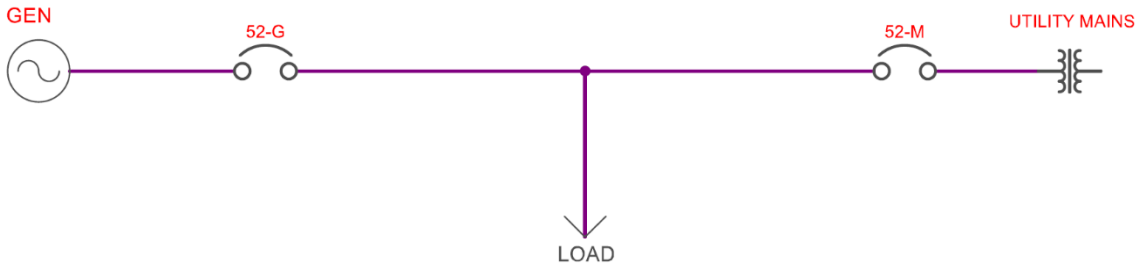
APPLICATION GUIDE

How to Set Up the DGC-2020HD for Single Generator Automatic Mains Fail

From a Single-Line Diagram:



To a Fully Functional System:

Purpose

This application guide is intended to be used as a quick start guide for implementing the use of the DGC-2020HD in a single generator Automatic Mains Fail (AMF) application, without the use of a physical Automatic Transfer Switch (ATS). The purpose is to provide users with direction on the minimum settings that need to be configured, and logic that needs to be created to achieve genset control. This application guide 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 for further details.

About the Author

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About Basler

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Application Overview

In this application, the DGC-2020HD should be set up to control the generator, the generator breaker, and the mains breaker. There is no ATS hardware in the system. The DGC-2020HD performs genset control and leads the automatic mains fail sequence of operations. Note that this arrangement requires a dedicated automatically controlled mains breaker to isolate the utility from the system.

The DGC-2020HD can be set up to perform open or closed transitions. Generator and mains bus-sensing wires must be terminated on the DGC-2020HD. Sensing of the load bus is optional. Current sensing of the mains bus can be three phase or single phase. If single-phase sensing is used, the controller assumes that all three phases are carrying the same magnitude of current. A single-line diagram is shown in Figure 1.

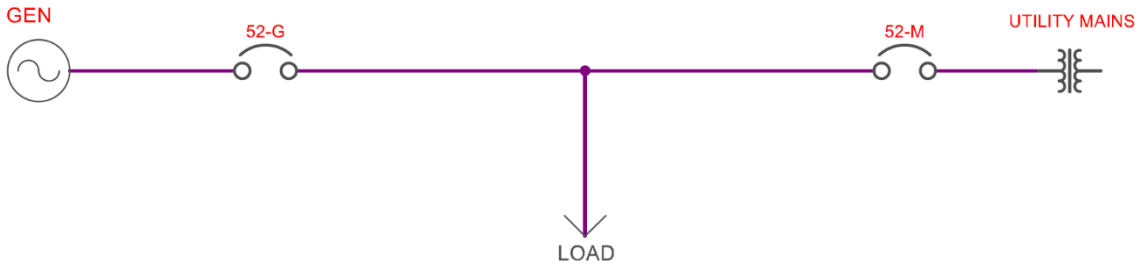
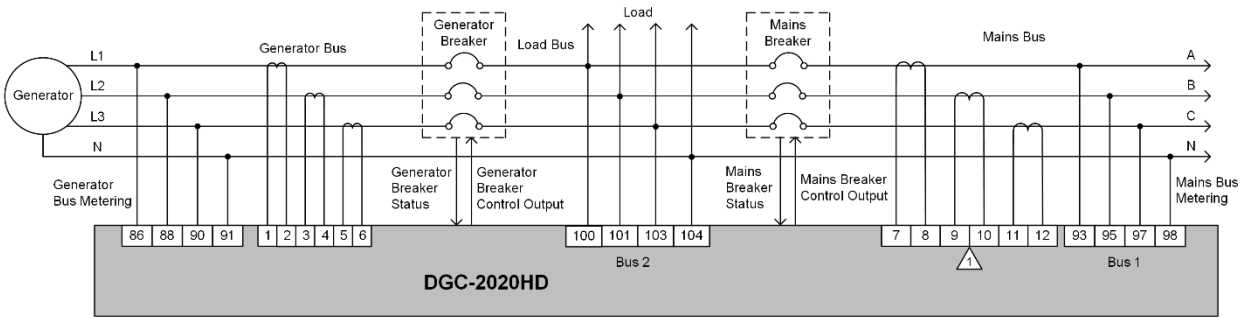


Figure 1. Single-Line Diagram

Figure 2 illustrates DGC-2020HD to generator wiring for generator and mains breaker control without ATS.



Notes:
1. An auxiliary CT is only required for mains breaker power measurement. Mains breaker power measurement is required for the Zero Power Transfer or Mains Power Control functions.

Figure 2. DGC-2020HD to Generator Wiring for Generator and Mains Breaker Control without ATS

Figure 3 illustrates DGC-2020HD to engine wiring.

