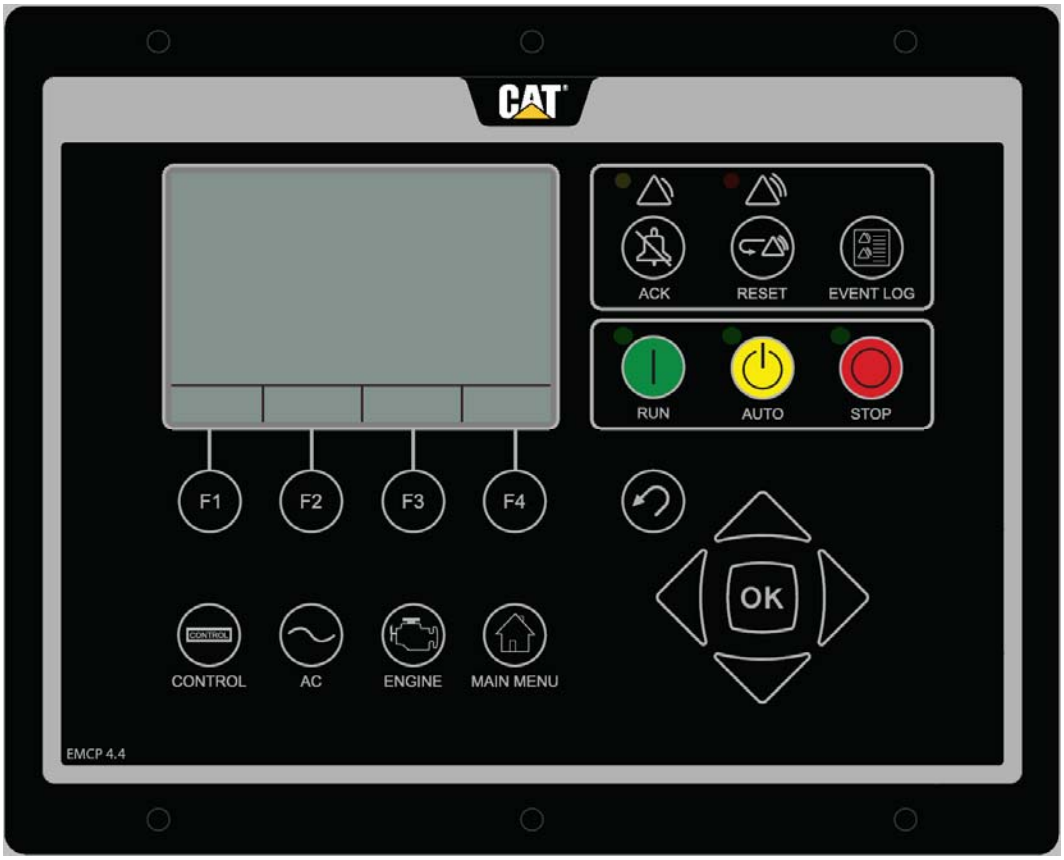
APPLICATION AND INSTALLATION GUIDE

EMCP 4.3, 4.4
GENERATOR SET CONTROL



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FOREWORD

This Application and Installation Guide describes the EMCP 4.3 and 4.4 series electric power generator set controls.

Some data used in this guide is generalized and is provided only for the purpose of comparison or illustration. Also, PC application screenshots and EMCP 4 screen images may be actual screens or simulated and are shown for illustrative purposes only. These images may not be identical to those seen by the user. Screen images of the EMCP 4 may differ from the actual screens depending on flash file language, setpoint configuration, or series of the EMCP (4.3 versus 4.4).

In various places throughout this document, reference is made to the release date of the EMCP 4 software. This information can be found by connecting to the subject module using the Cat® Service Tool, and viewing the ECM Summary (this is the default startup screen). The release date is found in the field entitled Software Group Release Date. See Figure 1, showing the release date for a Thermocouple module.

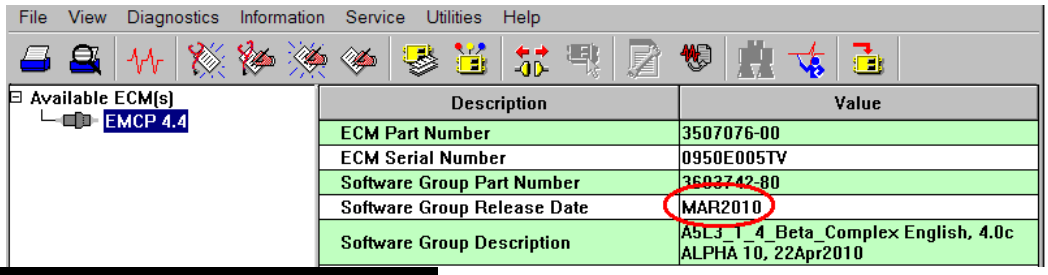


Figure 1: EMCP Software Release Date

Other product specific information and data is available from a variety of sources. For more information, contact the Cat Dealer or dealer TC nearest you.

1 GENERAL INFORMATION

1.1 INTRODUCTION

Caterpillar has developed a product line of Generator Set Controls for use in the Electronic Modular Control Panel 4 (EMCP 4). They are available in four versions based on Generator Set Control feature sets.

The EMCP 4 Generator Set Control, or GSC, is the primary controller within the Generator Set Control system. The EMCP 4 line of Generator Set Controllers includes EMCP 4.1, 4.2, 4.3, and 4.4. Appendix B shows a full view of the EMCP 4.3 and 4.4.

This Application and Installation Guide is intended to cover the EMCP 4.3 and 4.4 Generator Set Control and its application in generator set systems. It also includes information on optional add-on modules. The intended audience for this guide includes Cat generator set system designers, Caterpillar service support personnel, Cat Dealers and Service Technicians, contractors, and customers.

1.2 APPLICATIONS

The EMCP 4 product line of generator set controllers is designed for use in a wide range of applications. They can be used on standby and prime Cat brand power diesel generator sets. The configurability of the controllers allows them to be used, in some cases, on other applications such as Marine auxiliary generators, switchgear applications, industrial engines and generator sets, and gas generator sets.

Most of the information in this document applies to all applications. However, the document was written with Cat brand diesel generator sets in mind. Please contact your Cat support representative for questions regarding different applications.

Note: Proper application of EMCP 4.4 paralleling controllers is critical; along with the technical requirements outlined elsewhere in this guide, please consider the following commercial requirements:

1. The EMCP 4.4 is generally expected to be used in applications whose aggregate current for paralleled units is 6000A or less.
2. Applications, whose aggregate current for paralleled units is between 6000A and 10,000A are acceptable; however, review/approval of the application by Caterpillar A&I Engineering, via the ASC, is required prior to installation.
   Applications whose aggregate current for paralleled units exceeds 10,000A are not generally recommended; dealers wishing consideration/support for such opportunities must contact the ASC to secure written approval from the Systems Product Team prior to sale. Cat floor-standing paralleling switchgear better suits large-scale, complex applications such as these.
3. EMCP 4.4 paralleling is intended for low voltage generator set applications only (less than 1000V); Cat floor-standing control or switchgear should be utilized for medium and high voltage applications.

1.3 REFERENCES

The System Operation Testing, Troubleshooting, and Adjusting manual (UENR 1210) is also available for EMCP 4.3 and 4.4 Generator Sets. The genset Operations and Maintenance manual contains details for specific products.

2 SAFETY INFORMATION

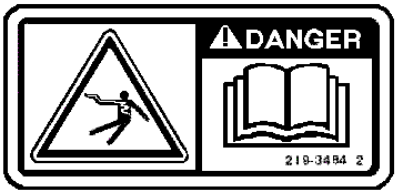
2.1 ELECTRICAL SAFETY

DO NOT operate or work on a generator set unless you have read and understand the instructions and warnings in the Operation and Maintenance Manual. Failure to follow the instructions or heed the warnings could result in injury or death. Contact any Cat Dealer for replacement manuals. Proper care is your responsibility.

WARNING

2.2 ELECTROSTATIC DISCHARGE AWARENESS

EMCP 4 control contains components that are sensitive to **ELECTROSTATIC DISCHARGE** (ESD). An electrostatic charge can damage the control resulting in EMCP 4 breakdown or improper operation.



Take the following precautions while installing/removing/handling the control:

- Handle equipment correctly. Use ESD protective packaging and material handling containers that are anti-static and provide discharge protection and electric field suppression.
- Use protective devices: ESD-protective workstations and/or work surfaces (grounding mat, anti-static wrist strap, etc).
- Keep all plastic items away from the devices. Any plastic item is a potential static generator. This includes candy wrappers, foam cups, synthetic carpet, foam cushions, etc.
- The anti-static bag cannot function as a static dissipating mat.
- **DO NOT** use an anti-static bag for any other purpose than to enclose a product.

Caution: The 120-pin connector (and additional 70-pin connector for EMCP 4.4) on the back of the control is the most vulnerable area to **ELECTROSTATIC DISCHARGE** (ESD). While handling the EMCP 4, extra attention is required to the back of the control. The control may become damaged or inoperable if extra care is not taken.

Note: Locking out the genset does not remove voltage on the EMCP 4.4 at the bus voltage sensing leads.

Consult the Electrostatic Discharge Association for proper procedure during particular situations: http://www.esda.org.

3 INSTALLATION

3.1 MOUNTING LOCATION

When selecting a mounting location for the EMCP 4, consider the following:

- Protection from high-voltage and high-current devices.
- Protection from devices which may produce electromagnetic interference.
- Protection from excessive vibration. The EMCP 4 controls are designed to withstand normal generator set vibrations. They should not be mounted directly to the engine block.
- Protection from direct exposure to water. Once installed, the EMCP 4 controllers are sealed to a level of IP Level 56 for resistance to moisture.

Suitable for Flat Surface Mounting in a Type 1 Enclosure only.

3.2 OPERATING TEMPERATURE RANGE

EMCP 4 has a continuous operating temperature range of –20°C to +70°C ambient.

3.3 POWER REQUIREMENTS

The EMCP 4.3 and 4.4 require a nominal voltage of 12 VDC or 24 VDC. A DC to DC converter may be needed for 12VDC applications. If batteries are used for operating power, a charging source such as an alternator or dual-mode battery charger is necessary to maintain a stable supply voltage. The maximum power consumption of the 4.3 and 4.4 with all I/O at maximum power drain will not exceed 10A at 24VDC.

Regional electrical codes must be followed. In the case of standby operation, follow the regional requirements for installing standby power systems. An example of this is the National Fire Protection Association (NFPA) guidelines for emergency power systems.

When connecting the EMCP 4 to the DC power source, make sure that there is only one common connection to the negative potential of the power source. Make extra effort to avoid any ground loops in the DC electrical system. A single point common ground for sensitive electronics is recommended at the negative battery terminal or Power Distribution Box.

Avoid daisy-chaining power supply connections from one device to another. This builds resistance from one Battery (-) point to the next, effectively building a potential difference between two different reference points. Each electronics subsystem and major engine subsystem should have its own DC network so that they do not interfere with each other (see Figure 2).

As shown in Figure 2, all sensitive electronics are electrically isolated from higher current loads, such as the starter motor. All electronics have a **COMMON POWER BUS** and **SINGLE POINT REFERENCE**. This point is the genset customer ground connection. The **CHASSIS GROUND** should be bonded separately to the customer ground connection and not be used as the electronics reference.

The sensitive electronics, such as sensors and control modules, have isolated power source paths. High current loads such as starters and solenoids can cause interference and possibly damage to low current loads, such as controllers and sensors.

Caution: Extra effort must be made to keep the high current and low current loads electrically separated.

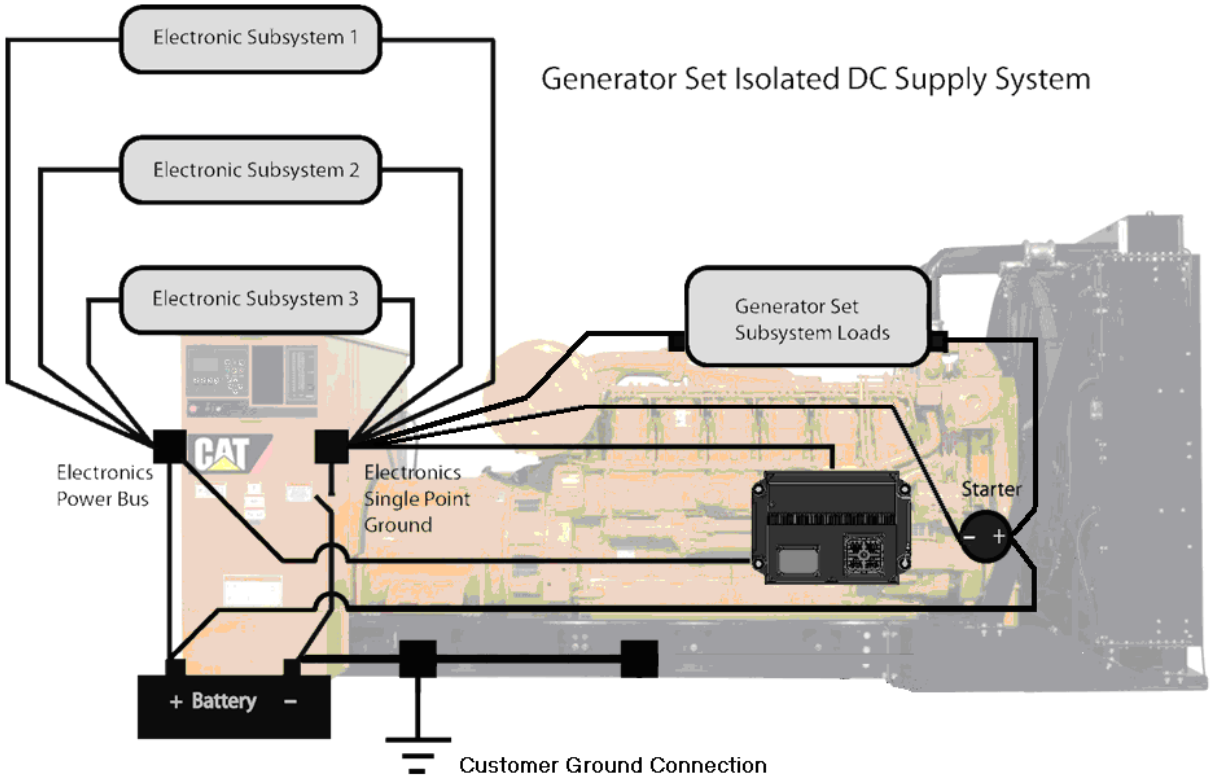


Figure 2: Generator Set Network Isolation

The two types of loads may share common Battery (+) and Battery (–) connections but, they should not be electrically connected at any other point. This strategy ensures maximum isolation between high current and low current loads.

The battery **DISCONNECT SWITCH** is located on the negative side of the battery supply.

3.4 BATTERY CHARGER

If a battery charger is to be used, it should be connected on the battery side of the disconnect switch. Most battery chargers are not to be used as power supplies. Proper battery charger operation requires that the actual battery load be present.

If battery charger fault condition wiring is connected to the EMCP Digital Inputs and these Digital Inputs are set to **DISABLED**, then any battery charger faults or events will not be broadcast or annunciated on the network. See Chapter 8.

3.5 ELECTRICAL CONNECTIONS

The EMCP 4.3 has one 120-pin connector on the back of the control (not all of the 120 pins are used). The EMCP 4.4 has the same 120-pin connector on the back of the control as the EMCP 4.3 and an additional 70-pin connector (not all of the 70 pins are used). The 70-pin connector on the EMCP 4.4 is not the same as the 70-pin connector on the EMCP 4.1 and 4.2.

Figure 3 and Figure 4 show:

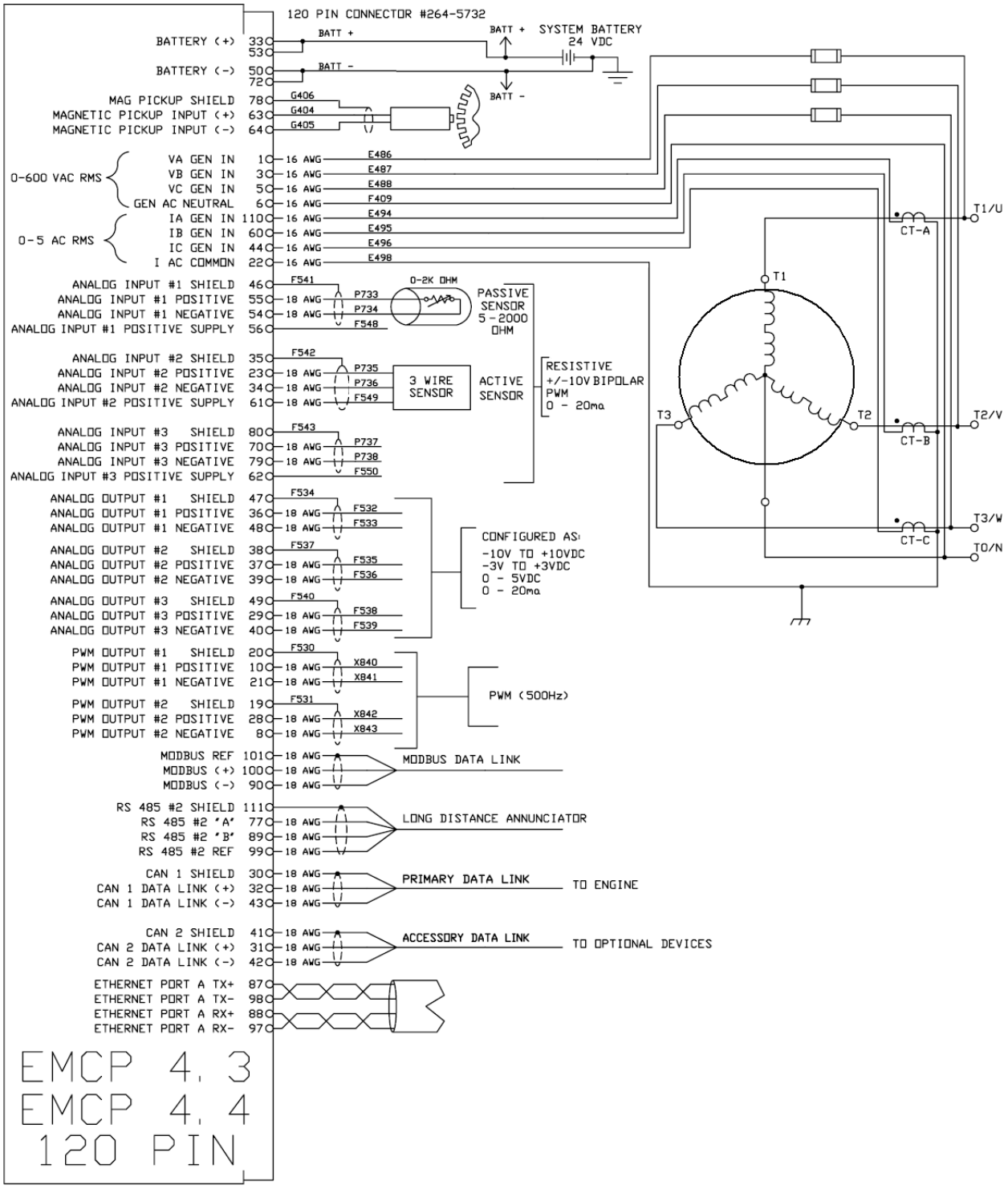
- All possible connections
- What pins are used for connections
- How each pin is connected for each control version

3.6 EUI ENGINES

For EUI engines, the Oil Pressure and Coolant Temperature sensors will typically be wired to the engine ECM and the EMCP 4 will get that information from the engine ECM via the Primary CAN Data Link. Ensure the EMCP 4 Oil Pressure and Coolant Temperature setpoints are configured for Data Link.

In order for the genset to function properly in Cooldown mode, some setpoints in the EMCP 4 must be coordinated with some ADEM setpoints. For gensets where the engine ECM controls cooldown, the cooldown time should be set to 0 seconds in the EMCP. For gensets where the engine ECM does not control cooldown, the cooldown time should be set to 0 seconds in the engine ECM.

3.7 EMCP 4.3 AND 4.4 ELECTRICAL DIAGRAMS



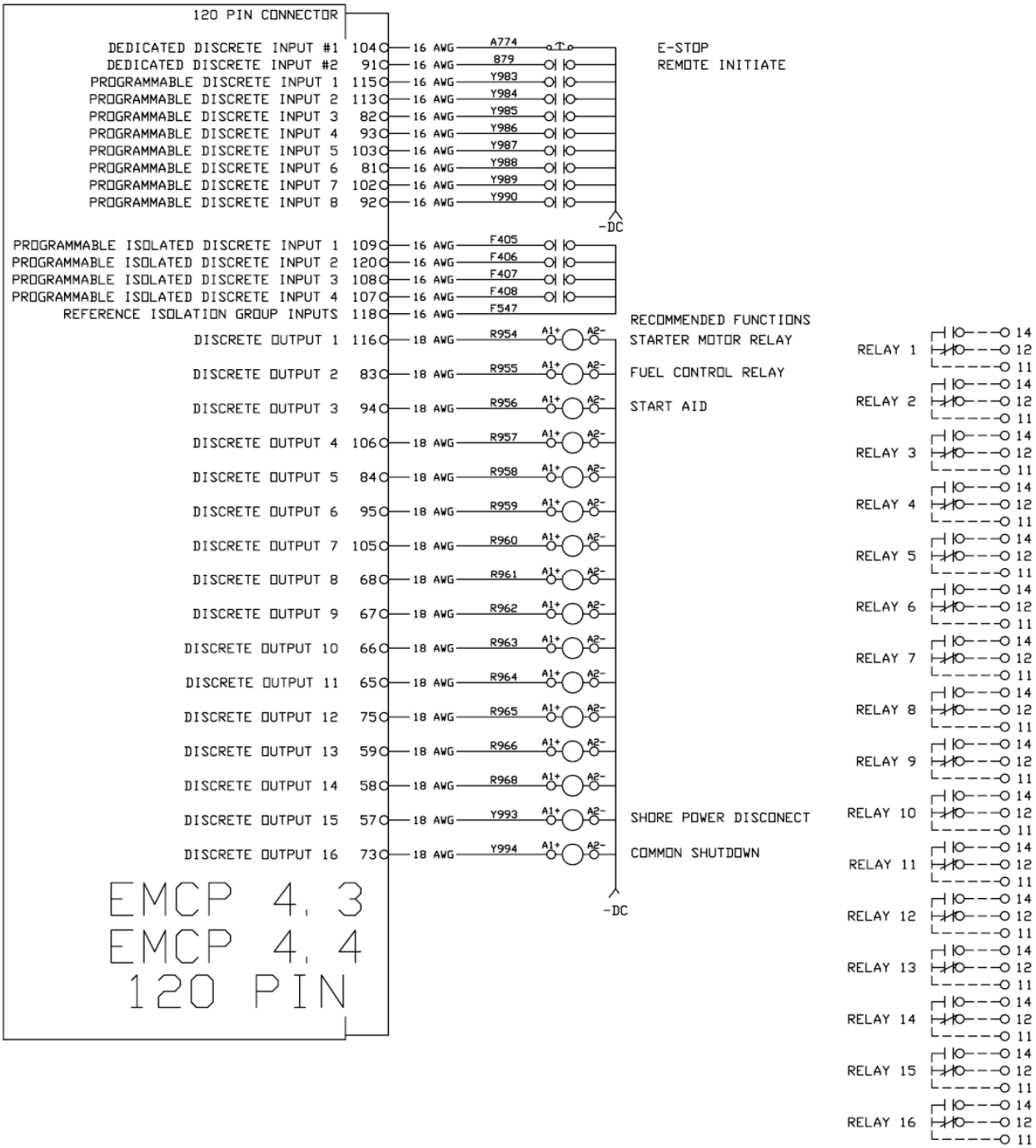


Figure 3: EMCP 4.3 and EMCP 4.4 120-Pin Connector Electrical Diagram

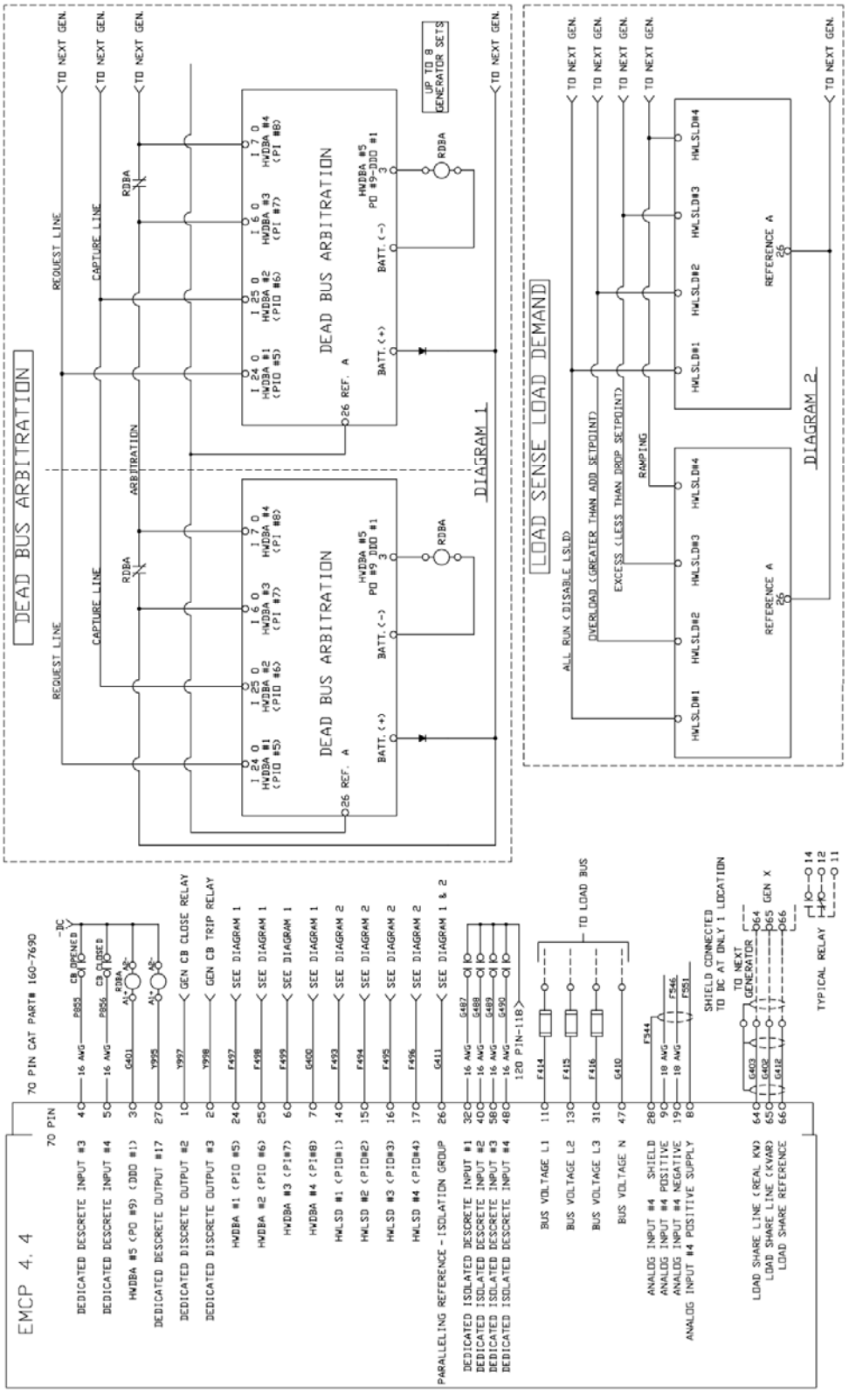


Figure 4: EMCP 4.4 Electrical Diagram

3.8 WINDING CONNECTIONS

The connections between the generator and the EMCP 4 depend on the winding configuration as shown in the connection diagrams below.

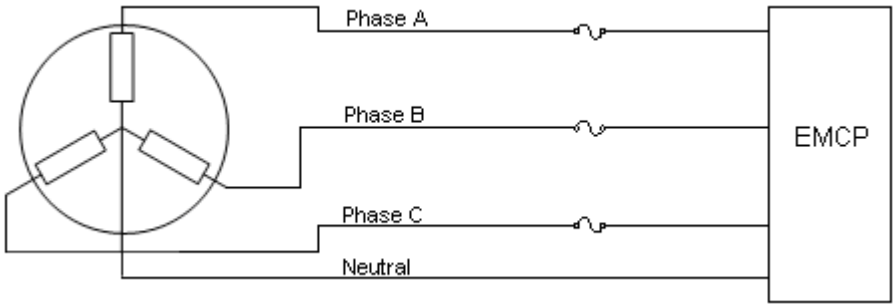


Figure 5: Three Phase Four Wire (Series Or Parallel) WYE (Star)

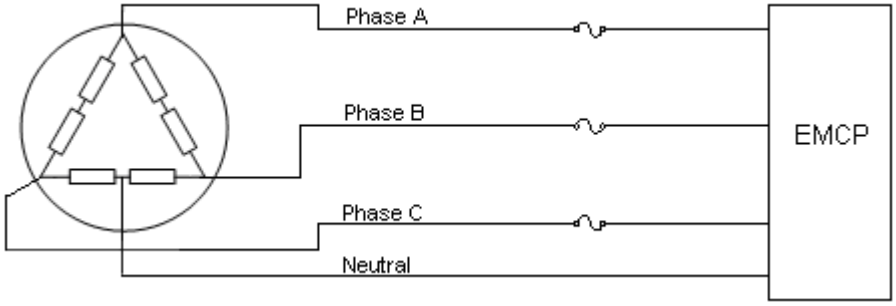


Figure 6: Three Phase Four Wire Delta

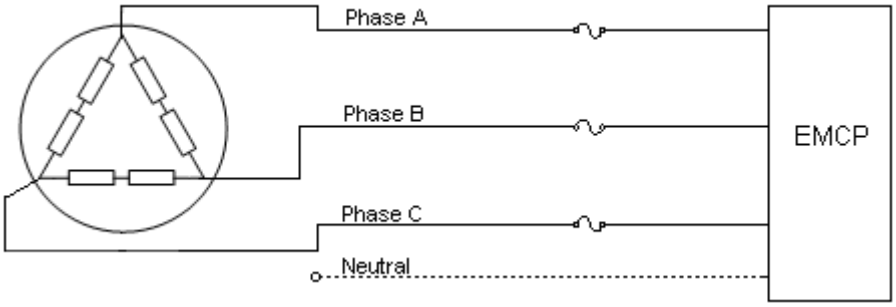


Figure 7: Three Phase Three Wire Delta

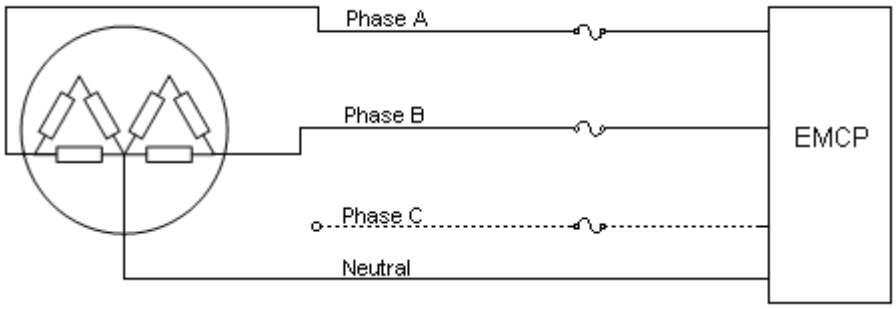


Figure 8: Single Phase Three Wire, Double Delta (Not supported with EMCP 4.4 paralleling)

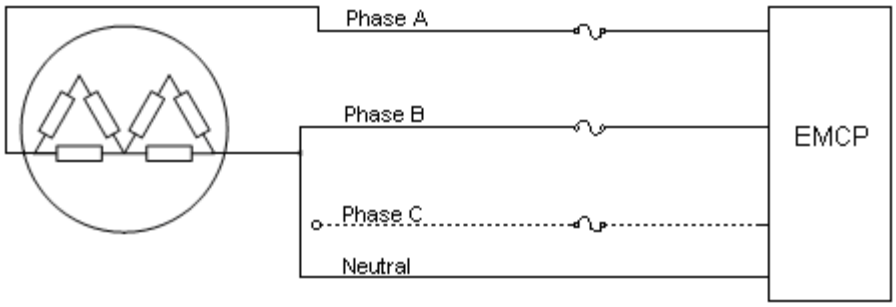


Figure 9: Single Phase Two Wire, Double Delta (Not supported with EMCP 4.4 paralleling)

3.9 TRANSFORMER CONNECTIONS

In order to monitor generator output voltages greater than 600 Volts nominal, external potential transformers must be used.

Note: The EMCP 4 must be programmed for the correct winding ratios when connecting external potential transformers. See Chapter 7, Setpoints for more information on how to program the winding ratios. If delta potential transformers are used on a WYE generator, the EMCP must be programmed for a delta generator.

Caution: The **WYE** configuration of external potential transformers is preferred for 4-wire WYE generators because of the greater accuracy when loads are unbalanced. With the open delta configuration, some power parameters can not be determined. These parameters are real power phase A, B, C and power factor phase A, B, C. For maximum accuracy, the open delta configuration of external potential transformers should be used only for 3-wire delta generators. See Table 1: Power Values Available by Generator Configuration**.**

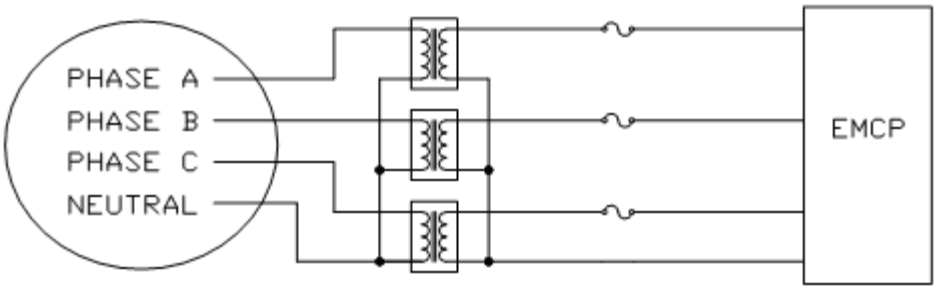


Figure 10: WYE Configuration Of External Potential Transformers (PT) on the 4-Wire WYE Connected Generator

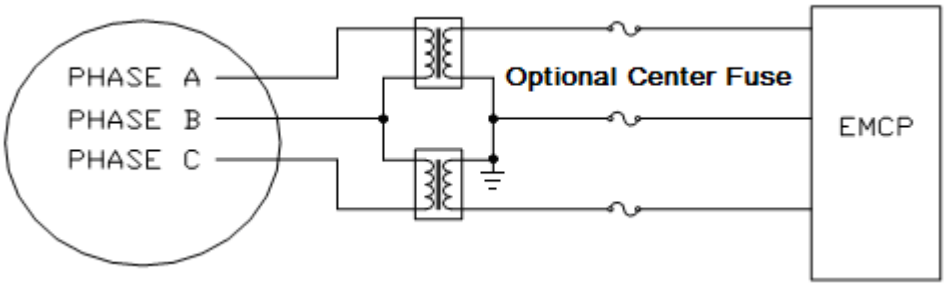


Figure 11: Open Delta Configuration Of External Potential Transformers (PT) on the 3-Wire Delta Connected Generator

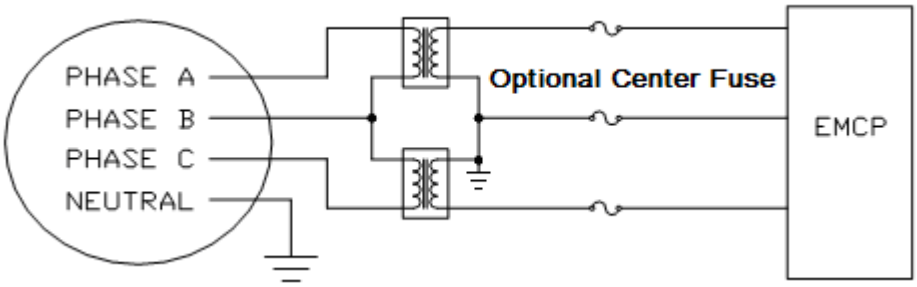


Figure 12: Open Delta Configuration Of External Potential Transformers (PT) on the 4-Wire WYE Connected Generator

TRANSFORMER CONNECTIONS					
Parameter	**STAR**	**3-WIRE DELTA**	**4-WIRE DELTA**	**2-WIRE 1-PHASE**	**3-WIRE 1-PHASE**
Gen Freq	Available	Available	Available	Available	Available
$V_{L\text{-}L\ AVG}$	Available	Available	Available	Available	Available
$V_{A\text{-}B}$	Available	Available	Available	Available	Available
$V_{B\text{-}C}$	Available	Available	Available	Not Available	Not Available
$V_{C\text{-}A}$	Available	Available	Available	Not Available	Not Available
$V_{L\text{-}N\ AVG}$	Available	Available	Available	Not Available	Available
V_A	Available	Not Available	Available	Not Available	Available
V_B	Available	Not Available	Available	Not Available	Available
V_C	Available	Not Available	Available	Not Available	Not Available
I_{AVG}	Available	Available	Available	Available	Available
I_A	Available	Available	Available	Available	Available
I_B	Available	Available	Available	Available	Available
I_C	Available	Available	Available	Not Available	Not Available

Table 1: Power Values Available by Generator Configuration

Note: Accuracy of the potential and current transformers will affect the accuracy of the voltage and current readings.

3.10 WIRING REQUIREMENTS

When selecting the type of wire to use, consideration must be given to the wire voltage drop (line loss), accuracy, communication error, and other requirements. See Table 2.

Component	Wire Size (AWG)	Type of Wire	Connections [1]
Three-Wire Sensors (When applicable. Not used on all systems)	16	Shielded twisted triad cable is recommended. For conduits inside facilities, use Belden 8618. For the engine harness, use the 4G-2556 Shielded Cable. The cable must be resistant to fuel and oil. The cable must have a temperature range from -40ºC (-40ºF) to plus 125ºC (257ºF).	Deutsch DT type of connectors are recommended. If Spring Spade or Ring Terminals are used, the connection between the terminals and the wire should be crimped and soldered.
Two-Wire Components (Magnetic Speed Sensors)	16 or 18	Shielded twisted pair cable is recommended. For conduits inside facilities, use the 123-2376 Electrical Cable or the 3E-4594 Electrical Cable. For the engine harness, use the 6V-2744 Wire. The cable must be resistant to fuel and oil. The cable must have a temperature range of -40ºC (-40ºF) to plus 125ºC (257ºF).	
Primary and Accessory Data Link cable	16 or 18	Part number 153-2707 is available for lengths of up to 200ft. The cable has a temperature range of -40ºC (-40ºF) to plus 125ºC (257ºF). For longer runs, select a cable that meets SAE J1939-11 requirements.	Deutsch DT type of connectors are recommended. If Spring Spade or Ring Terminals are used, the connection between the terminals and the wire should be crimped and soldered.
Engine Solenoids (Air Shutoff)	Multiple 14	Stranded wire normally used on engine harnesses. The cable must be resistant to fuel and oil. The cable must have a temperature range of -40ºC (-40ºF) to plus 125ºC (257ºF).	The leads of the cable should have Spring Spade Terminals or Ring Terminals. The Connection between the wire and the terminal should be crimped and soldered.
Power			
RS-485 Annunciator	14 or 16	Shielded twisted triad cable is recommended. Stranded wire normally used on engine harnesses. The cable must be resistant to fuel and oil. The cable must have a temperature range of -40ºC (-40ºF) to plus 125ºC (257ºF).	Deutsch DT type of connectors are recommended.
Ethernet Connector	18 or 20	Cat 5, Cat 5e, or Cat 6. Dual twisted pair wire maybe used to wire from the EMCP. Cat part numbers 143-2454 (20 AWG), 9X-8922 (18 AWG), or quantity of 2 of 143-5018 (18 AWG) may be suitable for this purpose. The cable must be resistant to fuel and oil. The cable must have a temperature range of -40ºC (-40ºF) to plus 125ºC (257ºF).	RJ-45 male connector

[1] The number of connections must be kept to a minimum.

Table 2: Wiring Requirements

3.11 SHIELDED AND COMMUNICATION WIRING

Shielded twisted pair cable is required for the magnetic speed sensor. CAN cable is required for Primary and Accessory CAN data links. This cable is used for maximum protection against inductive noise, electromagnetic interference, and radio frequency interference. The shield greatly reduces the amplitude of any unwanted voltages on the signal wire. The shields should not be connected to the sheet metal. If the shields are connected to sheet metal, the connections are susceptible to loose bolts, corrosion, etc. The faulty connections increase the resistance of the shield. Faulty connections also reduce the effectiveness of the shield.

Sensor shields should be brought to the EMCP if pins are allocated on the controller for that purpose. When the cable terminates at junction boxes, the shields must be connected to each other in order to maintain a continuous path. A continuous path must be maintained in the shield wire for sensors, whenever possible. Wire exposed beyond the shield should be as short as possible. When no provisions exist to incorporate the draining of the shield wire internal to the controller, the shield must be connected to battery negative as close to the controller as possible. Shields should be drained at one point only. When possible, this should be done at, or close to, the EMCP 4.

To avoid electromagnetic interference, do not run shielded signal wires near other wires carrying large currents. In installations with unavoidable risk of electromagnetic interference (EMI), shielded wire run in conduit, extra shielding, or other precautions may be necessary.

4 INITIAL OPERATION AND USER ORIENTATION

4.1 TYPES OF EVENTS

The EMCP 4 has two lamps to annunciate events. The amber lamp indicates warning-type events, while the red lamp indicates shutdown-type events. The lamps flash when new events arrive, and remain flashing (often accompanied by an audible horn) until acknowledged by pressing the acknowledge button locally or remotely. Shutdown-type events do not clear until the user fixes the condition(s) that caused the shut down and "resets" the events. The EMCP 4 supports a very large number of events, and most can be configured based on application needs. For information on viewing, resetting, and configuring events, see Chapter 5.

Note: The EMCP 4 will annunciate and display events from other modules, even if these events are not generated by the EMCP 4. These events are not logged in the EMCP itself, but are viewable from the individual module log located in the EMCP 4.

4.2 USING THE CAT SERVICE TOOL

Many of the features of the EMCP 4 system can be accessed via the Cat Service Tool. These features include viewing status data, monitoring optional modules, viewing and resetting events, and configuring setpoints.

Note: A minimum of the Cat Service Tool version 2010C is required to communicate properly with the EMCP 4. If an earlier version is used, the EMCP 4 will be grayed out.

Throughout this document, instructions for accessing a feature both via the EMCP 4 display and via the Cat Service Tool will be given. However, the Cat Service Tool also offers other unique features that are useful for site commissioning, ECM retrofitting, or troubleshooting, such as the ability to log data to a file or graph data in real-time. Such features are not in the scope of this document. For more information on the Cat Service Tool, refer to the Cat Service Tool documentation and training.

Figure 13 outlines the available EMCP 4 features that are available within the Electronic Technician software.

1. ßStatus Tool
2. Active Diagnostic Codes
3. Logged Diagnostic Codes
4. Active Event Codes
5. Logged Event Codes
6. ECM Summary
7. Configuration Tool
8. Connect/Disconnect
9. Winflash

Figure 13: Electronic Technician EMCP 4 Features

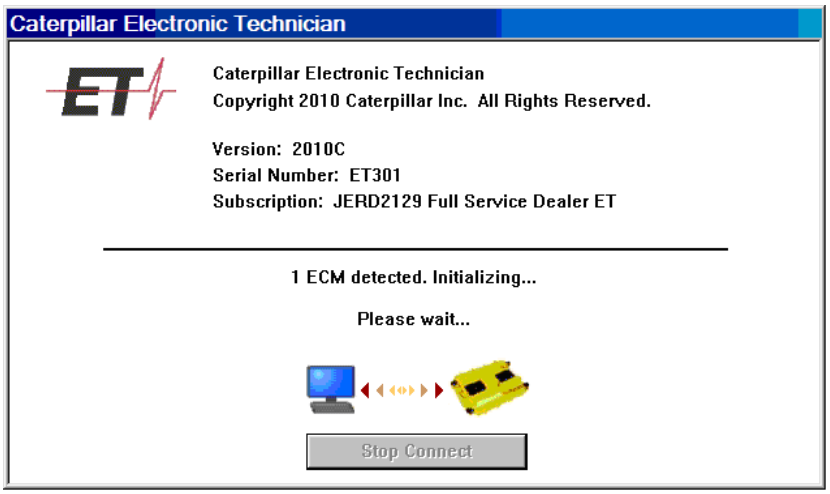
When in the Status tool, buttons to Active Codes and Events are provided at the bottom of the screen.

CONNECTING TO THE EMCP 4 TO CONFIGURE SETPOINTS

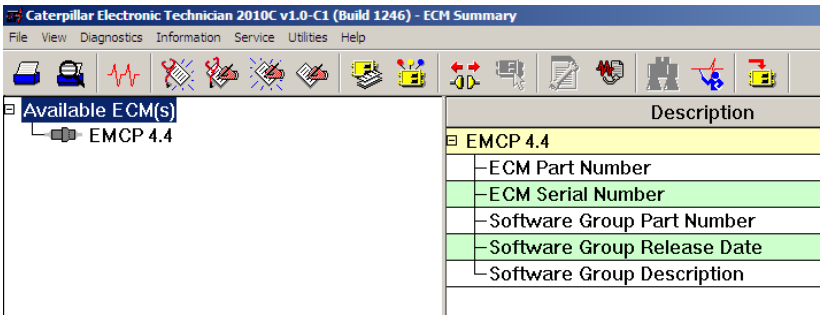
In order to use the Cat Service Tool with the EMCP and configure setpoints, do the following:

1. Connect the Service Tool to the PC and configure the port settings as appropriate.
2. Ensure the Service Tool is connected to the Primary Data Link (CAN 1).
3. Start the Electronic Technician software.

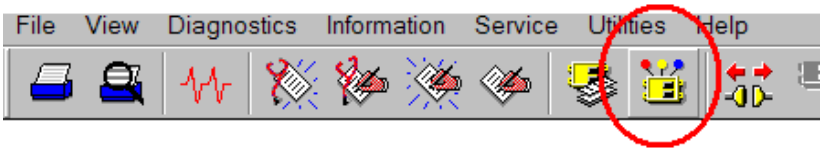
4. The software will search the data links.



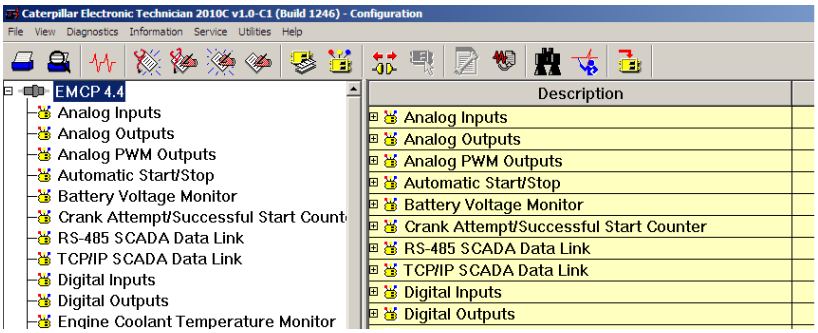
5. When the software finds the EMCP and connects to it, The ECM Summary screen will appear.



6. To view configurable parameters within the EMCP 4, press the Configuration button.



7. The parameter groups will appear.



8. Selecting a group in the left pane will show all the parameters within that group in the right pane.

4.3 VIEWING SYSTEM PARAMETERS

Many generator and engine parameters are viewable in real time from both the Cat Service Tool, and the EMCP 4 display.

FROM THE CAT SERVICE TOOL

Parameters are accessed by selecting Information > Status from the menu, or by clicking on the **STATUS TOOL** icon in the toolbar. Refer to the Cat Service Tool help from the Help > Contents menu for more information on the Status Tool.

FROM THE EMCP 4 DISPLAY

Parameters are accessed (irrespective of the current screen position) by pressing the **AC**

OVERVIEW, **ENGINE OVERVIEW**, **Main Menu**, or **Control** buttons located below the screen. Detailed screens provide even more information by pressing the **SCROLL DOWN** button from each of the overview screens. Alternately, this additional information may be accessed by pressing “Page Down” from the soft keys. For a description of the front view and navigation keys, refer to Appendix B.

The EMCP 4 parameters are organized with different levels of users in mind. These levels are as follows: View, Control, and Configure. Some of the parameters are accessible from multiple paths. For a complete menu structure, refer to Appendix A.

SUPPORTED PARAMETERS

Different revisions of the EMCP 4 support different numbers of parameters. EMCP 4.4 supports several parameters not supported on the EMCP 4.3. Some parameters are only available in certain configurations, for example, electronic engine ECMs provide more engine data than what is available from mechanical engines. The sections below list all of the parameters available, and on which level of EMCP 4 they may be available.

Parameters are displayed with units, some of which are configurable. For changing units or setting other user preferences see Section 4.4, Viewing and adjusting preferences.

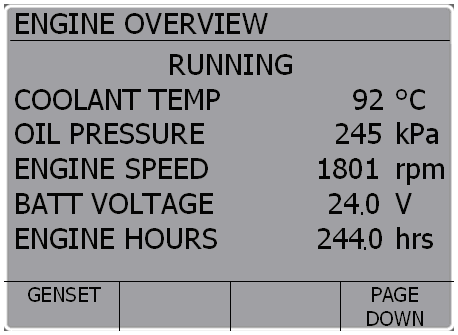
Parameters that are not available to the EMCP 4 are shown as ******** (four asterisks). This may indicate an incorrect software configuration, a wiring problem, or a problem with the sensor.

ENGINE OVERVIEW

The Engine Overview screens display various engine parameters. Soft keys provide a quick link to the Genset Overview screens and a page down button to access the remainder of the engine parameters not shown on the first screen. An additional soft key will access the Bus Overview screen (EMCP 4.4 only). The following parameters are displayed on the Engine Overview screens:

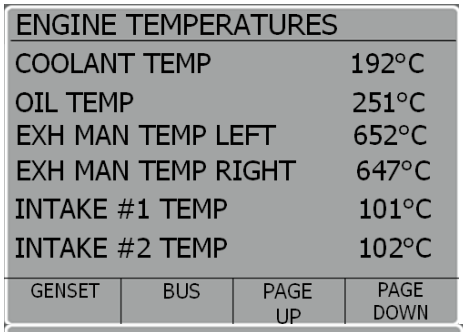
ENGINE OVERVIEW SCREEN

- Engine Operating State (Initialization, Pre-Crank, Starting, Running, Pre-Cooldown, Cooldown, Stopping, Stopped, Idling; many states are transient and only briefly active, and some states may not occur in some configurations)
- Engine Coolant Temperature
- Engine Oil Pressure
- Engine Speed
- Battery Voltage, as measured at the connector entering the EMCP 4
- Engine Operating Hours



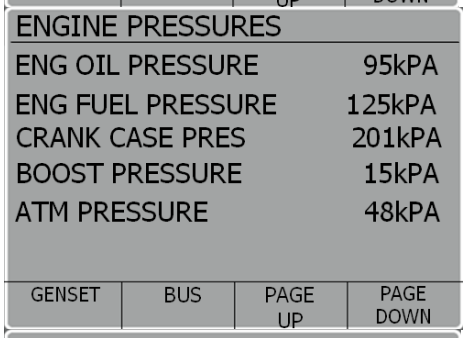
ENGINE TEMPERATURES SCREEN

- Engine Coolant Temperature
- Engine Oil Temperature
- Engine Exhaust Manifold – Left Temperature
- Engine Exhaust Manifold – Right Temperature
- Engine Intake #1 Temperature
- Engine Intake #2 Temperature



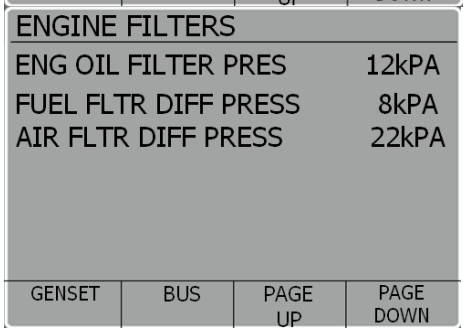
ENGINE PRESSURES SCREEN

- Engine Oil Pressure
- Engine Fuel Pressure
- Crankcase Pressure
- Boost Pressure
- ATM Pressure



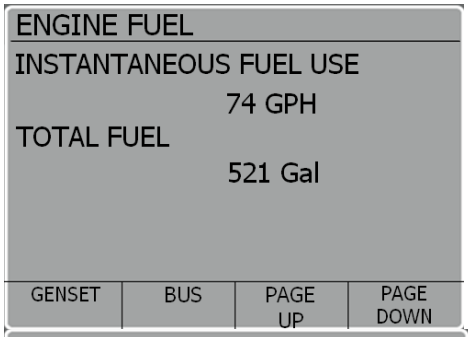
ENGINE FILTERS SCREEN

- Engine Oil Filter Pressure
- Engine Fuel Filter Differential Pressure
- Air Filter Differential Pressure



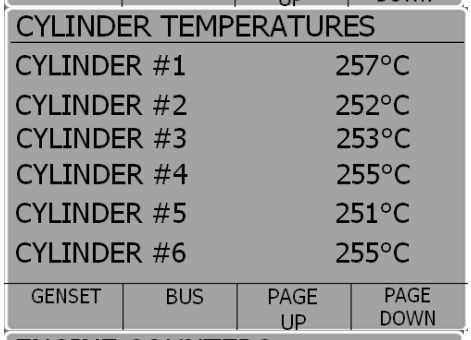
FUEL SCREEN

- Instantaneous Fuel Use
- Total Fuel



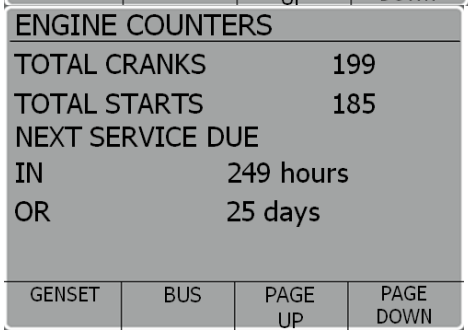
ENGINE OVERVIEW SCREEN 2 (CYLINDER TEMPERATURES)

- Cylinder #X Temperature



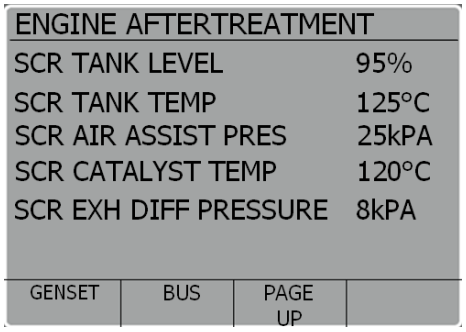
ENGINE COUNTERS SCREEN

- Total engine Cranks since last reset (a crank is defined as the number of times the starter motor switches on)
- Total engine Starts since last reset (a start is defined as the number of times the engine transitions from below the Crank Terminate speed setpoint to above it)
- Engine Hours remaining until Service Maintenance Interval expires
- Calendar Days remaining until Service Maintenance Interval expires



ENGINE AFTERTREATMENT SCREEN

- SCR Tank Level
- SCR Tank Temperature
- SCR Air Assist Pressure
- SCR Catalyst Temperature
- SCR Exhaust Differential Pressure

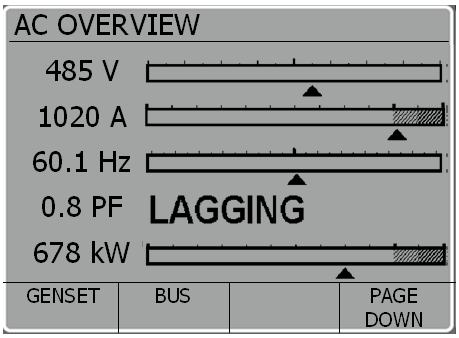


AC OVERVIEW

The AC Overview screens display various generator parameters. Soft keys provide a quick link to the Engine Overview screens, Bus Overview screens (EMCP 4.4), and a page down button to access the remainder of the engine parameters not shown on the first screen. The following parameters are displayed on the AC Overview screens:

AC OVERVIEW SCREEN

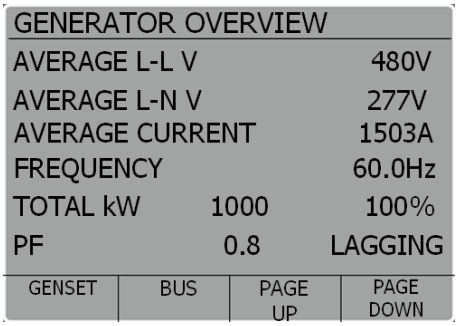
- Average Line-Line AC Voltage (numerical and graphical)
- Average Current (numerical and graphical)
- AC Frequency (numerical and graphical)
- Power Factor
- Power Factor Lead/Lag status
- Total Generator Real Power – kW (numerical and graphical)



Note: The lighter shaded area on the graph represents 100-110% of full rated, while the darker shaded area represents 110-120% of rated.

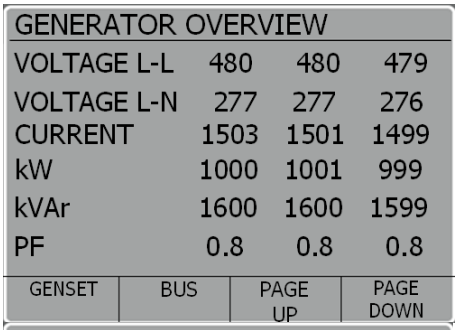
GENERATOR OVERVIEW SCREEN 1

- Average Line-Line AC Voltage
- Average Line-Neutral AC Voltage
- Average Current
- AC Frequency
- Total Generator Real Power – kW
- Percent Real Power as a percentage of Generator Rated Power
- Power Factor
- Power Factor Lead/Lag status



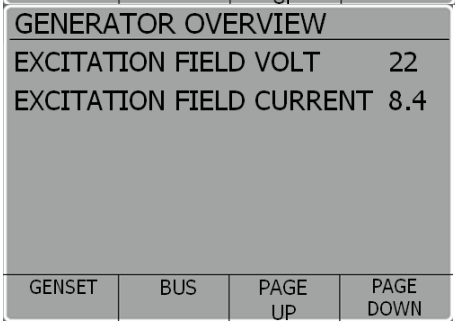
GENERATOR OVERVIEW SCREEN 2

- Line-Line Voltages: A-B, B-C, C-A
- Line-Neutral Voltages: A-N, B-N, C-N
- Phase Currents: A, B, C
- Per Phase Generator Real Power: A, B, C
- Per Phase Generator Reactive Power: A, B, C
- Per Phase Power Factor: A, B, C



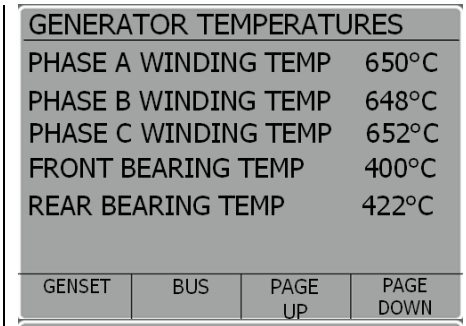
GENERATOR OVERVIEW SCREEN 3

- Generator Excitation Field Voltage
- Generator Excitation Field Current



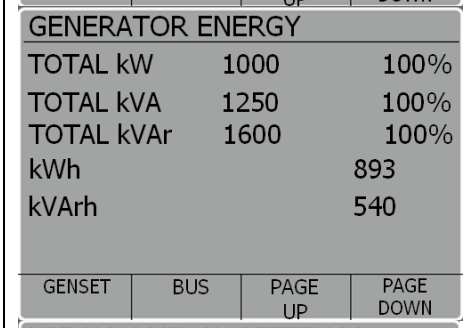
GENERATOR TEMPERATURE SCREEN

- Generator Phase A Winding Temperature
- Generator Phase B Winding Temperature
- Generator Phase C Winding Temperature
- Generator Front Bearing Temperature
- Generator Rear Bearing Temperature



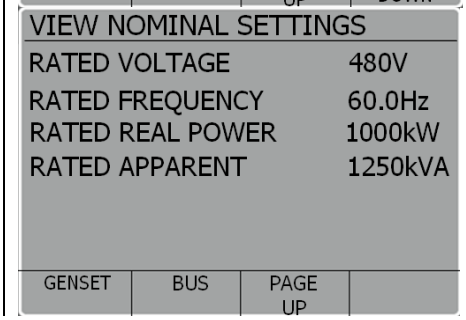
GENERATOR ENERGY SCREEN

- Total kW
- % kW
- Total kVA
- % kVA
- Total kVAr
- % kVAr



VIEW NOMINAL SETTINGS SCREEN

- Rated Voltage
- Rated Frequency
- Rated Real Power
- Rated Apparent Power

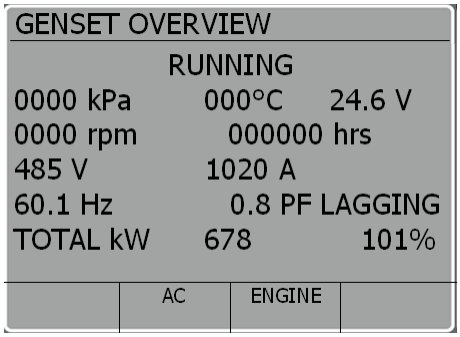


GENSET OVERVIEW

The Genset Overview screen displays a combination of engine and generator parameters on one convenient screen. Soft keys provide quick links to the AC Overview and Engine Overview screens. The following parameters are displayed on the Genset Overview screen:

GENSET OVERVIEW

- Engine Operating State (Initialization, Pre-Crank, Starting, Running, Pre-Cooldown, Cooldown, Stopping, Stopped, Idling; many states are transient and only briefly active, and some states may not occur in some configurations)
- Engine Oil Pressure
- Engine Coolant Temperature
- Battery Voltage, as measured at the connector entering the EMCP 4
- Engine Speed
- Engine Operating Hours
- Average Line-Line AC Voltage
- Average Current
- AC Frequency
- Power Factor
- Power Factor Lead/Lag status
- Total Generator Real Power – kW
- Percent Real Power – as a percent of Generator Rated Power setpoint

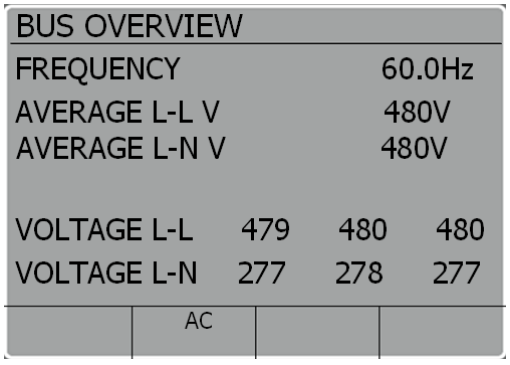


BUS OVERVIEW (EMCP 4.4 ONLY)

The Bus Overview screens display various bus parameters. A soft key provides a quick link to the AC Overview screen. The following parameters are displayed on the Bus Overview screens:

BUS OVERVIEW SCREEN

- Bus AC Frequency
- Average Bus Line-Line AC Voltage
- Average Bus Line-Neutral AC Voltage
- Bus Line-Line Voltages: A-B, B-C, C-A
- Bus Line-Neutral Voltages: A-N, B-N, C-N



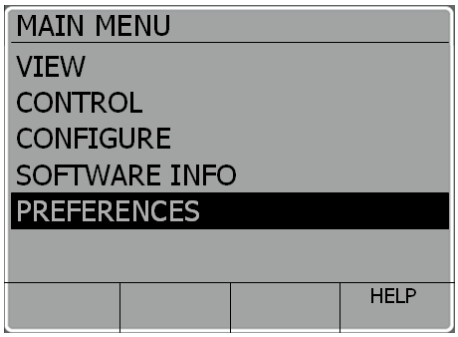
4.4 VIEWING AND ADJUSTING PREFERENCES

The EMCP 4 display can be used for monitoring the generator status, viewing and resetting events, and configuring setpoints. There are several preferences to alter how you view the data on the display. These include: display contrast, units used to display pressure, units used to display temperature, units used to display volume, circuit breaker symbol (EMCP 4.4 only), and displayed language (to select between the customer language and Technician English).

Note: These preferences do not affect operation of the EMCP 4 or the data as viewed in the Cat Service Tool. They only affect how the text and data is converted and displayed on the EMCP 4 display.

