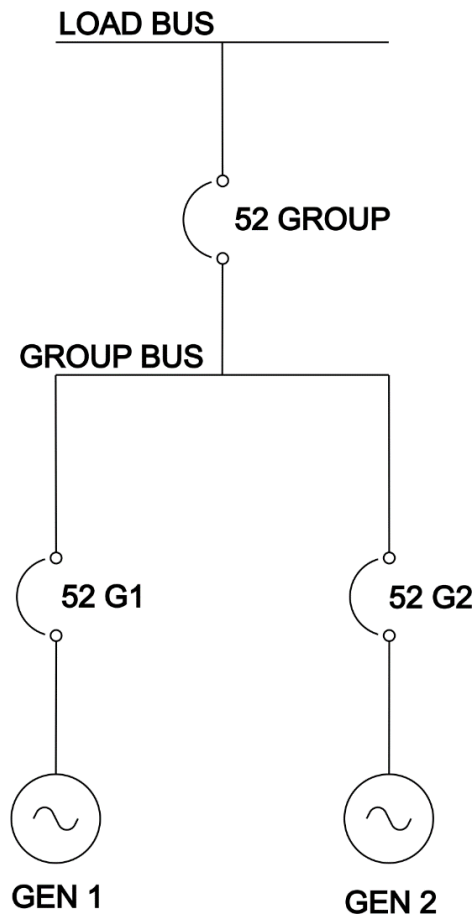




# APPLICATION GUIDE

How to set up a system of DGC-2020HDs to achieve Generator and Group Breaker Control



From a single-line diagram to a fully functional system!



## **Purpose**

This application guide is intended to be used as a quick start reference guide for implementing the use of multiple DGC-2020HD controllers to achieve generator and group breaker control. In this setup, DGC-2020HD devices control gensets as in a typical paralleling setup, and an additional DGC-2020HD controls a group tie breaker. The purpose of this application guide is to provide users with direction on the minimum settings and logic that needs to be configured to meet the control needs of this application. This document is not a comprehensive instruction manual that covers all features and functions of the DGC-2020HD. Users should always refer to the DGC-2020HD instruction manuals available at [www.basler.com](http://www.basler.com) for further details.

## **About the Author**

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## Application Overview

Consider the single-line diagram shown in Figure 1 below. Generator 1 and Generator 2 are capable of running in parallel. Each generator is controlled by a DGC-2020HD. Once the generators are running, either generator's breaker can be closed to the group bus when it is dead, and the other generator can then be synchronized and closed to the live group bus. For details on paralleling multiple generators to a common bus using the DGC-2020HD, review the application guide "*How to set up the DGC-2020HD for Paralleling in a Multiple Generator Setup*".

The system shown in Figure 1 entails a little more complexity than a simple paralleling setup. There is a tie breaker downstream from the individual generator breakers. This special case of a tie breaker is called a group tie breaker. A third DGC-2020HD set up for tie breaker control will control the group breaker. The group breaker system controller communicates with the other two DGC-2020HDs over Ethernet communications to achieve system control.

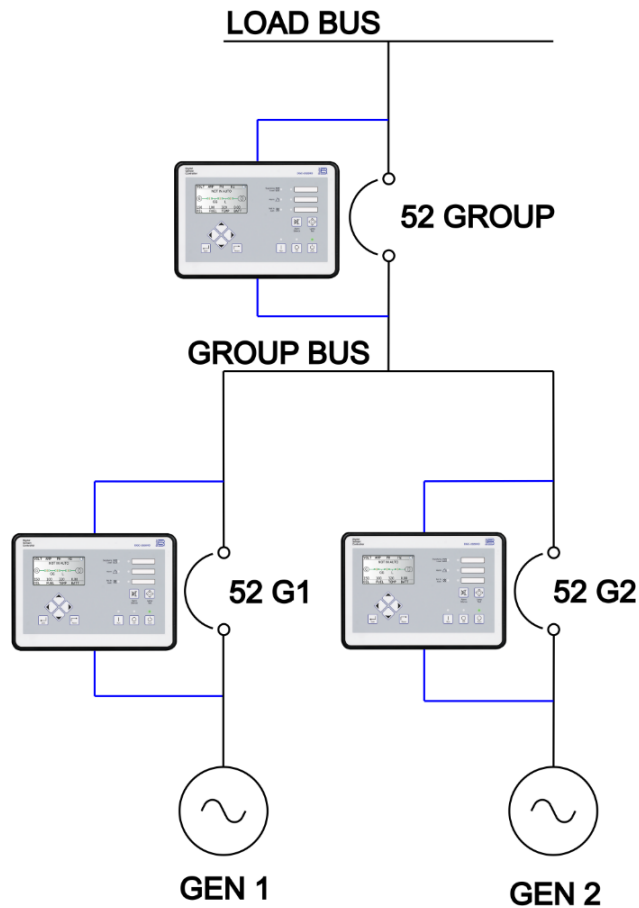


Figure 1. Single-Line Diagram for Generator and Group Breaker Control

A DGC-2020HD configured for tie breaker control does not send raise/lower adjustments to a genset directly. It must be networked with one or more DGC-2020HDs configured for a breaker configuration that includes genset control. In our example, the genset controller's breaker configuration is generator breaker to segmented system.

There are two different uses of the DGC-2020HD in this application:

- Genset controller
- Group tie breaker controller

First, we will explore the required settings and logic for the DGC-2020HDs functioning as genset controllers.

## DGC-2020HDs Functioning as Genset Controllers

A DGC-2020HD that is controlling a genset in a generator and group breaker system topology can be wired for current and voltage sensing as shown in Figure 2. Note that Bus 1 is the group bus.

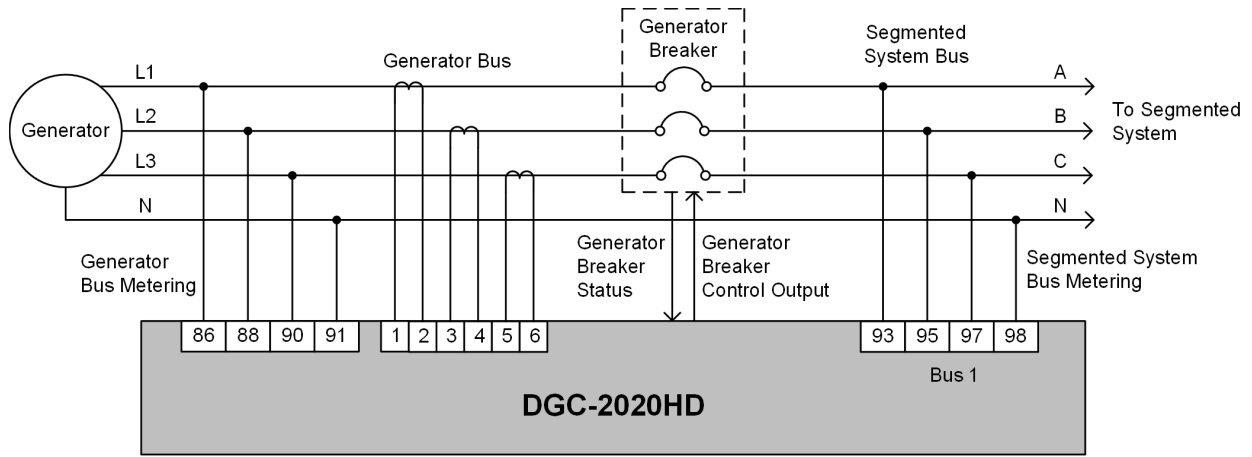


Figure 2. DGC-2020HD to Generator Wiring for Generator Breaker to Segmented Bus Configuration

Figure 3 illustrates DGC-2020HD to engine wiring.

