DECS-450

Digital Excitation Control System

Instruction Manual

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Preface

This instruction manual provides information about the installation and operation of the DECS-450. 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
- Math model

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.

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Warning!

READ THIS MANUAL. Read this manual before installing, operating, or maintaining this equipment. 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.

Caution

Installing previous versions of firmware may result in compatibility issues causing the inability to operate properly and may not have the enhancements and resolutions to issues that more recent versions provide. Basler Electric highly recommends using the latest version of firmware at all times. Using previous versions of firmware is at the user's risk and may void the warranty of the unit.

Note

Basler Electric does not assume any responsibility to compliance or noncompliance with national code, local code, or any other applicable code. This manual serves as reference material that must be well understood prior to installation, operation, or maintenance.

For terms of service relating to this product and software, see the *Commercial Terms of Products and Services* document available at www.basler.com/customer-terms-and-conditions.

This publication contains confidential information of Basler Electric Company, an Illinois corporation. It is loaned for confidential use, subject to return on request, and with the mutual understanding that it will not be used in any manner detrimental to the interests of Basler Electric Company and used strictly for the purpose intended.

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Over time, improvements and revisions may be made to this publication. Before performing any of the following procedures, contact Basler Electric for the latest revision of this manual.

The English-language version of this manual serves as the only approved manual version.

Be sure that the device is hard-wired to earth ground with no smaller than 12 AWG (3.3 mm^2) 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.

Note

Revision History

A historical summary of the changes made to this instruction manual is provided below. Revisions are listed in reverse chronological order.

Visit www.basler.com to download the latest hardware, firmware, and BESTCOMS*Plus*® revision histories.

Instruction Manual Revision History

Manual Revision and Date	Change
G, Aug 2026	• Added Manual FVR Only and System In Use logic elements • Added mode logic inputs • Added Toggle Latch logic component • Added statement about open priority for simultaneous open and close requests • Updated Device Information screen • Added NTP compatibility information • Increased ranges for OEL Scale Takeover/Summing Scale registers • Added Configurable Protection Parameters 54 through 86 to Modbus • Removed Russian front panel language setting option • Added operating mode control and primary generator metering registers to Profibus • Changed references from BESTwave to BESTdata
F, Apr 2025	• Added references to the CEM-125 • Clarified or updated descriptions in *Synchronizer, Regulation, Auxiliary Control, Limiters, Metering, Stability Tuning, BESTlogic™Plus, Analog Expansion Module,* and *Contact Expansion Module* • Updated drawings in *PSS* and *Mounting* • Removed wording about activating the DECS-450 plugin • Removed IE 5.01 requirement • Updated Windows compatibility • Removed references to CD-ROM • Added Viewing the Security Log section • Corrected Modbus register numbers/bits • Added resolution increments to *Modbus Communication* • Corrected USB driver location • Updated China RoHS compliance • Added FCC credentials • Removed EAC credentials from *CEM-2020* and *AEM-2020* • Added *Math Model*
E, Dec 2023	• Added China RoHS compliance
D, Mar 2023	• Added a note box about simultaneous application of contact inputs • Replaced Gain conversion screenshot • Updated Transition Plate section and added new drawings • Added a figure for BCM-2/IT-2 connections • Added Operation Mode section and figure • Changed UL 6200 to UL 6200:2019
C, Jul 2022	• Added impedance specification for meter driver outputs • Adjusted CE compliance information and added UKCA compliance information for the DECS-450, AEM-2020, and CEM-2020 • Added maritime recognition for the AEM-2020 and CEM-2020 • Made assorted, minor edits and corrections
B1, Aug 2021	• Removed hazardous location compliance for CEM-2020

B, Jul 2021	• Clarified that the DECS-450 senses and responds to rms generator voltage • Added ABS maritime certification • Clarified operation of the DECS-400 gain converter • Enhanced the description of analog output logic operation • Added caution statement advising against downgrading DECS-450 firmware
A, Dec 2020	• Added instructions for installing a transition plate • Added relative humidity to *Specifications* • Minor text edits
—, Aug 2020	• Initial release

Contents

1 • Introduction

The DECS-450 Digital Excitation Control System is a microprocessor-based controller that offers excitation control, logic control, and optional power system stabilization in an integrated package. The DECS-450 controls field excitation by providing an analog signal used to control the output of an external power bridge. The DECS-450 monitors generator or motor parameters and acts to control, limit, and protect the machine from operating outside its capability.

The optional, onboard power system stabilizer (PSS) is an IEEE-defined PSS2A/2B/2C, dual-input, "integral of accelerating power" stabilizer that provides supplementary damping for low-frequency, local mode and power system oscillations.

BESTCOMS*Plus*® PC software provides a point-and-click means to set and monitor the DECS-450 and makes the configuration of one or several DECS-450 controllers fast and efficient. BESTlogic™*Plus* Programmable Logic, within BESTCOMS*Plus*, is used to program DECS-450 logic for protection elements, inputs, outputs, alarms, etc. The user can easily drag and drop elements, components, inputs, and outputs onto the program grid and make connections between them to create the desired logic scheme with up to 256 logic gates per diagram.

The DECS-450 is designed for use with Basler Electric's Bridge Control Module (BCM-2) or Interface Firing Module (IFM-150), and three- or six-SCR power bridges. However, it will work equally well with any power bridge with a controller that is compatible with the output signal from the DECS-450.

Features and Functions

DECS-450 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
- Auto Tune feature: The revolutionary auto-tuning function automatically establishes optimum PID and gain settings, taking the guesswork out of system setup, reducing commissioning time and cost while maximizing overall system performance.
- Programmable analog control output selectable for 4 to 20 mAdc, –10 to +10 Vdc, or 0 to +10 Vdc
- Remote setpoint control input accepts analog voltage or current control signal
- Real-time metering
- Automatic synchronizer
- Optional integrated PSS (IEEE Std 421.5 type PSS2A/2B/2C)
    - Generator or motor control modes, accommodates phase rotation changes between modes
    - Speed and power sensing or speed-only sensing
    - Three-wattmeter method of power measurement
- Soft start and voltage buildup control
- Five limiting functions:
    - Overexcitation: summing point and takeover
    - Underexcitation
    - Stator current

    - Reactive power (var)
    - Underfrequency or volts per hertz
- Twenty-five protection functions:
    - Volts per hertz (24)
    - Generator undervoltage (27)
    - Generator overvoltage (59)
    - Loss of sensing (LOS)
    - Overfrequency (81O)
    - Two Underfrequency (81U)
    - Reverse power (32R)
    - Loss of excitation (40Q)
    - Field overvoltage
    - Field overcurrent
    - Field overtemperature
    - Loss of Field Isolation Transducer
    - Exciter diode failure
    - Sync-check (25)
    - Generator below 10 hertz
    - Watchdog timer
    - Eight configurable protection elements
- External crowbar activation alarm support
- BESTCOMS*Plus*® software
- BESTlogic™*Plus* programmable logic
    - Drag-and-drop interface
    - 256 logic gates per diagram
- Network Load Sharing over Ethernet provides easy implementation in complex paralleled systems.
- 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
    - 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 external control system, optional AEM-2020 Analog Expansion Module, or optional CEM-125 or CEM-2020 Contact Expansion Module
    - Optional Profibus communication protocol
- Data logging, sequence of events recording, and trending
- Optional CEM-125 or CEM-2020 Contact Expansion Module provides:
    - Ten contact inputs
    - Twenty-four contact outputs
    - 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-450 is intended for synchronous generator or synchronous motor applications. The DECS-450 controls field excitation by providing an analog signal used to control the output of an external power bridge. The level of excitation power is based on the monitored voltage and current, and a regulation setpoint established by the user.

Package

A front panel HMI provides local annunciation and control through a backlit liquid crystal display (LCD), light-emitting diodes (LEDs), and pushbuttons. The DECS-450 provides multiple communication interfaces: CAN Bus, Ethernet, Modbus®, optional Profibus, and optional Interactive Display Panels: IDP-801 and IDP-1201.

Optional Features and Capabilities

DECS-450 optional features and capabilities are defined by a combination of letters and numbers that make up the style number. The model 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 1-1 defines the electrical characteristics and operational features available in the DECS-450.

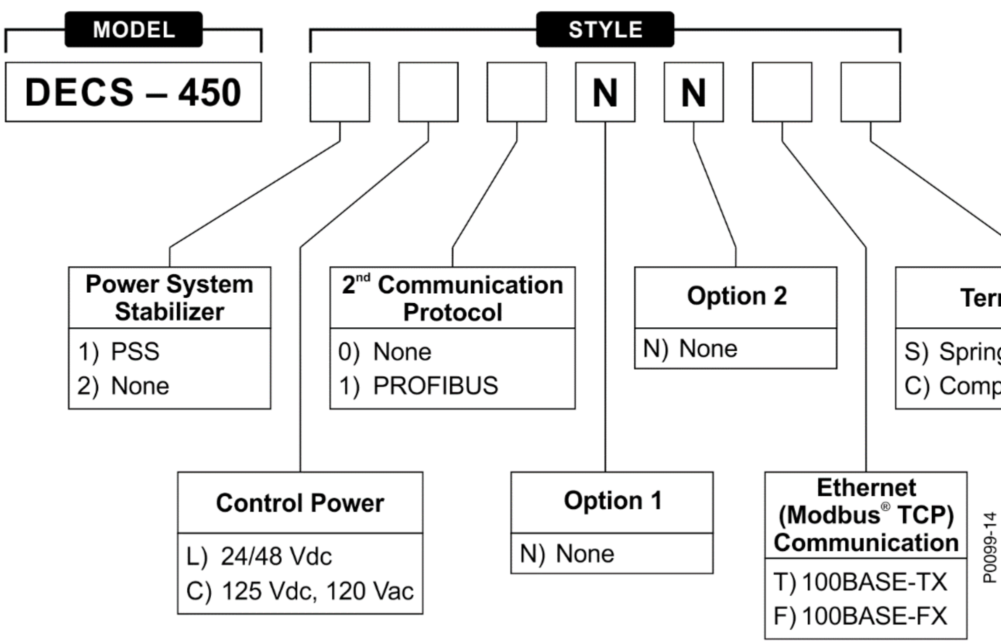


Figure 1-1. DECS-450 Style Chart

2 • 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-450 controls and indicators are illustrated in Figure 2-1 and described in Table 2-1. The locators and descriptions of Table 2-1 correspond to the locators shown in Figure 2-1.

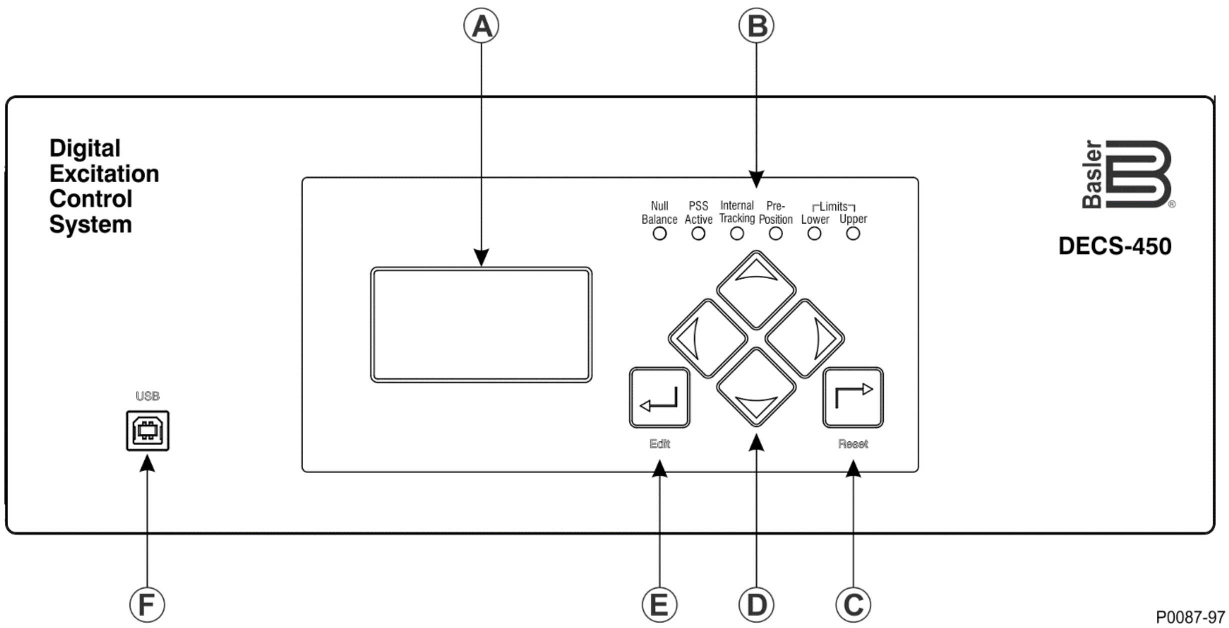


Figure 2-1. Front Panel Controls and Indicators

Table 2-1. Front Panel Control and Indicators Descriptions

Locator	Description
A	*Display.* The liquid crystal display (LCD) serves as a local source of information provided by the DECS-450. 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	*Null Balance Indicator.* This green light emitting diode (LED) lights when the setpoint of the inactive operating modes (AVR, FCR, FVR, Var, and PF) match the setpoint of the active mode.
	PSS Active Indicator. 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.
	Internal Tracking Indicator. 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.
	Pre-Position Indicator. This red LED lights when the active mode setpoint is at any of the three pre-position (predefined) settings.
	Limit Indicators. Two red LEDs indicate when the active mode setpoint reaches the minimum or maximum value.
C	*Reset Pushbutton.* This button cancels editing sessions, resets alarm annunciations and latched alarm relays, and can be used for quick access to the metering screen.
D	*Scrolling Pushbuttons.* 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	*Edit Pushbutton.* Pressing this button starts an editing session and enables changes to DECS-450 settings. At the conclusion of the editing session, the Edit pushbutton is pressed to save the settings changes.
F	*Communication Port.* This type B USB jack connects the DECS-450 with a PC operating BESTCOMS*Plus*® for local communication. BESTCOMS*Plus* is supplied with the DECS-450.

Menu Navigation

The DECS-450 provides local access to DECS-450 settings and metering values through a menu structure displayed on the front panel LCD. An overview of the menu structure is illustrated in Table 2-2. Movement through the menu structure is achieved by pressing the four scrolling pushbuttons.

Table 2-2. DECS-450 Menu Structure Overview

Metering (Metering Explorer)	**Settings** (Settings Explorer)	**Metering Summary Screen**
Generator Power Bus Field PSS (optional) Synchronization Aux Input Tracking Network Load Share Control Panel Status Reports	General Settings Communication System Parameters Report Configuration Operating Settings PSS (optional) Sync/Voltage Matching Protection Prog. Inputs Prog. Outputs Logic	Generator Voltage Field Current Vars Alarms Status Limiter Status Setpoint Status DECS Unit Status

Adjusting Settings

Make setting adjustments 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* section 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

BESTCOMS*Plus* 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 BESTCOMS*Plus* settings are illustrated in Figure 2-3.

LCD

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

Sleep Mode

Sleep mode 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.

Language

Language modules are available for the DECS-450. Once a language module is implemented, it can be enabled via the Language Selection setting.

Screen Scrolling

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

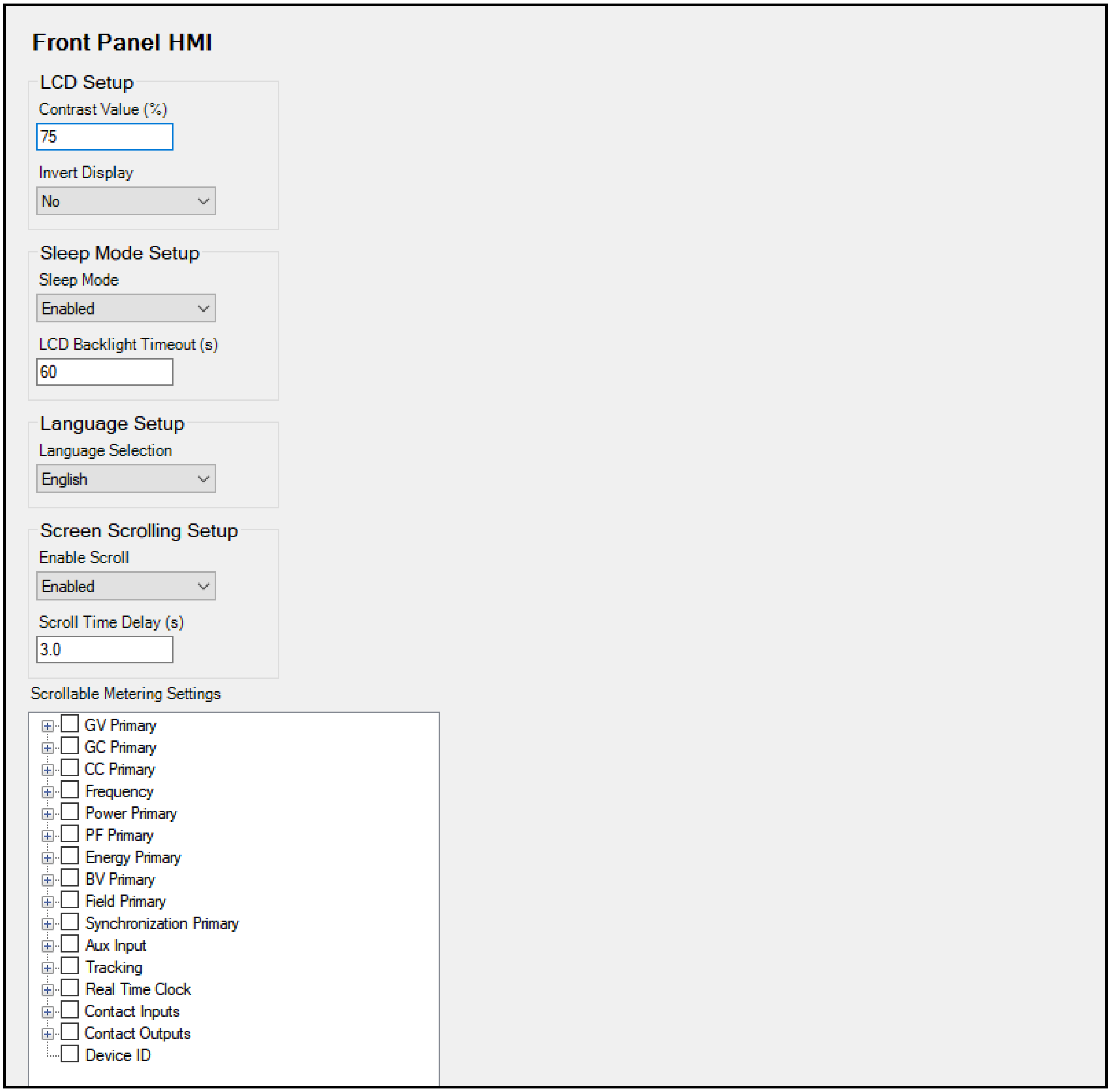


Figure 2-2. Front Panel HMI Settings

3 • Power Input

The control power input supplies power to an internal power supply that provides power for logic, protection, and control functions. Control power input voltage is determined by the DECS-450 style number.

Style XLXXXXX has one, dc-only input that accepts 16 to 60 Vdc (24 or 48 Vdc nominal).

Style XCXXXXX has two inputs, one for ac and one for dc. The ac input accepts 82 to 132 Vac at 50/60 Hz (120 Vac nominal). The dc input accepts 90 to 150 Vdc (125 Vdc nominal). One input, either ac or dc, is sufficient for operation, but two inputs provide redundancy (for style XCXXXXX only). AC control power is applied at terminals L and N. DC control power is applied at terminals BATT+ and BATT–.

Caution

When both control power inputs are used (style XCXXXXX only), an isolation transformer is required for the ac input.

Refer to the *Terminals and Connectors* and *Typical Connections* sections for more information.

4 • Voltage and Current Sensing

The DECS-450 senses generator voltage, generator current, and bus voltage through dedicated, isolated inputs. Field sensing values are supplied to DECS-450 from the Field Isolation Transducer (supplied with the DECS-450).

Generator Voltage

Three-phase generator sensing voltage is applied to DECS-450 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 240 Vac (nominal) and has a burden of less than 1 VA per phase.

The transformer primary and secondary winding voltages are entered in settings that the DECS-450 uses to interpret the applied sensing voltage and calculate system parameters. The phase rotation of the generator sensing voltage may be configured as ABC or ACB. Information about configuring the DECS-450 for the generator sensing voltage is provided in the *Configuration* section of this manual.

Typical generator voltage sensing connections are illustrated in Figure 4-1.

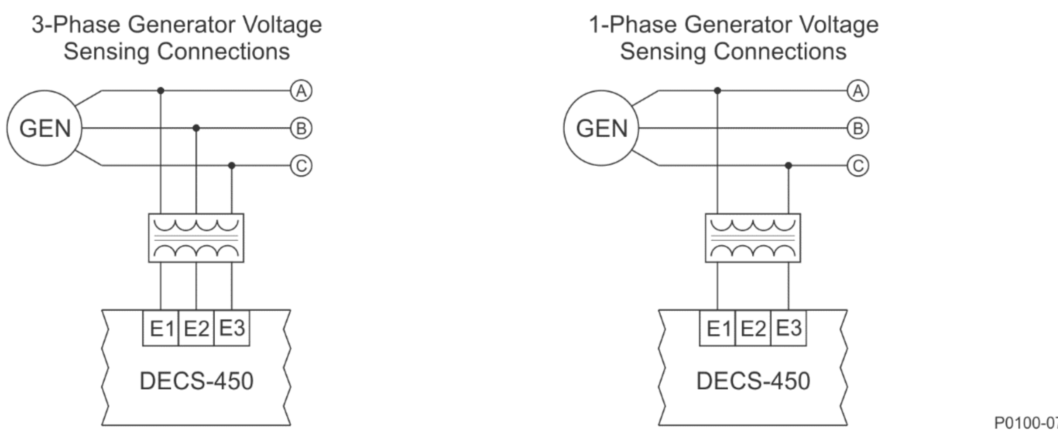


Figure 4-1. Typical Generator Voltage Sensing Connections

Generator Current

Generator current sensing inputs consist of A-phase, B-phase, C-phase, and cross-current compensation.

Notes
• Current transformer (CT) grounding should be applied in accordance with local codes and conventions. • In this manual, CT terminals are shown with polarity designations (+/–) and terminal numbers, however, physical DECS-450 CT terminals are labeled with terminal numbers only.

Phase Sensing

For single- or three-phase configurations, apply A-phase sensing current to DECS-450 terminals 75 (CTA+) and 76 (CTA–), B-phase to terminals 77 (CTB+) and 78 (CTB–) and, C-phase to terminals 79 (CTC+) and 80 (CTC–) through user-supplied current transformers.

The DECS-450 is compatible with CTs having 5 Aac or 1 Aac nominal secondary ratings. The DECS-450 uses this secondary rating, along with the CT nominal primary ratings to interpret the sensed current and calculate system parameters.

For information on sensing transformer settings, refer to the *Configuration* section of this manual. Typical generator phase-current sensing connections are shown in Figure 4-2.

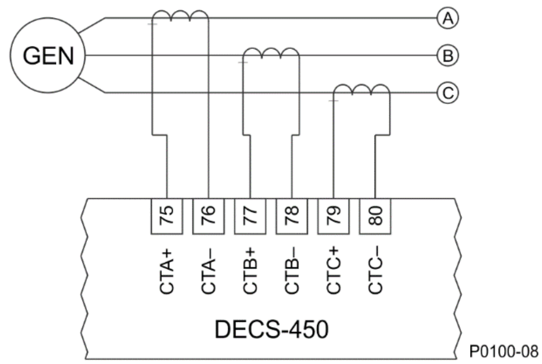


Figure 4-2. Typical Generator Current Sensing Connections

Note
Three-phase sensing is required for PSS applications.

Cross-Current Compensation

Cross-current compensation (reactive differential) mode allows two or more paralleled generators to share a common load. As shown in Figure 4-3, each generator is controlled by a DECS-450 using the DECS-450 cross-current compensation terminals 81 (CCCT+) and 82 (CCCT–) and a dedicated, external CT to sense generator current (B phase only). The resistors shown in Figure 4-3 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.

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.

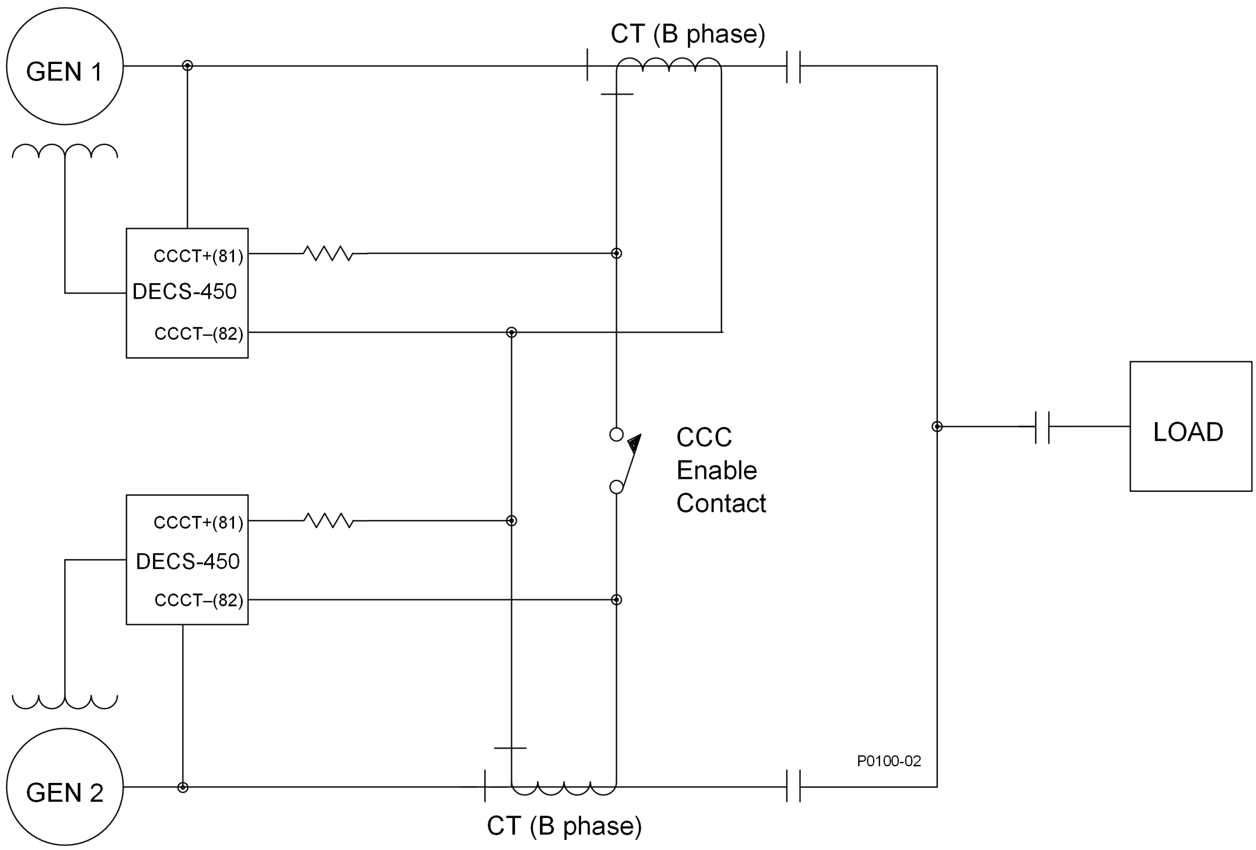


Figure 4-3. Connections for Cross-Current Compensation

Bus Voltage

Bus voltage monitoring provides bus failure detection, generator and bus voltage matching, and synchronization of the generator with the utility/bus. These features are discussed in the *Synchronizer* section of this manual. Three-phase bus sensing voltage is applied to DECS-450 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 240 Vac (nominal) and has a burden of less than 1 VA per phase.

The transformer primary and secondary winding voltages are entered in settings that the DECS-450 uses to interpret the applied sensing voltage. Information about configuring the DECS-450 for the bus sensing voltage is provided in the *Configuration* section of this manual.

Typical bus voltage sensing connections are illustrated in Figure 4-4.

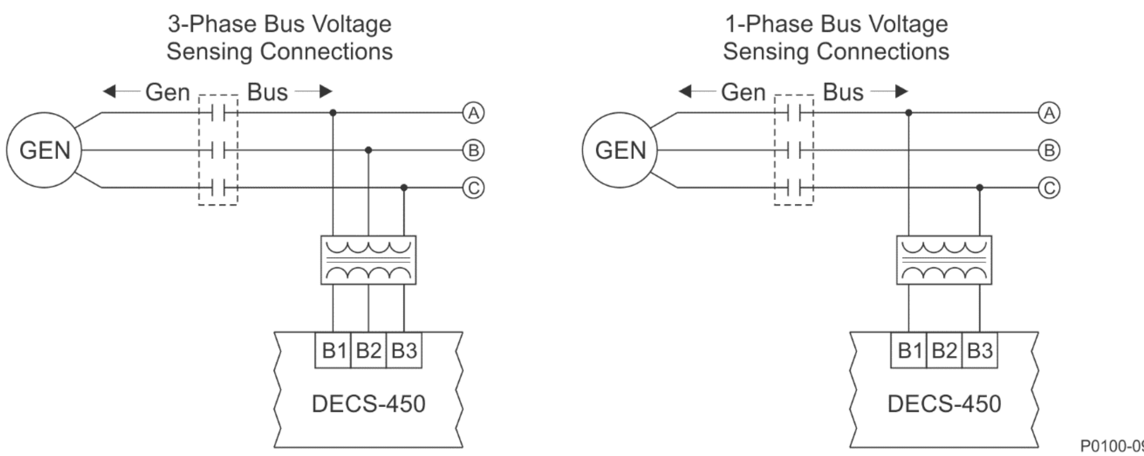


Figure 4-4. Typical Bus Voltage Sensing Connections

Field Voltage and Current

The DECS-450 receives field voltage and current signals from the Field Isolation Transducer (supplied). The Field Isolation Transducer transmits field voltage and current signals through a dedicated cable terminated at the DECS-450 rear panel Field Isolation Transducer connector.

For field voltage sensing, the Field Isolation Transducer accepts the following range of nominal voltages: 63 Vdc, 125 Vdc, 250 Vdc, 375 Vdc, or 625 Vdc. The applied field voltage may be ±300% of the nominal value. The Field Isolation Transducer supplies the DECS-450 with a field voltage signal over the range of 0.9 to 9.1 Vdc, where 5.0 Vdc equals zero field voltage.

For field current sensing, the Field Isolation Transducer accepts nominal current shunt output voltages of 0 to 50 mVdc or 0 to 100 mVdc. The applied shunt voltage may be up to 300% of either range. The Field Isolation Transducer supplies the DECS-450 with a field current signal over the range of 2.0 to 9.5 Vdc, where 2.0 Vdc equals zero field current.

5 • Synchronizer

DECS-450 controllers are equipped with an automatic synchronizer that aligns 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.

Caution

Because the DECS-450 sync-check and automatic synchronizer functions share internal circuitry, the sync-check function is disabled if the automatic synchronizer function is enabled.

A Basler Electric sync-check (25) relay is recommended for independent supervision.

Generator Synchronization

BESTCOMS*Plus* Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Synchronizer
HMI Navigation Path: Settings, Sync/Voltage Matching, Synchronizer

Two modes of automatic generator synchronization are available: phase lock loop (PLL) and anticipatory. In PLL mode, the DECS-450 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. In anticipatory mode, the DECS-450 drives the generator frequency close to the bus frequency and closes the breaker at a phase angle of zero by 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-450 compensates for the breaker closing time by monitoring the slip frequency between the generator and bus and calculating the advance phase angle required to close the breaker at a zero-degree phase angle.

Frequency Correction

The Slip Frequency setting establishes the maximum slip allowed for breaker closure. When the measured slip frequency is less than the value of the Min Slip Control Limit setting, the error output is set to zero. When the measured slip frequency is between the values of the Max Slip Control Limit and Min Slip Control Limit settings, the error output is proportional to the difference between the measured slip frequency and the value of the Min Slip Control Limit setting with the opposite polarity. When the measured slip frequency is greater than the value of the Max Slip Control Limit setting, the error output is set to maximum with the opposite polarity.

To minimize the impact on the bus during synchronization, the generator frequency can be forced to exceed the bus frequency at the moment of breaker closure. If this is the case, the DECS-450 will drive the generator frequency higher than the bus frequency before closing the breaker. The breaker closing angle setting defines the maximum allowable phase angle difference between the generator and bus. To close the breaker, the slip angle must remain less than the value of this setting for the duration of the sync activation delay.

The Min Slip Control Limit, Max Slip Control Limit, and Breaker Closing Angle settings are used only in the PLL mode.

Voltage Correction

Voltage correction is initiated when the generator voltage is outside the defined voltage window. The voltage window setting 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 causes the DECS-450 to drive the generator voltage higher than the bus voltage prior to synchronizing. A generator to bus PT matching level setting is provided to compensate for step-up or step-down transformers in the system. The DECS-450 adjusts the sensed bus 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 setting is provided to offset phase shift caused by transformers in the system. The angle compensation value is added only to the generator angle. For example, it is given that the generator and bus are synchronized but the DECS-450 metered slip angle reads –30°. Equation 5-1, below, illustrates the DECS-450 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 30°. 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-450.

$$G - B + A = Slip\ Angle$$

Equation 5-1. DECS-450 Metered Slip Angle

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

Gen to Bus PT Match Level

A generator to bus PT matching level setting is provided to compensate for step-up or step-down transformers in the system. The DECS-450 adjusts the sensed bus 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. To calculate the appropriate Gen to Bus PT Match Level value, refer to Equation 5-2.

$$\left(\frac{Gen\ Primary}{Bus\ Primary}\right) \times 100 = Gen\ to\ Bus\ PT\ Match\ Level\ (\%)\ Setting$$

Equation 5-2. Gen to Bus PT Match Level Calculation

Failure of Synchronization

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

When generator voltage rotation does not match bus voltage rotation a Phase Rotation Mismatch alarm is annunciated and generator synchronization is aborted.

BESTCOMS*Plus*® generator synchronization settings are illustrated in Figure 5-1.

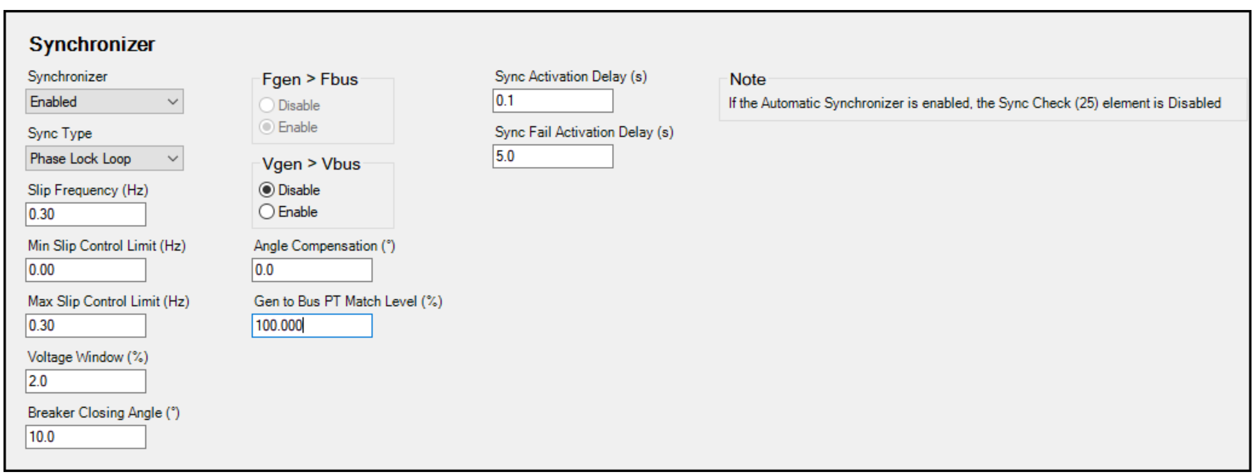


Figure 5-1. Generator Synchronizer Settings

Voltage Matching

BESTCOMS*Plus* Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Voltage Matching
HMI Navigation Path: Settings, Sync/Voltage Matching, Voltage Matching

When enabled, 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 defines how close in magnitude generator and bus voltage must be to each other for voltage matching to be active. The band level setting is a percentage of rated generator voltage.

A generator to bus PT matching level setting is provided to compensate for error between generator and bus PTs in the system. The DECS-450 adjusts the sensed bus voltage by this percentage. This setting also appears on the Synchronizer screen, above. When the value is changed, it is reflected in both places. To calculate the appropriate Gen to Bus PT Match Level value, refer to Equation 5-2.

Voltage matching settings are illustrated in Figure 5-2.

Figure 5-2. Voltage Matching Settings

Breaker Hardware Configuration

BESTCOMS*Plus* Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Breaker Hardware
HMI Navigation Path: Settings, Sync/Voltage Matching, Breaker Hardware

The DECS-450 can control and monitor a generator breaker. Breaker hardware settings are illustrated in Figure 5-3.

Breaker Failure

When a close command is issued to the breaker, the DECS-450 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. Typically, the wait delay is set to be longer than the actual breaker closing time.

Generator Breaker

The DECS-450 must be configured with the generator breaker characteristics before the breaker can be controlled by the DECS-450. Breakers controlled by pulse or continuous control inputs are supported. During anticipatory-mode synchronization, if the generator breaker is serving to tie the generator to the bus, the DECS-450 uses the breaker closing time to calculate the optimum time to close the breaker. For a pulse-controlled generator breaker, the breaker open and close pulse times are used by the DECS-450 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 and/or dead generator condition.

Caution

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

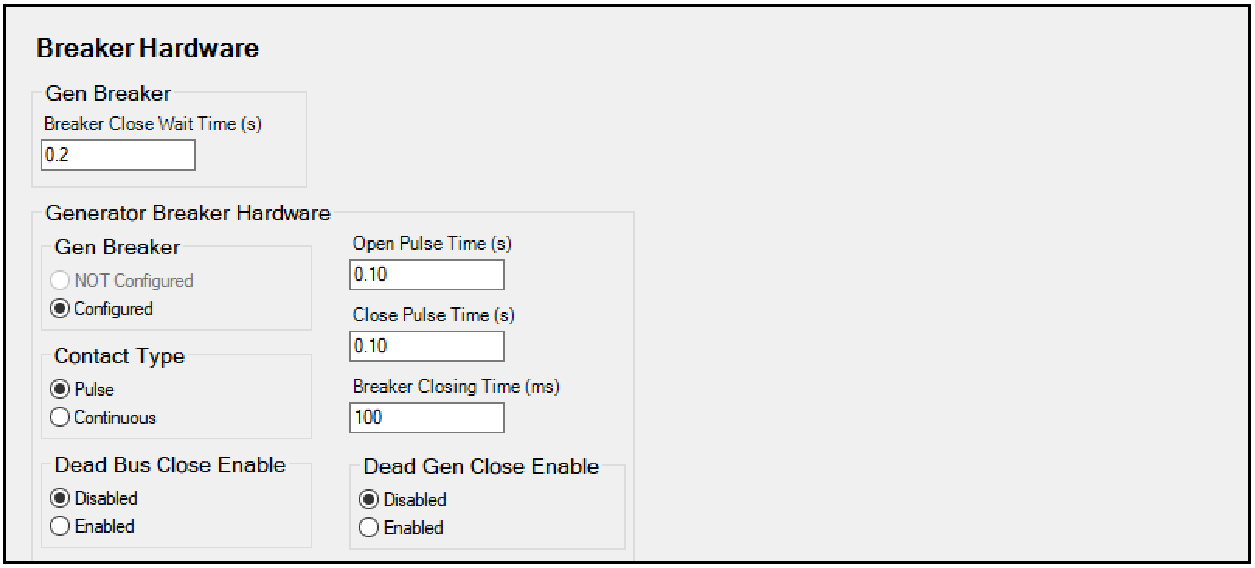


Figure 5-3. Breaker Hardware Configuration Settings

Generator and Bus Condition Detection

BESTCOMS*Plus* Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Bus Condition Detection
HMI Navigation Path: Settings, Sync/Voltage Matching, Bus Condition

The DECS-450 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 5-4.

Generator Condition

A dead generator is recognized by the DECS-450 when the generator voltage decreases below the dead generator threshold for the duration of the dead generator activation delay.

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. 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, undervoltage, overfrequency, and under-frequency. Recognition of generator stability is further controlled by a generator stability activation delay. 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-450 when the bus voltage decreases below the dead bus threshold for the duration of the dead bus activation delay.

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. 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, undervoltage, overfrequency, and underfrequency. Recognition of bus stability is further controlled by a bus stability activation delay. 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.

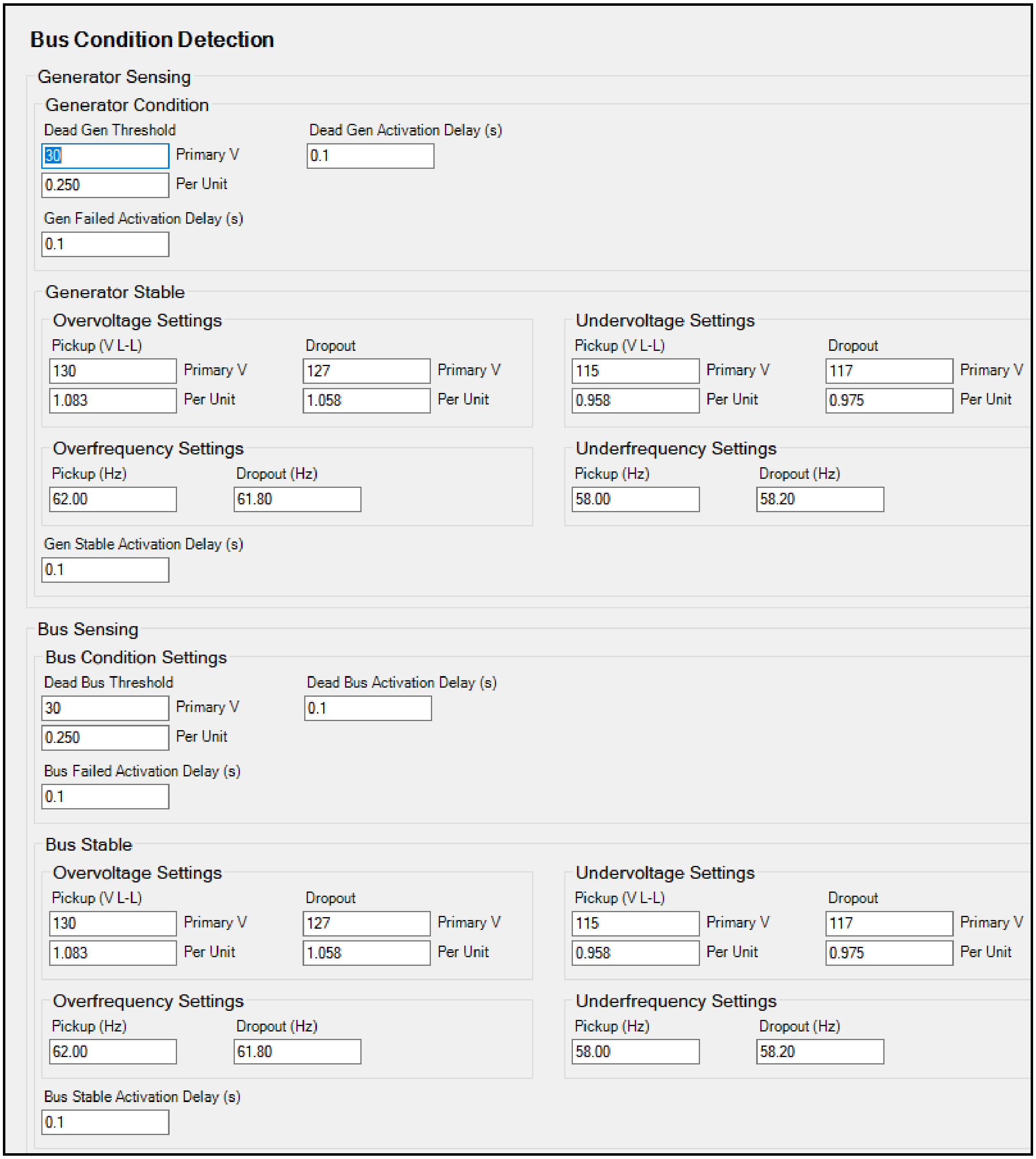


Figure 5-4. Generator and Bus Condition Detection Settings

Generator Governor Control

BESTCOMS*Plus* Navigation Path: Settings Explorer, Synchronizer/Voltage Matching, Governor Bias Control Settings

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

During synchronization, the DECS-450 adjusts the generator voltage and frequency by issuing speed correction signals to the speed governor. Correction signals are issued in the form of DECS-450 output contact closures. These correction signals may be either continuous, fixed, or proportional. When fixed correction is selected, the correction pulses and intervals are determined by the Correction Pulse Width and Correction Pulse Interval settings respectively. When proportional correction is selected, the correction pulse width varies in proportion to the error and the intervals are determined by the Correction Pulse Interval setting. 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 5-5.

Figure 5-5. Generator Governor Control Settings

6 • Regulation

The DECS-450 provides a control signal to a power amplifier (typically a firing circuit and rectifier bridge) and adjusts the control signal as needed to achieve precise regulation of the controlled parameter such as terminal voltage, field current, field voltage, reactive power or power factor. 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-450 to be configured for multiple system and application needs.

Per Unit Settings

Some BESTCOMS*Plus*® settings provide fields for primary and per unit values. When one of these fields is edited, BESTCOMS*Plus* automatically recalculates the other field based on the new value and the associated rated data (on the System Parameters, Rated Data screen).

If the Rated Data parameters are changed after all per unit values are assigned, BESTCOMS*Plus* automatically recalculates all actual unit settings.

Regulation Modes

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

The DECS-450 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-450 regulates the excitation level in order to maintain the generator terminal voltage setpoint in response to changes in load and operating conditions. AVR setpoint (or operating point) adjustment is made through:

- Application of contacts at DECS-450 contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450 Auxiliary Control input.
- The BESTCOMS*Plus*® Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through a DECS-450 CAN bus or Modbus port

The range of adjustment is defined by Minimum and Maximum 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.

The AVR setpoint has an actual unit of Primary Volts and the rated data associated with it is Machine Rated Data, Voltage (on the System Parameters, Rated Data screen).

These settings are illustrated in Figure 6-1.

FCR

When operating in FCR (Field Current Regulation) mode, the DECS-450 regulates the level of current supplied to the field based on the FCR setpoint. 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-450 contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450 Auxiliary Control input
- The BESTCOMS*Plus*® Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through a DECS-450 CAN bus or Modbus port

The range of adjustment is defined by Minimum and Maximum 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.

The FCR setpoint has a native unit of Primary Amps and the rated data associated with it is Field Rated Data, Current – Full Load (on the System Parameters, Rated Data screen).

These settings are illustrated in Figure 6-1.

FVR

FVR (Field Voltage Regulation) mode enables generator modeling and validation testing in accordance with WECC testing requirements. FVR mode can also be used in synchronous motor applications.

When operating in FVR mode, the DECS-450 regulates the level of field voltage supplied to the field based on the FVR setpoint. 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-450 contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450 auxiliary Control input
- The BESTCOMS*Plus* Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through a DECS-450 CAN bus or Modbus port

The range of adjustment is defined by Minimum and Maximum 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 setting.

The FVR setpoint has a native unit of Primary Volts and the rated data associated with it is Field Rated Data, Voltage – Full Load (on the System Parameters, Rated Data screen).

These settings are illustrated in Figure 6-1.

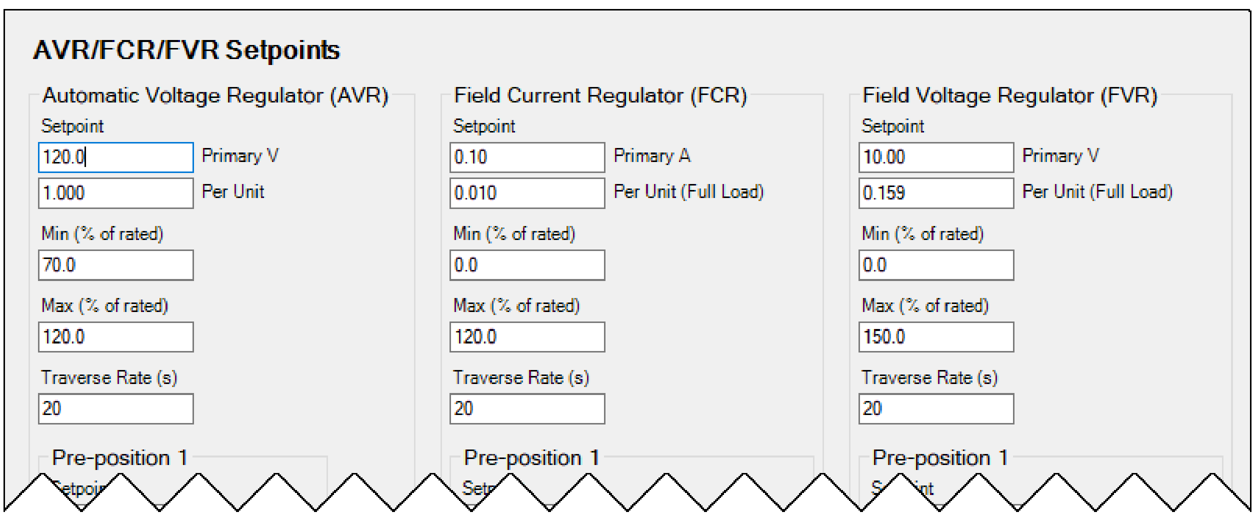


Figure 6-1. AVR, FCR, and FVR Regulation Settings

Var

When operating in var mode, the DECS-450 regulates the reactive power (var) output of the generator based on the var setpoint. 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-450 contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450 Auxiliary Control input
- The BESTCOMS*Plus* Control Panel screen (available in the BESTCOMS*Plus* Metering Explorer)
- A raise or lower command transmitted through a DECS-450 CAN bus or Modbus port

The range of adjustment is defined by Minimum and Maximum 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. A Fine Voltage Adjustment Band setting defines the upper and lower boundaries of voltage correction when operating in var or power factor regulation modes.

The Reactive Power Control setpoint has a native unit of Primary kvar and the rated data associated with it is Machine Rated Data, Rating (kVA) (on the System Parameters, Rated Data screen).

Var mode settings are illustrated in Figure 6-2.

Power Factor

When operating in Power Factor (PF) mode, the DECS-450 controls the var output of the generator to maintain the Power Factor setpoint as the kW load on the generator varies. The setting range of the PF setpoint is determined by the PF – Leading and PF – Lagging settings. The length of time required to adjust the PF setpoint from one limit to the other is controlled by a Traverse Rate setting. A Fine Voltage Adjustment Band setting defines the upper and lower boundaries of voltage correction when the DECS-450 is operating in Var or Power Factor regulation modes. PF Active Power Level establishes the level of generator output power (kW) where the DECS-450 switches to/from Droop Compensation/Power Factor mode. If the level of power decreases below the setting, the DECS-450 switches from Power Factor mode to Droop Compensation mode. Conversely, as the level of power increases above the setting, the DECS-450 switches from Droop Compensation mode to Power Factor mode.

Power Factor mode settings are illustrated in Figure 6-2.

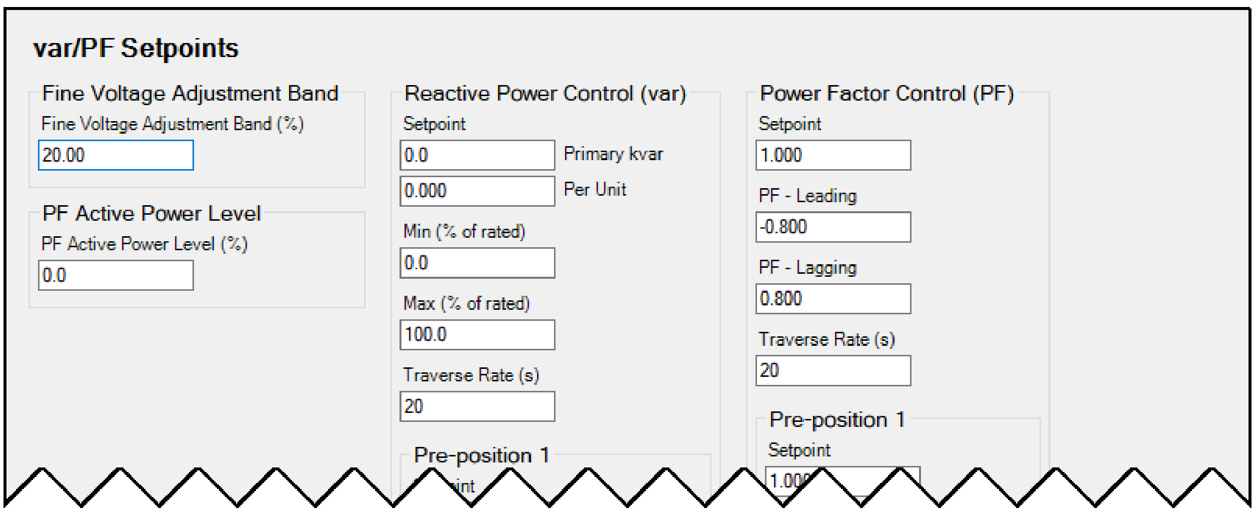


Figure 6-2. Var and Power Factor Regulation Settings

Pre-Position Setpoints

Each regulation mode has three pre-position setpoints that allow the DECS-450 to be configured for multiple system and application needs. Each pre-position setpoint is associated with a programmable logic element in BESTlogic*Plus*. When a pre-position logic element receives a true input, the setpoint is driven to the corresponding pre-position value.

Each pre-position function has three settings: Setpoint, Traverse Rate, and Mode. The setting range of each pre-position setpoint is identical to that of the corresponding control mode setpoint. The Traverse Rate setting establishes the time it takes to adjust from one end of the full setpoint range to the other (Min to Max). To determine the actual traverse rate, divide 100% by the traverse rate value. For example, a Traverse Rate setting of 8 seconds, results in a 12.5% per second traverse rate (100% / 8s = 12.5%/s). This rate is used when adjusting from the current setpoint to the pre-position setpoint. A Traverse Rate setting of zero implements an instantaneous step.

Mode

The Mode setting determines whether or not the DECS-450 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 will be ignored or granted based on priority while the appropriate contact input is closed. Pre-position 3 has the highest priority and pre-position 1 has the lowest priority. For example, if pre-position 1 (maintaining) is active and pre-position 3 closes, the setpoint will change to pre-position 3. However, if pre-position 2 (maintaining) is active and pre-position 1 closes, the setpoint will not change because pre-position 2 is a higher priority than pre-position 1. 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 AVR, FCR, and FVR modes are illustrated in Figure 6-3. (Pre-Position Setpoints for var and PF modes are similar and not shown here.)

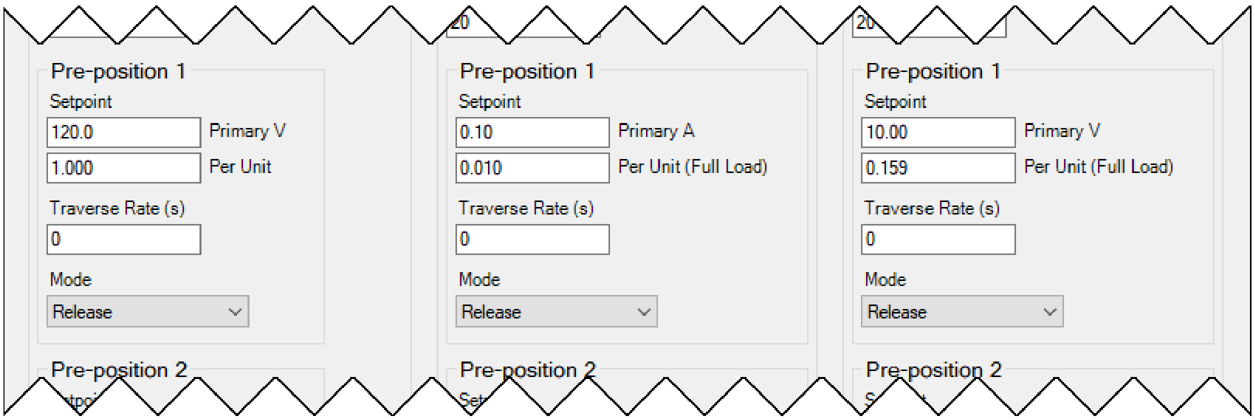


Figure 6-3. Pre-Position Setpoints

Inner Loop Field Regulator

This setting (Figure 6-4) enables the inner control loop of the field regulator for compensation of the exciter gains and time constants. When the inner control loop is enabled, the regulator response depends upon the AVR gains and inner loop gains. Inner loop gains are selected on the Operating Settings, Gain, Inner Loop Field Regulator screen. See the *Stability Tuning* section in this manual for more information on inner loop gain settings.

Figure 6-4. Inner Loop Field Regulator

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-450 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 setting, a current threshold setting, and a minimum duration 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 generator 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, a clearing voltage threshold, and a clearing voltage delay. 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 above the AVR setpoint. The clearing voltage delay determines how long the line voltage must exceed the clearing voltage threshold before setpoint adjustment is terminated.

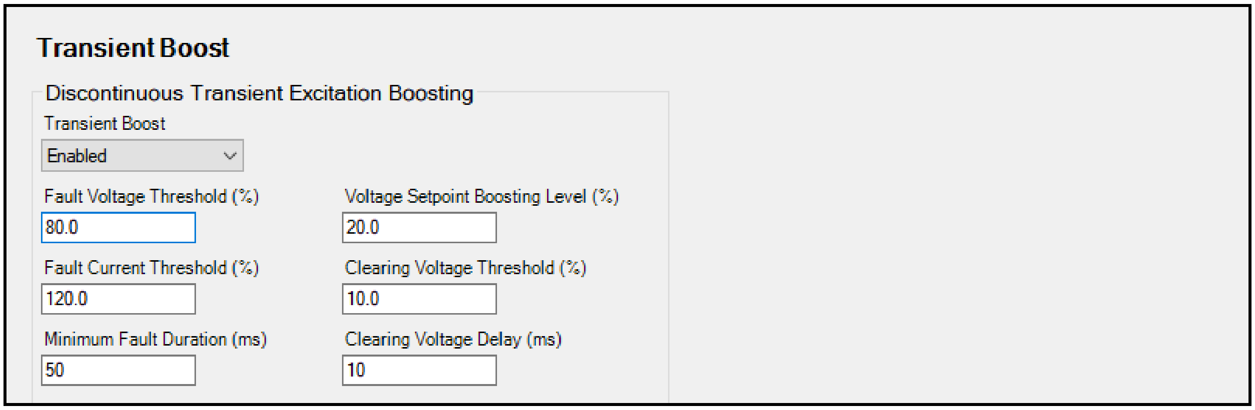


Figure 6-5. Transient Boost Settings

Operation with Paralleled Generators

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Parallel Compensation
HMI Navigation Path: Settings, Operating Settings, Parallel Compensation

The DECS-450 provides several functions for load sharing among paralleled generators: reactive droop compensation, line drop compensation, cross-current compensation, and network load sharing. The DECS-450 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 6-6 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. When droop compensation is enabled, the generator voltage is adjusted in proportion to the measured generator reactive power. The reactive droop compensation setting is expressed as a percentage of the generator rated terminal voltage.

Note
For droop compensation to operate, the PARALLEL_ENABLE_LM logic block must be set true in BESTlogic™*Plus* 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-450 cross-current compensation input (which is connected to the B-phase transformer). Unbalanced sharing of reactive load causes a differential current to be fed into the cross-current compensation input. When cross-current compensation is enabled, this input causes the DECS-450 to respond with the proper level of regulation. The response of the DECS-450 is controlled by the cross-current compensation gain setting 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 Sensing* section of this manual.

Network Load Sharing

In a multiple-generator application, the Network 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-450 controllers is accomplished through the Ethernet port of each DECS-450 communicating over a peer-to-peer network dedicated for the load sharing function. Each DECS-450 measures the reactive current of its associated generator and broadcasts its measurement to all other DECS-450 controllers on the network. Each DECS-450 compares its level of reactive current to the sum of all measured currents and adjusts its excitation level accordingly.

A Load Share ID setting identifies the DECS-450 as a load sharing unit in the network. Checking a Load Sharing Unit number box allows any DECS-450 load sharing units on the network with that Load Share ID number to share load with the currently connected DECS-450. It is not necessary for the Load Share ID to be unique for each unit. This allows for load sharing units to be grouped.

When the unit's configuration does not match the configuration of the other units with load sharing enabled, the Network Load Share Config Mismatch logic element becomes true. The Configuration Mismatch Delay setting adds a delay before the element becomes true.

Load sharing settings consist of an Enable checkbox and Droop, Kg, Ki, Max Vc, Configuration Mismatch Delay, and Load Share ID settings.

Line Drop Compensation

When enabled, line drop compensation can be used to maintain voltage at a load located at a distance from the generator. The DECS-450 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.

Equation 6-1 is used to calculate the Line Drop Value.

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

Equation 6-1. 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 6-2 is used to determine the voltage needed to adjust for line drop.

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

Equation 6-2. Voltage Needed to Adjust for Line Drop

Equation 6-3 is used to obtain primary units.

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

Equation 6-3. Obtain Primary Units

The new line drop adjusted setpoint is calculated using Equation 6-4.

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

Equation 6-4. Line Drop Adjusted Setpoint

Refer to Figure 6-6 for an illustration of the Line drop compensation settings.

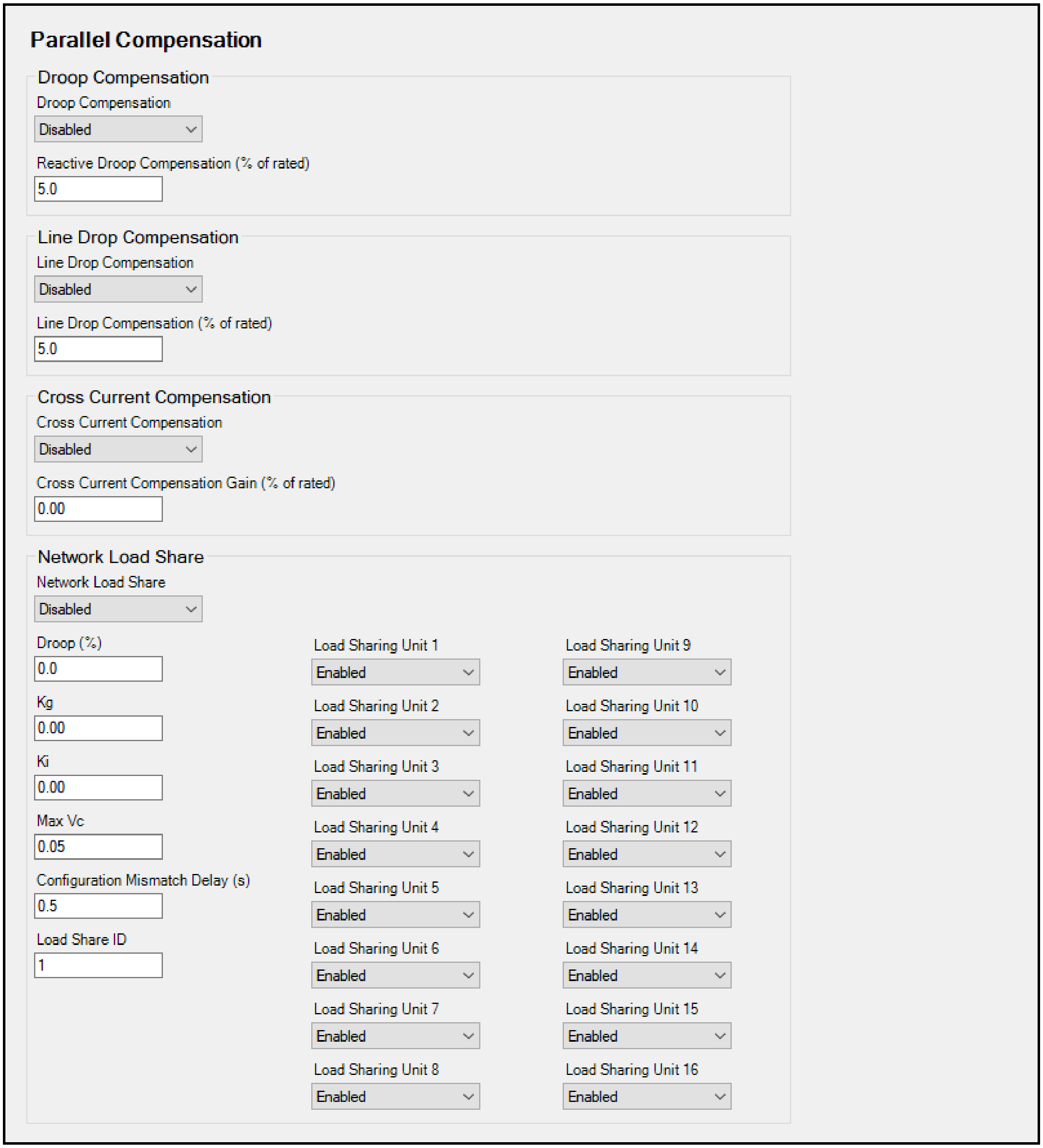


Figure 6-6. Paralleled Generators and Line Drop Compensation Settings

Autotracking

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Autotracking
HMI Navigation Path: Settings, Operating Settings, Autotracking

Internal and external regulation mode setpoint tracking are standard features on the DECS-450. Autotracking settings are illustrated in Figure 6-7.

Internal Setpoint Tracking

In applications using a single DECS-450, internal tracking can be enabled so that the inactive regulation modes continuously 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.
- While performing routine testing of the DECS-450 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: Delay and Traverse Rate. When a large system disturbance is detected, the non-active mode setpoints do not track to the new setpoint until after the time delay has expired. A traverse rate setting establishes the length of time it takes 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-450 can provide backup excitation control. The DECS-450 provides excitation redundancy with its external tracking and transfer provisions between DECS-450 controllers. The secondary DECS-450 can be configured to track the primary DECS-450 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, delay, and traverse rate settings.

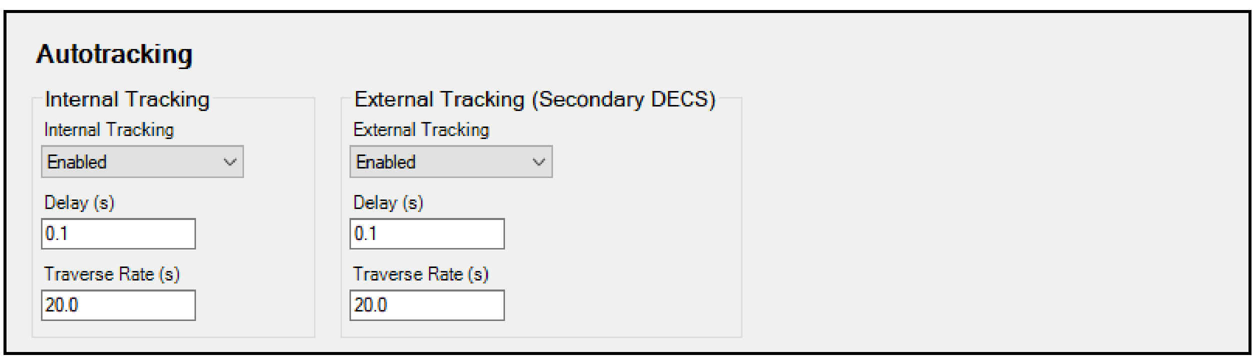


Figure 6-7. Autotracking Settings

Setpoint Configure

When Auto Save is enabled, the DECS-450 automatically saves the active setpoint in 10-minute intervals. Otherwise, the last setpoint sent to the DECS-450 is retained. Figure 6-8 illustrates the Setpoint Configure screen.

Figure 6-8. Setpoint Configure Setting

7 • Auxiliary Control

BESTCOMS*Plus*® Navigation Path: Settings Explorer, Operating Settings, Auxiliary Input
HMI Navigation Path: Settings, Operating Settings, Auxiliary Input

The DECS-450 accepts an external analog control signal for auxiliary control of the regulation setpoint (in all modes), limiter scaling, or power system stabilizer. A No Control mode provides auxiliary input metering only. Auxiliary control settings are illustrated in Figure 7-1.

Auxiliary Control Input Type

Either a voltage or current control signal may be used for auxiliary control. Terminals I+ and I– accept a 4 to 20 mAdc signal. Terminals V+ and V– accept a –10 to +10 Vdc signal. An adjacent terminal labeled GND provides the connection for a recommended cable shield.

Auxiliary Control Input Function

The auxiliary input can be used to bias the regulation setpoint, as a power system stabilizer test input, for limiter scaling, or for metering only.

When using the current auxiliary input, the DECS-450 responds to out-of-range inputs in the following ways. If the applied signal decreases below 2 mAdc, the DECS-450 assumes the bias signal has been lost and reverts to an unbiased state. An applied current that exceeds 20 mAdc is interpreted as full bias.

DECS-450 Input

When the auxiliary input is used for auxiliary control of the regulation setpoint, it provides a bias signal to the regulator, shifting the regulation setpoint. The setpoint shown in BESTCOMS*Plus*® or communicated via CAN Bus, Modbus®, or PROFIBUS will not reflect the bias contribution of the auxiliary input. The displayed setpoint will remain at the same level as if there is zero auxiliary input applied.

Setpoint Limits

Minimum and maximum setpoint limits are observed regardless of auxiliary input level when the "With Limit" setting is enabled.

PSS Test Input

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

Limiter Scaling

When the auxiliary 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 full load 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* section of this manual.

No Control

A No Control mode provides auxiliary input metering only. In this mode, the input signal controls no functions, but it retains all monitoring, scaling, and labeling features of the other modes.

Auxiliary Control Gains

When a current input type is selected, the input current is converted internally by the DECS-450 into a voltage signal in the range of –10 to +10 Vdc. The DECS-450 uses Equation 7-1 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 7-1. 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.

If the auxiliary input is actively biasing an inactive mode's regulation setpoint while internal tracking is enabled, then internal tracking will allow a transfer to the inactive mode with no disturbance to the system. This may limit the effective range of the auxiliary control input.

The following example demonstrates how the effective range of the auxiliary input could be limited:

- If the excitation system is operating in FCR mode while the AVR mode's setpoint is being biased by a +1 Vdc signal to the auxiliary input, when a transfer to AVR mode is triggered, there would be no change in generator voltage if internal tracking is enabled. However, the auxiliary input would still be at +1 Vdc regardless of generator voltage magnitude. This leaves an effective adjustment range of 9 Vdc in the upward direction and 11 Vdc in the lower direction since the auxiliary input's range is –10 to +10 Vdc.

AVR Mode

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

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

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. The resulting value relates to a percentage of the rated no load field current.

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

FVR Mode

In FVR mode, the auxiliary control signal is multiplied by the FVR gain setting. The resulting value relates to a percentage of the rated no load field voltage.

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

Var Mode

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

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

Power Factor Mode

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

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

Summing Type

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.

No Control Settings

Label Text

A customizable label is provided to identify the auxiliary input in metering.

Ranges

Ranges must be set for the No Control input function. Param Min correlates to Min Input Current or Min Input Voltage and Param Max correlates to Max Input Current or Max Input Voltage.

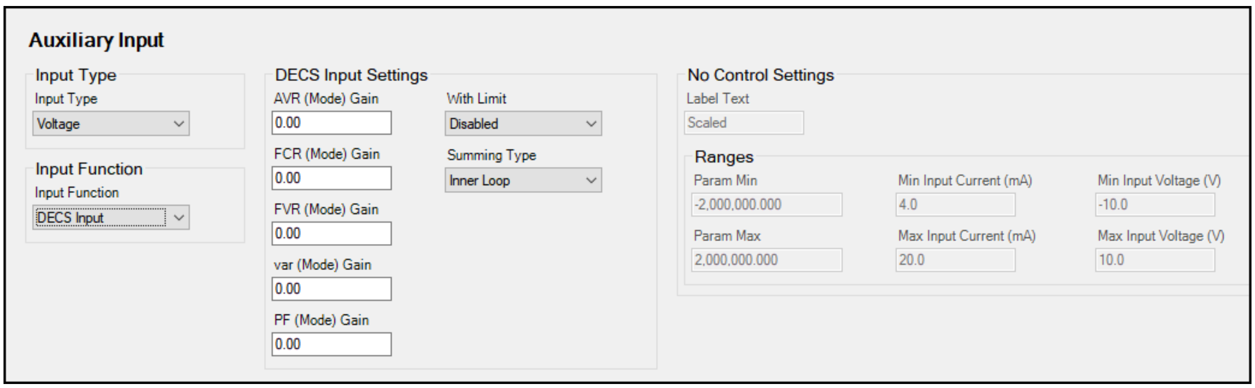


Figure 7-1. Auxiliary Input Settings

8 • Programmable Inputs and Outputs

Sixteen isolated contact sensing inputs (14 programmable, 2 fixed) are available for initiating DECS-450 actions. Twelve sets of output contacts provide annunciation and control. A dedicated Control Output provides analog control signals to a power amplifier. Four analog outputs provide meter driver signals and may be configured to represent DECS-450 metered values.

An analog input is provided for auxiliary control of the regulation setpoint, power system stabilizer test input, limiter scaling, or for metering only. Refer to the *Auxiliary Control* section in this manual for more information.

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-450 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-125 or CEM-2020). Contact Basler Electric for ordering information.

All DECS-450 contact inputs are compatible with dry relay/switch contacts or open-collector outputs from a PLC. Each contact input has an isolated interrogation voltage 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-450. If the DECS-450 receives Start and Stop contact inputs simultaneously, the Stop input takes priority. Start contact input connections are made at terminals START (pin 1) and COM (pin 2). Stop contact input connections are made at terminals STOP (pin 3) and COM (pin 4).

Programmable Inputs

The 14 programmable inputs may be used to monitor the status of excitation system contacts and switches. Using BESTlogic™*Plus* programmable logic, the inputs may be configured 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 *BESTlogic™Plus* section.

To make the programmable contact inputs easier to identify, customized labels may be assigned that relate to the inputs/functions of your system. Figure 8-1 shows a portion of the BESTCOMS*Plus*® Contact Inputs screen where each of the 14 inputs may be assigned a custom name.

Note

Simultaneous application of contacts at contact inputs configured for:

- Raising and lowering the active setpoint will result in no change to the setpoint
- Auto and manual mode selection will result in selection of manual mode

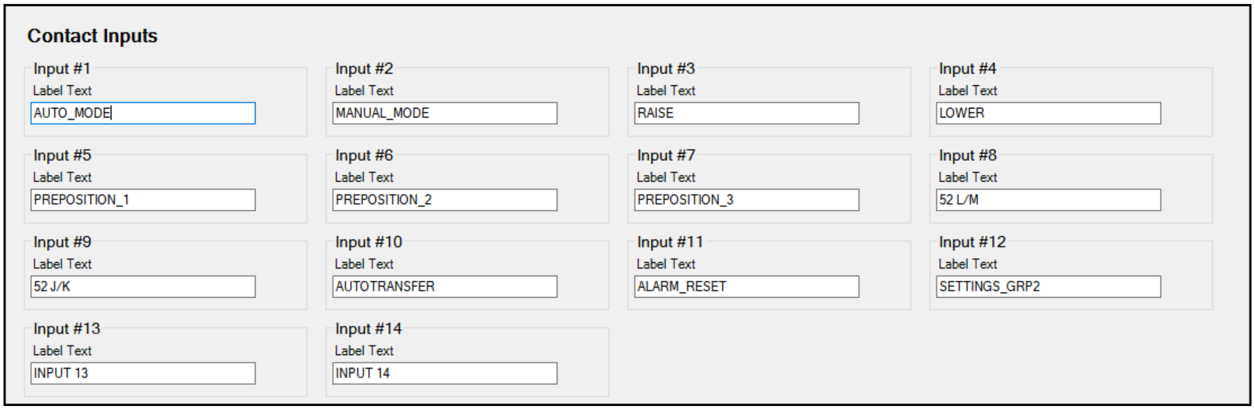


Figure 8-1. Contact Input Label Text

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

Contact Outputs

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Outputs, Contact Outputs
HMI Navigation Path: Not available through HMI.

DECS-450 contact outputs consist of a dedicated watchdog output and 11 programmable outputs. The optional CEM-125 or 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 BESTlogic*Plus.*

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

Programmable Outputs

The 11 programmable, normally-open contact outputs may be configured to annunciate DECS-450 status, active alarms, active protection functions, and active limiter functions. Using BESTlogic*Plus* programmable logic, these outputs may be configured 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* section.

To make the programmable contact outputs easier to identify, customized labels may be assigned that relate to the functions of your system. Figure 8-2 shows the BESTCOMS*Plus* Contact Outputs screen where each of the 11 outputs may be assigned a custom name.

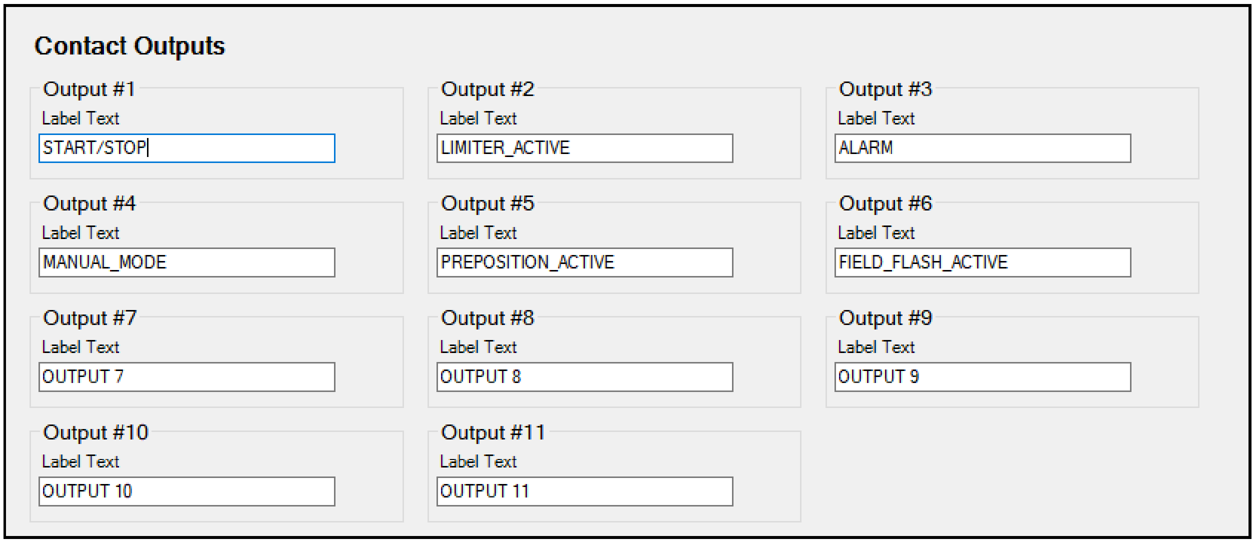


Figure 8-2. Contact Output Label Text

Control Output

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Outputs, Analog Outputs, Control Output

HMI Navigation Path: Settings, Programmable Outputs, Analog Outputs, Control Output

A dedicated analog output provides a control signal over the range of 0 to 10 Vdc, –10 to +10 Vdc, or 4 to 20 mAdc. Settings consist of Output Type, Invert Output, and Power Amplifier Type. These settings are described below and shown in Figure 8-3.

Output Type

The control output may be configured to transmit a voltage or current signal. Selections for the signal ranges are 0 to 10 Vdc, –10 to +10 Vdc, or 4 to 20 mAdc.

Invert Output

When using the DECS-450 with an exciter that requires an inverted output, enable to invert the DECS-450 control output.

Power Amplifier Type

The Power Amplifier Type setting establishes whether the controlled power amplifier is capable of positive voltage only or capable of negative forcing.

Regulator Output Range

These read-only fields display the selected control output configuration.

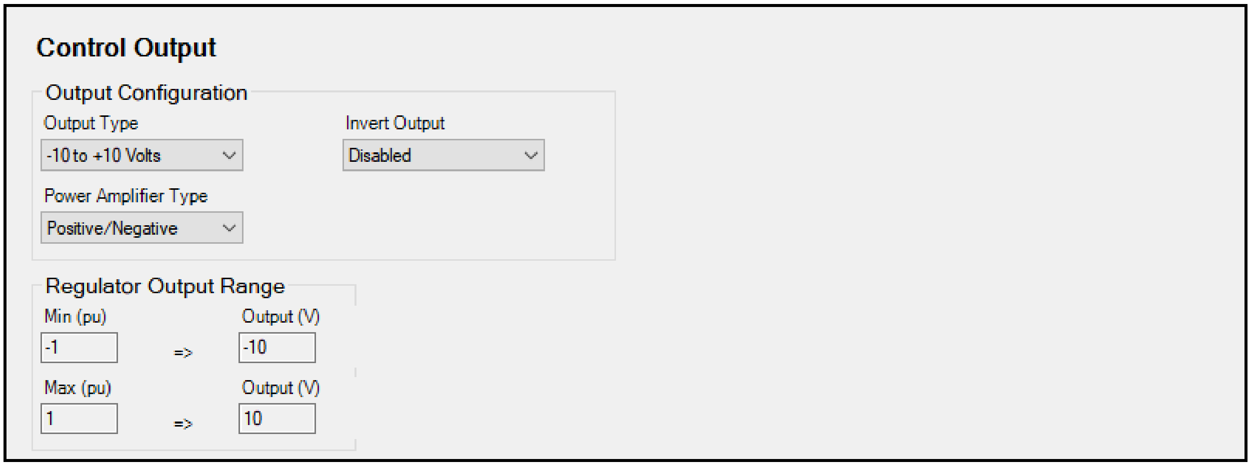


Figure 8-3. Control Output Screen

Logic Connections

Logic connections for the "Control Output Out of Range" status input are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The Control Output Out of Range status input logic block is illustrated in Figure 8-4. The output is true during a trip condition.

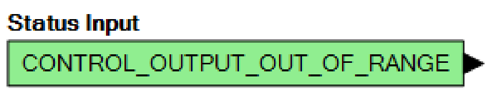


Figure 8-4. Control Output Out of Range Status Input

Meter Driver Circuits

BESTCOMS*Plus* Navigation Path: Settings Explorer, Programmable Outputs, Analog Outputs, Analog Output X

HMI Navigation Path: Settings, Programmable Outputs, Analog Outputs, Analog Output X

Four analog outputs provide meter driver signals over a range of either 4 to 20 mA or -10 to +10 Vdc. Settings consist of parameter selection, output type, out of range activation delay, and ranges. These settings are described below and shown in Figure 8-5.

Parameter Selection

The following parameters can be selected:

- Analog Inputs 1 through 8 (optional AEM-2020 required)
- Auxiliary Input Current (mA)
- Auxiliary Input Voltage
- Bus Frequency
- Bus Voltage: VAB, VBC, or VCA
- Control Output pu (per unit)
- EDM Ripple
- Exciter Field Current
- Exciter Field Temperature
- Exciter Field Voltage
- Gen Current: IA, IB, IC, or Average
- Gen Frequency
- Gen Power Factor and Scaled Power Factor
- Gen Voltage: VAB, VBC, VCA, or Average
- Kilovarhours
- Kilowatthours

- Negative Sequence Current
- Negative Sequence Voltage
- NLS Error Percent
- Positive Sequence Current
- Positive Sequence Voltage
- PSS Output
- RTD Inputs 1 through 8 (optional AEM-2020 required)
- Setpoint Position
- Thermocouples 1 and 2 (optional AEM-2020 required)
- Total kVA
- Total kvar
- Total kW
- Tracking Error

Output Type

Each analog output may be configured to transmit a voltage or current signal.

The minimum and maximum output current may be set to any value between 4 and 20 mAdc and the minimum and maximum output voltage may be set to any value between -10 and +10 Vdc.

This accommodates for the typical ranges, 4 to 20 mAdc, 0 to 10 Vdc, and -10 to +10 Vdc, as well as custom ranges.

Out of Range Activation Delay

When the value of the selected parameter is out of range for the duration of the Out of Range Activation Delay, the condition is annunciated in logic. See Logic Connections, below.

Ranges

Ranges must be set for the selected output type. Param Min is represented by Min Output Current or Min Output Voltage and Param Max is represented by Max Output Current or Max Output Voltage.

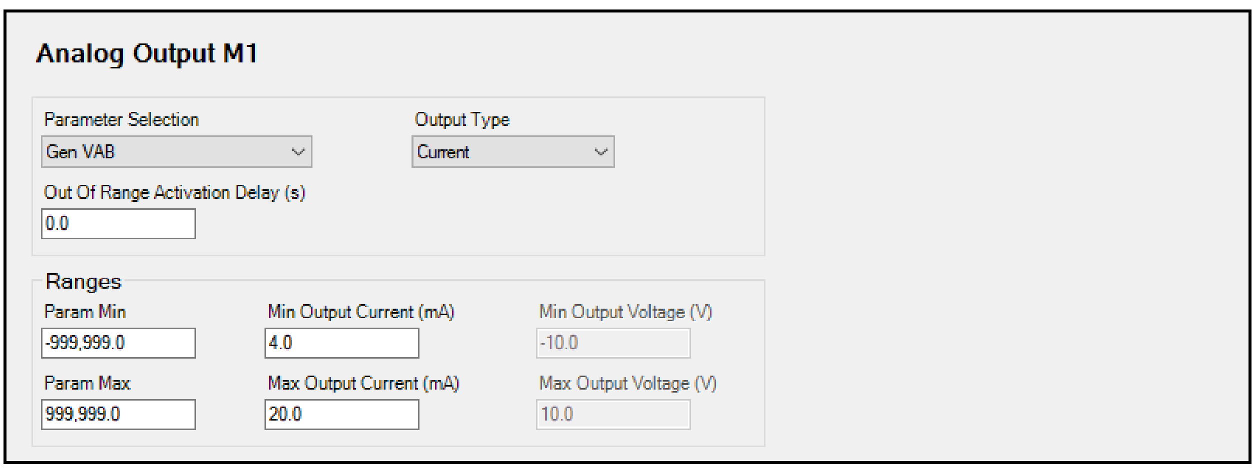


Figure 8-5. Analog Output M1 Screen

Logic Connections

Logic connections for the four "Analog Output Out of Range" status inputs are made on the BESTlogic*Plus* screen in BESTCOMS*Plus*. The Analog Output 1 Out of Range status input logic block is illustrated in Figure 8-6. The output is true during a trip condition.

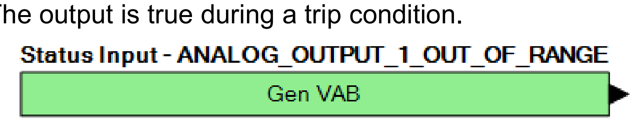


Figure 8-6. Analog Output 1 Out of Range Status Input

9 • Protection

The DECS-450 offers protection relating to machine voltage, frequency, power, field parameters, rotating exciter diodes, 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*.

Per Unit Settings

Some BESTCOMS*Plus*® settings provide fields for actual and per unit values. When one of these fields is edited, BESTCOMS*Plus* automatically recalculates the other field based on the new value and the associated rated data (on the System Parameters, Rated Data screen).

If the Rated Data parameters are changed after all per unit values are assigned, BESTCOMS*Plus* automatically recalculates all actual unit settings.

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 settings for a definite amount of time. 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-450 to provide flexible generator and generator step-up transformer overexcitation protection. An inverse square timing characteristic is provided through the Inverse Time Pickup Setpoint and Time Dial settings. These settings enable the DECS-450 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 setting. Volts per hertz protection may be enabled and disabled 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.

Setting any of the pickups to 0 disables the corresponding timer function.

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 9-1 and Figure 9-2.

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

Equation 9-1. Trip Time

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

Equation 9-2. 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)
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.)

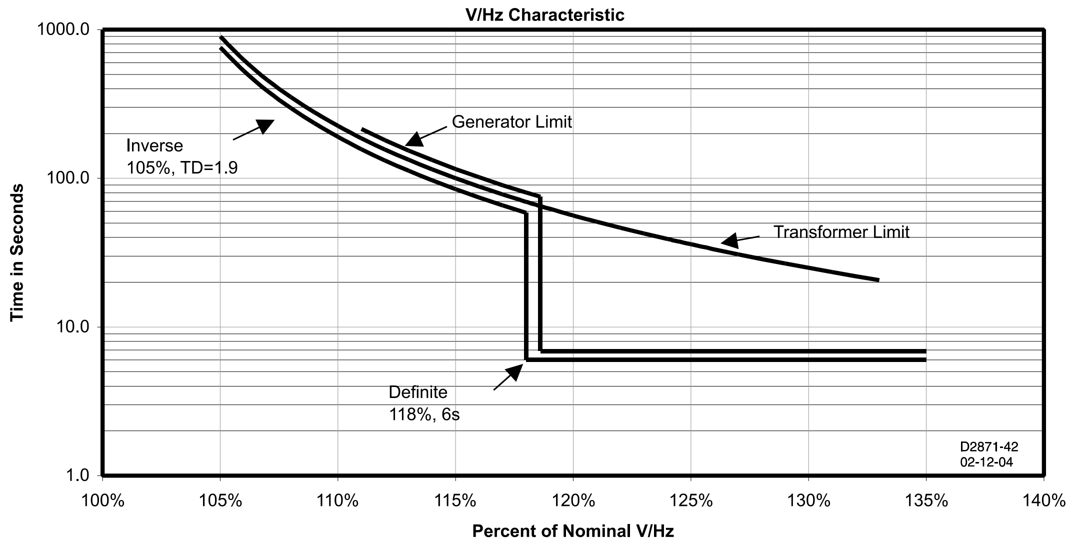


Figure 9-1. V/Hz Characteristic – Time Shown on Vertical Axis

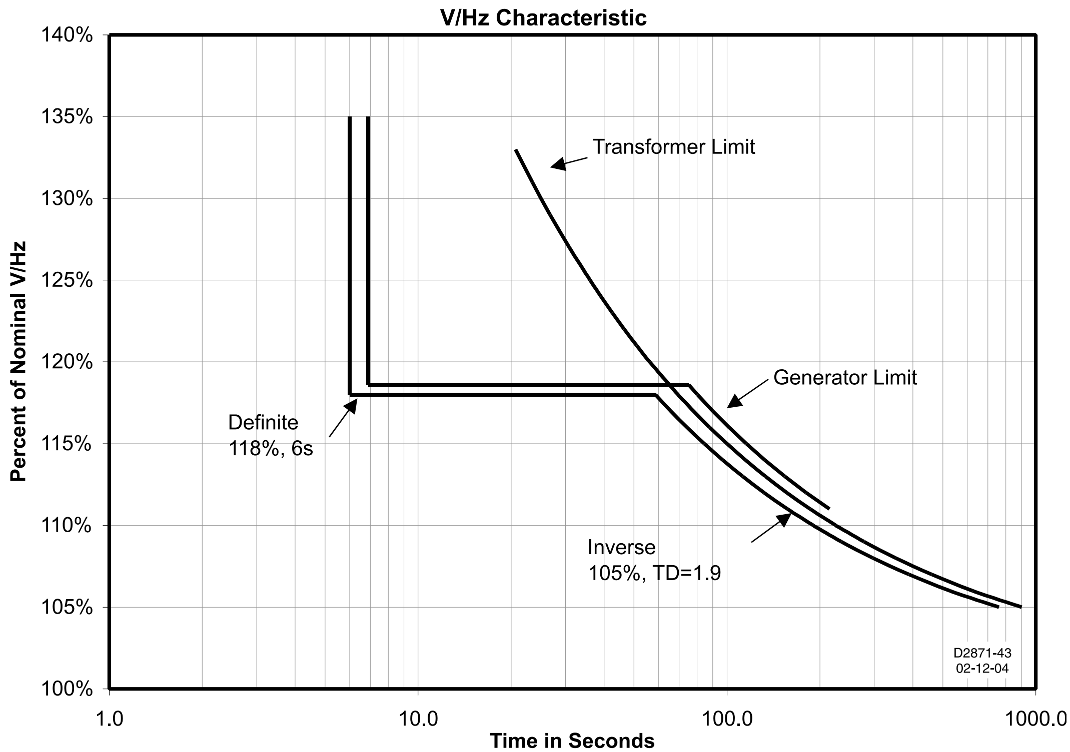


Figure 9-2. V/Hz Characteristic – Time Shown on Horizontal Axis

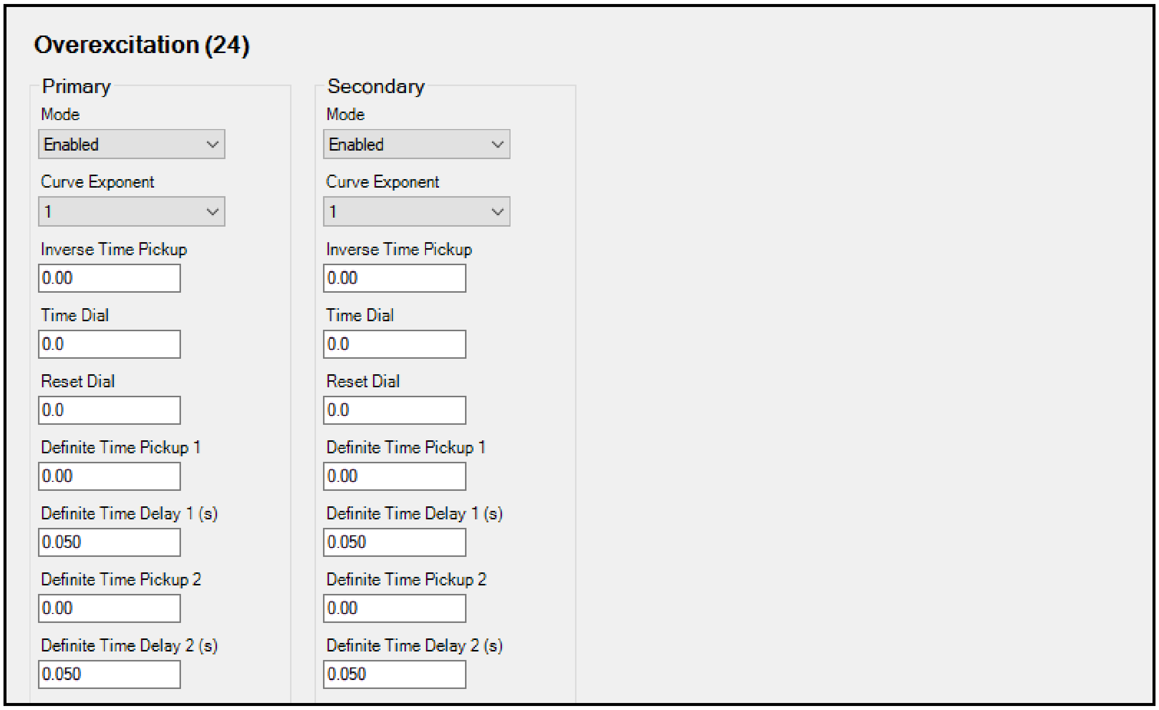


Figure 9-3. Overexcitation Protection Settings

Generator Undervoltage

An undervoltage pickup condition occurs when the sensed generator terminal voltage decreases below the pickup setting. An undervoltage trip condition occurs if the generator voltage remains below the pickup threshold for the duration of the time delay setting. Generator undervoltage protection may be enabled and disabled without altering the pickup and time delay settings. Undervoltage pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

The Undervoltage pickup has a native unit of Primary Volts and the rated data associated with it is Machine Rated Data, Voltage (on the System Parameters, Rated Data screen).

BESTCOMS*Plus*® generator undervoltage settings are illustrated in Figure 9-4.

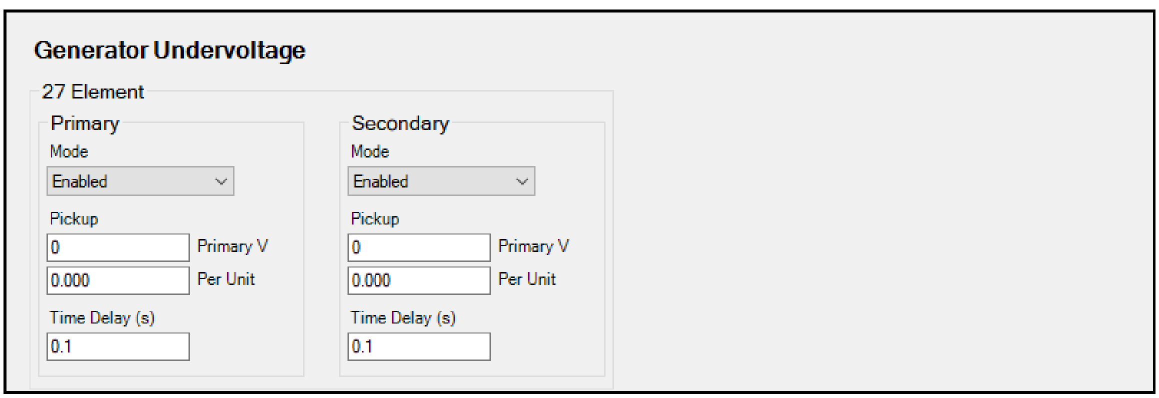


Figure 9-4. Generator Undervoltage Protection Settings

Generator Overvoltage

An overvoltage pickup condition occurs when the sensed generator terminal voltage increases above the pickup setting. An overvoltage trip condition occurs if the generator voltage remains above the pickup threshold for the duration of the time delay setting. Generator overvoltage protection may be enabled and disabled without altering the pickup and time delay settings. Overvoltage pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

The Overvoltage pickup has a native unit of Primary Volts and the rated data associated with it is Machine Rated Data, Voltage (on the System Parameters, Rated Data screen).

BESTCOMS*Plus*® generator overvoltage settings are illustrated in Figure 9-5.

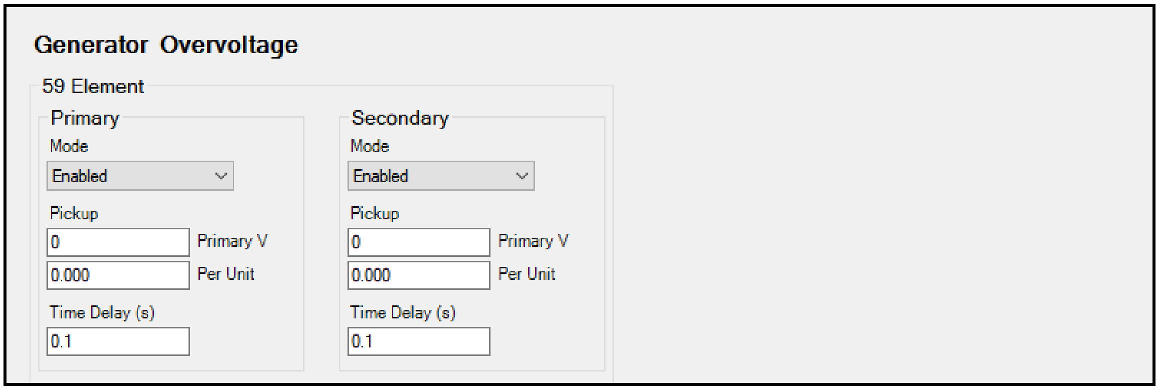


Figure 9-5. Generator Overvoltage Protection Settings

Loss of Sensing

The generator voltage is monitored for a loss of sensing (LOS) condition. LOS protection settings are illustrated in Figure 9-6.

In the DECS-450, an LOS event is calculated using sequence components. LOS trip criteria is listed in Table 9-1.

Table 9-1. Loss of Sensing Trip Criteria

Loss of either 1 or 2 phases (3-phase sensing)	Loss of all 3 phases (3-phase sensing)	Loss of single-phase sensing
3-phase, 3-wire sensing selected	3-phase, 3-wire sensing selected	Single-phase sensing selected
V1 > BV% of AVR setpoint	BV% of AVR Setpoint > V1	BV% of AVR Setpoint > VGEN
V2 > UV% of V1	200% of I_{rated} > I1	200% of I_{rated} > I1
17.7% of I1 > I2 OR 1% of I_{rated} > I1		17.7% of I1 > I2 OR 1% of I_{rated} > I1

V1 = Positive sequence voltage
V2 = Negative sequence voltage
I1 = Positive sequence current
I2 = Negative sequence current
I_{rated} = Rated current
BV% = Balanced voltage percent
UV% V1 = Unbalanced voltage percent
VGEN = Average generator voltage

When all criteria in a column are true for the duration of the time delay setting, an LOS trip condition occurs.

An LOS condition may be used to initiate a transfer to manual (FCR) control mode. It may be configured in BESTlogic*Plus* to initiate other actions as well. Protection may be enabled and disabled 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.

Figure 9-6. Loss of Sensing Protection Settings

Frequency Protection

BESTCOMS*Plus* 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 for the duration of the 81O time delay setting. Overfrequency protection may be enabled and disabled without altering the pickup and time delay settings. Overfrequency pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMS*Plus* overfrequency settings are illustrated in Figure 9-7.

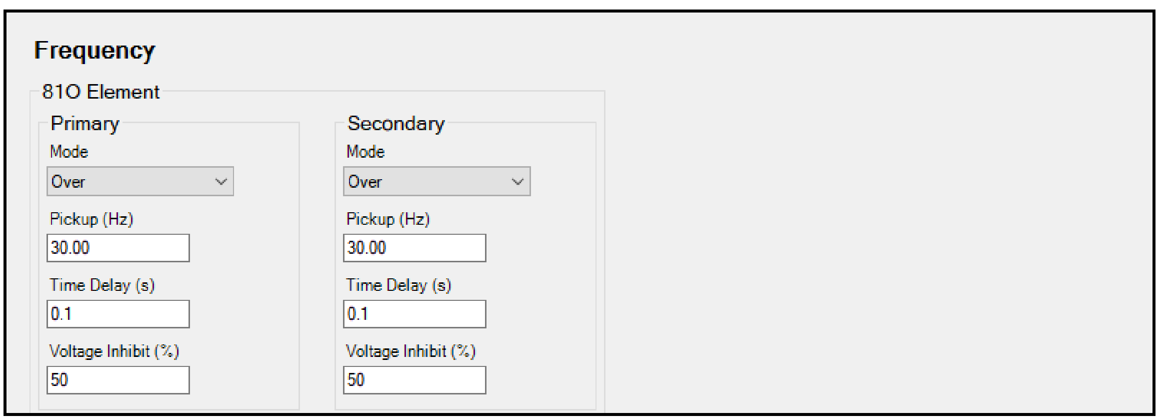


Figure 9-7. Overfrequency Protection Settings

Underfrequency

The DECS-450 provides two underfrequency elements designated 81U-1 and 81U-2. An underfrequency condition occurs when the frequency of the generator voltage decreases below the 81U pickup threshold for the duration of the 81U time delay setting. A voltage inhibit setting, expressed as a percentage of the rated generator voltage, may be implemented to prevent an underfrequency trip from occurring during startup when the generator voltage is rising toward the nominal level. Underfrequency protection may be enabled and disabled without altering the pickup, delay, and inhibit settings. Underfrequency pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition. BESTCOMS*Plus* underfrequency settings are illustrated in Figure 9-8.

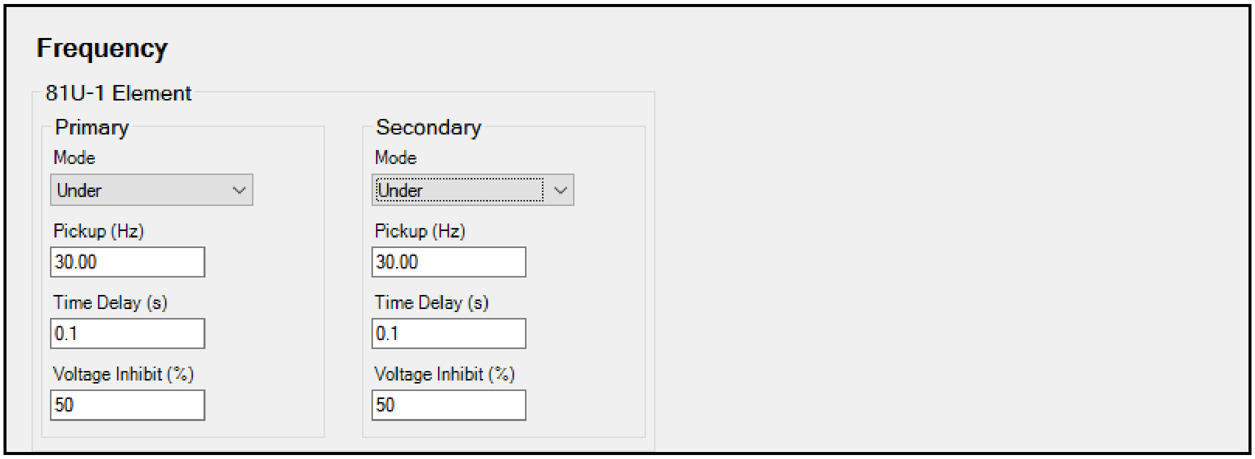


Figure 9-8. Underfrequency Protection Settings

Power Protection

BESTCOMS*Plus* 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 for the duration of the 32R time delay. Reverse power protection may be enabled and disabled without altering the pickup and time delay settings. The DECS-450 does not initiate a shutdown, however, reverse power pickup and trip elements in BESTlogic*Plus* may be used to initiate corrective action in response to the condition.

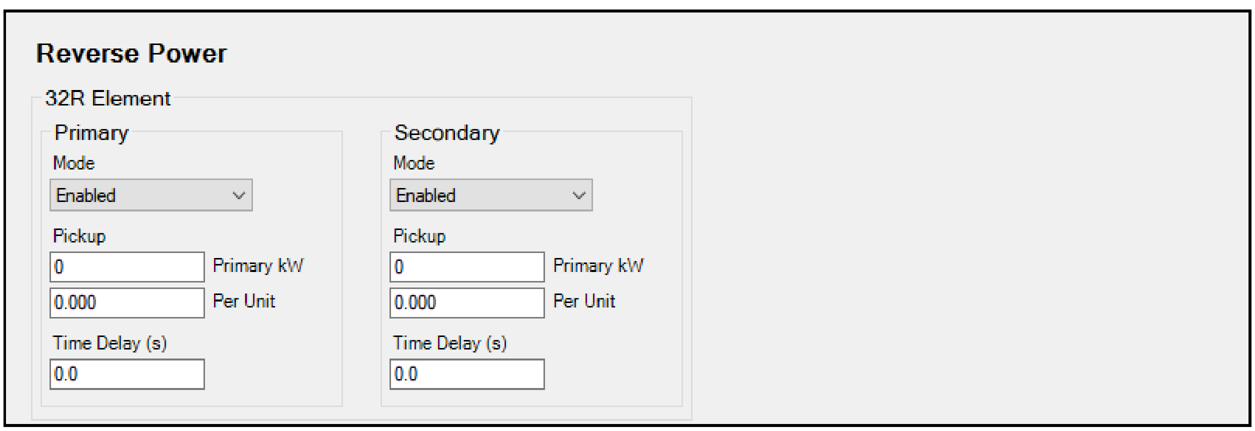


Figure 9-9. Reverse Power Protection Settings

The Reverse Power pickup setting may be set in Primary Kilowatts or Per Unit and the rated data associated with it is Machine Rated Data, Rating (kVA) (on the System Parameters, Rated Data screen).