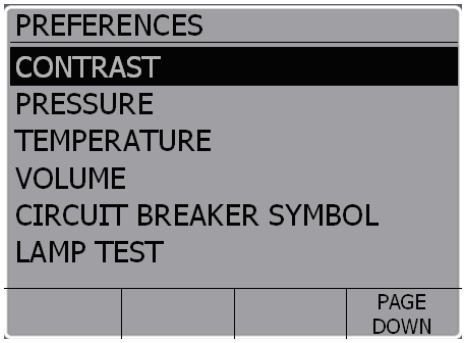
SETTING THE PREFERENCES USING THE EMCP 4 DISPLAY

On the EMCP 4 display, the Preferences menu is located at the bottom of the Main Menu.



For any preference, press **OK KEY** 

to accept the change (or **ESCAPE KEY**  to reject the change) and return to the Preferences menu.



PREFERENCES

CONTRAST This determines the darkness of the pixels on the display. A minimum contrast setting (reached by pressing and holding the down or left arrow) effectively blanks the screen, and a maximum contrast setting (reached by pressing and holding the up or right arrow) effectively darkens the entire screen. To change the contrast if the screen is unreadable due to a misconfiguration or ambient conditions, see **CHANGING THE EMCP 4 CONTRAST WHEN THE DISPLAY IS UNREADABLE**.

PRESSURE This allows pressure parameters (such as Engine Oil Pressure) and setpoints (such as Low Engine Oil Pressure Event Threshold) to be shown in either kPa, psi, or bar. Select the desired unit with the up or down arrows, or the Function keys.

TEMPERATURE This allows temperature parameters (such as Engine Coolant Temperature) and setpoints (such High Engine Coolant Temperature Event Threshold) to be shown in either Celsius (Centigrade) or degrees Fahrenheit. Select the desired unit with the up or down arrows, or the Function keys.

VOLUME This allows volume parameters (such as Fuel Volume) to be shown in Liters, Imperial Gallons, or US Gallons. Select the desired unit with the up or down arrows, or the Function keys.

CIRCUIT BREAKER SYMBOL (EMCP 4.4 only) This allows the graphic for the circuit breaker to be either the ISO symbol, or the US symbol. Select the desired symbol with the left or right arrows.

LAMP TEST

When this selection is highlighted, pressing and holding the **OK KEY** 

will darken all pixels on the screen and illuminate all LEDs on the face of the controller.

LANGUAGE This allows the display to be switched between Technician English (always listed first) and the customer language (always listed second, and written in the font of the customer language). The below example shows the language selection in the German language flash file. Select the desired language with the up or down arrows. To change the language to Technician English, regardless of the current screen, and without needing to read the text, see **CHANGING THE EMCP 4 DISPLAY TO TECHNICIAN ENGLISH**.

The **LANGUAGE** setting has been conveniently located at the bottom of the Preferences menu, which is at the bottom of the Main Menu.

CHANGING THE EMCP 4 CONTRAST WHEN THE DISPLAY IS UNREADABLE

1. Press the **MAIN MENU**  key
2. Scroll **DOWN**  until scrolling stops
3. Press the **OK KEY**  (this will take you into the Preferences Menu)
4. Press the **OK KEY**  again (this will take you into the Contrast selection)
5. Press and hold either **LEFT ARROW**  or **RIGHT ARROW**  until the text and graphics become visible
6. Press the **OK KEY**  to accept the adjustment

CHANGING THE EMCP 4 DISPLAY TO TECHNICIAN ENGLISH

1. Press the **MAIN MENU**  key
2. **SCROLL DOWN**  until the scrolling stops
3. Press the **OK KEY**  (this will take you into the Preferences Menu)
4. **SCROLL DOWN**  until the scrolling stops
5. Press the **OK KEY**  (this will take you into the Language selection)
6. Press the **UP ARROW**  key until the scrolling stops
7. Press the **OK KEY**  to select **TECHNICIAN ENGLISH**

The EMCP 4 language setting is changed back to **TECHNICIAN ENGLISH**.

Similar steps can be followed by a customer who is unfamiliar with English, to change the language setting back to their primary language:

CHANGING THE EMCP 4 DISPLAY TO THE PRIMARY LANGUAGE

1. Press the **MAIN MENU** key
2. **SCROLL DOWN** until the scrolling stops
3. Press the **OK KEY** (this will take you into the Preferences Menu)
4. **SCROLL DOWN** until the scrolling stops
5. Press the **OK KEY** (this will take you into the language selection)
6. Press the **SCROLL DOWN** arrow to select the customer language
7. Press the **OK KEY** to change to the customer language

The EMCP 4 language setting is changed back to the customer language.

SETTING THE PREFERENCES USING THE SERVICE TOOL

Only the preferences for units can be configured using the Cat Service Tool. They are located in the Configuration Tool. Select Display Preferences from the left panel.

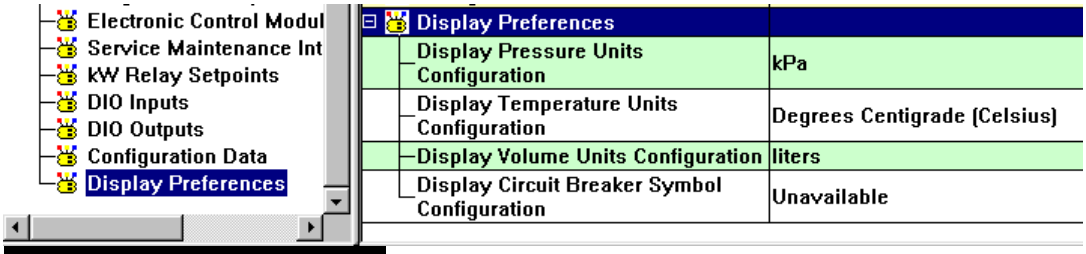


Figure 14: Display Preferences

The display units can be changed the same way other setpoints are changed with the Service Tool.

PRESSURE This allows pressure parameters (such as Engine Oil Pressure) and setpoints (such as Low Engine Oil Pressure Event Threshold) to be shown in either kPa, psi, or bar.

TEMPERATURE This allows temperature parameters (such as Engine Coolant Temperature) and setpoints (such High Engine Coolant Temperature Event Threshold) to be shown in either Celsius (Centigrade) or degrees Fahrenheit.

VOLUME This allows volume parameters (such as Fuel Volume) to be shown in either Liters, Imperial Gallons, or US Gallons.

CIRCUIT BREAKER SYMBOL (EMCP 4.4 ONLY) This allows a choice of graphics for the circuit breaker symbol for various display screens.

4.5 CONFIGURING TIME/DATE

The EMCP 4.3 and 4.4 have an internal Real Time clock that is used for time-stamping events, Programmable Cycle Timer (Chapter 16), and the Status Log (Chapter 5). The timestamps for the last date and time an event has occurred and the first date and time the event has occurred are viewed by selecting a module in the Event Log and pressing the OK key. See Figure 15.

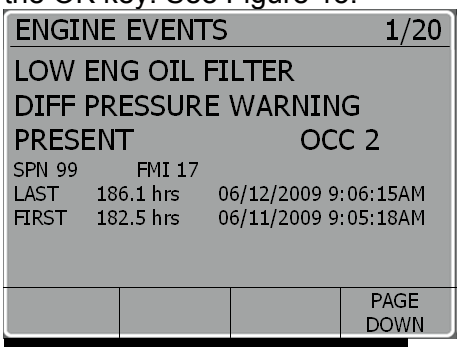


Figure 15: Event Details Screens

CHANGING THE TIME / DATE

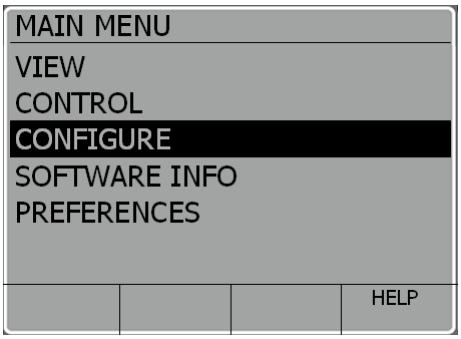
The EMCP 4 clock allows the time/date to be modified. Changing the time/date will change the timestamp on all future events, but not for existing events. (For example, an event that has occurred previously will still show the same FIRST time/date, but if it occurs again after the time/date has been adjusted, the LAST time/date will reflect the change.)

This procedure must be performed on the EMCP 4 display; it cannot be done using the Cat Service Tool. In order to update time/date, **LEVEL 1 ACCESS** is required. Refer to Chapter 6, Security for information on obtaining **LEVEL 1 ACCESS**.

To change the time/date, do the following:

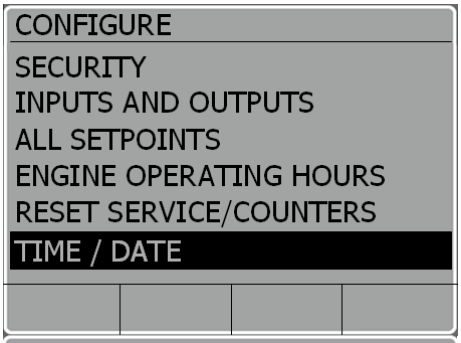
At **MAIN MENU** scroll **DOWN** to **CONFIGURE.**

Press the **OK KEY**.

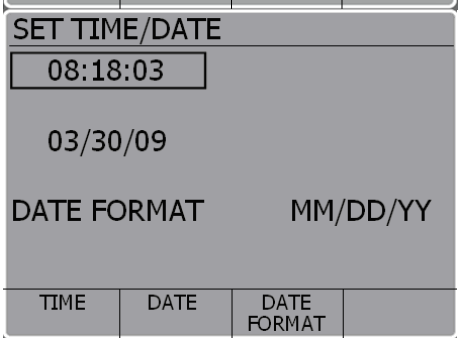


Scroll **DOWN** to **TIME/DATE.**

Press the **OK KEY**.



To begin editing the time, press the **OK KEY** while the current time is selected.



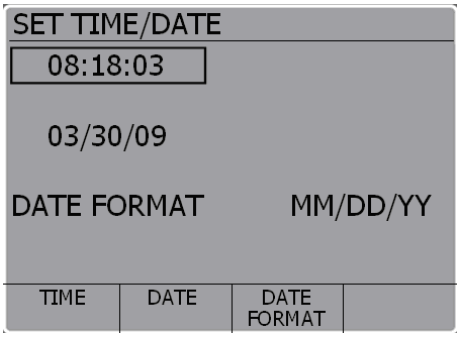
Select a digit using the **LEFT ARROW** or **RIGHT ARROW**

To change the selected digit use the **UP ARROW** or **DOWN ARROW**

To accept changes, press the **OK KEY**. To reject changes, press the **ESCAPE KEY**.

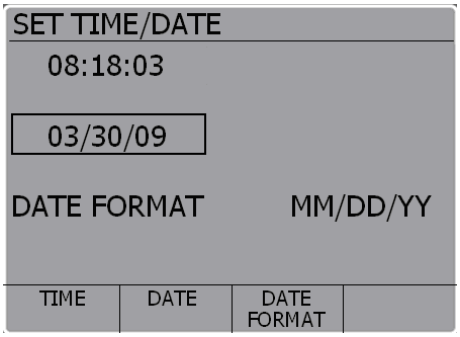
TO CHANGE THE DATE FROM THIS POINT

Press the **ESCAPE KEY** again to return to the **SET TIME/DATE** screen.



Press the **DOWN ARROW** key to put the box around the date.

Alternately, pressing the DATE softkey from the Set Time screen will bring up this screen



To begin editing the date, press the **OK KEY** while the current date is selected.

Select a digit using the **LEFT ARROW** or **RIGHT ARROW**.

To change the selected digit use the **UP ARROW** or **DOWN ARROW**.

To accept changes, press the **OK KEY**. To reject changes, press the **ESCAPE KEY**.

CHANGING DATE FORMAT

The data format can be set to either display in the form Month/Day/Year or the form Day/Month/Year. This procedure must be performed on the EMCP 4 display; it cannot be done using the Cat Service Tool.

Note: This preference does not affect operation of the EMCP 4 or the data as viewed in the Cat Service Tool. It only affects how the date is displayed on the EMCP 4 display and the format of the event time stamps.

To change the date format, do the following:

At **MAIN MENU** scroll **DOWN** to **CONFIGURE.**

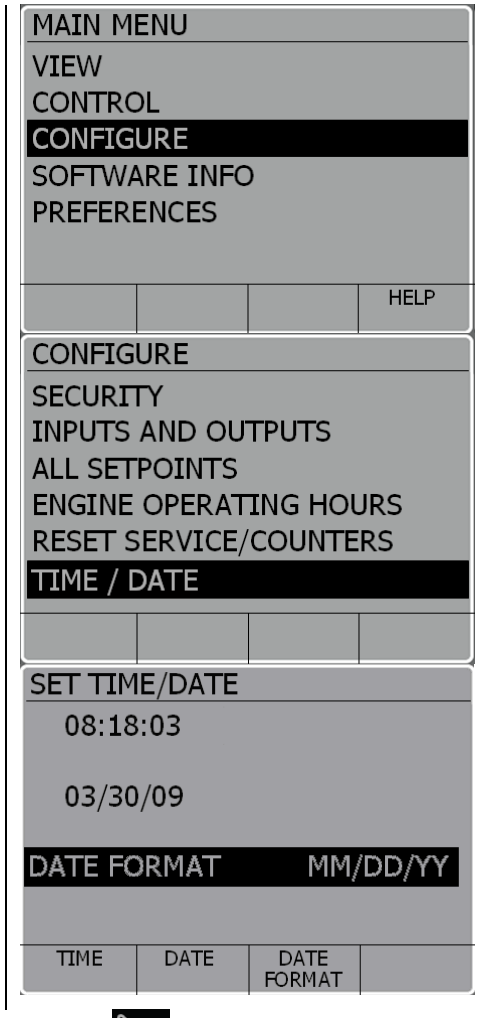
Press the **OK KEY**.

SCROLL DOWN to **TIME/DATE.**

Press the **OK KEY**.

Press the **DOWN ARROW** key to highlight the date format.

Press the **OK KEY**.



Select the format using the **LEFT ARROW** or **RIGHT ARROW** or soft keys, then press the **OK KEY** to accept, or the **ESCAPE KEY** to reject, the change.

4.6 ADJUSTING GENERATOR SET PARAMETERS

On many gensets, the engine speed, generator output voltage, and idle/rated status can be adjusted from the display of the EMCP 4. This ability is dependent upon the engine interface strategy and input/output configuration.

GENERATOR OUTPUT VOLTAGE

If the genset is equipped with a Cat Digital Voltage Regulator (Cat DVR), then the generator output voltage setpoint can be adjusted from the display of the EMCP 4, provided the Cat DVR is programmed to allow this control. In order for the **VOLTAGE ADJUST** to work via CAN, the **AVR VOLTAGE CONTROL DESIRED INPUT CONFIGURATION** setpoint in the Cat DVR must be programmed for **CAN INPUT**. If that setpoint is set to **SWITCH**, the **VOLTAGE CONTROL** from the EMCP 4 will **NOT WORK**.

ENGINE SPEED

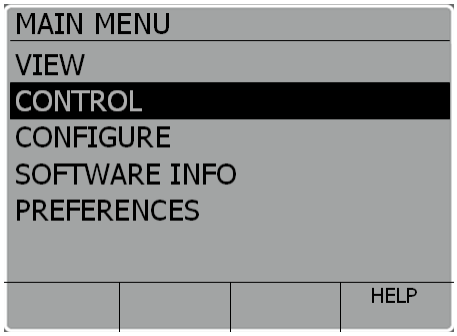
If the genset is equipped with an ADEM A3 or A4 governor, then the engine speed setpoint can be adjusted from the display of the EMCP 4, provided the A3 is programmed to allow this control. In order for the **SPEED ADJUST** to work via CAN, the **DESIRED THROTTLE INPUT CONFIGURATION** setpoint in the A3 or A4 must be programmed for **CAN INPUT**. If that setpoint is set to **PWM**, the **SPEED CONTROL** from the EMCP 4 will **NOT WORK**.

PROGRAMMING THE GENERATOR OUTPUT VOLTAGE AND ENGINE SPEED

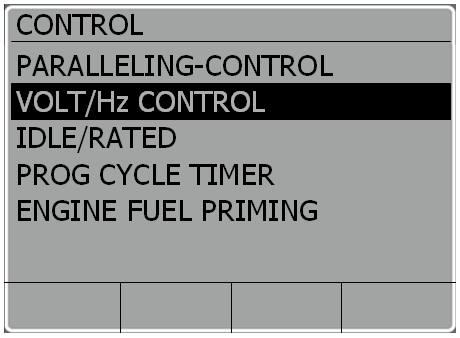
From the **MAIN MENU** select **CONTROL.**

Press the **OK KEY** 

.

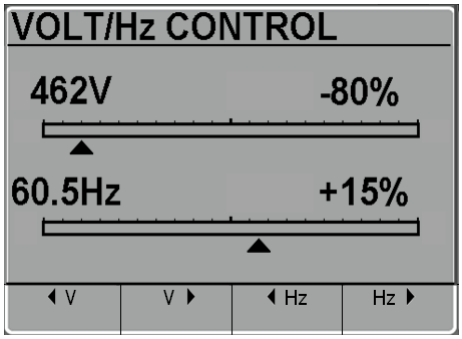


From the **CONTROL MENU**, select **VOLT/HZ CONTROL.**



Press the **OK KEY** 

.
The speed and voltage adjust screen will be displayed. The small arrow below the bar indicates the value of voltage or speed relative to the setpoint. Numerical values, along with percentages away from the setpoints, are also shown for reference.



To adjust the generator voltage from this screen:

Press the **F1 KEY** 

to **DECREASE** the generator voltage.

Press the **F2 KEY** 

to **INCREASE** the generator voltage.

To adjust the engine speed from this screen:

Press the **F3 KEY** 

to **DECREASE** the engine speed.

Press the **F4 KEY** 

to **INCREASE** the engine speed.

The EMCP 4 will broadcast an engine speed bias based on the adjustment that is made. When the engine speed is adjusted, then that value will remain until either it is adjusted again or until the control is power-cycled.

For the EMCP 4.3, if an Analog or Digital Input is programmed for desired engine speed, this can affect the desired engine speed along with the Function keys. If the EMPC 4.3 is power cycled, then any bias made by a Digital Input, or change from the Function keys will not be saved. However, the bias from the analog input will be there when it powers back up.

For the EMCP 4.4, if the controller is in Auto, the Sync Mode Switch is in Check, or the circuit breaker is closed (in Load Share or Load Control mode), then the Function keys, Digital and Analog Inputs programmed for desired engine speed will not affect engine speed. If the EMCP 4.4 is in Manual mode with the CB open, or if the Sync Mode Switch is in the Off position, then the desired engine speed works just like the EMCP 4.3.

Unlike the setpoints or preferences (i.e. contrast), any changes to this screen take effect immediately. The **OK KEY** 

and **ESCAPE KEY**  do not serve to accept or cancel changes.

IDLE/RATED

The EMCP 4.3 and EMCP 4.4 both have the ability to be placed into Idle mode via the display, a Discrete Input, or through the SCADA Data Link. With some genset systems, the ADEM governor may also send the EMCP into Idle mode when the ADEM is operating in Idle mode. Idle mode will disable Under Speed, Under Voltage, and Under Frequency protections in the EMCP 4.

Note: The Engine Forced Idle Feature Enable Status parameter must be set to "Enabled" within Cat ET prior to seeing this menu option on the display. This setpoint is under the Automatic Start/Stop submenu in Cat ET.

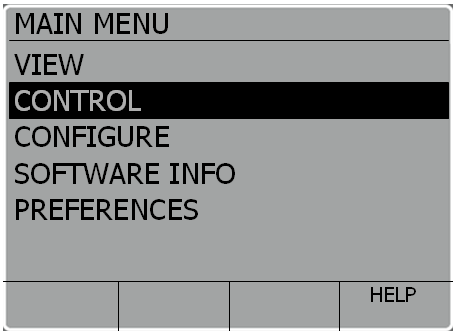
When the EMCP 4 is placed in Idle mode, a programmable output may be programmed and wired to signal that it is operating in Idle. In some wiring configurations, the EMCP will also send a signal via the Primary CAN Data Link to the ADEM. If an Analog Output on the EMCP is sending the desired speed signal to the engine governor, then when the programmable output gives an Idle command, the desired engine speed signal will not change on the Analog Output when the Idle command is removed.

The engine speed can be toggled between **LOW IDLE** and **RATED SPEED** from the display of the control as follows:

From the **MAIN MENU** select **CONTROL.**

Press the **OK KEY** 

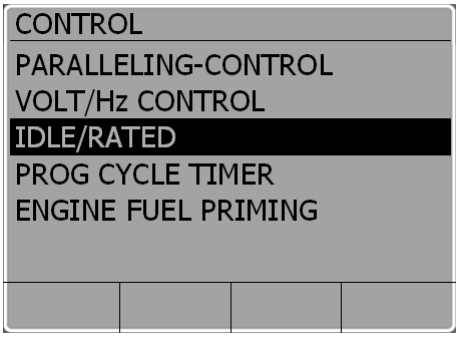
.



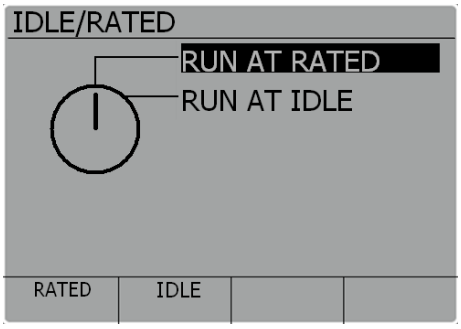
From the **CONTROL MENU** select **IDLE/RATED.**

Press the **OK KEY** 

.



The **IDLE/RATED** screen will be displayed and the current state will be shown.



Press the **UP ARROW** or **DOWN ARROW** or the soft keys to change the state.

Press the **OK KEY**.

ENGINE SENSOR VERSUS DATA LINK

The Engine Oil Pressure and Engine Coolant Temperature setpoints need special care when programming. These can be configured as either SENSOR or DATA LINK.

Note: The Engine Forced Idle Feature Enable Status parameter must be set to "Enabled" within Cat ET prior to seeing this menu option on the display. This setpoint is under the Automatic Start/Stop submenu in Cat ET.

When SENSOR is configured, the physical sensor is connected directly to the EMCP 4. In this configuration, Analog Inputs are configured with the desired setpoints for the rated speed warnings and shutdowns. The idle setpoints are still configured under the Engine Oil Pressure Monitor.

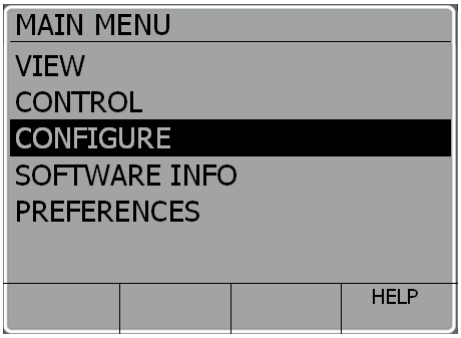
When DATA LINK is configured, the physical sensors are connected to the engine ECM. The engine ECM is configured with setpoints to protect the engine. Sensor values may also be communicated to the EMCP over the data link. The EMCP allows for redundant setpoints to be assigned based on this information seen from the engine.

TO CONFIGURE THE CONTROLLER AS SENSOR OR DATA LINK USING THE DISPLAY:

At **MAIN MENU SCROLL**

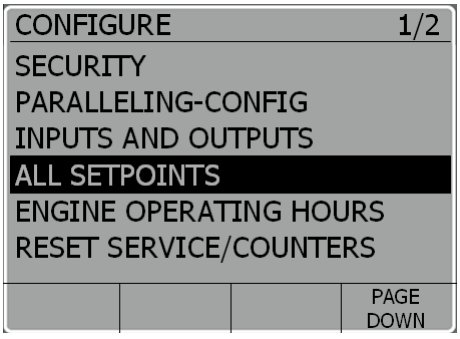
SCROLL DOWN to **CONFIGURE**

Press the **OK KEY**.



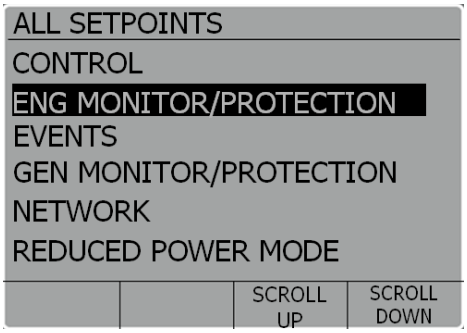
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



SCROLL DOWN to **ENG MONITOR/PROTECT.**

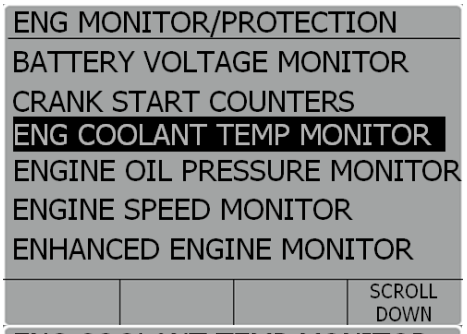
Press the **OK KEY**.



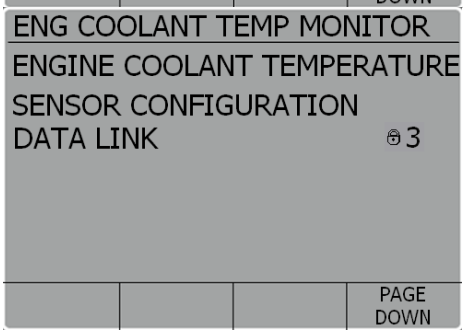
SCROLL DOWN to **ENG COOL TEMP MON OR ENG OIL PRES MON.**

Press the **OK KEY**.

Note: Level 3 password is required.



Press the **OK KEY**.

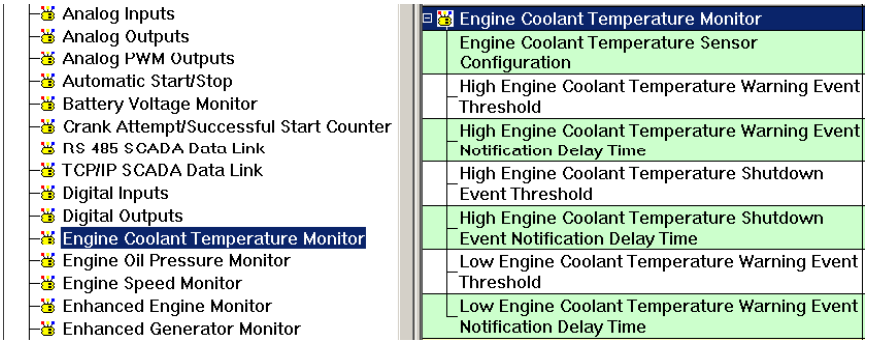


To change the selection use the **UP ARROW** or **DOWN ARROW**.

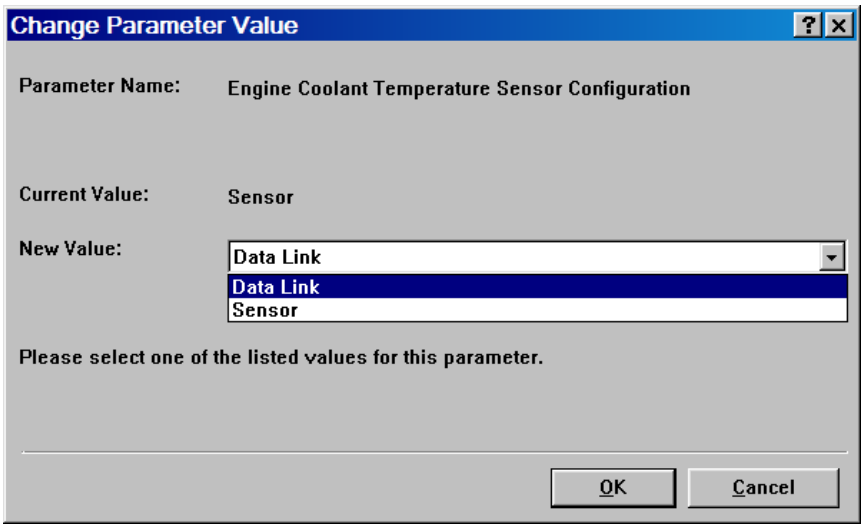
Press the **OK KEY**.

TO CONFIGURE THE CONTROLLER AS SENSOR OR DATA LINK USING CAT ET:

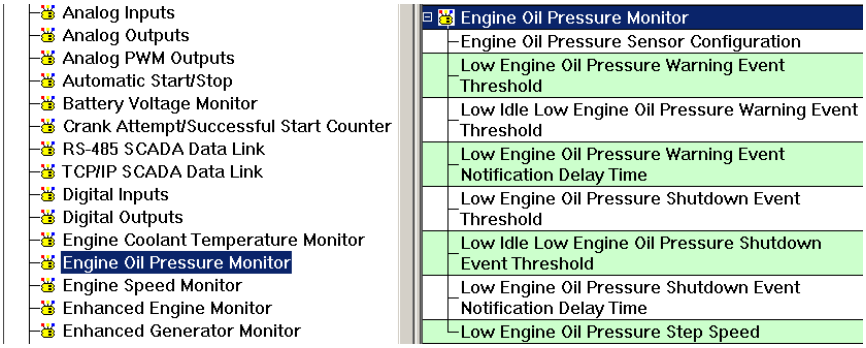
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Engine Coolant Temperature Monitor on the left.



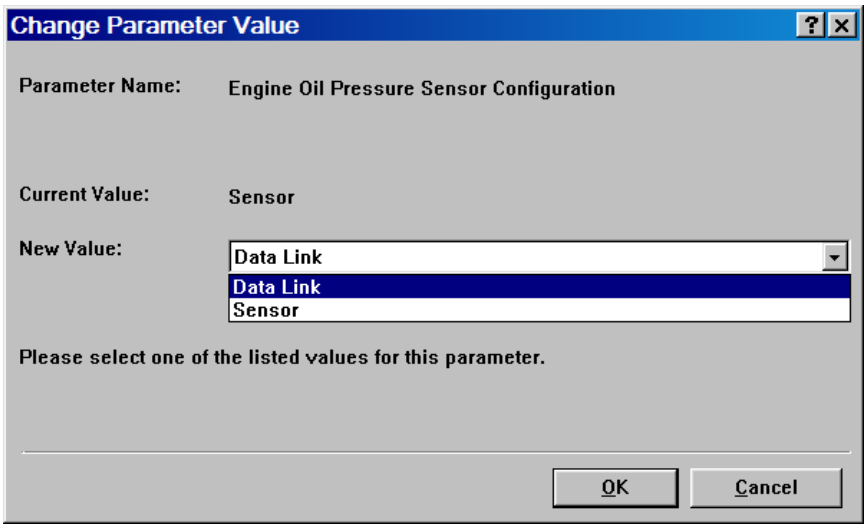
3. Double click the Engine Coolant Temperature Sensor Configuration setpoint to change this value from the drop down menu. Click the OK button to program.



4. Select Engine Oil Pressure Monitor on the left.



5. Double click the Engine Oil Pressure Sensor Configuration setpoint to change this value from the drop down menu. Click the OK button to program.



ENGINE OIL PRESSURE

The Engine Oil Pressure setpoints need special care when programming. The first step is to set the configuration as either SENSOR or DATA LINK.

When SENSOR is configured, the physical sensor is connected directly to the EMCP 4. In this configuration, Analog Input #1 (normally used for Oil Pressure Sensor) is configured with the desired setpoints for the rated speed Oil Pressure warnings and shutdowns. The idle speed step and idle oil pressure setpoints are still configured under the Engine Oil Pressure Monitor.

When DATA LINK is configured, the physical sensor is connected to the engine ECM. The engine ECM is configured with setpoints to protect the engine. Sensor values may also be communicated to the EMCP over the data link. The EMCP allows for redundant setpoints to be assigned based on this information seen from the engine.

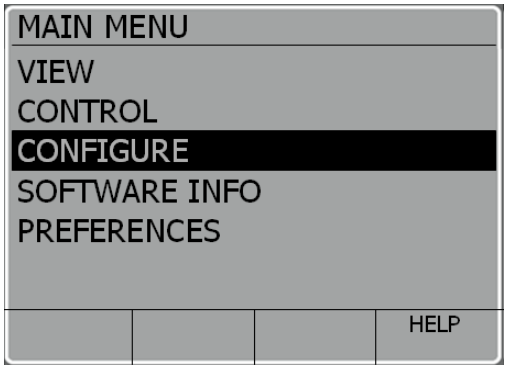
SENSOR CONFIGURATION

In SENSOR configuration, Analog Input #1 contains the parameters for warnings and shutdowns for High and Low OIL PRESSURE. Security Level 3 is required to program Analog Input #1.

TO CONFIGURE ANALOG INPUT #1 FOR ENGINE OIL PRESSURE:

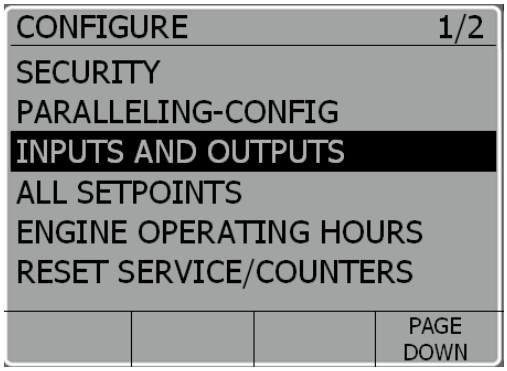
AT THE MAIN MENU, scroll down  to **CONFIGURE**

Press the **OK KEY**  .



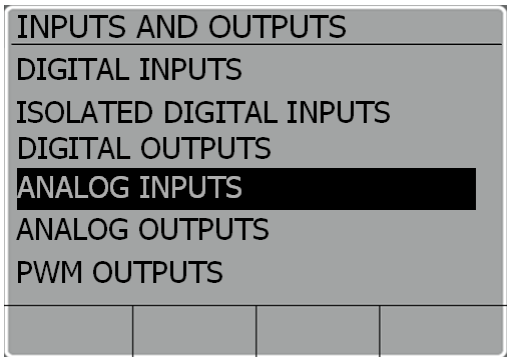
SCROLL DOWN  to **INPUTS & OUTPUTS**

Press the **OK KEY**  .



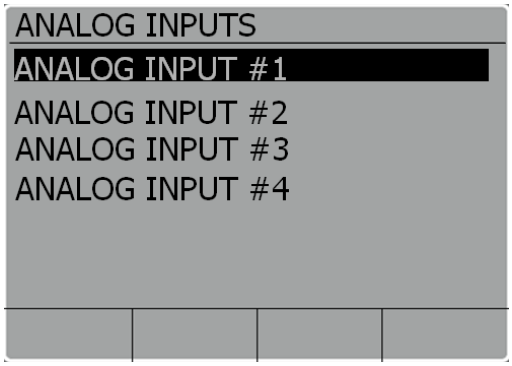
SCROLL DOWN  to **ANALOG INPUTS**

Press the **OK KEY**  .
Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

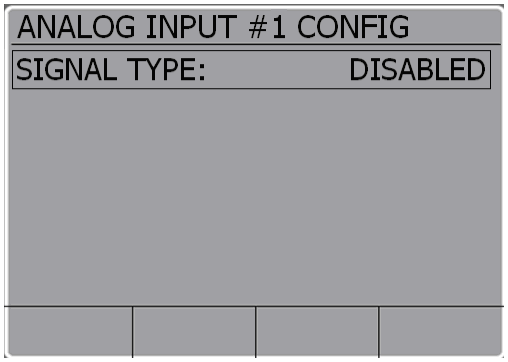


Select the **ANALOG INPUT #1.**

Press the **OK KEY**  .

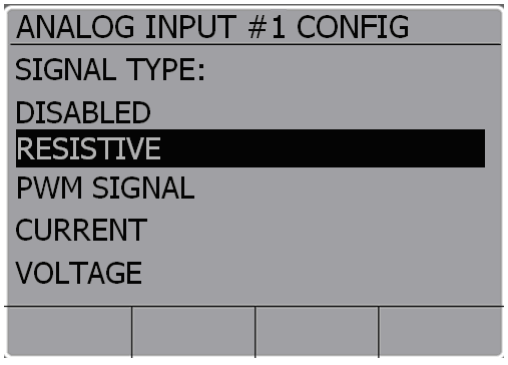


Press the **OK KEY**  to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE)**.



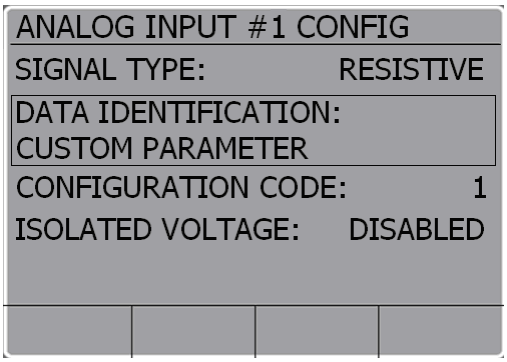
Scroll **DOWN**  to **RESISTIVE**

Press the **OK KEY**  .



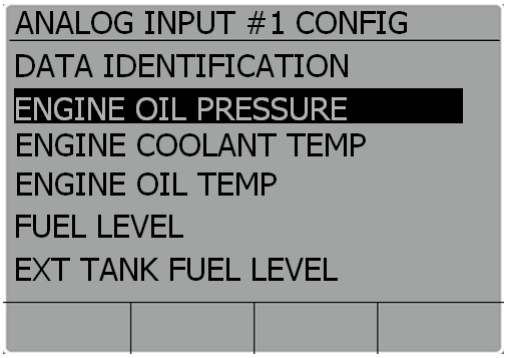
Scroll **DOWN**  to **DATA IDENTIFICATION**

Press the **OK KEY**  to change the current **DATA IDENTIFICATION.**



Select the **DATA IDENTIFICATION** to ENG OIL PRES.

Press the **OK KEY**  .



Scroll **DOWN**  to configure the remaining setpoints for Analog Input #1:

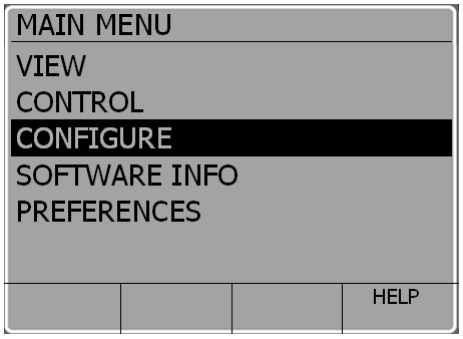
- Map Selection Number
- Low Warning Threshold
- Low Warning Delay
- Low Warning Event Response
- Low S/D Threshold
- Low S/D Delay
- Low S/D Event Response
- Isolated Supply Voltage

In addition to the setpoints for high and low Oil Pressure available in Analog Input #1, setpoints for LOW IDLE LOW OIL PRESSURE and STEP SPEED are also available in the ENG MONITOR/PROTECT menu.

TO CONFIGURE THESE SETPOINTS:
At **MAIN MENU SCROLL**

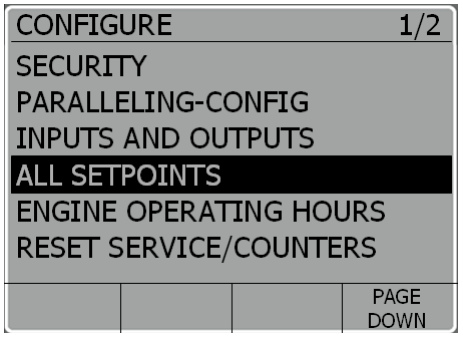
SCROLL DOWN to **CONFIGURE**

Press the **OK KEY**.



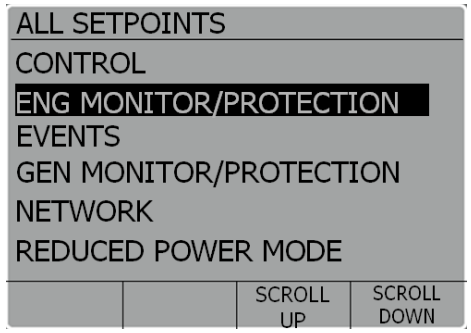
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



SCROLL DOWN to **ENG MONITOR/PROTECT.**

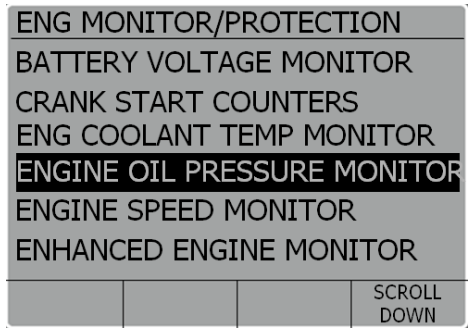
Press the **OK KEY**.



SCROLL DOWN to **ENG OIL PRES MON.**

Press the **OK KEY**

Note: Level 3 password is required.



Scroll **DOWN** to configure the remaining setpoints for Engine Oil Pressure Monitor:

- Low Eng Oil Pressure Warning Threshold
- Low Idle Low Eng Oil Pres Warn Threshold
- Low Eng Oil Pressure Warning Delay Time
- Low Eng Oil Pressure Shutdown Threshold
- Low Idle Low Eng Oil Pres S/D Threshold
- Low Eng Oil Pressure Shutdown Delay Time
- Low Engine Oil Pressure Step Speed

Note: All DATA LINK OIL PRESSURE setpoints in this menu are inactive when in SENSOR configuration. They are labeled as DATA LINK to refer to the fact they are only active when the DATA LINK configuration is chosen.

DATA LINK

The OIL PRESSURE setpoints when in the DATA LINK configuration are redundant to the primary protection provided by the engine ECM. If these protections are not programmed to match those in the ADEM and an event occurs, check the Event Logs to determine which module generated the event.

ENGINE COOLANT TEMPERATURE

The Engine Coolant Temperature setpoints need special care when programming. The first step is to set the configuration as either SENSOR or DATA LINK.

When SENSOR is configured, the physical sensor is connected directly to the EMCP. In this configuration, Analog Input #2 (normally used for Coolant Temperature) is configured with the desired setpoints for Coolant Temperature warnings and shutdowns.

When DATA LINK is configured, the physical sensor is connected to the engine ECM. The engine ECM is configured with setpoints to protect the engine. Sensor values may also be communicated to the EMCP over the data link. The EMCP allows for redundant setpoints to be assigned based on this information seen from the engine.

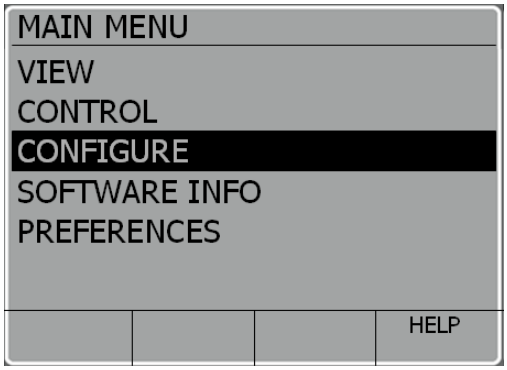
SENSOR CONFIGURATION

In SENSOR configuration, Analog Input #2 is contains the configurations for alarms and shutdowns for High and Low COOLANT TEMPERATURE. Security Level 3 is required to program Analog Input #2.

TO CONFIGURE ANALOG INPUT #2 FOR ENGINE COOLANT TEMPERATURE:

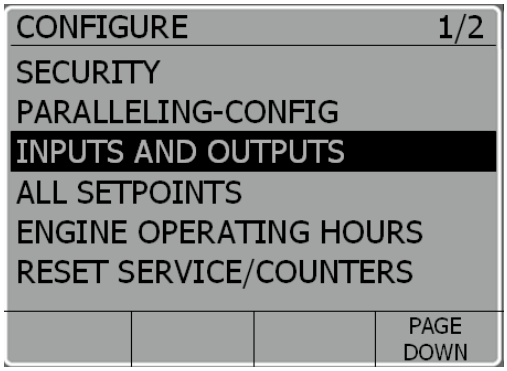
AT THE MAIN MENU, scroll down  to **CONFIGURE**

Press the **OK KEY**  **.**



SCROLL DOWN  to **INPUTS & OUTPUTS**

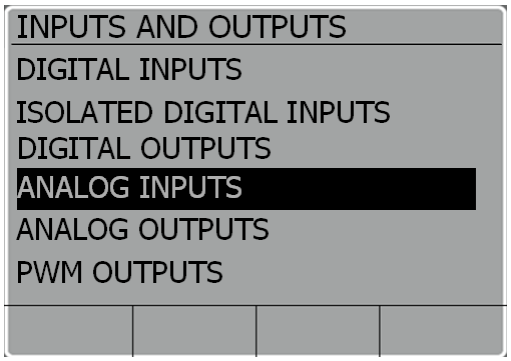
Press the **OK KEY**  .



SCROLL DOWN to **ANALOG INPUTS**

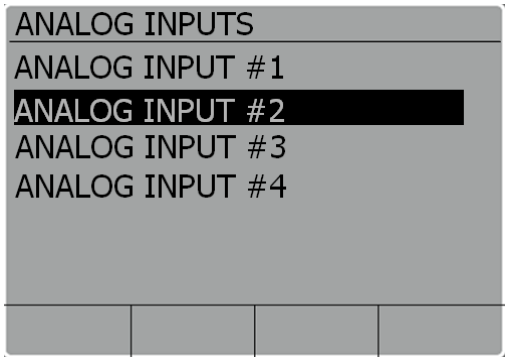
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

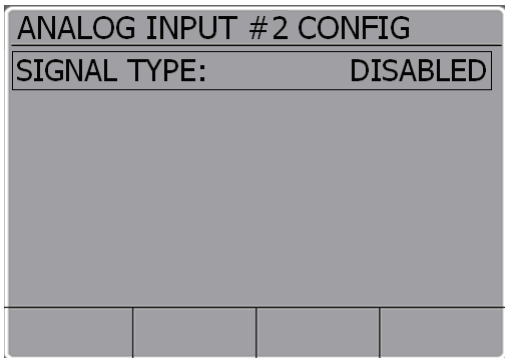


Select the **ANALOG INPUT #2.**

Press the **OK KEY**.

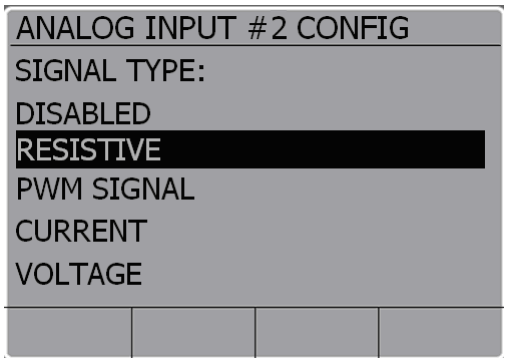


Press the **OK KEY** to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE)**.



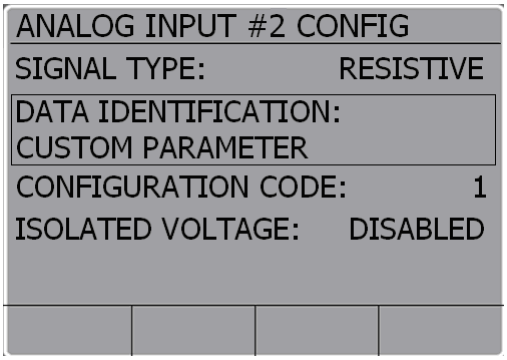
Scroll **DOWN** to **RESISTIVE**

Press the **OK KEY**.



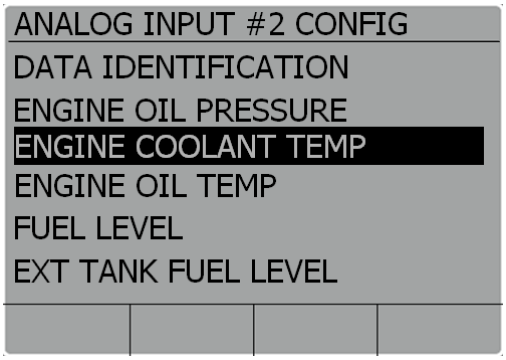
Scroll **DOWN** to **DATA IDENTIFICATION**

Press the **OK KEY** to change the current **DATA IDENTIFICATION.**



Select the **DATA IDENTIFICATION** to ENG COOLANT TEMP.

Press the **OK KEY**.



Scroll **DOWN** to configure the remaining setpoints for Analog Input #2:

- Map Selection Number
- Low Warning Threshold
- Low Warning Delay
- Low Warning Event Response
- Low S/D Threshold
- Low S/D Delay
- Low S/D Event Response
- Isolated Supply Voltage

Note: All COOLANT TEMP setpoints in the ENG MONITOR/PROTECT menu are inactive when in SENSOR configuration. They are labeled as DATA LINK to refer to the fact they are only active when the DATA LINK configuration is chosen.

DATA LINK

The COOLANT TEMPERATURE setpoints when in the DATA LINK configuration are redundant to the primary protection provided by the engine ECM. If these protections are not programmed to match those in the ADEM and an event occurs, check the Event Logs to determine which module generated the event.

4.7 STARTING AND STOPPING THE GENERATOR SET

STARTING THE ENGINE

Once the control is configured correctly, the control panel is powered up, and the generator set is ready to be operated, the generator set can be started. Refer to Figure 16, Stopping The Engine**.** There are several ways the generator set can be started from the control panel.

To **START** the engine:

1. In **MANUAL OPERATION**, press the **RUN KEY** 

   or

   Activate a Digital Input programmed for ECS in Run

   or

   Place the control in **AUTO** mode then,

   The engine can be started **THREE DIFFERENT WAYS**.

   a. Activate **DEDICATED DISCRETE INPUT #2**, which is the **REMOTE START INPUT**.

   b. Activate a **REMOTE INITIATE** over the MODBUS data link.

   c. Configure a **PROGRAMMABLE CYCLE TIMER.** See Chapter 16.

When the control panel initiates a start command on a diesel engine, the control checks to make sure there are no **SHUTDOWN EVENTS** present (labeled **PRESENT**) or that there are no latched **SHUTDOWN EVENTS** (labeled **ACTIVE**).

If there are no shutdown events that are active or present, and after any pre-crank or start-aid activities have completed, the starter motor and fuel control will be activated. The EMCP 4 will activate the Digital Output programmed to activate the starter motor magnetic switch, and the Digital Output programmed to activate the fuel enable circuit.

On electronic engines with ADEM™ A3 or newer engine ECMs using Common Engine Interface, the start command and fuel enable signals may be sent from the EMCP 4 to the engine ECM via the PRIMARY CAN data link. After receiving the signals, the engine ECM will operate the fuel control relay and starter motor magnetic switch. Digital Outputs #1 and #2 are not needed on those engines and can be configured for other uses.

The Starter Motor Relay will remain active until the programmed **ENGINE CRANK TIME** has been reached, or until the engine speed has reached the programmed **CRANK TERMINATE SPEED** setpoint value.

Note: The EMCP 4 Crank setpoints number of cranks, crank duration, and crank terminate speed are not used on engines with the Common Engine Interface option or newer engine ECM. These values must be adjusted in the engine ECM.

Caution: To determine the exact starting sequence for your engine, consult your engine's Operation and Maintenance Manual.

Note: If a Digital Input is programmed for ECS in Auto, or Run, or Stop, and a maintaining switch latches that input to make it active, the front panel buttons will not have any effect.

EMCP 4 REMOTE START

The EMCP 4 has the ability to accept a remote start signal. If this signal is activated, the EMCP will send an Engine Start request to the engine controller. If the Remote Start signal is removed, the EMCP will send a Stop request signal to the engine controller. A momentary signal will not keep the engine running.

This signal should be wired into pin 91 on the 120-pin connector. This input will be come active when pulled down to battery-.

STOPPING THE ENGINE

Once the engine is started, the engine can be stopped by pressing the **STOP KEY** 

on the control panel, or activating a Digital Input programmed for ECS in Stop. If the control is in **AUTO**, the engine can also be stopped by **DEACTIVATING** all of the remote initiate commands. There are three possible sources for this command:

2. The **REMOTE START INPUT**
3. The **REMOTE START COMMAND** over the Modbus data link.
4. The **PROGRAMMABLE CYCLE TIMER**. See Chapter 16

Once the **STOP** command is issued, the control will go into **COOLDOWN MODE**. Cooldown mode will run for the duration of time that it is programmed in the **COOLDOWN DURATION** setpoint. If the cooldown time is set for zero minutes, the engine will stop immediately.

On engines with ADEM™ A4 or newer engine ECMs using Common Engine Interface, the cooldown timer in the EMCP 4 should be set to 0 (Zero) minutes because the cooldown time is controlled from the engine ECM (if this is not done, both cooldown timers will run in sequence). Also, the **ENGINE OPERATING STATE INPUT CONFIGURATION** parameter must be set to **CAN INPUT**.

The cooldown timer can be overridden by pressing and holding the **STOP KEY** 

for approximately 5 seconds. The display will show a splash screen that will ask if you want to **BYPASS COOLDOWN**? or continue with the cooldown cycle.

If the **OK KEY** 

is pressed from the splash screen, the cooldown timer will be bypassed.

If the **ESCAPE KEY**  is pressed from the splash screen, the cooldown cycle will continue until the programmed cooldown time has elapsed.

When the cooldown timer has elapsed or has been bypassed, the Discrete or Relay Output programmed for fuel injection will be disabled (by default, Relay Output #2 will deactivate, but this may be programmed differently). The **STOP** command will also be sent over the PRIMARY CAN data link for those engines that require it. The engine will come to a stop.

Any time, while the engine is **RUNNING**:

> If the EMCP 4 detects a condition where an engine or generator parameter is **ABOVE** or **BELOW** programmed thresholds for a programmed amount of time, or another **SHUTDOWN EVENT** occurs, then the EMCP 4 will attempt to shut the engine down.

Note: Event behavior is determined by setpoints called EVENT RESPONSE CONFIGURATIONS. If a shutdown-type event's EVENT RESPONSE CONFIGURATION is disabled or not set to shutdown, it may not shut the engine down. Appropriate default values are pre-configured in the factory. Modify EVENT RESPONSE CONFIGURATIONS at your own risk! See Section 5.2.

Note: If a Digital Input is programmed for ECS in Auto, or Run, or Stop, and a maintaining switch latches that input to make it active, the front panel buttons will not have any effect.

Depending on how a specific **EVENT RESPONSE** configuration is programmed, the EMCP 4 will either put the engine in **COOLDOWN,** followed by a shutdown (**SOFT SHUTDOWN**) or shut the engine down immediately (**HARD SHUTDOWN**). See Figure 16.

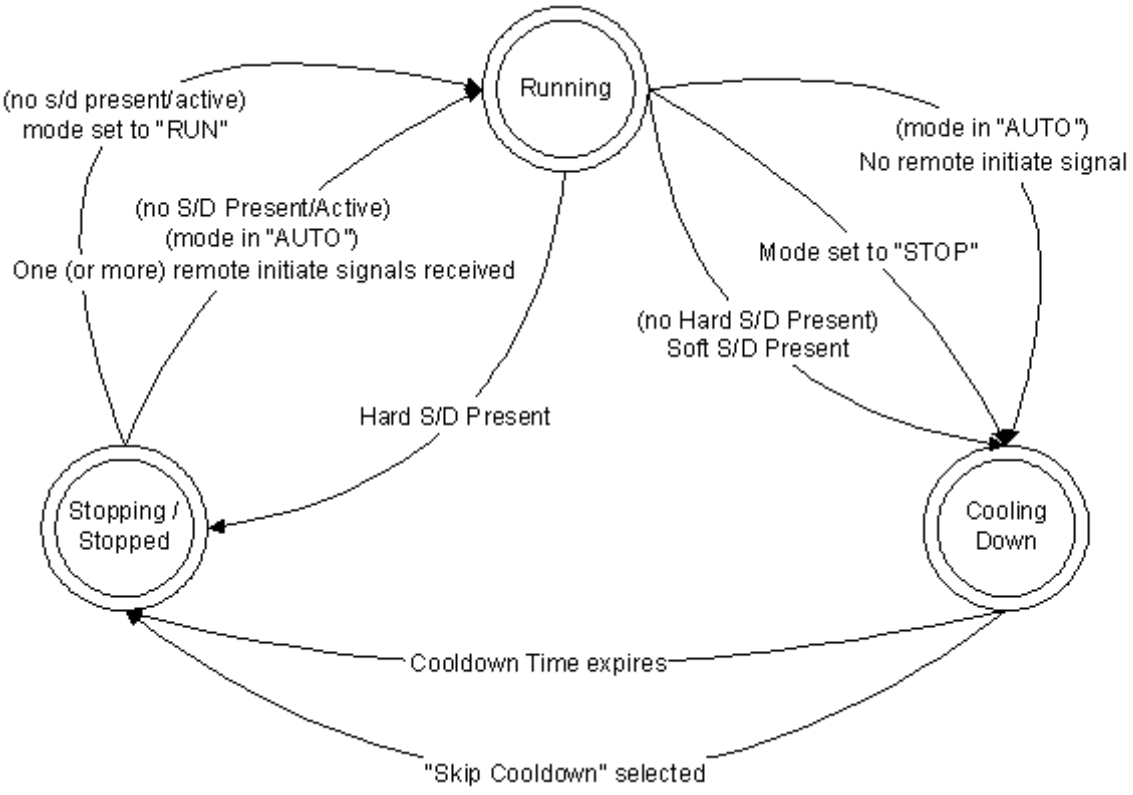


Figure 16: Stopping the Engine

EMERGENCY STOP

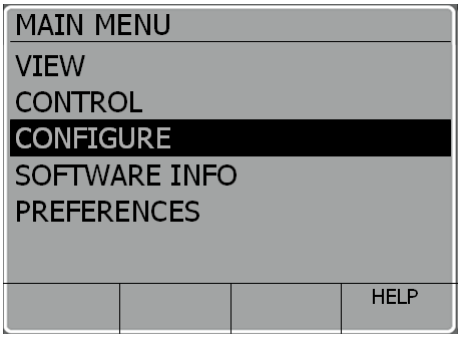
The EMCP 4 Emergency Stop input is configurable as Active High, or Active Low. The active state may be viewed within the EMCP 4, but is only configurable within Cat ET.

TO VIEW THE E-STOP ACTIVE STATE CONFIGURATION FROM THE DISPLAY, DO THE FOLLOWING:

At **MAIN MENU SCROLL**

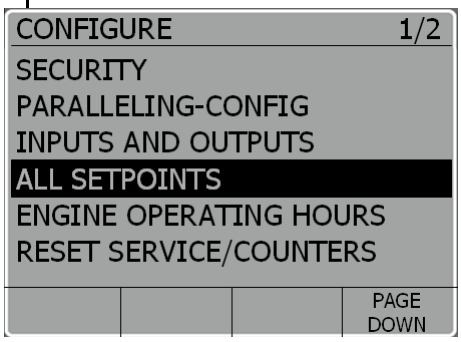
SCROLL DOWN to **CONFIGURE**

Press the **OK KEY**.



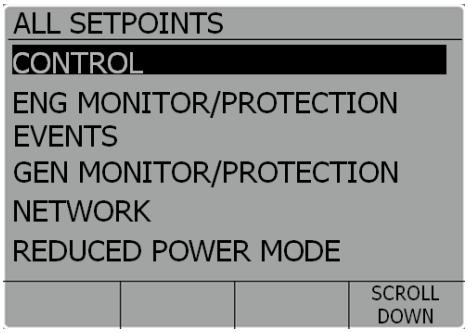
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



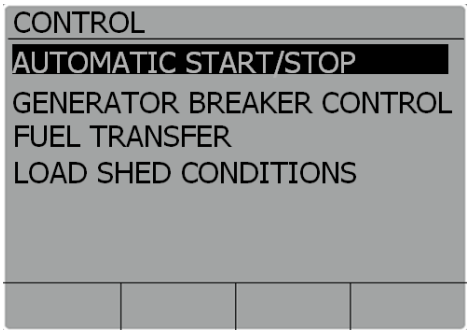
SCROLL DOWN to **CONTROL.**

Press the **OK KEY**.

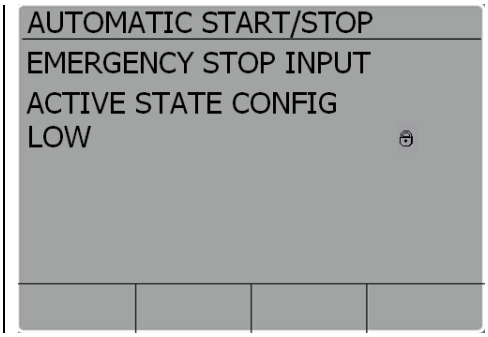


SCROLL DOWN to **AUTO START/STOP.**

Press the **OK KEY**.

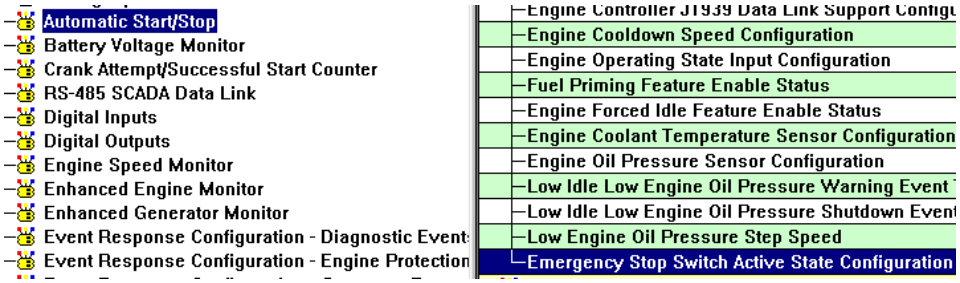


SCROLL DOWN  to **EMERGENCY STOP INPUT ACTIVE STATE CONFIG.**

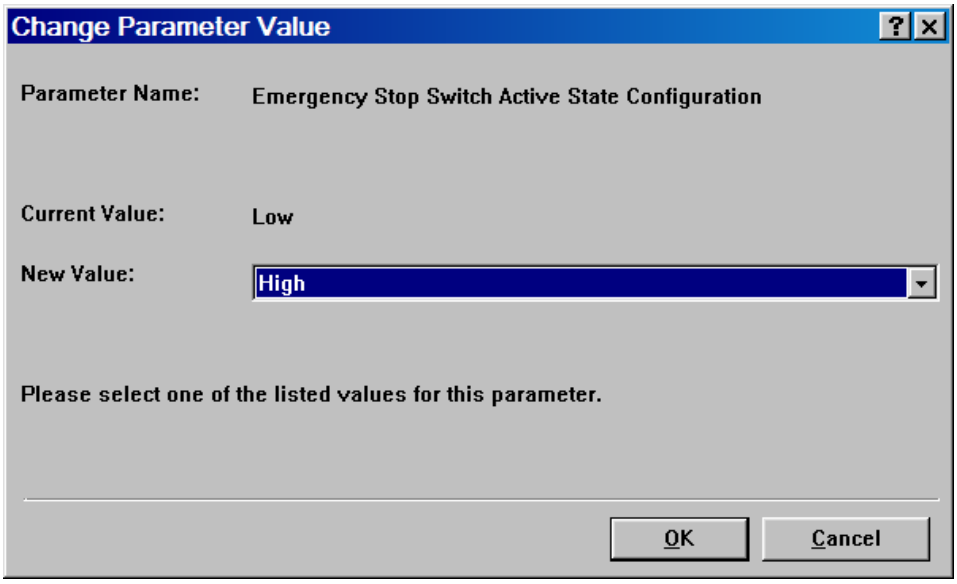


TO CHANGE THE E-STOP ACTIVE STATE CONFIGURATION, DO THE FOLLOWING:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Automatic Start/Stop on the left.



3. Double click Emergency Stop Switch Input Configuration on the right to select a new value.



EMCP 4 REMOTE STOP

The EMCP 4 has the ability to accept a remote stop signal. For Common Engine Interface, if this signal is activated, the EMCP will send an Engine Stop request to the engine controller. If the Remote Stop signal is removed, and the EMCP is in Auto mode, the EMCP may send a Start request signal to the engine controller if other conditions are already met (a Digital Input programmed for Run, for example).

This signal should be wired into pin 104 on the 120-pin connector.

4.8 ENGINE SETPOINT VERIFICATION

The engine setpoint verification procedure verifies that the EMCP 4 operates correctly when a **LOW OIL PRESSURE** or **HIGH COOLANT TEMPERATURE** event occurs. The engine setpoint verification procedure also verifies that the EMCP 4 operates correctly when an **ENGINE OVERSPEED** event occurs.

On an **ENGINE OVERSPEED EVENT**, the EMCP 4 will shut the engine down.

LOW OIL PRESSURE and **HIGH COOLANT TEMPERATURE** each have two events, **WARNING** and **SHUTDOWN.** The EMCP 4 will issue a **WARNING** whenever the warning threshold is reached and a **SHUTDOWN** whenever the shutdown threshold is reached. This verification procedure will modify configuration setpoints used in normal operation. The steps below outline how to perform the LOW OIL PRESSURE SHUTDOWN and HIGH COOLANT TEMPERATURE SHUTDOWN PROCEDURE. A similar process can be used for LOW OIL PRESSURE WARNING and HIGH COOLANT TEMPERATURE WARNING, along with LOW IDLE LOW OIL PRESSURE.