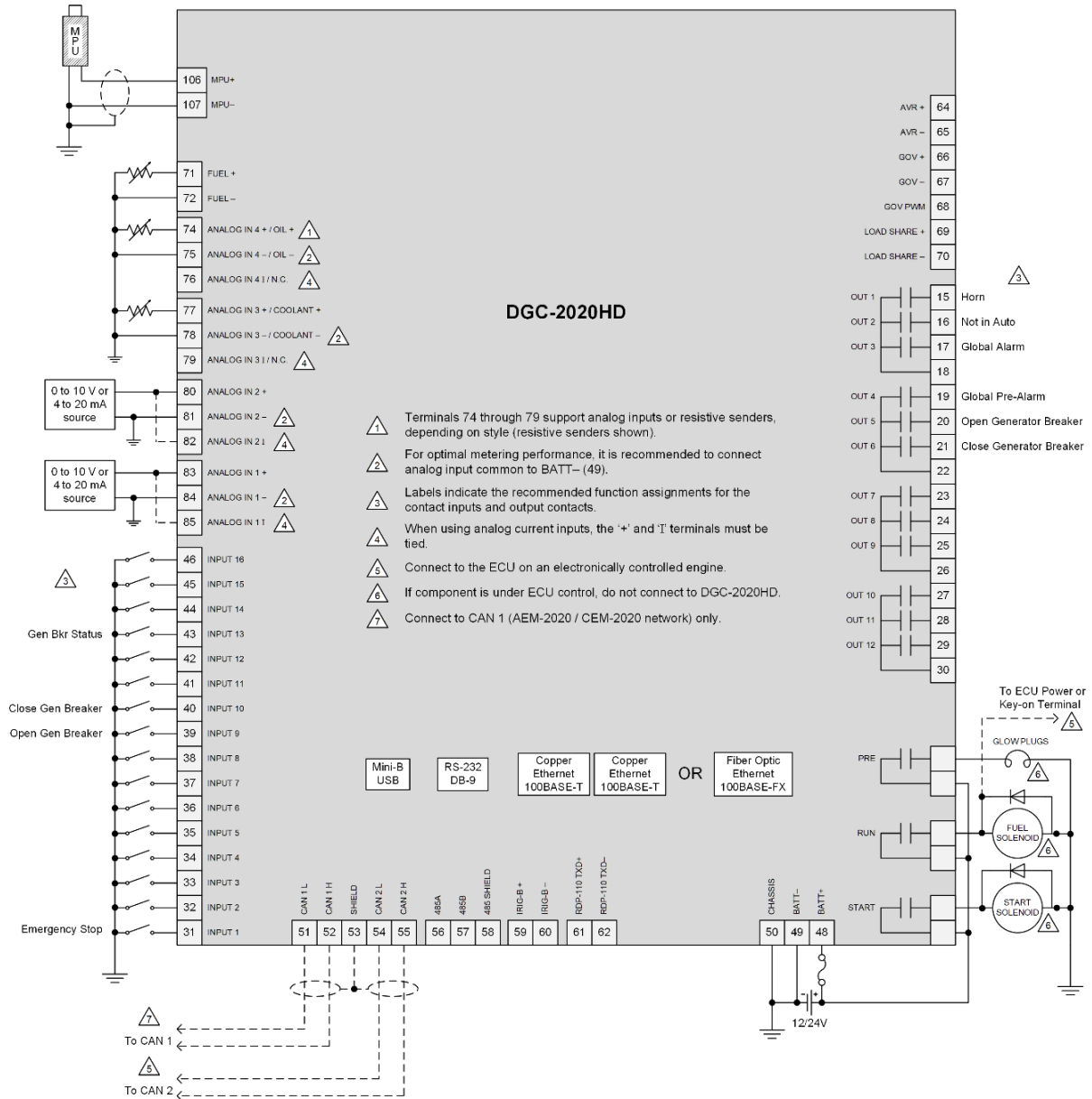


Figure 3. DGC-2020HD to Engine Wiring

## Style Number

When the DGC-2020HD is configured for genset control, the auto-synchronizer option is needed for paralleling. Base option selections will suffice for the other options. Users can opt for higher tier style options if desired. Note that over current protection with inverse time curves is not available with the standard protection option. A snippet of the DGC-2020HD Style Number setting page is shown in Figure 4.

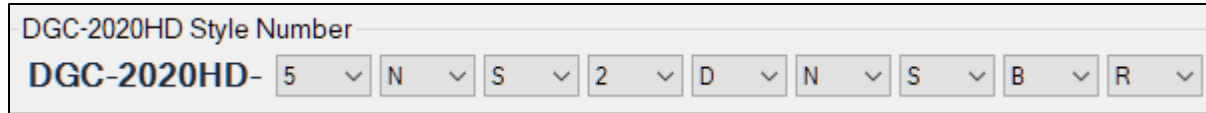


Figure 4. DGC-2020HD Style Number

## Settings Summary

Most of the settings for paralleling multiple generators to a common bus can be carried over to the genset controllers in a generator and group breaker control system configuration, with a few exceptions. Refer to the application guide “*How to set up the DGC-2020HD for Paralleling in a Multiple Generator Setup*” for guidance on the following settings:

- CAN Bus Setup
- ECU Setup
- Speed Setup
- Crank Settings
- Programmable Inputs
- Programmable Outputs
- Generator Breaker Settings
- Generator and Bus Condition Detection
- Bias Control Settings
- AVR Bias Control Settings
- Governor Bias Control Settings
- Multi Generator Management
- Programmable Senders

Moving forward, we will examine only the settings that need to be changed to create a generator and group breaker control system configuration.

## System Settings

When multiple generators are paralleled to a common bus, there is no bus segmentation (Figure 5). However, when a tie breaker is introduced into the system, the bus is now segmented (Figure 6).

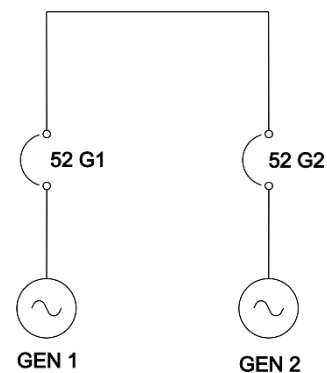


Figure 5. Non-Segmented Bus

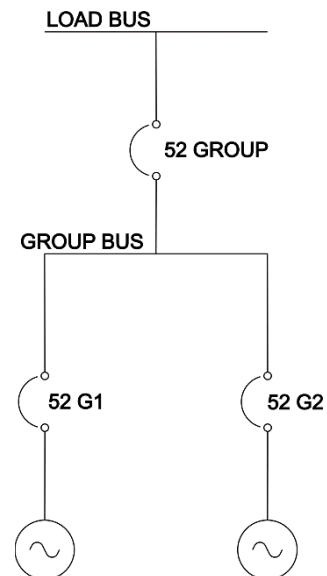


Figure 6. Segmented Bus

Hence, the System Type needs to be set to “Segmented Bus System”. In addition, the system breaker configuration needs to be set to “Generator Breaker to Segmented System”. Bus 1’s label can be changed to “Group” for proper identification. The System Settings screen is shown in Figure 7.

