Application Note

DGC-2020HD Setpoint Handling

DGC-2020HDs Controlling a Mains Breaker

In each DGC-2020HD controlling a mains breaker, there is a mains power controller function that can implement system base load, peak shaving, or fixed power export. Based on the operating mode and associated settings, the mains power controller calculates kW levels required from the generators to achieve the desired control and sends that calculated demand to the generator controllers. When the Mains Power Control Mode in the generator controller is set for Automatic, the generators will generate kW equal to the demand sent from the mains power controller.

The settings for the mains power controller are found under Settings Explorer→DGC-2020HD→Bias Control Settings→Mains Power Controller. There is a setpoint for each mode along with the setpoint adjustment settings of Auto Save, Setpoint Min and Max, Analog Bias Source, Bias Min, Bias Max, Adjust Rate, Prepositions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

The Mains Power Controller settings are shown in Figure 1 and Figure 2.

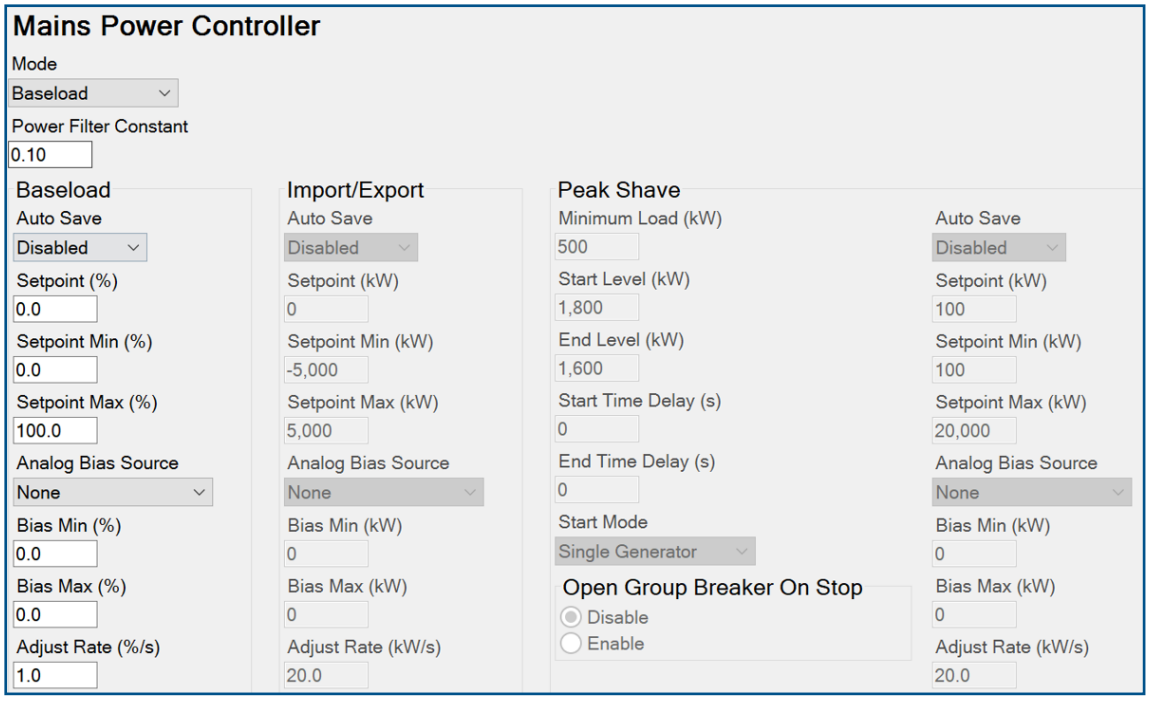

Figure 1 - Mains Power Controller Settings Screen (Upper)

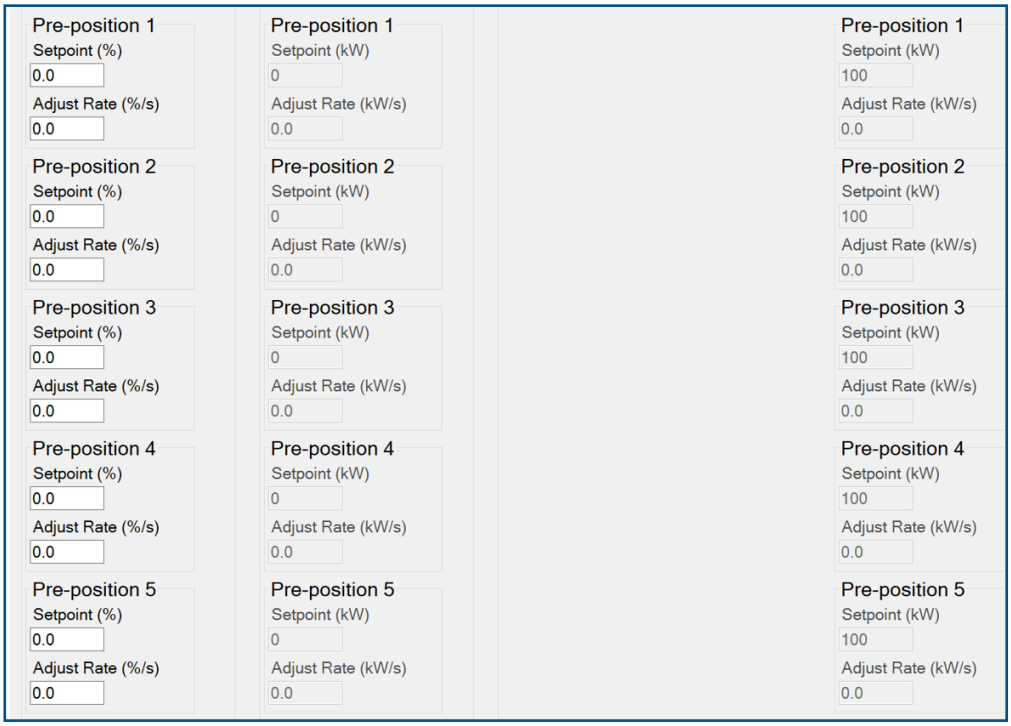

Figure 2 - Mains Power Controller Settings Screen (Lower)

Logic elements exist for each mains power control mode to allow Raise/Lower and Pre-Position selection through logic as shown in Figure 3.

