Application Note

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

Setting up a numeric relay has never been easier than with 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. BESTspace files combat the issue by clearly identifying relevant settings and adapting to your specific application - minimizing errors and time spent creating settings files. 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.

Overcurrent Protection with Control

This guide is a walkthrough of the *Overcurrent Protection with Control* 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 contains three time overcurrent and a total of six instantaneous elements. Automatic reclosing is included and is initiated (RI) by a protective trip

or by an external reclose initiate contact. It is similar to Overcurrent Protection with Reclosing but has the added ability to manually open and close the breaker by using the virtual breaker control switch (101). Breaker failure, virtual breaker control and protective voltage features are not activated in this scheme. However, these features may be activated through BESTlogic™*Plus*. Unneeded elements can be disabled without changing the logic.

Recently, the BESTspace feature was added to BESTCOMS*Plus*. Opening a BESTspace automatically formats the BESTCOMS*Plus* environment to support specific activities. BESTspace files do not add or alter actual settings. The BESTspace discussed in this document is specially designed to work with the *Overcurrent Protection with Control* logic scheme developed by Basler.

Opening the BESTspace

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.

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/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 1.

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 file as shown in Figure 3.
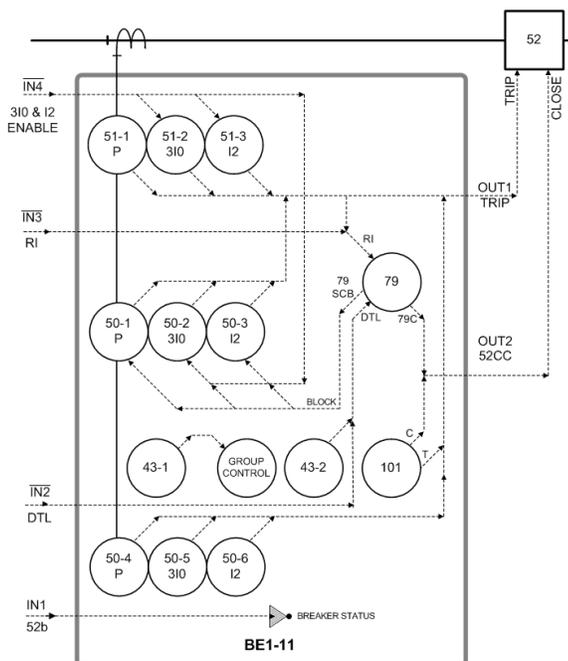

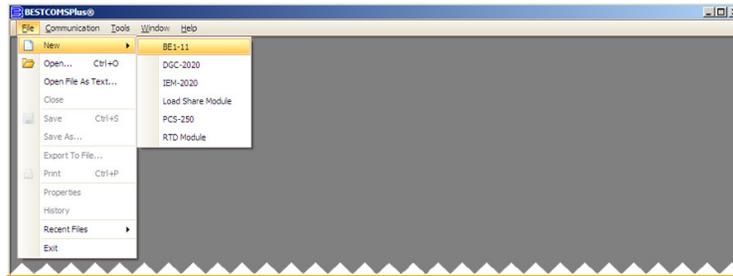**Figure 1 - One-Line Diagram of Overcurrent Protection with Control**
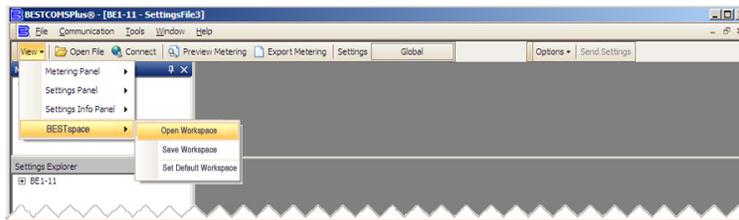
Figure 2 - Opening a File in BESTCOMS*Plus*

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

Based on Figure 4, click 'Load' on the Load/Save Window BESTspace File window and browse for BESTspace file 'OvercurrentProtectionwith-Control.bswx'. Click 'Apply' to open the BESTspace.
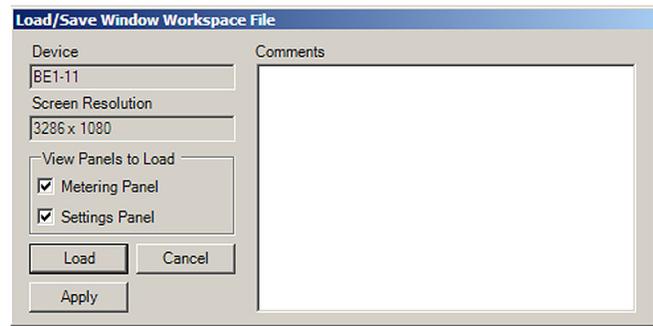