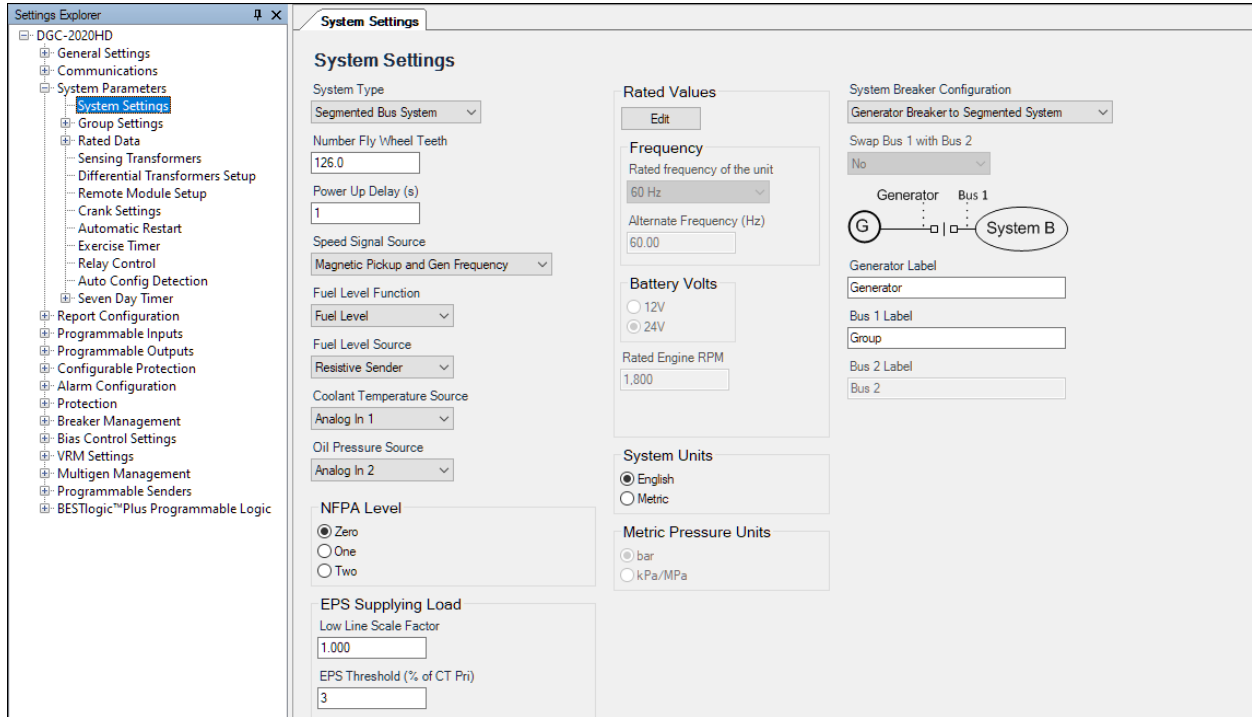


Figure 7. System Settings for Genset Controllers

### Group Segment Settings

On the Group Segment settings screen, enable System Breaker Configuration Detection. This will allow the network of controllers to auto detect the system configuration. In our example, the system configuration is generator and group breaker control.

The Group B segment is defined by the bus segment across the generator breakers. In this case, it is the Group Bus. See Figure 8 below.

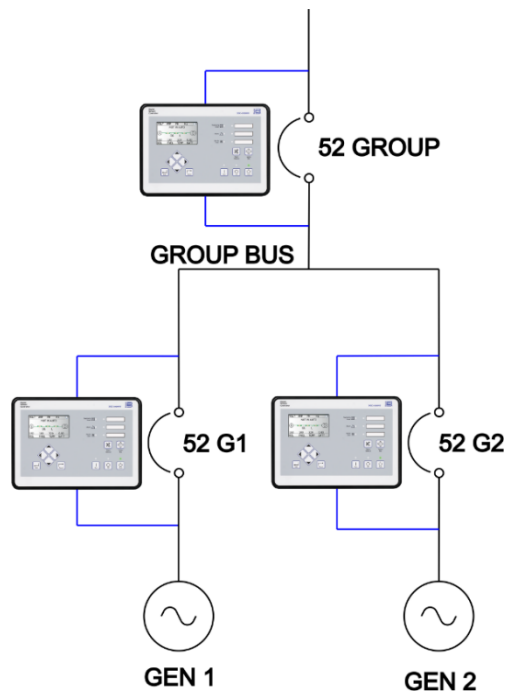


Figure 8. Segment B is the Group Bus

Specific breakers can be designated as critical breakers in the system. If communication with the controller that is controlling a critical breaker is lost, the Critical Breakers Missing pre-alarm can be set up to annunciate that event.

The same breaker labels used to define breakers on the Breaker Hardware Settings screen must be used to identify critical breakers on the Group Segment Settings screen (Figure 9). Breaker labels are limited to four alphanumeric characters.

The expected number of tie breaker controllers needs to be set to the total number of tie breakers controlled by DGC-2020HDs in the system. For this example, enter “1” for the Expected Number of Tie Breaker Controllers setting.

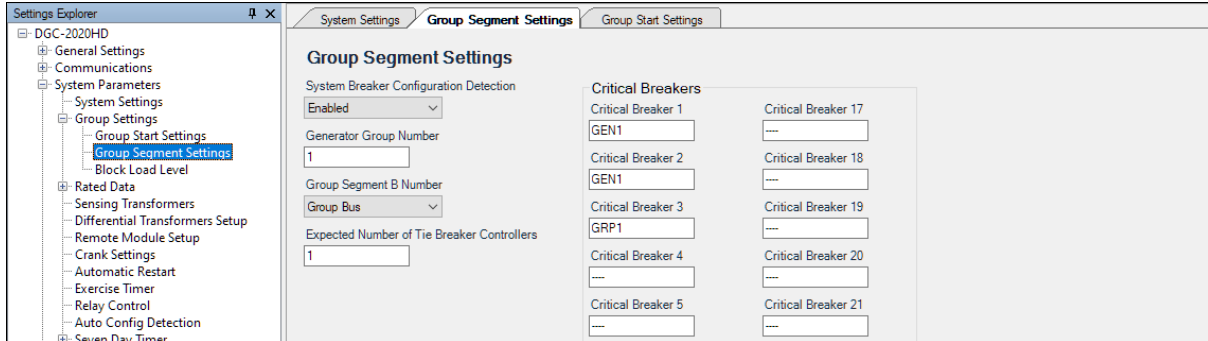


Figure 9. Group Segment Settings

## Rated Data Settings

The Rated Data settings screen is shown in Figure 10.