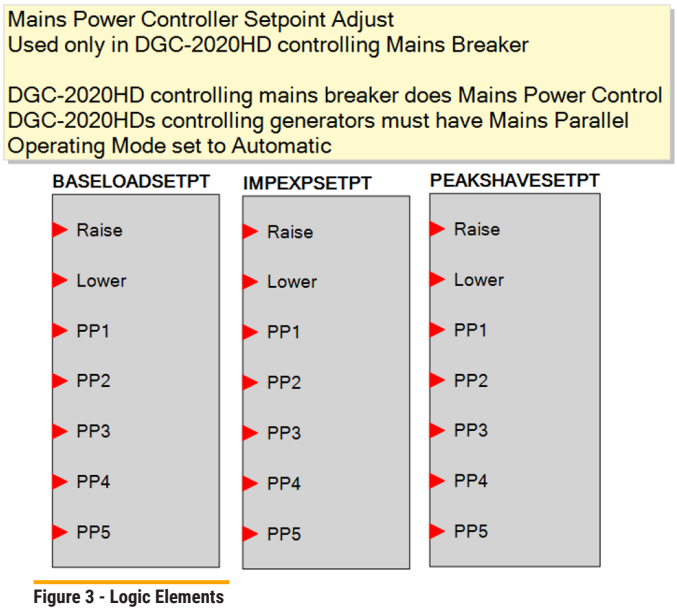

Figure 3 - Logic Elements

DGC-2020HDs Controlling Generators

In each DGC-2020HD controlling a generator, there are settings for the Islanded Mode and Mains Parallel Mode operation.

Governor Bias Control Settings kW Control

The kW controller must be enabled for operating in parallel with other generators for island load share or in parallel to mains operations. The kW control settings consist of the Load Control Enabled setting, PID Gains, Sync Gain, Ramp Rate, Ramp Overshoot Reduction, and Maximum kW Demand.

These settings are explained in detail in the DGC-2020HD instruction manuals and will not be discussed here except to state that Load Control must be enabled for any of the setpoints discussed herein to be operational.

The kW Control settings are shown in Figure 4.

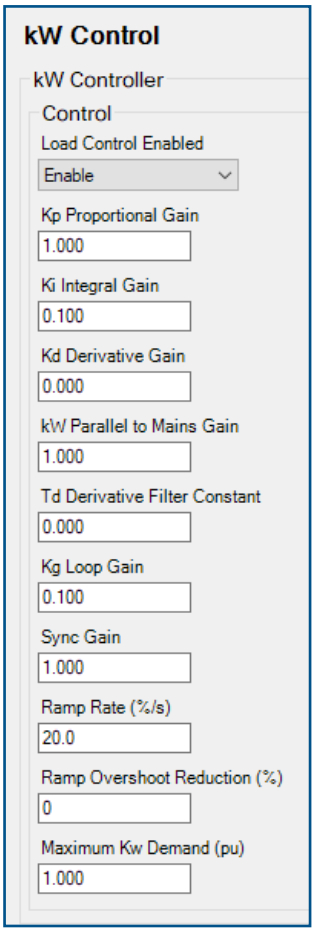

Figure 4 - kW Control Settings Screen

Governor Bias Control Settings Islanded Mode

Islanded Operating Mode:

- Bias Control Settings→Governor Bias Control Settings→Islanded Mode→Operating Mode
- Applicable when the PARTOMAINS logic element (Parallel to Mains) is FALSE
- Manual: Single Unit Baseload
- Automatic: Setpoint from Load Share or Droop control

The Islanded Mode settings (Figure 5) consist of the Operating Mode, Base Load Level Source, Load Share Interface, and Baseload Analog Min (%) and Baseload Analog Max (%) settings.

Islanded Operating Mode Set for Automatic:

When the generator is paralleled to other machines, it will share load with them. The amount of kW generation is determined by the load sharing calculations.

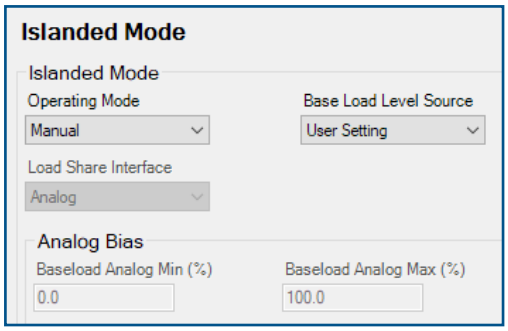

Figure 5 - Islanded Mode Settings Screen

Islanded Operating Mode Set for Manual:

The unit will be baseload, which is to export a fixed amount of power equal to the percentage of rated kW at the level specified by the Base Load Level (%) setting.

When the Operating Mode is set for Manual, the Base Load Level Source specifies whether the base load level comes from the Baseload Level (%) user setting or is determined from an analog input. When an analog input is specified and the analog input is at the lower limit of its range, the base load level will be equal to the Baseload Analog Min (%) setting. Similarly, when an analog input is specified and the analog input is at the upper limit of its range, the baseload level will be equal to the Baseload Analog Max (%) setpoint.

In addition, there are setpoint adjustment settings for the island baseload mode (Manual) operation consisting of AutoSave, Base Load Level Setpoint, Setpoint Min and Max, Analog Bias Source, Bias Min, Bias Max, Adjust Rate, Pre-positions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

Additional islanded mode settings are shown in Figure 6.