During this procedure

- Each configuration setpoint should be recorded prior to adjustment.
- Returned back to the original setting after the setpoint has been verified.

The following conditions are required before the **ENGINE SETPOINTS** are verified:

REQUIRED CONDITIONS

- The setpoints must be correct for the engine application.
- No shutdown events should be present. If necessary, troubleshoot, correct, and reset any and all shutdown events.

PROCEDURE FOR OVERSPEED VERIFICATION

Note: Adjustment of **ENGINE OVER SPEED SHUTDOWN THRESHOLD** setpoint from the display requires a level 3 password. For details on changing security levels refer to Chapter 6, Security.

The Security Level only affects changing parameters from the EMCP 4. Changing parameters with the Cat Service Tool does not require passwords.

1. Start the engine and run the engine at rated speed.

2. Adjust the setpoint value for Engine Over Speed Shutdown Threshold to a value that is below the speed that the engine is running at. An Engine Overspeed Shutdown event will occur immediately after the setpoint is changed, and the engine will shut down.
3. View the event by going to the Genset Control event log. Reset the event. For more information about how to view and reset the event, refer to Chapter 5, Handling Events.
4. Return the setpoint value for Engine Over Speed Shutdown Threshold to the original value.

PROCEDURE FOR LOW OIL PRESSURE VERIFICATION

Note: Low Oil Pressure Shutdown is disabled during start-up and while the engine is not running by the Fault Protection Timer (FPT). The fault protection timer starts timing when crank terminate RPM is reached during the starting sequence. The fault protection timer will then run for a programmed time which is determined by the Engine Start Fault Protection Activation Delay Time setpoint. Make sure the fault protection timer has elapsed before starting the Low Oil Pressure Verification.

1. Start the engine and run the engine at rated speed.
2. Determine whether the controller is set for SENSOR or DATA LINK, refer to Section 4.6.

   If SENSOR is selected, perform steps 3-5 in the CONFIGURE➔INPUTS & OUTPUTS➔ANALOG INPUTS configuration for ANALOG INPUT#1 setpoints.

   If DATA LINK is selected, perform steps 3-5 in the CONFIGURE➔ALL SETPOINTS➔ENG MONITOR/PROTECT➔ENG OIL PRES MON setpoints.
3. Adjust the setpoint value for Low Engine Oil Pressure Shutdown Event Threshold to a value that is above the oil pressure that the engine is operating at. The shutdown event will occur after the programmable time delay (the Low Engine Oil Pressure Shutdown Delay Time setpoint).
4. View the event by going to the Genset Control event log. Reset the event. For more information about how to view and reset the event, refer to Chapter 5, Handling Events.
5. Return setpoint value for Low Engine Oil Pressure Shutdown Event Threshold to the original value.

PROCEDURE FOR HIGH COOLANT TEMPERATURE VERIFICATION

Note: High Coolant Temperature shutdown is disabled during start-up and while the engine is not running by the Fault Protection Timer (FPT). The fault protection timer starts timing when the crank terminate RPM is reached during the starting sequence. The fault protection timer will then run for a programmed time (the Engine Start Fault Protection Activation Delay Time setpoint). Make sure the fault protection timer has elapsed before starting the High Coolant Temperature Verification.

1. Start the engine and run the engine at rated speed.
2. Determine whether the controller is set for SENSOR or DATA LINK, refer to Section 4.6.

If SENSOR is selected, perform steps 3-5 in the CONFIGURE➔INPUTS & OUTPUTS➔ANALOG INPUTS configuration for ANALOG INPUT#2 setpoints.

If DATA LINK is selected, perform steps 3-5 in the CONFIGURE➔ALL SETPOINTS➔ENG MONITOR/PROTECT➔ENG COOL TEMP MON setpoints.

3. Adjust setpoint value for High Engine Coolant Temperature Shutdown Event Threshold to a value that is below the engine coolant temperature that the engine is operating at. The minimum value for this setpoint is 49ºC (120ºF), so you may have to run the engine for a few minutes to get the temperature above the minimum value. The shutdown event will occur after the programmable time delay (the High Engine Coolant Temperature Shutdown Event Notification Delay Time setpoint).
4. View the event by going to the Genset Control event log.
5. Reset the event. Refer to Handling Events for more information about how to view and reset the event.
6. Return setpoint value for High Engine Coolant Temperature Shutdown Event Threshold to the original value.

4.9 ENGINE OPERATING HOURS

One of the features of the EMCP 4 is the ability to maintain the **ENGINE OPERATING HOURS**, which is the cumulative amount of time that the engine has run above the Crank Terminate speed. This time is displayed on the Engine Overview screen, just below Battery Voltage.

UPDATING ENGINE OPERATING HOURS

For applications where a new EMCP 4 is fitted to a generator set that was previously in operation, the EMCP 4 allows the user to increment the engine hours to match the engine.

Note: Engine Hours can only be increased. They cannot be decreased.

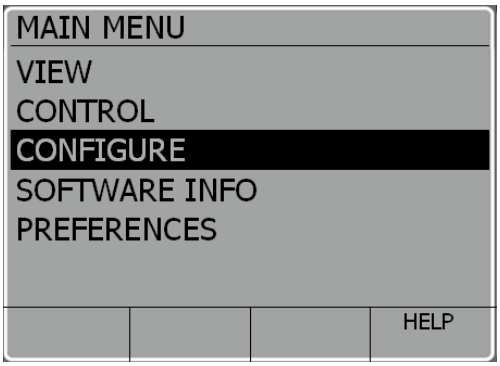
This procedure must be performed on the EMCP 4 display; it cannot be done using the Cat Service Tool. In order to update engine hours, **LEVEL 3 ACCESS** is required. Refer to Chapter 6, Security for information on obtaining **LEVEL 3 ACCESS**.

UPDATING ENGINE HOURS

At **MAIN MENU SCROLL**

SCROLL DOWN to **CONFIGURE**

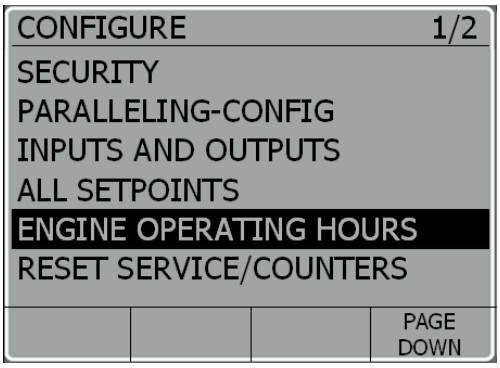
Press the **OK KEY**.



Scroll **DOWN** to **ENGINE OPERATING HOURS**

Press **OK KEY**.

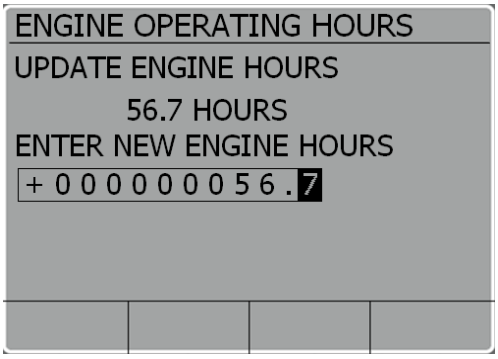
(if pressing OK has no effect, then Level 3 access has not been obtained)



Current **ENGINE HOURS** are displayed.

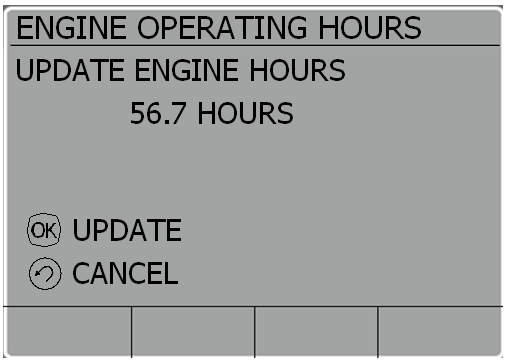
To edit the **ENGINE HOURS**, Select a digit using the **LEFT ARROW** or **RIGHT ARROW**

To change the selected digit use the **UP ARROW** or **DOWN ARROW**.



To accept the changes, press the **OK KEY**. To reject the changes, press the **ESCAPE KEY**.

Again, press the **OK KEY** to confirm, or the **ESCAPE KEY** to reject the changes.



5 HANDLING EVENTS

The EMCP 4 shows previous and current events from both the EMCP and external modules. These events are organized into logs for each physical EMCP 4 module.

The logs include:

STATUS EVENTS	Recent event history (See Chapter 20)
GENSET CONTROL	Events for the EMCP 4 GSC
ENGINE CONTROL ECM	Events for a Primary CAN Data Link-compatible engine
DIGITAL AVR	Events for the Cat Digital Voltage Regulator (Cat DVR)
THERMOCOUPLE	Events for the Thermocouple Module
EXTERNAL I/O	Events for the Discrete Input/Output (DIO) module
RTD MODULE	Events for the Resistive Temperature Device (RTD) module
SCR MODULE	Events for Engine Aftertreatment systems

The Genset Control Log stores events generated by the EMCP 4. Any other event is stored within the module that generated the event. Even if the EMCP annunciates an event, it does not mean that the EMCP logs that event. It may be within another module's log.

Each log is visible only if the module is connected to the appropriate data link, either the Primary data link or the Accessory data link, and is communicating with the EMCP 4.

The list of Event Logs can be viewed by pressing the Event Log key 

or via the View Submenu. Select the log you wish to view and press OK to view the events.

The EMCP 4 supports more than one instance of some of the above modules. (See Chapter 20, for the number of modules supported by each of the EMCP models). Those modules are uniquely identified with a number at the end of the log name.

The module number is software-configured, and is called the module's **ECU INSTANCE NUMBER**. The ECU Instance Number can be viewed and modified by the Cat Service Tool. See the appropriate sub section of Chapter 20, for the expansion module in question, to see how to program the Instance Number.

An event in the EMCP 4 Genset Control Log can be in one of three states; **PRESENT**, **ACTIVE**, or **INACTIVE**.

PRESENT This state is only applicable to the Genset Control Log. **PRESENT** means that the condition that caused the event is still present. The condition needs to be addressed before the event can be reset.

Note: This state only applies to Genset Control events. Other modules will not have Present in logs.

ACTIVE The event was previously in a "Present" state, but it is no longer present. It has been latched by the event system and needs to be reset before the engine can be restarted.

Within the Genset Control Log, the condition that caused the event is still affecting the system, but may be reset. (See Sections 5.3 to 5.6 on how to Reset Events). Warning type events automatically reset when the condition that caused the event is resolved and will never be Active.

Within any log other than the Genset Control Log, the condition that caused the event is affecting the system. The event may, or may not, be resettable. If the Reset All command fails to reset the event, then this event is still occurring and must be resolved before the event can be reset.

Note: Many events go from Present to Active when the engine is shutdown and may reoccur once the engine starts running again. Further action may be required to resolve the issue.

INACTIVE The event has happened at some time in the past but is no longer affecting the system. Inactive events are stored for historical purposes only.

5.1 CONFIGURING EVENT RESPONSES

The category of event, as well as other behavior when an event occurs, can be configured via a group of EMCP 4 setpoints called **EVENT RESPONSE CONFIGURATIONS**. An example of an event response configuration is **LOW ENGINE LOW OIL PRESSURE WARNING EVENT RESPONSE CONFIGURATION**. This setpoint determines what actions the EMCP 4 takes when it receives an event.

Note: Event Response Configuration is only valid for the EMCP 4, not any other modules.

Each **EVENT RESPONSE CONFIGURATION** type setpoint can either be viewed or edited. By default, VIEW is highlighted. These setpoints can only be edited when the ECS is in the Stop mode.

The following is a list of all the possible options for an event response configuration:

WARNING Creates a Warning event in the event log and lights the amber LED. The engine will not shut down. A Warning event will reset by itself (i.e. it will go from the “Present” state to the “Inactive” state) as soon as the condition that caused it goes away.

AUDIBLE ALERT Determines whether this event will also trigger an audible horn. If so, the event activates any relays that are programmed for Horn Control (see Chapter 10). If no relay is programmed for Horn Control, no action will be taken; the EMCP 4 does not have an internal horn. Audible Alert can only be programmed if either a Warning or Shutdown is also programmed.

SOFT SHUTDOWN Creates a Shutdown event in the event log, lights the red LED, and shuts the engine down after the cooldown period has expired (see Section 4.7: Starting and Stopping the Engine).

HARD SHUTDOWN Creates a Shutdown event in the event log, shuts the engine down immediately and lights the red LED.

BREAKER #1 TRIP Activates a Breaker #1 Trip, which can be programmed for a Relay Output or Digital Output for external use. Breaker #1 usually refers to the Generator circuit breaker.

BREAKER #2 TRIP Activates a Breaker #2 Trip, which can be programmed for a Digital Output or Relay Output for external use. Breaker #2 may refer to a second circuit breaker.

FAULT PROTECTION TIMER ENABLED Suppresses the event unless the engine is running and the Fault Protection Timer has expired (this prevents nuisance events during startup, or ones that are not relevant when the engine is stopped).

ACTIVE ONLY Creates an Active Only event in the event log. Active Only events are for informational purposes only. They typically do not light the Amber LED or behave like a Warning (although many events can be configured to do so). When the condition goes away, the event disappears from the event log.

Note: Not all options are available for all setpoints. For example, the Engine Low Oil Pressure Warning event cannot be configured as a shutdown, because there is a separate event (Engine Low Oil Pressure Shutdown) dedicated for that purpose. Likewise, events cannot be generated for any and all conditions. For example, a Low Engine Coolant Temperature Shutdown is meaningless and cannot be generated.

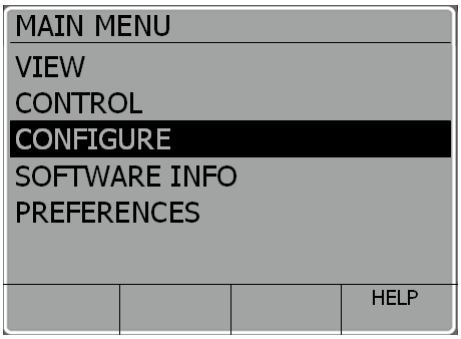
5.2 CHANGING AN EVENT RESPONSE CONFIGURATION

To change an event response configuration, the control must be in **STOP** mode.

Here are the steps to access event response configurations on the EMCP 4 display.

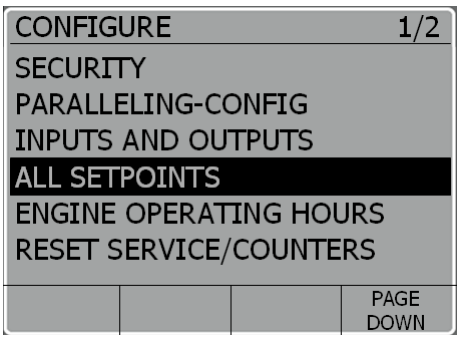
At the **MAIN MENU,** scroll **DOWN** to **CONFIGURE**

Press the **OK KEY**.



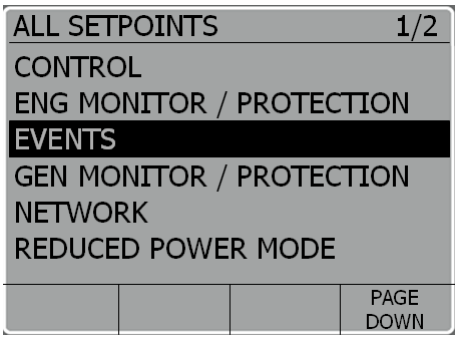
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



Scroll **DOWN** to **EVENTS**

Press the **OK KEY**.



The group name should help find the setpoint. However, a list of setpoints in each group, or submenu is given in Table 3.

Diagnostics Config

- Accessory Data Link
- Engine Speed
- Primary Data Link
- RS-485 SCADA Data Link
- TCP/IP SCADA Data Link
- Batt Charger Fail
- Eng Cont Not Resp
- RS485-Annunciator Data Link
- Analog Inputs

Engine Protection Config

Pressures

- Engine Oil
- Gas Pressure

Temperatures

- Engine Coolant
- Engine Oil
- Exhaust

Levels

- Engine Coolant
- Engine Oil
- Fuel Level
- Ext Fuel Tank Level

Others

- Air Damper Closed
- Unexpected Engine Shutdown
- Overspeed
- Underspeed
- Emergency Stop
- Fail to Start
- Fuel Leak
- Service Maintenance Interval
- Engine Inlet Manifold Charge Combustion
- Remote E-Stop

Generator Protection Config

- Generator Rear Bearing Temperature
- Generator Over Current
- Generator Over Frequency
- Generator Under Frequency
- Reverse Power
- Generator Over Voltage
- Generator Under Voltage
- Earth Fault
- Generator Winding Temperature #1
- Generator High Power
- Generator Current Balance
- Reverse Reactive Power
- Gen to Bus Synch Failure
- Gen Not Ready to Auto Parallel

Custom Event Config

- Digital Input Custom Events
- Analog Input Custom Events

Other System Config

- Battery Voltage
- Battery Charging System Voltage
- Engine in Cooldown
- Speed-Frequency Mismatch
- Not in Auto
- Earth Leakage
- EPS Supplying Load
- Battery Cranking Voltage

Event System

- Breaker #1 Trip Response Auto Reset Enable Status (only configurable within Cat ET)

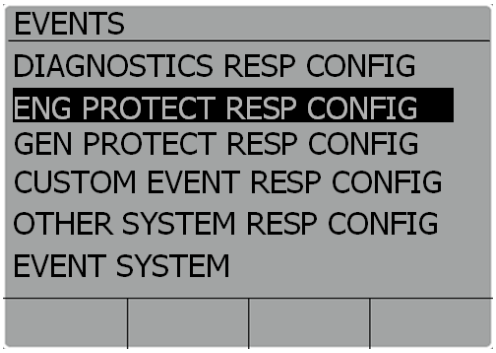
Table 3: Event Response Configuration Setpoints

EXAMPLE:

Select **ENGINE PROTECTION CONFIG**

Press the **OK KEY** 

.

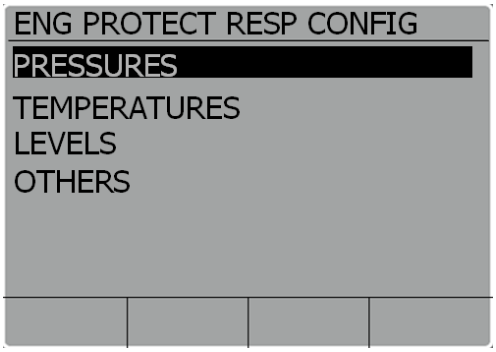


In this group of event response configurations, there are four types of events, grouped by the type of data: Pressures, Temperatures, Levels, and Others (such as status).

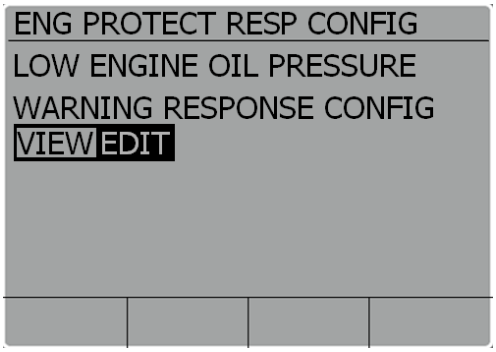
Select **PRESSURES**

Press the **OK KEY** 

.



To edit a setpoint, press the **RIGHT ARROW**  key to highlight **EDIT**.



This brings up a list of event response configuration setpoints. Use the Up or Down arrows to scroll though the list.

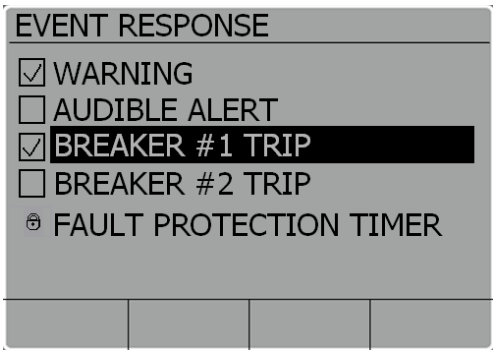
Note: This will only work if the control is in **STOP** mode. Some setpoints cannot be configured, or require a minimum security level. Those setpoints will display a lock icon to the right of the **EDIT** text.

Then, press the **OK KEY** 

to edit the setpoint.

Use the **LEFT ARROW**  and **RIGHT ARROW**  to toggle between checked and unchecked, and use the **UP ARROW**  and **DOWN ARROW**  to move between the responses.

Here you can edit individual responses, as described above.



Some responses are fixed and cannot be disabled. For those responses, a lock will be displayed instead of a checkbox.

5.3 RESETTING INDIVIDUAL ACTIVE EVENTS FOR THE EMCP 4

There are three ways to reset events. One way, described in this chapter, which applies to the EMCP 4 GSC only (the “Genset Control” log), is to reset individual Active events by navigating to the desired event in the event log, described below.

The second way, which applies to all modules other than the EMCP 4, is to reset all Active events in that module’s event log by navigating to one of the Active events in the event log (see Section 5.4).

The third way is an approach that resets all Active events for all modules (see Section 5.5).

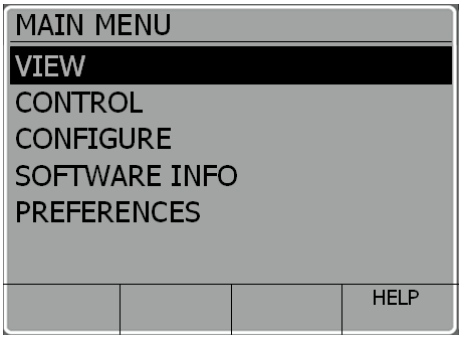
With any of these methods, you must be in **STOP** mode.

To reset individual events on the EMCP 4, start by navigating to the event log:

At **MAIN MENU** Select **VIEW** by pressing the **OK KEY** 

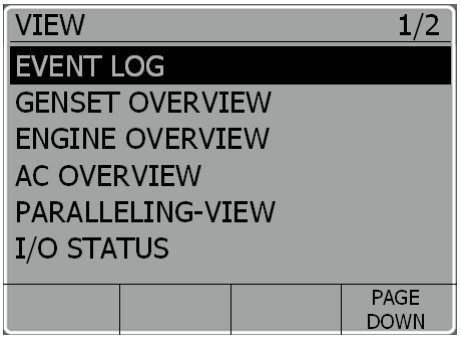
.

Alternately, press the **EVENT LOG BUTTON** to access the **EVENT LOG.**



Select **EVENT LOGS** by pressing the **OK KEY** 

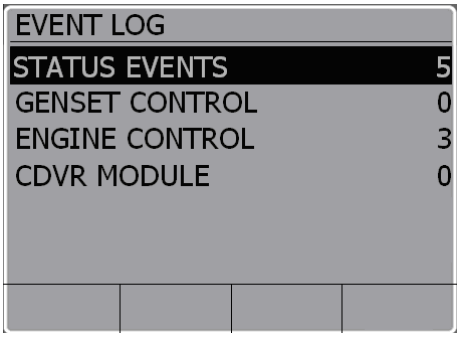
.



Scroll up  or down  to select the **GENSET CONTROL LOG**

Press the **OK KEY** 

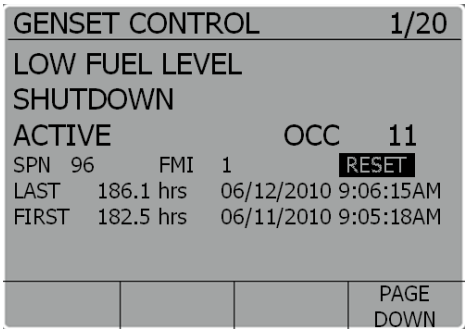
.



In this example image, there are five **STATUS** events and three **PRESENT** or **ACTIVE** events under Engine Control.

Scroll up  or down  through the list of events and find the **ACTIVE** event that requires resetting. If the control is in **STOP** mode, **RESET** will be shown and highlighted.

Generally, events are ordered by the status of the event; **PRESENT** events are listed first, followed by **ACTIVE** events, and finally the **INACTIVE** events. Within each status, the events are listed with the most recent first.



Pressing the **OK KEY** 

will RESET the event.

Note: If the event status is present, the **RESET** text will **not** be visible and the event cannot be reset until the condition that caused the event has been addressed.

5.4 RESETTING ALL ACTIVE EVENTS FOR A SINGLE MODULE

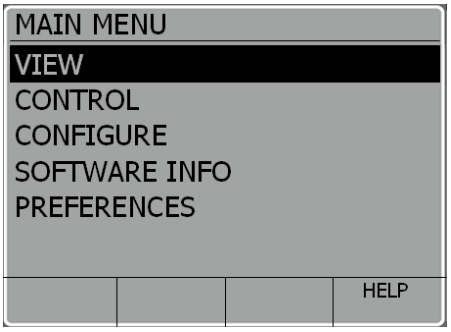
The second way to reset events, described in this chapter, which applies to all modules other than the EMCP 4, is to reset all of the module's Active events by navigating to one of the Active events in the event log. This method doesn't apply to the EMCP 4 GENSET CONTROL log. For information on resetting events on the EMCP 4, see Sections 5.3 or 5.5. This method also doesn't apply to the Status Event log. For more information about the Status Event log, see Chapter 5.

With any method, you must be in **STOP** mode. A key difference between the EMCP 4 and all other modules is that the other modules don't display a **PRESENT** status for events.

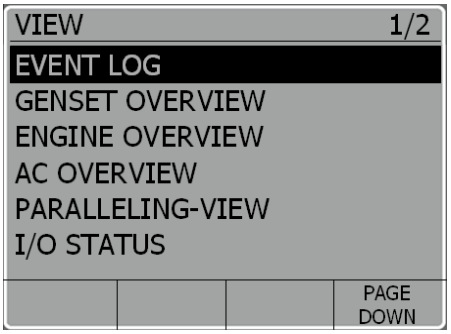
Events are shown as **ACTIVE** if they are currently affecting the system, or as **INACTIVE** if they are not.

To reset all of a modules Active events on any individual module except the EMCP 4 (listed as **GENSET CONTROL** in the event log), start by navigating to the event log.

At **MAIN MENU** scroll **DOWN**  to **VIEW** by pressing the **OK KEY**  .

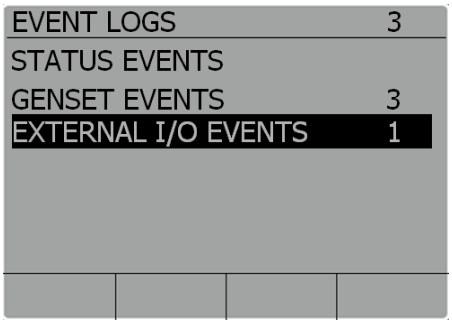


Select **EVENT LOGS** by pressing the **OK KEY**  .



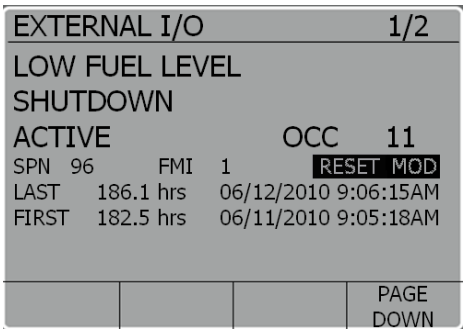
Scroll up  or down  to select the desired log and

Press the **OK KEY**  .



In this example image, there are three **PRESENT** or **ACTIVE** events under Engine Control #1, and one **ACTIVE** event in the External I/O module.

Press **OK KEY**  to view an event.



If the control is in STOP mode, and engine speed is zero, **RESET MOD** will be shown and highlighted.

Pressing the **OK KEY**  will RESET all of the **ACTIVE** events in that module's event log that can be reset.

Note: Modules other than the EMCP 4 cannot display events as **PRESENT**. If pressing **OK KEY**  at **RESET ALL** doesn't reset all of the events, the condition causing the event being viewed may still be present. For example, if the engine shut down on high coolant temperature, then the events will not reset until the coolant temperature drops below the shutdown threshold.

5.5 RESETTING ALL ACTIVE EVENTS FOR ALL MODULES

The third way to reset events, described in this chapter, is a shortcut that resets all Active events for all modules. With any method, you must be in **STOP** mode.

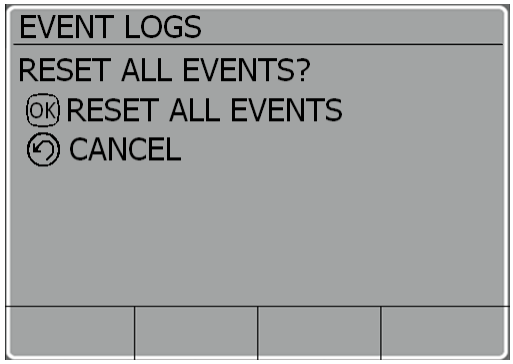
Once all of the condition(s) that are causing the events have been corrected, all Active events (those for which the condition is not present) on all modules can be reset using the **RESET ALL EVENTS** feature.

In order to do this, the control must be in **STOP** mode and engine speed should be zero.

FROM ANY SCREEN:

Press the **RESET KEY**  .

A confirmation prompt will appear.



Pressing the **OK KEY**  will continue and **RESET** all events on all modules.

Pressing the **ESCAPE KEY**  will **CANCEL** the reset operation.

The controller will display which events were reset, and which ones were not.

Note: Reset All Events will not reset Present events! For example, if the E-Stop switch is pressed and an **EMERGENCY STOP SWITCH ACTIVATED SHUTDOWN** is present, it cannot be reset until the E-Stop is pulled out and the event status changes from **PRESENT** to **ACTIVE**.

5.6 RESETTING EVENTS FOR ENGINE ECMS WITHOUT PRIMARY CAN DATA LINK SUPPORT

The EMCP 4 has the ability to reset all events for electronic engines with no PRIMARY CAN support by means of a Digital Output. A number of conditions must be satisfied in order for this to work.

FIRST: One of the Outputs must be configured as a Command/Status for **ECU FAULT RESET**. See Chapter 10.

SECOND: The corresponding output must be wired to a corresponding Fault Reset I/O pin on the engine ECM or it must be setup to power cycle the ECM.

THIRD: Pressing the **RESET ALL KEY** 

with this option selected will activate the **ECU FAULT RESET**, which will activate the corresponding Relay Output and trigger the engine ECU to reset its faults or will power cycle the ECU. This will only active the ECU FAULT RESET OUTPUT if the EMCP has a warning or fault. This warning or fault can be triggered by using a custom event on a digital input that is wired to the fault alarm of the ECU.

5.7 TROUBLESHOOTING RESETTING EVENTS

There are common reasons for the EMCP 4 not allowing events to be reset. First of all, in order to reset any event, the EMCP 4 must be in STOP mode. In order to reset engine ECM events, the engine speed must also be zero.

SERVICE MAINTENANCE INTERVAL WARNING and **NOT IN AUTO WARNING** are explained more fully below.

NOT IN AUTO WARNING

This event is Present whenever the control is in either RUN or STOP. As a result, it **can not** be reset in STOP (since the event is present). The event will reset when the control is returned to **AUTO** 

. This event can be disabled by modifying the GENERATOR CONTROL NOT IN AUTOMATIC WARNING EVENT RESPONSE CONFIGURATION setpoint. See Chapter 10 for instructions on editing that setpoint.

SERVICE MAINTENANCE INTERVAL

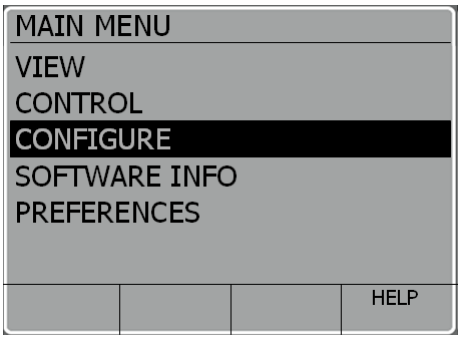
If a **SERVICE MAINTENANCE INTERVAL WARNING** is **PRESENT**, it **cannot** be reset. The warning is PRESENT because the countdown timer has reached zero. To clear the warning, the timer must be reset, rather than the event. When the timer is reset, it returns to the programmed interval (default is 180 calendar days or 500 engine hours). This timer must be reset from the display; it cannot be reset by using the Service Tool alone. This warning can only be disabled with the Event Response Configuration. See Section 5.1.

Note: This warning does not appear on the face of the EMCP 4 as a flashing LED unless configured to do so within Cat ET under Event Response Configuration – Engine Protection Events.

TO VIEW AND RESET THE TIMER SETTINGS ON THE DISPLAY:

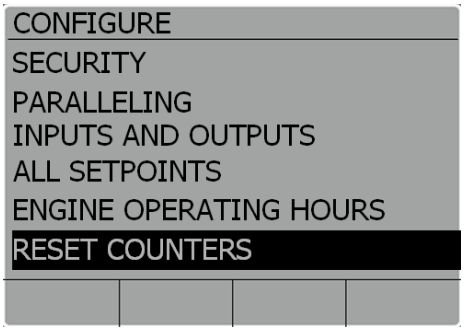
At **MAIN MENU** scroll **DOWN**  to **CONFIGURE**

Press the **OK KEY**  .



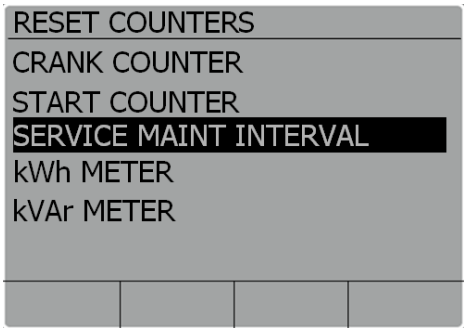
Scroll **DOWN**  to **RESET COUNTER**

Press the **OK KEY**  .



Scroll **DOWN**  until you reach **SERVICE MAINTENANCE INTERVAL**

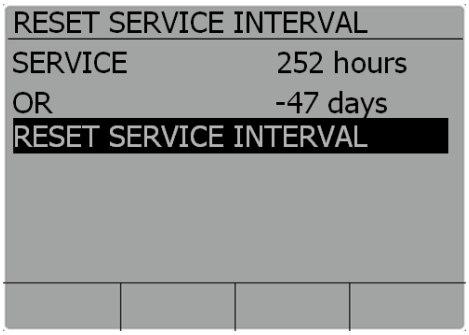
Press the **OK KEY**  .



The **SERVICE MAINTENANCE INTERVAL HOURS AND DAYS** are displayed along with the

PASSWORD REQUIRED TO RESET THE SERVICE MAINTENANCE INTERVAL.

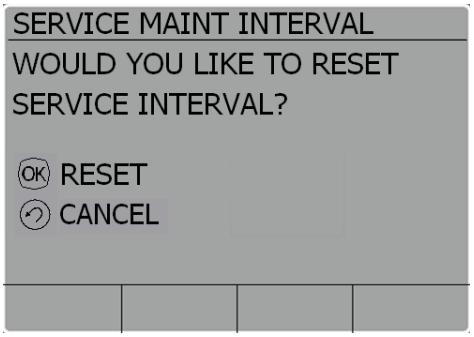
The security level required is level 3 but, the required security level can be changed by using the Service Tool.



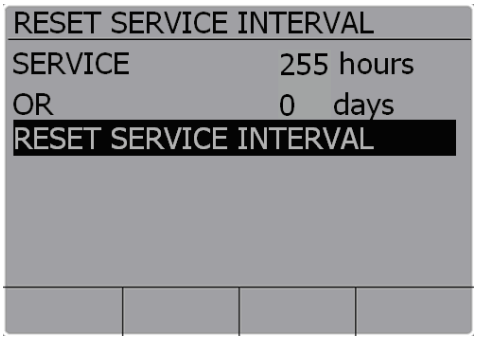
To **RESET** the service interval press the **OK KEY** 

. A confirmation prompt will appear. Pressing the **OK KEY** 

will continue and **RESET** the service maintenance interval. Pressing the **ESCAPE KEY**  will **CANCEL** the reset operation.



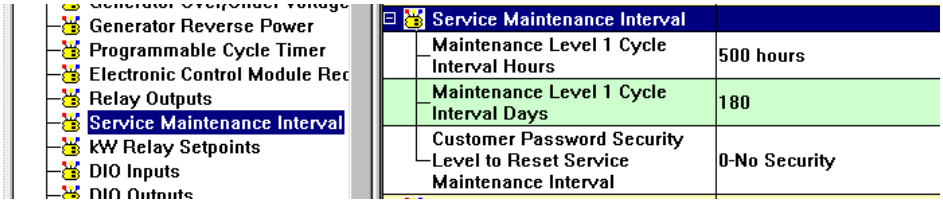
The new Service intervals will be displayed.



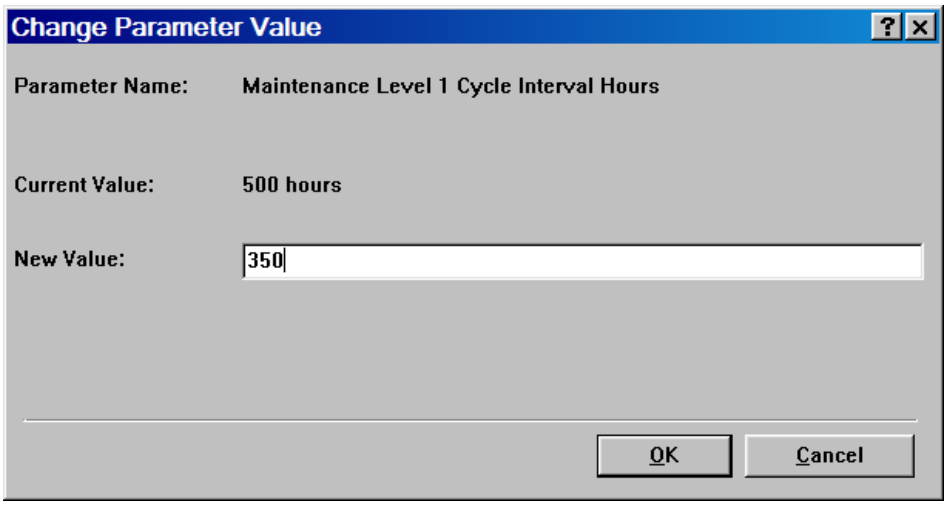
Caution: Be sure to change the password level (using the Service Tool) back to **LEVEL 3** after the reset, to prevent inadvertently resetting the timer at other times!

TO ADJUST THE TIMER SETTINGS FROM CAT ET, DO THE FOLLOWING:

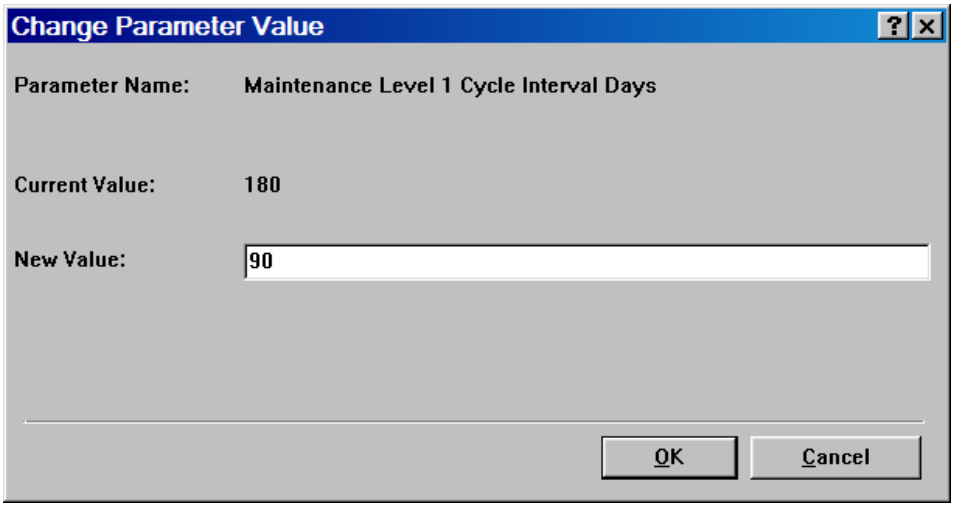
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Service Maintenance Interval on the left.



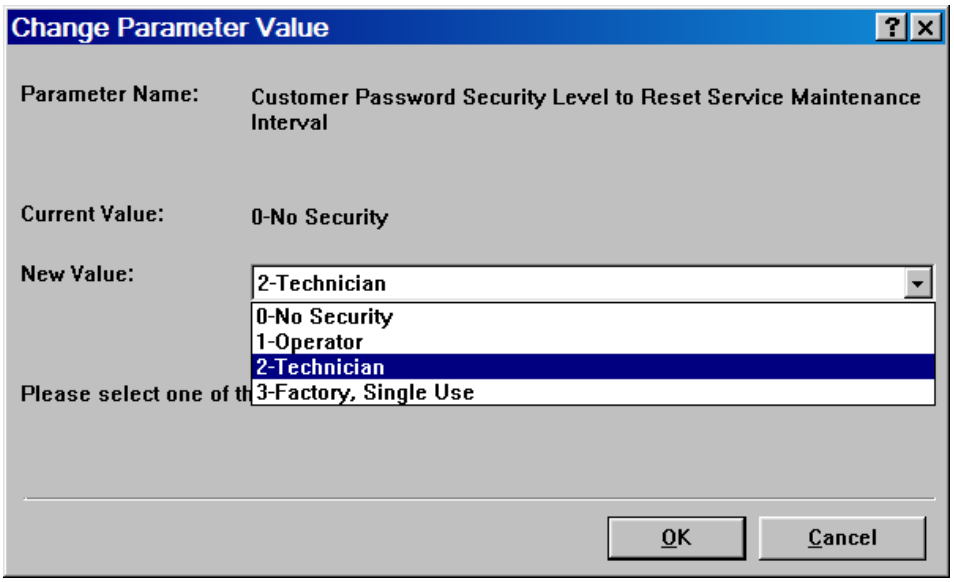
3. Double click Maintenance Level 1 Cycle Interval Hours on the right to enter a new interval.



4. Double click Maintenance Level 1 Cycle Interval Days on the right to enter a new interval.



5. Double click Customer Password Security Level to Reset Service Maintenance Interval on the right to enter a new security level.



Caution: Be sure to change the password level back to **LEVEL 3** after the reset, to prevent inadvertently resetting the timer at other times!

6 SECURITY

There are five levels of security access on EMCP 4: **LEVEL 0**, **LEVEL 1**, **LEVEL 2**, **LEVEL 3**, and **SERVICE TOOL**. Any configurable parameter or function that is set to Level 0 can be accessed by anyone at any time, and there will never be any security information on the display screen.

LEVEL 1 ACCESS and **LEVEL 2 ACCESS** represent increasing levels of access to the setpoints and functions of the controller. Both levels 1 and 2 can be password protected with separate user-defined passwords.

Note: These are optional levels of security; by default these passwords are disabled, and the default access level is LEVEL 2 from Parts Service.

LEVEL 3 ACCESS is password protected at the factory, and requires contacting the Cat Dealer TC to obtain a password.

> If the present security level of the controller is below the level needed to perform a desired function, a padlock and a number will be displayed at the bottom right hand corner of the display. The number represents the level of security that is required in order to perform the desired function; 1, 2, or 3.
>
> If there is a padlock but no number, then the Cat Service Tool is required in order to perform the desired function; or the setpoint may be read only and cannot be changed.

All of the adjustable parameters are associated with a specific level of security required to make an adjustment to the parameter. Certain functions, such as resetting the number of crank attempts, are also associated with a specific level of security. The passwords only affect actions taken at the EMCP 4. Access of the EMCP 4 remotely via the Cat Service Tool or via the SCADA data link is not affected by the security level on the EMCP 4 display.

Changing parameters with the Cat Service Tool does not require passwords, since the Service Tool already has the highest level of access.

When connecting via the **SCADA DATA LINK**, passwords can also be used. The levels of access granted via SCADA are identical to the levels of access granted at the EMCP 4. However, the passwords themselves may differ. Further more, the EMCP 4 and the SCADA data link may be at different levels of access at any given time. For more information about SCADA security see Chapter 10.

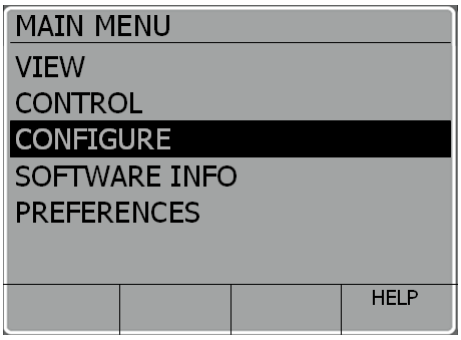
Level 1 and Level 2 passwords are usually **DISABLED** when shipped from the factory. Level 1 and Level 2 passwords can be user defined if desired. If the Level 1 and Level 2 passwords are not user defined, the Level 2 will be the **MINIMUM LEVEL**. All parameters that require Level 0, Level 1, or Level 2 security will be able to be changed by anyone at any time.

Note: The EMCP 4 will always move up in security level to the highest level of access that is not password protected when a certain level of access is requested. For example, if a Level 1 password has been defined, but a Level 2 password has not, the EMCP 4 will start at Level 0 on power up. When the Level 1 password is entered, the EMCP 4 will move up to Level 2 access.

THE SECURITY MENU

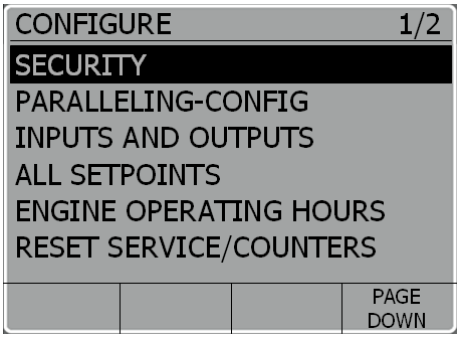
To get to the security menu:

At **MAIN MENU** scroll **DOWN**  to Configure

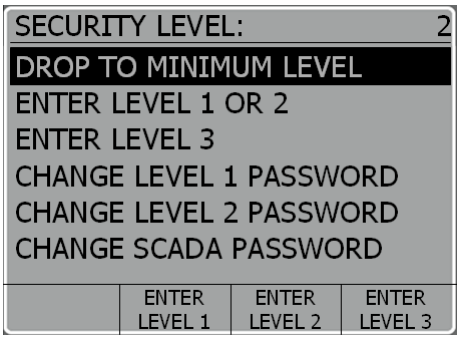


Press the **OK KEY**  .

At **SECURITY,** press the **OK KEY**  .



The **SECURITY MENU** will show the current level of security at the top of the screen.



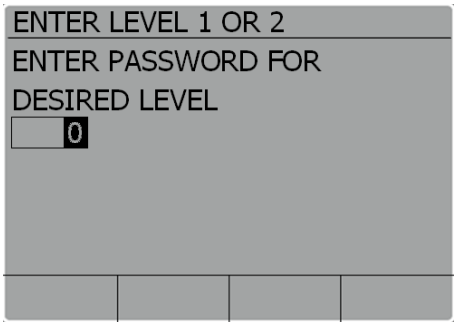
There are six options on the security menu:

DROP TO MINIMUM LEVEL	CHANGE LEVEL 1 PASSWORD
ENTER LEVEL 1 OR 2	CHANGE LEVEL 2 PASSWORD
ENTER LEVEL 3	CHANGE SCADA PASSWORD

Selecting **DROP TO MIN LEVEL** will make the control go to the minimum level of security. As previously discussed, if the level 1 and level 2 passwords are not defined by the user, the minimum level of security will be level 2. If a level 2 password is defined by the user, but not a level 1 password, then the minimum level of security will be level 1.

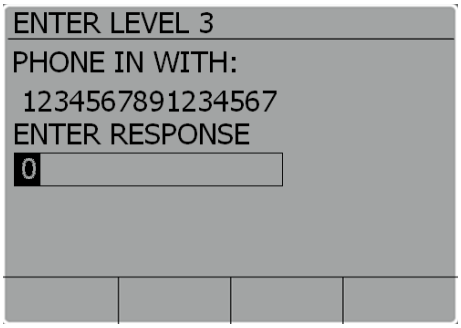
In contrast, if a level 1 password is defined by the user, but not a level 2 password, then the minimum level of security will be level 0.

Selecting **ENTER LEVEL 1 OR 2** will open up a password entry screen.



The password entry screen will have 4 spaces. In each space a numbers from 0 through 9 can be entered. The password can be from 1 to 4 digits and is entirely user defined. Enter the password for either level 1 or level 2 if either of those passwords have been defined. Use the **UP ARROW** or **DOWN ARROW** to change the value of any highlighted digit. Use the **LEFT ARROW** or **RIGHT ARROW** to navigate between digits.

Selecting **ENTER LEVEL 3** will cause the display to say "**PHONE IN WITH"** and a 16 digit number will be displayed. Under that, **ENTER RESPONSE** will be highlighted with a password entry field. Record the 16 digit number and call the Cat Dealer TC with this number. The TC will reply with another 16 digit number. Enter the password that was supplied by the TC in the same manner as the other types of passwords.



Press the **OK KEY** to confirm, or **ESCAPE KEY** to reject the change. Pressing the **OK KEY** after entering the number will set the current level to 3. The control will remain in level 3 security level until no key presses have been made for 10 minutes. After 10 minutes of inactivity the control will revert back to the minimum level of security.

Note: To change a level 3 parameter requires either a level 3 password from the TC or a PC connection using a Service Tool. Therefore, if you have a Service Tool, try to change the parameter using the Service Tool rather than calling the TC.

Selecting **CHANGE LVL 1 PSWD** will allow for the level 1 password to be changed. The control must be at level 1 security in order to select **CHANGE LVL 1 PSWD**. The **CHANGE LVL 1 PSWD** screen looks just like the password entry screen. It has 4 blank spaces that can each be set to a number from 0 to 9. The password can use as few as one digit and can use as many as 4 digits. It is entirely up to the user. If a password has been set but, it is now desired to **not** have level 1 password protection, the level 1 password can be disabled by setting the password to be a single 0.

Once the desired password is entered, press the **OK KEY** and the control will go back to the security screen and the level 1 password will be set.

Selecting **CHANGE LVL 2 PSWD** will allow for the level 2 password to be changed. The control must be at level 2 security in order to select **CHANGE LVL 2 PSWD**. The **CHANGE LVL 2 PSWD** screen looks just like the password entry screen. It has 4 blank spaces that can each be set to a number from 0 to 9. Selecting a password is entirely up to the user and can use as few as one digit or as many as 4 digits.

The level 2 password can be disabled by setting the password to be a single 0.

Once the desired password is entered, press the **OK KEY** 

and the control will go back to the **SECURITY SCREEN** and the level 2 password will be set.

Selecting **CHANGE SCADA PSWD** will allow for the SCADA password to be changed.

This password, if **ENABLED**, will require a SCADA system to first enter the password into the **WRITE ACCESS PASSWORD** register prior to conducting any other reads and writes. The control must be at level 2 security in order to select **CHANGE SCADA PSWD**. The **CHANGE SCADA PSWD** screen looks just like the password entry screen. It has 8 blank spaces that can each be set to a number from 0 to 9. The password can use as few as one digit and can use as many as 8 digits.

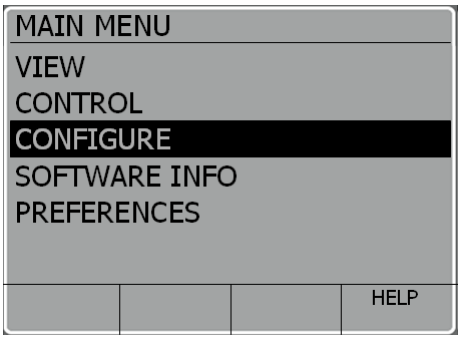
Just as with level 1 and level 2 passwords, entering a single 0 will **DISABLE** the SCADA password.

7 SETPOINTS

The EMCP 4.3 and 4.4 have a variety of setpoints that can be programmed or adjusted. These setpoints can be adjusted via the display, or via the Cat Service Tool. In order to program the setpoints via the display, go through the following menu options:

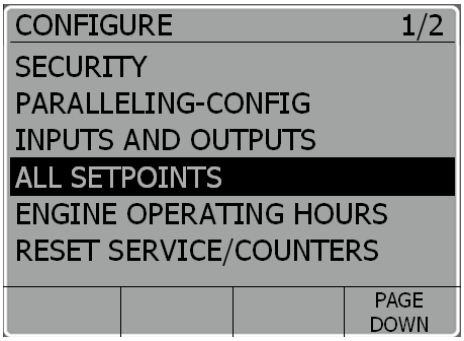
At **MAIN MENU** scroll **DOWN**  to **CONFIGURE**

Press the **OK KEY**  .



Scroll **DOWN**  to **ALL SETPOINTS**

Press the **OK KEY**  .



All of the setpoints on EMCP 4 can be accessed through this menu. However, setpoints related to input and output configuration can also be accessed through the **INPUTS AND OUTPUTS** menu under **CONFIGURE**. It is recommended to use the latter to configure inputs and outputs. For more information on configuring inputs and outputs, see Chapters 8 to 12.

7.1 CONFIGURING SETPOINTS

Setpoints can be one of four different types: **NUMERICAL ENTRY**, **SELECTION**, **SUSPECT PARAMETER NUMBER,** or **EVENT RESPONSE.** Each type is configured differently. For configuring any setpoint via the display, the user must first have the proper security access. See Chapter 6 for more information on security.

NUMERICAL ENTRY setpoints are parameters like time delays, thresholds, etc. For these setpoints the display will show the current value.

To change the value of a **NUMERICAL ENTRY** type setpoint:

1. Press the **OK KEY**  when the setpoint is highlighted. The current value of the setpoint will be shown with the rightmost digit highlighted.
2. Use the **UP**  and **DOWN**  arrow keys to adjust that digit to the desired value. Digits will wrap around. Therefore, pressing up when 9 is shown will change it to 0, or pressing down when 0 is shown will change it to 9.

3. Once that digit is set to the desired value, use the **LEFT**  arrow key to move the cursor to the next digit.
4. Then use the **UP**  and **DOWN**  arrow keys to adjust that digit to the desired value.
5. Continue this process until the desired value for the setpoint is set.
6. Then press the **OK KEY**  to save the value.

Tip: You can quickly select the largest possible value for the setpoint by pressing the **LEFT**  arrow key until the leftmost digit is shown, and then pressing the **UP**  arrow key until the value stops changing. Similarly you can select the smallest possible value by pressing the **LEFT**  arrow key until the leftmost digit is shown, and then pressing and holding **DOWN**  arrow key until the value stops changing.

SELECTION type setpoints, such as Generator Configuration, or Active State, have options that are not numerical. For these setpoints, the display will show the current setting.

To change the value of a **SELECTION** type setpoint:

1. Press the **OK KEY**  when the setpoint is highlighted. The current setting of the setpoint will be shown.
2. Use the **UP**  or **DOWN**  arrow keys to scroll through the options that are available for that setpoint. Scroll quickly by holding the key.
3. When the desired option is displayed, press the **OK KEY**  to save the setting.

SUSPECT PARAMETER NUMBER type setpoints are similar to **SELECTION** type setpoints, but the selections are grouped into four groups:

1. Pressures
2. Temperatures
3. Levels
4. Others

Any selection with units that are not pressure, temperature, or percent will be in the “Others” group. This group also contains Custom Parameters and Custom Events. Suspect parameter numbers indicating status (like Gen Breaker Open) will also be here.

To change the value of a **SUSPECT PARAMETER NUMBER** type setpoint:

1. Press the **OK KEY** 

when the setpoint is highlighted. Notice here that the setpoint value is not shown. Instead, the first group name, PRESSURE, is shown.
2. Use the **UP**  or **DOWN**  arrow keys to scroll through the four groups: PRESSURE, TEMPERATURE, LEVEL, OTHERS.
3. When the desired option is displayed, press the **OK KEY** 

to see the suspect parameter numbers (by name) in that group.
4. Use the **UP**  or **DOWN**  arrow keys to scroll through the suspect parameter numbers (by name) until the desired one is selected.
5. Press the **OK KEY** 

to save the setting. Alternately, press the **BACK**  key to return to the group selection: PRESSURE, TEMPERATURE, LEVEL, OTHERS.

EVENT RESPONSE CONFIGURATION type setpoints are a little different from the previously discussed setpoints. Each setpoint configures one or more actions that occur when the event occurs. See Section 5.1 for more information.

7.2 SETPOINT SUB-MENUS

The setpoints in the EMCP 4 are organized into multiple submenus. See Appendix A and the appropriate sections of this document for more information.

7.3 SETPOINTS ON THE CAT SERVICE TOOL

EMCP 4 setpoints can also be configured using the Cat Service Tool (ET). To access setpoints, see Section 4.2.

If a value is changed from the EMCP display, Cat ET will not refresh the setpoint automatically. Press the “Config Tool” icon to refresh the list.

Categories of setpoints are listed along the left pane, and clicking on one of them will bring up that list in the right pane.

The EMCP 4.3 and 4.4 have different numbers of setpoints. The categories shown here match those in ET version 2010C. Older versions may have less, and newer versions may have more.

Note: Any setpoint with a value given as Unavailable is not applicable to that level of EMCP 4.

SETPOINT CATEGORIES

Here are the categories of setpoints as found in the left pane of the ET Configuration Tool:

ANALOG INPUTS

Setpoints related to Analog Inputs. See Chapter 9.

ANALOG OUTPUTS

Setpoints related to Analog Outputs. See Chapter 11.

ANALOG PWM OUTPUTS

Setpoints related to Analog Outputs. See Chapter 11.

AUTOMATIC START/STOP

Setpoints related to starting and stopping the generator set, as well as engine configuration.

BATTERY VOLTAGE MONITOR

Setpoints related to monitoring battery voltage from the battery power input to the EMCP 4.

CRANK ATTEMPT/SUCCESSFUL START COUNTER

Setpoints related to crank/start counters.

RS-485 SCADA DATA LINK

Setpoints related to SCADA (Modbus) data link communications. See Chapter 21.

TCP/IP SCADA DATA LINK

Setpoints related to Ethernet communications. See Chapter 22.

DIGITAL INPUTS

Setpoints related to Digital Inputs. See Chapter 8.

DIGITAL OUTPUTS

Setpoints related to the polarity Digital Outputs. See Chapter 10.

ENGINE COOLANT TEMPERATURE MONITOR

Setpoints related to monitoring engine coolant temperature.

ENGINE OIL PRESSURE MONITOR

Setpoints related to monitoring engine oil pressure.

ENGINE COOLANT TEMPERATURE MONITOR

Setpoints related to monitoring engine coolant temperature.

ENGINE OIL PRESSURE MONITOR

Setpoints related to monitoring engine oil pressure.

ENGINE SPEED MONITOR

Setpoints related to monitoring engine speed using the Magnetic Pick-Up (MPU) input.

ENHANCED ENGINE MONITOR

Setpoints related engine cylinder temperature monitoring via the optional Thermocouple module.

ENHANCED GENERATOR MONITOR

Setpoints related to generator bearing and winding temperature monitoring via the optional RTD module.

EVENT RESPONSE CONFIGURATION - DIAGNOSTIC EVENTS

Setpoints used to configure the EMCP 4 response to diagnostic events. See Chapter 5.

EVENT RESPONSE CONFIGURATION - ENGINE PROTECTION EVENTS

Setpoints used to configure the EMCP 4 response to engine protection events. See Chapter 5.

EVENT RESPONSE CONFIGURATION - GENERATOR PROTECTION EVENTS

Setpoints used to configure the EMCP 4 response to generator protection events. See Chapter 5.

EVENT RESPONSE CONFIGURATION - OTHER SYSTEM EVENTS

Setpoints used to configure the EMCP 4 response to events that do not fit into the category of diagnostics, engine protection, or generator protection. See Chapter 5.

EVENT RESPONSE CONFIGURATION – CUSTOM EVENTS

Setpoints used to configure the EMCP 4 response to custom events. See Chapter 5.

EVENT SYSTEM

Setpoint related to auto reseting a breaker.

FUEL TRANSFER

Setpoints related to fuel transfer feature.

GENERATOR AC MONITOR

Setpoints related to generator configuration (for EMCP 4 calculation and reporting).

GENERATOR AC POWER MONITOR

Setpoints related to generator power monitoring.

GENERATOR BREAKER CONTROL

Setpoints related to the generator breaker.

GENERATOR CURRENT MONITORING

Setpoints related to generator AC overcurrent monitoring.

GENERATOR DEAD BUS ARBITRATION

Setpoints related to hard Wired Dead Bus Arbitration. See Chapter 13.

GENERATOR OVER/UNDER FREQUENCY

Setpoints related to generator overfrequency and underfrequency monitoring.

GENERATOR OVER/UNDER VOLTAGE

Setpoints related to generator AC overvoltage and undervoltage monitoring.

GENERATOR LOAD SHARING AND CONTROL

Setpoints related to Load Sharing tuning.

GENERATOR REVERSE POWER

Setpoints related to generator AC reverse power monitoring.

GENERATOR TO BUS SYNCHRONIZER

Setpoints related to synchronization with the bus.

LOAD SENSE/LOAD DEMAND

Setpoints related to Hard Wired load Sense Load Demand. See Chapter 13.

LOAD SHED CONDITIONS

Setpoints related to breaker control and load shed conditions.

PROGRAMMABLE CYCLE TIMER

Setpoints related to configuring Programmable Cycle Timers. See Chapter 16..

ELECTRONIC CONTROL MODULE REDUCED POWER MODE

Setpoints related to a power-saving mode of the EMCP 4 called Reduced Power Mode. See Chapter 16.

SERVICE MAINTENANCE INTERVAL

Setpoints related to configuring and resetting the timers used to indicate a service needed warning. See Chapter 16.

KW RELAY SETPOINTS

Setpoints related to configuring the behavior of the Trip Point function, which is used to indicate that the generator is approaching overload.

DIO INPUTS

These setpoints are not currently used. Currently programmed in the DIO module.

DIO OUTPUTS

These setpoints are not currently used. Currently programmed in the DIO module.

CONFIGURATION DATA

Contains the Engine Serial Number setpoint, which is read-only.

DISPLAY PREFERENCES

Setpoints determining the units used on the EMCP 4 display. Note that this does not affect the data as viewed on the Cat Service Tool. See Section 4.4

8 DIGITAL INPUTS

The EMCP 4.3 and 4.4 have eight programmable Digital Inputs and four isolated programmable Digital Inputs. The user programmable Digital Inputs are referenced to Battery (-) and will see a change in state at ~3VDC with a 1VDC hysteresis. The isolated user programmable Digital Inputs are all referenced to a common signal that is user supplied and will see a change in state at ~4VDC. This user supplied reference should be wired to pin 118 on the 120-pin connector of the EMCP 4.3 and 4.4.

In addition to the user programmable Digital Inputs, the EMCP 4.3 and 4.4 have dedicated Digital Inputs, both isolated and non-isolated. The dedicated isolated Digital Inputs are all referenced to a common signal that is user supplied and is the same as the user supplied reference wired to pin 118 on the 120-pin connector of the EMCP 4.3 and 4.4.

Table 4 outlines which functions are assigned to each of the dedicated inputs. A “Y” under a controller name indicates that the input is supported, while an “N/A” indicates it is not.

Input	EMCP 4.3	EMCP 4.4	Onscreen Label	Dedicated function
Dedicated Digital #1	Y	Y	A	Emergency Stop
Dedicated Digital #2	Y	Y	B	Remote Initiate
Dedicated Digital #3	N/A	Y	C	Gen CB Aux “A”
Dedicated Digital #4	N/A	Y	D	Gen CB Aux “B”
Dedicated Isolated Digital #1	N	Y	A	Group Start*
Dedicated Isolated Digital #2	N	Y	B	Gen CB Bell Alarm
Dedicated Isolated Digital #3	N	Y	C	Gen CB Trip Manual Command
Dedicated Isolated Digital #4	N	Y	D	Gen CB Close Manual Command

Table 4: Dedicated Input Assignments

*If using Group Start, Reduced Power Mode should NOT be used.

The other inputs are linked to functions that are called **SYSTEM EVENTS** and can be configured to trigger warnings or shutdowns in the EMCP 4. System Event configurations determine the EMCP 4 response to any supported event. For more information on Event Response Configurations, see Chapter 55.1.

The programming of the Digital Inputs starts by selecting a “Usage Type“. The rest of the programming is dependent upon what Usage Type is selected. Figure 17 summarizes the paths possible for Programming a Digital Input.

