default Password is “**A**”.
3. In the side column, highlight a port to change.
4. On the right side of the screen, use the drop-down menus to select the Unsecured Access Level and Secured Access Level for the highlighted port. The Unsecured Access Level setting sets the max level of access that can be gained without entering a username/password. The Secured Access Level setting sets the max level of access that can be gained with a password.

Caution
Setting the Secured Access Level to None on any port will make that port unusable. If the Secured Access Level is set to None on all available ports, the BE1-11*d* must be returned to Basler Electric for repair.

5. Click the Save Port button to save to the settings to BESTCOMS*Plus* memory.
6. Pull down the Communication menu and select Upload Security to Device. The Login dialog box pops up. An administrator level is required to upload security to the device.
7. Enter the username and password of the administrator and then click the Log In button. The default administrator username is “**A**” and the default password is “**A**”. BESTCOMS*Plus* notifies you when the upload is successful.

Access Control

The Access Timeout setting defines the amount of time before access expires. The timer resets every time a setting is changed. If a username or password is entered incorrectly more than x times (Login Attempts) in y seconds (Login Time Window), then access is prohibited for z seconds (Login Lockout Time).

When the HMI Login Required Reset setting is disabled, target and alarm reset can be set outside of security control, allowing reset without logging in.

The BESTCOMS*Plus* Access Control screen is illustrated in Figure 36-4.

Figure 36-4. Access Control Screen

1. Use the Settings Explorer in BESTCOMS*Plus* to select Access Control under General Settings, Device Security Setup. The Access Control screen is shown in Figure 36-4.
2. Configure the Access Timeout and Login Failure settings.
3. Pull down the Communication menu and select Upload Security to Device. The Login dialog box pops up. An administrator level is required to upload security to the device.
4. Enter the username and password of the administrator and then click the Log In button. The default administrator username is "**A**" and the default password is "**A**". BESTCOMS*Plus* notifies you when the upload is successful.

Viewing the Security Log

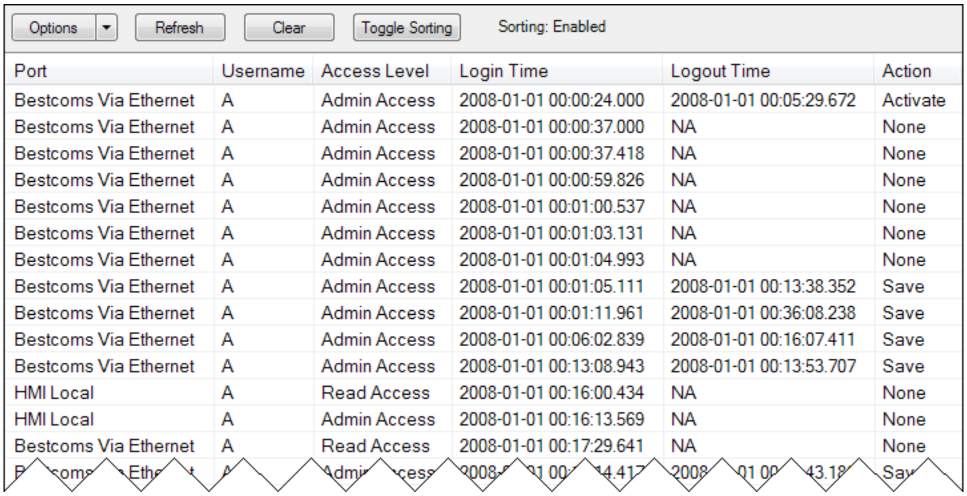
BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Security Log

HMI Navigation Path: Not available through the front panel

The BE1-11*d* records information about user logins including the port used to log in, the access level granted, the type of action performed, and the time of logout and creates security logs. A log will also be triggered when a user attempts to log in, but fails due to an invalid username or incorrect password.

A maximum of 200 entries are stored in nonvolatile memory. When a new entry is generated, the BE1-11*d* discards the oldest of the 200 entries and replaces it with a new one.

Use the Metering Explorer to open the Reports, Security Log screen. If an active connection to a BE1-11*d* is present, the security log will automatically download. Using the Options button, you can copy, print, or save the security log. The Refresh button is used to refresh/update the security log. The Clear button clears the security log. The Toggle Sorting button enables sorting. Click on a column header to sort. See Figure 36-5.



Port	Username	Access Level	Login Time	Logout Time	Action
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:24.000	2008-01-01 00:05:29.672	Activate
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:37.000	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:37.418	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:59.826	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:00.537	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:03.131	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:04.993	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:05.111	2008-01-01 00:13:38.352	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:11.961	2008-01-01 00:36:08.238	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:06:02.839	2008-01-01 00:16:07.411	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:13:08.943	2008-01-01 00:13:53.707	Save
HMI Local	A	Read Access	2008-01-01 00:16:00.434	NA	None
HMI Local	A	Admin Access	2008-01-01 00:16:13.569	NA	None
Bestcoms Via Ethernet	A	Read Access	2008-01-01 00:17:29.641	NA	None

Figure 36-5. Security Log

Authenticity and Encryption

The BE1-11*d* supports authentication and encryption of communications with BESTCOMS*Plus*. This is done using the Transport Layer Security protocol, version 1.2 (TLS 1.2). To enable this mode, an X.509 certificate and private key must be uploaded to the BE1-11*d*.

In TLS 1.2, a certificate is used to verify the authenticity of the server (BE1-11*d*). The supported certificate formats are Standard PEM, DER/Binary, and PFX (PKCS#12). The BE1-11*d* supports RSA encryption up to 8192 bit keys. The recommended key length is 2048 as longer keys will slow the initial connection. DER and PEM formats commonly have the private key stored in a separate file. If this is the case, you will be asked for an additional file containing the key. If a password is required for the key, you will also need to enter it into the form. It is recommended that certificates be uploaded over a trusted connection or through the USB port.

Generate a Certificate

BESTCOMS*Plus* is used to generate a self-signed X.509 certificate for use in identifying a connected device. In order for the certificate to work, the common name must match the domain name or the IP address of the device. Alternate names can be used if multiple domain names match the device. The valid dates specify how long the certificate may be used. A new certificate should be issued after one expires.

To generate a certificate, click on the Tools drop-down menu in BESTCOMS*Plus* and select Generate Certificate. Fill in all applicable fields. A password is optional. Click Save to generate a .pfx file which is the certificate and the private key required to upload to the BE1-11*d*.

Self-signed certificates can be less secure than using a Certificate Authority to sign the certificate for the device. It will allow encryption from end to end. Use caution when choosing this method. Distribution of the generated file compromises security.

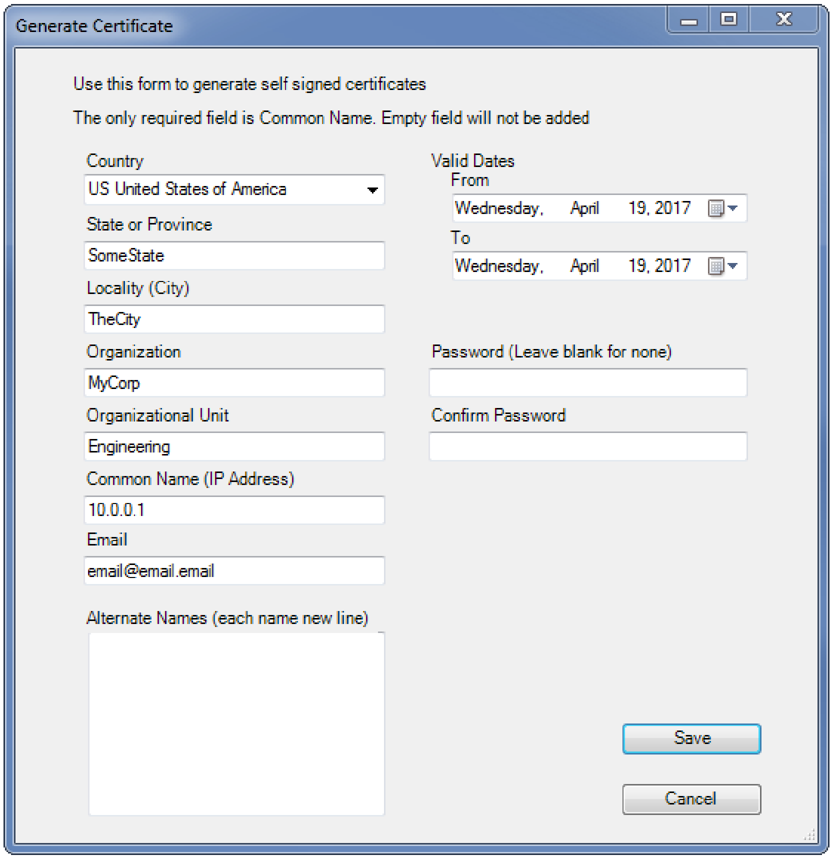


Figure 36-6. Generate Certificate Screen

Upload a Certificate to the Device

To upload a security certificate, click on the Communication drop-down menu in BESTCOMS*Plus* and select Certificate > Upload Certificate to Device. Then, select the certificate type, browse for the certificate file, and click the Upload button. See Figure 36-7.

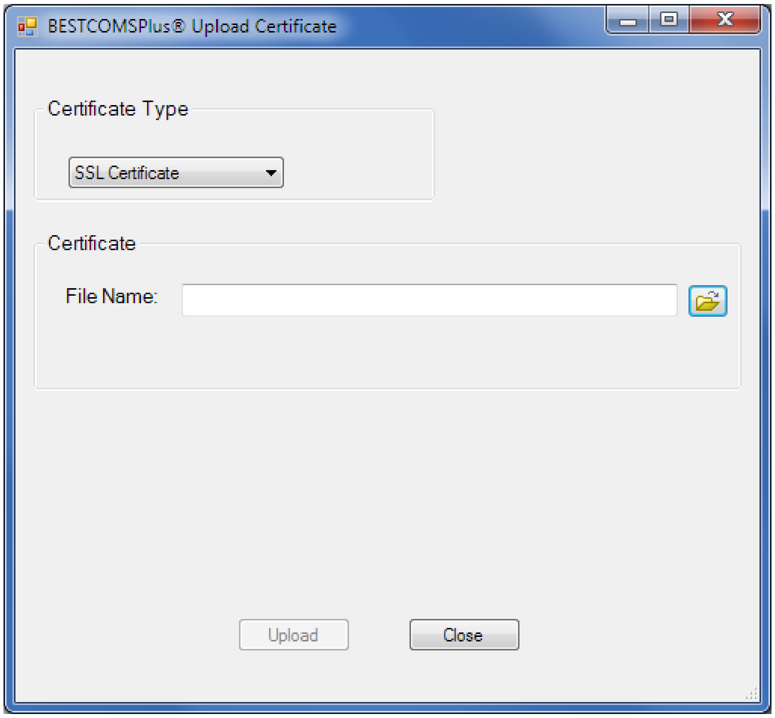


Figure 36-7. Upload Certificate Screen

Remove a Certificate from the Device

To remove a security certificate, click on the Communication drop-down menu in BESTCOMS*Plus* and select Certificate > Remove Certificate from Device.

Authenticate a Certificate

Two methods for authenticating certificates are available. In the first method, a built-in Windows® mechanism verifies that the certificate chain is signed by a trusted root certificate authority. If you upload a certificate chain to the BE1-11*d* with a root trusted by Windows, it will automatically authenticate and connect. If it is not trusted, there is a second option to manually accept the certificate. All information about the certificate is displayed. The certificate can be accepted once (temporarily) or permanently. See Figure 36-8. If the certificate changes in any way, the prompt to manually accept the certificate is shown again.

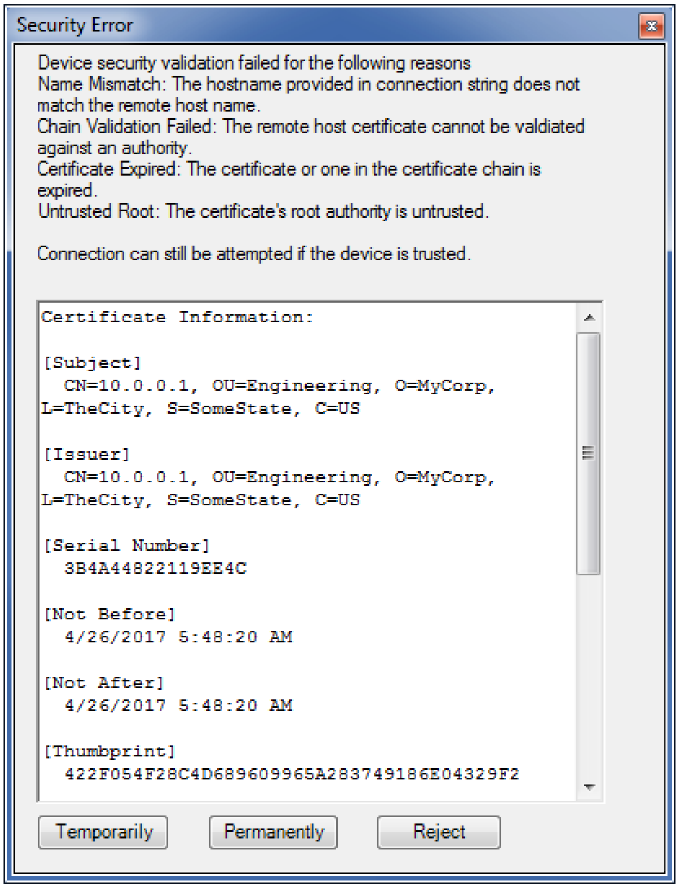
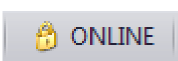


Figure 36-8. Security Error Screen

A lock symbol in the lower status bar of BESTCOMS*Plus* means the connection is secure.



Remove Accepted Device

To remove a previously accepted device, click on the Tools drop-down menu in BESTCOMS*Plus* and select Accepted Certificates. See Figure 36-9.

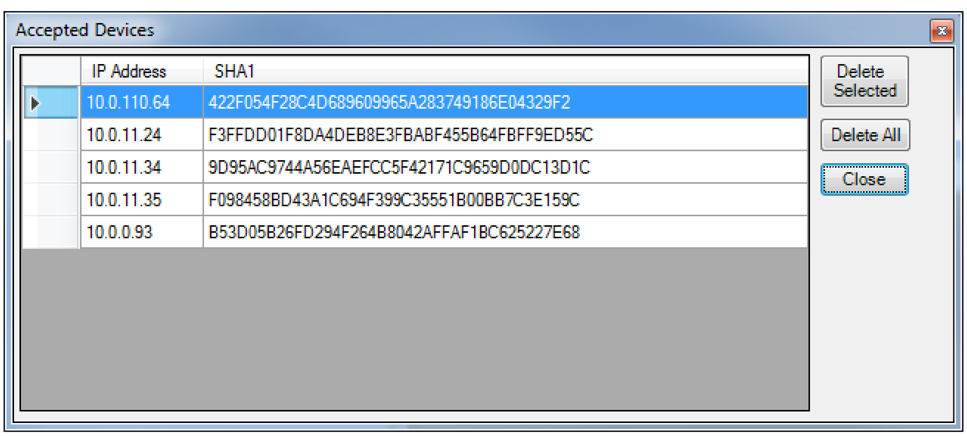


Figure 36-9. Accepted Devices

37 • Timekeeping

The BE1-11*d* provides a real-time clock with capacitor backup that is capable of operating the clock for up to 24 hours after power is removed from the BE1-11*d*. As the capacitor nears depletion, an internal backup battery takes over and maintains timekeeping. The backup battery is standard and will maintain the clock for more than five years depending on conditions.

The clock is used by the demand reporting function, the fault reporting function, the oscillography recording function, and the sequence of events recorder function to time-stamp events. The clock function records the year in two-digit format.

Clock Setup

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Clock Setup

HMI Navigation Path: Settings Explorer, General Settings, Clock Setup

Clock settings are made through the communication ports using BESTCOMS*Plus*® or through the front-panel interface. Write access to ports is required to program the clock. An alarm point is provided in the programmable alarms to detect when the BE1-11*d* has powered up and the clock has not been set. The BESTCOMS*Plus* Clock Setup screen is illustrated in Figure 37-1.

The local time zone is configured on this screen. The Time Zone Offset is the local offset to UTC (Coordinated Universal Time). The Time Zone Offset is required if NTP or IRIG-B is used for time synchronization or when the Start/End Time Reference is set to UTC (Coordinated Universal Time). The Start/End Time Reference is set to UTC time if required by local daylight savings time rules. The Start/End Hour/Minute settings determine the time when the DST will go into effect. The Bias setting is the amount of time that the clock moves forward or backward. The default settings are configured for the Central Time Zone in the United States as shown in Figure 37-1. Using these settings, the clock would move forward 1 hour at 2:00 a.m. on the second Sunday in March and move backward 1 hour at 2:00 a.m. on the first Sunday in November. DST can also be configured for a specific day of the month by selecting Fixed Dates under DST Configuration.

Time Priority Setup

There are three available protocols (NTP, IRIG-B, and DNP), which can be assigned priorities to update the date and time. Double-click on an available item to move it to the Enabled box. Use the arrow buttons to set the priority of the selected item. If all three protocols are disabled, the date and time will not be updated automatically.

The NTP (Network Time Protocol) synchronizes the real-time clock to a network time server when an Ethernet cable is connected. An address of a valid NTP server must be entered when NTP is selected in the Time Priority Setup, Enabled box. If using a named server, use the Additional NTP Sources and leave the NTP Address at 0.0.0.0.

IRIG Decoding

The IRIG Decoding signal defines whether or not to decode the year field in the IRIG signal. Refer to the manufacturer of your equipment to determine if the year field is being sent to the BE1-11*d*.

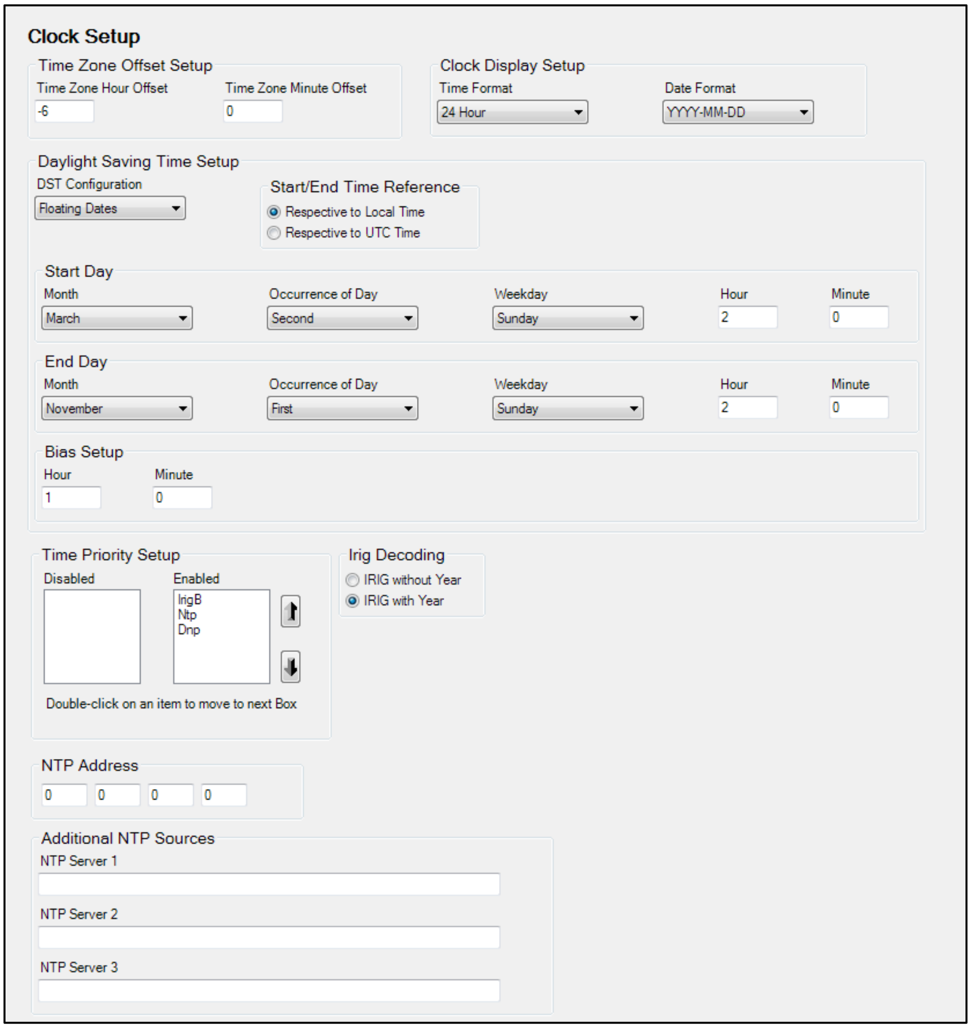


Figure 37-1. Clock Setup Screen

Setting the Time and Date

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Real Time Clock

HMI Navigation Path: Metering Explorer, Status, Real Time Clock

Time and date settings can be made through BESTCOMS*Plus* on the Real Time Clock screen (Figure 37-2) under the Status branch of the Metering Explorer. Settings can also be made through the front panel.

Figure 37-2. Status, Real Time Clock Screen

IRIG Port

IRIG time code signal connections are located on the rear panel. When a valid time code signal is detected at the port, it is used to synchronize the clock function. Note that the IRIG time code signal received from older IRIG receivers does not contain year information. If this is the case, it will be necessary to enter the date manually. Year information is stored in nonvolatile memory so that when operating power is restored after an outage and the clock is re-synchronized the current year is restored. When the clock rolls over to a new year, the year is automatically incremented in nonvolatile memory. An alarm bit is included in the programmable alarm function for loss of IRIG signal. The alarm point monitors for IRIG signal loss once a valid signal is detected at the IRIG port.

Connections

IRIG connections are located on a terminal block shared with the RS-485 and input power terminals. Terminal designations and functions are shown in Table 37-1.

Table 37-1. IRIG Terminal Assignments

Terminal	Function
A1	(+) Signal
A2	(–) Reference

Specifications

Interface supports IRIG Standard 200-04, Format B006.

Input Signal .... Demodulated dc. Level-shifted, digital signal
Input Voltage Range .... ±10 Vdc maximum
Input Resistance .... Nonlinear, approximately 4 kΩ at 3.5 Vdc, approximately 3 kΩ at 20 Vdc

Logic Voltage Threshold

High .... 3.5 Vdc minimum
Low .... 0.5 Vdc maximum

Real-Time Clock Specifications

Resolution .... 1 s
Accuracy .... ±1.73 s/d at 77°F (25°C)

Clock Holdup

Capacitor Holdup Time .... Up to 24 hours depending on conditions
Battery Holdup Time .... Greater than 5 years depending on conditions
Battery Type .... BR2032 or CR2032
Coin-type, 3 Vdc, 195 mAh
Basler Electric P/N 38526

Backup Battery for the Real-Time Clock

The backup battery for the real time clock is a standard feature of the BE1-11*d*. A battery is used to maintain clock function during loss of power supply voltage. In mobile substation and line-powered applications, the voltage that supplies the BE1-11*d* power supply may be disconnected for extended periods (weeks, months) between uses. Without battery backup for the real time clock, clock functions will cease if battery input power is removed.

The backup battery has a life expectancy of greater than five years depending on conditions. After this time, you should contact Basler Electric to order a new battery, Basler Electric P/N 38526.

Caution

Replacement of the backup battery for the real-time clock should be performed only by qualified personnel.

Do not short-circuit the battery, reverse battery polarity, or attempt to recharge the battery. Observe polarity markings on the battery socket when inserting a new battery. The battery polarity must be correct in order to provide backup for the real-time clock.

Note

Failure to replace the battery with Basler Electric P/N 38526 may void the warranty.

Battery Replacement Procedure

Battery access is located behind the front cover of the BE1-11*d* on the front-panel circuit board. See Figure 37-3.

Step 1: Remove the BE1-11*d* from service.

Step 2: Use a 7/64” hex tool to remove the front cover screws and remove the cover.

Step 3: Locate the battery holder attached to the rear of the cover. Remove the old battery. Consult your local ordinance for proper battery disposal.

Step 4: Insert the new battery so that the polarity markings on the battery match the polarity markings on the battery holder and circuit board.

Step 5: Reattach the front cover by pressing equally and firmly on both sides as shown in Figure 37-4. Using a 7/64” hex tool, tighten the front cover screws to 10 in-lbs (1.12 N•m).

Step 6: Return the BE1-11*d* to service.

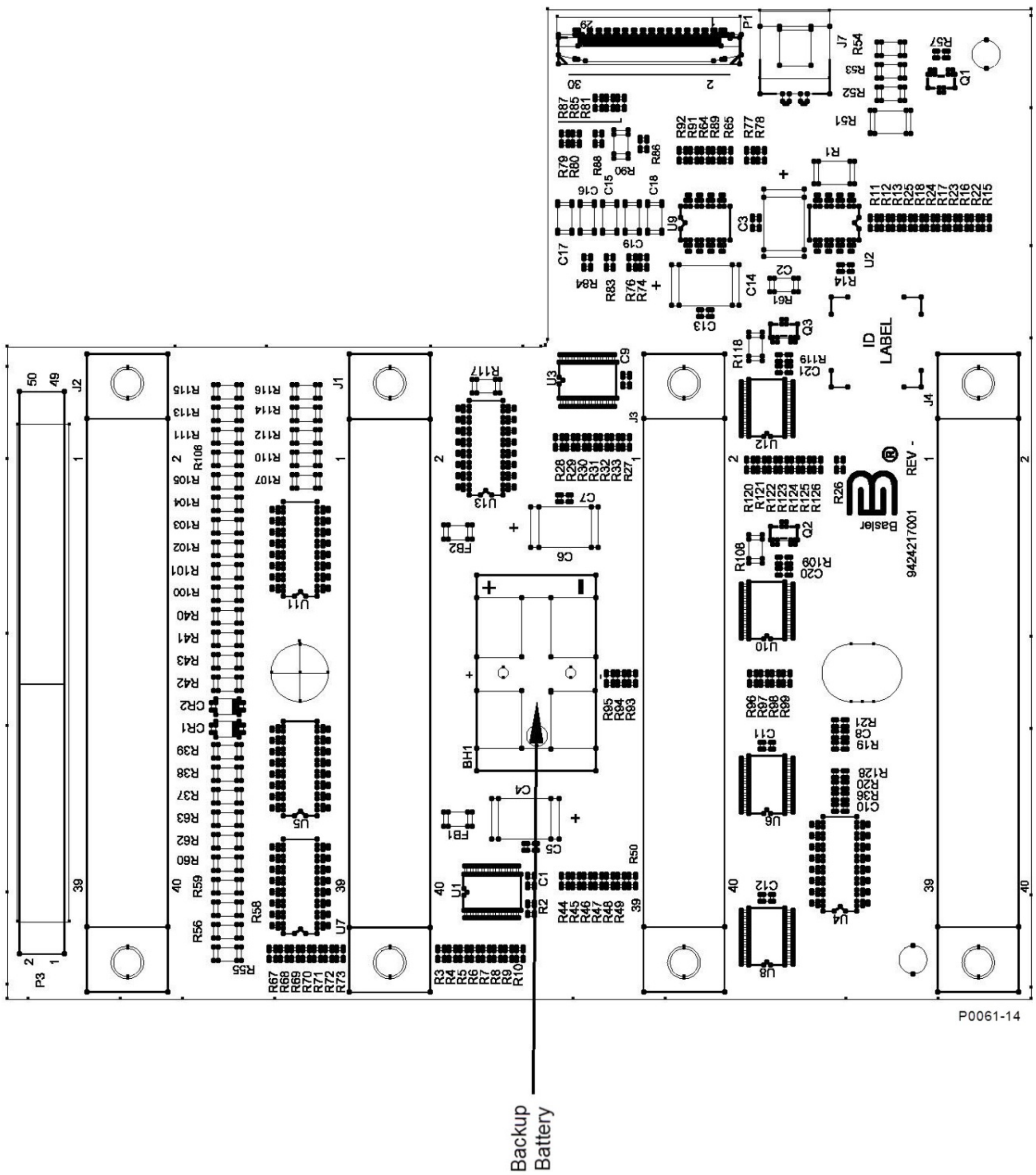


Figure 37-3. Front-Panel Circuit Board, Backup Battery Location

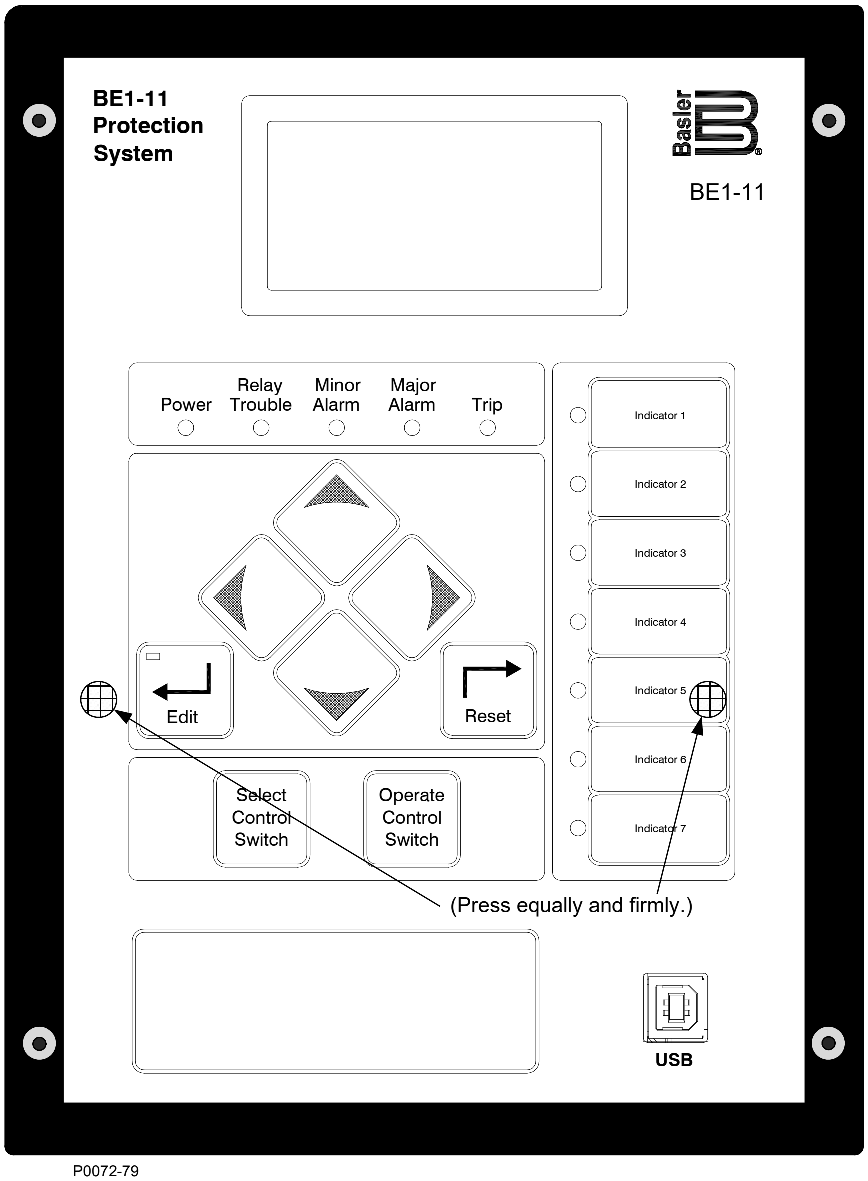


Figure 37-4. Re-Attaching the Front Cover

38 • Device Information

BE1-11*d* identification labels, firmware version, serial number, and style number are found on the Device Info screen in BESTCOMS*Plus*®. The process for updating firmware is described later in this chapter.

Style Number

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Style Number

HMI Navigation Path: Settings Explorer, General Settings, Device Information

The model number, together with the style number, describes the options included in a specific device and appears on labels located on the front panel and inside the case.

The style number of the BE1-11*d* is displayed on the BESTCOMS*Plus* Style Number screen after downloading settings from the device. When configuring BE1-11*d* settings off-line, the style number for the unit to be configured can be entered into BESTCOMS*Plus* to enable configuration of the required settings. The BESTCOMS*Plus* Style Number screen is illustrated in Figure 38-1.

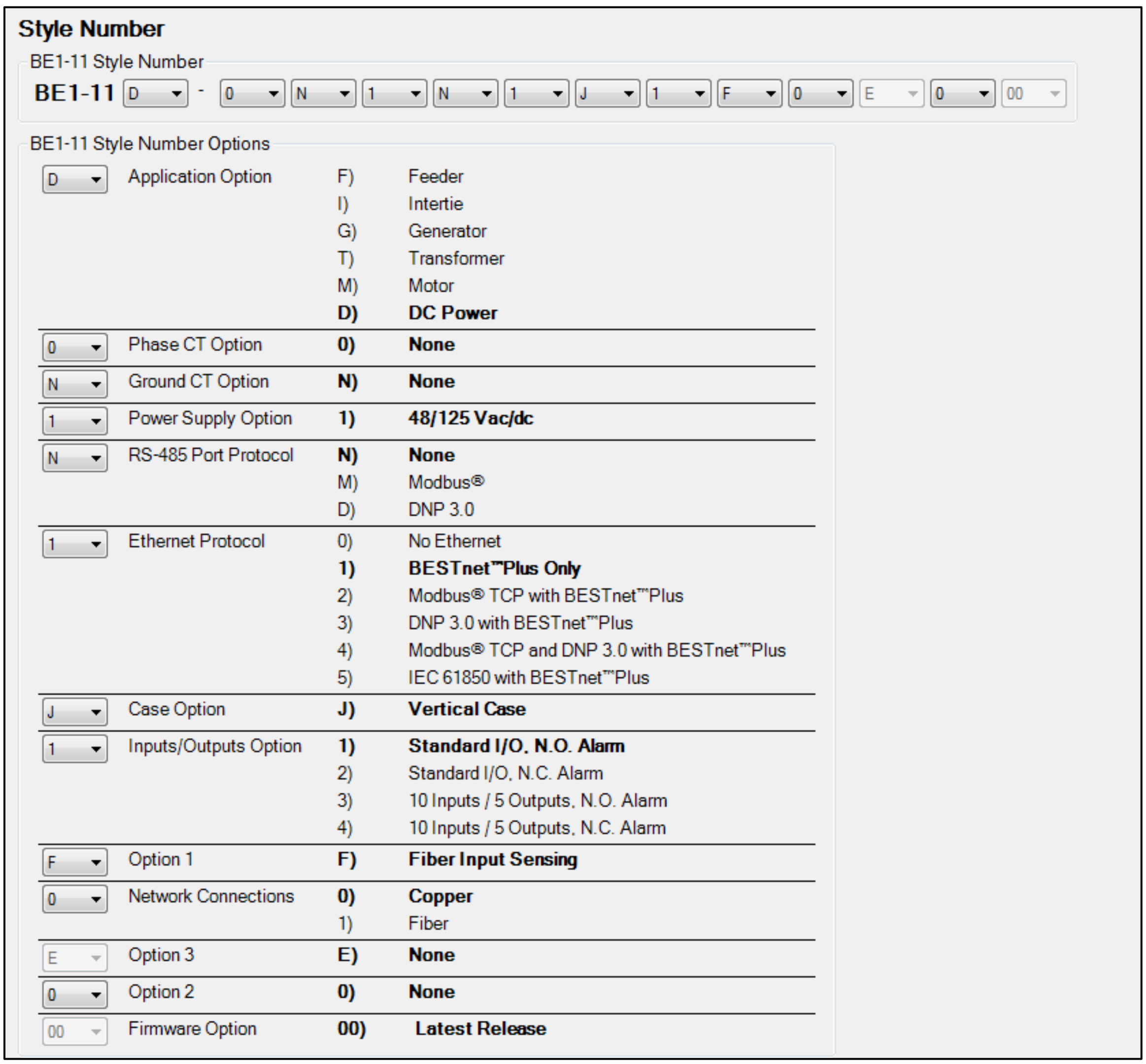


Figure 38-1. Style Number Screen

Device Info

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Info

HMI Navigation Path: Settings Explorer, General Settings, Device Information

Information about a BE1-11*d* communicating with BESTCOMS*Plus* can be obtained on the Device Info screen of BESTCOMS*Plus* after downloading settings from the device.