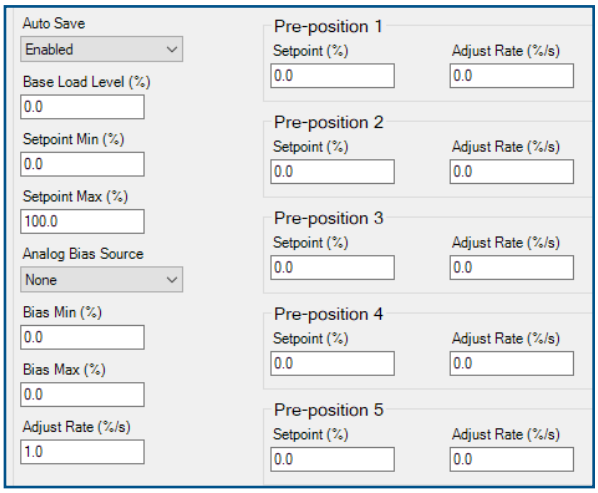

Figure 6 - Additional Islanded Mode Settings

Governor Bias Control Settings Mains Parallel Mode

Mains Parallel Operating Mode:

- Bias Control Settings→Governor Bias Control Settings→Mains Parallel Mode→Operating Mode
- Applicable when PARTOMAINS logic element (Parallel to Mains) is TRUE
- Manual: Single Unit Baseload
- Automatic: Setpoint from Mains Power Controller (local or from Ethernet)

The Mains Parallel Mode settings (Figure 7) consist of the Operating Mode, Base Load Level Source, Baseload Analog Min (%), and Baseload Analog Max (%) settings.

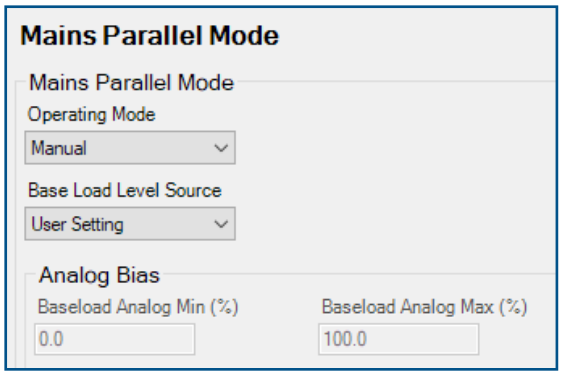

Figure 7 - Mains Parallel Mode Settings Screen

Mains Parallel Mode Operating Mode Set for Automatic:

When the generator is paralleled to utility, the amount of kW generation is determined by the mains power controller.

Mains Parallel Operating Mode Set for Manual:

When the generator is paralleled to utility, the unit will baseload, which is to export a fixed amount of power equal to the percentage of rated kW specified by the Base Load Level (%) setpoint.

When the Operating Mode is set for Manual, the Base Load Level Source setting specifies whether the baseload level comes from the Base Load Level (%) user setting or whether it is determined from an analog input. When an analog input is specified and the analog input is at the lower limit of its range, the baseload level will be equal to the Baseload Analog Min (%) setting. Similarly, when an analog input is specified and the analog input is at the upper limit of its range, the base load level will be equal to the Baseload Analog Max (%) setting.

In addition, there are setpoint adjustment settings for the mains parallel baseload (Manual) operation consisting of AutoSave, Base Load Level Setpoint, Setpoint Min and Max, Analog Bias Source, Bias Min, Bias Max, Adjust Rate, Pre-positions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

Additional Mains Parallel Mode settings are shown in Figure 7.

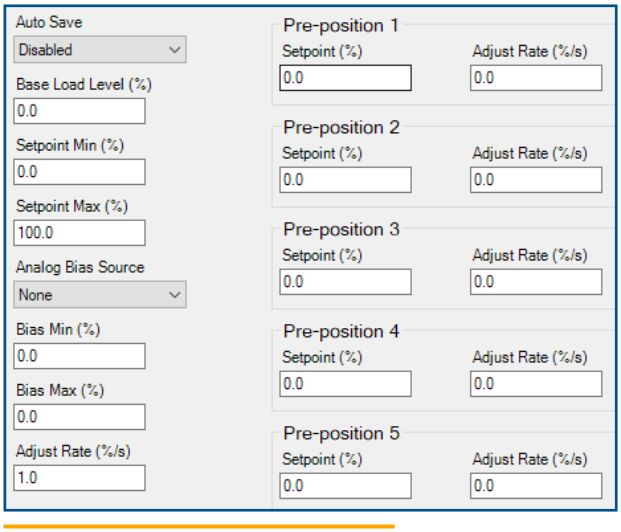

Figure 8 - Additional Mains Parallel Mode Settings

Logic elements (Figure 9) exist for islanded manual (Baseload) operation and mains parallel manual (Baseload) operation to allow Raise/Lower and Pre-Position selection through logic.

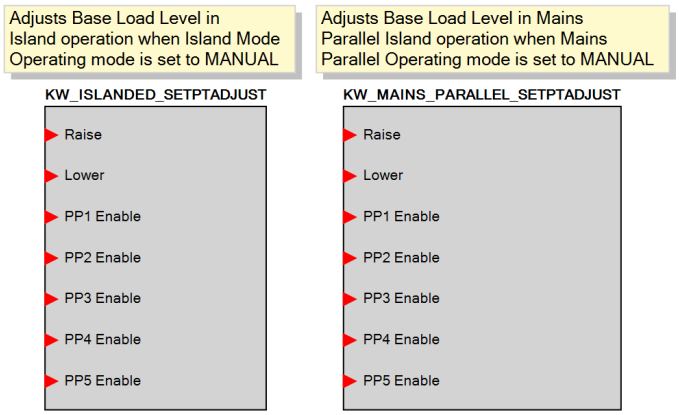

Figure 9 - Logic Elements

Governor Bias Control Settings Speed Control

Speed trim is active when a generator is in an islanded system of generators, the islanded mode operation Mode is Automatic, kW Control is enabled, and Speed Trim is enabled.