Figure 4 - Loading a BESTspace File

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.
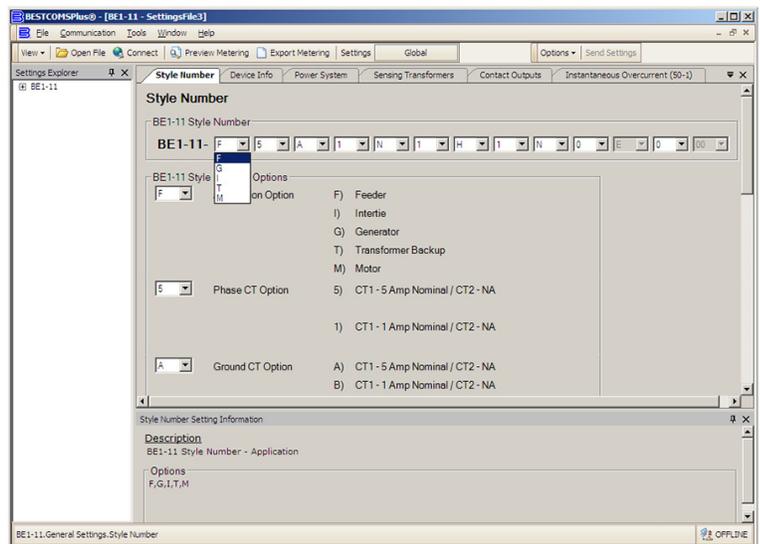

Figure 5 - The Style Number screen is on top when starting a BESTspace

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 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.

Power System

The Power System screen contains information about your system that the relay uses to perform internal calculations. Starting under Nominal Settings, enter the system frequency, nominal secondary voltage in terms of PN quantities, and nominal secondary current (this is the secondary rating of your CT). For a basic overcurrent application, the auxiliary voltage input is not typically used, so this setting is left as-is. 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 useful, they are not necessary if the information is not available. MTA is necessary only if you plan to specify a directional overcurrent element. 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. These settings are important for accurate primary metering and pickup values set in terms of primary quantities. Enter the turns ratio for the phase and ground CTs. For example, if your CT is 1200:5, the setting would be 1200/5=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 is not necessary for a typical overcurrent 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 *Overcurrent Protection with Control* scheme utilizes four contact inputs, it may be helpful to label them.

- Input #1 is a designated 52b breaker status input.
- Input #2 is a manual input to drive the 79 to lockout.
- Input #3 is a manual input to initiate a reclose sequence.
- Input #4 is used in the scheme to enable or disable neutral and negative sequence overcurrent elements.

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.
- Output #2 is the reclose (79) output. Output #2 also is tied to a manual close output of the virtual breaker control switch.
- Output #3 is a minor alarm output.
- Output #4 is a major alarm output.

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:

- I_A, I_B, I_C operates only on the selected phase of current.
- 3 Phase will monitor all three phases and operate on any one of them.
- $3I_0$ operates on the calculated zero sequence current (calculated 50G).

- I_2 operates on the calculated negative sequence current (46).
- I_G operates on the ground CT input only (50G).
- I_1 operates on the calculated positive sequence current.
- Unbalance operates on calculated unbalanced current.

Choose the mode that best fits your application for these elements. The *Overcurrent Protection with Control* logic scheme is set up for six instantaneous overcurrent elements. The intention is for phase, neutral and negative sequence overcurrent protection for both high levels and low levels of fault current. Low set elements are for detecting transient faults that may be cleared after reclosing the breaker. They initiate a reclose sequence for phase (50-1), neutral (50-2) and negative sequence (50-3) pickups.

The three high set elements detect severe bolted faults and drive the 79 to lockout. These elements are designated phase (50-4), neutral (50-5) and negative sequence (50-6). Virtual switch 43-2 also drives the relay to lockout.

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 tabs.

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. Both the inverse timing curve and the reset time can be viewed by changing the selection below the graph.

Recloser (79)

The reclosing function allows for up to four reclosing attempts that can be initiated by a protective trip or by one of the contact sensing inputs. This element is enabled by selecting a mode of operation. To make additional attempts available, enter in a valid time for Reclose Time 1. Reclose times are settable between 100 and 600,000 ms.

The logic scheme has the ability to block protective re-trips. Sequence Controlled Blocking (SCB) is logically tied to the block input of the 50-1, 50-2, and 50-3 elements so they may be blocked, if necessary for your application. If you wish to inhibit these elements for any re-trip, enable SCB by checking the appropriate box. For more information on the SCB feature, please consult the BE1-11 instruction manual.

