

# Application Note

## BESTCOMSPUs® Series – BE1-11 Step-By-Step Guide to Using BESTCOMSPUs®, BESTspace™, and Preprogrammed Logic Schemes: *Primary Bus Overcurrent Protection*

**Setting up a numeric relay has never been easier than with the BESTCOMSPUs BESTspace tool.** A recent national study on electrical reliability has shown that the majority of numeric relay misoperations are caused by incorrect settings/design error. BESTspace combats the issue by clearly identifying relevant settings and adapting to your specific application - minimizing errors and time spent creating a settings file. Although BESTspace files can be created and customized, the purpose of this guide is to assist you in using Basler Electric preconfigured BESTspace and preprogrammed logic files.

### Primary Bus Overcurrent Protection

This guide is a walkthrough of the *Primary Bus Overcurrent Protection* BESTspace and logic scheme. The logic scheme provides protection for the system represented by the one line diagram shown in Figure 1. The logic scheme is applied to a bus main relay to provide primary bus overcurrent protection. It contains logic to interconnect with the *Feeder Protection with Interlock*

logic scheme to provide high-speed overcurrent protection for the bus under normal conditions. It also contains logic to trip the feeder breakers while the feeder relays using the *Feeder Protection with Interlock* logic scheme are out of service. Unneeded elements may be disabled without changing the logic.

Recently, the BESTspace feature was added to BESTCOMSPUs. Opening a BESTspace file automatically formats the BESTCOMSPUs environment to support specific activities. BESTspace files do not add or alter actual settings. The BESTspace discussed here is specially designed to work with the *Primary Bus Overcurrent Protection* logic scheme developed by Basler.

### Opening the BESTspace

BESTCOMSPUs refers to the software suite used to program BE1-11 relays. The BESTspace tool is only compatible with BESTCOMSPUs v 2.11.01 or greater.

If not already installed on your computer, it is easy to download the latest version at [www.basler.com](http://www.basler.com). BESTCOMSPUs requires an activation key for use without an active BE1-11 connection. Please email request for activation to [info@basler.com](mailto:info@basler.com).

The BESTspace file can be downloaded from [www.basler.com/Product/BE1-11-Logic-Schemes](http://www.basler.com/Product/BE1-11-Logic-Schemes).

To begin, launch BESTCOMSPUs and click on the 'File' dropdown menu at the top left-hand corner of the window. Select to open a new BE1-11 file as shown in Figure 2.

BESTCOMSPUs will then open a default settings file. To open the BESTspace, click on 'View' directly below 'File' and select to open a new BESTspace as shown in Figure 3.

Based on the screen capture in Figure 4, click 'Load' on the Load/Save Window BESTspace File window and browse for the BESTspace file 'PrimaryBusOvercurrent-Protection.bswx'. Click 'Apply' to open the BESTspace.