The application version must be selected when configuring BE1-11*d* settings off-line. When on-line, read-only information includes the application version, application part number, application build date, boot code version, model number, style number, serial number, language module version, and language module part number.

BE1-11*d* protection systems have three identification fields: Device ID, Station ID, and User ID. These fields are used in the header information lines of the Fault Reports, Oscillograph Records, and Sequence of Events Records.

The BESTCOMS*Plus* Device Info screen is illustrated in Figure 38-2.

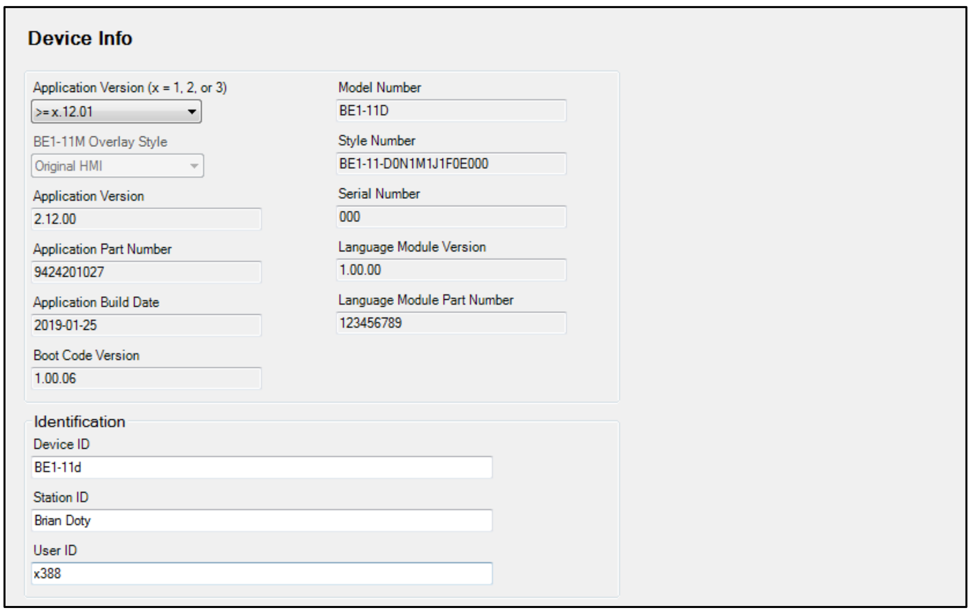


Figure 38-2. Device Info Screen

Firmware Updates

Caution
Default settings will be loaded into the BE1-11*d*, reports and events will be cleared, and the BE1-11*d* will reboot when firmware is updated. BESTCOMS*Plus* can be used to download settings and save the settings in a file so that they can be restored after updating firmware. Refer to *Settings File Management* for help with saving a settings file.

Maintaining the latest version of BE1-11*d* firmware ensures worry-free operation using the latest features and functions. If you have obtained a package file containing an updated firmware file for your device, you can upload it by selecting Upload Device Files from the Communication pull-down menu on the main screen in BESTCOMS*Plus*. The Basler Electric Device Package Uploader screen will appear. See Figure 38-3.

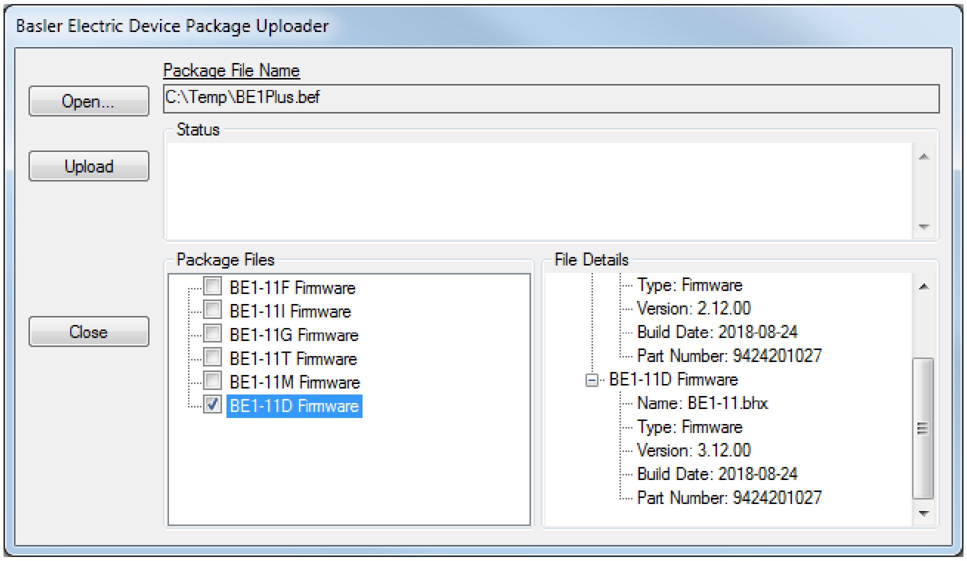


Figure 38-3. Basler Electric Device Package Uploader

Use the Open button to browse for the device file that you obtained from Basler Electric. Place a checkmark next to the file you want to upload. Click the Upload button. The BE1-11*d* will reboot automatically after the firmware upload is complete.

After rebooting, the Relay Trouble LED on the front panel is lit and Defaults Loaded is displayed on the Relay Alarms screen. To reset the alarm, use the Metering Explorer in BESTCOMS*Plus* to navigate to the Status, Alarms screen (Figure 38-4) and click the Reset Relay Alarms button. This alarm can also be reset through the front panel by navigating to Metering > Status > Alarms > Relay Alarms and pressing the Reset button. Admin access is required to reset the Defaults Loaded alarm. The default username is "**A**" and the default password is "**A**". Alarm reset can also be set outside of security control, allowing reset without logging in. Refer to the *Security* chapter for more information. Restore your settings file.

Figure 38-4. BESTCOMS*Plus* Alarms Screen

39 • Configuration

The BE1-11*d* consists of three fiber inputs for voltage sensing and one fiber input for current sensing (shunt input). Each input is isolated and uses simplex (one-way) communication from the IT-D to the BE1-11*d*.

System Measurements

System inputs, as described in the introduction, are measured and sampled by the IT-D Isolation Transducer. The sample information is then sent from the IT-D to the BE1-11*d* via the fiber-optic interface. The BE1-11*d* collects voltage and current data from these samples and updates calculated quantities every quarter-cycle (based on system nominal frequency). The results are used for metering and protective functions. System inputs are described in the paragraphs under the following headings: *Current*, *Voltage*, and *Power*.

Current Measurement

Low-voltage dc output from power system equipment shunts is applied to the IT-D low-voltage sensing input where it is scaled, filtered, measured, digitized, and transmitted to the BE1-11*d*. Input waveforms are sampled by 18-bit analog-to-digital converters.

Voltage Measurement

High-voltage dc from the system is applied to the IT-D high-voltage sensing input where it is scaled, filtered, measured, digitized, and transmitted to the BE1-11*d*. Input waveforms are sampled by 18-bit analog-to-digital converters.

Power Calculation

The measured current and voltage as described previously in this chapter are used to calculate the power.

System Settings

The BE1-11*d* requires information about the system to provide metering, fault reporting, and protective relaying.

System settings are configured on the Fiber Input Settings and Power Voltage Source screens in BESTCOMS*Plus*®. A summary of the settings appear at the end of this section.

BESTCOMS*Plus* Navigation Path: Settings Explorer, System Parameters, Power System

HMI Navigation Path: Settings Explorer, System Parameters

Shunt Ratio

The shunt ratios are defined on this screen.

Bus Voltage Selection

This setting defines which voltage source the BE1-11*d* should use to calculate power (P1).

Power Source Frequency

This setting is used by the oscillography recording function. Select the frequency of the connected IT-D module.

Settings

System settings are configured on the Power System screen (Figure 39-1) in BESTCOMS*Plus*.

Figure 39-1. Power System

Display Units

The Display Units screen is shown in Figure 39-2.

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Display Units

HMI Navigation Path: Settings Explorer, System Parameters

System Units

This setting configures the BE1-11*d* to display and report temperature in English or metric units of measure.

Figure 39-2. Display Units Screen

40 • Introduction to Testing

The need to test protection systems to confirm performance as designed by manufacturers has always existed. However, numeric system design is changing the industry testing paradigms that have been in use since the first protective relay was built. Each time a fault occurs, the numeric protection system is tested, and because of its fault and event recording capability, the test is documented. In the unlikely event of a protection system problem, continuous monitoring along with remote communications capability provide for removing the affected device from service, auto switching to backup systems, and immediate notification of an attended facility. These features have virtually eliminated the need for periodic maintenance. Simple acceptance tests that verify the integrity of the BE1-11*d* measuring circuits and commissioning tests that verify the BE1-11*d* “electronic wiring” (control logic) are Basler Electric’s recommended pre-installation tests.

The testing chapters provide guidelines for performing these tests and others. For assistance in conducting BE1-11*d* self-tests and troubleshooting using internal diagnostics, contact Basler Electric Technical Support Services.

Testing Philosophies

Testing is generally divided into the following categories:

- Acceptance
- Commissioning
- Periodic (user scheduled maintenance)
- Functional Testing

While all types of tests can be performed, all users do not generally perform these tests. Likewise, the degree to which you will conduct each type of test depends on need, economics, and perceived system value.

Acceptance Testing

Acceptance testing confirms that a particular BE1-11*d* delivered to a customer meets published specifications. Because this is a numerical device whose characteristics are defined by software, Basler Electric does not require the user to test each operational setting in the BE1-11*d*. Successful completion of the Acceptance Test verifies proper response of the protection system’s input and output circuits as well as its response to all external sensing input quantities (voltage and current).

Basler Electric performs detailed acceptance testing on all devices to verify all functions meet published specifications. All products are packaged and shipped with the strictest standards. The BE1-11*d* is a microprocessor-based device whose operating characteristics will not change over time. The BE1-11*d* will also not experience any change in operating characteristics during transit. However, it remains important that the user perform these acceptance tests to verify the device has not suffered any degradation in transit. Basler Electric warrants all products against any decay in performance outside of the published specified tolerances that result from problems created during transit.

Commissioning Testing

Commissioning testing verifies all physical connections and functional aspects of theBE1-11*d* for a new installation. This includes a thorough review and documentation of the operational settings to verify that the users calculated values match the actual values on each enabled protection element of the BE1-11*d*. All of the following connections or functions can be verified during commissioning tests:

- Proper connection and sensing of current and voltage signals as applicable
- Connections of I/O contacts
- I/O sensing versus virtual sensing

- Setting validation
- Proper operation of equipment (main or auxiliary)
- Proper alarming (to SCADA) and/or targeting

Periodic Testing

Periodic testing can be performed at regularly scheduled intervals or upon an indication of problems or questionable operations within the BE1-11*d*. Verifying the integrity of the protection system's performance, short of playback of recorded events, may be necessary by performing certain tests similar to those accomplished in the *Acceptance Testing* chapter. Verification that the BE1-11*d* is measuring signals faithfully, that BE1-11*d* logic is appropriate, and that protective elements and equipment (main or auxiliary) operate correctly are goals that can be achieved during this type of testing.

Basler Electric recommends that all captured fault records and sequence of event records be analyzed and kept on file as in-service periodic test results for this particular device. This is an indication that all protective elements and the associated equipment are operating satisfactorily.

It is not the intent of this manual to elaborate on every conceivable test possible because this would encroach on individual preferences, techniques, and philosophies. It is the intent to pursue relevant testing methods to verify this BE1-11*d* meets published design specifications and applicability.

Functional Testing

Basler Electric performs a thorough and comprehensive functional test of all protection systems before shipping. This ensures that this device is within specified tolerances, measures accurately, and operates correctly as designed.

Testing and Troubleshooting Aids

Under test or in-service, the BE1-11*d* provides several ways to check operations, targets, or events. The status of the system is monitored by a continuous self-test. The most basic reporting function is targets. Targets can be viewed through BESTCOMS*Plus*® or the front-panel display. Fault Summary Reports, Sequence of Events Recorder (SER) Reports, and Oscillographic Records yield more detail.

Each time a system disturbance occurs in or around this BE1-11*d* zone of protection, it is a test of the BE1-11*d* performance during the fault. If a questionable operation results in the need for troubleshooting, you have several ways in which to troubleshoot the BE1-11*d*, the installation, and overall application.

Performance Testing

Performance testing can be accomplished through the capture and playback of system fault records. In actual applications, this type of test realizes further confirmation of faithful BE1-11*d* responses during system disturbances. For specific power system disturbances, protection systems can be subjected to a re-creation of captured events with the aid of equipment capable of replicating COMTRADE record files. In these instances, there is significant merit in testing protection systems in this manner to assess BE1-11*d* performance. Correct response of BE1-11*d* action in a performance test is supplemental verification of the conclusions drawn from functional (or application) tests.

This type of testing verifies not only whether the device operated correctly for a particular system disturbance but also offers additional confirmation of your protection philosophy in this application. It is beyond the scope of this manual to develop performance tests for this device. For assistance in developing these types of tests, please consult Basler Electric and your test equipment.

BE1-11*d* Self-Test

All internal circuitry and software that affect the BE1-11*d* core functionality are monitored by the continuous self-test diagnostics. For specific relay trouble alarms, the self-test diagnostics force the microprocessor to reset and try to correct the problem. If unsuccessful, OUTA operates, the Relay Trouble LED on the front panel turns ON, all of the output relays are disabled, internal logic point Relay

Alarms is set, and the BE1-11*d* is taken off line. For more information on self-test diagnostics and relay trouble alarms, see the *Contact Inputs and Outputs* chapter.

Status Reporting Features

Status reporting is available by using the Metering Explorer in BESTCOMS*Plus*. This report assembles all of the information required to determine the BE1-11*d* status.

Fault reporting and target data is dependent on the proper setting of trip, pickup, and logic trigger expressions (via BESTlogic™*Plus* Programmable Logic) and the assignment of protective elements to be logged as targets (via BESTCOMS*Plus*).

While the design of the BE1-11*d* facilitates obtaining and verifying targets and event data, it is not always necessary to use the BE1-11*d* functions to determine if the device operated while testing. You can simply use an ohmmeter or continuity tester to monitor the output contact status.

The following is a summary of where target and event data can be viewed in BESTCOMS*Plus*:

- Fault records in memory - Metering Explorer/Reports/Fault Records
- Target data - Metering Explorer/Status/Targets
- Sequence of events (SOE) records - Metering Explorer/Reports/Sequence of Events

For more information on front-panel display menu trees, see the *Controls and Indicators* chapter.

Event Reporting Features

The SOE function of the BE1-11*d* records protective element output changes, overcurrent element pickup or dropout, input/output contact state changes, logic triggers, setting group changes, and setting changes. For more information on event reporting, see the *Sequence of Events* chapter.

The following summarizes the reporting capabilities of the BE1-11*d* through the front-panel display:

- Trip LED (Flashing): flashes during pickup of protective elements based on the pickup logic expression set in BESTlogic*Plus* Programmable Logic.
- Trip LED (Sealed-In): stays lit after trip logic becomes true based on the trip logic expression set in BESTlogic*Plus* Programmable Logic.
- TARGETS: Metering > Status > Targets screen provides target data.
- ALARMS: Metering > Status > Alarms screen provides alarm data.
- FAULT REPORTS: Metering > Fault Reports screen indicates new fault reports.

41 • Acceptance Testing

Although Basler Electric performs detailed acceptance testing on all new protection systems, it is generally recommended that you perform each of the following acceptance test steps before installation. The following steps test each function of the BE1-11*d* to validate that it was manufactured properly and that no degradation of performance occurred because of shipping.

Test Equipment

Suitable test equipment requires a minimum of one dc voltage source and a contact wetting voltage. A PC with BESTCOMS*Plus*® installed and configured for communication with the BE1-11*d* is also required.

Power Up

Purpose: To verify that the BE1-11*d* performs the power-up sequence.

Step 1: Apply 48/125 Vac/dc to input power terminals A6 and A7.

Step 2: Verify that the Power LED is ON, and that characters are displayed on the front panel. Upon power-up, the BE1-11*d* will perform a brief self-test. During this brief test, the display indicates each step of the self-test; Performing BIOS Tests…, Loading Application…, Initializing Protection…, and then the default display screen. Contact Basler Electric Technical Support Services if anything appears out of the ordinary or if an LCD error message appears.

Communications

Purpose: To verify that the BE1-11*d* communicates through the USB and optional Ethernet port.

Step 1: Use BESTCOMS*Plus* to connect to the BE1-11*d* through the front-panel USB port and through the optional rear panel Ethernet port. Refer to the *Communication* chapter.

Style Number and Serial Number Verification

Purpose: To verify that the BE1-11*d* style number and serial number matches the unit and unit labels.

Step 1: Connect to the BE1-11*d* through BESTCOMS*Plus*.

Step 2: Use the Settings Explorer to open the General Settings, Style Number screen and verify that the style number matches the unit labels.

Step 3: Use the Settings Explorer to open the General Settings, Device Info screen and verify that the serial number matches the unit labels.

IRIG Verification (if used)

Purpose: To verify that the BE1-11*d* acquires and updates IRIG time and date information.

Step 1: Connect a suitable IRIG source to BE1-11*d* terminals A1 (+) and A2 (–).

Step 2: Upon receiving the IRIG signal, the BE1-11*d* clock will be updated with the current time, day, and month. Verify this on the Metering > Status > Real Time Clock screen on the front-panel display.

Contact Sensing Inputs

Purpose: To verify that the BE1-11*d* senses hardware input status.

Step 1: Apply an external voltage source within the range of the voltages listed in Table 41-1 to contact sensing inputs IN1 (B1/B2), IN2 (B3/B4), IN3 (B5/B6), IN4 (B7/B8), IN5 (E1/E2), IN6 (E3/E4), and IN7 (E5/E6).

Table 41-1. Contact Sensing Turn-On Voltages

Nominal Input Voltage	Contact Sensing Turn-On Voltage*	
	Jumper Installed (Low Position)	Jumper Not Installed (High Position)
48 Vdc or 125 Vac/dc	26 to 38 Vdc	69 to 100 Vdc 56 to 97 Vac

* For information on setting contact-sensing input jumpers, refer to the *Contact Inputs and Outputs* chapter.

Step 2: To verify that all inputs have been detected, use the Metering Explorer in BESTCOMS*Plus* to open the Status, Inputs screen.

Control Outputs

Purpose: To verify that the BE1-11*d* senses hardware output status.

Step 1: Connect to the BE1-11*d* through BESTCOMS*Plus*.

Step 2: Use the Metering Explorer to open the Control, Output Override screen.

Step 3: Click on the Disabled button for Output #1. The button changes to Enabled indicating that the output control override capability of the relay is enabled.

Step 4: Select Set from the Action drop-down menu and click on the green arrow button to energize Output #1. Verify that the Output #1 Status LED, located on the Output Override screen of BESTCOMS*Plus*, turns on. Navigate to Metering > Status > Outputs on the front-panel display and verify that Output #1 changes state.

Step 5: Select Reset from the Action drop-down menu and click on the green arrow button to de-energize Output #1. Verify that the Output #1 Status LED, located on the Output Override screen of BESTCOMS*Plus*, turns off. Navigate to Metering > Status > Outputs on the front-panel display and verify that Output #1 changes state.

Step 6: Verify that the sequence of events recorder logged the events by using the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen.

Step 7: Use the Metering Explorer in BESTCOMS*Plus* to return to the Control, Output Override screen and click the Enabled button for Output #1. The button changes to Disabled indicating that the output control override capability of the relay is disabled.

Step 8: Repeat Steps 3 through 7 for all desired output contacts.

Current Circuit Verification

Step 1: Set Shunt Rated Millivolts = 100 and Shunt Rated Current = 100 on the *Settings Explorer, System Parameters, Power System* screen in BESTCOMS*Plus*.

Step 2: Connect the IT-D module(s) to the BE1-11*d* as shown in Figure 41-1.

Step 3: To verify I1, connect a dc voltage source to Terminals 3 and 4 on IT-D-1.

Step 4: Apply the appropriate voltage values in Table 41-2 to IT-D-1. Verify current measuring accuracy by opening the Analog Metering, Current screen inside the Metering Explorer of BESTCOMS*Plus*. I1 current measurement can also be verified on the Metering > Analog Metering > Current > System Current screen of the front-panel display.

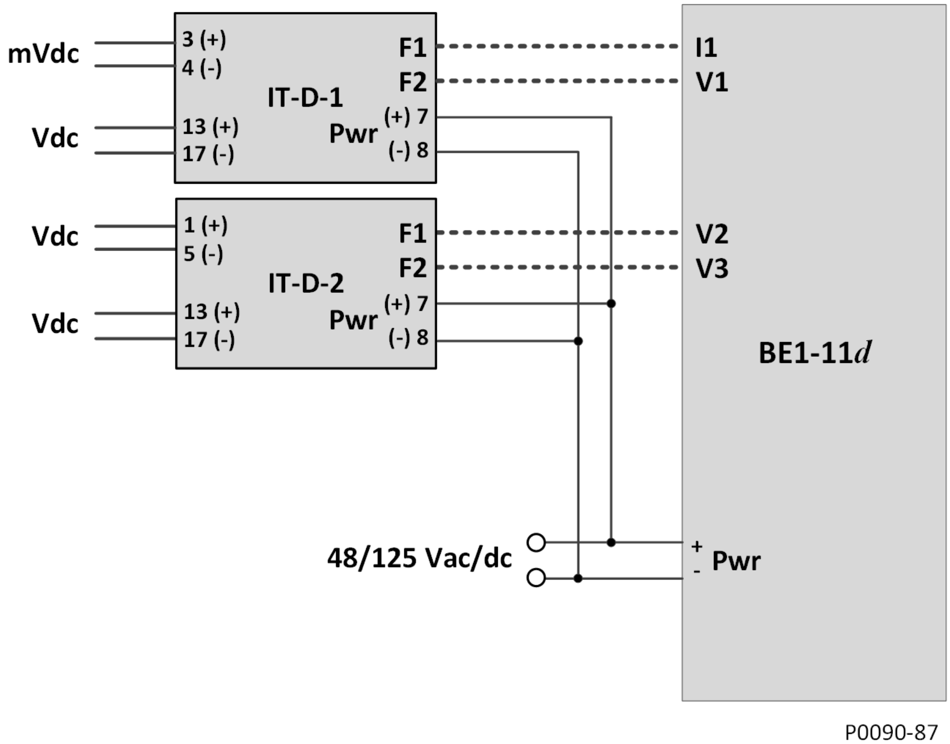


Figure 41-1. IT-D to BE1-11*d* Connections

Table 41-2. Current Circuit Verification Values

Applied Voltage	Measured System Current	
	Lower Limit	Upper Limit
50 mVdc	49.5 A	50.5 A
100 mVdc	99 A	101 A
500 mVdc	495 A	505 A
1.00 Vdc	990 A	1.01 A
–50 mVdc	–49.5 A	–50.5 A
–100 mVdc	–99 A	–101 A
–500 mVdc	–495 A	–505 A
–1.00 Vdc	–990 A	–1.1 A

Step 5: Turn off source voltage and disconnect.

Voltage Circuit Verification

Step 1: Connect the IT-D modules to the BE1-11*d* as shown in Figure 41-1.

Step 2: To verify V1, connect a dc voltage source to terminals 13 and 17 on IT-D-1.

Step 3: Apply the appropriate voltage values in Table 41-3 to IT-D-1. Verify voltage measuring accuracy by opening the Analog Metering, Voltage screen inside the Metering Explorer of BESTCOMS*Plus*. V1 voltage measurement can also be verified on the Metering > Analog Metering > Voltage > System Voltage screen of the front-panel display.

Table 41-3. Voltage Circuit Verification Values

Applied Voltage	Measured Voltage	
	Lower Limit	Upper Limit
10 Vdc	9.9 Vdc	10.1 Vdc
100 Vdc	99 Vdc	101 Vdc
300 Vdc	297 Vdc	303 Vdc
–10 Vdc	–9.9 Vdc	–10.1 Vdc
–100 Vdc	–99 Vdc	–101 Vdc
–300 Vdc	–297 Vdc	–303 Vdc

Caution

Testing may be performed at voltages up to 2,000 Vdc. Use caution when working with dc voltages.

Step 4: If a second IT-D module is used, repeat all steps to verify V2 and V3 with voltage source connected to IT-D-2.

Step 5: Turn off source voltage and disconnect.

42 • Commissioning Testing

Special precautions should be taken to ensure that all tests are performed with safety as the greatest concern. Any current circuit signals routed through this device as part of a protection scheme, including discrete relays or as a stand-alone device, should be shorted and isolated from this BE1-11*d* during these tests.

If this BE1-11*d* is being installed in an existing installation, be aware of the equipment monitoring features of this device, especially if the monitoring logic will be utilized. Make note of any pretest operation levels, duty levels, etc. on existing equipment (e.g., breakers). As the user, you can make the determination of what values the BE1-11*d* should have as initial monitoring values when it is placed in service.

It may on occasion be necessary to temporarily disable some of the protective elements while testing the BE1-11*d* to isolate testing of individual functions. Always remember to enable these functions before placing the BE1-11*d* in service.

To assist you in the commissioning testing of this BE1-11*d*, you can refer to the related reporting and alarms chapters.

Please refer to the related protection and control chapters of the instruction manual for assistance on any particular functions of the BE1-11*d*. If you require further assistance, contact Basler Electric field application personnel or the factory.

Digital I/O Connection Verification

Contact Sensing Inputs

Purpose: To verify operation, labels, and logic settings of the contact sensing inputs.

Chapter Reference: Contact Inputs and Outputs

Step 1: Use the Settings Explorer in BESTCOMS*Plus*® to open the Programmable Inputs, Contact Inputs screen and verify the Input 1 through Input 10 user-defined name, recognition time, debounce time, energized state label, and de-energized state label. Refer to the style chart for I/O options.

Step 2: Use the Metering Explorer in BESTCOMS*Plus* to open the Status, Inputs screen. Verify the status of Input 1. From the actual field device, energize (or de-energize) the specific contact that supplies BE1-11*d* Input 1. While maintaining contact position, verify that Input 1 has changed state on the Status, Inputs screen of BESTCOMS*Plus* or the front-panel display. Return the field contact to its original state, verifying that Input 1 returns to its original state. Use the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen. Click on the Refresh button and review the events associated with the field contact change.

Step 3: Repeat Step 2 for each connected input.

Output Contacts

Purpose: To verify operation, labels, and logic settings of the output contacts.

Chapter Reference: Contact Inputs and Outputs

Step 1: Use the Settings Explorer in BESTCOMS*Plus* to open the Programmable Output, Output Contacts screen and verify the Output 1 through Output 8, and Output A label, energized state label, de-energized state label, and hold attribute. Refer to the style chart for I/O options.

Step 2: Use the Metering Explorer in BESTCOMS*Plus* to open the Control, Output Override screen. Verify the status of OUT1 through OUT8. Use the procedure outlined under *Acceptance Testing, Control Outputs* to actuate selected output contacts (OUT1 through OUT8) and actually trip or close the connected field device (circuit breaker, lockout, etc.). Verify that the selected output has changed state on the Control, Output Override screen of BESTCOMS*Plus* or the front-panel display. Return the output to its original state, verifying that the output returns to its original state. Use the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen. Click on the Refresh button and review the events associated with the output contact change.

Step 3: Repeat Step 2 to verify that operation of the alarm output relay (OUTA) initiates the appropriate alarm response.

Virtual Selector Switches

Purpose: To verify operation, labels, and logic settings of the 43 switches.

Chapter Reference: Virtual Control Switches (43)

Step 1: Use the Settings Explorer in BESTCOMS*Plus* to open the Control, Virtual Control Switches screen and verify the 43-1 through 43-5 mode, name label, on label, and off label.

Step 2: Use the Metering Explorer in BESTCOMS*Plus* to open the Control, Virtual Switches screen and obtain the position of the five virtual selector switches. Alternately, the virtual selector switch positions can be obtained on the Metering > Control > Virtual Switches screen of the front-panel display.

Step 3: Obtain write access to the BE1-11*d*. For each virtual selector switch enabled in your logic scheme, change the switch position by following the procedure described in the *Virtual Control Switches (43)* chapter.

Step 4: Verify each switch position change on the Control, Virtual Switches screen of BESTCOMS*Plus* or on the front-panel display.

Step 5: Return each virtual selector switch to the original position.

Step 6: Use the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen. Click on the Refresh button and review the events associated with the virtual switch activities.

Virtual Control Switch

Purpose: To verify operation and logic setting for the 101 switch.

Chapter Reference: Breaker Control Switch (101)

Step 1: Use the Settings Explorer in BESTCOMS*Plus* to open the Control, Breaker Control Switch screen and verify the 101 element mode.

Step 2: Use the Metering Explorer in BESTCOMS*Plus* to open the Control, Breaker Control Switch screen and obtain the position of the breaker control switch. Alternately, the breaker control switch position can be obtained on the Metering > Control > 101 Breaker Control SW screen of the front-panel display.

Step 3: Obtain write access to the BE1-11*d*. Change the switch position by following the procedure described in the *Breaker Control Switch (101)* chapter.

Step 4: Verify the switch position change on the Control, Breaker Control Switch screen of BESTCOMS*Plus* or on the front-panel display.

Step 5: Return the breaker control switch to the original position.

Step 6: Use the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen. Click on the Refresh button and review the events associated with the breaker control switch.

Protection and Control Function Verification

Before placing the BE1-11*d* in service, the user should ensure that all system ac and dc connections are correct, that the BE1-11*d* functions as intended with user settings applied, and that all equipment external to the BE1-11*d* operates as intended. All connected or monitored inputs and outputs should be tested. Verify that:

- Power supply voltages and contact wetting voltages are correct.
- User desired protection and control functions are enabled and connected to the correct current or voltage fiber input circuits from the IT-D.
- The programmable logic settings (electronic wiring) provide the proper interconnection of these functions with the I/O of the BE1-11*d*.

Simple user-designed fault tests should be used to verify that the operational settings are correct, that the proper output relays are actuated, and proper targeting occurs. It is not necessary to test every protection element, timer, and function in these tests.

Use of the fault and event recording capability of the BE1-11*d* will aid in the verification of the protection and control logic. Use the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen. In addition, it is helpful to click on the Clear button prior to starting a test. This allows the user to review only those operations recorded since the sequence of events was last cleared. Refer to the *Sequence of Events* chapter for more detail.

It may be necessary to disable protection elements or change setting logic to verify a specific function. To guard against placing the BE1-11*d* in service with unwanted operational or logic settings, it is good practice to save a copy of the original setting file before the testing process begins. When testing is complete, compare the copy of the saved settings to the actual settings as a final verification.

Use the settings compare feature in BESTCOMS*Plus* to compare setting files. Refer to the *BESTCOMSPlus Software* chapter for more information.

Verify Other Setpoints as Appropriate

Consult the individual functional testing chapters for guidelines on testing and verifying setpoints of other protection and control functions.

Reporting and Alarm Functions

Just prior to placing the BE1-11*d* in service, the following reporting and alarm functions should be reset and/or verified.

Clock Display

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Real Time Clock

HMI Navigation Path: Metering Explorer, Status, Real Time Clock

Chapter Reference: Timekeeping

Set the real time clock to the current date and time. If an IRIG signal or NTP server is used, day, time, and year are automatically synchronized with the source. Note that the time code signal from older IRIG time code generating equipment does not contain the current year information thus necessitating the entry of the year.

Energy Data

BESTCOMS*Plus* Navigation Path: Metering Explorer, Analog Metering, Energy

HMI Navigation Path: Metering Explorer, Analog Metering, Energy

Chapter Reference: Metering

Read or reset thermal capacity and power energy.

Demand Data

BESTCOMS*Plus* Navigation Path: Metering Explorer, Demand

HMI Navigation Path: Metering Explorer, Demand Meter

Chapter Reference: Demands

Reset the peak current and watt demand registers to “0” or a pre-existing value.

Breaker Monitoring

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Breaker Monitor

HMI Navigation Path: Metering Explorer, Reports, Breaker Report

Chapter Reference: Breaker Monitoring

If the Breaker Monitoring features of the BE1-11*d* are enabled, reset the counter and the duty registers to “0” or a pre-existing value.

Relay Trouble Alarms

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Alarms

HMI Navigation Path: Metering Explorer, Status, Alarms

Chapter Reference: Alarms

Reset and verify that the relay trouble alarm is not lit. If required, alarm information can be read by using the Metering Explorer in BESTCOMS*Plus* to open the Status, Alarms screen. To attempt clearing a Relay Trouble Alarm, press the Reset Relay Alarms button or navigate to Metering > Status > Alarms > Relay Alarms on the front-panel display and press the front-panel Reset button. Refer to the *Alarms* chapter for setting details.

Major/Minor Programmable Alarms

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Alarms

HMI Navigation Path: Metering Explorer, Status, Alarms

Chapter Reference: Alarms

Reset and verify that the programmable alarms, Major and Minor, as set to meet user needs, are not lit or asserted. If required, alarm information can be read by using the Metering Explorer in BESTCOMS*Plus* to open the Status, Alarms screen. To reset a Major/Minor alarm, press the Reset Major, Minor Alarms button or navigate to Metering > Status > Alarms > Major or Minor Alarms on the front-panel display and press the front-panel Reset button. Refer to the *Alarms* chapter for settings details.

Targets

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Targets

HMI Navigation Path: Metering Explorer, Status, Targets

Chapter Reference: Fault Reporting

Reset any active targets and verify that they clear. Targets are reset by navigating to Metering > Status > Targets on the front-panel display and pressing the Reset button or by using the Metering Explorer in BESTCOMS*Plus* to open the Status, Targets screen and clicking on the Reset Targets button. Write access is required to reset targets through BESTCOMS*Plus*. Refer to the *Fault Reporting* chapter for setting details.

Fault Summary Reports

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Fault Records

HMI Navigation Path: Metering Explorer, Reports, Fault Reports

Chapter Reference: Fault Reporting

Reset “new” fault summary directory records to “0” by using the Metering Explorer in BESTCOMS*Plus* to open the Reports, Fault Records screen and clicking on the Reset button. Write access is required. Verify the new faults are “0” by clicking on the Refresh button. Refer to the *Fault Reporting* chapter for setting details.

Sequence of Events Recorder (SER)

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Sequence of Events

HMI Navigation Path: Not available through the front panel

Chapter Reference: Sequence of Events

Reset the “new” SER records counter to “0” by using the Metering Explorer in BESTCOMS*Plus* to open the Reports, Sequence of Events screen and clicking on the Clear button. Write access is required. Verify that the new records are “0” by clicking on the Refresh button. Refer to the *Sequence of Events* chapter setting details.