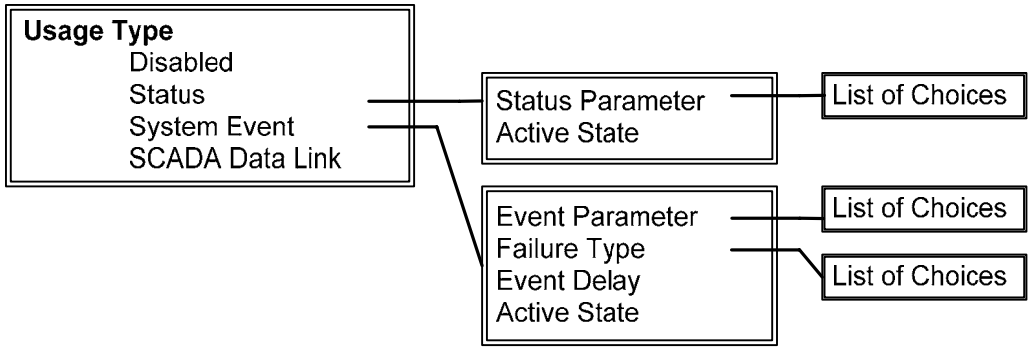


Figure 17: Digital Input Programming Paths

The Usage Type of **DISABLED** is used to completely disable the input. No status will be shown, and no action will be taken by the EMCP 4.

The Usage Type of **STATUS** is used to make certain system conditions be known by the EMCP 4; an example of a system condition is the Generator Breaker status.

The Usage Type of **SYSTEM EVENT** is used to inform the EMCP 4 of system conditions that require the EMCP 4 to trigger an event.

The Usage Type of **SCADA DATA LINK** is used to bring in data to the EMCP 4 for express use by the SCADA data link. EMCP 4 will not take any action or trigger any events on such an input.

The Digital Inputs of the EMCP 4 are tied to an internal pull-up resistor inside the controller. Therefore, if a Digital Input is **UNCONNECTED**, the Digital Input will sit at a **PHYSICAL HIGH** state. See Figure 18. Note that a Digital Input wired to battery positive will always remain Active if programmed for Active High, and will always remain Inactive if programmed for Active Low.

A battery negative input should be switched to each EMCP 4 Digital Input for proper operation.

If an **ACTIVE HIGH** configuration is desired, the ground or battery negative input should be wired through a normally-closed switch.

If an **ACTIVE LOW** configuration is desired, the ground or battery negative input should be wired through a normally-open switch.

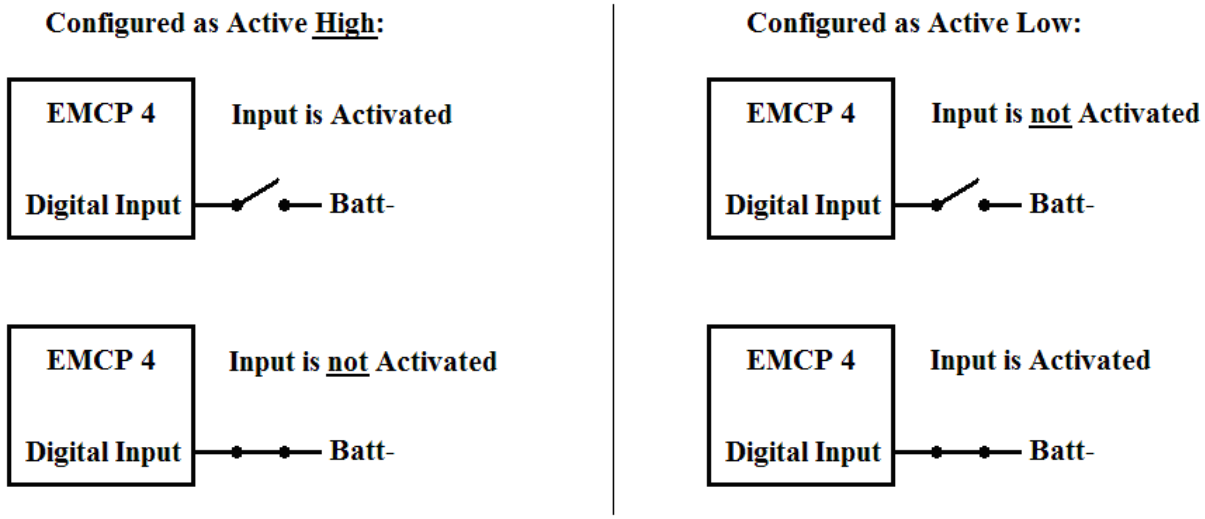


Figure 18: Valid States of Digital Input Wiring and Configuration

Note: Improper configuration of these inputs can cause a false event to be triggered, or cause an event to not be triggered when desired.

8.1 PROGRAMMING DIGITAL INPUTS USING THE DISPLAY

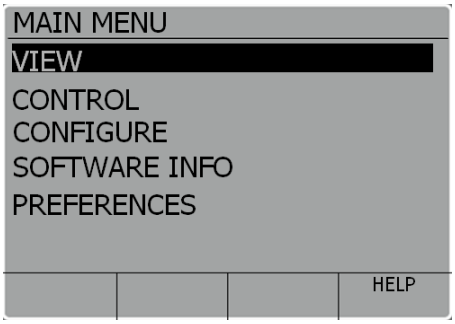
The steps to configure the Digital Inputs for each of the Usage Types are described below.

VIEWING THE CURRENT DIGITAL INPUT STATUS

To view the current status of a Digital Input, go through the following menu options:

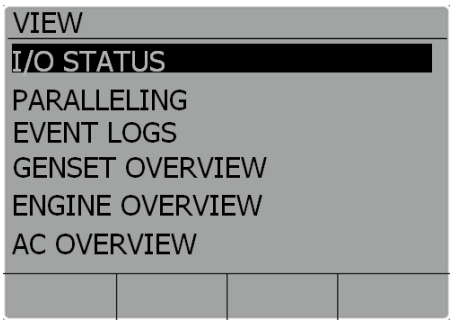
AT THE MAIN MENU, scroll **DOWN**  **TO VIEW**

Press the **OK KEY**  .



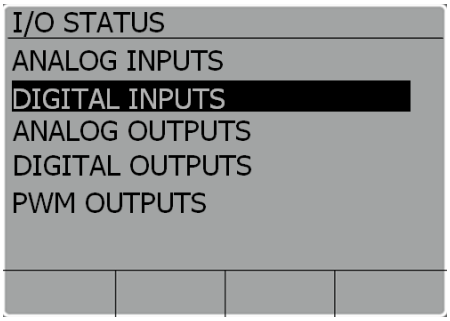
Scroll **DOWN**  to **I/O STATUS**

Press the **OK KEY**  .



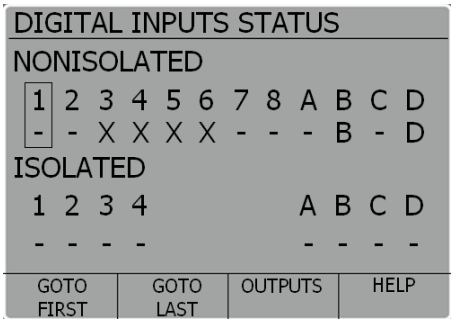
Scroll **DOWN**  to **DIGITAL INPUTS**

Press the **OK KEY**  .



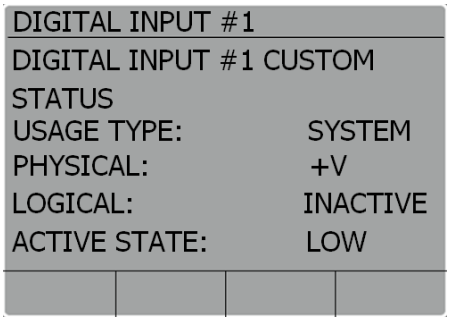
The status of all Digital Inputs is shown.

A dash under an input number (or letter) indicates an input that is programmed, but inactive. A large "X" under an input number (or letter) indicates an input that is disabled. A number (or letter) under an input number (or letter) indicates an input that is programmed and active.



With the **LEFT ARROW**  or **RIGHT ARROW**  , select the **DIGITAL INPUT** that you want to view, then press the **OK KEY**  .

The programmed parameters of the selected Digital Input are shown.

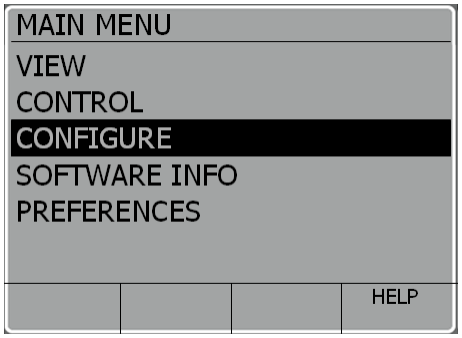


CONFIGURING DIGITAL INPUTS FOR STATUS PARAMETERS

Command or Status parameters are used to control specific functions within the control system or to make certain conditions within the system be known. To configure a Digital Input as a Command or Status Parameter, go through the following menu options:

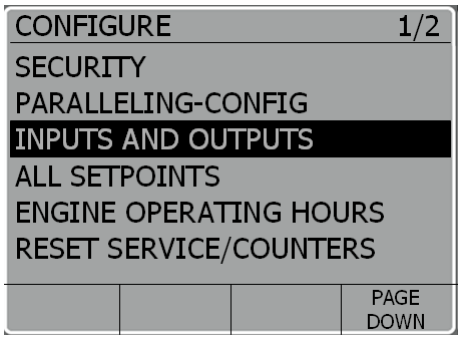
AT THE MAIN MENU, scroll **DOWN** **TO CONFIGURE**

Press the **OK KEY**.

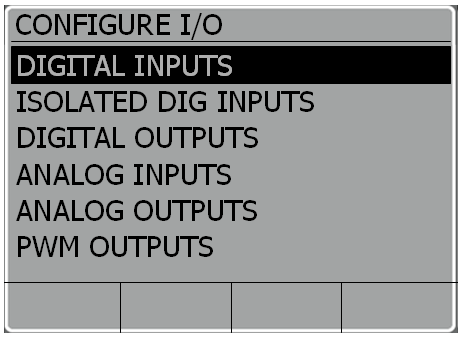


Scroll **DOWN** to **INPUTS & OUTPUTS**

Press the **OK KEY**.
Alternately, access to the **INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

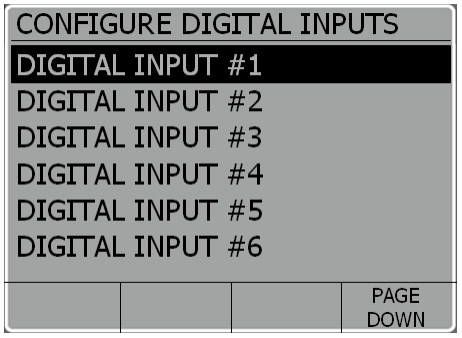


Press the **OK KEY** to access **DIGITAL INPUTS**.

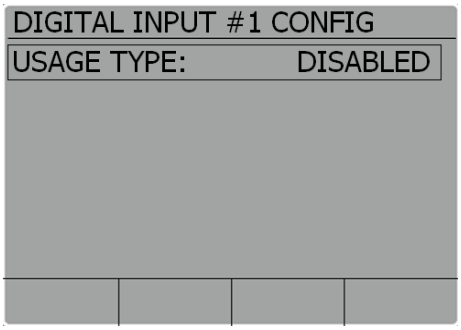


Select the **DIGITAL INPUT** that you want to program

Press the **OK KEY**.

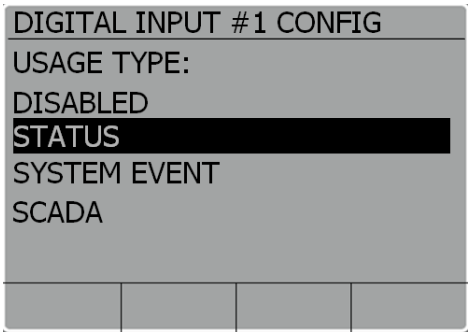


Press the **OK KEY** to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA)**.



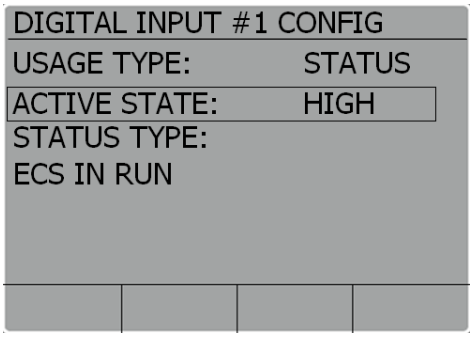
Scroll **DOWN** to **STATUS**

Press the **OK KEY**.



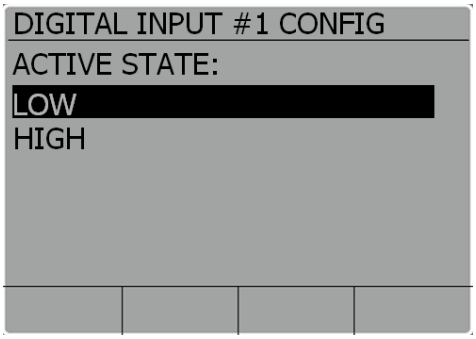
Scroll **DOWN** to **ACTIVE STATE**

Press the **OK KEY** to highlight the current **ACTIVE STATE.**



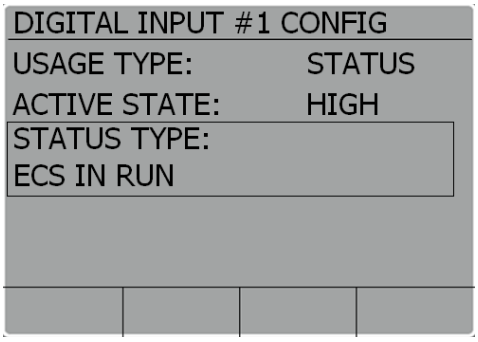
Select the **ACTIVE STATE** that you want to program and

Press the **OK KEY**.



Scroll **DOWN** to **STATUS TYPE**

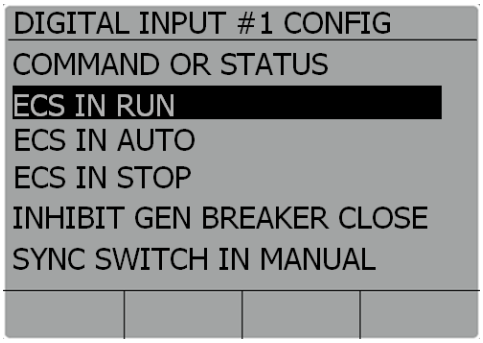
Press the **OK KEY** to highlight the current **STATUS TYPE.**



Select the **STATUS TYPE** that you want to program

Press the **OK KEY** 

.



Any Digital Input can be configured for any one of the Status parameters in Table 5:

ECS in Run*	Inhibit Cooldown
ECS in Auto*	Raise Voltage
ECS in Stop*	Lower Voltage
Inhibit Generator Breaker Closure (4.4)	Raise Speed
Sync Mode Switch in Manual (4.4)	Lower Speed
Sync Mode Switch in Auto (4.4)	Auto Load Fuel
Sync Mode Switch in Check (4.4)	kVAr Power Sharing Inhibit (4.4)
Idle Mode Command	Start Aid Timer Bypass

***If a Digital Input is programmed for ECS in Auto, or Run, or Stop, and a maintained switch latches that input to make it active, the front panel buttons will not have any effect.

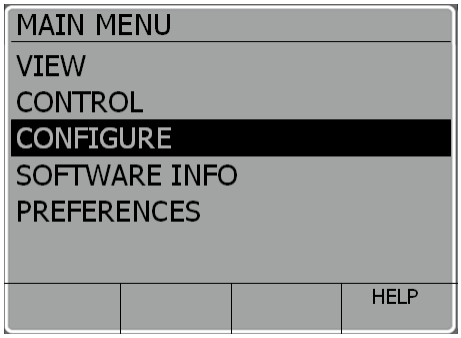
Table 5: Digital Input Status Choices

CONFIGURING DIGITAL INPUTS FOR SYSTEM EVENTS

System Events are used to know when specific conditions are reached and to alert the control system of warning or shutdown conditions. To configure a Digital Input as a System Event, go through the following menu options:

AT THE MAIN MENU, scroll down to **CONFIGURE**

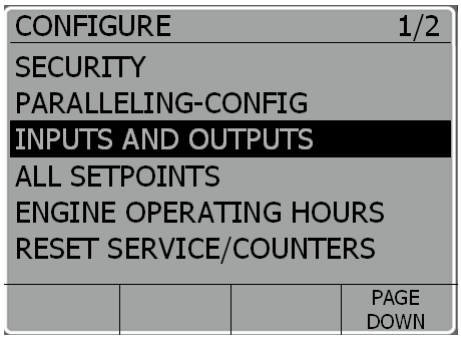
Press the **OK KEY**.



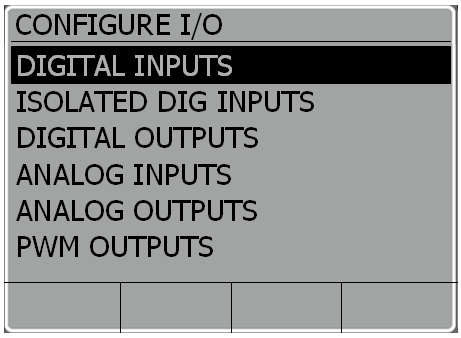
SCROLL DOWN to **INPUTS & OUTPUTS**

Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

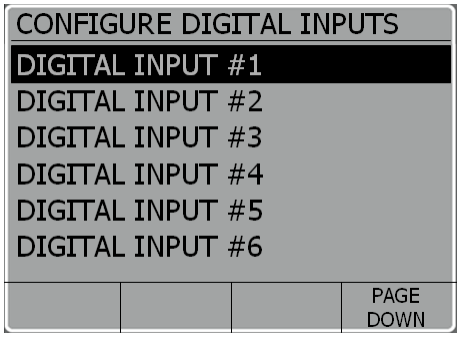


Press the **OK KEY** to access **DIGITAL INPUTS**.

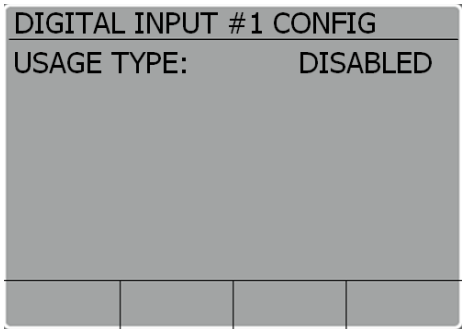


Select the **DIGITAL INPUT** that you want to program and

Press the **OK KEY**.

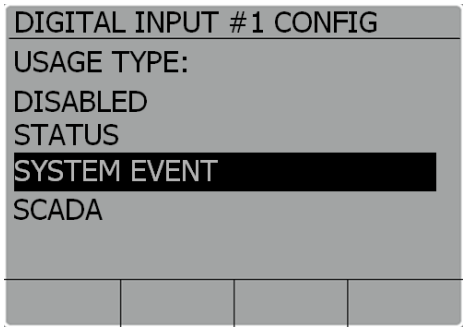


Press the **OK KEY** to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA)**.



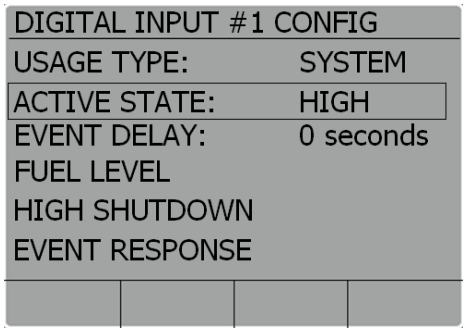
Scroll **DOWN** to **SYSTEM EVENT**

Press the **OK KEY**.



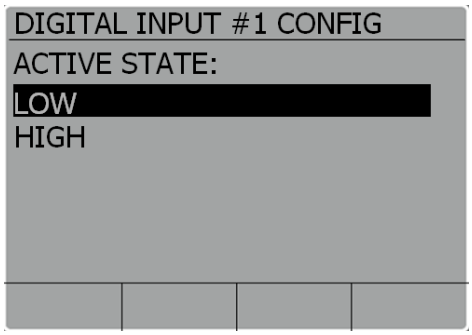
Scroll **DOWN** to **ACTIVE STATE**

Press the **OK KEY** to highlight the current **ACTIVE STATE**



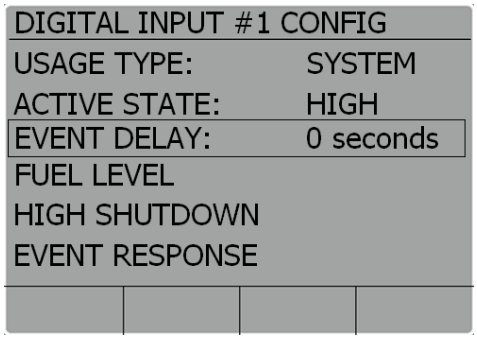
Select the **ACTIVE STATE** that you want to program and

Press the **OK KEY**.



Scroll **DOWN** to **EVENT DELAY.**

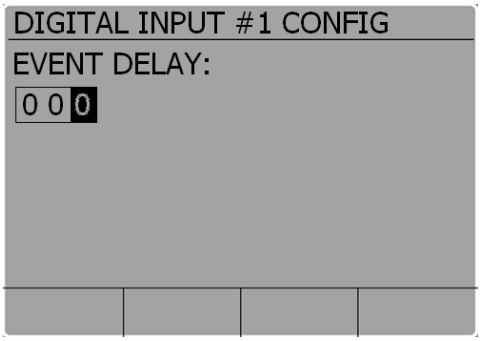
Press the **OK KEY** to highlight the current **EVENT DELAY.**



Select the **EVENT DELAY** that you want

Press the **OK KEY** 

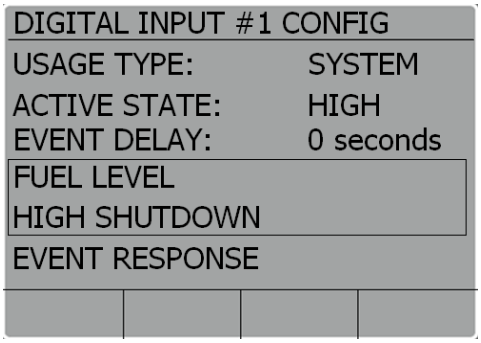
.



Scroll **DOWN**  to **EVENT PARAMETER**

Press the **OK KEY** 

to edit the current **STATUS PARAMETER.**



Select the type of **EVENT PARAMETER** that you want to program (Pressures, Temperatures, Levels, or Others)

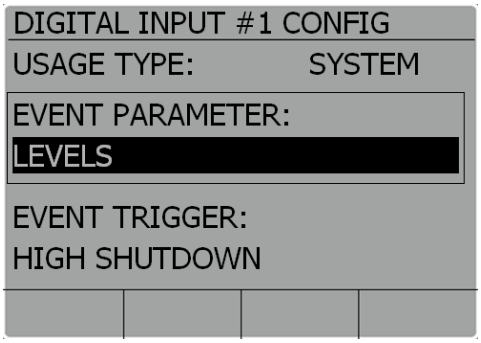
Press the **OK KEY** 

.

Select the **EVENT PARAMETER** that you want to program

Press the **OK KEY** 

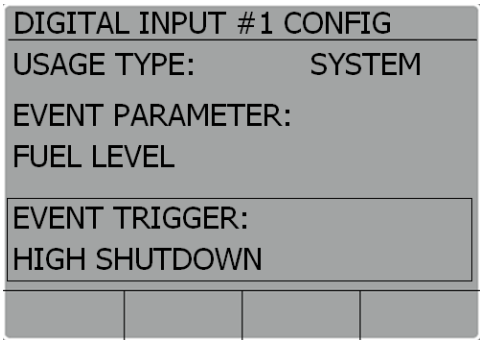
.



Scroll **DOWN**  to **EVENT TRIGGER.**

Press the **OK KEY** 

to highlight the current **EVENT TRIGGER.**



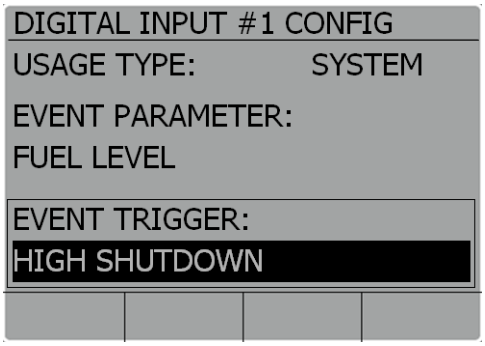
Select the **EVENT TRIGGER** that you want

Press the **OK KEY** 

.

Press the **ESC KEY** 

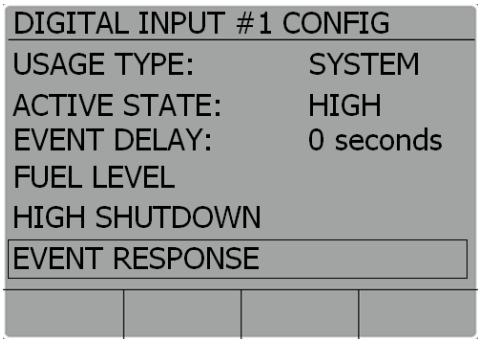
.



Scroll **DOWN**  to **EVENT RESPONSE.**

Press the **OK KEY** 

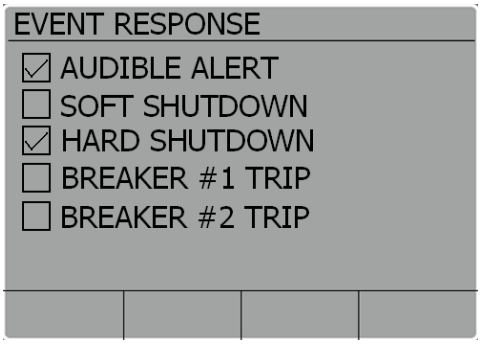
.



Select the **EVENT RESPONSE** that you want

Press the **OK KEY** 

.



Any Digital Input can be configured for any one of the System Event parameters in Table 6:

Pressures	**Others**
Engine Oil Pres	Custom Event
Gas Pressure	Air Dmpr Closed
Temperatures	Batt Chrgr Fail
Eng Coolant Temp	Fuel Leak
Engine Oil Temp	Earth Fault
Exhaust Temp	Earth Leakage
Gen Rear Brg Tmp	Bat Chg Sys Volt
Gen Windg #1 Tmp	Gen Bkr Closed (EMCP 4.3 only)
Levels	Gen Bkr Open (EMCP 4.3 only)
Eng Coolant Lvl	Gen Current
Engine Oil Level	Gen Output Power
Fuel Level	In Man Chrg Comb
Ext Tank Fuel Lvl	EPS Supply Load
	Emrg Stop Switch

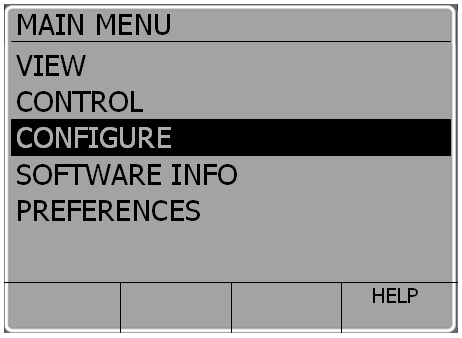
Table 6: Digital Input System Events

CONFIGURING DIGITAL INPUTS FOR SCADA DATA LINK

When a Digital Input is configured for SCADA Data Link, the state of the input will be placed into the appropriate MODBUS register. No alarms or warnings will be generated by the EMCP. To configure a Digital Input for SCADA Data Link, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

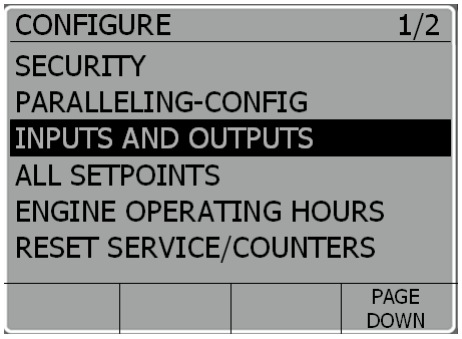
Press **OK KEY**



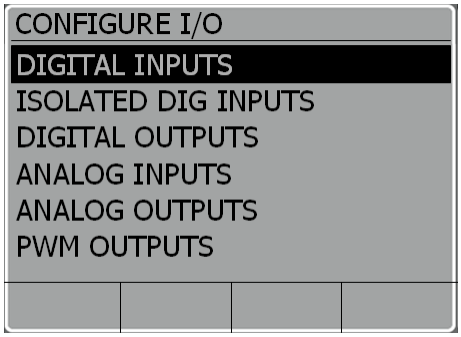
SCROLL DOWN to inputs & outputs

Press **OK KEY**

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

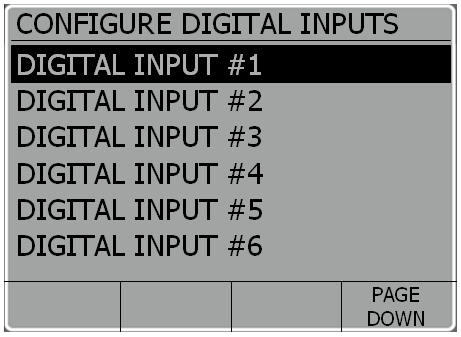


Press **OK KEY**  to access **DIGITAL INPUTS**

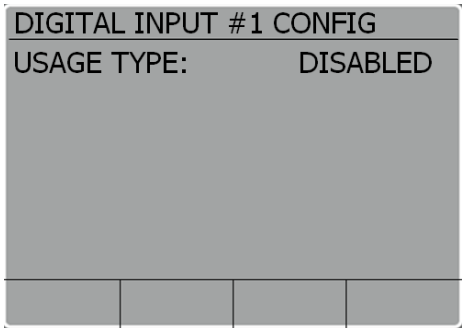


Select the **DIGITAL INPUT** that you want to program and

Press the **OK KEY**  .



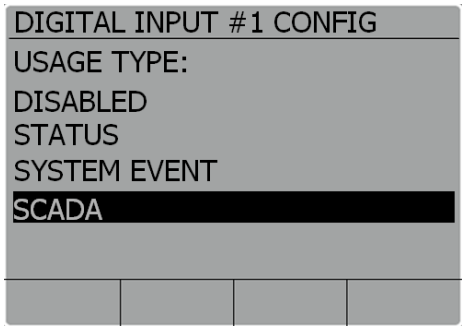
Press the **OK KEY**  to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA)**.



Scroll **DOWN**  to:

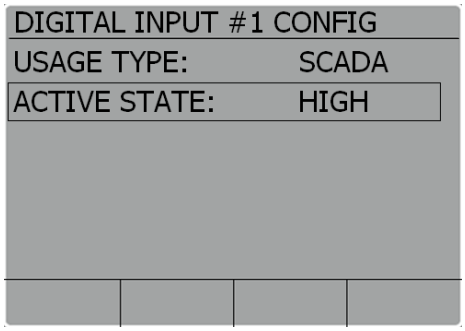
SCADA

Press the **OK KEY**  .



Scroll **DOWN**  to **ACTIVE STATE**

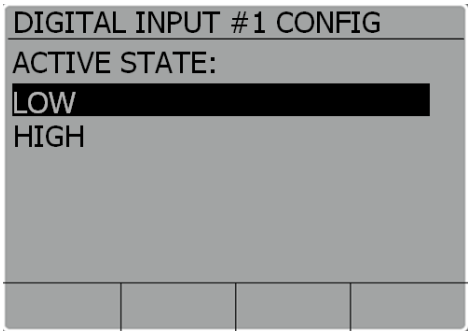
Press the **OK KEY**  to highlight the current **ACTIVE STATE.**



Select the **ACTIVE STATE** that you want to program

Press the **OK KEY** 

.



For information on reading the status of Digital Inputs via MODBUS, please refer to the SCADA documentation.

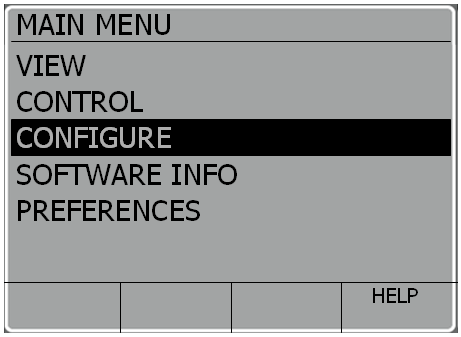
DISABLING DIGITAL INPUTS

To disable a Digital Input, go through the following menu options:

AT THE MAIN MENU, scroll down  **TO CONFIGURE**

Press the **OK KEY** 

.

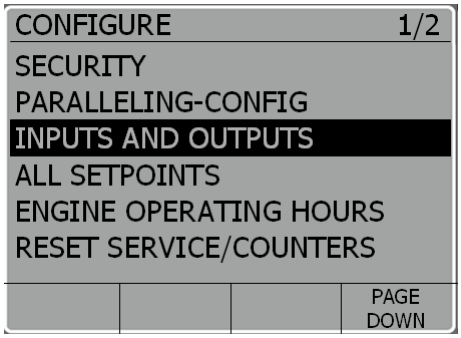


SCROLL DOWN  to **INPUTS & OUTPUTS**

Press the **OK KEY** 

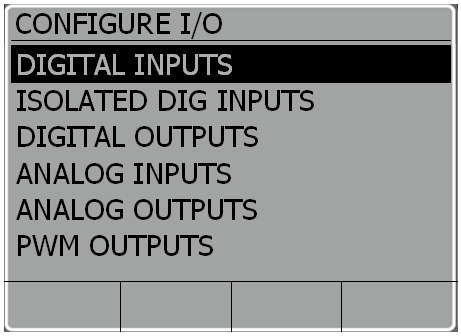
.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



Press the **OK KEY** 

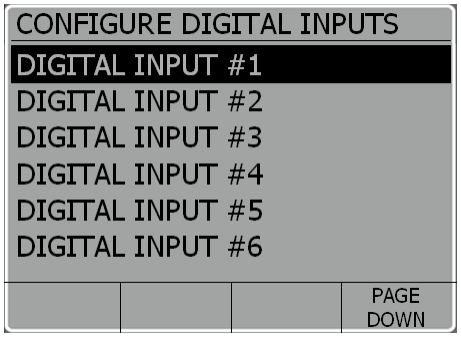
to access **DIGITAL INPUTS**.



Select the **DIGITAL INPUT** that you want to program and

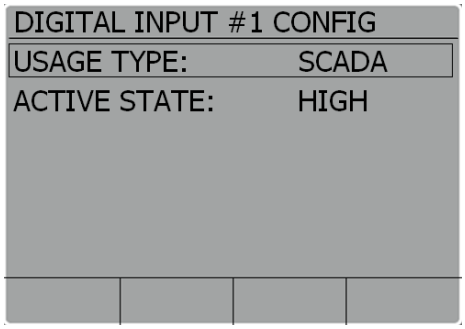
Press the **OK KEY** 

.



Press the **OK KEY** 

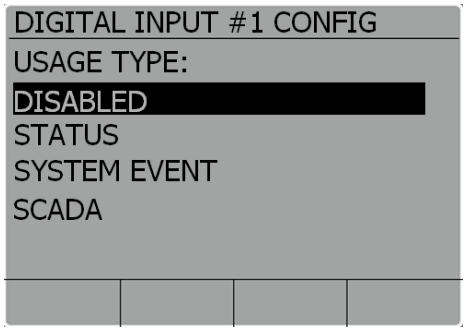
to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA)**.



Scroll **DOWN**  to **DISABLED**

Press the **OK KEY** 

.

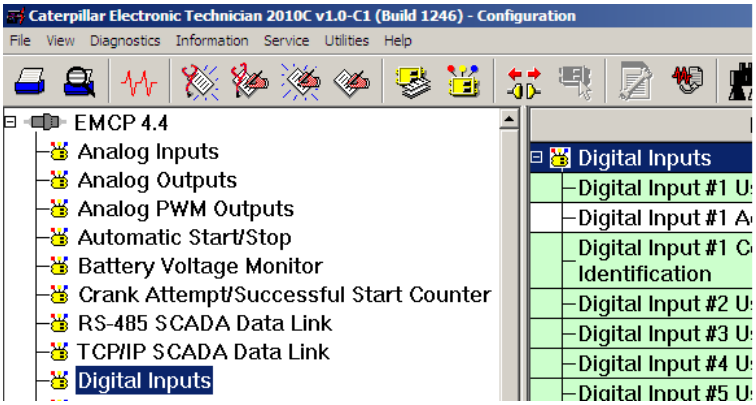


Note: If a Digital Input is set to **Disabled**, then any faults or events on that input will not be broadcast or annunciated on the network.

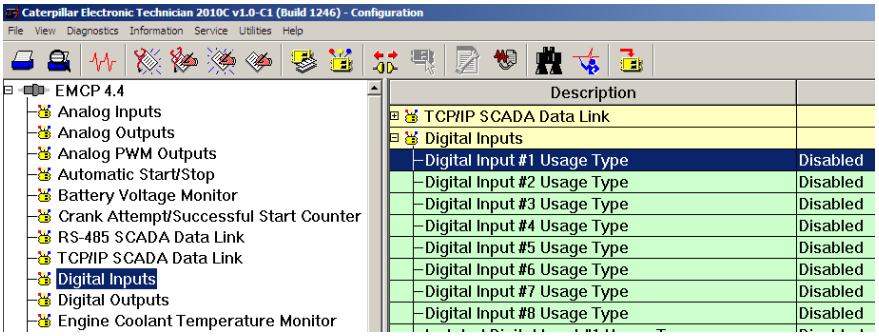
8.2 PROGRAMMING DIGITAL INPUTS USING THE CAT SERVICE TOOL

The EMCP 4 Digital Inputs can be configured using the Cat Service Tool. The key to programming them is to program the setpoints related to each input in order from top to bottom. To program an input, do the following steps:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Digital Inputs on the left.



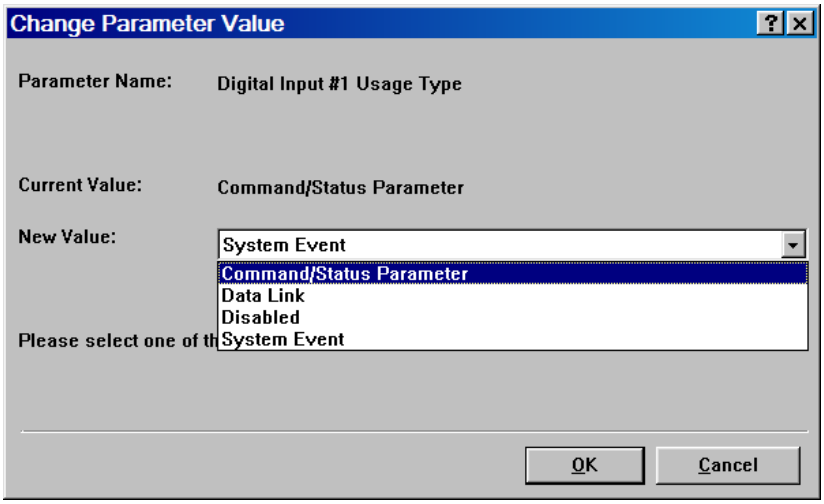
3. Determine which input is to be configured. For example, all of the setpoints for Digital Input #1 have the text “#1” in their name.



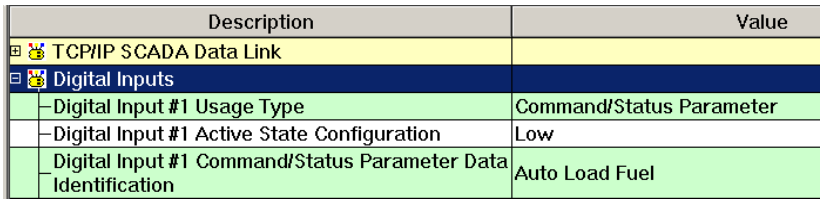
4. Next follow the steps below according to which Usage Type is desired.

CONFIGURING DIGITAL INPUTS FOR STATUS PARAMETER

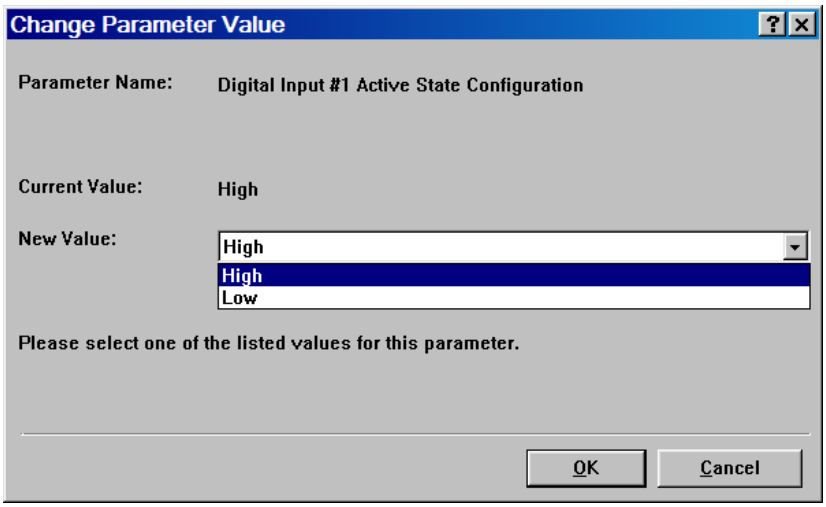
1. Double click the Digital Input #N Usage type to change this value to Command/Status Parameter from the drop down menu. Click the OK button to program.



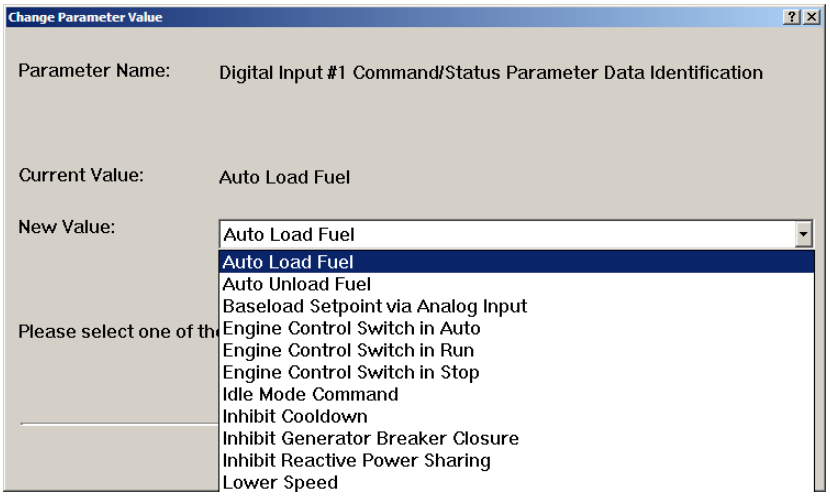
2. The Digital Input #N Command/Status Parameter Data Identification and Active State Configuration parameters will now be visible in the right pane.



3. Configure the Active State Configuration setpoint according to your wiring – either active High or active Low. Click the OK button to program.



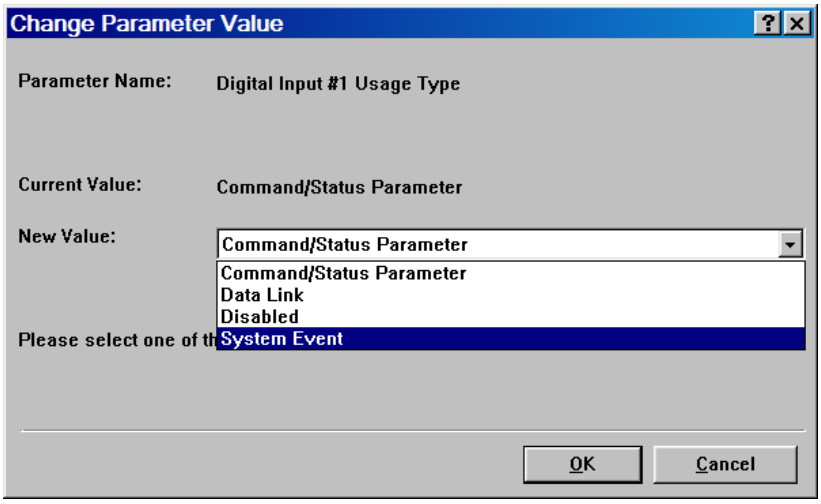
4. Double click the Configure the Command/Status Parameter Data Identification setpoint to change this value from the drop down menu. Click the OK button to program.



See Table 5 in Section 8.1 for a complete list of possible Status Parameter Data Identifications.

CONFIGURING DIGITAL INPUTS FOR SYSTEM EVENTS

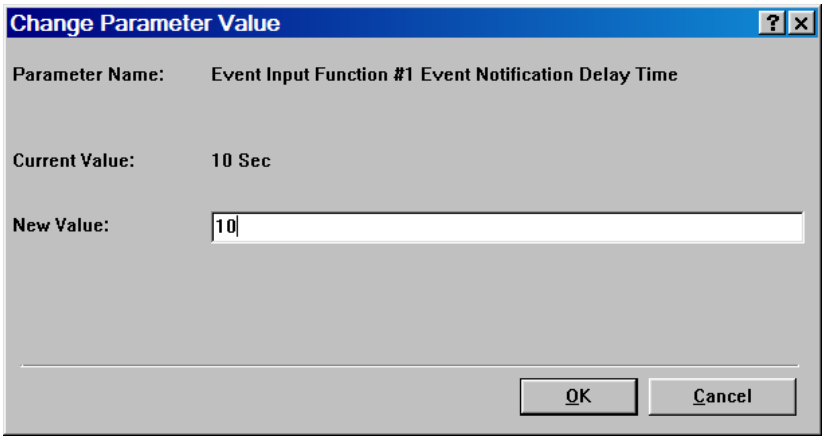
1. Double click the Digital Input #N Usage type to change this value to System Event from the drop down menu. Click the OK button to program.



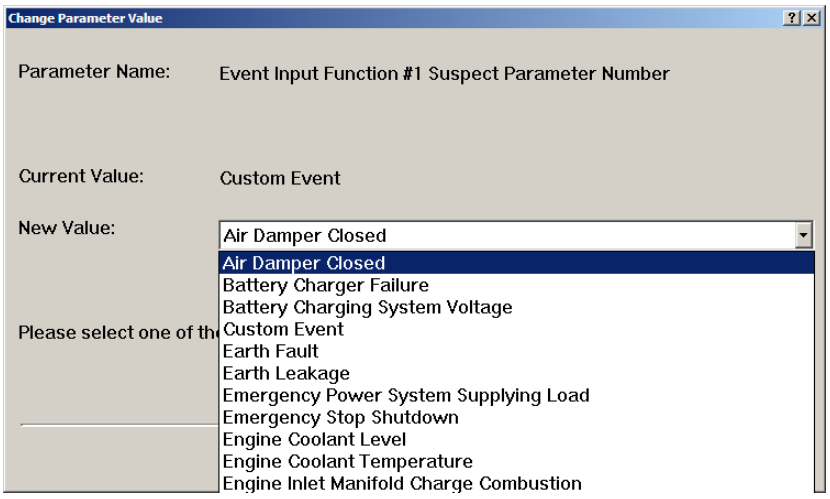
2. The Event Input Function #N Event Notification Delay Time, Suspect Parameter Number (SPN), Failure Mode Identifier (FMI) and Active State Configuration parameters will now be visible in the right pane.

Description	Value
Digital Inputs	
Digital Input #1 Usage Type	System Event
Digital Input #1 Active State Configuration	Low
Event Input Function #1 Event Notification Delay Time	0 sec
Event Input Function #1 Suspect Parameter Number	Custom Event
Event Input Function #1 Failure Mode Identifier	Condition Exists

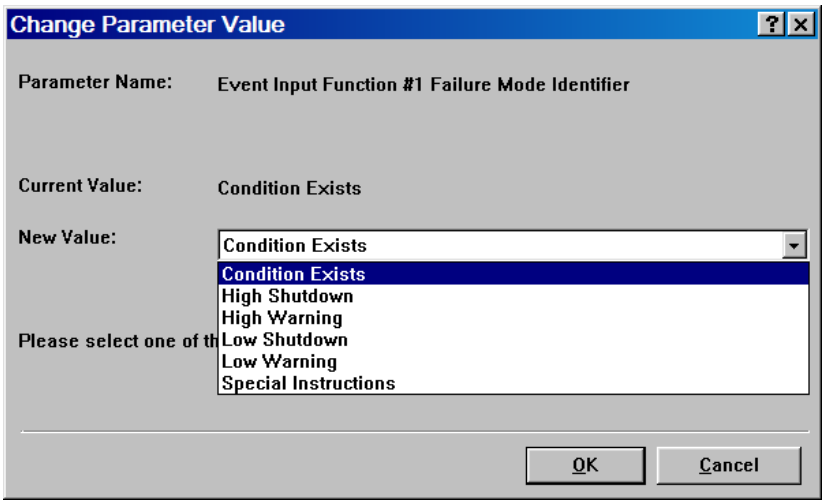
3. Double click the Event Input Function #N Event Notification Delay Time setpoint to change this value. Click the OK button to program.



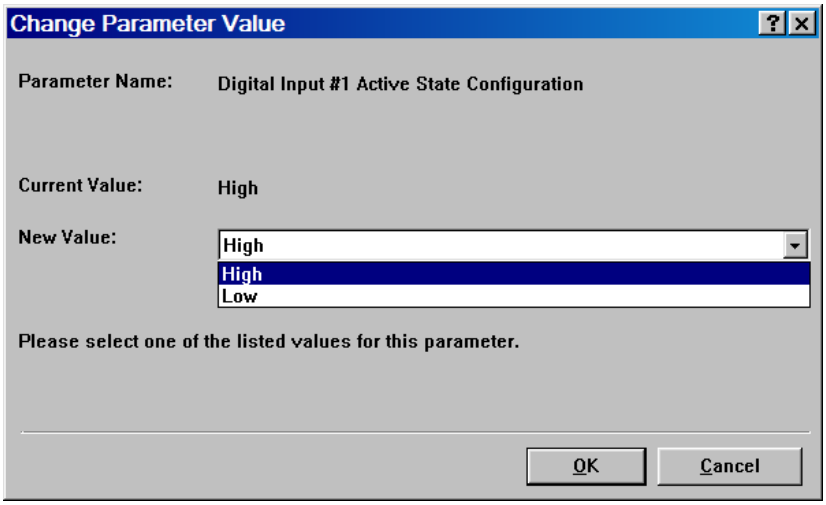
4. Double click the Event Input Function #N Suspect Parameter Number (SPN) setpoint to change this value from the drop down menu. Click the OK button to program.



5. Double click the Event Input Function #N Failure Mode Identifier (FMI) setpoint to change this value from the drop down menu. Click the OK button to program.



6. Configure the Active State Configuration setpoint according to your wiring – either active High or active Low. Click the OK button to program.



7. Once the input is set with an SPN and FMI, the Event Response Configuration may have to be checked. For information on Event Response Configurations and how to program them, see Chapter 5.

Not all SPN and FMI combinations are valid. Table 7 indicates which FMIs are valid for which SPNs. If a combination other than one indicated with a “Y” in the table above is configured, the event will not trigger any response by the EMCP 4. The EMCP 4 may not give the option of an invalid FMI for a given SPN. In Cat ET, there is no restriction on the SPN/FMI combination. An invalid combination in Cat ET will result in an “Out of Range” error.

Category	Suspect Parameter Number	Failure Mode Identifier Valid Options				
		High Shutdown	**Low Shutdown**	**High Warning**	**Low Warning**	**Status**
Pressures	Engine Oil Pressure	Y (4.4 only)	Y	Y (4.4 only)	Y	Y*
	Gas Pressure	Y	Y	Y	Y	
Temperatures	Engine Coolant Temperature	Y	Y (4.4 only)	Y	Y	
	Engine Oil Temperature	Y	Y	Y	Y	
	Exhaust Temperature	Y	Y	Y	Y	
	Generator Rear Bearing Temperature	Y	Y	Y	Y	
	Generator Winding #1 Temperature	Y		Y		
Levels	Engine Coolant Level	Y	Y	Y	Y	
	Engine Oil Level	Y	Y	Y	Y	
	Fuel Level	Y	Y	Y	Y	
	External Tank Fuel Level	Y	Y	Y	Y	
Others	Air Damper Closed	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Battery Charging System Voltage	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y	
	Battery Charger Failure	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Custom Event (see note below)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Earth Fault	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Earth Leakage	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Emrg Stop Switch	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y*
	EPS Supply Load	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Fuel Leak	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y
	Gen Bkr Closed (EMCP 4.3 only)					Y
	Gen Bkr Open (EMCP 4.3 only)					Y
	Generator Current	Y	Y	Y	Y	
	Generator Power	Y (4.4 only)	Y	Y	Y	
	In Man Chrg Comb	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y (4.4 only)	Y

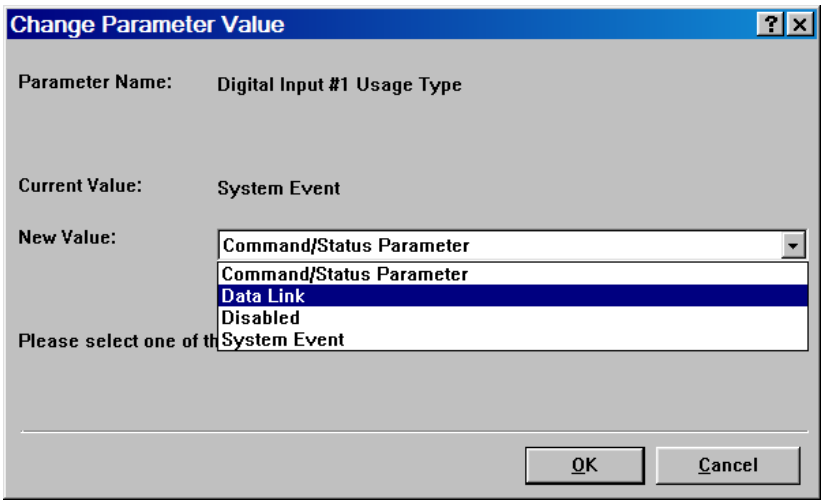
Table 7: Event Input Function SPN and FMI Options

*This status is FMI 14 (Special Instruction), not FMI 31 (Condition Exists).

Note: For Custom Events, each input can only trigger the custom event number that matches the Digital Input number (Digital Input #1 can only activate Custom Event #1, etc).

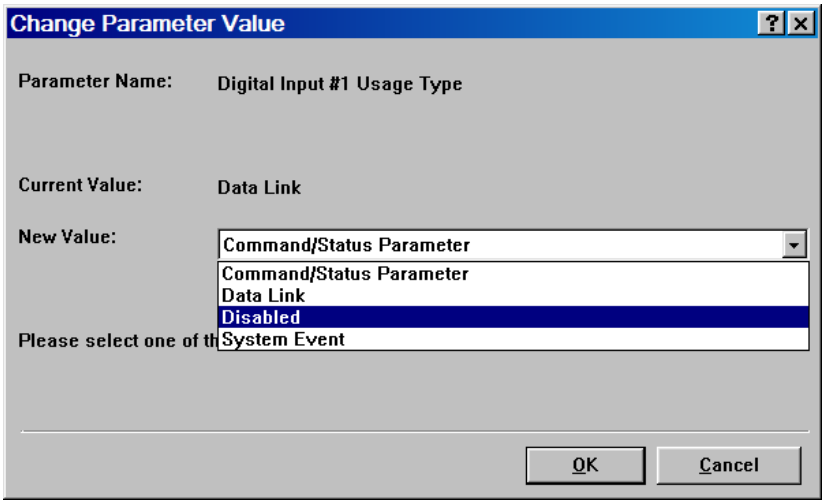
CONFIGURING DIGITAL INPUTS FOR SCADA DATA LINK

1. Double click the Digital Input #N Usage type to change this value to Data Link from the drop down menu. Click the OK button to program.



DISABLING DIGITAL INPUTS

1. Double click the Digital Input #N Usage type to change this value to Disabled from the drop down menu. Click the OK button to program.



9 ANALOG INPUTS

The EMCP 4.3 supports three (EMCP 4.4 supports four) 2-wire (plus shield) individually isolated Analog Inputs. None of these inputs are dedicated to specific functions. These are individually selectable +/- 10V bipolar, PWM, Resistive Sender or current (0-20mA) inputs for interface to senders, customer signals, etc. For resistive senders, the negative signal is tied to the negative pin on the controller for that sender. The modes of operation are described below:

- Voltage mode: The input impedance is a minimum of 1M Ohms (see Table 10 in Section 9.3).
- PWM Mode: approximately 500 Hz, non-synchronized, 5VDC peak, 0.5% accuracy or better with software selectable sub-ranges.
- Current Mode: The input impedance is a minimum of 50 Ohms and maximum of 250 Ohms with software selectable sub-ranges.
- Resistive Sender (VDO) Mode: 0-2000 Ohms, with 1% accuracy or 0.5 Ohms, whichever is worse.

For the EMCP 4.3 and 4.4, each of these Analog Inputs have an individual isolated power supply capable of supplying up to 50mA, are software configurable as 5V or 8V, and have overload protection. These supplies are to be used to provide power to sensors if required by the source power pin and Analog Input negative. These supplies are isolated from battery negative.

See Electrical Connections Section 3.5 for illustrations on how to connect the sensors to the control.

Analog Inputs programmed to monitor pressures should be wired to sensors that read gauge, not absolute pressure, unless absolute pressure is desired.

For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Chapter 5).

The first and second Analog Inputs are configured by default for non-electronic engines to monitor engine oil pressure and engine coolant temperature, respectively, and are protected by Level 3 security. The third and fourth Analog Inputs are protected at Level 2 security. For help on programming the Level 3 password prior to running this procedure, see Chapter 6, Security. Alternately, the Cat Service Tool can be used to program these setpoints.

Note: If the Analog Inputs are set to **DISABLED**, then any sensor faults or events will not be broadcast or annunciated on the network.

Note: If more than one Analog Input is configured for the same physical quantity (i.e. the setpoint Analog Input Data Identification matches between two Analog Inputs), then the lowest numbered Analog Input value will be displayed on the Engine Overview screen. For example, if both Analog Input #2 and Analog Input #3 are configured for oil temperature, but the sensor is connected only to Analog Input #3 (and Analog Input #2 is left open), an open circuit diagnostic will result. The Engine Overview screen will display the value from Analog Input #3. Warnings and Shutdowns will be monitored for both Analog Inputs. **When troubleshooting inputs, always make sure to check for configuration conflicts!**

The Analog Inputs are not used for electronic engines that use ADEM™ A3, A4 or newer, engine ECM. On these engines, the engine oil pressure sensor and the engine coolant temperature sensors are wired to the engine ECM and not to the generator set control. In order to receive the sensor information from the data link instead of from sensors wired into the EMCP 4, the setpoints Engine Oil Pressure Sensor Configuration and Engine Coolant Temperature Sensor Configuration must be set to Data Link. If they are not set this way, the sensor values on the Engine Overview screen on the EMCP 4 display will show ******** (asterisks).

Note: Improper configuration of these inputs can cause a false event to be triggered, or cause an event to not be triggered when desired. If a user disables an input without including other external protection, or disables the annunciation of an enabled input, detection will not be available. If a spare input is enabled, but not wired to a sensor, a false event may occur.

The programming of the Analog Inputs starts by selecting a “Usage Type“. The rest of the programming is dependent upon what Usage Type is selected. Figure 19 summarizes the paths possible for Programming an Analog Input.

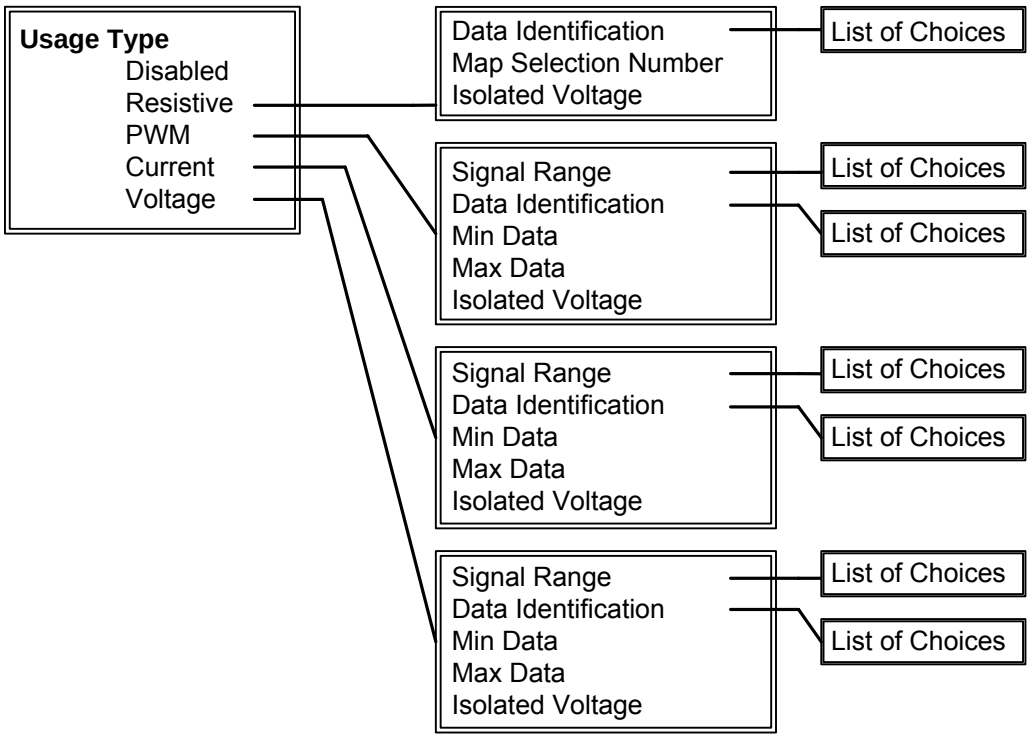


Figure 19: Analog Input Programming Paths

9.1 PROGRAMMING ANALOG INPUTS USING THE DISPLAY

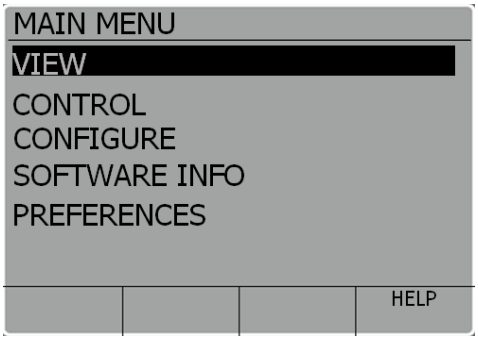
The steps to configure the Analog Inputs for each of the Usage Types are described below. Level 3 security is required for Analog Inputs #1 and #2. Level 2 security is required for Analog Input #3 and #4.

VIEWING THE CURRENT ANALOG INPUT STATUS

To view the current status of an Analog Input, go through the following menu options:

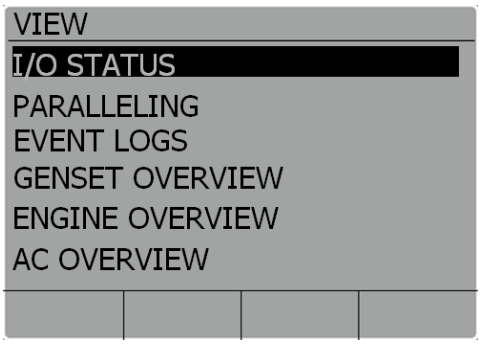
AT THE MAIN MENU, scroll **DOWN**  **TO VIEW**

Press the **OK KEY**  .



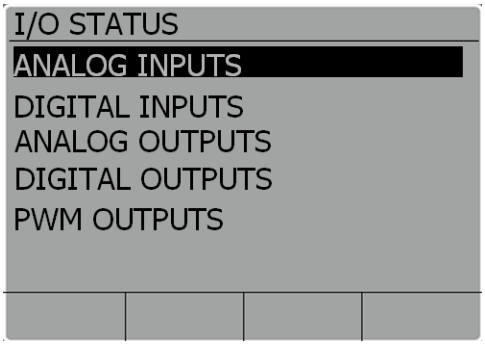
Scroll **DOWN**  to **I/O STATUS**

Press the **OK KEY**  .



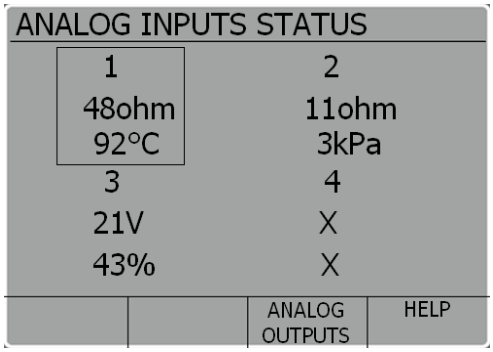
Scroll **DOWN**  to **ANALOG INPUTS**

Press the **OK KEY**  .



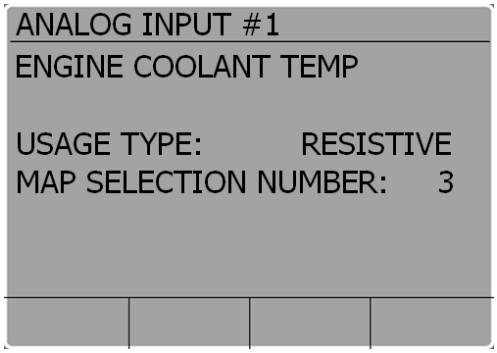
The status of all Analog Inputs is shown.

