

INSTRUCTION MANUAL

FOR

DECS-250N

Digital Excitation Control System



 **Basler Electric®**

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Preface

This instruction manual provides information about the installation and operation of the DECS-250N Digital Excitation Control System. To accomplish this, the following information is provided:

- General Information
- Human-machine interface
- Functional description
- Installation
- BESTCOMS^{Plus}® software
- Setup
- Communication protocols
- Maintenance
- Specifications
- Expansion modules

Conventions Used in this Manual

Important safety and procedural information is emphasized and presented in this manual through warning, caution, and note boxes. Each type is illustrated and defined as follows.

Warning!

Warning boxes call attention to conditions or actions that may cause personal injury or death.

Caution

Caution boxes call attention to operating conditions that may lead to equipment or property damage.

Note

Note boxes emphasize important information pertaining to installation or operation.

Note

Be sure that the device is hard-wired to earth ground with no smaller than 12 AWG (3.3 mm²) copper wire attached to the case ground terminal. When the device is configured in a system with other devices, a separate lead should be connected from the ground bus to each device.

Current transformer (CT) grounding should be applied in accordance with local codes and conventions.



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Warning!

READ THIS MANUAL. Read this manual before installing, operating, or maintaining the DECS-250N. Note all warnings, cautions, and notes in this manual as well as on the product. Keep this manual with the product for reference. Only qualified personnel should install, operate, or service this system. Failure to follow warning and cautionary labels may result in personal injury or property damage. Exercise caution at all times.

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Introduction

DECS-250N Digital Excitation Control Systems offer precise excitation control and machine protection in a compact package. DECS-250N adaptability to many applications is assured through configurable contact inputs and outputs, flexible communication capabilities, and programmable logic implemented with the provided BESTCOMS*Plus*® software.

Features and Functions

DECS-250N features and functions include:

- Precise excitation control for synchronous generator or synchronous motor applications
 - Power factor and var metering values will be opposite in motor mode
- Five excitation control modes:
 - Automatic Voltage Regulation (AVR)
 - Field Current Regulation (FCR)
 - Field Voltage Regulation (FVR)
 - Power Factor Regulation (PF)
 - Var Regulation (var)
- Three pre-position setpoints for each excitation control mode
- Internal tracking between operating mode setpoints and external tracking of a second DECS excitation setpoint
- Two PID stability groups with Auto Tune feature
- Remote setpoint control input accepts analog voltage or current control signal
- Real-time metering
- Optional automatic synchronizer
- Optional integrated power system stabilizer (PSS)
 - Generator or motor control modes, accommodates phase rotation changes between modes
 - Speed and power sensing or speed-only sensing
 - Two wattmeter or three-wattmeter methods of power measurement
- Soft start and voltage buildup control
- Five limiting functions:
 - Overexcitation: summing point and takeover
 - Underexcitation
 - Stator current
 - Reactive power (var)
 - Underfrequency
- Twenty protection functions:
 - Generator undervoltage (27)
 - Generator overvoltage (59)
 - Loss of sensing (LOS)
 - Overfrequency (81O)
 - Underfrequency (81U)
 - Reverse power (32R)
 - Loss of excitation (40Q)
 - Field overvoltage
 - Field overcurrent
 - Loss of PMG
 - Exciter diode failure
 - Sync-check (25)
 - Eight configurable protection elements
- IRIG or network time synchronization
- Sixteen contact sensing inputs
 - Two fixed-function inputs: Start and Stop
 - Fourteen programmable inputs

- Twelve contact outputs
 - One, fixed-function output: Watchdog (SPDT configuration)
 - Eleven programmable outputs
- Flexible communication
 - Serial communication through front-panel USB port
 - Modbus communication through RS-485 port or Modbus TCP
 - Ethernet communication through an optional copper or fiber optic port
 - CAN communication with an ECU (engine control unit), optional AEM-2020 Analog Expansion Module, or optional CEM-2020 Contact Expansion Module
 - Optional PROFIBUS communication protocol
- Data logging, sequence of events recording, and trending
- Optional CEM-2020 Contact Expansion Module provides:
 - Ten contact inputs
 - Eighteen contact outputs (CEM-2020H) or 24 contact outputs (CEM-2020)
 - Customizable input and output functions assigned through BESTlogic™ *Plus* programmable logic
 - Communication via CAN protocol
- Optional AEM-2020 Analog Expansion Module provides:
 - Eight analog inputs
 - Eight resistive thermocouple device (RTD) inputs
 - Two thermocouple inputs
 - Four analog outputs
 - Customizable input and output functions assigned through BESTlogic *Plus* programmable logic
 - Communication via CAN protocol

Applications

The DECS-250N is intended for synchronous generator or synchronous motor applications. The DECS-250N controls the machine output through the application of regulated DC excitation power to the exciter field. The level of excitation power is based on the monitored voltage and current, and a regulation setpoint established by the user. The operating mode, generator or motor, is changed on the Operating Mode settings screen. Power factor and var metering values will be opposite in motor mode.

Excitation power is supplied from the DECS-250N by means of a six-SCR, full-wave bridge. It is capable of two-quadrant operation; it can produce negative as well as positive output power. With nominal operating voltage applied, the DECS-250N is capable of supplying 20 Adc continuously at a nominal voltage of 32, 63, or 125 Vdc.

Package

A single, compact package contains all excitation control and power components.

A front panel HMI provides local annunciation and control through a backlit liquid crystal display (LCD), light-emitting diodes (LEDs), and pushbuttons. Remote annunciation and control is provided through a flexible communication interface which accommodates Ethernet, Modbus, optional PROFIBUS, and the optional Interactive Display Panel (IDP-800).

Optional Features and Capabilities

DECS-250N optional features and capabilities are defined by a combination of letters and numbers that make up the style number. The model number and style number describe options and characteristics in a specific device and appear on a label affixed to the device.

Style Number

The style number identification chart in Figure 1 defines the electrical characteristics and operational features available in the DECS-250N.

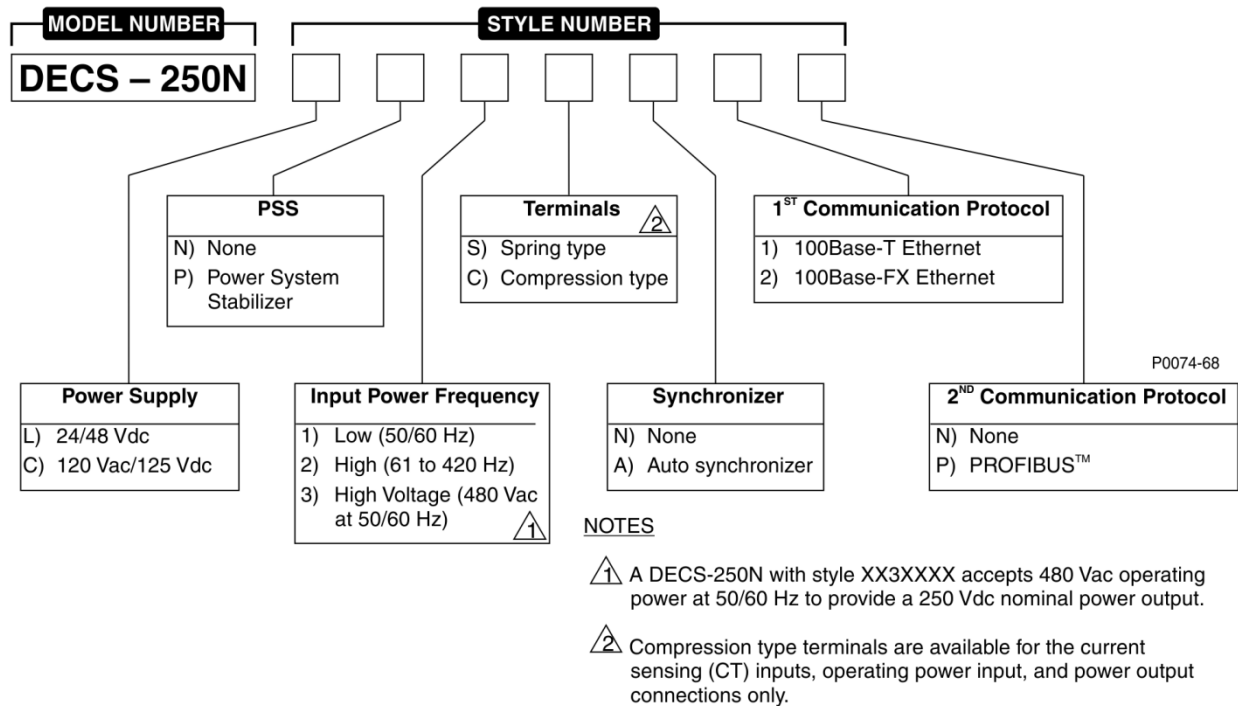


Figure 1. DECS-250N Style Chart

Storage

If a DECS-250N will not be placed in service right away, store it in the original shipping carton in a moisture- and dust-free environment. The temperature of the storage environment must be within the range of –40 to 85°C (–40 to 185°F).

Electrolytic Capacitor Considerations

The DECS-250N contains long-life aluminum electrolytic capacitors. For a DECS-250N kept in storage as a spare, the life of these capacitors can be maximized by energizing the device for 30 minutes once per year. Refer to the energizing procedures provided in *Maintenance*.



Controls and Indicators

All controls and indicators are located on the front panel and consist of pushbuttons, LED indicators, and a liquid-crystal display (LCD).

Front Panel Illustration and Description

DECS-250N controls and indicators are illustrated in Figure 2 and described in Table 1. The locators and descriptions of Table 1 correspond to the locators shown in Figure 2.

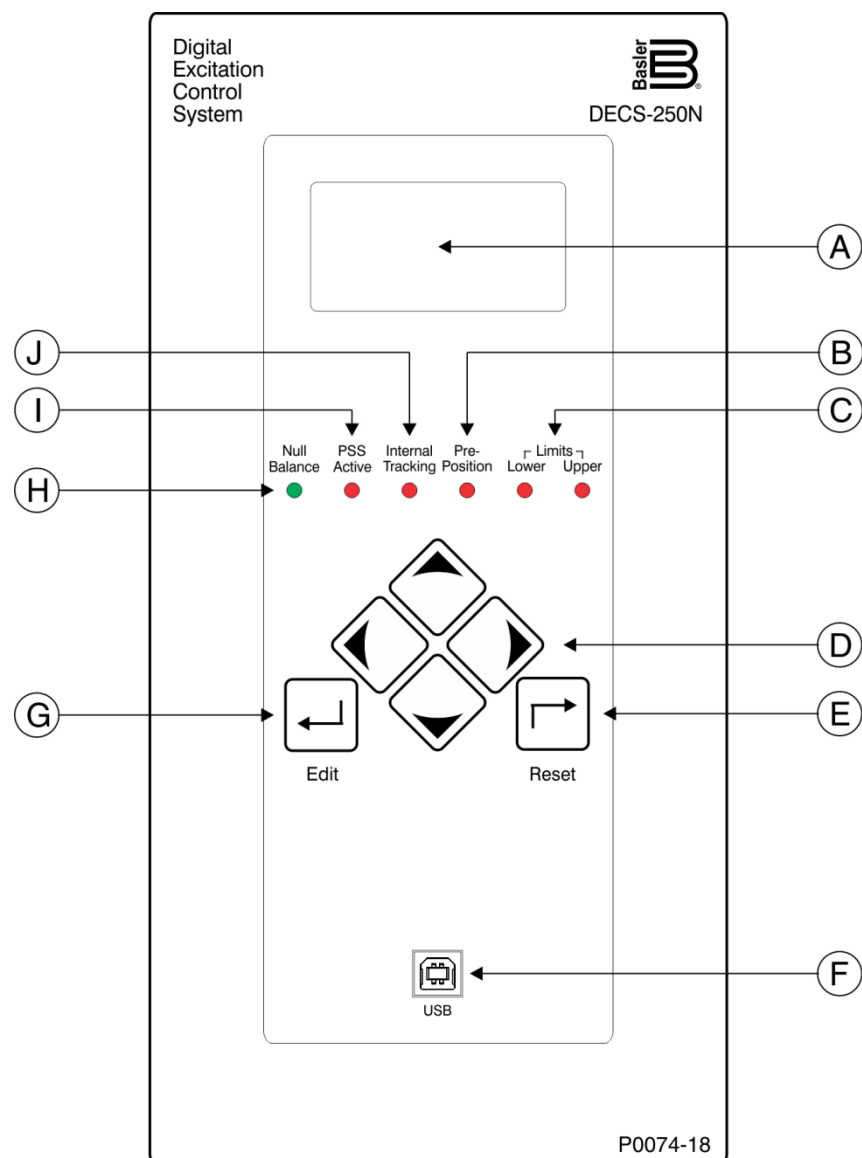


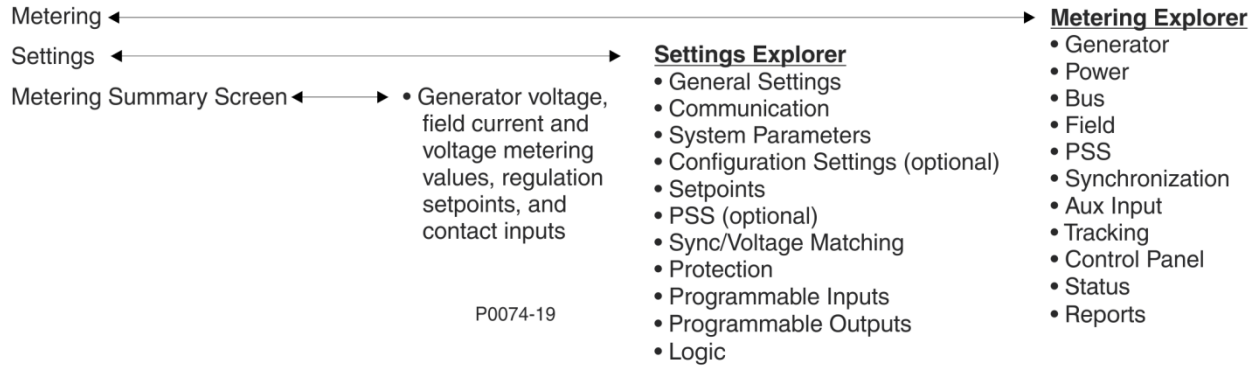
Figure 2. Front Panel Controls and Indicators

Table 1. Front Panel Control and Indicators Descriptions

| Locator | Description |
|---------|--|
| A | <i>Display.</i> The liquid crystal display (LCD) serves as a local source of information provided by the DECS-250N. The LCD displays operating setpoints, loop gains, metering, protection functions, system parameters, and general settings. The 128 by 64 dot pixel, backlit LCD displays white characters on a blue background. |
| B | <i>Pre-Position Indicator.</i> This red light emitting diode (LED) lights when the active mode setpoint is at any of the three pre-position (predefined) settings. |
| C | <i>Limit Indicators.</i> Two red LEDs indicate when the active mode setpoint reaches the minimum or maximum value. |
| D | <i>Scrolling Pushbuttons.</i> These four buttons are used to scroll up, down, left, and right through the menus displayed on the LCD (locator A). During an editing session, the left and right scrolling pushbuttons select the variable to be changed and the up and down scrolling pushbuttons change the value of the variable. |
| E | <i>Reset Pushbutton.</i> This button cancels editing sessions, resets alarm annunciations and latched alarm relays, and can be used for quick access to the metering screen. |
| F | <p><i>Communication Port.</i> This type B USB jack connects the DECS-250N with a PC operating BESTCOMSPlus® for local communication. BESTCOMSPlus is supplied with the DECS-250N.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p style="text-align: center;">Caution</p> <p>In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.</p> </div> |
| G | <i>Edit Pushbutton.</i> Pressing this button starts an editing session and enables changes to DECS-250N settings. At the conclusion of the editing session, the Edit pushbutton is pressed to save the settings changes. |
| H | <i>Null Balance Indicator.</i> This green LED lights when the setpoint of the inactive operating modes (AVR, FCR, FVR, var, and PF) match the setpoint of the active mode. |
| I | <i>PSS Active Indicator.</i> This red LED lights when the integrated power system stabilizer is enabled and can generate a stabilizing signal in response to a power system disturbance. |
| J | <i>Internal Tracking Indicator.</i> This red LED lights when any inactive mode (AVR, FCR, FVR, Var, or Power Factor) is tracking the setpoint of the active mode to achieve a “bumpless” transfer when changing active modes. |

Menu Navigation

The DECS-250N provides local access to DECS-250N settings and metering values through a menu structure displayed on the front panel LCD. An overview of the menu structure is illustrated in Figure 3. Movement through the menu structure is achieved by pressing the four scrolling pushbuttons.

DECS-250N Menu**Figure 3. Menu Structure Overview**

Adjusting Settings

A setting adjustment is made at the front panel by performing the following steps.

1. Navigate to the screen listing the setting to be changed.
2. Press the Edit button and enter the appropriate username and password to gain the needed level of security access. (Information about implementing and using username and password protection is provided in the *Security* chapter of this manual.)
3. Highlight the desired setting and press the Edit button to view the setting editing screen. This screen lists the setting range or the permissible setting selection.
4. Use the scrolling pushbuttons to select the setting digits/selections and adjust/change the setting.
5. Press the Edit button to save the change.

Display Setup

BESTCOMSPlus Navigation Path: Settings Explorer, General Settings, Front Panel HMI

HMI Navigation Path: Settings, General Settings, Front Panel HMI

Front panel display appearance and behavior can be customized to meet user preferences and site conditions. These BESTCOMSPlus settings are illustrated in Figure 4.

LCD

LCD setup includes a contrast adjustment^A to suit the viewing angle used or compensate for environmental conditions. The ability to reverse the display colors^B is provided to accommodate lighting conditions and user preferences.

Sleep Mode

Sleep mode^C reduces the demand on control power by turning off the LCD backlight when no pushbutton activity is seen for the duration of the LCD Backlight Timeout setting^D.

Language

Language modules are available for the DECS-250N. Once a language module is implemented it can be enabled via the Language Selection setting^E.

Screen Scrolling

The display can be set to automatically scroll through a user-selected list^F of metered values. This feature is enabled and disabled with the Enable Scroll setting^G. The rate at which scrolling occurs is configured with the Scroll Time Delay setting^H.

Figure 4. Front Panel HMI Settings

^A **Contrast Value (%)**: Adjustable from 0 to 100 in 1% increments.

^B **Invert display**: Deselect for white characters on a blue background. Select for blue characters on a white background.

^C **Sleep Mode**: Enable or disable.

^D **LCD Backlight Timeout**: Adjustable from 0 to 120 seconds in 1 second increments.

^E **Language Selection**: Select English, Russian, Spanish, German, or Chinese.

^F **Scrollable Metering Settings**: Select from main categories of GV Primary, GC Primary, CC Primary, Frequency, Power Primary, PF Primary, Energy Primary, BV Primary, Field Primary, PSS Primary, Synchronization Primary, Aux Input, Tracking, Real Time Clock, Contact Inputs, Contact Outputs, or Device ID. Follow this selection by the desired parameters within each category.

^G **Enable Scroll**: Enable or disable.

^H **Scroll Time Delay (s)**: Adjustable from 1 to 600 seconds in 1 second increments.

Power Inputs

Power is applied to two separate inputs: control power and operating power. The control power input supplies power to an internal power supply that provides power for logic, protection, and control functions. The power stage uses the operating power input as the source for the converted excitation power that it applies to the field.

Control Power

Two inputs supply the DECS-250N with control power. One input accepts dc control power and the other input accepts ac control power. The level of acceptable control power voltage is determined by the style number. One of two levels is possible. Style Lxxxxxx indicates a nominal voltage of 24 or 48 Vdc and accepts a voltage range of 16 to 60 Vdc. Style Cxxxxxx indicates a nominal voltage of 120 Vac/125 Vdc and accepts a voltage range of 90 to 150 Vdc and 82 to 132 Vac (50/60 Hz). One input (either dc or ac) is sufficient for operation but two inputs provide redundancy (for style Cxxxxxx only). When both control power inputs are used, an isolation transformer is required for the ac input. DC control power is applied at terminals BATT+ and BATT-. AC control power is applied at terminals L and N.

Operating Power

Operating power is applied at terminals A, B, and C. To achieve the desired level of excitation, the appropriate operating power input voltage must be applied. Table 2 lists the acceptable operating power voltage ranges for the DECS-250N. The operating power frequency range for the DECS-250N is listed in Table 3.

Table 2. DECS-250N Operating Power Specifications

| Desired Nominal Excitation Power Voltage | Applied Operating Power Voltage Range |
|---|--|
| 63 Vdc | 100 to 139 Vac |
| 125 Vdc | 190 to 277 Vac |
| 250 Vdc | 380 to 528 Vac, 50/60 Hz (style xx3xxxx) |

Table 3. DECS-250N Operating Power Frequency Specifications

| DECS-250N Style Number | Operating Power Frequency Range |
|---------------------------|--|
| xx1xxxx | 50/60 Hz |
| xx2xxxx | 61 to 420 Hz |
| xx3xxxx | 50/60 Hz (480 Vac input, 250 Vdc output) |



Power Stage

The DECS-250N supplies regulated dc excitation power to the field of a brushless exciter. Excitation power is supplied at terminals F+ and F–.

DECS-250N power stage operating power accepts single- or three-phase ac power from a transformer or PMG. Power stage operating power is applied at terminals A, B, and C. The GND terminal serves as a ground connection.

The DECS-250N power stage employs a six-SCR, full-wave bridge that converts the ac operating power input into dc excitation power. It is capable of two-quadrant operation; it can produce negative as well as positive output power as long as positive current is flowing in the machine field (in excess of the minimum holding current required for the SCRs). The DECS-250N power stage is capable of supplying 20 Adc continuously at nominal voltages of 63, 125, or 250 Vdc.

Nominal DECS-250N operating power levels include 480 Vac for a 250 Vdc continuous exciter field requirement (style XX3XXXX), 240 Vac for a 125 Vdc requirement, or 120 Vac for a 63 Vdc requirement. The frequency range of the operating power voltage is determined by the DECS-250N style number. Style XX1XXXX indicates an operating power frequency of 50 to 60 hertz, style XX2XXXX indicates a frequency of 61 to 420 hertz, and style XX3XXXX limits the frequency to 50 or 60 hertz (for an operating voltage of 480 Vac).

Field Transient Protection

Fault conditions such as generator overloading or loss of synchronism can induce transients into the field circuit. If this energy is not dissipated, it has the potential to damage the power stage SCRs. The DECS-250N has two modes of field transient protection.

Most voltage transients are less than 150 microseconds in duration and are limited to a safe level by internal DECS-250N components.

During major system faults, an SCR crowbar circuit protects the DECS-250N power stage. When field overvoltage is detected, the power stage SCR firing pulses are blocked, the crowbar circuit is energized, and a crowbar annunciation is made. During a normal shutdown, the same actions are taken but no crowbar annunciation is made.

Inverting Style Excitation System Compatibility

The DECS-250N power stage can be configured for operation in the negative direction to supply the control windings of an inverting style excitation system.



Voltage and Current Sensing

The DECS-250N senses generator voltage, generator current, and bus voltage through dedicated, isolated inputs.

Generator Voltage

Three-phase generator sensing voltage is applied to DECS-250N terminals E1, E2, and E3. This sensing voltage is typically applied through a user-supplied voltage transformer, but may be applied directly. These terminals accept three-phase, three-wire connections at terminals E1 (A), E2 (B), and E3 (C) or single-phase connections at E1 (A) and E3 (C).

The generator voltage sensing input accepts a maximum voltage of 600 Vac and has a burden of less than 1 VA.

The transformer primary and secondary winding voltages are entered in settings that the DECS-250N uses to interpret the applied sensing voltage and calculate system parameters. The phase rotation of the generator sensing voltage can be configured as ABC or ACB. Information about configuring the DECS-250N for the generator sensing voltage is provided in the *Configuration* chapter of this manual.

Typical generator voltage sensing connections are illustrated in Figure 5.

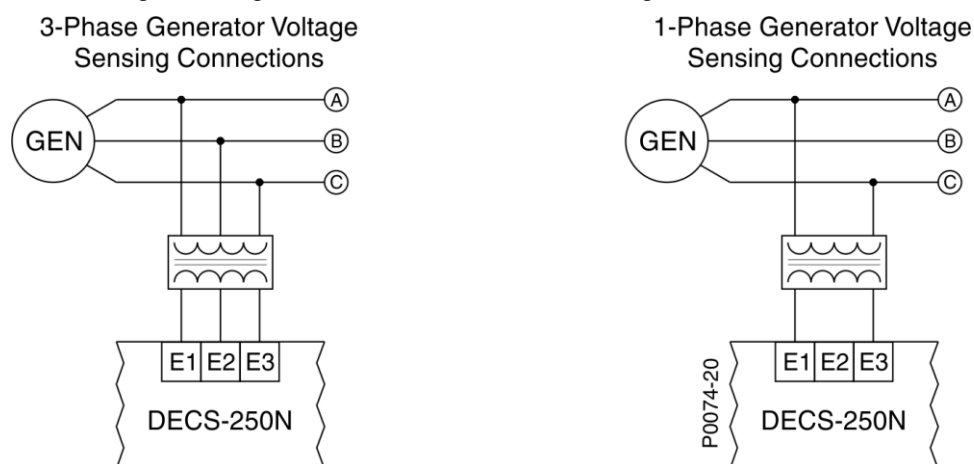


Figure 5. Typical Generator Voltage Sensing Connections

Generator Current

Generator current sensing inputs consist of three phase-sensing inputs and a sensing input for cross-current compensation.

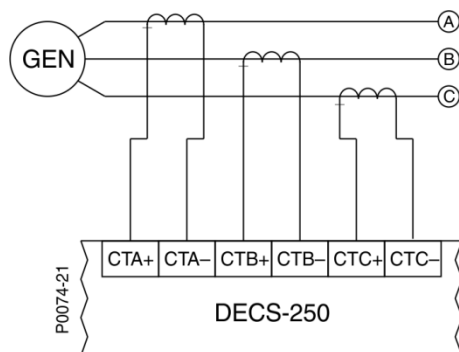
Note

Current transformer (CT) grounding should be applied in accordance with local codes and conventions.

Phase Sensing

Three-phase generator sensing current is applied to DECS-250N terminals CTA+ and CTA–, CTB+ and CTB–, and CTC+ and CTC– through user-supplied current transformers (CTs). Single-phase generator sensing current is applied to DECS-250N terminals CTB+ and CTB–. The DECS-250N is compatible with CTs having 5 Aac or 1 Aac nominal secondary ratings. The DECS-250N uses this secondary rating, along with the CT nominal primary ratings to interpret the sensed current and calculate system parameters.

Information about configuring the DECS-250N the generator sensing voltage is provided in the *Configuration* chapter of this manual. Typical generator phase-current sensing connections are shown in Figure 6.



NOTES

1. If only one CT is used, connect it to the B-phase.
2. Three-phase current sensing is required for PSS applications.

Figure 6. Typical Generator Current Sensing Connections

Cross-Current Compensation

Cross-current compensation (reactive differential) mode allows two or more paralleled generators to share a common load. As shown in Figure 7, each generator is controlled by a DECS-250N using the DECS-250N cross-current compensation input (terminals CCCT+ and CCCT-) and a dedicated, external current transformer (CT) to sense generator current. The resistors shown in Figure 7 are used to set the burden and may be adjusted to suit the application. Ensure that the power rating of the resistors is adequate for the application.

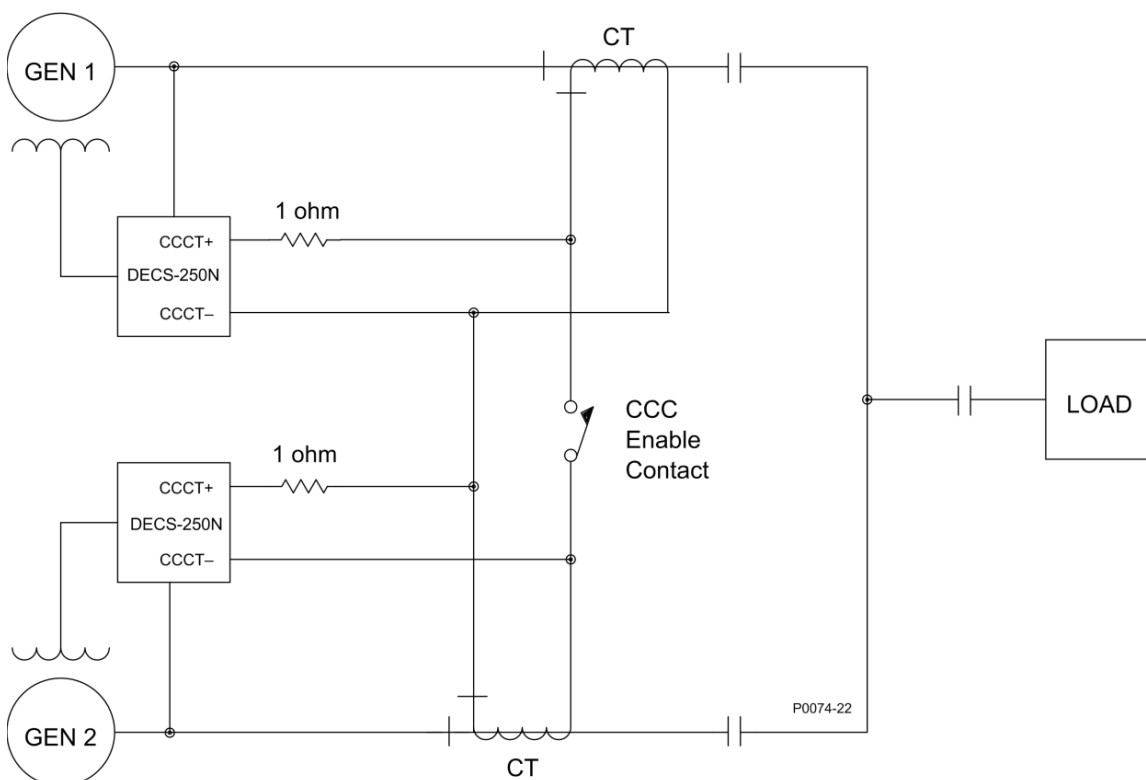


Figure 7. Connections for Cross-Current Compensation

Note

If a machine is taken offline, then the secondary winding of that machine's cross-current compensation CT must be shorted. Otherwise, the cross-current compensation scheme will not function.

Bus Voltage

Bus voltage monitoring enables bus failure detection, generator and bus voltage matching, and synchronization of the generator with the utility/bus. These features are discussed in the *Synchronizer* chapter of this manual. Three-phase bus sensing voltage is applied to DECS-250N terminals B1, B2, and B3. This sensing voltage is typically applied through a user-supplied voltage transformer, but may be applied directly. These terminals accept three-phase, three-wire connections at terminals B1 (A), B2 (B), and B3 (C) or single-phase connections at B3 (C) and B1 (A).

The bus voltage sensing input accepts a maximum voltage of 600 Vac and has a burden of less than 1 VA.

The transformer primary and secondary winding voltages are entered in settings that the DECS-250N uses to interpret the applied sensing voltage. Information about configuring the DECS-250N for the bus sensing voltage is provided in the *Configuration* chapter of this manual.

Typical bus voltage sensing connections are illustrated in Figure 8.

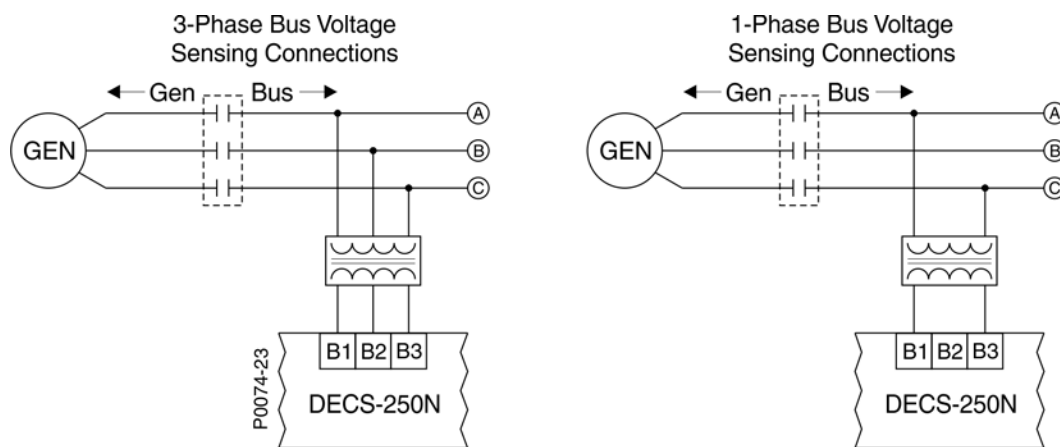


Figure 8. Typical Bus Voltage Sensing Connections



Synchronizer

DECS-250N controllers with a style number of xxxxAxx are equipped with an automatic synchronizer that acts to align the voltage, phase angle, and frequency of the generator with the bus. The synchronizer function includes compensation settings for the generator breaker and bias control settings for the generator governor. Related synchronizer features include voltage matching and bus condition detection.

Generator Synchronization

BESTCOMSPlus Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Synchronizer
HMI Navigation Path: Settings, Sync/Voltage Matching, Synchronizer

Two modes of generator synchronization are available: phase lock loop and anticipatory^A. In either mode, the DECS-250N matches the voltage, phase angle, and frequency of the generator with the bus and then connects the generator to the bus by closing the generator breaker. Anticipatory mode has the added capability of compensating for the breaker closing time. (Breaker closing time is the delay between the issuance of a breaker close command and closure of the breaker contacts.) The DECS-250N compensates for the breaker closure time by monitoring the frequency difference between the generator and bus and calculating the advance phase angle required to close the breaker at a zero-degree phase angle.

Frequency Correction

Generator frequency correction is defined by the slip frequency and further refined by the breaker closing angle. The slip frequency setting^B establishes the maximum allowable deviation of the generator speed (frequency) from the bus frequency. The Min Slip Control Limit setting^C and Max Slip Control Limit setting^D are used to calculate the slip frequency error and to provide continuous slip frequency control while in phase lock synchronization. If the slip frequency magnitude is above the Max Slip Control Limit, the error is set equal to the Max Error in the opposite polarity. If the slip frequency magnitude is below the Min Slip Control Limit, the error is set equal to the Max Error in the opposite polarity. When it is between the two limits, the error is zero (0). Slip frequency error is shown in Figure 9.

To minimize the impact on the bus during synchronization, the generator frequency can be forced to exceed the bus frequency^E at the moment of breaker closure. If this is the case, the DECS-250N will drive the generator frequency higher than the bus frequency before closing the breaker. The breaker closing angle setting^F defines the maximum allowable phase angle difference between the generator and bus. For breaker closure to be considered, the slip angle must remain within this setting for the duration of the sync activation delay^G.

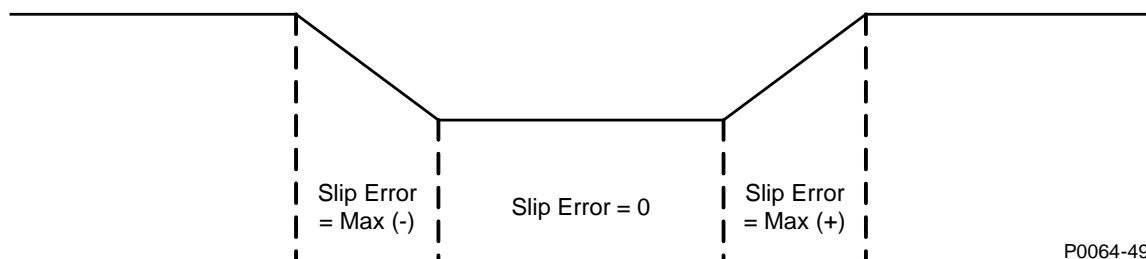


Figure 9. Slip Frequency Error

Voltage Correction

Voltage correction is initiated when the generator voltage is outside the defined voltage window. The voltage window setting^H is expressed as a percentage of the bus voltage and determines the band of generator voltage surrounding the bus voltage where breaker closure will be considered. Enabling the Vgen>Vbus setting^I causes the DECS-250N to drive the generator voltage higher than the bus voltage prior to synchronizing. A generator to bus PT matching level^J setting is provided to compensate for step-up or step-down transformers in the system. The DECS-250N adjusts the sensed generator voltage by

this percentage. This setting also appears on the Voltage Matching screen, below. When the value is changed, it is reflected in both places.

Angle Compensation

An angle compensation^K setting is provided to offset phase shift caused by transformers in the system. The angle compensation value is added only to the bus angle. For example, it is given that the generator and bus are synchronized but the DECS-250N metered slip angle reads -30° . Equation 1, below, illustrates the DECS-250N slip angle calculation. This means that the generator angle is lagging behind the bus angle by 30° due to transformer phase shift. To compensate for this phase shift, the angle compensation setting should contain a value of 330° . This value is added to the metered bus angle resulting in an adjusted slip angle of zero degrees. Only the metered bus angle is affected by the angle compensation setting, the metered generator angle is not biased by the DECS-250N.

$$G - (B + A) = \text{Slip Angle}$$

Equation 1. DECS-250N Metered Slip Angle

Where:

- G = metered generator angle
- B = metered bus angle
- A = angle compensation value

Failure of Synchronization

Generator synchronization is aborted if generator synchronization fails to occur within a timeframe^L established by the user.

BESTCOMSPlus[®] generator synchronization settings are illustrated in Figure 10.

Figure 10. Generator Synchronizer Settings

^A *Sync Type*: Select Anticipatory or Phase Lock Loop.

^B *Slip Frequency*: Adjustable from 0.1 to 0.5 Hz in 0.05 Hz increments.

^C *Min Slip Control Limit*: Adjustable from 0.1 to 2.0 Hz in 0.1 Hz increments.

^D *Max Slip Control Limit*: Adjustable from 0.1 to 2.0 Hz in 0.1 Hz increments.

^E *Fgen>Fbus*: Select Enable or Disable.

^F *Breaker Closing Angle*: Adjustable from 3 to 20° in 0.5° increments.

^G *Sync Activation Delay*: Adjustable from 0.1 to 0.8 s in 0.1 s increments.

^H *Voltage Window*: Adjustable from 2 to 15% in 0.5% increments.

^I *Vgen>Vbus*: Select Enable or Disable.

^J *Gen to Bus PT Match Level*: Adjustable from 0 to 700% in 0.1% increments.

^K *Angle Compensation (°)*: Adjustable from 0.0 to 359.9° in 0.1° increments.

^L *Sync Fail Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

Voltage Matching

BESTCOMSPlus Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Voltage Matching

HMI Navigation Path: Settings, Sync/Voltage Matching, Voltage Matching

When enabled^A, voltage matching is active in AVR control mode and automatically adjusts the AVR mode setpoint to match the sensed bus voltage. Voltage matching is based on two parameters: band and matching level.

The voltage matching band^B defines the window in which the generator voltage must be for voltage matching to occur.

The generator to bus PT matching level^C defines the percentage of the sensed bus voltage to which the generator sensed voltage will be adjusted.

Voltage matching settings are illustrated in Figure 11.

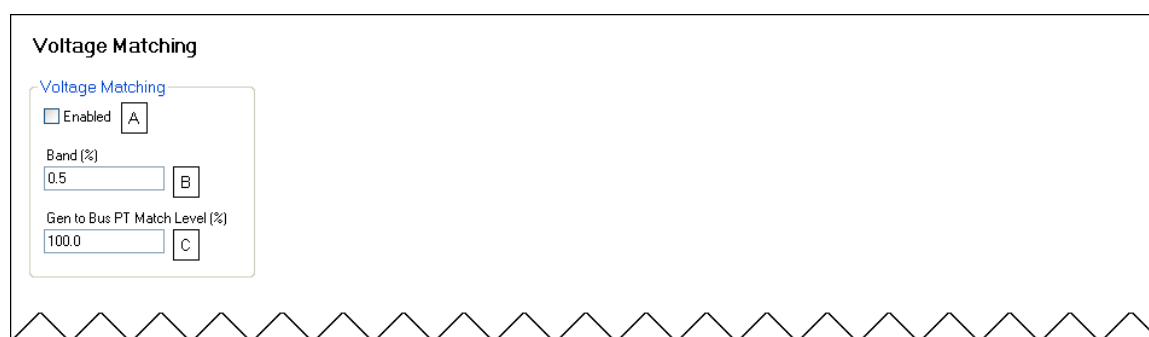


Figure 11. Voltage Matching Settings

^A *Voltage Matching*: Select Enabled to enable function.

^B *Band*: Adjustable from 0 to 20% in 0.1% increments.

^C *Gen to Bus PT Match Level*: Adjustable from 0 to 700% in 0.1% increments.

Breaker Hardware Configuration

BESTCOMSPlus Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Breaker Hardware

HMI Navigation Path: Settings, Sync/Voltage Matching, Breaker Hardware

The DECS-250N can control and monitor a generator breaker. Breaker hardware settings are illustrated in Figure 12.

Breaker Failure

When a close command is issued to the breaker, the DECS-250N monitors the breaker status and annunciates a breaker failure if the breaker does not close within the time defined by the breaker close wait delay^A. Typically, the wait delay is set to be longer than the actual breaker closing time.

Generator Breaker

The DECS-250N must be configured^B with the generator breaker characteristics before the breaker can be controlled by the DECS-250N. Breakers controlled by pulse or continuous control inputs^C are supported. During anticipatory-mode synchronization, if the generator breaker is serving to tie the generator to the bus, the DECS-250N uses the breaker closing time^D to calculate the optimum time to close the breaker. For a pulse-controlled generator breaker, the breaker open^E and close^F pulse times are used by

the DECS-250N when issuing open and close commands to the breaker. When setting the pulse times, the open and close times should be set at or longer than the breaker closing time setting.

If desired, breaker closure is possible during a dead bus condition^G and/or dead generator condition^H.

Caution

Use caution when connecting a “dead” generator to a “dead” bus. Undesired system damage can occur if the bus becomes energized while a “dead” generator is connected to it.

Figure 12. Breaker Hardware Configuration Settings

^A *Breaker Close Wait Time*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^B *Gen Breaker*: Select Configured or NOT Configured.

^C *Contact Type*: Select Pulse or Continuous.

^D *Breaker Closing Time*: Adjustable from 0 to 800 ms in 5 ms increments.

^E *Open Pulse Time*: Adjustable from 0.01 to 5 s in 0.01 s increments. Setting is available only when Contact Type is Pulse.

^F *Close Pulse Time*: Adjustable from 0.01 to 5 s in 0.01 s increments. Setting is available only when Contact Type is Pulse.

^G *Dead Bus Close*: Select Disabled or Enabled.

^H *Dead Gen Close Enable*: Select Disabled or Enabled.

Generator and Bus Condition Detection

BESTCOMSPlus Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Bus Condition Detection

HMI Navigation Path: Settings, Sync/Voltage Matching, Bus Condition Detection

The DECS-250N monitors the voltage and frequency of the generator and bus for determining when a breaker closure is appropriate. Generator and bus condition detection settings are illustrated in Figure 13.

Generator Condition

A dead generator is recognized by the DECS-250N when the generator voltage decreases below the dead generator threshold^A for the duration of the dead generator activation delay^B.

A failed generator is recognized when the generator voltage or frequency does not meet the established generator stability criteria for the duration of the failed generator activation delay^C. Generator stability parameters are described in *Generator Stability*.

Generator Stability

Before initiating a breaker closure (tying the generator to a stable or dead bus), the generator voltage must be stable. Several settings are used to determine generator stability. These settings include pickup and dropout levels for overvoltage^D, undervoltage^E, overfrequency^F, and under-frequency^G. Recognition of generator stability is further controlled by a generator stability activation delay^H. Breaker closure is not considered if the voltage conditions are not within the stability pickup and dropout settings for the duration of the stability activation delay.

Bus Condition

A dead bus is recognized by the DECS-250N when the bus voltage decreases below the dead bus threshold^I for the duration of the dead bus activation delay^J.

A failed bus is recognized when the bus voltage or frequency does not meet the established stability criteria for the duration of the failed bus activation delay^K. Bus stability parameters are described in *Bus Stability*.

Bus Stability

Before initiating a breaker closure (tying the generator to a live bus), the bus voltage must be stable. Several settings are used to determine bus stability. These settings include pickup and dropout levels for overvoltage^L, undervoltage^M, overfrequency^N, and underfrequency^O. Recognition of bus stability is further controlled by a bus stability activation delay^P. Breaker closure is not considered if the voltage conditions are not within the stability pickup and dropout settings for the duration of the stability activation delay.

Bus Condition Detection

Generator Sensing

Generator Condition Settings

Dead Gen Threshold (Primary V) **A**

Dead Gen Activation Delay (s) **B**

Gen Failed Activation Delay (s) **C**

Generator Stable

Overvoltage Settings

Pickup (Primary V) V L-L

Dropout (Primary V) **D**

Undervoltage Settings

Pickup (Primary V) V L-L

Dropout (Primary V) **E**

Overfrequency Settings

Pickup (Hz)

Dropout (Hz) **F**

Underfrequency Settings

Pickup (Hz)

Dropout (Hz) **G**

Gen Stable Activation Delay (s) **H**

Bus Sensing

Bus Condition Settings

Dead Bus Threshold (Primary V) **I**

Dead Bus Activation Delay (s) **J**

Bus Failed Activation Delay (s) **K**

Bus Stable

Overvoltage Settings

Pickup (Primary V) V L-L

Dropout (Primary V) **L**

Undervoltage Settings

Pickup (Primary V) V L-L

Dropout (Primary V) **M**

Overfrequency Settings

Pickup (Hz)

Dropout (Hz) **N**

Underfrequency Settings

Pickup (Hz)

Dropout (Hz) **O**

Bus Stable Activation Delay (s) **P**

Figure 13. Generator and Bus Condition Detection Settings

^A *Dead Gen Threshold*: Adjustable from 0 to 600,000 Vac in 1 Vac increments.

^B *Dead Gen Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^C *Gen Failed Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^D *Generator Stability Overvoltage Pickup and Dropout*: Adjustable from 10 to 600,000 Vac in 1 Vac increments.

^E *Generator Stability Undervoltage Pickup and Dropout*: Adjustable from 10 to 600,000 Vac in 1 Vac increments.

^F *Generator Stability Overfrequency Pickup and Dropout*: Adjustable from 46 to 64 Hz in 0.05 Hz increments.

^G *Generator Stability Underfrequency Pickup and Dropout*: Adjustable from 46 to 64 Hz in 0.05 Hz increments.

^H *Generator Stability Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^I *Dead Bus Threshold*: Adjustable from 0 to 600,000 Vac in 1 Vac increments.

^J *Dead Bus Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^K *Bus Failed Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

^L *Bus Stability Overvoltage Pickup and Dropout*: Adjustable from 10 to 600,000 Vac in 1 Vac increments.

^M *Bus Stability Undervoltage Pickup and Dropout*: Adjustable from 10 to 600,000 Vac in 1 Vac increments.

^N *Bus Stability Overfrequency Pickup and Dropout*: Adjustable from 46 to 64 Hz in 0.05 Hz increments.

^O *Bus Stability Underfrequency Pickup and Dropout*: Adjustable from 46 to 64 Hz in 0.05 Hz increments.

^P *Bus Stable Activation Delay*: Adjustable from 0.1 to 600 s in 0.1 s increments.

Generator Governor Control

BESTCOMSPlus Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Governor Bias Control Settings

HMI Navigation Path: Settings, Sync/Voltage Matching, Governor Bias Control Settings

During synchronization, the DECS-250N adjusts the generator voltage and frequency by issuing speed correction signals to the speed governor. Correction signals are issued in the form of DECS-250N output contact closures. These correction signals may be either continuous or proportional^A. When proportional correction is selected, the correction pulses are of varying widths^B and intervals^C. Initially, long pulses are issued when the frequency difference between the generator and bus is large. As the correction pulses take effect and the frequency difference becomes smaller, the correction pulse widths are proportionally decreased.

Governor bias control settings are illustrated in Figure 14.

Governor Bias Control Settings

Bias Control Contact Type
 A

Correction Pulse Width (s)
 B

Correction Pulse Interval (s)
 C

The waveform below shows a series of pulses of varying widths, representing the correction pulses.

Figure 14. Generator Governor Control Settings

^A *Bias Control Contact Type*: Select Continuous Pulse or Proportional Pulse.

^B *Correction Pulse Width*: Adjustable from 0 to 99.9 s in 0.1 s increments.

^C *Correction Pulse Interval*: Adjustable from 0 to 99.9 s in 0.1 s increments.



Regulation

The DECS-250N precisely regulates the level of supplied excitation power in each of the five available regulation modes. Stable regulation is enhanced by the automatic tracking of the active-mode setpoint by the inactive regulation modes. Pre-position setpoints within each regulation mode enable the DECS-250N to be configured for multiple system and application needs.

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, AVR/FCR/FVR and VAR/PF

HMI Navigation Path: Settings, Operating Settings, AVR/FCR/FVR and VAR/PF

Regulation Modes

The DECS-250N provides five regulation modes: Automatic Voltage Regulation (AVR), Field Current Regulation (FCR), Field Voltage Regulation (FVR), var, and Power Factor (PF).

AVR

When operating in AVR (Automatic Voltage Regulation) mode, the DECS-250N regulates the excitation level in order to maintain the generator terminal voltage setpoint^A despite changes in load and operating conditions. AVR setpoint (or operating point) adjustment is made through:

- Application of contacts at DECS-250N contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-250N Auxiliary Control input.
- The BESTCOMS*Plus*® Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through the DECS-250N Modbus port

The range of adjustment is defined by Minimum^B and Maximum^C settings that are expressed as a percentage of the rated generator voltage. The length of time required to adjust the AVR setpoint from one limit to the other is controlled by a Traverse Rate setting^D. These settings are illustrated in Figure 15.

FCR

When operating in FCR (Field Current Regulation) mode, the DECS-250N regulates the level of current it supplies to the field based on the FCR setpoint^E. The setting range of the FCR setpoint depends on the field rated data and other associated settings. FCR setpoint adjustment is made through:

- Application of contacts at DECS-250N contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the Auxiliary Control input
- The BESTCOMS*Plus* Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through the DECS-250N Modbus port

The range of adjustment is defined by Minimum^F and Maximum^G settings that are expressed as a percentage of the rated field current. The length of time required to adjust the FCR setpoint from one limit to the other is controlled by a Traverse Rate setting^H. These settings are illustrated in Figure 15.

FVR

FVR (Field Voltage Regulation) mode enables generator modeling and validation testing in accordance with WECC testing requirements. FVR mode can also be used to smooth the transfer from the active DECS-250N to a secondary DECS.

When operating in FVR mode, the DECS-250N regulates the level of field voltage it supplies to the field based on the FVR setpoint^I. The setting range of the FVR setpoint depends on the field rated data and other associated settings. FVR setpoint adjustment is made through:

- Application of contacts at DECS-250N contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-250N Auxiliary Control input

- The BESTCOMS*Plus* Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through the DECS-250N Modbus port

The range of adjustment is defined by Minimum^J and Maximum^K settings that are expressed as a percentage of the rated field voltage. The length of time required to adjust the FVR setpoint from one limit to the other is controlled by a Traverse Rate^L setting. These settings are illustrated in Figure 15.

Figure 15. AVR, FCR, and FVR Regulation Settings

^A **AVR Setpoint:** Range of adjustment is based on the rated generator voltage and limited by the AVR Min (B) and Max (C) settings.

^B **Min (% of rated):** Adjustable from 70 to 120% in 0.1% increments.

^C **Max (% of rated):** Adjustable from 71 to 120% in 0.1% increments.

^D **Traverse Rate (s):** Adjustable from 10 to 200 seconds in 1 second increments.

^E **FCR Setpoint:** Range of adjustment is based on the rated field current and limited by the FCR Min (F) and Max (G) settings.

^F **Min (% of rated):** Adjustable from 0 to 120% in 0.1% increments.

^G **Max (% of rated):** Adjustable from 0 to 120% in 0.1% increments.

^H **Traverse Rate (s):** Adjustable from 10 to 200 seconds in 1 second increments.

^I **FVR Setpoint:** Range of adjustment is based on the rated field voltage and limited by the FCR Min (J) and Max (K) settings.

^J **Min (% of rated):** Adjustable from 0 to 150% in 0.1% increments.

^K **Max (% of rated):** Adjustable from 0 to 150% in 0.1% increments.

^L **Traverse Rate:** Adjustable from 10 to 200 seconds in 1 second increments.

Var

When operating in var mode, the DECS-250N regulates the reactive power (var) output of the generator based on the var setpoint^A. The setting range of the var setpoint depends on the generator ratings and other associated settings. Var setpoint adjustment is made through:

- Application of contacts at DECS-250N contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the Auxiliary Control input
- The BESTCOMS*Plus* Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through the DECS-250N Modbus port

The range of adjustment is defined by Minimum^B and Maximum^C settings that are expressed as a percentage of the generator rated kVA output. The length of time required to adjust the Var setpoint from one limit to the other is controlled by a Traverse Rate setting^D. A Fine Voltage Adjustment Band setting^E defines the upper and lower boundaries of voltage correction when operating in var or power factor regulation modes. Var mode settings are illustrated in Figure 16.

Power Factor

When operating in Power Factor (PF) mode, the DECS-250N controls the var output of the generator to maintain the Power Factor setpoint^F as the kW load on the generator varies. The setting range of the PF setpoint is determined by the PF – Leading^G and PF – Lagging^H settings. The length of time required to adjust the PF setpoint from one limit to the other is controlled by a Traverse Rate setting^I. A Fine Voltage Adjustment Band setting^E defines the upper and lower boundaries of voltage correction when the DECS-250N is operating in Var or Power Factor regulation modes. PF Active Power Level^J establishes the level of generator output power (kW) where the DECS-250N switches to/from Droop Compensation/Power Factor mode. If the level of power decreases below the setting, the DECS-250N switches from Power Factor mode to Droop Compensation mode. Conversely, as the level of power increases above the setting, the DECS-250N switches from Droop Compensation mode to Power Factor mode. A setting of 0 to 30% may be entered in 0.1% increments.

Power Factor mode settings are illustrated in Figure 16.

| var/PF Setpoints | | |
|--|--|--|
| Fine Voltage Adjustment Band Fine Voltage Adjustment Band <input type="text" value="20.00"/> E | Reactive Power Control (var) Setpoint (Primary kvar) <input type="text" value="0.00"/> A Min (%) <input type="text" value="0.0"/> B Max (%) <input type="text" value="100.0"/> C Traverse Rate <input type="text" value="20"/> D Pre-position 1 Setpoint (Primary kvar) <input type="text" value="0.00"/> A | Power Factor Control (PF) Setpoint <input type="text" value="1.000"/> F PF - Leading <input type="text" value="-0.800"/> G PF - Lagging <input type="text" value="0.800"/> H Traverse Rate <input type="text" value="20"/> I Pre-position 1 Setpoint <input type="text" value="1.000"/> F |

Figure 16. Var and Power Factor Regulation Settings

^A *Setpoint*: Range of adjustment is based on the generator ratings and limited by the Var Minimum (B) and Var Maximum (C) settings.

^B *Min (% of rated)*: Adjustable from –100 to 100% in 0.1% increments.

^C *Max (% of rated)*: Adjustable from 0 to 100% in 0.1% increments.

^D *Traverse Rate (s)*: Adjustable from 10 to 200 seconds in 1 second increments.

^E *Fine Voltage Adjustment Band*: Adjustable from 0 to 30% in 0.01% increments.

^F *PF Setpoint*: Range of adjustment is determined by the PF Leading (G) and Lagging (H) settings.

^G *PF – Leading*: Adjustable from –1 to –0.5 in 0.005 increments.

^H *PF – Lagging*: Adjustable from 0.5 to 1 in 0.005 increments.

^I *Traverse Rate (s)*: Adjustable from 10 to 200 seconds in 1 second increments.

^J *PF Active Power Level*: Adjustable from 0 to 30% in 0.1% increments.

Pre-Position Setpoints

Each regulation mode has three pre-position setpoints which allow the DECS-250N to be configured for multiple system and application needs. Each pre-position setpoint can be assigned to a programmable contact input. When the appropriate contact input is closed, the setpoint is driven to the corresponding pre-position value. Each pre-position function has two settings: Setpoint and Mode. The setting range of each pre-position setpoint^A is identical to that of the corresponding control mode setpoint. The Mode^B setting determines whether or not the DECS-250N will respond to further setpoint change commands while the pre-position command is being asserted. If the pre-position mode is Release, setpoint change commands are accepted to raise and lower the setpoint while the pre-position command is being asserted. Additionally, if the inactive pre-position mode is Release and internal tracking is enabled, the pre-position value will respond to the tracking function. If the pre-position mode is Maintain, further setpoint change commands are ignored while the appropriate contact input is closed. Additionally, if the inactive pre-position mode is Maintain and internal tracking is enabled, the inactive mode will maintain the

inactive setpoint at the pre-position value and override the tracking function. A portion of the pre-position setpoints for var and PF modes are illustrated in Figure 17. (Pre-Position Setpoints for AVR, FCR, and FVR modes are similar and not shown here.)

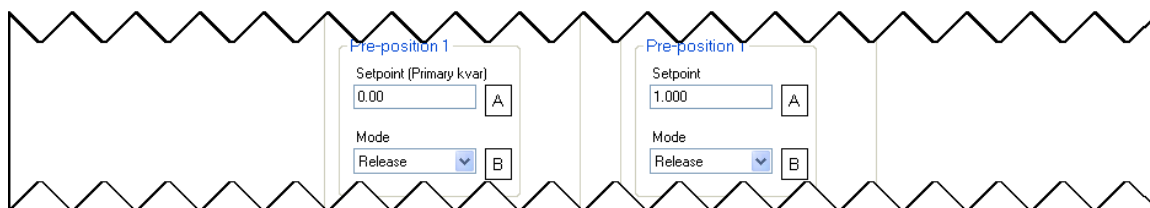


Figure 17. Pre-Position Setpoints

^A *Setpoint*: Range of adjustment is based on the generator ratings and limited by the Var Minimum and Var Maximum settings.

^B *Mode*: Select Release or Maintain

Transient Boost

The transient excitation boosting function improves response to successive faults by providing increased excitation support. When a simultaneous line current increase and line voltage decrease occurs, the DECS-250N compensates by elevating the voltage setpoint above the nominal setpoint. When the line voltage recovers, the voltage setpoint is restored to the nominal value.

Fault detection is controlled by a voltage threshold^A setting, a current threshold^B setting, and a duration^C setting. Fault voltage threshold is expressed as a percentage of the AVR setpoint and fault current threshold is expressed as a percentage of the rated field current. The duration setting determines how long a fault condition is tolerated before the setpoint is adjusted.

Setpoint adjustment is controlled by a voltage setpoint boosting level^D, a clearing voltage threshold^E, and a clearing voltage delay^F. The setpoint boosting level is expressed as a percentage above the AVR setpoint. Transient boost is disabled once the line voltage recovers above the clearing voltage threshold. The clearing voltage threshold is expressed as a percentage below the AVR setpoint. The clearing voltage delay determines how long the line voltage must exceed the clearing voltage threshold before setpoint adjustment is terminated.

Figure 18. Transient Boost Settings

^A *Fault Voltage Threshold (%)*: Adjustable from 0.0 to 100.0%, in 0.1% increments.

^B *Fault Current Threshold (%)*: Adjustable from 0.0 to 400.0%, in 0.1% increments.

^C *Minimum Fault Duration (ms)*: Adjustable from 0 to 1,000 ms, in 1 ms increments.

^D *Voltage Setpoint Boosting Level (%)*: Adjustable from 0.0 to 100.0%, in 0.1% increments.

^E *Clearing Voltage Threshold (%)*: Adjustable from 0.0 to 50.0%, in 0.1% increments.

^F *Clearing Voltage Delay (ms)*: Adjustable from 0 to 1,000 ms, in increments of 1 ms.

Operation with Paralleled Generators

BESTCOMS^{Plus} Navigation Path: Settings Explorer, Operating Settings, Parallel/LineDrop Compensation

HMI Navigation Path: Settings, Operating Settings, Parallel/LineDrop Compensation

The DECS-250N can be used to control the excitation level of two or more generators operating in parallel so that the generators share the reactive load. The DECS-250N can employ either droop compensation or cross-current compensation (reactive differential) schemes for reactive load sharing. A separate load sharing function enables each machine to share the load proportionally without incurring a voltage and frequency droop.

Paralleled generator settings are illustrated in Figure 19 and described in the following paragraphs.

Reactive Droop Compensation

Droop compensation serves as a method of controlling reactive current when the generator is connected in parallel with another energy source. Droop compensation utilizes the B-phase CT in single-phase applications. When droop compensation is enabled^A, the generator voltage is adjusted in proportion to the measured generator reactive power. The reactive droop compensation setting^B is expressed as a percentage of the generator rated terminal voltage.

| Note |
|---|
| For droop compensation to operate, the PARALLEL_EN_LM logic block must be set true in BESTlogic TM <i>Plus</i> programmable logic. |

Cross-Current Compensation

Cross-current compensation (reactive differential) mode serves as a method of connecting multiple generators in parallel to share reactive load. When reactive load is shared properly, no current is fed into the DECS-250N cross-current compensation input (which is connected to the B-phase transformer). Improper sharing of reactive load causes a differential current to be fed into the cross-current compensation input. When cross-current compensation is enabled^C, this input causes the DECS-250N to respond with the proper level of regulation. The response of the DECS-250N is controlled by the cross-current compensation gain setting^D which is expressed as a percentage of the system nominal CT setting.

Application information about cross-current compensation is available in the *Voltage and Current* chapter of this manual.

Network Load Sharing

In a multiple-generator application, the load sharing function ensures equal generator reactive-power sharing. It operates in a similar manner to cross-current compensation but without the external hardware requirements and distance limitations. Instead of sharing load based on the CT ratio, load is shared on a per-unit basis calculated from the generator rated data. Sharing of load information between DECS-250N controllers is accomplished through the Ethernet port of each DECS-250N communicating over a peer-to-peer network dedicated for the load sharing function. Each DECS-250N measures the reactive current of its associated generator and broadcasts its measurement to all other DECS-250N controllers on the network. Each DECS-250N compares its level of reactive current to the sum of all measured currents and adjusts its excitation level accordingly.

Network load sharing implements a fading droop function based on the droop setting, washout filter gain, and washout filter time constant. During transients, load sharing will droop according to the droop percentage and washout filter gain settings. The droop characteristic will fade with a time constant according to the washout filter time constant.

A Load Share ID setting identifies the DECS-250N as a load sharing unit in the network. Checking a Load Sharing Unit number box allows any DECS-250N load sharing units on the network with that Load Share

ID number to share load with the currently connected DECS-250N. It is not necessary for the Load Share ID to be unique for each unit. This allows for load sharing units to be grouped.

Load sharing settings consist of an Enable checkbox^E and Droop^F, Gain^G, Washout Filter Time Constant^H, Washout Filter Gain^I and Load Share ID^J settings.

Line Drop Compensation

When enabled^K, line drop compensation can be used to maintain voltage at a load located at a distance from the generator. The DECS-250N achieves this by measuring the line current and calculating the voltage for a specific point on the line. Line drop compensation is applied to both the real and reactive portion of the generator line current. It is expressed as a percentage of the generator terminal voltage^L.

Equation 2 is used to calculate the Line Drop Value.

$$LD_{Value} = \sqrt{\left(V_{avg} - \left[LD \times I_{avg} \times \cos(I_{bang})\right]\right)^2 + \left(LD \times I_{avg} \times \sin(I_{bang})\right)^2}$$

Equation 2. Line Drop Value

| | | |
|--------------|---|--|
| LD_{Value} | = | Line drop value (per unit) |
| V_{avg} | = | Average voltage, metered value (per unit) |
| LD | = | Line Drop % / 100 |
| I_{avg} | = | Average Current, metered value (per unit) |
| I_{bang} | = | Angle of phase B current (no compensation) |

The LD_{Value} is the per-unit value seen down the line from the synchronous machine. Equation 3 is used to determine the voltage needed to adjust for line drop.

$$V_{adjust,PU} = V_{rms,PU} - LD_{Value}$$

Equation 3. Voltage Needed to Adjust for Line Drop

Equation 4 is used to obtain primary units.

$$V_{adjust} = V_{adjust,PU} \times V_{rated}$$

Equation 4. Obtain Primary Units

The new line drop adjusted setpoint is calculated using Equation 5.

$$V_{Adjusted\ Setpoint} = V_{Setpoint} + V_{adjust}$$

Equation 5. Line Drop Adjusted Setpoint

Refer to Figure 19 for an illustration of the Line drop compensation settings.

Parallel/Line Drop Compensation

Droop Compensation

☐ Enable **A**
Reactive Droop Compensation (% of rated)
5.0 **B**

Line Drop Compensation

☐ Enable **K**
Line Drop Compensation (% of rated)
5.0 **L**

Cross Current Compensation

☐ Enable **C**
Cross Current Compensation Gain (% of rated)
0.00 **D**

Network Load Share

☐ Enable **E**
Droop (%)
0.0 **F**
Gain
0.00 **G**
Washout Filter Time Constant
1.00 **H**
Washout Filter Gain
1.00 **I**
Load Share ID
1 **J**

| | |
|---|--|
| <input checked="" type="checkbox"/> Load Sharing Unit 1 | <input checked="" type="checkbox"/> Load Sharing Unit 9 |
| <input checked="" type="checkbox"/> Load Sharing Unit 2 | <input checked="" type="checkbox"/> Load Sharing Unit 10 |
| <input checked="" type="checkbox"/> Load Sharing Unit 3 | <input checked="" type="checkbox"/> Load Sharing Unit 11 |
| <input checked="" type="checkbox"/> Load Sharing Unit 4 | <input checked="" type="checkbox"/> Load Sharing Unit 12 |
| <input checked="" type="checkbox"/> Load Sharing Unit 5 | <input checked="" type="checkbox"/> Load Sharing Unit 13 |
| <input checked="" type="checkbox"/> Load Sharing Unit 6 | <input checked="" type="checkbox"/> Load Sharing Unit 14 |
| <input checked="" type="checkbox"/> Load Sharing Unit 7 | <input checked="" type="checkbox"/> Load Sharing Unit 15 |
| <input checked="" type="checkbox"/> Load Sharing Unit 8 | <input checked="" type="checkbox"/> Load Sharing Unit 16 |

Figure 19. Paralleled Generators and Line Drop Compensation Settings

- ^A *Droop Compensation Enable*: Place a check in the checkbox to enable droop compensation.
- ^B *Reactive Droop Compensation*: Adjustable from 0 to +30% in 0.1% increments.
- ^C *Cross-Current Compensation Enable*: Place a check in the checkbox to enable cross-current compensation.
- ^D *Cross-Current Compensation Gain*: Adjustable from –30 to +30% in 0.1% increments.
- ^E *Load Share Enable*: Place a check in the checkbox to enable load sharing.
- ^F *Load Share Droop*: Adjustable from 0 to 30% in 0.1% increments.
- ^G *Load Share Gain*: Adjustable from 0 to 1,000 in increments of 0.01.
- ^H *Load Share Washout Filter Time Constant*: Adjustable from 0 to 1 in increments of 0.01.
- ^I *Load Share Washout Filter Gain*: Adjustable from 0 to 1,000 in increments of 0.01.
- ^J *Load Share ID*: Adjustable from 1 to 16 in increments of 1.
- ^K *Line Drop Compensation Enable*: Place a check in the checkbox to enable line drop compensation.
- ^L *Line Drop Compensation*: Adjustable from 0 to 30% in increments of 0.1%.

Autotracking

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Autotracking

HMI Navigation Path: Settings, Operating Settings, Autotracking.

Internal regulation mode setpoint tracking and external setpoint tracking are standard features on the DECS-250N. Autotracking settings are illustrated in Figure 20.

Internal Setpoint Tracking

In applications using a single DECS-250N, internal tracking can be enabled^A so that the inactive regulation modes track the active regulation mode.

The following examples demonstrate the advantages of internal tracking:

- If the excitation system is operating online with internal tracking enabled, a loss of sensing condition could trigger a transfer to FCR mode. Autotracking minimizes the impact that a loss of sensing condition has on the exciter's ability to maintain the proper excitation level.
- While performing routine testing of the DECS-250N in backup mode, the internal tracking feature allows a transfer to an inactive mode that will result in no disturbance to the system.

Two parameters control the behavior of internal tracking. A delay setting^B determines the time delay between large system disturbance and the start of setpoint tracking. A traverse rate setting^C configures the length of time for the inactive mode setpoints to traverse the full setting range of the active mode setpoint.

External Setpoint Tracking

For critical applications, a second DECS-250N can provide backup excitation control. The DECS-250N allows for excitation redundancy by providing external tracking and transfer provisions between DECS-250N controllers. The secondary DECS-250N can be configured to track the primary DECS-250N setpoint. Proper redundant excitation system design allows for removal of the failed system.

Note

Periodic testing of the backup system must be performed to ensure that it is operational and can be placed in service without warning.

Like internal tracking, external setpoint tracking uses enable/disable^D, delay^E, and traverse rate^F settings.

Figure 20. Autotracking Settings

^A *Internal Tracking Enabled*: Place a check in the checkbox to enable internal tracking.

^B *Internal Tracking Delay*: Adjustable from 0 to 8 seconds in 0.1 second increments.

^C *Internal Tracking Traverse Rate*: Adjustable from 1 to 80 seconds in 0.1 second increments.

^D *External Tracking Enabled*: Place a check in the checkbox to enable external tracking.

^E *External Tracking Delay*: Adjustable from 0 to 8 seconds in 0.1 second increments.

^F *External Tracking Traverse Rate*: Adjustable from 1 to 80 seconds in 0.1 second increments.

Setpoint Configure

When the Auto Save setting is enabled, the DECS-250N automatically saves the active setpoint in one-minute intervals. Otherwise, the setpoint which was last sent to the DECS-250N is retained. Figure 21 illustrates the Setpoint Configure screen.

Figure 21. Setpoint Configure Setting

Auxiliary Control

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Auxiliary Inputs

HMI Navigation Path: Settings, Operating Settings, Auxiliary Inputs

The DECS-250N accepts an external analog control signal for auxiliary control of the regulation setpoint. Auxiliary setpoint control is possible in all regulation modes: AVR, PF, Var, FCR, and FVR. The control signal can also be used for limiter scaling or power system stabilizer control. Auxiliary control settings are illustrated in Figure 22.

Auxiliary Control Input Type^A

Either a voltage or current control signal may be used for auxiliary control. Terminals I+ and I– accept a 4 to 20 mA_{dc} signal. Terminals V+ and V– accept a –10 to +10 V_{dc} signal. An adjacent terminal labeled GND provides the connection for a recommended cable shield. The input type is selected in BESTCOMSPlus[®].

Auxiliary Control Input Function^B

The analog control input can be used for auxiliary control of the regulation setpoint, as a power system stabilizer test input, or for limiter scaling.

PSS Test Input

The auxiliary control input can be used for control of the optional power system stabilizer function during testing and validation. More information is provided in the *Power System Stabilizer* chapter of this manual.

Limiter Scaling

When the auxiliary control input is configured for limiter scaling, the stator current limiter (SCL) and overexcitation limiter (OEL) low-level values can be automatically adjusted. Automatic adjustment of the SCL and OEL is based on six parameters: signal and scale for three points. The signal value for each point represents the accessory input voltage. The scale value defines the limiter low level as a percentage of rated field current for the OEL and rated stator current for the SCL. For accessory input voltages between two of the three defined points, the low-level limiter setting is linearly adjusted between the two scale values. Limiter settings and limiter scaling are discussed in detail in the *Limiters* chapter of this manual.

Setpoint Limits

Minimum and maximum setpoint limits are observed when the With Limit box is checked.

Auxiliary Control Gains

When a current input type is selected, the input current is converted internally by the DECS-250N into a voltage signal in the range of –10 to +10 V_{dc}. The DECS-250N uses the following equation when converting the applied current into a voltage.

$$V_{aux} = (I_{aux} - 0.004) \times \left(\frac{20.0}{0.016} \right) - 10.0$$

Equation 6. Input Current to Voltage Signal Conversion

Where: V_{aux} is the calculated voltage signal and I_{aux} is the applied current in amperes.

For setpoint control, V_{aux} is multiplied by the appropriate regulation mode auxiliary gain setting.

If the auxiliary input is unused, all auxiliary control gains should be set to zero.

AVR Mode

In AVR mode, the auxiliary control signal is multiplied by the AVR gain setting^c. The result defines the setpoint change as a percentage of the rated generator voltage.

$$\text{Generator Voltage Adjust} = V_{aux} \times 0.01 \times \text{AVR Gain} \times \text{Rated Voltage}$$

For example, applying +10 Vdc with an AVR gain of 1.0 raises the AVR setpoint 10% of rated generator voltage. This example also applies to the following modes.

FCR Mode

In FCR mode, the auxiliary control signal is multiplied by the FCR gain setting^d. The resulting value relates to a percentage of the rated field current.

$$\text{FCR Adjust} = V_{aux} \times 0.01 \times \text{FCR Gain} \times \text{No Load Rated Field Current}$$

FVR Mode

In FVR mode, the auxiliary control signal is multiplied by the FVR gain setting^e. The resulting value relates to a percentage of the rated field voltage.

$$\text{FVR Adjust} = V_{aux} \times 0.01 \times \text{FVR Gain} \times \text{No Load Rated Field Voltage}$$

Var Mode

In var mode, the auxiliary control signal is multiplied by the Var gain setting^f. The resulting value relates to a percentage of the rated apparent power (kVA).

$$\text{var Adjust} = V_{aux} \times 0.01 \times \text{var Gain} \times 1.7321 \times \text{Rated Voltage} \times \text{Rated Current (Outerloop selected)}$$

Power Factor Mode

In Power Factor mode, the auxiliary control signal is multiplied by the PF gain setting^g to define the PF setpoint change.

$$\text{PF Adjust} = V_{aux} \times 0.01 \times \text{PF Gain (Outerloop selected)}$$

Summing Type^h

The auxiliary control signal can be configured to control the inner or outer regulation control loop. Selecting the inner loop limits auxiliary control to AVR, FCR, and FVR modes. Selecting the outer loop limits auxiliary control to PF and Var modes.

Auxiliary Input

Input Type

Input Type: Voltage [A]

Input Function

Input Function: DECS Input [B]

☐ With Limit

Summing Type

Summing Type: Inner Loop [H]

Auxiliary Gain Settings

AVR (Mode) Gain: 1.00 [C]

FCR (Mode) Gain: 1.00 [D]

FVR (Mode) Gain: 1.00 [E]

VAR (Mode) Gain: 1.00 [F]

PF (Mode) Gain: 1.00 [G]

Figure 22. Auxiliary Input Settings

-
- ^A *Input Type*: Select Voltage or Current.
- ^B *Input Function*: Select DECS Input, Limiter Scaling, or PSS Test Input.
- ^C *AVR (Mode) Gain*: Adjustable from –99 to +99 in 0.01 increments.
- ^D *FCR (Mode) Gain*: Adjustable from –99 to +99 in 0.01 increments.
- ^E *FVR (Mode) Gain*: Adjustable from –99 to +99 in 0.01 increments.
- ^F *Var (Mode) Gain*: Adjustable from –99 to +99 in 0.01 increments.
- ^G *PF (Mode) Gain*: Adjustable from –99 to +99 in 0.01 increments.
- ^H *Summing Type*: Select Inner Loop or Outer Loop.



Contact Inputs and Outputs

Sixteen isolated, contact sensing inputs are available for initiating DECS-250N actions. Twelve sets of output contacts provide annunciation and control.

Contact Inputs

BESTCOMS^{Plus} Navigation Path: Settings Explorer, Programmable Inputs, Contact Inputs

HMI Navigation Path: Not available through HMI.

Sixteen contact inputs are provided for initiating DECS-250N actions. Two of the contact inputs are fixed-function inputs: Start and Stop. The remaining 14 contact inputs are programmable. An additional 10 contact inputs are available with the optional Contact Expansion Module (CEM-2020). Contact Basler Electric for ordering information.

All contact inputs are compatible with dry relay/switch contacts or open-collector outputs from a PLC. Each contact input has an isolated interrogation voltage and current of 12 Vdc at 4 mAdc. Appropriate switches/contacts should be selected for operation with this signal level.

| Note |
|---|
| The length of wiring connected to each contact input terminal must not exceed 150 feet (45.7 meters). Longer wiring lengths may allow induced electrical noise to interfere with the recognition of contact inputs. |

Start and Stop Inputs

The Start and Stop inputs accept a momentary contact closure that enables (Start) and disables (Stop) the DECS-250N. If the DECS-250N receives Start and Stop contact inputs simultaneously, the Stop input takes priority. Start contact input connections are made at terminals START and COM A. Stop contact input connections are made at terminals STOP and COM A.

Programmable Inputs

The 14 programmable inputs can be connected to monitor the status of excitation system contacts and switches. Then, using BESTlogicTM *Plus* programmable logic, these inputs can be used as part of a user-configured logic scheme to control and annunciate a variety of system conditions and contingencies. Information about using the programmable inputs in a logic scheme is provided in the *BESTlogicPlus* chapter.

To make the programmable contact inputs easier to identify, you can assign a custom name^A that relates to the inputs/functions of your system. Figure 23 shows a portion of the BESTCOMS^{Plus}® Contact Inputs screen where each of the 14 inputs can be assigned a custom name.

Figure 23. Contact Input Label Text

^A *Label Text*: Enter a string of up to 64 alphanumeric characters.

See the *Terminals and Connectors* chapter for an illustration of the programmable input terminals.

Contact Outputs

BESTCOMSPlus Navigation Path: Settings Explorer, Programmable Outputs, Contact Outputs

HMI Navigation Path: Not available through HMI.

DECS-250N contact outputs consist of a dedicated watchdog output and 11 programmable outputs. An additional 18 contact outputs are available with the optional Contact Expansion Module (CEM-2020H). The optional CEM-2020 provides an additional 24 contact outputs. Contact Basler Electric for ordering information.

Watchdog Output

This SPDT (Form C) output changes state during the following conditions:

- Control power is lost
- Normal firmware execution ceases
- Transfer Watchdog Trip is asserted in *BESTlogicPlus*.

Watchdog output connections are made at terminals WTCHD1 (normally open), WTCHD (common), and WTCHD2 (normally closed).

Programmable Outputs

The 11 programmable, normally-open contact outputs can be configured to annunciate DECS-250N status, active alarms, active protection functions, and active limiter functions. Using *BESTlogicPlus* programmable logic, these outputs can be used as part of a user-configured logic scheme to control and annunciate a variety of system conditions and contingencies. Information about using the programmable outputs in a logic scheme is provided in the *BESTlogicPlus* chapter.

To make the programmable contact outputs easier to identify, you can assign a custom name^A that relates to the functions of your system. Figure 24 shows the *BESTCOMSPlus* Contact Outputs screen where each of the 11 outputs can be assigned a custom name.

Output #1

Label Text

OUTPUT 1

A

Output #2

Label Text

OUTPUT 2

Output #3

Label Text

OUTPUT 3

Output #4

Label Text

OUTPUT 4

Output #5

Label Text

OUTPUT 5

Output #6

Label Text

OUTPUT 6

Output #7

Label Text

OUTPUT 7

Output #8

Label Text

OUTPUT 8

Output #9

Label Text

OUTPUT 9

Output #10

Label Text

OUTPUT 10

Output #11

Label Text

OUTPUT 11

Figure 24. Contact Output Label Text

^A *Label Text*: Enter a string of up to 64 alphanumeric characters.

See the *Terminals and Connectors* chapter for an illustration of the programmable output terminals. Contact output electrical ratings are listed in the *Specifications* chapter.



Protection

The DECS-250N offers protection relating to generator voltage, frequency, power, field parameters, rotating exciter diodes, power input failure, and generator-to-bus synchronism. Configurable protection elements supplement this protection with additional, user-defined system parameters that have multiple pickup thresholds per parameter. Most protection functions have two groups of settings labeled Primary and Secondary. Two setting groups enable independent protection coordination which is selectable in BESTlogic™ *Plus*.

Voltage Protection

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Voltage

HMI Navigation Path: Settings, Protection, Voltage Protection

Voltage protection includes overexcitation, generator undervoltage, generator overvoltage, and loss of sensing voltage.

Overexcitation (Volts per Hertz)

Volts per hertz protection is annunciated if the ratio of the per-unit voltage to the per-unit frequency (volts/hertz) exceeds one of the Volts per Hertz Pickup Level^A settings for a definite amount of time^B. If the Volts per Hertz Pickup level is exceeded, timing will continue until the volts per hertz ratio drops below the dropout ratio (95%). Volts per hertz protection also guards against other potentially damaging system conditions such as a change in system voltage and reduced frequency conditions that can exceed the system's excitation capability.

Several volts per hertz settings enable the DECS-250N to provide flexible generator and generator step-up transformer overexcitation protection. An inverse square timing characteristic is provided through the Inverse Time Pickup Setpoint^C and Time Dial^D settings. These settings enable the DECS-250N to approximate the heating characteristic of the generator and generator step-up transformer during overexcitation. A linear reset characteristic is provided through the Reset Dial^E setting. Volts per hertz protection can be enabled and disabled^F without altering the pickup and time delay settings.

Two sets of fixed-time, overexcitation pickup settings are available through the Definite Time Pickup #1, #2 and Definite Time Delay #1, #2 settings.

The following equations represent the trip time and reset time for a constant V/Hz level. Volts per hertz characteristic curves are illustrated in Figure 25 and Figure 26.

$$T_T = \frac{D_T}{\left(\frac{V / Hz_{MEASURED}}{V / Hz_{NOMINAL}} - 1 \right)^n}$$

Equation 7. Trip Time

$$T_R = D_R \times \frac{E_T}{FST} \times 100$$

Equation 8. Reset Time

Where:

T_T = time to trip

T_R = time to reset

D_T = time dial trip

D_R = time dial, reset

E_T = elapsed time

n = curve exponent (0.5, 1, 2)^G

FST=full scale trip time (T_T)

E_T/FST =fraction of total travel toward trip that integration had progressed to. (After a trip, this value will be equal to 1.)

BESTCOMS*Plus*® overexcitation settings are illustrated in Figure 27.

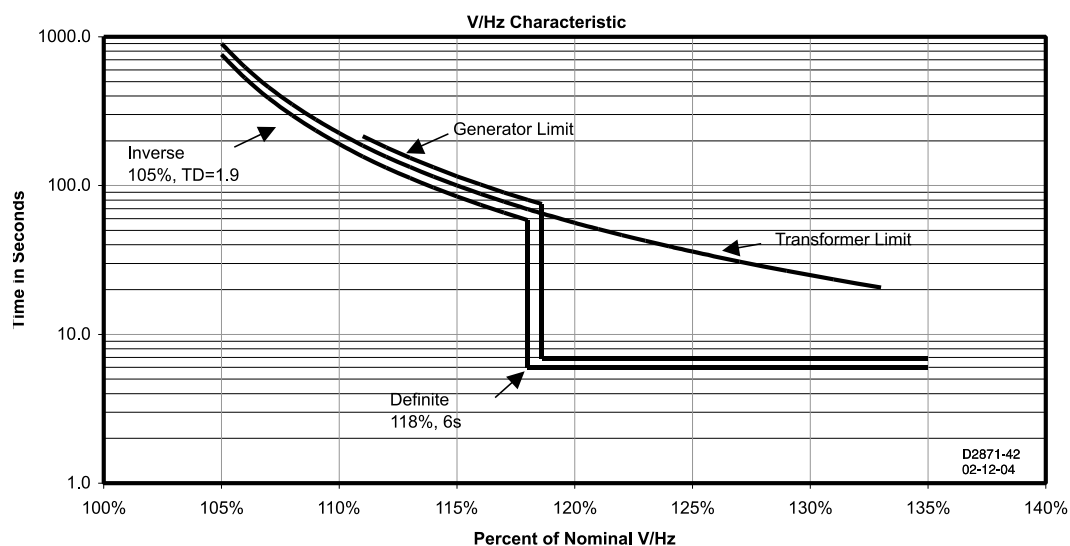


Figure 25. V/Hz Characteristic – Time Shown on Vertical Axis

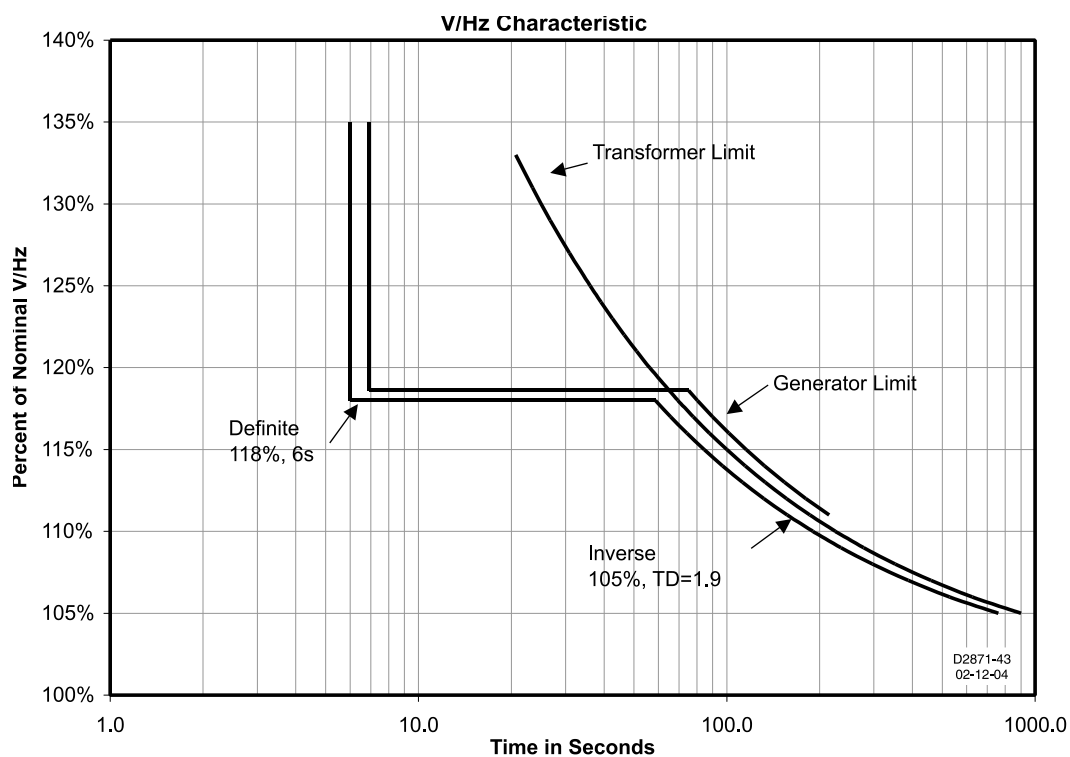


Figure 26. V/Hz Characteristic – Time Shown on Horizontal Axis

Figure 27. Overexcitation Protection Settings

- ^A *Definite Time Pickup*: Adjustable from 0 or 0.5 to 6.00 in increments of 0.01.
^B *Definite Time Delay*: Adjustable from 0.05 to 600 seconds in increments of 0.001 seconds.
^C *Inverse Time Pickup*: Adjustable from 0 or 0.5 to 6.00 in increments of 0.01.
^D *Time Dial*: Adjustable from 0.0 to 9.9 in increments of 0.1.
^E *Reset Dial*: Adjustable from 0.0 to 9.9 in increments of 0.1.
^F *Mode*: Select Enabled or Disabled.
^G *Curve Exponent*: Select 0.5, 1, or 2

Generator Undervoltage

An undervoltage pickup condition occurs when the sensed generator terminal voltage decreases below the pickup setting^A. An undervoltage trip condition occurs if the generator voltage remains below the pickup threshold for the duration of the time delay setting^B. Generator undervoltage protection can be enabled and disabled^C without altering the pickup and time delay settings. Undervoltage pickup and trip elements in BESTLogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus generator undervoltage settings are illustrated in Figure 28.

Figure 28. Generator Undervoltage Protection Settings

- ^A *Generator Undervoltage Pickup (V)*: Adjustable from 0 to 600,000 Vac in 1 Vac increments.
^B *Generator Undervoltage Time Delay (s)*: Adjustable from 0.1 to 60 seconds in 0.1 second increments.
^C *Generator Undervoltage Enable/Disable*: Select Enabled or Disabled.

Generator Overvoltage

An overvoltage pickup condition occurs when the sensed generator terminal voltage increases above the pickup setting^A. An overvoltage trip condition occurs if the generator voltage remains above the pickup threshold for the duration of the time delay setting^B. Generator overvoltage protection can be enabled and disabled^C without altering the pickup and time delay settings. Overvoltage pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPPlus generator overvoltage settings are illustrated in Figure 29.

Generator Overvoltage

59 Element

| Primary | Secondary |
|---------------------------|---------------------------|
| Mode: Enabled [C] | Mode: Enabled [C] |
| Pickup (Primary V): 0 [A] | Pickup (Primary V): 0 [A] |
| Time Delay (s): 0.1 [B] | Time Delay (s): 0.1 [B] |

Figure 29. Generator Overvoltage Protection Settings

^A *Generator Overvoltage Pickup (V)*: Adjustable from 0 to 600,000 Vac in 1 Vac increments.

^B *Generator Overvoltage Time Delay (s)*: Adjustable from 0.1 to 60 seconds in 0.1 second increments.

^C *Generator Overvoltage Enable/Disable*: Select Enabled or Disabled.

Loss of Sensing

The generator voltage is monitored for a loss of sensing (LOS) condition. LOS protection settings are illustrated in Figure 30.

In the DECS-250N, a loss of sensing event is calculated using sequence components. A loss of sensing event occurs when the positive sequence voltage drops below the balanced^A setting percentage of the AVR setpoint, or when the negative sequence voltage increases above the unbalanced^B setting percentage of the positive sequence voltage. A delay timer^C is started when the event occurs, delaying the alarm by a predetermined time

A LOS condition can be used to initiate a transfer to manual (FCR) control mode^D. It also can be configured in BESTlogicPlus to initiate other actions. Protection can be enabled and disabled^E without altering the individual loss of sensing settings.

LOS protection is automatically disabled when a short circuit exists. A short circuit is detected when the measured current is greater than twice the rated current for a single-phase CT connection and when the positive sequence current is greater than twice the rated current for a three-phase CT connection.

Loss of Sensing

LOS Element

Mode: Disabled [E]

Time Delay (s): 2.0 [C]

Voltage Balanced Level (%): 8.8 [A]

Voltage Unbalanced Level (%): 25.0 [B]

Transfer To Manual: Disabled [D]

Figure 30. Loss of Sensing Protection Settings

^A *Voltage Balanced Level*: Adjustable from 0 to 100% in 0.1% increments.

^B *Voltage Unbalanced Level*: Adjustable from 0 to 100% in 0.1% increments.

^C *Time Delay*: Adjustable from 0 to 30 seconds in 0.1 second increments.

^D *Transfer to Manual*: Select Disabled or Enabled.

^E *Mode*: Select Disabled or Enabled.

Frequency Protection

BESTCOMSPlus Navigation Path: Settings Explorer, Protection, Frequency

HMI Navigation Path: Settings, Protection, Frequency Protection 81

The frequency of the generator terminal voltage is monitored for overfrequency and under-frequency conditions.

Overfrequency

An overfrequency condition occurs when the frequency of the generator voltage exceeds the 81O pickup threshold^A for the duration of the 81O time delay setting^B. Overfrequency protection can be enabled and disabled^C without altering the pickup and time delay settings. Overfrequency pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus overfrequency settings are illustrated in Figure 31.

Figure 31. Overfrequency Protection Settings

^A *Overfrequency (81O) Pickup (Hz)*: Adjustable from 30 to 70 hertz in 0.01 hertz increments.

^B *Overfrequency (81O) Time Delay (s)*: Adjustable from 0.1 to 300 seconds in 0.1 second increments.

^C *Overfrequency (81O) Mode*: Select Disabled or Over.

Underfrequency

An underfrequency condition occurs when the frequency of the generator voltage decreases below the 81U pickup threshold^A for the duration of the 81U time delay setting^B. A voltage inhibit setting^C, expressed as a percentage of the rated generator voltage, can be implemented to prevent an underfrequency trip from occurring during startup when the generator voltage is rising toward the nominal level.

Underfrequency protection can be enabled and disabled^D without altering the pickup, delay, and inhibit settings. Underfrequency pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus underfrequency settings are illustrated in Figure 32.

Frequency

81U Element

Primary

Mode: Under [D]

Pickup (Hz): 30.00 [A]

Time Delay (s): 0.1 [B]

Voltage Inhibit (%): 50 [C]

Secondary

Mode: Under [D]

Pickup (Hz): 30.00 [A]

Time Delay (s): 0.1 [B]

Voltage Inhibit (%): 50 [C]

Figure 32. Underfrequency Protection Settings

- ^A Underfrequency (81U) Pickup (Hz): Adjustable from 30 to 70 hertz in 0.01 hertz increments.
- ^B Underfrequency (81U) Time Delay (s): Adjustable from 0.1 to 300 seconds in 0.1 second increments.
- ^C Underfrequency (81U) Voltage Inhibit (%): Adjustable from 50 to 100% in 1% increments.
- ^D Underfrequency (81U) Mode: Select Disable or Under.

Power Protection

BESTCOMSPlus Navigation Path: Settings Explorer, Protection, Power

HMI Navigation Path: Settings, Protection, Power

Generator power levels are monitored to protect against reverse power flow and loss of excitation.

Reverse Power

Reverse power protection guards against reverse power flow that may result from a loss of prime mover torque (and lead to generator motoring). A reverse power condition occurs when the flow of reverse power exceeds the 32R pickup threshold^A for the duration of the 32R time delay^B. Reverse power protection can be enabled and disabled^C without altering the pickup and time delay settings. Reverse power pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus reverse power protection settings are illustrated in Figure 33.

Reverse Power

32R Element

Primary

Mode: Enabled [C]

Pickup (%): 0 [A]

Time Delay (s): 0.0 [B]

Secondary

Mode: Enabled [C]

Pickup (%): 0 [A]

Time Delay (s): 0.0 [B]

Figure 33. Reverse Power Protection Settings

- ^A Reverse Power (32R) Pickup (%): Adjustable from 0 to 150% in 1% increments.
- ^B Reverse Power (32R) Time Delay (s): Adjustable from 0 to 300 seconds in 0.1 second increments.
- ^C Reverse Power (32R) Mode: Select Disabled or Enabled.

Loss of Excitation

The loss of excitation element operates on excessive var flow into the machine, indicating abnormally low field excitation. This element protects controlled generators as well as motors. A diagram of the 40Q

pickup response is illustrated in Figure 34. BESTCOMS*Plus* settings are described below and shown in Figure 35.

Generator Protection

During loss of excitation, the generator absorbs reactive power from the power system which can overheat the stator windings. The Loss of Excitation element acts on the principal that if a generator begins to absorb vars outside its steady-state capability curve, it has likely lost its normal excitation supply. The element is always calibrated to the equivalent three-phase power even if the connection is single-phase.

The Loss of Excitation element compares the reactive power to a map of the allowed reactive power as defined by the Pickup setting. The Loss of Excitation element remains in a pickup condition until power flow falls below the dropout ratio of 95% of the actual pickup. A time delay is recommended for tripping. For settings well outside the generator capability curve, adding a 0.5 second time delay helps prevent transient fault conditions. However, recovery from power system swings after a major fault may take several seconds. Therefore, if the unit is to pick up near the steady-state capability curve of the generator, longer time delays are recommended. See Figure 34 for details.

Motor Protection

The DECS-250N compares the real power (kW) flowing into the motor with the reactive power (kvar) being supplied. Operation of synchronous motors drawing reactive power from the system can result in overheating in parts of the rotor that do not normally carry current. The 40Q pickup response is shown in Figure 34.

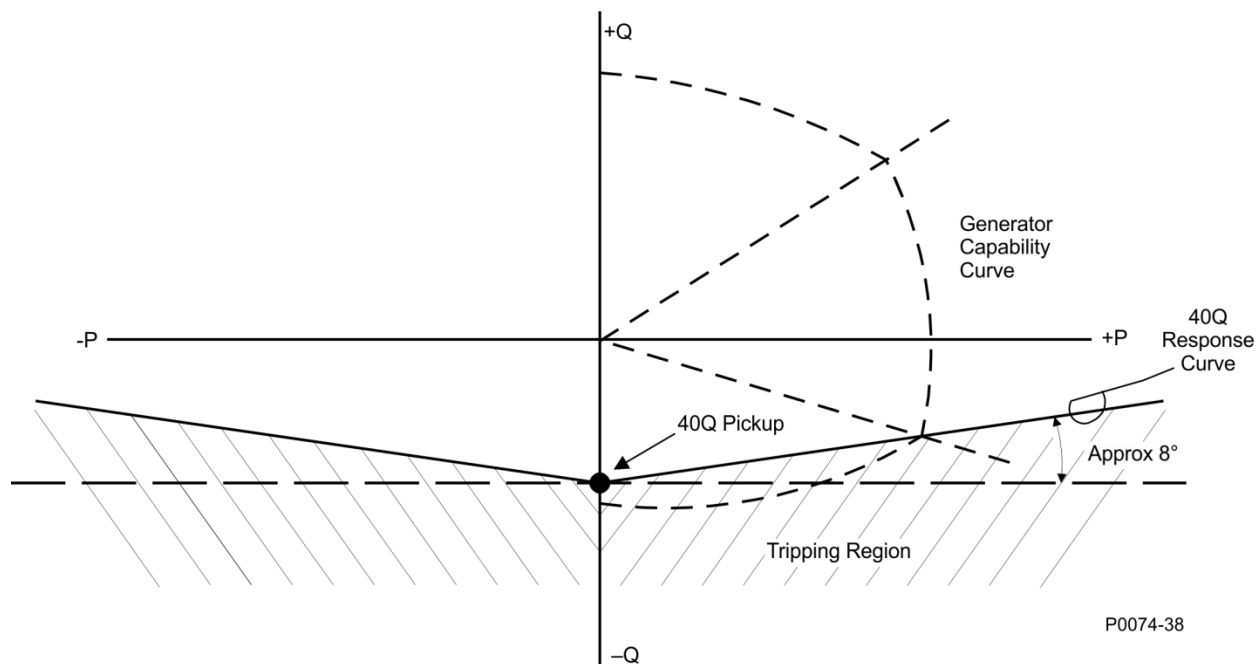


Figure 34. Generator Capability Curve vs. 40Q Response

Pickup and Trip

A loss of excitation condition exists when the level of absorbed vars exceeds the loss of excitation (40Q) threshold^A for the duration of the 40Q time delay^B. A time delay setting of zero (0) makes the Loss of Excitation element instantaneous with no intentional time delay. If the pickup condition subsides before the time delay expires, the timer and pickup are reset, no corrective action is taken, and the element is rearmed for any other occurrences of loss of excitation.

The 40Q threshold is expressed as a percentage of the rated var flow for the machine. Loss of excitation protection can be enabled and disabled^C without altering the pickup and time delay settings. BESTCOMS*Plus* loss of excitation settings are illustrated in Figure 35.

Loss of Excitation

40Q Element

| Primary | Secondary |
|---------------------------------|---------------------------------|
| Mode: Enabled [C] | Mode: Enabled [C] |
| Pickup (% of Rated vars): 0 [A] | Pickup (% of Rated vars): 0 [A] |
| Time Delay (s): 0.0 [B] | Time Delay (s): 0.0 [B] |

Figure 35. Loss of Excitation Protection Settings

^A *Pickup (% of rated vars)*: Adjustable from 0 to 150% in 1% increments.

^B *Time Delay*: Adjustable from 0 to 300 seconds in 0.1 second increments.

^C *Mode*: Select Disabled or Enabled.

Field Protection

BESTCOMSPlus Navigation Path: Settings Explorer, Protection, Field

HMI Navigation Path: Settings, Protection, Field

Field protection provided by the DECS-250N includes field overvoltage, field overcurrent, an exciter diode monitor, and power input failure.

Field Overvoltage

A field overvoltage condition occurs when the field voltage exceeds the field overvoltage threshold^A for the duration of the field overvoltage time delay^B. Field overvoltage protection can be enabled and disabled^C without altering the pickup and time delay settings. Field overvoltage pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTlogicPlus field overvoltage settings are illustrated in Figure 36.

Field Overvoltage

| Primary | Secondary |
|---------------------------|---------------------------|
| Mode: Enabled [C] | Mode: Enabled [C] |
| Pickup (Primary V): 1 [A] | Pickup (Primary V): 1 [A] |
| Time Delay (s): 0.2 [B] | Time Delay (s): 0.2 [B] |

Figure 36. Field Overvoltage Protection Settings

^A *Field Overvoltage Pickup (V)*: Adjustable from 0 to 325 Vdc in 1 Vdc increments.

^B *Field Overvoltage Time Delay (s)*: Adjustable from 0.2 to 30 seconds in 0.1 second increments.

^C *Field Overvoltage Mode*: Select Disabled or Enabled.