The PID gain settings are located on the Speed Control settings screen shown in Figure 10. How they are used is specified in the PID Tuning section of the DGC-2020HD instruction manual. The Droop Percentage and Droop Offset settings specify how speed droop operates. Speed droop operates when kW Control is disabled or a droop override comes from logic.

On this screen, speed trim can be enabled or disabled.

When enabled and operating, speed trim will control the generator frequency at the frequency specified by the Speed Trim Setpoint.

In addition, there are setpoint adjustment settings for the speed trim operation consisting of AutoSave, Setpoint Min and Max, Adjust Rate, Remote Speed Bias, Bias Min, Bias Max, Pre-positions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

A logic element (Figure 11) exists for speed trim setpoint adjustment to allow Raise/Lower and Pre-Position selection through logic.

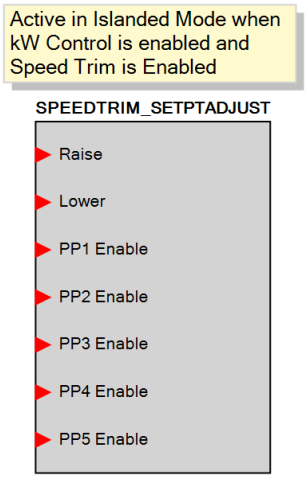

Figure 11 - Logic Element

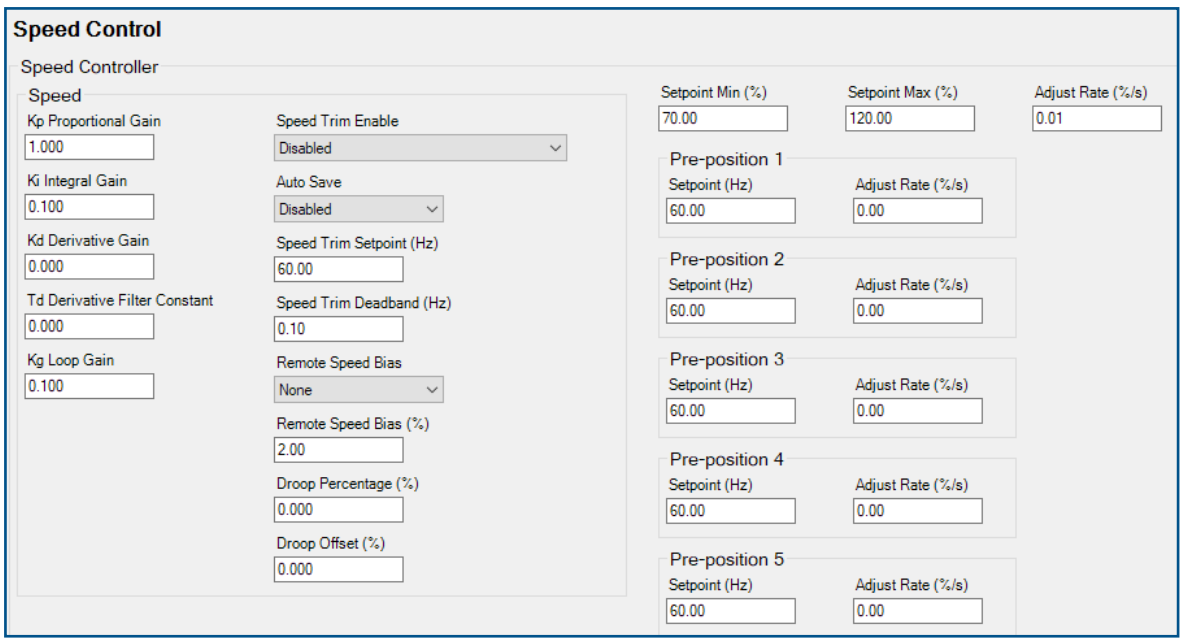

Figure 10 - Speed Control Settings Screen

AVR Bias Control Settings Var/PF Control

The var/PF controller must be enabled for operating in parallel with other generators for island var share, or for var or power factor control in parallel to mains operations. The var/PF controller settings consist of the Control Enabled setting, PID Gains, Sync Gain, Ramp Rate, Ramp Overshoot Reduction, and Maximum kvar Demand.

These settings are explained in detail in the DGC-2020HD manuals and will not be discussed here except to state that var/PF control must be enabled for any of the setpoints discussed herein to be operational. The settings are shown in Figure 12.

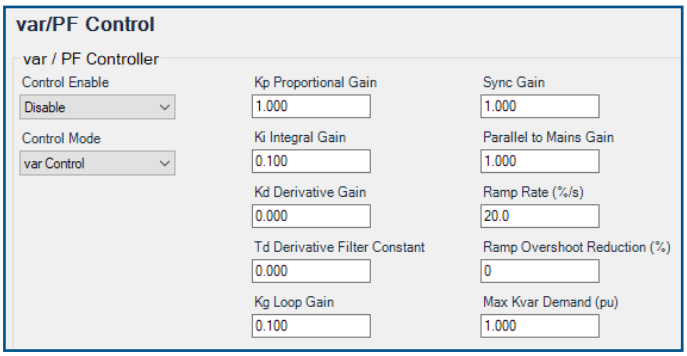

Figure 12 - Var/PF Control Settings Screen

AVR Bias Control Settings Var Control

The var control settings apply when the generator is operating in mains parallel mode and the var/PF controller is set for var control. The var control settings screen is shown in Figure 13.