A dash under an input number indicates an input that is programmed, but inactive. A large “X” under an input number indicates an input that is disabled. A number under an input number indicates an input that is programmed and active.



With the arrow keys, select the **ANALOG INPUT** that you want to view, then press the **OK KEY** OK.

The programmed parameters of the selected Analog Input are shown.

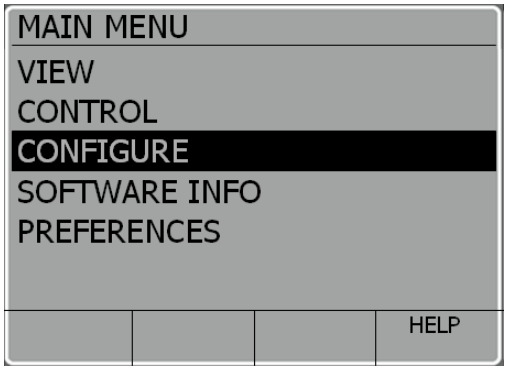


CONFIGURING ANALOG INPUTS FOR RESISTIVE MODE

To configure an Analog Input for Resistive Mode, go through the following menu options:

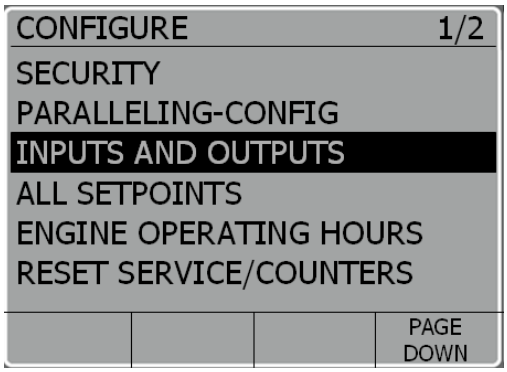
AT THE MAIN MENU, scroll down to **CONFIGURE**

Press the **OK KEY** OK.



SCROLL DOWN to **INPUTS & OUTPUTS**

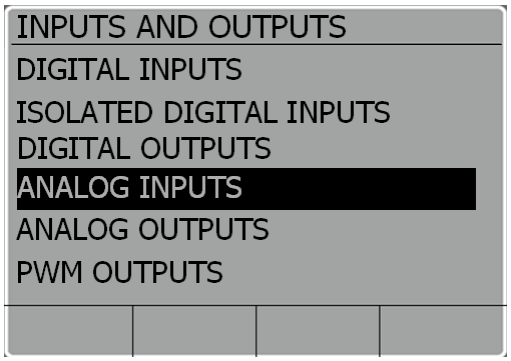
Press the **OK KEY** OK.



SCROLL DOWN  to **ANALOG INPUTS**

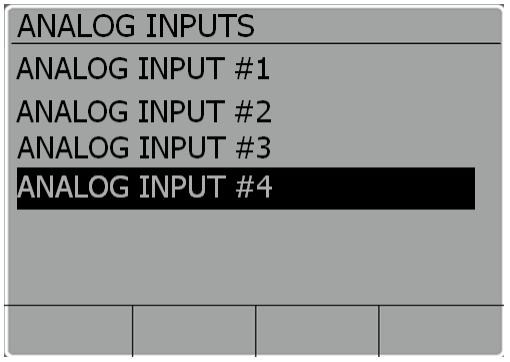
Press the **OK KEY**  .

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

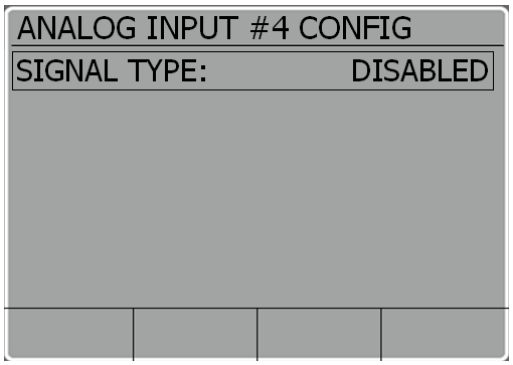


Select the **ANALOG INPUT** that you want to program

Press the **OK KEY**  .

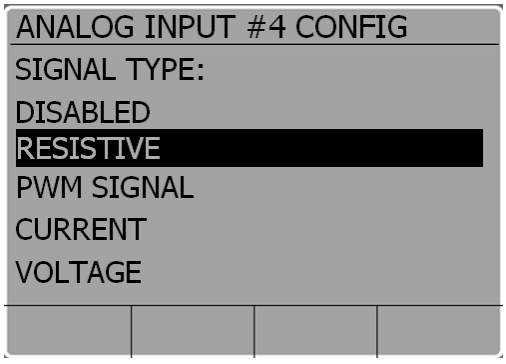


Press the **OK KEY**  to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE**).



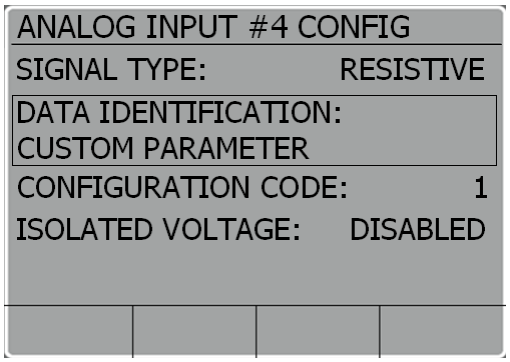
Scroll **DOWN**  to **RESISTIVE**

Press the **OK KEY**  .



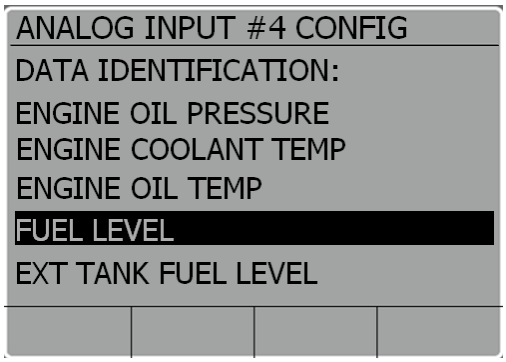
Scroll **DOWN** to **DATA IDENTIFICATION**

Press the **OK KEY** to change the current **DATA IDENTIFICATION.**



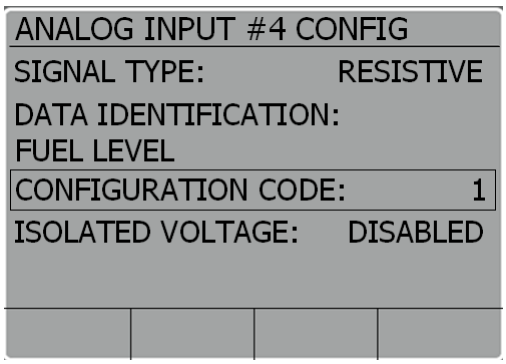
Select the **DATA IDENTIFICATION** that you want to program

Press the **OK KEY**.



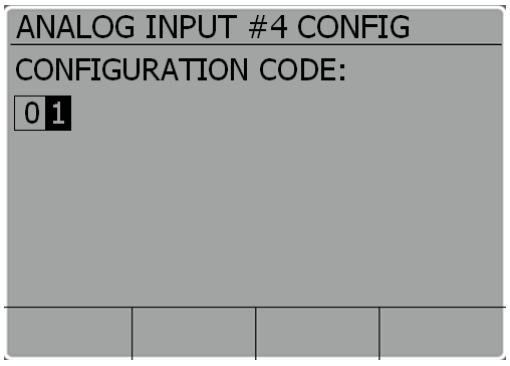
Scroll **DOWN** to **CONFIGURATION CODE**

Press the **OK KEY** to change the current **CONFIGURATION CODE.**



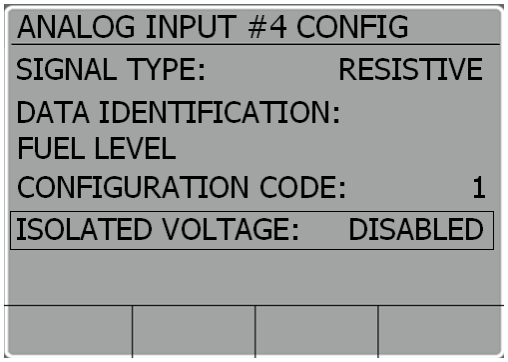
Select the **CONFIGURATION CODE** that you want to program

Press the **OK KEY**.



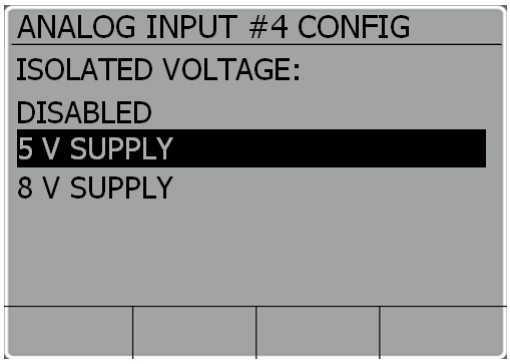
Scroll **DOWN** to **ISOLATED VOLTAGE**

Press the **OK KEY** to change the current **ISOLATED VOLTAGE.**



Select the **ISOLATED VOLTAGE** that you want to program

Press the **OK KEY**.



The Data Identification will remain the same when switching between Resistive or Voltage.

Any Analog Input can be configured for any one of the Data Identification parameters in Table 8:

Engine Oil Pres	Utility PF Reading (4.4 Only)
Eng Coolant Temp	Desired Gen PF (4.4 Only)
Engine Oil Temp	Base Load Setpoint (4.4 Only)
Engine Fuel Level	Custom Parameters 1-3
Ext Tank Fuel Level	Data Link – SCADA
Urea Level	Engine Speed Control
Utility kW Reading (4.4 Only)	Gen Voltage Control
Utility kVAr Reading (4.4 Only)	

Table 8: Analog Input Data Identifications

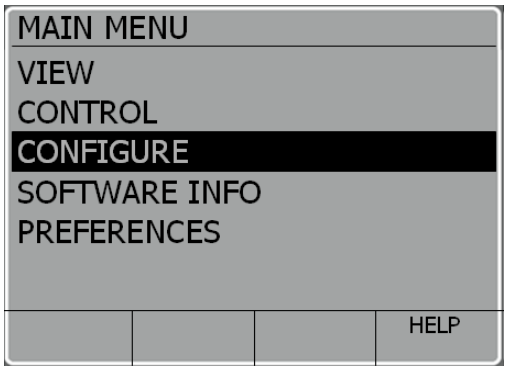
The Sensor Codes correspond to sensor maps as defined in Section 9.3.

CONFIGURING ANALOG INPUTS FOR PWM MODE

To configure an Analog Input for PWM Mode, go through the following menu options:

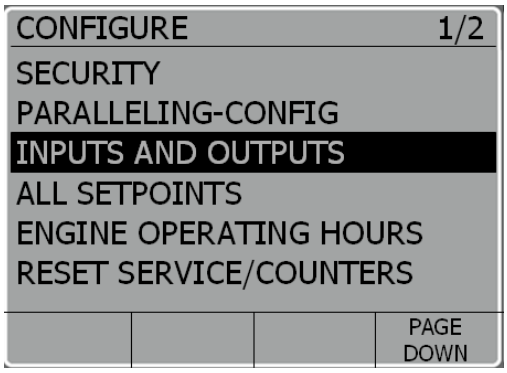
AT THE MAIN MENU, scroll down to **CONFIGURE**

Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

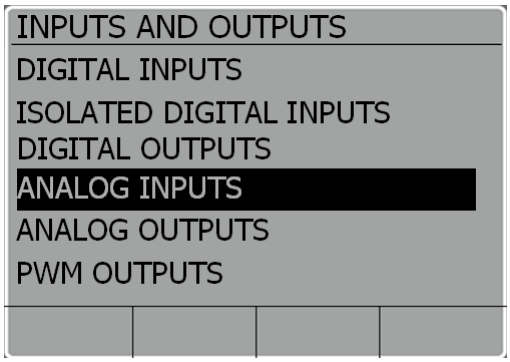
Press the **OK KEY**.



SCROLL DOWN to **ANALOG INPUTS**

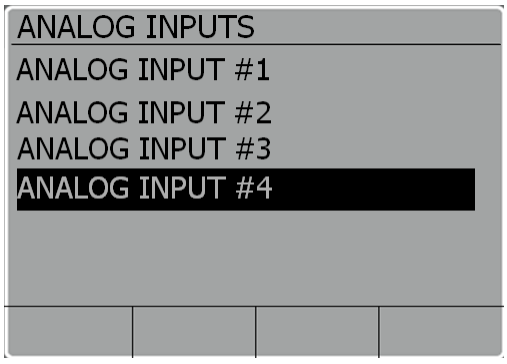
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

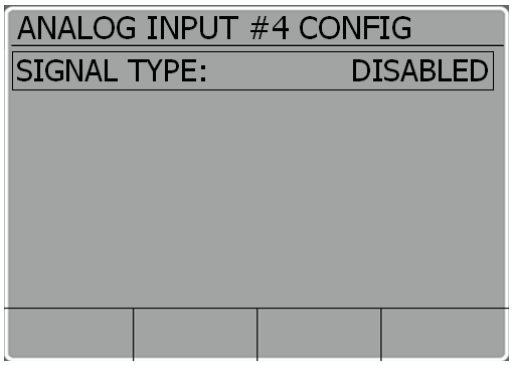


Select the **ANALOG INPUT** that you want to program

Press the **OK KEY**.

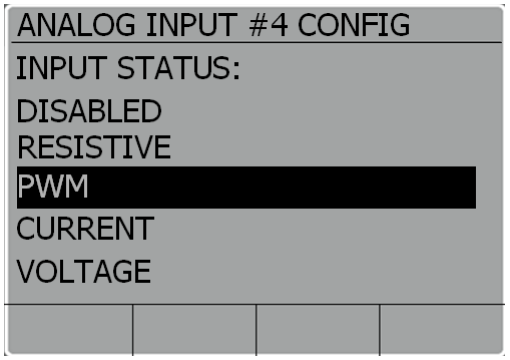


Press the **OK KEY** to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE)**.



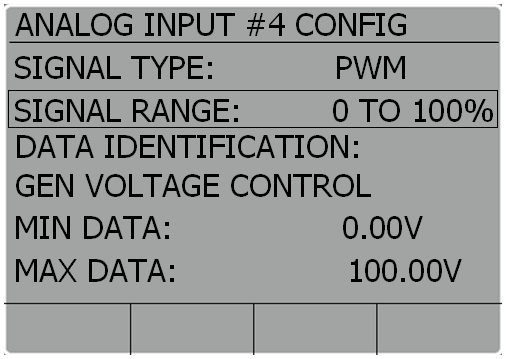
Scroll **DOWN** to **PWM**

Press the **OK KEY**.



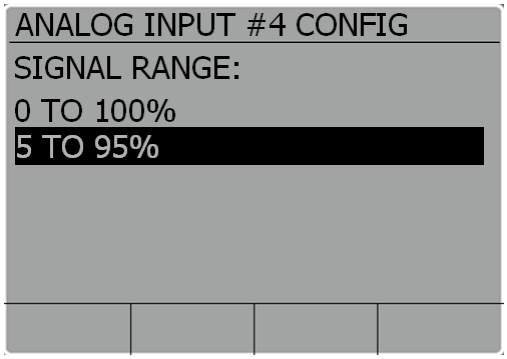
Scroll **DOWN** to **SIGNAL RANGE**

Press the **OK KEY** to change the current **SIGNAL RANGE.**



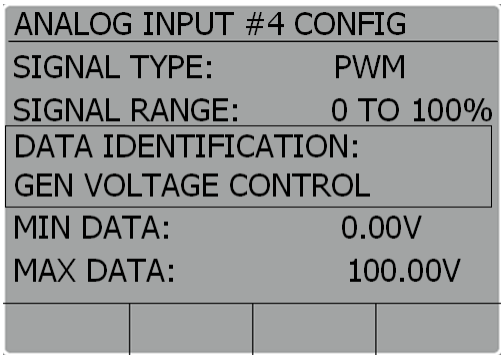
Select the **SIGNAL RANGE** that you want to program

Press the **OK KEY**.



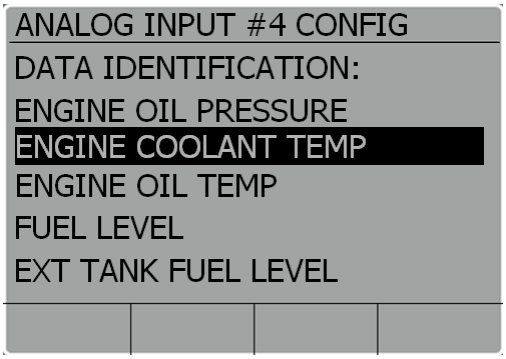
Scroll **DOWN** to **DATA IDENTIFICATION**

Press the **OK KEY** to change the current **DATA IDENTIFICATION.**



Select the **DATA IDENTIFICATION** that you want to program

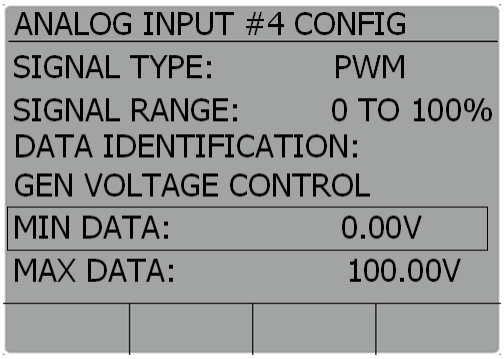
Press the **OK KEY**.



Scroll **DOWN** to **MIN DATA**

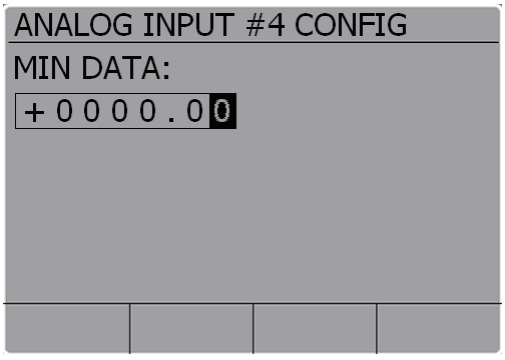
Press the **OK KEY** to change the current **MIN DATA.**

For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).



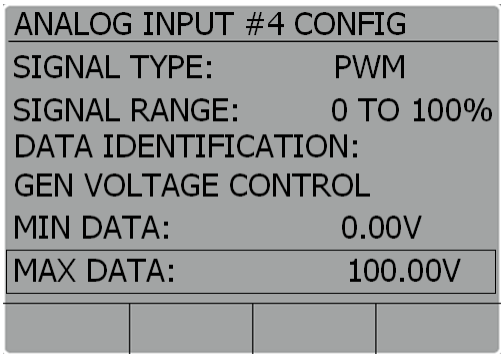
Select the **MIN DATA** that you want to program

Press the **OK KEY**.



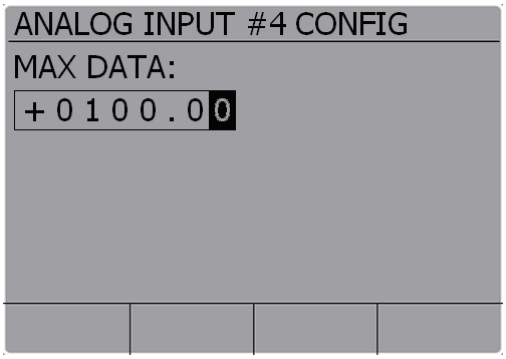
Scroll **DOWN**  to **MAX DATA**

Press the **OK KEY**  to change the current **MAX DATA.**



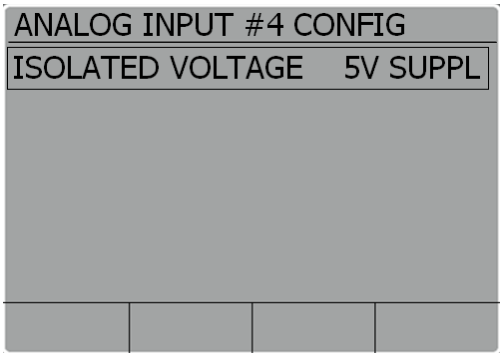
Select the **MAX DATA** that you want to program

Press the **OK KEY**  .



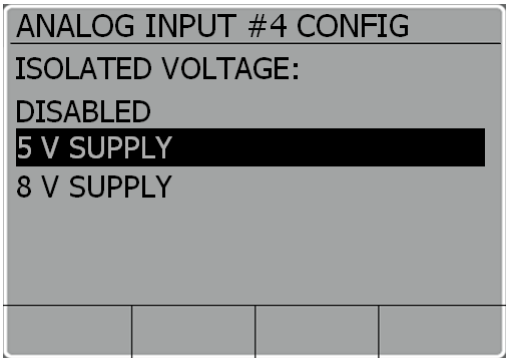
Scroll **DOWN**  to **ISOLATED VOLTAGE**

Press the **OK KEY**  to change the current **ISOLATED VOLTAGE.**



Select the **ISOLATED VOLTAGE** that you want to program

Press the **OK KEY**  .

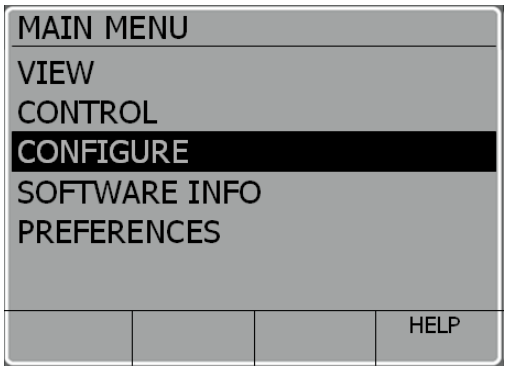


CONFIGURING ANALOG INPUTS FOR CURRENT MODE

To configure an Analog Input for Current Mode, go through the following menu options:

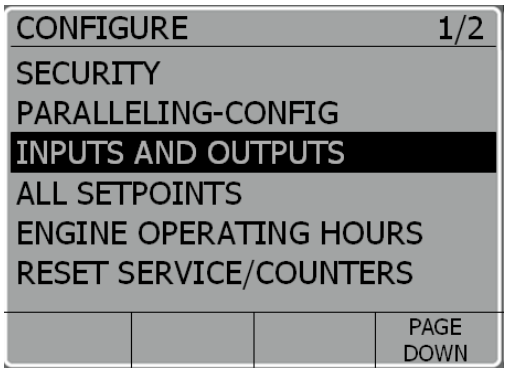
AT THE MAIN MENU, scroll down to **CONFIGURE**

Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

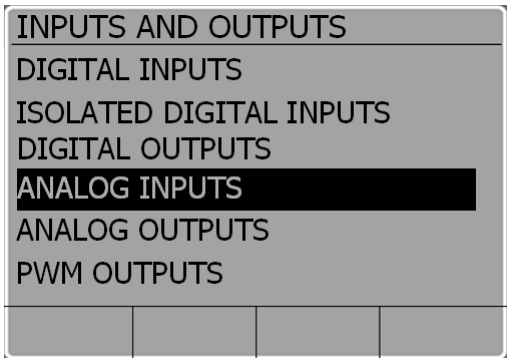
Press the **OK KEY**.



SCROLL DOWN to **ANALOG INPUTS**

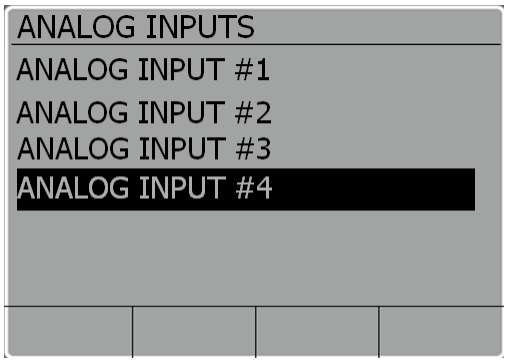
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

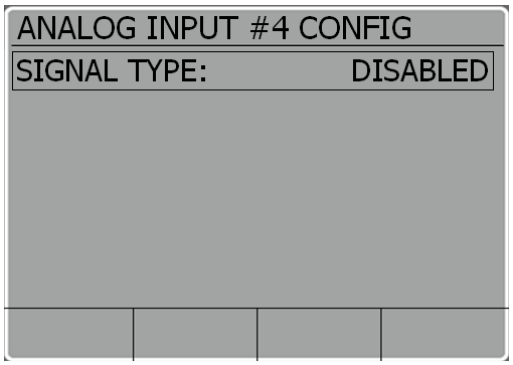


Select the **ANALOG INPUT** that you want to program

Press the **OK KEY**.

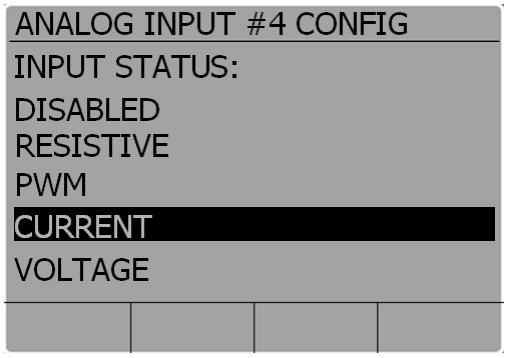


Press the **OK KEY** to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE)**.



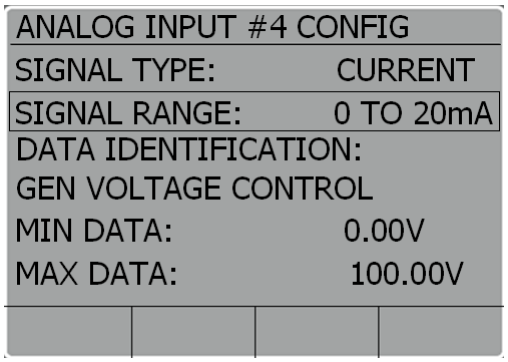
Scroll **DOWN** to **CURRENT**

Press the **OK KEY**.



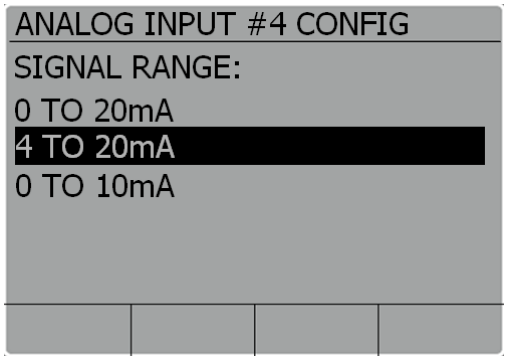
Scroll **DOWN** to **SIGNAL RANGE**

Press the **OK KEY** to change the current **SIGNAL RANGE.**



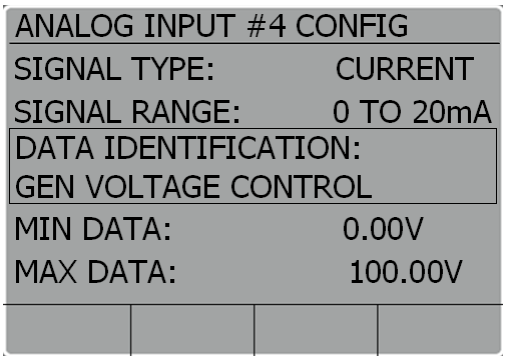
Select the **SIGNAL RANGE** that you want to program

Press the **OK KEY**.



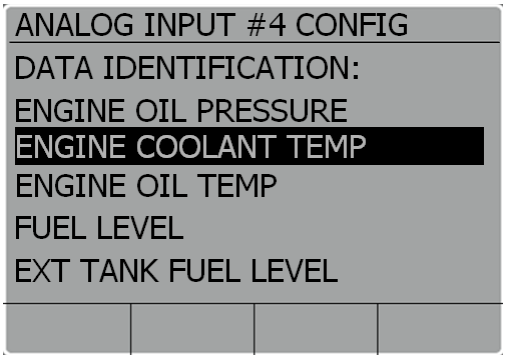
Scroll **DOWN** to **DATA IDENTIFICATION**

Press the **OK KEY** to change the current **DATA IDENTIFICATION.**



Select the **DATA IDENTIFICATION** that you want to program

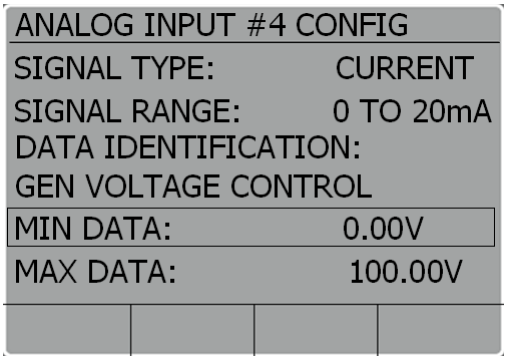
Press the **OK KEY**.



Scroll **DOWN** to **MIN DATA**

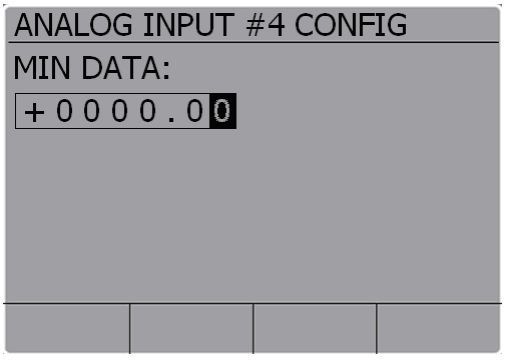
Press the **OK KEY** to change the current **MIN DATA.**

For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).



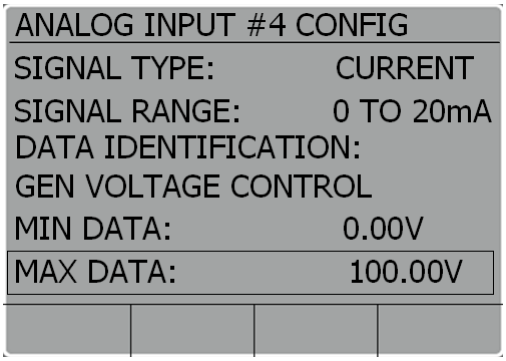
Select the **MIN DATA** that you want to program

Press the **OK KEY**.



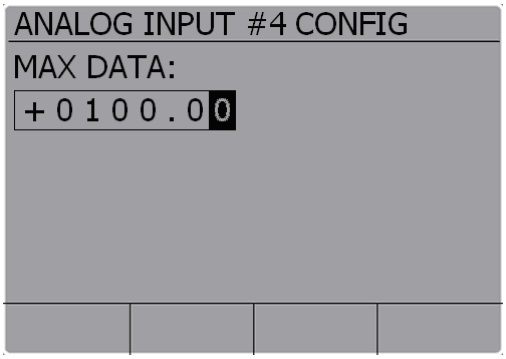
Scroll **DOWN** to **MAX DATA**

Press the **OK KEY** to change the current **MAX DATA.**



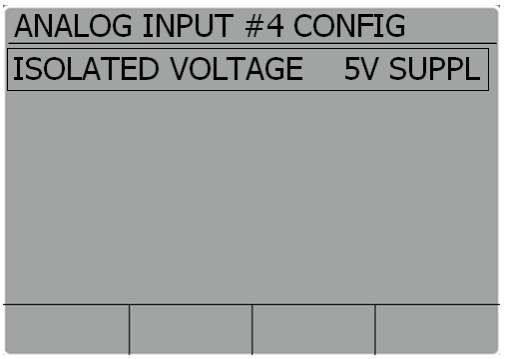
Select the **MAX DATA** that you want to program

Press the **OK KEY**.



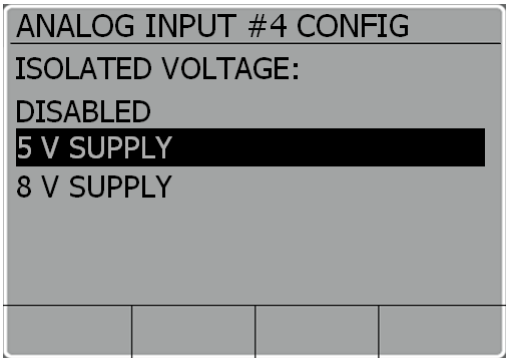
Scroll **DOWN** to **ISOLATED VOLTAGE**

Press the **OK KEY** to change the current **ISOLATED VOLTAGE.**



Select the **ISOLATED VOLTAGE** that you want to program

Press the **OK KEY**.

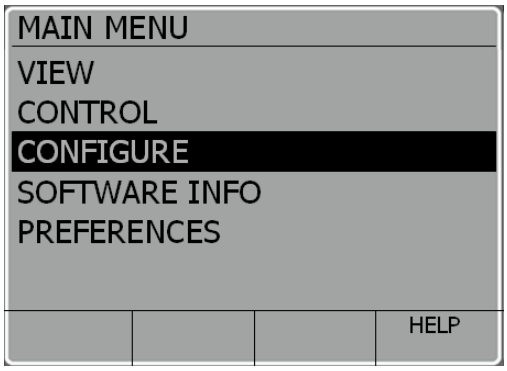


CONFIGURING ANALOG INPUTS FOR VOLTAGE MODE

To configure an Analog Input for Voltage Mode, go through the following menu options:

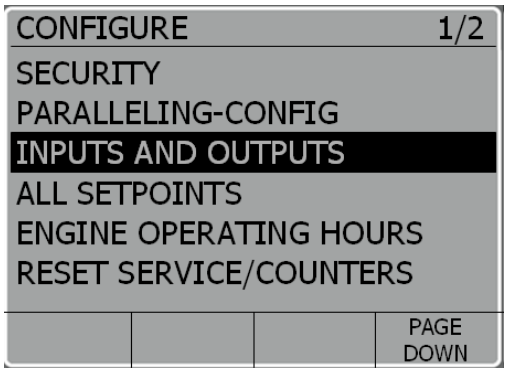
AT THE MAIN MENU, scroll down to **CONFIGURE**

Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

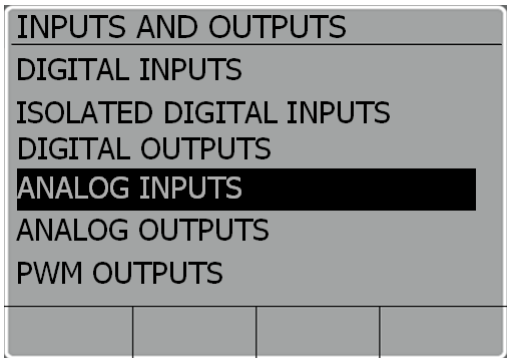
Press the **OK KEY**.



SCROLL DOWN to **ANALOG INPUTS**

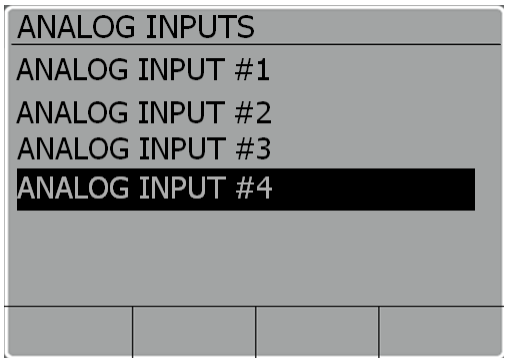
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

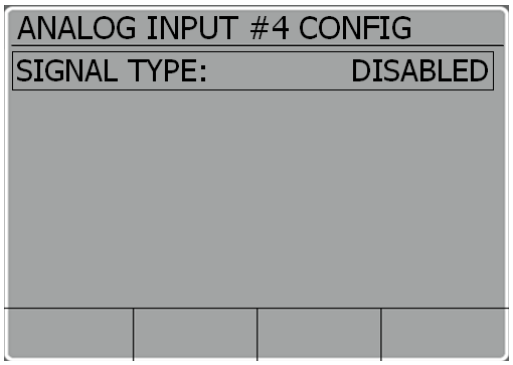


Select the **ANALOG INPUT** that you want to program

Press the **OK KEY**.

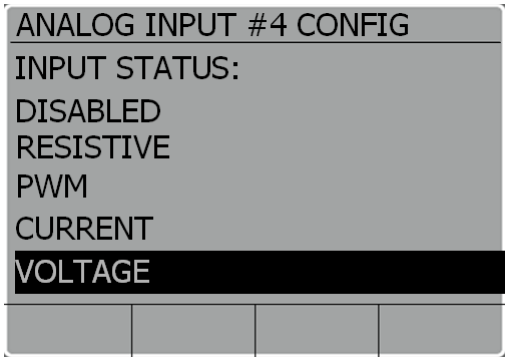


Press the **OK KEY** to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE)**.



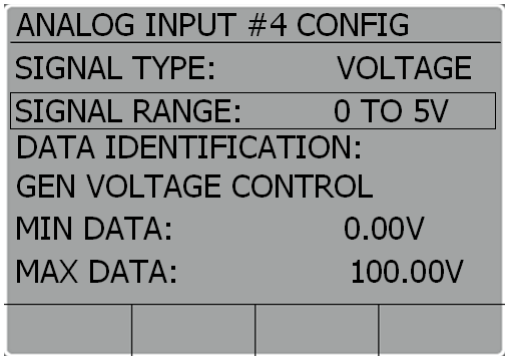
Scroll **DOWN** to **VOLTAGE**

Press the **OK KEY**.



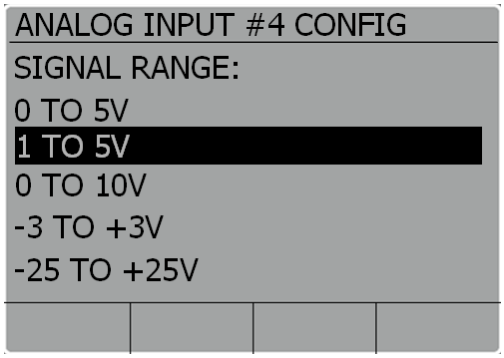
Scroll **DOWN** to **SIGNAL RANGE**

Press the **OK KEY** to change the current **SIGNAL RANGE.**



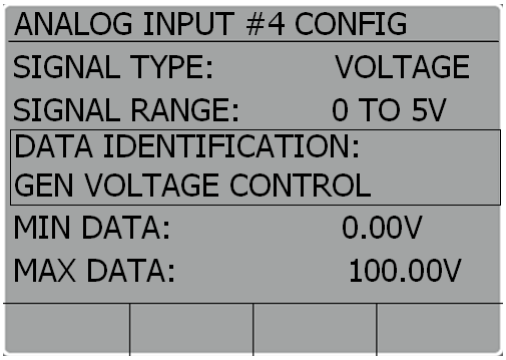
Select the **SIGNAL RANGE** that you want to program

Press the **OK KEY**.



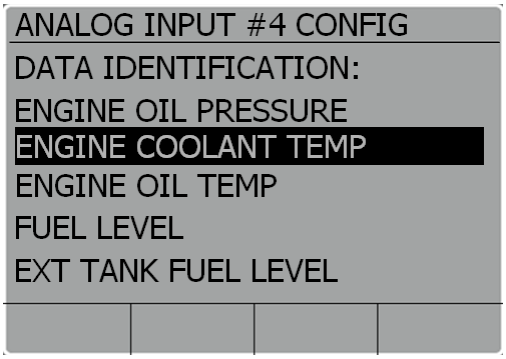
Scroll **DOWN** to **DATA IDENTIFICATION**

Press the **OK KEY** to change the current **DATA IDENTIFICATION.**



Select the **DATA IDENTIFICATION** that you want to program

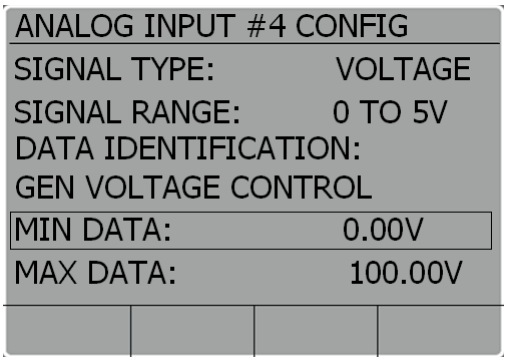
Press the **OK KEY**.



Scroll **DOWN** to **MIN DATA**

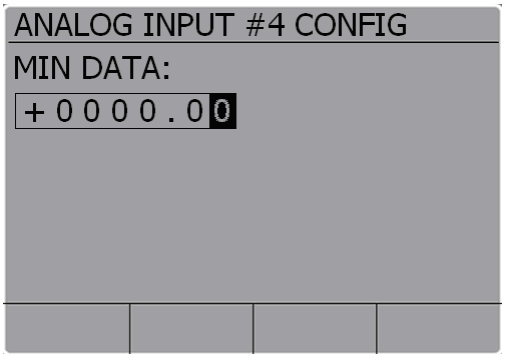
Press the **OK KEY** to change the current **MIN DATA.**

For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).



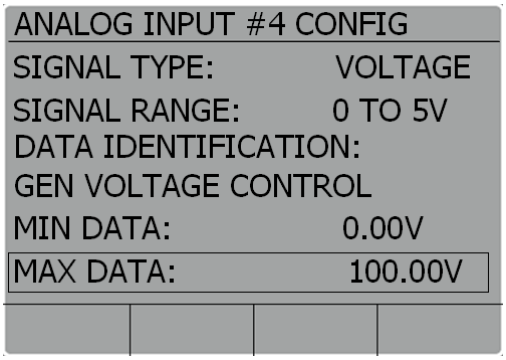
Select the **MIN DATA** that you want to program

Press the **OK KEY**.



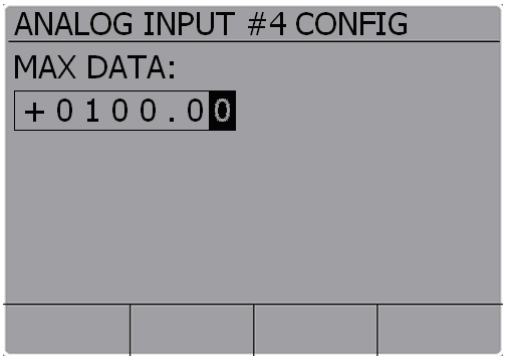
Scroll **DOWN** to **MAX DATA**

Press the **OK KEY** to change the current **MAX DATA.**



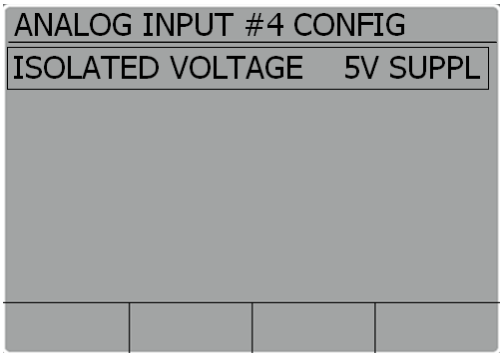
Select the **MAX DATA** that you want to program

Press the **OK KEY**.



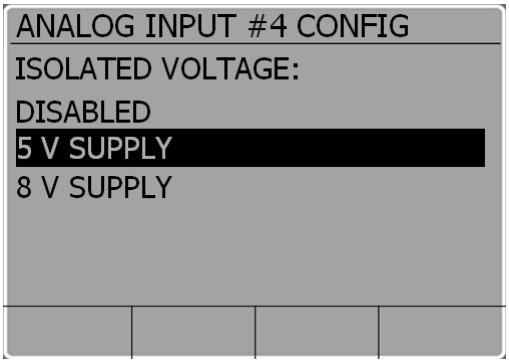
Scroll **DOWN** to **ISOLATED VOLTAGE**

Press the **OK KEY** to change the current **ISOLATED VOLTAGE.**



Select the **ISOLATED VOLTAGE** that you want to program

Press the **OK KEY**.



The Data Identification list is the same whether Signal Type is Resistive, PWM, or Voltage.

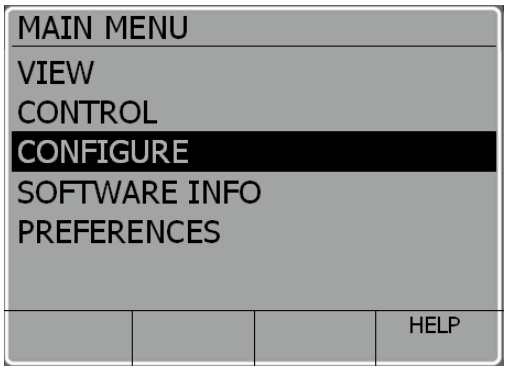
Any Analog Input can be configured for any one of the Data Identification parameters in Table 8.

DISABLING ANALOG INPUTS

To configure an Analog Input for Voltage Mode, go through the following menu options:

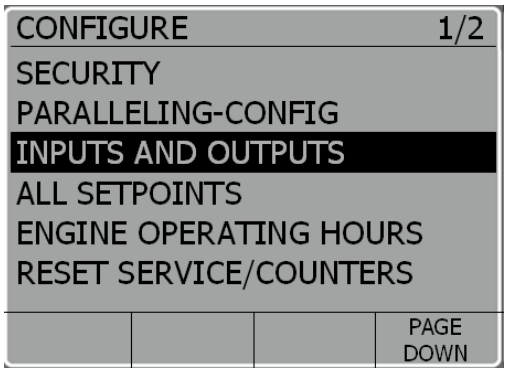
AT THE MAIN MENU, scroll down to **CONFIGURE**

Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

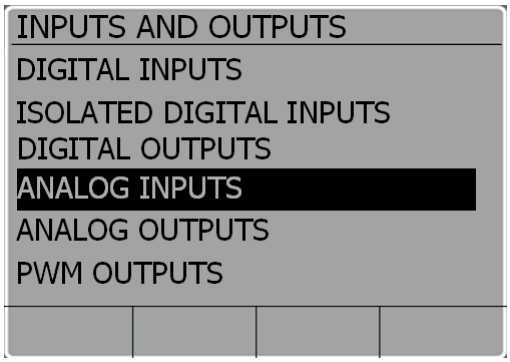
Press the **OK KEY**.



SCROLL DOWN to **ANALOG INPUTS**

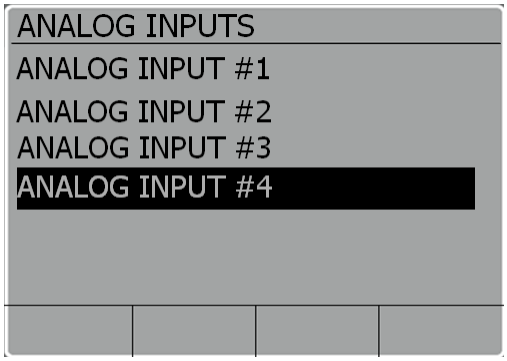
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**

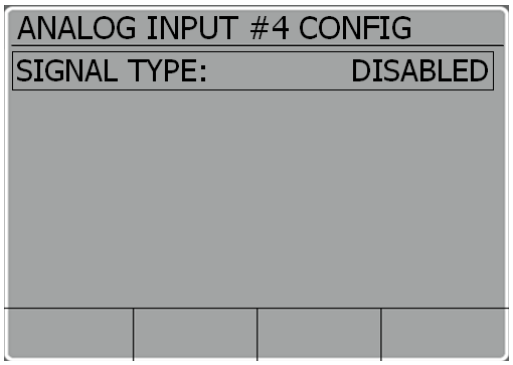


Select the **ANALOG INPUT** that you want to program

Press the **OK KEY**.

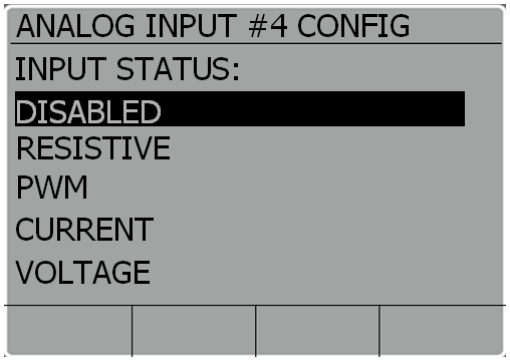


Press the **OK KEY**  to highlight the current configuration (**DISABLED, RESISTIVE, PWM SIGNAL, CURRENT, OR VOLTAGE**).



Scroll **DOWN**  to **DISABLED**

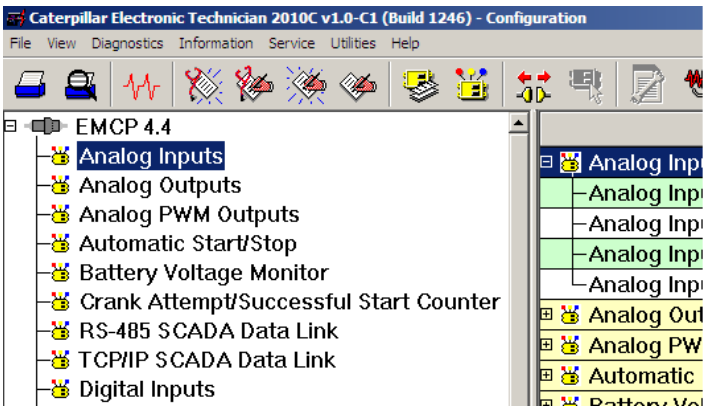
Press the **OK KEY**  .



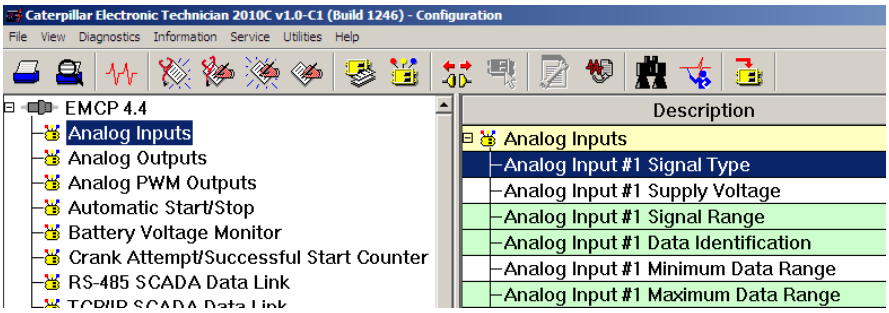
9.2 PROGRAMMING ANALOG INPUTS USING THE CAT SERVICE TOOL

The EMCP 4 Analog Inputs can be configured using the Cat Service Tool. The key to programming them is to program the setpoints related to each input in order from top to bottom. To program an Analog Input, do the following steps:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Analog Inputs on the left.



3. Determine which input is to be configured. For example, all of the setpoints for Analog Input #1 have the text “#1” in their name.

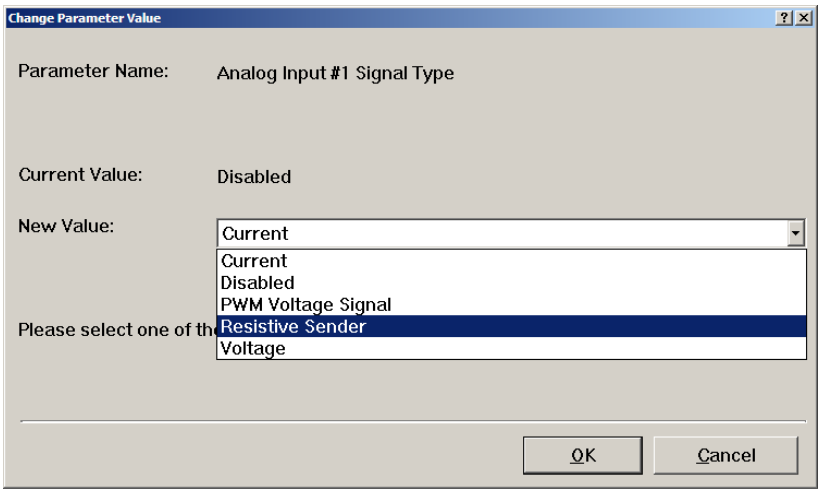


4. Next follow the steps below according to which Usage Type is desired.

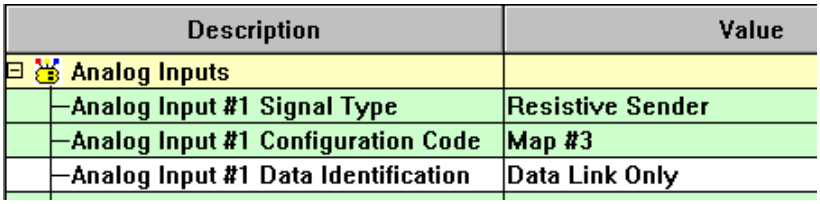
CONFIGURING ANALOG INPUTS FOR RESISTIVE MODE

The EMCP 4 supports resistive sender maps, which are nonlinear maps representing the transfer function of the resistive sender. Once an Analog Input is configured as a Resistive input type, a map must be selected.

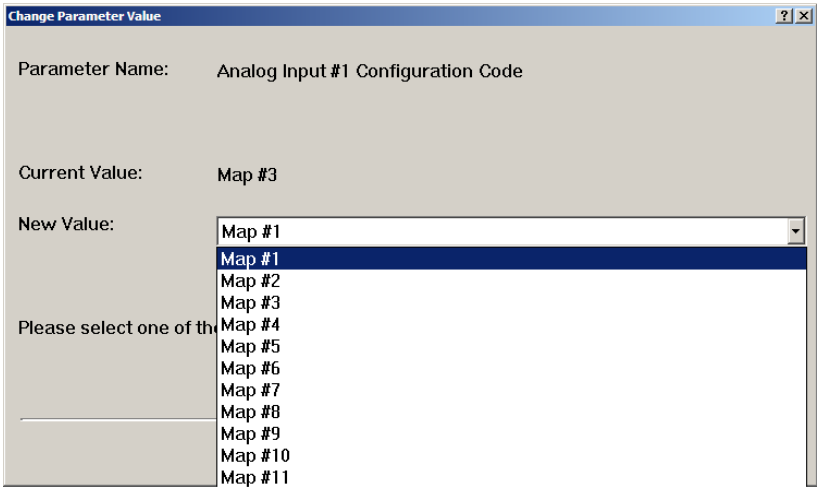
1. Double click the Analog Input #N Usage type to change this value to Resistive Sender from the drop down menu. Click the OK button to program.



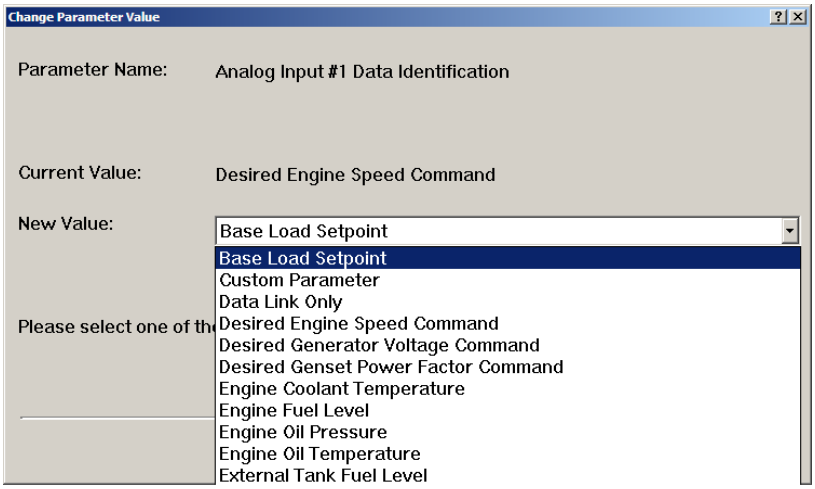
2. The Analog Input #N Configuration Code and Data Identification parameters will now be visible in the right pane.



3. Double click the Configuration Code setpoint to change this value from the drop down menu. Click the OK button to program.



4. Double click the Data Identification setpoint to change this value from the drop down menu. Click the OK button to program.



Based on whether or not the selected option supports events, the list of setpoints shown will adjust accordingly. If the selected option does not support events, then the configuration is complete.

5. If the selected option does support events, then continue and configure the event thresholds and delays. The Analog Input #N Threshold and Delay Time parameters will now be visible in the right pane.

Description	Value
Analog Inputs	
—Analog Input #1 Signal Type	Resistive Sender
—Analog Input #1 Configuration Code	Map #1
—Analog Input #1 Data Identification	Custom Parameter
—Analog Input #1 High Warning Event Threshold	80
—Analog Input #1 High Warning Event Delay Time	0 Sec
—Analog Input #1 High Shutdown Event Threshold	84
—Analog Input #1 High Shutdown Event Delay Time	0 Sec
—Analog Input #1 Low Warning Event Threshold	20
—Analog Input #1 Low Warning Event Delay Time	0 Sec
—Analog Input #1 Low Shutdown Event Threshold	16
—Analog Input #1 Low Shutdown Event Delay Time	0 Sec

Table 8 lists the options and which, if any, events they support. Not all SPN and FMI combinations are valid. Table 9 indicates which FMIs are valid for which SPNs. If a combination other than one indicated with a “y” in the table above is configured, the event will not trigger any response by the EMCP 4. The EMCP 4 may not give the option of an invalid FMI for a given SPN. In Cat ET, there is no restriction on the SPN/FMI combination. An invalid combination in Cat ET will result in an “Out of Range” error.

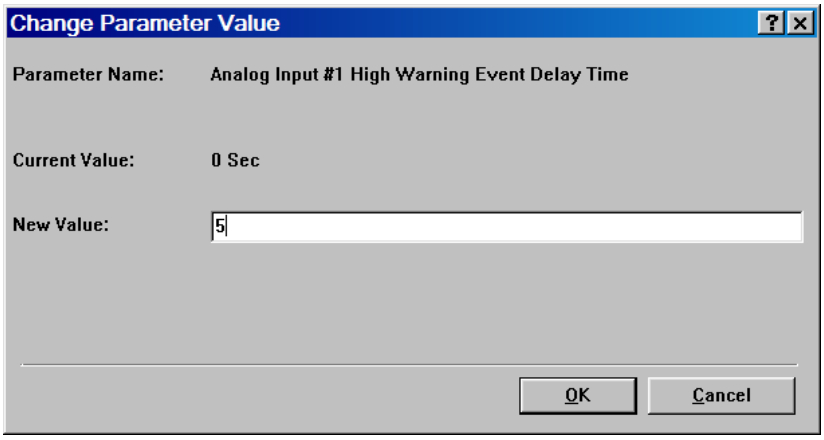
	Failure Mode Identifier Valid Options			
Suspect Parameter Number	**High Shutdown**	**Low Shutdown**	**High Warning**	**Low Warning**
Engine Oil Pressure		y		y
Engine Coolant Temperature	y	y	y	y
Engine Oil Temperature	y	y	y	y
Fuel Level	y	y	y	y
External Tank Fuel Level	y	y	y	y
Urea Level*				
Utility kW Reading (4.4 Only)*				
Utility kVAr Reading (4.4 Only)*				
Utility PF Reading (4.4 Only)*				
Desired Gen PF (4.4 Only)*				
Base Load Setpoint (4.4 Only)*				
Custom Parameter (see note below)	y	y	y	y
Data Link – SCADA*				
Engine Speed Control*				
Gen Voltage Control*				

*Information only.

Table 9: Event Input Function SPN and FMI Options

Note: For Custom Events, each input can only trigger the custom event number that matches the Analog Input number (Analog Input #1 can only activate Custom Event #1, etc).

6. Configure each of these setpoints by double clicking each one and typing a new value. Click the OK button to program.

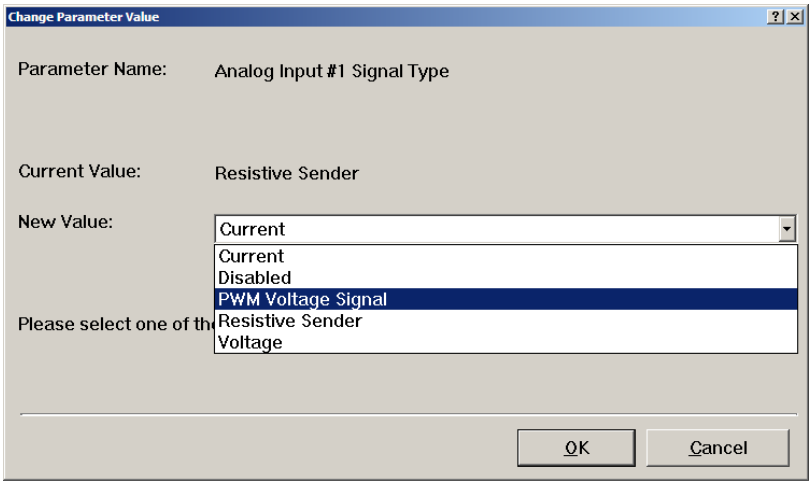


Note: The units for the event thresholds are not shown. For pressures, the units are always kPa. For temperatures, they are always degrees Celsius. For levels, they are always percent. For the custom parameter type, they are unitless. The range for custom parameters is defined by the selected sensor map if programmed for resistive.

CONFIGURING ANALOG INPUTS FOR PWM MODE

The EMCP 4 supports PWM voltage senders, which are senders whose output voltage varies linearly with the change in a physical measurement. Once the Analog Input is configured as a PWM Input type, the linear mapping must be defined by entering the sensor voltage range and the corresponding minimum and maximum physical measurement range.

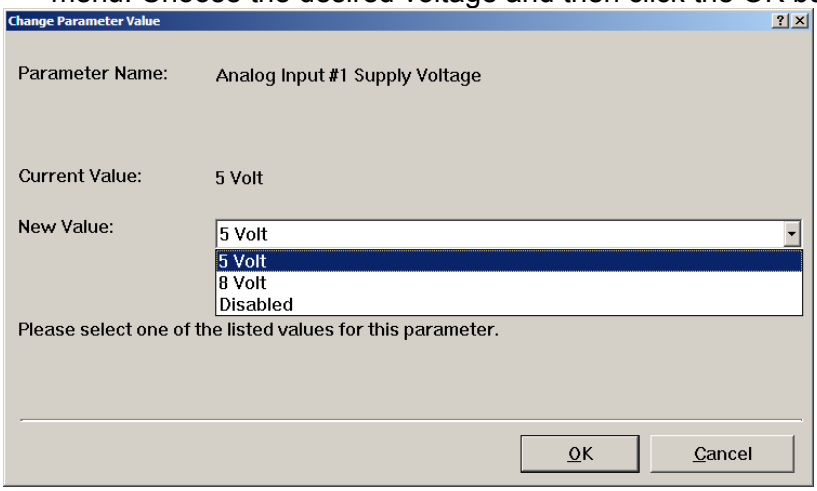
1. Double click the Analog Input #N Usage type to change this value to PWM Voltage Sender from the drop down menu. Click the OK button to program.



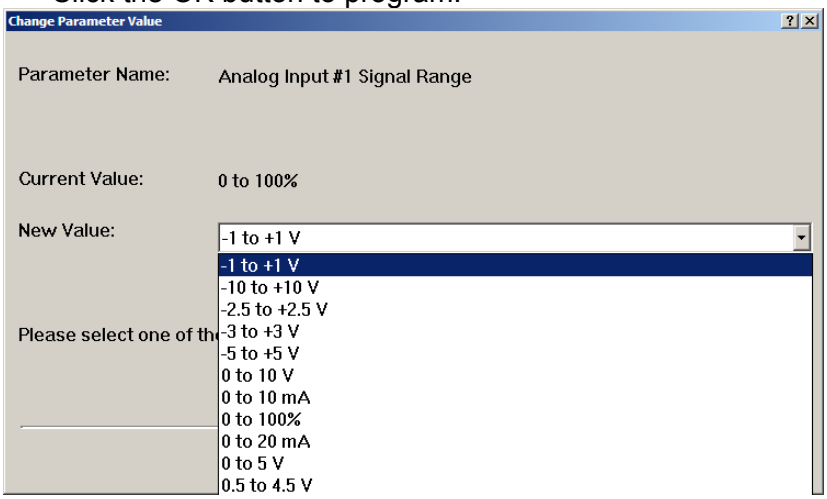
2. The Analog Input #N Supply Voltage, Signal Range, Data Identification, and Minimum and Maximum Data Range parameters will now be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	PWM Voltage Signal
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 100%
Analog Input #1 Data Identification	Data Link Only
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000

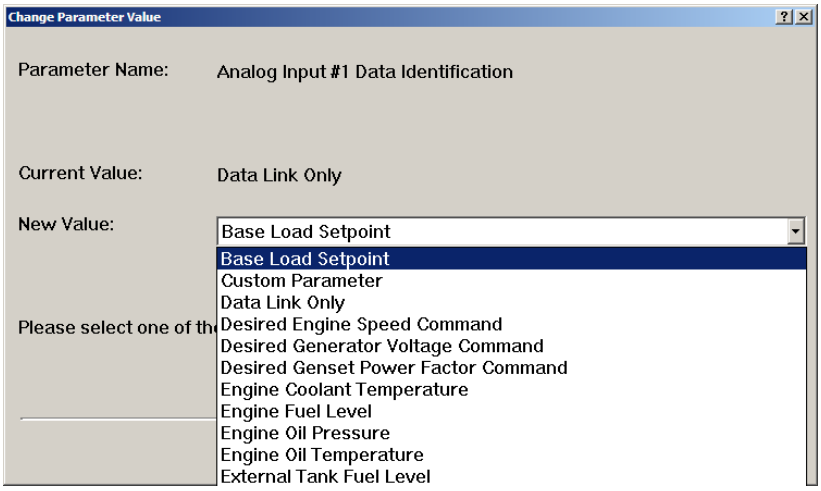
3. Double click the Supply Voltage setpoint to change this value from the drop down menu. Choose the desired voltage and then click the OK button to program.