Just Prior to Energizing - Report Documentation

After completing the previous steps, use the Metering Explorer in BESTCOMS*Plus* to open the Status tree branch. Capture and save the information for Inputs, Outputs, Alarms, Targets, and Digital Points. This report should be kept in a permanent record file of the device so the data can be used for comparison in future maintenance procedures.

Also, save the entire settings record for future reference by using BESTCOMS*Plus* and selecting Download Settings and Logic from Device from the Communication pull-down menu. After settings and logic are downloaded into BESTCOMS*Plus* memory, select Save from the File pull-down menu. Use this record during the maintenance cycle or during the analysis of an operation to verify that the “as found” settings are exactly as left during the commissioning process.

Refer to the related reporting and alarms chapters and the *BESTCOMSPlus Software* chapter.

In Service Readings

After energizing the equipment, use the Metering Explorer in BESTCOMS*Plus* to verify the analog metering values for voltage. Save this record along with the status record mentioned earlier for future reference.

43 • Periodic Testing

Because the BE1-11*d* has extensive internal test capabilities, periodic testing of the protection system can be greatly reduced. BE1-11*d* operating characteristics are a function of programming instructions that do not drift over time. Thus, the user may wish to verify items that the protection system's self-testing features cannot completely determine. Periodic testing may consist of the following settings and function checks:

- Verify that the setpoints that were proven during commissioning have not been changed.
- Verify proper interfacing between the inputs and outputs and the rest of the protection and control system.
- Verify that the system analog parameters used by the protection and control functions are measured accurately.

Settings Verification

Verification of the BE1-11*d* digital I/O connections can be accomplished in different ways. The method used depends on your preferences and practices. You may choose to use either of the following two methods:

- Repeat the digital I/O connection and label verification under commissioning tests.
- Monitor SER, status, and fault reports for proper sensing of digital signals and proper output tripping during normal operation.

Note

In redundant protection systems where multiple relays will trip a given breaker or other device for a fault, fault record monitoring may not indicate a failed output contact. The BE1-11*d* may report that it energized an output when tripping was actually accomplished by the redundant relay. In this situation, testing the contact is recommended.

Analog Circuit Verification

Verification of BE1-11*d* analog measurement circuits can be accomplished in multiple ways and depends on your preferences and practices. Either of the two following methods may be used:

- Repeat the acceptance tests by injecting test quantities into the BE1-11*d*.
- Use the BE1-11*d* metering functions to compare the protection system's measurements with those made by similar devices that are measuring the same signals. Redundant relays or metering devices can provide this independent confirmation of measured signals. If the BE1-11*d* is connected to an integration system, this verification can even be automated and done on a semi-continuous basis.

Note

If verifying the analog measurement circuits by comparison to independent devices is used, you should ensure that the two devices use similar measurement algorithms.

Functional testing is NOT required for this device. It is necessary only when performing a comprehensive assessment to determine suitability for an application.

44 • Frequently Asked Questions (FAQ)

Electrical/Connections

Is the power supply polarity sensitive?

No, the power supply will accept either an ac or dc voltage input. Refer to the *Typical Connections* chapter.

Are the sensing contacts polarity sensitive?

Yes, refer to the *Typical Connections* chapter for more information.

What voltage level is used to develop current flow through the contact sensing inputs?

Voltage level is dependent on the power supply option (called out in the BE1-11*d* style chart). For additional information, refer to the *Contact Inputs and Outputs* chapter and the style chart in the *Introduction* chapter.

Can the IRIG signal be daisy-chained to multiple BE1-11*d* units?

Yes, multiple BE1-11*d* units can use the same IRIG-B input signal by daisy-chaining the BE1-11*d* inputs. The burden data is nonlinear, approximately 4 kΩ at 3.5 Vdc and 3 kΩ at 20 Vdc. See the *Specifications* chapter for additional information.

General Operation

Does the BE1-11*d* trip output contact latch after a fault?

The answer to the question is yes and no. In general, once the fault goes away the output contacts open. The BE1-11*d* does offer an option to ensure that the contact will stay closed for at least 200 milliseconds. See the *Contact Inputs and Outputs* chapter for additional information on that function. Also, a Set Priority Latch in BESTlogic™*Plus* can keep the relay outputs closed as long as power is applied.

Can I make logic settings at the front panel?

No, logic settings cannot be programmed at the front panel. Logic settings must be programmed using BESTCOMS*Plus*® communication software.

Since the BE1-11*d* is a programmable device, what are the factory defaults?

Default settings are shown with each function in the instruction manual. For input or output default settings see the *Contact Inputs and Outputs* chapter. For protection and control functions, see the appropriate chapters. The factory default logic scheme is defined in the BESTlogic*Plus* chapter.

Does the BE1-11*d* have a battery installed as the backup power source for the internal clock on loss of power?

A ride-through capacitor, up to 24 hours, and a backup battery, greater than five years, are standard features of the BE1-11*d*. Refer to the *Timekeeping* chapter for more information on the backup battery including replacement.

How are reports and other information obtained from the BE1-11*d* saved in files for future use?

BESTCOMS*Plus* can be used to view sequence of events, fault records, security log, load profile, and breaker status. See the appropriate chapters for more information.

How can I check the version number of my BE1-11*d*?

The application version can be found in four different ways: One, on the Settings > General Settings > Device Information screen of the front-panel display. Two, on the Settings Explorer, General Settings, Device Info screen of BESTCOMS*Plus*. Three, on the *Status* (home) page of the web page interface. Four, on the Metering Explorer, Device Info screen of BESTCOMS*Plus*.

Communications

Is the IRIG signal modulated or demodulated?

The BE1-11*d* accepts an IRIG-B signal that is demodulated (dc level-shifted digital signal). See the *Specifications* chapter for additional information.

45 • Troubleshooting

Basler microprocessor-based protection systems are similar in nature to a panel of electromechanical or solid-state component relays. Both must be wired together with inputs and outputs, and have operating settings applied. Logic settings determine which protection elements are electronically wired to the inputs and outputs of the device. Operating settings determine the pickup thresholds and time delays.

The logic and operating settings should be tested by applying actual inputs and operating quantities and verifying proper output response. For more details, refer to the testing chapters. All of the following connections and functions should be verified during commissioning tests:

- Proper connection and sensing of current and voltage signals
- Input and output contact connections
- I/O sensing
- Settings validation
- Proper operation of equipment (main or auxiliary)
- Proper alarming (to SCADA) and/or targeting

If you do not get the results that you expect from the BE1-11*d,* first check the programmable settings for the appropriate function. Use the following troubleshooting procedures when difficulties are encountered in the operation of your BE1-11*d*.

Warning!
Troubleshooting of the BE1-11*d* should be performed only by qualified personnel. High voltage may be present on the rear terminals of the BE1-11*d* or on the terminals of the IT-D Isolation Transducers.

Communications

Ethernet Port Does Not Operate Properly

Step 1. Verify that the proper port of your computer is being used. For more information, refer to the *Communication* chapter.

Step 2. Verify that the network configuration of the BE1-11*d* is set up properly. For more information, refer to the *Communication* chapter.

USB Port Does Not Operate Properly

Verify that the USB driver was installed properly. For more information, refer to the *BESTCOMSPlus Software* chapter.

USB Driver Did Not Install Properly on Windows® 7, 8, or 10

Step 1. If the message in Figure 45-1 is shown, close all programs and restart the computer.

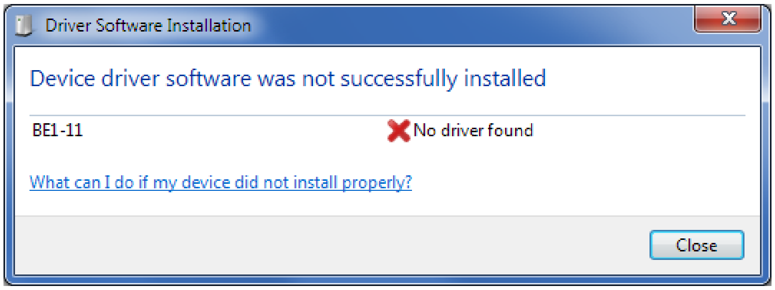


Figure 45-1. Driver Software Installation

Step 2. Open the Windows® Device Manger as shown in Figure 45-2. Right-click on BE1-11 (or Unknown Device) under Other Devices and select Properties.

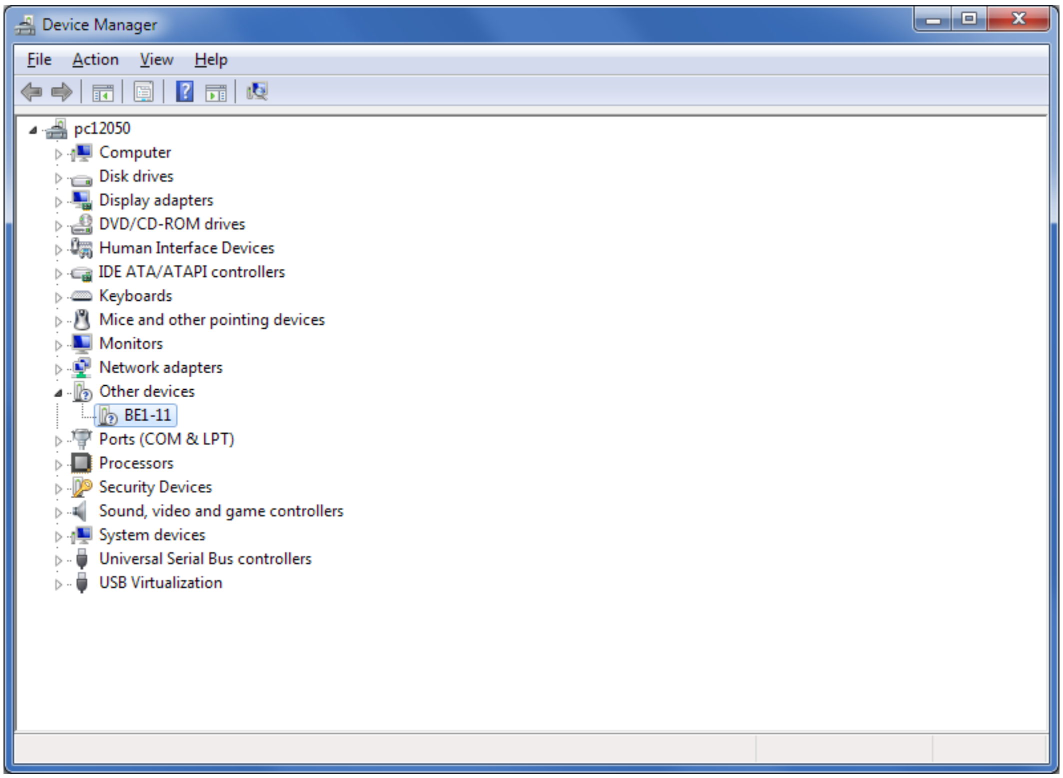


Figure 45-2. Device Manager

Step 3. In the Properties windows, select the Driver tab and click Update Driver. See Figure 45-3.

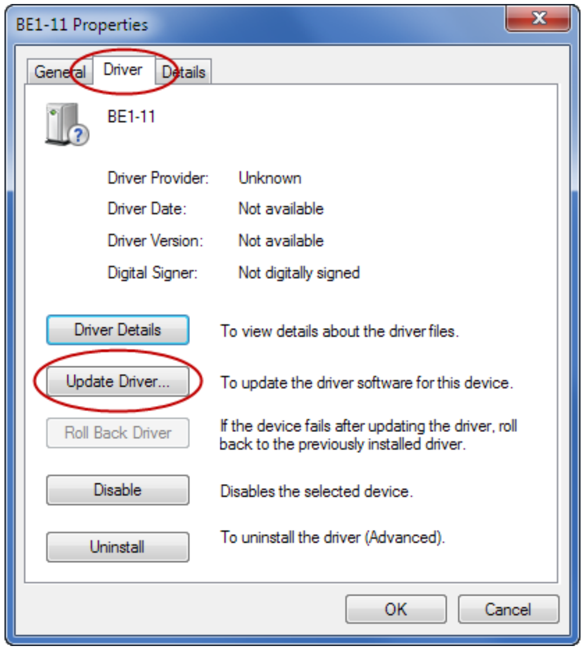


Figure 45-3. BE1-11 Properties

Step 4. Select Browse My Computer for Driver Software as shown in Figure 45-4.

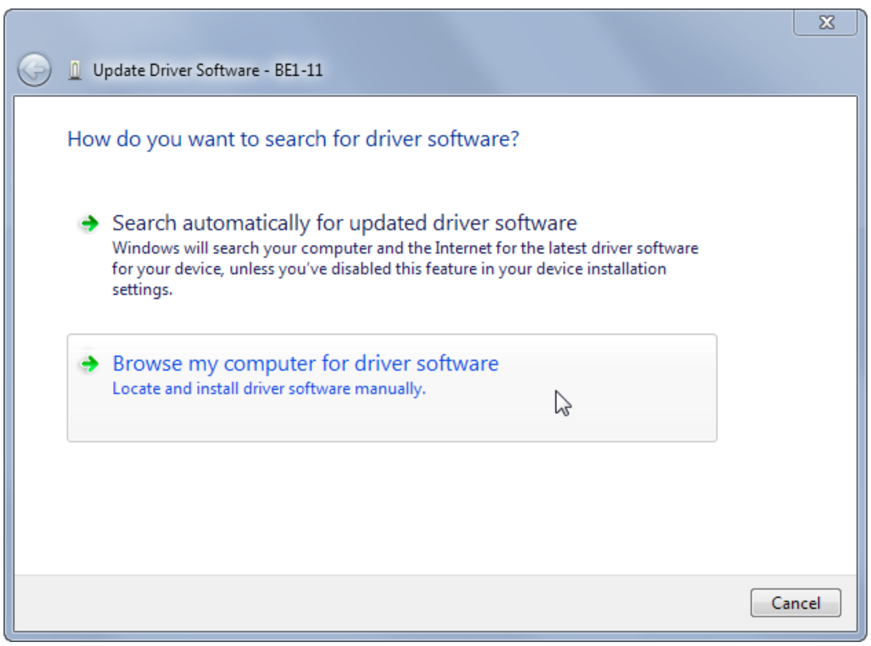


Figure 45-4. Update Driver Software - BE1-11

Step 5. Click Browse and navigate to C:\Program Files\Basler Electric\USB Device Drivers\USBIO. Click Next. See Figure 45-5.

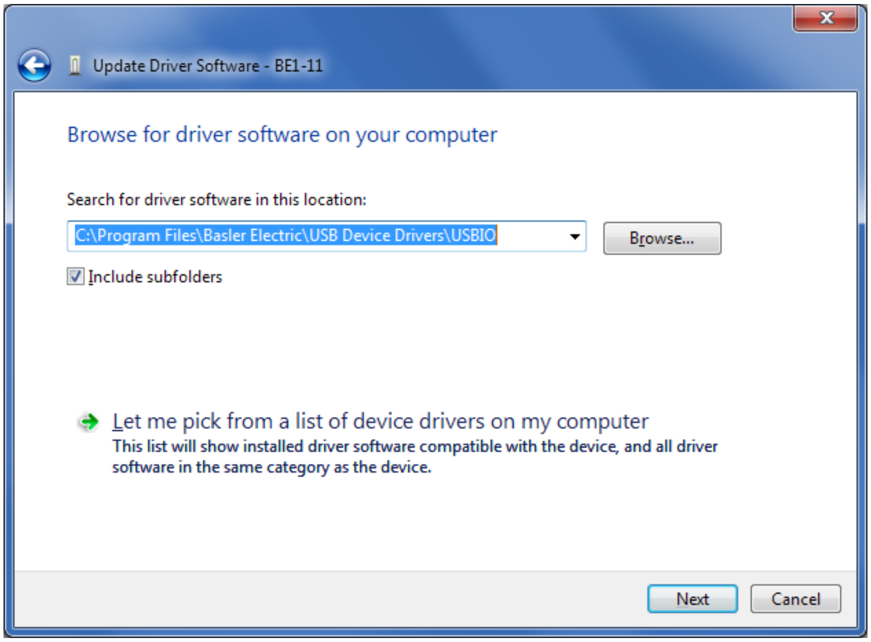


Figure 45-5. Update Driver Software - BE1-11

Step 6. If a Windows Security window (Figure 45-6) appears, click Install.

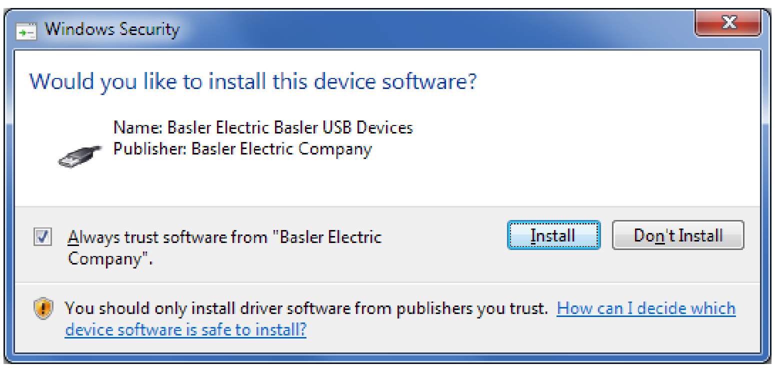


Figure 45-6. Windows Security

Step 7. The window in Figure 45-7 appears if driver installation was successful.

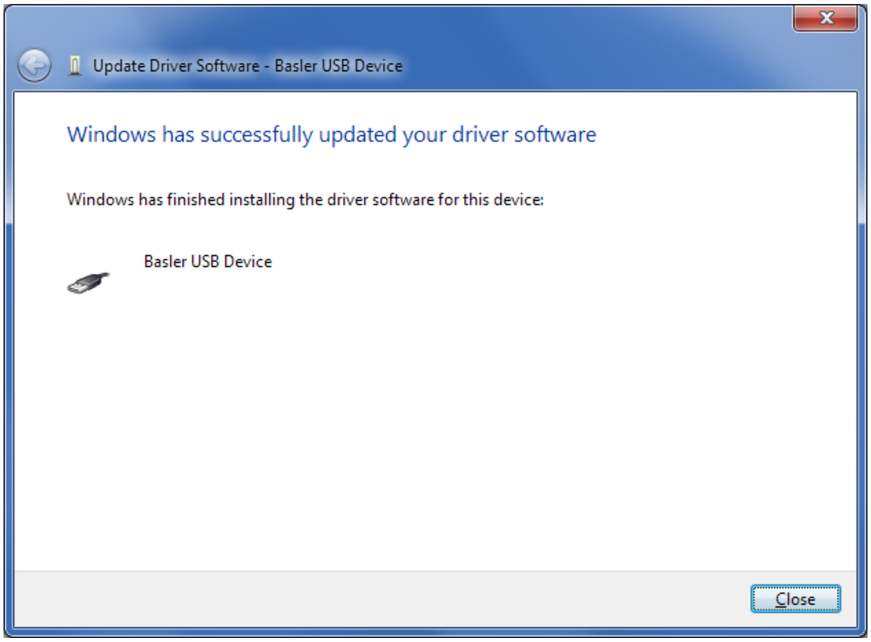


Figure 45-7. Driver Software Update Successful

Why do I keep getting access conflict errors when I attempt communication with the BE1-11*d*?

If you try to gain access to more than one port at a time, an access conflict results. The BE1-11*d* has three communication ports: front-panel USB, rear panel optional Ethernet, and rear panel RS-485. Each communication method has its own access. For example, if you gain access through Modbus TCP, then you cannot gain access using BESTCOMS*Plus* over Ethernet. Access needs to be gained only when a write command to the BE1-11*d* is required (control or setting change or report reset).

When access is gained through a port, a user-defined access control timer starts counting down to zero. When port activity occurs, the timer resets to the user-defined access control timer setting and resumes counting down. If no activity is seen for the duration of the access control timer setting, access is withdrawn and any unsaved changes are lost. When activity at a port is no longer required, access should be terminated.

To close front panel access immediately, press the Reset button while any menu screen is displayed. The BE1-11*d* should flash “Read Only” on the LCD screen to indicate access through the front panel has been terminated.

Obtaining data or reports from the BE1-11*d* never requires password access. The security log is an exception, as it requires Administrator access.

In Modbus® TCP/IP, the master cannot communicate with the BE1-11*d*, but can communicate over Modbus TCP/IP with other devices on the same network

Step 1. Verify that there is no IP address or Modbus slave address conflict.

Step 2. For some devices on an Ethernet network, only the IP address is required to communicate over Modbus TCP/IP. This is because each device must have a different IP address. With BE1-11*d* DC Power Protection Systems, in addition to the correct IP address, the master must also use the correct slave address.

Why don’t the BE1-11*d* security parameters get sent to the relay when I upload settings?

The security settings are not sent with the Upload Settings and Logic to Device or Upload Settings to Device commands found under the Communications drop-down menu in BESTCOMS*Plus*. The Upload Security to Device command must be used to send security parameters to the BE1-11*d*.

Inputs and Outputs

Programmable Inputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to the *Typical Connections* chapter.

Step 2. Verify that the inputs are programmed properly.

Step 3. Verify that the sensing input jumpers are in the correct position. Refer to the *Contact Inputs and Outputs* chapter.

Programmable Outputs Do Not Operate as Expected

Step 1. Verify that all wiring is properly connected. Refer to the *Typical Connections* chapter.

Step 2. Verify that the outputs are programmed properly.

Step 3. Verify that the output is not being set by other means. There can be more than one connection to an output (check the physical outputs tab in BESTlogic*Plus*). Also, check that the output override is not set for the output.

Metering/Display

Incorrect Display of Current

Step 1. Verify that all wiring is properly connected. Refer to the *Typical Connections* chapter.

Incorrect Display of Voltage

Step 1. Verify that all wiring is properly connected. Refer to the *Typical Connections* chapter.

General Operation

Why won't the Trip LED reset when I press the Reset key on the front panel?

The Reset key is context sensitive. To reset the Trip LED or the targets, the Targets screen must be displayed. To reset the alarms, the Alarms screen must be displayed.

Do I have to log in to reset the targets or alarms?

It depends on the security setup. You can reset the targets or alarms through a specific port without logging in if the Unsecured Access Level is set to Operator or higher on that port. Target and alarm reset can also be set outside of security control, allowing reset through the front-panel interface without logging in. Refer to the *Security* chapter for more information.

Why don't the targets or trip LED work properly?

If a protective element is tripping at the desired level, but the targets are not behaving as expected, use BESTCOMS*Plus* to verify that the targets are enabled for the protective function. Refer to the *Fault Reporting* chapter for detailed information about targets.

Trip LED behavior depends on the pickup and trip expression of the protective function. When the functions pickup expression is true and the trip expression is false, the Trip LED flashes. In other words, a flashing LED means that a protection element is in a picked up state and is timing toward a trip. When both the pickup and trip expression is true, the Trip LED lights steadily. The Trip LED also lights steadily when neither expression is true but latched targets exist. When resetting a target, the Trip LED will not turn off if the fault is still present. The truth table of Table 45-1 serves as an aid to interpreting Trip LED indications.

Table 45-1. Trip LED Truth Table

Trip	Pickup	Targets	Trip LED
No	No	No	Off
No	No	Yes	On
No	Yes	No	Flash
No	Yes	Yes	Flash
Yes	No	No	On
Yes	No	Yes	On
Yes	Yes	No	On
Yes	Yes	Yes	On

46 • Specifications

BE1-11*d* protection systems have the following features and capabilities.

Operational Specifications

Metered Current Values and Accuracy

I1 Range (Shunt) .... 0 to ±1.0 Vdc
Accuracy .... ±1% of reading or ±0.15% of full range, whichever is greater at 77°F (25°C)
Temperature Dependence .... ≤ ±0.02% per °C

Metered Voltage Values and Accuracy

V1, V2, V3 Range .... 0 to ±2,000 Vdc
Accuracy .... ±1% of reading or ±0.15% of full range, whichever is greater at 77°F (25°C)
Temperature Dependence .... ≤ ±0.02% per °C

Calculated Values and Accuracy

Demand

Type .... Exponential
Accuracy .... ±2% of reading or ±0.3% of full range, whichever is greater at 77°F (25°C)
Temperature Dependence .... ≤ ±0.04% per °C
Interval .... 1 to 60 min

Power

Accuracy .... ±2% of reading or ±0.3% of full range, whichever is greater at 77°F (25°C)
Temperature Dependence .... <±0.04% per °C

Energy Data Reporting

Rollover Value of Registers .... 1,000,000 kWhr
Accuracy .... ±2.5% of reading or 0.8% of full range, whichever is greater
Temperature Dependence .... <±0.04% per °C

27 – Undervoltage Protection

Pickup

Setting Range .... 50 to 1,875 Vdc
Accuracy .... ±1% or ±3 V, whichever is greater at 77°F (25°C)
Reset/Pickup Ratio .... 102% ±1%

Inhibit Level

Setting Range .... 50 to 1,875 Vdc
Accuracy .... ±1% or ±3 V, whichever is greater at 77°F (25°C)
Reset Inhibit Ratio .... 102% ±1%

Time Delay

Setting Range .... 0 to 60,000 ms
Accuracy.. ±0.5% or ±40 ms, whichever is greater

32 – Power Protection

Pickup

Setting Range .... 5 V x mV (50 Vdc x 0.1 mVdc) to 187,500 V x mV (1,875 Vdc x 100 mVdc)
Accuracy.. ±2.5% of setting (750 to 1,500 V, 25 to 100 mV) Max ±2% of full setting range
Reset/Pickup Ratio (Over) .... 95 to 99%
Reset/Pickup Ratio (Under) .... 102 to 107%

Time Delay

Setting Range .... 50 to 600,000 ms
Accuracy.. ±0.5% or 40 ms, whichever is greater

49 – Thermal Overload

Overload Pickup

Setting Range .... 0 or 0.5 to 300 mV
Accuracy.. ±1% of setting or ±0.7% of setting range, whichever is greater at 77°F (25°C)

Trip Time Constant

Setting Range .... 0 to 1,000 min
Accuracy.. ±5% or ±50 ms, whichever is greater

Reset

Reset Time Constant

Setting Range .... 0 to 1,000 min
Accuracy.. ±5% or ±50 ms, whichever is greater

Minimum Reset Time

Setting Range .... 0 to 1,000 min
Accuracy.. ±5% or ±50 ms, whichever is greater

Alarm

Setting Range .... 10 to 100%

49RTD – Resistance Temperature Device Protection (Optional)

Pickup

Setting Range .... 32 to 482°F (0 to 250°C)
Accuracy.. ±2% or ±3.6°F (±2°C), whichever is greater
Reset/Pickup Ratio.. 105% / 95% ±1% (over / under) or 41°F (5°C) minimum

Time Delay

Setting Range .... 0 to 600,000 ms
Accuracy.. ±1 s

59 – Overvoltage Protection

Pickup

Setting Range .... 50 to 1,875 Vdc
Accuracy... ±1% or ±3 V, whichever is greater at 77°F (25°C)
Dropout/Pickup Ratio .... 98% ±1%

Time Delay

Setting Range .... 50 to 60,000 ms
Accuracy... ±0.5% or ±40 ms, whichever is greater

62 – Logic Timers

Modes... Pickup/Dropout, One-Shot/Non-Retriggerable, One-Shot/Retriggerable, Oscillator, Integrating Timer, Latched
Setting Range .... 0 to 9,999,000 ms
Accuracy... ±0.5% or ±12 ms, whichever is greater

76 – DC Overcurrent Protection

Pickup

Setting Range .... 2.5 to 1,000 mV
Dropout/Pickup Rato .... 90 to 96% of the actual pickup value
Accuracy... ±1% of setting or ±0.15% of setting range, whichever is greater at 77°F (25°C)

Direction of Protection

Forward, Reverse, or Non-Directional

Time Delay (Definite Time)

Setting Range .... 50 to 6,000,000 ms
Accuracy... ±0.5% or ±30 ms, whichever is greater, plus trip time for instantaneous response (0.0 setting)*

* Trip time for 0.0 Delay Setting is 20 ms maximum for currents > 5 times the pickup setting, 28 ms maximum for a current of 2 times the pickup setting, 32 ms maximum for a current of 1.05 times the pickup setting

Time Dial (Inverse Time)

Setting Range .... 0 to 9.9
Time Curve... ±5% or ±25 ms, whichever is greater, for time settings greater than 0.1 and multiples of 2 to 40 times the pickup setting. Refer to the *Time Curve Characteristics* chapter for information on available timing curves.

82 – Recloser Protection

Load Calculation

R_{Sense} Setting Range .... 10 to 9,999 ohms
R_{Limit} Setting Range .... 0.01 to 5 ohms

Load Measure Timing

Duration Setting Range .... 0.5 to 9.9 s
Accuracy.. ±0.5 or ±40 ms, whichever is greater

Voltage Monitor (Live Line, Live Bus, Dead, Line, Dead Bus)

Setting Range .... 50 to 1,500 Vdc
Accuracy.. ±1% or ±3 V, whichever is greater at 77°F (25°C)

Rate of Rise

Pickup

di/dt Trigger

Setting Range .... 25 to 2,500 mV/second

di/dt Minimum

Setting Range .... 25 to 2,500 mV/second

Delta Current Timer Maximum

Setting Range .... 0 to 500 ms

Delta Timer Maximum

Setting Range .... 0 to 500 ms

Current Maximum/Minimum

Setting Range .... 2.5 to 500 mV

Automatic Setting Group Characteristics

Number of Setting Groups 4

Control Modes

Automatic .... Cold-Load Pickup, Dynamic Load or Unbalance
External .... Discrete Input Logic, Binary Input Logic

Switch Threshold

Range.. 0 to 500 mV
Accuracy.. ±1% of setting or ±0.3% of setting range, whichever is greater at 77°F (25°C)

Switch Time

Range.. 0 to 60 min with 1 min increments where 0 = disabled
Accuracy.. ±0.5% or ±2 s, whichever is greater

BESTlogic™*Plus*

Update Rate .... ¼ cycle (based on Power Source Frequency selection)

General Specifications

Shunt Input (IT-D)

Continuous Rating.. ±1.2 Vdc
One Second Rating.. ±1.4 Vdc
Begins to Clip (Saturate).. ±1.3 Vdc
Burden.. 2.2 kΩ

Voltage Inputs (IT-D)

Continuous Rating .... ±2,200 Vdc
One Second Rating .... ±2,400 Vdc
Burden .... 1 VA @ 2,000 Vdc

Power Supply

Terminals A6, A7

(48/125 Vdc, 120 Vac)
DC Operating Range .... 35 to 150 Vdc
AC Operating Range .... 55 to 135 Vac

Frequency Range
40 to 70 Hz, dc

Burden
BE1-11*d* .... 12 W continuous, 14 W maximum with all outputs energized
IT-D .... 6 W continuous

Output Contacts

Make and Carry for Tripping Duty .... 30 A, 250 Vdc for 0.2 seconds per IEEE Std C37.90-2005 - *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*; 7 A continuous AC or DC
Break Resistive or Inductive .... 0.3 A at 125 or 250 Vdc (L/R = 0.04 maximum)

Terminals
OUT 1 .... C1, C2
OUT 2 .... C3, C4
OUT 3 .... C5, C6
OUT 4 .... C7, C8
OUT 5 .... C9, C10
OUT 6 .... E11, E12
OUT 7 .... E9, E10
OUT 8 .... E7, E8
OUT A C11, C12

Contact-Sensing Inputs

Maximum Input Voltage

The maximum input voltages are the highest voltage for each power-supply range listed under the *Power Supply* section.

Turn-On Voltage

Contact-sensing turn-on voltages are listed in Table 46-1.

Table 46-1. Contact-Sensing Turn-On Voltages

Nominal Input Voltage	Contact-Sensing Turn-On Voltage*	
	Jumper Installed (Low Position) †	Jumper Not Installed (High Position) †
48 Vdc or 125 Vac/dc	26 to 38 Vdc	69 to 100 Vdc 56 to 97 Vac

* AC voltage ranges are calculated using the default recognition time (4 ms) and debounce time (4 ms).

† Voltage ranges depend on jumper configurations. See the *Contact Inputs and Outputs* chapter for more information.

Input Burden

Burden values shown in Table 46-2 assume nominal value of input voltage applied.

Table 46-2. Contact-Sensing Input Burden

Nominal Input Voltage	Burden	
	Jumper Installed (Low Position)	Jumper Not Installed (High Position)
48 Vdc or 125 Vac/dc	22 kΩ	53 kΩ

Recognition Time

Programmable.. 4 to 255 ms

Note

All timing specifications are for the worst-case response. This includes output contact operate times and standard BESTlogic*Plus* operation timing but excludes input debounce timing and nonstandard logic configurations. If a nonstandard logic scheme involves feedback, then one or more BESTlogic*Plus* update rate delays must be included to calculate the worst-case delay. An example of feedback is logic outputs driving logic inputs. For more information, see *BESTlogicPlus*.

Terminals

IN1 .... B1, B2
IN2 .... B3, B4
IN3 .... B5, B6
IN4 .... B7, B8
IN5 (Optional) E1, E2
IN6 (Optional) E3, E4
IN7 (Optional) E5, E6
IN8 (Optional) E7, E8
IN9 (Optional) E9, E10
IN10 (Optional) E11, E12

IRIG Interface

Standard.. 200-98, Format B002, and 200-04, Format B006
Input Signal .... Demodulated (dc level-shifted signal)
Logic High Level.............................. 3.5 Vdc, minimum
Logic Low Level .... 0.5 Vdc, maximum
Input Voltage Range .... –10 to +10 Vdc
Input Resistance .... Nonlinear, approximately 4 kΩ at 3.5 Vdc, 3 kΩ at 20 Vdc
Response Time .... <1 cycle
Terminals.. A1, A2

Real-Time Clock

Clock has leap year and selectable daylight saving time correction. Backup capacitor and standard backup battery sustain timekeeping during losses of BE1-11*d* operating power.

Resolution .... 1 s
Accuracy.. ±1.73 s/d at 77°F (25°C)

Clock Holdup

Capacitor Holdup Time .... Up to 24 hours depending on conditions
Battery Holdup Time .... Greater than 5 years depending on conditions
Battery Type .... BR2032 or CR2032, coin-type, 3 Vdc, 195 mAh
Basler Electric P/N 38526

Caution

Replacement of the backup battery for the real-time clock should be performed only by qualified personnel.
Observe polarity markings on the battery socket while inserting a new battery. The battery polarity must be correct in order to provide backup for the real-time clock.

Note

Failure to replace the battery with Basler Electric P/N 38526 may void the warranty.

Communication Ports

Communication ports consist of USB, serial, and Ethernet connections.

USB

A front-panel B-type USB connector provides local communication with a PC operating BESTCOMS*Plus*® software. Compatible with USB 2.0 specification.
Data Transfer Speed .... 12 MB/s (Full Speed)

RS-485

Rear-panel RS-485 port (compression terminals) that supports Modbus and DNP3.
Port Speed (Baud) .... Up to 115,200

Terminals

A A3
B A4
C A5

Ethernet (Optional)

Either an RJ45 or a fiber optic Ethernet port is available. See style chart. These connectors provide dynamic addressing (DHCP), web pages (HTTP), e-mail alerts (SMTP), network time protocol (NTP) to synchronize the real-time clock, as well as communication with BESTCOMS*Plus* software. Modbus, DNP3, and IEC 61850 communication through Ethernet is optional.

Copper Type (RJ45 Connector)

Version 10BASE-T/100BASE-TX
Maximum Length (One Network Segment)............... 328 ft (100 m)

Fiber Optic Type (ST Connector)

Version .... 100BASE-FX, multimode
Maximum Length (Half-Duplex) .... 1,310 ft (399 m)
Maximum Length (Full-Duplex)................................ 6,600 ft (2,011 m)

Panel Display

64 by 128 dot pixels LCD with LED backlight.

