Application Note

BESTCOMS*Plus*® Series – BE1-11 Step-By-Step Guide to Using BESTCOMS*Plus*®, BESTspace™, and Preprogrammed Logic Schemes: *Backup Bus Overcurrent Protection*

Setting up a numeric relay has never been easier than with the BESTCOMS*Plus* 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. Workspaces combat 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.

Backup Bus Overcurrent Protection

This guide is a walkthrough of the *Backup 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 backup bus overcurrent protection, as well as breaker failure protection, for the bus breaker under normal conditions. It also provides primary bus overcurrent protection when the relay using the *Primary Bus Overcurrent Protection* logic scheme is providing feeder protection or when the primary bus relay is out of service. Unneeded elements can be disabled without changing the logic.

Recently, the BESTspace feature was added to BESTCOMS*Plus*. Opening a BESTspace file automatically formats the BESTCOMS*Plus* 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 *Backup Bus Overcurrent Protection* logic scheme developed by Basler.

Opening the BESTspace™ File

BESTCOMS*Plus* refers to the software suite used to program BE1-11 relays. The BESTspace feature is only compatible with BESTCOMS*Plus* v 2.11.01 or greater.

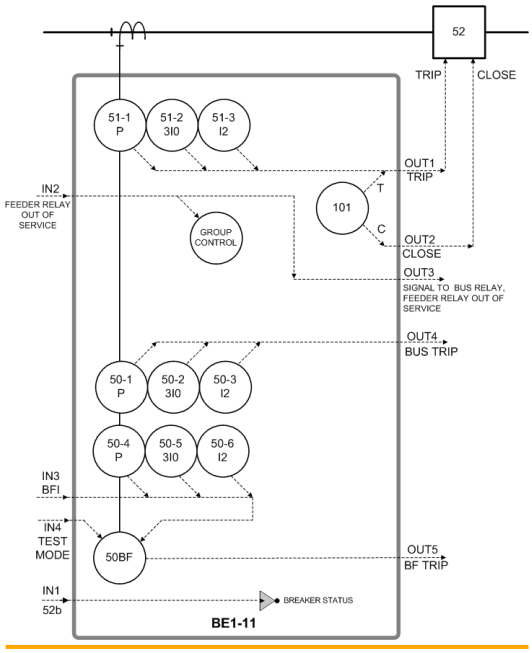

Figure 1 - One-Line Diagram of *Backup Bus Overcurrent Protection*

If not already installed on your computer, it is easy to download the latest version at www.basler.com. BESTCOMS*Plus* requires an activation key for use without an active BE1-11 connection. Please email request for activation to info@basler.com.

The BESTspace file can be downloaded from www.basler.com/Product/BE1-11-Logic-Schemes

To begin, launch BESTCOMS*Plus* 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.

BESTCOMS*Plus* will then open a default settings file. To open the BESTspace file, 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 'BackupBusOvercurrent-Protection.bswx'. Click 'Apply' to open the BESTspace.