BESTCOMS*Plus* reverse power protection settings are illustrated in Figure 9-9.

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 9-10. BESTCOMS*Plus* settings are described below and shown in Figure 9-11.

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 9-10 for details.

Motor Protection

The DECS-450 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 9-10.

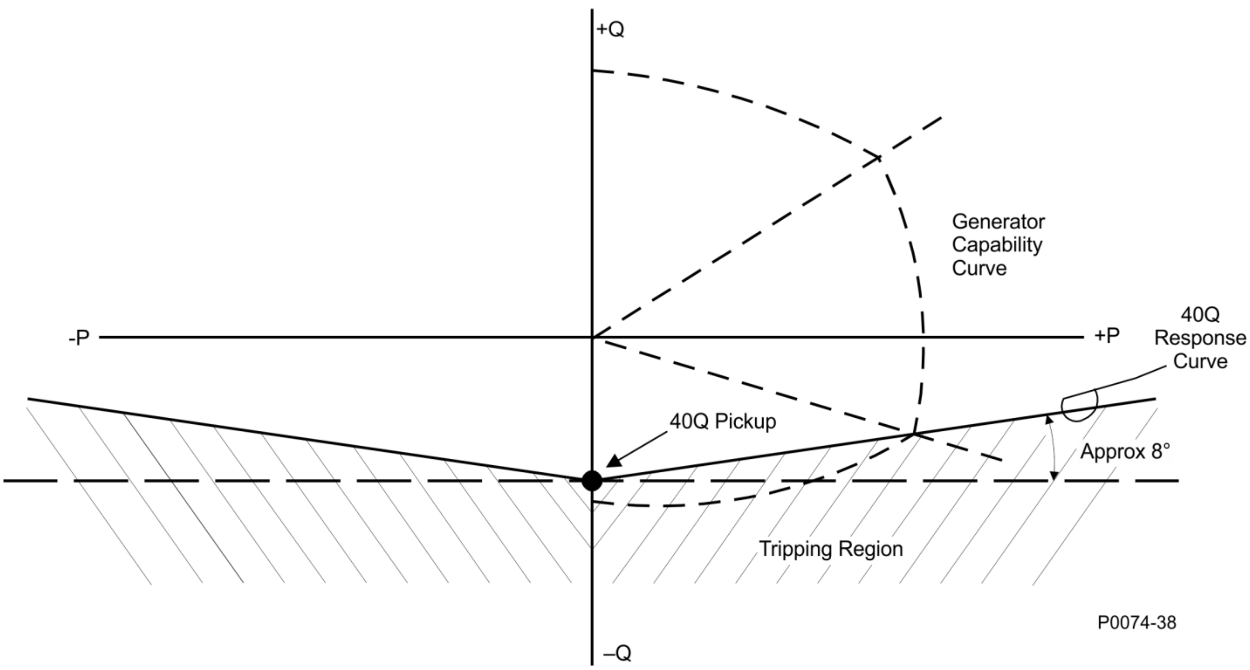


Figure 9-10. Generator Capability Curve vs. 40Q Response

Pickup and Trip

A loss of excitation condition exists when the level of absorbed vars exceeds the loss of excitation (40Q) threshold for the duration of the 40Q time delay. A time delay setting of zero 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 further occurrences of loss of excitation. Loss of excitation protection may be enabled and disabled without altering the pickup and time delay settings.

The Loss of Excitation pickup setting may be set in Primary Kilovars or Per Unit and the rated data associated with it is Machine Rated Data, Rating (kVA) (on the System Parameters, Rated Data screen).

BESTCOMS*Plus* loss of excitation settings are illustrated in Figure 9-11.

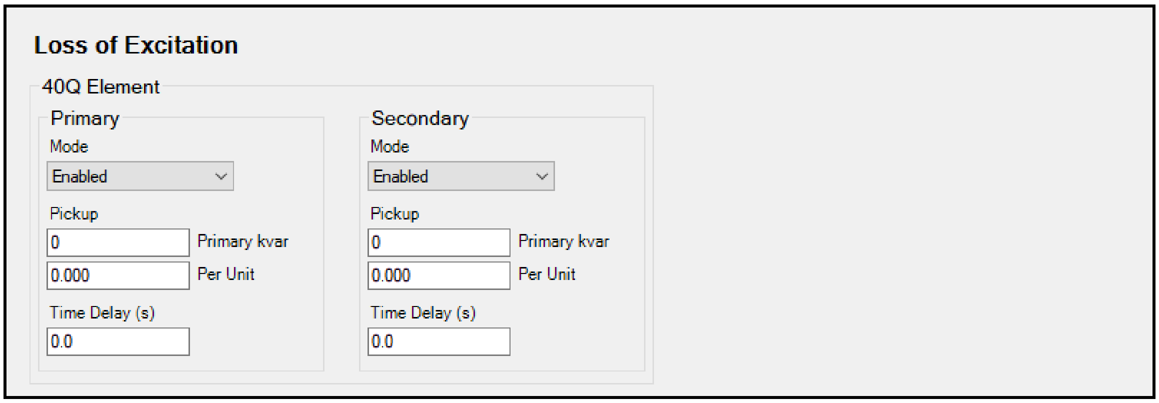


Figure 9-11. Loss of Excitation Protection Settings

Field Protection

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Field
HMI Navigation Path: Settings, Protection, Field

Field protection provided by the DECS-450 includes field overvoltage, field overcurrent, field overtemperature, loss of field isolation transducer, and an exciter diode monitor.

Field Overvoltage

A field overvoltage condition occurs when the field voltage exceeds the field overvoltage threshold for the duration of the field overvoltage time delay. Field overvoltage protection may be enabled and disabled without altering the pickup and time delay settings. Field overvoltage pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

The Overvoltage pickup has a native unit of Primary Volts and the rated data associated with it is Field Rated Data, Voltage – Full Load (on the System Parameters, Rated Data screen).

BESTCOMS*Plus* field overvoltage settings are illustrated in Figure 9-12.

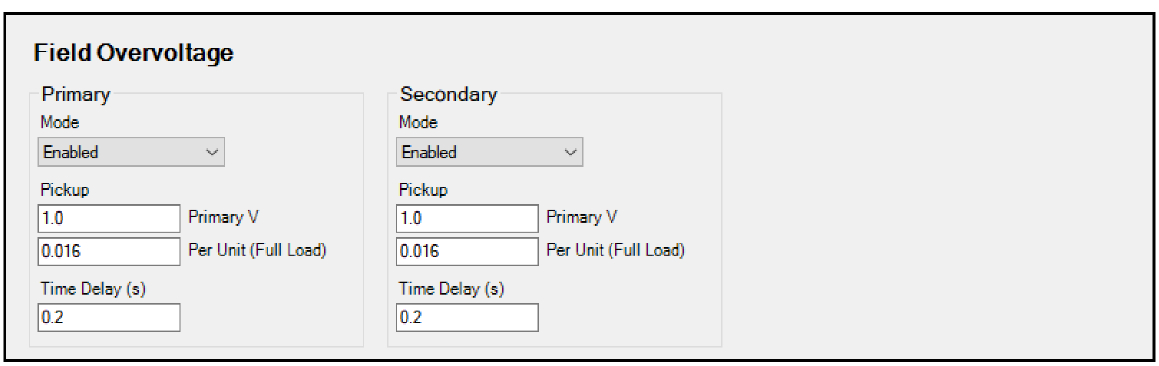


Figure 9-12. Field Overvoltage Protection Settings

Field Overcurrent

A field overcurrent condition is annunciated when the field current exceeds the field overcurrent pickup level for the duration of the field overcurrent time delay. Depending on the selected timing mode, the time delay may be fixed or related to an inverse function. Definite timing mode uses a fixed time delay. In inverse timing mode, the time delay is shortened in relation to the level of field current above the pickup level. The time dial setting acts as a linear multiplier for the time to an annunciation. This enables the DECS-450 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 (Equation 9-3) and reset time (Equation 9-4) delays.

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

Equation 9-3. 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, 2.5>

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

Equation 9-4. 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 <0.0, 0.95>

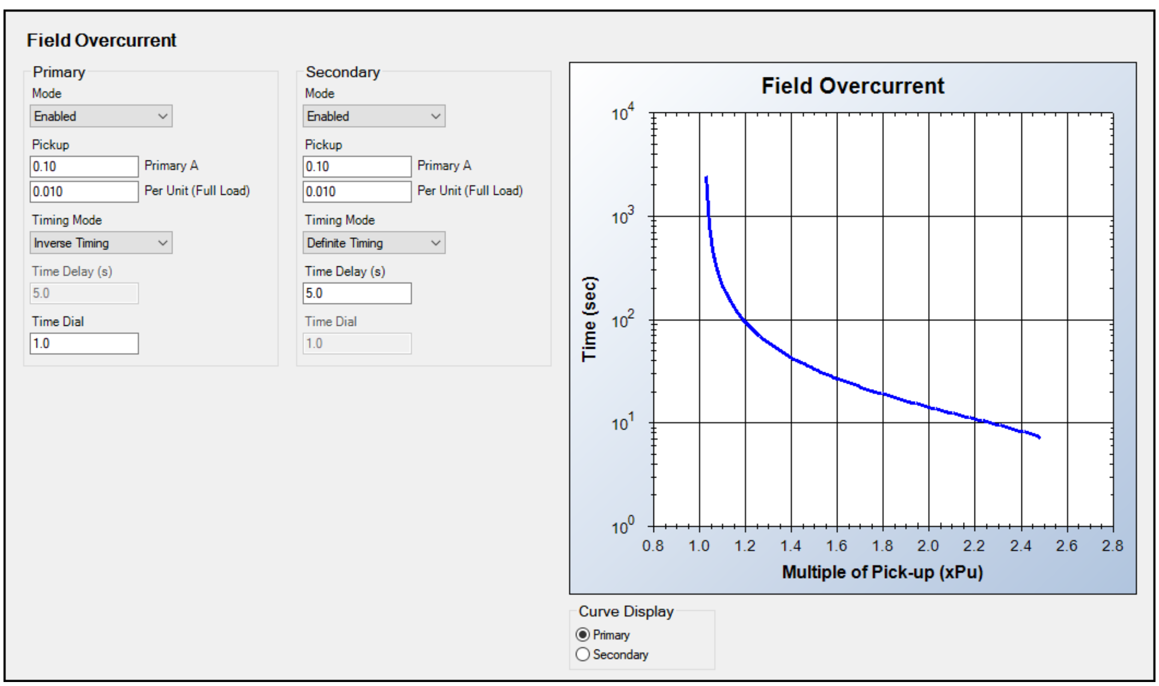


Figure 9-13. Field Overcurrent Protection Settings

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

Field overcurrent protection may be enabled and disabled without altering the pickup and time delay settings. Field overcurrent pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

The Overcurrent pickup has a native unit of Primary Amps and the rated data associated with it is Field Rated Data, Current – Full Load (on the System Parameters, Rated Data screen).

BESTCOMS*Plus* field overcurrent settings are illustrated in Figure 9-13. In BESTCOMS*Plus,* a plot of the field overcurrent setting curve is displayed. The plot can display the primary or secondary setting curves.

Field Overtemperature

The DECS-450 calculates field temperature based on the generator main field resistance, the field ambient temperature, and the voltage drop across the generator main field brushes. Field overtemperature protection is intended for static exciter applications supplying a generator's main field or for rotary exciter applications where the field voltage and current is measured at the slip rings and main field current shunt on the brush-type rotary exciter.

A field overtemperature condition occurs when the field temperature exceeds the field overtemperature threshold for the duration of the field overtemperature time delay. Field overtemperature protection may be enabled and disabled without altering the pickup and time delay settings. Field overtemperature pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

BESTCOMS*Plus* field overvoltage settings are illustrated in Figure 9-14.

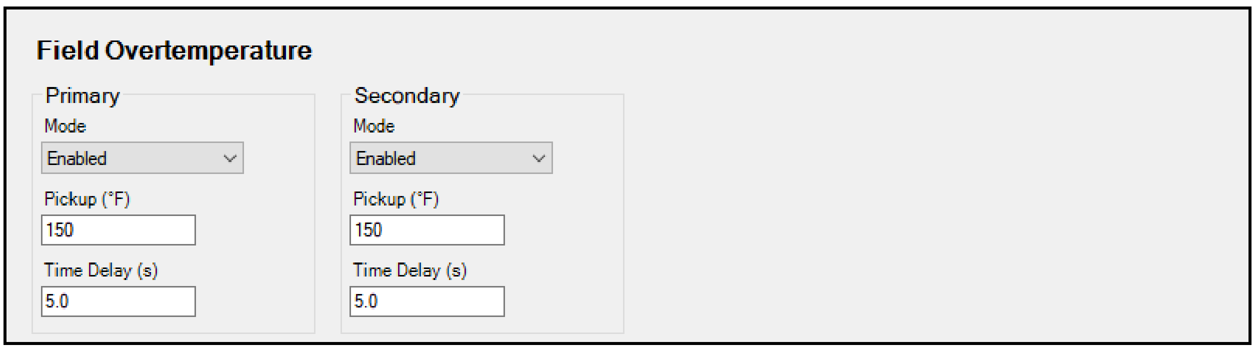


Figure 9-14. Field Overtemperature Protection Settings

Loss of Field Isolation Transducer

A loss of field isolation transducer condition occurs when the field current signal from the field isolation transducer decreases below a predetermined level for the duration of the time delay. Loss of field isolation transducer protection may be enabled and disabled without altering the pickup and time delay settings. Loss of field isolation transducer pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

Figure 9-15. Loss of Field Isolation Transducer Settings

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 9-16. When implementing the EDM, it is imperative that the user specify the number of poles for the exciter armature and the generator rotor. A pole ratio calculator, available in BESTCOMS*Plus,* may be used to calculate the pole ratio from the number of exciter armature and generator rotor poles.

Notes
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 may be detected. If the number of poles is unknown, disable all exciter open diode protection and set the generator and exciter pole parameters to 1.0 to prevent false tripping. 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 and shorted diode detection. 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 or shorted diode 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 BESTlogic*Plus* may 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 may be used to disable both open- and shorted-diode protection when the field current drops below the user-defined percentage of rated. EDM protection may be disabled and enabled 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 may 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 may 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 may 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-450 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.

Setting the Pickup Level—Number of Generator Poles Unknown

The DECS-450 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 to 1.0, and enable shorted diode protection. Multiply the maximum EDM ripple level, obtained under *Finding the Maximum Field Ripple Current*, by 30. The multiplier may 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.

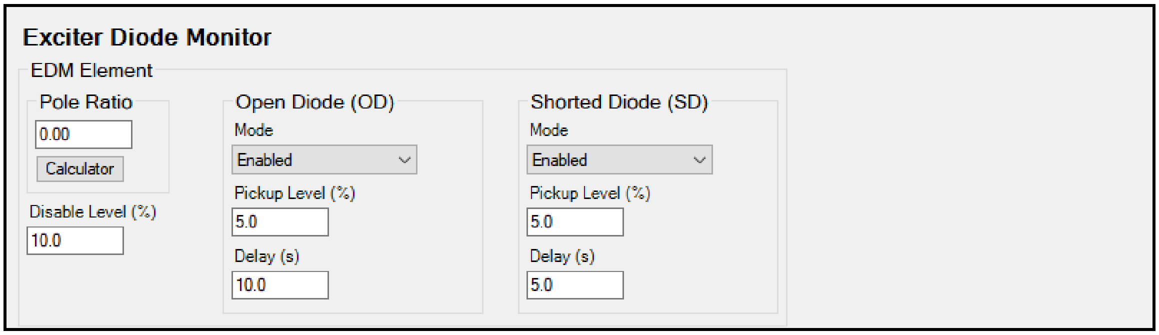


Figure 9-16. Exciter Diode Monitor Protection Settings

Sync-Check Protection

BESTCOMS*Plus* Navigation Path: Settings Explorer, Protection, Sync Check (25)
HMI Navigation Path: Settings, Protection, Sync Check (25)

Caution
Because the DECS-450 sync-check and automatic synchronizer functions share internal circuitry, the sync-check function is disabled if the automatic synchronizer function is enabled. If using the DECS-450 automatic synchronizer, consider separate sync-check supervision.

Figure 9-17. Sync-Check Protection Settings

When enabled, 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, slip angle, and slip frequency 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 may be configured (in BESTlogic*Plus*) to assert a DECS-450 contact output. This contact output can, in turn, enable the closure of a breaker tying the generator to the bus.

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

When the Gen Freq > Bus Freq 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 9-17.

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

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

HMI Navigation Path: Settings, Protection, Configurable Protection

The DECS-450 has eight configurable protection elements that may be used to supplement the standard DECS-450 protection. BESTCOMS*Plus* configurable protection settings are illustrated in Figure 9-18. To make the protection elements easier to identify, each element may be renamed through BESTCOMS*Plus*. A protection element is configured by selecting the parameter to be monitored and then establishing the operating characteristics for the element. Any one of the following parameters may be selected.

- Analog Inputs 1 through 8 (optional AEM-2020 required)
- Auxiliary Input Current (mA)
- Auxiliary Input Voltage
- Bus Frequency
- Bus Voltage: V_{AB}, V_{BC}, or V_{CA}
- Control Output
- EDM Ripple
- Exciter Field Current
- Exciter Field Temperature
- Exciter Field Voltage
- Gen Current: I_A, I_B, I_C, or Average
- Gen Frequency
- Gen Power Factor and Scaled Power Factor
- Gen Voltage: V_{AB}, V_{BC}, V_{CA}, or Average
- Kilovarhours
- Kilowatthours
- Negative Sequence Current
- Negative Sequence Voltage
- NLS Error Percent
- Positive Sequence Current
- Positive Sequence Voltage
- PSS Output
- RTD Inputs 1 through 8 (optional AEM-2020 required)
- Setpoint Position
- Thermocouples 1 and 2 (optional AEM-2020 required)
- Total kVA
- Total kvar
- Total kW
- Tracking Error

When the Stop Mode Inhibit setting is enabled, the configurable protection element is disabled when the DECS-450 is in STOP mode. When the DECS-450 enters START mode, the arming delay timer begins counting down and, when it expires, the configurable protection element is enabled. If Stop Mode Inhibit is disabled, the arming delay is ignored.

A hysteresis function holds the protection function active for a user-defined percentage 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 adjustable thresholds. Each threshold may be set to pick up when the monitored parameter increases above the pickup setting (Over) or decreases below the pickup setting (Under). The pickup level for the monitored parameter is defined by a threshold setting. The threshold setting range is very broad, so be sure to use appropriate values for the selected parameter or else the protection function may not operate as intended.

After the threshold has been exceeded for the duration of the activation delay, the configurable protection element trips. If the threshold detection drops out before the activation delay time expires, the activation delay timer is reset.

Configurable protection pickup and trip elements in BESTlogic*Plus* may be used in a logic scheme to initiate corrective action in response to the condition.

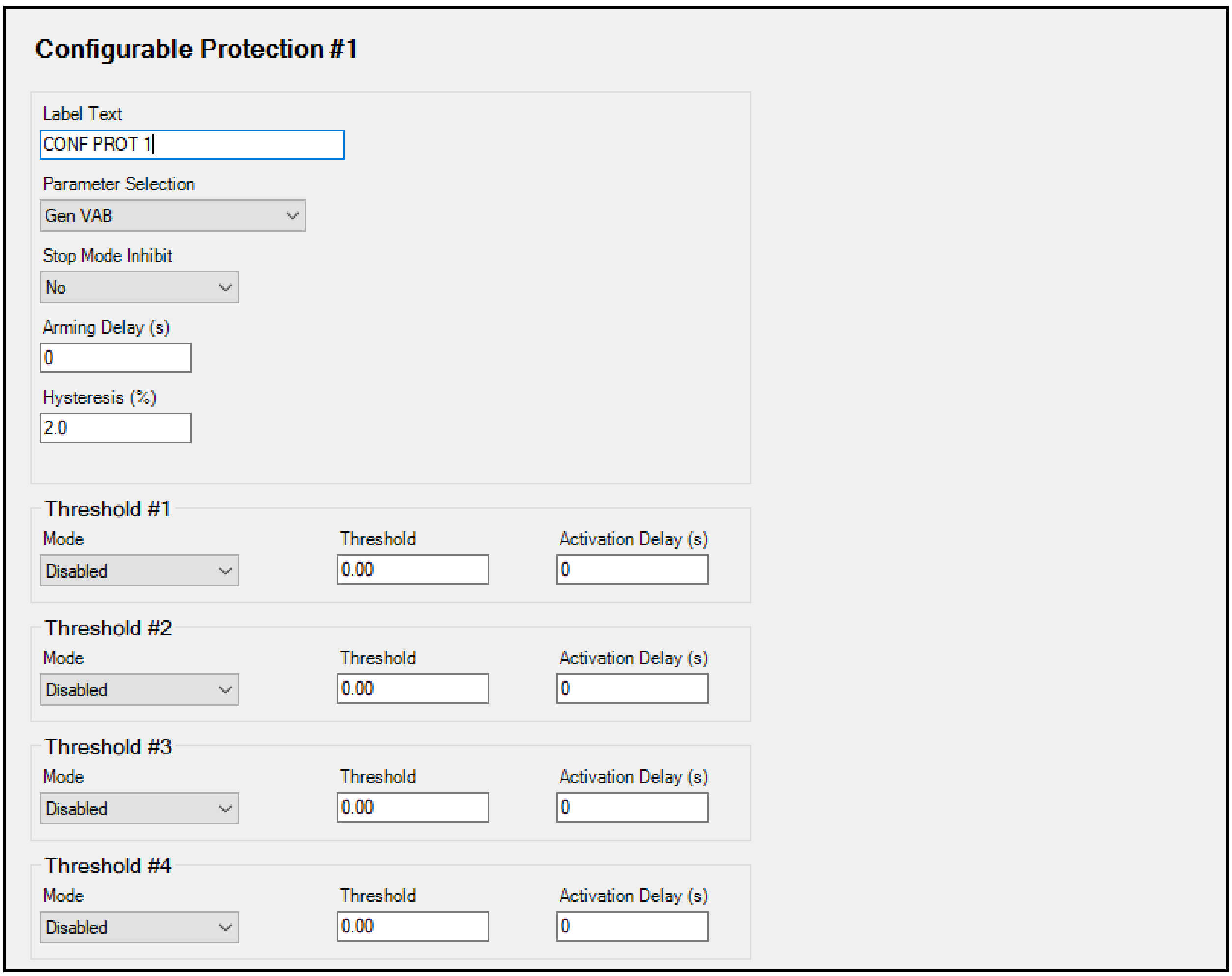


Figure 9-18. Configurable Protection Settings

10 • Limiters

DECS-450 limiters ensure that the controlled machine does not exceed its capabilities. Limiters include overexcitation, underexcitation, stator current, var, and underfrequency/volts per hertz.

Per Unit Settings

Some BESTCOMS*Plus*® settings provide fields for actual and per unit values. When one of these fields is edited, BESTCOMS*Plus* automatically recalculates the other field based on the new value and the associated rated data (on the System Parameters, Rated Data screen).

If the Rated Data parameters are changed after all per unit values are assigned, BESTCOMS*Plus* automatically recalculates all actual unit settings.

Overexcitation Limiter

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Limiters, OEL
HMI Navigation Path: Settings, Operating Settings, Limiters, OEL

The overexcitation limiter (OEL) monitors the level of field current supplied by the DECS-450 and limits it to prevent field overheating.

The OEL can be enabled 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*. When OEL is disabled in manual mode via BESTlogic*Plus*, OEL will still annunciate the condition, but limiting will not occur.

Two styles of overexcitation limiting are available in the DECS-450: summing point or takeover. The summing point-type OEL provides a control signal to the summing point of the voltage regulator's control loop, whereas the takeover-type OEL overrides the voltage regulator's primary control loop. Refer to the *Math Model* chapter for more details.

OEL settings are illustrated in Figure 10-3, Figure 10-4, and Figure 10-6.

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: High and Low. Figure 10-1 illustrates the relationship of these levels.

Initially, excitation current will not be permitted to exceed the High Level threshold. Upon expiration of the High Time delay, excitation current will be limited to the value of the Low Level setting. Excitation current will be permitted to remain indefinitely at this level as needed by the application. The OEL is active any time that excitation current is equal to or above the Low Level threshold.

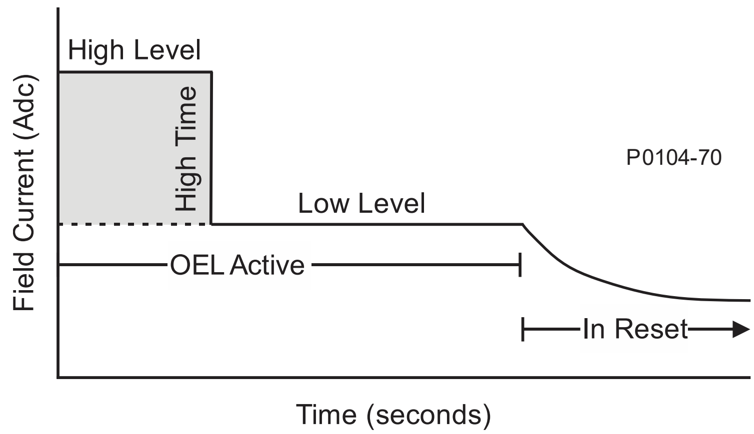


Figure 10-1. Summing Point, Offline, Overexcitation Limiting

Offline OEL Reset

Once excitation current drops below the Low Level threshold, a Reset Timer becomes active. If the OEL reactivates prior to the Reset Timer expiring, then the OEL Timing will begin from a value equal to the previous OEL Active duration plus 100 electrical cycles minus the time in reset. Once the Reset Timer is allowed to expire, then the OEL Active timer is completely reset.

Reset Timer:

1. If the OEL Active duration is less than the High Time delay minus 100 cycles, then the Reset Timer will be equal to the OEL Active duration plus 100 cycles.
2. If the OEL Active duration is equal to or greater than the High Time delay minus 100 cycles, then the Reset Timer is equal to the High Time delay.

Online Operation

For online operation, there are three levels of summing-point overexcitation limiting: Low, Medium, and High. Figure 10-2 illustrates the relationship of these levels.

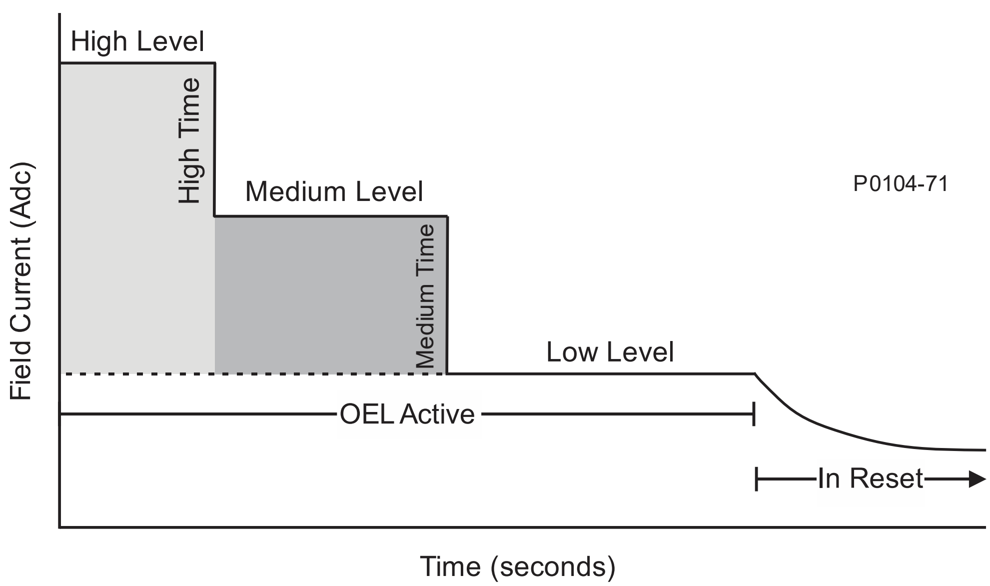


Figure 10-2. Summing Point, Online, Overexcitation Limiting

Initially, excitation current will not be permitted to exceed the High Level threshold. Upon expiration of the High Time delay, excitation current will no longer be allowed to exceed the Medium Level threshold. After the expiration of the Medium Time delay, excitation current will be limited to the value of the Low Level setting. Excitation current will be permitted to remain indefinitely at this level as needed by the application. The OEL will be active any time that excitation current is equal to or above the Low Level threshold.

Online OEL Reset

Once excitation current drops below the Low Level threshold, a Reset Timer becomes active. If the OEL reactivates prior to the Reset Timer expiring, then the OEL Timing will begin from a value equal to the previous OEL Active duration plus 100 electrical cycles minus the time in reset. Once the Reset Timer is allowed to expire, then the OEL Active timer is completely reset.

Reset Timer:

1. If the OEL Active duration is less than the High Time delay minus 100 cycles, then the Reset Timer will be equal to the OEL Active duration plus 100 cycles.
2. If the OEL Active duration is equal to or greater than the High Time delay minus 100 cycles but less than the sum of the High Time and Medium Time delays, then the Reset Timer will be equal to the High Time delay.
3. If the OEL Activation duration is equal to or greater than the sum of the High Time and Medium Time delays, then the Reset Timer is equal to the sum of the High Time and Medium Time delays.

OEL Voltage Dependency

The OEL voltage dependency option is used with the Online Summing Point OEL. When enabled, the Online OEL High-Level limit is not activated during normal OEL activity. Only the Medium-Level and Low-Level settings are enabled. While the OEL is active, if a fault occurs which causes terminal voltage to drop rapidly (-dV), then the High Level will become available for a period equal to the High Time delay. Activation of the High Level requires that the quotient of the negative per-unit drop in terminal voltage divided by the duration of time (dV/dt) is less than the dV/dt Level setting.

Per Unit Settings

Settings that are related to machine ratings can be set in either actual units or in per unit values. When a native unit is edited, BESTCOMS*Plus* automatically recalculates the per unit value based on the native unit setting and the rated data parameter (on the System Parameters, Rated Data screen) associated with it. When a per-unit value is edited, BESTCOMS*Plus* automatically recalculates the native value based on the per-unit setting and the rated data parameter associated with it.

Once all per unit values are assigned, if the rated data parameters are changed, BESTCOMS*Plus* automatically recalculates all native unit settings based on the modified rated data parameters.

The levels have native units of Primary Amps and the rated data associated with them is full load rated field current (on the System Parameters, Rated Data screen).

Figure 10-3. OEL Configuration Settings

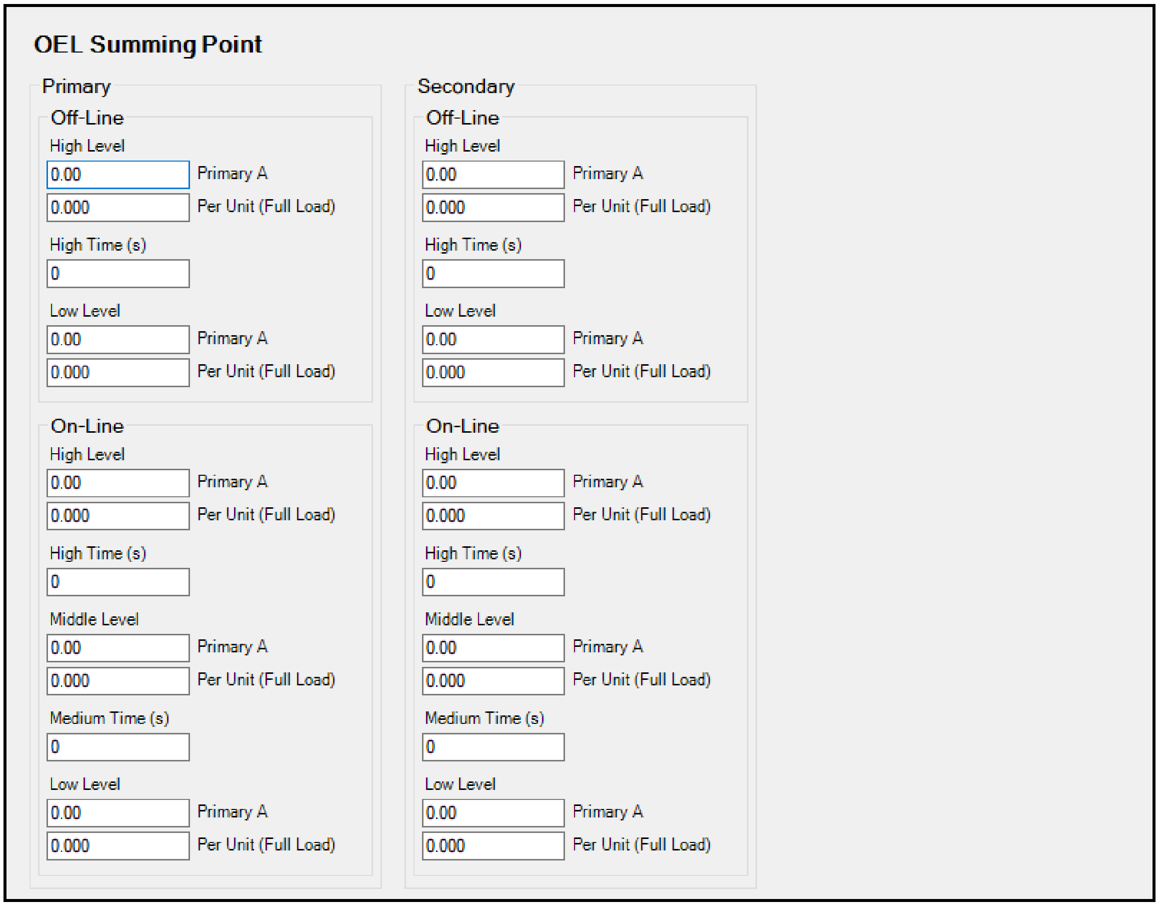


Figure 10-4. Summing Point OEL Settings

Takeover OEL

Takeover overexcitation limiting limits the field current level in relation to an inverse time characteristic similar to that shown in Figure 10-5. It overrides the voltage regulator's primary control loop (refer to the *Math Model* chapter for more details). 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 10-1.

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

Equation 10-1. 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, 2.5>

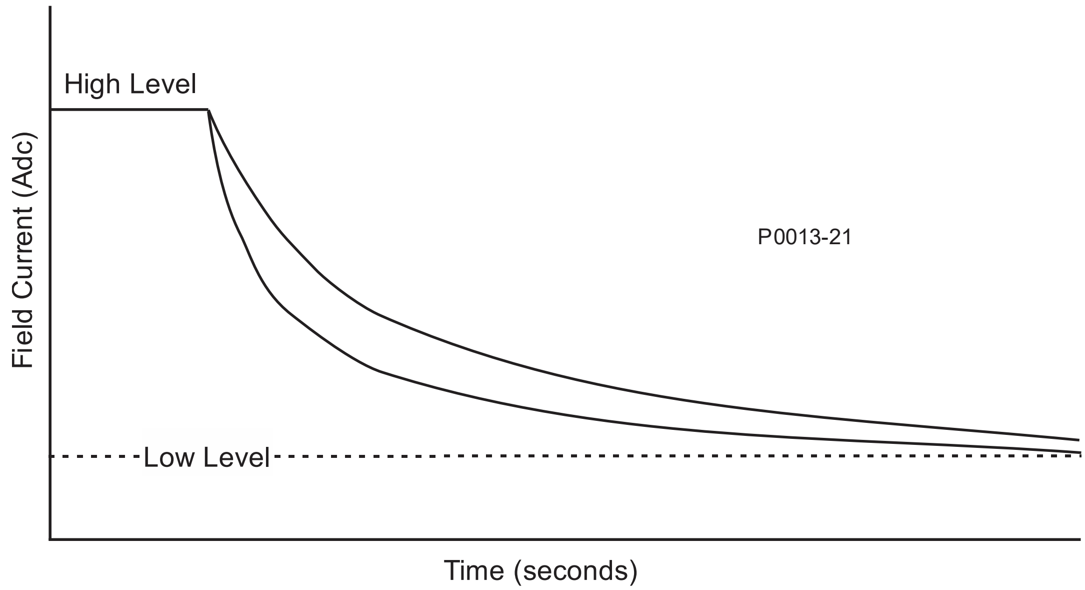


Figure 10-5. Inverse Time Characteristic for Takeover OEL

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

Once the field current decreases below the dropout level (95% of pickup), the function is reset based on the selected reset method. 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 10-2) to calculate maximum reset time.

$$Reset\ Time\ Constant = \frac{RC\ \times TD \times 0.05}{1 - (MOP \times 1.03)^2}$$

Equation 10-2. Inverse Reset Time Characteristic

Where:

Reset Time Constant = maximum time to reset in seconds
RC = reset coefficient setting <0.01, 100>
TD = time dial setting <0.1, 20>
MOP = multiple of pickup

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.

BESTCOMS*Plus*® displays a plot of the takeover OEL setting curves as shown in Figure 10-6.

The levels have native units of Primary Amps and the rated data associated with them is Machine Rated Data, Current – Full Load (on the System Parameters, Rated Data screen).

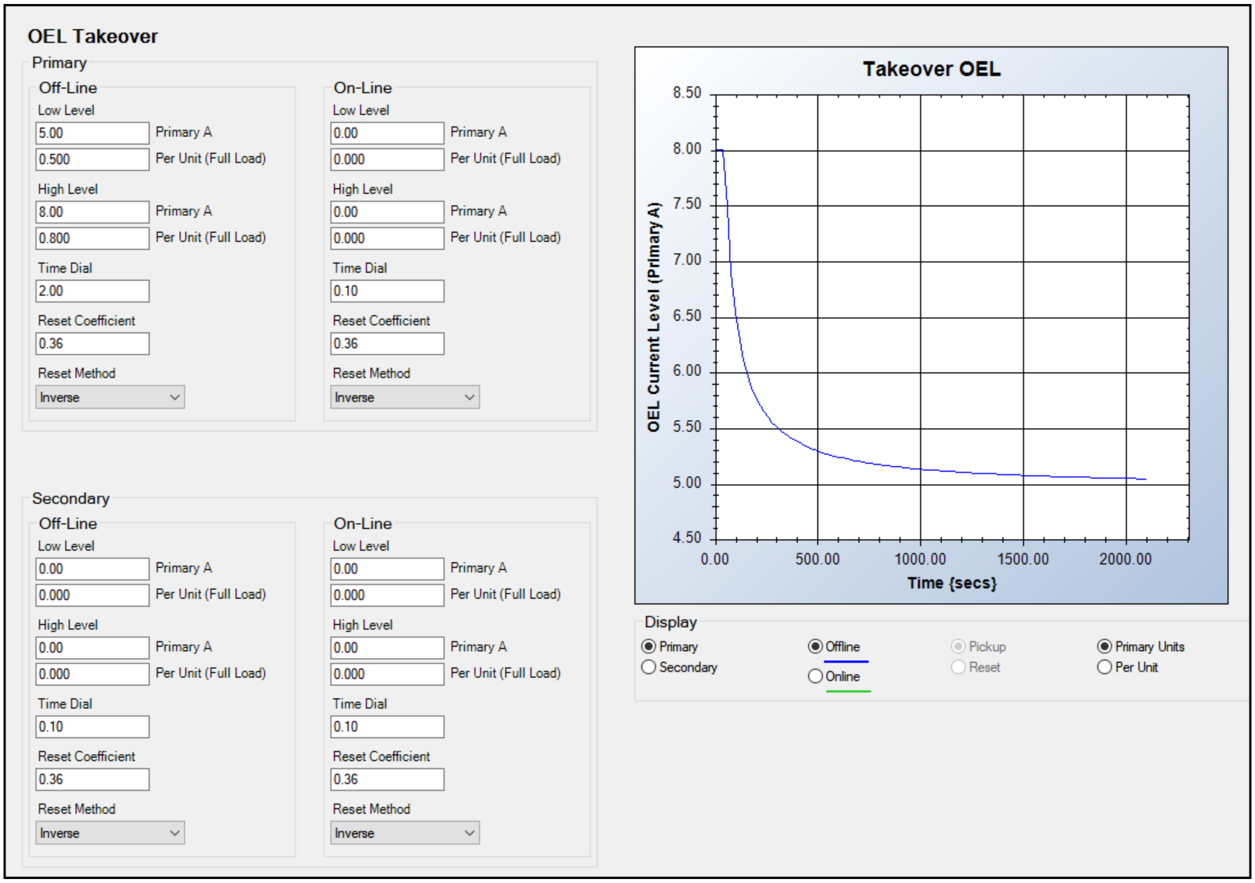


Figure 10-6. Takeover OEL Settings

Underexcitation Limiter

BESTCOMS*Plus* 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. When enabled, 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 BESTlogic*Plus*.

Note
For UEL to operate, the PARALLEL_EN_LM logic block must be set true in BESTlogic*Plus* programmable logic.

UEL settings are illustrated in Figure 10-7 and Figure 10-8.

Underexcitation limiting is implemented through an internally-generated UEL curve or a user-defined UEL curve. 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 for your application.

A user-defined curve can have a maximum of five points. 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. 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 that is applied to the low-pass filter for the real power output.

Figure 10-7. UEL Configuration Settings

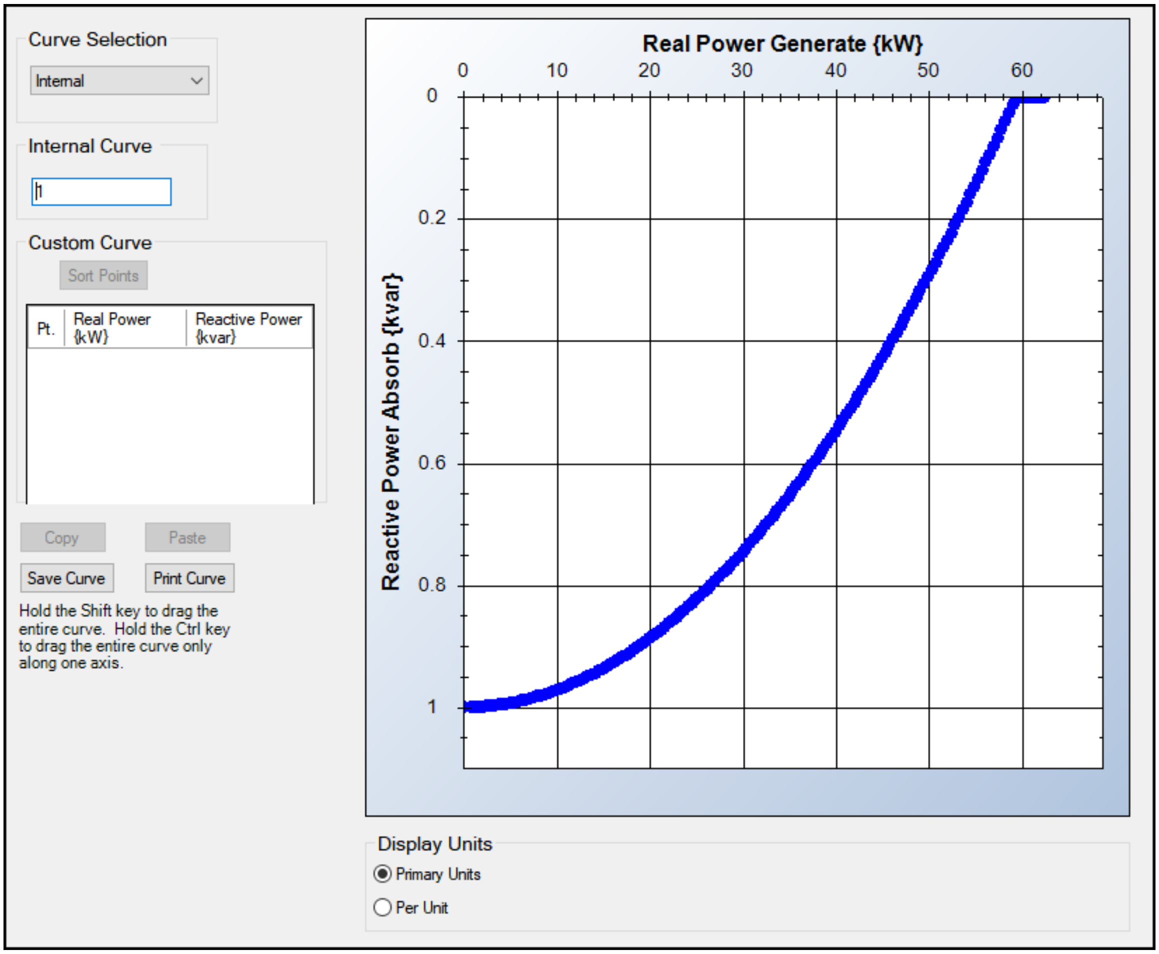


Figure 10-8. UEL Custom Curve Screen

Stator Current Limiter

BESTCOMS*Plus* 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 in all regulation modes. When operating in Manual mode, the DECS-450 will announce high stator current but will not act to limit it. Primary and secondary SCL setting groups provide additional control for two distinct machine operating conditions. Stator current limiting is provided at two levels: low and high (see Figure 10-9). SCL settings are illustrated in Figure 10-10.

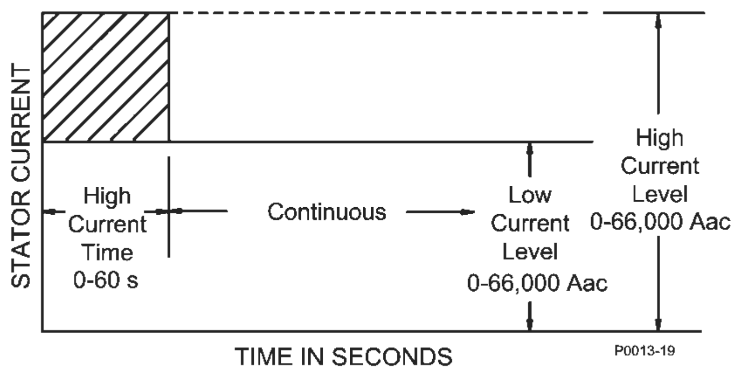


Figure 10-9. Stator Current Limiting

The levels have native units of Primary Amps and the rated data associated with them is Machine Rated Data, Current (on the System Parameters, Rated Data screen).

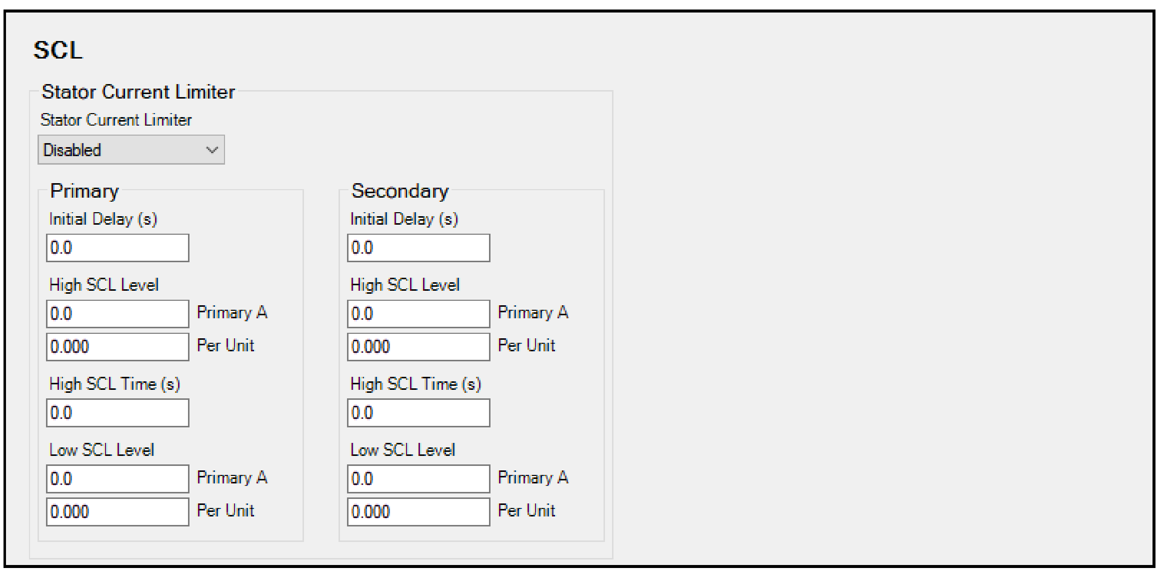


Figure 10-10. Stator Current Limiter Settings

Low-Level Limiting

When the stator current exceeds the low-level setting, the DECS-450 annunciates the elevated level. If this condition persists for the duration of the High SCL Time setting, the DECS-450 acts to limit the current to the low-level SCL Setting. When the stator current is below the Low-Level SCL setting, no SCL limiting action is taken by the DECS-450. The High Current Timer counts down either from the high time, if the High Current Timer has expired, or from the amount of time spent at high level, if the High Current Timer has not expired. 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, the DECS-450 acts to limit the current to the value of the High-Level setting and a High Level Timer is initiated. If this level of current persists until this timer reaches the High-Level Time setting, the DECS-450 acts to limit the current to the value of 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 expires.

Var Limiter

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Limiters, var
HMI Navigation Path: Settings, Operating Settings, Limiters, VAR

The var limiter can be enabled 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 is expressed as a percentage of the calculated, maximum VA rating for the machine. A delay setting establishes a time delay between when the var threshold is exceeded and the DECS-450 acts to limit the var flow.

Var limiter settings are illustrated in Figure 10-11.

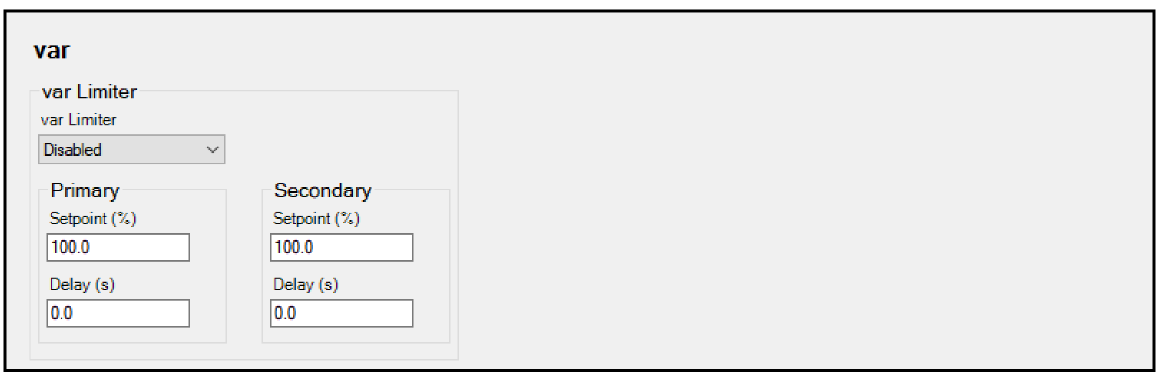


Figure 10-11. Var Limiter Settings

Limiter Scaling

BESTCOMS*Plus* 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-450 auxiliary control input and through the optional AEM-2020 Analog Expansion Module RTD inputs. Limiter scaling settings are illustrated in Figure 10-12. OEL and SCL scaling may be independently enabled and disabled. 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 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–.. See the *Auxiliary Control* section 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* section of this manual for details.

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

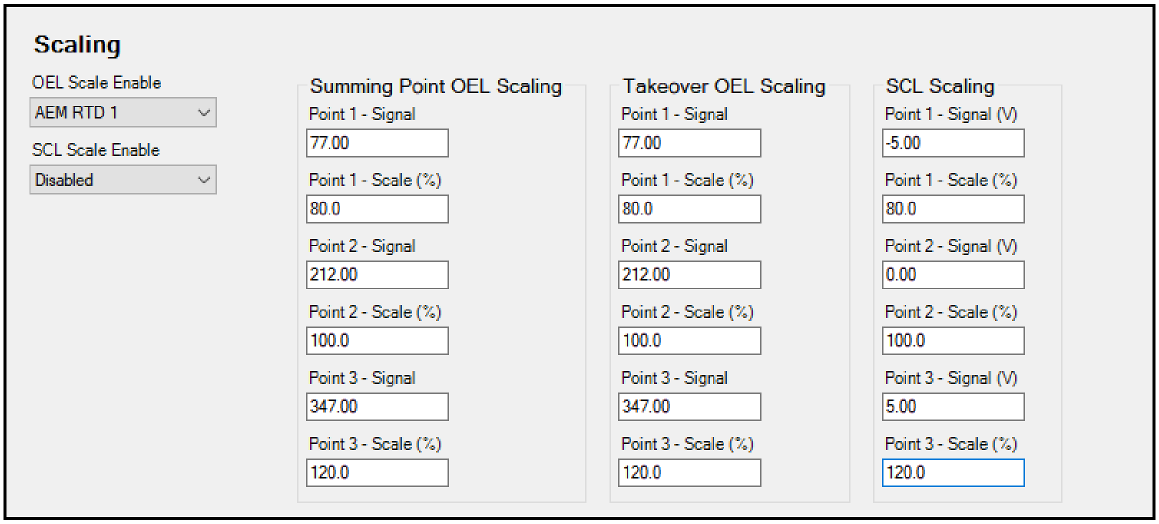


Figure 10-12. Limiter Scaling Settings

Underfrequency Limiter

BESTCOMS*Plus* 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. These limiters protect the generator from damage due to excessive magnetic flux resulting from low frequency and/or overvoltage.

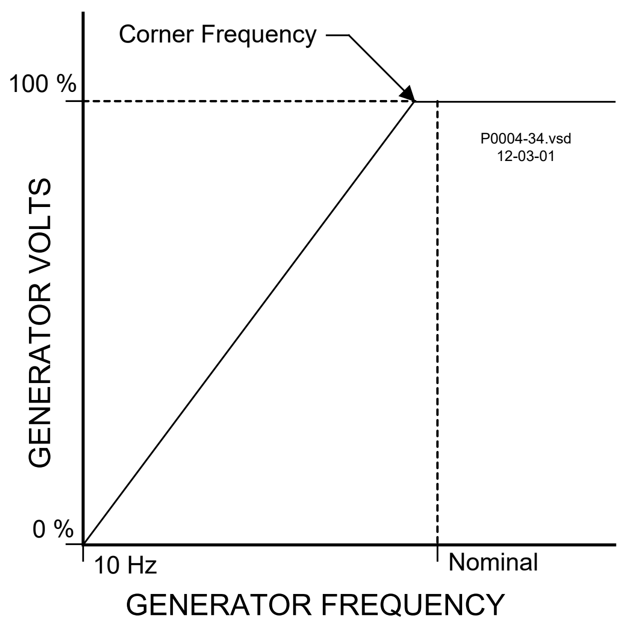


Figure 10-13. Typical Underfrequency Compensation Curve

Underfrequency and volts per hertz limiter settings are illustrated in Figure 10-15.

If the generator frequency decreases below the corner frequency for the selected underfrequency slope (Figure 10-13), the DECS-450 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-450 to precisely match the operating characteristics of the prime mover and the loads being applied to the generator.

Volts per Hertz

The volts per hertz limiter prevents the regulation setpoint from exceeding the volts per hertz ratio defined by the V/Hz High Limiter and V/Hz Low Limiter settings. A typical volts per hertz limiter curve is illustrated in Figure 10-14.

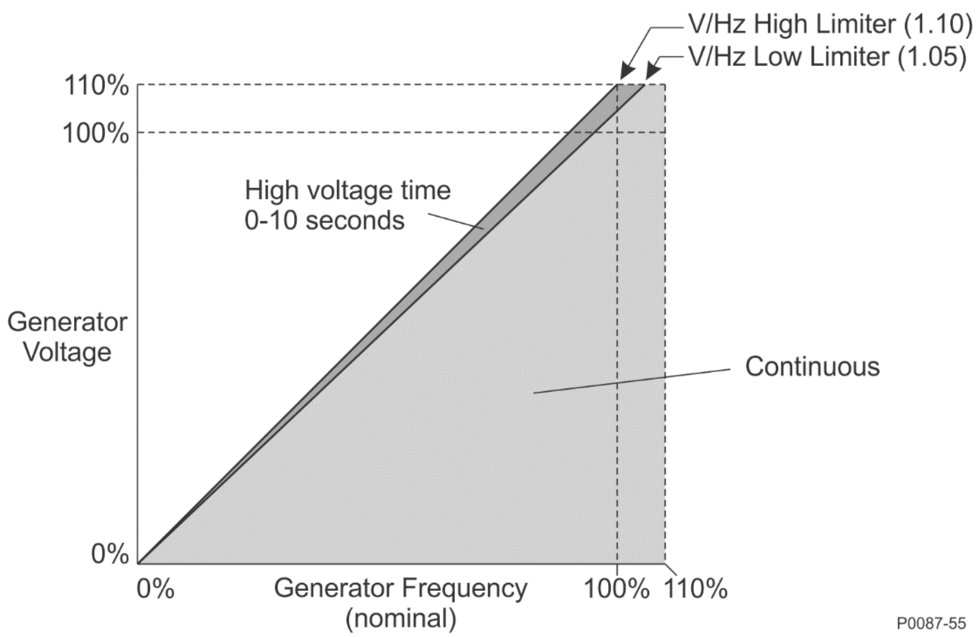


Figure 10-14. Typical Volts per Hertz Limiter Slopes

Volts per hertz limiter operation is established by the V/Hz High Limiter, V/Hz Low Limiter, and V/Hz Time Limiter settings. The generator may operate continuously at setpoints below the low limit threshold. When the regulation setpoint is greater than the low limit threshold for the duration of the time delay, the setpoint is reduced to the low limit threshold and is prevented from exceeding the low limit threshold. The regulation setpoint is prevented from exceeding the value of the high limit threshold at all times.

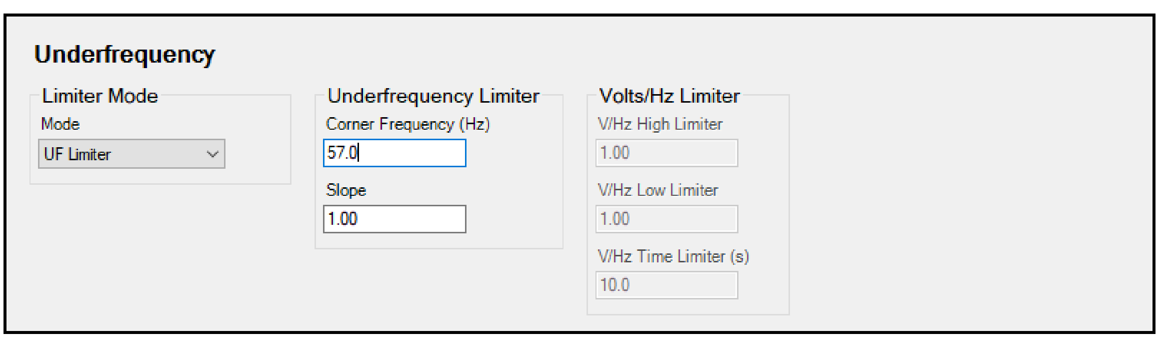


Figure 10-15. Underfrequency/Volts per Hertz Limiter Settings

11 • Metering

The DECS-450 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-450 metering is accessed through the metering explorer menu on the front panel HMI or the BESTCOMS*Plus*® metering explorer.

HMI

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

BESTCOMS*Plus*®

In BESTCOMS*Plus*, 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 11-1.

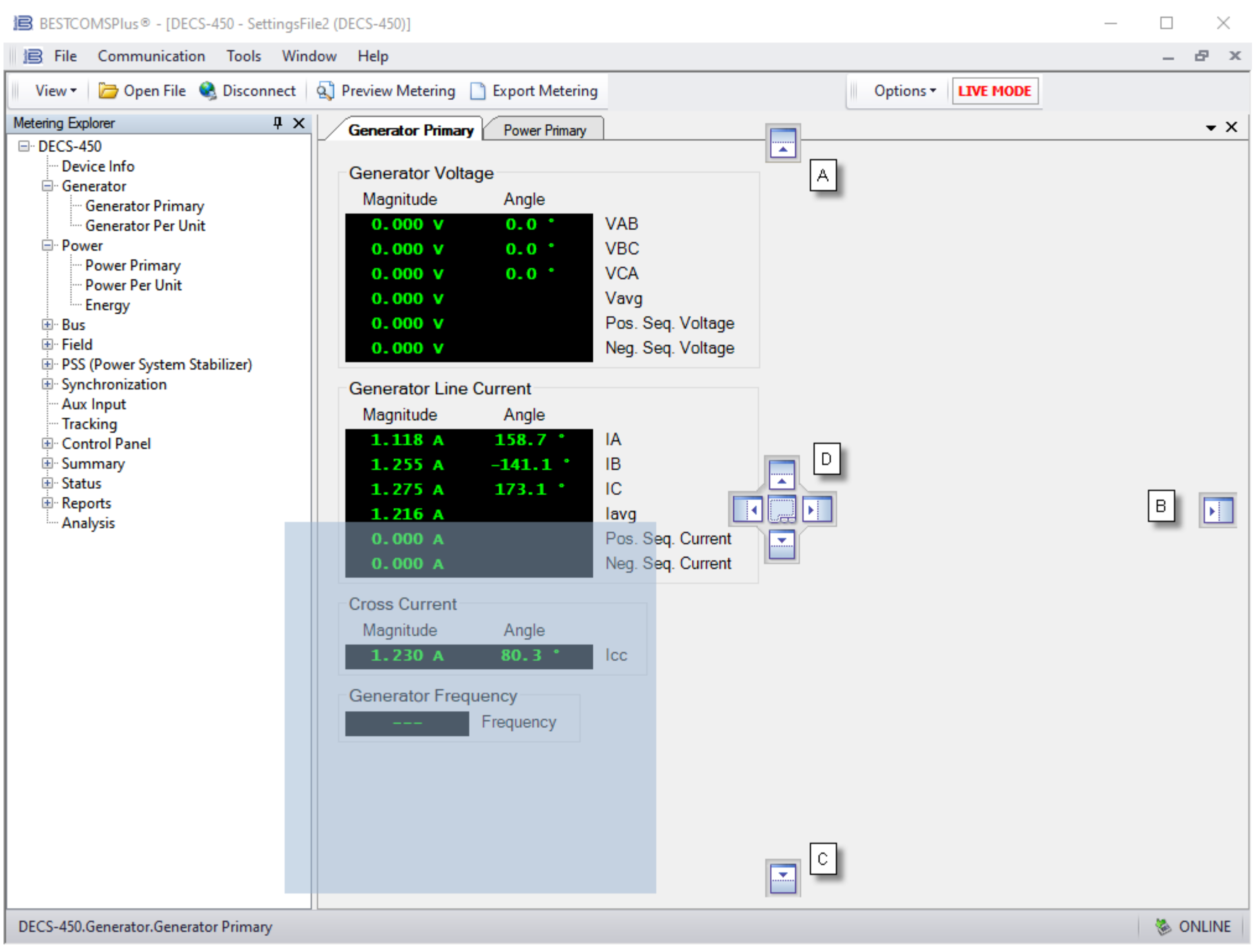


Figure 11-1. Metering Screen Docking Controls

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-450 metering categories include generator, power, bus, field, power system stabilizer (PSS), and generator synchronization parameters.

Generator

BESTCOMS*Plus* 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 11-2 illustrates the generator primary-values metering screen.

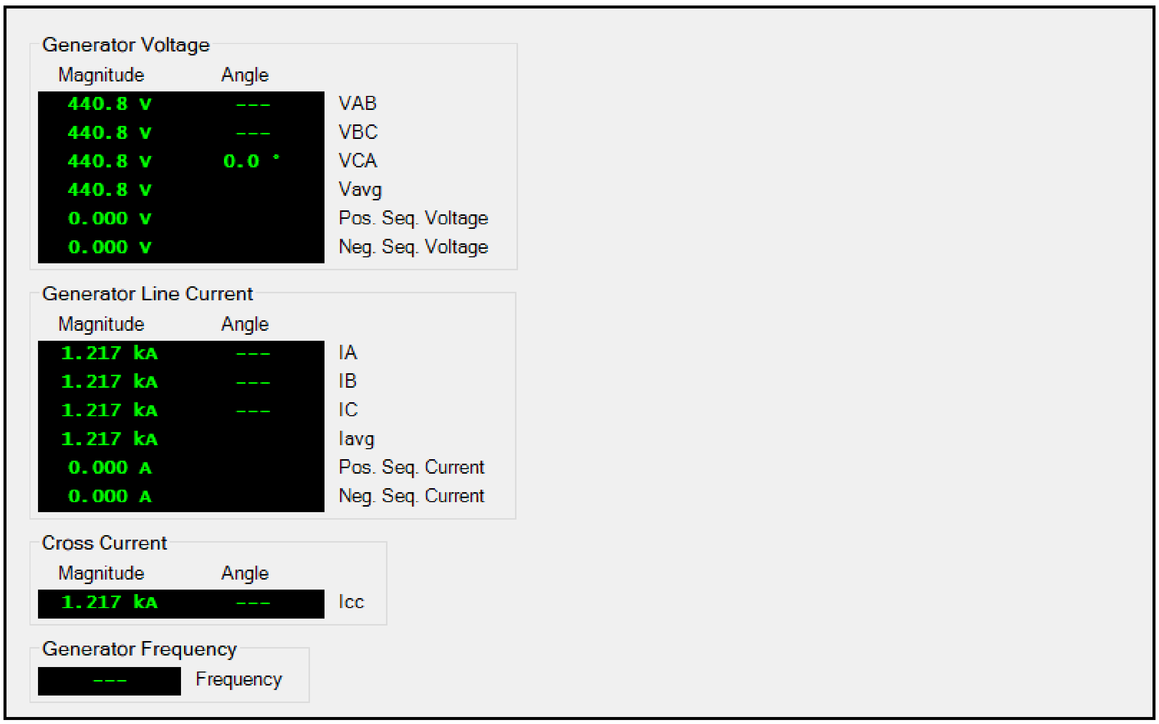


Figure 11-2. Generator Primary-Values Metering

Power

BESTCOMS*Plus* Navigation Path: Metering Explorer, Power
HMI Navigation Path: Metering Explorer, Power

Metered power parameters include real power (kW), apparent power (kVA), reactive power (kvar), and machine power factor. Primary- and per-unit values are available. Accumulated kilowatthours (positive and negative kWh), kilovarhours (positive and negative kvarh), and kilovoltampere hours (kVAh) are also metered. Figure 11-3 illustrates the power primary-values screen and Figure 11-4 illustrates the energy screen.

Figure 11-3. Power Primary-Values

Figure 11-4. Energy

When operating in motor mode, values for var and power factor are opposite in BESTCOMS*Plus* and on the front-panel HMI.

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 11-5 illustrates the bus primary-values metering screen.

Figure 11-5. Bus Primary-Values Metering

Field

BESTCOMS*Plus* Navigation Path: Metering Explorer, Field
HMI Navigation Path: Metering Explorer, Field

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

The DECS-450 requires the field current to be at least 20% of the shunt current rating in order to calculate the field temperature. For field current less than 20%, the ambient settings value will be reported.

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 11-6 illustrates the field primary-values metering screen.

Figure 11-6. Field Primary-Values Metering

PSS

BESTCOMS*Plus* 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, per-unit PSS output level and PSS frequency rate of change. The PSS function on/off status is also reported. Primary- and per-unit values are available. Figure 11-7 illustrates the PSS primary-values metering screen.

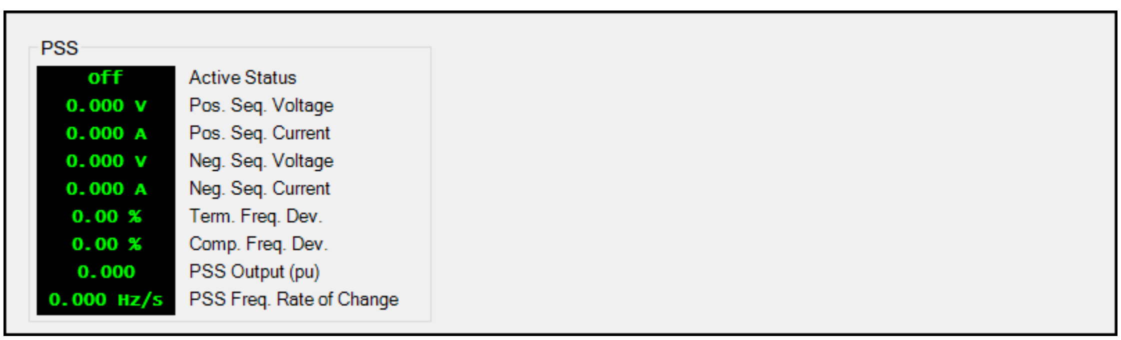


Figure 11-7. PSS Primary-Values Metering

Synchronization

BESTCOMS*Plus* Navigation Path: Metering Explorer, Synchronization

HMI Navigation Path: Metering Explorer, Synchronization

Figure 11-8. Synchronization Primary Values Metering

Metered generator-to-bus synchronization parameters include the slip frequency, slip angle, and voltage difference. Primary- and per-unit values are available. Figure 11-8 illustrates the synchronization primary-values metering screen.

Auxiliary Control Input

BESTCOMS*Plus* Navigation Path: Metering Explorer, Aux Input

HMI Navigation Path: Metering Explorer, Aux Input

The control signal applied at the DECS-450 auxiliary control input is indicated on the Aux Input metering screen (Figure 11-9). As configured in BESTCOMS*Plus*, a dc voltage or dc current signal may be applied.

Figure 11-9. Auxiliary Control Input Metering

Tracking

BESTCOMS*Plus* Navigation Path: Metering Explorer, Tracking

HMI Navigation Path: Metering Explorer, Tracking

The metered setpoint tracking error between DECS-450 operating modes is displayed on the Tracking metering screen (Figure 11-10). Status fields are provided for the on/off status for internal setpoint tracking, external setpoint tracking and null balance, which indicates when the setpoint of an inactive operating mode matches the metered value.

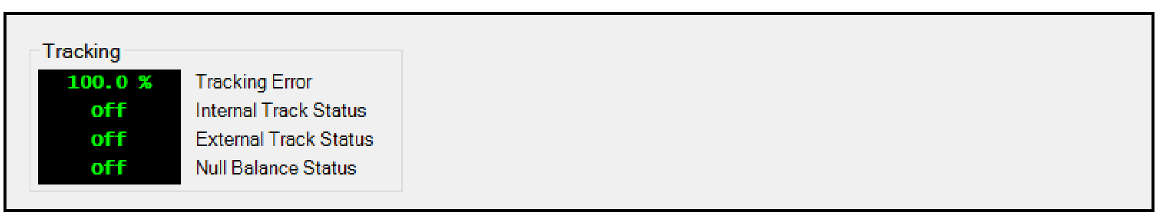


Figure 11-10. Tracking Metering

Control Panel

BESTCOMS*Plus* Navigation Path: Metering Explorer, Control Panel
HMI Navigation Path: Metering Explorer, Control Panel

The Control Panel (Figure 11-11) 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.

Start/Stop Mode: Two indicators show the start/stop mode of the DECS-450. When a mode is active, its corresponding indicator changes from gray to green. To Start DECS-450 regulation, click the Start button. Click the Stop button to stop DECS-450 regulation.

AVR/Manual Mode: AVR and Manual Mode status is reported by two indicators. When a mode is active, its corresponding indicator changes from gray to green. AVR mode is selected by clicking the *AVR* button and manual mode is selected by clicking the *Manual* button.

FCR/FVR Mode: FCR and FVR mode status is reported by two indicators. When a mode is active, its corresponding indicator changes from gray to green. FCR mode is selected by clicking the *FCR* button and FVR mode is selected by clicking the *FVR* button.

Var/PF Mode: Three indicators report whether Var mode, Power Factor mode, or neither mode is active. When a mode is active, its corresponding 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 and 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.

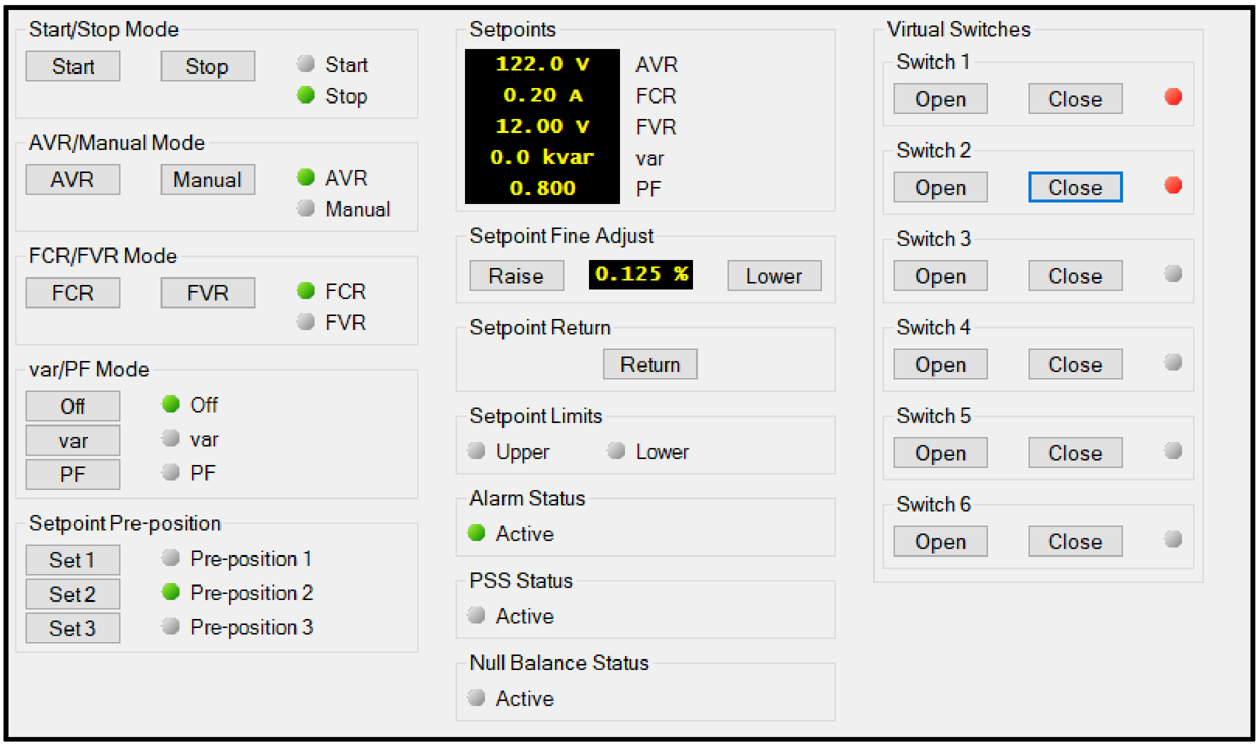


Figure 11-11. Control Panel

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 BESTCOMS*Plus*. For details on operating setpoint settings, see the *Regulation* section.

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 directly proportional to the adjustment range and inversely proportional to the traverse rate.

Setpoint Return: Clicking the Return button changes the active operating setpoint back to the original value before it was adjusted.

Setpoint Limits: The Upper indicator changes from gray to green when the upper setpoint limit threshold has been exceeded. The Lower indicator changes from gray to green when the lower setpoint limit threshold has been exceeded.

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

BESTCOMS*Plus* 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 (Figure 11-12). The primary- and per-unit metering summary screens are available only in BESTCOMS*Plus*.

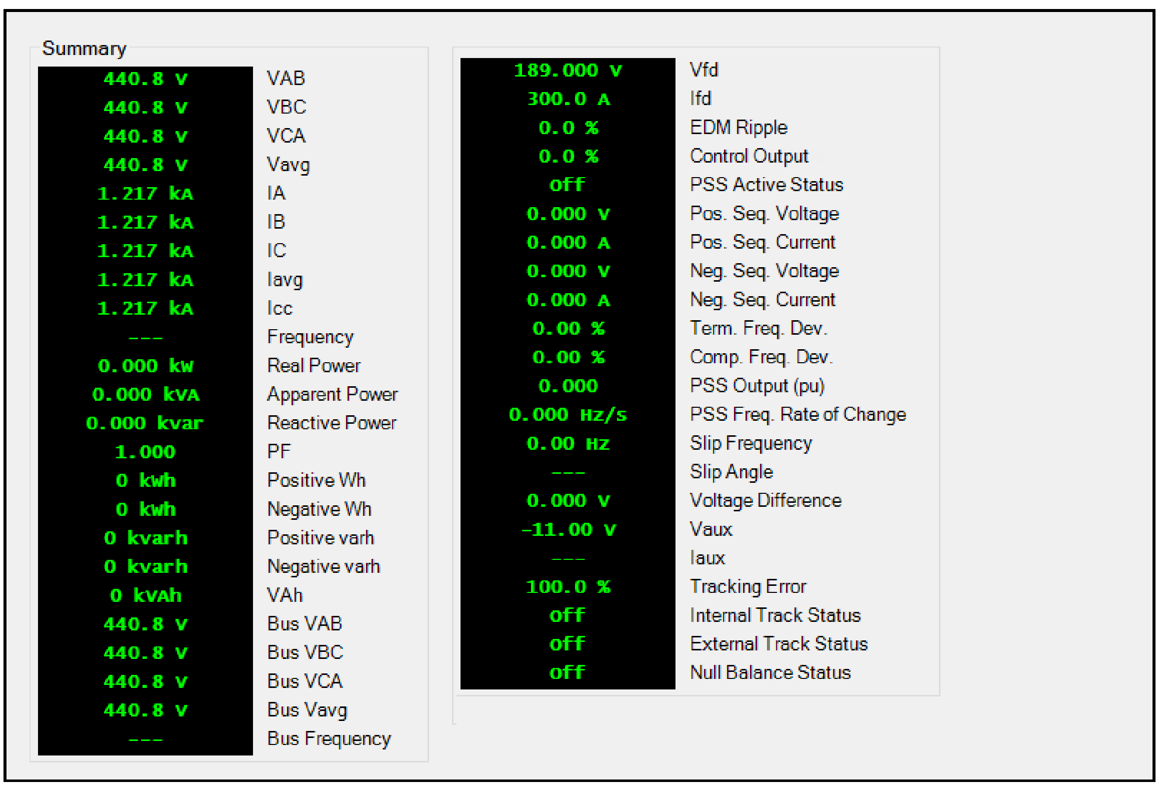


Figure 11-12. Metering Summary Screen

Status Indication

Status indication is provided for DECS-450 system functions, inputs, outputs, network load share, configurable protection, alarms, and the real-time clock.

System Status

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, System Status
HMI Navigation Path: Metering Explorer, Status, System Status

When any of the system functions illustrated in Figure 11-13 are active, the corresponding indicator changes from gray to green. An inactive function is represented by a gray indicator.

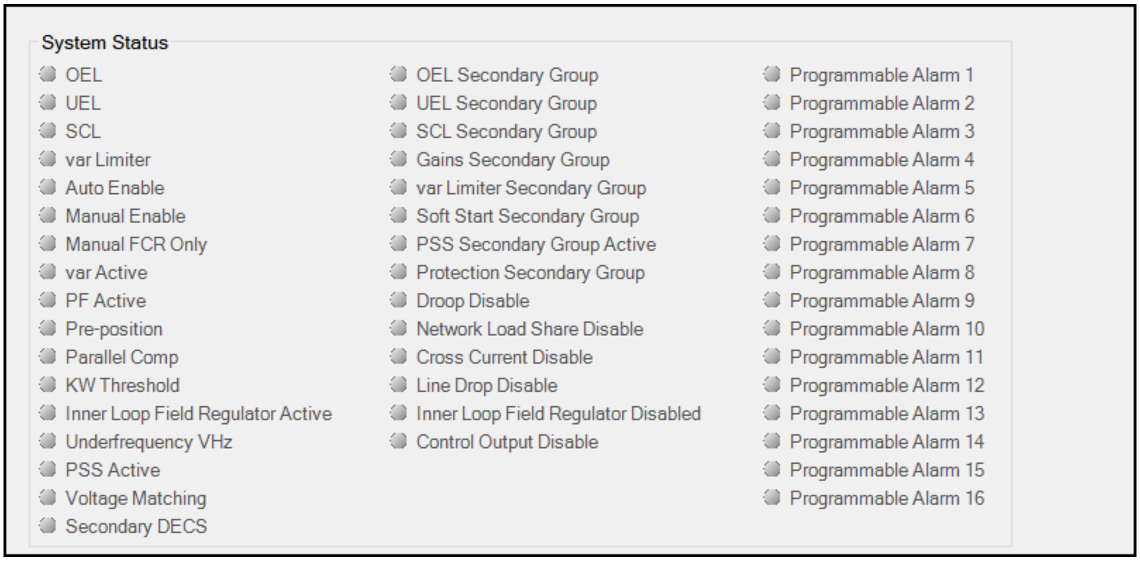


Figure 11-13. System Status Indication Screen

Inputs

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

Status annunciation is provided for the DECS-450, optional Contact Expansion Module (CEM-125 or CEM-2020) inputs and optional Analog Expansion Module (AEM-2020) inputs.

Figure 11-14. DECS-450 Contact Inputs Status Indication Screen

DECS-450 Contact Inputs

Status indication for the DECS-450's 16 contact sensing inputs is provided on the BESTCOMS*Plus* contact inputs screen illustrated in Figure 11-14. An indicator changes from gray to red when a closed contact is sensed at the corresponding input.

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* section of this manual.

CEM-125 and CEM-2020 Contact Inputs

The status of the 10 contact sensing inputs of the optional CEM-125 or CEM-2020 Contact Expansion Module is provided on the BESTCOMS*Plus* remote contact inputs screen. See the *Contact Expansion Module* section of this manual for a description and illustration of this screen.

Outputs

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

HMI Navigation Path: Metering Explorer, Status, Outputs

Status annunciation is provided for the DECS-450 contact outputs and optional Contact Expansion Module (CEM-125 or CEM-2020) contact outputs. Annunciation is also provided for the optional Analog Expansion Module (AEM-2020) analog outputs.

DECS-450 Contact Outputs

Status indication for the DECS-450's Watchdog and 11 programmable contact outputs is provided on the BESTCOMS*Plus* contact outputs screen illustrated in Figure 11-15. An indicator changes from gray to green when the corresponding output changes state (Watchdog output) or closes (Output 1 through 11).

CEM-125 and CEM-2020 Contact Outputs

The status of the 24 contact outputs of the optional CEM-125 or CEM-2020 Contact Expansion Module is provided on the BESTCOMS*Plus* remote contact inputs screen. See the *Contact Expansion Module* section 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* section of this manual.

Figure 11-15. DECS-450 Contact Outputs Status Indication Screen

Network Load Share

The screen shown in Figure 11-16 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.

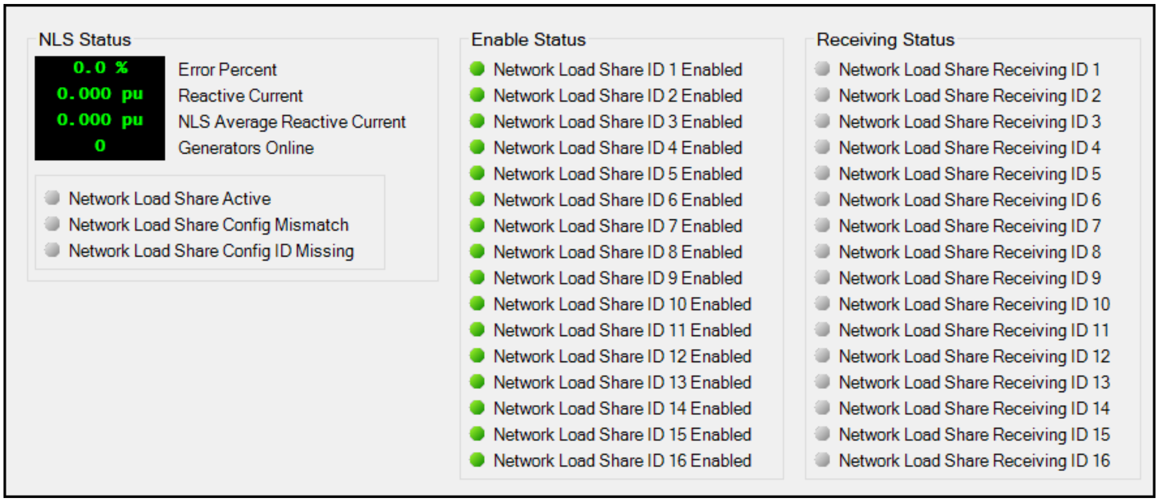


Figure 11-16. NLS Status Screen

Configurable Protection

BESTCOMS*Plus* 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 BESTCOMS*Plus* configurable protection screen (Figure 11-17). An indicator for each protection element's four trip thresholds changes from gray to green when the corresponding trip threshold is exceeded.

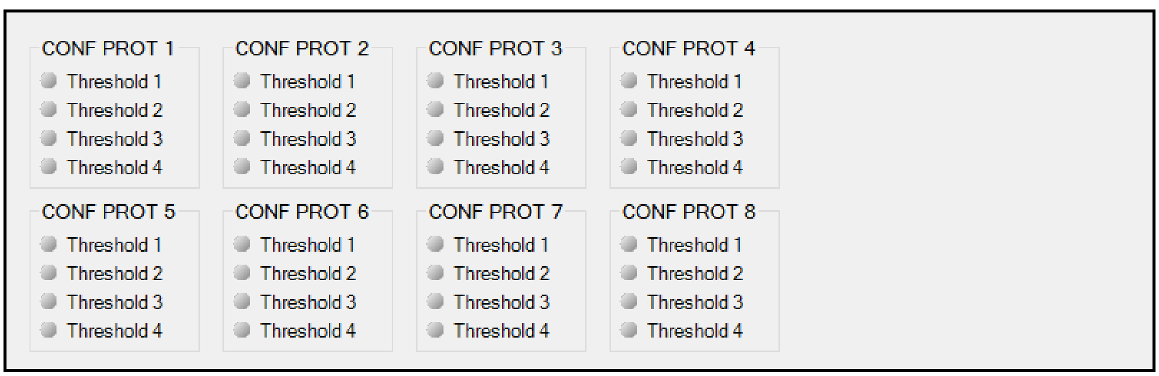


Figure 11-17. Configurable Protection Indication Status Screen

Alarms

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Alarms
HMI Navigation Path: Alarms automatically displayed when active

Figure 11-18. DECS-450 Alarm Annunciation and Reset Screen

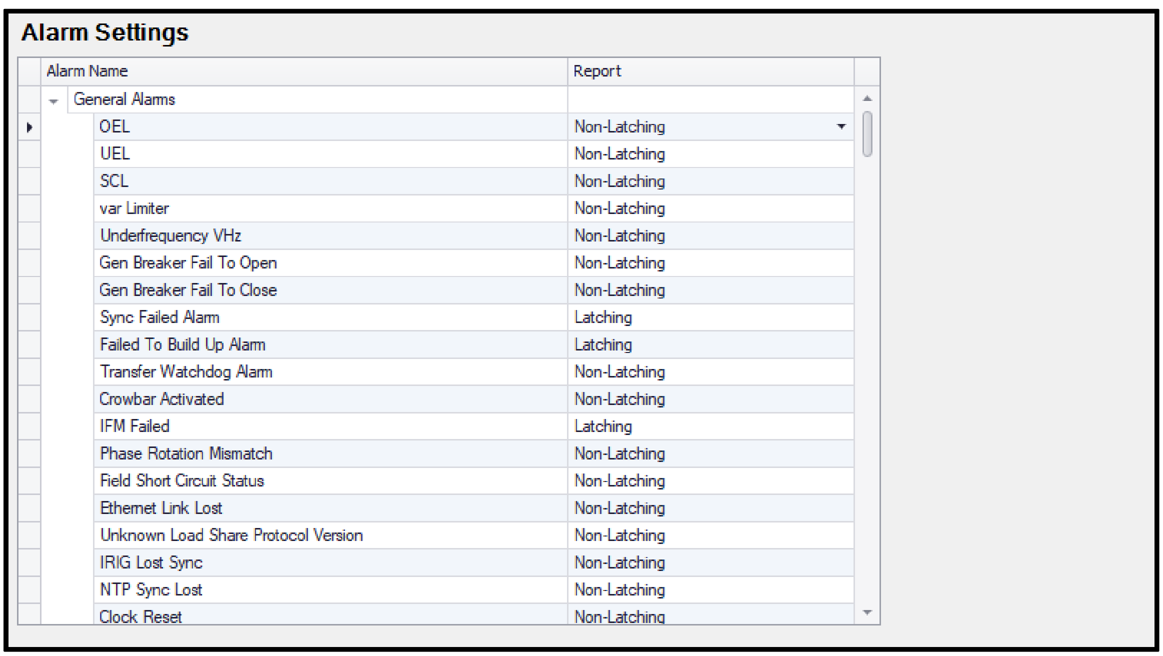
System parameters, communication links, protection functions, and remote inputs/outputs are monitored for alarm conditions. Active and previously latched alarms are listed on the front panel display and the Alarms screen of BESTCOMS*Plus*. At the front panel, an inactive alarm is reset by selecting the alarm and then pressing the Reset pushbutton. Click the Reset Alarms button on the Alarms screen to clear all inactive alarms in BESTCOMS*Plus*. The BESTCOMS*Plus* Alarms screen is illustrated in Figure 11-18.

Alarm Configuration

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, Alarms

Alarms are configured using BESTCOMS*Plus*. 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-450 is lost. Active alarms are shown on the front panel HMI and in BESTCOMS*Plus* 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 BESTCOMS*Plus* Alarm Settings screen is shown in Figure 11-19 below.


Alarm Settings

Alarm Name	Report
General Alarms	
OEL	Non-Latching
UEL	Non-Latching
SCL	Non-Latching
var Limiter	Non-Latching
Underfrequency VHz	Non-Latching
Gen Breaker Fail To Open	Non-Latching
Gen Breaker Fail To Close	Non-Latching
Sync Failed Alarm	Latching
Failed To Build Up Alarm	Latching
Transfer Watchdog Alarm	Non-Latching
Crowbar Activated	Non-Latching
IFM Failed	Latching
Phase Rotation Mismatch	Non-Latching
Field Short Circuit Status	Non-Latching
Ethernet Link Lost	Non-Latching
Unknown Load Share Protocol Version	Non-Latching
IRIG Lost Sync	Non-Latching
NTP Sync Lost	Non-Latching
Clock Reset	Non-Latching

Figure 11-19. Alarm Settings Screen

User-Programmable Alarms

BESTCOMS*Plus* Navigation Path: Settings Explorer, Alarm Configuration, User Programmable Alarms

Sixteen user-programmable alarms are available. User alarm labels are entered on the User Programmable Alarms screen (Figure 11-20). If the trip condition exists for the duration of the Activation Delay, the alarm trips. When active, the label of a user-programmable alarm is displayed on the BESTCOMS*Plus* Alarms screen, on the front panel display, and in the sequence of events reports.

Each user-programmable alarm has a trigger element and alarm output, both of which can be mapped using BESTlogic™*Plus* Programmable Logic as desired. Refer to the *BESTlogicPlus* section for more information on setting up alarm logic.

Retrieving Alarm Information

Alarms are automatically displayed in the sequence of events reports and on the front panel display when active. To view active alarms using BESTCOMS*Plus*, open the Metering Explorer, Status, Alarms screen.

Resetting Alarms

BESTlogic*Plus* may be used to reset alarms. Use the Settings Explorer within BESTCOMS*Plus* to open the BESTlogic*Plus* 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* section for more information.

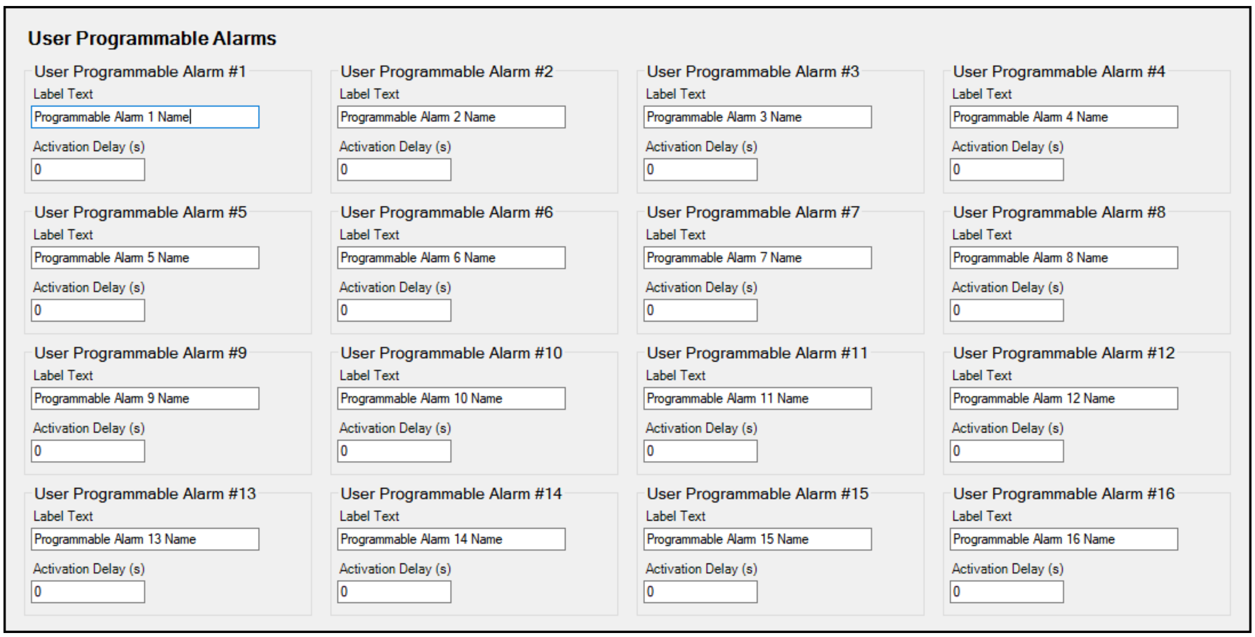


Figure 11-20. User Programmable Alarms Screen

Real-Time Clock

BESTCOMS*Plus* Navigation Path: Metering Explorer, Status, Real Time Clock

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

The DECS-450's time and date is displayed and adjusted on the Real-Time Clock screen (Figure 11-21). In BESTCOMS*Plus*, clicking the Edit button displays a window where the time and date may be adjusted either manually or synchronized with the connected PC's clock. Through the HMI, time and date may be edited manually only.

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

Figure 11-21. Real-Time Clock Screen

Auto Export Metering

The Auto Export Metering function, in the BESTCOMS*Plus* Tools menu, automatically saves metering data files at specific intervals over a period of time while connected to a DECS-450. Enter the number of exports and the interval between each export. Click the Filter button to choose which parameters are included in the data file. Enter a base filename for the data files and specify a directory for storing the files. Click Start to begin the Auto Export Metering session. The first export is performed immediately upon clicking the Start button. Figure 11-22 illustrates the Auto Export Metering screen.

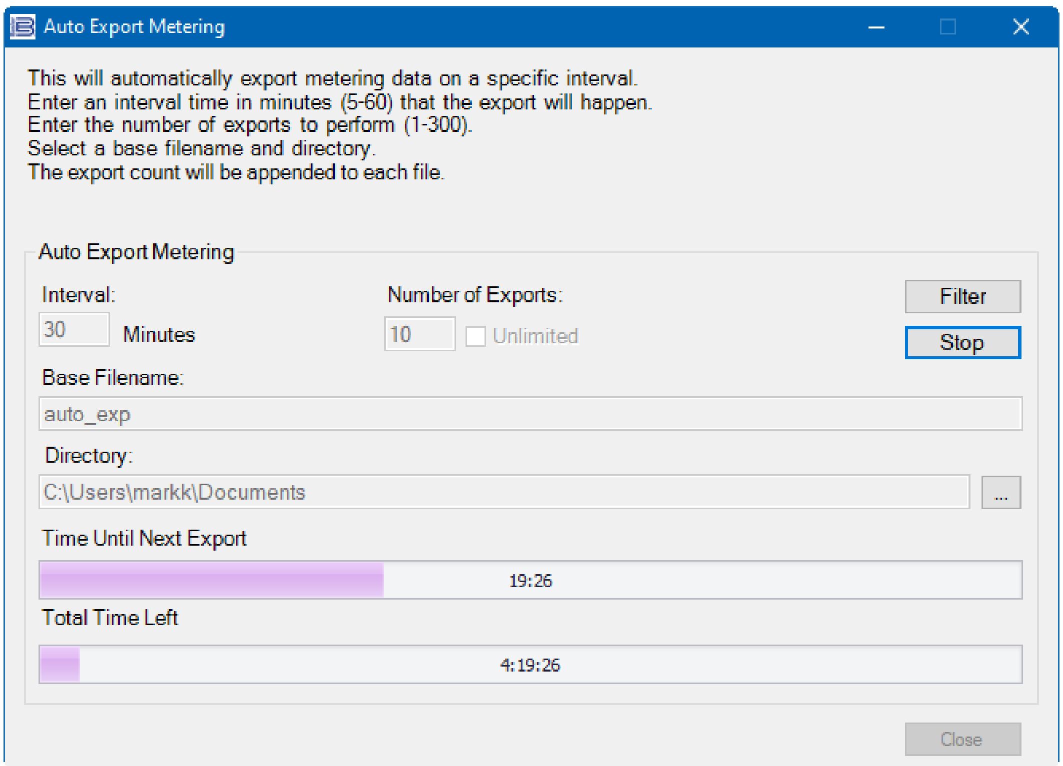


Figure 11-22. Auto Export Metering

12 • Event Recorder

DECS-450 event recorder functions include sequence-of-events recording (SER), data logging (oscillography), and trending.

Sequence-of-Events Recording

BESTCOMS*Plus* Navigation Path: Settings Explorer, Report Configuration, Sequence of Events Setup
HMI Navigation Path: Not available through the HMI

The DECS-450 SER scans parameters at four-millisecond intervals and records any changes of state (event) with a time and date stamp. Up to 2,047 events are stored in the record and, if the record is full, the oldest events are overwritten as new events occur.

More than 400 different parameters are scanned by default, but each parameter may be filtered on or off to suit user preference. To adjust parameter filters, use the BESTCOMS*Plus* Settings Explorer to open Report Configuration, Sequence of Events Setup (Figure 12-1). Parameter filter settings are not available through the HMI.

To view the current SER record, use the BESTCOMS*Plus* Metering Explorer to open Reports, Sequence of Events.

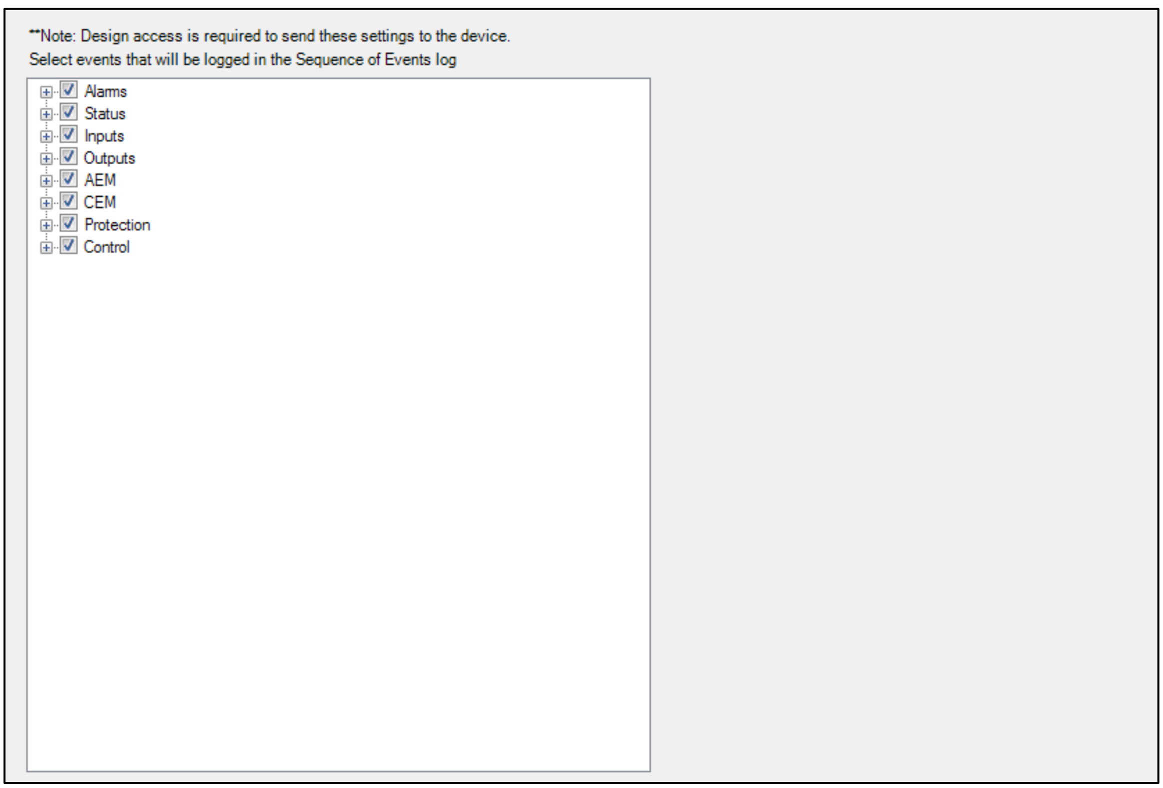


Figure 12-1. Sequence of Events Setup

Data Logging

BESTCOMS*Plus* Navigation Path: Settings Explorer, Report Configuration, Data Log
HMI Navigation Path: Settings, Report Configuration, Datalog

The data logging function of the DECS-450 can record up to six oscillography records. DECS-450 oscillography records use the IEEE Standard Common Format for Transient Data Exchange (COMTRADE). Each record is time- and date-stamped. After six records have been recorded, the

DECS-450 begins recording the next record over the oldest record. Because oscillography records are stored in nonvolatile memory, interruptions in DECS-450 control power will not affect the integrity of the records. Data log settings are configured in BESTCOMS*Plus* and illustrated in Figure 12-2 through Figure 12-5.

Setup

When oscillography is enabled, the records consist of up to six user-selectable parameters with up to 1,200 data points recorded for each parameter. Data log setup settings are illustrated in Figure 12-2.

A Pre-Trigger Points setting specifies the number of data points to include in a data log that were recorded prior to the event trigger. The value of this setting affects the duration of the recorded pre-trigger points, the recorded post-trigger points, and the duration of the post-trigger points. A sample interval setting 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 for a data log.

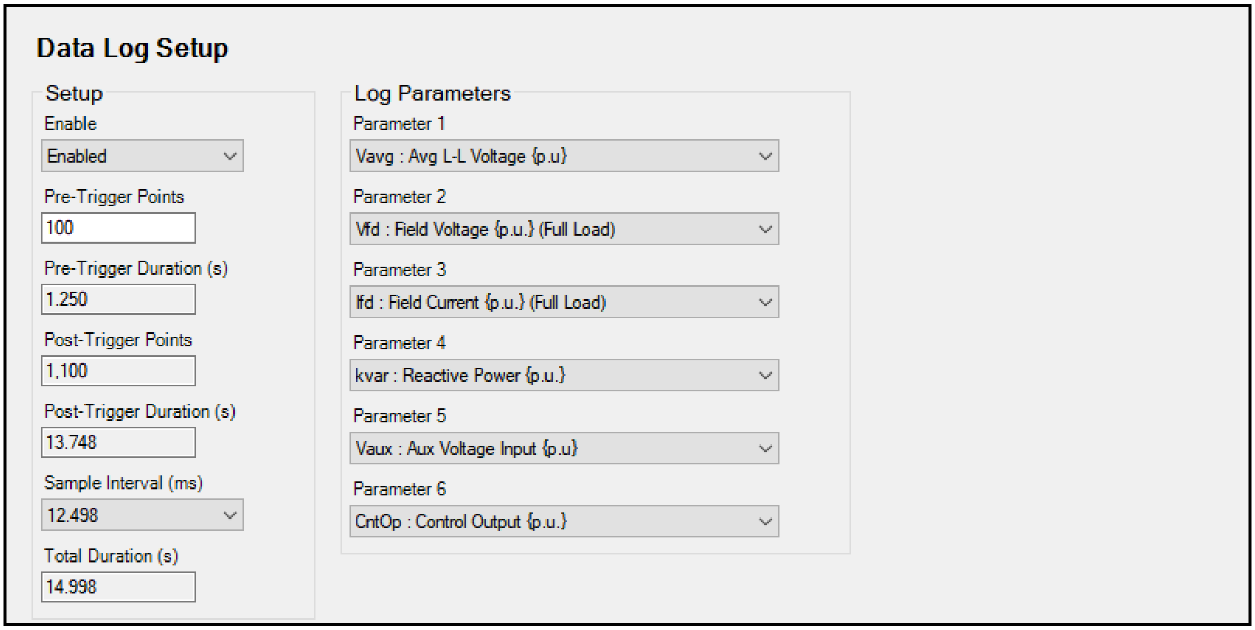


Figure 12-2. Data Log Setup

Triggers

BESTCOMS*Plus* Navigation Path: Settings Explorer, Report Configuration, Data Log
HMI Navigation Path: Settings, Configuration Settings, Data Log

Data logging may be triggered by mode triggers, logic triggers, level triggers, or manually through BESTCOMS*Plus*.

Mode Triggers

Mode triggers initiate data logging as a result of an internal or external DECS-450 status change. A data log can be triggered by any of the following status changes:

- Start or Stop mode selected
- Soft Start mode enabled or disabled
- Underfrequency condition
- Manual or AVR mode selected
- Power Factor or Var mode selected
- Limiter active
- Voltage matching enabled or disabled
- Primary or secondary DECS selected
- PSS enabled or disabled
- Auto Sync enabled or disabled

- FCR or FVR mode selected
- Droop mode enabled or disabled
- Network Load Share enabled or disabled
- Line drop compensation enabled or disabled
- Cross-current compensation enabled or disabled
- Test mode enabled or disabled

Mode trigger settings are illustrated in Figure 12-3.