Operating Temperature .... –40 to 158°F (–40 to 70°C). Display contrast adjustment may be impaired below –4°F (–20°C).

Temperature

Operating Temperature Range .... –40 to 158°F (–40 to 70°C)*

Storage Temperature Range .... –40 to 158°F (–40 to 70°C)

* Display is inoperative below –20°C (–4°F)

Isolation

BE1-11d

All Circuit Groups to Ground .... 2,000 Vac

All Circuit Groups to Circuit Group* .... 2,000 Vac

Communication Ports to Ground............................... 700

* Excludes communication ports

IT-D

Inputs to Inputs... 4,800 Vdc

Sensing Inputs to Ground .... 4,800 Vdc

Power Supply Inputs to Ground .... 2,000 Vac

Standards

IEC Standards

BE1-11d

- IEC 60068-1 – *Environmental Testing Part 1: General and Guidance. Temperature Test*
- IEC 60068-2-1 – *Basic Environmental Testing Procedures, Part 2: Tests - Test Ad: Cold (Type Test)*
- IEC 60068-2-2 – *Basic Environmental Testing Procedures, Part 2: Tests - Test Bd: Dry Heat (Type Test)*
- IEC 60068-2-28 – *Environmental Testing Part 2: Testing-Guidance for Damp Heat Tests*
- IEC 60068-2-78 – *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*
- IEC 60255-4 – *Single Input Energizing Quantity Measuring Relays with Dependent Specified Time*
- IEC 60255-5 – *Electrical Insulation Tests for Electrical Relays. Dielectric Test and Impulse Test*
- IEC 60255-6 – *Electrical Relays - Measuring Relays and Protection Equipment*
- IEC 60255-21-1 – *Vibration, Shock, Bump, and Seismic Tests on Measuring Relays and Protective Equipment (Section 1 - Vibration Test - Sinusoidal). Class 1*
- IEC 60255-21-2 – *Vibration, Shock, Bump, and Seismic Tests on Measuring Relays and Protective Equipment (Section 2 - Shock and Bump Test - Sinusoidal). Class 1*
- IEC 60255-21-3 – *Vibration, Shock, Bump, and Seismic Tests on Measuring Relays and Protective Equipment (Section 3 – Seismic Test). Class 1*

IT-D

- EN 62477-1:2012 – *Safety requirements for power electronic converter systems and equipment - Part 1: General*
- EN 61000-6-2:2005 – *Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments*
- EN 61000-6-4:2007; with AMD 1:2011 – *Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments*

- EN 50581:2012, Ed 12 – *Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances*

IEEE Standards

BE1-11*d*

- IEEE C37.90-2005 – *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*
- IEEE Std C37.90.1-2002 – *IEEE Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*
- IEEE Std C37.90.2-2004 – *IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers*
- IEEE Std C37.90.3-2001 – *IEEE Standard Electrostatic Discharge Test for Protective Relays*

IT-D

- IEEE C37.90-2005 – *IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus*
- IEEE C37.90.1-2012 – *IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*
- IEEE C37.90.2-2004 – *IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers*
- IEEE Std C37.90.3-2001 – *IEEE Standard Electrostatic Discharge Test for Protective Relays*

CE and UKCA Compliance

BE1-11d

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives:

- LVD 2014/35/EU
- EMC 2014/30/EU
- ROHS 2011/65/EU as amended by (EU) 2015/863

Harmonized standards used for evaluation:

- IEC 60255-1:2010 – *Measuring Relays and Protection Equipment, Part 1: Common Requirements*
- IEC 60255-26:2014 – *Measuring Relays and Protection Equipment, Part 26: Electromagnetic Compatibility Requirements*
- IEC 60255-27:2014 – *Measuring Relays and Protection Equipment, Part 27: Product Safety Requirements*

IT-D

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives:

- LVD 2014/35/EU
- EMC 2014/30/EU
- ROHS 2011/65/EU

Harmonized standards used for evaluation:

- EN 62477-1:2012 – *Safety requirements for power electronic converter systems and equipment - Part 1: General*
- EN 61000-6-2:2005 – *Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments*

- EN 61000-6-4:2007; with AMD 1:2011 – *Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments*
- EN 50581:2012, Ed 12 – *Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances*

UL Recognition (BE1-11*d*)

This product is recognized to applicable U.S. and Canadian safety standards and requirements by UL.

Standards used for evaluation:

- UL 508
- CSA C22.2 No. 14

Warning! - EXPLOSION HAZARD
Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. Do not engage USB unless power has been switched off or the area is known to be non-hazardous.

CSA Certification (BE1-11*d*)

This product was tested and has met the certification requirements for industrial control equipment.

Standards used for evaluation:

- CSA C22.2 No. 14

FCC Requirements

This product complies with FCC 47 CFR Part 15.

China RoHS

The following table serves as the declaration of hazardous substances for China in accordance with PRC standard SJ/T 11364-2014. The EFUP (Environment Friendly Use Period) for this product is 40 years.

PRODUCT:	BE1-11*d*									
	有害物质 Hazardous Substances									
零件名称 Part Name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲酸二酯 Bis(2-ethylhexyl) phthalate (BEHP)	邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)
金属零件 Metal parts	O	O	O	O	O	O	O	O	O	O
聚合物 Polymers	O	O	O	O	O	O	O	O	O	O
电子产品 Electronics	X	O	O	O	O	O	O	O	O	O
电缆和互连配件 Cables & interconnect accessories	O	O	O	O	O	O	O	O	O	O
绝缘材料 Insulation material	O	O	O	O	O	O	O	O	O	O

本表格依据 SJ/T11364 的规定编制。

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

This form was prepared according to the provisions of standard SJ/T11364.

O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26252.

X: Indicates that the hazardous substance content in at least one of the homogenous materials of this part exceeds the limit specified in standard GB/T 26572.

Shock and Vibration (IT-D)

- IEC 60255-21-1:1988
- IEC 60255-21-2:1988
- IEC 60255-21-3:1993

Humidity (IT-D)

- IEC 60255-21-1:1988
- IEC 60255-21-2:1988
- IEC 60255-21-3:1993

HALT (Highly Accelerated Life Testing)

Basler Electric uses HALT testing to subject the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. Some of the extreme testing conditions included in HALT testing are temperature extremes of –80°C to +130°C, vibration extremes of 5 to 45 G at +20°C, and temperature/vibration extremes of 45 G over a temperature range of –60°C to +110°C. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels.

DNP Certification

DNP3-2009, V2.6 compliant, Subset Level 2, by Advanced Control Systems, Inc.

IEC 61850 Certification

KEMA certified per IEC 61850 Certificate Level A.

Physical

BE1-11d

IP Class IP20
Case Size .... Refer to the *Mounting* chapter.
Weight .... 5.1 lb (2.3 kg)

IT-D

IP Class IP20
Case Size .... 9.77 x 10.38 x 1.763 inches (248.3 x 263.7 x 44.8 mm)
Weight .... 2.7 lb (1.22 kg)

47 • Time Curve Characteristics

This chapter provides time curve information for the DC overcurrent (76) functions of the BE1-11*d*.

General

The DC overcurrent (76) time curves provided by the BE1-11*d* closely emulate most of the common electromechanical, induction-disk, overcurrent relays sold in North America. To further improve proper BE1-11*d* coordination, selection of integrated reset or instantaneous reset characteristics is also provided.

Curve Specifications

Twenty-two inverse time functions, one fixed time function, one 46 time function, one programmable time function, and four Table Curve functions can be selected. Characteristic curves for the inverse and definite time functions are defined by the following equations and comply with IEEE Std C37.112 - 1996 - *IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays*.

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

Equation 47-1

$$T_R = \frac{RD}{|M^2 - 1|}$$

Equation 47-2

T_T = Time to trip when M ≥ 1

T_R = Time to reset if BE1-11*d* is set for integrating reset when M < 1. Otherwise, reset is 50 milliseconds or less

D = Time Dial setting (0.0 to 9.9)*

M = Multiple of Pickup setting (0 to 40)

A, B, C, N, K = Constants for the particular curve

R = Constant defining the reset time.

* Timing range is one second times the Time Dial setting when the F (fixed) curve is selected.

Table 47-1 lists time characteristic curve constants. See the figures after the tables for graphs of the characteristics.

Table 47-1. 51 Time Characteristic Curve Constants

Curve Selection	Curve Name	Trip Characteristic Constants					Reset ∗
		A	B	C	N	K	R
S1	CO Short Inverse	0.2663	0.03393	1	1.2969	0.028	0.5
S2	IAC Short Inverse	0.0286	0.0208	1	0.9844	0.028	0.094
A	Standard Inverse	0.01414	0	1	0.02	0.028	2
A1	IEC Inverse	0.14	0	1	0.02	0	2
I1	CO Inverse Time	8.9341	0.17966	1	2.0938	0.028	9
I2	IAC Inverse Time	0.2747	0.10426	1	0.4375	0.028	0.8868
M	CO Moderately Inverse	0.3022	0.1284	1	0.5	0.028	1.75
D1	IEEE Moderately Inverse	0.0515	0.114	1	0.02	0	4.85

Curve Selection	Curve Name	Trip Characteristic Constants					Reset ∗
		A	B	C	N	K	R
L1	CO Long Inverse	5.6143	2.18592	1	1	0.028	15.75
L2	IAC Long Inverse	2.3955	0	1	0.3125	0.028	7.8001
G	Long Time Inverse (I^2t)	12.1212	0	1	1	0.028	29
V1	CO Very Inverse	5.4678	0.10814	1	2.0469	0.028	5.5
V2	IAC Very Inverse	4.4309	0.0991	1	1.9531	0.028	5.8231
B	Very Inverse (I^2t)	1.4636	0	1	1.0469	0.028	3.25
B1	IEC Very Inverse	13.5	0	1	1	0	3.25
E3	IEEE Very Inverse	19.61	0.491	1	2	0	21.6
E1	CO Extremely Inverse	7.7624	0.02758	1	2.0938	0.028	7.75
E2	IAC Extremely Inverse	4.9883	0.0129	1	2.0469	0.028	4.7742
C	Extremely Inverse (I^2t)	8.2506	0	1	2.0469	0.028	8
C1	IEC Extremely Inverse	80	0	1	2	0	8
F1	IEEE Extremely Inverse	28.2	0.1217	1	2	0	29.1
D	CO Definite Time	0.4797	0.21359	1	1.5625	0.028	0.875
F	Fixed Time ‡	0	1	0	0	0	1
46	I^2t Characteristic	†	0	0	2	0.028	100
P	User Programmable §	0 to 600	0 to 25	0 to 1	0.5 to 2.5	0.028	0 to 30
T1	User Table 1 ‖	n/a	n/a	n/a	n/a	n/a	n/a
T2	User Table 2 ‖	n/a	n/a	n/a	n/a	n/a	n/a
T3	User Table 3 ‖	n/a	n/a	n/a	n/a	n/a	n/a
T4	User Table 4 ‖	n/a	n/a	n/a	n/a	n/a	n/a

∗ Instantaneous or integrating reset is selected on the DC Overcurrent setup screen in BESTCOMS*Plus*®.

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

‡ Curve F has a fixed delay of one second times the Time Dial setting.

§ The programmable curve allows for four significant digits after the decimal place for every variable.

‖ There is a minimum of 2 and maximum of 40 points that can be entered for any one T curve. For information on setting T curves, refer to the *DC Overcurrent (76) Protection* chapter.

Time Overcurrent Characteristic Curve Graphs

The figures after the tables illustrate the characteristic curves of the BE1-11*d*. Table 47-2 cross-references each curve to existing electromechanical relay characteristics. Equivalent time dial settings were calculated at a value of five times pickup.

Table 47-2. Characteristic Curve Cross-Reference

Curve	Curve Name	Similar To
S1	CO Short Inverse	ABB CO-2
S2	IAC Short Inverse	GE IAC-55
A	Standard Inverse	Refer to BS 142

Curve	Curve Name	Similar To
A1	IEC Inverse	Refer to IEC 60255-151 Ed. 1
I1	CO Inverse Time	ABB CO-8
I2	IAC Inverse Time	GE IAC-51
M	CO Moderately Inverse	ABB CO-7
D1	IEEE Moderately Inverse	Refer to IEC 60255-151 Ed. 1
L1	CO Long Inverse	ABB CO-5
L2	IAC Long Inverse	GE IAC-66
G	Long Time Inverse (I^2t)	Refer to BS 142
V1	CO Very Inverse	ABB CO-9
V2	IAC Very Inverse	GE IAC-53
B	Very Inverse (I^2t)	Refer to BS 142
B1	IEC Very Inverse	Refer to IEC 60255-151 Ed. 1
E3	IEEE Very Inverse	Refer to IEC 60255-151 Ed. 1
E1	CO Extremely Inverse	ABB CO-11
E2	IAC Extremely Inverse	GE IAC-77
C	Extremely Inverse (I^2t)	Refer to BS 142
C1	IEC Extremely Inverse	Refer to IEC 60255-151 Ed. 1
F1	IEEE Extremely Inverse	Refer to IEC 60255-151 Ed. 1
D	CO Definite Time	ABB CO-6
F	Fixed Time	n/a
46	I^2t Characteristic	n/a
P	User Programmable	n/a
T1, T2, T3, T4	User Tables	n/a

Time Dial Setting Cross-Reference

Although the time characteristic curve shapes have been optimized for each relay, time dial settings of Basler Electric protection systems are not identical to the settings of electromechanical induction disk overcurrent relays. Table 47-3 helps you convert the time dial settings of induction disk relays to the equivalent setting for Basler Electric protection systems. Enter time dial settings using BESTCOMS*Plus*. For more information, refer to the *DC Overcurrent (76) Protection* chapter.

Using Table 47-3

Cross-reference table values were obtained by inspection of published electromechanical time current characteristic curves. The time delay for a current of five times tap was entered into the time dial calculator function for each time dial setting. The equivalent Basler Electric time dial setting was then entered into the cross-reference table.

If your electromechanical relay time dial setting is between the values provided in the table, it will be necessary to estimate the correct intermediate value between the electromechanical setting and the Basler Electric setting.

Basler Electric protection systems have a maximum time dial setting of 9.9. The Basler Electric equivalent time dial setting for the electromechanical maximum setting is provided in the cross-reference table even if it exceeds 9.9. This allows interpolation as noted above.

Basler Electric time current characteristics are determined by a linear mathematical equation. The induction disk of an electromechanical relay has a certain degree of non-linearity due to inertial and friction effects. For this reason, even though every effort has been made to provide characteristic curves with minimum deviation from the published electromechanical curves, slight deviations can exist between them.

In applications where the time coordination between curves is extremely close, we recommend that you choose the optimal time dial setting by inspection of the coordination study. In applications where coordination is tight, it is recommended that you retrofit your circuits with Basler Electric protection systems to ensure high timing accuracy.

Table 47-3. Time Dial Setting Cross-Reference

Curve	Equivalent To	Electromechanical Relay Time Dial Setting											
		0.5	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**7.0**	**8.0**	**9.0**	**10.0**	**11.0**
		Basler Electric Equivalent Time Dial Setting											
S1	ABB CO-2	0.3	0.8	1.7	2.4	3.4	4.2	5.0	5.8	6.7	7.7	8.6	9.7
S2	GE IAC-55	0.2	1.0	2.0	3.1	4.0	4.9	6.1	7.2	8.1	8.9	9.8	n/a
I1	ABB CO-8	0.3	0.7	1.5	2.3	3.2	4.0	5.0	5.8	6.8	7.6	8.7	n/a
I2	GE IAC-51	0.6	1.0	1.9	2.7	3.7	4.8	5.7	6.8	8.0	9.3	n/a	n/a
M	ABB CO-7	0.4	0.8	1.7	2.5	3.3	4.3	5.3	6.1	7.0	8.0	9.0	9.8
L1	ABB CO-5	0.4	0.8	1.5	2.3	3.3	4.2	5.0	6.0	7.0	7.8	8.8	9.9
L2	GE IAC-66	0.4	0.9	1.8	2.7	3.9	4.9	6.3	7.2	8.5	9.7	n/a	n/a
V1	ABB CO-9	0.3	0.7	1.4	2.1	3.0	3.9	4.8	5.7	6.7	7.8	8.7	9.6
V2	GE IAC-53	0.4	0.8	1.6	2.4	3.4	4.3	5.1	6.3	7.2	8.4	9.6	n/a
E1	ABB CO-11	0.3	0.7	1.5	2.4	3.2	4.2	5.0	5.7	6.6	7.8	8.5	n/a
E2	GE IAC-77	0.5	1.0	1.9	2.7	3.5	4.3	5.2	6.2	7.4	8.2	9.9	n/a
D	ABB CO-6	0.5	1.1	2.0	2.9	3.7	4.5	5.0	5.9	7.2	8.0	8.9	n/a

The 46 Curve

The 46 curve is an I^2t characteristic that emulates the melting, arching, or clearing integral of a fuse.

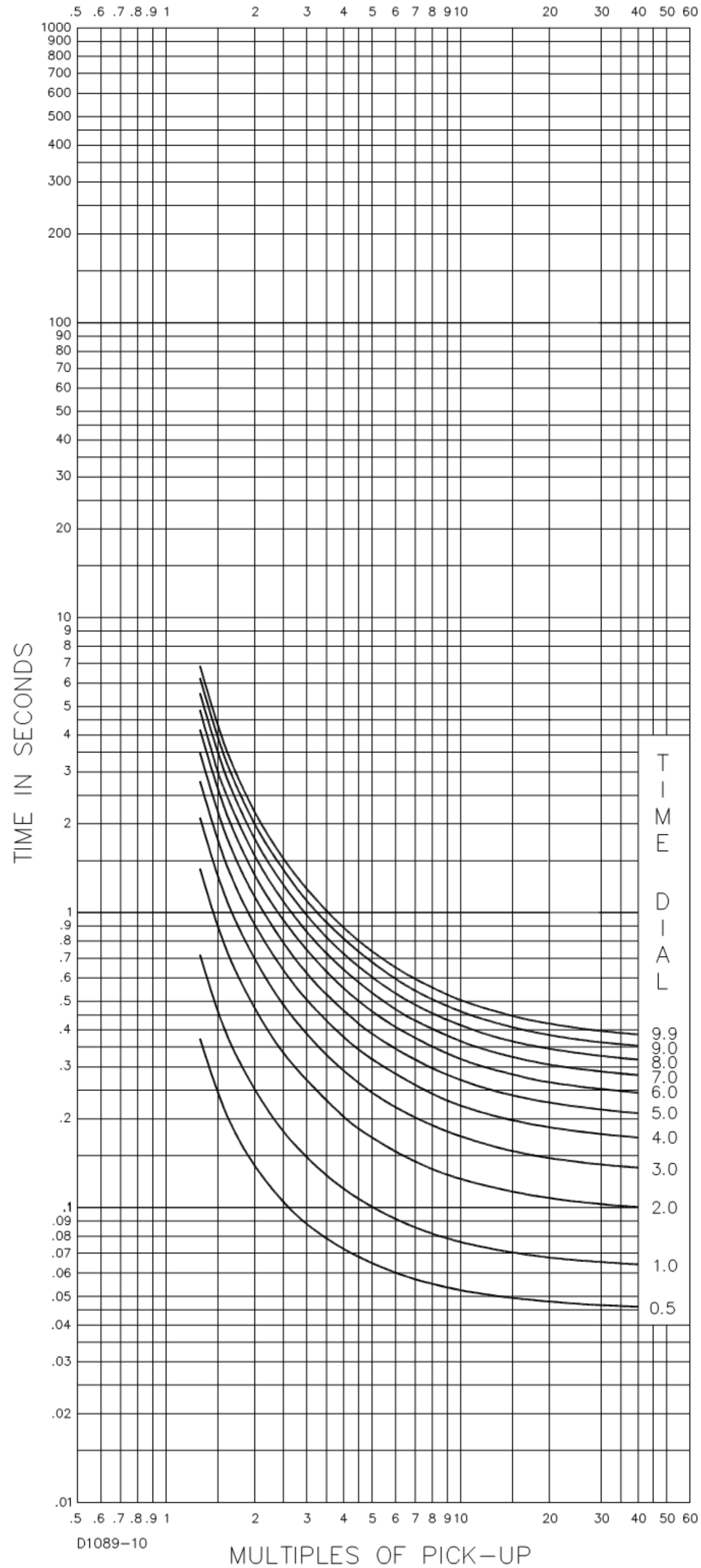


Figure 47-1. Time Characteristic Curve S1, Short Inverse (Similar to ABB CO-2)

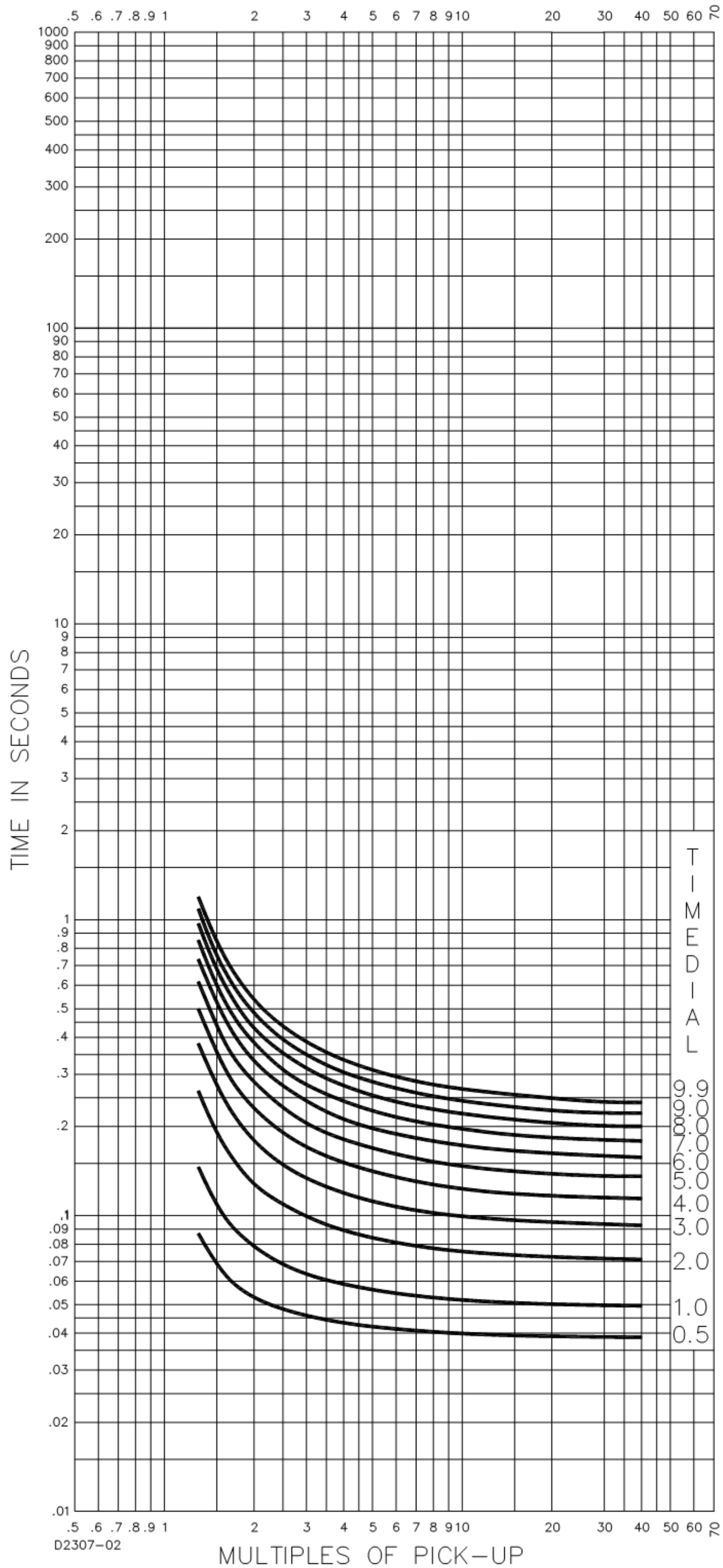


Figure 47-2. Time Characteristic Curve S2, Short Inverse (Similar To GE IAC-55)

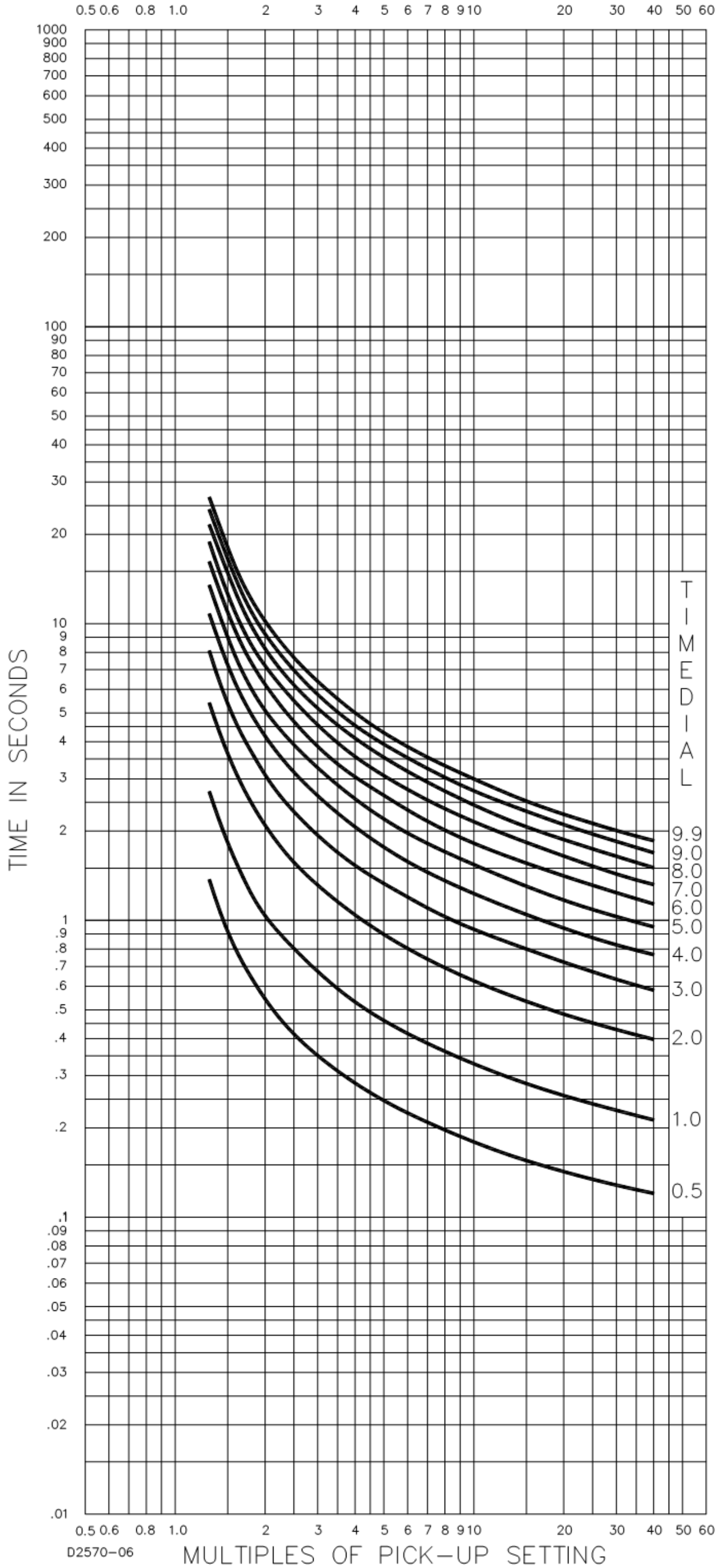


Figure 47-3. Time Characteristic Curve A, Standard Inverse (BS 142)

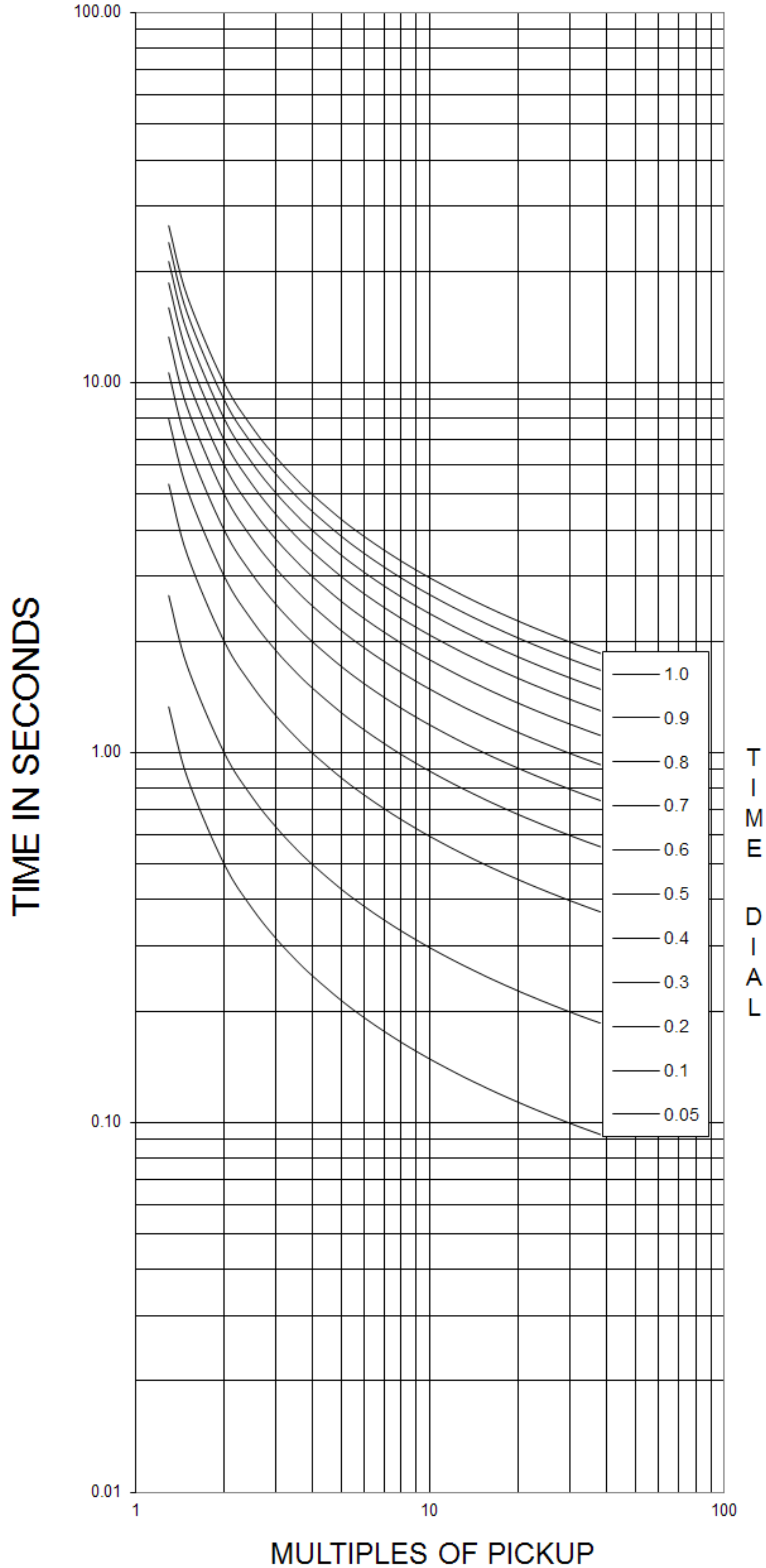


Figure 47-4. Time Characteristic Curve A1, Inverse (IEC 60255-151 Ed. 1)

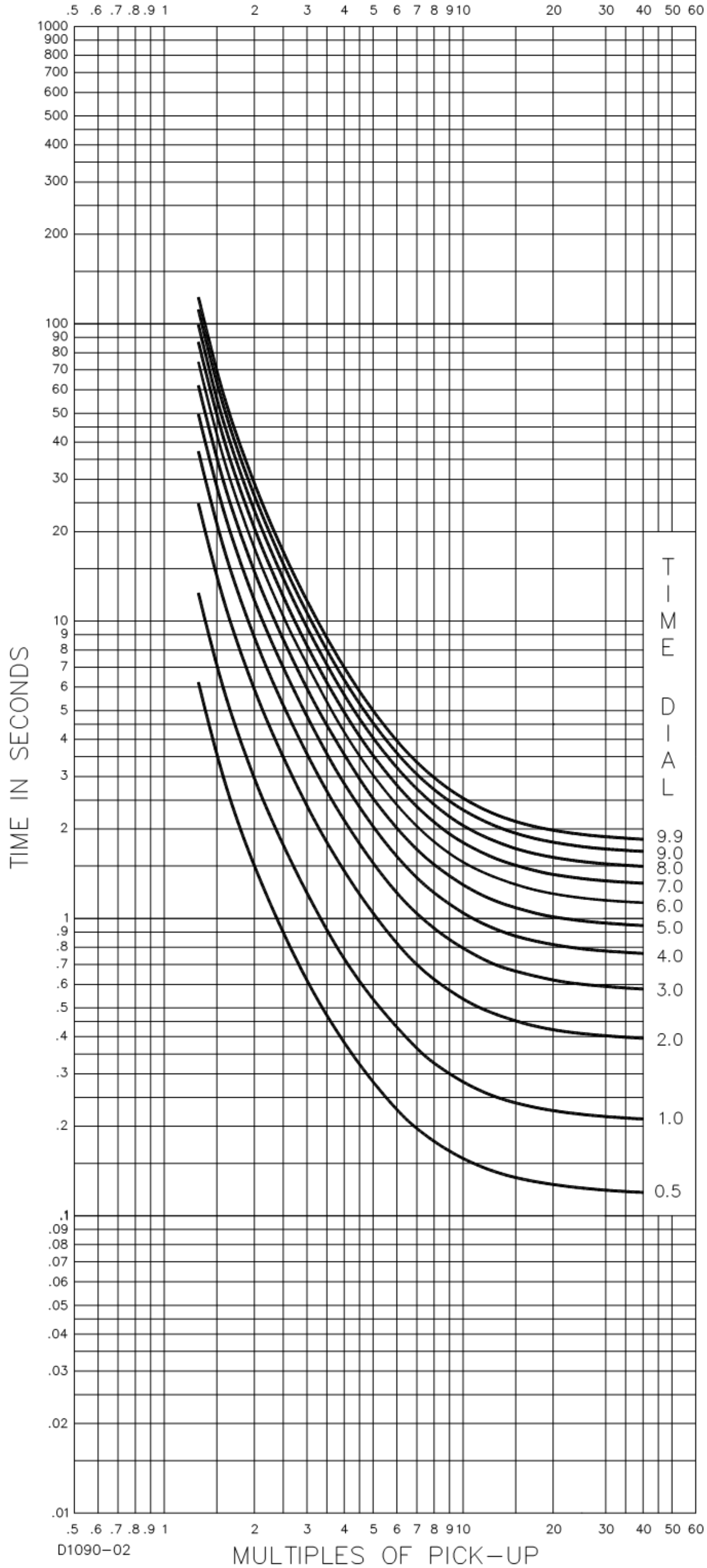


Figure 47-5. Time Characteristic Curve I1, Inverse Time (Similar to ABB CO-8)