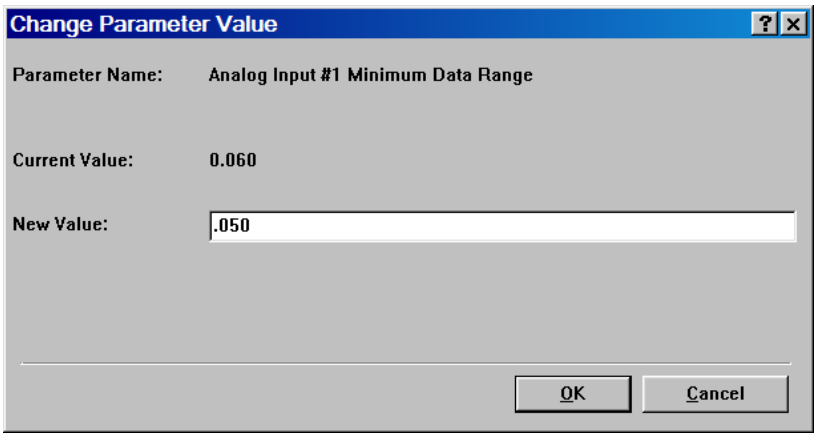
4. Double click the Signal Range setpoint to change this value from the drop down menu to match the range supported by your sensor (or the next larger range). See Section 9.3 for what to do if the desired sensor's range is not supported. Click the OK button to program.



5. Double click the Data Identification setpoint to change this value from the drop down menu. Click the OK button to program. For a full list of options available, see Section 9.3.



6. Configure each of the Minimum and Maximum Data Range setpoints by double clicking each setpoint and typing a new value. Click the OK button to program.

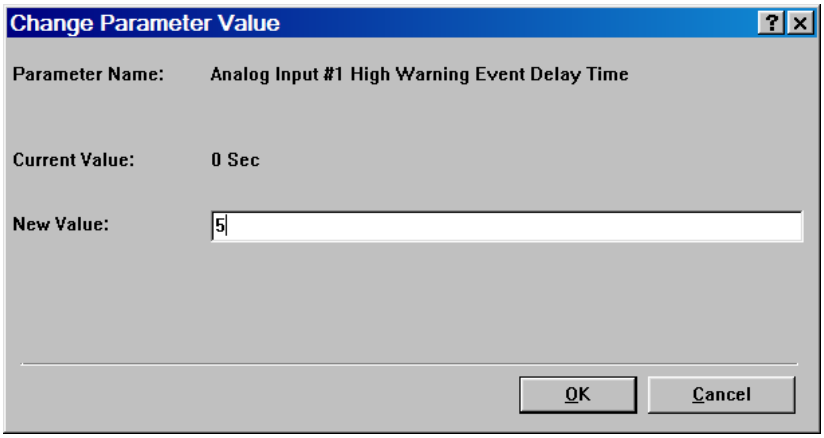


For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).

7. If the selected Data Identification does support events, then continue and configure the event thresholds and delays. The Analog Input #N Threshold and Delay Time parameters will be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	PWM Voltage Signal
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 100%
Analog Input #1 Data Identification	Custom Parameter
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000
Analog Input #1 High Warning Event Threshold	255
Analog Input #1 High Warning Event Delay Time	2.5 sec
Analog Input #1 High Shutdown Event Threshold	200
Analog Input #1 High Shutdown Event Delay Time	5.5 sec
Analog Input #1 Low Warning Event Threshold	10
Analog Input #1 Low Warning Event Delay Time	8.3 sec
Analog Input #1 Low Shutdown Event Threshold	0
Analog Input #1 Low Shutdown Event Delay Time	1.7 sec

8. Configure each of these setpoints by double clicking each one and typing a new value. Click the OK button to program.

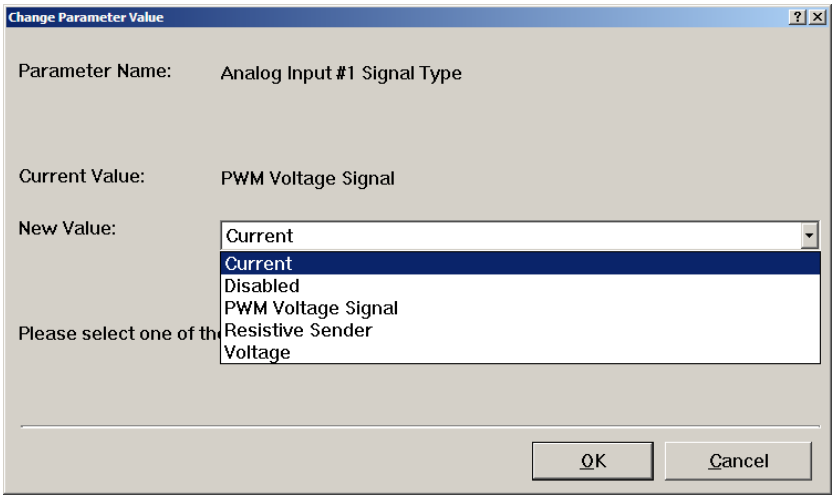


Note: The units for the event thresholds are not shown. For pressures, the units are always kPa. For temperatures, they are always degrees Celsius. For levels, they are always percent. For the custom parameter type, they are unitless. The range for custom parameters is defined by the selected sensor map.

CONFIGURING ANALOG INPUTS FOR CURRENT MODE

The EMCP 4 supports current senders, which are senders whose output voltage varies linearly with the change in a physical measurement. Once the Analog Input is configured as a Voltage Input type, the linear mapping must be defined by entering the sensor voltage range and the corresponding minimum and maximum physical measurement range.

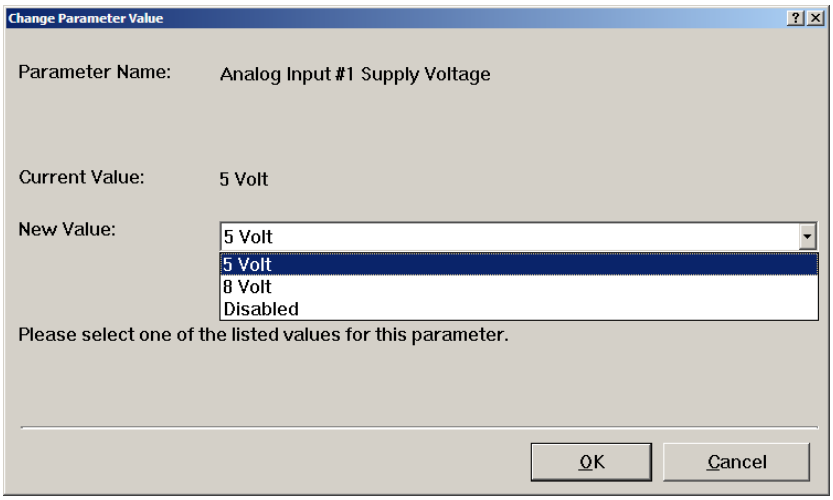
1. Double click the Analog Input #N Usage type to change this value to PWM Voltage Sender from the drop down menu. Click the OK button to program.



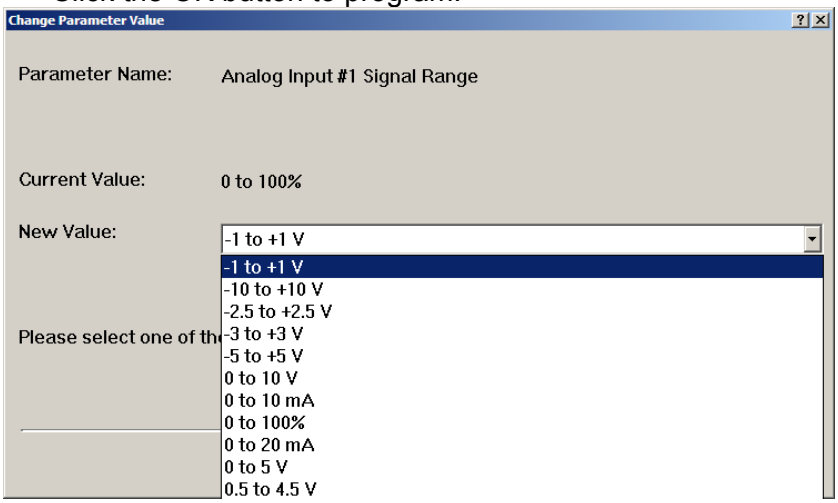
2. The Analog Input #N Supply Voltage, Signal Range, Data Identification, and Minimum and Maximum Data Range parameters will now be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	Current
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 20 mA
Analog Input #1 Data Identification	Data Link Only
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000

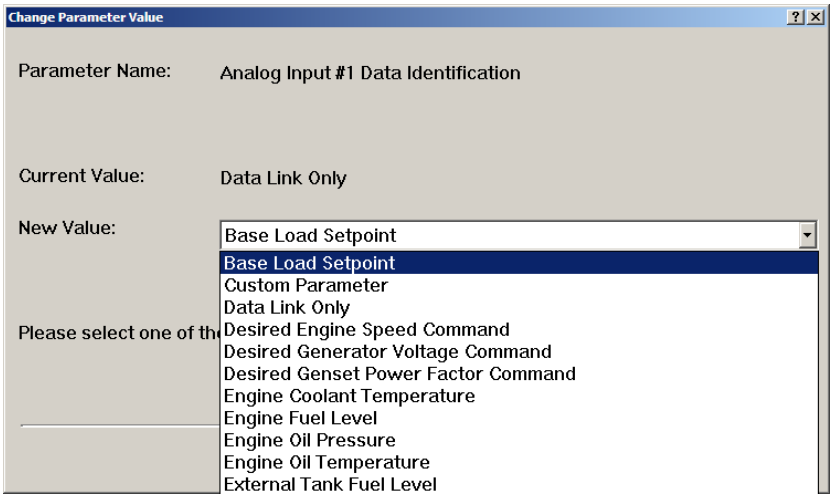
3. Double click the Supply Voltage setpoint to change this value from the drop down menu. Choose the desired voltage and then click the OK button to program.



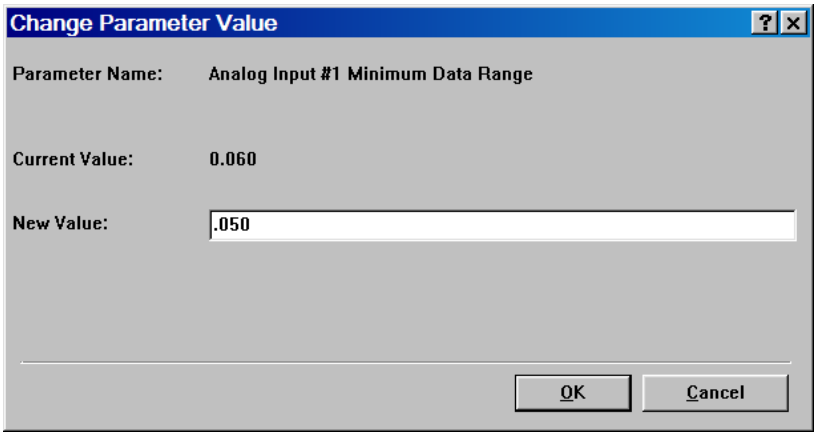
4. Double click the Signal Range setpoint to change this value from the drop down menu to match the range supported by your sensor (or the next larger range). See Section 9.3 for what to do if the desired sensor's range is not supported. Click the OK button to program.



5. Double click the Data Identification setpoint to change this value from the drop down menu. Click the OK button to program. For a full list of options available, see Section 9.3.



6. Based on whether or not the selected option supports events, the list of setpoints shown will adjust accordingly. Table 8 lists the options and which, if any, events they support.
7. Configure each of the Minimum and Maximum Data Range setpoints by double clicking each setpoint and typing a new value. Click the OK button to program.

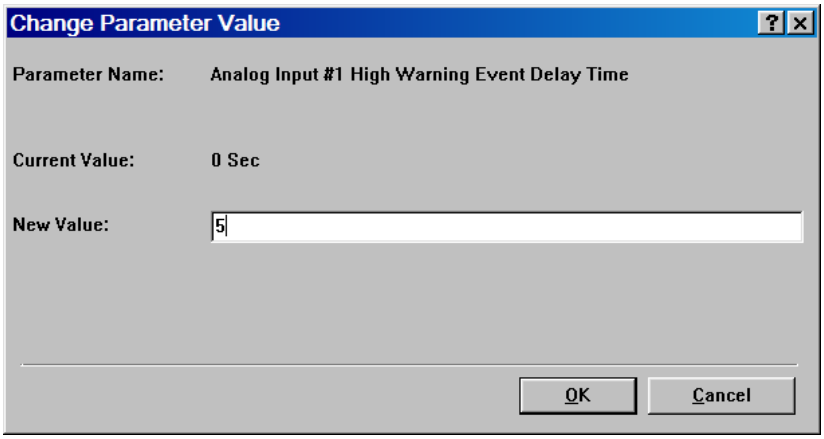


For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).

8. If the selected Data Identification does support events, then continue and configure the event thresholds and delays. The Analog Input #N Threshold and Delay Time parameters will be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	Current
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 20 mA
Analog Input #1 Data Identification	Custom Parameter
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000
Analog Input #1 High Warning Event Threshold	255
Analog Input #1 High Warning Event Delay Time	2.5 sec
Analog Input #1 High Shutdown Event Threshold	200
Analog Input #1 High Shutdown Event Delay Time	5.5 sec
Analog Input #1 Low Warning Event Threshold	10
Analog Input #1 Low Warning Event Delay Time	8.3 sec
Analog Input #1 Low Shutdown Event Threshold	0
Analog Input #1 Low Shutdown Event Delay Time	1.7 sec

9. Configure each of these setpoints by double clicking each one and typing a new value. Click the OK button to program.

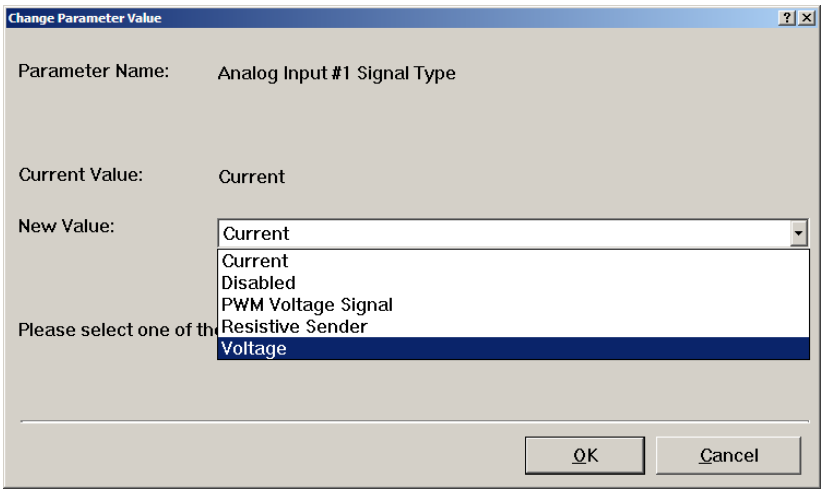


Note: The units for the event thresholds are not shown. For pressures, the units are always kPa. For temperatures, they are always degrees Celsius. For levels, they are always percent. For the custom parameter type, they are unitless. The range for custom parameters is defined by the selected sensor map.

CONFIGURING ANALOG INPUTS FOR VOLTAGE MODE

The EMCP 4 supports linear voltage senders, which are senders whose output voltage varies linearly with the change in a physical measurement. Once the Analog Input is configured as a Voltage Input type, the linear mapping must be defined by entering the sensor voltage range and the corresponding minimum and maximum physical measurement range.

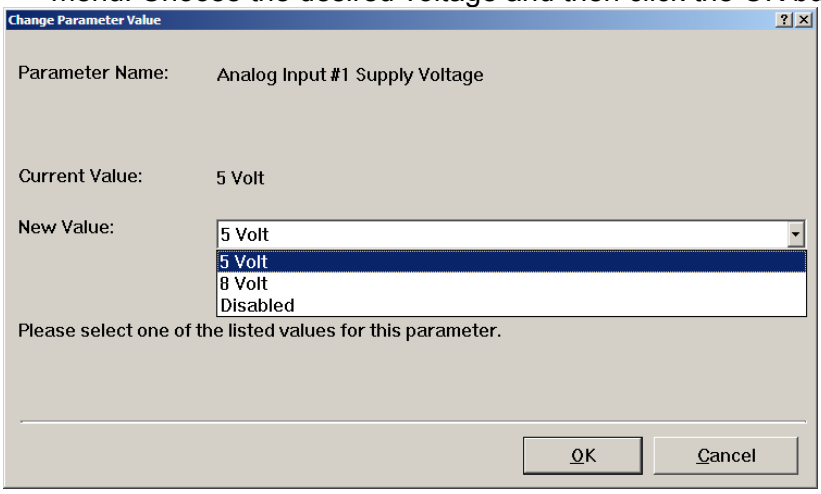
1. Double click the Analog Input #N Usage type to change this value to Voltage from the drop down menu. Click the OK button to program.



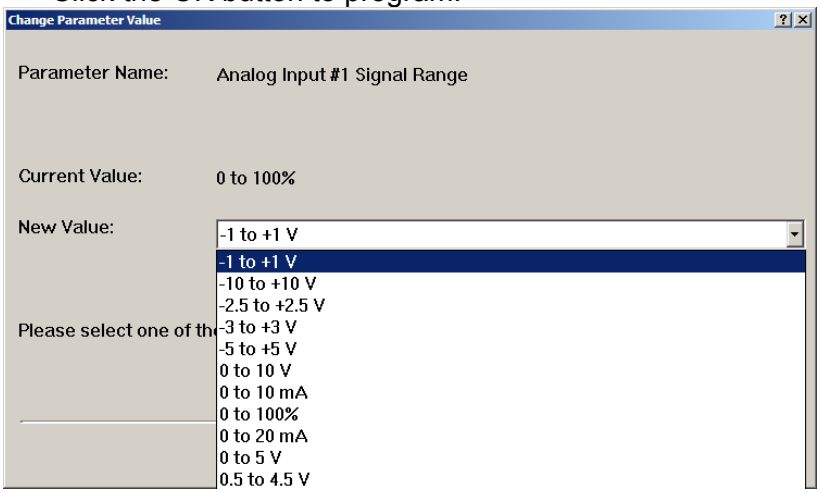
2. The Analog Input #N Signal Range, Data Identification, and Minimum and Maximum Data Range parameters will now be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	Voltage
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 5 V
Analog Input #1 Data Identification	Data Link Only
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000

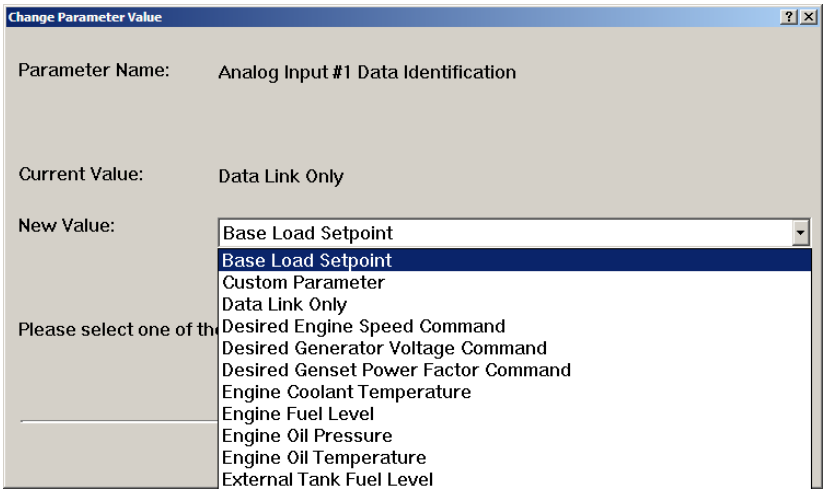
3. Double click the Supply Voltage setpoint to change this value from the drop down menu. Choose the desired voltage and then click the OK button to program.



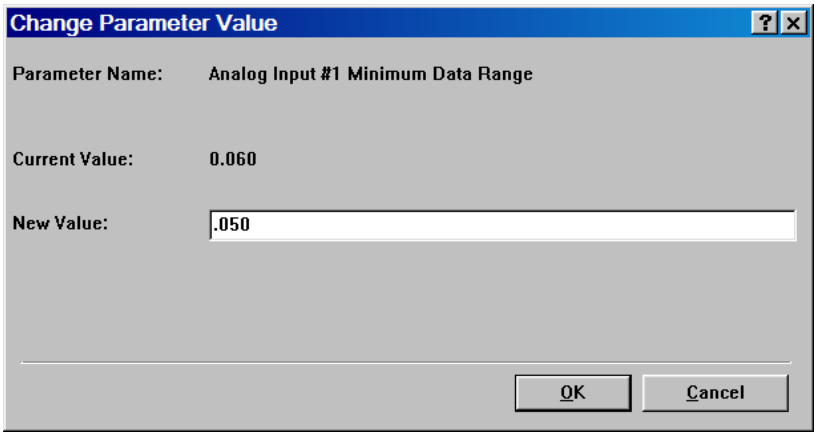
4. Double click the Signal Range setpoint to change this value from the drop down menu to match the range supported by your sensor (or the next larger range). See Section 9.3 for what to do if the desired sensor's range is not supported. Click the OK button to program.



5. Double click the Data Identification setpoint to change this value from the drop down menu. Click the OK button to program.



6. Based on whether or not the selected option supports events, the list of setpoints shown will adjust accordingly. Table 8 lists the options and which, if any, events they support.
7. Configure each of the Minimum and Maximum Data Range setpoints by double clicking each setpoint and typing a new value. Click the OK button to program.

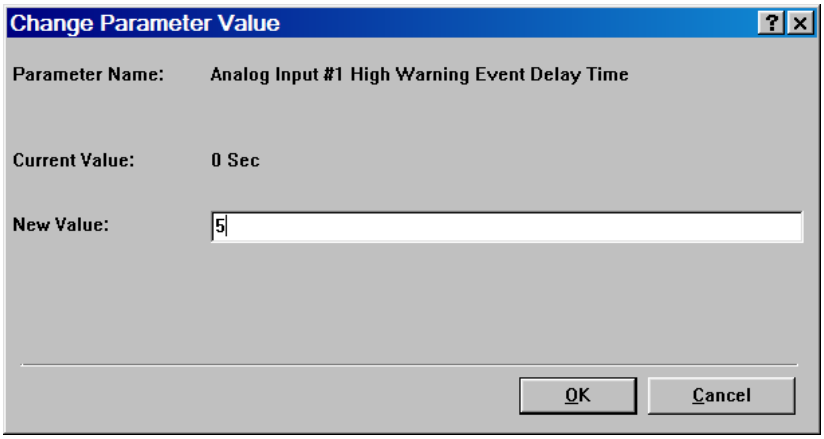


For Analog Inputs, the data range can be positive or negative, but Event thresholds are only positive. Therefore, to prevent nuisance alarms for low warnings, disable the Event Response Configuration if data is acceptable to be negative (see Section 5.2).

8. If the selected Data Identification does support events, then continue and configure the event thresholds and delays. The Analog Input #N Threshold and Delay Time parameters will be visible in the right pane.

Description	Value
Analog Inputs	
Analog Input #1 Signal Type	Voltage
Analog Input #1 Supply Voltage	5 Volt
Analog Input #1 Signal Range	0 to 5 V
Analog Input #1 Data Identification	Custom Parameter
Analog Input #1 Minimum Data Range	0.000
Analog Input #1 Maximum Data Range	100.000
Analog Input #1 High Warning Event Threshold	255
Analog Input #1 High Warning Event Delay Time	2.5 sec
Analog Input #1 High Shutdown Event Threshold	200
Analog Input #1 High Shutdown Event Delay Time	5.5 sec
Analog Input #1 Low Warning Event Threshold	10
Analog Input #1 Low Warning Event Delay Time	8.3 sec
Analog Input #1 Low Shutdown Event Threshold	0
Analog Input #1 Low Shutdown Event Delay Time	1.7 sec

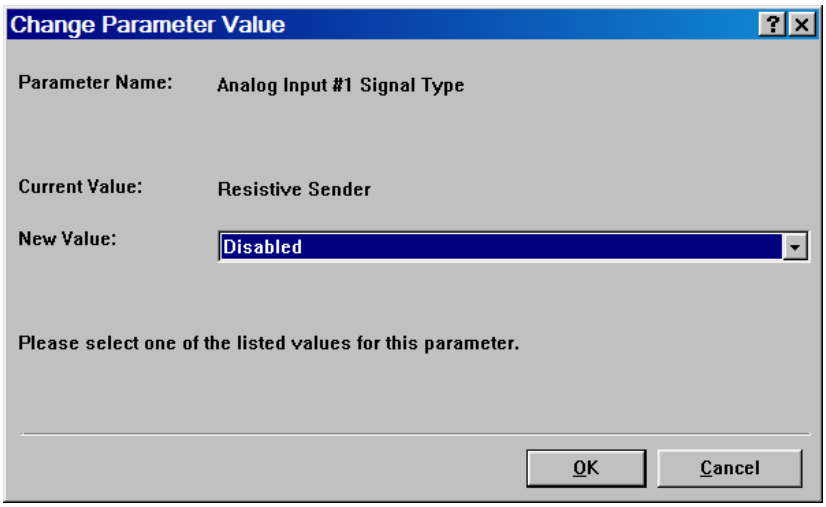
9. Configure each of these setpoints by double clicking each one and typing a new value. Click the OK button to program.



Note: The units for the event thresholds are not shown. For pressures, the units are always kPa. For temperatures, they are always degrees Celsius. For levels, they are always percent. For the custom parameter type, they are unitless. The range for custom parameters is defined by the selected sensor map.

DISABLING ANALOG INPUTS

1. Double click the Analog Input #N Usage type to change this value to Disabled from the drop down menu. Click the OK button to program.



Note: If the Analog Inputs are set to Disabled, then any sensor faults or events will not be broadcast or annunciated on the network.

9.3 ANALOG INPUT MAPS

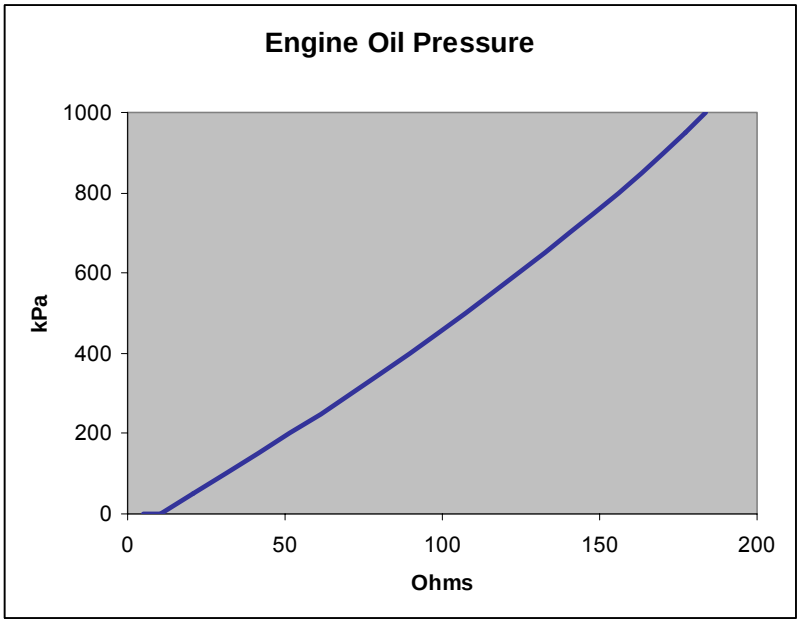
Resistive senders can use nonlinear sensor maps. These maps are not available for Voltage or Current modes. Maps are predefined in the software flash file, and can be selected by the customer. The Analog Inputs are capable of reading resistance from ~5 ohms up to 2000 ohms.

The following maps are predefined:

Analog Input Map #1

Engine Oil Pressure Map #1

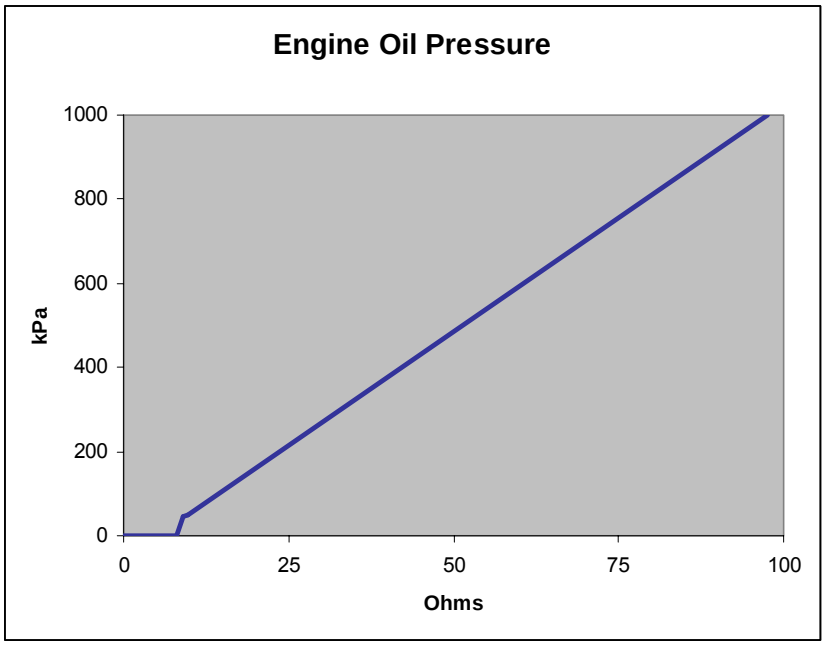
Ohms	kPa
5.15625	0
10.234375	0
20.859375	50
31.328125	100
41.5625	150
51.5625	200
61.328125	250
70.9375	300
80.390625	350
89.53125	400
98.59375	450
107.34375	500
115.9375	550
124.296875	600
132.5	650
140.46875	700
148.203125	750
155.78125	800
163.125	850
170.234375	900
177.1875	950
183.90625	1000



Analog Input Map #2

Engine Oil Pressure

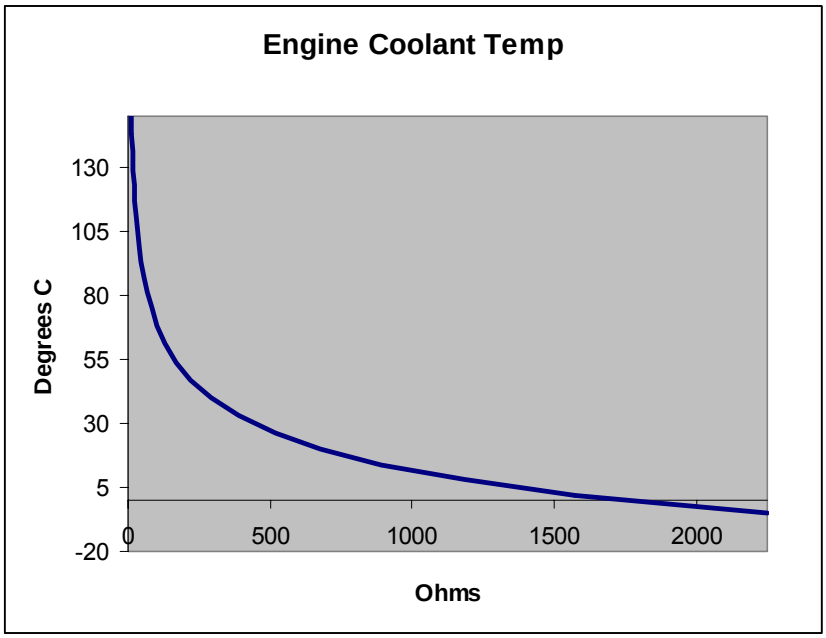
Ohms	kPa
0	0
8	0
9	45
9.79280164	50
97.53483284	1000



Analog Input Map #3

Engine Coolant Temp. Map #1

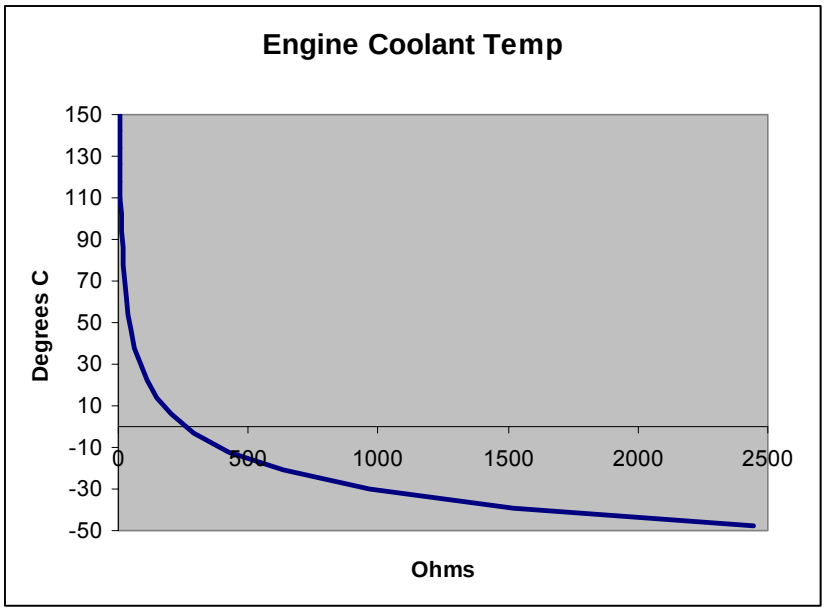
Ohms	Degrees C
10.96	150
12.833486	143
15.097968	136
17.873487	129
20.7791	123
24.243433	117
28.351106	111
33.4	105
39.575632	99
46.921325	93
56.092114	87
67.912203	81
82.36	75
103.630957	68
129.551496	61
168.012845	54
221.883488	47
291.46	40
387.47457	33
520.636327	26
676.95	20
890.619054	14
1182.891558	8
1575.596421	2
2249.4	-5



Analog Input Map #4

Engine Coolant Temp. Map #2

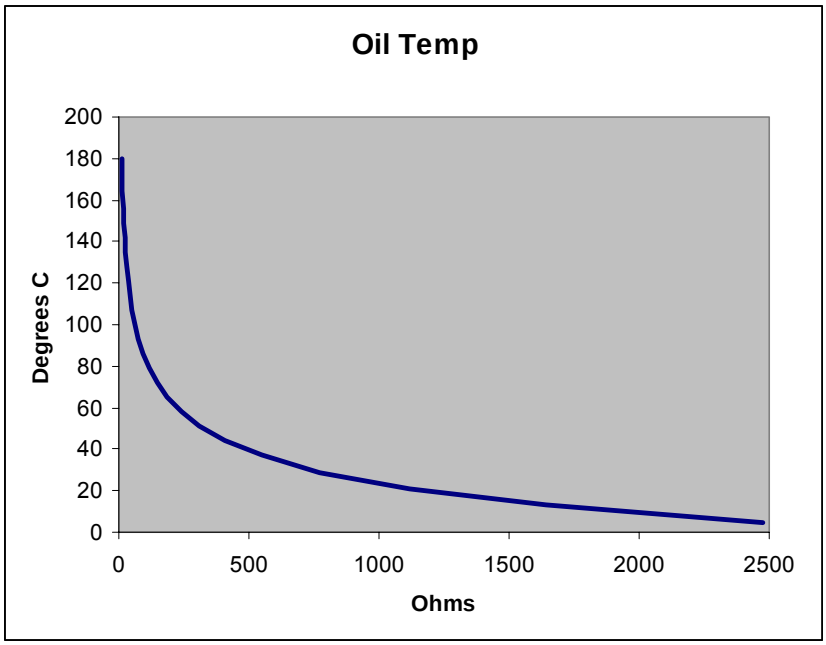
Ohms	Degrees C
2442	-48
1518	-39
968.9	-30
633.6	-21
423.9	-12
289.7	-3
201.9	6
148.8	14
111.2	22
84.2	30
64.5	38
50	46
39.2	54
31	62
24.8	70
20	78
16.3	86
13.3	94
11.03	102
9.18	110
7.7	118
6.5	126
5.53	134
4.72	142
4.06	150



Analog Input Map #5

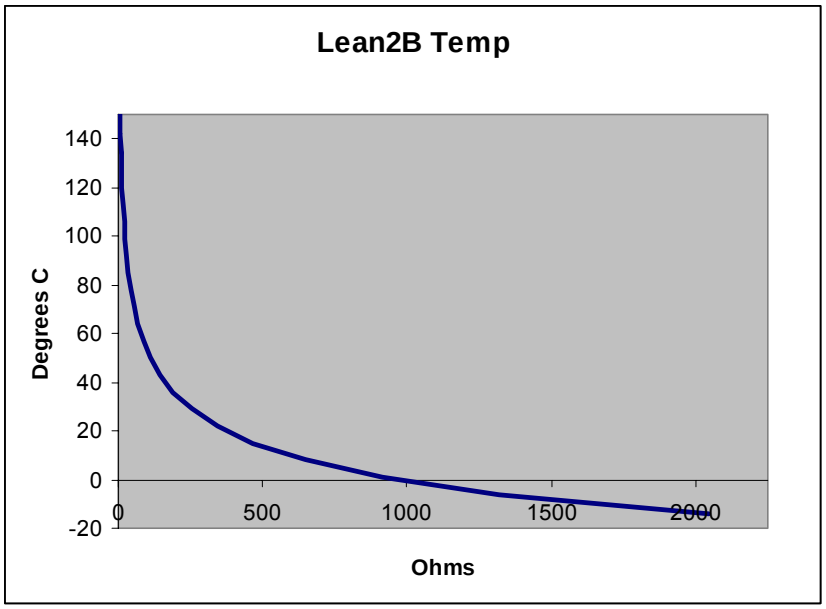
Oil Temp

Ohms	Degrees C
10.24	180
11.915106	172
13.936869	164
16.397384	156
18.986869	149
22.021713	142
25.7	135
30.17989	128
35.6296	121
42.512367	114
51.202344	107
61.92	100
75.805097	93
93.55964	86
115.597997	79
145.179619	72
184.72	65
238.039938	58
309.945216	51
408.742034	44
546.580666	37
773.706899	29
1114.873752	21
1640.337776	13
2473.6	5



Analog Input Map #6
Engine Coolant Temp
Map #3

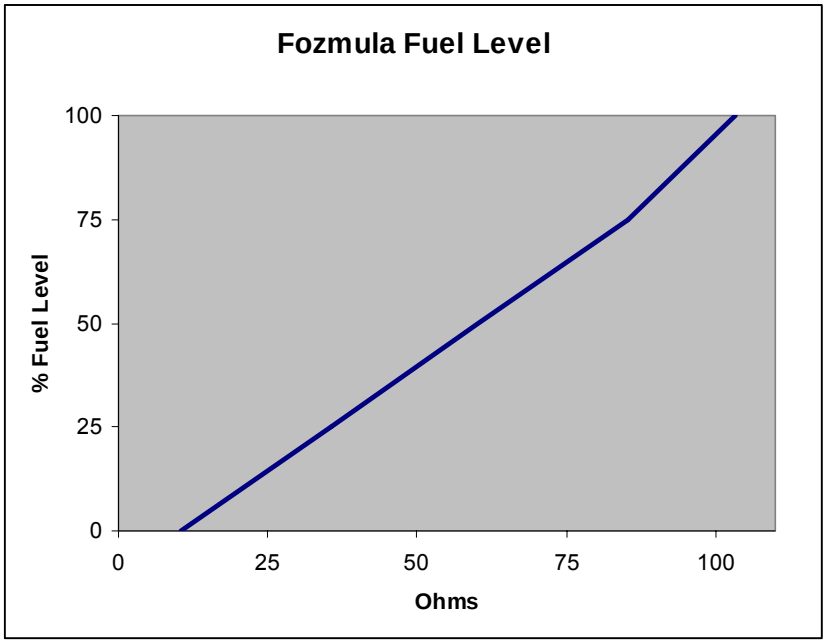
Ohms	Degrees C
6.875	150
8.203125	142
9.84375	134
11.5625	127
13.75	120
16.328125	113
19.609375	106
23.671875	99
28.828125	92
35.390625	85
43.671875	78
54.453125	71
68.515625	64
87.109375	57
111.796875	50
145.078125	43
190.46875	36
253.359375	29
341.484375	22
467.03125	15
648.828125	8
916.640625	1
1318.515625	-6
2046.5625	-14



Analog Input Map #7

Fozmula Fuel Level

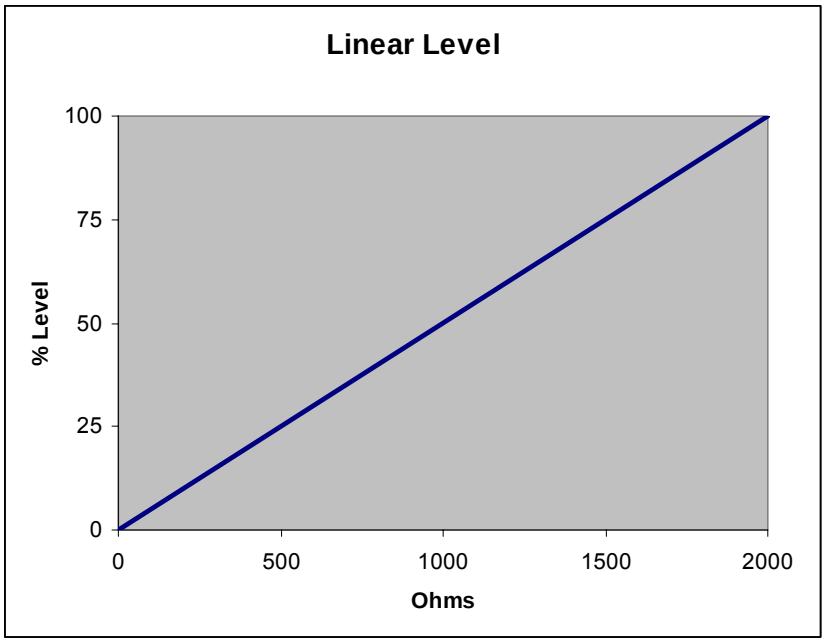
Ohms	%
10.5	0
35.6	25
60.2	50
85.2	75
103.2	100



Analog Input Map #8

Linear Level

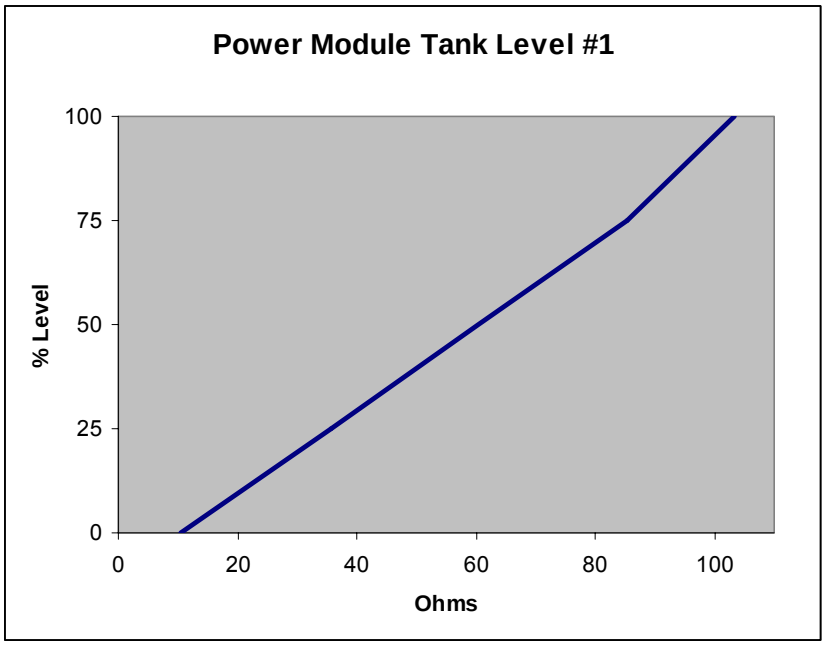
Ohms	%
0	0
2000	100



Analog Input Map #9

Power Module Tank Level #1

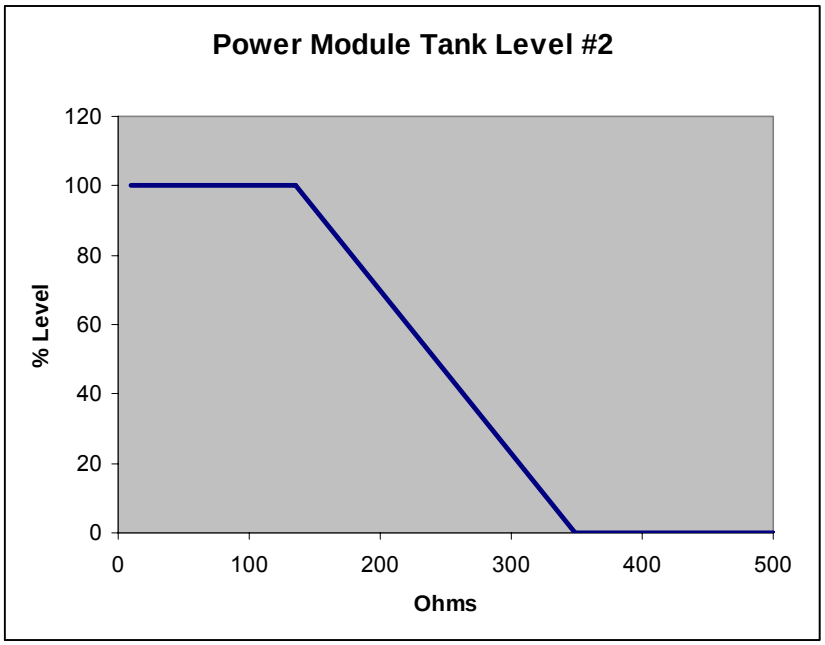
Ohms	%
10.46875	0
35.625	25
60.234375	50
85.234375	75
103.203125	100



Analog Input Map #10

Power Module Tank Level #2

Ohms	%
10	100
135	100
348.203125	0
500	0



For EMCP 4.3 and 4.4, PWM, voltage, and current senders can be configured within the ranges in Table 10:

PWM Sender Ranges	Current Sender Ranges	Voltage Sender Ranges
0 to 100%	0 to 20mA	0 to 5V
5 to 95%	4 to 20mA	1 to 5V
	0 to 10mA	0 to 10V
		-3 to +3V
		-2.5 to +2.5V
		-5 to +5V
		-10 to +10V
		0.5 to 4.5V
		-1 to +1V

Table 10: Analog Input Ranges

Analog Input data ranges can be defined with positive and negative values, but Event thresholds are only programmable as positive values. Therefore, to prevent nuisance alarms for low warnings when using negative numbers for data ranges, the Event Response Config can be disabled, if input data is acceptable to be negative.

WARNINGS AND SHUTDOWNS

Each of these inputs can be configured to have **HIGH WARNINGS**, **LOW WARNINGS, HIGH SHUTDOWNS** and **LOW SHUTDOWNS** with configurable thresholds. Any value below the bottom point on the map or above the highest point on the map will raise a corresponding diagnostic event. Also, all of the events associated with the Analog Inputs have programmable time delays. Low Idle Oil Pressure setpoints are also available under the Engine Oil Monitor area. Information on how to program these thresholds and time delays can be found in Chapter 7, Setpoints.

UNSUPPORTED ANALOG INPUT SENSOR RANGES

There may be Voltage sensors available that use ranges not explicitly supported by the EMCP 4. Depending on the situation, there may be different ways to handle this. The following sections give options on how to handle these situations.

SENSOR RANGE IS SMALLER THAN SETPOINT OPTIONS

If the desired sensor range is smaller than one of the available setpoint options, then extrapolation may be used to support the desired sensor. For example, for a 0-3V temperature sensor reads -30°C to 120°C, the only range that includes all of 0-3V is 0-5V. The 0-5V range should be used. The range between 3V and 5V will simply never be used. To make the data accurate, set the Minimum Data Range to -30°C, and determine the Maximum Data Range mathematically. See Figure 20.

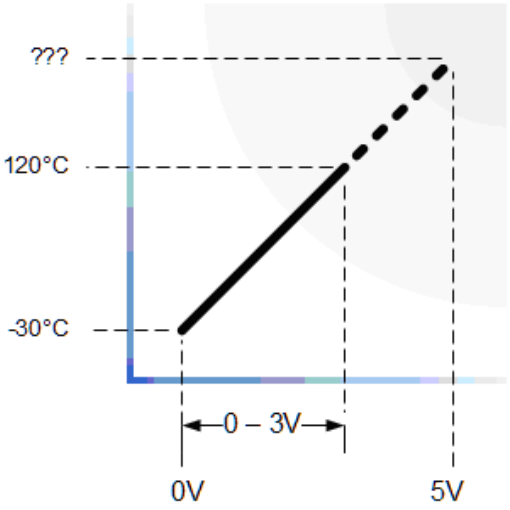


Figure 20: Mathematical Extrapolation of Maximum Data Range

The Maximum Data Range can be found graphically or algebraically. In this example, the Maximum Data Range would be defined by the equation of the line after the slope is determined. Since the data rises by 50 degrees for every volt, increasing two volts above the three volt limit requires the maximum range to be 100 degrees above the sensor limit of 120 degrees, or 220 degrees total. See Figure 21.

$$\left[\frac{[120C - (-30C)]}{(3V - 0V)}\right] * (5V) + (-30C) = 220C$$

Figure 21: Example Calculation for Extrapolation of Maximum Data Range

SENSOR RANGE IS LARGER THAN SETPOINT OPTIONS, BUT USABLE RANGE IS NOT

If the desired sensor range is larger than one of the available setpoint options, but the useful range for the sensor is within the supported ranges, then interpolation may be used to support the desired sensor. For example, for a 0-6V temperature sensor that reads -40°C to 500°C, the EMCP 4 will not support the analog voltages higher than 5V. However, as long as the sensor will not exceed 5V, the 0-5V range may be used. To make the data accurate, set the Minimum Data Range to -40°C, and determine the Maximum Data Range mathematically. See Figure 22.

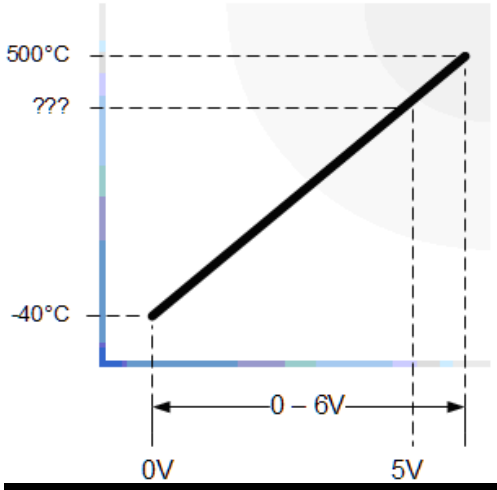


Figure 22: Mathematical Interpolation of Maximum Data Range

The Maximum Data Range can be found graphically or algebraically. In this example, the Maximum Data Range would be defined by the equation of the line after the slope is determined. Since the data rises by 90 degrees for every volt, decreasing one volt below the six volt limit requires the maximum range to be 90 degrees below the sensor limit of 500 degrees, or 410 degrees total. See Figure 23.

$$\left[\frac{[500C - (-40C)]}{(6V - 0V)}\right] * (5V) + (-40C) = 410C$$

Figure 23: Example Calculation for Interpolation of Maximum Data Range

SENSOR RANGE IS LARGER THAN SETPOINT OPTIONS, AND USABLE RANGE IS LARGER THAN SETPOINT OPTIONS

If the desired sensor range is larger than one of the available setpoint options, and the useful range for the sensor is outside of the supported ranges, a third party device is required to convert the signal range into a supported range. See Figure 24.

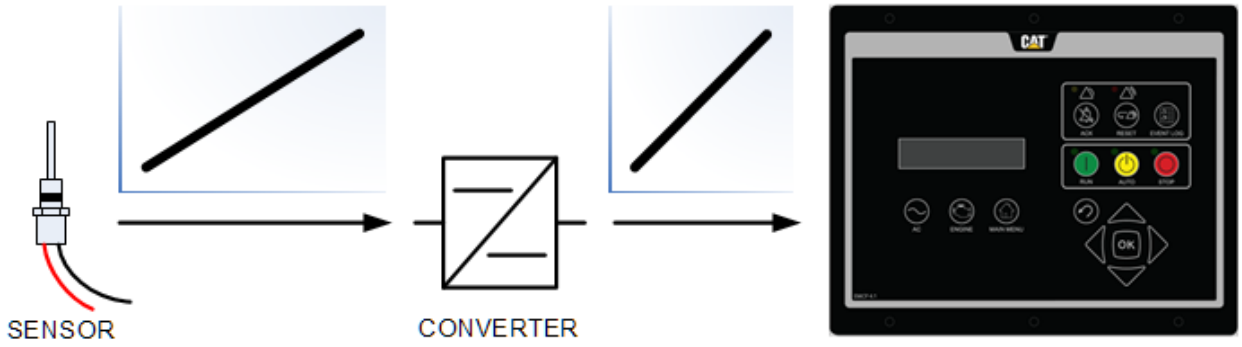


Figure 24: Signal Conversion of Sensor Range

10 DIGITAL OUTPUTS

The EMCP 4.3 and 4.4 support 16 programmable discrete sourcing outputs capable of driving 200mA per channel. The voltage of these outputs will be the source voltage to the EMCP 4 plus a voltage drop of ~1 VDC. The common signal is Battery (-). The EMCP 4.4 has an additional 17th programmable discrete sourcing output capable of driving 200mA.

The EMCP 4.4 additionally supports two dedicated discrete sourcing outputs capable of driving 300mA per channel and one capable of driving 100mA. The 300mA outputs are reserved for CB Close Command (DDO #2) and CB Trip Command (DDO #3). The 100mA output is reserved as a paralleling output (HWDBA #5/DDO #1).

Outputs can be configured by using the EMCP 4 display. For some of the setpoints, LEVEL 2 OR LEVEL 3 ACCESS is required. For information on obtaining Level 2 Access refer to Chapter 6, Security. This section will assume that Level 2 or Level 3 Access has already been obtained. Alternately, the Cat Service Tool can be used to configure these outputs.

The programming of the Digital Outputs starts by selecting a “Usage Type“. The rest of the programming is dependent upon what Usage Type is selected. Figure 25 summarizes the paths possible for Programming a Digital Output.

Note: If the Engine Operating State is configured as Hardwired, then Digital Output #1 must be programmed to Starter Motor Relay and Digital Output #2 must be programmed to Fuel Control Relay.

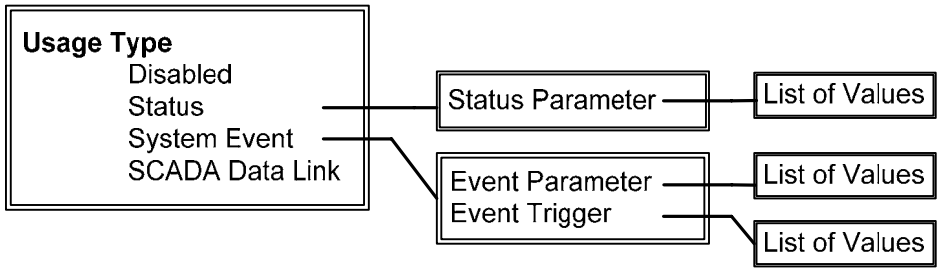


Figure 25: Digital Output Programming Paths

10.1 PROGRAMMING DIGITAL OUTPUTS USING THE DISPLAY

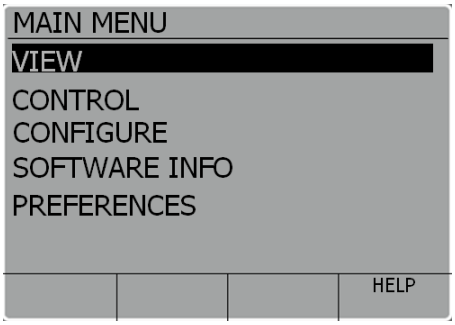
For some of the setpoints, LEVEL 2 OR LEVEL 3 ACCESS is required. For information on obtaining Level 2 Access refer to Chapter 6, Security. This section will assume that Level 2 or Level 3 Access has already been obtained.

VIEWING THE CURRENT DIGITAL OUTPUT STATUS

To view the current status of an Output, go through the following menu options:

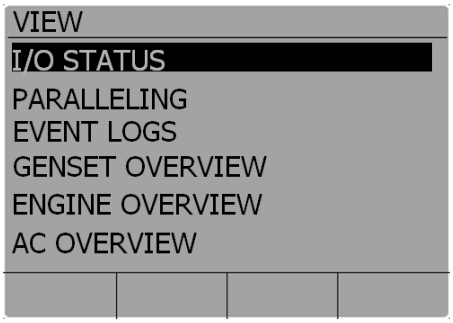
AT THE MAIN MENU, scroll **DOWN** **TO VIEW**

Press the **OK KEY**.



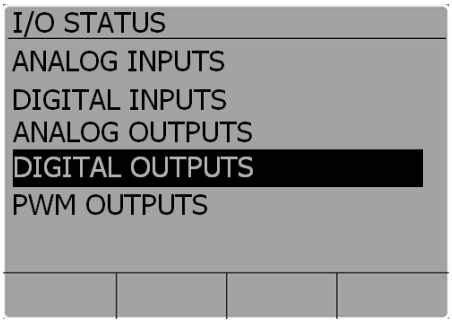
Scroll **DOWN** to **I/O STATUS**

Press the **OK KEY**.



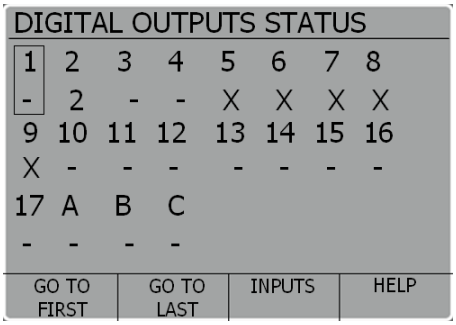
Scroll **DOWN** to access **DIGITAL OUTPUTS**.

Press the **OK KEY**.



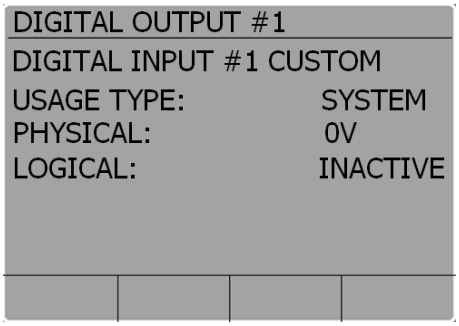
The status of all Digital Outputs is shown.

A dash under an output number indicates an output that is programmed, but inactive. A large “X” under an output number indicates an output that is disabled. A number under an output number indicates an output that is programmed and active.



With the **LEFT ARROW** or **RIGHT ARROW**, select the **DIGITAL OUTPUT** that you want to view, then press the **OK KEY**.

The programmed parameters of the selected Digital Output are shown.



CONFIGURING DIGITAL OUTPUTS FOR STATUS PARAMETERS

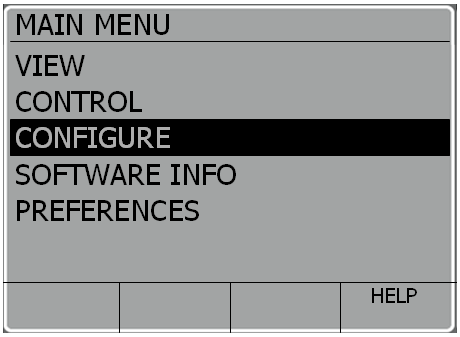
Command or Status parameters are used to control specific functions within the control system or to make certain conditions within the system be known.

Note: The Fuel Control Relay does not pickup when the Engine Operating State is set to CAN. Engine Start Initiated can be used in Lieu of the Fuel Control Relay for most purposes.

To configure a Digital Output as a Status Parameter, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

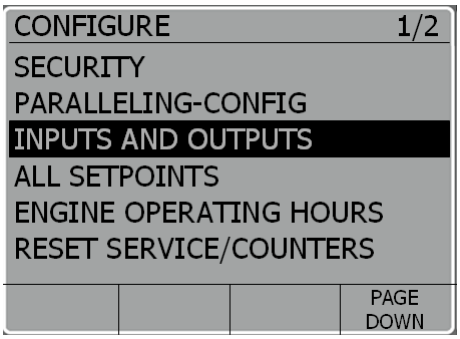
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

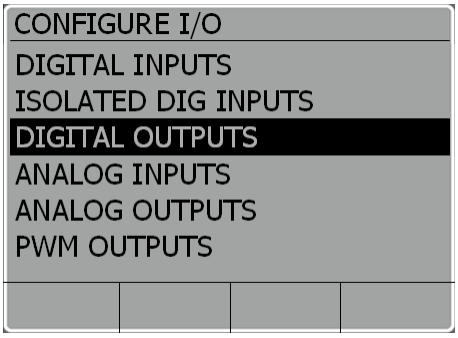
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



SCROLL DOWN to **DIGITAL OUTPUTS**

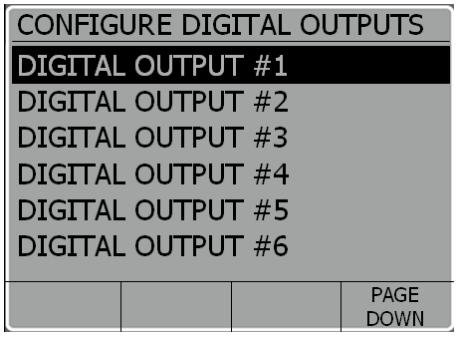
Press the **OK KEY**.



Select the **DIGITAL OUTPUT** that you want to program

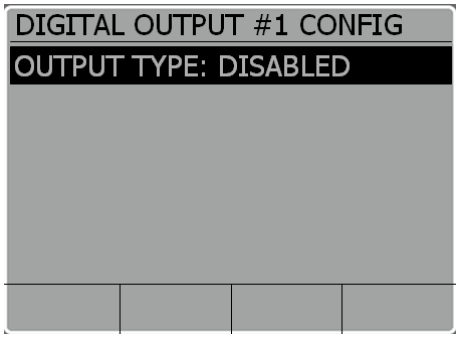
Press the **OK KEY** 

.



Press the **OK KEY** 

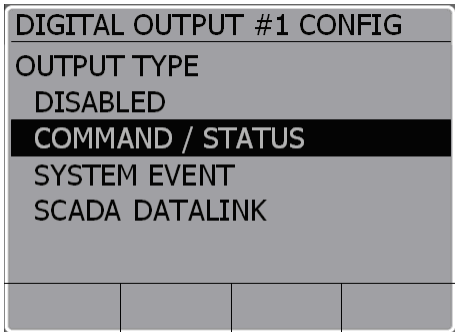
to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA DATA LINK)**.



Scroll **DOWN**  to **COMMAND/STATUS**

Press the **OK KEY** 

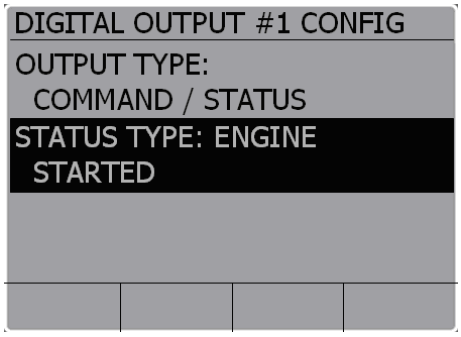
.



Scroll **DOWN**  to **STATUS TYPE**

Press the **OK KEY** 

to highlight the current **STATUS TYPE.**



Select the **STATUS PARAMETER** that you want to program and press the **OK KEY** 

.