Field Overcurrent

A field overcurrent condition is annunciated when the field current exceeds the field overcurrent pickup level^A for the duration of the field overcurrent time delay. Depending on the selected timing mode^B, the time delay can be fixed or related to an inverse function. Definite timing mode uses a fixed time delay^C. In inverse timing mode, the time delay is shortened in relation to the level of field current above the pickup level. The time dial^D setting acts as a linear multiplier for the time to an annunciation. This enables the DECS-250N to approximate the heating characteristic of the generator and generator step-up transformer

during overexcitation. The field current must fall below the dropout ratio (95%) for the function to begin timing to reset. The following equations are used to calculate the field overcurrent pickup and reset time delays.

$$t_{pickup} = \frac{A \times TD}{B + \sqrt{C + D \times MOP}}$$

Equation 9. Inverse Field Overcurrent Pickup

Where:

t_{pickup} = time to pick up in seconds
 A = -95.908
 B = -17.165
 C = 490.864
 D = -191.816
 TD = time dial setting <0.1, 20>
 MOP = multiple of pickup <1.03, 205>

$$Time_{reset} = \frac{0.36 \times TD}{(MOP_{reset})^2 - 1}$$

Equation 10. Inverse Field Overcurrent Reset

Where:

$Time_{reset}$ = maximum time to reset in seconds
 TD = time dial setting <0.1, 20>
 MOP_{reset} = multiple of pickup <1.03, 205>

Primary and secondary setting groups provide additional control for two distinct machine operating conditions.

Field overcurrent protection can be enabled and disabled^E without altering the pickup and time delay settings. Field overcurrent pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus field overcurrent settings are illustrated in Figure 37. In BESTCOMSPlus, a plot of the field overcurrent setting curve is displayed. The plot can display the primary or secondary setting curves.

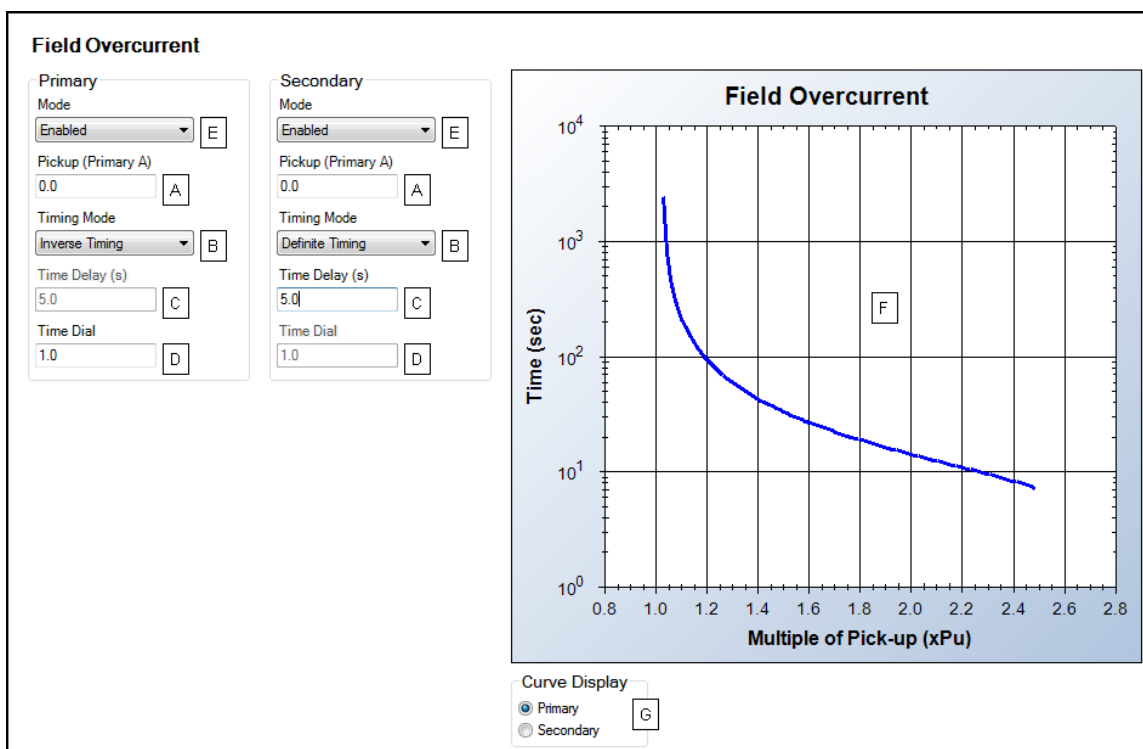


Figure 37. Field Overcurrent Protection Settings

- ^A *Field Overcurrent Pickup (A)*: Adjustable from 0 to 22 Adc in 0.1 Adc increments.
- ^B *Timing Mode*: Select Definite Timing or Inverse Timing
- ^C *Field Overcurrent Time Delay (s)*: Adjustable from 0 or 5 to 60 seconds in 0.1 second increments.
- ^D *Field Overcurrent Time Dial*: Adjustable from 0.1 to 20 in increments of 0.1.
- ^E *Field Overcurrent Mode*: Select Disabled or Enabled.
- ^F Inverse field overcurrent pickup curve.
- ^G Curve display selections.

Exciter Diode Monitor

The exciter diode monitor (EDM) monitors the condition of a brushless exciter's power semiconductors by monitoring the exciter field current. The EDM detects both open and shorted rotating diodes in the exciter bridge. EDM settings are illustrated in Figure 38. When implementing the EDM, it is imperative that the user know and specify the number of poles for the exciter armature and the generator rotor. For reliable open diode detection, the exciter to generator pole ratio^A should be 1.5 or higher and the level of field current should be no less than 1.5 Adc. A pole ratio calculator, available in BESTCOMS*Plus*, can be used to calculate the pole ratio from the number of exciter armature and generator rotor poles.

Note

If the number of poles for the exciter armature and the generator rotor is unknown, the EDM function will still operate. However, only a shorted diode can be detected. If the number of poles is not known, it is best to disable all exciter open diode protection parameters. In this situation, the generator and exciter pole parameters must be set at zero to prevent false tripping.

An open exciter diode may not be detected if the generator frequency and operating power frequency are the same and the DECS-250N operating power is supplied by a single-phase source. Three-phase operating power is recommended for reliable open diode detection. Open diode detection will also be impaired when a permanent magnet generator (PMG) is supplying DECS-250N operating power and the PMG frequency is the same or lower than the generator frequency.

All of the EDM setup guidelines presented here assume that the exciter diodes are not open or shorted at the time of setup and testing.

The EDM estimates the fundamental harmonic of the exciter field current using discrete Fourier transforms (DFTs). The harmonic, expressed as a percentage of the field current, is then compared to the pickup level for open diode detection^B and shorted diode detection^C. If the percentage of field current exceeds the open diode or shorted diode pickup level, then the appropriate time delay will begin. After the time delay for the open diode^D or shorted diode^E condition expires and if the percentage of field current continues to exceed the open or shorted diode pickup setting, the condition is annunciated. EDM pickup and trip elements in *BESTlogicPlus* can be used in a logic scheme to initiate corrective action in response to an open or shorted diode condition.

An EDM disable level setting prevents nuisance annunciations due to low excitation current or the generator frequency being out of range. A disable level setting^F can be used to disable both open- and shorted-diode protection when the rated field current drops below the user-defined percentage. EDM protection can be disabled and enabled^G by the user without altering the individual protection settings.

Applying EDM Protection

It is especially difficult to detect open diode conditions when the number of generator and exciter poles is unknown. For this reason, the ratio of the number of brushless exciter armature poles to the number of generator rotor poles should be entered to ensure detection of both open and shorted diodes.

Finding the Maximum Field Ripple Current

To set the open diode pickup level and shorted diode pickup level, the maximum ripple current on the field must be known. This can be accomplished by running the generator unloaded and at rated speed. Vary the generator voltage from minimum to maximum while monitoring the EDM ripple level on the HMI display. Record the highest value.

Setting the Pickup Level—Number of Generator Poles Known

Multiply the highest EDM ripple value, obtained in the preceding paragraph, by 2. The result is the open diode pickup level setting. The multiplier can be varied between 1.5 and 5 to increase or decrease the trip margin. However, reducing the multiplier could result in nuisance open diode indications.

Multiply the highest EDM ripple value, obtained in the preceding paragraph by 50. The result is the shorted diode pickup level setting. The multiplier can be varied between 40 and 70 to increase or decrease the trip margin. However, reducing the multiplier could result in nuisance shorted diode indications.

The DECS-250N has fixed EDM inhibit levels to prevent nuisance failed-diode indications while the generator frequency is less than 40 hertz or greater than 70 hertz. EDM operation is also inhibited when the level of field current is below the disable level setting.

Figure 38. Exciter Diode Monitor Protection Settings

- ^A EDM Pole Ratio: Adjustable from 0 to 10 in 0.01 increments.
- ^B Open Diode Pickup Level (%): Adjustable from 0 to 100% in 0.1% increments.
- ^C Shorted Diode Pickup Level (%): Adjustable from 0 to 100% in 0.1% increments.
- ^D Open Diode Delay (s): Adjustable from 10 to 60 seconds in 0.1 second increments.
- ^E Shorted Diode Delay (s): Adjustable from 5 to 30 seconds in 0.1 second increments.
- ^F Disable Level (%): Adjustable from 0 to 100% in 0.1% increments.
- ^G Mode: Select Disabled or Enabled.

Setting the Pickup Level—Number of Generator Poles Unknown

The DECS-250N can detect shorted diode conditions when the number of generator poles is not known. To provide this protection, disable open diode protection, set the pole ratio at zero, and enable shorted diode protection. Multiply the maximum EDM ripple level, obtained under *Finding the Maximum Field Ripple Current*, by 30. The multiplier can be varied between 20 and 40 to increase or decrease the pickup margin. However, reducing the multiplier could result in nuisance shorted diode indications.

Testing the EDM Settings

Start the generator from rest and increase the speed and voltage to the rated value. Load the machine to its rating and confirm that no failed diode annunciations occur. All of the EDM setup guidelines presented here assume that the exciter diodes were not opened or shorted at the time of setup and testing.

Power Input Failure

A power input failure condition exists when any one of the following occurs:

1-Phase Operating Power

- When operating power decreases below 50 Vac, a power input failure condition exists.

3-Phase Operating Power

- All three phases of operating power decrease below 50 Vac
- One or more phases of operating power decreases below 10 Vac
- A phase-to-phase voltage imbalance greater than 20% exists at the operating power input

The DECS-250N settings must be properly set to match the active operating power configuration. For example, if the DECS-250N settings reflect a 3-phase power configuration but the actual operating power configuration is 1-phase then the DECS-250N will interpret the one phase as an imbalance and set an alarm/trip. For more information on 1- and 3-phase operating power settings see *Configuration and Specifications*.

Power input failure protection can be used for PMG applications, shunt-, or PMG-powered systems. This protection is only active in *Start* mode and after soft start. A time delay setting^A delays power input failure annunciations to accommodate transient reductions/imbalance in the operating power input voltage. Power input failure protection can be enabled and disabled^B without altering the time delay setting. The

selected power input configuration^C is shown as a read-only value. Power input failure pickup and trip elements in BESTlogicPlus can be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMSPlus power input failure settings are illustrated in Figure 39.

Figure 39. Power Input Failure Protection Settings

^A Time Delay (s): Adjustable from 0 to 10 seconds in 0.1 second increments.

^B Mode: Select Disabled or Enabled.

^C Power Input Configuration: Read-only value

Sync-Check Protection

BESTCOMSPlus Navigation Path: Settings Explorer, Protection, Sync Check (25)

HMI Navigation Path: Settings, Protection, Sync Check (25)

Caution

Because the DECS-250N sync-check and automatic synchronizer functions share internal circuitry, the sync-check function is not available when the automatic synchronizer style option is selected.

When enabled^A, the sync-check (25) function supervises the automatic or manual synchronism of the controlled generator with a bus/utility. During synchronizing, the 25 function compares the voltage^B, slip angle^C, and slip frequency^D differences between the generator and bus. When the generator/bus differences fall within the setting for each parameter, the 25 status virtual output asserts. This virtual output can be configured (in BESTlogicPlus) to assert a DECS-250N contact output. This contact output can, in turn, enable the closure of a breaker tying the generator to the bus.

An angle compensation^E setting is provided to offset phase shift caused by transformers in the system. For more details on the angle compensation setting, see the *Synchronizer* chapter.

When the Gen Freq > Bus Freq^F setting box is checked, the 25 status virtual output will not assert unless the generator frequency is greater than the bus frequency. Sync-check protection settings are illustrated in Figure 40.

Figure 40. Sync-Check Protection Settings

^A *Sync-Check Mode*: Select Disabled or Enabled.

^B *Sync-Check Voltage Difference (%)*: Adjustable from 0 to 50% in 0.1% increments.

^C *Sync-Check Slip Angle (Degrees)*: Adjustable from 1 to 99° in 0.1° increments.

^D *Sync-Check Slip Freq (Hz)*: Adjustable from 0.01 to 0.5 Hz in 0.01 Hz increments.

^E *Angle Compensation (°)*: Adjustable from 0.0 to 359.9° in 0.1° increments.

^F *Gen Freq > Bus Freq*: Enable (checked) or Disable (unchecked)

Generator Frequency Less Than 10 Hertz

A *Generator Below 10 Hz* condition is annunciated when the generator frequency decreases below 10 Hz or when residual voltage is low at 50/60 Hz. A *Generator Below 10 Hz* annunciation is automatically reset when the generator frequency increases above 10 Hz or the residual voltage increases above the threshold.

Configurable Protection

BESTCOMSPlus Navigation Path: Settings Explorer, Protection, Configurable Protection

HMI Navigation Path: Settings, Protection, Configurable Protection

The DECS-250N has eight configurable protection elements which can be used to supplement the standard DECS-250N protection. BESTCOMSPlus configurable protection settings are illustrated in Figure 41. To make the protection elements easier to identify, each element can be given a user-assigned name^A. A protection element is configured by selecting the parameter^B to be monitored and then establishing the operating characteristics for the element. Any one of the following parameters may be selected.

- Analog Input 1, 2, 3, 4, 5, 6, 7, 8
- Auxiliary Input Current (mA)
- Auxiliary Input Voltage
- Bus Frequency
- Bus Voltage: V_{AB} , V_{BC} , or V_{CA}
- EDM Ripple
- Exciter Field Current
- Exciter Field Voltage
- Gen Current: I_A , I_B , I_C , or Average
- Gen Frequency
- Gen Power Factor
- Gen Voltage: V_{AB} , V_{BC} , V_{CA} , or Average

- Kilovarhours
- Kilowatthours
- Negative Sequence Current
- Negative Sequence Voltage
- Positive Sequence Current
- Positive Sequence Voltage
- PSS Output
- RTD Input 1, 2, 3, 4, 5, 6, 7, 8
- Setpoint Position
- Thermocouple 1, 2
- Total kVA
- Total kvar
- Total kW
- Tracking Error

If an optional Analog Expansion Module (AEM-2020) is used, any one of the following analog, RTD, and thermocouple inputs may be selected.

- Analog Input 1, 2, 3, 4, 5, 6, 7, or 8
- RTD Input 1, 2, 3, 4, 5, 6, 7, or 8
- Thermocouple 1 or 2

Protection can be always enabled or enabled only when the DECS-250N is enabled and supplying excitation^c. When protection is enabled only in Start mode, an arming time delay^d can be used to delay protection following the start of excitation.

A hysteresis function holds the protection function active for a user-defined percentage^e above/below the pickup threshold. This prevents repeated pickups and dropouts where the monitored parameter is hovering around the pickup threshold. For example, with a hysteresis setting of 5% on a protection element configured to pick up at 100 Aac of A-phase generator overcurrent, the protection element would pick up when the current rises above 100 Aac and remain picked up until the current decreases below 95 Aac.

Each of the eight configurable protection elements has four individually-adjustable thresholds. Each threshold can be set for pickup when the monitored parameter increases above the pickup setting (Over), pickup when the monitored parameter decreases below the pickup setting (Under), or no pickup (Disabled)^f. The pickup level for the monitored parameter is defined by a threshold setting^g. While the threshold setting range is broad, you must use a value within the setting range limits for the monitored parameter. Using an out-of-limits threshold will prevent the protection element from functioning. An activation delay^h serves to delay a protective trip after the threshold (pickup) level is exceeded.

Configurable Protection #1

Label Text

 A

Parameter Selection

 B

Stop Mode Inhibit

 C

Arming Delay (s)

 D

Hysteresis (%)

 E

Threshold #1

Mode F

Threshold G

Activation Delay (s) H

Threshold #2

Mode F

Threshold G

Activation Delay (s) H

Threshold #3

Mode F

Threshold G

Activation Delay (s) H

Threshold #4

Mode F

Threshold G

Activation Delay (s) H

Figure 41. Configurable Protection Settings

^A *Label Text*: Accepts a maximum of 16 alphanumeric characters.

^B *Param Selection*: Select Gen VAB, Gen VBC, Gen VCA, Gen V Average, Bus Freq, Bus VAB, Bus VBC, Bus VCA, Gen Freq, Gen PF, KWH, kvarh, Gen IA, Gen IB, Gen IC, Gen I Average, KW Total, KVA Total, kvar Total, EDM Ripple, Exciter Field Voltage, Exciter Field Current, Auxiliary Input Voltage, Auxiliary Input Current (mA), Setpoint Position, Tracking Error, Negative Sequence Voltage, Negative Sequence Current, Positive Sequence Voltage, Positive Sequence Current, PSS Output, Analog Input 1, Analog Input 2, Analog Input 3, Analog Input 4, Analog Input 5, Analog Input 6, Analog Input 7, Analog Input 8, RTD Input 1, RTD Input 2, RTD Input 3, RTD Input 4, RTD Input 5, RTD Input 6, RTD Input 7, RTD Input 8, Thermocouple 1, Thermocouple 2, Power Input, or NLS Error Percent.

^C *Stop Mode Inhibit*: Select Yes or No.

^D *Arming Delay*: Adjustable from 0 to 300 seconds in 1 second increments.

^E *Hysteresis*: Adjustable from 0 to 100% of the threshold setting in 0.1% increments.

^F *Mode*: Select Over, Under, or Disabled.

^G *Threshold*: Adjustable from -999,999 to +999,999 in 0.01 increments.

^H *Activation Delay (s)*: Adjustable from 0 to 300 seconds in 1 second increments.

Limiters

DECS-250N limiters ensure that the controlled machine does not exceed its capabilities. Overexcitation, underexcitation, stator current, and reactive power are limited by the DECS-250N. It also limits the voltage during underfrequency conditions.

Overexcitation Limiter

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, OEL

HMI Navigation Path: Settings, Operating Settings, Limiters, OEL

Operating in the overexcited region of a generator's capability curve can cause excessive field current and field winding heating. The overexcitation limiter (OEL) monitors the level of field current supplied by the DECS-250N and limits it to prevent field overheating.

The OEL can be enabled^A in all regulation modes. OEL behavior in manual mode can be configured to limit excitation or issue an alarm. This behavior is configured in BESTlogic™ Plus.

Two styles of overexcitation limiting are available in the DECS-250N: summing point or takeover.^B OEL settings are illustrated in Figure 45, Figure 46, and Figure 47.

Summing Point OEL

Summing point overexcitation limiting compensates for field overcurrent conditions while the machine is offline or online. Offline and online OEL behavior is dictated by two separate groups of settings. Primary and secondary setting groups (selectable in configurable logic) provide additional control for two distinct machine operating conditions.

Offline Operation

For offline operation, there are two levels of summing-point overexcitation limiting: low and high. Figure 42 illustrates the relationship of the high-level and low-level OEL thresholds.

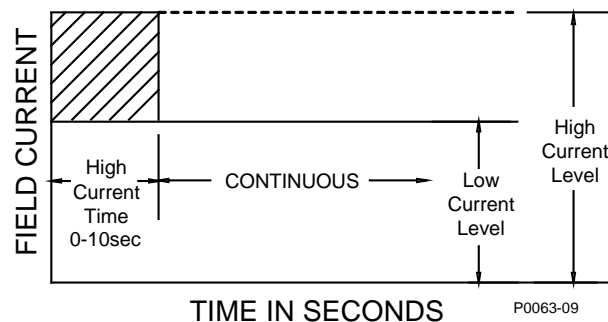


Figure 42. Summing Point, Offline, Overexcitation Limiting

The offline, low-level OEL threshold is determined by the low-level setting^C. When the excitation level is below the low-level setting, no action is taken by the DECS-250N. The generator is permitted to operate indefinitely with this level of excitation.

The offline, high-level OEL threshold is determined by a high level^D and high time^E setting. When the excitation level exceeds the high level setting, the DECS-250N acts to limit the excitation to the value of the high-level setting. If this level of excitation persists for the duration of the high time setting, the DECS-250N acts to limit the excitation to the value of the low-level setting.

Online Operation

For online operation, there are three levels of summing-point overexcitation limiting: low, medium, and high. Figure 43 illustrates the relationship of the low-, medium-, and high-level OEL thresholds.

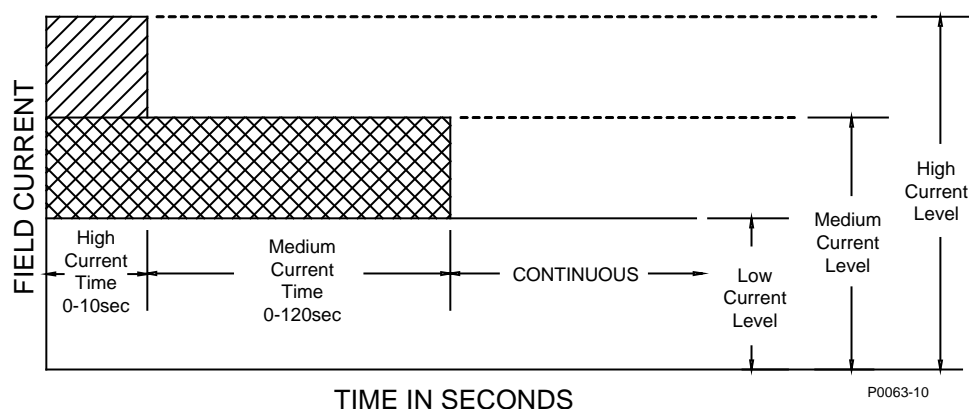


Figure 43. Summing Point, Online, Overexcitation Limiting

The online, low-level OEL threshold is determined by the low-level setting^F. When the excitation level is below the low-level setting, no action is taken by the DECS-250N. The generator is permitted to operate indefinitely with this level of excitation. When the excitation level exceeds the low-level setting for the duration of the medium time setting, the DECS-250N acts to limit the excitation to the value of the low-level setting.

The online, medium-level OEL threshold is determined by a medium level^G and medium time^H setting. When the excitation level exceeds the medium level setting, the DECS-250N acts to limit the excitation to the value of the medium-level setting. If this level of excitation persists for the duration of the high time setting, the DECS-250N acts to limit the excitation to the value of the medium-level setting.

The online, high-level OEL threshold is determined by a high level^I and high time^J setting. When the excitation level exceeds the high level setting, the DECS-250N instantaneously acts to limit the excitation to the value of the medium-level setting.

OEL Voltage Dependency

Online OEL operation can be tailored for fault proximity by enabling^K the OEL voltage dependency function. If a fault is close to the generator, the OEL high-level setting is disabled (based upon the rate of change) and switches to the medium-level setting. If a fault is away from the machine, all three (high, medium, and low) settings remain active. In other words, if the rate of terminal voltage reduction exceeds the OEL voltage dependency setting^L, the high-level setting remains enabled. Otherwise, the high-level setting is disabled.

Takeover OEL

Takeover overexcitation limiting limits the field current level in relation to an inverse time characteristic similar to that shown in Figure 44. Separate curves may be selected for online and offline operation. If the system enters an overexcitation condition, the field current is limited and forced to follow the selected curve. The inverse time characteristic is defined by Equation 11.

$$t_{pickup} = \frac{A \times TD}{B + \sqrt{C + D \times MOP}}$$

Equation 11. Inverse Pickup Time Characteristic

Where:

t_{pickup} = time to pick up in seconds

A = -95.908

B = -17.165

C = 490.864

D = -191.816

TD = time dial setting <0.1, 20>

MOP = multiple of pickup <1.03, 205>

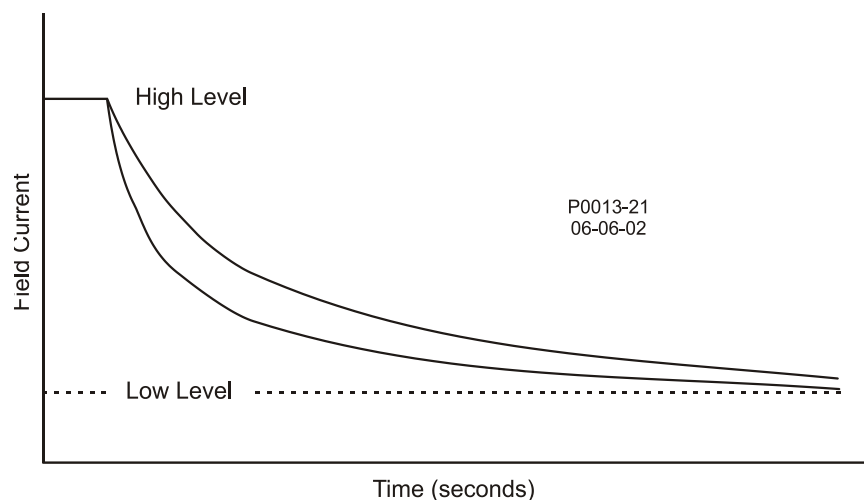


Figure 44. Inverse Time Characteristic for Takeover OEL

Primary and secondary setting groups provide additional control for two distinct machine operating conditions. Each mode of takeover OEL operation (offline and online) has a low-level^M, high-level^N, and time dial^O setting.

Once the field current decreases below the dropout level (95% of pickup), the function is reset based on the selected reset method^P. The available reset methods are inverse, integrating, and instantaneous.

Using the inverse method, the OEL is reset based on time versus multiple of pickup (MOP). The lower the field current level, the less time is required for reset. Inverse reset uses the following curve (Equation 12) to calculate maximum reset time.

$$Time_{reset} = \frac{RC \times TD}{(MOP_{reset})^2 - 1}$$

Equation 12. Inverse Reset Time Characteristic

Where:

Time_{reset} = maximum time to reset in seconds
 RC = reset coefficient setting^O <0.01, 100>
 TD = time dial setting <0.1, 20>
 MOP_{reset} = multiple of pickup <1.03, 205>

For the integrating reset method, the reset time is equal to the pickup time. In other words, the amount of time spent above the low level threshold is the amount of time required to reset.

Instantaneous reset has no intentional time delay.

In BESTCOMSPlus[®], a plot of the takeover OEL setting curves is displayed. Settings enable selection of the displayed curves. The plot can display the primary or secondary setting curves, the offline or online settings curves, and the pick up or reset settings curves.

OEL Configure

OEL Configuration

☐ OEL Enable

A

OEL Mode

Summing Point

B

OEL Voltage Dependency

☒ dv/dt Enable

K

dv/dt Level

-5.00

L

Figure 45. OEL Configuration Settings

OEL Summing Point

Primary

Off-Line

High Level (Primary A)

0.0

D

High Time (s)

0

E

Low Level (Primary A)

0.0

C

On-Line

High Level (Primary A)

0.0

I

High Time (s)

0

J

Middle Level (Primary A)

0.0

G

Medium Time (s)

0

H

Low Level (Primary A)

0.0

F

Secondary

Off-Line

High Level (Primary A)

0.0

D

High Time (s)

0

E

Low Level (Primary A)

0.0

C

On-Line

High Level (Primary A)

0.0

I

High Time (s)

0

J

Middle Level (Primary A)

0.0

G

Medium Time (s)

0

H

Low Level (Primary A)

0.0

F

Figure 46. Summing Point OEL Settings

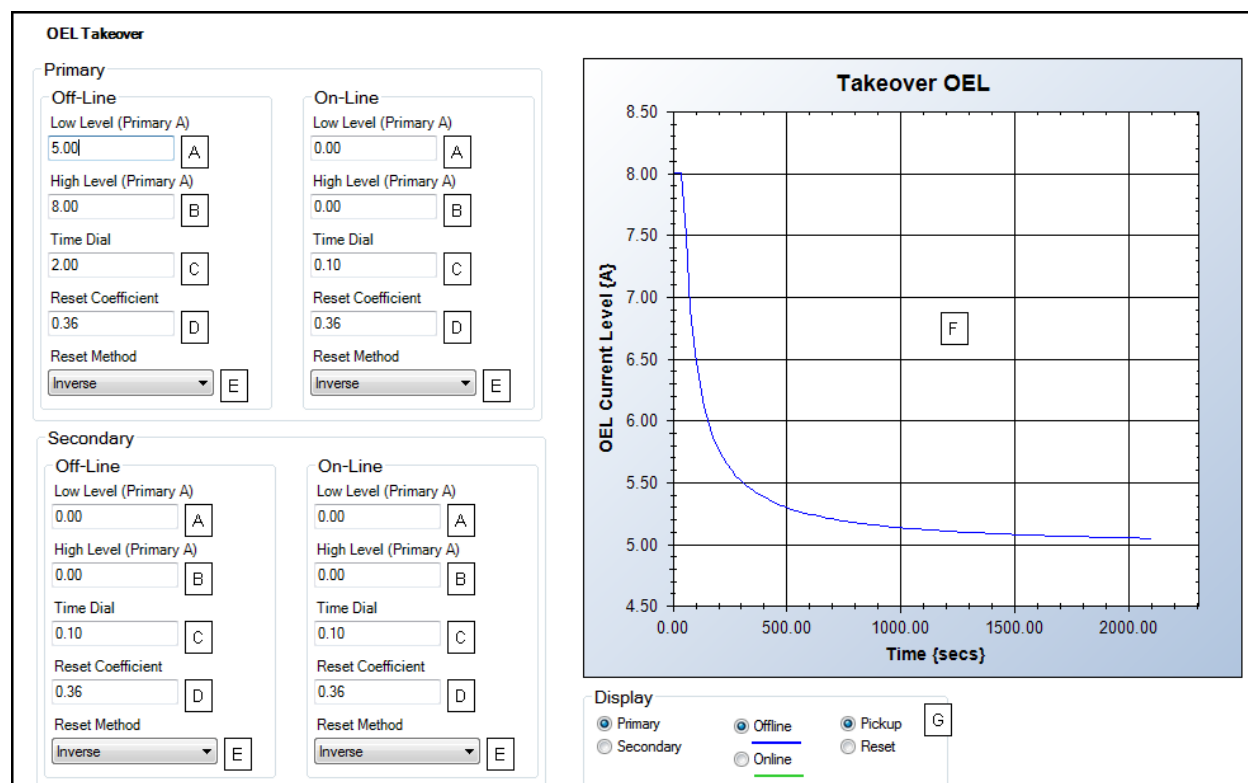


Figure 47. Takeover OEL Settings

- ^A OEL Enable: Select checkbox to enable OEL.
- ^B OEL Mode: Select Summing Point or Takeover.
- ^C Summing Point OEL Offline Low Level: Adjustable from 0 to 20 Adc. The setting increment is 0.01 Adc.
- ^D Summing Point OEL Offline High Level: Adjustable from 0 to 40 Adc. The setting increment is 0.01 Adc.
- ^E Summing Point OEL Offline High Time: Adjustable from 0 to 10 s in 1 s increments.
- ^F Summing Point OEL Online Low Level: Adjustable from 0 to 20 Adc. The setting increment is 0.01 Adc.
- ^G Summing Point OEL Online Medium Level: Adjustable from 0 to 30 Adc. The setting increment is 0.01 Adc.
- ^H Summing Point OEL Online Medium Time: Adjustable from 0 to 120 s in 1 s increments.
- ^I Summing Point OEL Online High Level: Adjustable from 0 to 40 Adc for the DECS-250. The setting increment is 0.01 Adc.
- ^J Summing Point OEL Online High Time: Adjustable from 0 to 10 s in 1 s increments.
- ^K dv/dt Enable: Check box to enable OEL voltage dependency.
- ^L dv/dt Level: Adjustable from -10 to 0 in 0.1 increments (per unit).
- ^M Takeover OEL Low Level: Adjustable from 0 to 15 Adc in increments of 0.01 Adc.
- ^N Takeover OEL High Level: Adjustable range varies depending on value of Low Level setting.
- ^O Takeover OEL Time Dial: Adjustable from 0.1 to 20 in increments of 0.1.
- ^P Reset Method: Select Inverse, Integrating, or Instantaneous.
- ^Q Reset Coefficient: Adjustable from 0.01 to 100 in increments of 0.01.
- ^F Takeover OEL curve.
- ^G Curve display selections/legend.

Underexcitation Limiter

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, UEL

HMI Navigation Path: Settings, Operating Settings, Limiters, UEL

Operating a generator in an underexcited condition can cause the stator end iron to overheat. Extreme underexcitation may lead to a loss of synchronism. The underexcitation limiter (UEL) senses the leading var level of the generator and limits decreases in excitation to limit end-iron heating. When enabled^A, the

UEL operates in all regulation modes. UEL behavior in manual mode can be configured to limit excitation or issue an alarm. This behavior is configured in *BESTlogicPlus*.

| |
|---|
| Note |
| For UEL to operate, the PARALLEL_EN_LM logic block must be set true in <i>BESTlogicPlus</i> programmable logic. |

UEL settings are illustrated in Figure 48 and Figure 49.

Underexcitation limiting is implemented through an internally-generated UEL curve or a user-defined UEL curve^B. The internally-generated curve is based on the desired reactive power limit at zero real power with respect to the generator voltage and current rating. The absorbed reactive power axis of the curve on the UEL Custom Curve screen can be tailored^C for your application.

A user-defined curve can have a maximum of five points^D. This curve allows the user to match a specific generator characteristic by specifying the coordinates of the intended leading reactive power (kvar) limit at the appropriate real power (kW) level.

The levels entered for the user-defined curve are defined for operation at the rated generator voltage. The user-defined UEL curve can be automatically adjusted based on generator operating voltage by using the UEL voltage dependency real-power exponent^E. The user-defined UEL curve is automatically adjusted based on the ratio of the generator operating voltage divided by the generator rated voltage raised to the power of the UEL voltage dependency real-power exponent. UEL voltage dependency is further defined by a real power filter time constant^F that is applied to the low-pass filter for the real power output.



Figure 48. UEL Configuration Settings

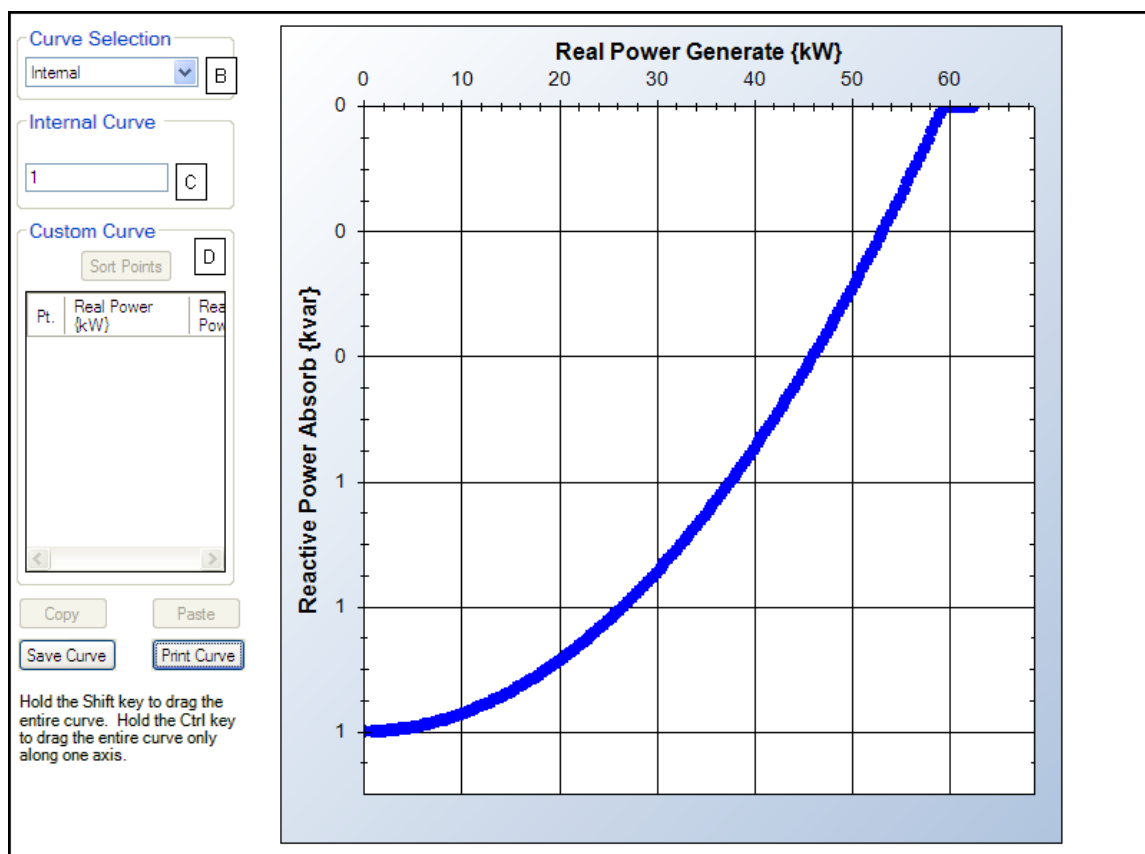


Figure 49. UEL Custom Curve Screen

^A *UEL Configuration Enable*: Check box to enable underexcitation limiter.

^B *Curve Selection*: Select Internal or Customized.

^C *Internal Curve*: Enter number to adjust range of y axis.

^D *Custom Curve*: Insert, enter, and delete curve data points as needed.

^E *Real Power Exponent*: Enter a value of 1 or 2.

^F *Real Power Filter Time Constant*: Enter a value from 0 to 20 seconds in 0.1 second increments.

Stator Current Limiter

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, SCL

HMI Navigation Path: Settings, Operating Settings, Limiters, SCL

The stator current limiter (SCL) monitors the level of stator current and limits it to prevent stator overheating. To limit the stator current, the SCL modifies the excitation level according to the direction of var flow into or out of the generator. Excessive stator current with leading power factor calls for increased excitation. Excessive stator current with lagging power factor calls for reduced excitation.

The SCL can be enabled^A in all regulation modes. When operating in Manual mode, the DECS-250N will announce high stator current but will not act to limit it. Primary and secondary SCR setting groups provide additional control for two distinct machine operating conditions. Stator current limiting is provided at two levels: low and high (see Figure 50). SCL settings are illustrated in Figure 51.

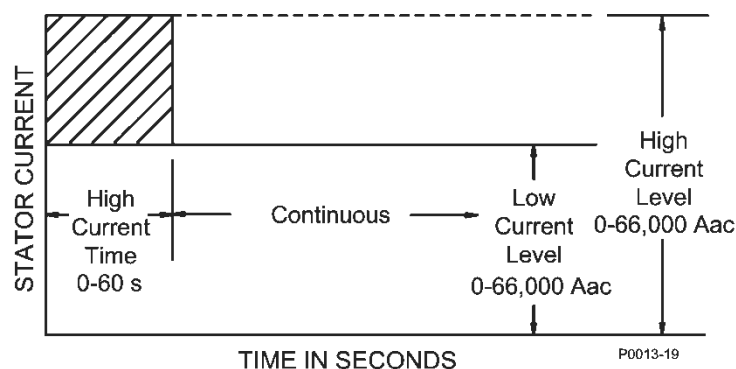


Figure 50. Stator Current Limiting

Low-Level Limiting

When the stator current exceeds the low-level setting^B, the DECS-250N annunciates the elevated level. If this condition persists for the duration of the High SCL Time setting, the DECS-250N acts to limit the current to the low-level SCL Setting. The generator is permitted to operate indefinitely at or below the low-level threshold.

High-Level Limiting

When the stator current exceeds the high-level setting^C, the DECS-250N acts to limit the current to the high-level value. If this level of current persists for the duration of the high-level time setting^D, the DECS-250N acts to limit the current to the low-level SCL setting.

Initial Delay

In the case of low- or high-level stator current limiting, the limiting function will not respond until an initial time delay^E expires.

Figure 51. Stator Current Limiter Settings

^A *Stator Current Limiter Enable*: Check box to enable.

^B *Low SCL Level*: Adjustable from 0 to 66,000 Aac in 0.1 Aac increments.

^C *High SCL Level*: Adjustable from 0 to 66,000 Aac in 0.1 Aac increments.

^D *High SCL Time*: Adjustable from 0 to 60 s in 0.1 s increments.

^E *Initial Delay*: Adjustable from 0 to 10 s in 0.1 s increments.

Var Limiter

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, var

HMI Navigation Path: Settings, Operating Settings, Limiters, VAR

The var limiter can be enabled^A to limit the level of reactive power exported from the generator. Primary and secondary setting groups provide additional control for two distinct machine operating conditions. The var limiter setpoint^B is expressed as a percentage of the calculated, maximum VA rating for the machine. A delay setting^C establishes a time delay between when the var threshold is exceeded and the DECS-250N acts to limit the var flow.

Var limiter settings are illustrated in Figure 52.

Figure 52. Var Limiter Settings

^A *Var Limiter Enable:* Select checkbox to enable var limiter.

^B *Var Limiter Setpoint:* Adjustable from 0 to 200% in 0.1% increments.

^C *Var Limiter Delay:* Adjustable from 0 to 300 s in 0.1 s increments.

Limiter Scaling

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, Scaling

HMI Navigation Path: Settings, Operating Settings, Limiters, Scaling

Automatic adjustment (scaling) of the overexcitation limiter and stator current limiter is possible through the DECS-250N auxiliary control input. Limiter scaling settings are illustrated in Figure 53. OEL and SCL scaling may be independently enabled and disabled^A. Automatic adjustment of the OEL and SCL is based on six parameters: signal and scale for three points (levels).

With the scaling input set to *Auxiliary Input*, the signal value^B for each point represents the auxiliary control input. This input can be a 4 to 20 mAdc signal applied to terminals I+ and I– or a –10 to +10 Vdc signal applied to terminals V+ and V–. (The input type is selected in BESTCOMSPlus). See the *Auxiliary Control* chapter of this manual for details.

With the scaling input set to *AEM RTD #*, the signal value for each point represents an AEM RTD input in degrees Fahrenheit. See the *Analog Expansion Module* chapter of the manual for details.

The scale value^C for each point defines the limiter low level as a percent of rated field current for the OEL and rated stator current for the SCL.

Scaling

Oel Scale Enable
AEM RTD 1

Scl Scale Enable
Disabled

| Summing Point OEL Scaling | Takeover OEL Scaling | SCL Scaling |
|--|--|--|
| Point 1 - Signal (Degrees F) 77 <input type="button" value="B"/> | Point 1 - Signal (Degrees F) 77 <input type="button" value="B"/> | Point 1 - Signal (V) -5.00 <input type="button" value="B"/> |
| Point 1 - Scale 80.0 <input type="button" value="C"/> | Point 1 - Scale 80.0 <input type="button" value="C"/> | Point 1 - Scale 80.0 <input type="button" value="C"/> |
| Point 2 - Signal (Degrees F) 212 <input type="button" value="B"/> | Point 2 - Signal (Degrees F) 212 <input type="button" value="B"/> | Point 2 - Signal (V) 0.00 <input type="button" value="B"/> |
| Point 2 - Scale 100.0 <input type="button" value="C"/> | Point 2 - Scale 100.0 <input type="button" value="C"/> | Point 2 - Scale 100.0 <input type="button" value="C"/> |
| Point 3 - Signal (Degrees F) 347 <input type="button" value="B"/> | Point 3 - Signal (Degrees F) 347 <input type="button" value="B"/> | Point 3 - Signal (V) 5.00 <input type="button" value="B"/> |
| Point 3 - Scale 120.0 <input type="button" value="C"/> | Point 3 - Scale 120.0 <input type="button" value="C"/> | Point 3 - Scale 120.0 <input type="button" value="C"/> |

Figure 53. Limiter Scaling Settings

^A OEL and SCL Scale Enable: Select Auxiliary Input, AEM RTD 1 to AEM RTD 8, or Disabled.

^B Signal: Adjustable from -10 to +10 in 0.01 increments when *Auxiliary Input* is selected.

Adjustable from -58 to +482 in increments of 1 when any *AEM RTD* input is selected.

^C Scale: Adjustable from 0 to 200 in increments of 0.1.

Underfrequency Limiter

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Limiters, Underfrequency

HMI Navigation Path: Settings, Operating Settings, Limiters, UEL

The underfrequency limiter is selectable for underfrequency limiting or volts per hertz limiting^A. These limiters protect the generator from damage due to excessive magnetic flux resulting from low frequency and/or overvoltage.

Underfrequency and volts per hertz limiter settings are illustrated in Figure 56.

If the generator frequency decreases below the corner frequency^B for the selected underfrequency slope^C (Figure 54), the DECS-250N adjusts the voltage setpoint so that the generator voltage follows the underfrequency slope. The adjustment range of the corner frequency and slope settings enables the DECS-250N to precisely match the operating characteristics of the prime mover and the loads being applied to the generator.

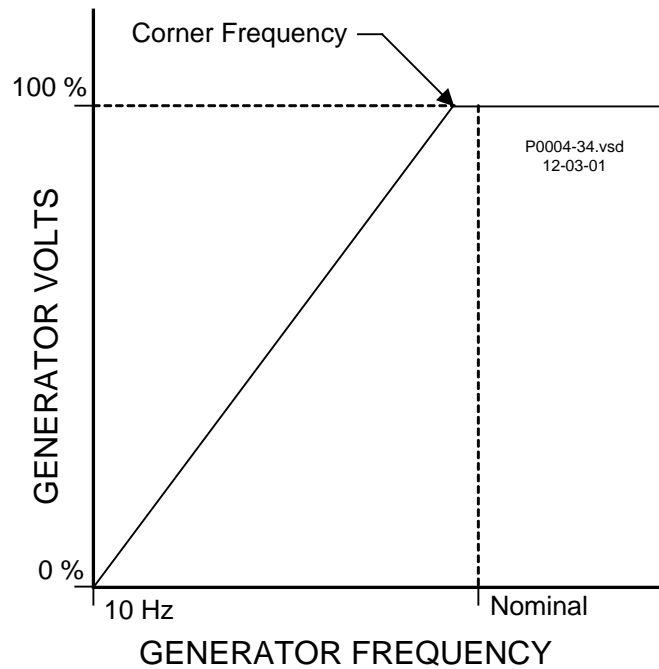


Figure 54. Typical Underfrequency Compensation Curve

Volts per Hertz

The volts per hertz limiter prevents the regulation setpoint from exceeding the volts per hertz ratio defined by the underfrequency slope setting^C. A typical volts per hertz limiter curve is illustrated in Figure 55.

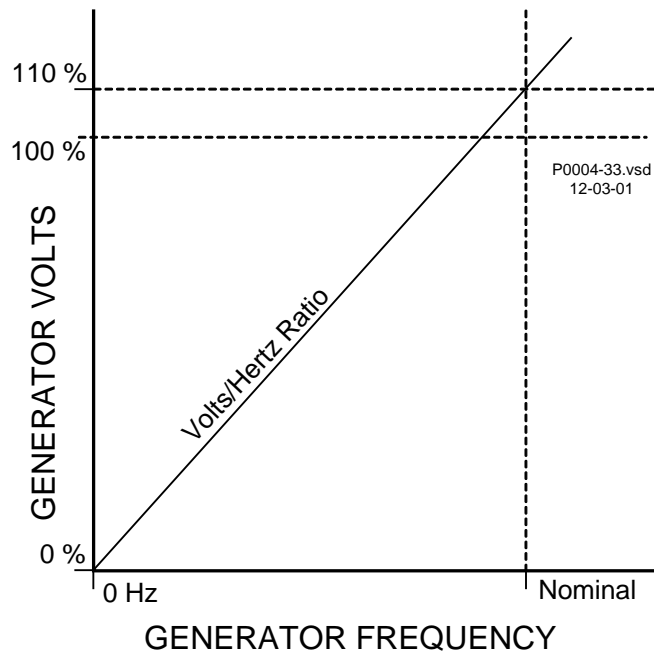


Figure 55. Typical 1.1 PU Volts per Hertz Limiter Curve

Beside the underfrequency slope setting, volts per hertz limiter operation is determined by the high limiter setting, low limiter setting, and time limiter setting. The high limiter setting^D establishes the maximum threshold for volts per hertz limiting, the low limiter setting^E establishes the minimum threshold for volts per hertz limiting, and the time limiter setting^F establishes the time delay for limiting.

Underfrequency

Limiter Mode
Mode
UF Limiter ▼ A

Underfrequency Limiter
Corner Frequency (Hz)
57.0 B
Slope
1.00 C

Volts/Hz Limiter
V/Hz High Limiter
1.00 D
V/Hz Low Limiter
1.00 E
V/Hz Time Limiter (s)
10.0 F

Figure 56. Underfrequency/Volts per Hertz Limiter Settings

^A *Limiter Mode*: Select UF Limiter or V/Hz Limiter.

^B *Underfrequency Limiter Corner Frequency*: Adjustable from 40 to 75 Hz in 0.1 Hz increments.

^C *Underfrequency Limiter Slope*: Adjustable from 0 to 3 in increments of 0.01.

^D *V/Hz High Limiter*: Adjustable from 0 to 3 in increments of 0.01.

^E *V/Hz Low Limiter*: Adjustable from 0 to 3 in increments of 0.01.

^F *V/Hz Time Limiter*: Adjustable from 0 to 10 s in 0.2 s increments.

Metering

The DECS-250N provides comprehensive metering of internal and system conditions. These capabilities include extensive parameter metering, status indication, reporting, and real-time metering analysis.

Metering Explorer

DECS-250N metering is accessed through the metering explorer menu on the front panel HMI or the BESTCOMSPlus® metering explorer.

HMI

On the front panel HMI, the metering explorer is accessed through the Metering branch of the HMI menu.

BESTCOMSPlus®

In BESTCOMSPlus, the metering explorer is located in the upper left portion of the application window.

Metering Screen Docking

A docking feature within the metering explorer allows arrangement and docking of multiple metering screens. Clicking and dragging a metering screen tab displays a blue, transparent square, several arrow boxes, and a tab box. These docking elements are illustrated in Figure 57.

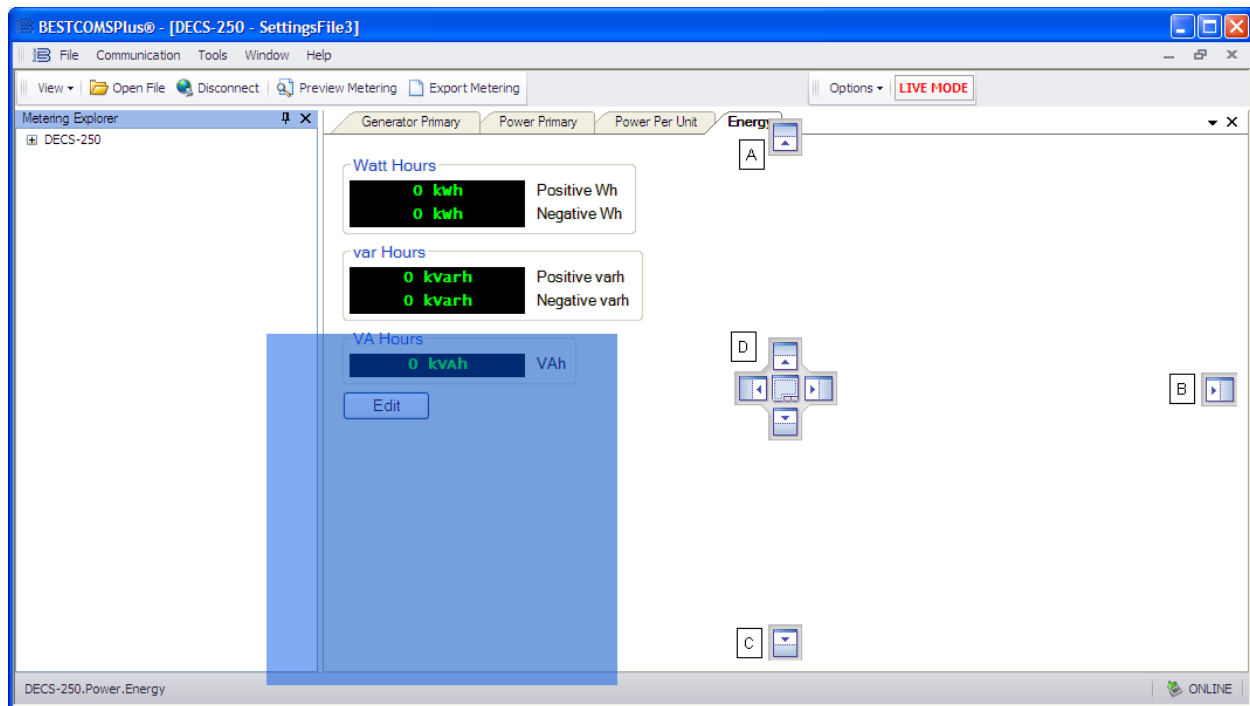


Figure 57. Metering Screen Docking Controls

Dragging the blue square to the “up” (locator A), “right” (locator B), or “down” (locator C) arrow box places the selected metering screen across the top, along the side, or at the bottom of the window. Once placed, the screen’s thumbtack icon can be clicked to dock the screen on the corresponding top, right, or lower bar. A docked screen is viewed by hovering the mouse pointer over the docked screen.

Dragging the blue square to one of the four arrow boxes (locator D) places the screen inside the selected window according to the arrow box selected. A metering screen can be placed as a tab inside the selected window by dropping the screen on the tab box at the center of the four arrow boxes.

Dragging the blue square anywhere other than one of the arrow/tab boxes places the selected metering screen as a floating window.

Metered Parameters

DECS-250N metering categories include generator, power, bus, field, power system stabilizer (PSS), and generator synchronization parameters.

Generator

BESTCOMSPlus Navigation Path: Metering Explorer, Generator

HMI Navigation Path: Metering Explorer, Generator

Metered generator parameters include the voltage (magnitude and angle), current (magnitude and angle), and frequency. Primary- and per-unit values are available. Figure 58 illustrates the generator primary-values metering screen.



Figure 58. Generator Primary-Values Metering

Power

BESTCOMSPlus Navigation Path: Metering Explorer, Power

HMI Navigation Path: Metering Explorer, Power

Metered power parameters include true power (kW), apparent power (kVA), reactive power (kvar), and machine power factor. Primary- and per-unit values are available. Accumulated watthours (positive and negative kWh), varhours (positive and negative kvarh), and voltampere hours (kVAh) are also metered. Figure 59 illustrates the power primary-values screen and Figure 60 illustrates the energy screen.

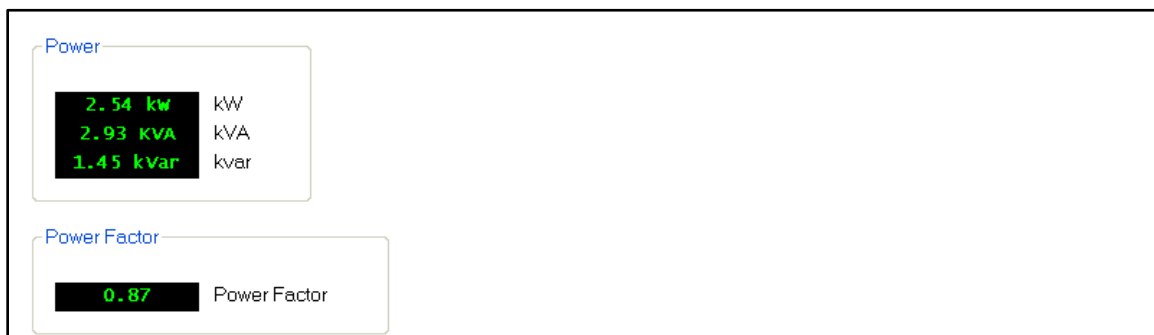


Figure 59. Power Primary-Values



Figure 60. Energy

When operating in motor mode, values for var and power factor will be opposite in BESTCOMS*Plus* and on the front-panel HMI. See Table 4.

Table 4. Operating Mode

| Sign of Vars | DECS-250 Operating Mode | |
|--------------|-------------------------|------------|
| | Generator | Motor |
| Positive (+) | Leading PF | Lagging PF |
| Negative (-) | Lagging PF | Leading PF |

Bus

BESTCOMS*Plus* Navigation Path: Metering Explorer, Bus

HMI Navigation Path: Metering Explorer, Bus

Metered bus parameters include the voltage across phases A and B (Vab), phases B and C (Vbc), phases A and C (Vca), and the average bus voltage. The frequency of the bus voltage is also metered. Primary- and per-unit values are available. Figure 61 illustrates the bus primary-values metering screen.

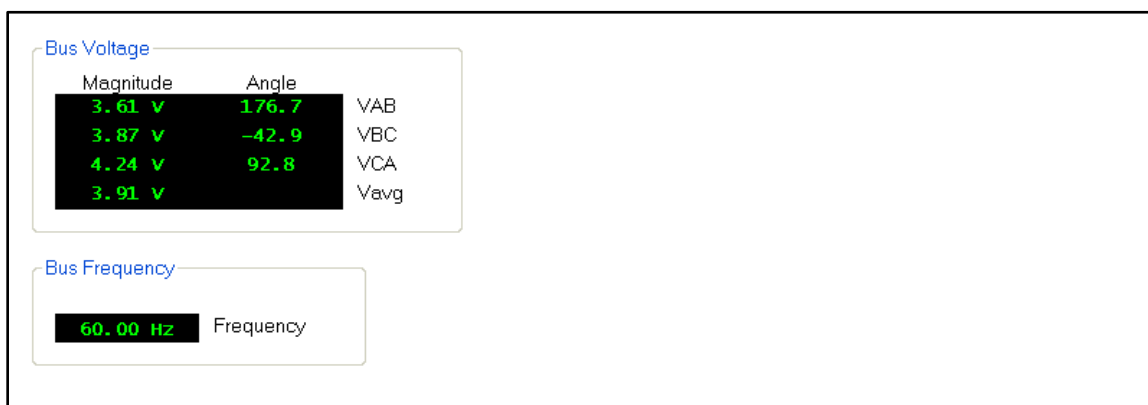


Figure 61. Bus Primary-Values Metering

Field

BESTCOMSPlus Navigation Path: Metering Explorer, Field

HMI Navigation Path: Metering Explorer, DECS Output

Metered field parameters include the field voltage (Vfd), current (Ifd), and exciter diode ripple. The exciter diode ripple is reported by the exciter diode monitor (EDM) and is reported as a percentage of the induced ripple in the exciter field current.

To achieve the desired level of excitation, the appropriate level of operating power input voltage must be applied. This value is displayed as the power input voltage.

The level of excitation power supplied to the field is displayed as a percentage, with 0% being the minimum and 100% being the maximum.

Primary- and per-unit values are available. Figure 62 illustrates the field primary-values metering screen.



Figure 62. Field Primary-Values Metering

PSS

BESTCOMSPlus Navigation Path: Metering Explorer, PSS (Power System Stabilizer)

HMI Navigation Path: Metering Explorer, PSS

Values metered by the power system stabilizer function display positive sequence voltage and current, negative sequence voltage and current, terminal frequency deviation, compensated frequency deviation, and the per-unit PSS output level. The PSS function on/off status is also reported. Primary- and per-unit values are available. Figure 63 illustrates the PSS primary-values metering screen.

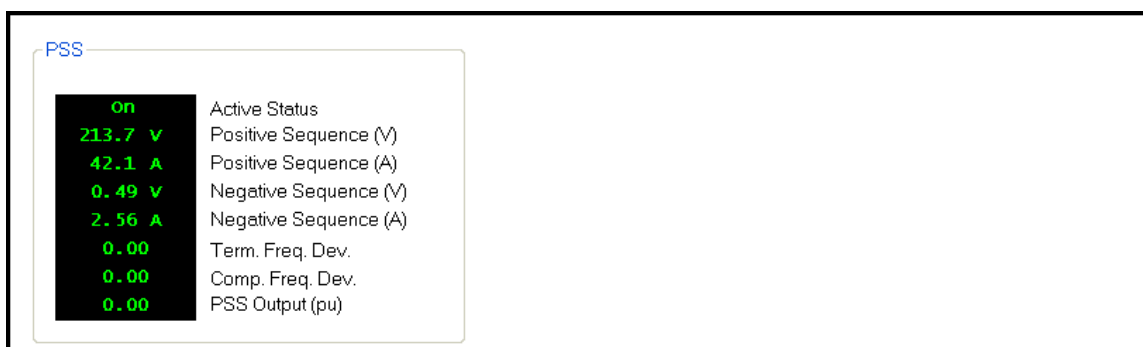


Figure 63. PSS Primary-Values Metering

Synchronization

BESTCOMSPlus Navigation Path: Metering Explorer, Synchronization

HMI Navigation Path: Metering Explorer, Synchronization

Metered generator-to-bus synchronization parameters include the slip frequency, slip angle, and voltage difference. Primary- and per-unit values are available. Figure 64 illustrates the synchronization primary-values metering screen.

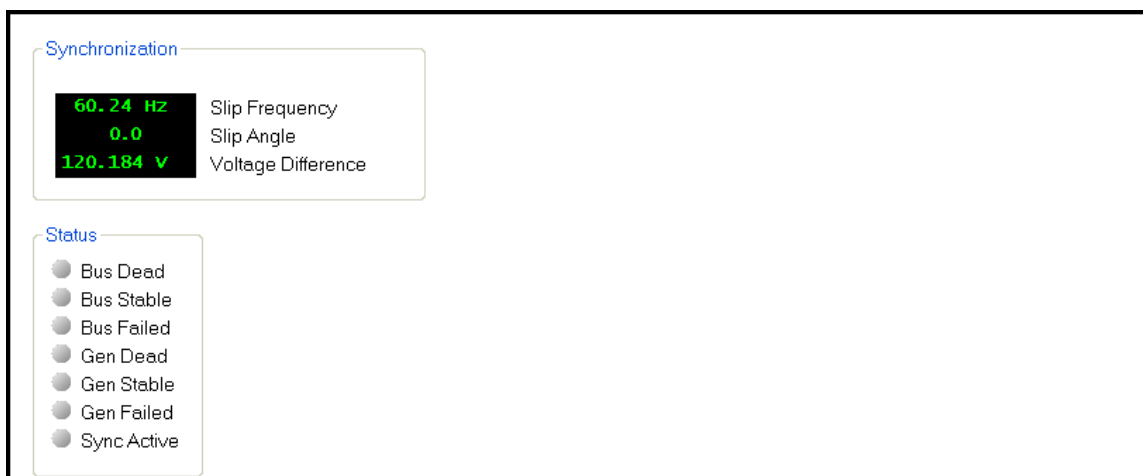


Figure 64. Synchronization Primary Values Metering

Auxiliary Control Input

BESTCOMSPlus Navigation Path: Metering Explorer, Aux Input

HMI Navigation Path: Metering Explorer, Aux Input

The control signal applied at the DECS-250N auxiliary control input is indicated on the Aux Input metering screen (Figure 65). As configured in BESTCOMSPlus, a dc voltage or dc current signal may be applied.

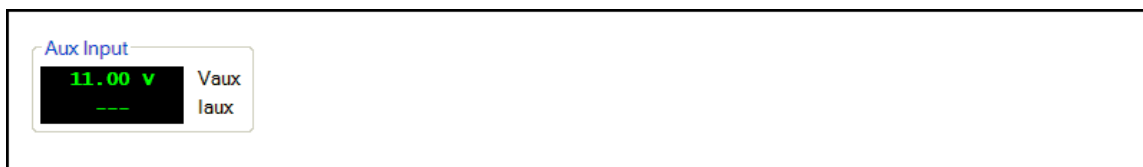


Figure 65. Auxiliary Control Input Metering

Tracking

BESTCOMSPlus Navigation Path: Metering Explorer, Tracking

HMI Navigation Path: Metering Explorer, Tracking

The metered setpoint tracking error between DECS-250N operating modes is displayed on the Tracking metering screen (Figure 66). Status fields are also provided for the on/off status for internal and external setpoint tracking. An additional status field indicates when the setpoint of an inactive operating mode matches the metered value.



Figure 66. Tracking Metering

Control Panel

BESTCOMSPlus Navigation Path: Metering Explorer, Control Panel

HMI Navigation Path: Metering Explorer, Control Panel

The Control Panel (Figure 67) provides options for changing operating modes, selecting setpoint pre-positions, fine tuning setpoints, and toggling virtual switches. The setpoints for AVR, FCR, FVR, var, and PF are displayed, as well as Alarm status, PSS status, and Null Balance status.

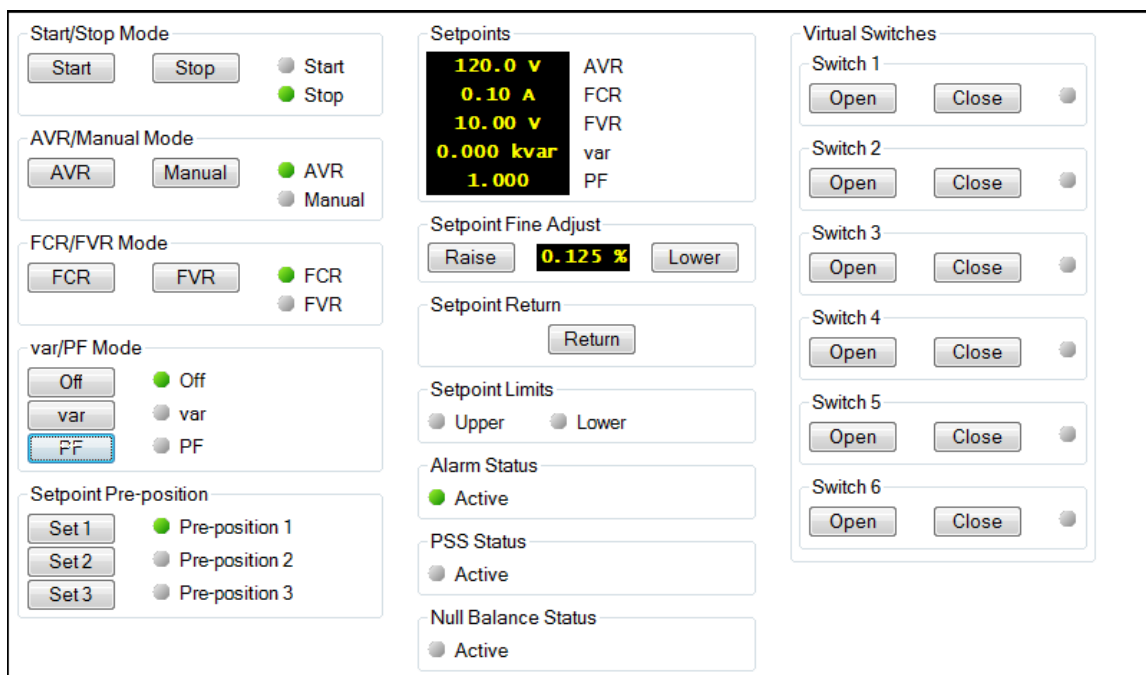


Figure 67. Control Panel

Start/Stop Mode: Two indicators show the start/stop mode of the DECS-250N. In Stop mode, the Stop indicator changes from gray to green. In Start mode the Start indicator changes from gray to green. To select the DECS-250N Start status, click the Start button. Click the Stop button to select DECS-250N Stop status.

AVR/Manual Mode: AVR and Manual Mode status is reported by two indicators. When the DECS-250N is operating in AVR mode, the AVR indicator changes from gray to green. When operating in manual mode, the manual indicator changes from gray to green. AVR mode is selected by clicking the *AVR* button, manual mode is selected by clicking the *Manual* button.

FCR/FVR Mode: FCR and FVR mode status is reported by two indicators. When the DECS-250N is operating in FCR mode, the FCR indicator changes from gray to green. When operating in FVR mode,

the FVR indicator changes from gray to green. FCR mode is selected by clicking the *FCR* button. FVR mode is selected by clicking the *FVR* button.

Var/PF Mode: Three indicators report whether Var mode is active, Power Factor mode is active, or neither mode is active. When Var mode is active the var indicator changes from gray to green. When Power Factor mode is active, the PF indicator changes from gray to green. When neither mode is active, the Off indicator changes from gray to green. Var mode is enabled by clicking the *var* button. Power Factor mode is enabled by clicking the *PF* button. Neither mode is enabled by clicking the *Off* button. Only one mode can be enabled at any time.

Setpoint Pre-position: A control button and indicator is provided for the three setpoint pre-positions. Clicking the *Set 1* button adjusts the excitation setpoint to the Pre-position 1 value and changes the Pre-position 1 indicator to green. Pre-positions 2 and 3 are selected by clicking either the *Set 2* or *Set 3* button.

Setpoints: Five status fields display the active setpoints for AVR mode, FCR mode, FVR mode, var mode, and Power Factor mode. These active setpoints, represented by a yellow font, are not to be confused with metered analog values which are represented by a green font throughout *BESTCOMSPlus*. For details on operating setpoint settings, see the *Regulation* chapter.

Setpoint Fine Adjust: Clicking the *Raise* button increases the active operating setpoint. Clicking the *Lower* button decreases the active operating setpoint. The raise and lower increment is a function of the setpoint range of adjustment and the active mode traverse rate. The increments are directly proportional to the adjustment range and inversely proportional to the traverse rate.

Alarm Status: The Alarm Status indicator changes from gray to green when there is an active alarm.

PSS Status: The PSS Status indicator changes from gray to green when the PSS is active.

Null Balance: The Null Balance indicator changes from gray to green when the setpoint of the inactive operating modes (AVR, FCR, FVR, var, and PF) match the setpoint of the active mode.

Virtual Switches: These buttons control the open or closed status of the six virtual switches. Clicking the *Open* button sets the switch to the open position and changes the switch indicator to gray. Clicking the *Close* button sets the switch to the closed position and changes the switch indicator to red. A dialog will appear asking if you are sure you want to open or close the switch.

Metering Summary

BESTCOMSPlus Navigation Path: [Metering Explorer, Summary](#)

HMI Navigation Path: Not available via HMI

All of the metering values displayed on the individual, previously-described metering screens are consolidated on the metering summary screen. Primary- and per-unit values are available. Figure 68 illustrates the primary-values metering summary screen. The primary- and per-unit metering summary screens are available only in *BESTCOMSPlus*.

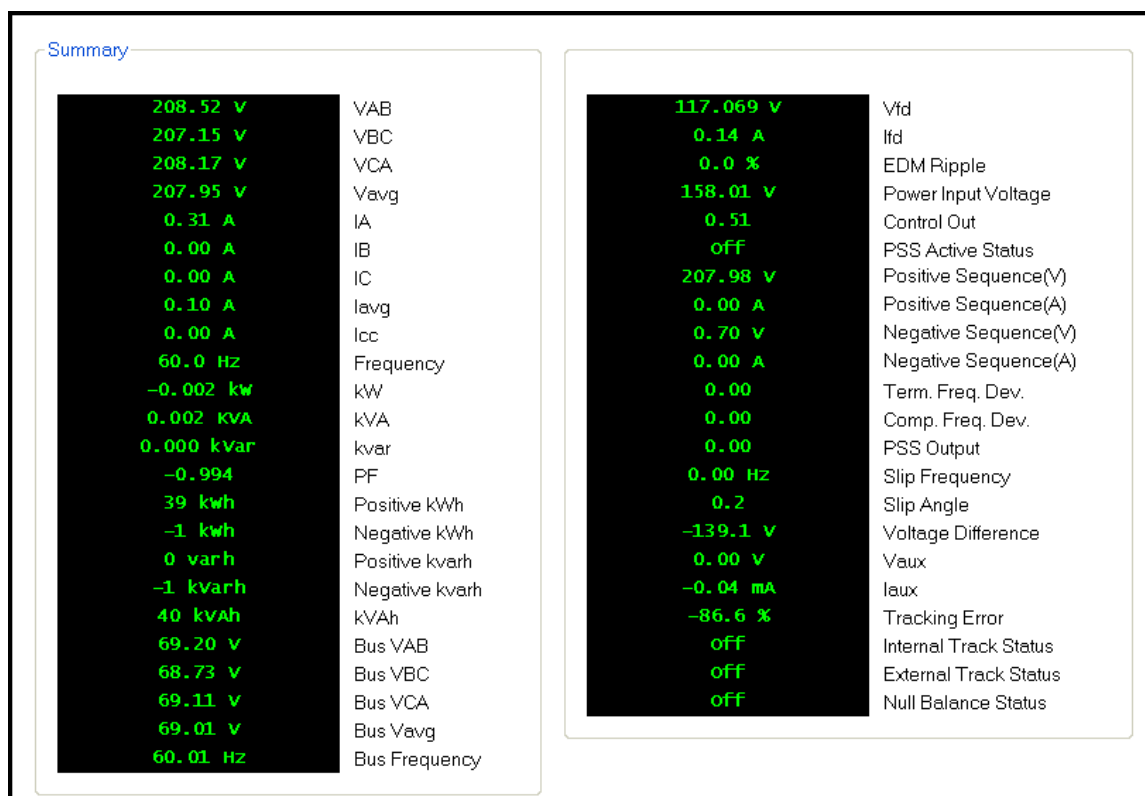


Figure 68. Metering Summary Screen

Status Indication

Status indication is provided for DECS-250N system functions, inputs, outputs, network load share, configurable protection, alarms, and the real-time clock.

System Status

BESTCOMSPlus Navigation Path: Metering Explorer, Status, System Status

HMI Navigation Path: Metering Explorer, Status, System Status

When any of the system functions illustrated in Figure 69 are active, the corresponding indicator changes from gray to green. An inactive function is represented by a gray indicator.

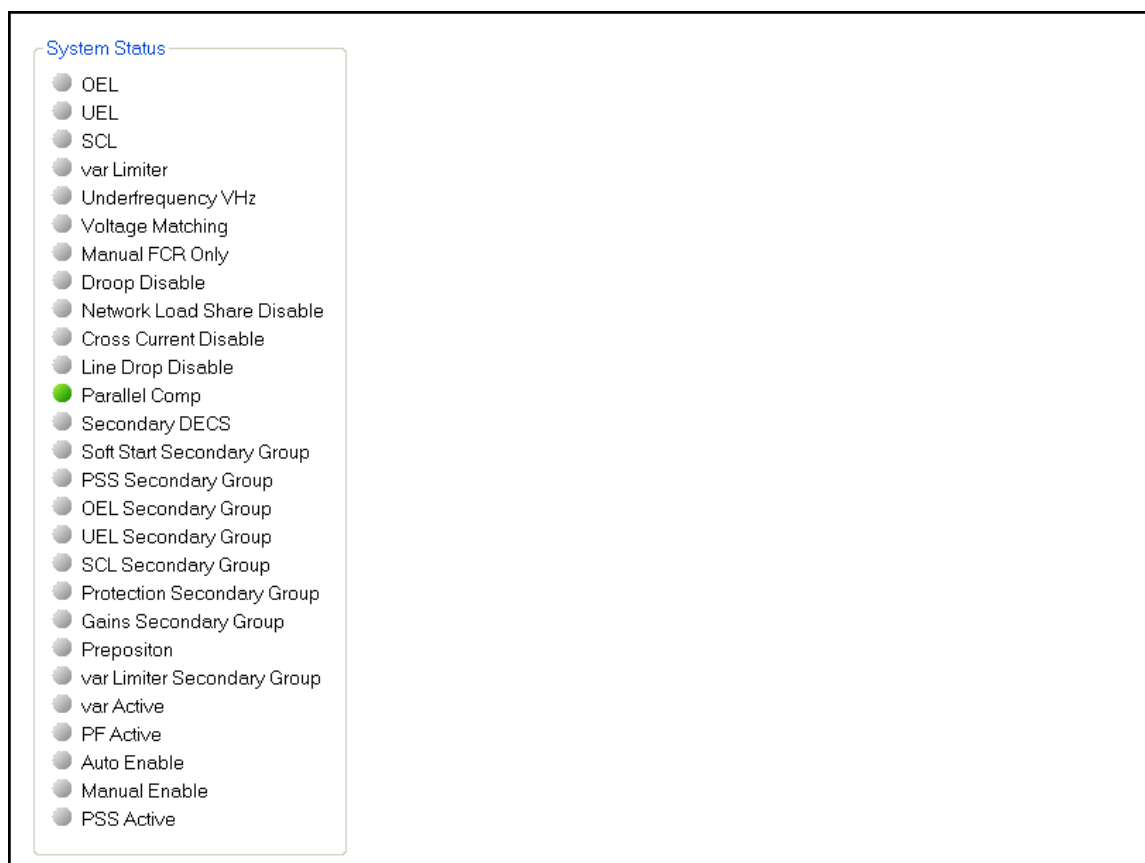


Figure 69. System Status Indication Screen

Inputs

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Inputs

HMI Navigation Path: Metering Explorer, Status, Inputs

Status annunciation is provided for the DECS-250N and optional Contact Expansion Module (CEM-2020) inputs. Annunciation is also provided for the optional Analog Expansion Module (AEM-2020) inputs.

DECS-250N Contact Inputs

Status indication for the DECS-250N's 16 contact sensing inputs is provided on the BESTCOMS*Plus* contact inputs screen illustrated in Figure 70. An indicator changes from gray to red when a closed contact is sensed at the corresponding input.



Figure 70. DECS-250N Contact Inputs Status Indication Screen

CEM-2020 Contact Inputs

The status of the 10 contact sensing inputs of the optional CEM-2020 Contact Expansion Module is provided on the BESTCOMS*Plus*® remote contact inputs screen. See the *Contact Expansion Module* chapter of this manual for a description and illustration of this screen.

AEM-2020 Inputs

Status annunciations for the optional AEM-2020 Analog Expansion Module's analog, RTD, thermocouple, and analog metering inputs are provided on the BESTCOMS*Plus* remote analog inputs, remote RTD inputs, remote thermocouple inputs, and remote analog input values screens. These screens are described and illustrated in the *Analog Expansion Module* chapter of this manual.

Outputs

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Outputs

HMI Navigation Path: Metering Explorer, Status, Outputs

Status annunciation is provided for the DECS-250N contact outputs and optional Contact Expansion Module (CEM-2020) contact outputs. Annunciation is also provided for the optional Analog Expansion Module (AEM-2020) analog outputs.

DECS-250 Contact Outputs

Status indication for the DECS-250N's Watchdog and 11 contact outputs is provided on the BESTCOMS*Plus* contact outputs screen illustrated in Figure 71. An indicator changes from gray to green when the corresponding output changes state (Watchdog output) or closes (Output 1 through 11).

CEM-2020 Contact Outputs

The status of the 24 contact outputs of the optional CEM-2020 Contact Expansion Module is provided on the BESTCOMS*Plus*® remote contact inputs screen. See the *Contact Expansion Module* chapter of this manual for a description and illustration of this screen.

AEM-2020 Analog Outputs

Metering and status indications provided by the optional AEM-2020 Analog Expansion Module are shown on the BESTCOMS*Plus* remote analog outputs screen. This screen is described and illustrated in the *Analog Expansion Module* chapter of this manual.

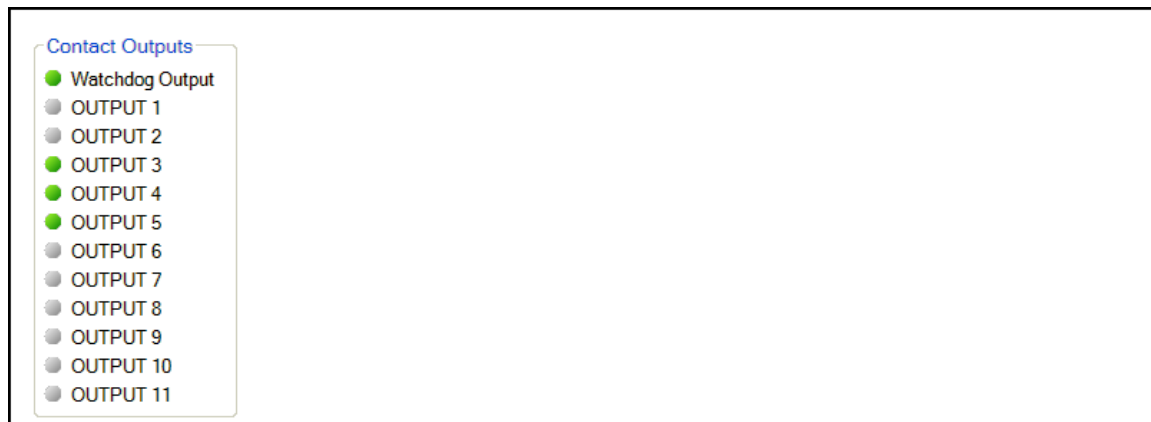


Figure 71. DECS-250 Contact Outputs Status Indication Screen

Network Load Share

The screen shown in Figure 72 reports the error percent, reactive current, NLS average reactive current, and number of generators online. The status indicators change from gray to green when a status is active.

The Error percent is the deviation of the unit's reactive current from the system average. The NLS Average Reactive Current is the average of the reactive current of every unit in the system. Generators Online is the number of units actively load sharing.

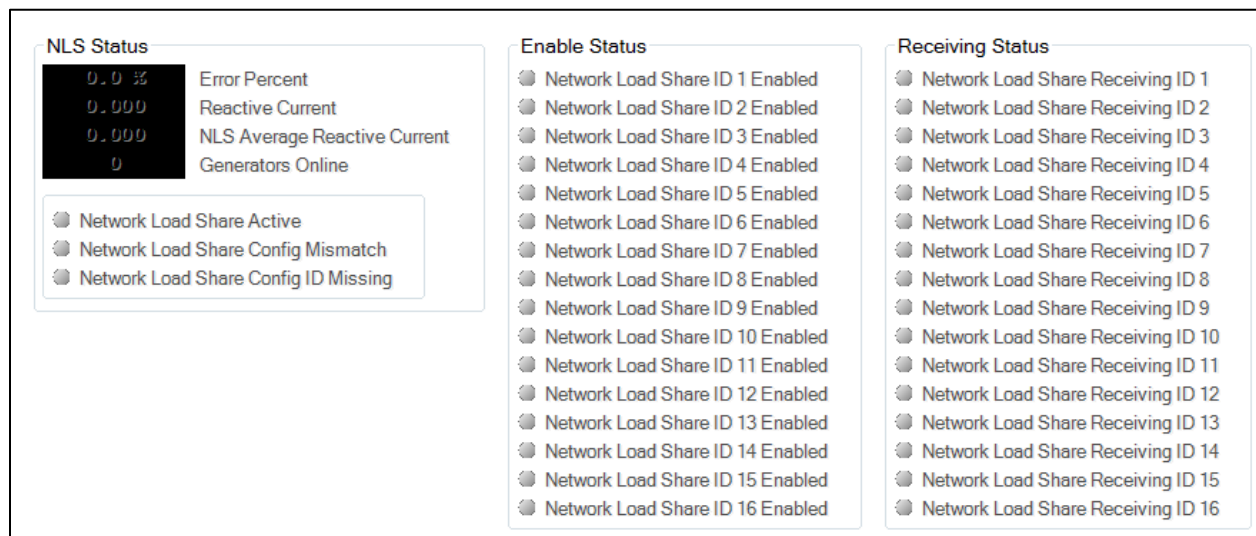


Figure 72. NLS Status Screen

Configurable Protection

BESTCOMSPlus Navigation Path: Metering Explorer, Status, Configurable Protection

HMI Navigation Path: Metering Explorer, Status, Configurable Protection

Trip status for the eight configurable, supplemental protection elements is annunciated on the BESTCOMSPlus configurable protection screen (Figure 73). An indicator for each protection element's four trip thresholds changes from gray to green when the corresponding trip threshold is exceeded.

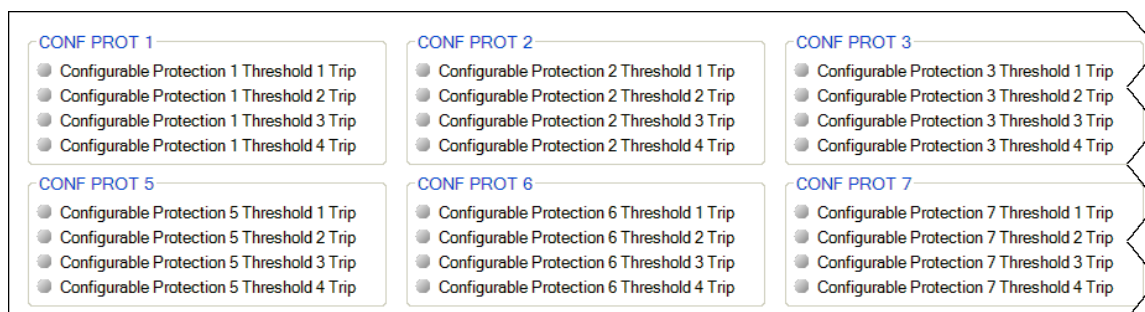


Figure 73. Configurable Protection Indication Status Screen

Alarms

BESTCOMSPlus Navigation Path: Metering Explorer, Status, Alarms

HMI Navigation Path: Alarms automatically displayed when active

System parameters, communication links, protection functions, and remote inputs/outputs are constantly monitored for alarm conditions. Active and previously latched alarms are listed on the front panel display and the Alarms screen of BESTCOMSPlus. At the front panel, an inactive alarm is reset by selecting the alarm and then pressing the Reset pushbutton. A Reset Alarms button on the Alarms screen is clicked to clear all inactive alarms in BESTCOMSPlus. The BESTCOMSPlus Alarms screen is illustrated in Figure 74. All possible DECS-250N alarms are listed below.



Figure 74. DECS-250N Alarm Annunciation and Reset Screen

| | |
|------------------------------|------------------------------|
| 27P Protection | AEM Input 3 Threshold 1 Trip |
| 32 Protection | AEM Input 3 Threshold 2 Trip |
| 40Q | AEM Input 3 Threshold 3 Trip |
| 59P Protection | AEM Input 3 Threshold 4 Trip |
| 81O Protection | AEM Input 4 Out of Range |
| 81U Protection | AEM Input 4 Threshold 1 Trip |
| AEM Communication Failure | AEM Input 4 Threshold 2 Trip |
| AEM Input 1 Out of Range | AEM Input 4 Threshold 3 Trip |
| AEM Input 1 Threshold 1 Trip | AEM Input 4 Threshold 4 Trip |
| AEM Input 1 Threshold 2 Trip | AEM Input 5 Out of Range |
| AEM Input 1 Threshold 3 Trip | AEM Input 5 Threshold 1 Trip |
| AEM Input 1 Threshold 4 Trip | AEM Input 5 Threshold 2 Trip |
| AEM Input 2 Out of Range | AEM Input 5 Threshold 3 Trip |
| AEM Input 2 Threshold 1 Trip | AEM Input 5 Threshold 4 Trip |
| AEM Input 2 Threshold 2 Trip | AEM Input 6 Out of Range |
| AEM Input 2 Threshold 3 Trip | AEM Input 6 Threshold 1 Trip |
| AEM Input 2 Threshold 4 Trip | AEM Input 6 Threshold 2 Trip |
| AEM Input 3 Out of Range | AEM Input 6 Threshold 3 Trip |

| | |
|--|-------------------------------|
| AEM Input 6 Threshold 4 Trip | Field Short Circuit Status |
| AEM Input 7 Out of Range | Firmware Change |
| AEM Input 7 Threshold 1 Trip | Generator Below 10Hz |
| AEM Input 7 Threshold 2 Trip | IRIG Lost Sync |
| AEM Input 7 Threshold 3 Trip | Loss of Sensing |
| AEM Input 7 Threshold 4 Trip | No Logic |
| AEM Input 8 Out of Range | NTP Sync Lost |
| AEM Input 8 Threshold 1 Trip | OEL |
| AEM Input 8 Threshold 2 Trip | Phase Rotation Mismatch |
| AEM Input 8 Threshold 3 Trip | Power Input Failure |
| AEM Input 8 Threshold 4 Trip | Programmable Alarm 1 Name |
| AEM Output 1 Out of Range | Programmable Alarm 10 Name |
| AEM Output 2 Out of Range | Programmable Alarm 11 Name |
| AEM Output 3 Out of Range | Programmable Alarm 12 Name |
| AEM Output 4 Out of Range | Programmable Alarm 13 Name |
| CEM Communications Failure | Programmable Alarm 14 Name |
| CEM Communications Failure | Programmable Alarm 15 Name |
| CEM Hardware Mismatch | Programmable Alarm 16 Name |
| Configurable Protection 1 Threshold 1 Trip | Programmable Alarm 2 Name |
| Configurable Protection 1 Threshold 2 Trip | Programmable Alarm 3 Name |
| Configurable Protection 1 Threshold 3 Trip | Programmable Alarm 4 Name |
| Configurable Protection 1 Threshold 4 Trip | Programmable Alarm 5 Name |
| Configurable Protection 2 Threshold 1 Trip | Programmable Alarm 6 Name |
| Configurable Protection 2 Threshold 2 Trip | Programmable Alarm 7 Name |
| Configurable Protection 2 Threshold 3 Trip | Programmable Alarm 8 Name |
| Configurable Protection 2 Threshold 4 Trip | Programmable Alarm 9 Name |
| Configurable Protection 3 Threshold 1 Trip | Protection Field Over Current |
| Configurable Protection 3 Threshold 2 Trip | Protection Field Over Voltage |
| Configurable Protection 3 Threshold 3 Trip | RTD Input 1 Out of Range |
| Configurable Protection 3 Threshold 4 Trip | RTD Input 1 Threshold 1 Trip |
| Configurable Protection 4 Threshold 1 Trip | RTD Input 1 Threshold 2 Trip |
| Configurable Protection 4 Threshold 2 Trip | RTD Input 1 Threshold 3 Trip |
| Configurable Protection 4 Threshold 3 Trip | RTD Input 1 Threshold 4 Trip |
| Configurable Protection 4 Threshold 4 Trip | RTD Input 2 Out of Range |
| Configurable Protection 5 Threshold 1 Trip | RTD Input 2 Threshold 1 Trip |
| Configurable Protection 5 Threshold 2 Trip | RTD Input 2 Threshold 2 Trip |
| Configurable Protection 5 Threshold 3 Trip | RTD Input 2 Threshold 3 Trip |
| Configurable Protection 5 Threshold 4 Trip | RTD Input 2 Threshold 4 Trip |
| Configurable Protection 6 Threshold 1 Trip | RTD Input 3 Out of Range |
| Configurable Protection 6 Threshold 2 Trip | RTD Input 3 Threshold 1 Trip |
| Configurable Protection 6 Threshold 2 Trip | RTD Input 3 Threshold 2 Trip |
| Configurable Protection 6 Threshold 3 Trip | RTD Input 3 Threshold 3 Trip |
| Configurable Protection 6 Threshold 4 Trip | RTD Input 3 Threshold 4 Trip |
| Configurable Protection 7 Threshold 1 Trip | RTD Input 4 Out of Range |
| Configurable Protection 7 Threshold 2 Trip | RTD Input 4 Threshold 1 Trip |
| Configurable Protection 7 Threshold 3 Trip | RTD Input 4 Threshold 2 Trip |
| Configurable Protection 7 Threshold 4 Trip | RTD Input 4 Threshold 3 Trip |
| Configurable Protection 8 Threshold 1 Trip | RTD Input 4 Threshold 4 Trip |
| Configurable Protection 8 Threshold 2 Trip | RTD Input 5 Out of Range |
| Configurable Protection 8 Threshold 3 Trip | RTD Input 5 Threshold 1 Trip |
| Configurable Protection 8 Threshold 4 Trip | RTD Input 5 Threshold 2 Trip |
| Duplicate AEM | RTD Input 5 Threshold 3 Trip |
| Duplicate CEM | RTD Input 5 Threshold 4 Trip |
| Ethernet Link Lost | RTD Input 6 Out of Range |
| Exciter Open Diode | RTD Input 6 Threshold 1 Trip |
| Exciter Shorted Diode | RTD Input 6 Threshold 2 Trip |
| Failed to Build Up Alarm | RTD Input 6 Threshold 3 Trip |
| Field Short Circuit Status | RTD Input 6 Threshold 4 Trip |

RTD Input 7 Out of Range
 RTD Input 7 Threshold 1 Trip
 RTD Input 7 Threshold 2 Trip
 RTD Input 7 Threshold 3 Trip
 RTD Input 7 Threshold 4 Trip
 RTD Input 8 Out of Range
 RTD Input 8 Threshold 1 Trip
 RTD Input 8 Threshold 2 Trip
 RTD Input 8 Threshold 3 Trip
 RTD Input 8 Threshold 4 Trip
 SCL
 Thermocouple 1 Threshold 1 Trip

Thermocouple 1 Threshold 2 Trip
 Thermocouple 1 Threshold 3 Trip
 Thermocouple 1 Threshold 4 Trip
 Thermocouple 2 Threshold 1 Trip
 Thermocouple 2 Threshold 2 Trip
 Thermocouple 2 Threshold 3 Trip
 Thermocouple 2 Threshold 4 Trip
 Transfer Watchdog Alarm
 UEL
 Underfrequency VHz
 Unknown NLS Protocol Version
 Var Limiter

Alarm Configuration

BESTCOMSPlus Navigation Path: Settings Explorer, Alarm Configuration, Alarms

Alarms are configured using **BESTCOMSPlus**. Customize the reporting style of each alarm by choosing *Disabled*, *Latching*, or *Non-Latching*. Latching alarms are stored in nonvolatile memory and are retained even when control power to the DECS-250N is lost. Active alarms are shown on the front panel LCD and in **BESTCOMSPlus** until they are cleared. Non-latching alarms are cleared when control power is removed. Disabling an alarm affects only the annunciation of the alarm and not the actual operation of the alarm. This means that the alarm will still trip when trip conditions are met and the occurrence will appear on the sequence of events reports.

The **BESTCOMSPlus** Alarm Settings screen is illustrated in Figure 75 below.

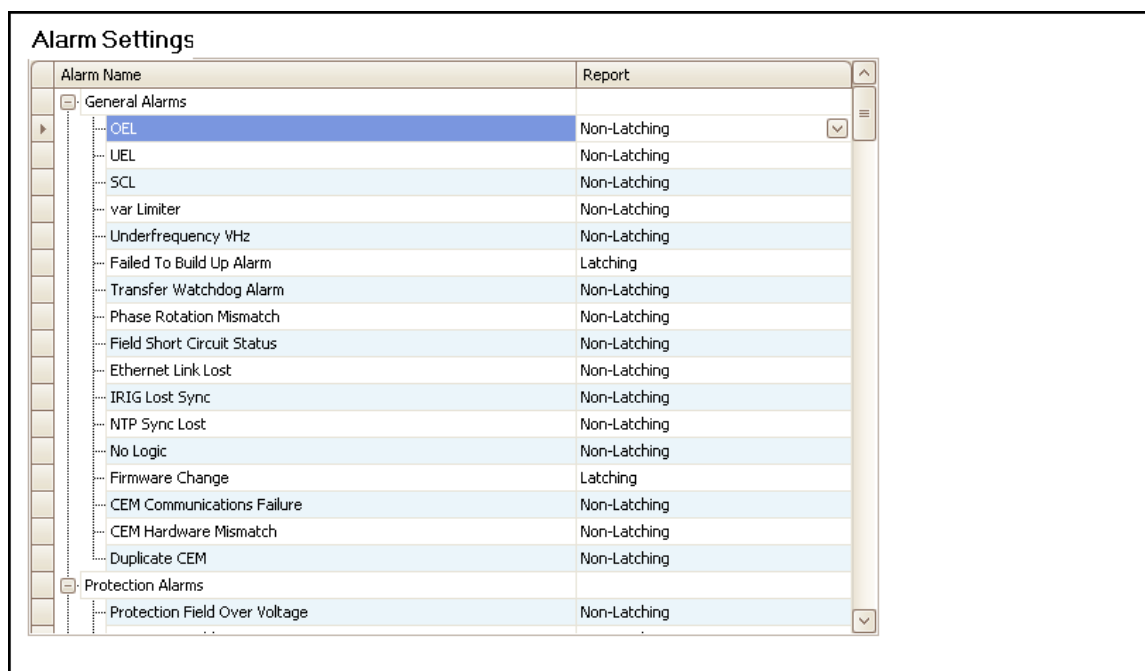


Figure 75. Alarm Settings Screen

User-Programmable Alarms

BESTCOMSPlus Navigation Path: Settings Explorer, Alarm Configuration, User Programmable Alarms

Sixteen user programmable alarms are available. User alarm labels^A are entered on the User Programmable Alarms screen (Figure 76). If the trip condition exists for the duration of the Activation Delay^B, the alarm is tripped. When active, the label of a user programmable alarm is displayed on the **BESTCOMSPlus**® Alarms screen, on the front panel display, and in the sequence of events reports.

Each alarm provides a logic output that can be connected to a physical output or other logic input using *BESTlogicPlus* Programmable Logic. Refer to the *BESTlogicPlus* chapter for more information on setting up alarm logic.

The screenshot displays the 'User Programmable Alarms' configuration screen. It features a grid of 15 individual alarm configuration panels, labeled 'User Programmable Alarm #1' through 'User Programmable Alarm #15'. Each panel includes a 'Label Text' field (e.g., 'Programmable Alarm 1 Name'), an 'Activation Delay (s)' field (e.g., '0'), and a small status indicator box labeled 'A' or 'B'.

Figure 76. User Programmable Alarms Screen

^A *Label Text*: Enter a string of alphanumeric characters.

^B *Activation Delay*: Adjustable from 0 to 300 in 1 second increments.

Retrieving Alarm Information

Alarms are displayed in the sequence of events reports. Alarms are automatically shown on the front panel display when active. To view active alarms using *BESTCOMSPlus*, use the Metering Explorer to open the Status, Alarms screen. See the *Metering* chapter for more information.

Resetting Alarms

A *BESTlogicPlus* expression can be used to reset the alarms. Use the Settings Explorer within *BESTCOMSPlus* to open the *BESTlogicPlus* Programmable Logic screen. Select the ALARM_RESET logic block from the list of *Elements*. Use the drag and drop method to connect a variable or series of variables to the *Reset* input. When this input is set TRUE, this element resets all active alarms. Refer to the *BESTlogicPlus* chapter for more information.

Real-Time Clock

BESTCOMSPlus Navigation Path: Metering Explorer, Status, Real Time Clock

HMI Navigation Path: Metering Explorer, Status, Real Time Clock

The DECS-250N time and date is displayed and adjusted on the *BESTCOMSPlus* Real-Time Clock screen (Figure 77). Manual adjustment of the DECS-250N clock is made by clicking the Edit button. This displays a window where the DECS-250N time and date can be adjusted manually or according to the connected PC clock's date and time.

Advanced clock settings such as time and date format, daylight saving time, network time protocol, and IRIG are described in the *Timekeeping* chapter of this manual.



Figure 77. Real-Time Clock Screen

Auto Export Metering

Found under the *Tools* menu, the auto export metering function is an automated method for saving multiple metering data files at specific intervals over a period of time while connected to a DECS-250N. The user specifies the *Number of Exports* and the *Interval* between each export. Enter a base filename for the metering data and a folder in which to save. The exports are counted and the count number will be appended to the base filename, making each filename unique. The first export is performed immediately after clicking the *Start* button. Figure 78 illustrates the *Auto Export Metering* screen.

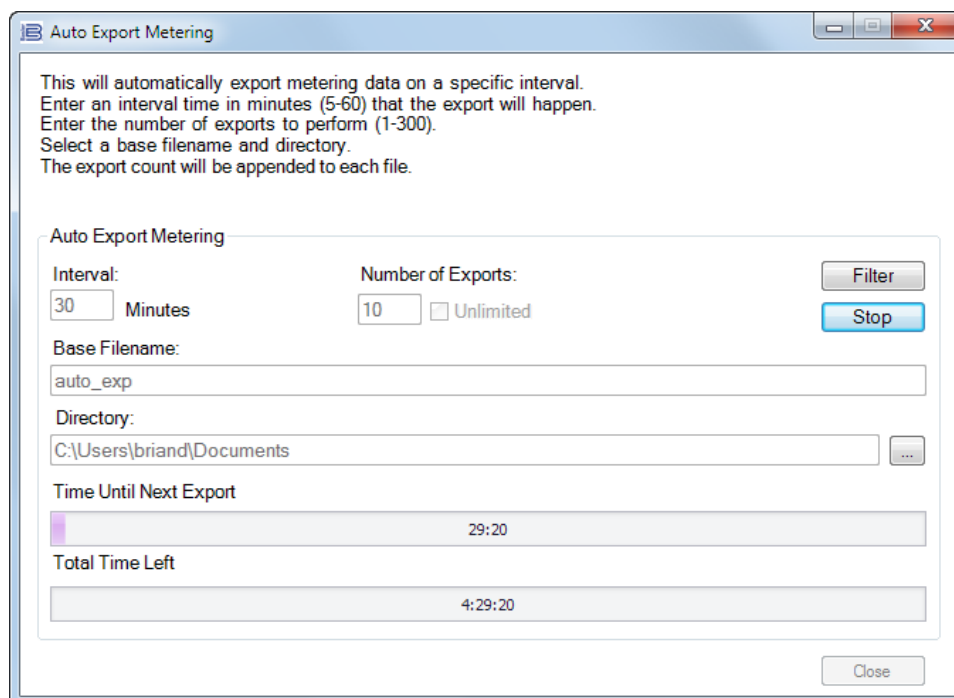


Figure 78. Auto Export Metering

Event Recorder

DECS-250N event recorder functions include sequence-of-events recording (SER), data logging (oscillography), and trending.

Sequence-of-Events Recording

BESTCOMSPlus Navigation Path: Metering Explorer, Reports, Sequence of Events

HMI Navigation Path: Metering Explorer, Reports, Sequence of Events

A sequence of events recorder monitors the internal and external status of the DECS-250N. Events are scanned at four millisecond intervals with 1,023 events stored per record. All changes of state that occur during each scan are time- and date-stamped. Sequence of events reports are available through BESTCOMSPlus®.