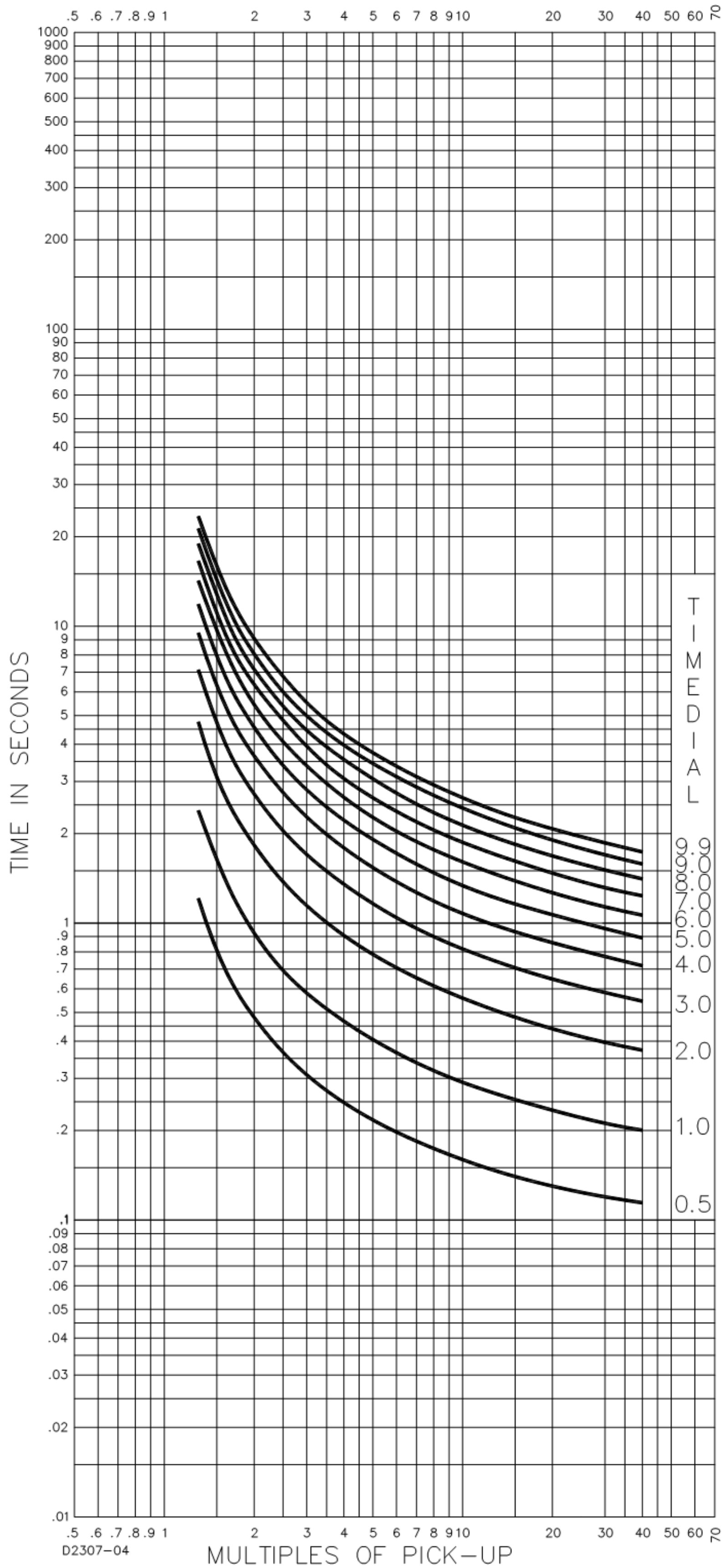


Figure 47-6. Time Characteristic Curve I2, Inverse Time (Similar to GE IAC-51)

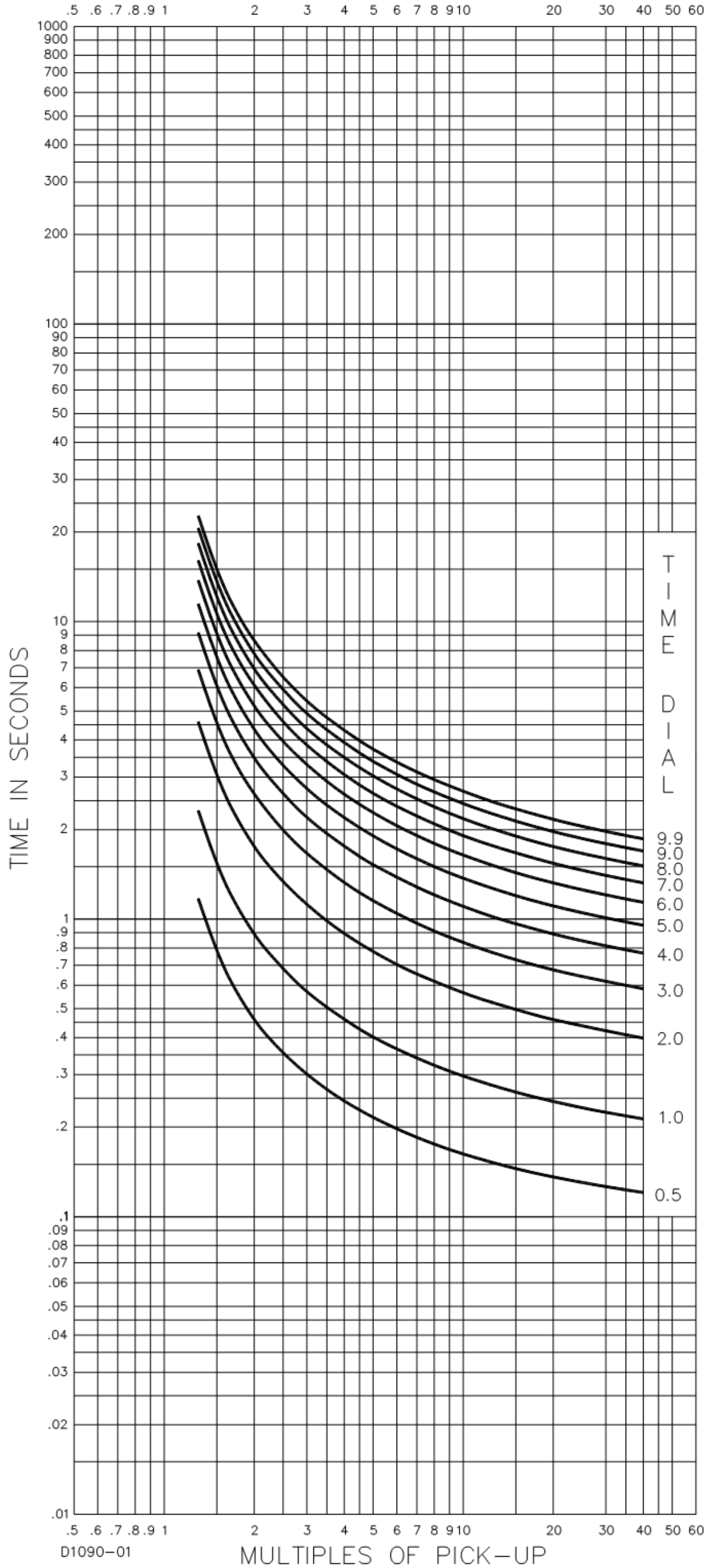


Figure 47-7. Time Characteristic Curve M, Moderately Inverse (Similar to ABB CO-7)

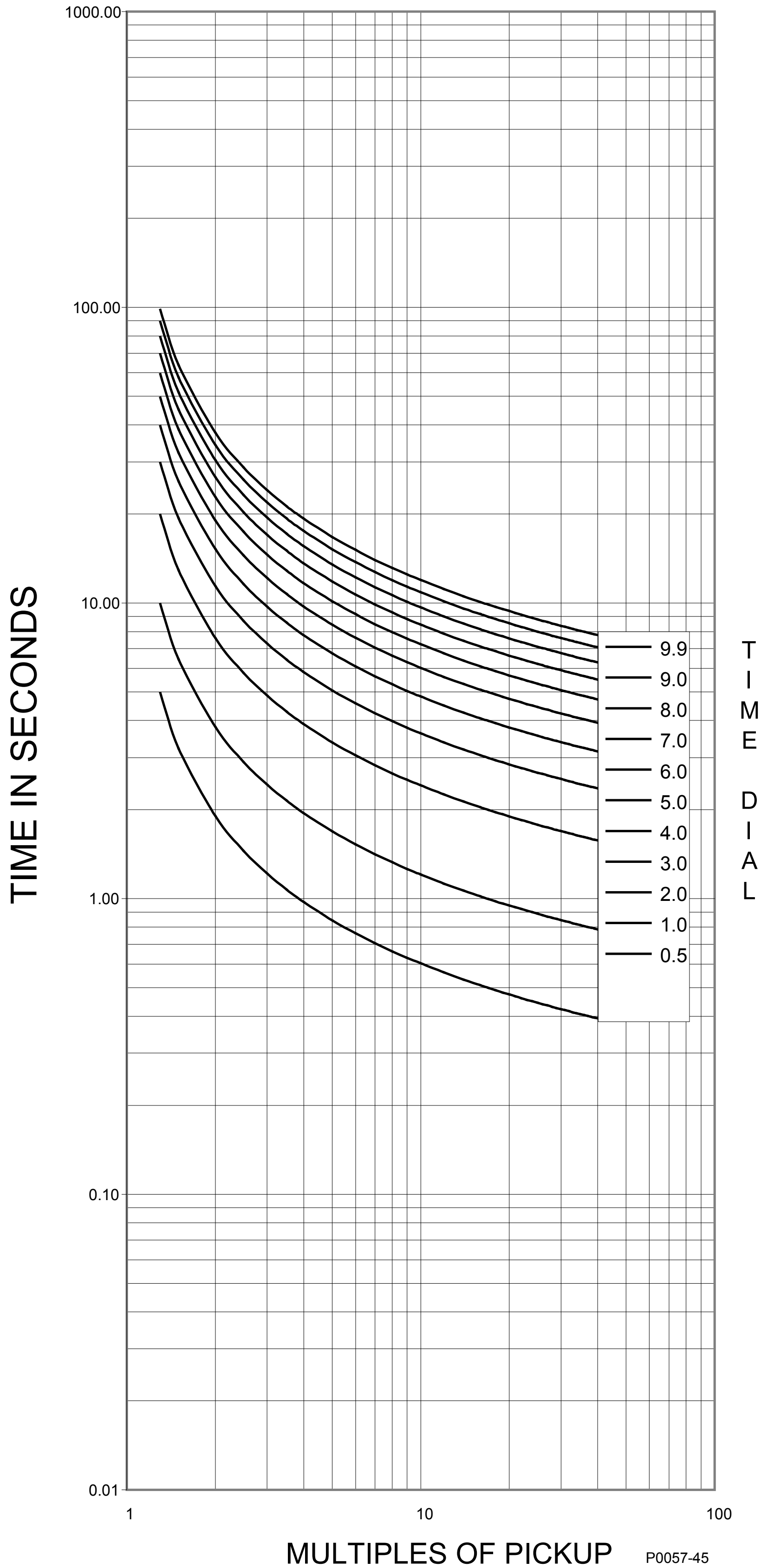


Figure 47-8. Time Characteristic Curve D1, Moderately Inverse (IEC 60255-151 Ed. 1)

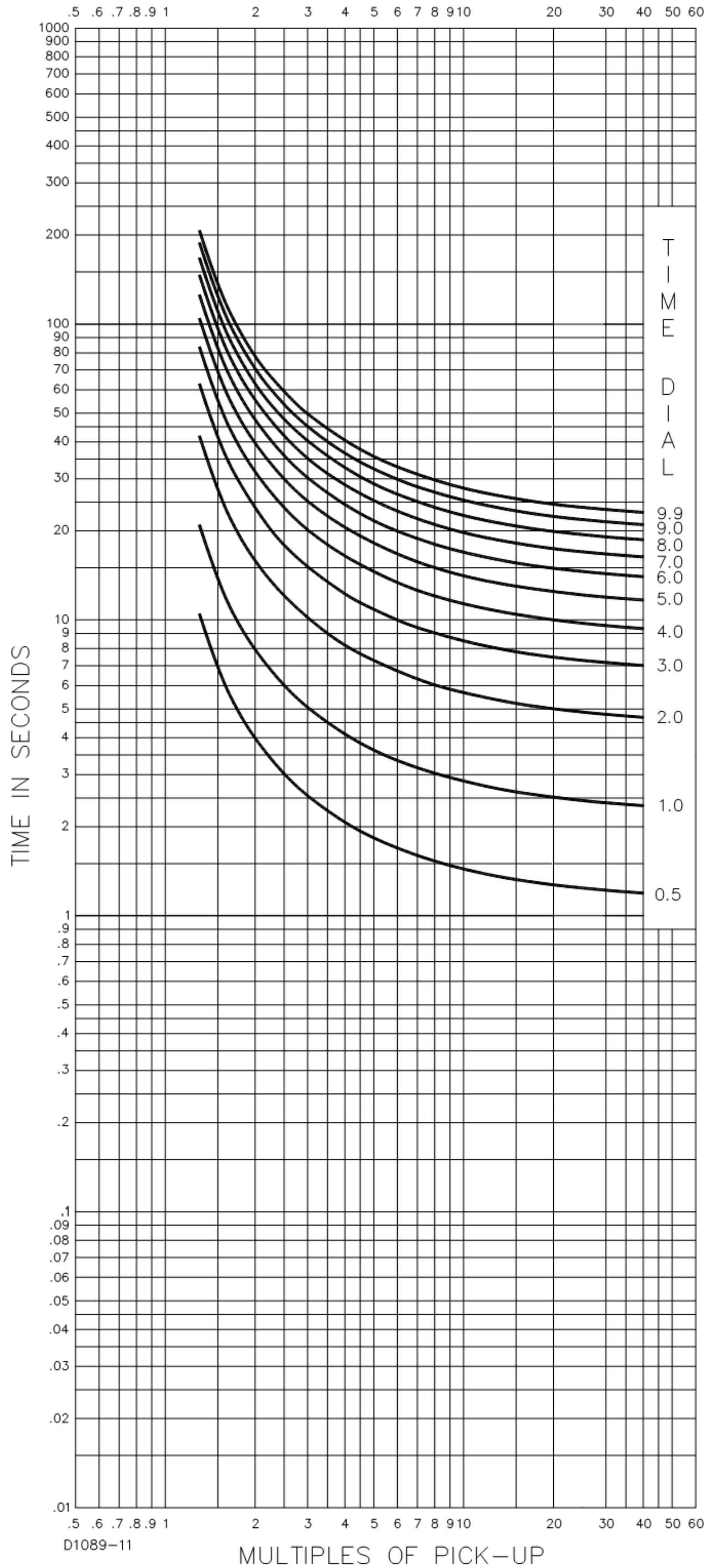


Figure 47-9. Time Characteristic Curve L1, Long Inverse (Similar to ABB CO-5)

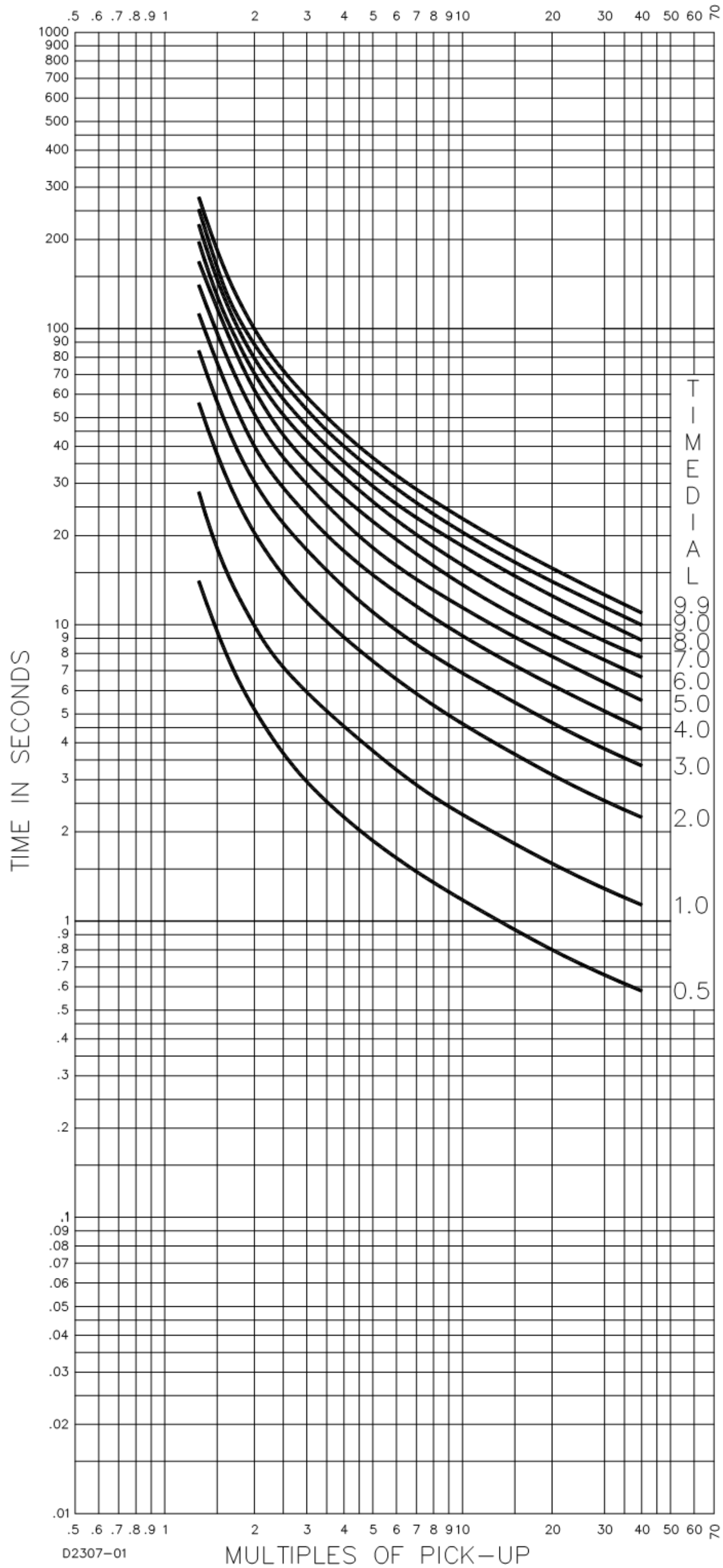


Figure 47-10. Time Characteristic Curve L2, Long Inverse (Similar To GE IAC-66)

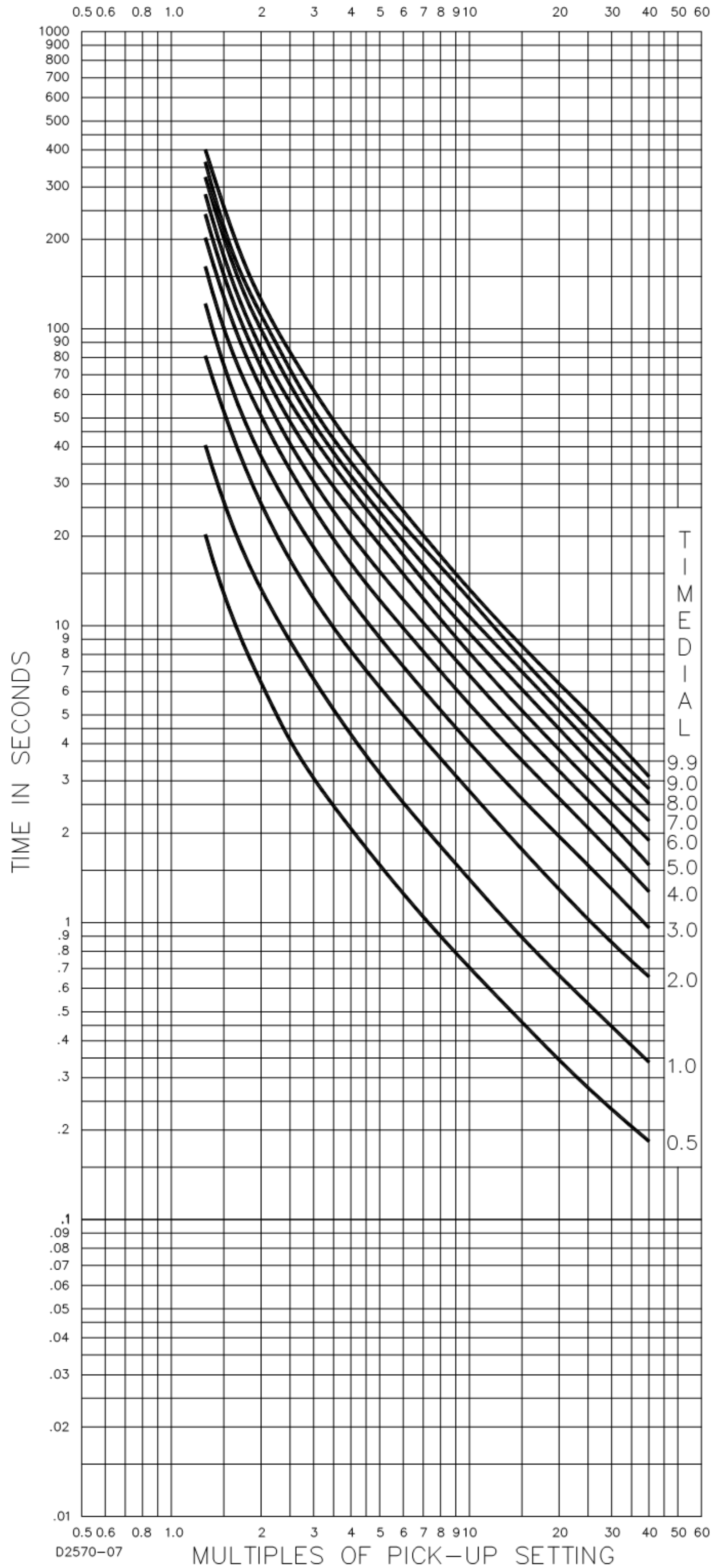


Figure 47-11. Time Characteristic Curve G, Long Time Inverse (BS 142)

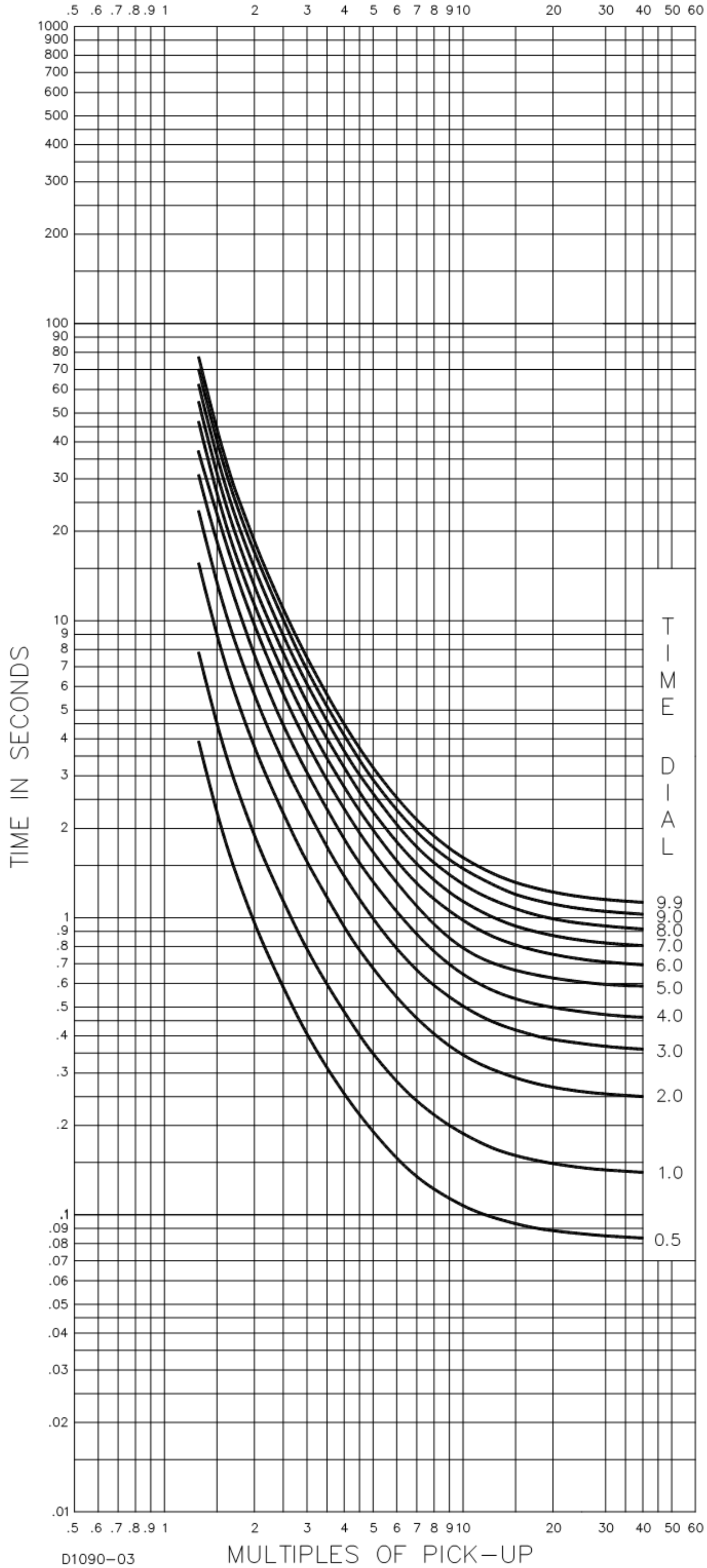


Figure 47-12. Time Characteristic Curve V1, Very Inverse (Similar to ABB CO-9)

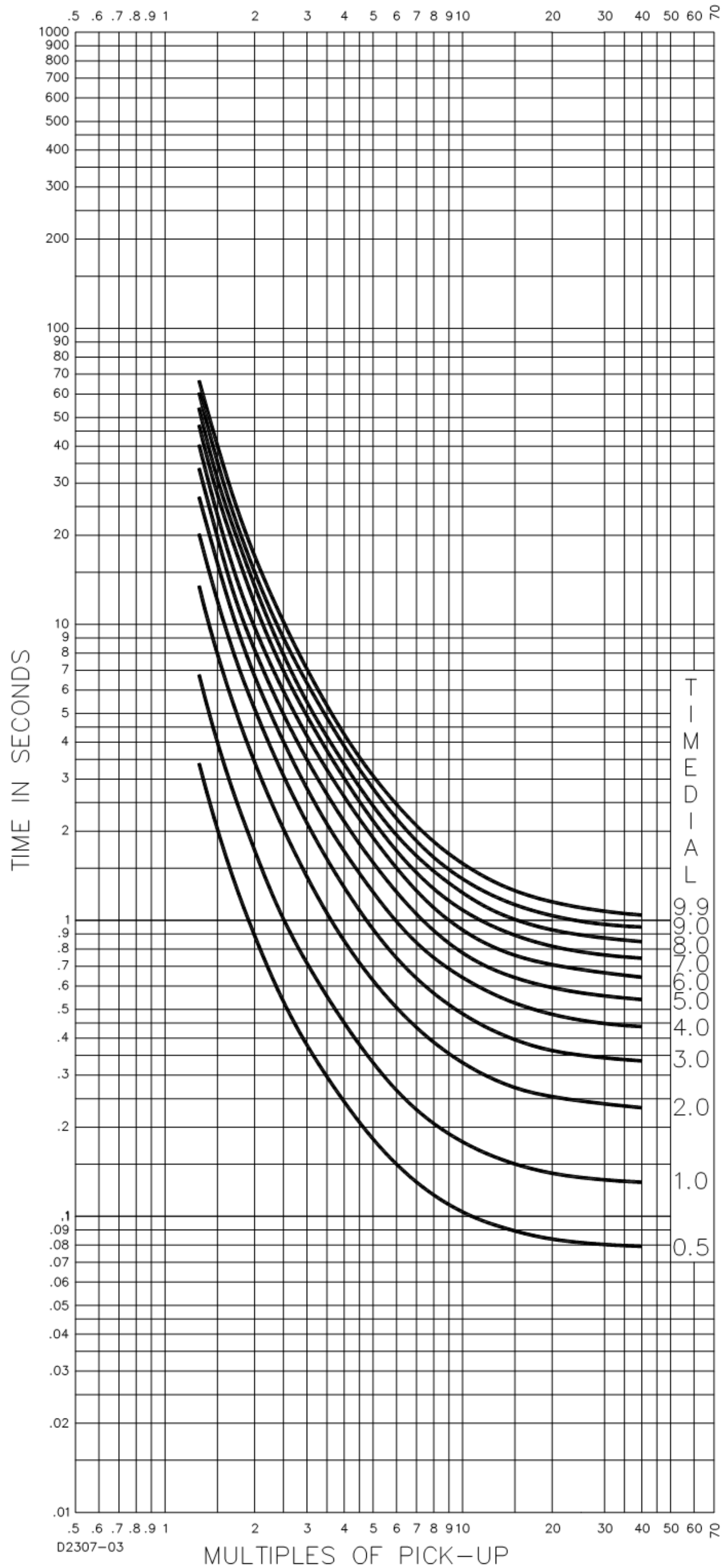


Figure 47-13. Time Characteristic Curve V2, Very Inverse (Similar to GE IAC-53)

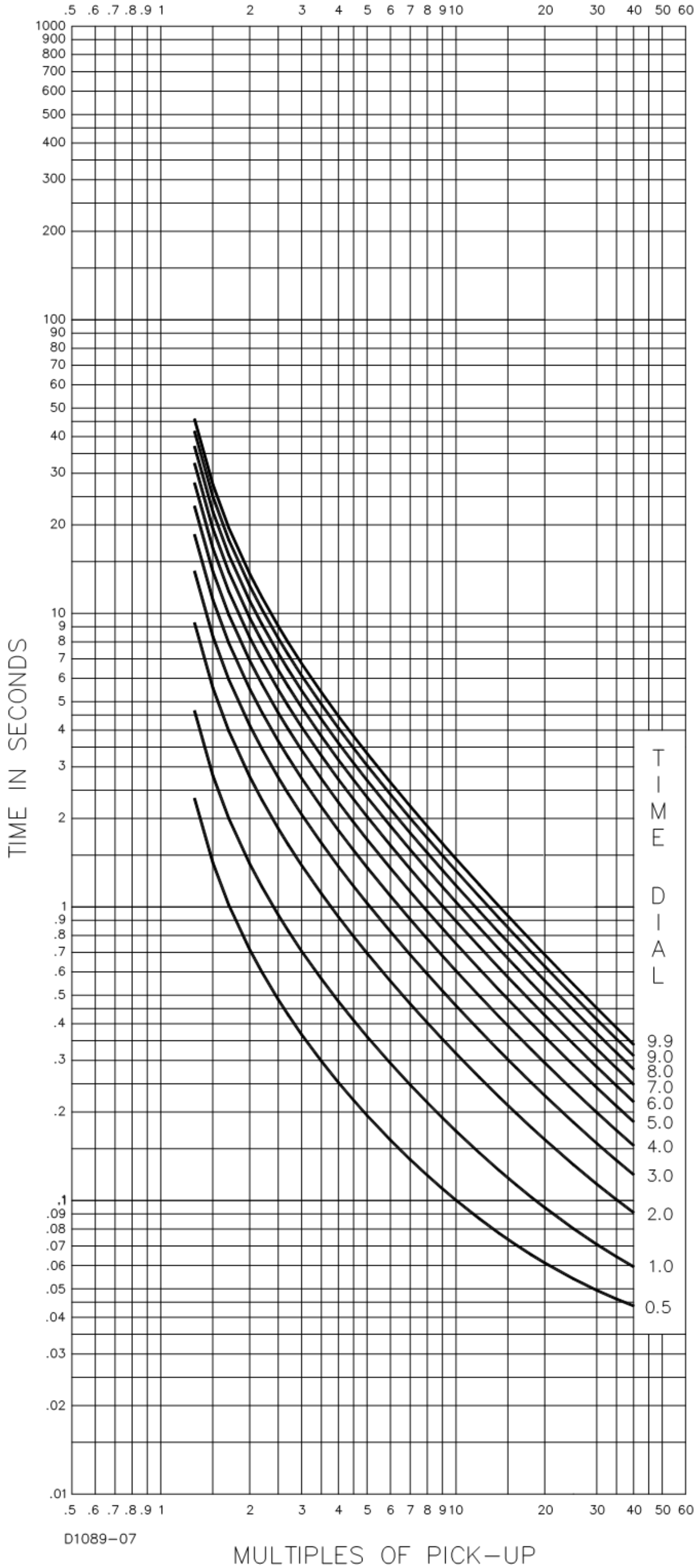


Figure 47-14. Time Characteristic Curve B, Very Inverse (BS 142)

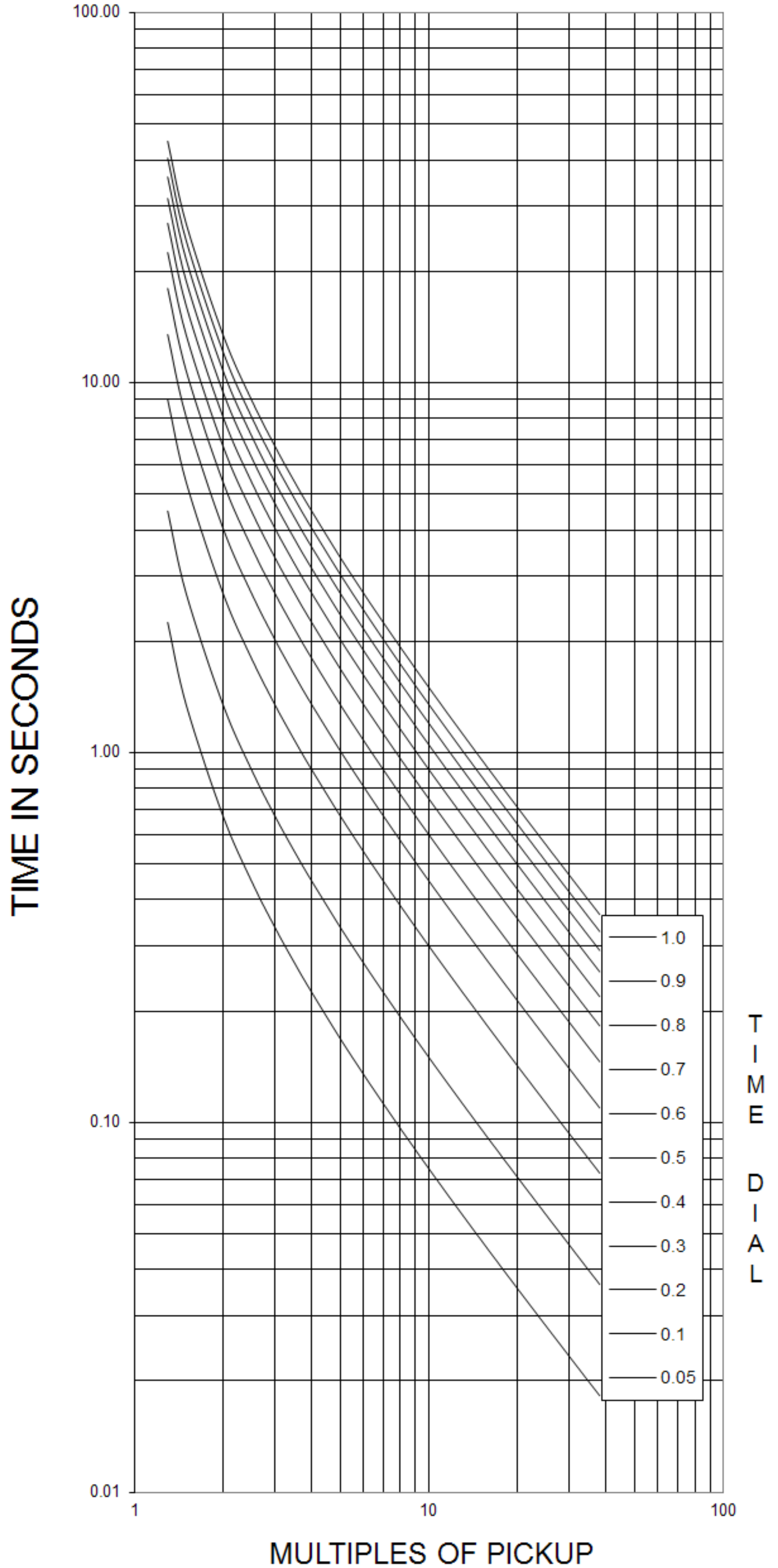


Figure 47-15. Time Characteristic Curve B1, Very Inverse (IEC 60255-151 Ed. 1)