Any Output can be configured for any one of the Status parameters in Table 11:

Run Mode	Common Shutdown
Auto Mode	ECU Fault Reset
Stop Mode	Air Shutoff
Package Not in Auto	Programmable Cycle Timer Output #2
Fuel Control Relay*	Programmable kW relay Trip #1
Starter Motor Relay	Programmable kW relay Trip #2
Start Aid	Common Alarm
Disable Aux AC Supply	Breaker #1 Trip (4.3 only)**
Crank Alert	Breaker #2 Trip**
Engine Start Initiated	Not in Reduced Power Mode
Engine Started	Transfer Fuel In
Rated Speed	Load Shed Command
V/Hz Within Limits	Voltage Raise Command
Engine in Cooldown	Voltage Lower Command
Package Waiting on Delay on Stop	Speed Raise Command
Horn Control	Speed Lower Command
Common Warning	Live Bus Indication (EMCP 4.4 only)

Table 11: Output Status List

*****The Fuel Control Relay does not pickup when the Engine Operating State is set to CAN. Engine Start Initiated can be used in Lieu of the Fuel Control Relay for most purposes.

** This output does not control a circuit breaker unless the user makes the connections to do so. This output type should be viewed as having a generic name because the name does not necessarily imply the action that is performed.

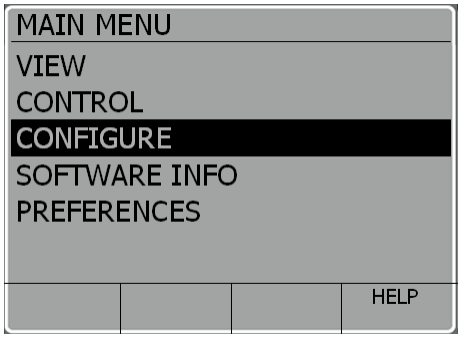
Note: If the Engine State Configuration is configured for Hard Wired, then Digital Output #1 must be programmed for the Status Parameter of Starter Motor Relay and Digital Output #2 must be programmed for Fuel Control Relay.

CONFIGURING DIGITAL OUTPUTS FOR SYSTEM EVENTS

System Events are used to know when specific conditions are reached and to alert the control system of warning or shutdown conditions. To configure a Digital Output as a System Event, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

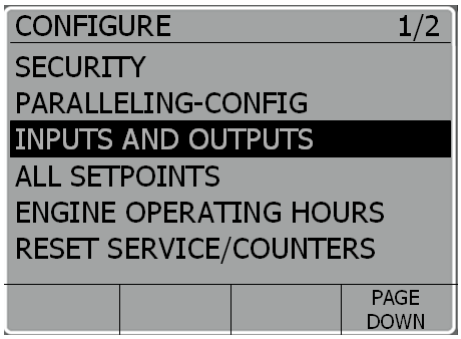
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

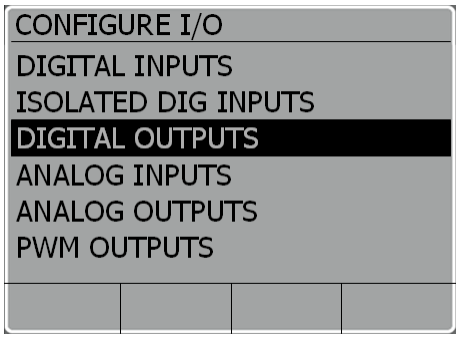
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



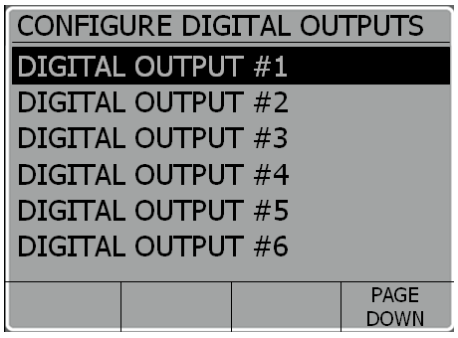
SCROLL DOWN to **DIGITAL OUTPUTS**

Press the **OK KEY**.

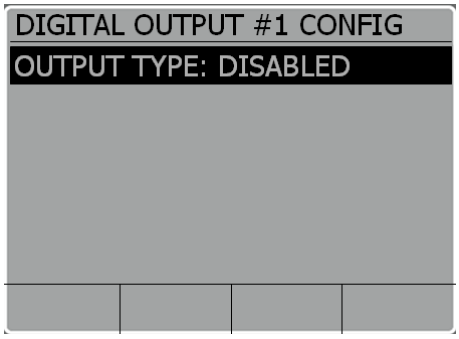


Select the **DIGITAL OUTPUT** that you want to program

Press the **OK KEY**.

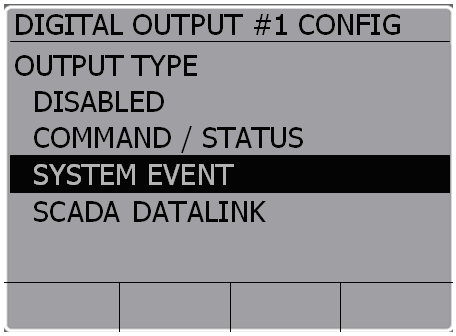


Press the **OK KEY** to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA DATA LINK)**.



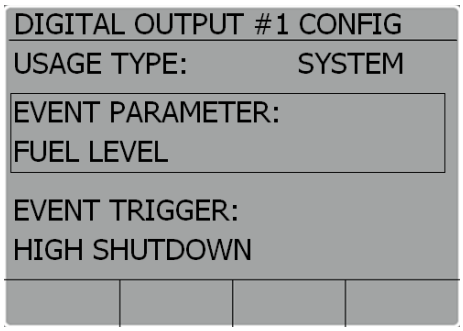
Scroll **DOWN** to **SYSTEM EVENT**

Press the **OK KEY**.



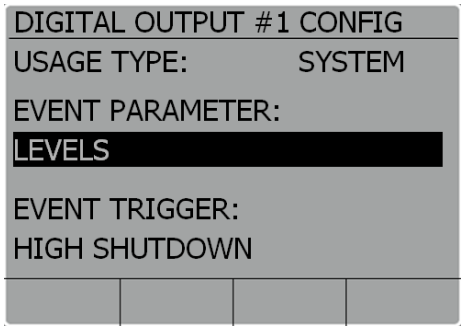
Scroll **DOWN** to **EVENT PARAMETER**

Press the **OK KEY** to edit the current **EVENT PARAMETER.**



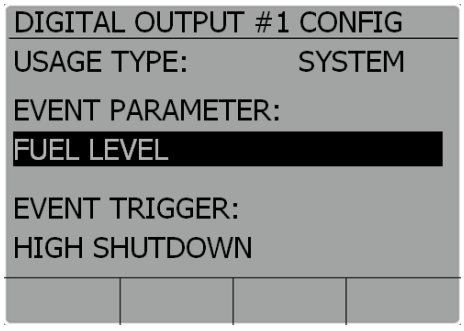
Select the type of **EVENT PARAMETER** that you want to program (Pressures, Temperatures, Levels, or Others)

Press the **OK KEY**.



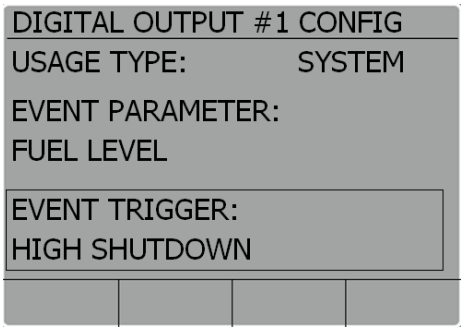
Select the **EVENT PARAMETER** that you want to program

Press the **OK KEY**.



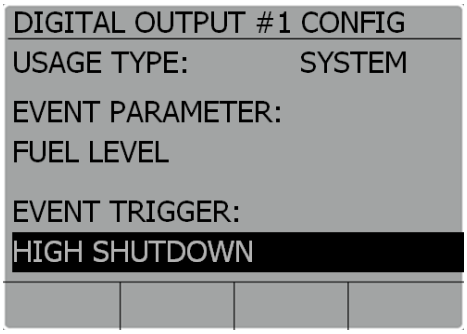
Scroll **DOWN**  to **EVENT TRIGGER**

Press the **OK KEY**  to edit the current **EVENT TRIGGER.**



Select the **EVENT TRIGGER** that you want to program

Press the **OK KEY**  .



Any Output can be configured for any one of the System Events in Table 12:

Pressure	**Others**	**Custom Events**
Engine Oil Pressure	Any Suspect Parameter Number	Digital Input #1 Custom Event
Gas Pressure	Accessory Data Link	Digital Input #2 Custom Event
	Battery Charging System Voltage	Digital Input #3 Custom Event
Temperature	Battery Voltage	Digital Input #4 Custom Event
Engine Coolant Temperature	Emergency Stop Switch	Digital Input #5 Custom Event
Engine Oil Temperature	Engine in Cooldown	Digital Input #6 Custom Event
Exhaust Temperature	Engine Failure to Start	Digital Input #7 Custom Event
Generator Rear Bearing Temperature	Engine Speed	Digital Input #8 Custom Event
Generator Winding #1 Temperature	Generator Control Not in Automatic	Isolated Dig Input #1 Custom
	Generator Current (Amp)	Isolated Dig Input #2 Custom
Levels	Generator Output Frequency	Isolated Dig Input #3 Custom
Engine Coolant Level	Generator Output Power	Isolated Dig Input #4 Custom
Engine Oil Level	Generator Output Voltage	Analog Input #1 Custom Event
Fuel Level	Primary Data Link	Analog Input #2 Custom Event
External Tank Fuel Level	SCADA Data Link	Analog Input #3 Custom Event
	Serv Maint Interval Expired	Analog Input #4 Custom Event (4.4 Only)
	Unexpected Engine Shutdown	
	Earth Fault	
	Earth Leakage	
	Engine Controller	
	Fuel Leak	
	Air Damper Closed	
	Battery Charger Failure	
	Generator Circuit Breaker Open	
	Generator Circuit Breaker Closed	

Table 12: Output System Events

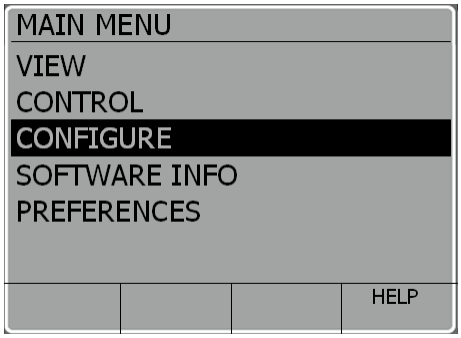
Care must be taken in configuring the correct triggers. Only some of these can be configured for a specific System Event and even if it can be configured, it may not be representative of the system requirements.

CONFIGURING DIGITAL OUTPUTS FOR SCADA DATA LINK

When a Digital Output is configured for SCADA Data Link, an active state will be sent over MODBUS. No alarms or warnings will be generated by the EMCP. To configure a Digital Output for SCADA Data Link, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

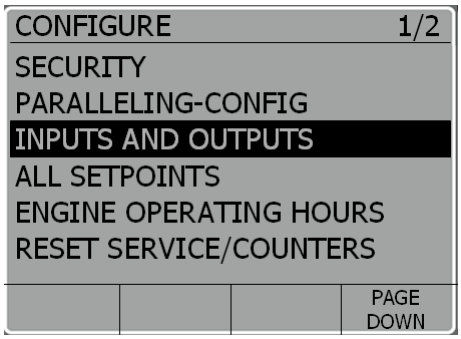
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

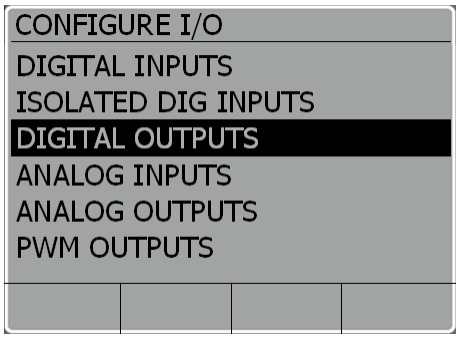
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



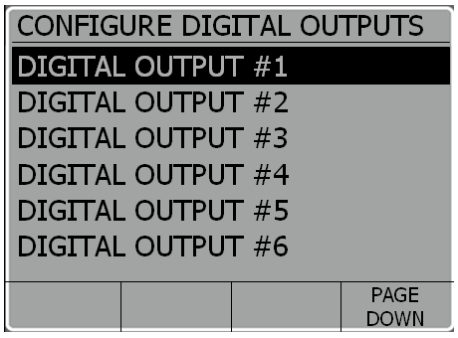
SCROLL DOWN to **DIGITAL OUTPUTS**

Press the **OK KEY**.

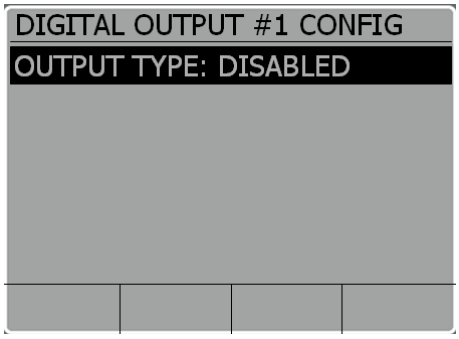


Select the **DIGITAL OUTPUT** that you want to program

Press the **OK KEY**.

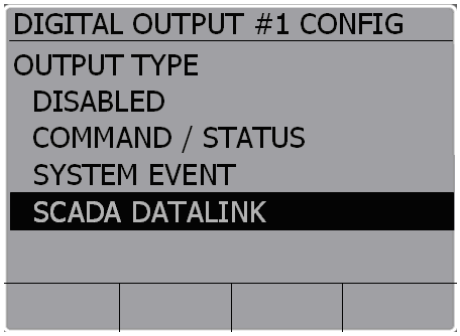


Press the **OK KEY** to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA DATA LINK**).



Scroll **DOWN** to **SCADA DATA LINK**

Press the **OK KEY**.

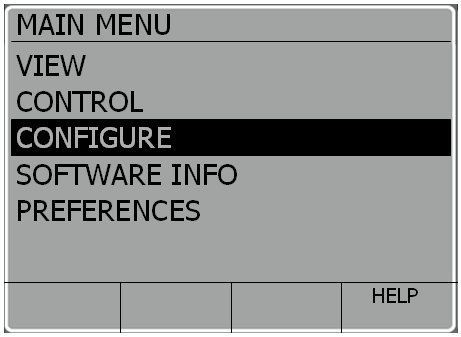


DISABLING DIGITAL OUTPUTS

To disable a Digital Output, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

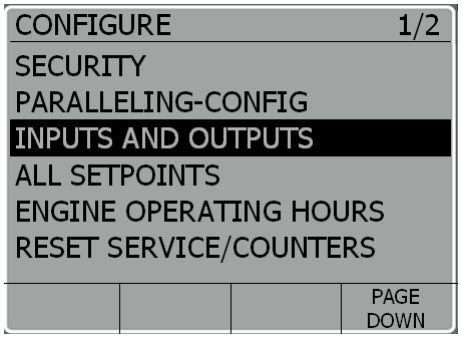
Press the **OK KEY.**



SCROLL DOWN to **INPUTS & OUTPUTS**

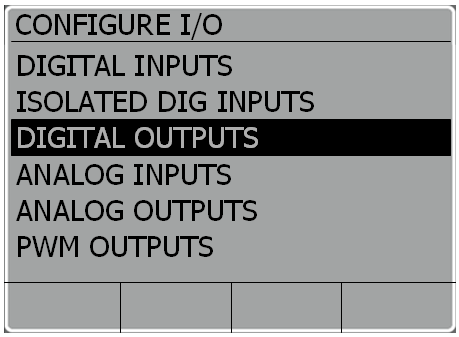
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



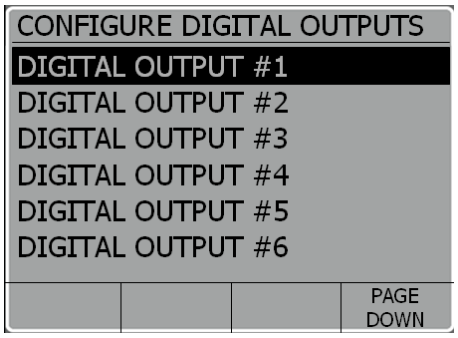
SCROLL DOWN to **DIGITAL OUTPUTS**

Press the **OK KEY**.

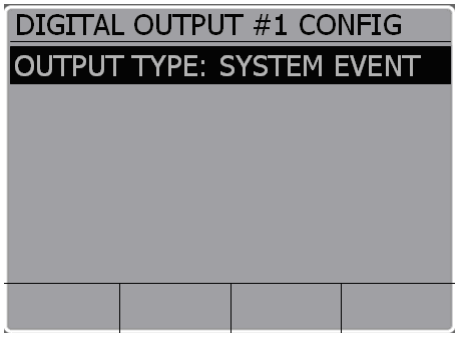


Select the **DIGITAL OUTPUT** that you want to program

Press the **OK KEY**.

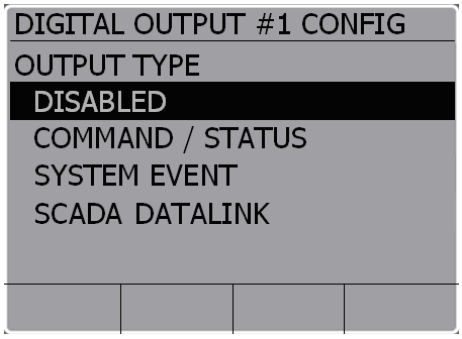


Press the **OK KEY** to highlight the current configuration (**DISABLED, STATUS, SYSTEM EVENT, OR SCADA DATA LINK**).



Scroll **DOWN** to **DISABLED**

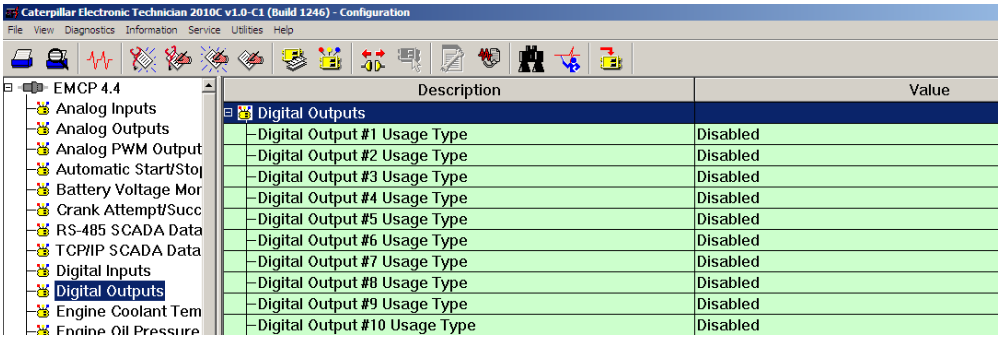
Press the **OK KEY**.



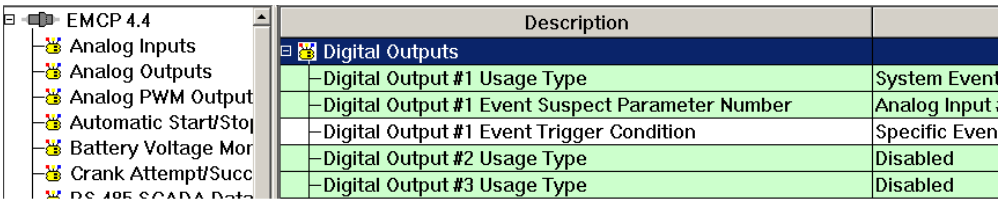
10.2 PROGRAMMING DIGITAL OUTPUTS USING THE CAT SERVICE TOOL

The EMCP 4 Digital Outputs can be configured by using the Cat Service Tool. The key to programming them is to program the setpoints related to each input in order from top to bottom. To program a Digital Output, do the following steps:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Digital Outputs on the left.



3. Determine which Digital Output is to be configured. For example, all of the setpoints for Digital Output #1 have the text “#1” in their name.



4. Next follow the steps below according to which Usage Type is desired.

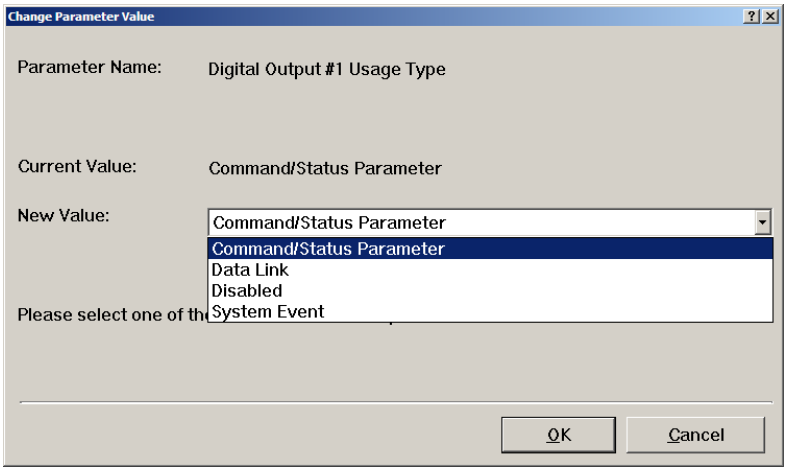
CONFIGURING DIGITAL OUTPUTS FOR STATUS PARAMETERS

Command or Status parameters are used to control specific functions within the control system or to make certain conditions within the system be known.

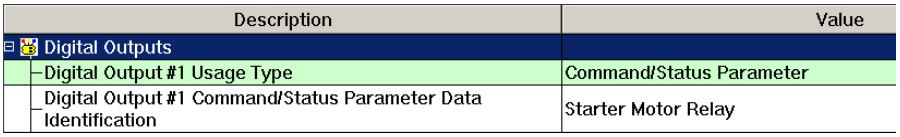
Note: The Fuel Control Relay does not pickup when the Engine Operating State is set to CAN. Engine Start Initiated can be used in Lieu of the Fuel Control Relay for most purposes.

To configure a Digital Output as a Command or Status Parameter, go through the following menu options:

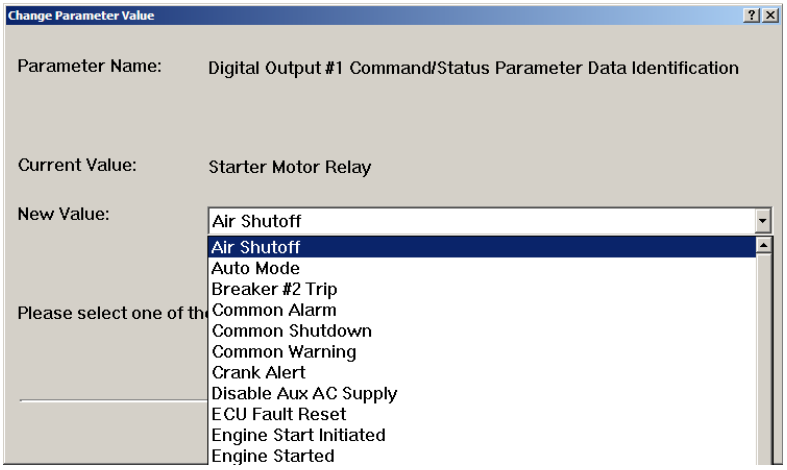
1. Double click the Digital Output #N Usage type to change this value to Command/Status Parameter from the drop down menu. Click the OK button to program.



2. The Digital Output #N Command/Status Parameter Data Identification parameter will now be visible in the right pane.



3. Double click the Configure the Command/Status Parameter Data Identification setpoint to change this value from the drop down menu. Click the OK button to program.

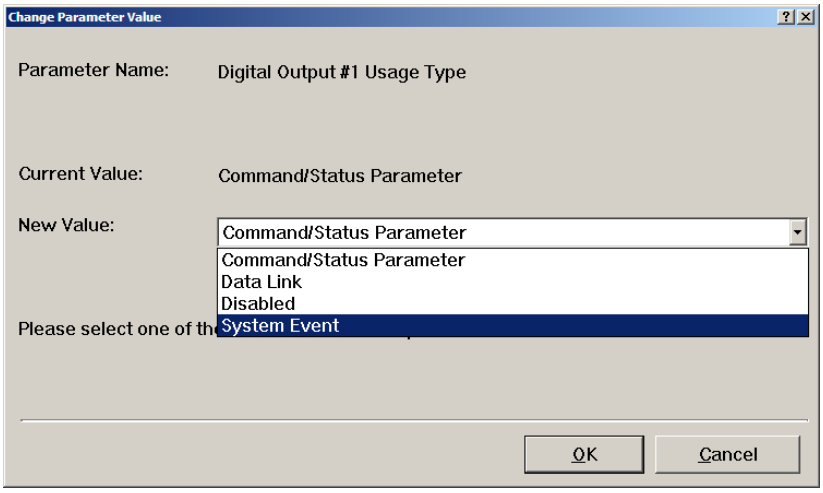


See Table 11 in Section 10.1 for a complete list of possible Status Parameter Data Identifications.

CONFIGURING DIGITAL OUTPUTS FOR SYSTEM EVENTS

System Events are used to know when specific conditions are reached and to alert the control system of warning or shutdown conditions. To configure a Digital Output as a System Event, go through the following menu options:

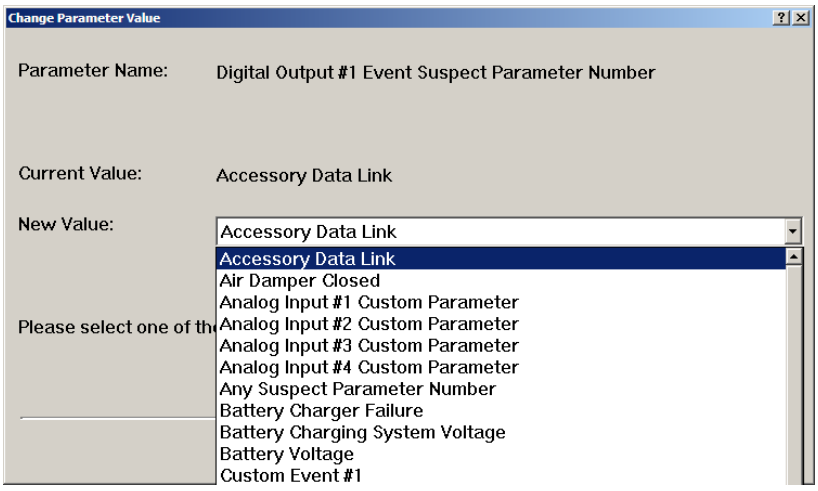
1. Double click the Digital Output #N Usage Type to change this value to System Event from the drop down menu. Click the OK button to program.



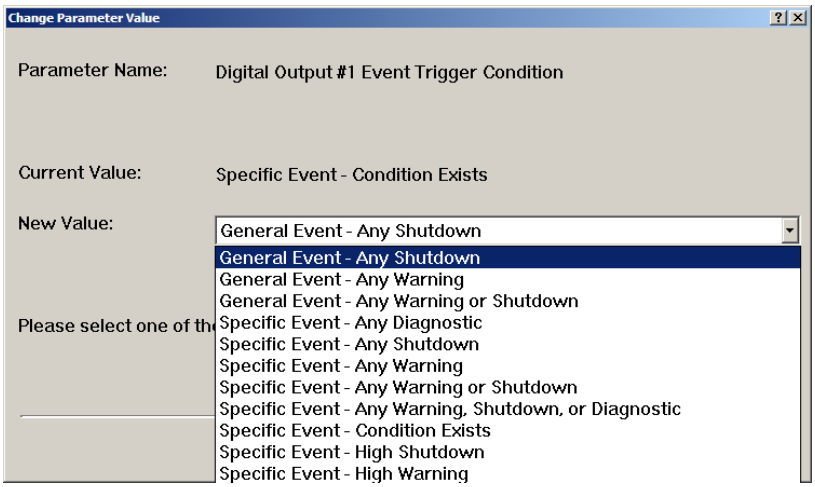
2. The Digital Output #N Suspect Parameter Number (SPN) and Event Trigger Condition parameters will now be visible in the right pane.

Description	Value
Digital Outputs	
Digital Output #1 Usage Type	System Event
Digital Output #1 Event Suspect Parameter Number	Analog Input #4 Custom Parameter
Digital Output #1 Event Trigger Condition	Specific Event - Condition Exists

3. Double click the Digital Output #N Suspect Parameter Number (SPN) setpoint to change this value from the drop down menu. Click the OK button to program.



4. Double click the Digital Output #N Event Trigger Condition setpoint to change this value from the drop down menu. Click the OK button to program.

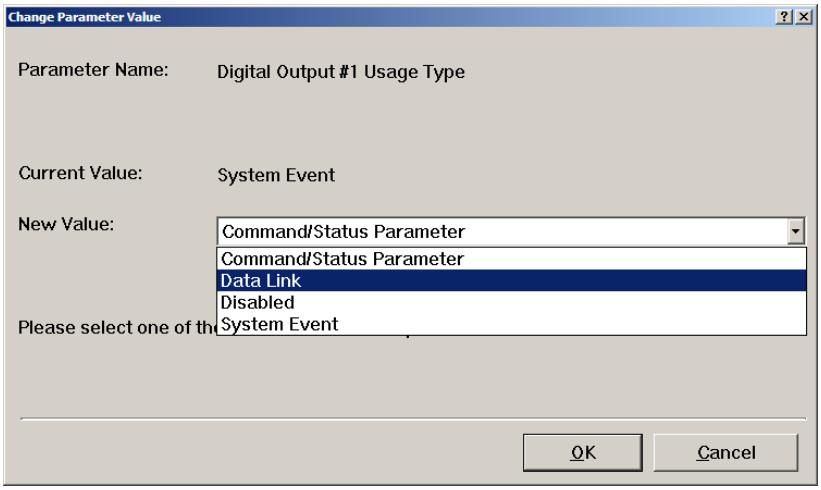


See Table 12 in Section 10.1 for a complete list of possible System Events.

CONFIGURING DIGITAL OUTPUTS FOR SCADA DATA LINK

When a Digital Output is configured for SCADA Data Link, an active state will be sent over MODBUS. No alarms or warnings will be generated by the EMCP. To configure a Digital Output for SCADA Data Link, go through the following menu options:

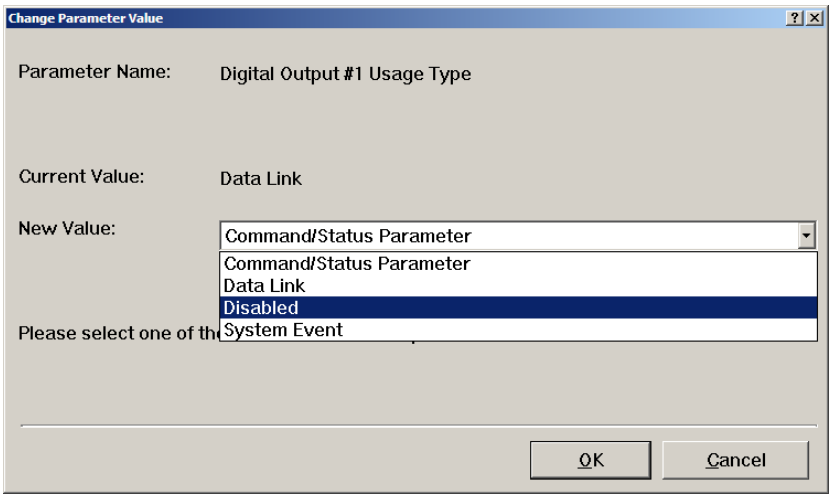
1. Double click the Digital Output #N Usage type to change this value to Data Link from the drop down menu. Click the OK button to program.



DISABLING DIGITAL OUTPUTS

To disable a Digital Output, go through the following menu options:

1. Double click the Digital Output #N Usage type to change this value to Disabled from the drop down menu. Click the OK button to program.



11 ANALOG OUTPUTS

The EMCP 4.3 and 4.4 support three 2-wire (plus shield) fully individually isolated Analog Output channels (individually switchable for 0 to 20mA current) or analog voltage -10 to 0 to +10VDC.

Full resolution, with a minimum of 8 bits (256 points) of data, is supported -10 to +10VDC, -3 to +3VDC, 0-5VDC, along with equivalent current ranges (0 to 20mA).

Configurable Analog Outputs can be configured to two different types: voltage or current. The hardware limitations are: -10V to +10V for voltage, 0 to 20mA for current. Refer to Table 13 for the valid configuration ranges.

Current Sender Ranges	Voltage Sender Ranges
0 to 20mA	0 to 5V
4 to 20mA	1 to 5V
0 to 10mA	0 to 10V
	-3 to +3V
	-2.5 to +2.5V
	-5 to +5V
	-10 to +10V
	0.5 to 4.5V
	-1 to +1V

Table 13: Analog Output Confuration Ranges

If a load share module is installed, and an Analog Output is used as a requested speed signal, set a Digital Output to Run at Rated (or Run at Idle) and wire the corresponding relay contact to the load share module Idle/Rated Ramp input. Check the load share module input to determine which of Run at Rated or Run at Idle is required.

11.1 PROGRAMMING ANALOG OUTPUTS USING THE DISPLAY

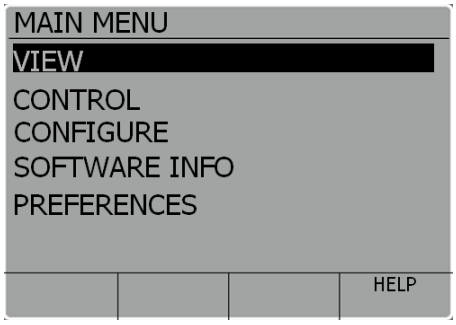
VIEWING THE CURRENT ANALOG OUTPUT STATUS

To view the current status of an Analog Output, go through the following menu options:

AT THE MAIN MENU, scroll **DOWN**  **TO VIEW**

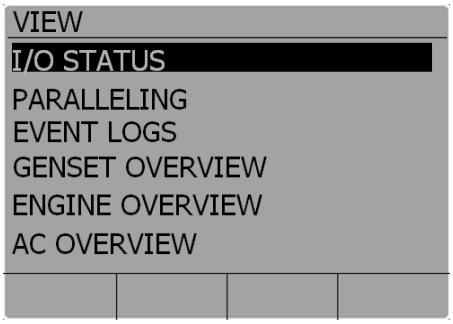
Press the **OK KEY** 

.



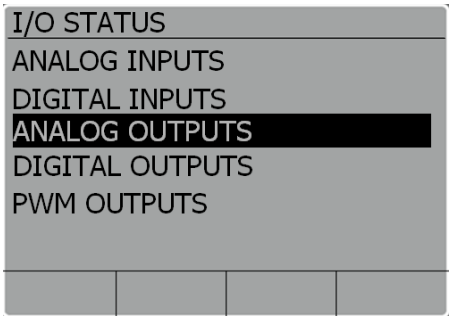
Scroll **DOWN** to **I/O STATUS**

Press the **OK KEY**.



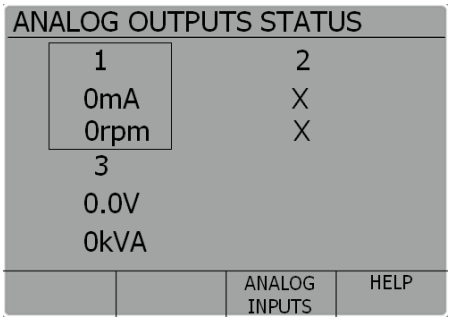
Scroll **DOWN** to access **ANALOG OUTPUTS**.

Press the **OK KEY**.



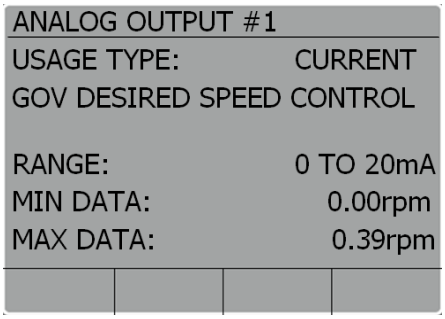
The status of all Analog Outputs is shown.

A dash under an output number indicates an output that is programmed, but inactive. A large “X” under an output number indicates an output that is disabled. A number under an output number indicates an output that is programmed and active.



With the **LEFT ARROW** or **RIGHT ARROW**, select the **ANALOG OUTPUT** that you want to view, then press the **OK KEY**.

The programmed Usage Type, Range, Min Data, and Max Data of the selected Analog output are shown.

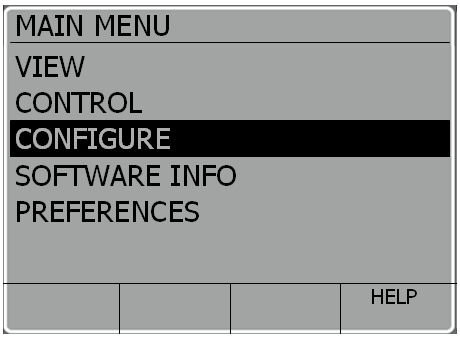


CONFIGURING ANALOG OUTPUTS FOR VOLTAGE MODE

To configure an Analog Output for Voltage mode using the EMCP 4 display, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

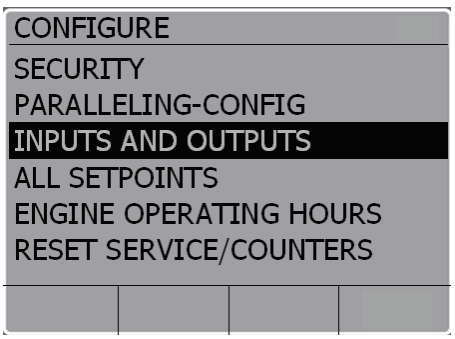
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

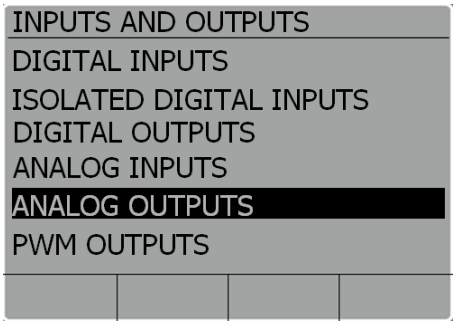
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



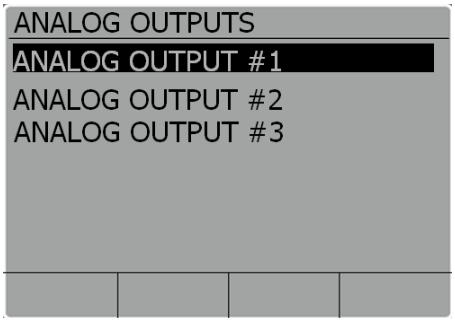
Scroll **DOWN** to **ANALOG OUTPUTS**

Press the **OK KEY**.

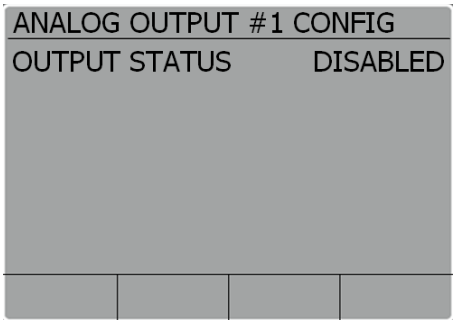


Select the **ANALOG OUTPUT** that you want to program

Press the **OK KEY**.

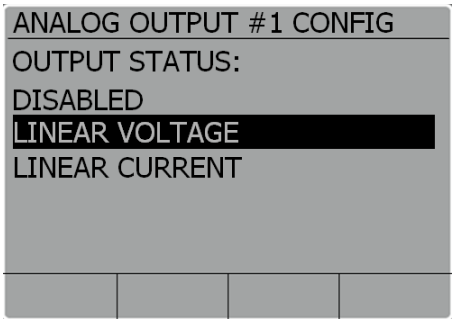


Press the **OK KEY** to highlight the current **OUTPUT TYPE** (**DISABLED, LINEAR VOLTAGE, OR LINEAR CURRENT**).



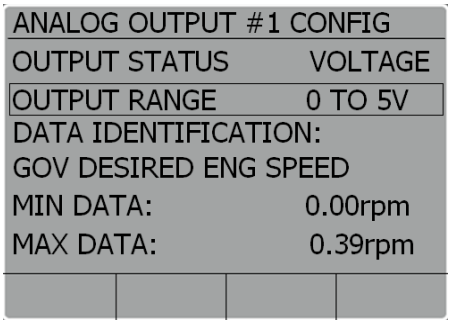
Scroll **DOWN** to select **VOLTAGE**

Press the **OK KEY**.



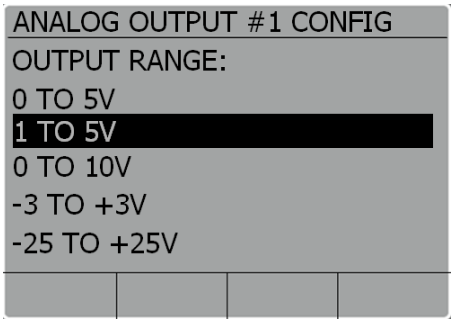
Scroll **DOWN** to **OUTPUT RANGE**

Press the **OK KEY**.



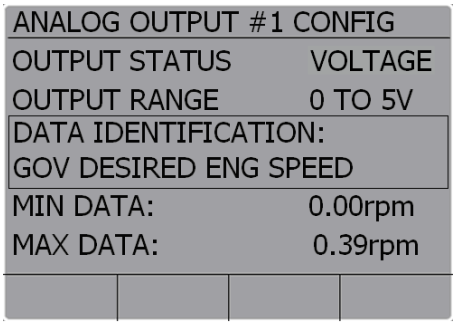
Select the **OUTPUT RANGE** that you want (see Table 13 above)

Press the **OK KEY**.



Scroll **DOWN** to **DATA IDENTIFICATION**

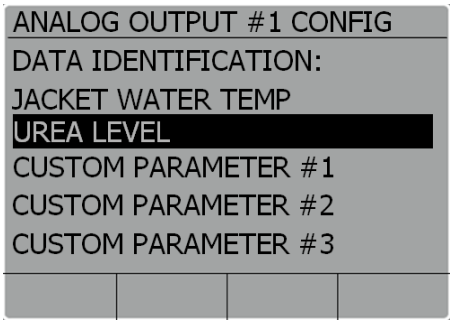
Press the **OK KEY** to edit the current **DATA IDENTIFICATION.**



Select the type of **DATA IDENTIFICATION** that you want to program

Press the **OK KEY** 

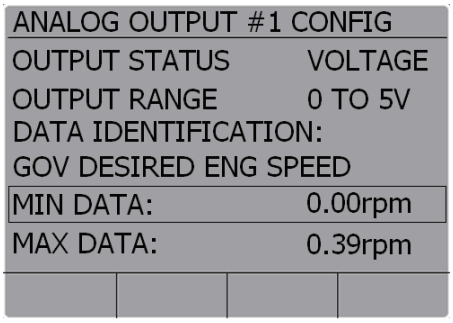
.



Scroll **DOWN**  to **MIN DATA**

Press the **OK KEY** 

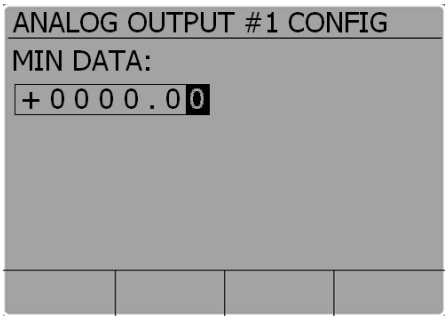
to edit the current **MIN DATA.**



Select the **MIN DATA** that you want to program

Press the **OK KEY** 

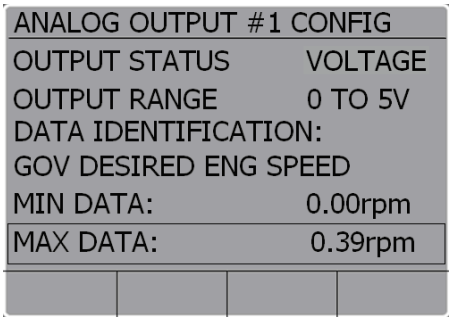
.



Scroll **DOWN**  to **MAX DATA**

Press the **OK KEY** 

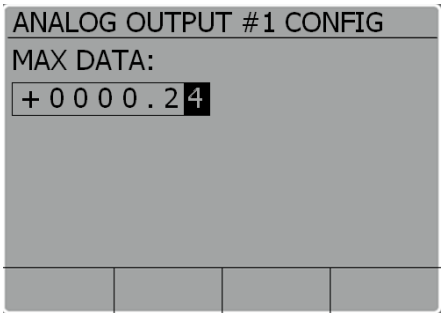
to edit the current **MAX DATA.**



Select the **MAX DATA** that you want to program

Press the **OK KEY** 

.

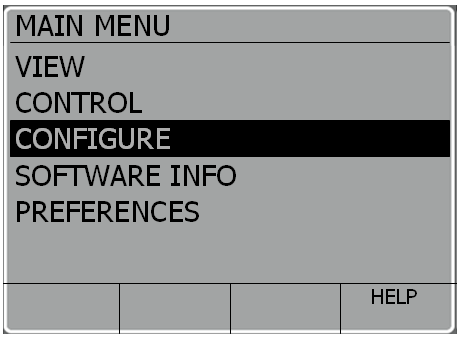


CONFIGURING ANALOG OUTPUTS FOR CURRENT MODE

To configure an Analog Output for Current mode using the EMCP 4 display, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

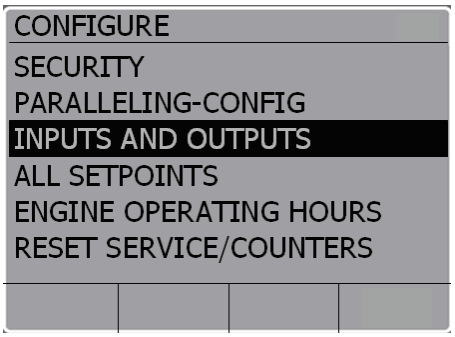
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

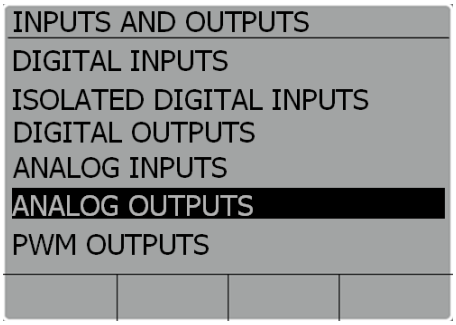
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



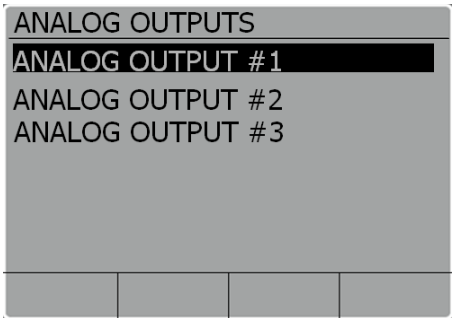
Scroll **DOWN** to **ANALOG OUTPUTS**

Press the **OK KEY**.

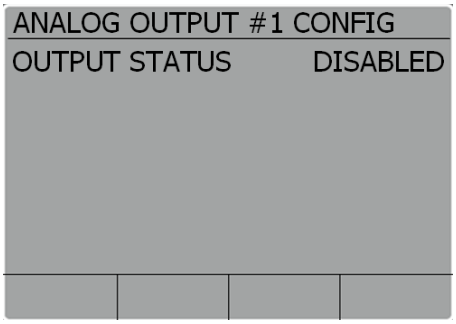


Select the **ANALOG OUTPUT** that you want to program

Press the **OK KEY**.

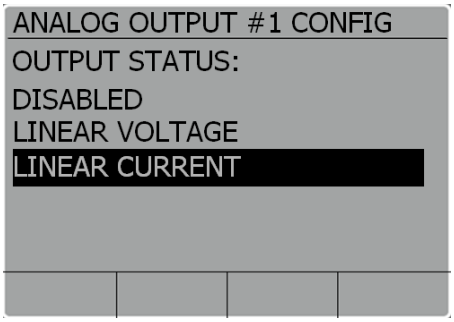


Press the **OK KEY** to highlight the current **OUTPUT TYPE** (**DISABLED, LINEAR VOLTAGE, OR LINEAR CURRENT**).



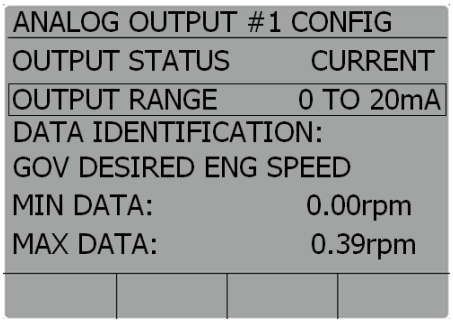
Scroll **DOWN** to select **CURRENT**

Press the **OK KEY**.



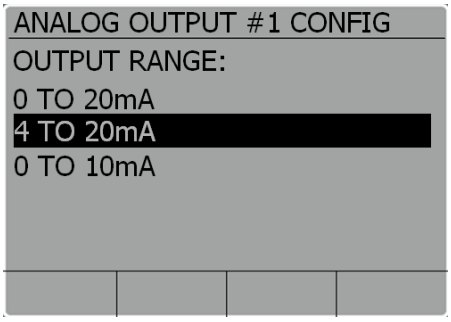
Scroll **DOWN** to **OUTPUT RANGE**

Press the **OK KEY**.



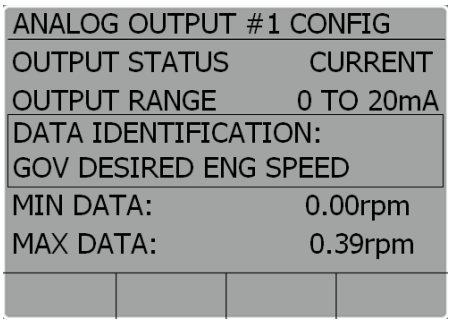
Select the **OUTPUT RANGE** that you want (see Table 13 above)

Press the **OK KEY**.



Scroll **DOWN** to **DATA IDENTIFICATION**

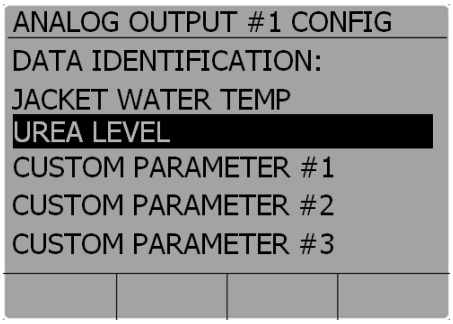
Press the **OK KEY** to edit the current **DATA IDENTIFICATION**.



Select the type of **DATA IDENTIFICATION** that you want to program

Press the **OK KEY** 

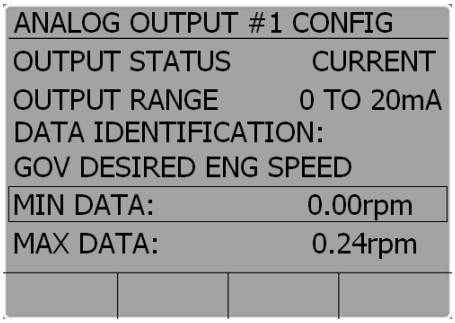
.



Scroll **DOWN**  to **MIN DATA**

Press the OK Key 

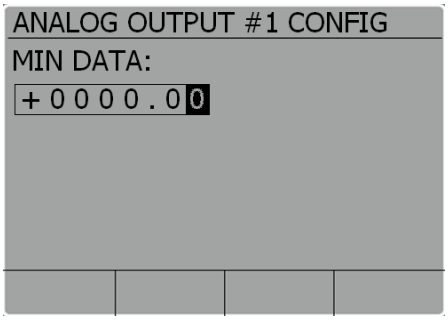
to edit the current **MIN DATA**.



Select the **MIN DATA** that you want to program

Press the **OK KEY** 

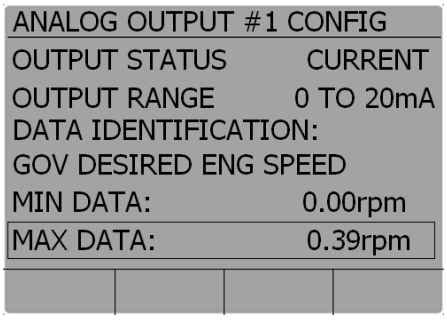
.



Scroll **DOWN**  to **MAX DATA**

Press the **OK KEY** 

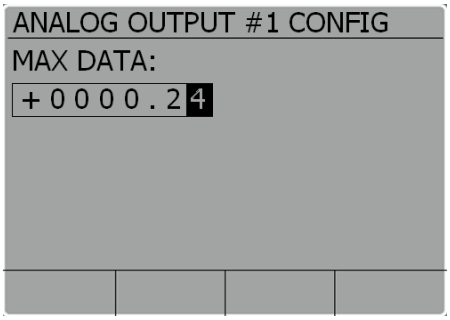
to edit the current **MAX DATA**.



Select the **MAX DATA** that you want to program

Press the **OK KEY** 

.



Any Analog Output can be configured for any one of the Data Identifications in Table 14:

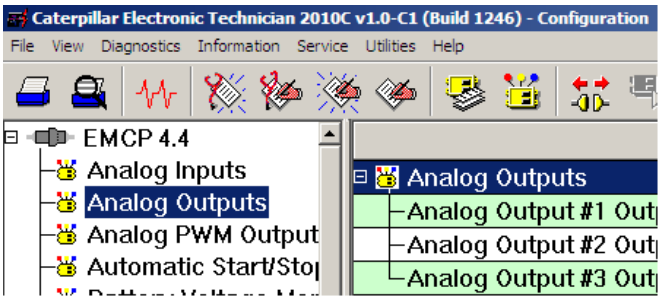
GOV DESIRED ENG SPEED	GEN AVG L-N VOLTAGE
AVR DESIRED VOLTAGE	GEN AVG L-L VOLTAGE
GEN REAL POWER	AVG PHASE CURRENT
GEN REACTIVE POWER	ENGINE SPEED
GEN APPARENT POWER	ENGINE COOLANT TEMP
GEN PF	UREA LEVEL
ENG OIL TEMP	CUSTOM PARAMETER #1
GEN FREQUENCY	CUSTOM PARAMETER #2
GEN CURRENT PHASE A	CUSTOM PARAMETER #3
GEN CURRENT PHASE B	CUSTOM PARAMETER #4 (4.4 Only)
GEN CURRENT PHASE C	GEN WINDING TEMP PHASE A
GEN L-N VOLT PHASE A	GEN WINDING TEMP PHASE B
GEN L-N VOLT PHASE B	GEN WINDING TEMP PHASE C
GEN L-N VOLT PHASE C	GEN FRT BEARING TEMP
GEN L-L VOLT PHASE A-B	GEN REAR BEARING TEMP
GEN L-L VOLT PHASE B-C	OUTPUT FROM SCADA
GEN L-L VOLT PHASE C-A	ENGINE FUEL LEVEL

Table 14: Analog Output Data Identifications List

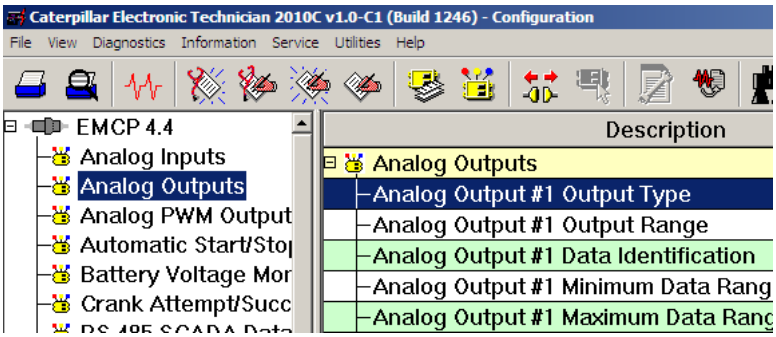
11.2 PROGRAMMING ANALOG OUTPUTS USING THE CAT SERVICE TOOL

The EMCP 4 Analog Outputs can be configured by using the Cat Service Tool. The key to programming them is to program the setpoints related to each output in order from top to bottom. To program an Analog Output, do the following steps:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Analog Outputs on the left.



3. Determine which Analog Output is to be configured. For example, all of the setpoints for Analog Output #1 have the text “#1” in their name.

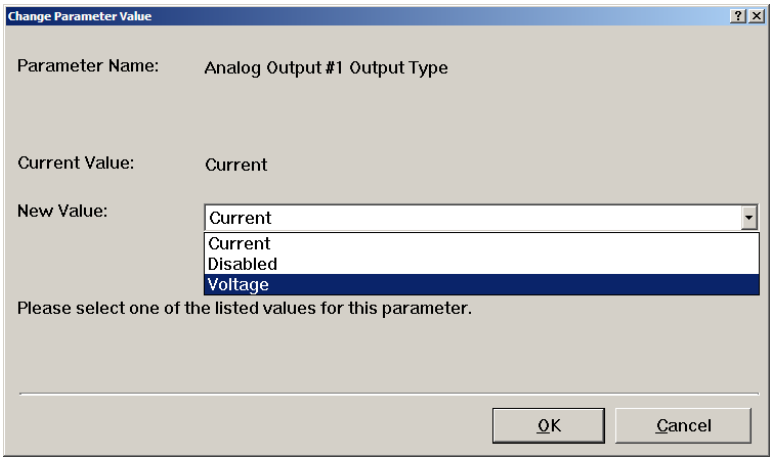


4. Next follow the steps below according to which Usage Type is desired.

CONFIGURING ANALOG OUTPUTS FOR VOLTAGE MODE

To configure an Analog Output for Voltage mode, go through the following menu options:

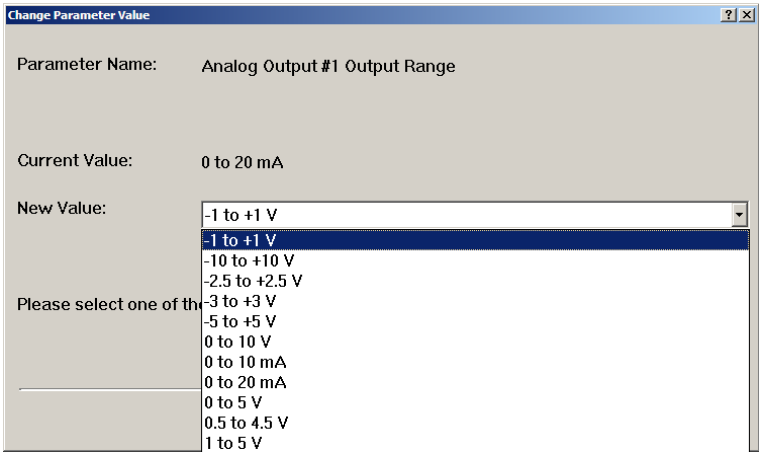
1. Double click the Analog Output #N Output Type to change this value to Voltage from the drop down menu. Click the OK button to program.



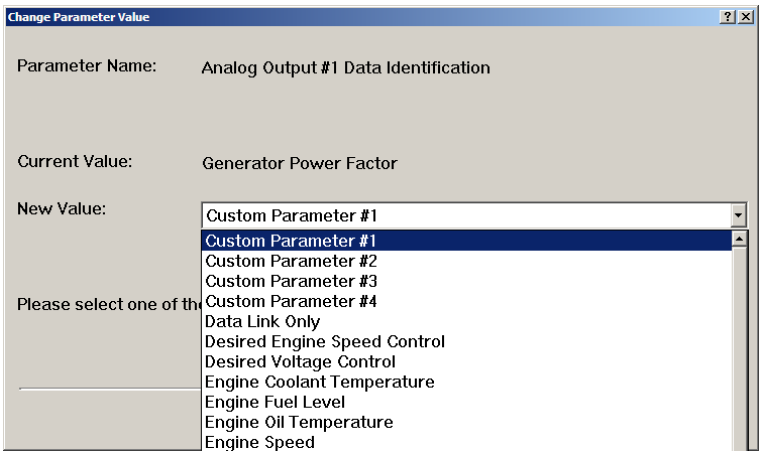
2. The remaining Analog Output #N Voltage parameters will now be visible in the right pane.

Description	Value
Analog Outputs	
Analog Output #1 Output Type	Voltage
Analog Output #1 Output Range	0 to 5 V
Analog Output #1 Data Identification	Generator Power Factor
Analog Output #1 Minimum Data Range	0.000
Analog Output #1 Maximum Data Range	1.000

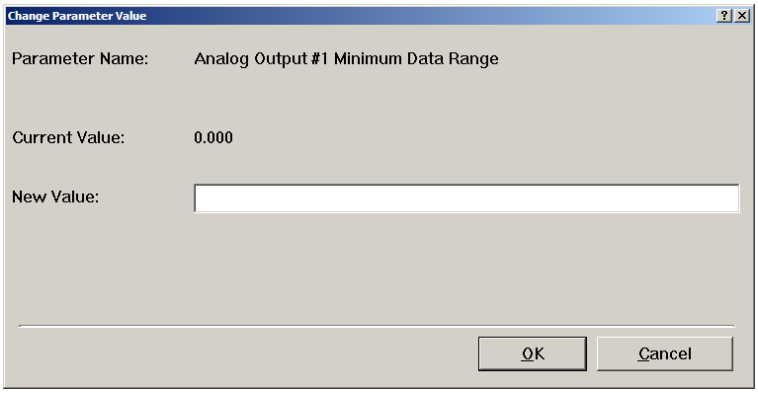
3. Double click the Analog Output #N Output Range to change this value from the drop down menu. Click the OK button to program.



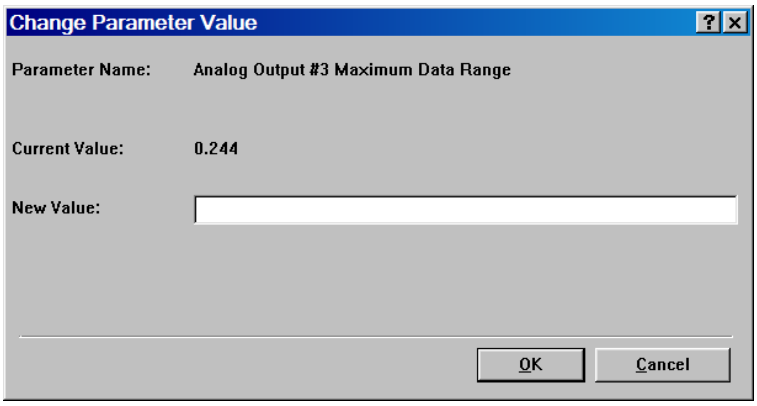
4. Double click the Analog Output #N Data Identification to change this value from the drop down menu. Click the OK button to program.



5. Double click the Analog Output #N Minimum Data Range to change this value. Click the OK button to program.



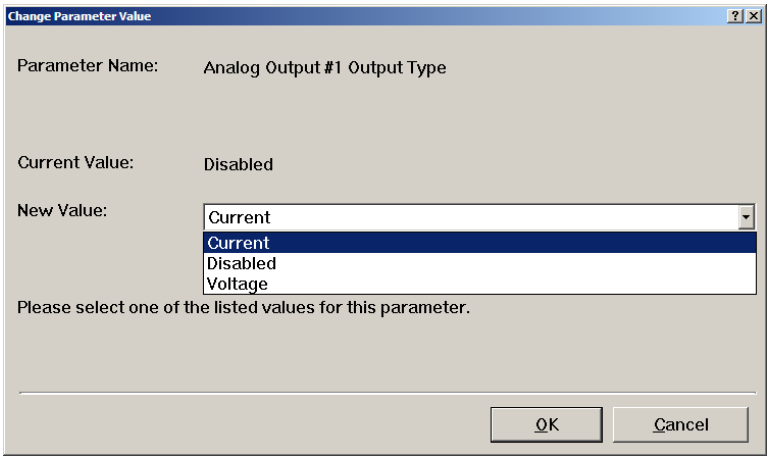
6. Double click the Analog Output #N Maximum Data Range to change this value. Click the OK button to program.



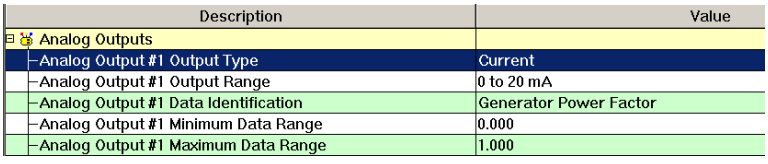
CONFIGURING ANALOG OUTPUTS FOR CURRENT MODE

To configure an Analog Output for Current mode, go through the following menu options:

1. Double click the Analog Output #N Output Type to change this value to Current from the drop down menu. Click the OK button to program.