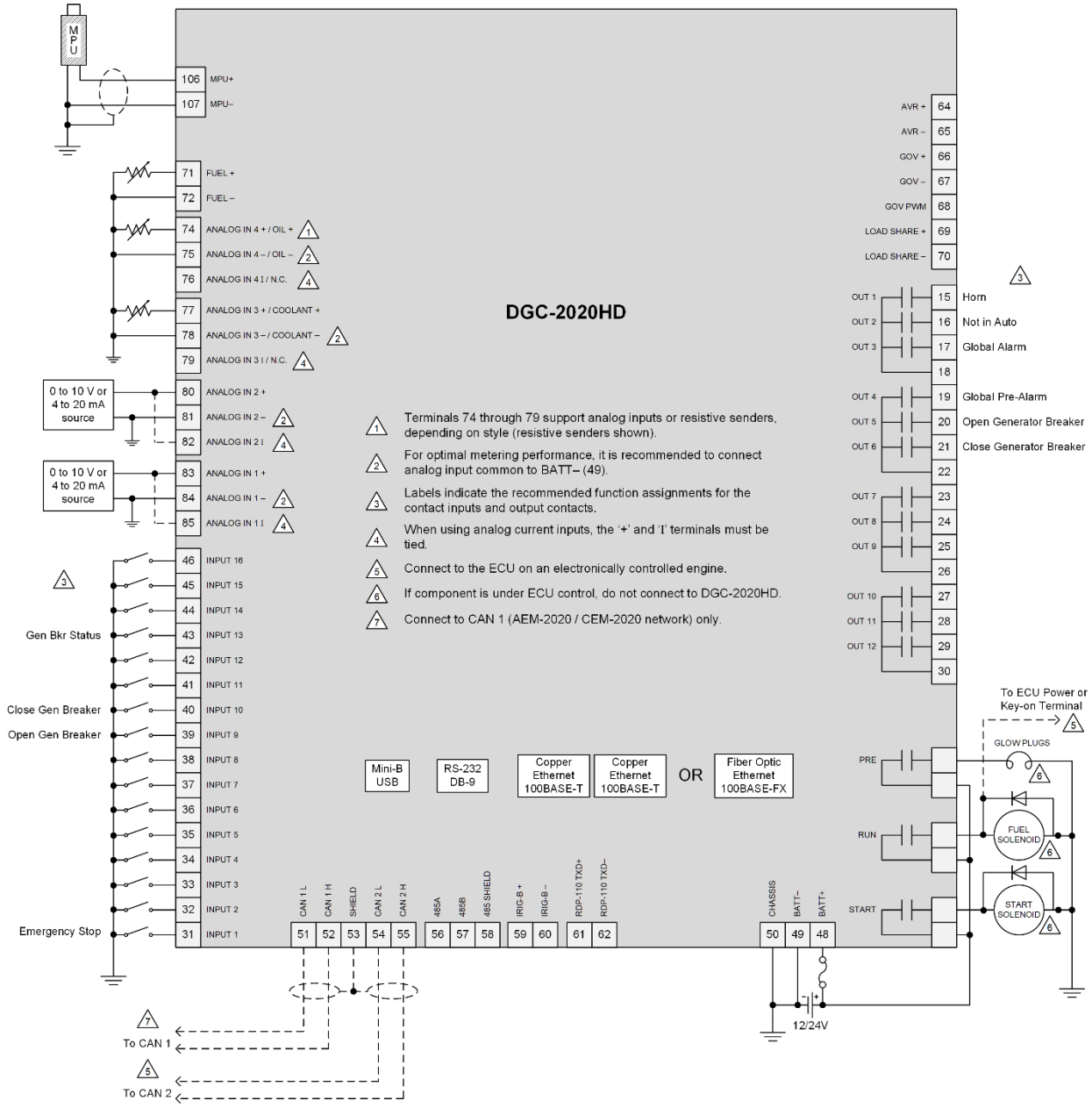


Figure 3. DGC-2020HD to Engine Wiring

Style Number

A style number composed of base options is sufficient for open transitions. The Auto Sync option is needed for closed transitions. The Auto Sync option is also needed if the generator being commissioned will be paralleled with other generators or a mains bus in the future. Note that overcurrent protection using inverse time curves is not available with the standard protection option. To sense the load bus in addition to the generator and the mains bus as shown in Figure 2, the Enhanced Sensing option must be selected. Figure 4 shows the DGC-2020HD Style Number Selection.

Figure 4. DGC-2020HD Style Number

The DGC-2020HD is capable of numerous functions through the configuration of several settings in BESTCOMS*Plus*® and implementation of logic in BESTlogic™*Plus* Programmable Logic. However, with only a few settings, and minimal logic, the DGC-2020HD can be programmed to achieve basic genset control in an AMF application.

Some of the key settings that need to be configured are described next.

CAN Bus Setup

In order to avoid communications errors, it is important to first ensure that CAN Bus network installations are done correctly. The following list summarizes the CAN Bus installation requirements for all DGC controllers:

- If the DGC is providing one end of the J1939 bus, a 120-ohm 1/2 watt terminating resistor should be installed across the CAN2 L and CAN2 H terminals. Refer to the appropriate DGC instruction manual for terminal numbering.
- If the DGC is not part of the J1939 bus, the stub connecting the DGC to the bus should not exceed 914 mm (3 ft) in length.
- The maximum bus length, not including stubs, is 40 m (131 ft).
- The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the DGC.

On the CAN Bus Setup page shown in Figure 5, ECU support needs to be enabled if the DGC-2020HD will communicate with an engine ECU. DTC support must be enabled if the DGC-2020HD will receive DTCs sent to it from the engine ECU. Four (4) is the most common SPN conversion method, but it should be changed if necessary. Some engine manufacturers specify a J1939 ECU address for transmitting requests to the engine ECU. These include RPM requests to run the engine at a specific speed, engine start requests, and engine stop requests. Engine control parameter transmit needs to be enabled if the controller will send control requests to the engine ECU. On the list shown in Table 1, the CAN Bus address is user selectable for some ECUs. The standard ECU is listed for ECU types that are not included in Table 1.

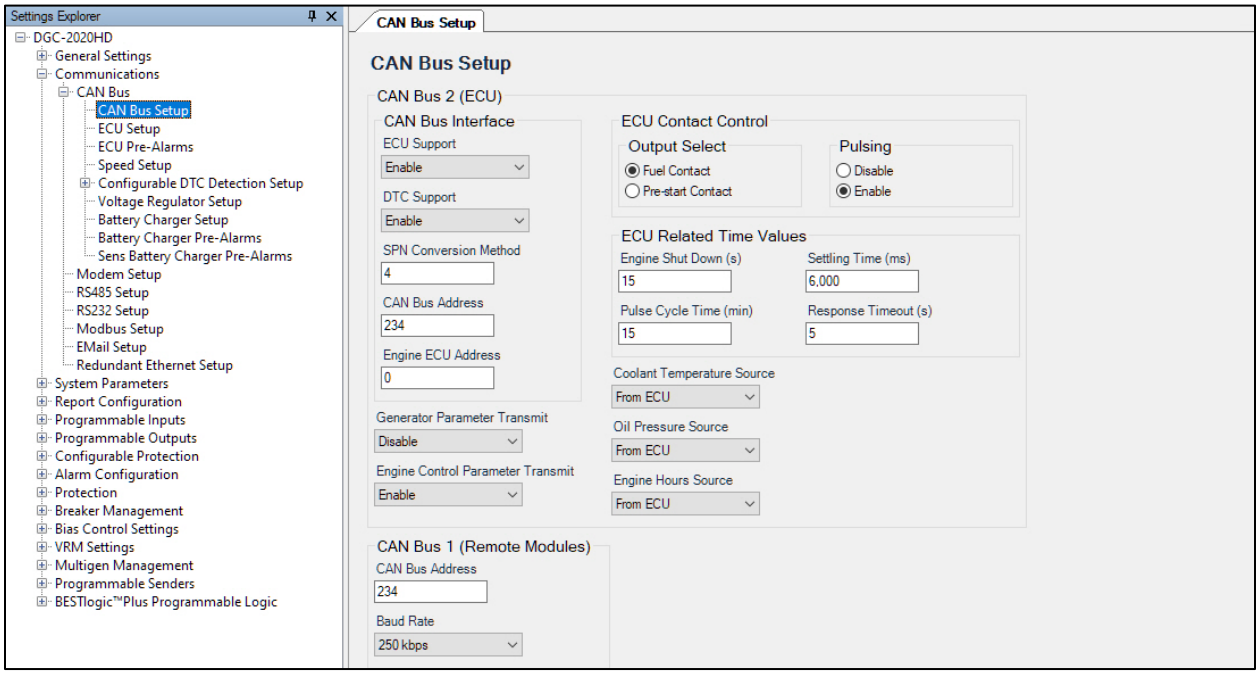


Figure 5. CAN Bus Setup

Table 1. CAN Bus Address per ECU Type

ECU Type	CAN Bus Address
Cummins	220
Daimler CPC4	User-selectable
GM/Doosan	User-selectable
Isuzu	User-selectable
John Deere	User-selectable
mtu ADEC	1
mtu ECU7/ECU8	6
mtu MDEC	6
mtu Smart Connect	234
Scania	39
Standard	User-selectable
Volvo Penta	User-selectable
Woodward PG Plus	230

Note that the ECU CAN Bus wires need to be terminated on the DGC-2020HD's CAN 2 terminals. CAN 1 is dedicated for Basler Electric's accessory modules: the AEM-2020, CEM-2020, and VRM-2020. On the CAN Bus Setup page, there are settings for ECU contact control, ECU related time values, coolant temperature source, and oil pressure source. The default settings are typical for an ECU controlled engine, but they can be changed if necessary.