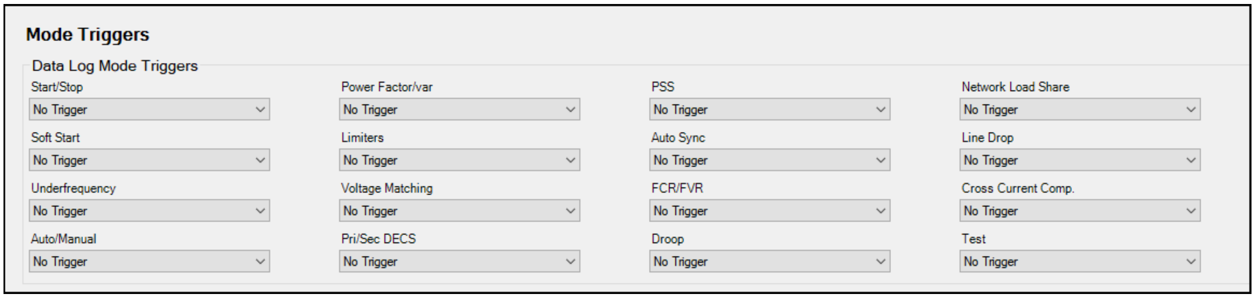


Figure 12-3. Data Log Mode Triggers

Level Triggers

Level triggering initiates a data log when the value of a system parameter crosses an upper threshold, lower threshold, or both. The parameters available to trigger a data log are listed below.

Level triggers are configured in the BESTCOMS*Plus* Settings Explorer, Report Configuration, Data Log, Level Triggers screen (Figure 12-4).

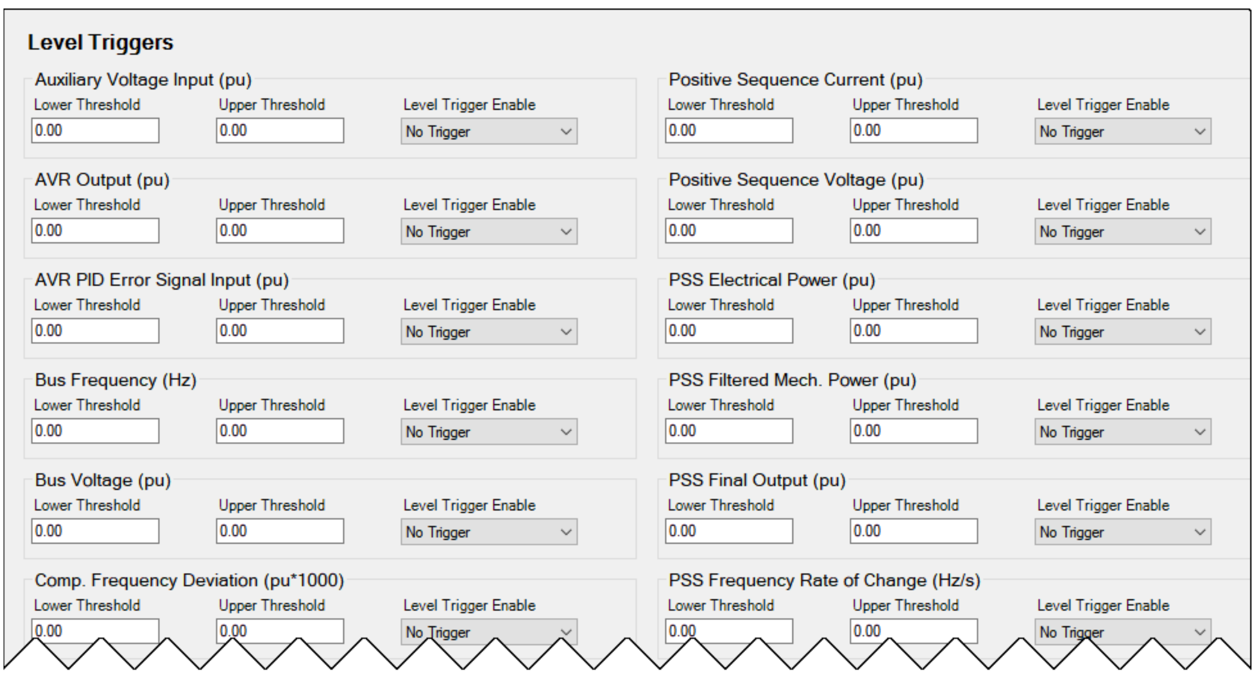


Figure 12-4. Data Log Level Triggers

- 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 (Full Load)
- Field voltage (Full Load)
- Field temperature
- 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
- Internal State
- Negative sequence current
- Negative sequence voltage
- Network Load Share
- Null balance level
- OEL controller output
- OEL ref.
- OEL state
- Position Indication
- Positive sequence current
- Positive sequence voltage
- PSS electrical power
- PSS filtered mech. Power
- PSS final output
- PSS frequency rate of change
- 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
- 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 12-5.

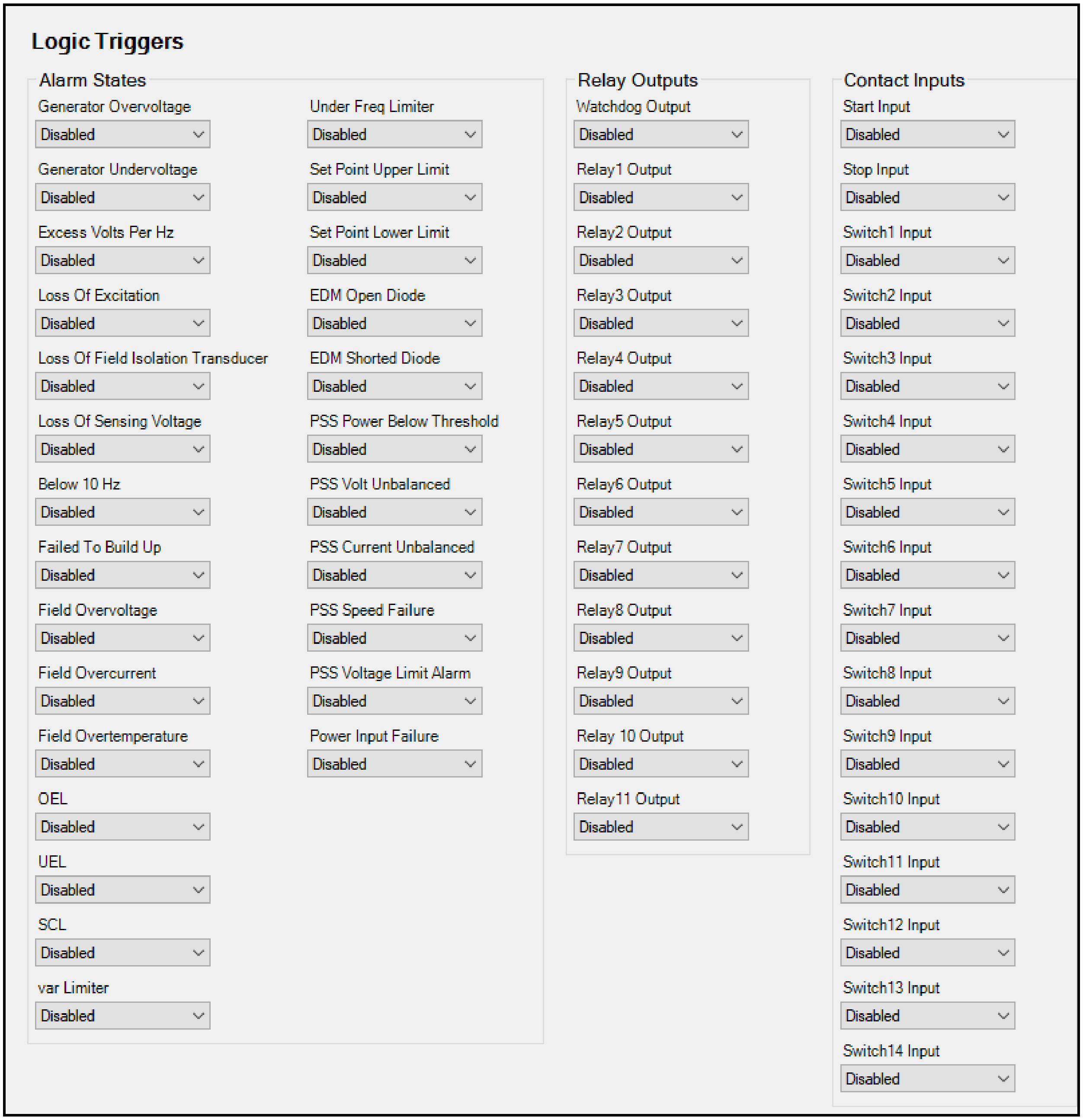


Figure 12-5. Data Log Logic Triggers

Trending

BESTCOMS*Plus* Navigation Path: Settings Explorer, Report Configuration, Trending
HMI Navigation Path: Settings, Configuration Settings, Trending

The trend log records the activity of DECS-450 parameters over an extended period of time. When enabled, up to six parameters can be monitored over a user-defined duration ranging from 1 to 720 hours. Trend log settings are illustrated in Figure 12-6.

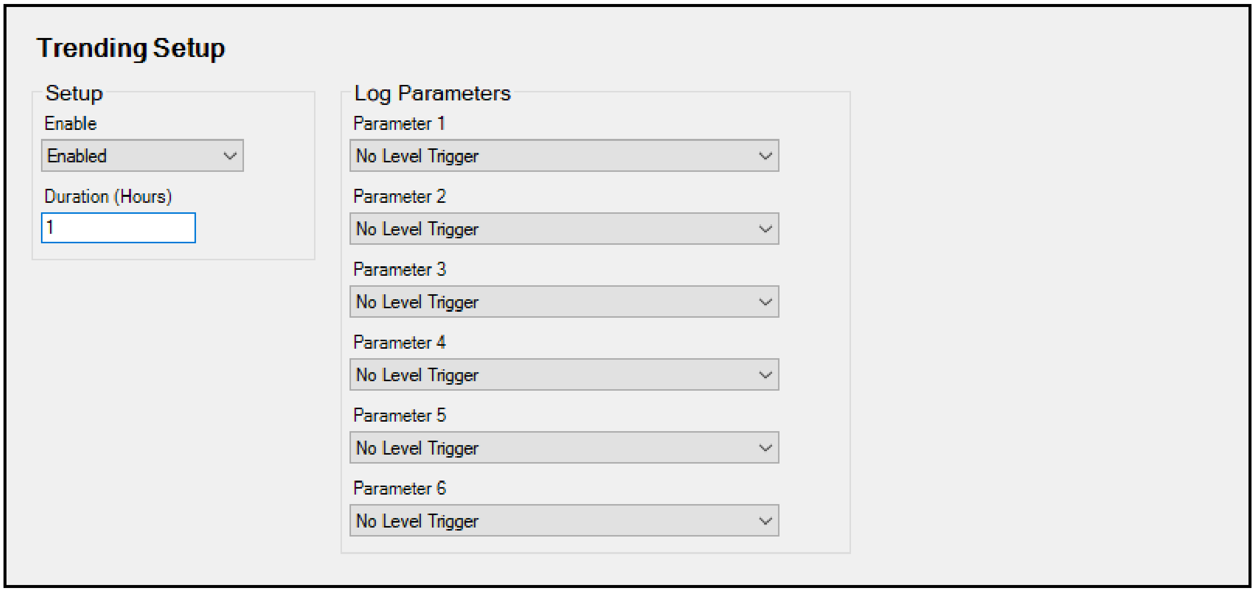


Figure 12-6. Trend Log Setup

13 • Power System Stabilizer

The optional, integrated power system stabilizer (PSS) (DECS-450 style 1XXXXXX) is an IEEE Std 421.5 type PSS2A/2B/2C, dual-input, “integral of accelerating power” stabilizer that provides supplementary damping for low-frequency, local-mode oscillations and power system oscillations. For more detailed information on the model used, refer to the *Math Model* chapter.

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

Note
Three-phase current sensing and three-phase voltage sensing are required for PSS operation.

PSS settings are illustrated in Figure 13-9, Figure 13-10, Figure 13-11, and Figure 13-12.

BESTCOMSPlus 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 power-on threshold setting 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* section of this manual provides information about entering the generator and system ratings.) A hysteresis setting 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, a threshold setting 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 determines the level of (decreasing) power where a transfer back to the primary gain settings will occur.

Frequency Rate of Change

The PSS rate-of-change function adjusts the PSS output to compensate for a generator rate-of-frequency change that exceeds the user-defined threshold. This threshold has an adjustment range of 0 to 10 hertz per second. When the generator frequency rate of change threshold is exceeded for the duration of a user-defined time delay, the PSS output is driven to zero and then ramped up to its previous, nominal value over the duration of a user-specified block timer. The delay time and block time are each adjustable from 0 to 20 seconds. The low-pass filter time constant and washout filter time constant settings are used to calculate the rate of change. These two settings have an adjustment range of 0 to 20 seconds.

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.

More information on PSS function can be found in the *Math Model* chapter. An illustration is also available in BESTCOMS*Plus*® by clicking the PSS Model Info button located on the Control tab.

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 Tw1 and Tw2. Low-pass filtering of the speed deviation signal can be enabled or disabled through software switch SSW 0. The low-pass filter time constant is adjusted by the Tl1 setting.

Figure 13-1 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.)

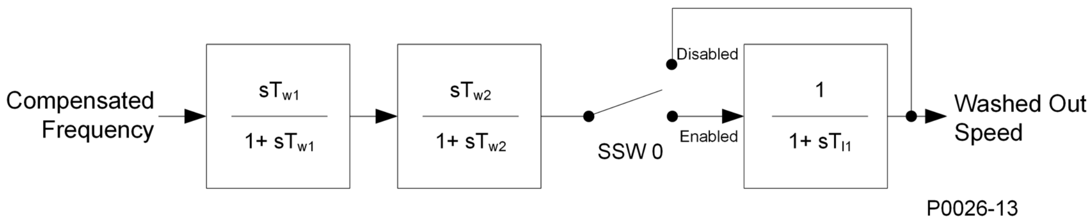


Figure 13-1. Speed Signal

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-450 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 Xq setting.

Generator Electrical Power Signal

Figure 13-2 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-450. Three-phase current sensing is required for PSS.

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. The first high-pass filter is controlled by time constant setting Tw3 and the second high-pass filter is controlled by time constant setting Tw4.

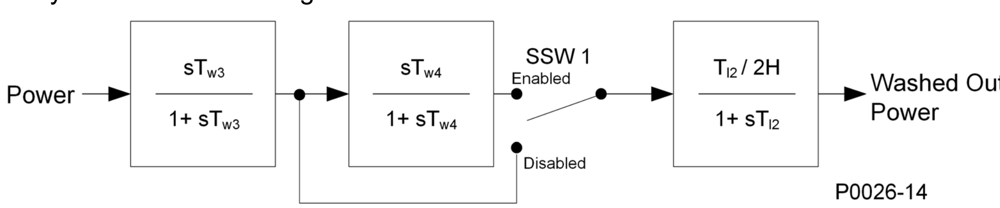


Figure 13-2. Generator Electrical Power Signal

After high-pass filtering, the electrical power signal is integrated and scaled, combining the generator inertia constant (2H) with the speed signal. Low-pass filtering within the integrator is controlled by time constant T_{I2}.

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, K_{PE}, 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 T_{L3} 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 T_R. An exponent consisting of a numerator and denominator is applied to the mechanical power filter.

Processing of the derived integral of mechanical power signal is illustrated in Figure 13-3.

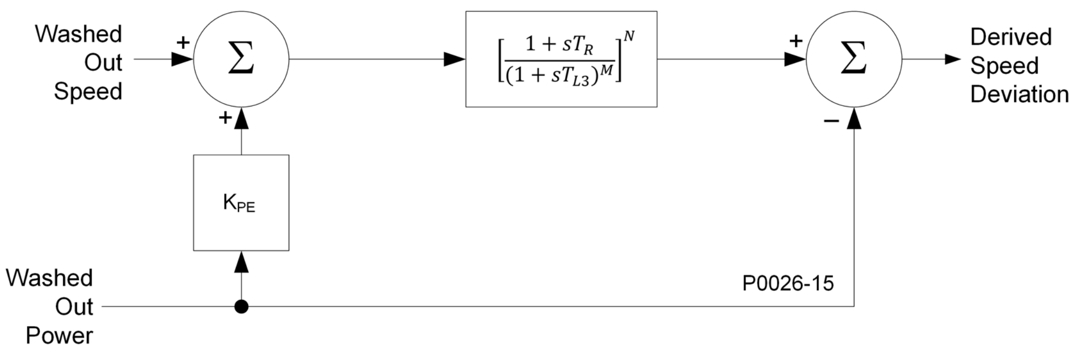


Figure 13-3. Derived Mechanical Power Signal

Stabilizing Signal Selection

Figure 13-4 illustrates how software switches SSW 2 and SSW 3 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.)

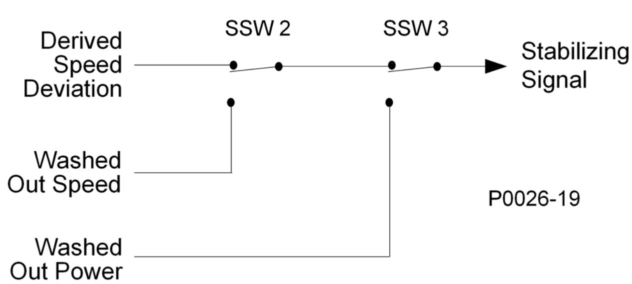


Figure 13-4. Stabilizing Signal Selection

Torsional Filters

Two torsional filters, shown in Figure 13-5, 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.

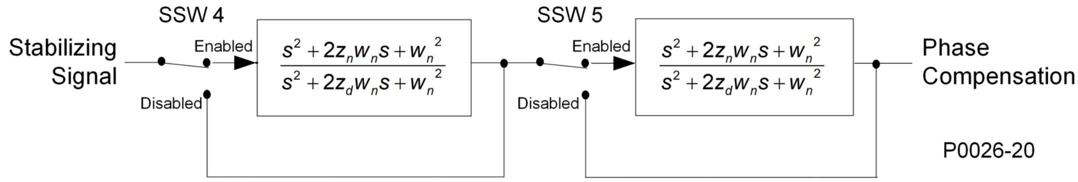


Figure 13-5. Torsional Filters

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

Torsional filters 1 and 2 are controlled by a zeta numerator (Zeta Num), zeta denominator (Zeta Den), and a frequency response parameter (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 (T1, T3, T5, T7) and a phase lag time constant (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 and SSW 7. Figure 13-6 illustrates the phase compensation stages and associated software switches.

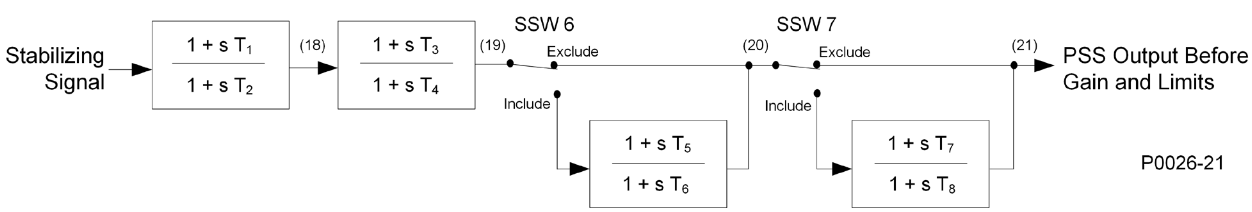


Figure 13-6. Phase Compensation

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 enables and bypasses the washout filter and logic limiter. The washout filter has two time constants: normal and limit (less than normal).

The logic limiter compares the signal from the washout filter with the logic limiter upper and lower limit settings. If the counter reaches the set delay time, 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 13-7 illustrates the washout filter and logic limiter.

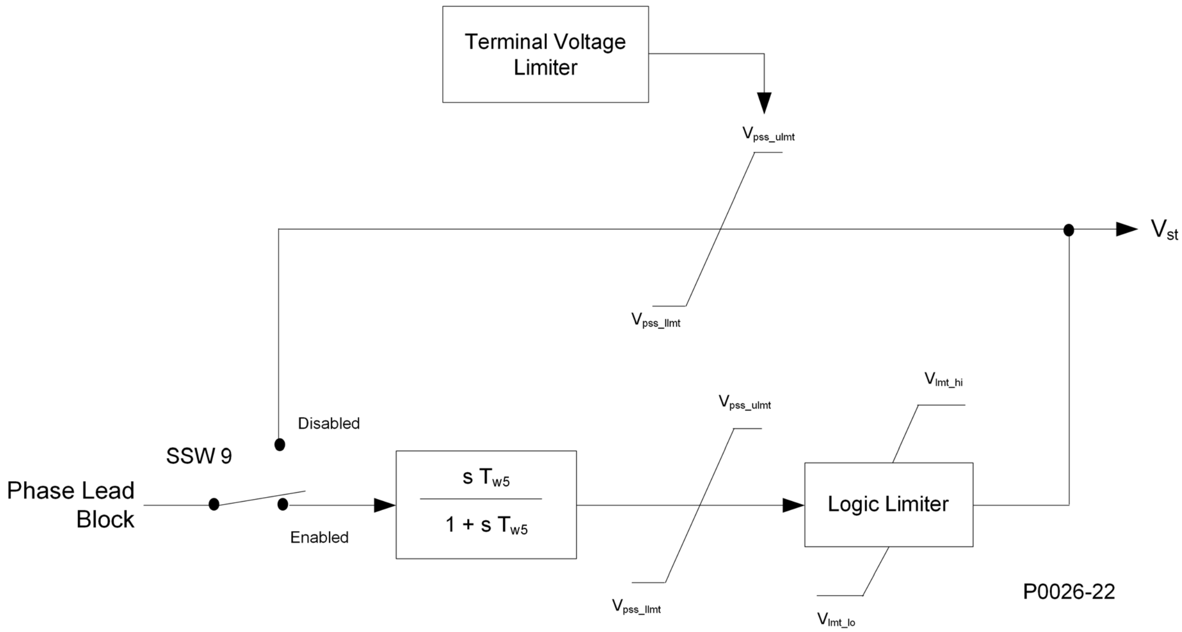


Figure 13-7. Washout Filter and Logic Limiter

Output Stage

Prior to connecting the stabilizer output signal to the voltage regulator input, adjustable gain and upper and lower limits are applied. The stabilizer output is connected to the voltage regulator input when the software switch SSW 10 setting is On. Processing of the stabilizer output signal is illustrated in Figure 13-8.

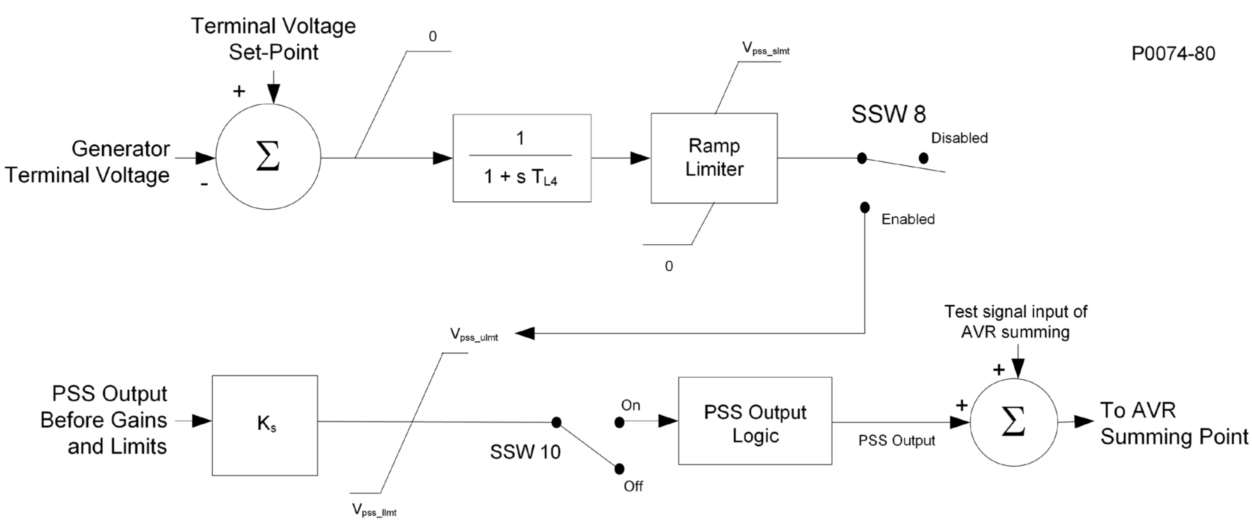


Figure 13-8. Output Stage

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 13-7) that reduces the upper output limit to zero when the generator voltage exceeds the terminal voltage setpoint. The terminal voltage limiter is enabled and disabled by software switch SSW 8. 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.

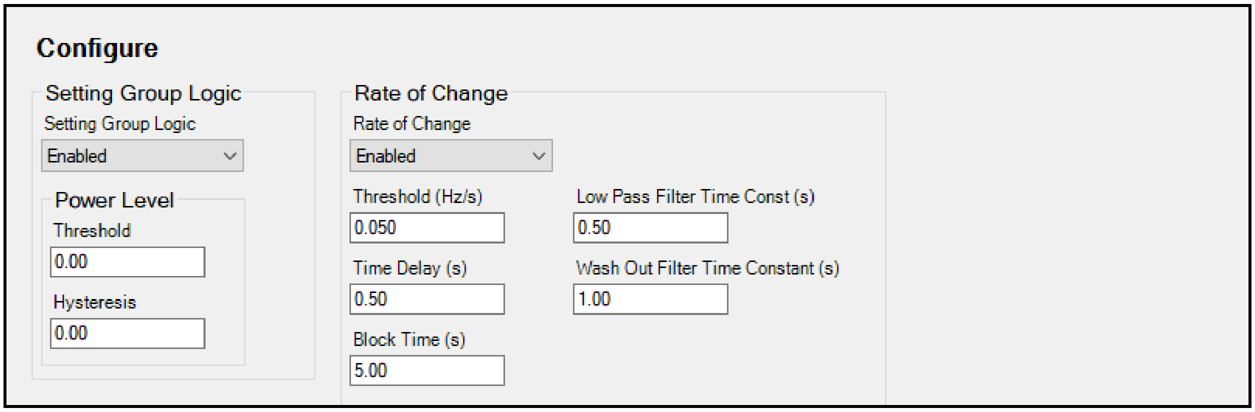


Figure 13-9. PSS Configuration Settings

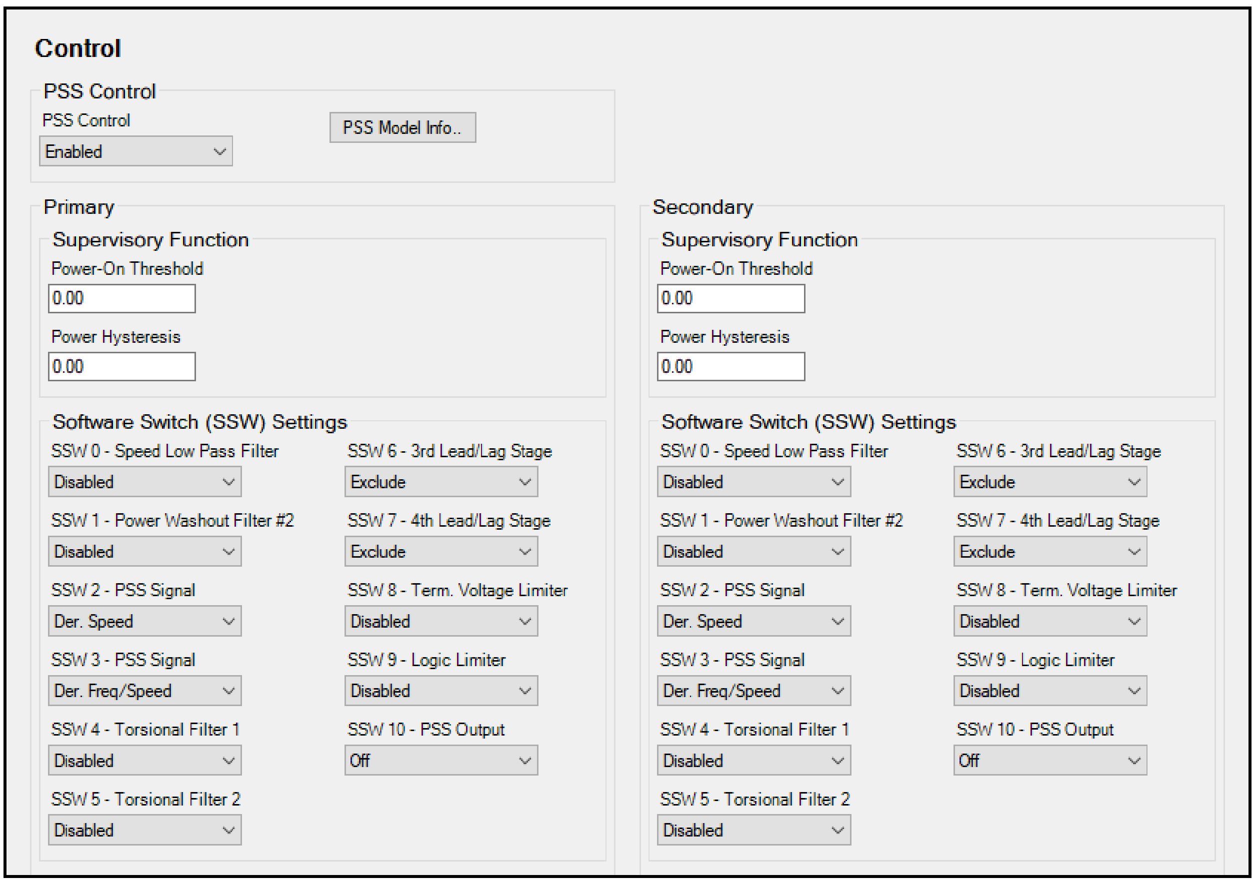


Figure 13-10. PSS Control Settings

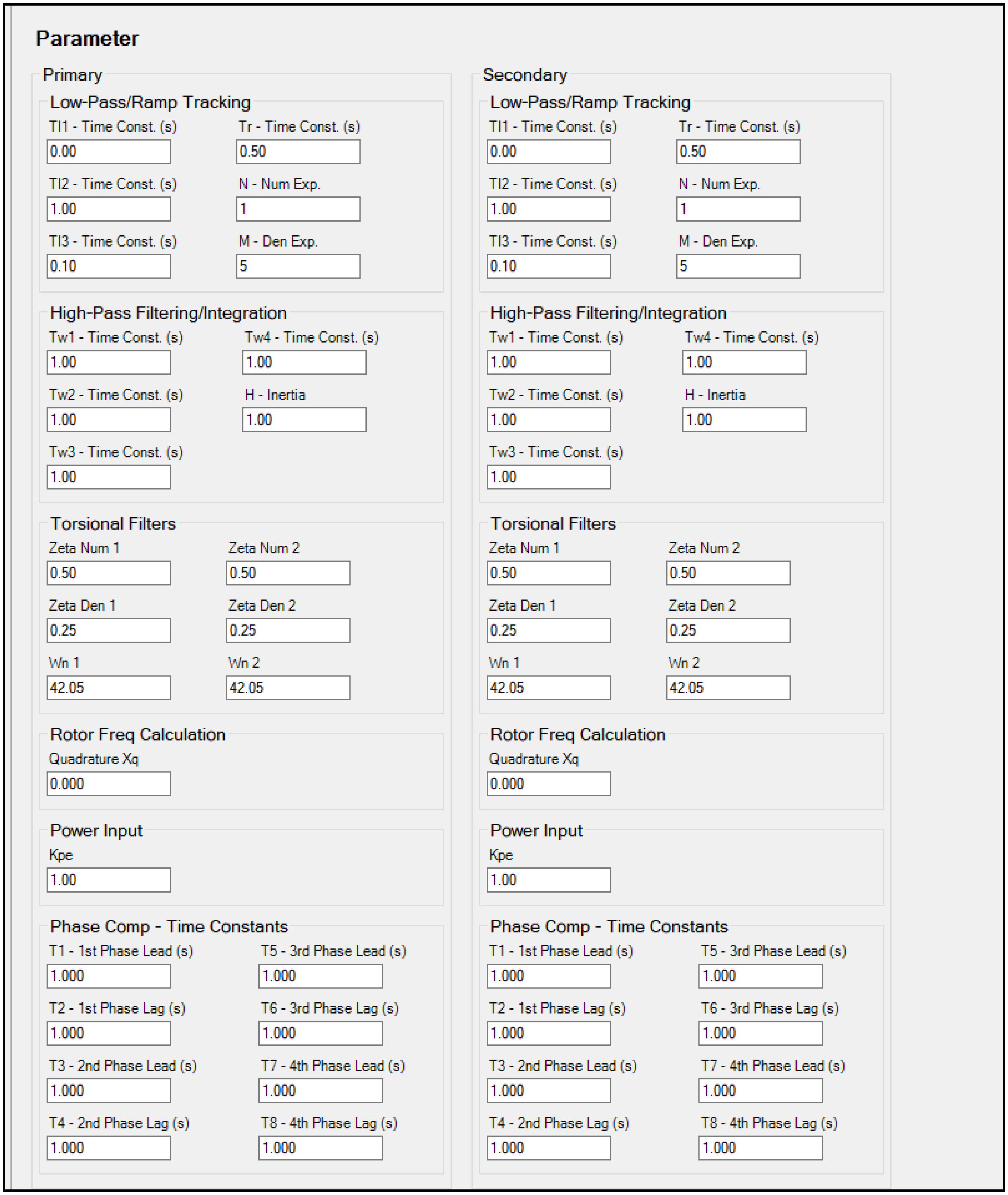


Figure 13-11. PSS Parameter Settings

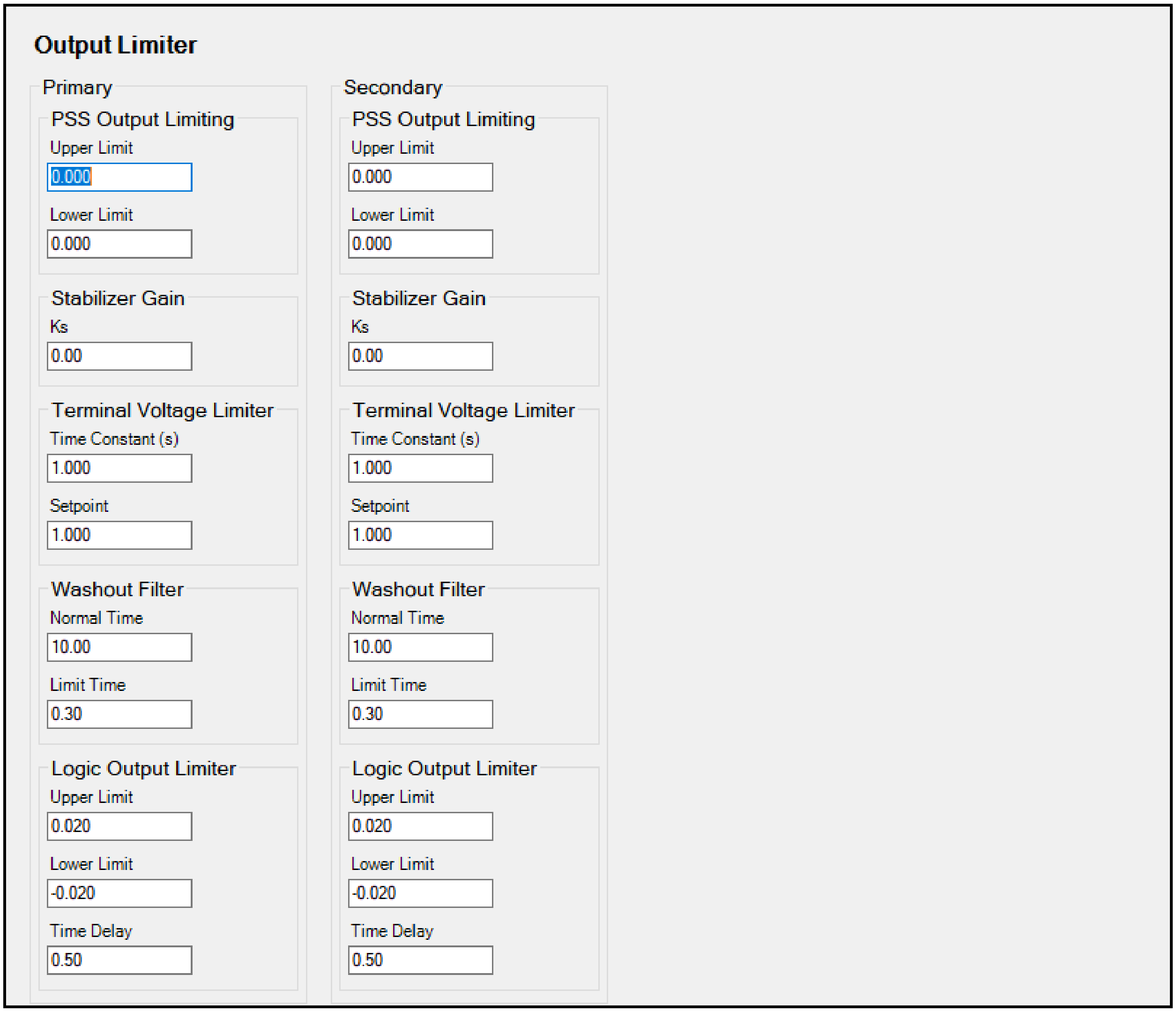


Figure 13-12. PSS Output Limiter Settings

14 • Stability Tuning

A PID control loop is used to tune the transient performance of a DECS-450-based excitation system. The word proportional indicates that the response of the DECS-450 output is proportional or relative to the amount of difference observed. Integral means that the DECS-450 output is proportional to the amount of time that a difference is observed. Integral action eliminates steady state error. Derivative means that the DECS-450 output is proportional to the required rate of excitation change. Derivative action minimizes 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 may provide stable operation when the PSS is disabled. BESTCOMS*Plus*® primary and secondary AVR stability settings are shown in Figure 14-1.

Predefined Stability Settings

Twenty predefined sets of stability settings are available with the DECS-450. Appropriate PID values are implemented based on the nominal generator frequency selected (see the *Configuration* section 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 T_d) and set the voltage regulator gain level of the PID algorithm (K_a). Using the recommended K_a value will per unitize the PID control loop, simplifying system modeling and validation.

Custom Stability Settings

Stability tuning can be tailored for optimum generator transient performance. Selecting the *Custom* primary gain option enables entry of custom proportional (K_p), integral (K_i), and derivative (K_d) gains.

When tuning the stability gain settings, consider the following guidelines:

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

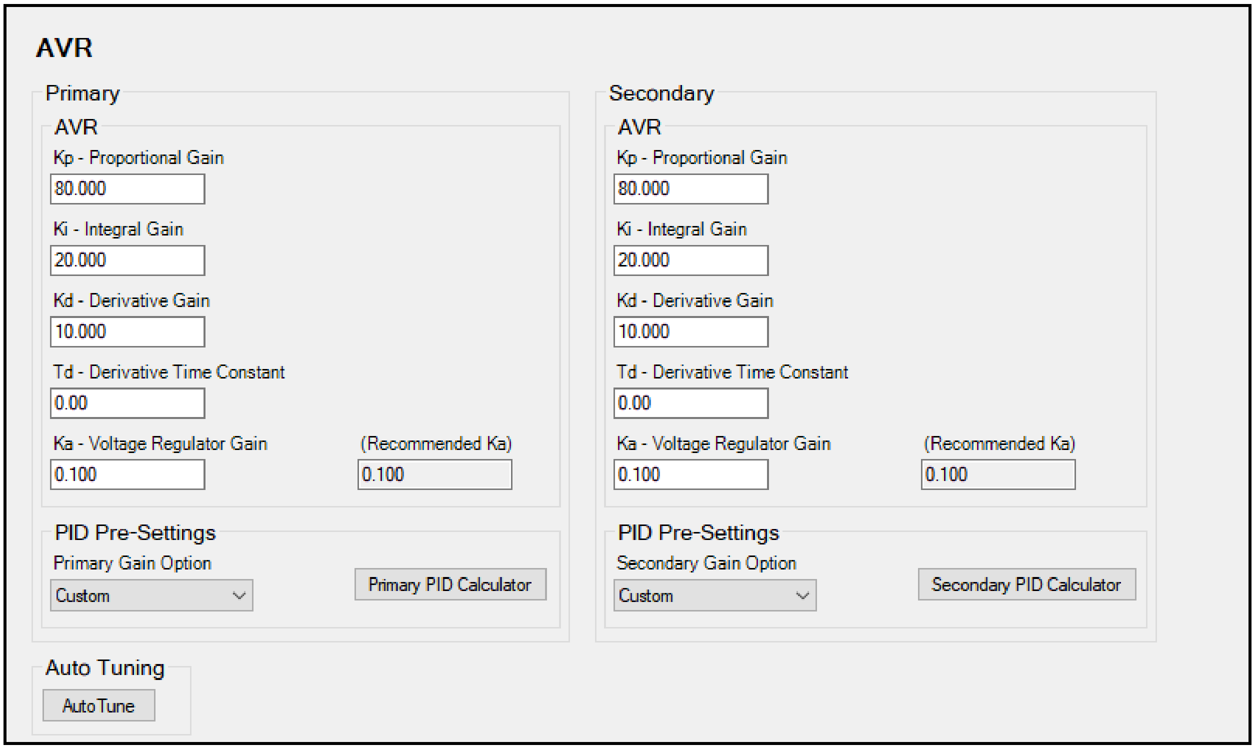


Figure 14-1. AVR Stability Settings

PID Calculator

The PID calculator is accessed by clicking the PID calculator button (Figure 14-1) and is available only when the primary gain option is *Custom*. The PID calculator (Figure 14-2) calculates the gain parameters K_p, K_i, and K_d based on the generator time constants (T'do) and exciter time constant (T_e). If the exciter time constant is not known, it can be forced to the default value, which is the generator time constant divided by six. A derivative time constant (T_d) setting field enables the removal of noise effects on numerical differentiation. A voltage regulator gain (K_a) setting field sets the voltage regulator gain level of the PID algorithm. Calculated and entered parameters can be applied upon closure of the PID calculator.

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

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.

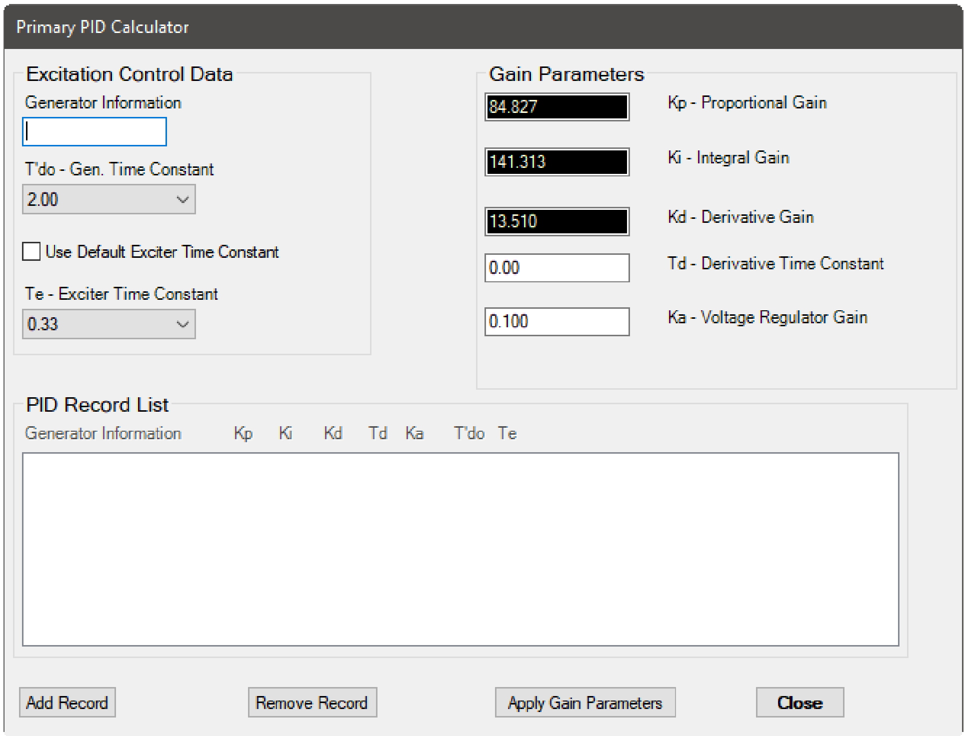


Figure 14-2. PID Calculator

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.

Auto tuning uses a patented particle swarm optimization algorithm to determine system parameters and calculates corresponding PID gains. The auto tuning function is accessed by clicking the *Auto Tune* button (Figure 14-1). BESTCOMS*Plus* must be in Live Mode in order to begin the auto tuning process. The auto tuning window (Figure 14-3) provides options for choosing the PID Design Mode and the Power Input Mode. When the desired settings are selected, click the *Start Auto Tune* button to start the process. After the process is complete, click the *Save PID Gains (Primary)* 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.

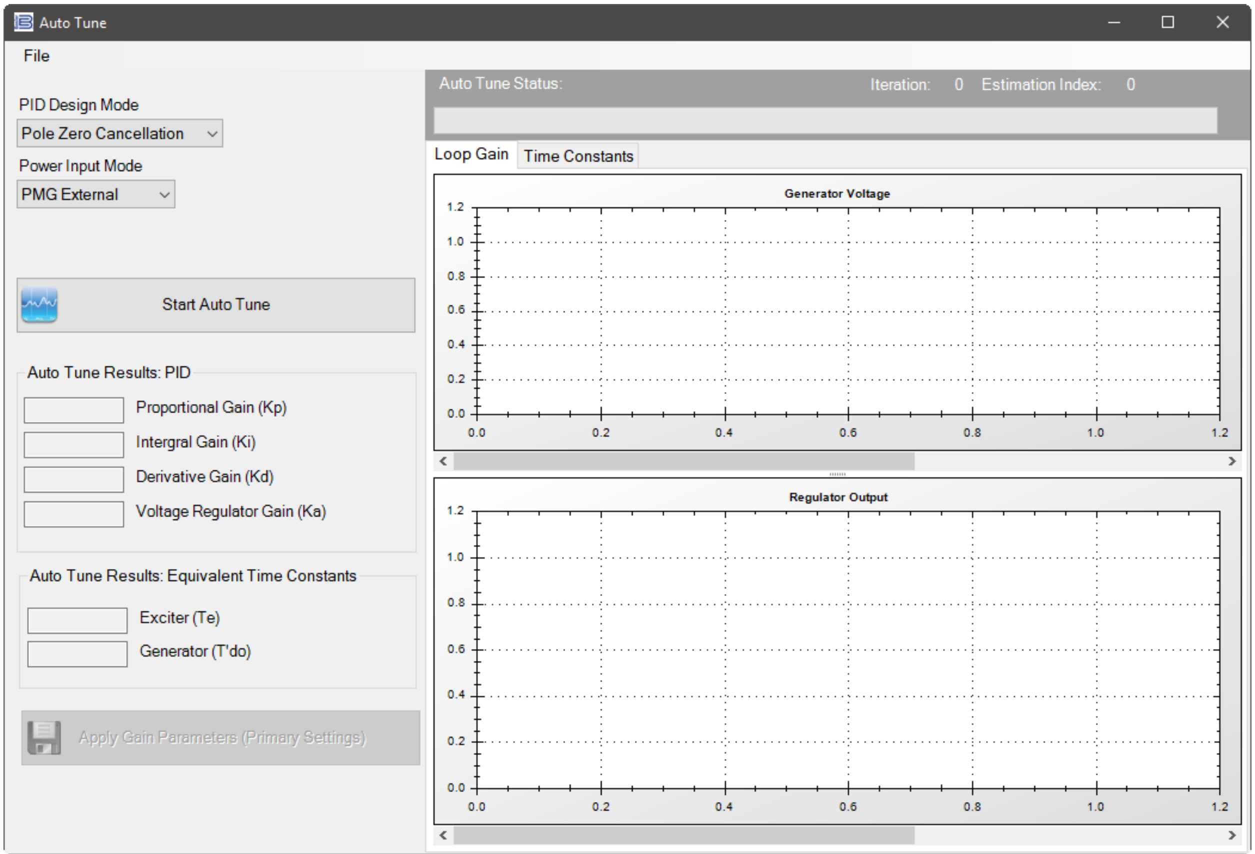


Figure 14-3. Auto Tuning Window

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

FCR and FVR Modes

BESTCOMS*Plus* 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. BESTCOMS*Plus* FCR stability settings and FVR stability settings are illustrated in Figure 14-4.

FCR Mode Stability Settings

The DECS-450 bases its field current response upon the following settings.

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

The derivative gain (K_d) 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) and set the voltage regulator gain level of the PID algorithm (K_a). Using the recommended K_a value will per unitize the PID control loop, simplifying system modeling and validation.

FVR Mode Stability Settings

The DECS-450 bases its field voltage response upon the following settings.

The proportional gain (K_p) 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) 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) 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) and set the voltage regulator gain level of the PID algorithm (K_a). Using the recommended K_a value will per unitize the PID control loop, simplifying system modeling and validation.

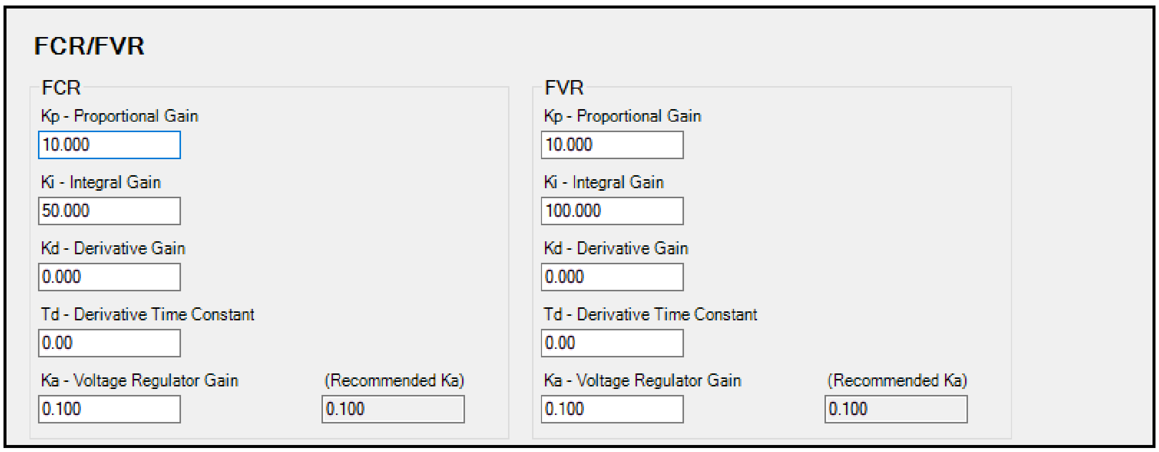


Figure 14-4. FCR and FVR Gain Settings

Other Modes and Functions

BESTCOMS*Plus* 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-450 along with settings for stability tuning of limiters, the voltage matching function, and main field voltage response. Figure 14-5 illustrates these settings as they appear in BESTCOMS*Plus*.

Var Mode

The integral gain (K_i) adjusts the Var mode integral gain which determines the characteristic of the DECS-450 dynamic response to a changed var setpoint.

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

Power Factor Mode

The integral gain (K_i) adjusts the integral gain which determines the characteristic of the DECS-450 dynamic response to a changed power factor setpoint.

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

Overexcitation Limiter (OEL)

The integral gain (K_i) adjusts the rate at which the DECS-450 responds during an overexcitation condition.

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

Underexcitation Limiter (UEL)

The integral gain (K_i) adjusts the rate at which the DECS-450 responds during an underexcitation condition.

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

Stator Current Limiter (SCL)

The integral gain (K_i) adjusts the rate at which the DECS-450 limits stator current.

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

Var Limiter

The integral gain (K_i) adjusts the rate at which the DECS-450 limits reactive power.

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

Voltage Matching

The loop gain (K_g) adjusts the rate at which the DECS-450 matches the generator voltage to the bus voltage.

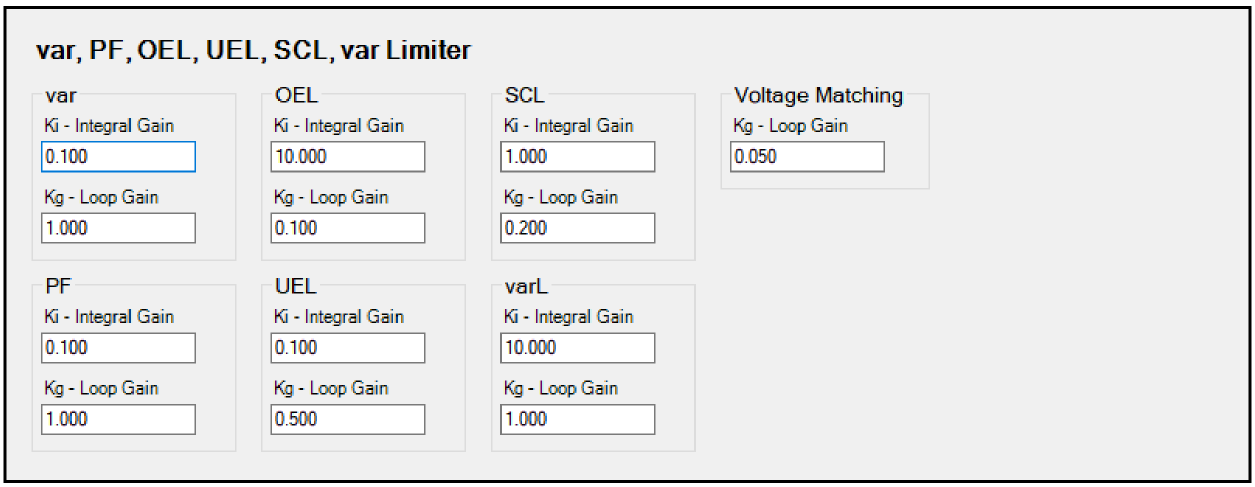


Figure 14-5. Other Mode and Function Gain Settings

Inner Loop Field Regulation

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Gain, Inner Loop Field Regulator

HMI Navigation Path: Settings, Operating Settings, Gains, Inner Loop Field Regulator

When the inner control loop is enabled, the regulator response depends upon the AVR gains and inner loop gains.

The Ki - Integral Gain setting adjusts the rate at which the DECS-450 responds to changes in the main field voltage. The Kg - Loop Gain setting adjusts the coarse loop-gain level of the PI algorithm for the inner loop field regulator. Figure 14-6 illustrates these settings as they appear in BESTCOMS*Plus*.

Figure 14-6. Inner Loop Field Regulator Gain Settings

Converting Gains from a DECS-300 or DECS-400

The DECS-450 uses a per-unitized control loop while the DECS-300 and DECS-400 do not. A software conversion tool is included to make upgrading to a DECS-450 easier. It can calculate per-unitized gains for a DECS-450 to match the response of a DECS-300 or DECS-400 in a specific application. In BESTCOMS*Plus*, click Tools, Convert Gains to open the screen.

Note
All settings in the System Parameter’s settings group must be programmed prior to running the converter tool. These settings include Rated Data, Sensing Transformers, and Field Isolation Transducer. Refer to the *Configuration* section of this manual for additional information on these settings. Gains not included in the converter utility must be entered manually and do not require modification.

Simply enter the DECS-300 or DECS-400 gains into the appropriate fields in the DECS-300 / DECS-400 column. Select whether OEL Mode is Summing Point or Takeover. Click Convert to review the new gain values displayed in the DECS-450 Equivalent column. The Apply Gain button automatically enters the new gain values into the appropriate DECS-450 gain settings. Figure 14-7 illustrates these settings as they appear in BESTCOMS*Plus*.

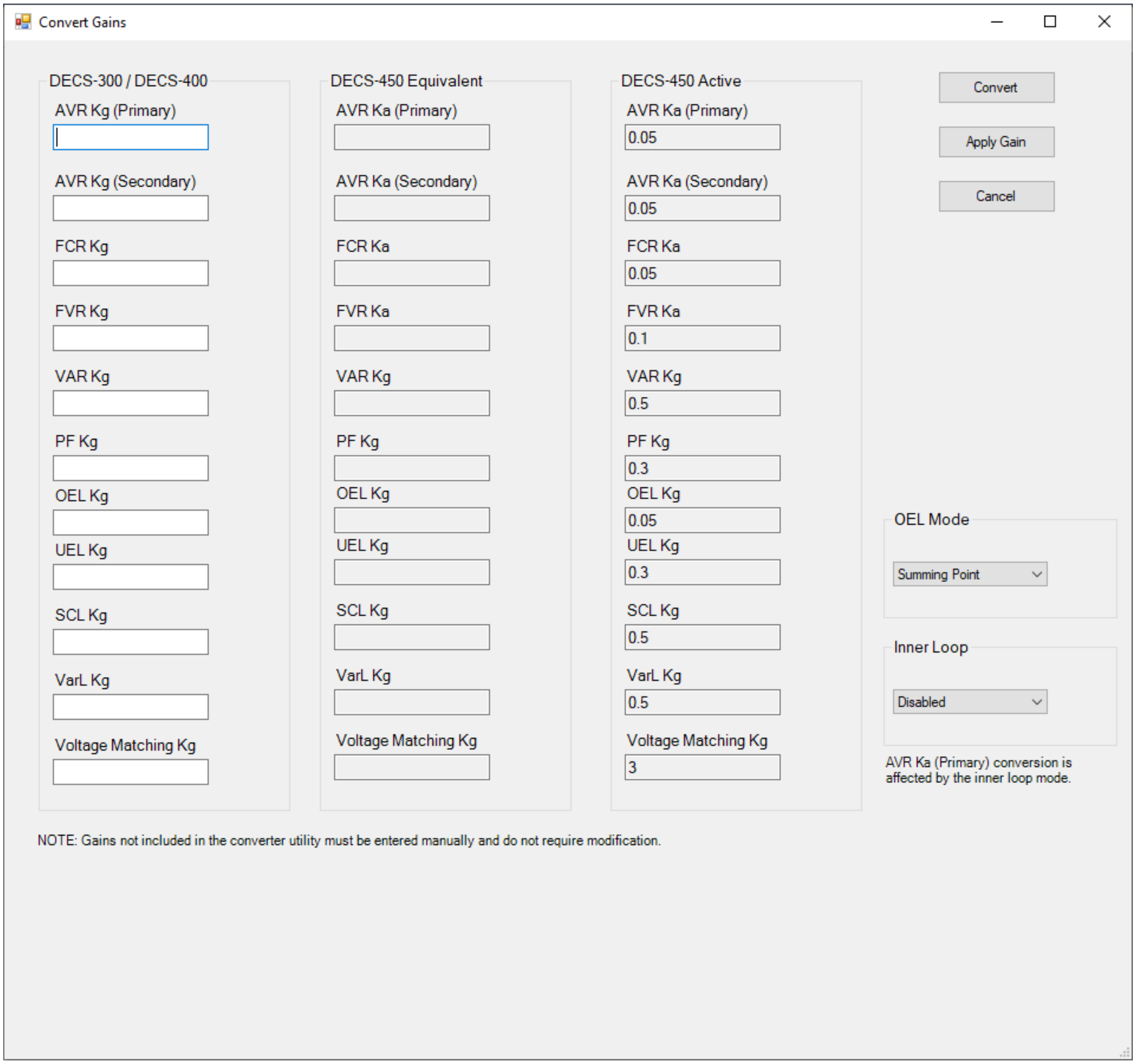


Figure 14-7. Convert Gains Screen

15 • Mounting

When not shipped as part of assembled equipment, DECS-450 Digital Excitation Control Systems are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a DECS-450, check the model and style number against the requisition and packing list for agreement. Inspect for damage and, if there is evidence of such, file a claim with the carrier and notify the Basler Electric regional sales office, your sales representative, or a sales representative at Basler Electric.

If the unit is not installed immediately, store it in the original shipping package in a moisture- and dust-free environment.

Mounting Considerations

Because the DECS-450 and Field Isolation Transducer are of solid-state design, they can be mounted at any convenient angle in an environment where the temperature does not decrease below –40°C (–40°F) or exceed 60°C (140°F).

DECS-450

An escutcheon plate is required for panel (or cubicle door) mounting. Overall dimensions for the DECS-450 and escutcheon plate are shown in Figure 15-1. Figure 15-2 shows the panel cutting and drilling dimensions for mounting a DECS-450 with the escutcheon plate.

Brackets are also available for mounting the DECS-450 in a 19-inch rack. Order part number 9365207030 (two brackets required).

A retrofit kit is available for installing a DECS-450 into a DECS-300 panel cutout. Order part number 9369707009.

The DECS-450 can be installed directly into a DECS-400 panel cutout and existing escutcheon. A transition plate simplifies the process of wiring a DECS-450 with existing DECS-400 wiring. Order part number 9597106100. See *Transition Plate* below for installation instructions.

Field Isolation Transducer

The Field Isolation Transducer is intended for surface mounting and no panel cutout is required. Figure 15-3 shows the Field Isolation Transducer dimensions and hole drilling locations.

Isolation Power Transformer

In applications where redundant control power is used, ac control power must be applied to the DECS-450 through an isolation transformer. Basler Electric part number BE31449001 is recommended. Figure 15-4 illustrates the dimensions and mounting hole locations of part number BE31449001.

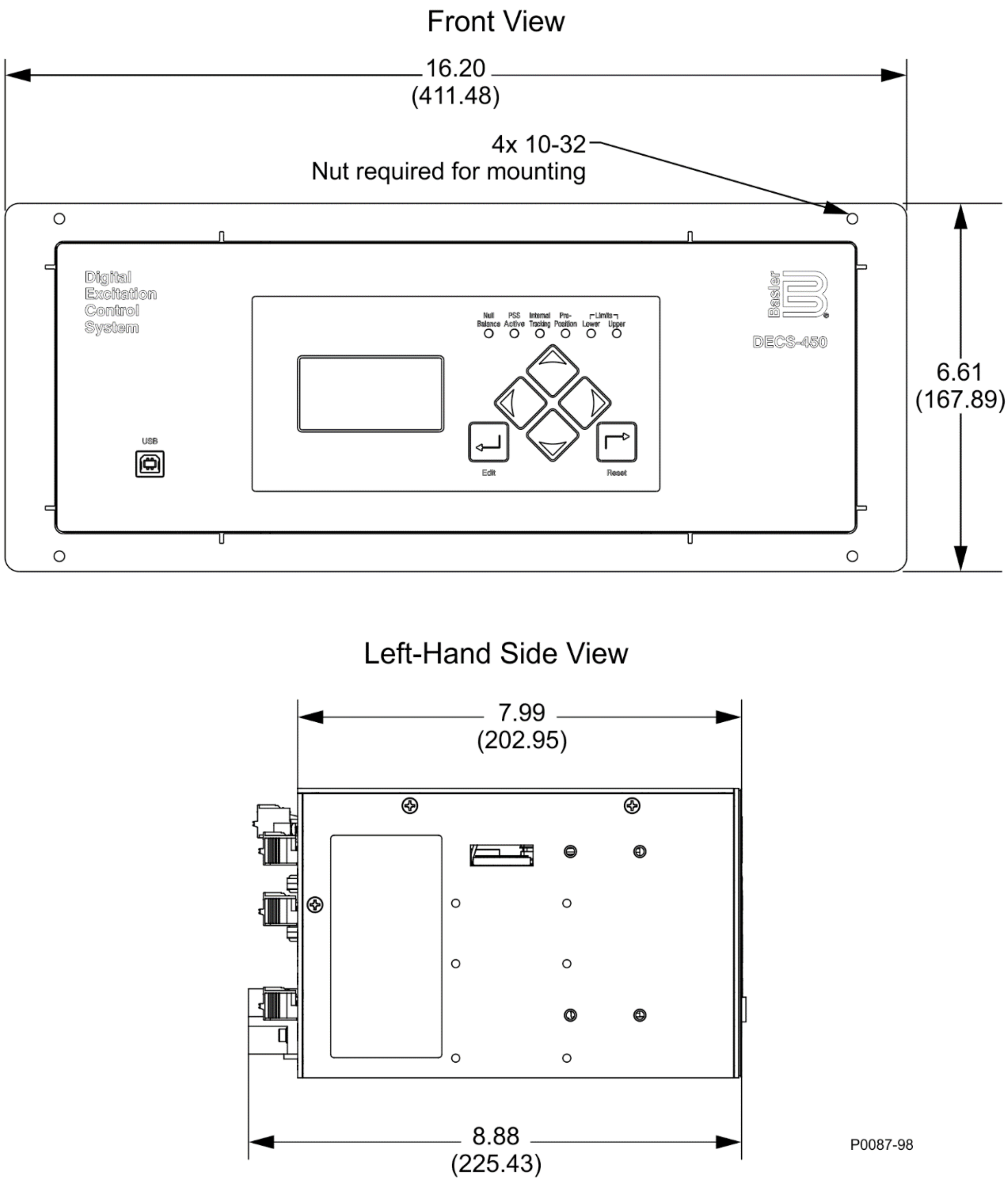


Figure 15-1. DECS-450 with Escutcheon Plate, Overall Dimensions

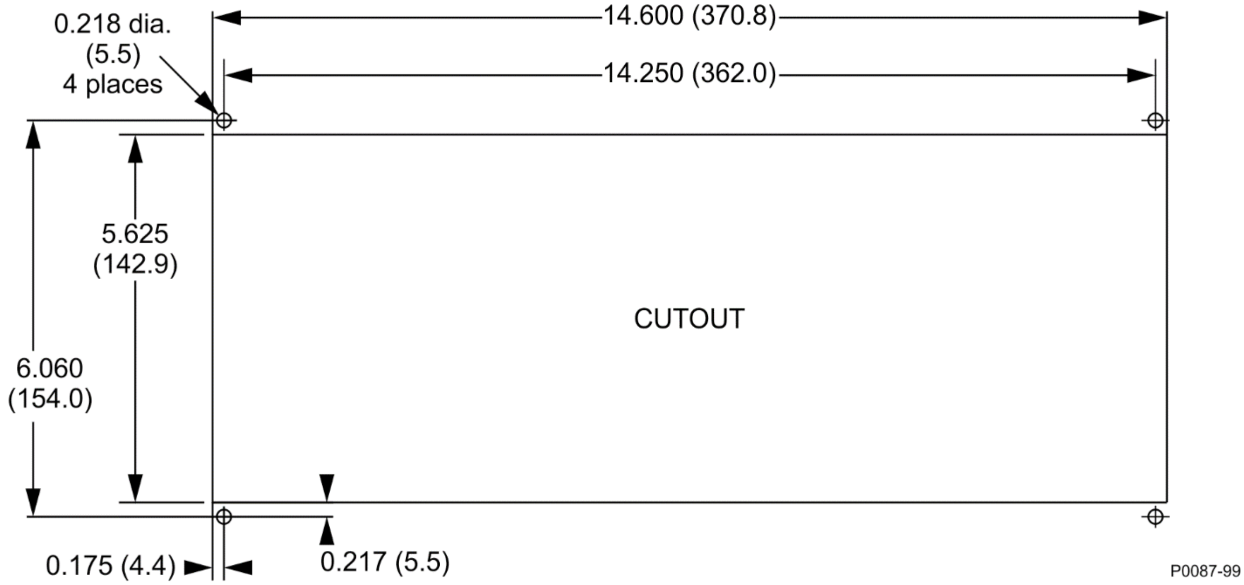


Figure 15-2. Panel Cutting and Drilling Dimensions

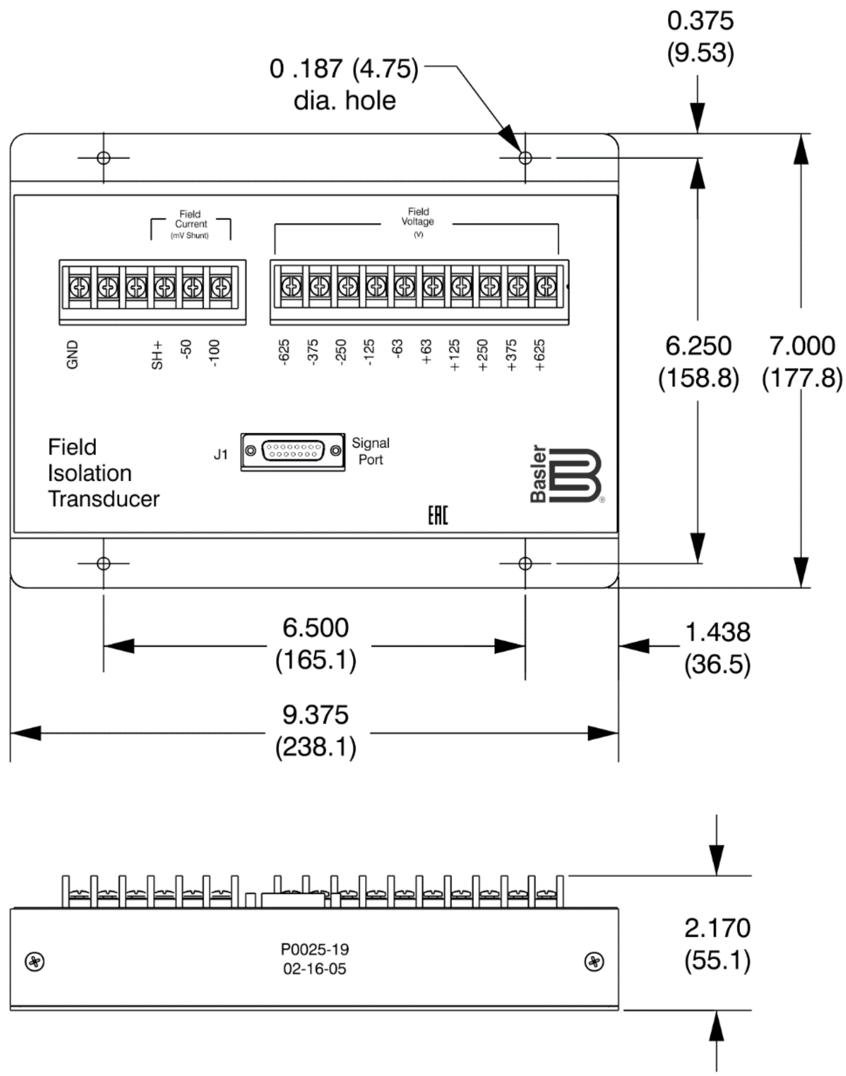


Figure 15-3. Field Isolation Transducer Dimensions

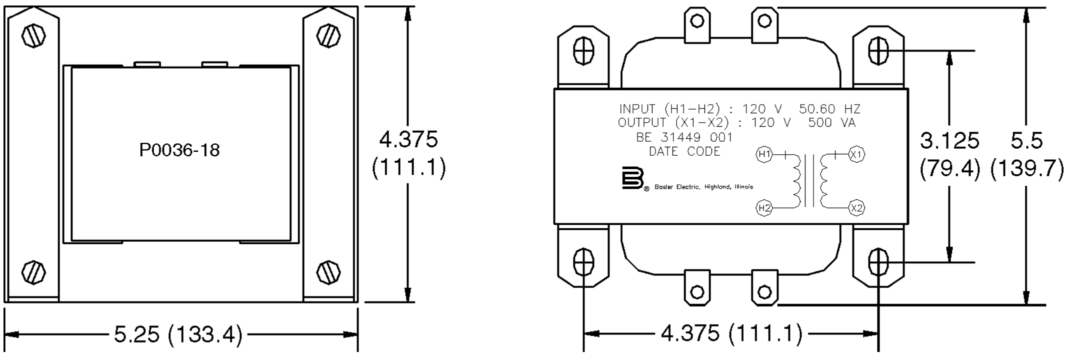


Figure 15-4. Isolation Transformer (BE31449001) Dimensions

Transition Plate

Upgrading from a DECS-400 to the DECS-450 is simplified by an optional transition plate. The transition plate (Figure 15-5) relocates the DECS-450 terminals so that they align with the wiring previously connected to a DECS-400.

Figure 15-5. Transition Plate Wiring to DECS-450

Transition plate terminals are prewired to connectors and ring lugs that mate with the headers, connectors, and terminal screws of the DECS-450. The transition plate attaches to the back of the DECS-450 and its terminals align with those of the removed DECS-400. While the terminal layout of the transition plate matches that of the DECS-400, its terminal function labeling matches that of the DECS-450. Transition plate terminals are shown in Figure 15-6.

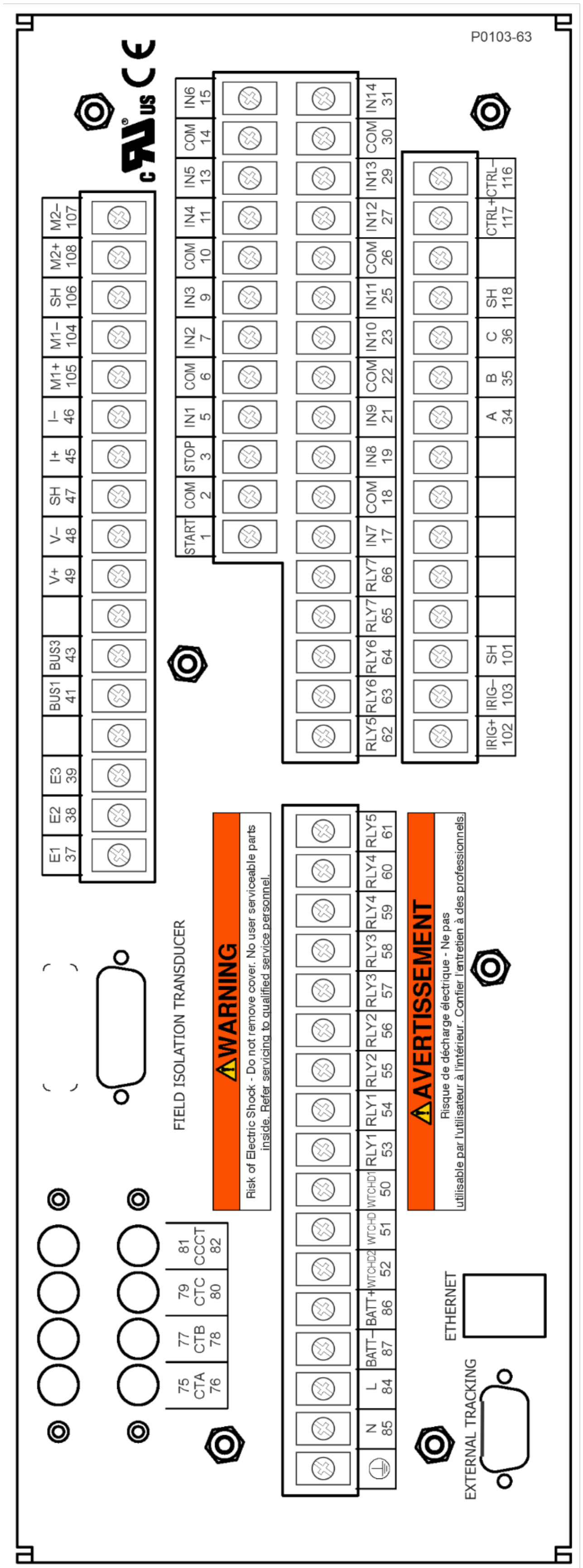


Figure 15-6. Transition Plate Terminal Assignments

Installation

To install the transition plate, perform the following steps.

1. Remove the six DECS-450 screws shown in Figure 15-7 (locators A, B, and C). Three screws are located on the left side of the DECS-450 and three screws are located on the right side of the DECS-450.

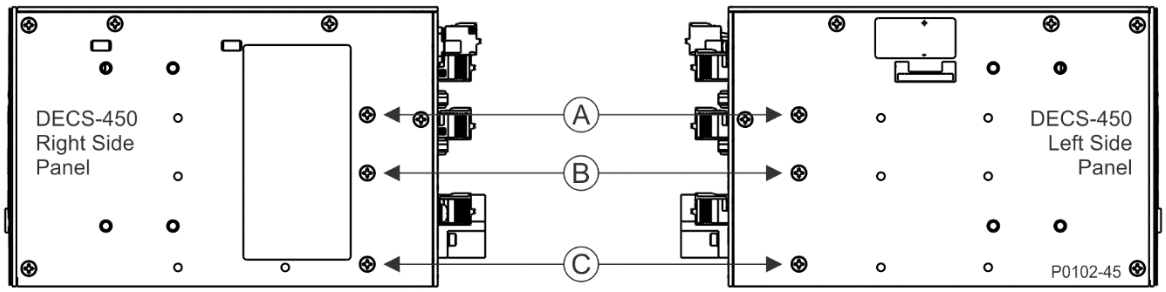


Figure 15-7. Mounting Screw Locations

2. Slide the transition plate assembly onto the rear of the DECS-450 as shown in Figure 15-5. Align the lowermost mounting holes of the transition plate assembly with those of the DECS-450 (Figure 15-7 locator C). Install two of the supplied screws in the lowermost mounting holes so that the transition plate is attached to the DECS-450 but can be rotated away from the DECS-450 and allow access to the DECS-450 terminals. See Figure 15-5.
3. Connect the ground wire (labeled GND) of the transition plate to the ground terminal of the DECS-450. Maximum torque for the ground terminal screw is 21 in-lb (2.4 N•m).
4. Connect the wires from the CT terminals of the transition plate to the corresponding CT terminals of the DECS-450. These wires are stamped with numbers that correspond to the CT terminals of the DECS-450. Maximum torque for these screws is 21 in-lb (2.4 N•m).
5. Connect the following cables from the transition plate assembly to their corresponding ports on the DECS-450:
   a. Field Isolation Transducer (15-pin, D-type connector)
   b. External Tracking (9-pin, D-type connector)
   c. Ethernet (RJ-45 connector)
6. Plug the nine remaining cables from the transition plate assembly into the corresponding connector headers of the DECS-450. The cable connectors of the transition plate assembly are keyed to prevent connection errors.
7. Rotate the transition plate assembly into position on the DECS-450 and align the remaining mounting holes. Ensure that no wires or cables are pinched between the DECS-450 and transition plate. Install the remaining four supplied screws, two per side, as shown in Figure 15-7 (locators A and B).
8. Tighten the six screws (locators A, B, and C) with a maximum torque of 11 in-lb (1.2 N•m).

If removing a transition plate, perform the installation procedure in reverse order.

16 • Terminals and Connectors

This section describes the terminals and connectors of the DECS-450 and the Field Isolation Transducer.

DECS-450 Connections

DECS-450 terminals and connectors are located on the rear panel. DECS-450's current sensing transformer connections consist of screw terminals and the remaining connections have single-row, multiple-pin headers that mate with removable connectors wired by the user. DECS-450 connectors vary according to their function and the specified options.

Figure 16-1 illustrates the DECS-450 rear panel terminals and connectors. Locator letters in the illustration correspond to the terminal block and connector descriptions in Table 16-1. The front-panel USB port is illustrated and described in the *Controls and Indicators* section of this manual.

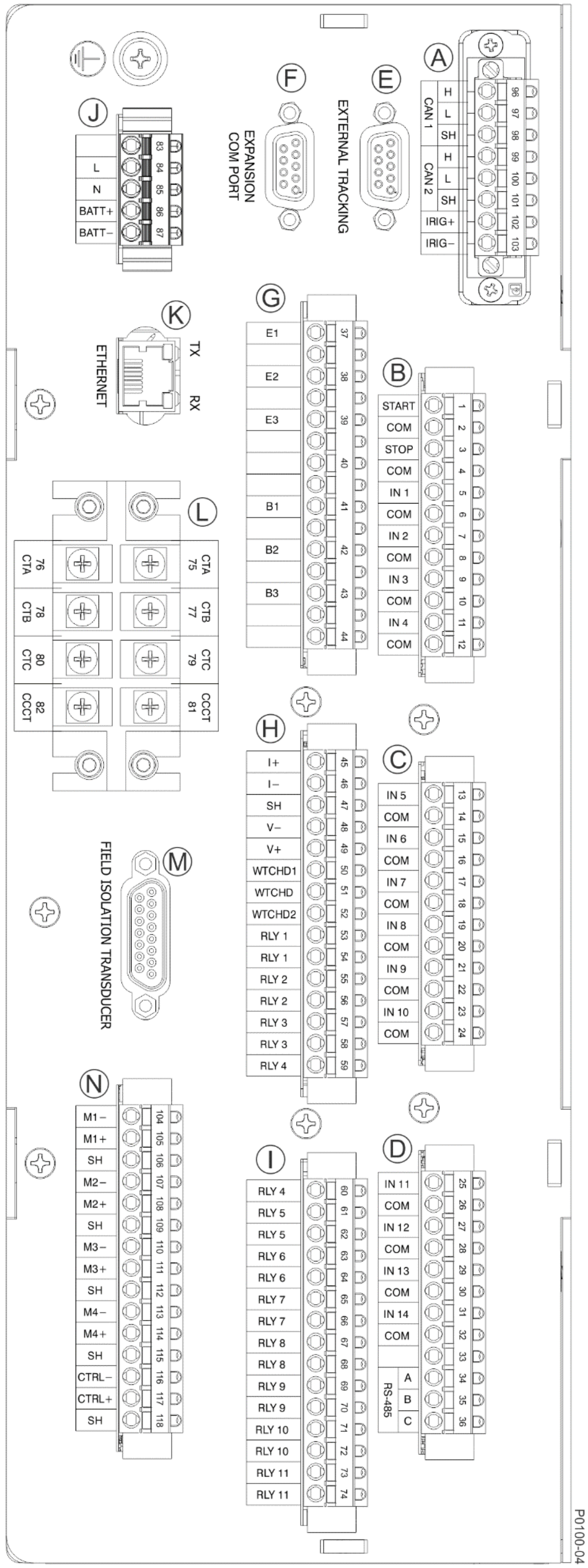


Figure 16-1. Rear Panel Terminals and Connectors

Table 16-1. DECS-450 Rear Panel Terminal and Connector Descriptions

Locator	Description
A	Three terminal sets within this block include two CAN communication ports and an IRIG input. Both CAN ports are SAE J1939 compliant. CAN 1 is used to communicate with add-on modules such as the Basler Electric CEM-125, CEM-2020, and AEM-2020. CAN 2 is used to communicate with an external controller. The IRIG terminals connect to an IRIG source for synchronization of DECS-450 timekeeping.
B	Contact inputs for the Start and Stop functions and programmable contact inputs 1 through 4 are applied to these terminals.
C	Programmable contact inputs 5 through 10 are applied to these terminals.
D	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.
E	A second DECS-450 connects through a null modem/crossover serial cable (part number 9310300032) to this DB-9 connector for external setpoint tracking.
F	This DB-9 connector is provided for PROFIBUS communication (style XX1XXXX).
G	Three-phase generator and bus sensing voltage, obtained from user-supplied voltage transformers (VTs), connect to these terminals.
H	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 SH 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.
I	Relay contact outputs for programmable relay outputs 4 through 11 connect to these terminals.
J	These terminals accept ac and dc control power to enable DECS-450 operation.
K	This optional Ethernet communication port uses the Modbus TCP protocol to provide remote metering, annunciation, and control. A copper (100BASE-TX) port (style XXXXXTX) uses a standard RJ-45 jack (as shown) and a fiber optic (100BASE-FX) port (style XXXXXFX) uses two fiber optic connectors.
L	These terminals connect to user-supplied current transformers (CTs) providing three phases of generator sensing current and a cross-current compensation signal.
M	This 15-pin, D-type connector is provided for communication with the Field Isolation Transducer.
N	A portion of this terminal block provides outputs for the four programmable meter drivers. The remaining terminal block pins supply analog excitation control output.

DECS-450 Wiring

All pluggable headers may have either spring or compression terminals, specified by style. Spring terminals (style XXXXXXS) secure each wire with a spring-loaded contact. Compression terminals (style XXXXXXC) secure each wire with a screw compression contact.

All headers accept a maximum wire size of 12 AWG with a recommended wire strip length of 0.4 inches (10 mm). For compression terminals, the maximum screw torque is 5.3 in-lb (0.6 N•m). All headers are keyed to help prevent misconnections.

Current sensing connections are made through #8 screw terminals (locator L in Figure 17-1) and accept a maximum lug width of 0.32 inches (8.1 mm) and a maximum wire size of 14 AWG. The maximum screw torque is 21 in-lb (2.4 N•m).

Field Isolation Transducer Connections

Field Isolation Transducer connections consist of #6 screw terminals and a 15-pin, female, D-type connector designated J1. Figure 16-2 illustrates the Field Isolation Transducer terminals.

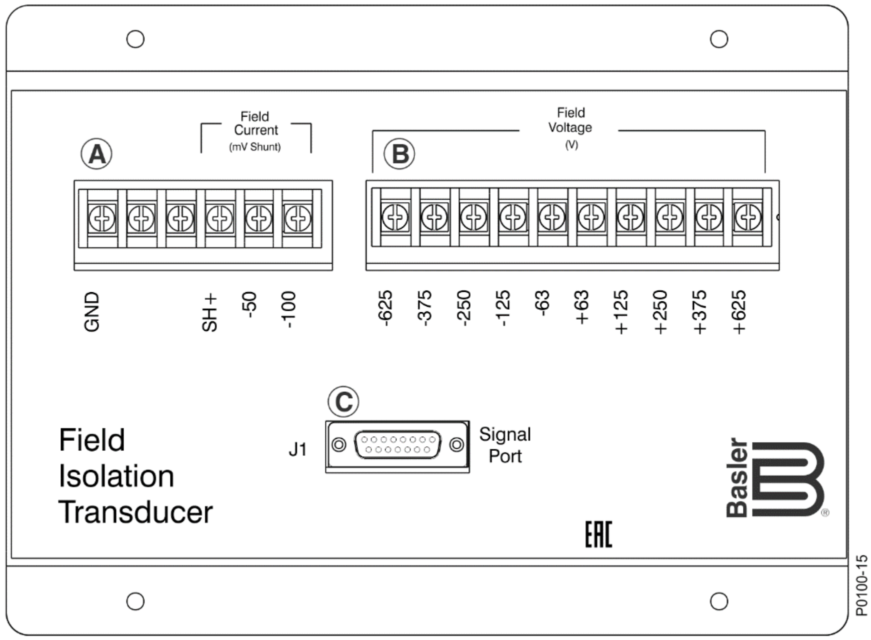


Figure 16-2. Field Isolation Transducer Terminals and Connectors

Table 16-2. Field Isolation Transducer Terminal and Connector Descriptions

Locator	Description
A	GND: The GND terminal serves as the chassis ground connection. Be sure that the Field Isolation Transducer is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to terminal GND. SH+: Connects to positive output terminal of current shunt –50: Connects to negative output terminal of 50 mVdc current shunt (if used) –100: Connects to negative output terminal of 100 mVdc current shunt (if used)
B	The field voltage sensing input accepts field voltage at one of five nominal levels. Terminal sets are provided for a nominal field voltage of 63, 125, 250, 375, and 625 Vdc. Each voltage input has a positive and negative terminal.
C	Signal port connector J1 receives operating power from the DECS-450 and sends field current and field voltage signals to the DECS-450. J1 connects to the DECS-450 Field Isolation Transducer connector through a cable (Basler P/N 9372900021) supplied with the DECS-450.

Field Isolation Transducer Wiring

All connections are made through #6 screw terminals and accept a maximum wire size of 12 AWG. The recommended screw torque is 9 in-lb (1.01 N•m).

17 • Typical Connections

Typical connection diagrams are provided in this section as a guide when wiring the DECS-450 for communication and sensing. For cross-current compensation connections, refer to the *Voltage and Current Sensing* section in this manual.

Typical connections with an IFM-150 are shown in Figure 17-1. Typical connections with a BCM-2 are shown in Figure 17-2. The “Machine” in Figures 17-1 and 17-2 represents a generator when the DECS-450 is operating in generator mode and a motor when it is operating in motor mode. The numbered note locators in Figures 17-1 and 17-2 correspond to the descriptions in Table 17-1.

Notes
• Current transformer (CT) grounding should be applied in accordance with local codes and conventions. • In this manual, CT terminals are shown with polarity designations (+/–) and terminal numbers, however, physical DECS-450 CT terminals are labeled with terminal numbers only.

DECS-450 contact inputs and outputs are shown in Figure 17-3.

Table 17-1. Typical Connection Drawing Notes

Locator	Description
1	Generator voltage sensing input. Potential transformer required if line voltage exceeds 240 Vac.
2	Connections required only if voltage matching, sync-check, or auto synchronizer functions are used.
3	See the *Power Inputs* or *Specifications* section for control power input ratings. When redundant 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-450.
4	If the DECS-450 is providing one end of the J1939 bus, a 120-ohm, 0.5-watt terminating resistor must be installed across terminals 96 (H) and 97 (L) for CAN 1 and 99 (H) and 100 (L) for CAN 2.

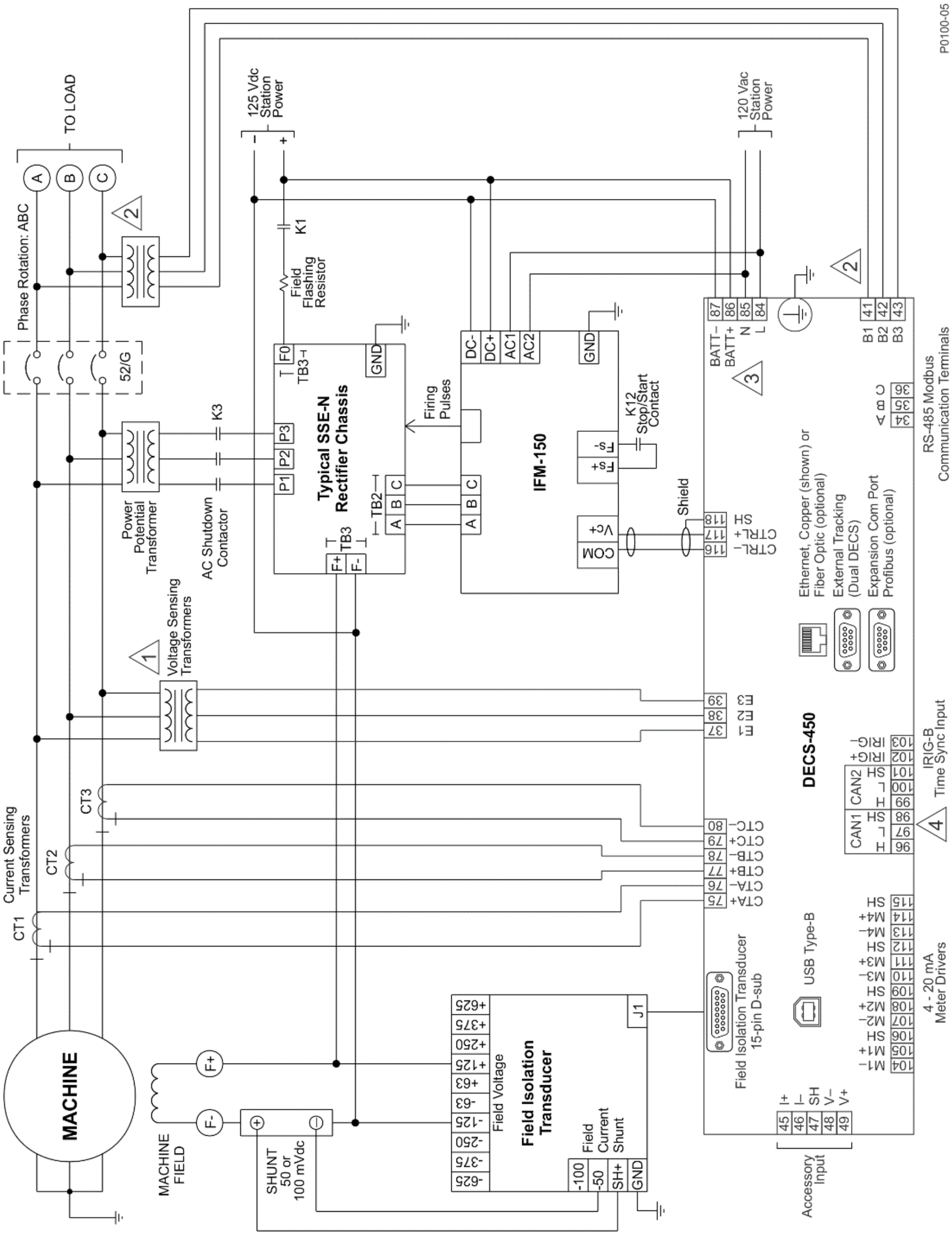


Figure 17-1. Typical DECS-450 Connections with IFM-150

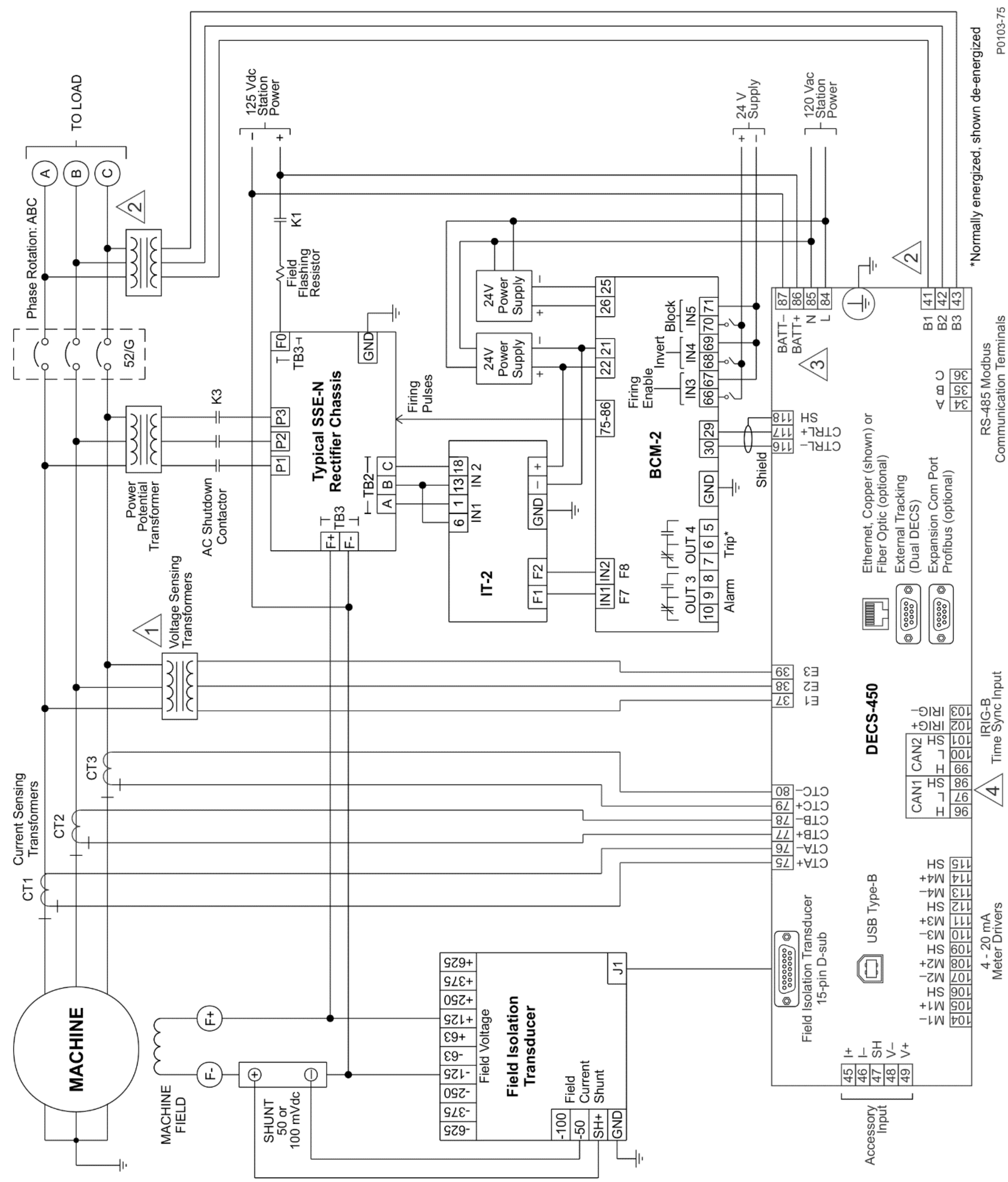


Figure 17-2. Typical DECS-450 Connections with BCM-2

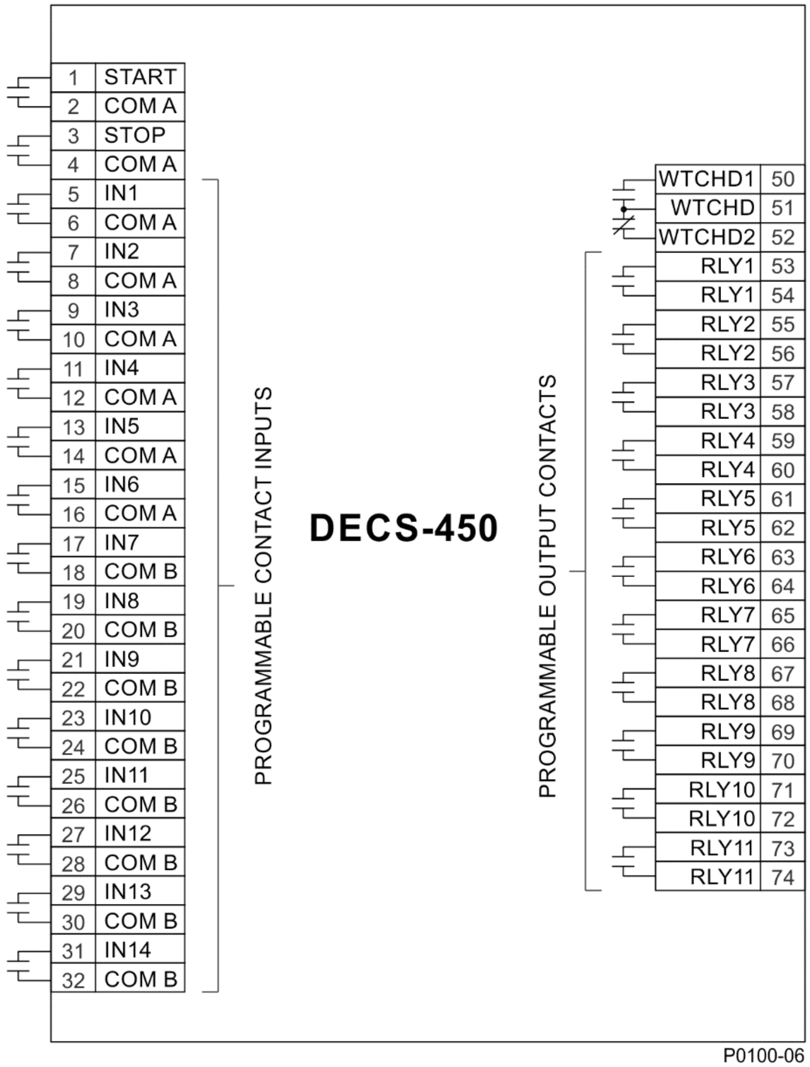


Figure 17-3. DECS-450 Contact Inputs and Outputs

Installation for CE Compliant Systems

To meet EMC requirements for CE compliant systems, install the following:

- A Field Isolation Transducer (FIT) assembly (Basler P/N: 9372900104 or 9372900105)
- An FIT Cable (Basler P/N: 9372900021 [included with 9372900104 and -105] or 9372900022)
- A single ferrite bead around all control power wires near DECS-450 terminals 84 through 87 (Basler P/N: 37995, Fair Rite 0444164181)
- A single ferrite bead around both control output wires near DECS-450 terminals 116 and 117 (Basler P/N: 37995, Fair Rite 0444164181)
- If 100BASE-TX (copper) Ethernet is used, the Ethernet cable must be shielded.

18 • BESTCOMS*Plus*® Software

General Description

BESTCOMS*Plus*® is a Windows®-based, PC application that provides a user-friendly, graphical user interface (GUI) for use with Basler Electric communicating products. The name BESTCOMS*Plus* is an acronym that stands for Basler Electric Software Tool for Communications, Operations, Maintenance, and Settings.

BESTCOMS*Plus* provides the user with a point-and-click means to set and monitor the DECS-450. The capabilities of BESTCOMS*Plus* make the configuration of one or more DECS-450 controllers fast and efficient. A primary advantage of BESTCOMS*Plus* is that a settings scheme can be created, saved as a file, and then uploaded to the DECS-450 when convenient.

BESTCOMS*Plus* uses plugins that enable the user to manage multiple Basler Electric products. The DECS-450 plugin opens inside the BESTCOMS*Plus* main shell.

The DECS-450 plugin opens inside the BESTCOMS*Plus* main shell. The same default logic scheme that is shipped with the DECS-450 is brought into BESTCOMS*Plus* by downloading settings and logic from the DECS-450. 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-450 logic for protection elements, inputs, outputs, alarms, etc. Simply drag and drop elements, components, inputs, and outputs onto the program grid and draw connections between them to create the desired logic scheme.

BESTCOMS*Plus* also allows for downloading industry-standard COMTRADE files for analysis of stored oscillography data. Detailed analysis of the oscillography files can be accomplished using BESTdata software (available at www.basler.com free of charge).

Figure 18-1 illustrates the typical user interface components of the DECS-450 plugin with BESTCOMS*Plus*.

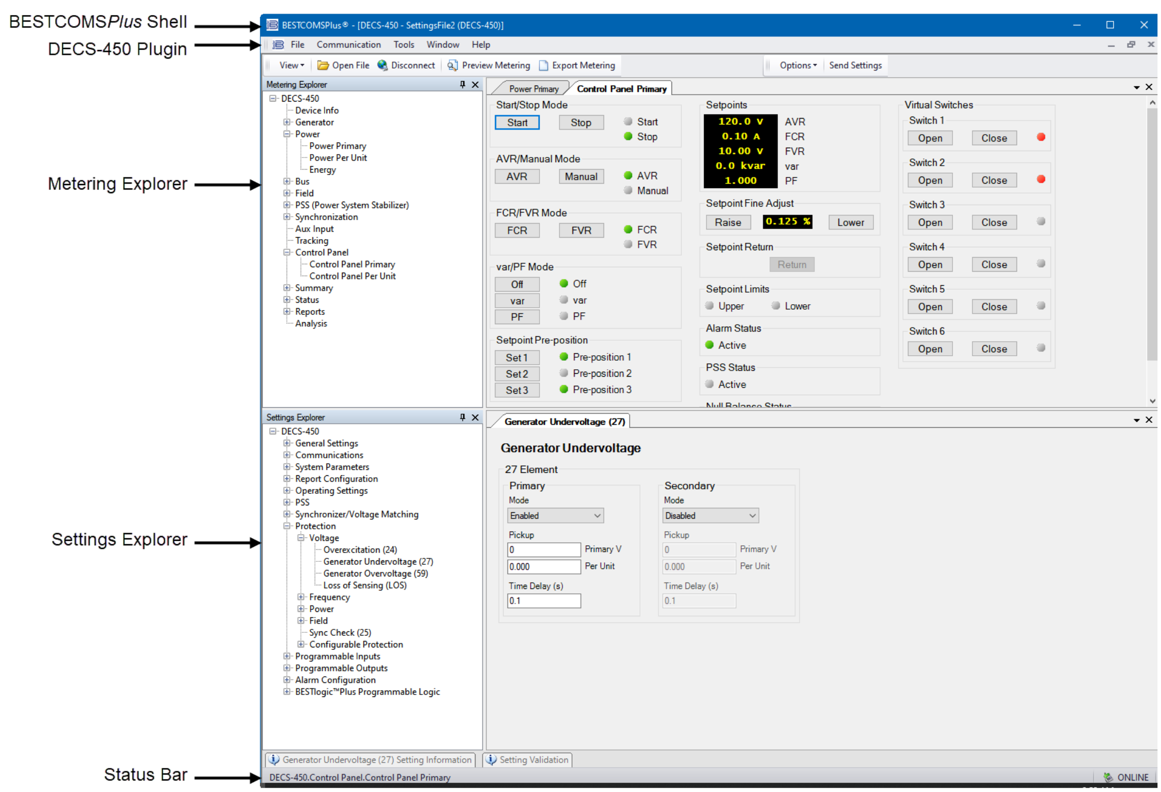


Figure 18-1. Typical User Interface Components

Installation

BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10, and Windows 11. BESTCOMS*Plus*® software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the DECS-450 plugin and the required version of .NET Framework (if not already installed). System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 18-1.

Table 18-1. 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
32/64 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC.)
		4.5 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 may not be permitted to save files in certain folders.

Install BESTCOMS*Plus*®

Warning!

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. Download BESTCOMS*Plus* from www.basler.com.
2. Click the installation button for BESTCOMS*Plus*. The setup utility installs BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the DECS-450 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.

Connect the DECS-450 and Start BESTCOMSPlus®

The DECS-450 plugin is a module that runs inside the BESTCOMS*Plus* shell and it contains specific operational and logic settings for the DECS-450.

Connect a USB Cable

The USB driver was copied to your PC during BESTCOMS*Plus*® installation and is installed automatically after connecting to the DECS-450. USB driver installation progress is shown in the Windows Taskbar area. Windows will notify you when installation is complete.

Note

In some instances, the Found New Hardware Wizard will prompt you for the USB driver. If this happens, direct the wizard to the following folder:

C:\Program Files\Basler Electric\USB Connect Driver\

If the USB driver does not install properly, refer to the *Maintenance and Troubleshooting* section for a troubleshooting procedure.

Connect a USB cable between the PC and your DECS-450. Apply control power to the DECS-450 and wait until the boot sequence is complete.

Start BESTCOMS*Plus*®

To start BESTCOMS*Plus*, 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 18-2). You can choose to have this screen displayed each time BESTCOMS*Plus* 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.

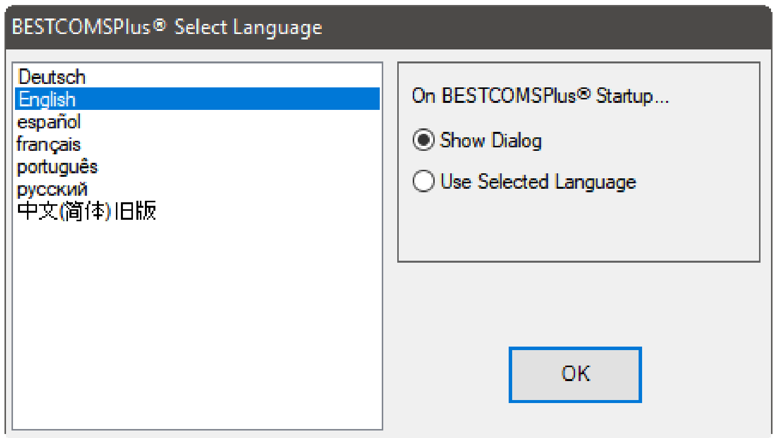


Figure 18-2. BESTCOMS*Plus* Select Language Screen

The BESTCOMS*Plus*® platform window opens. Select *New Connection* from the *Communication* pull-down menu and select *DECS-450*. See Figure 18-3.