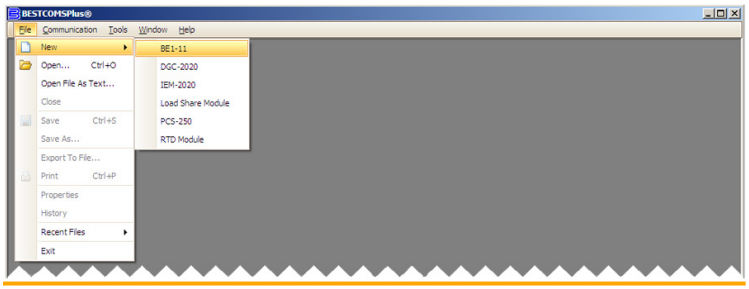

Figure 2 - Opening a File in BESTCOMS*Plus*

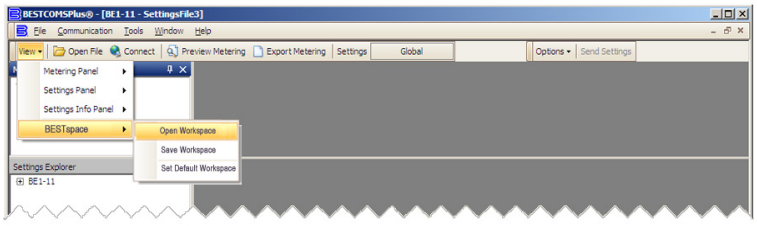

Figure 3 - Opening a New BESTspace in BESTCOMS*Plus*

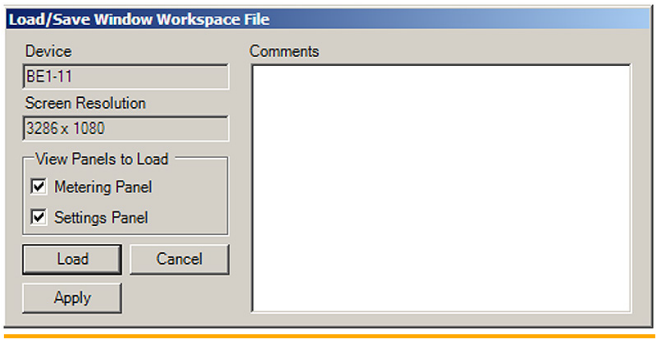

Figure 4 - Loading a BESTspace File

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.

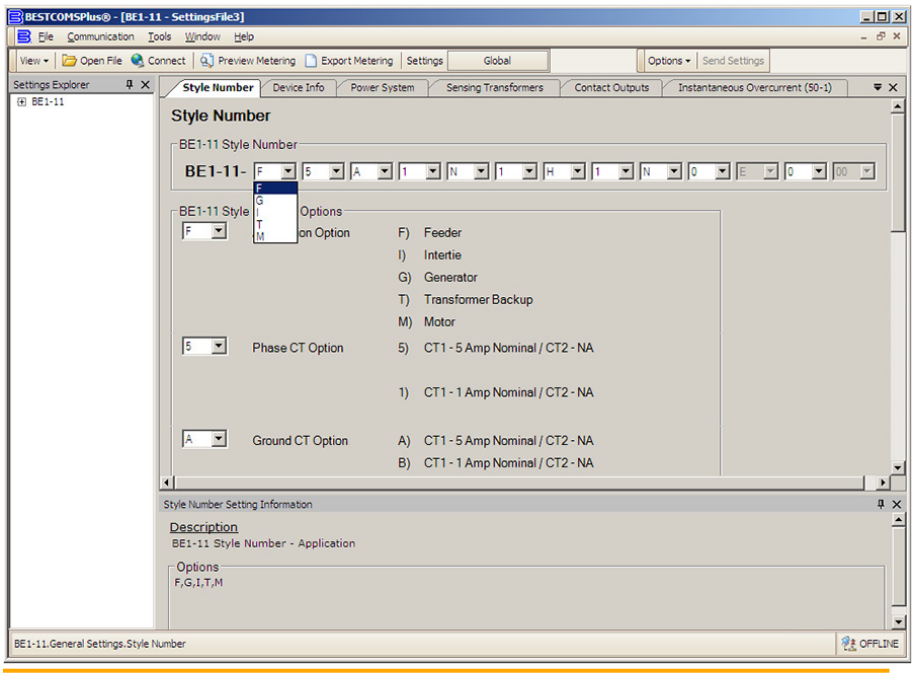

Figure 5 - The Style Number screen is on top when starting a BESTspace file

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 BE1-11 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 BE1-11 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 BE1-11 instruction 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 BE1-11 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 *Backup 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 is driven by a contact output from the relay using the *Feeder Protection with Interlock* logic scheme indicating it is out of service. This input should change the settings group to settings group 1.
- Input #3 is an external breaker failure initiate.
- Input #4 is used in the scheme to enable or disable test mode.

The hold attribute serves several purposes for contact outputs. The main use for the BE1-11 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 and the 50BF re-trip.

- Output #2 closes the breaker through the virtual breaker 101 switch.
- Output #3 is used to signal the relay using the *Primary Bus Overcurrent Protection* logic scheme to change settings groups when the relay using the *Backup Bus Overcurrent Protection* logic scheme detects the feeder relay is out of service.
- Output #4 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, … 50-6)

The next six tabs contain settings for the instantaneous overcurrent elements (50-1), (50-2), … (50-6). 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 BE1-11:

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 *Backup Bus Overcurrent Protection* logic scheme is set up for instantaneous overcurrent elements - phase (50-1), neutral (50-2), and negative sequence (50-3). There are three additional elements - phase (50-4), neutral (50-5), and negative sequence (50-6) used to initiate breaker failure detection (50BFI). During normal operation, the task of the backup bus relay is to provide the primary bus relay with support for bus faults with an 18 to 20-cycle coordination interval.

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 done.