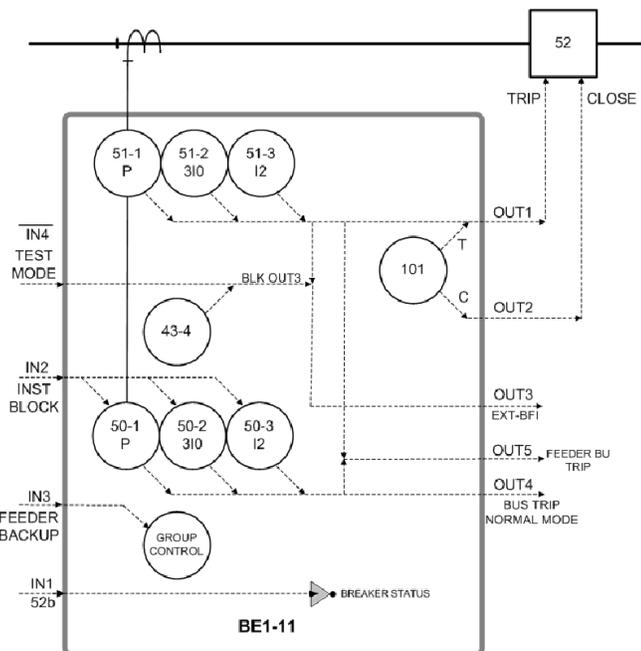


Figure 1 - One-Line Diagram of Primary Bus Overcurrent Protection

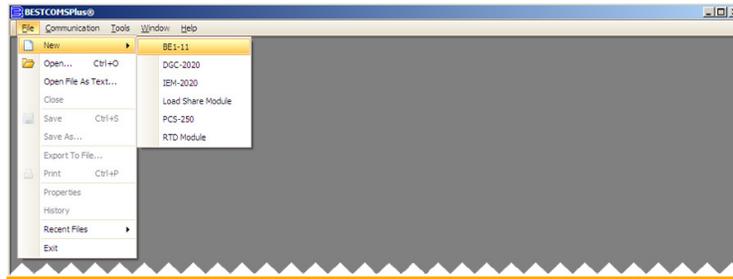


Figure 2 - Opening a File in BESTCOMSPlus

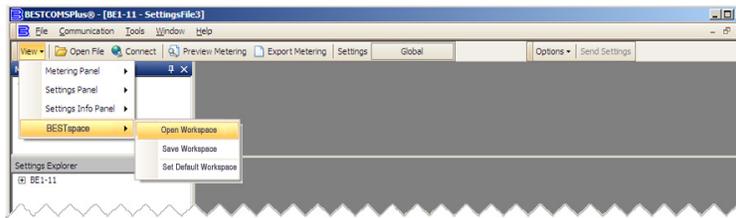


Figure 3 - Opening a New BESTspace in BESTCOMSPlus

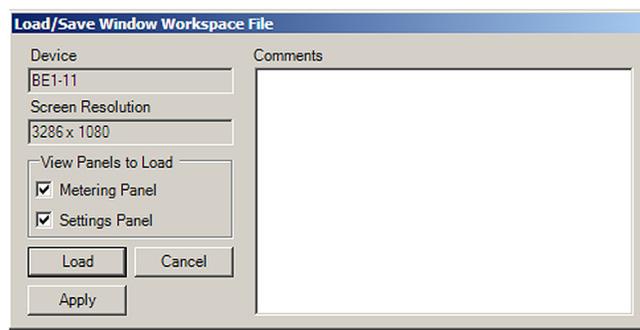


Figure 4 - Loading a BESTspace File

## Establishing the Style Number

Figure 5 demonstrates how the BESTspace formats the working environment with the Style Number screen on top. The environment is tab-based, with tabs aligned across the top of the screen. Check the relay front faceplate for the style number and enter it on the style number screen using the dropdown selection boxes. The right-hand bottom portion of the viewable area contains settings information such as settings ranges and units. It can be closed at any time to increase viewing area. Tabs can be closed by clicking on the 'x' to the right of the right-most tab. Doing this will close the active tab. Close the style number screen when finished. Successive tabs should be closed once you are finished, except where noted.

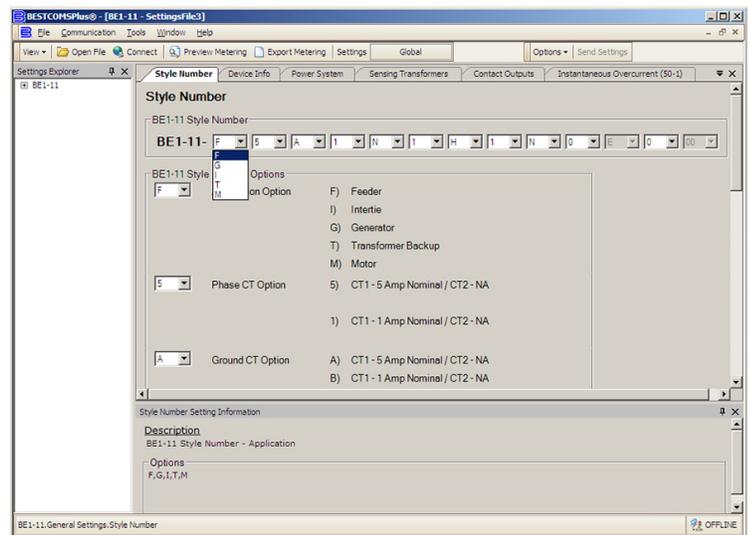


Figure 5 - The Style Number screen is on top when starting a BESTspace

## Accessing Device Info

Closing the style number screen causes the next tab to the right, "Device Info", to activate. The Device Info screen contains information about the embedded software in the connected BEI-II relay. If you are not connected to a relay, this should be mostly blank. It will populate information automatically when settings are downloaded from a relay. Device, station, and user IDs also can be specified here.