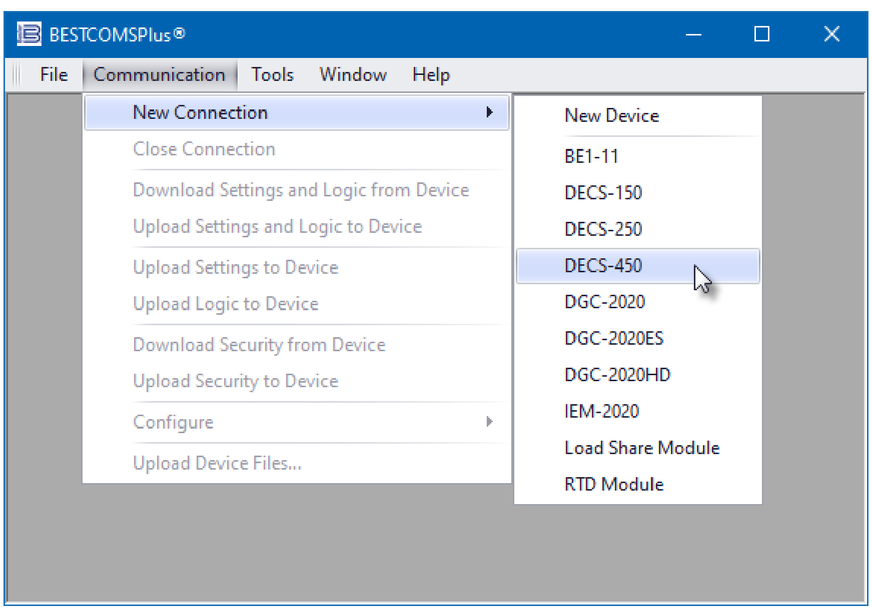


Figure 18-3. Communication Pull-Down Menu

The *DECS-450 Connection* screen shown in Figure 18-4 appears. Select *USB Connection* and click *Connect*.

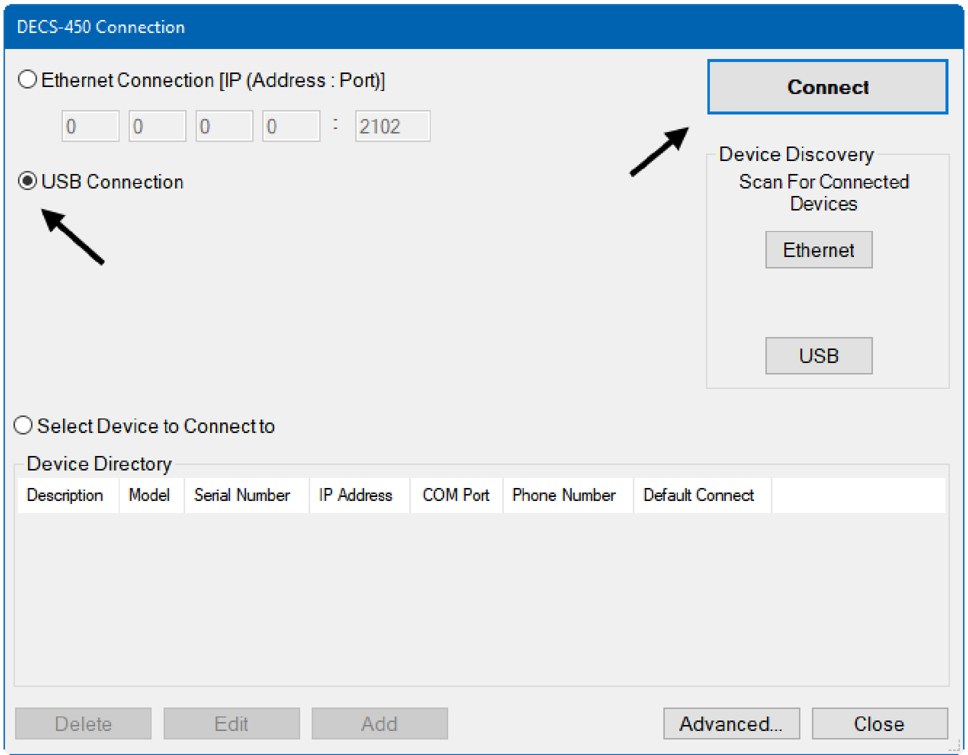


Figure 18-4. DECS-450 Connection Screen

Establishing Communication

Communication between BESTCOMS*Plus* and the DECS-450 is established by clicking the *Connect* button on the *DECS-450 Connection* screen (see Figure 18-4) or by clicking the *Connect* button on the lower menu bar of the main BESTCOMS*Plus* screen (Figure 18-1). 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 device by selecting *Download Settings and Logic* from the *Communication* pull-down menu. BESTCOMS*Plus* will read all settings and logic from the DECS-450 and load them into BESTCOMS*Plus* memory.

Menu Bars

The menu bars are located near the top of the BESTCOMS*Plus*® screen (see Figure 18-1). 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 18-2.

Table 18-2. Upper Menu Bar (BESTCOMS*Plus*® Shell)

Menu Item	Description
File	
New	Create a new settings file
Open	Open an existing settings file

Menu Item	Description
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 BESTCOMS*Plus* program
Communication	
New Connection	Choose new device or DECS-450
Close Connection	Close communication between BESTCOMS*Plus* and DECS-450
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
Tools	
Check for Updates	Check for BESTCOMS*Plus*® updates via the internet
Select Language	Select BESTCOMS*Plus* language
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
Convert Gains	Converts DECS-400 AVR Kg gain value for use in the DECS-450. Refer to the *Stability Tuning* section for details.
Event Log - View	View the BESTCOMS*Plus* event log
Event Log - Verbose Logging	Enable/disable verbose logging
Event Log - Verbose Communication Logging	Enable/disable verbose communication logging
Generate Certificate	Generate a certificate (not applicable to DECS-450)
Accepted Devices	View and delete accepted devices (not applicable to DECS-450)
Window	
Cascade All	Cascade all windows
Tile	Tile horizontally or vertically
Maximize All	Maximize all windows
Help	
Check for Updates	Check for BESTCOMS*Plus*® updates via the internet
Check for Update Settings	Enable or change automatic checking for update
About	View general, detailed build, and system information

Lower Menu Bar (DECS-450 Plugin)

Lower menu bar functions are listed and described in Table 18-3.

Table 18-3. Lower Menu Bar (DECS-450 Plugin)

Menu Button	Description
View	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.
Open File	Opens a saved settings file.
Connect/Disconnect	Opens the *DECS-450 Connection* screen, which enables you to connect to the DECS-450 via USB or Ethernet. Also used to disconnect a connected DECS-450.
Preview Metering	Displays the *Print Preview* screen where a preview of the Metering printout is shown. Click on the printer button to send to a printer.
Export Metering	Enables all metering values to be exported into a *.csv file.
Options	Displays a drop-down list entitled *Live Mode Settings,* which enables *Live* mode where settings are automatically sent to the device in real time as they are changed.
Send Settings	Sends settings to the DECS-450 when BESTCOMS*Plus* is not operating in Live Mode. Click on this button after making a setting change to send the modified setting to the DECS-450.

Settings Explorer

The Settings Explorer is a convenient tool within BESTCOMS*Plus*® used to navigate through the various settings screens of the DECS-450 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.

Settings Entry

When entering settings in BESTCOMS*Plus*, each setting is validated against prescribed limits. Entered settings that do not conform to the prescribed limits are accepted but flagged as noncompliant. Figure 18-5 illustrates an example of flagged, noncompliant settings (locator A) and the Setting Validation window (locator B) used to diagnose faulty settings.

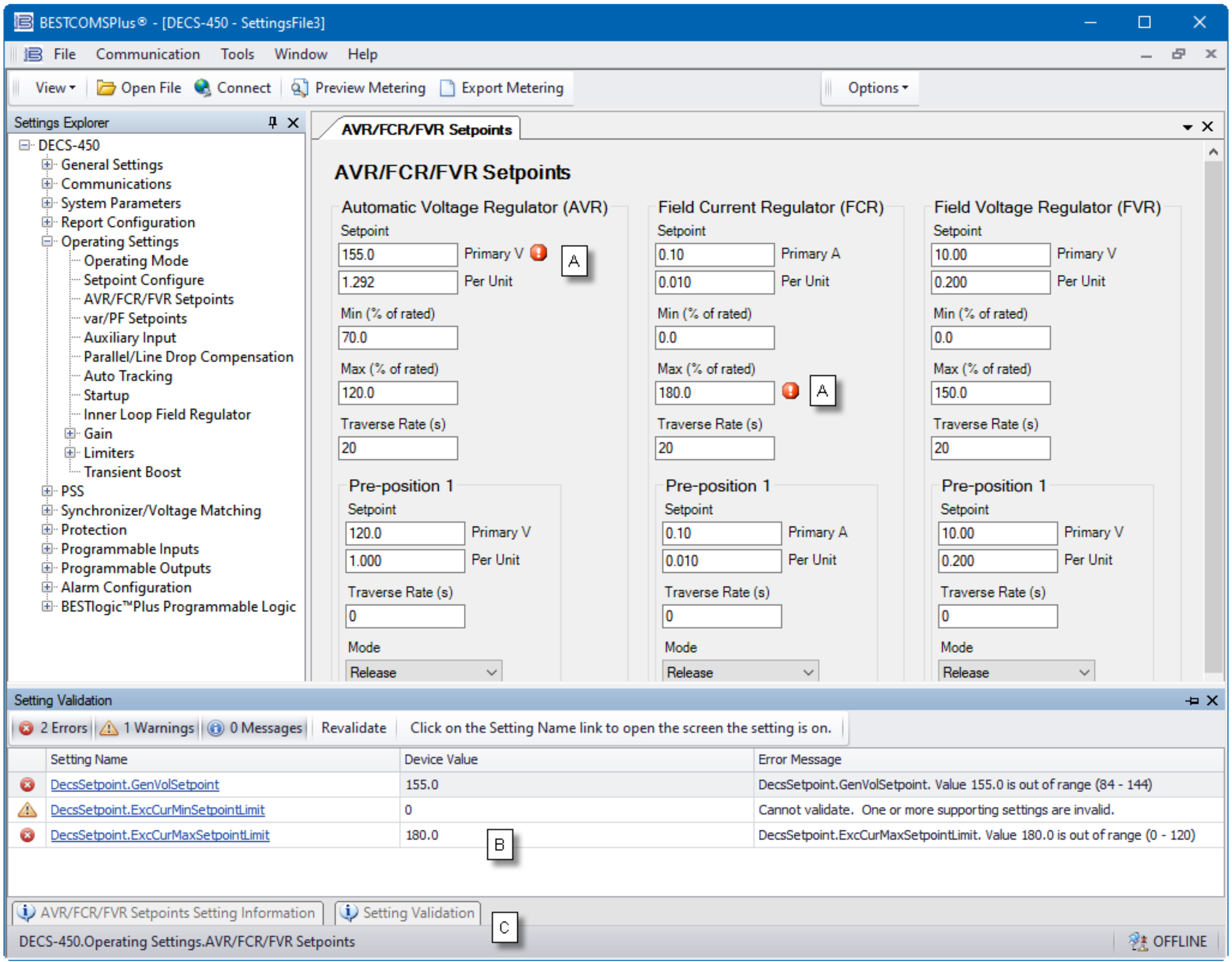


Figure 18-5. Flagged, Noncompliant Settings and the Seting Validation Window

The Setting Validation window, viewed by selecting the Setting Validation tab (locator C), displays three types of annunciations: errors, warnings, and messages. An error describes a problem such as a setting that is out of range. A warning describes a condition where supporting settings are invalid, causing other settings to be noncompliant with the prescribed limits. A message describes a minor setting issue that was automatically resolved by BESTCOMS*Plus*. An example of a condition triggering a message is entry of a settings value with a resolution that exceeds the limit imposed by BESTCOMS*Plus*. In this situation, the value is automatically rounded and a message is triggered. Each annunciation lists a hyperlinked name for the noncompliant setting and an error message describing the issue. Clicking the hyperlinked setting name takes you to the setting screen with the offending setting. Right-clicking the hyperlinked setting name will restore the setting to its default value.

Note
It is possible to save a DECS-450 settings file in BESTCOMS*Plus* with noncompliant settings. However, it is not possible to upload noncompliant settings to the DECS-450.

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* section for more information about the Metering Explorer.

Settings File Management

A settings file contains all DECS-450 settings and logic and its file extension is “bst4”.

It is possible to save only the DECS-450 logic displayed on the BESTlogic*Plus* Programmable Logic screen as a separate logic library file. This is helpful when similar logic is required for multiple DECS-450 systems. The file extension of a logic file created in BESTCOMS*Plus* is “bsl4”.

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* section.

Opening a Settings File

To open a DECS-450 settings file with BESTCOMS*Plus*, click 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 BESTCOMS*Plus* 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-450, open the file or create a new file through BESTCOMS*Plus*. 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-450, pull down the *Communication* menu and select *Download Settings and Logic from Device*. If the settings in BESTCOMS*Plus*® 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. BESTCOMS*Plus* reads all settings and logic from the DECS-450 and loads them into BESTCOMS*Plus* memory.

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

BESTCOMS*Plus* 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 18-6). 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.

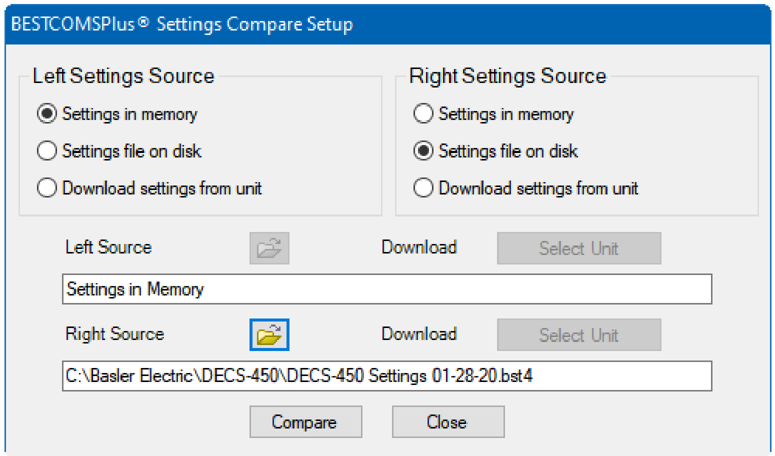


Figure 18-6. BESTCOMS*Plus* Settings Compare Setup

A dialog box will appear and notify you if any differences were found. The BESTCOMS*Plus*® *Settings Compare* dialog box (Figure 18-7) 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.

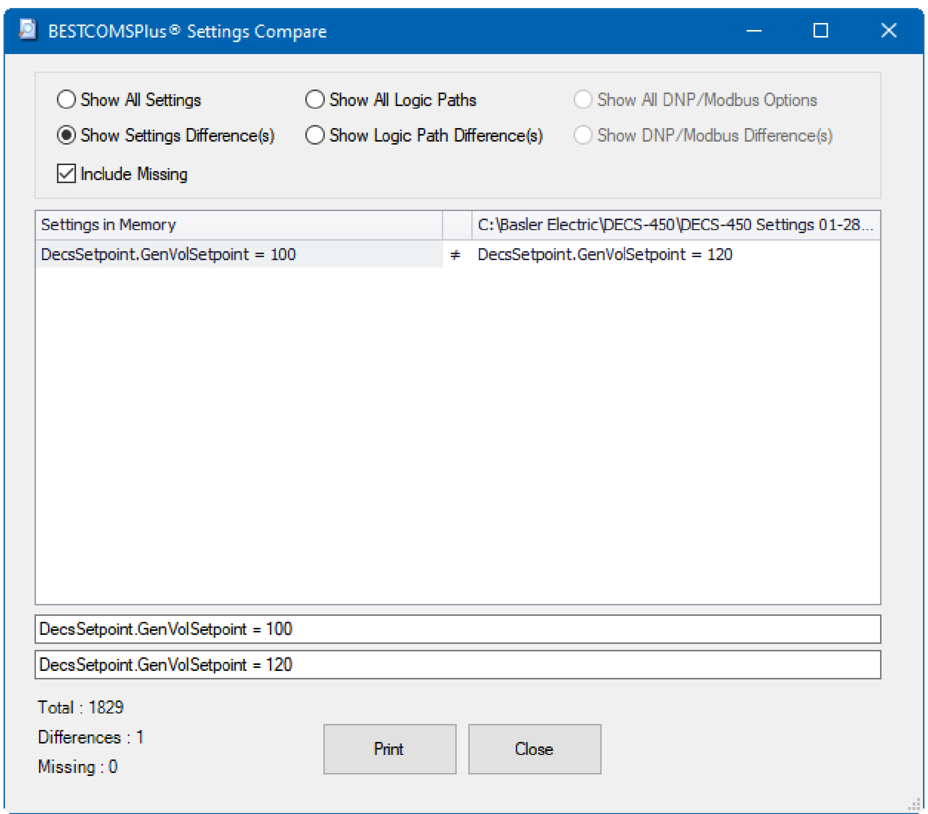


Figure 18-7. BESTCOMS*Plus*® Settings Compare

Automatic Metering Export

The auto export metering function automatically exports metering data over a user-defined period when a DECS-450 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 18-8 illustrates the *Auto Export Metering* screen.

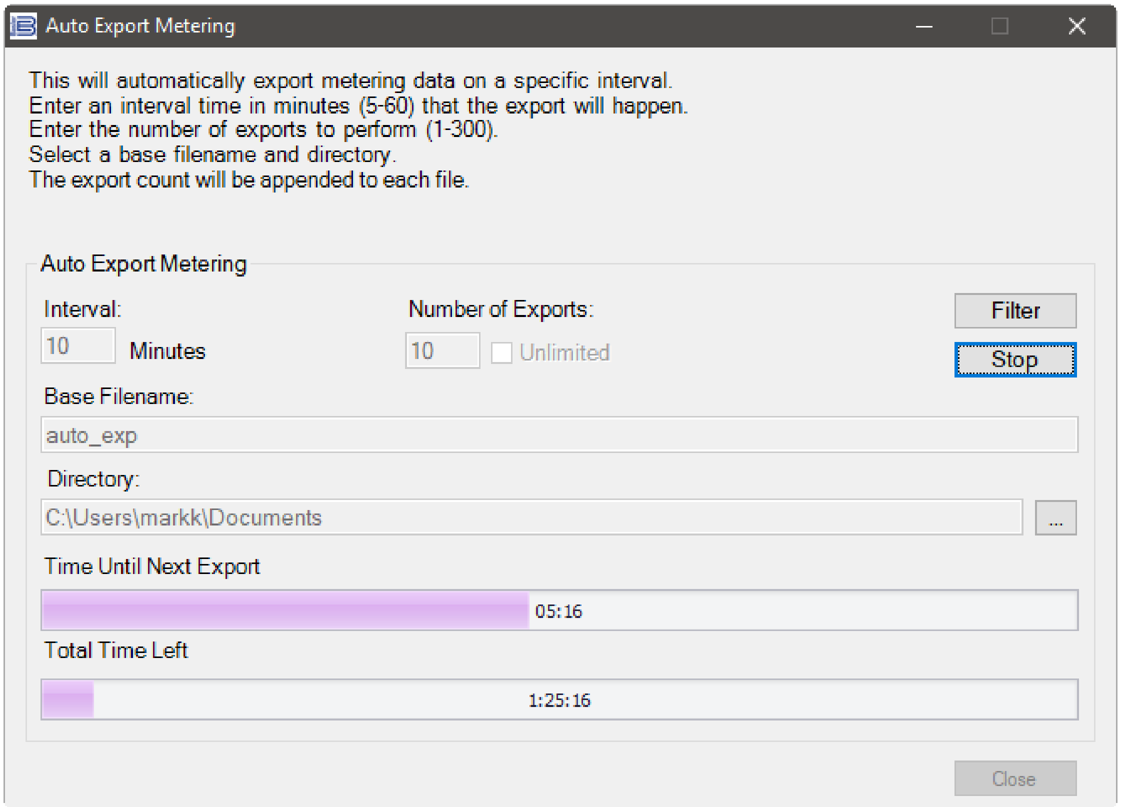


Figure 18-8. Auto Export Metering Screen

Firmware Updates

Future enhancements to the DECS-450 functionality may require a firmware update. Because default settings are loaded when DECS-450 firmware is updated, your settings should be saved in a file prior to upgrading firmware.

Warning!
Before performing any maintenance procedures, remove the DECS-450 from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450.

Caution – Settings will be lost!

Default settings will be loaded into the DECS-450, reports and events will be cleared, and the DECS-450 will reboot when firmware is updated. BESTCOMS*Plus*® 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.

Caution

Installing previous versions of firmware may result in compatibility issues causing the inability to operate properly and may not have the enhancements and resolutions to issues that more recent versions provide. Basler Electric highly recommends using the latest version of firmware at all times. Using previous versions of firmware is at the user's risk and may void the warranty of the unit.

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-450, the optional Contact Expansion Module (CEM-125 or CEM-2020), and the optional Analog Expansion Module (AEM-2020). Embedded firmware is the operating program that controls the actions of the DECS-450. The DECS-450 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-450 can be used in conjunction with CEM-125, CEM-2020, or AEM-2020 expansion modules which expand the DECS-450 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. **Expansion modules must be upgraded before the DECS-450.** This is necessary because the DECS-450 must be able to communicate with the expansion modules in order send firmware to them. If the DECS-450 is upgraded first, and the new firmware included a change to the expansion module communication protocol, it is possible that the expansion modules could no longer communicate with the upgraded DECS-450. Without communications between the DECS-450 and the expansion modules, upgrading the expansion modules is not possible.

Note

If power is lost or communication is interrupted during file transfer to the DECS-450, 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-450. If no expansion module is present, proceed to *Upgrading Firmware in the DECS-450.*

1. Remove the DECS-450 from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450.
2. Apply control power to the DECS-450.
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-450 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-450 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 18-9) 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.

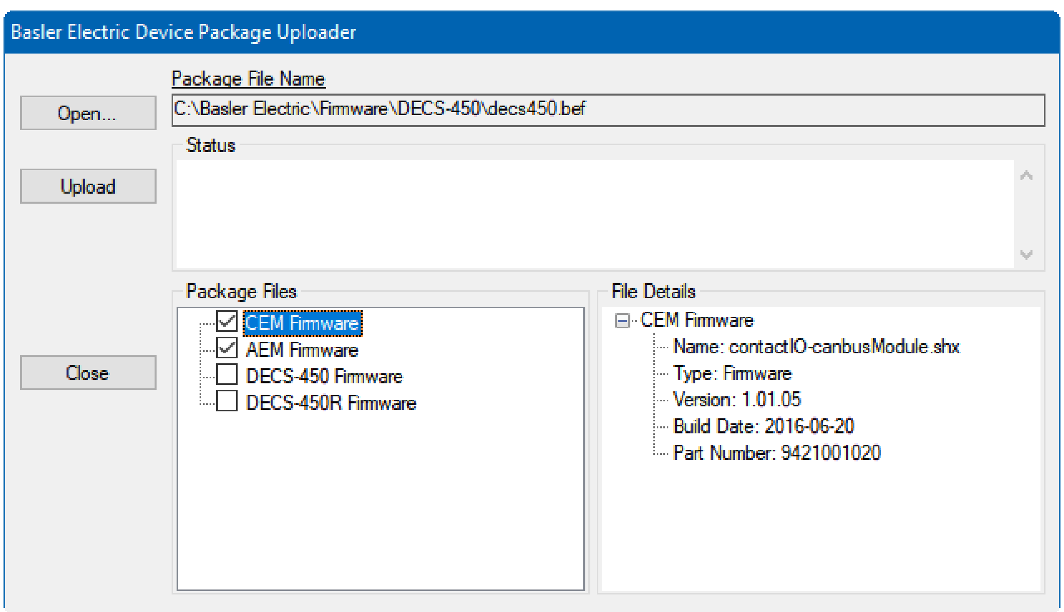


Figure 18-9. Basler Electric Device Package Uploader

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-450 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-450.

Upgrading Firmware in the DECS-450

The following procedure is used to upgrade firmware in the DECS-450. This must be completed after upgrading firmware in any expansion modules.

1. Remove the DECS-450 from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450.
2. Apply control power to the DECS-450.
3. Connect to the DECS-450 with BESTCOMS*Plus*. 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-450 at this time. Save settings when prompted, if desired.
5. Open the desired device package file (decs450.bef).
6. Check the box for DECS-450 Firmware. Note the version number of the DECS-450 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-450.
9. Load the saved settings file into the DECS-450.
    a. Close all settings files.
    b. From the File pull-down menu, select New, DECS-450.
    c. Connect to the DECS-450.
    d. Once all settings have been read from the DECS-450, 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-450 style number in the saved file matches that of the DECS-450 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-450 into which it is to be loaded, disconnect from the DECS-450, then modify the style number in the settings file. Then repeat the steps titled *Load the Saved Settings File into the DECS-450.*

BESTCOMSPlus® Updates

Enhancements to DECS-450 firmware typically coincide with enhancements to the DECS-450 plugin for BESTCOMS*Plus*®. When a DECS-450 is updated with the latest version of firmware, the latest version of BESTCOMS*Plus* should also be obtained.

- You can download the latest version of BESTCOMS*Plus* at www.basler.com.
- BESTCOMS*Plus* automatically checks for updates when enabled. To enable, click *Help*, then *Check for Update Settings*. When the dialog opens, click the *Check Automatically* box and *Save*. (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* menu. (An internet connection is required.)

19 • 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-450 Digital Excitation Control System. Each DECS-450 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-450 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-450 is called a logic scheme.

Two default active logic schemes are preloaded into the DECS-450. 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. BESTCOMS*Plus*® can be used to open a logic scheme that was previously saved as a file and upload it to the DECS-450. The default logic schemes can also be customized to suit your application. Detailed information about logic schemes is provided later in this section.

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-450. Detailed information about operating settings is provided in other sections of this instruction manual.

Caution
This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

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 19-1.

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.

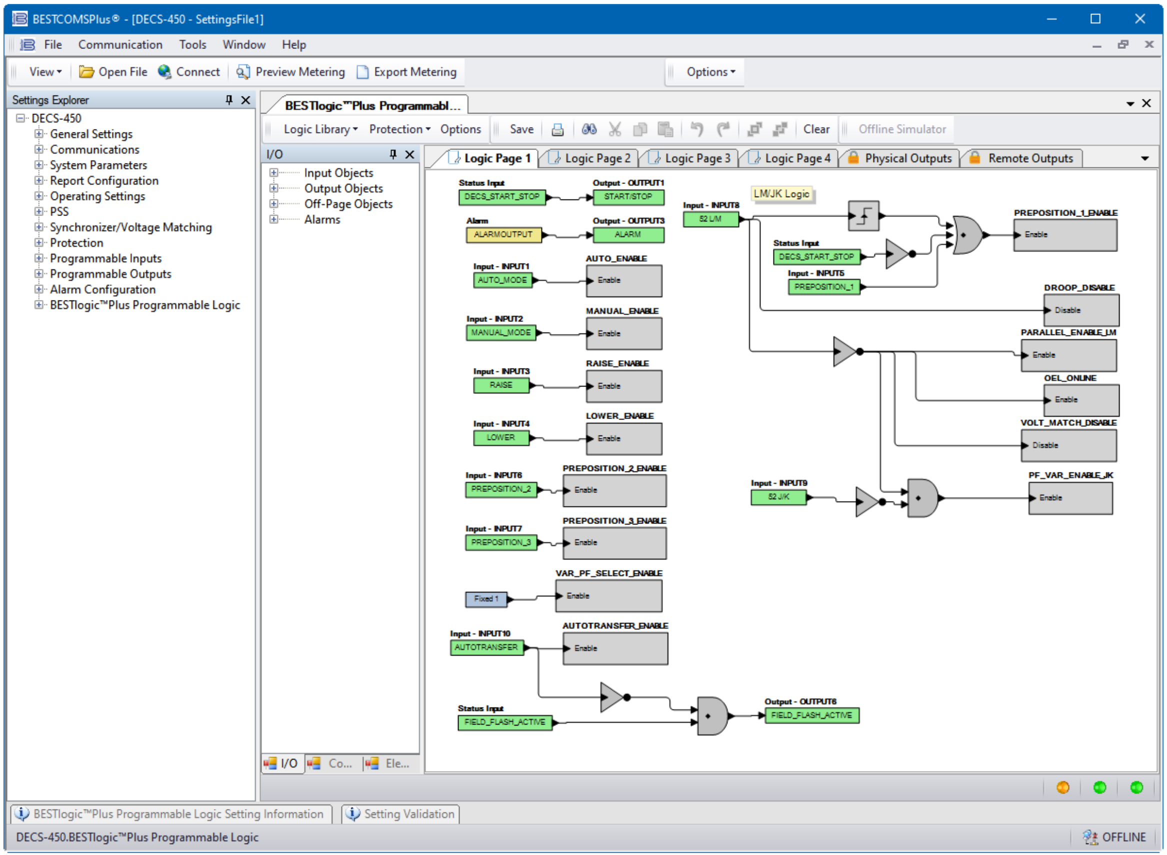


Figure 19-1. BESTlogic*Plus* Programmable Logic Tree Branch

BESTlogic™*Plus* Composition

There are three main groups of objects used for programming BESTlogic*Plus*. These groups are *I/O, Components*, and *Elements*. For details on how these objects are used to program BESTlogic*Plus*, see the paragraphs on *Programming BESTlogicPlus.*

<u>*I/O*</u>

This group contains Input Objects, Output Objects, Off-Page Objects, and Alarms. Table 19-1 lists the names and descriptions of the objects in the *I/O* group.

Table 19-1. I/O Group, Names and Descriptions

Name	Description	Symbol
Input Objects		
Logic 0	Always FALSE (Low).	Fixed 0
Logic 1	Always TRUE (High).	Fixed 1
Status, Front Panel Buttons		
Down Button	True while the front panel Down arrow button is pressed.	Status Input DownButton
Edit Button	True while the front panel Edit button is pressed.	Status Input EditButton
Left Button	True while the front panel Left arrow button is pressed.	Status Input LeftButton

Name	Description	Symbol
Reset Button	True while the front panel Reset button is pressed.	Status Input ResetButton
Right Button	True while the front panel Right arrow button is pressed.	Status Input RightButton
Up Button	True while the front panel Up arrow button is pressed.	Status Input UpButton
Physical Inputs		
Start Input	True when the physical Start input is active.	Input - STARTINPUT STARTINPUT
Stop Input	True when the physical Stop input is active.	Input - STOPINPUT STOPINPUT
IN1 - IN14	True when Physical Input x is active.	Input - INPUT1 INPUT 1
Remote Inputs		
IN15 - IN24	True when Remote Input x is active. (Available when an optional CEM-125 or CEM-2020 is connected.)	Input - IN15 INPUT 15
Virtual Inputs		
VIN1 - VIN6	True when Virtual Input x is active.	Input - VIRTUALSWITCH1 VIRTUALSWITCH1
Status Inputs		
Anticipatory Sync Selected	True when Anticipatory is selected. (Synchronizer screen)	Status Input ANTICIPATORY_SYNC_SELECT
Auto Mode Active	True when the unit is actively in Auto mode (AVR).	Status Input AUTO_ACTIVE
Auto Sync Enabled	True when DECS auto-sync is enabled.	Status Input DECS_AUTOSYNC_ENABLE
Bus Dead	True when the Bus Dead condition settings have been exceeded.	Status Input BUS_DEAD
Bus Failed	True when the Bus Stable condition settings are not met.	Status Input BUS_FAILED
Bus Stable	True when the Bus Stable condition settings have been exceeded.	Status Input BUS_STABLE_COND
Control Power Input Failure	True when the DECS-450 control power is low (16 Vdc or lower for units with style number XLXXXXX and 86 Vdc; 65 Vac or lower for units with style number XCXXXXX).	Status Input CONTROLPOWERINPUTFAILURE
Crowbar Activated	True when the CROWBARSTATUS logic element has a TRUE input.	Status Input CROWBARACTIVATED

Name	Description	Symbol
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.	Status Input DEAD_BUS_CLOSE_REQUEST
External Tracking Active	True when external tracking is running.	Status Input EXT_TRACKING_ACTIVE
Failed To Buildup	True when the Failed to Buildup alarm is active.	Status Input FAILEDTOBUILDUP
FCR Active	True when the unit has FCR mode pre-selected.	Status Input FCR_Active
Field Flash Active	True when field flash is active.	Status Input FIELD_FLASH_ACTIVE
Field Short Circuit Status	True when a field short circuit condition is detected.	Status Input FIELDSHORTCIRCUITSTATUS
FVR Active	True when the unit has FVR mode pre-selected.	Status Input FVR_Active
Gen Breaker Fail to Close	The generator breaker did not close in the close wait time period.	Status Input GEN_BREAKER_FAIL_TO_CLOSE
Gen Breaker Fail to Open	The generator breaker did not open in the close wait time period.	Status Input GEN_BREAKER_FAIL_TO_OPEN
Gen Breaker Sync Fail	True when generator breaker sync has failed.	Status Input GEN_BREAKER_SYNC_FAIL
Gen Dead	True when the Generator Breaker Dead condition settings have been exceeded.	Status Input GEN_DEAD
Gen Failed	True when the Generator Breaker Stable condition settings are not met.	Status Input GEN_FAILED
Gen Stable	True when the Generator Breaker Stable condition settings have been exceeded.	Status Input GEN_STABLE
GOV Contact Type Proportional	True when this option is selected. (Governor Bias Control Settings screen)	Status Input CONTACT_TYPE_PROPORTIONAL
In AVR Mode	True when AVR mode is both selected and the current active mode.	Status Input IN_AVR_MODE
In FCR Mode	True when FCR mode is both selected and the current active mode.	Status Input IN_FCR_MODE
In FVR Mode	True when FVR mode is both selected and the current active mode.	Status Input IN_FVR_MODE
In PF Mode	True when PF mode is both selected and the current active mode.	Status Input IN_PF_MODE

Name	Description	Symbol
In Var Mode	True when VAR mode is both selected and the current active mode.	Status Input IN_VAR_MODE
Inner Loop Field Regulator Active	True when the inner loop field regulator is active.	Status Input INNER_LOOP_FIELD_REGULATOR_ACTIVE
Internal Tracking Active	True when internal tracking is running.	Status Input INT_TRACKING_ACTIVE
IRIG Sync Lost	True when IRIG signal is not being received.	Status Input IRIG_SYNC_LOST_ALM
KW Threshold	True when kW output is below the standard (non-Grid Code) PF Active Power Level.	Status Input KW_THRESHOLD_STATUS
Manual Mode Active	True when the unit is actively 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
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
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
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 has PF mode pre-selected.	Status Input PF_Active
PLL Sync Selected	True when phase locked loop (PLL) is selected. (Synchronizer screen)	Status Input PLL_SYNC_SELECTED

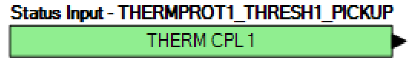
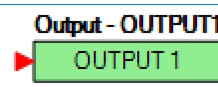
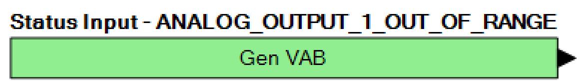
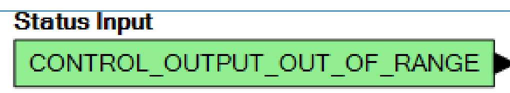
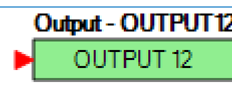
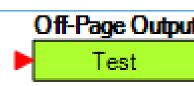
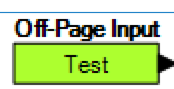
Name	Description	Symbol
Preposition Active	True when any preposition is active.	Status Input DECS_PREPOSITION
Preposition 1 Active	True when Preposition 1 is active.	Status Input PREPOSITION_1_ACTIVE
Preposition 2 Active	True when Preposition 2 is active.	Status Input PREPOSITION_2_ACTIVE
Preposition 3 Active	True when Preposition 3 is active.	Status Input PREPOSITION_3_ACTIVE
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 Active (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-450 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 mode's setpoint is at the lower limit.	Status Input Setpoint_At_Lower_Limit
Setpoint at Upper Limit	True when the active mode's setpoint is at the upper limit.	Status Input Setpoint_At_Upper_Limit
Soft Start Active	True during softstart.	Status Input SOFTSTART_ACTIVE
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

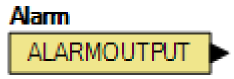
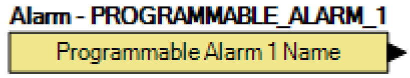
Name	Description	Symbol
Transfer Watchdog	True when watchdog has timed out and system control will switch to an alternate redundant DECS-450.	Status Input TRANSFERWATCHDOG
Transient Boost Active	True when transient boost is active.	Status Input TRANSIENT_BOOST_ACTIVE
UEL	True when the Under Excitation 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 has VAR mode pre-selected.	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_ACTIVE
Status, Protection		
24 Pickup	True when this protective element has picked up.	Status Input PROTECTION24PICKUP
24 Trip	True when this protective element has tripped.	Status Input PROTECTION24TRIP
25-1 Status	True when the conditions for synchronization are met.	Status Input PROTECTION25STATUS
27 Pickup	True when this protective element has picked up.	Status Input PROTECTION27PICKUP
27 Trip	True when this protective element has tripped.	Status Input PROTECTION27TRIP
32R Pickup	True when this protective element has picked up.	Status Input PROTECTION32RPICKUP
32R Trip	True when this protective element has tripped.	Status Input PROTECTION32RTRIP
40Q Pickup	True when this protective element has picked up.	Status Input PROTECTION40QPICKUP
40Q Trip	True when this protective element has tripped.	Status Input PROTECTION40QTRIP
59 Overvoltage Pickup	True when this protective element has picked up.	Status Input PROTECTION27TRIP

Name	Description	Symbol
59 Overvoltage Trip	True when this protective element has tripped.	Status Input PROTECTION59TRIP
81 Overfrequency Pickup	True when this protective element has picked up.	Status Input PROTECTION81O1PICKUP
81 Overfrequency Trip	True when this protective element has tripped.	Status Input PROTECTION81O1TRIP
81 Underfrequency Pickup	True when this protective element has picked up.	Status Input PROTECTION81U1PICKUP
81 Underfrequency Trip	True when this protective element has tripped.	Status Input PROTECTION81U1TRIP
Exciter Open Diode Pickup	True when this protective element has picked up.	Status Input EXCITEROPENDIODEPICKUP
Exciter Open Diode Trip	True when this protective element has tripped.	Status Input EXCITEROPENDIODETRIP
Exciter Shorted Diode Pickup	True when this protective element has picked up.	Status Input EXCITERSHORTEDDIODEPICKUP
Exciter Shorted Diode Trip	True when this protective element has tripped.	Status Input EXCITERSHORTEDDIODETRIP
Field Overcurrent Pickup	True when this protective element has picked up.	Status Input PROTFIELDOVERCURRENTPU
Field Overcurrent Trip	True when this protective element has tripped.	Status Input PROTFIELDOVERCURRENTTRIP
Field Overtemperature Pickup	True when this protective element has picked up.	Status Input PROTFIELDOVERTEMPERATUREPU
Field Overtemperature Trip	True when this protective element has tripped.	Status Input PROTFIELDOVERTEMPERATURETRIP
Field Overvoltage Pickup	True when this protective element has picked up.	Status Input PROTFIELDOVERVOLTAGEPU
Field Overvoltage Trip	True when this protective element has tripped.	Status Input PROTFIELDOVERVOLTAGETRIP
Gen Below 10 Hz Pickup	True when this protective element has picked up.	Status Input - PROTECTGENBELOW10HZPICKUP Gen Below 10Hz Pickup
Gen Below 10 Hz Trip	True when this protective element has tripped.	Status Input - PROTECTGENBELOW10HZTRIP Gen Below 10Hz Trip
Loss of Field Isolation Transducer Pickup	True when this protective element has picked up.	Status Input LOSSOFFIELDISOTRANSDUCERPICKUP
Loss of Field Isolation Transducer Trip	True when this protective element has tripped.	Status Input LOSSOFFIELDISOTRANSDUCERTRIP

Name	Description	Symbol
Loss of Sensing Pickup	True when this protective element has picked up.	Status Input LOSSOFSENSINGPICKUP
Loss of Sensing Trip	True when this protective element has tripped.	Status Input LOSSOFSENSINGTRIP
Status, Configurable Protection		
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 the *Protection* section 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
Status, Contact Expansion Module		
Contact Expansion Module Connected	Contact Expansion Module Connected. True when an optional CEM-125 or CEM-2020 is connected to the DECS-450.	Status Input CEM_CONNECTED
Contact Expansion Module Comms Failure	True when there is no communication from the CEM.	Status Input CEM_COMMS_FAILURE
Contact Expansion Module Duplicate CEM	True when more than one CEM is detected. Only one CEM is supported at a time.	Status Input CEM_DUP_CEM
Contact Expansion Module Hardware Mismatch	True when selected CEM type differs from detected CEM type. Go to *Settings Explorer, Communications, CAN Bus, Remote Module Setup* to select the CEM type (18 or 24 contacts).	Status Input CEM_HW_MISMATCH
Status, Analog Expansion Module		
Analog Expansion Module Connected	Analog Expansion Module Connected. True when an optional AEM-2020 is connected to the DECS-450.	Status Input AEM_CONNECTED
Analog Expansion Module Comms Failure	True when there is no communication from the AEM.	Status Input AEM_COMMS_FAILURE
Analog Expansion Module Duplicate AEM	True when more than one AEM is detected. Only one AEM is supported at a time.	Status Input DUP_AEM

Name	Description	Symbol
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 *Analog Expansion Module* section 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 ANALOG IN 1 Status Input - PROT1_THRESH1_TRIP ANALOG IN 1
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 IN 1
Analog Expansion Module Remote Analog Outputs 1-4	True when the analog output connection is open.	Status Input - AEM_OUTPUT_1_OUT_OF_RANGE Gen VAB
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 *Analog Expansion Module* section 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 - RTDPROT1_THRESH1_PU RTD IN 1 Status Input - RTDPROT1_THRESH1_TRIP RTD IN 1
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.	Status Input - RTD_INPUT_1_OUT_OF_RANGE RTD IN 1

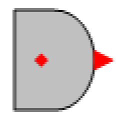
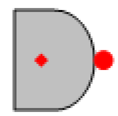
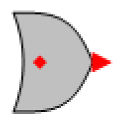
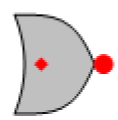
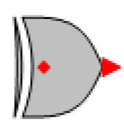
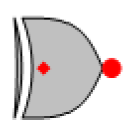
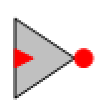
Name	Description	Symbol
Analog Expansion Module Remote Thermocouple Inputs 1-2	There are four thresholds for both of the Remote Thermocouple Input blocks. Each threshold has a separate logic block for the pickup and the trip. Remote Thermocouple Input #1 with its Threshold #1 Pickup and Trip blocks is shown to the right. For more details on configuring the Remote Thermocouple Inputs, see the *Analog Expansion Module* section 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.	 
Output Objects		
Physical Outputs OUT1 - OUT11	Physical Contact Outputs 1 through 11.	
Analog Outputs Analog Output M1 Out of Range – Analog Output M4 Out of Range	True when the selected parameter exceeds the set range.	
Analog Outputs Control Output Out of Range	True when the control output exceeds the selected range.	
Remote Outputs OUT12 - OUT35	Remote Contact Outputs 12 through 35. (Available when an optional CEM-125 or CEM-2020 is connected.)	
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.	
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		

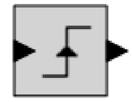
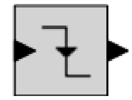
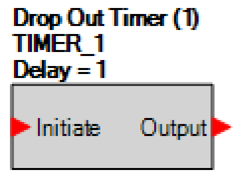
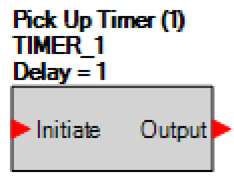
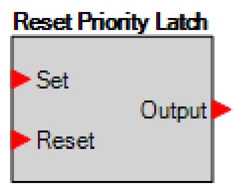
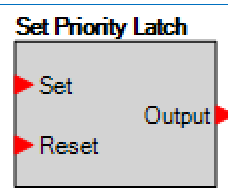
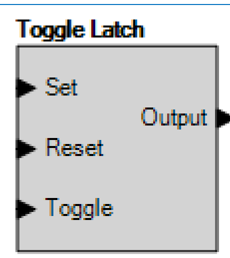
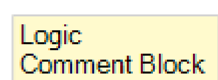
Name	Description	Symbol
Global Alarm	True when one or more alarms are set.	
Programmable Alarms 1 - 16	True when a programmable alarm is set.	

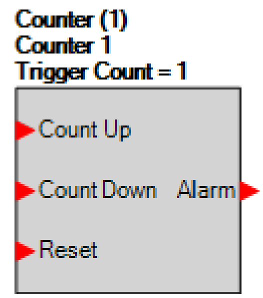
Components

This group contains Logic Gates, Pickup and Dropout Timers, Latches, and Comment Blocks. Table 19-2 lists the names and descriptions of the objects in the *Components* group.

Table 19-2. Components Group, Names and Descriptions

<table>
<tr><th>Name</th><th>Description</th><th>Symbol</th></tr>
<tr><td colspan="3">Logic Gates</td></tr>
<tr><td>AND</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>NAND</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>OR</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>NOR</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>XOR</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>XNOR</td><td><table><tr><th colspan="2">Input</th><th>Output</th></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></td><td></td></tr>
<tr><td>NOT (INVERTER)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td></td></tr>
</table>

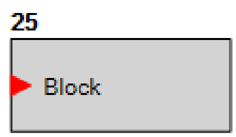
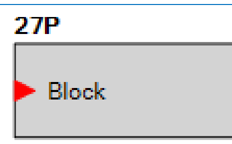
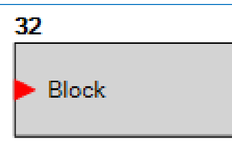
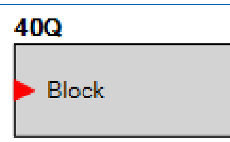
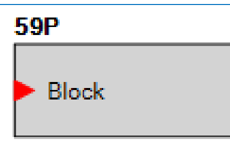
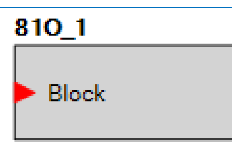
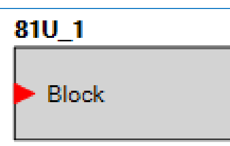
Name	Description	Symbol
Rising Edge	The output is TRUE when the rising edge of a pulse is detected on the input signal.	
Falling Edge	The output is TRUE when the falling edge of a pulse is detected on the input signal.	
Pickup and Dropout Timers		
Drop Out Timer	Used to set a delay in the logic. For more information, refer to *Programming BESTlogicPlus, Pickup and Dropout Timers,* later in this section.	
Pick Up Timer	Used to set a delay in the logic. For more information, refer to *Programming BESTlogicPlus, Pickup and Dropout Timers,* later in this section.	
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.	
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.	
Toggle 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. When the Toggle input is on, the latch will switch to the opposite state.	
Other		
Comment Block	Enter user comments.	

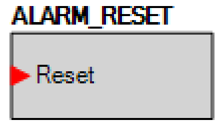
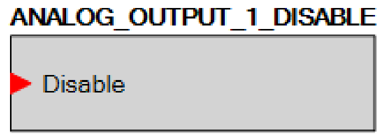
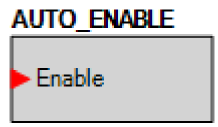
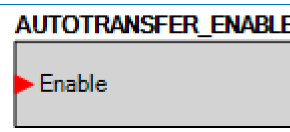
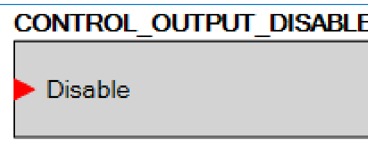
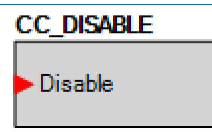
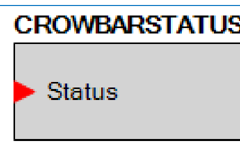
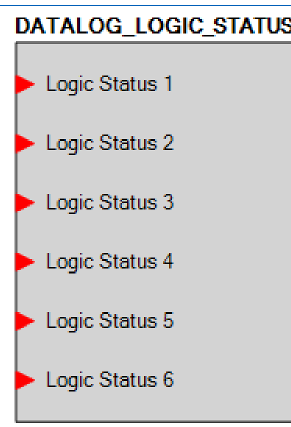
Name	Description	Symbol
Counter	True when the count reaches a user-selected number. COUNT_UP increments the count when a TRUE is received. COUNT_DOWN decrements the count when a TRUE is received. RESET resets the count to zero when a TRUE is received. OUTPUT is TRUE when the count reaches the trigger count. The trigger count is set by the user and is found in *Settings Explorer, BESTlogicPlus Programmable Logic, Logic Counters*.	

Elements

Table 19-3 lists the names and descriptions of the elements in the *Elements* group.

Table 19-3. Elements Group, Names and Descriptions

Name	Description	Symbol
24	When TRUE, this element blocks, or disables, the 24 overexcitation protection function.	
25	When TRUE, this element blocks, or disables, the 25 sync-check protection function.	
27P	When TRUE, this element blocks, or disables, the 27 undervoltage protection function.	
32	When TRUE, this element blocks, or disables, the 32 reverse power protection function.	
40Q	When TRUE, this element blocks, or disables, the 40Q loss of excitation protection function.	
59P	When TRUE, this element blocks, or disables, the 59 overvoltage protection function.	
81O	When TRUE, this element blocks, or disables, the 81O overfrequency protection function.	
81U	When TRUE, this element blocks, or disables, the 81U underfrequency protection function.	

Name	Description	Symbol
ALARM RESET	When TRUE, this element resets all active alarms.	
ANALOG OUTPUT 1-4 DISABLE	When TRUE, this element disables analog output 1. Similar elements are provided for analog outputs 2 through 4. Analog Output Disable: When TRUE, the analog output signal is electrically removed from the output terminal. (Note that metering in BESTCOMS*Plus* remains active.) This logic block allows for multiple analog outputs to be paralleled. Paralleling the analog outputs is useful when a primary and redundant DECS share a panel meter or firing circuit controller.	
AUTO ENABLE	When TRUE, this element sets the unit in Auto mode (AVR).	
AUTO TRANSFER ENABLE	When TRUE, this element sets the unit as secondary. When FALSE, the unit is primary.	
CONTROL OUTPUT DISABLE	When TRUE, this element disables the control output.	
CROSS CURRENT COMPENSATION DISABLE	When TRUE, this element disables cross current compensation.	
CROWBAR STATUS	When TRUE, this element sets the Crowbar Activated Status Input TRUE.	
DATALOG LOGIC STATUS	When TRUE, Logic Status x can be selected and displayed in the data log and the real-time monitor.	

Name	Description	Symbol
DATALOG TRIGGER	When TRUE, this element triggers the datalog to begin recording data.	DATALOGTRIGGER Trigger
DROOP DISABLE	When TRUE, this element disables droop when the unit is operating in AVR mode.	DROOP_DISABLE Disable
EXCITER OPEN DIODE	When TRUE, this element blocks, or disables, the Exciter Diode Monitor, Open Diode protection function.	EXCITEROPENDIODE Block
EXCITER SHORTED DIODE	When TRUE, this element blocks, or disables, the Exciter Diode Monitor, Shorted Diode protection function.	EXCITERSHORTEDDIODE Block
EXTERNAL TRACKING DISABLE	When TRUE, this element disables external tracking.	EXT_TRACKING_DISABLE Disable
FIELD OVERCURRENT	When TRUE, this element blocks, or disables, the Field Overcurrent protection function.	FIELD_OVERCURRENT Block
FIELD OVERTEMPERATURE	When TRUE, this element blocks, or disables, the Field Overtemperature protection function.	FIELD_OVERTEMPERATURE Block
FIELD OVERVOLTAGE	When TRUE, this element blocks, or disables, the Field Overvoltage protection function.	FIELD_OVERVOLTAGE Block
GEN BELOW 10 HZ	When TRUE, this element blocks, or disables, the Gen Below 10 Hz protection function.	GENBELOW10HZ Block
GENERATOR BREAKER	This element is used to connect the breaker open and close output signals from the DECS-450 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.	GENBRK Status Open Open Close Close

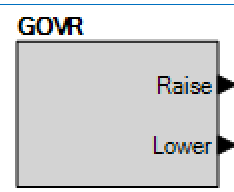
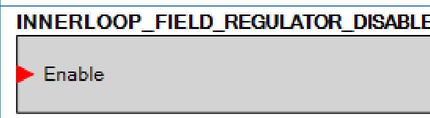
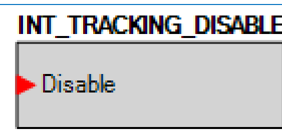
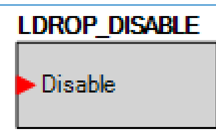
<u>GENERATOR BREAKER Inputs</u>

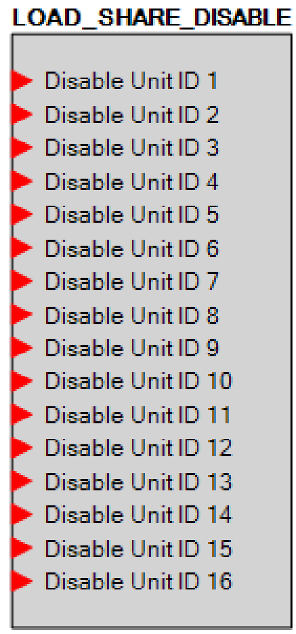
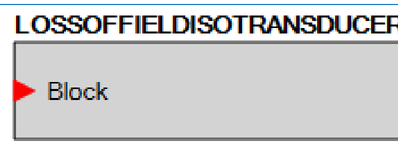
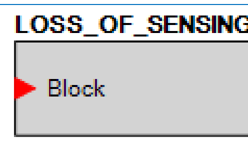
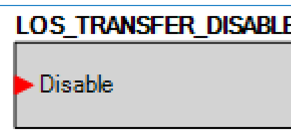
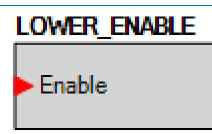
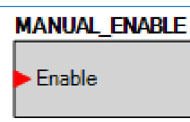
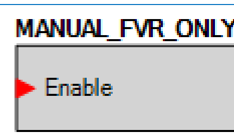
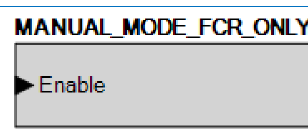
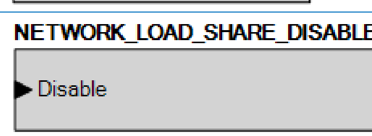
Status: This input allows a contact input to be mapped that will provide breaker status feedback to the DECS-450. When the contact input is closed, the breaker is indicated to be closed. When the contact input is open, the breaker is indicated to be open.

<u>GENERATOR BREAKER Outputs</u>

The outputs must be mapped to the contact outputs of the DECS-450 that will be used to drive the breaker.

Open: This output is pulsed TRUE (closes the output contact it is mapped to) when the DECS-450 is providing a signal to the breaker to open. It will be a pulse if the Breaker Output Contact Type is set to Pulse

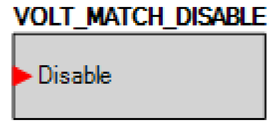
Name	Description	Symbol
Open: This input allows a contact input to be mapped that can be used to initiate a manual breaker open request. When this input is pulsed closed, the breaker opens. *Close:* This input allows a contact input to be mapped that can be used to initiate a manual breaker close request. 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-450 will synchronize the generator to the bus, and then close the breaker. If both open and close requests are made simultaneously, the open request will be prioritized.	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 close before the pulse is removed. *Close:* This output is pulsed TRUE (closes the output contact it is mapped to) when the DECS-450 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 Close 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.	
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.	
INNER LOOP FIELD REGULATOR DISABLE	When TRUE, this element disables the inner loop field regulator.	
INTERNAL TRACKING DISABLE	When TRUE, this element disables internal tracking.	
LINE DROP DISABLE	When TRUE, this element disables line drop when the unit is operating in AVR mode.	

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-450.	
LOSS OF FIELD ISOLATION TRANSDUCER	When TRUE, this element disables the Loss of Field Isolation Transducer function.	
LOSS OF SENSING DISABLE	When TRUE, this element disables the Loss of Sensing function.	
LOSS OF SENSING TRANSFER DISABLE	When TRUE, this element disables the transfer to Manual mode during a Loss of Sensing condition.	
LOWER ENABLE	When TRUE, this element lowers the active setpoint.	
MANUAL ENABLE	When TRUE, this element switches the unit to Manual mode.	
MANUAL FVR ONLY	When TRUE, this element switches the Manual mode to FVR.	
MANUAL MODE FCR ONLY	When TRUE, this element switches the Manual mode to FCR.	
NETWORK LOAD SHARE DISABLE	When TRUE, this element disables network load sharing.	

Name	Description	Symbol
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 Output 1 Output 2 Output 3 Output 4
OEL DISABLE	When TRUE, this element disables the OEL.	OEL_DISABLE Disable
OEL DISABLED IN MANUAL MODE	When TRUE, this element disables OEL when the unit is operating in Manual mode.	OEL_DISABLED_IN_MAN_MODE Enable
OEL ONLINE	When TRUE, this element enables the use of OEL when the unit is considered online.	OEL_ONLINE Enable
OEL SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings for OEL.	OEL_SELECT_GROUP_2 Enable
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 Enable
PID SELECT SECONDARY SETTINGS	When TRUE, this element selects secondary PID settings.	PID_SELECT_GROUP_2 Enable
PF/VAR ENABLE	When TRUE, this element enables the PF and Var controller. The Var/PF Selection element must be set to TRUE to use var or PF mode.	PF_VAR_ENABLE_JK Enable
PREPOSITION 1 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 1.	PREPOSITION_1_ENABLE Enable
PREPOSITION 2 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 2.	PREPOSITION_2_ENABLE Enable
PREPOSITION 3 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 3.	PREPOSITION_3_ENABLE Enable
PROTECTION SELECT SECONDARY SETTINGS	When TRUE, this element informs the unit to use secondary values for protection.	PROTECT_SELECT_GROUP_2 Enable

Name	Description	Symbol
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 1XXXXXX)	PSS_CNTRL_OUT_DISABLE Disable
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 1XXXXXX)	PSS_SEQ_CNTRL_ENABLED Enable
PSS SEQ CNTRL SELECTION	When TRUE, ACB phase rotation is selected. When FALSE, ABC phase rotation is selected. (Available when the controller is equipped with the optional Power System Stabilizer, style number 1XXXXXX)	PSS_SEQ_CNTRL_SELECTION Mode
PSS MOTOR	When TRUE, the PSS is in motor mode. When FALSE the PSS is in generator mode. (Available when the controller is equipped with the optional Power System Stabilizer, style number 1XXXXXX)	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 1XXXXXX)	PSS_SELECT_GROUP_2 Enable
RAISE ENABLE	When TRUE, this element raises the active setpoint.	RAISE_ENABLE Enable
SCL DISABLE	When TRUE, this element disables the SCL.	SCL_DISABLE Disable
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 soft start.	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

Name	Description	Symbol
SYSTEM IN USE STATUS	When TRUE, users will be prompted before making changes that could affect real time processes.	SYSTEMINUSE System In Use
Transfer Watchdog Trip	When TRUE, this element energizes the transfer watchdog output relay.	TransferWatchdogTrip Trip
UEL DISABLE	When TRUE, this element disables the UEL.	UEL_DISABLE Disable
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
UNDERFREQUENCY V/HZ DISABLE	When TRUE, this element disables the V/Hz Underfrequency limiter.	UNDERFREQUENCYVHZ_DISABLE Disable
USER PROGRAMMABLE ALARM 1 - 16	When TRUE, this element triggers a programmable alarm.	USERALM1 Programmable Alarm 1 Name Trigger
VAR LIMITER DISABLE	When TRUE, this element disables the var limiter.	VAR_LIMITER_DISABLE Disable
VAR LIMITER SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings on the Var limiter.	VAR_LIM_SELECT_GROUP_2 Enable
VAR/PF MODE	The var input selects var control and the PF input selects power factor control.	VAR_PF_MODE Off var PF
VAR/PF SELECT ENABLE	When TRUE, this element allows the selection of Var and PF modes.	VAR_PF_SELECT_ENABLE Enable

Name	Description	Symbol
VOLTAGE MATCHING DISABLE	When TRUE, this element disables voltage matching when the unit is operating in AVR mode.	

Logic Schemes

A logic scheme is a group of interconnected logic blocks that define the operation of a DECS-450 Digital Excitation System. Only one logic scheme can be active at a 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-450 needs an active logic scheme in order to function. All DECS-450 controllers are delivered with a default, active logic scheme preloaded in memory. If the default logic scheme meets the requirements of your application, then only the operating settings (system parameters and threshold settings) need to be adjusted before placing the DECS-450 in service.

Sending and Retrieving Logic Schemes

Retrieving a Logic Scheme from the DECS-450

To retrieve settings from the DECS-450, the unit must be connected to a computer through a communications port. Once connected, settings can be downloaded from the DECS-450 by selecting *Download Settings and Logic* on the *Communication* menu.

Sending a Logic Scheme to the DECS-450

To send settings to the DECS-450, the unit must be connected to a computer through a communications port. Once connected, settings can be uploaded to the DECS-450 by selecting *Upload Settings and Logic* on the *Communication* menu.

Caution
Always remove the DECS-450 from service prior to changing or modifying the active logic scheme. Attempting to modify a logic scheme while the DECS-450 is in service could generate unexpected or unwanted outputs. Modifying a logic scheme in BESTCOMS*Plus*® does not automatically make that scheme active in the DECS-450. The modified scheme must be uploaded into the DECS-450. 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 19-2 and Figure 19-3 and the default logic scheme for PSS-enabled systems is shown in Figure 19-4, Figure 19-5, and Figure 19-6. The default logic for physical outputs is the same for PSS-disabled and PSS-enabled systems and is shown in Figure 19-7.

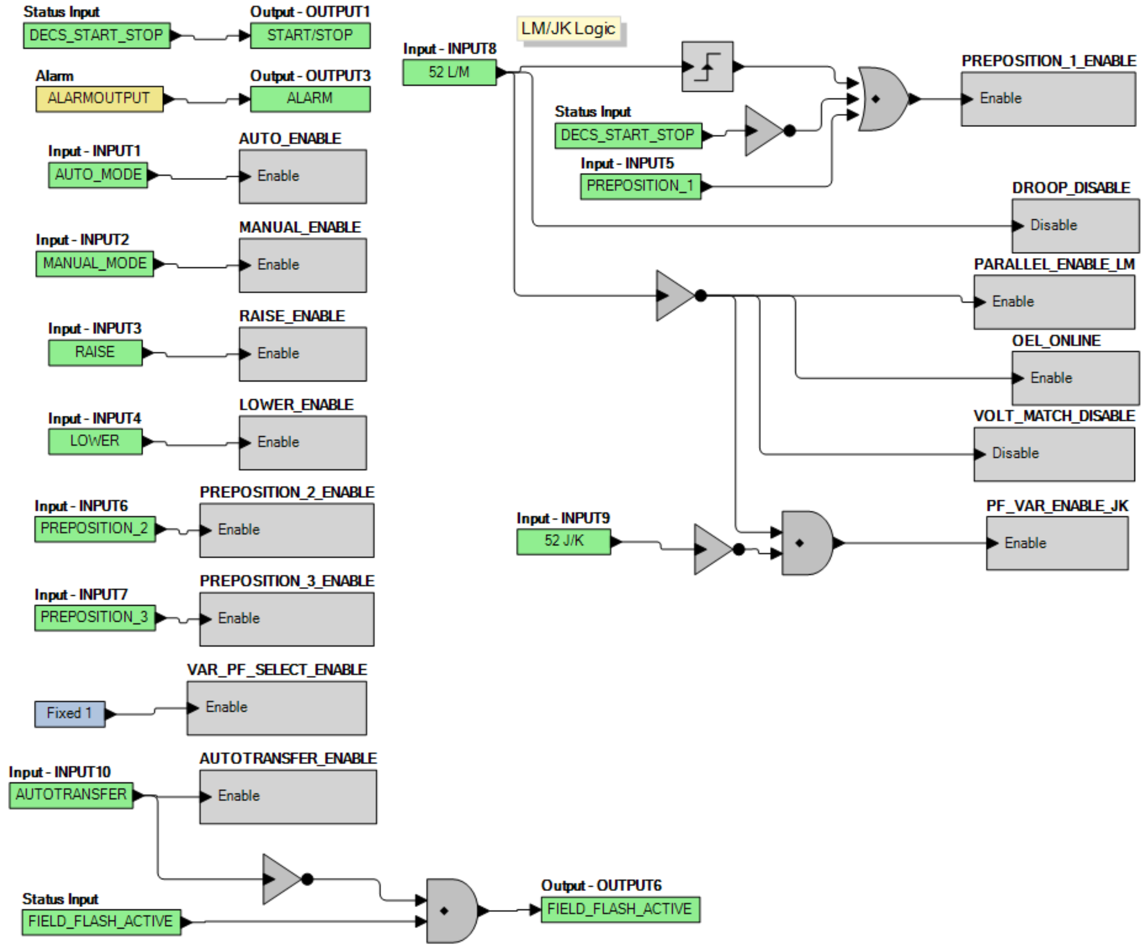


Figure 19-2. PSS-Disabled Default Logic – Logic Page 1 Tab

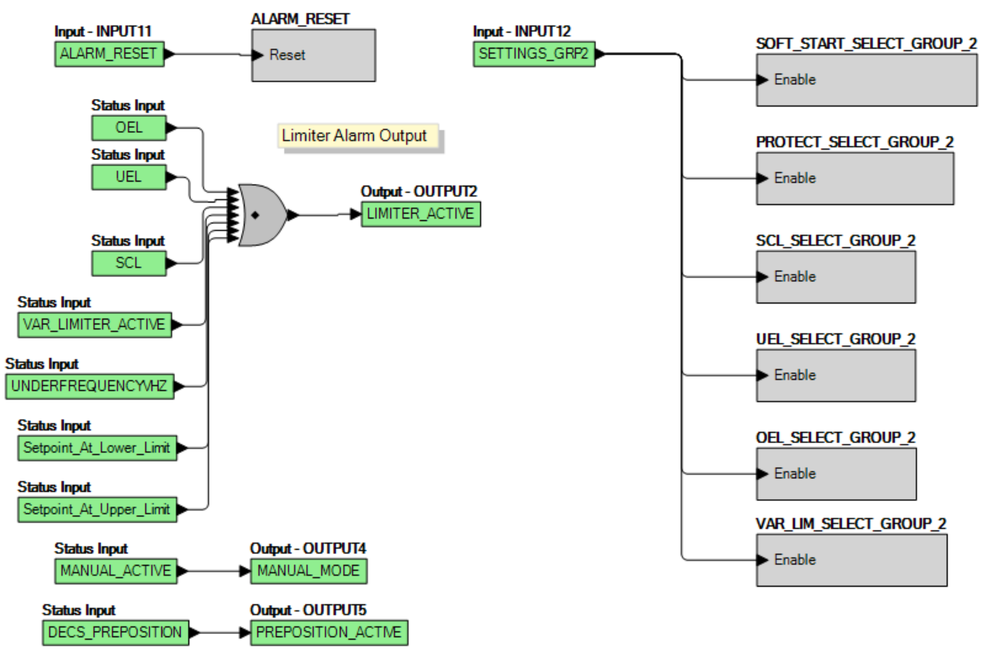


Figure 19-3. PSS-Disabled Default Logic - Logic Page 2 Tab

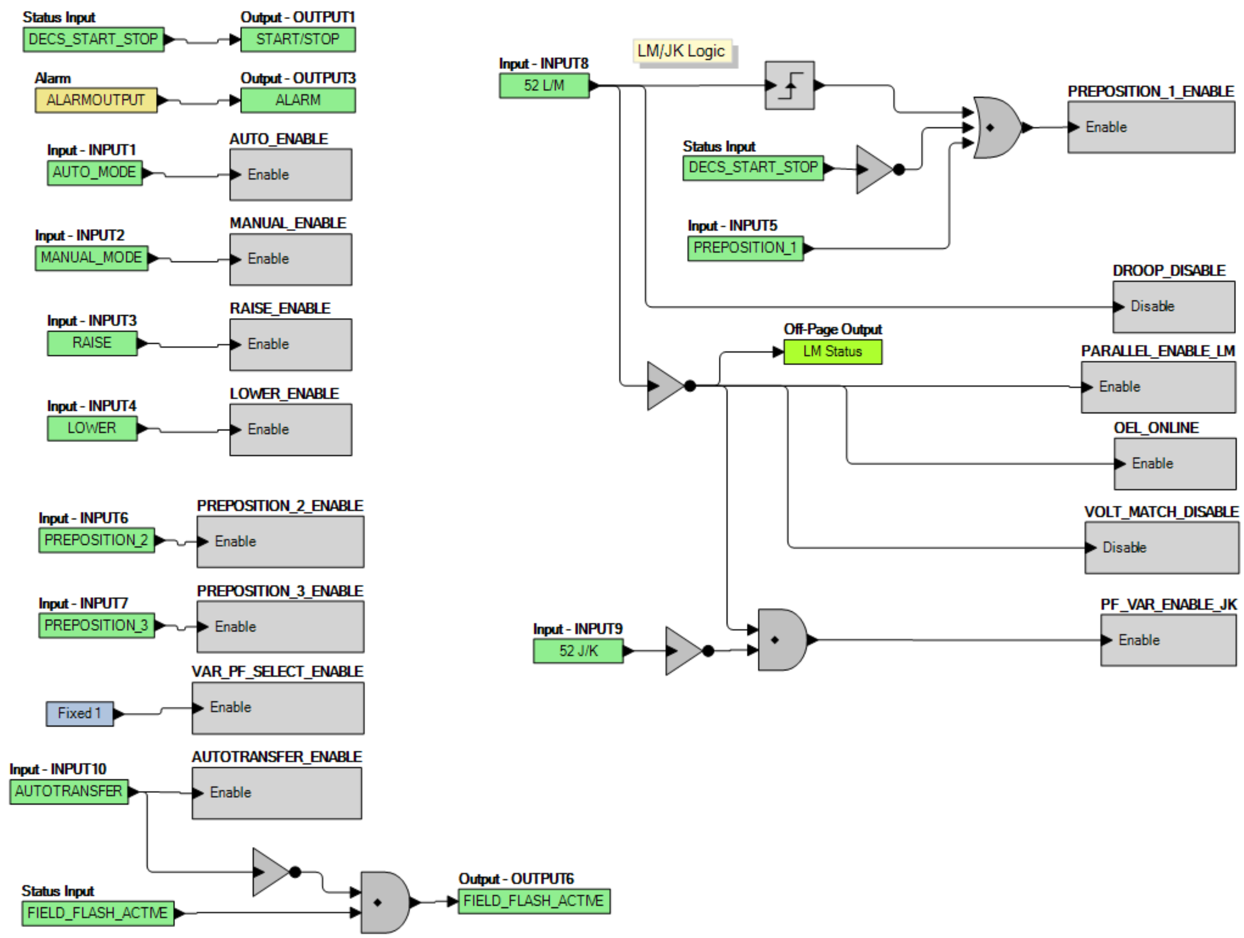


Figure 19-4. PSS-Enabled Default Logic - Logic Page 1 Tab

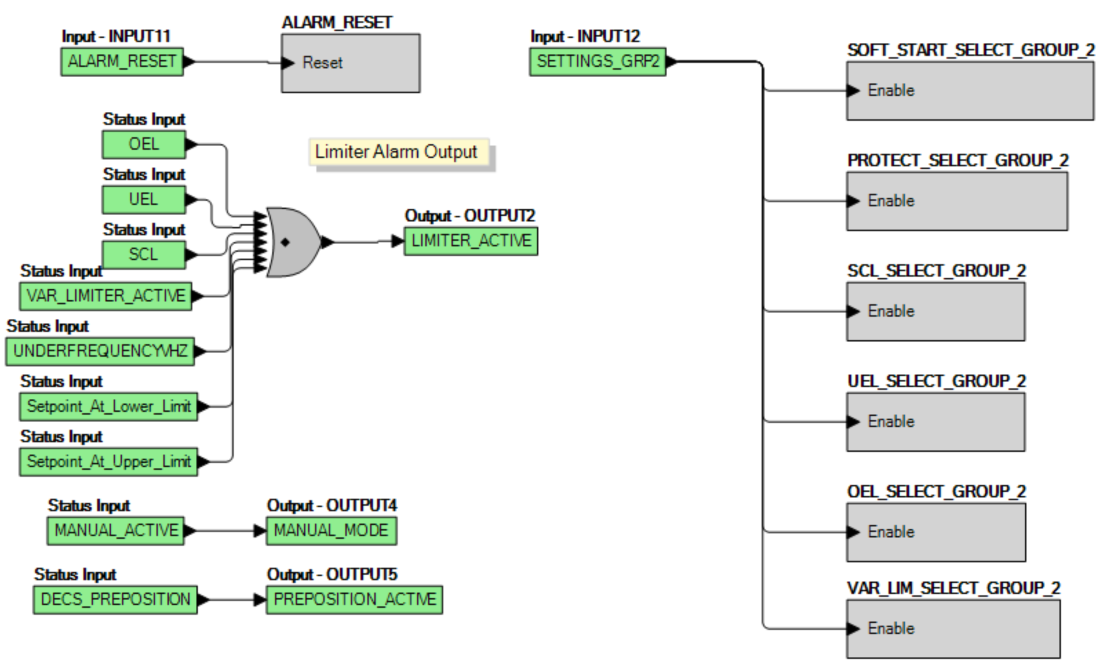


Figure 19-5. PSS-Enabled Default Logic - Logic Page 2 Tab

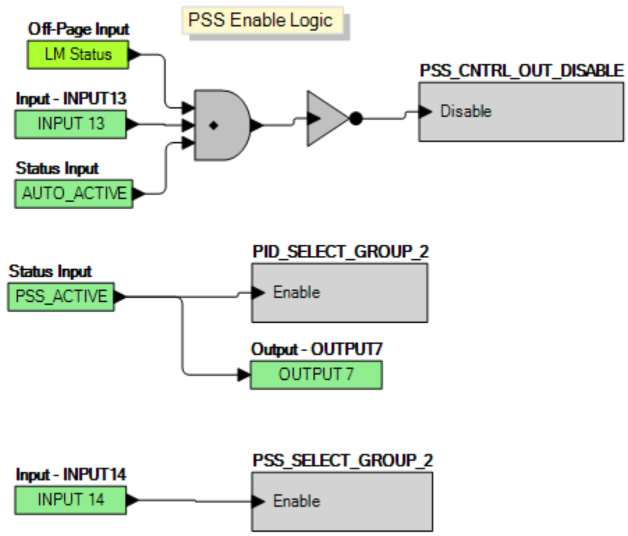


Figure 19-6. PSS-Enabled Default Logic - Logic Page 3 Tab

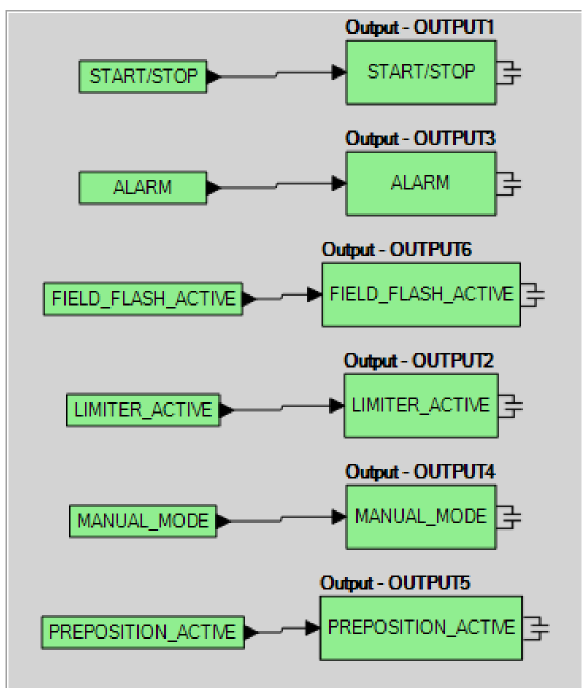


Figure 19-7. Default Logic - Physical Outputs Tab

Programming in BESTlogic™Plus

To program BESTlogic*Plus*, use the Settings Explorer within BESTCOMS*Plus* to open the *BESTlogicPlus Programmable Logic* tree branch as shown in Figure 19-1.

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 link from port to port (triangles), left click on a port, pull the link onto another port, and release the left mouse button. The endpoint of the link automatically snaps to the nearest port when within a certain proximity. 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 links from input to input or output to output is not allowed. Only one link may be connected to any one output.

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-450.

Logic blocks may be automatically arranged by right clicking a blank area in the program grid and selecting *Auto-Layout.*

The following conditions must be met before BESTCOMS*Plus* will allow logic to be uploaded to the DECS-450:

- 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 is considered 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 includes 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 indicators are located in the lower right corner of the BESTlogic*Plus* window. These indicators show the *Logic Save Status*, *Logic Diagram Status*, and *Logic Layer Status*. Table 19-4 defines the colors for each indicator.

Table 19-4. Status Indicators

Indicator	Color	Definition
Logic Save Status (Left)	Orange	Logic has changed since last save.
	Green	Logic has NOT changed since last save.
Logic Diagram Status (Center)	Red	Requirements NOT met as listed above.
	Green	Requirements met as listed above.
Logic Layer Status (Right)	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 19-8, *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 will appear on the timer logic block. The *Time Delay* value range is 0 to 250 hours in 1 hour increments, 0 to 59 minutes in 1 minute increments, or 0 to 59.9 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 and pick *Select Timer* from the menu to open the *Logic Timer Properties* window. From here, select the desired timer's radio button and click OK.

Timing accuracy is ±15 milliseconds.

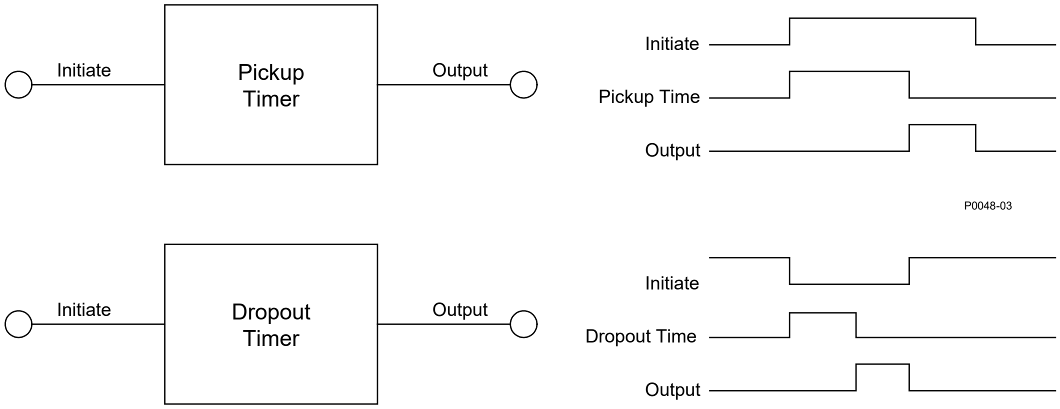


Figure 19-8. Pickup and Dropout Timer Logic Blocks

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.

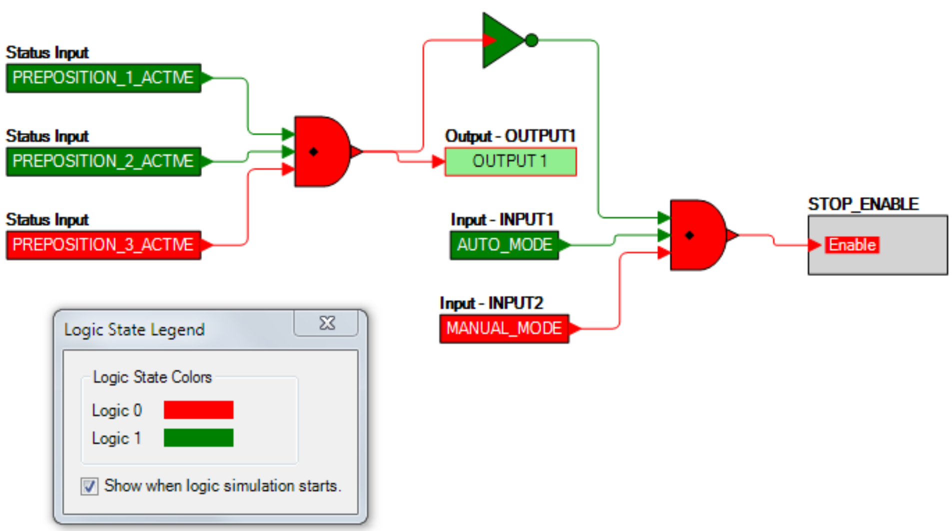


Figure 19-9. Offline Logic Simulator Example

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 BESTlogic*Plus* 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 BESTlogic*Plus* 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 19-9. 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).

BESTlogic™Plus File Management

To manage BESTlogic*Plus* files, use the Settings Explorer to open the *BESTlogicPlus Programmable Logic* tree branch. Use the BESTlogic*Plus* Programmable Logic toolbar to manage BESTlogic*Plus* files. Refer to Figure 19-10. For information on Settings Files management, refer to the *BESTCOMSPlus Software* section.

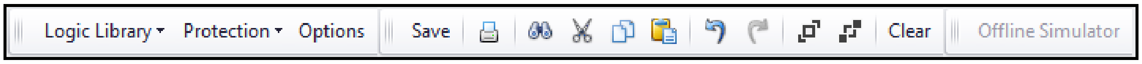


Figure 19-10. BESTlogic*Plus* Programmable Logic Toolbar

Saving a BESTlogic*Plus* File

After programming BESTlogic*Plus* settings, click on the *Save* button to save the settings to memory.

Before the new BESTlogic*Plus* settings can be uploaded to the DECS-450, you must select *Save* from the *File* pull-down menu located at the top of the BESTCOMS*Plus* main shell. This step will save both the BESTlogic*Plus* settings and the operating settings to a file.

The user also has the option to save the BESTlogic*Plus* settings to a unique file that contains only BESTlogic*Plus* settings. Click on the *Logic Library* drop-down button and select *Save Logic Library File.* Use standard Windows® techniques to save the file and enter a filename.

Opening a BESTlogic*Plus* File

To open a saved BESTlogic*Plus* file, click on the *Logic Library* down button on the BESTlogic*Plus* Programmable Logic toolbar and select *Open Logic Library File.* Use standard Windows techniques to find and open the file.

Protecting a BESTlogic*Plus* File

Locking and protecting is useful when sending logic files to other personnel to be modified. 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* button. Establishing a password is optional.

Uploading a BESTlogic*Plus* File

To upload a BESTlogic*Plus* file to the DECS-450, first open, or create, the file in BESTCOMS*Plus*. Then click the *Communication* menu and select *Upload Logic.*

Downloading a BESTlogic*Plus* File

To download a BESTlogic*Plus* file from the DECS-450, click the *Communication* menu and select *Download Settings and Logic from Device.* If the logic currently in BESTCOMS*Plus* has changed, a dialog box will prompt you to save the current logic changes, then the download will begin.

Copying and Renaming Preprogrammed Logic Schemes

To copying a saved logic scheme and assign a unique name, load the desired logic scheme into BESTCOMS*Plus.* Click on the *Logic Library* button and select *Save Logic Library File.* Use standard Windows® techniques to save the new file and enter a unique filename.

Printing a BESTlogic*Plus* File

Clicking the *Printer* icon, located on the BESTlogic*Plus* Programmable Logic toolbar, opens the *Print Preview* screen. This screen displays a print preview of the logic scheme and provides many standard printer and page setup settings.

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 19-11 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.

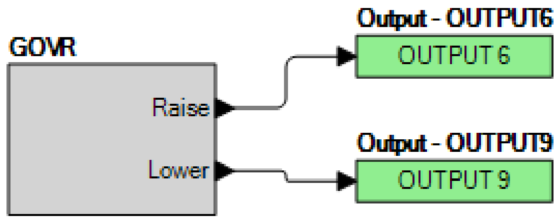


Figure 19-11. Example 1 - GOVR Logic Block Connections

Example 2 - AND Gate Connections

Figure 19-12 illustrates a typical AND gate connection. In this example, Output 11 will become active when the bus and the generator are dead.

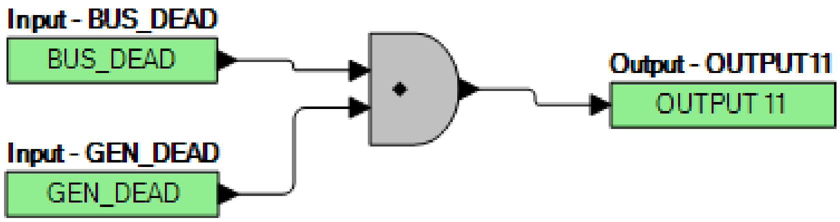


Figure 19-12. Example 2 - AND Gate Connections

20 • Communication

Local Communication

The USB port (type B) connects the DECS-450 with a PC operating BESTCOMS*Plus*® 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* section of this manual. A USB device driver for the DECS-450 is automatically installed on your PC during the installation of BESTCOMS*Plus*. Information about establishing communication between BESTCOMS*Plus* and the DECS-450 is provided in the *BESTCOMSPlus Software* section of this manual.

Caution
This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

Communication with a Second DECS-450

BESTCOMS*Plus* Navigation Path: Settings Explorer, Communications, RS232 Setup
HMI Navigation Path: Settings, Communications, RS232 Setup.

Communication between two DECS-450s enables external regulation setpoint tracking to occur in a dual, or redundant, application.

DECS-450 controllers use a female DB-9 (RS-232) connector for communication. This connector is located on the rear panel and is illustrated in the *Terminals and Connectors* section of this manual. A five-foot (1.5 meter) cable, part number 9310300032, is available for interconnecting two DECS-450 controllers.

Modbus® Communication

BESTCOMS*Plus* Navigation Path: Settings Explorer, Communications, Modbus Setup
HMI Navigation Path: Settings, Communications, Modbus

DECS-450 systems support the RS-485 mode and Modbus TCP (Ethernet) mode at the same time. DECS-450 Modbus communication registers are listed and defined in the *Modbus Communication* section of this manual.

Modbus settings for RS-485 and Ethernet are illustrated in Figure 20-1.

Figure 20-1. Modbus Setup

RS-485 Communication

BESTCOMS*Plus* 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-801 Interactive Display Panel. RS-485 terminals are located on the rear 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 20-2 illustrates typical RS-485 connections for multiple DECS-450 controllers communicating over a Modbus network.

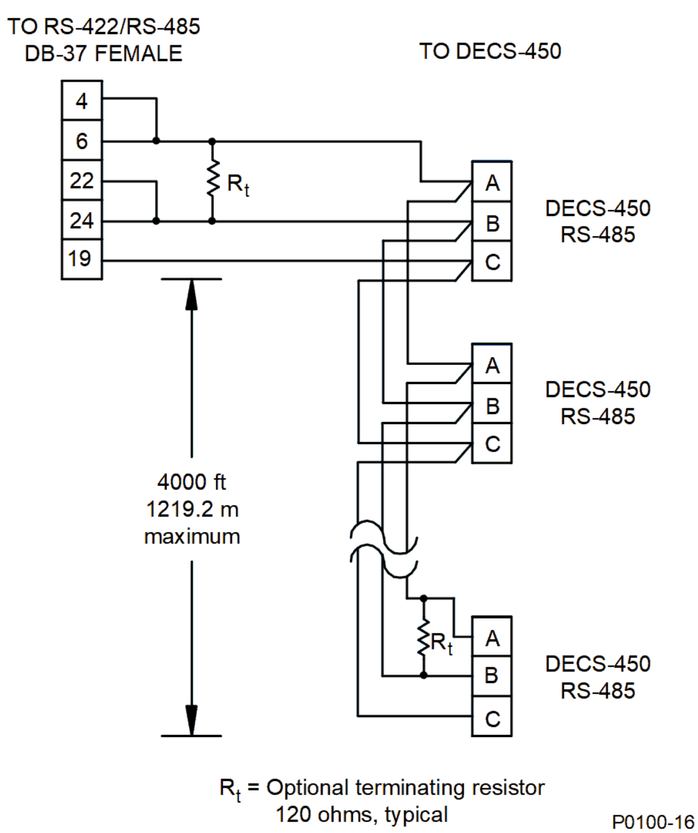


Figure 20-2. Typical RS-485 Connections

RS-485 port communication settings are illustrated in Figure 20-3.

Figure 20-3. RS-485 Port Communication Settings

CAN Communication

BESTCOMS*Plus* Navigation Path: Settings Explorer, Communications, CAN Bus, CAN Bus Setup
HMI Navigation Path: Settings, Communications, CAN Bus, CAN Bus Setup

Two separate CAN (controller area network) ports are provided on the DECS-450. One CAN interface (CAN 1) facilitates communication between the DECS-450 and optional modules such as the contact expansion module (CEM-125 or CEM-2020) or analog expansion module (AEM-2020). A second CAN interface (CAN 2) enables the DECS-450 to transmit generator and system parameters to a generator controller such as Basler's DGC-2020HD. CAN 2 also permits DECS-450 setpoint and mode control from an external device connected to the CAN.

Both CAN bus interfaces utilize the SAE J1939 messaging protocol.

DECS-450 CAN parameters are listed and defined in the *CAN Communication* section of this manual.

Connections

DECS-450 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* section of this manual.

Port Configuration

Each DECS-450 CAN port must be identified by a unique address number. The baud rate of each port can be configured for 125 kbps or 250 kbps.

The Allowed Command Address is the J1939 address from which the DECS-450 will accept broadcast data. If the address is set to 255 or the same as the DECS-450 CAN Bus Interface address, then broadcast data is accepted from any address. Otherwise, broadcast data is accepted from only the specified address. Port configuration settings are illustrated in Figure 20-4.

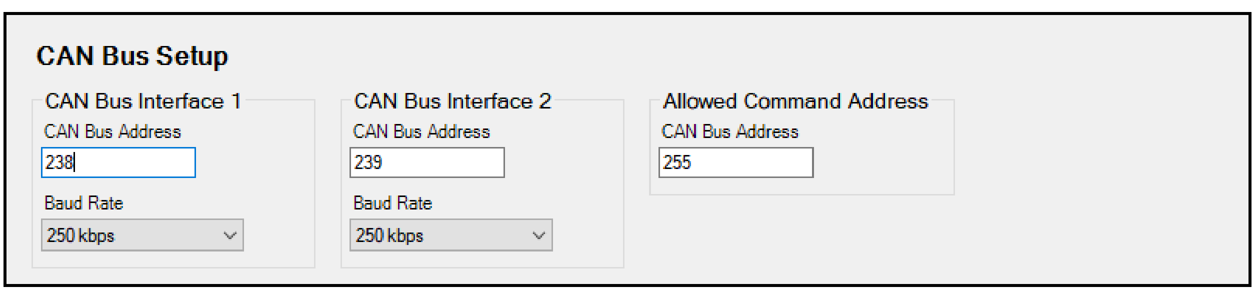


Figure 20-4. CAN Port Configuration Settings

Remote Module Setup

BESTCOMS*Plus* 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-125 or CEM-2020) and analog expansion module (AEM-2020), communicate via the DECS-450 CAN 1 interface and are configured through the DECS-450 front panel HMI and BESTCOMS*Plus*. These settings are illustrated in Figure 20-5.

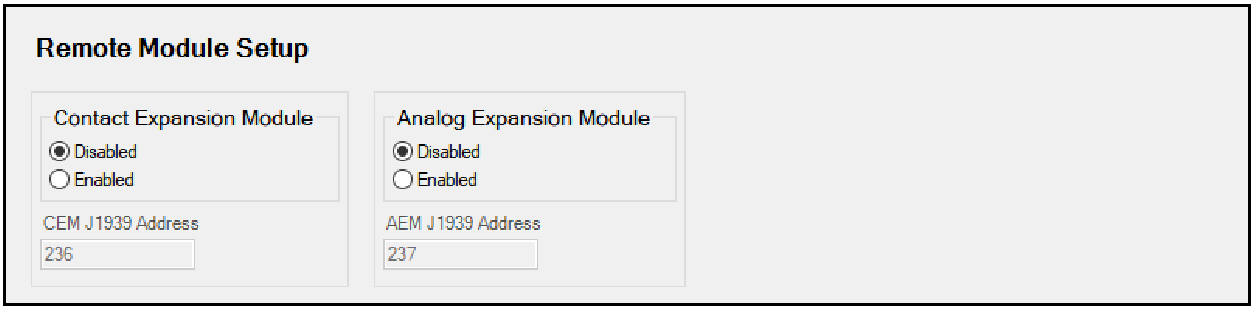


Figure 20-5. Remote Module Setup

Ethernet Communication

An Ethernet port uses the Modbus TCP protocol for polled communication with other networked devices or remote annunciation and control with an IDP-801 or IDP-1201 Interactive Display Panel.

Depending upon the style number, each DECS-450 is equipped with either a copper (100BASE-TX) Ethernet communication port (style XXXXXTX) or a fiber optic (100BASE-FX) Ethernet communication port (style XXXXXFX). The ST type fiber optic port uses a 1300 nanometer, near-infrared (NIR) light wavelength transmitted via two strands of multimode optical fiber, one for receive (RX) and the other for transmit (TX). The copper or fiber optic Ethernet connector is located on the rear panel. DECS-450 metering, annunciation, and control is provided through the Ethernet port using the Modbus TCP protocol. DECS-450 Modbus communication registers are listed and defined in the *Modbus Communication* section 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-450 to the PC using a standard Ethernet cable.
2. In BESTCOMS*Plus*, click *Communication, New Connection, DECS-450*, or click the *Connection* button on the lower menu bar. The DECS-450 Connection window appears. (Figure 20-6)
3. If you know the IP address of the DECS-450, click the radio button for the Ethernet Connection IP at the top of the DECS-450 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 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 20-7)

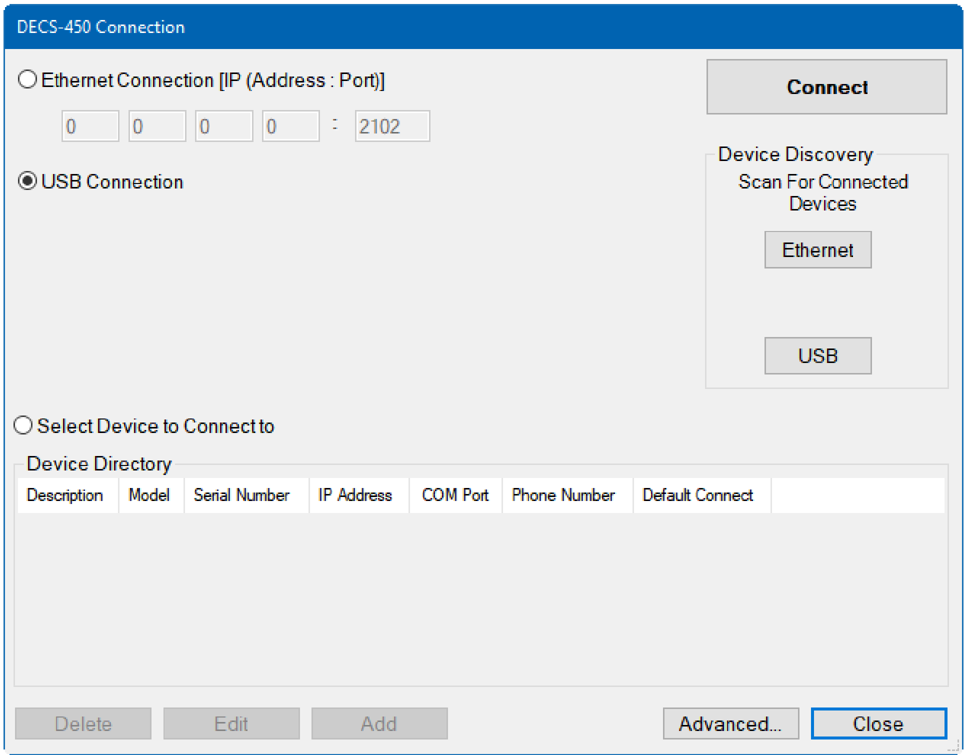


Figure 20-6. DECS-450 Connection Window

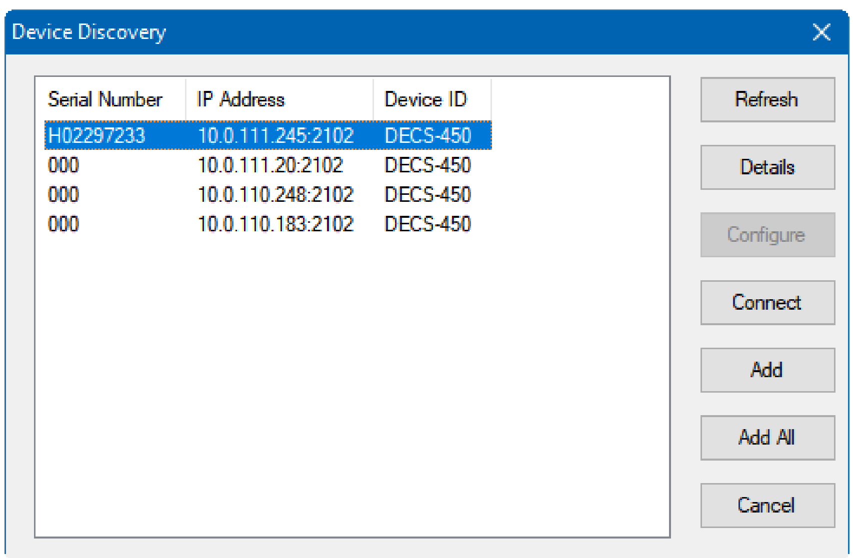


Figure 20-7. Device Discovery Window

5. Adding any or all of the detected devices to the Device Directory eliminates 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-450 Connection window.
6. Choose the desired device from the list and click *Connect.* Wait for connection to complete.

7. The *Advanced* button displays the window shown in Figure 20-8. It contains options for enabling Auto Reconnect, downloading settings after reconnect, the delay between retries (in milliseconds), and the maximum number of attempts (Figure 20-8).

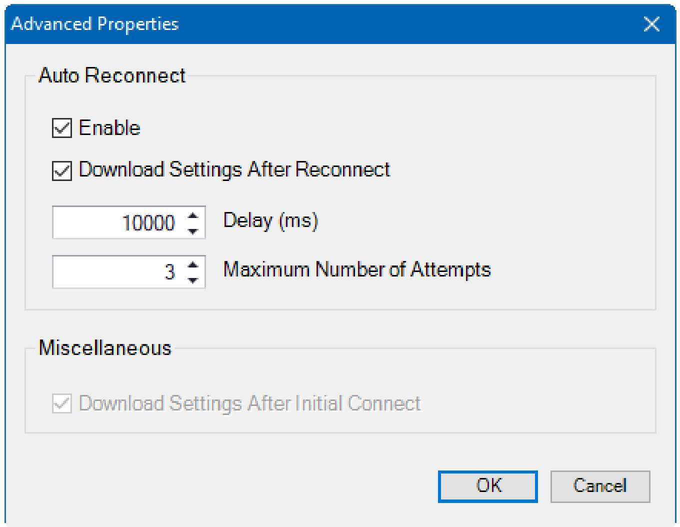


Figure 20-8. Advanced Properties, Auto Reconnect

Note
The PC running BESTCOMS*Plus* software must be configured correctly to communicate with the DECS-450. The PC must have an IP address in the same subnet range as the DECS-450 if the DECS-450 is operating on a private, local network. Otherwise, the PC must have a valid IP address with access to the network and the DECS-450 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

BESTCOMS*Plus* Navigation Path: Settings Explorer, Communications, Profibus Setup
HMI Navigation Path: Settings, Communications, Profibus

On units equipped with the PROFIBUS communication protocol (style XX1XXXX), the DECS-450 sends and receives PROFIBUS data through a DB-9 port located on the rear panel. DECS-450 PROFIBUS communication parameters are listed and defined in the *PROFIBUS Communication* section of this manual.

PROFIBUS communication settings are illustrated in Figure 20-9.

Figure 20-9. Profibus Setup

21 • Configuration

Before the DECS-450 is placed in service, it must be configured for the controlled equipment and application.

Operating Mode

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Operating Mode
HMI Navigation Path: Settings, Operating Settings, Operating Mode

Operating mode settings are illustrated in Figure 21-1.

Mode

The mode can be set to accommodate a generator or motor application. Based on this setting, all parameter and setting labels displayed in BESTCOMS*Plus* and on the HMI display adjust automatically to show the appropriate machine type (generator or motor).

In Motor mode, there is an inverse relationship between excitation (field current) and vars. As excitation increases, the amount of vars supplied to the motor decreases.

Raise/Lower Configuration

Raise/Lower Configuration settings are available to customize how the DECS-450 responds while operating in Motor mode.

When Adjust Excitation is selected, a Raise command increases excitation and a Lower command decreases excitation.

When Adjust Setpoint is selected, the DECS-450 responds to Raise and Lower commands by Raising or Lowering the setpoint for the mode in control.

Figure 21-1. Operating Mode

Generator, Field, and Bus Ratings

BESTCOMS*Plus* 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 21-2.

For proper excitation control and protection, the DECS-450 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, frequency, power factor, and apparent power (kVA). Generator current and real power (kW) 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 and current, full load voltage and current, field resistance, ambient temperature and brush voltage drop.

In applications where the generator will be synchronized/paralleled with a bus, the DECS-450 must be configured with the rated bus voltage.

The *Operating Power, PPT Secondary Voltage* setting is used to calculate the recommended Ka (Loop Gain) value.

When using the DECS-450 with an exciter requiring an inverted output, enable the *Invert Output* setting to invert the DECS-450 control output. Refer to the *Programmable Inputs and Outputs* section in the manual for more information.

Caution
Selecting inverted control output with an excitation system that does not require it may result in equipment damage.

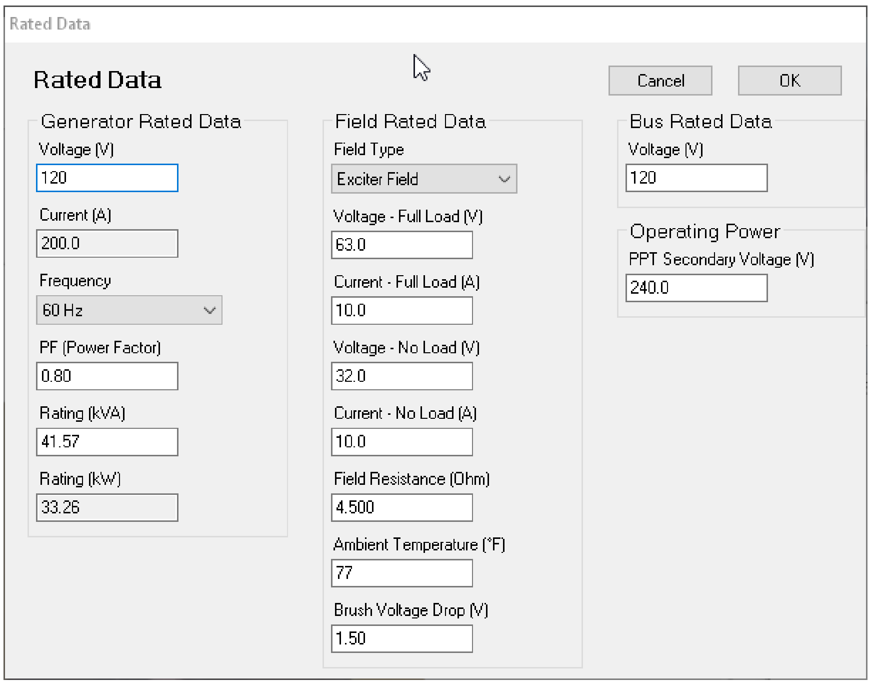


Figure 21-2. Generator, Bus, Field, Ratings

Field Isolation Transducer

BESTCOMSPlus Navigation Path: Settings Explorer, System Parameters, Field Isolation Transducer
HMI Navigation Path: Settings, System Parameters, Field Isolation Transducer

Figure 21-3. Field Isolation Transducer Ratings

Field Isolation Transducer configuration consists of settings for shunt rating and field voltage input. See Figure 21-3.

Sensing Transformer Ratings and Configuration

BESTCOMS*Plus* Navigation Path: Settings Explorer, System Parameters, Sensing Transformers
HMI Navigation Path: Settings, System Parameters, Sensing Transformers

DECS-450 configuration includes entry of the primary and secondary values for the transformers that supply generator and bus sensing values to the DECS-450. These configuration settings are illustrated in Figure 21-4.

Generator PT

Voltage settings for the generator PT primary and secondary windings establish the nominal PT voltages expected by the DECS-450. Phase rotation (ABC or ACB) can be specified. Options for the generator voltage sensing connections include single-phase (across phases A and C) and three-phase sensing.

Generator CTs

Current settings for the generator CT primary and secondary windings establish the nominal CT current values expected by the DECS-450. Options for the generator current sensing connections include A-phase, B-phase, C-phase, or three-phase.

Bus PT

Voltage settings for the bus PT primary and secondary windings establish the nominal bus PT voltages expected by the DECS-450. Options for the bus voltage sensing connections include single-phase (across phases A and C) and three-phase sensing.

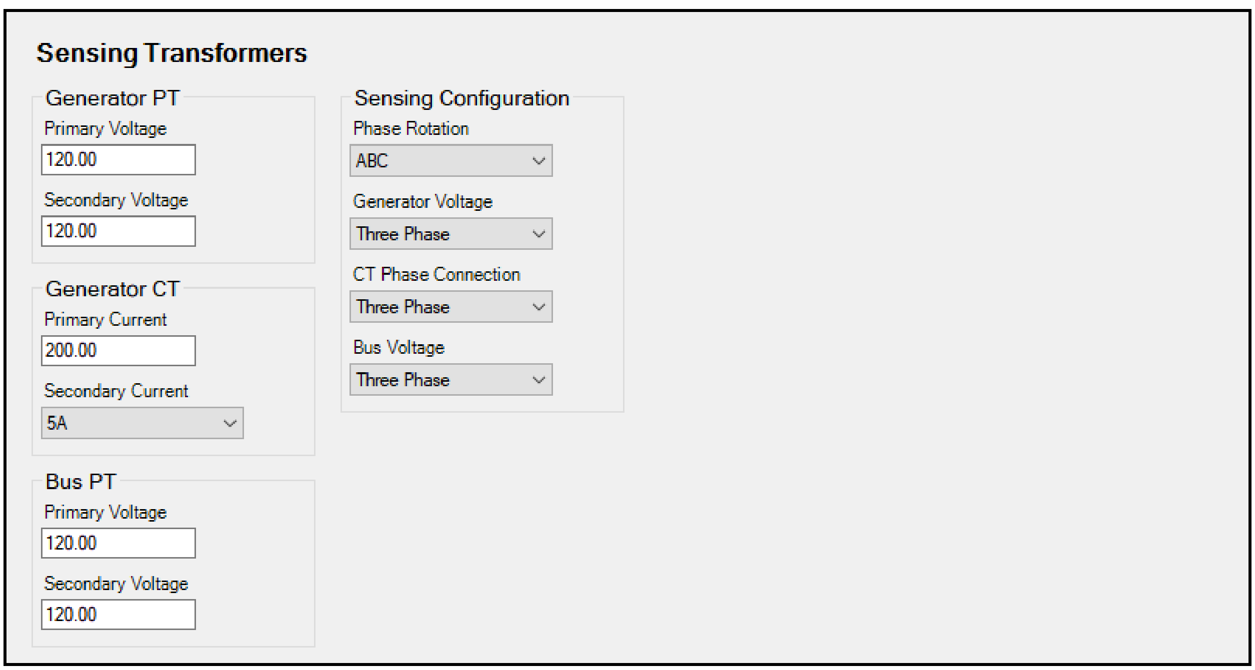


Figure 21-4. Sensing Transformer Ratings and Configuration

Startup Functions

BESTCOMS*Plus* Navigation Path: Settings Explorer, Operating Settings, Startup
HMI Navigation Path: Settings, Operating Settings, Startup

DECS-450 startup functions consist of soft start and field flashing. These settings are illustrated in Figure 21-5.