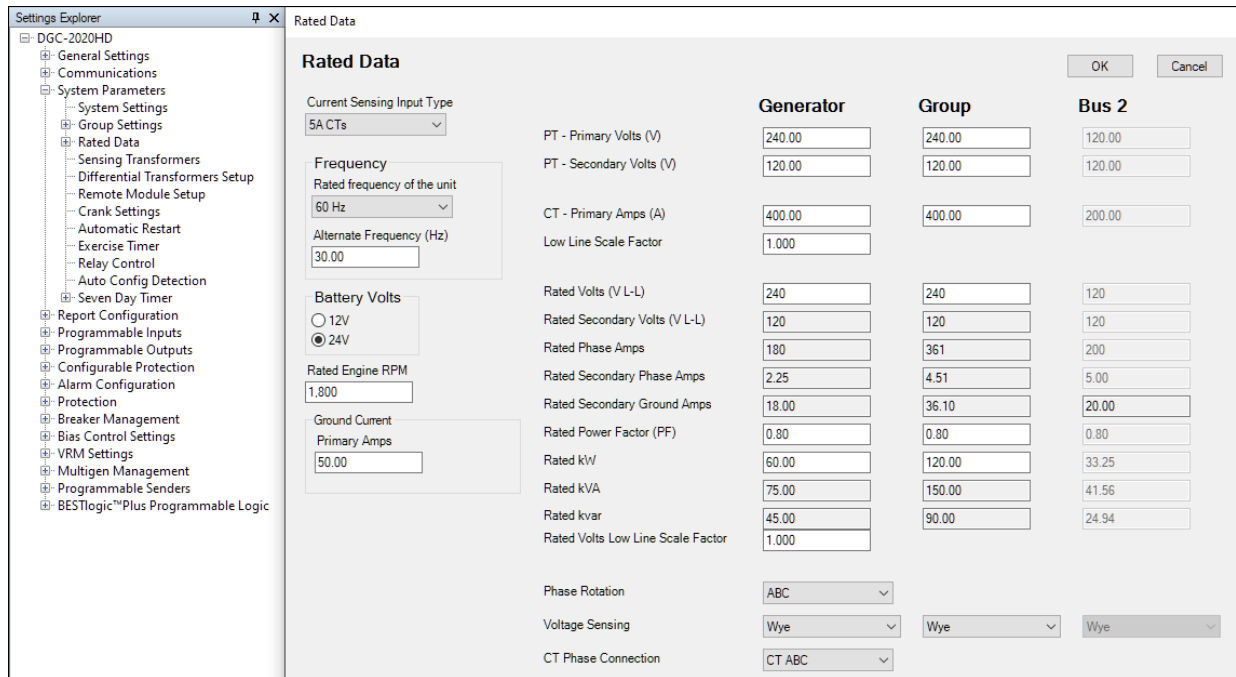


Figure 10. Rated Data Settings for DGC-2020HD Configured for Genset Control

## BESTlogic™ Plus Programmable Logic

The logic scheme for Generator Breaker to Segmented System Setup is shown in Figure 11. When the start input to the RUNWITHLOAD logic element is pulsed, the generator will start, get up to rated speed and voltage, and a breaker close request will be sent once the generator is stable. If the group bus is dead, the generator breaker will close to the dead bus. If the group bus is live, the DGC-2020HD's auto-synchronizer will become active to synchronize the generator to the bus. A breaker close request will be permitted once a Synch Breaker Close Ok status is achieved. See the Sequence of Operations section at the end of this Application Guide for more information on how the DGC-2020HDs control a system in a generator and group breaker system configuration.

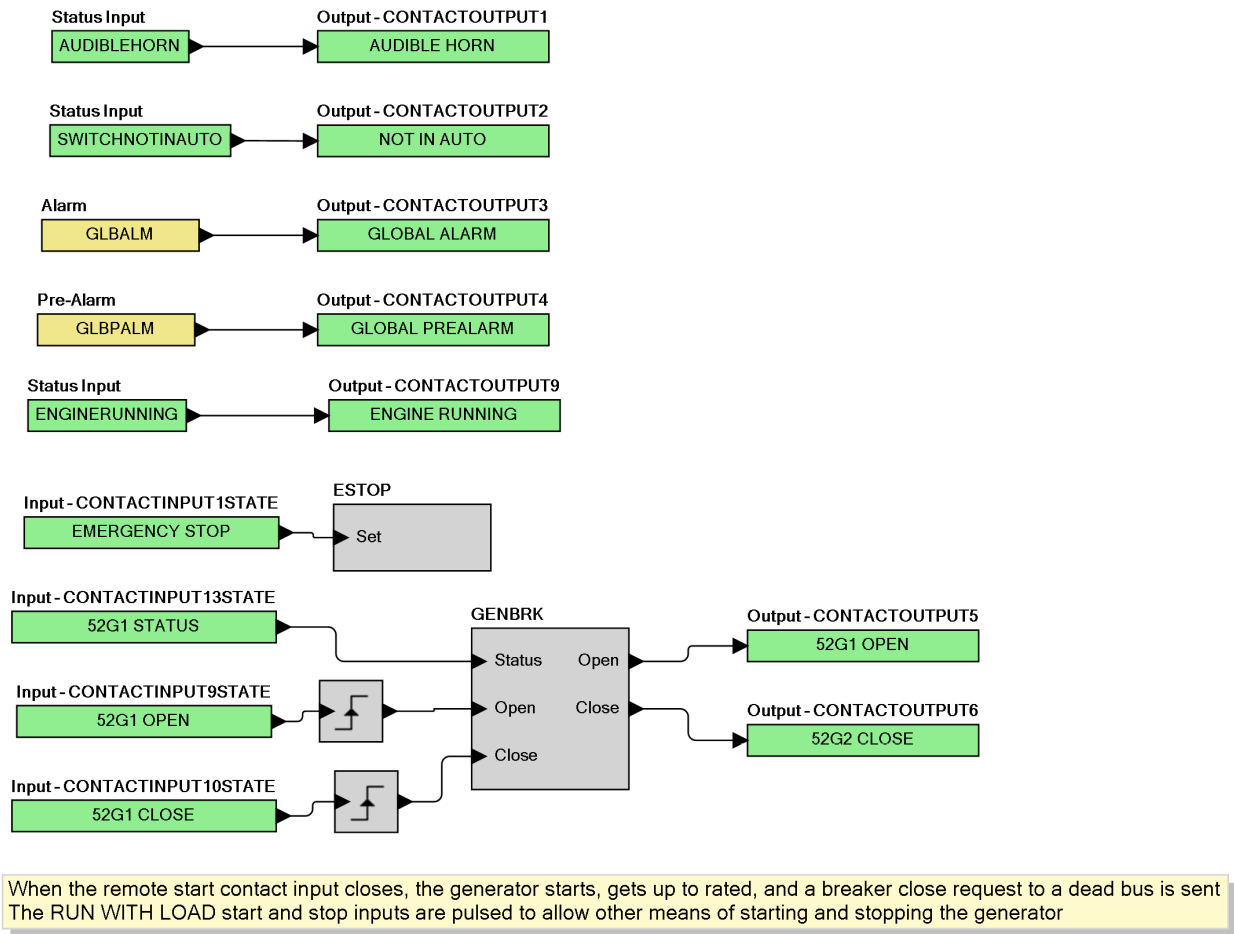


Figure 11. Logic Scheme for Generator Breaker to Segmented Setup

### DCG-2020HD Functioning as a Tie Breaker Controller

A DCG-2020HD that is functioning as a tie breaker controller can be wired for current and voltage sensing as shown in Figure 12. Note that Bus 1 is the group bus.

