DECS-450R

Digital Excitation Control System

Instruction Manual

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Preface

This instruction manual provides information about the installation and operation of the DECS-450R. To accomplish this, the following information is provided:

- General information
- Human-machine interface
- Functional description
- Installation
- BESTCOMS*Plus*® software
- Setup
- Communication protocols
- Maintenance
- Specifications

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.

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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

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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
D, Jan 2025	• *Introduction:* Updated the style chart • *Regulation:* Updated Pre-Position Setpoints description • *BESTlogicPlus:* Updated Transfer Watchdog logic block description • *Stability Tuning:* Updated to Converting Gains from a DECS-300 or DECS-400 • *Specifications:* Updated China RoHS table
C, Dec 2023	• Added China RoHS compliance
B, Aug 2023	• *Mounting*: Updated Transition Plate section and added new drawings • *Typical Connections*: Added a figure for BCM-2/IT-2 connections • *Configuration*: Added Operation Mode section and figure • *Security*: Added section on viewing the security log • *BESTCOMSPlus Software*: Removed activation requirements and updated installation procedure • *Specifications*: Added impedance specification for meter driver outputs, adjusted CE compliance information and added UKCA compliance information, updated Maritime Recognition section • Made assorted, minor edits and corrections
A, Dec 2020	• Added instructions for installing a transition plate • Added relative humidity to *Specifications* • Minor text edits
—, Aug 2020	• Initial release

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1 • Introduction

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

BESTCOMS*Plus*® PC software provides a point-and-click means to set and monitor the DECS-450R and makes the configuration of one or several DECS-450R controllers fast and efficient. BESTlogic™*Plus* Programmable Logic, within BESTCOMS*Plus*, is used to program DECS-450R 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-450R is designed for use with Basler Electric's Bridge Control Module (BCM-2) or Interface Firing Module (IFM) 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-450R.

Features and Functions

DECS-450R 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
- 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
- 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
- Fourteen protection functions:
  - Generator undervoltage (27)
  - Generator overvoltage (59)
  - Loss of sensing (LOS)
  - Overfrequency (81O)
  - Underfrequency (81U) x 2
  - Reverse power (32R)
  - Loss of excitation (40Q)

  - Field overvoltage
  - Field overcurrent
  - Loss of Field Isolation Transducer
  - Sync-check (25)
  - Generator below 10 hertz
  - Watchdog timer
- External crowbar activation alarm support
- BESTCOMS*Plus*® software
- BESTlogic™*Plus* programmable logic
  - Drag-and-drop interface
  - 256 logic gates per diagram
- 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
  - Optional Profibus communication protocol
- Data logging, sequence of events recording, and trending

Applications

The DECS-450R is intended for synchronous generator or synchronous motor applications. The DECS-450R 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-450R provides multiple communication interfaces: Ethernet, Modbus®, optional Profibus, and optional Interactive Display Panels: IDP-801 and IDP-1201.

Optional Features and Capabilities

DECS-450R 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-450R.

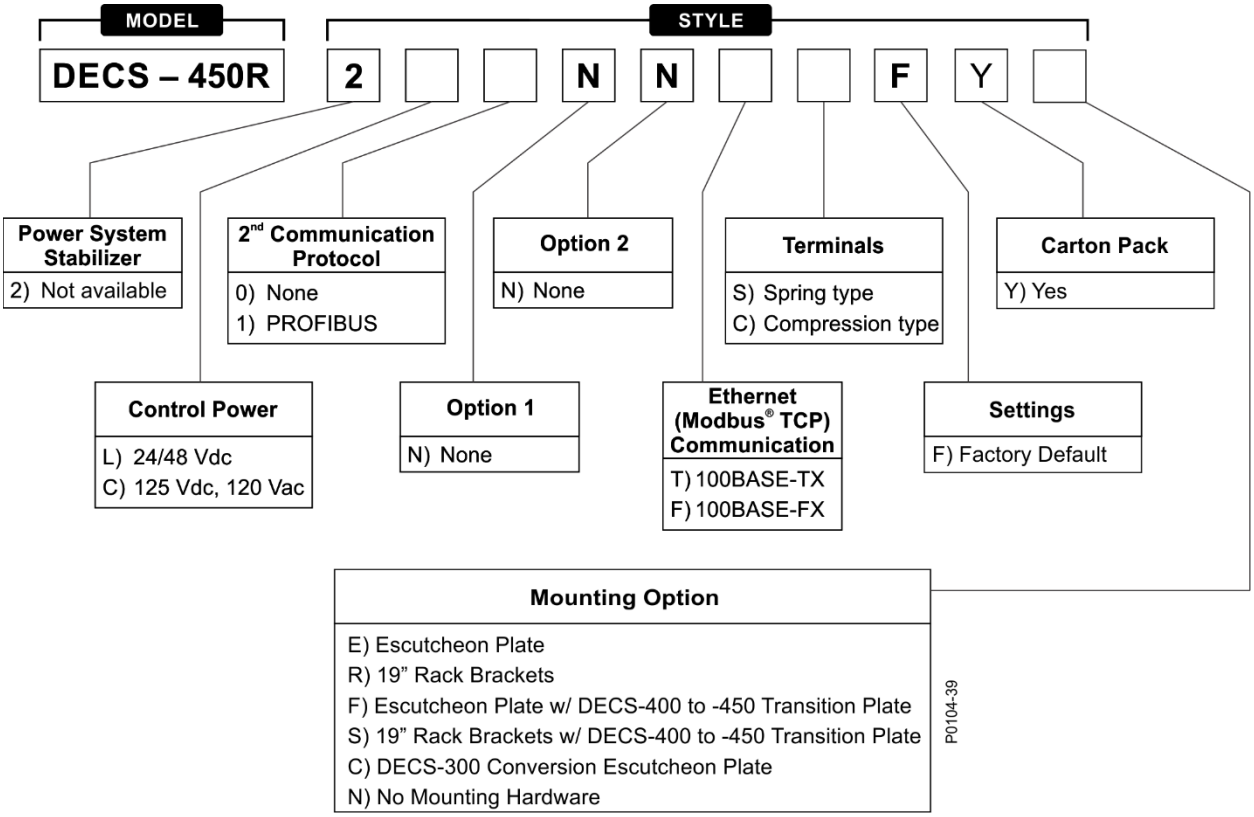


Figure 1-1. DECS-450R Style Chart

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-450R 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.

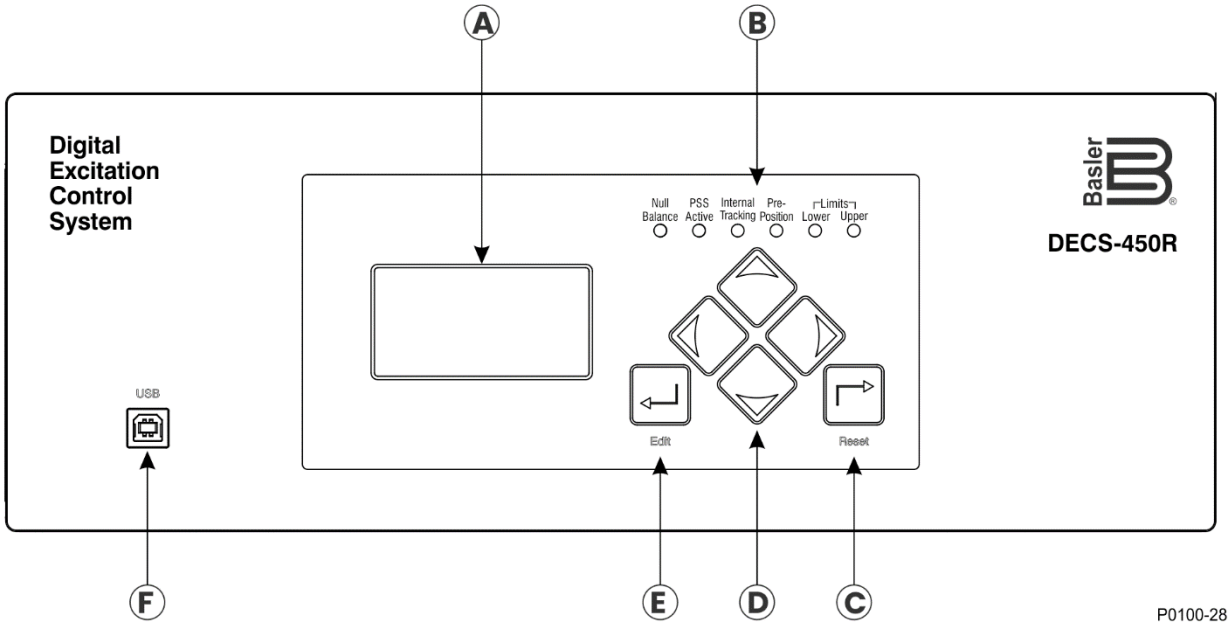


Figure 2-1. Front Panel Controls and Indicators

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-450R. 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. Not used.
	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-450R 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-450R with a PC operating BESTCOMS*Plus*® for local communication. BESTCOMS*Plus* is supplied with the DECS-450R.

Menu Navigation

The DECS-450R provides local access to DECS-450R 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 Synchronization Aux Input Tracking Control Panel Status Reports	General Settings Communication System Parameters Report Configuration Operating Settings 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-450R. 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.

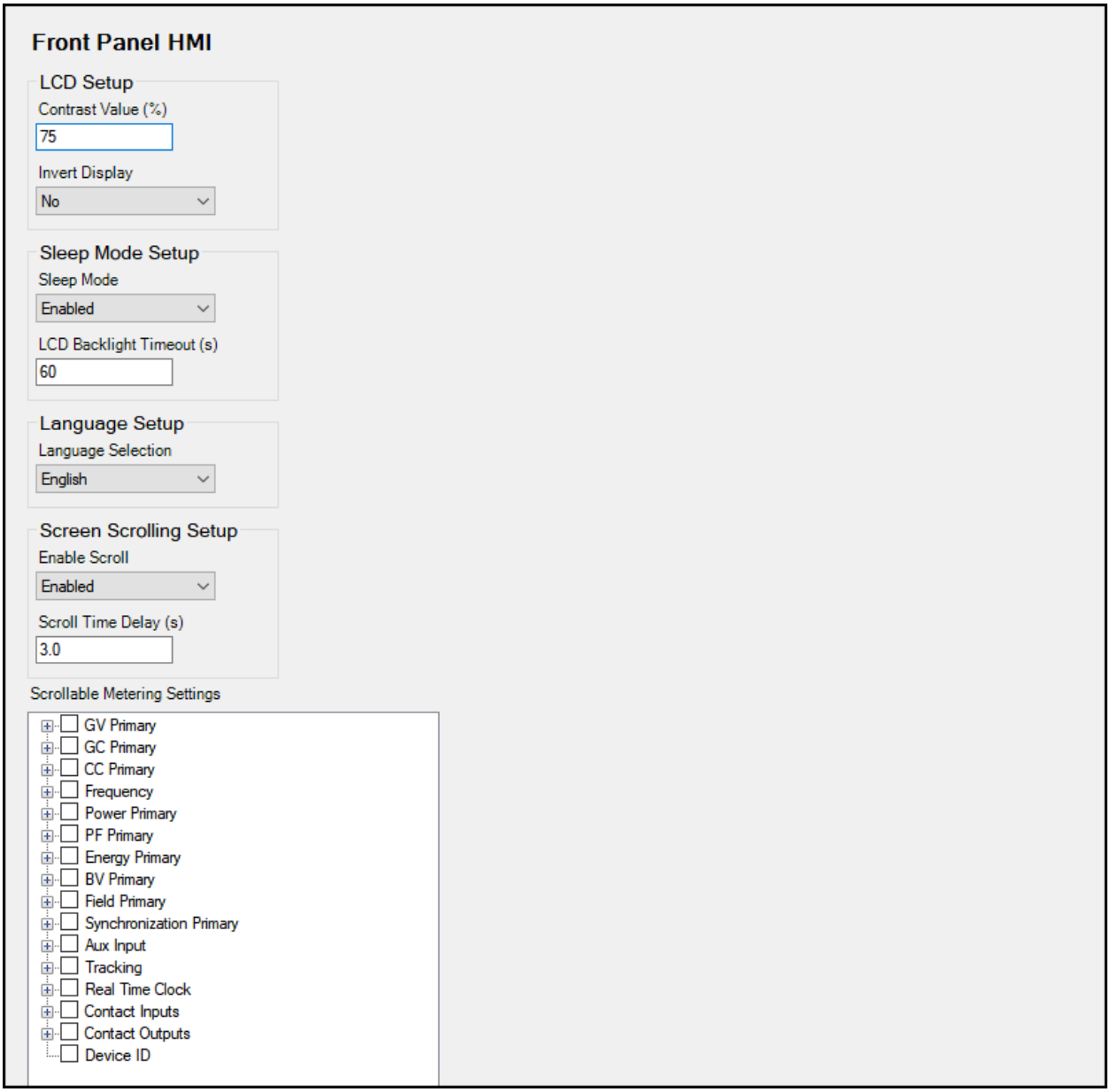


Figure 2-2. Front Panel HMI Settings

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

Generator Voltage

Three-phase generator sensing voltage is applied to DECS-450R 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-450R 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-450R 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.

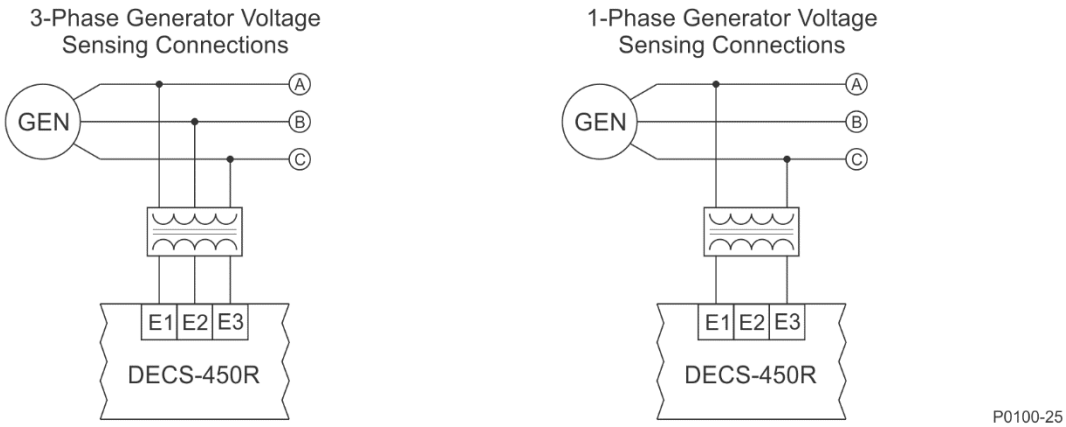


Figure 4-1. Typical Generator Voltage Sensing Connections

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-450R CT terminals are labeled with terminal numbers only.

Phase Sensing

For single- or three-phase configurations, apply A-phase sensing current to DECS-450R 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-450R is compatible with CTs having 5 Aac or 1 Aac nominal secondary ratings. The DECS-450R 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.

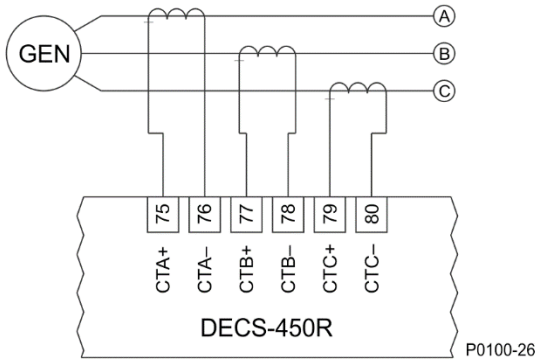


Figure 4-2. Typical Generator Current Sensing Connections

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-450R using the DECS-450R 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.

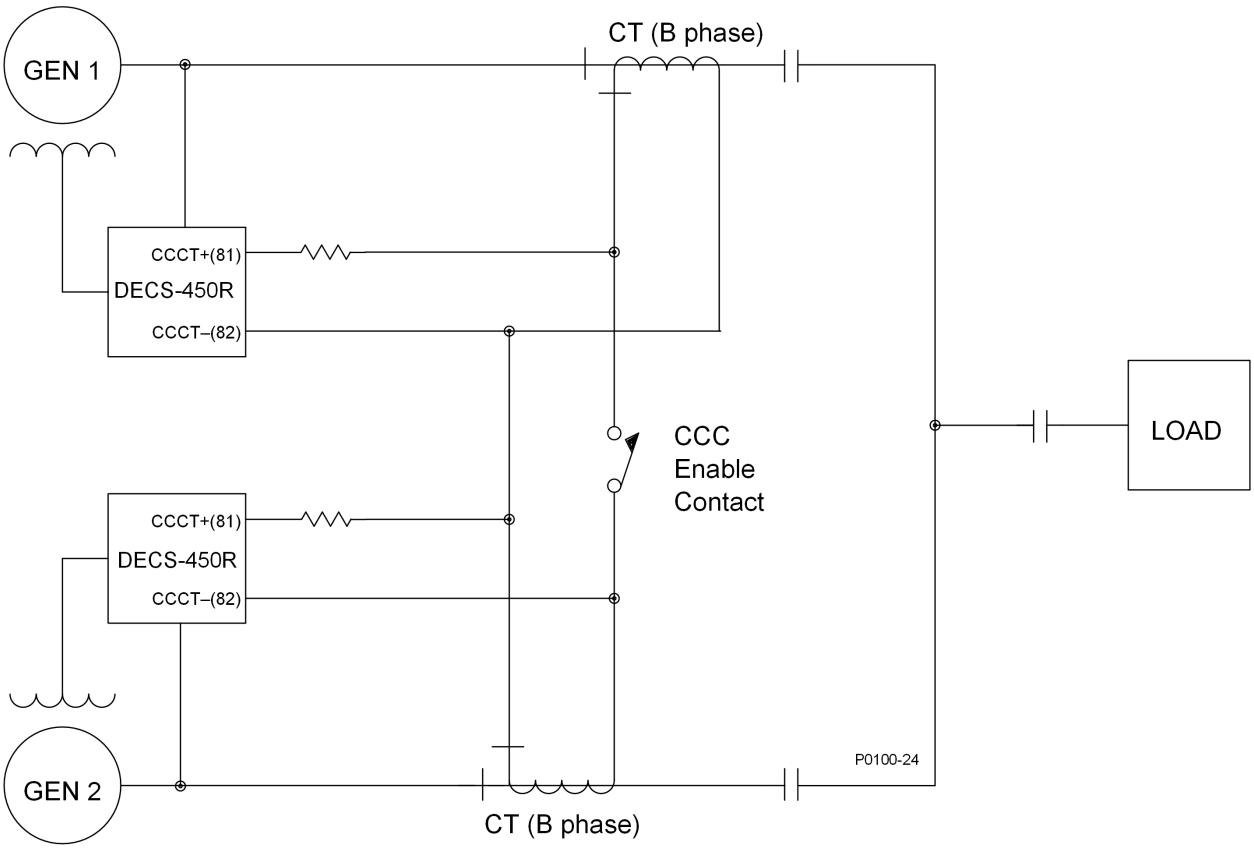


Figure 4-3. Connections for Cross-Current Compensation

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-450R 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-450R uses to interpret the applied sensing voltage. Information about configuring the DECS-450R 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.

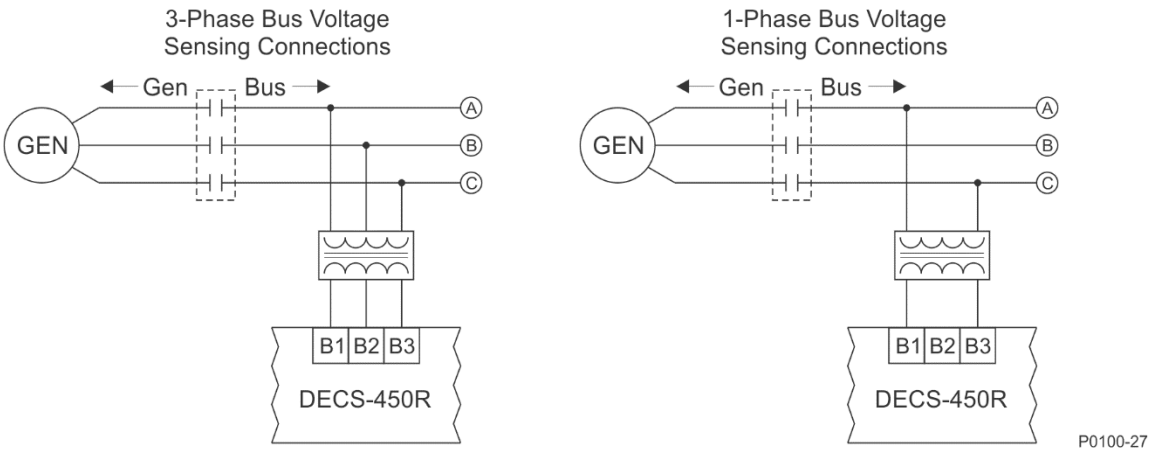


Figure 4-4. Typical Bus Voltage Sensing Connections

Field Voltage and Current

The DECS-450R 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-450R 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-450R 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-450R with a field current signal over the range of 2.0 to 9.5 Vdc, where 2.0 Vdc equals zero field current.

5 • Voltage Matching

DECS-450R controllers are equipped with voltage matching which automatically adjusts the AVR mode setpoint to match the sensed bus voltage.

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 the window in which the generator voltage must be for voltage matching to occur.

A generator to bus PT matching level setting is provided to compensate for step-up or step-down transformers in the system. The DECS-450R adjusts the sensed generator voltage by this percentage. To calculate the appropriate Gen to Bus PT Match Level value, refer to Equation 5-1.

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

Equation 5-1. Gen to Bus PT Match Level Calculation

Voltage matching settings are illustrated in Figure 5-1.

Figure 5-1. Voltage Matching Settings

6 • Regulation

The DECS-450R 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-450R 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-450R 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-450R 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-450R contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450R 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-450R 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-450R 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-450R contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450R 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-450R 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-450R 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-450R contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450R 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-450R 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.

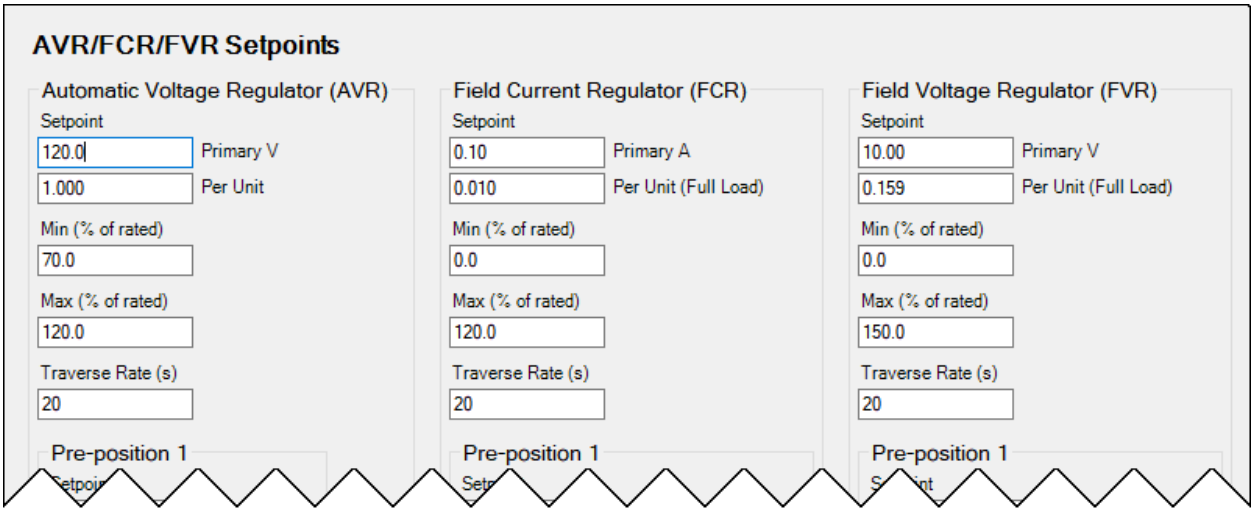


Figure 6-1. AVR, FCR, and FVR Regulation Settings

Var

When operating in var mode, the DECS-450R 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-450R contact inputs configured for raising and lowering the active setpoint
- Application of an analog control signal at the DECS-450R 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-450R 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-450R 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-450R is operating in Var or Power Factor regulation modes. PF Active Power Level establishes the level of generator output power (kW) where the DECS-450R switches to/from Droop Compensation/Power Factor mode. If the level of power decreases below the setting, the DECS-450R switches from Power Factor mode to Droop Compensation mode. Conversely, as the level of power increases above the setting, the DECS-450R switches from Droop Compensation mode to Power Factor mode.

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

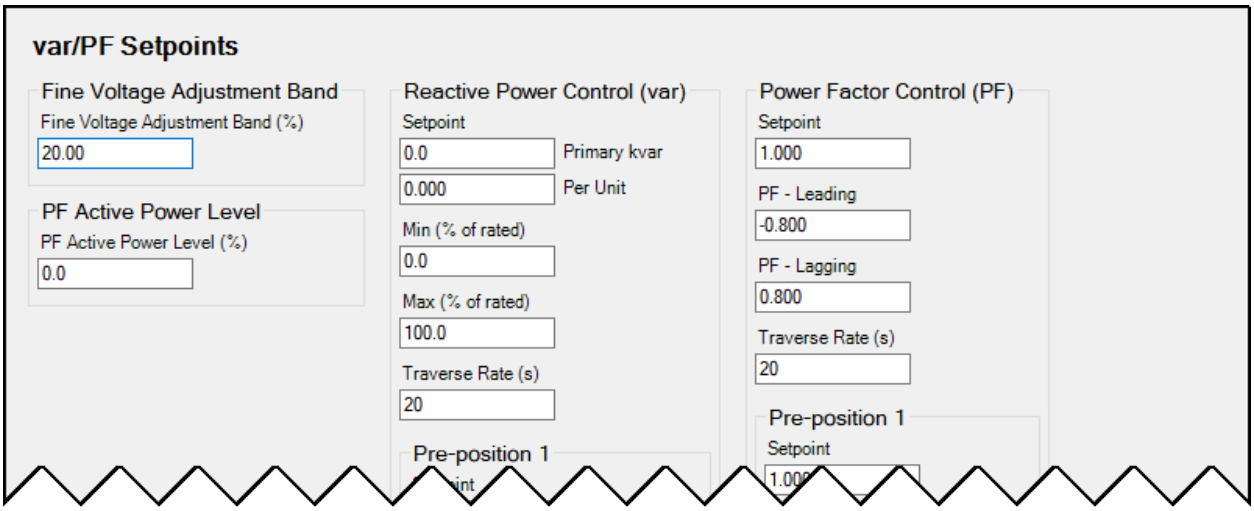


Figure 6-2. Var and Power Factor Regulation Settings

Pre-Position Setpoints

Each regulation mode has three pre-position setpoints that allow the DECS-450R 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-450R 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.)

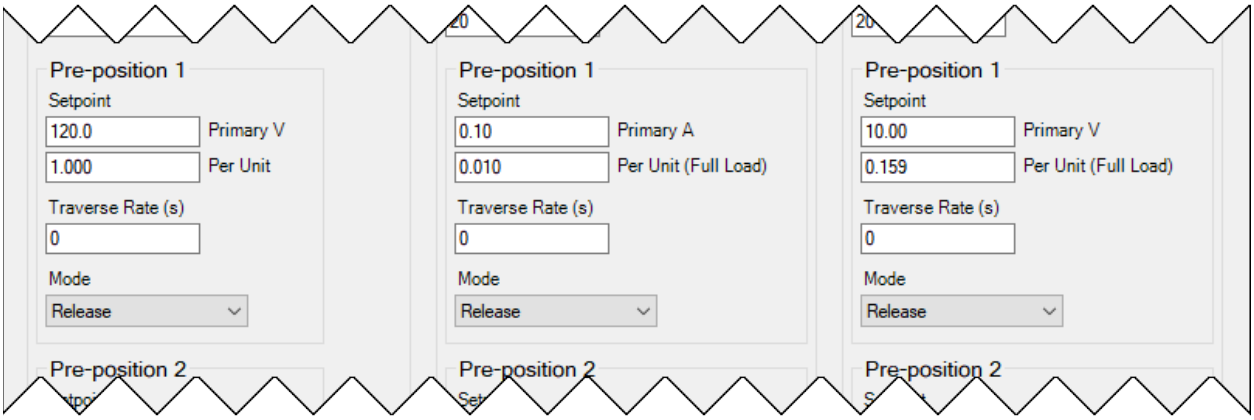


Figure 6-3. Pre-Position Setpoints

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

Operation with Paralleled Generators

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

The DECS-450R provides several functions for load sharing among paralleled generators: reactive droop compensation, line drop compensation, and cross-current compensation. The DECS-450R 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 6-5 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-450R 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-450R to respond with the proper level of regulation. The response of the DECS-450R 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.

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-450R 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 6-5 for an illustration of the Line drop compensation settings.

Figure 6-5. 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 regulation mode setpoint tracking is a standard feature on the DECS-450R. Autotracking settings are illustrated in Figure 6-6.

Internal Setpoint Tracking

In applications using a single DECS-450R, 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-450R 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.

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

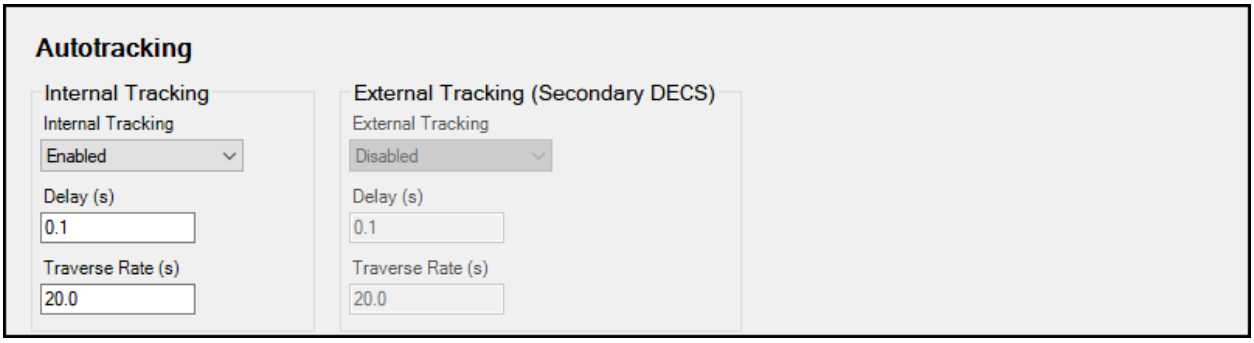


Figure 6-6. Autotracking Settings

Setpoint Configure

When Auto Save is enabled, the DECS-450R automatically saves the active setpoint in 10-minute intervals. Otherwise, the last setpoint sent to the DECS-450R is retained. Figure 6-7 illustrates the Setpoint Configure screen.

Figure 6-7. 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-450R accepts an external analog signal for auxiliary control of the regulation setpoint (in all modes), or limiter scaling. 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 analog control input can be used for auxiliary control of the regulation setpoint, limiter scaling, or for metering only.

When using a current auxiliary control input, the DECS-450R responds to out-of-range inputs in the following ways. If the applied signal decreases below 2 mAdc, the DECS-450R 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.

Limiter Scaling

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

Setpoint Limits

Minimum and maximum setpoint limits are observed when With Limit is enabled.

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-450R into a voltage signal in the range of –10 to +10 Vdc. The DECS-450R 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.

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 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 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.

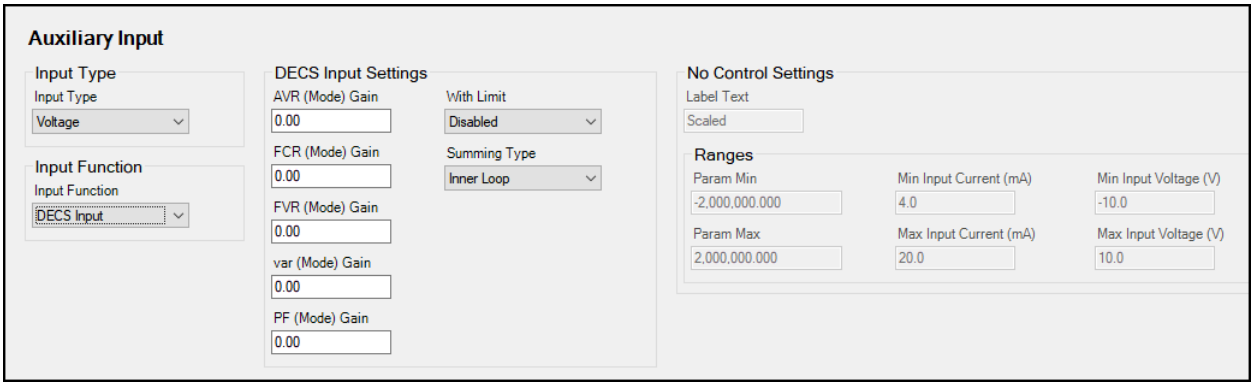


Figure 7-1. Auxiliary Input Settings

8 • Programmable Inputs and Outputs

Sixteen isolated contact sensing inputs (14 programmable, 2 fixed) are available for initiating DECS-450R 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-450R metered values.

An analog input is provided for auxiliary control of the regulation setpoint, 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-450R actions. Two of the contact inputs are fixed-function inputs: Start and Stop. The remaining 14 contact inputs are programmable.

All DECS-450R 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-450R. If the DECS-450R 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

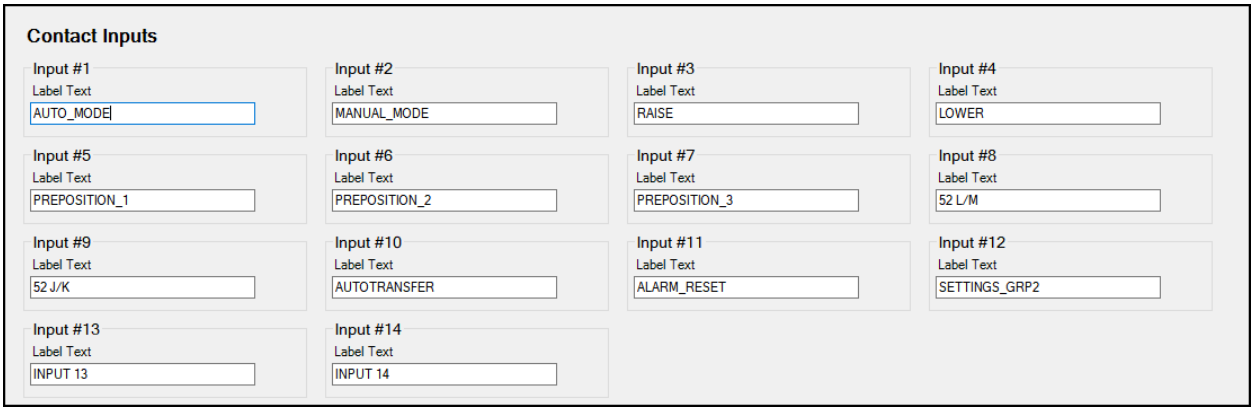


Figure 8-1. Contact Input Label Text

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-450R contact outputs consist of a dedicated watchdog output and 11 programmable outputs.

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-450R 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.

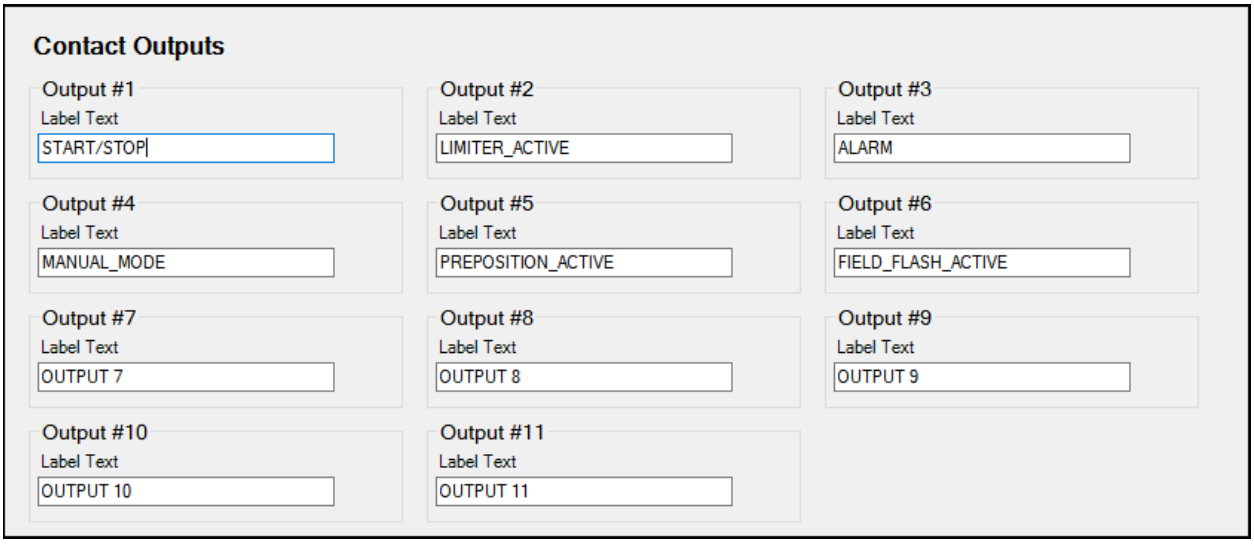


Figure 8-2. Contact Output Label Text

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

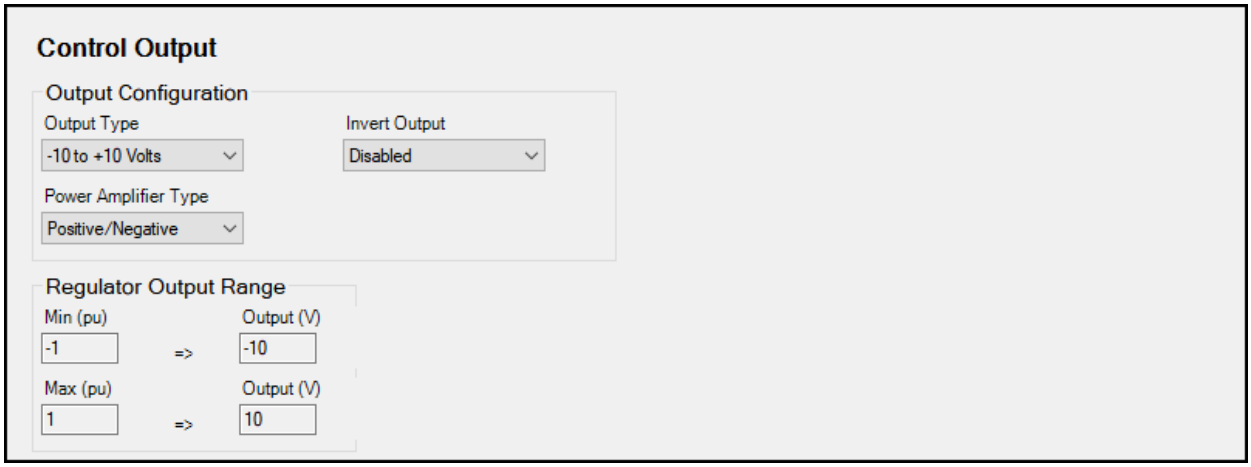


Figure 8-3. Control Output Screen

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.

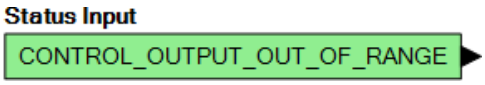


Figure 8-4. Control Output Out of Range Status Input

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:

- Auxiliary Input Current (mA)
- Auxiliary Input Voltage
- Bus Frequency
- Bus Voltage: VAB, VBC, or VCA
- Control Output pu (per unit)
- 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

- Positive Sequence Current
- Positive Sequence Voltage
- Setpoint Position
- 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.

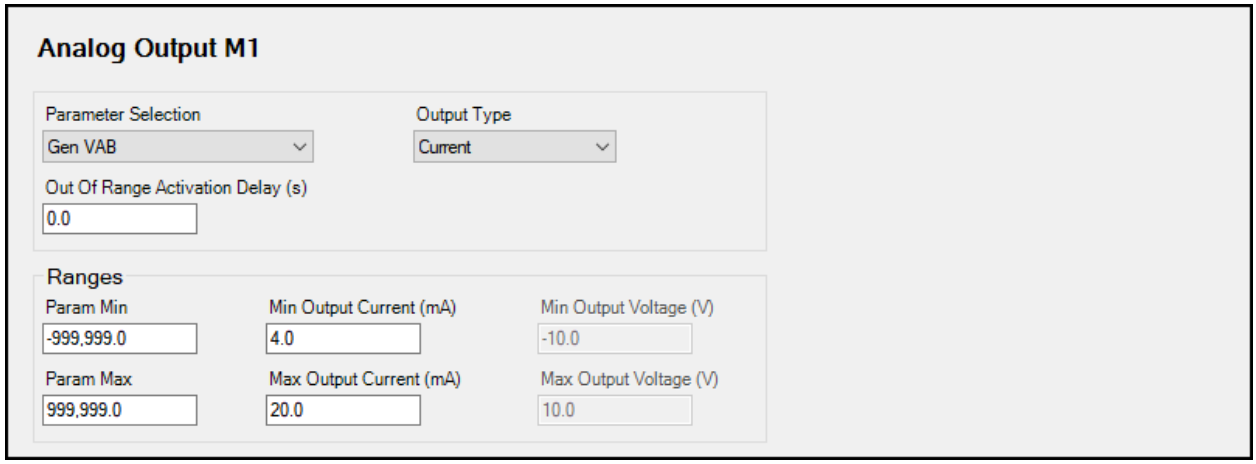


Figure 8-5. Analog Output M1 Screen

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.

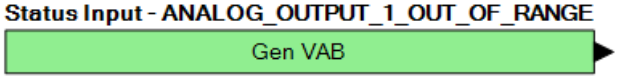


Figure 8-6. Analog Output 1 Out of Range Status Input

9 • Protection

The DECS-450R offers protection relating to machine voltage, frequency, power, field parameters, and generator-to-bus synchronism. 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 generator undervoltage, generator overvoltage, and loss of sensing voltage.

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 9-1.

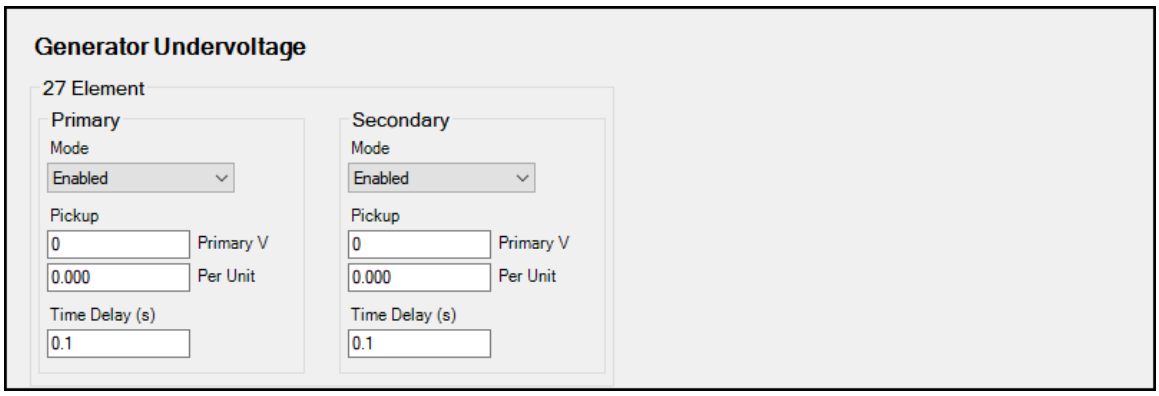


Figure 9-1. Generator Undervoltage Protection Settings

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 9-2.

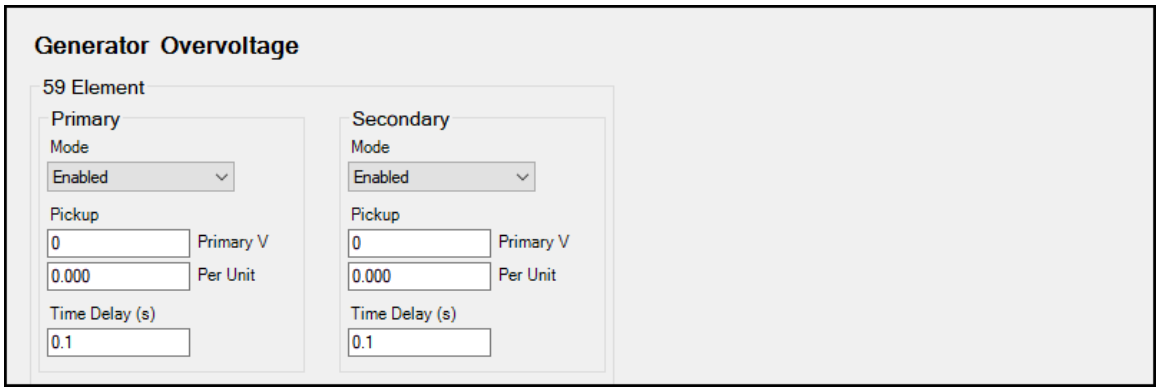


Figure 9-2. Generator Overvoltage Protection Settings

Loss of Sensing

The generator voltage is monitored for a loss of sensing (LOS) condition. LOS protection settings are illustrated in Figure 9-3.

In the DECS-450R, 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 9-3. 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 9-4.

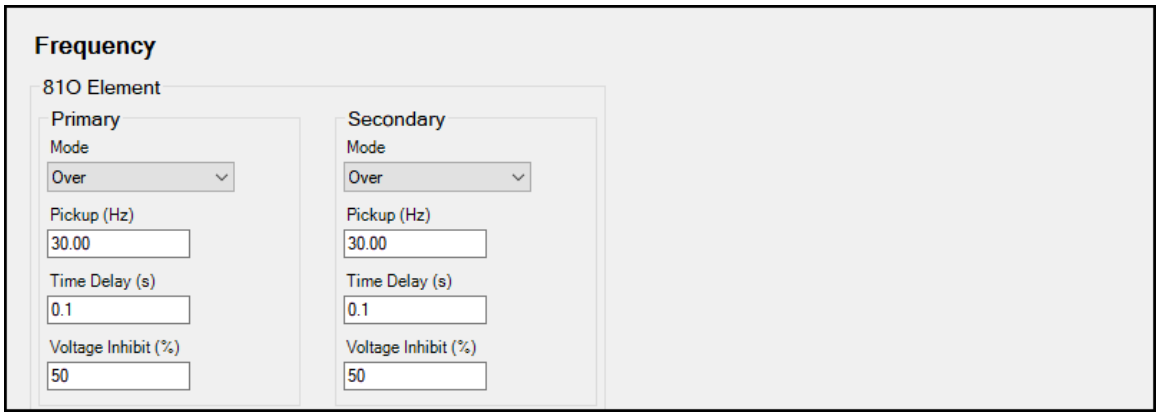


Figure 9-4. Overfrequency Protection Settings

Underfrequency

The DECS-450R 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 9-5.