Any one of over 400 monitored data/status points can be recorded in the sequence of events. All points are enabled by default. Sequence of Events Setup is illustrated in Figure 79.



Figure 79. Sequence of Events Setup

Data Logging

BESTCOMSPlus Navigation Path: Settings Explorer, Report Configuration, DataLog

HMI Navigation Path: Settings, Configuration Settings, Data Log

The data logging function of the DECS-250N can record up to 6 oscillography records. DECS-250N oscillography records use the IEEE Standard Common Format for Transient Data Exchange (COMTRADE). Each record is time- and date-stamped. After 6 records have been recorded, the DECS-250N begins recording the next record over the oldest record. Because oscillography records are stored in nonvolatile memory, interruptions in DECS-250N control power will not affect the integrity of the records. Data log settings are configured in BESTCOMSPlus and illustrated in Figure 80 through Figure 83.

Setup

When oscillography is enabled^A, each record can consist of up to six user-selectable parameters^B with up to 1,200 data points recorded for each parameter. Data log setup settings are illustrated in Figure 80.

A pre-trigger-points setting^C enables a user-defined number of data points recorded prior to the event trigger to be included in a data log. The value of this setting affects the duration^D of the recorded pre-trigger points, the recorded post-trigger points^E, and the duration of the post-trigger points^F. A sample interval setting^G establishes the sample rate of the data points recorded. The value of this setting affects the pre- and post-trigger duration values and the total recording duration^H for a data log.

Figure 80. Data Log Setup

^A *Enable*: Select Enabled or Disabled.

^B *Log Parameters*: For each of the six parameters, select No Level Trigger, Vab, Vbc, Vca, Vbus, Ia, Ib, Ic, Vavg, Iavg, Iaux, Vfd, Ifd, Vaux, kW, kvar, kVA, PF, V1, V2, I1, I2, G Hz, B Hz, Test, Ptest, TermF, CompF, PsskW, Vtmag, x2, WashW, x5, WashP, x7, x8, x9, x10, x11, MechP, Synth, Tftl, x29, x15, x16, x17, x31, Prelim, Post, POut, CntOp, TrnOp, ErrIn, Oel Output, Uel Output, Scl Output, varLimOutput, Null Balance, PositionInd, AvrOut, FcrErr, FcrState, FcrOut, FvrErr, FvrState, FvrOut, var/PfErr, var/PfState, var/PfOut, Oel State, Uel State, Scl State, VarLimState, Droop, Network Load Share, Oel Ref, Uel Ref, Scl Ref, Scl PfRef, VarLimRef, ProgrammableDiagnostic1, ProgrammableDiagnostic2, ProgrammableDiagnostic3, ProgrammableDiagnostic4, ProgrammableDiagnostic5, ProgrammableDiagnostic6. (Selecting “No Level Trigger” excludes a parameter from data logging.)

^C *Pre-Trigger Points*: Adjustable from 0 to 1,199 in increments of 1.

^D *Pre-Trigger Duration*: Read-only value based on the Pre-Trigger Points and Sample Interval settings.

^E *Post-Trigger Points*: Read-only value based on the Pre-Trigger Points setting.

^F *Post-Trigger Duration*: Read-only value based on the Pre-Trigger Points and Sample Interval settings.

^G *Sample Interval*: Adjustable from 4 to 10,000 milliseconds in 4 millisecond increments for 60 Hz nominal generator frequency. Adjustable from 5 to 12,500 milliseconds in 5 millisecond increments for 50 Hz nominal generator frequency.

^H *Total Duration*: Read-only value is the sum of the pre- and post-trigger duration values.

Triggers

BESTCOMSPlus Navigation Path: Settings Explorer, Report Configuration, DataLog

HMI Navigation Path: Settings, Configuration Settings, Data Log

Data logging may be triggered by mode triggers, logic triggers, level triggers, or manually through BESTCOMSPlus.

Mode Triggers

Mode triggers initiate data logging as a result of an internal or external DECS-250N status change. A data log can be triggered by any of the following status changes:

- Start or Stop mode selected^A
- Soft Start mode enabled or disabled^B
- Underfrequency condition^C
- Manual or AVR mode selected^D
- Power Factor or Var mode selected^E
- Limiter active^F
- Voltage matching enabled or disabled^G
- Primary or secondary DECS selected^H
- PSS enabled or disabled^I
- Auto Sync enabled or disabled^J
- FCR or FVR mode selected^K
- Droop mode enabled or disabled^L
- Network Load Share enabled or disabled^M
- Line drop compensation enabled or disabled^N
- Cross-current compensation enabled or disabled^O
- Test mode enabled or disabled^P

Mode trigger settings are illustrated in Figure 81.

| Data Log Mode Triggers | | | |
|--------------------------------|----------------------------------|---------------------------|-------------------------------------|
| Start/Stop No Trigger A | Power Factor/Var No Trigger E | PSS No Trigger I | Network Load Share No Trigger M |
| Soft Start No Trigger B | Limiters No Trigger F | Auto Sync No Trigger J | Line Drop No Trigger N |
| Underfrequency No Trigger C | Voltage Matching No Trigger G | FCR/FVR No Trigger K | Cross Current Comp. No Trigger O |
| Auto/Manual No Trigger D | Pri/Sec DECS No Trigger H | Droop No Trigger L | Test No Trigger P |

Figure 81. Data Log Mode Triggers

^A **Start/Stop:** Select Trigger on stop mode, Trigger on start mode, or No Trigger.

^B **Soft Start:** Select Soft Start Mode Off, Soft Start Mode Active, or No Trigger.

^C **Underfrequency:** Select Inactive Trigger, Active Trigger, or No Trigger.

^D **Auto/Manual:** Select Manual Control Trigger, AVR Control Trigger, or No Trigger.

^E **Var/Power Factor:** Select Operating Mode Off Trigger, Operating Mode PF Trigger, Operating Mode VAR Trigger, or No Trigger.

^F **Limiters:** Select Limiter Off Trigger, Limiter UEL Trigger, Limiter OEL Trigger, Limiter UEL OEL Trigger, Limiter SCL Trigger, Limiter UEL SCL Trigger, Limiter OEL SCL Trigger, Limiter UEL OEL SCL Trigger, or No Trigger.

^G **Voltage Matching:** Select VMM Off Trigger, VMM On Trigger, or No Trigger.

^H **Pri/Sec DECS:** Select Primary Trigger, Secondary Trigger, or No Trigger.

^I **PSS:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

^J **Auto Sync:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

^K **FCR/FVR:** Select FVR Trigger, FCR Trigger, or No Trigger.

^L **Droop:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

^M **Network Load Share:** Disabled Trigger, Enabled Trigger, or No Trigger.

^N **Line Drop Comp.:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

^O **Cross-Current Comp.:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

^P **Test:** Select Disabled Trigger, Enabled Trigger, or No Trigger.

Level Triggers

Level triggering initiates a data log based on the value of an internal variable. The variable can be a minimum or maximum value and can be specified to trigger a record when the monitored variable crosses a minimum threshold from above, or a maximum threshold from below. A minimum and maximum threshold may also be selected for the monitored variable, causing the monitored value to trigger a record when it rises above its maximum threshold or decreases below its minimum threshold.

Level triggers are configured in BESTCOMS*Plus* on the Level Triggers tab (Figure 82) in the Data Log area of the Report Configuration. The Level Triggers tab consists of a list of parameters that can be selected to trigger a data log. Each parameter has a level trigger enable setting which configures triggering of a data log when the parameter increases above the upper threshold setting or decreases below the lower threshold setting. The parameters available to trigger a data log are listed below.

Figure 82. Data Log Level Triggers

- Auxiliary voltage input
- AVR output
- AVR PID error signal input
- Bus frequency
- Bus voltage
- Comp. frequency deviation
- Control output
- Cross current input
- Droop
- FCR error
- FCR output
- FCR state
- Field current
- Field voltage
- Frequency response
- FVR error
- FVR output
- FVR state
- Generator apparent power
- Generator average current
- Generator average voltage
- Generator current Ia
- Generator current Ib
- Generator current Ic
- Generator frequency
- Generator power factor
- Generator reactive power
- Generator real power
- Generator voltage Vab
- Generator voltage Vbc
- Generator voltage Vca
- Negative sequence current
- Negative sequence voltage
- Null balanced level
- OEL controller output
- OEL ref.
- OEL state
- Internal state
- Position indication
- Positive sequence current
- Positive sequence voltage
- PSS electrical power
- PSS filtered mech. power
- PSS final output
- PSS lead/lag #1
- PSS lead/lag #2
- PSS lead/lag #3
- PSS lead/lag #4
- PSS mechanical power
- PSS mechanical power LP #1
- PSS mechanical power LP #2
- PSS mechanical power LP #3
- PSS mechanical power LP #4
- PSS post-limit output

- PSS power HP #1
- PSS pre-limit output
- PSS speed HP #1
- PSS synthesized speed
- PSS terminal voltage
- PSS torsional filter #1
- PSS torsional filter #2
- PSS washed out power
- PSS washed out speed
- Network Load Share
- SCL controller output
- SCL PF ref.
- SCL ref.
- SCL state
- Terminal frequency deviation
- Time response
- UEL controller output
- UEL ref.
- UEL state
- Var limit output
- Var limit ref
- Var limit state
- Var/PF error
- Var/PF output
- Var/PF state

Logic Triggers

Logic triggering initiates a data log as a result of an internal or external status change. A data log can be triggered by any combination of alarm, contact output, or contact input state changes. The available logic triggers are illustrated in Figure 83.

| Logic Triggers | | |
|---|--|--|
| Alarm States <ul style="list-style-type: none"> <input type="checkbox"/> Generator Overvolt <input type="checkbox"/> Generator Undervolt <input type="checkbox"/> Excess Volts Per Hz <input type="checkbox"/> Loss Of Field <input type="checkbox"/> Loss Of Sensing Voltage <input type="checkbox"/> Below 10 Hz <input type="checkbox"/> Failed To Build Up <input type="checkbox"/> Field Over Voltage <input type="checkbox"/> Field Over Current <input type="checkbox"/> OEL <input type="checkbox"/> UEL <input type="checkbox"/> SCL <input type="checkbox"/> Under Freq Limiter <input type="checkbox"/> Set Point Upper Limit <input type="checkbox"/> Set Point Lower Limit <input type="checkbox"/> EDM Open Diode <input type="checkbox"/> EDM Shorted Diode <input type="checkbox"/> PSS Power Below Threshold <input type="checkbox"/> PSS Volt Unbalanced <input type="checkbox"/> PSS Current Unbalanced <input type="checkbox"/> PSS Speed Failure <input type="checkbox"/> PSS Voltage Limit Alarm | Relay Outputs <ul style="list-style-type: none"> <input type="checkbox"/> Watchdog Output <input type="checkbox"/> Relay1 Output <input type="checkbox"/> Relay2 Output <input type="checkbox"/> Relay3 Output <input type="checkbox"/> Relay4 Output <input type="checkbox"/> Relay5 Output <input type="checkbox"/> Relay6 Output <input type="checkbox"/> Relay7 Output <input type="checkbox"/> Relay8 Output <input type="checkbox"/> Relay9 Output <input type="checkbox"/> Relay 10 Output <input type="checkbox"/> Relay11 Output | Contact Inputs <ul style="list-style-type: none"> <input type="checkbox"/> Start Input <input type="checkbox"/> Stop Input <input type="checkbox"/> Switch1 Input <input type="checkbox"/> Switch2 Input <input type="checkbox"/> Switch3 Input <input type="checkbox"/> Switch4 Input <input type="checkbox"/> Switch5 Input <input type="checkbox"/> Switch6 Input <input type="checkbox"/> Switch7 Input <input type="checkbox"/> Switch8 Input <input type="checkbox"/> Switch9 Input <input type="checkbox"/> Switch10 Input <input type="checkbox"/> Switch11 Input <input type="checkbox"/> Switch12 Input <input type="checkbox"/> Switch13 Input <input type="checkbox"/> Switch14 Input |

Figure 83. Data Log Logic Triggers

Trending

BESTCOMSPlus Navigation Path: Settings Explorer, Report Configuration, Trending

HMI Navigation Path: Settings, Configuration Settings, Trending

The trend log records the activity of DECS-250N parameters over an extended period of time. When enabled^A, up to six selectable parameters^B can be monitored over a user-defined duration^C ranging from one to 720 hours. Trend log settings are illustrated in Figure 84.

Trending Setup

Setup

Enable: Disabled A

Duration (Hours): 1 C

Log Parameters B

Parameter 1: No Level Trigger

Parameter 2: No Level Trigger

Parameter 3: No Level Trigger

Parameter 4: No Level Trigger

Parameter 5: No Level Trigger

Parameter 6: No Level Trigger

Figure 84. Trend Log Setup

^A *Trending Enable*: Select Enabled or Disabled.

^B *Trending Log Parameters*: Select NO Level Trigger, Vab: PhA-PhB L-L Voltage {p.u}, Vbc: PhB-PhC L-L Voltage {p.u}, Vca: PhC-PhA L-L Voltage {p.u}, Vbus: Bus Voltage {p.u}, Ia : Phase A Current {p.u}, Ib: Phase B Current {p.u}, Ic: Phase C Current {p.u}, Vavg: Avg L-L Voltage {p.u}, Iavg: Avg Line Current {p.u}, Iaux: Cross Current Input {p.u}, Vfd: Field Voltage {p.u}, Ifd: Field Current {p.u}, Vaux: Aux Voltage Input {p.u}, kW: Real Power {p.u}, kvar: Reactive Power {p.u}, kVA: Total Power {p.u}, PF: Power Factor, V1: Positive Sequence Voltage {p.u}, V2: Negative Sequence Voltage {p.u}, I1: Positive Sequence Current {p.u}, I2: Negative Sequence Current {p.u}, G Hz: Generator Frequency (Hz), B Hz: Bus Frequency (Hz), Test: Frequency Response Signal {p.u}, or Ptest: Time Response Signal {p.u}, TermF: Terminal Frequency Deviation (%), CompF: Compensated Frequency Deviation, PssKW: Pss Electric Power {p.u}, Vtmag: PSS Term Voltage, x2 : Speed HP #1, WashW : Washed Out Speed {p.u}, x5 : Power HP #1 {p.u}, WashP: Washed Out Power {p.u}, x7: Mechanical Power {p.u}, x8: Mechanical Power LP #1, x9: Mechanical Power LP #2, x10: Mechanical Power LP #3, x11: Mechanical Power LP #4, MechP: Filtered Mechanical Power {p.u}, Synth: Synthesized Speed {p.u}, Tflt1: Torsional Filter #1 {p.u}, x29: Torsional Filter #2 {p.u}, x15: Lead-Lag #1 {p.u}, x16: Lead-Lag #2 {p.u}, x17: Lead-Lag #3 {p.u}, x31: Lead-Lag #4 {p.u}, Prelim: Pre-Limit Output {p.u}, Post: Post-Limit Output {p.u}, POut: Final PSS Output {p.u}, CntOp: Control Output {p.u}, TrnOp: Internal State {p.u}, ErrIn: Avr Error Signal, OelOutput: OEL Controller Output, UelOutput: UEL Controller Output, SclOutput: SCL Controller Output, varLimOutput: var Limiter Output, NullBalance: Null Balance Level {p.u}, PositionInd: Position Indication {p.u}, AvrOut, FcrErr, FcrState, FcrOut, FvrErr, FvrState, FvrOut, var/PfErr, var/PfState, var/PfOut, OelState, UelState, SclState, varLimState, Droop, Rcc, OelRef, UelRef, SclRef, SclPfRef, varLimRef, ProgrammableDiagnostic1, ProgrammableDiagnostic2, ProgrammableDiagnostic3, ProgrammableDiagnostic4, ProgrammableDiagnostic5, or ProgrammableDiagnostic6.

^C *Trending Duration*: Adjustable from 1 to 720 hours in 1 hour increments.

Power System Stabilizer

The optional (style xPxxxxx), integrated power system stabilizer (PSS) is an IEEE type PSS2A, dual-input, “integral of accelerating power” stabilizer that provides supplementary damping for low-frequency, local-mode oscillations and power system oscillations.

PSS features include user-selectable, speed-only sensing, two- or three-wattmeter power measurement, optional frequency-based operation, and generator and motor control modes.

PSS settings are configured exclusively through the BESTCOMS*Plus*® interface. These settings are illustrated in Figure 94, Figure 95, Figure 96, and Figure 97.

BESTCOMS*Plus* Navigation Path: Settings Explorer, PSS

HMI Navigation Path: Settings, PSS

Supervisory Function and Setting Groups

A supervisory function enables PSS operation only when a sufficient load is applied to the generator. Two separate groups of PSS settings enable stabilizer operation tailored for two distinct load conditions.

Supervisory Function

When PSS control is enabled^A, a power-on threshold setting^B determines the level of power (watts) where PSS operation is automatically enabled. This threshold is a per-unit setting based on the generator ratings. (The *Configuration* chapter of this manual provides information about entering the generator and system ratings.) A hysteresis setting^C provides a margin below the power-on threshold so that transient dips in power (watts) will not disable stabilizer operation. This hysteresis is a per-unit setting based on the generator ratings.

Setting Groups

When setting group selection is enabled^D, a threshold setting^E establishes the power level where the PSS gain settings are switched from the primary group to the secondary group. After a transfer to the secondary gain settings, a hysteresis setting^F determines the level of (decreasing) power where a transfer back to the primary gain settings will occur.

Theory of Operation

The PSS uses an indirect method of power system stabilization that employs two signals: shaft speed and electrical power. This method eliminates the undesirable components from the speed signal (such as noise, lateral shaft run-out, or torsional oscillations) while avoiding a reliance on the difficult-to-measure mechanical power signal.

PSS function is illustrated by the function blocks and software switches shown in Figure 85. This illustration is also available in BESTCOMS*Plus* by clicking the PSS Model Info button located on the Control tab.

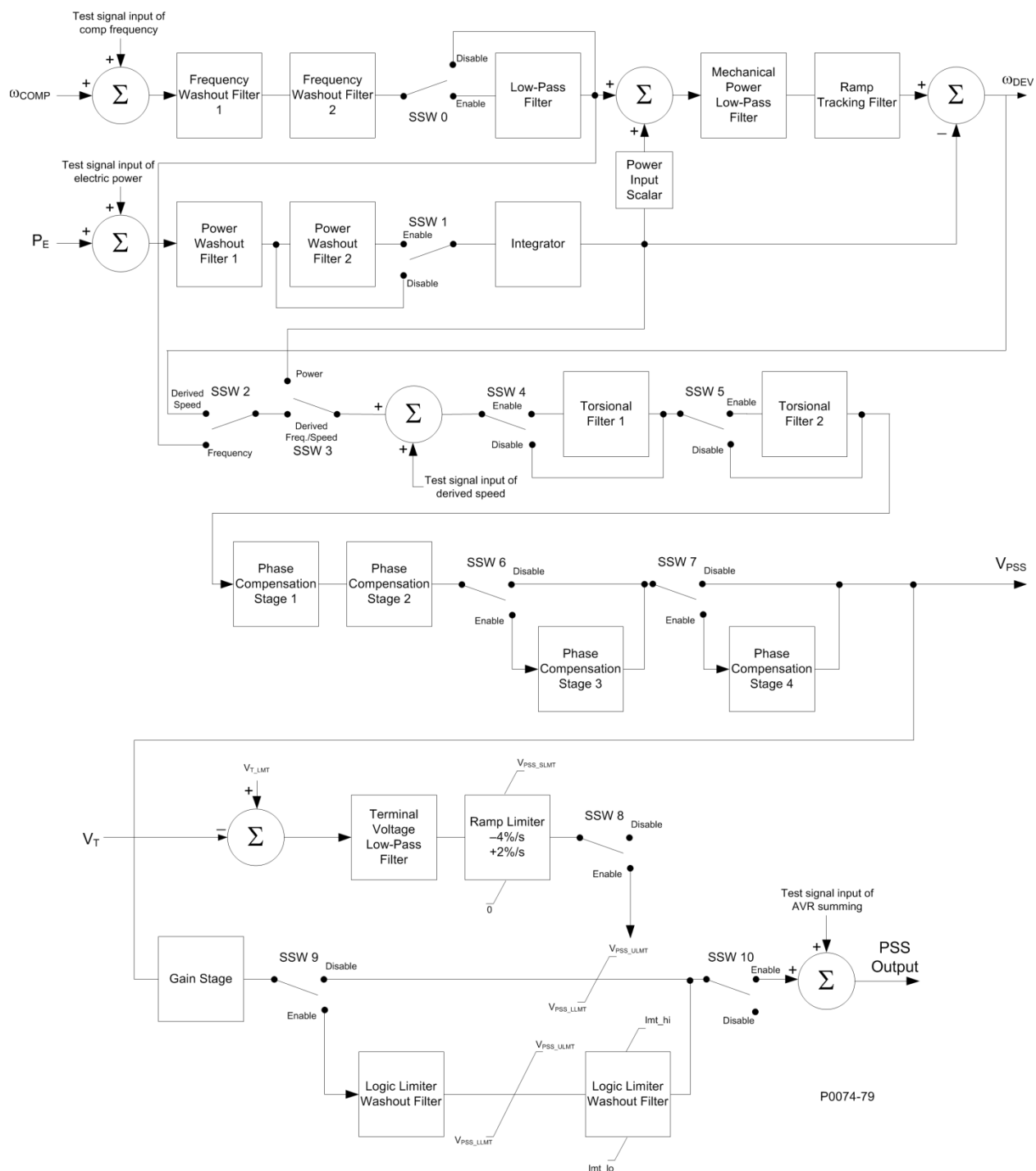


Figure 85. PSS Function Blocks and Software Switches

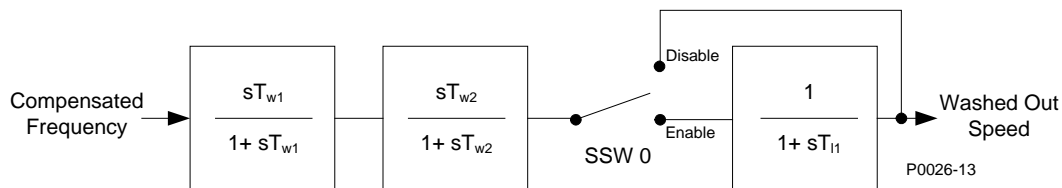
Speed Signal

The speed signal is converted to a constant level that is proportional to the shaft speed (frequency).

Two high-pass (frequency washout) filter stages are applied to the resulting signal to remove the average speed level and produce a speed deviation signal. This ensures that the stabilizer reacts only to changes in speed and does not permanently alter the generator terminal voltage reference.

The frequency washout filter stages are controlled by time constant settings T_{w1}^G and T_{w2}^H . Low-pass filtering of the speed deviation signal can be enabled or disabled through software switch SSW 0^I. The low-pass filter time constant is adjusted by the T_{I1} setting^J.

Figure 86 shows the high-pass and low-pass filter transfer function blocks in frequency domain form. (The letter s is used to represent the complex frequency of Laplace operator.)



PSS Frequency Input Signal

Figure 86. Speed Signal

Rotor Frequency Calculation

During steady-state conditions, the terminal frequency of the generator is a good measure of rotor speed. However, this may not be the case during low frequency transients, due to the voltage drop across the machine reactance. To compensate for this effect, the DECS-250N first calculates the terminal voltages and currents. It then adds the voltage drop across the quadrature reactance to the terminal voltages to obtain internal machine voltages. These voltages are then used to calculate the rotor frequency. This gives a more accurate measure of rotor speed during low frequency transients when stabilizing action is required.

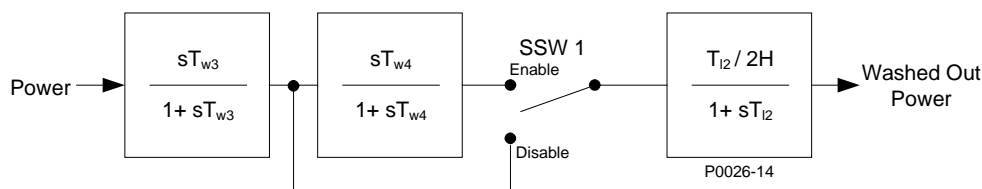
The quadrature axis compensation used in the rotor frequency calculation is entered through the Quadrature X_q setting^K.

Generator Electrical Power Signal

Figure 87 illustrates the operations performed on the power input signal to produce the integral of electrical power deviation signal.

The generator electrical power output is derived from the generator VT secondary voltages and generator CT secondary currents applied to the DECS-250N.

The power output is high-pass (washout) filtered to produce the required power deviation signal. If additional washout filtering is desired, a second high-pass filter can be enabled by software switch SSW 1^L. The first high-pass filter is controlled by time constant setting T_{w3}^M and the second high-pass filter is controlled by time constant setting T_{w4}^N .



PSS Power Input Signal

Figure 87. Generator Electrical Power Signal

After high-pass filtering, the electrical power signal is integrated and scaled, combining the generator inertia constant^o (2H) with the speed signal. Low-pass filtering within the integrator is controlled by time constant T12^p.

Derived Mechanical Power Signal

The speed deviation signal and integral of electrical power deviation signal are combined to produce a derived, integral of mechanical power signal.

An adjustable gain stage, Kpe^o, establishes the amplitude of the electrical power input used by the PSS function.

The derived integral of mechanical power signal is then passed through a mechanical-power, low-pass filter and ramp tracking filter. The low-pass filter is controlled by time constant T13^r and provides attenuation of torsional components appearing in the speed input path. The ramp tracking filter produces a zero, steady-state error to ramp changes in the integral of electric power input signal. This limits the stabilizer output variation to very low levels for the mechanical power rates of change that are normally encountered during operation of utility-scale generators. The ramp tracking filter is controlled by time constant Tr^s. An exponent consisting of a numerator^T and denominator^U is applied to the mechanical power filter.

Processing of the derived integral of mechanical power signal is illustrated in Figure 88.

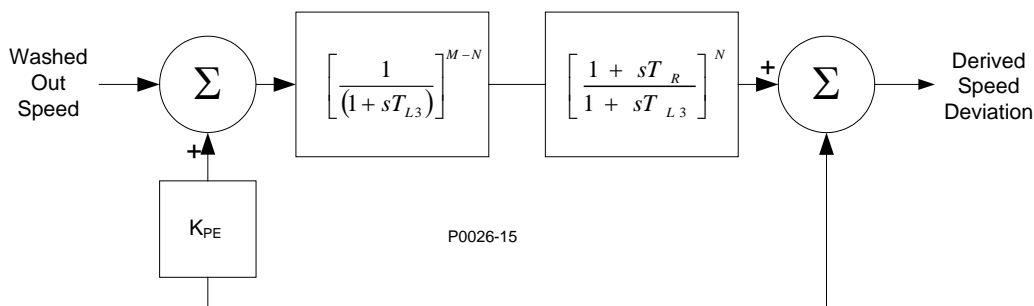


Figure 88. Derived Mechanical Power Signal

Stabilizing Signal Selection

Figure 89 illustrates how software switches SSW 2^v and SSW 3^w are used to select the stabilizing signal. Derived speed deviation is selected as the stabilizing signal when the SSW 2 setting is Derived Speed and the SSW 3 setting is Derived Frequency/Speed. Washed out speed is selected as the stabilizing signal when the SSW 2 setting is Frequency and the SSW 3 setting is Derived Frequency/Speed. Washed out power is selected as the stabilizing signal when the SSW 3 setting is Power. (When the SSW 3 setting is Power, the SSW 2 setting has no effect.)

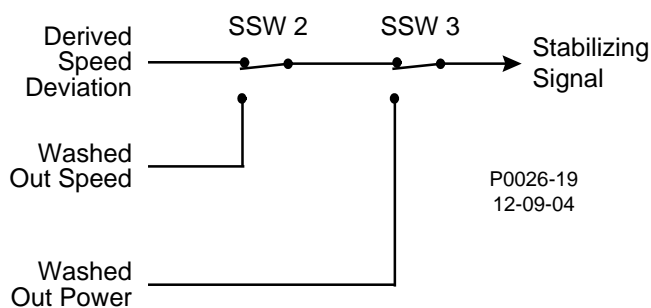


Figure 89. Stabilizing Signal Selection

Torsional Filters

Two torsional filters, shown in Figure 90, are available after the stabilizing signal and before the phase compensation blocks. The torsional filters provide the desired gain reduction at a specified frequency. The filters compensate the torsional frequency components present in the input signal.

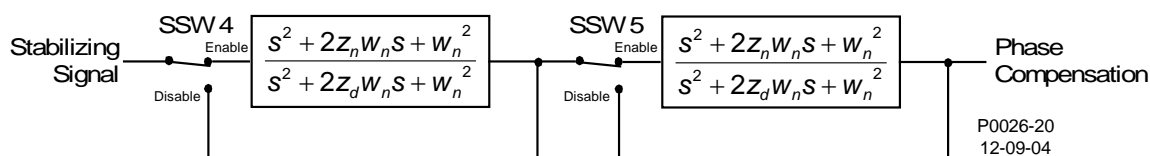


Figure 90. Torsional Filters

Software switch SSW 4^x enables and disables torsional filter 1 and SSW 5^y enables and disables torsional filter 2.

Torsional filters 1 and 2 are controlled by a zeta numerator^z (Zeta Num), zeta denominator^{AA} (Zeta Den), and a frequency response parameter^{BB} (Wn).

Phase Compensation

The derived speed signal is modified before it is applied to the voltage regulator input. Filtering of the signal provides phase lead at the electromechanical frequencies of interest (0.1 to 5 Hz). The phase lead requirement is site-specific and is required to compensate for phase lag introduced by the closed-loop voltage regulator.

Four phase compensation stages are available. Each phase compensation stage has a phase lead time constant^{CC} (T1, T3, T5, T7) and a phase lag time constant^{DD} (T2, T4, T6, T8). Normally, the first two lead-lag stages are adequate to match the phase compensation requirements of a unit. If needed, the third and fourth stages may be added through the settings of software switches SSW 6^{EE} and SSW 7^{FF}. Figure 91 illustrates the phase compensation stages and associates software switches.

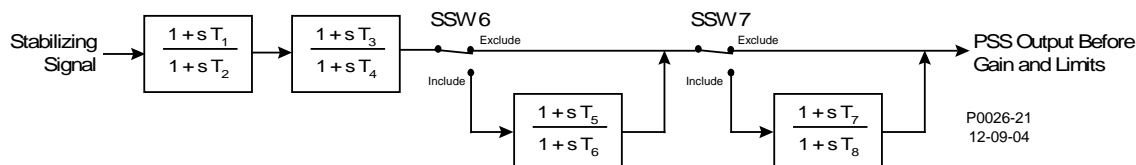


Figure 91. Phase Compensation

Washout Filter and Logic Limiter

The output of the phase compensation stages is connected, through a stabilizer gain stage, to the washout filter and logic limiter.

Software switch SSW 9^{GG} enables and bypasses the washout filter and logic limiter. The washout filter has two time constants: normal^{HH} and limit^{II} (less than normal).

The logic limiter compares the signal from the washout filter with the logic limiter upper^{JJ} and lower^{KK} limit settings. If the counter reaches the set delay time^{LL}, the time constant for the washout filter changes from the normal time constant to the limit time constant. When the signal returns to within the specified limits, the counter resets and the washout filter time constant changes back to the normal time constant.

Figure 92 illustrates the washout filter and logic limiter.

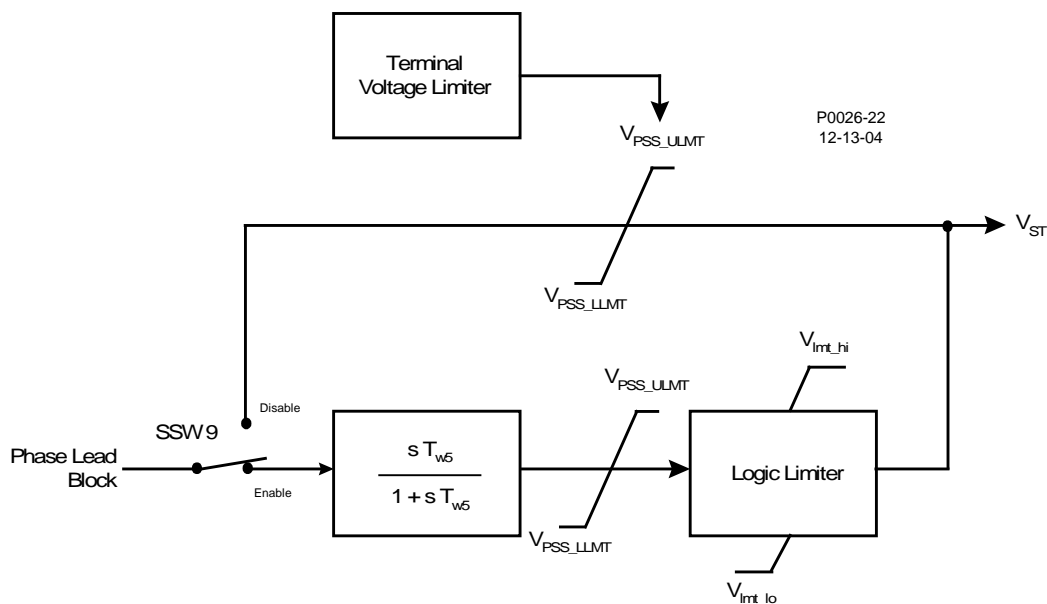


Figure 92. Washout Filter and Logic Limiter

Output Stage

Prior to connecting the stabilizer output signal to the voltage regulator input, adjustable gain^{MM} and upper^{NN} and lower^{OO} limits are applied. The stabilizer output is connected to the voltage regulator input when the software switch SSW 10^{PP} setting is On. Processing of the stabilizer output signal is illustrated in Figure 93.

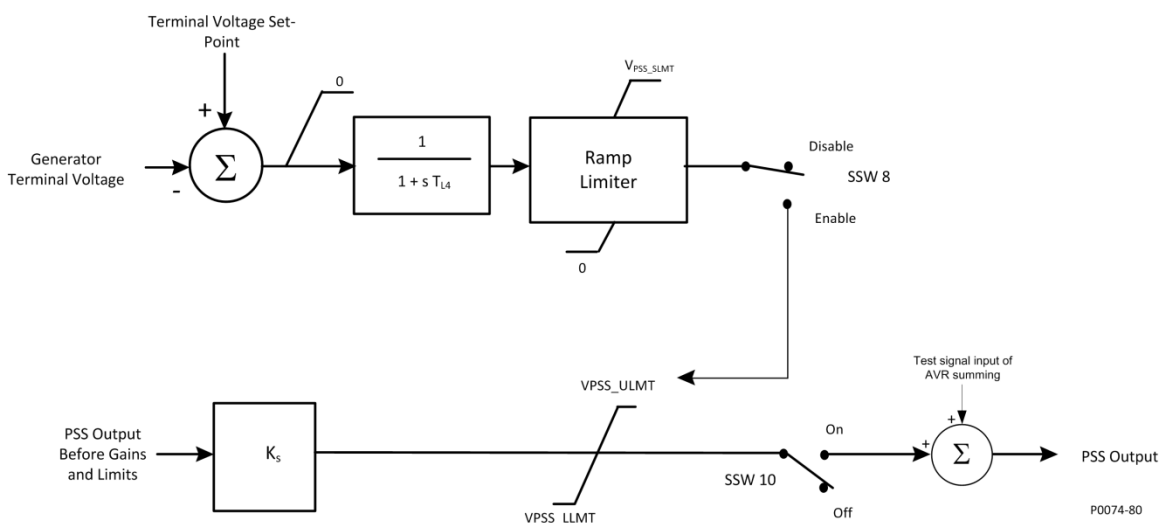


Figure 93. Output Stage

Terminal Voltage Limiter

Since the PSS operates by modulating the excitation, it may counteract the voltage regulator's attempts to maintain terminal voltage within a tolerance band. To avoid creating an overvoltage condition, the PSS has a terminal voltage limiter (shown in Figure 92) that reduces the upper output limit to zero when the

generator voltage exceeds the terminal voltage setpoint^{QQ}. The terminal voltage limiter is enabled and disabled by software switch SSW 8^{RR}. The limit setpoint is normally selected such that the limiter will eliminate any contribution from the PSS before the timed overvoltage or volts per hertz protection operates.

The limiter reduces the stabilizer's upper limit, V_{PSS_ULMT} , at a fixed rate until zero is reached or overvoltage is no longer present. The limiter does not reduce the AVR reference below its normal level; it will not interfere with system voltage control during disturbance conditions. The error signal (terminal voltage minus the limit start point) is processed through a conventional low-pass filter to reduce the effect of measurement noise. The low-pass filter is controlled by a time constant^{SS}.

Figure 94. PSS Configuration Settings

Figure 95. PSS Control Settings

| Parameter | |
|--|---------------------------------|
| Primary | |
| Low-Pass/Ramp Tracking | |
| TI1 - Time Const. 0.00 J | Tr - Time Const. 0.50 S |
| TI2 - Time Const. 1.00 P | N - Num Exp. 1 T |
| TI3 - Time Const. 0.10 R | M - Den Exp. 5 U |
| High-Pass Filtering/Integration | |
| Tw1 - Time Const. 1.00 G | Tw4 - Time Const. 1.00 N |
| Tw2 - Time Const. 1.00 H | H - Inertia 1.00 O |
| Tw3 - Time Const. 1.00 M | |
| Torsional Filters | |
| Zeta Num 1 0.50 Z | Zeta Num 2 0.50 Z |
| Zeta Den 1 0.25 AA | Zeta Den 2 0.25 AA |
| Wn 1 42.05 BB | Wn 2 42.05 BB |
| Rotor Freq Calculation | |
| Quadrature Xq 0.000 K | |
| Power Input | |
| Kpe 1.00 Q | |
| Phase Comp - Time Constants | |
| T1 - 1st Phase Lead 1.000 CC | T5 - 3rd Phase Lead 1.000 CC |
| T2 - 1st Phase Lag 1.000 DD | T6 - 3rd Phase Lag 1.000 DD |
| T3 - 2nd Phase Lead 1.000 CC | T7 - 4th Phase Lead 1.000 CC |
| T4 - 2nd Phase Lag 1.000 DD | T8 - 4th Phase Lag 1.000 DD |
| Secondary | |
| Low-Pass/Ramp Tracking | |
| TI1 - Time Const. 0.00 J | Tr - Time Const. 0.50 S |
| TI2 - Time Const. 1.00 P | N - Num Exp. 1 T |
| TI3 - Time Const. 0.10 R | M - Den Exp. 5 U |
| High-Pass Filtering/Integration | |
| Tw1 - Time Const. 1.00 G | Tw4 - Time Const. 1.00 N |
| Tw2 - Time Const. 1.00 H | H - Inertia 1.00 O |
| Tw3 - Time Const. 1.00 M | |
| Torsional Filters | |
| Zeta Num 1 0.50 Z | Zeta Num 2 0.50 Z |
| Zeta Den 1 0.25 AA | Zeta Den 2 0.25 AA |
| Wn 1 42.05 BB | Wn 2 42.05 BB |
| Rotor Freq Calculation | |
| Quadrature Xq 0.000 K | |
| Power Input | |
| Kpe 1.00 Q | |
| Phase Comp - Time Constants | |
| T1 - 1st Phase Lead 1.000 CC | T5 - 3rd Phase Lead 1.000 CC |
| T2 - 1st Phase Lag 1.000 DD | T6 - 3rd Phase Lag 1.000 DD |
| T3 - 2nd Phase Lead 1.000 CC | T7 - 4th Phase Lead 1.000 CC |
| T4 - 2nd Phase Lag 1.000 DD | T8 - 4th Phase Lag 1.000 DD |

Figure 96. PSS Parameter Settings

| Output Limiter | |
|---|---|
| Primary PSS Output Limiting Upper Limit <input type="text" value="0.000"/> <input type="button" value="NN"/> Lower Limit <input type="text" value="0.000"/> <input type="button" value="OO"/> | Secondary PSS Output Limiting Upper Limit <input type="text" value="0.000"/> <input type="button" value="NN"/> Lower Limit <input type="text" value="0.000"/> <input type="button" value="OO"/> |
| Stabilizer Gain Ks <input type="text" value="0.00"/> <input type="button" value="MM"/> | Stabilizer Gain Ks <input type="text" value="0.00"/> <input type="button" value="MM"/> |
| Terminal Voltage Limiter Time Constant <input type="text" value="1.000"/> <input type="button" value="SS"/> Setpoint <input type="text" value="1.000"/> <input type="button" value="QQ"/> | Terminal Voltage Limiter Time Constant <input type="text" value="1.000"/> <input type="button" value="SS"/> Setpoint <input type="text" value="1.000"/> <input type="button" value="QQ"/> |
| Logic Limiter Washout Filter Normal Time <input type="text" value="10.0"/> <input type="button" value="HH"/> Limit Time <input type="text" value="0.30"/> <input type="button" value="II"/> | Logic Limiter Washout Filter Normal Time <input type="text" value="10.0"/> <input type="button" value="HH"/> Limit Time <input type="text" value="0.30"/> <input type="button" value="II"/> |
| Logic Output Limiter Upper Limit <input type="text" value="0.020"/> <input type="button" value="JJ"/> Lower Limit <input type="text" value="-0.020"/> <input type="button" value="KK"/> Time Delay <input type="text" value="0.50"/> <input type="button" value="LL"/> | Logic Output Limiter Upper Limit <input type="text" value="0.020"/> <input type="button" value="JJ"/> Lower Limit <input type="text" value="-0.020"/> <input type="button" value="KK"/> Time Delay <input type="text" value="0.50"/> <input type="button" value="LL"/> |

Figure 97. PSS Output Limiter Settings

- ^A PSS Control: Select Check box to enable.
- ^B Supervisory Function Power-On Threshold: Adjustable from 0 to 1 in 0.01 increments.
- ^C Supervisory Function Power Hysteresis: Adjustable from 0 to 1 in 0.01 increments.
- ^D Setting Group Logic: Check box to enable.
- ^E Power Level Threshold: Adjustable from 0 to 1 in 0.01 increments.
- ^F Power Level Hysteresis: Adjustable from 0 to 1 in 0.01 increments.
- ^G High-Pass Filtering/Integration Time Constant Tw1: Adjustable from 1 to 20 in 0.01 increments.
- ^H High-Pass Filtering/Integration Time Constant Tw2: Adjustable from 1 to 20 in 0.01 increments.
- ^I Speed Low-Pass Filter Switch SSW 0: Select Enabled or Disabled.
- ^J Low-Pass/Ramp Tracking Time Constant TI1: Adjustable from 1 to 20 in 0.01 increments.
- ^K Rotor Frequency Calculation – Quadrature Xq: Adjustable from 0 to 5 in 0.001 increments.
- ^L Power Washout Filter #2 Software Switch SSW 1: Select Enabled or Disabled.
- ^M High-Pass Filtering/Integration Time Constant Tw3: Adjustable from 1 to 20 in 0.01 increments.
- ^N High-Pass Filtering/Integration Time Constant Tw4: Adjustable from 1 to 20 in 0.01 increments.
- ^O High-Pass Filtering/Integration Inertia (H): Adjustable from 1 to 25 in 0.01 increments.
- ^P Low-Pass/Ramp Tracking Time Constant TI2: Adjustable from 1 to 20 in 0.01 increments.
- ^Q Power Input Gain Stage Kpe: Adjustable from 0 to 2 in 0.01 increments.
- ^R Low-Pass/Ramp Tracking Time Constant TI3: Adjustable from 0.05 to 0.2 in 0.01 increments.
- ^S Low-Pass/Ramp Tracking Time Constant Tr: Adjustable from 0.05 to 1 in 0.01 increments.
- ^T Low-Pass/Ramp Tracking Exponent Numerator: Adjustable from 0 to 1 in increments of 1.
- ^U Low-Pass/Ramp Tracking Exponent Denominator: Adjustable from 1 to 5 in increments of 1.
- ^V PSS Signal Software Switch SSW 2: Select Frequency or Der. Speed.
- ^W PSS Signal Software Switch SSW 3: Select Power or Der. Freq/Speed.

-
- ^X *Torsional Filter 1 Software Switch SSW 4*: Select Disabled or Enabled.
- ^Y *Torsional Filter 2 Software Switch SSW 5*: Select Disabled or Enabled.
- ^Z *Torsional Filter Zeta Numerator*: Adjustable from 0 to 1 in 0.01 increments.
- ^{AA} *Torsional Filter Zeta Denominator*: Adjustable from 0 to 1 in 0.01 increments.
- ^{BB} *Torsional Filter Frequency Response Parameter (W_n)*: Adjustable from 10 to 150 in 0.05 increments.
- ^{CC} *Phase Compensation Phase Lead Time Constant*: Adjustable from 0.001 to 6 in 0.001 increments.
- ^{DD} *Phase Compensation Phase Lag Time Constant*: Adjustable from 0.001 to 6 in 0.001 increments.
- ^{EE} ^{3rd} *Lead/Lag Stage Software Switch SSW 6*: Select Include or Exclude.
- ^{FF} ^{4th} *Lead/Lag Stage Software Switch SSW 7*: Select Include or Exclude.
- ^{GG} *Logic Limiter Software Switch SSW 9*: Select Enabled or Disabled.
- ^{HH} *Logic Limiter Washout Filter Normal Time Constant*: Adjustable from 5 to 30 in 0.1 increments.
- ^{II} *Logic Limiter Washout Filter Limit Time Constant*: Adjustable from 0 to 1 in 0.01 increments.
- ^{JJ} *Logic Output Limiter Upper Limit*: Adjustable from 0.01 to 0.04 in 0.01 increments.
- ^{KK} *Logic Output Limiter Lower Limit*: Adjustable from -0.04 to -0.01 in 0.01 increments.
- ^{LL} *Logic Output Limiter Time Delay*: Adjustable from 0 to 2 in 0.01 increments.
- ^{MM} *Stabilizer Gain (K_s)*: Adjustable from 0 to 50 in 0.01 increments.
- ^{NN} *PSS Output Limiting Upper Limit*: Adjustable from 0 to 0.5 in 0.01 increments.
- ^{OO} *PSS Output Limiting Lower Limit*: Adjustable from -0.5 to 0 in 0.01 increments.
- ^{PP} *PSS Output Software Switch SSW 10*: Select On or Off.
- ^{QQ} *Terminal Voltage Limiter Setpoint*: Adjustable from 0 to 10 in 0.001 increments.
- ^{RR} *Terminal Voltage Limiter Software Switch SSW 8*: Select Enabled or Disabled.
- ^{SS} *Terminal Voltage Limiter Time Constant*: Adjustable from 0.02 to 5 in 0.01 increments.

Stability Tuning

Generator stability tuning in the DECS-250N is achieved through the calculation of PID parameters. PID stands for Proportional, Integral, Derivative. The word proportional indicates that the response of the DECS-250N output is proportional or relative to the amount of difference observed. Integral means that the DECS-250N output is proportional to the amount of time that a difference is observed. Integral action eliminates offset. Derivative means that the DECS-250N output is proportional to the required rate of excitation change. Derivative action avoids excitation overshoot.

Caution

All stability tuning must be performed with no load on the system or equipment damage may occur.

AVR Mode

BESTCOMS^{Plus} Navigation Path: Settings Explorer, Operating Settings, Gain, AVR

HMI Navigation Path: Settings, Operating Settings, Gains, AVR Gains

Two sets of PID settings are provided to optimize performance under two distinct operating conditions, such as with the power system stabilizer (PSS) in or out of service. A fast controller provides optimum transient performance with the PSS in service while a slower controller can provide improved damping of first swing oscillations when the PSS is offline. BESTCOMS^{Plus}® primary and secondary AVR stability settings are shown in Figure 98.

Predefined Stability Settings

Twenty predefined sets^A of stability settings are available with the DECS-250N. Appropriate PID values are implemented based on the nominal generator frequency selected (see the *Configuration* chapter of this manual) and the combination of generator (T'do) and exciter (Texc) time constants selected from the gain option list. (The default value for the exciter time constant is the generator time constant divided by six.)

Additional settings are available to remove the effects of noise on numerical differentiation (AVR derivative time constant Td)^B and set the voltage regulator gain level of the PID algorithm (Ka)^C.

Custom Stability Settings

Stability tuning can be tailored for optimum generator transient performance. Selecting a primary gain option of “custom” enables entry of custom proportional (Kp)^D, integral (Ki)^E, and derivative (Kd)^F gains.

When tuning the stability gain settings, consider the following guidelines

- If the transient response has too much overshoot, decrease Kp. If the transient response is too slow, with little or no overshoot, increase Kp.
- If the time to reach steady-state is too long, increase Ki.
- If the transient response has too much ringing, increase Kd.

AVR

Primary

AVR

Kp - Proportional Gain
10.000 D

Ki - Integral Gain
30.000 E

Kd - Derivative Gain
1.000 F

Td - Derivative Time Constant
0.00 B

Ka - Voltage Regulator Gain (Recommended Ka)
0.100 C 0.099 I

PID Pre-Settings

Primary Gain Option
Custom A

Primary PID Calculator G

Auto Tuning

AutoTune H

Secondary

AVR

Kp - Proportional Gain
10.000 D

Ki - Integral Gain
30.000 E

Kd - Derivative Gain
1.000 F

Td - Derivative Time Constant
0.00 B

Ka - Voltage Regulator Gain (Recommended Ka)
0.100 C 0.099 I

PID Pre-Settings

Secondary Gain Option
Custom A

Secondary PID Calculator G

Figure 98. AVR Stability Settings

^A *Gain Option*: Select T'do=1.0 Te=0.17, T'do=1.5 Te=0.25, T'do=2.0 Te=0.33, T'do=2.5 Te=0.42, T'do=3.0 Te=0.50, T'do=3.5 Te=0.58, T'do=4.0 Te=0.67, T'do=4.5 Te=0.75, T'do=5.0 Te=0.83, T'do=5.5 Te=0.92, T'do=6.0 Te=1.00, T'do=6.5 Te=1.08, T'do=7.0 Te=1.17, T'do=7.5 Te=1.25, T'do=8.0 Te=1.33, T'do=8.5 Te=1.42, T'do=9.0 Te=1.50, T'do=9.5 Te=1.58, T'do=10.0 Te=1.67, T'do=10.5 Te=1.75, or Custom.

^B *Td – AVR Derivative Time Constant*: Adjustable from 0 to 1 in 0.01 increments.

^C *Ka – Voltage Regulator Gain*: Adjustable from 0 to 1 in 0.001 increments.

^D *Kp – Proportional Gain*: Adjustable from 0 to 1,000 in 0.001 increments.

^E *Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.

^F *Kd – Derivative Gain*: Adjustable from 0 to 1,000 in 0.001 increments.

PID Calculator

The PID calculator is accessed by clicking the PID calculator button (Figure 98, locator G) and is available only when the primary gain option is "Custom". The PID calculator (Figure 99) calculates the gain parameters K_p^A , K_i^B , and K_d^C based on the generator time constants ($T'do$)^D and exciter time constant (Te)^E. If the exciter time constant is not known, it can be forced to the default value^F which is the generator time constant divided by six. A derivative time constant (Td)^G setting field enables the removal of noise effects on numerical differentiation. A voltage regulator gain (Ka)^H setting field sets the voltage regulator gain level of the PID algorithm. Calculated and entered parameters can be applied^I upon closure^J of the PID calculator.

Generator information^K appears in the PID Record List where records can be added^L or removed^M.

A group of settings can be saved with a unique name and added to a list of gain setting records available for application. Upon completion of stability tuning, undesired records can be removed from the record list.

Caution

Calculated or user-defined PID values are to be implemented only after their suitability for the application has been verified by the user. Incorrect PID numbers can result in poor system performance or equipment damage.

Primary PID Calculator

Excitation Control Data

Generator Information: [K]

T'do - Gen. Time Constant: [D]

☐ Use Default Exciter Time Constant [F]

Te - Exciter Time Constant: [E]

Gain Parameters

A: Kp - Proportional Gain

B: Ki - Integral Gain

C: Kd - Derivative Gain

G: Td - Derivative Time Constant

H: Ka - Voltage Regulator Gain

PID Record List

| Generator Information | Kp | Ki | Kd | Td | Ka | T'do | Te |
|-----------------------|--------|---------|--------|------|-------|------|------|
| : | 84.827 | 141.313 | 13.510 | 0.00 | 0.100 | 2.00 | 0.33 |

[L] [M] [I] [J]

Add Record Remove Record Apply Gain Parameters Close

Figure 99. PID Calculator

- ^A *Kp* – Proportional Gain: Read-only, calculated gain value.
- ^B *Ki* – Integral Gain: Read-only, calculated gain value.
- ^C *Kd* – Derivative Gain: Read-only, calculated gain value.
- ^D *T'do* – Gen. Time Constant: Select a value within the range of 1 to 15 seconds.
- ^E *Te* – Exciter Time Constant: Select a value within the range of 0.04 to 1.0 seconds.
- ^F *Use Default Exciter Time Constant*: Select or deselect.
- ^G *Td* – Derivative Time Constant: Adjustable from 0 to 1 in 0.01 increments.
- ^H *Ka* – Voltage Regulator Gain: Adjustable from 0 to 1 in 0.001 increments.
- ^I *Apply Gain Parameters Button*: Click button to apply gain parameters.
- ^J *Close Button*: Click button to close PID calculator.
- ^K *Generator Information*: Enter up to 30 alphanumeric characters.
- ^L *Add Record*: Adds a PID record.
- ^M *Remove Record*: Removes a PID record.

Auto Tuning

During commissioning, excitation system parameters may not be known. These unknown variables traditionally cause the commissioning process to consume large amounts of time and fuel. With the development of auto tuning, the excitation system parameters are now automatically identified and the PID gains are calculated using well-developed algorithms. Automatically tuning the PID controller greatly reduces commissioning time and cost. The auto tuning function is accessed by clicking the *Auto Tune* button (Figure 98, Locator H). BESTCOMS*Plus* must be in Live Mode in order to begin the auto tuning process. The auto tuning window (Figure 100) provides options for choosing the PID Design Mode^A and the Power Input Mode^B. When the desired settings are selected, the *Start Auto Tune*^C button is clicked to start the process. After the process is complete, click the *Save PID Gains (Primary)*^D button to save the data.

Caution

PID values calculated by the Auto Tuning function are to be implemented only after their suitability for the application has been verified by the user. Incorrect PID numbers can result in poor system performance or equipment damage.

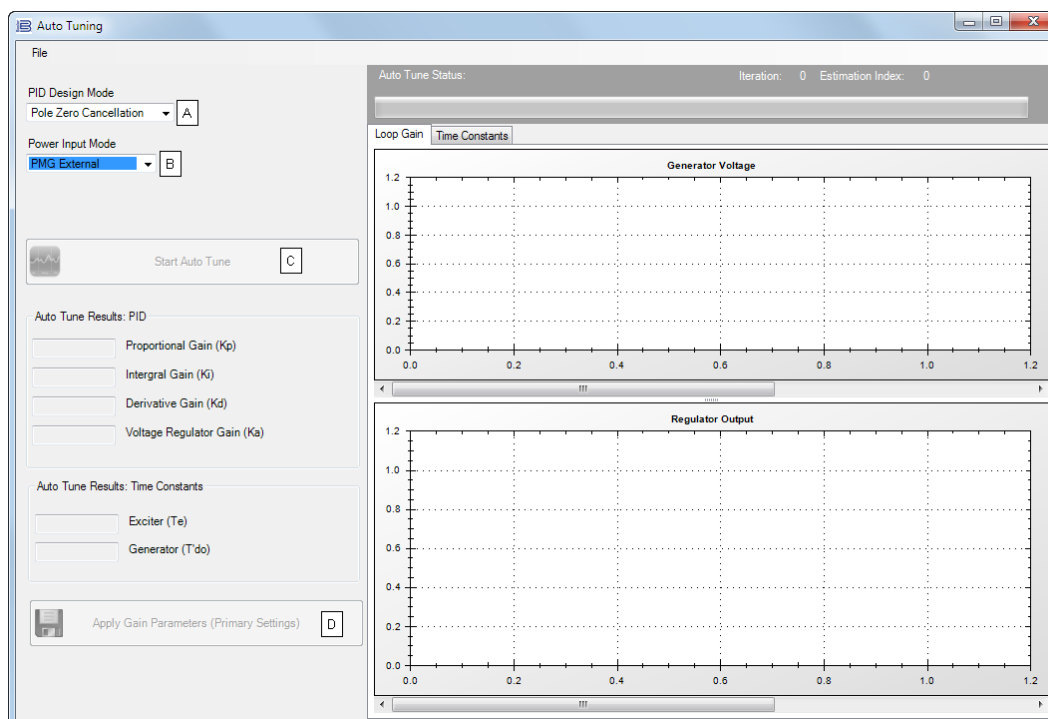


Figure 100. Auto Tuning Window

^A *PID Design Mode*: Set to either Pole Zero Cancellation or Pole Placement.

^B *Power Input Mode*: Set to either PMG External or Shunt.

^C *Start Auto Tune Button*: Begins the auto tuning process.

^D *Save PID Gains Button*: Saves the calculated PID gains.

The File menu contains options for importing, exporting, and printing a graph (.gph) file.

FCR and FVR Modes

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Gain, FCR/FVR

HMI Navigation Path: Settings, Operating Settings, Gains, FCR Gains or FVR Gains

Stability tuning can be tailored for optimum performance when operating in field current regulation or field voltage regulation mode. BESTCOMSPlus FCR stability settings and FVR stability settings are illustrated in Figure 101.

FCR Mode Stability Settings

The DECS-250N bases its field current output upon the following settings.

The proportional gain (K_p)^A is multiplied by the error between the field current setpoint and the actual field current value. Decreasing K_p reduces overshoot in the transient response. Increasing K_p speeds the transient response.

The integral gain (K_i)^B is multiplied by the integral of the error between the current setpoint and the actual field current value. Increasing K_i reduces the time to reach a steady state.

The derivative gain (K_d)^C is multiplied by the derivative of the error between the current setpoint and the actual field current value. Increasing K_d reduces ringing in the transient response.

Additional FCR stability settings remove the noise effect on numerical differentiation (derivative time constant T_d)^D and set the voltage regulator gain level of the PID algorithm (K_a)^E with recommended gain calculation^F.

FVR Mode Stability Settings

The DECS-250N bases its field voltage output upon the following settings.

The proportional gain (K_p)^G is multiplied by the error between the field voltage setpoint and the actual field voltage value. Decreasing K_p reduces overshoot in the transient response. Increasing K_p speeds the transient response.

The integral gain (K_i)^H is multiplied by the integral of the error between the voltage setpoint and the actual field voltage value. Increasing K_i reduces the time to reach a steady state.

The derivative gain (K_d)^I is multiplied by the derivative of the error between the voltage setpoint and the actual field voltage value. Increasing K_d reduces ringing in the transient response.

Additional FVR stability settings remove the noise effect on numerical differentiation (derivative time constant T_d)^J and set the voltage regulator gain level of the PID algorithm (K_a)^K with recommended gain calculation^L.

| Parameter | FCR Value | Callout | FVR Value | Callout |
|-------------------------------|-----------|---------|-----------|---------|
| Kp - Proportional Gain | 80.000 | A | 80.000 | F |
| Ki - Integral Gain | 20.000 | B | 20.000 | G |
| Kd - Derivative Gain | 0.000 | C | 0.000 | H |
| Td - Derivative Time Constant | 0.00 | D | 0.00 | I |
| Ka - Voltage Regulator Gain | 0.100 | E | 0.100 | J |
| (Recommended Ka) | 0.099 | K | 0.099 | L |

Figure 101. FCR and FVR Gain Settings

^A K_p – Proportional Gain: Adjustable from 0 to 1,000 in 0.001 increments.

^B K_i – Integral Gain: Adjustable from 0 to 1,000 in 0.001 increments.

^C K_d – Derivative Gain: Adjustable from 0 to 1,000 in 0.001 increments.

^D T_d – Derivative Time Constant: Adjustable from 0 to 1,000 in 0.01 increments.

^E K_a – Voltage Regulator Gain: Adjustable from 0 to 1 in 0.001 increments.

^F K_p – Proportional Gain: Adjustable from 0 to 1,000 in 0.1 increments.

^G K_i – Integral Gain: Adjustable from 0 to 1,000 in 0.1 increments.

^H K_d – Derivative Gain: Adjustable from 0 to 1,000 in 0.1 increments.

^I T_d – Derivative Time Constant: Adjustable from 0 to 1,000 in 0.1 increments.

^J K_a – Voltage Regulator Gain: Adjustable from 0 to 1 in 0.001 increments.

^K FCR Recommended K_a : Recommended K_a based on calculation using no load field voltage and operating power input voltage.

^L FVR Recommended K_a : Recommended K_a based on calculation using no load field voltage and operating power input voltage.

Other Modes and Functions

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Gain, var, PF, OEL, UEL, SCL, VAR Limiter

HMI Navigation Path: Settings, Operating Settings, Gains, Other Gains

Settings for stability tuning of the Var and Power Factor modes are provided in the DECS-250N along with settings for stability tuning of limiters, the voltage matching function, and main field voltage response. Figure 102 illustrates these settings as they appear in BESTCOMSPlus.

Var Mode

The integral gain $(K_i)^A$ adjusts the Var mode integral gain which determines the characteristic of the DECS-250N dynamic response to a changed var setpoint.

The loop gain $(K_g)^B$ adjusts the coarse loop-gain level of the PI algorithm for var control.

Power Factor Mode

The integral gain $(K_i)^C$ adjusts the integral gain which determines the characteristic of the DECS-250N dynamic response to a changed power factor setpoint.

The loop gain $(K_g)^D$ adjusts the coarse loop-gain level of the PI algorithm for power factor control.

Overexcitation Limiter (OEL)

The integral gain $(K_i)^E$ adjusts the rate at which the DECS-250N responds during an overexcitation condition.

The integral loop gain $(K_g)^F$ adjusts the coarse loop-gain level of the PI algorithm for the overexcitation limiter function.

Underexcitation Limiter (UEL)

The integral gain $(K_i)^G$ adjusts the rate at which the DECS-250N responds during an underexcitation condition.

The loop gain $(K_g)^H$ adjusts the coarse loop-gain level of the PI algorithm for the underexcitation limiter function.

Stator Current Limiter (SCL)

The integral gain $(K_i)^I$ adjusts the rate at which the DECS-250N limits stator current.

The loop gain $(K_g)^J$ adjusts the coarse loop-gain level of the PI algorithm for the stator current limiter function.

Var Limiter

The integral gain $(K_i)^K$ adjusts the rate at which the DECS-250N limits reactive power.

The loop gain $(K_g)^L$ adjusts the coarse loop-gain level of the PID algorithm for the reactive power limiter function.

Voltage Matching

The integral gain $(K_i)^M$ adjusts the rate at which the DECS-250N matches the generator voltage to the bus voltage.

var, PF, OEL, UEL, SCL, VAR Limiter

| var | OEL | SCL | Voltage Matching |
|---------------------------------|---------------------------------|---------------------------------|-----------------------------|
| Ki - Integral Gain 0.050 [A] | Ki - Integral Gain 0.050 [E] | Ki - Integral Gain 0.050 [I] | Kg - Loop Gain 0.050 [M] |
| Kg - Loop Gain 0.050 [B] | Kg - Loop Gain 0.050 [F] | Kg - Loop Gain 0.050 [J] | |

| PF | UEL | varL |
|---------------------------------|---------------------------------|----------------------------------|
| Ki - Integral Gain 0.050 [C] | Ki - Integral Gain 0.050 [G] | Ki - Integral Gain 10.000 [K] |
| Kg - Loop Gain 0.050 [D] | Kg - Loop Gain 0.050 [H] | Kg - Loop Gain 1.000 [L] |

Figure 102. Other Mode and Function Gain Settings

- ^A *Var Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^B *Var Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^C *PF Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^D *PF Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^E *OEL Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^F *OEL Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^G *UEL Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^H *UEL Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^I *SCL Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^J *SCL Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.001 increments.
- ^K *VARL Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.1 increments.
- ^L *VARL Kg – Loop Gain*: Adjustable from 0 to 1,000 in 0.1 increments.
- ^M *Voltage Matching Ki – Integral Gain*: Adjustable from 0 to 1,000 in 0.001 increments.



Mounting

As delivered, the DECS-250N is configured for projection (wall) mounting. Front panel mounting is possible with an optional escutcheon kit. Kits are supplied with an escutcheon and screws for securing the escutcheon to the DECS-250N. For a new installation, request kit part number 9440311101. When replacing a DECS-200N with the DECS-250N, request kit part number 9440506101. The panel mounting holes of this kit align with the DECS-200N escutcheon mounting holes so no panel drilling is required.

Mounting Considerations

DECS-250N heat sink orientation necessitates vertical mounting for maximum cooling. Any other mounting angle will reduce heat dissipation and possibly lead to premature failure of critical components.

The DECS-250N may be mounted anywhere the ambient temperature does not exceed the maximum operating temperature as listed in the *Specifications* chapter.

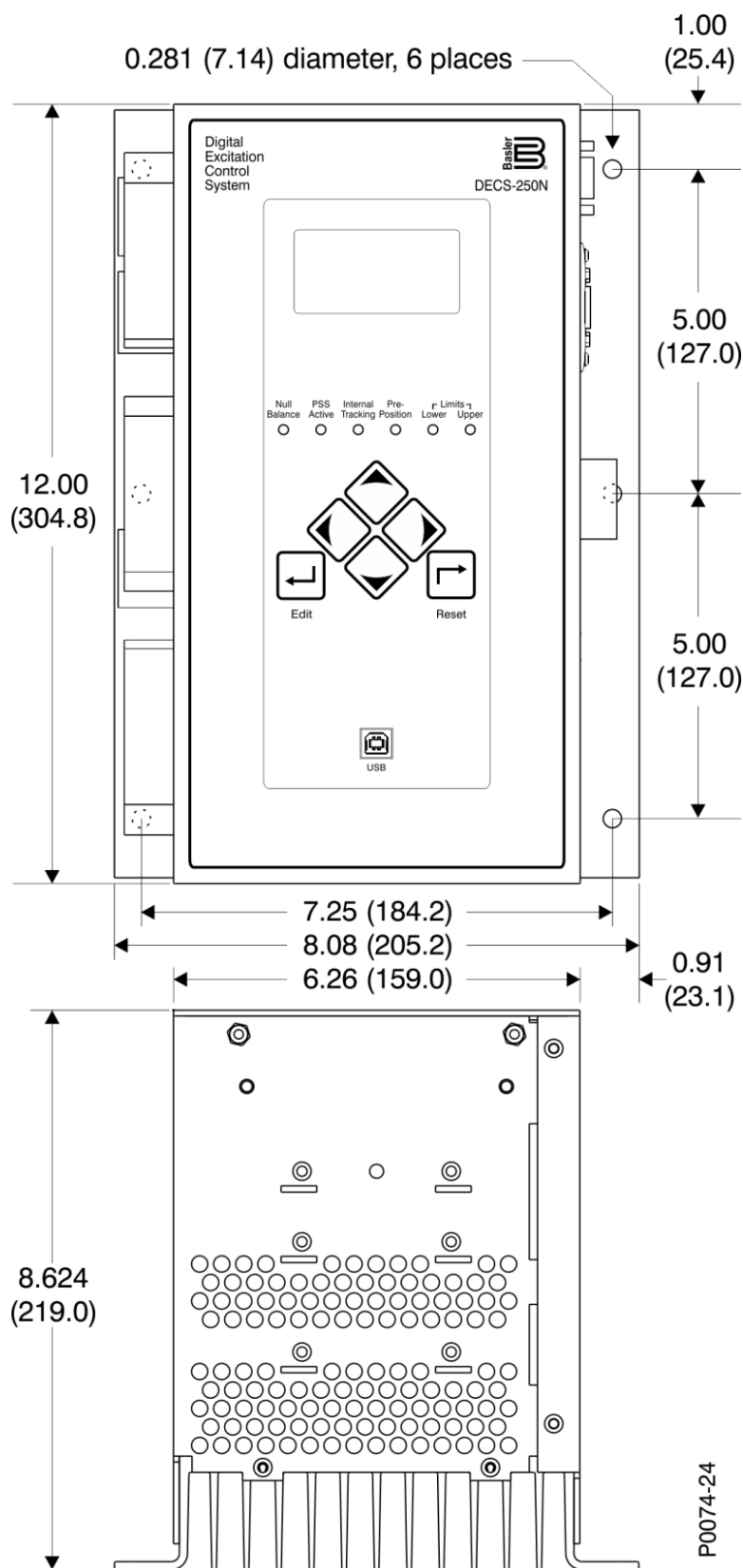
Projection Mounting

Figure 103 illustrates the mounting dimensions for projection (wall) mounting of the DECS-250N.

Behind-the-Panel Mounting

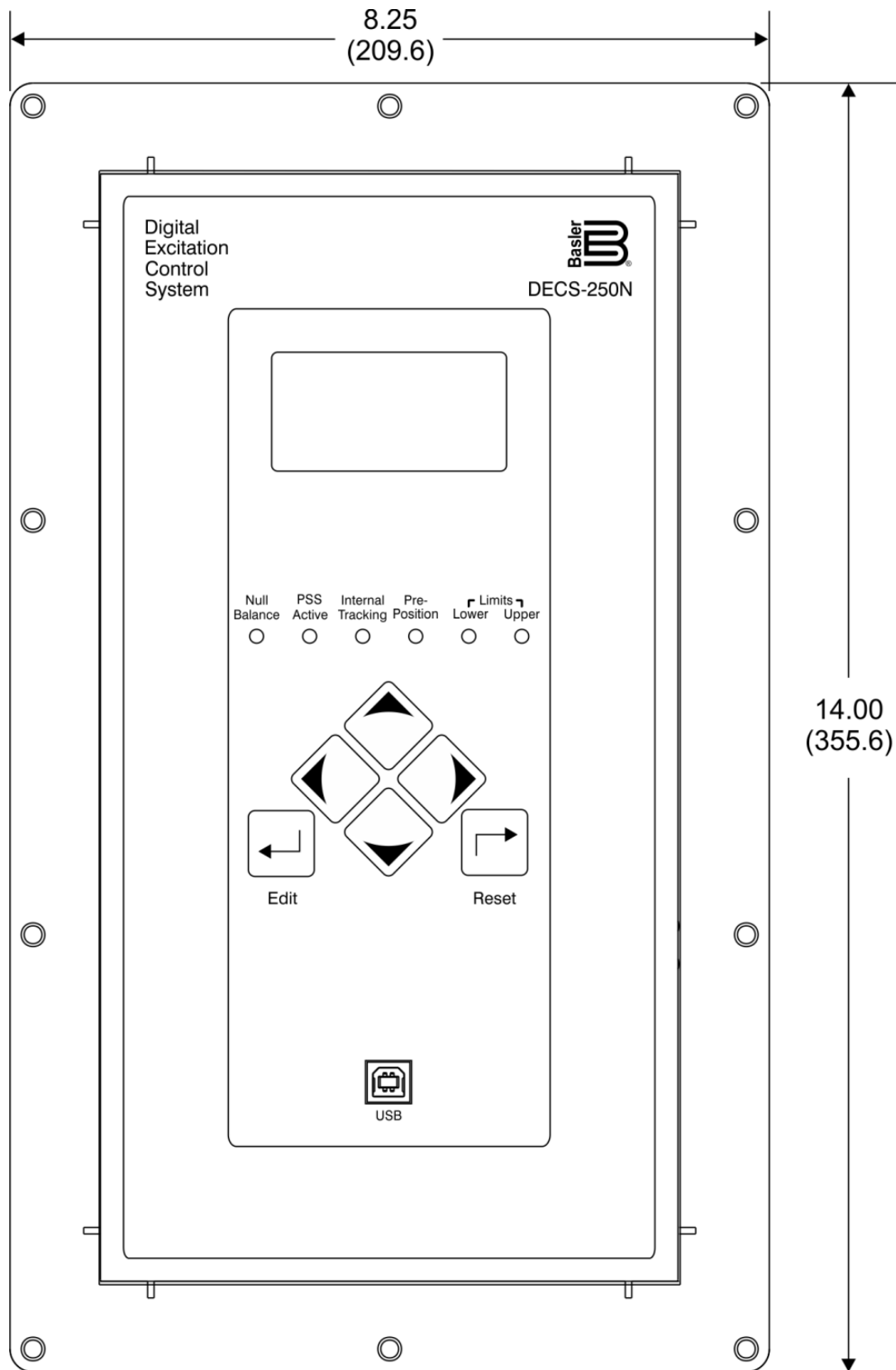
Figure 104 shows the front dimensions of the optional escutcheon mounting plate used with the DECS-250N for new installations. Panel cutting and drilling dimensions for panel mounting are shown in Figure 105.

Figure 106 shows the front dimensions of the optional escutcheon mounting plate used when replacing a DECS-200N with the DECS-250N.



Note: All dimensions are in inches (millimeters).

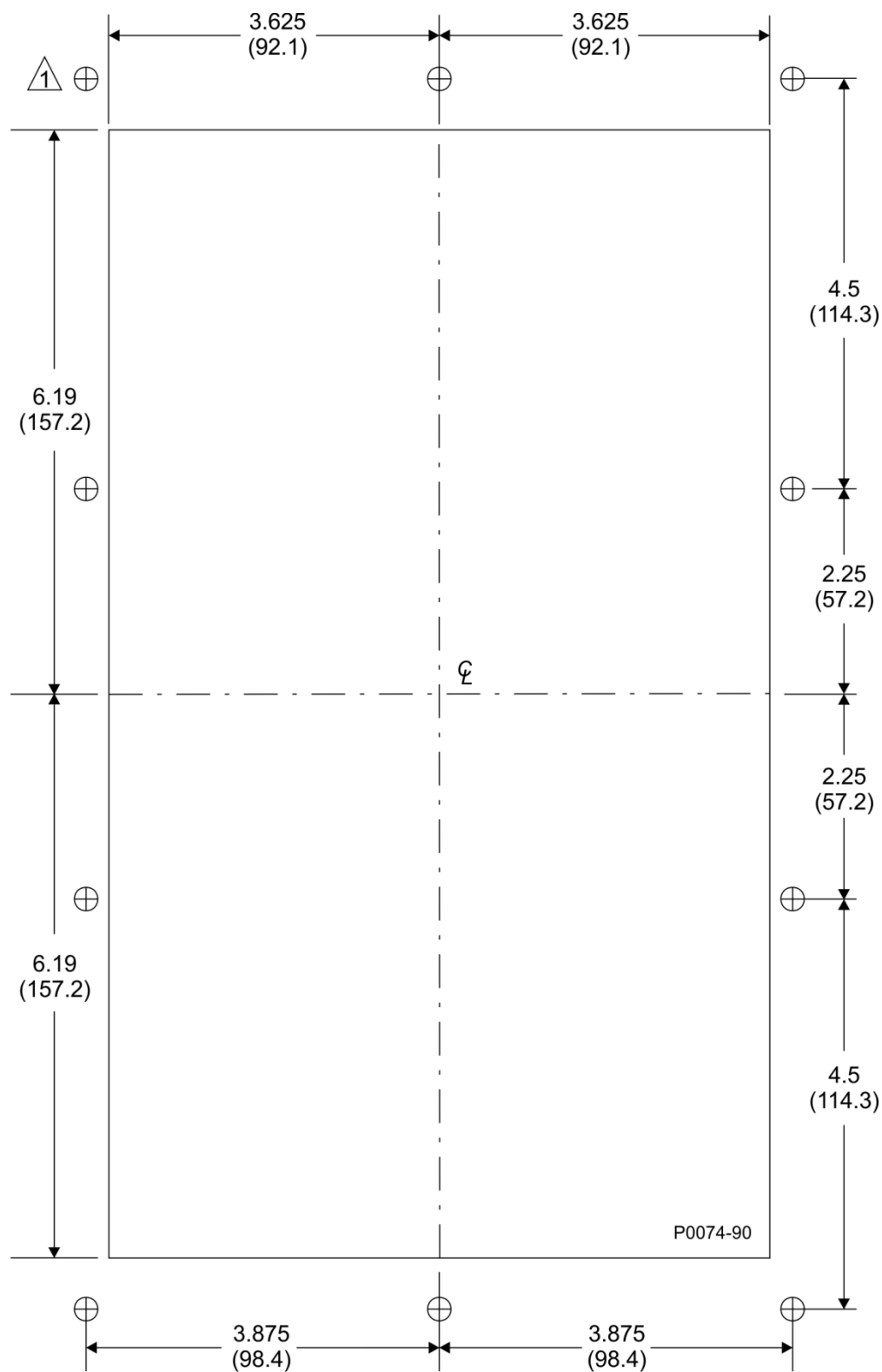
Figure 103. Overall and Projection Mounting Dimensions



Note: All dimensions are in inches (millimeters).

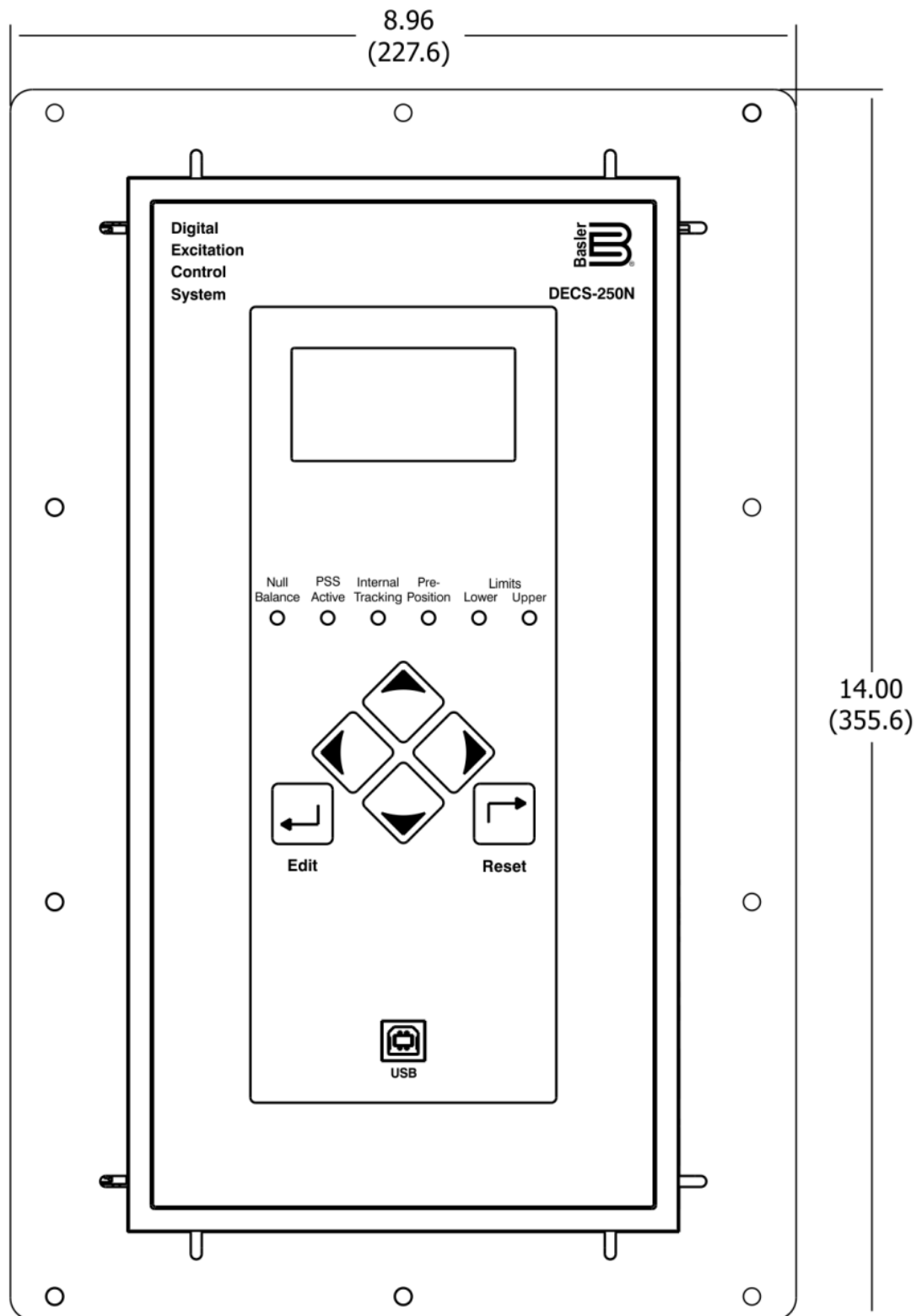
P0062-49

Figure 104. DECS-250N Optional Escutcheon Plate Dimensions (Basler P/N 9440311101) for New Installations



- 1 Mounting holes (10 places) are 0.218 (5.54) diameter.
- 2 Use provided hardware when attaching escutcheon plate to DECS-250N.
- 3 All dimensions are in inches (millimeters).

Figure 105. Panel Cutting and Drilling Dimensions for DECS-250N Panel Mounting for New Installations



Note: All dimensions are in inches (millimeters).

P0067-47

Figure 106. DECS-250N Optional Escutcheon Plate Dimensions (Basler P/N 9440506101) for Replacing a DECS-200N with the DECS-250N



Terminals and Connectors

DECS-250N terminals and connectors are located on the left side panel, front panel, and right side panel. DECS-250N terminals consist of single-row, multiple-pin headers that mate with removable connectors wired by the user. DECS-250N connectors vary according to their function and the specified options.

Overview

Figure 107 illustrates the left side panel terminals and Figure 108 illustrates the right side panel connectors and terminals. Locator letters in each illustration correspond to the terminal block and connector descriptions in Table 5 and Table 6. The front-panel USB jack is illustrated and described in the *Controls and Indicators* chapter of this manual.

Caution

In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.

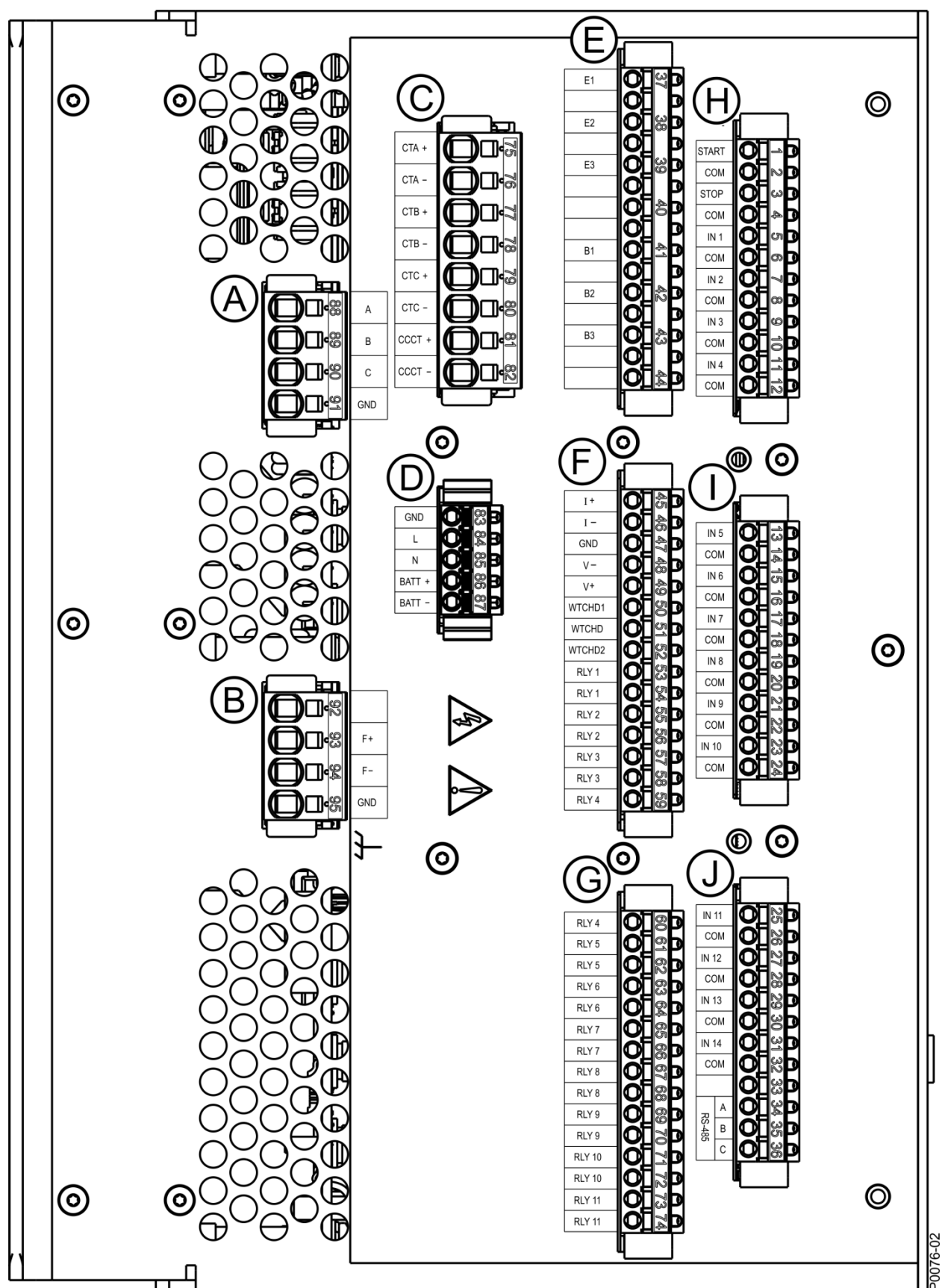


Figure 107. Left Side Panel Terminals

Table 5. Left Side Terminal and Connector Descriptions

| Locator | Description |
|----------------|---|
| A | These terminals accept three-phase operating power for the excitation power stage of the DECS-250N. A ground for the operating power connections is provided at terminal GND. |
| B | Excitation power is supplied to the field through the terminals labeled F+ and F–. The GND terminal serves as the chassis ground for the DECS-250N. |
| C | These terminals connect to user-supplied current transformers (CTs) providing three phases of generator sensing current and a cross-current compensation signal. |
| D | These terminals accept ac and/or dc control power to enable DECS-250N operation. A ground terminal is also provided. |
| E | Three-phase generator and bus sensing voltage, obtained from user-supplied voltage transformers (VTs), connect to these terminals. |
| F | A portion of this terminal block accepts an external analog control signal for auxiliary control of the regulation setpoint. Terminals I+, I–, V+, and V– are used for external control of the regulation setpoint with the GND terminal serving as a cable shield connection. The remaining terminal block pins serve as connections for the Watchdog and programmable relay outputs 1 through 4. |
| G | Relay contact outputs for programmable relay outputs 4 through 11 connect to these terminals. |
| H | Contact inputs for the Start and Stop functions and programmable contact inputs 1 through 4 are applied to these terminals. |
| I | Programmable contact inputs 5 through 10 are applied to these terminals. |
| J | A portion of these terminal block pins accept connections for programmable contact inputs 11 through 14. The remaining terminal block pins serve as connections for RS-485 communication. |

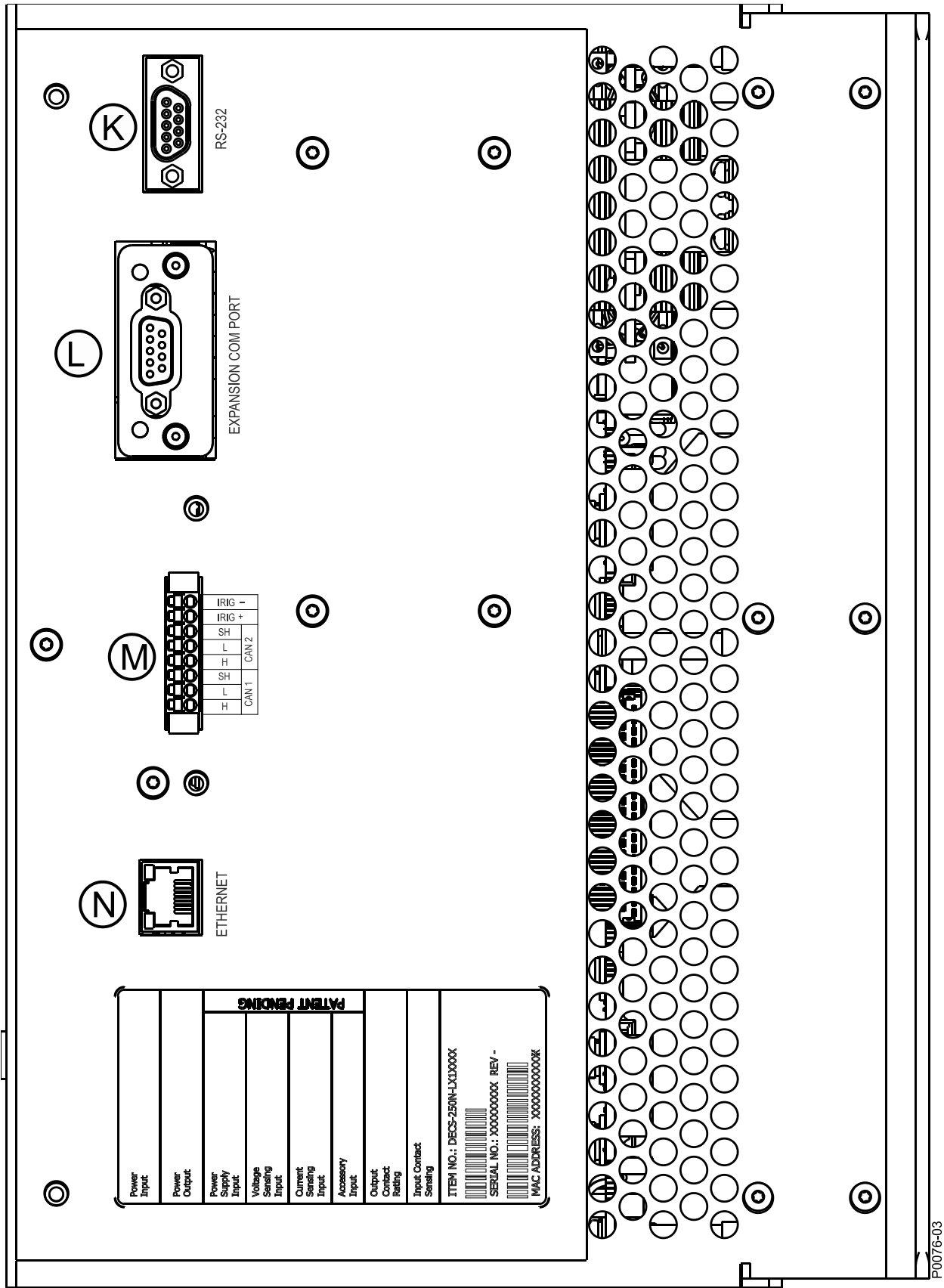


Figure 108. Right Side Connectors and Terminals

Table 6. Right Side Terminal and Connector Descriptions

| Locator | Description |
|---------|--|
| K | A second DECS-250N connects through a standard serial cable to this DB-9 connector for the purpose of setpoint tracking. Setpoint tracking between a DECS-250N and DECS-200N is possible. |
| L | This DB-9 connector is provided for PROFIBUS communication (style xxxxxxP) and the future implementation of other communication protocols. Contact Basler Electric for protocol availability. |
| M | <p>Three terminal sets within this block include two CAN communication ports and an IRIG input. The IRIG terminals connect to an IRIG source for synchronization of DECS-250N timekeeping with the IRIG source. Both CAN ports are SAE J1939 compliant. CAN 1 is used to connect add-on modules such as the Basler Electric CEM-2020 and AEM-2020. CAN 2 is used to communicate with a genset engine controller.</p> <p>The terminal numbers (shown below) are located on the mating side of the connector.</p> <ul style="list-style-type: none"> • 96 - CAN 1 High • 97 - CAN 1 Low • 98 - CAN 1 Shield • 99 - CAN 2 High • 100 - CAN 2 Low • 101 - CAN 2 Shield • 102 - IRIG + • 103 - IRIG – |
| N | This optional Ethernet communication port uses the Modbus TCP protocol to provide remote metering, annunciation, and control. A copper (100Base-T) port (style xxxxx1X) uses a standard RJ45 jack while a fiber optic (100Base-FX) port (style xxxxx2x) uses two fiber optic connectors (not shown). |

Terminal Types

Spring terminals are supplied on DECS-250N controllers with a style number of xxxSxxx. These removable connectors secure each wire with a spring-loaded contact.

Compression terminals are supplied for the operating power terminals (locator A), field power output terminals (locator B), and current sensing terminals (locator C) when a style number of xxxCxxx is specified. The remaining connectors use spring terminals.

Table 7 lists the acceptable wire sizes, strip lengths, and screw torques (compression terminals only) for each terminal block. The locator letters used in Table 7 correspond to the locator letters shown in Figure 107 and Figure 108.

Table 7. Connector Wiring Specifications

| Terminal Block | Maximum Wire Size | Compression Terminals | | Spring Terminals |
|---------------------|--|-----------------------|--------------------------|------------------|
| | | Strip Length | Maximum Screw Torque | Strip Length |
| A, B, C | 10 AWG 10 mm ² (solid) 6 mm ² (stranded) | 0.4 in (10 mm) | 6.64 in-lb (0.75 N•m) | 0.6 in (15 mm) |
| D, E, F, G, H, I, J | 12 AWG 2.5 mm ² (solid and stranded) | N/A | N/A | 0.4 in (10 mm) |

| Terminal Block | Maximum Wire Size | Compression Terminals | | Spring Terminals |
|----------------|--|-----------------------|-----|------------------|
| M | 16 AWG 1.5 mm ² (solid and stranded) | N/A | N/A | 0.35 in (9 mm) |

Spring terminal connector blocks identified by locators A through J and M are held in place by retaining clips.

Connectors identified by locators A, B, E, F, G, H, I, and J are keyed to avoid misconnections.

Typical Connections

Typical connection diagrams are provided in this chapter as a guide when wiring the DECS-250N for communication, contact inputs, contact outputs, sensing, and operating power.

Typical connections for shunt powered applications are shown in Figure 109. Typical connections for PMG powered applications are shown in Figure 110. Typical connections for station powered applications are shown in Figure 111. Three-phase-delta voltage sensing connections are shown. The drawing notes in Figures 109, 110, 111 and correspond to the descriptions found in Table 8.

Note

Field wires, connected to terminals F+ and F–, must be twisted pair with approximately one turn per inch for an EMC compliant installation.

Table 8. Typical Connection Drawing Descriptions

| Locator | Description |
|---------|---|
| 1 | Operating (bridge) power input. For single-phase power, omit one phase connection. See <i>Power Inputs</i> or <i>Specifications</i> for operating power ratings. |
| 2 | Generator voltage sensing input. Potential transformer required if line voltage exceeds 600 Vac. |
| 3 | Cross-current compensation input, 1 Aac or 5 Aac. |
| 4 | Connections required only if voltage matching, sync-check, or auto synchronizer functions are used. |
| 5 | Labels indicate the functions assigned by the default programmable logic to the contact inputs and outputs. |
| 6 | See the <i>Power Inputs</i> or <i>Specifications</i> chapter for control power input ratings. |
| 7 | RS-232 port used for communication with another DECS in a redundant DECS system. |
| 8 | Optional communication port (style xxxxxxP) uses Profibus protocol. |
| 9 | IRIG time synchronization input. |
| 10 | Ethernet communication port can be copper (style xxxxx1x) or fiber optic (style xxxxx2x) and uses Modbus communication protocol. |
| 11 | Type B USB jack for temporary, local communication. <div> Caution In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground. </div> |
| 12 | This input/output is unassigned by default if the DECS-250N is not equipped with the optional PSS (style number xPxxxxx). |
| 13 | RS-485 port uses the Modbus RTU protocol for communication with other networked devices. |
| 14 | Optional - ICRM (Inrush Current Reduction Module), Basler part number 9387900104. |

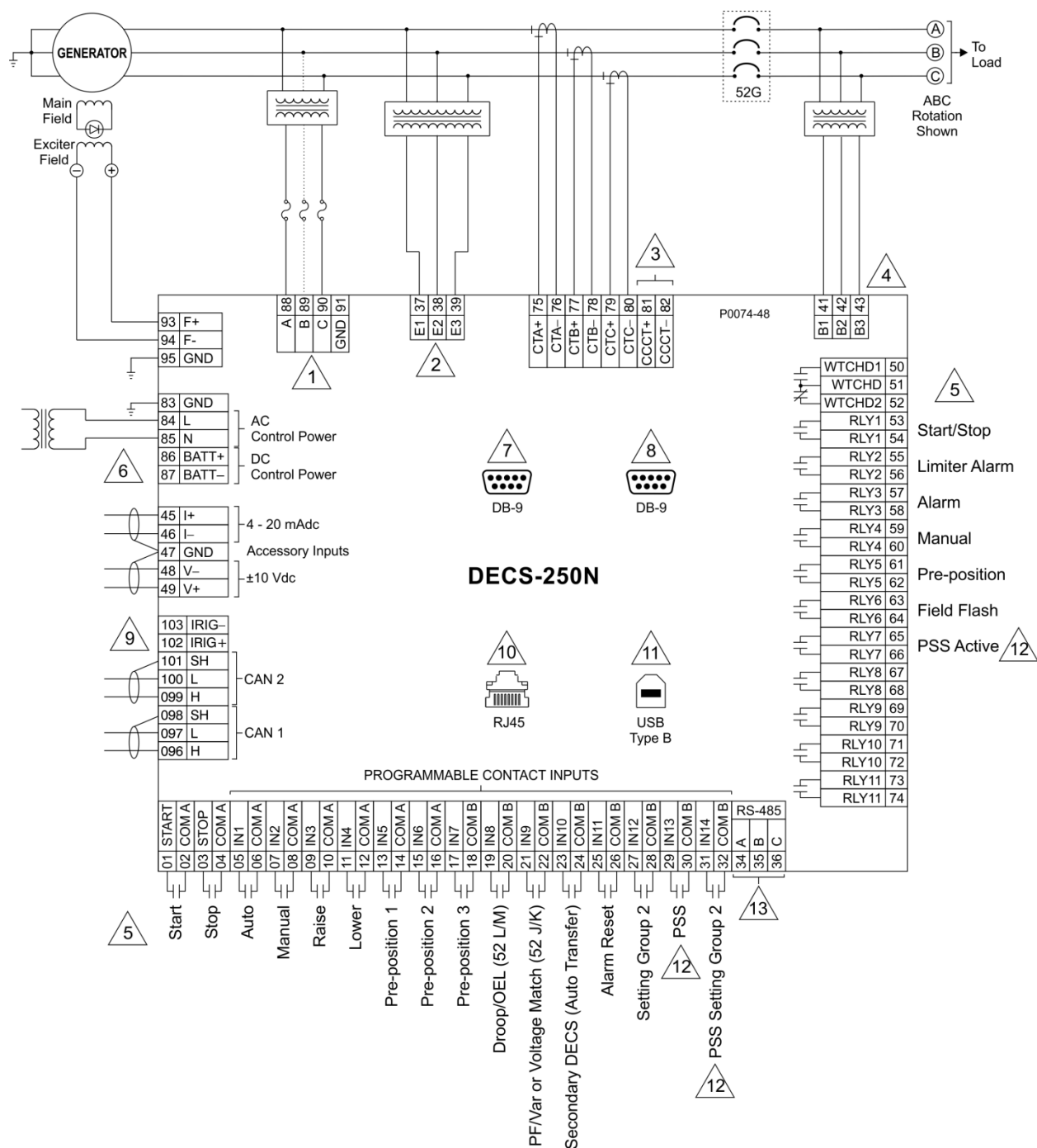


Figure 109. Typical DECS-250N Connections for Shunt Powered Applications

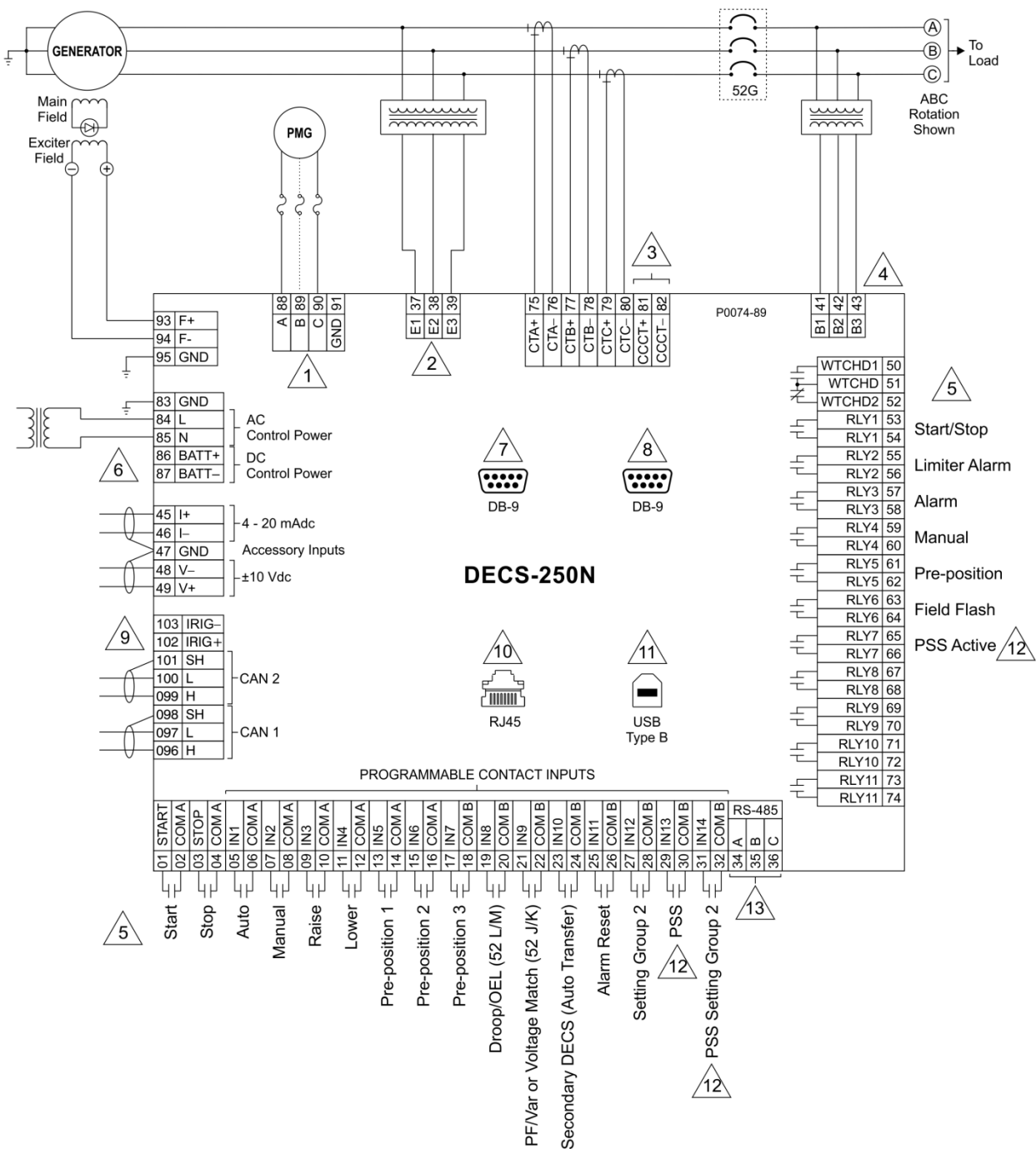


Figure 110. Typical DECS-250N Connections for PMG Powered Applications

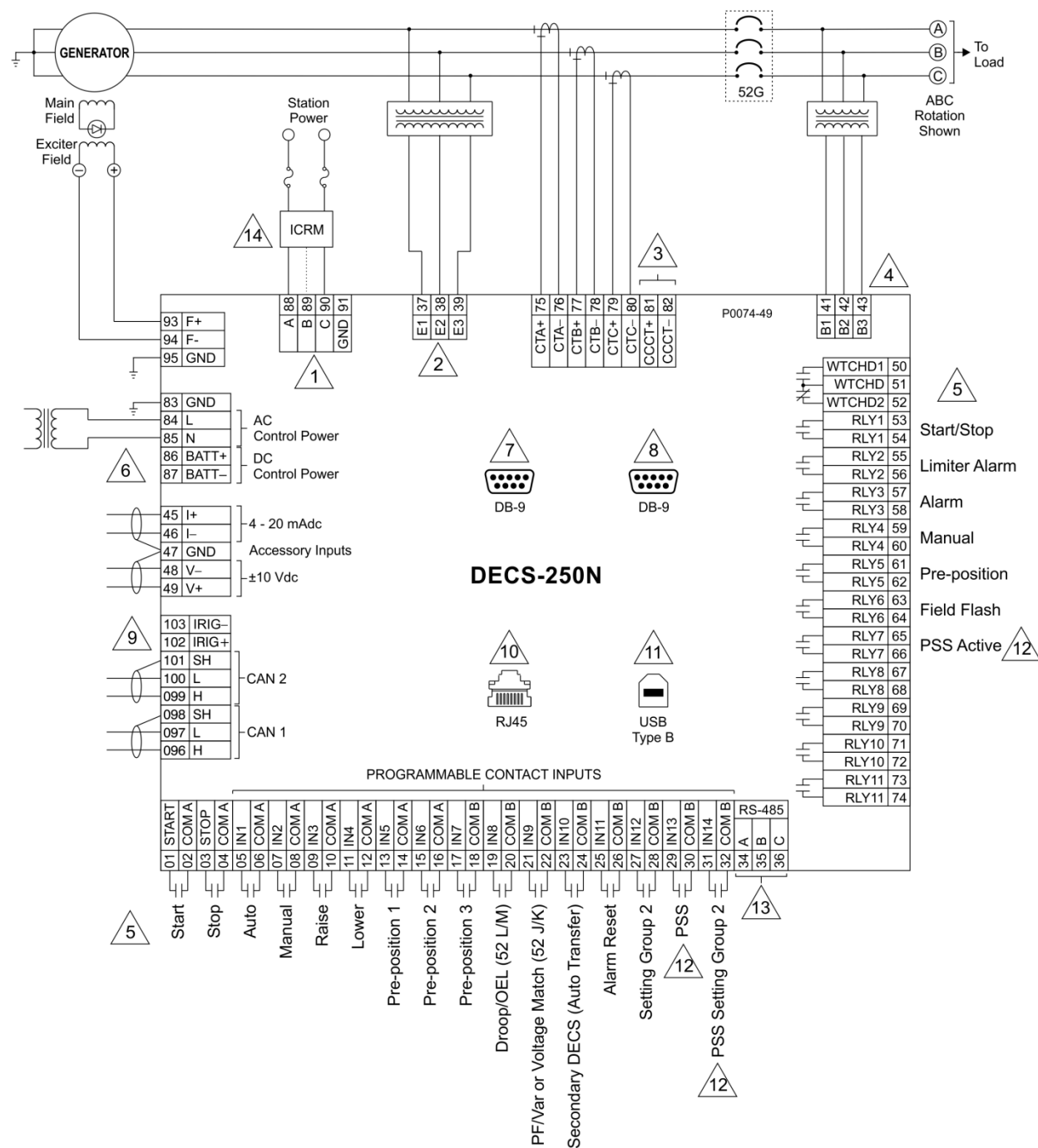


Figure 111. Typical DECS-250N Connections for Station Powered Applications

BESTCOMSPlus® Software

General Description

BESTCOMSPlus® is a Windows®-based, PC application that provides a user-friendly, graphical user interface (GUI) for use with Basler Electric communicating products. The name **BESTCOMSPlus** is an acronym that stands for **B**asler **E**lectric **S**oftware **T**ool for **C**ommunications, **O**perations, **M**aintenance, and **S**ettings.