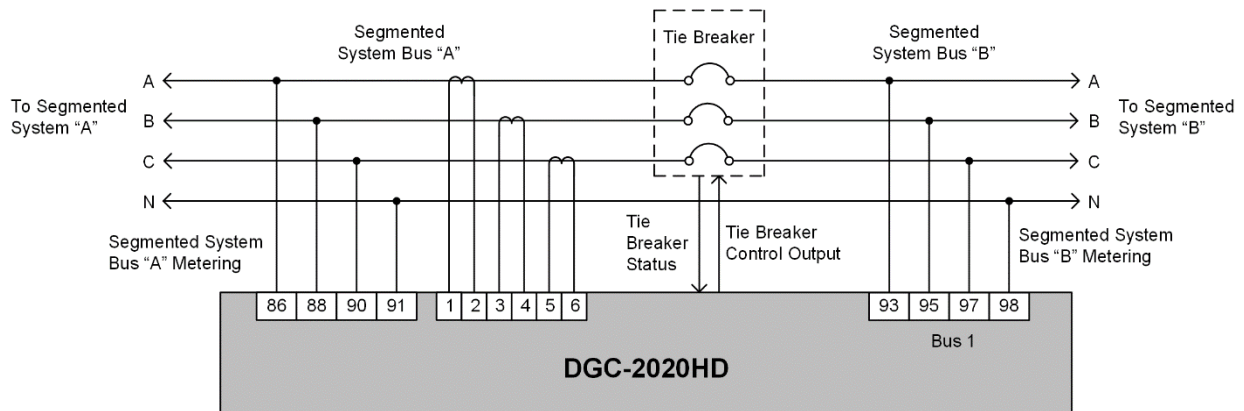


Figure 12. DCG-2020HD to Generator Wiring for Tie Breaker Control

In our example, Segment A is the group bus and Segment B is the load bus. Bus 2 is unused since the DGC-2020HD is only controlling one tie breaker.

There is no engine interface wiring for the group tie breaker controller.

### Style Number

The style options shown below will generally work for most group tie breaker controller applications. The Auto Sync option is needed for synchronization purposes. The Analog option is recommended because resistive sender inputs are typically used on engines.

The DGC-2020HD Style Number screen is shown in Figure 13.

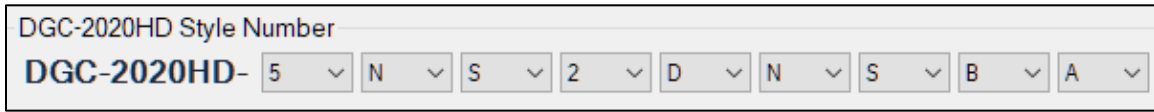


Figure 13. DGC-2020HD Style Number

### Setting Summary

The key settings that need to be changed for the group tie breaker controller are discussed in the sections below.

### System Settings

On the System Settings screen (Figure 14), change the System Type to “Segmented Bus System”. Change the System Breaker Configuration to “Tie Breaker Control”.

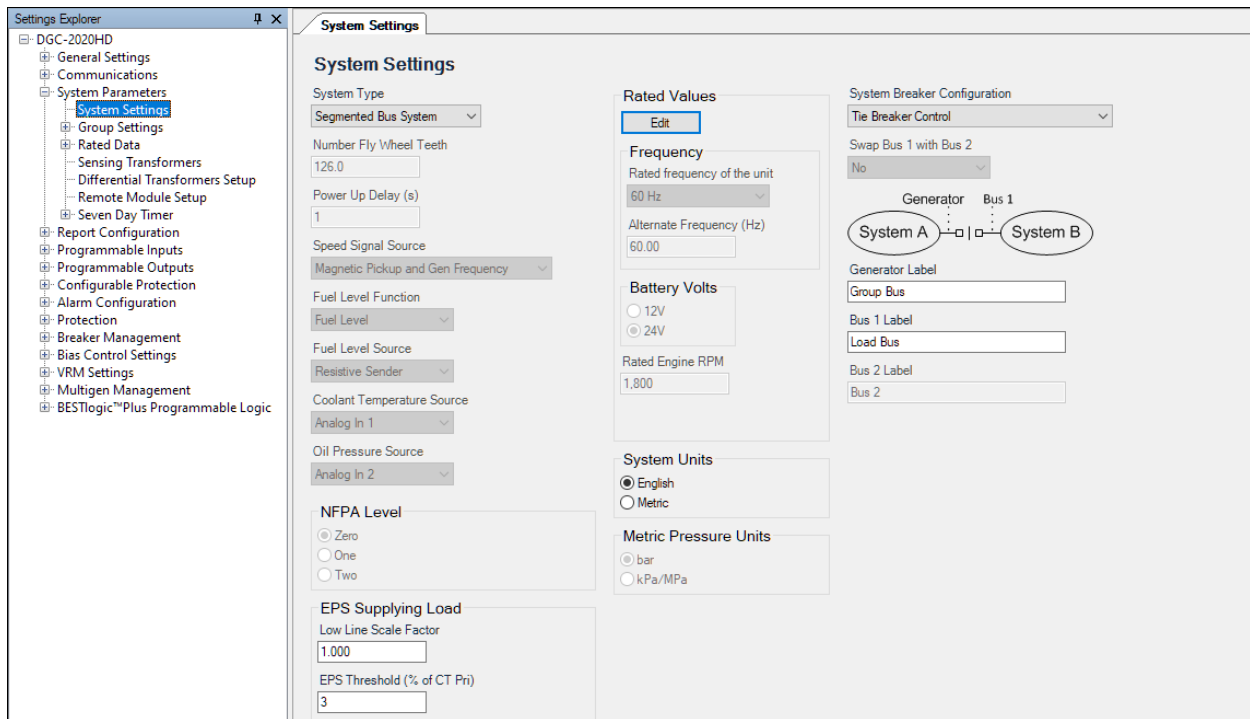


Figure 14. System Settings for Tie Breaker Control

### Group Segment Settings

On the Group Segment Settings screen (Figure 15):

- Set the System Breaker Configuration Detection setting to “Enabled”.
- Since there is only one generator group:
  - Set the Generator Group A Number to “1”.
  - Set the Generator Group B Number to “1”.
- Set the Group Segment A Number to “Group Bus”.

- Set the Group Segment B Number to “Load Bus”.
- Set the Expected Number of Tie Breaker Controllers to “1”.

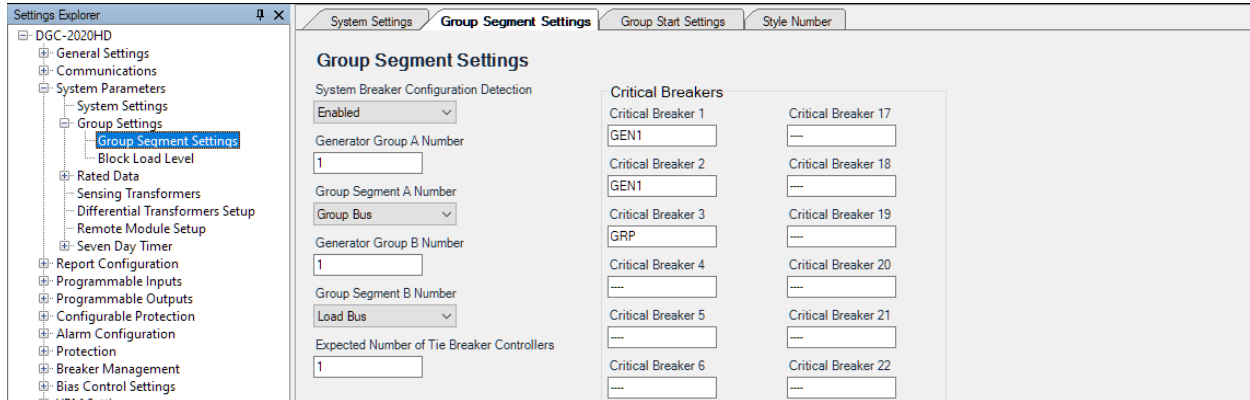


Figure 15. Group Settings for Tie Breaker Control

This completes the segmented bus setup.