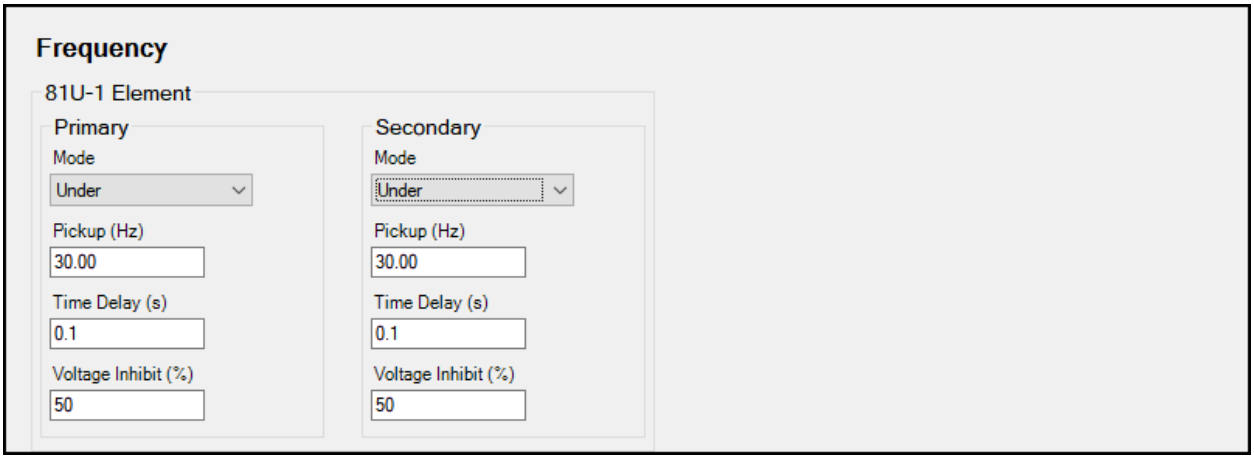


Figure 9-5. Underfrequency Protection Settings

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-450R 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.

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 9-6.

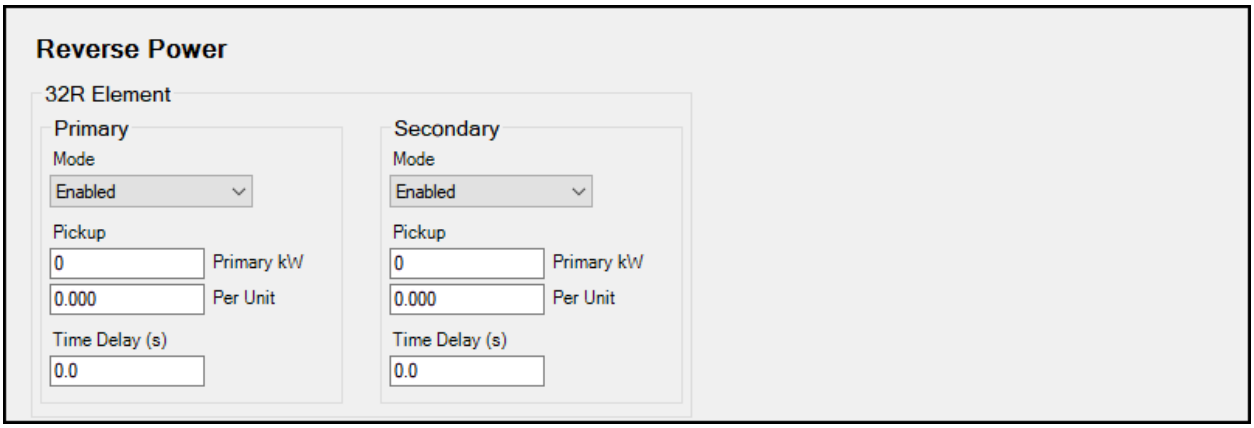


Figure 9-6. Reverse Power Protection Settings

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 9-7. BESTCOMS*Plus* settings are described below and shown in Figure 9-8.

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 9-7 for details.

Motor Protection

The DECS-450R 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 9-7.

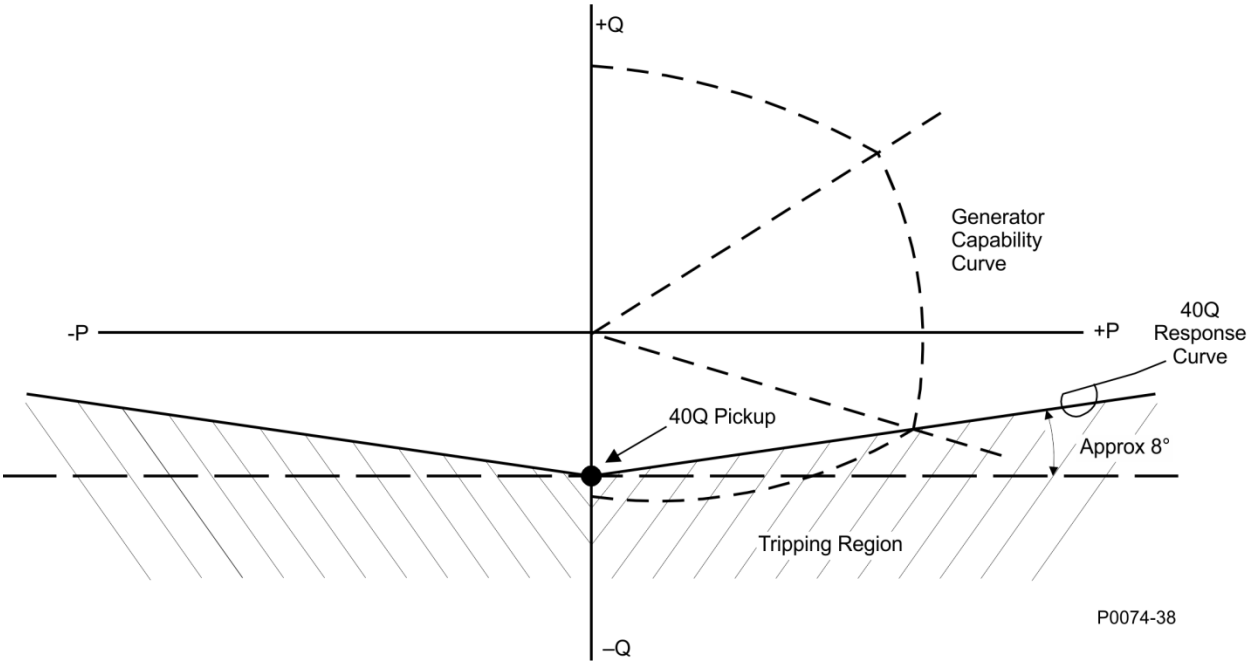


Figure 9-7. Generator Capability Curve vs. 40Q Response

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 9-8.

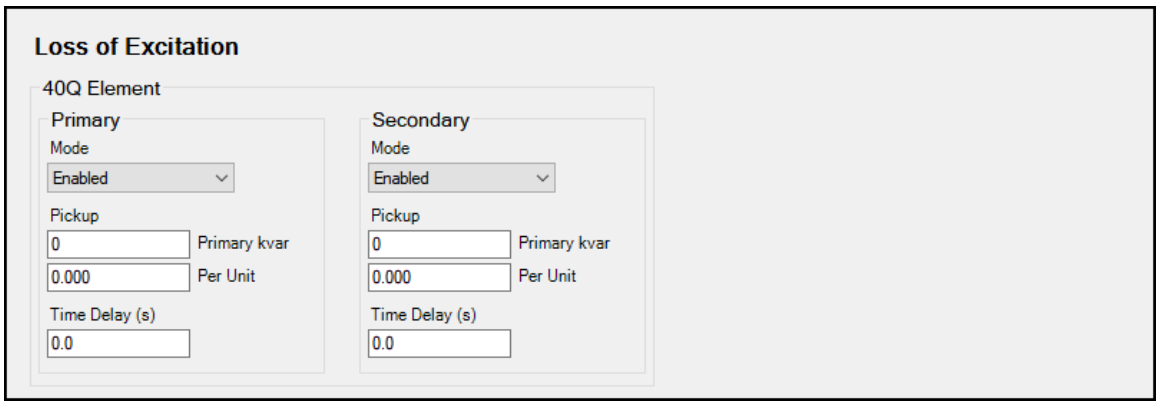


Figure 9-8. Loss of Excitation Protection Settings

Field Protection

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

Field protection provided by the DECS-450R includes field overvoltage, field overcurrent, and loss of field isolation transducer.

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 9-9.

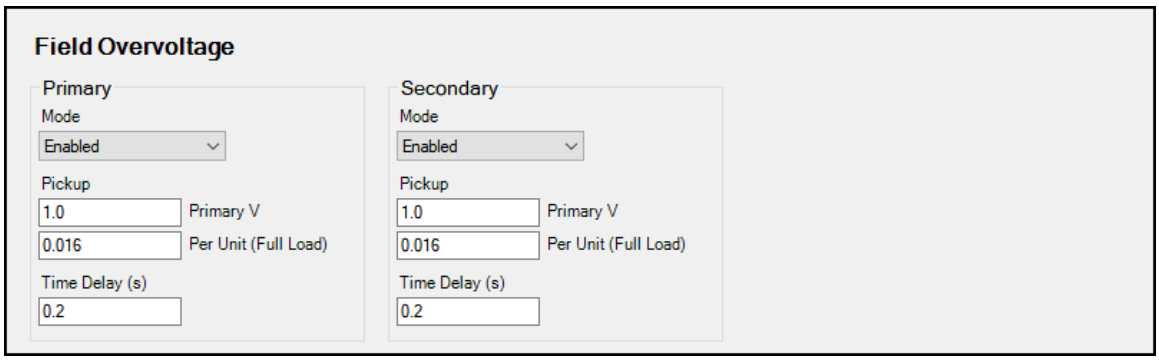


Figure 9-9. Field Overvoltage Protection Settings

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-450R 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 9-1) and reset time (Equation 9-2) delays.

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

Equation 9-1. 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 9-2. 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>

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 9-10. In BESTCOMS*Plus,* a plot of the field overcurrent setting curve is displayed. The plot can display the primary or secondary setting curves.

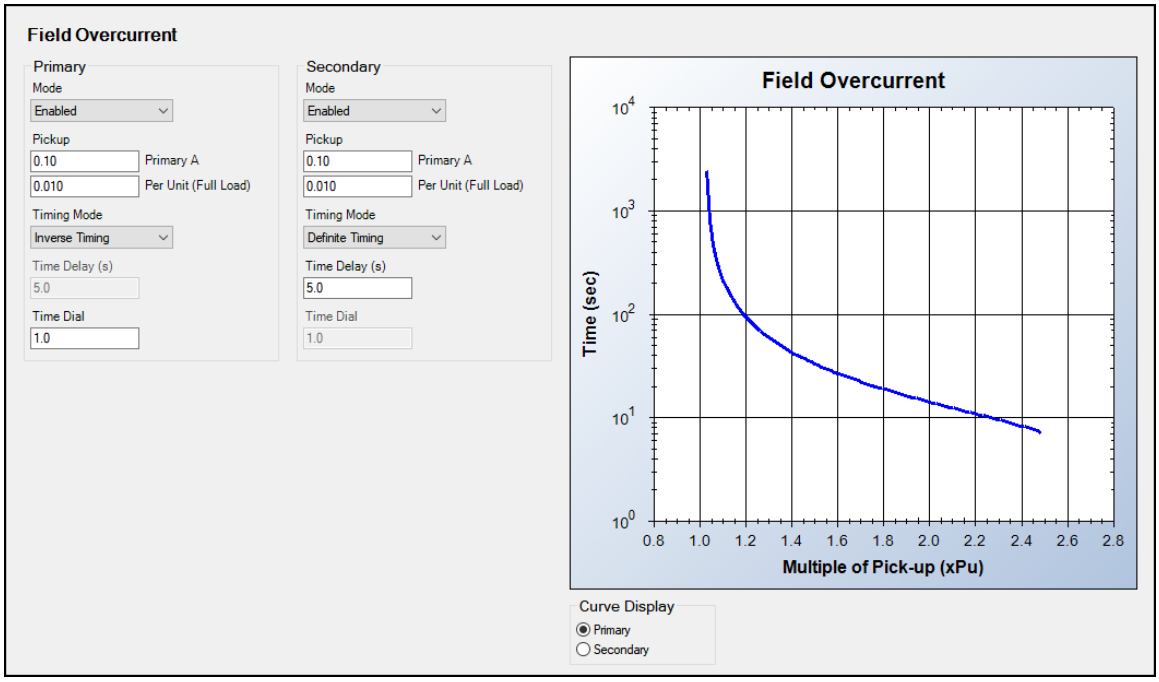


Figure 9-10. Field Overcurrent Protection Settings

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 9-11. Loss of Field Isolation Transducer 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-450R 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-450R automatic synchronizer, consider separate sync-check supervision.

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-450R 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 9-12.

Figure 9-12. Sync-Check Protection Settings

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.

10 • Limiters

DECS-450R 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-450R 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*.

Two styles of overexcitation limiting are available in the DECS-450R: summing point or takeover. 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: low and high. Figure 10-1 illustrates the relationship of the high-level and low-level OEL thresholds.

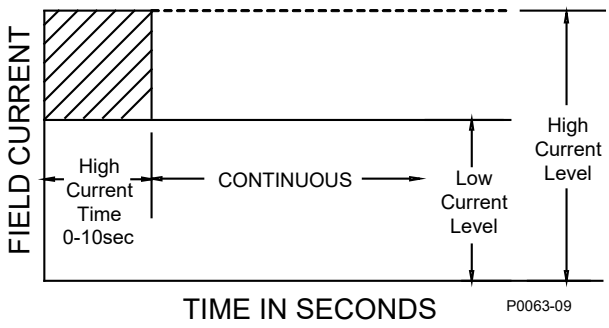


Figure 10-1. Summing Point, Offline, Overexcitation Limiting

The Offline, Low-Level OEL threshold is determined by the Low-Level setting. When the OEL becomes inactive, the High Current Timer counts down from either 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 with this level of excitation.

The Offline, High-Level OEL threshold is determined by the High Level and High Time settings. When the excitation level exceeds the High Level setting, the DECS-450R acts to limit the excitation to the value of

the High-Level setting and a High Level Timer is initiated. If this level of excitation persists until this timer reaches the High Time setting, the DECS-450R acts to limit the excitation to the value of the Low-Level setting.

Online Operation

For online operation, there are three levels of summing-point overexcitation limiting: low, medium, and high. Figure 10-2 illustrates the relationship of the low-, medium-, and high-level OEL thresholds.

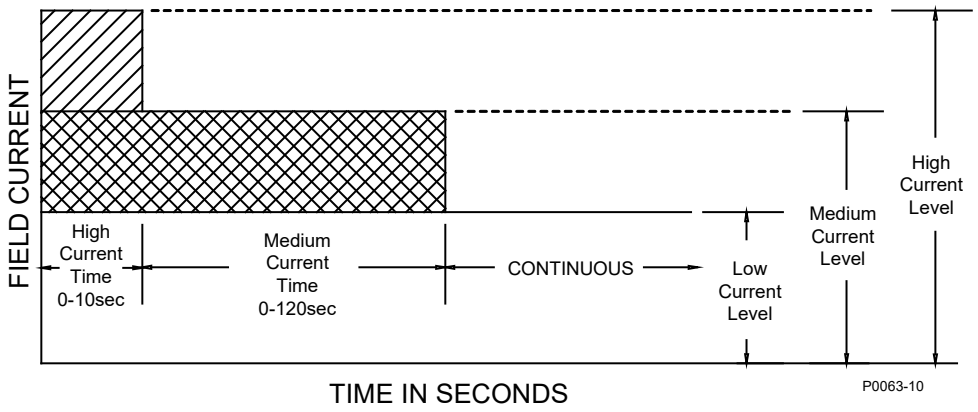


Figure 10-2. Summing Point, Online, Overexcitation Limiting

The online, low-level OEL threshold is determined by the low-level setting. When the excitation level is below the low-level setting, no action is taken by the DECS-450R. The generator is permitted to operate indefinitely with this level of excitation. When the excitation level exceeds the low-level setting for the duration of the medium and high time settings, the DECS-450R acts to limit the excitation to the value of the low-level setting.

The online, medium-level OEL threshold is determined by a medium level and medium time setting. When the excitation level exceeds the medium level setting for the duration of the high time setting, the DECS-450R acts to limit the excitation to the value of the medium-level setting.

The online, high-level OEL threshold is determined by a high level and high time setting. When the excitation level exceeds the high level setting, the DECS-450R instantaneously acts to limit the excitation to the value of the high-level setting.

Figure 10-3. OEL Configuration Settings

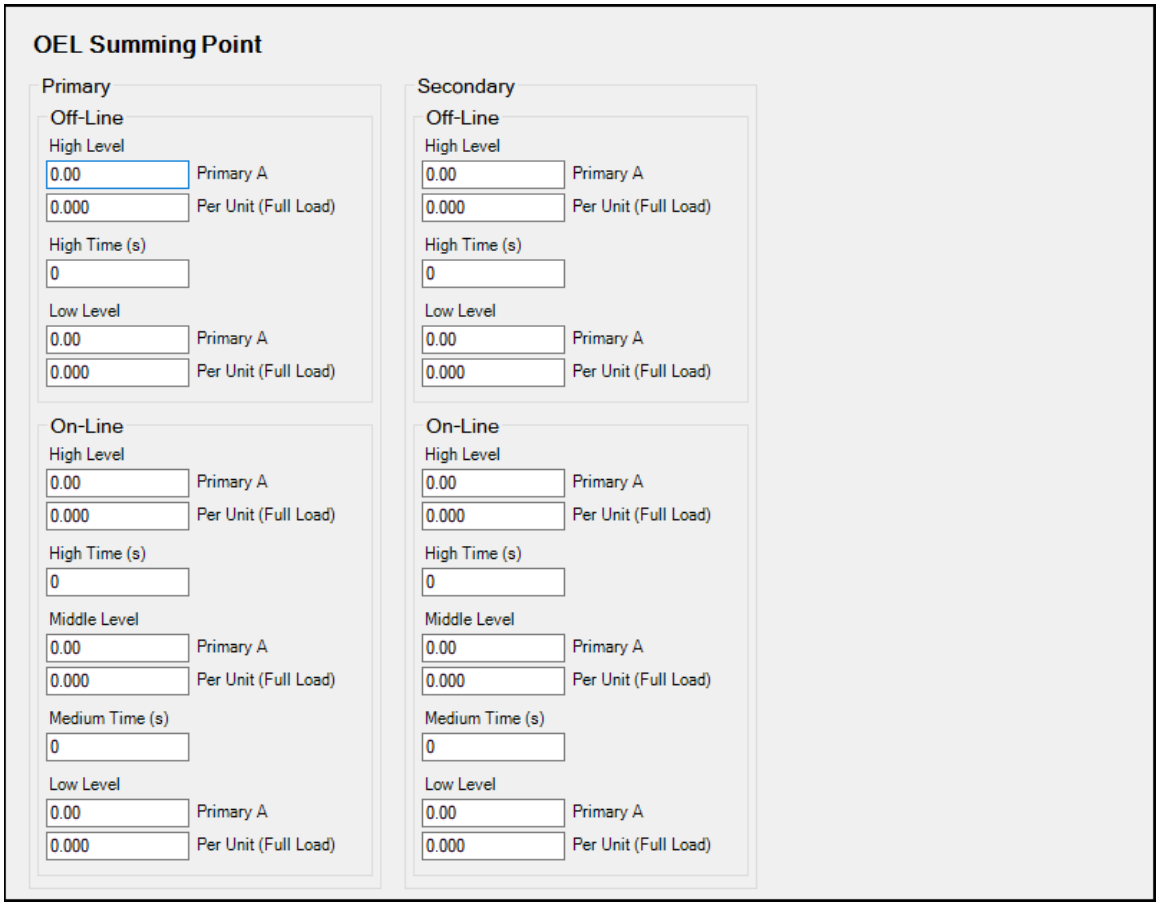


Figure 10-4. Summing Point OEL Settings

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. 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>

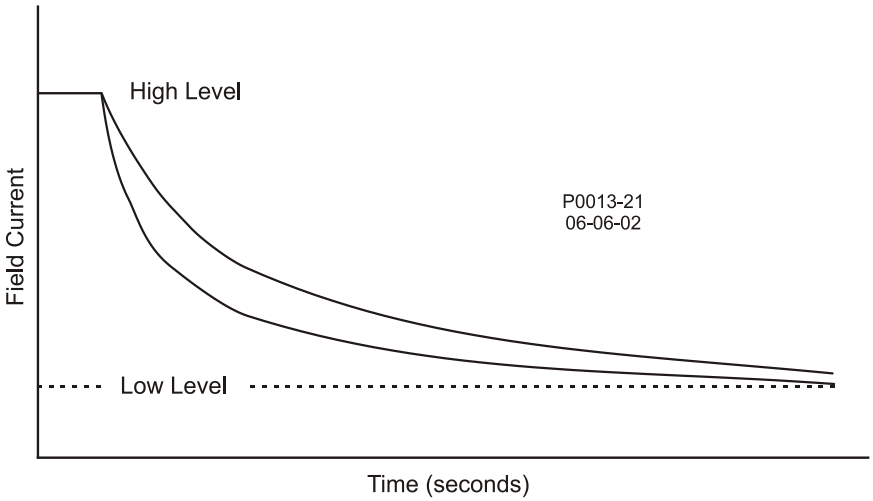


Figure 10-5. Inverse Time Characteristic for Takeover OEL

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).

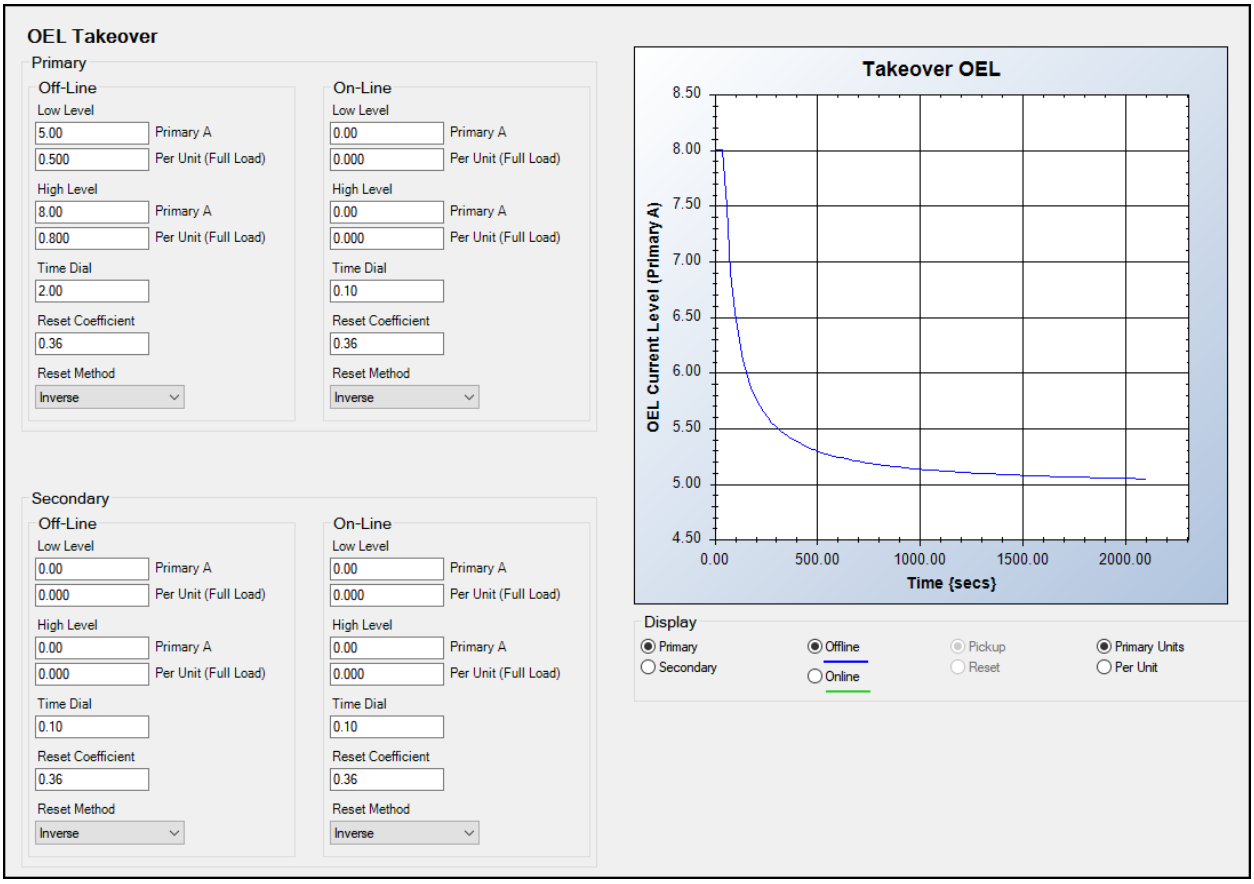


Figure 10-6. Takeover OEL Settings

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

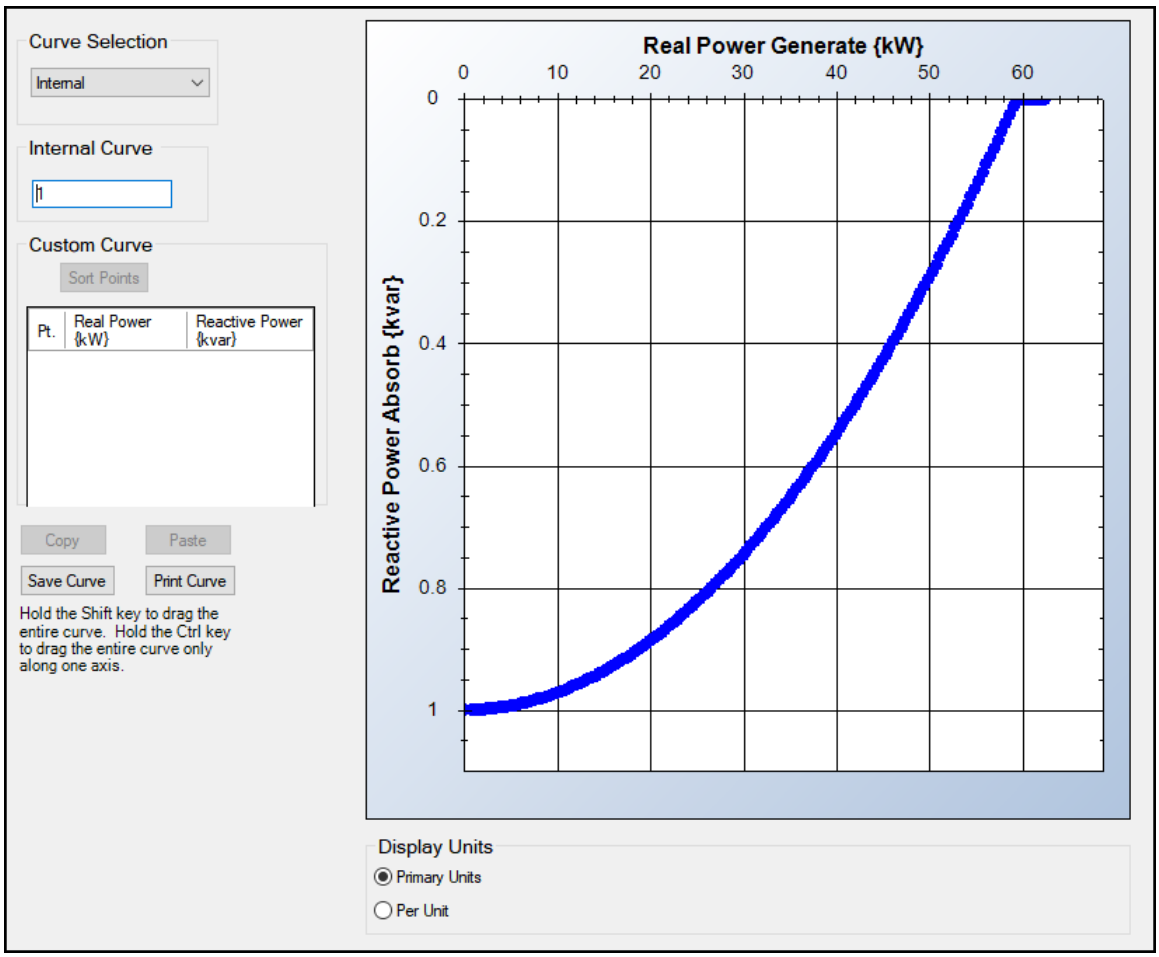


Figure 10-8. UEL Custom Curve Screen

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-450R 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.

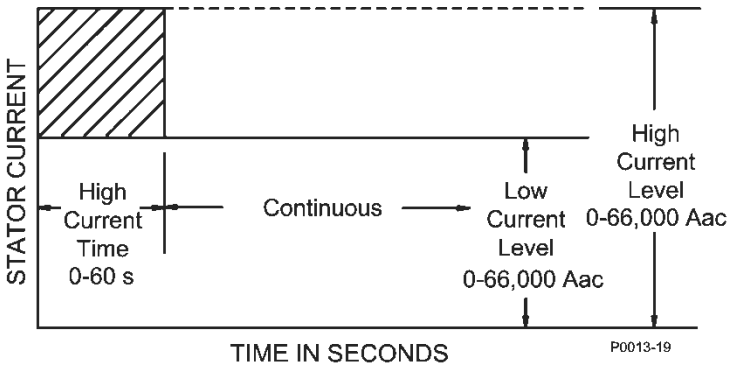


Figure 10-9. Stator Current Limiting

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).

Low-Level Limiting

When the stator current exceeds the low-level setting, the DECS-450R annunciates the elevated level. If this condition persists for the duration of the High SCL Time setting, the DECS-450R 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-450R. 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-450R 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-450R 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.

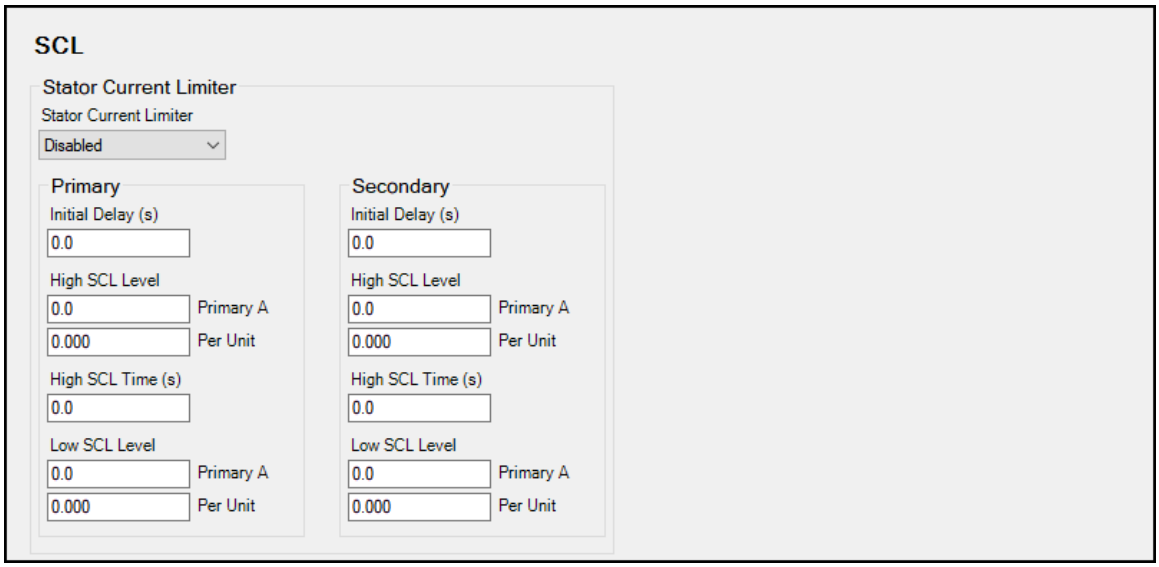


Figure 10-10. Stator Current Limiter Settings

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-450R 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-450R auxiliary control input. 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.

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.

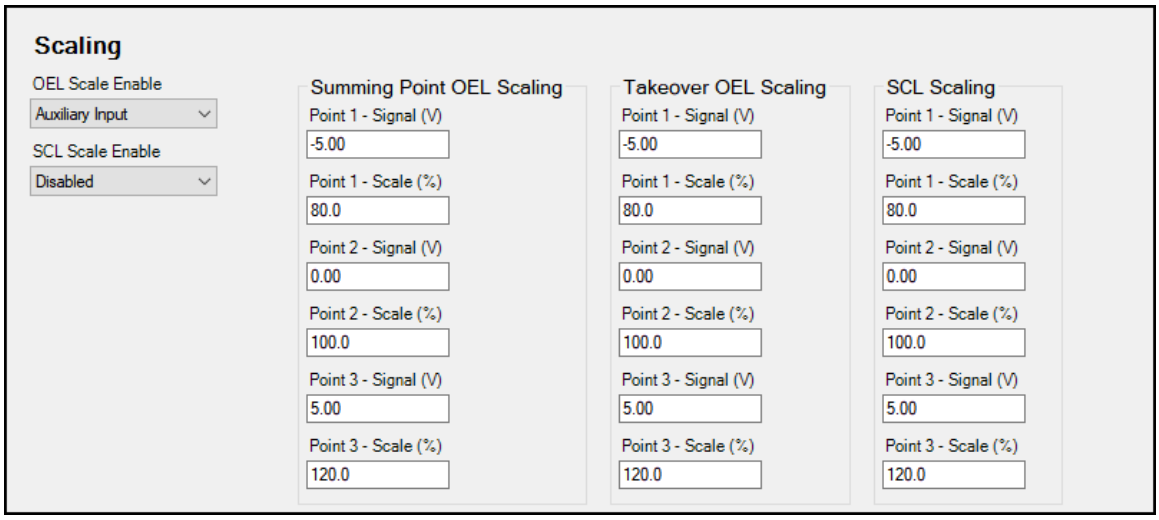


Figure 10-12. Limiter Scaling Settings

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.

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-450R 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-450R to precisely match the operating characteristics of the prime mover and the loads being applied to the generator.

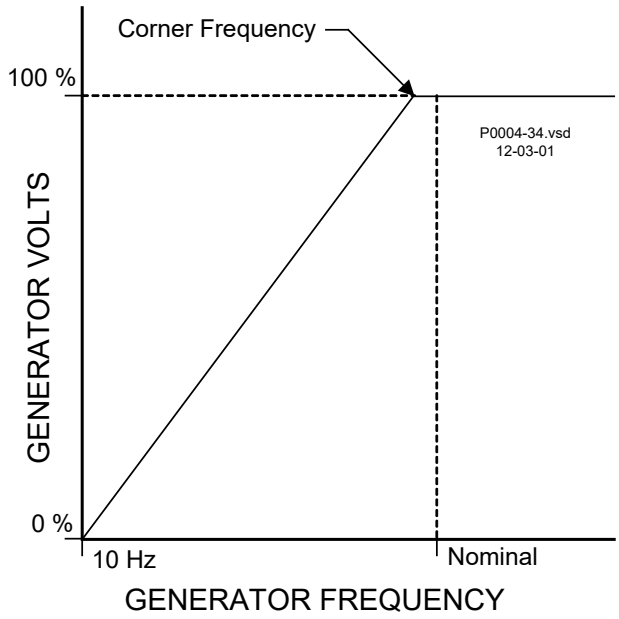


Figure 10-13. Typical Underfrequency Compensation Curve

Volts per Hertz

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

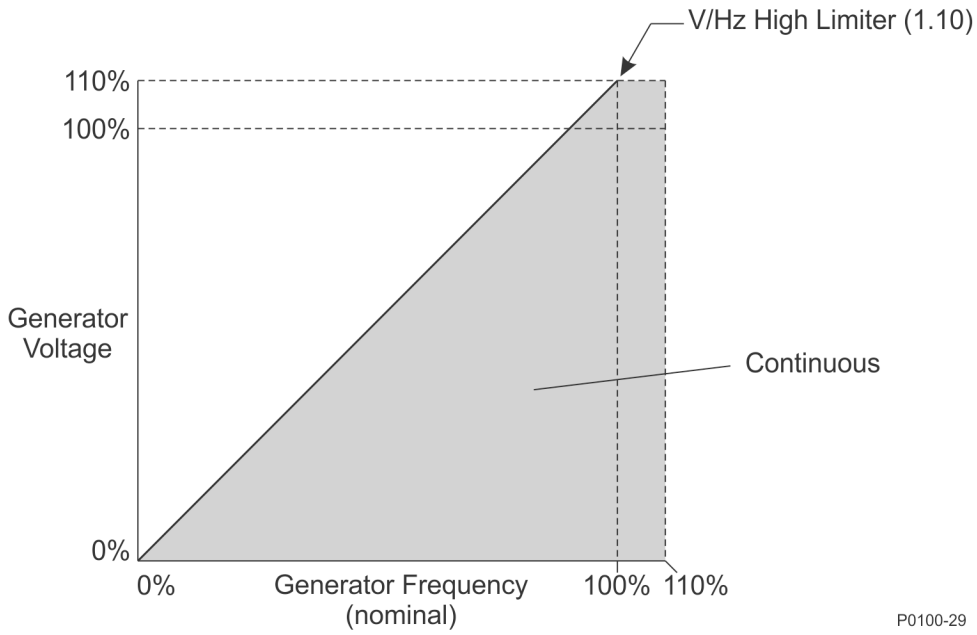


Figure 10-14. Typical Volts per Hertz Limiter Slopes

Volts per hertz limiter operation is established by the V/Hz High Limiter and V/Hz Time Limiter settings. The generator may operate continuously at setpoints below the high limit threshold. The regulation setpoint is prevented from exceeding the value of the high limit threshold at all times.

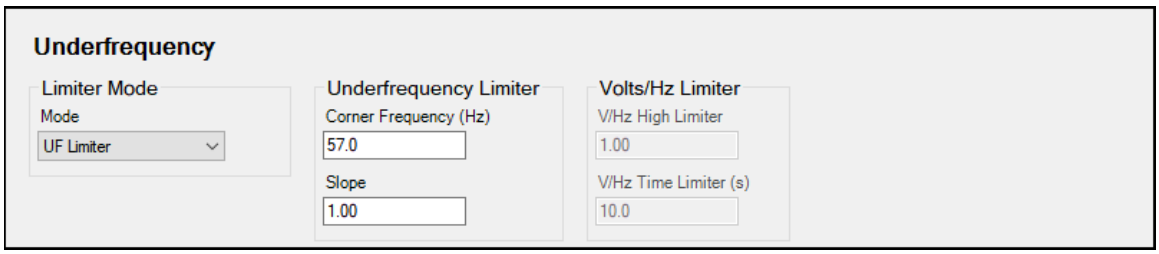


Figure 10-15. Underfrequency/Volts per Hertz Limiter Settings

11 • Metering

The DECS-450R 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-450R 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.

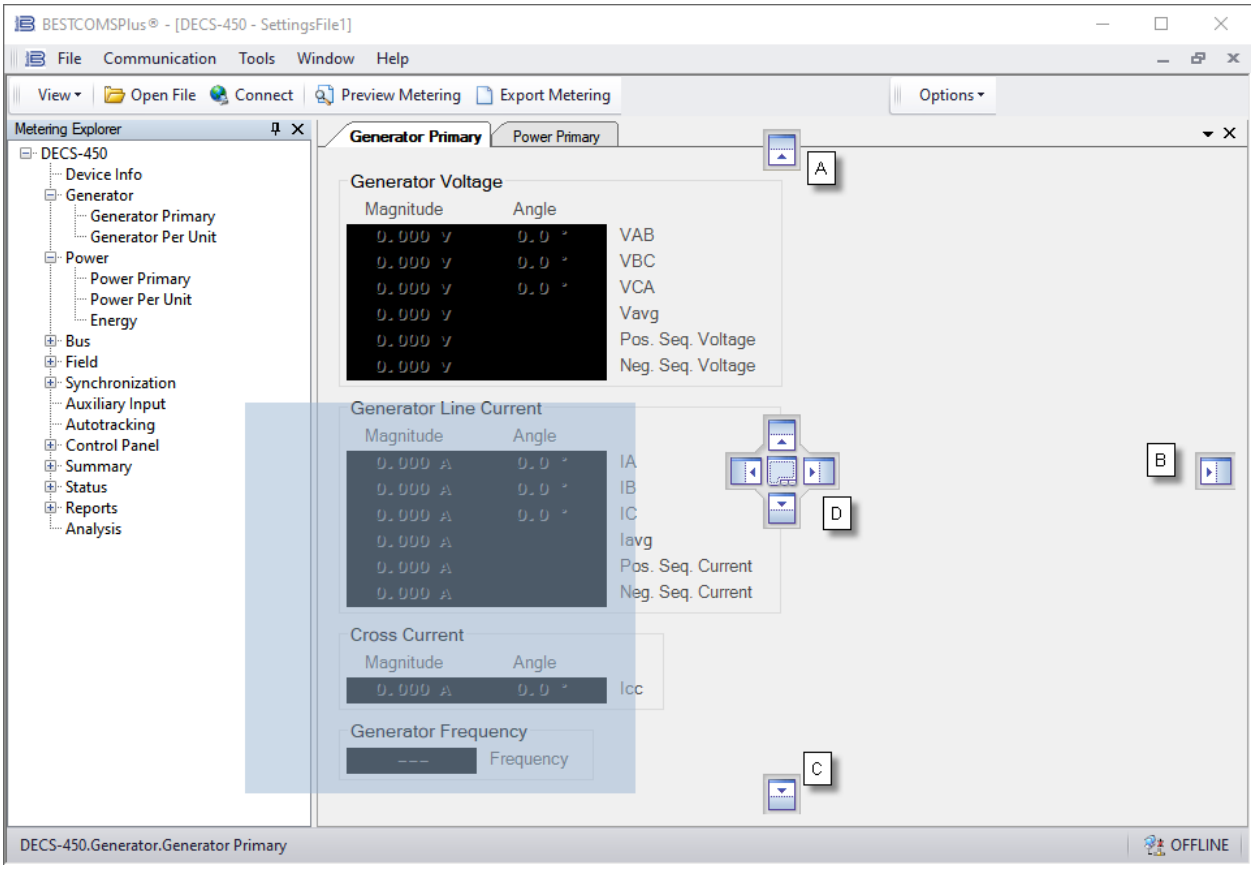


Figure 11-1. Metering Screen Docking Controls

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-450R metering categories include generator, power, bus, field, 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.

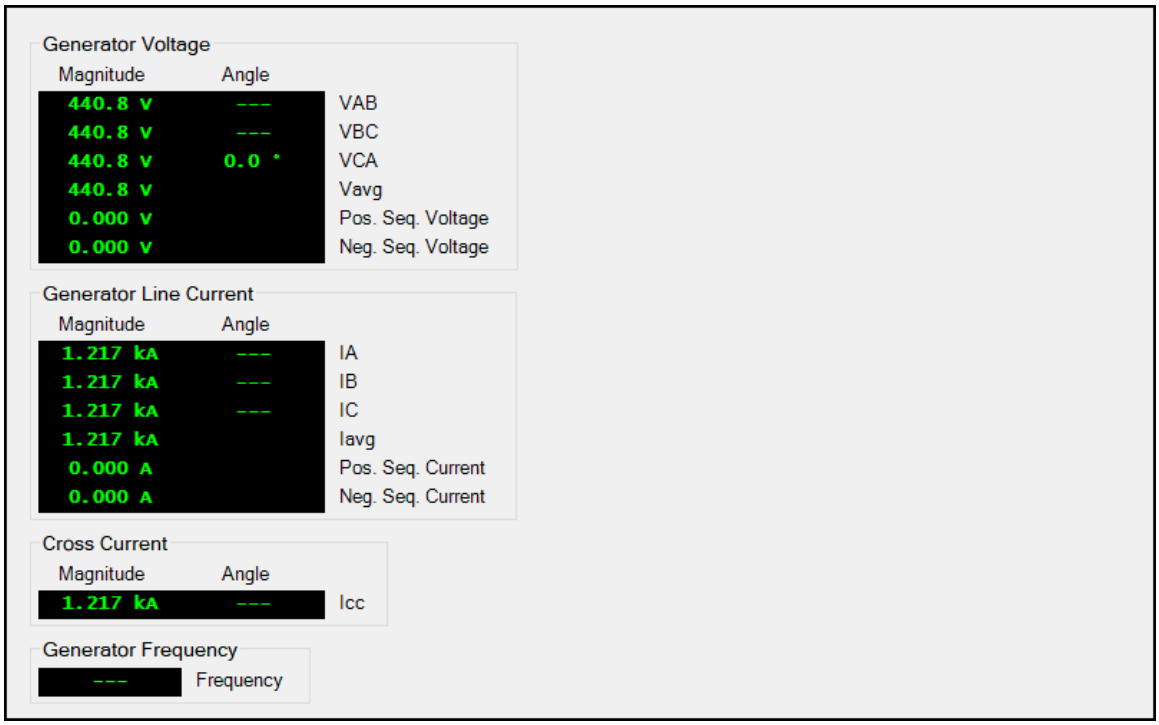


Figure 11-2. Generator Primary-Values Metering

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) and field current (Ifd).

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

Synchronization

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

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

Figure 11-7. Synchronization Primary Values Metering

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-450R 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 11-8. 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-450R 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 and null balance, which indicates when the setpoint of an inactive operating mode matches the metered value.

Figure 11-9. 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, and Null Balance status.

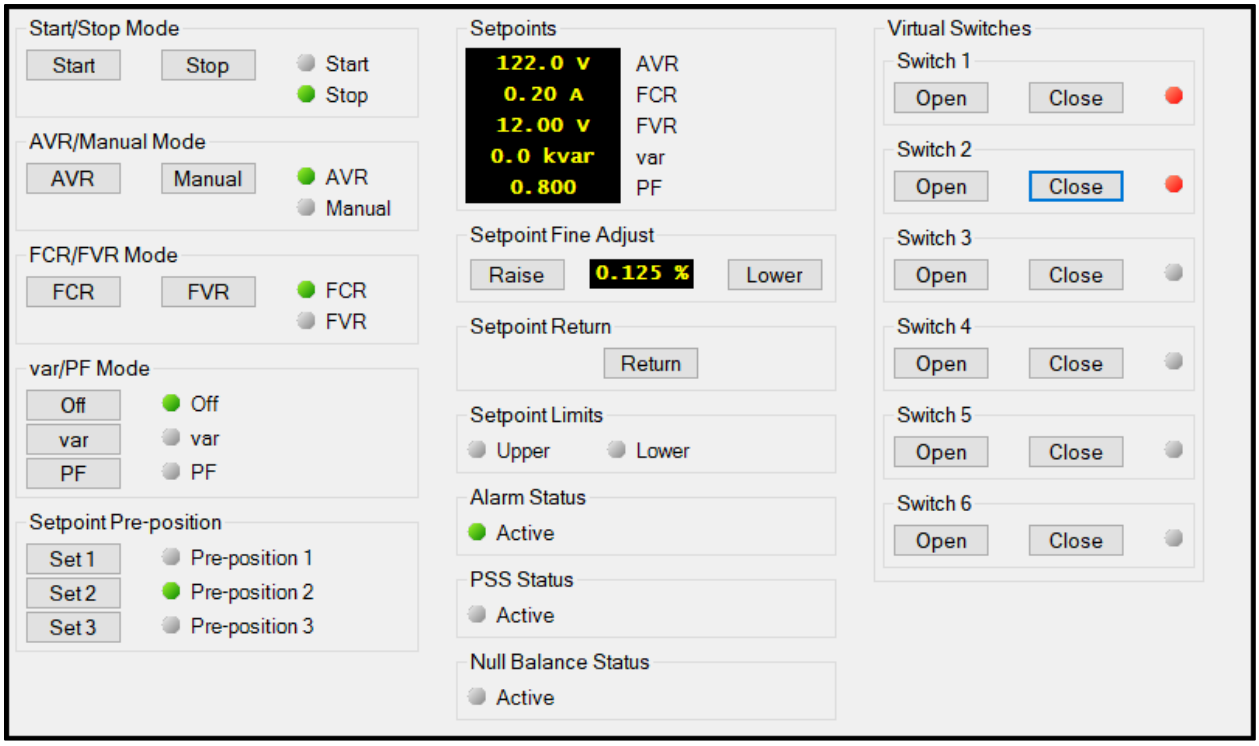


Figure 11-10. Control Panel

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

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.

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*.