Virtual Control Switches (43, 101)

The BE1-11 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*

BESTlogic*Plus* 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 and download the logic scheme "Backup Bus Overcurrent Logic".

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

The BESTlogic*Plus* working environment is nested within BESTCOMS*Plus* 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 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. Here you also will find the breaker failure element that is blocked by the 43-4 or Input #4. When unblocked, it is initiated by any of the overcurrent elements. You can find information on the virtual switch and 50BF element 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 'Pickup' and 'Trip' signals 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 for performing other functions elsewhere in the logic scheme. The settings groups and fault trigger oscillography elements also are on this tab.

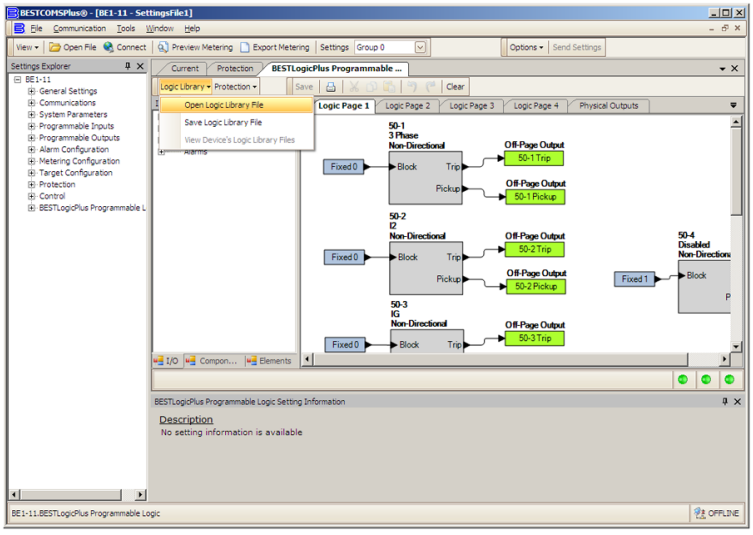

Figure 6 - Working with the Logic Library

To use the logic scheme, click on the 'Save' button as 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 BESTCOMS*Plus* window and select 'Save' or 'Save As...' from the dropdown menu.

For More Information

To get more information on BESTCOMS*Plus* and the BE1-11 product line, including application notes, product bulletins and instruction manuals, go to www.basler.com or contact Technical Support at 618-654-2341.

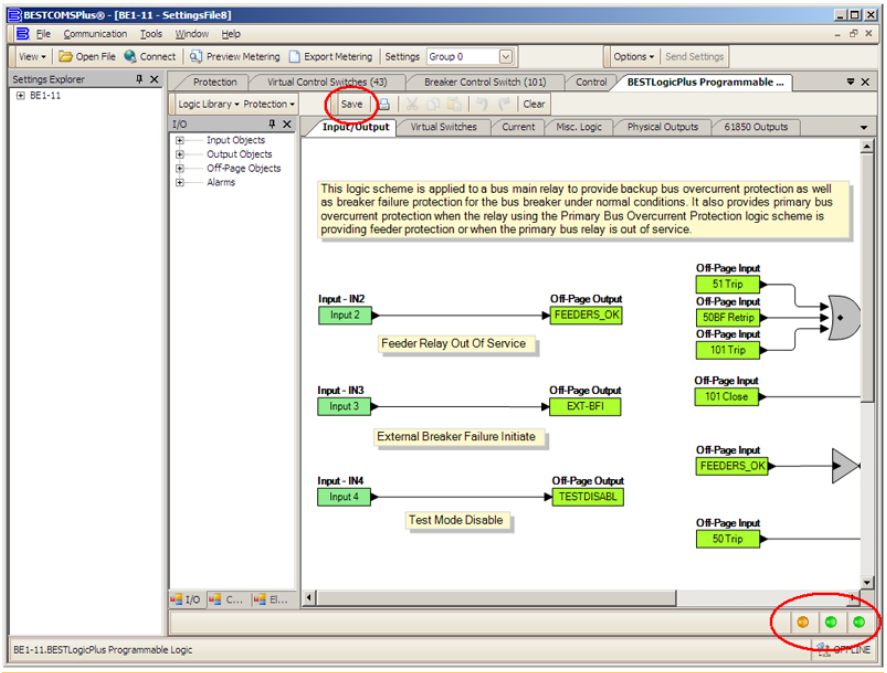

Figure 7 - Saving a Settings File with a Functional Logic Scheme

Basler Electric®

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

Quality System Certification Basler ISO 9001:2015