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 is expressed as a percentage of the setpoint of the active mode and determines the starting point for generator voltage buildup during startup. The soft start time 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 setting determines the level where field flashing is withdrawn. The field flash dropout level is expressed as a percentage of the setpoint of the active mode.

The Maximum Field Flash Time setting defines the maximum length of time that field flashing may be applied during startup.

To use the field flashing function, one of the DECS-450 programmable contact outputs must be configured as a field flashing output.

Figure 21-5. Startup Function Settings

Device Information

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Info
HMI Navigation Path: Settings, General Settings, Device Information, DECS-450

Device information includes user-assigned identification labeling and read-only firmware version information and product information. Device information (Figure 21-6) is provided for the DECS-450, CEM-125 or 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 BESTCOMS*Plus*.

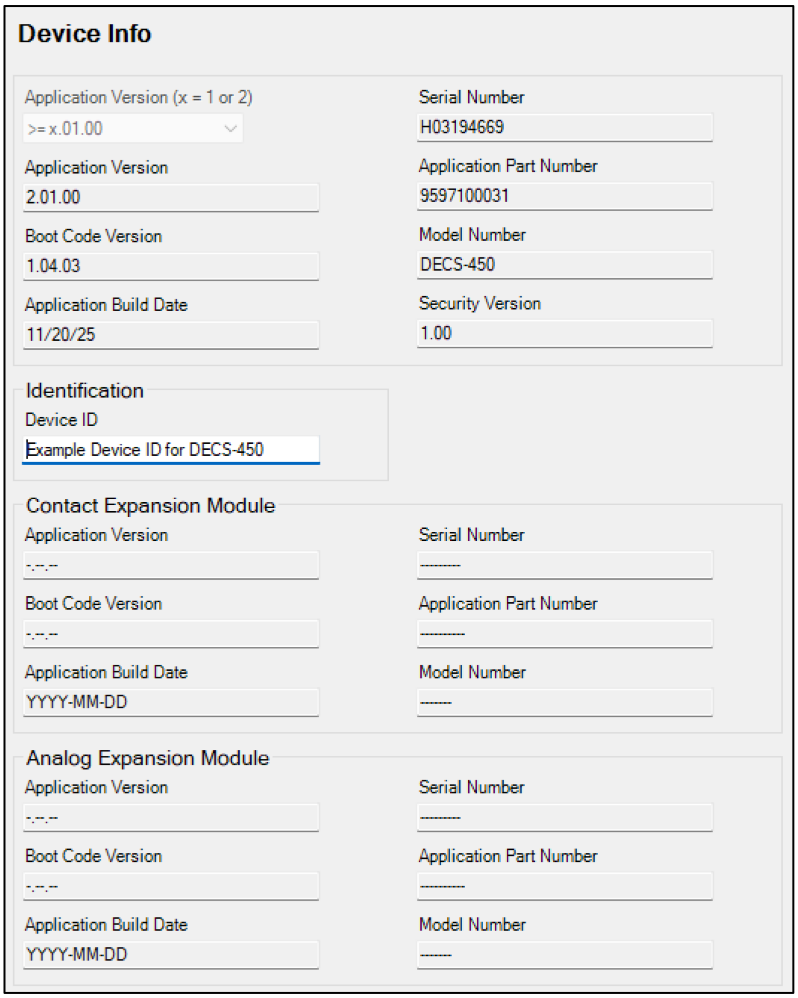


Figure 21-6. Device Information

Firmware Information

Firmware information is provided for the DECS-450, optional CEM-125 or CEM-2020, and optional AEM-2020. This information includes the application part number, application version, application build date, boot code version, and security version. When configuring settings in BESTCOMS*Plus* while disconnected from a DECS-450, an Application Version Number setting is available to ensure compatibility between the selected settings and the actual settings available in the DECS-450.

Product Information

Product information for the DECS-450, CEM-125 or CEM-2020, and AEM-2020 includes the device model number and serial number.

Device Identification

The user-assigned *Device ID* is used to identify DECS-450 controllers in reports and during polling.

Display Units

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Display Units
HMI Navigation Path: Settings, General Settings, Display Units

When working with DECS-450 settings in BESTCOMS*Plus*, you have the option of viewing the settings in English or Metric units. The *display units* setting is illustrated in Figure 21-7.

Figure 21-7. Display Units

22 • Security

DECS-450 units are secured by password-protected user accounts. Each account is assigned an access level that permits certain operations. An additional layer of security controls the type of operations allowed through certain DECS-450 communication ports.

Security settings are uploaded and downloaded separately from the settings and logic. See the *BESTCOMSPlus*® section for more information on uploading and downloading security settings.

Password Access

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Security Setup, User Name Setup

User accounts may be created which consist of a user name, password, and an access level. The different access levels are listed in Table 22-1. An account has access to the assigned access level as well as all the levels below it. For example, an account with Settings access level has access to operations granted by the Settings, Operator, Control, and Read access levels.

Table 22-1. Password Access Levels and Descriptions

Access Level	Description
Admin (6)	Create, edit, and delete users and device security. Includes levels 1 through 5 below.
Design (5)	Create or change programmable logic. Includes levels 1 through 4 below.
Settings (4)	Edit all settings. Does not include logic settings. Includes levels 1, 2, and 3 below.
Operator (3)	Set date and time, reset accumulated metering values, and erase event data. Includes levels 1 and 2 below.
Control (2)	Operate real-time controls. Includes level 1 below.
Read (1)	Read all system parameters, metering, and logs. No changes or operation allowed.
None (0)	All access is denied.

Password Creation and Configuration

User accounts are created and configured on the BESTCOMS*Plus* User Name Setup screen (Figure 22-1). To create and configure a username and password, perform the following steps.

1. Disable Live Mode in BESTCOMS*Plus*.
2. In the BESTCOMS*Plus* settings explorer, navigate to General Settings, Device Security Setup, User Name Setup. When prompted, enter a username of “A” and a password of “A” and log on. This factory-default username and password grants administrator-level access. It is highly recommended that this factory-default password be changed immediately to prevent undesired access.
3. To set up a new account, select an “UNASSIGNED” entry in the user list. To edit an existing account, select it in the user list.
4. Enter a username.
5. Enter a password for the user.
6. Reenter the password created in step 5 to verify.
7. Select the maximum allowed access level for the user.
8. To set an expiration date for a user’s access, enter number of days. Otherwise, leave the expiration value at zero.
9. Click the Save User button.

10. Open the Communication menu, and click Upload Security to Device.
11. BESTCOMS*Plus* notifies you when the security upload is successful.

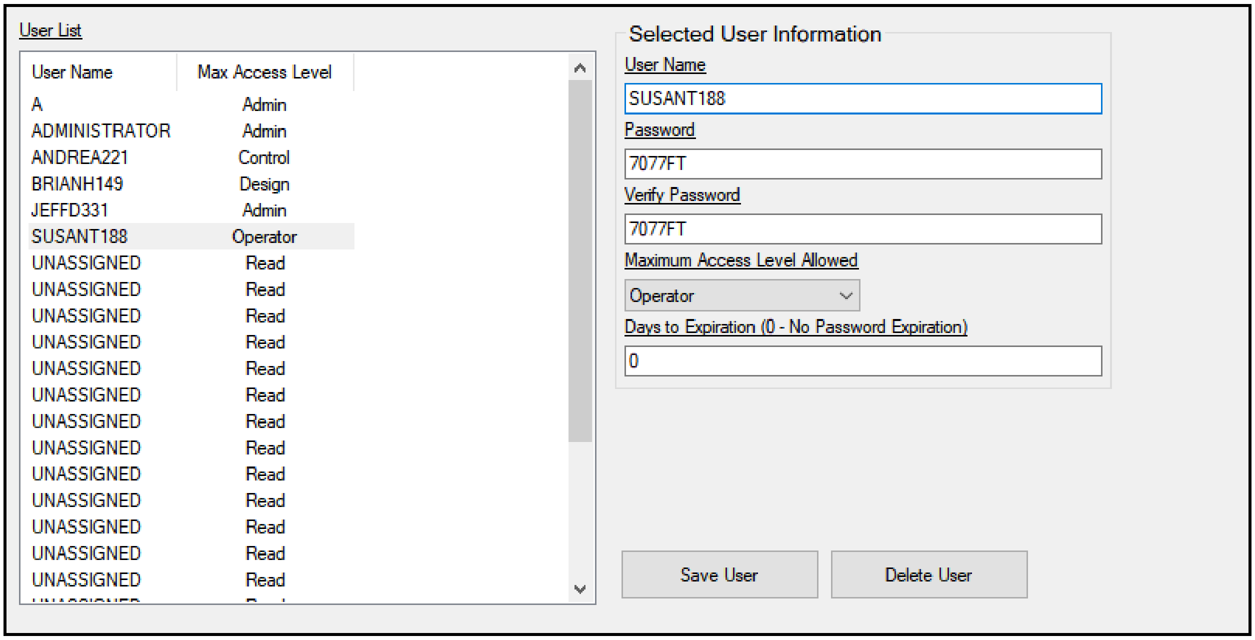


Figure 22-1. Password Access Settings

Port Security

BESTCOMS*Plus* Navigation Path: Settings Explorer, General Settings, Device Security Setup, Port Access Setup

An additional layer of security restricts operations through the DECS-450 communication ports.

The Unsecured Access Level setting sets the maximum level of access allowed without entering a username/password. The Secured Access Level setting sets the maximum level of access allowed with a password.

Caution
Setting the Secured Access Level to None on any port makes that port unusable. If the Secured Access Level is set to None on all available ports, the DECS-450 must be returned to Basler Electric for repair.

Only one port can be in use at a time by an account with Control access or higher. For example, if a user is logged in with Control access at one port, all users at other ports (even Admins) are granted only Read access until the initial user with Control access logs off. Modbus and CAN Bus are exceptions and can be logged into a port with an access level higher than read simultaneously with another port. This is so that communication is not restricted while another port is in use and also so that all other ports are not blocked if communication is active.

Port Access Configuration

Communication port access is configured on the BESTCOMS*Plus* Port Access Setup screen (Figure 22-2). To configure communication port access, perform the following steps.

1. Disable Live Mode in BESTCOMS*Plus*.
2. In the BESTCOMS*Plus* settings explorer, navigate to General Settings, Device Security Setup, Port Access 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.

3. Highlight the desired communication port in the port list.
4. Select the highest unsecured access level for the port.
5. Select the highest secured access level for the port.
6. Save the configuration by clicking the Save Port button.
7. Open the Communication menu, and click Upload Security to Device.
8. BESTCOMS*Plus* notifies you when the security upload is successful.

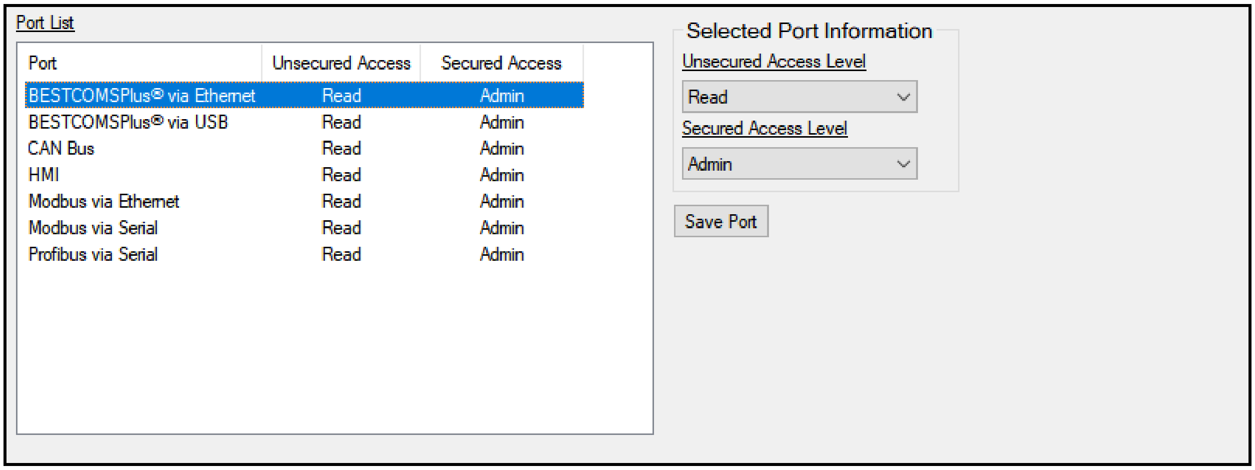


Figure 22-2. Port Access Configuration Settings

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 22-3.

Access Timeout

The Access Timeout setting maintains security by automatically withdrawing password access if a user neglects to log out. If no activity is detected for the duration of the access timeout setting, password access is automatically withdrawn.

Login Failure

A Login Attempts setting limits the number of times that login can be attempted. A Login Time Window setting 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.

System In Use Notification

When enabled, this feature warns users that they are connected to a functioning system and their actions can have severe consequences. A pop-up window in BESTCOMS*Plus* will appear displaying a custom message prior to authenticating a login if the system is in use. By default, a DECS-450 system is determined “In Use” when the Generator Below 10Hz logic bit is FALSE and the unit is not in Stop mode. Settings can be configured further using BESTlogic™*Plus*.

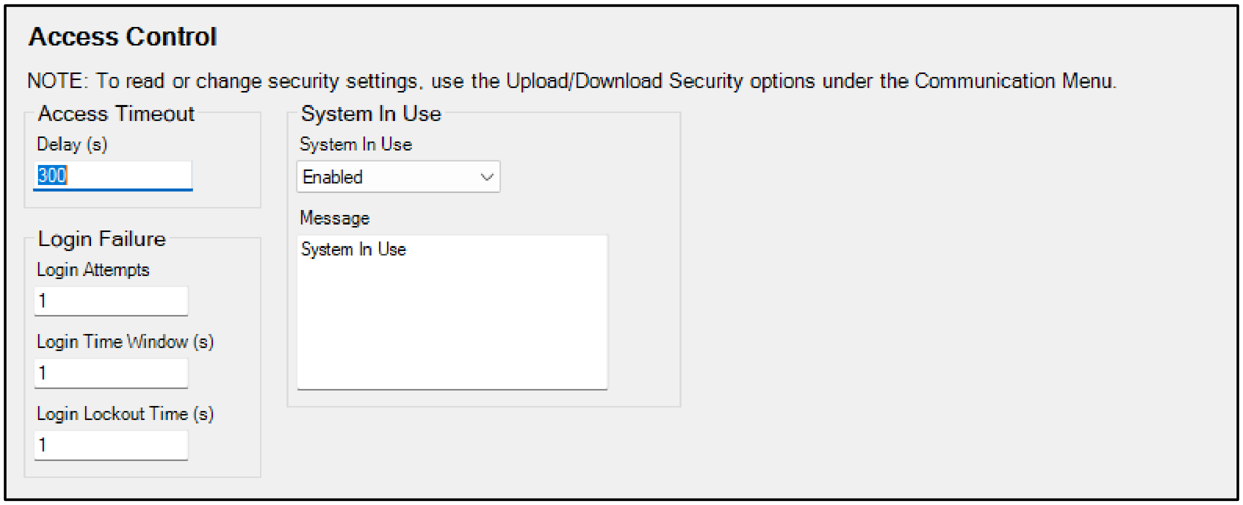


Figure 22-3. Access Control Settings

Security Shutdown Alarm

The DECS-450 verifies its style and serial numbers during power-on self-test. The Security Shutdown alarm is annunciated when the DECS-450 has detected an unauthenticated style or serial number.

When the security shutdown alarm is active, the following occurs:

1. The transfer watchdog will trip and remain latched to indicate that this unit is not in control.
2. The DECS-450 will neither start excitation nor run other control functions.
3. The DECS-450 will retain communication functions to annunciate the alarm.

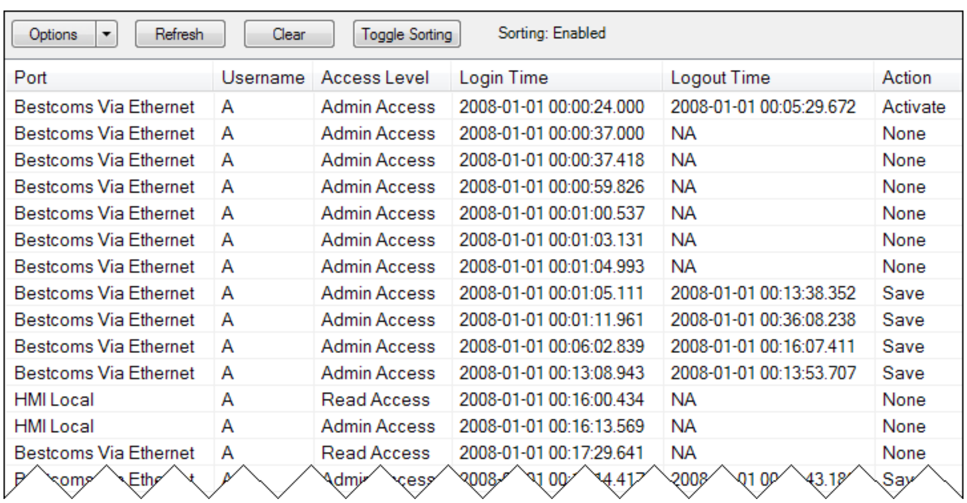
If your DECS-450 has annunciated this alarm, contact Basler Electric for support.

Viewing the Security Log

BESTCOMSPlus Navigation Path: Metering Explorer, Reports, Security Log

HMI Navigation Path: Not available through the front panel

The DECS-450 records information about user logins including the port used to log in, the access level granted, the type of action performed, and the time of logout in the security log. Information will also be recorded when a user attempts to log in, but fails due to an invalid username or incorrect password.



Port	Username	Access Level	Login Time	Logout Time	Action
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:24.000	2008-01-01 00:05:29.672	Activate
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:37.000	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:37.418	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:00:59.826	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:00.537	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:03.131	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:04.993	NA	None
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:05.111	2008-01-01 00:13:38.352	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:01:11.961	2008-01-01 00:36:08.238	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:06:02.839	2008-01-01 00:16:07.411	Save
Bestcoms Via Ethernet	A	Admin Access	2008-01-01 00:13:08.943	2008-01-01 00:13:53.707	Save
HMI Local	A	Read Access	2008-01-01 00:16:00.434	NA	None
HMI Local	A	Admin Access	2008-01-01 00:16:13.569	NA	None
Bestcoms Via Ethernet	A	Read Access	2008-01-01 00:17:29.641	NA	None

Figure 22-4. Security Log

A maximum of 200 entries are stored in nonvolatile memory. When a new entry is generated, the DECS-450 discards the oldest of the 200 entries and replaces it with a new one.

Use the Metering Explorer to open the Reports, Security Log screen. If an active connection to a DECS-450 is present, the security log will automatically download. Using the Options button, you can copy, print, or save the security log. The Refresh button is used to refresh/update the security log. The Clear button clears the security log. The Toggle Sorting button enables sorting. Click on a column header to sort. See Figure 22-4.

23 • Timekeeping

The DECS-450 clock is used by the logging functions to timestamp events. DECS-450 timekeeping may be either 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 23-1.

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-450 to match the local conventions. The time may be configured for either the 12- or 24-hour format with the Time Format setting. The Date Format setting 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-450 can automatically compensate for the start and end of daylight saving time (DST) on a fixed- or floating-date basis. An example of a fixed date is “March 2” and an example of a floating date is “Second Sunday of March”. DST compensation may be set in respect to your local time or coordinated universal time (UTC). DST start and end dates are fully configurable and include a bias adjustment.

Network Time Protocol (NTP)

When connected to an Ethernet network, the DECS-450 can use NTP to synchronize with a radio, atomic, or other clock located on the internet/intranet, to maintain accurate timekeeping. The DECS-450 uses NTPv4 and is also compatible with devices using NTPv3.

NTP Settings

NTP is enabled in the DECS-450 by entering the internet protocol (IP) address of the network timeserver in the four decimal-separated fields of the NTP Address setting. Time zone offset settings 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 can be used to rank the sources according to their priority.

IRIG

When the IRIG source is enabled, through the Time Priority Setup, it synchronizes the DECS-450 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. 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 rear panel.

Use Time Priority Setup to enable a connected time source. When multiple time sources are connected, the Time Priority Setup may be used to rank the sources according to their priority.

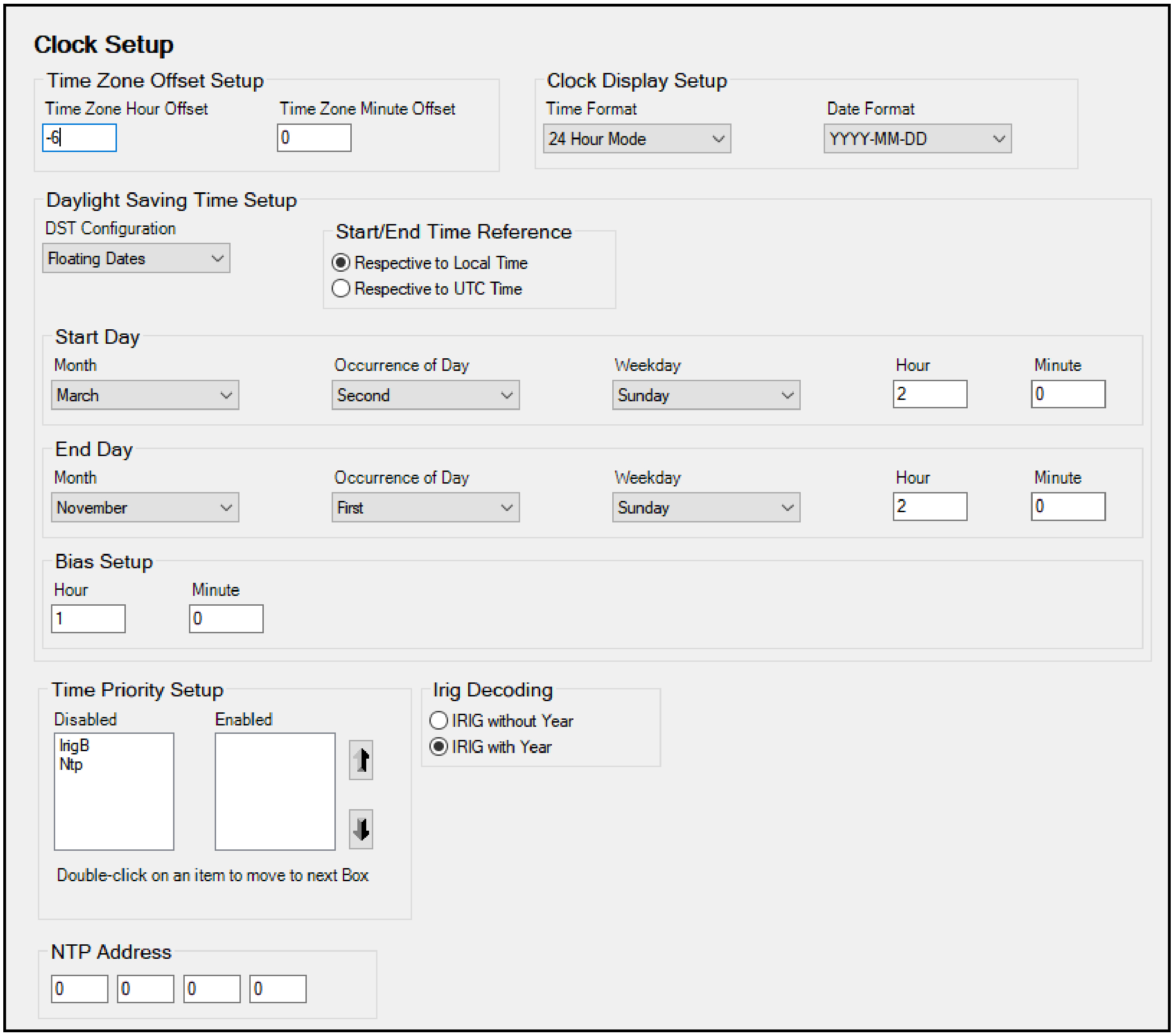


Figure 23-1. Clock Setup

24 • Testing

Testing of the DECS-450’s regulation and optional power system stabilizer (PSS) (style 1XXXXXX) performance is possible through the integrated analysis tools of BESTCOMS*Plus*®.

Real-Time Metering Analysis

BESTCOMS*Plus* Navigation Path: Metering Explorer, Analysis

HMI Navigation Path: Analysis functions are not available through front panel HMI.

Proper voltage regulator performance is critical to PSS 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 BESTCOMS*Plus* Real-Time Metering Analysis screen is used to perform and monitor online AVR and PSS testing. Six plots of user-selected data may be generated and the logged data may be stored in a file for later examination. BESTCOMS*Plus* must be in *Live Mode* 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 24-1.

Figure 24-1. RTM Analysis Screen

The RTM Analysis screen controls are provided for:

- Selecting the parameters to be graphed
- Adjusting the resolution of the graph x axis and the range of the graph y axis
- Starting and stopping plot captures
- Opening existing graph files, saving captured plots in graph files, and printing captured graphs

Graph Parameters

Any six of the following parameters may be selected for plotting.

- Auxiliary voltage input (Vaux)
- Average line current (Iavg)
- Average line-to-line voltage (Vavg)
- AVR error signal (ErrIn)
- AVR PID output
- Bus frequency (B Hz)
- Bus voltage (Vbus)
- Compensated frequency deviation (CompF)
- Control output (CntOp)
- Cross-current input (Iaux)
- Droop
- FCR error to PID
- FCR integrator value
- FCR PID output
- Field current (Ifd) (Full Load)
- Field temperature
- Field voltage (Vfd) (Full Load)
- Filtered mechanical power (MechP)
- Final PSS output (Pout)
- Frequency response signal (Test)
- FVR error to PID
- FVR integrator value
- FVR PID output
- Generator frequency (G Hz)
- Inner loop error
- Inner loop field voltage feedback
- Inner loop output
- Inner loop PID input
- Inner loop reference
- Internal state (TrnOp)
- Lead-lag #1 (x15)
- Lead-lag #2 (x16)
- Lead-lag #3 (x17)
- Lead-lag #4 (x31)
- Logic limiter washout filter
- 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 error
- Network load share PI output
- Null Balance Level (Null Balance)
- Null Balance State (Null State)
- OEL controller output
- OEL field current reference
- OEL integrator value
- 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)
- Rate of frequency change
- Reactive power (kvar)
- Real power (kW)
- S1 Logic status point 1
- S2 Logic status point 2
- S3 Logic status point 3
- S4 Logic status point 4
- S5 Logic status point 5
- S6 Logic status point 6
- SCL controller output
- SCL gen current reference
- SCL integrator value
- SCL PF reference
- Speed HP #1 (x2)
- Synthesized speed (Synth)
- Terminal frequency deviation (TermF)
- Terminal voltage low-pass filter
- Terminal voltage ramp filter
- Time response signal (Ptest)
- Torsional filter #1 (Tflt1)
- Torsional filter #2 (x29)
- Total power (kVA)
- Transfer output
- UEL controller output (UelOutput)
- UEL integrator value
- UEL var reference
- Var limiter integrator value

- Var limiter output
- Var limiter reference
- Var/PF error to PID
- Var/PF integrator value
- Var/PF PID output
- Washed out power (WashP)
- Washed out speed (WashW)

Frequency Response

Frequency response testing functions are available by clicking the Frequency Response button on the RTM Analysis screen. Frequency Response screen functions are illustrated in Figure 24-2 and described below.

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, BESTCOMS*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.

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.

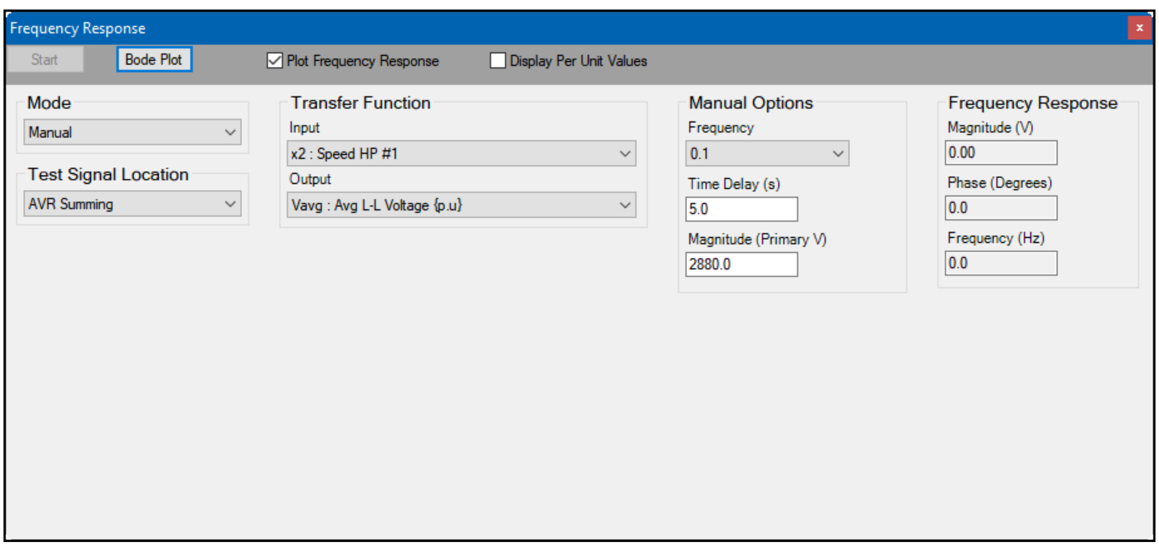


Figure 24-2. Frequency Response Screen

Bode Plotting

A Bode plot can be printed, opened, and saved in graph (.gph) format.

Transfer Function

The point in the DECS-450 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
- FvrErr
- FvrOut
- 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} (Full Load)
- 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
- PF: Power Factor
- Post: Post-Limit Output {pu}
- POut: Final PSS Output {pu}
- Prelim: Pre-Limit Output {pu}
- PssW: PSS Electric Power {pu}
- Ptest: Time Response Signal {pu}
- SclOutput: SCL Controller Output
- Synth: Synthsized Speed {pu}
- TermF: Terminal Frequency Deviation
- Test: Frequency Response Signal {pu}
- Tflt1: Torsional Filter #1 {pu}
- TrnOp: Internal State {pu}
- UelOutput: UEL Controller Output
- V1: Positive Sequence Voltage {pu}
- V2: Negative Sequence Voltage {pu}
- Vab: PhA-PhB L-L Voltage {pu}
- Var/PfErr
- Var/PfOut
- VarLimOutput: Var Limiter Output
- 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} (Full Load)
- Vtmag: PSS Term Voltage
- WashP: Washed Out Power
- WashW: Washed Out Speed {pu}
- x02: Speed HP #1
- x05: Power HP #1 {pu}
- x07: Mechanical Power {pu}
- x08: Mechanical Power LP #1
- x09: Mechanical Power LP #2
- 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}
- x29: Torsional Filter #2 {pu}
- x31: Lead-Lag #4 {pu}

Frequency Response

Read-only frequency response fields indicate the magnitude response, phase response, and test signal frequency. The magnitude response and phase response correspond 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. Avoid frequencies that are close to the resonant frequency of the machine or neighboring machines. 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 24-3. 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.

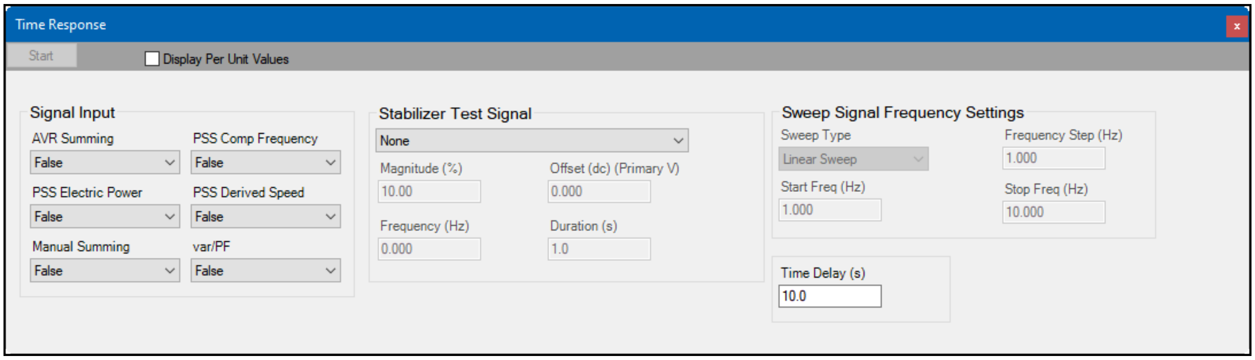


Figure 24-3. Time Response Screen

Test Signal Characteristics

Test signal characteristics (magnitude, offset, frequency, and duration) may 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 may 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 Frequency Step every half-cycle of the system frequency. For logarithmic sweeps, the test signal frequency is multiplied by 1.0 plus Frequency 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 24-4) is accessed by clicking the Step Response button in the RTM Analysis window. The Step Response Analysis screen consists of:

- Metering fields: average generator voltage, vars, total PF, field voltage, and field current
- An alarms window that displays any active alarms possibly triggered by a step change
- 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-450 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 have similar controls that enable the application of step changes to their respective setpoints. The AVR tab controls are illustrated in Figure 24-4. AVR, FCR, and FVR tab controls are described below.

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. Three read-only fields indicate the current setpoint, a one-step increase in setpoint, a one-step decrease in setpoint, and the original setpoint. A button is provided to return the setpoint to its original value, which is displayed in the read-only field adjacent to the button.

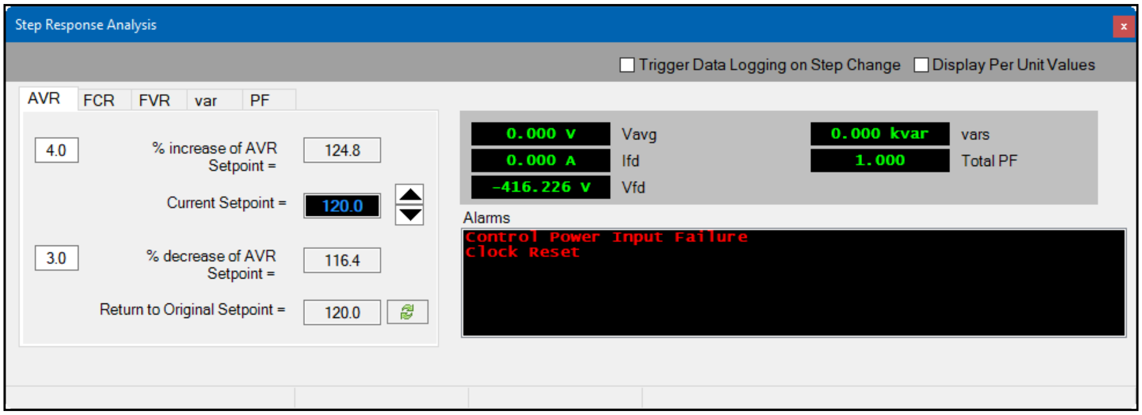


Figure 24-4. Step Response Analysis - AVR Tab

Var and PF Tabs

The var and PF tabs have similar controls that apply step changes to their respective setpoints. PF tab controls are illustrated in Figure 24-5. Var and PF tab controls are described below.

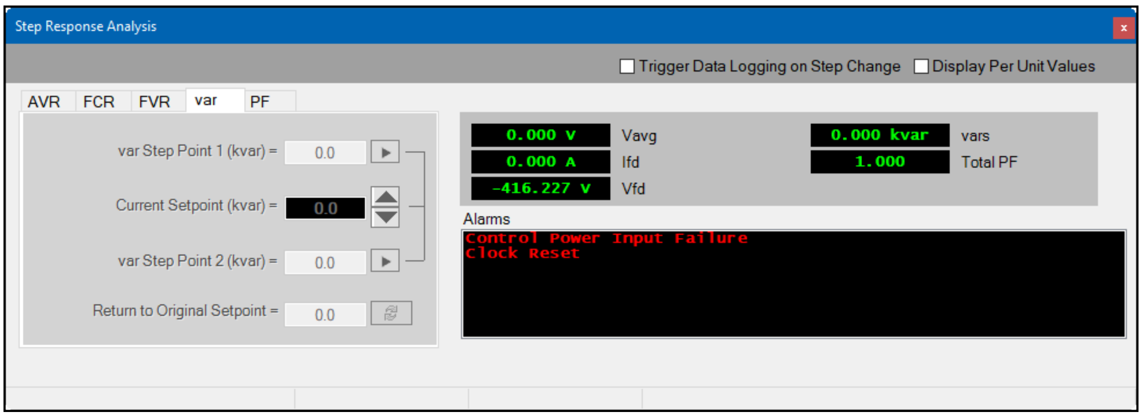


Figure 24-5. Step Response Analysis - Var Tab

The setpoint may be adjusted by clicking the increment (up arrow) or decrement (down arrow) button. Two Var Step Point settings are provided. Clicking the right-arrow button beside the fields initiates a step change to the corresponding setpoint value. A button is provided to return the setpoint to its original value, which 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. Check the Cursors Enabled box to enable cursors used for measuring between two horizontal points. See Figure 24-6.

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 improve PC performance while plotting.

Check the Sync Graph Scrolling box to sync scrolling of all graphs when any horizontal scroll bar is moved. See Figure 24-7.

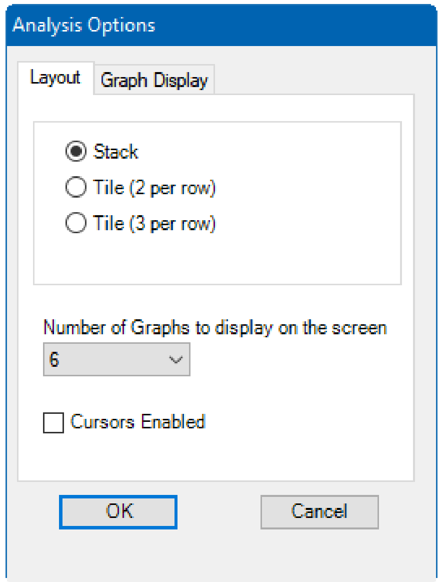


Figure 24-6. Analysis Options Screen, Layout Tab

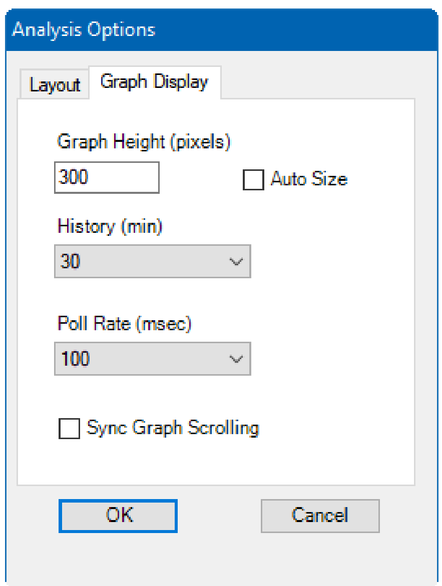


Figure 24-7. Analysis Options Screen, Graph Display Tab

25 • CAN Communication

Introduction

The DECS-450 provides two CAN Bus interfaces, designated as CAN 1 and CAN 2.

CAN Bus interface 1 facilitates communication between the DECS-450 and optional modules such as the Contact Expansion Module (CEM-125 or CEM-2020) and Analog Expansion Module (AEM-2020). Refer to the *Contact Expansion Module* and *Analog Expansion Module* sections for more information.

CAN Bus interface 2 enables the DECS-450 to provide generator and system parameters to a generator controller such as the Basler DGC-2020HD. CAN 2 also permits DECS-450 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 use the SAE J1939 messaging protocol.

Refer to the *Communication* section for CAN port configuration and the *Terminals and Connectors* section for wiring.

Note
For the DECS-450 to receive data from CAN Bus devices, the Secured Access Level must be set to Admin. Refer to the *Security* section for port access configuration.

CAN Parameters

Supported CAN parameters are listed in Table 25-1. 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 25-1. 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	

PGN	Name	Units	SPN	Broadcast Rate
0xFE04	Generator Average AC Frequency	Hertz	2436	100 ms
	Generator Average AC RMS Current	Amps	2448	
	Generator Total Reactive Power	var	2456	
	Generator Overall PF	n/a	2464	
	Generator Overall PF Lagging	n/a	2518	
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

PGN	Name	Units	SPN	Broadcast Rate
	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-450 sends an unsolicited message for 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 25-2 lists the diagnostic information that the DECS-450 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 25-2. Diagnostic Information Obtained Over CAN Bus Interface 2

PGN	Name
0xEA00	Request DTCs
0xFECA	Currently Active DTCs
0xFECB	Previously Active DTCs
0xFECC	Clear Previously Active DTCs
0xFED3	Clear Active DTCs

Table 25-3. 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.

26 • Modbus® Communication

Introduction

This document describes the Modbus® communications protocol employed by DECS-450 systems and how to exchange information with DECS-450 systems over a Modbus network. DECS-450 systems communicate by emulating a subset of the Modicon 984 Programmable Controller.

Caution
This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

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-450) 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-450 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-450 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-450 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-450 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 26-1.

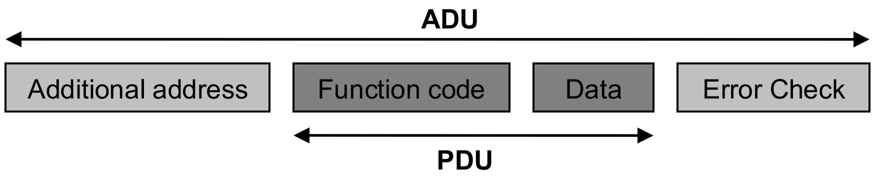


Figure 26-1. General Modbus Frame

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-450 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-450 Modbus supports baud rates up to 115200. The factory default baud rate is 19200.

DECS-450 systems support RS-485 compatible serial interfaces. This interface is accessible from the left side panel of the DECS-450.

Message Framing and Timing Considerations

When receiving a message via the RS-485 communication port, the DECS-450 requires an inter-byte latency of 3.5 character times before considering the message complete.

Once a valid query is received, the DECS-450 waits a specified amount of time before responding. This time delay is set on the Modbus Setup screen under Communications in BESTCOMS*Plus*®. This parameter contains a value from 10 - 10,000 milliseconds. The default value is 10 milliseconds.

Table 26-1 provides the response message transmission time (in seconds) and 3.5 character times (in milliseconds) for various message lengths and baud rates.

Table 26-1. Timing Considerations

Baud Rate	3.5 Character Time (ms)	Message Tx Time (s)	
		128 Bytes	256 Bytes
1200	32.08	1.17	2.34
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
38400	1.0026	0.04	0.07
57600	0.6684	0.02	0.04
115200	0.3342	0.01	0.02

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 26-2.

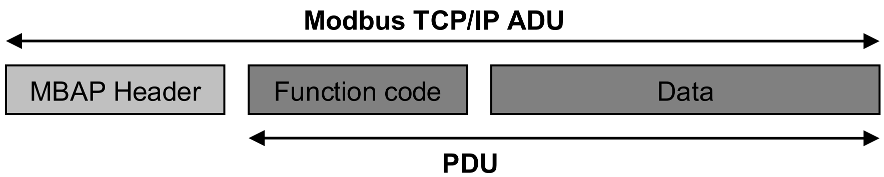


Figure 26-2. Modbus Request/Response Over TCP/IP

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 26-2.

Table 26-2. 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-450 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-450 are provided in Table 26-3.

Table 26-3. 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-450 Modbus® via Ethernet

Modbus can communicate through Ethernet if the IP address of the DECS-450 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-450 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-450 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-450 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-450 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-450 continues to monitor all queries. The DECS-450 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-450 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 DECS-450 will perform the write when the device address in query is a broadcast address or the same as the DECS-450 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-450 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-450 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 26-4 shows the floating-point format.

Table 26-4. Floating Point Format

Sign	Exponent + 127	Mantissa
1 Bit	8 Bits	23 Bits

The floating-point format allows for values ranging from approximately $8.43X10^{-37}$ to $3.38X10^{38}$. 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:

Holding Register	Value
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:

Holding Register	Value
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 26-7), 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:

Holding Register	Value
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:

Holding Register	Value
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:

Holding Register	Value
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-450 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 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-450 Login via Modbus

To login to the DECS-450 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 "|" symbol, and substitute "password" with the password of the chosen access level. To view the current access level, read the Current Access register (45420). Write any value to the Logout register (45417) to log out of the DECS-450. Upon disconnecting from Modbus over TCP/IP, the user is automatically logged out of the DECS-450. However, upon disconnecting from Modbus over serial line, the user remains logged in.

Modbus Parameters

General

General parameters are listed in Table 26-5.

Table 26-5. General Group Parameters

Group	Name	Register	Type	Bytes	R/W	Range
System Data	Model Number	45000	String	64	R	0–64
System Data	App Version Information	45032	String	64	R	0–64
System Data	App Sub-version Version	45064	String	64	R	0–64
System Data	Boot Version Information	45096	String	64	R	0–64
System Data	Firmware Part Number	45128	String	64	R	0–64
Time	Date	45160	String	16	R	0–16
Time	Time	45168	String	16	R	0–16
Unit Information	Style Number	45176	String	32	R	0–32
Unit Information	Serial Number	45192	String	32	R	0–32
DECS Control	Control Output Var PF	45208	Float	4	R	n/a
DECS Control	Control Output OEL	45210	Float	4	R	n/a
DECS Control	Control Output UEL	45212	Float	4	R	n/a
DECS Control	Control Output SCL	45214	Float	4	R	n/a
DECS Control	Control Output AVR	45216	Float	4	R	n/a
DECS Control	Control Output FCR	45218	Float	4	R	n/a
DECS Control	Control Output FVR	45220	Float	4	R	n/a
DECS Control	Invert Output (SCT/PPT)	45222	Uint32	4	RW	Disabled=0 Enabled=1

Security

Table 26-6. Security Group Parameters

Group	Name	Register	Type	Bytes	R/W	Increment	Range
Security	Secure Login	45400	String	34	RW	1	0–34
Security	Logout	45417	String	5	RW	1	0–5
Security	Current Access	45420	Uint32	4	R	n/a	No Access=0, Read Access=1 Control Access=2 Operator Access=3 Setting Access=4 Design Access=5 Administrator Access=6
Security	Save Changes	45422	Uint32	4	RW	n/a	n/a

Binary Points

Table 26-7. Binary Point Group Parameters

Group	Name	Register	Type	Bytes	R/W	Range
System Data	RF trig	45800 bit 0	Uint16	2	R	True=1 False=0
System Data	PU logic	45800 bit 1	Uint16	2	R	True=1 False=0
System Data	Trip logic	45800 bit 2	Uint16	2	R	True=1 False=0
System Data	Logic trig	45800 bit 3	Uint16	2	R	True=1 False=0
System Data	Breaker Status	45800 bit 4	Uint16	2	R	True=1 False=0
Alarms	Real Time Clock Alarm	45800 bit 5	Uint16	2	R	True=1 False=0
Alarms	Date Time Set Alarm	45800 bit 6	Uint16	2	R	True=1 False=0
Alarms	Firmware Change Alarm	45800 bit 7	Uint16	2	R	True=1 False=0
Alarms	Frequency out of range alarm	45800 bit 8	Uint16	2	R	True=1 False=0
Reserved		45800 bit 9				
Alarms	USB com alarm	45800 bit 10	Uint16	2	R	True=1 False=0
Alarms	IRIG sync lost alarm	45800 bit 11	Uint16	2	R	True=1 False=0
Alarms	Logic equal none alarm	45800 bit 12	Uint16	2	R	True=1 False=0
Alarms	No user setting alarm	45800 bit 13	Uint16	2	R	True=1 False=0
Alarms	NTP sync lost alarm	45800 bit 14	Uint16	2	R	True=1 False=0
Alarms	Microprocessor Reset Alarm	45800 bit 15	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 1	45801 bit 0	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 2	45801 bit 1	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 3	45801 bit 2	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 4	45801 bit 3	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 5	45801 bit 4	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 6	45801 bit 5	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 7	45801 bit 6	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 8	45801 bit 7	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 9	45801 bit 8	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 10	45801 bit 9	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 11	45801 bit 10	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 12	45801 bit 11	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 13	45801 bit 12	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 14	45801 bit 13	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 15	45801 bit 14	Uint16	2	R	True=1 False=0
Alarms	Programmable Alarm 16	45801 bit 15	Uint16	2	R	True=1 False=0
Alarms	Underfrequency V/Hz Alarm	45802 bit 0	Uint16	2	R	True=1 False=0
Alarms	OEL alarm	45802 bit 1	Uint16	2	R	True=1 False=0
Alarms	UEL alarm	45802 bit 2	Uint16	2	R	True=1 False=0
Alarms	Failed to build up alarm	45802 bit 3	Uint16	2	R	True=1 False=0
Alarms	SCL alarm	45802 bit 4	Uint16	2	R	True=1 False=0
Alarms	PSS voltage unbalanced alarm	45802 bit 5	Uint16	2	R	True=1 False=0
Alarms	PSS current unbalanced alarm	45802 bit 6	Uint16	2	R	True=1 False=0
Alarms	PSS power below threshold alarm	45802 bit 7	Uint16	2	R	True=1 False=0
Alarms	PSS speed failed alarm	45802 bit 8	Uint16	2	R	True=1 False=0
Alarms	PSS voltage limit alarm	45802 bit 9	Uint16	2	R	True=1 False=0
Alarms	Transfer watchdog alarm	45802 bit 10	Uint16	2	R	True=1 False=0
Alarms	Crowbar activated	45802 bit 11	Uint16	2	R	True=1 False=0
Alarms	Var limiter active alarm	45802 bit 12	Uint16	2	R	True=1 False=0
Alarms	Voltage Matching active	45802 bit 13	Uint16	2	R	True=1 False=0
Alarms	Invalid logic alarm	45802 bit 14	Uint16	2	R	True=1 False=0
Alarms	Control Power Input Failure	45802 bit 15	Uint16	2	R	True=1 False=0
Alarm Report	Alarm Output	45803 bit 0	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
Contact Inputs	Start Input	45803 bit 1	Uint16	2	R	True=1 False=0
Contact Inputs	Stop Input	45803 bit 2	Uint16	2	R	True=1 False=0
Contact Inputs	Input 1	45803 bit 3	Uint16	2	R	True=1 False=0
Contact Inputs	Input 2	45803 bit 4	Uint16	2	R	True=1 False=0
Contact Inputs	Input 3	45803 bit 5	Uint16	2	R	True=1 False=0
Contact Inputs	Input 4	45803 bit 6	Uint16	2	R	True=1 False=0
Contact Inputs	Input 5	45803 bit 7	Uint16	2	R	True=1 False=0
Contact Inputs	Input 6	45803 bit 8	Uint16	2	R	True=1 False=0
Contact Inputs	Input 7	45803 bit 9	Uint16	2	R	True=1 False=0
Contact Inputs	Input 8	45803 bit 10	Uint16	2	R	True=1 False=0
Contact Inputs	Input 9	45803 bit 11	Uint16	2	R	True=1 False=0
Contact Inputs	Input 10	45803 bit 12	Uint16	2	R	True=1 False=0
Contact Inputs	Input 11	45803 bit 13	Uint16	2	R	True=1 False=0
Contact Inputs	Input 12	45803 bit 14	Uint16	2	R	True=1 False=0
Contact Inputs	Input 13	45803 bit 15	Uint16	2	R	True=1 False=0
Contact Inputs	Input 14	45804 bit 0	Uint16	2	R	True=1 False=0
Contact Outputs	Watchdog Output	45804 bit 1	Uint16	2	R	True=1 False=0
Contact Outputs	Output 1	45804 bit 2	Uint16	2	R	True=1 False=0
Contact Outputs	Output 2	45804 bit 3	Uint16	2	R	True=1 False=0
Contact Outputs	Output 3	45804 bit 4	Uint16	2	R	True=1 False=0
Contact Outputs	Output 4	45804 bit 5	Uint16	2	R	True=1 False=0
Contact Outputs	Output 5	45804 bit 6	Uint16	2	R	True=1 False=0
Contact Outputs	Output 6	45804 bit 7	Uint16	2	R	True=1 False=0
Contact Outputs	Output 7	45804 bit 8	Uint16	2	R	True=1 False=0
Contact Outputs	Output 8	45804 bit 9	Uint16	2	R	True=1 False=0
Contact Outputs	Output 9	45804 bit 10	Uint16	2	R	True=1 False=0
Contact Outputs	Output 10	45804 bit 11	Uint16	2	R	True=1 False=0
Contact Outputs	Output 11	45804 bit 12	Uint16	2	R	True=1 False=0
Hardware Ports	Field Short Circuit Status	45804 bit 13	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 1	45804 bit 14	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 2	45804 bit 15	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 3	45805 bit 0	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 4	45805 bit 1	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 5	45805 bit 2	Uint16	2	R	True=1 False=0
Virtual Switch	Virtual Switch 6	45805 bit 3	Uint16	2	R	True=1 False=0
DECS Control	Manual FCR only	45805 bit 4	Uint16	2	R	True=1 False=0
DECS Control	Droop disable	45805 bit 5	Uint16	2	R	True=1 False=0
DECS Control	Cross-current compensation disable	45805 bit 6	Uint16	2	R	True=1 False=0
DECS Control	Line drop disable	45805 bit 7	Uint16	2	R	True=1 False=0
DECS Control	Parallel enable LM	45805 bit 8	Uint16	2	R	True=1 False=0
DECS Control	Auto transfer enable	45805 bit 9	Uint16	2	R	True=1 False=0
DECS Control	Soft start select group 2	45805 bit 10	Uint16	2	R	True=1 False=0
DECS Control	PSS select group 2	45805 bit 11	Uint16	2	R	True=1 False=0
DECS Control	OEL select group 2	45805 bit 12	Uint16	2	R	True=1 False=0
DECS Control	UEL select group 2	45805 bit 13	Uint16	2	R	True=1 False=0
DECS Control	SCL select group 2	45805 bit 14	Uint16	2	R	True=1 False=0
DECS Control	Protection select group 2	45805 bit 15	Uint16	2	R	True=1 False=0
DECS Control	PID select group 2	45806 bit 0	Uint16	2	R	True=1 False=0
DECS Control	Var PF selection	45806 bit 1	Uint16	2	R	True=1 False=0
DECS Control	DECS start stop (external)	45806 bit 2	Uint16	2	R	True=1 False=0
DECS Control	DECS manual auto	45806 bit 3	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
DECS Control	Null balance	45806 bit 4	Uint16	2	R	True=1 False=0
DECS Control	DECS pre-position	45806 bit 5	Uint16	2	R	True=1 False=0
DECS Control	Var limiter select group 2	45806 bit 6	Uint16	2	R	True=1 False=0
DECS Control	Pre-position 1 active	45806 bit 7	Uint16	2	R	True=1 False=0
DECS Control	Pre-position 2 active	45806 bit 8	Uint16	2	R	True=1 False=0
DECS Control	Pre-position 3 active	45806 bit 9	Uint16	2	R	True=1 False=0
DECS Control	Var active	45806 bit 10	Uint16	2	R	True=1 False=0
DECS Control	PF active	45806 bit 11	Uint16	2	R	True=1 False=0
DECS Control	FVR active	45806 bit 12	Uint16	2	R	True=1 False=0
DECS Control	FCR active	45806 bit 13	Uint16	2	R	True=1 False=0
DECS Control	Manual active	45806 bit 14	Uint16	2	R	True=1 False=0
DECS Control	Auto active	45806 bit 15	Uint16	2	R	True=1 False=0
DECS PSS Meter	PSS active	45807 bit 0	Uint16	2	R	True=1 False=0
DECS Regulator Meter	Setpoint at lower limit	45807 bit 1	Uint16	2	R	True=1 False=0
DECS Regulator Meter	Setpoint at upper limit	45807 bit 2	Uint16	2	R	True=1 False=0
Field Overvoltage	Block	45807 bit 3	Uint16	2	R	True=1 False=0
Field Overvoltage	Pickup	45807 bit 4	Uint16	2	R	True=1 False=0
Field Overvoltage	Trip	45807 bit 5	Uint16	2	R	True=1 False=0
Field Overcurrent	Block	45807 bit 6	Uint16	2	R	True=1 False=0
Field Overcurrent	Pickup	45807 bit 7	Uint16	2	R	True=1 False=0
Field Overcurrent	Trip	45807 bit 8	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Block open diode	45807 bit 9	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Pickup open diode	45807 bit 10	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Trip open diode	45807 bit 11	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Block shorted diode	45807 bit 12	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Pickup shorted diode	45807 bit 13	Uint16	2	R	True=1 False=0
Exciter Diode Monitor	Trip shorted diode	45807 bit 14	Uint16	2	R	True=1 False=0
Loss of Sensing	Block	45808 bit 0	Uint16	2	R	True=1 False=0
Loss of Sensing	Pickup	45808 bit 1	Uint16	2	R	True=1 False=0
Loss of Sensing	Trip	45808 bit 2	Uint16	2	R	True=1 False=0
25	Block	45808 bit 3	Uint16	2	R	True=1 False=0
25	Status	45808 bit 4	Uint16	2	R	True=1 False=0
25	VM1 status	45808 bit 5	Uint16	2	R	True=1 False=0
27P	Block	45808 bit 6	Uint16	2	R	True=1 False=0
27P	Pickup	45808 bit 7	Uint16	2	R	True=1 False=0
27P	Trip	45808 bit 8	Uint16	2	R	True=1 False=0
59P	Block	45808 bit 9	Uint16	2	R	True=1 False=0
59P	Pickup	45808 bit 10	Uint16	2	R	True=1 False=0
59P	Trip	45808 bit 11	Uint16	2	R	True=1 False=0
81O	Block	45808 bit 12	Uint16	2	R	True=1 False=0
81O	Pickup	45808 bit 13	Uint16	2	R	True=1 False=0
81O	Trip	45808 bit 14	Uint16	2	R	True=1 False=0
81U-1	Block	45808 bit 15	Uint16	2	R	True=1 False=0
81U-1	Pickup	45809 bit 0	Uint16	2	R	True=1 False=0
81U-1	Trip	45809 bit 1	Uint16	2	R	True=1 False=0
Gen Below 10 Hz	Block	45809 bit 2	Uint16	2	R	True=1 False=0
Gen Below 10 Hz	Pickup	45809 bit 3	Uint16	2	R	True=1 False=0
Gen Below 10 Hz	Trip	45809 bit 4	Uint16	2	R	True=1 False=0
40Q	Block	45809 bit 5	Uint16	2	R	True=1 False=0
40Q	Pickup	45809 bit 6	Uint16	2	R	True=1 False=0
40Q	Trip	45809 bit 7	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
32R	Block	45809 bit 8	Uint16	2	R	True=1 False=0
32R	Pickup	45809 bit 9	Uint16	2	R	True=1 False=0
32R	Trip	45809 bit 10	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 1 Pickup	45809 bit 11	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 1 Trip	45809 bit 12	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 2 Pickup	45809 bit 13	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 2 Trip	45809 bit 14	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 3 Pickup	45809 bit 15	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 3 Trip	45810 bit 0	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 4 Pickup	45810 bit 1	Uint16	2	R	True=1 False=0
Configurable Protection 1	Configurable Protection Threshold 4 Trip	45810 bit 2	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 1 Pickup	45810 bit 3	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 1 Trip	45810 bit 4	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 2 Pickup	45810 bit 5	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 2 Trip	45810 bit 6	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 3 Pickup	45810 bit 7	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 3 Trip	45810 bit 8	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 4 Pickup	45810 bit 9	Uint16	2	R	True=1 False=0
Configurable Protection 2	Configurable Protection Threshold 4 Trip	45810 bit 10	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 1 Pickup	45810 bit 11	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 1 Trip	45810 bit 12	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 2 Pickup	45810 bit 13	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 2 Trip	45810 bit 14	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 3 Pickup	45810 bit 15	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 3 Trip	45811 bit 0	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 4 Pickup	45811 bit 1	Uint16	2	R	True=1 False=0
Configurable Protection 3	Configurable Protection Threshold 4 Trip	45811 bit 2	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 1 Pickup	45811 bit 3	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 1 Trip	45811 bit 4	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 2 Pickup	45811 bit 5	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 2 Trip	45811 bit 6	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 3 Pickup	45811 bit 7	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 3 Trip	45811 bit 8	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 4 Pickup	45811 bit 9	Uint16	2	R	True=1 False=0
Configurable Protection 4	Configurable Protection Threshold 4 Trip	45811 bit 10	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 1 Pickup	45811 bit 11	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 1 Trip	45811 bit 12	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 2 Pickup	45811 bit 13	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 2 Trip	45811 bit 14	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 3 Pickup	45811 bit 15	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 3 Trip	45812 bit 0	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 4 Pickup	45812 bit 1	Uint16	2	R	True=1 False=0
Configurable Protection 5	Configurable Protection Threshold 4 Trip	45812 bit 2	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 1 Pickup	45812 bit 3	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 1 Trip	45812 bit 4	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 2 Pickup	45812 bit 5	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 2 Trip	45812 bit 6	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 3 Pickup	45812 bit 7	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 3 Trip	45812 bit 8	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 4 Pickup	45812 bit 9	Uint16	2	R	True=1 False=0
Configurable Protection 6	Configurable Protection Threshold 4 Trip	45812 bit 10	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
Configurable Protection 7	Configurable Protection Threshold 1 Pickup	45812 bit 11	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 1 Trip	45812 bit 12	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 2 Pickup	45812 bit 13	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 2 Trip	45812 bit 14	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 3 Pickup	45812 bit 15	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 3 Trip	45813 bit 0	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 4 Pickup	45813 bit 1	Uint16	2	R	True=1 False=0
Configurable Protection 7	Configurable Protection Threshold 4 Trip	45813 bit 2	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 1 Pickup	45813 bit 3	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 1 Trip	45813 bit 4	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 2 Pickup	45813 bit 5	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 2 Trip	45813 bit 6	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 3 Pickup	45813 bit 7	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 3 Trip	45813 bit 8	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 4 Pickup	45813 bit 9	Uint16	2	R	True=1 False=0
Configurable Protection 8	Configurable Protection Threshold 4 Trip	45813 bit 10	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Communication Failure	45813 bit 11	Uint16	2	R	True=1 False=0
AEM Configuration	Duplicate AEM	45813 bit 12	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 1 Out of Range	45813 bit 13	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 2 Out of Range	45813 bit 14	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 3 Out of Range	45813 bit 15	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 4 Out of Range	45814 bit 0	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 5 Out of Range	45814 bit 1	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 6 Out of Range	45814 bit 2	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 7 Out of Range	45814 bit 3	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Input 8 Out of Range	45814 bit 4	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 1 Out of Range	45814 bit 5	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 2 Out of Range	45814 bit 6	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 3 Out of Range	45814 bit 7	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 4 Out of Range	45814 bit 8	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 5 Out of Range	45814 bit 9	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 6 Out of Range	45814 bit 10	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 7 Out of Range	45814 bit 14	Uint16	2	R	True=1 False=0
AEM Configuration	RTD Input 8 Out of Range	45814 bit 12	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Output 1 Out of Range	45814 bit 13	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Output 2 Out of Range	45814 bit 14	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Output 3 Out of Range	45814 bit 15	Uint16	2	R	True=1 False=0
AEM Configuration	AEM Output 4 Out of Range	45815 bit 0	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 1 Pickup	45815 bit 1	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 1 Trip	45815 bit 2	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 2 Pickup	45815 bit 3	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 2 Trip	45815 bit 4	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 3 Pickup	45815 bit 5	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 3 Trip	45815 bit 6	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 4 Pickup	45815 bit 7	Uint16	2	R	True=1 False=0
AEM Protection 1	Threshold 4 Trip	45815 bit 8	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 1 Pickup	45815 bit 9	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 1 Trip	45815 bit 10	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 2 Pickup	45815 bit 11	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 2 Trip	45815 bit 12	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 3 Pickup	45815 bit 13	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
AEM Protection 2	Threshold 3 Trip	45815 bit 14	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 4 Pickup	45815 bit 15	Uint16	2	R	True=1 False=0
AEM Protection 2	Threshold 4 Trip	45816 bit 0	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 1 Pickup	45816 bit 1	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 1 Trip	45816 bit 2	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 2 Pickup	45816 bit 3	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 2 Trip	45816 bit 4	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 3 Pickup	45816 bit 5	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 3 Trip	45816 bit 6	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 4 Pickup	45816 bit 7	Uint16	2	R	True=1 False=0
AEM Protection 3	Threshold 4 Trip	45816 bit 8	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 1 Pickup	45816 bit 9	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 1 Trip	45816 bit 10	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 2 Pickup	45816 bit 11	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 2 Trip	45816 bit 12	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 3 Pickup	45816 bit 13	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 3 Trip	45816 bit 14	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 4 Pickup	45816 bit 15	Uint16	2	R	True=1 False=0
AEM Protection 4	Threshold 4 Trip	45817 bit 0	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 1 Pickup	45817 bit 1	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 1 Trip	45817 bit 2	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 2 Pickup	45817 bit 3	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 2 Trip	45817 bit 4	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 3 Pickup	45817 bit 5	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 3 Trip	45817 bit 6	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 4 Pickup	45817 bit 7	Uint16	2	R	True=1 False=0
AEM Protection 5	Threshold 4 Trip	45817 bit 8	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 1 Pickup	45817 bit 9	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 1 Trip	45817 bit 10	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 2 Pickup	45817 bit 11	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 2 Trip	45817 bit 12	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 3 Pickup	45817 bit 13	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 3 Trip	45817 bit 14	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 4 Pickup	45817 bit 15	Uint16	2	R	True=1 False=0
AEM Protection 6	Threshold 4 Trip	45818 bit 0	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 1 Pickup	45818 bit 1	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 1 Trip	45818 bit 2	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 2 Pickup	45818 bit 3	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 2 Trip	45818 bit 4	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 3 Pickup	45818 bit 5	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 3 Trip	45818 bit 6	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 4 Pickup	45818 bit 7	Uint16	2	R	True=1 False=0
AEM Protection 7	Threshold 4 Trip	45818 bit 8	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 1 Pickup	45818 bit 9	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 1 Trip	45818 bit 10	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 2 Pickup	45818 bit 11	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 2 Trip	45818 bit 12	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 3 Pickup	45818 bit 13	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 3 Trip	45818 bit 14	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 4 Pickup	45818 bit 15	Uint16	2	R	True=1 False=0
AEM Protection 8	Threshold 4 Trip	45819 bit 0	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
RTD Protection 1	Threshold 1 Pickup	45819 bit 1	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 1 Trip	45819 bit 2	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 2 Pickup	45819 bit 3	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 2 Trip	45819 bit 4	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 3 Pickup	45819 bit 5	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 3 Trip	45819 bit 6	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 4 Pickup	45819 bit 7	Uint16	2	R	True=1 False=0
RTD Protection 1	Threshold 4 Trip	45819 bit 8	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 1 Pickup	45819 bit 9	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 1 Trip	45819 bit 10	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 2 Pickup	45819 bit 11	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 2 Trip	45819 bit 12	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 3 Pickup	45819 bit 13	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 3 Trip	45819 bit 14	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 4 Pickup	45819 bit 15	Uint16	2	R	True=1 False=0
RTD Protection 2	Threshold 4 Trip	45820 bit 0	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 1 Pickup	45820 bit 1	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 1 Trip	45820 bit 2	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 2 Pickup	45820 bit 3	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 2 Trip	45820 bit 4	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 3 Pickup	45820 bit 5	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 3 Trip	45820 bit 6	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 4 Pickup	45820 bit 7	Uint16	2	R	True=1 False=0
RTD Protection 3	Threshold 4 Trip	45820 bit 8	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 1 Pickup	45820 bit 9	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 1 Trip	45820 bit 10	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 2 Pickup	45820 bit 11	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 2 Trip	45820 bit 12	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 3 Pickup	45820 bit 13	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 3 Trip	45820 bit 14	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 4 Pickup	45820 bit 15	Uint16	2	R	True=1 False=0
RTD Protection 4	Threshold 4 Trip	45821 bit 0	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 1 Pickup	45821 bit 1	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 1 Trip	45821 bit 2	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 2 Pickup	45821 bit 3	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 2 Trip	45821 bit 4	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 3 Pickup	45821 bit 5	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 3 Trip	45821 bit 6	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 4 Pickup	45821 bit 7	Uint16	2	R	True=1 False=0
RTD Protection 5	Threshold 4 Trip	45821 bit 8	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 1 Pickup	45821 bit 9	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 1 Trip	45821 bit 10	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 2 Pickup	45821 bit 11	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 2 Trip	45821 bit 12	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 3 Pickup	45821 bit 13	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 3 Trip	45821 bit 14	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 4 Pickup	45821 bit 15	Uint16	2	R	True=1 False=0
RTD Protection 6	Threshold 4 Trip	45822 bit 0	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 1 Pickup	45822 bit 1	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 1 Trip	45822 bit 2	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 2 Pickup	45822 bit 3	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
RTD Protection 7	Threshold 2 Trip	45822 bit 4	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 3 Pickup	45822 bit 5	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 3 Trip	45822 bit 6	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 4 Pickup	45822 bit 7	Uint16	2	R	True=1 False=0
RTD Protection 7	Threshold 4 Trip	45822 bit 8	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 1 Pickup	45822 bit 9	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 1 Trip	45822 bit 10	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 2 Pickup	45822 bit 11	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 2 Trip	45822 bit 12	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 3 Pickup	45822 bit 13	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 3 Trip	45822 bit 14	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 4 Pickup	45822 bit 15	Uint16	2	R	True=1 False=0
RTD Protection 8	Threshold 4 Trip	45823 bit 0	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 1 Pickup	45823 bit 1	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 1 Trip	45823 bit 2	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 2 Pickup	45823 bit 3	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 2 Trip	45823 bit 4	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 3 Pickup	45823 bit 5	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 3 Trip	45823 bit 6	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 4 Pickup	45823 bit 7	Uint16	2	R	True=1 False=0
Thermocouple Protection 1	Threshold 4 Trip	45823 bit 8	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 1 Pickup	45823 bit 9	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 1 Trip	45823 bit 10	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 2 Pickup	45823 bit 11	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 2 Trip	45823 bit 12	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 3 Pickup	45823 bit 13	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 3 Trip	45823 bit 14	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 4 Pickup	45823 bit 15	Uint16	2	R	True=1 False=0
Thermocouple Protection 2	Threshold 4 Trip	45824 bit 0	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 1	45824 bit 1	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 2	45824 bit 2	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 3	45824 bit 3	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 4	45824 bit 4	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 5	45824 bit 5	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 6	45824 bit 6	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 7	45824 bit 7	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 8	45824 bit 8	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 9	45824 bit 9	Uint16	2	R	True=1 False=0
Contact Expansion Module	Input 10	45824 bit 10	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 1	45824 bit 11	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 2	45824 bit 12	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 3	45824 bit 13	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 4	45824 bit 14	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 5	45824 bit 15	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 6	45825 bit 0	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 7	45825 bit 1	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 8	45825 bit 2	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 9	45825 bit 3	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 10	45825 bit 4	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 11	45825 bit 5	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 12	45825 bit 6	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
Contact Expansion Module	Output 13	45825 bit 7	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 14	45825 bit 8	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 15	45825 bit 9	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 16	45825 bit 10	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 17	45825 bit 11	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 18	45825 bit 12	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 19	45825 bit 13	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 20	45825 bit 14	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 21	45825 bit 15	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 22	45826 bit 0	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 23	45826 bit 1	Uint16	2	R	True=1 False=0
Contact Expansion Module	Output 24	45826 bit 2	Uint16	2	R	True=1 False=0
Synchronizer	Synchronization failed alarm	45826 bit 3	Uint16	2	R	True=1 False=0
Network Load Share	Network load share disable	45826 bit 4	Uint16	2	R	True=1 False=0
Network Load Share	Unknown load share protocol version	45826 bit 5	Uint16	2	R	True=1 False=0
Network Load Share	RCC active	45826 bit 6	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 1	45826 bit 7	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 2	45826 bit 8	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 3	45826 bit 9	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 4	45826 bit 10	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 5	45826 bit 11	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 6	45826 bit 12	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 7	45826 bit 13	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 8	45826 bit 14	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 9	45826 bit 15	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 10	45827 bit 0	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 11	45827 bit 1	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 12	45827 bit 2	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 13	45827 bit 3	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 14	45827 bit 4	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 15	45827 bit 5	Uint16	2	R	True=1 False=0
Network Load Share	Receiving ID 16	45827 bit 6	Uint16	2	R	True=1 False=0
Network Load Share	Network load share configuration mismatch	45827 bit 7	Uint16	2	R	True=1 False=0
Network Load Share	Network load share ID missing	45827 bit 8	Uint16	2	R	True=1 False=0
Network Load Share	ID 1 enabled	45827 bit 9	Uint16	2	R	True=1 False=0
Network Load Share	ID 2 enabled	45827 bit 10	Uint16	2	R	True=1 False=0
Network Load Share	ID 3 enabled	45827 bit 11	Uint16	2	R	True=1 False=0
Network Load Share	ID 4 enabled	45827 bit 12	Uint16	2	R	True=1 False=0
Network Load Share	ID 5 enabled	45827 bit 13	Uint16	2	R	True=1 False=0
Network Load Share	ID 6 enabled	45827 bit 14	Uint16	2	R	True=1 False=0
Network Load Share	ID 7 enabled	45827 bit 15	Uint16	2	R	True=1 False=0
Network Load Share	ID 8 enabled	45828 bit 0	Uint16	2	R	True=1 False=0
Network Load Share	ID 9 enabled	45828 bit 1	Uint16	2	R	True=1 False=0
Network Load Share	ID 10 enabled	45828 bit 2	Uint16	2	R	True=1 False=0
Network Load Share	ID 11 enabled	45828 bit 3	Uint16	2	R	True=1 False=0
Network Load Share	ID 12 enabled	45828 bit 4	Uint16	2	R	True=1 False=0
Network Load Share	ID 13 enabled	45828 bit 5	Uint16	2	R	True=1 False=0
Network Load Share	ID 14 enabled	45828 bit 6	Uint16	2	R	True=1 False=0
Network Load Share	ID 15 enabled	45828 bit 7	Uint16	2	R	True=1 False=0
Network Load Share	ID 16 enabled	45828 bit 8	Uint16	2	R	True=1 False=0
Network Load Share	NLS status 1	45828 bit 9	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
Network Load Share	NLS status 2	45828 bit 10	Uint16	2	R	True=1 False=0
Network Load Share	NLS status 3	45828 bit 11	Uint16	2	R	True=1 False=0
Network Load Share	NLS status 4	45828 bit 12	Uint16	2	R	True=1 False=0
24	Block	45828 bit 13	Uint16	2	R	True=1 False=0
24	Pickup	45828 bit 14	Uint16	2	R	True=1 False=0
24	Trip	45828 bit 15	Uint16	2	R	True=1 False=0
24	24 alarm	45829 bit 0	Uint16	2	R	True=1 False=0
DECS Control	Transient boost active	45829 bit 1	Uint16	2	R	True=1 False=0
DECS Control	KW threshold status	45829 bit 2	Uint16	2	R	True=1 False=0
DECS Control	Manual FVR only	45829 bit 3	Uint16	2	R	True=1 False=0
More Alarms	Bridge overtemperature warning	45829 bit 4	Uint16	2	R	True=1 False=0
More Alarms	Bridge overtemperature alarm	45829 bit 5	Uint16	2	R	True=1 False=0
More Alarms	Pole slip alarm	45829 bit 6	Uint16	2	R	True=1 False=0
More Alarms	Security shutdown alarm	45829 bit 7	Uint16	2	R	True=1 False=0
More Alarms	PSS blocked	45829 bit 8	Uint16	2	R	True=1 False=0
Reserved		45829 bit 9				
Reserved		45829 bit 10				
Field Overtemperature	Block	45829 bit 11	Uint16	2	R	True=1 False=0
Field Overtemperature	Pickup	45829 bit 12	Uint16	2	R	True=1 False=0
Field Overtemperature	Trip	45829 bit 13	Uint16	2	R	True=1 False=0
Loss of Field Isolation Transducer	Block	45829 bit 14	Uint16	2	R	True=1 False=0
Loss of Field Isolation Transducer	Pickup	45829 bit 15	Uint16	2	R	True=1 False=0
Loss of Field Isolation Transducer	Trip	45830 bit 0	Uint16	2	R	True=1 False=0
81U-2	Block	45830 bit 1	Uint16	2	R	True=1 False=0
81U-2	Pickup	45830 bit 2	Uint16	2	R	True=1 False=0
81U-2	Trip	45830 bit 3	Uint16	2	R	True=1 False=0
Analog Output	Analog output 1 out of range	45830 bit 4	Uint16	2	R	True=1 False=0
Analog Output	Analog output 2 out of range	45830 bit 5	Uint16	2	R	True=1 False=0
Analog Output	Analog output 3 out of range	45830 bit 6	Uint16	2	R	True=1 False=0
Analog Output	Analog output 4 out of range	45830 bit 7	Uint16	2	R	True=1 False=0
Analog Output	Control output out of range	45830 bit 8	Uint16	2	R	True=1 False=0

Metering

Table 26-8. Metering Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Per Unit Meter	Gen Vab pu	45900	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Vbc pu	45902	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Vca pu	45904	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Vavg pu	45906	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Ia pu	45908	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Ib pu	45910	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Ic pu	45912	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Iavg pu	45914	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Kw pu	45916	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Kva pu	45918	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Gen Kvar pu	45920	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Positive sequence voltage pu	45922	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Negative sequence voltage pu	45924	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Positive sequence current pu	45926	Float	4	R	Per Unit	0.001	-10–10

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Per Unit Meter	Negative sequence current pu	45928	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Bus Vab pu	45930	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Bus Vbc pu	45932	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Bus Vca pu	45934	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Bus vavg pu	45936	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Voltage difference pu	45938	Float	4	R	Per Unit	0.001	-10–10
Reserved		45940	Float	4	R	Per Unit	0.001	n/a
Per Unit Meter	Gen frequency pu	45942	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Bus frequency pu	45944	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Field current pu	45946	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Field voltage pu	45948	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Slip frequency pu	45950	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Icc pu	45952	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	AVR setpoint pu	45954	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	FCR setpoint pu	45956	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	FVR setpoint pu	45958	Float	4	R	Per Unit	0.001	-10–10
Per Unit Meter	Var setpoint pu	45960	Float	4	R	Per Unit	0.001	-10–10
Field Voltage Meter	V_X	45962	Float	4	R	Volt	0.001	-1000–1000
Field Current Meter	I_X	45964	Float	4	R	Amp	0.01	0–2000000000
DECS PSS Meter	Terminal Frequency Deviation	45966	Float	4	R	Percent	n/a	n/a
DECS PSS Meter	Compensated Frequency Deviation	45968	Float	4	R	Percent	n/a	n/a
DECS PSS Meter	PSS output	45970	Float	4	R	n/a	n/a	n/a
DECS Regulator Meter	Tracking error	45972	Float	4	R	Percent	n/a	n/a
DECS Regulator Meter	Control output PU	45974	Float	4	R	Per Unit	0.001	-10–10
DECS Regulator Meter	Exciter Diode Monitor Ripple Percent	45976	Float	4	R	Percent	n/a	n/a
DECS Regulator Meter	Control output	45978	Float	4	R	Percent	n/a	n/a
DECS Regulator Meter	NLS error percent	45980	Float	4	R	Percent	n/a	n/a
DECS Regulator Meter	LL magnitude pu	45982	Float	4	R	Per Unit	0.001	-10–10
DECS Regulator Meter	NLS LL magnitude avg pu	45984	Float	4	R	Per Unit	0.001	-10–10
DECS Regulator Meter	NLS number generators online	45986	Int 32	4	R	n/a	n/a	n/a
Generator Voltage Meter Magnitude 1	V_{AB}	45988	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Magnitude 1	V_{BC}	45990	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Magnitude 1	V_{CA}	45992	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Magnitude 1	V_{AVG} LL	45994	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Primary 1	V_{AB}	45996	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Primary 1	V_{BC}	45998	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Primary 1	V_{CA}	46000	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Primary 1	V_{AVG} LL	46002	Float	4	R	Volt	0.01	0–2000000000
Generator Voltage Meter Angle 1	V_{AB}	46004	Float	4	R	Degree	0.1	0–360

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Generator Voltage Meter Angle 1	V_{BC}	46006	Float	4	R	Degree	0.1	0–360
Generator Voltage Meter Angle 1	V_{CA}	46008	Float	4	R	Degree	0.1	0–360
Generator Voltage Meter Angle 1	V_{AB}	46010	String	24	R	n/a	n/a	0–24
Generator Voltage Meter Angle 1	V_{BC}	46022	String	24	R	n/a	n/a	0–24
Generator Voltage Meter Angle 1	V_{CA}	46034	String	24	R	n/a	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{AB}	46046	String	24	R	n/a	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{BC}	46058	String	24	R	n/a	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{CA}	46070	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Magnitude 1	V_{AB}	46082	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Magnitude 1	V_{BC}	46084	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Magnitude 1	V_{CA}	46086	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Magnitude 1	V_{AVG} LL	46088	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Primary 1	V_{AB}	46090	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Primary 1	V_{BC}	46092	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Primary 1	V_{CA}	46094	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Primary 1	V_{AVG} LL	46096	Float	4	R	Volt	0.01	0–2000000000
Bus Voltage Meter Angle 1	V_{AB}	46098	Float	4	R	Degree	0.1	0–360
Bus Voltage Meter Angle 1	V_{BC}	46100	Float	4	R	Degree	0.1	0–360
Bus Voltage Meter Angle 1	V_{CA}	46102	Float	4	R	Degree	0.1	0–360
Bus Voltage Meter Angle 1	V_{AB}	46104	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Magnitude Angle 1	V_{BC}	46116	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Magnitude Angle 1	V_{CA}	46128	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{AB}	46140	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{BC}	46152	String	24	R	n/a	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{CA}	46164	String	24	R	n/a	n/a	0–24
Generator Current Meter Magnitude 1	I_A	46176	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Magnitude 1	I_B	46178	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Magnitude 1	I_C	46180	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Magnitude 1	I_{AVG}	46182	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Primary 1	I_A	46184	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Primary 1	I_B	46186	Float	4	R	Amp	0.01	0–2000000000

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Generator Current Meter Primary 1	I_C	46188	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Primary 1	I_{AVG}	46190	Float	4	R	Amp	0.01	0–2000000000
Generator Current Meter Angle 1	I_A	46192	Float	4	R	Degree	0.1	0–360
Generator Current Meter Angle 1	I_B	46194	Float	4	R	Degree	0.1	0–360
Generator Current Meter Angle 1	I_C	46196	Float	4	R	Degree	0.1	0–360
Generator Current Meter Magnitude Angle 1	I_A	46198	String	24	R	n/a	n/a	0–24
Generator Current Meter Magnitude Angle 1	I_B	46210	String	24	R	n/a	n/a	0–24
Generator Current Meter Magnitude Angle 1	I_C	46222	String	24	R	n/a	n/a	0–24
Generator Current Meter Primary Angle 1	I_A	46234	String	24	R	n/a	n/a	0–24
Generator Current Meter Primary Angle 1	I_B	46246	String	24	R	n/a	n/a	0–24
Generator Current Meter Primary Angle 1	I_C	46258	String	24	R	n/a	n/a	0–24
Icc Current Meter Magnitude 1	I_X	46270	Float	4	R	Amp	0.01	0–2000000000
Icc Current Meter Primary 1	I_X	46272	Float	4	R	Amp	0.01	0–2000000000
Power Meter	Total watts secondary	46274	Float	4	R	Watt	0.01	n/a
Power Meter	Total watts primary	46276	Float	4	R	Watt	0.01	n/a
Power Meter	Total vars secondary	46278	Float	4	R	Var	0.01	n/a
Power Meter	Total vars primary	46280	Float	4	R	Var	0.01	n/a
Power Meter	Total S secondary	46282	Float	4	R	VA	0.01	n/a
Power Meter	Total S primary	46284	Float	4	R	VA	0.01	n/a
Power Meter	Total PF secondary	46286	Float	4	R	PF	0.01	-1–1
Power Meter	Total PF primary	46288	Float	4	R	PF	0.01	-1–1
Power Meter	Positive watthour total	46290	Float	4	R	Watthour	1	0.00E+00–1.00E+12
Power Meter	Positive varhour total	46292	Float	4	R	Varhour	1	0.00E+00–1.00E+12
Power Meter	Negative watthour total	46294	Float	4	R	Watthour	1	-1.00E+12–0.00E+00
Power Meter	Negative varhour total	46296	Float	4	R	Varhour	1	-1.00E+12–0.00E+00
Power Meter	VA hour total	46298	Float	4	R	VA hour	1	0.00E+00–1.00E+12
Power Meter	Scaled PF	46300	Float	4	R	PF	0.01	-1–1
Energy Meter	Positive watthour total	46302	Float	4	RW	Watthour	1	0.00E+00–1.00E+12
Energy Meter	Positive varhour total	46304	Float	4	RW	Varhour	1	0.00E+00–1.00E+12
Energy Meter	Negative watthour total	46306	Float	4	RW	Watthour	1	-1.00E+12–0.00E+00
Energy Meter	Negative varhour total	46308	Float	4	RW	Varhour	1	-1.00E+12–0.00E+00
Energy Meter	VA hour total	46310	Float	4	RW	Varhour	1	0.00E+00–1.00E+12
Sync Meter 1	Slip Angle	46312	Float	4	R	Degree	0.1	-359.9–359.9

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Sync Meter 1	Slip Frequency	46314	Float	4	R	Hertz	n/a	n/a
Sync Meter 1	Voltage Difference	46316	Float	4	R	Volt	n/a	n/a
Generator Frequency Meter 1	Frequency	46318	Float	4	R	Hertz	0.001	10–180
Bus Frequency Meter 1	Frequency	46320	Float	4	R	Hertz	0.001	10–180
Auxiliary Input Voltage 1	Value	46322	Float	4	R	Volt	0.01	-9999999–9999999
Auxiliary Input Current 1	Value	46324	Float	4	R	Amp	0.01	-9999999–9999999
Configurable Protection 1	Math result	46326	Float	4	R	n/a	n/a	n/a
Configurable Protection 2	Math result	46328	Float	4	R	n/a	n/a	n/a
Configurable Protection 3	Math result	46330	Float	4	R	n/a	n/a	n/a
Configurable Protection 4	Math result	46332	Float	4	R	n/a	n/a	n/a
Configurable Protection 5	Math result	46334	Float	4	R	n/a	n/a	n/a
Configurable Protection 6	Math result	46336	Float	4	R	n/a	n/a	n/a
Configurable Protection 7	Math result	46338	Float	4	R	n/a	n/a	n/a
Configurable Protection 8	Math result	46340	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 1 raw value	46342	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 2 raw value	46344	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 3 raw value	46346	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 4 raw value	46348	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 5 raw value	46350	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 6 raw value	46352	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 7 raw value	46354	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 8 raw value	46356	Float	4	R	MilliAmp	n/a	n/a
AEM Metering	Analog input 1 scaled value	46358	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 2 scaled value	46360	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 3 scaled value	46362	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 4 scaled value	46364	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 5 scaled value	46366	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 6 scaled value	46368	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 7 scaled value	46370	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog input 8 scaled value	46372	Float	4	R	n/a	n/a	n/a
AEM Metering	RTD Input 1 Raw Value	46374	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 2 Raw Value	46376	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 3 Raw Value	46378	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 4 Raw Value	46380	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 5 Raw Value	46382	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 6 Raw Value	46384	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 7 Raw Value	46386	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 8 Raw Value	46388	Float	4	R	Ohm	n/a	n/a
AEM Metering	RTD Input 1 Scaled Value	46390	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 2 Scaled Value	46392	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 3 Scaled Value	46394	Float	4	R	Deg F	1	-40000–9999999

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
AEM Metering	RTD Input 4 Scaled Value	46396	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 5 Scaled Value	46398	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 6 Scaled Value	46400	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 7 Scaled Value	46402	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	RTD Input 8 Scaled Value	46404	Float	4	R	Deg F	1	-40000–9999999
AEM Metering	Thermocouple Input 1 raw value	46406	Float	4	R	Millivolt	n/a	n/a
AEM Metering	Thermocouple Input 2 raw value	46408	Float	4	R	Millivolt	n/a	n/a
AEM Metering	Analog output 1 raw value	46410	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 2 raw value	46412	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 3 raw value	46414	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 4 raw value	46416	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 1 scaled value	46418	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 2 scaled value	46420	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 3 scaled value	46422	Float	4	R	n/a	n/a	n/a
AEM Metering	Analog output 4 scaled value	46424	Float	4	R	n/a	n/a	n/a
AEM Metering	Thermocouple Input 1 scaled value	46426	Float	4	R	Deg F	n/a	n/a
AEM Metering	Thermocouple Input 2 scaled value	46428	Float	4	R	Deg F	n/a	n/a
AEM Metering	RTD Input 1 Metric Value	46430	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 2 Metric Value	46432	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 3 Metric Value	46434	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 4 Metric Value	46436	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 5 Metric Value	46438	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 6 Metric Value	46440	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 7 Metric Value	46442	Float	4	R	Deg C	n/a	n/a
AEM Metering	RTD Input 8 Metric Value	46444	Float	4	R	Deg C	n/a	n/a
AEM Metering	Thermocouple Input 1 Metric Value	46446	Float	4	R	Deg C	n/a	n/a
AEM Metering	Thermocouple Input 2 Metric Value	46448	Float	4	R	Deg C	n/a	n/a
Reserved		46450-46528						
Independent Meter	PSS frequency rate of change	46530	Float	4	R	Hz/second	0.01	-15–15
Independent Meter	PSS frequency rate of change pu	46532	Float	4	R	PU/second	0.01	-1.5–1.5
Independent Meter	Field temperature	46534	Float	4	R	Deg F	0.01	-40–572
Independent Meter	Inner Loop Reference	46536	Float	4	R	Per Unit	0.001	-10–10
Independent Meter	Inner Loop Field Voltage Feedback	46538	Float	4	R	Per Unit	0.001	-10–10
Independent Meter	Inner Loop Error	46540	Float	4	R	Per Unit	0.001	-10–10
Independent Meter	Inner Loop PID Output	46542	Float	4	R	Per Unit	0.001	-10–10
Independent Meter	Inner Loop Output	46544	Float	4	R	Per Unit	0.001	-10–10
Independent Meter	Scaled Auxiliary Input Meter Value	46546	Float	4	R	n/a	0.001	-2000000–2000000
Analog Output 1 Metering	Raw	46548	Float	4	R	n/a	n/a	n/a
Analog Output 1 Metering	Scaled	46550	Float	4	R	n/a	n/a	n/a
Analog Output 2 Metering	Raw	46552	Float	4	R	n/a	n/a	n/a

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Analog Output 2 Metering	Scaled	46554	Float	4	R	n/a	n/a	n/a
Analog Output 3 Metering	Raw	46556	Float	4	R	n/a	n/a	n/a
Analog Output 3 Metering	Scaled	46558	Float	4	R	n/a	n/a	n/a
Analog Output 4 Metering	Raw	46560	Float	4	R	n/a	n/a	n/a
Analog Output 4 Metering	Scaled	46562	Float	4	R	n/a	n/a	n/a
Control Output Metering	Raw	46564	Float	4	R	n/a	n/a	n/a
Control Output Metering	Scaled	46566	Float	4	R	n/a	n/a	n/a

Limiters

Table 26-9. Limiter Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
OEL Primary Current Hi	46600	Float	4	R W	Amp	0.01	0–12000
OEL Primary Current Mid	46602	Float	4	R W	Amp	0.01	0–12000
OEL Primary Current Lo	46604	Float	4	R W	Amp	0.01	0–12000
OEL Primary Time Hi	46606	Float	4	R W	Second	1	0–240
OEL Primary Time Mid	46608	Float	4	R W	Second	1	0–240
OEL Primary Current Hi Off	46610	Float	4	R W	Amp	0.01	0–12000
OEL Primary Current Lo Off	46612	Float	4	R W	Amp	0.01	0–12000
OEL Primary Current Time Off	46614	Float	4	R W	Second	1	0–240
OEL Primary Takeover Current Max Off	46616	Float	4	R W	Amp	0.01	0–12000
OEL Primary Takeover Current Min Off	46618	Float	4	R W	Amp	0.01	0–12000
OEL Primary Takeover Time Dial Off	46620	Float	4	R W	n/a	0.1	0.1–20
OEL Primary Takeover Current Max On	46622	Float	4	R W	Amp	0.01	0–12000
OEL Primary Takeover Current Min On	46624	Float	4	R W	Amp	0.01	0–12000
OEL Primary Takeover Time Dial On	46626	Float	4	R W	n/a	0.1	0.1–20
OEL Primary Dvdt Enable	46628	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
OEL Primary Dvdt Ref	46630	Float	4	R W	n/a	0.1	-10–0
OEL Secondary Current Hi	46632	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Current Mid	46634	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Current Lo	46636	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Time Hi	46638	Float	4	R W	Second	1	0–240
OEL Secondary Time Mid	46640	Float	4	R W	Second	1	0–240
OEL Secondary Current Hi Off	46642	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Current Lo Off	46644	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Current Time Off	46646	Float	4	R W	Second	1	0–240
OEL Secondary Takeover Current Max Off	46648	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Takeover Current Min Off	46650	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Takeover Time Dial Off	46652	Float	4	R W	n/a	0.1	0.1–20
OEL Secondary Takeover Current Max On	46654	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Takeover Current Min On	46656	Float	4	R W	Amp	0.01	0–12000
OEL Secondary Takeover Time Dial On	46658	Float	4	R W	n/a	0.1	0.1–20

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
OEL Scale Enable	46660	Uint32	4	R W	n/a	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	46662	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Takeover Signal 2	46664	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Takeover Signal 3	46666	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Takeover Scale 1	46668	Float	4	R W	Percent	0.1	0–1,000
OEL Scale Takeover Scale 2	46670	Float	4	R W	Percent	0.1	0–1,000
OEL Scale Takeover Scale 3	46672	Float	4	R W	Percent	0.1	0–1,000
OEL Scale Summing Signal 1	46674	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Summing Signal 2	46676	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Summing Signal 3	46678	Float	4	R W	Limiter Scale Volt	0.01	-10–10
OEL Scale Summing Scale 1	46680	Float	4	R W	Percent	0.1	0–1,000
OEL Scale Summing Scale 2	46682	Float	4	R W	Percent	0.1	0–1,000
OEL Scale Summing Scale 3	46684	Float	4	R W	Percent	0.1	0–1,000
UEL Primary Curve X1	46686	Float	4	R W	kilowatt	1	0–62
UEL Primary Curve X2	46688	Float	4	R W	kilowatt	1	0–62
UEL Primary Curve X3	46690	Float	4	R W	kilowatt	1	0–62
UEL Primary Curve X4	46692	Float	4	R W	kilowatt	1	0–62
UEL Primary Curve X5	46694	Float	4	R W	kilowatt	1	0–62
UEL Primary Curve Y1	46696	Float	4	R W	kilovar	1	0–62
UEL Primary Curve Y2	46698	Float	4	R W	kilovar	1	0–62
UEL Primary Curve Y3	46700	Float	4	R W	kilovar	1	0–62
UEL Primary Curve Y4	46702	Float	4	R W	kilovar	1	0–62
UEL Primary Curve Y5	46704	Float	4	R W	kilovar	1	0–62
UEL Primary Power Filter TC	46706	Float	4	R W	Second	0.1	0–20
UEL Primary Voltage Dependent Exponent	46708	Float	4	R W	n/a	1	0–2
UEL Secondary Curve X1	46710	Float	4	R W	kilowatt	1	0–62
UEL Secondary Curve X2	46712	Float	4	R W	kilowatt	1	0–62
UEL Secondary Curve X3	46714	Float	4	R W	kilowatt	1	0–62
UEL Secondary Curve X4	46716	Float	4	R W	kilowatt	1	0–62
UEL Secondary Curve X5	46718	Float	4	R W	kilowatt	1	0–62
UEL Secondary Curve Y1	46720	Float	4	R W	kilovar	1	0–62
UEL Secondary Curve Y2	46722	Float	4	R W	kilovar	1	0–62
UEL Secondary Curve Y3	46724	Float	4	R W	kilovar	1	0–62
UEL Secondary Curve Y4	46726	Float	4	R W	kilovar	1	0–62
UEL Secondary Curve Y5	46728	Float	4	R W	kilovar	1	0–62
SCL Primary Reference Hi	46730	Float	4	R W	Amp	0.1	0–66000
SCL Primary Reference Lo	46732	Float	4	R W	Amp	0.1	0–66000
SCL Primary Time Hi	46734	Float	4	R W	Second	0.1	0–240

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
SCL Primary No Response Time	46736	Float	4	R W	Second	0.1	0–10
SCL Secondary Reference Hi	46738	Float	4	R W	Amp	0.1	0–66000
SCL Secondary Reference Lo	46740	Float	4	R W	Amp	0.1	0–66000
SCL Secondary Time Hi	46742	Float	4	R W	Second	0.1	0–240
SCL Secondary No Response Time	46744	Float	4	R W	Second	0.1	0–10
SCL Scale Enable	46746	Uint32	4	R W	n/a	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	46748	Float	4	R W	Limiter Scale Volt	0.01	-10–10
SCL Scale Signal 2	46750	Float	4	R W	Limiter Scale Volt	0.01	-10–10
SCL Scale Signal 3	46752	Float	4	R W	Limiter Scale Volt	0.01	-10–10
SCL Scale Point 1	46754	Float	4	R W	Percent	0.1	0–200
SCL Scale Point 2	46756	Float	4	R W	Percent	0.1	0–200
SCL Scale Point 3	46758	Float	4	R W	Percent	0.1	0–200
Var Limit Enable	46760	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Var Limit Primary Delay	46762	Float	4	R W	Second	0.1	0–300
Var Limit Primary Setpoint	46764	Float	4	R W	Percent	0.1	0–200
Var Limit Secondary Delay	46766	Float	4	R W	Second	0.1	0–300
Var Limit Secondary Setpoint	46768	Float	4	R W	Percent	0.1	0–200
Var Limit Enable Status	46770	Uint32	4	R	n/a	n/a	Off=0 On=1
OEL Primary Takeover Reset Time Coefficient Off	46772	Float	4	R W	n/a	0.01	0.01–100
OEL Primary Takeover Reset Time Coefficient On	46774	Float	4	R W	n/a	0.01	0.01–100
OEL Secondary Takeover Reset Time Coefficient Off	46776	Float	4	R W	n/a	0.01	0.01–100
OEL Secondary Takeover Reset Time Coefficient On	46778	Float	4	R W	n/a	0.01	0.01–100
OEL Primary Takeover Reset Type Off	46780	Uint32	4	R W	n/a	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Primary Takeover Reset Type On	46782	Uint32	4	R W	n/a	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Secondary Takeover Reset Type Off	46784	Uint32	4	R W	n/a	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Secondary Takeover Reset Type On	46786	Uint32	4	R W	n/a	n/a	Inverse=0 Integrating=1 Instantaneous=2

Setpoints

Table 26-10. Setpoint Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Excitation Current Setpoint	46900	Float	4	R W	Amp	0.01	0–12
Excitation Current Traverse Rate	46902	Float	4	R W	Second	1	10–200
Excitation Current Pre-position Mode 1	46904	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Current Pre-position 1	46906	Float	4	R W	Amp	0.01	0–12

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Excitation Current Pre-position Mode 2	46908	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Current Pre-position 2	46910	Float	4	R W	Amp	0.01	0–12
Excitation Current Minimum Setpoint Limit	46912	Float	4	R W	Percent	0.1	0–120
Excitation Current Maximum Setpoint Limit	46914	Float	4	R W	Percent	0.1	0–120
Generator Voltage Setpoint	46916	Float	4	R W	Volt	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator Voltage Traverse Rate	46918	Float	4	R W	Second	1	10–200
Generator Voltage Pre-position Mode 1	46920	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator Voltage Pre-position 1	46922	Float	4	R W	Volt	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator Voltage Pre-position Mode 2	46924	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator Voltage Pre-position 2	46926	Float	4	R W	Volt	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator Voltage Minimum Setpoint Limit	46928	Float	4	R W	Percent	0.1	70–120
Generator Voltage Maximum Setpoint Limit	46930	Float	4	R W	Percent	0.1	70–120
Generator var Setpoint	46932	Float	4	R W	kilovar	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator var Traverse Rate	46934	Float	4	R W	Second	1	10–200
Generator var Pre-position Mode 1	46936	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator var Pre-position 1	46938	Float	4	R W	kilovar	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator var Pre-position Mode 2	46940	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator var Pre-position 2	46942	Float	4	R W	kilovar	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator var Minimum Setpoint Limit	46944	Float	4	R W	Percent	0.1	-100–100
Generator var Maximum Setpoint Limit	46946	Float	4	R W	Percent	0.1	-100–100
Generator PF Setpoint	46948	Float	4	R W	Power Factor	0.01	-2–2
Generator PF Traverse Rate	46950	Float	4	R W	Second	1	10–200
Generator PF Pre-position Mode 1	46952	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator PF Pre-position 1	46954	Float	4	R W	Power Factor	0.001	-2–2
Generator PF Pre-position Mode 2	46956	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator PF Pre-position 2	46958	Float	4	R W	Power Factor	0.001	-2–2
Generator PF Minimum Setpoint Limit	46960	Float	4	R W	Power Factor	0.01	0.5–1
Generator PF Maximum Setpoint Limit	46962	Float	4	R W	Power Factor	0.01	-1–(-0.5)
Excitation Voltage Setpoint	46964	Float	4	R W	Volt	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Excitation Voltage Traverse Rate	46966	Float	4	R W	Second	1	10–200
Excitation Voltage Pre-position Mode 1	46968	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Voltage Pre-position 1	46970	Float	4	R W	Volt	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Excitation Voltage Pre-position Mode 2	46972	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Voltage Pre-position 2	46974	Float	4	R W	Volt	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Excitation Voltage Minimum Setpoint Limit	46976	Float	4	R W	Percent	0.1	0–150
Excitation Voltage Maximum Setpoint Limit	46978	Float	4	R W	Percent	0.1	0–150
Sc Set Option	46980	Int32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Sc Set Voltage Level	46982	Float	4	R W	Percent	0.1	0–100
Sc Set Current Level	46984	Float	4	R W	Percent	0.1	0–400
Sc Set Present Time	46986	Float	4	R W	Second	0.001	0–1
Sc Set Ref Change	46988	Float	4	R W	Percent	0.1	0–100
Sc Set Resp Change Level	46990	Float	4	R W	Percent	0.1	0–50
Sc Set Clear Time	46992	Float	4	R W	Second	0.001	0–1
Droop Value	46994	Float	4	R W	Percent	0.1	0–30
L-Drop Value	46996	Float	4	R W	Percent	0.1	0–30
Auxiliary Limit Enable	46998	Int32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Excitation Current Regulation Pre-position Mode 3	47000	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Current Regulation Pre-position 3	47002	Float	4	R W	Amp	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator Voltage Pre-position Mode 3	47004	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator Voltage Pre-position 3	47006	Float	4	R W	Volt	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator var Pre-position Mode 3	47008	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator var Pre-position 3	47010	Float	4	R W	kilovar	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Generator PF Pre-position Mode 3	47012	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Generator PF Pre-position 3	47014	Float	4	R W	Power Factor	0.001	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Excitation Voltage Pre-position Mode 3	47016	Uint32	4	R W	n/a	n/a	Maintain=0 Release=1
Excitation Voltage Pre-position 3	47018	Float	4	R W	Volt	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Active Excitation Current Regulation Setpoint	47020	Float	4	R W	Amp	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Active Generator Voltage Setpoint	47022	Float	4	R W	Volt	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Active Generator var Setpoint	47024	Float	4	R W	kilovar	0.1	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Active Generator PF Setpoint	47026	Float	4	R W	Power Factor	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Active Excitation Voltage Setpoint	47028	Float	4	R W	Volt	0.01	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Excitation Current Pre-Position Traverse 1	47030	Float	4	R W	Second	1	0–720
Excitation Current Pre-Position Traverse 2	47032	Float	4	R W	Second	1	0–720
Excitation Current Pre-Position Traverse 3	47034	Float	4	R W	Second	1	0–720
Generator Voltage Pre-Position Traverse 1	47036	Float	4	R W	Second	1	0–720
Generator Voltage Pre-Position Traverse 2	47038	Float	4	R W	Second	1	0–720
Generator Voltage Pre-Position Traverse 3	47040	Float	4	R W	Second	1	0–720
Generator var Pre-Position Traverse 1	47042	Float	4	R W	Second	1	0–720
Generator var Pre-Position Traverse 2	47044	Float	4	R W	Second	1	0–720
Generator var Pre-Position Traverse 3	47046	Float	4	R W	Second	1	0–720
Generator PF Pre-Position Traverse 1	47048	Float	4	R W	Second	1	0–720
Generator PF Pre-Position Traverse 2	47050	Float	4	R W	Second	1	0–720
Generator PF Pre-Position Traverse 3	47052	Float	4	R W	Second	1	0–720
Excitation Voltage Pre-Position Traverse 1	47054	Float	4	R W	Second	1	0–720
Excitation Voltage Pre-Position Traverse 2	47056	Float	4	R W	Second	1	0–720
Excitation Voltage Pre-Position Traverse 3	47058	Float	4	R W	Second	1	0–720

Global Settings

Table 26-11. Global Settings Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
System Configuration	Operating Mode	47200	Int32	4	R W	n/a	n/a	Generator=0 Motor=1
Gen Current Configuration	Rotation	47202	Uint32	4	R W	n/a	n/a	Forward=0 Reverse=1
PLC Timed Element Settings	Timer 1 Timeout Hours	47204	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 1 Timeout Minutes	47206	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 1 Timeout Seconds	47208	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 2 Timeout Hours	47210	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 2 Timeout Minutes	47212	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 2 Timeout Seconds	47214	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 3 Timeout Hours	47216	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 3 Timeout Minutes	47218	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 3 Timeout Seconds	47220	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 4 Timeout Hours	47222	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 4 Timeout Minutes	47224	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 4 Timeout Seconds	47226	Uint32	4	R W	Decisecond	1	0–599