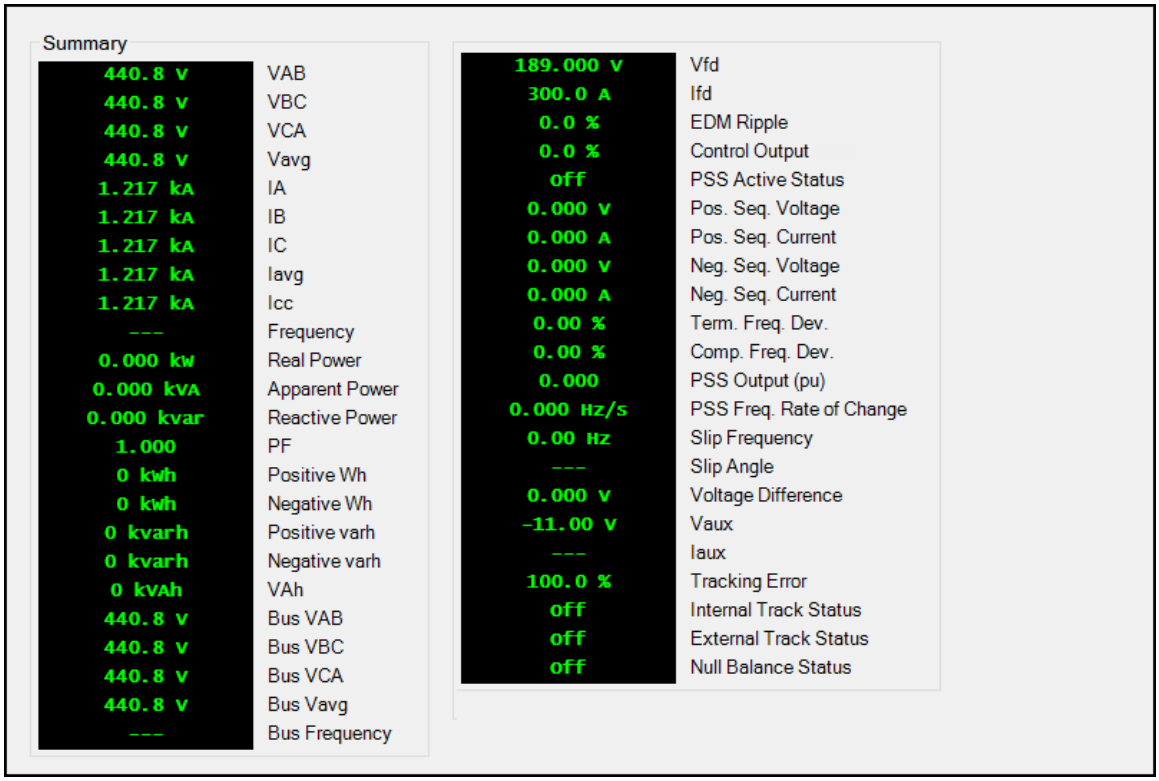


Figure 11-11. Metering Summary Screen

Status Indication

Status indication is provided for DECS-450R system functions, inputs, outputs, 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.

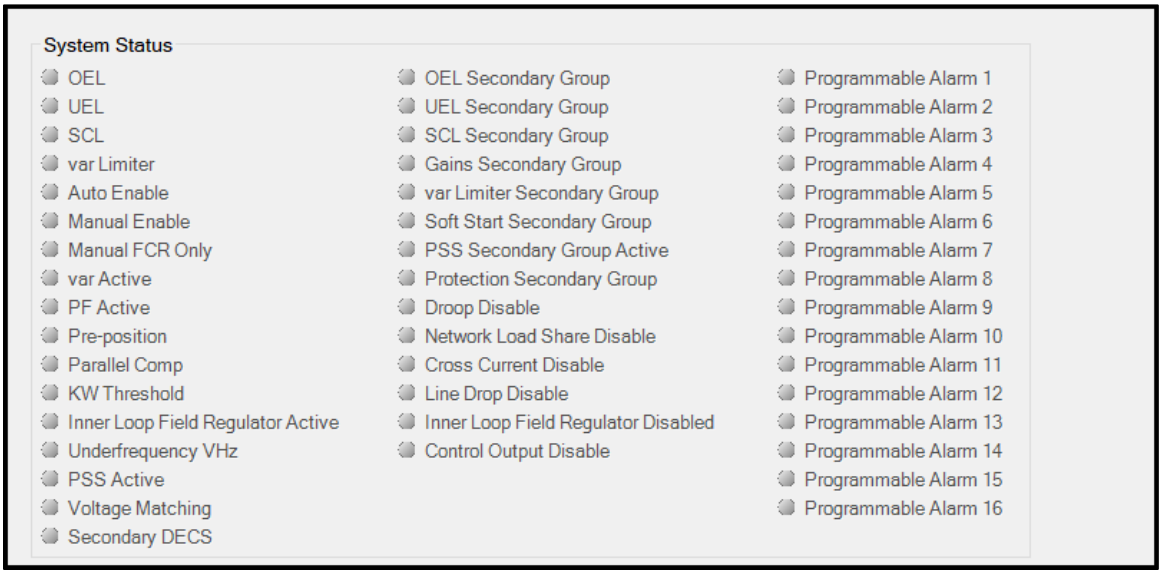


Figure 11-12. System Status Indication Screen

Inputs

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

Status annunciation is provided for the DECS-450R inputs.

DECS-450R Contact Inputs

Status indication for the DECS-450R'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.

Figure 11-13. DECS-450R Contact Inputs Status Indication Screen

Outputs

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

Status annunciation is provided for the DECS-450R contact outputs.

DECS-450R Contact Outputs

Status indication for the DECS-450R'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).

Figure 11-14. DECS-450R Contact Outputs Status Indication Screen

Alarms

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

System parameters, communication links, protection functions, and remote inputs/outputs are 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.

Figure 11-15. DECS-450R Alarm Annunciation and Reset Screen

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-450R 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.

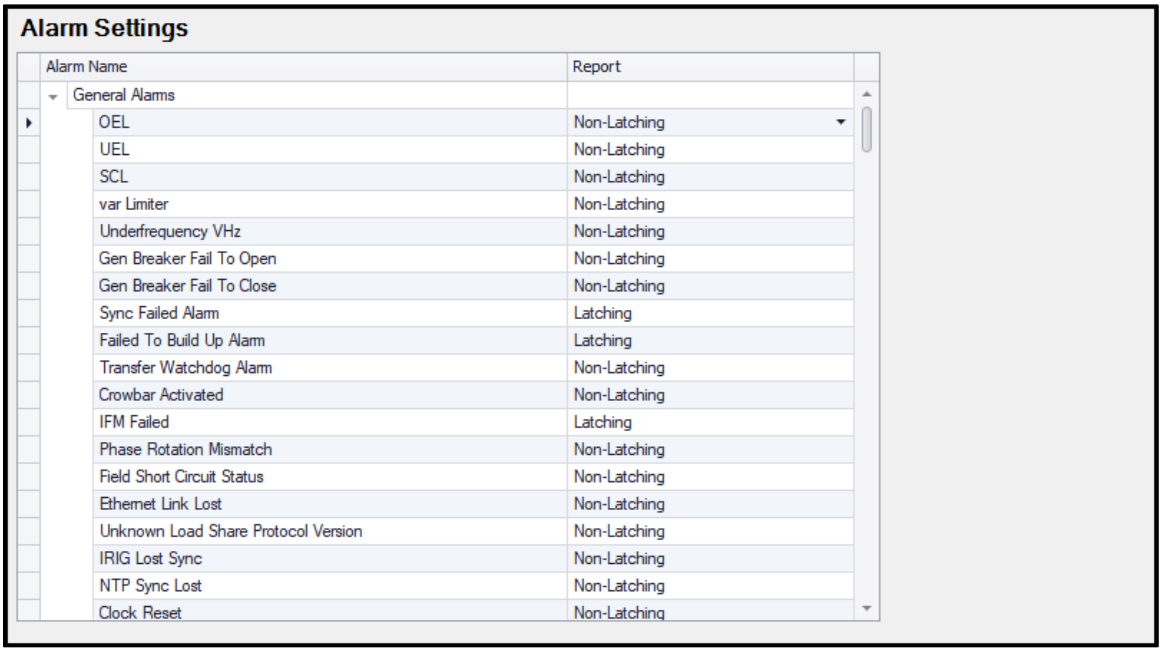


Figure 11-16. Alarm Settings Screen

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

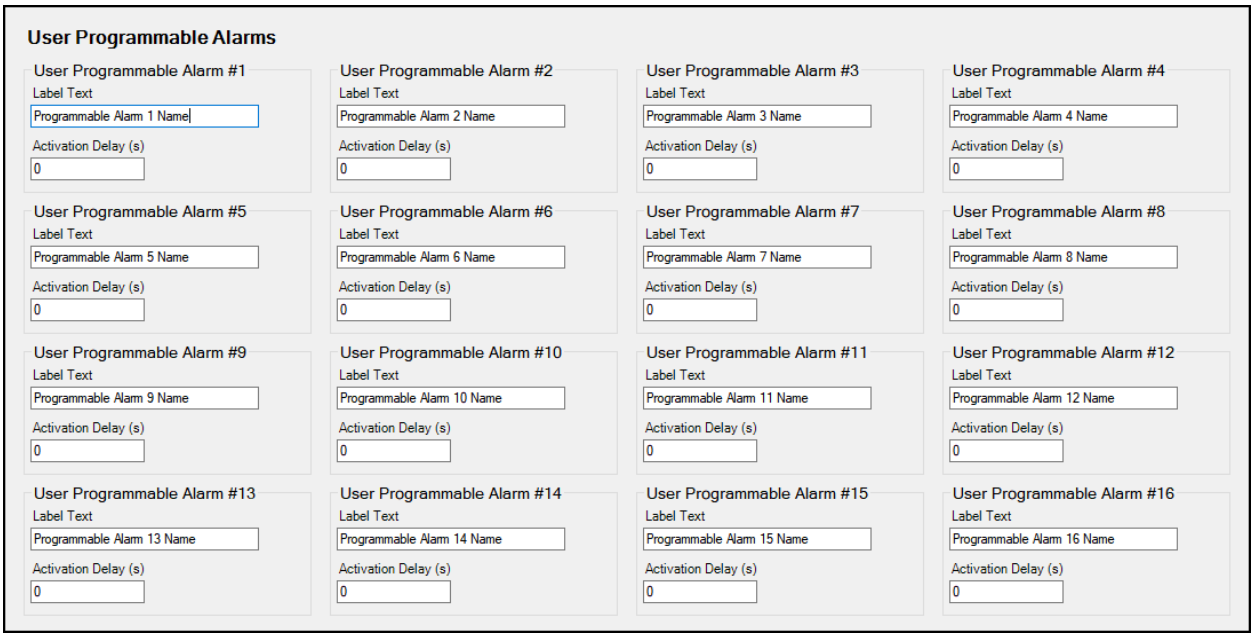


Figure 11-17. User Programmable Alarms Screen

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.

Real-Time Clock

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

The DECS-450R'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 11-18. 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-450R. 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.

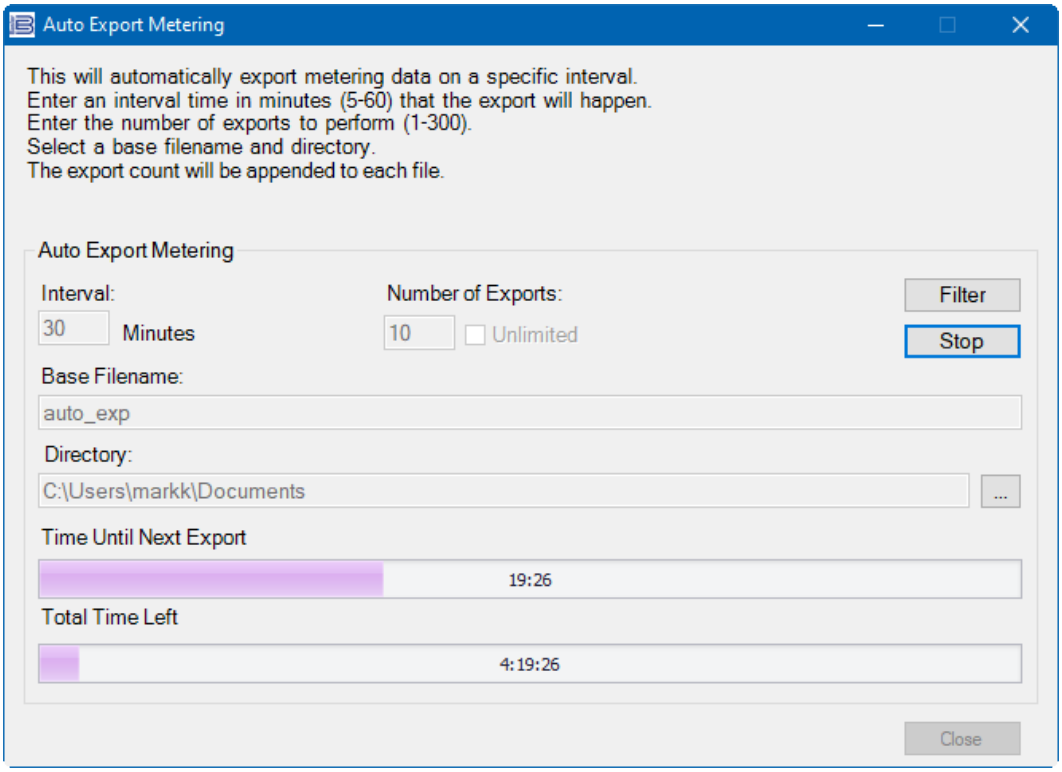


Figure 11-19. Auto Export Metering

12 • Event Recorder

DECS-450R 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-450R 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.

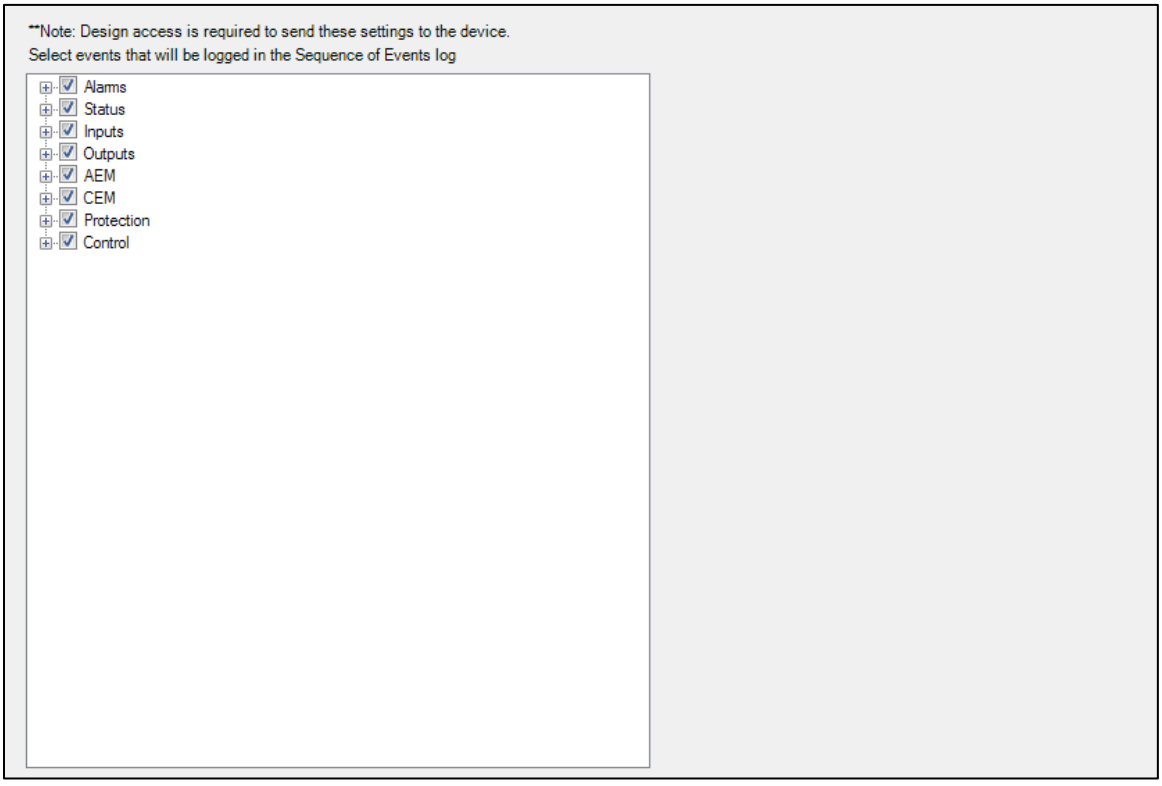


Figure 12-1. Sequence of Events Setup

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-450R can record up to six oscillography records. DECS-450R 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-

450R begins recording the next record over the oldest record. Because oscillography records are stored in nonvolatile memory, interruptions in DECS-450R 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.

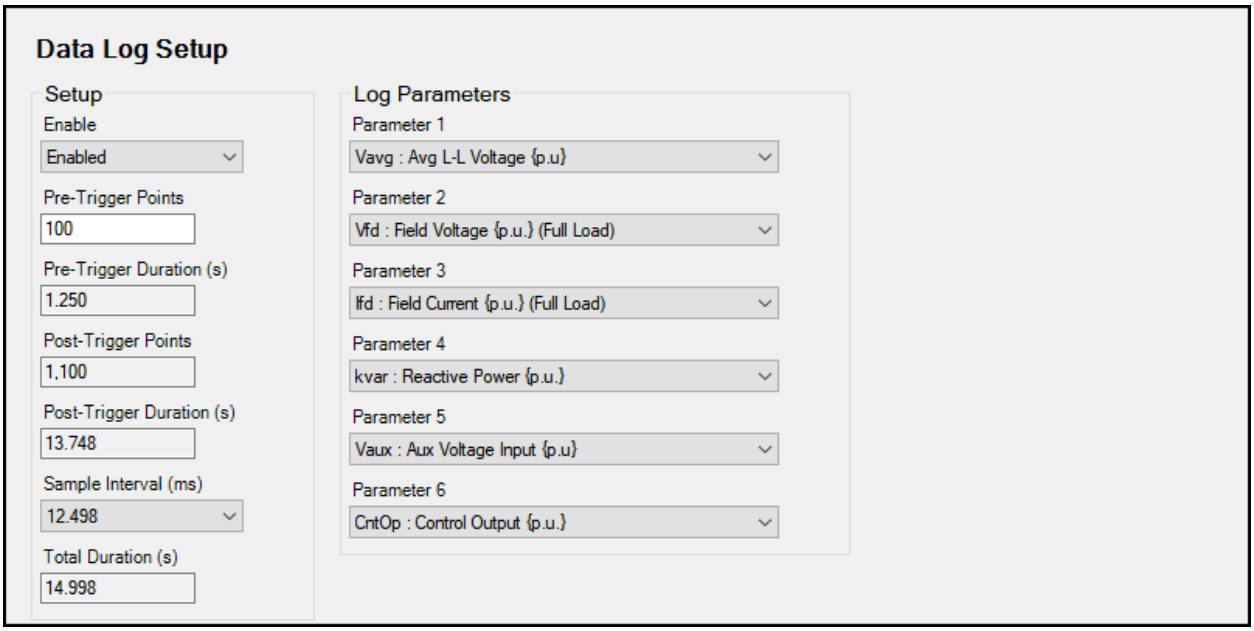


Figure 12-2. Data Log Setup

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-450R 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
- Auto Sync enabled or disabled
- FCR or FVR mode selected

- Droop mode 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.

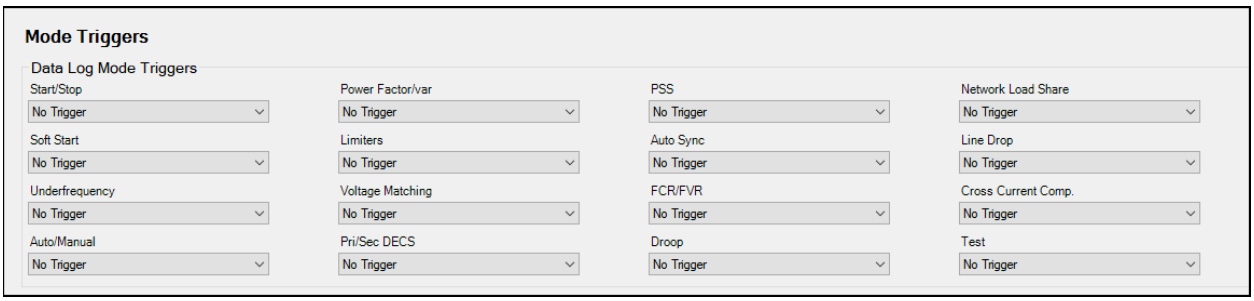


Figure 12-3. Data Log Mode Triggers

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).

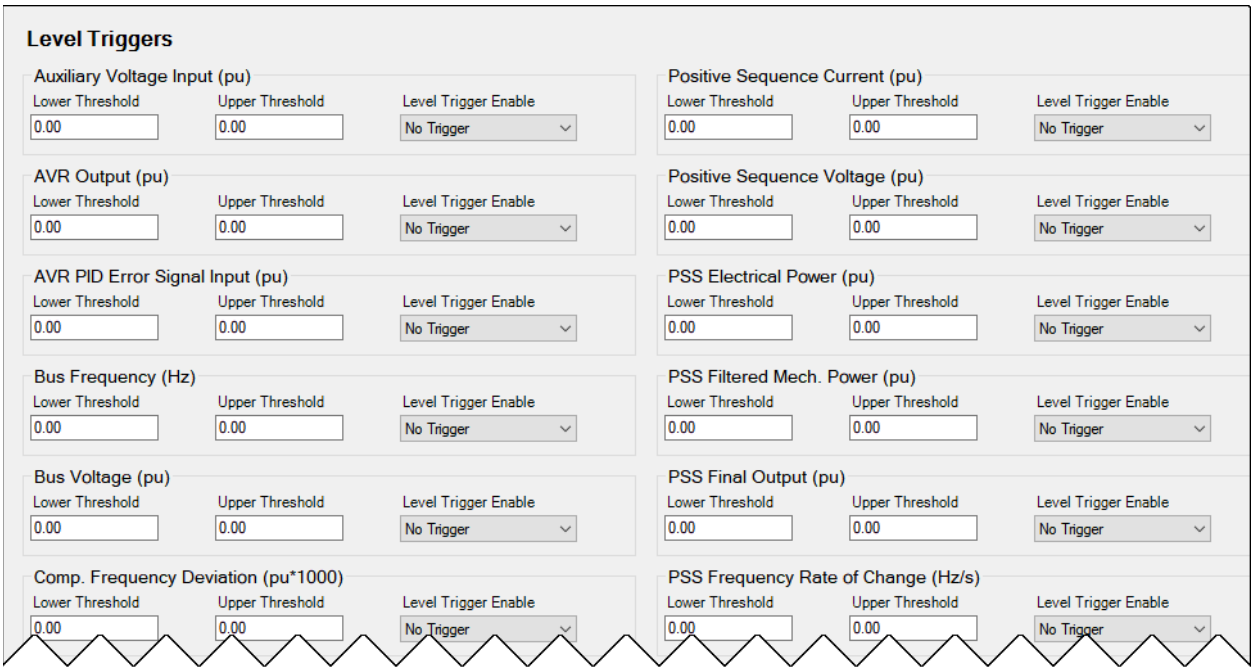


Figure 12-4. Data Log Level Triggers

- 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)
- 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
- Null balance level
- OEL controller output
- OEL ref.
- OEL state
- Position Indication
- Positive sequence current
- Positive sequence voltage
- 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.

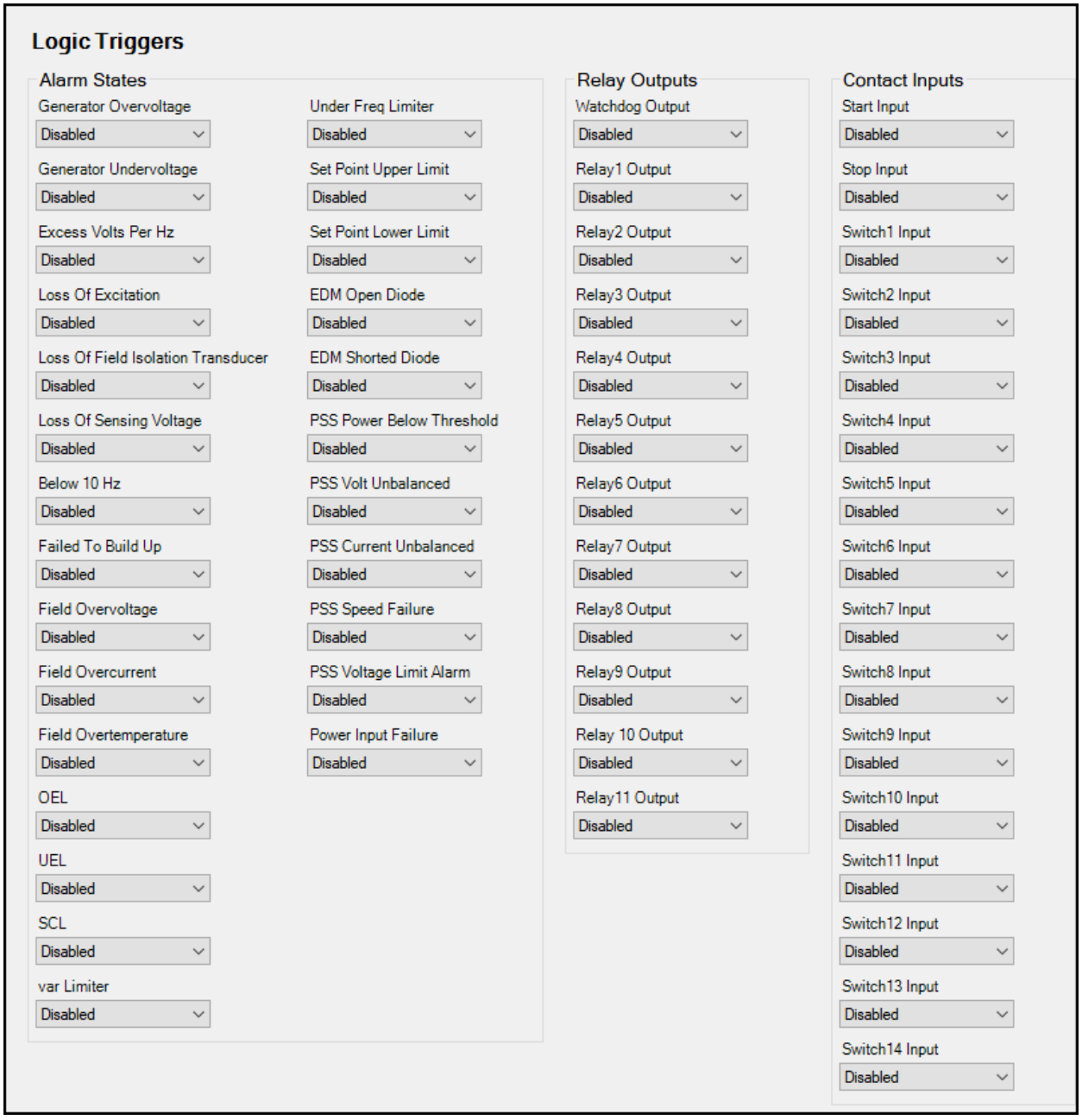


Figure 12-5. Data Log Logic Triggers

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-450R 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.

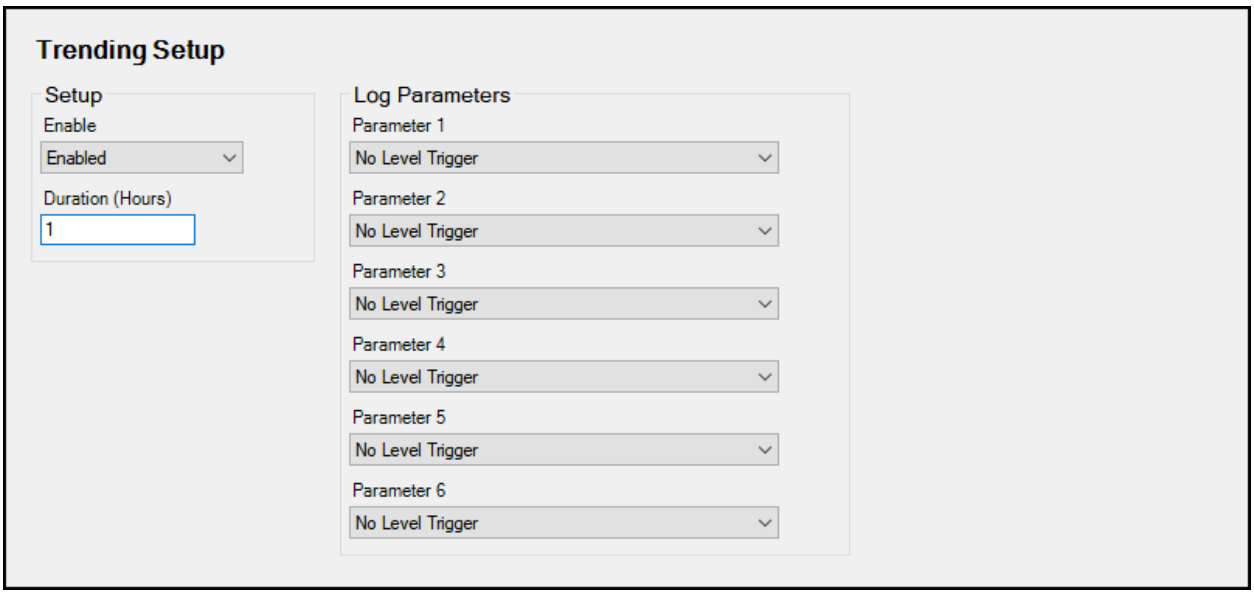


Figure 12-6. Trend Log Setup

13 • Stability Tuning

A PID control loop is used to tune the transient performance of a DECS-450R-based excitation system. The word proportional indicates that the response of the DECS-450R output is proportional or relative to the amount of difference observed. Integral means that the DECS-450R output is proportional to the amount of time that a difference is observed. Integral action eliminates steady state error. Derivative means that the DECS-450R 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. BESTCOMS*Plus*® primary and secondary AVR stability settings are shown in Figure 13-1.

Predefined Stability Settings

Twenty predefined sets of stability settings are available with the DECS-450R. 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.

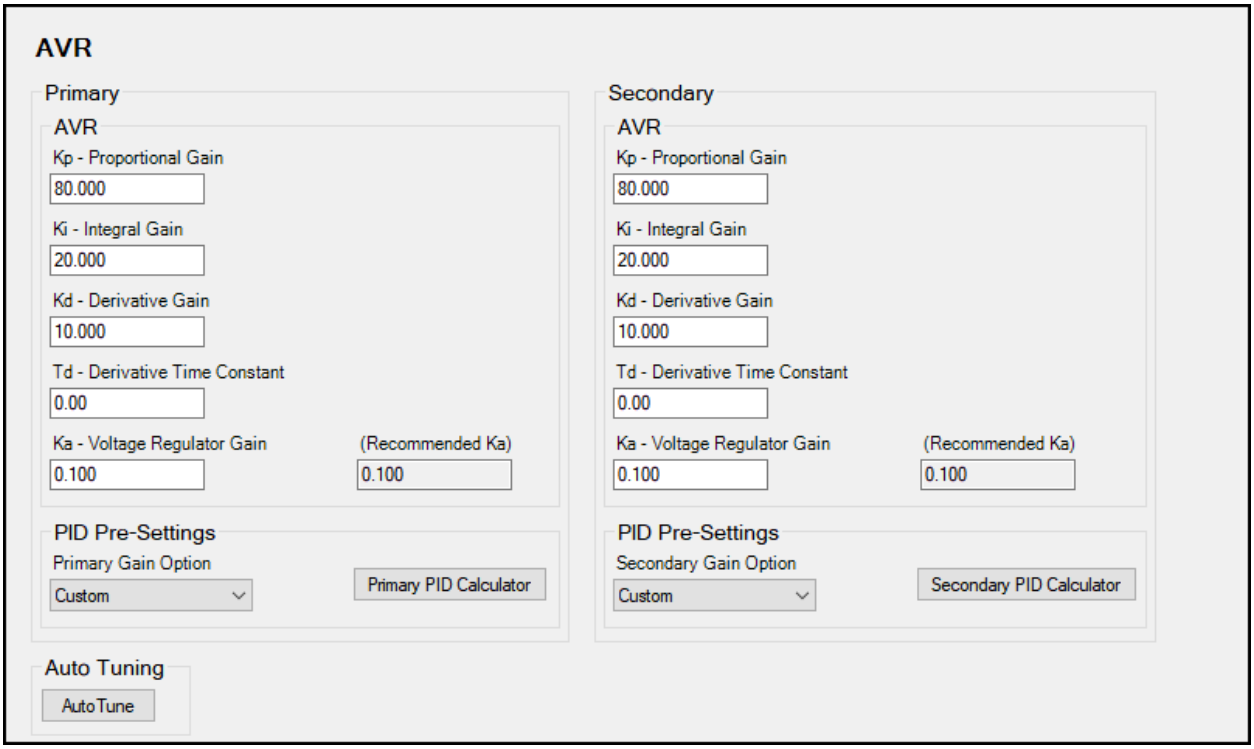


Figure 13-1. AVR Stability Settings

PID Calculator

The PID calculator is accessed by clicking the PID calculator button (Figure 13-1) and is available only when the primary gain option is *Custom*. The PID calculator (Figure 13-2) 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.

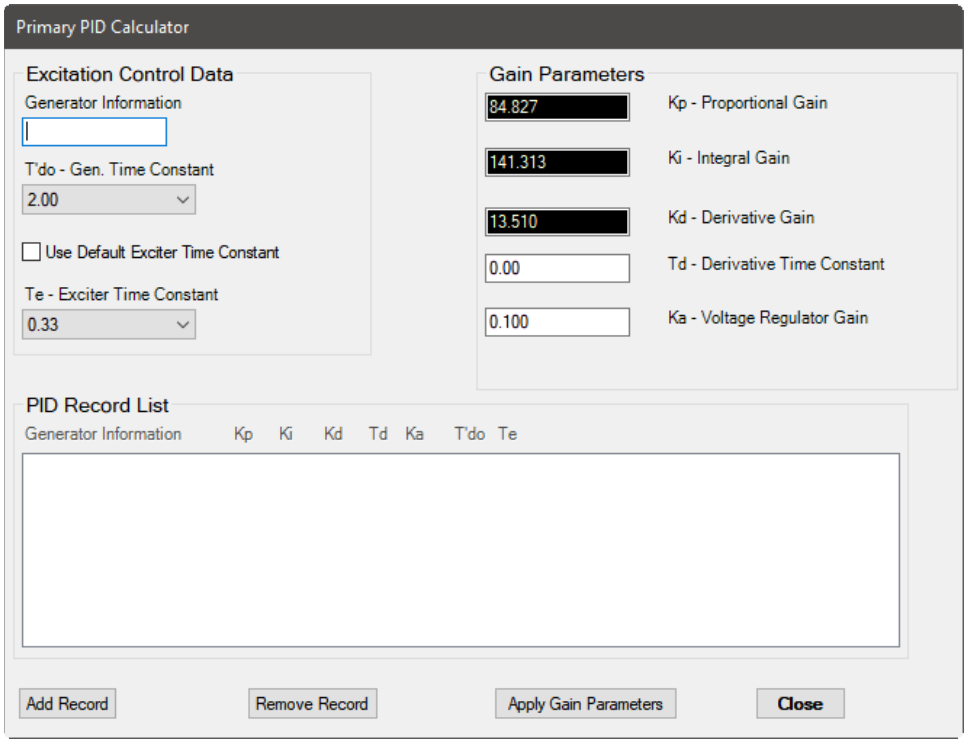


Figure 13-2. PID Calculator

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 13-1). BESTCOMS*Plus* must be in Live Mode in order to begin the auto tuning process. The auto tuning window (Figure 13-3) 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.

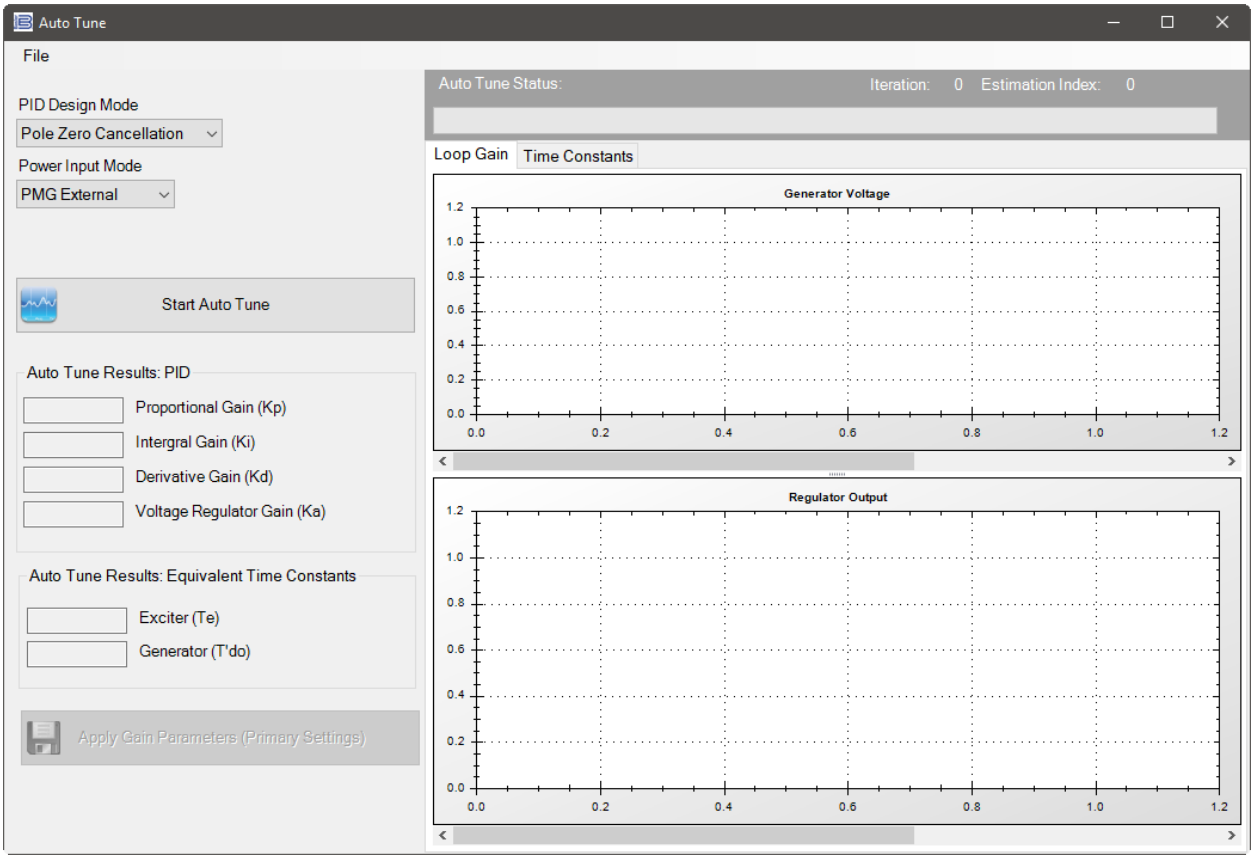


Figure 13-3. Auto Tuning Window

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 13-4.

FCR Mode Stability Settings

The DECS-450R 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-450R 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.

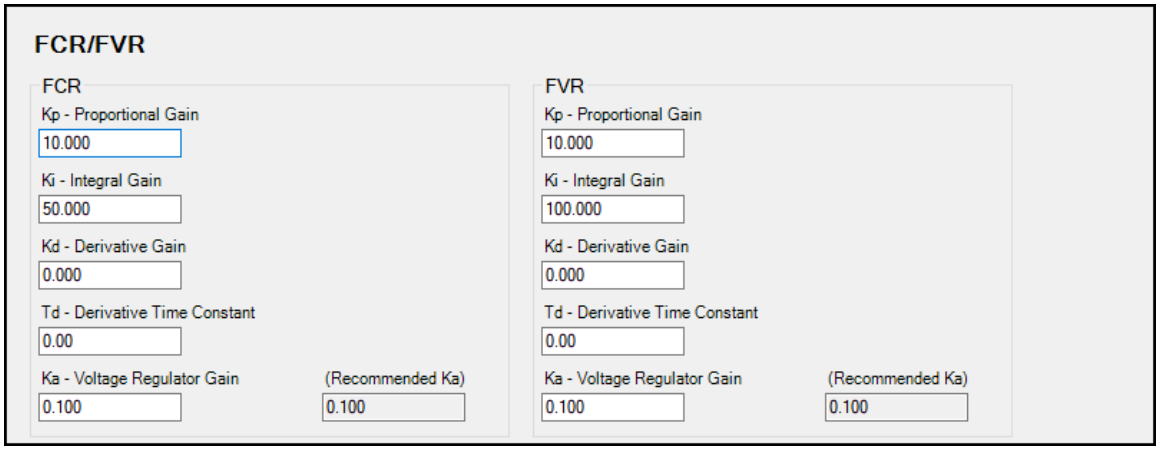


Figure 13-4. FCR and FVR Gain Settings

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-450R along with settings for stability tuning of limiters, the voltage matching function, and main field voltage response. Figure 13-5 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-450R 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-450R 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-450R 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-450R 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-450R 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-450R 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-450R matches the generator voltage to the bus voltage.

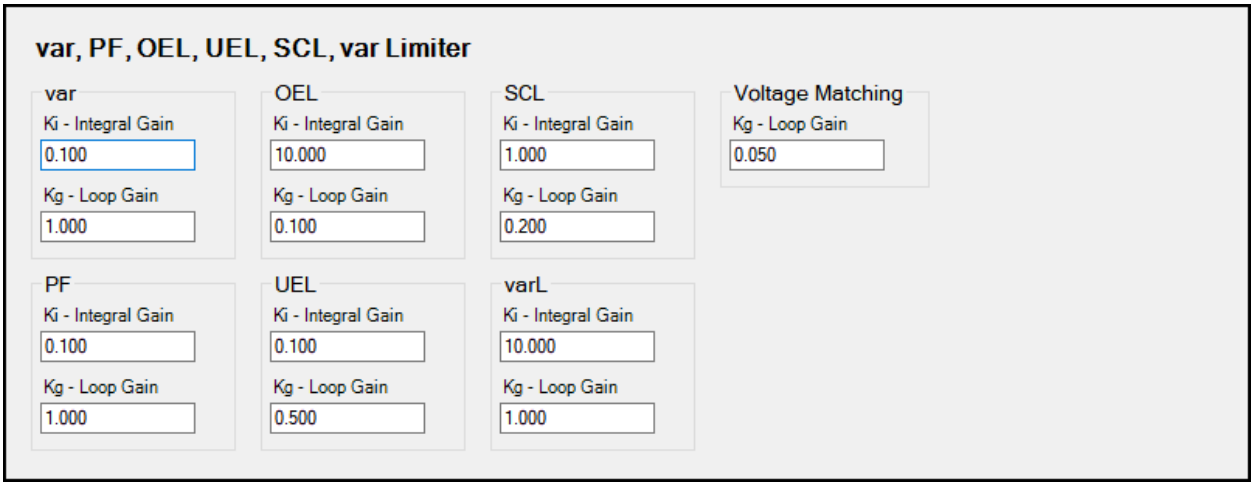


Figure 13-5. Other Mode and Function Gain Settings

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-450R 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 13-6 illustrates these settings as they appear in BESTCOMS*Plus*.

Figure 13-6. Inner Loop Field Regulator Gain Settings

Converting Gains from a DECS-300 or DECS-400

The DECS-450R uses a per-unitized control loop while the DECS-300 and DECS-400 do not. A software conversion tool in BESTCOMSPlus makes upgrading to a DECS-450R easier. The tool calculates per-unitized gains for a DECS-450R 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.

Notes

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-400 gains into the appropriate fields in the DECS-400 column. Select whether OEL Mode is Summing Point or Takeover. Click Convert to review the new gain values displayed in the DECS-450R Equivalent column. The Apply Gain button automatically enters the new gain values into the appropriate DECS-450R gain settings. Figure 13-7 illustrates these settings as they appear in BESTCOMS*Plus*.

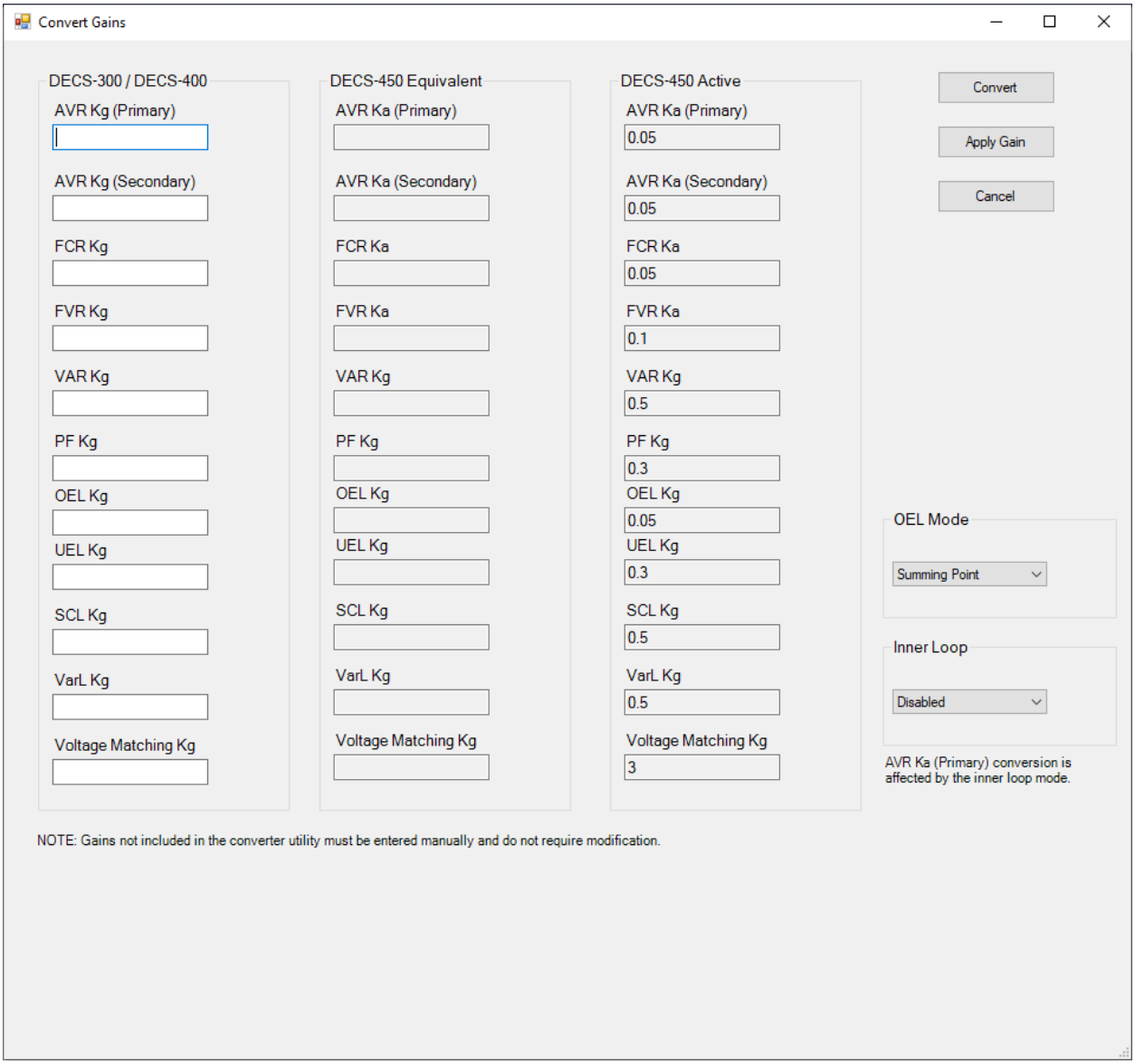


Figure 13-7. Convert Gains Screen

14 • Mounting

When not shipped as part of assembled equipment, DECS-450R Digital Excitation Control Systems are delivered in sturdy cartons to prevent shipping damage. Upon receipt of a DECS-450R, 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-450R 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-450R

An escutcheon plate is required for panel (or cubicle door) mounting. Overall dimensions for the DECS-450R and escutcheon plate are shown in Figure 14-1. Figure 14-2 shows the panel cutting and drilling dimensions for mounting a DECS-450R with the escutcheon plate.