When operating in var control mode, the machine will baseload a fixed kvar level as specified by the var Controller Setpoint Source. The var Controller Setpoint Source setting specifies whether the var level comes from the Setpoint (%) user setting or whether it is determined from an analog input. When an analog input is specified and the analog input is at the lower limit of its range, the var level will be equal to the kvar Analog Min (%) setting. Similarly, when an analog input is specified and the analog input is at the upper limit of its range, the var level will be equal to the kvar Analog Max (%) setting.

In addition, there are setpoint adjustment settings for the var controller operation consisting of AutoSave, Setpoint %, Setpoint Min and Max, Analog Bias Source, Bias Min, Bias Max, Adjust Rate, Pre-positions 1–5, and Adjust Rates 1–5.

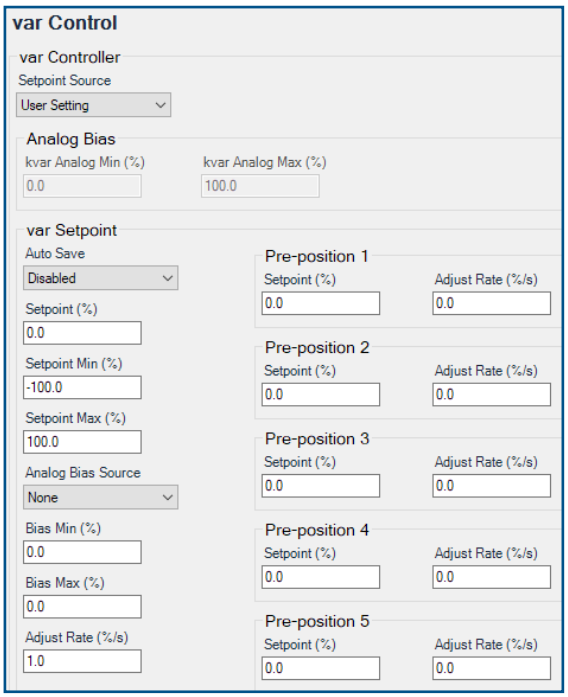

Figure 13 - Var Control Settings Screen

The operation of the setpoint adjustment settings will be presented later in this document.

A logic element exists for kvar setpoint adjustment to allow Raise/Lower and Pre-Position selection through logic. The logic element is shown in Figure 14.

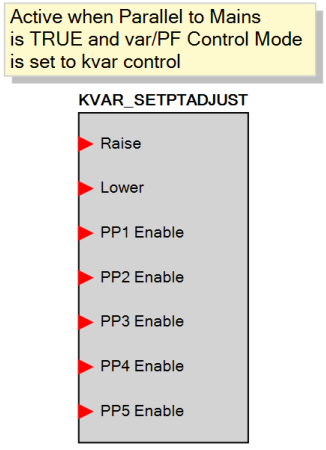

Figure 14 - Logic Element

AVR Bias Control Settings Power Factor (PF) Control

The power factor control settings apply when the generator is operating in mains parallel mode and the var/PF controller is set for power factor (PF) control.

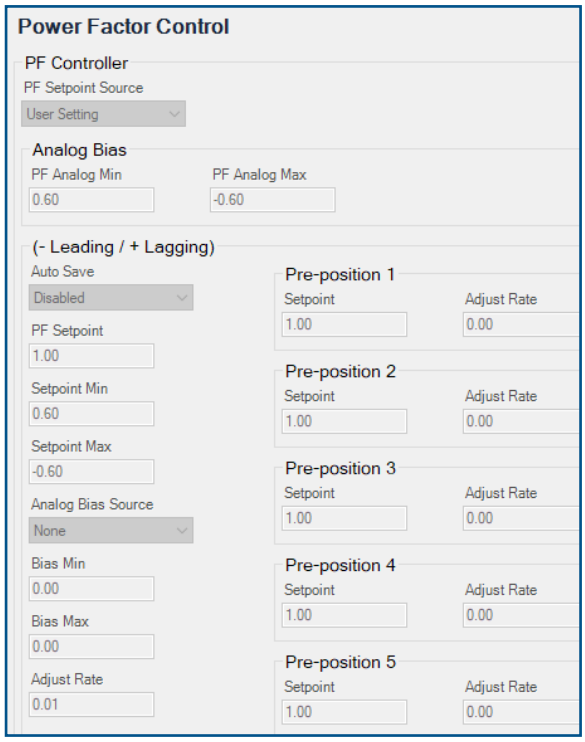

Figure 15 - Power Factory Control Settings Screen

When operating in PF control mode, the machine will output a kvar level that maintains the power factor of the machine at the power factor level specified by the PF Setpoint Source. The PF Setpoint Source specifies whether the PF level comes from the PF setpoint or a user setting, or whether it is determined from an analog input. When an analog input is specified and the analog input is at the lower limit of its range, the PF level will be equal to the PF Analog Min setting. Similarly, when an analog input is specified and the analog input is at the upper limit of its range, the PF Level will be equal to the PF Analog Max setting.

In addition, there are setpoint adjustment settings for the PF controller operation consisting of AutoSave, Setpoint (%), Setpoint Min and Max, Analog Bias Source, Bias Min, Bias Max, Adjust Rate, Pre-positions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

A logic element exists for PF setpoint adjustment to allow Raise/Lower and Pre-Position selection through logic. The logic element is shown in Figure 16.

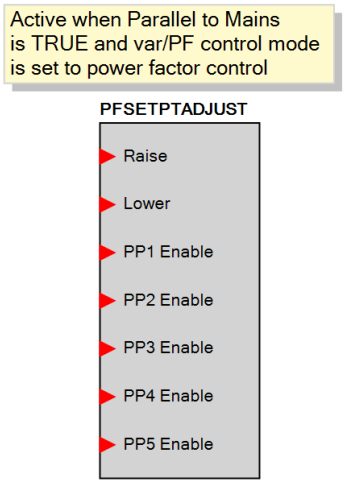

Figure 16 - Logic Element

AVR Bias Control Voltage Control

Voltage trim is active when a generator is in an islanded system of generators, var/PF Control is enabled, and Voltage Trim is enabled. The Voltage Control settings are shown in Figure 17.