BESTCOMSPlus provides the user with a point-and-click means to set and monitor the DECS-250N. The capabilities of BESTCOMSPlus make the configuration of one or several DECS-250N controllers fast and efficient. A primary advantage of BESTCOMSPlus is that a settings scheme can be created, saved as a file, and then uploaded to the DECS-250N at the user's convenience.

BESTCOMSPlus uses plugins allowing the user to manage several different Basler Electric products. The DECS-250N plugin must be activated before use. The plugin can be activated automatically by connecting to a DECS-250N or activated manually by requesting an activation key from Basler Electric.

The DECS-250N plugin opens inside the BESTCOMSPlus main shell. The same default logic scheme that is shipped with the DECS-250N is brought into BESTCOMSPlus by downloading settings and logic from the DECS-250N. This gives the user the option of developing a custom setting file by modifying the default logic scheme or by building a unique scheme from scratch.

BESTlogic™ Plus Programmable Logic is used to program DECS-250N logic for protection elements, inputs, outputs, alarms, etc. This is accomplished by the drag-and-drop method. The user can drag elements, components, inputs, and outputs onto the program grid and make connections between them to create the desired logic scheme.

BESTCOMSPlus also allows for downloading industry-standard COMTRADE files for analysis of stored oscillography data. Detailed analysis of the oscillography files can be accomplished using BESTwave™ software.

Figure 112 illustrates the typical user interface components of the DECS-250N plugin with BESTCOMSPlus.

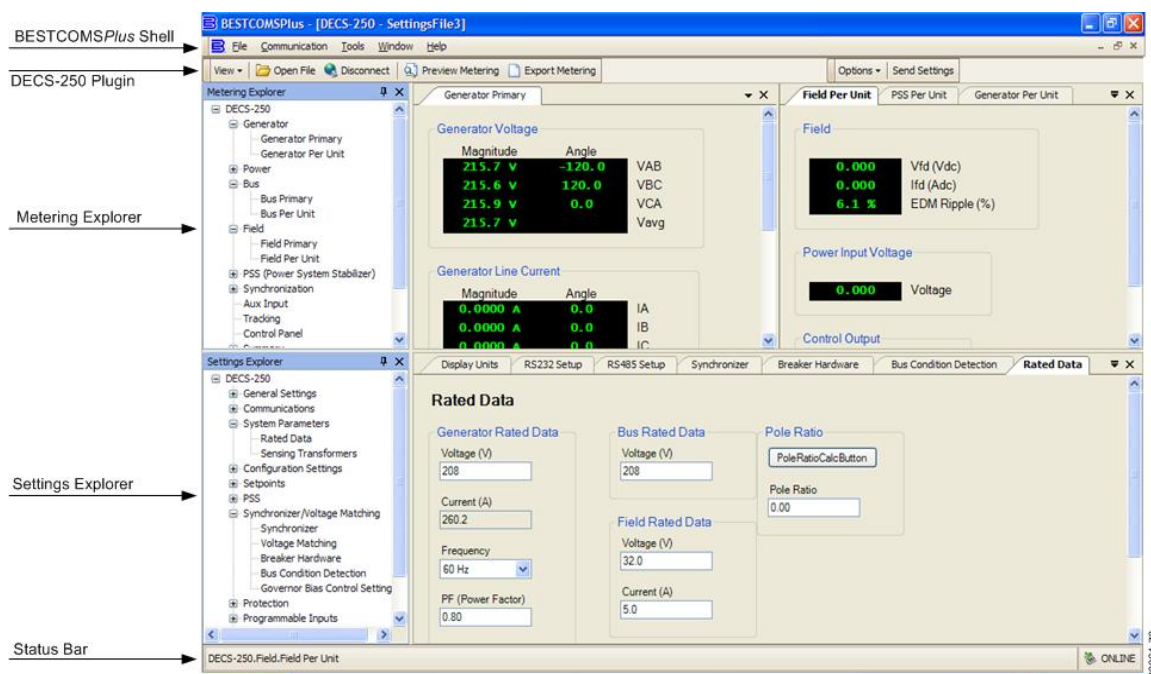


Figure 112. Typical User Interface Components

Installation

BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the DECS-250N plugin and the required version of .NET Framework (if not already installed). BESTCOMS*Plus* operates with systems using Windows® XP 32-bit SP2/SP3, Windows Vista 32-bit (all editions), Windows 7 32-bit (all editions), Windows 7 64-bit (all editions) and Windows 8. Microsoft Internet Explorer 5.01 or later must be installed on your PC before installing BESTCOMS*Plus*. System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 9.

Table 9. System Recommendations for BESTCOMS*Plus* and the .NET Framework

| System Type | Component | Recommendation |
|-------------|------------|--|
| 32/64 bit | Processor | 2.0 GHz |
| 32/64 bit | RAM | 1 GB minimum, 2 GB recommended |
| 32 bit | Hard Drive | 100 MB (if .NET Framework is already installed on PC.) |
| | | 950 MB (if .NET Framework is not already installed on PC.) |
| 64 bit | Hard Drive | 100 MB (if .NET Framework is already installed on PC.) |
| | | 2.1 GB (if .NET Framework is not already installed on PC.) |

To install and run BESTCOMS*Plus*, a Windows user must have Administrator rights. A Windows user with limited rights might not be permitted to save files in certain folders.

Install BESTCOMS*Plus*®

Note

Do not connect a USB cable until setup completes successfully. Connecting a USB cable before setup is complete may result in unwanted or unexpected errors.

1. Insert the BESTCOMS*Plus* CD-ROM into the PC CD-ROM drive.
2. When the BESTCOMS*Plus* Setup and Documentation CD menu appears, click the *Install* button for the BESTCOMS*Plus* application. The setup utility installs BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the DECS-250N plugin for BESTCOMS*Plus* on your PC.

When BESTCOMS*Plus* installation is complete, a Basler Electric folder is added to the Windows programs menu. This folder is accessed by clicking the Windows *Start* button and then accessing the Basler Electric folder in the *Programs* menu. The Basler Electric folder contains an icon that starts BESTCOMS*Plus* when clicked.

Activation of the DECS-250N Plugin for BESTCOMS*Plus*®

The DECS-250N plugin is a module that runs inside the BESTCOMS*Plus* shell. The DECS-250N plugin contains specific operational and logic settings for only the DECS-250N. Uploading settings to the DECS-250N is possible only after activating the DECS-250N plugin.

The DECS-250N plugin can be activated automatically or manually. Automatic activation is achieved by using a USB cable to establish communication between the DECS-250N and BESTCOMS*Plus*. Manual activation is initiated by contacting Basler Electric for an activation key and entering the key into BESTCOMS*Plus*. Manual activation is useful if you want to create a settings file prior to receiving your digital excitation system. Note that if a DECS-250N is not connected, you will not be able to configure certain Ethernet settings. Ethernet settings can be changed only when an active USB or Ethernet connection is present. Refer to *Manual Activation of DECS-250N Plugin*.

Connect a USB Cable

The USB driver was copied to your PC during BESTCOMSPlus installation and is installed automatically after powering the DECS-250N. USB driver installation progress is shown in the Windows Taskbar area. Windows will notify you when installation is complete.

Connect a USB cable between the PC and your DECS-250N. Apply operating power (per style chart in the *Introduction* chapter) to the DECS-250N at rear terminals A, B, and C. Wait until the boot sequence is complete.

Caution

In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.

Start BESTCOMSPlus® and Activate DECS-250N Plugin Automatically

To start BESTCOMSPlus, click the *Start* button, point to *Programs, Basler Electric*, and then click the *BESTCOMSPlus* icon. During initial startup, the *BESTCOMSPlus Select Language* screen is displayed (Figure 113). You can choose to have this screen displayed each time BESTCOMSPlus is started, or you can select a preferred language and this screen will be bypassed in the future. Click *OK* to continue. This screen can be accessed later by selecting *Tools* and *Select Language* from the menu bar.

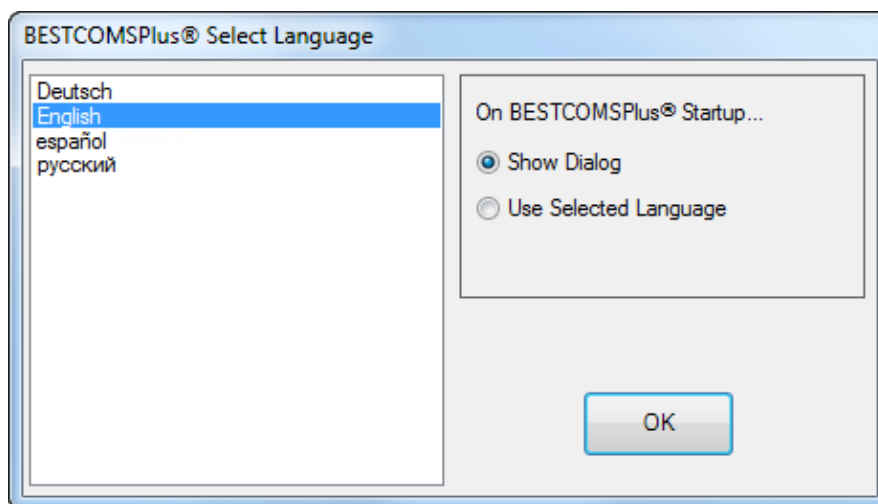


Figure 113. BESTCOMSPlus Select Language Screen

The BESTCOMSPlus splash screen is shown for a brief time. See Figure 114.



Figure 114. BESTCOMSPlus Splash Screen

The BESTCOMSPlus platform window opens. Select *New Connection* from the *Communication* pull-down menu and select *DECS-250N*. See Figure 115. The DECS-250N plugin is activated automatically after connecting to a DECS-250N.

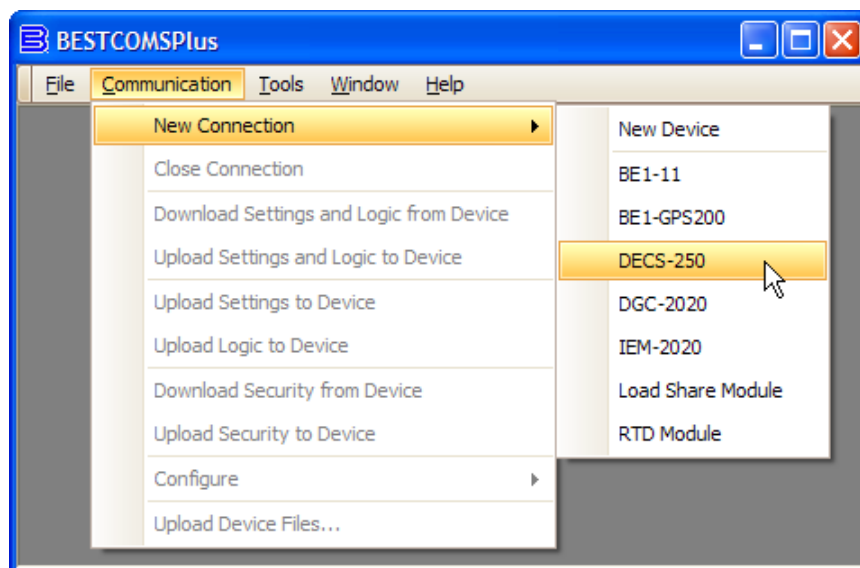


Figure 115. Communication Pull-Down Menu

The *DECS-250N Connection* screen shown in Figure 116 appears. Select *USB Connection* and click *Connect*.

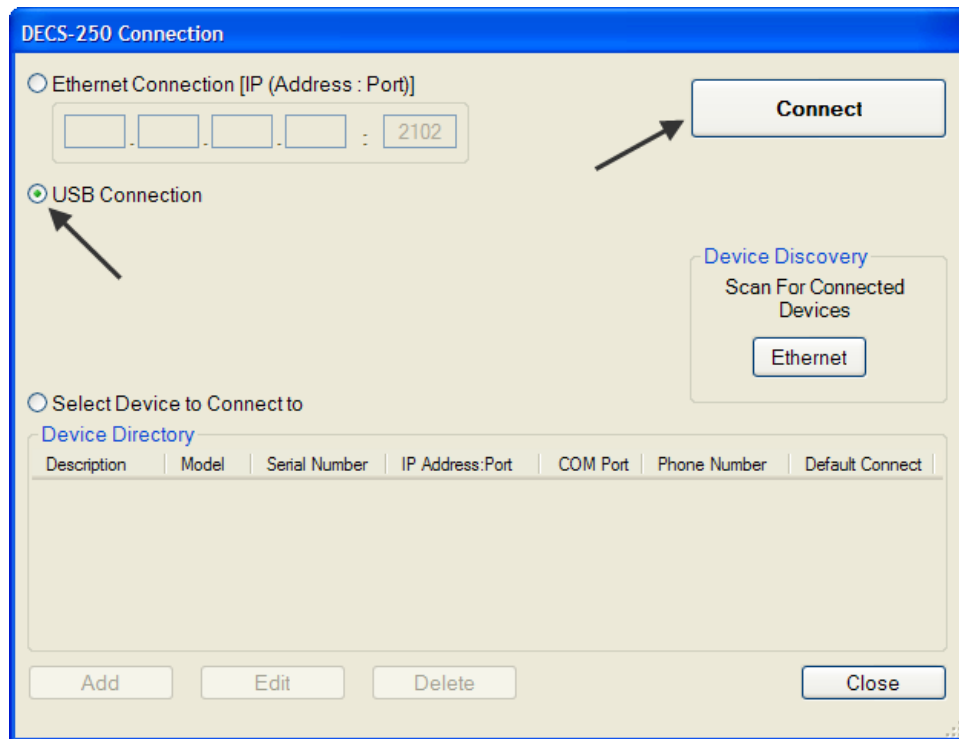


Figure 116. DECS-250N Connection Screen

The DECS-250N plugin opens indicating that activation was successful. You can now configure the DECS-250N communication ports and other DECS-250N settings.

Manual Activation of the DECS-250N Plugin

Manual activation of the DECS-250N plugin is required only if your initial use of BESTCOMS*Plus* will be on a PC that is not connected to a DECS-250N. Manual activation is described in the following paragraphs.

Requesting an Activation Key

When initially running the DECS-250N, the *Activate Device Plugin* pop-up appears. You must contact Basler Electric for an activation key before you can activate the DECS-250N plugin. You can request an activation key through email or the Basler Electric website. Click either the *Website* or *Email* button. Click the *Activate* button when you are ready to enter the activation key you received from Basler Electric. The *Activate Device Plugin* pop-up appears. Refer to Figure 117.

Figure 117. Activate Device Plugin Screen

Entering an Activation Key

Select DECS-250N from the *Device* pull-down menu. Enter your *Email Address* and *Activation Key* provided by Basler Electric. If you received an email containing the *Activation Key*, you can select all of the text in the email and copy it to the Windows clipboard using normal Windows techniques. The *Get Data* button extracts the *Device*, *Email Address*, and *Activation Key* from the Windows clipboard and pastes it into the appropriate fields. Click the *Activate* button to continue. The *Activate Device Plugin* screen is also found by selecting *Activate Device* from the *Tools* pull-down menu of the BESTCOMS*Plus* main screen.

Establishing Communication

Communication between BESTCOMS*Plus* and the DECS-250N is established by clicking the *Connect* button on the *DECS-250N Connection* screen (see Figure 116) or by clicking the *Connect* button on the lower menu bar of the main BESTCOMS*Plus* screen (Figure 112). If you receive an “Unable to Connect to Device” error message, verify that communications are configured properly. Only one Ethernet connection is allowed at one time. Download all settings and logic from the relay by selecting *Download Settings and Logic* from the *Communication* pull-down menu. BESTCOMS*Plus* will read all settings and logic from the DECS-250N and load them into BESTCOMS*Plus* memory. See Figure 118.

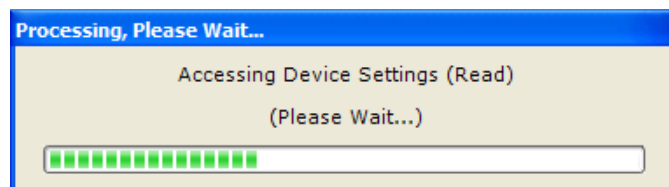


Figure 118. Processing, Please Wait...

Menu Bars

The menu bars are located near the top of the BESTCOMS*Plus* screen (see Figure 112). The upper menu bar has five pull-down menus. With the upper menu bar, it is possible to manage settings files, configure communication settings, upload and download settings and security files, and compare settings files. The lower menu bar consists of clickable icons. The lower menu bar is used to change BESTCOMS*Plus* views, open a settings file, connect/disconnect, preview metering printout, switch to live mode, and send settings after a change is made when not in live mode.

Upper Menu Bar (BESTCOMS*Plus*® Shell)

Upper menu bar functions are listed and described in Table 10.

Table 10. Upper Menu Bar (BESTCOMSPlus Shell)

| Menu Item | Description |
|---|---|
| <u>File</u> | |
| New | Create a new settings file |
| Open | Open an existing settings file |
| Open File As Text | Generic file viewer for *.csv, *.txt, etc. files |
| Close | Close settings file |
| Save | Save settings file |
| Save As | Save settings file with a different name |
| Export To File | Save settings as a *.csv file |
| Print | Open the print menu |
| Properties | View properties of a settings file |
| History | View history of a settings file |
| Recent Files | Open a previously opened file |
| Exit | Close BESTCOMSPlus program |
| <u>Communication</u> | |
| New Connection | Choose new device or DECS-250N |
| Close Connection | Close communication between BESTCOMSPlus and DECS-250N |
| Download Settings and Logic from Device | Download operational and logic settings from the device |
| Upload Settings and Logic to Device | Upload operational and logic settings to the device |
| Upload Settings to Device | Upload operational settings to the device |
| Upload Logic to Device | Upload logic settings to the device |
| Download Security from Device | Download security settings from the device |
| Upload Security to Device | Upload security settings to the device |
| Configure | Ethernet settings |
| Upload Device Files | Upload firmware to the device |
| <u>Tools</u> | |
| Select Language | Select BESTCOMSPlus language |
| Activate Device | Activate the DECS-250N plugin |
| Set File Password | Password protect a settings file |
| Compare Settings Files | Compare two settings files |
| Auto Export Metering | Exports metering data on a user-defined interval |
| Event Log - View | View the BESTCOMSPlus event log |
| Event Log - Verbose Logging | Enable enhanced logging (used for troubleshooting) |
| <u>Window</u> | |
| Cascade All | Cascade all windows |
| Tile | Tile horizontally or vertically |
| Maximize All | Maximize all windows |
| <u>Help</u> | |
| Check for Updates | Check for BESTCOMSPlus updates via the internet |
| Check for Update Settings | Enable or change automatic checking for updates |
| About | View general, detailed build, and system information |

Lower Menu Bar (DECS-250N Plugin)

Lower menu bar functions are listed and described in Table 11.

Table 11. Lower Menu Bar (DECS-250N Plugin)

| Menu Button | Description |
|---------------------------|---|
| <i>View</i> | Enables you to view the Metering Panel, Settings Panel, or Show Settings Information. Opens and saves workspaces. Customized workspaces make switching between tasks easier and more efficient. |
| <i>Open File</i> | Opens a saved settings file. |
| <i>Connect/Disconnect</i> | Opens the <i>DECS-250N Connection</i> screen which enables you to connect to the DECS-250N via USB or Ethernet. Also used to disconnect a connected DECS-250N. |
| <i>Preview Metering</i> | Displays the <i>Print Preview</i> screen where a preview of the Metering printout is shown. Click on the printer button to send to a printer. |
| <i>Export Metering</i> | Enables all metering values to be exported into a *.csv file. |
| <i>Options</i> | Displays a drop-down list entitled <i>Live Mode Settings</i> which enables <i>Live</i> mode where settings are automatically sent to the device in real time as they are changed. |
| <i>Send Settings</i> | Sends settings to the DECS-250N when BESTCOMS <i>Plus</i> is not operating in Live Mode. Click on this button after making a setting change to send the modified setting to the DECS-250N. |

Settings Explorer

The Settings Explorer is a convenient tool within BESTCOMS*Plus* used to navigate through the various settings screens of the DECS-250N plugin. Descriptions of these configuration settings are organized as follows:

- General Settings
- Communications
- System Parameters
- Report Configuration
- Operating Settings
- PSS
- Synchronizer/Voltage Matching
- Protection
- Programmable Inputs
- Programmable Outputs
- Alarm Configuration
- BESTlogic™ *Plus* Programmable Logic

Logic setup will be necessary after making certain setting changes. For more information, refer to the *BESTlogicPlus* chapter.

Metering Explorer

The Metering Explorer is used to view real-time system data including generator voltages and currents, input/output status, alarms, reports, and other parameters. Refer to the *Metering* chapter for full details about the Metering Explorer.

Settings File Management

A settings file contains all DECS-250N settings including logic. A settings file assumes a file extension of “*.bstx”. It is possible to save the logic only as a separate logic library file on the *BESTlogicPlus Programmable Logic* screen. This function is helpful when similar logic is required for several devices. A logic library file assumes a file extension of “*.bslx”. It is important to note that settings and logic can be uploaded to the device separately or together, but are always downloaded together. For more information on logic files, refer to the *BESTlogicPlus* chapter.

Opening a Settings File

To open a DECS-250N settings file with *BESTCOMSPlus*, pull down the *File* menu and choose *Open*. The *Open* dialog box appears. This dialog box allows you to use normal Windows techniques to select the file that you want to open. Select the file and choose *Open*. You can also open a file by clicking on the *Open File* button on the lower menu bar. If connected to a device, you will be asked to upload the settings and logic from the file to the current device. If you choose *Yes*, the settings displayed in *BESTCOMSPlus* instance will be overwritten with the settings of the opened file.

Saving a Settings File

Select *Save* or *Save As* from the *File* pull-down menu. A dialog box pops up allowing you to enter a filename and location to save the file. Select the *Save* button to complete the save.

Upload Settings and/or Logic to Device

To upload a settings file to the DECS-250N, open the file or create a new file through *BESTCOMSPlus*. Then pull down the *Communication* menu and select *Upload Settings and Logic to Device*. If you want to upload operational settings without logic, select *Upload Settings to Device*. If you want to upload logic without operational settings, select *Upload Logic to Device*. You are prompted to enter the username and password. The default username is “A” and the default password is “A”. If the username and password are correct, the upload begins and the progress bar is shown.

Download Settings and Logic from Device

To download settings and logic from the DECS-250N, pull down the *Communication* menu and select *Download Settings and Logic from Device*. If the settings in *BESTCOMSPlus* have changed, a dialog box will open asking if you want to save the current settings changes. You can choose *Yes* or *No*. After you have taken the required action to save or discard the current settings, downloading begins. *BESTCOMSPlus* reads all settings and logic from the DECS-250N and loads them into *BESTCOMSPlus* memory. See Figure 119.

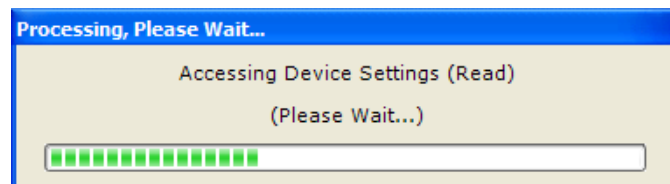


Figure 119. Processing, Please Wait...

Printing a Settings File

To view a preview of the settings printout, select *Print* from the *File* pull-down menu. To print the settings, select the printer icon in the upper left corner of the Print Preview screen.

Comparing Settings Files

BESTCOMSPlus has the ability to compare two settings files. To compare files, pull down the *Tools* menu and select *Compare Settings Files*. The *BESTCOMSPlus Settings Compare Setup* dialog box appears

(Figure 120). Select the location of the first file under *Left Settings Source* and select the location of the second file under *Right Settings Source*. If you are comparing a settings file located on your PC hard drive or portable media, click the folder button and navigate to the file. If you want to compare settings downloaded from a unit, click the *Select Unit* button to set up the communication port. Click the *Compare* button to compare the selected settings files.

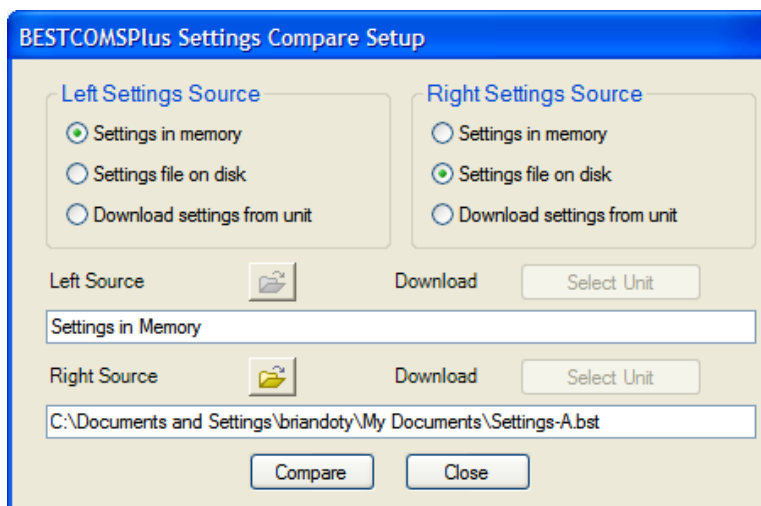


Figure 120. BESTCOMSPlus Settings Compare Setup

A dialog box will appear and notify you if any differences were found. The BESTCOMSPlus Settings Compare dialog box (Figure 121) is displayed where you can view all settings (*Show All Settings*), view only the differences (*Show Settings Differences*), view all logic (*Show All Logic Paths*), or view only logic differences (*Show Logic Path Differences*). Select *Close* when finished.

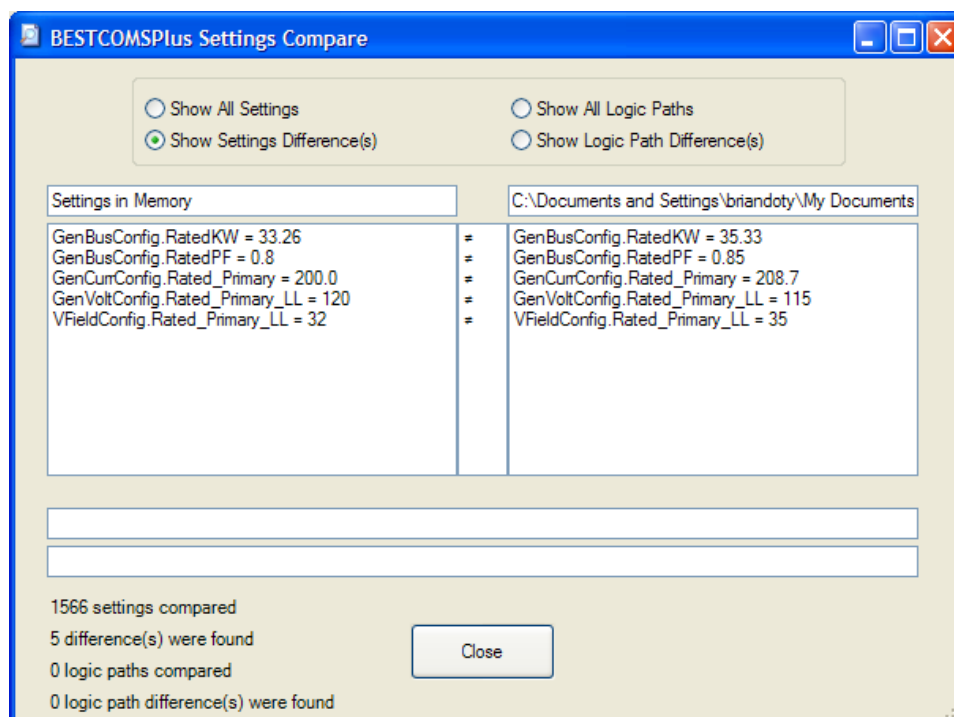


Figure 121. BESTCOMSPlus® Settings Compare

Automatic Metering Export

The auto export metering function automatically exports metering data over a user-defined period when a DECS-250N connection is active. The user specifies the *Number of Exports* and the *Interval* between each export. Enter a filename for the metering data and a folder in which to save. The first export is performed immediately after clicking the *Start* button. Click the *Filter* button to select specific metering screens. Figure 122 illustrates the *Auto Export Metering* screen.

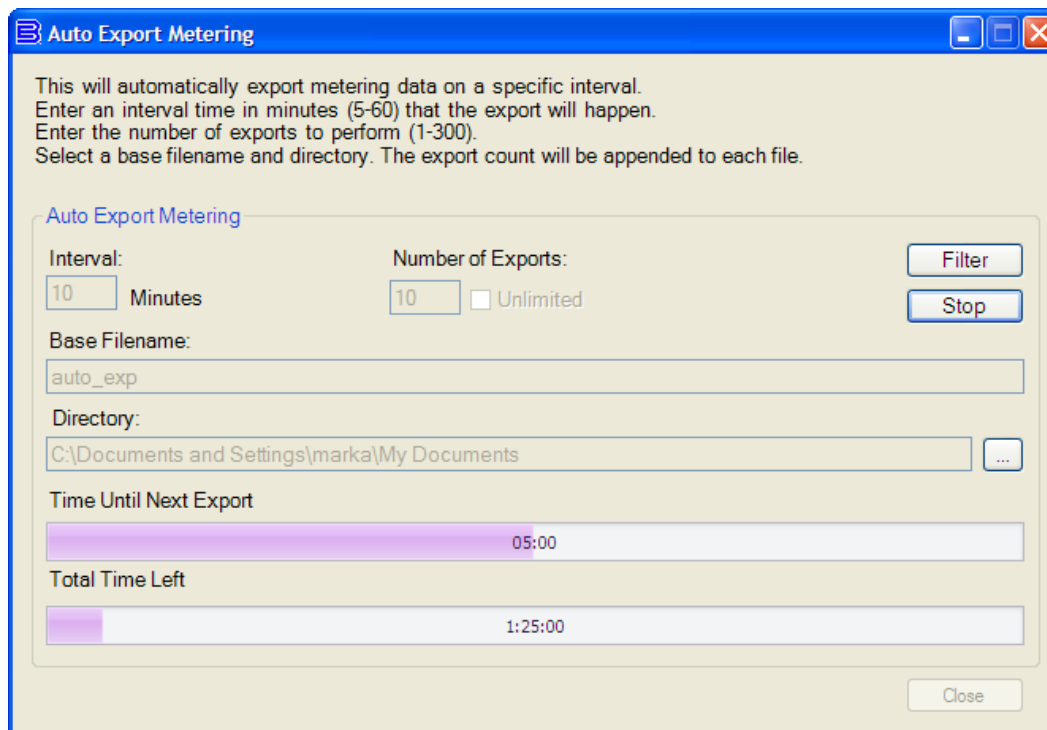


Figure 122. Auto Export Metering Screen

Firmware Updates

Future enhancements to the DECS-250N functionality may require a firmware update. Because default settings are loaded when DECS-250N firmware is updated, your settings should be saved in a file prior to upgrading firmware.

Warning!

Before performing any maintenance procedures, remove the DECS-250N from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-250N.

Caution – Settings will be lost!

Default settings will be loaded into the DECS-250N, reports and events will be cleared, and the DECS-250N will reboot when firmware is updated. BESTCOMSPPlus® can be used to download settings and save the settings in a file so that they can be restored after updating firmware. Refer to *Settings File Management* for help with saving a settings file.

Note

The latest version of BESTCOMS*Plus* software should be downloaded from the Basler Electric website and installed before performing a firmware upgrade.

A device package contains firmware for the DECS-250N, the optional Contact Expansion Module (CEM-2020), and the optional Analog Expansion Module (AEM-2020). Embedded firmware is the operating program that controls the actions of the DECS-250N. The DECS-250N stores firmware in nonvolatile flash memory that can be reprogrammed through the communication ports. It is not necessary to replace EPROM chips when updating the firmware with a newer version.

The DECS-250N can be used in conjunction with CEM-2020 or AEM-2020 expansion modules which expand the DECS-250N capabilities. When upgrading the firmware in any component of this system, the firmware in ALL of the components of the system should be upgraded to ensure compatibility of communications between the components.

Caution

The order in which the components are upgraded is critical. Assuming a system of a DECS-250N and expansion module(s) is in a state where the DECS-250N is communicating with the system expansion module(s), **the expansion module must be upgraded before the DECS-250N**. This is necessary because the DECS-250N must be able to communicate with the expansion module(s) before the DECS-250N can send firmware to it. If the DECS-250N were upgraded first, and the new firmware included a change to the expansion module communication protocol, it is possible that the expansion module(s) could no longer communicate with the upgraded DECS-250N. Without communications between the DECS-250N and the expansion module(s), upgrading the expansion module(s) is not possible.

Note

If power is lost or communication is interrupted during file transfer to the DECS-250N, the firmware upload will fail. The device will continue to use the previous firmware. Once communication has been restored, the user must start the firmware upload again. Select Upload Device Files from the Communication pull-down menu and proceed normally.

Upgrading Firmware in Expansion Modules

The following procedure is used to upgrade firmware in the expansion modules. This must be completed before upgrading firmware in the DECS-250N. If no expansion module is present, proceed to *Upgrading Firmware in the DECS-250N*.

1. Remove the DECS-250N from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-250N.
2. Apply only control power to the DECS-250N.
3. Enable the expansion modules that are present in the system. If they have not already been enabled, enable the expansion modules in the BESTCOMS*Plus* Settings Explorer, Communications, CAN Bus, Remote Module Setup screen.
4. Verify that the DECS-250N and the associated expansion modules are communicating. This can be verified by examining the alarm status using the Metering Explorer in BESTCOMS*Plus* or from

the front panel by navigating to Metering > Status > Alarms. When communications are functioning properly, there should be no active AEM or CEM Communications Failure alarms.

5. Connect to the DECS-250N through the USB or Ethernet port if not already connected.
6. Select Upload Device Files from the Communication pull-down menu.
7. You will be asked to save the current settings file. Select Yes or No.
8. When the Basler Electric Device Package Uploader screen (Figure 123) appears, click on the Open button to browse for the device package you have received from Basler Electric. The Package Files along with File Details are listed. Place a check in the boxes next to the individual files you want to upload.

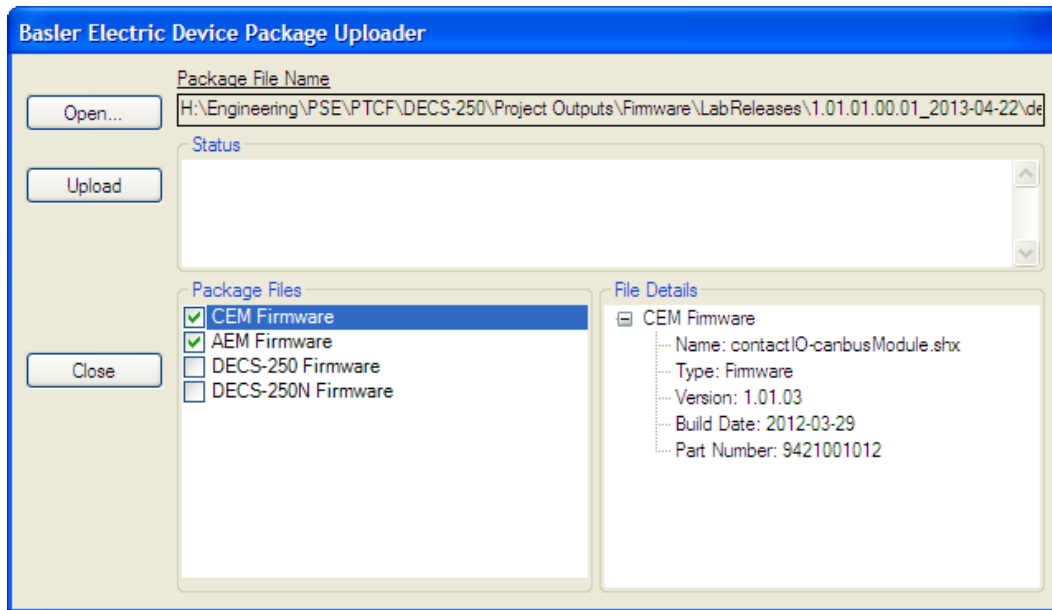


Figure 123. Basler Electric Device Package Uploader

9. Click on the Upload button and the Proceed with Device Upload screen will appear. Select Yes or No.
10. After selecting Yes, the DECS-250N Selection screen will appear. Select either USB or Ethernet.
11. After file(s) have been uploaded, click the *Close* button on the Basler Electric Device Package Uploader screen and disconnect communication to the DECS-250N.

Upgrading Firmware in the DECS-250N

The following procedure is used to upgrade firmware in the DECS-250N. This must be completed after upgrading firmware in any expansion modules.

1. Remove the DECS-250N from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-250N.
2. Apply only control power to the DECS-250N.
3. Connect to the DECS-250N with BESTCOMSP*lus*. Check the firmware Application Version on the General Settings > Device Info screen.
4. Select Upload Device Files from the Communication pull-down menu. You do not have to be connected to the DECS-250N at this time. Save settings when prompted, if desired.
5. Open the desired device package file (decs-250.bef).
6. Check the box for DECS-250N Firmware. Note the version number of the DECS-250N firmware; this is the version that will be used to set the Application Version in the settings file in a later step.

7. Click the Upload button and follow the instructions that appear to begin the upgrade process.
8. After the upload is complete, disconnect communication to the DECS-250N.
9. Load the saved settings file into the DECS-250N.
 - a. Close all settings files.
 - b. From the File pull-down menu, select New, DECS-250N.
 - c. Connect to the DECS-250N.
 - d. Once all settings have been read from the DECS-250N, open the saved settings file by selecting File, Open File in the BESTCOMS*Plus* menu. Then browse for the file to upload.
 - e. When BESTCOMS*Plus* asks if you wish to upload settings and logic to the device, click Yes.
 - f. If you are receiving upload failures and indications that the logic is incompatible with the firmware version, check that the DECS-250N style number in the saved file matches that of the DECS-250N into which the file is being uploaded. The style number in the settings file is found under General Settings > Style Number in BESTCOMS*Plus*.
 - g. If the style number of the settings file does not match that of the DECS-250N into which it is to be loaded, disconnect from the DECS-250N, then modify the style number in the settings file. Then repeat the steps titled *Load the Saved Settings File into the DECS-250N*.

BESTCOMS*Plus*® Updates

Enhancements to DECS-250N firmware typically coincide with enhancements to the DECS-250N plugin for BESTCOMS*Plus*®. When a DECS-250N is updated with the latest version of firmware, the latest version of BESTCOMS*Plus* should also be obtained.

- If you obtained a CD-ROM containing a firmware update from Basler Electric, then that CD-ROM will also contain the corresponding version of BESTCOMS*Plus* software.
- You can download the latest version of BESTCOMS*Plus* by visiting www.basler.com.
- BESTCOMS*Plus* automatically checks for updates when Check Automatically is selected on the Check for Updates User Settings screen. This screen is accessed under the Help drop-down menu. (An internet connection is required.)
- You can use the manual “check for updates” function in BESTCOMS*Plus* to ensure that the latest version is installed by selecting Check for Updates in the Help drop-down menu. (An internet connection is required.)

BESTlogic™ *Plus*

Introduction

BESTlogic™ *Plus* Programmable Logic is a programming method used for managing the input, output, protection, control, monitoring, and reporting capabilities of Basler Electric's DECS-250N Digital Excitation Control System. Each DECS-250N has multiple, self-contained logic blocks that have all of the inputs and outputs of its discrete component counterpart. Each independent logic block interacts with control inputs and hardware outputs based on logic variables defined in equation form with BESTlogic*Plus*.

BESTlogic*Plus* equations entered and saved in the DECS-250N system's nonvolatile memory integrate (electronically wire) the selected or enabled protection and control blocks with control inputs and hardware outputs. A group of logic equations defining the logic of the DECS-250N is called a logic scheme.

Two default active logic schemes are preloaded into the DECS-250N. One default logic scheme is tailored for a system with the PSS option disabled and the other is for a system with PSS enabled. The proper default logic scheme is loaded depending on the PSS option selected in the system style number. These schemes are configured for a typical protection and control application of a synchronous generator and virtually eliminate the need for "start-from-scratch" programming. The default logic schemes are similar to that of a DECS-200N. BESTCOMS*Plus*® can be used to open a logic scheme that was previously saved as a file and upload it to the DECS-250N. The default logic schemes can also be customized to suit your application. Detailed information about logic schemes is provided later in this chapter.

BESTlogic*Plus* is not used to define the operating settings (modes, pickup thresholds, and time delays) of the individual protection and control functions. Operating settings and logic settings are interdependent but separately programmed functions. Changing logic settings is similar to rewiring a panel and is separate and distinct from making the operating settings that control the pickup thresholds and time delays of a DECS-250N. Detailed information about operating settings is provided in other chapters of this instruction manual.

Overview of BESTlogic™ *Plus*

Use BESTCOMS*Plus* to make BESTlogic*Plus* settings. Use the Settings Explorer to open the *BESTlogicPlus Programmable Logic* tree branch as shown in Figure 124.

The *BESTlogicPlus Programmable Logic* screen contains a logic library for opening and saving logic files, tools for creating and editing logic documents, and protection settings.

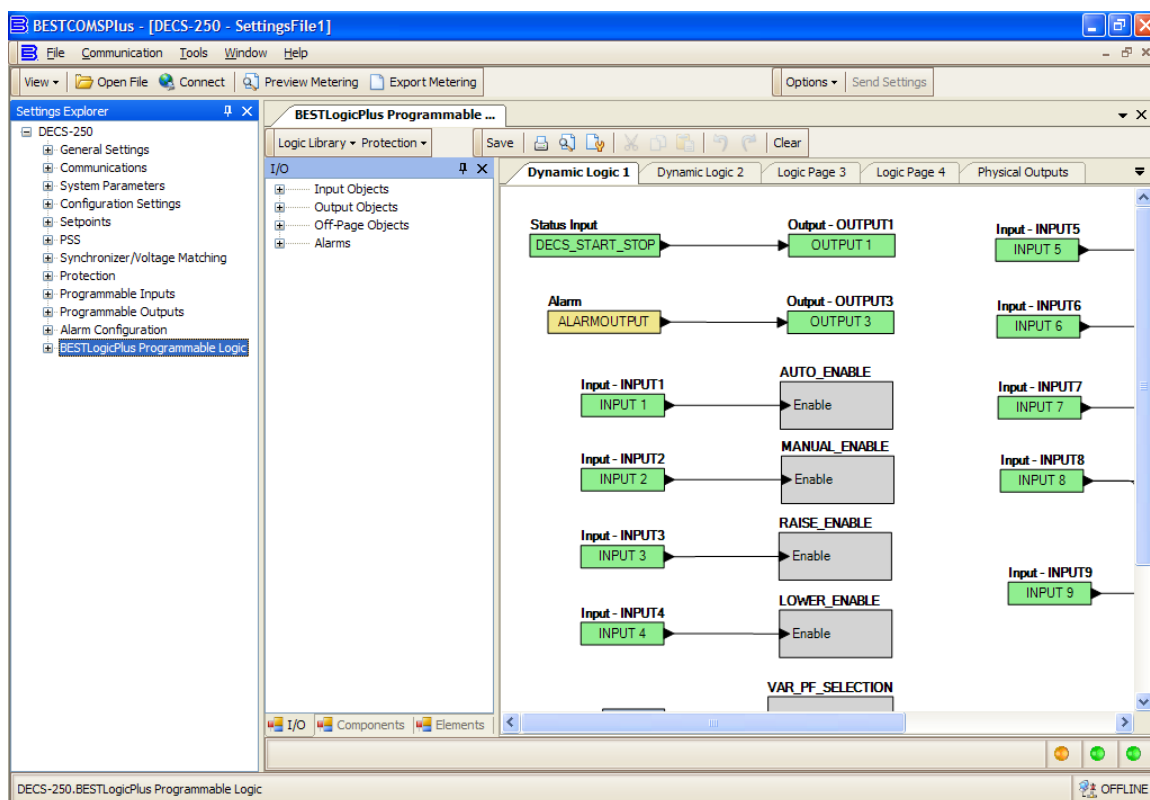


Figure 124. BESTlogicPlus Programmable Logic Tree Branch

BESTlogic™Plus Composition

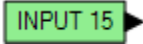
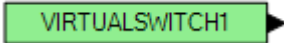
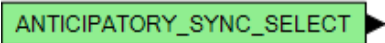
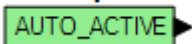
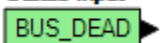
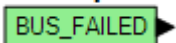
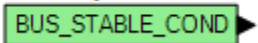
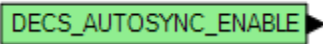
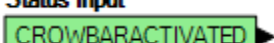
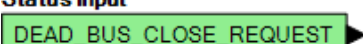
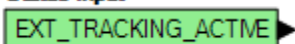
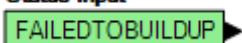
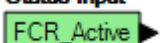
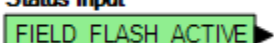
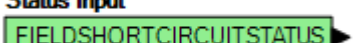
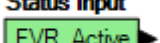
There are three main groups of objects used for programming BESTlogicPlus. These groups are *I/O*, *Components*, and *Elements*. For details on how these objects are used to program BESTlogicPlus, see the paragraphs on *Programming BESTlogicPlus*.

I/O

This group contains Input Objects, Output Objects, Off-Page Objects, and Alarms. Table 12 lists the names and descriptions of the objects in the *I/O* group.

















Table 12. I/O Group, Names and Descriptions

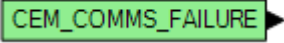
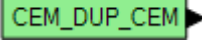
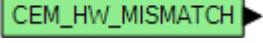
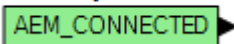
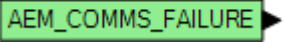
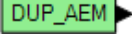



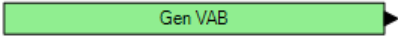
| Name | Description | Symbol |
|------------------------|---|--------|
| Input Objects | | |
| Logic 0 | Always false (Low). | |
| Logic 1 | Always true (High). | |
| <i>Physical Inputs</i> | | |
| Start Input | True when the physical Start input is active. | |
| Stop Input | True when the physical Stop input is active. | |
| IN1 - IN14 | True when Physical Input x is active. | |

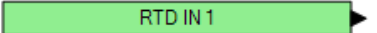
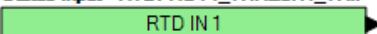
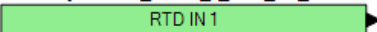
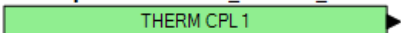
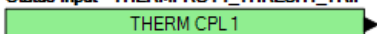
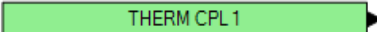
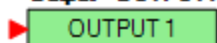
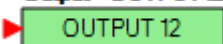
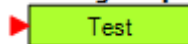
| Name | Description | Symbol |
|----------------------------|--|---|
| <i>Remote Inputs</i> | | |
| IN15 - IN24 | True when Remote Input x is active. (Available when an optional CEM-2020 is connected.) | Input - IN15  |
| <i>Virtual Inputs</i> | | |
| VIN1 - VIN6 | True when Virtual Input x is active. | Input - VIRTUALSEWITCH1  |
| <i>Status Inputs</i> | | |
| Anticipatory Sync Selected | True when Anticipatory is selected. (Synchronizer screen) | Status Input  |
| Auto Mode Active | True when the unit is in Auto mode (AVR). | Status Input  |
| Bus Dead | True when the Bus Dead condition settings have been exceeded. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input  |
| Bus Failed | True when the Bus Stable condition settings are not met. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input  |
| Bus Stable | True when the Bus Stable condition settings have been exceeded. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input  |
| Auto Sync Enabled | True when DECS auto-sync is enabled. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input  |
| Crowbar Activated | True when the crowbar is active. | Status Input  |
| Dead Bus Close Request | True when this option is user-enabled; a dead bus is closed automatically upon detection. False when this option is disabled; a dead bus will remain open. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input  |
| External Tracking Active | True when external tracking is running. | Status Input  |
| Failed To Buildup | True when the Failed to Buildup alarm is active. | Status Input  |
| FCR Active | True when the unit is in FCR mode. | Status Input  |
| Field Flash Active | True when field flash is active. | Status Input  |
| Field Short Circuit Status | True when a field short circuit condition is detected. | Status Input  |
| FVR Active | True when the unit is in FVR mode. | Status Input  |

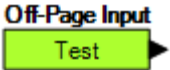
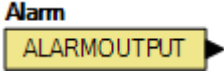
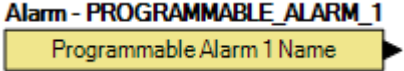
| Name | Description | Symbol |
|--|--|---|
| Gen Breaker Fail to Open | The generator breaker did not open in the close wait time period. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_BREAKER_FAIL_TO_OPEN |
| Gen Breaker Fail to Close | The generator breaker did not close in the close wait time period. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_BREAKER_FAIL_TO_CLOSE |
| Gen Breaker Sync Fail | True when generator breaker sync has failed. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_BREAKER_SYNC_FAIL |
| Gen Dead | True when the Generator Breaker Dead condition settings have been exceeded. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_DEAD |
| Gen Failed | True when the Generator Breaker Stable condition settings are not met. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_FAILED |
| Gen Stable | True when the Generator Breaker Stable condition settings have been exceeded. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) | Status Input GEN_STABLE |
| GOV Contact Type Proportional | True when this option is selected. (Governor Bias Control Settings screen) | Status Input CONTACT_TYPE_PROPORTIONAL |
| Internal Tracking Active | True when internal tracking is running. | Status Input INT_TRACKING_ACTME |
| IRIG Sync Lost | True when IRIG signal is not being received. | Status Input IRIG_SYNC_LOST_ALM |
| Manual Mode Active | True when the unit is in Manual mode (FCR/FVR). | Status Input MANUAL_ACTIVE |
| Network Load Share Active | True when network load sharing is active. | Status Input NLS_ACTIVE |
| Network Load Share Config Mismatch | True when the unit's configuration does not match the configuration of the other units with load sharing enabled. | Status Input NLS_CONFIG_MISMATCH |
| Network Load Share ID Missing | True when any of the load sharing enabled units are not detected on the network. | Status Input NLS_ID_MISSING |
| Network Load Share Receiving ID 1 - 16 | True when data is being received from a specific unit on the load share network. | Status Input RCC_RECEIVING_ID_1 |
| No Network Load Share Data Received | True when Network Load Sharing is enabled but there is no data being received from other network load sharing devices. | Status Input NO_NETWORK_LOADSHARE_DATA |
| Network Load Share Status 1-4 | This element functions in conjunction with the Network Load Share Broadcast elements on all units on the network. True when the corresponding Network Load Share Broadcast element input is true on another unit on the network. | Status Input NLS_STATUS_1 |

| Name | Description | Symbol |
|--------------------------------------|--|---|
| NTP Sync Lost | True when NTP server has lost communications. | Status Input NTP_SYNC_LOST_ALM |
| Null Balance | True when Null Balance is achieved in both external and internal tracking. | Status Input NULL_BALANCE |
| OEL | True when the Overexcitation Limiter is active. | Status Input OEL |
| PF Controller Active | True when the unit is in PF mode. | Status Input PF_Active |
| PLL Sync Selected | True when phase locked loop (PLL) is selected. (Synchronizer screen) | Status Input PLL_SYNC_SELECTED |
| Preposition Active | True when any preposition is active. | Status Input DECS_PREPOSITION |
| Preposition 1 Active | True when Preposition 1 is active. | Status Input PREPOSITION_1_ACTME |
| Preposition 2 Active | True when Preposition 2 is active. | Status Input PREPOSITION_2_ACTME |
| Preposition 3 Active | True when Preposition 3 is active. | Status Input PREPOSITION_3_ACTME |
| PSS Active (Optional) | True when the power system stabilizer (PSS) is turned on and running. | Status Input PSS_ACTIVE |
| PSS Current Unbalanced (Optional) | True when the phase current is unbalanced and the PSS is active. | Status Input PSSCURRENTUNBALANCED |
| PSS Power Below Threshold (Optional) | True when the input power is below the Power Level threshold and the PSS is active. | Status Input PSSPOWERBELOWTHRESHOLD |
| PSS Secondary Group (Optional) | True when the PSS is using secondary settings. | Status Input PSS_USING_SEC_SETTINGS |
| PSS Speed Failed (Optional) | True when the frequency is out of range for a length of time calculated internally by the DECS-250N and the PSS is active. | Status Input PSSSPEEDFAILED |
| PSS Test On (Optional) | True when the power system stabilizer test signal (Frequency Response) is active. | Status Input PSS_TEST_MODE |
| PSS Voltage Limit (Optional) | True when the calculated terminal voltage upper or lower limit is reached and the PSS is active. | Status Input PSSVOLTAGELIMIT |
| PSS Voltage Unbalanced (Optional) | True when the phase voltage is unbalanced and the PSS is active. | Status Input PSSVOLTAGEUNBALANCED |
| SCL | True when the Stator Current Limiter is active. | Status Input SCL |
| Setpoint at Lower Limit | True when the active modes setpoint is at the lower limit. | Status Input Setpoint_At_Lower_Limit |

| Name | Description | Symbol |
|---|--|--|
| Setpoint at Upper Limit | True when the active modes setpoint is at the upper limit. | Status Input Setpoint_At_Upper_Limit  |
| Soft Start Active | True during softstart. | Status Input SOFTSTART_ACTME  |
| Start Status | True when the unit is in Start mode. | Status Input DECS_START_STOP  |
| Sync Active | True when synchronization is active. | Status Input SYNC_ACTIVE  |
| Transfer Watchdog | True when watchdog has timed out and system control will switch to an alternate redundant DECS-250N. | Status Input TRANSFERWATCHDOG  |
| Transient Boost Active | True when transient boost is active. | Status Input TRANSIENT_BOOST_ACTME  |
| UEL | True when the Under Excitation Limiter is active. | Status Input UEL  |
| Under Frequency V/Hz | True when the Under Frequency or the Volts/Hz Limiter is active. | Status Input UNDERFREQUENCYVHZ  |
| Unknown Network Load Share Protocol Version | True when there is another unit on the network whose load share protocol version is not the same as this units load share protocol version. | Status Input UNKNOWN_LOAD_SHARE_VER  |
| VAR Controller Active | True when the unit is in VAR mode. | Status Input VAR_Active  |
| VAR Limiter Active | True when the Var Limiter is active. | Status Input VAR_LIMITER_ACTIVE  |
| Voltage Matching Active | True when Voltage Matching is active. | Status Input VOLTAGE_MATCHING_ACTME  |
| Protection | Several protection status alarms are available. The 25 Sync-Check Status Alarm input is shown to the right. These elements are true when the pickup threshold is exceeded for the duration of the time delay. | Status Input PROTECTION25STATUS  |
| Configurable Protection 1-8 | There are four thresholds for each of the eight Configurable Protection blocks. Each threshold can be set to Over or Under mode and the threshold limit and activation delay can each be set. See <i>Protection</i> chapter in this manual for more details. Each threshold has a separate logic block for the pickup and the trip. Configurable Protection #1 with its Threshold #1 Pickup and Trip blocks is shown to the right. The pickup block is true when the threshold is exceeded. The trip block is true when the corresponding pickup block threshold is exceeded for the duration of the time delay. | Status Input ConfProt1Thresh1Pickup  Status Input ConfProt1Thresh1Trip  |
| Contact Expansion Module, CEM Connected | Contact Expansion Module Connected. True when an optional CEM-2020 is connected to the DECS-250N. | Status Input CEM_CONNECTED  |

| Name | Description | Symbol |
|--|--|--|
| Contact Expansion Module, Comms Failure | True when there is no communication from the CEM. | Status Input  |
| Contact Expansion Module, Duplicate CEM | True when more than one CEM is detected. Only one CEM is supported at a time. | Status Input  |
| Contact Expansion Module, Hardware Mismatch | True when selected CEM type differs from detected CEM type. Go to <i>Settings Explorer, Communications, CANBus, Remote Module Setup</i> to select the CEM type (18 or 24 contacts). | Status Input  |
| Analog Expansion Module, Connected | Analog Expansion Module Connected. True when an optional AEM-2020 is connected to the DECS-250N. | Status Input  |
| Analog Expansion Module, Comms Failure | True when there is no communication from the AEM. | Status Input  |
| Analog Expansion Module, Duplicate AEM | True when more than one AEM is detected. Only one AEM is supported at a time. | Status Input  |
| Analog Expansion Module, Remote Analog Inputs 1-8 | There are four thresholds for each of the eight Remote Analog Input blocks. Each threshold has a separate logic block for the pickup and the trip. Remote Analog Input #1 with its Threshold #1 Pickup and Trip blocks is shown to the right. For more details on configuring the Remote Analog Inputs, see the <i>Analog Expansion Module</i> chapter in this manual. The pickup block is true when the threshold is exceeded. The trip block is true when the corresponding pickup block threshold is exceeded for the duration of the time delay. | Status Input - PROT1_THRESH1_PICKUP  Status Input - PROT1_THRESH1_TRIP  |
| Analog Expansion Module Remote Analog Inputs, Out of Range 1-8 | Each Remote Analog Input has one Out of Range Block. True when parameters exceed out of range threshold. This function alerts the user of an open or damaged analog input wire. | Status Input - PROT1_OUT_OF_RANGE  |
| Analog Expansion Module Remote Analog Outputs 1-4 | True when the analog output connection is open. | Status Input - AEM_OUTPUT_1_OUT_OF_RANGE  |

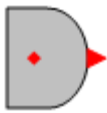
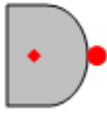



| Name | Description | Symbol |
|---|--|---|
| Analog Expansion Module Remote RTD Inputs 1-8 | There are four thresholds for each of the eight Remote RTD Input blocks. Each threshold has a separate logic block for the pickup and the trip. Remote RTD Input #1 with its Threshold #1 Pickup and Trip blocks is shown to the right. For more details on configuring the Remote RTD Inputs, see the <i>Analog Expansion Module</i> chapter in this manual. The pickup block is true when the threshold is exceeded. The trip block is true when the corresponding pickup block threshold is exceeded for the duration of the time delay. | <p>Status Input - RTDPROT1_THRESH1_PU</p>  <p>Status Input - RTDPROT1_THRESH1_TRIP</p>  |
| Analog Expansion Module Remote RTD Inputs, Out of Range 1-8 | Each Remote RTD Input has one Out of Range Block. True when parameters exceed out of range threshold. This function alerts the user of an open or damaged analog input wire. | <p>Status Input - RTD_INPUT_1_OUT_OF_RANGE</p>  |
| Analog Expansion Module Remote Thermocouple Inputs 1-2 | There are four thresholds for both of the Remote Thermocouple Input blocks. Each threshold has a separate logic block for the pickup and the trip. Remote Thermocouple Input #1 with its Threshold #1 Pickup and Trip blocks is shown to the right. For more details on configuring the Remote Thermocouple Inputs, see the <i>Analog Expansion Module</i> chapter in this manual. The pickup block is true when the threshold is exceeded. The trip block is true when the corresponding pickup block threshold is exceeded for the duration of the time delay. | <p>Status Input - THERMPROT1_THRESH1_PICKUP</p>  <p>Status Input - THERMPROT1_THRESH1_TRIP</p>  |
| Analog Expansion Module Remote Thermocouple Inputs, Out of Range 1-2 | Each Remote Thermocouple Input has one Out of Range Block. True when parameters exceed out of range threshold. This function alerts the user of an open or damaged analog input wire. | <p>Status Input - THERMAL_1_OUT_OF_RANGE</p>  |
| Output Objects | | |
| Physical Outputs OUT1 - OUT11 | Physical Outputs 1 through 11. | <p>Output - OUTPUT1</p>  |
| Remote Outputs OUT12 - OUT35 | Remote Outputs 12 through 35. (Available when an optional CEM-2020 is connected.) | <p>Output - OUTPUT12</p>  |
| Off-Page Objects | | |
| Off-Page Output | Used in conjunction with the Off-Page Input to transform an output on one logic page into an input on another logic page. Outputs can be renamed by right-clicking and selecting Rename Output. Right-clicking will also show pages that the corresponding inputs can be found on. Selecting the page will take you to that page. | <p>Off-Page Output</p>  |



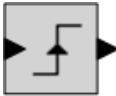
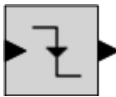
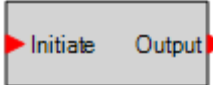
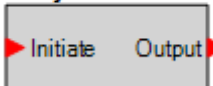
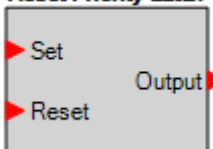
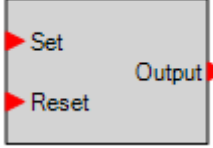
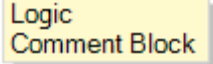
| Name | Description | Symbol |
|----------------------------|---|---|
| Off-Page Input | Used in conjunction with the Off-Page Output to transform an output on one logic page into an input on another logic page. Inputs can be renamed by right-clicking and selecting Rename Input. Right-clicking will also show pages that the corresponding outputs can be found on. Selecting the page will take you to that page. |  |
| Alarms | | |
| Global Alarm | True when one or more alarms are set. |  |
| Programmable Alarms 1 - 16 | True when a programmable alarm is set. |  |

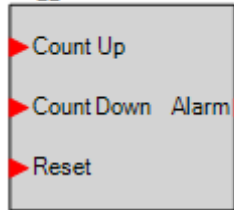
Components

This group contains Logic Gates, Pickup and Dropout Timers, Latches, and Comment Blocks. Table 13 lists the names and descriptions of the objects in the *Components* group.

Table 13. Components Group, Names and Descriptions

| Name | Description | | | | Symbol | | | | | | | | | | | | | | |
|-------------|-------------|---|-------|--|--------|---|---|---|---|---|---|---|---|---|---|---|---|--|---|
| Logic Gates | | | | | | | | | | | | | | | | | | | |
| AND | | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table> | Input | | Output | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | |  |
| Input | | Output | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | | | | | | | | | | | | | | | | | |
| 0 | 1 | 0 | | | | | | | | | | | | | | | | | |
| 1 | 0 | 0 | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | | | | | | | | | | | | | | | | | |
| NAND | | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table> | Input | | Output | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | |  |
| Input | | Output | | | | | | | | | | | | | | | | | |
| 0 | 0 | 1 | | | | | | | | | | | | | | | | | |
| 0 | 1 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 0 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 1 | 0 | | | | | | | | | | | | | | | | | |
| OR | | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table> | Input | | Output | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | |  |
| Input | | Output | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | | | | | | | | | | | | | | | | | |
| 0 | 1 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 0 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | | | | | | | | | | | | | | | | | |
| NOR | | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table> | Input | | Output | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | |  |
| Input | | Output | | | | | | | | | | | | | | | | | |
| 0 | 0 | 1 | | | | | | | | | | | | | | | | | |
| 0 | 1 | 0 | | | | | | | | | | | | | | | | | |
| 1 | 0 | 0 | | | | | | | | | | | | | | | | | |
| 1 | 1 | 0 | | | | | | | | | | | | | | | | | |
| XOR | | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table> | Input | | Output | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | |  |
| Input | | Output | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | | | | | | | | | | | | | | | | | |
| 0 | 1 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 0 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 1 | 0 | | | | | | | | | | | | | | | | | |

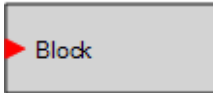

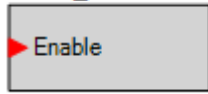

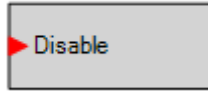
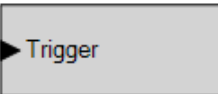
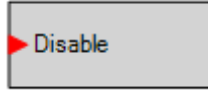

| Name | Description | | Symbol | | | | | | | | | | | | | | | |
|----------------------------------|---|--------|---|--------|---|---|---|---|---|---|---|---|---|---|---|---|--|---|
| XNOR | <table><tr><td colspan="2">Input</td><td>Output</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table> | Input | | Output | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | |  |
| Input | | Output | | | | | | | | | | | | | | | | |
| 0 | 0 | 1 | | | | | | | | | | | | | | | | |
| 0 | 1 | 0 | | | | | | | | | | | | | | | | |
| 1 | 0 | 0 | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | | | | | | | | | | | | | | | | |
| NOT (INVERTER) | <table><tr><td>Input</td><td>Output</td></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table> | Input | Output | 0 | 1 | 1 | 0 | |  | | | | | | | | | |
| Input | Output | | | | | | | | | | | | | | | | | |
| 0 | 1 | | | | | | | | | | | | | | | | | |
| 1 | 0 | | | | | | | | | | | | | | | | | |
| Rising Edge | The output is true when the rising edge of a pulse is detected on the input signal. | |  | | | | | | | | | | | | | | | |
| Falling Edge | The output is true when the falling edge of a pulse is detected on the input signal. | |  | | | | | | | | | | | | | | | |
| Pickup and Dropout Timers | | | | | | | | | | | | | | | | | | |
| Drop Out Timer | Used to set a delay in the logic. For more information, refer to <i>Programming BESTlogicPlus, Pickup and Dropout Timers</i> , later in this chapter. | | Drop Out Timer (1) TIMER_1 Delay = 1  | | | | | | | | | | | | | | | |
| Pick Up Timer | Used to set a delay in the logic. For more information, refer to <i>Programming BESTlogicPlus, Pickup and Dropout Timers</i> , later in this chapter. | | Pick Up Timer (1) TIMER_1 Delay = 1  | | | | | | | | | | | | | | | |
| Latches | | | | | | | | | | | | | | | | | | |
| Reset Priority Latch | When the Set input is on and the Reset input is off, the latch will go to the SET (ON) state. When the Reset input is on and the Set input is off, the latch will go to the RESET (OFF) state. If both the Set and Reset inputs are on at the same time, a reset priority latch will go to the RESET (OFF) state. | | Reset Priority Latch  | | | | | | | | | | | | | | | |
| Set Priority Latch | When the Set input is on and the Reset input is off, the latch will go to the SET (ON) state. When the Reset input is on and the Set input is off, the latch will go to the RESET (OFF) state. If both the Set and Reset inputs are on at the same time, a set priority latch will go to the SET (ON) state. | | Set Priority Latch  | | | | | | | | | | | | | | | |
| Other | | | | | | | | | | | | | | | | | | |
| Comment Block | Enter user comments. | |  | | | | | | | | | | | | | | | |

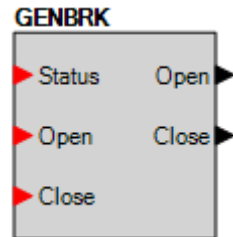
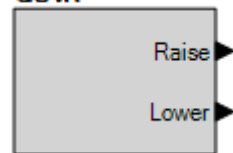
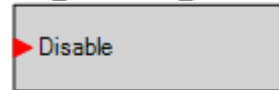
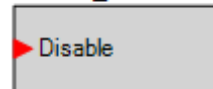
| Name | Description | Symbol |
|---------|---|---|
| Counter | True when the count reaches a user-selected number. Count Up increments the count when a true is received. Count Down decrements the count when a true is received. Reset resets the count to zero when a true is received. OUTPUT is true when the count reaches the trigger count. The trigger count is set by the user and is found in <i>Settings Explorer</i> , <i>BESTlogicPlus Programmable Logic</i> , <i>Logic Counters</i> . | Counter (1) Counter 1 Trigger Count = 1  |

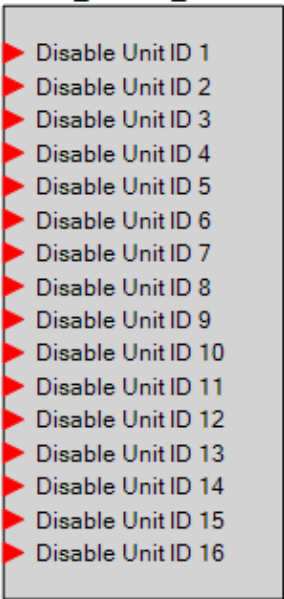

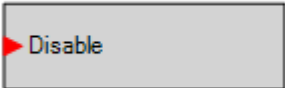
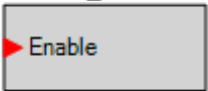
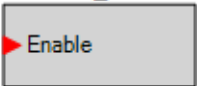


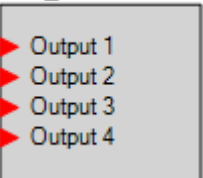
Elements


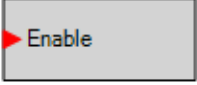
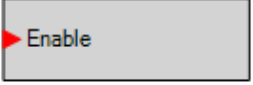

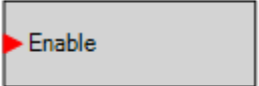
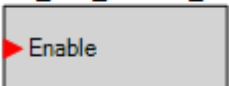

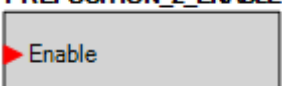
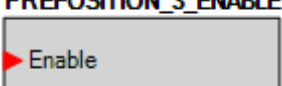
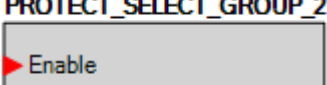
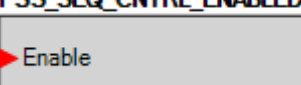
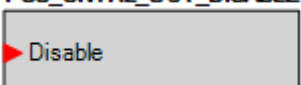
Table 14 lists the names and descriptions of the elements in the *Elements* group.

Table 14. Elements Group, Names and Descriptions

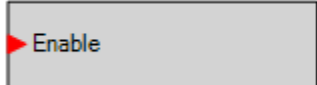

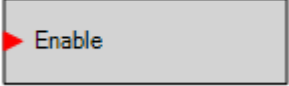

| Name | Description | Symbol |
|------------------------------------|---|---|
| 27 | When true, this element blocks, or disables, the 27 undervoltage protection function. | 27  |
| ALARM RESET | When true, this element resets all active alarms. | ALARM_RESET  |
| AUTO ENABLE | When true, this element sets the unit in Auto mode (AVR). | AUTO_ENABLE  |
| AUTO TRANSFER ENABLE | When true, this element sets the unit as secondary. When false, the unit is primary. | AUTOTRANSFER_ENABLE  |
| CROSS CURRENT COMPENSATION DISABLE | When true, this element disables cross current compensation. | CC_DISABLE  |
| DATALOG TRIGGER | When true, this element triggers the datalog to begin recording data. | DATALOGTRIGGER  |
| DROOP DISABLE | When true, this element disables droop when the unit is operating in AVR mode. | DROOP_DISABLE  |
| EXTERNAL TRACKING DISABLE | When true, this element disables external tracking. | EXT_TRACKING_DISABLE  |

| Name | Description | Symbol |
|---|---|---|
| GENERATOR BREAKER | This element is used to connect the breaker open and close output signals from the DECS-250N to physical output contacts to open and close the generator breaker, and map breaker status feedback to a contact input. In addition, contact inputs can be mapped to allow switches to be implemented to manually initiate breaker open and close requests. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) |  <p>GENBRK</p> <p>Inputs: Status, Open, Close (indicated by red triangles pointing right).</p> <p>Outputs: Open, Close (indicated by black triangles pointing right).</p> |
| <p>GENERATOR BREAKER Inputs</p> <p><i>Status:</i> This input allows a contact input to be mapped that will provide breaker status feedback to the DECS-250N. When the contact input is closed, the breaker is indicated to be closed. When the contact input is open, the breaker is indicated to be open.</p> <p><i>Open:</i> This input allows a contact input to be mapped that can be used to initiate a manual breaker open request. When this input is pulsed closed, the breaker opens.</p> <p><i>Close:</i> This input allows a contact input to be mapped that can be used to initiate a manual breaker close request. When this input is pulsed and the generator is stable, a close request is initiated. If the Dead Bus Close Enable parameter is TRUE, and the bus is dead, the breaker will close. If the bus is stable, the DECS-250N will synchronize the generator to the bus, and then close the breaker.</p> | | <p>GENERATOR BREAKER Outputs</p> <p>The outputs must be mapped to the contact outputs of the DECS-250N that will be used to drive the breaker.</p> <p><i>Open:</i> This output is pulsed TRUE (closes the output contact it is mapped to) when the DECS-250N is providing a signal to the breaker to open. It will be a pulse if the Breaker Output Contact Type is set to Pulse on the Breaker Hardware screen under Synchronizer/Voltage Matching in the Settings Explorer, and the length is determined by the Open Pulse Time. It will be a constant output if the Generator Breaker Hardware Contact Type is set to continuous. Note the pulse time must be set long enough for the breaker to actually open before the pulse is removed.</p> <p><i>Close:</i> This output is pulsed TRUE (closes the output contact it is mapped to) when the DECS-250N is providing a signal to the breaker to close. It will be a pulse if the Breaker Output Contact Type is set to Pulse on the Breaker Hardware screen under Synchronizer/Voltage Matching in the Settings Explorer, and the length is determined by the Open Pulse Time. It will be a constant output if the Generator Breaker Hardware Contact Type is set to continuous. Note the pulse time must be set long enough for the breaker to actually open before the pulse is removed.</p> |
| GOVERNOR | Can be connected to inputs of other logic blocks. When the Governor is being raised, the Raise output is true. When being lowered, the Lower output is true. (Available when the controller is equipped with the optional Auto synchronizer, style number xxxxAxx) |  <p>GOWR</p> <p>Outputs: Raise, Lower (indicated by black triangles pointing right).</p> |
| INTERNAL TRACKING DISABLE | When true, this element disables internal tracking. |  <p>INT_TRACKING_DISABLE</p> <p>Input: Disable (indicated by a red triangle pointing right).</p> |
| LINE DROP DISABLE | When true, this element disables line drop when the unit is operating in AVR mode. |  <p>LDROP_DISABLE</p> <p>Input: Disable (indicated by a red triangle pointing right).</p> |

| Name | Description | Symbol |
|----------------------------------|--|---|
| LOAD SHARE DISABLE | This element allows load sharing with specific units on the network to be disabled. When an input to this block is true, load share data received from that unit is ignored by the DECS-250N. | LOAD_SHARE_DISABLE  |
| LOSS OF SENSING DISABLE | When true, this element disables the Loss of Sensing function. | LOSS_OF_SENSING  |
| LOSS OF SENSING TRANSFER DISABLE | When true, this element disables the transfer to Manual mode during a Loss of Sensing condition. | LOS_TRANSFER_DISABLE  |
| LOWER ENABLE | When true, this element lowers the active setpoint. | LOWER_ENABLE  |
| MANUAL ENABLE | When true, this element switches the unit to Manual mode. | MANUAL_ENABLE  |
| MANUAL MODE FCR ONLY | When true, this element switches the Manual mode to FCR. | MANUAL_MODE_FCR_ONLY  |
| NETWORK LOAD SHARE DISABLE | When true, this element disables network load sharing. | NETWORK_LOAD_SHARE_DISABLE  |
| NLS BROADCAST | This element functions in conjunction with the Network Load Share Status inputs on all units on the network. When an input is true, the corresponding Network Load Share Status input on all units on the network is true. | NLS_BROADCAST  |

| Name | Description | Symbol |
|--------------------------------------|--|---|
| OEL DISABLED IN MANUAL MODE | When true, this element disables OEL when the unit is operating in Manual mode. | OEL_DISABLED_IN_MAN_MODE  |
| OEL ONLINE | When true, this element enables the use of OEL when the unit is considered online. | OEL_ONLINE  |
| OEL SELECT SECONDARY SETTINGS | When true, this element selects the secondary settings for OEL. | OEL_SELECT_GROUP_2  |
| PARALLEL ENABLE LM | When true, this element informs the unit that it is online. The element should be enabled when the 52LM is closed. This element also allows UEL and droop compensation to operate when true. | PARALLEL_ENABLE_LM  |
| PID SELECT SECONDARY SETTINGS | When true, this element selects secondary settings on the PID. | PID_SELECT_GROUP_2  |
| PF/VAR ENABLE | When true, this element enables the PF and Var controller, and informs the unit that it is online. The Var/PF Selection element must be set to true to use var or PF mode. This element should be enabled when the 52JK is closed. | PF_VAR_ENABLE_JK  |
| PREPOSITION 1 ENABLE | When true, this element informs the unit to use setpoints for Preposition 1. | PREPOSITION_1_ENABLE  |
| PREPOSITION 2 ENABLE | When true, this element informs the unit to use setpoints for Preposition 2. | PREPOSITION_2_ENABLE  |
| PREPOSITION 3 ENABLE | When true, this element informs the unit to use setpoints for Preposition 3. | PREPOSITION_3_ENABLE  |
| PROTECTION SELECT SECONDARY SETTINGS | When true, this element informs the unit to use secondary values for protection. | PROTECT_SELECT_GROUP_2  |
| PSS SEQ CNTRL ENABLED | When true, PSS sequence (phase rotation) control is enabled. (Available when the controller is equipped with the optional Power System Stabilizer, style number xPxxxxx) | PSS_SEQ_CNTRL_ENABLED  |
| PSS OUTPUT DISABLE | When true, this element disables the output of the PSS. The PSS continues to run, but the output is not used. (Available when the controller is equipped with the optional Power System Stabilizer, style number xPxxxxx) | PSS_CNTRL_OUT_DISABLE  |

| Name | Description | Symbol |
|--------------------------------------|---|--|
| PSS SEQ CNTRL SELECTION | When true, phase rotation is selected to be ACB. False when phase rotation is selected to be ABC. (Available when the controller is equipped with the optional Power System Stabilizer, style number xPxxxxx) | PSS_SEQ_CNTRL_SELECTION Mode |
| PSS MOTOR | When true, the PSS is in motor mode. False when in generator mode. (Available when the controller is equipped with the optional Power System Stabilizer, style number xPxxxxx) | PSS_MOTOR Mode |
| PSS SELECT SECONDARY SETTINGS | When true, this element selects secondary settings for the PSS. (Available when the controller is equipped with the optional Power System Stabilizer, style number xPxxxxx) | PSS_SELECT_GROUP_2 Enable |
| RAISE ENABLE | When true, this element raises the active setpoint. | RAISE_ENABLE Enable |
| SCL SELECT SECONDARY SETTINGS | When true, this element selects the secondary settings for SCL. | SCL_SELECT_GROUP_2 Enable |
| SOFT START SELECT SECONDARY SETTINGS | When true, this element selects the secondary settings for softstart. | SOFT_START_SELECT_GROUP_2 Enable |
| START ENABLE | When true, this element starts the unit. | START_ENABLE Enable |
| STOP ENABLE | When true, this element stops the unit. | STOP_ENABLE Enable |
| Transfer Watchdog Trip | When true, this element opens the transfer watchdog output. | TransferWatchdogTrip Trip |
| UEL DISABLED IN MANUAL MODE | When true, this element disables UEL when the unit is operating in Manual mode. | UEL_DISABLED_IN_MAN_MODE Enable |
| UEL SELECT SECONDARY SETTINGS | When true, this element selects secondary settings for UEL. | UEL_SELECT_GROUP_2 Enable |
| USER PROGRAMMABLE ALARM 1 - 16 | When true, this element triggers a programmable alarm. | USERALM1 Programmable Alarm 1 Name Trigger |

| Name | Description | Symbol |
|--|---|---|
| VAR LIMITER SELECT SECONDARY SETTINGS | When true, this elements selects the secondary settings on the Var limiter. | VAR_LIM_SELECT_GROUP_2  |
| VAR/PF MODE | The var input selects var control and the PF input selects power factor control. | VAR_PF_MODE  |
| VAR/PF SELECT ENABLE | When true, this element allows the selection of Var and PF. | VAR_PF_SELECT_ENABLE  |
| VOLTAGE MATCHING DISABLE | When true, this element disables voltage matching when the unit is operating in AVR mode. | VOLT_MATCH_DISABLE  |

Logic Schemes

A logic scheme is a group of logic variables written in equation form that defines the operation of a DECS-250N Digital Excitation System. Each logic scheme is given a unique name. This gives you the ability to select a specific scheme and be confident that the selected scheme is in operation. One logic scheme is configured for a typical protection and control application of a synchronous generator and is the default active logic scheme. Only one logic scheme can be active at a given time. In most applications, preprogrammed logic schemes eliminate the need for custom programming. Preprogrammed logic schemes may provide more inputs, outputs, or features than are needed for a particular application. This is because a preprogrammed scheme is designed for a large number of applications with no special programming required. Unneeded logic block outputs may be left open to disable a function or a function block can be disabled through operating settings.

When a custom logic scheme is required, programming time is reduced by modifying the default logic scheme.

The Active Logic Scheme

The DECS-250N must have an active logic scheme in order to function. All DECS-250N controllers are delivered with a default, active logic scheme preloaded in memory. The functionality of this logic scheme is similar to the scheme provided with the DECS-200N. If the function block configuration and output logic of the default logic scheme meet the requirements of your application, then only the operating settings (system parameters and threshold settings) need to be adjusted before placing the DECS-250N in service.

Sending and Retrieving Logic Schemes

Retrieving a Logic Scheme from the DECS-250N

To retrieve settings from the DECS-250N, the DECS-250N must be connected to a computer through a communications port. Once the necessary connections are made, settings can be downloaded from the DECS-250N by selecting *Download Settings and Logic* on the *Communication* pull-down menu.

Sending a Logic Scheme to the DECS-250N

To send settings to the DECS-250N, the DECS-250N must be connected to a computer through a communications port. Once the necessary connections are made, settings can be uploaded to the DECS-250N by selecting *Upload Settings and Logic* on the *Communication* pull-down menu.

Caution

Always remove the DECS-250N from service prior to changing or modifying the active logic scheme. Attempting to modify a logic scheme while the DECS-250N is in service could generate unexpected or unwanted outputs.

Modifying a logic scheme in *BESTCOMSPlus* does not automatically make that scheme active in the DECS-250N. The modified scheme must be uploaded into the DECS-250N. See the paragraphs on *Sending and Retrieving Logic Schemes* above.

Default Logic Schemes

The default logic scheme for PSS-disabled systems is shown in Figure 125 through Figure 127 and the default logic scheme for PSS-enabled systems is shown in Figure 128 through Figure 131.

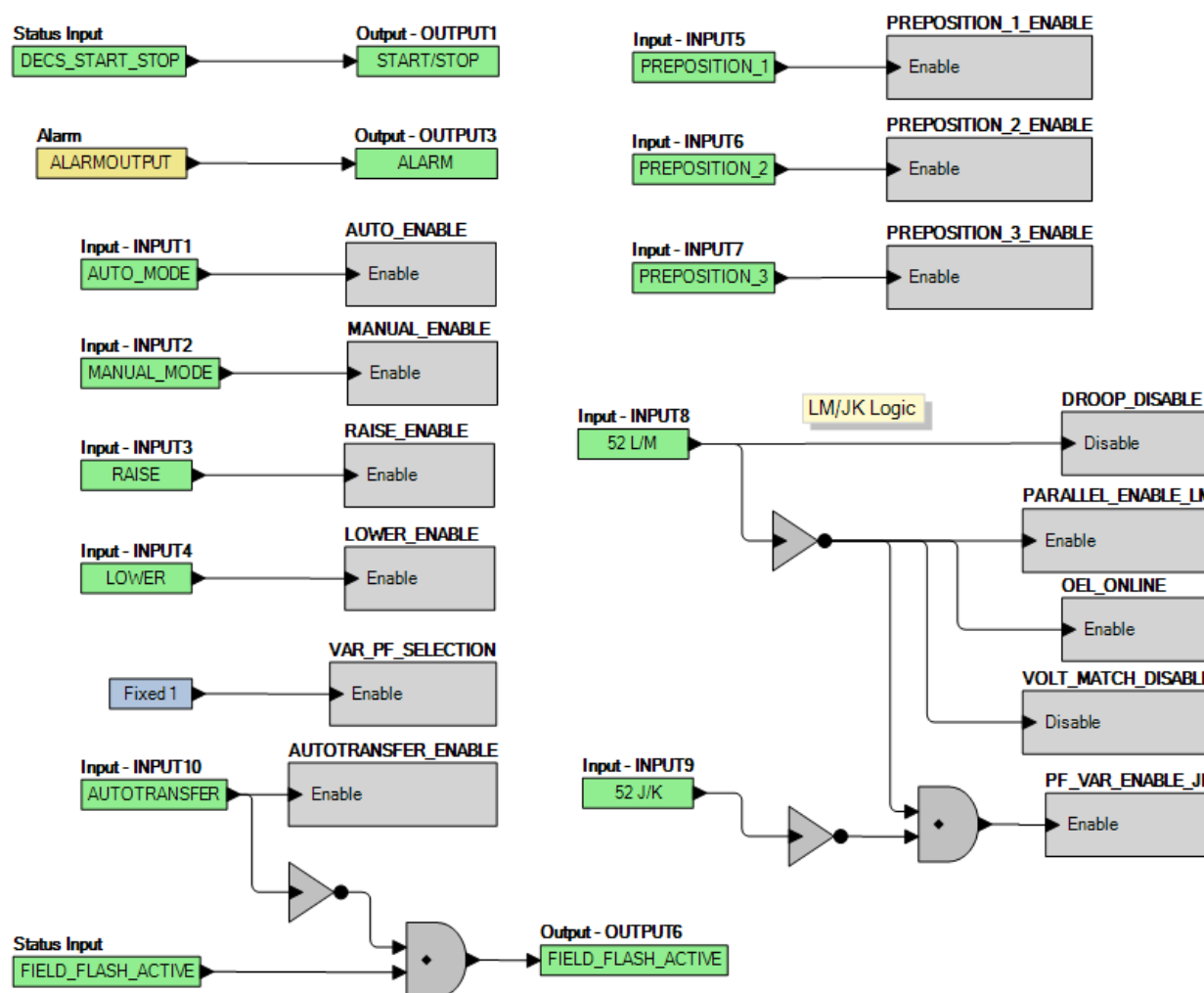


Figure 125. PSS-Disabled Default Logic – Logic Page 1 Tab

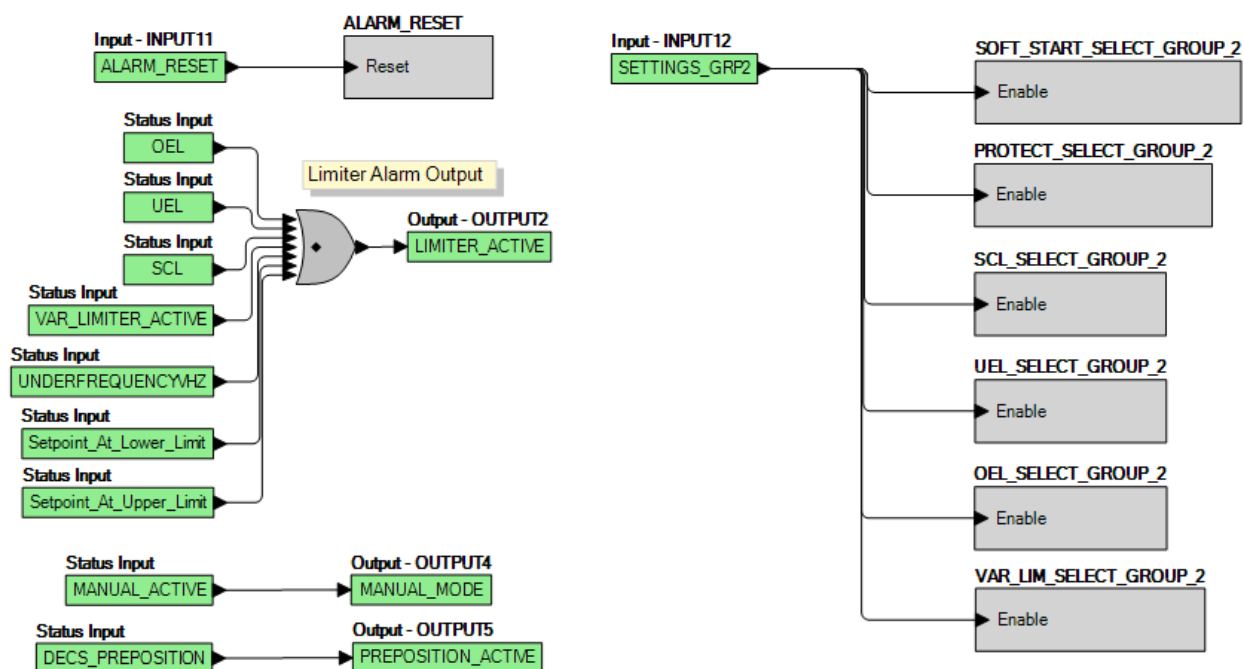


Figure 126. PSS-Disabled Default Logic - Logic Page 2 Tab

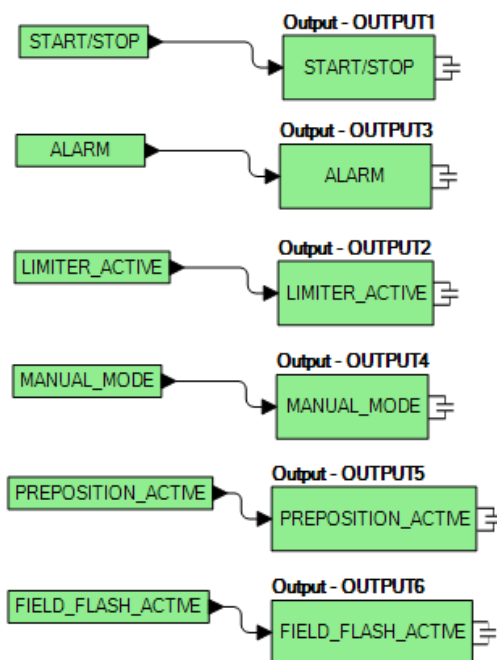


Figure 127. PSS-Disabled Default Logic - Physical Outputs Tab

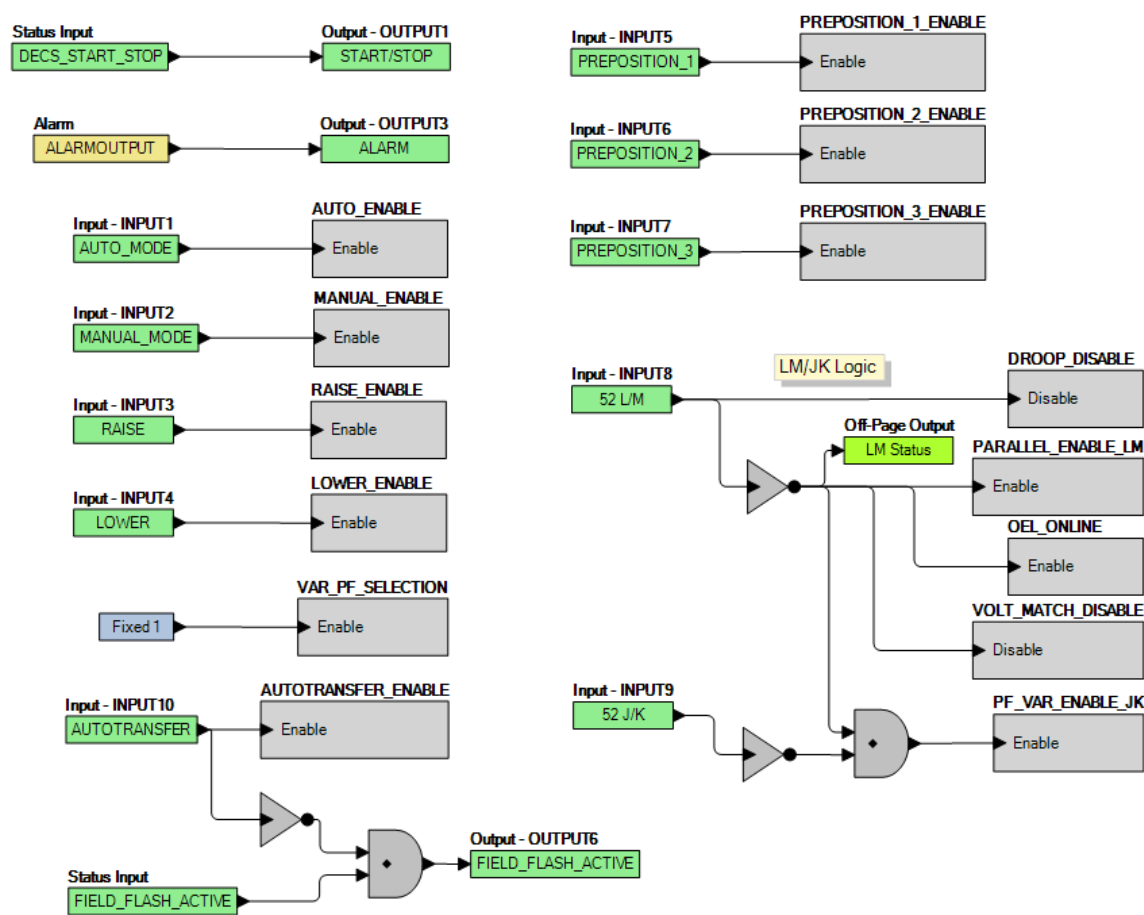


Figure 128. PSS-Enabled Default Logic - Logic Page 1 Tab

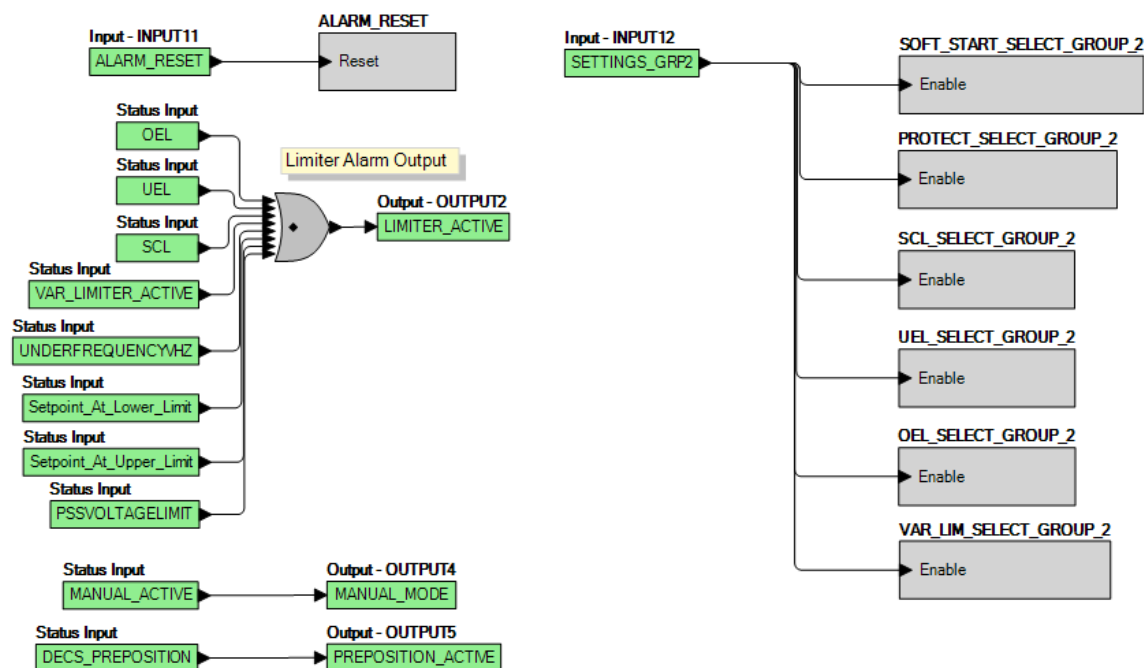


Figure 129. PSS-Enabled Default Logic - Logic Page 2 Tab

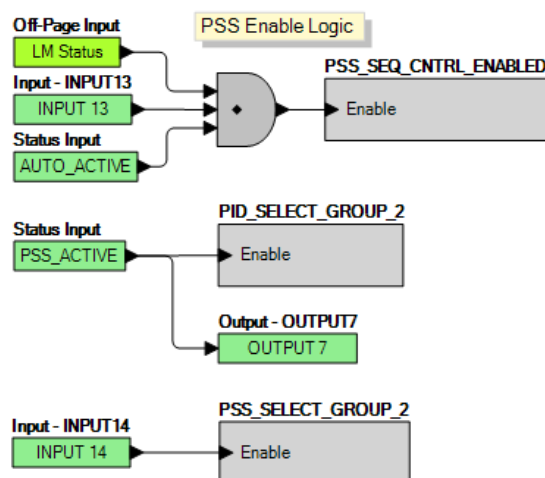


Figure 130. PSS-Enabled Default Logic – Logic Page 3 Tab

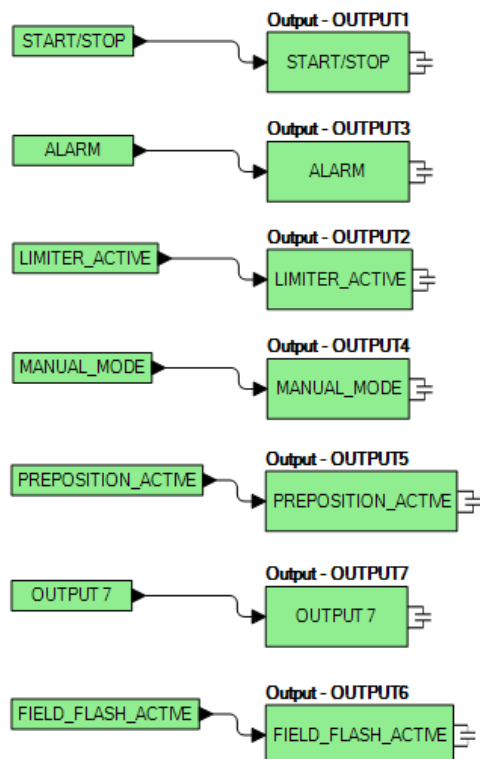


Figure 131. PSS-Enabled Default Logic - Physical Outputs Tab

Programming BESTlogic™ Plus

Use BESTCOMS*Plus* to program BESTlogic*Plus*. Using BESTlogic*Plus* is analogous to physically attaching wire between discrete DECS-250N terminals. To program BESTlogic*Plus*, use the Settings Explorer within BESTCOMS*Plus* to open the *BESTlogicPlus Programmable Logic* tree branch as shown in Figure 124.