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

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

The DECS-450R 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 14-3 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-450R through an isolation transformer. Basler Electric part number BE31449001 is recommended. Figure 14-4 illustrates the dimensions and mounting hole locations of part number BE31449001.

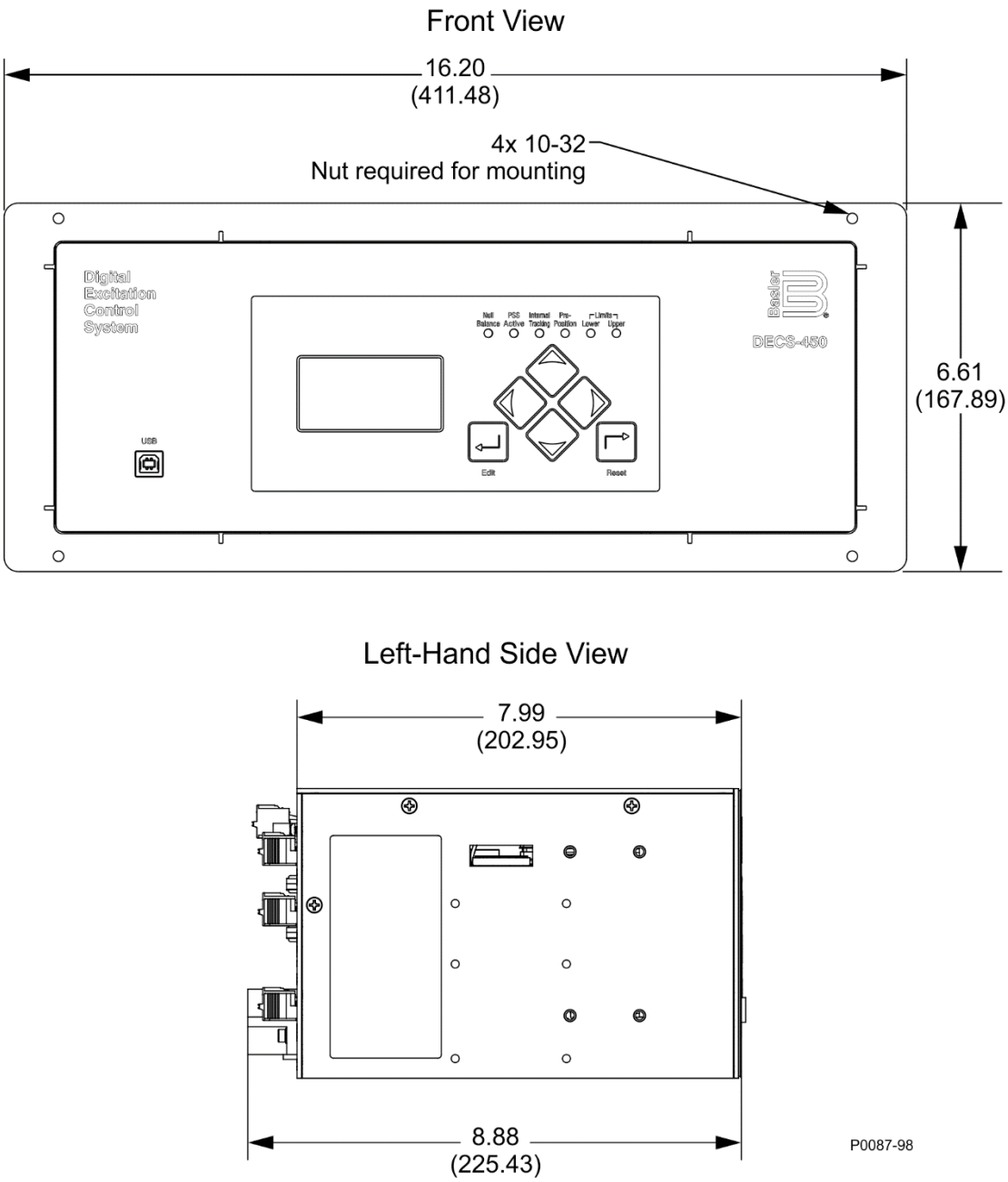


Figure 14-1. DECS-450R with Escutcheon Plate, Overall Dimensions

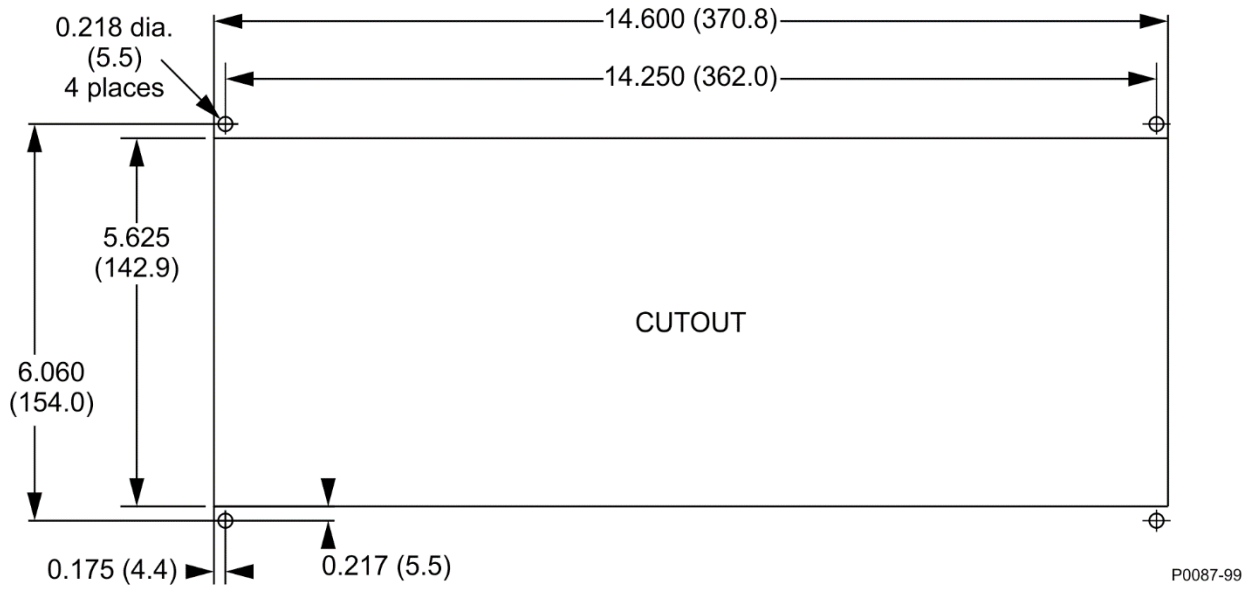


Figure 14-2. Panel Cutting and Drilling Dimensions

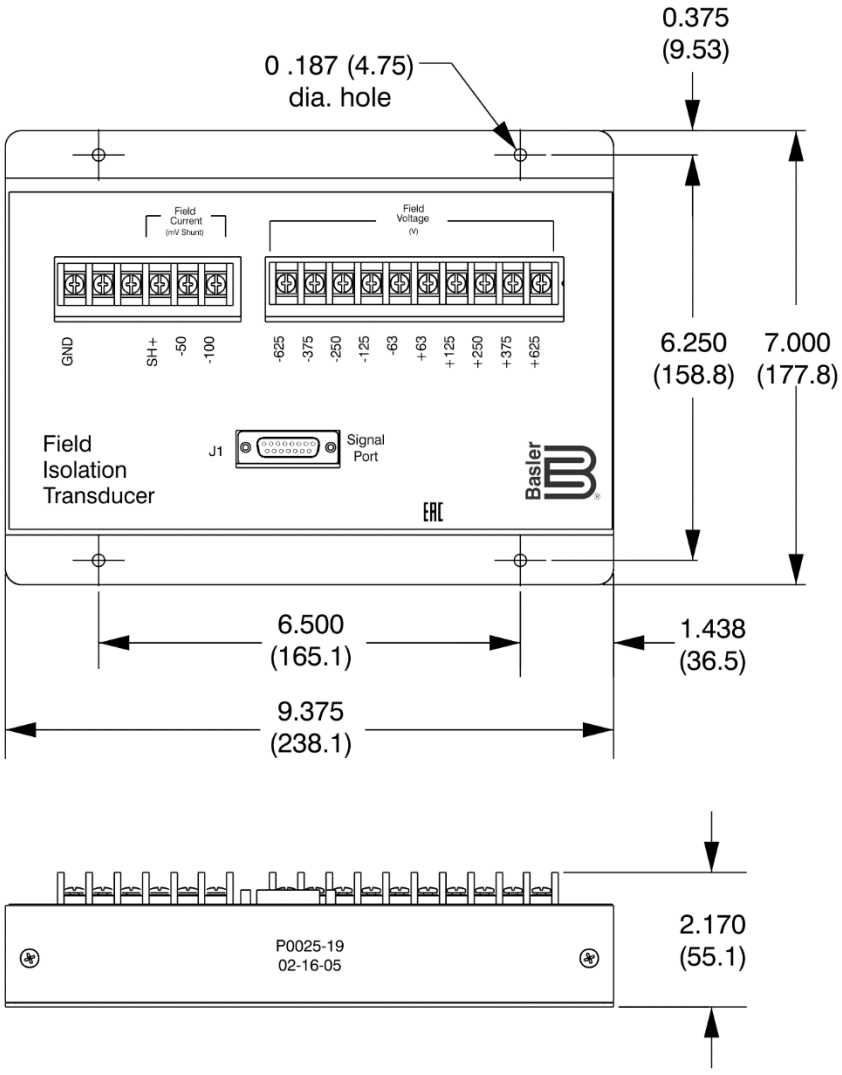


Figure 14-3. Field Isolation Transducer Dimensions

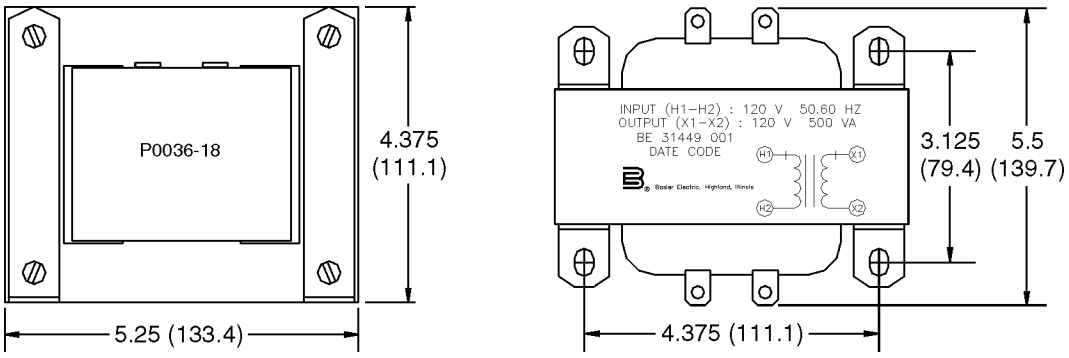


Figure 14-4. Isolation Transformer (BE31449001) Dimensions

Transition Plate

Upgrading from a DECS-400 to the DECS-450R is simplified by an optional transition plate. The transition plate (Figure 14-5) relocates the DECS-450R terminals so that they align with the wiring previously connected to a DECS-400.

Figure 14-5. Transition Plate Wiring to DECS-450R (DECS-450 Shown)

Transition plate terminals are prewired to connectors and ring lugs that mate with the headers, connectors, and terminal screws of the DECS-450R. The transition plate attaches to the back of the DECS-450R 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-450R. Transition plate terminals are shown in Figure 14-6.

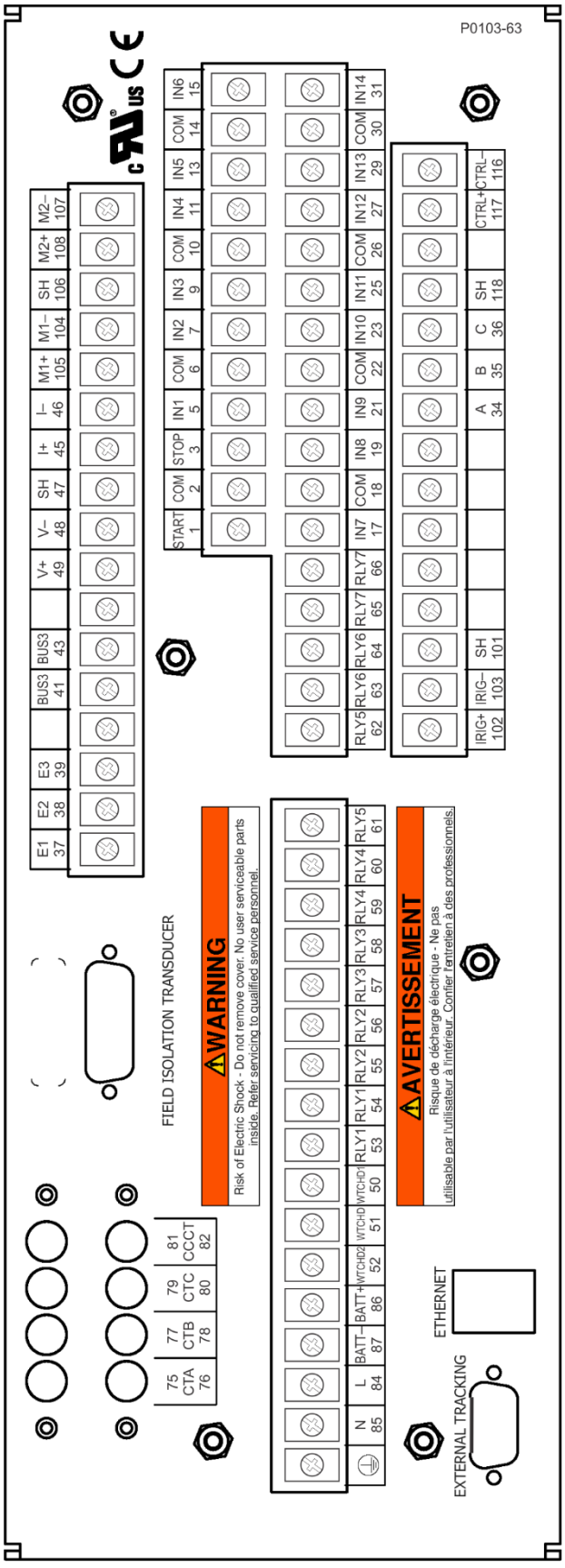


Figure 14-6. Transition Plate Terminal Assignments (DECS-450 Shown)

Installation

To install the transition plate, perform the following steps.

1. Remove the six DECS-450R screws shown in Figure 14-7 (locators A, B, and C). Three screws are located on the left side of the DECS-450R and three screws are located on the right side of the DECS-450R.

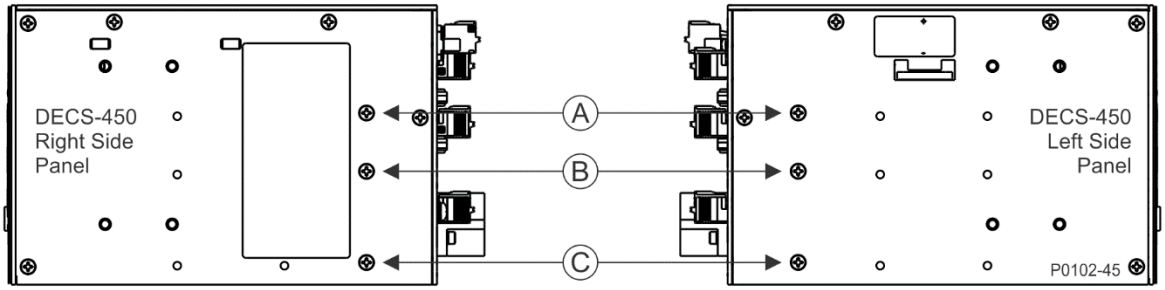


Figure 14-7. Mounting Screw Locations (DECS-450 Shown)

2. Slide the transition plate assembly onto the rear of the DECS-450R as shown in Figure 14-5. Align the lowermost mounting holes of the transition plate assembly with those of the DECS-450R (Figure 14-7 locator C). Install two of the supplied screws in the lowermost mounting holes so that the transition plate is attached to the DECS-450R but can be rotated away from the DECS-450R and allow access to the DECS-450R terminals. See Figure 14-5.
3. Connect the ground wire (labeled GND) of the transition plate to the ground terminal of the DECS-450R. 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-450R. These wires are stamped with numbers that correspond to the CT terminals of the DECS-450R. 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-450R:
   a. Field Isolation Transducer (15-pin, D-type connector)
   b. Ethernet (RJ-45 connector)
6. Plug the remaining cables from the transition plate assembly into the corresponding connector headers of the DECS-450R. 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-450R and align the remaining mounting holes. Ensure that no wires or cables are pinched between the DECS-450R and transition plate. Install the remaining four supplied screws, two per side, as shown in Figure 14-7 (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.

15 • Terminals and Connectors

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

DECS-450R Connections

DECS-450R terminals and connectors are located on the rear panel. DECS-450R'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-450R connectors vary according to their function and the specified options.

Figure 15-1 illustrates the DECS-450R rear panel terminals and connectors. Locator letters in the illustration correspond to the terminal block and connector descriptions in Table 15-1. The front-panel USB port is illustrated and described in the *Controls and Indicators* section of this manual.

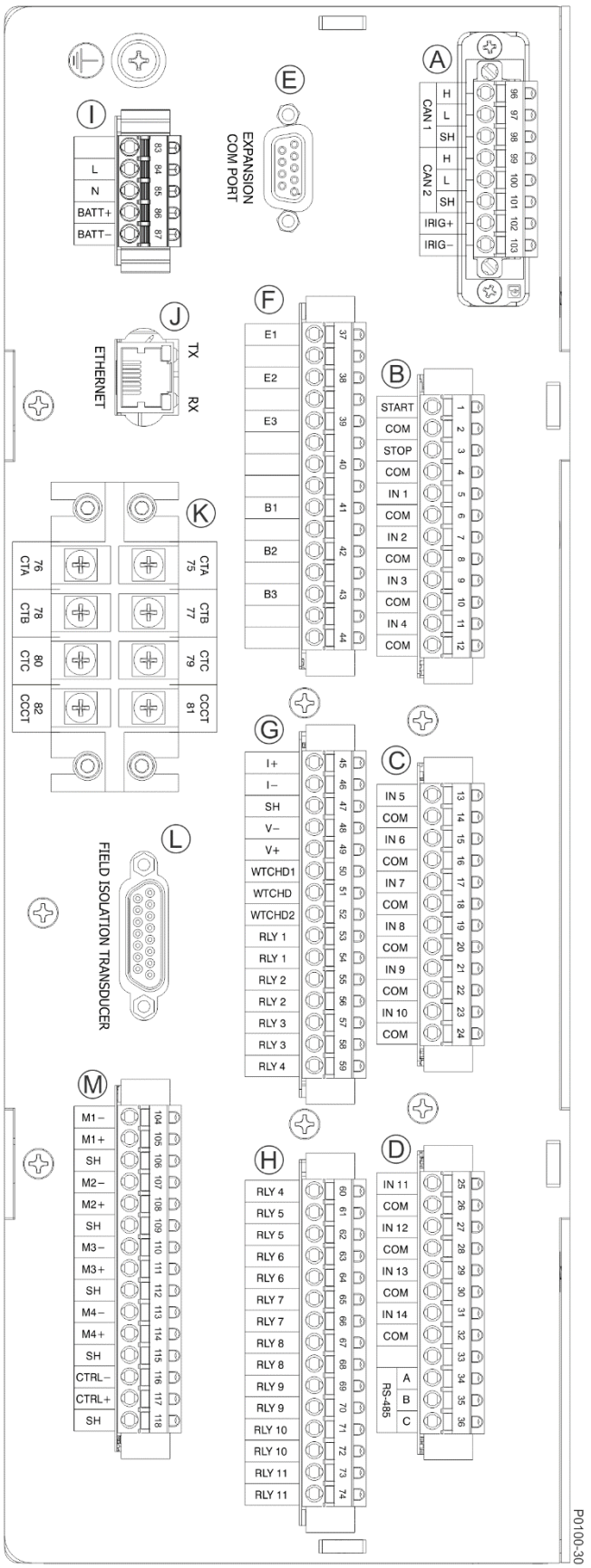


Figure 15-1. Rear Panel Terminals and Connectors

Table 15-1. DECS-450R Rear Panel Terminal and Connector Descriptions

Locator	Description
A	The IRIG terminals connect to an IRIG source for synchronization of DECS-450R 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	This DB-9 connector is provided for PROFIBUS communication (style XX1XXXX).
F	Three-phase generator and bus sensing voltage, obtained from user-supplied voltage transformers (VTs), connect to these terminals.
G	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.
H	Relay contact outputs for programmable relay outputs 4 through 11 connect to these terminals.
I	These terminals accept ac and dc control power to enable DECS-450R operation.
J	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.
K	These terminals connect to user-supplied current transformers (CTs) providing three phases of generator sensing current and a cross-current compensation signal.
L	This 15-pin, D-type connector is provided for communication with the Field Isolation Transducer.
M	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-450R 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 15-2 illustrates the Field Isolation Transducer terminals.

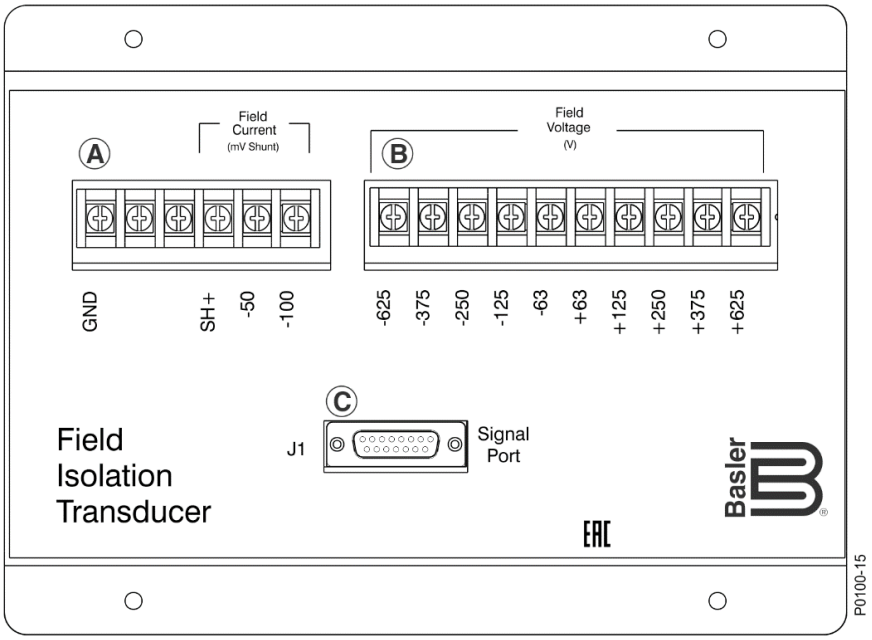


Figure 15-2. Field Isolation Transducer Terminals and Connectors

Table 15-2. 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-450R and sends field current and field voltage signals to the DECS-450R. J1 connects to the DECS-450R Field Isolation Transducer connector through a cable (Basler P/N 9372900021) supplied with the DECS-450R.

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).

16 • Typical Connections

Typical connection diagrams are provided in this section as a guide when wiring the DECS-450R 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 16-1. Typical connections with a BCM-2 are shown in Figure 16-2. The “Machine” in Figures 16-1 and 16-2 represents a generator when the DECS-450R is operating in generator mode and a motor when it is operating in motor mode. The numbered note locators in Figures 16-1 and 16-2 correspond to the descriptions in Table 16-1.

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-450R CT terminals are labeled with terminal numbers only.

DECS-450R contact inputs and outputs are shown in Figure 16-3.

Table 16-1. 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-450R.

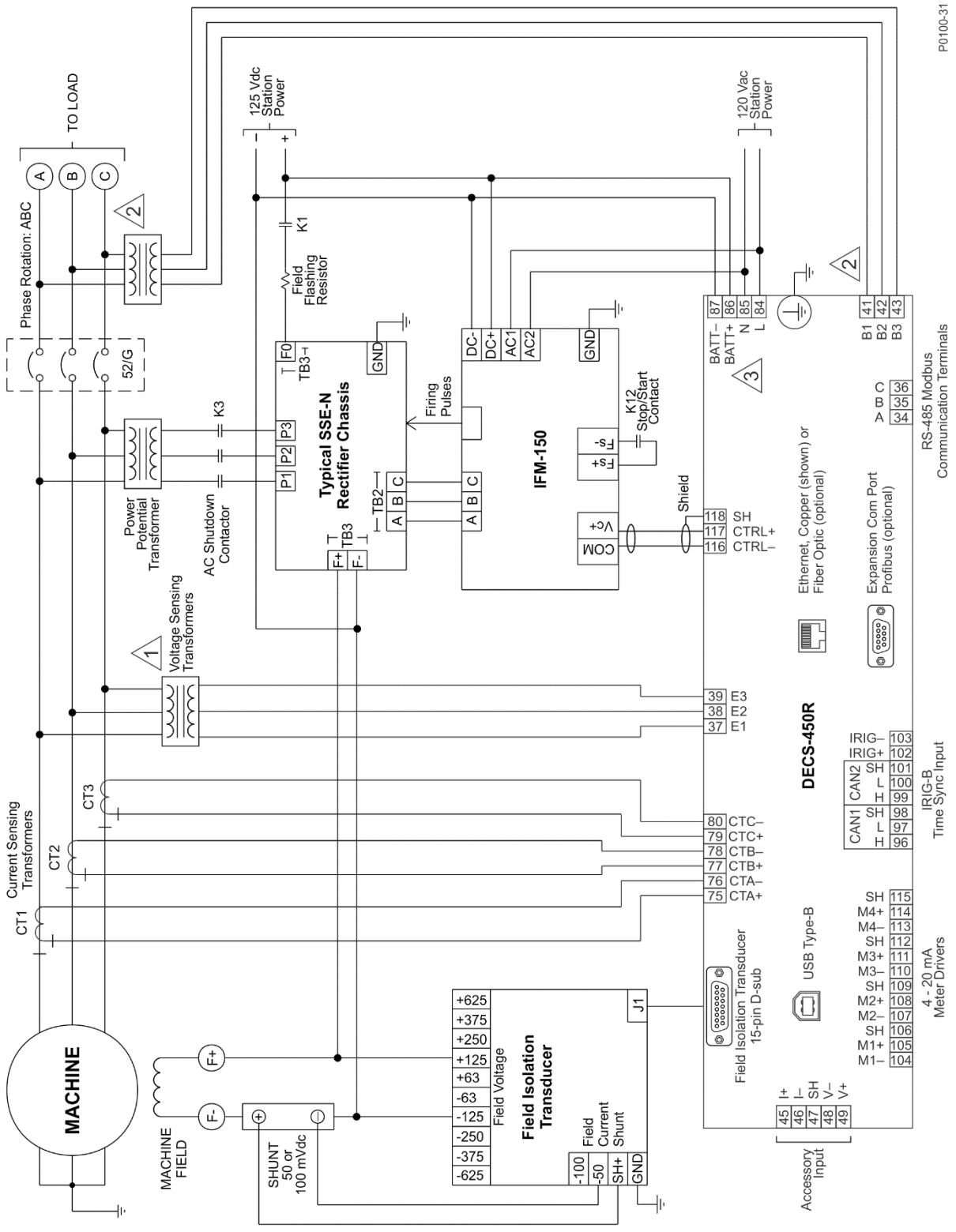


Figure 16-1. Typical DECS-450R Connections with IFM-150

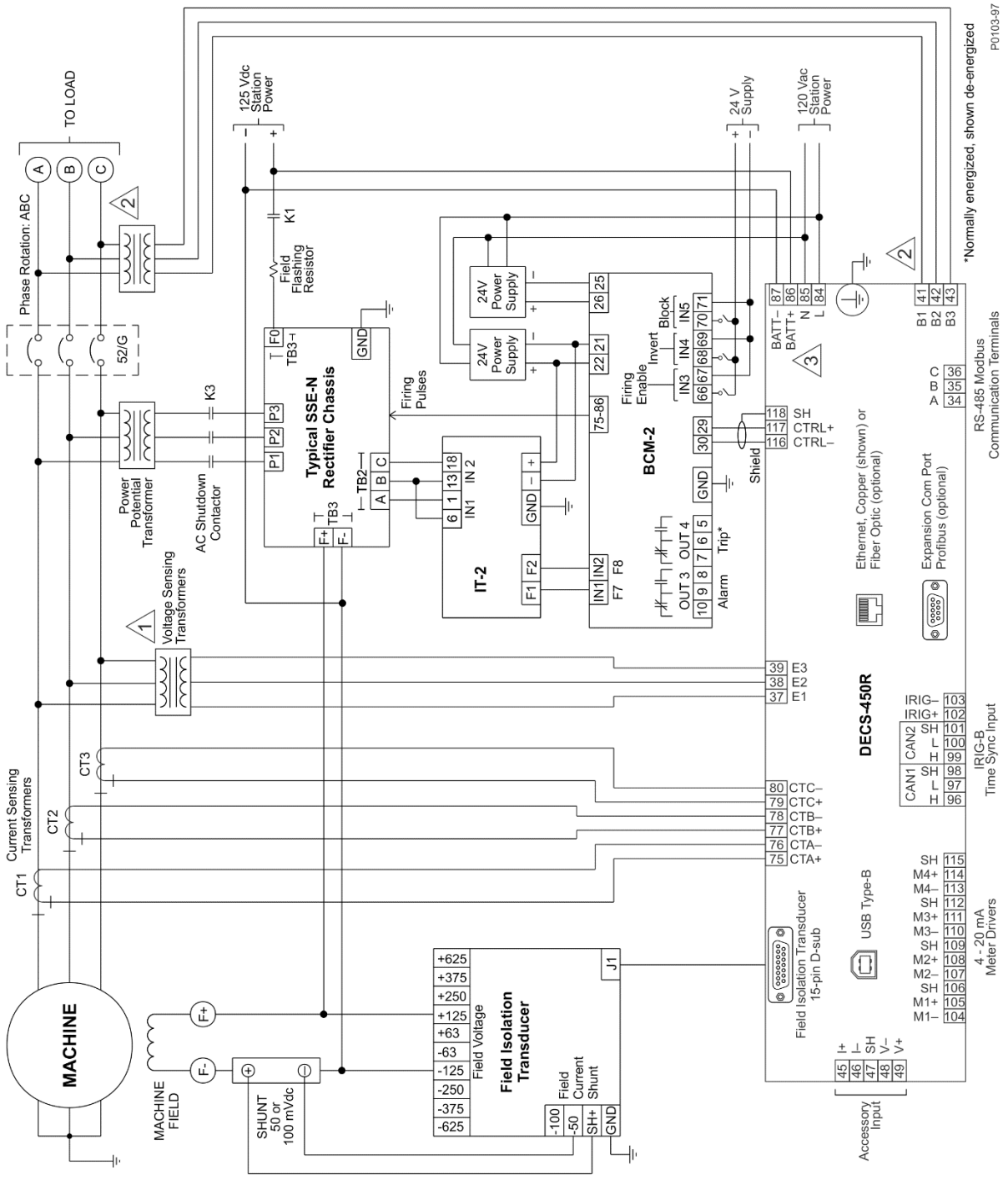


Figure 16-2. Typical DECS-450R Connections with BCM-2

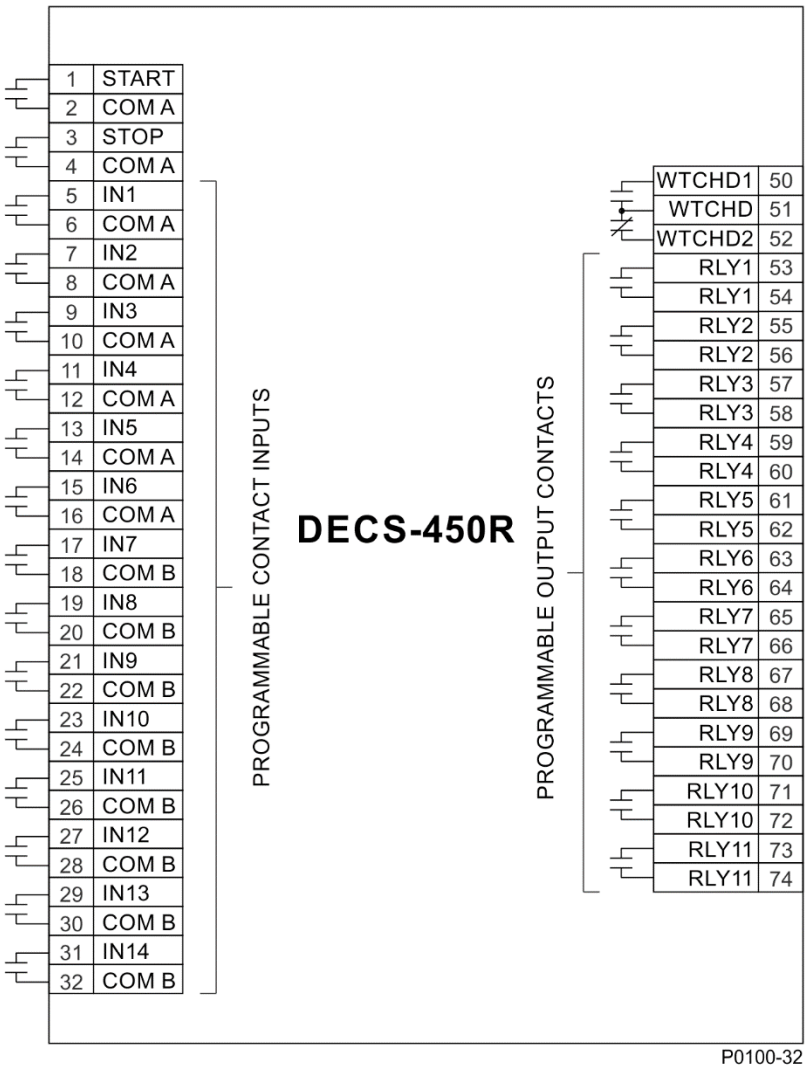


Figure 16-3. DECS-450R Contact Inputs and Outputs

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-450R terminals 84 through 87 (Basler P/N: 37995, Fair Rite 0444164181)
- A single ferrite bead around both control output wires near DECS-450R terminals 116 and 117 (Basler P/N: 37995, Fair Rite 0444164181)
- If 100BASE-TX (copper) Ethernet is used, the Ethernet cable must be shielded.

17 • 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-450R. The capabilities of BESTCOMS*Plus* make the configuration of one or more DECS-450R 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-450R when convenient.

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

The same default logic scheme that is shipped with the DECS-450R is brought into BESTCOMS*Plus* by downloading settings and logic from the DECS-450R. 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-450R 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 BESTwave™ software.

Figure 17-1 illustrates the typical user interface components of the DECS-450R plugin with BESTCOMS*Plus*.

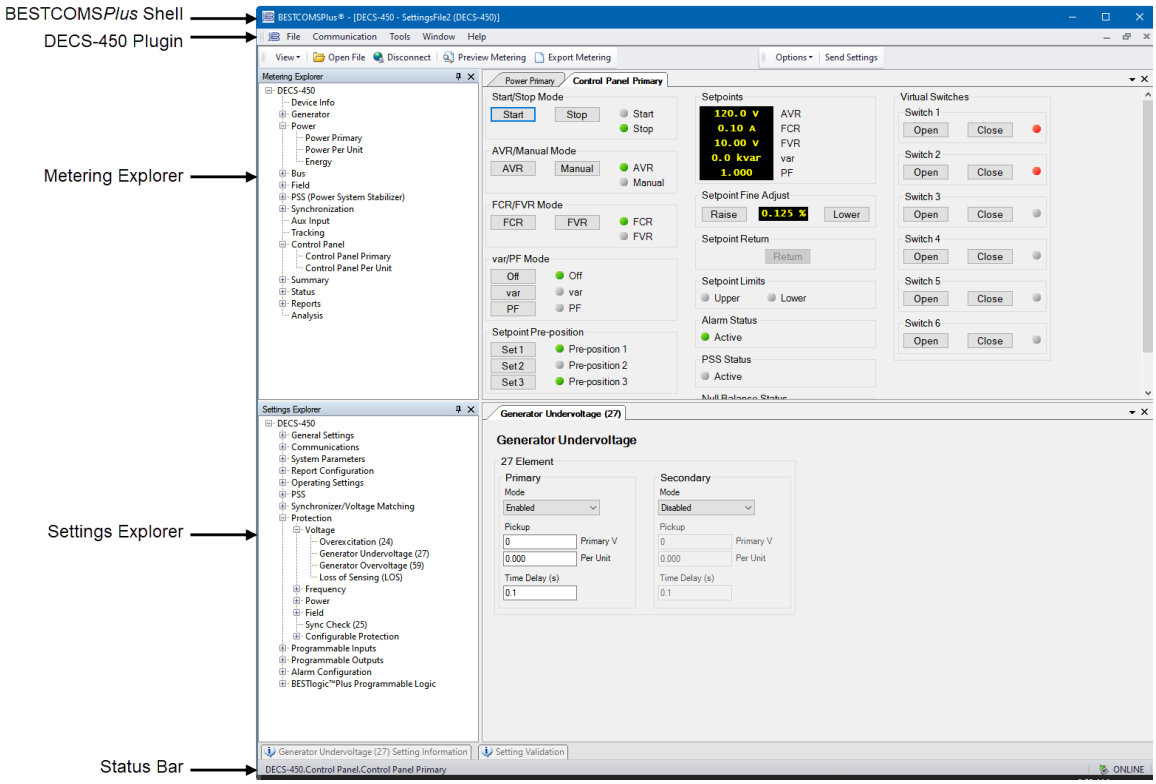


Figure 17-1. Typical User Interface Components

Installation

BESTCOMS*Plus* operates with systems using Windows® 7 SP1, Windows 8.1, Windows 10 version 1607 (Anniversary Update) or later, 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-450R 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 17-1.

Table 17-1. 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-450R and Start BESTCOMSPlus®

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

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-450R. 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-450R. Apply control power to the DECS-450R 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 17-2). 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.

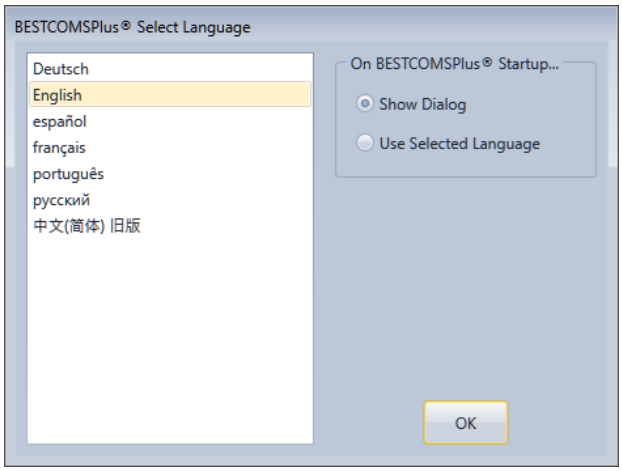


Figure 17-2. BESTCOMS*Plus* Select Language Screen

The BESTCOMS*Plus*® platform window opens. Select *New Connection* from the *Communication* pull-down menu and select *DECS-450R*. See Figure 17-3.

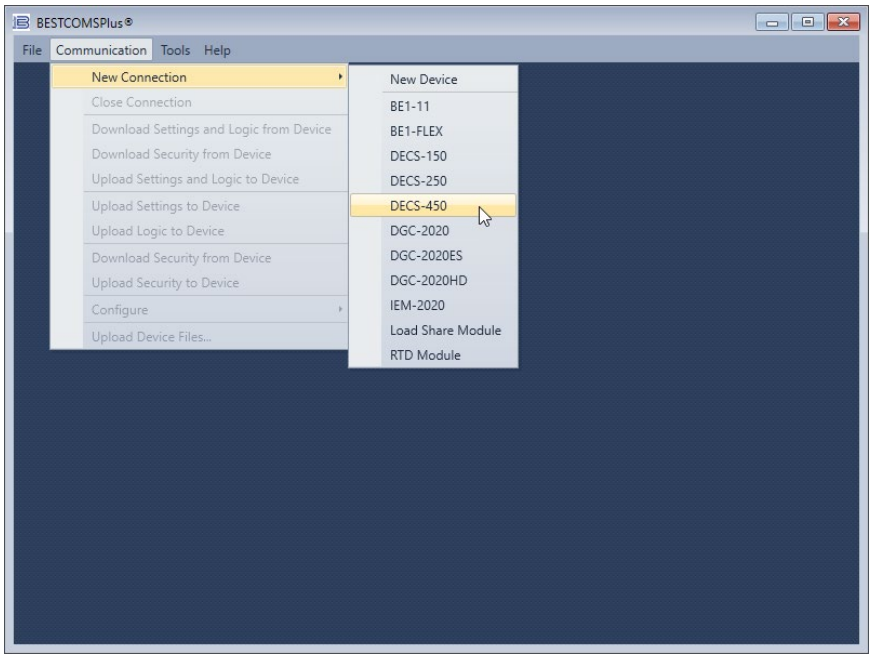


Figure 17-3. Communication Pull-Down Menu

The *DECS-450R Connection* screen shown in Figure 17-4 appears. Select *USB Connection* and click *Connect*.

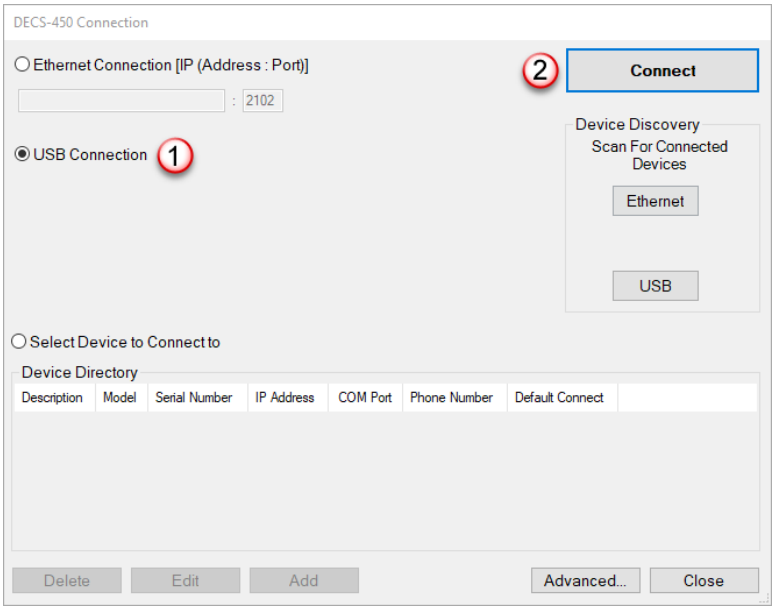


Figure 17-4. DECS-450R Connection Screen

Establishing Communication

Communication between BESTCOMS*Plus* and the DECS-450R is established by clicking the *Connect* button on the *DECS-450R Connection* screen (see Figure 17-4) or by clicking the *Connect* button on the lower menu bar of the main BESTCOMS*Plus* screen (Figure 17-1). 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-450R and load them into BESTCOMS*Plus* memory.

Menu Bars

The menu bars are located near the top of the BESTCOMS*Plus*® screen (see Figure 17-1). 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 17-2.

Table 17-2. Upper Menu Bar (BESTCOMS*Plus*® Shell)

Menu Item	Description
File	
New	Create a new settings file
Open	Open an existing settings file
Open File As Text	Generic file viewer for *.csv, *,txt, etc. files
Close	Close settings file
Save	Save settings file
Save As	Save settings file with a different name
Export To File	Save settings as a *.csv file
Print	Open the print menu

Menu Item	Description
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-450R
Close Connection	Close communication between BESTCOMS*Plus* and DECS-450R
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-450R. 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-450R)
Accepted Devices	View and delete accepted devices (not applicable to DECS-450R)
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-450R Plugin)

Lower menu bar functions are listed and described in Table 17-3.

Table 17-3. Lower Menu Bar (DECS-450R 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-450R Connection* screen, which enables you to connect to the DECS-450R via USB or Ethernet. Also used to disconnect a connected DECS-450R.
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-450R 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-450R.

Settings Explorer

The Settings Explorer is a convenient tool within BESTCOMS*Plus*® used to navigate through the various settings screens of the DECS-450R plugin. Descriptions of these configuration settings are organized as follows:

- General Settings
- Communications
- System Parameters
- Report Configuration
- Operating Settings
- 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 17-6 illustrates an example of flagged, noncompliant settings (locator A) and the Setting Validation window (locator B) used to diagnose faulty settings.

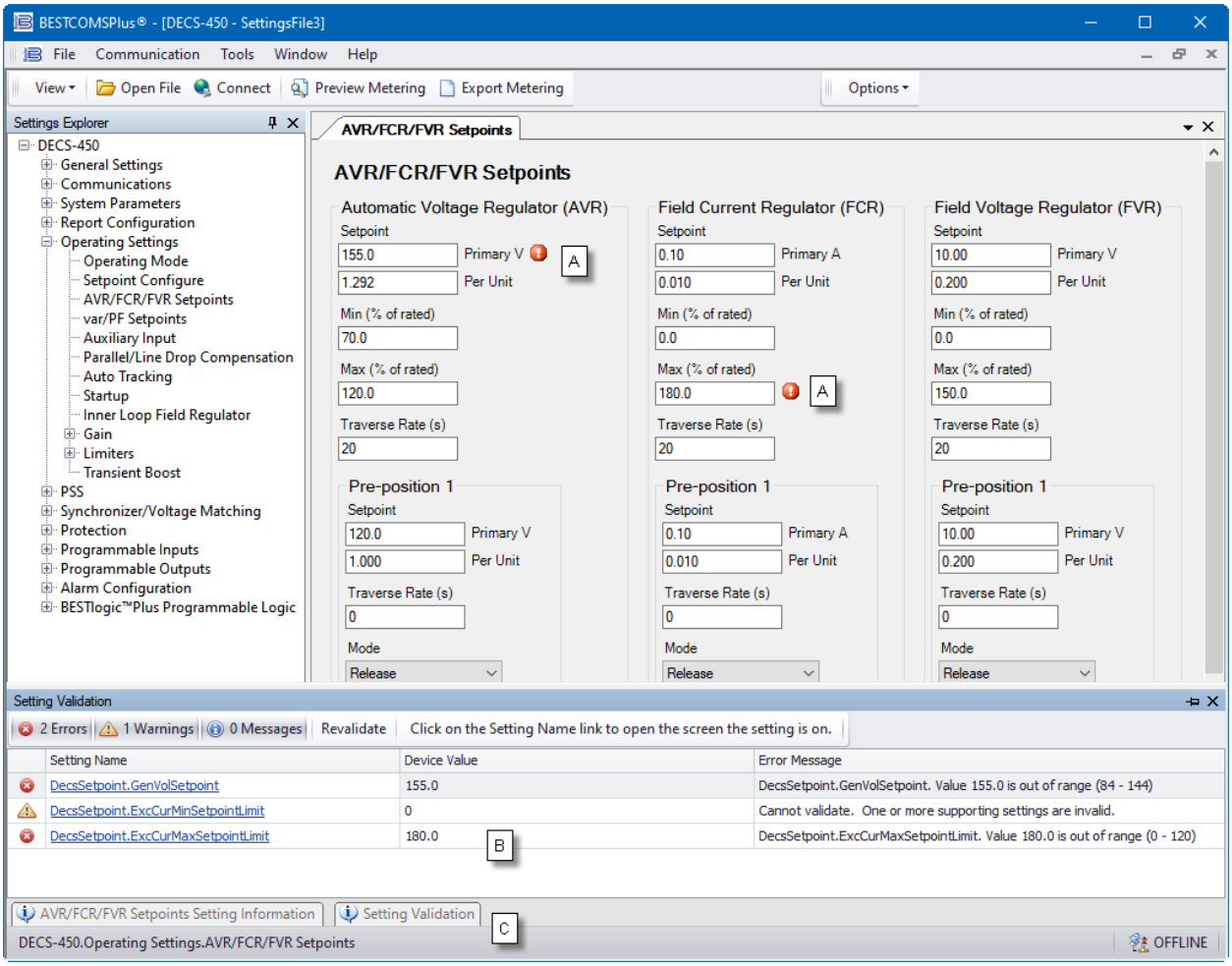


Figure 17-5. Flagged, Noncompliant Settings and the Seting Validation Window

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

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-450R settings and logic and its file extension is “bst4”.