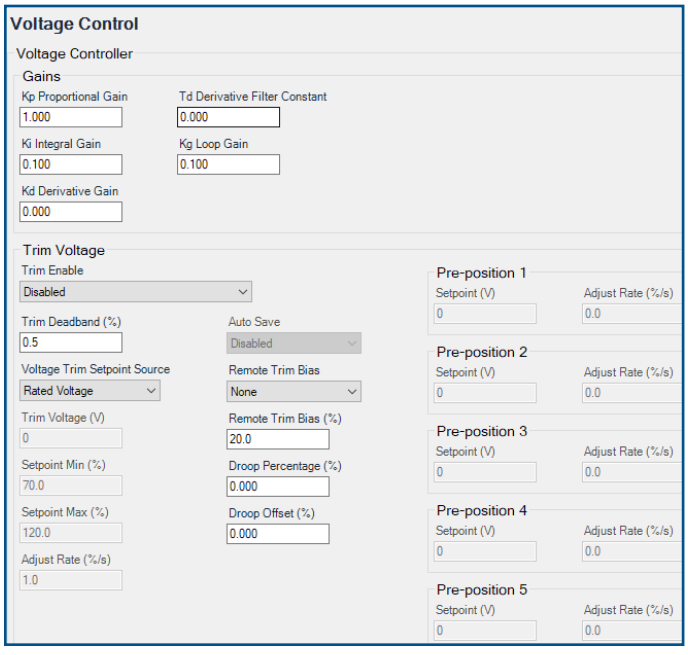

Figure 17 - Voltage Control Settings Screen

On this screen, voltage trim can be enabled or disabled. The Voltage Trim Setpoint Source specifies whether the Voltage Trim Setpoint is determined from the Voltage Trim Setpoint or the rated voltage of the Machine. When enabled and operating, voltage trim will control the generator voltage at the voltage specified by the Voltage Trim Setpoint Source.

In addition, there are setpoint adjustment settings for the voltage trim operation consisting of AutoSave, Setpoint Min and Max, Adjust Rate, Remote Speed Bias, Bias Min, Bias Max, Pre-Positions 1–5, and Adjust Rates 1–5. The operation of the setpoint adjustment settings will be presented later in this document.

A logic element exists for voltage trim setpoint Adjustment to allow Raise/Lower and Pre-Position selection through logic. The logic element is shown in Figure 18.

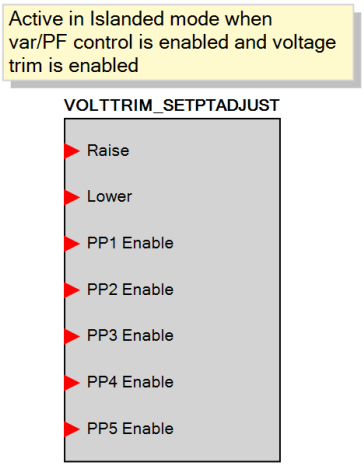

Figure 18 - Logic Element

AVR Bias Control Adjust

Mains Parallel Operating Mode:

- Bias Control Settings→Governor Bias Control Settings→Mains Parallel Mode→operating Mode
- Applicable when the PARTOMAINS logic element (Parallel to Mains) is TRUE
- Manual: Single Unit Baseload
- Automatic: Setpoint from Mains Power Controller (local or from Ethernet)

Logic elements for AVR bias control adjust are shown in Figure 19.

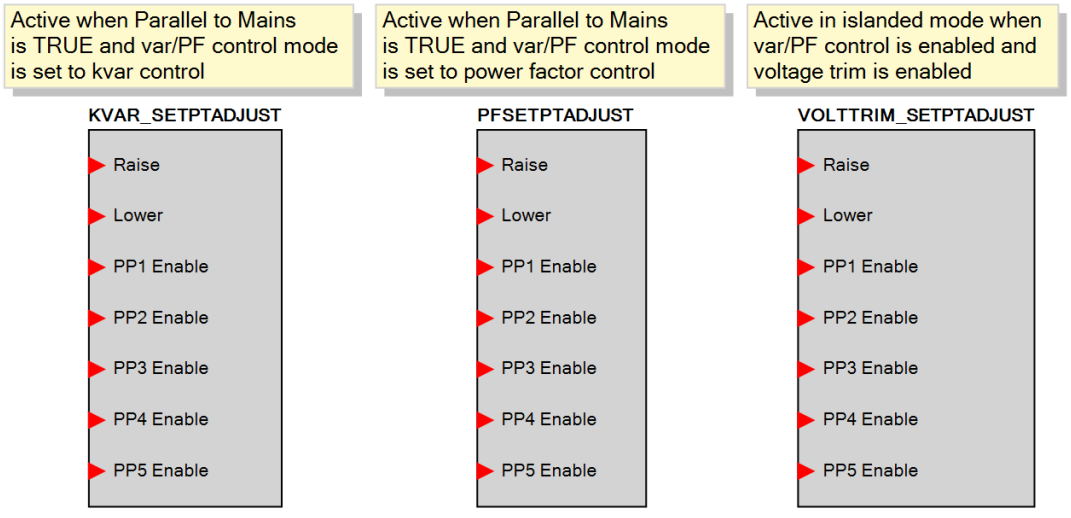

Figure 19 - Logic Elements

Changing Mains Parallel Mode and Island Mode Operating Modes with Logic Elements

Logic can be used to override mains parallel operating mode when desired. The Mains Parallel Auto kW mode and mains parallel manual kW mode logic overrides are shown in Figure 20.