## Setting Group Setup

Settings groups are useful for using a relay in multiple applications that require different settings. Settings groups can conditionally be changed in a few ways. For normal operation, the Primary Bus and Backup Bus relays use Setting Group 0. In Setting Group 0, the two relays will only trip the bus breaker.

IN2 of the Backup Bus relay identifies when a feeder relay is out of service. The Backup Bus relay will close OUT3, which is connected to IN3 of the Primary Bus relay. Both relays then switch to Setting Group 1. Binary coded setting group selection is used to recognize the group setting state. When input D0 of the setting group selection function block is logic 1 (True), it is interpreted as a binary 1 and causes the logic to switch to Setting Group 1. Set the mode for Binary Inputs on this screen.

## Power System

The Power System screen contains information about your system that the relay uses to perform internal calculations. Starting under Nominal Settings, enter in the system frequency, nominal secondary voltage in terms of PN quantities, and nominal secondary current (this is the secondary rating of your CT). For overcurrent only applications, the auxiliary voltage input typically is not used so do not change this setting.

The phase rotation of the system is crucial. A reverse setting will cause the relay to calculate erroneous negative sequence current and possibly misoperate.

Although the power line parameters are used in the BEI-II for calculating the distance to faults, they are not necessary. MTA is necessary only if you plan to specify a directional overcurrent element (reverse direction). Additional details on the power line parameter and MTA settings can be found in the BEI-II manual.

## Sensing Transformers

The Sensing Transformers screen contains settings used to calculate primary voltage and current from the sensed secondary values. Enter the turns ratio for the phase and ground CTs. For example, if your CT is 1200:5, the setting would be 240. If there is no ground CT in your system, this setting can be left unchanged.

Follow the same process for the phase VT setup, making sure to specify the type of transformer connection (4W-Y, 3W, PN, or PP). The auxiliary VT ratio and connection type settings are not necessary for a typical overcurrent only application. When using a 4W-Y connection, the relay can operate on PN or PP sensed voltage for the 27 and 59 element. Since no voltage elements are to be used, this setting also can be left unchanged.

## Contact Inputs and Outputs

Closing the previous screen will pull up two successive Contact Inputs and Outputs screens. These screens allow you to customize the physical alarms and contact I/O with labels and energized state labels, which will appear on the BEI-II LCD screen.

Each input has a contact recognition and debounce setting. The default contact recognition and debounce settings enable their use on ac signals as well as dc signals. Since the *Primary Bus Overcurrent Protection* scheme utilizes three contact inputs, it may be helpful to label them.

- Input #1 is designated as a 52b breaker status input to *Backup Bus* and *Primary Bus* logic schemes.
- Input #2 blocks the instantaneous overcurrent element when the feeder relay picks up.
- Input #3 is a signal that a feeder relay is out of service from the bus source relay utilizing *Backup Bus Overcurrent Protection* logic.
- Input #4 is used in the scheme to enable or disable test mode and disable breaker failure.

The hold attribute serves several purposes for contact outputs. The main use for the BEI-II is to prevent the relay contact from dropping out until the current has been interrupted by the 52a contacts in series with the trip coil. If the tripping contact opens before the dc current is interrupted, the contact might be damaged. Now label the contact outputs:

- Output #1 is the designated trip output for protective elements. It is also tied logically to the virtual breaker 101 trip switch.
- Output #2 closes the breaker through the virtual breaker 101 switch.

- Output #3 is a breaker failure indicator and provides the BFI input to another device.
- Output #4 and #5 provides a Bus trip.
- Output #5 provides a Feeder trip.

Labeling of the output contacts is not required but it is useful for categorizing outputs as the settings file is created and for later analyzing relay operations.

### Instantaneous Overcurrent (50-1, 50-2, 50-3)

The next three tabs contain settings for the Instantaneous Overcurrent elements (50-1), (50-2), (50-3). By default, all protection elements are disabled. Choosing a mode of operation enables them. There are several modes of operation for overcurrent elements on the BEI-II:

1.  $I_A, I_B, I_C$  operates only on the selected phase of current.
2. 3 Phase will monitor all three phases and operate on any one of them.
3.  $3I_0$  operates on the calculated zero sequence current (calculated 50G).
4.  $I_2$  operates on the calculated negative sequence current (46).
5.  $I_G$  operates on the ground CT input only (50G).
6.  $I_1$  operates on the calculated positive sequence current.
7. Unbalance operates on calculated unbalanced current.