It is possible to save only the DECS-450R 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-450R 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-450R 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-450R, 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-450R, 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-450R 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 17-7). 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.

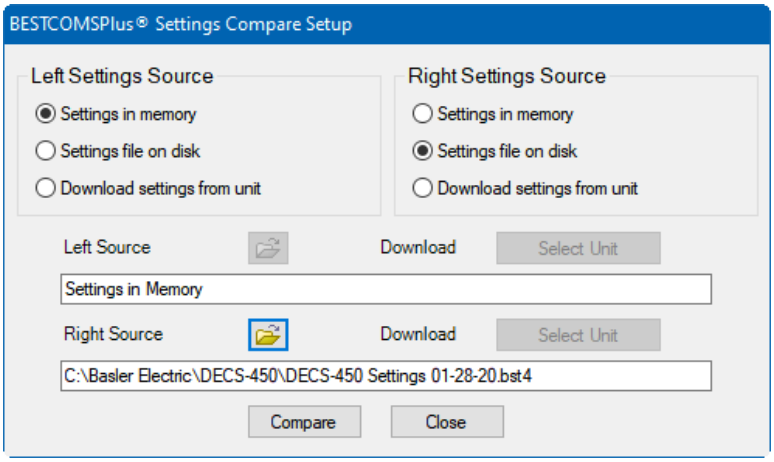


Figure 17-6. BESTCOMS*Plus* Settings Compare Setup

A dialog box will appear and notify you if any differences were found. The BESTCOMS*Plus*® *Settings Compare* dialog box (Figure 17-8) 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.

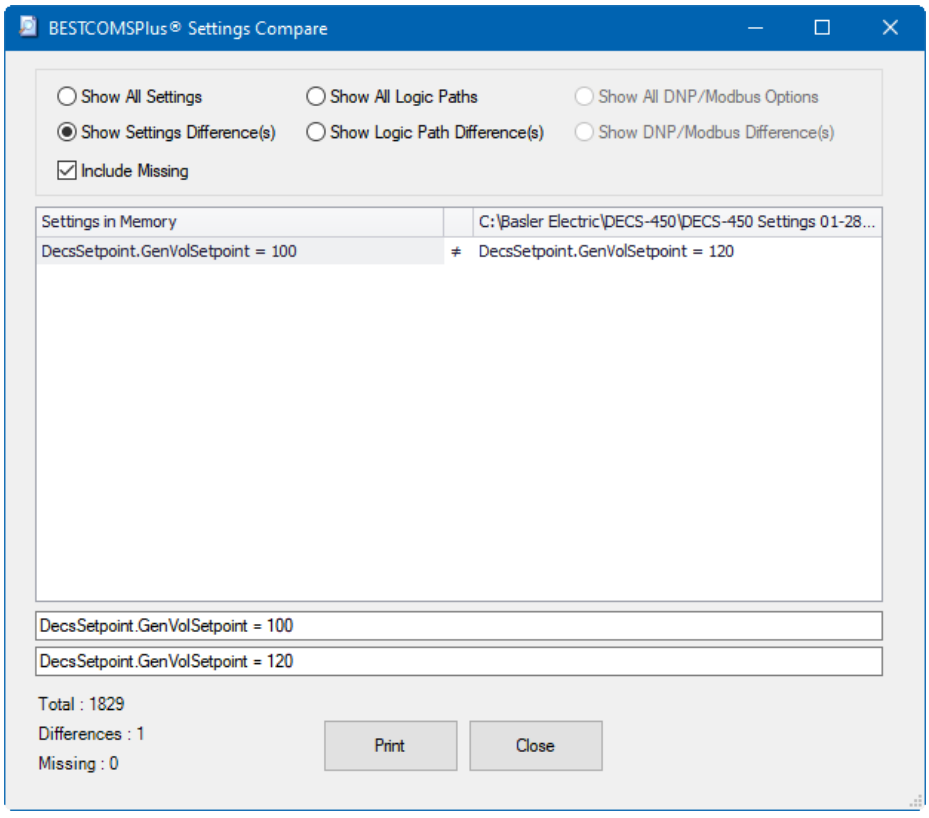


Figure 17-7. BESTCOMS*Plus*® Settings Compare

Automatic Metering Export

The auto export metering function automatically exports metering data over a user-defined period when a DECS-450R 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 17-9 illustrates the *Auto Export Metering* screen.

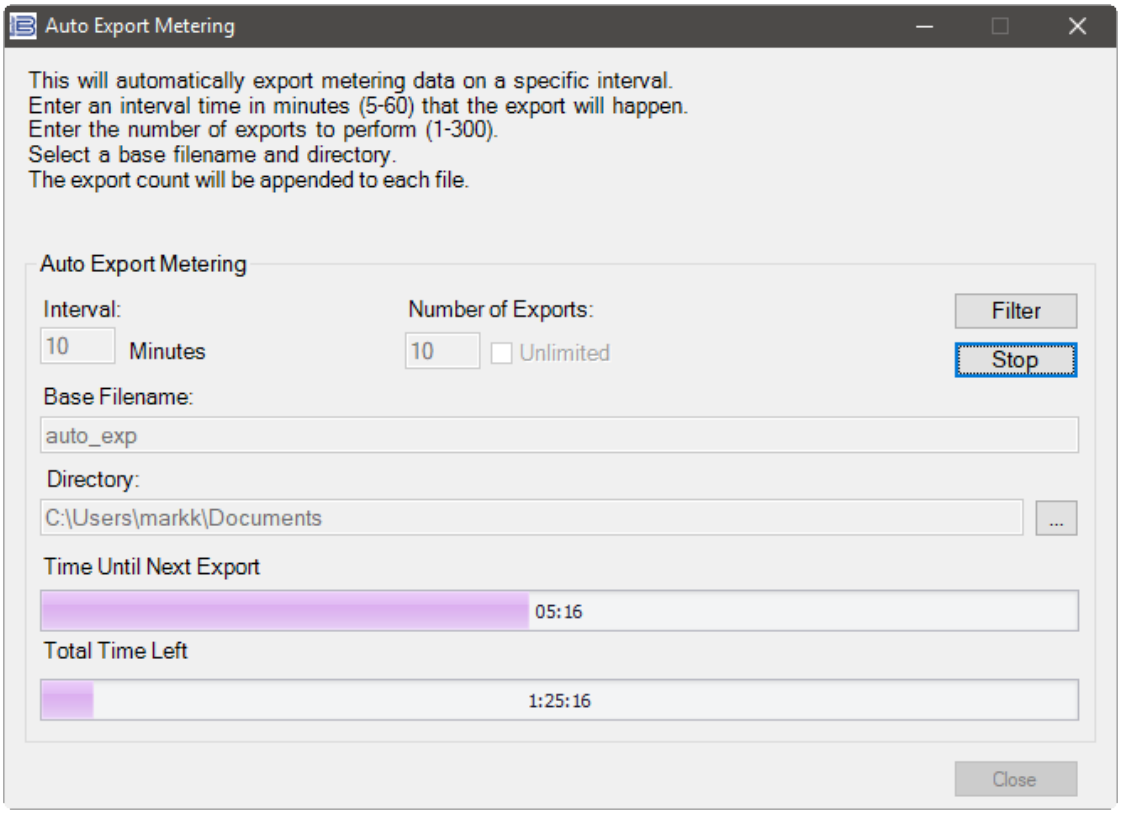


Figure 17-8. Auto Export Metering Screen

Firmware Updates

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

Warning!

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

Caution – Settings will be lost!

Default settings will be loaded into the DECS-450R, reports and events will be cleared, and the DECS-450R 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-450R. Embedded firmware is the operating program that controls the actions of the DECS-450R. The DECS-450R 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.

Note

If power is lost or communication is interrupted during file transfer to the DECS-450R, 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 the DECS-450R

The following procedure is used to upgrade firmware in the DECS-450R.

1. Remove the DECS-450R from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450R.
2. Apply control power to the DECS-450R.
3. Connect to the DECS-450R 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-450R at this time. Save settings when prompted, if desired.
5. Open the desired device package file (decs450.bef).
6. Check the box for DECS-450R Firmware. Note the version number of the DECS-450R 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-450R.
9. Load the saved settings file into the DECS-450R.
    a. Close all settings files.
    b. From the File pull-down menu, select New, DECS-450R.
    c. Connect to the DECS-450R.

d. Once all settings have been read from the DECS-450R, 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-450R style number in the saved file matches that of the DECS-450R 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-450R into which it is to be loaded, disconnect from the DECS-450R, then modify the style number in the settings file. Then repeat the steps titled *Load the Saved Settings File into the DECS-450R.*

BESTCOMSPlus® Updates

Enhancements to DECS-450R firmware typically coincide with enhancements to the DECS-450R plugin for BESTCOMS*Plus*®. When a DECS-450R 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.)

18 • 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-450R Digital Excitation Control System. Each DECS-450R 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-450R 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-450R is called a logic scheme.

The default active logic scheme is configured for a typical protection and control application of a synchronous generator and virtually eliminates 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-450R. The default logic scheme 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-450R. 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 18-1.

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.

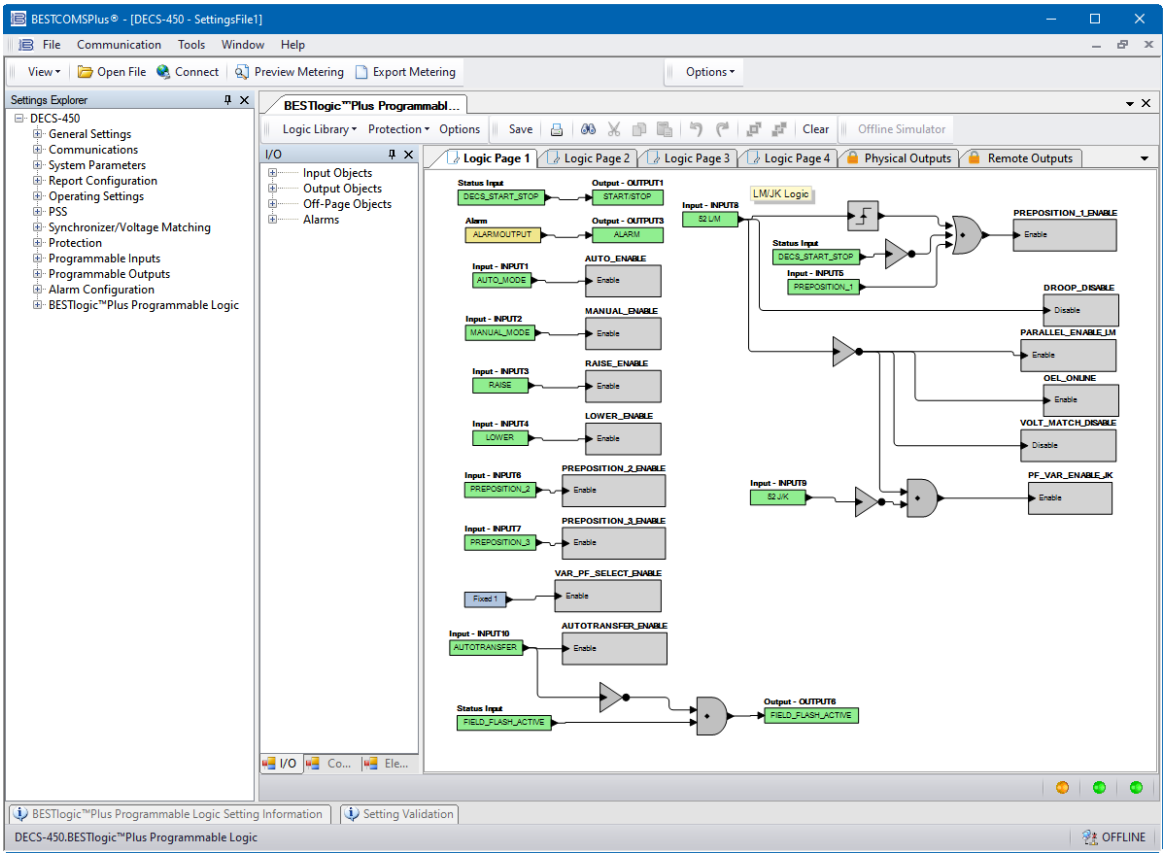


Figure 18-1. BESTlogic*Plus* Programmable Logic Tree Branch

BESTlogic™*Plus* Composition

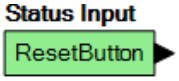
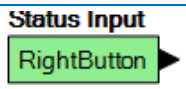
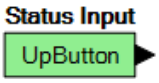
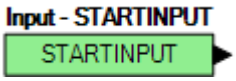
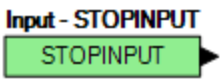
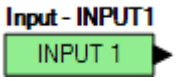
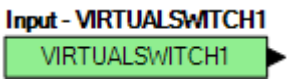
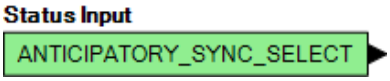
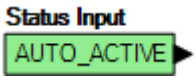
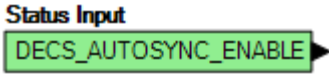
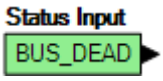
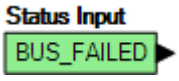
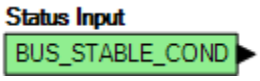
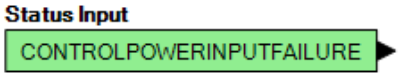
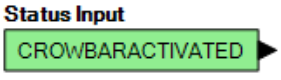
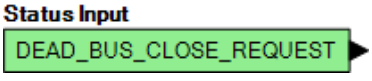
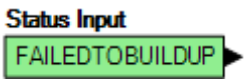
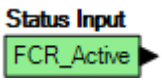
There are three main groups of objects used for programming BESTlogic*Plus*. These groups are *I/O, Components,* and *Elements.* For details on how these objects are used to program BESTlogic*Plus*, see the paragraphs on *Programming BESTlogicPlus.*

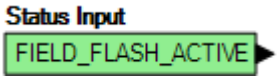
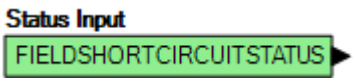
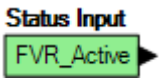
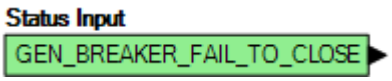
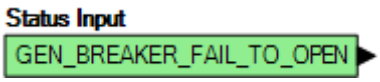
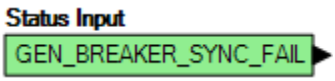
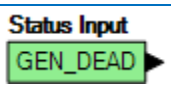
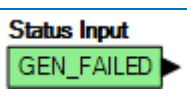
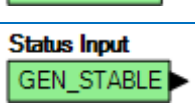
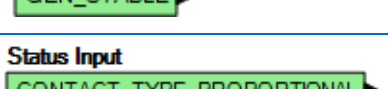
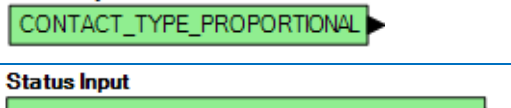
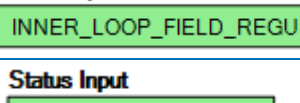
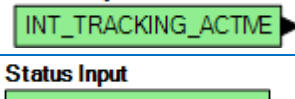
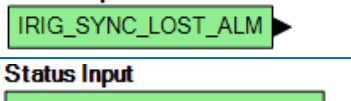
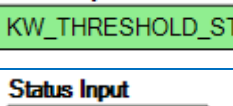
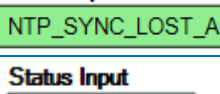
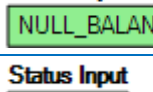
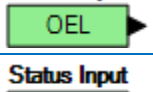
I/O

This group contains Input Objects, Output Objects, Off-Page Objects, and Alarms. Table 18-1 lists the names and descriptions of the objects in the *I/O* group.

Table 18-1. I/O Group, Names and Descriptions

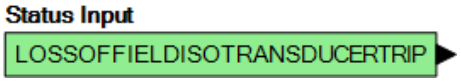
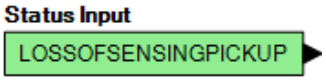
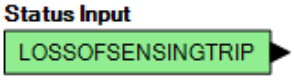
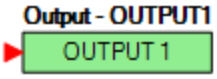
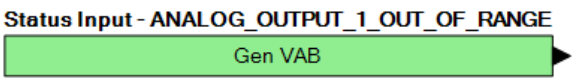
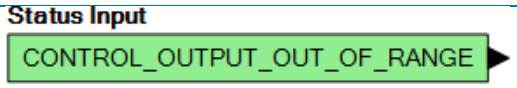
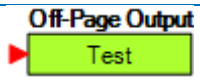
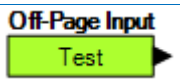
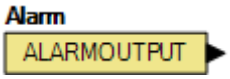
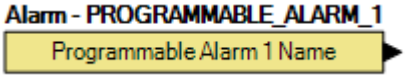
Name	Description	Symbol
Input Objects		
Logic 0	Always FALSE (Low).	Fixed 0
Logic 1	Always TRUE (High).	Fixed 1
Status, Front Panel Buttons		
Down Button	True while the front panel Down arrow button is pressed.	Status Input DownButton
Edit Button	True while the front panel Edit button is pressed.	Status 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.	
Right Button	True while the front panel Right arrow button is pressed.	
Up Button	True while the front panel Up arrow button is pressed.	
Physical Inputs		
Start Input	True when the physical Start input is active.	
Stop Input	True when the physical Stop input is active.	
IN1 - IN14	True when Physical Input x is active.	
Virtual Inputs		
VIN1 - VIN6	True when Virtual Input x is active.	
Status Inputs		
Anticipatory Sync Selected	True when Anticipatory is selected. (Synchronizer screen)	
Auto Mode Active	True when the unit is in Auto mode (AVR).	
Auto Sync Enabled	True when DECS auto-sync is enabled.	
Bus Dead	True when the Bus Dead condition settings have been exceeded.	
Bus Failed	True when the Bus Stable condition settings are not met.	
Bus Stable	True when the Bus Stable condition settings have been exceeded.	
Control Power Input Failure	True when the DECS-450R power supply is lost.	
Crowbar Activated	True when the CROWBARSTATUS logic element has a TRUE input.	
Dead Bus Close Request	True when this option is user-enabled; a dead bus is closed automatically upon detection. False when this option is disabled; a dead bus will remain open.	
Failed To Buildup	True when the Failed to Buildup alarm is active.	
FCR Active	True when the unit is in FCR mode.	

Name	Description	Symbol
Field Flash Active	True when field flash is active.	
Field Short Circuit Status	True when a field short circuit condition is detected.	
FVR Active	True when the unit is in FVR mode.	
Gen Breaker Fail to Close	The generator breaker did not close in the close wait time period.	
Gen Breaker Fail to Open	The generator breaker did not open in the close wait time period.	
Gen Breaker Sync Fail	True when generator breaker sync has failed.	
Gen Dead	True when the Generator Breaker Dead condition settings have been exceeded.	
Gen Failed	True when the Generator Breaker Stable condition settings are not met.	
Gen Stable	True when the Generator Breaker Stable condition settings have been exceeded.	
GOV Contact Type Proportional	True when this option is selected. (Governor Bias Control Settings screen)	
Inner Loop Field Regulator Active	True when the inner loop field regulator is active.	
Internal Tracking Active	True when internal tracking is running.	
IRIG Sync Lost	True when IRIG signal is not being received.	
KW Threshold	True when kW output is below the standard (non-Grid Code) PF Active Power Level.	
Manual Mode Active	True when the unit is in Manual mode (FCR/FVR).	
NTP Sync Lost	True when NTP server has lost communications.	
Null Balance	True when Null Balance is achieved in internal tracking.	
OEL	True when the Overexcitation Limiter is active.	
PF Controller Active	True when the unit is in PF mode.	

Name	Description	Symbol
PLL Sync Selected	True when phase locked loop (PLL) is selected. (Synchronizer screen)	Status Input PLL_SYNC_SELECTED
Preposition Active	True when any preposition is active.	Status Input DECS_PREPOSITION
Preposition 1 Active	True when Preposition 1 is active.	Status Input PREPOSITION_1_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
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
Transfer Watchdog	True when watchdog has timed out.	Status Input TRANSFERWATCHDOG
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
Var Controller Active	True when the unit is in VAR mode.	Status Input VAR_Active
Var Limiter Active	True when the Var Limiter is active.	Status Input VAR_LIMITER_ACTIVE
Voltage Matching Active	True when Voltage Matching is active.	Status Input VOLTAGE_MATCHING_ACTIVE
Status, Protection		
25-1 Status	True when the conditions for synchronization are met.	Status Input PROTECTION25STATUS

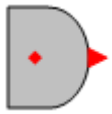
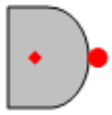
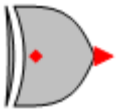
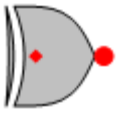
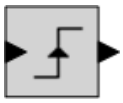
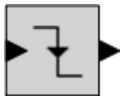
Name	Description	Symbol
27 Pickup	True when this protective element has picked up.	Status Input PROTECTION27PICKUP
27 Trip	True when this protective element has tripped.	Status Input PROTECTION27TRIP
32R Pickup	True when this protective element has picked up.	Status Input PROTECTION32RPICKUP
32R Trip	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
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
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 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

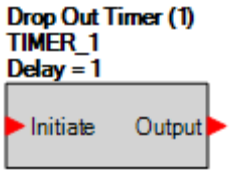
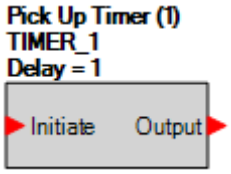
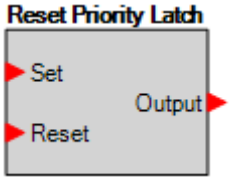
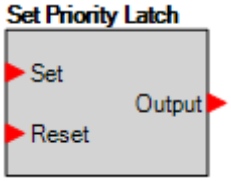
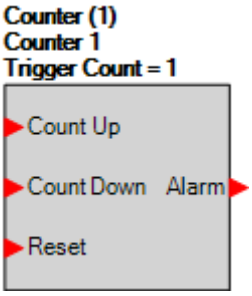
Name	Description	Symbol
Loss of Field Isolation Transducer Trip	True when this protective element has tripped.	
Loss of Sensing Pickup	True when this protective element has picked up.	
Loss of Sensing Trip	True when this protective element has tripped.	
Output Objects		
Physical Outputs OUT1 - OUT11	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.	
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		
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 18-2 lists the names and descriptions of the objects in the *Components* group.

Table 18-2. Components Group, Names and Descriptions

Name	Description	Symbol
Logic Gates		
AND	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 0 / 0 / 0 / 1	
NAND	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 1 / 1 / 1 / 0	
OR	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 0 / 1 / 1 / 1	
NOR	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 1 / 0 / 0 / 0	
XOR	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 0 / 1 / 1 / 0	
XNOR	Input: 0 0 / 0 1 / 1 0 / 1 1 — Output: 1 / 0 / 0 / 1	
NOT (INVERTER)	Input: 0 / 1 — Output: 1 / 0	
Rising Edge	The output is TRUE when the rising edge of a pulse is detected on the input signal.	
Falling Edge	The output is TRUE when the falling edge of a pulse is detected on the input signal.	

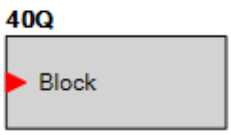
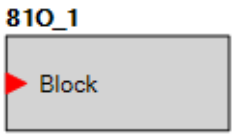
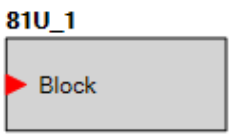
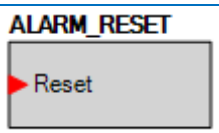
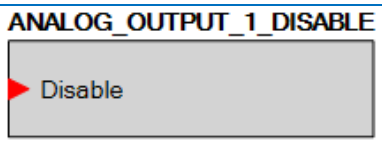
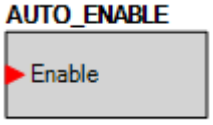
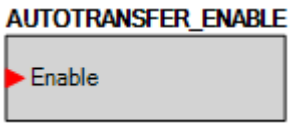
Name	Description	Symbol
Pickup and Dropout Timers		
Drop Out Timer	Used to set a delay in the logic. For more information, refer to *Programming BESTlogicPlus, Pickup and Dropout Timers,* later in this section.	
Pick Up Timer	Used to set a delay in the logic. For more information, refer to *Programming 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.	
Other		
Comment Block	Enter user comments.	
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*.	

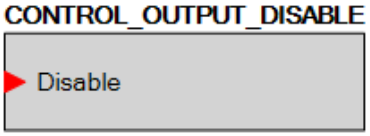
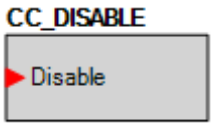
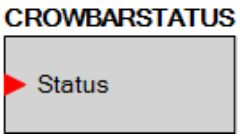
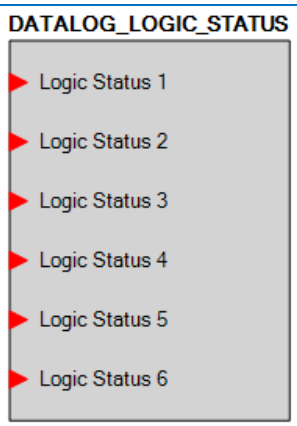
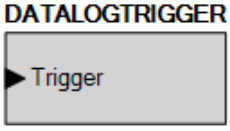
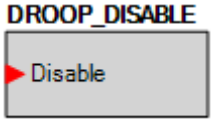
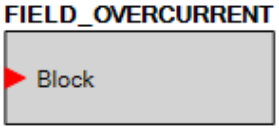
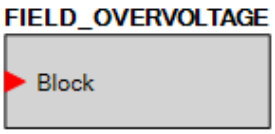
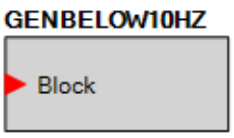
Elements

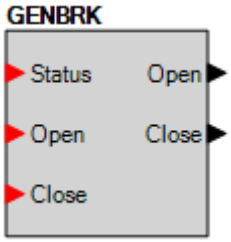
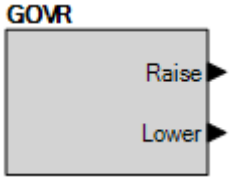
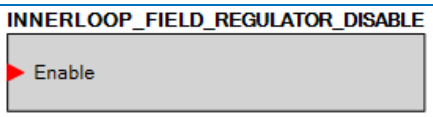
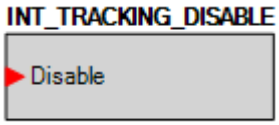
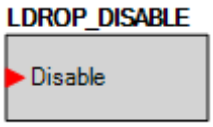
Table 18-3 lists the names and descriptions of the elements in the *Elements* group.

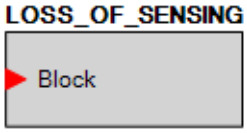
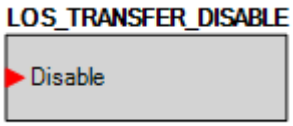
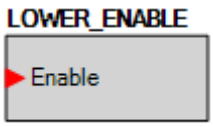
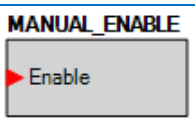
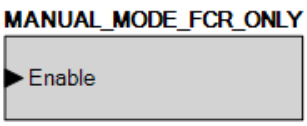
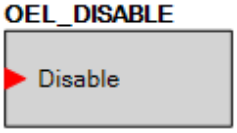
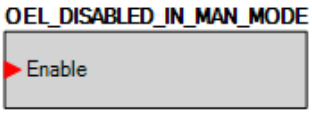
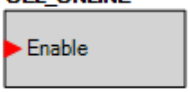
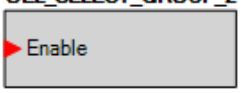
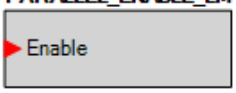
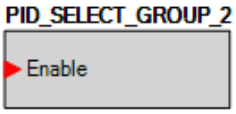
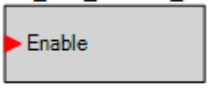
Table 18-3. Elements Group, Names and Descriptions

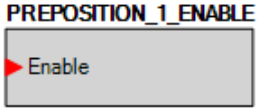
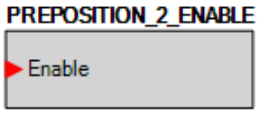
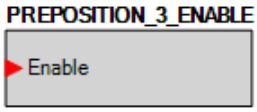
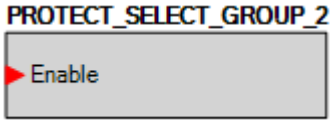
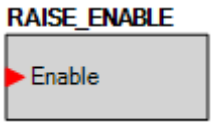
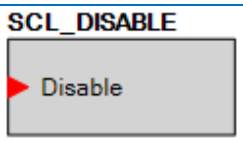
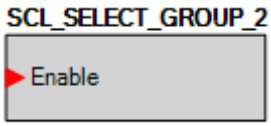
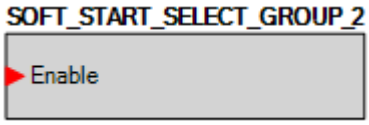
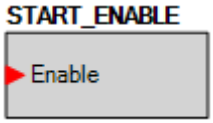
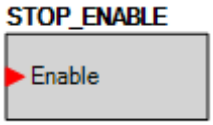
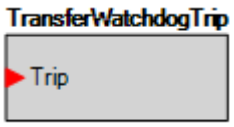
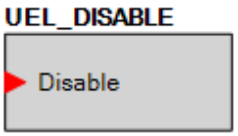
Name	Description	Symbol
25	When TRUE, this element blocks, or disables, the 25 sync-check protection function.	

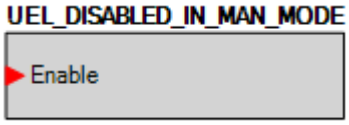
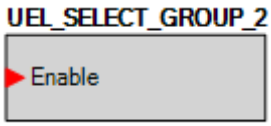
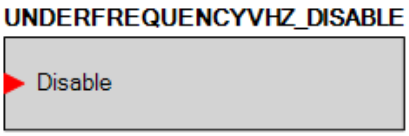
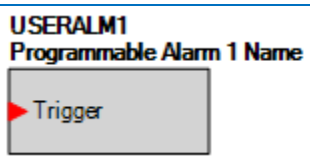
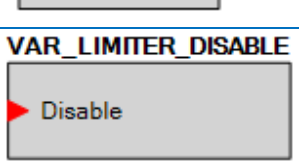
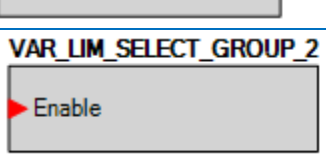
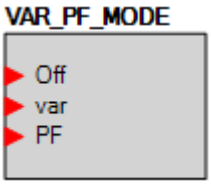
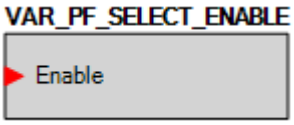
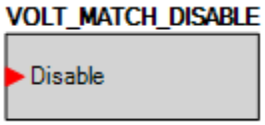
Name	Description	Symbol
27P	When TRUE, this element blocks, or disables, the 27 undervoltage protection function.	
32	When TRUE, this element blocks, or disables, the 32 reverse power protection function.	
40Q	When TRUE, this element blocks, or disables, the 40Q loss of excitation protection function.	
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.	
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.	

Name	Description	Symbol
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.	
DATALOG TRIGGER	When TRUE, this element triggers the datalog to begin recording data.	
DROOP DISABLE	When TRUE, this element disables droop when the unit is operating in AVR mode.	
FIELD OVERCURRENT	When TRUE, this element blocks, or disables, the Field Overcurrent protection function.	
FIELD OVERVOLTAGE	When TRUE, this element blocks, or disables, the Field Overvoltage protection function.	
GEN BELOW 10 HZ	When TRUE, this element blocks, or disables, the Gen Below 10 Hz protection function.	

Name	Description	Symbol
GENERATOR BREAKER	This element is used to connect the breaker open and close output signals from the DECS-450R 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.	
GENERATOR BREAKER Inputs *Status:* This input allows a contact input to be mapped that will provide breaker status feedback to the DECS-450R. 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. *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-450R will synchronize the generator to the bus, and then close the breaker.	GENERATOR BREAKER Outputs The outputs must be mapped to the contact outputs of the DECS-450R 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-450R is providing a signal to the breaker to open. It will be a pulse if the Breaker Output Contact Type is set to Pulse on the Breaker Hardware screen under Synchronizer/Voltage Matching in the Settings Explorer, and the length is determined by the Open Pulse Time. It will be a constant output if the Generator Breaker Hardware Contact Type is set to continuous. Note the pulse time must be set long enough for the breaker to actually close before the pulse is removed. *Close:* This output is pulsed TRUE (closes the output contact it is mapped to) when the DECS-450R 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.	
LOSS OF FIELD ISOLATION TRANSDUCER	When TRUE, this element disables the Loss of Field Isolation Transducer function.	

Name	Description	Symbol
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 MODE FCR ONLY	When TRUE, this element switches the Manual mode to FCR.	
OEL DISABLE	When TRUE, this element disables the OEL.	
OEL DISABLED IN MANUAL MODE	When TRUE, this element disables OEL when the unit is operating in Manual mode.	
OEL ONLINE	When TRUE, this element enables the use of OEL when the unit is considered online.	
OEL SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings for OEL.	
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.	
PID SELECT SECONDARY SETTINGS	When TRUE, this element selects secondary PID settings.	
PF/VAR ENABLE	When TRUE, this element enables the PF and Var controller, and informs the unit that it is online. The Var/PF Selection element must be set to TRUE to use var or PF mode. This element should be enabled when the 52JK is closed.	

Name	Description	Symbol
PREPOSITION 1 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 1.	
PREPOSITION 2 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 2.	
PREPOSITION 3 ENABLE	When TRUE, this element informs the unit to use setpoints for Preposition 3.	
PROTECTION SELECT SECONDARY SETTINGS	When TRUE, this element informs the unit to use secondary values for protection.	
RAISE ENABLE	When TRUE, this element raises the active setpoint.	
SCL DISABLE	When TRUE, this element disables the SCL.	
SCL SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings for SCL.	
SOFT START SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings for soft start.	
START ENABLE	When TRUE, this element starts the unit.	
STOP ENABLE	When TRUE, this element stops the unit.	
Transfer Watchdog Trip	When TRUE, this element energizes the transfer watchdog output relay.	
UEL DISABLE	When TRUE, this element disables the UEL.	

Name	Description	Symbol
UEL DISABLED IN MANUAL MODE	When TRUE, this element disables UEL when the unit is operating in Manual mode.	
UEL SELECT SECONDARY SETTINGS	When TRUE, this element selects secondary settings for UEL.	
UNDERFREQUENCY V/HZ DISABLE	When TRUE, this element disables the V/Hz Underfrequency limiter.	
USER PROGRAMMABLE ALARM 1 - 16	When TRUE, this element triggers a programmable alarm.	
VAR LIMITER DISABLE	When TRUE, this element disables the var limiter.	
VAR LIMITER SELECT SECONDARY SETTINGS	When TRUE, this element selects the secondary settings on the Var limiter.	
VAR/PF MODE	The var input selects var control and the PF input selects power factor control.	
VAR/PF SELECT ENABLE	When TRUE, this element allows the selection of Var and PF modes.	
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-450R 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-450R needs an active logic scheme in order to function. All DECS-450R 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-450R in service.

Sending and Retrieving Logic Schemes

Retrieving a Logic Scheme from the DECS-450R

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

Sending a Logic Scheme to the DECS-450R

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

Caution

Always remove the DECS-450R from service prior to changing or modifying the active logic scheme. Attempting to modify a logic scheme while the DECS-450R 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-450R. The modified scheme must be uploaded into the DECS-450R. See the paragraphs on *Sending and Retrieving Logic Schemes* above.

Default Logic Schemes

The default logic scheme is shown in Figure 18-2 and Figure 18-3. The default logic for physical outputs is shown in Figure 18-4.

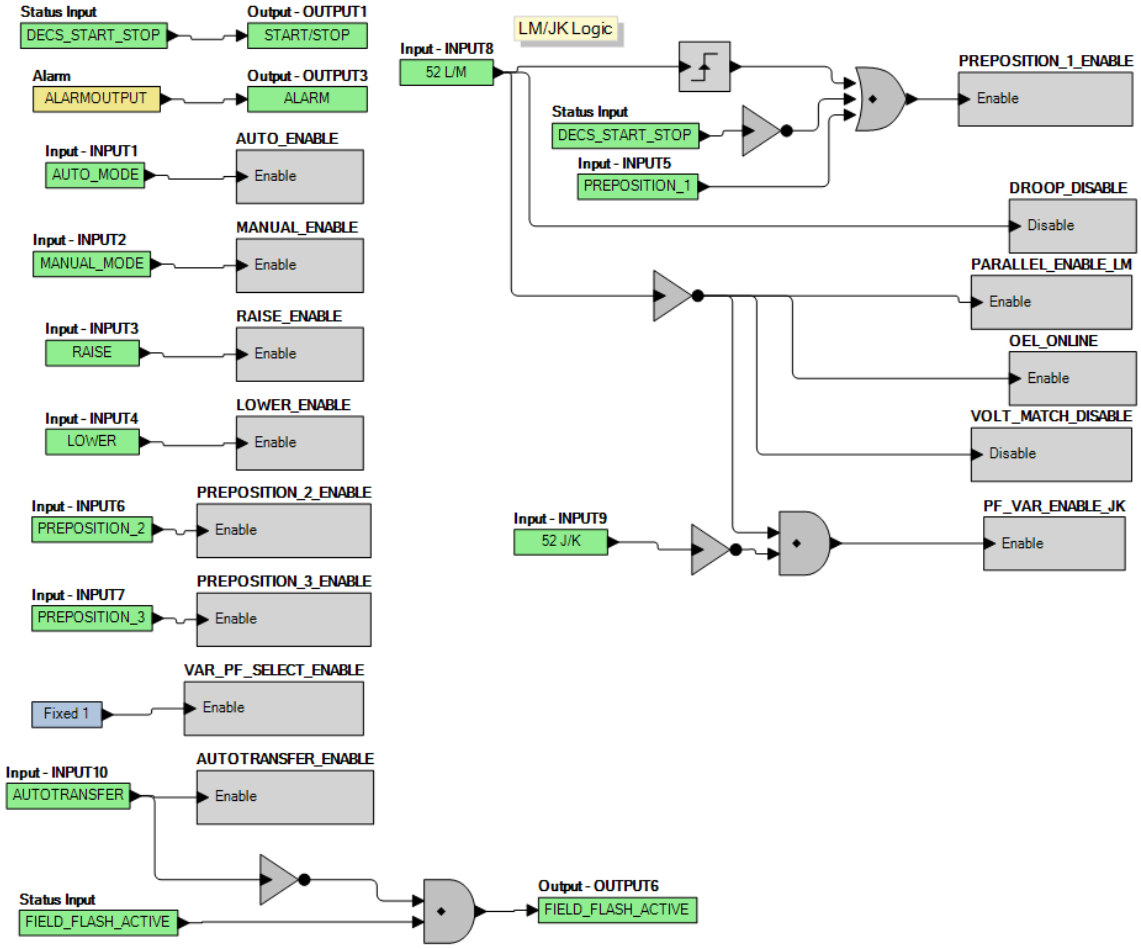


Figure 18-2. Default Logic – Logic Page 1 Tab

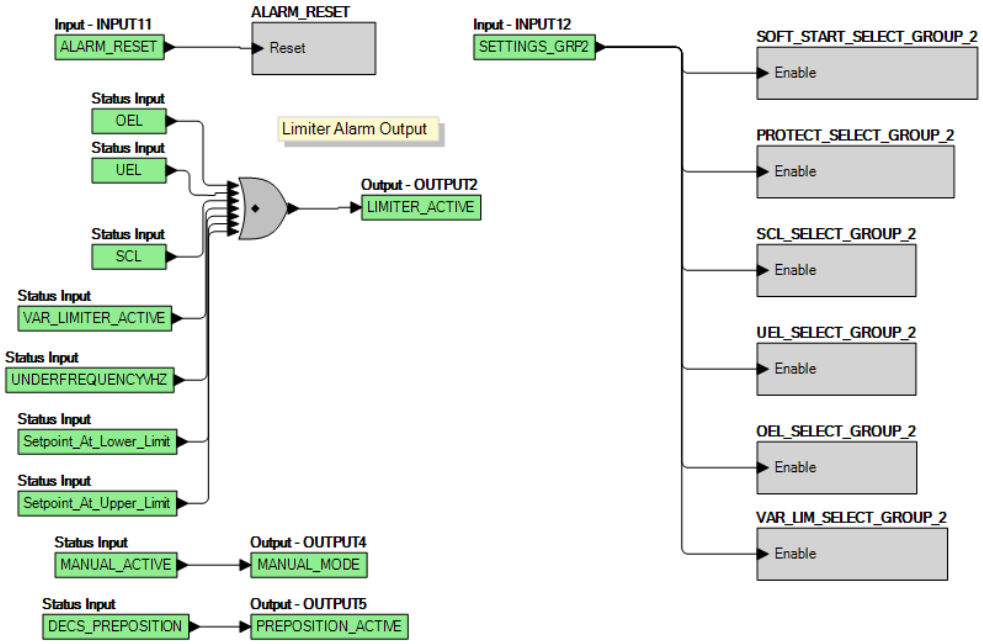


Figure 18-3. Default Logic - Logic Page 2 Tab

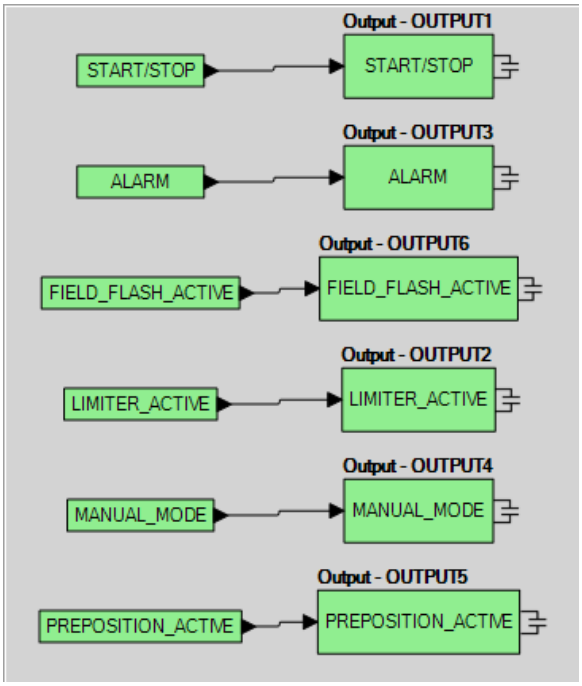


Figure 18-4. Default Logic - Physical Outputs Tab

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 18-1.

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-450R.

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-450R:

- 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 18-4 defines the colors for each indicator.

Table 18-4. 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 18-5, *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.

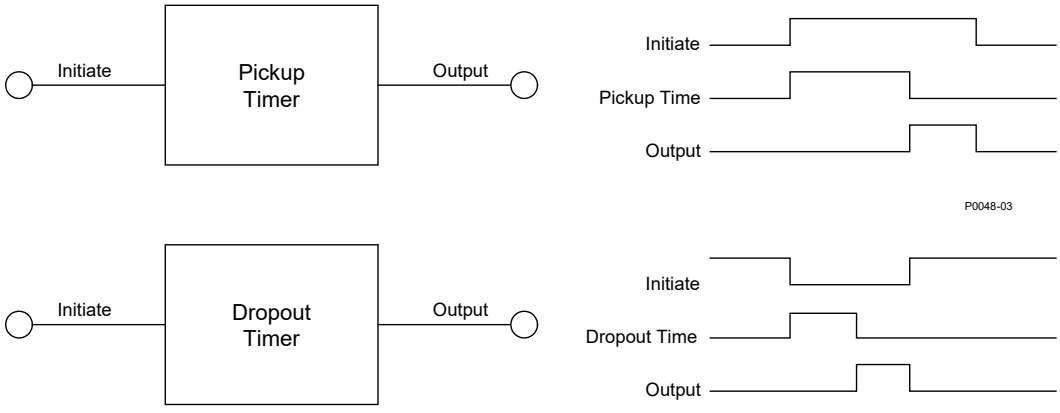


Figure 18-5. Pickup and Dropout Timer Logic Blocks

Offline Logic Simulator

You can use the offline logic simulator to test your custom logic before placing it in operation. The state of various logic elements can be toggled to verify that the logic states travel through the system as expected.

The offline logic simulator allows you to change the state of various logic elements to illustrate how that state travels through the system. Before running the logic simulator, you must click the Save button on the 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 18-6. STOP_ENABLE is Logic 0 (red) when Input 1 is Logic 1 (green), Input 2 is Logic 0 (red), and the inverter is Logic 1 (green).

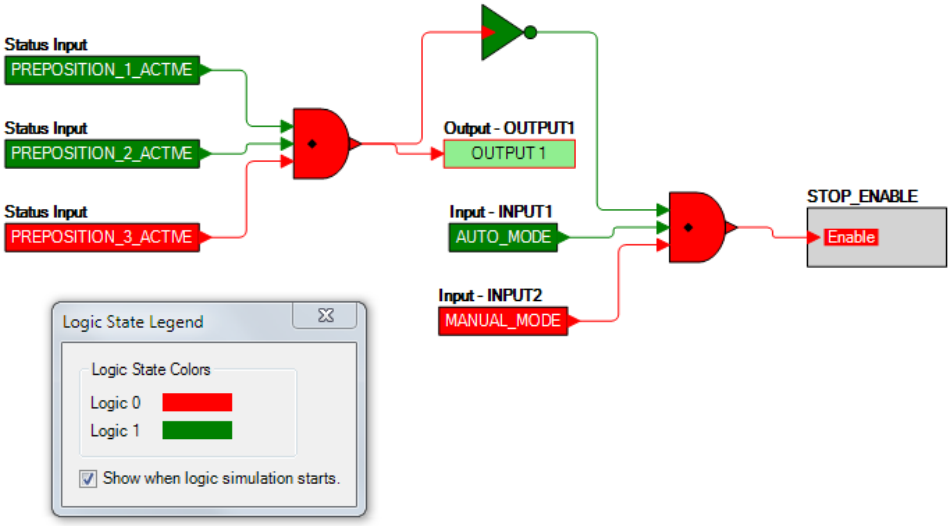


Figure 18-6. Offline Logic Simulator Example

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 18-7. For information on Settings Files management, refer to the *BESTCOMSPlus Software* section.

Figure 18-7. 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-450R, 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-450R, 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-450R, 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 18-8 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.