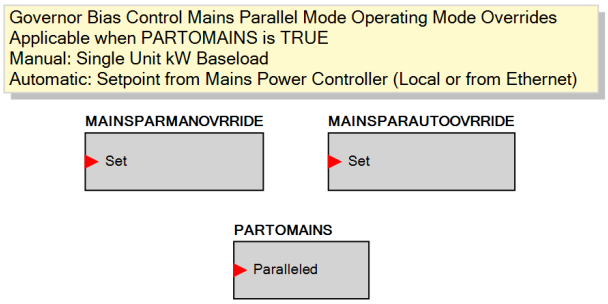

Figure 20 - Logic Elements

Similarly, logic can be used to override islanded operating modes when desired. The Islanded Auto kW mode and islanded manual kW mode overrides are shown in Figure 21.

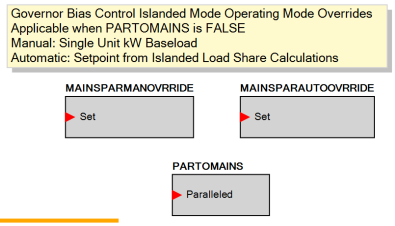

Figure 21 - Logic Elements

Setpoint Adjustment Example

There are setpoint adjustment capabilities for the mains power controller baseload, import/export control, and peak shave control setpoints along with the mains parallel manual baseload setpoint, island manual baseload setpoint, mains parallel var and power factor setpoints, and the speed trim and voltage trim controller setpoints.

The setpoint adjustment capabilities include raise and lower from contact inputs selection of up to five pre-position settings and setpoint adjustment from analog inputs. The voltage trim setpoint will be used as an example in this section to show how the setpoint adjustment are used to set the voltage trim setpoints. The settings and logic element associated with the voltage trim controller are shown in Figures 22 and 23 with values that will be used to illustrate the setpoint adjustment features.

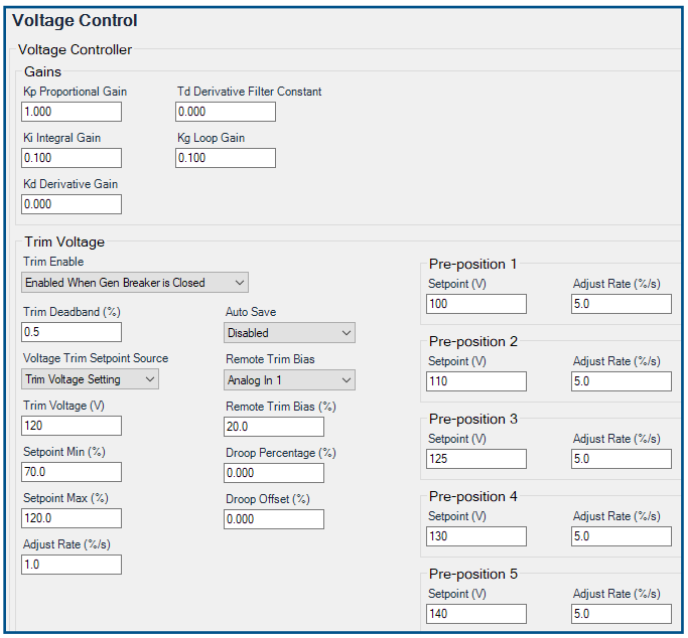

Figure 22 - Voltage Control Settings Screen

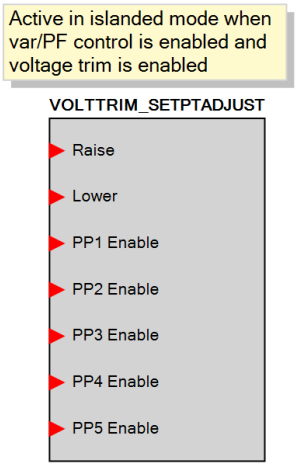

Figure 23 - Logic Element

If it is desired that setpoints are automatically saved to nonvolatile memory after they have been changed with the setpoint adjustment features, the Auto Save setting should be enabled. If not enabled, the setpoint can be adjusted as desired, but the changed setpoint will not be saved to nonvolatile memory.

The setpoint source for voltage trim (Figure 24) is either Rated Voltage or Trim Voltage Setting. In this example, the Trim Voltage Setting is selected. The Setpoint Min (%), Setpoint Max (%), and Adjust Rate specify the range over which the Raise/Lower inputs can adjust the range. The speed at which Raise/Lower inputs adjust the range is specified by the Adjust Rate setting.

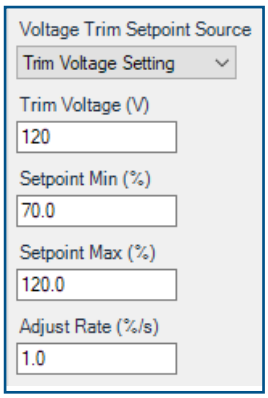

Figure 24 - Voltage Trim Setpoint Source

The Voltage Trim setpoint adjustment is implemented in logic as shown in Figure 25.

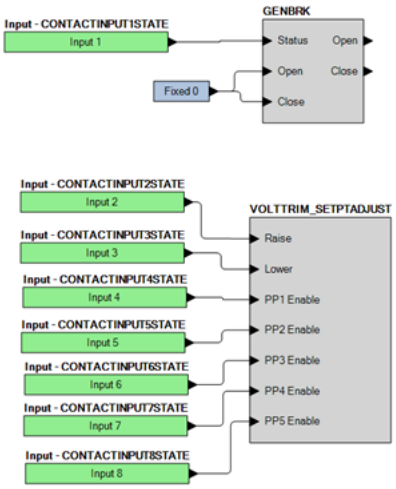

Figure 25 - Voltage Trim Setpoints Logic

Closing Input 2, and keeping it closed, will cause the Voltage Trim Setpoint to rise from 120 V to 144 V at a rate of 1% per second, so getting from the nominal setpoint of 120 V up to 20% above that requires 144 V and it takes approximately 20 seconds. Figure 26 shows that the setpoint rose to 144 V.