The *Primary Bus Overcurrent Protection* logic scheme is set up for instantaneous overcurrent elements - phase (50-1), neutral (50-2), and negative sequence (50-3).

During normal operation, the task of the Primary Bus relay is to provide high-speed fault protection (2 to 4 cycles coordination interval) and timed overload or high unbalanced load protection.

Enter the secondary current pickup and intentional time delay (if no intentional time delay is desired, leave at 0). Choose the directionality of the element "Non-Directional". If six instantaneous overcurrent elements are not needed, they can be left disabled as you continue to the next tab.

### Inverse Overcurrent (51-1, 51-2, 51-3)

The inverse overcurrent elements have the same mode selections as the instantaneous elements. There are three of them for phase, neutral, and negative sequence protection. The element screen contains a setting for pickup, time dial, curve, direction, and reset timing. There are many curves to choose from. However, if the curves do not fit your needs, you can program your own custom curve using the IEEE C37.112 equation or construct one of up to 40 custom points using a table curve.

The Table Curve feature adds points to the curve and uses a point and click interface to move points around once they are inserted. A separate screen under Protection > Current allows you to configure a table curve.

Be sure to set the directionality and reset type. An integrating reset mimics the behavior of an electro-mechanical reset. When used to provide high-speed overcurrent protection for the substation bus, it is recommended that all 51 function timing curves be set for instantaneous reset. Both the inverse timing curve and the reset time can be viewed by changing the selection below the graph.

### Current/Protection/Control Setting Summary

The Current, Protection and Control summary screens allow you to view all elements that are enabled and the modes of operation. If elements are disabled when you believe they should be enabled, it will appear on these screens. Each element will have a status color to the right and the mode of operation to the right. Green status indicates the element is enabled, yellow indicates the setting is disabled by a setting other than the mode (i.e. the element has an invalid setting such as a pickup of 0.000 amps), blue indicates the setting is disabled by only the mode setting, and gray indicates the element has both an invalid setting and disabled mode.

It is a good idea to leave these screens open and double check the protection elements you have set up once you are finished.

### Virtual Control Switches (43, 101)

The BEI-II contains two types of virtual switches. The 43 is a general purpose virtual switch while the 101 is designated for breaker control.

The 43 tab allows labeling of the switch and on/off positions. Labeling is not required but is useful for determining switch operations at a glance. The switch 43-4 can be used to enable or disable test mode and is the only virtual switch used in the pre-built logic scheme. If you plan to use the virtual breaker switch, enable it on the 101 tab.

## BESTlogic™Plus

BESTlogicPlus is a powerful logic editor used to customize relay operation and internally route trip signals and other virtual I/O into physical I/O. Notable features in the logic editor include being able to conditionally enable or disable protective elements and trigger oscillographic records.

Preprogrammed logic schemes make it easy to import a file for common applications. To download logic files, please visit [www.basler.com/Product/BE1-11-Logic-Schemes](http://www.basler.com/Product/BE1-11-Logic-Schemes) and download the logic scheme 'Primary Bus Overcurrent'.

Importing a file is easy; click on the 'Logic Library' dropdown menu shown in Figure 6 and open 'PrimaryBusOvercurrentProtection.bslx'.

The BESTlogicPlus working environment is nested within BESTCOMSPPlus and follows the same tabbed interface. Each tab is a new page to organize and build logic. To the left of the logic pages is a toolbox containing all

status, physical I/O, logic gates, and elements. Items in the toolbox can be dragged and dropped onto any logic page. Logical I/O are conveyed between pages using custom labeled off-page inputs and outputs.

Preprogrammed logic is complete as downloaded. No changes are necessary to use it. Reviewing it is recommended as it provides useful detail on the operation and purpose of the logic. Below are the tabs present.