The *Overcurrent Protection with Control* logic scheme may be modified so 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 settings groups allows changing protection coordination during the reclosing sequence.

For example, you could have a fast 51 curve on the first two trips in the reclosing sequence and then switch to a new group on the second reclose using a slow 51 curve. For more information on settings groups, please consult the BE1-11 manual.

The reset time is the length of time required to elapse before the 79 resets after a successful reclose. A maximum cycle timer keeps track of the entire reclose sequence, locking out the 79 when the specified time is exceeded. The reclose fail time is the acceptable time between a reclose output and the breaker state input.

Current/Protection/Control 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. Three 43 switches are used on this scheme.

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.

In the preconfigured logic scheme:

- 43-1 toggles automatic/manual settings group changes
- 43-2 is a drive to lockout virtual switch
- 43-3 is a virtual neutral and negative sequence overcurrent switch

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 'Overcurrent with Control'.

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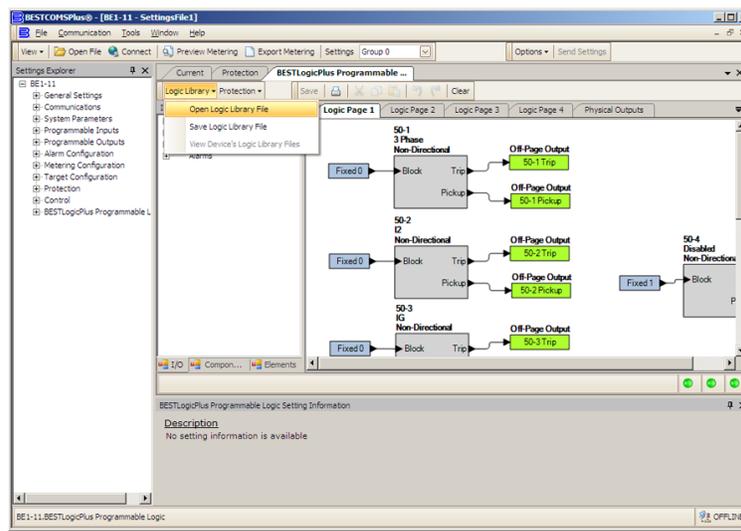

Figure 6 - Working with the Logic Library

- *Recloser* - This shows the recloser element. Elements such as the recloser are represented by blocks with logic inputs on the left-hand side and outputs on the right. For a full description of the 79 logic element, please consult the BE1-11 instruction manual. This tab also contains the element for changing between settings groups. As mentioned earlier, this element can be used for changing settings during different reclose attempts. For full descriptions of the logic elements in these tabs and changing settings groups, please consult the BE1-11 instruction manual.

- *Current* - Logic elements can be blocked by asserting logic 1 at the 'Block' input. The 'Current' tab utilizes this feature on the low set instantaneous overcurrent elements by tying the block inputs to other off-page inputs. Logic elements such as the 50-1 generate '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 two more off-page outputs, 'Trip Bus' and 'Pickup Bus'. It is useful to have a consolidated bit for triggering oscillography and for having a single trip output.

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 that 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 additional application notes, product bulletins, and instruction manuals, go to www.basler.com or contact Technical Support at 618-654-2341.
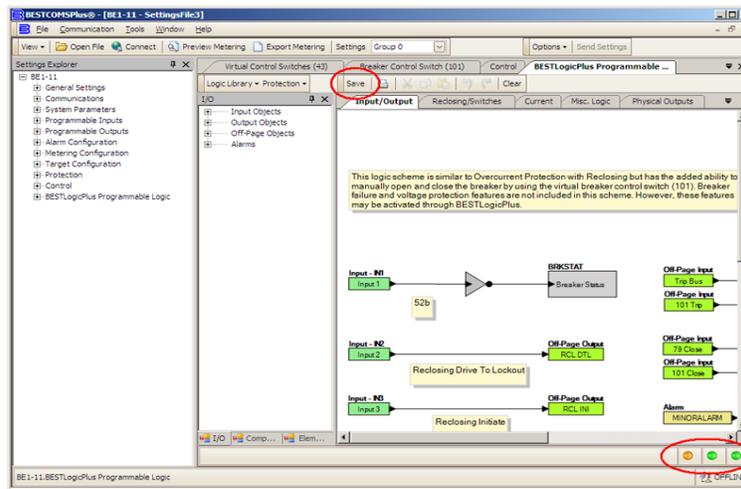

Figure 7 - Saving a Settings File with a Functional Logic Scheme