ECU Setup

For ECU controlled engines only, there are settings to be selected on the ECU Setup page shown in Figure 6. The ECU type can be selected on this page. There are additional settings that apply to specific ECU types. Standard ECU is an available selection for ECU types that are not listed on the drop down list of ECU types.

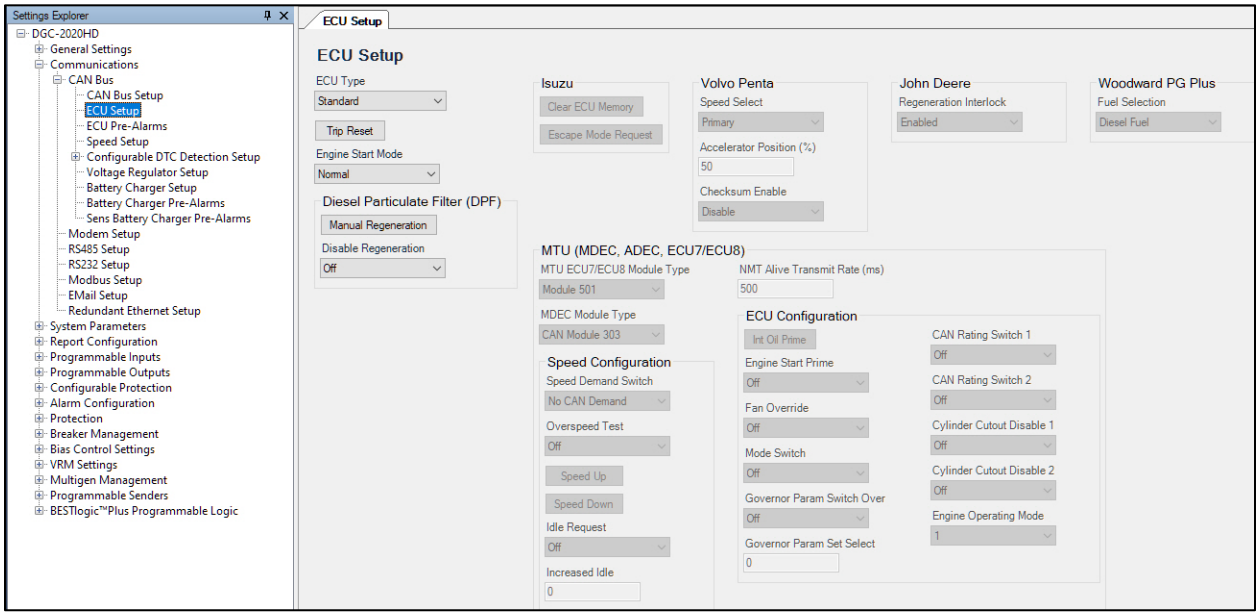


Figure 6. ECU Setup

Speed Setup

For J1939 controlled engines that are receiving RPM requests from the genset controller, CAN Bus RPM request must be enabled on the Speed Setup page shown in Figure 7. The remaining settings on this page can be adjusted as needed for the application.

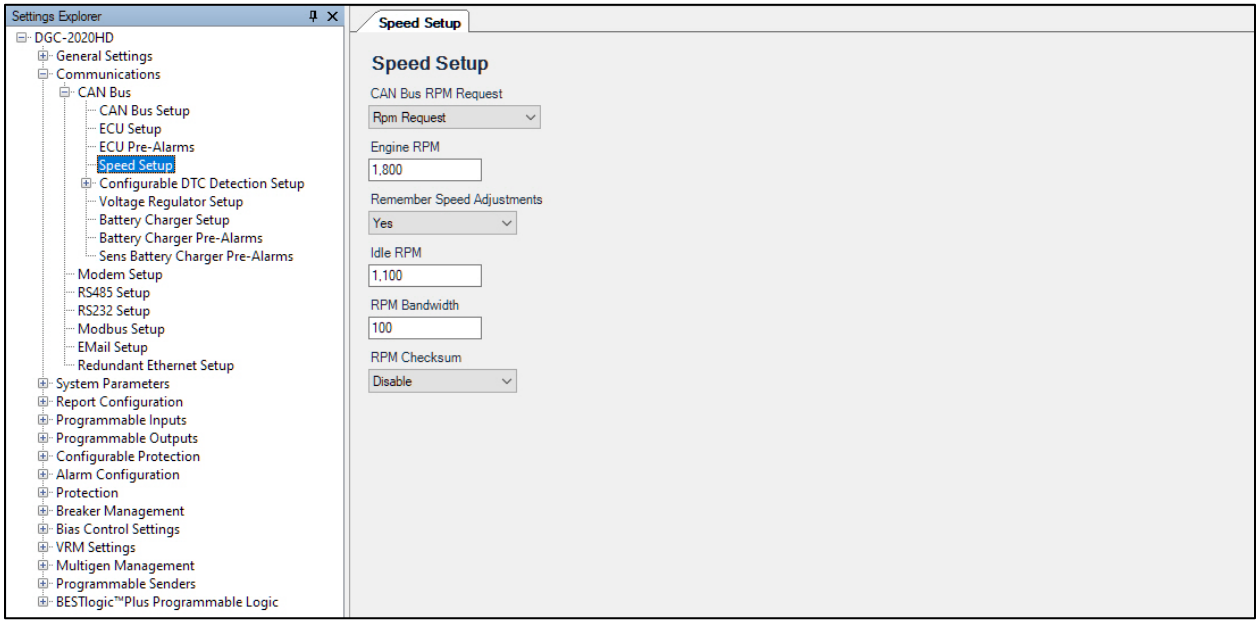


Figure 7. Speed Setup

System Settings

On the System Settings page shown in Figure 8, the system type should be set to Single Generator. The System Breaker Configuration should be set to Generator and Mains Breaker Control. The other settings should be adjusted as needed.