- *Input/Output* - You will find a brief description of the logic scheme on this page. Additionally you will find the physical output assignments with a description of its intended purpose.
- *Virtual Switches* - This tab shows the configuration of the 101 virtual breaker control and the 43-4 test mode virtual switch. The 43-4 switch and input #4 operate as virtual and physical switches for enabling/disabling test mode. You can find information on the virtual switch in the BE1-11 instruction manual.
- *Current* - Logic elements can be blocked by asserting logic 1 at the 'Block' input. Logic elements such as the 50-1 generate a 'Pickup' and 'Trip' signals that are used elsewhere in the logic scheme via off page outputs to generate physical trips and oscillography.
- *Misc. Logic* - The Misc. Logic tab shows the consolidation of the element off-page outputs using OR gates and four more off-page outputs, 'Trip Bus', 'Pickup Bus', '50 Trip', and '51 Trip'. It is useful to have a consolidated bit for triggering oscillography and performing other functions elsewhere in the logic scheme. The settings groups and fault trigger oscillography elements are also on this tab.

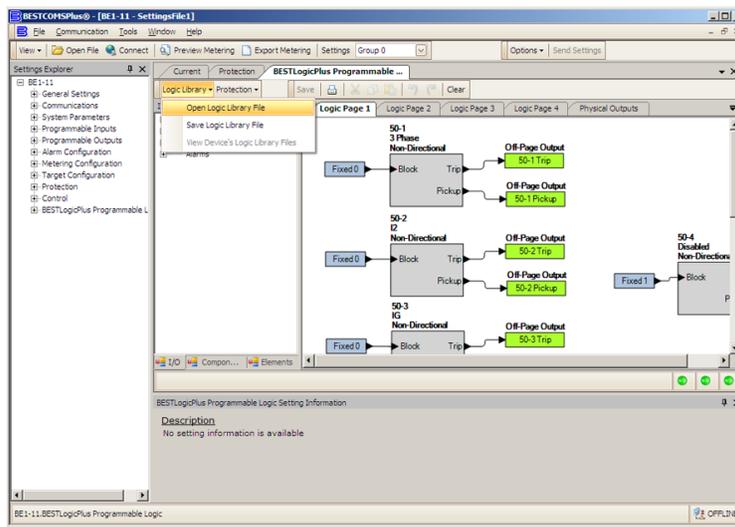


Figure 6 - Working with the Logic Library

To use the logic scheme, click on the 'Save' button shown in Figure 7 so that it is saved to the settings file. Before saving, a healthy logic scheme will have three indicators at the bottom right-hand corner of the window. A yellow and two greens indicate there are no errors in the scheme and it can be saved. Saving the logic will result in three green indicators.

To finish, save the entire settings file by clicking on 'File' at the top left-hand corner of the BESTCOMSPi.us window and select 'Save' or 'Save As...' from the dropdown menu.

### For More Information

To get more information on BESTCOMSPi.us and the BEI-II product line, including additional application notes, product bulletins, and instruction manuals, go to [www.basler.com](http://www.basler.com) or contact Technical Support at 618-654-2341.

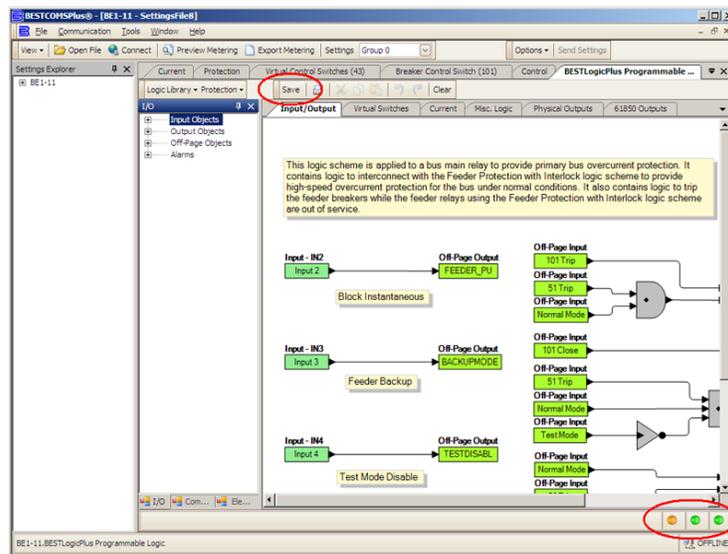


Figure 7 - Saving a Settings File with a Functional Logic Scheme