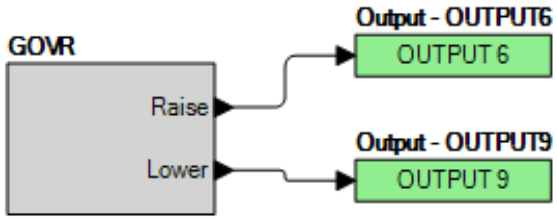


Figure 18-8. Example 1 - GOVR Logic Block Connections

Example 2 - AND Gate Connections

Figure 18-9 illustrates a typical AND gate connection. In this example, Output 11 will become active when the bus and the generator are dead.

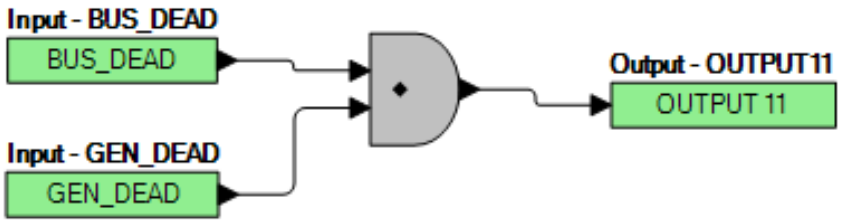


Figure 18-9. Example 2 - AND Gate Connections

19 • Communication

Local Communication

The USB port (type B) connects the DECS-450R 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-450R is automatically installed on your PC during the installation of BESTCOMS*Plus*. Information about establishing communication between BESTCOMS*Plus* and the DECS-450R 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.

Modbus® Communication

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

DECS-450R systems support the RS-485 mode and Modbus TCP (Ethernet) mode at the same time. DECS-450R 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 19-1.

Figure 19-1. 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 19-2 illustrates typical RS-485 connections for multiple DECS-450R controllers communicating over a Modbus network.

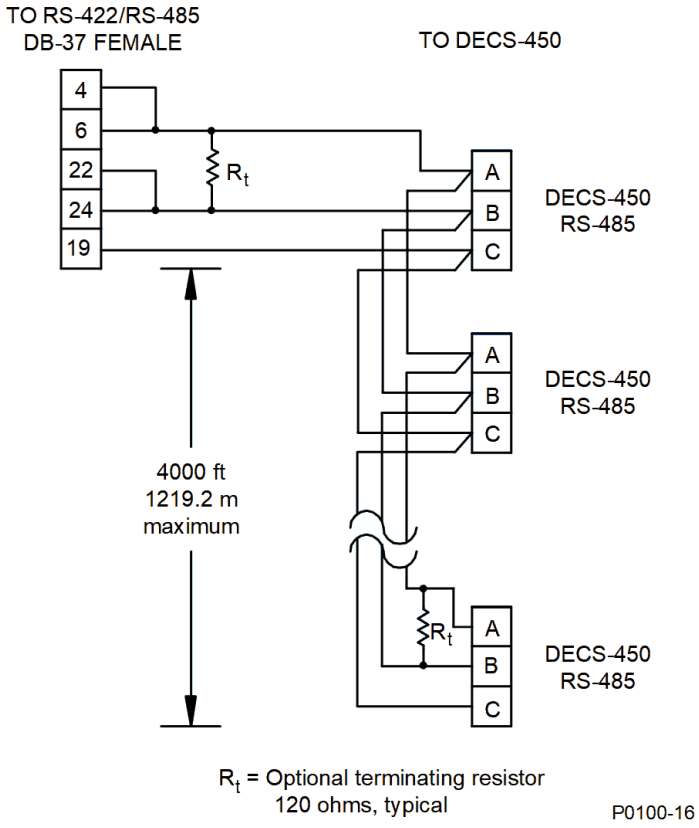


Figure 19-2. Typical RS-485 Connections

RS-485 port communication settings are illustrated in Figure 19-3.

Figure 19-3. RS-485 Port Communication Settings

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-450R 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-450R metering, annunciation, and control is provided through the Ethernet port using the Modbus TCP protocol. DECS-450R 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-450R to the PC using a standard Ethernet cable.
2. In BESTCOMS*Plus*, click *Communication, New Connection, DECS-450R*, or click the *Connection* button on the lower menu bar. The DECS-450R Connection window appears. (Figure 19-4)
3. If you know the IP address of the DECS-450R, click the radio button for the Ethernet Connection IP at the top of the DECS-450R 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 19-5)

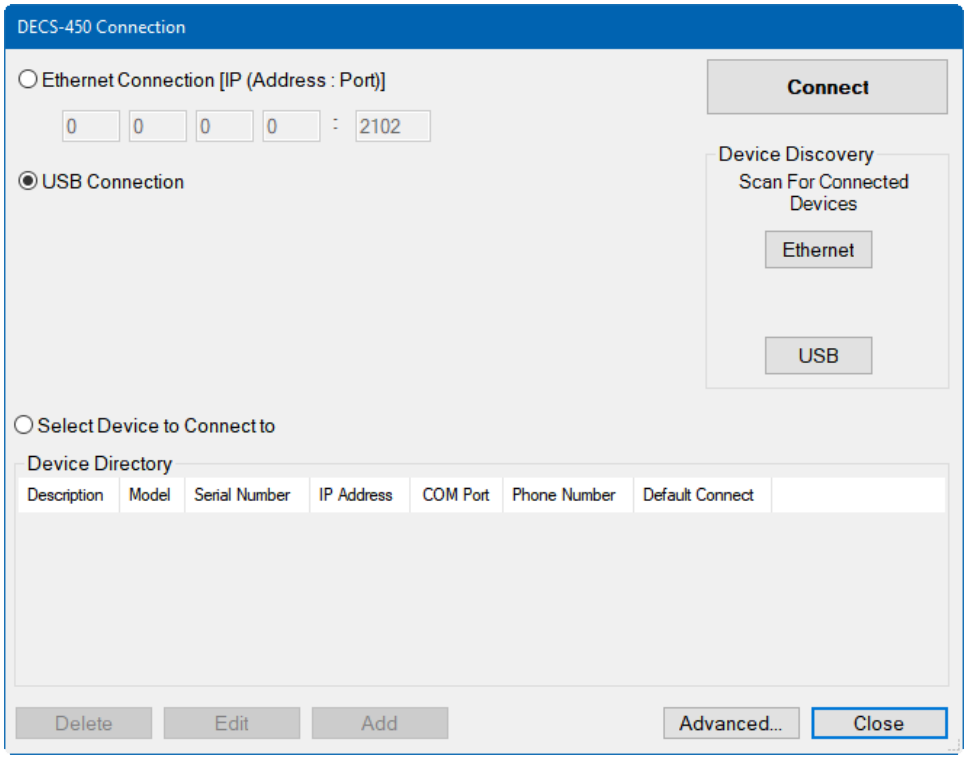


Figure 19-4. DECS-450R Connection Window

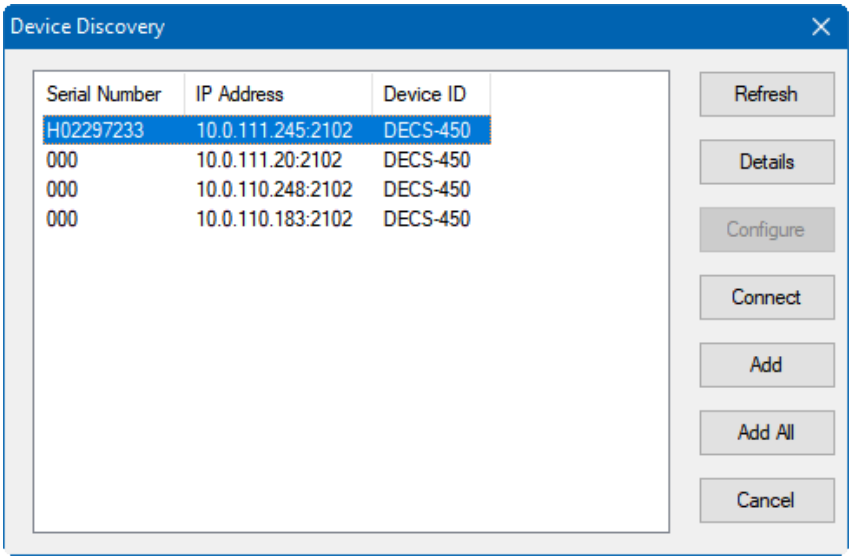


Figure 19-5. Device Discovery Window

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-450R 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 19-6. It contains options for enabling Auto Reconnect, downloading settings after reconnect, the delay between retries (in milliseconds), and the maximum number of attempts (Figure 19-6).

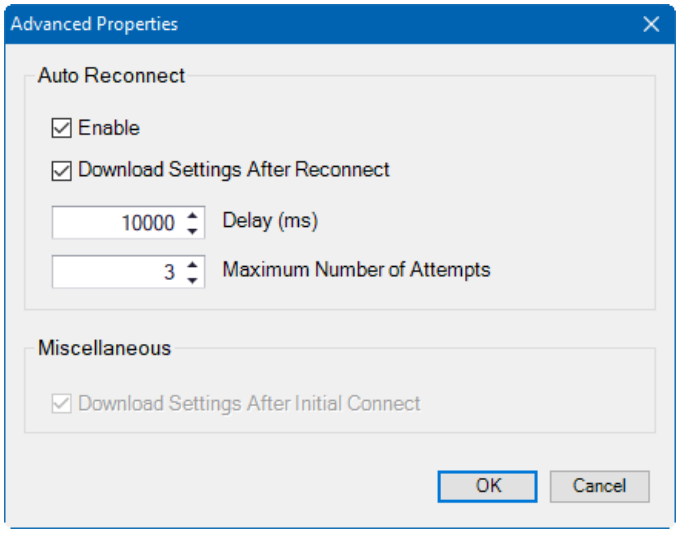


Figure 19-6. Advanced Properties, Auto Reconnect

Note

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

Otherwise, the PC must have a valid IP address with access to the network and the DECS-450R 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-450R sends and receives PROFIBUS data through a DB-9 port located on the rear panel. DECS-450R PROFIBUS communication parameters are listed and defined in the *PROFIBUS Communication* section of this manual.

PROFIBUS communication settings are illustrated in Figure 19-7.

Figure 19-7. Profibus Setup

20 • Configuration

Before the DECS-450R 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 20-1.

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-450R 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-450R responds to Raise and Lower commands by Raising or Lowering the setpoint for the mode in control.

Figure 20-1. 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 20-2.

For proper excitation control and protection, the DECS-450R 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-450R 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-450R with an exciter requiring an inverted output, enable the *Invert Output* setting to invert the DECS-450R 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.

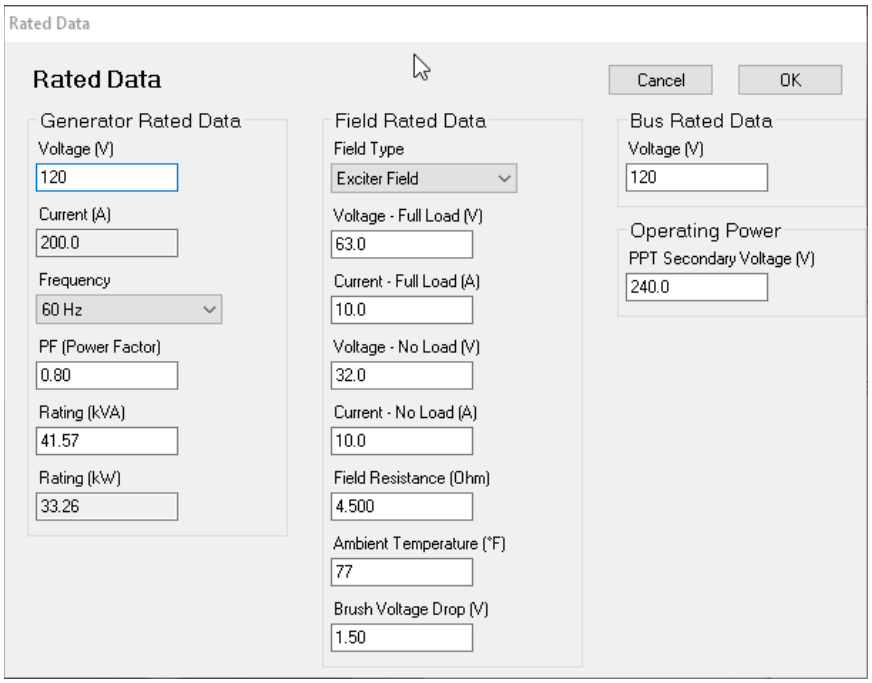


Figure 20-2. Generator, Bus, Field, Ratings

Field Isolation Transducer

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

Field Isolation Transducer configuration consists of settings for shunt rating and field voltage input. See Figure 20-3.

Figure 20-3. Field Isolation Transducer Ratings

Sensing Transformer Ratings and Configuration

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

DECS-450R configuration includes entry of the primary and secondary values for the transformers that supply generator and bus sensing values to the DECS-450R. These configuration settings are illustrated in Figure 20-4.

Generator PT

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

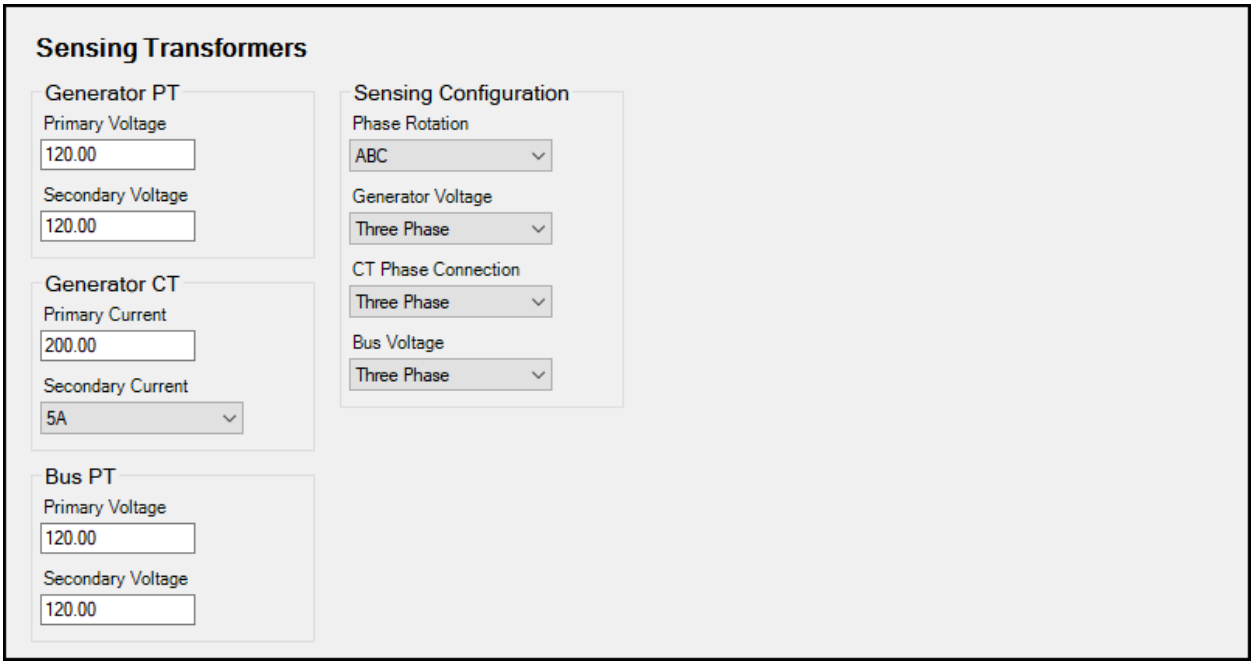


Figure 20-4. Sensing Transformer Ratings and Configuration

Startup Functions

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

DECS-450R startup functions consist of soft start and field flashing. These settings are illustrated in Figure 20-5.

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 of generator voltage where field flashing is withdrawn. In AVR mode, the field flash dropout level is expressed as a percentage of the setpoint of the active mode. In FCR mode, the level is expressed as a percentage of the field current. In FVR mode, the level is expressed as a percentage of the field voltage.

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-450R programmable contact outputs must be configured as a field flashing output.

Figure 20-5. Startup Function Settings

Device Information

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

Device information includes user-assigned identification labeling and read-only firmware version information and product information. Device information (Figure 20-6) is provided for the DECS-450R.

Firmware and Product Information

Firmware and product information can be viewed on the HMI display and Device Info tab of BESTCOMS*Plus*.

Firmware Information

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

Product Information

Product information for the DECS-450R includes the device model number and serial number.

Device Identification

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

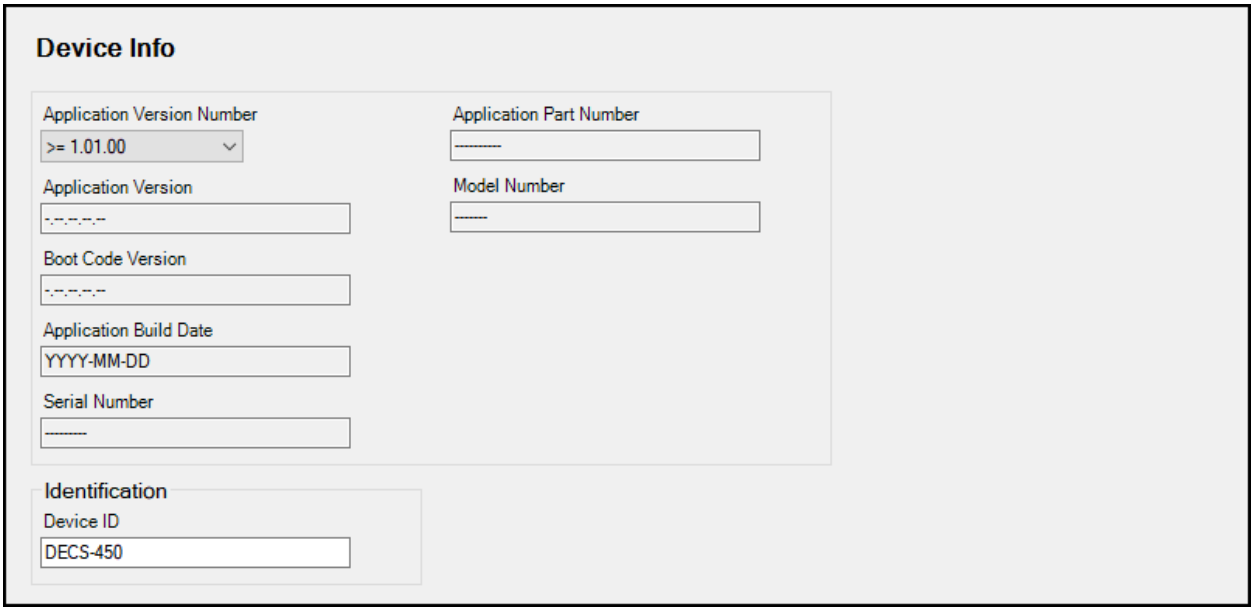


Figure 20-6. Device Information

Display Units

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

When working with DECS-450R 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 20-7.

Figure 20-7. Display Units

21 • Security

DECS-450R 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-450R 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 21-1. 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 21-1. 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 21-1). 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.

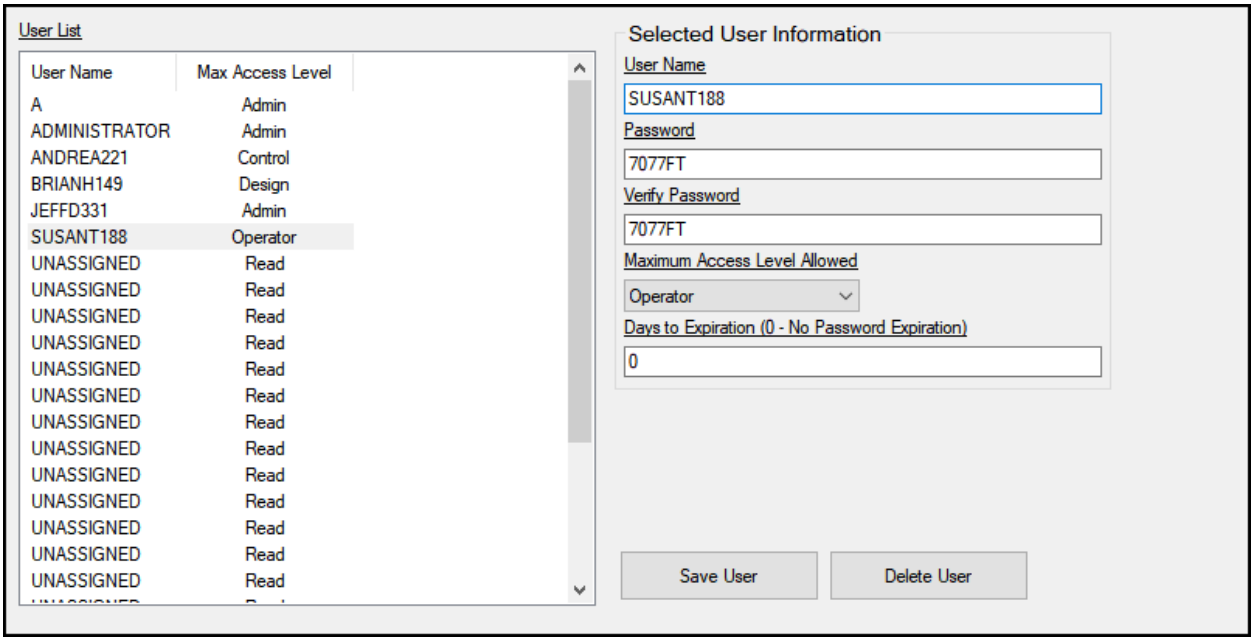


Figure 21-1. Password Access Settings

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-450R 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-450R 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.

Port Access Configuration

Communication port access is configured on the BESTCOMS*Plus* Port Access Setup screen (Figure 21-2). 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.

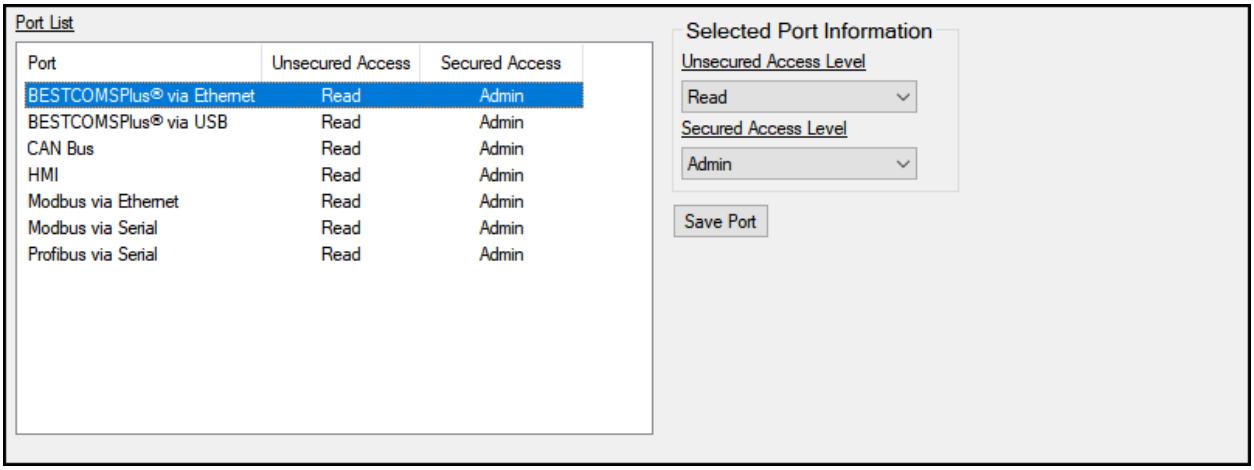


Figure 21-2. Port Access Configuration Settings

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 21-3.

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.

Figure 21-3. Login and Access Control Settings

Security Shutdown Alarm

The DECS-450R verifies its style and serial numbers during power-on self-test. The Security Shutdown alarm is annunciated when the DECS-450R 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-450R will neither start excitation nor run other control functions.
3. The DECS-450R will retain communication functions to annunciate the alarm.

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

Viewing the Security Log

BESTCOMS*Plus* Navigation Path: Metering Explorer, Reports, Security Log

HMI Navigation Path: Not available through the front panel

The DECS-450R 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.

A maximum of 200 entries are stored in nonvolatile memory. When a new entry is generated, the DECS-450R 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-450R 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.

22 • Timekeeping

The DECS-450R clock is used by the logging functions to timestamp events. DECS-450R 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 22-1.

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-450R 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-450R 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-450R can use NTP to synchronize with a radio, atomic, or other clock located on the internet/intranet, to maintain accurate timekeeping.

NTP Settings

NTP is enabled in the DECS-450R 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-450R 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.

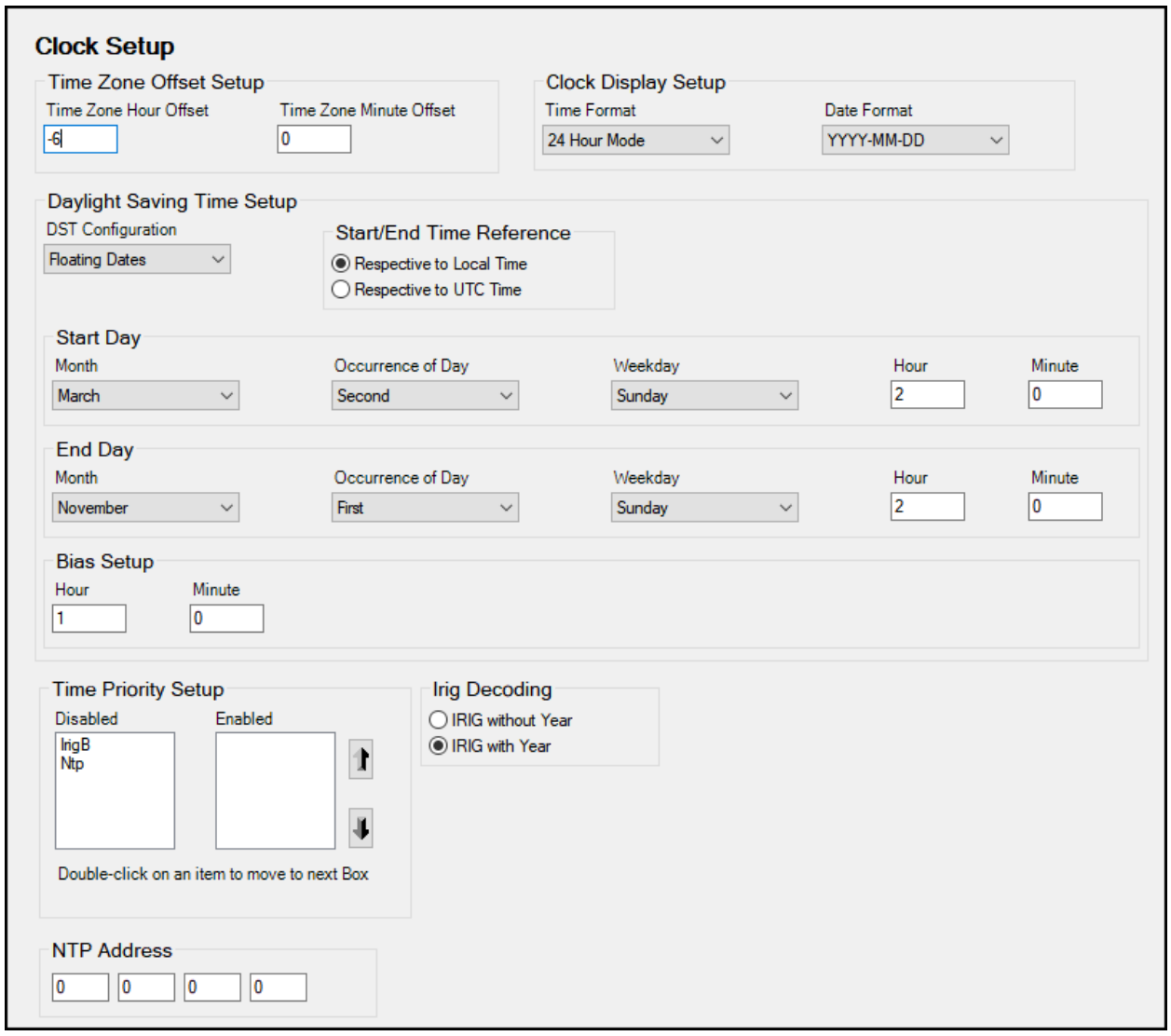


Figure 22-1. Clock Setup

23 • Testing

Testing of the DECS-450R's regulation 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.

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. 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 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 23-1.

Figure 23-1. 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 (Errln)
- 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)
- 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
- 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)
- 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 23-2 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.

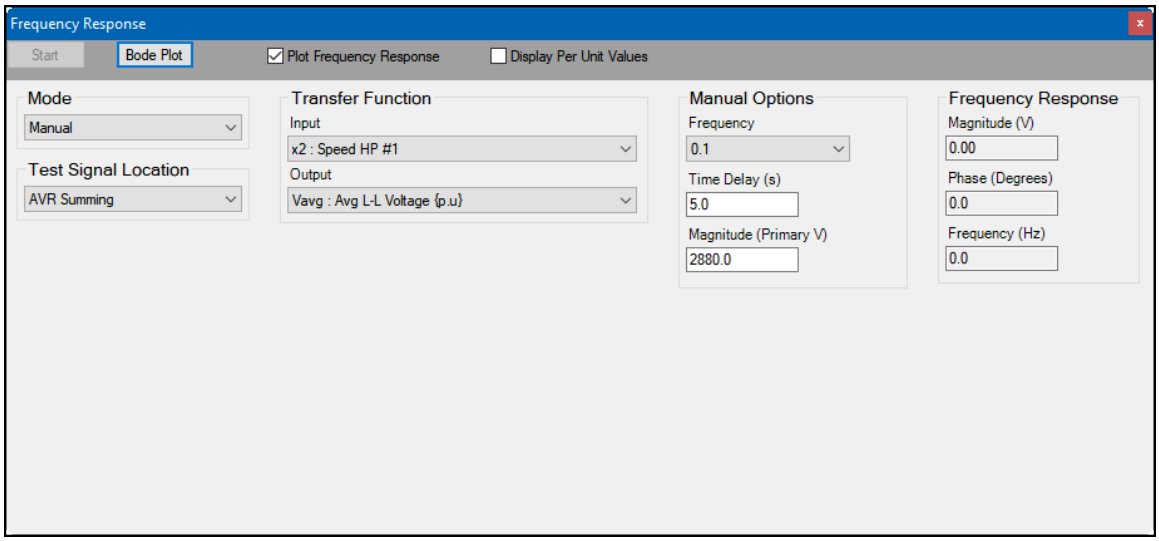


Figure 23-2. Frequency Response Screen

Bode Plotting

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

Transfer Function

The point in the DECS-450R logic circuitry where a signal is injected for analysis of magnitude and phase responses is selectable. Signal points include 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
- NullBalance: Null Balance Level
- OelOutput: OEL Controller Output
- PF: Power Factor
- Post: Post-Limit Output {pu}
- Prelim: Pre-Limit Output {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)
- 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.

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 23-3) 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-450R 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 23-3. 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.

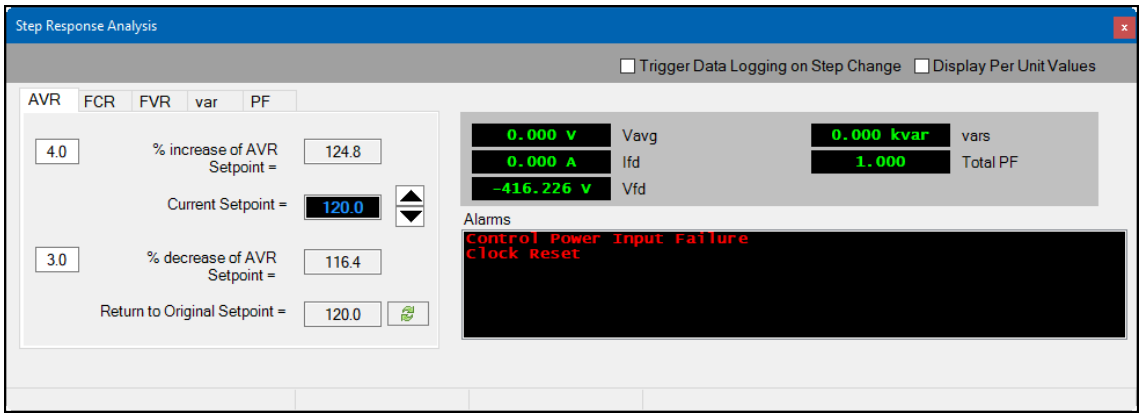


Figure 23-3. Step Response Analysis - AVR Tab

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 23-4. Var and PF tab controls are described below.

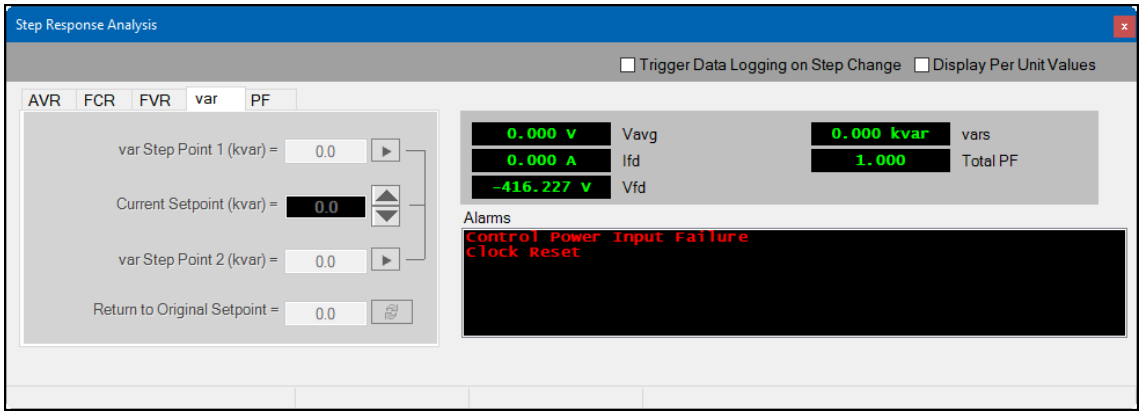


Figure 23-4. Step Response Analysis - Var Tab

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 23-5.

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 23-6.

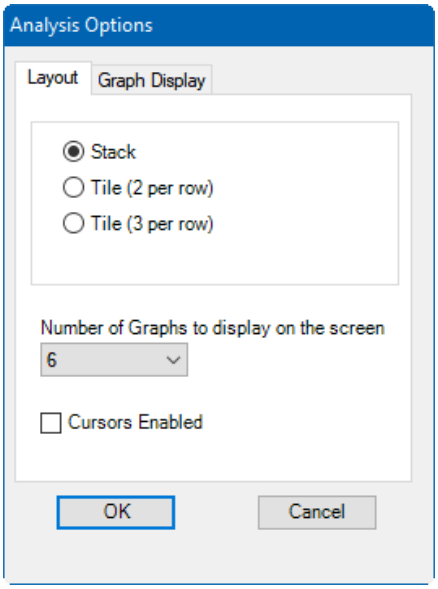


Figure 23-5. Analysis Options Screen, Layout Tab

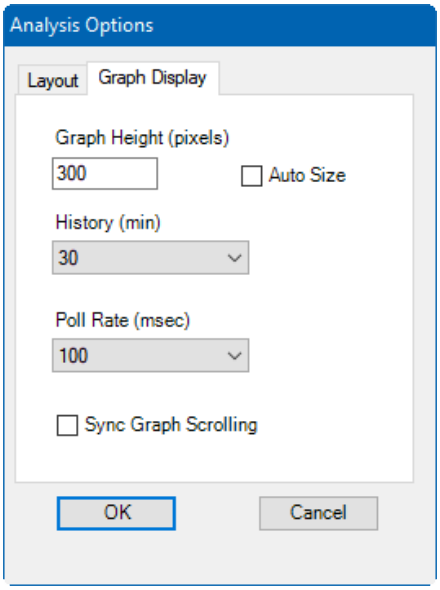


Figure 23-6. Analysis Options Screen, Graph Display Tab

24 • Modbus® Communication

Introduction

This document describes the Modbus® communications protocol employed by DECS-450R systems and how to exchange information with DECS-450R systems over a Modbus network. DECS-450R 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-450R) 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-450R 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-450R 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-450R 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-450R 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 24-1.

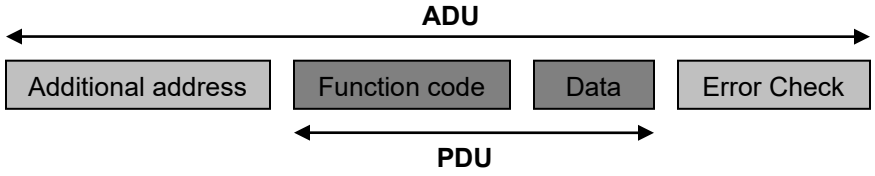


Figure 24-1. General Modbus Frame

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

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

Message Framing and Timing Considerations

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

Once a valid query is received, the DECS-450R 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 24-1 provides the response message transmission time (in seconds) and 3.5 character times (in milliseconds) for various message lengths and baud rates.

Table 24-1. 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 24-2.

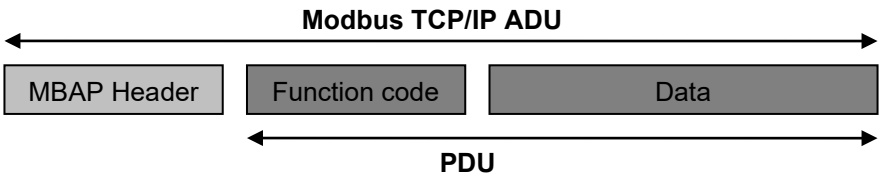


Figure 24-2. Modbus Request/Response Over TCP/IP

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 24-2.

Table 24-2. 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-450R 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-450R are provided in Table 24-3.

Table 24-3. 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-450R Modbus® via Ethernet

Modbus can communicate through Ethernet if the IP address of the DECS-450R 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-450R 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-450R 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-450R 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-450R 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-450R continues to monitor all queries. The DECS-450R 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-450R 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-450R will perform the write when the device address in query is a broadcast address or the same as the DECS-450R 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-450R 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-450R 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 24-4 shows the floating-point format.

Table 24-4. 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 24-7), 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-450R 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-450R Login via Modbus

To login to the DECS-450R 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-450R. Upon disconnecting from Modbus over TCP/IP, the user is automatically logged out of the DECS-450R. However, upon disconnecting from Modbus over serial line, the user remains logged in.

Modbus Parameters

General

General parameters are listed in Table 24-5.

Table 24-5. 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 24-6. Security Group Parameters

Group	Name	Register	Type	Bytes	R/W	Range
Security	Secure Login	45400	String	34	RW	0–34
Security	Logout	45417	String	5	RW	0–5
Security	Current Access	45420	Uint32	4	R	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

Binary Points

Table 24-7. 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

Group	Name	Register	Type	Bytes	R/W	Range
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
Reserved		45802 bits 5-9				
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
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

Group	Name	Register	Type	Bytes	R/W	Range
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
Reserved		45805 bit 11				
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
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
Reserved		45807 bit 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

Group	Name	Register	Type	Bytes	R/W	Range
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
Reserved		45807 bits 9-14				
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
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
Reserved		45809 bit 11 - 45829 bit 1				
DECS Control	KW threshold status	45829 bit 2	Uint16	2	R	True=1 False=0
More Alarms	Bridge overtemperature warning	45829 bit 3	Uint16	2	R	True=1 False=0
More Alarms	Bridge overtemperature alarm	45829 bit 4	Uint16	2	R	True=1 False=0
Reserved		45829 bit 5				
More Alarms	Security shutdown alarm	45829 bit 6	Uint16	2	R	True=1 False=0
Reserved		45829 bit 7				
Grid Code Parameters	APC bridge active	45829 bit 8	Uint16	2	R	True=1 False=0
Grid Code Parameters	LVRT bride active	45829 bit 9	Uint16	2	R	True=1 False=0
Reserved		45829 bits 10-12				
Loss of Field Isolation Transducer	Block	45829 bit 13	Uint16	2	R	True=1 False=0
Loss of Field Isolation Transducer	Pickup	45829 bit 14	Uint16	2	R	True=1 False=0
Loss of Field Isolation Transducer	Trip	45829 bit 15	Uint16	2	R	True=1 False=0
81U-2	Block	45830 bit 0	Uint16	2	R	True=1 False=0
81U-2	Pickup	45830 bit 1	Uint16	2	R	True=1 False=0
81U-2	Trip	45830 bit 2	Uint16	2	R	True=1 False=0
Analog Output	Analog output 1 out of range	45830 bit 3	Uint16	2	R	True=1 False=0

Group	Name	Register	Type	Bytes	R/W	Range
Analog Output	Analog output 2 out of range	45830 bit 4	Uint16	2	R	True=1 False=0
Analog Output	Analog output 3 out of range	45830 bit 5	Uint16	2	R	True=1 False=0
Analog Output	Analog output 4 out of range	45830 bit 6	Uint16	2	R	True=1 False=0
Analog Output	Control output out of range	45830 bit 7	Uint16	2	R	True=1 False=0

Metering

Table 24-8. Metering Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Range
Per Unit Meter	Gen Vab pu	45900	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Vbc pu	45902	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Vca pu	45904	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Vavg pu	45906	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Ia pu	45908	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Ib pu	45910	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Ic pu	45912	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Iavg pu	45914	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Kw pu	45916	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Kva pu	45918	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Gen Kvar pu	45920	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Positive sequence voltage pu	45922	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Negative sequence voltage pu	45924	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Positive sequence current pu	45926	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Negative sequence current pu	45928	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Bus Vab pu	45930	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Bus Vbc pu	45932	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Bus Vca pu	45934	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Bus vavg pu	45936	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Voltage difference pu	45938	Float	4	R	Per Unit	-10 - 10
Reserved		45940					
Per Unit Meter	Gen frequency pu	45942	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Bus frequency pu	45944	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Field current pu	45946	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Field voltage pu	45948	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Slip frequency pu	45950	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Icc pu	45952	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	AVR setpoint pu	45954	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	FCR setpoint pu	45956	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	FVR setpoint pu	45958	Float	4	R	Per Unit	-10 - 10
Per Unit Meter	Var setpoint pu	45960	Float	4	R	Per Unit	-10 - 10
Field Voltage Meter	V_X	45962	Float	4	R	Volt	-1000 – 1000
Field Current Meter	I_X	45964	Float	4	R	Amp	0–2000000000
Reserved		45966 - 45970					
DECS Regulator Meter	Tracking error	45972	Float	4	R	Percent	n/a
DECS Regulator Meter	Control output PU	45974	Float	4	R	Per Unit	-10 – 10
Reserved		45976					
DECS Regulator Meter	Control output	45978	Float	4	R	Percent	n/a
Reserved		45980					
DECS Regulator Meter	LL magnitude pu	45982	Float	4	R	Per Unit	-10 – 10
DECS Regulator Meter	NLS LL magnitude avg pu	45984	Float	4	R	Per Unit	-10 – 10
DECS Regulator Meter	NLS number generators online	45986	Int 32	4	R	n/a	n/a

Group	Name	Register	Type	Bytes	R/W	Unit	Range
Generator Voltage Meter Magnitude 1	V_{AB}	45988	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Magnitude 1	V_{BC}	45990	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Magnitude 1	V_{CA}	45992	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Magnitude 1	V_{AVG} LL	45994	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Primary 1	V_{AB}	45996	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Primary 1	V_{BC}	45998	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Primary 1	V_{CA}	46000	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Primary 1	V_{AVG} LL	46002	Float	4	R	Volt	0–2000000000
Generator Voltage Meter Angle 1	V_{AB}	46004	Float	4	R	Degree	0–360
Generator Voltage Meter Angle 1	V_{BC}	46006	Float	4	R	Degree	0–360
Generator Voltage Meter Angle 1	V_{CA}	46008	Float	4	R	Degree	0–360
Generator Voltage Meter Angle 1	V_{AB}	46010	String	24	R	n/a	0–24
Generator Voltage Meter Angle 1	V_{BC}	46022	String	24	R	n/a	0–24
Generator Voltage Meter Angle 1	V_{CA}	46034	String	24	R	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{AB}	46046	String	24	R	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{BC}	46058	String	24	R	n/a	0–24
Gen Voltage Meter Primary Angle 1	V_{CA}	46070	String	24	R	n/a	0–24
Bus Voltage Meter Magnitude 1	V_{AB}	46082	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Magnitude 1	V_{BC}	46084	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Magnitude 1	V_{CA}	46086	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Magnitude 1	V_{AVG} LL	46088	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Primary 1	V_{AB}	46090	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Primary 1	V_{BC}	46092	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Primary 1	V_{CA}	46094	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Primary 1	V_{AVG} LL	46096	Float	4	R	Volt	0–2000000000
Bus Voltage Meter Angle 1	V_{AB}	46098	Float	4	R	Degree	0–360
Bus Voltage Meter Angle 1	V_{BC}	46100	Float	4	R	Degree	0–360
Bus Voltage Meter Angle 1	V_{CA}	46102	Float	4	R	Degree	0–360
Bus Voltage Meter Angle 1	V_{AB}	46104	String	24	R	n/a	0–24
Bus Voltage Meter Magnitude Angle 1	V_{BC}	46116	String	24	R	n/a	0–24
Bus Voltage Meter Magnitude Angle 1	V_{CA}	46128	String	24	R	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{AB}	46140	String	24	R	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{BC}	46152	String	24	R	n/a	0–24
Bus Voltage Meter Primary Angle 1	V_{CA}	46164	String	24	R	n/a	0–24

Group	Name	Register	Type	Bytes	R/W	Unit	Range
Generator Current Meter Magnitude 1	I_A	46176	Float	4	R	Amp	0–2000000000
Generator Current Meter Magnitude 1	I_B	46178	Float	4	R	Amp	0–2000000000
Generator Current Meter Magnitude 1	I_C	46180	Float	4	R	Amp	0–2000000000
Generator Current Meter Magnitude 1	I_{AVG}	46182	Float	4	R	Amp	0–2000000000
Generator Current Meter Primary 1	I_A	46184	Float	4	R	Amp	0–2000000000
Generator Current Meter Primary 1	I_B	46186	Float	4	R	Amp	0–2000000000
Generator Current Meter Primary 1	I_C	46188	Float	4	R	Amp	0–2000000000
Generator Current Meter Primary 1	I_{AVG}	46190	Float	4	R	Amp	0–2000000000
Generator Current Meter Angle 1	I_A	46192	Float	4	R	Degree	0–360
Generator Current Meter Angle 1	I_B	46194	Float	4	R	Degree	0–360
Generator Current Meter Angle 1	I_C	46196	Float	4	R	Degree	0–360
Generator Current Meter Magnitude Angle 1	I_A	46198	String	24	R	n/a	0–24
Generator Current Meter Magnitude Angle 1	I_B	46210	String	24	R	n/a	0–24
Generator Current Meter Magnitude Angle 1	I_C	46222	String	24	R	n/a	0–24
Generator Current Meter Primary Angle 1	I_A	46234	String	24	R	n/a	0–24
Generator Current Meter Primary Angle 1	I_B	46246	String	24	R	n/a	0–24
Generator Current Meter Primary Angle 1	I_C	46258	String	24	R	n/a	0–24
Icc Current Meter Magnitude 1	I_X	46270	Float	4	R	Amp	0–2000000000
Icc Current Meter Primary 1	I_X	46272	Float	4	R	Amp	0–2000000000
Power Meter	Total watts secondary	46274	Float	4	R	Watt	n/a
Power Meter	Total watts primary	46276	Float	4	R	Watt	n/a
Power Meter	Total vars secondary	46278	Float	4	R	Var	n/a
Power Meter	Total vars primary	46280	Float	4	R	var	n/a
Power Meter	Total S secondary	46282	Float	4	R	VA	n/a
Power Meter	Total S primary	46284	Float	4	R	VA	n/a
Power Meter	Total PF secondary	46286	Float	4	R	PF	-1 – 1
Power Meter	Total PF primary	46288	Float	4	R	PF	-1 – 1
Power Meter	Positive watthour total	46290	Float	4	R	Watthour	0.00E+00–1.00E+12
Power Meter	Positive varhour total	46292	Float	4	R	Varhour	0.00E+00–1.00E+12
Power Meter	Negative watthour total	46294	Float	4	R	Watthour	-1.00E+12–0.00E+00
Power Meter	Negative varhour total	46296	Float	4	R	Varhour	-1.00E+12–0.00E+00
Power Meter	VA hour total	46298	Float	4	R	VA hour	0.00E+00–1.00E+12
Power Meter	Scaled PF	46300	Float	4	R	PF	-1 – 1
Energy Meter	Positive watthour total	46302	Float	4	RW	Watthour	0.00E+00–1.00E+12
Energy Meter	Positive varhour total	46304	Float	4	RW	Varhour	0.00E+00–1.00E+12