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
PLC Timed Element Settings	Timer 5 Timeout Hours	47228	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 5 Timeout Minutes	47230	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 5 Timeout Seconds	47232	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 6 Timeout Hours	47234	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 6 Timeout Minutes	47236	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 6 Timeout Seconds	47238	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 7 Timeout Hours	47240	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 7 Timeout Minutes	47242	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 7 Timeout Seconds	47244	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 8 Timeout Hours	47246	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 8 Timeout Minutes	47248	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 8 Timeout Seconds	47250	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 9 Timeout Hours	47252	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 9 Timeout Minutes	47254	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 9 Timeout Seconds	47256	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 10 Timeout Hours	47258	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 10 Timeout Minutes	47260	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 10 Timeout Seconds	47262	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 11 Timeout Hours	47264	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 11 Timeout Minutes	47266	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 11 Timeout Seconds	47268	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 12 Timeout Hours	47270	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 12 Timeout Minutes	47272	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 12 Timeout Seconds	47274	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 13 Timeout Hours	47276	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 13 Timeout Minutes	47278	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 13 Timeout Seconds	47280	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 14 Timeout Hours	47282	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 14 Timeout Minutes	47284	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 14 Timeout Seconds	47286	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 15 Timeout Hours	47288	Uint32	4	R W	Hour	1	0–250

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
PLC Timed Element Settings	Timer 15 Timeout Minutes	47290	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 15 Timeout Seconds	47292	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Timer 16 Timeout Hours	47294	Uint32	4	R W	Hour	1	0–250
PLC Timed Element Settings	Timer 16 Timeout Minutes	47296	Uint32	4	R W	Minute	1	0–59
PLC Timed Element Settings	Timer 16 Timeout Seconds	47298	Uint32	4	R W	Decisecond	1	0–599
PLC Timed Element Settings	Counter 1 Output Timeout	47300	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 2 Output Timeout	47302	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 3 Output Timeout	47304	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 4 Output Timeout	47306	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 5 Output Timeout	47308	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 6 Output Timeout	47310	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 7 Output Timeout	47312	Float	4	R W	n/a	1	0–1800
PLC Timed Element Settings	Counter 8 Output Timeout	47314	Float	4	R W	n/a	1	0–1800
DECS PSS	PSS Enable	47316	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
DECS PSS	PSS Enable Status	47318	Uint32	4	R	n/a	n/a	Off=0 On=1
DECS PSS	PSS Rate of Change Enable	47320	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
DECS PSS	PSS Rate of Change Threshold	47322	Float	4	R W	Hz/Sec	0.01	0–10
DECS PSS	PSS Rate of Change Time Delay	47324	Float	4	R W	Second	0.01	0–20
DECS PSS	PSS Rate of Change Block Time	47326	Float	4	R W	Second	0.01	0–20
DECS PSS	PSS Rate of Change Low Pass Filter Time Constant	47328	Float	4	R W	Second	0.01	0–20
DECS PSS	PSS Rate of Change Washout Filter Time Constant	47330	Float	4	R W	Second	0.01	0–20
Synchronizer	Sync Type	47332	Uint32	4	R W	n/a	n/a	Anticipatory=0 Phase Lock Loop=1
Synchronizer	Slip Frequency	47334	Float	4	R W	Hertz	0.05	0.1–0.5
Synchronizer	Generator Frequency Greater Than Bus Frequency	47336	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Synchronizer	Breaker Closing Angle	47338	Float	4	R W	Degree	0.5	3–20
Synchronizer	Sync Activation Delay	47340	Float	4	R W	Second	0.1	0.1–0.8
Synchronizer	Generator Voltage Greater Than Bus Voltage	47342	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Synchronizer	Sync Fail Activation Delay	47344	Float	4	R W	Second	0.1	0.1–600
Synchronizer	Sync Speed Gain	47346	Float	4	R W	n/a	0.001	0.001–1000
Synchronizer	Sync Voltage Gain	47348	Float	4	R W	n/a	0.001	0.001–1000
Synchronizer	Voltage Window	47350	Float	4	R W	Percent	0.5	2–15
Synchronizer	Sys Option Input Auto Sync Enabled	47352	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Synchronizer	Max Slip Control Limit Hz	47354	Float	4	R W	Hertz	0.01	0–2
Synchronizer	Min Slip Control Limit Hz	47356	Float	4	R W	Hertz	0.01	0–2

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Synchronizer	Angle Compensation	47358	Float	4	R W	Degree	0.1	0–359.9
Network Load Share	Load Share Enable	47360	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Network Load Share	Load Share Droop Percent	47362	Float	4	R W	Percent	0.1	0–30
Network Load Share	Load Share Gain	47364	Float	4	R W	n/a	0.01	0–1000
Reserved		47366	Float	4	R W	n/a	0.01	
Reserved		47368	Float	4	R W	n/a	0.01	
Reserved		47370					0.01	
Network Load Share	Ki Gain	47372	Float	4	R W	n/a	0.01	0–1000
Network Load Share	Max Vc	47374	Float	4	R W	No Unit	0.01	0–1
Network Load Share	Disable Time Delay	47376	Float	4	R W	Second	0.001	1–3600

Relay Settings

Table 26-12. Relay Settings Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
System Configuration	Nominal Frequency	47400	Uint32	4	R W	n/a	n/a	50 Hz=50 60 Hz=60
System Configuration	DECS Auxiliary Summing Mode	47402	Uint32	4	R W	n/a	n/a	Voltage=0 Var=1
System Configuration	DECS Auxiliary Input Mode	47404	Uint32	4	R W	n/a	n/a	Voltage=0 Current=1
System Configuration	DECS Auxiliary Input Function	47406	Uint32	4	R W	n/a	n/a	DECS Input=0 PSS Test Input=1 Limiter Selection=2 No Control=4
System Configuration	DECS Auxiliary Voltage Gain	47408	Float	4	R W	n/a	0.01	-99–99
System Configuration	DECS Auto Track Time Delay	47410	Float	4	R W	Second	0.1	0–8
System Configuration	DECS Auto Track Traverse Rate	47412	Float	4	R W	Second	0.1	1–80
System Configuration	DECS Null Balance Level	47414	Float	4	R W	Percent	0.01	0–9999
System Configuration	DECS Auto Trans Time Delay	47416	Float	4	R W	Second	0.1	0–8
System Configuration	DECS Auto Trans Traverse Rate	47418	Float	4	R W	Second	0.1	1–80
Gen Volt Configuration	Ratio Primary	47420	Float	4	R W	n/a	1	1–500000
Gen Volt Configuration	Ratio Secondary	47422	Float	4	R W	n/a	1	1–600
Gen Volt Configuration	Rated Primary LL	47424	Float	4	R W	Volt	1	1–500000
Bus Volt Configuration	Ratio Primary	47426	Float	4	R W	n/a	1	1–500000
Bus Volt Configuration	Ratio Secondary	47428	Float	4	R W	n/a	1	1–600
Bus Volt Configuration	Rated Primary LL	47430	Float	4	R W	Volt	1	1–500000
Gen Current Configuration	Ratio Primary	47432	Float	4	R W	n/a	1	1–99999
Gen Current Configuration	Ratio Secondary	47434	Int32	4	R W	n/a	n/a	1=1 5=5
Gen Current Configuration	Rated Primary	47436	Float	4	R	Amp	0.1	0–180000
Modbus	Auto Save	47438	Uint16	2	R W	n/a	n/a	Off=0 On=1
Virtual Switch	Virtual Switch 1 State	47439	Uint32	4	R W	n/a	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 2 State	47441	Uint32	4	R W	n/a	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 3 State	47443	Uint32	4	R W	n/a	n/a	Open=0 Closed=1

Group	Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Virtual Switch	Virtual Switch 4 State	47445	Uint32	4	R W	n/a	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 5 State	47447	Uint32	4	R W	n/a	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 6 State	47449	Uint32	4	R W	n/a	n/a	Open=0 Closed=1
DECS Control	Start Stop Request	47451	Uint32	4	R W	n/a	n/a	Stop=0 =1 Start =2
DECS Control	System Option Underfrequency Hz	47453	Float	4	R W	Hertz	0.1	15–90
DECS Control	System Input COM Port Manual Enabled	47455	Uint32	4	R W	n/a	n/a	Manual=1 Automatic=2
DECS Control	System Input COM Port PF var Enabled	47457	Uint32	4	R W	n/a	n/a	Off=0 PF=1 Var=2
DECS Control	System Input COM Port External Tracking Enabled	47459	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
DECS Control	System Input COM Port Pre-position Enabled	47461	Uint32	4	R W	n/a	n/a	NOT SET=0 SET=1
DECS Control	System Input COM Port Pre-position Enabled 2	47463	Uint32	4	R W	n/a	n/a	NOT SET=0 SET=1
DECS Control	System Input COM Port Raise Enabled	47465	Uint32	4	R W	n/a	n/a	NOT SET=0 Raise=1
DECS Control	System Input COM Port Lower Enabled	47467	Uint32	4	R W	n/a	n/a	NOT SET=0 Lower=1
DECS Control	System Option Input Voltage Match Enabled	47469	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
DECS Control	System Option Underfrequency Mode	47471	Uint32	4	R W	n/a	n/a	UF Limiter=0 V/Hz Limiter=1
DECS Control	System Option Limiter Mode	47473	Uint32	4	R W	n/a	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	47475	Float	4	R W	Percent	0.01	0–20
DECS Control	System Option Voltage Match Reference	47477	Float	4	R W	Percent	0.001	0–700
DECS Control	System Option Underfrequency Slope	47479	Float	4	R W	n/a	0.01	0–3
DECS Control	System Option PF to Droop kW Threshold	47481	Float	4	R W	Percent	0.1	0–30
DECS Control	Startup Primary Soft-start Bias	47483	Float	4	R W	Percent	1	0–90
DECS Control	Startup Primary Soft-start Time	47485	Float	4	R W	Second	1	1–7200
DECS Control	Startup Secondary Soft-start Bias	47487	Float	4	R W	Percent	1	0–90
DECS Control	Startup Secondary Soft-start Time	47489	Float	4	R W	Second	1	1–7200

Protection Settings

Table 26-13. Protection Settings Group Parameters

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
Field Overvoltage	Primary Mode	47600	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overvoltage	Primary Pickup	47602	Float	4	R W	V	0.1	Disabled=0, 1–2400
Field Overvoltage	Primary Time Delay	47604	Float	4	R W	ms	100	Instantaneous=0, 200–30000
Field Overvoltage	Secondary Mode	47606	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overvoltage	Secondary Pickup	47608	Float	4	R W	V	0.1	Disabled=0, 1–2400
Field Overvoltage	Secondary Time Delay	47610	Float	4	R W	ms	100	Instantaneous=0, 200–30000
Field Overcurrent	Primary Mode	47612	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overcurrent	Primary Pickup	47614	Float	4	R W	Amp	0.1	Disabled=0, 0.1–20000
Field Overcurrent	Primary Time Delay	47616	Float	4	R W	ms	100	Instantaneous=0, 200–30000
Field Overcurrent	Primary Timing Mode	47618	Uint32	4	R W	n/a	n/a	Definite Timing=0 Inverse Timing=1
Field Overcurrent	Primary Time Dial	47620	Float	4	R W	n/a	0.1	0.1–20

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
Field Overcurrent	Secondary Mode	47622	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overcurrent	Secondary Pickup	47624	Float	4	R W	Amp	0.01	Disabled=0, 0.1–20000
Field Overcurrent	Secondary Time Delay	47626	Float	4	R W	ms	100	Instantaneous=0, 200–30000
Field Overcurrent	Secondary Timing Mode	47628	Uint32	4	R W	n/a	n/a	Definite Timing=0 Inverse Timing=1
Field Overcurrent	Secondary Time Dial	47630	Float	4	R W	n/a	0.1	0.1–20
Exciter Diode Monitor	Exciter Open Diode Enable	47632	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Exciter Diode Monitor	Exciter Shorted Diode Enable	47634	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Exciter Diode Monitor	Exciter Diode Inhibit Threshold	47636	Float	4	R W	%	0.1	0–100
Exciter Diode Monitor	Exciter Open Diode Pickup	47638	Float	4	R W	%	0.1	0–100
Exciter Diode Monitor	Exciter Open Diode Time Delay	47640	Float	4	R W	Sec	0.1	10–60
Exciter Diode Monitor	Exciter Shorted Diode Pickup	47642	Float	4	R W	%	0.1	0–100
Exciter Diode Monitor	Exciter Shorted Diode Time Delay	47644	Float	4	R W	Sec	0.1	5–30
Exciter Diode Monitor	Exciter Pole Ratio	47646	Float	4	R W	n/a	0.01	Disabled=0, 1–10
Loss Of Sensing	Mode	47648	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Loss Of Sensing	Time Delay	47650	Float	4	R W	Sec	0.1	0–30
Loss Of Sensing	Voltage Balanced Level	47652	Float	4	R W	%	0.1	0–100
Loss Of Sensing	Voltage Unbalanced Level	47654	Float	4	R W	%	0.1	0–100
25	Mode	47656	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
25	Voltage Monitor Mode	47658	Uint32	4	R W	n/a	n/a	Disabled=0 DLDA=1 DLLA=2 DLDA_DLLA=3 LLDA=4 LLDA_DLDA=5 DLLA_LLDA=6 DLDA_DLLA_LLDA=7
25	Phase Angle	47660	Float	4	R W	Deg	1	1–99
25	Slip Frequency	47662	Float	4	R W	Hz	0.01	0.01–0.5
25	Voltage Magnitude Error Percent	47664	Float	4	R W	%	0.1	0.1–50
25	Generator Frequency Greater Than Bus Frequency	47666	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
25	Dead Voltage	47668	Float	4	R W	%	1	Disabled=0, 10–90
25	Live Voltage	47670	Float	4	R W	%	1	Disabled=0, 10–90
25	Dropout Delay	47672	Float	4	R W	ms	1	50–60000
25	Angle Compensation	47674	Float	4	R W	Deg	0.1	0–359.9
25	VMM Dead Line, Dead Aux	47676	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
25	VMM Dead Line, Live Aux	47678	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
25	VMM Live Line, Dead Aux	47680	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
27P	Primary Mode	47682	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
27P	Primary Pickup	47684	Float	4	R W	V	1	Disabled=0, 1–600000
27P	Primary Time Delay	47686	Float	4	R W	ms	100	100–60000
27P	Secondary Mode	47688	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
27P	Secondary Pickup	47690	Float	4	R W	V	1	Disabled=0, 1–600000
27P	Secondary Time Delay	47692	Float	4	R W	ms	100	100–60000
59P	Primary Mode	47694	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
59P	Primary Pickup	47696	Float	4	R W	V	1	0–600000
59P	Primary Time Delay	47698	Float	4	R W	ms	100	100–60000

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
59P	Secondary Mode	47700	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
59P	Secondary Pickup	47702	Float	4	R W	V	1	0–600000
59P	Secondary Time Delay	47704	Float	4	R W	ms	100	100–60000
81O	Primary Mode	47706	Uint32	4	R W	n/a	n/a	Disabled=0 Over=1
81O	Primary Pickup	47708	Float	4	R W	Hz	0.01	Disabled=0, 15–70
81O	Primary Time Delay	47710	Float	4	R W	ms	100	100–300000
81O	Secondary Mode	47712	Uint32	4	R W	n/a	n/a	Disabled=0 Over=1
81O	Secondary Pickup	47714	Float	4	R W	Hz	0.01	Disabled=0, 15–70
81O	Secondary Time Delay	47716	Float	4	R W	ms	100	100–300000
81U	Primary Mode	47718	Uint32	4	R W	n/a	n/a	Disabled=0 Under=2
81U	Primary Pickup	47720	Float	4	R W	Hz	0.01	Disabled=0, 15–70
81U	Primary Time Delay	47722	Float	4	R W	ms	100	100–300000
81U	Primary Voltage Inhibit	47724	Float	4	R W	%	1	Disabled=0, 5–100
81U	Secondary Mode	47726	Uint32	4	R W	n/a	n/a	Disabled=0 Under=2
81U	Secondary Pickup	47728	Float	4	R W	Hz	0.01	Disabled=0, 15–70
81U	Secondary Time Delay	47730	Float	4	R W	ms	100	100–300000
81U	Secondary Voltage Inhibit	47732	Float	4	R W	%	1	Disabled=0, 5–100
40Q	Primary Mode	47734	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
40Q	Primary Pickup	47736	Float	4	R W	kvar	1	0–3000000
40Q	Primary Time Delay	47738	Float	4	R W	ms	100	0–300000
40Q	Secondary Mode	47740	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
40Q	Secondary Pickup	47742	Float	4	R W	kvar	1	0–3000000
40Q	Secondary Time Delay	47744	Float	4	R W	ms	100	0–300000
32R	Primary Mode	47746	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=4
32R	Primary Pickup	47748	Float	4	R W	kW	1	0–3000000
32R	Primary Time Delay	47750	Float	4	R W	ms	100	0–300000
32R	Secondary Mode	47752	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=4
32R	Secondary Pickup	47754	Float	4	R W	kW	1	0–3000000
32R	Secondary Time Delay	47756	Float	4	R W	ms	100	0–300000
Configurable Protection 1	Parameter Selection	47758	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 1	Math Operator	47760	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 1	Scale Factor 1	47761	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 1	Offset 1	47763	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 1	Scale Factor 2	47765	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 1	Offset 2	47767	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 2	Parameter Selection	47769	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 2	Math Operator	47771	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 2	Scale Factor 1	47772	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 2	Offset 1	47774	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 2	Scale Factor 2	47776	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 2	Offset 2	47778	Float	4	R W	n/a	0.01	-999999–999999

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
Configurable Protection 3	Parameter Selection	47780	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 3	Math Operator	47782	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 3	Scale Factor 1	47783	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 3	Offset 1	47785	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 3	Scale Factor 2	47787	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 3	Offset 2	47789	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 4	Parameter Selection	47791	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 4	Math Operator	47793	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 4	Scale Factor 1	47794	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 4	Offset 1	47796	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 4	Scale Factor 2	47798	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 4	Offset 2	47800	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 5	Parameter Selection	47802	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 5	Math Operator	47804	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 5	Scale Factor 1	47805	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 5	Offset 1	47807	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 5	Scale Factor 2	47809	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 5	Offset 2	47811	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 6	Parameter Selection	47813	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 6	Math Operator	47815	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 6	Scale Factor 1	47816	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 6	Offset 1	47818	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 6	Scale Factor 2	47820	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 6	Offset 2	47822	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 7	Parameter Selection	47824	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 7	Math Operator	47826	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 7	Scale Factor 1	47827	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 7	Offset 1	47829	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 7	Scale Factor 2	47831	Float	4	R W	n/a	0.01	-999999–999999

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
Configurable Protection 7	Offset 2	47833	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 8	Parameter Selection	47835	Int32	4	R W	n/a	n/a	See *Configurable Protection Parameters* at the end of this section for a complete list.
Configurable Protection 8	Math Operator	47837	Int8	1	R W	n/a	n/a	None=0 +=1 –=2 *=3 /=4
Configurable Protection 8	Scale Factor 1	47838	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 8	Offset 1	47840	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 8	Scale Factor 2	47842	Float	4	R W	n/a	0.01	-999999–999999
Configurable Protection 8	Offset 2	47844	Float	4	R W	n/a	0.01	-999999–999999
24	Primary Mode	47846	Uint32	4	R W	n/a	n/a	Disabled=0, Enabled=1
24	Primary Definite Time Pickup 1	47848	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Primary Definite Time Pickup 2	47850	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Primary Definite Time Delay 1	47852	Float	4	R W	ms	1	50–600000
24	Primary Definite Time Delay 2	47854	Float	4	R W	ms	1	50–600000
24	Primary Inverse Time Pickup	47856	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Primary Time Dial Trip	47858	Float	4	R W	n/a	0.1	0–9.9
24	Primary Time Dial Reset	47860	Float	4	R W	n/a	0.1	0–9.9
24	Primary Curve Exponent	47862	Uint32	4	R W	n/a	n/a	0.5=0, 1=1, 2=2
24	Secondary Mode	47864	Uint32	4	R W	n/a	n/a	Disabled=0, Enabled=1
24	Secondary Definite Time Pickup 1	47866	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Secondary Definite Time Pickup 2	47868	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Secondary Definite Time Delay 1	47870	Float	4	R W	ms	1	50–600000
24	Secondary Definite Time Delay 2	47872	Float	4	R W	ms	1	50–600000
24	Secondary Inverse Time Pickup	47874	Float	4	R W	n/a	0.01	Disabled=0, 0.5–6
24	Secondary Time Dial Trip	47876	Float	4	R W	n/a	0.1	0–9.9
24	Secondary Time Dial Reset	47878	Float	4	R W	n/a	0.1	0–9.9
24	Curve Exponent	47880	Uint32	4	R W	n/a	n/a	0.5=0, 1=1, 2=2
Field Overtemperature	Primary Mode	47882	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overtemperature	Primary Pickup	47884	Float	4	R W	Deg F	1	0–572
Field Overtemperature	Primary Time Delay	47886	Float	4	R W	Ms	100	100–60000
Field Overtemperature	Secondary Mode	47888	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overtemperature	Secondary Pickup	47890	Float	4	R W	Deg F	1	0–572
Field Overtemperature	Secondary Time Delay	47892	Float	4	R W	Ms	100	100–60000
Loss of FIT	Mode	47894	Uint32	4	R W	n/a	n/a	Disabled=0 Enabled=1
Loss of FIT	Time Delay	47896	Float	4	R W	Ms	100	0–9900
81U-2	Primary Mode	47898	Uint32	4	R W	n/a	n/a	Disabled=0 Under=2
81U-2	Primary Pickup	47900	Float	4	R W	Hz	0.01	Disabled=0; 15–70
81U-2	Primary Time Delay	47902	Float	4	R W	Ms	100	100–300000

Group	Name	Register	Type	Sz	R/W	Unit	Increment	Range
81U-2	Primary Voltage Inhibit	47904	Float	4	R W	%	1	Disabled=0; 5–100
81U-2	Secondary Mode	47906	Uint32	4	R W	n/a	n/a	Disabled=0 Under=2
81U-2	Secondary Pickup	47908	Float	4	R W	Hz	0.01	Disabled=0; 15–70
81U-2	Secondary Time Delay	47910	Float	4	R W	Ms	100	100–300000
81U-2	Secondary Voltage Inhibit	47912	Float	4	R W	%	1	Disabled=0; 5–100

Gains Settings

Table 26-14. Gains Settings Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Primary Gain Option	48200	Uint32	4	R W	n/a	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	48202	Uint32	4	R W	n/a	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	48204	Float	4	R W	n/a	0.001	0–1000
AVR Ki Primary	48206	Float	4	R W	n/a	0.001	0–1000
AVR Kd Primary	48208	Float	4	R W	n/a	0.001	0–1000
AVR Td Primary	48210	Float	4	R W	n/a	0.01	0–1
FCR Kp	48212	Float	4	R W	n/a	0.001	0–1000
FCR Ki	48214	Float	4	R W	n/a	0.001	0–1000
FCR Kd	48216	Float	4	R W	n/a	0.001	0–1000
FCR Td	48218	Float	4	R W	n/a	0.01	0–1
FVR Kp	48220	Float	4	R W	n/a	0.001	0–1000
FVR Ki	48222	Float	4	R W	n/a	0.001	0–1000
FVR Kd	48224	Float	4	R W	n/a	0.001	0–1000
FVR Td	48226	Float	4	R W	n/a	0.01	0–1
PF Ki	48228	Float	4	R W	n/a	0.001	0–1000
PF Kg	48230	Float	4	R W	n/a	0.001	0–1000
Var Ki	48232	Float	4	R W	n/a	0.001	0–1000
Var Kg	48234	Float	4	R W	n/a	0.001	0–1000
OEL Ki	48236	Float	4	R W	n/a	0.001	0–1000
OEL Kg	48238	Float	4	R W	n/a	0.001	0–1000
UEL Ki	48240	Float	4	R W	n/a	0.001	0–1000
UEL Kg	48242	Float	4	R W	n/a	0.001	0–1000
SCL Ki	48244	Float	4	R W	n/a	0.001	0–1000
SCL Kg	48246	Float	4	R W	n/a	0.001	0–1000
Vm Kg	48248	Float	4	R W	n/a	0.001	0–1000
Inner Loop Kp	48250	Float	4	R W	n/a	0.001	0–1000
Inner Loop Ki	48252	Float	4	R W	n/a	0.001	0–1000
AVR Kp Secondary	48254	Float	4	R W	n/a	0.001	0–1000
AVR Ki Secondary	48256	Float	4	R W	n/a	0.001	0–1000

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
AVR Kd Secondary	48258	Float	4	R W	n/a	0.001	0–1000
AVR Td Secondary	48260	Float	4	R W	n/a	0.01	0–1
Var Limit Ki	48262	Float	4	R W	n/a	0.001	0–1000
Var Limit Kg	48264	Float	4	R W	n/a	0.001	0–1000
AVR Primary Ka	48266	Float	4	R W	n/a	0.001	0–1
AVR Secondary Ka	48268	Float	4	R W	n/a	0.001	0–1
FCR Ka	48270	Float	4	R W	n/a	0.001	0–1
FVR Ka	48272	Float	4	R W	n/a	0.001	0–1

Legacy Modbus

Table 26-15. Legacy Modbus Parameters

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Model Information Character 1	40001	Uint8	1	R	n/a	n/a	n/a
Model Information Character 2	40002	Uint8	1	R	n/a	n/a	n/a
Model Information Character 3	40003	Uint8	1	R	n/a	n/a	n/a
Model Information Character 4	40004	Uint8	1	R	n/a	n/a	n/a
Model Information Character 5	40005	Uint8	1	R	n/a	n/a	n/a
Model Information Character 6	40006	Uint8	1	R	n/a	n/a	n/a
Model Information Character 7	40007	Uint8	1	R	n/a	n/a	n/a
Model Information Character 8	40008	Uint8	1	R	n/a	n/a	n/a
Model Information Character 9	40009	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 1	40010	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 2	40011	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 3	40012	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 4	40013	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 5	40014	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 6	40015	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 7	40016	Uint8	1	R	n/a	n/a	n/a
Application Program Version Character 8	40017	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 1	40018	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 2	40019	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 3	40020	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 4	40021	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 5	40022	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 6	40023	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 7	40024	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 8	40025	Uint8	1	R	n/a	n/a	n/a
Application Version Date Character 9	40026	Uint8	1	R	n/a	n/a	n/a
Reserved 8 bit: 1-17	40027 - 40043	Uint8	1	R	n/a	1	0–255
Boot Program Version Character 1	40044	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 2	40045	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 3	40046	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 4	40047	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 5	40048	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 6	40049	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 7	40050	Uint8	1	R	n/a	n/a	n/a
Boot Program Version Character 8	40051	Uint8	1	R	n/a	n/a	n/a
Reserved 8 bit: 18-29	40052 - 40063	Uint8	1	R	n/a	1	0–255

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Reserved 1	40064	C1 filler	274	R	n/a	n/a	n/a
Leading Lagging Indicator	40201	Uint16	2	R	n/a	n/a	Leading=0 Lagging=1
Motoring Generating Indicator	40202	Uint16	2	R	n/a	n/a	Motoring=0 Generating=1
Status of Front Panel LEDs	40203	Uint16	2	R	n/a	n/a	n/a
Contact Input States	40204	Uint16	2	R	n/a	n/a	n/a
Voltage Matching Status Indicator	40205	Uint16	2	R	n/a	n/a	n/a
Active Setpoint Adjustment Range	40206	Uint16	2	R	n/a	n/a	n/a
Annunciation Status Bit Flags 1	40207	Uint16	2	R	n/a	n/a	Annunciation status bit flags (0 = clear and 1 = annunciation is present) b0 = field overvoltage, b1 = field overcurrent, b2 = generator undervoltage, b3 = generator overvoltage, b4 = underfrequency, b5 = in OEL, b6 = in UEL, b7 = in FCR mode, b8 = no sensing, b9 = setpoint lower limit, b10 = setpoint upper limit, b11 = generator failed to build up, b12 = generator below 10 Hz, b13 = field overtemperature, b14 = EDM open diode, b15 = EDM shorted diode
Annunciation Status Bit Flags 2	40208	Uint16	2	R	n/a	n/a	Annunciation status bit flags (0 = clear and 1 = annunciation is present) b0 = loss of field, b1 = in SCL, b2 = V/Hz, b3 = loss of FIT, b4 = power low, b5 = PSS V unbalance, b6 = PSS I unbalance, b7 = PSS power below threshold, b8 = PSS speed failure, b9 = PSS voltage limit, b10 = clock reset, b11 = loss of IRIG, b12–b15 = unassigned
Protection Status Bit Flags 1	40209	Uint16	2	R	n/a	n/a	n/a
Protection Status Bit Flags 2	40210	Uint16	2	R	n/a	n/a	n/a
Relay Output States	40211	Uint16	2	R	n/a	n/a	n/a
Unused Registers 1	40212	U1 filler	78	R	n/a	n/a	n/a
RMS Generator Volts Phase A to B	40251	Float	4	R	n/a	n/a	n/a
RMS Generator Volts Phase B to C	40253	Float	4	R	n/a	n/a	n/a
RMS Generator Volts Phase C to A	40255	Float	4	R	n/a	n/a	n/a
RMS Bus Voltage in Volts	40257	Float	4	R	n/a	n/a	n/a
Generator Current Ia in Amps	40259	Float	4	R	n/a	n/a	n/a
Generator Current Ib in Amps	40261	Float	4	R	n/a	n/a	n/a
Generator Current Ic in Amps	40263	Float	4	R	n/a	n/a	n/a
Average RMS L-L Volts	40265	Float	4	R	n/a	n/a	n/a
Average Generator Phase Current	40267	Float	4	R	n/a	n/a	n/a
Field Voltage in Volts	40269	Float	4	R	n/a	n/a	n/a
Field Current in Amps	40271	Float	4	R	n/a	n/a	n/a
Auxiliary Input in Volts	40273	Float	4	R	n/a	n/a	n/a
Magnitude of A-B Voltage Fundamental Phasor	40275	Float	4	R	n/a	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Magnitude of B-C Voltage Fundamental Phasor	40277	Float	4	R	n/a	n/a	n/a
Magnitude of C-A Voltage Fundamental Phasor	40279	Float	4	R	n/a	n/a	n/a
Magnitude of Line A Current Fundamental Phasor	40281	Float	4	R	n/a	n/a	n/a
Magnitude of Line B Current Fundamental Phasor	40283	Float	4	R	n/a	n/a	n/a
Magnitude of Line C Current Fundamental Phasor	40285	Float	4	R	n/a	n/a	n/a
Current Input for Load Compensation	40287	Float	4	R	n/a	n/a	n/a
Angle Between Vab and Vca	40289	Float	4	R	n/a	n/a	n/a
Angle Between Vbc and Vca	40291	Float	4	R	n/a	n/a	n/a
Angle Between Ia and Vca	40293	Float	4	R	n/a	n/a	n/a
Angle Between Ib and Vca	40295	Float	4	R	n/a	n/a	n/a
Angle Between Ic and Vca	40297	Float	4	R	n/a	n/a	n/a
Angle Between Iaux and Vca	40299	Float	4	R	n/a	n/a	n/a
Gen Real Power in kW	40301	Float	4	R	n/a	n/a	n/a
Gen Reactive Power in kvar	40303	Float	4	R	n/a	n/a	n/a
Gen Apparent Power in kVA	40305	Float	4	R	n/a	n/a	n/a
Power Factor	40307	Float	4	R	n/a	n/a	n/a
Gen Positive Sequence Voltage	40309	Float	4	R	n/a	n/a	n/a
Gen Negative Sequence Voltage	40311	Float	4	R	n/a	n/a	n/a
Gen Positive Sequence Current	40313	Float	4	R	n/a	n/a	n/a
Gen Negative Sequence Current	40315	Float	4	R	n/a	n/a	n/a
Gen Frequency in Hertz	40317	Float	4	R	n/a	n/a	n/a
Bus Frequency in Hertz	40319	Float	4	R	n/a	n/a	n/a
Null Balance in Percent	40321	Float	4	R	n/a	n/a	n/a
Active Controller Output	40323	Float	4	R	n/a	n/a	n/a
Error Signal to Autotracking Loop	40325	Float	4	R	n/a	n/a	n/a
Rotor Temperature	40327	Float	4	R	n/a	n/a	n/a
Shorted Diode Harmonic Current	40329	Float	4	R	n/a	n/a	n/a
Open Diode Harmonic Current	40331	Float	4	R	n/a	n/a	n/a
Var/PF Controller Output in Volts	40333	Float	4	R	n/a	n/a	n/a
PSS Terminal Frequency Deviation	40335	Float	4	R	n/a	n/a	n/a
PSS Compensated Frequency Deviation	40337	Float	4	R	n/a	n/a	n/a
PSS Washed Out Speed Deviation	40339	Float	4	R	n/a	n/a	n/a
PSS Washed Out Power Deviation	40341	Float	4	R	n/a	n/a	n/a
PSS Mechanical Power Filter Output	40343	Float	4	R	n/a	n/a	n/a
PSS Signal Before Phase Lead-Lag Blocks	40345	Float	4	R	n/a	n/a	n/a
PSS Signal After Phase Lead-Lag Blocks	40347	Float	4	R	n/a	n/a	n/a
PSS Signal After Terminal Voltage Limiter	40349	Float	4	R	n/a	n/a	n/a
Final PSS Output	40351	Float	4	R	n/a	n/a	n/a
Reserved 2	40353	C2 Filler	96	R	n/a	n/a	n/a
Sensing Mode	40401	Uint16	2	R W	n/a	n/a	ABC=0 ACB=1
Auxiliary Input Summing Mode	40402	Uint16	2	R W	n/a	n/a	Voltage=0 var=1
Power Output Mode	40403	Uint16	2	R	n/a	n/a	n/a
Gen Field Type	40404	Uint16	2	R W	n/a	n/a	Exciter Field=0 Main Field=1
Voltage Sensing HW Gain Control	40405	Uint16	2	R	n/a	n/a	n/a
Auxiliary Input Mode	40406	Uint16	2	R W	n/a	n/a	Voltage=0 Current=1

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Rotor Temperature Mode	40407	Uint16	2	R	n/a	n/a	n/a
Number of CTs	40408	Uint16	2	R W	n/a	n/a	n/a
Selected CTs	40409	Uint16	2	R W	n/a	n/a	n/a
Motor/Gen Mode	40410	Uint16	2	R	n/a	n/a	Generator=0 Motor=1
Auxiliary Input Function	40411	Uint16	2	R W	n/a	1	DECS Input=0 PSS Test Input=1 Limiter Selection=2 No Control=3
Unused Registers 2	40412	U2 Filler	78	R	n/a	n/a	n/a
Gen Rated Frequency	40451	Float	4	R W	n/a	10	50.0–60.0
Gen PT Primary Voltage Rating	40453	Float	4	R W	n/a	1	1–500000
Gen PT Secondary Voltage Rating	40455	Float	4	R W	n/a	1	1–600
Gen CT Primary Current Rating	40457	Float	4	R W	n/a	1	1–99999
Gen CT Secondary Current Rating	40459	Float	4	R W	n/a	10	1.0–5.0
Field Current Shunt Rating	40461	Float	4	R W	Amp	0.1	1–10000
Field Voltage Isolation Module Input	40463	Float	4	R W	n/a	1	63–625
Bus Sensing PT Primary Rating	40465	Float	4	R W	n/a	1	1–500000
Bus Sensing PT Secondary Rating	40467	Float	4	R W	n/a	1	1–600
Maximum Field Flash Time	40469	Float	4	R W	n/a	1	1–50
Field Flash Dropout Level	40471	Float	4	R W	n/a	1	0–100
Gen Rated Voltage	40473	Float	4	R W	Volt	1	1–500000
Gen Rated kVA	40475	Float	4	R W	KiloVA	0.01	1–2000000
Gen Rated Field Voltage	40477	Float	4	R W	Volt	0.1	1–1000
Gen Rated Field Current	40479	Float	4	R W	Amp	0.1	0.1–10000
Nominal Bus Voltage	40481	Float	4	R W	Volt	1	1–500000
Auxiliary Input Gain for AVR Mode	40483	Float	4	R W	n/a	0.01	-99–99
Time Delay Before Autotracking	40485	Float	4	R W	Second	0.1	0–8
Traverse Rate of Autotracking	40487	Float	4	R W	Second	0.1	1–80
Reserved 3	40489	Float	4	R	n/a	n/1	n/a
Gain for Cross Current Compensation	40491	Float	4	R W	Percent	0.01	-30–30
External Tracking Time Delay	40493	Float	4	R W	Second	0.1	0–8
External Tracking Traverse Rate	40495	Float	4	R W	Second	0.1	1–80
Auxiliary Input Gain for FCR Mode	40497	Float	4	R W	n/a	0.01	-99–99
Auxiliary Input Gain for VAR Mode	40499	Float	4	R W	n/a	0.01	-99–99
Auxiliary Input Gain for PF Mode	40501	Float	4	R W	n/a	0.01	-99–99
Exciter Field Resistance	40503	Float	4	R W	ohm	0.001	0.001–99.999
Ambient Temperature	40505	Float	4	R W	Deg F	1	32–572
Brush Voltage Drop	40507	Float	4	R W	Volt	0.01	0–20
Gen Power Factor	40509	Float	4	R W	PF	0.01	-2–2
Auxiliary Input Gain for FVR Mode	40511	Float	4	R W	n/a	0.01	-99–99
Reserved 4	40513	C3 Filler	176	R	n/a	n/a	n/a
Unit Mode Virtual Toggle	40601	Uint16	2	R W	n/a	n/a	No Change=0 Change State=1
Control Mode Virtual Toggle	40602	Uint16	2	R W	n/a	n/a	No Change=0 Change State=1
Parallel Mode Virtual Toggle	40603	Uint16	2	R W	n/a	n/a	No Change=0 Change State=1
Operating Mode Virtual Switch	40604	Uint16	2	R W	n/a	n/a	Off=0 PF=1 var=2
AutoTrack Enabled Status	40605	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Pre-position Enable	40606	Uint16	2	R W	n/a	n/a	=0 SET=1
Raise Enabled Status	40607	Uint16	2	R W	n/a	n/a	=0 Raise=1
Lower Enabled Status	40608	Uint16	2	R W	n/a	n/a	=0 Lower=1

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Limiter Mode Options	40609	Uint16	2	R W	n/a	n/a	Off=0 UEL=1 OEL=2 UEL & OEL=3 SCL=4 UEL & SCL=5 OEL & SCL=6 UEL & OEL & SCL=7
Voltage Matching Mode Status	40610	Uint16	2	R	n/a	n/a	n/a
Operating Mode Status	40611	Uint16	2	R	n/a	n/a	n/a
Unit Mode Status	40612	Uint16	2	R	n/a	n/a	n/a
Control Mode Status	40613	Uint16	2	R	n/a	n/a	n/a
AutoTrack Status	40614	Uint16	2	R	n/a	n/a	n/a
Pre-position Enable Status	40615	Uint16	2	R	n/a	n/a	n/a
Autotransfer Status	40616	Uint16	2	R	n/a	n/a	n/a
Load Compensation Mode Status	40617	Uint16	2	R	n/a	n/a	n/a
Alarm Reset Enable	40618	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Loss-of-Sensing Detection Enable	40619	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Loss-of-Sensing Triggered Transfer-to-FCR-mode Enable	40620	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
External Tracking Enabled	40621	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Under Frequency or V/Hz Mode Enable	40622	Uint16	2	R W	n/a	n/a	UF Limiter=0 V/Hz Limiter=1
Reserved 5	40623	Float	4	R	n/a	n/a	n/a
Reserved 6	40625	Float	4	R	n/a	n/a	n/a
Reserved 7	40627	Float	4	R	n/a	n/a	n/a
Reserved 8	40629	Float	4	R	n/a	n/a	n/a
Droop Enabled	40631	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
L Drop Enabled	40632	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
CC Enabled	40633	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
OEL Style Mode	40634	Uint16	2	R	n/a	n/a	No Change=0 Change State=1
Autotransfer Enable Status	40635	Uint16	2	R	n/a	n/a	n/a
OEL Style Virtual Toggle	40636	Uint16	2	R W	n/a	n/a	No Change=0 Change State=1
Pre-position 2 Enable Status	40637	Uint16	2	R	n/a	n/a	n/a
UEL Style Mode	40638	Uint16	2	R	n/a	n/a	n/a
OEL Option Mode	40639	Uint16	2	R	n/a	n/a	Offline=0 Online=1
Pre-position Selection	40640	Uint16	2	R	n/a	n/a	n/a
UEL Style Enabled	40641	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Volt Match Mode	40642	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
OEL Enabled	40643	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
UEL Enabled	40644	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
SCL Enabled	40645	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Internal Tracking Mode	40646	Uint16	2	R	n/a	n/a	n/a
External Tracking Mode	40647	Uint16	2	R	n/a	n/a	n/a
Voltage Matching Mode	40648	Uint16	2	R	n/a	n/a	n/a
Unused Registers 3	40649	U3 Filler	52	R	n/a	n/a	n/a
Var Limiter Enable	40675	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Unused Registers 4	40676	U4 Filler	50	R	n/a	n/a	n/a
FCR Pre-Position Mode	40701	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
AVR Pre-Position Mode	40702	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
Var Pre-Position Mode	40703	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
PF Pre-Position Mode	40704	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
FCR Pre-Position 2 Mode	40705	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
AVR Pre-Position 2 Mode	40706	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Var Pre-Position 2 Mode	40707	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
PF Pre-Position 2 Mode	40708	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
FVR Pre-Position Mode	40709	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
FVR Pre-Position 2 Mode	40710	Uint16	2	R W	n/a	n/a	Maintain=0 Release=1
Unused Registers 5	40711	U5 Filler	80	R	n/a	n/a	n/a
FCR Mode Setpoint	40751	Float	4	R W	Amp	0.01	0–12
AVR Mode Setpoint	40753	Float	4	R W	Volt	0.1	84–144
Var Mode Setpoint in kvar	40755	Float	4	R W	kvar	0.1	0–0
PF Mode Setpoint	40757	Float	4	R W	PF	0.01	-2–2
Droop Setting in Percent	40759	Float	4	R W	Percent	0.1	0–30
FCR Minimum Setpoint	40761	Float	4	R	n/a	n/a	n/a
AVR Minimum Setpoint	40763	Float	4	R	n/a	n/a	n/a
Var Minimum Setpoint	40765	Float	4	R	n/a	n/a	n/a
PF Minimum Setpoint	40767	Float	4	R	n/a	n/a	n/a
FCR Maximum Setpoint	40769	Float	4	R	n/a	n/a	n/a
AVR Maximum Setpoint	40771	Float	4	R	n/a	n/a	n/a
Var Maximum Setpoint	40773	Float	4	R	n/a	n/a	n/a
PF Maximum Setpoint	40775	Float	4	R	n/a	n/a	n/a
FCR Mode Traverse Rate	40777	Float	4	R W	Second	1	10–200
AVR Mode Traverse Rate	40779	Float	4	R W	Second	1	10–200
Var Mode Traverse Rate	40781	Float	4	R W	Second	1	10–200
PF Mode Traverse Rate	40783	Float	4	R W	Second	1	10–200
FCR Mode Setpoint Pre-Position	40785	Float	4	R W	Amp	0.01	0–12
AVR Mode Setpoint Pre-Position	40787	Float	4	R W	Volt	0.1	84–144
Var Mode Setpoint Pre-Position in kvar	40789	Float	4	R W	kvar	0.1	0–0
PF Mode Setpoint Pre-Position	40791	Float	4	R W	PF	0.001	-2–2
FCR Mode Setpoint Step Size	40793	Float	4	R	n/a	n/a	n/a
AVR Mode Setpoint Step Size	40795	Float	4	R	n/a	n/a	n/a
Var Mode Setpoint Step Size	40797	Float	4	R	n/a	n/a	n/a
PF Mode Setpoint Step Size	40799	Float	4	R	n/a	n/a	n/a
FCR Mode Setpoint Adjustable Minimum	40801	Float	4	R W	Percent	0.1	0–120
AVR Mode Setpoint Adjustable Minimum	40803	Float	4	R W	Percent	0.1	70–120
Var Mode Setpoint Adjustable Minimum	40805	Float	4	R W	Percent	0.1	-100–100
PF Mode Setpoint Adjustable Minimum	40807	Float	4	R W	PF	0.01	0.5–1
FCR Mode Setpoint Adjustable Maximum	40809	Float	4	R W	Percent	0.1	0–120
AVR Mode Setpoint Adjustable Maximum	40811	Float	4	R W	Percent	0.1	70–120
Var Mode Setpoint Adjustable Maximum	40813	Float	4	R W	Percent	0.1	-100–100
PF Mode Setpoint Adjustable Maximum	40815	Float	4	R W	PF	0.01	-1–(-0.5)
Minimum Value for FCR Adjustable Minimum	40817	Float	4	R	n/a	n/a	n/a
Minimum Value for AVR Adjustable Minimum	40819	Float	4	R	n/a	n/a	n/a
Minimum Value for Var Adjustable Minimum	40821	Float	4	R	n/a	n/a	n/a
Minimum Value for PF Adjustable Minimum	40823	Float	4	R	n/a	n/a	n/a
Maximum Value for FCR Adjustable Maximum	40825	Float	4	R	n/a	n/a	n/a
Maximum Value for AVR Adjustable Maximum	40827	Float	4	R	n/a	n/a	n/a
Maximum Value for Var Adjustable Maximum	40829	Float	4	R	n/a	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Maximum Value for PF Adjustable Maximum	40831	Float	4	R	n/a	n/a	n/a
Step Size for FCR Adjustable Maximum	40833	Float	4	R	n/a	n/a	n/a
Step Size for AVR Adjustable Maximum	40835	Float	4	R	n/a	n/a	n/a
Step Size for Var Adjustable Maximum	40837	Float	4	R	n/a	n/a	n/a
Step Size for PF Adjustable Maximum	40839	Float	4	R	n/a	n/a	n/a
FCR Mode Setpoint Pre-Position 2	40841	Float	4	R W	Amp	0.01	0–12
AVR Mode Setpoint Pre-Position 2	40843	Float	4	R W	Volt	0.1	84–144
Var Mode Setpoint Pre-Position 2	40845	Float	4	R W	kvar	0.1	0–0
PF Mode Setpoint Pre-Position 2	40847	Float	4	R W	PF	0.001	-2–2
Line Drop Compensation Setpoint	40849	Float	4	R W	n/a	n/a	n/a
FVR Mode Setpoint	40851	Float	4	R W	Volt	0.01	0–75
FVR Minimum Setpoint	40853	Float	4	R	n/a	n/a	n/a
FVR Maximum Setpoint	40855	Float	4	R	n/a	n/a	n/a
FVR Mode Traverse Rate	40857	Float	4	R W	Second	1	10–200
FVR Mode Setpoint Pre-Position	40859	Float	4	R W	Volt	0.01	0–75
FVR Mode Setpoint Step Size	40861	Float	4	R	n/a	n/a	n/a
FVR Mode Setpoint Adjustable Minimum	40863	Float	4	R W	Percent	0.1	0–150
FVR Mode Setpoint Adjustable Maximum	40865	Float	4	R W	Percent	0.1	0–150
Minimum Value for FVR Adjustable Minimum	40867	Float	4	R	n/a	n/a	n/a
Maximum Value for FVR Adjustable Maximum	40869	Float	4	R	n/a	n/a	n/a
Step Size for FVR Adjustable Maximum	40871	Float	4	R	n/a	n/a	n/a
FVR Mode Setpoint Pre-Position 2	40873	Float	4	R W	Volt	0.01	0–75
Reserved 9	40875	C5 Filler	50	R	n/a	n/a	n/a
Exc Cur Preposition 1Traverse Rate	40900	Float	4	R W	Second	1	0–720
Exc Cur Preposition 2Traverse Rate	40902	Float	4	R W	Second	1	0–720
Gen Volt Preposition 1Traverse Rate	40904	Float	4	R W	Second	1	0–720
Gen Volt Preposition 2Traverse Rate	40906	Float	4	R W	Second	1	0–720
Gen Var Preposition 1Traverse Rate	40908	Float	4	R W	Second	1	0–720
Gen Var Preposition 2Traverse Rate	40910	Float	4	R W	Second	1	0–720
Gen PF Preposition 1Traverse Rate	40912	Float	4	R W	Second	1	0–720
Gen PF Preposition 2Traverse Rate	40914	Float	4	R W	Second	1	0–720
Exc Volt Preposition 1Traverse Rate	40916	Float	4	R W	Second	1	0–720
Exc Volt Preposition 2Traverse Rate	40918	Float	4	R W	Second	1	0–720
Unused Registers 6	40920	U6 Filler	462	R	n/a	n/a	n/a
Setting Group Indication, Soft Start	41151	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
PSS Power Level Enable	41152	Uint16	2	R	n/a	n/a	n/a
Unused Registers 7	41153	U7 Filler	36	R	n/a	n/a	n/a
Soft Start Threshold	41171	Float	4	R W	Percent	1	0–90
Soft Start Duration	41173	Float	4	R W	Second	1	1–7200
Underfrequency Corner Frequency	41175	Float	4	R W	Hertz	0.1	15–90
Volts per Hz High Setting	41177	Float	4	R W	n/a	0.01	0–3
Volts per Hz Low Setting	41179	Float	4	R W	n/a	0.01	0–3
Volts per Hz Time Setting	41181	Float	4	R W	Second	0.2	0–10
Width of Voltage Matching Window	41183	Float	4	R W	Percent	0.01	0–20
Voltage Matching Reference	41185	Float	4	R W	Percent	0.001	0–700
Fine Voltage Adjust Band	41187	Float	4	R W	Percent	0.01	0–30
Time Required for Loss of Sensing	41189	Float	4	R W	Second	0.1	0–30

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Loss of Sensing Level Under Balanced Conditions	41191	Float	4	R W	Percent	0.1	0–100
Loss of Sensing Level Under Unbalanced Conditions	41193	Float	4	R W	Percent	0.1	0–100
Reserved 10	41195	Float	4	R	n/a	0.001	0–10000
Slope of Underfrequency Curve	41197	Float	4	R W	n/a	0.01	0–3
Reserved 11	41199	Float	4	R W	n/a	0.001	0–10000
Reserved 12	41201	Float	4	R W	n/a	0.001	0–10000
PF Active Power Level	41203	Float	4	R W	Percent	0.1	0–30
Unused Registers 8	41205	U8 Filler	132	R	n/a	n/a	n/a
Soft Start Threshold Secondary	41271	Float	4	R W	Percent	1	0–90
Soft Start Duration Secondary	41273	Float	4	R W	Second	1	1–7200
Reserved 13	41275	C6 Filler	152	R	n/a	n/a	n/a
Active OEL Limiter Setting Group	41351	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
OEL dvdt Enable	41352	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Setting Group Selection for Var Limiter	41353	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
Unused Registers 9	41354	U9 Filler	14	R	n/a	n/a	n/a
On-line High OEL Level	41361	Float	4	R W	Amp	0.01	0–12000
Time Allowed for On-line High OEL Level	41363	Float	4	R W	Second	1	0–240
On-line Medium OEL Level	41365	Float	4	R W	Amp	0.01	0–12000
Time Allowed for On-line Medium OEL Level	41367	Float	4	R W	Second	1	0–240
On-line Low OEL Level	41369	Float	4	R W	Amp	0.01	0–12000
Off-line High OEL Level	41371	Float	4	R W	Amp	0.01	0–12000
Off-line Low OEL Level	41373	Float	4	R W	Amp	0.01	0–12000
Time Allowed for Off-line High OEL	41375	Float	4	R W	Second	1	0–240
Takeover OEL Offline High Limit Level	41377	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Offline Low Limit Level	41379	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Offline Time Dial	41381	Float	4	R W	n/a	0.1	0.1–20
Takeover OEL Online High Limit Level	41383	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Online Low Limit Level	41385	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Online Time Dial	41387	Float	4	R W	n/a	0.1	0.1–20
Unused Registers 10	41389	U10 Filler	44	R	n/a	n/a	n/a
Active UEL Limiter Setting Group	41411	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
Unused Registers 11	41412	U11 Filler	18	R	n/a	n/a	n/a
First UEL Point kW Value	41421	Float	4	R W	KW	1	0–62
Second UEL Point kW Value	41423	Float	4	R W	KW	1	0–62
Third UEL Point kW Value	41425	Float	4	R W	KW	1	0–62
Fourth UEL Point kW Value	41427	Float	4	R W	KW	1	0–62
Fifth UEL Point kW Value	41429	Float	4	R W	KW	1	0–62
First UEL Point kvar Value	41431	Float	4	R W	kvar	1	0–62
Second UEL Point kvar Value	41433	Float	4	R W	kvar	1	0–62
Third UEL Point kvar Value	41435	Float	4	R W	kvar	1	0–62
Fourth UEL Point kvar Value	41437	Float	4	R W	kvar	1	0–62
Fifth UEL Point kvar Value	41439	Float	4	R W	kvar	1	0–62
Primary UEL Bias	41441	Float	4	R W	Var	1	0–99
Real Power Filter Time Constant	41443	Float	4	R W	Second	0.1	0–20

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Real Power Exponent	41445	Float	4	R W	n/a	1	0–2
Unused Registers 12	41447	U12 Filler	48	R	n/a	n/a	n/a
Active SCL Limiter Setting Group	41471	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
Unused Registers 13	41472	U13 Filler	18	R	n/a	n/a	n/a
SCL High Limit Level	41481	Float	4	R W	Amp	0.1	0–66000
Time Allowed at SCL High Limit Level	41483	Float	4	R W	Second	0.1	0–240
Reserved 14	41485	Float	4	R	n/a	0.001	0–10000
Reserved 15	41487	Float	4	R	n/a	0.001	0–10000
SCL Low Limit Level	41489	Float	4	R W	Amp	0.1	0–66000
Primary SCL No Response Time	41491	Float	4	R W	Second	0.1	0–10
Unused Registers 14	41493	U14 Filler	184	R	n/a	n/a	n/a
OEL dvdt Setting	41585	Float	4	R W	n/a	0.1	-10–0
Var Limiter Setpoint for Primary Selection	41587	Float	4	R W	Percent	0.1	0–200
Var Limiter Initial Delay for Primary Selection	41589	Float	4	R W	Second	0.1	0–300
Unused Registers 15	41591	U15 Filler	260	R	n/a	n/a	n/a
On-line High OEL Level Secondary	41721	Float	4	R W	Amp	0.01	0–12000
Time Allowed for On-line High OEL Level Secondary	41723	Float	4	R W	Second	1	0–240
On-line Medium OEL Level Secondary	41725	Float	4	R W	Amp	0.01	0–12000
Time Allowed for On-line Medium OEL Level Secondary	41727	Float	4	R W	Second	1	0–240
On-line Low OEL Level Secondary	41729	Float	4	R W	Amp	0.01	0–12000
Off-line High OEL Level Secondary	41731	Float	4	R W	Amp	0.01	0–12000
Off-line Low OEL Level Secondary	41733	Float	4	R W	Amp	0.01	0–12000
Time Allowed for Off-line High OEL Secondary	41735	Float	4	R W	Second	1	0–240
Takeover OEL Offline High Limit Level Secondary	41737	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Offline Low Limit Level Secondary	41739	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Offline Time Dial Secondary	41741	Float	4	R W	n/a	0.1	0.1–20
Takeover OEL Online High Limit Level Secondary	41743	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Online Low Limit Level Secondary	41745	Float	4	R W	Amp	0.01	0–12000
Takeover OEL Online Time Dial Secondary	41747	Float	4	R W	n/a	0.1	0.1–20
Unused Registers 16	41749	U16 Filler	64	R	n/a	n/a	n/a
First UEL Point kW Value Secondary	41781	Float	4	R W	KW	1	0–62
Second UEL Point kW Value Secondary	41783	Float	4	R W	Kilowatt	1	0–62
Third UEL Point kW Value Secondary	41785	Float	4	R W	Kilowatt	1	0–62
Fourth UEL Point kW Value Secondary	41787	Float	4	R W	Kilowatt	1	0–62
Fifth UEL Point kW Value Secondary	41789	Float	4	R W	Kilowatt	1	0–62
First UEL Point kvar Value Secondary	41791	Float	4	R W	Kilovar	1	0–62
Second UEL Point kvar Value Secondary	41793	Float	4	R W	Kilovar	1	0–62
Third UEL Point kvar Value Secondary	41795	Float	4	R W	Kilovar	1	0–62
Fourth UEL Point kvar Value Secondary	41797	Float	4	R W	Kilovar	1	0–62
Fifth UEL Point kvar Value Secondary	41799	Float	4	R W	Kilovar	1	0–62
Secondary UEL Bias	41801	Float	4	R W	Var	1	0–99

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Unused Registers 17	41803	U17 Filler	76	R	n/a	n/a	n/a
SCL High Limit Level Secondary	41841	Float	4	R W	Amp	0.1	0–66000
Time Allowed at SCL High Limit Level Secondary	41843	Float	4	R W	Second	0.1	0–240
Reserved 16	41845	Float	4	R	n/a	0.001	0–10000
Reserved 17	41847	Float	4	R	n/a	0.001	0–10000
SCL Low Limit Level Secondary	41849	Float	4	R W	Amp	0.1	0–66000
Secondary SCL No Response Time	41851	Float	4	R W	Second	0.1	0–10
Var Limiter Setpoint for Secondary Selection	41853	Float	4	R W	Percent	0.1	0–200
Var Limiter Initial Delay for Secondary Selection	41855	Float	4	R W	Second	0.1	0–300
Reserved 18	41857	C7 Filler	1238	R	n/a	n/a	n/a
Active Gain Setting Group	42476	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
Unused Registers 18	42477	U18 Filler	48	R	n/a	n/a	n/a
Index into Table of Gain Constants	42501	Float	4	R W	n/a	1	1–21
Primary AVR Mode Proportional Gain	42503	Float	4	R W	n/a	0.001	0–1000
Primary AVR Mode Integral Gain	42505	Float	4	R W	n/a	0.001	0–1000
Primary AVR Mode Derivative Gain	42507	Float	4	R W	n/a	0.001	0–1000
OEL Proportional Gain - Kp	42509	Float	4	R W	n/a	0.001	0–1000
OEL Integral Gain - Ki	42511	Float	4	R W	n/a	0.001	0–1000
PF Mode Integral Gain - Ki	42513	Float	4	R W	n/a	0.001	0–1000
Var Mode Integral Gain - Ki	42515	Float	4	R W	n/a	0.001	0–1000
FCR Mode Loop Gain - Kg	42517	Float	4	R W	n/a	0.001	0–1000
Primary AVR Mode Loop Gain - Kg	42519	Float	4	R W	n/a	0.001	0–1000
Var Mode Loop Gain - Kg	42521	Float	4	R W	n/a	0.001	0–1000
PF Mode Loop Gain - Kg	42523	Float	4	R W	n/a	0.001	0–1000
OEL Loop Gain - Kg	42525	Float	4	R W	n/a	0.001	0–1000
UEL Loop Gain - Kg	42527	Float	4	R W	n/a	0.001	0–1000
Voltage Matching Loop Gain - Kg	42529	Float	4	R W	n/a	0.001	0–1000
Voltage Matching Proportional Gain - Kp	42531	Float	4	R W	n/a	0.001	0–1000
Voltage Matching Integral Gain - Ki	42533	Float	4	R W	n/a	0.001	0–1000
Reserved 19	42535	Float	4	R	n/a	0.001	0–10000
Reserved 20	42537	Float	4	R	n/a	0.001	0–10000
Reserved 21	42539	Float	4	R	n/a	0.001	0–10000
UEL Proportional Gain - Kp	42541	Float	4	R W	n/a	0.001	0–1000
UEL Integral Gain - Ki	42543	Float	4	R W	n/a	0.001	0–1000
Primary AVR Mode Derivative Time Constant - Td	42545	Float	4	R W	n/a	0.01	0–1
SCL Loop Gain - Kg	42547	Float	4	R W	n/a	0.001	0–1000
SCL Proportional Gain - Kp	42549	Float	4	R W	n/a	0.001	0–1000
SCL Integral Gain - Ki	42551	Float	4	R W	n/a	0.001	0–1000
Primary FCR Mode Proportional Gain	42553	Float	4	R W	n/a	0.001	0–1000
Primary FCR Mode Integral Gain	42555	Float	4	R W	n/a	0.001	0–1000
Primary FCR Mode Derivative Gain	42557	Float	4	R W	n/a	0.001	0–1000
Primary FCR Mode Derivative Time Constant - Td	42559	Float	4	R W	n/a	0.01	0–1
FVR Mode Proportional Gain	42561	Float	4	R W	n/a	0.001	0–1000
FVR Mode Integral Gain	42563	Float	4	R W	n/a	0.001	0–1000
FVR Mode Derivative Gain	42565	Float	4	R W	n/a	0.001	0–1000

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
FVR Mode Derivative Time Constant - Td	42567	Float	4	R W	n/a	0.01	0–1
FVR Mode Loop Gain - Kg	42569	Float	4	R W	n/a	0.001	0–1000
Unused Registers 19	42571	U19 Filler	76	R	n/a	n/a	n/a
Loop Gain for Var Limiter - Kg	42609	Float	4	R W	n/a	0.001	0–1000
Integral Gain for Var Limiter - Ki	42611	Float	4	R W	n/a	0.001	0–1000
Unused Registers 20	42613	U20 Filler	126	R	n/a	n/a	n/a
Secondary Gain Option Index	42676	Uint32	4	R W	n/a	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	42678	Float	4	R W	n/a	0.001	0–1000
Secondary AVR Mode Integral Gain - Ki	42680	Float	4	R W	n/a	0.001	0–1000
Secondary AVR Mode Derivative Gain - Kd	42682	Float	4	R W	n/a	0.001	0–1000
Secondary AVR Mode Loop Gain - Kg	42684	Float	4	R W	n/a	0.001	0–1000
Secondary AVR Derivative Time Constant - Td	42686	Float	4	R W	n/a	0.01	0–1
Reserved 22	42688	C8 Filler	626	R	n/a	n/a	n/a
Field Overvoltage Alarm Enable	43001	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Field Overcurrent Alarm Enable	43002	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Stator Undervoltage Alarm Enable	43003	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Stator Overvoltage Alarm Enable	43004	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Field Over Temperature Alarm Enable	43005	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Loss of Field Alarm Enable	43006	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Loss of Field Isolation Transducer Alarm Enable	43007	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Control Power Low Alarm Enable	43008	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Protection 24 Volts per Hz Mode	43009	Uint16	2	R W	n/a	n/a	n/a
Reserved 23	43010	Uint16	2	R	n/a	1	0–65535
Reserved 24	43011	Uint16	2	R	n/a	1	0–65535
Reserved 25	43012	Uint16	2	R	n/a	1	0–65535
Protection 24 Inverse Time Curve Exponent	43013	Uint16	2	R W	n/a	n/a	0.5=0 1=1 2=2
Unused Registers 21	43014	U21 Filler	22	R	n/a	n/a	n/a
Active Protection Setting Group	43025	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
Field Overvoltage Level	43026	Float	4	R W	Volt	0.1	0; 1–2400
Field Overcurrent Base Level	43028	Float	4	R W	Amp	0.01	0.1–20000
Stator Undervoltage Level	43030	Float	4	R W	Volt	1	0; 1–600000
Stator Overvoltage Level	43032	Float	4	R W	Volt	1	0–600000

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Field Overvoltage Delay	43034	Float	4	R W	Second	0.1	0; 0.2–30.0
Field Overcurrent Delay	43036	Float	4	R W	Second	0.1	0; 0.2–30.0
Stator Undervoltage Delay	43038	Float	4	R W	Second	0.1	0.1–60.0
Stator Overvoltage Delay	43040	Float	4	R W	Second	0.1	0.1–60.0
Field Over Temperature Level	43042	Float	4	R W	Deg F	1	0–572
Field Over Temperature Time Delay	43044	Float	4	R W	Millisecond	100	100–60000
Loss of Field Pickup Level	43046	Float	4	R W	KiloVAr	1	0–3000000
Loss of Field Time Delay	43048	Float	4	R W	Second	0.1	0; 0–300.0
Loss of Field Isolation Transducer Level	43050	Float	4	R	n/a	n/a	n/a
Loss of Field Isolation Transducer Time Delay	43052	Float	4	R W	n/a	n/a	n/a
Control Power Low Level	43054	Float	4	R	n/a	n/a	n/a
Control Power Low Time Delay	43056	Float	4	R	n/a	n/a	n/a
Protection 24 Inverse Time Pickup Setpoint	43058	Float	4	R W	n/a	n/a	n/a
Protection 24 Inverse Time Pickup Time Dial	43060	Float	4	R W	n/a	n/a	n/a
Protection 24 Reset Time Dial	43062	Float	4	R W	n/a	n/a	n/a
Protection 24 Definite Time Pickup 1	43064	Float	4	R W	n/a	n/a	n/a
Protection 24 Definite Time Delay 1	43066	Float	4	R W	n/a	n/a	n/a
Protection 24 Definite Time Pickup 2	43068	Float	4	R W	n/a	n/a	n/a
Protection 24 Definite Time Delay 2	43070	Float	4	R W	n/a	n/a	n/a
Reserved 26	43072	C9 Filler	608	R	n/a	n/a	n/a
Reserved 27	43376	Uint16	2	R	n/a	1	0–65535
Reserved 28	43377	Uint16	2	R	n/a	1	0–65535
Exciter Open Diode Protection Enable	43378	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Exciter Shorted Diode Protection Enable	43379	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Unused Registers 22	43380	U22 Filler	42	R	n/a	n/a	n/a
Exciter Open Diode Ripple Pickup Level	43401	Float	4	R W	Percent	0.1	0–100
Exciter Shorted Diode Ripple Pickup Level	43403	Float	4	R W	Percent	0.1	0–100
EDM Protection Disable Level	43405	Float	4	R W	Percent	0.1	0–100
Exciter Open Diode Time Delay	43407	Float	4	R W	Second	0.1	10–60
Exciter Shorted Diode Time Delay	43409	Float	4	R W	Second	0.1	5–30
Pole Ratio	43411	Float	4	R W	n/a	0.01	0; 1–10
Reserved 29	43413	C10 Filler	226	R	n/a	n/a	n/a
Output for Relay 1	43526	Uint16	2	R	n/a	n/a	n/a
Unused Registers 23	43527	U23 Filler	98	R	n/a	n/a	n/a
Output for Relay 2	43576	Uint16	2	R	n/a	n/a	n/a
Unused Registers 23-2	43577	U23 Filler	98	R	n/a	n/a	n/a
Output for Relay 3	43626	Uint16	2	R	n/a	n/a	n/a
Unused Registers 23-3	43627	U23 Filler	98	R	n/a	n/a	n/a
Output for Relay 4	43676	Uint16	2	R	n/a	n/a	n/a
Unused Registers 23-4	43677	U23 Filler	98	R	n/a	n/a	n/a
Output for Relay 5	43726	Uint16	2	R	n/a	n/a	n/a
Unused Registers 23-5	43727	U23 Filler	98	R	n/a	n/a	n/a
Output for Relay 6	43776	Uint16	2	R	n/a	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Reserved 30	43777	C11 Filler	698	R	n/a	n/a	n/a
RS232 Baud Rate	44126	Uint16	2	R W	n/a	n/a	4800 Baud=4800 9600 Baud=9600 19200 Baud=19200 38400 Baud=38400 57600 Baud=57600 115200 Baud=115200
Reserved 31	44127	Uint16	2	R W	n/a	1	0–65535
RS485 Baud Rate	44128	Uint16	2	R W	n/a	n/a	1200 Baud=1200 2400 Baud=2400 4800 Baud=4800 9600 Baud=9600 19200 Baud=19200 38400 Baud=38400 57600 Baud=57600 115200 Baud=115200
RS485 Parity	44129	Uint16	2	R W	n/a	1	69–79
RS485 Stop Bits	44130	Uint16	2	R W	n/a	n/a	1 Stop Bit=1 2 Stop Bits=2
DECS-250 Polling Address	44131	Uint16	2	R W	n/a	1	1–247
Modbus Response Time Delay	44132	Uint16	2	R W	Millisecond	10	10–10000
System Clock Month	44133	Uint16	2	R W	n/a	1	1–12
System Clock Day	44134	Uint16	2	R W	n/a	1	1–31
System Clock Year	44135	Uint16	2	R W	n/a	1	2000–2099
System Clock Daylight Savings Time	44136	Uint16	2	R W	n/a	n/a	On=0 Off=1
System Clock Hour	44137	Uint16	2	R W	n/a	1	0–23
System Clock Minute	44138	Uint16	2	R W	n/a	1	0–59
System Clock Second	44139	Uint16	2	R W	n/a	1	0–59
System Clock Twelve Hour Mode	44140	Uint16	2	R W	n/a	n/a	12 Hour Mode=0 24 Hour Mode=1
System Clock AM PM	44141	Uint16	2	R W	n/a	n/a	AM=0 PM=1
Reserved 32	44142	C12 Filler	118	R	n/a	n/a	n/a
Reserved 33	44201	C13 Filler	100	R	n/a	n/a	n/a
PSS Enable	44251	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Active PSS Setting Group	44252	Uint16	2	R	n/a	n/a	Primary=1 Secondary=2
PSS RoC Enable	44253	Uint16	2	R	n/a	n/a	Disabled=0 Enabled=1
Block PSS RoC mode	44254	Uint16	2	R	n/a	n/a	Disabled=0 Enabled=1
Unused Registers 24	44255	U24 Filler	10	R	n/a	n/a	n/a
Power System Stabilizer Primary Switch0	44260	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Primary Switch1	44261	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Primary Switch2	44262	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Primary Switch3	44263	Uint16	2	R W	n/a	n/a	Frequency=0 Der. Speed=1
Power System Stabilizer Primary Switch4	44264	Uint16	2	R W	n/a	n/a	Power=0 Der. Freq/Speed=1
Power System Stabilizer Primary Switch5	44265	Uint16	2	R W	n/a	n/a	Exclude=0 Include=1
Power System Stabilizer Primary Switch6	44266	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Primary Switch7	44267	Uint16	2	R W	n/a	n/a	Off=0 On=1
Power System Stabilizer Primary Switch8	44268	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Primary Switch9	44269	Uint16	2	R W	n/a	n/a	Exclude=0 Include=1
Power System Stabilizer Primary Switch10	44270	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Unused Registers 25	44271	U25 Filler	60	R	n/a	n/a	n/a
Power System Stabilizer Primary Tw1	44301	Float	4	R W	Second	0.01	1–20

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Power System Stabilizer Primary Tw2	44303	Float	4	R W	Second	0.01	1–20
Power System Stabilizer Primary H	44305	Float	4	R W	n/a	0.01	0.01–25
Power System Stabilizer Primary Tlpf1 (time constant, low-pass filter)	44307	Float	4	R W	Second	0.01	0–20
Power System Stabilizer Primary T1	44309	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T2	44311	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T3	44313	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T4	44315	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T5	44317	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T6	44319	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T7	44321	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary T8	44323	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Primary EtLmtTlpf (time constant, low pass filter)	44325	Float	4	R W	Second	0.001	0.02–5
Power System Stabilizer Primary EtLmtVref	44327	Float	4	R W	n/a	0.001	0–10
Power System Stabilizer Primary Zn1	44329	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Zd1	44331	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Wn1	44333	Float	4	R W	n/a	0.05	10–150
Power System Stabilizer Primary Zn2	44335	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Zd2	44337	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Wn2	44339	Float	4	R W	n/a	0.05	10–150
Power System Stabilizer Primary LmtVhi	44341	Float	4	R W	n/a	0.001	0.01–0.04
Power System Stabilizer Primary LmtVlo	44343	Float	4	R W	n/a	0.001	-0.04–(-0.01)
Power System Stabilizer Primary LmtTDelay	44345	Float	4	R W	n/a	0.01	0–2
Power System Stabilizer Primary Tw5Normal	44347	Float	4	R W	n/a	0.1	5–30
Power System Stabilizer Primary Tw5Limit	44349	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Ks	44351	Float	4	R W	n/a	0.01	-100–100
Power System Stabilizer Primary Limit Plus	44353	Float	4	R W	n/a	0.001	0–0.5
Power System Stabilizer Primary Limit Minus	44355	Float	4	R W	n/a	0.001	-0.5–0
Power System Stabilizer Primary Xq	44357	Float	4	R W	n/a	0.001	0–5
Power System Stabilizer Primary Output Scale	44359	Float	4	R W	n/a	0.01	-3–3
Power System Stabilizer Primary Power On Threshold	44361	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Power Hysteresis	44363	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Power On Threshold Inst	44365	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Power Hysteresis Inst	44367	Float	4	R W	n/a	0.01	0–1
Unused Registers 26	44369	U26 Filler	52	R	n/a	n/a	n/a
Power System Stabilizer Primary Power Level Percentage	44395	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Primary Power Level Hysteresis	44397	Float	4	R W	n/a	0.01	0–1
Unused Registers 27	44399	U27 Filler	40	R	n/a	n/a	n/a
Power System Stabilizer Rate of Change Threshold	44419	Float	4	R W	Hertz Per Second	0.01	0–10
Power System Stabilizer Rate of Change Time Delay	44421	Float	4	R W	Second	0.01	0–20

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Power System Stabilizer Rate of Change Block Time	44423	Float	4	R W	Second	0.01	0–20
Power System Stabilizer Rate of Change Low Pass Filter Time Constant	44425	Float	4	R W	Second	0.01	0–20
Power System Stabilizer Rate of Change Washout Filter Time Constant	44427	Float	4	R W	Second	0.01	0–20
Power System Stabilizer Frequency Rate of Change	44429	Float	4	R	Hertz Per Second	0.01	-15–15
Unused Registers 28	44431	U28 Filler	158	R	n/a	n/a	n/a
Power System Stabilizer Secondary Switch0	44510	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Secondary Switch1	44511	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Secondary Switch2	44512	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Secondary Switch3	44513	Uint16	2	R W	n/a	n/a	Frequency=0 Der. Speed=1
Power System Stabilizer Secondary Switch4	44514	Uint16	2	R W	n/a	n/a	Power=0 Der. Freq/Speed=1
Power System Stabilizer Secondary Switch5	44515	Uint16	2	R W	n/a	n/a	Exclude=0 Include=1
Power System Stabilizer Secondary Switch6	44516	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Secondary Switch7	44517	Uint16	2	R W	n/a	n/a	Off=0 On=1
Power System Stabilizer Secondary Switch8	44518	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Power System Stabilizer Secondary Switch9	44519	Uint16	2	R W	n/a	n/a	Exclude=0 Include=1
Power System Stabilizer Secondary Switch10	44520	Uint16	2	R W	n/a	n/a	Disabled=0 Enabled=1
Unused Registers 25-2	44521	U25 Filler	60	R	n/a	n/a	n/a
Power System Stabilizer Secondary Tw1	44551	Float	4	R W	Second	0.01	1–20
Power System Stabilizer Secondary Tw2	44553	Float	4	R W	Second	0.01	1–20
Power System Stabilizer Secondary H	44555	Float	4	R W	n/a	0.01	0.01–25
Power System Stabilizer Secondary Tlpf1 (time constant, low-pass filter)	44557	Float	4	R W	Second	0.01	0–20
Power System Stabilizer Secondary T1	44559	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T2	44561	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T3	44563	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T4	44565	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T5	44567	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T6	44569	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T7	44571	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary T8	44573	Float	4	R W	Second	0.001	0.001–6
Power System Stabilizer Secondary EtLmtTlpf (time constant, low-pass filter)	44575	Float	4	R W	Second	0.001	0.02–5
Power System Stabilizer Secondary EtLmtVref	44577	Float	4	R W	n/a	0.001	0–10
Power System Stabilizer Secondary Zn1	44579	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Zd1	44581	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Wn1	44583	Float	4	R W	n/a	0.05	10–150
Power System Stabilizer Secondary Zn2	44585	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Zd2	44587	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Wn2	44589	Float	4	R W	n/a	0.05	10–150
Power System Stabilizer Secondary Lmt Vhi	44591	Float	4	R W	n/a	0.001	0.01–0.04

Name	Register	Type	Bytes	R/W	Unit	Increment	Range
Power System Stabilizer Secondary Lmt Vlo	44593	Float	4	R W	n/a	0.001	-0.04–(-0.01)
Power System Stabilizer Secondary Lmt T Delay	44595	Float	4	R W	n/a	0.01	0–2
Power System Stabilizer Secondary Tw5 Normal	44597	Float	4	R W	n/a	0.1	5–30
Power System Stabilizer Secondary Tw5 Limit	44599	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Ks	44601	Float	4	R W	n/a	0.01	-100–100
Power System Stabilizer Secondary Limit Plus	44603	Float	4	R W	n/a	0.001	0–0.5
Power System Stabilizer Secondary Limit Minus	44605	Float	4	R W	n/a	0.001	-0.5–0
Power System Stabilizer Secondary Xq	44607	Float	4	R W	n/a	0.001	0–5
Power System Stabilizer Secondary Output Scale	44609	Float	4	R W	n/a	0.01	-3–3
Power System Stabilizer Secondary Power On Threshold	44611	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Power Hysteresis	44613	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Power On Threshold Inst	44615	Float	4	R W	n/a	0.01	0–1
Power System Stabilizer Secondary Power Hysteresis Inst	44617	Float	4	R W	n/a	0.01	0–1
Reserved 34	44619	C14 Filler	760	R	n/a	n/a	n/a

Configurable Protection Parameters

All selectable parameters available to configurable protection elements are listed below.

Gen VAB=0
Gen VBC=1
Gen VCA=2
Gen V Average=3
Bus Frequency=4
Bus VAB=5
Bus VBC=6
Bus VCA=7
Gen Frequency=8
Gen Power Factor=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
Field Voltage=20
Field Current=21
Aux Input Voltage=22
Aux Input Current (mA)=23
Setpoint Position=24
Tracking Error=25
Neg V=26
Neg I=27
Pos V=28
Pos 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
Network Load Share Error Percent=50
Gen Scaled PF=51
Control Output Per Unit=52
Field Temperature=53
Reserved=54
Reserved=55
AVR PID Output Per Unit=56
AVR Error Signal=57
Frequency Response Signal=58
Time Response Signal Per Unit=59
Term Freq Deviation=60
Compensation Frequency Deviation=61
PSS Electric Power Per Unit=62
PSS Term Voltage=63
Speed HP #1=64
Washed Out Speed Per Unit=65
Power HP #1 Per Unit=66
Washed Out Power Per Unit=67
Mechanical Power Per Unit=68
Mechanical Power LP #1=69
Mechanical Power LP #2=70
Mechanical Power LP #3=71
Mechanical Power LP #4=72
Filter Mechanical Power Per Unit=73
Synthesized Speed Per Unit=74
Torsional Filter #1 Per Unit=75
Torsional Filter #2 Per Unit=76
Lead-Lag #1 Per Unit=77
Lead-Lag #2 Per Unit=78
Lead-Lag #3 Per Unit=79
Lead-Lag #4 Per Unit=80
Terminal Voltage Low-Pass Filter=81
Terminal Voltage Ramp Limiter=82
Logic Limit Washout Filter=83
Pre-Limit Output Per Unit=84
Post-Limit Output Per Unit=85
Final PSS Output Per Unit=86

27 • PROFIBUS Communication

On units equipped with the PROFIBUS communication protocol (style XX1XXXX), the DECS-450 sends and receives PROFIBUS data through a DB-9 port located on the rear panel.

Caution
This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

Refer to the *Communication* chapter for PROFIBUS communication settings in BESTCOMS*Plus*® and the *Terminals and Connectors* chapter for wiring.

The DECS-450 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 27-6 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 27-6 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 27-1 illustrates the sizes of the UINT8 cyclic data instances.

Table 27-1. 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

Instance Number	Number of Parameters in the Instance	Number of Parameters Divided by Eight	Total Data Size
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 27-6. 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-450 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 27-2 shows the parameters of instance 8 as they appear in Table 27-6. 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 27-2. Instance 8 Parameters

Instance Name	Inst. #	Type	RW	Key Name	Range
Controller Status Cyclic	8	UINT8	R	DECS control in AVR mode	Not in AVR mode=0, In AVR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in FCR mode	Not in FCR mode=0, In FCR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in FVR mode	Not in FVR mode=0, In FVR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in PF mode	Not in PF mode=0, In PF mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in VAR mode	Not in var mode=0, In var mode=1

Table 27-3 shows the bit number of each parameter in instance 8 and an example packet returned from a DECS-450. Reading a value of 0x02 (0000 0010) for instance 8 indicates that the device is operating in FCR mode.

Table 27-3. Instance 8 Bit Order

Instance Number	Bit Number	Key Name	Packet Returned from DECS-450
8	0	DECS control in AVR mode	0
	1	DECS control in FCR mode	1
	2	DECS control in FVR mode	0
	3	DECS control in PF mode	0
	4	DECS control 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 27-4 shows the parameters of instance 11 as they appear in Table 27-6. 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 27-4. Instance 11 Parameters

Instance Name	Inst. #	Type	RW	Key Name	Range
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs Watchdog output	Open=0, Closed=1

Instance Name	Inst. #	Type	RW	Key Name	Range
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 1	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 2	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 3	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 4	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 5	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 6	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 7	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 8	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 9	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 10	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact outputs output 11	Open=0, Closed=1

Table 27-5 shows the bit number of each parameter in instance 11 and an example packet returned from a DECS-450. 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 27-5. Instance 11 Bit Order

Instance Number	Byte Number	Bit Number	Key Name	Packet Returned from DECS-450
11	1	0	Contact outputs watchdog	0
		1	Contact outputs output 1	0
		2	Contact outputs output 2	1
		3	Contact outputs output 3	0
		4	Contact outputs output 4	0
		5	Contact outputs output 5	1
		6	Contact outputs output 6	0
		7	Contact outputs output 7	1
	2	0	Contact outputs output 8	0
		1	Contact outputs output 9	1
		2	Contact outputs output 10	1
		3	Contact outputs output 11	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-450 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-450 GSD file from the Basler website: www.basler.com
2. Using PLC configuration software, import the GSD file. This allows the DECS-450 to be included in the bus configuration as a slave.
3. Assign a unique PROFIBUS address to the DECS-450. This allows the master to exchange data with the DECS-450.

4. Select modules from the 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 27-6). Instances 1 through 5 consist of 26 float types. Instances 6 through 12 consist of 9 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 27-6. 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 27-6. 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	Frequency 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	Frequency 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
Field Metering Cyclic	3	Float	R	Field Temperature GG	Deg F	-40 – 572
Setpoint Metering Cyclic	4	Float	R	Gen Voltage Setpoint GG	V	84 - 144
Setpoint Metering Cyclic	4	Float	R	Excitation Current Setpoint GG	Amp	0 - 12
Setpoint Metering Cyclic	4	Float	R	Excitation Voltage Setpoint GG	V	0 - 75
Setpoint Metering Cyclic	4	Float	R	Gen Var Setpoint GG	kvar	n/a
Setpoint Metering Cyclic	4	Float	R	Gen Pf Setpoint GG	PF	n/a
Synchronizer Metering Cyclic	5	Float	R	Slip Angle GG	Deg	-359.9 - 359.9

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Synchronizer Metering Cyclic	5	Float	R	Slip Frequency 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	No Unit	Not Active=0, Active=1
Limiter Status Cyclic	6	UINT8	R	Alarms UEL ALM	No Unit	Not Active=0, Active=1
Limiter Status Cyclic	6	UINT8	R	Alarms SCL ALM	No Unit	Not Active=0, Active=1
Limiter Status Cyclic	6	UINT8	R	Alarms VAR Limiter Active	No Unit	Not Active=0, Active=1
Limiter Status Cyclic	6	UINT8	R	Alarms Underfrequency V/Hz ALM	No Unit	Not Active=0, Active=1
HMI Indicators Cyclic	7	UINT8	R	DECS control DECS null balance	No Unit	Not Active=0, Active=1
HMI Indicators Cyclic	7	UINT8	R	DECS PSS meter DECS PSS active	No Unit	Not Active=0, Active=1
HMI Indicators Cyclic	7	UINT8	R	DECS regulator meter DECS Internal tracking active	No Unit	Not Active=0, Active=1
HMI Indicators Cyclic	7	UINT8	R	DECS control DECS preposition	No Unit	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	DECS regulator meter setpoint At lower limit	No Unit	Active setpoint is not at minimum value=0, Active setpoint is at minimum value=1
HMI Indicators Cyclic	7	UINT8	R	DECS regulator meter setpoint At upper limit	No Unit	Active setpoint is not at maximum value=0, Active setpoint is at maximum value=1
Controller Status Cyclic	8	UINT8	R	DECS control in AVR mode	No Unit	Not in AVR mode=0, In AVR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in FCR mode	No Unit	Not in FCR mode=0, In FCR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in FVR mode	No Unit	Not in FVR mode=0, In FVR mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in PF mode	No Unit	Not in PF mode=0, In PF mode=1
Controller Status Cyclic	8	UINT8	R	DECS control in var mode	No Unit	Not in var mode=0, In var mode=1
System Status Cyclic	9	UINT8	R	DECS control DECS start stop	No Unit	Stopped=0, Started=1
System Status Cyclic	9	UINT8	R	Alarms if limit	No Unit	No field short circuit condition=0, Field short circuit condition=1
System Status Cyclic	9	UINT8	R	DECS control DECS Soft start active	No Unit	Not in soft start=0, In soft start=1
System Status Cyclic	9	UINT8	R	Alarm report alarm output	No Unit	No active alarms=0, Active alarms=1
System Status Cyclic	9	UINT8	R	DECS control DECS pf var Enable 52 j k	No Unit	PF/var not enabled via PLC=0, PF/var enabled via PLC=1
System Status Cyclic	9	UINT8	R	DECS control DECS parallel Enable 52 l m	No Unit	Parallel not enabled via PLC=0, Parallel enabled via PLC=1
System Status Cyclic	9	UINT8	R	More alarms: bridge overtemperature alarm	No Unit	Not Active=0, Active=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact inputs start input	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact inputs stop input	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 1	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 2	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 3	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 4	No Unit	Open=0, Closed=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 5	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 6	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 7	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 8	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 9	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 10	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 11	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 12	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 13	No Unit	Open=0, Closed=1
Local Contact Inputs Cyclic	10	UINT8	R	Contact Inputs Input 14	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Watchdog Output	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 1	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 2	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 3	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 4	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 5	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 6	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 7	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 8	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 9	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 10	No Unit	Open=0, Closed=1
Local Contact Outputs Cyclic	11	UINT8	R	Contact Outputs Output 11	No Unit	Open=0, Closed=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS soft start Select secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS PSS select Secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS OEL select Secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS UEL select Secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS SCL select Secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS protect Select secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS PID Select secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
Settings Group Indication Cyclic	12	UINT8	R	DECS control DECS var limiter Select secondary settings	No Unit	Primary settings active=0, Secondary settings active=1
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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	Frequency GG	Hz	10 - 180
Gen Metering Per Unit	17	Float	R	Vab per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Vbc per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Vca per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Vavg per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Ia per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Ib per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Ic per unit GG	Per Unit	-10 - 10
Gen Metering Per Unit	17	Float	R	Iavg per unit GG	Per Unit	-10 - 10
Power Metering	18	Float	R	Total Watts Primary GG	Watt	n/a
Power Metering	18	Float	R	Total VARS Primary GG	var	n/a
Power Metering	18	Float	R	Total S Primary GG	VA	n/a
Power Metering	18	Float	R	Total PF GG	PF	-1 - 1
Power Metering	18	Float	R	POS Watthour Total GG	watthour	0.00E+00 - 1.00E+12
Power Metering	18	Float	R	POS varhour Total GG	varhour	0.00E+00 - 1.00E+12
Power Metering	18	Float	R	NEG Watthour Total GG	watthour	-1.00E+12 - 0.00E+00
Power Metering	18	Float	R	NEG varhour Total GG	varhour	-1.00E+12 - 0.00E+00
Power Metering Per Unit	19	Float	R	kW per unit GG	Per Unit	-10 - 10
Power Metering Per Unit	19	Float	R	kVA per unit GG	Per Unit	-10 - 10
Power Metering Per Unit	19	Float	R	kvar per unit GG	Per 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	Frequency GG	Hz	10 - 180
Bus Metering Per Unit	21	Float	R	Bus Vab per unit GG	Per Unit	-10 - 10
Bus Metering Per Unit	21	Float	R	Bus Vbc per unit GG	Per Unit	-10 - 10
Bus Metering Per Unit	21	Float	R	Bus Vca per unit GG	Per Unit	-10 - 10
Bus Metering Per Unit	21	Float	R	Bus Vavg per unit GG	Per 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
Field Metering	22	Float	R	Field Temperature GG	Deg F	-40 - 572
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 Frequency DEV GG	Percent	n/a
PSS Metering	23	Float	R	Comp Frequency DEV GG	Percent	n/a
PSS Metering	23	Float	R	PSS Output GG	No Unit	n/a
PSS Metering	23	Float	R	PSS Frequency Rate of Change GG	Hz/s	-15 - 15
PSS Metering Per Unit	24	Float	R	Pos Seq V per unit GG	Per Unit	-10 - 10
PSS Metering Per Unit	24	Float	R	Neq Seq V per unit GG	Per Unit	-10 - 10

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
PSS Metering Per Unit	24	Float	R	Pos Seq I per unit GG	Per Unit	-10 - 10
PSS Metering Per Unit	24	Float	R	Neq Seq I per unit GG	Per Unit	-10 - 10
PSS Metering Per Unit	24	Float	R	PSS Frequency Rate of Change per unit GG	PU/s	-1.5 – 1.5
Synchronization	25	Float	R	Slip Angle GG	Deg	-359.9 - 359.9
Synchronization	25	Float	R	Slip Frequency 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	DECS Regulator Meter DECS Internal Tracking Active	No Unit	Not active=0, Active=1
Tracking Status	28	UINT8	R	DECS Regulator Meter DECS External Tracking Active	No Unit	Not active=0, Active=1
Tracking Status	28	UINT8	R	DECS Control DECS Null Balance	No Unit	Not active=0, Active=1
Control Panel Setpoint Metering	29	Float	R	Gen Voltage Setpoint GG	V	84 - 144
Control Panel Setpoint Metering	29	Float	R	Excitation Current Setpoint GG	Amp	0 - 12
Control Panel Setpoint Metering	29	Float	R	Excitation Voltage Setpoint GG	V	0 - 75
Control Panel Setpoint Metering	29	Float	R	Gen Var Setpoint GG	Kvar	n/a
Control Panel Setpoint Metering	29	Float	R	Gen Pf Setpoint GG	PF	n/a
Control Panel Status	30	UINT8	R	DECS Control DECS Start Stop	No Unit	Stopped=0, Started=1
Control Panel Status	30	UINT8	R	DECS Control DECS is in Automatic Mode	No Unit	Not in automatic=0, In automatic=1
Control Panel Status	30	UINT8	R	DECS Control DECS is in Manual Mode	No Unit	Not in manual=0, In manual=1
Control Panel Status	30	UINT8	R	DECS Control DECS FCR Controller Active	No Unit	FCR not active=0, FCR active=1
Control Panel Status	30	UINT8	R	DECS Control DECS FVR Controller Active	No Unit	FVR not active=0, FVR active=1
Control Panel Status	30	UINT8	R	DECS Control DECS VAR Controller Active	No Unit	VAR not active=0, VAR active=1
Control Panel Status	30	UINT8	R	DECS Control DECS PF Controller Active	No Unit	PF not active=0, PF active=1
Control Panel Status	30	UINT8	R	DECS Control DECS Preposition 1 Active	No Unit	Active setpoint is not at pre-position 1 value=0, Active setpoint is at pre-position 1 value=1
Control Panel Status	30	UINT8	R	DECS Control DECS Preposition 2 Active	No Unit	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	DECS Control DECS Preposition 3 Active	No Unit	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	Virtual Switch 1	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Virtual Switch 2	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Virtual Switch 3	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Virtual Switch 4	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Virtual Switch 5	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Virtual Switch 6	No Unit	Open=0, Closed=1
Control Panel Status	30	UINT8	R	Alarm Report Alarm Output	No Unit	No active alarms=0, Active alarms=1
Control Panel Status	30	UINT8	R	DECS PSS Meter DECS PSS Active	No Unit	PSS not active=0, PSS active=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Control Panel Status	30	UINT8	R	DECS Control DECS Null Balance	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	Alarms OEL ALM	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	Alarms UEL ALM	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	Alarms SCL ALM	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	Alarms VAR LIMITER ACTIVE	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	Alarms VOLTAGE MATCHING ACTIVE	No Unit	Not active=0, Active=1
System Status	31	UINT8	R	DECS Control DECS Soft Start Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS CONTROL DECS PSS Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS OEL Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS UEL Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS SCL Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS Protect Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS PID Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS VAR Limiter Select Secondary Settings	No Unit	Primary settings active=0, Secondary settings active=1
System Status	31	UINT8	R	DECS Control DECS Preposition	No Unit	Active setpoint is not at a pre-position value=0, Active setpoint is at a pre-position value=1
System Status	31	UINT8	R	DECS Control DECS VAR Controller Active	No Unit	VAR not active=0, VAR active=1
System Status	31	UINT8	R	DECS Control DECS PF Controller Active	No Unit	PF not active=0, PF active=1
System Status	31	UINT8	R	DECS Control DECS Auto Mode Enable	No Unit	Auto mode not enabled via PLC=0, Auto mode enabled via PLC=1
System Status	31	UINT8	R	DECS Control DECS Manual Mode Enable	No Unit	Manual mode not enabled via PLC=0, Manual mode enabled via PLC=1
System Status	31	UINT8	R	DECS Control DECS FVR Controller Active	No Unit	FVR not active=0, FVR active=1
System Status	31	UINT8	R	DECS Control DECS FCR Controller Active	No Unit	FCR not active=0, FCR active=1
System Status	31	UINT8	R	DECS Control DECS Field Flashing in Progress	No Unit	Field flashing not in progress=0, Field flashing in progress=1
System Status	31	UINT8	R	DECS Control DECS IS in Manual Mode	No Unit	Not in manual=0, In manual=1
System Status	31	UINT8	R	DECS Control DECS is in Automatic Mode	No Unit	Not in automatic=0, In automatic=1
System Status	31	UINT8	R	DECS Control DECS PSS Output Disable	No Unit	PSS not disabled via PLC=0, PSS disabled via PLC=1
Contact Input Status	32	UINT8	R	Contact Inputs Start Input	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Stop Input	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 1	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 2	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 3	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 4	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 5	No Unit	Open=0, Closed=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Contact Input Status	32	UINT8	R	Contact Inputs Input 6	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 7	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 8	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 9	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 10	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 11	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 12	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 13	No Unit	Open=0, Closed=1
Contact Input Status	32	UINT8	R	Contact Inputs Input 14	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 1	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 2	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 3	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 4	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 5	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 6	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 7	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 8	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 9	No Unit	Open=0, Closed=1
CEM Input Status	33	UINT8	R	CEM Input 10	No Unit	Open=0, Closed=1
AEM Analog Input Meter	34	Float	R	Analog Input 1 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 2 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 3 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 4 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 5 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 6 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 7 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 8 Raw Value GG	V or mA	0 - 10 V or 4 - 20 mA
AEM Analog Input Meter	34	Float	R	Analog Input 1 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 2 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 3 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 4 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 5 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 6 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 7 Scaled Value GG	No Unit	n/a
AEM Analog Input Meter	34	Float	R	Analog Input 8 Scaled Value GG	No Unit	n/a
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 1 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 2 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 3 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 4 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 5 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 6 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 7 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Config AEM Input 8 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 1 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 1 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AEM Analog Input Status	35	UINT8	R	AEM Protection 1 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 1 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 2 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 2 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 2 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 2 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 3 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 3 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 3 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 3 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 4 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 4 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 4 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 4 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 5 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 5 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 5 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 5 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 6 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 6 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 6 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 6 Thresh Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 7 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 7 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 7 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 7 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 8 Thresh 1 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 8 Thresh 2 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 8 Thresh 3 Trip	No Unit	Not tripped-0, Tripped=1
AEM Analog Input Status	35	UINT8	R	AEM Protection 8 Thresh 4 Trip	No Unit	Not tripped-0, Tripped=1
AEM RTD Input Meter	36	Float	R	RTD Input 1 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 2 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 3 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 4 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 5 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 6 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 7 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 8 Raw Value GG	Ohm	n/a
AEM RTD Input Meter	36	Float	R	RTD Input 1 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 2 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 3 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 4 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 5 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 6 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 7 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Meter	36	Float	R	RTD Input 8 Scaled Value GG	Deg F	-40000 - 9999999
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 1 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 2 Out of Range	No Unit	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	AEM Config RTD Input 3 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 4 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 5 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 6 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 7 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	AEM Config RTD Input 8 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 1 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 1 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 1 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 1 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 2 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 2 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 2 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 2 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 3 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 3 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 3 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 3 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 4 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 4 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 4 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 4 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 5 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 5 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 5 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 5 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 6 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 6 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 6 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 6 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 7 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 7 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 7 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 7 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 8 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 8 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 8 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM RTD Input Status	37	UINT8	R	RTD Protection 8 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Meter	38	Float	R	Thermocouple Input 1 Raw Value GG	mV	n/a
AEM TC Input Meter	38	Float	R	Thermocouple Input 2 Raw Value GG	mV	n/a
AEM TC Input Meter	38	Float	R	Thermocouple Input 1 Scaled Value GG	Deg F	n/a
AEM TC Input Meter	38	Float	R	Thermocouple Input 2 Scaled Value GG	Deg F	n/a
AEM TC Input Status	39	UINT8	R	AEM Config Thermocouple 1 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM TC Input Status	39	UINT8	R	AEM Config Thermocouple 2 Out of Range	No Unit	Value in range=0, Value out of range=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 1 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 1 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 1 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 1 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 2 Thresh 1 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 2 Thresh 2 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 2 Thresh 3 Trip	No Unit	Not tripped=0, Tripped=1
AEM TC Input Status	39	UINT8	R	Thermocouple Protection 2 Thresh 4 Trip	No Unit	Not tripped=0, Tripped=1
Contact Output Status	40	UINT8	R	Contact Outputs Watchdog Output	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 1	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 2	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 3	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 4	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 5	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 6	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 7	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 8	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 9	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 10	No Unit	Open=0, Closed=1
Contact Output Status	40	UINT8	R	Contact Outputs Output 11	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 1	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 2	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 3	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 4	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 5	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 6	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 7	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 8	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 9	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 10	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 11	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 12	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 13	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 14	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 15	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 16	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 17	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 18	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 19	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 20	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 21	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 22	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 23	No Unit	Open=0, Closed=1
CEM Output Status	41	UINT8	R	CEM Output 24	No Unit	Open=0, Closed=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AEM Analog Output Meter	42	Float	R	Analog Output 1 Raw Value GG	V or mA	0 – 10 V or 4 – 20 mA
AEM Analog Output Meter	42	Float	R	Analog Output 2 Raw Value GG	V or mA	0 – 10 V or 4 – 20 mA
AEM Analog Output Meter	42	Float	R	Analog Output 3 Raw Value GG	V or mA	0 – 10 V or 4 – 20 mA
AEM Analog Output Meter	42	Float	R	Analog Output 4 Raw Value GG	V or mA	0 – 10 V or 4 – 20 mA
AEM Analog Output Meter	42	Float	R	Analog Output 1 Scaled Value GG	No Unit	n/a
AEM Analog Output Meter	42	Float	R	Analog Output 2 Scaled Value GG	No Unit	n/a
AEM Analog Output Meter	42	Float	R	Analog Output 3 Scaled Value GG	No Unit	n/a
AEM Analog Output Meter	42	Float	R	Analog Output 4 Scaled Value GG	No Unit	n/a
AEM Analog Output Status	43	UINT8	R	Remote Analog Output 1 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Output Status	43	UINT8	R	Remote Analog Output 2 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Output Status	43	UINT8	R	Remote Analog Output 3 Out of Range	No Unit	Value in range=0, Value out of range=1
AEM Analog Output Status	43	UINT8	R	Remote Analog Output 4 Out of Range	No Unit	Value in range=0, Value out of range=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 1 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 1 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 1 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 1 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 2 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 2 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 2 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 2 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 3 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 3 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 3 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 3 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 4 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 4 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 4 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 4 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Configurable Protection Status	44	UINT8	R	Configurable Protection 5 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 5 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 5 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 5 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 6 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 6 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 6 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 6 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 7 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 7 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 7 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 7 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 8 Configurable Protection Threshold 1 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 8 Configurable Protection Threshold 2 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 8 Configurable Protection Threshold 3 Trip	No Unit	Not tripped=0, Tripped=1
Configurable Protection Status	44	UINT8	R	Configurable Protection 8 Configurable Protection Threshold 4 Trip	No Unit	Not tripped=0, Tripped=1
Real Time Clock	45	String	R	Date GG	No Unit	0 – 16 characters
Real Time Clock	45	String	R	Time GG	No Unit	0 – 16 characters
Front Panel Settings	46	UINT32	R	LCD Contrast GG	%	0 - 100
Front Panel Settings	46	UINT32	R	LCD Invert Display GG	No Unit	No=0 Yes=1
Front Panel Settings	46	UINT32	R	LCD Sleep Mode GG	No Unit	Disabled=0 Enabled=1
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 French=3 Spanish=4 German=5 Portuguese=6
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
DECS-450 Device Info App Version	47	String	R	External Version GG	No Unit	0 - 25 characters
DECS-450 Device Info Boot Version	48	String	R	External Boot Version GG	No Unit	0 - 25 characters

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
DECS-450 Device Info App Build Date	49	String	R	App Build Date GG	No Unit	0 - 25 characters
DECS-450 Device Info Serial	50	String	R	Serial Number GG	No Unit	0 - 32 characters
DECS-450 Device Info App Part Number	51	String	R	Firmware Part Number GG	No Unit	0 - 64 characters
DECS-450 Device Info Model	52	String	R	Model Number GG	No Unit	0 - 64 characters
AEM Device Info App Version	53	String	R	App Version Number GG	No Unit	0 - 25 characters
AEM Device Info Boot Version	54	String	R	Boot Version Number 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 Number GG	No Unit	0 - 25 characters
AEM Device Info App Part Number	57	String	R	App Part Number GG	No Unit	0 - 25 characters
AEM Device Info Model	58	String	R	Model Number GG	No Unit	0 - 25 characters
CEM Device Info App Version	59	String	R	App Version Number GG	No Unit	0 - 25 characters
CEM Device Info Boot Version	60	String	R	Boot Version Number 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 Number GG	No Unit	0 - 25 characters
CEM Device Info App Part Number	63	String	R	App Part Number GG	No Unit	0 - 25 characters
CEM Device Info Model	64	String	R	Model Number GG	No Unit	0 - 25 characters
System Parameter	65	UINT32	R/W	Nominal Frequency GG	No Unit	50 Hz=50 60 Hz=60
System Parameter	66	Float	R/W	Rated Primary LL GG (Gen Voltage Config)	V	1 – 500000
System Parameter	66	Float	R/W	Rated Primary LL GG (Bus Voltage Config)	V	1 - 500000
System Parameter	66	Float	R/W	Rated PF GG	PF	0.5 – -0.5
System Parameter	66	Float	R/W	Rated KVA GG	KVA	1 – 2000000
System Parameter	66	Float	R/W	Rated Field Volt Full Load GG	V	1 – 1000
System Parameter	66	Float	R/W	Rated Field Volt No Load GG	V	1 – 1000
System Parameter	66	Float	R/W	Rated Field Current Full Load GG	Amp	0.1 – 10000
System Parameter	66	Float	R/W	Rated Field Current No Load GG	Amp	0.1 – 10000
System Parameter	66	Float	R/W	Exciter Pole Ratio GG	No Unit	1 – 10
AVR Setpoints	67	UINT32	R/W	Gen Voltage Preposition Mode 1 GG	No Unit	Maintain=0 Release=1
AVR Setpoints	67	UINT32	R/W	Gen Voltage Preposition Mode 2 GG	No Unit	Maintain=0 Release=1
AVR Setpoints	67	UINT32	R/W	Gen Voltage Preposition Mode 3 GG	No Unit	Maintain=0 Release=1
AVR Setpoints	68	Float	R/W	Gen Voltage Traverse Rate GG	Sec	10 - 200
AVR Setpoints	68	Float	R/W	Gen Voltage Setpoint GG	V	84 - 144
AVR Setpoints	68	Float	R/W	Gen Voltage Min Setpoint Limit GG	%	70 - 120
AVR Setpoints	68	Float	R/W	Gen Voltage Max Setpoint Limit GG	%	70 - 120
AVR Setpoints	68	Float	R/W	Gen Voltage Preposition1 GG	V	84 - 144
AVR Setpoints	68	Float	R/W	Gen Voltage Preposition2 GG	V	84 - 144