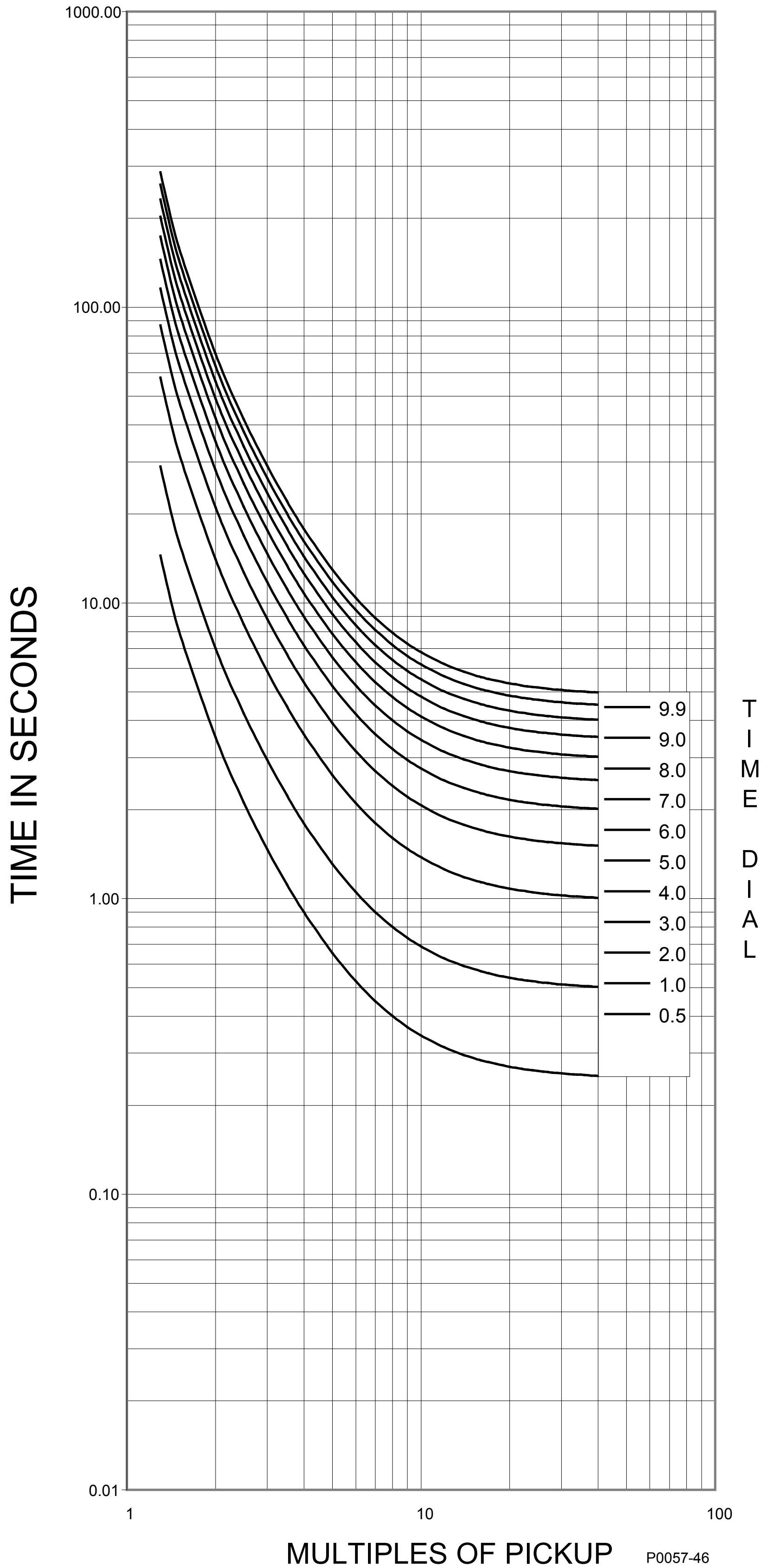


Figure 47-16. Time Characteristic Curve E3, Very Inverse (IEC 60255-151 Ed. 1)

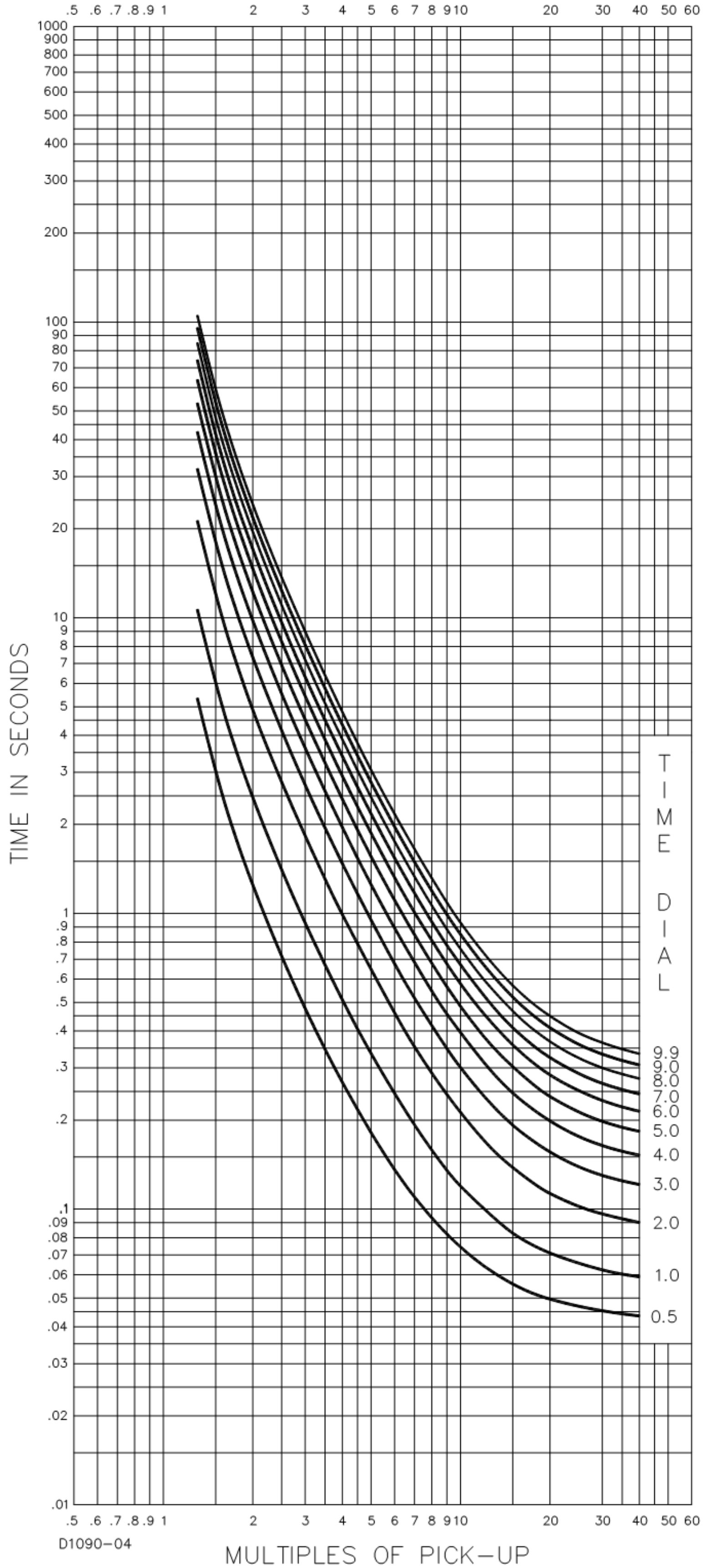


Figure 47-17. Time Characteristic Curve E1, Extremely Inverse (Similar to ABB CO-11)

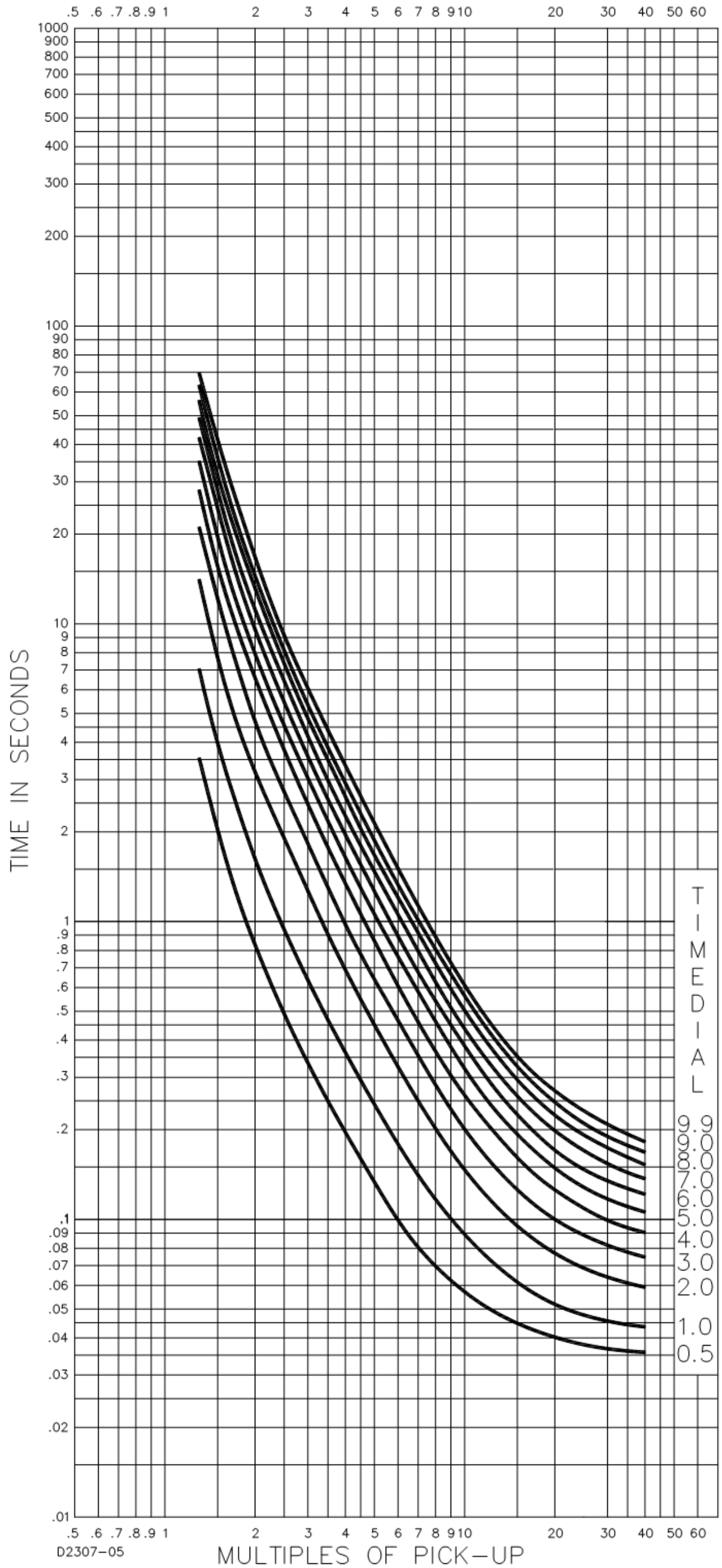


Figure 47-18. Time Characteristic Curve E2, Extremely Inverse (Similar to GE IAC-77)

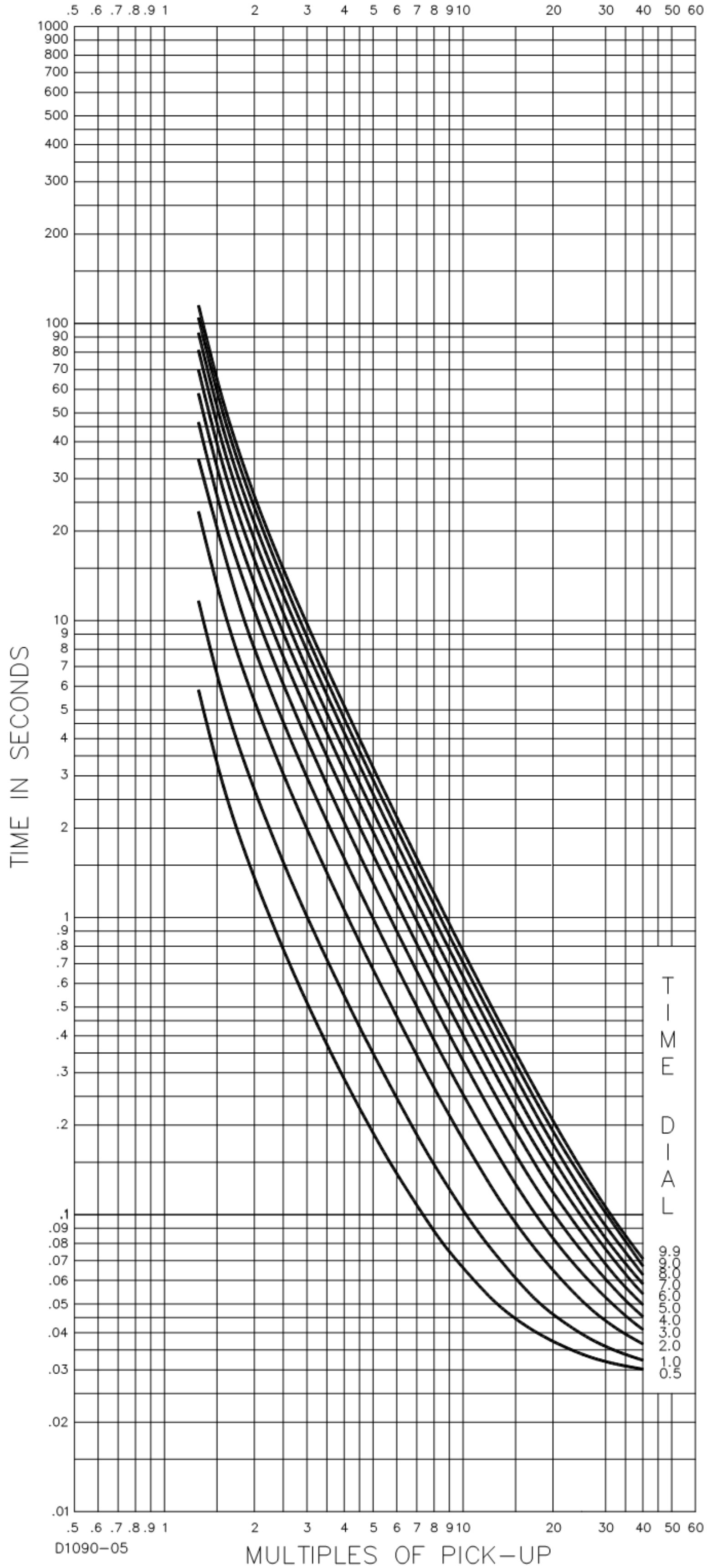


Figure 47-19. Time Characteristic Curve C, Extremely Inverse (BS 142)

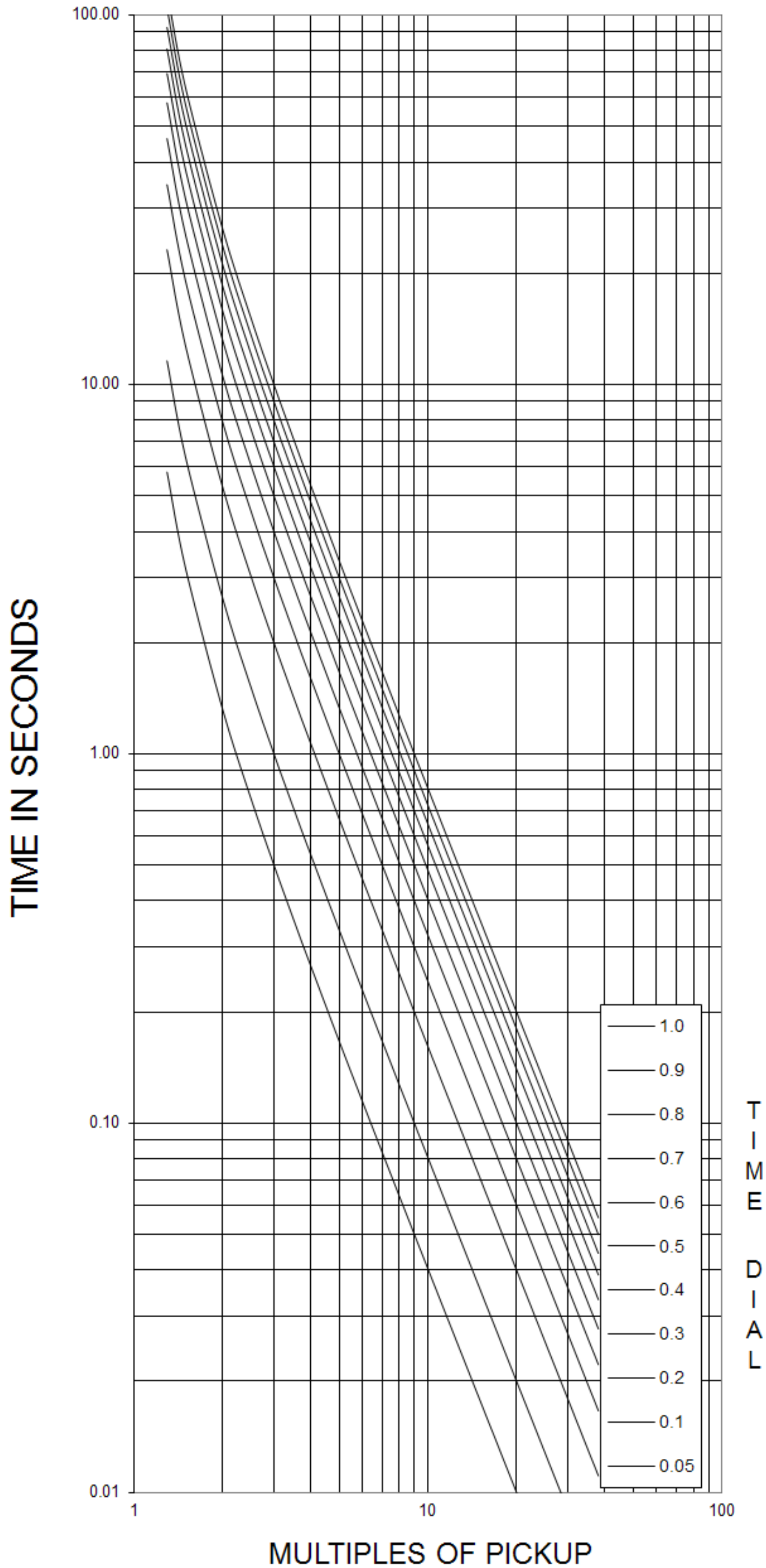


Figure 47-20. Time Characteristic Curve C1, Extremely Inverse (IEC 60255-151 Ed. 1)

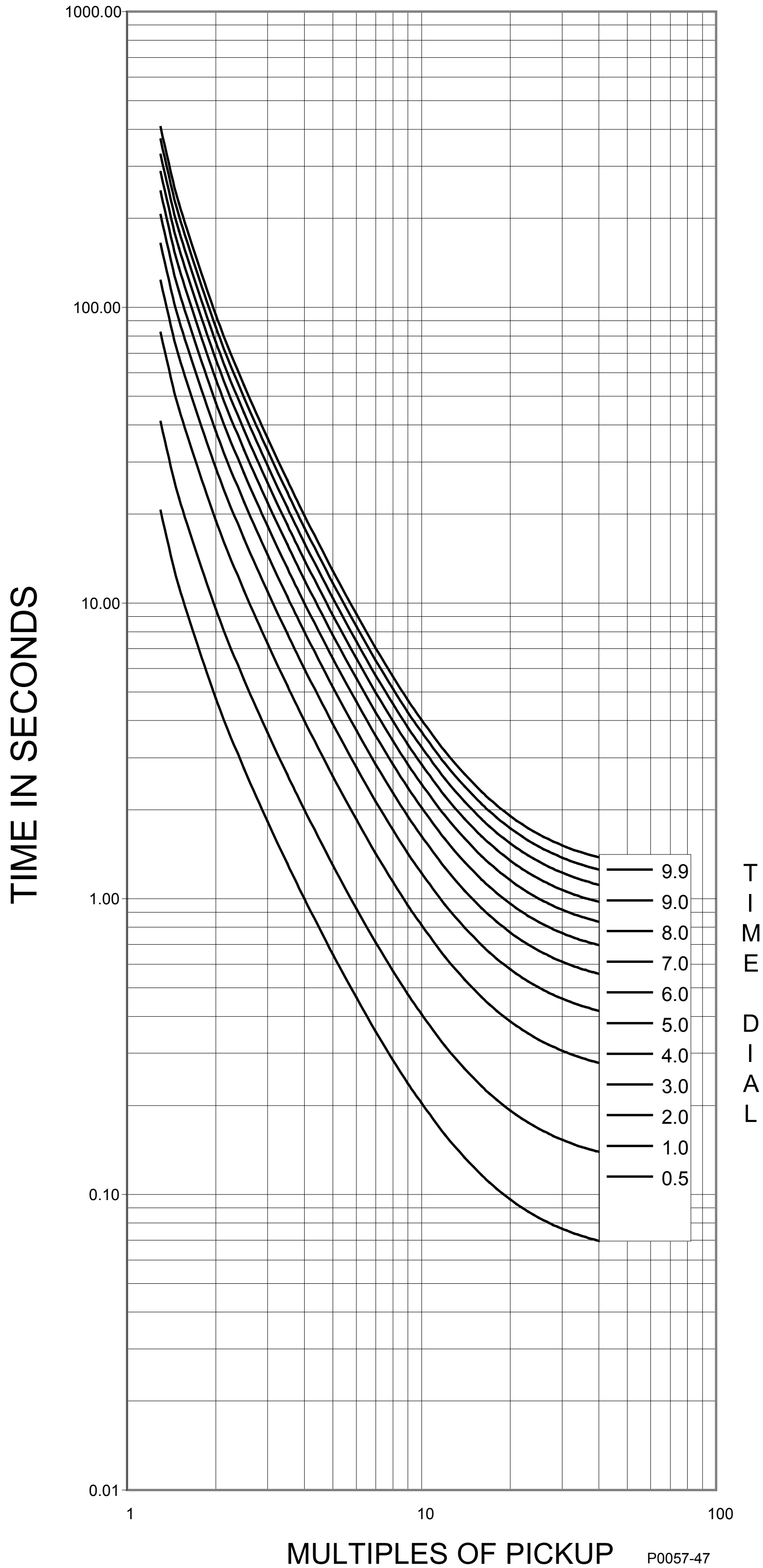


Figure 47-21. Time Characteristic Curve F1, Extremely Inverse (IEC 60255-151 Ed. 1)

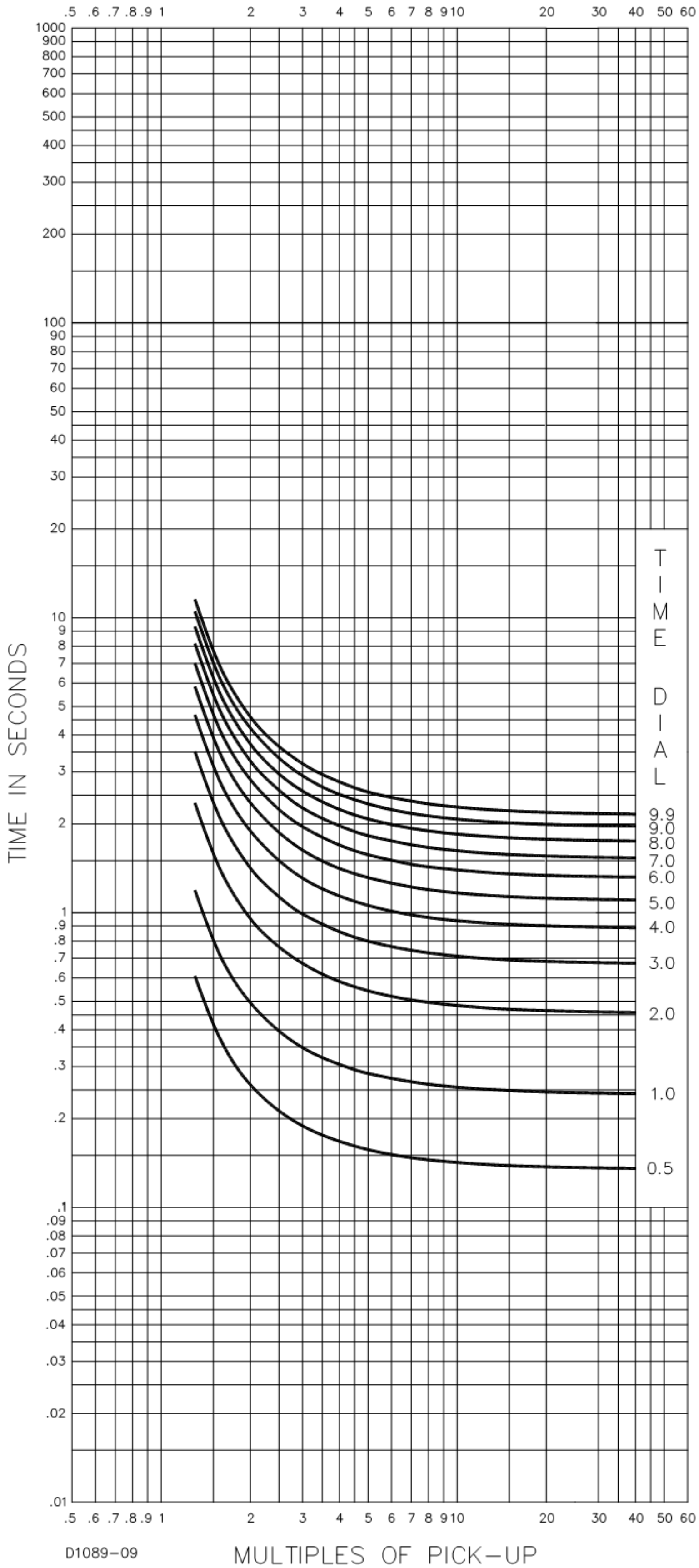


Figure 47-22. Time Characteristic Curve D, Definite Time (Similar To ABB CO-6)

48 • IT-D Isolation Transducer

Up to two IT-D Isolation Transducers can be used with each BE-11*d* DC Protection System. An IT-D transducer electrically isolates the BE1-11*d* from power parameters monitored by the system. Each IT-D can monitor two parameters. Parameters monitored by the IT-D include dc system voltages and current (measured through a metering shunt). The output of each IT-D channel is a pulsed digital signal. These fiber optic channel outputs are provided to the BE1-11*d* DC Protection System.

At least one IT-D module is required. Each IT-D has two input channels per module. Order p/n 9587000101 (60-Hz rectified) or p/n 9587000102 (50-Hz rectified). Two 30-foot fiber optic cables are supplied with each IT-D. The metal enclosure of the IT-D offers electric shock protection from incidental contact.

Refer to the *Specifications* chapter for IT-D and BE1-11*d* specifications.

Installation

IT-D Isolation Transducers are contained in a metal enclosure and may be mounted in any convenient position using UNC ¼-20 or equivalent screws. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

Note
Shielded, twisted-pair wiring for the Low Voltage (shunt) input with shield terminated to chassis mounting of the IT-D is recommended.

Connections

IT-D connections consist of screw terminal connectors and fiber optic connectors.

Electrical Connections

Pin Assignments

Power Input ....7, 8 (non-polarized), 9 (GND)

Power Output ....10, 11 (non-polarized)

Sensing Input 1 ....1–2 (internally connected) (HV+)
3 (SH+), 4 (SH–)
5–6 (internally connected) (HV–)

Sensing Input 2 ....13–14 (internally connected) (HV+)
15 (SH+), 16 (SH–)
17–18 (internally connected) (HV–)

Screw Terminal Connectors

Connectors with screw-down compression terminals are used for the sensing inputs, operating power input, and operating power output. The connectors, and the headers that they plug into, have a dovetailed edge that ensures proper connector orientation. Similar-sized connectors and headers are uniquely keyed to ensure that a connector mates only with the correct header to prevent damage to the IT-D. However, care must still be taken to ensure that the proper connector is inserted into the appropriate header. Connector screw terminals accept a maximum wire size of 12 AWG. The maximum screw torque is 5.3 in-lb (0.6 N•m).

Fiber Optic Outputs

Fiber optic connectors transmit electrically isolated, digital signals to the BE1-11*d*.

Connector Assignments

Connectors....................F1, F2
Cables ....Two 30-foot cables supplied with each IT-D

Dimensions

See Figure 48-1 for IT-D overall dimensions. All dimensions are shown in inches with millimeters in parenthesis. IT-D connectors and indicators are also illustrated in Figure 48-1. Locator letters in Figure 48-1 correspond to the lettered descriptions in Table 48-1.

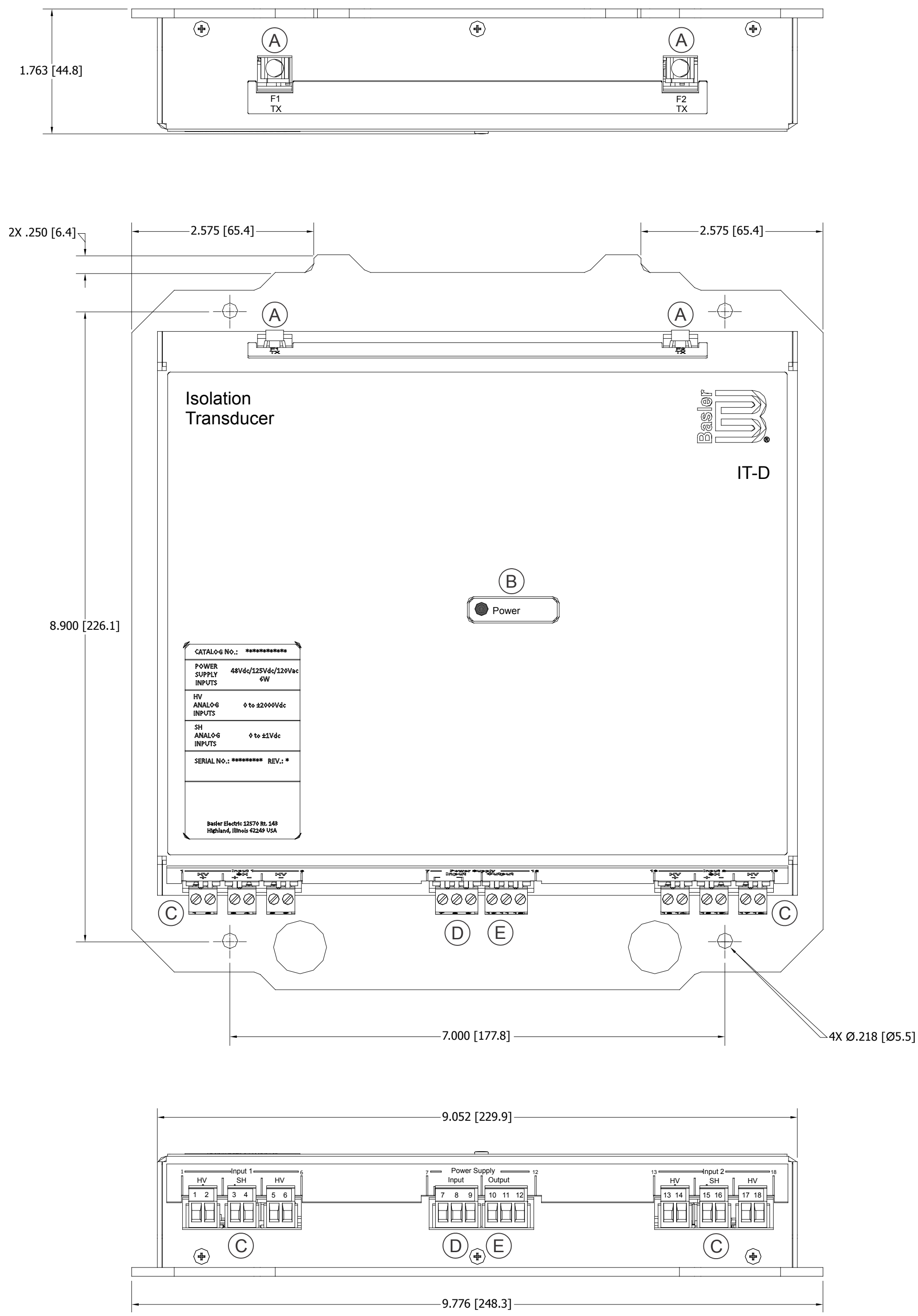


Figure 48-1. IT-D Dimensions, Connectors, and Indicators

Table 48-1. IT-D Connector and Indicator Descriptions

Locator	Description
A	Fiber optic connectors. F1 and F2 connect to BE1-11*d*.
B	Power Supply LED indicator.
C	Sensing input connectors: Input 1 and Input 2.
D	Power supply Input connector: Accepts 48 to 125 Vdc, 120 Vac nominal.
E	Power supply Output connector: Provides power to a second IT-D.

Operation

The IT-D has two isolated channels. The BE1-11*d*, which receives signals from the IT-D, may be configured using BESTCOMS*Plus*® software. This software provides adjustment for each specific input.

Sensing Inputs

A high-voltage connector and a low-voltage connector are provided for each channel. The high-voltage connectors accept up to 2,000 Vdc. Low-voltage connectors accept up to 1 Vdc. Each channel accepts only a high- or low-voltage input at one time. High-voltage connectors are labeled HV+ and HV–. They are located on either side of the SH+/– connector for each channel and the two pins in each high-voltage connector are electrically tied.

Fiber Optic Outputs

Two fiber optic output channels transmit isolated, digital signals from high-resolution analog-to-digital converters.

Operating Power

IT-D operating power is provided through the Input connector. The Output connector provides power, if needed, to a second IT-D.

Power Indicator

This green LED lights to indicate the presence of IT-D operating power at the power supply input.

Repair

IT-D Isolation Transducers are manufactured using state-of-the-art surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

Before returning the IT-D for repair, contact the Basler Electric Technical Services Department at 618.654.2341 for a return authorization number.

Maintenance

Preventive maintenance consists of periodically checking that the connections between the IT-D and the system are clean and tight.

Storage

This device contains long-life aluminum electrolytic capacitors. For devices that are not in service (spares in storage), the life of these capacitors can be maximized by energizing the device for 30 minutes once per year.

49 • RTD Module

The RTD (Resistance Temperature Detector) module is an optional remote device that provides RTD inputs, analog inputs, and analog outputs for DC power protection applications.