The drag and drop method is used to connect a variable or series of variables to the logic inputs, outputs, components, and elements. To draw a wire/link from port to port (triangles), click the left mouse button on a port, pull the wire onto another port, and release the left mouse button. A red port indicates that a

connection to the port is required or missing. A black port indicates that a connection to the port is not required. Drawing wires/links from input to input or output to output is not allowed. Only one wire/link can be connected to any one output. If the proximity of the endpoint of the wire/link is not exact, it may attach to an unintended port.

If an object or element is disabled, it will have a yellow X on it. To enable the element, navigate to the settings page for that element. A red X indicates that an object or element is not available per the style number of the DECS-250N.

The view of the Main Logic and Physical Outputs can be automatically arranged by clicking the right mouse button on the window and selecting *Auto-Layout*.

The following must be met before BESTCOMS*Plus* will allow logic to be uploaded to the DECS-250N:

- A minimum of two inputs and a maximum of 32 inputs on any multi-port (AND, OR, NAND, NOR, XOR, and XNOR) gate.
- A maximum of 32 logic levels for any particular path. A path being an input block or an output side of an element block through gates to an output block or an input side of an element block. This is to include any OR gates on the Physical Outputs page, but not the matched pairs of Physical Outputs blocks.
- A maximum of 256 gates per logic level with a maximum of 256 gates allowed per diagram. All output blocks and input sides of element blocks are at the maximum logic level of the diagram. All gates are pushed forward/upwards in logic levels and buffered to reach the final output block or element block if needed.

Three status LEDs are located in the lower right corner of the BESTlogic*Plus* window. These LEDs show the *Logic Save Status*, *Logic Diagram Status*, and *Logic Layer Status*. Table 15 defines the colors for each LED.

Table 15. Status LEDs

| LED | Color | Definition |
|--------------------------------------|----------|--|
| Logic Save Status (Left LED) | ● Orange | Logic has changed since last save. |
| | ● Green | Logic has NOT changed since last save. |
| Logic Diagram Status (Center LED) | ● Red | Requirements NOT met as listed above. |
| | ● Green | Requirements met as listed above. |
| Logic Layer Status (Right LED) | ● Red | Requirements NOT met as listed above. |
| | ● Green | Requirements met as listed above. |

Pickup and Dropout Timers

A pickup timer produces a TRUE output when the elapsed time is greater than or equal to the Pickup Time setting after a FALSE to TRUE transition occurs on the Initiate input from the connected logic. Whenever the Initiate input status transitions to FALSE, the output transitions to FALSE immediately.

A drop out timer produces a TRUE output when the elapsed time is greater than or equal to the Dropout Time setting after a TRUE to FALSE transition occurs on the Initiate input from the connected logic. Whenever the Initiate input transitions to TRUE, the output transitions to FALSE immediately.

Refer to Figure 132, *Pickup and Dropout Logic Timer Blocks*.

To program logic timer settings, use the Settings Explorer within BESTCOMS*Plus* to open the *BESTlogicPlus Programmable Logic/Logic Timers* tree branch. Enter a *Name* label that you want to appear on the timer logic block. The *Time Delay* value range is 0 to 250 hours in 1 hour increments, 0 to 250 minutes in 1 minute increments, or 0 to 1,800 seconds in 0.1 second increments.

Next, open the *Components* tab inside the BESTlogic*Plus* window and drag a timer onto the program grid. Right click on the timer to select the timer you want to use that was previously set on the *Logic Timers* tree branch. The *Logic Timer Properties Dialog Box* will appear. Select the timer you want to use.

Timing accuracy is ± 15 milliseconds.

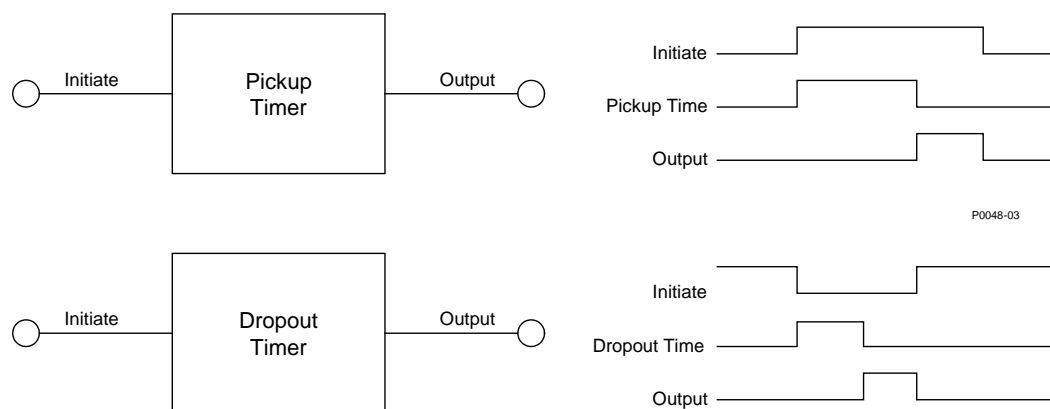


Figure 132. Pickup and Dropout Timer Logic Blocks

Offline Logic Simulator

You can use the offline logic simulator to test your custom logic before placing it in operation. The state of various logic elements can be toggled to verify that the logic states travel through the system as expected.

The offline logic simulator allows you to change the state of various logic elements to illustrate how that state travels through the system. Before running the logic simulator, you must click the Save button on the BESTlogicPlus toolbar to save the logic to memory. Changes to the logic (other than changing the state) are disabled when the simulator is enabled. Colors are selected by clicking the Options button on the BESTlogicPlus toolbar. By default, Logic 0 is red and Logic 1 is green. Using your mouse, double-click on a logic element to change its state.

An example of the offline logic simulator is shown in Figure 133. STOP_ENABLE is Logic 0 (red) when Input 1 is Logic 1 (green), Input 2 is Logic 0 (red), and the inverter is Logic 1 (green).

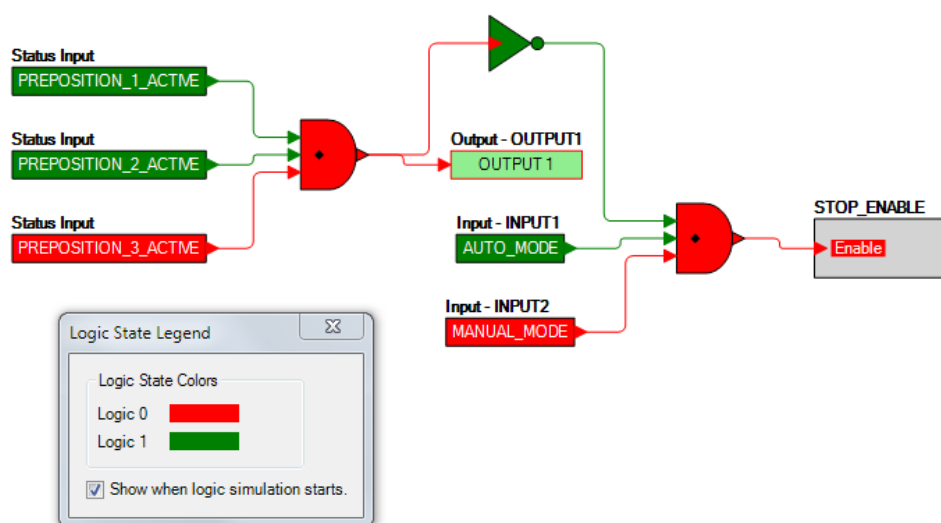


Figure 133. Offline Logic Simulator Example

BESTlogic™Plus File Management

To manage BESTlogicPlus files, use the Settings Explorer to open the *BESTlogicPlus Programmable Logic* tree branch. Use the BESTlogicPlus Programmable Logic toolbar to manage BESTlogicPlus files.

Refer to Figure 134. For information on Settings Files management, refer to the *BESTCOMSPlus Software* chapter.

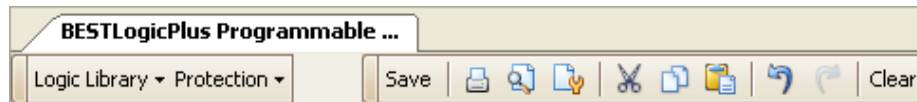


Figure 134. BESTlogicPlus Programmable Logic Toolbar

Saving a BESTlogicPlus File

After programming BESTlogicPlus settings, click on the *Save* button to save the settings to memory.

Before the new BESTlogicPlus settings can be uploaded to the DECS-250N, you must select *Save* from the *File* pull-down menu located at the top of the BESTCOMSPlus main shell. This step will save both the BESTlogicPlus settings and the operating settings to a file.

The user also has the option to save the BESTlogicPlus settings to a unique file that contains only BESTlogicPlus settings. Click on the *Logic Library* drop-down button and select *Save Logic Library File*. Use normal Windows® techniques to browse to the folder where you want to save the file and enter a filename to save as.

Opening a BESTlogicPlus File

To open a saved BESTlogicPlus file, click on the *Logic Library* drop-down button on the BESTlogicPlus Programmable Logic toolbar and select *Open Logic Library File*. Use normal Windows techniques to browse to the folder where the file is located.

Protecting a BESTlogicPlus File

Objects in a logic diagram can be locked so that when the logic document is protected these objects cannot be changed. Locking and protecting is useful when sending logic files to other personnel to be modified. The locked object(s) cannot be changed. To view the lock status of the object(s), select *Show Lock Status* from the *Protection* drop-down menu. To lock object(s), use the mouse to select object(s) to be locked. Right click on the selected object(s) and select *Lock Object(s)*. The gold colored padlock next to the object(s) will change from an open to a locked state. To protect a logic document, select *Protect Logic Document* from the *Protection* drop-down button. Establishing a password is optional.

Uploading a BESTlogicPlus File

To upload a BESTlogicPlus file to the DECS-250N, you must first open the file through BESTCOMSPlus or create the file using BESTCOMSPlus. Then pull down the *Communication* menu and select *Upload Logic*.

Downloading a BESTlogicPlus File

To download a BESTlogicPlus file from the DECS-250N, you must pull down the *Communication* menu and select *Download Settings and Logic from Device*. If the logic in your BESTCOMSPlus has changed, a dialog box will open asking you if want to save the current logic changes. You may choose *Yes* or *No*. After you have taken the required action to save or not save the current logic, the downloading is executed.

Copying and Renaming Preprogrammed Logic Schemes

Copying a saved logic scheme and assigning a unique name is accomplished by first loading the saved logic scheme into BESTCOMSPlus. Click on the *Logic Library* drop-down button and select *Save Logic Library File*. Use normal Windows® techniques to browse to the folder where you want to save the new file and enter a filename to save as. Changes are not activated until the new settings have been saved and uploaded to the device.

Printing a BESTlogicPlus File

To view a preview of the printout, click on the *Print Preview* icon located on the BESTlogicPlus Programmable Logic toolbar. If you wish to print to a printer, select the printer icon in the upper left corner of the *Print Preview* screen.

You may skip the print preview and go directly to print by clicking on the *Printer* icon on the BESTlogicPlus Programmable Logic toolbar. A dialog box, *Select Views to Print* opens allowing you to check which views you would like to print. Next, the *Print* dialog box opens with the typical Windows choice to setup the properties of printer. Execute this command, as necessary, and then select *Print*.

A *Page Setup* icon is also provided on the BESTlogicPlus Programmable Logic toolbar allowing you to select *Paper Size*, *Paper Source*, *Orientation*, and *Margins*.

Clearing the On-Screen Logic Diagram

Click on the *Clear* button to clear the on-screen logic diagram and start over.

BESTlogic™ Plus Examples

Example 1 - GOVR Logic Block Connections

Figure 135 illustrates the GOVR logic block and two output logic blocks. Output 6 is active while the governor is being raised and Output 9 is active while the governor is being lowered.

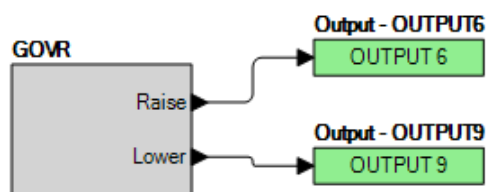


Figure 135. Example 1 - GOVR Logic Block Connections

Example 2 - AND Gate Connections

Figure 136 illustrates a typical AND gate connection. In this example, Output 11 will become active when the bus and the generator are dead.

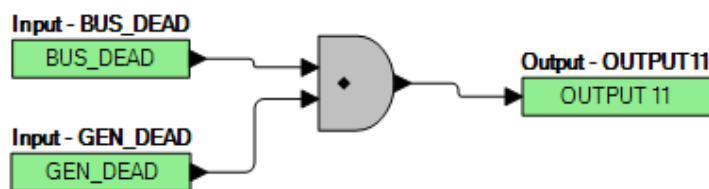


Figure 136. Example 2 - AND Gate Connections

Communication

Local Communication

A type B, USB port connects the DECS-250N with a PC operating BESTCOMSP[®] for local, short-term communication. This mode of communication is useful for settings configuration and system commissioning. The USB port is located on the front panel and illustrated in the *Controls and Indicators* chapter of this manual. A USB device driver for the DECS-250N is automatically installed on your PC during the installation of BESTCOMSP[®]. Information about establishing communication between BESTCOMSP[®] and the DECS-250N is provided in the *BESTCOMSP[®] Software* chapter of this manual.

Caution

In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.

Communication with a Second DECS

BESTCOMSP[®] Navigation Path: Settings Explorer, Communications, RS232 Setup

HMI Navigation Path: Settings, Communications, RS232 Setup.

Communication with a second DECS enables regulation setpoint tracking to occur in a dual, or redundant, DECS application. External setpoint tracking is possible between a DECS-250N and second DECS-250N or a DECS-250N and DECS-200N.

All DECS controllers mentioned here use a female DB-9 (RS-232) connector for communication with a second DECS. On the DECS-250N, this connector is located on the right side panel and is illustrated in the *Terminals and Connectors* chapter of this manual. A five-foot (1.5 meter) cable, part number 9310300032, is available for interconnecting two DECS controllers.

RS-232 port communication settings are illustrated in Figure 137 and consist of the baud rate^A, number of bits per character^B, parity^C, and the number of stop bits^D. When connecting the DECS-250N to a DECS-200N, you must ensure that the communication settings of the DECS-200N match those of the DECS-250N.

RS232 Setup

Communication Settings

Baud Rate: 19200 Baud (A)

Bits Per Char: 8 bits/character (B)

Parity: No Parity (C)

Stop Bits: 1 stop bit (D)

Figure 137. RS232 Setup

^A **Baud Rate:** Select 4800, 9600, 19200, 38400, 57600, or 115200.

^B **Bits Per Char:** Select 7 or 8 bits/character.

^C **Parity:** Select Even, Odd, or No parity.

^D **Stop Bits:** Select 1 or 2 stop bits.

Modbus™ Communication

BESTCOMSPlus Navigation Path: Settings Explorer, Communications, Modbus Setup

HMI Navigation Path: Not available through HMI.

DECS-250N systems support the RS-485 mode and Modbus/TCP (Ethernet) mode at the same time. DECS-250N Modbus communication registers are listed and defined in the *Modbus Communication* chapter of this manual.

Modbus settings for RS-485 and Ethernet are illustrated in Figure 138 and consist of RS-485 Unit ID^A, RS-485 Response Delay^B, and Ethernet Unit ID^C.

The figure shows a 'Modbus Setup' window with two panels. The 'RS485 Settings' panel on the left contains a 'Unit ID' field with the value '1' and a label 'A' to its right, and a 'Response Delay (ms)' field with the value '10' and a label 'B' to its right. The 'Ethernet Settings' panel on the right contains a 'Unit ID' field with the value '1' and a label 'C' to its right.

Figure 138. Modbus Setup

^A RS-485 Unit ID: Adjustable from 1 to 247 in increments of 1.

^B RS-485 Response Delay: Adjustable from 10 to 10,000 ms in 10 ms increments.

^C Ethernet Unit ID: Adjustable from 1 to 247 in increments of 1.

RS-485 Port

BESTCOMSPlus Navigation Path: Settings Explorer, Communications, RS-485 Setup

HMI Navigation Path: Settings, Communications, RS-485 Setup

An RS-485 port uses the Modbus RTU (remote terminal unit) protocol for polled communication with other networked devices or remote annunciation and control with an IDP-800 Interactive Display Panel. RS-485 port terminals are located on the left side panel and are identified as RS-485 A, B, and C. Terminal A serves as the send/receive A terminal, terminal B serves as the send/receive B terminal, and terminal C serves as the signal ground terminal. Figure 139 illustrates typical RS-485 connections for multiple DECS-250N controllers communicating over a Modbus network.

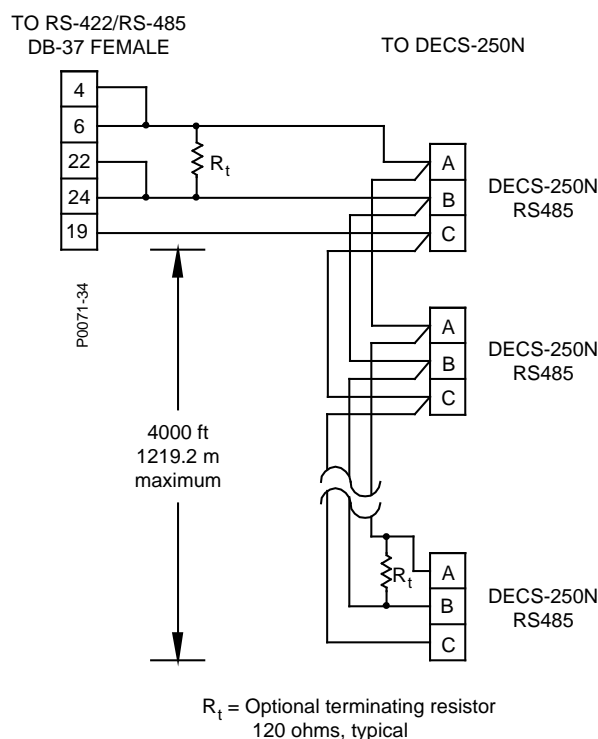


Figure 139. Typical RS-485 Connections

RS-485 port communication settings are illustrated in Figure 140 and consist of the baud rate^A, number of bits per character^B, parity^C, and the number of stop bits^D.

RS485 Setup

Communication Settings

Baud Rate
19200 Baud A

Bits Per Char
8 bits/character B

Parity
No Parity C

Stop Bits
1 stop bit D

Figure 140. RS-485 Port Communication Settings

^A **Baud Rate:** Select 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

^B **Bits Per Char:** Select 7 or 8 bits/character.

^C **Parity:** Select Even, Odd, or No parity.

^D **Stop Bits:** Select 1 or 2 stop bits.

Ethernet Port

An Ethernet port uses the Modbus/TCP protocol for polled communication with other networked devices or remote annunciation and control with an IDP-800 Interactive Display Panel.

CAN Communication

BESTCOMSPlus Navigation Path: Settings Explorer, Communications, CAN Bus, CAN Bus Setup

HMI Navigation Path: Settings, Communications, CAN Bus, CAN Bus Setup

One CAN (controller area network) interface (CAN 1) facilitates communication between the DECS-250N and optional modules such as the contact expansion module (CEM-2020) and analog expansion module (AEM-2020).

A second CAN interface (CAN 2) enables the DECS-250N to provide generator and system parameters to a generator controller such as the Basler DGC-2020. CAN 2 also permits DECS-250N setpoint and mode control from an external device connected to the CAN.

Both CAN bus interfaces utilize the SAE J1939 messaging protocol.

DECS-250N CAN parameters are listed and defined in the *CAN Communication* chapter of this manual.

Connections

DECS-250N CAN connections should be made with twisted-pair, shielded cable. Each CAN port (designated CAN 1 and CAN 2) has a CAN high (H) terminal, a CAN low (L) terminal, and a CAN drain (SH) terminal. CAN port terminals are illustrated in the *Terminals and Connectors* chapter of this manual.

Port Configuration

Each DECS-250N CAN port must be identified by a unique address number^A. The baud rate^B of each port can be configured for 125 kbps or 250 kbps. Port configuration settings are illustrated in Figure 141.

Figure 141. CAN Port Configuration Settings

^A CAN bus Address: Adjustable from 1 to 253.

^B Baud Rate: Select 125 kbps or 250 kbps.

Remote Module Setup

BESTCOMSPlus Navigation Path: Settings Explorer, Communications, CAN Bus, Remote Module Setup

HMI Navigation Path: Settings, Communications, CAN Bus, Remote Module Setup

Optional, external modules, such as the contact expansion module (CEM-2020) and analog expansion module (AEM-2020), communicate via the DECS-250N CAN 1 interface and are configured through the DECS-250N BESTCOMSPlus interface. These settings are illustrated in Figure 142.

Contact Expansion Module

When enabled^A for operation, the CEM-2020 CAN address^B is assigned a unique number and the number of outputs^C is selected. Standard module (CEM-2020) provides 24 output contacts and high-current module (CEM-2020H) provides 18 output contacts.

Analog Expansion Module

When enabled^D for operation, the AEM-2020 CAN address^E is assigned a unique address for communication on the network.

Figure 142. Remote Module Setup

- ^A *Contact Expansion Module Enable/Disable*: Select Enabled or Disabled.
- ^B *CEM J1939 Address*: Adjustable from 1 to 253.
- ^C *CEM Outputs*: Select 18 Outputs (CEM-2020H) or 24 Outputs (CEM-2020).
- ^D *Analog Expansion Module Enable/Disable*: Select Enabled or Disabled.
- ^E *AEM J1939 Address*: Adjustable from 1 to 253.

Ethernet Communication

Depending upon the style number, each DECS-250N is equipped with a copper (100Base-T) Ethernet communication port (style xxxxx1x) or a fiber optic (100Base-FX) Ethernet communication port (style xxxxx2x). The copper or fiber optic Ethernet connector is located on the right side panel. DECS-250N metering, annunciation, and control is provided through the Ethernet port using the Modbus TCP protocol. DECS-250N Modbus communication registers are listed and defined in the *Modbus Communication* chapter of this manual.

Note

Industrial Ethernet devices designed to comply with IEC 61000-4 series of specifications are recommended.

Ethernet Connection

1. Connect the DECS-250N to the PC using a standard Ethernet cable.
2. In *BESTCOMSPlus*, click *Communication*, *New Connection*, *DECS-250N*, or click the *Connection* button on the lower menu bar. The DECS-250 Connection window appears. (Figure 143)
3. If you know the IP address of the DECS-250N, click the radio button for the Ethernet Connection IP at the top of the DECS-250N Connection window, enter the address into the fields and click the *Connect* button.
4. If you don't know the IP address, you can perform a scan (Figure 144) to search for all connected devices by clicking the *Ethernet* button in the Device Discovery box. After the scan is complete, a window containing the connected devices will be displayed. (Figure 145)

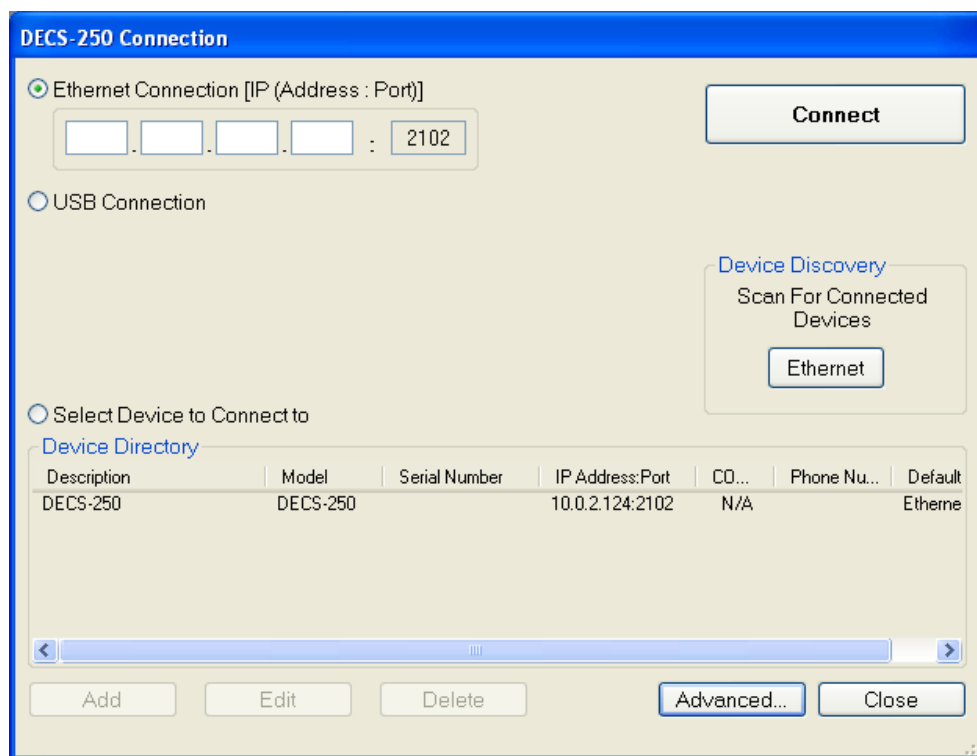


Figure 143. DECS-250 Connection Window

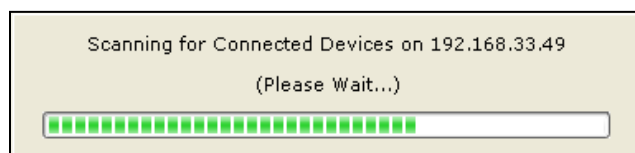


Figure 144. Scanning for Connected Devices

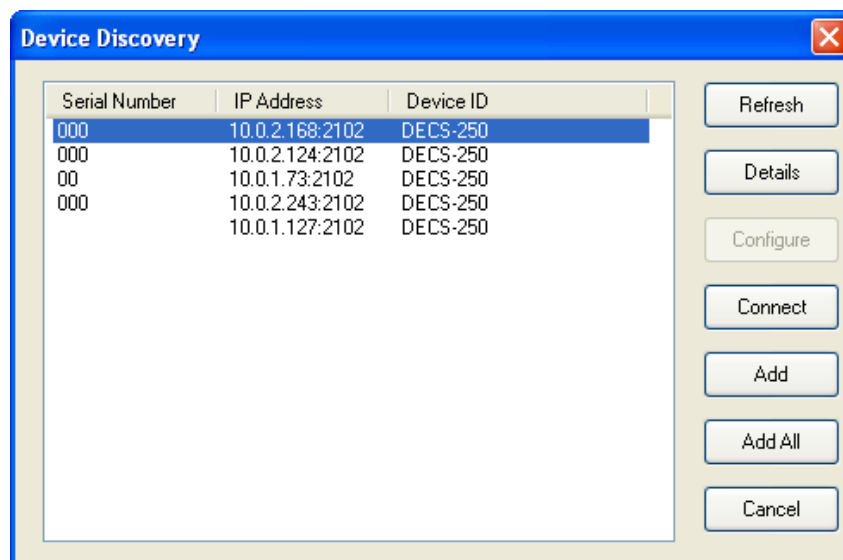


Figure 145. Device Discovery Window

5. At this point you can also add any or all of the detected devices to the Device Directory. This prevents the need to scan for connected devices each time a connection is desired. Simply select a device from the list and click *Add*. Clicking *Add All* will add all detected devices from the list to the Device Directory. The Device Directory stores the name, model, and address of devices you have added. Click the radio button for *Select Device to Connect to*, select the device from the Device Directory list, and click the *Connect* button at the top of the DECS-250N Connection window.
6. Choose the desired device from the list and click *Connect*. Wait for connection to complete (Figure 146).



Figure 146. Waiting for Connection

7. The *Advanced* button displays the following window. It contains options for enabling Auto Reconnect, the delay between retries (in milliseconds), and the maximum number of attempts. (Figure 147)

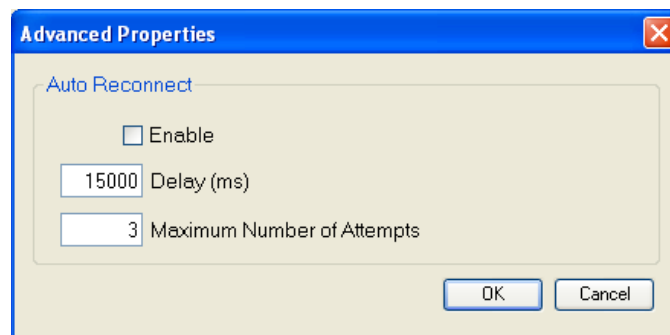


Figure 147. Advanced Properties, Auto Reconnect

Note

The PC running BESTCOMS*Plus* software must be configured correctly to communicate with the DECS-250N. The PC must have an IP address in the same subnet range as the DECS-250N if the DECS-250N is operating on a private, local network.

Otherwise, the PC must have a valid IP address with access to the network and the DECS-250N must be connected to a properly configured router. The network settings of the PC depend on the operating system installed. Refer to the operating system manual for instructions.

On most Microsoft Windows based PCs, the network settings can be accessed through the *Network Connections* icon located inside the Control Panel.

PROFIBUS Communication

BESTCOMSPlus Navigation Path: Settings Explorer, Communications, Profibus Setup

HMI Navigation Path: Settings, Communications, Profibus

On units equipped with the PROFIBUS communication protocol (style xxxxxxP), the DECS-250N sends and receives PROFIBUS data through a DB-9 port located on the right side panel. DECS-250N PROFIBUS communication parameters are listed and defined in the *PROFIBUS Communication* chapter of this manual.

DB-9 port communication settings are illustrated in Figure 148 and consist of the address^A and network byte order^B.



Figure 148. Profibus Setup

^A Address: Adjustable from 0 to 126 in increments of 1.

^B Network Byte Order: MSB First or LSB First.

Configuration

Before the DECS-250N is placed in service, it must be configured for the controlled equipment and application.

Generator, Field, and Bus Ratings

BESTCOMSPlus Navigation Path: Settings Explorer, System Parameters, Rated Data

HMI Navigation Path: Settings, System Parameters, Rated Data

Generator, field, and bus rating settings are illustrated in Figure 149.

For proper excitation control and protection, the DECS-250N must be configured with the ratings of the controlled generator and field. These ratings are typically shown on the generator nameplate or can be obtained from the generator manufacturer. Required generator ratings include the voltage^A, frequency^B, power factor^C, and apparent power^D (kVA). Generator current^E, real power^F (kW), and reactive power (kvar)^G are listed with the other generator ratings as read-only settings. These values are automatically calculated from the other generator ratings entered by the user. Required field ratings include the no load dc voltage^H and current^I and full load voltage^J and current^K.

The ratio^L of exciter poles to generator poles is used by the exciter diode monitor (EDM) function to detect open and shorted exciter diodes. The calculated value can be entered directly or calculated using the pole calculator^M. A minimum ratio of 1.5 is recommended to ensure consistent EDM operation.

In applications where the generator will be synchronized/paralleled with a bus, the DECS-250N must be configured with the rated bus voltage^N.

The nominal operating power input voltage^O is used to calculate the recommended Ka (Loop Gain) value. This value is also used in metering calculations.

When using the DECS-250N with an exciter requiring an inverted output, check this box^P to enable the inverting of the DECS-250N control output.

Caution

Enabling inverted bridge output with an exciter which does not require inverted bridge output will result in equipment damage.

Rated Data

| Generator Rated Data | Field Rated Data | Pole Ratio | Bus Rated Data | Operating Power Input |
|-------------------------------|--|------------------------|------------------------|--------------------------------------|
| Voltage (V) 120 [A] | Voltage - Full Load (V) 63.0 [J] | Pole Ratio 0.00 [L] | Voltage (V) 120 [N] | Power Input Voltage (V) 240.0 [O] |
| Current (A) 200.0 [E] | Current - Full Load (A) 5.0 [K] | [Calculator] [M] | | |
| Frequency 60 Hz [B] | Voltage - No Load (V) 32.0 [H] | | | |
| PF (Power Factor) 0.80 [C] | Current - No Load (A) 5.0 [I] | | | |
| Rating (kVA) 41.57 [D] | Bridge Output <input type="checkbox"/> Inverter for SCT/PPT [P] | | | |
| Rating (kW) 33.26 [F] | | | | |
| Rating (kvar) 24.94 [G] | | | | |

Figure 149. Generator, Bus, Field, and Pole Ratio Ratings

- ^A *Generator Voltage Rating*: Adjustable from 1 to 500,000 Vac in 1 Vac increments.
- ^B *Generator Frequency Rating*: Select 50 or 60 Hz.
- ^C *Generator PF (Power Factor)*: Adjustable from –0.5 to 0.5 in 0.001 increments.
- ^D *Generator Voltamperes*: Adjustable from 0 to 1,000,000 kVA in 0.01 kVA increments.
- ^E *Generator Current*: Read-only value calculated from the generator VA and voltage.
- ^F *Generator Power*: Read-only value calculated from the generator voltage, current, and PF.
- ^G *Generator Reactive Power*: Read-only value calculated from the generator VA and PF.
- ^H *Field Voltage No Load*: Adjustable from 1 to 264 Vdc in 0.1 Vdc increments.
- ^I *Field Current No Load*: Adjustable from 0.1 to 20 Adc in 0.1 Adc increments.
- ^J *Field Voltage Full Load*: Adjustable from 1 to 264 Vdc in 0.1 Vdc increments.
- ^K *Field Current Full Load*: Adjustable from 0.1 to 20 Adc in 0.1 Adc increments.
- ^L *Pole Ratio*: Adjustable from 0 to 10 in 0.01 increments.
- ^M *Calculator*: Choose number of exciter and generator poles to calculate pole ratio.
- ^N *Bus Voltage*: Adjustable from 1 to 500,000 Vac in 1 Vac increments.
- ^O *Power Input Voltage*: Adjustable from 1 to 480 V in .01 increments.
- ^P *Inverted Output*: Check box to enable inversion, uncheck to disable inversion.

Sensing Transformer Ratings and Configuration

BESTCOMSPlus Navigation Path: Settings Explorer, System Parameters, Sensing Transformers

HMI Navigation Path: Settings, System Parameters, Sensing Transformers

DECS-250N configuration includes entry of the primary and secondary values for the transformers that supply generator and bus sensing values to the DECS-250N. These configuration settings are illustrated in Figure 150.

Generator PT

Voltage settings for the generator PT primary^A and secondary^B windings establish the nominal PT voltages expected by the DECS-250N. ABC or ACB phase rotation^C can be accommodated. Options for the generator voltage sensing connections^D include single-phase (across phases C and A) and three-phase sensing using three-wire connections.

Generator CTs

Current settings for the generator CT primary^E and secondary^F windings establish the nominal CT current values expected by the DECS-250N. DECS-250N sensing current can be obtained from a single phase or all three generator phases^G.

Bus PT

Voltage settings for the bus PT primary^H and secondary^I windings establish the nominal bus PT voltages expected by the DECS-250N. Options for the bus voltage sensing connections^J include single-phase (across phases A and C) and three-phase sensing using three-wire delta connections.

Sensing Transformers

Generator PT
 Primary Voltage: 120 [A]
 Secondary Voltage: 120 [B]

Generator CT
 Primary Current: 200 [E]
 Secondary Current: 5A [F]

Bus PT
 Primary Voltage: 120 [H]
 Secondary Voltage: 120 [I]

Sensing Configuration
 Phase Rotation: ABC [C]
 Generator Voltage: 3W-D [D]
 Phase Connection: CT_ABC [G]
 Bus Voltage: 3W-D [J]

Figure 150. Sensing Transformer Ratings and Configuration

- ^A *Generator PT Primary Voltage*: Adjustable from 1 to 500,000 Vac in 1 Vac increments.
- ^B *Generator PT Secondary Voltage*: Adjustable from 1 to 600 Vac in 1 Vac increments.
- ^C *Generator PT Phase Rotation*: Select ABC or ACB rotation.
- ^D *Generator Voltage Connections*: Select CA or 3W-D.
- ^E *Generator CT Primary Current*: Adjustable from 1 to 99,999 Aac in 1 Aac increments.
- ^F *Generator CT Secondary Current*: Select 1 or 5 Aac.
- ^G *Generator CT Configuration*: Select B or CT_ABC.
- ^H *Bus PT Primary Voltage*: Adjustable from 1 to 500,000 Vac in 1 Vac increments.
- ^I *Bus PT Secondary Voltage*: Adjustable from 1 to 600 Vac in 1 Vac increments.
- ^J *Bus Voltage Sensing Connections*: Select CA or 3W-D.

Bridge Operating Power Configuration

BESTCOMSPlus Navigation Path: Settings Explorer, System Parameters, Bridge

HMI Navigation Path: Settings, System Parameters, Bridge

DECS-250N bridge operating power configuration includes selection of the input voltage range and mode of operation. These settings are illustrated in Figure 151.

Operating Power Input

AC voltage range^A settings for bridge operating power establish the values expected by the DECS-250N.

Modes of Operation

Firing Pulse Mode

Firing Pulse Mode^B settings for the bridge operating power establish the number of phases expected by the DECS-250N.

Single-Phase Selection

Single-phase^C settings establish which pair of phases the DECS-250N expects to supply bridge operating power. This option is disabled when *Three Phase* is the selected firing pulse mode.

Rated Frequency

A Rated Frequency^D setting establishes the rated operating power frequency to be expected by the DECS-250N.

Maximum Over-Speed

The Maximum Over-Speed^E setting establishes the maximum frequency to be expected by the DECS-250N during an over-speed condition.

Figure 151. Bridge Operating Power Configuration

^A *Voltage*: Select 100-139 or 190-277.

^B *Firing Pulse Mode*: Select Single Phase or Three Phase

^C *Single Phase Selection*: Select A-B, B-C, or A-C.

^D *Rated Frequency*: Adjustable from 20 to 60 Hz, or 61 to 420 Hz in 1 Hz increments depending on style.

^E *Maximum Over-Speed*: Adjustable from 50 to 320% in 1% increments.

Startup Functions

BESTCOMSPlus Navigation Path: Settings Explorer, Operating Settings, Startup

HMI Navigation Path: Settings, Operating Settings, Startup

DECS-250N startup functions consist of soft start and field flashing. These settings are illustrated in Figure 152.

Soft Start

During startup, the soft start function prevents voltage overshoot by controlling the rate of generator terminal voltage buildup (toward the setpoint). Soft start is active in AVR, FCR, and FVR regulation modes. Soft start behavior is based on two parameters: level and time. The soft start level^A is expressed as a percentage of the nominal generator terminal voltage and determines the starting point for generator voltage buildup during startup. The soft start time^B defines the amount of time allowed for the buildup of generator voltage during startup. Two groups of soft start settings (primary and secondary) provide for independent startup behavior which is selectable through BESTlogic™ Plus.

Field Flashing

To ensure generator voltage buildup, the field flashing function applies and removes flashing power from an external field flashing source. Field flashing is active in AVR, FCR, and FVR control modes. During system startup, the application of field flashing is based on two parameters: level and time.

The field flash dropout level^C determines the level of generator voltage where field flashing is withdrawn. In AVR mode, the field flash dropout level is expressed as a percentage of the generator terminal voltage. In FCR mode, the level is expressed as a percentage of the field current. And in FVR mode, the level is expressed as a percentage of the field voltage.

The field flash time^D defines the maximum length of time that field flashing may be applied during startup.

To use the field flashing function, one of the DECS-250N programmable contact outputs must be configured as a field flashing output.

Figure 152. Startup Function Settings

^A Soft Start Level (%): Adjustable from 0 to 90% in 1% increments.

^B Soft Start Time (s): Adjustable from 1 to 7,200 seconds in 1 second increments.

^C Field Flash Dropout Level: Adjustable from 0 to 100% in 1% increments.

^D Maximum Field Flash Time: Adjustable from 1 to 50 seconds in 1 second increments.

Device Information

BESTCOMSPlus Navigation Path: Settings Explorer, General Settings, Device Info

HMI Navigation Path: Settings, General Settings, Device Information, DECS-250N

Device information includes user-assigned identification labeling and read-only firmware version information and product information. Device information (Figure 153) is provided for the DECS-250N, CEM-2020 Contact Expansion Module, and AEM-2020 Analog Expansion Module.

Firmware and Product Information

Firmware and product information can be viewed on the HMI display and Device Info tab of BESTCOMSPlus®.

Firmware Information

Firmware information is provided for the DECS-250N, optional CEM-2020, and optional AEM-2020. This information includes the application part number^A, version number^B, and build date^C. Also included is the version of the boot code^D. When configuring settings in BESTCOMSPlus while disconnected from a DECS-250N, an Application Version Number setting^E is available to ensure compatibility between the selected settings and the actual settings available in the DECS-250N.

Product Information

Product information for the DECS-250N, CEM-2020, and AEM-2020 includes the device model number^F and serial number^G.

Device Identification

The user-assigned *Device ID*^H can be used to identify DECS-250N controllers in reports and during polling.

Device Info

Application Version Number: [E]

Application Part Number: [A]

Application Version: [B]

Model Number: [F]

Boot Code Version: [D]

Application Build Date: [C]

Serial Number: [G]

Identification

Device ID: [H]

Contact Expansion Module

Application Version: [B]

Serial Number: [G]

Boot Code Version: [D]

Application Part Number: [A]

Application Build Date: [C]

Model Number: [F]

Analog Expansion Module

Application Version: [B]

Serial Number: [G]

Boot Code Version: [D]

Application Part Number: [A]

Application Build Date: [C]

Model Number: [F]

Figure 153. Device Information

- ^A *Application Part Number*: Read-only field indicates the firmware file part number.
- ^B *Application Version*: Read-only field indicates the firmware version number.
- ^C *Application Build Date*: Read-only field indicates the release date of the device firmware.
- ^D *Boot Code Version*: Read-only field indicates the version of hardware boot code.
- ^E *Application Version Number*: When configuring settings offline, select the appropriate firmware version to ensure settings/features compatibility with the DECS-250N.
- ^F *Model Number*: Read-only field displays the product model number.
- ^G *Serial Number*: Read-only field displays the serial number of the product.
- ^H *Device ID*: Enter up to 60 alphanumeric characters.

Display Units

BESTCOMSPlus Navigation Path: General Settings, Display Units

HMI Navigation Path: N/A

When working with DECS-250N settings in BESTCOMSPlus, you have the option of viewing the settings in English or Metric^A units and as primary units or per-unit values^B. When per-unit values are selected, settings are entered as per-unit values and BESTCOMSPlus converts the per-unit inputs to high-side values based on the generator rated data. The *display units* setting is illustrated in Figure 154 and is not available for settings shown on the front panel display.

Display Units

System Units

System Units

English ▼ A

Settings Display Modes

Thresholds

Primary Units ▼ B

* BESTCOMSPlus® Only

Figure 154. Display Units

^A *System Units*: Select English or Metric

^B *Thresholds*: Select Primary Units or Per Unit.



Security

DECS-250N security is provided in the form of passwords which control the type of operations allowed by a particular user. Passwords can be tailored to provide access to specific operations. Additional security is available by controlling the type of operations allowed through certain DECS-250N communication ports.

Security settings are uploaded and downloaded separately from the settings and logic. See the *BESTCOMSPlus*® chapter for more information on uploading and downloading security.

Password Access

BESTCOMSPlus Navigation Path: Settings Explorer, General Settings, Device Security Setup, User Name Setup

A username and password can be established for one of six functional access areas within the DECS-250N. These access areas are listed in Table 16 according to rank. A username and password with higher access can be used to gain access to operations controlled by a password with lower access. For example, a settings-level username and password has access to operations protected by the settings-, operator-, control-, and read-level usernames and passwords. This screen cannot be accessed when in Live Mode.

Table 16. Password Access Levels and Descriptions

| Access Level | Description |
|--------------|---|
| Admin (1) | Access to security setup, communications settings, and software upgrades. Includes levels 2, 3, 4, 5, and 6 below. |
| Design (2) | Access to create and edit programmable logic. Includes levels 3, 4, 5, and 6 below. |
| Settings (3) | Access to edit settings. Does <u>not</u> include logic settings, security setup, communications settings, and software upgrades. Includes levels 4, 5, and 6 below. |
| Operator (4) | Access to set date and time, trigger and clear logs, and edit energy values. Includes levels 5 and 6 below. |
| Control (5) | Access to change setpoints, raise and lower, reset alarms, and preposition. Includes level 6 below. |
| Read (6) | Access to read all system parameters, metering, and logs. No write access. |
| None (7) | Lowest access level. All access is denied. |

Password Creation and Configuration

Usernames and passwords are created and configured in *BESTCOMSPlus* on the Username Setup tab (Figure 155) of the Device Security Setup area. To create and configure a username and password, perform the following steps.

1. In the *BESTCOMSPlus* settings explorer, select *User Name Setup*. This selection is located under *General Settings, Device Security Setup*. When prompted, enter a username of “A” and a password of “A” and log on. This factory-default username and password allows administrator-level access. It is highly recommended that this factory-default password be changed immediately to prevent undesired access.
2. Highlight an “UNASSIGNED” entry in the user list^A. (Highlighting a previously-established username will display the password and access level for the user. This enables the password and access level for an existing user to be changed.)
3. Enter the desired username^B.

4. Enter the desired password for the user^C.
5. Reenter the password created in step 4 to verify the password^D.
6. Select the maximum allowed access level^E for the user.
7. If a maximum duration is desired for the user's access, enter the limit^F (in days). Otherwise, leave the expiration value at zero.
8. Click the Save User button^G to save the user settings.
9. Open the *Communication* menu, and click *Upload Security to Device*.
10. BESTCOMS*Plus* notifies you when the security upload is successful.

User List

| User Name | Max Access Level |
|---------------|------------------|
| A | Admin |
| ADMINISTRATOR | Admin |
| ANDREA221 | Control |
| BRIANH149 | Design |
| JEFFD331 | Admin |
| SUSANT188 | Operator |
| UNASSIGNED | Read |
| UNASSIGNED | Read |
| UNASSIGNED | Read |
| UNASSIGNED | Read |
| UNASSIGNED | Read |
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| UNASSIGNED | Read |
| UNASSIGNED | Read |

Selected User Information

User Name: SUSANT188

Password: 7077FT

Verify Password: 7077FT

Maximum Access Level Allowed: Operator

Days to Expiration (0 - No Password Expiration): 0

Buttons: Save User, Delete User

Callouts: A (User List), B (User Name), C (Password), D (Verify Password), E (Maximum Access Level Allowed), F (Days to Expiration), G (Save User button)

Figure 155. Password Access Settings

^A *User List*: Displays 26 usernames and the corresponding maximum access levels.

^B *User Name*: Accepts up to a 16 character label that may include upper and lowercase letters, numbers, and special characters.

^C *Password*: Accepts up to a 16 character label that may include upper and lowercase letters, numbers, and special characters.

^D *Verify Password*: Accepts up to a 16 character label that may include upper and lowercase letters, numbers, and special characters.

^E *Maximum Access Level Allowed*: Select Read, Control, Operator, Settings, Design, or Admin.

^F *Days to Expiration*: Adjustable from 0 to 50,000 days in 1 day increments. 0 disables setting.

^G *Save User*: Click button to save username and password settings.

Port Security

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Security Setup, Port Access Setup

An additional dimension of security is provided by the ability to restrict the control available through the DECS-250N communication ports. At any given time, only one port can be in use with read or higher access. For example, if a user gains settings access at one port, users at other ports will be able to gain no higher than read access until the user with settings access logs off. This screen cannot be accessed when in Live Mode.

Port Access Configuration

Communication port access is configured in BESTCOMS*Plus* on the Port Access Setup tab (Figure 156) of the Device Security Setup area. To configure communication port access, perform the following steps.

1. In the BESTCOMS*Plus* settings explorer, select *Port Access Setup*. This selection is located under *General Settings, Device Security Setup*. When prompted, enter a username of “A” and a password of “A” and log on. This factory-default username and password allows administrator-level access. It is highly recommended that this factory-default password be changed immediately to prevent undesired access.
2. Highlight the desired communication port in the port list^A.
3. Select the unsecured access level^B for the port.
4. Select the secured access level^C for the port.
5. Save the configuration by clicking the Save port button^D.
6. Open the *Communication* menu, and click *Upload Security to Device*.
7. BESTCOMS*Plus*[®] notifies you when the security upload is successful.

| Port | Unsecured Access | Secured Access |
|-------------------------------------|------------------|----------------|
| BESTCOMS <i>Plus</i> ® via Ethernet | Read | Admin |
| BESTCOMS <i>Plus</i> ® via USB | Read | Admin |
| CAN Bus | Read | Admin |
| HMI | Read | Admin |
| Modbus via Ethernet | Read | Admin |
| Modbus via Serial | Read | Admin |
| Profibus via Serial | Read | Admin |

Selected Port Information

Unsecured Access Level: Read [B]

Secured Access Level: Admin [C]

Save Port [D]

A

Figure 156. Port Access Configuration Settings

^A *Port List*: Displays available communication ports and the corresponding access levels.

^B *Unsecured Access Level*: Select None, Read, Control, Operator, Settings, Design, or Admin.

^C *Secured Access Level*: Select None, Read, Control, Operator, Settings, Design, or Admin.

^D *Save Port*: Click button to save port access settings.

Login and Access Controls

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Security Setup, Access Control

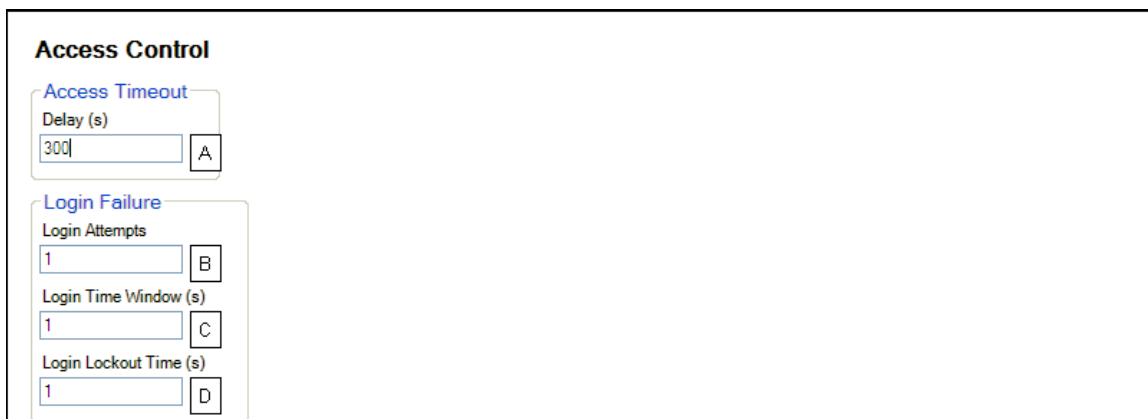
Additional controls are available to limit login time and login attempts. These control settings are illustrated in Figure 157.

Access Timeout

The access timeout setting^A maintains security by automatically withdrawing password access if a user neglects to log out. If no activity is seen for the duration of the access timeout setting, password access is automatically withdrawn.

Login Failure

A login attempts setting^B limits the number of times that login can be attempted. A login time window^C limits the length of time permitted during the login process. If login is unsuccessful, access is blocked for the duration of the login lockout time setting^D.



The screenshot shows a web-based configuration interface for 'Access Control'. It contains two main sections: 'Access Timeout' and 'Login Failure'. The 'Access Timeout' section has a 'Delay (s)' input field with the value '300' and a button labeled 'A'. The 'Login Failure' section has three input fields: 'Login Attempts' with the value '1' and button 'B', 'Login Time Window (s)' with the value '1' and button 'C', and 'Login Lockout Time (s)' with the value '1' and button 'D'.

| Section | Setting | Value | Label |
|----------------|------------------------|-------|-------|
| Access Control | Access Timeout | | |
| | Delay (s) | 300 | A |
| Login Failure | Login Attempts | 1 | B |
| | Login Time Window (s) | 1 | C |
| | Login Lockout Time (s) | 1 | D |

Figure 157. Login and Access Control Settings

^A *Access Timeout*: Adjustable from 10 to 3,600 s in 1 s increments.

^B *Login Attempts*: Adjustable from 1 to 10 in increments of 1.

^C *Login Time Window*: Adjustable from 1 to 99,999 s in 1 s increments.

^D *Login Lockout Time*: Adjustable from 1 to 99,999 s in 1 s increments.

Timekeeping

The DECS-250N clock is used by the logging functions to timestamp events. DECS-250N timekeeping can be self-managed by the internal clock or coordinated with an external source through a network or IRIG device.

BESTCOMS^{Plus}® Timekeeping settings are shown in Figure 158.

BESTCOMS^{Plus} Navigation Path: Settings Explorer, General Settings, Clock Setup

HMI Navigation Path: Settings, General Settings, Clock Setup

Time and Date Format

Clock display settings enable you to configure the time and date reported by the DECS-250N to match the conventions used in your organization/facility. The reported time can be configured for either the 12- or 24-hour format^A with the Time Format setting. The Date Format setting^A configures the reported date for one of three available formats: MM-DD-YYYY, DD-MM-YYYY, or YYYY-MM-DD.

Daylight Saving Time Adjustments

The DECS-250N can automatically compensate for the start and end of daylight saving time (DST) on a fixed- or floating-date basis^B. A fixed-date, for example, is March 2, and an example of a floating-date is, “Second Sunday of March”. DST compensation can be made in respect to your local time or coordinated universal time (UTC)^C. DST start^D and end^E points are fully configurable and include a bias adjustment^F.

Network Time Protocol (NTP)

When connected to an Ethernet network, the DECS-250N can use NTP to assure accurate, synchronized timekeeping. By synchronizing with a radio, atomic, or other clock located on the internet/intranet, each DECS-250N maintains accurate timekeeping that is coordinated with the time source.

NTP Settings

NTP is enabled in the DECS-250N by entering the internet protocol (IP) address of the network timeserver in the four decimal-separated fields of the NTP Address setting^G. Time zone offset settings^H provide the necessary offset from the coordinated universal time (UTC) standard. Central standard time is six hours and zero minutes behind (–6, 0) UTC and is the default setting.

The Time Priority Setup must be used to enable a connected time source. When multiple time sources are connected, the Time Priority Setup^I can be used to rank the sources according to their priority.

IRIG

When the IRIG source is enabled, through the Time Priority Setup, it begins synchronizing the DECS-250N internal clock with the time code signal.

Some older IRIG receivers may use a time code signal compatible with IRIG standard 200-98, format B002, which does not contain year information. To use this standard, select the *IRIG without Year* radio button in the *IRIG Decoding box*^J. Year information is stored in nonvolatile memory so the year is retained during a control power interruption.

The IRIG input accepts a demodulated (dc level-shifted) signal. For proper recognition, the applied IRIG signal must have a logic high level of no less than 3.5 Vdc and a logic low level that is no higher than 0.5 Vdc. The input signal voltage range is –10 Vdc to +10 Vdc. Input resistance is nonlinear and approximately 4 kΩ at 3.5 Vdc and 3 kΩ at 20 Vdc. IRIG signal connections are made at terminals IRIG+ and IRIG– which are located on the right side panel.

The Time Priority Setup must be used to enable a connected time source. When multiple, time sources are connected, the Time Priority Setup¹ can be used to rank the sources according to their priority.

Clock Setup

Time Zone Offset Setup
 Time Zone Hour Offset: 16
 Time Zone Minute Offset: 0
 H

Clock Display Setup
 Time Format: 24 Hour Mode
 Date Format: YYYY-MM-DD
 A

Daylight Saving Time Setup
 DST Configuration: Floating Dates
 B

Start/End Time Reference
 Respective to Local Time
 Respective to UTC Time
 C

Start Day
 Month: March
 Occurrence of Day: Second
 Weekday: Sunday
 Hour: 2
 Minute: 0
 D

End Day
 Month: November
 Occurrence of Day: First
 Weekday: Sunday
 Hour: 2
 Minute: 0
 E

Bias Setup
 Hour: 1
 Minute: 0
 F

Time Priority Setup
 Disabled: IrigB, Ntp
 Enabled: [Empty Box]
 Double-click on an item to move to next Box
 I

IRIG Decoding
 IRIG without Year
 IRIG with Year
 J

NTP Address
 0 . 0 . 0 . 0
 G

Figure 158. Clock Setup

^A **Time Format and Date Format:** Time format is 12- or 24-hour mode. Date format is MM-DD-YYYY, DD-MM-YYYY, or YYYY-MM-DD.

^B **DST Config:** Select Disabled, Floating Dates, or Fixed Dates.

^C **Start/End Time Reference:** Select “Respective to Local Time” or “Respective to UTC Time”.

^D For Floating Date DST Configuration:

DST Start Month: Select desired month for DST start.

DST Start Week of Month: Select First, Second, Third, Fourth, or Last.

DST Start Day of Week: Select desired day of the week for DST start.

DST Start Hour: Adjustable from hour 0 to 23 in 1 hour increments.

DST Start Minutes: Adjustable from minute 0 to 59 in 1 minute increments.

For Fixed Date DST Configuration:

DST Start Month: Select desired month for DST start.

<Day>: Select desired day (number) of month.

DST Start Hour: Adjustable from hour 0 to 23 in 1 hour increments.

DST Start Minutes: Adjustable from minute 0 to 59 in 1 minute increments.

^E For Floating Date DST Configuration:

DST Stop Month: Select desired month for DST stop.

DST Stop Week of Month: Select First, Second, Third, Fourth, or Last.

DST Stop Day of Week: Select desired day of the week for DST stop.

DST Stop Hour: Adjustable from hour 0 to 23 in 1 hour increments.

DST Stop Minutes: Adjustable from minute 0 to 59 in 1 minute increments.

For Fixed Date DST Configuration:

DST Stop Month: Select desired month for DST stop.

<Day>: Select desired day (number) of month.

DST Stop Hour: Adjustable from hour 0 to 23 in 1 hour increments.

DST Stop Minutes: Adjustable from minute 0 to 59 in 1 minute increments.

^F *DST Bias Hours:* Adjustable from –12 to 12 hours in 1 hour increments.

DST Bias Minutes: Adjustable from –59 to 59 minutes in 1 minute increments.

^G *NTP Address:* Four decimal-separated numbers determined by the IP address of the networked time source.

^H *Time Zone hour and Minute Offset:* Hour offset is adjustable over the range of –12 to 12 hours in 1 hour increments. Minute offset is adjustable over the range of –59 to 59 minutes in 1 minute increments.

^I *Time Priority Setup:* Sort available time sources using the two arrow buttons.

^J *IRIG Decoding:* Select IRIG without Year or IRIG with Year.



Testing

Testing of the DECS-250N's regulation and optional power system stabilizer (style XPXXXXX) performance is possible through the integrated analysis tools of BESTCOMSPlus®.

Real-Time Metering Analysis

BESTCOMSPlus Navigation Path: Metering Explorer, Analysis

HMI Navigation Path: Analysis functions are not available through HMI.

Proper voltage regulator performance is critical to power system stabilizer performance. Step response measurements of the voltage regulator should be performed to confirm the AVR gain and other critical parameters. A transfer function measurement between terminal voltage reference and terminal voltage should be performed with the machine operating at very low load. This test provides an indirect measurement of the PSS phase requirement. As long as the machine is operating at very low load, the terminal voltage modulation does not produce significant speed and power changes.

The BESTCOMSPlus Real-Time Metering Analysis screen can be used to perform and monitor on-line AVR and PSS testing. Six plots of user-selected data can be generated and the logged data can be stored in a file for later examination. BESTCOMSPlus must be in *Live Mode* in order to start plotting. Live Mode is found under the *Options* menu on the lower menu bar. RTM Analysis screen controls and indications are illustrated in Figure 159.



Figure 159. RTM Analysis Screen

With the RTM Analysis screen controls, you can:

- Select the parameters to be graphed
- Adjust the resolution of the graph x axis and the range of the graph y axis
- Start and stop plot captures
- Open an existing graph file, save a captured plot in a graph file, and print a captured graph

Graph Parameters

Any four of the following parameters may be selected for plotting in the graph areas.

- Auxiliary voltage input (Vaux)
- Average line current (Iavg)
- Average line-to-line voltage (Vavg)
- AVR error signal (ErrIn)
- AVR output
- Bus frequency (B Hz)
- Bus voltage (Vbus)
- Compensated frequency deviation (CompF)
- Control output (CntOp)
- Cross-current input (Iaux)
- Droop
- FCR error
- FCR state
- FCR output
- Field current (Ifd)
- Field voltage (Vfd)
- Filtered mechanical power (MechP)
- Final PSS output (Pout)
- Frequency response signal (Test)
- FVR error
- FVR state
- FVR output
- Generator frequency (G Hz)
- Internal state (TrnOp)
- Lead-lag #1 (x15)
- Lead-lag #2 (x16)
- Lead-lag #3 (x17)
- Lead-lag #4 (x31)
- Mechanical power (x10)
- Mechanical power (x11)
- Mechanical power (x7)
- Mechanical power (x8)
- Mechanical power (x9)
- Negative sequence current (I2)
- Negative sequence voltage (V2)
- Network Load Share
- Null Balance Level (Null Balance)
- Null Balance State (Null State)
- OEL controller output (OelOutput)
- OEL reference
- OEL state
- Phase A current (Ia)
- Phase A to B, line-to-line voltage (Vab)
- Phase B current (Ib)
- Phase B to C, line-to-line voltage (Vbc)
- Phase C current (Ic)
- Phase C to A, line-to-line voltage Vca
- Position Indication (PositionInd)
- Positive sequence current (I1)
- Positive sequence voltage (V1)
- Post-limit output (Post)
- Power factor (PF)
- Power HP #1 (x5)
- Pre-limit output (Prelim)
- PSS electrical power (PSSkW)
- PSS terminal voltage (Vtmag)
- Reactive power (kvar)
- Real power (kW)
- SCL controller output (SclOutput)
- SCL reference
- SCL state
- SCL PF reference
- Speed HP #1 (x2)
- Synthesized speed (Synth)
- Terminal frequency deviation (TermF)
- Time response signal (Ptest)
- Torsional filter #1 (Tflt1)
- Torsional filter #2 (x29)
- Total power (kVA)
- UEL controller output (UelOutput)
- UEL reference
- UEL state
- Var limiter output (VArLimOutput)
- Var limiter reference
- Var limiter state
- Var/PF error
- Var/PF state
- Var/PF output
- Washed out power (WashP)
- Washed out speed (WashW)

Frequency Response

Frequency response testing functions are available by clicking the RTM Analysis screen Frequency Response button. Frequency Response screen functions are illustrated in Figure 160 and described as follows.

Test Mode

Frequency response testing may be performed in Manual or Auto mode. In Manual mode, a single frequency can be specified to obtain the corresponding magnitude and phase responses. In Auto mode,

BESTCOMSP_{Plus} will sweep the range of frequencies and obtain the corresponding magnitude and phase responses.

Manual Test Mode Options

Manual test mode options include settings to select the frequency and magnitude of the applied test signal. A time delay setting selects the time after which the magnitude and phase response corresponding to the specified frequency is computed. This delay allows transients to settle before computations are made.

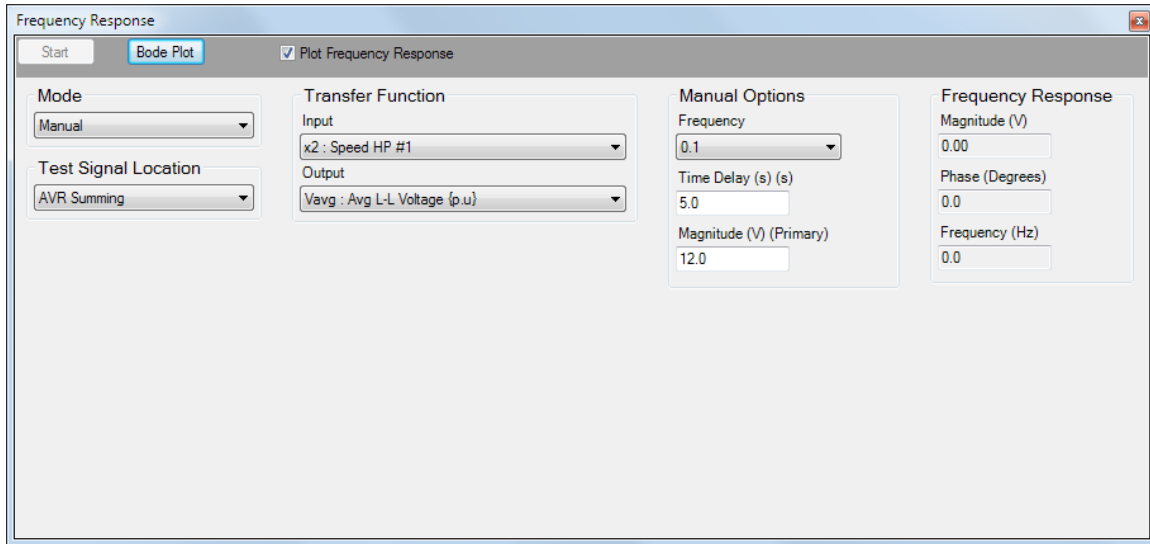


Figure 160. Frequency Response Screen

Auto Test Mode Options

Automatic test mode options include settings to select the minimum frequency, maximum frequency, and magnitude of the sinusoidal wave that is applied during a frequency response test.

Bode Plotting

A Bode plot can be printed, opened, and saved in graph (.gph) format.

Transfer Function

The point in the DECS-250N logic circuitry where a signal is injected for analysis of magnitude and phase responses is selectable. Signal points include PSS Comp Frequency, PSS Electric Power, AVR Summing, AVR PID Input, and Manual PID Input.

The type of input signal to be injected and output point are selectable, and include:

- AvrOut
- B Hz: Bus Frequency {Hz}
- CntOp: Control Output {pu}
- CompF: Compensated Frequency Deviation
- Droop
- ErrIn: AVR Error Signal
- FcrErr
- FcrOut
- FcrState
- FvrErr
- FvrOut
- FvrState
- G Hz: Generator Frequency {Hz}
- I1: Positive Sequence Current {pu}
- I2: Negative Sequence Current {pu}
- Ia: Phase A Current {pu}
- Iaux: Cross Current Input {pu}
- Iavg: Ave Line Current {pu}
- Ib: Phase B Current {pu}
- Ic: Phase C Current {pu}
- Ifd: Field Current {pu}
- kVA: Total Power {pu}
- kvar: Reactive Power {pu}
- kW: Real Power {pu}
- MechP: Filtered Mechanical Power
- Network Load Share
- NullBalance: Null Balance Level

- OelOutput: OEL Controller Output
- OelRef
- OelState
- PF: Power Factor
- PositionInd: Position Indication {pu}
- Post: Post-Limit Output {pu}
- POut: Final PSS Output {pu}
- Prelim: Pre-Limit Output {pu}
- PsskW: PSS Electric Power {pu}
- Ptest: Time Response Signal {pu}
- SclOutput: SCL Controller Output
- SclRef
- SclPfRef
- SclState
- Synth: Synthesized Speed {pu}
- TermF: Terminal Frequency Deviation
- Test: Frequency Response Signal {pu}
- Tflt1: Torsional Filter #1 {pu}
- TrnOp: Internal State {pu}
- UelOutput: UEL Controller Output
- UelRef
- UelState
- V1: Positive Sequence Voltage {pu}
- V2: Negative Sequence Voltage {pu}
- Vab: PhA-PhB L-L Voltage {pu}
- Var/PfErr
- Var/PfOut
- Var/PfState
- VarLimOutput: Var Limiter Output
- VarLimRef
- VarLimState
- Vaux: Aux Voltage Input {pu}
- Vavg: Ave L-L Voltage {pu}
- Vbc: PhB-PhC L-L Voltage {pu}
- Vbus: Bus Voltage {pu}
- Vca: PhC-PhA L-L Voltage {pu}
- Vfd: Field Voltage {pu}
- Vtmag: PSS Term Voltage
- WashP: Washed Out Power
- WashW: Washed Out Speed {pu}
- x10: Mechanical Power LP #3
- x11: Mechanical Power LP #4
- x15: Lead-Lag #1 {pu}
- x16: Lead-Lag #2 {pu}
- x17: Lead-Lag #3 {pu}
- x2: Speed HP #1
- x29: Torsional Filter #2 {pu}
- x31: Lead-Lag #4 {pu}
- x5: Power HP #1 {pu}
- x7: Mechanical Power {pu}
- x8: Mechanical Power LP #1
- x9: Mechanical Power LP #2

Frequency Response

Read-only frequency response fields indicate the magnitude response, phase response, and test signal frequency. The magnitude response and phase response corresponds to the test signal previously applied. The test frequency value reflects the frequency of the test signal currently being applied.

Caution

Exercise caution when performing frequency response testing on a generator connected to the grid. Frequencies that are close to the resonant frequency of the machine or neighboring machines are to be avoided. Frequencies above 3 Hz may correspond to the lowest shaft torsional frequencies of a generator. A torsional profile for the machine should be obtained from the manufacturer and consulted before conducting any frequency response tests.

Time Response

Tests should be performed at various load levels to confirm that the input signals are calculated or measured correctly. Since the PSS function uses compensated terminal frequency in place of speed, the derived mechanical power signal should be examined carefully to ensure that it does not contain any components at the electromechanical oscillation frequencies. If such components are present, it indicates that the frequency compensation is less than ideal, or that the machine inertia value is incorrect.

PSS test signal configuration settings are provided on the Time Response screen shown in Figure 161. Click the RTM Analysis screen's Time Response button to access this screen.

Signal Input

Signal input selections determine the point in the PSS circuitry where the test signal is applied. Test points include AVR Summing, PSS Comp Frequency, PSS Electric Power, PSS Derived Speed, Manual Summing, and var/PF.

A time delay is provided to delay the start of a PSS test after the Time Response screen Start button is clicked.

The screenshot shows the 'Time Response' window with a 'Start' button at the top left. The window is divided into three main sections:

- Signal Input:** A list of checkboxes for selecting the test signal point:
 - ☐ AVR Summing
 - ☐ PSS Comp Frequency
 - ☐ PSS Electric Power
 - ☐ PSS Derived Speed
 - ☐ Manual Summing
 - ☐ var/PF
- Stabilizer Test Signal:** A dropdown menu currently set to 'None'. Below it are input fields for:
 - Magnitude (%): 10.00
 - Offset (dc) (Primary V): 0.000
 - Frequency (Hz): 0.000
 - Duration (s): 1.0
- Sweep Signal Frequency Settings:**
 - Sweep Type: Linear Sweep (dropdown)
 - Frequency Step (Hz): 1.000
 - Start Freq (Hz): 1.000
 - Stop Freq (Hz): 10.000
 - Time Delay (s): 10.0

Figure 161. Time Response Screen

Test Signal Characteristics

Test signal characteristics (magnitude, offset, frequency, and duration) can be adjusted according to the type of test signal selected.

Magnitude

The test signal magnitude is expressed as a percentage and excludes the gain of externally-applied signals.

Offset

A dc offset can be applied to the PSS test signal. The offset is expressed as a per-unit value used in proper context wherever the test signal is applied. A dc offset cannot be applied to a Step test signal.

Frequency

The test signal frequency can be adjusted as desired for Step and Sine test signals. See *Swept Sine Test Signal* for information about configuring the frequency attributes of swept sine test signals.

Duration

A duration setting controls the total test duration for Sine and External test signals. For Step test signals, the duration setting determines the “on” period of the signal. The duration setting does not apply to Swept Sine signals.

Swept Sine Test Signals

Swept Sine test signals employ a unique set of characteristics that include the sweep style, frequency step, and start/stop frequencies.

Sweep Type

A Swept Sine test signal can be configured as linear or logarithmic.

Start and Stop Frequencies

The range of a Swept Sine test signal is determined by Start Frequency and Stop Frequency settings.

Frequency Step

The frequency of a Swept Sine test signal is incremented according to the sweep type used. For linear sweeps, the test signal frequency is incremented by “step” every half-cycle of the system frequency. For

logarithmic sweeps, the test signal frequency is multiplied by 1.0 + step every half-cycle of the system frequency.

Step Response Analysis

A standard technique for verifying overall system response is through step response measurements. This involves exciting the local electromechanical oscillation modes through a fixed step change in the AVR reference. Damping and frequency of oscillation can be measured directly from recordings of generator speed and power for different operating conditions and settings. Normally this test is performed with variations of the following:

- Generator active and reactive power loading
- Stabilizer gain
- System configuration (e.g., lines out of service)
- Stabilizer parameters (e.g., phase lead, frequency compensation)

As the stabilizer gain is increased, the damping should increase continuously while the natural frequency of oscillation should remain relatively constant. Large changes in the frequency of oscillation, a lack of improvement in damping, or the emergence of new modes of oscillation are all indications of problems with the selected settings.

Step response testing is performed using the Step Response Analysis screen. This screen (Figure 162) is accessed by clicking the Step Response button in the RTM Analysis window. The Step Response Analysis screen consists of:

- Metering fields: generator VA, total vars and PF, field voltage, and field current
- An alarms window that displays any active alarms triggered by a step change
- Control buttons to start and stop step response analysis and a button to close the screen
- A checkbox to select triggering of a data record when a setpoint step change is performed
- Tabs for controlling the application of step changes to the AVR, FCR, FVR, var, and PF setpoints. Tab functions are described in the following paragraphs.

Note

If logging is in progress, another log cannot be triggered.

Response characteristics displayed on the Step Response Analysis screen are not automatically updated when the DECS-250N operating mode is switched externally. The screen must be manually updated by exiting and then reopening the screen.

AVR, FCR, and FVR Tabs

The AVR, FCR, and FVR tabs are similar in their controls that enable the application of step changes to their respective setpoints. AVR tab controls are illustrated in Figure 162. AVR, FCR, and FVR tab controls operate as follows.

Step changes that increase or decrease the setpoint are applied by clicking the increment (up arrow) or decrement (down arrow) button. Step-change setting fields (one for increase and one for decrease) establish the percent change in the setpoint that occurs when the increment or decrement button is clicked. A read-only setpoint field indicates the current setpoint and what the setpoint will be when a step change occurs. A button is provided to return the setpoint to its original value before any step changes were invoked. This original value is the setpoint established in the Setpoints section of the BESTCOMSP_{Plus} settings explorer and is displayed in the read-only field adjacent to the button.

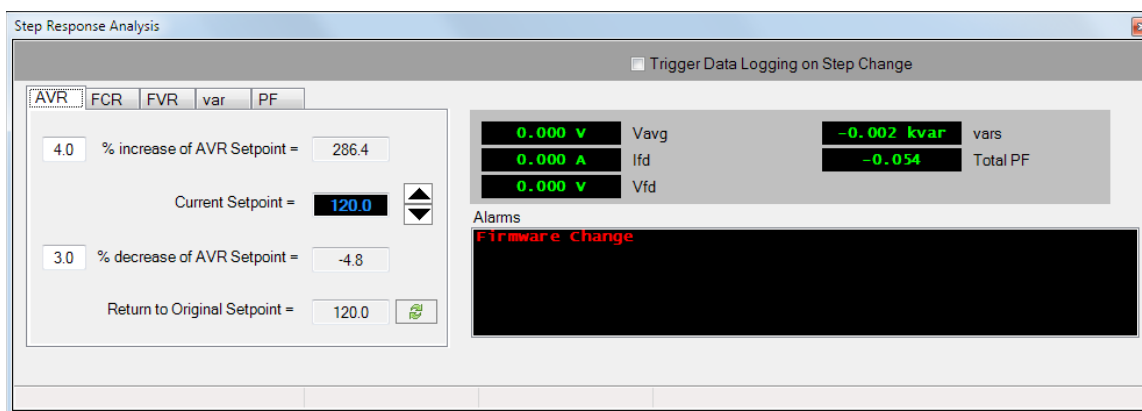


Figure 162. Step Response Analysis - AVR Tab

Var and PF Tabs

The var and PF tabs are similar in their controls that enable the application of step changes to their respective setpoints. PF tab controls are illustrated in Figure 163. Var and PF tab controls operate as follows.

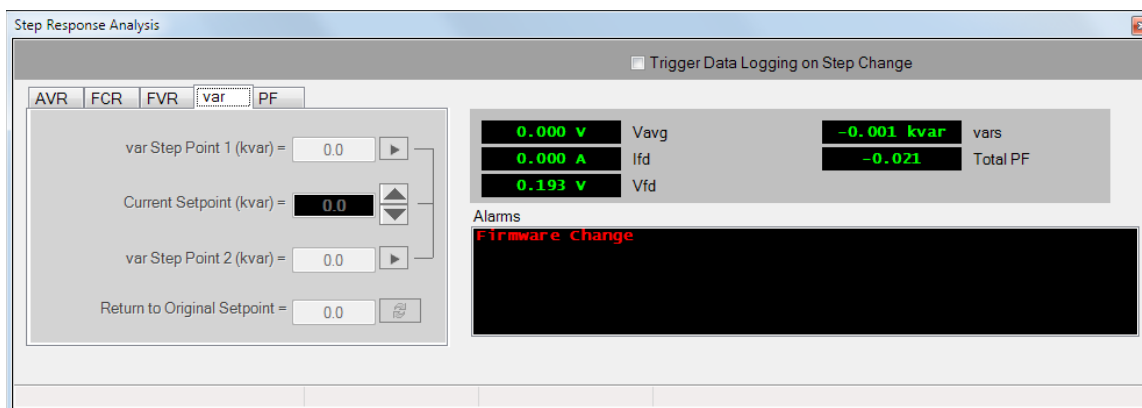


Figure 163. Step Response Analysis - PF Tab

Step changes that increase or decrease the setpoint can be applied by clicking the increment (up arrow) or decrement (down arrow) button. Step-change setpoints can be entered in two setting fields. Clicking the right-arrow button beside one of the two fields initiates a step change to the corresponding setpoint value. A button is provided to return the setpoint to its original value before any step changes were invoked. This original value is the setpoint established in the Setpoints section of the BESTCOMSP_{Plus} settings explorer and is displayed in the read-only field adjacent to the button.

Analysis Options

Options are provided to arrange the layout of plots and adjust graph display.

Layout Tab

Up to six data plots may be displayed in three different layouts on the RTM screen. Place a check in the Cursors Enabled box to enable cursors used for measuring between two horizontal points. See Figure 164.

Graph Display Tab

Options are provided to adjust graph history and poll rate. Graph height sets the displayed graphs to a fixed height in pixels. When the Auto Size box is checked, all displayed graphs are automatically sized to equally fit the available space. History length is selectable from 1 to 30 minutes. Poll rate is adjustable

between 100 to 500 milliseconds. Lowering the history and poll rate may also result in improved PC performance while plotting.

Place a check in the Sync Graph Scrolling box to sync scrolling between all graphs when any horizontal scroll bar is moved. See Figure 165.

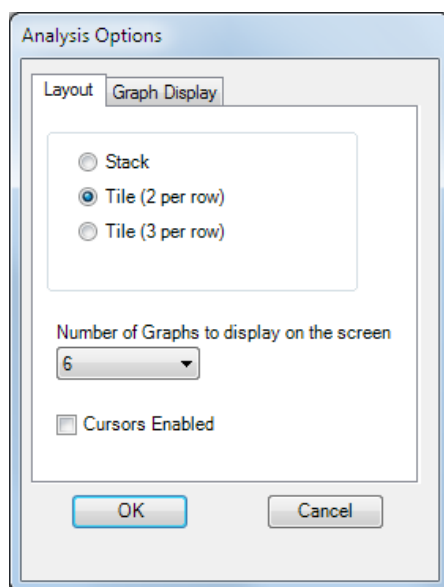


Figure 164. Analysis Options Screen, Layout Tab

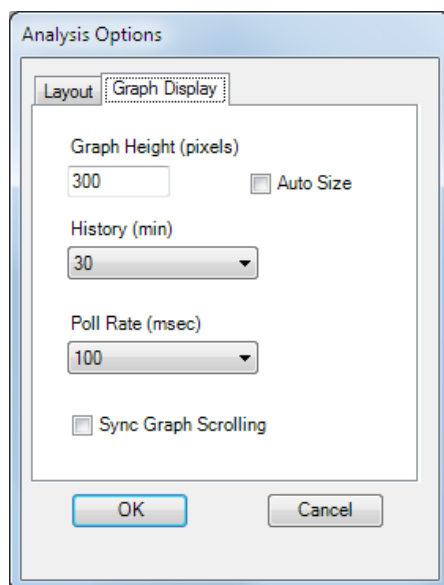


Figure 165. Analysis Options Screen, Graph Display Tab

CAN Communication

Introduction

CAN Bus interface 1 facilitates communication between the DECS-250N and optional modules such as the contact expansion module (CEM-2020) and analog expansion module (AEM-2020). Refer to the chapters *Contact Expansion Module* and *Analog Expansion Module* for more information.

CAN Bus interface 2 enables the DECS-250N to provide generator and system parameters to a generator controller such as the Basler DGC-2020. CAN 2 also permits DECS-250N setpoint and mode control from an external device connected to the CAN. The parameters sent over CAN 2 are listed in this chapter.

Both CAN Bus interfaces utilize the SAE J1939 messaging protocol.

Refer to the *Communication* chapter for CAN port configuration and the *Terminals and Connectors* chapter for wiring.

CAN Parameters

Supported CAN parameters are listed in Table 17. The first column contains the parameter group number (PGN), the second column contains the parameter name, the third column contains the unit of measurement for a parameter, the fourth column contains the suspect parameter number (SPN), and the fifth column contains the broadcast rate for a parameter.

Table 17. CAN Parameters

| PGN | Name | Units | SPN | Broadcast Rate |
|--------|---|---------|------|----------------|
| 0xFDA6 | Generator Excitation Field Voltage | Volts | 3380 | 100 ms |
| | Generator Excitation Field Current | Amps | 3381 | |
| | Generator Output Voltage Bias Percentage | Percent | 3382 | |
| 0xFDA7 | Voltage Regulator Load Compensation Mode | n/a | 3375 | 1 s |
| | Voltage Regulator var/PF Operating Mode | n/a | 3376 | |
| | Voltage Regulator Underfrequency Compensation Enabled | n/a | 3377 | |
| | Voltage Regulator Soft Start State | n/a | 3378 | |
| | Voltage Regulator Enabled | n/a | 3379 | |
| 0xFDFD | Generator Phase CA L-L AC RMS Voltage | Volts | 2443 | 100 ms |
| | (Unsupported) | n/a | 2247 | |
| | Generator Phase C AC RMS Current | Amps | 2451 | |
| 0xFE00 | Generator Phase BC L-L AC RMS Voltage | Volts | 2442 | 100 ms |
| | (Unsupported) | n/a | 2446 | |
| | Generator Phase B AC RMS Current | Amps | 2450 | |
| 0xFE03 | Generator Phase AB L-L AC RMS Voltage | Volts | 2441 | 100 ms |
| | (Unsupported) | n/a | 2445 | |
| | Generator Phase A AC RMS Current | Amps | 2249 | |
| 0xFE06 | Generator Average L-L AC RMS Voltage | Volts | 2440 | 100 ms |
| | (Unsupported) | n/a | 2444 | |
| | Generator Average AC Frequency | Hertz | 2436 | |
| | Generator Average AC RMS Current | Amps | 2448 | |
| 0xFE04 | Generator Total Reactive Power | var | 2456 | 100 ms |
| | Generator Overall PF | n/a | 2464 | |
| | Generator Overall PF Lagging | n/a | 2518 | |

| PGN | Name | Units | SPN | Broadcast Rate |
|--------|--|-------|------|----------------|
| 0xFE05 | Generator Total Real Power | Watts | 2452 | 100 ms |
| | Generator Total Apparent Power | VA | 2460 | |
| 0xFF00 | <u>Contact I/O Status</u> Start Input - Byte 0, bits 0,1 Stop Input - Byte 0, bits 2,3 Input 1 - Byte 0, bits 4,5 Input 2 - Byte 0, bits 6,7 Input 3 - Byte 1, bits 0,1 Input 4 - Byte 1, bits 2,3 Input 5 - Byte 1, bits 4,5 Input 6 - Byte 1, bits 6,7 Input 7 - Byte 2, bits 0,1 Input 8 - Byte 2, bits 2,3 Input 9 - Byte 2, bits 4,5 Input 10 - Byte 2, bits 6,7 Input 11 - Byte 3, bits 0,1 Input 12 - Byte 3, bits 2,3 Input 13 - Byte 3, bits 4,5 Input 14 - Byte 3, bits 6,7 Watchdog Output - Byte 4, bits 0,1 Output 1 - Byte 4, bits 2,3 Output 2 - Byte 4, bits 4,5 Output 3 - Byte 4, bits 6,7 Output 4 - Byte 5, bits 0,1 Output 5 - Byte 5, bits 2,3 Output 6 - Byte 5, bits 4,5 Output 7 - Byte 5, bits 6,7 Output 8 - Byte 6, bits 0,1 Output 9 - Byte 6, bits 2,3 Output 10 - Byte 6, bits 4,5 Output 11 - Byte 6, bits 6,7 <u>Notes</u> 0 = Open 1 = Closed 2 = Reserved 3 = Reserved | n/a | n/a | 100 ms |
| 0xFF01 | Requested Generator Excitation Field Voltage (FVR Setpoint) | Volts | 3380 | n/a |
| | Requested Generator Excitation Field Current (FCR Setpoint) | Amps | 3381 | n/a |
| 0xFF02 | <u>Requested Operating Mode</u> Byte 0, Bits 0-2 <u>Notes</u> 1 = FCR 2 = AVR 3 = VAR 4 = PF 5 = FVR Will not override if held by logic. Byte 0, Bits 3-7 unused Bytes 1-7 unused | n/a | n/a | 100 ms |
| 0xF015 | Requested Generator Total AC Reactive Power (var Setpoint) | var | 3383 | n/a |
| | Requested Generator Overall PF (PF Setpoint) | n/a | 3384 | n/a |
| | Requested Generator Overall PF Lagging (PF Setpoint) | n/a | 3385 | n/a |
| 0xF01C | Requested Generator Average L-L AC RMS Voltage (AVR Setpoint) | Volts | 3386 | n/a |

Diagnostic Trouble Codes (DTCs)

The DECS-250N will send an unsolicited message of a currently active diagnostic trouble code (DTC). Previously active DTCs are available upon request. Active and previously active DTCs can be cleared on request. Table 18 lists the diagnostic information that the DECS-250N obtains over the CAN Bus interface.

DTCs are reported in coded diagnostic information that includes the Suspect Parameter Number (SPN), Failure Mode Identifier (FMI), and Occurrence Count (OC) as listed in Table 3. All parameters have an SPN and are used to display or identify the items for which diagnostics are being reported. The FMI defines the type of failure detected in the subsystem identified by an SPN. The reported problem may not be an electrical failure but a subsystem condition needing to be reported to an operator or technician. The OC contains the number of times that a fault has gone from active to previously active.

Table 18. Diagnostic Information Obtained Over CAN Bus Interface 2

| PGN | Name |
|--------|------------------------------|
| 0xEA00 | Request DTCs |
| 0xFECA | Currently Active DTCs |
| 0xFECE | Previously Active DTCs |
| 0xFECC | Clear Previously Active DTCs |
| 0xFED3 | Clear Active DTCs |

Table 19. Reported DTCs

| SPN hex (decimal) | Name | FMI hex (decimal) * |
|-------------------|--------------------------|---------------------|
| 0x263 (611) | Loss of Sensing Fault | 0x00 (0) |
| 0x264 (612) | EDM Fault | 0x0E (14) |
| 0xD34 (3380) | Field Overvoltage Fault | 0x00 (0) |
| 0xD35 (3381) | Field Overcurrent Fault | 0x00 (0) |
| 0x988 (2440) | Overvoltage Fault | 0x0F (15) |
| 0x988 (2440) | Undervoltage Fault | 0x11 (17) |
| 0x998 (2456) | Loss of Excitation Fault | 0x11 (17) |

* 0 = Data valid but above normal range, most severe.

14 = Special instructions.

15 = Data valid but above normal range, least severe.

17 = Data valid but below normal range, least severe.



Modbus™ Communication

Introduction

This document describes the Modbus™ communications protocol employed by DECS-250N systems and how to exchange information with DECS-250N systems over a Modbus network. DECS-250N systems communicate by emulating a subset of the Modicon 984 Programmable Controller.

Modbus communications use a master-slave technique in which only the master can initiate a transaction. This transaction is called a query. When appropriate, a slave (DECS-250N) responds to the query. When a Modbus master communicates with a slave, information is provided or requested by the master. Information residing in the DECS-250N is grouped categorically as follows:

- General
- Binary Points
- Metering
- Limiters
- Setpoints
- Global Settings
- Relay Settings
- Protection Settings
- Gains
- Legacy Modbus

All supported data can be read as specified in the Register Table. Abbreviations are used in the Register Table to indicate the register type. Register types are:

- Read/Write = RW
- Read Only = R

When a slave receives a query, the slave responds by either supplying the requested data to the master or performing the requested action. A slave device never initiates communications on the Modbus and will always generate a response to the query unless certain error conditions occur. The DECS-250N is designed to communicate on the Modbus network only as slave devices.

Refer to the *Communication* chapter for Modbus communication setup and the *Terminals and Connectors* chapter for wiring.

Message Structure

Device Address Field

The device address field contains the unique Modbus address of the slave being queried. The addressed slave repeats the address in the device address field of the response message. This field is 1 byte.

Although Modbus protocol limits a device address from 1 - 247. The address is user-selectable at installation and can be altered during real-time operation.

Function Code Field

The function code field in the query message defines the action to be taken by the addressed slave. This field is echoed in the response message and is altered by setting the most significant bit (MSB) of the field to 1 if the response is an error response. This field is 1 byte in length.

The DECS-250N maps all available data into the Modicon 984 holding register address space supports the following function codes:

- Function 03 (03 hex) - read holding registers
- Function 06 (06 hex) - preset single register
- Function 08 (08 hex), subfunction 00 - diagnostics: return query data

- Function 08 (08 hex), subfunction 01 - diagnostics: restart communications option
- Function 08 (08 hex), subfunction 04 - diagnostics: force listen only mode
- Function 16 (10 hex) - preset multiple registers

Data Block Field

The query data block contains additional information needed by the slave to perform the requested function. The response data block contains data collected by the slave for the queried function. An error response will substitute an exception response code for the data block. The length of this field varies with each query.

Error Check Field

The error check field provides a method for the slave to validate the integrity of the query message contents and allows the master to confirm the validity of response message contents. This field is 2 bytes.

Modbus Modes of Operation

A standard Modbus network offers the remote terminal unit (RTU) transmission mode and Modbus/TCP mode for communication. DECS-250N systems support the Modbus/TCP mode and RS-485 mode at the same time. To enable editing over Modbus TCP, or RS-485, the unsecured access level for the port must be configured to the appropriate access level. See the *Security* chapter of this manual for more information on security and access levels. These two modes of operation are described below.

A master can query slaves individually or universally. A universal ("broadcast") query, when allowed, evokes no response from any slave device. If a query to an individual slave device requests actions unable to be performed by the slave, the slave response message contains an exception response code defining the error detected. Exception response codes are quite often enhanced by the information found in the "Error Details" block of holding registers.

The Modbus protocol defines a simple Protocol Data Unit (PDU) independent of the underlying communication layers. The mapping of the Modbus protocol on specific buses or networks can introduce some additional fields on the Application Data Unit (ADU). See Figure 166.

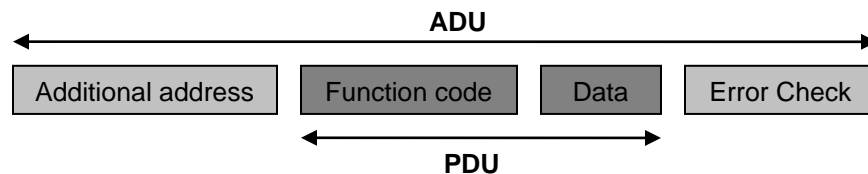


Figure 166. General Modbus Frame

The client that initiates a Modbus transaction builds the Modbus Application Data Unit. The function code indicates to the server which kind of action to perform.

Modbus™ Over Serial Line

Message Structure

Master initiated queries and DECS-250N responses share the same message structure. Each message is comprised of four message fields. They are:

- Device Address (1 byte)
- Function Code (1 byte)
- Data Block (n bytes)
- Error Check field (2 bytes)

Each 8-bit byte in a message contains two 4-bit hexadecimal characters. The message is transmitted in a continuous stream with the LSB of each byte of data transmitted first. Transmission of each 8-bit data byte occurs with one start bit and either one or two stop bits. Parity checking is performed, when enabled, and can be either odd or even. The transmission baud rate is user-selectable, and can be set at

installation and altered during real-time operation. The DECS-250N Modbus supports baud rates up to 115200. The factory default baud rate is 19200.

DECS-250N systems support RS-485 compatible serial interfaces. This interface is accessible from the left side panel of the DECS-250N.

Message Framing and Timing Considerations

When receiving a message via the RS-485 communication port, the DECS-250N requires an inter-byte latency of 3.5 character times before considering the message complete.

Once a valid query is received, the DECS-250N waits a specified amount of time before responding. This time delay is set on the Modbus Setup screen under Communications in BESTCOMSP^{Plus}®. This parameter contains a value from 10 - 10,000 milliseconds. The default value is 10 milliseconds.

Table 20 provides the response message transmission time (in seconds) and 3.5 character times (in milliseconds) for various message lengths and baud rates.

Table 20. Timing Considerations

| Baud Rate | 3.5 Character Time (ms) | Message Tx Time(s) | |
|-----------|-------------------------|--------------------|-----------|
| | | 128 Bytes | 256 Bytes |
| 2400 | 16.04 | 0.59 | 1.17 |
| 4800 | 8.021 | 0.29 | 0.59 |
| 9600 | 4.0104 | 0.15 | 0.29 |
| 19200 | 2.0052 | 0.07 | 0.15 |

Modbus on TCP/IP

Application Data Unit

The following describes the encapsulation of a Modbus request or response when it is carried on a Modbus TCP/IP network. See Figure 167.

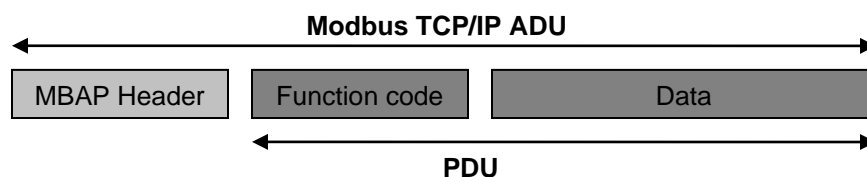


Figure 167. Modbus Request/Response Over TCP/IP

A dedicated header is used on TCP/IP to identify the Modbus Application Data Unit. It is called the MBAP header (Modbus Application Protocol header).

This header provides some differences compared to the Modbus RTU application data unit used on a serial line:

- The Modbus 'slave address' field usually used on Modbus Serial Line is replaced by a single byte 'Unit Identifier' within the MBAP header. The 'Unit Identifier' is used to communicate via devices such as bridges, routers, and gateways that use a single IP address to support multiple independent Modbus end units.
- All Modbus requests and responses are designed in such a way that the recipient can verify that a message is finished. For function codes where the Modbus PDU has a fixed length, the function code alone is sufficient. For function codes carrying a variable amount of data in the request or response, the data field includes a byte count.
- When Modbus is carried over TCP, additional length information is carried in the MBAP header to allow the recipient to recognize message boundaries even if the message has been split into multiple packets for transmission. The existence of explicit and implicit length rules and use of a

CRC-32 error check code (on Ethernet) results in an infinitesimal chance of undetected corruption to a request or response message.

MBAP Header Description

The MBAP Header contains the fields listed in Table 21.

Table 21. MBAP Header Fields

| Fields | Length | Description | Client | Server |
|------------------------|---------|--|--------------------------------------|---|
| Transaction Identifier | 2 Bytes | Identification of a Modbus request/response transaction. | Initialized by the client. | Recopied by the server from the received request. |
| Protocol Identifier | 2 Bytes | 0 = Modbus protocol. | Initialized by the client. | Recopied by the server from the received request. |
| Length | 2 Bytes | Number of following bytes. | Initialized by the client (request). | Initialized by the server (response). |
| Unit Identifier | 1 Byte | Identification of a remote slave connected on a serial line or on other buses. | Initialized by the client. | Recopied by the server from the received request. |

The header is 7 bytes long:

- *Transaction Identifier* – Used for transaction pairing, the Modbus server copies in the response the transaction identifier of the request.
- *Protocol Identifier* – Used for intra-system multiplexing. The Modbus protocol is identified by the value 0.
- *Length* – A byte count of the following fields, including the Unit Identifier and data fields.
- *Unit Identifier* – Used for intra-system routing purpose. It is typically used to communicate to a Modbus or a Modbus serial line slave through a gateway between an Ethernet TCP/IP network and a Modbus serial line. This field is set by the Modbus Client in the request and must be returned with the same value in the response by the server.

Note: All Modbus/TCP ADU are sent via TCP on registered port 502.

Error Handling and Exception Responses

Any query received that contains a non-existent device address, a framing error, or CRC error is ignored. No response is transmitted. Queries addressed to the DECS-250N with an unsupported function or illegal values in the data block result in an error response message with an exception response code. The exception response codes supported by the DECS-250N are provided in Table 22.

Table 22. Supported Exception Response Codes

| Code | Name | Description |
|------|----------------------|--|
| 01 | Illegal Function | The query Function/Subfunction Code is unsupported; query read of more than 125 registers; query preset of more than 100 registers. |
| 02 | Illegal Data Address | A register referenced in the data block does not support queried read/write; query preset of a subset of a numerical register group. |
| 03 | Illegal Data Value | A preset register data block contains an incorrect number of bytes or one or more data values out of range. |

DECS-250N Modbus™ via Ethernet

Modbus can communicate through Ethernet if the IP address of the DECS-250N is configured as described in the *Communications* chapter of this manual.

Detailed Message Query and Response for RTU Transmission Mode

A detailed description of DECS-250N supported message queries and responses is provided in the following paragraphs.

Read Holding Registers

Query

This query message requests a register or block of registers to be read. The data block contains the starting register address and the quantity of registers to be read. A register address of N will read holding register N+1. If the query is a broadcast (device address = 0), no response message is returned.

Device Address
 Function Code = 03 (hex)
 Starting Address Hi
 Starting Address Lo
 No. of Registers Hi
 No. of Registers Lo
 CRC Hi error check
 CRC Lo error check

The number of registers cannot exceed 125 without causing an error response with the exception code for an illegal function.

Response

The response message contains the data queried. The data block contains the block length in bytes followed by the data (one Data Hi byte and one Data Lo byte) for each requested register.

Reading an unassigned holding register returns a value of zero.

Device Address
 Function Code = 03 (hex)
 Byte Count
 Data Hi (For each requested register, there is one Data Hi and one Data Lo.)
 Data Lo
 .
 .
 Data Hi
 Data Lo
 CRC Hi error check
 CRC Lo error check

Return Query Data

This query contains data to be returned (looped back) in the response. The response and query messages should be identical. If the query is a broadcast (device address = 0), no response message is returned.

Device Address
 Function Code = 08 (hex)
 Subfunction Hi = 00 (hex)
 Subfunction Lo = 00 (hex)
 Data Hi = xx (don't care)
 Data Lo = xx (don't care)
 CRC Hi error check

CRC Lo error check

Restart Communications Option

This query causes the remote communications function of the DECS-250N to restart, terminating an active listen only mode of operation. No effect is made upon primary relay operations. Only the remote communications function is affected. If the query is a broadcast (device address = 0), no response message is returned.