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AVR Setpoints	68	Float	R/W	Gen Voltage Preposition3 GG	V	84 - 144
FCR Setpoints	69	UINT32	R/W	Excitation Current Preposition Mode 1 GG	No Unit	Maintain=0 Release=1
FCR Setpoints	69	UINT32	R/W	Excitation Current Preposition Mode 2 GG	No Unit	Maintain=0 Release=1
FCR Setpoints	69	UINT32	R/W	Excitation Current Preposition Mode 3 GG	No Unit	Maintain=0 Release=1
FCR Setpoints	70	Float	R/W	Excitation Current Traverse Rate GG	Sec	10 - 200
FCR Setpoints	70	Float	R/W	Excitation Current Setpoint GG	Amp	0 - 12
FCR Setpoints	70	Float	R/W	Excitation Current Min Setpoint Limit GG	%	0 - 120
FCR Setpoints	70	Float	R/W	Excitation Current Max Setpoint Limit GG	%	0 - 120
FCR Setpoints	70	Float	R/W	Excitation Current Preposition 1 GG	Amp	0 - 12
FCR Setpoints	70	Float	R/W	Excitation Current Preposition 2 GG	Amp	0 - 12
FCR Setpoints	70	Float	R/W	Excitation Current Preposition 3 GG	Amp	0 - 12
FVR Setpoints	71	UINT32	R/W	Excitation Voltage Preposition Mode 1 GG	No Unit	Maintain=0 Release=1
FVR Setpoints	71	UINT32	R/W	Excitation Voltage Preposition Mode 2 GG	No Unit	Maintain=0 Release=1
FVR Setpoints	71	UINT32	R/W	Excitation Voltage Preposition Mode 3 GG	No Unit	Maintain=0 Release=1
FVR Setpoints	72	Float	R/W	Excitation Voltage Traverse Rate GG	Sec	10 - 200
FVR Setpoints	72	Float	R/W	Excitation Voltage Setpoint GG	V	0 - 75
FVR Setpoints	72	Float	R/W	Excitation Voltage Min Setpoint Limit GG	%	0 - 150
FVR Setpoints	72	Float	R/W	Excitation Voltage Max Setpoint Limit GG	%	0 - 150
FVR Setpoints	72	Float	R/W	Excitation Voltage Preposition 1 GG	V	0 - 75
FVR Setpoints	72	Float	R/W	Excitation Voltage Preposition 2 GG	V	0 - 75
FVR Setpoints	72	Float	R/W	Excitation Voltage Preposition 3 GG	V	0 - 75
VAR Setpoints	73	UINT32	R/W	Gen Var Preposition Mode1 GG	No Unit	Maintain=0 Release=1
VAR Setpoints	73	UINT32	R/W	Gen Var Preposition Mode2 GG	No Unit	Maintain=0 Release=1
VAR Setpoints	73	UINT32	R/W	Gen Var Preposition Mode 3 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	Per Unit	0 - 1.001
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 Preposition 1 GG	Per Unit	0 - 1.001
VAR Setpoints	74	Float	R/W	Gen var Preposition 2 GG	Per Unit	0 - 1.001
VAR Setpoints	74	Float	R/W	Gen var Preposition 3 GG	Per Unit	0 - 1.001
PF Setpoints	75	UINT32	R/W	Gen PF Preposition Mode 1 GG	No Unit	Maintain=0 Release=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
PF Setpoints	75	UINT32	R/W	Gen PF Preposition Mode 2 GG	No Unit	Maintain=0 Release=1
PF Setpoints	75	UINT32	R/W	Gen PF Preposition Mode 3 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 Preposition 1 GG	PF	0.5 – -0.5
PF Setpoints	76	Float	R/W	Gen PF preposition 2 GG	PF	0.5 – -0.5
PF Setpoints	76	Float	R/W	Gen PF Preposition 3 GG	PF	0.5 – -0.5
Aux Input Settings	77	UINT32	R/W	DECS Aux Input Mode GG	No Unit	Voltage=0 Current=1
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 No Control=4
Aux Input Settings	78	Float	R/W	DECS Aux Voltage 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	LS Gain GG	No Unit	0 - 1000
Load Share	82	Float	R/W	Washout Filter Time Constant GG	No Unit	0 - 1
Load Share	82	Float	R/W	Washout Filter Gain GG	No Unit	0 - 1000
Load Share	82	Float	R/W	Disable Time Delay GG	Sec	1 – 3600
Load Share	82	Float	R/W	Reserved GG	No Unit	0 - 1000
Load Share	82	Float	R/W	LS Ki Gain GG	No Unit	0 - 1000
Load Share	82	Float	R/W	LS Max Vc GG	No Unit	0 - 1
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Startup	86	Float	R/W	Startup Primary Soft Start Bias GG	%	0 - 90
Startup	86	Float	R/W	Startup Primary Soft Start Time GG	Sec	1 - 7200
Startup	86	Float	R/W	Startup Sec Soft Start Bias GG	%	0 - 90
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 Primary GG	No Unit	0 - 1000
AVR Gains	88	Float	R/W	AVR Ki Primary GG	No Unit	0 - 1000

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AVR Gains	88	Float	R/W	AVR Kd Primary GG	No Unit	0 - 1000
AVR Gains	88	Float	R/W	AVR Td Primary GG	No Unit	0 - 1
AVR Gains	88	Float	R/W	AVR Kg Primary GG	No Unit	0 - 1000
AVR Gains	88	Float	R/W	AVR Kp Sec GG	No Unit	0 - 1000
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
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 - 12000
OEL Summing Point	110	Float	R/W	OEL Pri Cur Mid GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Pri Cur Lo GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Pri Time Hi GG	Sec	0 – 240
OEL Summing Point	110	Float	R/W	OEL Pri Time Mid GG	Sec	0 – 240
OEL Summing Point	110	Float	R/W	OEL Pri Cur Hi Off GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Pri Cur Lo Off GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Pri Cur Time Off GG	Sec	0 – 240
OEL Summing Point	110	Float	R/W	OEL Sec Cur Hi GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Sec Cur Mid GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Sec Cur Lo GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Sec Time Hi GG	Sec	0 – 240
OEL Summing Point	110	Float	R/W	OEL Sec Time Mid GG	Sec	0 – 240

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
OEL Summing Point	110	Float	R/W	OEL Sec Cur Hi Off GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Sec Cur Lo Off GG	Amp	0 - 12000
OEL Summing Point	110	Float	R/W	OEL Sec Cur Time Off GG	Sec	0 – 240
OEL Takeover	112	Float	R/W	OEL Pri Takeover Cur Max Off GG	Amp	0 – 12000
OEL Takeover	112	Float	R/W	OEL Pri Takeover Cur Min Off GG	Amp	0 – 12000
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 – 12000
OEL Takeover	112	Float	R/W	OEL Pri Takeover Cur Min On GG	Amp	0 – 12000
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 – 12000
OEL Takeover	112	Float	R/W	OEL Sec Takeover Cur Min Off GG	Amp	0 – 12000
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 – 12000
OEL Takeover	112	Float	R/W	OEL Sec Takeover Cur Min On GG	Amp	0 – 12000
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 – 240
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 - 240
SCL Settings	120	Float	R/W	SCL Sec No Response Time GG	Sec	0 - 10
SCL Settings	120	Float	R/W	SCL Scale Signal 2_GG	Limiter Scale Voltage	-10 - 10
SCL Settings	120	Float	R/W	SCL Scale Signal 3_GG	Limiter Scale Voltage	-10 - 10
SCL Settings	120	Float	R/W	SCL Scale Point 1_GG	Percent	0 - 200
SCL Settings	120	Float	R/W	SCL Scale Point 2_GG	Percent	0 - 200
SCL Settings	120	Float	R/W	SCL Scale Point 3_GG	Percent	0 - 200
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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	SCL Scale Signal 1 GG	V	-10 - 10
SCL Scaling	126	Float	R/W	SCL Scale Signal 2 GG	V	-10 - 10
SCL Scaling	126	Float	R/W	SCL Scale Signal 3 GG	V	-10 - 10
SCL Scaling	126	Float	R/W	SCL Scale Point 1 GG	%	0 - 200
SCL Scaling	126	Float	R/W	SCL Scale Point 2 GG	%	0 - 200
SCL Scaling	126	Float	R/W	SCL Scale Point 3 GG	%	0 - 200
Underfrequency/Volts per hertz	127	UINT32	R/W	Sys Option Under Freq Mode GG	No Unit	UF Limiter=0 V2H Limiter=1
Underfrequency /Volts per Hertz	128	Float	R/W	Sys Option Under Freq Hz GG	Hz	15 - 90
Underfrequency /Volts per Hertz	128	Float	R/W	Sys Option Under Freq Slope GG	No Unit	0 - 3
Underfrequency /Volts per Hertz	128	Float	R/W	Sys Option Voltage Per Hz Slope Hi GG	No Unit	0 - 3
Underfrequency /Volts per Hertz	128	Float	R/W	Sys Option Voltage Per Hz Slope Lo GG	No Unit	0 - 3
Underfrequency /Volts per Hertz	128	Float	R/W	Sys Option Voltage Per Hz 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 Primary Power Level Percentage GG	No Unit	0 - 1
PSS Configure	130	Float	R/W	PSS Primary 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	PSS Primary Switch 10 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 11 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 3 GG	No Unit	Frequency=0 Der. Speed=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 4 GG	No Unit	Power=0 Der. Freq/Speed=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 0 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 1 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 5 GG	No Unit	Exclude=0 Include=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 9 GG	No Unit	Exclude=0 Include=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 6 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 8 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 7 GG	No Unit	OFF=0 ON=1
PSS Control Primary	131	UINT32	R/W	PSS Primary Switch 2 GG	No Unit	Disabled=0 Enabled=1
PSS Control Primary	132	Float	R/W	PSS Primary Power On Threshold GG	No Unit	0 - 1
PSS Control Primary	132	Float	R/W	PSS Primary Power Hysteresis GG	No Unit	0 - 1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 10 GG	No Unit	Disabled=0 Enabled=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 11 GG	No Unit	Disabled=0 Enabled=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 3 GG	No Unit	Frequency=0 Der. Speed=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 4 GG	No Unit	Power=0 Der. Freq/Speed=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 0 GG	No Unit	Disabled=0 Enabled=1

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 1 GG	No Unit	Disabled=0 Enabled=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 5 GG	No Unit	Exclude=0 Include=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 9 GG	No Unit	Exclude=0 Include=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 6 GG	No Unit	Disabled=0 Enabled=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 8 GG	No Unit	Disabled=0 Enabled=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 7 GG	No Unit	OFF=0 ON=1
PSS Control Secondary	133	UINT32	R/W	PSS Sec Switch 2 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 Primary Ramp Flt M GG	No Unit	1 - 5
PSS Filter Parameter Primary Int	135	UINT32	R/W	PSS Primary Ramp Flt N GG	No Unit	0 - 1
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Time Constant Low Pass Filter 1 GG	Sec	0 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Time Constant Low Pass Filter 2 GG	Sec	0.01 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Time Constant Low Pass Filter 3 GG	Sec	0.05 - 0.2
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Tr GG	Sec	0.01 - 1
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Tw 1 GG	Sec	1 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Tw 2 GG	Sec	1 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Tw 3 GG	Sec	1 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary Tw 4 GG	Sec	1 - 20
PSS Filter Parameter Primary Float	136	Float	R/W	PSS Primary H GG	No Unit	0.01 - 25
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Zn 1 GG	No Unit	0 - 1
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Zn 2 GG	No Unit	0 - 1
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Zd 1 GG	No Unit	0 - 1
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Zd 2 GG	No Unit	0 - 1
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Wn 1 GG	No Unit	10 - 150
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Wn 2 GG	No Unit	10 - 150
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Xq GG	No Unit	0 - 5
PSS Parameter Primary Float	138	Float	R/W	PSS Primary Kpe GG	No Unit	0 - 2
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T1 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T2 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T3 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T4 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T5 GG	Sec	0.001 - 6

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T6 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T7 GG	Sec	0.001 - 6
PSS Parameter Primary Phase Comp Float	140	Float	R/W	PSS Primary T8 GG	Sec	0.001 - 6
PSS Parameter Secondary Filters Int	141	UINT32	R/W	PSS Secondary Ramp Flt M GG	No Unit	1 - 5
PSS Parameter Secondary Filters Int	141	UINT32	R/W	PSS Secondary Ramp Flt N GG	No Unit	0 - 1
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Time Constant Low Pass Filter 1 GG	Sec	0 - 20
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Time Constant Low Pass Filter 2 GG	Sec	0.01 – 20
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Time Constant Low Pass Filter 3 GG	Sec	0.05 - 0.2
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Tr GG	Sec	0.01 - 1
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Tw1 GG	Sec	1 - 20
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Tw2 GG	Sec	1 - 20
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Tw3 GG	Sec	1 - 20
PSS Parameter Secondary Filters Float	142	Float	R/W	PSS Secondary Tw4 GG	Sec	1 - 20
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Zn1 GG	No Unit	0 - 1
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Zn2 GG	No Unit	0 - 1
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Zd1 GG	No Unit	0 - 1
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Zd2 GG	No Unit	0 - 1
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Wn1 GG	No Unit	10 - 150
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Wn2 GG	No Unit	10 - 150
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Xq GG	No Unit	0 - 5
PSS Parameter Secondary Float	144	Float	R/W	PSS Secondary Kpe GG	No Unit	0 - 2
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T1 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T2 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T3 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T4 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T5 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T6 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T7 GG	Sec	0.001 - 6
PSS Parameter Secondary Phase Comp Float	146	Float	R/W	PSS Secondary T8 GG	Sec	0.001 - 6
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Limit Plus GG	No Unit	0 - 0.5
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Limit Minus GG	No Unit	-0.5 - 0
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Ks GG	No Unit	-100 - 100

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Et Lmt Time Constant Low Pass Filter GG	Sec	0.02 - 5
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Et Lmt Vref GG	No Unit	0 - 10
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Tw5 Normal GG	No Unit	5 - 30
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Tw5 Limit GG	No Unit	0 - 1
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Lmt Vhi GG	No Unit	0.01 - 0.04
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Lmt Vlo GG	No Unit	-0.04 - -0.01
PSS Output Limiter Primary	148	Float	R/W	PSS Primary Lmt T Delay GG	No Unit	0 - 2
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Limit Plus GG	No Unit	0 - 0.5
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Limit Minus GG	No Unit	-0.5 - 0
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Ks GG	No Unit	-100 - 100
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Et Lmt Time Constant Low Pass Filter GG	Sec	0.02 - 5
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Et Lmt Vref GG	No Unit	0 - 10
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Tw5 Normal GG	No Unit	5 - 30
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Tw5 Limit GG	No Unit	0 - 1
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Lmt Vhi GG	No Unit	0.01 - 0.04
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary Lmt Vlo GG	No Unit	-0.04 - -0.01
PSS Output Limiter Secondary	150	Float	R/W	PSS Secondary 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
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 Voltage Match Band GG	%	0 - 20
Voltage Matching	154	Float	R/W	Sys Option Voltage 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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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 Voltage Pickup 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	15 - 64
Bus Condition Detection (Gen Sensing)	158	Float	R/W	Gen Stable Over Frequency Dropout GG	Hz	15 - 64
Bus Condition Detection (Gen Sensing)	158	Float	R/W	Gen Stable Under Frequency Pickup GG	Hz	15 - 64
Bus Condition Detection (Gen Sensing)	158	Float	R/W	Gen Stable Under Frequency Dropout GG	Hz	15 – 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
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	15 - 64
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Over Frequency Dropout GG	Hz	15 - 64
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Under Frequency Pickup GG	Hz	15 - 64
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Under Frequency Dropout GG	Hz	15 - 64
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Activation Delay GG	Sec	0.1 - 600

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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 Fixed=1 Proportional=2
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 Undervoltage	163	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Gen Undervoltage	163	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Gen Undervoltage	164	Float	R/W	Pickup PP	V	1 - 600000
Gen Undervoltage	164	Float	R/W	Time Delay PP	ms	100 - 60000
Gen Undervoltage	164	Float	R/W	Pickup PS	V	1 - 600000
Gen Undervoltage	164	Float	R/W	Time Delay PS	ms	100 - 60000
Gen Overvoltage	165	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Gen Overvoltage	165	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Gen Overvoltage	166	Float	R/W	Pickup PP	V	0 - 600000
Gen Overvoltage	166	Float	R/W	Time Delay PP	ms	100 - 60000
Gen Overvoltage	166	Float	R/W	Pickup PS	V	0 - 600000
Gen Overvoltage	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	15 - 70
81O	170	Float	R/W	Time Delay PP	ms	100 - 300000
81O	170	Float	R/W	Pickup PS	Hz	15 - 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-1	171	UINT32	R/W	Mode PP	No Unit	Disabled=0 Under=2
81U-1	171	UINT32	R/W	Mode PS	No Unit	Disabled=0 Under=2
81U-1	172	Float	R/W	Pickup PP	Hz	15 - 70
81U-1	172	Float	R/W	Time Delay PP	ms	100 - 300000
81U-1	172	Float	R/W	Voltage Inhibit PP	%	5 - 100
81U-1	172	Float	R/W	Pickup PS	Hz	15 - 70
81U-1	172	Float	R/W	Time Delay PS	ms	100 - 300000
81U-1	172	Float	R/W	Voltage Inhibit PS	%	5 – 100
81U-2	173	UINT32	R/W	Mode PP	No Unit	Disabled=0 Under=2
81U-2	173	UINT32	R/W	Mode PS	No Unit	Disabled=0 Under=2
81U-2	174	Float	R/W	Pickup PP	Hz	15 - 70
81U-2	174	Float	R/W	Time Delay PP	ms	100 - 300000
81U-2	174	Float	R/W	Voltage Inhibit PP	%	5 - 100

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
81U-2	174	Float	R/W	Pickup PS	Hz	15 - 70
81U-2	174	Float	R/W	Time Delay PS	ms	100 - 300000
81U-2	174	Float	R/W	Voltage Inhibit PS	%	5 – 100
Reverse Power	175	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=4
Reverse Power	175	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=4
Reverse Power	176	Float	R/W	Pickup PP	kW	0 – 3000000
Reverse Power	176	Float	R/W	Pickup PS	kW	0 – 3000000
Reverse Power	176	Float	R/W	Time Delay PP	ms	0 – 300000
Reverse Power	176	Float	R/W	Time Delay PS	ms	0 – 300000
Loss of Excitation	177	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Loss of Excitation	177	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Loss of Excitation	178	Float	R/W	Pickup PP	Kvar	0 – 3000000
Loss of Excitation	178	Float	R/W	Time Delay PP	ms	0 – 300000
Loss of Excitation	178	Float	R/W	Pickup PS	Kvar	0 – 3000000
Loss of Excitation	178	Float	R/W	Time Delay PS	ms	0 – 300000
Field Overvoltage	179	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Field Overvoltage	179	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Field Overvoltage	180	Float	R/W	Pickup PP	V	1 – 2400
Field Overvoltage	180	Float	R/W	Time Delay PP	ms	200 - 30000
Field Overvoltage	180	Float	R/W	Pickup PS	V	1 – 2400
Field Overvoltage	180	Float	R/W	Time Delay PS	ms	200 – 30000
Field Overcurrent	181	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Field Overcurrent	181	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Field Overcurrent	182	Float	R/W	Pickup PP	Amp	0 – 12000
Field Overcurrent	182	Float	R/W	Time Delay PP	ms	5000 – 60000
Field Overcurrent	182	Float	R/W	Pickup PS	Amp	0 – 12000
Field Overcurrent	182	Float	R/W	Time Delay PS	ms	5000 – 60000
Field Overtemperature	183	UINT32	R/W	Mode PP	No Unit	Disabled=0 Enabled=1
Field Overtemperature	183	UINT32	R/W	Mode PS	No Unit	Disabled=0 Enabled=1
Field Overtemperature	184	Float	R/W	Pickup PP	Deg F	0 – 572
Field Overtemperature	184	Float	R/W	Time Delay PP	ms	100 – 60000
Field Overtemperature	184	Float	R/W	Pickup PS	Deg F	0 – 572
Field Overtemperature	184	Float	R/W	Time Delay PS	ms	100 - 60000
Exciter Diode Monitor	185	UINT32	R/W	Exciter Open Diode Enable GG	No Unit	Disabled=0 Enabled=1
Exciter Diode Monitor	185	UINT32	R/W	Exciter Shorted Diode Enable GG	No Unit	Disabled=0 Enabled=1
Exciter Diode Monitor	186	Float	R/W	Exciter Diode Inhibit Threshold GG	%	0 - 100
Exciter Diode Monitor	186	Float	R/W	Exciter Open Diode Pickup GG	%	0 - 100
Exciter Diode Monitor	186	Float	R/W	Exciter Open Diode Time Delay GG	Sec	10 - 60
Exciter Diode Monitor	186	Float	R/W	Exciter Shorted Diode Pickup GG	%	0 - 100
Exciter Diode Monitor	186	Float	R/W	Exciter Shorted Diode Time Delay GG	Sec	5 - 30
Exciter Diode Monitor	186	Float	R/W	Exciter Pole Ratio GG	No Unit	1 - 10
Sync Check	187	UINT32	R/W	Mode GG	No Unit	Disabled=0 Enabled=1
Sync Check	188	Float	R/W	Phase Angle GG	Deg	1 - 99
Sync Check	188	Float	R/W	Slip Frequency GG	Hz	0.01 - 0.5
Sync Check	188	Float	R/W	Voltage Magnitude Error Percent GG	%	0.1 - 50

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Configurable Protection 1	189	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 1	189	UINT32	R/W	Stop Mode Inhibit GG	No Unit	NO=0 YES=1
Configurable Protection 1	189	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 1	189	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 1	189	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 1	189	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 1	190	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 1	190	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 1	190	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 1	190	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 1	190	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 1	190	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 1	190	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 1	190	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 1	190	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 1	190	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 2	191	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 2	191	UINT32	R/W	Stop Mode Inhibit GG	No Unit	NO=0 YES=1
Configurable Protection 2	191	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 2	191	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 2	191	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 2	191	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 2	192	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 2	192	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 2	192	Float	R/W	Threshold1Pickup GG	No Unit	-999999 - 999999
Configurable Protection 2	192	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 2	192	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 2	192	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 2	192	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 2	192	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 2	192	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 2	192	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 3	193	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 3	193	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 3	193	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Configurable Protection 3	193	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 3	193	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 3	193	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 3	194	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 3	194	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 3	194	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 3	194	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 3	194	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 3	194	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 3	194	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 3	194	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 3	194	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 3	194	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 4	195	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 4	195	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 4	195	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 4	195	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 4	195	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 4	195	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 4	196	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 4	196	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 4	196	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 4	196	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 4	196	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 4	196	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 4	196	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 4	196	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 4	196	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 4	196	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 5	197	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 5	197	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 5	197	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 5	197	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 5	197	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 5	197	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 5	198	Float	R/W	Hysteresis GG	%	0 - 100

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Configurable Protection 5	198	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 5	198	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 5	198	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 5	198	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 5	198	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 5	198	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 5	198	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 5	198	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 5	198	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 6	199	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 6	199	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 6	199	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 6	199	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 6	199	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 6	199	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 6	200	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 6	200	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 6	200	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 6	200	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 6	200	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 6	200	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Configurable Protection 6	200	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 6	200	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 6	200	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 6	200	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 7	201	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 7	201	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 7	201	UINT32	R/W	Threshold1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 7	201	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 7	201	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 7	201	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 7	202	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 7	202	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 7	202	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 7	202	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 7	202	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 7	202	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Configurable Protection 7	202	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 7	202	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 7	202	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 7	202	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Configurable Protection 8	203	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Configurable Protection 8	203	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Configurable Protection 8	203	UINT32	R/W	Threshold 1Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 8	203	UINT32	R/W	Threshold Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 8	203	UINT32	R/W	Threshold Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 8	203	UINT32	R/W	Threshold Type GG	No Unit	Disabled=0 Over=1 Under=2
Configurable Protection 8	204	Float	R/W	Hysteresis GG	%	0 - 100
Configurable Protection 8	204	Float	R/W	Arming Delay GG	Sec	0 - 300
Configurable Protection 8	204	Float	R/W	Threshold 1 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 8	204	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Configurable Protection 8	204	Float	R/W	Threshold 2 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 8	204	Float	R/W	Threshold 2 Activation Delay	Sec	0 - 300
Configurable Protection 8	204	Float	R/W	Threshold 3 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 8	204	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Configurable Protection 8	204	Float	R/W	Threshold 4 Pickup GG	No Unit	-999999 - 999999
Configurable Protection 8	204	Float	R/W	Threshold Activation Delay GG	Sec	0 - 300
Remote Analog In 1	205	UINT32	R/W	Stop Mode Inhibit GG	No Unit	NO=0 YES=1
Remote Analog In 1	205	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 1	205	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 1	205	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 1	205	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 1	205	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 1	206	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 1	206	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 1	206	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 1	206	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 1	206	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 1	206	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 1	206	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 1	206	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 1	206	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 1	206	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 1	206	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 1	206	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote Analog In 1	206	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 1	206	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 1	206	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 1	206	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 2	207	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 2	207	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 2	207	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 2	207	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 2	207	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 2	207	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 2	208	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 2	208	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 2	208	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 2	208	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 2	208	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 2	208	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 2	208	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 2	208	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 2	208	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 2	208	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 2	208	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 3	209	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 3	209	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 3	209	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 3	209	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 3	209	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 3	209	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 3	210	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 3	210	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 3	210	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 3	210	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 3	210	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 3	210	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 3	210	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 3	210	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 3	210	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote Analog In 3	210	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 3	210	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 3	210	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 3	210	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 3	210	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 3	210	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 3	210	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 4	211	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 4	211	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 4	211	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 4	211	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 4	211	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 4	211	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 4	212	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 4	212	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 4	212	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 4	212	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 4	212	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 4	212	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 4	212	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 4	212	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 4	212	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 4	212	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 4	212	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 5	213	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 5	213	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 5	213	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 5	213	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 5	213	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 5	213	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 5	214	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 5	214	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 5	214	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 5	214	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote Analog In 5	214	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 5	214	Float	R/W	Threshold4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 5	214	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 5	214	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 5	214	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 5	214	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 5	214	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 6	215	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 6	215	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 6	215	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 6	215	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 6	215	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 6	215	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 6	216	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 6	216	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 6	216	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 6	216	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 6	216	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 6	216	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 6	216	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 6	216	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 6	216	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 6	216	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 6	216	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 7	217	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 7	217	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 7	217	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 7	217	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 7	217	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 7	217	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 7	218	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 7	218	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 7	218	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote Analog In 7	218	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 7	218	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 7	218	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 7	218	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 7	218	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 7	218	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 7	218	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 7	218	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 7	218	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 7	218	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 7	218	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 7	218	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 7	218	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog In 8	219	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote Analog In 8	219	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 8	219	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 8	219	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 8	219	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote Analog In 8	219	UINT32	R/W	Type GG	No Unit	Voltage=0 Current=1
Remote Analog In 8	220	Float	R/W	Hysteresis GG	%	0 - 100
Remote Analog In 8	220	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote Analog In 8	220	Float	R/W	Threshold 1 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote Analog In 8	220	Float	R/W	Threshold 2 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote Analog In 8	220	Float	R/W	Threshold 3 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote Analog In 8	220	Float	R/W	Threshold 4 Pickup GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog In 8	220	Float	R/W	Parameter Min GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Parameter Max GG	No Unit	-9999 - 9999
Remote Analog In 8	220	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog In 8	220	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog In 8	220	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog In 8	220	Float	R/W	Voltage Max GG	V	0 - 10
Remote RTD In 1	221	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 1	221	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 1	221	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 1	221	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 1	221	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote RTD In 1	221	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 1	222	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 1	222	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 1	222	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 1	222	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 1	222	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 1	222	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 1	222	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 1	222	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 1	222	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 1	222	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 1	222	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 2	223	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 2	223	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 2	223	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 2	223	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 2	223	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 2	223	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 2	224	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 2	224	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 2	224	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 2	224	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 2	224	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 2	224	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 2	224	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 2	224	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 2	224	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 2	224	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 2	224	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 3	225	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 3	225	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 3	225	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 3	225	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 3	225	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 3	225	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 3	226	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 3	226	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 3	226	Float	R/W	Arming Delay GG	Sec	0 - 300

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote RTD In 3	226	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 3	226	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 3	226	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 3	226	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 3	226	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 3	226	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 3	226	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 3	226	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 4	227	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 4	227	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 4	227	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 4	227	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 4	227	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 4	227	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 4	228	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 4	228	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 4	228	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 4	228	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 4	228	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 4	228	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 4	228	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 4	228	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 4	228	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 4	228	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 4	228	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 5	229	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 5	229	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 5	229	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 5	229	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 5	229	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 5	229	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 5	230	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 5	230	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 5	230	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 5	230	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 5	230	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 5	230	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 5	230	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote RTD In 5	230	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 5	230	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 5	230	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 5	230	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 6	231	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 6	231	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 6	231	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 6	231	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 6	231	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 6	231	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 6	232	Float	R/W	Cal Off set GG	Deg F	-99999 - 99999
Remote RTD In 6	232	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 6	232	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 6	232	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 6	232	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 6	232	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 6	232	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 6	232	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 6	232	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 6	232	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 6	232	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote RTD In 7	233	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 7	233	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 7	233	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 7	233	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 7	233	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 7	233	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 7	234	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 7	234	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 7	234	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 7	234	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 7	234	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 7	234	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 7	234	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 7	234	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 7	234	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 7	234	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 7	234	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote RTD In 8	235	UINT32	R/W	Type GG	No Unit	10 Ohm Cu=0 100 Ohm Pt=1
Remote RTD In 8	235	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote RTD In 8	235	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 8	235	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 8	235	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 8	235	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote RTD In 8	236	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote RTD In 8	236	Float	R/W	Hysteresis GG	%	0 - 100
Remote RTD In 8	236	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote RTD In 8	236	Float	R/W	Threshold 1 Pickup GG	Deg F	-58 - 482
Remote RTD In 8	236	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote RTD In 8	236	Float	R/W	Threshold 2 Pickup GG	Deg F	-58 - 482
Remote RTD In 8	236	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote RTD In 8	236	Float	R/W	Threshold 3 Pickup GG	Deg F	-58 - 482
Remote RTD In 8	236	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote RTD In 8	236	Float	R/W	Threshold 4 Pickup GG	Deg F	-58 - 482
Remote RTD In 8	236	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote TC In 1	237	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote TC In 1	237	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 1	237	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 1	237	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 1	237	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 1	238	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote TC In 1	238	Float	R/W	Hysteresis GG	%	0 - 100
Remote TC In 1	238	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote TC In 1	238	Float	R/W	Threshold 1 Pickup GG	Deg F	32 - 2507
Remote TC In 1	238	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote TC In 1	238	Float	R/W	Threshold 2 Pickup GG	Deg F	32 - 2507
Remote TC In 1	238	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote TC In 1	238	Float	R/W	Threshold 3 Pickup GG	Deg F	32 - 2507
Remote TC In 1	238	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote TC In 1	238	Float	R/W	Threshold 4 Pickup GG	Deg F	32 - 2507
Remote TC In 1	238	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote TC In 2	239	UINT32	R/W	Stop Mode Inhibit GG	No Unit	No=0 Yes=1
Remote TC In 2	239	UINT32	R/W	Threshold 1 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 2	239	UINT32	R/W	Threshold 2 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 2	239	UINT32	R/W	Threshold 3 Type GG	No Unit	Disabled=0 Over=1 Under=2

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote TC In 2	239	UINT32	R/W	Threshold 4 Type GG	No Unit	Disabled=0 Over=1 Under=2
Remote TC In 2	240	Float	R/W	Cal Offset GG	Deg F	-99999 - 99999
Remote TC In 2	240	Float	R/W	Hysteresis GG	%	0 - 100
Remote TC In 2	240	Float	R/W	Arming Delay GG	Sec	0 - 300
Remote TC In 2	240	Float	R/W	Threshold 1 Pickup GG	Deg F	32 - 2507
Remote TC In 2	240	Float	R/W	Threshold 1 Activation Delay GG	Sec	0 - 300
Remote TC In 2	240	Float	R/W	Threshold 2 Pickup GG	Deg F	32 - 2507
Remote TC In 2	240	Float	R/W	Threshold 2 Activation Delay GG	Sec	0 - 300
Remote TC In 2	240	Float	R/W	Threshold 3 Pickup GG	Deg F	32 - 2507
Remote TC In 2	240	Float	R/W	Threshold 3 Activation Delay GG	Sec	0 - 300
Remote TC In 2	240	Float	R/W	Threshold 4 Pickup GG	Deg F	32 - 2507
Remote TC In 2	240	Float	R/W	Threshold 4 Activation Delay GG	Sec	0 - 300
Remote Analog Out 1	241	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Remote Analog Out 1	241	UINT32	R/W	Output Type GG	No Unit	Voltage=0 Current=1
Remote Analog Out 1	242	Float	R/W	Out of Range Activation Delay GG	Sec	0 - 300
Remote Analog Out 1	242	Float	R/W	Parameter Min GG	No Unit	-99999 - 99999
Remote Analog Out 1	242	Float	R/W	Parameter Max GG	No Unit	-99999 - 99999
Remote Analog Out 1	242	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog Out 1	242	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog Out 1	242	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog Out 1	242	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog Out 2	243	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Remote Analog Out 2	243	UINT32	R/W	Output Type GG	No Unit	Voltage=0 Current=1
Remote Analog Out 2	244	Float	R/W	Out of Range Activation Delay GG	Sec	0 - 300
Remote Analog Out 2	244	Float	R/W	Parameter Min GG	No Unit	-99999 - 99999
Remote Analog Out 2	244	Float	R/W	Parameter Max GG	No Unit	-99999 - 99999
Remote Analog Out 2	244	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog Out 2	244	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog Out 2	244	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog Out 2	244	Float	R/W	Voltage Max GG	V	0 - 10
Remote Analog Out 3	245	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.
Remote Analog Out 3	245	UINT32	R/W	Output Type GG	No Unit	Voltage=0 Current=1
Remote Analog Out 3	246	Float	R/W	Out of Range Activation Delay GG	Sec	0 - 300
Remote Analog Out 3	246	Float	R/W	Parameter Min GG	No Unit	-99999 - 99999
Remote Analog Out 3	246	Float	R/W	Parameter Max GG	No Unit	-99999 - 99999
Remote Analog Out 3	246	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog Out 3	246	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog Out 3	246	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog Out 3	246	Float	R/W	Voltage Max GG	V	0 – 10
Remote Analog Out 4	247	UINT32	R/W	Parameter Selection GG	No Unit	See *Parameter Selection* at the end of this section for a complete list.

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Remote Analog Out 4	247	UINT32	R/W	Output Type GG	No Unit	Voltage=0 Current=1
Remote Analog Out 4	248	Float	R/W	Out of Range Activation Delay GG	Sec	0 - 300
Remote Analog Out 4	248	Float	R/W	Parameter Min GG	No Unit	-99999 - 99999
Remote Analog Out 4	248	Float	R/W	Parameter Max GG	No Unit	-99999 - 99999
Remote Analog Out 4	248	Float	R/W	Current Min GG	mA	4 - 20
Remote Analog Out 4	248	Float	R/W	Current Max GG	mA	4 - 20
Remote Analog Out 4	248	Float	R/W	Voltage Min GG	V	0 - 10
Remote Analog Out 4	248	Float	R/W	Voltage Max GG	V	0 - 10
User Programmable Alarms	250	Float	R/W	Programmable Alarm 1 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 2 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 3 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 4 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 5 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 6 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 7 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 8 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 9 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 10 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 11 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 12 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 13 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 14 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 15 Delay GG	Sec	0 - 300
User Programmable Alarms	250	Float	R/W	Programmable Alarm 16 Delay GG	Sec	0 - 300
Logic Timers	251	UINT32	R/W	Timer 1 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 2 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 3 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 4 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 5 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 6 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 7 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 8 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 9 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 10 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 11 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 12 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 13 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 14 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 15 Timeout Hours GG	Hour	0 – 250
Logic Timers	251	UINT32	R/W	Timer 16 Timeout Hours GG	Hour	0 – 250

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Logic Timers	252	UINT32	R/W	Timer 1 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 2 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 3 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 4 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 5 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 6 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 7 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 8 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 9 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 10 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 11 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 12 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 13 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 14 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 15 Timeout Minutes GG	Minute	0 – 59
Logic Timers	252	UINT32	R/W	Timer 16 Timeout Minutes GG	Minute	0 – 59
Logic Timers	253	UINT32	R/W	Timer 1 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 2 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 3 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 4 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 5 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 6 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 7 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 8 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 9 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 10 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 11 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 12 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 13 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 14 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 15 Timeout Seconds GG	Decisecond	0 – 599
Logic Timers	253	UINT32	R/W	Timer 16 Timeout Seconds GG	Decisecond	0 – 599
Logic Counters	255	Float	R/W	Counter 1 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 2 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 3 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 4 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 5 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 6 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 7 Output Timeout GG	No Unit	0 - 1800
Logic Counters	255	Float	R/W	Counter 8 Output Timeout GG	No Unit	0 - 1800
AEM RTD TC Metric Meter	256	Float	R	RTD Input 1 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 2 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 3 Metric Value GG	Deg C	n/a

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
AEM RTD TC Metric Meter	256	Float	R	RTD Input 4 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 5 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 6 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 7 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	RTD Input 8 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	Thermocouple Input 1 Metric Value GG	Deg C	n/a
AEM RTD TC Metric Meter	256	Float	R	Thermocouple Input 2 Metric Value GG	Deg C	n/a
Active Setpoint Meter	257	Float	R	Active Generator Voltage Setpoint	V	n/a
Active Setpoint Meter	257	Float	R	Active Excitation Current Setpoint	Amp	n/a
Active Setpoint Meter	257	Float	R	Active Excitation Voltage Setpoint	V	n/a
Active Setpoint Meter	257	Float	R	Active Generator Var Setpoint	kvar	n/a
Active Setpoint Meter	257	Float	R	Active Generator PF Setpoint	PF	n/a
Operating Mode Control	258	UINT32	R/W	System Input Comport Manual Enabled GG	No Unit	Manual=1 Automatic=2
Operating Mode Control	258	UINT32	R/W	System Input Comport PF/Var Enabled GG	No Unit	OFF=0 PF=1 Var=2
Operating Mode Control	258	UINT32	R/W	System Input Comport FCR/FVR Enabled GG	No Unit	FVR=0 FCR=1
Gen Metering Primary	259	Float	R	VAB GG	V	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	VBC GG	V	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	VCA GG	V	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	IA GG	Amp	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	IB GG	Amp	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	IC GG	Amp	0 – 2,000,000,000
Gen Metering Primary	259	Float	R	IAVG GG	Amp	0 – 2,000,000,000

Parameter Selection

Generator VAB=0
Generator VBC=1
Generator VCA=2
Generator V Average=3
Bus Frequency=4
Bus VAB=5
Bus VBC=6
Bus VCA=7
Generator Frequency=8
Generator Power Factor=9
KWH=10
KVARH=11
Generator IA=12
Generator IB=13
Generator IC=14
Generator I Average=15
kW Total=16
kVA Total=17
kvar Total=18
Exciter Diode Monitor 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
Negative Sequence Voltage=26
Negative Sequence Current=27
Positive Sequence Voltage=28
Positive Sequence Current=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
Power Input=49
Network Load Share Error Percent=50
Generator Scaled Power Factor=51
Control Output Per Unit=52
Field Temperature=53

28 • Maintenance and Troubleshooting

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-450 from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450.

Storage

If the unit is not to be installed immediately, store it in the original shipping package 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).

Preventive Maintenance

Connections

Periodically check the connections of the DECS-450 to ensure they are clean and tight and remove any accumulation of dust.

Electrolytic Capacitors

The DECS-450 contains long-life aluminum electrolytic capacitors. For a DECS-450 kept in storage as a spare, the life of these capacitors can be maximized by energizing the device for 30 minutes once per year. Apply DECS-450 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 XLXXXXX: 24/48 Vdc (16 to 60 Vdc)
- Style XCXXXXX: 120 Vac (82 to 132 Vac at 50/60 Hz) or 125 Vdc (90 to 150 Vdc)

Cleaning the Front Panel

Only a soft cloth and water-based solutions should be used to clean the front panel. Do not use solvents.

Backup Battery Replacement

An internal battery maintains real-time clock information when DECS-450 control power is removed or lost. The 3-volt, lithium, backup battery is secured in a tray located in the left side panel. The backup battery has a life expectancy of approximately five years depending on conditions. After this time, you should contact Basler Electric to order a new battery, Basler Electric P/N 38526.

Warning!

Only qualified personnel should replace the backup battery.

To avoid risk of electric shock, the DECS-450 must be powered down when removing or installing the battery.

Do not short-circuit the battery, reverse the battery polarity, or attempt to recharge the battery as personal injury or equipment damage may result.

1. Obtain a replacement battery (Murata CR2032X, Murata CR2032W, Panasonic CR2032A, Rayovac BR2032-BA, Basler Electric 38526, or equivalent).
2. Remove the DECS-450 from service by observing all applicable safety and shutdown procedures.
3. Locate the battery access slot. Using a small, pointed, non-conductive tool, remove the battery tray from the access slot. Real-time clock information will be lost when the battery is removed.
4. Note the orientation (polarity) of the battery in the tray or refer to the battery polarity label (Figure 28-1) on the DECS-450 side panel. The new battery must be installed with the same orientation.

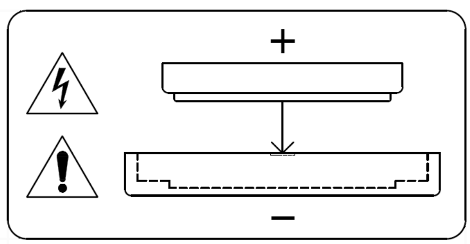


Figure 28-1. Shock Hazard and Battery Polarity Label

5. Remove the battery from the tray and dispose of properly or recycle.

Note

The battery should be disposed of properly. Consult your local health, solid waste disposal, or recycling agency for battery disposal guidelines.

6. Place the new battery into the battery tray. Ensure that the polarity of the installed battery is correct (+ to + and – to –).
7. Slide the battery tray into battery access slot until fully seated.
8. Place the DECS-450 back in service by observing all applicable safety and startup procedures.
9. Set the DECS-450's real-time clock.

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-450, first check the programmable settings for the appropriate function.

The DECS-450 Appears to be Inoperative

If the DECS-450 does not power up (no backlighting on front panel display), ensure that the control power applied to the unit is at the correct level (ac terminals: L and N, dc terminals: BATT+ and BATT–). If dc control power is used, verify that the polarity is correct. Units with style number XLXXXXX have an input voltage range of 16 to 60 Vdc. Units with style number XCXXXXX have an input voltage range of 90 to 150 Vdc or 82 to 132 Vac (50/60 Hz).

Note

When 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-450.

Display is 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-450 settings for the following system configurations:

a. Generator potential transformer (PT) primary voltage
b. Generator PT secondary voltage
c. Analog control output signal type

Check the DECS-450 soft start settings:

d. Maximum field flash dropout time
e. Field flash dropout level
f. Generator soft start bias
g. Generator soft start time

Check the external field flashing components:

h. Field flashing contactor
i. Field flashing power source fuses
j. Field flashing current limiting resistor values

If the generator voltage still does not build, increase the soft start setting values in paragraphs d through f, and decrease the setting for paragraph g.

Temporarily turn off the overexcitation limiter.

Generator Voltage Builds but DECS-450 Fails To Flash

Check the DECS-450 settings for the following system configurations:

a. Generator potential transformer (PT) primary voltage
b. Generator PT secondary voltage
c. Analog control output signal type

Check the DECS-450 soft start settings:

d. Maximum field flash dropout time
e. Field flash dropout level
f. Generator soft start bias
g. Generator soft start time

If the generator voltage still does not build, increase the soft start setting values in steps d through f, and decrease the setting for paragraph g.

Temporarily turn off the overexcitation limiter.

Check the exciter power circuitry: rectifier bridge, firing circuit, and power input transformer.

If the problem persists, contact Basler Electric.

Field Voltage or Current Reading Does Not Change

Check the status of the Loss of Field Isolation Transducer alarm and ensure it is enabled.

Check the connections and polarity between the Field Isolation Transducer and the DECS-450.

Check the connections and polarity between the Field Isolation Transducer and shunt (field current sensing) and between the Field Isolation Transducer and the output of the exciter (field voltage sensing).

Low Generator Voltage in AVR Mode

Check the following DECS-450 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. Underfrequency or V/Hz limiters (not activated)

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

High Generator Voltage in AVR Mode

Check the following DECS-450 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)

Switch into FCR operation mode. If the generator voltage becomes stable, check AVR gains.

If the problem persists, contact the Basler Electric Technical Sales Support department for advice.

Poor Voltage Regulation

Poor voltage regulation may result from insufficient K_a loop gain. Increase the AVR loop gain accordingly.

No Buildup in FCR Mode

Low K_a loop gain may hinder buildup when operating in FCR mode.

No Control Signal at Firing Circuit Input

Ensure that the *Control Output Disable* logic element is not inhibiting the control output.

Check the control signal setting and output of the DECS-450. Depending on the signal selected, the DECS-450 produces a 0 to 10 Vdc, 4 to 20 mAdc, or –10 to +10 Vdc control signal.

Limiters Do Not Limit at the Desired Level

Insufficient K_g loop gain for the limiters may hinder limiter operation. Increase the limiter loop gain accordingly.

Poor Reactive Control

Poor reactive control may result if the AVR droop setting is too low. Adjust the AVR droop accordingly.

Protection or Limiter 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.

Meter Readings Incorrect

If PF, var, or watt readings are significantly different from the expected readings for a known load, verify proper PT and CT connections and phase relationship.

No Communication

If communication with the DECS-450 cannot be initiated, check the connections at the communication ports, the baud rate, and supporting software.

Real-Time Clock Information Lost After Loss of Control Power

A loss of real-time clock information indicates a depleted backup battery. See *Backup Battery Replacement,* above, for the battery replacement procedure.

The DECS-450 Reboots Frequently

Check the status of the Control Power Input Failure alarm.

If a single DECS-450 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-450 will reboot. Increase the control power source voltage so that it is within the specified operating range. Units with style number XLXXXXX have an input voltage range of 16 to 60 Vdc. Units with style number XCXXXXX have an input voltage range of 90 to 150 Vdc or 82 to 132 Vac (50/60 Hz).

USB Drivers Failed to Install Automatically

Perform the following steps to manually install the DECS-450 USB drivers.

1. In the Windows Device Manager, under Other Devices, right-click on DECS-450 and select Properties. The Properties window appears. (If the DECS-450 is displayed as an “Unknown Device”, restart the PC and repeat this step.)
2. In the Properties window, click the Update Driver button on the Driver tab.
3. Select “Browse my computer for driver software”.
4. Click Browse and navigate to the following directory: C:\Program Files\Basler Electric\USB Connect Driver\.
5. Click Next to install the drivers.

Support

Contact the Basler Electric Technical Services Department at +1 (618) 654-2341 for troubleshooting support or to receive a return authorization number.

29 • Specifications

DECS-450 electrical and physical characteristics are listed in the following paragraphs.

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.

AC Input (Style XCXXXXX only)

Nominal .... 120 Vac
Range.. 82 to 132 Vac
Frequency .... 50/60 Hz
Burden... 50 VA
Terminals... L, N

DC Input (Style XCXXXXX, XLXXXXX)

Nominal
  Style XCXXXXX......................... 125 Vdc
  Style XLXXXXX .... 24/48 Vdc
Range
  Style XCXXXXX......................... 90 to 150 Vdc
  Style XLXXXXX .... 16 to 60 Vdc
Burden... 35 W
Terminals... BATT+, BATT–

Generator and Bus Voltage Sensing

Nominal Input .... 100/200 Vac (50 Hz), 120/240 Vac (60 Hz)
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

50/60 Hz Sensing Voltage Nominal Input Range

90 to 264 Vac

Generator Current Sensing

Configuration................................... 4 inputs: A-, B-, C-phase, and cross-current compensation CT input
Type .... 1-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............................ <1 VA
  5 Aac Sensing............................ <1 VA

Terminals

A-Phase... CTA (terminals 75 and 76)
B-Phase... CTB (terminals 77 and 78)
C-Phase .... CTC (terminals 79 and 80)
Cross-Current Compensation .... CCCT (terminals 81 and 82)

Field Voltage and Current Sensing

The DECS-450 receives field voltage and current signals from the Field Isolation Transducer (supplied). The Field Isolation Transducer transmits field voltage and current signals through a dedicated cable terminated at the DECS-450 rear panel Field Isolation Transducer connector. See *Field Isolation Transducer*.

Field Isolation Transducer

Electrical Specifications

Operating Power .... +5 Vdc, ±12 Vdc from DECS-450
Sensing Ranges
Field Voltage .... ±300% of the five nominal ranges: 63 Vdc, 125 Vdc, 250 Vdc, 375 Vdc, and 625 Vdc
Field Current .... 0 to 300% of the two nominal shunt ranges: 50 mVdc and 100 mVdc
Signal Output
Field Voltage .... 0.9 to 9.1 Vdc (5.0 Vdc = zero field voltage)
Field Current .... 2.0 to 9.5 Vdc (2.0 Vdc = zero field current)

Physical Specifications

Temperature
Operating .... –40 to 60 °C (–40 to 140°F)
Storage .... –40 to 85°C (–40 to 185°F)
Weight .... 680 g (1.5 lb)
Size .... Refer to the *Mounting* section for Field Isolation Transducer dimensions.

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–

Metering Accuracy

Generator and Bus Voltage .... ±1% of rated over nominal range
The greater of ±0.5% of reading or ±0.1% of full range at 25°C
Generator and Bus Frequency .... ±0.1 Hz over range
Generator Line Current .... ±1% of rated over nominal range
Power Quantities .... ±1% of rated
Power Factor .... ±0.02
Field Current and Voltage .... ±2% of nominal range
Accessory Input .... ±1% of range
The greater of ±0.5% of reading or ±0.1% of full range at 25°C

Control Output

Range .... 0 to 10 Vdc, –10 to +10 Vdc, or 4 to 20 mAdc
Terminals .... CTRL+, CTRL–

Minimum/Maximum Impedance

Current Output .... ≤800 Ω
Voltage Output .... ≥1 kΩ

Meter Driver Outputs

Four analog outputs, each configurable to provide a 0 to 10 Vdc, –10 to +10 Vdc, or 4 to 20 mAdc signal.

Minimum/Maximum Impedance

Current Output .... ≤800 Ω
Voltage Output .... ≥1 kΩ

Terminals.. M1+, M1–, M2+, M2–, M3+, M3–, M4+, M4–

Contact Inputs

Type .... Dry contact, accept PLC open-collector outputs
Interrogation Voltage........................ 12 Vdc

Terminals

Start.. START, COM
Stop .... STOP, COM
Programmable Input 1...................... IN 1, COM
Programmable Input 2...................... IN 2, COM
Programmable Input 3...................... IN 3, COM
Programmable Input 4...................... IN 4, COM
Programmable Input 5...................... IN 5, COM
Programmable Input 6...................... IN 6, COM
Programmable Input 7...................... IN 7, COM
Programmable Input 8...................... IN 8, COM
Programmable Input 9...................... IN 9, COM
Programmable Input 10.................... IN 10, COM
Programmable Input 11.................... IN 11, COM
Programmable Input 12.................... IN 12, COM
Programmable Input 13.................... IN 13, COM
Programmable Input 14.................... IN 14, COM

Communication Ports

Controller Area Network (CAN)

Type .... SAE J1939 message protocol
Interface .... Spring (style XXXXXXS) or compression (style XXXXXXC) type terminals
Location... Rear 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

Ethernet, Copper (style XXXXXTX)

Type 100BASE-TX
Interface .... RJ45 jack
Location... Rear panel

Ethernet, Fiber Optic (style XXXXXFX)

Type .... 100BASE-FX, multimode
Interface .... ST type connectors for RX and TX BNC style male connectors
Maximum Length (Full-Duplex)........ 6,562 ft. (2,000 m)
Location... Rear panel

PROFIBUS

Type .... PROFIBUS DP (Decentralized Peripherals)
Interface .... DB-9 connector
Location... Rear panel

RS-232

Type .... RS-232 (for external autotracking)
Interface .... DB-9 connector
Location... Rear panel

RS-485

Type .... RS-485, half duplex
Interface .... Spring (style XXXXXXS) or compression (style XXXXXXC) type terminals
Location... Rear panel
Terminals... RS-485 A, B, C

Universal Serial Bus (USB)

Interface .... USB type B port
Location... Front panel

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 kΩ at 3.5 Vdc, 3 kΩ 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

Regulation

In regulation modes that rely upon the monitoring of the generator terminal voltage, the DECS-450 senses and responds to the measured rms voltage.

FCR Operating Mode

Setpoint Range .... 0 to 120% of rated continuous field current, in 0.01 ampere increments
Regulation Accuracy .... ±1.0% for a 10% change in ac input power or for a 20% change in field resistance. For greater changes, regulation may be up to ±5.0%.

FVR Operating Mode

Setpoint Range .... 0 to 150% of nominal field voltage, in increments of 0.1%
Regulation Accuracy .... ±1.0% of nominal

AVR Operating Mode

Setpoint Range .... 70 to 120% of rated generator voltage, in increments of 0.1%
Regulation Accuracy .... ±0.2% over load range at rated PF with constant generator frequency and ambient temperature
Steady-State Stability .... ±0.1% at rated PF with constant generator frequency and ambient temperature
Temperature Drift .... ±0.5% between 0 and 50°C ambient temperature at constant load and generator frequency

Var Operating Mode

Setpoint Range .... 100% rated generator vars absorbing to 100% rated generator vars exporting, based on rated generator kVA and power factor.
Regulation Range .... 0 to 100% of real power over the rated generator kW range
Regulation Accuracy .... ±2.0% of rated generator kVA

Power Factor Operating Mode

Setpoint Range .... 0.5 per unit leading to 0.5 per unit lagging, in 0.001 per unit increments
Regulation Range .... 0 to 100% power factor importing and 0 to 100% power factor exporting
Regulation Accuracy .... ±0.02 per unit of the PF setpoint across the setpoint range for rated generator kW from less than 10% to 100%.

Parallel Compensation

Modes... Reactive Droop, Line Drop, and Cross-Current with CT network or Ethernet communication
Cross-Current Input Burden .... May exceed 1 VA if external balance resistors are added to the cross-current compensation circuit
Cross-Current Input Terminals......... CCCT (terminals 81 and 82)

Compensation 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

Overexcitation (24)

Inverse Time

Curve Exponent .... 0.5, 1, or 2
Pickup Range.................................. 0 or 0.5 to 6 V/Hz
Time Dial Range .... 0.0 to 9.9
Reset Dial Range .... 0.0 to 9.9

Definite Time 1 and 2

Pickup
Range... 0 or 0.5 to 6
Increment 0.01

Time Delay
Range... 0.05 to 600
Increment 0.001

Overvoltage (59) and Undervoltage (27)

Pickup

Range... 0 to 600,000 Vac
Increment .... 1 Vac
Hysteresis....................................... 2%

Time Delay

Range... 0.1 to 60 s
Increment .... 0.1 s

Loss of Sensing

Time Delay

Range... 0.1 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... 15 to 70 Hz
Increment .... 0.01 Hz

Time Delay

Time Delay Range .... 0.1 to 300 s

Increment .... 0.1 s

Voltage Inhibit
Range... 5 to 100% of rated voltage
Increment 1%

Reverse Power (32R)

Pickup
Range... 0 to 1.5 pu of rated kVA
Increment .... 0.01 pu

Time Delay
Range... 0 to 300 s
Increment .... 0.1 s

Loss of Excitation (40Q)

Pickup
Range... 0 to 1.5 pu of rated kVA
Increment 1%

Time Delay
Range... 0 to 300 s
Increment .... 0.1 s

Field Protection Functions

Field Overvoltage

Pickup
Range... 1.0 to 2.4 pu of rated field voltage
Increment .... 0.1 pu

Time Delay
Range... 0.2 to 30 s
Increment .... 0.1 s

Field Overcurrent

Pickup
Range... 0.1 to 2.0 pu of maximum rated field current
Increment .... 0.1 Adc

Inverse Time
Time Dial Range .... 0.1 to 20
Increment 0.1

Definite Time Delay
Range... 0.2 to 30 s
Increment .... 0.1 s

Field Overtemperature

Pickup
Range... 0 to 572°F (-18 to 300°C)
Increment .... 1°

Time Delay
Range... 0.1 to 60 s
Increment .... 0.1 s

Loss of Field Isolation Transducer

Time Delay
Range... 0.0 to 9.9 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 EDM ripple 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... 0.1 to 50%
Increment 0.1%

Slip Angle

Range... 1 to 99°
Increment .... 0.1°

Angle Compensation

Range... 0 to 359.9°
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

Automatic Synchronizer

Synchronizer Types .... Phase-Locked Loop, Anticipatory
Contact Output Types .... Continuous, Proportional

Voltage Window

Range... 2 to 15%
Increment 0.5%

Slip Frequency

Range... 0.1 to 0.5 Hz
Increment .... 0.05 Hz

Breaker Closing Angle

Range... 3 to 20°
Increment .... 0.5°

Sync Activation Delay

Range... 0.1 to 0.8 s
Increment .... 0.1 s

Sync Fail Activation Delay

Range... 0.1 to 600.0 s
Increment .... 0.1 s

Angle Compensation

Range... 0.0 to 359.9°
Increment .... 0.1°

Generator to Bus PT Matching Level

Range... 0 to 700%
Increment 0.001%

Voltage Matching

Accuracy.. Generator rms voltage is matched with the bus rms voltage to within ±0.5% of the generator voltage.

Power System Stabilizer (Style 1XXXXXX)

Model... IEEE Std 421.5 type PSS2A/2B/2C
Operating Mode .... Generator or Motor, ABC or ACB phase sequence
Sensing Configuration....................... Power and Speed or Speed only
Power Measurement .... Three Wattmeter method

On-Line Overexcitation Limiting

High Current Level

Pickup
Range... 0 to 12,000 Adc
Increment .... 0.01 Adc

Time
Range... 0 to 240 s
Increment .... 1 s

Middle Current Level

Pickup
Range... 0 to 12,000 Adc
Increment .... 0.01 Adc

Time
Range... 0 to 240 s
Increment .... 1 s

Low Current Level

Pickup
Range... 0 to 12,000 Adc
Increment .... 0.01 Adc

Off-Line Overexcitation Limiting

High Current Level

Pickup
Range... 0 to 12,000 Adc
Increment .... 0.01 Adc

Time
Range... 0 to 240 s
Increment .... 1 s

Low Current Level

Pickup
Range... 0 to 12,000 Adc
Increment .... 0.01 Adc

Underexcitation Limiting (UEL)

UEL is implemented through an internally-generated UEL curve or a user-defined five-point UEL curve. 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.

Reactive Power

Range... 0 to 62
Increment 0.001

Real Power

Range... 0 to 62
Increment 0.001

Stator Current Limiting (SCL)

High SCL Level

Pickup
Range... 0 to 66,000 Adc
Increment .... 0.1 Adc

Time
Range:.. 0 to 240 s
Increment: .... 0.1 s

Low SCL Level

Pickup
Range... 0 to 66,000 Adc
Increment .... 0.1 Adc

Underfrequency Limiting

Underfrequency

Corner Frequency
Range... 15 to 90 Hz
Increment .... 0.1 Hz

Slope
Range... 0 to 3
Increment 0.01

Volts per Hertz

V/Hz High
Range... 1 to 3
Increment 0.01

V/Hz Low
Range... 0 to 3
Increment 0.01

V/Hz Time
Range... 0 to 10 s
Increment .... 0.2 s

Var Limiting

Setpoint
Range... 0 to 200%
Increment 0.1%

Delay
Range... 0 to 300 s
Increment .... 0.1 s

Sequence of Events Recording (SER)

The SER scans more than 400 parameters in four-millisecond intervals and records any changes of state (events) into a record of up to 2,047 events.

Data Logging

Records consist of up to six user-selectable parameters with up to 1,200 data points per parameter and are saved in the IEEE Standard Common Format for Transient Data Exchange (COMTRADE).

Environment

Temperature

Operating Range .... –40 to +60°C (–40 to +140°F)
Storage Range .... –40 to +85°C (–40 to +185°F)

Humidity

IEC 60068-2-78 .... Tested at 40°C and 93% relative humidity

Salt Fog

IEC 60068-2-11

Type Tests

Shock

IEC 60255-21-2 Class 1

Vibration

IEC 60255-21-2 Class 1

Impulse

IEC 60255-5

Transients

IEC 61000-4-4

IEEE C37.90.1

Static Discharge

IEC 61000-4-2

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-450 was subjected to temperature tests (tested over a temperature range of –100 to +120°C (–148 to +248°F)), vibration tests (of 5 to 50 G at +20°C (68°F)), and temperature/vibration tests (tested at 50 G over a temperature range of –95 to +115°C (–139 to +239°F)). Combined temperature and vibration testing at these extremes proves that the DECS-450 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.

Physical

Dimensions...................................... Refer to the *Mounting* section.
Weight .... 4.4 kg (9.6 lb)

Regulatory Certifications and Standards

Maritime Recognition

Recognized per Standard IACS UR (section E10) by American Bureau of Shipping (ABS).

For current certificate, see www.basler.com.

UL Certification

This product is a Recognized Component (cURus) covering the US and Canada.

UL File (E97035-FPTM2/FPTM8)

Standards used for evaluation:

- ANSI/CAN/UL/ULC 6200:2019 - Standard for Controllers for Use in Power Production, First Edition, May 31, 2019

CE and UKCA Compliance

This product has been evaluated and complies with the relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives

LVD 2014/35/EU
EMC 2014/30/EU
RoHS2... 2011/65/EU as amended by (EU) 2015/863

UK Designated Standards

LVD .... SI 2016/1101
EMC .... SI 2016.1091
RoHS2... SI 2012.3032 as amended by SI 2019/492

This product conforms to the following harmonized standards:

- IEC 62477-1:2016 Ed. 1.0 and BS EN 62477-1:2012/A11:2014, Safety requirements for power electronic converter systems and equipment, Part 1: General
- IEC 61000-6-2:2016 Ed. 3.0 and BS EN 61000-6-2:2005/AC:2005, Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - immunity for industrial environments
- IEC 61000-6-4:2018 Ed. 3.0 and BS EN 61000-6-4:2007/A1:2011, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - emission standard for industrial environments
- IEC 63000:2016 Ed. 1.0 and BS EN 63000:2018, Technical documentation for assessment of electrical and electronic products with respect to restriction of hazardous substances
- IEC 62474:2018 Ed. 2.0, Material declaration for products of and for the electrotechnical industry

The *Typical Connections* section in this manual contains specific installation instructions for meeting EMC requirements.

FCC Requirements

This product complies with FCC 47 CFR Part 15.

China RoHS

The following table serves as the declaration of hazardous substances for China in accordance with PRC standard SJ/T 11364-2014. The EFUP (Environment Friendly Use Period) for this product is 40 years.

PRODUCT:	DECS-450									
零件名称 Part Name	有害物质 Hazardous Substances									
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲酸二酯 Bis(2-ethylhexyl) phthalate (BEHP)	邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)
金属零件 Metal parts	O	O	O	O	O	O	O	O	O	O
聚合物 Polymers	O	O	O	O	O	O	O	O	O	O
电子产品 Electronics	X	O	O	O	O	O	O	O	O	O
电缆和互连配件 Cables & interconnect accessories	X	O	O	O	O	O	O	O	O	O
绝缘材料 Insulation material	O	O	O	O	O	O	O	O	O	O

本表格依据 SJ/T11364 的规定编制。

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

This form was prepared according to the provisions of standard SJ/T11364.

O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26252.

X: Indicates that the hazardous substance content in at least one of the homogenous materials of this part exceeds the limit specified in standard GB/T 26572.

30 • Analog Expansion Module

General Information

The optional AEM-2020 is a remote auxiliary device that provides additional DECS-450 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).............±0.044 Ω @ 25°C, ±0.005 Ω/°C drift over ambient temperature
Accuracy (100 Ω Platinum).........±0.39 Ω @ 25°C, ±0.047Ω/°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....................................±40uV @ 25°C, ±5 uV/°C drift over ambient temperature

Analog Outputs

The AEM-2020 contains four programmable analog outputs.

Rating ....4 to 20 mA or -10 to 10 Vdc (user-selectable)

Communication Interface

The AEM-2020 communicates with the DECS-450 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* section 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

Agency, Standards, and Directives

UL Approval

The AEM-2020 is a Recognized Component for the US and Canada under UL file E97035

(CCN-FTPM2/FTPM8) covered under the Standards below:

- UL 6200:2019
- CSA C22.2 No.14-13

The AEM-2020 is a Recognized Component for the US and Canada under UL file E470837

(CCN-FTWD2/FTWD8) for use in Hazardous Locations:

- Class I Division 2
- Groups A, B, C & D

CE and UKCA Compliance

This product has been evaluated and complies with relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives

LVD 2014/35/EU
EMC 2014/30/EU
RoHS2.......................................2011/65/EU as amended by (EU) 2015/863

UK Designated Standards

LVD ....SI 2016/1101
EMC ....SI 2016.1091/30/EU
RoHS2.......................................SI 2012.3032 as amended by SI 2019/492

This product conforms to the following harmonized standards:

- BS EN 50178:1997, Electronic equipment for use in power installations
- BS EN 61000-6-2:2005/AC:2005, Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - immunity for industrial environments
- BS EN 61000-6-4:2007/A1:2011, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - emission standard for industrial environments
- IEC 63000:2016 Ed. 1.0 and BS EN 63000:2018, Technical documentation for assessment of electrical and electronic products with respect to restriction of hazardous substances
- IEC 62474:2018 Ed. 2.0, Material declaration for products of and for the electrotechnical industry

FCC Requirements

This product complies with FCC 47 CFR Part 15.

Maritime Recognition

American Bureau of Shipping (ABS) – for current certificates, see www.basler.com.

China RoHS

The following table serves as the declaration of hazardous substances for China in accordance with PRC standard SJ/T 11364-2014. The EFUP (Environment Friendly Use Period) for this product is 40 years.

PRODUCT:	AEM-2020									
	有害物质 Hazardous Substances									
零件名称 Part Name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲酸二酯 Bis(2-ethylhexyl) phthalate (BEHP)	邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)
金属零件 Metal parts	O	O	O	O	O	O	O	O	O	O
聚合物 Polymers	O	O	O	O	O	O	O	O	O	O
电子产品 Electronics	X	O	O	O	O	O	O	O	O	O
电缆和互连配件 Cables & interconnect accessories	X	O	O	O	O	O	O	O	O	O
绝缘材料 Insulation material	O	O	O	O	O	O	O	O	O	O
本表格依据 SJ/T11364 的规定编制。 O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。										

PRODUCT:	AEM-2020									
	有害物质 Hazardous Substances									
零件名称 Part Name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲酸二酯 Bis(2-ethylhexyl) phthalate (BEHP)	邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)
X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。 This form was prepared according to the provisions of standard SJ/T11364. O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26252. X: Indicates that the hazardous substance content in at least one of the homogenous materials of this part exceeds the limit specified in standard GB/T 26572.										

Physical

Weight ....1.80 lb (816 g)
Dimensions.................................See *Installation* below.

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 30-1 for AEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

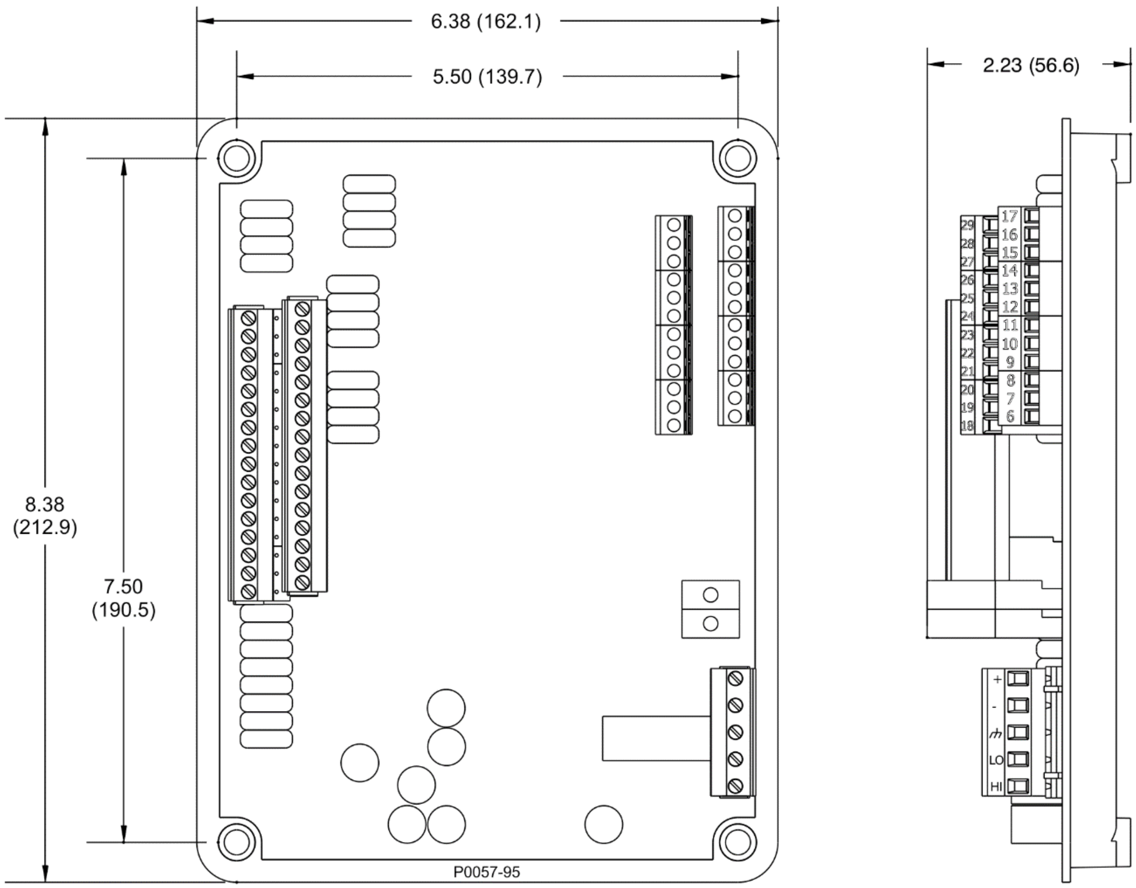


Figure 30-1. AEM-2020 Overall Dimensions

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-2020 will not operate.
> Be sure that the AEM-2020 is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the chassis ground terminal on the module.
>
> It is recommended to minimize the vibration load on the connector plug by ensuring that wires are well-constrained, with no more than 6 to 8 inches of unconstrained wire length near the connector plugs.

Terminations

The terminal interface consists of both plug-in connectors and a permanently mounted connector with screw-down compression terminals.

AEM-2020 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-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. 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 30-1.

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 30-1. 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 30-2 and listed in Table 30-2.

Table 30-2. 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

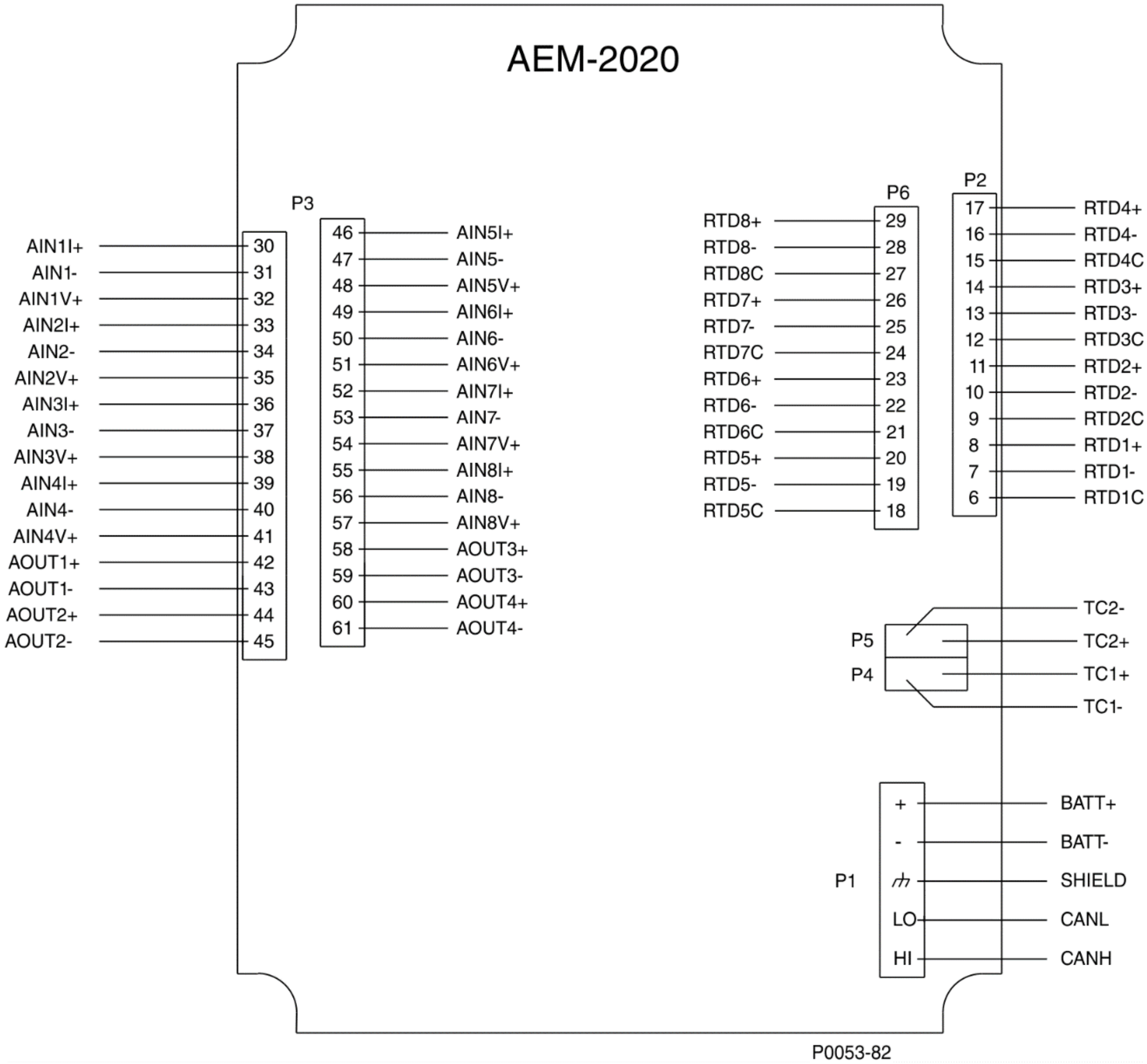


Figure 30-2. Input and Output Terminals

External Analog Input Connections

Voltage input connections are shown in Figure 30-3 and current input connections are shown in Figures 30-4 through 30-6. When using the current input, AIN V+ and AIN I+ must be tied together.

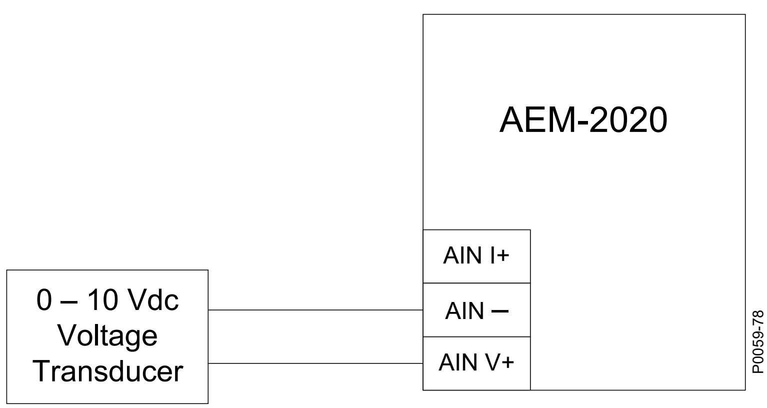


Figure 30-3. Analog Inputs - Voltage Input Connections

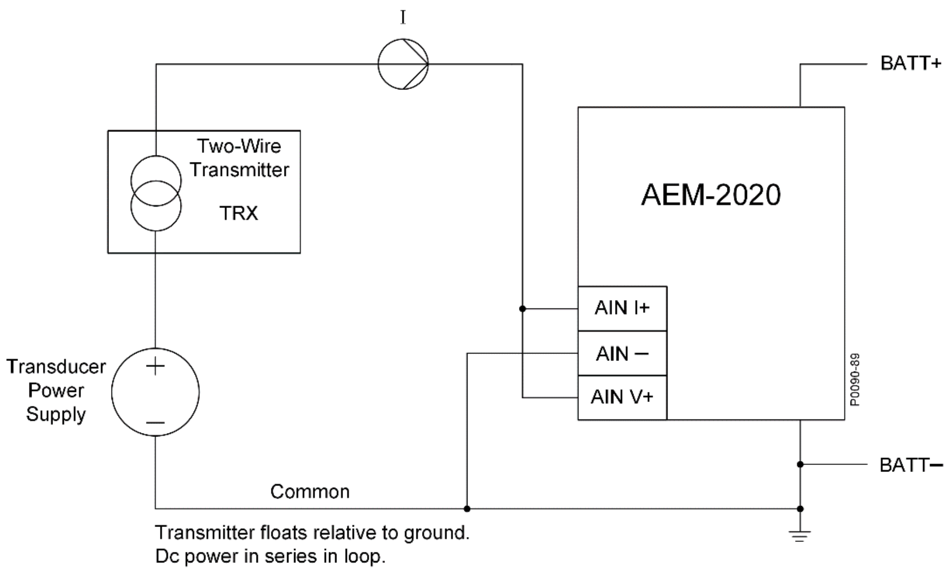


Figure 30-4. Analog Inputs - Current Input Connections, Type II 2-Wire Circuit

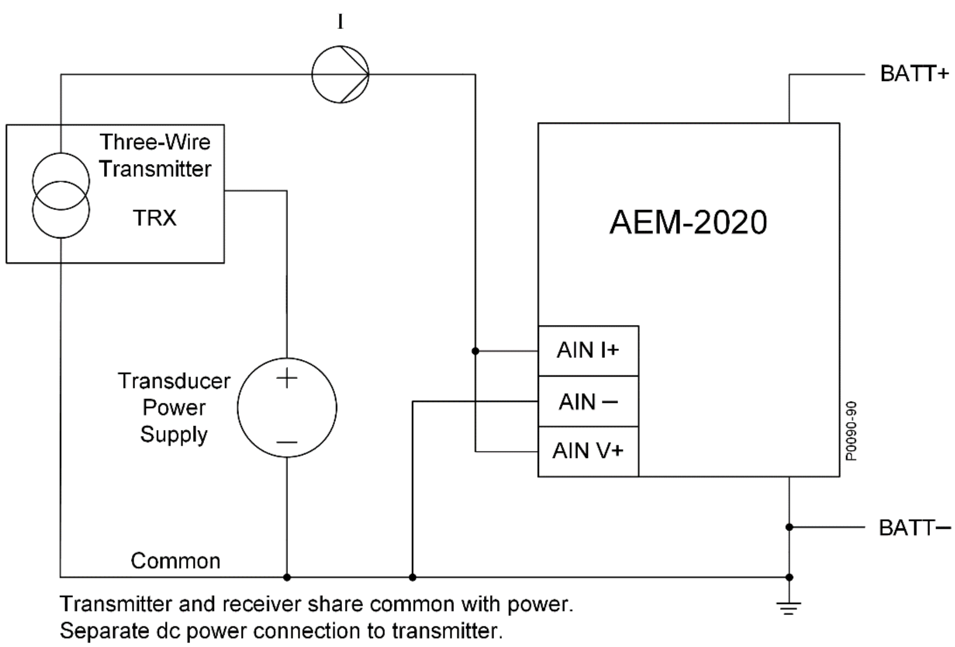


Figure 30-5. Analog Inputs - Current Input Connections, Type III 2-Wire Circuit

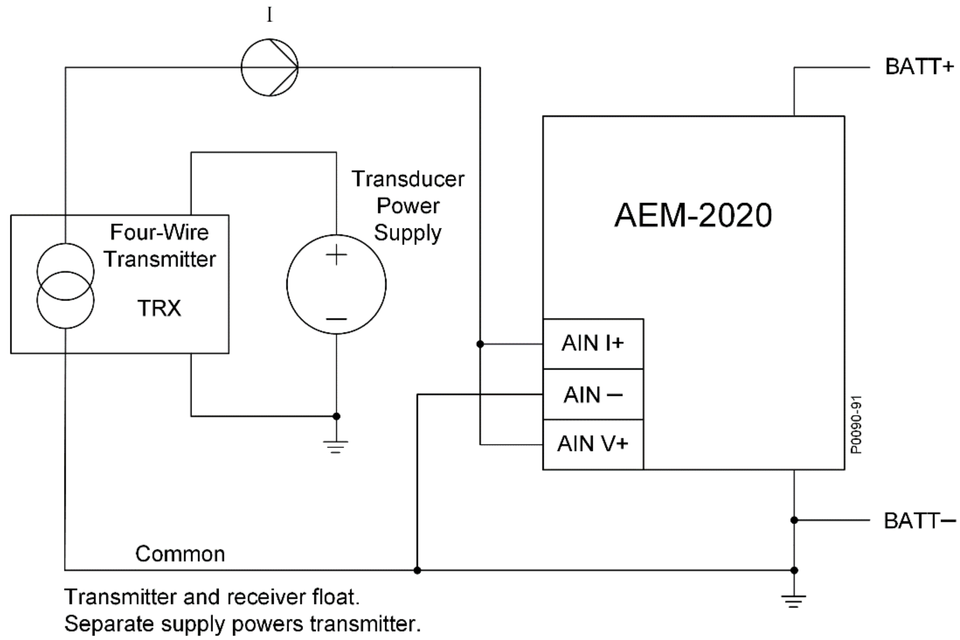


Figure 30-6. Analog Inputs - Current Input Connections, Type IV 2-Wire Circuit

External RTD Input Connections

External 2-wire RTD input connections are shown in Figure 30-7. Figure 30-8 shows external 3-wire RTD input connections. RTD cable shields should connect to ground as close to the AEM-2020 as possible with as short a lead as practical.

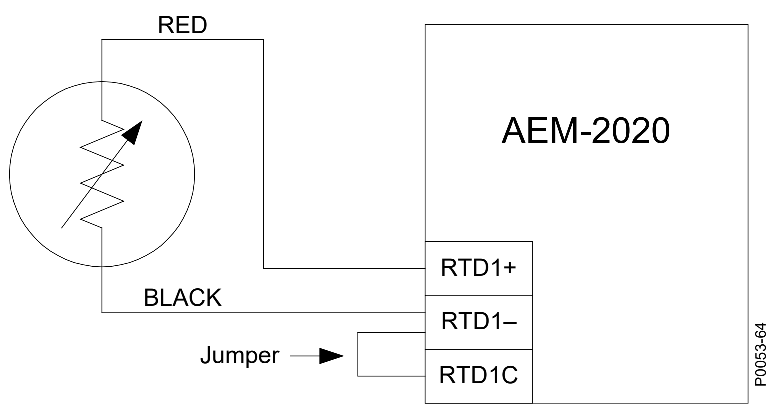


Figure 30-7. External Two-Wire RTD Input Connections

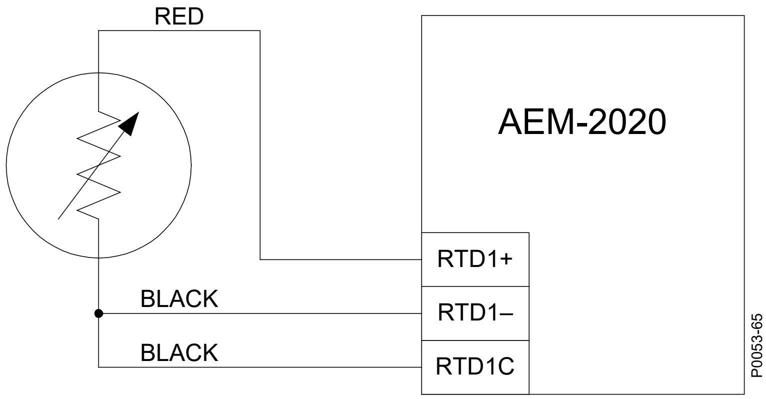


Figure 30-8. External Three-Wire RTD Input Connections

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-450. Connections between the AEM-2020 and DECS-450 should be made with twisted-pair, shielded cable. CAN Bus interface terminals are listed in Table 30-3. Refer to Figure 30-9 and Figure 30-10.

Table 30-3. 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

Notes

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.

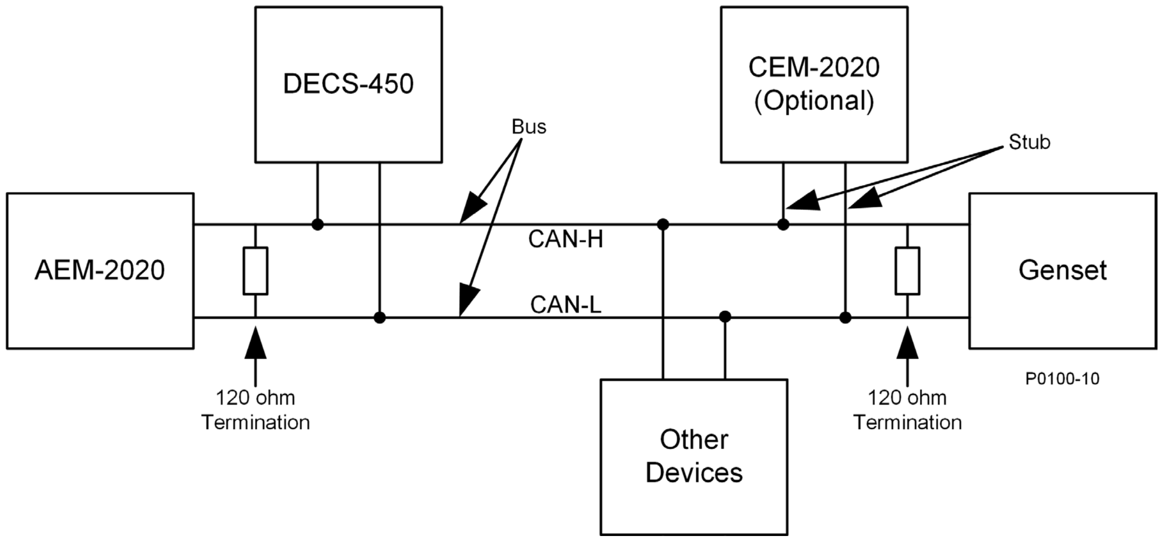


Figure 30-9. CAN Bus Interface with AEM-2020 providing One End of the Bus

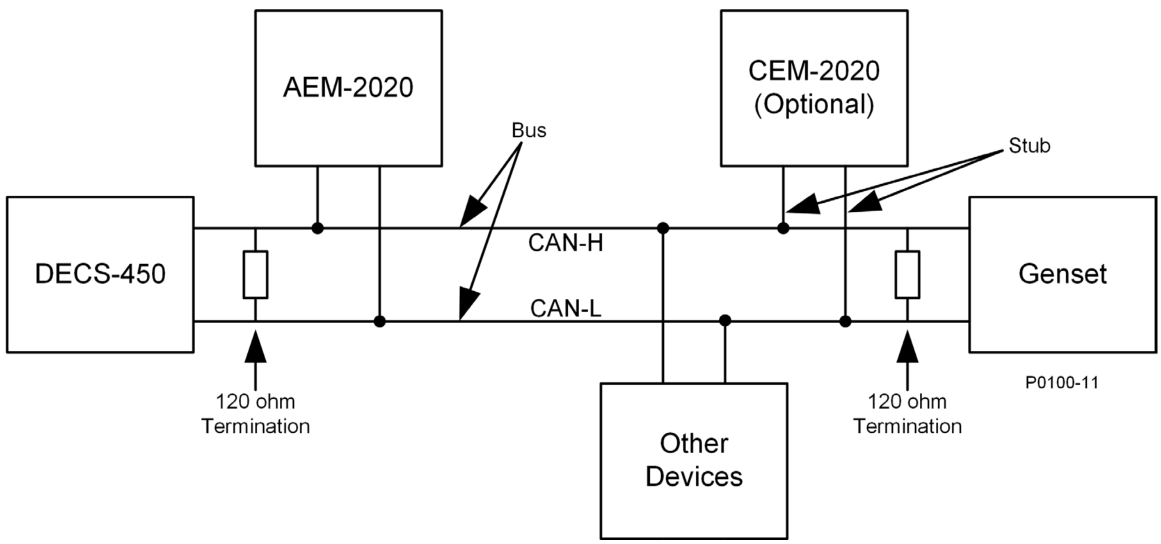


Figure 30-10. CAN Bus Interface with DECS-450 providing One End of the Bus

Communications

BESTCOMS*Plus*® 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-450. The Remote Module Setup screen is illustrated in Figure 30-11.

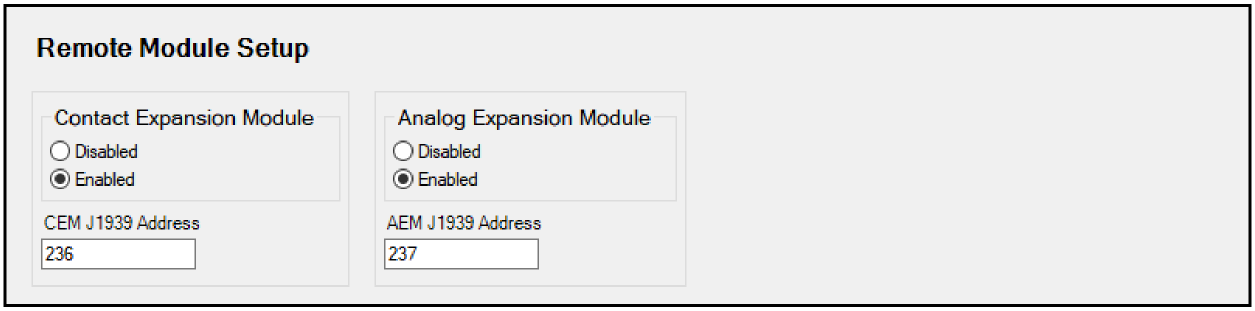


Figure 30-11. Remote Module Setup

Functional Description

Analog Inputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Inputs, Remote Analog Inputs
HMI Navigation Path: Settings, Programmable Inputs, Remote Analog Input

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 can be given to each input.

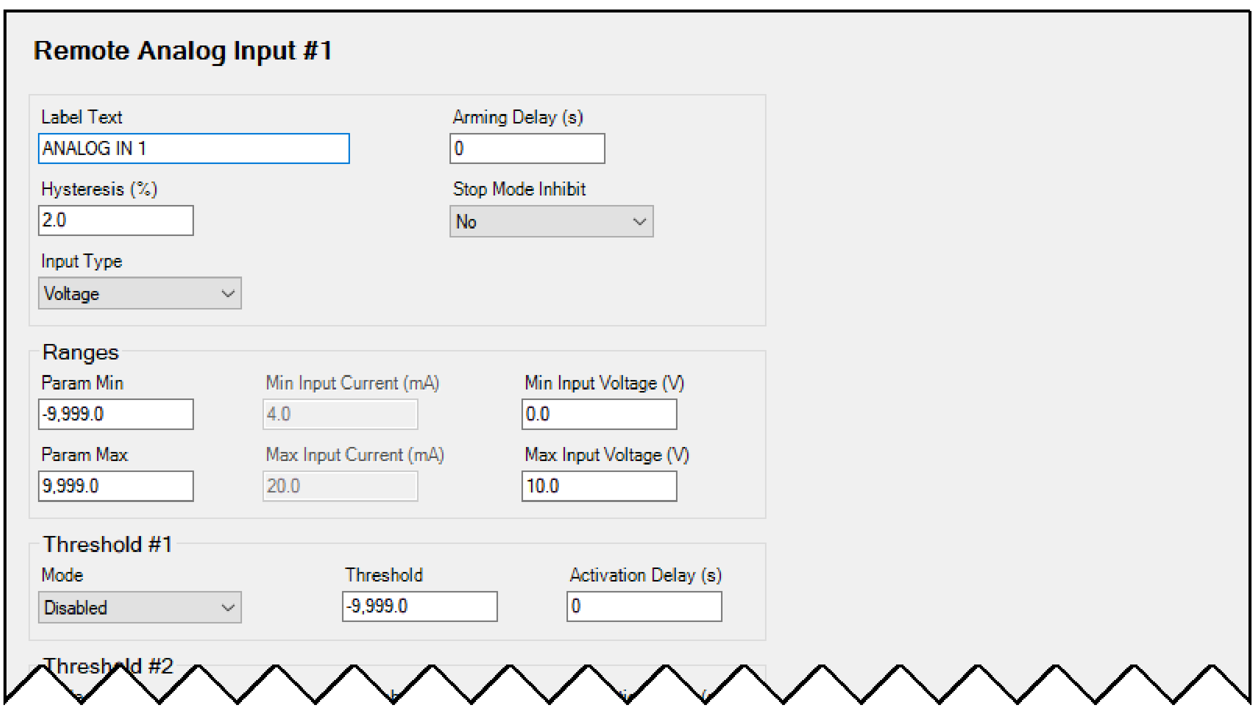


Figure 30-12. Remote Analog Input Settings

Select the input type. Select the amount of hysteresis needed to prevent rapid switching of the alarm. A user-adjustable arming delay 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 BESTCOMS*Plus*, alerts the user of an open or damaged analog input wire. When enabled, Stop Mode Inhibit turns off analog input protection when excitation is stopped.

Ranges must be set for the selected input type. Param Min correlates to Min Input Current or Min Input Voltage and Param Max correlates to Max Input Current or Max Input Voltage.

Each analog input can be independently configured for over or under mode to annunciate an alarm when the analog input signal falls beyond the threshold. Alarms are configured on the *Alarm Configuration, Alarms* screen in BESTCOMS*Plus*. A user-adjustable activation delay setting delays alarm annunciation after the threshold has been exceeded.

The remote analog inputs 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 *BESTlogicPlus* section.

BESTCOMS*Plus* settings for remote analog inputs are illustrated in Figure 30-12. Remote Analog Input #1 is shown.

RTD Inputs

BESTCOMS*Plus*® 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 can be given to each input.

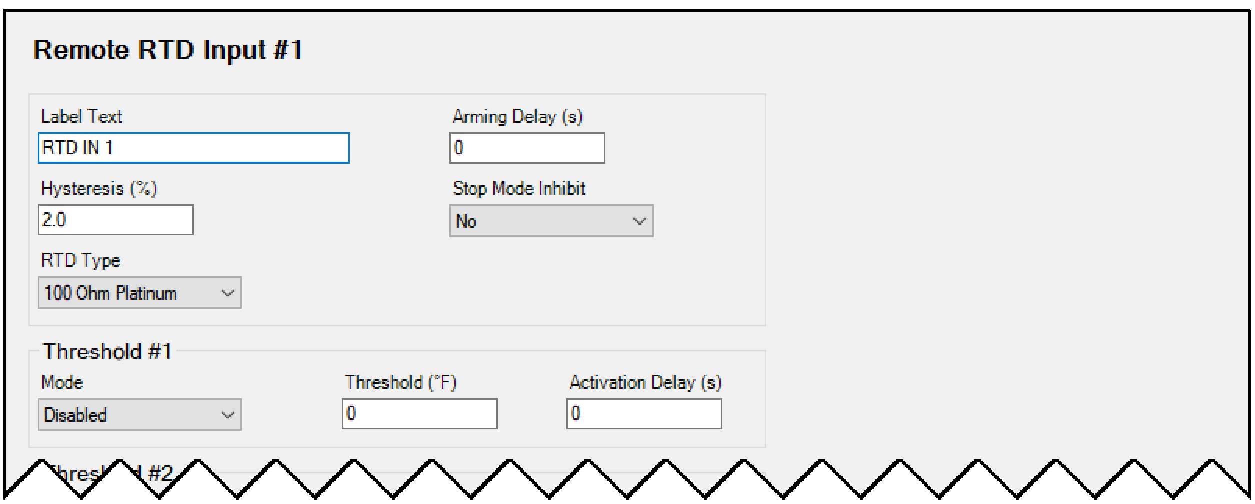


Figure 30-13. Remote RTD Input Settings

Select the amount of hysteresis needed to prevent rapid switching of the alarm. Select the RTD type. A user-adjustable arming delay 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 BESTCOMS*Plus*, alerts the user of an open or damaged RTD input wire. When enabled, Stop Mode Inhibit turns off RTD input protection when excitation is stopped.

Each RTD input can be independently configured for over or under mode to annunciate an alarm when the RTD input signal falls beyond the threshold. Alarms are configured on the *Alarm Configuration,* *Alarms* screen in BESTCOMS*Plus*. A user-adjustable activation delay setting delays alarm annunciation after the threshold has been exceeded.

The remote RTD inputs 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 *BESTlogicPlus* section.

BESTCOMS*Plus*® settings for remote RTD inputs are illustrated in Figure 30-13. Remote RTD Input #1 is shown.

Thermocouple Inputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Inputs, Remote Thermocouple Inputs
HMI Navigation Path: Settings, Programmable Inputs, Remote Thermo Input

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 can be given to each input.

Select the amount of hysteresis needed to prevent rapid switching of the alarm. A user-adjustable arming delay 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 BESTCOMS*Plus*, alerts the user of an open or damaged thermocouple input wire. When enabled, Stop Mode Inhibit turns off thermocouple input protection when excitation is stopped.

Each thermocouple input can be independently configured for over or under mode to annunciate an alarm when the thermocouple input signal falls beyond the threshold. Alarms are configured on the *Alarm Configuration, Alarms* screen in BESTCOMS*Plus*. A user-adjustable activation delay setting delays alarm annunciation after the threshold has been exceeded.

The remote thermocouple inputs 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 *BESTlogicPlus* section.

BESTCOMS*Plus*® settings for remote thermocouple inputs are illustrated in Figure 30-14. Remote Thermocouple Input #1 is shown.

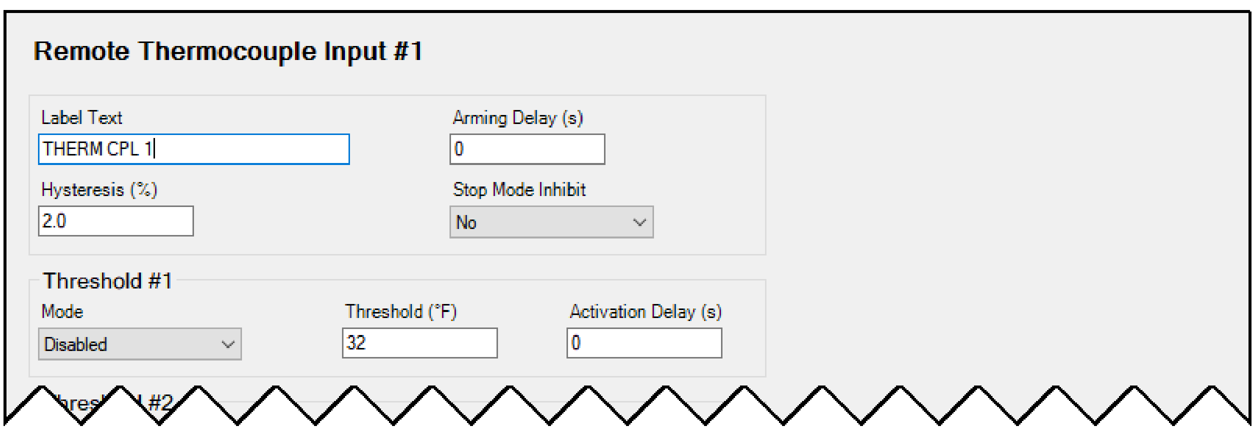


Figure 30-14. Remote Thermocouple Input Settings

Analog Outputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Outputs, Remote Analog Outputs
HMI Navigation Path: Settings, Programmable Outputs, Remote Analog Output

The AEM-2020 provides four analog outputs.

Make a parameter selection and select the output type. An out-of-range alarm configured on the *Alarm Configuration, Alarms* screen in BESTCOMS*Plus*, alerts the user of an open or damaged analog output wire. An out-of-range activation delay setting delays alarm annunciation.

Ranges must be set for the selected output type. Param Min correlates to Min Output Current or Min Output Voltage and Param Max correlates to Max Output Current or Max Output Voltage.

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 *BESTlogicPlus* section.

BESTCOMS*Plus* settings for remote analog outputs are illustrated in Figure 30-15. Remote Analog Output #1 is shown.

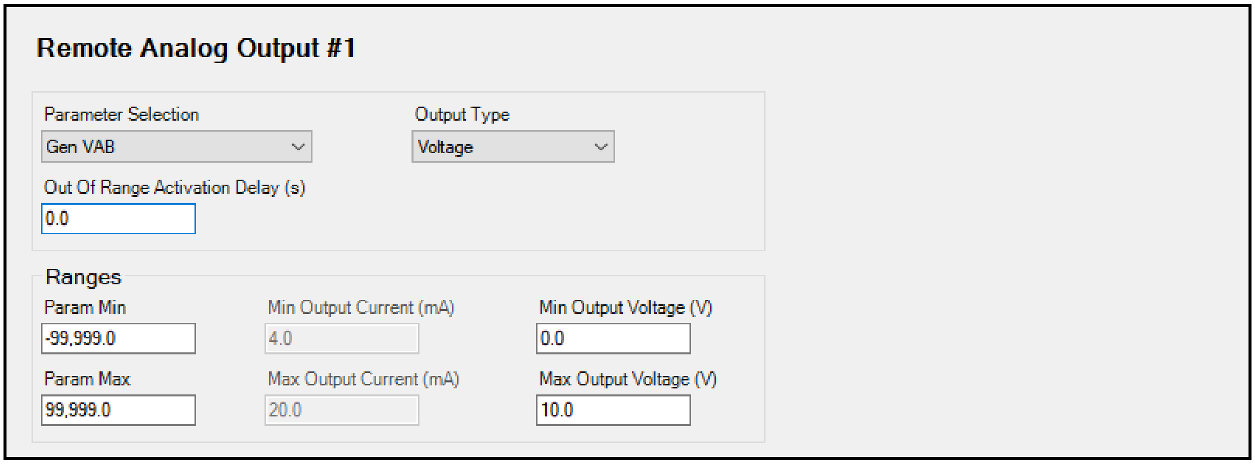


Figure 30-15. Remote Analog Output Settings

Status LED

This red LED flashes to indicate that the AEM-2020 is powered up and functioning properly. The LED lights solid during power up. When the power-up sequence is complete, this LED flashes. If the LED does not flash after power up, contact Basler Electric.

Metering

Analog Inputs

BESTCOMS*Plus*® 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 30-16. Remote Analog Input #1 is shown.

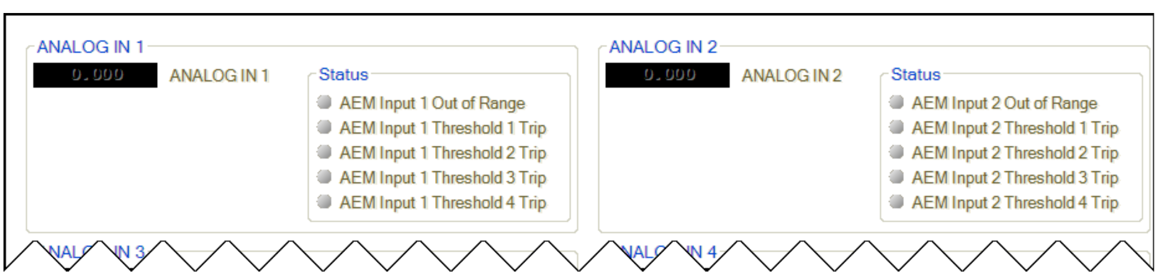


Figure 30-16. Remote Analog Inputs Metering

RTD Inputs

BESTCOMS*Plus* 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 30-17. Remote RTD Input #1 is shown.

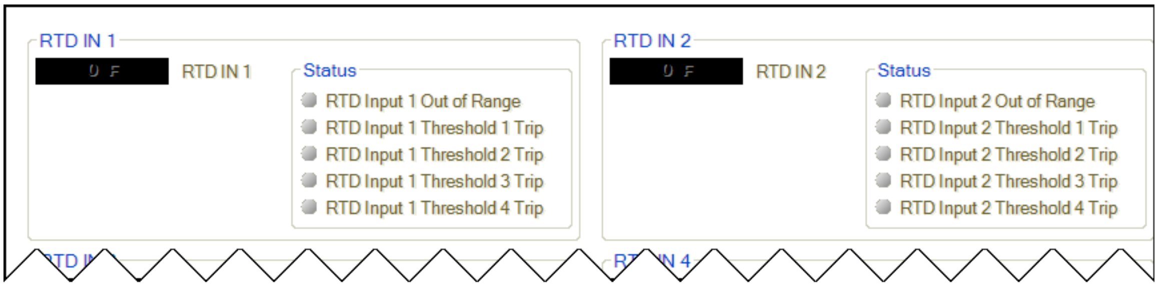


Figure 30-17. Remote RTD Inputs Metering

Thermocouple Inputs

BESTCOMS*Plus* 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 30-18. Remote Thermocouple Input #1 is shown.

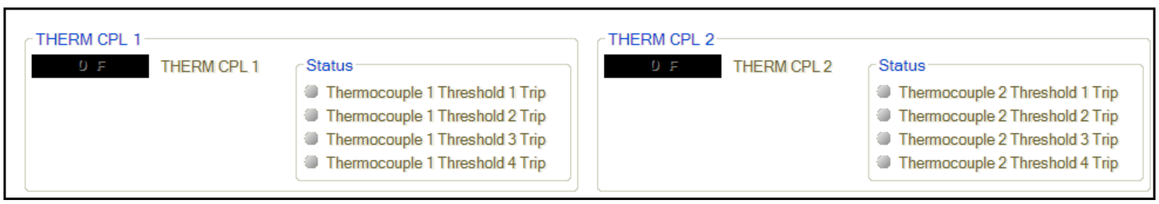


Figure 30-18. Remote Thermocouple Inputs Metering

Analog Input Values

BESTCOMS*Plus* 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 30-19.

When connected to an AEM-2020, the *Calibrate* button shown on the Remote Analog Input Values screen opens the Analog Input Temperature Calibration screen shown in Figure 30-20. This screen is used to calibrate RTD inputs 1 through 8 and thermocouple inputs 1 and 2.

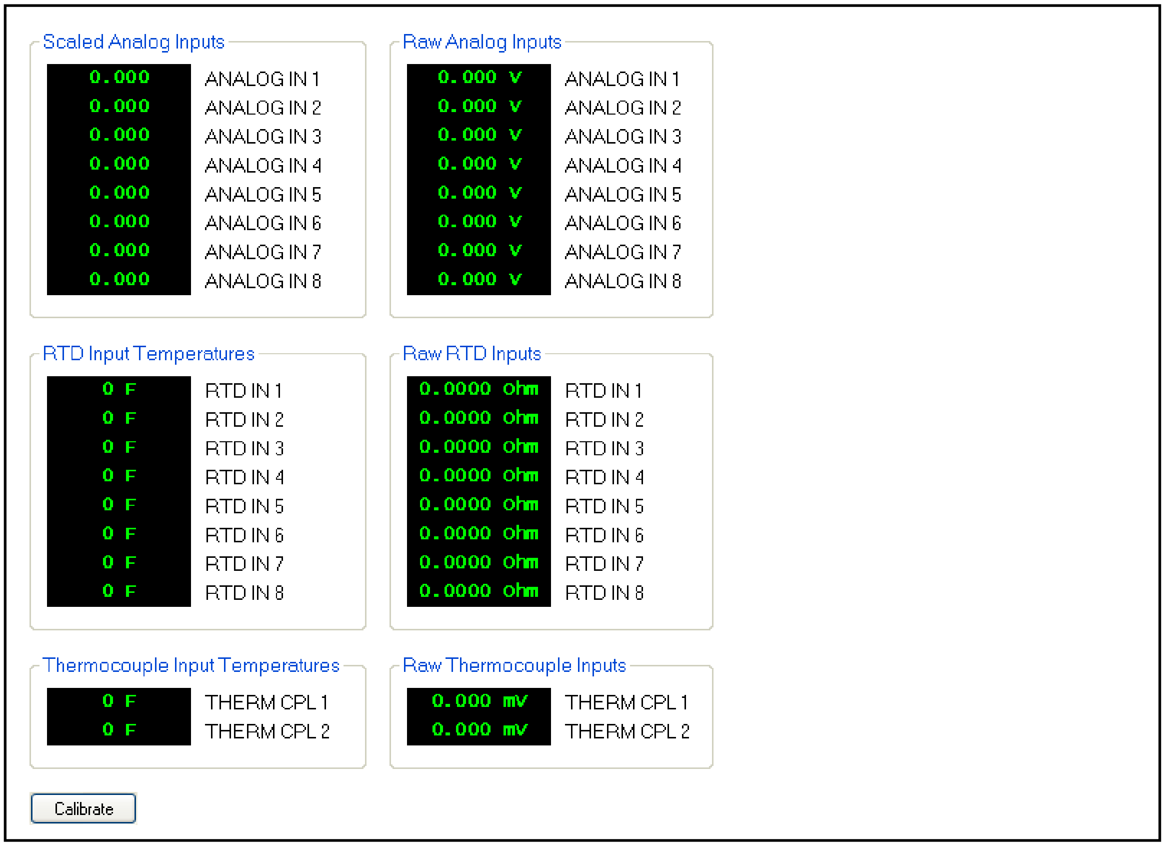


Figure 30-19. Remote Analog Input Values Metering

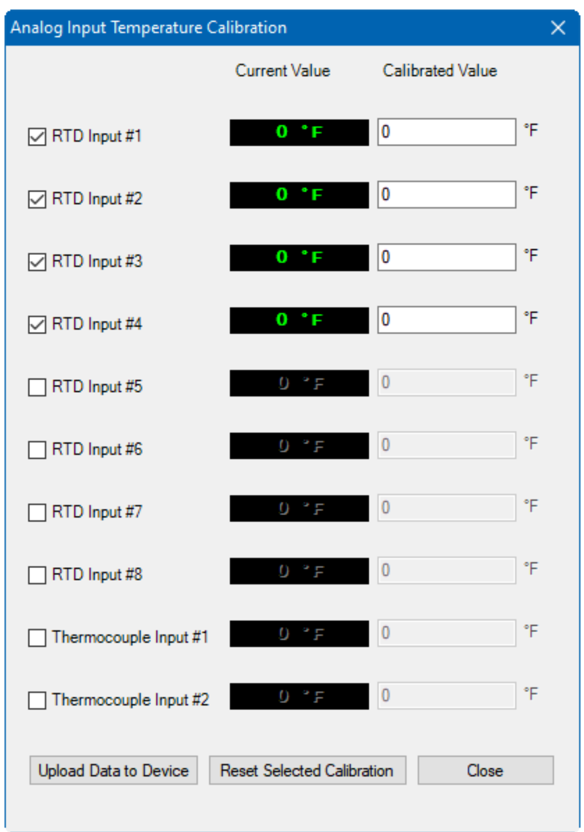


Figure 30-20. Remote Analog Input Temperature Calibration

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 30-21.