Critical breakers can be defined. See page 5 for the definition of critical breakers.

### Rated Data Settings

The rated data for each bus monitored by the group tie controller must be entered on the Rated Data settings screen shown in Figure 16.

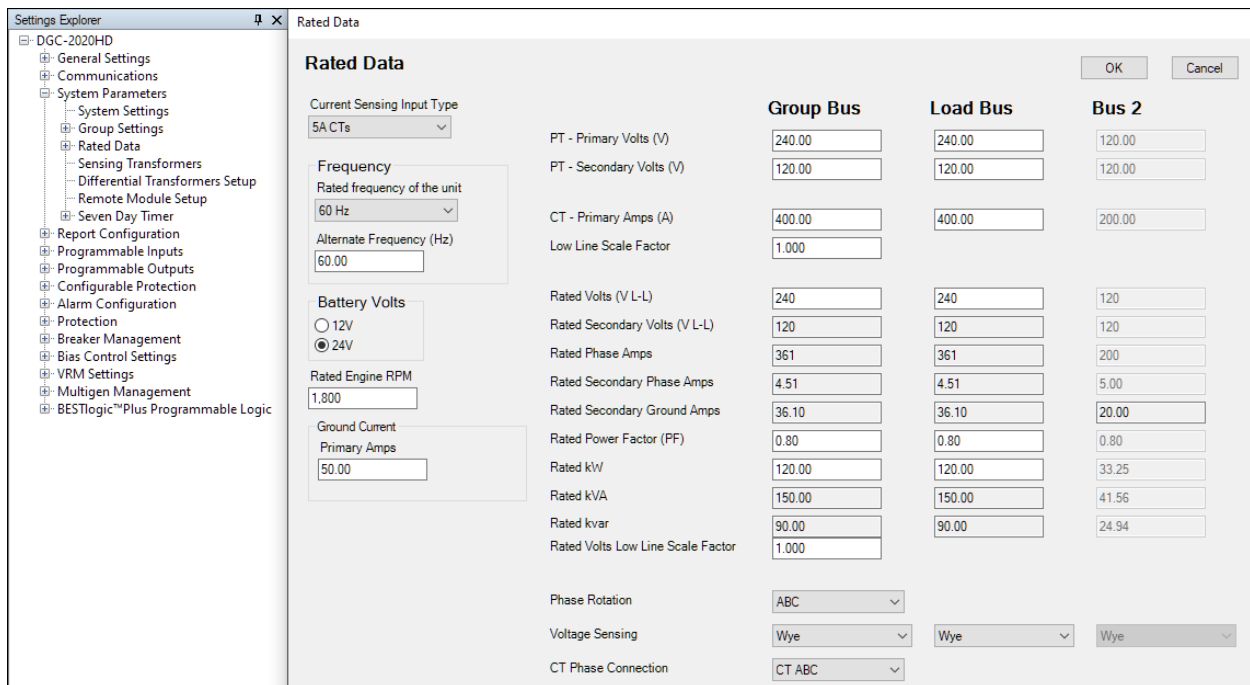


Figure 16. Rated Data Settings for Group Breaker Controller

### Sensing CT Settings

On a DGC-2020HD configured for tie breaker control, CT secondary input terminals 1 through 6 can be used to monitor the current from the generator group. On controllers equipped with the enhanced sensing option, four auxiliary CT inputs are available for current metering. In this example, three of the four auxiliary CT inputs are being used to meter the load bus current.

The Sensing Transformers screen is shown in Figure 17.

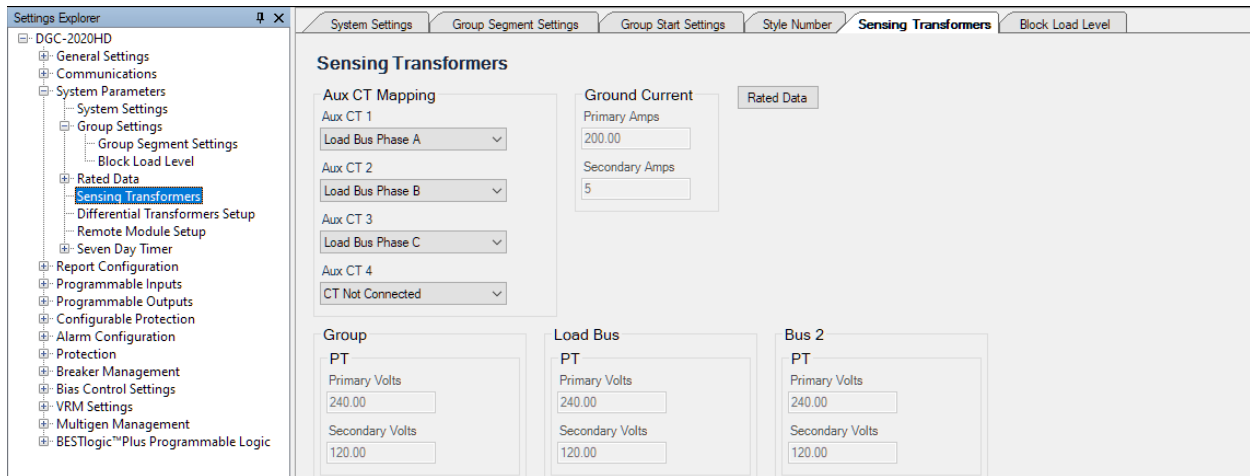


Figure 17. CT Input Settings for Load Bus Metering

On controllers with the basic sensing style option, only one auxiliary CT input is available.

## Inputs and Outputs

Digital inputs and outputs are needed to control the group tie breaker. For simplicity, minimal inputs and outputs are used in this example.

- Input 13 – Tie breaker status
- Contact inputs are not assigned to the open and close input bits on the Tie Breaker Control logic element because manual breaker operations are not needed for this example. Manual breaker control logic can be added if desired.

## Protection

Multiple protection elements are available for use. For each protection element, the source can be defined, whether the group bus or the load bus. It is up to the user to determine the appropriate levels of protection for the application. For details on the protective relay capabilities of the DGC-2020HD, refer to Chapter 17 of the “*DGC-2020HD Configuration Instruction Manual*”.

The Protection Settings tree in BESTCOMSPPlus® is shown in Figure 18.

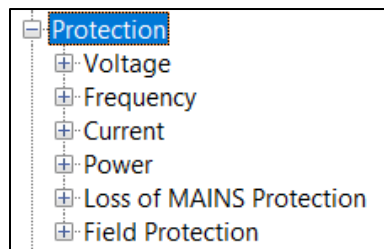


Figure 18. Protection Settings

## Breaker Settings

Refer to the Tie Breaker settings screen shown in Figure 19. Use up to four alphanumeric characters to enter the breaker label. Set the contact type according to the requirements of the breaker control mechanism. For example, motor operated breakers typically require a short duration pulse for opening and closing. Several settings are available to determine when to allow and disallow the tie breaker to close. In this example, we want to be able to close the tie breaker to a dead bus, or synchronize the generators and close to a live bus.