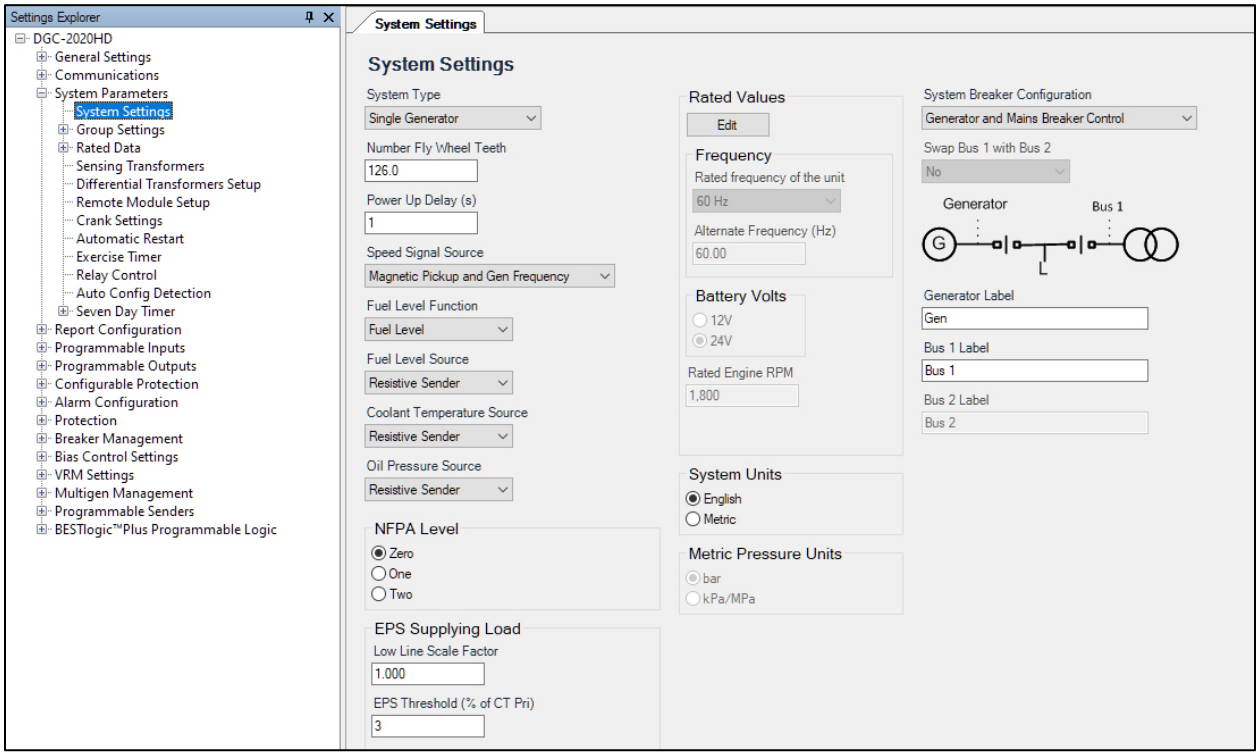


Figure 8. System Settings

Rated Data Settings

Rated data settings for the generator and the bus need to be entered on the Rated Data Settings page. In the example shown in Figure 9, the generator is rated for 100 KW, 0.8 pf, 208/120 Vac wye, 60 Hz. The current transformers (CTs) have a 400:5 turns ratio. Potential transformers (PTs) are not needed because the DGC-2020HD is capable of sensing up to 576 Vac directly.

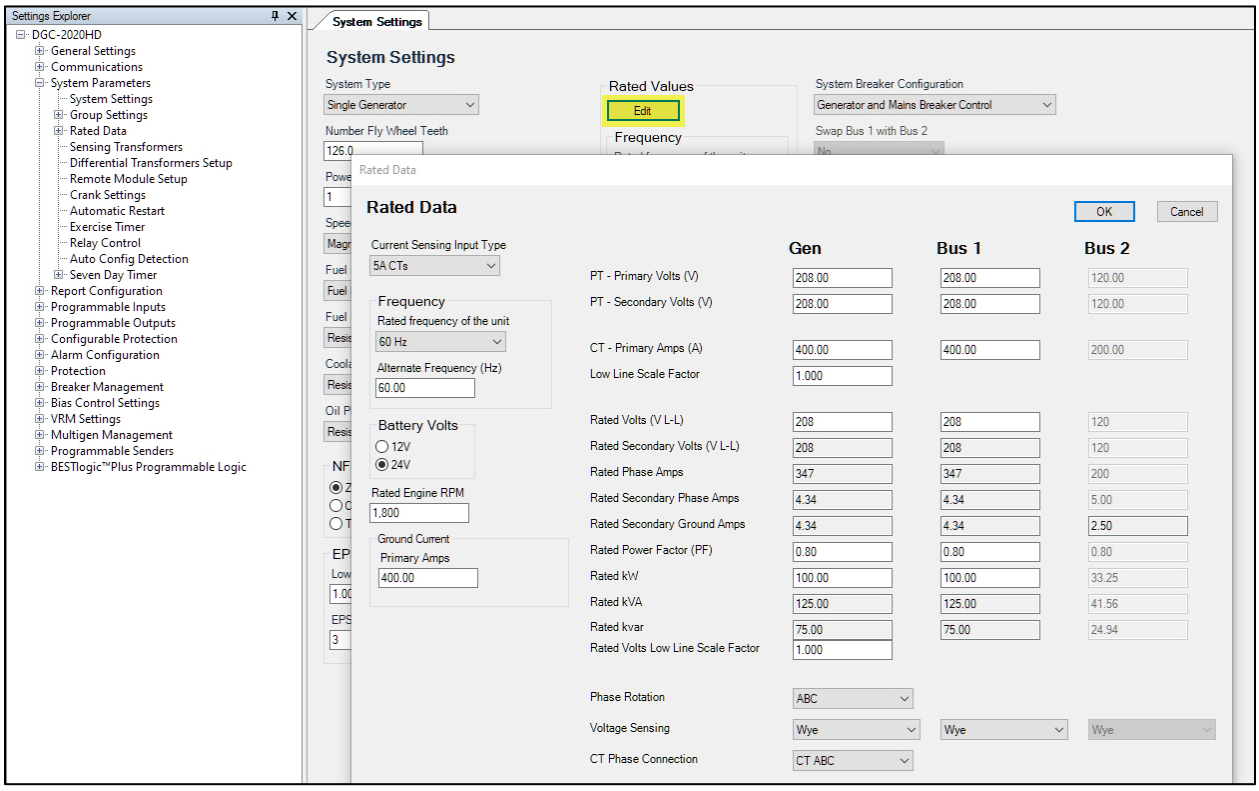


Figure 9. Rated Data Settings

Crank Settings

On the Crank Settings page shown in Figure 10, a time setting can be entered for a pre-crank delay. The pre-start relay can be used to control a circuit to power equipment that needs to be turned on before the engine cranks. Examples include glow plugs, coolant heaters, pre-lube pumps, etc.

The cranking style can be set to continuous or cycle. If cycle is chosen, the number of crank cycles, crank time, and the rest time can be changed. The crank disconnect limit can be set as a percentage of engine rated speed. Alternatively, the oil pressure crank disconnect setting can be enabled and an oil pressure threshold can be set for crank disconnect.

The DGC-2020HD can be configured to allow the genset to cooldown before shutting down. A time setting can be entered for the “No Load Cool Down” Time setting. During cooldown, the generator runs at rated speed, with no load.

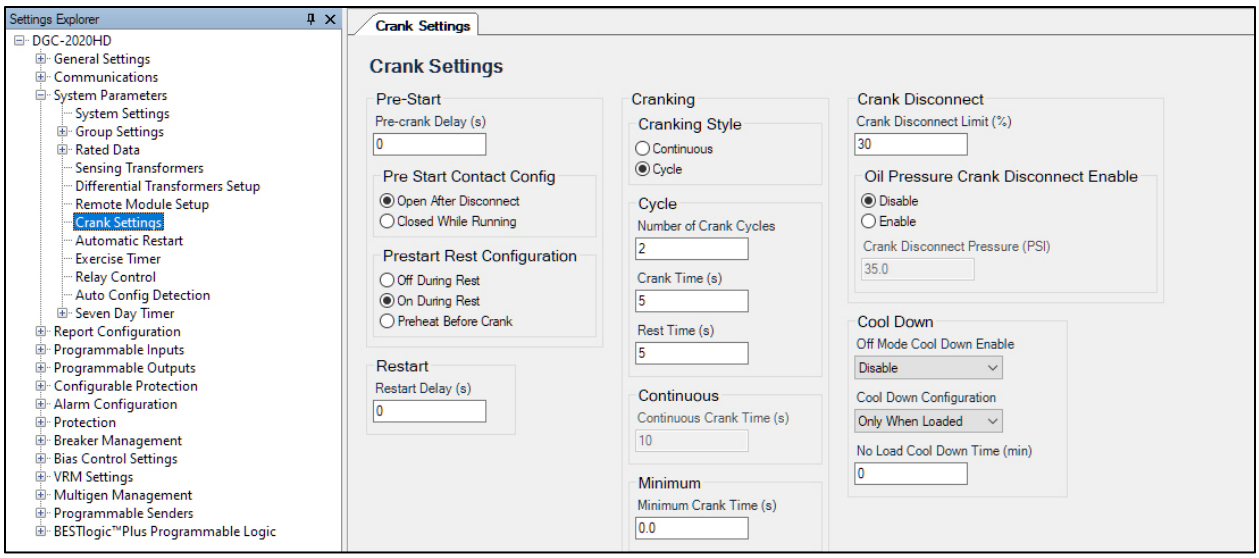


Figure 10. Crank Settings

Programmable Inputs

The 16 programmable inputs on the DGC-2020HD can be used in logic as desired. Inputs have been designated as follows, consistent with the interconnect diagram shown in Figure 3 and the logic diagram shown in Figure 20.