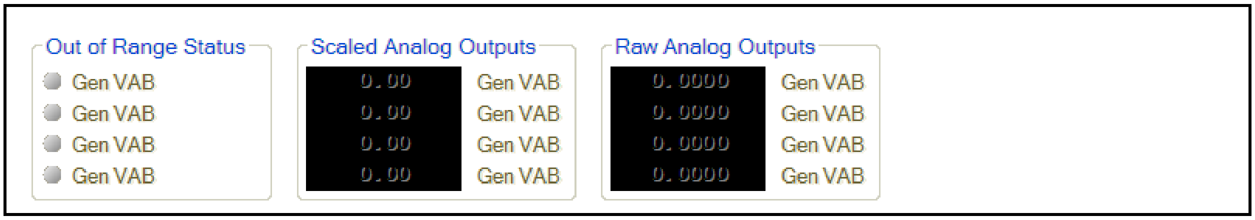


Figure 30-21. Remote Analog Outputs Metering

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*® section for instructions on updating firmware in the AEM-2020.

31 • Contact Expansion Module

General Information

The optional CEM-2020 is a remote auxiliary device that provides additional DECS-450 contact inputs and outputs.

This chapter covers the CEM-2020. For information on the CEM-125, refer to Basler publication 9636500990.

Features

CEM-2020s have the following features:

- Contact sensing inputs: 10
- Output contacts: 24
- Functionality of inputs and outputs assigned by BESTlogic™*Plus* programmable logic
- Communications via CAN Bus

Specifications

Control Power

Nominal ....12 or 24 Vdc
Range..8 to 32 Vdc (Withstands ride-through down to 6 Vdc for 500 ms.)
Burden.......................................14 W

Contact Inputs

The 14 standard programmable inputs, located on the DECS-450, are numbered 1 through 14 and the 10 programmable inputs, located on the CEM-2020, are numbered 15 through 24.

The CEM-2020 contains 10 programmable inputs that accept normally open and normally closed, dry contacts.

Contact Outputs

The 11 standard programmable outputs, located on the DECS-450, are numbered 1 through 11 and the 24 programmable outputs, located on the CEM-2020, are numbered 12 through 35.

Outputs 12 through 23 ....1 Adc at 30 Vdc, Form C, gold contacts∗
Outputs 24 through 35 ....4 Adc at 30 Vdc, Form C, 1.2 A pilot duty†

∗ Gold contacts intended for low voltage signaling to dry circuits. Not rated for inductive loads or pilot duty.
† For pilot duty, the load must be in parallel with a diode rated at least 3 times the coil current and 3 times the coil voltage.

Communication Interface

The CEM-2020 communicates with the DECS-450 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°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 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* section 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

Agency, Standards, and Directives

UL Approval

The CEM-2020 is a Recognized Component for the US and Canada under UL file E97035.

(CCN-FTPM2/FTPM8) covered under the Standards below:

- UL 6200:2019
- CSA C22.2 No.14-13

CE and UKCA Compliance

This product has been evaluated and complies with relevant essential requirements set forth by the EU legislation and UK Parliament.

EC Directives
LVD 2014/35/EU
EMC 2014/30/EU
RoHS2.......................................2011/65/EU as amended by (EU) 2015/863

UK Designated Standards
LVD ....SI 2016/1101
EMC ....SI 2016.1091/30/EU
RoHS2.......................................SI 2012.3032 as amended by SI 2019/492

This product conforms to the following harmonized standards:

- BS EN 50178:1997, Electronic equipment for use in power installations
- BS EN 61000-6-2:2005/AC:2005, Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - immunity for industrial environments

- BS EN 61000-6-4:2007/A1:2011, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - emission standard for industrial environments
- IEC 63000:2016 Ed. 1.0 and BS EN 63000:2018, Technical documentation for assessment of electrical and electronic products with respect to restriction of hazardous substances
- IEC 62474:2018 Ed. 2.0, Material declaration for products of and for the electrotechnical industry

FCC Requirements

This product is compliant with FCC 47 CFR Part 15.

Maritime Recognition

American Bureau of Shipping (ABS) – for current certificates, see www.basler.com.

China RoHS

The following table serves as the declaration of hazardous substances for China in accordance with PRC standard SJ/T 11364-2014. The EFUP (Environment Friendly Use Period) for this product is 40 years.

PRODUCT:	CEM-2020									
	有害物质 Hazardous Substances									
零件名称 Part Name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)	邻苯二甲酸二丁酯 Dibutyl Phthalate (DBP)	邻苯二甲酸丁苄酯 Benzyl butyl phthalate (BBP)	邻苯二甲酸二酯 Bis(2-ethylhexyl) phthalate (BEHP)	邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)
金属零件 Metal parts	O	O	O	O	O	O	O	O	O	O
聚合物 Polymers	O	O	O	O	O	O	O	O	O	O
电子产品 Electronics	X	O	X	O	O	O	O	O	O	O
电缆和互连配件 Cables & interconnect accessories	O	O	O	O	O	O	O	O	O	O
绝缘材料 Insulation material	O	O	O	O	O	O	O	O	O	O

本表格依据 SJ/T11364 的规定编制。

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

This form was prepared according to the provisions of standard SJ/T11364.

O: Indicates that the hazardous substance content in all homogenous materials of this part is below the limit specified in standard GB/T 26252.

X: Indicates that the hazardous substance content in at least one of the homogenous materials of this part exceeds the limit specified in standard GB/T 26572.

Physical

Weight ....2.25 lb (1.02 kg)
Dimensions.................................See *Installation* below.

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 31-1 for CEM-2020 overall dimensions. All dimensions are shown in inches with millimeters in parenthesis.

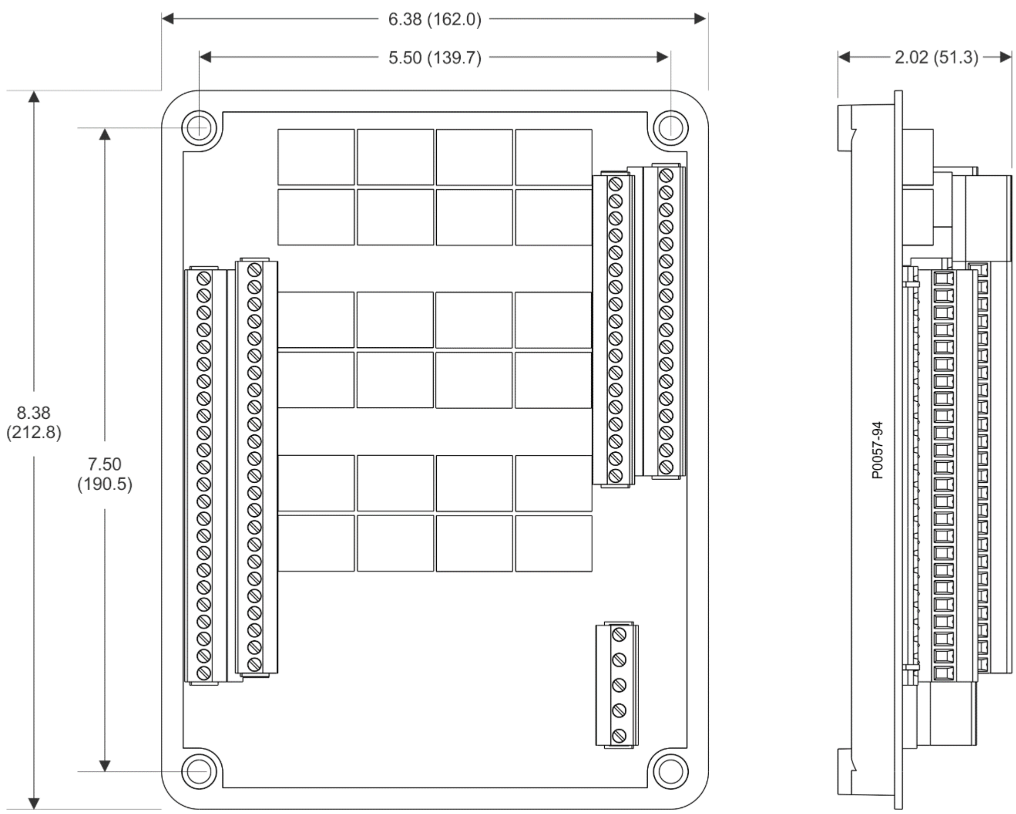


Figure 31-1. CEM-2020 Overall Dimensions

Connections

Contact Expansion Module connections are dependent on the application. Incorrect wiring may result in damage to the module.

Notes
Control 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. It is recommended to minimize the vibration load on the connector plug by ensuring that wires are well-constrained, with no more than 6 to 8 inches of unconstrained wire length near the connector plugs.

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).

Control Power

The Contact Expansion Module control power input accepts either 12 Vdc or 24 Vdc and tolerates voltage over the range of 6 to 32 Vdc. Control power must be of the correct polarity. Although reverse polarity will not cause damage, the CEM-2020 will not operate. Control power terminals are listed in Table 31-1.

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 31-1. Control Power Terminals

Terminal	Description
P1- ⏚ (SHIELD)	Chassis ground connection
P1- – (BATT–)	Negative side of control power input
P1- + (BATT+)	Positive side of control power input

Contact Inputs and Contact Outputs

The CEM-2020 (Figure 31-2) has 10 contact inputs and 24 contact outputs.

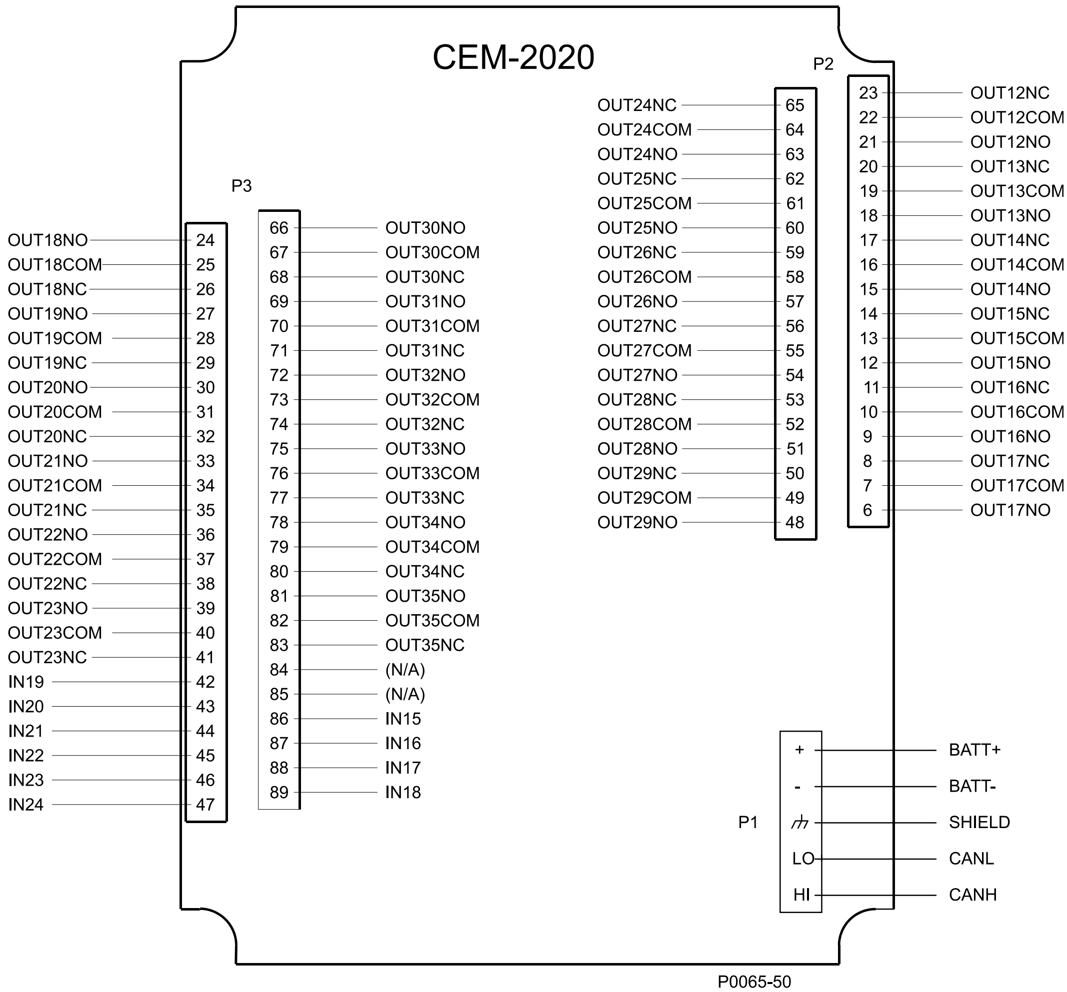


Figure 31-2. CEM-2020 Input Contact and Output Contact Terminals

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-450. Connections between the CEM-2020 and DECS-450 should be made with twisted-pair, shielded cable. CAN Bus interface terminals are listed in Table 31-2. Refer to Figure 31-3 and Figure 31-4.

Table 31-2. 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.

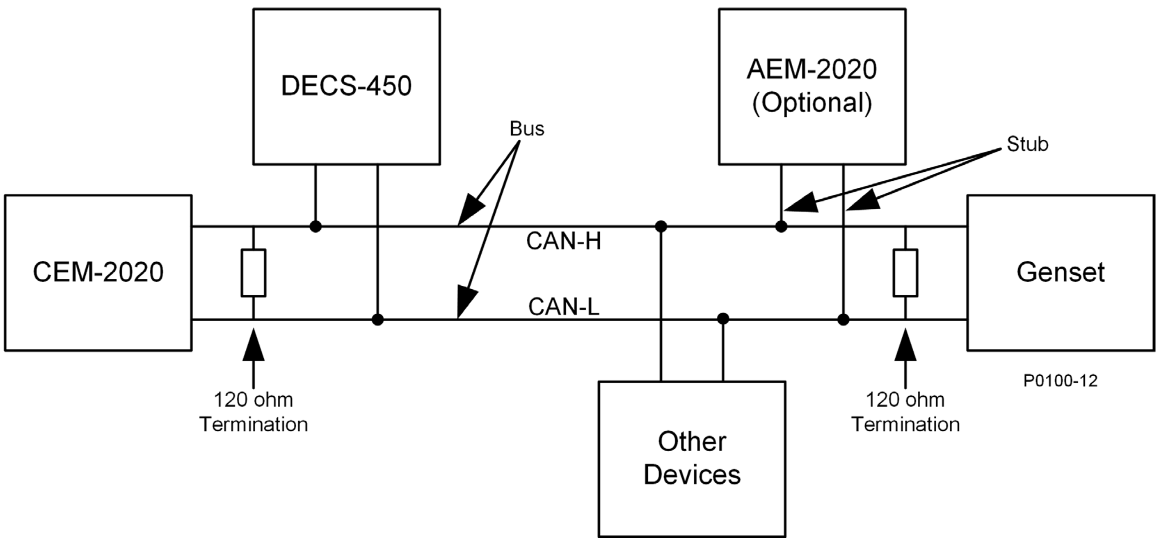


Figure 31-3. CAN Bus Interface with CEM-2020 providing One End of the Bus

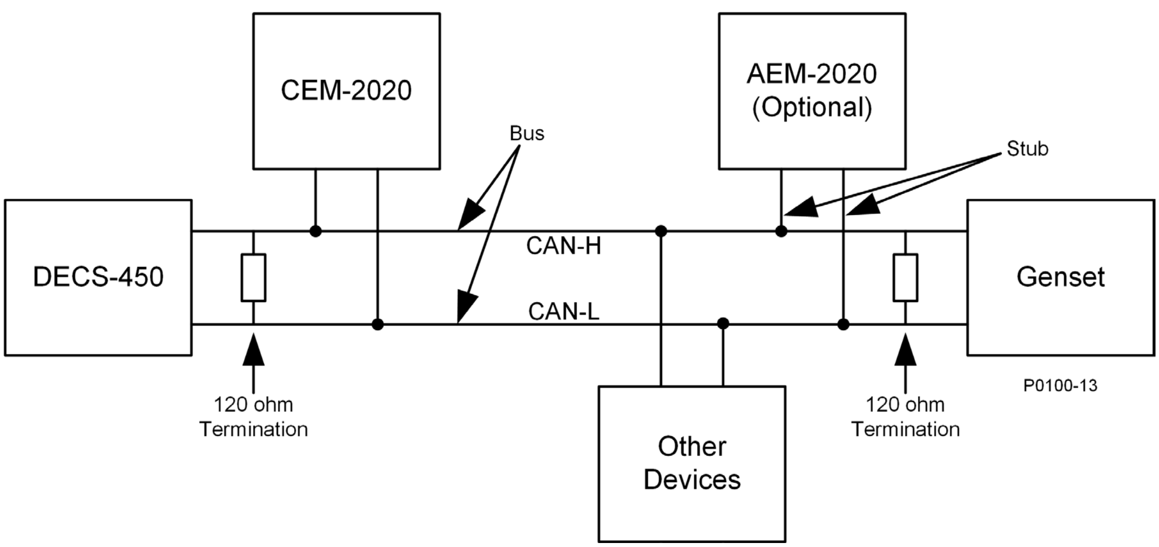


Figure 31-4. CAN Bus Interface with DECS-450 providing One End of the Bus

Communications

BESTCOMS*Plus*® 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-450. The Remote Module Setup screen is illustrated in Figure 31-5.

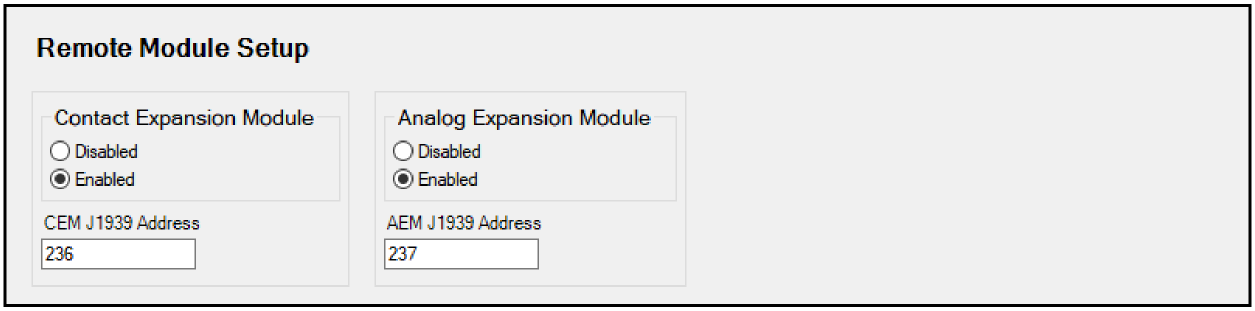


Figure 31-5. Remote Module Setup

Functional Description

Contact Inputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Inputs, Remote Contact Inputs

HMI Navigation Path: Not available through HMI.

The CEM-2020 provides 10 programmable contact inputs with the same functionality as the contact inputs on the DECS-450. 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 BESTlogic*Plus* programmable logic scheme by selecting them from the *I/O* group in BESTlogic*Plus*. For more details, refer to the BESTlogic*Plus* section.

BESTCOMS*Plus* settings for remote contact inputs are illustrated in Figure 31-6.

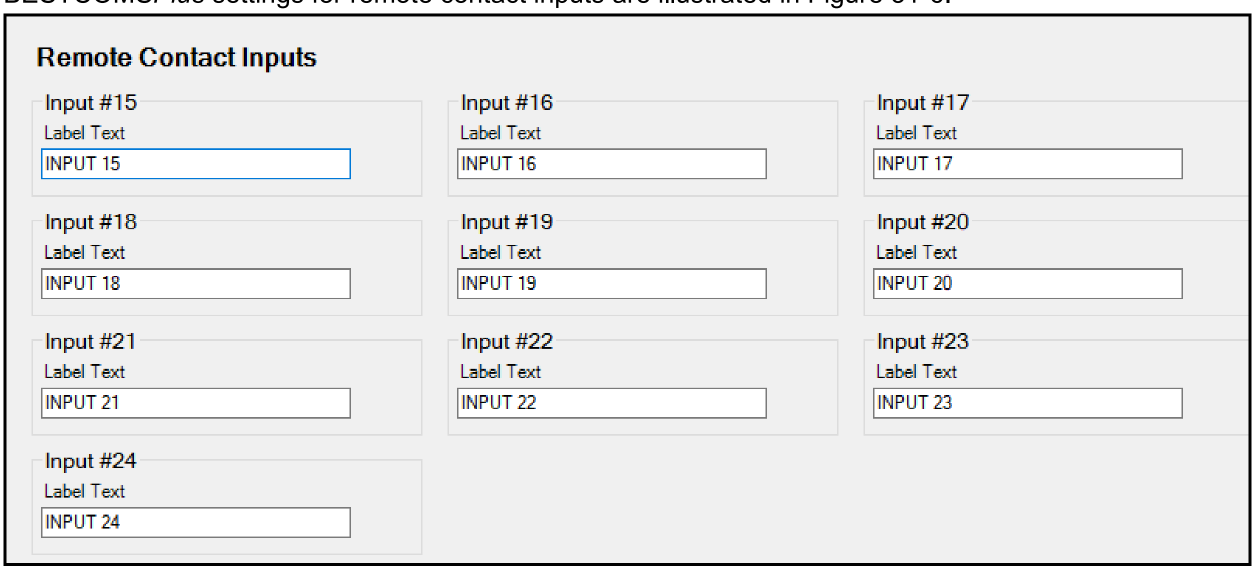


Figure 31-6. Remote Contact Inputs Settings

Contact Outputs

BESTCOMS*Plus* Navigation Path: Settings, Programmable Outputs, Remote Contact Outputs
HMI Navigation Path: Not available through HMI.

The CEM-2020 provides 24 programmable contact outputs with the same functionality as the contact outputs on the DECS-450. Outputs 12 through 23 can carry 1 A. Outputs 24 through 35 can carry 4 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* section.

BESTCOMS*Plus* settings for remote contact outputs are illustrated in Figure 31-7.

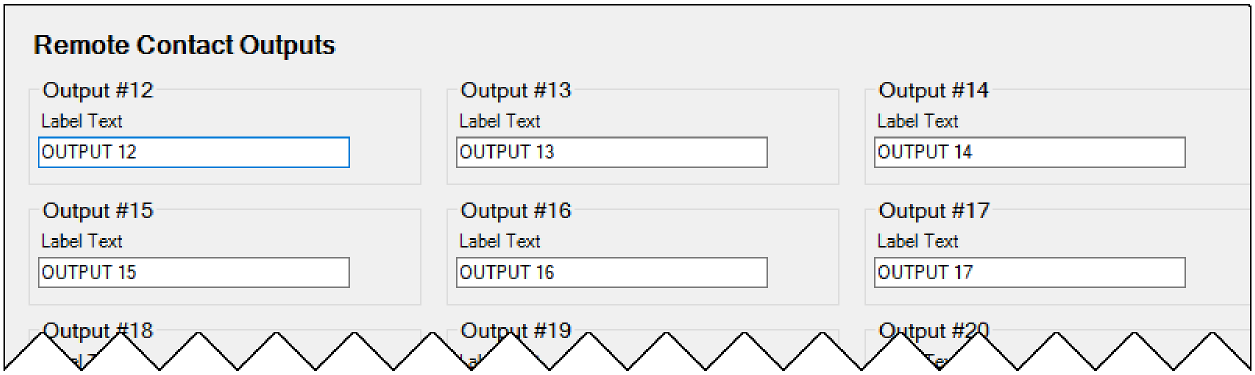


Figure 31-7. Remote Contact Outputs Settings

Status LED

This red LED flashes to indicate that the CEM-2020 is powered up and functioning properly. The LED remains lit during power up. When the power-up sequence is complete, this LED flashes. If the LED does not flash after power up, contact Basler Electric.

Metering

Contact Inputs

BESTCOMS*Plus* Navigation Path: Metering, Status, Inputs, Remote Contact Inputs
HMI Navigation Path: Metering, Status, Inputs, Remote Contact Inputs

The status of the remote contact inputs are shown on this screen. The status is TRUE when the corresponding indicator is green. Refer to Figure 31-8.

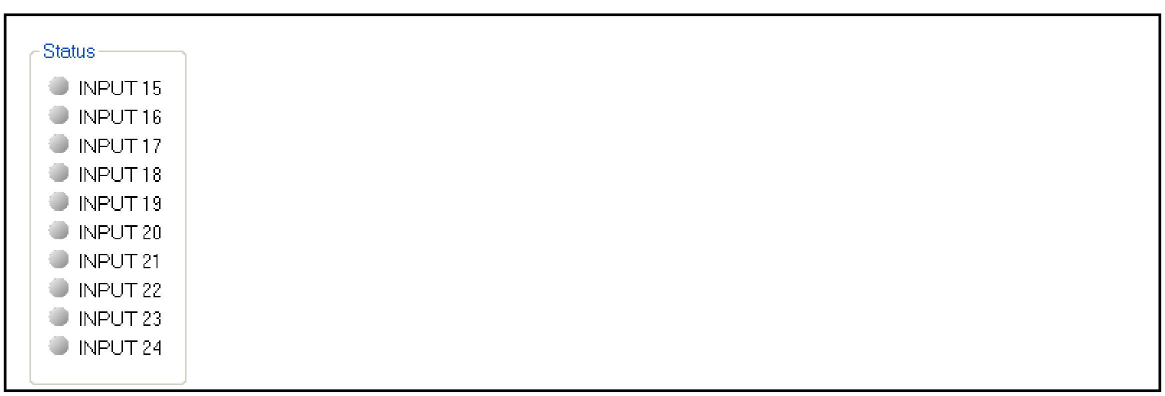


Figure 31-8. Remote Contact Inputs Metering

Contact Outputs

BESTCOMS*Plus*® Navigation Path: Metering, Programmable Outputs, Remote Contact Outputs
HMI Navigation Path: Metering, Status, Outputs, Remote Contact Outputs

The status of the remote contact outputs are shown on this screen. The status is TRUE when the corresponding indicator is green. Refer to Figure 31-9.

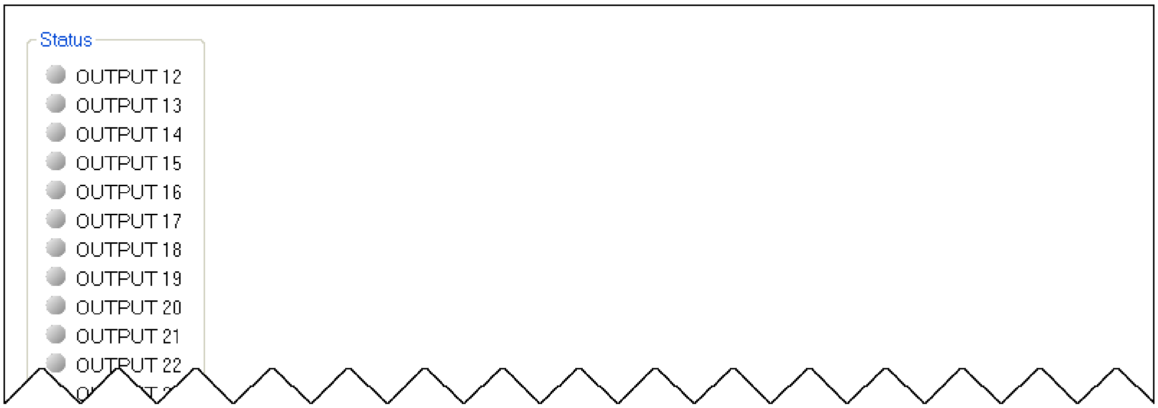


Figure 31-9. Remote Contact Outputs Metering

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*® section for instructions on updating firmware in the CEM-2020.

32 • BESTCOMS*Plus*® Settings Loader Tool

Introduction

The BESTCOMS*Plus*® Settings Loader Tool is a software application, which allows the user to instantly upload settings to Basler BESTCOMS*Plus*-compatible products by scanning a pre-registered bar code, which promotes consistency, reduces potential errors, and saves time.

Setup

The BESTCOMS*Plus* Settings Loader Tool software and a bar code reader (acquired separately) must be installed on the same PC.

BESTCOMS*Plus* Settings Loader Tool Installation

System Recommendations

BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10, and Windows 11. The BESTCOMS*Plus*® Settings Loader Tool is bundled with BESTCOMS*Plus* software. BESTCOMS*Plus* software is built on the Microsoft® .NET Framework. The setup utility that installs BESTCOMS*Plus* on your PC also installs the BESTCOMS*Plus* Settings Loader Tool and the required version of .NET Framework (if not already installed). System recommendations for the .NET Framework and BESTCOMS*Plus* are listed in Table 32-1.

Table 32-1. 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)
32/64 bit	Hard Drive	200 MB (if .NET Framework is already installed on PC)
		4.5 GB (if .NET Framework is not already installed on PC)

To install and run BESTCOMS*Plus*, a Windows user must have Administrator rights.

Installation

Note

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

1. Download BESTCOMS*Plus* from www.basler.com.
2. Click the installation button for BESTCOMS*Plus*. The setup utility installs BESTCOMS*Plus*, the .NET Framework (if not already installed), the USB driver, and the BESTCOMS*Plus* Settings Loader Tool 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 the BESTCOMS*Plus* Settings Loader Tool.

Bar Code Reader and Bar Codes

The BESTCOMS*Plus*® Settings Loader Tool is compatible with bar code readers, which conform to UnifiedPOS specifications. Bar code readers and bar code labels are not provided and must be acquired separately. Refer to the bar code reader's documentation for installation instructions.

Any bar code compatible with your bar code reader may be used.

BESTCOMSPlus® Settings Loader Tool Settings

BESTCOMS*Plus* Settings Loader Tool settings are found on two main screens, the Loader Grid and Configuration screen. The Loader Grid contains management options for the product settings files and their associated bar codes. The Configuration screen contains product-specific options for the default behavior of the BESTCOMS*Plus* Settings Loader Tool. These settings are described in the following paragraphs.

Loader Grid

One entry, or row, in the Loader Grid contains all of the necessary data to associate a product settings file with a bar code. New entries can be added. Existing entries can be edited, deleted, and uploaded to a Basler product.

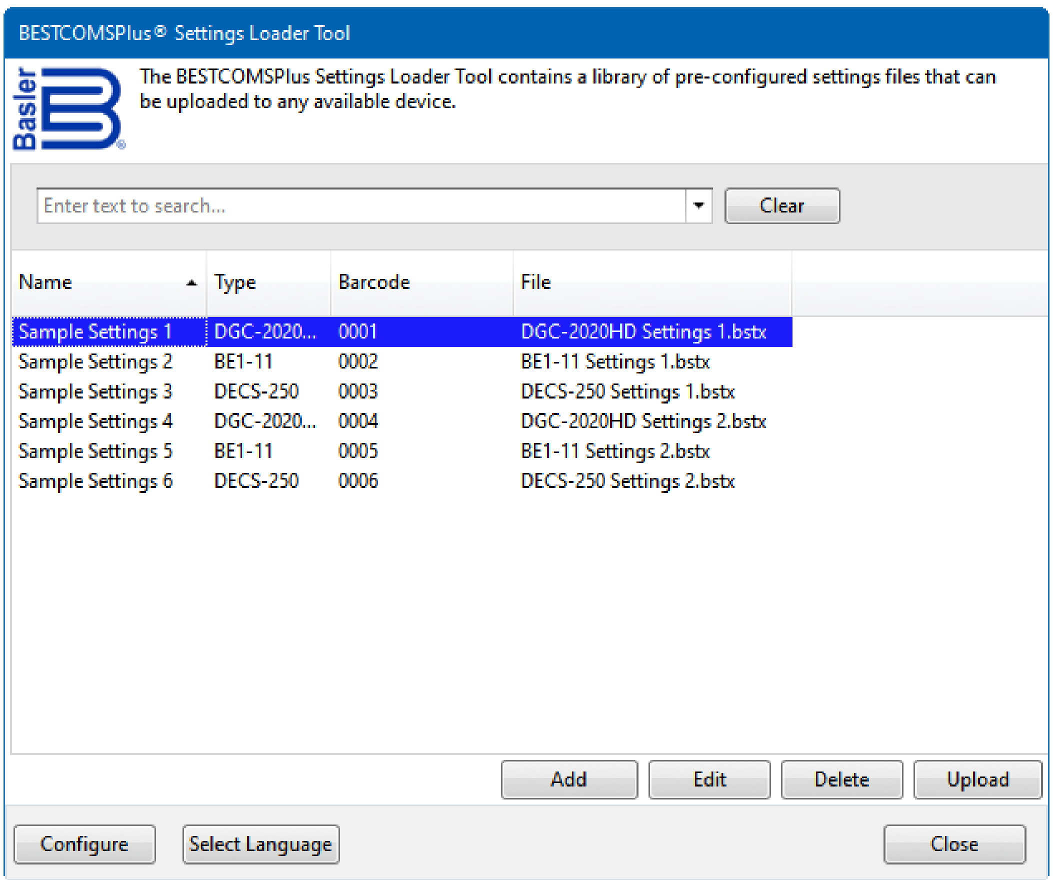


Figure 32-1. Loader Grid

Scanning Bar Codes

Place the cursor in the text field, found at the top of the Loader Grid screen, and scan a bar code. If successful, the digits which comprise the bar code appear in the text field. The BESTCOMS*Plus* Settings Loader Tool automatically searches for this bar code among the entries in the Loader Grid and displays the matching entry. Click Clear to remove the digits from the text field.

Adding an Entry

Click Add to create an entry. The BESTCOMS*Plus*® Settings Loader Tool: Add Device dialog box appears (Figure 32-2).

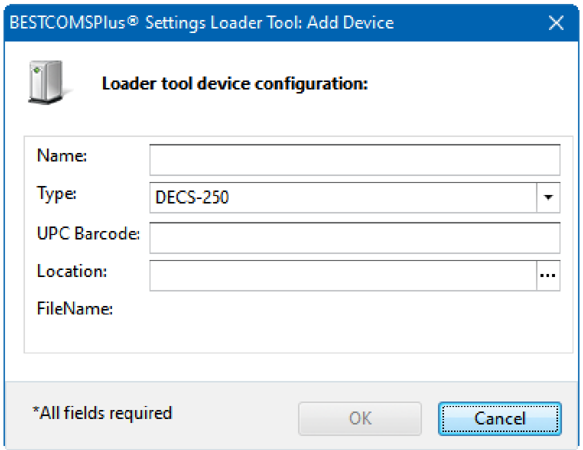


Figure 32-2. Add Device Screen

Enter the name of the entry in the Name field. This appears in the first column of the Loader Grid.

Select the product type from the Type drop-down menu. This appears in the second column of the Loader Grid.

Enter the bar code of the entry in the UPC Barcode field by placing the cursor in the UPC Barcode field and scanning the bar code.

To select the product settings file for the entry, click the browse (…) button in the Location field. Use standard Windows methods to navigate to the desired product settings file and click Open. Ensure that the selected product type in the Type field matches that of the product settings file specified in the Location field.

Click OK when finished.

Editing an Entry

To Edit an existing entry, select the entry in the Loader Grid and click Edit. The BESTCOMSPlus Settings Loader Tool: Edit Device dialog box appears. The options are identical to those of the Add Device dialog. When the desired changes have been made, click OK.

Deleting an Entry

To delete an entry from the Loader Grid, select the entry and click the Delete button. A prompt appears providing the option to confirm or cancel the deletion.

Uploading an Entry

Select an entry and click Upload. A dialog appears which provides connection options for the appropriate type of device. Refer to the Basler product instruction manual for detailed connection information. Once a connection is established, the product settings associated with the entry are uploaded.

Configuration Settings

For configuration settings, click the Configure button in the bottom left of the Loader Grid. The product tabs on the left represent the compatible Basler products. Each product tab contains tabs for Settings Files and Connection Options. The options on these tabs are described below.

Setting Files Options

Use Saved Path: When enabled, the path specified in the Loader Grid entry is used when uploading the settings file.

Single Folder: When enabled, this specifies a single folder, which contains all settings files for the product. The Windows filename specified in the Location field of the Loader Grid entry is searched for in the Single Folder location. For example, all settings files for a product are located in “C:\files”. The Location field in the Loader Grid entry for a device contains “C:\documents\settings\DECS-250 Settings.bstx”. The BESTCOMS*Plus* Settings Loader Tool searches in “C:\files” for the file named “DECS-250 Settings.bstx”.

Append Bar-Code to Location: When enabled, the bar code is appended to the specified location when uploading the settings file. For example, an entry with the bar code “0002” is located in C:\files\0002 and an entry with the bar code “0003” is located in C:\files\0003.

Logon: If User Name and Password are specified, you will not be prompted for credentials when required.

Save After Upload: After uploading a settings file, the settings are downloaded from the connected device and saved to the specified location, when enabled.

Upload Security: When enabled, the security settings stored in the settings file are uploaded to the device. Credentials will be requested if not already specified.

Figure 32-3 illustrates the Setting Files tab.

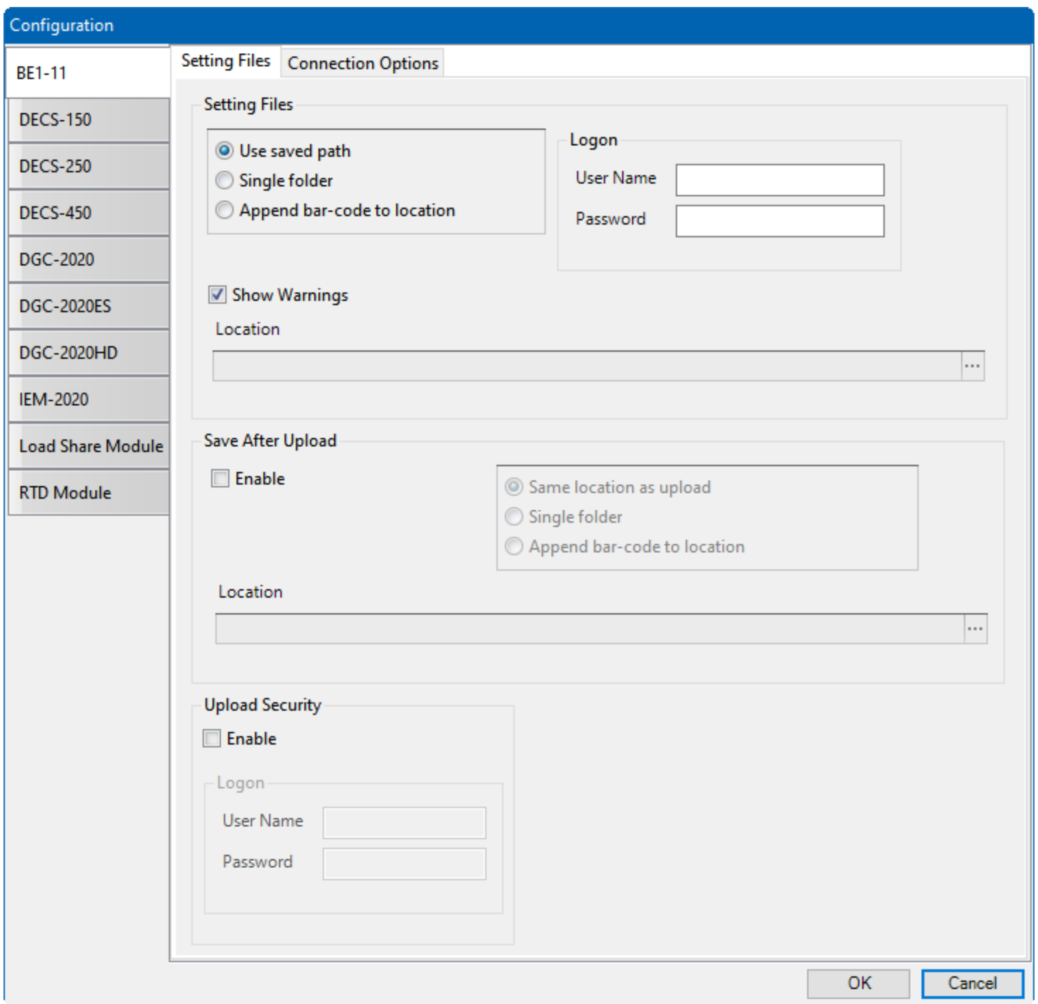


Figure 32-3. Configuration, Settings Files Tab

Connection Options

Connection options consist of the three selections described below. Refer to the Basler product instruction manual for detailed connection information.

Always Prompt for Connection: When enabled, a dialog appears which provides connection options for the appropriate type of device each time a connection attempt is made.

Ethernet Connection: When enabled, the BESTCOMS*Plus* Settings Loader Tool automatically attempts to connect to the specified IP address before uploading settings.

USB Connection: When enabled, the BESTCOMS*Plus*® Settings Loader Tool automatically attempts to connect to the device via USB port before uploading settings.

Figure 32-4 illustrates the Connection Options tab.

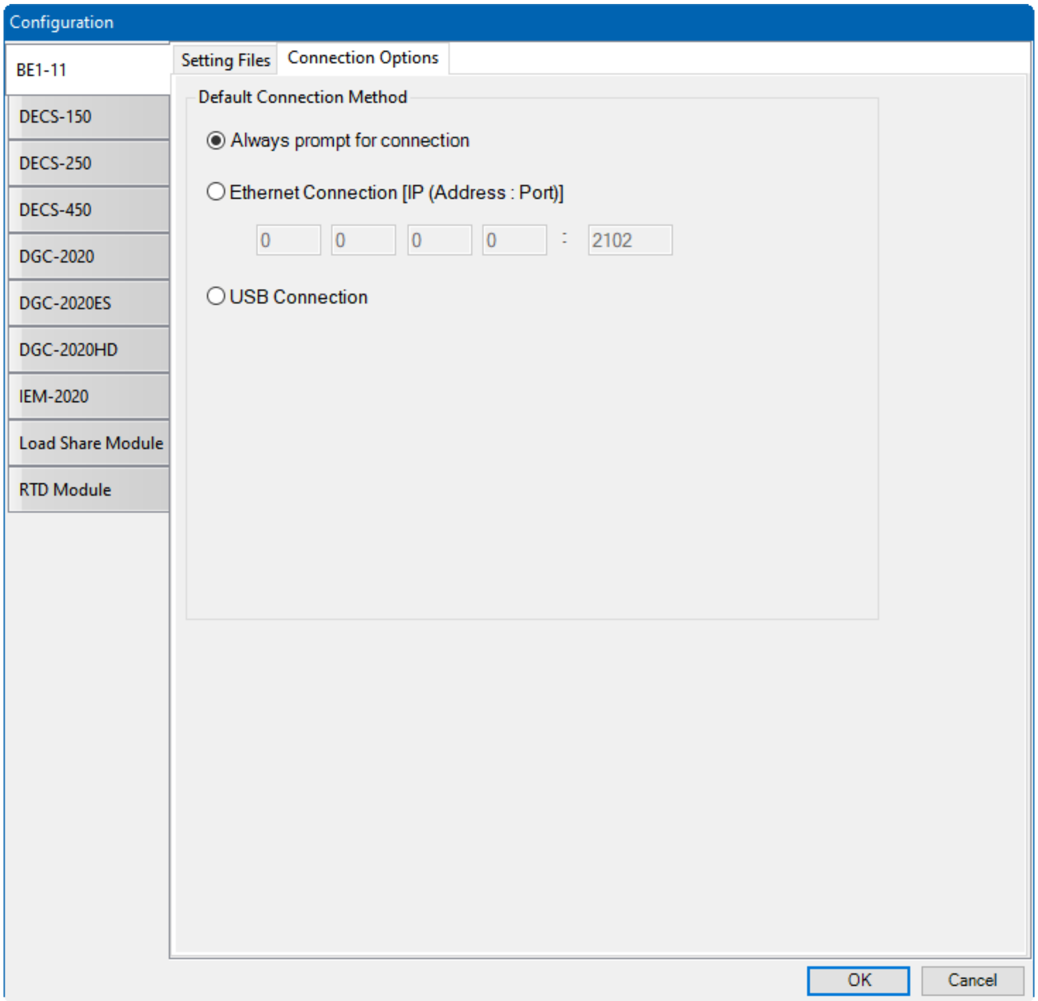


Figure 32-4. Configuration, Connection Options Tab

General Operation

The steps listed below are provided as a general guideline for how to operate the BESTCOMS*Plus* Settings Loader Tool when the initial setup is complete and the settings files are associated with bar codes.

1. Power on the device that will receive the new settings. Ensure proper communication connections have been made between the device and the PC running BESTCOMS*Plus* Settings Loader Tool.
2. Run BESTCOMS*Plus* Settings Loader Tool.
3. Place cursor in search bar.
4. Scan bar code.
5. Settings file is automatically highlighted and isolated in the grid.

6. Click Upload.
7. BESTCOMS*Plus* Settings Loader Tool automatically connects to device and uploads settings. Device connection is automatic unless “Always prompt for connection” is enabled.

33 • Math Model

Introduction

This chapter describes and illustrates the DECS-450 mathematical model.

References

DECS-450 mathematical models and timing characteristics are based on the following.

- IEEE Standard 421.5™-2016, *IEEE Recommended Practice for Excitation System Models for Power System Stability Studies*
- IEEE Standard C37.112™-2018, *IEEE Standard Inverse Time Characteristic Equations for Over Current Relays*
- IEEE Standard C50.13™-2014, *IEEE Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated MVA and Above*
- P. Kundur and O. Malik, “Excitation Systems” in *Power System Stability and Control*, 2nd ed. New York, NY, USA: McGraw-Hill, 2022, ch. 8, sec. 5.7, pp. 255–303.

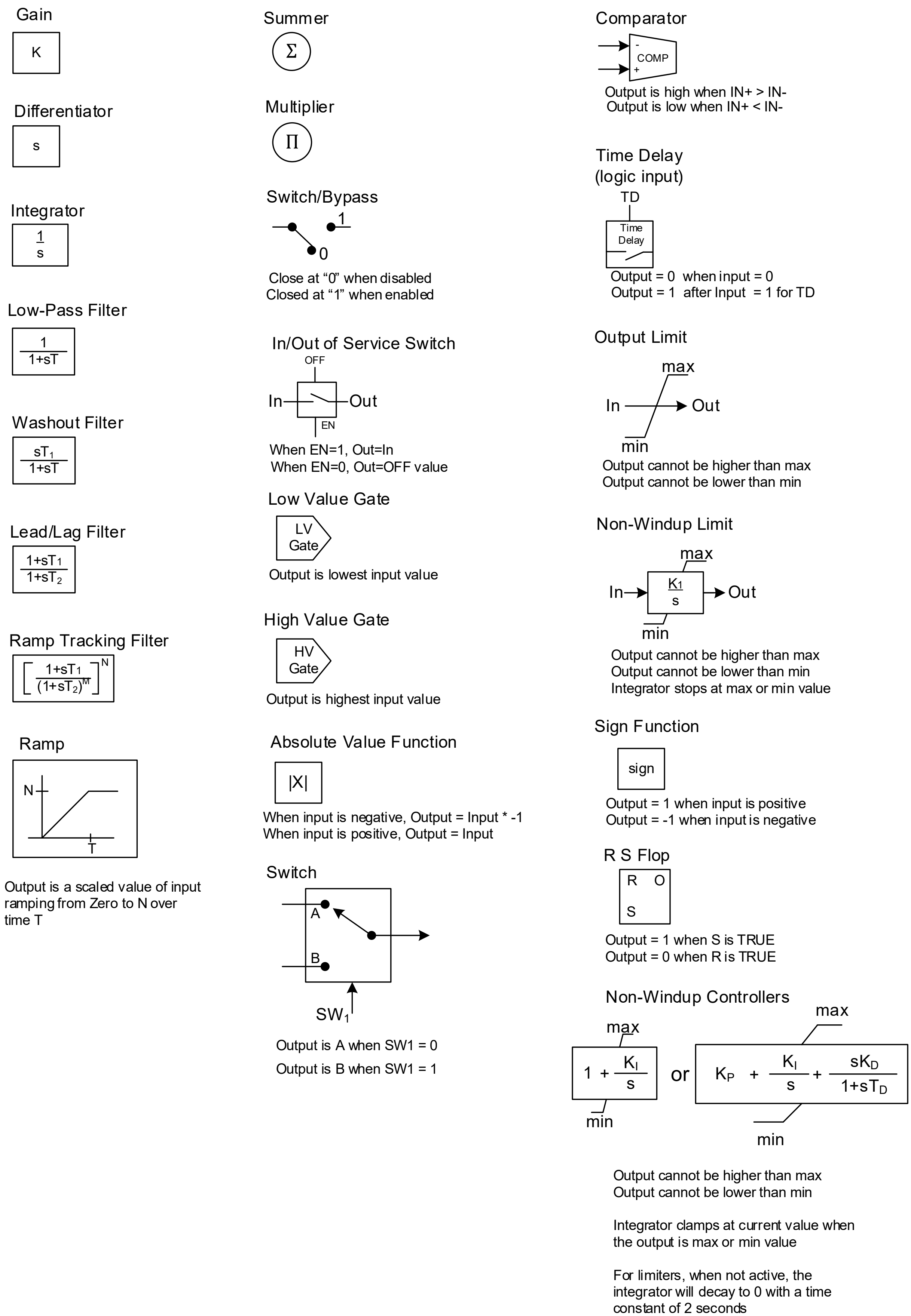


Figure 33-1. Symbol Definitions

Synchronous Machine Terminal Voltage Transducer and Load Compensator Model

The Basler DECS-450 implements load compensation by using the vector sum of the magnitudes of the terminal voltage and of the terminal current. The model provided in IEEE Std 421.5™-2016 for terminal voltage transducers and load compensators can be used to model this function in the Basler DECS-450 system as shown in Figure 33-2.

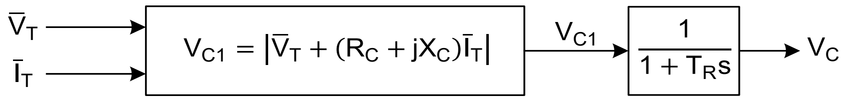


Figure 33-2. Terminal Voltage and Load Compensation Element

The values used in this model can be derived from the Basler DECS-450 settings as follows:

$R_C = 0$ (Resistive load compensation is not available)

$X_C = \pm\, 0.01 * DRP$

$T_R = 5$ ms

The parameter DRP corresponds to the reactive droop or line drop compensation percentages set by the user. Values for the DRP can range from 0% to 30% of the rated per-unit generator terminal voltage. The value of the reactive component of compensation X_C is positive for reactive droop compensation and negative for line drop compensation.

Power Source Model

Figure 33-3 shows the power source model for the DECS-450 with the rectifier regulation function shown in Figure 33-4. The models are described in Annex D of IEEE Std 421.5™-2016. The maximum forcing represented by the regulator potential circuit gain parameter K_P is related to the power-input voltage (V_{P_VOL}) of the regulator and the nominal exciter field voltage (E_{FE_BASE}) as follows:

$$K_P = 1.17 * \frac{V_{P\_VOL}}{E_{FE\_BASE}} \text{ for the three-phase power input}$$

$$K_P = 0.78 * \frac{V_{P\_VOL}}{E_{FE\_BASE}} \text{ for the single-phase power input}$$

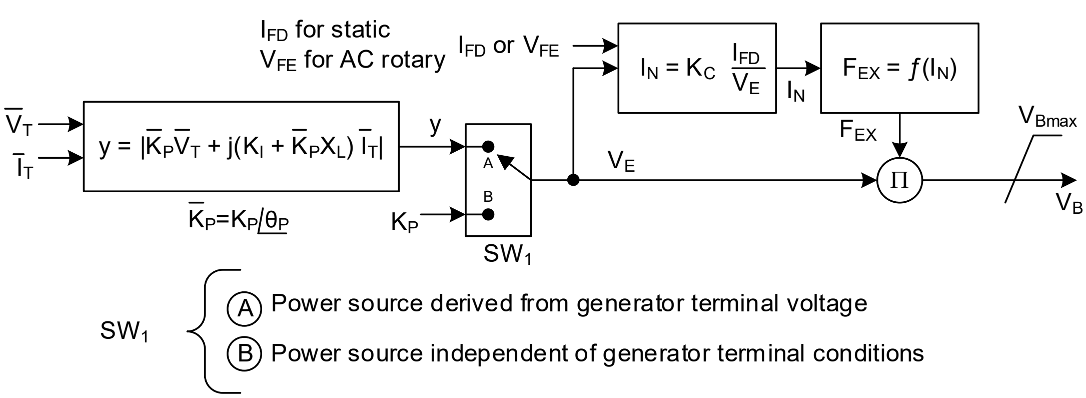


Figure 33-3. Power Source for Excitation

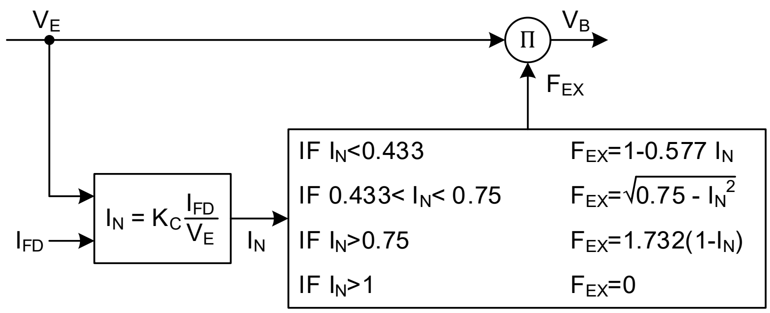


Figure 33-4. Rectifier Regulation Function (F_{EX})

Voltage Regulator

Figure 33-5 shows the model of the Basler DECS-450 voltage regulator. It can be modeled as an AC8C or ST4C model from the IEEE Std 421.5™. The exciter is excluded from Figure 33-5.

The limits, V_{RMAX} and V_{RMIN}, are determined as follows:

$V_{RMAX} = 1$

$V_{RMIN} = -1$ for the 6-SCR Bridge

$V_{RMIN} = 0$ for the 3-SCR Bridge

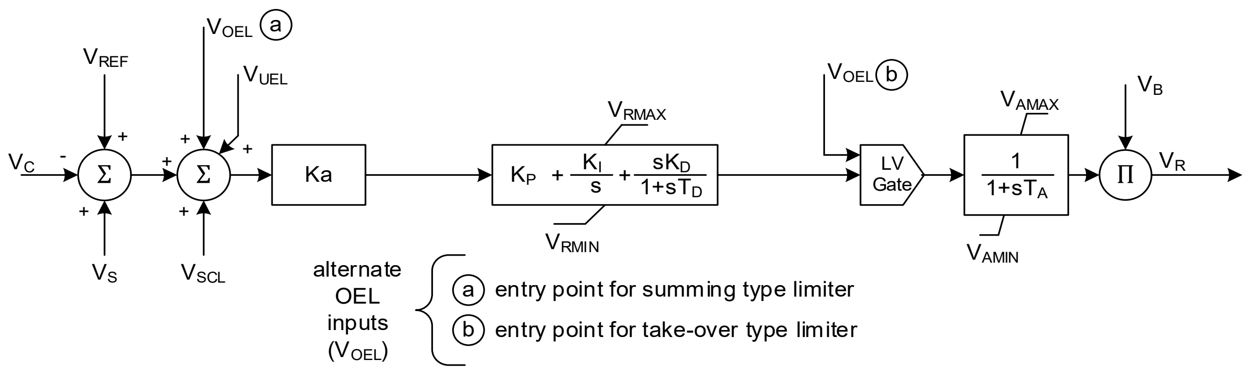


Figure 33-5. Per-Unit AVR Block Diagram

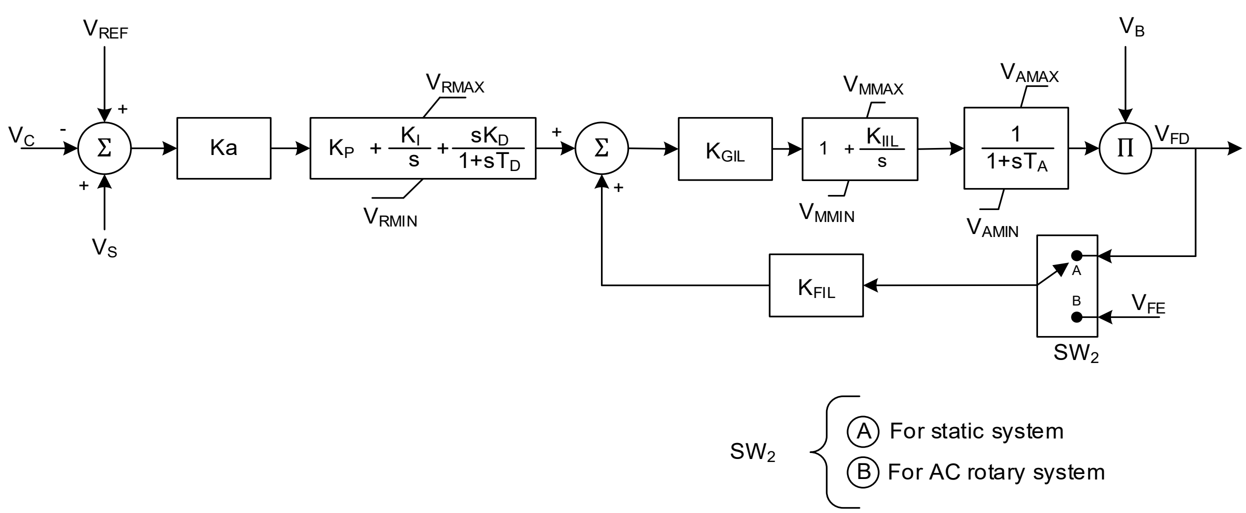


Figure 33-6. Per-Unit AVR Block Diagram with Inner Loop Field Regulator

The PID gains K_P, K_I, and K_D are custom designed for the best performance for each generator/exciter system. These continuous time gains are discretized and implemented in the DECS-450 digital controller. The PID gains can be read from the tables provided by Basler Electric or can be obtained from a program made available to the user by Basler Electric.

The inner loop field voltage regulator in Figure 33-6 is comprised of the gains K_{FIL}, K_{GIL} and K_{IIL}, which is used to linearize the exciter control output by compensating the nonlinear characteristics due to power source variation. The inner loop feedback gain K_{FIL} is set as 0.1.

Figure 33-7 depicts the model of the Basler DECS-450 excitation system used with a simplified rotating exciter, brush or brushless type. The rotary exciter depicted in Figure 33-7 is an ac rotary exciter. If the actual system utilizes a dc rotary exciter instead, the ac rotary exciter's block diagram would be replaced with the block diagram of a dc rotary exciter similar to the one depicted in IEEE Std 421.5™-2016. The rotating exciter parameters are not included in this discussion since they are the responsibility of the exciter manufacturer.

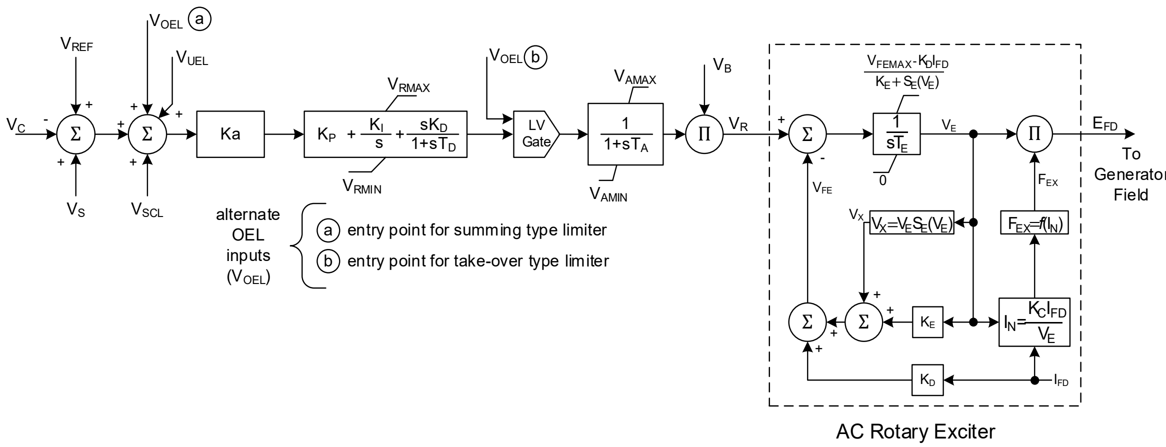


Figure 33-7. Per-Unit Block Diagram for a Simplified Rotating Exciter

Var/Power Factor Controller

The var and power factor (PF) controllers are summing point type controllers and make up the outside loop of a two-loop system. These controllers are implemented as slow PI-type controllers. The voltage regulator forms the inner loop and is implemented as a fast PID controller.

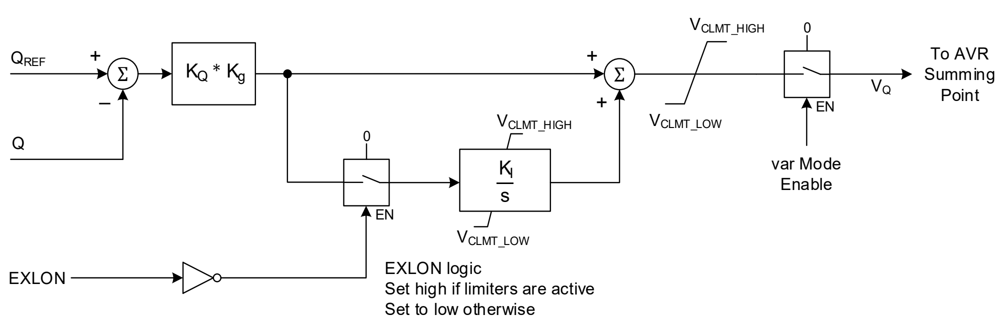


Figure 33-8. Per-Unit Var Controller Block Diagram

The models of the Basler DECS-450 var and power factor controller are shown in Figure 33-8 and Figure 33-9, respectively. They may be modelled as IEEE Std 421.5™ Type 2 Var/Power Factor controllers. The P_{TMIN} threshold for the PF controller is based on a settable percentage of rated power. The non-windup limit (V_{CLMT}) is used for bounding the var and PF controllers' output voltages (V_Q and V_{PF}). V_{CLMT} is related to the programmed parameter "Fine Voltage Adjustment Band" (FVAB) as follows:

$$V_{CLMT\_HIGH} = \frac{FVAB}{100}$$

$$V_{CLMT\_LOW} = -\frac{FVAB}{100}$$

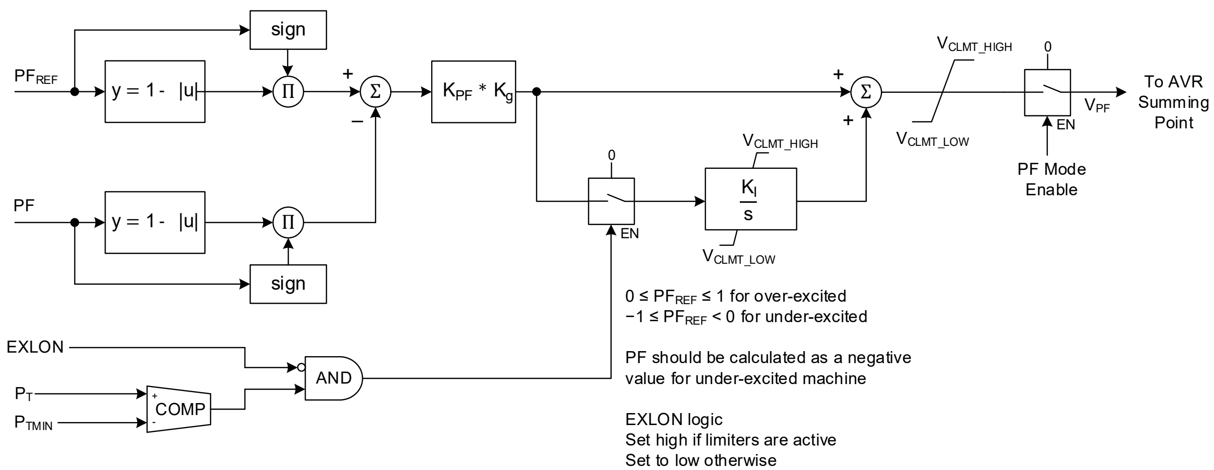


Figure 33-9. Per-Unit Power Factor Controller Block Diagram

Limiters

The Basler DECS-450 has six limiters: the underexcitation limiter (UEL), the overexcitation limiter (OEL), the stator current limiter (SCL), the var limiter (varL), the underfrequency limiter (UFL), and the volts-per-hertz limiter (V/Hz). The OEL can be implemented as either summing point-type limiters or takeover-type limiters. The UEL, SCL, underfrequency limiter, V/Hz, and varL are only available as summing point-type limiters. With regards to the underfrequency limiter and the volts-per-hertz limiter, only one of these limiters may be enabled at a time.

Underexcitation Limiter (UEL)

Figure 33-10 shows the DECS-450 model of the summing-point type underexcitation limiter (UEL). It makes up the outer loop, and the voltage regulator makes up the inner loop. The UEL uses a PI-type controller.

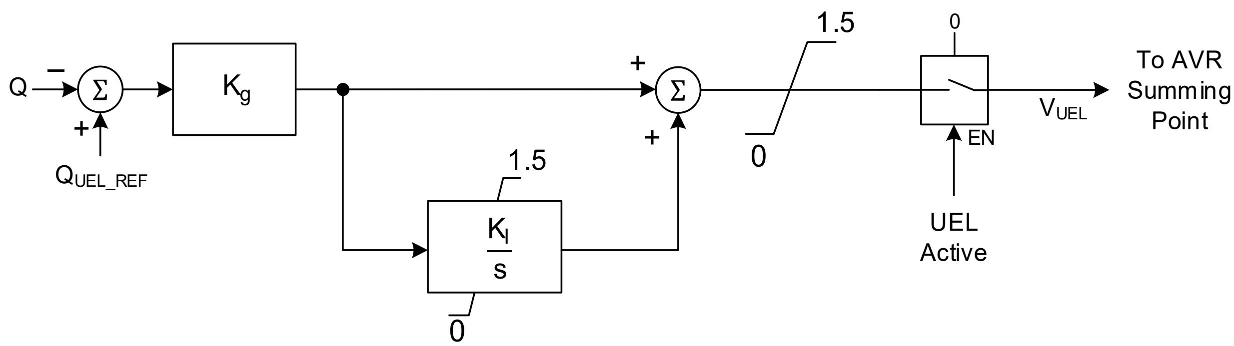


Figure 33-10. Per-Unit Underexcitation Limiter Block Diagram

The UEL operating characteristic is selected from one of the following methods:

1. The internal UEL operating characteristic is designed to mimic the operational limits of the generator on the P-Q plane as illustrated in Figure 33-11. The UEL reference (Q_{UEL_REF}) is generated based on the user input parameter "UEL Bias (Q_{BIAS})" and the active power (P) as follows:

$$Q_{UEL\_REF} = \left(0.49 * P^2 - 1\right) * Q_{BIAS}$$

2. The levels entered for the user-defined curve are defined for operation at the rated generator voltage. The user-defined UEL curve is automatically adjusted based on generator operating

voltage and real power by using the UEL voltage dependency real-power exponent as shown in Figure 33-12.

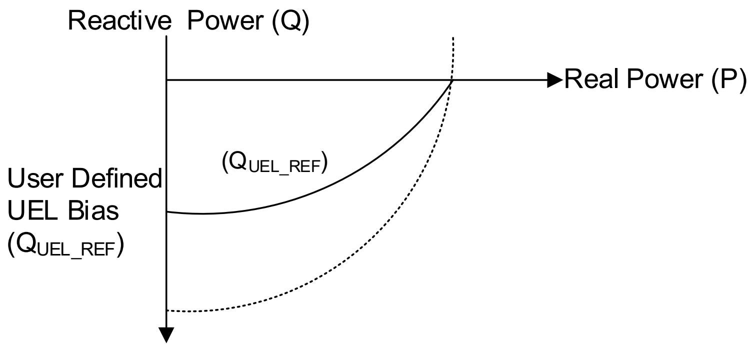


Figure 33-11. Underexcitation Limiter Reference

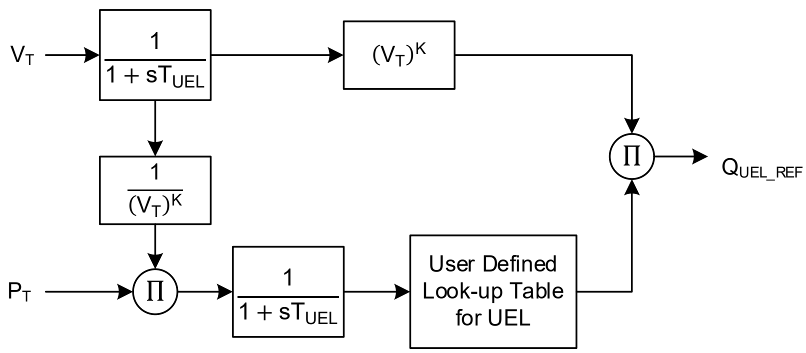


Figure 33-12. Adjustment of UEL Curve based on Generator Voltage and Real Power

Figure 33-13 shows the customized UEL operating characteristic for a UEL in which the limit is comprised of multiple straight-line segments, showing up to six segments.

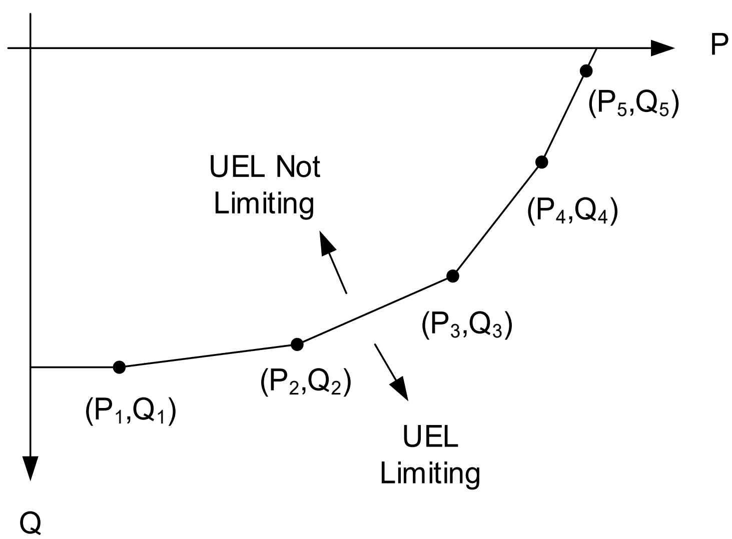


Figure 33-13. User-Defined UEL Curve Characteristic with Five Points

Overexcitation Limiter (OEL)

The Basler DECS-450 has two types of overexcitation limiter (OEL): summing point type and takeover type. These are shown in Figure 33-14 and Figure 33-15. In the summing point type of the Basler DECS-450 OEL, a PI-type controller is used and the OEL output is added to the summing point of the voltage regulator. In addition to the summing point OEL described above, the DECS-450 has a takeover-style overexcitation limiter. It uses a PI-type controller. In this control scheme, the actual field current is compared with the OEL setpoint. In order to allow large field voltage due to transient response in the AVR loop, the actual field current is filtered before comparing with the OEL setpoint. The integrator of the OEL loop is reinitialized every 4 ms with the current excitation level if it is below the limit. When it is above the limit, the OEL limiter output becomes less than the AVR output, and the OEL takes over to control at a proper excitation level. When the OEL is active, the AVR loop stops integration and compares its output with the OEL output to get out of the OEL loop. Note that the I_{FD} per-unit base in the OEL model is the shunt rating programmed into the Basler DECS-450.

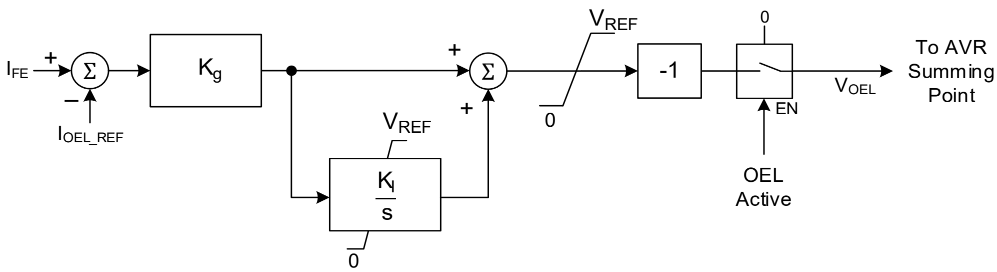


Figure 33-14. Per-Unit Summing Point-Type Overexcitation Limiter Block Diagram

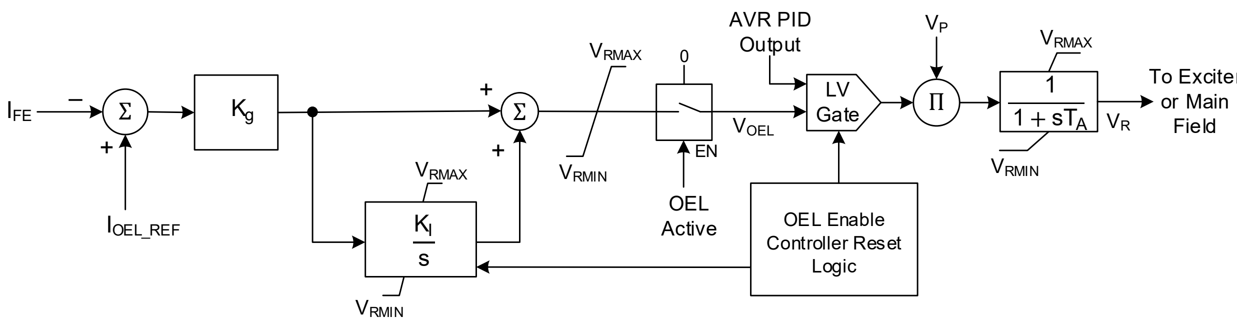


Figure 33-15. Per-Unit Takeover-Type Overexcitation Limiter Block Diagram

Two methods for calculating the field current reference for the OEL loop are implemented in the DECS-450. For the summing point OEL, the reference field current is calculated based on the user input parameters as shown in Figure 33-16. It approximates the field current short-time overload capability given in IEEE C50.13™. The low level (OEI3) is normally set just above the exciter's continuous field current rating. The OEL loop becomes inactive if field current lower than OEI3 is required by an external event. It is illustrated at time t_o in Figure 33-16.

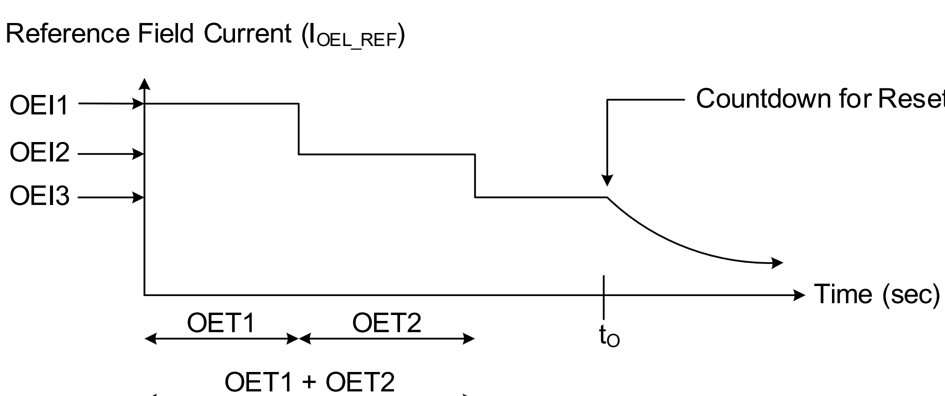


Figure 33-16. Overexcitation Limiter Reference for Summing Point Type

In the takeover OEL, the reference field current (I_{OEL_REF}) is calculated based on the inverse-time characteristic found in IEEE C37.112™. Input parameters from the user are as follows:

I_{FD_max}: Maximum allowed field current (OEL high level current)

I_{FD_min}: Maximum continuous field current (OEL low level current)

TD: Time dial setting.

The reference field current (I_{OEL_REF}) in per-unit is obtained by:

$$I_{OEL\_REF} = \frac{\frac{1}{192} * \left[490 - \left\{\frac{-95.9 * (TD)}{Time} + 17.17\right\}^2\right] * I_{BASE}}{I_{FE\_BASE}}$$

where $I_{BASE} = \frac{I_{FD\_min}}{1.03}$. When the takeover OEL is active, the field current will be limited to follow the curve of the reference field current given by the equation above.

Stator Current Limiter (SCL)

The stator current limiter (SCL) modifies the excitation level based on whether vars are being absorbed (leading) or exported (lagging) by the synchronous machine. Figure 33-17 shows the model of the stator current limiter. The SCL makes up the outer loop, and the voltage regulator makes up the inner loop. The PI-type controller is used to achieve a desired response. The sign (Q) is defined as positive (+1) for overexcitation and negative (–1) for underexcitation condition. This limiter may be modelled as a type SCL1C model.

The SCL current reference (I_{SCL_REF}) is generated based on a two-step waveform with a high current level (I_{high}), a high current time (T_{high}), and a low current level (I_{low}) as shown in Figure 33-18.

The SCL loop becomes inactive if stator current lower than a low current level (I_{low}) is required by an external event. It is illustrated at time t_o in Figure 33-18.

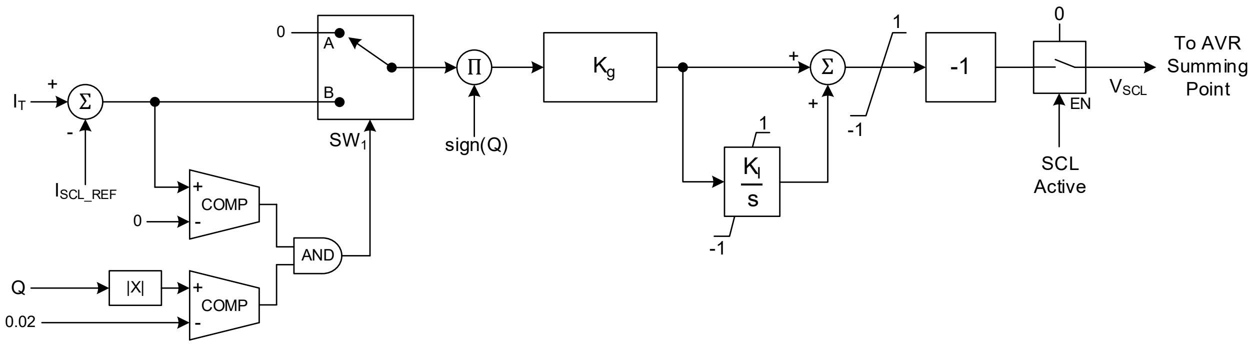


Figure 33-17. Per-Unit Stator Current Limiter Block Diagram

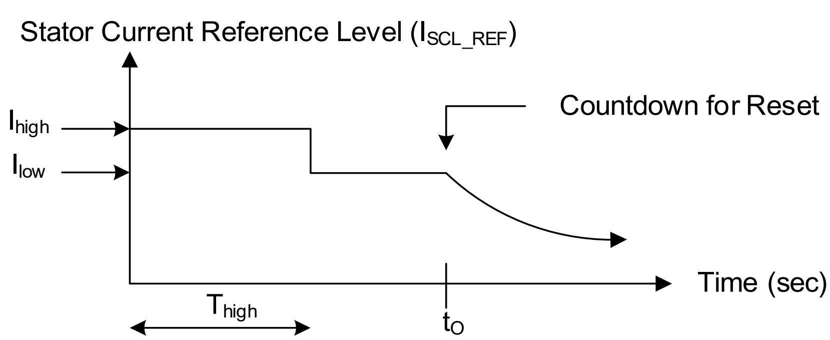


Figure 33-18. Stator Current Limiter Reference

Volts-Per-Hertz (V/Hz) / Underfrequency (UF) Limiters

The volts-per-hertz and underfrequency limiters are implemented to prevent excessive magnetic flux from damaging the generator and any connected transformers during low frequency operation or overvoltage events.

The underfrequency limiter has been designed with an adjustable slope (K_{VHZ}) from 0 pu to 3 pu [Volts/Hz]. When the system is in an underfrequency condition, the voltage reference is adjusted by the amount calculated based on two programmable parameters: the corner frequency and the volts-per-hertz slope. Its mathematical model is shown in Figure 33-19.

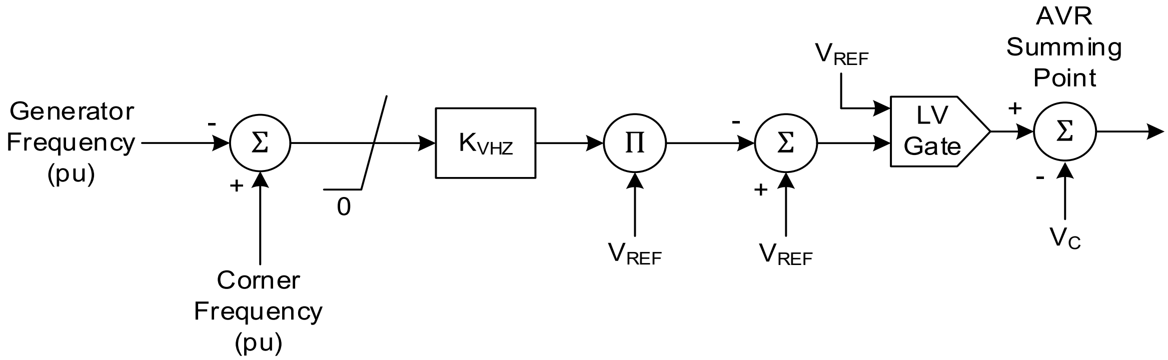


Figure 33-19. Per-Unit Underfrequency Limiter Block Diagram

As presented by Figure 33-20, K_{VHz} is determined by a two-step waveform with a high limit setpoint and a low limit setpoint. These setpoints are available in BESTCOMS*Plus*®.

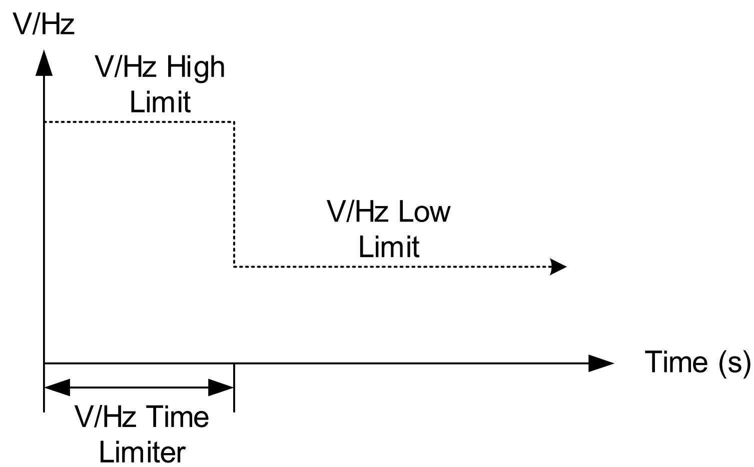


Figure 33-20. Volts-per-Hertz Slope Selection

The V/Hz limiter has been designed with an adjustable slope (K_{VHZ}) from 0 pu to 3 pu [Volts/Hz]. When the system frequency and voltage are above the volts-per-hertz line, the setpoint is adjusted to maintain operation on the volts-per-hertz line. Its mathematical model is shown in Figure 33-21.

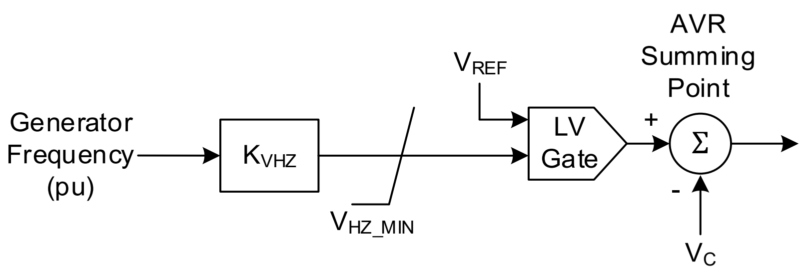


Figure 33-21. Volts-per-Hertz Limiter

Var Limiter (varL)

The var limiter (varL) acts to limit the level of reactive power exported from the generator. A PI type controller is used and the varL output is subtracted from the summing point of the voltage regulator. A delay setting establishes a time delay between when the var threshold is exceeded and when the DECS-450 acts to limit the generator's exported reactive power level.

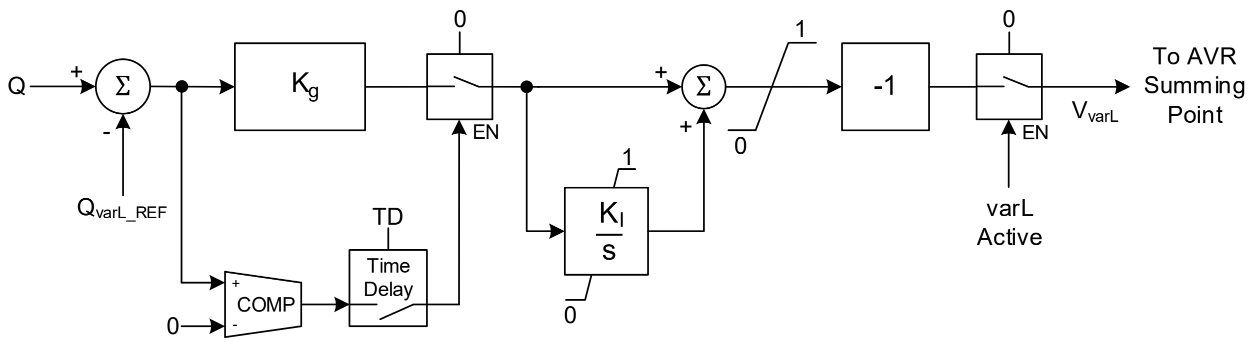


Figure 33-22. Per-Unit Block Diagram of the Var Limiter

Soft Start Control

The soft start control function is provided to cause orderly build-up of terminal voltage from residual to the rated voltage in the desired time with minimal overshoot. In the Basler DECS-450, the fast dynamic response is used while the voltage reference is adjusted based on the elapsed time. When the system is under the startup condition, the voltage reference is adjusted by the amount calculated based on two programmable parameters: the initial soft start voltage level (V_0) and the desired time to build up to the rated voltage (T_{SS}). Its mathematical model is shown in Figure 33-23. The soft start gain (K_{SS}) is calculated as follows:

$$K_{SS} = \frac{1}{T_{SS}}$$

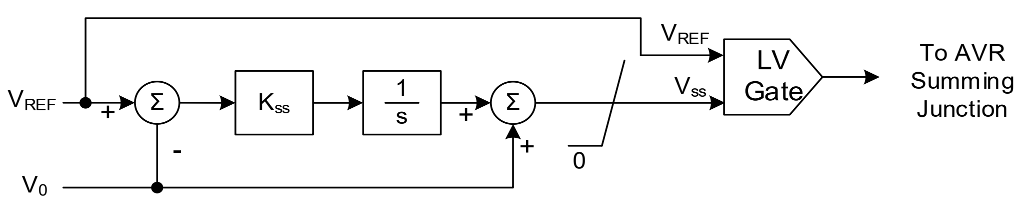


Figure 33-23. Per-Unit Soft Start Control Block Diagram

Discontinuous Transient Excitation Boost

The transient boost function provides a means to potentially improve system response to successive faults by providing increased excitation support. If a simultaneous increase in line current above the fault current threshold and a decrease in line voltage below the fault voltage threshold occurs for a fixed amount of time, the regulator reference setpoint will be increased. Once the line voltage rises above the clearing voltage threshold for fixed duration, the regulator reference setpoint will be restored to the pre-fault value. Figure 33-24 shows the model of the transient boost function. The transient boost function output (V_{TB}) is added to the summing point of the PID controller.

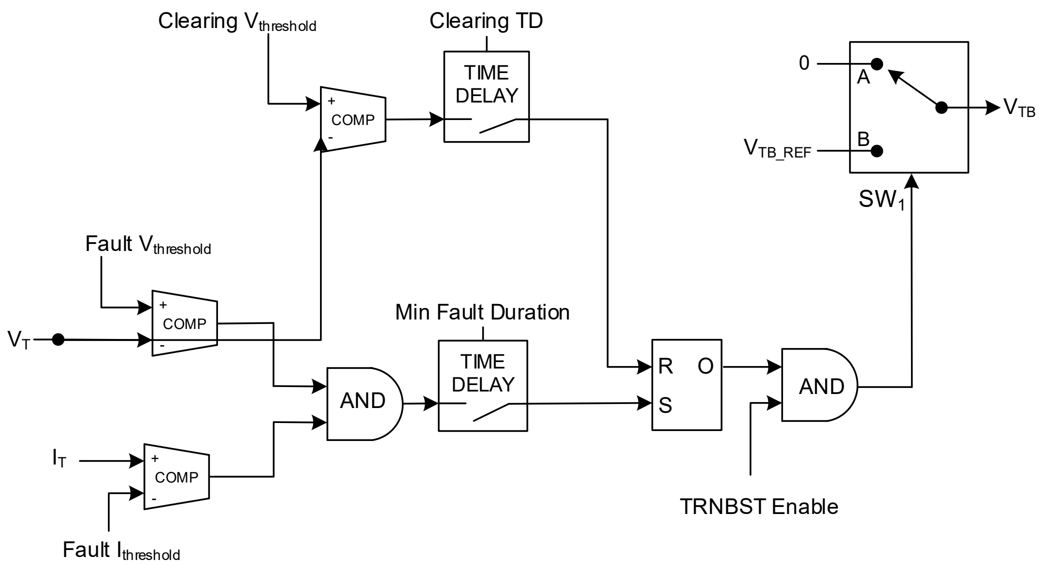


Figure 33-24. Per-Unit Transient Excitation Boost Block Diagram

Field Current and Field Voltage Regulators

In the DECS-450, the field current and field voltage regulators are the same as that shown in Figure 33-5 with the following changes:

Field Current Regulator:

V_C becomes I_{FE}

V_{REF} becomes I_{FE_REF}

Field Voltage Regulator:

V_C becomes V_{FE}

V_{REF} becomes V_{FE_REF}

Also note the derivative terms K_D and T_D are typically set to zero for field current and field voltage regulation.

Dual Input Power System Stabilizer (PSS)

The Basler power system stabilizer (PSS) is a dual input PSS that uses combinations of power and speed to derive the stabilizing signal. It is based on the type PSS2C model available in IEEE Std 421.5™-2016.

The PSS is designed to add damping to the generator rotor oscillations by controlling its excitation using a supplemental stabilizing signal. To supplement the generator's natural damping, it produces a component of electrical torque that opposes changes in rotor speed and introduces a signal proportional to measured rotor speed deviation into the automatic voltage regulator (AVR) input.

As depicted in Figure 33-25, the PSS monitors frequency and power to produce the integral of accelerating power, which is used for obtaining a derived speed deviation signal (ω_{DEV}). Filtering of the derived speed signal provides a phase lead at the electro-mechanical frequency of interest. This phase lead compensates for the phase lag introduced by the closed-loop voltage regulator. Prior to connecting the stabilizer output signal to the voltage regulator input, adjustable gain and limiting are applied as depicted in Figure 33-25.

The PSS performance is configured using filter time constants and software control switches. Figure 33-26 illustrates the detailed block diagram including the default position of each software switch and

Table 33-1 contains the list of locations for the PSS variables displayed in BESTCOMS*Plus*.

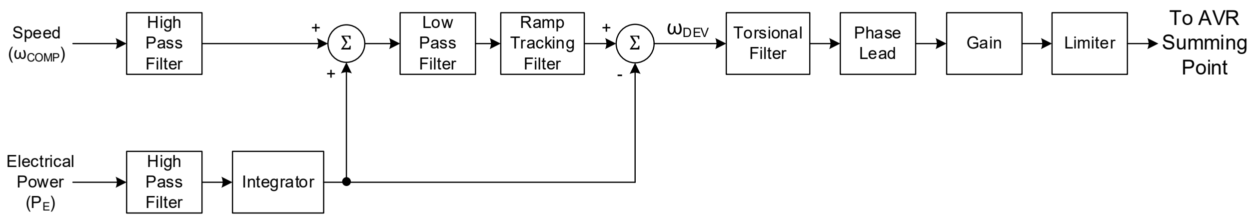


Figure 33-25. Functional Block Diagram of the PSS

High-Pass Filtering and Integration

High-pass filtering is used to remove low frequency components from electrical power and rotor speed (or compensated frequency) signals. This ensures that the stabilizer does not alter the steady-state reference to the voltage regulator. High-pass filtering is implemented using time constants T_{w1}, T_{w2}, and T_{L1}. Integration of the electrical power signal is accomplished using time constants (T_{w3}, T_{w4} and T_{L2}) and the rotor inertia constant H. The outputs of these are added together to obtain the integral of mechanical power deviation. Time constants T_{w1}, T_{w2}, T_{w3}, and T_{w4} are also called the washout time constants.

Low-Pass/Ramp Tracking Filter

A fourth order low-pass filter processes the calculated mechanical power deviation signal. This filtering may be excessive for units with high rates of mechanical power change. An optional filter stage is provided to allow for ramp changes to the input mechanical power.

Torsional Filter

The torsional filter provides desired gain reduction at the specified frequency. The filter is used to compensate the torsional frequency components present in the input signal. There are two stages of torsional filters that can be selected by SSW 4 and SSW 5.

Phase Compensation

Filtering of the derived speed signal provides a phase lead at the electromechanical frequency of interest. As depicted in Figure 33-26, the derived speed signal is modified before it is applied to the voltage regulator input. The signal is filtered to provide phase lead at the electromechanical frequencies of interest (i.e., 0.1 Hz to 5.0 Hz). The phase lead requirement is site-specific and is required to compensate for phase lag introduced by the closed-loop voltage regulator. With switches SSW 2 and SSW 3 in the closed position, the derived speed deviation is used as the stabilizing signal. These software switches allow the user to select an alternate configuration based upon the available input signals. The first two lead-lag blocks are normally adequate to match the phase compensation requirements of a unit; however, two additional stages may be added by opening software switches SSW 6 and SSW 7. The transfer function for each stage of phase compensation is a simple pole-zero combination.

Washout Filter and Logic Limiter

If software switch SSW 9 is set to its enabled position, the scaled PSS signal will be passed through an additional washout filter and logic limiter. The logic limiter allows for the user to automatically change the time constant of the washout filter if the signal from the washout filter exceeds either of the logic limiter's bounds for a user-defined amount of time. The logic limiter will instantaneously return the washout filter's time constant to its original value once the washout filter's output returns to within the bounds of the logic limiter.

Terminal Voltage Limiter

If software switch SSW 9 is instead set to its disabled position, the scaled PSS signal will be passed through a limiter whose upper bound can be controlled based on the generator's terminal voltage. If the generator's terminal voltage rises above the terminal voltage level selected by the user in the PSS setting's while software switch SSW 8 is enabled, the PSS's terminal voltage limiter will act to reduce the upper limit of the PSS output signal at a fixed rate of –4% per second until zero is reached or the overvoltage condition is no longer present. Once the overvoltage condition is no longer present, the upper limit of the PSS output signal will increase at a rate of 2% per second until the upper limit returns to the user-defined setpoint. If software switch SSW 8 is disabled, then the scaled PSS signal will just be bound by the user-defined limits.

Output Logic

If the PSS is not enabled; the real power level is below the kW threshold setpoint of the PSS; or the DECS-450 is not regulating in AVR mode, then the final PSS output will be equal to 0.

Table 33-1. PSS Variable Names Used in BESTCOMS*Plus*® and Their Corresponding Location in Figure 33-26

Callout Number	BESTCOMS*Plus*® Variable	BESTCOMS*Plus*® Variable Name
1	Ptest	Time Response Signal
2	CompF	Compensated Frequency Deviation
3	PssW	PSS Electric Power
4	Vtmag	PSS Term Voltage
5	x2	Speed HP #1
6	WashW	Washed Out Speed
7	x5	Power HP #1
8	WashP	Washed Out Power
9	x7	Mechanical Power
10	x8	Mechanical Power LP #1
11	x9	Mechanical Power LP #2
12	x10	Mechanical Power LP #3
13	x11	Mechanical Power LP #4
14	MechP	Filtered Mechanical Power
15	Synth	Synthesized Speed
16	Tflt1	Torsional Filter #1
17	x29	Torsional Filter #2
18	x15	Lead-Lag #1
19	x16	Lead-Lag #2
20	x17	Lead-Lag #3
21	x31	Lead-Lag #4
22	Tvlpf	Terminal Voltage Low-Pass Filter
23	Tvrl	Terminal Voltage Ramp Limiter
24	Llwf	Logic Limiter Washout Filter
25	Prelim	Pre-Limit Output
26	Post	Post-Limit Output
27	POut	Final PSS Output

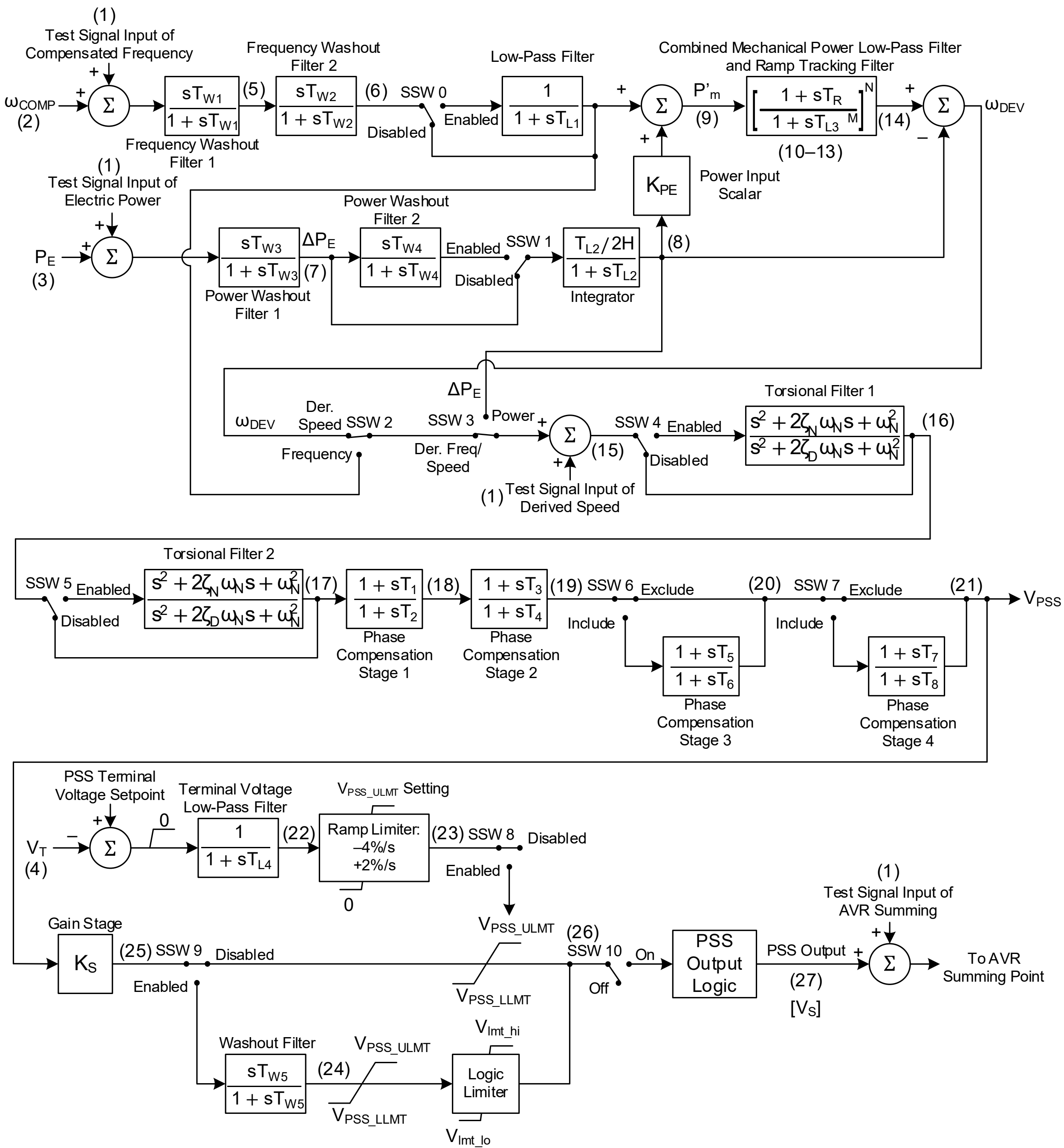


Figure 33-26. Detailed Block Diagram of the PSS

PSS Blocking with Rate-of-Change (ROC) in Frequency

The PSS output is blocked when the rate-of-change (ROC) in the generator frequency is greater than the programmable level. Figure 33-27 provides a means to measure the rate-of-change of generator frequency. The absolute value of the measured rate-of-change is compared to a programmable threshold value ($ROC_{THRESHOLD}$). If the absolute value of the measured rate-of-change is above the threshold and ROC is enabled, then the algorithm will begin counting. If the count exceeds a programmable timeout (ROC TD), then a ramp signal (K_{S_SF}) will be produced with a programmable blocking time duration ($BLOCK_{TIME}$). The maximum ramp output becomes 1.0 after the blocking time duration. The PSS output is multiplied by the ramp signal.

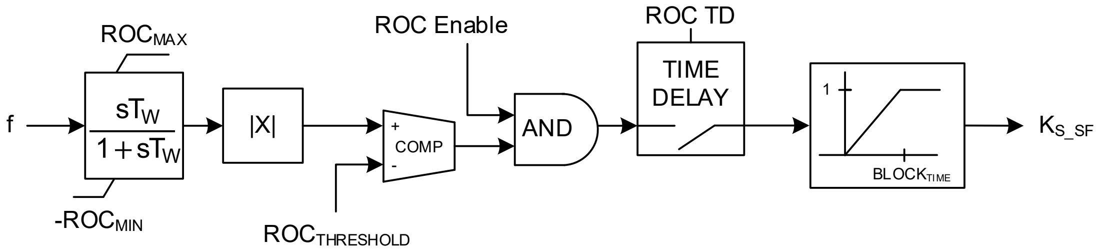


Figure 33-27. Per-Unit PSS Rate-of-Change Blocking Block Diagram

Network Load Share (NLS) Using Cross-Current Compensation (CCC)

A cross-current compensation (CCC) implementation for network load share (NLS) is depicted in Figure 33-28.

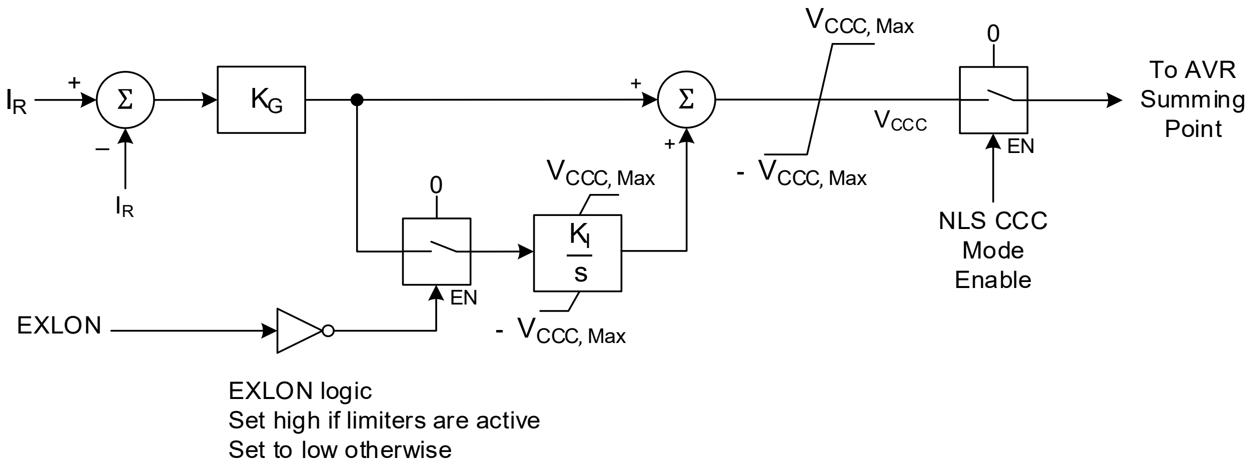


Figure 33-28. Per-Unit Network Load Share Cross-Current Compensation Block Diagram

The block diagram depicted in Figure 33-28 consists of a PI controller whose input is the difference between the reactive current of the target unit (I_R) and the average reactive current of the other paralleled units ($\bar{I}_R$). The NLS CCC output V_{CCC} is limited by the $V_{CCC, Max}$ variable. If a limiter is active, the integral action of the NLS CCC controller is disabled.

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