Features

RTD modules have the following features:

- 12 RTD Inputs
- 4 Analog Inputs
- 4 Analog Outputs
- Secured Read/Write Access*
- Reporting and Alarm Functions
- Communications via Ethernet or RS-485

* The default password for uploading settings to the RTD module is "**OEM**" in upper case letters.

Functional Description

A functional description of the RTD module's inputs and outputs is provided below.

Analog Inputs

The RTD module provides four analog inputs that are user-selectable for 4 to 20 mAdc or 0 to 10 Vdc. Each analog input has under/over thresholds that when exceeded, trip an analog input protection element. RTD modules with firmware 1.01.01 and above limit measurements in relation to the 4 to 20 mAdc or 0 to 10 Vdc range. Firmware below 1.01.01 is not operational outside the ranges. The label text of each analog input is customizable.

RTD Inputs

The RTD module provides 12 user-configurable RTD inputs for monitoring system temperatures. Each RTD input can be configured to protect against high or low temperature conditions. The label text of each RTD input is customizable.

Analog Outputs

The RTD module provides four analog outputs that are user-selectable for 4 to 20 mAdc or 0 to 10 Vdc. A wide selection of parameters including BE1-11*d* metered voltages and currents, analog inputs, and RTD inputs can be configured as analog outputs. Refer to the Programmable Outputs, Remote Analog Outputs screen in BESTCOMS*Plus*® for a full list of parameter selections.

Alarm Contact Functions

The RTD module provides form C (SPDT) alarm contacts that operate when an internal RTD module failure exists. The contacts also operate when operating power is cycled.

Real-Time Status Functions

The RTD module is equipped with a multi-function LED with the following functions.

- Slow Flashing - Communications established
- Quick Flashing - Communications lost
- Steady On - Power applied

Mounting

RTD modules are contained in a potted plastic case and may be mounted in any convenient position using UNC ¼-20 or equivalent screws. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 49-1 for RTD module overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

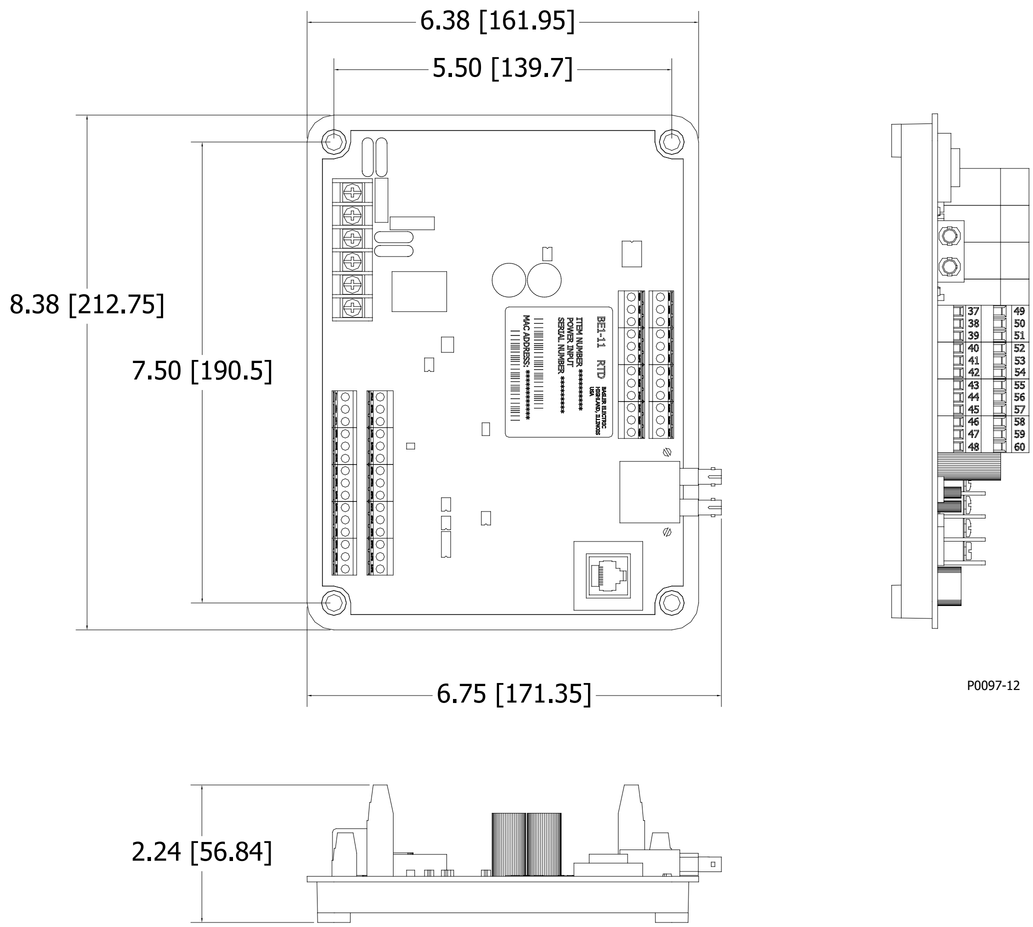


Figure 49-1. RTD Module Overall Dimensions

Connections

RTD module connections are dependent on the application. Incorrect wiring may result in damage to the module.

Note
Be sure that the RTD module is hard-wired to earth ground with no smaller than 12 AWG (3.31 mm^2) copper wire attached to the chassis ground terminal on the module.

Terminations

The terminal interface consists of permanently mounted connectors with screw-down compression terminals.

RTD module connections are made with one 6-position connector, two 12-position connectors, and two 15-position connectors. Connector screw terminals accept a maximum wire size of 12 AWG (3.31 mm^2). Maximum screw torque is 5 inch-pounds (0.56 N•m) for the 12- and 15-position connectors. Maximum screw torque is 9 inch-pounds (1.01 N•m) for the 6-position connector.

Operating Power

The RTD module operating power input accepts 125/250 Vac/dc and tolerates voltage over the range of 90 to 270 Vac or 90 to 300 Vdc. The operating power inputs are not polarity sensitive. Operating power terminals are listed in Table 49-1.

Table 49-1. Operating Power Terminals

Terminal	Description
TB1-1	Operating power input
TB1-2	Operating power input
TB1-3	Chassis ground connection

Alarm Contacts

These terminals provide form C (SPDT) alarm contacts. Alarm contact terminals are listed in Table 49-2.

Table 49-2. Alarm Contact Terminals

Terminal	Description
TB1-4	Normally Open
TB1-5	Common
TB1-6	Normally Closed

RTD Module Inputs and Outputs

Input and output terminals are shown in Figure 49-2 and listed in Table 49-3.

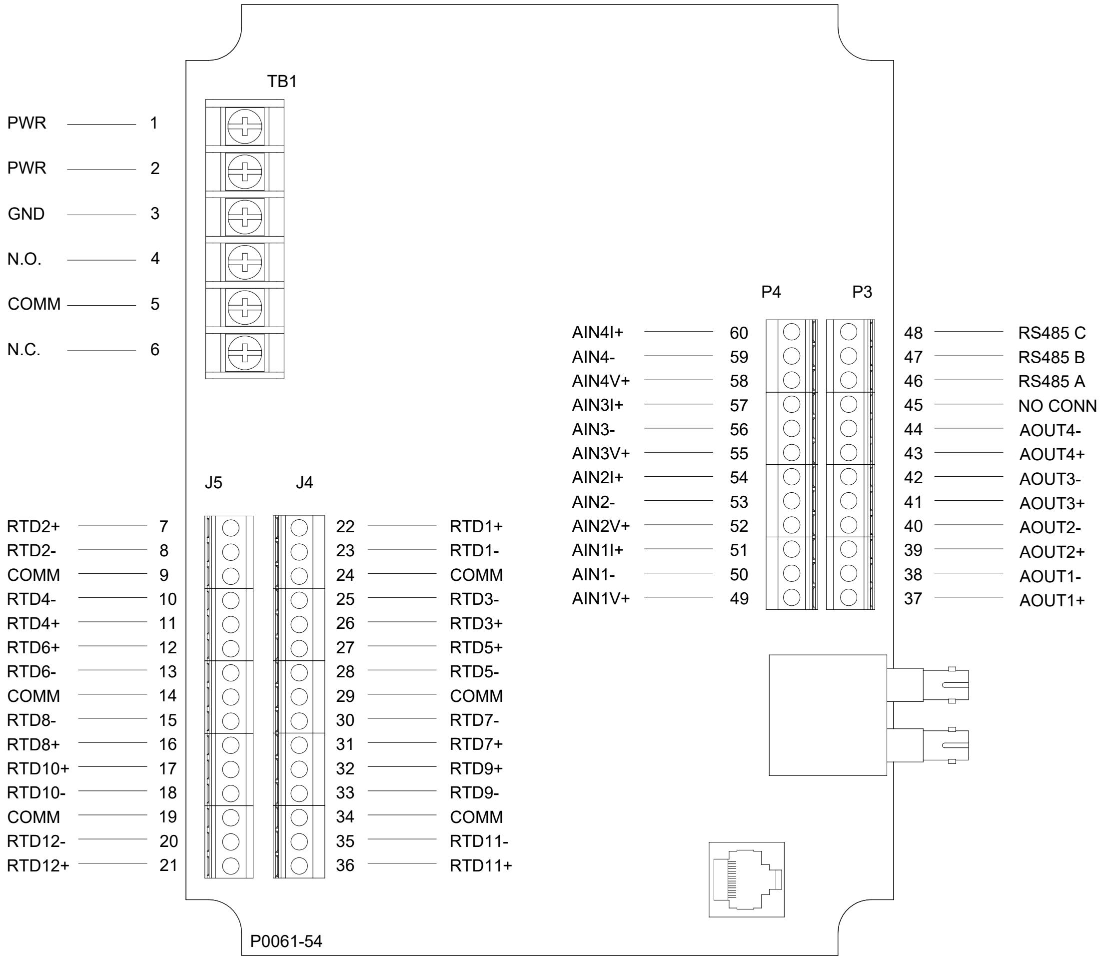


Figure 49-2. Input and Output Terminals

Table 49-3. Input and Output Terminals

Connector	Description
TB1	Operating Power and Alarm Contacts
J4	RTD Inputs 1, 3, 5, 7, 9, 11
J5	RTD Inputs 2, 4, 6, 8, 10, 12
P3	Analog Outputs 1 - 4 and RS485 Connection
P4	Analog Inputs 1 - 4

External Analog Input Connections

Voltage input connections are shown in Figure 49-3 and current input connections are shown in Figure 49-4. When using the current input, AIN V+ and AIN I+ must be tied together.

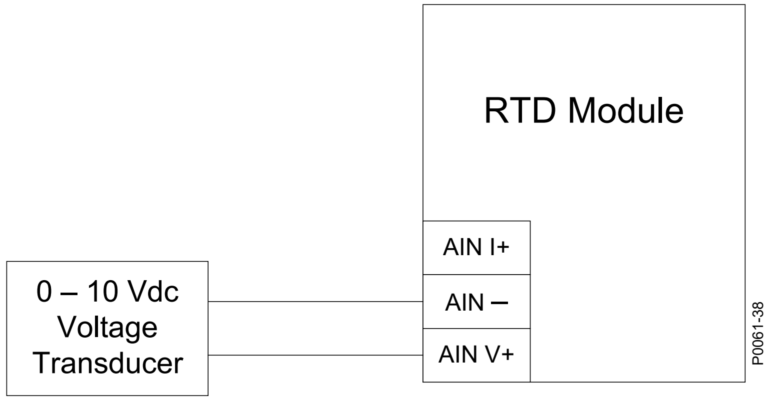


Figure 49-3. Analog Inputs - Voltage Input Connections

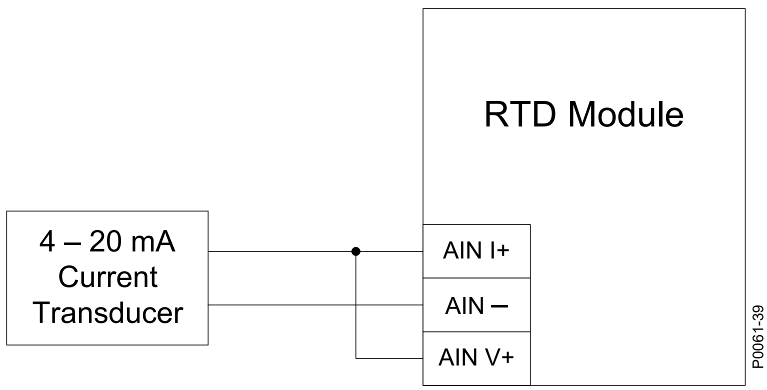


Figure 49-4. Analog Inputs - Current Input Connections

External RTD Input Connections

External 2-wire RTD input connections are shown in Figure 49-5. Figure 49-6 shows external 3-wire RTD input connections.

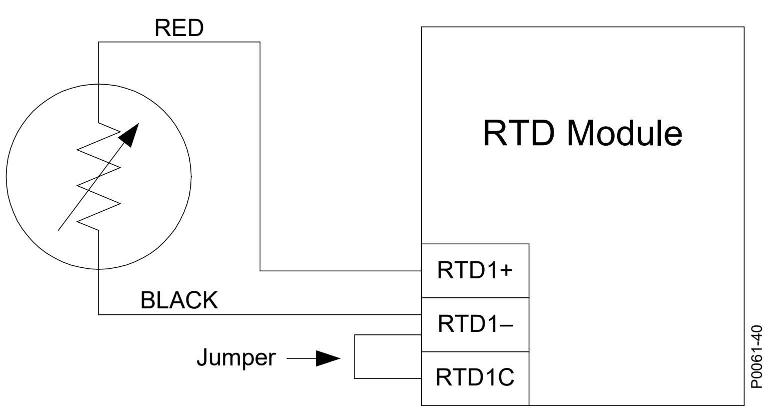


Figure 49-5. External Two-Wire RTD Input Connections

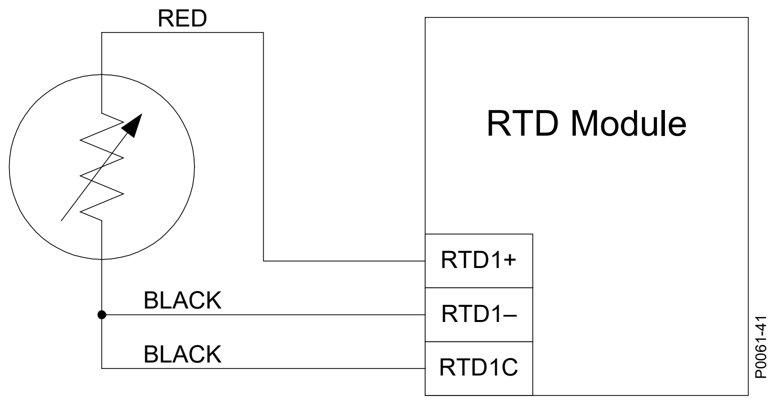


Figure 49-6. External Three-Wire RTD Input Connections

RTD Module Communications Setup Procedure

Communication between the BE1-11*d* and the RTD module can be accomplished via Ethernet or RS-485. For RS-485 communication, RS-485 Port Protocol option must be "N". Initial settings for the RTD module must be made via Ethernet.

An IP address is assigned to the RTD module in all cases even if the connection between the RTD module and the BE1-11*d* will be RS-485. Assigning an IP address to the RTD module gives the user the option to save a settings file and to view the serial number and firmware version of the RTD module using BESTCOMS*Plus*.

Perform one of the following procedures to set up the RTD module. It is assumed that the BE1-11*d* is already connected to the PC or network.

Procedure 1

The PC and BE1-11*d* are connected through a network or the PC is connected directly to the BE1-11*d* via Ethernet cable or USB cable. The RTD module connects to the BE1-11*d* via Ethernet or RS-485. See Figure 49-7.

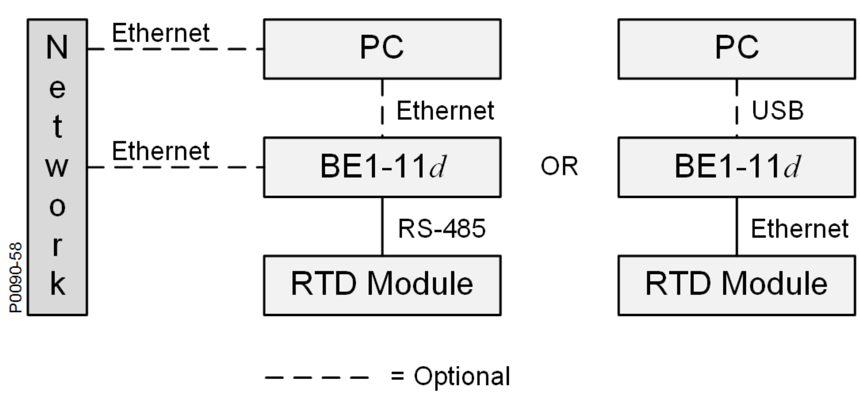


Figure 49-7. Procedure 1

<u>*Connect to RTD Module*</u>

1. Connect an Ethernet cable directly between the PC and RTD module.
2. Apply operating power to the RTD module.
3. Determine the IP address, Subnet Mask, and Default Gateway of the PC Ethernet port for later use. Open a Windows® command prompt by clicking Start > Run. Type "cmd", and click OK. Type "ipconfig" and press enter.

4. Record the IP address, Subnet Mask, and Default Gateway of the PC Ethernet port that is connected to the RTD module. Close the Windows command prompt window.
5. Open the RTD Module plugin in BESTCOMS*Plus.*
6. Pull down the Communication menu and select New Connection > RTD Module. The RTD Module Connection screen appears.
7. Under Device Discovery, click the Ethernet button to scan for connected devices.
8. After scanning for connected devices, the Device Discovery screen appears.
9. Use the computer mouse to highlight the desired RTD module and click the Configure button.
10. The Configure - RTD Module screen appears. The BE1-11*d* uses the Device Address (Remote Module ID) to communicate with the RTD module. The RTD module comes with a default address of 255 (module disabled). Enter the desired device address between 1 and 254.
11. Assign an IP Address to the RTD module by entering an address in the same range as the IP address of the PC recorded in Step 4. For example, if the IP address recorded in Step 4 was 169.254.153.**248**, you could enter 169.254.153.**150** or 169.254.153.**45**. (The range is 1 to 255.)
12. The PC and RTD module must have the same Subnet Mask and Default Gateway. Assign the Subnet Mask and Default Gateway to the RTD module using the values of the PC recorded in Step 4.
13. Click Send to Device. A password is required. The default password is "**OEM**". Click Close.
14. Click Cancel on the Device Discovery screen.
15. Cycle power to the RTD module to activate the new IP address.

Verify RTD Module Communication and Save a Settings File

16. To verify that the IP address of the RTD module was correctly configured or to save a settings file for the RTD module, click the Ethernet button under Device Discovery to scan for connected devices.
17. After scanning for connected devices, the Device Discovery screen appears.
18. Use the computer mouse to highlight the desired RTD module and click the Connect button. If the connection was successful, BESTCOMS*Plus* will show **Online** in the lower right corner.
19. Review settings or save a settings file if desired.
20. Click the Disconnect button near the top of BESTCOMS*Plus* to close the RTD module connection.

Configure the BE1-11d to Communicate with the RTD Module

21. Connect an Ethernet or USB cable between the PC and BE1-11*d*.
22. Open the BE1-11 plugin in BESTCOMS*Plus* and connect to the BE1-11*d*.
23. Use the Settings Explorer to open the Remote Module Communications screen under System Parameters.
24. Set the *Status* to **Enabled**. Set Communication Type to **Ethernet** or **RS485**. Set Remote Module ID to match the remote module ID entered in Step 10.
25. Perform this step if the RTD Module is connected to the BE1-11*d* via a direct Ethernet connection. The BE1-11*d* communicates with the RTD Module only if its Active IP Address is a nonzero value. To confirm/set the IP Address, open the Ethernet screen under Communication, Configure and de-select the Use DHCP box. Then, enter any nonzero value for the IP Address. Click the Send to Device button to apply the settings to the BE1-11*d*.
26. Perform this step if the RTD module is connected to the BE1-11*d* via RS-485. The RTD Module communicates with the BE1-11*d* only at 19200 baud when using RS-485. Open the RS485 Setup screen under Communications and set Baud Rate to **19200 Baud**, Bits Per Character to **8 Bits**, Parity to **No Parity**, and Stop Bits to **1 stop bit**.
27. Use BESTCOMS*Plus* to send settings to the BE1-11*d*.

Procedure 2

The PC, BE1-11*d*, and RTD module are connected through a network. See Figure 49-8.

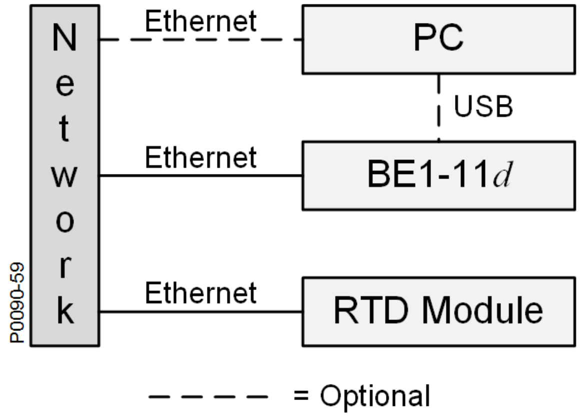


Figure 49-8. Procedure 2

Connect to RTD Module

1. Connect an Ethernet cable directly between the PC and RTD module.
2. Apply operating power to the RTD module.
3. Open the RTD Module plugin in BESTCOMS*Plus.*
4. Pull down the Communication menu and select New Connection > RTD Module. The RTD Module Connection screen appears.
5. Under Device Discovery, click the Ethernet button to scan for connected devices.
6. After scanning for connected devices, the Device Discovery screen appears.
7. Use the computer mouse to highlight the desired RTD module and click the Configure button.
8. The Configure - RTD Module screen appears. The BE1-11*d* uses the Device Address (Remote Module ID) to communicate with the RTD module. The RTD module comes with a default address of 255 (module disabled). Enter the desired device address between 1 and 254.
9. DHCP (Dynamic Host Configuration Protocol) allows the RTD module to send a broadcast request for configuration information. The DHCP server receives the request and responds with configuration information. DHCP is disabled by default. To enable, check the DHCP box.

If DHCP is not being used, use BESTCOMS*Plus* to configure the Ethernet port as described in the following paragraphs.

Configurable Ethernet options include:

IP Address:	Internet Protocol Address to be used by the RTD module.
Default Gateway:	Default host to send data destined for a host not on the network subnet.
Subnet Mask:	Mask used to determine the range of the current network subnet.
Use DHCP:	When this box is checked, the IP Address, Default Gateway, and Subnet Mask are automatically configured via DHCP. This can be used only if the Ethernet network has a properly configured DHCP server running. Uncheck the box if DHCP is not being used.

Obtain the values for these options from the site administrator if the RTD module is intended to share the network with other devices.

If the RTD module is operating on an isolated network, the IP address can be chosen from one of the following ranges as listed in IETF publication RFC 1918, *Address Allocation for Private Networks.*

- 10.0.0.0 - 10.255.255.255

- 172.16.0.0 - 172.31.255.255
- 192.168.0.0 - 192.168.255.255

10. Click Send to Device. A password is required. The default password is "**OEM**". Click Close.
11. Click Cancel on the Device Discovery screen.
12. Remove operating power from the RTD module. Connect the RTD module to the network. Apply operating power to the RTD module

Verify RTD Module Communication and Save a Settings File

13. Connect the PC to the same network as the RTD module.
14. To verify that the IP address of the RTD module was correctly configured or to save a settings file for the RTD module, click the Ethernet button under Device Discovery to scan for connected devices.
15. After scanning for connected devices, the Device Discovery screen appears.
16. Use the computer mouse to highlight the desired RTD module and click the Connect button. If the connection was successful, BESTCOMS*Plus* will show **Online** in the lower right corner.
17. Review settings or save a settings file if desired.
18. Click the Disconnect button near the top of BESTCOMS*Plus* to close the RTD module connection.

Configure the BE1-11d to Communicate with the RTD Module

19. Connect an Ethernet or USB cable between the PC and BE1-11*d*.
20. Open the BE1-11 plugin in BESTCOMS*Plus* and connect to the BE1-11*d*.
21. Use the Settings Explorer to open the Remote Module Communications screen under System Parameters.
22. Set the *Status* to **Enabled**. Set Communication Type to **Ethernet**. Set Remote Module ID to match the remote module ID entered in Step 8.
23. Use BESTCOMS*Plus* to send settings to the BE1-11*d*.

RTD Module Plugin for BESTCOMSPlus®

The setup utility that installs BESTCOMS*Plus* on your PC also installs the RTD Module plugin. The RTD Module plugin is used to set the device address, set device security, and view device information such as firmware version and serial number. RTD Module operational settings such as metering and protective elements are found in the BE1-11 plugin for BESTCOMS*Plus*.

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the RTD module. Installation and operation of BESTCOMS*Plus* is described in the *BESTCOMSPlus Software* chapter.

Automatic Startup

To start BESTCOMS*Plus*, click the Windows® Start button, point to Programs, Basler Electric, and then click the BESTCOMS*Plus* icon. During initial startup, the BESTCOMS*Plus* Select Language screen is displayed (Figure 49-9). You can choose to have this screen displayed each time BESTCOMS*Plus* is started, or you can select a preferred language and this screen will be bypassed in the future. Click OK to continue. This screen can be accessed later by selecting Tools and Select Language from the menu bar.

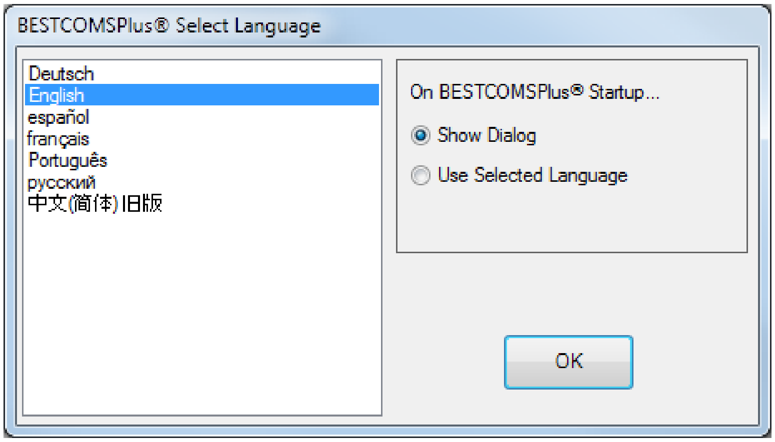


Figure 49-9. BESTCOMS*Plus* Select Language Screen

The BESTCOMS*Plus* splash screen is shown for a brief time. See Figure 49-10.

Figure 49-10. BESTCOMS*Plus* Splash Screen

The BESTCOMS*Plus* platform window opens. Select New Connection from the Communication pull-down menu and select RTD Module. See Figure 49-11.

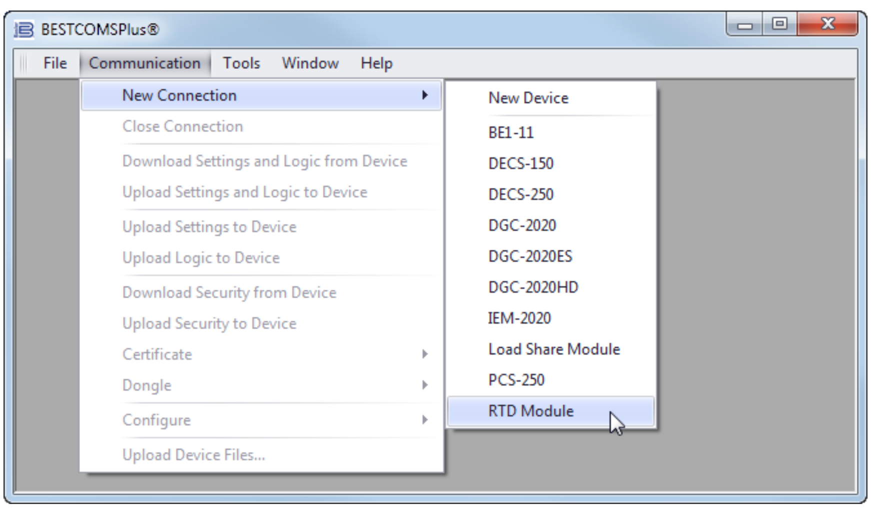


Figure 49-11. Communication Pull-Down Menu

The RTD Module Connection screen shown in Figure 49-12 appears. Under Device Discovery, click the Ethernet button.

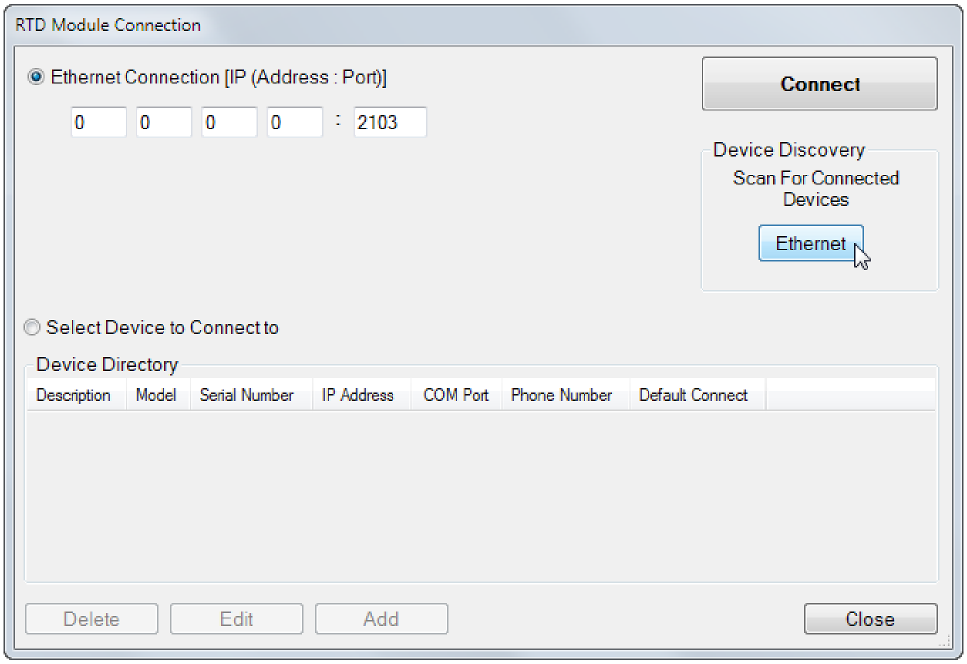


Figure 49-12. RTD Module Connection Screen

Wait until scanning is complete. See Figure 49-13.

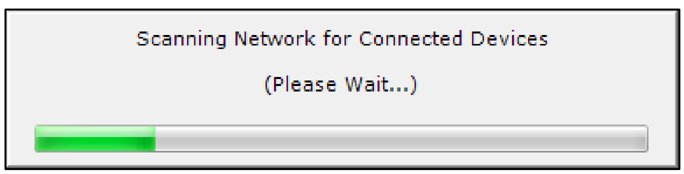


Figure 49-13. Scanning for Connected Devices

The Device Discovery screen shown in Figure 49-14 appears. Use the computer mouse to highlight the desired RTD module and click the Connect button (or proceed to configure communications as explained in the next paragraph). The RTD Module plugin opens. You can now configure the RTD module settings.

Click the Configure button to change RTD module communication settings.

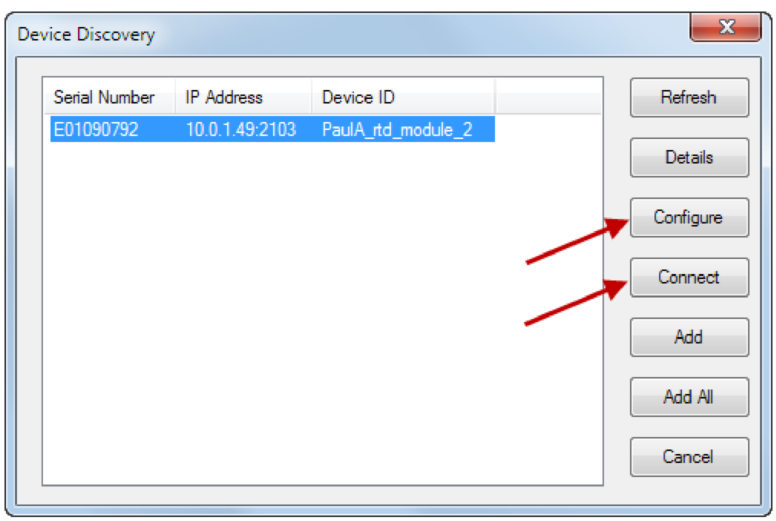


Figure 49-14. Device Discovery Screen

The Configure - RTD Module screen shown in Figure 49-15 appears. The BE1-11*d* uses the Device Address to communicate with the connected RTD module through Ethernet or RS-485. All other settings are only for the Ethernet port. Program the desired settings and click Send to Device. A password is required. The default password is "**OEM**". Click the Close button.

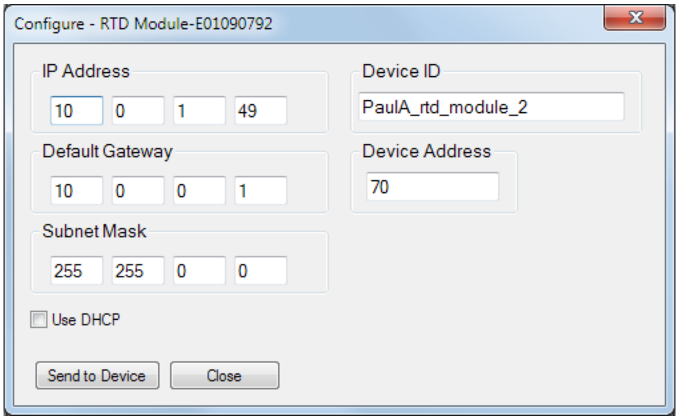


Figure 49-15. Configure - RTD Module Screen

The Device Discovery screen shown in Figure 49-14 re-appears. Click the Connect button. The RTD Module plugin opens. You can now configure the RTD module settings.

Device Info

Information about an RTD module communicating with BESTCOMS*Plus* can be obtained on the Device Info screen of BESTCOMS*Plus*.

Select application version when configuring RTD module settings off-line. When on-line, read-only information includes application version, boot code version, application build date, serial number, application part number, and model number. A specific Device ID can be assigned by the user.

BESTCOMS*Plus* device information values and settings are illustrated in Figure 49-16.

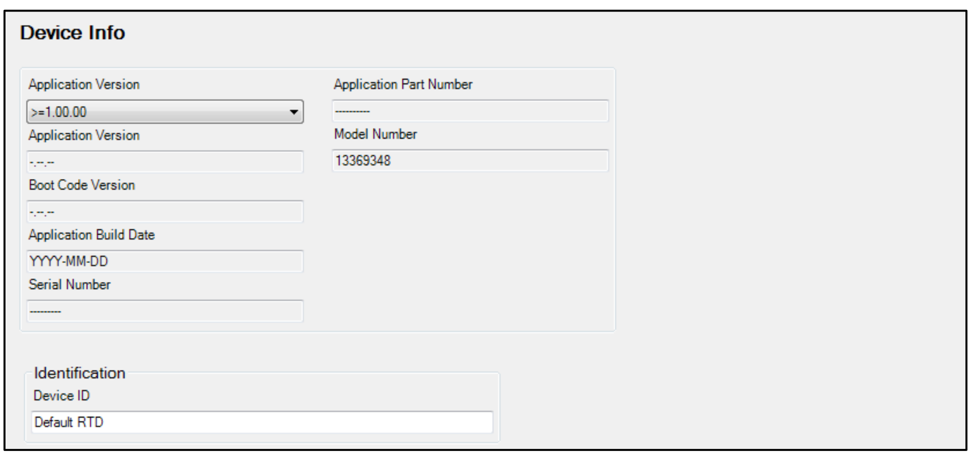


Figure 49-16. Device Info Screen

Remote Module ID

The default setting is 255 (communications disabled). Assign a remote module ID (1 to 254) to the RTD module. The BE1-11*d* uses this unique ID to communicate with the connected RTD module. To obtain metering values in BESTCOMS*Plus* or through the BE1-11*d* front panel, the same ID must be entered on the Remote Module Communications screen under System Parameters in the Settings Explorer of the BE1-11 plugin. The Device Address screen is shown in Figure 49-17.