- Input 1 – Emergency stop
- Input 2 – Remote start
- Input 9 – Generator breaker open request
- Input 10 – Generator breaker close request
- Input 11 – Mains breaker open request
- Input 12 – Mains breaker close request
- Input 13 – Generator breaker status feedback
- Input 14 – Mains breaker status feedback

Programmable Outputs

The programmable outputs can be used in logic as desired. Outputs have been designated as shown in Figure 11 for consistency with the controller to engine interconnect diagram shown in Figure 3, and the logic diagram shown in Figure 20.

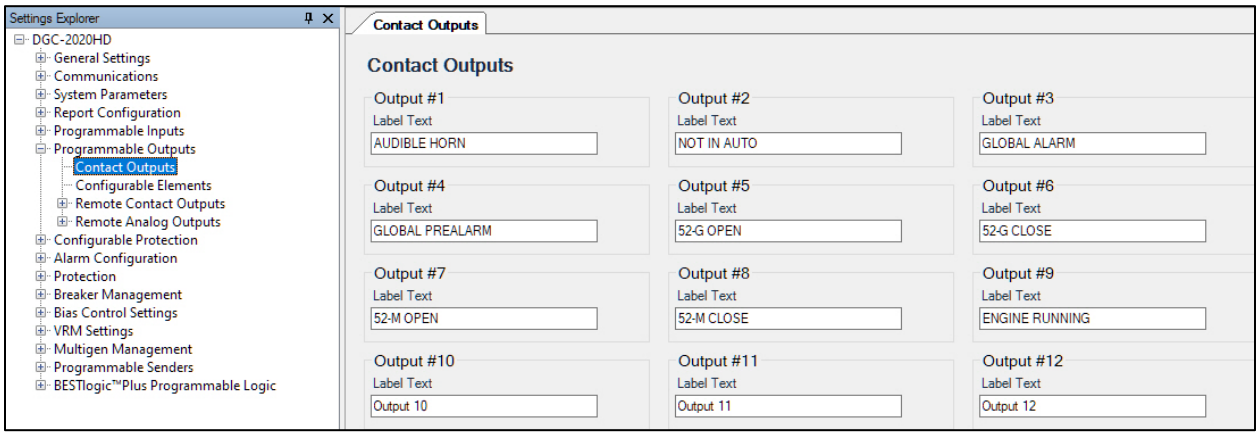


Figure 11. Programmable Outputs

Multiple protection elements are available for protecting the generator against fault conditions, depending on the style number of the controller. All protection elements are disabled by default. If the DGC-2020HD controller is the device that is responsible for protecting the generator, appropriate protection settings

should be selected for the application. Refer to Chapter 17 of the *DGC-2020HD Configuration Instruction Manual* for descriptions of each protection element and associated settings. **It is the responsibility of the person(s) commissioning the generator to ensure that it is adequately protected before running it.**

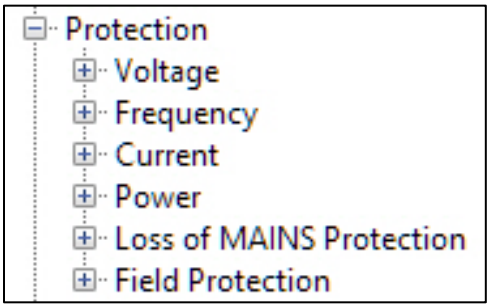


Figure 12. Protection Elements

Breaker Management Settings

For the Mains Fail Transfer (MTF) to become active in the DGC-2020HD, the Mains Fail Transfer setting must be enabled. The mains fail transfer type can be set to open or closed transition. Six time delays can be configured to add delays to the transfers. The Breaker Management settings page is shown in Figure 13. Additional settings are described below.

- Alarm State Transfer to Mains – Enabling this setting will cause the DGC-2020HD to enter an alarm state if the Max Return Timer expires and the load has not transferred to the mains.
- Max Parallel Time – This setting applies to closed transitions only. It is the maximum amount of time that the generator will be allowed to parallel to the mains. During a transition to mains event, if the max parallel timer expires before the transfer is complete, the generator breaker will open, and the balance of the load will immediately be transferred to the mains. It is good practice to ensure that the Max Parallel Time setting is longer than the Transfer Time setting. The transfer time can be estimated by dividing the generator % load by the ramp rate, found in the kW control settings shown in Figure 14.
- Mains Fail Return Delay – This setting is used to allow some time delay once the mains bus re-energized after a failure, before initiating a transfer to the mains.
- Max Return Time – This setting is the maximum allowed time for the transfer to mains to take place. If this timer expires and the load has not transferred to the mains bus, the controller will enter an alarm state if the Alarm State Transfer to Mains setting is enabled.
- Mains Fail Transfer Delay – This setting is used to allow some time delay after a dead mains bus is sensed before initiating a generator start.
- Open Transition Delay – This setting applies to open transitions only. The open transition delay timer starts timing after the mains fail transfer timer expires. Once the open transition delay timer expires, a generator start request is sent.