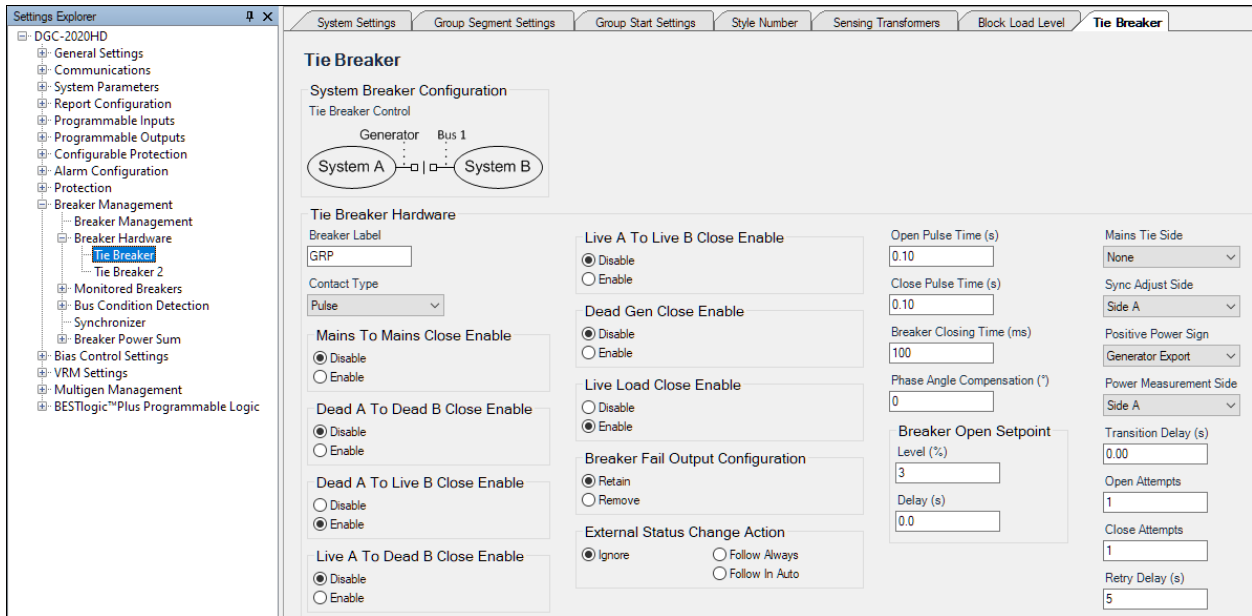


Figure 19. Breaker Settings

### Bus Condition Detection

The Bus Condition Detection settings (Figure 20) are automatically updated when the rated data settings are changed. However, it is important to review these settings to ensure that the frequency and voltage ranges that define each bus condition are acceptable for the application. The bus condition is either stable, dead, or failed.

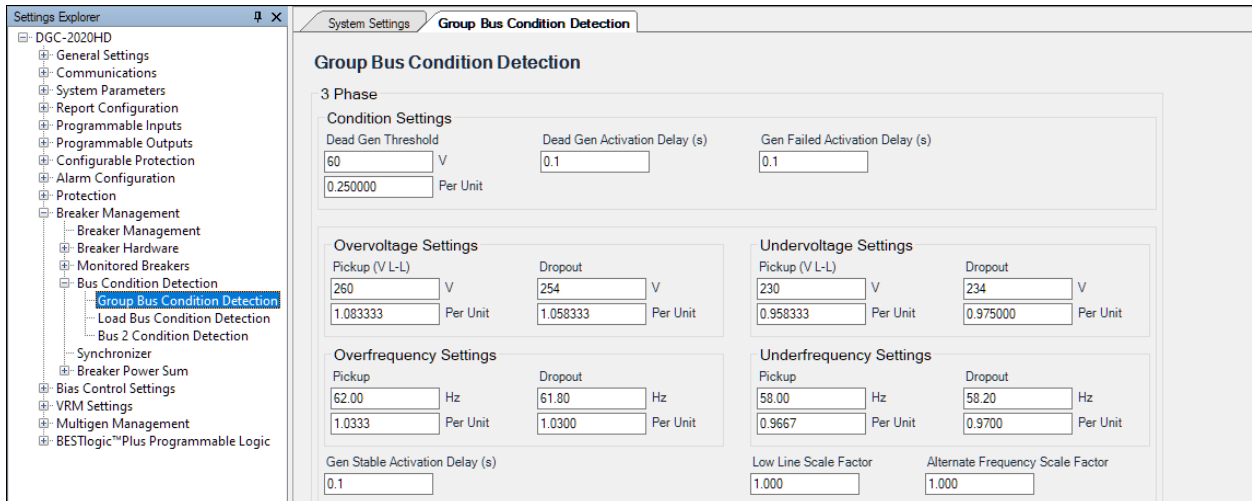


Figure 20. Bus Condition Detection Settings

### Synchronization

For applications that involve auto synchronization across the group breaker, it is important to review the synchronization settings in the group breaker controller to ensure the synchronizer delivers satisfactory performance during the synchronization process. Synchronization settings may need to be adjusted during commissioning to obtain best results.

The Synchronizer settings screen is shown in Figure 21. Refer to chapter 13 of the “*DGC-2020HD Configuration Instruction Manual*” for more information on synchronization.

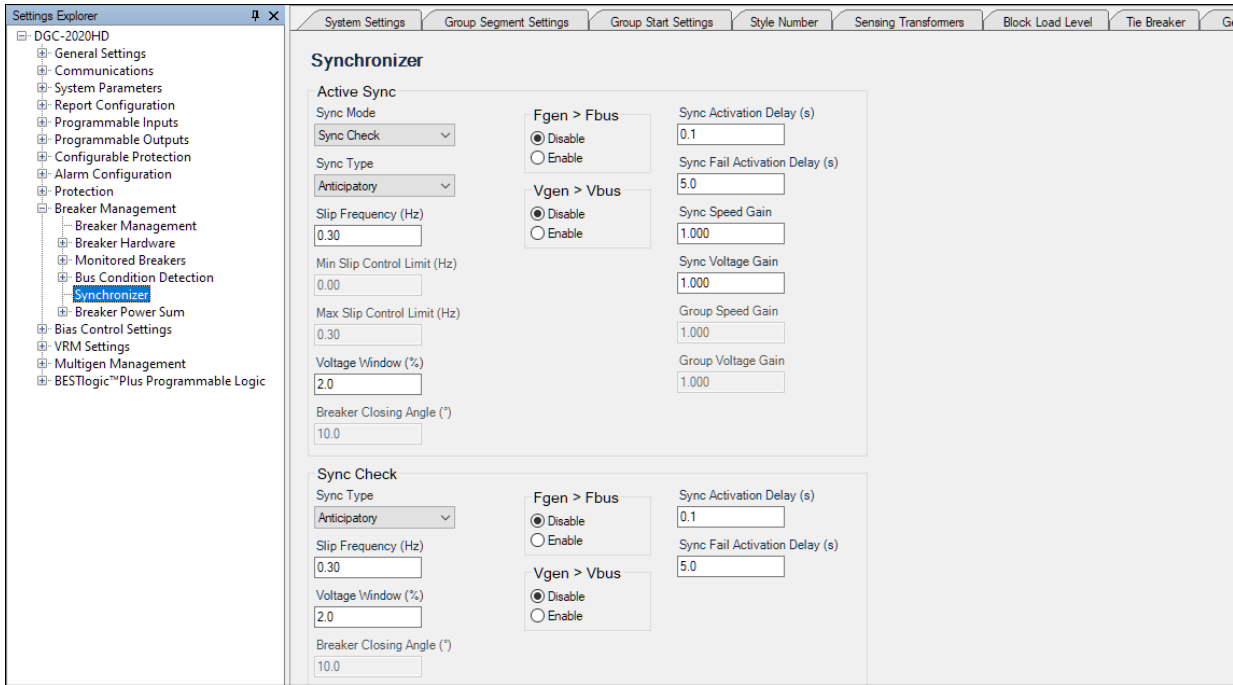


Figure 21. Synchronization Settings

### Network Configuration

The same expected sequence IDs that were entered in the settings for the DGC-2020HDs functioning as genset controllers need to be entered in the settings for the group tie breaker controller as shown in Figure 22.