If the DECS-250N receives this query while in the listen only mode, no response message is generated. Otherwise, a response message identical to the query message is transmitted prior to the communications restart.

| | |
|--------------------|-----------------|
| Device Address | |
| Function Code = | 08 (hex) |
| Subfunction Hi = | 00 (hex) |
| Subfunction Lo = | 01 (hex) |
| Data Hi = | xx (don't care) |
| Data Lo = | xx (don't care) |
| CRC Hi error check | |
| CRC Lo error check | |

Listen Only Mode

This query forces the addressed DECS-250N to the listen only mode for Modbus communications, isolating it from other devices on the network. No responses are returned.

While in the listen only mode, the DECS-250N continues to monitor all queries. The DECS-250N does not respond to any other query until the listen only mode is removed. All write requests with a query to Preset Multiple Registers (Function Code = 16) are also ignored. When the DECS-250N receives the restart communications query, the listen only mode is removed.

| | |
|--------------------|-----------------|
| Device Address | |
| Function Code = | 08 (hex) |
| Subfunction Hi = | 00 (hex) |
| Subfunction Lo = | 04 (hex) |
| Data Hi = | xx (don't care) |
| Data Lo = | xx (don't care) |
| CRC Hi error check | |
| CRC Lo error check | |

Preset Multiple Registers

A preset multiple registers query could address multiple registers in one slave or multiple slaves. If the query is a broadcast (device address = 0), no response message is returned.

Query

A Preset Multiple Register query message requests a register or block of registers to be written. The data block contains the starting address and the quantity of registers to be written, followed by the Data Block byte count and data. The will perform the write when the device address in query is a broadcast address or the same as the DECS-250N Modbus Unit ID (device address).

A register address of N will write Holding Register N+1.

Data will cease to be written if any of the following exceptions occur.

- Queries to write to Read Only registers result in an error response with Exception Code of "Illegal Data Address".
- Queries attempting to write more than 100 registers cause an error response with Exception Code "Illegal Function".
- An incorrect Byte Count will result in an error response with Exception Code of "Illegal Data Value".

- There are several instances of registers that are grouped together to collectively represent a single numerical DECS-250N data value (i.e. - floating point data, 32-bit integer data, and strings). A query to write a subset of such a register group will result in an error response with Exception Code "Illegal Data Address".
- A query to write a not allowed value (out of range) to a register results in an error response with Exception Code of "Illegal Data Value".

Device Address
 Function Code = 10 (hex)
 Starting Address Hi
 Starting Address Lo
 No. of Registers Hi
 No. of Registers Lo
 Byte Count
 Data Hi
 Data Lo
 .
 .
 Data Hi
 Data Lo
 CRC Hi error check
 CRC Lo error check

Response

The response message echoes the starting address and the number of registers. There is no response message when the query is a broadcast (device address = 0).

Device Address
 Function Code = 10 (hex)
 Starting Address Hi
 Starting Address Lo
 No. of Registers Hi
 No. of Registers Lo
 CRC Hi Error Check
 CRC Lo Error Check

Preset Single Register

A Preset Single Register query message requests a single register to be written. If the query is a broadcast (device address = 0), no response message is returned.

Note: Only data types INT16, INT8, UINT16, UINT8, and String (not longer than 2 bytes), can be preset by this function.

Query

Data will cease to be written if any of the following exceptions occur.

- Queries to write to Read Only registers result in an error response with Exception Code of "Illegal Data Address".
- A query to write an unallowed value (out of range) to a register results in an error response with Exception Code of "Illegal Data Value".

Device Address
 Function Code = 06 (hex)
 Address Hi
 Address Lo
 Data Hi
 Data Lo
 CRC Hi error check

CRC Lo error check

Response

The response message echoes the Query message after the register has been altered.

Data Formats

DECS-250N systems support the following data types:

- Data types mapped to 2 registers
 - Unsigned Integer 32 (Uint32)
 - Floating Point (Float)
 - Strings maximum 4 characters long (String)
- Data types mapped to 1 register
 - Unsigned Integer 16 (Uint16)
 - Unsigned Integer 8 (Uint8)
 - Strings maximum 2 characters long (String)
- Data types mapped to more than 2 registers
 - Strings longer than 4 characters (String)

Floating Point Data Format (Float)

The Modbus floating point data format uses two consecutive holding registers to represent a data value. The first register contains the low-order 16 bits of the following 32-bit format:

- MSB is the sign bit for the floating-point value (0 = positive).
- The next 8 bits are the exponent biased by 127 decimal.
- The 23 LSBs comprise the normalized mantissa. The most-significant bit of the mantissa is always assumed to be 1 and is not explicitly stored, yielding an effective precision of 24 bits.

The value of the floating-point number is obtained by multiplying the binary mantissa times two raised to the power of the unbiased exponent. The assumed bit of the binary mantissa has the value of 1.0, with the remaining 23 bits providing a fractional value. Table 23 shows the floating-point format.

Table 23. Floating Point Format

| Sign | Exponent + 127 | Mantissa |
|-------|----------------|----------|
| 1 Bit | 8 Bits | 23 Bits |

The floating-point format allows for values ranging from approximately 8.43×10^{-37} to 3.38×10^{38} . A floating-point value of all zeroes is the value zero. A floating-point value of all ones (not a number) signifies a value currently not applicable or disabled.

Example: The value 95,800 represented in floating-point format is hexadecimal 47BB1C00. This number will read from two consecutive holding registers as follows:

| Holding Register | Value |
|------------------|--------|
| K (Hi Byte) | hex 1C |
| K (Lo Byte) | hex 00 |
| K+1(Hi Byte) | hex 47 |
| K+1(Lo Byte) | hex BB |

The same byte alignments are required to write.

Long Integer Data Format (Uint32)

The Modbus long integer data format uses two consecutive holding registers to represent a 32-bit data value. The first register contains the low-order 16 bits and the second register contains the high-order 16 bits.

Example: The value 95,800 represented in long integer format is hexadecimal 0x00017638. This number will read from two consecutive holding registers as follows:

| <u>Holding Register</u> | <u>Value</u> |
|-------------------------|--------------|
| K (Hi Byte) | hex 76 |
| K (Lo Byte) | hex 38 |
| K+1(Hi Byte) | hex 00 |
| K+1(Lo Byte) | hex 01 |

The same byte alignments are required to write.

Integer Data Format (Uint16) or Bit-Mapped Variables in Uint16 Format

The Modbus integer data format uses a single holding register to represent a 16-bit data value.

Example: The value 4660 represented in integer format is hexadecimal 0x1234. This number will read from a holding register as follows:

| <u>Holding Register</u> | <u>Value</u> |
|-------------------------|--------------|
| K (Hi Byte) | hex 12 |
| K (Lo Byte) | hex 34 |

The same byte alignments are required to write.

The Uint16 Data Format is listed in *Binary Points* (Table 26), below.

Example: Register 900 occupies 16 rows in the Register Table where each row gives the name of specific bit-mapped data such as 900-0 indicates bit 0 of register 900 is mapped to RF-TRIG.

Short Integer Data Format/Byte Character Data Format (Uint8)

The Modbus short integer data format uses a single holding register to represent an 8-bit data value. The holding register high byte will always be zero.

Example: The value 132 represented in short integer format is hexadecimal 0x84. This number will read from a holding register as follows:

| <u>Holding Register</u> | <u>Value</u> |
|-------------------------|--------------|
| K (Hi Byte) | hex 00 |
| K (Lo Byte) | hex 84 |

The same byte alignments are required to write.

String Data Format (String)

The Modbus string data format uses one or more holding registers to represent a sequence, or string, of character values. If the string contains a single character, the holding register high byte will contain the ASCII character code and the low byte will be zero.

Example: The string "PASSWORD" represented in string format will read as follows:

| <u>Holding Register</u> | <u>Value</u> |
|-------------------------|--------------|
| K (Hi Byte) | 'P' |
| K (Lo Byte) | 'A' |
| K+1(Hi Byte) | 'S' |
| K+1(Lo Byte) | 'S' |
| K+2(Hi Byte) | 'W' |
| K+2(Lo Byte) | 'O' |
| K+3(Hi Byte) | 'R' |

K+3(Lo Byte) 'D'

Example: If the above string is changed to "P", the new string will read as follows:

| <u>Holding Register</u> | <u>Value</u> |
|-------------------------|--------------|
| K (Hi Byte) | 'P' |
| K (Lo Byte) | hex 00 |
| K+1(Hi Byte) | hex 00 |
| K+1(Lo Byte) | hex 00 |
| K+2(Hi Byte) | hex 00 |
| K+2(Lo Byte) | hex 00 |
| K+3(Hi Byte) | hex 00 |
| K+3(Lo Byte) | hex 00 |

The same byte alignments are required to write.

CRC Error Check

This field contains a two-byte CRC value for transmission error detection. The master first calculates the CRC and appends it to the query message. The DECS-250N system recalculates the CRC value for the received query and performs a comparison to the query CRC value to determine if a transmission error has occurred. If so, no response message is generated. If no transmission error has occurred, the slave calculates a new CRC value for the response message and appends it to the message for transmission.

The CRC calculation is performed using all bytes of the device address, function code, and data block fields. A 16-bit CRC-register is initialized to all 1's. Then each eight-bit byte of the message is used in the following algorithm:

First, exclusive-OR the message byte with the low-order byte of the CRC-register. The result, stored in the CRC-register, will then be right-shifted eight times. The CRC-register MSB is zero-filled with each shift. After each shift, the CRC-register LSB is examined. If the LSB is a 1, the CRC-register is then exclusive-ORed with the fixed polynomial value A001 (hex) prior to the next shift. Once all bytes of the message have undergone the above algorithm, the CRC-register will contain the message CRC value to be placed in the error check field.

Secure DECS-250N Login via Modbus

To login to the DECS-250N via Modbus, write the string *username|password* to the Secure Login register (40500). Substitute "username" with the user name of the desired access level, include the pipe "|" character, and substitute "password" with the password of the chosen access level. To view the current access level, read the Current Access register (40520). Write any value to the Logout register (40517) to log out of the DECS-250N. Upon disconnecting from Modbus over TCP/IP, the user is automatically logged out of the DECS-250N. However, upon disconnecting from Modbus over serial line, the user remains logged in.

Modbus Parameters

General

General parameters are listed in Table 24.

Table 24. General Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Range |
|-------------|--------------------------|----------|--------|-------|-----|--------|
| System Data | Model Number | 40001 | String | 64 | R | 0 - 64 |
| System Data | App Version Information | 40033 | String | 64 | R | 0 - 64 |
| System Data | App Sub-version Version | 40065 | String | 64 | R | 0 - 64 |
| System Data | Boot Version Information | 40097 | String | 64 | R | 0 - 64 |
| System Data | Firmware Part Number | 40129 | String | 64 | R | 0 - 64 |
| Time | Date | 40161 | String | 16 | R | 0 - 16 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|------------------|-------------------------|----------|--------|-------|-----|----------------------|
| Time | Time | 40169 | String | 16 | R | 0 - 16 |
| Unit Information | Style Number | 40177 | String | 32 | R | 0 - 32 |
| Unit Information | Serial Number | 40193 | String | 32 | R | 0 - 32 |
| DECS Control | Control Output Var PF | 40209 | Float | 4 | R | n/a |
| DECS Control | Control Output OEL | 40211 | Float | 4 | R | n/a |
| DECS Control | Control Output UEL | 40213 | Float | 4 | R | n/a |
| DECS Control | Control Output SCL | 40215 | Float | 4 | R | n/a |
| DECS Control | Control Output AVR | 40217 | Float | 4 | R | n/a |
| DECS Control | Control Output FCR | 40219 | Float | 4 | R | n/a |
| DECS Control | Control Output FVR | 40221 | Float | 4 | R | n/a |
| DECS Control | Invert Output (SCT/PPT) | 40223 | Uint | 4 | RW | Disabled=0 Enabled=1 |

Security

Table 25. Security Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Range |
|----------|----------------|----------|--------|-------|-----|---|
| Security | Secure Login | 40500 | String | 34 | RW | 0 – 34 |
| Security | Logout | 40517 | String | 5 | RW | 0 – 5 |
| Security | Current Access | 40520 | Uint32 | 4 | R | No Access=0, Read Access=1 Control Access=2 Operator Access=3 Setting Access=4 Design Access=5 Administrator Access=6 |

Binary Points

Table 26. Binary Point Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Range |
|-------------|------------------------------|--------------|--------|-------|-----|----------------|
| System Data | RF trig | 40900 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| System Data | PU logic | 40900 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| System Data | Trip logic | 40900 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| System Data | Logic trig | 40900 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| System Data | Breaker Status | 40900 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Real Time Clock Alarm | 40900 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Date Time Set Alarm | 40900 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Firmware Change Alarm | 40900 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Frequency out of range alarm | 40900 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Ethernet link lost alarm | 40900 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | USB com alarm | 40900 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | IRIG sync lost alarm | 40900 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Logic equal none alarm | 40900 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | No user setting alarm | 40900 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | NTP sync lost alarm | 40900 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Microprocessor Reset Alarm | 40900 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 1 | 40901 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 2 | 40901 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 3 | 40901 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 4 | 40901 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 5 | 40901 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 6 | 40901 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 7 | 40901 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 8 | 40901 bit 7 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|-----------------------|---------------------------------|--------------|--------|-------|-----|----------------|
| Alarms | Programmable Alarm 9 | 40901 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 10 | 40901 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 11 | 40901 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 12 | 40901 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 13 | 40901 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 14 | 40901 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 15 | 40901 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Programmable Alarm 16 | 40901 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Underfrequency V/Hz Alarm | 40902 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | OEL alarm | 40902 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | UEL alarm | 40902 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Failed to build up alarm | 40902 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | SCL alarm | 40902 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | PSS voltage unbalanced alarm | 40902 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | PSS current unbalanced alarm | 40902 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | PSS power below threshold alarm | 40902 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | PSS speed failed alarm | 40902 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | PSS voltage limit alarm | 40902 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Transfer watchdog alarm | 40902 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Crowbar activated | 40902 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Var limiter active alarm | 40902 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Alarm Report | Alarm Output | 40902 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Hardware Ports | Field Short Circuit Status | 40902 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Auto transfer enable | 40902 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Var PF selection | 40903 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | DECS start stop (external) | 40903 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Pre-position 1 active | 40903 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Pre-position 2 active | 40903 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Pre-position 3 active | 40903 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Auto active | 40903 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Field Overvoltage | Block | 40903 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Field Overvoltage | Pickup | 40903 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Field Overvoltage | Trip | 40903 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Field Overcurrent | Block | 40903 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Field Overcurrent | Pickup | 40903 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Field Overcurrent | Trip | 40903 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Block open diode | 40903 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Pickup open diode | 40903 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Trip open diode | 40903 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Block shorted diode | 40903 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Pickup shorted diode | 40904 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Trip shorted diode | 40904 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Power Input Failure | Block | 40904 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Power Input Failure | Pickup | 40904 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Power Input Failure | Trip | 40904 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Loss of Sensing | Block | 40904 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Loss of Sensing | Pickup | 40904 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Loss of Sensing | Trip | 40904 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| 25 | Block | 40904 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| 25 | Status | 40904 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| 25 | VM1 status | 40904 bit 10 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|---------------------------|--|--------------|--------|-------|-----|----------------|
| 27P | Block | 40904 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| 27P | Pickup | 40904 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| 27P | Trip | 40904 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| 59P | Block | 40904 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| 59P | Pickup | 40904 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| 59P | Trip | 40905 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| 81O | Block | 40905 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| 81O | Pickup | 40905 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| 81O | Trip | 40905 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| 81U | Block | 40905 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| 81U | Pickup | 40905 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| 81U | Trip | 40905 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Gen Below 10 Hz | Block | 40905 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Gen Below 10 Hz | Pickup | 40905 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Gen Below 10 Hz | Trip | 40905 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| 40Q | Block | 40905 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| 40Q | Pickup | 40905 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| 40Q | Trip | 40905 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| 32R | Block | 40905 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| 32R | Pickup | 40905 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| 32R | Trip | 40905 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 1 Pickup | 40906 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 1 Trip | 40906 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 2 Pickup | 40906 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 2 Trip | 40906 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 3 Pickup | 40906 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 3 Trip | 40906 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 4 Pickup | 40906 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 1 | Configurable Protection Threshold 4 Trip | 40906 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 1 Pickup | 40906 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 1 Trip | 40906 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 2 Pickup | 40906 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 2 Trip | 40906 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 3 Pickup | 40906 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 3 Trip | 40906 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 4 Pickup | 40906 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 2 | Configurable Protection Threshold 4 Trip | 40906 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 1 Pickup | 40907 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 1 Trip | 40907 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 2 Pickup | 40907 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 2 Trip | 40907 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 3 Pickup | 40907 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 3 Trip | 40907 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 4 Pickup | 40907 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 3 | Configurable Protection Threshold 4 Trip | 40907 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 1 Pickup | 40907 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 1 Trip | 40907 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 2 Pickup | 40907 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 2 Trip | 40907 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 3 Pickup | 40907 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 3 Trip | 40907 bit 13 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|---------------------------|---|--------------|--------|-------|-----|----------------|
| Configurable Protection 4 | Configurable Protection Threshold 4 Pickup | 40907 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 4 | Configurable Protection Threshold 4 Trip | 40907 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 1 Pickup | 40908 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 1 Trip | 40908 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 2 Pickup | 40908 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 2 Trip | 40908 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 3 Pickup | 40908 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 3 Trip | 40908 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 4 Pickup | 40908 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 5 | Configurable Protection Threshold 4 Trip | 40908 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 1 Pickup | 40908 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 1 Trip | 40908 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 2 Pickup | 40908 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 2 Trip | 40908 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 3 Pickup | 40908 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 3 Trip | 40908 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 4 Pickup | 40908 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 6 | Configurable Protection Threshold 4 Trip | 40908 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 1 Pickup | 40909 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 1 Trip | 40909 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 2 Pickup | 40909 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 2 Trip | 40909 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 3 Pickup | 40909 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 3 Trip | 40909 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 4 Pickup | 40909 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 7 | Configurable Protection Threshold 4 Trip | 40909 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 1 Pickup | 40909 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 1 Trip | 40909 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 2 Pickup | 40909 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 2 Trip | 40909 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 3 Pickup | 40909 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 3 Trip | 40909 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 4 Pickup | 40909 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Configurable Protection 8 | Configurable Protection Threshold 4 Trip | 40909 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Synchronizer | Sync Failed Alarm | 40910 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Unknown Network Load Share Protocol Version | 40910 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Voltage Matching Active | 40910 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Start Input | 40910 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Stop Input | 40910 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 1 | 40910 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 2 | 40910 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 3 | 40910 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 4 | 40910 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 5 | 40910 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 6 | 40910 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 7 | 40910 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 8 | 40910 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 9 | 40910 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 10 | 40910 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 11 | 40910 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 12 | 40911 bit 0 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|--------------------------|----------------------------|--------------|--------|-------|-----|----------------|
| Contact Inputs | Input 13 | 40911 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Contact Inputs | Input 14 | 40911 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Watchdog Output | 40911 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 1 | 40911 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 2 | 40911 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 3 | 40911 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 4 | 40911 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 5 | 40911 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 6 | 40911 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 7 | 40911 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 8 | 40911 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 9 | 40911 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 10 | 40911 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Contact Outputs | Output 11 | 40911 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 1 | 40911 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 2 | 40912 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 3 | 40912 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 4 | 40912 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 5 | 40912 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Virtual Switch | Virtual Switch 6 | 40912 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Manual FCR Only | 40912 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Droop Disable | 40912 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | CC Disable | 40912 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Line Drop Disable | 40912 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Parallel Enable | 40912 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Soft Start Select Group 2 | 40912 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | PSS Select Group 2 | 40912 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | OEL Select Group 2 | 40912 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | UEL Select Group 2 | 40912 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | SCL Select Group 2 | 40912 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Protect Select Group 2 | 40912 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | PID Select Group 2 | 40913 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | DECS Manual Auto | 40913 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Null Balance | 40913 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | DECS Pre-position | 40913 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Var Limiter Select Group 2 | 40913 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Var Active | 40913 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | PF Active | 40913 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | FVR Active | 40913 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | FCR Active | 40913 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Manual Active | 40913 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| DECS PSS Meter | PSS Active | 40913 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| DECS Regulator Meter | Setpoint at Lower Limit | 40913 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| DECS Regulator Meter | Setpoint at Upper Limit | 40913 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Exciter Diode Monitor | Trip Open or Shorted Diode | 40913 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 1 | 40913 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 2 | 40913 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 3 | 40914 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 4 | 40914 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 5 | 40914 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 6 | 40914 bit 3 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|--------------------------|----------------------------|--------------|--------|-------|-----|----------------|
| Contact Expansion Module | Input 7 | 40914 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 8 | 40914 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 9 | 40914 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Input 10 | 40914 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 1 | 40914 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 2 | 40914 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 3 | 40914 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 4 | 40914 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 5 | 40914 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 6 | 40914 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 7 | 40914 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 8 | 40914 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 9 | 40915 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 10 | 40915 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 11 | 40915 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 12 | 40915 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 13 | 40915 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 14 | 40915 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 15 | 40915 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 16 | 40915 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 17 | 40915 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 18 | 40915 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 19 | 40915 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 20 | 40915 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 21 | 40915 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 22 | 40915 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 23 | 40915 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Contact Expansion Module | Output 24 | 40915 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Network Load Share Disable | 40916 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Alarms | Invalid Logic Alarm | 40916 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| 24 | Block | 40916 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| 24 | Pickup | 40916 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| 24 | Trip | 40916 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| 24 | Reserved | 40916 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| DECS Control | Transient Boost Active | 40916 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Communication Failure | 40916 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | Duplicate AEM | 40916 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 1 Out of Range | 40916 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 2 Out of Range | 40916 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 3 Out of Range | 40916 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 4 Out of Range | 40916 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 5 Out of Range | 40916 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 6 Out of Range | 40916 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 7 Out of Range | 40916 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Input 8 Out of Range | 40917 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 1 Out of Range | 40917 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 2 Out of Range | 40917 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 3 Out of Range | 40917 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 4 Out of Range | 40917 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 5 Out of Range | 40917 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 6 Out of Range | 40917 bit 6 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|-------------------|---------------------------|--------------|--------|-------|-----|----------------|
| AEM Configuration | RTD Input 7 Out of Range | 40917 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | RTD Input 8 Out of Range | 40917 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Output 1 Out of Range | 40917 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Output 2 Out of Range | 40917 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Output 3 Out of Range | 40917 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Configuration | AEM Output 4 Out of Range | 40917 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 1 Pickup | 40917 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 1 Trip | 40917 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 2 Pickup | 40917 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 2 Trip | 40918 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 3 Pickup | 40918 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 3 Trip | 40918 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 4 Pickup | 40918 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 1 | Threshold 4 Trip | 40918 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 1 Pickup | 40918 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 1 Trip | 40918 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 2 Pickup | 40918 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 2 Trip | 40918 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 3 Pickup | 40918 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 3 Trip | 40918 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 4 Pickup | 40918 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 2 | Threshold 4 Trip | 40918 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 1 Pickup | 40918 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 1 Trip | 40918 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 2 Pickup | 40918 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 2 Trip | 40919 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 3 Pickup | 40919 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 3 Trip | 40919 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 4 Pickup | 40919 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 3 | Threshold 4 Trip | 40919 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 1 Pickup | 40919 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 1 Trip | 40919 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 2 Pickup | 40919 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 2 Trip | 40919 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 3 Pickup | 40919 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 3 Trip | 40919 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 4 Pickup | 40919 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 4 | Threshold 4 Trip | 40919 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 1 Pickup | 40919 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 1 Trip | 40919 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 2 Pickup | 40919 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 2 Trip | 40920 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 3 Pickup | 40920 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 3 Trip | 40920 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 4 Pickup | 40920 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 5 | Threshold 4 Trip | 40920 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 1 Pickup | 40920 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 1 Trip | 40920 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 2 Pickup | 40920 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 2 Trip | 40920 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 3 Pickup | 40920 bit 9 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|------------------|--------------------|--------------|--------|-------|-----|----------------|
| AEM Protection 6 | Threshold 3 Trip | 40920 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 4 Pickup | 40920 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 6 | Threshold 4 Trip | 40920 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 1 Pickup | 40920 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 1 Trip | 40920 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 2 Pickup | 40920 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 2 Trip | 40921 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 3 Pickup | 40921 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 3 Trip | 40921 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 4 Pickup | 40921 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 7 | Threshold 4 Trip | 40921 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 1 Pickup | 40921 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 1 Trip | 40921 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 2 Pickup | 40921 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 2 Trip | 40921 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 3 Pickup | 40921 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 3 Trip | 40921 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 4 Pickup | 40921 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| AEM Protection 8 | Threshold 4 Trip | 40921 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 1 Pickup | 40921 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 1 Trip | 40921 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 2 Pickup | 40921 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 2 Trip | 40922 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 3 Pickup | 40922 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 3 Trip | 40922 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 4 Pickup | 40922 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 1 | Threshold 4 Trip | 40922 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 1 Pickup | 40922 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 1 Trip | 40922 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 2 Pickup | 40922 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 2 Trip | 40922 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 3 Pickup | 40922 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 3 Trip | 40922 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 4 Pickup | 40922 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 2 | Threshold 4 Trip | 40922 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 1 Pickup | 40922 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 1 Trip | 40922 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 2 Pickup | 40922 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 2 Trip | 40923 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 3 Pickup | 40923 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 3 Trip | 40923 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 4 Pickup | 40923 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 3 | Threshold 4 Trip | 40923 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 1 Pickup | 40923 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 1 Trip | 40923 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 2 Pickup | 40923 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 2 Trip | 40923 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 3 Pickup | 40923 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 3 Trip | 40923 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 4 Pickup | 40923 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 4 | Threshold 4 Trip | 40923 bit 12 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|---------------------------|--------------------|--------------|--------|-------|-----|----------------|
| RTD Protection 5 | Threshold 1 Pickup | 40923 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 1 Trip | 40923 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 2 Pickup | 40923 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 2 Trip | 40924 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 3 Pickup | 40924 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 3 Trip | 40924 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 4 Pickup | 40924 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 5 | Threshold 4 Trip | 40924 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 1 Pickup | 40924 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 1 Trip | 40924 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 2 Pickup | 40924 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 2 Trip | 40924 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 3 Pickup | 40924 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 3 Trip | 40924 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 4 Pickup | 40924 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 6 | Threshold 4 Trip | 40924 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 1 Pickup | 40924 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 1 Trip | 40924 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 2 Pickup | 40924 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 2 Trip | 40925 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 3 Pickup | 40925 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 3 Trip | 40925 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 4 Pickup | 40925 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 7 | Threshold 4 Trip | 40925 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 1 Pickup | 40925 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 1 Trip | 40925 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 2 Pickup | 40925 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 2 Trip | 40925 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 3 Pickup | 40925 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 3 Trip | 40925 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 4 Pickup | 40925 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| RTD Protection 8 | Threshold 4 Trip | 40925 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 1 Pickup | 40925 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 1 Trip | 40925 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 2 Pickup | 40925 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 2 Trip | 40926 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 3 Pickup | 40926 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 3 Trip | 40926 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 4 Pickup | 40926 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 1 | Threshold 4 Trip | 40926 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 1 Pickup | 40926 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 1 Trip | 40926 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 2 Pickup | 40926 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 2 Trip | 40926 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 3 Pickup | 40926 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 3 Trip | 40926 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 4 Pickup | 40926 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Thermocouple Protection 2 | Threshold 4 Trip | 40926 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Active | 40926 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 1 | 40926 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 2 | 40926 bit 15 | Uint16 | 2 | R | True=1 False=0 |

| Group | Name | Register | Type | Bytes | R/W | Range |
|--------------------|----------------------------|--------------|--------|-------|-----|----------------|
| Network Load Share | Receiving ID 3 | 40927 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 4 | 40927 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 5 | 40927 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 6 | 40927 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 7 | 40927 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 8 | 40927 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 9 | 40927 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 10 | 40927 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 11 | 40927 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 12 | 40927 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 13 | 40927 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 14 | 40927 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 15 | 40927 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | Receiving ID 16 | 40927 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Configuration Mismatch | 40927 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS ID Missing | 40927 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 1 Enabled | 40928 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 2 Enabled | 40928 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 3 Enabled | 40928 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 4 Enabled | 40928 bit 3 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 5 Enabled | 40928 bit 4 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 6 Enabled | 40928 bit 5 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 7 Enabled | 40928 bit 6 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 8 Enabled | 40928 bit 7 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 9 Enabled | 40928 bit 8 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 10 Enabled | 40928 bit 9 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 11 Enabled | 40928 bit 10 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 12 Enabled | 40928 bit 11 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 13 Enabled | 40928 bit 12 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 14 Enabled | 40928 bit 13 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 15 Enabled | 40928 bit 14 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | ID 16 Enabled | 40928 bit 15 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Status 1 | 40929 bit 0 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Status 2 | 40929 bit 1 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Status 3 | 40929 bit 2 | Uint16 | 2 | R | True=1 False=0 |
| Network Load Share | NLS Status 4 | 40929 bit 3 | Uint16 | 2 | R | True=1 False=0 |

Metering

Table 27. Metering Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|----------------------|--------------------------------------|----------|-------|-------|-----|---------|----------------|
| Field Voltage Meter | V_x | 41000 | Float | 4 | R | Volt | -1000 - 1000 |
| Field Current Meter | I_x | 41002 | Float | 4 | R | Amp | 0 - 2000000000 |
| DECS PSS Meter | Terminal Frequency Deviation | 41004 | Float | 4 | R | n/a | n/a |
| DECS PSS Meter | Compensated Frequency Deviation | 41006 | Float | 4 | R | n/a | n/a |
| DECS PSS Meter | PSS output | 41008 | Float | 4 | R | n/a | n/a |
| DECS Regulator Meter | Tracking error | 41010 | Float | 4 | R | Percent | n/a |
| DECS Regulator Meter | Control output PU | 41012 | Float | 4 | R | n/a | -10 - 10 |
| DECS Regulator Meter | Exciter Diode Monitor Ripple Percent | 41014 | Float | 4 | R | Percent | n/a |
| DECS Regulator Meter | Power Input | 41016 | Float | 4 | R | Volt | 0 - 2000000000 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|-------------------------------------|---------------------|----------|--------|-------|-----|--------|----------------|
| Generator Voltage Meter Magnitude 1 | V _{AB} | 41018 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Magnitude 1 | V _{BC} | 41020 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Magnitude 1 | V _{CA} | 41022 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Magnitude 1 | V _{AVG} LL | 41024 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Primary 1 | V _{AB} | 41026 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Primary 1 | V _{BC} | 41028 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Primary 1 | V _{CA} | 41030 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Primary 1 | V _{AVG} LL | 41032 | Float | 4 | R | Volt | 0 - 2000000000 |
| Generator Voltage Meter Angle 1 | V _{AB} | 41034 | Float | 4 | R | Degree | 0 - 360 |
| Generator Voltage Meter Angle 1 | V _{BC} | 41036 | Float | 4 | R | Degree | 0 - 360 |
| Generator Voltage Meter Angle 1 | V _{CA} | 41038 | Float | 4 | R | Degree | 0 - 360 |
| Generator Voltage Meter Angle 1 | V _{AB} | 41040 | String | 24 | R | n/a | 0 - 24 |
| Generator Voltage Meter Angle 1 | V _{BC} | 41052 | String | 24 | R | n/a | 0 - 24 |
| Generator Voltage Meter Angle 1 | V _{CA} | 41064 | String | 24 | R | n/a | 0 - 24 |
| Gen Voltage Meter Primary Angle 1 | V _{AB} | 41076 | String | 24 | R | n/a | 0 - 24 |
| Gen Voltage Meter Primary Angle 1 | V _{BC} | 41088 | String | 24 | R | n/a | 0 - 24 |
| Gen Voltage Meter Primary Angle 1 | V _{CA} | 41100 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Magnitude 1 | V _{AB} | 41112 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Magnitude 1 | V _{BC} | 41114 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Magnitude 1 | V _{CA} | 41116 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Magnitude 1 | V _{AVG} LL | 41118 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Primary 1 | V _{AB} | 41120 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Primary 1 | V _{BC} | 41122 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Primary 1 | V _{CA} | 41124 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Primary 1 | V _{AVG} LL | 41126 | Float | 4 | R | Volt | 0 - 2000000000 |
| Bus Voltage Meter Angle 1 | V _{AB} | 41128 | Float | 4 | R | Degree | 0 - 360 |
| Bus Voltage Meter Angle 1 | V _{BC} | 41130 | Float | 4 | R | Degree | 0 - 360 |
| Bus Voltage Meter Angle 1 | V _{CA} | 41132 | Float | 4 | R | Degree | 0 - 360 |
| Bus Voltage Meter Angle 1 | V _{AB} | 41134 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Magnitude Angle 1 | V _{BC} | 41146 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Magnitude Angle 1 | V _{CA} | 41158 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Primary Angle 1 | V _{AB} | 41170 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Primary Angle 1 | V _{BC} | 41182 | String | 24 | R | n/a | 0 - 24 |
| Bus Voltage Meter Primary Angle 1 | V _{CA} | 41194 | String | 24 | R | n/a | 0 - 24 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|---|-------------------------|----------|--------|-------|-----|----------|----------------------|
| Generator Current Meter Magnitude 1 | I_A | 41206 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Magnitude 1 | I_B | 41208 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Magnitude 1 | I_C | 41210 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Magnitude 1 | I_{AVG} | 41212 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Primary 1 | I_A | 41214 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Primary 1 | I_B | 41216 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Primary 1 | I_C | 41218 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Primary 1 | I_{AVG} | 41220 | Float | 4 | R | Amp | 0 - 2000000000 |
| Generator Current Meter Angle 1 | I_A | 41222 | Float | 4 | R | Degree | 0 - 360 |
| Generator Current Meter Angle 1 | I_B | 41224 | Float | 4 | R | Degree | 0 - 360 |
| Generator Current Meter Angle 1 | I_C | 41226 | Float | 4 | R | Degree | 0 - 360 |
| Generator Current Meter Magnitude Angle 1 | I_A | 41228 | String | 24 | R | n/a | 0 - 24 |
| Generator Current Meter Magnitude Angle 1 | I_B | 41240 | String | 24 | R | n/a | 0 - 24 |
| Generator Current Meter Magnitude Angle 1 | I_C | 41252 | String | 24 | R | n/a | 0 - 24 |
| Generator Current Meter Primary Angle 1 | I_A | 41264 | String | 24 | R | n/a | 0 - 24 |
| Generator Current Meter Primary Angle 1 | I_B | 41276 | String | 24 | R | n/a | 0 - 24 |
| Generator Current Meter Primary Angle 1 | I_C | 41288 | String | 24 | R | n/a | 0 - 24 |
| Icc Current Meter Magnitude 1 | I_x | 41300 | Float | 4 | R | Amp | 0 - 2000000000 |
| Icc Current Meter Primary 1 | I_x | 41302 | Float | 4 | R | Amp | 0 - 2000000000 |
| Power Meter | Total watts secondary | 41304 | Float | 4 | R | Watt | n/a |
| Power Meter | Total watts primary | 41306 | Float | 4 | R | Watt | n/a |
| Power Meter | Total vars secondary | 41308 | Float | 4 | R | VA | n/a |
| Power Meter | Total vars primary | 41310 | Float | 4 | R | VA | n/a |
| Power Meter | Total S secondary | 41312 | Float | 4 | R | VA | n/a |
| Power Meter | Total S primary | 41314 | Float | 4 | R | VA | n/a |
| Power Meter | Total PF secondary | 41316 | Float | 4 | R | PF | -1 - 1 |
| Power Meter | Total PF primary | 41318 | Float | 4 | R | PF | -1 - 1 |
| Power Meter | Positive watthour total | 41320 | Float | 4 | RW | WattHour | 0.00E+00 - 1.00E+09 |
| Power Meter | Positive varhour total | 41322 | Float | 4 | RW | VAHour | 0.00E+00 - 1.00E+09 |
| Power Meter | Negative watthour total | 41324 | Float | 4 | RW | WattHour | -1.00E+09 - 0.00E+00 |
| Power Meter | Negative varhour total | 41326 | Float | 4 | RW | VAHour | -1.00E+09 - 0.00E+00 |
| Power Meter | VA hour total | 41328 | Float | 4 | RW | VAHour | 0.00E+00 - 1.00E+09 |
| Energy Meter | Positive watthour total | 41330 | Float | 4 | RW | WattHour | 0.00E+00 - 1.00E+09 |
| Energy Meter | Positive varhour total | 41332 | Float | 4 | RW | VAHour | 0.00E+00 - 1.00E+09 |
| Energy Meter | Negative watthour total | 41334 | Float | 4 | RW | WattHour | -1.00E+09 - 0.00E+00 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|-----------------------------|--------------------------------------|----------|-------|-------|-----|---------|----------------------|
| Energy Meter | Negative varhour total | 41336 | Float | 4 | RW | VArHour | -1.00E+09 - 0.00E+00 |
| Energy Meter | VA hour total | 41338 | Float | 4 | RW | VAHour | 0.00E+00 - 1.00E+09 |
| Sync Meter 1 | Slip Angle | 41340 | Float | 4 | R | Degree | -359.9 – 359.9 |
| Sync Meter 1 | Slip Frequency | 41342 | Float | 4 | R | Hertz | n/a |
| Sync Meter 1 | Voltage Difference | 41344 | Float | 4 | R | Volt | n/a |
| Generator Frequency Meter 1 | Frequency | 41346 | Float | 4 | R | Hertz | 10 - 180 |
| Bus Frequency Meter 1 | Frequency | 41348 | Float | 4 | R | Hertz | 10 - 180 |
| Auxiliary Input Voltage 1 | Value | 41350 | Float | 4 | R | Volt | -9999999 - 9999999 |
| Auxiliary Input Current 1 | Value | 41352 | Float | 4 | R | Amp | -9999999 - 9999999 |
| AEM Metering | RTD Input 1 Raw Value | 41354 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 2 Raw Value | 41356 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 3 Raw Value | 41358 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 4 Raw Value | 41360 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 5 Raw Value | 41362 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 6 Raw Value | 41364 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 7 Raw Value | 41366 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 8 Raw Value | 41368 | Float | 4 | R | Ohm | n/a |
| AEM Metering | RTD Input 1 Scaled Value | 41370 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 2 Scaled Value | 41372 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 3 Scaled Value | 41374 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 4 Scaled Value | 41376 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 5 Scaled Value | 41378 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 6 Scaled Value | 41380 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 7 Scaled Value | 41382 | Float | 4 | R | Deg F | -40000 - 9999999 |
| AEM Metering | RTD Input 8 Scaled Value | 41384 | Float | 4 | R | Deg F | -40000 - 9999999 |
| DECS Regulator Meter | Control Output | 41386 | Float | 4 | R | Percent | n/a |
| AEM Metering | RTD Input 1 Metric Value | 41388 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 2 Metric Value | 41390 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 3 Metric Value | 41392 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 4 Metric Value | 41394 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 5 Metric Value | 41396 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 6 Metric Value | 41398 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 7 Metric Value | 41400 | Float | 4 | R | Deg C | n/a |
| AEM Metering | RTD Input 8 Metric Value | 41402 | Float | 4 | R | Deg C | n/a |
| AEM Metering | Thermocouple Input 1 Metric Value | 41404 | Float | 4 | R | Deg C | n/a |
| AEM Metering | Thermocouple Input 2 Metric Value | 41406 | Float | 4 | R | Deg C | n/a |
| DECS Regulator Meter | NLS Error Percent | 41408 | Float | 4 | R | Percent | n/a |
| DECS Regulator Meter | Current Magnitude Pickup | 41410 | Float | 4 | R | n/a | -10 - 10 |
| DECS Regulator Meter | NLS Current Magnitude Average Pickup | 41412 | Float | 4 | R | n/a | -10 - 10 |
| DECS Regulator Meter | NLS Number of Generators Online | 41414 | Int32 | 4 | R | n/a | n/a |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|----------------|----------------------------------|----------|-------|-------|-----|--------------|----------|
| Per Unit Meter | Vab Pickup | 41416 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Vbc Pickup | 41418 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Vca Pickup | 41420 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | V Average Pickup | 41422 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Ia Pickup | 41424 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Ib Pickup | 41426 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Ic Pickup | 41428 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | I Average Pickup | 41430 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | kW Pickup | 41432 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | kVA Pickup | 41434 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Kvar Pickup | 41436 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Positive Sequence Voltage Pickup | 41438 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Negative Sequence Voltage Pickup | 41440 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Positive Sequence Current Pickup | 41442 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Negative Sequence Current Pickup | 41444 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Bus Vab Pickup | 41446 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Bus Vbc Pickup | 41448 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Bus Vca Pickup | 41450 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Bus V Average Pickup | 41452 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Voltage Difference Pickup | 41454 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Power in Voltage Pickup | 41456 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Generator Frequency Pickup | 41458 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Bus Frequency Pickup | 41460 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | I _{fd} Pickup | 41462 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | V _{fd} Pickup | 41464 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Slip Frequency Pickup | 41466 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | I _{cc} Pickup | 41468 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | AVR Setpoint Pickup | 41470 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | FCR Setpoint Pickup | 41472 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | FVR Setpoint Pickup | 41474 | Float | 4 | R | n/a | -10 - 10 |
| Per Unit Meter | Var Setpoint Pickup | 41476 | Float | 4 | R | n/a | -10 - 10 |
| Power Meter | Scaled PF | 41478 | Float | 4 | R | Power Factor | -1 - 1 |
| AEM Metering | Analog Input 1 Raw Value | 41480 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 2 Raw Value | 41482 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 3 Raw Value | 41484 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 4 Raw Value | 41486 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 5 Raw Value | 41488 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 6 Raw Value | 41490 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 7 Raw Value | 41492 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 8 Raw Value | 41494 | Float | 4 | R | Milliamp | n/a |
| AEM Metering | Analog Input 1 Scaled Value | 41496 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 2 Scaled Value | 41498 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 3 Scaled Value | 41500 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 4 Scaled Value | 41502 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 5 Scaled Value | 41504 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 6 Scaled Value | 41506 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 7 Scaled Value | 41508 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Input 8 Scaled Value | 41510 | Float | 4 | R | n/a | n/a |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|--------------|-----------------------------------|----------|-------|-------|-----|-----------|-------|
| AEM Metering | Thermocouple 1 Raw Value | 41512 | Float | 4 | R | Millivolt | n/a |
| AEM Metering | Thermocouple 2 Raw Value | 41514 | Float | 4 | R | Millivolt | n/a |
| AEM Metering | Analog Output 1 Raw Value | 41516 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 2 Raw Value | 41518 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 3 Raw Value | 41520 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 4 Raw Value | 41522 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 1 Scaled Value | 41524 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 2 Scaled Value | 41526 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 3 Scaled Value | 41528 | Float | 4 | R | n/a | n/a |
| AEM Metering | Analog Output 4 Scaled Value | 41530 | Float | 4 | R | n/a | n/a |
| AEM Metering | Thermocouple Input 1 Scaled Value | 41532 | Float | 4 | R | Deg F | n/a |
| AEM Metering | Thermocouple Input 2 Scaled Value | 41534 | Float | 4 | R | Deg F | n/a |

Limiters

Table 28. Limiter Group Parameters

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--|----------|--------|-------|-----|--------|----------------------|
| OEL Primary Current Hi | 41700 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Primary Current Mid | 41702 | Float | 4 | R W | Amp | 0 - 20 |
| OEL Primary Current Lo | 41704 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Primary Time Hi | 41706 | Float | 4 | R W | Second | 0 - 10 |
| OEL Primary Time Mid | 41708 | Float | 4 | R W | Second | 0 - 120 |
| OEL Primary Current Hi Off | 41710 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Primary Current Lo Off | 41712 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Primary Current Time Off | 41714 | Float | 4 | R W | Second | 0 - 10 |
| OEL Primary Takeover Current Max Off | 41716 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Primary Takeover Current Min Off | 41718 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Primary Takeover Time Dial Off | 41720 | Float | 4 | R W | n/a | 0.1 - 20 |
| OEL Primary Takeover Current Max On | 41722 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Primary Takeover Current Min On | 41724 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Primary Takeover Time Dial On | 41726 | Float | 4 | R W | n/a | 0.1 - 20 |
| OEL Primary Dvdt Enable | 41728 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| OEL Primary Dvdt Ref | 41730 | Float | 4 | R W | n/a | -10 - 0 |
| OEL Secondary Current Hi | 41732 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Secondary Current Mid | 41734 | Float | 4 | R W | Amp | 0 - 20 |
| OEL Secondary Current Lo | 41736 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Secondary Time Hi | 41738 | Float | 4 | R W | Second | 0 - 10 |
| OEL Secondary Time Mid | 41740 | Float | 4 | R W | Second | 0 - 120 |
| OEL Secondary Current Hi Off | 41742 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Secondary Current Lo Off | 41744 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Secondary Current Time Off | 41746 | Float | 4 | R W | Second | 0 - 10 |
| OEL Secondary Takeover Current Max Off | 41748 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Secondary Takeover Current Min Off | 41750 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Secondary Takeover Time Dial Off | 41752 | Float | 4 | R W | n/a | 0.1 - 20 |
| OEL Secondary Takeover Current Max On | 41754 | Float | 4 | R W | Amp | 0 - 30 |
| OEL Secondary Takeover Current Min On | 41756 | Float | 4 | R W | Amp | 0 - 15 |
| OEL Secondary Takeover Time Dial On | 41758 | Float | 4 | R W | n/a | 0.1 - 20 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--|----------|--------|-------|-----|--------------------------------------|---|
| OEL Scale Enable | 41760 | UInt32 | 4 | R W | n/a | Disabled=0 Auxiliary Input=1 AEM RTD 1=2 AEM RTD 2=3 AEM RTD 3=4 AEM RTD 4=5 AEM RTD 5=6 AEM RTD 6=7 AEM RTD 7=8 AEM RTD 8=9 |
| OEL Scale Takeover Signal 1 | 41762 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Takeover Signal 2 | 41764 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Takeover Signal 3 | 41766 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Takeover Scale 1 | 41768 | Float | 4 | R W | Percent | 0 – 200 |
| OEL Scale Takeover Scale 2 | 41770 | Float | 4 | R W | Percent | 0 – 200 |
| OEL Scale Takeover Scale 3 | 41772 | Float | 4 | R W | Percent | 0 – 200 |
| OEL Scale Summing Signal 1 | 41774 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Summing Signal 2 | 41776 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Summing Signal 3 | 41778 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41760. -10 – 10 V when 41760 = 1 -58 – 482°F when 41760 = 2-8 |
| OEL Scale Summing Scale 1 | 41780 | Float | 4 | R W | Percent | 0 – 200 |
| OEL Scale Summing Scale 2 | 41782 | Float | 4 | R W | Percent | 0 – 200 |
| OEL Scale Summing Scale 3 | 41784 | Float | 4 | R W | Percent | 0 – 200 |
| UEL Primary Curve X1 | 41786 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Primary Curve X2 | 41788 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Primary Curve X3 | 41790 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Primary Curve X4 | 41792 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Primary Curve X5 | 41794 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Primary Curve Y1 | 41796 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Primary Curve Y2 | 41798 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Primary Curve Y3 | 41800 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Primary Curve Y4 | 41802 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Primary Curve Y5 | 41804 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Primary Power Filter TC | 41806 | Float | 4 | R W | Second | 0 – 20 |
| UEL Primary Voltage Dependent Exponent | 41808 | Float | 4 | R W | n/a | 0 – 2 |
| UEL Secondary Curve X1 | 41810 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve X2 | 41812 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve X3 | 41814 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve X4 | 41816 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve X5 | 41818 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve Y1 | 41820 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve Y2 | 41822 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve Y3 | 41824 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| UEL Secondary Curve Y4 | 41826 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|----------|--------|-------|-----|--------------------------------------|---|
| UEL Secondary Curve Y5 | 41828 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| SCL Primary Reference Hi | 41830 | Float | 4 | R W | Amp | 0 - 66000 |
| SCL Primary Reference Lo | 41832 | Float | 4 | R W | Amp | 0 - 66000 |
| SCL Primary Time Hi | 41834 | Float | 4 | R W | Second | 0 - 60 |
| SCL Primary No Response Time | 41836 | Float | 4 | R W | Second | 0 - 10 |
| SCL Secondary Reference Hi | 41838 | Float | 4 | R W | Amp | 0 - 66000 |
| SCL Secondary Reference Lo | 41840 | Float | 4 | R W | Amp | 0 - 66000 |
| SCL Secondary Time Hi | 41842 | Float | 4 | R W | Second | 0 - 60 |
| SCL Secondary No Response Time | 41844 | Float | 4 | R W | Second | 0 - 10 |
| SCL Scale Enable | 41846 | Uint32 | 4 | R W | n/a | Disabled=0 Auxiliary Input=1 AEM RTD 1=2 AEM RTD 2=3 AEM RTD 3=4 AEM RTD 4=5 AEM RTD 5=6 AEM RTD 6=7 AEM RTD 7=8 AEM RTD 8=9 |
| SCL Scale Signal 1 | 41848 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41846. -10 – 10 V when 41846 = 1 -58 – 482°F when 41846 = 2-8 |
| SCL Scale Signal 2 | 41850 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41846. -10 – 10 V when 41846 = 1 -58 – 482°F when 41846 = 2-8 |
| SCL Scale Signal 3 | 41852 | Float | 4 | R W | Limiter Scale Volt or Deg F | Adjustment range is determined by register 41846. -10 – 10 V when 41846 = 1 -58 – 482°F when 41846 = 2-8 |
| SCL Scale Point 1 | 41854 | Float | 4 | R W | Percent | 0 - 200 |
| SCL Scale Point 2 | 41856 | Float | 4 | R W | Percent | 0 - 200 |
| SCL Scale Point 3 | 41858 | Float | 4 | R W | Percent | 0 - 200 |
| Var Limit Enable | 41860 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Var Limit Primary Delay | 41862 | Float | 4 | R W | Second | 0 - 300 |
| Var Limit Primary Setpoint | 41864 | Float | 4 | R W | Percent | 0 - 200 |
| Var Limit Secondary Delay | 41866 | Float | 4 | R W | Second | 0 - 300 |
| Var Limit Secondary Setpoint | 41868 | Float | 4 | R W | Percent | 0 - 200 |
| Var Limit Enable Status | 41870 | Uint32 | 4 | R | n/a | Off=0 On=1 |
| OEL Primary Takeover Reset Time Coefficient Off | 41872 | Float | 4 | R W | n/a | 0.01 – 100 |
| OEL Primary Takeover Reset Time Coefficient On | 41874 | Float | 4 | R W | n/a | 0.01 – 100 |
| OEL Secondary Takeover Reset Time Coefficient Off | 41876 | Float | 4 | R W | n/a | 0.01 – 100 |
| OEL Secondary Takeover Reset Time Coefficient On | 41878 | Float | 4 | R W | n/a | 0.01 – 100 |
| OEL Primary Takeover Reset Type Off | 41880 | Uint32 | 4 | R W | n/a | Inverse=0,Integrating=1,Instantaneous=2 |
| OEL Primary Takeover Reset Type On | 41882 | Uint32 | 4 | R W | n/a | Inverse=0,Integrating=1,Instantaneous=2 |
| OEL Secondary Takeover Reset Type Off | 41884 | Uint32 | 4 | R W | n/a | Inverse=0,Integrating=1,Instantaneous=2 |
| OEL Secondary Takeover Reset Type On | 41886 | Uint32 | 4 | R W | n/a | Inverse=0,Integrating=1,Instantaneous=2 |

Setpoints

Table 29. Setpoint Group Parameters

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--|----------|-------|-------|-----|--------|--|
| Field Current Regulation Setpoint | 42200 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 42212 and 42214. |
| Field Current Regulation Traverse Rate | 42202 | Float | 4 | R W | Second | 10 – 200 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|----------|--------|-------|-----|--------------|--|
| Field Current Regulation Pre-position Mode 1 | 42204 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Field Current Regulation Pre-position 1 | 42206 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 42212 and 42214. |
| Field Current Regulation Pre-position Mode 2 | 42208 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Field Current Regulation Pre-position 2 | 42210 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 42212 and 42214. |
| Field Current Regulation Minimum Setpoint Limit | 42212 | Float | 4 | R W | Percent | 0 – 120 |
| Field Current Regulation Maximum Setpoint Limit | 42214 | Float | 4 | R W | Percent | 0 – 120 |
| Generator Voltage Setpoint | 42216 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42228 and 42230. |
| Generator Voltage Traverse Rate | 42218 | Float | 4 | R W | Second | 10 – 200 |
| Generator Voltage Pre-position Mode 1 | 42220 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator Voltage Pre-position 1 | 42222 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42228 and 42230. |
| Generator Voltage Pre-position Mode 2 | 42224 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator Voltage Pre-position 2 | 42226 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42228 and 42230. |
| Generator Voltage Minimum Setpoint Limit | 42228 | Float | 4 | R W | Percent | 70 - 120 |
| Generator Voltage Maximum Setpoint Limit | 42230 | Float | 4 | R W | Percent | 70 - 120 |
| Generator var Setpoint | 42232 | Float | 4 | R W | kilovar | Setpoint adjustment range determined by registers 42244 and 42246. |
| Generator var Traverse Rate | 42234 | Float | 4 | R W | Second | 10 - 200 |
| Generator var Pre-position Mode 1 | 42236 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator var Pre-position 1 | 42238 | Float | 4 | R W | kilovar | Setpoint adjustment range determined by registers 42244 and 42246. |
| Generator var Pre-position Mode 2 | 42240 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator var Pre-position 2 | 42242 | Float | 4 | R W | kilovar | Setpoint adjustment range determined by registers 42244 and 42246. |
| Generator var Minimum Setpoint Limit | 42244 | Float | 4 | R W | Percent | -100 – 100 |
| Generator var Maximum Setpoint Limit | 42246 | Float | 4 | R W | Percent | -100 – 100 |
| Generator PF Setpoint | 42248 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 42260 and 42262. |
| Generator PF Traverse Rate | 42250 | Float | 4 | R W | Second | 10 – 200 |
| Generator PF Pre-position Mode 1 | 42252 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator PF Pre-position 1 | 42254 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 42260 and 42262. |
| Generator PF Pre-position Mode 2 | 42256 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator PF Pre-position 2 | 42258 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 42260 and 42262. |
| Generator PF Minimum Setpoint Limit | 42260 | Float | 4 | R W | Power Factor | 0.5 – 1 |
| Generator PF Maximum Setpoint Limit | 42262 | Float | 4 | R W | Power Factor | -1 – -0.5 |
| FVR Setpoint | 42264 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42276 and 42278. |
| FVR Traverse Rate | 42266 | Float | 4 | R W | Second | 10 – 200 |
| FVR Pre-position Mode 1 | 42268 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| FVR Pre-position 1 | 42270 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42276 and 42278. |
| FVR Pre-position Mode 2 | 42272 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| FVR Pre-position 2 | 42274 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42276 and 42278. |
| FVR Minimum Setpoint Limit | 42276 | Float | 4 | R W | Percent | 0 - 150 |
| FVR Maximum Setpoint Limit | 42278 | Float | 4 | R W | Percent | 0 - 150 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--|----------|--------|-------|-----|--------------|---|
| Droop Value | 42280 | Float | 4 | R W | Percent | 0 - 30 |
| L-Drop Value | 42282 | Float | 4 | R W | Percent | 0 - 30 |
| Auxiliary Limit Enable | 42284 | Int32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Field Current Regulation Pre-position Mode 3 | 42286 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Field Current Regulation Pre-position 3 | 42288 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 42212 and 42214. |
| Generator Voltage Pre-position Mode 3 | 42290 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator Voltage Pre-position 3 | 42292 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42228 and 42230. |
| Generator var Pre-position Mode 3 | 42294 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator var Pre-position 3 | 42296 | Float | 4 | R W | kilovar | Setpoint adjustment range determined by registers 42244 and 42246. |
| Generator PF Pre-position Mode 3 | 42298 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| Generator PF Pre-position 3 | 42300 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 42260 and 42262. |
| FVR Pre-position Mode 3 | 42302 | Uint32 | 4 | R W | n/a | Maintain=0 Release=1 |
| FVR Pre-position 3 | 42304 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42276 and 42278. |
| Active Field Current Regulation Setpoint | 42306 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 42212 and 42214. |
| Active Generator Voltage Setpoint | 42308 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42228 and 42230. When the With Limits box is checked on the Auxiliary Input screen in BESTCOMSP _{Plus} , register 42308 equals register 42216 plus the Aux input. When the With Limits box is not checked on the Auxiliary Input screen in BESTCOMSP _{Plus} , register 42308 equals register 42216. |
| Active Generator var Setpoint | 42310 | Float | 4 | R W | kilovar | Setpoint adjustment range determined by registers 42244 and 42246. |
| Active Generator PF Setpoint | 42312 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 42260 and 42262. |
| Active FVR Setpoint | 42314 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 42276 and 42278. |
| Transient Boost Enable | 42316 | Int32 | 4 | R W | n/a | Disabled=0,Enabled=1 |
| Transient Boost, Fault Voltage Threshold | 42318 | Float | 4 | R W | Percent | 0 – 100 |
| Transient Boost, Fault Current Threshold | 42320 | Float | 4 | R W | Percent | 0 – 400 |
| Transient Boost, Minimum Fault Duration | 42322 | Float | 4 | R W | Second | 0 – 1 |
| Transient Boost, Voltage Setpoint Boosting Level | 42324 | Float | 4 | R W | Percent | 0 – 100 |
| Transient Boost, Clearing Voltage Threshold | 42326 | Float | 4 | R W | Percent | 0 – 50 |
| Transient Boost, Clearing Voltage Delay | 42328 | Float | 4 | R W | Second | 0 – 1 |

Global Settings

Table 30. Global Settings Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|----------------------------|------------------------------|----------|-------|-------|-----|------|----------|
| PLC Timed Element Settings | Logic Timer 1 Output Timeout | 42400 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 2 Output Timeout | 42402 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 3 Output Timeout | 42404 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 4 Output Timeout | 42406 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 5 Output Timeout | 42408 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 6 Output Timeout | 42410 | Float | 4 | R W | Sec | 0 - 1800 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|---------------------------------|--|----------|--------|-------|-----|--------|--|
| PLC Timed Element Settings | Logic Timer 7 Output Timeout | 42412 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 8 Output Timeout | 42414 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 9 Output Timeout | 42416 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 10 Output Timeout | 42418 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 11 Output Timeout | 42420 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 12 Output Timeout | 42422 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 13 Output Timeout | 42424 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 14 Output Timeout | 42426 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 15 Output Timeout | 42428 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Logic Timer 16 Output Timeout | 42430 | Float | 4 | R W | Sec | 0 - 1800 |
| PLC Timed Element Settings | Counter 1 Output Timeout | 42432 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 2 Output Timeout | 42434 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 3 Output Timeout | 42436 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 4 Output Timeout | 42438 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 5 Output Timeout | 42440 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 6 Output Timeout | 42442 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 7 Output Timeout | 42444 | Float | 4 | R W | n/a | 0 - 1800 |
| PLC Timed Element Settings | Counter 8 Output Timeout | 42446 | Float | 4 | R W | n/a | 0 - 1800 |
| DECS PSS | PSS Enable | 42448 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| DECS PSS | PSS Enable Status | 42450 | Uint32 | 4 | R | n/a | Off=0 On=1 |
| Synchronizer | Sync Type | 42452 | Uint32 | 4 | R W | n/a | Anticipatory=0 Phase Lock Loop=1 |
| Synchronizer | Slip Frequency | 42454 | Float | 4 | R W | Hz | 0.1 - 0.5 |
| Synchronizer | Generator Frequency Greater Than Bus Frequency | 42456 | Uint32 | 4 | R W | | Disabled=0 Enabled=1 |
| Synchronizer | Breaker Closing Angle | 42458 | Float | 4 | R W | Deg | 3 - 20 |
| Synchronizer | Sync Activation Delay | 42460 | Float | 4 | R W | Sec | 0.1 - 0.8 |
| Synchronizer | Generator Voltage Greater Than Bus Voltage | 42462 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Synchronizer | Sync Fail Activation Delay | 42464 | Float | 4 | R W | Sec | 0.1 - 600 |
| Synchronizer | Sync Speed Gain | 42466 | Float | 4 | R W | n/a | 0.001 - 1000 |
| Synchronizer | Sync Voltage Gain | 42468 | Float | 4 | R W | n/a | 0.001 - 1000 |
| Synchronizer | Voltage Window | 42470 | Float | 4 | R W | % | 2 - 15 |
| Synchronizer | Sys Option Input AutoSync Enabled | 42472 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Synchronizer | Max Slip Control Limit Hz | 42474 | Float | 4 | R W | Hz | 0 - 2 |
| Synchronizer | Min Slip Control Limit Hz | 42476 | Float | 4 | R W | Hz | 0 - 2 |
| Network Load Share | Load Share Enable | 42478 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Network Load Share | Load Share Droop Percent | 42480 | Float | 4 | R W | % | 0 - 30 |
| Network Load Share | Load Share Gain | 42482 | Float | 4 | R W | n/a | 0 - 1000 |
| Reserved | | 42484-87 | | | | | |
| Generator Current Configuration | Rotation | 42488 | Uint32 | 4 | R W | n/a | Forward=0 Reverse=1 |
| Synchronizer | Angle Compensation | 42490 | Float | 4 | R W | Degree | 0 – 359.9 |
| System Configuration | Operating Mode | 42492 | Int32 | 4 | R W | n/a | Generator=0 Motor=1 |

Relay Settings

Table 31. Relay Settings Group Parameters

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|----------------------|-------------------|----------|--------|-------|-----|------|-------------------|
| System Configuration | Nominal Frequency | 42600 | Uint32 | 4 | R W | n/a | 50 Hz=50 60 Hz=60 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|---------------------------|---|----------|--------|-------|-----|---------|--|
| System Configuration | DECS Auxiliary Summing Mode | 42602 | UInt32 | 4 | R W | n/a | Voltage=0 Var=1 |
| System Configuration | DECS Auxiliary Input Mode | 42604 | UInt32 | 4 | R W | n/a | Voltage=0 Current=1 |
| System Configuration | DECS Auxiliary Input Function | 42606 | UInt32 | 4 | R W | n/a | DECS Input=0 PSS Test Input=1 Limiter Selection=2 |
| System Configuration | DECS Auxiliary Voltage Gain | 42608 | Float | 4 | R W | n/a | -99 – 99 |
| System Configuration | DECS Auto Track Time Delay | 42610 | Float | 4 | R W | Second | 0 - 8 |
| System Configuration | DECS Auto Track Traverse Rate | 42612 | Float | 4 | R W | Second | 1 - 80 |
| System Configuration | DECS Null Balance Level | 42614 | Float | 4 | R W | Percent | 0 - 9999 |
| System Configuration | DECS Auto Trans Time Delay | 42616 | Float | 4 | R W | Second | 0 - 8 |
| System Configuration | DECS Auto Trans Traverse Rate | 42618 | Float | 4 | R W | Second | 1 - 80 |
| Gen Volt Configuration | Ratio Primary | 42620 | Float | 4 | R W | n/a | 1 - 500000 |
| Gen Volt Configuration | Ratio Secondary | 42622 | Float | 4 | R W | n/a | 1 - 600 |
| Gen Volt Configuration | Rated Primary LL | 42624 | Float | 4 | R W | Volt | 1 - 500000 |
| Bus Volt Configuration | Ratio Primary | 42626 | Float | 4 | R W | n/a | 1 - 500000 |
| Bus Volt Configuration | Ratio Secondary | 42628 | Float | 4 | R W | n/a | 1 - 600 |
| Bus Volt Configuration | Rated Primary LL | 42630 | Float | 4 | R W | Volt | 1 - 500000 |
| Gen Current Configuration | Ratio Primary | 42632 | Float | 4 | R W | n/a | 1 - 99999 |
| Gen Current Configuration | Ratio Secondary | 42634 | Int32 | 4 | R W | n/a | 1=1 5=5 |
| Gen Current Configuration | Rated Primary | 42636 | Float | 4 | R | Amp | 0 - 180000 |
| DECS Control | Start Stop Request | 42638 | UInt32 | 4 | R W | n/a | Stop=0 =1 Start =2 |
| DECS Control | System Option Underfrequency Hz | 42640 | Float | 4 | R W | Hertz | 40 - 75 |
| DECS Control | System Input COM Port Manual Enabled | 42642 | UInt32 | 4 | R W | n/a | Manual=1 Automatic=2 |
| DECS Control | System Input COM Port PF var Enabled | 42644 | UInt32 | 4 | R W | n/a | Off=0 PF=1 Var=2 |
| DECS Control | System Input COM Port External Tracking Enabled | 42646 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| DECS Control | System Input COM Port Pre-position Enabled | 42648 | UInt32 | 4 | R W | n/a | NOT SET=0 SET=1 |
| DECS Control | System Input COM Port Pre-position Enabled 2 | 42650 | UInt32 | 4 | R W | n/a | NOT SET=0 SET=1 |
| DECS Control | System Input COM Port Raise Enabled | 42652 | UInt32 | 4 | R W | n/a | NOT SET=0 Raise=1 |
| DECS Control | System Input COM Port Lower Enabled | 42654 | UInt32 | 4 | R W | n/a | NOT SET=0 Lower=1 |
| DECS Control | System Option Input Voltage Match Enabled | 42656 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| DECS Control | System Option Underfrequency Mode | 42658 | UInt32 | 4 | R W | n/a | UF Limiter=0 V/Hz Limiter=1 |
| DECS Control | System Option Limiter Mode | 42660 | UInt32 | 4 | R W | n/a | Off=0 UEL=1 OEL=2 UEL & OEL=3 SCL=4 UEL & SCL=5 OEL & SCL=6 UEL & OEL & SCL=7 |
| DECS Control | System Option Voltage Match Band | 42662 | Float | 4 | R W | Percent | 0 - 20 |
| DECS Control | System Option Voltage Match Reference | 42664 | Float | 4 | R W | Percent | 0 - 700 |
| DECS Control | System Option Underfrequency Slope | 42666 | Float | 4 | R W | n/a | 0 - 3 |
| DECS Control | Startup Primary Soft-start Bias | 42668 | Float | 4 | R W | Percent | 0 - 90 |

| Group | Name | Register | Type | Bytes | R/W | Unit | Range |
|--------------|--|----------|-------|-------|-----|---------|----------|
| DECS Control | Startup Primary Soft-start Time | 42670 | Float | 4 | R W | Second | 1 - 7200 |
| DECS Control | Startup Secondary Soft-start Bias | 42672 | Float | 4 | R W | Percent | 0 - 90 |
| DECS Control | Startup Secondary Soft-start Time | 42674 | Float | 4 | R W | Second | 1 - 7200 |
| DECS Control | System Option PF to Droop kW Threshold | 42676 | Float | 4 | R W | Percent | 0 - 30 |

Protection Settings

Table 32. Protection Settings Group Parameters

| Group | Name | Register | Type | Sz | R/W | Unit | Range |
|-----------------------|--|----------|--------|----|-----|------|-------------------------------|
| Field Overvoltage | Primary Mode | 43100 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Field Overvoltage | Primary Pickup | 43102 | Float | 4 | R W | V | Disabled=0, 1 - 325 |
| Field Overvoltage | Primary Time Delay | 43104 | Float | 4 | R W | ms | Instantaneous=0, 200 - 30000 |
| Field Overvoltage | Secondary Mode | 43106 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Field Overvoltage | Secondary Pickup | 43108 | Float | 4 | R W | V | Disabled=0, 1 - 325 |
| Field Overvoltage | Secondary Time Delay | 43110 | Float | 4 | R W | ms | Instantaneous=0, 200 - 30000 |
| Field Overcurrent | Primary Mode | 43112 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Field Overcurrent | Primary Pickup | 43114 | Float | 4 | R W | Amp | Disabled=0, 0 - 22 |
| Field Overcurrent | Primary Time Delay | 43116 | Float | 4 | R W | ms | Instantaneous=0, 5000 - 60000 |
| Field Overcurrent | Secondary Mode | 43118 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Field Overcurrent | Secondary Pickup | 43120 | Float | 4 | R W | Amp | Disabled=0, 0 - 22 |
| Field Overcurrent | Secondary Time Delay | 43122 | Float | 4 | R W | ms | Instantaneous=0, 5000 - 60000 |
| Exciter Diode Monitor | Exciter Open Diode Enable | 43124 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Exciter Diode Monitor | Exciter Shorted Diode Enable | 43126 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Exciter Diode Monitor | Exciter Diode Disable Level | 43128 | Float | 4 | R W | % | 0 - 100 |
| Exciter Diode Monitor | Exciter Open Diode Pickup | 43130 | Float | 4 | R W | % | 0 - 100 |
| Exciter Diode Monitor | Exciter Open Diode Time Delay | 43132 | Float | 4 | R W | Sec | 10 – 60 |
| Exciter Diode Monitor | Exciter Shorted Diode Pickup | 43134 | Float | 4 | R W | % | 0 - 100 |
| Exciter Diode Monitor | Exciter Shorted Diode Time Delay | 43136 | Float | 4 | R W | Sec | 5 – 30 |
| Exciter Diode Monitor | Exciter Pole Ratio | 43138 | Float | 4 | R W | n/a | Disabled=0, 1 – 10 |
| Power Input Failure | Mode | 43140 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Power Input Failure | Time Delay | 43142 | Float | 4 | R W | Sec | 0 - 10 |
| Loss Of Sensing | Mode | 43144 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| Loss Of Sensing | Time Delay | 43146 | Float | 4 | R W | Sec | 0 - 30 |
| Loss Of Sensing | Voltage Balanced Level | 43148 | Float | 4 | R W | % | 0 - 100 |
| Loss Of Sensing | Voltage Unbalanced Level | 43150 | Float | 4 | R W | % | 0 - 100 |
| 25 | Mode | 43152 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 25 | Slip Angle | 43156 | Float | 4 | R W | Deg | 1 - 99 |
| 25 | Slip Frequency | 43158 | Float | 4 | R W | Hz | 0.01 - 0.5 |
| 25 | Voltage Difference | 43160 | Float | 4 | R W | % | 0.1 - 50 |
| 25 | Generator Frequency Greater Than Bus Frequency | 43162 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 25 | Dead Voltage | 43164 | Float | 4 | R W | % | Disabled=0, 10 – 90 |
| 25 | Live Voltage | 43166 | Float | 4 | R W | % | Disabled=0, 10 – 90 |
| 25 | Dropout Delay | 43168 | Float | 4 | R W | ms | 50 – 60000 |
| 25 | Angle Compensation | 43170 | Float | 4 | R W | Deg | 0 – 359.9 |
| 25 | VMM Dead Line, Dead Aux | 43172 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 25 | VMM Dead Line, Live Aux | 43174 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 25 | VMM Live Line, Dead Aux | 43176 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 27P | Primary Mode | 43178 | Uint32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 27P | Primary Pickup | 43180 | Float | 4 | R W | V | Disabled=0, 1 - 600000 |
| 27P | Primary Time Delay | 43182 | Float | 4 | R W | ms | 100 - 60000 |

| Group | Name | Register | Type | Sz | R/W | Unit | Range |
|-------------------|-----------------------------------|----------|--------|----|-----|------|---------------------------------------|
| 27P | Secondary Mode | 43184 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 27P | Secondary Pickup | 43186 | Float | 4 | R W | V | Disabled=0, 1 - 600000 |
| 27P | Secondary Time Delay | 43188 | Float | 4 | R W | ms | 100 - 60000 |
| 59P | Primary Mode | 43190 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 59P | Primary Pickup | 43192 | Float | 4 | R W | V | Disabled=0, 0 - 600000 |
| 59P | Primary Time Delay | 43194 | Float | 4 | R W | ms | 100 - 60000 |
| 59P | Secondary Mode | 43196 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 59P | Secondary Pickup | 43198 | Float | 4 | R W | V | Disabled=0, 0 - 600000 |
| 59P | Secondary Time Delay | 43200 | Float | 4 | R W | ms | 100 - 60000 |
| 81O | Primary Mode | 43202 | UInt32 | 4 | R W | n/a | Disabled=0 Over=1 |
| 81O | Primary Pickup | 43204 | Float | 4 | R W | Hz | Disabled=0, 30 - 70 |
| 81O | Primary Time Delay | 43206 | Float | 4 | R W | ms | 100 - 300000 |
| 81O | Secondary Mode | 43208 | UInt32 | 4 | R W | n/a | Disabled=0 Over=1 |
| 81O | Secondary Pickup | 43210 | Float | 4 | R W | Hz | Disabled=0, 30 - 70 |
| 81O | Secondary Time Delay | 43212 | Float | 4 | R W | ms | 100 - 300000 |
| 81U | Primary Mode | 43214 | UInt32 | 4 | R W | n/a | Disabled=0 Under=2 |
| 81U | Primary Pickup | 43216 | Float | 4 | R W | Hz | Disabled=0, 30 - 70 |
| 81U | Primary Time Delay | 43218 | Float | 4 | R W | ms | 100 - 300000 |
| 81U | Primary Voltage Inhibit | 43220 | Float | 4 | R W | % | Disabled=0, 50 - 100 |
| 81U | Secondary Mode | 43222 | UInt32 | 4 | R W | n/a | Disabled=0 Under=2 |
| 81U | Secondary Pickup | 43224 | Float | 4 | R W | Hz | Disabled=0, 30 - 70 |
| 81U | Secondary Time Delay | 43226 | Float | 4 | R W | ms | 100 - 300000 |
| 81U | Secondary Voltage Inhibit | 43228 | Float | 4 | R W | % | Disabled=0, 50 - 100 |
| 40Q | Primary Mode | 43230 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 40Q | Primary Pickup | 43232 | Float | 4 | R W | % | Disabled=0, 0 - 150 |
| 40Q | Primary Time Delay | 43234 | Float | 4 | R W | ms | Instantaneous=0, 0 - 300000 |
| 40Q | Secondary Mode | 43236 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=1 |
| 40Q | Secondary Pickup | 43238 | Float | 4 | R W | % | Disabled=0, 0 - 150 |
| 40Q | Secondary Time Delay | 43240 | Float | 4 | R W | ms | Instantaneous=0, 0 - 300000 |
| 32R | Primary Mode | 43242 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=4 |
| 32R | Primary Pickup | 43244 | Float | 4 | R W | % | Disabled=0, 0 - 150 |
| 32R | Primary Time Delay | 43246 | Float | 4 | R W | ms | Instantaneous =0, 0 - 300000 |
| 32R | Secondary Mode | 43248 | UInt32 | 4 | R W | n/a | Disabled=0 Enabled=4 |
| 32R | Secondary Pickup | 43250 | Float | 4 | R W | % | Disabled=0, 0 - 150 |
| 32R | Secondary Time Delay | 43252 | Float | 4 | R W | ms | Instantaneous=0, 0 - 300000 |
| Field Overcurrent | Timing Mode, Protection Primary | 43254 | UInt32 | 4 | R W | n/a | Definite Timing=0 Inverse Timing=1 |
| Field Overcurrent | Time Dial, Protection Primary | 43256 | Float | 4 | R W | n/a | 0.1 – 20 |
| Field Overcurrent | Timing Mode, Protection Secondary | 43258 | UInt32 | 4 | R W | n/a | Definite Timing=0 Inverse Timing=1 |
| Field Overcurrent | Time Dial, Protection Secondary | 43260 | Float | 4 | R W | n/a | 0.1 – 20 |
| 24 | Primary Mode | 43262 | UInt32 | 4 | R W | n/a | Disabled=0, Enabled=1 |
| 24 | Primary Definite Time Pickup 1 | 43264 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Primary Definite Time Pickup 2 | 43266 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Primary Definite Time Delay 1 | 43268 | Float | 4 | R W | ms | 50 – 600000 |
| 24 | Primary Definite Time Delay 2 | 43270 | Float | 4 | R W | ms | 50 – 600000 |
| 24 | Primary Inverse Time Pickup | 43272 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Primary Time Dial Trip | 43274 | Float | 4 | R W | n/a | 0 – 9.9 |
| 24 | Primary Time Dial Reset | 43276 | Float | 4 | R W | n/a | 0 – 9.9 |
| 24 | Primary Curve Exponent | 43278 | UInt32 | 4 | R W | n/a | 0.5=0,1=1,2=2 |
| 24 | Secondary Mode | 43280 | UInt32 | 4 | R W | n/a | Disabled=0, Enabled=1 |

| Group | Name | Register | Type | Sz | R/W | Unit | Range |
|-------|----------------------------------|----------|--------|----|-----|------|---------------|
| 24 | Secondary Definite Time Pickup 1 | 43282 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Secondary Definite Time Pickup 2 | 43284 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Secondary Definite Time Delay 1 | 43286 | Float | 4 | R W | ms | 50 – 600000 |
| 24 | Secondary Definite Time Delay 2 | 43288 | Float | 4 | R W | ms | 50 – 600000 |
| 24 | Secondary Inverse Time Pickup | 43290 | Float | 4 | R W | n/a | 0.5 – 6 |
| 24 | Secondary Time Dial Trip | 43292 | Float | 4 | R W | n/a | 0 – 9.9 |
| 24 | Secondary Time Dial Reset | 43294 | Float | 4 | R W | n/a | 0 – 9.9 |
| 24 | Curve Exponent | 43296 | Uint32 | 4 | R W | n/a | 0.5=0,1=1,2=2 |

Gains Settings

Table 33. Gains Settings Group Parameters

| Name | Register | Type | Bytes | R/W | Unit | Range |
|-----------------------|----------|--------|-------|-----|------|--|
| Primary Gain Option | 43800 | Uint32 | 4 | R W | n/a | T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21 |
| Secondary Gain Option | 43802 | Uint32 | 4 | R W | n/a | T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21 |
| AVR Kp Primary | 43804 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Ki Primary | 43806 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Kd Primary | 43808 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Td Primary | 43810 | Float | 4 | R W | n/a | 0 - 1 |
| FCR Kp | 43812 | Float | 4 | R W | n/a | 0 - 1000 |
| FCR Ki | 43814 | Float | 4 | R W | n/a | 0 - 1000 |
| FCR Kd | 43816 | Float | 4 | R W | n/a | 0 - 1000 |
| FCR Td | 43818 | Float | 4 | R W | n/a | 0 - 1 |
| FVR Kp | 43820 | Float | 4 | R W | n/a | 0 - 1000 |
| FVR Ki | 43822 | Float | 4 | R W | n/a | 0 - 1000 |
| FVR Kd | 43824 | Float | 4 | R W | n/a | 0 - 1000 |
| FVR Td | 43826 | Float | 4 | R W | n/a | 0 - 1 |
| PF Ki | 43828 | Float | 4 | R W | n/a | 0 - 1000 |
| PF Kg | 43830 | Float | 4 | R W | n/a | 0 - 1000 |
| Var Ki | 43832 | Float | 4 | R W | n/a | 0 - 1000 |
| Var Kg | 43834 | Float | 4 | R W | n/a | 0 - 1000 |
| OEL Ki | 43836 | Float | 4 | R W | n/a | 0 - 1000 |
| OEL Kg | 43838 | Float | 4 | R W | n/a | 0 - 1000 |
| UEL Ki | 43840 | Float | 4 | R W | n/a | 0 - 1000 |
| UEL Kg | 43842 | Float | 4 | R W | n/a | 0 - 1000 |
| SCL Ki | 43844 | Float | 4 | R W | n/a | 0 - 1000 |
| SCL Kg | 43846 | Float | 4 | R W | n/a | 0 - 1000 |
| Vm Kg | 43848 | Float | 4 | R W | n/a | 0 - 1000 |
| Inner Loop Kp | 43850 | Float | 4 | R W | n/a | 0 - 1000 |
| Inner Loop Ki | 43852 | Float | 4 | R W | n/a | 0 - 1000 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|------------------|----------|-------|-------|-----|------|----------|
| AVR Kp Secondary | 43854 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Ki Secondary | 43856 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Kd Secondary | 43858 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Td Secondary | 43860 | Float | 4 | R W | n/a | 0 - 1 |
| Var Limit Ki | 43862 | Float | 4 | R W | n/a | 0 - 1000 |
| Var Limit Kg | 43864 | Float | 4 | R W | n/a | 0 - 1000 |
| AVR Primary Ka | 43866 | Float | 4 | R W | n/a | 0 - 1 |
| AVR Secondary Ka | 43868 | Float | 4 | R W | n/a | 0 - 1 |
| FCR Ka | 43870 | Float | 4 | R W | n/a | 0 - 1 |
| FVR Ka | 43872 | Float | 4 | R W | n/a | 0 - 1 |

Legacy Modbus

Table 34. Legacy Modbus Parameters

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|----------|-------|-------|-----|------|---------|
| Model Information Character 1 | 47001 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 2 | 47002 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 3 | 47003 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 4 | 47004 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 5 | 47005 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 6 | 47006 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 7 | 47007 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 8 | 47008 | UInt8 | 1 | R | n/a | n/a |
| Model Information Character 9 | 47009 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 1 | 47010 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 2 | 47011 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 3 | 47012 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 4 | 47013 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 5 | 47014 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 6 | 47015 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 7 | 47016 | UInt8 | 1 | R | n/a | n/a |
| Application Program Version Character 8 | 47017 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 1 | 47018 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 2 | 47019 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 3 | 47020 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 4 | 47021 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 5 | 47022 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 6 | 47023 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 7 | 47024 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 8 | 47025 | UInt8 | 1 | R | n/a | n/a |
| Application Version Date Character 9 | 47026 | UInt8 | 1 | R | n/a | n/a |
| Reserved | 47027-43 | UInt8 | 1 | R | n/a | 0 - 255 |
| Boot Program Version Character 1 | 47044 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 2 | 47045 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 3 | 47046 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 4 | 47047 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 5 | 47048 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 6 | 47049 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 7 | 47050 | UInt8 | 1 | R | n/a | n/a |
| Boot Program Version Character 8 | 47051 | UInt8 | 1 | R | n/a | n/a |
| Reserved | 47052-64 | UInt8 | 1 | R | n/a | 0 - 255 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|----------|--------|-------|-----|----------|---|
| RMS Generator Volts Phase A to B | 47251 | Float | 4 | R | n/a | n/a |
| RMS Generator Volts Phase B to C | 47253 | Float | 4 | R | n/a | n/a |
| RMS Generator Volts Phase C to A | 47255 | Float | 4 | R | n/a | n/a |
| Average RMS L-L Volts | 47257 | Float | 4 | R | n/a | n/a |
| Generator Current IB in amps | 47259 | Float | 4 | R | n/a | n/a |
| Generator Apparent Power in kVA | 47261 | Float | 4 | R | n/a | n/a |
| Generator Real Power in kW | 47263 | Float | 4 | R | n/a | n/a |
| Generator Reactive Power in kvar | 47265 | Float | 4 | R | n/a | n/a |
| Power Factor | 47267 | Float | 4 | R | n/a | n/a |
| Generator Frequency in Hertz | 47269 | Float | 4 | R | n/a | n/a |
| Bus Frequency in Hertz | 47271 | Float | 4 | R | n/a | n/a |
| RMS Bus Voltage in Volts | 47273 | Float | 4 | R | n/a | n/a |
| Field Voltage in Volts | 47275 | Float | 4 | R | n/a | n/a |
| Field Current in Amps | 47277 | Float | 4 | R | n/a | n/a |
| Var/PF Controller Output in Volts | 47279 | Float | 4 | R | Per Unit | n/a |
| Phase Angle Between Phase B Voltage and Current | 47281 | Float | 4 | R | n/a | n/a |
| Auxiliary Input in Volts | 47283 | Float | 4 | R | n/a | n/a |
| Current Input for Load Compensation | 47285 | Float | 4 | R | n/a | n/a |
| Null Balance in Percent | 47287 | Float | 4 | R | n/a | n/a |
| Error Signal to Autotracking Loop | 47289 | Float | 4 | R | n/a | n/a |
| Active Controller Output | 47291 | Float | 4 | R | n/a | n/a |
| PF State | 47293 | Uint16 | 2 | R | n/a | n/a |
| Generator State | 47294 | Uint16 | 2 | R | n/a | n/a |
| Status of Front Panel LEDs | 47295 | Uint16 | 2 | R | n/a | (bit flags, 0 = off, 1 = on for all LEDs except Null Balance and Internal Tracking, which are reversed): b0 = Null Balance, b1 = Tracking, b2 = Pre-position, b3 = Upper Limit, b4 = Lower Limit, b5 = Edit, b6-b15 = unassigned |
| Voltage Matching Status | 47296 | Uint16 | 2 | R | n/a | n/a |
| Protection Status Bit Flags 1 | 47297 | Uint16 | 2 | R | n/a | (0 = clear, 1 = condition present): b0 = field overvoltage, b1 = field overcurrent, b2 = gen. Undervoltage, b3 = gen. overvoltage, b4 = underfrequency, b5 = in OEL, b6 = in UEL, b7 = in FCR mode, b8 = loss of sensing voltage, b9 = setpoint at lower limit, b10 = setpoint at upper limit, b11 = gen. failed to build up, b12 = gen. below 10Hz, b13 = unassigned, b14 = exciter diode open, b15 = exciter diode shorted. |
| Reserved | 47298 | Float | 4 | R | n/a | n/a |
| Active Operating Setpoint in Percent | 47300 | Float | 4 | R | n/a | n/a |
| Contact Input States | 47302 | Uint16 | 2 | R | n/a | n/a |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---------------------------------------|-----------|-----------|-------|-----|---------|--|
| Annunciation Status Bit Flags 1 | 47303 | Uint16 | 2 | R | n/a | (0 = clear, 1 = annunciation present); b0 = field overvoltage, b1 = field overcurrent, b2 = gen. undervoltage, b3 = gen. overvoltage, b4 = underfrequency, b5 = in OEL, b6 = in UEL, b7 = in FCR, b8 = loss of sensing voltage, b9 = setpoint at lower limit, b10 = setpoint at upper limit, b11 = gen. failed to build up, b12 = gen. below 10Hz, b13 = unassigned, b14 = exciter diode open, b15 = exciter diode shorted |
| Reserved 3 | 47304 | Float | 4 | R | n/a | n/a |
| Protection Status Bit Flags 2 | 47306 | Uint16 | 2 | R | n/a | (0 = clear, 1 = condition present) b0 = loss of field, b1 = in SCL, b2 – b15 are unassigned |
| Annunciation Status Bit Flags 2 | 47307 | Uint16 | 2 | R | n/a | (0 = clear, 1 = condition present) b0 = loss of field, b1 = in SCL, b2 – b15 are unassigned |
| Reserved 4 | 47308-375 | C2 Filler | 136 | n/a | n/a | n/a |
| Reserved 5 | 47376-499 | C3 Filler | 248 | n/a | n/a | n/a |
| Auxiliary Input Function | 47500 | Uint16 | 2 | n/a | n/a | DECS Input=0 PSS Test Input=1 Limiter Selection=2 |
| Generator Rated Frequency | 47501 | Uint32 | 4 | R W | n/a | 50 Hz=50 60 Hz=60 |
| Generator PT Primary Voltage Rating | 47503 | Float | 4 | R W | n/a | 1 - 500000 |
| Generator PT Secondary Voltage Rating | 47505 | Float | 4 | R W | n/a | 1 - 600 |
| Generator CT Primary Current Rating | 47507 | Float | 4 | R W | n/a | 1 - 99999 |
| Generator CT Secondary Current Rating | 47509 | Int32 | 4 | R W | n/a | 1=1 5=5 |
| Not used in DECS-250N | 47511 | Float | 4 | R W | n/a | |
| Reserved Float 1 | 47513 | Float | 4 | R | n/a | 0 - 10000 |
| Bus Sensing PT Primary Rating | 47515 | Float | 4 | R W | n/a | 1 - 500000 |
| Bus Sensing PT Secondary Rating | 47517 | Float | 4 | R W | n/a | 1 - 600 |
| Reserved 6 | 47519 | Float | 4 | R | n/a | n/a |
| Reserved 7 | 47521 | Float | 4 | R | n/a | n/a |
| Generator Rated Voltage | 47523 | Float | 4 | R W | Volt | 1 - 500000 |
| Generator Rated Current | 47525 | Float | 4 | R | Amp | 0 – 180000 |
| Generator Rated Field Voltage | 47527 | Float | 4 | R W | Volt | 1 – 250 if the unit is a DECS-250N with power configuration style #3. |
| Generator Rated Field Current | 47529 | Float | 4 | R W | Amp | 1 – 20 |
| Nominal Bus Voltage | 47531 | Float | 4 | R W | Volt | 1 - 500000 |
| Auxiliary Input Gain for AVR Mode | 47533 | Float | 4 | R W | n/a | -99 – 99 |
| Time Delay Before Autotracking | 47535 | Float | 4 | R W | Second | 0 – 8 |
| Traverse Rate of Autotracking | 47537 | Float | 4 | R W | Second | 1 – 80 |
| Not used in DECS-250N | 47539 | Float | 4 | R W | n/a | |
| Gain for Cross Current Compensation | 47541 | Float | 4 | R W | Percent | -30 – 30 |
| Sensing Mode | 47543 | Uint16 | 2 | R W | | 1-phase (A-C)=0 3-phase=1 |
| Auxiliary Input Summing Mode | 47544 | Uint16 | 2 | R W | | Voltage=0 Var=1 |
| Not used in DECS-250N | 47545 | Uint16 | 2 | R | n/a | n/a |
| Reserved 8 | 47546 | Uint16 | 2 | R | n/a | n/a |
| Auxiliary Input Mode | 47547 | Uint16 | 2 | R W | | Voltage=0 Current=1 |
| For Future Use | 47548 | Uint16 | 2 | R | n/a | n/a |
| External Tracking Time Delay | 47549 | Float | 4 | R W | Second | 0 - 8 |
| External Tracking Traverse Rate | 47551 | Float | 4 | R W | Second | 1 – 80 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|-----------|-----------|-------|-----|--------------|---|
| Reserved 29 | 47553 | UInt16 | 2 | R | n/a | n/a |
| Auxiliary Input Gain for FCR Mode | 47554 | Float | 4 | R W | n/a | -99 – 99 |
| Auxiliary Input Gain for VAR Mode | 47556 | Float | 4 | R W | n/a | -99 – 99 |
| Auxiliary Input Gain for PF Mode | 47558 | Float | 4 | R W | n/a | -99 – 99 |
| Reserved 9 | 47560 | UInt16 | 2 | R | n/a | n/a |
| Unit Mode Virtual Toggle | 47561 | UInt16 | 2 | R W | n/a | An entry of '1' toggles through the following modes: Stop, Start |
| Control Mode Virtual Toggle | 47562 | UInt16 | 2 | R W | n/a | An entry of '1' toggles through the following modes: Manual, Automatic |
| Operating Mode Virtual Switch | 47563 | UInt16 | 2 | R W | n/a | Off=0 PF=1 Var=2 |
| Auto Track Enabled Status | 47564 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Pre-position Enable | 47565 | UInt16 | 2 | R W | n/a | =0 SET=1 |
| Raise Enabled Status | 47566 | UInt16 | 2 | R W | n/a | =0 Raise=1 |
| Lower Enabled Status | 47567 | UInt16 | 2 | R W | n/a | =0 Lower=1 |
| External Tracking Enable Status | 47568 | UInt16 | 2 | R | n/a | Off=0 Enabled=1 |
| Limiter Mode Options | 47569 | UInt16 | 2 | R W | n/a | Off=0 UEL=1 OEL=2 UEL & OEL=3 SCL=4 UEL & SCL=5 OEL & SCL=6 UEL & OEL & SCL=7 |
| Voltage Match Mode | 47570 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Operating Mode Status | 47571 | UInt16 | 2 | R | n/a | n/a |
| Unit Mode Status | 47572 | UInt16 | 2 | R | n/a | n/a |
| Control Mode Status | 47573 | UInt16 | 2 | R | n/a | FCR=1 AVR=2 |
| Internal Tracking Status | 47574 | UInt16 | 2 | R | n/a | Off=0 Enabled=1 |
| Pre-position Enable Status | 47575 | UInt16 | 2 | R | n/a | n/a |
| Autotransfer Status | 47576 | UInt16 | 2 | R | n/a | Primary=0 Secondary=1 |
| Load Compensation Mode Status | 47577 | UInt16 | 2 | R | n/a | Off=0 Droop=1 Line Drop=2 |
| Load Compensation Mode Select | 47578 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Alarm Reset Enable | 47579 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Loss-of-Sensing Detection Enable | 47580 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Loss-of-Sensing Triggered Transfer-to-FCR-mode Enable | 47581 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Underfrequency or V/Hz Mode Enable | 47582 | UInt16 | 2 | R W | n/a | UF Limiter=0 V/Hz Limiter=1 |
| External Tracking Enabled | 47583 | UInt16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| OEL Style Virtual Toggle | 47584 | UInt16 | 2 | R W | n/a | Summing=0 Takeover=1 |
| Reserved 16bit 32 | 47585 | UInt16 | 2 | R W | n/a | 0 - 65535 |
| PF/var Option Status | 47586 | UInt16 | 2 | R | n/a | Off=0 PF=1 var=2 |
| Reserved 10 | 47587-620 | C5 Filler | 68 | n/a | n/a | n/a |
| FCR Mode Setpoint | 47621 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 47655 and 47663. |
| AVR Mode Setpoint | 47623 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 47657 and 47665. |
| Var Mode Setpoint in kvar | 47625 | Float | 4 | R W | kvar | Setpoint adjustment range determined by registers 47659 and 47667. |
| PF Mode Setpoint | 47627 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 47661 and 47669. |
| Droop Setting in Percent | 47629 | Float | 4 | R W | Percent | 0 - 30 |
| FCR Mode Traverse Rate | 47631 | Float | 4 | R W | Second | 10 - 200 |
| AVR Mode Traverse Rate | 47633 | Float | 4 | R W | Second | 10 - 200 |
| Var Mode Traverse Rate | 47635 | Float | 4 | R W | Second | 10 - 200 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--|----------|--------|-------|-----|--------------|---|
| PF Mode Traverse Rate | 47637 | Float | 4 | R W | Second | 10 - 200 |
| FCR Mode Setpoint Pre-Position | 47639 | Float | 4 | R W | Amp | Setpoint adjustment range determined by registers 47655 and 47663. |
| AVR Mode Setpoint Pre-Position | 47641 | Float | 4 | R W | Volt | Setpoint adjustment range determined by registers 47657 and 47665. |
| Var Mode Setpoint Pre-Position in kvar | 47643 | Float | 4 | R W | Kvar | Setpoint adjustment range determined by registers 47659 and 47667. |
| PF Mode Setpoint Pre-Position | 47645 | Float | 4 | R W | Power Factor | Setpoint adjustment range determined by registers 47661 and 47669. |
| FCR Mode Setpoint Step Size | 47647 | Float | 4 | R | n/a | n/a |
| AVR Mode Setpoint Step Size | 47649 | Float | 4 | R | n/a | n/a |
| Var Mode Setpoint Step Size | 47651 | Float | 4 | R | n/a | n/a |
| PF Mode Setpoint Step Size | 47653 | Float | 4 | R | n/a | n/a |
| FCR Mode Setpoint Adjustable Minimum | 47655 | Float | 4 | R W | Percent | 0 - 120 |
| AVR Mode Setpoint Adjustable Minimum | 47657 | Float | 4 | R W | Percent | 70 - 120 |
| Var Mode Setpoint Adjustable Minimum | 47659 | Float | 4 | R W | Percent | -100 – 100 |
| PF Mode Setpoint Adjustable Minimum | 47661 | Float | 4 | R W | Power Factor | 0.5 - 1 |
| FCR Mode Setpoint Adjustable Maximum | 47663 | Float | 4 | R W | Percent | 0 - 120 |
| AVR Mode Setpoint Adjustable Maximum | 47665 | Float | 4 | R W | Percent | 70 - 120 |
| Var Mode Setpoint Adjustable Maximum | 47667 | Float | 4 | R W | Percent | -100 – 100 |
| PF Mode Setpoint Adjustable Maximum | 47669 | Float | 4 | R W | Power Factor | -1 – -0.5 |
| Minimum Value for FCR Adjustable Maximum | 47671 | Float | 4 | R | n/a | n/a |
| Minimum Value for AVR Adjustable Maximum | 47673 | Float | 4 | R | n/a | n/a |
| Minimum Value for Var Adjustable Maximum | 47675 | Float | 4 | R | n/a | n/a |
| Mini Value for PF Adjustable Max | 47677 | Float | 4 | R | n/a | n/a |
| Max Value for FCR Adjustable Max | 47679 | Float | 4 | R | n/a | n/a |
| Max Value for AVR Adjustable Max | 47681 | Float | 4 | R | n/a | n/a |
| Max Value for Var Adjustable Max | 47683 | Float | 4 | R | n/a | n/a |
| Max Value for PF Adjustable Max | 47685 | Float | 4 | R | n/a | n/a |
| Step Size for FCR Adjustable Max | 47687 | Float | 4 | R | n/a | n/a |
| Step Size for AVR Adjustable Max | 47689 | Float | 4 | R | n/a | n/a |
| Step Size for Var Adjustable Max | 47691 | Float | 4 | R | n/a | n/a |
| Step Size for PF Adjustable Max | 47693 | Float | 4 | R | n/a | n/a |
| FCR Pre-Position Mode | 47695 | Uint16 | 2 | R W | n/a | Maintain=0 Release=1 |
| AVR Pre-Position Mode | 47696 | Uint16 | 2 | R W | n/a | Maintain=0 Release=1 |
| Var Pre-Position Mode | 47697 | Uint16 | 2 | R W | n/a | Maintain=0 Release=1 |
| PF Pre-Position Mode | 47698 | Uint16 | 2 | R W | n/a | Maintain=0 Release=1 |
| FCR Minimum Setpoint | 47699 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47655 and 47529. |
| AVR Minimum Setpoint | 47701 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47657 and 47525. |
| Var Minimum Setpoint | 47703 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47659 and Rated VA. |
| PF Minimum Setpoint | 47705 | Float | 4 | R | n/a | Range determined by register 47661. |
| FCR Maximum Setpoint | 47707 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47663 and 47529. |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|-----------|-----------|-------|-----|----------|---|
| AVR Maximum Setpoint | 47709 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47665 and 47525. |
| Var Maximum Setpoint | 47711 | Float | 4 | R | n/a | Setpoint adjustment range determined by registers 47667 and Rated VA. |
| PF Maximum Setpoint | 47713 | Float | 4 | R | n/a | Range determined by register 47669. |
| Reserved 11 | 47715-740 | C6 Filler | 52 | n/a | n/a | n/a |
| Soft Start Threshold | 47741 | Float | 4 | R W | Percent | 0 - 90 |
| Soft Start Duration | 47743 | Float | 4 | R W | Second | 1 - 7200 |
| Underfrequency Corner Frequency | 47745 | Float | 4 | R W | Hertz | 40 - 75 |
| Slope of Underfrequency Curve | 47747 | Float | 4 | R W | n/a | 0 - 3 |
| Width of Voltage Matching Window | 47749 | Float | 4 | R W | Percent | 0 - 20 |
| Voltage Matching Reference | 47751 | Float | 4 | R W | Percent | 0 - 700 |
| Fine Voltage Adjust Band | 47753 | Float | 4 | R W | Percent | 0 - 30 |
| Time Required for Loss of Sensing | 47755 | Float | 4 | R W | Second | 0 - 30 |
| Loss of Sensing Level Under Balanced Conditions | 47757 | Float | 4 | R W | Percent | 0 - 100 |
| Loss of Sensing Level Under Unbalanced Conditions | 47759 | Float | 4 | R W | Percent | 0 - 100 |
| Reserved 12 | 47761-800 | C7 Filler | 80 | n/a | n/a | n/a |
| On-line High OEL Level | 47801 | Float | 4 | R W | Amp | 0 - 30 |
| Time Allowed for On-line High OEL Level | 47803 | Float | 4 | R W | Second | 0 - 10 |
| On-line Medium OEL Level | 47805 | Float | 4 | R W | Amp | 0 - 20 |
| Time Allowed for On-line Medium OEL Level | 47807 | Float | 4 | R W | Second | 0 - 120 |
| On-line Low OEL Level | 47809 | Float | 4 | R W | Amp | 0 - 15 |
| Reserved 13 | 47811 | Float | 4 | R W | var | 0 - 99 |
| Time Allowed for Off-line High OEL | 47813 | Float | 4 | R W | Second | 0 - 10 |
| Off-line High OEL Level | 47815 | Float | 4 | R W | Amp | 0 - 30 |
| Off-line Low OEL Level | 47817 | Float | 4 | R W | Amp | 0 - 15 |
| First UEL Point kW Value | 47819 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| Second UEL Point kW Value | 47821 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| Third UEL Point kW Value | 47823 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| Fourth UEL Point kW Value | 47825 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| Fifth UEL Point kW Value | 47827 | Float | 4 | R W | kilowatt | 0 – 1.5 • Rated kVA |
| First UEL Point kvar Value | 47829 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| Second UEL Point kvar Value | 47831 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| Third UEL Point kvar Value | 47833 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| Fourth UEL Point kvar Value | 47835 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| Fifth UEL Point kvar Value | 47837 | Float | 4 | R W | kilovar | 0 – 1.5 • Rated kVA |
| SCL High Limit Level | 47839 | Float | 4 | R W | Amp | 0 - 66000 |
| Time Allowed at SCL High Limit Level | 47841 | Float | 4 | R W | Second | 0 - 60 |
| SCL Low Limit Level | 47843 | Float | 4 | R W | Amp | 0 - 66000 |
| Takeover OEL Offline High Limit Level | 47845 | Float | 4 | R W | Amp | 0 - 30 |
| Takeover OEL Offline Low Limit Level | 47847 | Float | 4 | R W | Amp | 0 - 15 |
| Takeover OEL Offline Time Dial | 47849 | Float | 4 | R W | n/a | 0.1 - 20 |
| Takeover OEL Online High Limit Level | 47851 | Float | 4 | R W | Amp | 0 - 30 |
| Takeover OEL Online Low Limit Level | 47853 | Float | 4 | R W | Amp | 0 - 15 |
| Takeover OEL Online Time Dial | 47855 | Float | 4 | R W | n/a | 0.1 - 20 |
| Reserved 14 | 47857-860 | C8 Filler | 8 | n/a | n/a | n/a |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|-----------|-----------|-------|-----|-------------|--|
| Index into Table of Gain Constants | 47861 | Float | 4 | R W | n/a | 1 - 21 |
| Primary AVR Mode Proportional Gain | 47863 | Float | 4 | R W | n/a | 0 - 1000 |
| Primary AVR Mode Integral Gain | 47865 | Float | 4 | R W | n/a | 0 - 1000 |
| Primary AVR Mode Derivative Gain | 47867 | Float | 4 | R W | n/a | 0 - 1000 |
| OEL Integral Gain: Ki | 47869 | Float | 4 | R W | n/a | 0 - 1000 |
| PF Mode Integral Gain: Ki | 47871 | Float | 4 | R W | n/a | 0 - 1000 |
| Var Mode Integral Gain: Ki | 47873 | Float | 4 | R W | n/a | 0 - 1000 |
| FCR Mode Loop Gain: Ka | 47875 | Float | 4 | R W | n/a | 0 - 1000 |
| Primary AVR Mode Loop Gain: Ka | 47877 | Float | 4 | R W | n/a | 0 - 1000 |
| Var Mode Loop Gain: Kg | 47879 | Float | 4 | R W | n/a | 0 - 1000 |
| PF Mode Loop Gain: Kg | 47881 | Float | 4 | R W | n/a | 0 - 1000 |
| OEL Loop Gain: Kg | 47883 | Float | 4 | R W | n/a | 0 - 1000 |
| UEL Loop Gain: Kg | 47885 | Float | 4 | R W | n/a | 0 - 1000 |
| UEL Integral Gain: Ki | 47887 | Float | 4 | R W | n/a | 0 - 1000 |
| Voltage Matching Loop Gain: Kg | 47889 | Float | 4 | R W | n/a | 0 - 1000 |
| Primary AVR Mode Derivative Time Constant: Td | 47891 | Float | 4 | R W | n/a | 0 - 1 |
| Secondary Gain Option Index | 47893 | Uint32 | 4 | R W | n/a | T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21 |
| Secondary AVR Mode Proportional Gain - Kp | 47895 | Float | 4 | R W | n/a | 0 - 1000 |
| Secondary AVR Mode Integral Gain - Ki | 47897 | Float | 4 | R W | n/a | 0 - 1000 |
| Secondary AVR Mode Derivative Gain - Kd | 47899 | Float | 4 | R W | n/a | 0 - 1000 |
| Secondary AVR Mode Loop Gain - Kg | 47901 | Float | 4 | R W | n/a | 0 - 1000 |
| Secondary AVR Derivative Time Constant - Td | 47903 | Float | 4 | R W | n/a | 0 - 1 |
| Active Gain Setting Group | 47905 | Uint16 | 2 | R | n/a | n/a |
| SCL Loop Gain - Kg | 47906 | Float | 4 | R W | n/a | 0 - 1000 |
| SCL Integral Gain - Ki | 47908 | Float | 4 | R W | n/a | 0 - 1000 |
| Reserved 14 | 47910-920 | C9 Filler | 22 | n/a | n/a | n/a |
| Field Overvoltage Level | 47921 | Float | 4 | R W | Volt | Disabled=0, 1 - 325 |
| Field Overcurrent Base Level | 47923 | Float | 4 | R W | Amp | Disabled=0, 0 - 22 |
| Stator Undervoltage Level | 47925 | Float | 4 | R W | Volt | Disabled=0, 1 - 600000 |
| Stator Overvoltage Level | 47927 | Float | 4 | R W | Volt | Disabled=0, 0 - 600000 |
| Field Overvoltage Delay | 47929 | Float | 4 | R W | Millisecond | Disabled=0, 200 - 30000 |
| Overcurrent Delay | 47931 | Float | 4 | R W | Millisecond | Disabled=0, 5000 - 60000 |
| Stator Undervoltage Delay | 47933 | Float | 4 | R W | Millisecond | 100 - 60000 |
| Stator Overvoltage Delay | 47935 | Float | 4 | R W | Millisecond | 100 - 60000 |
| Field Overvoltage Alarm Enable | 47937 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Field Overcurrent Alarm Enable | 47938 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Stator Undervoltage Alarm Enable | 47939 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Stator Overvoltage Alarm Enable | 47940 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|---|------------|--------------|-------|-----|-------------|--|
| Reserved 15 | 47941 | Float | 4 | R | n/a | n/a |
| Reserved 16 | 47943 | Float | 4 | R | n/a | n/a |
| Reserved 17 | 47945 | Uint16 | 2 | R | n/a | n/a |
| Exciter Open Diode Ripple Pickup Level | 47946 | Float | 4 | R W | Percent | 0 - 100 |
| Exciter Open Diode Time Delay | 47948 | Float | 4 | R W | Second | 10 - 60 |
| Exciter Open Diode Protection Enable | 47950 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Exciter Shorted Diode Ripple Pickup Level | 47951 | Float | 4 | R W | Percent | 0 - 100 |
| Exciter Shorted Diode Time Delay | 47953 | Float | 4 | R W | Second | 5 - 30 |
| Exciter Shorted Diode Protection Enable | 47955 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| EDM Protection Disable Level | 47956 | Float | 4 | R W | Percent | 0 - 100 |
| Loss of Field Alarm Enable | 47958 | Uint16 | 2 | R W | n/a | Disabled=0 Enabled=1 |
| Loss of Field Pickup Level | 47959 | Float | 4 | R W | Percent | Disabled=0, 0 - 150 |
| Loss of Field Time Delay | 47961 | Float | 4 | R W | Millisecond | Instantaneous=0, 0 - 300000 |
| Reserved 18 | 47963-980 | C10 Filler | 36 | n/a | n/a | n/a |
| Reserved 19 | 47981-8040 | C11 Filler | 120 | n/a | n/a | n/a |
| Reserved 16 bit 1 | 48041 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Reserved 16 bit 2 | 48042 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Reserved 20 | 48043-056 | Annun Filler | 28 | R | n/a | n/a |
| Output for Relay 1 | 48057 | Uint16 | 2 | R | n/a | n/a |
| Reserved | 48058-76 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Output for Relay 2 | 48077 | Uint16 | 2 | R | n/a | n/a |
| Reserved | 48078-96 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Output for Relay 3 | 48097 | Uint16 | 2 | R | n/a | n/a |
| Reserved 16 bit 13 | 48098-116 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Output for Relay 4 | 48117 | Uint16 | 2 | R | n/a | n/a |
| Reserved 16 bit 18 | 48118-136 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Output for Relay 5 | 48137 | Uint16 | 2 | R | n/a | n/a |
| Reserved 16 bit 23 | 48138-141 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Reserved 16 bit 26 | 48161 | Uint16 | 2 | R | n/a | 0 - 65535 |
| Reserved 16 bit 27 | 48162 | Uint16 | 2 | R | n/a | 0 - 65535 |
| RS-232 Baud Rate | 48163 | Uint16 | 2 | R W | n/a | 1200 Baud=1200 2400 Baud=2400 4800 Baud=4800 9600 Baud=9600 19200 Baud=19200 38400 Baud=38400 57600 Baud=57600 |
| RS-485 Baud Rate | 48164 | Uint16 | 2 | R W | n/a | 1200 Baud=1200 2400 Baud=2400 4800 Baud=4800 9600 Baud=9600 19200 Baud=19200 38400 Baud=38400 57600 Baud=57600 |
| RS485 Parity | 48165 | Uint16 | 2 | R W | n/a | Even Parity=0 Odd Parity=1 No Parity=2 |
| RS485 Stop Bits | 48166 | Uint16 | 2 | R W | n/a | 1 Stop Bit=1 2 Stop Bits=2 |
| Polling Address | 48167 | Uint16 | 2 | R W | n/a | 1 - 247 |
| Modbus Response Time Delay | 48168 | Uint16 | 2 | R W | Millisecond | 10 - 10000 |
| Reserved 26 | 48169-220 | C13 Filler | 104 | n/a | n/a | n/a |

| Name | Register | Type | Bytes | R/W | Unit | Range |
|--------------------|-----------|------------|-------|-----|------|--------------------|
| Reserved 16 bit 29 | 48221-223 | Uint16 | 2 | R W | n/a | 0 - 65535 |
| Reserved | 48224-250 | C14 Filler | | n/a | n/a | n/a |
| Reserved | 48251-508 | C15 Filler | | n/a | n/a | n/a |
| Pole Ratio | 48509-510 | Float | 4 | R W | n/a | Disabled=0, 1 - 10 |



PROFIBUS Communication

On units equipped with the PROFIBUS communication protocol (style xxxxxxP), the DECS-250N sends and receives PROFIBUS data through a DB-9 port located on the right side panel.