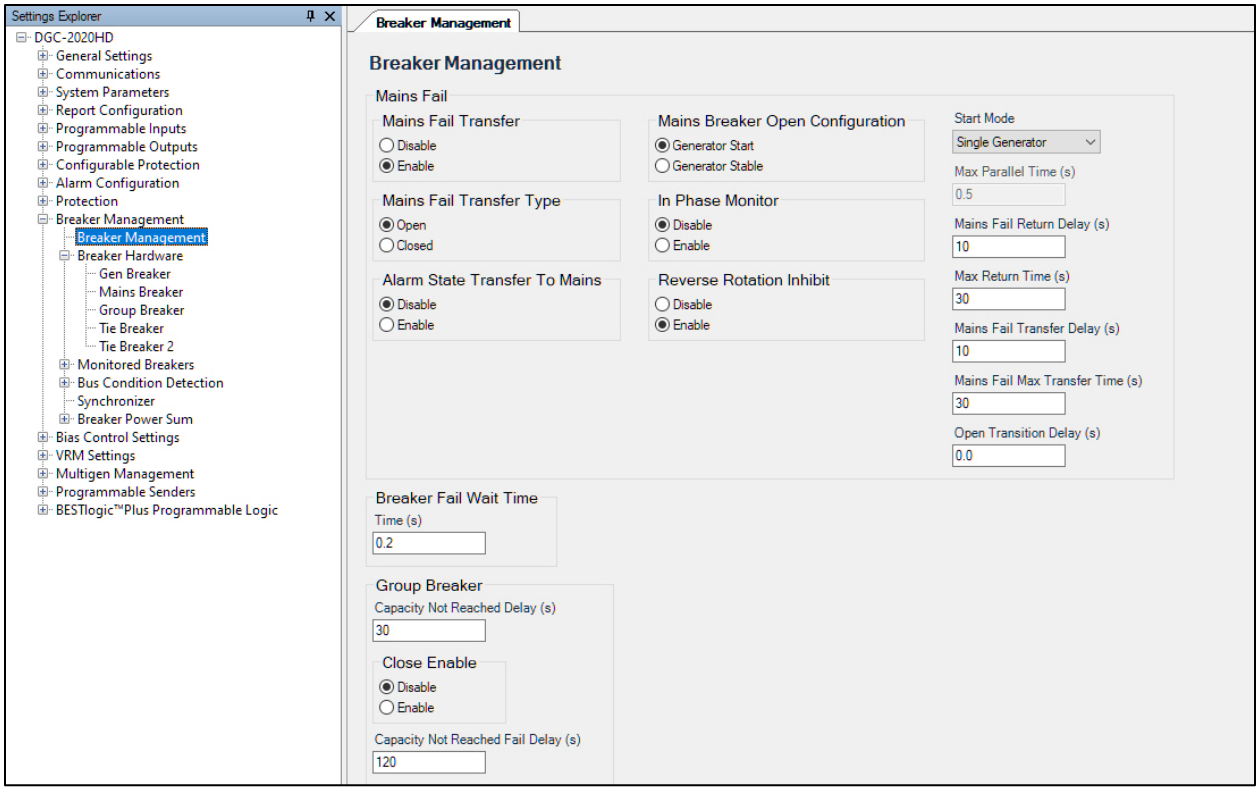


Figure 13. Breaker Management Settings

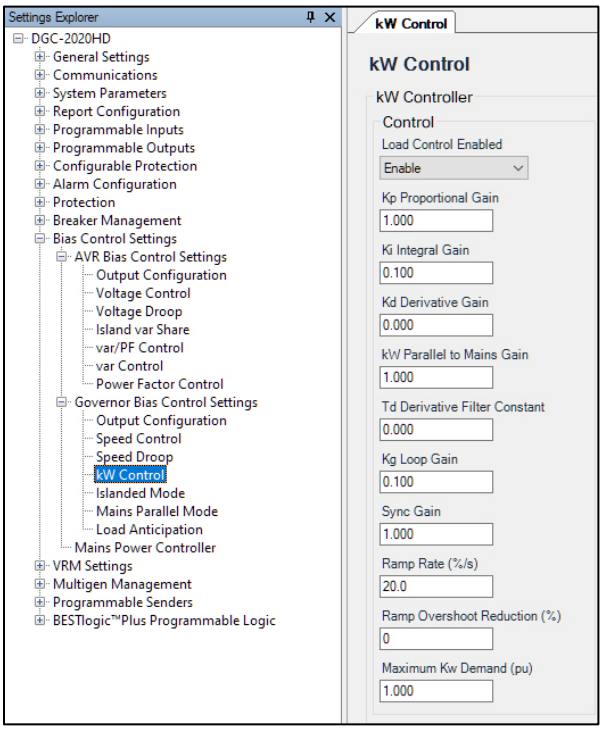


Figure 14. Generator Ramp Rate Setting

Once the DGC-2020HD is setup for generator and mains breaker control, and all the mains fail transfer settings are properly configured, the controller will be capable of performing the functions of an ATS without having an ATS installed in the system.

Generator Breaker Settings

In a single generator AMF application, the generator breaker will always close to a dead bus. Hence, the Dead Bus Close Enable setting must be enabled under Breaker Hardware, on the Gen Breaker settings page shown in Figure 15. The other settings on this page should be adjusted if necessary.

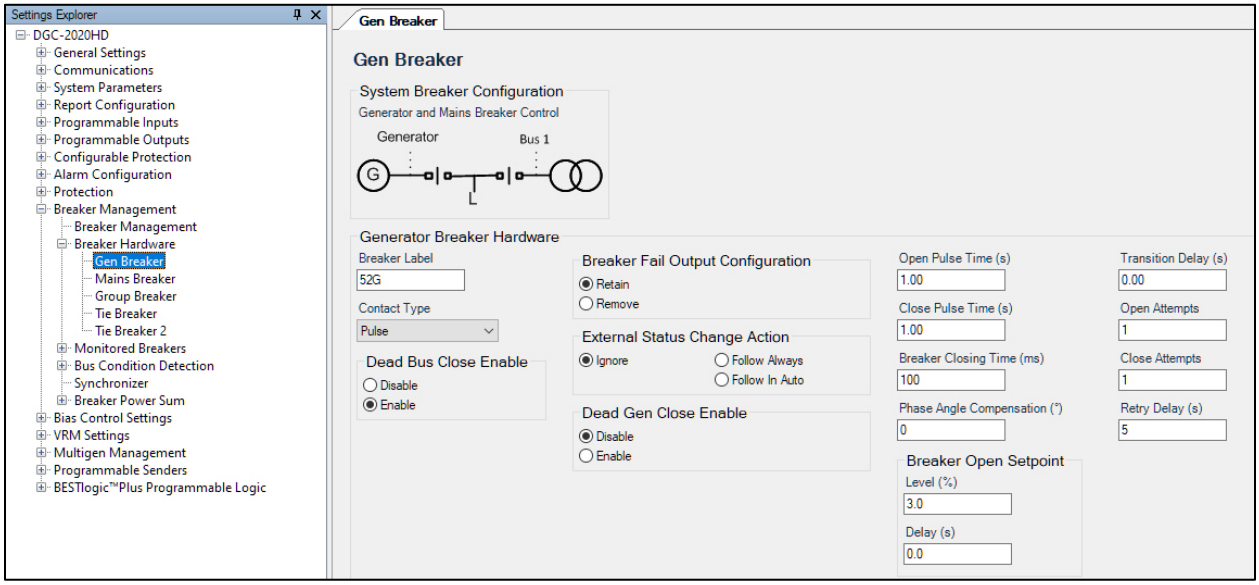


Figure 15. Generator Breaker Settings

Mains Breaker Settings

The mains breaker settings should be configured as needed. Refer to Figure 16.