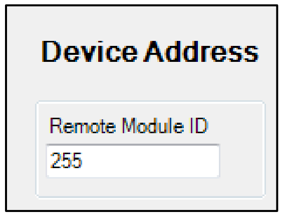


Figure 49-17. Device Address Screen

Device Security Setup

Password protection guards against unauthorized changing of RTD module settings. Passwords are case sensitive. OEM Access is the only level of password protection available. This password level allows access to all settings made using the RTD Module plugin for BESTCOMS*Plus*. The default, OEM-access password is "**OEM**".

Passwords can be changed only after communication between the PC and RTD module is established. A change to the password is made through the Device Security Setup screen.

Use the Settings Explorer in BESTCOMS*Plus* to select Device Security Setup under General Settings. The Login dialog box appears. See Figure 49-18.

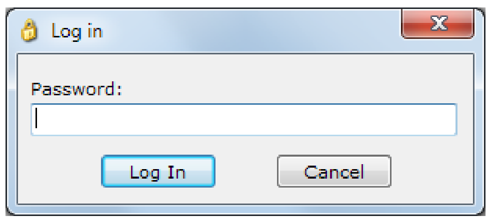


Figure 49-18. Login Screen

Enter the Password and then click the Log In button. The default password is "**OEM**". The Device Security Setup screen shown in Figure 49-19 appears.

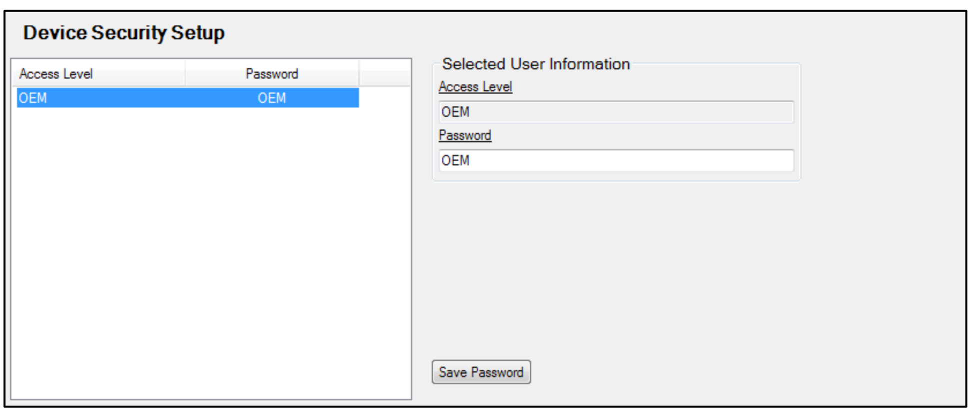


Figure 49-19. Device Security Setup Screen

A password is changed by clicking on the access level and entering the new password. Click the Save Password button to save the settings to BESTCOMS*Plus* memory.

Pull down the Communication menu and select Upload Security to Device. The Login dialog box pops up. An OEM access level is required to upload security settings to the device.

Enter the password and then click the Log In button. The default password is "**OEM**". BESTCOMS*Plus* notifies you when the upload is successful.

Remote Analog Inputs Configuration

The RTD module provides four analog inputs. The BE1-11*d* supports two RTD modules at once. To make identifying the analog inputs easier, a user-assigned name can be given to each input.

Protection settings for remote analog inputs are described in the *Analog Input Protection* chapter.

Configuration Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Inputs, Remote Analog Inputs

HMI Navigation Path: Settings Explorer, Analog Inputs

Configuration settings are made using the BE1-11 plugin for BESTCOMS*Plus*. To program the configuration settings, use the Settings Explorer to open the Programmable Inputs, Remote Analog Inputs tree branch and select the module and input to be modified. Refer to Figure 49-20. Use the drop-down menu under Type to select the type of configuration. The analog inputs are always monitored and their status is displayed on the appropriate metering screens.

Ranges must be set for the selected input type. Param Min correlates to Min Input Current or Min Input Voltage and Param Max correlates to Max Input Current or Max Input Voltage. Param Min and Param Max are scaled values of the Min/Max Voltage/Current settings that are used for protection.

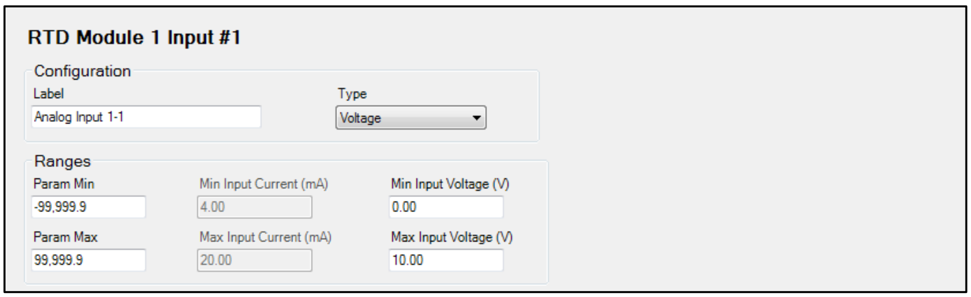


Figure 49-20. Module 1 Input #1 Screen

Remote Analog Outputs Configuration

The RTD module provides four analog outputs. The BE1-11*d* supports two RTD modules at once.

Configuration Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Outputs, Remote Analog Outputs

HMI Navigation Path: Settings Explorer, Analog Outputs

Configuration settings are made using the BE1-11 plugin for BESTCOMS*Plus*. To program the configuration settings, use the Settings Explorer to open the Programmable Outputs, Remote Analog Outputs tree branch and select the module and output to be modified. Refer to Figure 49-21. Use the drop-down menu under Param Selection to select a parameter. Select the Output Type. The analog outputs are always monitored and their status is displayed on the appropriate metering screens.

Ranges must be set for the selected output type. Param Min correlates to Min Output Current or Min Output Voltage and Param Max correlates to Max Output Current or Max Output Voltage.

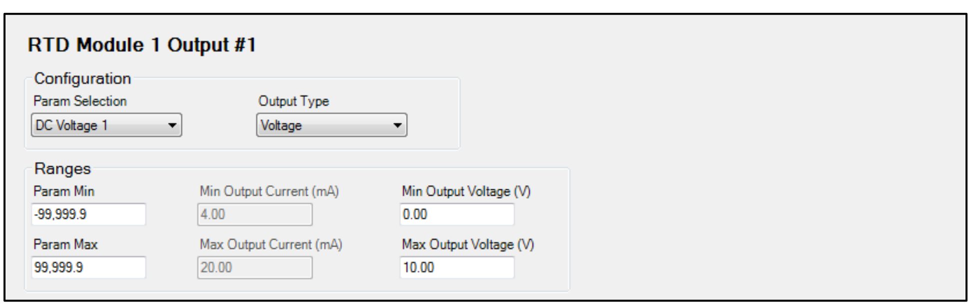


Figure 49-21. Module 1 Output #1 Screen

Table 49-4 defines the units of selectable parameters.

Table 49-4. Units of Selectable Parameters

Parameter	Unit	Note
DC Voltage 1, 2, or 3	V (system)	
DC Current 1	A (system)	
DC Power 1	W (system)	
Analog Input 1-1 through 1-4	Scale entered for the analog input	When an analog output is used to repeat an analog input, the scaled value is used (not the raw 4-20 mA or 0-10 V signal).
Analog Input 2-1 through 2-4	Scale entered for the analog input	
RTD 1-1 through RTD 1-12	Degrees C or F (depends on System Units setting)	
RTD 2-1 through RTD 2-12	Degrees C or F (depends on System Units setting)	
Thermal Capacity	%	

Remote Analog Output Metering

Analog output metering values are obtained through BESTCOMS*Plus* by using the Metering Explorer to open the Analog Metering, Analog Outputs tree branch. BESTCOMS*Plus* must be online with the BE1-11*d* to view analog output metering. Alternately, values can be obtained through the front-panel display by navigating to the Metering, Analog Metering, Analog Output screen.

Remote RTDs Configuration

The RTD module provides 12 RTD inputs. The BE1-11*d* supports two RTD modules at once. The RTDs are always monitored and their status is displayed on the appropriate metering screens.

Protection settings for remote RTDs are described in the *Resistance Temperature Detector (49RTD) Protection* chapter.

Out of Range Alarm

The BE1-11*d* reports an Out of Range alarm when the resistance from an RTD has exceeded an expected range for a properly functioning RTD. Exceeding the range indicates that the RTD may be shorted or open and cannot be relied on to provide thermal detection. Table 49-5 defines the resistance and equivalent temperature levels that will result in an Out of Range alarm.

Table 49-5. Out of Range Alarm Resistance/Temperature Levels

RTD Type	Min. Ohms	Min. Temperature	Max. Ohms	Max. Temperature
10 Ω Cu	7 Ω	–61°C (–77.8°F)	20 Ω	261°C (501.8°F)
100 Ω Pt	76 Ω	–61°C (–77.8°F)	198 Ω	261°C (501.8°F)
100 Ω Ni	69 Ω	–61°C (–77.8°F)	224 Ω	181°C (357.8°F)
120 Ω Ni	79 Ω	–61°C (–77.8°F)	383 Ω	261°C (501.8°F)

Configuration Settings

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Inputs, Remote RTD

HMI Navigation Path: Settings Explorer, RTD Types

Configuration settings are made using the BE1-11 plugin for BESTCOMS*Plus*. Before making configuration settings, remote module communications must be configured on the System Parameters, Remote Module Communications screen. To program the configuration settings, use the Settings Explorer to open the Programmable Inputs, Remote RTD, RTD Type Selection tree branch and select RTD Type Selection. Use the drop-down menu to select RTD Type. Refer to Figure 49-22.

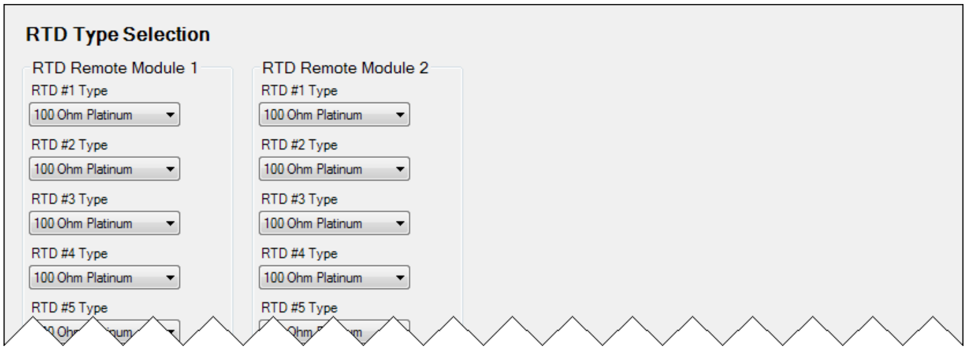


Figure 49-22. RTD Type Selection Screen

Use the Settings Explorer to open the Programmable Inputs, Remote RTD, RTD Block Configuration tree branch and enter a user-defined name (up to 64 alphanumeric characters) for the RTD Configuration Block selected. Check the boxes next to the RTDs to include in each configuration group. See Figure 49-23.

The source for the 49RTD protection elements can be set for RTD Group 1, 2, 3, 4, 5, 6, or 7. Refer to the *Resistance Temperature Detector (49RTD) Protection* chapter for information on setting 49RTD protection elements.

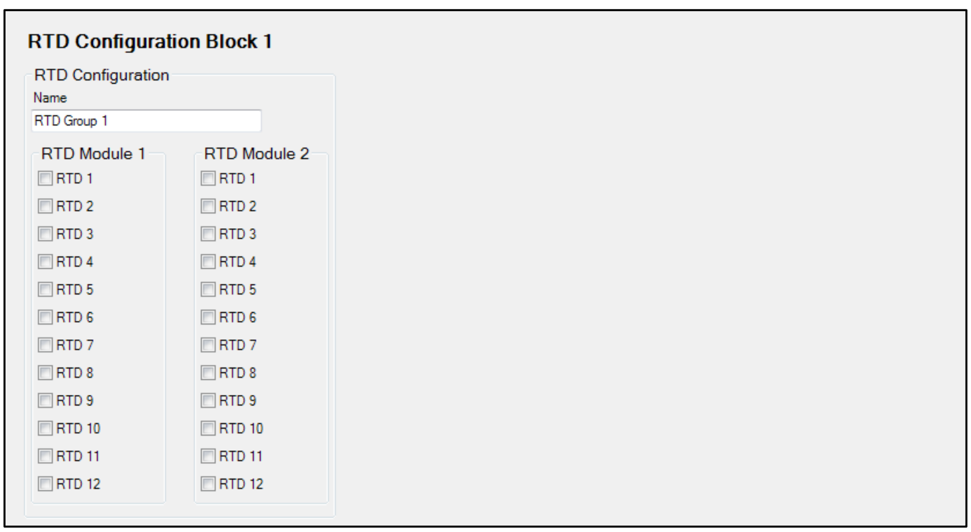


Figure 49-23. RTD Configuration Block Screen

Specifications

Operating Power

Nominal .... 125/250 Vac/dc
Range... 90 to 270 Vac or 90 to 300 Vdc
Maximum Consumption .... 9 W

Analog Inputs

The RTD module contains four programmable analog inputs.

Rating .... 4 to 20 mAdc or 0 to 10 Vdc (user-selectable)

RTD Inputs

The RTD module contains 12 programmable RTD inputs.

User-Selectable Types..............100 Ω Platinum (DIN43760), 10 Ω Copper, 100 Ω Nickel, or 120 Ω Nickel
Range.......................................–50 to 250°C (–58 to 482°F)
Accuracy...................................±2°C (3.6°F)
Maximum Lead Length...............150 feet (45.72 m) with 22 AWG (0.326 mm^2) wire
Sensing Current Level................2.5 mA
Isolation ....35 Vpp

Analog Outputs

The RTD module contains four programmable analog outputs.

Rating ....4 to 20 mAdc or 0 to 10 Vdc (user-selectable)

Current

Accuracy...................................±0.053% of full scale (10 V) at 25°C
Temperature Dependence ....±0.029% drift per degree Celsius

Voltage

Accuracy...................................±0.055% of full scale (20 mA) at 25°C
Temperature Dependence ....±0.04% drift per degree Celsius

Alarm Contact

Type ....Form C (SPDT)
Rating ....24/48/125/250 Vdc at:

- 30 A make for 0.2 seconds
- 7 A continuous
- 0.3 Adc Break (L/R = 0.04)

Communication Interface

Ethernet

An RTD module with part number 9444100101 is equipped with both fiber and copper Ethernet connections. An RTD module with part number 9444100100 is equipped with only a copper Ethernet connection.

Copper Type (RJ45 Connector)

Version 10BASE-T/100BASE-TX
Maximum Length (One Network Segment)............... 328 ft (100 m)

Fiber Optic Type (ST Connector)

Version .... 100BASE-FX, multimode
Maximum Length (Half-Duplex) .... 1,310 ft (399 m)
Maximum Length (Full-Duplex)................................. 6,600 ft (2,011 m)

Serial

RS-485 19,200 baud

Temperature

Operating Range........................–40°C to 70°C (–40°F to 158°F)
Storage Range ....–40°C to 70°C (–40°F to 158°F)

Standards

IEC 60068-1: *Environmental Testing Part 1: General and Guidance. Temperature Test*

IEC 60068-2-1: *Basic Environmental Testing Procedures, Part 2: Tests - Test Ad: Cold (Type Test)*

IEC 60068-2-2: *Basic Environmental Testing Procedures, Part 2: Tests - Test Bd: Dry Heat (Type Test)*

IEC 60068-2-28: *Environmental Testing Part 2: Testing-Guidance for Damp Heat Tests*

IEC 60255-4: *Single Input Energizing Quantity Measuring Relays with Dependent Specified Time*

IEC 60255-5: *Electrical Insulation Tests for Electrical Relays. Dielectric Test and Impulse Test*

IEC 60255-6: *Electrical Relays - Measuring Relays and Protection Equipment*

IEC 60255-21-1: *Vibration, Shock, Bump, and Seismic Tests on Measuring Relays and Protective Equipment (Section 1 - Vibration Test - Sinusoidal). Class 1*

IEC 60255-21-2: *Vibration, Shock, Bump, and Seismic Tests on Measuring Relays and Protective Equipment (Section 2 - Shock and Bump Test - Sinusoidal). Class 1*

IEEE C37.90.1: *Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*

IEEE C37.90.2: *Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers*

UL Approval

“cURus” recognized to UL Standard 508 & CSA Standard C22.2 No.14

CSA Certification

CSA certified to Standard C22.2 No.14.

CE and UKCA Compliance

This product has been evaluated and complies with the requirements set forth by the EU legislation and UK Parliament.

EC Directives:

- LVD 2014/35/EU
- EMC 2014/30/EU
- RoHS2 2011/65/EU

Harmonized Standards used for evaluation:

- EN 50178:1997 - *Electronic Equipment for use in Power Installations*
- EN 61000-6-4:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments*
- EN 61000-6-2:2001 - *Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments*
- EN 61000-4-2: *Electrostatic Discharge Immunity*
- EN 61000-4-3: *Radiated, Radio-Frequency, Electromagnetic Field Immunity*
- EN 61000-4-4: *EFT Immunity*
- EN 61000-4-5: *Surge Immunity*
- EN 61000-4-6: *Conducted Immunity*
- EN 61000-4-8: *Power Frequency Magnetic Field Immunity*
- EN 61000-4-11: *Voltage Dips and Interrupts*

HALT (Highly Accelerated Life Testing)

Basler Electric uses HALT to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the RTD module was subjected to temperature extremes of –80°C to +130°C, vibration extremes of 5 to 45 G at +20°C, and temperature/vibration extremes of 45 G over a temperature range of –60°C to

+110°C. Combined temperature and vibration testing at these extremes proves that the RTD module is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are listed under *Temperature*.

Physical

Weight ....2.15 lb (0.975 kg)
IP Class IP50
Size ....Refer to *Mounting.*

Repair

RTD modules are manufactured using state-of-the-art surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

Before returning the RTD module for repair, contact the Basler Electric Technical Services Department at 618-654-2341 for a return authorization number.

Maintenance

Preventive maintenance consists of periodically checking that the connections between the RTD module and the system are clean and tight.

Storage

This device contains long-life aluminum electrolytic capacitors. For devices that are not in service (spares in storage), the life of these capacitors can be maximized by energizing the device for 30 minutes once per year.

50 • BESTCOMS*Plus*® Settings Loader Tool

Introduction

The BESTCOMS*Plus*® Settings Loader Tool is a software application that allows the user to instantly upload settings to Basler BESTCOMS*Plus*-compatible products by scanning a pre-registered bar code, which promotes consistency, reduces potential errors, and saves time.

Setup

The BESTCOMS*Plus* Settings Loader Tool software and a bar code reader (acquired separately) must be installed on the same PC.

BESTCOMS*Plus* Settings Loader Tool Installation

System Recommendations

The BESTCOMS*Plus*® Settings Loader Tool is bundled with BESTCOMS*Plus* software. BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the BESTCOMS*Plus* Settings Loader Tool and the required version of .NET Framework (if not already installed). BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10, and Windows 11. Microsoft Internet Explorer 5.01 or later must be installed on your PC before installing BESTCOMS*Plus*. System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 50-1.

Table 50-1. System Recommendations for BESTCOMS*Plus* and the .NET Framework

System Type	Component	Recommendation
32/64 bit	Processor	2.0 GHz
32/64 bit	RAM	1 GB (minimum), 2 GB (recommended)
32 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)
64 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)

Download BESTCOMSPlus

Use the following procedure to download BESTCOMS*Plus* from the Basler Electric website.

1. Navigate to https://www.basler.com/Downloads.
2. Select BE1-11*d* from the model drop down menu.
3. Under the Software heading, click the download link for BESTCOMS*Plus*.
4. Sign in or create an account to continue with the download.

Install BESTCOMSPlus

To install and run BESTCOMS*Plus*, a Windows user must have Administrator rights.

Note

Do not connect a USB cable until setup completes successfully. Connecting a USB cable before setup is complete may result in errors.

Run the setup file for the BESTCOMS*Plus* application. The setup utility installs BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the BESTCOMS*Plus* Settings Loader Tool on your PC.

When BESTCOMS*Plus* installation is complete, a Basler Electric folder is added to the Windows programs menu. This folder is accessed by clicking the Windows Start button and then accessing the Basler Electric folder in the Programs menu. The Basler Electric folder contains an icon that starts the BESTCOMS*Plus* Settings Loader Tool.

Bar Code Reader and Bar Codes

The BESTCOMS*Plus* Settings Loader Tool is compatible with bar code readers that conform to UnifiedPOS specifications. Bar code readers and bar code labels are not provided and must be acquired separately. Refer to the bar code reader's documentation for installation instructions.

Any bar code compatible with your bar code reader may be used.

BESTCOMSPlus® Settings Loader Tool Settings

BESTCOMS*Plus* Settings Loader Tool settings are found on two main screens, the Loader Grid and Configuration screen. The Loader Grid contains management options for the product settings files and their associated bar codes. The Configuration screen contains product-specific options for the default behavior of the BESTCOMS*Plus* Settings Loader Tool. These settings are described in the following paragraphs.

Loader Grid

One entry, or row, in the Loader Grid contains all of the necessary data to associate a product settings file with a bar code. New entries can be added. Existing entries can be edited, deleted, and uploaded to a Basler product.

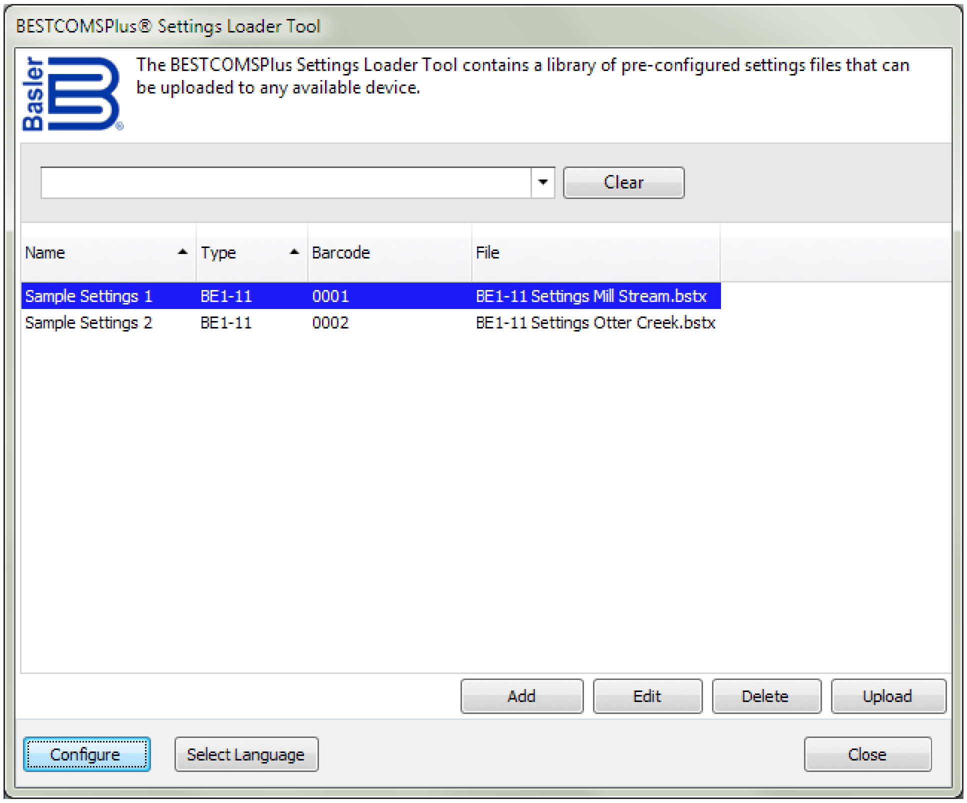


Figure 50-1. Loader Grid

Scanning Bar Codes

Place the cursor in the text field, found at the top of the Loader Grid screen, and scan a bar code. If successful, the digits that comprise the bar code appear in the text field. The BESTCOMS*Plus* Settings Loader Tool automatically searches for this bar code among the entries in the Loader Grid and displays the matching entry. Click Clear to remove the digits from the text field.

Adding an Entry

Click Add to create an entry. The BESTCOMS*Plus*® Settings Loader Tool: Add Device dialog box appears (Figure 50-2).

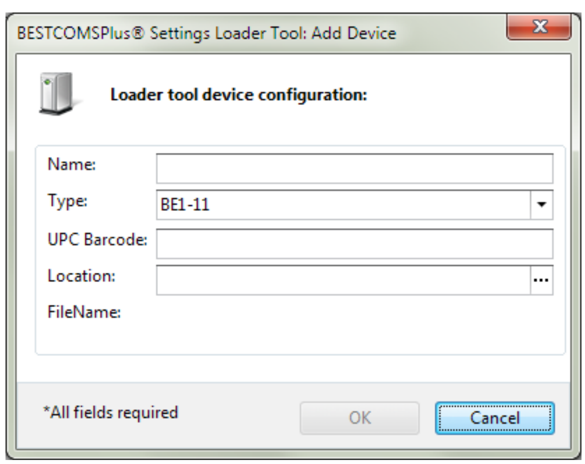


Figure 50-2. Add Device Screen

Enter the name of the entry in the Name field. This appears in the first column of the Loader Grid.

Select the product type from the Type drop-down menu. This appears in the second column of the Loader Grid.

Enter the bar code of the entry in the UPC Barcode field by placing the cursor in the UPC Barcode field and scanning the bar code.

To select the product settings file for the entry, click the browse (…) button in the Location field. Use standard Windows methods to navigate to the desired product settings file and click Open. Ensure that the selected product type in the Type field matches that of the product settings file specified in the Location field.

Click OK when finished.

Editing an Entry

To Edit an existing entry, select the entry in the Loader Grid and click Edit. The BESTCOMS*Plus* Settings Loader Tool: Edit Device dialog box appears. The options are identical to those of the Add Device dialog. When the desired changes have been made, click OK.

Deleting an Entry

To delete an entry from the Loader Grid, select the entry and click the Delete button. A prompt appears providing the option to confirm or cancel the deletion.

Uploading an Entry

Select an entry and click Upload. A dialog appears which provides connection options for the appropriate type of device. Refer to the Basler product instruction manual for detailed connection information. Once a connection is established, the product settings associated with the entry are uploaded.

Configuration Settings

For configuration settings, click the Configure button in the bottom left of the Loader Grid. The product tabs on the left represent the compatible Basler products. Each product tab contains tabs for Settings Files and Connection Options. The options on these tabs are described below.

Setting Files Options

Use Saved Path: When enabled, the path specified in the Loader Grid entry is used when uploading the settings file.

Single Folder: When enabled, this specifies a single folder that contains all settings files for the product. The Windows filename specified in the Location field of the Loader Grid entry is searched for in the Single Folder location. For example, all settings files for a product are located in “C:\Files”. The Location field in the Loader Grid entry for a device contains “C:\Documents\Settings\BE1-11 Settings.bstx”. The BESTCOMS*Plus* Settings Loader Tool searches in “C:\Files” for the filename “BE1-11 Settings.bstx”.

Append Bar-Code to Location: When enabled, the bar code is appended to the specified location when uploading the settings file. For example, an entry with the bar code “0002” is located in C:\Files\0002 and an entry with the bar code “0003” is located in C:\Files\0003.

Logon: If User Name and Password are specified, you will not be prompted for credentials when required.

Save After Upload: After uploading a settings file, the settings are downloaded from the connected device and saved to the specified location, when enabled.

Upload Security: When enabled, the security settings stored in the settings file are uploaded to the device. Credentials will be requested if not already specified.

Figure 50-3 illustrates the Setting Files tab.

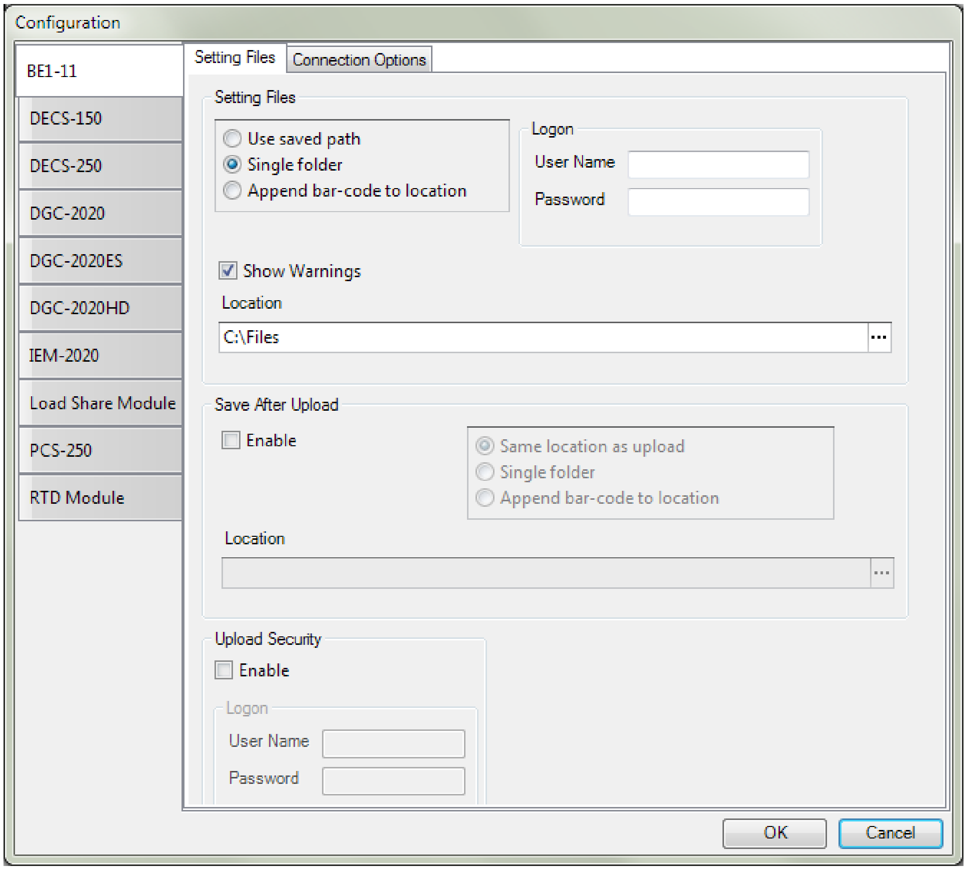


Figure 50-3. Configuration, Settings Files Tab

Connection Options

Connection options consist of the three selections described below. Refer to the Basler product instruction manual for detailed connection information.

Always Prompt for Connection: When enabled, a dialog appears which provides connection options for the appropriate type of device each time a connection attempt is made.

Ethernet Connection: When enabled, the BESTCOMS*Plus* Settings Loader Tool automatically attempts to connect to the specified IP address before uploading settings.

USB Connection: When enabled, the BESTCOMS*Plus*® Settings Loader Tool automatically attempts to connect to the device via USB port before uploading settings.

Figure 50-4 illustrates the Connection Options tab.

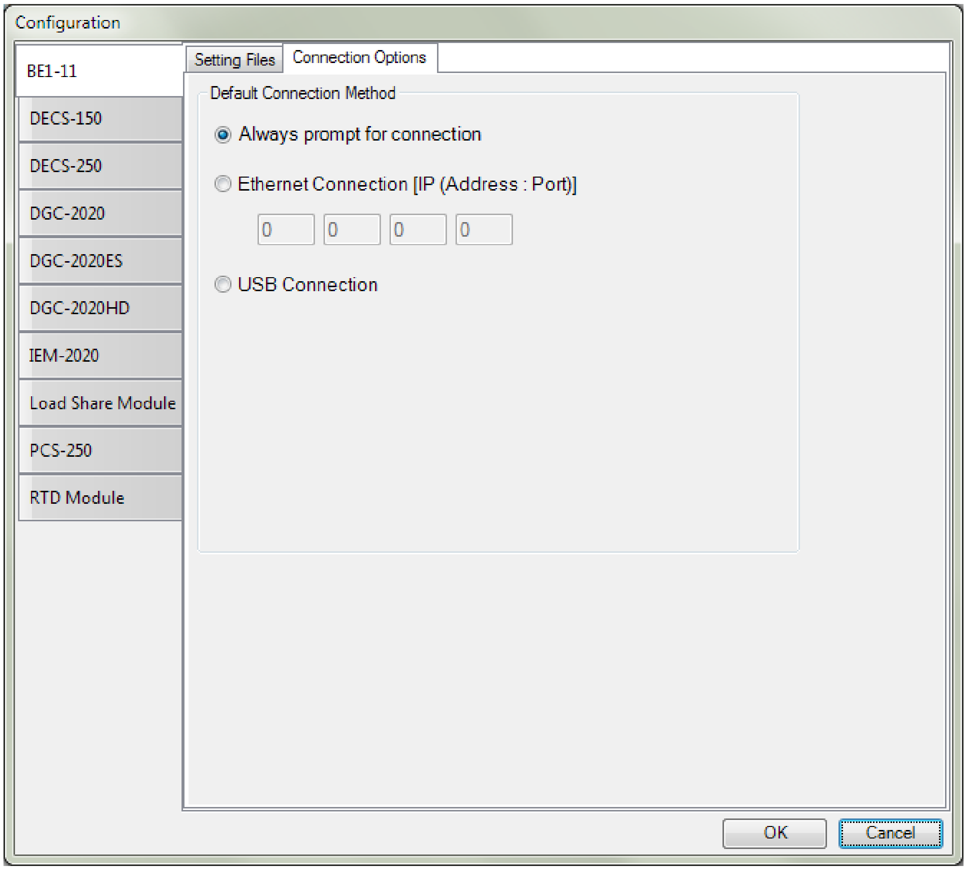


Figure 50-4. Configuration, Connection Options Tab

General Operation

The steps listed below are provided as a general guideline for how to operate the BESTCOMS*Plus* Settings Loader Tool when the initial setup is complete and the settings files are associated with bar codes.

1. Power on the device that will receive the new settings. Ensure proper communication connections have been made between the device and the PC running BESTCOMS*Plus* Settings Loader Tool.
2. Run BESTCOMS*Plus* Settings Loader Tool.
3. Place cursor in search bar.
4. Scan bar code.
5. Settings file is automatically highlighted and isolated in the grid.
6. Click Upload.
7. BESTCOMS*Plus* Settings Loader Tool automatically connects to device and uploads settings. Device connection is automatic unless “Always prompt for connection” is enabled.

www.basler.com

Highland, Illinois USA
Tel: +1 618.654.2341
Fax: +1 618.654.2351
email: info@basler.com

Suzhou, P.R. China
Tel: +86 512.8227.2888
Fax: +86 512.8227.2887
email: chinainfo@basler.com