Group	Name	Register	Type	Bytes	R/W	Unit	Range
Energy Meter	Negative watthour total	46306	Float	4	RW	Watthour	-1.00E+12–0.00E+00
Energy Meter	Negative varhour total	46308	Float	4	RW	Varhour	-1.00E+12–0.00E+00
Energy Meter	VA hour total	46310	Float	4	RW	Varhour	0.00E+00–1.00E+12
Sync Meter 1	Slip Angle	46312	Float	4	R	Degree	-359.9 – 359.9
Sync Meter 1	Slip Frequency	46314	Float	4	R	Hertz	n/a
Sync Meter 1	Voltage Difference	46316	Float	4	R	Volt	n/a
Generator Frequency Meter 1	Frequency	46318	Float	4	R	Hertz	10–180
Bus Frequency Meter 1	Frequency	46320	Float	4	R	Hertz	10–180
Auxiliary Input Voltage 1	Value	46322	Float	4	R	Volt	-9999999 – 9999999
Auxiliary Input Current 1	Value	46324	Float	4	R	Amp	-9999999 – 9999999
Reserved		46326 - 46532					
Independent Meter	Field temperature	46534	Float	4	R	Deg F	-40 – 572
Independent Meter	Inner Loop Reference	46536	Float	4	R	Per Unit	-10 - 10
Independent Meter	Inner Loop Field Voltage Feedback	46538	Float	4	R	Per Unit	-10 – 10
Independent Meter	Inner Loop Error	46540	Float	4	R	Per Unit	-10 – 10
Independent Meter	Inner Loop PID Output	46542	Float	4	R	Per Unit	-10 – 10
Independent Meter	Inner Loop Output	46544	Float	4	R	Per Unit	-10 – 10
Independent Meter	Scaled Auxiliary Input Meter Value	46546	Float	4	R	n/a	-2000000 - 2000000
Analog Output 1 Metering	Raw	46548	Float	4	R	n/a	n/a
Analog Output 1 Metering	Scaled	46550	Float	4	R	n/a	n/a
Analog Output 2 Metering	Raw	46552	Float	4	R	n/a	n/a
Analog Output 2 Metering	Scaled	46554	Float	4	R	n/a	n/a
Analog Output 3 Metering	Raw	46556	Float	4	R	n/a	n/a
Analog Output 3 Metering	Scaled	46558	Float	4	R	n/a	n/a
Analog Output 4 Metering	Raw	46560	Float	4	R	n/a	n/a
Analog Output 4 Metering	Scaled	46562	Float	4	R	n/a	n/a
Control Output Metering	Raw	46564	Float	4	R	n/a	n/a
Control Output Metering	Scaled	46566	Float	4	R	n/a	n/a

Limiters

Table 24-9. Limiter Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Range
OEL Primary Current Hi	46600	Float	4	R W	Amp	0 – 12000
OEL Primary Current Mid	46602	Float	4	R W	Amp	0 – 12000
OEL Primary Current Lo	46604	Float	4	R W	Amp	0 – 12000
OEL Primary Time Hi	46606	Float	4	R W	Second	0 – 240
OEL Primary Time Mid	46608	Float	4	R W	Second	0 – 240
OEL Primary Current Hi Off	46610	Float	4	R W	Amp	0 – 12000
OEL Primary Current Lo Off	46612	Float	4	R W	Amp	0 – 12000
OEL Primary Current Time Off	46614	Float	4	R W	Second	0 – 240
OEL Primary Takeover Current Max Off	46616	Float	4	R W	Amp	0 – 12000
OEL Primary Takeover Current Min Off	46618	Float	4	R W	Amp	0 – 12000
OEL Primary Takeover Time Dial Off	46620	Float	4	R W	n/a	0.1 – 20
OEL Primary Takeover Current Max On	46622	Float	4	R W	Amp	0 – 12000
OEL Primary Takeover Current Min On	46624	Float	4	R W	Amp	0 – 12000

Name	Register	Type	Bytes	R/W	Unit	Range
OEL Primary Takeover Time Dial On	46626	Float	4	R W	n/a	0.1–20
OEL Primary Dvdt Enable	46628	Uint32	4	R W	n/a	Disabled=0 Enabled=1
OEL Primary Dvdt Ref	46630	Float	4	R W	n/a	-10 – 0
OEL Secondary Current Hi	46632	Float	4	R W	Amp	0 – 12000
OEL Secondary Current Mid	46634	Float	4	R W	Amp	0 – 12000
OEL Secondary Current Lo	46636	Float	4	R W	Amp	0 – 12000
OEL Secondary Time Hi	46638	Float	4	R W	Second	0 – 240
OEL Secondary Time Mid	46640	Float	4	R W	Second	0 – 240
OEL Secondary Current Hi Off	46642	Float	4	R W	Amp	0 – 12000
OEL Secondary Current Lo Off	46644	Float	4	R W	Amp	0 – 12000
OEL Secondary Current Time Off	46646	Float	4	R W	Second	0 – 240
OEL Secondary Takeover Current Max Off	46648	Float	4	R W	Amp	0 – 12000
OEL Secondary Takeover Current Min Off	46650	Float	4	R W	Amp	0 – 12000
OEL Secondary Takeover Time Dial Off	46652	Float	4	R W	n/a	0.1–20
OEL Secondary Takeover Current Max On	46654	Float	4	R W	Amp	0 – 12000
OEL Secondary Takeover Current Min On	46656	Float	4	R W	Amp	0 – 12000
OEL Secondary Takeover Time Dial On	46658	Float	4	R W	n/a	0.1–20
OEL Scale Enable	46660	Uint32	4	R W	n/a	Disabled=0 Auxiliary Input=1
OEL Scale Takeover Signal 1	46662	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Takeover Signal 2	46664	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Takeover Signal 3	46666	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Takeover Scale 1	46668	Float	4	R W	Percent	0–200
OEL Scale Takeover Scale 2	46670	Float	4	R W	Percent	0–200
OEL Scale Takeover Scale 3	46672	Float	4	R W	Percent	0–200
OEL Scale Summing Signal 1	46674	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Summing Signal 2	46676	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Summing Signal 3	46678	Float	4	R W	Limiter Scale Volt	-10 – 10
OEL Scale Summing Scale 1	46680	Float	4	R W	Percent	0–200
OEL Scale Summing Scale 2	46682	Float	4	R W	Percent	0–200
OEL Scale Summing Scale 3	46684	Float	4	R W	Percent	0–200
UEL Primary Curve X1	46686	Float	4	R W	kilowatt	0 – 62
UEL Primary Curve X2	46688	Float	4	R W	kilowatt	0 – 62
UEL Primary Curve X3	46690	Float	4	R W	kilowatt	0 – 62
UEL Primary Curve X4	46692	Float	4	R W	kilowatt	0 – 62
UEL Primary Curve X5	46694	Float	4	R W	kilowatt	0 – 62
UEL Primary Curve Y1	46696	Float	4	R W	kilovar	0 – 62
UEL Primary Curve Y2	46698	Float	4	R W	kilovar	0 – 62
UEL Primary Curve Y3	46700	Float	4	R W	kilovar	0 – 62
UEL Primary Curve Y4	46702	Float	4	R W	kilovar	0 – 62
UEL Primary Curve Y5	46704	Float	4	R W	kilovar	0 – 62
UEL Primary Power Filter TC	46706	Float	4	R W	Second	0–20
UEL Primary Voltage Dependent Exponent	46708	Float	4	R W	n/a	0–2
UEL Secondary Curve X1	46710	Float	4	R W	kilowatt	0 – 62

Name	Register	Type	Bytes	R/W	Unit	Range
UEL Secondary Curve X2	46712	Float	4	R W	kilowatt	0 – 62
UEL Secondary Curve X3	46714	Float	4	R W	kilowatt	0 – 62
UEL Secondary Curve X4	46716	Float	4	R W	kilowatt	0 – 62
UEL Secondary Curve X5	46718	Float	4	R W	kilowatt	0 – 62
UEL Secondary Curve Y1	46720	Float	4	R W	kilovar	0 – 62
UEL Secondary Curve Y2	46722	Float	4	R W	kilovar	0 – 62
UEL Secondary Curve Y3	46724	Float	4	R W	kilovar	0 – 62
UEL Secondary Curve Y4	46726	Float	4	R W	kilovar	0 – 62
UEL Secondary Curve Y5	46728	Float	4	R W	kilovar	0 – 62
SCL Primary Reference Hi	46730	Float	4	R W	Amp	0 – 66000
SCL Primary Reference Lo	46732	Float	4	R W	Amp	0 – 66000
SCL Primary Time Hi	46734	Float	4	R W	Second	0–240
SCL Primary No Response Time	46736	Float	4	R W	Second	0–10
SCL Secondary Reference Hi	46738	Float	4	R W	Amp	0–66000
SCL Secondary Reference Lo	46740	Float	4	R W	Amp	0–66000
SCL Secondary Time Hi	46742	Float	4	R W	Second	0–240
SCL Secondary No Response Time	46744	Float	4	R W	Second	0–10
SCL Scale Enable	46746	Uint32	4	R W	n/a	Disabled=0 Auxiliary Input=1
SCL Scale Signal 1	46748	Float	4	R W	Limiter Scale Volt	-10 – 10
SCL Scale Signal 2	46750	Float	4	R W	Limiter Scale Volt	-10 – 10
SCL Scale Signal 3	46752	Float	4	R W	Limiter Scale Volt	-10 – 10
SCL Scale Point 1	46754	Float	4	R W	Percent	0–200
SCL Scale Point 2	46756	Float	4	R W	Percent	0–200
SCL Scale Point 3	46758	Float	4	R W	Percent	0–200
Var Limit Enable	46760	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Var Limit Primary Delay	46762	Float	4	R W	Second	0–300
Var Limit Primary Setpoint	46764	Float	4	R W	Percent	0–200
Var Limit Secondary Delay	46766	Float	4	R W	Second	0–300
Var Limit Secondary Setpoint	46768	Float	4	R W	Percent	0–200
Var Limit Enable Status	46770	Uint32	4	R	n/a	Off=0 On=1
OEL Primary Takeover Reset Time Coefficient Off	46772	Float	4	R W	n/a	0.01–100
OEL Primary Takeover Reset Time Coefficient On	46774	Float	4	R W	n/a	0.01–100
OEL Secondary Takeover Reset Time Coefficient Off	46776	Float	4	R W	n/a	0.01–100
OEL Secondary Takeover Reset Time Coefficient On	46778	Float	4	R W	n/a	0.01–100
OEL Primary Takeover Reset Type Off	46780	Uint32	4	R W	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Primary Takeover Reset Type On	46782	Uint32	4	R W	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Secondary Takeover Reset Type Off	46784	Uint32	4	R W	n/a	Inverse=0 Integrating=1 Instantaneous=2
OEL Secondary Takeover Reset Type On	46786	Uint32	4	R W	n/a	Inverse=0 Integrating=1 Instantaneous=2

Setpoints

Table 24-10. Setpoint Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Range
Excitation Current Setpoint	46900	Float	4	R W	Amp	0 – 12
Excitation Current Traverse Rate	46902	Float	4	R W	Second	10 – 200
Excitation Current Pre-position Mode 1	46904	Uint32	4	R W	n/a	Maintain=0 Release=1
Excitation Current Pre-position 1	46906	Float	4	R W	Amp	0 – 12
Excitation Current Pre-position Mode 2	46908	Uint32	4	R W	n/a	Maintain=0 Release=1
Excitation Current Pre-position 2	46910	Float	4	R W	Amp	0 – 12
Excitation Current Minimum Setpoint Limit	46912	Float	4	R W	Percent	0–120
Excitation Current Maximum Setpoint Limit	46914	Float	4	R W	Percent	0–120
Generator Voltage Setpoint	46916	Float	4	R W	Volt	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	10 – 200
Generator Voltage Pre-position Mode 1	46920	Uint32	4	R W	n/a	Maintain=0 Release=1
Generator Voltage Pre-position 1	46922	Float	4	R W	Volt	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	Maintain=0 Release=1
Generator Voltage Pre-position 2	46926	Float	4	R W	Volt	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	70 – 120
Generator Voltage Maximum Setpoint Limit	46930	Float	4	R W	Percent	70 – 120
Generator var Setpoint	46932	Float	4	R W	kilovar	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	10 – 200
Generator var Pre-position Mode 1	46936	Uint32	4	R W	n/a	Maintain=0 Release=1
Generator var Pre-position 1	46938	Float	4	R W	kilovar	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	Maintain=0 Release=1
Generator var Pre-position 2	46942	Float	4	R W	kilovar	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	-100 – 100
Generator var Maximum Setpoint Limit	46946	Float	4	R W	Percent	-100 – 100
Generator PF Setpoint	46948	Float	4	R W	Power Factor	-2 – 2
Generator PF Traverse Rate	46950	Float	4	R W	Second	10 – 200
Generator PF Pre-position Mode 1	46952	Uint32	4	R W	n/a	Maintain=0 Release=1
Generator PF Pre-position 1	46954	Float	4	R W	Power Factor	-2 – 2
Generator PF Pre-position Mode 2	46956	Uint32	4	R W	n/a	Maintain=0 Release=1
Generator PF Pre-position 2	46958	Float	4	R W	Power Factor	-2 – 2
Generator PF Minimum Setpoint Limit	46960	Float	4	R W	Power Factor	0.5 – 1
Generator PF Maximum Setpoint Limit	46962	Float	4	R W	Power Factor	-1 – -0.5
Excitation Voltage Setpoint	46964	Float	4	R W	Volt	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	10 – 200
Excitation Voltage Pre-position Mode 1	46968	Uint32	4	R W	n/a	Maintain=0 Release=1
Excitation Voltage Pre-position 1	46970	Float	4	R W	Volt	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.

Name	Register	Type	Bytes	R/W	Unit	Range
Excitation Voltage Pre-position Mode 2	46972	Uint32	4	R W	n/a	Maintain=0 Release=1
Excitation Voltage Pre-position 2	46974	Float	4	R W	Volt	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 – 150
Excitation Voltage Maximum Setpoint Limit	46978	Float	4	R W	Percent	0 – 150
Sc Set Option	46980	Int32	4	R W	n/a	Disabled=0 Enabled=1
Sc Set Voltage Level	46982	Float	4	R W	Percent	0 – 100
Sc Set Current Level	46984	Float	4	R W	Percent	0 – 400
Sc Set Present Time	46986	Float	4	R W	Second	0 – 1
Sc Set Ref Change	46988	Float	4	R W	Percent	0 – 100
Sc Set Resp Change Level	46990	Float	4	R W	Percent	0 – 50
Sc Set Clear Time	46992	Float	4	R W	Second	0 – 1
Droop Value	46994	Float	4	R W	Percent	0–30
L-Drop Value	46996	Float	4	R W	Percent	0–30
Auxiliary Limit Enable	46998	Int32	4	R W	n/a	Disabled=0 Enabled=1
Excitation Current Regulation Pre-position Mode 3	47000	Uint32	4	R W	n/a	Maintain=0 Release=1
Excitation Current Regulation Pre-position 3	47002	Float	4	R W	Amp	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	Maintain=0 Release=1
Generator Voltage Pre-position 3	47006	Float	4	R W	Volt	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	Maintain=0 Release=1
Generator var Pre-position 3	47010	Float	4	R W	kilovar	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	Maintain=0 Release=1
Generator PF Pre-position 3	47014	Float	4	R W	Power Factor	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	Maintain=0 Release=1
Excitation Voltage Pre-position 3	47018	Float	4	R W	Volt	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	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	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	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	The range depends on the rated value of the machine and the minimum and maximum setpoint limits.
Active Excitation Voltage Setpoint	47028	Float	4	R W	Volt	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	0 – 720
Excitation Current Pre-Position Traverse 2	47032	Float	4	R W	Second	0 – 720
Excitation Current Pre-Position Traverse 3	47034	Float	4	R W	Second	0 – 720
Generator Voltage Pre-Position Traverse 1	47036	Float	4	R W	Second	0 – 720

Name	Register	Type	Bytes	R/W	Unit	Range
Generator Voltage Pre-Position Traverse 2	47038	Float	4	R W	Second	0 – 720
Generator Voltage Pre-Position Traverse 3	47040	Float	4	R W	Second	0 – 720
Generator var Pre-Position Traverse 1	47042	Float	4	R W	Second	0 – 720
Generator var Pre-Position Traverse 2	47044	Float	4	R W	Second	0 – 720
Generator var Pre-Position Traverse 3	47046	Float	4	R W	Second	0 – 720
Generator PF Pre-Position Traverse 1	47048	Float	4	R W	Second	0 – 720
Generator PF Pre-Position Traverse 2	47050	Float	4	R W	Second	0 – 720
Generator PF Pre-Position Traverse 3	47052	Float	4	R W	Second	0 – 720
Excitation Voltage Pre-Position Traverse 1	47054	Float	4	R W	Second	0 – 720
Excitation Voltage Pre-Position Traverse 2	47056	Float	4	R W	Second	0 – 720
Excitation Voltage Pre-Position Traverse 3	47058	Float	4	R W	Second	0 – 720

Global Settings

Table 24-11. Global Settings Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Range
System Configuration	Operating Mode	47200	Int32	4	R W	n/a	Generator=0 Motor=1
Gen Current Configuration	Rotation	47202	Uint32	4	R W	n/a	Forward=0 Reverse=1
PLC Timed Element Settings	Timer 1 Timeout Hours	47204	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 1 Timeout Minutes	47206	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 1 Timeout Seconds	47208	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 2 Timeout Hours	47210	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 2 Timeout Minutes	47212	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 2 Timeout Seconds	47214	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 3 Timeout Hours	47216	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 3 Timeout Minutes	47218	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 3 Timeout Seconds	47220	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 4 Timeout Hours	47222	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 4 Timeout Minutes	47224	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 4 Timeout Seconds	47226	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 5 Timeout Hours	47228	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 5 Timeout Minutes	47230	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 5 Timeout Seconds	47232	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 6 Timeout Hours	47234	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 6 Timeout Minutes	47236	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 6 Timeout Seconds	47238	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 7 Timeout Hours	47240	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 7 Timeout Minutes	47242	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 7 Timeout Seconds	47244	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 8 Timeout Hours	47246	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 8 Timeout Minutes	47248	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 8 Timeout Seconds	47250	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 9 Timeout Hours	47252	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 9 Timeout Minutes	47254	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 9 Timeout Seconds	47256	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 10 Timeout Hours	47258	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 10 Timeout Minutes	47260	Uint32	4	R W	Minute	0 – 59

Group	Name	Register	Type	Bytes	R/W	Unit	Range
PLC Timed Element Settings	Timer 10 Timeout Seconds	47262	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 11 Timeout Hours	47264	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 11 Timeout Minutes	47266	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 11 Timeout Seconds	47268	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 12 Timeout Hours	47270	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 12 Timeout Minutes	47272	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 12 Timeout Seconds	47274	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 13 Timeout Hours	47276	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 13 Timeout Minutes	47278	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 13 Timeout Seconds	47280	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 14 Timeout Hours	47282	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 14 Timeout Minutes	47284	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 14 Timeout Seconds	47286	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 15 Timeout Hours	47288	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 15 Timeout Minutes	47290	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 15 Timeout Seconds	47292	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Timer 16 Timeout Hours	47294	Uint32	4	R W	Hour	0 – 250
PLC Timed Element Settings	Timer 16 Timeout Minutes	47296	Uint32	4	R W	Minute	0 – 59
PLC Timed Element Settings	Timer 16 Timeout Seconds	47298	Uint32	4	R W	Decisecond	0 – 599
PLC Timed Element Settings	Counter 1 Output Timeout	47300	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 2 Output Timeout	47302	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 3 Output Timeout	47304	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 4 Output Timeout	47306	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 5 Output Timeout	47308	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 6 Output Timeout	47310	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 7 Output Timeout	47312	Float	4	R W	n/a	0–1800
PLC Timed Element Settings	Counter 8 Output Timeout	47314	Float	4	R W	n/a	0–1800

Relay Settings

Table 24-12. Relay Settings Group Parameters

Group	Name	Register	Type	Bytes	R/W	Unit	Range
System Configuration	Nominal Frequency	47400	Uint32	4	R W	n/a	50 Hz=50 60 Hz=60
System Configuration	DECS Auxiliary Summing Mode	47402	Uint32	4	R W	n/a	Voltage=0 Var=1
System Configuration	DECS Auxiliary Input Mode	47404	Uint32	4	R W	n/a	Voltage=0 Current=1
System Configuration	DECS Auxiliary Input Function	47406	Uint32	4	R W	n/a	DECS Input=0 n/a=1 Limiter Selection=2 No Control=4
System Configuration	DECS Auxiliary Voltage Gain	47408	Float	4	R W	n/a	-99 – 99
System Configuration	DECS Auto Track Time Delay	47410	Float	4	R W	Second	0–8
System Configuration	DECS Auto Track Traverse Rate	47412	Float	4	R W	Second	1–80
System Configuration	DECS Null Balance Level	47414	Float	4	R W	Percent	0–9999
System Configuration	DECS Auto Trans Time Delay	47416	Float	4	R W	Second	0–8
System Configuration	DECS Auto Trans Traverse Rate	47418	Float	4	R W	Second	1–80
Gen Volt Configuration	Ratio Primary	47420	Float	4	R W	n/a	1–500000

Group	Name	Register	Type	Bytes	R/W	Unit	Range
Gen Volt Configuration	Ratio Secondary	47422	Float	4	R W	n/a	1–600
Gen Volt Configuration	Rated Primary LL	47424	Float	4	R W	Volt	1–500000
Bus Volt Configuration	Ratio Primary	47426	Float	4	R W	n/a	1–500000
Bus Volt Configuration	Ratio Secondary	47428	Float	4	R W	n/a	1–600
Bus Volt Configuration	Rated Primary LL	47430	Float	4	R W	Volt	1–500000
Gen Current Configuration	Ratio Primary	47432	Float	4	R W	n/a	1–99999
Gen Current Configuration	Ratio Secondary	47434	Int32	4	R W	n/a	1=1 5=5
Gen Current Configuration	Rated Primary	47436	Float	4	R	Amp	0–180000
Modbus	Auto Save	47438	Uint16	2	R W	n/a	Off=0 On=1
Virtual Switch	Virtual Switch 1 State	47439	Uint32	4	R W	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 2 State	47441	Uint32	4	R W	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 3 State	47443	Uint32	4	R W	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 4 State	47445	Uint32	4	R W	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 5 State	47447	Uint32	4	R W	n/a	Open=0 Closed=1
Virtual Switch	Virtual Switch 6 State	47449	Uint32	4	R W	n/a	Open=0 Closed=1
DECS Control	Start Stop Request	47451	Uint32	4	R W	n/a	Stop=0 =1 Start =2
DECS Control	System Option Underfrequency Hz	47453	Float	4	R W	Hertz	15 – 90
DECS Control	System Input COM Port Manual Enabled	47455	Uint32	4	R W	n/a	Manual=1 Automatic=2
DECS Control	System Input COM Port PF var Enabled	47457	Uint32	4	R W	n/a	Off=0 PF=1 Var=2
Reserved		47459					
DECS Control	System Input COM Port Pre-position Enabled	47461	Uint32	4	R W	n/a	NOT SET=0 SET=1
DECS Control	System Input COM Port Pre-position Enabled 2	47463	Uint32	4	R W	n/a	NOT SET=0 SET=1
DECS Control	System Input COM Port Raise Enabled	47465	Uint32	4	R W	n/a	NOT SET=0 Raise=1
DECS Control	System Input COM Port Lower Enabled	47467	Uint32	4	R W	n/a	NOT SET=0 Lower=1
DECS Control	System Option Input Voltage Match Enabled	47469	Uint32	4	R W	n/a	Disabled=0 Enabled=1
DECS Control	System Option Underfrequency Mode	47471	Uint32	4	R W	n/a	UF Limiter=0 V/Hz Limiter=1
DECS Control	System Option Limiter Mode	47473	Uint32	4	R W	n/a	Off=0 UEL=1 OEL=2 UEL & OEL=3 SCL=4 UEL & SCL=5 OEL & SCL=6 UEL & OEL & SCL=7
DECS Control	System Option Voltage Match Band	47475	Float	4	R W	Percent	0–20
DECS Control	System Option Voltage Match Reference	47477	Float	4	R W	Percent	0–700
DECS Control	System Option Underfrequency Slope	47479	Float	4	R W	n/a	0–3
DECS Control	System Option PF to Droop kW Threshold	47481	Float	4	R W	Percent	0–30
DECS Control	Startup Primary Soft-start Bias	47483	Float	4	R W	Percent	0–90
DECS Control	Startup Primary Soft-start Time	47485	Float	4	R W	Second	1–7200
DECS Control	Startup Secondary Soft-start Bias	47487	Float	4	R W	Percent	0–90
DECS Control	Startup Secondary Soft-start Time	47489	Float	4	R W	Second	1–7200

Protection Settings

Table 24-13. Protection Settings Group Parameters

Group	Name	Register	Type	Sz	R/W	Unit	Range
Field Overvoltage	Primary Mode	47600	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Field Overvoltage	Primary Pickup	47602	Float	4	R W	V	Disabled=0, 1–2400

Group	Name	Register	Type	Sz	R/W	Unit	Range
Field Overvoltage	Primary Time Delay	47604	Float	4	R W	ms	Instantaneous=0, 200–30000
Field Overvoltage	Secondary Mode	47606	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Field Overvoltage	Secondary Pickup	47608	Float	4	R W	V	Disabled=0, 1–2400
Field Overvoltage	Secondary Time Delay	47610	Float	4	R W	ms	Instantaneous=0, 200–30000
Field Overcurrent	Primary Mode	47612	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Field Overcurrent	Primary Pickup	47614	Float	4	R W	Amp	Disabled=0, 0.1–20000
Field Overcurrent	Primary Time Delay	47616	Float	4	R W	ms	Instantaneous=0, 200–30000
Field Overcurrent	Primary Timing Mode	47618	Uint32	4	R W	n/a	Definite Timing=0 Inverse Timing=1
Field Overcurrent	Primary Time Dial	47620	Float	4	R W	n/a	0.1 – 20
Field Overcurrent	Secondary Mode	47622	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Field Overcurrent	Secondary Pickup	47624	Float	4	R W	Amp	Disabled=0, 0.1–20000
Field Overcurrent	Secondary Time Delay	47626	Float	4	R W	ms	Instantaneous=0, 200–30000
Field Overcurrent	Secondary Timing Mode	47628	Uint32	4	R W	n/a	Definite Timing=0 Inverse Timing=1
Field Overcurrent	Secondary Time Dial	47630	Float	4	R W	n/a	0.1 – 20
Reserved		47632 - 47646					
Loss Of Sensing	Mode	47648	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Loss Of Sensing	Time Delay	47650	Float	4	R W	Sec	0–30
Loss Of Sensing	Voltage Balanced Level	47652	Float	4	R W	%	0–100
Loss Of Sensing	Voltage Unbalanced Level	47654	Float	4	R W	%	0–100
25	Mode	47656	Uint32	4	R W	n/a	Disabled=0 Enabled=1
25	Voltage Monitor Mode	47658	Uint32	4	R W	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	1–99
25	Slip Frequency	47662	Float	4	R W	Hz	0.01–0.5
25	Voltage Magnitude Error Percent	47664	Float	4	R W	%	0.1–50
25	Generator Frequency Greater Than Bus Frequency	47666	Uint32	4	R W	n/a	Disabled=0 Enabled=1
25	Dead Voltage	47668	Float	4	R W	%	Disabled=0, 10–90
25	Live Voltage	47670	Float	4	R W	%	Disabled=0, 10–90
25	Dropout Delay	47672	Float	4	R W	ms	50–60000
25	Angle Compensation	47674	Float	4	R W	Deg	0–359.9
25	VMM Dead Line, Dead Aux	47676	Uint32	4	R W	n/a	Disabled=0 Enabled=1
25	VMM Dead Line, Live Aux	47678	Uint32	4	R W	n/a	Disabled=0 Enabled=1
25	VMM Live Line, Dead Aux	47680	Uint32	4	R W	n/a	Disabled=0 Enabled=1
27P	Primary Mode	47682	Uint32	4	R W	n/a	Disabled=0 Enabled=1
27P	Primary Pickup	47684	Float	4	R W	V	Disabled=0, 1–600000
27P	Primary Time Delay	47686	Float	4	R W	ms	100–60000
27P	Secondary Mode	47688	Uint32	4	R W	n/a	Disabled=0 Enabled=1
27P	Secondary Pickup	47690	Float	4	R W	V	Disabled=0, 1 - 600000
27P	Secondary Time Delay	47692	Float	4	R W	ms	100–60000
59P	Primary Mode	47694	Uint32	4	R W	n/a	Disabled=0 Enabled=1
59P	Primary Pickup	47696	Float	4	R W	V	0–600000
59P	Primary Time Delay	47698	Float	4	R W	ms	100–60000
59P	Secondary Mode	47700	Uint32	4	R W	n/a	Disabled=0 Enabled=1
59P	Secondary Pickup	47702	Float	4	R W	V	0–600000
59P	Secondary Time Delay	47704	Float	4	R W	ms	100–60000
81O	Primary Mode	47706	Uint32	4	R W	n/a	Disabled=0 Over=1
81O	Primary Pickup	47708	Float	4	R W	Hz	Disabled=0, 15–70
81O	Primary Time Delay	47710	Float	4	R W	ms	100–300000
81O	Secondary Mode	47712	Uint32	4	R W	n/a	Disabled=0 Over=1

Group	Name	Register	Type	Sz	R/W	Unit	Range
81O	Secondary Pickup	47714	Float	4	R W	Hz	Disabled=0, 15–70
81O	Secondary Time Delay	47716	Float	4	R W	ms	100–300000
81U	Primary Mode	47718	Uint32	4	R W	n/a	Disabled=0 Under=2
81U	Primary Pickup	47720	Float	4	R W	Hz	Disabled=0, 15–70
81U	Primary Time Delay	47722	Float	4	R W	ms	100–300000
81U	Primary Voltage Inhibit	47724	Float	4	R W	%	Disabled=0, 5–100
81U	Secondary Mode	47726	Uint32	4	R W	n/a	Disabled=0 Under=2
81U	Secondary Pickup	47728	Float	4	R W	Hz	Disabled=0, 15–70
81U	Secondary Time Delay	47730	Float	4	R W	ms	100–300000
81U	Secondary Voltage Inhibit	47732	Float	4	R W	%	Disabled=0, 5–100
40Q	Primary Mode	47734	Uint32	4	R W	n/a	Disabled=0 Enabled=1
40Q	Primary Pickup	47736	Float	4	R W	kvar	0 - 3000000
40Q	Primary Time Delay	47738	Float	4	R W	ms	0 - 300000
40Q	Secondary Mode	47740	Uint32	4	R W	n/a	Disabled=0 Enabled=1
40Q	Secondary Pickup	47742	Float	4	R W	kvar	0 - 3000000
40Q	Secondary Time Delay	47744	Float	4	R W	ms	0 - 300000
32R	Primary Mode	47746	Uint32	4	R W	n/a	Disabled=0 Enabled=4
32R	Primary Pickup	47748	Float	4	R W	kW	0 - 3000000
32R	Primary Time Delay	47750	Float	4	R W	ms	0 - 300000
32R	Secondary Mode	47752	Uint32	4	R W	n/a	Disabled=0 Enabled=4
32R	Secondary Pickup	47754	Float	4	R W	kW	0 - 3000000
32R	Secondary Time Delay	47756	Float	4	R W	ms	0 - 300000
Reserved		47758 - 47892					
Loss of FIT	Mode	47894	Uint32	4	R W	n/a	Disabled=0 Enabled=1
Loss of FIT	Time Delay	47896	Float	4	R W	Ms	0 - 9900
81U-2	Primary Mode	47898	Uint32	4	R W	n/a	Disabled=0 Under=2
81U-2	Primary Pickup	47900	Float	4	R W	Hz	Disabled=0; 15 - 70
81U-2	Primary Time Delay	47902	Float	4	R W	Ms	100 - 300000
81U-2	Primary Voltage Inhibit	47904	Float	4	R W	%	Disabled=0; 5 – 100
81U-2	Secondary Mode	47906	Uint32	4	R W	n/a	Disabled=0 Under=2
81U-2	Secondary Pickup	47908	Float	4	R W	Hz	Disabled=0; 15 - 70
81U-2	Secondary Time Delay	47910	Float	4	R W	Ms	100 - 300000
81U-2	Secondary Voltage Inhibit	47912	Float	4	R W	%	Disabled=0; 5 - 100

Gains Settings

Table 24-14. Gains Settings Group Parameters

Name	Register	Type	Bytes	R/W	Unit	Range
Primary Gain Option	48200	Uint32	4	R W	n/a	T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21
Secondary Gain Option	48202	Uint32	4	R W	n/a	T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21
AVR Kp Primary	48204	Float	4	R W	n/a	0–1000

Name	Register	Type	Bytes	R/W	Unit	Range
AVR Ki Primary	48206	Float	4	R W	n/a	0–1000
AVR Kd Primary	48208	Float	4	R W	n/a	0–1000
AVR Td Primary	48210	Float	4	R W	n/a	0–1
FCR Kp	48212	Float	4	R W	n/a	0–1000
FCR Ki	48214	Float	4	R W	n/a	0–1000
FCR Kd	48216	Float	4	R W	n/a	0–1000
FCR Td	48218	Float	4	R W	n/a	0–1
FVR Kp	48220	Float	4	R W	n/a	0–1000
FVR Ki	48222	Float	4	R W	n/a	0–1000
FVR Kd	48224	Float	4	R W	n/a	0–1000
FVR Td	48226	Float	4	R W	n/a	0–1
PF Ki	48228	Float	4	R W	n/a	0–1000
PF Kg	48230	Float	4	R W	n/a	0–1000
Var Ki	48232	Float	4	R W	n/a	0–1000
Var Kg	48234	Float	4	R W	n/a	0–1000
OEL Ki	48236	Float	4	R W	n/a	0–1000
OEL Kg	48238	Float	4	R W	n/a	0–1000
UEL Ki	48240	Float	4	R W	n/a	0–1000
UEL Kg	48242	Float	4	R W	n/a	0–1000
SCL Ki	48244	Float	4	R W	n/a	0–1000
SCL Kg	48246	Float	4	R W	n/a	0–1000
Vm Kg	48248	Float	4	R W	n/a	0–1000
Inner Loop Kp	48250	Float	4	R W	n/a	0–1000
Inner Loop Ki	48252	Float	4	R W	n/a	0–1000
AVR Kp Secondary	48254	Float	4	R W	n/a	0–1000
AVR Ki Secondary	48256	Float	4	R W	n/a	0–1000
AVR Kd Secondary	48258	Float	4	R W	n/a	0–1000
AVR Td Secondary	48260	Float	4	R W	n/a	0–1
Var Limit Ki	48262	Float	4	R W	n/a	0–1000
Var Limit Kg	48264	Float	4	R W	n/a	0–1000
AVR Primary Ka	48266	Float	4	R W	n/a	0–1
AVR Secondary Ka	48268	Float	4	R W	n/a	0–1
FCR Ka	48270	Float	4	R W	n/a	0–1
FVR Ka	48272	Float	4	R W	n/a	0–1

Legacy Modbus

Table 24-15. Legacy Modbus Parameters

Name	Register	Type	Bytes	R/W	Unit	Range
Model Information Character 1	40001	Uint8	1	R	n/a	n/a
Model Information Character 2	40002	Uint8	1	R	n/a	n/a
Model Information Character 3	40003	Uint8	1	R	n/a	n/a
Model Information Character 4	40004	Uint8	1	R	n/a	n/a
Model Information Character 5	40005	Uint8	1	R	n/a	n/a
Model Information Character 6	40006	Uint8	1	R	n/a	n/a
Model Information Character 7	40007	Uint8	1	R	n/a	n/a
Model Information Character 8	40008	Uint8	1	R	n/a	n/a
Model Information Character 9	40009	Uint8	1	R	n/a	n/a
Application Program Version Character 1	40010	Uint8	1	R	n/a	n/a
Application Program Version Character 2	40011	Uint8	1	R	n/a	n/a
Application Program Version Character 3	40012	Uint8	1	R	n/a	n/a
Application Program Version Character 4	40013	Uint8	1	R	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Range
Application Program Version Character 5	40014	Uint8	1	R	n/a	n/a
Application Program Version Character 6	40015	Uint8	1	R	n/a	n/a
Application Program Version Character 7	40016	Uint8	1	R	n/a	n/a
Application Program Version Character 8	40017	Uint8	1	R	n/a	n/a
Application Version Date Character 1	40018	Uint8	1	R	n/a	n/a
Application Version Date Character 2	40019	Uint8	1	R	n/a	n/a
Application Version Date Character 3	40020	Uint8	1	R	n/a	n/a
Application Version Date Character 4	40021	Uint8	1	R	n/a	n/a
Application Version Date Character 5	40022	Uint8	1	R	n/a	n/a
Application Version Date Character 6	40023	Uint8	1	R	n/a	n/a
Application Version Date Character 7	40024	Uint8	1	R	n/a	n/a
Application Version Date Character 8	40025	Uint8	1	R	n/a	n/a
Application Version Date Character 9	40026	Uint8	1	R	n/a	n/a
Reserved 8 bit: 1-17	40027 - 40043					
Boot Program Version Character 1	40044	Uint8	1	R	n/a	n/a
Boot Program Version Character 2	40045	Uint8	1	R	n/a	n/a
Boot Program Version Character 3	40046	Uint8	1	R	n/a	n/a
Boot Program Version Character 4	40047	Uint8	1	R	n/a	n/a
Boot Program Version Character 5	40048	Uint8	1	R	n/a	n/a
Boot Program Version Character 6	40049	Uint8	1	R	n/a	n/a
Boot Program Version Character 7	40050	Uint8	1	R	n/a	n/a
Boot Program Version Character 8	40051	Uint8	1	R	n/a	n/a
Reserved 8 bit: 18-29	40052 - 40063					
Reserved 1	40064	C1 filler	274			
Leading Lagging Indicator	40201	Uint16	2	R	n/a	Leading=0 Lagging=1
Motoring Generating Indicator	40202	Uint16	2	R	n/a	Motoring=0 Generating=1
Status of Front Panel LEDs	40203	Uint16	2	R	n/a	n/a
Contact Input States	40204	Uint16	2	R	n/a	n/a
Voltage Matching Status Indicator	40205	Uint16	2	R	n/a	n/a
Active Setpoint Adjustment Range	40206	Uint16	2	R	n/a	n/a
Annunciation Status Bit Flags 1	40207	Uint16	2	R	n/a	n/a
Annunciation Status Bit Flags 2	40208	Uint16	2	R	n/a	n/a
Protection Status Bit Flags 1	40209	Uint16	2	R	n/a	n/a
Protection Status Bit Flags 2	40210	Uint16	2	R	n/a	n/a
Relay Output States	40211	Uint16	2	R	n/a	n/a
Unused Registers 1	40212	U1 filler	78	R	n/a	n/a
RMS Generator Volts Phase A to B	40251	Float	4	R	n/a	n/a
RMS Generator Volts Phase B to C	40253	Float	4	R	n/a	n/a
RMS Generator Volts Phase C to A	40255	Float	4	R	n/a	n/a
RMS Bus Voltage in Volts	40257	Float	4	R	n/a	n/a
Generator Current Ia in Amps	40259	Float	4	R	n/a	n/a
Generator Current Ib in Amps	40261	Float	4	R	n/a	n/a
Generator Current Ic in Amps	40263	Float	4	R	n/a	n/a
Average RMS L-L Volts	40265	Float	4	R	n/a	n/a
Average Generator Phase Current	40267	Float	4	R	n/a	n/a
Field Voltage in Volts	40269	Float	4	R	n/a	n/a
Field Current in Amps	40271	Float	4	R	n/a	n/a
Auxiliary Input in Volts	40273	Float	4	R	n/a	n/a
Magnitude of A-B Voltage Fundamental Phasor	40275	Float	4	R	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Range
Magnitude of B-C Voltage Fundamental Phasor	40277	Float	4	R	n/a	n/a
Magnitude of C-A Voltage Fundamental Phasor	40279	Float	4	R	n/a	n/a
Magnitude of Line A Current Fundamental Phasor	40281	Float	4	R	n/a	n/a
Magnitude of Line B Current Fundamental Phasor	40283	Float	4	R	n/a	n/a
Magnitude of Line C Current Fundamental Phasor	40285	Float	4	R	n/a	n/a
Current Input for Load Compensation	40287	Float	4	R	n/a	n/a
Angle Between Vab and Vca	40289	Float	4	R	n/a	n/a
Angle Between Vbc and Vca	40291	Float	4	R	n/a	n/a
Angle Between Ia and Vca	40293	Float	4	R	n/a	n/a
Angle Between Ib and Vca	40295	Float	4	R	n/a	n/a
Angle Between Ic and Vca	40297	Float	4	R	n/a	n/a
Angle Between Iaux and Vca	40299	Float	4	R	n/a	n/a
Gen Real Power in kW	40301	Float	4	R	n/a	n/a
Gen Reactive Power in kvar	40303	Float	4	R	n/a	n/a
Gen Apparent Power in kVA	40305	Float	4	R	n/a	n/a
Power Factor	40307	Float	4	R	n/a	n/a
Gen Positive Sequence Voltage	40309	Float	4	R	n/a	n/a
Gen Negative Sequence Voltage	40311	Float	4	R	n/a	n/a
Gen Positive Sequence Current	40313	Float	4	R	n/a	n/a
Gen Negative Sequence Current	40315	Float	4	R	n/a	n/a
Gen Frequency in Hertz	40317	Float	4	R	n/a	n/a
Bus Frequency in Hertz	40319	Float	4	R	n/a	n/a
Null Balance in Percent	40321	Float	4	R	n/a	n/a
Active Controller Output	40323	Float	4	R	n/a	n/a
Error Signal to Autotracking Loop	40325	Float	4	R	n/a	n/a
Rotor Temperature	40327	Float	4	R	n/a	n/a
Shorted Diode Harmonic Current	40329	Float	4	R	n/a	n/a
Open Diode Harmonic Current	40331	Float	4	R	n/a	n/a
Var/PF Controller Output in Volts	40333	Float	4	R	n/a	n/a
Reserved	40335 - 40353					
Sensing Mode	40401	Uint16	2	R W	n/a	ABC=0 ACB=1
Auxiliary Input Summing Mode	40402	Uint16	2	R W	n/a	Voltage=0 var=1
Power Output Mode	40403	Uint16	2	R	n/a	n/a
Gen Field Type	40404	Uint16	2	R W	n/a	Exciter Field=0 Main Field=1
Voltage Sensing HW Gain Control	40405	Uint16	2	R	n/a	n/a
Auxiliary Input Mode	40406	Uint16	2	R W	n/a	Voltage=0 Current=1
Rotor Temperature Mode	40407	Uint16	2	R	n/a	n/a
Number of CTs	40408	Uint16	2	R W	n/a	n/a
Selected CTs	40409	Uint16	2	R W	n/a	n/a
Motor/Gen Mode	40410	Uint16	2	R	n/a	Generator=0 Motor=1
Auxiliary Input Function	40411	Uint16	2	R W	n/a	DECS Input=0 n/a=1 Limiter Selection=2 No Control=3
Unused Registers 2	40412	U2 Filler	78	R	n/a	n/a
Gen Rated Frequency	40451	Float	4	R W	n/a	50.0 - 60.0
Gen PT Primary Voltage Rating	40453	Float	4	R W	n/a	1 - 500000
Gen PT Secondary Voltage Rating	40455	Float	4	R W	n/a	1 - 600
Gen CT Primary Current Rating	40457	Float	4	R W	n/a	1 - 99999

Name	Register	Type	Bytes	R/W	Unit	Range
Gen CT Secondary Current Rating	40459	Float	4	R W	n/a	1.0 - 5.0
Field Current Shunt Rating	40461	Float	4	R W	Amp	1 - 10000
Field Voltage Isolation Module Input	40463	Float	4	R W	n/a	63 - 625
Bus Sensing PT Primary Rating	40465	Float	4	R W	n/a	1 - 500000
Bus Sensing PT Secondary Rating	40467	Float	4	R W	n/a	1 - 600
Maximum Field Flash Time	40469	Float	4	R W	n/a	1 - 50
Field Flash Dropout Level	40471	Float	4	R W	n/a	0 - 100
Gen Rated Voltage	40473	Float	4	R W	Volt	1 - 500000
Gen Rated kVA	40475	Float	4	R W	KiloVA	1 - 2000000
Gen Rated Field Voltage	40477	Float	4	R W	Volt	1 - 1000
Gen Rated Field Current	40479	Float	4	R W	Amp	0.1 - 10000
Nominal Bus Voltage	40481	Float	4	R W	Volt	1 - 500000
Auxiliary Input Gain for AVR Mode	40483	Float	4	R W	n/a	-99 - 99
Time Delay Before Autotracking	40485	Float	4	R W	Second	0 - 8
Traverse Rate of Autotracking	40487	Float	4	R W	Second	1 - 80
Reserved 3	40489					
Gain for Cross Current Compensation	40491	Float	4	R W	Percent	-30 - 30
Reserved	40493 - 40495					
Auxiliary Input Gain for FCR Mode	40497	Float	4	R W	n/a	-99 - 99
Auxiliary Input Gain for VAR Mode	40499	Float	4	R W	n/a	-99 - 99
Auxiliary Input Gain for PF Mode	40501	Float	4	R W	n/a	-99 - 99
Exciter Field Resistance	40503	Float	4	R W	ohm	0.001 – 99.999
Ambient Temperature	40505	Float	4	R W	Deg F	32 – 572
Brush Voltage Drop	40507	Float	4	R W	Volt	0 – 20
Gen Power Factor	40509	Float	4	R W	PF	-2 – 2
Auxiliary Input Gain for FVR Mode	40511	Float	4	R W	n/a	-99 - 99
Reserved 4	40513	C3 Filler	176			
Unit Mode Virtual Toggle	40601	Uint16	2	R W	n/a	No Change=0 Change State=1
Control Mode Virtual Toggle	40602	Uint16	2	R W	n/a	No Change=0 Change State=1
Parallel Mode Virtual Toggle	40603	Uint16	2	R W	n/a	No Change=0 Change State=1
Operating Mode Virtual Switch	40604	Uint16	2	R W	n/a	Off=0 PF=1 var=2
AutoTrack Enabled Status	40605	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Pre-position Enable	40606	Uint16	2	R W	n/a	=0 SET=1
Raise Enabled Status	40607	Uint16	2	R W	n/a	=0 Raise=1
Lower Enabled Status	40608	Uint16	2	R W	n/a	=0 Lower=1
Limiter Mode Options	40609	Uint16	2	R W	n/a	Off=0 UEL=1 OEL=2 UEL & OEL=3 SCL=4 UEL & SCL=5 OEL & SCL=6 UEL & OEL & SCL=7
Voltage Matching Mode Status	40610	Uint16	2	R	n/a	n/a
Operating Mode Status	40611	Uint16	2	R	n/a	n/a
Unit Mode Status	40612	Uint16	2	R	n/a	n/a
Control Mode Status	40613	Uint16	2	R	n/a	n/a
AutoTrack Status	40614	Uint16	2	R	n/a	n/a
Pre-position Enable Status	40615	Uint16	2	R	n/a	n/a
Autotransfer Status	40616	Uint16	2	R	n/a	n/a
Load Compensation Mode Status	40617	Uint16	2	R	n/a	n/a
Alarm Reset Enable	40618	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Loss-of-Sensing Detection Enable	40619	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Loss-of-Sensing Triggered Transfer-to-FCR-mode Enable	40620	Uint16	2	R W	n/a	Disabled=0 Enabled=1
External Tracking Enabled	40621	Uint16	2	R W	n/a	Disabled=0 Enabled=1