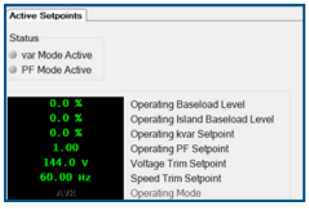

Figure 26 - Active Setpoints Metering

Pressing and holding Lower will cause the setpoint to go down to 84 V, taking around 50 seconds since it is traversing 50% of the setting range at 1% per second. See Figure 27.

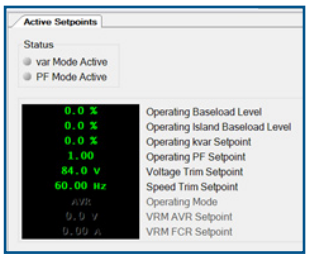

Figure 27 - Active Setpoints Metering

Releasing the Lower input, Pre-Position 3 can be used to get back to 120 V. Since the adjust rate on this pre-position is 5% per second and we need to go through 30% of the range, it will take approximately 6 seconds to get from 84 V back to 120 V. See Figure 28.

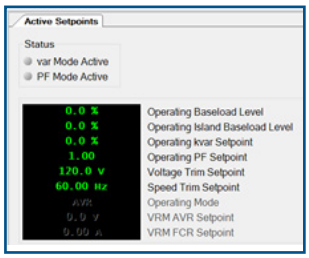

Figure 28 - Active Setpoints Metering

Engaging Pre-Positions 1–5 in order results in the Pre-Position setpoints changing between 110, 115, 120, 125, and 130. See Figures 29a through 29e.

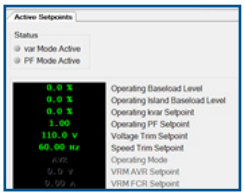

Figure 29a - Active Setpoints Metering

Figure 29b - Active Setpoints Metering

Figure 29c - Active Setpoints Metering

Figure 29d - Active Setpoints Metering

Figure 29e - Active Setpoints Metering

A third mechanism for setpoint bias is through an analog input specified in the Remote Trim Bias setting. In this example, Analog Input 1 is selected. When the analog input is at the lowest point in its range, the bias will be –20%. When it is at the highest point in its range, the bias will be +20% in this example.

Looking at the settings for Analog Input 1, select a voltage analog input and set the range from 0 to 10 V and the parameter range from 96 to 124 V to correspond with the voltage range over which the Voltage Trim setting is being biased. The parameter range is just for convenience (it has no effect on functionality), but it is best to set it to reflect system operation in some form. Otherwise, it will likely be confusing.

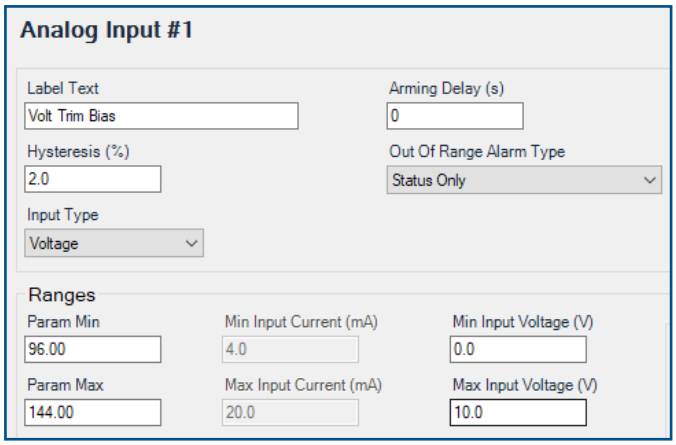

Figure 30 - Analog Input #1 Settings Screen

The range of 0 to 10 V on the analog input will bias the Voltage Trim Setpoint from 96 to 144 V. When the input voltage is at the middle of its range (5V), there should be zero bias, so the Voltage Trim Setpoint would be 120 V. Figures 31a through 31c show cases where an analog input value of 0 V results in a Voltage Trim Setpoint of 96 V, an analog input value of 5 V results in a Voltage Trim Setpoint of 120 V, and an analog input value of 10 V results in a Voltage Trim Setpoint of 144 V.

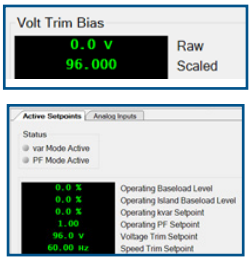

Figure 31a - Active Setpoints Metering

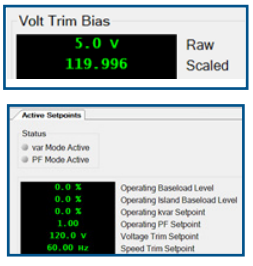

Figure 31b - Active Setpoints Metering

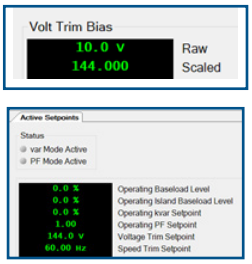

Figure 31c - Active Setpoints Metering

This example has presented setpoint adjustment via Raise/Lower, Pre-Positions, and Analog Input biasing of the Voltage Trim Setpoint. Other setpoints work in a similar manner.

For More Information

For detailed information on the BE1-FLEX, please visit the Basler Electric website at www.basler.com to download product bulletins, instruction manuals, and BESTCOMS*Plus*® software. You can contact Basler's technical support or application specialists at +1 618.654.2341 or by email to info@basler.com.

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