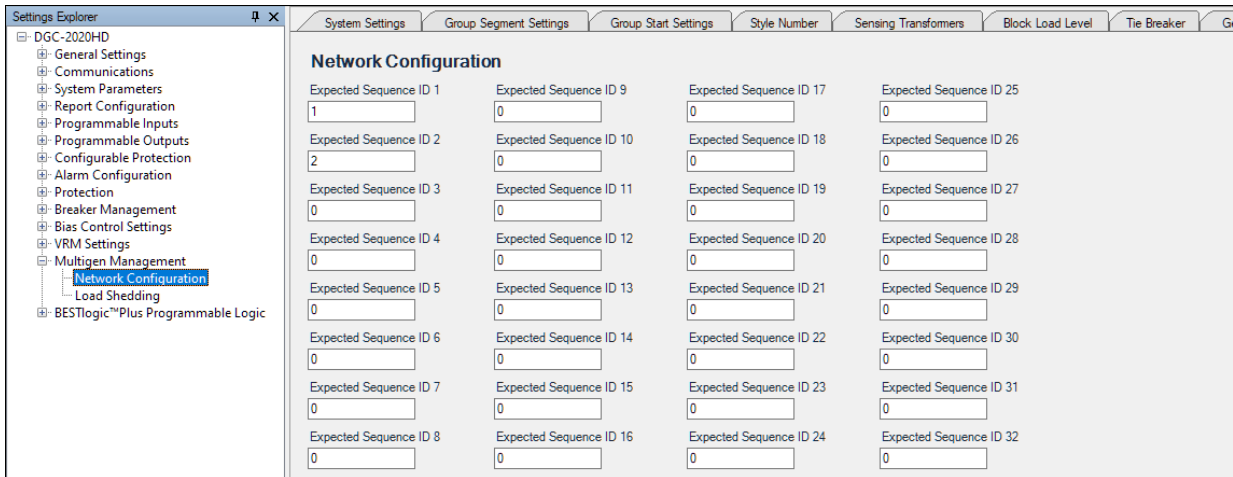


Figure 22. Network Configuration Settings

### BESTlogic™ Plus Programmable Logic

Programmable logic for Tie Breaker Control is shown in Figure 23.

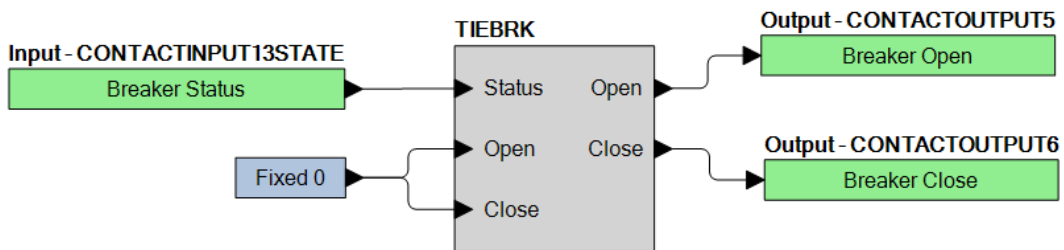


Figure 23. Programmable Logic for Tie Breaker Control

## System Breaker Configuration

Once all settings configuration is complete in the DGC-2020HDs controlling generators and the DGC-2020HD controlling the group breaker, all the DGC-2020HD controllers are networked together to form a Generator and Group System Breaker Configuration. When connected to any DGC-2020HD on the network with a computer via BESTCOMSPlus®, the System Breaker Configuration can be seen on the System Breaker Status screen (Figure 24) under System Status in the Metering Explorer.

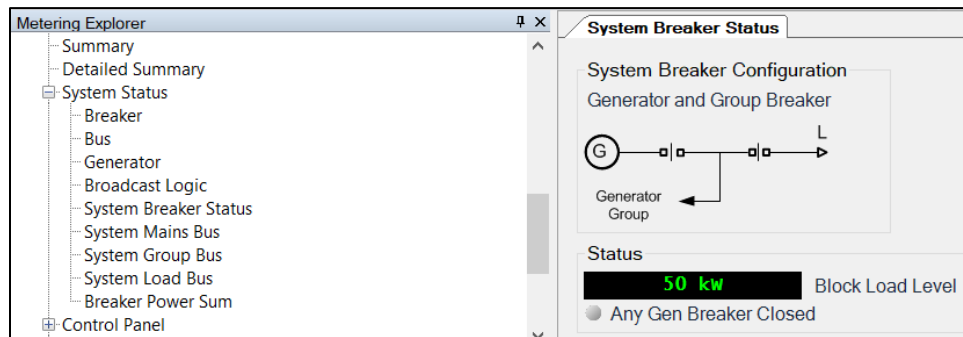


Figure 24. System Breaker Status

## Sequence of Operations

Generators within the generator group can be started and stopped just as they would if there were no group breaker. Remote starting and stopping can be done via multiple means, including using automatic transfer switches, PLCs, the exerciser function, the demands start/stop function, etc. This setup can be used for continuous, prime, or standby power. In the case of standby power, an automatic transfer switch would typically be installed in the system to connect the load to either the normal or the emergency source of power.

The same logic scheme used for paralleling multiple generators to a common bus can be used in this application. A contact input, a Modbus® switch, or a virtual switch can be used to set the RUNWITHLOAD logic element.

Once the two generators are paralleled to the group bus, the group tie breaker needs to be closed for the generator to drive the load. If the load bus is dead, the group breaker controller will close the group breaker to the dead bus. If the group and the load buses are energized, the group breaker controller will determine the frequency, phase angle, and voltage differences of the two buses, and send raise/lower requests to the individual genset controllers. The genset controllers in turn send adjustment signals to the engine governors and the voltage regulators until the frequency, phase angle, and voltage of the group bus matches the load bus. The group breaker controller will send a breaker close request after it receives a Sync Breaker Close Ok status.

Once the group breaker is closed, the two DGC-2020HDs controlling the generators will handle kW and kvar sharing over the intergenset communications network if Ethernet load sharing is implemented. This setup allows multiple machines to share kW and kvar proportionally on a percentage capacity basis, while maintaining the rated frequency and voltage of the system throughout the load profile. Implementing the logic scheme shown in Figure 11 will allow multiple DGC-2020HDs to control a system of gensets paralleled to a segmented bus as described above.

## To Learn More

To learn more, please email [usatechsupport@basler.com](mailto:usatechsupport@basler.com) or call 618.654.2341 to speak with a Basler representative.