Refer to the *Communication* chapter for PROFIBUS communication settings in BESTCOMS^{Plus}® and the *Terminals and Connectors* chapter for wiring.

The DECS-250N utilizes PROFIBUS DP (Decentralized Peripherals) to operate sensors and actuators via a centralized controller in production (factory) automation applications.

Per IEC 61158, PROFIBUS, consists of digitized signals transmitted over a simple, two-wire bus. It is intended to replace the industry-standard, 4 to 20 mA signal used in the transmission of system parameters. PROFIBUS expands the amount of information shared by system devices and makes the exchange of data faster and more efficient.

Data Types

Float/UINT32

Parameters listed in Table 40 as Float or UINT32 types are “Input 2 word” (4 byte) parameters. The Network Byte Order setting allows the byte order of these parameters to be set to MSB first or LSB first. This setting can be found by using the following navigation paths.

BESTCOMS^{Plus} Navigation Path: Settings Explorer, Communications, Profibus Setup

HMI Navigation Path: Settings, Communications, Profibus Setup

UINT8

Parameters listed in Table 40 as UINT8 types are bit-packed binary data. This allows transmission of up to eight single-bit parameters in each byte of data. When configuring an instance of UINT8 type parameters, the data type is “Input 1 byte” and the size is determined by the number of parameters in the instance divided by eight, rounding up to the next integer. Table 35 illustrates the sizes of the UINT8 cyclic data instances.

Table 35. Instance Data Size Calculation

| Instance Number | Number of Parameters in the Instance | Number of Parameters Divided by Eight | Total Data Size |
|-----------------|--------------------------------------|---------------------------------------|-----------------|
| 6 | 5 | 0.625 | 1 byte |
| 7 | 7 | 0.875 | 1 byte |
| 8 | 5 | 0.625 | 1 byte |
| 9 | 6 | 0.75 | 1 byte |
| 10 | 16 | 2 | 2 bytes |
| 11 | 12 | 1.5 | 2 bytes |
| 12 | 8 | 1 | 1 byte |

Within these instances, the data is packed in the order listed in Table 40. The first item is the lowest bit of the first byte. If there are unused bits, they are filled with a value of zero. Parameters of UINT8 type are not affected by the DECS-250N Network Byte Order setting. The examples, below, show the bit packing order for instances 8 (Controller Status Cyclic) and 11 (Local Contact Outputs Cyclic).

Example 1: Bit Packing Order for Instance 8

The total data size of Instance 8 is one byte. Table 36 shows the parameters of instance 8 as they appear in Table 40. The first parameter in instance 8, with key name DECSCONTROL_IN_AVR_MODE, is represented by the lowest bit in the byte (bit 0). Bit 1 represents the next parameter with key name

DECSCONTROL_IN_FCR_MODE and so on. The three highest bits in this instance are unused and thus always return a value of zero.

Table 36. Instance 8 Parameters

| Instance Name | Inst. # | Type | RW | Key Name | Range |
|--------------------------|---------|-------|----|-------------------------|----------------------------------|
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL_IN_AVR_MODE | Not in AVR mode=0, In AVR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL_IN_FCR_MODE | Not in FCR mode=0, In FCR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL_IN_FVR_MODE | Not in FVR mode=0, In FVR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL_IN_PF_MODE | Not in PF mode=0, In PF mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL_IN_VAR_MODE | Not in var mode=0, In var mode=1 |

Table 37 shows the bit number of each parameter in instance 8 and an example packet returned from a DECS-250N. Reading a value of 0x02 (0000 0010) for instance 8 indicates that the device is operating in FCR mode.

Table 37. Instance 8 Bit Order

| Instance Number | Bit Number | Key Name | Packet Returned from DECS-250N |
|-----------------|------------|-------------------------|--------------------------------|
| 8 | 0 | DECSCONTROL_IN_AVR_MODE | 0 |
| | 1 | DECSCONTROL_IN_FCR_MODE | 1 |
| | 2 | DECSCONTROL_IN_FVR_MODE | 0 |
| | 3 | DECSCONTROL_IN_PF_MODE | 0 |
| | 4 | DECSCONTROL_IN_VAR_MODE | 0 |
| | 5 | 0 (unused) | 0 |
| | 6 | 0 (unused) | 0 |
| | 7 | 0 (unused) | 0 |

Example 2: Bit Packing Order for Instance 11

The total size of Instance 11 is two bytes. Table 38 shows the parameters of instance 11 as they appear in Table 40. The first parameter in instance 11, with key name CONTACTOUTPUTS_WATCHDOGOUTPUT, is represented by the lowest bit in the first byte (bit 0). The ninth parameter, with key name CONTACTOUTPUTS_OUTPUT8, is represented by the lowest bit in the second byte (bit 0). The four highest bits in the second byte are unused and thus always return a value of zero.

Table 38. Instance 11 Parameters

| Instance Name | Inst. # | Type | RW | Key Name | Range |
|------------------------------|---------|-------|----|-------------------------------|------------------|
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_WATCHDOGOUTPUT | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT1 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT2 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT3 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT4 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT5 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT6 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT7 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT8 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT9 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT10 | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS_OUTPUT11 | Open=0, Closed=1 |

Table 39 shows the bit number of each parameter in instance 11 and an example packet returned from a DECS-250N. Reading a value of 0xA4 06 (1010 0100 0000 0110) for instance 11 indicates that contact outputs 2, 5, 7, 9, and 10 are closed. The first byte is 1010 0100 and the second is 0000 0110.

Table 39. Instance 11 Bit Order

| Instance Number | Byte Number | Bit Number | Key Name | Packet Returned from DECS-250N |
|-----------------|-------------|------------|-------------------------|--------------------------------|
| 11 | 1 | 0 | CONTACTOUTPUTS_WATCHDOG | 0 |
| | | 1 | CONTACTOUTPUTS_OUTPUT1 | 0 |
| | | 2 | CONTACTOUTPUTS_OUTPUT2 | 1 |
| | | 3 | CONTACTOUTPUTS_OUTPUT3 | 0 |
| | | 4 | CONTACTOUTPUTS_OUTPUT4 | 0 |
| | | 5 | CONTACTOUTPUTS_OUTPUT5 | 1 |
| | | 6 | CONTACTOUTPUTS_OUTPUT6 | 0 |
| | | 7 | CONTACTOUTPUTS_OUTPUT7 | 1 |
| | 2 | 0 | CONTACTOUTPUTS_OUTPUT8 | 0 |
| | | 1 | CONTACTOUTPUTS_OUTPUT9 | 1 |
| | | 2 | CONTACTOUTPUTS_OUTPUT10 | 1 |
| | | 3 | CONTACTOUTPUTS_OUTPUT11 | 0 |
| | | 4 | 0 (unused) | 0 |
| | | 5 | 0 (unused) | 0 |
| | | 6 | 0 (unused) | 0 |
| | | 7 | 0 (unused) | 0 |

Setup

The following steps are provided to assist in setting up the DECS-250N as a slave on a PROFIBUS network. Please refer to the documentation included with your PLC configuration software for installation and operation instructions.

1. Download the DECS-250N GSD file from the Basler website: www.basler.com

2. Using PLC configuration software, import the DECS-250N GSD file. This allows the DECS-250N to be included in the bus configuration as a slave.
3. Assign a unique PROFIBUS address to the DECS-250N. This allows the master to exchange data with the DECS-250N.
4. Select modules from the DECS-250N GSD file to be part of the data exchange. Selecting the cyclic parameters is recommended. The cyclic parameters are comprised of the first 12 instances in the PROFIBUS parameters table (Table 40). The first 25 parameters, which make up the first five instances, are float types. The next 59 parameters, which make up the last seven instances of cyclic parameters, are UINT8 types.
5. Set each selected module to an address in the master's memory bank.
6. Compile and download the configuration to the master before going online.

When the PROFIBUS network is initialized, the master connects to each slave checking for address mismatches and sending configuration data. The configuration data is sent so that the master and slave agree on the data exchange to occur. Then, the master begins polling each slave in a cyclic order.

Note

It is not possible to write a portion of an instance by specifying a length smaller than the size of the instance. To modify a single parameter, read the entire instance, update the desired parameter, and write the entire instance back to the device.

PROFIBUS Parameters

PROFIBUS parameters are listed in Table 40. Instances with names ending in “cyclic” are automatically transmitted at a periodic rate. All other instances are acyclic and transmitted only when requested by the PLC.

Table 40. PROFIBUS Parameters

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------------|---------|-------|----|---------------------|------|----------------------|
| Gen Metering Cyclic | 1 | Float | R | VAB GG | V | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | VBC GG | V | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | VCA GG | V | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | IA GG | Amp | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | IB GG | Amp | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | IC GG | Amp | 0 - 2000000000 |
| Gen Metering Cyclic | 1 | Float | R | Freq GG | Hz | 10 - 180 |
| Gen Metering Cyclic | 1 | Float | R | Total Watts AVG GG | Watt | -3.00E+14 - 3.00E+14 |
| Gen Metering Cyclic | 1 | Float | R | Total Vars AVG GG | Var | -3.00E+14 - 3.00E+14 |
| Gen Metering Cyclic | 1 | Float | R | Total S GG | VA | -3.00E+14 - 3.00E+14 |
| Gen Metering Cyclic | 1 | Float | R | Total PF GG | PF | -1 - 1 |
| Bus Metering Cyclic | 2 | Float | R | VAB GG | V | 0 - 2000000000 |
| Bus Metering Cyclic | 2 | Float | R | VBC GG | V | 0 - 2000000000 |
| Bus Metering Cyclic | 2 | Float | R | VCA GG | V | 0 - 2000000000 |
| Bus Metering Cyclic | 2 | Float | R | Freq GG | Hz | 10 - 180 |
| Field Metering Cyclic | 3 | Float | R | VX GG | V | -1000 - 1000 |
| Field Metering Cyclic | 3 | Float | R | IX GG | Amp | 0 - 2000000000 |
| Setpoint Metering Cyclic | 4 | Float | R | Gen Vol Setpoint GG | V | 84 - 144 |
| Setpoint Metering Cyclic | 4 | Float | R | Exc Cur Setpoint GG | Amp | 0 - 12 |
| Setpoint Metering Cyclic | 4 | Float | R | Exc Vol Setpoint GG | V | 0 - 75 |
| Setpoint Metering Cyclic | 4 | Float | R | Gen Var Setpoint GG | kvar | 0 - 41.57 |
| Setpoint Metering Cyclic | 4 | Float | R | Gen Pf Setpoint GG | PF | 0.5 - -0.5 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|------------------------------|---------|-------|----|---|------|--|
| Synchronizer Metering Cyclic | 5 | Float | R | Slip Angle GG | Deg | -359.9 - 359.9 |
| Synchronizer Metering Cyclic | 5 | Float | R | Slip Freq GG | Hz | n/a |
| Synchronizer Metering Cyclic | 5 | Float | R | Voltage Diff GG | V | n/a |
| Limiter Status Cyclic | 6 | UINT8 | R | ALARMS OEL ALM | | Not Active=0, Active=1 |
| Limiter Status Cyclic | 6 | UINT8 | R | ALARMS UEL ALM | | Not Active=0, Active=1 |
| Limiter Status Cyclic | 6 | UINT8 | R | ALARMS SCL ALM | | Not Active=0, Active=1 |
| Limiter Status Cyclic | 6 | UINT8 | R | ALARMS VAR LIMITER ACTIVE | | Not Active=0, Active=1 |
| Limiter Status Cyclic | 6 | UINT8 | R | ALARMS UNDERFREQUENCYVHZ ALM | | Not Active=0, Active=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSCONTROL DECS NULL BALANCE | | Not Active=0, Active=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSPSSMETER DECS PSS ACTIVE | | Not Active=0, Active=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSREGULATORMETER DECS INTERNAL TRACKING ACTIVE | | Not Active=0, Active=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSCONTROL DECS PREPOSITION | | Active setpoint is not at a pre-position value=0, Active setpoint is at a pre-position value=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSREGULATORMETER SETPOINT AT LOWER LIMIT | | Active setpoint is not at minimum value=0, Active setpoint is at minimum value=1 |
| HMI Indicators Cyclic | 7 | UINT8 | R | DECSREGULATORMETER SETPOINT AT UPPER LIMIT | | Active setpoint is not at maximum value=0, Active setpoint is at maximum value=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL IN AVR MODE | | Not in AVR mode=0, In AVR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL IN FCR MODE | | Not in FCR mode=0, In FCR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL IN FVR MODE | | Not in FVR mode=0, In FVR mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL IN PF MODE | | Not in PF mode=0, In PF mode=1 |
| Controller Status Cyclic | 8 | UINT8 | R | DECSCONTROL IN VAR MODE | | Not in var mode=0, In var mode=1 |
| System Status Cyclic | 9 | UINT8 | R | DECSCONTROL DECS START STOP | | Stopped=0, Started=1 |
| System Status Cyclic | 9 | UINT8 | R | ALARMS IFLIMIT | | No field short circuit condition=0, Field short circuit condition=1 |
| System Status Cyclic | 9 | UINT8 | R | DECSCONTROL DECS SOFT START ACTIVE | | Not in soft start=0, In soft start=1 |
| System Status Cyclic | 9 | UINT8 | R | ALARMREPORT ALARMOUTPUT | | No active alarms=0, Active alarms=1 |
| System Status Cyclic | 9 | UINT8 | R | DECSCONTROL DECS PF VAR ENABLE 52 J K | | PF/var not enabled via PLC=0, PF/var enabled via PLC=1 |
| System Status Cyclic | 9 | UINT8 | R | DECSCONTROL DECS PARALLEL ENABLE 52 L M | | Parallel not enabled via PLC=0, Parallel enabled via PLC=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS STARTINPUT | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS STOPINPUT | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT1 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT2 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT3 | | Open=0, Closed=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------------------|---------|-------|----|--|------|--|
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT4 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT5 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT6 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT7 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT8 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT9 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT10 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT11 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT12 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT13 | | Open=0, Closed=1 |
| Local Contact Inputs Cyclic | 10 | UINT8 | R | CONTACTINPUTS INPUT14 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS WATCHDOGOUTPUT | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT1 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT2 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT3 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT4 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT5 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT6 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT7 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT8 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT9 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT10 | | Open=0, Closed=1 |
| Local Contact Outputs Cyclic | 11 | UINT8 | R | CONTACTOUTPUTS OUTPUT11 | | Open=0, Closed=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS SOFT START SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS PSS SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS OEL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS UEL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS SCL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS PROTECT SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS PID SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| Settings Group Indication Cyclic | 12 | UINT8 | R | DECSCONTROL DECS VAR LIMITER SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-------------------------|---------|-------|----|--------------------------------|---------|----------------------|
| Gen Metering | 16 | Float | R | VAB GG (Gen Voltage Magnitude) | V | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | VBC GG (Gen Voltage Magnitude) | V | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | VCA GG (Gen Voltage Magnitude) | V | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | VAB GG (Gen Voltage Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | VBC GG (Gen Voltage Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | VCA GG (Gen Voltage Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | IA GG (Gen Current Magnitude) | Amp | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | IB GG (Gen Current Magnitude) | Amp | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | IC GG (Gen Current Magnitude) | Amp | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | IA GG (Gen Current Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | IB GG (Gen Current Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | IC GG (Gen Current Angle) | Deg | 0 - 360 |
| Gen Metering | 16 | Float | R | IAVG GG | Amp | 0 - 2000000000 |
| Gen Metering | 16 | Float | R | Freq GG | Hz | 10 - 180 |
| Gen Metering Per Unit | 17 | Float | R | vab pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | vbc pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | vca pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | vavg pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | ia pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | ib pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | ic pu GG | No Unit | -10 - 10 |
| Gen Metering Per Unit | 17 | Float | R | iavg pu GG | No Unit | -10 - 10 |
| Power Metering | 18 | Float | R | TOTAL WATTS AVG GG | Watt | -3.00E+14 - 3.00E+14 |
| Power Metering | 18 | Float | R | TOTAL VARS AVG GG | Var | -3.00E+14 - 3.00E+14 |
| Power Metering | 18 | Float | R | TOTAL S GG | VA | -3.00E+14 - 3.00E+14 |
| Power Metering | 18 | Float | R | TOTAL PF GG | PF | -1 - 1 |
| Power Metering | 18 | Float | R | POS WATT HOUR TOTAL GG | Wh | 0.00E+00 - 1.00E+09 |
| Power Metering | 18 | Float | R | POS VAR HOUR TOTAL GG | VARh | 0.00E+00 - 1.00E+09 |
| Power Metering | 18 | Float | R | NEG WATT HOUR TOTAL GG | Wh | -1.00E+09 - 0.00E+00 |
| Power Metering | 18 | Float | R | NEG VAR HOUR TOTAL GG | VARh | -1.00E+09 - 0.00E+00 |
| Power Metering Per Unit | 19 | Float | R | kw pu GG | No Unit | -10 - 10 |
| Power Metering Per Unit | 19 | Float | R | kva pu GG | No Unit | -10 - 10 |
| Power Metering Per Unit | 19 | Float | R | kvar pu GG | No Unit | -10 - 10 |
| Bus Metering | 20 | Float | R | VAB GG (Bus Voltage Magnitude) | V | 0 - 2000000000 |
| Bus Metering | 20 | Float | R | VBC GG (Bus Voltage Magnitude) | V | 0 - 2000000000 |
| Bus Metering | 20 | Float | R | VCA GG (Bus Voltage Magnitude) | V | 0 - 2000000000 |
| Bus Metering | 20 | Float | R | VAB GG (Bus Voltage Angle) | Deg | 0 - 360 |
| Bus Metering | 20 | Float | R | VBC GG (Bus Voltage Angle) | Deg | 0 - 360 |
| Bus Metering | 20 | Float | R | VCA GG (Bus Voltage Angle) | Deg | 0 - 360 |
| Bus Metering | 20 | Float | R | Freq GG | Hz | 10 - 180 |
| Bus Metering Per Unit | 21 | Float | R | bus vab pu GG | No Unit | -10 - 10 |
| Bus Metering Per Unit | 21 | Float | R | bus vbc pu GG | No Unit | -10 - 10 |
| Bus Metering Per Unit | 21 | Float | R | bus vca pu GG | No Unit | -10 - 10 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|------------------------------------|---------|-------|----|---|---------|---|
| Bus Metering Per Unit | 21 | Float | R | bus vavg pu GG | No Unit | -10 - 10 |
| Field Metering | 22 | Float | R | VX GG | V | -1000 - 1000 |
| Field Metering | 22 | Float | R | IX GG | Amp | 0 - 2000000000 |
| Field Metering | 22 | Float | R | EDM RIPPLE PERCENT GG | % | n/a |
| PSS Metering | 23 | Float | R | V1 GG | V | 0 - 2000000000 |
| PSS Metering | 23 | Float | R | V2 GG | V | 0 - 2000000000 |
| PSS Metering | 23 | Float | R | I1 GG | Amp | 0 - 2000000000 |
| PSS Metering | 23 | Float | R | I2 GG | Amp | 0 - 2000000000 |
| PSS Metering | 23 | Float | R | TERM FREQ DEV GG | No Unit | n/a |
| PSS Metering | 23 | Float | R | COMP FREQ DEV GG | No Unit | n/a |
| PSS Metering | 23 | Float | R | PSS OUTPUT GG | No Unit | n/a |
| PSS Metering Per Unit | 24 | Float | R | pos seq v pu GG | No Unit | -10 - 10 |
| PSS Metering Per Unit | 24 | Float | R | neg seq v pu GG | No Unit | -10 - 10 |
| PSS Metering Per Unit | 24 | Float | R | pos seq i pu GG | No Unit | -10 - 10 |
| PSS Metering Per Unit | 24 | Float | R | neg seq i pu GG | No Unit | -10 - 10 |
| Synchronization | 25 | Float | R | Slip Angle GG | Deg | -359.9 - 359.9 |
| Synchronization | 25 | Float | R | Slip Freq GG | Hz | n/a |
| Synchronization | 25 | Float | R | Voltage Diff GG | V | n/a |
| Aux Input Metering | 26 | Float | R | Value GG (Aux Input Voltage) | V | -9999999 - 9999999 |
| Aux Input Metering | 26 | Float | R | Value GG (Aux Input Current) | Amp | -9999999 - 9999999 |
| Tracking | 27 | Float | R | TRACKING ERROR GG | % | n/a |
| Tracking Status | 28 | UINT8 | R | DECSREGULATORMETER DECS INTERNAL TRACKING ACTIVE | | Not active=0, Active=1 |
| Tracking Status | 28 | UINT8 | R | DECSREGULATORMETER DECS EXTERNAL TRACKING ACTIVE | | Not active=0, Active=1 |
| Tracking Status | 28 | UINT8 | R | DECSCONTROL DECS NULL BALANCE | | Not active=0, Active=1 |
| Control Panel Setpoint Metering | 29 | Float | R | Gen Vol Setpoint GG | V | 84 - 144 |
| Control Panel Setpoint Metering | 29 | Float | R | Exc Cur Setpoint GG | Amp | 0 - 12 |
| Control Panel Setpoint Metering | 29 | Float | R | Exc Vol Setpoint GG | V | 0 - 75 |
| Control Panel Setpoint Metering | 29 | Float | R | Gen Var Setpoint GG | kvar | 0 – 41.57 |
| Control Panel Setpoint Metering | 29 | Float | R | Gen Pf Setpoint GG | PF | 0.5 – -0.5 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS START STOP | | Stopped=0, Started=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS IS IN AUTOMATIC MODE | | Not in automatic=0, In automatic=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS IS IN MANUAL MODE | | Not in manual=0, In manual=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS FCR CONTROLLER ACTIVE | | FCR not active=0, FCR active=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS FVR CONTROLLER ACTIVE | | FVR not active=0, FVR active=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS VAR CONTROLLER ACTIVE | | VAR not active=0, VAR active=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS PF CONTROLLER ACTIVE | | PF not active=0, PF active=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS PREPOSITION 1 ACTIVE | | Active setpoint is not at pre- position 1 value=0, Active setpoint is at pre-position 1 value=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------|---------|-------|----|--|------|---|
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS PREPOSITION 2 ACTIVE | | Active setpoint is not at pre- position 2 value=0, Active setpoint is at pre-position 2 value=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS PREPOSITION 3 ACTIVE | | Active setpoint is not at pre- position 3 value=0, Active setpoint is at pre-position 3 value=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH1 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH2 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH3 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH4 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH5 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | VIRTUALSWITCH VIRTUALSWITCH6 | | Open=0, Closed=1 |
| Control Panel Status | 30 | UINT8 | R | ALARMREPORT ALARMOUTPUT | | No active alarms=0, Active alarms=1 |
| Control Panel Status | 30 | UINT8 | R | DECSPSSMETER DECS PSS ACTIVE | | PSS not active=0, PSS active=1 |
| Control Panel Status | 30 | UINT8 | R | DECSCONTROL DECS NULL BALANCE | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | ALARMS OEL ALM | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | ALARMS UEL ALM | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | ALARMS SCL ALM | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | ALARMS VAR LIMITER ACTIVE | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | ALARMS VOLTAGE MATCHING ACTIVE | | Not active=0, Active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS SOFT START SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PSS SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS OEL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS UEL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS SCL SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PROTECT SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PID SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS VAR LIMITER SELECT SECONDARY SETTINGS | | Primary settings active=0, Secondary settings active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PREPOSITION | | Active setpoint is not at a pre- position value=0, Active setpoint is at a pre-position value=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS VAR CONTROLLER ACTIVE | | VAR not active=0, VAR active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PF CONTROLLER ACTIVE | | PF not active=0, PF active=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|------------------------|---------|-------|----|---|--------|--|
| System Status | 31 | UINT8 | R | DECSCONTROL DECS AUTO MODE ENABLE | | Auto mode not enabled via PLC=0, Auto mode enabled via PLC=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS MANUAL MODE ENABLE | | Manual mode not enabled via PLC=0, Manual mode enabled via PLC=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS FVR CONTROLLER ACTIVE | | FVR not active=0, FVR active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS FCR CONTROLLER ACTIVE | | FCR not active=0, FCR active=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS FIELD FLASHING IN PROGRESS | | Field flashing not in progress=0, Field flashing in progress=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS IS IN MANUAL MODE | | Not in manual=0, In manual=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS IS IN AUTOMATIC MODE | | Not in automatic=0, In automatic=1 |
| System Status | 31 | UINT8 | R | DECSCONTROL DECS PSS OUTPUT DISABLE | | PSS not disabled via PLC=0, PSS disabled via PLC=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS STARTINPUT | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS STOPINPUT | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT1 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT2 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT3 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT4 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT5 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT6 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT7 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT8 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT9 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT10 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT11 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT12 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT13 | | Open=0, Closed=1 |
| Contact Input Status | 32 | UINT8 | R | CONTACTINPUTS INPUT14 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 1 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 2 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 3 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 4 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 5 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 6 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 7 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 8 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 9 | | Open=0, Closed=1 |
| CEM Input Status | 33 | UINT8 | R | CEM INPUT 10 | | Open=0, Closed=1 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput1RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput2RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput3RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput4RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput5RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput6RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput7RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput8RawValue GG | V / mA | 0 - 10 V or 4 - 20 mA |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-------------------------|---------|-------|----|------------------------------------|---------|--|
| AEM Analog Input Meter | 34 | Float | R | AnalogInput1ScaledValue GG | No Unit | -9999 - 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput2ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput3ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput4ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput5ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput6ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput7ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Meter | 34 | Float | R | AnalogInput8ScaledValue GG | No Unit | -9999 – 9999 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 1 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 2 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 3 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 4 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 5 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 6 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 7 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMCONFIG AEM INPUT 8 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION1 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION1 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION1 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION1 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION2 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION2 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION2 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION2 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION3 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION3 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION3 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION3 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION4 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION4 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION4 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION4 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION5 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION5 THRESH2 TRIP | | Not tripped=0, Tripped=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-------------------------|---------|-------|----|------------------------------------|-------|--|
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION5 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION5 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION6 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION6 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION6 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION6 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION7 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION7 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION7 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION7 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION8 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION8 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION8 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM Analog Input Status | 35 | UINT8 | R | AEMPROTECTION8 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Meter | 36 | Float | R | RtdInput1RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput2RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput3RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput4RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput5RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 ohms (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput6RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput7RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 ohms (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput8RawValue GG | Ohm | 7.1 – 18.73 or 80.31 – 194.1 (cu or pt) |
| AEM RTD Input Meter | 36 | Float | R | RtdInput1ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput2ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput3ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput4ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput5ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput6ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput7ScaledValue GG | Deg F | n/a |
| AEM RTD Input Meter | 36 | Float | R | RtdInput8ScaledValue GG | Deg F | n/a |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 1 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 2 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 3 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 4 OUT OF RANGE | | Value in range=0, Value out of range=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------|---------|-------|----|------------------------------------|------|--|
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 5 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 6 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 7 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | AEMCONFIG RTD INPUT 8 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION1 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION1 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION1 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION1 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION2 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION2 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION2 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION2 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION3 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION3 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION3 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION3 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION4 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION4 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION4 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION4 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION5 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION5 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION5 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION5 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION6 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION6 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION6 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION6 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION7 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION7 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION7 THRESH3 TRIP | | Not tripped=0, Tripped=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------------|---------|-------|----|---|-------|---|
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION7 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION8 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION8 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION8 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM RTD Input Status | 37 | UINT8 | R | RTDPROTECTION8 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Meter | 38 | Float | R | ThermInput1RawValue GG | mV | n/a |
| AEM TC Input Meter | 38 | Float | R | ThermInput2RawValue GG | mV | n/a |
| AEM TC Input Meter | 38 | Float | R | ThermInput1ScaledValue GG | Deg F | n/a |
| AEM TC Input Meter | 38 | Float | R | ThermInput2ScaledValue GG | Deg F | n/a |
| AEM TC Input Status | 39 | UINT8 | R | AEMCONFIG THERMAL COUPLE 1 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM TC Input Status | 39 | UINT8 | R | AEMCONFIG THERMAL COUPLE 2 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION1 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION1 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION1 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION1 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION2 THRESH1 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION2 THRESH2 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION2 THRESH3 TRIP | | Not tripped=0, Tripped=1 |
| AEM TC Input Status | 39 | UINT8 | R | THERMPROTECTION2 THRESH4 TRIP | | Not tripped=0, Tripped=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS WATCHDOGOUTPUT | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT1 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT2 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT3 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT4 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT5 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT6 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT7 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT8 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT9 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT10 | | Open=0, Closed=1 |
| Contact Output Status | 40 | UINT8 | R | CONTACTOUTPUTS OUTPUT11 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 1 | | Open=0, Closed=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------------|---------|-------|----|----------------------------------|---------|--|
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 2 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 3 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 4 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 5 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 6 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 7 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 8 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 9 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 10 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 11 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 12 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 13 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 14 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 15 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 16 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 17 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 18 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 19 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 20 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 21 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 22 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 23 | | Open=0, Closed=1 |
| CEM Output Status | 41 | UINT8 | R | CEM OUTPUT 24 | | Open=0, Closed=1 |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput1RawValue GG | No Unit | 0 – 10 V or 4 – 20 mA |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput2RawValue GG | No Unit | 0 – 10 V or 4 – 20 mA |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput3RawValue GG | No Unit | 0 – 10 V or 4 – 20 mA |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput4RawValue GG | No Unit | 0 – 10 V or 4 – 20 mA |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput1ScaledValue GG | No Unit | n/a |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput2ScaledValue GG | No Unit | n/a |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput3ScaledValue GG | No Unit | n/a |
| AEM Analog Output Meter | 42 | Float | R | AnalogOutput4ScaledValue GG | No Unit | n/a |
| AEM Analog Output Status | 43 | UINT8 | R | REMOTEANALOGOUTPUT1 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Output Status | 43 | UINT8 | R | REMOTEANALOGOUTPUT2 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Output Status | 43 | UINT8 | R | REMOTEANALOGOUTPUT3 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| AEM Analog Output Status | 43 | UINT8 | R | REMOTEANALOGOUTPUT4 OUT OF RANGE | | Value in range=0, Value out of range=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT1 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT1 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT1 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT1 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT2 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT2 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------|---------|------------|----|------------------------------------|---------|--------------------------|
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT2 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT2 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT3 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT3 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT3 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT3 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT4 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT4 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT4 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT4 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT5 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT5 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT5 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT5 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT6 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT6 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT6 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT6 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT7 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT7 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT7 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT7 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT8 CONFPROTTHRESH1TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT8 CONFPROTTHRESH2TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT8 CONFPROTTHRESH3TRIP | | Not tripped=0, Tripped=1 |
| Config. Prot. Status | 44 | UINT8 | R | CONFIGPROT8 CONFPROTTHRESH4TRIP | | Not tripped=0, Tripped=1 |
| Real Time Clock | 45 | String | R | Date GG | | 0 – 25 characters |
| Real Time Clock | 45 | String | R | Time GG | | 0 – 25 characters |
| Front Panel Settings | 46 | UINT3 2 | R | LCD Contrast GG | % | 0 - 100 |
| Front Panel Settings | 46 | UINT3 2 | R | LCD Invert Display GG | No Unit | NO=0 YES=1 |
| Front Panel Settings | 46 | UINT3 2 | R | LCD Sleep Mode GG | No Unit | DISABLED=0 ENABLED=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------------------|---------|--------|-----|--|---------|--|
| Front Panel Settings | 46 | UINT32 | R | LCD Backlight Timeout GG | Sec | 1 - 120 |
| Front Panel Settings | 46 | UINT32 | R | LCD Language Selection GG | No Unit | English=0 Chinese=1 Russian=2 Spanish=4 German=5 |
| Front Panel Settings | 46 | UINT32 | R | Enable Scroll GG | No Unit | DISABLED=0 ENABLED=1 |
| Front Panel Settings | 46 | UINT32 | R | Scroll Time Delay GG | Sec | 1 - 600 |
| 250 Device Info App Version | 47 | String | R | External Version GG | No Unit | 0 - 25 characters |
| 250 Device Info Boot Version | 48 | String | R | External Boot Version GG | No Unit | 0 - 25 characters |
| 250 Device Info App Build Date | 49 | String | R | App Build Date GG | No Unit | 0 - 25 characters |
| 250 Device Info Serial | 50 | String | R | Serial Num GG | No Unit | 0 - 25 characters |
| 250 Device Info App Part Num | 51 | String | R | Firmware Part Number GG | No Unit | 0 - 25 characters |
| 250 Device Info Model | 52 | String | R | Model Number GG | No Unit | 0 - 25 characters |
| AEM Device Info App Version | 53 | String | R | App Version Num GG | No Unit | 0 - 25 characters |
| AEM Device Info Boot Version | 54 | String | R | Boot Version Num GG | No Unit | 0 - 25 characters |
| AEM Device Info Build Date | 55 | String | R | App Build Date GG | No Unit | 0 - 25 characters |
| AEM Device Info Serial | 56 | String | R | Serial Num GG | No Unit | 0 - 25 characters |
| AEM Device Info App Part Num | 57 | String | R | App Part Num GG | No Unit | 0 - 25 characters |
| AEM Device Info Model | 58 | String | R | Model Num GG | No Unit | 0 - 25 characters |
| CEM Device Info App Version | 59 | String | R | App Version Num GG | No Unit | 0 - 25 characters |
| CEM Device Info Boot Version | 60 | String | R | Boot Version Num GG | No Unit | 0 - 25 characters |
| CEM Device Info App Build Date | 61 | String | R | App Build Date GG | No Unit | 0 - 25 characters |
| CEM Device Info Serial | 62 | String | R | Serial Num GG | No Unit | 0 - 25 characters |
| CEM Device Info App Part Num | 63 | String | R | App Part Num GG | No Unit | 0 - 25 characters |
| CEM Device Info Model | 64 | String | R | Model Num GG | No Unit | 0 - 25 characters |
| System Param | 65 | UINT32 | R/W | NOM FREQ GG | No Unit | 50 Hz=50 60 Hz=60 |
| System Param | 66 | Float | R/W | Rated Primary LL GG (Gen Voltage Config) | V | 1 – 500000 |
| System Param | 66 | Float | R/W | Rated Primary LL GG (Bus Voltage Config) | V | 1 - 500000 |
| System Param | 66 | Float | R/W | Rated PF GG | PF | 0.5 – -0.5 |
| System Param | 66 | Float | R/W | Rated KVA GG | KVA | 1 - 1000000 |
| System Param | 66 | Float | R/W | Rated Field Volt Full Load GG | V | 1 - 250 |
| System Param | 66 | Float | R/W | Rated Field Volt No Load GG | V | 1 - 250 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|-------------------------------|---------|----------------------|
| System Param | 66 | Float | R/W | Rated Field Curr Full Load GG | Amp | 0.1 - 15 |
| System Param | 66 | Float | R/W | Rated Field Curr No Load GG | Amp | 0.1 - 15 |
| System Param | 66 | Float | R/W | Exciter Pole Ratio GG | No Unit | 1 - 10 |
| AVR Setpoints | 67 | UINT32 | R/W | Gen Vol Prepos Mode1 GG | No Unit | Maintain=0 Release=1 |
| AVR Setpoints | 67 | UINT32 | R/W | Gen Vol Prepos Mode2 GG | No Unit | Maintain=0 Release=1 |
| AVR Setpoints | 67 | UINT32 | R/W | Gen Vol Prepos Mode3 GG | No Unit | Maintain=0 Release=1 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Traverse Rate GG | Sec | 10 - 200 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Setpoint GG | V | 84 - 144 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Min Setpoint Limit GG | % | 70 - 120 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Max Setpoint Limit GG | % | 70 - 120 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Preposition1 GG | V | 84 - 144 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Preposition2 GG | V | 84 - 144 |
| AVR Setpoints | 68 | Float | R/W | Gen Vol Preposition3 GG | V | 84 - 144 |
| FCR Setpoints | 69 | UINT32 | R/W | Exc Cur Prepos Mode1 GG | No Unit | Maintain=0 Release=1 |
| FCR Setpoints | 69 | UINT32 | R/W | Exc Cur Prepos Mode2 GG | No Unit | Maintain=0 Release=1 |
| FCR Setpoints | 69 | UINT32 | R/W | Exc Cur Prepos Mode3 GG | No Unit | Maintain=0 Release=1 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Traverse Rate GG | Sec | 10 - 200 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Setpoint GG | Amp | 0 - 12 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Min Setpoint Limit GG | % | 0 - 120 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Max Setpoint Limit GG | % | 0 - 120 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Preposition1 GG | Amp | 0 - 12 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Preposition2 GG | Amp | 0 - 12 |
| FCR Setpoints | 70 | Float | R/W | Exc Cur Preposition3 GG | Amp | 0 - 12 |
| FVR Setpoints | 71 | UINT32 | R/W | Exc Vol Prepos Mode1 GG | No Unit | Maintain=0 Release=1 |
| FVR Setpoints | 71 | UINT32 | R/W | Exc Vol Prepos Mode2 GG | No Unit | Maintain=0 Release=1 |
| FVR Setpoints | 71 | UINT32 | R/W | Exc Vol Prepos Mode3 GG | No Unit | Maintain=0 Release=1 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Traverse Rate GG | Sec | 10 - 200 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|--------------------------------|---------|----------------------|
| FVR Setpoints | 72 | Float | R/W | Exc Vol Setpoint GG | V | 0 - 75 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Min Setpoint Limit GG | % | 0 - 150 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Max Setpoint Limit GG | % | 0 - 150 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Preposition1 GG | V | 0 - 75 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Preposition2 GG | V | 0 - 75 |
| FVR Setpoints | 72 | Float | R/W | Exc Vol Preposition3 GG | V | 0 - 75 |
| VAR Setpoints | 73 | UINT32 | R/W | Gen Var Prepos Mode1 GG | No Unit | Maintain=0 Release=1 |
| VAR Setpoints | 73 | UINT32 | R/W | Gen Var Prepos Mode2 GG | No Unit | Maintain=0 Release=1 |
| VAR Setpoints | 73 | UINT32 | R/W | Gen Var Prepos Mode3 GG | No Unit | Maintain=0 Release=1 |
| VAR Setpoints | 74 | Float | R/W | Sys Option Fine Adjust Band GG | % | 0 - 30 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Traverse Rate GG | Sec | 10 - 200 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Setpoint GG | kvar | 0 – 41.57 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Min Setpoint Limit GG | % | -100 - 100 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Max Setpoint Limit GG | % | -100 - 100 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Preposition1 GG | kvar | 0 – 41.57 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Preposition2 GG | kvar | 0 – 41.57 |
| VAR Setpoints | 74 | Float | R/W | Gen Var Preposition3 GG | kvar | 0 – 41.57 |
| PF Setpoints | 75 | UINT32 | R/W | Gen Pf Prepos Mode1 GG | No Unit | Maintain=0 Release=1 |
| PF Setpoints | 75 | UINT32 | R/W | Gen Pf repos Mode2 GG | No Unit | Maintain=0 Release=1 |
| PF Setpoints | 75 | UINT32 | R/W | Gen Pf repos Mode3 GG | No Unit | Maintain=0 Release=1 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Traverse Rate GG | Sec | 10 - 200 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Setpoint GG | PF | 0.5 – -0.5 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Min Setpoint Limit GG | PF | 0.5 – 1 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Max Setpoint Limit GG | PF | -1 - -0.5 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Preposition1 GG | PF | 0.5 – -0.5 |
| PF Setpoints | 76 | Float | R/W | Gen PfPreposition2 GG | PF | 0.5 – -0.5 |
| PF Setpoints | 76 | Float | R/W | Gen Pf Preposition3 GG | PF | 0.5 – -0.5 |
| Aux Input Settings | 77 | UINT32 | R/W | Decs Aux Input Mode GG | No Unit | Voltage=0 Current=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|--|---------|---|
| Aux Input Settings | 77 | UINT32 | R/W | Decs Aux Summing Mode GG | No Unit | Voltage=0 Var=1 |
| Aux Input Settings | 77 | UINT32 | R/W | Decs Aux Input Function GG | No Unit | DECS Input=0 PSS Test Input=1 Limiter Selection=2 |
| Aux Input Settings | 78 | Float | R/W | Decs Aux Vol Gain GG | No Unit | -99 - 99 |
| Aux Input Settings | 78 | Float | R/W | Decs Aux Fcr Gain GG | No Unit | -99 - 99 |
| Aux Input Settings | 78 | Float | R/W | Decs Aux Fvr Gain GG | No Unit | -99 - 99 |
| Aux Input Settings | 78 | Float | R/W | Decs Aux Var Gain GG | No Unit | -99 - 99 |
| Aux Input Settings | 78 | Float | R/W | Decs Aux Pf Gain GG | No Unit | -99 - 99 |
| Parallel/Line Drop | 79 | UINT32 | R/W | Sys Option Input Droop Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Parallel/Line Drop | 79 | UINT32 | R/W | Sys Option Input L Drop Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Parallel/Line Drop | 79 | UINT32 | R/W | Sys Option Input CC Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Parallel/Line Drop | 80 | Float | R/W | Droop Value GG | % | 0 - 30 |
| Parallel/Line Drop | 80 | Float | R/W | L Drop Value GG | % | 0 - 30 |
| Parallel/Line Drop | 80 | Float | R/W | Decs Aux Amp Gain GG | % | -30 - 30 |
| Load Share | 81 | UINT32 | R/W | LS Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| Load Share | 82 | Float | R/W | LS Droop Percent GG | % | 0 - 30 |
| Load Share | 82 | Float | R/W | Gain GG | No Unit | 0 - 1000 |
| Load Share | 82 | Float | R/W | Washout Filter Time Const GG | No Unit | 0 - 1 |
| Load Share | 82 | Float | R/W | Washout Filter Gain GG | No Unit | 0 - 1000 |
| Auto Tracking | 83 | UINT32 | R/W | Sys Input Comport Int Track Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Auto Tracking | 83 | UINT32 | R/W | Sys Input Comport Ext Track Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Auto Tracking | 84 | Float | R/W | Decs Auto Track T Delay GG | Sec | 0 - 8 |
| Auto Tracking | 84 | Float | R/W | Decs Auto Track T Rate GG | Sec | 1 - 80 |
| Auto Tracking | 84 | Float | R/W | Decs Auto Trans T Delay GG | Sec | 0 - 8 |
| Auto Tracking | 84 | Float | R/W | Decs Auto Trans T Rate GG | Sec | 1 - 80 |
| Startup | 86 | Float | R/W | Startup Pri Soft Start Bias GG | % | 0 - 90 |
| Startup | 86 | Float | R/W | Startup Pri Soft Start Time GG | Sec | 1 - 7200 |
| Startup | 86 | Float | R/W | Startup Sec Soft Start Bias GG | % | 0 - 90 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|--------------------------------|---------|--|
| Startup | 86 | Float | R/W | Startup Sec Soft Start Time GG | Sec | 1 - 7200 |
| Startup | 86 | Float | R/W | Decs Field Flash Level GG | No Unit | 0 - 100 |
| Startup | 86 | Float | R/W | Decs Field Flash Time GG | No Unit | 1 - 50 |
| AVR Gains | 87 | UINT32 | R/W | Primary Gain Option GG | No Unit | TpdoEQ1pt0 TeEQ0pt17=1 TpdoEQ1pt5 TeEQ0pt25=2 TpdoEQ2pt0 TeEQ0pt33=3 TpdoEQ2pt5 TeEQ0pt42=4 TpdoEQ3pt0 TeEQ0pt50=5 TpdoEQ3pt5 TeEQ0pt58=6 TpdoEQ4pt0 TeEQ0pt67=7 TpdoEQ4pt5 TeEQ0pt75=8 TpdoEQ5pt0 TeEQ0pt83=9 TpdoEQ5pt5 TeEQ0pt92=10 TpdoEQ6pt0 TeEQ1pt00=11 TpdoEQ6pt5 TeEQ1pt08=12 TpdoEQ7pt0 TeEQ1pt17=13 TpdoEQ7pt5 TeEQ1pt25=14 TpdoEQ8pt0 TeEQ1pt33=15 TpdoEQ8pt5 TeEQ1pt42=16 TpdoEQ9pt0 TeEQ1pt50=17 TpdoEQ9pt5 TeEQ1pt58=18 TpdoEQ10pt0 TeEQ1pt67=19 TpdoEQ10pt5 TeEQ1pt75=20 Custom=21 |
| AVR Gains | 87 | UINT32 | R/W | Secondary Gain Option GG | No Unit | TpdoEQ1pt0 TeEQ0pt17=1 TpdoEQ1pt5 TeEQ0pt25=2 TpdoEQ2pt0 TeEQ0pt33=3 TpdoEQ2pt5 TeEQ0pt42=4 TpdoEQ3pt0 TeEQ0pt50=5 TpdoEQ3pt5 TeEQ0pt58=6 TpdoEQ4pt0 TeEQ0pt67=7 TpdoEQ4pt5 TeEQ0pt75=8 TpdoEQ5pt0 TeEQ0pt83=9 TpdoEQ5pt5 TeEQ0pt92=10 TpdoEQ6pt0 TeEQ1pt00=11 TpdoEQ6pt5 TeEQ1pt08=12 TpdoEQ7pt0 TeEQ1pt17=13 TpdoEQ7pt5 TeEQ1pt25=14 TpdoEQ8pt0 TeEQ1pt33=15 TpdoEQ8pt5 TeEQ1pt42=16 TpdoEQ9pt0 TeEQ1pt50=17 TpdoEQ9pt5 TeEQ1pt58=18 TpdoEQ10pt0 TeEQ1pt67=19 TpdoEQ10pt5 TeEQ1pt75=20 Custom=21 |
| AVR Gains | 88 | Float | R/W | Avr Kp Pri GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Ki Pri GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Kd Pri GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Td Pri GG | No Unit | 0 - 1 |
| AVR Gains | 88 | Float | R/W | Avr Kg Pri GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Kp Sec GG | No Unit | 0 - 1000 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-------------------|---------|-------|-----|-----------------|---------|----------|
| AVR Gains | 88 | Float | R/W | Avr Ki Sec GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Kd Sec GG | No Unit | 0 - 1000 |
| AVR Gains | 88 | Float | R/W | Avr Td Sec GG | No Unit | 0 - 1 |
| AVR Gains | 88 | Float | R/W | Avr Kg Sec GG | No Unit | 0 - 1000 |
| FCR Gains | 90 | Float | R/W | Fcr Kp GG | No Unit | 0 - 1000 |
| FCR Gains | 90 | Float | R/W | Fcr Ki GG | No Unit | 0 - 1000 |
| FCR Gains | 90 | Float | R/W | Fcr Kd GG | No Unit | 0 - 1000 |
| FCR Gains | 90 | Float | R/W | Fcr Td GG | No Unit | 0 - 1 |
| FCR Gains | 90 | Float | R/W | Fcr Kg GG | No Unit | 0 - 1000 |
| FVR Gains | 92 | Float | R/W | Fvr Kp GG | No Unit | 0 - 1000 |
| FVR Gains | 92 | Float | R/W | Fvr Ki GG | No Unit | 0 - 1000 |
| FVR Gains | 92 | Float | R/W | Fvr Kd GG | No Unit | 0 - 1000 |
| FVR Gains | 92 | Float | R/W | Fvr Td GG | No Unit | 0 - 1 |
| FVR Gains | 92 | Float | R/W | Fvr Kg GG | No Unit | 0 - 1000 |
| VAR Gains | 94 | Float | R/W | Var Ki GG | No Unit | 0 - 1000 |
| VAR Gains | 94 | Float | R/W | Var Kg GG | No Unit | 0 - 1000 |
| PF Gains | 96 | Float | R/W | Pf Ki GG | No Unit | 0 - 1000 |
| PF Gains | 96 | Float | R/W | Pf Kg GG | No Unit | 0 - 1000 |
| OEL Gains | 98 | Float | R/W | Oel Ki GG | No Unit | 0 - 1000 |
| OEL Gains | 98 | Float | R/W | Oel Kg GG | No Unit | 0 - 1000 |
| UEL Gains | 100 | Float | R/W | Uel Ki GG | No Unit | 0 - 1000 |
| UEL Gains | 100 | Float | R/W | Uel Kg GG | No Unit | 0 - 1000 |
| SCL Gains | 102 | Float | R/W | Scl Ki GG | No Unit | 0 - 1000 |
| SCL Gains | 102 | Float | R/W | Scl Kg GG | No Unit | 0 - 1000 |
| VAR Limiter Gains | 104 | Float | R/W | Var Limit Ki GG | No Unit | 0 - 1000 |
| VAR Limiter Gains | 104 | Float | R/W | Var Limit Kg GG | No Unit | 0 - 1000 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------|---------|--------|-----|--|---------|----------------------|
| Voltage Match Gains | 106 | Float | R/W | Vm Ki GG | No Unit | 0 - 1000 |
| Voltage Match Gains | 106 | Float | R/W | Vm Kg GG | No Unit | 0 - 1000 |
| OEL Configure | 107 | UINT32 | R/W | Sys Option Input Oel Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| OEL Configure | 107 | UINT32 | R/W | Sys Option Input Oel Style Enabled GG | No Unit | Summing=0 Takeover=1 |
| OEL Configure | 107 | UINT32 | R/W | Oel Pri Dvdt Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| OEL Configure | 108 | Float | R/W | Oel Pri Dvdt Ref GG | No Unit | -10 - 0 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Hi GG | Amp | 0 - 30 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Mid GG | Amp | 0 - 20 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Lo GG | Amp | 0 - 15 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Time Hi GG | Sec | 0 - 10 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Time Mid GG | Sec | 0 - 120 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Hi Off GG | Amp | 0 - 30 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Lo Off GG | Amp | 0 - 15 |
| OEL Summing Point | 110 | Float | R/W | Oel Pri Cur Time Off GG | Sec | 0 - 10 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Hi GG | Amp | 0 - 30 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Mid GG | Amp | 0 - 20 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Lo GG | Amp | 0 - 15 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Time Hi GG | Sec | 0 - 10 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Time Mid GG | Sec | 0 - 120 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Hi Off GG | Amp | 0 - 30 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Lo Off GG | Amp | 0 - 15 |
| OEL Summing Point | 110 | Float | R/W | Oel Sec Cur Time Off GG | Sec | 0 - 10 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Cur Max Off GG | Amp | 0 - 30 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Cur Min Off GG | Amp | 0 - 15 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Time Dial Off GG | No Unit | 0.1 - 20 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Cur Max On GG | Amp | 0 - 30 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Cur Min On GG | Amp | 0 - 15 |
| OEL Takeover | 112 | Float | R/W | Oel Pri Takeover Time Dial On GG | No Unit | 0.1 - 20 |
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Cur Max Off GG | Amp | 0 - 30 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------------|---------|--------|-----|--------------------------------------|------------|----------------------|
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Cur Min Off GG | Amp | 0 - 15 |
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Time Dial Off GG | No Unit | 0.1 - 20 |
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Cur Max On GG | Amp | 0 - 30 |
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Cur Min On GG | Amp | 0 - 15 |
| OEL Takeover | 112 | Float | R/W | Oel Sec Takeover Time Dial On GG | No Unit | 0.1 - 20 |
| UEL Configure | 113 | UINT32 | R/W | Sys Option Input Uel Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| UEL Configure | 114 | Float | R/W | Uel Pri Pow Filter TC GG | Sec | 0 - 20 |
| UEL Configure | 114 | Float | R/W | Uel Pri Volt Dep Exponent GG | No Unit | 0 - 2 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve X1 GG | KW | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve X2 GG | KW | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve X3 GG | KW | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve X4 GG | KW | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve X5 GG | KW | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve Y1 GG | kvar | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve Y2 GG | kvar | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve Y3 GG | kvar | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve Y4 GG | kvar | 0 - 62 |
| UEL Curve Float Primary | 116 | Float | R/W | Uel Pri Curve Y5 GG | kvar | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve X1 GG | KW | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve X2 GG | KW | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve X3 GG | KW | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve X4 GG | KW | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve X5 GG | KW | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve Y1 GG | kvar | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve Y2 GG | kvar | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve Y3 GG | kvar | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve Y4 GG | kvar | 0 - 62 |
| UEL Curve Float Secondary | 118 | Float | R/W | Uel Sec Curve Y5 GG | kvar | 0 - 62 |
| SCL Settings | 119 | UINT32 | R/W | Sys Option Input Scl Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| SCL Settings | 120 | Float | R/W | Scl Pri Ref Hi GG | Amp | 0 - 66000 |
| SCL Settings | 120 | Float | R/W | Scl Pri Ref Lo GG | Amp | 0 - 66000 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------|---------|--------|-----|-------------------------------|---------|---|
| SCL Settings | 120 | Float | R/W | Scl Pri Time Hi GG | Sec | 0 - 60 |
| SCL Settings | 120 | Float | R/W | Scl Pri No Response Time GG | Sec | 0 - 10 |
| SCL Settings | 120 | Float | R/W | Scl Sec Ref Hi GG | Amp | 0 - 66000 |
| SCL Settings | 120 | Float | R/W | Scl Sec Ref Lo GG | Amp | 0 - 66000 |
| SCL Settings | 120 | Float | R/W | Scl Sec Time Hi GG | Sec | 0 - 60 |
| SCL Settings | 120 | Float | R/W | Scl Sec No Response Time GG | Sec | 0 - 10 |
| SCL Settings | 120 | Float | R/W | Reserved | n/a | n/a |
| SCL Settings | 120 | Float | R/W | Reserved | n/a | n/a |
| SCL Settings | 120 | Float | R/W | Reserved | n/a | n/a |
| SCL Settings | 120 | Float | R/W | Reserved | n/a | n/a |
| SCL Settings | 120 | Float | R/W | Reserved | n/a | n/a |
| VAR Limiter Settings | 121 | UINT32 | R/W | Var Limit Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| VAR Limiter Settings | 122 | Float | R/W | Var Limit Pri Delay GG | Sec | 0 - 300 |
| VAR Limiter Settings | 122 | Float | R/W | Var Limit Pri Setpoint GG | % | 0 - 200 |
| VAR Limiter Settings | 122 | Float | R/W | Var Limit Sec Delay GG | Sec | 0 - 300 |
| VAR Limiter Settings | 122 | Float | R/W | Var Limit Sec Setpoint GG | % | 0 - 200 |
| OEL Scaling | 123 | UINT32 | R/W | Oel Scale Enable GG | No Unit | DISABLED=0 Auxiliary Input=1 AEM RTD 1=2 AEM RTD 2=3 AEM RTD 3=4 AEM RTD 4=5 AEM RTD 5=6 AEM RTD 6=7 AEM RTD 7=8 AEM RTD 8=9 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Signal1 GG | V | -10 - 10 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Signal2 GG | V | -10 - 10 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Signal3 GG | V | -10 - 10 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Scale1 GG | % | 0 - 200 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Scale2 GG | % | 0 - 200 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Summing Scale3 GG | % | 0 - 200 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Signal1 GG | V | -10 - 10 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Signal2 GG | V | -10 - 10 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------------|---------|--------|-----|--------------------------------------|---------|---|
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Signal3 GG | V | -10 - 10 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Scale1 GG | % | 0 - 200 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Scale2 GG | % | 0 - 200 |
| OEL Scaling | 124 | Float | R/W | Oel Scale Takeover Scale3 GG | % | 0 - 200 |
| SCL Scaling | 125 | UINT32 | R/W | Scl Scale Enable GG | No Unit | DISABLED=0 Auxiliary Input=1 AEM RTD 1=2 AEM RTD 2=3 AEM RTD 3=4 AEM RTD 4=5 AEM RTD 5=6 AEM RTD 6=7 AEM RTD 7=8 AEM RTD 8=9 |
| SCL Scaling | 126 | Float | R/W | SclScaleSignal1 GG | V | -10 - 10 |
| SCL Scaling | 126 | Float | R/W | SclScaleSignal2 GG | V | -10 - 10 |
| SCL Scaling | 126 | Float | R/W | SclScaleSignal3 GG | V | -10 - 10 |
| SCL Scaling | 126 | Float | R/W | SclScalePoint1 GG | % | 0 - 200 |
| SCL Scaling | 126 | Float | R/W | SclScalePoint2 GG | % | 0 - 200 |
| SCL Scaling | 126 | Float | R/W | SclScalePoint3 GG | % | 0 - 200 |
| Underfreq/Volts per hertz | 127 | UINT32 | R/W | Sys Option Under Freq Mode GG | No Unit | UF Limiter=0 V2H Limiter=1 |
| Underfreq/Volts per Hertz | 128 | Float | R/W | Sys Option Under Freq Hz GG | Hz | 40 - 75 |
| Underfreq/Volts per Hertz | 128 | Float | R/W | Sys Option Under Freq Slope GG | No Unit | 0 - 3 |
| Underfreq/Volts per Hertz | 128 | Float | R/W | Sys Option Vol Per Hz Slope Hi GG | No Unit | 0 - 3 |
| Underfreq/Volts per Hertz | 128 | Float | R/W | Sys Option Vol Per Hz Slope Lo GG | No Unit | 0 - 3 |
| Underfreq/Volts per Hertz | 128 | Float | R/W | Sys Option Vol PerHz Slope Time GG | Sec | 0 - 10 |
| PSS Configure | 129 | UINT32 | R/W | Sys Option Pss Power Level Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Configure | 130 | Float | R/W | Pss Pri Power Level Percentage GG | No Unit | 0 - 1 |
| PSS Configure | 130 | Float | R/W | Pss Pri Power Level Hysteresis GG | No Unit | 0 - 1 |
| PSS Control Primary | 131 | UINT32 | R/W | Pss Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch10 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch11 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch3 GG | No Unit | Frequency=0 Der. Speed=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|----------------------------------|---------|--------|-----|-------------------------------|---------|---------------------------|
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch4 GG | No Unit | Power=0 Der. Freq/Speed=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch0 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch1 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch5 GG | No Unit | Exclude=0 Include=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch9 GG | No Unit | Exclude=0 Include=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch6 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch8 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch7 GG | No Unit | OFF=0 ON=1 |
| PSS Control Primary | 131 | UINT32 | R/W | PssPriSwitch2 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Primary | 132 | Float | R/W | Pss Pri Power On Threshold GG | No Unit | 0 - 1 |
| PSS Control Primary | 132 | Float | R/W | Pss Pri Power Hysteresis GG | No Unit | 0 - 1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch10 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch11 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch3 GG | No Unit | Frequency=0 Der. Speed=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch4 GG | No Unit | Power=0 Der. Freq/Speed=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch0 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch1 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch5 GG | No Unit | Exclude=0 Include=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch9 GG | No Unit | Exclude=0 Include=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch6 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch8 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch7 GG | No Unit | OFF=0 ON=1 |
| PSS Control Secondary | 133 | UINT32 | R/W | PssSecSwitch2 GG | No Unit | DISABLED=0 ENABLED=1 |
| PSS Control Secondary | 134 | Float | R/W | Pss Sec Power On Threshold GG | No Unit | 0 - 1 |
| PSS Control Secondary | 134 | Float | R/W | Pss Sec Power Hysteresis GG | No Unit | 0 - 1 |
| PSS Filter Parameter Primary Int | 135 | UINT32 | R/W | Pss Pri Ramp Flt M GG | No Unit | 1 - 5 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--|---------|--------|-----|-----------------------|---------|------------|
| PSS Filter Parameter Primary Int | 135 | UINT32 | R/W | Pss Pri Ramp Flt N GG | No Unit | 0 - 1 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | PssPriTlpf1 GG | Sec | 0 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tlpf 2 GG | Sec | 1 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tlpf 3 GG | Sec | 0.05 - 0.2 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tr GG | Sec | 0.05 - 1 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tw 1 GG | Sec | 1 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tw 2 GG | Sec | 1 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tw 3 GG | Sec | 1 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri Tw 4 GG | Sec | 1 - 20 |
| PSS Filter Parameter Primary Float | 136 | Float | R/W | Pss Pri H GG | No Unit | 1 - 25 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Zn 1 GG | No Unit | 0 - 1 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Zn 2 GG | No Unit | 0 - 1 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Zd 1 GG | No Unit | 0 - 1 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Zd 2 GG | No Unit | 0 - 1 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Wn 1 GG | No Unit | 10 - 150 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Wn 2 GG | No Unit | 10 - 150 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Xq GG | No Unit | 0 - 5 |
| PSS Parameter Primary Float | 138 | Float | R/W | Pss Pri Kpe GG | No Unit | 0 - 2 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T1 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T2 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T3 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T4 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T5 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T6 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T7 GG | Sec | 0.001 - 6 |
| PSS Parameter Primary Phase Comp Float | 140 | Float | R/W | Pss Pri T8 GG | Sec | 0.001 - 6 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--|---------|--------|-----|-----------------------|---------|------------|
| PSS Parameter Secondary Filters Int | 141 | UINT32 | R/W | Pss Sec Ramp Flt M GG | No Unit | 1 - 5 |
| PSS Parameter Secondary Filters Int | 141 | UINT32 | R/W | Pss Sec Ramp Flt N GG | No Unit | 0 - 1 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | PssSecTlpf1 GG | Sec | 0 - 20 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tlpf 2 GG | Sec | 1 - 20 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tlpf 3 GG | Sec | 0.05 - 0.2 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tr GG | Sec | 0.05 - 1 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tw1 GG | Sec | 1 - 20 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tw2 GG | Sec | 1 - 20 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tw3 GG | Sec | 1 - 20 |
| PSS Parameter Secondary Filters Float | 142 | Float | R/W | Pss Sec Tw4 GG | Sec | 1 - 20 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Zn1 GG | No Unit | 0 - 1 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Zn2 GG | No Unit | 0 - 1 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Zd1 GG | No Unit | 0 - 1 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Zd2 GG | No Unit | 0 - 1 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Wn1 GG | No Unit | 10 - 150 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Wn2 GG | No Unit | 10 - 150 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Xq GG | No Unit | 0 - 5 |
| PSS Parameter Secondary Float | 144 | Float | R/W | Pss Sec Kpe GG | No Unit | 0 - 2 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT1 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT2 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT3 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT4 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT5 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT6 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT7 GG | Sec | 0.001 - 6 |
| PSS Parameter Secondary Phase Comp Float | 146 | Float | R/W | PssSecT8 GG | Sec | 0.001 - 6 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|------------------------------|---------|--------|-----|--------------------------|---------|----------------------------------|
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Limit Plus GG | No Unit | 0 - 0.5 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Limit Minus GG | No Unit | -0.5 - 0 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Ks GG | No Unit | 0 - 50 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Et Lmt Tlpf GG | Sec | 0.02 - 5 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Et Lmt Vref GG | No Unit | 0 - 10 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Tw5 Normal GG | No Unit | 5 - 30 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Tw5 Limit GG | No Unit | 0 - 1 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Lmt Vhi GG | No Unit | 0.01 - 0.04 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Lmt Vlo GG | No Unit | -0.04 - -0.01 |
| PSS Output Limiter Primary | 148 | Float | R/W | Pss Pri Lmt T Delay GG | No Unit | 0 - 2 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Limit Plus GG | No Unit | 0 - 0.5 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Limit Minus GG | No Unit | -0.5 - 0 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Ks GG | No Unit | 0 - 50 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Et Lmt Tlpf GG | Sec | 0.02 - 5 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Et Lmt Vref GG | No Unit | 0 - 10 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Tw5 Normal GG | No Unit | 5 - 30 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Tw5 Limit GG | No Unit | 0 - 1 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Lmt Vhi GG | No Unit | 0.01 - 0.04 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec LmtVlo GG | No Unit | -0.04 - -0.01 |
| PSS Output Limiter Secondary | 150 | Float | R/W | Pss Sec Lmt T Delay GG | No Unit | 0 - 2 |
| Synchronizer | 151 | UINT32 | R/W | Sync Type GG | No Unit | Anticipatory=0 Phase Lock Loop=1 |
| Synchronizer | 151 | UINT32 | R/W | Fgen GT Fbus GG | No Unit | DISABLED=0 ENABLED=1 |
| Synchronizer | 151 | UINT32 | R/W | Vgen GT Vbus GG | No Unit | DISABLED=0 ENABLED=1 |
| Synchronizer | 152 | Float | R/W | Slip Frequency GG | Hz | 0.1 - 0.5 |
| Synchronizer | 152 | Float | R/W | Voltage Window GG | % | 2 - 15 |
| Synchronizer | 152 | Float | R/W | Breaker Closing Angle GG | Deg | 3 - 20 |
| Synchronizer | 152 | Float | R/W | Sync Activation Delay GG | Sec | 0.1 - 0.8 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------------------------|---------|--------|-----|--|---------|-------------------------------|
| Synchronizer | 152 | Float | R/W | Sync Fail Activation Delay GG | Sec | 0.1 - 600 |
| Synchronizer | 152 | Float | R/W | Sync Speed Gain GG | No Unit | 0.001 - 1000 |
| Synchronizer | 152 | Float | R/W | Sync Voltage Gain GG | No Unit | 0.001 - 1000 |
| Voltage Matching | 153 | UINT32 | R/W | Sys Option Input Volt Match Enabled GG | No Unit | DISABLED=0 ENABLED=1 |
| Voltage Matching | 154 | Float | R/W | Sys Option Vol Match Band GG | % | 0 - 20 |
| Voltage Matching | 154 | Float | R/W | Sys Option Vol Match Ref GG | % | 0 - 700 |
| Breaker Hardware | 155 | UINT32 | R/W | Gen Breaker GG | No Unit | Not Configured=0 Configured=1 |
| Breaker Hardware | 155 | UINT32 | R/W | Gen Contact Type GG | No Unit | Pulse=0 Continuous=1 |
| Breaker Hardware | 155 | UINT32 | R/W | Dead Bus Close Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| Breaker Hardware | 155 | UINT32 | R/W | Dead Gen Close Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| Breaker Hardware | 156 | Float | R/W | Breaker Close Wait Time GG | Sec | 0.1 - 600 |
| Breaker Hardware | 156 | Float | R/W | Gen Open Pulse Time GG | Sec | 0.01 - 5 |
| Breaker Hardware | 156 | Float | R/W | Gen Close Pulse Time GG | Sec | 0.01 - 5 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Dead Gen Threshold GG | V | 0 - 600000 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Dead Gen Time Delay GG | Sec | 0.1 - 600 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Over VoltageP ickup GG | V | 10 - 600000 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Over Voltage Dropout GG | V | 10 - 600000 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Under Voltage Pickup GG | V | 10 - 600000 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Under Voltage Dropout GG | V | 10 - 600000 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Over Frequency Pickup GG | Hz | 46 - 64 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Over Frequency Dropout GG | Hz | 46 - 64 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Under Frequency Pickup GG | Hz | 46 - 64 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Under Frequency Dropout GG | Hz | 46 - 64 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Activation Delay GG | Sec | 0.1 - 600 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Failed Activation Delay GG | Sec | 0.1 - 600 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------------------------|---------|--------|-----|--|---------|-----------------------------|
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Low Line Scale Factor GG | No Unit | 0.001 - 3 |
| Bus Condition Detection (Gen Sensing) | 158 | Float | R/W | Gen Stable Alternate Frequency Scale Factor GG | No Unit | 0.001 - 100 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Dead Bus Threshold GG | V | 0 - 600000 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Dead Bus Time Delay GG | Sec | 0.1 - 600 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus S table Over Voltage Pickup GG | V | 10 - 600000 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Over Voltage Dropout GG | V | 10 - 600000 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Under Voltage Pickup GG | V | 10 - 600000 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Under Voltage Dropout GG | V | 10 - 600000 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Over Frequency Pickup GG | Hz | 46 - 64 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Over Frequency Dropout GG | Hz | 46 - 64 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Under Frequency Pickup GG | Hz | 46 - 64 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Under Frequency Dropout GG | Hz | 46 - 64 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Activation Delay GG | Sec | 0.1 - 600 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Failed Activation Delay GG | Sec | 0.1 - 600 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Low Line Scale Factor GG | No Unit | 0.001 - 3 |
| Bus Condition Detection (Bus Sensing) | 160 | Float | R/W | Bus Stable Alternate Frequency Scale Factor GG | No Unit | 0.001 - 100 |
| Governor Bias Control | 161 | UINT32 | R/W | Control Contact Type GG | No Unit | Continuous=0 Proportional=1 |
| Governor Bias Control | 162 | Float | R/W | Correction Pulse Width GG | Sec | 0 - 99.9 |
| Governor Bias Control | 162 | Float | R/W | Correction Pulse Interval GG | Sec | 0 - 99.9 |
| Gen Undervolt | 163 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=1 |
| Gen Undervolt | 163 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=1 |
| Gen Undervolt | 164 | Float | R/W | Pickup PP | V | 1 - 600000 |
| Gen Undervolt | 164 | Float | R/W | Time Delay PP | ms | 100 - 60000 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|---------------------------------------|---------|----------------------|
| Gen Undervolt | 164 | Float | R/W | Pickup PS | V | 1 - 600000 |
| Gen Undervolt | 164 | Float | R/W | Time Delay PS | ms | 100 - 60000 |
| Gen Overvolt | 165 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=1 |
| Gen Overvolt | 165 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=1 |
| Gen Overvolt | 166 | Float | R/W | Pickup PP | V | 0 - 600000 |
| Gen Overvolt | 166 | Float | R/W | Time Delay PP | ms | 100 - 60000 |
| Gen Overvolt | 166 | Float | R/W | Pickup PS | V | 0 - 600000 |
| Gen Overvolt | 166 | Float | R/W | Time Delay PS | ms | 100 - 60000 |
| Loss of Sensing | 167 | UINT32 | R/W | Mode GG | No Unit | DISABLED=0 ENABLED=1 |
| Loss of Sensing | 167 | UINT32 | R/W | Sys Option No Sense To Manual Mode GG | No Unit | DISABLED=0 ENABLED=1 |
| Loss of Sensing | 168 | Float | R/W | Time Delay GG | Sec | 0 - 30 |
| Loss of Sensing | 168 | Float | R/W | Voltage Balanced Level GG | % | 0 - 100 |
| Loss of Sensing | 168 | Float | R/W | Voltage Unbalanced Level GG | % | 0 - 100 |
| 81O | 169 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 OVER=1 |
| 81O | 169 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 OVER=1 |
| 81O | 170 | Float | R/W | Pickup PP | Hz | 30 - 70 |
| 81O | 170 | Float | R/W | Time Delay PP | ms | 100 - 300000 |
| 81O | 170 | Float | R/W | Pickup PS | Hz | 30 - 70 |
| 81O | 170 | Float | R/W | Time Delay PS | ms | 100 - 300000 |
| 81O | 170 | Float | R/W | Voltage Inhibit PP | % | 5 - 100 |
| 81O | 170 | Float | R/W | Voltage Inhibit PS | % | 5 - 100 |
| 81U | 171 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 UNDER=2 |
| 81U | 171 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 UNDER=2 |
| 81U | 172 | Float | R/W | Pickup PP | Hz | 30 - 70 |
| 81U | 172 | Float | R/W | Time Delay PP | ms | 100 - 300000 |
| 81U | 172 | Float | R/W | Voltage Inhibit PP | % | 5 - 100 |
| 81U | 172 | Float | R/W | Pickup PS | Hz | 30 - 70 |
| 81U | 172 | Float | R/W | Time Delay PS | ms | 5 - 300000 |
| 81U | 172 | Float | R/W | Voltage Inhibit PS | % | 50 - 100 |
| Reverse Power | 173 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=4 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------------|---------|--------|-----|------------------------------------|---------|----------------------|
| Reverse Power | 173 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=4 |
| Reverse Power | 174 | Float | R/W | Pickup PP | % | 0 - 150 |
| Reverse Power | 174 | Float | R/W | Pickup PS | % | 0 - 150 |
| Reverse Power | 174 | Float | R/W | Time Delay PP | ms | 0 - 300000 |
| Reverse Power | 174 | Float | R/W | Time Delay PS | ms | 0 - 300000 |
| Loss of Excitation | 175 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=1 |
| Loss of Excitation | 175 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=1 |
| Loss of Excitation | 176 | Float | R/W | Pickup PP | % | 0 - 150 |
| Loss of Excitation | 176 | Float | R/W | Time Delay PP | ms | 0 - 300000 |
| Loss of Excitation | 176 | Float | R/W | Pickup PS | % | 0 - 150 |
| Loss of Excitation | 176 | Float | R/W | Time Delay PS | ms | 0 - 300000 |
| Field Overvolt | 177 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=1 |
| Field Overvolt | 177 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=1 |
| Field Overvolt | 178 | Float | R/W | Pickup PP | V | 1 - 325 |
| Field Overvolt | 178 | Float | R/W | Time Delay PP | ms | 200 - 30000 |
| Field Overvolt | 178 | Float | R/W | Pickup PS | V | 1 - 325 |
| Field Overvolt | 178 | Float | R/W | Time Delay PS | ms | 200 - 30000 |
| Field Overcurrent | 179 | UINT32 | R/W | Mode PP | No Unit | DISABLED=0 ENABLED=1 |
| Field Overcurrent | 179 | UINT32 | R/W | Mode PS | No Unit | DISABLED=0 ENABLED=1 |
| Field Overcurrent | 180 | Float | R/W | Pickup PP | Amp | 0 - 22 |
| Field Overcurrent | 180 | Float | R/W | Time Delay PP | ms | 5000 - 60000 |
| Field Overcurrent | 180 | Float | R/W | Pickup PS | Amp | 0 - 22 |
| Field Overcurrent | 180 | Float | R/W | Time Delay PS | ms | 5000 - 60000 |
| Power Input Failure | 181 | UINT32 | R/W | Mode GG | No Unit | DISABLED=0 ENABLED=1 |
| Power Input Failure | 182 | Float | R/W | Time Delay GG | Sec | 0 - 10 |
| Exciter Diode Monitor | 183 | UINT32 | R/W | Exciter Open Diode Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| Exciter Diode Monitor | 183 | UINT32 | R/W | Exciter Shorted Diode Enable GG | No Unit | DISABLED=0 ENABLED=1 |
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Diode Inhibit Threshold GG | % | 0 - 100 |
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Open Diode Pickup GG | % | 0 - 100 |
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Open Diode Time Delay GG | Sec | 10 - 60 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------------|---------|--------|-----|-------------------------------------|---------|--|
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Shorted Diode Pickup GG | % | 0 - 100 |
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Shorted Diode Time Delay GG | Sec | 5 - 30 |
| Exciter Diode Monitor | 184 | Float | R/W | Exciter Pole Ratio GG | No Unit | 1 - 10 |
| Sync Check | 185 | UINT32 | R/W | Mode GG | No Unit | DISABLED=0 ENABLED=1 |
| Sync Check | 186 | Float | R/W | Phase Angle GG | Deg | 1 - 99 |
| Sync Check | 186 | Float | R/W | Slip Freq GG | Hz | 0.01 - 0.5 |
| Sync Check | 186 | Float | R/W | Volt Mag Error Percent GG | % | 0.1 - 50 |
| Config Prot 1 | 187 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 1 | 187 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 1 | 187 | UINT32 | R/W | Threshold1Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 1 | 187 | UINT32 | R/W | Threshold2Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 1 | 187 | UINT32 | R/W | Threshold3Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 1 | 187 | UINT32 | R/W | Threshold4Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 1 | 188 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 1 | 188 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 1 | 188 | Float | R/W | Threshold1Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 1 | 188 | Float | R/W | Threshold1 Activation Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|-----------------------------------|---------|--|
| Config Prot 1 | 188 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 1 | 188 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 1 | 188 | Float | R/W | Threshold3Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 1 | 188 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 1 | 188 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 1 | 188 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 2 | 189 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 2 | 189 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 2 | 189 | UINT32 | R/W | Threshold1Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 2 | 189 | UINT32 | R/W | Threshold2Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 2 | 189 | UINT32 | R/W | Threshold3Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 2 | 189 | UINT32 | R/W | Threshold4Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 2 | 190 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 2 | 190 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 2 | 190 | Float | R/W | Threshold1Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 2 | 190 | Float | R/W | Threshold1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 2 | 190 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|-----------------------------------|------------|--|
| Config Prot 2 | 190 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 2 | 190 | Float | R/W | Threshold3Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 2 | 190 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 2 | 190 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 2 | 190 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 3 | 191 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 3 | 191 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 3 | 191 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 3 | 191 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 3 | 191 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 3 | 191 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 3 | 192 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 3 | 192 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 3 | 192 | Float | R/W | Threshold1Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 3 | 192 | Float | R/W | Threshold1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 3 | 192 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 3 | 192 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|-----------------------------------|---------|--|
| Config Prot 3 | 192 | Float | R/W | Threshold3Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 3 | 192 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 3 | 192 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 3 | 192 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 4 | 193 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 4 | 193 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 4 | 193 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 4 | 193 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 4 | 193 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 4 | 193 | UINT32 | R/W | Threshold4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 4 | 194 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 4 | 194 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 4 | 194 | Float | R/W | Threshold 1 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 4 | 194 | Float | R/W | Threshold1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 4 | 194 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 4 | 194 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 4 | 194 | Float | R/W | Threshold3Pickup GG | No Unit | -999999 - 999999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|------------------------------------|------------|--|
| Config Prot 4 | 194 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 4 | 194 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 4 | 194 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 5 | 195 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 5 | 195 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 5 | 195 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 5 | 195 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 5 | 195 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 5 | 195 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 5 | 196 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 5 | 196 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 5 | 196 | Float | R/W | Threshold 1 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 5 | 196 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 5 | 196 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 5 | 196 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 5 | 196 | Float | R/W | Threshold 3 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 5 | 196 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|---------------------------------|---------|--|
| Config Prot 5 | 196 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 5 | 196 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 6 | 197 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 6 | 197 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 6 | 197 | UINT32 | R/W | Threshold1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 6 | 197 | UINT32 | R/W | Threshold 2Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 6 | 197 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 6 | 197 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 6 | 198 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 6 | 198 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 6 | 198 | Float | R/W | Threshold 1 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 6 | 198 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 6 | 198 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 6 | 198 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 6 | 198 | Float | R/W | Threshold 3 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 6 | 198 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 6 | 198 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------|---------|--------|-----|-----------------------------------|------------|--|
| Config Prot 6 | 198 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 7 | 199 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 7 | 199 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 7 | 199 | UINT32 | R/W | Threshold1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 7 | 199 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 7 | 199 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 7 | 199 | UINT32 | R/W | Threshold 4Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 7 | 200 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 7 | 200 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 7 | 200 | Float | R/W | Threshold1Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 7 | 200 | Float | R/W | Threshold1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 7 | 200 | Float | R/W | Threshold2Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 7 | 200 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 7 | 200 | Float | R/W | Threshold3Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 7 | 200 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 7 | 200 | Float | R/W | Threshold4Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 7 | 200 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|---------------------------------|---------|--|
| Config Prot 8 | 201 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Config Prot 8 | 201 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Config Prot 8 | 201 | UINT32 | R/W | Threshold 1Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 8 | 201 | UINT32 | R/W | Threshold Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 8 | 201 | UINT32 | R/W | Threshold Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 8 | 201 | UINT32 | R/W | Threshold Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Config Prot 8 | 202 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Config Prot 8 | 202 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Config Prot 8 | 202 | Float | R/W | Threshold 1 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 8 | 202 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 8 | 202 | Float | R/W | Threshold 2 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 8 | 202 | Float | R/W | Threshold 2 Activation Delay | Sec | 0 - 300 |
| Config Prot 8 | 202 | Float | R/W | Threshold 3 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 8 | 202 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Config Prot 8 | 202 | Float | R/W | Threshold 4 Pickup GG | No Unit | -999999 - 999999 |
| Config Prot 8 | 202 | Float | R/W | Threshold Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 203 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote Analog In 1 | 203 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 1 | 203 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 1 | 203 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 1 | 203 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 1 | 203 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 1 | 204 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 1 | 204 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold2Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold4Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Threshold4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 1 | 204 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 1 | 204 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 1 | 204 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 1 | 204 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 1 | 204 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Threshold1Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Threshold2Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Threshold3Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Threshold4Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 2 | 205 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 2 | 206 | Float | R/W | Hysteresis GG | % | 0 - 100 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote Analog In 2 | 206 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 2 | 206 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 2 | 206 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 2 | 206 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 2 | 206 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 2 | 206 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 3 | 207 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 3 | 208 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 3 | 208 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote Analog In 3 | 208 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 3 | 208 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 3 | 208 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 3 | 208 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 3 | 208 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 3 | 208 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 3 | 208 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 3 | 208 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Threshold1Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Threshold2Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Threshold3Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Threshold4Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 4 | 209 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 4 | 210 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 4 | 210 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 4 | 210 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 4 | 210 | Float | R/W | Current Min GG | mA | 4 - 20 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote Analog In 4 | 210 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 4 | 210 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 4 | 210 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 5 | 211 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 5 | 212 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 5 | 212 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 5 | 212 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 5 | 212 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 5 | 212 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 5 | 212 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 5 | 212 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 6 | 213 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 6 | 213 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 6 | 213 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote Analog In 6 | 213 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 6 | 213 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 6 | 213 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 6 | 214 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 6 | 214 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 6 | 214 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 6 | 214 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 6 | 214 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 6 | 214 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 6 | 214 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 7 | 215 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 7 | 216 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 7 | 216 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote Analog In 7 | 216 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 7 | 216 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 7 | 216 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 7 | 216 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 7 | 216 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 7 | 216 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 7 | 216 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 7 | 216 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote Analog In 8 | 217 | UINT32 | R/W | Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog In 8 | 218 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote Analog In 8 | 218 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 1 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 2 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 3 Pickup GG | No Unit | -9999 - 9999 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 8 | 218 | Float | R/W | Threshold 4 Pickup GG | No Unit | -9999 - 9999 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote Analog In 8 | 218 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog In 8 | 218 | Float | R/W | Param Min GG | No Unit | -9999 - 9999 |
| Remote Analog In 8 | 218 | Float | R/W | Param Max GG | No Unit | -9999 - 9999 |
| Remote Analog In 8 | 218 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog In 8 | 218 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog In 8 | 218 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog In 8 | 218 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 1 | 219 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 1 | 220 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 1 | 220 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 1 | 220 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold3 ActivationDelay GG | Sec | 0 - 300 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold4Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 1 | 220 | Float | R/W | Threshold4 ActivationDelay GG | Sec | 0 - 300 |
| Remote RTD In 2 | 221 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 2 | 221 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 2 | 221 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 2 | 221 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote RTD In 2 | 221 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 2 | 221 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 2 | 222 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 2 | 222 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 2 | 222 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 2 | 222 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 3 | 223 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 3 | 224 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 3 | 224 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 3 | 224 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 3 | 224 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote RTD In 3 | 224 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 4 | 225 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 4 | 226 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 4 | 226 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 4 | 226 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 4 | 226 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 5 | 227 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 5 | 228 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 5 | 228 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 5 | 228 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote RTD In 5 | 228 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 5 | 228 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 6 | 229 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 6 | 230 | Float | R/W | Cal Off set GG | Deg F | -99999 - 99999 |
| Remote RTD In 6 | 230 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 6 | 230 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 6 | 230 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 7 | 231 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 7 | 231 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 7 | 231 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 7 | 231 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|---------------------------------|---------|---------------------------|
| Remote RTD In 7 | 231 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 7 | 231 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 7 | 232 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 7 | 232 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 7 | 232 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 7 | 232 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Type GG | No Unit | 10 Ohm Cu=0 100 Ohm Pt=1 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 8 | 233 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote RTD In 8 | 234 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote RTD In 8 | 234 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote RTD In 8 | 234 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 1 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 2 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 3 Pickup GG | Deg F | -58 - 482 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote RTD In 8 | 234 | Float | R/W | Threshold 4 Pickup GG | Deg F | -58 - 482 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-----------------|---------|--------|-----|------------------------------------|------------|---------------------------|
| Remote RTD In 8 | 234 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 1 | 235 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote TC In 1 | 235 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 1 | 235 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 1 | 235 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 1 | 235 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 1 | 236 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote TC In 1 | 236 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote TC In 1 | 236 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 1 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 2 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 3 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 4 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 1 | 236 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 2 | 237 | UINT32 | R/W | Stop Mode Inhibit GG | No Unit | NO=0 YES=1 |
| Remote TC In 2 | 237 | UINT32 | R/W | Threshold 1 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 2 | 237 | UINT32 | R/W | Threshold 2 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 2 | 237 | UINT32 | R/W | Threshold 3 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 2 | 237 | UINT32 | R/W | Threshold 4 Type GG | No Unit | Disabled=0 Over=1 Under=2 |
| Remote TC In 2 | 238 | Float | R/W | Cal Offset GG | Deg F | -99999 - 99999 |
| Remote TC In 2 | 238 | Float | R/W | Hysteresis GG | % | 0 - 100 |
| Remote TC In 2 | 238 | Float | R/W | Arming Delay GG | Sec | 0 - 300 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 1 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 1 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 2 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 2 Activation Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------|---------|--------|-----|----------------------------------|---------|--|
| Remote TC In 2 | 238 | Float | R/W | Threshold 3 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 3 Activation Delay GG | Sec | 0 - 300 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 4 Pickup GG | Deg F | 32 - 2507 |
| Remote TC In 2 | 238 | Float | R/W | Threshold 4 Activation Delay GG | Sec | 0 - 300 |
| Remote Analog Out 1 | 239 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Remote Analog Out 1 | 239 | UINT32 | R/W | Output Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog Out 1 | 240 | Float | R/W | Out Of Range Activation Delay GG | Sec | 0 - 300 |
| Remote Analog Out 1 | 240 | Float | R/W | Param Min GG | No Unit | -99999 - 99999 |
| Remote Analog Out 1 | 240 | Float | R/W | Param Max GG | No Unit | -99999 - 99999 |
| Remote Analog Out 1 | 240 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog Out 1 | 240 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog Out 1 | 240 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog Out 1 | 240 | Float | R/W | Voltage Max GG | V | 0 - 10 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------|---------|--------|-----|----------------------------------|---------|--|
| Remote Analog Out 2 | 241 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Remote Analog Out 2 | 241 | UINT32 | R/W | Output Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog Out 2 | 242 | Float | R/W | Out Of Range Activation Delay GG | Sec | 0 - 300 |
| Remote Analog Out 2 | 242 | Float | R/W | Param Min GG | No Unit | -99999 - 99999 |
| Remote Analog Out 2 | 242 | Float | R/W | Param Max GG | No Unit | -99999 - 99999 |
| Remote Analog Out 2 | 242 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog Out 2 | 242 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog Out 2 | 242 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog Out 2 | 242 | Float | R/W | Voltage Max GG | V | 0 - 10 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|---------------------|---------|--------|-----|----------------------------------|---------|--|
| Remote Analog Out 3 | 243 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Remote Analog Out 3 | 243 | UINT32 | R/W | Output Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog Out 3 | 244 | Float | R/W | Out Of Range Activation Delay GG | Sec | 0 - 300 |
| Remote Analog Out 3 | 244 | Float | R/W | Param Min GG | No Unit | -99999 - 99999 |
| Remote Analog Out 3 | 244 | Float | R/W | Param Max GG | No Unit | -99999 - 99999 |
| Remote Analog Out 3 | 244 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog Out 3 | 244 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog Out 3 | 244 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog Out 3 | 244 | Float | R/W | Voltage Max GG | V | 0 - 10 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------------|---------|--------|-----|----------------------------------|---------|--|
| Remote Analog Out 4 | 245 | UINT32 | R/W | Param Selection GG | No Unit | Gen VAB=0 Gen VBC=1 Gen VCA=2 Gen V Average=3 Bus Freq=4 Bus VAB=5 Bus VBC=6 Bus VCA=7 Gen Freq=8 Gen PF=9 KWH=10 KVARH=11 Gen IA=12 Gen IB=13 Gen IC=14 Gen I Average=15 KW Total=16 KVA Total=17 KVAR Total=18 EDM Ripple=19 Exciter Field Voltage=20 Exciter Field Current=21 Auxiliary Input Voltage=22 Auxiliary Input Current (mA)=23 Setpoint Position=24 Tracking Error=25 Neg Seq V=26 Neg Seq I=27 Pos Seq V=28 Pos Seq I=29 PSS Output=30 Analog Input 1=31 Analog Input 2=32 Analog Input 3=33 Analog Input 4=34 Analog Input 5=35 Analog Input 6=36 Analog Input 7=37 Analog Input 8=38 RTD Input 1=39 RTD Input 2=40 RTD Input 3=41 RTD Input 4=42 RTD Input 5=43 RTD Input 6=44 RTD Input 7=45 RTD Input 8=46 Thermocouple 1=47 Thermocouple 2=48 |
| Remote Analog Out 4 | 245 | UINT32 | R/W | Output Type GG | No Unit | Voltage=0 Current=1 |
| Remote Analog Out 4 | 246 | Float | R/W | Out Of Range Activation Delay GG | Sec | 0 - 300 |
| Remote Analog Out 4 | 246 | Float | R/W | Param Min GG | No Unit | -99999 - 99999 |
| Remote Analog Out 4 | 246 | Float | R/W | Param Max GG | No Unit | -99999 - 99999 |
| Remote Analog Out 4 | 246 | Float | R/W | Current Min GG | mA | 4 - 20 |
| Remote Analog Out 4 | 246 | Float | R/W | Current Max GG | mA | 4 - 20 |
| Remote Analog Out 4 | 246 | Float | R/W | Voltage Min GG | V | 0 - 10 |
| Remote Analog Out 4 | 246 | Float | R/W | Voltage Max GG | V | 0 - 10 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 1 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 2 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 3 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 4 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 5 Delay GG | Sec | 0 - 300 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|--------------------------|---------|-------|-----|----------------------------------|------|----------|
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 6 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 7 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 8 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 9 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 10 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 11 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 12 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 13 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 14 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 15 Delay GG | Sec | 0 - 300 |
| User Programmable Alarms | 248 | Float | R/W | Programmable Alarm 16 Delay GG | Sec | 0 - 300 |
| Logic Timers | 250 | Float | R/W | Logic Timer 1 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 2 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 3 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 4 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 5 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 6 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 7 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 8 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 9 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 10 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 11 Output Timeout GG | Sec | 0 - 1800 |

| Instance Name | Inst. # | Type | RW | Key Name | Unit | Range |
|-------------------------|---------|-------|-----|----------------------------------|---------|----------|
| Logic Timers | 250 | Float | R/W | Logic Timer 12 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 13 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 14 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 15 Output Timeout GG | Sec | 0 - 1800 |
| Logic Timers | 250 | Float | R/W | Logic Timer 16 Output Timeout GG | Sec | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 1 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 2 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 3 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 4 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 5 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 6 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 7 Output Timeout GG | No Unit | 0 - 1800 |
| Logic Counters | 252 | Float | R/W | Counter 8 Output Timeout GG | No Unit | 0 - 1800 |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 1 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 2 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 3 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 4 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 5 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 6 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 7 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | RTD Input 8 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | Therm Input 1 Metric Value GG | Deg C | n/a |
| AEM RTD TC Metric Meter | 253 | Float | R | Therm Input 2 Metric Value GG | Deg C | n/a |

Maintenance

Warning!

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions unless you are qualified to do so.

Before performing any maintenance procedures, remove the DECS-250N from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-250N.

Caution

In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.

Storage

If the unit is not installed immediately, store it in the original shipping package in a moisture- and dust-free environment.

Preventive Maintenance

Connections

Periodically check the connections of the DECS-250N to ensure they are clean and tight and remove any accumulation of dust.

Electrolytic Capacitors

The DECS-250N contains long-life aluminum electrolytic capacitors. For a DECS-250N kept in storage as a spare, the life of these capacitors can be maximized by energizing the device for 30 minutes once per year. The energizing procedure for the DECS-250N is shown below:

Apply control power as indicated by the device style number. For this maintenance procedure, it is recommended that the applied voltage not exceed the nominal value.

- Style Lxxxxxx: 24/48 Vdc (16 to 48 Vdc)
- Style Cxxxxxx: 120 Vac (82 to 120 Vac at 50/60 Hz) or 125 Vdc (90 to 125 Vdc)

It is not necessary to apply operating power to the bridge as this circuitry contains no electrolytic capacitors.

Cleaning the Front Panel

Only a soft cloth and water-based solutions should be used to clean the front panel. Do not use solvents.

Troubleshooting

The following troubleshooting procedures assume the excitation system components are properly matched, fully operational, and correctly connected. If you do not obtain the results that you expect from the DECS-250N, first check the programmable settings for the appropriate function.