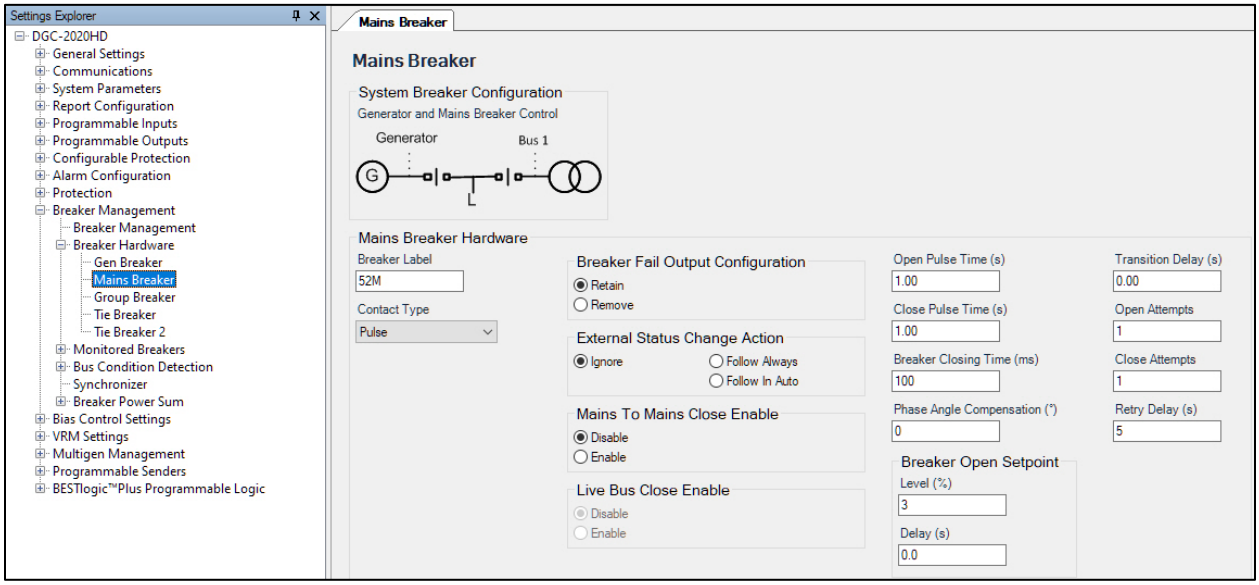


Figure 16. Mains Breaker Settings

Generator and Bus Condition Detection

The generator and bus condition detection settings are automatically updated when the rated data settings are updated. However, it is important to check these settings to ensure that they meet the application. The genset controller will receive a gen stable status only when the generator voltage and frequency are within the ranges shown in Figure 17. Bus stability is determined using the same criteria. It is important to note which bus is the mains bus. Under system settings, Bus 1 and Bus 2 can be swapped and can be assigned as either the load bus or the mains bus. The bus that receives the sensing inputs for the mains bus should be designated as the mains bus. The bus that receives the sensing inputs for the load bus should be designated as the load bus.

The controller will not send a generator breaker close request until it receives a generator stable status. The auto synchronizer will not become active until the DGC-2020HD determines that both the generator and mains buses are stable.

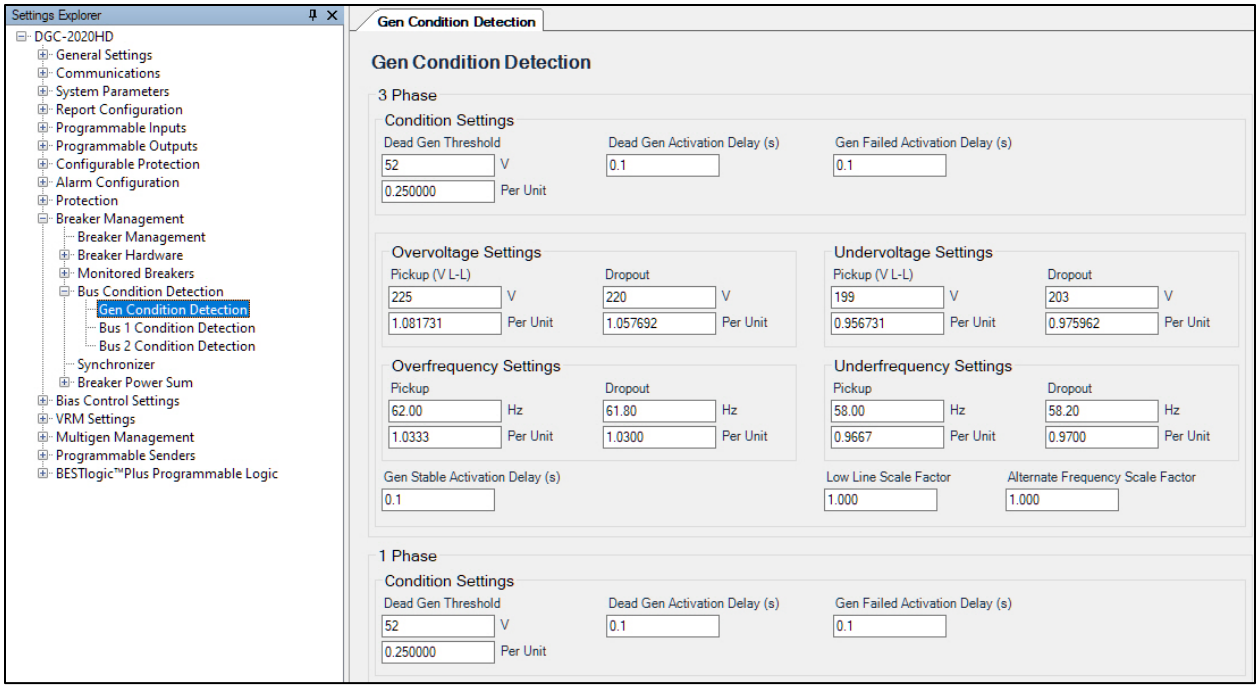


Figure 17. Generator Condition Detection Settings

Programmable Senders

A DGC-2020HD with a style number ending in “R” has resistive inputs for coolant temperature and oil pressure senders. For coolant level senders from the list shown in Figure 18, the sender curve can be selected by clicking the “Load Cool. Settings File” button. Curves for oil pressure and fuel level can be loaded in a similar manner. If the sender curve is not loaded in BESTCOMS*Plus*, a custom curve can be created by entering values for the 11 points in the table. The sender slope can be changed. DGC-2020HDs with a style number ending in “R” have two resistive inputs and two analog inputs. The analog inputs can receive signals in the -10 Vdc to +10 Vdc range, or as a 4 to 20 mA current signal. DGC-2020HDs with a style number ending in "A" have four analog inputs and no resistive inputs. DGC-2020HD controllers with style numbers ending in “R” or “A” have a resistive input for a fuel level sender.

The resistance ranges of the following senders are compatible with the DGC-2020HD. A compatible Fuel Level sender is the Isspro model R8925. Oil pressure senders compatible with the DGC-2020HD include Datcon model 02505-00, Isspro model R8919, Stewart-Warner models 279BF, 279C, 411K and 411M, and VDO models 360025 and 360811. Compatible Coolant Temperature senders include Datcon model 02019-00, Faria model TS4042, Isspro model, R8959, and Stewart-Warner model 334P. Other senders with matching resistance ranges may also be used.

Figure 18. Plug-and-Play Programmable Senders.

(From Chapter 8 of the *DGC-2020HD Configuration Instruction Manual*.)