Name	Register	Type	Bytes	R/W	Unit	Range
Under Frequency or V/Hz Mode Enable	40622	Uint16	2	R W	n/a	UF Limiter=0 V/Hz Limiter=1
Reserved	40623 - 40629					
Droop Enabled	40631	Uint16	2	R W	n/a	Disabled=0 Enabled=1
L Drop Enabled	40632	Uint16	2	R W	n/a	Disabled=0 Enabled=1
CC Enabled	40633	Uint16	2	R W	n/a	Disabled=0 Enabled=1
OEL Style Mode	40634	Uint16	2	R	n/a	No Change=0 Change State=1
Autotransfer Enable Status	40635	Uint16	2	R	n/a	n/a
OEL Style Virtual Toggle	40636	Uint16	2	R W	n/a	No Change=0 Change State=1
Pre-position 2 Enable Status	40637	Uint16	2	R	n/a	n/a
UEL Style Mode	40638	Uint16	2	R	n/a	n/a
OEL Option Mode	40639	Uint16	2	R	n/a	Offline=0 Online=1
Pre-position Selection	40640	Uint16	2	R	n/a	n/a
UEL Style Enabled	40641	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Volt Match Mode	40642	Uint16	2	R W	n/a	Disabled=0 Enabled=1
OEL Enabled	40643	Uint16	2	R W	n/a	Disabled=0 Enabled=1
UEL Enabled	40644	Uint16	2	R W	n/a	Disabled=0 Enabled=1
SCL Enabled	40645	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Internal Tracking Mode	40646	Uint16	2	R	n/a	n/a
Reserved	40647					
Voltage Matching Mode	40648	Uint16	2	R	n/a	n/a
Unused Registers 3	40649	U3 Filler	52	R	n/a	n/a
Var Limiter Enable	40675	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Unused Registers 4	40676	U4 Filler	50	R	n/a	n/a
FCR Pre-Position Mode	40701	Uint16	2	R W	n/a	Maintain=0 Release=1
AVR Pre-Position Mode	40702	Uint16	2	R W	n/a	Maintain=0 Release=1
Var Pre-Position Mode	40703	Uint16	2	R W	n/a	Maintain=0 Release=1
PF Pre-Position Mode	40704	Uint16	2	R W	n/a	Maintain=0 Release=1
FCR Pre-Position 2 Mode	40705	Uint16	2	R W	n/a	Maintain=0 Release=1
AVR Pre-Position 2 Mode	40706	Uint16	2	R W	n/a	Maintain=0 Release=1
Var Pre-Position 2 Mode	40707	Uint16	2	R W	n/a	Maintain=0 Release=1
PF Pre-Position 2 Mode	40708	Uint16	2	R W	n/a	Maintain=0 Release=1
FVR Pre-Position Mode	40709	Uint16	2	R W	n/a	Maintain=0 Release=1
FVR Pre-Position 2 Mode	40710	Uint16	2	R W	n/a	Maintain=0 Release=1
Unused Registers 5	40711	U5 Filler	80	R	n/a	n/a
FCR Mode Setpoint	40751	Float	4	R W	Amp	0 - 12
AVR Mode Setpoint	40753	Float	4	R W	Volt	84 - 144
Var Mode Setpoint in kvar	40755	Float	4	R W	kvar	0 - 0
PF Mode Setpoint	40757	Float	4	R W	PF	-2 - 2
Droop Setting in Percent	40759	Float	4	R W	Percent	0 - 30
FCR Minimum Setpoint	40761	Float	4	R	n/a	n/a
AVR Minimum Setpoint	40763	Float	4	R	n/a	n/a
Var Minimum Setpoint	40765	Float	4	R	n/a	n/a
PF Minimum Setpoint	40767	Float	4	R	n/a	n/a
FCR Maximum Setpoint	40769	Float	4	R	n/a	n/a
AVR Maximum Setpoint	40771	Float	4	R	n/a	n/a
Var Maximum Setpoint	40773	Float	4	R	n/a	n/a
PF Maximum Setpoint	40775	Float	4	R	n/a	n/a
FCR Mode Traverse Rate	40777	Float	4	R W	Second	10 - 200
AVR Mode Traverse Rate	40779	Float	4	R W	Second	10 - 200

Name	Register	Type	Bytes	R/W	Unit	Range
Var Mode Traverse Rate	40781	Float	4	R W	Second	10 - 200
PF Mode Traverse Rate	40783	Float	4	R W	Second	10 - 200
FCR Mode Setpoint Pre-Position	40785	Float	4	R W	Amp	0 - 12
AVR Mode Setpoint Pre-Position	40787	Float	4	R W	Volt	84 - 144
Var Mode Setpoint Pre-Position in kvar	40789	Float	4	R W	kvar	0 - 0
PF Mode Setpoint Pre-Position	40791	Float	4	R W	PF	-2 - 2
FCR Mode Setpoint Step Size	40793	Float	4	R	n/a	n/a
AVR Mode Setpoint Step Size	40795	Float	4	R	n/a	n/a
Var Mode Setpoint Step Size	40797	Float	4	R	n/a	n/a
PF Mode Setpoint Step Size	40799	Float	4	R	n/a	n/a
FCR Mode Setpoint Adjustable Minimum	40801	Float	4	R W	Percent	0 - 120
AVR Mode Setpoint Adjustable Minimum	40803	Float	4	R W	Percent	70 - 120
Var Mode Setpoint Adjustable Minimum	40805	Float	4	R W	Percent	-100 - 100
PF Mode Setpoint Adjustable Minimum	40807	Float	4	R W	PF	0.5 - 1
FCR Mode Setpoint Adjustable Maximum	40809	Float	4	R W	Percent	0 - 120
AVR Mode Setpoint Adjustable Maximum	40811	Float	4	R W	Percent	70 - 120
Var Mode Setpoint Adjustable Maximum	40813	Float	4	R W	Percent	-100 - 100
PF Mode Setpoint Adjustable Maximum	40815	Float	4	R W	PF	-1 - -0.5
Minimum Value for FCR Adjustable Minimum	40817	Float	4	R	n/a	n/a
Minimum Value for AVR Adjustable Minimum	40819	Float	4	R	n/a	n/a
Minimum Value for Var Adjustable Minimum	40821	Float	4	R	n/a	n/a
Minimum Value for PF Adjustable Minimum	40823	Float	4	R	n/a	n/a
Maximum Value for FCR Adjustable Maximum	40825	Float	4	R	n/a	n/a
Maximum Value for AVR Adjustable Maximum	40827	Float	4	R	n/a	n/a
Maximum Value for Var Adjustable Maximum	40829	Float	4	R	n/a	n/a
Maximum Value for PF Adjustable Maximum	40831	Float	4	R	n/a	n/a
Step Size for FCR Adjustable Maximum	40833	Float	4	R	n/a	n/a
Step Size for AVR Adjustable Maximum	40835	Float	4	R	n/a	n/a
Step Size for Var Adjustable Maximum	40837	Float	4	R	n/a	n/a
Step Size for PF Adjustable Maximum	40839	Float	4	R	n/a	n/a
FCR Mode Setpoint Pre-Position 2	40841	Float	4	R W	Amp	0 - 12
AVR Mode Setpoint Pre-Position 2	40843	Float	4	R W	Volt	84 - 144
Var Mode Setpoint Pre-Position 2	40845	Float	4	R W	kvar	0 - 0
PF Mode Setpoint Pre-Position 2	40847	Float	4	R W	PF	-2 - 2
Line Drop Compensation Setpoint	40849	Float	4	R W	n/a	n/a
FVR Mode Setpoint	40851	Float	4	R W	Volt	0 - 75
FVR Minimum Setpoint	40853	Float	4	R	n/a	n/a
FVR Maximum Setpoint	40855	Float	4	R	n/a	n/a
FVR Mode Traverse Rate	40857	Float	4	R W	Second	10 - 200
FVR Mode Setpoint Pre-Position	40859	Float	4	R W	Volt	0 - 75
FVR Mode Setpoint Step Size	40861	Float	4	R	n/a	n/a
FVR Mode Setpoint Adjustable Minimum	40863	Float	4	R W	Percent	0 - 150
FVR Mode Setpoint Adjustable Maximum	40865	Float	4	R W	Percent	0 - 150
Minimum Value for FVR Adjustable Minimum	40867	Float	4	R	n/a	n/a
Maximum Value for FVR Adjustable Maximum	40869	Float	4	R	n/a	n/a

Name	Register	Type	Bytes	R/W	Unit	Range
Step Size for FVR Adjustable Maximum	40871	Float	4	R	n/a	n/a
FVR Mode Setpoint Pre-Position 2	40873	Float	4	R W	Volt	0 - 75
Reserved 9	40875	C5 Filler	50			
Exc Cur Preposition 1Traverse Rate	40900	Float	4	R W	Second	0 - 720
Exc Cur Preposition 2Traverse Rate	40902	Float	4	R W	Second	0 - 720
Gen Volt Preposition 1Traverse Rate	40904	Float	4	R W	Second	0 - 720
Gen Volt Preposition 2Traverse Rate	40906	Float	4	R W	Second	0 - 720
Gen Var Preposition 1Traverse Rate	40908	Float	4	R W	Second	0 - 720
Gen Var Preposition 2Traverse Rate	40910	Float	4	R W	Second	0 - 720
Gen PF Preposition 1Traverse Rate	40912	Float	4	R W	Second	0 - 720
Gen PF Preposition 2Traverse Rate	40914	Float	4	R W	Second	0 - 720
Exc Volt Preposition 1Traverse Rate	40916	Float	4	R W	Second	0 - 720
Exc Volt Preposition 2Traverse Rate	40918	Float	4	R W	Second	0 - 720
Unused Registers 6	40920	U6 Filler	462	R	n/a	n/a
Setting Group Indication, Soft Start	41151	Uint16	2	R	n/a	Primary=1 Secondary=2
Reserved	41152					
Unused Registers 7	41153	U7 Filler	36	R	n/a	n/a
Soft Start Threshold	41171	Float	4	R W	Percent	0 - 90
Soft Start Duration	41173	Float	4	R W	Second	1 - 7200
Underfrequency Corner Frequency	41175	Float	4	R W	Hertz	15 - 90
Volts per Hz High Setting	41177	Float	4	R W	n/a	0 - 3
Volts per Hz Low Setting	41179	Float	4	R W	n/a	0 - 3
Volts per Hz Time Setting	41181	Float	4	R W	Second	0 - 10
Width of Voltage Matching Window	41183	Float	4	R W	Percent	0 - 20
Voltage Matching Reference	41185	Float	4	R W	Percent	0 - 700
Fine Voltage Adjust Band	41187	Float	4	R W	Percent	0 - 30
Time Required for Loss of Sensing	41189	Float	4	R W	Second	0 - 30
Loss of Sensing Level Under Balanced Conditions	41191	Float	4	R W	Percent	0 - 100
Loss of Sensing Level Under Unbalanced Conditions	41193	Float	4	R W	Percent	0 - 100
Reserved 10	41195					
Slope of Underfrequency Curve	41197	Float	4	R W	n/a	0 - 3
Reserved 11	41199					
Reserved 12	41201					
PF Active Power Level	41203	Float	4	R W	Percent	0 - 30
Unused Registers 8	41205	U8 Filler	132	R	n/a	n/a
Soft Start Threshold Secondary	41271	Float	4	R W	Percent	0 - 90
Soft Start Duration Secondary	41273	Float	4	R W	Second	1 - 7200
Reserved 13	41275	C6 Filler	152			
Active OEL Limiter Setting Group	41351	Uint16	2	R	n/a	Primary=1 Secondary=2
OEL dvdt Enable	41352	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Setting Group Selection for Var Limiter	41353	Uint16	2	R	n/a	Primary=1 Secondary=2
Unused Registers 9	41354	U9 Filler	14	R	n/a	n/a
On-line High OEL Level	41361	Float	4	R W	Amp	0 - 12000
Time Allowed for On-line High OEL Level	41363	Float	4	R W	Second	0 - 240
On-line Medium OEL Level	41365	Float	4	R W	Amp	0 - 12000

Name	Register	Type	Bytes	R/W	Unit	Range
Time Allowed for On-line Medium OEL Level	41367	Float	4	R W	Second	0 - 240
On-line Low OEL Level	41369	Float	4	R W	Amp	0 - 12000
Off-line High OEL Level	41371	Float	4	R W	Amp	0 - 12000
Off-line Low OEL Level	41373	Float	4	R W	Amp	0 - 12000
Time Allowed for Off-line High OEL	41375	Float	4	R W	Second	0 - 240
Takeover OEL Offline High Limit Level	41377	Float	4	R W	Amp	0 - 12000
Takeover OEL Offline Low Limit Level	41379	Float	4	R W	Amp	0 - 12000
Takeover OEL Offline Time Dial	41381	Float	4	R W	n/a	0.1 - 20
Takeover OEL Online High Limit Level	41383	Float	4	R W	Amp	0 - 12000
Takeover OEL Online Low Limit Level	41385	Float	4	R W	Amp	0 - 12000
Takeover OEL Online Time Dial	41387	Float	4	R W	n/a	0.1 - 20
Unused Registers 10	41389	U10 Filler	44	R	n/a	n/a
Active UEL Limiter Setting Group	41411	Uint16	2	R	n/a	Primary=1 Secondary=2
Unused Registers 11	41412	U11 Filler	18	R	n/a	n/a
First UEL Point kW Value	41421	Float	4	R W	KW	0 - 62
Second UEL Point kW Value	41423	Float	4	R W	KW	0 - 62
Third UEL Point kW Value	41425	Float	4	R W	KW	0 - 62
Fourth UEL Point kW Value	41427	Float	4	R W	KW	0 - 62
Fifth UEL Point kW Value	41429	Float	4	R W	KW	0 - 62
First UEL Point kvar Value	41431	Float	4	R W	kvar	0 - 62
Second UEL Point kvar Value	41433	Float	4	R W	kvar	0 - 62
Third UEL Point kvar Value	41435	Float	4	R W	kvar	0 - 62
Fourth UEL Point kvar Value	41437	Float	4	R W	kvar	0 - 62
Fifth UEL Point kvar Value	41439	Float	4	R W	kvar	0 - 62
Primary UEL Bias	41441	Float	4	R W	Var	0 - 99
Real Power Filter Time Constant	41443	Float	4	R W	Second	0 - 20
Real Power Exponent	41445	Float	4	R W	n/a	0 - 2
Unused Registers 12	41447	U12 Filler	48	R	n/a	n/a
Active SCL Limiter Setting Group	41471	Uint16	2	R	n/a	Primary=1 Secondary=2
Unused Registers 13	41472	U13 Filler	18	R	n/a	n/a
SCL High Limit Level	41481	Float	4	R W	Amp	0 - 66000
Time Allowed at SCL High Limit Level	41483	Float	4	R W	Second	0 - 240
Reserved 14	41485					
Reserved 15	41487					
SCL Low Limit Level	41489	Float	4	R W	Amp	0 - 66000
Primary SCL No Response Time	41491	Float	4	R W	Second	0 - 10
Unused Registers 14	41493	U14 Filler	184	R	n/a	n/a
OEL dvdt Setting	41585	Float	4	R W	n/a	-10 - 0
Var Limiter Setpoint for Primary Selection	41587	Float	4	R W	Percent	0 - 200
Var Limiter Initial Delay for Primary Selection	41589	Float	4	R W	Second	0 - 300
Unused Registers 15	41591	U15 Filler	260	R	n/a	n/a
On-line High OEL Level Secondary	41721	Float	4	R W	Amp	0 - 12000
Time Allowed for On-line High OEL Level Secondary	41723	Float	4	R W	Second	0 - 240
On-line Medium OEL Level Secondary	41725	Float	4	R W	Amp	0 - 12000
Time Allowed for On-line Medium OEL Level Secondary	41727	Float	4	R W	Second	0 - 240

Name	Register	Type	Bytes	R/W	Unit	Range
On-line Low OEL Level Secondary	41729	Float	4	R W	Amp	0 - 12000
Off-line High OEL Level Secondary	41731	Float	4	R W	Amp	0 - 12000
Off-line Low OEL Level Secondary	41733	Float	4	R W	Amp	0 - 12000
Time Allowed for Off-line High OEL Secondary	41735	Float	4	R W	Second	0 - 240
Takeover OEL Offline High Limit Level Secondary	41737	Float	4	R W	Amp	0 - 12000
Takeover OEL Offline Low Limit Level Secondary	41739	Float	4	R W	Amp	0 - 12000
Takeover OEL Offline Time Dial Secondary	41741	Float	4	R W	n/a	0.1 - 20
Takeover OEL Online High Limit Level Secondary	41743	Float	4	R W	Amp	0 - 12000
Takeover OEL Online Low Limit Level Secondary	41745	Float	4	R W	Amp	0 - 12000
Takeover OEL Online Time Dial Secondary	41747	Float	4	R W	n/a	0.1 - 20
Unused Registers 16	41749	U16 Filler	64	R	n/a	n/a
First UEL Point kW Value Secondary	41781	Float	4	R W	KW	0 - 62
Second UEL Point kW Value Secondary	41783	Float	4	R W	Kilowatt	0 - 62
Third UEL Point kW Value Secondary	41785	Float	4	R W	Kilowatt	0 - 62
Fourth UEL Point kW Value Secondary	41787	Float	4	R W	Kilowatt	0 - 62
Fifth UEL Point kW Value Secondary	41789	Float	4	R W	Kilowatt	0 - 62
First UEL Point kvar Value Secondary	41791	Float	4	R W	Kilovar	0 - 62
Second UEL Point kvar Value Secondary	41793	Float	4	R W	Kilovar	0 - 62
Third UEL Point kvar Value Secondary	41795	Float	4	R W	Kilovar	0 - 62
Fourth UEL Point kvar Value Secondary	41797	Float	4	R W	Kilovar	0 - 62
Fifth UEL Point kvar Value Secondary	41799	Float	4	R W	Kilovar	0 - 62
Secondary UEL Bias	41801	Float	4	R W	Var	0 - 99
Unused Registers 17	41803	U17 Filler	76	R	n/a	n/a
SCL High Limit Level Secondary	41841	Float	4	R W	Amp	0 - 66000
Time Allowed at SCL High Limit Level Secondary	41843	Float	4	R W	Second	0 - 240
Reserved 16	41845					
Reserved 17	41847					
SCL Low Limit Level Secondary	41849	Float	4	R W	Amp	0 - 66000
Secondary SCL No Response Time	41851	Float	4	R W	Second	0 - 10
Var Limiter Setpoint for Secondary Selection	41853	Float	4	R W	Percent	0 - 200
Var Limiter Initial Delay for Secondary Selection	41855	Float	4	R W	Second	0 - 300
Reserved 18	41857	C7 Filler	1238			
Active Gain Setting Group	42476	Uint16	2	R	n/a	Primary=1 Secondary=2
Unused Registers 18	42477	U18 Filler	48	R	n/a	n/a
Index into Table of Gain Constants	42501	Float	4	R W	n/a	1 - 21
Primary AVR Mode Proportional Gain	42503	Float	4	R W	n/a	0 - 1000
Primary AVR Mode Integral Gain	42505	Float	4	R W	n/a	0 - 1000
Primary AVR Mode Derivative Gain	42507	Float	4	R W	n/a	0 - 1000
OEL Proportional Gain - Kp	42509	Float	4	R W	n/a	0 - 1000
OEL Integral Gain - Ki	42511	Float	4	R W	n/a	0 - 1000
PF Mode Integral Gain - Ki	42513	Float	4	R W	n/a	0 - 1000
Var Mode Integral Gain - Ki	42515	Float	4	R W	n/a	0 - 1000

Name	Register	Type	Bytes	R/W	Unit	Range
FCR Mode Loop Gain - Kg	42517	Float	4	R W	n/a	0 - 1000
Primary AVR Mode Loop Gain - Kg	42519	Float	4	R W	n/a	0 - 1000
Var Mode Loop Gain - Kg	42521	Float	4	R W	n/a	0 - 1000
PF Mode Loop Gain - Kg	42523	Float	4	R W	n/a	0 - 1000
OEL Loop Gain - Kg	42525	Float	4	R W	n/a	0 - 1000
UEL Loop Gain - Kg	42527	Float	4	R W	n/a	0 - 1000
Voltage Matching Loop Gain - Kg	42529	Float	4	R W	n/a	0 - 1000
Voltage Matching Proportional Gain - Kp	42531	Float	4	R W	n/a	0 - 1000
Voltage Matching Integral Gain - Ki	42533	Float	4	R W	n/a	0 - 1000
Reserved 19	42535					
Reserved 20	42537					
Reserved 21	42539					
UEL Proportional Gain - Kp	42541	Float	4	R W	n/a	0 - 1000
UEL Integral Gain - Ki	42543	Float	4	R W	n/a	0 - 1000
Primary AVR Mode Derivative Time Constant - Td	42545	Float	4	R W	n/a	0 - 1
SCL Loop Gain - Kg	42547	Float	4	R W	n/a	0 - 1000
SCL Proportional Gain - Kp	42549	Float	4	R W	n/a	0 - 1000
SCL Integral Gain - Ki	42551	Float	4	R W	n/a	0 - 1000
Primary FCR Mode Proportional Gain	42553	Float	4	R W	n/a	0 - 1000
Primary FCR Mode Integral Gain	42555	Float	4	R W	n/a	0 - 1000
Primary FCR Mode Derivative Gain	42557	Float	4	R W	n/a	0 - 1000
Primary FCR Mode Derivative Time Constant - Td	42559	Float	4	R W	n/a	0 - 1
FVR Mode Proportional Gain	42561	Float	4	R W	n/a	0 - 1000
FVR Mode Integral Gain	42563	Float	4	R W	n/a	0 - 1000
FVR Mode Derivative Gain	42565	Float	4	R W	n/a	0 - 1000
FVR Mode Derivative Time Constant - Td	42567	Float	4	R W	n/a	0 - 1
FVR Mode Loop Gain - Kg	42569	Float	4	R W	n/a	0 - 1000
Unused Registers 19	42571	U19 Filler	76	R	n/a	n/a
Loop Gain for Var Limiter - Kg	42609	Float	4	R W	n/a	0 - 1000
Integral Gain for Var Limiter - Ki	42611	Float	4	R W	n/a	0 - 1000
Unused Registers 20	42613	U20 Filler	126	R	n/a	n/a
Secondary Gain Option Index	42676	Uint32	4	R W	n/a	T'do=1.0 Te=0.17=1 T'do=1.5 Te=0.25=2 T'do=2.0 Te=0.33=3 T'do=2.5 Te=0.42=4 T'do=3.0 Te=0.50=5 T'do=3.5 Te=0.58=6 T'do=4.0 Te=0.67=7 T'do=4.5 Te=0.75=8 T'do=5.0 Te=0.83=9 T'do=5.5 Te=0.92=10 T'do=6.0 Te=1.00=11 T'do=6.5 Te=1.08=12 T'do=7.0 Te=1.17=13 T'do=7.5 Te=1.25=14 T'do=8.0 Te=1.33=15 T'do=8.5 Te=1.42=16 T'do=9.0 Te=1.50=17 T'do=9.5 Te=1.58=18 T'do=10.0 Te=1.67=19 T'do=10.5 Te=1.75=20 Custom=21
Secondary AVR Mode Proportional Gain - Kp	42678	Float	4	R W	n/a	0 - 1000
Secondary AVR Mode Integral Gain - Ki	42680	Float	4	R W	n/a	0 - 1000
Secondary AVR Mode Derivative Gain - Kd	42682	Float	4	R W	n/a	0 - 1000
Secondary AVR Mode Loop Gain - Kg	42684	Float	4	R W	n/a	0 - 1000
Secondary AVR Derivative Time Constant - Td	42686	Float	4	R W	n/a	0 - 1
Reserved 22	42688	C8 Filler	626			

Name	Register	Type	Bytes	R/W	Unit	Range
Field Overvoltage Alarm Enable	43001	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Field Overcurrent Alarm Enable	43002	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Stator Undervoltage Alarm Enable	43003	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Stator Overvoltage Alarm Enable	43004	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Reserved	43005					
Loss of Field Alarm Enable	43006	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Loss of Field Isolation Transducer Alarm Enable	43007	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Control Power Low Alarm Enable	43008	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Protection 24 Volts per Hz Mode	43009	Uint16	2	R W	n/a	n/a
Reserved 23	43010					
Reserved 24	43011					
Reserved 25	43012					
Protection 24 Inverse Time Curve Exponent	43013	Uint16	2	R W	n/a	0.5=0 1=1 2=2
Unused Registers 21	43014	U21 Filler	22	R	n/a	n/a
Active Protection Setting Group	43025	Uint16	2	R	n/a	Primary=1 Secondary=2
Field Overvoltage Level	43026	Float	4	R W	Volt	0;1 - 2400
Field Overcurrent Base Level	43028	Float	4	R W	Amp	0.1 – 20000
Stator Undervoltage Level	43030	Float	4	R W	Volt	0;1 - 600000
Stator Overvoltage Level	43032	Float	4	R W	Volt	0 – 600000
Field Overvoltage Delay	43034	Float	4	R W	Second	0;0.2 - 30.0
Field Overcurrent Delay	43036	Float	4	R W	Second	0;0.2 - 30.0
Stator Undervoltage Delay	43038	Float	4	R W	Second	0.1 - 60.0
Stator Overvoltage Delay	43040	Float	4	R W	Second	0.1 - 60.0
Field Over Temperature Level	43042	Float	4	R W	Deg F	0 - 572
Field Over Temperature Time Delay	43044	Float	4	R W	Millisecond	100 - 60000
Loss of Field Pickup Level	43046	Float	4	R W	KiloVAr	0 - 3000000
Loss of Field Time Delay	43048	Float	4	R W	Second	0;0 - 300.0
Loss of Field Isolation Transducer Level	43050	Float	4	R	n/a	n/a
Loss of Field Isolation Transducer Time Delay	43052	Float	4	R W	n/a	n/a
Control Power Low Level	43054	Float	4	R	n/a	n/a
Control Power Low Time Delay	43056	Float	4	R	n/a	n/a
Protection 24 Inverse Time Pickup Setpoint	43058	Float	4	R W	n/a	n/a
Protection 24 Inverse Time Pickup Time Dial	43060	Float	4	R W	n/a	n/a
Protection 24 Reset Time Dial	43062	Float	4	R W	n/a	n/a
Protection 24 Definite Time Pickup 1	43064	Float	4	R W	n/a	n/a
Protection 24 Definite Time Delay 1	43066	Float	4	R W	n/a	n/a
Protection 24 Definite Time Pickup 2	43068	Float	4	R W	n/a	n/a
Protection 24 Definite Time Delay 2	43070	Float	4	R W	n/a	n/a
Reserved 26	43072	C9 Filler	608			
Reserved 27	43376					
Reserved 28	43377					
Exciter Open Diode Protection Enable	43378	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Exciter Shorted Diode Protection Enable	43379	Uint16	2	R W	n/a	Disabled=0 Enabled=1
Unused Registers 22	43380	U22 Filler	42	R	n/a	n/a
Reserved	43401 - 43409					

Name	Register	Type	Bytes	R/W	Unit	Range
Pole Ratio	43411	Float	4	R W	n/a	0;1 - 10
Reserved 29	43413	C10 Filler	226			
Output for Relay 1	43526	Uint16	2	R	n/a	n/a
Unused Registers 23	43527	U23 Filler	98	R	n/a	n/a
Output for Relay 2	43576	Uint16	2	R	n/a	n/a
Unused Registers 23-2	43577	U23 Filler	98	R	n/a	n/a
Output for Relay 3	43626	Uint16	2	R	n/a	n/a
Unused Registers 23-3	43627	U23 Filler	98	R	n/a	n/a
Output for Relay 4	43676	Uint16	2	R	n/a	n/a
Unused Registers 23-4	43677	U23 Filler	98	R	n/a	n/a
Output for Relay 5	43726	Uint16	2	R	n/a	n/a
Unused Registers 23-5	43727	U23 Filler	98	R	n/a	n/a
Output for Relay 6	43776	Uint16	2	R	n/a	n/a
Reserved 30	43777	C11 Filler	698			
Reserved	44126					
Reserved 31	44127					
RS485 Baud Rate	44128	Uint16	2	R W	n/a	1200 Baud=1200 2400 Baud=2400 4800 Baud=4800 9600 Baud=9600 19200 Baud=19200 38400 Baud=38400 57600 Baud=57600 115200 Baud=115200
RS485 Parity	44129	Uint16	2	R W	n/a	69 - 79
RS485 Stop Bits	44130	Uint16	2	R W	n/a	1 Stop Bit=1 2 Stop Bits=2
DECS-250 Polling Address	44131	Uint16	2	R W	n/a	1 - 247
Modbus Response Time Delay	44132	Uint16	2	R W	Millisecond	10 - 10000
System Clock Month	44133	Uint16	2	R W	n/a	1 - 12
System Clock Day	44134	Uint16	2	R W	n/a	1 - 31
System Clock Year	44135	Uint16	2	R W	n/a	2000 - 2099
System Clock Daylight Savings Time	44136	Uint16	2	R W	n/a	On=0 Off=1
System Clock Hour	44137	Uint16	2	R W	n/a	0 - 23
System Clock Minute	44138	Uint16	2	R W	n/a	0 - 59
System Clock Second	44139	Uint16	2	R W	n/a	0 - 59
System Clock Twelve Hour Mode	44140	Uint16	2	R W	n/a	12 Hour Mode=0 24 Hour Mode=1
System Clock AM PM	44141	Uint16	2	R W	n/a	AM=0 PM=1
Reserved 32	44142	C12 Filler	118			
Reserved 33	44201	C13 Filler	100			
Reserved	44251 - 44619					

25 • PROFIBUS Communication

On units equipped with the PROFIBUS communication protocol (style XX1XXXX), the DECS-450R 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-450R 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 25-6 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 25-6 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 25-1 illustrates the sizes of the UINT8 cyclic data instances.

Table 25-1. 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 25-6. 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-450R 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 25-2 shows the parameters of instance 8 as they appear in Table 25-6. 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 25-2. 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 25-3 shows the bit number of each parameter in instance 8 and an example packet returned from a DECS-450R. Reading a value of 0x02 (0000 0010) for instance 8 indicates that the device is operating in FCR mode.

Table 25-3. Instance 8 Bit Order

Instance Number	Bit Number	Key Name	Packet Returned from DECS-450R
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 25-4 shows the parameters of instance 11 as they appear in Table 25-6. 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 25-4. 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 25-5 shows the bit number of each parameter in instance 11 and an example packet returned from a DECS-450R. 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 25-5. Instance 11 Bit Order

Instance Number	Byte Number	Bit Number	Key Name	Packet Returned from DECS-450R
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-450R 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-450R GSD file from the Basler website: www.basler.com
2. Using PLC configuration software, import the GSD file. This allows the DECS-450R to be included in the bus configuration as a slave.
3. Assign a unique PROFIBUS address to the DECS-450R. This allows the master to exchange data with the DECS-450R.

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 25-6). 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 25-6. 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 25-6. 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 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 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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Gen Metering	16	Float	R	VBC GG (Gen Voltage Angle)	Deg	0 - 360
Gen Metering	16	Float	R	VCA GG (Gen Voltage Angle)	Deg	0 - 360
Gen Metering	16	Float	R	IA GG (Gen Current Magnitude)	Amp	0 - 2000000000
Gen Metering	16	Float	R	IB GG (Gen Current Magnitude)	Amp	0 - 2000000000
Gen Metering	16	Float	R	IC GG (Gen Current Magnitude)	Amp	0 - 2000000000
Gen Metering	16	Float	R	IA GG (Gen Current Angle)	Deg	0 - 360
Gen Metering	16	Float	R	IB GG (Gen Current Angle)	Deg	0 - 360
Gen Metering	16	Float	R	IC GG (Gen Current Angle)	Deg	0 - 360
Gen Metering	16	Float	R	IAVG GG	Amp	0 - 2000000000
Gen Metering	16	Float	R	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	Field Temperature GG	Deg F	-40 - 572

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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 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 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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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 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
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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
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 Russian=2 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-450R Device Info App Version	47	String	R	External Version GG	No Unit	0 - 25 characters
DECS-450R Device Info Boot Version	48	String	R	External Boot Version GG	No Unit	0 - 25 characters
DECS-450R Device Info App Build Date	49	String	R	App Build Date GG	No Unit	0 - 25 characters
DECS-450R Device Info Serial	50	String	R	Serial Number GG	No Unit	0 - 32 characters
DECS-450R Device Info App Part Number	51	String	R	Firmware Part Number GG	No Unit	0 - 64 characters
DECS-450R Device Info Model	52	String	R	Model Number GG	No Unit	0 - 64 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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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 n/a=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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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	84	Float	R/W	DECS Auto Track T Delay GG	Sec	0 - 8
Auto Tracking	84	Float	R/W	DECS Auto Track T Rate GG	Sec	1 - 80
Auto Tracking	84	Float	R/W	DECS Auto Trans T Delay GG	Sec	0 - 8
Auto Tracking	84	Float	R/W	DECS Auto Trans T Rate GG	Sec	1 - 80
Startup	86	Float	R/W	Startup 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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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
SCL Scaling	125	UINT32	R/W	SCL Scale Enable GG	No Unit	DISABLED=0 Auxiliary Input=1
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 Time GG	Sec	0 - 10

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
Bus Condition Detection (Gen Sensing)	158	Float	R/W	Gen Stable Low Line Scale Factor GG	No Unit	0.001 - 3
Bus Condition Detection (Gen Sensing)	158	Float	R/W	Gen Stable Alternate Frequency Scale Factor GG	No Unit	0.001 - 100
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Dead Bus Threshold GG	V	0 - 600000
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Dead Bus Time Delay GG	Sec	0.1 - 600
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus S table Over Voltage Pickup GG	V	10 - 600000
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Over Voltage Dropout GG	V	10 - 600000
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Under Voltage Pickup GG	V	10 - 600000
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Under Voltage Dropout GG	V	10 - 600000
Bus Condition Detection (Bus Sensing)	160	Float	R/W	Bus Stable Over Frequency Pickup GG	Hz	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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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
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

Instance Name	Inst. #	Type	RW	Key Name	Unit	Range
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
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

26 • 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-450R from service. Refer to the appropriate site schematics to ensure that all steps have been taken to properly and completely de-energize the DECS-450R.

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-450R to ensure they are clean and tight and remove any accumulation of dust.

Electrolytic Capacitors

The DECS-450R contains long-life aluminum electrolytic capacitors. For a DECS-450R 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-450R 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-450R 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-450R 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-450R 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 26-1) on the DECS-450R side panel. The new battery must be installed with the same orientation.

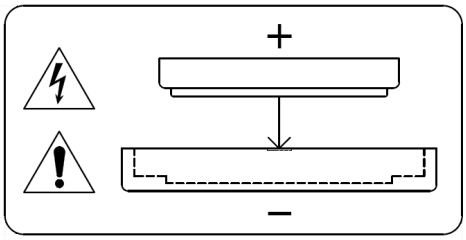


Figure 26-1. Shock Hazard and Battery Polarity Label

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-450R back in service by observing all applicable safety and startup procedures.
9. Set the DECS-450R'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-450R, first check the programmable settings for the appropriate function.

The DECS-450R Appears to be Inoperative

If the DECS-450R 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-450R.

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-450R 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-450R 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-450R Fails To Flash

Check the DECS-450R 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-450R 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-450R.

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-450R 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-450R 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-450R. Depending on the signal selected, the DECS-450R 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-450R 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-450R Reboots Frequently

Check the status of the Control Power Input Failure alarm.

If a single DECS-450R 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-450R 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-450R USB drivers.

1. In the Windows Device Manager, under Other Devices, right-click on DECS-450R and select Properties. The Properties window appears. (If the DECS-450R 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 Device Drivers\USBIO
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.

27 • Specifications

DECS-450R 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-450R 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-450R rear panel Field Isolation Transducer connector. See *Field Isolation Transducer*.

Field Isolation Transducer

Electrical Specifications

Operating Power ..... +5 Vdc, ±12 Vdc from DECS-450R
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

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-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-450R 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

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 sField 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

Loss of Field Isolation Transducer

Time Delay
Range..... 0.0 to 9.9 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.

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 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-450R 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-450R 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.

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-450R									
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.

28 • 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 version 1607 (Anniversary Update) or later, 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 28-1.

Table 28-1. 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 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.

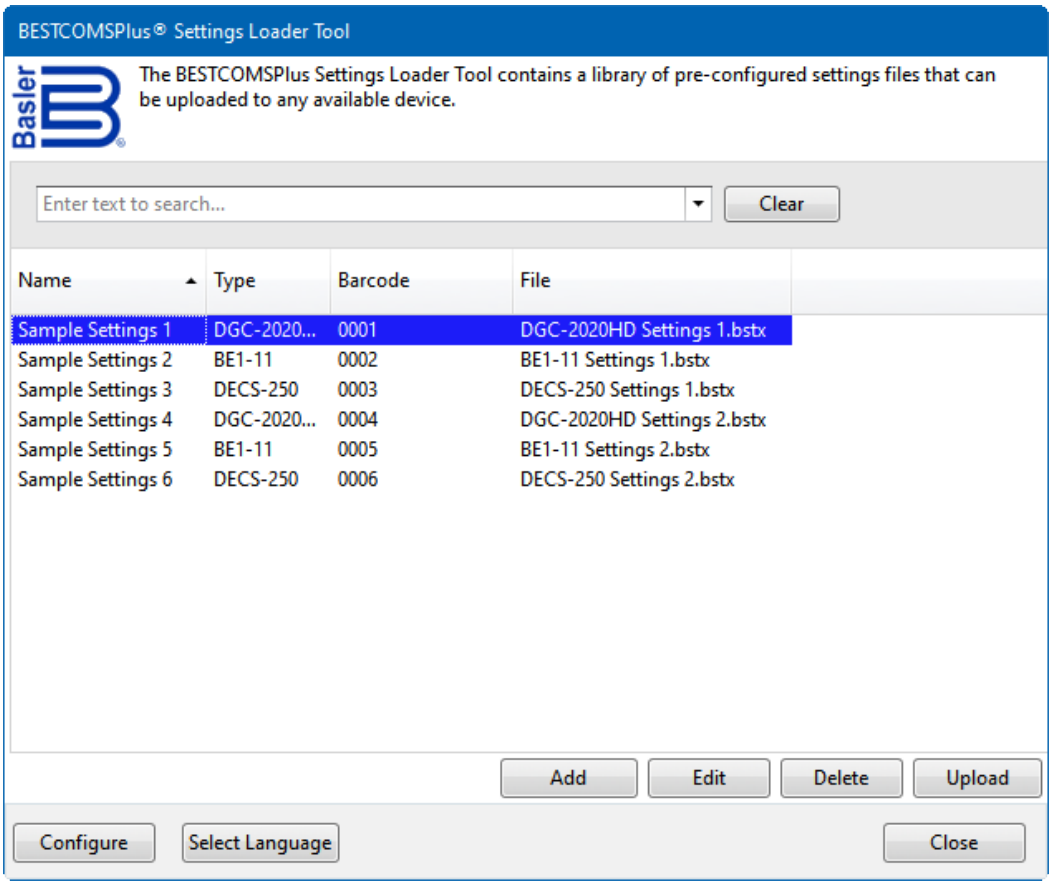


Figure 28-1. Loader Grid

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 28-2).

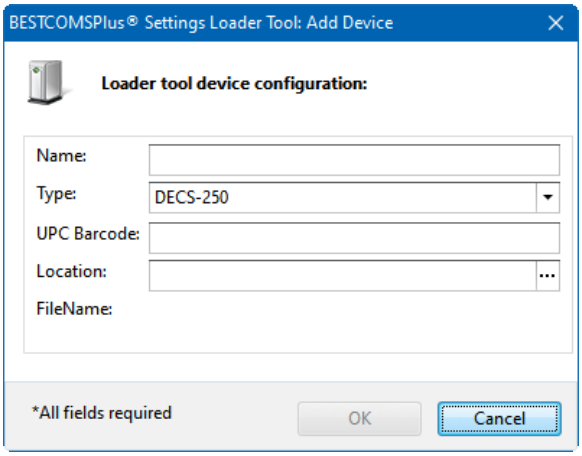


Figure 28-2. Add Device Screen

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 28-3 illustrates the Setting Files tab.

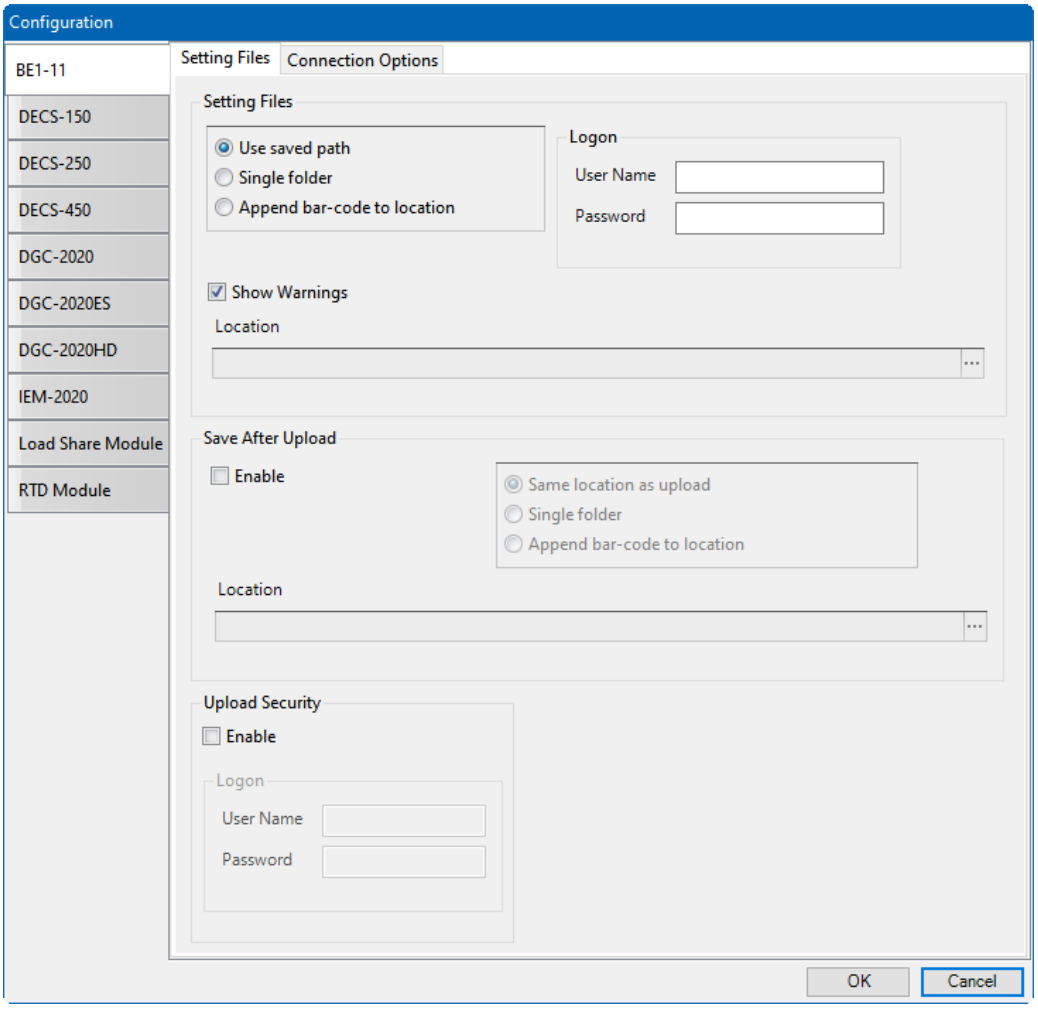


Figure 28-3. Configuration, Settings Files Tab

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 28-4 illustrates the Connection Options tab.

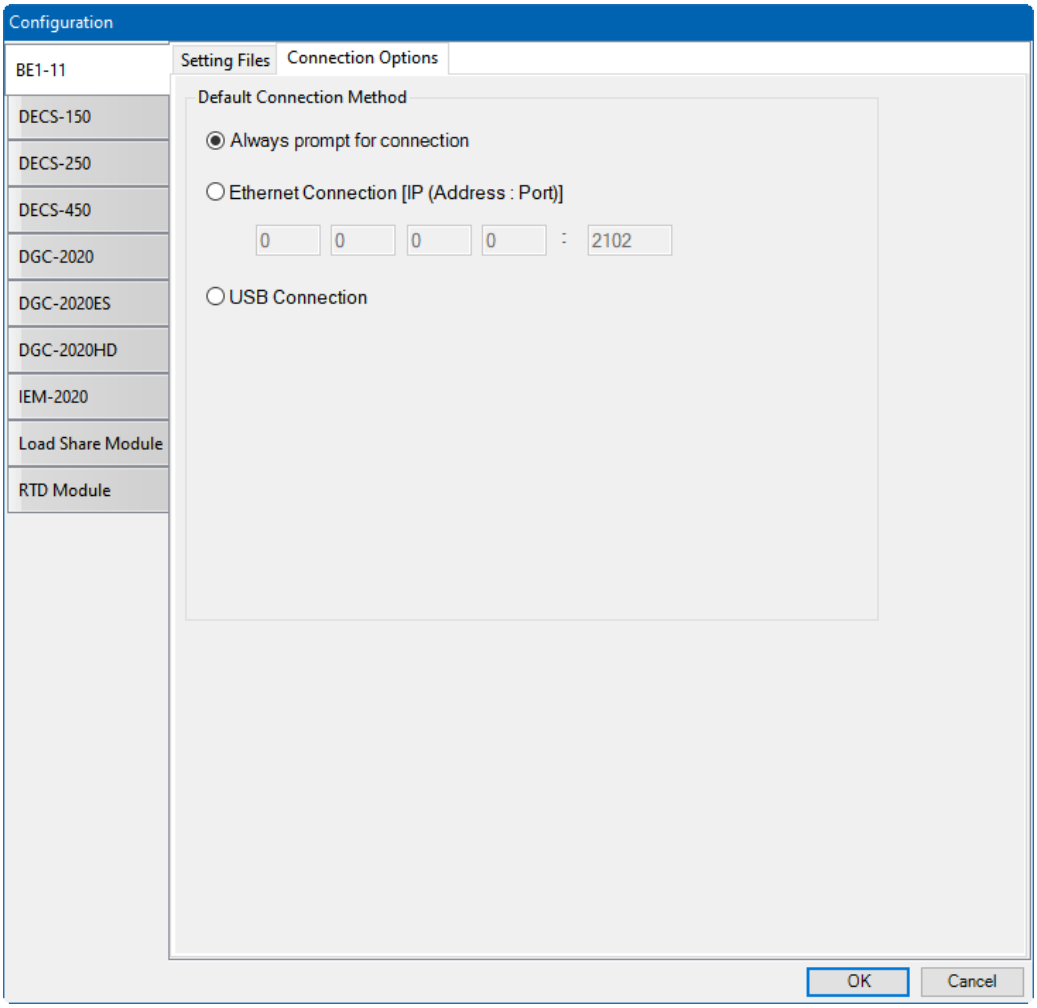


Figure 28-4. Configuration, Connection Options Tab

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.

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