DECS-250N Appears Inoperative

If the DECS-250N does not power up (no backlighting on front panel display), ensure that the control power applied to the unit (AC input terminals L and N, DC input terminals BATT+ and BATT–) is at the correct level. If dc control power is being used, verify that the polarity is correct. Units with style number Lxxxxxx have an input voltage range of 16 to 60 Vdc. Units with style number Cxxxxxx have an input voltage range of 90 to 150 Vdc or 82 to 132 Vac (50/60 Hz).

| Note |
|--|
| When both ac and dc control power is used, an isolation transformer must be connected between the ac voltage source and the ac control power terminals of the DECS-250N. |

Display Blank or Frozen

If the front panel display (LCD) is blank or frozen (does not scroll), remove control power for about 60 seconds and then reapply control power. If the problem occurred during software uploading, repeat the upload procedures as described in the associated instructions.

Generator Voltage Does Not Build

Check the DECS-250N settings and system voltages for the following:

- a. Generator potential transformer (PT) primary voltage
- b. Generator PT secondary voltage
- c. AC voltage on the DECS-250N operating (bridge) power terminals (C5 (A), C6 (B), and C7 (C))

Check the DECS-250N soft start bias and soft start time settings. If necessary, increase the generator soft start bias and decrease the generator soft start time.

If the generator voltage still does not build, increase the value of Kg.

Temporarily disable the overexcitation limiter.

Low Generator Voltage in AVR Mode

Check the following DECS-250N settings and system parameters:

- a. AVR voltage setpoint
- b. Generator potential transformer (PT) primary voltage
- c. Generator PT secondary voltage
- d. Overexcitation limiter (not activated)
- e. Accessory inputs (should be zero)
- f. Var/PF and droop (should be disabled)
- g. Cut-in underfrequency setting (should be below the generator operating frequency)

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

High Generator Voltage in AVR Mode

Check the following DECS-250N settings and system parameters:

- a. AVR voltage setpoint
- b. Generator potential transformer (PT) primary voltage
- c. Generator PT secondary voltage

- d. Accessory inputs (should be zero)
- e. Var/PF and droop (should be disabled)

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

Generator Voltage Unstable (Hunting)

Verify that the exciter power converter is working correctly by substituting the appropriate battery voltage in place of the DECS-250N drive voltage. If the problem is caused by the DECS-250N, check the gain settings for the specific mode of operation selected.

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

Protection or Limit Annunciation

If a protection function or limiting function is annunciated, check the associated setting values.

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

HMI Meter Readings Incorrect

If your PF, var, or watt readings are significantly different from the expected readings for a known load, verify that the B-phase current sensing input of the DECS-250N is connected to a CT on phase B and not phases A or C.

No Communication

If communication with the DECS-250N cannot be initiated, check the connections at the communication ports, the baud rate, and supporting software.

DECS-250N Reboots Frequently

If a single DECS-250N control power source is used and the power source is supplying less than the minimum required voltage or is fluctuating below the minimum required voltage, the DECS-250N will reboot. Increase the control power source voltage so that it is within the specified operating range. Units with style number Lxxxxxx have an input voltage range of 16 to 60 Vdc. Units with style number Cxxxxxx have an input voltage range of 90 to 150 Vdc or 82 to 132 Vac (50/60 Hz).

Support

Contact the Basler Electric Technical Services Department at (618) 654-2341 for troubleshooting support or to receive a return authorization number.



Specifications

DECS-250N electrical and physical characteristics are listed in the following paragraphs.

Operating Power

Voltage Range

For 63 Vdc Excitation Power..... 100 to 139 Vac 50/60 Hz or 61-420 Hz

For 125 Vdc Excitation Power..... 190 to 277 Vac 50/60 Hz or 61-420 Hz

For 250 Vdc Excitation Power..... 380 to 528 Vac 50/60 Hz

Frequency Range (Style Dependent)

Style xx1xxxx 50/60 Hz

Style xx2xxxx 61 to 420 Hz

Style xx3xxxx 50/60 Hz (480 Vac input, 250 Vdc output)

Table 41 lists the required nominal operating power voltage and configuration required to obtain 63, 125, and 250 Vdc continuous field power for the DECS-250N.

Table 41. Operating Power Requirements

| Excitation Power | Input Power Configuration | Nominal Input Voltage | Minimum Residual Voltage for Buildup | Operating Power Input Burden at 20 Adc Excitation Output |
|------------------|---------------------------|-----------------------|--------------------------------------|--|
| 63 Vdc | 1-Phase | 208 Vac | 12 Vac | 4,160 VA |
| | 3-Phase | 120 Vac | 12 Vac | 3,400 VA |
| 125 Vdc | 1-Phase | Not Recommended | | |
| | 3-Phase | 240 Vac | 24 Vac | 6,800 VA |
| 250 Vdc* | 1-Phase | Not Recommended | | |
| | 3-Phase | 480 Vac | 48 Vac | 13,600 VA |

* Style number DECS-250N-XX3XXXX required for this application.

Control Power

Two control power inputs enable continued operation if one of the two inputs is lost. The control power voltage rating is determined by the device style number.

Style LXXXXXX

DC Input

Nominal Input..... 24 or 48 Vdc

Input Range..... 16 to 60 Vdc

Burden..... 30 W

Style CXXXXXX

AC Input

Nominal Input..... 120 Vac, 50/60 Hz

Input Range..... 82 to 132 Vac, 50/60 Hz

Burden..... 50 VA

DC Input

Nominal Input 125 Vdc
 Input Range 90 to 150 Vdc
 Burden 30 W

Terminals

AC Input L, N
 DC Input BATT+, BATT–

Generator and Bus Voltage Sensing

Type 1-phase or 3-phase–3-wire
 Burden <1 VA per phase

Terminals

Generator Voltage Sensing E1, E2, E3
 Bus Voltage Sensing B1, B2, B3

50 Hz Sensing Voltage Nominal Input, Range

100 Vac 90 to 110 Vac
 200 Vac 180 to 220 Vac
 400 Vac 360 to 440 Vac

60 Hz Sensing Voltage Nominal Input, Range

120 Vac 108 to 132 Vac
 240 Vac 216 to 264 Vac
 480 Vac 432 to 528 Vac
 600 Vac 540 to 660 Vac

Generator Current Sensing

Configuration 4 inputs: A-, B-, C-phase, and cross-current compensation CT input
 Type 1-phase (B-phase), 1-phase with cross-current compensation, 3-phase, 3-phase with cross-current compensation
 Range 1 Aac or 5 Aac nominal
 Frequency 50/60 Hz

Burden

1 Aac Sensing <5 VA
 5 Aac Sensing <10 VA

Terminals

A-Phase CTA+, CTA–
 B-Phase CTB+, CTB–
 C-Phase CTC+, CTC–
 Cross-Current Compensation CCCT+, CCCT–

Accessory Inputs

Current Input

Range..... 4 to 20 mAdc
Burden..... Approximately 500 Ω
Terminals..... I+, I–

Voltage Input

Range..... –10 to +10 Vdc
Burden..... >20 kΩ
Terminals..... V+, V–

Contact Inputs

Type Dry contact, accept PLC open-collector outputs
Interrogation Voltage..... 12 Vdc

Terminals

Start..... START, COM A
Stop STOP, COM A
Programmable Input 1..... IN 1, COM A
Programmable Input 2..... IN 2, COM A
Programmable Input 3..... IN 3, COM A
Programmable Input 4..... IN 4, COM A
Programmable Input 5..... IN 5, COM A
Programmable Input 6..... IN 6, COM A
Programmable Input 7..... IN 7, COM B
Programmable Input 8..... IN 8, COM B
Programmable Input 9..... IN 9, COM B
Programmable Input 10..... IN 10, COM B
Programmable Input 11..... IN 11, COM B
Programmable Input 12..... IN 12, COM B
Programmable Input 13..... IN 13, COM B
Programmable Input 14..... IN 14, COM B

Communication Ports

Universal Serial Bus (USB)

Interface USB type B port
Location..... Front panel

Caution

In accordance with the guidelines defined in USB standards, the USB port on this device is not isolated. To prevent damage to a connected PC or laptop, the DECS-250N must be properly tied to ground.

RS-232

Type RS-232 (for external autotracking)
Interface DB-9 connector
Location..... Right side panel

RS-485

| | |
|-----------------|-----------------------|
| Type | RS-485, half duplex |
| Interface | Spring type terminals |
| Location | Left side panel |
| Terminals..... | RS-485 A, B, C |

Ethernet

| | |
|-----------------|---|
| Type | 100Base-T copper (style xxxxx1x) or 100Base-FX (style xxxxx2x) |
| Interface | RJ45 jack (style xxxxx1x) or locking duplex ST (straight tip) receptacle (style xxxxx2x) |
| Location | Right-side panel |

Controller Area Network (CAN)

| | |
|-------------------------------|--|
| Type | SAE J1939 message protocol |
| Interface | Spring (style xxxSxxx) or compression (style xxxCxxx) type terminals |
| Location | Right side panel |
| Terminals..... | CAN 1 H, L, SH CAN 2 H, L, SH |
| Differential Bus Voltage..... | 1.5 to 3 Vdc |
| Maximum Voltage | –32 to +32 Vdc |
| Communication Rate..... | 250 kb/s |

IRIG Time Synchronization Input

| | |
|---------------------------|---|
| Standard | 200-98, Format B002, and 200-04, Format B006 |
| Input Signal | Demodulated (dc level-shifted signal) |
| Logic High Level..... | 3.5 Vdc, minimum |
| Logic Low Level | 0.5 Vdc, maximum |
| Input Voltage Range | –10 to +10 Vdc |
| Input Resistance | Nonlinear, approximately 4 k Ω at 3.5 Vdc, 3 k Ω at 20 Vdc |
| Response Time | <1 cycle |
| Terminals..... | IRIG+, IRIG– |

Contact Outputs**Make and Break Ratings (Resistive)**

| | |
|------------------|---------|
| 24 Vdc..... | 7.0 Adc |
| 48 Vdc..... | 0.7 Adc |
| 125 Vdc..... | 0.2 Adc |
| 120/240 Vac..... | 7.0 Aac |

Carry Ratings (Resistive)

| | |
|--------------------|---------|
| 24/48/125 Vdc..... | 7.0 Adc |
| 120/240 Vac..... | 7.0 Aac |

Terminal Assignments

| | |
|---------------------|-----------------------|
| Watchdog..... | WTCHD1, WTCHD, WTCHD2 |
| Relay Output 1..... | RLY 1, RLY 1 |
| Relay Output 2..... | RLY 2, RLY 2 |
| Relay Output 3..... | RLY 3, RLY 3 |
| Relay Output 4..... | RLY 4, RLY 4 |
| Relay Output 5..... | RLY 5, RLY 5 |
| Relay Output 6..... | RLY 6, RLY 6 |
| Relay Output 7..... | RLY 7, RLY 7 |
| Relay Output 8..... | RLY 8, RLY 8 |
| Relay Output 9..... | RLY 9, RLY 9 |

Relay Output 10..... RLY 10, RLY 10
 Relay Output 11..... RLY 11, RLY 11

Field Power Output

Continuous Rating..... 20 Adc
 Forcing Rating..... 40 Adc for 10 s, 30 Adc for 120 s
 Terminals..... F+, F–

Maximum Positive Forcing Voltage

1-Phase

63 Vdc Application 130 Vdc, 40 Adc
 125 Vdc Application Not recommended
 250 Vdc Application Not recommended

3-Phase

63 Vdc Application 120 Vdc, 40 Adc
 125 Vdc Application 240 Vdc, 40 Adc
 250 Vdc Application 480 Vdc, 40 Adc

Maximum Negative Forcing Voltage

1-Phase

63 Vdc Application –105 Vdc, 40 Adc
 125 Vdc Application Not recommended
 250 Vdc Application Not recommended

3-Phase

63 Vdc Application –100 Vdc, 40 Adc
 125 Vdc Application –200 Vdc, 40 Adc
 250 Vdc Application –400 Vdc, 40 Adc

Minimum Field Resistance

63 Vdc Application 3.15 Ω
 125 Vdc Application 6.25 Ω
 250 Vdc Application 12.5 Ω

Regulation

FCR Operating Mode

Setpoint Range 0 to 18 Adc, in increments of 0.1%
 Regulation Accuracy $\pm 1.0\%$ of the nominal value for 10% of the power input voltage change or 20% of the field resistance change. Otherwise, $\pm 5.0\%$

FVR Operating Mode

Setpoint Range 0 to 270 Vdc, in increments of 0.1%
 Regulation Accuracy $\pm 1.0\%$ of the nominal value for 10% of the power input voltage change or 20% of the field resistance change. Otherwise, $\pm 5.0\%$

AVR Operating Mode

Setpoint Range 70 to 120% of rated generator voltage, in increments of 0.1%
 Regulation Accuracy $\pm 0.25\%$ over load range at rated PF with constant generator frequency and ambient temperature

| | |
|------------------------------|--|
| Steady-State Stability | ±0.25% at rated PF with constant generator frequency and ambient temperature |
| Temperature Drift | ±0.5% between 0 and 40°C at constant load and generator frequency |

Var Operating Mode

| | |
|---------------------------|--|
| Setpoint Range | –100% (leading) to +100% (lagging) of the generator nominal apparent power in increments of 0.1% |
| Regulation Accuracy | ±2.0% of the nominal generator apparent power rating at the rated generator frequency |

Power Factor Operating Mode

| | |
|---------------------------|---|
| Setpoint Range | 0.5 to 1.0 (lagging) and –0.5 to -1.0 (leading), in increments of 0.005 |
| Regulation Accuracy | ±0.02 PF of the PF setpoint for the real power between 10 and 100% at the rated frequency |

Parallel Compensation

| | |
|------------------------------------|--|
| Modes..... | Reactive Droop, Line Drop, and Reactive Differential (Cross-Current) |
| Cross-Current Input Burden..... | Can exceed 1 VA if external resistors are added to the CT circuit for cross-current compensation |
| Cross-Current Input Terminals..... | CCCT+, CCCT– |

Setpoint Range

| | |
|----------------------|-----------------------------------|
| Reactive Droop | 0 to +30% of Rated Voltage |
| Line Drop..... | 0 to 30% of Rated Voltage |
| Cross-Current..... | –30 to +30% of Primary CT Current |

Generator Protection Functions

Overvoltage (59) and Undervoltage (27)

Pickup

| | |
|-----------------|------------------|
| Range..... | 1 to 600,000 Vac |
| Increment | 1 Vac |

Time Delay

| | |
|-----------------|-------------|
| Range..... | 0.1 to 60 s |
| Increment | 0.1 s |

Loss of Sensing

Time Delay

| | |
|-----------------|-----------|
| Range..... | 0 to 30 s |
| Increment | 0.1 s |

Voltage Balanced Level

| | |
|-----------------|--|
| Range..... | 0 to 100% of Positive Sequence Voltage |
| Increment | 0.1% |

Voltage Unbalanced Level

| | |
|-----------------|--|
| Range..... | 0 to 100% of Positive Sequence Voltage |
| Increment | 0.1% |

Overfrequency (81O) and Underfrequency (81U)Pickup

Range..... 30 to 70 Hz
Increment 0.01 Hz

Time Delay

Time Delay Range 0 to 300 s
Increment 0.1 s

Voltage Inhibit (81U only)

Range..... 50 to 100% of Rated Voltage
Increment 1%

Reverse Power (32R)Pickup

Range..... 0 to 150% of Rated Watts
Increment 1%

Time Delay

Range..... 0 to 300 s
Increment 0.1 s

Loss of Excitation (40Q)Pickup

Range..... 0 to 150% of Rated kvars
Increment 1%

Time Delay

Range..... 0 to 300 s
Increment 0.1 s

Field Protection Functions

Field OvervoltagePickup

Range..... 1 to 325 Vdc
Increment 1 Vdc

Time Delay

Range..... 0.2 to 30 s
Increment 0.1 s

Field OvercurrentPickup

Range..... 0 to 22 Adc
Increment 0.1 Adc

Time Delay

Range..... 5 to 60 s
Increment 0.1 s

Loss of PMG

Pickup

Single-Phase Source <10 Vac

Three-Phase Source <50 Vac or a phase-to-phase imbalance >20%

Time Delay

Range 0 to 10 s

Increment 0.1 s

Exciter Diode Monitor (EDM)

Pole Ratio

Range 0 to 10

Increment 0.01

Pickup Level

Open and Shorted Diode 0 to 100% of Metered Field Current

Increment 0.1%

Delay

Open Diode Protection 10 to 60 s

Shorted Diode Protection 5 to 30 s

Increment 0.1 s

Synchronism Check (25) Protection

Voltage Difference

Range 1 to 50%

Increment 1%

Slip Angle

Range 1 to 99°

Increment 0.1°

Slip Frequency

Range 0.01 to 0.5 Hz

Increment 0.01 Hz

Startup

Soft Start Level

Range 0 to 90% of Rated Gen Voltage

Increment 1%

Soft Start Time

Range 1 to 7,200 s

Increment 1 s

Field Flash Dropout Level

Range 0 to 100% of Rated Gen Voltage

Increment 1%

Maximum Field Flash Time

Range..... 1 to 50 s

Increment 1 s

Voltage Matching

Accuracy..... Generator rms voltage is matched with the bus rms voltage to within $\pm 0.5\%$ of the generator voltage.

On-Line Overexcitation Limiting**High Current Level**Pickup

Range..... 0 to 40 Adc

Increment 0.1 Adc

Time

Range..... 0 to 10 s

Increment 1 s

Medium Current LevelPickup

Range..... 0 to 30 Adc

Increment 0.1 Adc

Time

Range..... 0 to 120 s

Increment 1 s

Low Current LevelPickup

Range..... 0 to 20 Adc

Increment 0.1 Adc

Off-Line Overexcitation Limiting**High Current Level**

Pickup Range..... 0 to 40 Adc

Pickup Range Increment..... 0.1 Adc

Time Delay Range 0 to 10 s

Time Delay Increment..... 1 s

Low Current Level

Pickup Range..... 0 to 20 Adc

Pickup Increment 0.1 Adc

Sequence of Events Recording (SER)2

Over 1,000 records are stored in nonvolatile memory (retrievable via BESTCOMSP^{lus}). The SER can be triggered by: Input/Output status changes, system operating status changes, or alarm annunciations.

Data Logging (Oscillography)

Up to 6 variables can be logged. The sampling rate is 1,200 data points per log, up to 1,199 pre-trigger, 4 ms to 10 s intervals, (4.8 s to 12,000 s total log duration).

Environment

Temperature

Operating Range..... –40 to +60°C (–40 to +140°F)

Storage Range –40 to +85°C (–40 to +185°F)

Humidity

MIL-STD-705B, Method 711-1C

Salt Fog

IEC 60068-2-52, Level 2 Severity

Type Tests

Shock

Withstands 15 G in 3 perpendicular planes.

Vibration

IEC 60068-2-6, Endurance by sweeping with the following parameters:

- 3 hours per plane
- 3 to 25 Hz, 1.5mm fixed displacement
- 25 to 2,000 Hz, 5 G acceleration
- Sweep Rate: 0.45 octaves per minute

Impulse

IEC 60255-5

Transients

EN61000-4-4

Static Discharge

EN61000-4-2

Radio Interference

Type tested using a 5 W, hand-held transceiver operating at random frequencies centered around 144 MHz and 440 MHz with the antenna located within 150 mm (6 inches) of the device in both vertical and horizontal planes.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the DECS-250N was subjected to temperature tests (tested over a temperature range of –100

to +120°C (–148 to +248°F)), vibration tests (of 5 to 45 G at +20°C (68°F)), and temperature/vibration tests (tested at 40 G over a temperature range of –100 to +120°C (–148 to +248°F)). Combined temperature and vibration testing at these extremes proves that the DECS-250N is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels.

Patent

Patent pending.

Physical

Dimensions..... Refer to the *Mounting* chapter.

Weight 6.75 kg (14.9 lb)

Regulatory Standards

Maritime Recognition

Recognized per standard IACS UR (sections E10 and E22) by the following:

- Bureau Veritas (BV) - BV Rules Pt. C, Ch. 3
- Det Norske Veritas (DNV) - No. 2.4
- Germanischer Lloyd (GL) - VI-7-2
- American Bureau of Shipping (ABS) - ABS Rules Part 1

IEC 60092-504 used for evaluation.

UL Approval

This product is recognized to applicable Canadian and US safety standards and requirements by UL.

Standards used for evaluation:

- UL 6200

CSA Certification

This product was tested and has met the certification requirements for electrical, plumbing, and/or mechanical products.

Standards used for evaluation:

- CSA C22.2 No. 0
- CSA C22.2 No. 14

CE Compliance

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation.

EC Directives:

- LVD 2014/35/EU
- EMC 2004/108/EC

Harmonized standards used for evaluation:

- EN 50178 – Electronic Equipment for use in Power Installations
- EN 61000-6-4 – Electromagnetic Compatibility (EMC), Generic Standards, Emission Standard for Industrial Environments
- EN 61000-6-2 – Electromagnetic Compatibility (EMC), Generic Standards, Immunity for Industrial Environments

EAC Mark (Eurasian Conformity)

- TP TC 004/2011
- TP TC 020/2011

Analog Expansion Module

General Information

The optional AEM-2020 is a remote auxiliary device that provides additional DECS-250N analog inputs and outputs.

Features

The AEM-2020 has the following features:

- Eight Analog Inputs
- Eight RTD Inputs
- Two Thermocouple Inputs
- Four Analog Outputs
- Functionality of Inputs and Outputs assigned by BESTlogic™ *Plus* programmable logic
- Communications via CAN Bus

Specifications

Operating Power

Nominal 12 or 24 Vdc
 Range 8 to 32 Vdc (Withstands ride-through down to 6 Vdc for 500 ms.)
 Maximum Consumption 5.1 W

Analog Inputs

The AEM-2020 contains eight programmable analog inputs.

Rating 4 to 20 mA or 0 to 10 Vdc (user-selectable)
 Burden
 4 to 20 mA 470 Ω maximum
 0 to 10 Vdc 9.65k Ω minimum

RTD Inputs

The AEM-2020 contains eight programmable RTD inputs.

Rating 100 Ω Platinum or 10 Ω Copper (user-selectable)
 Setting Range -50 to +250°C or -58 to +482°F
 Accuracy (10 Ω Copper) $\pm 0.044 \Omega$ @ 25°C, $\pm 0.005 \Omega/^{\circ}\text{C}$ drift over ambient temperature
 Accuracy (100 Ω Platinum) $\pm 0.39 \Omega$ @ 25°C, $\pm 0.047 \Omega/^{\circ}\text{C}$ drift over ambient temperature

Thermocouple Inputs

The AEM-2020 contains two thermocouple inputs.

Rating 2 K Type Thermocouples
 Setting Range 0 to 1,375°C or 0 to 2,507°F
 Display Range Ambient to 1,375°C or Ambient to 2,507°F
 Accuracy $\pm 40 \mu\text{V}$ @ 25°C, $\pm 5 \mu\text{V}/^{\circ}\text{C}$ drift over ambient temperature

Analog Outputs

The AEM-2020 contains four programmable analog outputs.

Rating 4 to 20 mA or 0 to 10 Vdc (user-selectable)

Communication Interface

The AEM-2020 communicates with the DECS-250N through CAN1.

CAN Bus

Differential Bus Voltage..... 1.5 to 3 Vdc

Maximum Voltage -32 to +32 Vdc with respect to negative battery terminal

Communication Rate..... 125 or 250 kb/s

Type Tests

Shock

Withstands 15 G in 3 perpendicular planes.

Vibration

Swept over the following ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep consisting of the following:

5 to 29 to 5 Hz 1.5 G peak for 5 min.

29 to 52 to 29 Hz 0.036" Double Amplitude for 2.5 min.

52 to 500 to 52 Hz 5 G peak for 7.5 min.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the AEM-2020 was subjected to temperature tests (tested over a temperature range of -80°C to +130°C), vibration tests (of 5 to 50 G at +25°C), and temperature/vibration tests (tested at 10 to 20 G over a temperature range of -60°C to +100°C). Combined temperature and vibration testing at these extremes proves that the AEM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in the *Specifications* chapter of this manual.

Environment

Temperature

Operating -40 to +70°C (-40 to +158°F)

Storage -40 to +85°C (-40 to +185°F)

Humidity IEC 68-2-38

UL Approval

This product is recognized to applicable Canadian and US safety standards and requirements by UL.

Standards used for evaluation:

- UL6200

CSA Certification

This product was tested and has met the certification requirements for electrical, plumbing, and/or mechanical products.

Standards used for evaluation:

- CSA C22.2 No. 0
- CSA C22.2 No. 14

CE Compliance

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation.

EC Directives:

- LVD 2014/35/EU
- EMC 2004/108/EC

Harmonized standards used for evaluation:

- EN 50178
- EN 61000-6-4
- EN 61000-6-2

Physical

Weight 1.80 lb (816 g)

Dimensions..... See *Installation* later in this chapter.

Installation

Analog Expansion Modules are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a module, check the part number against the requisition and packing list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify the Basler Electric regional sales office, your sales representative, or a sales representative at Basler Electric, Highland, Illinois USA.

If the device is not installed immediately, store it in the original shipping package in a moisture- and dust-free environment.

Mounting

Analog Expansion Modules are contained in a potted plastic case and may be mounted in any convenient position. The construction of an Analog Expansion Module is durable enough to mount directly on a genset using ¼-inch hardware. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 168 for AEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

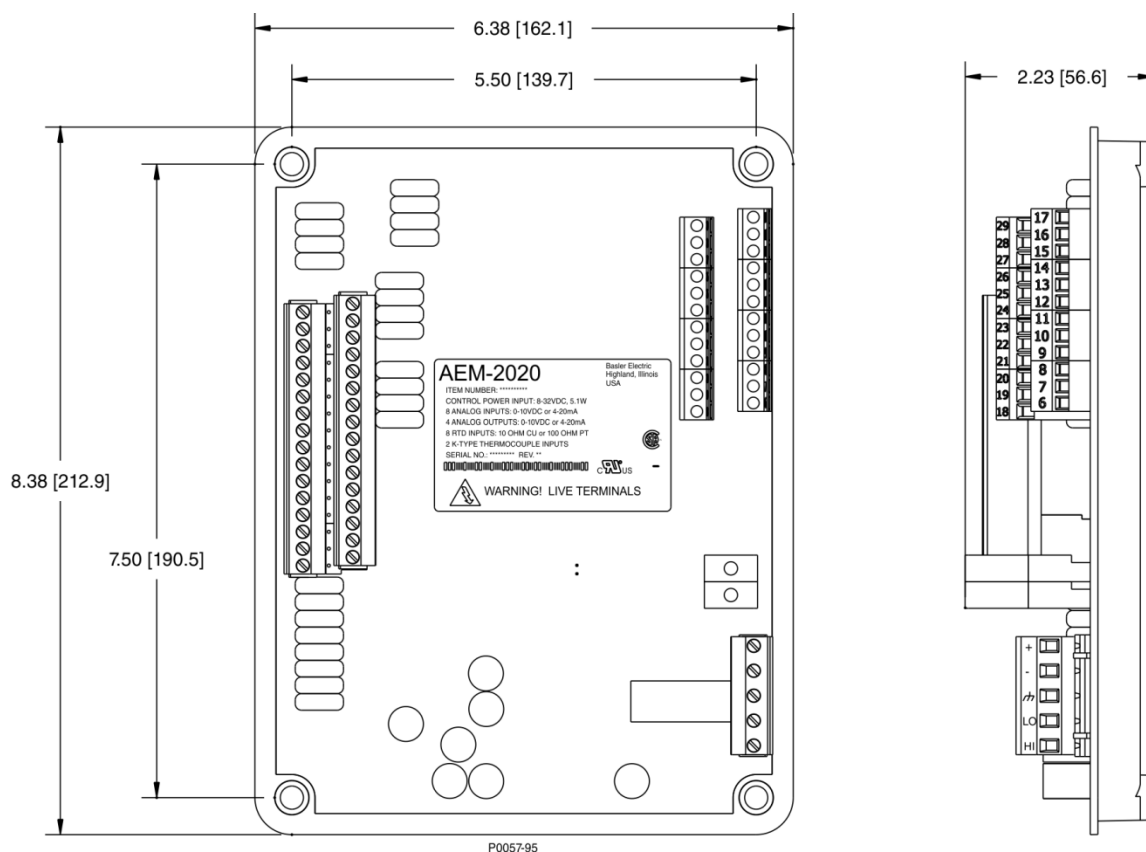


Figure 168. AEM-200 Overall Dimensions

Connections

Analog Expansion Module connections are dependent on the application. Incorrect wiring may result in damage to the module.

Note

Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the AEM-200 will not operate.

Be sure that the AEM-200 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.

Terminations

The terminal interface consists of both plug-in connectors and a permanently mounted connector with screw-down compression terminals.

AEM-200 connections are made with one 5-position connector, two 12-position connectors, two 16-position connectors, and two 2-position thermocouple connectors. The 16, 5, and 2-position connectors plug into headers on the AEM-200. The connectors and headers have dovetailed edges that ensure proper connector orientation. Also, the connectors and headers are uniquely keyed to ensure that the connectors mate only with the correct headers. The 12-position connector is not a plug-in connector and is mounted permanently to the board.

Connectors and headers may contain tin- or gold-plated conductors. Tin-plated conductors are housed in a black plastic casing and gold-plated conductors are housed in an orange plastic casing. Mate connectors to headers of the same color only.

Caution

By mating conductors of dissimilar metals, galvanic corrosion could occur which deteriorates connections and leads to signal loss.


Connector screw terminals accept a maximum wire size of 12 AWG. Thermocouple connectors accept a maximum thermocouple wire diameter of 0.177 inches (4.5 mm). Maximum screw torque is 5 in-lb (0.56 N•m).

Operating Power

The Analog Expansion Module operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the AEM-2020 will not operate. Operating power terminals are listed in Table 42.

It is recommended that a fuse be added for additional protection for the wiring to the battery input of the Analog Expansion Module. A Bussmann ABC-7 fuse or equivalent is recommended.

Table 42. Operating Power Terminals

| Terminal | Description |
|--|--|
| P1-  (SHIELD) | Chassis ground connection |
| P1- – (BATT–) | Negative side of operating power input |
| P1- + (BATT+) | Positive side of operating power input |

AEM-2020 Inputs and Outputs

Input and output terminals are shown in Figure 169 and listed in Table 43.

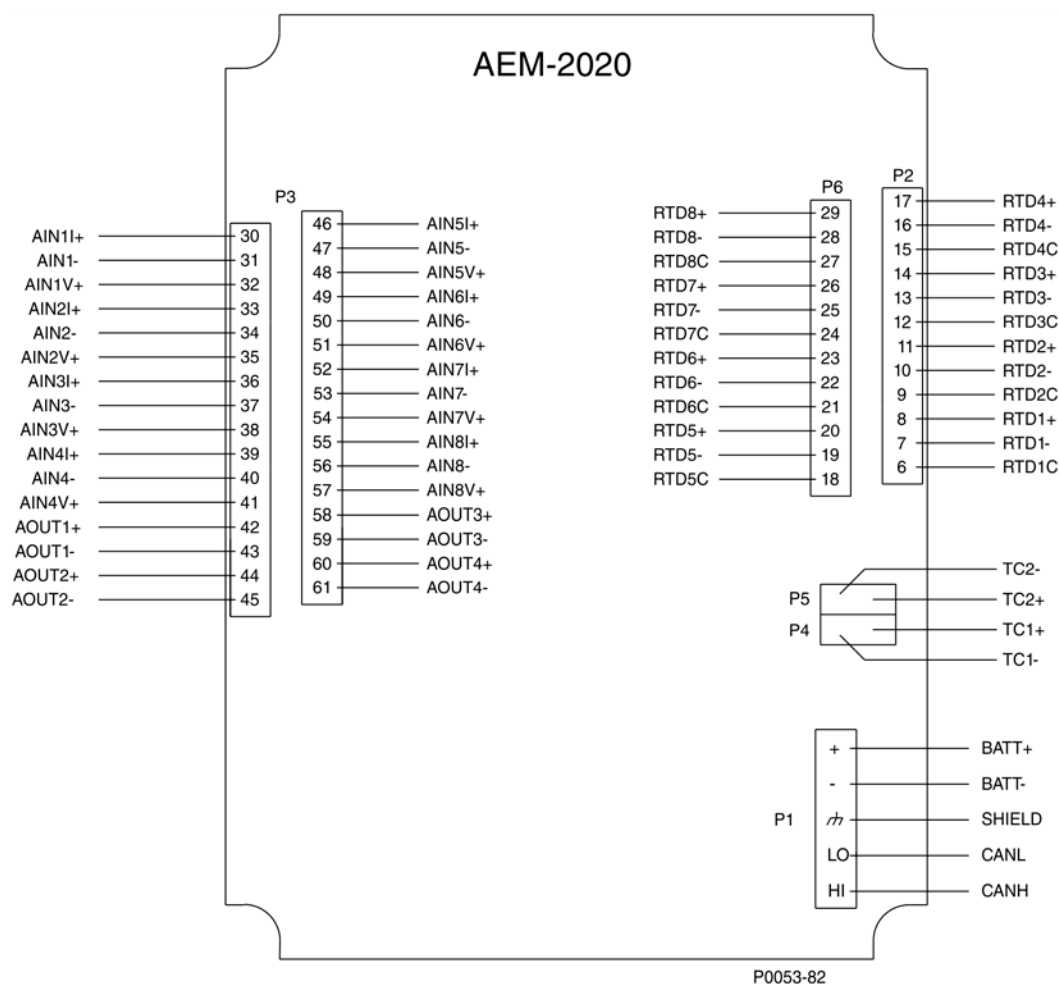


Figure 169. Input and Output Terminals

Table 43. Input and Output Terminals

| Connector | Description |
|-----------|--|
| P1 | Operating Power and CAN bus |
| P2 | RTD Inputs 1 - 4 |
| P3 | Analog Inputs 1 - 8 and Analog Outputs 1 - 4 |
| P4 | Thermocouple 1 Input |
| P5 | Thermocouple 2 Input |
| P6 | RTD Inputs 5 - 8 |

External Analog Input Connections

Voltage input connections are shown in Figure 170 and current input connections are shown in Figure 171. When using the current input, AIN V+ and AIN I+ must be tied together.

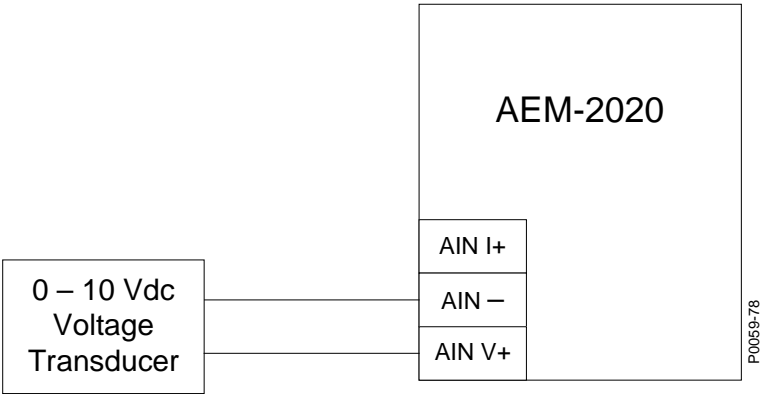


Figure 170. Analog Inputs - Voltage Input Connections

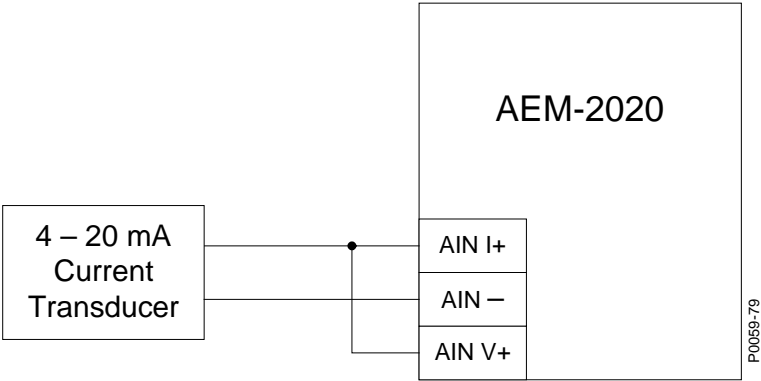


Figure 171. Analog Inputs - Current Input Connections

External RTD Input Connections

External 2-wire RTD input connections are shown in Figure 172. Figure 173 shows external 3-wire RTD input connections.

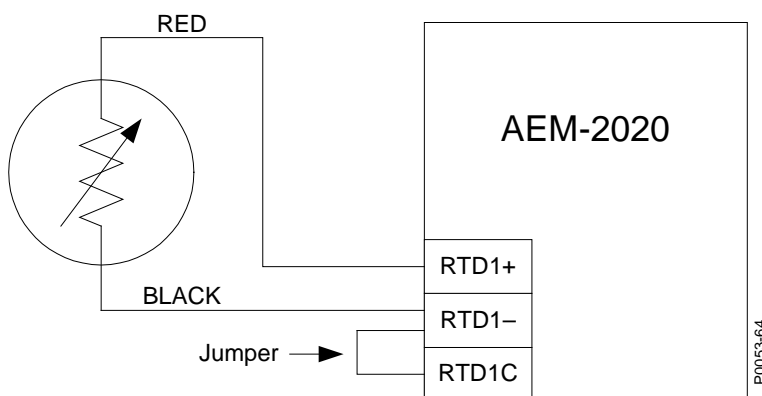


Figure 172. External Two-Wire RTD Input Connections

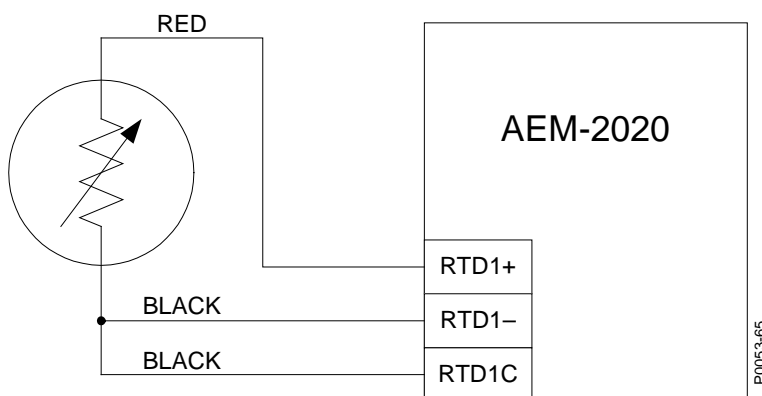



Figure 173. External Three-Wire RTD Input Connections

CAN Bus Interface

These terminals provide communication using the SAE J1939 protocol and provide high-speed communication between the Analog Expansion Module and the DECS-250N. Connections between the AEM-2020 and DECS-250N should be made with twisted-pair, shielded cable. CAN Bus interface terminals are listed in Table 44. Refer to Figure 174 and Figure 175.

Table 44. CAN Bus Interface Terminals

| Terminal | Description |
|--|-----------------------------------|
| P1- HI (CAN H) | CAN high connection (yellow wire) |
| P1- LO (CAN L) | CAN low connection (green wire) |
| P1-  (SHIELD) | CAN drain connection |

Note

1. If the AEM-2020 is providing one end of the J1939 bus, a 120 Ω , ½ watt terminating resistor should be installed across terminals P1- LO (CANL) and P1- HI (CANH).
2. If the AEM-2020 is not part of the J1939 bus, the stub connecting the AEM-2020 to the bus should not exceed 914 mm (3 ft) in length.
3. The maximum bus length, not including stubs, is 40 m (131 ft).
4. The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the AEM-2020.

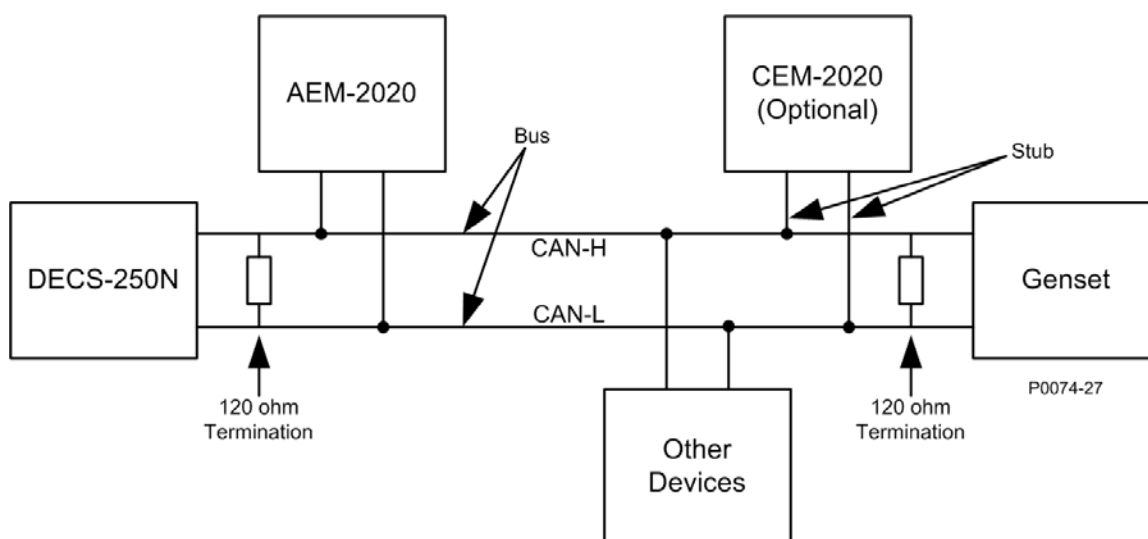


Figure 174. CAN Bus Interface with AEM-2020 providing One End of the Bus

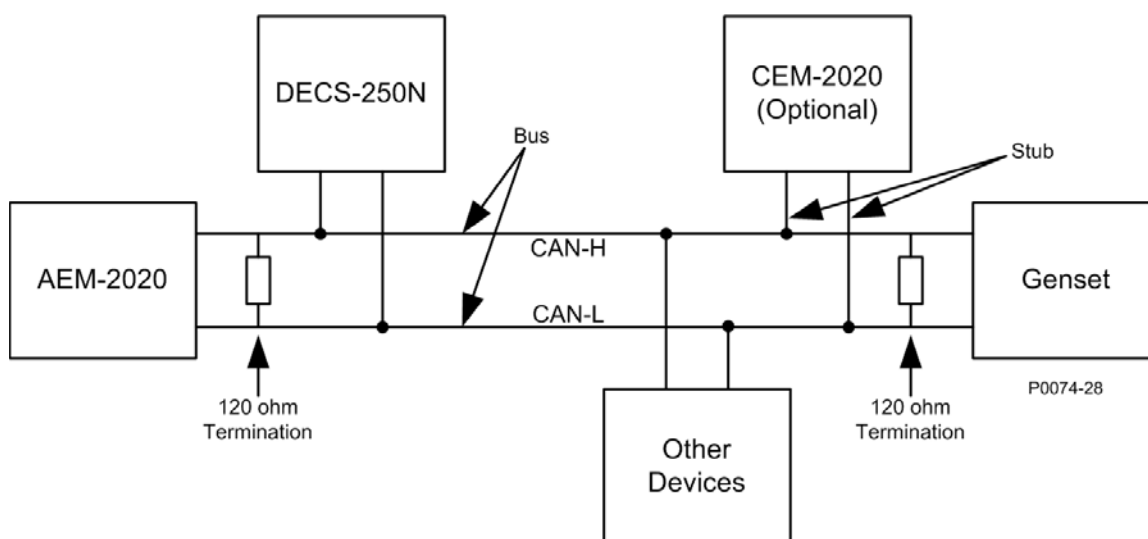


Figure 175. CAN Bus Interface with DECS-250N providing One End of the Bus

Communications

BESTCOMSPlus Navigation Path: Settings, Communications, CAN bus, Remote Module Setup

HMI Navigation Path: Settings, Communication, CAN bus, Remote Module Setup, Analog Expansion Module

The analog expansion module must be enabled with the correct J1939 address. A Control Area Network (CAN) is a standard interface that enables communication between the AEM-2020 and the DECS-250N. The Remote Module Setup screen is illustrated in Figure 176.

Figure 176. Remote Module Setup

Functional Description

Analog Inputs

BESTCOMSPlus Navigation Path: Settings, Programmable Inputs, Remote Analog Inputs

HMI Navigation Path: Settings, Programmable Inputs, Remote Analog Inputs

The AEM-2020 provides eight analog inputs that can annunciate a latching or non-latching alarm. The analog inputs are always monitored and their status is displayed on the appropriate metering screens. To make identifying the analog inputs easier, a user-assigned name^A can be given to each input.

Select the input type^B. Select the amount of hysteresis^C needed to prevent rapid switching of the alarm. A user-adjustable arming delay^D allows configuration of the analog input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether or not excitation is enabled. (2) When the arming delay is set to a non-zero value, threshold monitoring begins when the arming delay time has expired after system startup is complete. An out-of-range alarm, configured on the *Alarm Configuration, Alarms* screen in BESTCOMSPlus®, alerts the user of an open or damaged analog input wire. When enabled, Stop Mode Inhibit^E turns off analog input protection when excitation is stopped.

Ranges must be set for the selected input type. Param Min^F correlates to Min Input Current^G or Min Input Voltage^H and Param Max^I correlates to Max Input Current^J or Max Input Voltage^K.

Each analog input can be independently configured for over or under mode^L to annunciate an alarm when the analog input signal falls beyond the threshold^M. Alarms are configured on the *Alarm Configuration, Alarms* screen in BESTCOMSPlus. A user-adjustable activation delay^N setting delays alarm annunciation after the threshold has been exceeded.

The remote analog inputs are incorporated into a BESTlogicPlus programmable logic scheme by selecting them from the I/O group in BESTlogicPlus. For more details, refer to the *BESTlogicPlus* chapter.

BESTCOMSPlus settings for remote analog inputs are illustrated in Figure 177. Remote Analog Input #1 is shown.

Remote Analog Input #1

Label Text: ANALOG IN 1 A Arming Delay (s): 0 D

Hysteresis (%): 2.0 C Stop Mode Inhibit: No E

Input Type: Voltage B

Ranges

Param Min: -9999.0 F Min Input Current (mA): 4.0 G Min Input Voltage (V): 0.0 H

Param Max: 9999.0 I Max Input Current (mA): 20.0 J Max Input Voltage (V): 10.0 K

Threshold #1

Mode: Disabled L Threshold: -9999.0 M Activation Delay (s): 0 N

Figure 177. Remote Analog Input Settings

^A **Label Text:** An alphanumeric character string with a maximum of 64 characters.

^B **Input Type:** Voltage or Current.

^C **Hysteresis:** Adjustable from 0 to 100% in 0.1% increments.

^D **Arming Delay:** Adjustable from 0 to 300 s in 1 s increments.

^E **Stop Mode Inhibit:** Yes or No.

^F **Param Min:** Adjustable from -9999.0 to +9999.0 in increments of 0.1

^G **Min Input Current:** Adjustable from 4 to 20 mA in 0.1 mA increments.

^H **Min Input Voltage:** Adjustable from 0 to 10 V in 0.1 V increments.

^I **Param Max:** Adjustable from -9999.0 to +9999.0 in increments of 0.1.

^J **Max Input Current:** Adjustable from 4 to 20 mA in 0.1 mA increments.

^K **Max Input Voltage:** Adjustable from 0 to 10 V in 0.1 V increments.

^L **Mode:** Disabled, Over, or Under.

^M **Threshold:** Adjustable from -9999.0 to +9999.0 in increments of 0.1.

^N **Activation Delay:** Adjustable from 0 to 300 s in 1 s increments.

RTD Inputs

BESTCOMSPlus Navigation Path: Settings, Programmable Inputs, Remote RTD Inputs

HMI Navigation Path: Settings, Programmable Inputs, Remote RTD Inputs

The AEM-2020 provides eight user-configurable RTD inputs that can annunciate a latching or non-latching alarm. The RTD inputs are always monitored and their status is displayed on the appropriate metering screens. To make identifying the RTD inputs easier, a user-assigned name^A can be given to each input.

Select the amount of hysteresis^B needed to prevent rapid switching of the alarm. Select the RTD type^C. A user-adjustable arming delay^D allows configuration of the RTD input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether or not excitation is enabled. (2) When the arming delay is set to a non-zero value, threshold monitoring begins when the arming delay time has expired after system startup is complete. An out-of-range alarm, configured on the *Alarm Configuration, Alarms* screen in BESTCOMSPlus, alerts the user of an open or

damaged RTD input wire. When enabled, Stop Mode Inhibit^E turns off RTD input protection when excitation is stopped.

Each RTD input can be independently configured for over or under mode^F to annunciate an alarm when the RTD input signal falls beyond the threshold^G. Alarms are configured on the *Alarm Configuration, Alarms* screen in BESTCOMSPPlus. A user-adjustable activation delay^H setting delays alarm annunciation after the threshold has been exceeded.

The remote RTD inputs are incorporated into a BESTlogicPlus programmable logic scheme by selecting them from the I/O group in BESTlogicPlus. For more details, refer to the *BESTlogicPlus* chapter.

BESTCOMSPPlus settings for remote RTD inputs are illustrated in Figure 178. Remote RTD Input #1 is shown.

Figure 178. Remote RTD Input Settings

^A *Label Text*: An alphanumeric character string with a maximum of 64 characters.

^B *Hysteresis*: Adjustable from 0 to 100% in 0.1% increments.

^C *RTD Type*: 100 Ohm Platinum or 10 Ohm Copper.

^D *Arming Delay*: Adjustable from 0 to 300 s in 1 s increments.

^E *Stop Mode Inhibit*: Yes or No.

^F *Mode*: Disabled, Over, or Under.

^G *Threshold*: -58 to +482°F in 1°F increments.

^H *Activation Delay*: Adjustable from 0 to 300 s in 1 s increments.

Thermocouple Inputs

BESTCOMSPPlus Navigation Path: Settings, Programmable Inputs, Remote Thermocouple Inputs

HMI Navigation Path: Settings, Programmable Inputs, Remote Thermocouple Inputs

The AEM-2020 provides two thermocouple inputs. The thermocouple inputs are always monitored and their status is displayed on the appropriate metering screens. To make identifying the thermocouple inputs easier, a user-assigned name^A can be given to each input.

Select the amount of hysteresis^B needed to prevent rapid switching of the alarm. A user-adjustable arming delay^C allows configuration of the thermocouple input threshold monitoring in one of two ways. (1) When the arming delay is set to zero, threshold monitoring is performed all the time, whether or not excitation is enabled. (2) When the arming delay is set to a non-zero value, threshold monitoring begins when the arming delay time has expired after system startup is complete. An out-of-range alarm, configured on the *Alarm Configuration, Alarms* screen in BESTCOMSPPlus, alerts the user of an open or damaged thermocouple input wire. When enabled, Stop Mode Inhibit^D turns off thermocouple input protection when excitation is stopped.

Each thermocouple input can be independently configured for over or under mode^E to annunciate an alarm when the thermocouple input signal falls beyond the threshold^F. Alarms are configured on the *Alarm Configuration, Alarms* screen in *BESTCOMSPlus*. A user-adjustable activation delay^G setting delays alarm annunciation after the threshold has been exceeded.

The remote thermocouple inputs are incorporated into a *BESTlogicPlus* programmable logic scheme by selecting them from the *I/O* group in *BESTlogicPlus*. For more details, refer to the *BESTlogicPlus* chapter.

BESTCOMSPlus settings for remote thermocouple inputs are illustrated in Figure 179. Remote Thermocouple Input #1 is shown.

Figure 179. Remote Thermocouple Input Settings

^A *Label Text*: An alphanumeric character string with a maximum of 64 characters.

^B *Hysteresis*: Adjustable from 0 to 100% in 0.1% increments.

^C *Arming Delay*: Adjustable from 0 to 300 s in 1 s increments.

^D *Stop Mode Inhibit*: Yes or No.

^E *Mode*: Disabled, Over, or Under.

^F *Threshold*: Adjustable from 32 to 2,507°F in 1°F increments.

^G *Activation Delay*: Adjustable from 0 to 300 s in 1 s increments.

Analog Outputs

BESTCOMSPlus Navigation Path: Settings, Programmable Outputs, Remote Analog Outputs

HMI Navigation Path: Settings, Programmable Outputs, Remote Analog Outputs

The AEM-2020 provides four analog outputs.

Make a parameter selection^A and select the output type^B. An out-of-range alarm configured on the *Alarm Configuration, Alarms* screen in *BESTCOMSPlus*, alerts the user of an open or damaged analog output wire. An out-of-range activation delay^C setting delays alarm annunciation.

Ranges must be set for the selected output type. Param Min^D correlates to Min Output Current^E or Min Output Voltage^F and Param Max^G correlates to Max Output Current^H or Max Output Voltage^I.

The remote analog outputs are incorporated into a *BESTlogicPlus* programmable logic scheme by selecting them from the *I/O* group in *BESTlogicPlus*. For more details, refer to the *BESTlogicPlus* chapter.

BESTCOMSPlus settings for remote analog outputs are illustrated in Figure 180. Remote Analog Output #1 is shown.

Figure 180. Remote Analog Output Settings

^A *Parameter Selection:* Gen VAB, Gen VBC, Gen VCA, Gen V Average, Bus Freq, Bus VAB, Bus VBC, Bus VCA, Gen Freq, Gen PF, kWh, kvarh, Gen IA, Gen IB, Gen IC, Gen I Average, kW Total, kVA Total, kvar Total, EDM Ripple, Exciter Field Voltage, Exciter Field Current, Auxiliary Input Voltage, Auxiliary Input Current, Setpoint Position, Tracking Error, Negative Sequence Voltage, Negative Sequence Current, Positive Sequence Voltage, Positive Sequence Current, PSS Output, Analog Input 1-8, RTD Input 1-8, Thermocouple 1-2, Power Input, or NLS Error Percent.

^B *Output Type:* Voltage or Current.

^C *Out of Range Activation Delay:* Adjustable from 0 to 300 s in 1 s increments.

^D *Param Min:* Adjustable from -999,999.0 to +999,999.0 in increments of 0.1.

^E *Min Output Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.

^F *Min Output Voltage:* Adjustable from 0 to 10 V in 0.1 V increments.

^G *Param Max:* Adjustable from -999,999.0 to +999,999.0 in increments of 0.1.

^H *Max Output Current:* Adjustable from 4 to 20 mA in 0.1 mA increments.

^I *Max Output Voltage:* Adjustable from 0 to 10 V in 0.1 V increments.

Metering

Analog Inputs

BESTCOMSPlus Navigation Path: Metering, Status, Inputs, Remote Analog Inputs

HMI Navigation Path: Metering, Status, Inputs, Remote Analog Input Values

The value and status of the remote analog inputs are shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 181. Remote Analog Input #1 is shown.

Figure 181. Remote Analog Inputs Metering

RTD Inputs

BESTCOMSPlus Navigation Path: Metering, Status, Inputs, Remote RTD Inputs

HMI Navigation Path: Metering, Status, Inputs, Remote Analog Input Values

The value and status of the remote RTD inputs are shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 182. Remote RTD Input #1 is shown.

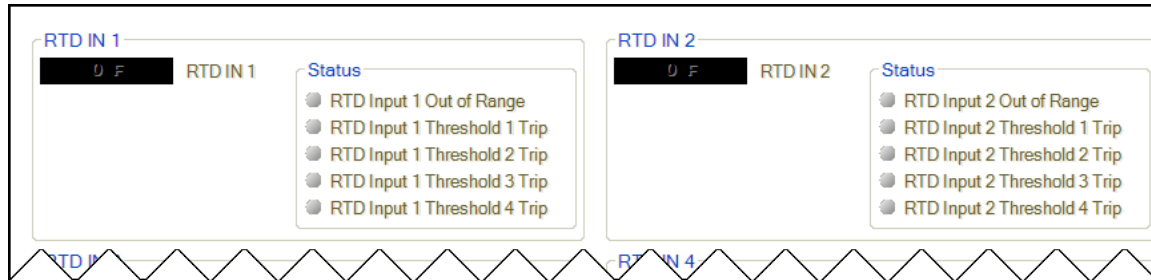


Figure 182. Remote RTD Inputs Metering

Thermocouple Inputs

BESTCOMSPlus Navigation Path: Metering, Status, Inputs, Remote Thermocouple Inputs

HMI Navigation Path: Metering, Status, Inputs, Remote Analog Input Values

The value and status of the remote thermocouple inputs are shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 183. Remote Thermocouple Input #1 is shown.

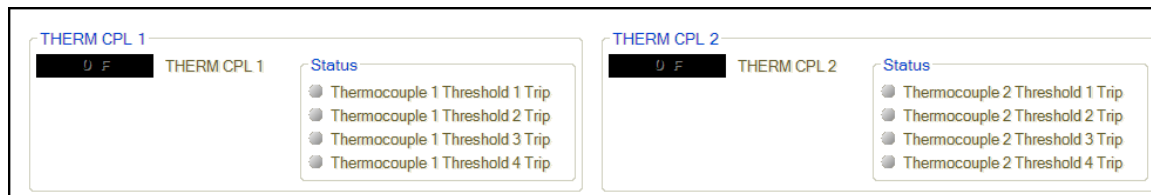


Figure 183. Remote Thermocouple Inputs Metering

Analog Input Values

BESTCOMSPlus Navigation Path: Metering, Status, Inputs, Remote Analog Input Values

HMI Navigation Path: Metering, Status, Inputs, Remote Analog Input Values

The values of the scaled analog inputs, raw analog inputs, RTD input temperatures, raw RTD inputs, thermocouple input temperatures, and raw thermocouple inputs are shown on this screen.

For each analog input, the raw metered input value is displayed, and the scaled metered input value. This is useful to check if the AEM-2020 is seeing a valid raw input value (i.e. the raw 0 to 10 volt voltage input or 4 to 20 mA current input). The scaled value is the raw input scaled up to the range specified by the Parameter Minimum and Parameter Maximum value parameters in the Remote Analog Input settings. Refer to Figure 184.

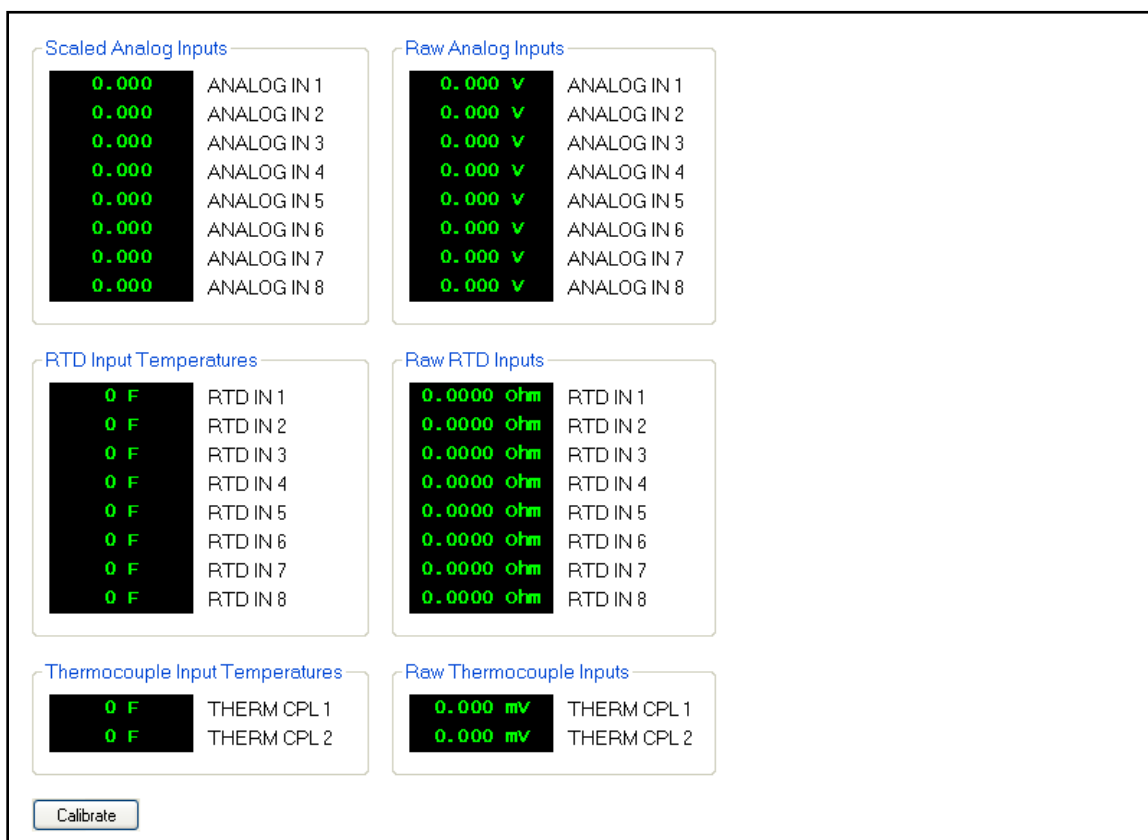


Figure 184. Remote Analog Input Values Metering

When connected to a DECS-250N, the *Calibrate* button shown on the Remote Analog Input Values screen opens the Analog Input Temperature Calibration screen shown in Figure 185. This screen is used to calibrate RTD inputs 1 through 8 and thermocouple inputs 1 and 2.

Analog Input Temperature Calibration

| | | |
|-------------------------------------|---------------------------|------|
| <input checked="" type="checkbox"/> | RTD Input #1 (F) | 0.00 |
| <input checked="" type="checkbox"/> | RTD Input #2 (F) | 0.00 |
| <input checked="" type="checkbox"/> | RTD Input #3 (F) | 0.00 |
| <input checked="" type="checkbox"/> | RTD Input #4 (F) | 0.00 |
| <input checked="" type="checkbox"/> | RTD Input #5 (F) | 0.00 |
| <input type="checkbox"/> | RTD Input #6 (F) | 0.00 |
| <input type="checkbox"/> | RTD Input #7 (F) | 0.00 |
| <input type="checkbox"/> | RTD Input #8 (F) | 0.00 |
| <input type="checkbox"/> | Thermocouple Input #1 (F) | 0.00 |
| <input type="checkbox"/> | Thermocouple Input #2 (F) | 0.00 |

Upload Data to Device Close

Figure 185. Remote Analog Input Temperature Calibration

Analog Outputs

BESTCOMS*Plus* Navigation Path: Metering, Status, Outputs, Remote Analog Outputs

HMI Navigation Path: Metering, Status, Outputs, Remote Analog Outputs

The status of the remote analog outputs, scaled analog output values, and raw analog output values are shown on this screen. Parameter selections are made on the Remote Analog Outputs screen under settings in BESTCOMS*Plus*. The status is TRUE when the corresponding LED is green. Refer to Figure 186.

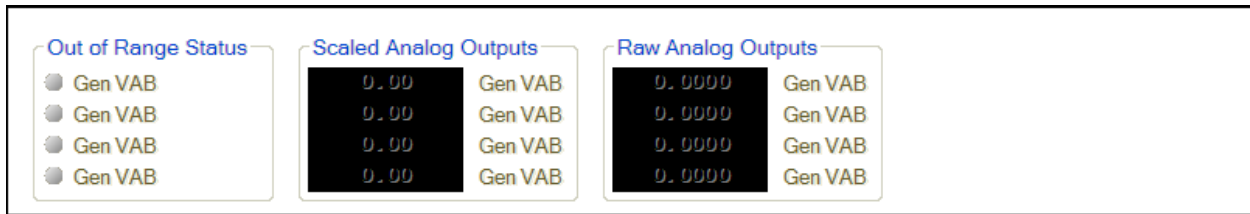


Figure 186. Remote Analog Outputs Metering

Maintenance

Preventive maintenance consists of periodically checking that the connections between the AEM-2020 and the system are clean and tight. Analog Expansion Modules are manufactured using state-of-the-art surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

Firmware Updates

Refer to the BESTCOMS*Plus* chapter for instructions on updating firmware in the AEM-2020.



Contact Expansion Module

General Information

The optional CEM-2020 is a remote auxiliary device that provides additional DECS-250N contact inputs and outputs. Two types of modules are available. A standard module (CEM-2020) provides 24 contact outputs and a high current module (CEM-2020H) provides 18 contact outputs.

Features

CEM-2020s have the following features:

- 10 Contact Inputs
- 18 Contact Outputs (CEM-2020H) or 24 Contact Outputs (CEM-2020)
- Functionality of Inputs and Outputs assigned by BESTlogic™ *Plus* programmable logic
- Communications via CAN Bus

Specifications

Operating Power

Nominal 12 or 24 Vdc

Range 8 to 32 Vdc (Withstands ride-through down to 6 Vdc for 500 ms.)

Maximum Consumption

CEM-2020 14 W

CEM-2020H 8 W

Contact Inputs

The CEM-2020 contains 10 programmable inputs that accept normally open and normally closed, dry contacts.

Contact Outputs

Ratings

CEM-2020

Outputs 12 through 23 .. 1 Adc at 30 Vdc, Form C, gold contacts

Outputs 24 through 35 .. 4 Adc at 30 Vdc, Form C

CEM-2020H

Outputs 12 through 23 .. 2 Adc at 30 Vdc, Form C, gold contacts

Outputs 24 through 29 .. 10 Adc at 30 Vdc, Form C

Communication Interface

The CEM-2020 communicates with the DECS-250N through CAN1.

CAN bus

Differential Bus Voltage 1.5 to 3 Vdc

Maximum Voltage -32 to +32 Vdc with respect to negative battery terminal

Communication Rate 125 or 250 kb/s

Type Tests

Shock

Withstands 15 G in 3 perpendicular planes.

Vibration

Swept over the following ranges for 12 sweeps in each of three mutually perpendicular planes with each 15-minute sweep consisting of the following:

5 to 29 to 5 Hz 1.5 G peak for 5 min.
 29 to 52 to 29 Hz 0.036" Double Amplitude for 2.5 min.
 52 to 500 to 52 Hz 5 G peak for 7.5 min.

HALT (Highly Accelerated Life Testing)

HALT is used by Basler Electric to prove that our products will provide the user with many years of reliable service. HALT subjects the device to extremes in temperature, shock, and vibration to simulate years of operation, but in a much shorter period span. HALT allows Basler Electric to evaluate all possible design elements that will add to the life of this device. As an example of some of the extreme testing conditions, the CEM-2020 was subjected to temperature tests (tested over a temperature range of -80°C to $+130^{\circ}\text{C}$), vibration tests (of 5 to 50 G at $+25^{\circ}\text{C}$), and temperature/vibration tests (tested at 10 to 20 G over a temperature range of -60°C to $+100^{\circ}\text{C}$). Combined temperature and vibration testing at these extremes proves that the CEM-2020 is expected to provide long-term operation in a rugged environment. Note that the vibration and temperature extremes listed in this paragraph are specific to HALT and do not reflect recommended operation levels. These operational ratings are included in the *Specifications* chapter of this manual.

Environment

Temperature

Operating -40 to $+70^{\circ}\text{C}$ (-40 to $+158^{\circ}\text{F}$)

Storage -40 to $+85^{\circ}\text{C}$ (-40 to $+185^{\circ}\text{F}$)

Humidity IEC 68-2-38

UL Approval (CEM-2020 and CEM-2020H)

This product is recognized to applicable Canadian and US safety standards and requirements by UL.

Standards used for evaluation:

- UL6200

CSA Certification

This product was tested and has met the certification requirements for electrical, plumbing, and/or mechanical products.

Standards used for evaluation:

- CSA C22.2 No. 0
- CSA C22.2 No. 14

CE Compliance

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation.

EC Directives:

- LVD 2014/35/EU
- EMC 2004/108/EC

Harmonized standards used for evaluation:

- EN 50178
- EN 61000-6-4
- EN 61000-6-2

Physical

Weight

CEM-2020.....2.25 lb (1.02 kg)

CEM-2020H1.90 lb (0.86 kg)

Dimensions.....See *Installation* later in this chapter.

Installation

Contact Expansion Modules are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a module, check the part number against the requisition and packing list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify the Basler Electric regional sales office, your sales representative, or a sales representative at Basler Electric, Highland, Illinois USA.

If the device is not installed immediately, store it in the original shipping package in a moisture- and dust-free environment.

Mounting

Contact Expansion Modules are contained in a potted plastic case and may be mounted in any convenient position. The construction of a Contact Expansion Module is durable enough to mount directly on a genset using ¼-inch hardware. Hardware selection should be based on any expected shipping/transportation and operating conditions. The torque applied to the mounting hardware should not exceed 65 in-lb (7.34 N•m).

See Figure 187 for CEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

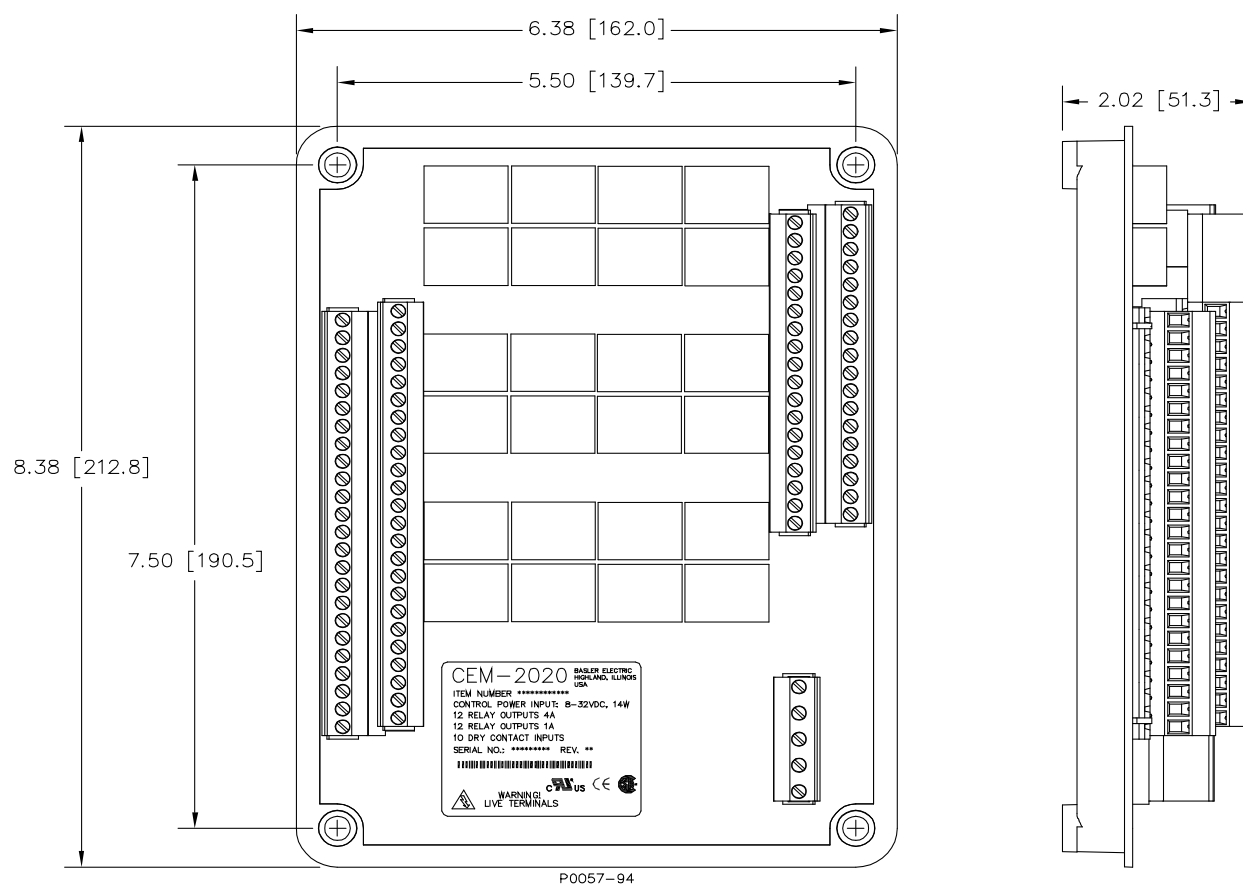


Figure 187. CEM-2020 Overall Dimensions

See Figure 188 for CEM-2020H overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

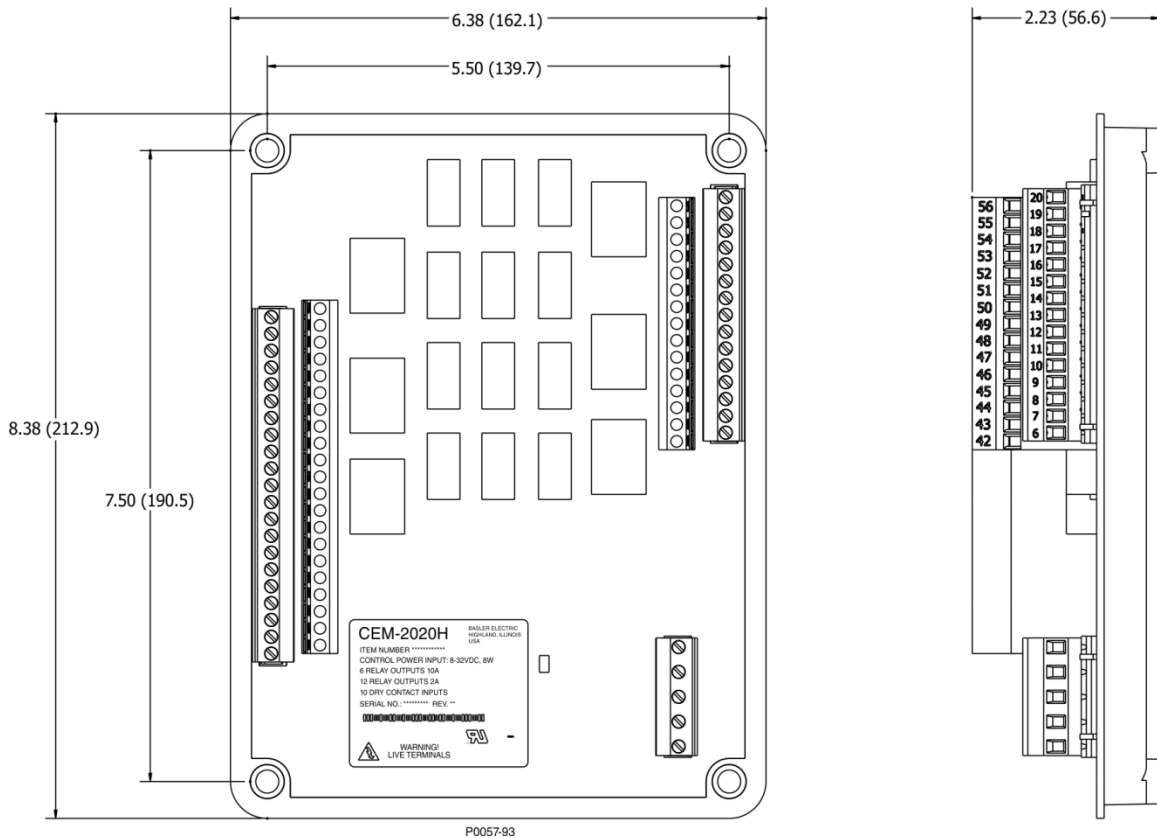


Figure 188. CEM-2020H Overall Dimensions

Connections

Contact Expansion Module connections are dependent on the application. Incorrect wiring may result in damage to the module.

Note

Operating power from the battery must be of the correct polarity. Although reverse polarity will not cause damage, the CEM-2020 will not operate.

Be sure that the CEM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.

Terminations

The terminal interface consists of plug-in connectors with screw-down compression terminals.

CEM-2020 connections are made with one 5-position connector, two 18-position connectors, and two 24-position connectors with screw-down compression terminals. These connectors plug into headers on the CEM-2020. The connectors and headers have dovetailed edges that ensure proper connector orientation. Also, the connectors and headers are uniquely keyed to ensure that the connectors mate only with the correct headers.

Connectors and headers may contain tin- or gold-plated conductors. Tin-plated conductors are housed in a black plastic casing and gold-plated conductors are housed in an orange plastic casing. Mate connectors to headers of the same color only.

Caution

By mating conductors of dissimilar metals, galvanic corrosion could occur which deteriorates connections and leads to signal loss.


Connector screw terminals accept a maximum wire size of 12 AWG. Maximum screw torque is 5 in-lb (0.56 N•m).

Operating Power

The Contact Expansion Module operating power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Operating power must be of the correct polarity. Although reverse polarity will not cause damage, the CEM-2020 will not operate. Operating power terminals are listed in Table 45.

It is recommended that a fuse be added for additional protection for the wiring to the battery input of the Contact Expansion Module. A Bussmann ABC-7 fuse or equivalent is recommended.

Table 45. Operating Power Terminals

| Terminal | Description |
|--|--|
| P1-  (SHIELD) | Chassis ground connection |
| P1- – (BATT–) | Negative side of operating power input |
| P1- + (BATT+) | Positive side of operating power input |

Contact Inputs and Contact Outputs

The CEM-2020 (Figure 189) has 10 contact inputs and 24 contact outputs. The CEM-2020H (Figure 190) has 10 contact inputs and 18 contact outputs.

Note

To follow UL guidelines, a fuse must be implemented in the 2Adc contact circuits (Outputs 12 through 23) of the CEM-2020H used in hazardous locations. The suggested fuse size in Adc = (100/Contact Voltage) with a maximum fuse size of 5Adc.

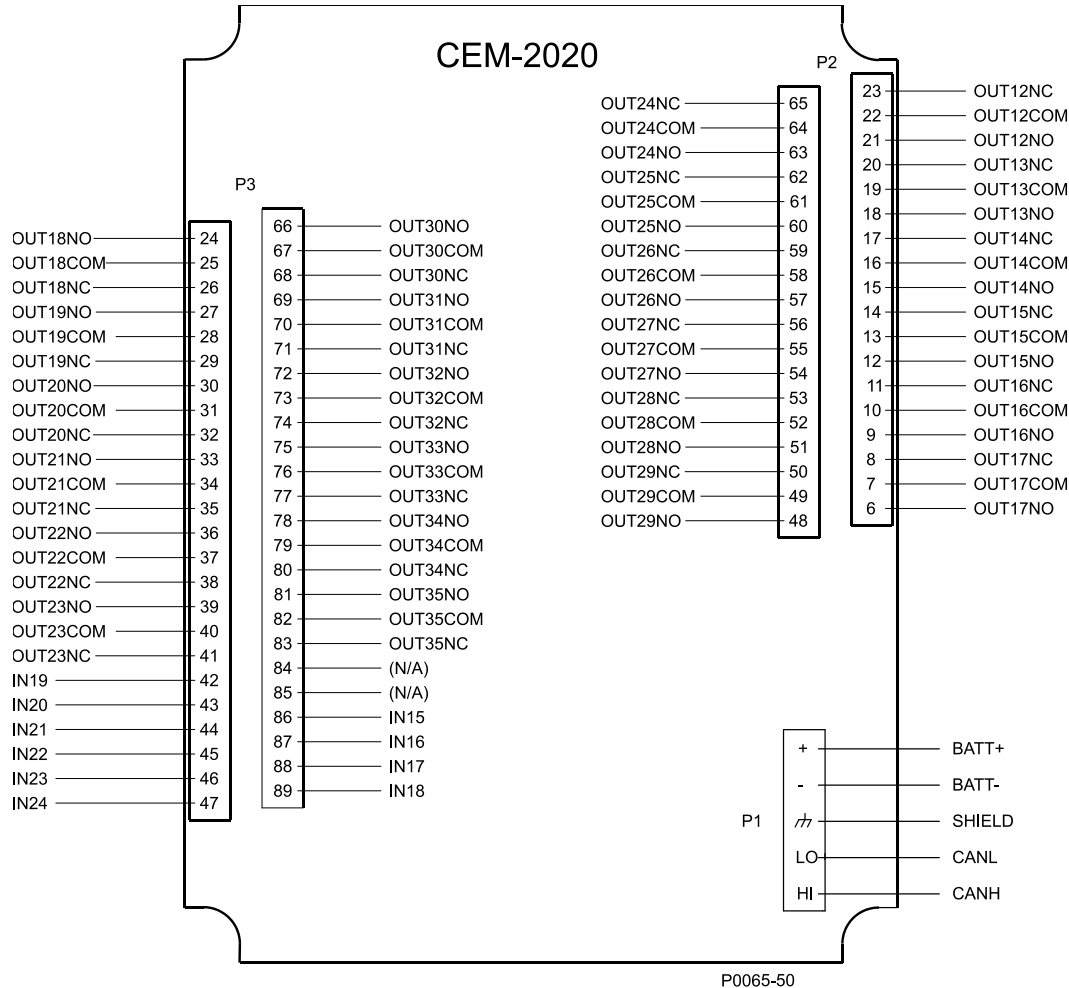


Figure 189. CEM-200 Input Contact and Output Contact Terminals

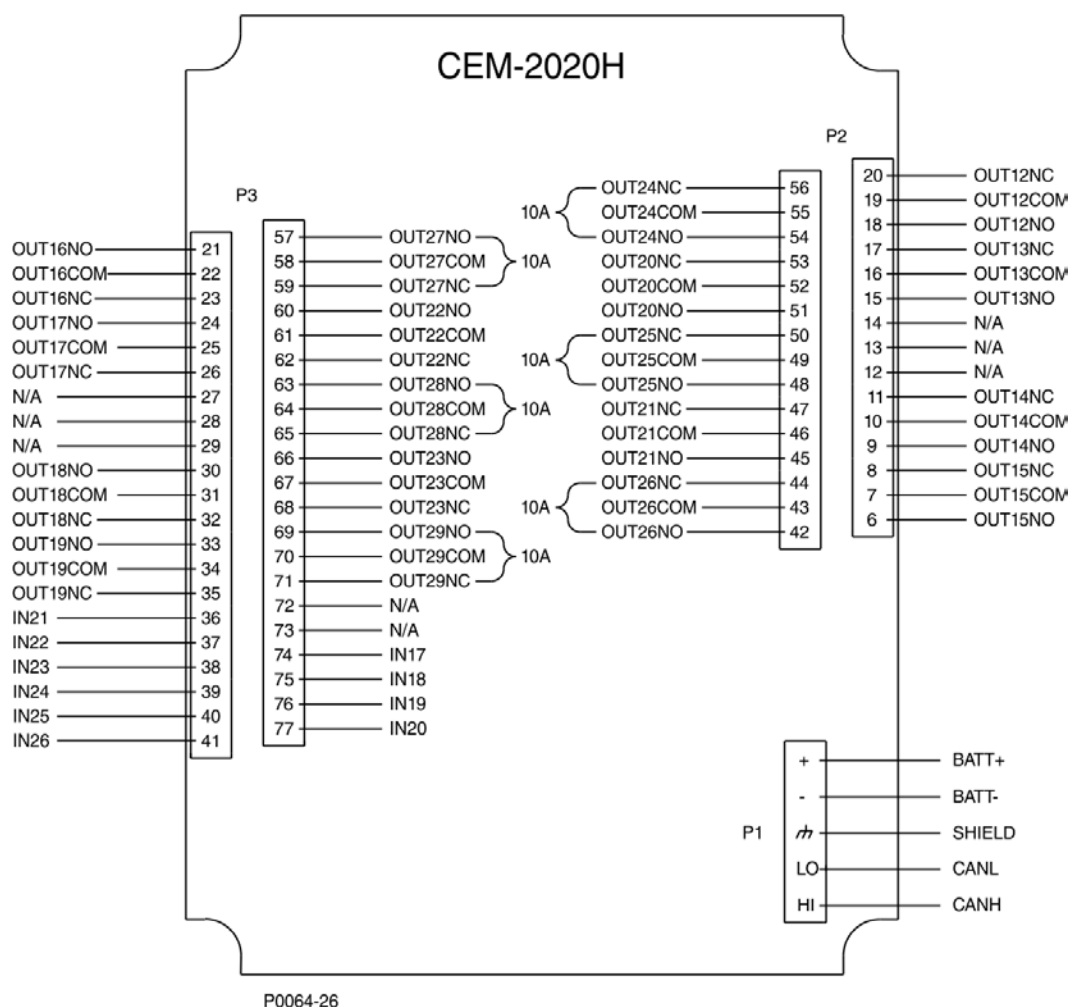


Figure 190. CEM-2020H Input Contact and Output Contact Terminals

CAN bus Interface

These terminals provide communication using the SAE J1939 protocol and provide high-speed communication between the Contact Expansion Module and the DECS-250N. Connections between the CEM-2020 and DECS-250N should be made with twisted-pair, shielded cable. CAN Bus interface terminals are listed in Table 46. Refer to Figure 191 and Figure 192.

Table 46. CAN Bus Interface Terminals

| Terminal | Description |
|-------------------------|-----------------------------------|
| P1- HI (CAN H) | CAN high connection (yellow wire) |
| P1- LO (CAN L) | CAN low connection (green wire) |
| P1- ⏏ (SHIELD) | CAN drain connection |

Note

1. If the CEM-2020 is providing one end of the J1939 bus, a 120 Ω , ½ watt terminating resistor should be installed across terminals P1- LO (CANL) and P1- HI (CANH).
2. If the CEM-2020 is not part of the J1939 bus, the stub connecting the CEM-2020 to the bus should not exceed 914 mm (3 ft) in length.
3. The maximum bus length, not including stubs, is 40 m (131 ft).
4. The J1939 drain (shield) should be grounded at one point only. If grounded elsewhere, do not connect the drain to the CEM-2020.

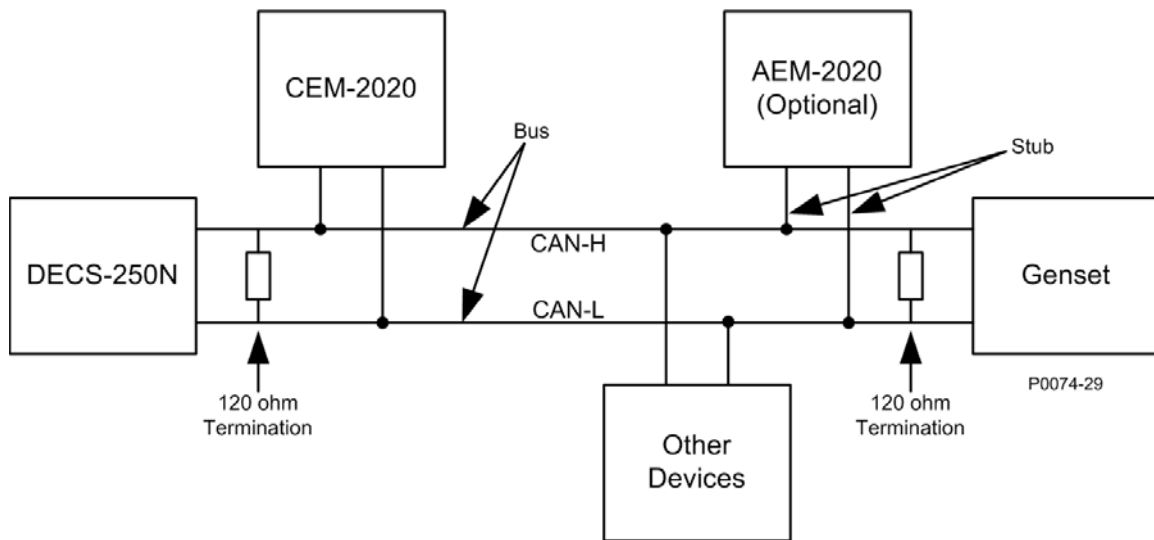


Figure 191. CAN Bus Interface with CEM-2020 providing One End of the Bus

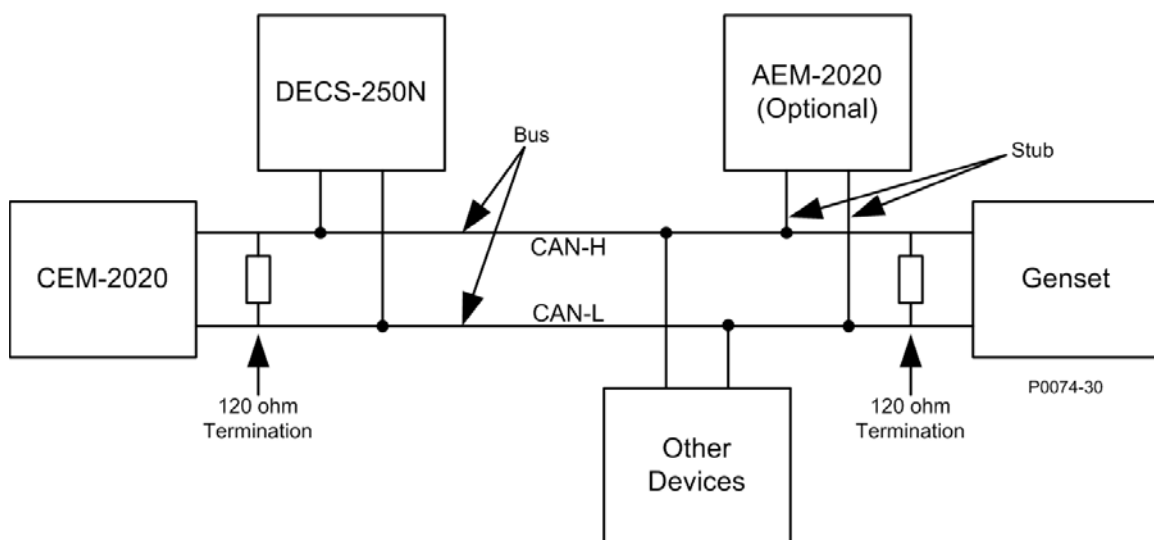


Figure 192. CAN Bus Interface with DECS-250 providing One End of the Bus

Communications

BESTCOMSPlus Navigation Path: Settings, Communications, CAN bus, Remote Module Setup

HMI Navigation Path: Settings, Communication, CAN bus, Remote Module Setup, Contact Expansion Module

The contact expansion module must be enabled with the correct J1939 address. A Control Area Network (CAN) is a standard interface that enables communication between the CEM-2020 and the DECS-250N. The Remote Module Setup screen is illustrated in Figure 193.

The screenshot displays the 'Remote Module Setup' interface. It contains two main sections: 'Contact Expansion Module' and 'Analog Expansion Module'. Each section has a 'Disabled' radio button and an 'Enabled' radio button, both of which are selected. Below the radio buttons, there is a text input field for the 'J1939 Address'. For the Contact Expansion Module, the address is '236'. For the Analog Expansion Module, the address is '237'. At the bottom of the Contact Expansion Module section, there is a dropdown menu labeled 'CEM Outputs' with '18 Outputs' selected.

Figure 193. Remote Module Setup

Functional Description

Contact Inputs

BESTCOMSPlus Navigation Path: Settings, Programmable Inputs, Remote Contact Inputs

HMI Navigation Path: Settings, Programmable Inputs, Remote Contact Inputs

The CEM-2020 provides 10 programmable contact inputs with the same functionality as the contact inputs on the DECS-250N. The label text of each contact input is customizable and accepts an alphanumeric character string with a maximum of 64 characters.

The remote contact inputs are incorporated into a BESTlogicPlus programmable logic scheme by selecting them from the I/O group in BESTlogicPlus. For more details, refer to the BESTlogicPlus chapter.

BESTCOMSPlus® settings for remote contact inputs are illustrated in Figure 194.

Remote Contact Inputs

| | | |
|---|---|---|
| Input #15 Label Text <input type="text" value="INPUT 15"/> | Input #16 Label Text <input type="text" value="INPUT 16"/> | Input #17 Label Text <input type="text" value="INPUT 17"/> |
| Input #18 Label Text <input type="text" value="INPUT 18"/> | Input #19 Label Text <input type="text" value="INPUT 19"/> | Input #20 Label Text <input type="text" value="INPUT 20"/> |
| Input #21 Label Text <input type="text" value="INPUT 21"/> | Input #22 Label Text <input type="text" value="INPUT 22"/> | Input #23 Label Text <input type="text" value="INPUT 23"/> |
| Input #24 Label Text <input type="text" value="INPUT 24"/> | | |

Figure 194. Remote Contact Inputs Settings

Contact Outputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Outputs, Remote Contact Outputs

HMI Navigation Path: Settings, Programmable Outputs, Remote Contact Outputs

The CEM-2020 provides 24 programmable contact outputs with the same functionality as the contact outputs on the DECS-250N. Outputs 12 through 23 can carry 1 A. Outputs 24 through 35 can carry 4 A.

The CEM-2020H provides 18 programmable contact outputs with the same functionality as the contact outputs on the DECS-250N. Outputs 12 through 23 can carry 2 A. Outputs 24 through 29 can carry 10 A.

The label text of each contact output is customizable and accepts an alphanumeric character string with a maximum of 64 characters.

The remote analog outputs are incorporated into a BESTlogic*Plus* programmable logic scheme by selecting them from the I/O group in BESTlogic*Plus*. For more details, refer to the BESTlogic*Plus* chapter.

BESTCOMS*Plus* settings for remote contact outputs are illustrated in Figure 195.

Remote Contact Outputs

| | | |
|---|---|---|
| Output #12 Label Text <input type="text" value="OUTPUT 12"/> | Output #13 Label Text <input type="text" value="OUTPUT 13"/> | Output #14 Label Text <input type="text" value="OUTPUT 14"/> |
| Output #15 Label Text <input type="text" value="OUTPUT 15"/> | Output #16 Label Text <input type="text" value="OUTPUT 16"/> | Output #17 Label Text <input type="text" value="OUTPUT 17"/> |

Figure 195. Remote Contact Outputs Settings

Metering

Contact Inputs

BESTCOMS*Plus* Navigation Path: Metering, Status, Inputs, Remote Contact Inputs

HMI Navigation Path: Metering, Status, Inputs, Remote Contact Input Values

The value and status of the remote contact inputs are shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 196.



Figure 196. Remote Contact Inputs Metering

Contact Outputs

BESTCOMS*Plus* Navigation Path: Metering, Programmable Outputs, Remote Contact Outputs

HMI Navigation Path: Metering, Status, Outputs, Remote Contact Outputs

The value and status of the remote contact outputs are shown on this screen. The status is TRUE when the corresponding LED is green. Refer to Figure 197.

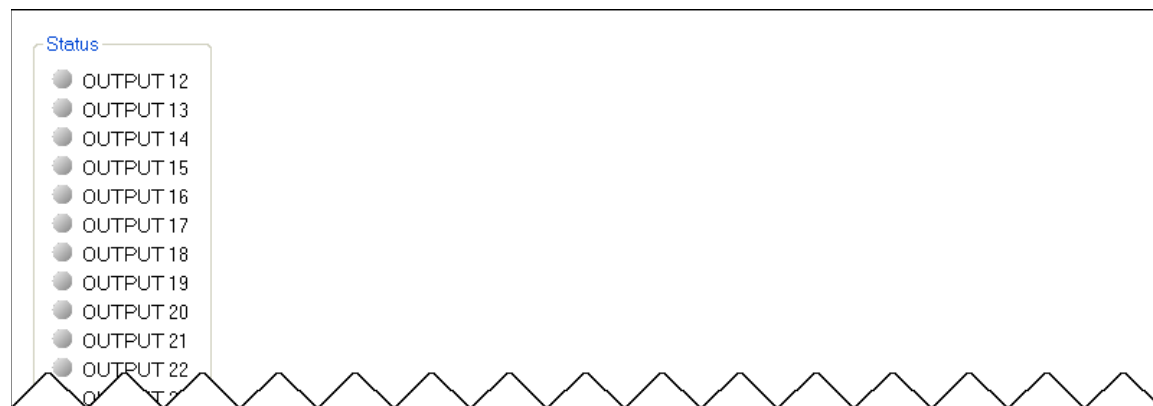


Figure 197. Remote Contact Outputs Metering

Maintenance

Preventive maintenance consists of periodically checking that the connections between the CEM-2020 and the system are clean and tight. Contact Expansion Modules are manufactured using state-of-the-art surface-mount technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel.

Firmware Updates

Refer to the BESTCOMS*Plus* chapter for instructions on updating firmware in the CEM-2020.

Revision History

Table 47 provides a historical summary of the changes made to the DECS-250N hardware. Firmware changes are listed in Table 48 and software changes are listed in Table 49. The corresponding revisions made to this instruction manual are summarized in Table 50. Revisions are listed in chronological order.

Table 47. Hardware Revision History

| Hardware Version and Date | Change |
|---------------------------|---|
| A, Jan-14 | <ul style="list-style-type: none"> Initial release |
| B, Apr-14 | <ul style="list-style-type: none"> Removed unused pins on ribbon cable to prevent hipot failure |
| C, Sep-14 | <ul style="list-style-type: none"> Improved hardware on the PowerPC board |
| D, Sep-14 | <ul style="list-style-type: none"> Increased length of screws holding SCR's |
| E, Oct-14 | <ul style="list-style-type: none"> Re-designed analog board to provide clearance for chassis screws |
| F, Jan-15 | <ul style="list-style-type: none"> Improved digital board components |
| G, Feb-15 | <ul style="list-style-type: none"> Released firmware version 1.03.00 and BESTCOMSP<i>lus</i> version 3.08.00 |
| H, Mar-15 | <ul style="list-style-type: none"> Improved manufacturing process |

Table 48. Firmware Revision History

| Firmware Version and Date | Change |
|---------------------------|--|
| 1.01.05, Mar-14 | <ul style="list-style-type: none"> Initial release |
| 1.02.00, May-14 | <ul style="list-style-type: none"> Added Russian language support Added overexcitation (24) protection Added transient excitation boosting function Added loss of excitation (40Q) protection for motors Added integrating reset method to takeover OEL Added angle compensation to synchronizer and sync check (25) Increased available real-time monitoring plots from two to six |

| Firmware Version and Date | Change |
|--------------------------------------|--|
| 1.03.00, Feb-15 | <ul style="list-style-type: none"> • Added Chinese language • Added Generator/Motor operating mode selection • Enhanced network load sharing <ul style="list-style-type: none"> ○ Added Network Load Share metering screen ○ Added Power Input and NLS Error Percent parameter selections for configurable protection ○ Added status logic elements for Config Mismatch, ID Missing, and Network Load Share Active ○ Added NLS Broadcast logic element to broadcast alarms to selected units actively sharing load • Added VAR/PF MODE logic element • Changed the default value of auxiliary control gains to zero • Modified datalog triggering by watchdog • Modified the way PF is scaled when used for an analog output • Modified display of setpoints • Modified datalog to trigger on contact input open • Added PF Active Power Level % to Modbus • Expanded the range for analog outputs to –999,999 to 999,999 • Added Modbus registers for AEM-2020 alarms • Modified unsecured access level security • Modified communication with IDP-800 • Modified total VA and total PF calculations • Modified frequency display in Comtrade files • Modified scaling of RTD values • Modified operation of SCL limiter |

Table 49. BESTCOMS*Plus*® Software Revision History

| Software Version and Date | Change |
|--------------------------------------|---|
| 3.05.03, Mar-14 | <ul style="list-style-type: none"> • Initial Release |
| 3.06.00, Apr-14 | <ul style="list-style-type: none"> • Updated to support firmware version 1.02.00 |
| 3.07.00, Oct-14 | <ul style="list-style-type: none"> • Improved graphing of UEL curve • Changed UEL Primary Curve screen to allow decimal points when in per unit mode • Removed duplicate results in the device discovery list • Improvements to device directory on Connection screen • Changed to allow a comma in the Device ID • Changed to annunciate a connection failure message when a device is not present on a selected port • Improved prompts to save settings when choosing to close all open views • Changed to allow the middle mouse button to close the security view • Improved display of raw analog input currents • Changed to make BESTlogic<i>Plus</i> status LEDs report all logic errors |

| Software Version and Date | Change |
|---------------------------|--|
| 3.07.03, Jan-15 | <ul style="list-style-type: none"> Modified autotuning |
| 3.08.00, Feb-15 | <ul style="list-style-type: none"> Added support for DECS-250N firmware version 1.03.00 Added pre-defined logic schemes with PSS |
| 3.08.02, Mar-15 | <ul style="list-style-type: none"> Maintenance release (DGC-2020HD changes) |

Table 50. Instruction Manual Revision History

| Manual Revision and Date | Change |
|--------------------------|---|
| A, Jan-14 | <ul style="list-style-type: none"> Initial release |
| B, May-14 | <ul style="list-style-type: none"> Added Russian language support Added overexcitation (24) protection Added transient excitation boosting function Added loss of excitation (40Q) protection for motors Added integrating reset method to takeover OEL Added angle compensation to synchronizer and sync check (25) Increased available real-time monitoring plots from two to six Minor text edits throughout manual |
| C, Feb-15 | <ul style="list-style-type: none"> Added support for DECS-250N firmware version 1.03.00 and BESTCOMS<i>Plus</i> version 3.08.00 Changed layout of Auxiliary Control Gains section and added equations in the <i>Auxiliary Control</i> chapter Added Off-Page Objects description in the <i>BESTlogicPlus</i> chapter Cleaned up various Modbus register names and descriptions in the <i>Modbus</i> chapter Added Modbus registers for AEM Configuration, AEM Protection, RTD Protection, and Thermocouple Protection in the <i>Modbus</i> chapter Expanded IRIG specifications in the <i>Specifications</i> chapter Added Maritime Recognition to the <i>Specifications</i> chapter Minor text edits throughout manual |
| D, May-15 | <ul style="list-style-type: none"> Improved description of optional escutcheon plate in the <i>Mounting</i> chapter Added a figure for station-powered applications in the <i>Typical Connections</i> chapter. Updated manual to reflect BESTCOMS<i>Plus</i> screen layout changes Added Offline Logic Simulator description in the <i>BESTlogicPlus</i> chapter Added descriptions for Cursors Enabled and Sync Graph Scrolling settings on the Analysis Options screen in the <i>Testing</i> chapter Added EAC certification in the <i>Specifications</i> chapter Minor text edits throughout manual |





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