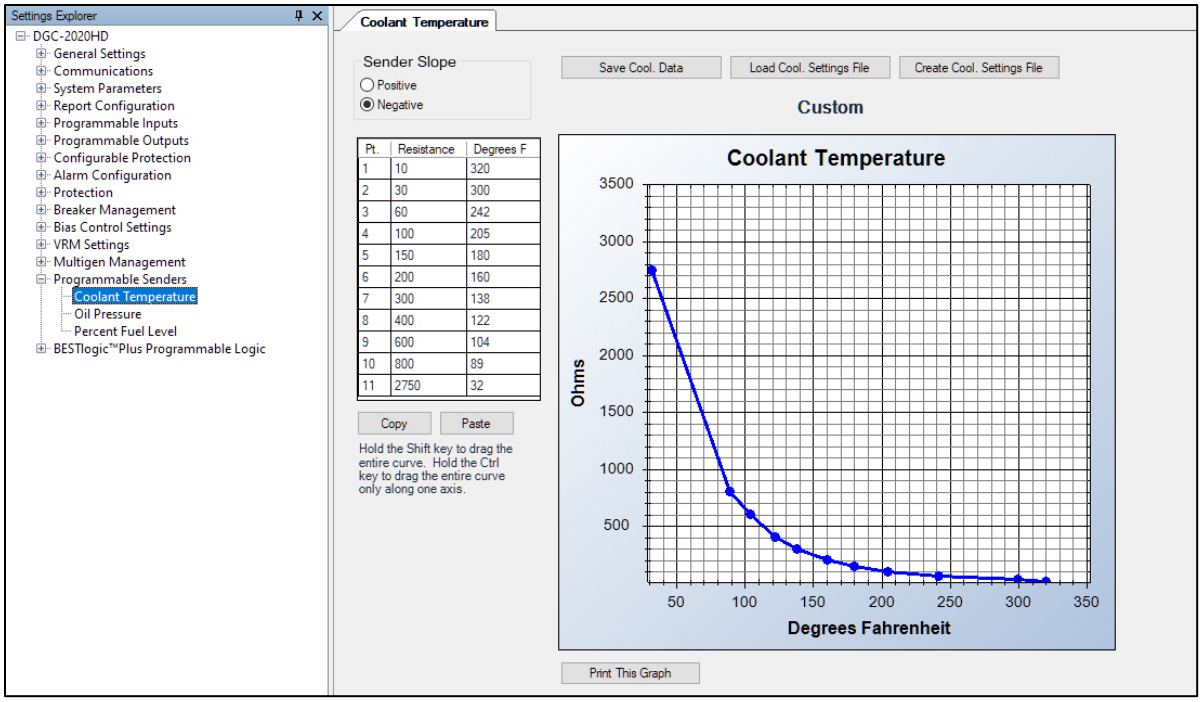


Figure 19. Programmable Sender Settings

So far, in this application guide, we have discussed the minimal settings that are needed for a DGC-2020HD to interface with a single genset in a standby application with separate generator and mains breakers, and no ATS. The DGC-2020HD is leading the sequence of operations and coordinating the transfer scheme.

Sequence of Operations

Loss of Normal Power

- The utility is the normal source of power and it is available. The loads are being driven by the utility.
- Utility power is lost.
- The DGC-2020HDsenses a dead mains bus.
- The mains fail transfer delay timer starts timing.
- Once the mains fail transfer delay timer expires, the generator starts and the mains breaker opens. Note that there is an option to open the mains breaker when the generator is stable.
- When the generator becomes stable, the generator breaker closes to a dead bus and picks up the load.

Restoration of Normal Power

Open Transition

- When the utility power is restored, the DGC-2020HD senses a live mains bus.
- When the DGC-2020HD determines that the mains bus is stable, the generator breaker opens and the generator begins its cooldown cycle.
- The mains fail return delay timer starts timing.
- Once the mains fail return delay timer has expired, the mains breaker closes.
- The generator will shut down once its cooldown timer expires.
- The load is now transferred to the mains, and the system is in its normal configuration again.

Closed Transition

- When the utility power is restored, the DGC-2020HD senses a live mains bus.
- When the DGC-2020HD determines that the mains bus is stable, a mains breaker close request is sent.
- Since the load bus is live, the auto synchronizer becomes active.
- The DGC-2020HD synchronizes the generator to the mains bus.
- Once synchronization has been achieved, the mains breaker closes and the transfer of load begins. The load will transfer at the ramp rate setting. See Figure 14.
- Either of two events will initiate a generator breaker open request:
    - The breaker open setpoint is reached
    - The max parallel time has expired
- Once the generator breaker opens, the generator begins its cooldown cycle.
- The generator will shut down once its cooldown timer expires.
- The load is now transferred to the mains, and the system is in its normal configuration again.

Implementing the logic scheme shown in Figure 20 will allow the DGC-2020HD to control the genset, generator breaker, and mains breaker to achieve the sequence of events described above.

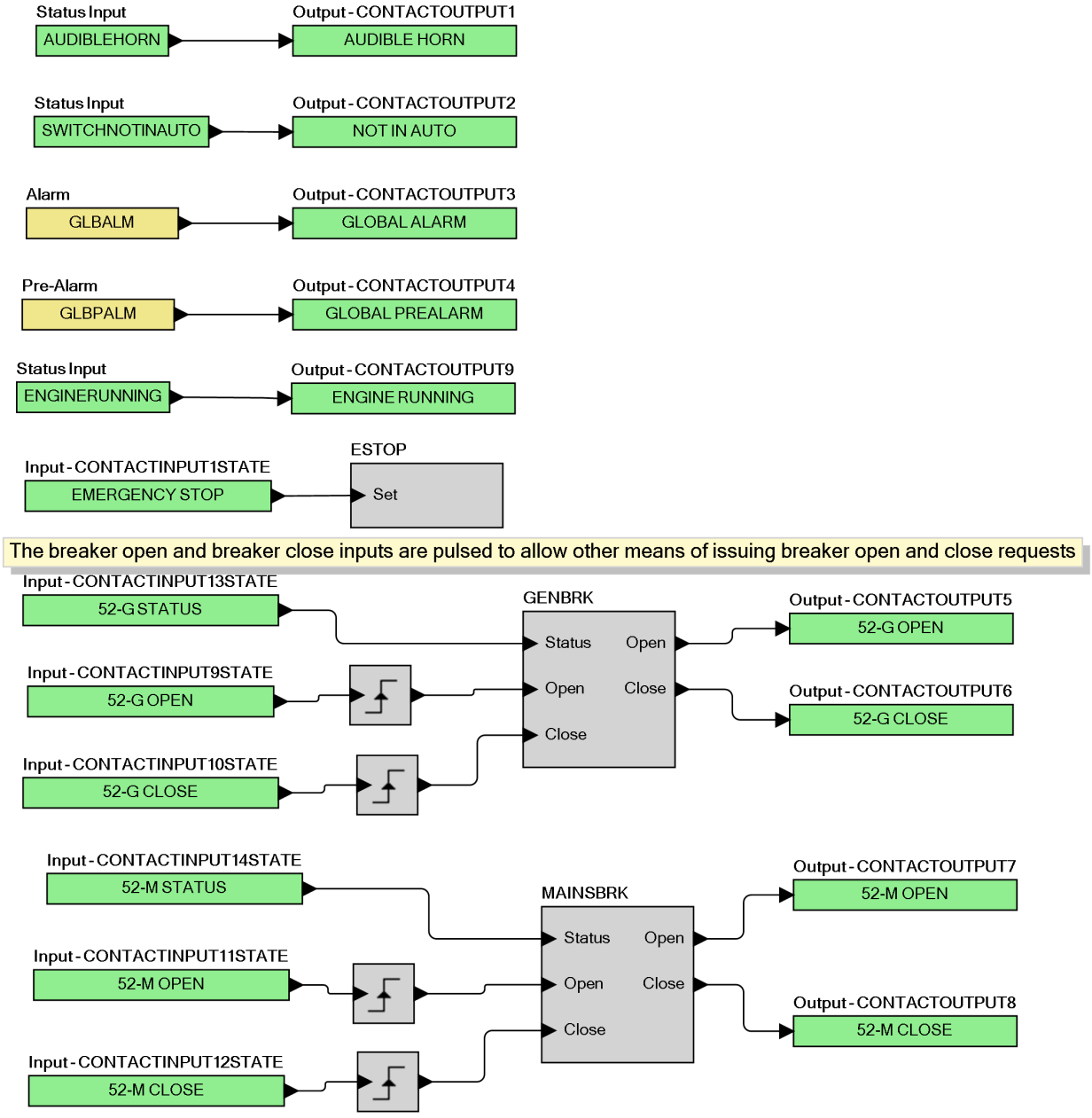


Figure 20. Logic Scheme

To Learn More

To learn more, please email usatechsupport@basler.com or call 618.654.2341 to speak with a Basler representative.