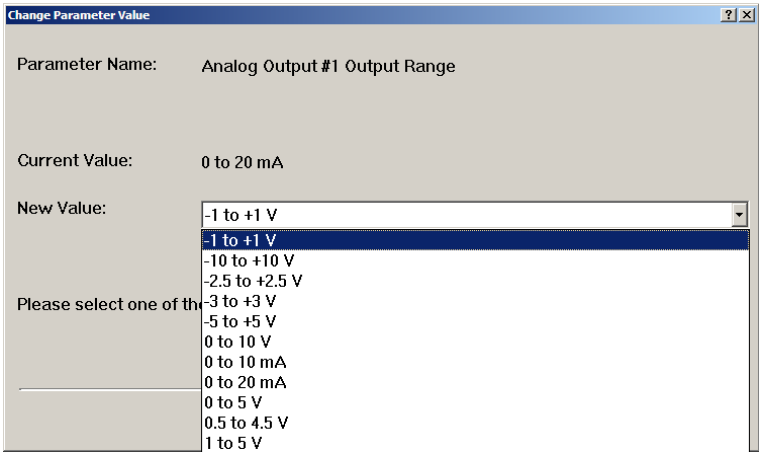


2. The remaining Analog Output #N Current parameters will now be visible in the right pane.

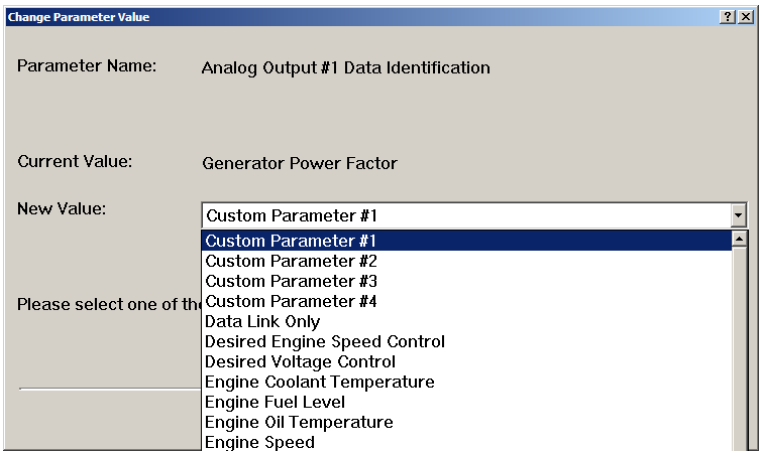


Description	Value
Analog Outputs	
Analog Output #1 Output Type	Current
Analog Output #1 Output Range	0 to 20 mA
Analog Output #1 Data Identification	Generator Power Factor
Analog Output #1 Minimum Data Range	0.000
Analog Output #1 Maximum Data Range	1.000

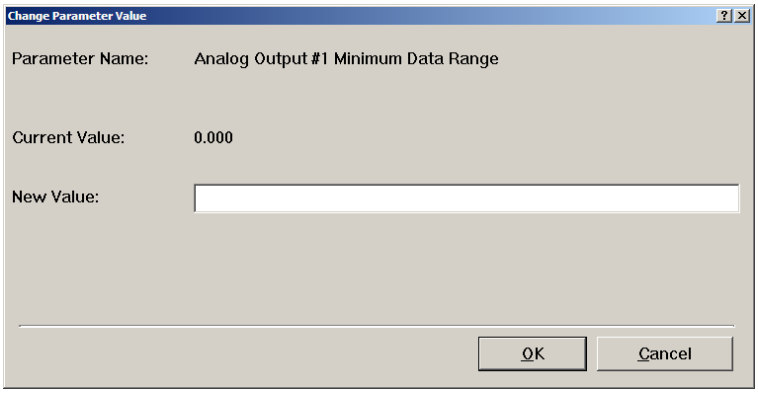
3. Double click the Analog Output #N Output Range to change this value from the drop down menu. Click the OK button to program.



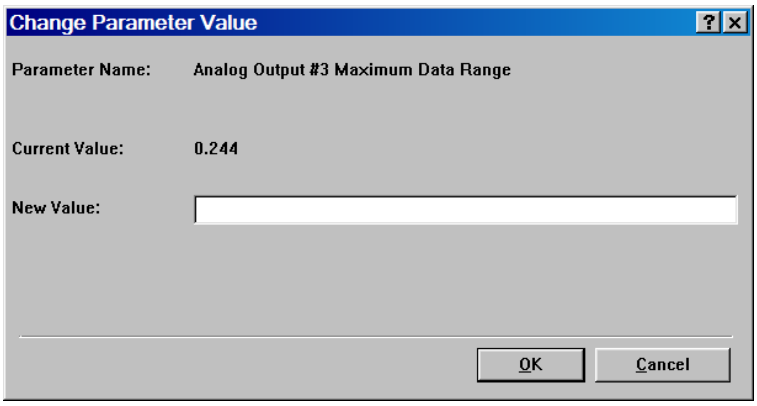
4. Double click the Analog Output #N Data Identification to change this value from the drop down menu. Click the OK button to program.



5. Double click the Analog Output #N Minimum Data Range to change this value. Click the OK button to program.



6. Double click the Analog Output #N Maximum Data Range to change this value. Click the OK button to program.



12 PWM OUTPUTS

The EMCP 4.3 and 4.4 support two 2-wire (plus shield) fully individually isolated analog PWM output channels.

The PWM outputs can be configured for one of two different ranges: 0 to 100%, or 5 to 95%. The data range is configurable and should be set to the generator voltage. The output signal is ~6V peak.

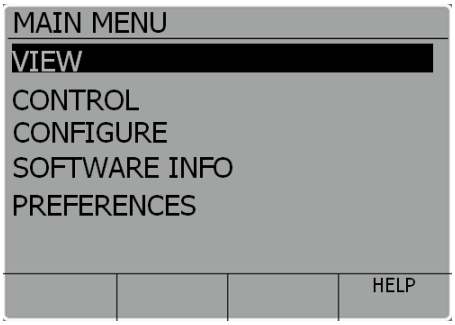
12.1 PROGRAMMING PWM OUTPUTS USING THE DISPLAY

VIEWING THE CURRENT PWM OUTPUT STATUS

To view the current status of a PWM Output, go through the following menu options:

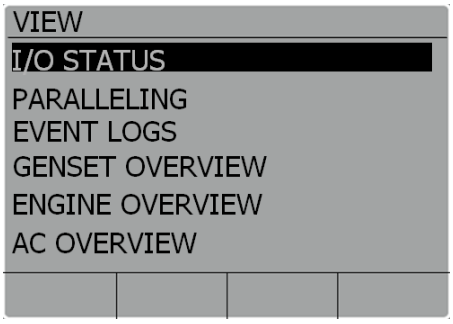
AT THE MAIN MENU, scroll **DOWN** **TO VIEW**

Press the **OK KEY**.



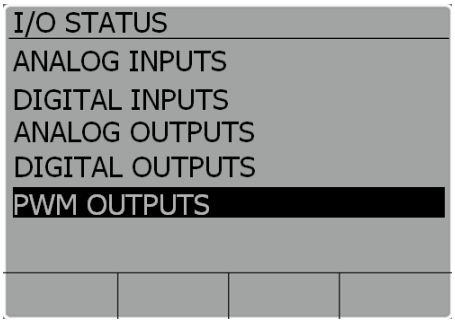
Scroll **DOWN** to **I/O STATUS**

Press the **OK KEY**.



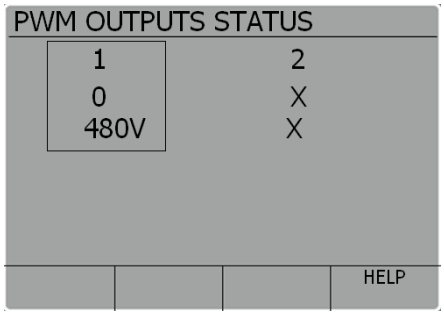
Scroll **DOWN** to access **PWM OUTPUTS**.

Press the **OK KEY**.



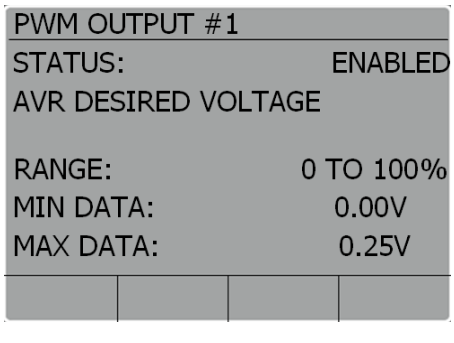
The status of all PWM Outputs is shown.

A dash under an output number indicates an output that is programmed, but inactive. A large “X” under an output number indicates an output that is disabled. A number under an output number indicates an output that is programmed and active.



With the **LEFT ARROW** or **RIGHT ARROW**, select the **PWM OUTPUT** that you want to view, then press the **OK KEY**.

The programmed Status, Usage Type, Range, Min Data, and Max Data of the selected Analog output are shown.

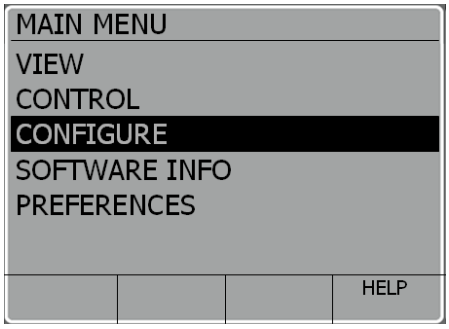


CONFIGURING PWM OUTPUTS

To configure a PWM Output using the EMCP 4 display, go through the following menu options:

AT THE MAIN MENU, scroll down **TO CONFIGURE**

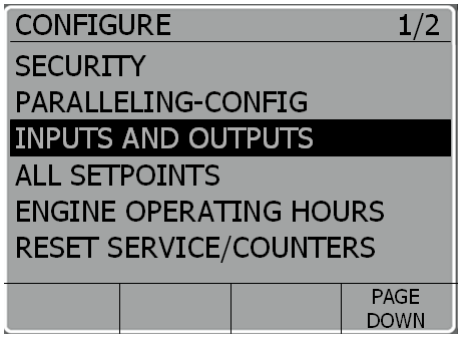
Press the **OK KEY**.



SCROLL DOWN to **INPUTS & OUTPUTS**

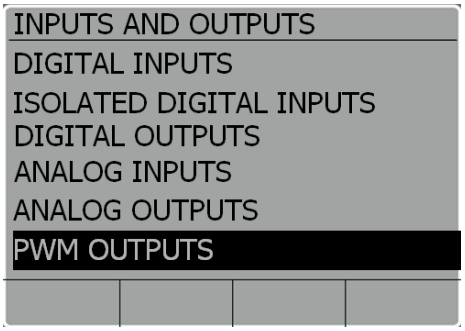
Press the **OK KEY**.

Alternately, access to **THE INPUTS & OUTPUTS** submenu is accessible from **ALL SETPOINTS.**



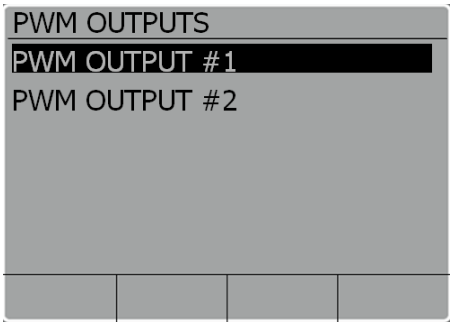
Scroll **DOWN** to **PWM OUTPUTS**

Press the **OK KEY**.

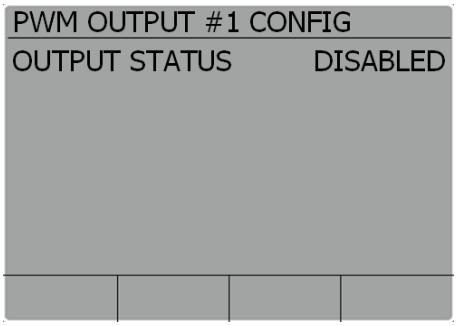


Select the **PWM OUTPUT** that you want to program

Press the **OK KEY**.

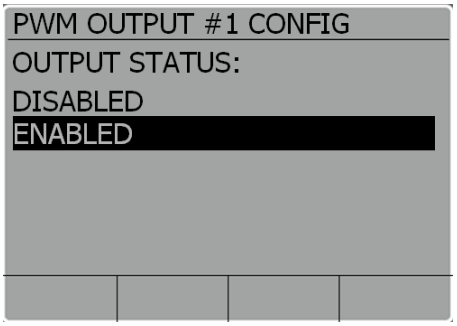


Press the **OK KEY** to highlight the current Output Type (**DISABLED, OR ENABLED**).



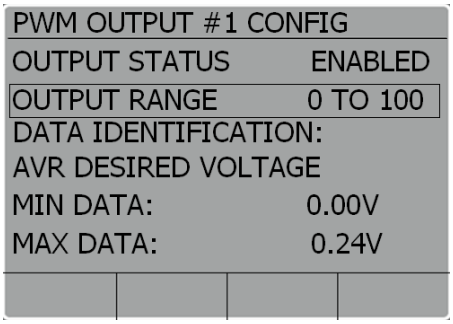
Scroll **DOWN** to select the desired **OUTPUT TYPE**

Press the **OK KEY**.



Scroll **DOWN** to **OUTPUT RANGE**

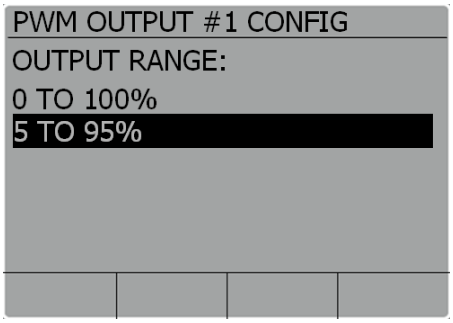
Press the **OK KEY**.



Select the **OUTPUT RANGE** that you want (0-100%, or 5-95%)

Press the **OK KEY** 

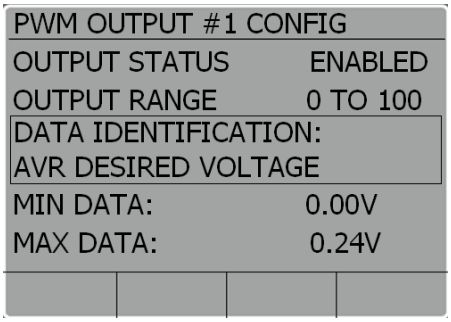
.



Scroll **DOWN**  to **DATA IDENTIFICATION**

Press the **OK KEY** 

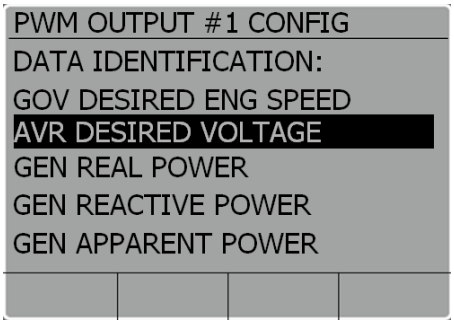
to edit the current **DATA IDENTIFICATION.**



Select the type of **DATA IDENTIFICATION** that you want to program

Press the **OK KEY** 

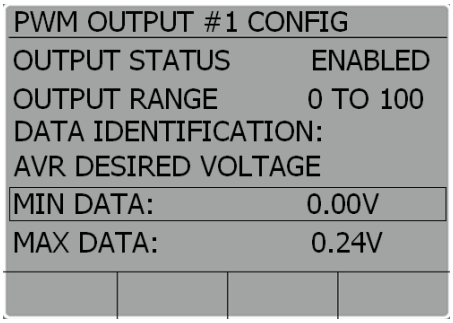
.



Scroll **DOWN**  to **MIN DATA**

Press the **OK KEY** 

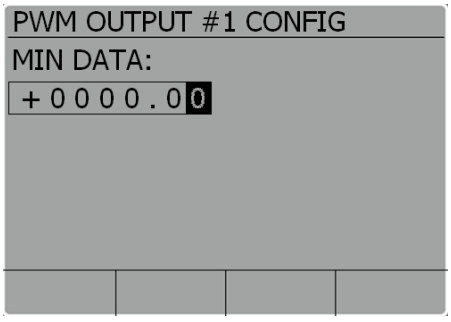
to edit the current **MIN DATA.**



Select the type of **MIN DATA** that you want to program

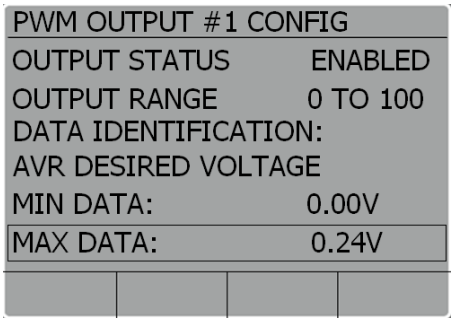
Press the **OK KEY** 

.



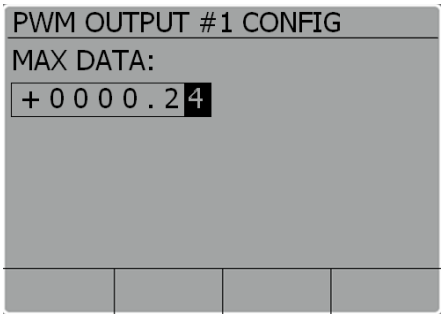
Scroll **DOWN**  to **MAX DATA**

Press the **OK KEY**  to edit the current **MAX DATA.**



Select the type of **MAX DATA** that you want to program

Press the **OK KEY**  .



Any PWM Output can be configured for any one of the Data Identifications in Table 15:

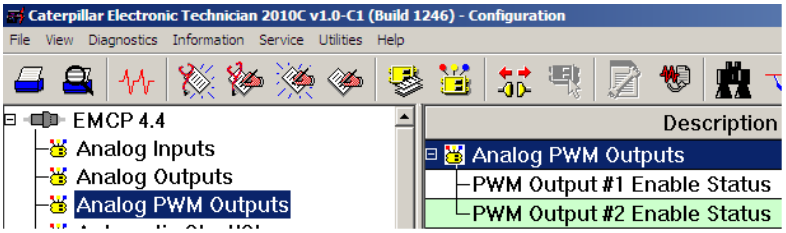
GOV DESIRED ENG SPEED	GEN AVG L-N VOLTAGE
AVR DESIRED VOLTAGE	GEN AVG L-L VOLTAGE
GEN REAL POWER	AVG PHASE CURRENT
GEN REACTIVE POWER	ENGINE SPEED
GEN APPARENT POWER	ENGINE COOLANT TEMP
GEN PF	UREA LEVEL
ENG OIL TEMP	CUSTOM PARAMETER #1
GEN FREQUENCY	CUSTOM PARAMETER #2
GEN CURRENT PHASE A	CUSTOM PARAMETER #3
GEN CURRENT PHASE B	CUSTOM PARAMETER #4 (4.4 Only)
GEN CURRENT PHASE C	GEN WINDING TEMP PHASE A
GEN L-N VOLT PHASE A	GEN WINDING TEMP PHASE B
GEN L-N VOLT PHASE B	GEN WINDING TEMP PHASE C
GEN L-N VOLT PHASE C	GEN FRT BEARING TEMP
GEN L-L VOLT PHASE A-B	GEN REAR BEARING TEMP
GEN L-L VOLT PHASE B-C	OUTPUT FROM SCADA
GEN L-L VOLT PHASE C-A	ENGINE FUEL LEVEL

Table 15: PWM Output Data Identifications List

12.2 PROGRAMMING PWM OUTPUTS USING THE CAT SERVICE TOOL

The EMCP 4 PWM Outputs can be configured by using the Cat Service Tool. The key to programming them is to program the setpoints related to each input in order from top to bottom. To program a PWM Output, do the following steps:

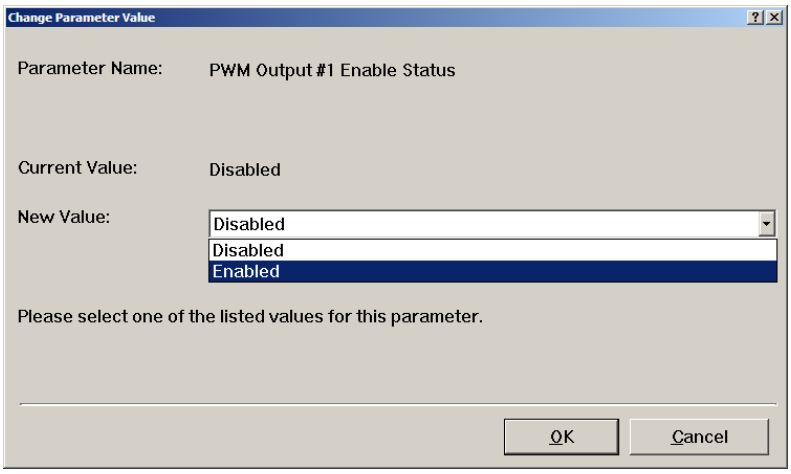
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Analog PWM Outputs on the left.



3. Determine which PWM Output is to be configured. For example, all of the setpoints for PWM Output #1 have the text “#1” in their name.

Description	Value
Analog PWM Outputs	
PWM Output #1 Enable Status	Disabled
PWM Output #2 Enable Status	Disabled

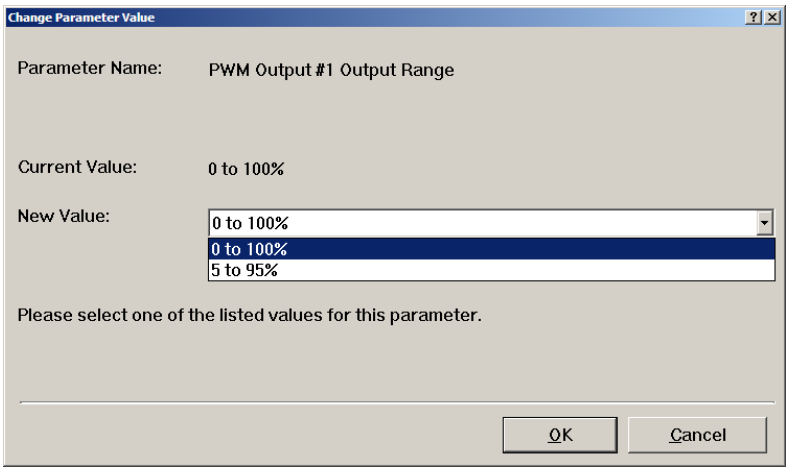
4. Double click the PWM Output #N Enable Status to change this value to Enabled from the drop down menu. Click the OK button to program.



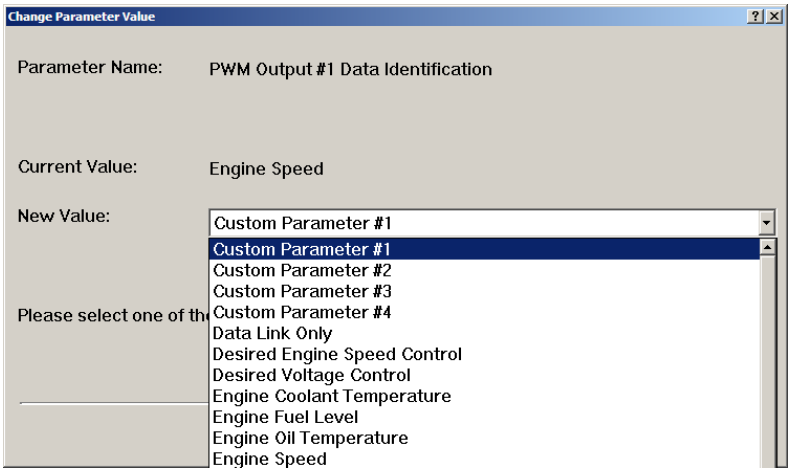
5. The remaining parameters will now be shown.

Description	Value
Analog PWM Outputs	
PWM Output #1 Enable Status	Enabled
PWM Output #1 Output Range	0 to 100%
PWM Output #1 Data Identification	Engine Speed
PWM Output #1 Minimum Data Range	0.000
PWM Output #1 Maximum Data Range	2000.000

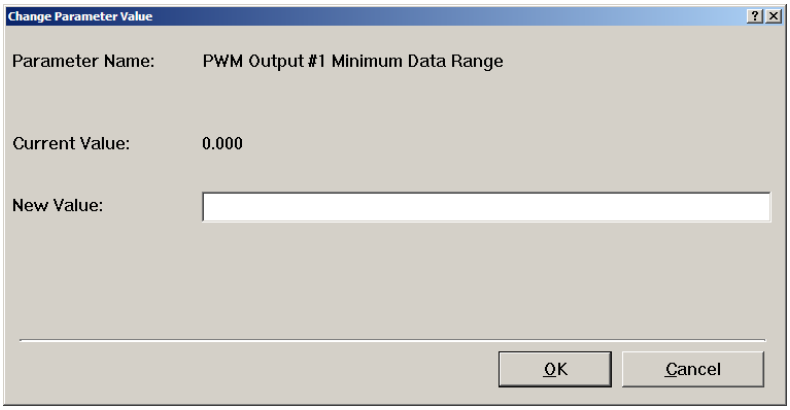
6. Double click the PWM Output #N Output Range to change this value from the drop down menu. Click the OK button to program.



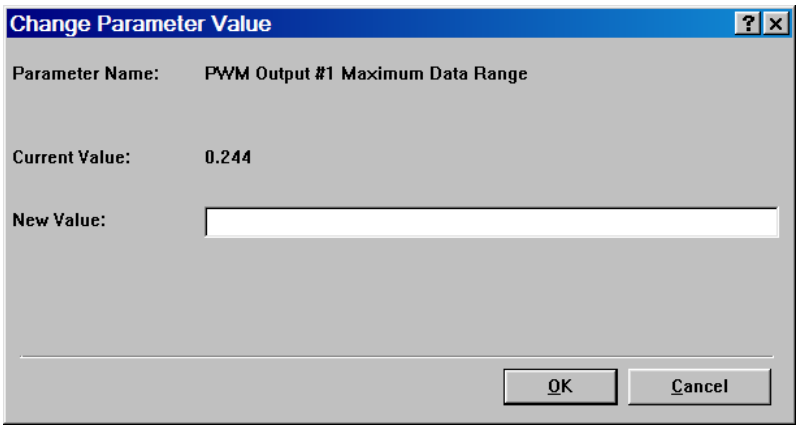
7. Double click the PWM Output #N Data Identification to change this value from the drop down menu. Click the OK button to program. For a full list of options, see Table 15.



8. Double click the PWM Output #N Minimum Data Range to change this value. Click the OK button to program.



9. Double click the PWM Output #N Maximum Data Range to change this value. Click the OK button to program.



13 PARALLELING (EMCP 4.4 ONLY)

The EMCP 4.4 has a variety of paralleling functions including dead bus arbitration, synchronizing, load sharing, load shed, and load sense/load demand. The EMCP 4.4 also provides for multiple modes of operation, including automatic synchronizing, manual synchronizing, and sync check mode.

13.1 PARALLELING FUNCTIONS

DEAD BUS ARBITRATION

The EMCP 4.4 incorporates true dead bus arbitration to determine and select the primary generator set to close to a dead bus, allowing only one unit to close to the dead bus. The dead bus arbitration control minimizes the time for the first generator set to close to the dead bus. See Section 13.3.

SYNCHRONIZING

The EMCP 4.4 monitors all three phases of the generator and main bus. The proprietary synchronizing algorithms drive the generator output frequency, voltage, and phase to match another source, and close the generator circuit breaker when conditions have been met. See Section 13.5.

LOAD SHARING

The EMCP 4.4 actively monitors the real (kW) and reactive (kVAr) load requirement of all paralleled generator sets as shown on the load sharing lines, and adjusts output of the generator set to maintain a balanced loading of all generator sets. See Section 13.6.

LOAD SHED

The EMCP 4 provides a configurable signal to aid in the removal of load. See Section 13.7.

LOAD SENSE/LOAD DEMAND

The EMCP 4.4 includes logic to sequence generator sets based on the total load requirement of the system. If the site load exceeds a minimum reserve kW threshold, additional generator sets will automatically start, synchronize, and close the generator breaker. If the site load falls below a reserve kW threshold, a generator set will automatically unload, open the generator circuit breaker, and shut down. See Section 13.4.

13.2 PARALLELING (SYNCHRONIZING) MODES OF OPERATION

AUTOMATIC PARALLELING (AUTO SYNCHRONIZING)

In the automatic paralleling mode, the EMCP 4.4 controller automatically adjusts the voltage and frequency of the generator set. When the generator output is synchronized with the second source, the EMCP 4.4 controller closes the generator circuit breaker. See Section 13.2.

MANUAL PARALLELING (MANUAL SYNCHRONIZING)

In the manual paralleling mode, the operator manually adjusts the voltage and frequency of the generator set. When the generator set is synchronized with the second source, the operator initiates a generator circuit breaker close command. A sync check function is also included to prevent out of phase paralleling. See Section 13.2.

SYNC CHECK MODE

In the sync check mode, the EMCP 4.4 controller automatically adjusts the voltage and frequency of the generator set without closing the generator circuit breaker. When the generator set is synchronized with the second source, the operator initiates a generator circuit breaker close command. See Section 13.2.

13.3 HARD WIRED DEAD BUS ARBITRATION

PURPOSE

The purpose of Hardwired Dead Bus Arbitration (HWDBA) is to determine whether or not a dead bus condition exists and provide dead bus close arbitration in the absence of a multiple genset data link. Dead Bus Arbitration selects the unit that is first ready to close to the dead bus and allows one and only one unit to close to that dead bus. If the selected unit is unable to close to the dead bus, Dead Bus Arbitration removes the permission from that unit and allows a different ready unit to close to the dead bus. In this way, Dead Bus Arbitration minimizes the amount of time for a unit to be able to close to a dead bus.

Hardwired Dead Bus Arbitration operates using hardwired inputs and outputs connected between up to 8 generator sets that are to be operated in parallel.

In HWDBA, arbitration between generators is accomplished using a virtual token-based procedure. All generators are allowed to request the token, but only one generator is allowed to capture the token, and subsequently close to the bus. To capture the token and then close to the bus, a generator must successfully obtain priority by passing arbitration conditions. A Request line is provided to allow a unit to detect whether to keep trying to close or to allow a different unit to attempt to close.

Once a unit has successfully connected to the dead bus, HWDBA is no longer needed. The generators may function under the Load Sharing mode or the Load Sense Load Demand mode from this point.

WIRING

Hardwired Dead Arbitration between generators requires five hardwired lines:

Requesting Line

- Capturing Line
- Arbitration Line
- Best Battery Positive
- Reference “A”

Additionally, HWDBA requires that only one genset have a hardwired line between the Best Battery Positive and its own HWDBA relay contact. All wires should be a minimum of 16AWG, 600V, or equivalent. The connections between generator sets are described in Figure 26.

1) **Requesting Line** – Internally referenced to Reference “A”. Connected between all gensets directly.
2) **Capturing Line** – Internally referenced to Reference“A”. Connected between all gensets directly.
3) **Arbitration Line** – Should connect between generators via series connected normally closed arbitration relay contacts. One arbitration relay is associated with each generator. The arbitration relay coil is controlled by a single Digital Output (HWDBA #5, rated 100 mA sinking). This line is pulled high by the Best Battery Positive line. HWDBA requires two input connections monitoring the status of both sides of the normally closed arbitration relay. This signal is referenced to local Battery negative.
4) **Best Battery Positive Line** – Should connect between generators at the installed diode cathode (which is installed between the genset Battery positive and the Best Battery Positive line).
5) **Reference “A”** – Common reference between gensets. This is the same line as Reference “A” for HWLSLD (see Section 13.3). Connected between all gensets directly.

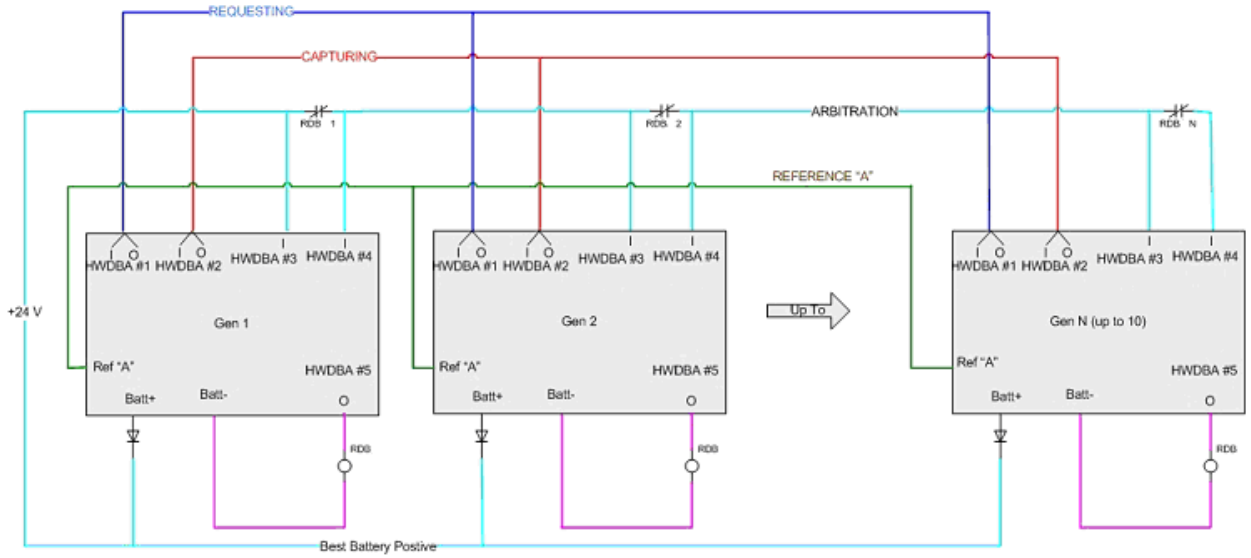


Figure 26: Hardwired Dead Bus Arbitration Wiring

The reference “A” that Hardwired Dead Bus Arbitration uses is the same reference “A” that the HWLSLD uses. Each of these outputs incorporates a pull up resistor internal to the controller to float the voltage and is pulled low to the isolated reference when active. The two arbitration relay inputs and one arbitration relay output do not use the reference A, but are referenced to local battery negative.

One, and only one, unit must be designated as the lead unit. This is accomplished by connecting the Best Battery Positive line of a unit to the HWDBA #3 input of that same unit.

Note: If breaker controls on a genset are wired to the EMCP 4.4 inputs, the breaker will not close if the Close control is activated unless HWDBA is enabled and the lead unit connection is installed.

BASIC OPERATION

The following cases describe typical behavior and order of operations for HWDBA:

Case 1 (Normal Operation): Multiple units come up to speed, but only unit X captures the token.

1. Multiple units come up to speed and voltage
2. Multiple units pull the Requesting line low
3. Unit X pulls the Capturing line low first, releases the Requesting line, and activates the Dead Bus Relay, thus capturing the token
4. No other units can pull the Capturing line low, but keep the Requesting line low
5. Unit X connects to the bus successfully

Case 2 (Unit Fails to Connect): Multiple units come up to speed, unit X captures the token, fails to connect to the bus, and unit Y captures the token.

1. Multiple units come up to speed and voltage
2. Multiple units pull the Requesting line low
3. Unit X pulls the Capturing line low first, releases the Requesting line, and activates RDB, thus capturing the token
4. No other units will pull the Capturing line low, but will keep the Requesting line low
5. Unit X fails to connect to the bus
6. Since Unit X knows that other units are ready to close, Unit X releases the Capturing line and de-energizes RDB, thus losing the token
7. Upon seeing the Capturing line released, unit Y pulls the Capturing line low next, releases the Requesting line, and activates RDB, thus capturing the token
8. No other units will pull the Capturing line low, but will keep the Requesting line low
9. Unit Y connects to the bus successfully

Case 3 (Simultaneous Token Capture): Multiple units come up to speed, and units X and Y try to capture the token at the same time (unit X has HWDBA #3 directly connected to Best Battery Positive).

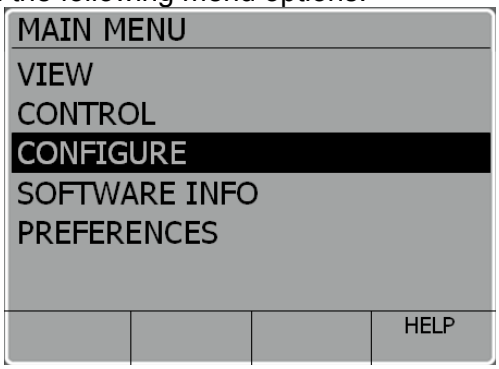
1. Multiple units come up to speed and voltage
2. Multiple units pull the Requesting line low
3. Units X and Y pull the Capturing line low together, release the Requesting line, and activate RDB, thus trying simultaneously to capture the token
4. No other units can pull the Capturing line low, but keep the Requesting line low
5. Unit Y releases the Capturing line since it does not see Best Battery Positive anymore on the Arbitration line due to unit X opening its RDB contacts
6. Unit X now has the token exclusively and connects to the bus successfully

ENABLING DEAD BUS ARBITRATION

In order to enable Dead Bus Arbitration, go through the following menu options:

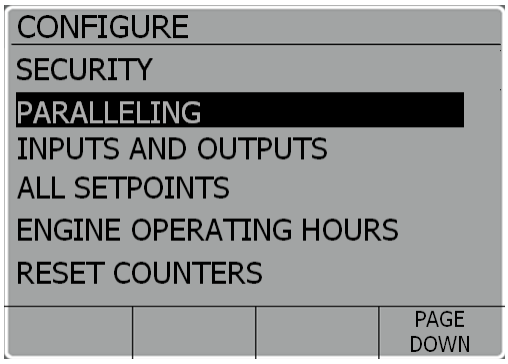
At the **MAIN MENU,** scroll **DOWN** to **CONFIGURE**

Press the **OK KEY**.



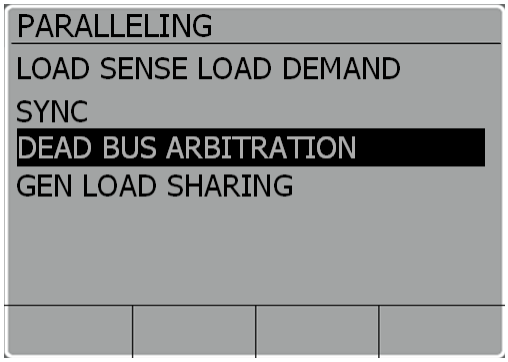
Scroll **DOWN** to **PARALLELING**

Press the **OK KEY**.

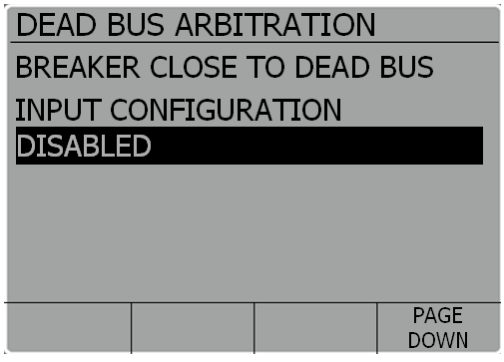


Scroll **DOWN** to **DEAD BUS ARBITRATION**

Press the **OK KEY**.



Press the **OK KEY** to highlight the **BREAKER CLOSE TO DEAD BUS INPUT CONFIGURATION** setting.



Select **HARD WIRED.**

Press the **OK KEY** 

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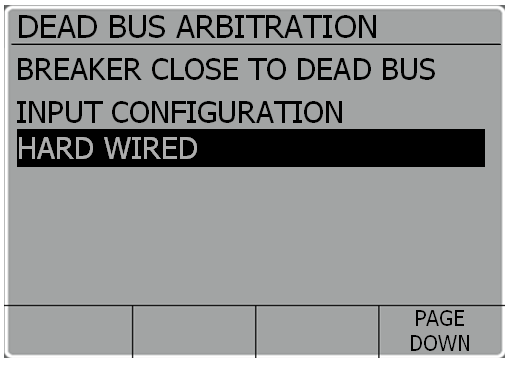

VIEWING PARAMETERS

Within the “View” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for viewing only. No control or configuration is available from this submenu. Soft keys allow for quick navigation between submenus.

The Dead Bus Arbitration screen shows the current status of the Dead Bus Arbitration circuit. The status of the HWDBA lines as well as the bus voltage, output breaker position, HWDBA relay position, and status of the generator Dead Bus Arbitration are shown. Soft keys allow quick toggling between the Sync Overview, Load Share, Dead Bus Arbitration, and Load Sense Load Demand. See Figure 27.

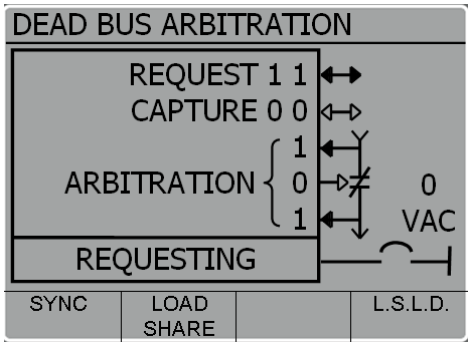

Figure 27: Dead Bus Arbitration –View Screen

A double ended arrow indicates a combined Input/Output line, while a single ended arrow indicates either an Input or an Output. If an arrow is shaded, it represents an active signal. If an arrow is not shaded, then it represents an inactive signal. The number to the left of the arrow also indicates the status of the lines. A “1” represents an active signal, while a “0” represents an inactive signal. For double digit lines, the left most digit represents the state of the incoming signal, while the right most digit represents the state of the outgoing signal. Whenever the outgoing signal is active, the incoming signal will also be active.

CONTROLLING PARAMETERS

Within the “Control” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for control. No configuration is available from this submenu.

The Dead Bus Arbitration screen shows the current status of the Dead Bus Arbitration circuit as well as control of parameters within the HWDBA Setup screen. The status of the HWDBA lines as well as the bus voltage, breaker position, and status of the generator Dead Bus Arbitration are shown. Soft keys allow quick toggling to the Sync Overview and HWDBA Setup screens. See Figure 28.

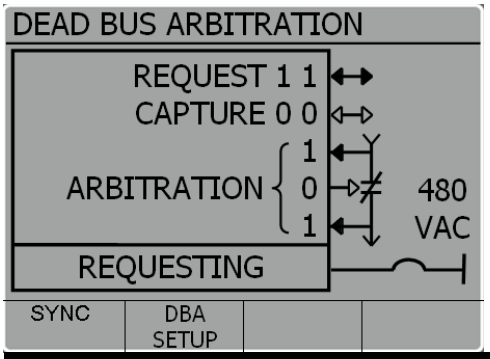

Figure 28: Dead Bus Arbitration – Control Screen

A double ended arrow indicates a combined Input/Output line, while a single ended arrow indicates either an Input or an Output. If an arrow is shaded, it represents an active signal. If an arrow is not shaded, then it represents an inactive symbol. The number to the left of the arrow also indicates the status of the lines. A “1” represents an active signal, while a “0” represents an inactive signal. For double digit lines, the left most digit represents the state of the incoming signal, while the right most digit represents the state of the outgoing signal.

Configuring Parameters

Within the “Configuration” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for configuration. These parameters may also be accessed through the “All Setpoints” submenu.

The Dead Bus Arbitration (HWDBA) configuration screen contains the parameters necessary to set up the functions associated with connecting a running genset to a dead bus and managing which genset will connect to the bus when multiple units simultaneously try to connect.

The “Dead Bus Arbitration” submenu allows for configuration of the following parameters by using the Page Down soft key:

Parameter	Range/Choices
Breaker Close to Dead Bus Input Configuration	Not Installed/Hard Wired input
Breaker Close to Dead Bus Maximum Time	0.1-10 seconds

13.4 HARDWIRED LOAD SENSE LOAD DEMAND DETAILS

PURPOSE

The purpose of Hardwired Load Sense Load Demand (HWLSLD) is to have an automatic priority sequencing function to modulate the number of gensets online to control load percentages per machine.

Hardwired Load Sense Load Demand operates using hardwired combined Input/Output pins connected between up to 8 equal or similar-sized generator sets that are to be operated in parallel. HWLSLD does not work well with gensets of significantly different kW ratings. This feature will work the best with equal sized generator sets. If generator sets are significantly different in power outputs, less flexibility of configuration and operation will occur.

Each generator set will monitor its own kilowatt (kW) output.

WIRING

Hardwired Load Sense Load Demand between generators requires five hardwired lines connected directly between gensets:

- All Run Line
- Overload Line
- Excess Line
- Ramping Line
- Reference “A” (same line as Reference “A” for HWDBA, see section 13.3)

These wires should be a minimum of 16AWG, 600V, or equivalent. The connections between generator sets are described in Figure 29.

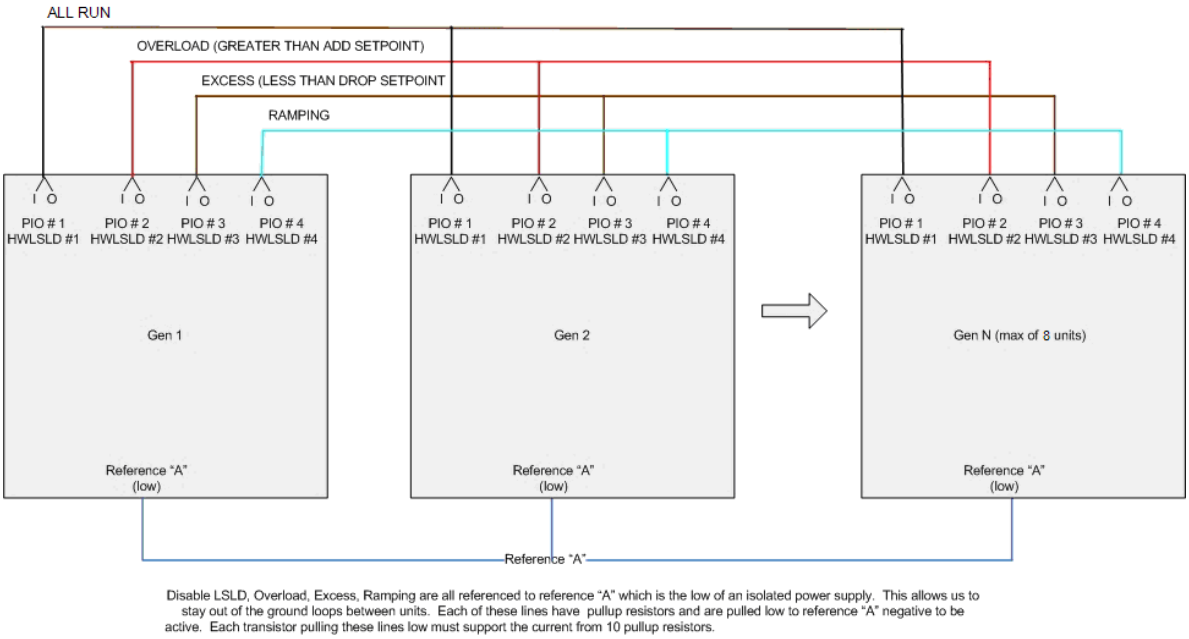

Figure 29: Hardwired Load Sense Load Demand Wiring

Basic Operation

Hardwired Load Sense Load Demand operates using hardwired inputs and outputs connected between up to 8 equal or similar-sized generator sets that are to be operated in parallel. All units at a site must be in HWLSLD for HWLSLD mode to take any units offline. If any unit is connected, but offline, the ALL RUN signal will stay active. In HWLSLD, each generator set is assigned a Paralleling Priority Unit Number (1 through N, with N being the highest number unit in the system). A default time delay is associated with the Paralleling Priority Unit Number, which is used as priority to ensure only one generator set starts, to act upon a request from any of the generator sets.

There are two setpoints that are key to understanding the HWLSLD scheme. The Drop Threshold setpoint determines the kW level in which a genset will drop off line. The Add Threshold setpoint determines the kW level in which an additional genset will need to come online to pick up the additional load requirement.

Each generator set monitors its own kilowatt (kW) output. If the kW output of any one of the generator sets is below (above) the programmable Drop (Add) Threshold setpoint, the controller(s) on the generator sets activate the Excess (Overload) Line output. The other controllers register the signal as an input and, after an adjustable time delay, begin the arbitration process of determining which generator set goes offline (or goes online).

The arbitration process works as follows. Once the adjustable time delay has expired, a second time delay is initiated based on the genset Paralleling Priority Unit Number. Once the Paralleling Priority Unit Number based time delay expires on a single controller, that controller shall energize its Ramping output, which will block the other controllers in the system from ramping. Then, the genset will continue to ramp up to share load (Overload condition) or ramp down to shed load (Excess condition).

HWLSLD is designed to operate with equal or similar sized generator sets. For operation with significantly unequal sized generators, rapidly changing load could cause non-optimum mix of generator set loading. In the unequal sized genset case, the smallest sized units should be designated with the lowest Paralleling Priority Unit Number (highest priority). Automatic cycling of priorities are not supported by HWLSLD.

If the ALL RUN is activated for any reason including underfrequency and undervoltage warnings, then all units will come online without any additional delay.

The following describes the Hardwired Load Sense Load Demand logic:

1) Before a unit is allowed to enter HWLSLD control, the following conditions must be true for each unit in the system:
   - Engine Control Switch in Auto
   - Synch Mode Switch in Auto
   - Idle/Rated in Rated
   - No Shutdown faults
   - **HWLSLD Enable Mode** setpoint set to “HW”
   - Valid Initiate command via Remote Initiate, Group Start*, or Programmable Cycle timer

Note: If using Group Start, Reduced Power Mode should NOT be used.

2) The unit will either NOT enter HWLSLD control or, if under HWLSLD control, will exit immediately under either of the following conditions:
   - If any unit has **the HWLSLD Enable Mode** setpoint set to “disable”, or
   - If any unit is running in manual and the generator circuit breaker is closed, regardless of the **HWLSLD Enable Mode** setpoint

3) Once the unit meets the conditions above, it will start as required, synchronize to get online, and accept its share of load based upon the analog load share line.

   - The unit will start the **HWLSLD Enable Delay** as soon as the Initiate command is received.
   - The *All Run Line* output will stay active when the unit first starts until the **HWLSLD Enable Delay** expires. If units differ in this time delay, the unit with the longest time delay will keep the *All Run Line* output active until the delay times out.
   - If any unit gets a disabling HWLSLD event (i.e. an under frequency or load shed output), the *All Run Line* output will go active, requiring all units in the system to exit HWLSLD control.
   - If the **HWLSLD Enable Mode** setpoint is set to “Disabled”, the *All Run Line* will be active. If any unit in the system has this line active, then all other units in the system will not be prohibited from running due to the HWLSLD logic. It is advised to set all units the same.

4) Once under HWLSLD control, a unit analyzes its own load with respect to its **HWLSLD Drop Unit Percentage Threshold** and **HWLSLD Add Unit Percentage Threshold** setpoints. If the load is within the **HWLSLD Drop Unit Percentage Threshold** and **HWLSLD Add Unit Percentage Threshold** the *Overload* and *Excess* Line outputs will be inactive.

5) An online unit that detects that its own load is greater than its **HWLSLD Add Unit Percentage Threshold** setpoint for the duration of the **HWLSLD Add Unit Delay** will activate the *Overload Line* output. The “overload” condition means the current online genset is overloaded and any available offline generators should come online to share load.

   - When the *Overload Line* input of a unit is activated and the *Ramping Line* input is not active, the arbitration process begins. In arbitration, the unit starts the **Paralleling Priority Unit Number Delay Timer**. After the **Paralleling Priority Unit Number Delay Time** expires, the unit may activate the *Ramping Line* output only if its *Ramping Line* input is NOT already active.
   - The offline unit with the shortest **Paralleling Priority Unit Number Delay Time** (highest priority) will be first to activate the *Ramping Line* output and win arbitration.
   - A unit that activates its *Ramping Line* following an activated *Overload Line* input does the following:
     - Ramps up to speed according to the **HWLSLD Add Unit Ramp Rate**, closes the breaker, and begins sharing load. If a disabling HWLSLD event (i.e. Close Circuit Breaker Failure, Fail to Sync, or Fail to Start) or any event that takes the Sync Mode Switch or Engine out of Auto occurs, the unit activates the *All Run Line* and disables HWLSLD for all units.
     - Releases the *Ramping Line* as soon as it reaches its share of the load.
     - Analyzes its own load with respect to the **HWLSLD Drop Unit Percentage Threshold** and **HWLSLD Add Unit Percentage Threshold** setpoints.

6) An online unit that senses that its own load is less than its own **HWLSLD Drop Unit Percentage Threshold** setpoint for the duration of the **HWLSLD Drop Unit Delay** will activate the *Excess Line* output. The “excess” condition means the current online genset has an excess capacity and the highest priority online unit should go offline.

- When the *Excess Line* input of a unit is activated and the *Ramping Line* input is not active, the arbitration process begins. In arbitration, the unit starts the **Paralleling Priority Unit Number Delay Timer**. After the **Paralleling Priority Unit Number Delay Time** expires, the unit may activate the *Ramping Line* output only if its *Ramping Line* input is NOT already active.
- The online unit with the shortest **Paralleling Priority Unit Number Delay Time** (highest priority) will be first to activate the *Ramping Line* output and win arbitration.
- A unit that activates its *Ramping Line* following an activated *Excess Line* input checks to see if it is the last unit online before ramping down. It checks by releasing its *Excess Line* Output and monitors its *Excess Line* Input after a short delay. The following steps are then taken:
  - If the *Excess Line* Input is not active, the unit is the last to go offline and the unit cancels the ramp down and remains online until an “overload” condition is detected and then follow the steps described above.
  - If the *Excess Line* Input is still active, the unit is NOT the last online unit and the unit does the following:
    - Ramps down according to the **HWLSLD Drop Unit Ramp Rate**. Once the load drops to the disconnect level (setpoint), then a signal is sent to the circuit breaker logic to open. The unit then cools down and stops (Handled in Gen Real Load Control Block).
    - Releases the *Ramping Line* as soon as its circuit breaker opens.
    - Waits until an “overload” condition is detected and follows the steps described above.

a) If an “overload” condition is detected while the unit is ramping down from an “excess” condition, the unit immediately begins ramping up according to the **HWLSLD Add Unit Ramp** Rate.

7) Any unit that detects a simultaneous overload and excess condition via the *Excess Line* and *Overload Line* inputs generates a warning and disables HWLSLD.

ENABLING LOAD SENSE LOAD DEMAND

In order to enable Load Sense Load Demand, go through the following menu options:

At the **MAIN MENU,** scroll **DOWN**  to **CONFIGURE**

Press the **OK KEY** 

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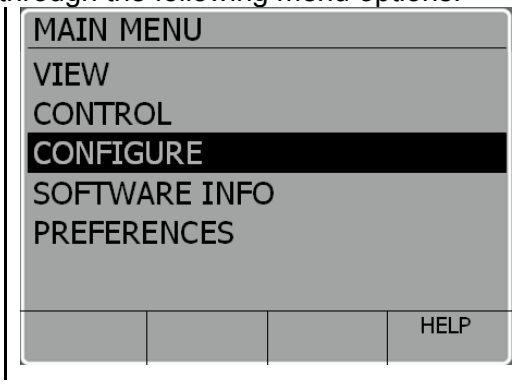
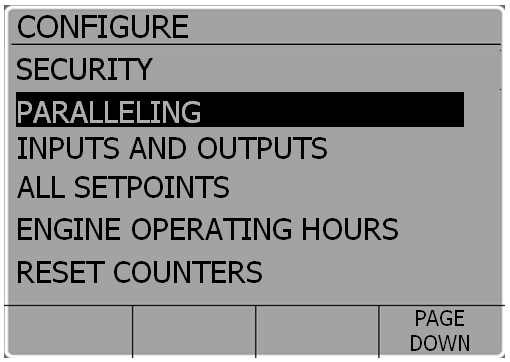


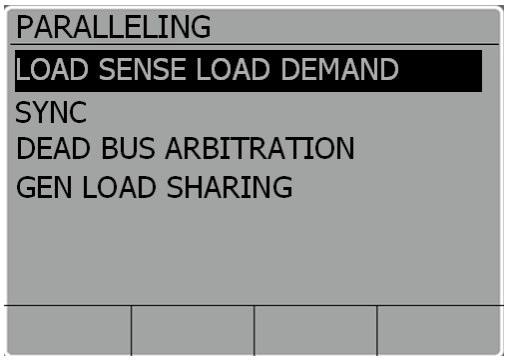
Scroll **DOWN** to **PARALLELING**

Press the **OK KEY**.

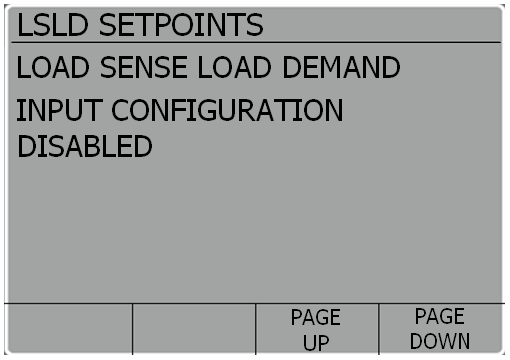


Press the **OK KEY** to enter **LOAD SENSE LOAD DEMAND**

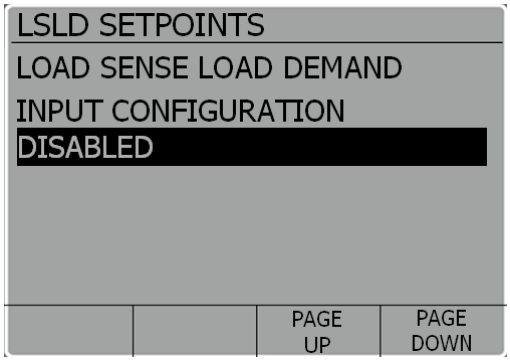
Press the **OK KEY**.



Press the **PAGE DOWN** soft key to access **LOAD SENSE LOAD DEMAND INPUT CONFIGURATION** setting.

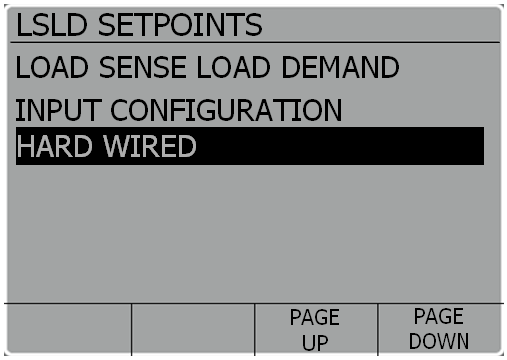


Press the **OK KEY** to highlight the **LOAD SENSE LOAD DEMAND INPUT CONFIGURATION** setting.



Select **HARD WIRED.**

Press the **OK KEY** OK.



VIEWING PARAMETERS

Within the “View” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for viewing only. No control or configuration is available from this submenu. Soft keys allow for quick navigation between submenus.

The Load Sense Load Demand screen shows the current status of the Load Sense Load Demand circuit. The status of the HWLSLD lines as well as the bus voltage, breaker position, percent of load, and status of the generator load sharing are shown. The genset priority number is also shown in the upper right corner. Soft keys allow quick toggling between the Sync Overview, Load Share, Dead Bus Arbitration, and Load Sense Load Demand. See Figure 30.

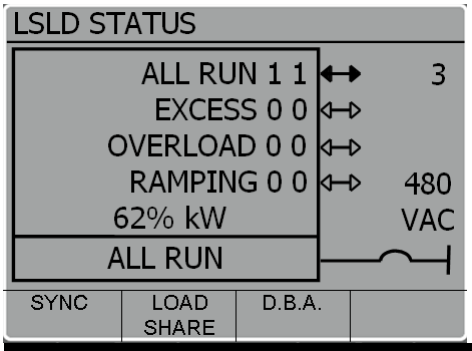


Figure 30: Load Sense Load Demand – View Screen

A double ended arrow indicates a combined Input/Output line. If an arrow is shaded, it represents an active signal. If an arrow is not shaded, then it represents an inactive symbol. The number to the left of the arrow also indicates the status of the lines. A “1” represents an active signal, while a “0” represents an inactive signal. For double digit lines, the left most digit represents the state of the incoming signal, while the right most digit represents the state of the outgoing signal.

CONTROLLING PARAMETERS

Within the “Control” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for control. No configuration is available from this submenu.

The Load Sense Load Demand screen shows the current status of the Load Sense Load Demand circuit as well as access to control of parameters within the HWLSLD Setup screen. The status of the HWLSLD lines as well as the bus voltage, breaker position, percent of load, and status of the generator load sharing are shown. The genset priority number is also shown in the upper right corner. Soft keys allow quick access to the AC Overview and HWLSLD Setup screens. See Figure 31.

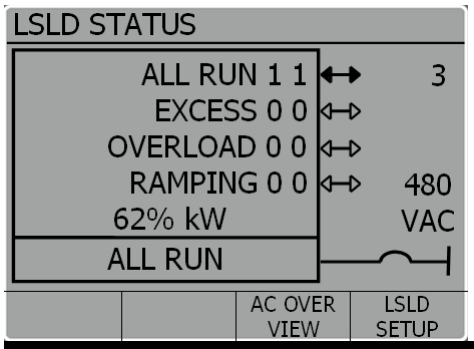


Figure 31: Load Sense load Demand – Control Screen

A double ended arrow indicates a combined Input/Output line. If an arrow is shaded, it represents an active signal. If an arrow is not shaded, then it represents an inactive symbol. The number to the left of the arrow also indicates the status of the lines. A “1” represents an active signal, while a “0” represents an inactive signal. For double digit lines, the left most digit represents the state of the incoming signal, while the right most digit represents the state of the outgoing signal.

CONFIGURING PARAMETERS

Within the “Configuration” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for configuration. These parameters may also be accessed through the “All Setpoints” submenu.

The Load Sense Load Demand (HWLSLD) configuration screen contains the parameters necessary for automatically bringing other gensets online and offline to share load under the HWLSLD scheme.

The “Load Sense Load Demand” submenu allows for configuration of the following parameters by pressing the Page Down soft key:

LOAD SENSE LOAD DEMAND ENABLE DELAY

This setpoint determines the amount of time to run before entering HWLSLD mode. The range for this setpoint is 1-30 minutes. It is the amount of time the generator must wait after the breaker closes before releasing the All Run HWLSLD line and allowing HWLSLD control to begin (see Section 13.4).

LOAD SENSE LOAD DEMAND INPUT CONFIGURATION

This setpoint determines if the EMCP 4.4 enables HWLSLD. Possible choices for this setpoint are Disabled and Hardwired.

LOAD SENSE LOAD DEMAND ADD UNIT PERCENTAGE THRESHOLD

This setpoint determines the percentage of the generator rated kW that the unit is providing before another unit is brought online to share load. The range for this setpoint is 50-90%. If the unit load extends above this setpoint an “overload” condition is triggered within the HWLSLD internal circuitry.

LOAD SENSE LOAD DEMAND ADD UNIT DELAY TIME

This setpoint determines the amount of time it will take to bring another unit online to share load. The range for this setpoint is 0-10 seconds. This setpoint is the amount of time the unit load must exceed the Add Unit Percentage Threshold setting before an "overload" condition is triggered within the HWLSLD internal circuitry.

LOAD SENSE LOAD DEMAND DROP UNIT PERCENTAGE THRESHOLD

This setpoint determines the percentage of the generator rated kW that the unit is providing before it is taken offline. The range for this setpoint is 10-50%. If the unit load is below this setpoint an "excess" condition is triggered within the HWLSLD internal circuitry.

LOAD SENSE LOAD DEMAND DROP UNIT DELAY TIME

This setpoint determines the amount of time it will take to take the current unit offline. The range for this setpoint is 0-10 seconds. This setpoint is the amount of time the unit load must be below the Drop Unit Percentage Threshold setting before an "excess" condition is triggered within the HWLSLD internal circuitry.

GENERATOR PARALLELING PRIORITY NUMBER

This setpoint determines what the current generator priority is for coming online and going offline for load sharing. If a generator has a lower number assigned, it will have a higher priority. For example, if two generators are programmed for priority 2 and 3 respectively, then generator 2 will go online first to share load on the system and generator 3 will be taken offline first.

13.5 SYNCHRONIZING DETAILS

SYNC MODE SWITCH

The Sync Mode Switch (SMS) is a four position soft switch within the EMCP 4.4 controller. It has "Auto", "Check", "Off", and "Manual" positions. The switch is automatically placed in the "Auto" position upon boot up of the controller or placing the engine control switch of the controller into "Auto". In any position of the engine control switch, the SMS may be placed into any other position using the display, or a programmable digital input. When the SMS is placed into "Check", the system shall operate as if in "Auto", but "Fail to Parallel" will be disabled and a breaker close signal will not be issued. In addition, the SMS may be changed in position using a momentary discrete switch wired to a programmable Digital Input. More detailed descriptions of each mode are described below.

Note: Any of these actions, or state selection via the display, can be overridden by activation of a Digital Input command for Sync Mode Switch in Auto, Sync Mode Switch in Manual, or Sync Mode Switch in Check. If more that one Digital Input command is active and maintained at one time, the Sync Mode Switch will be placed in the mode driven by the lowest numbered digital input. All other SMS commands are momentary (display, Modbus input, ECS changed to Auto) and therefore can all have the same priority. If one of these momentary commands is activated while a Digital Input command for SMS is activated, it will take effect immediately and then be overwritten by the Digital Input if the digital input is maintained.

A quick reference of which functions are enabled for the different SMS modes is shown in Table 16 with more detail described below.

	SMS Mode		
Function	**Auto**	**Manual**	**Check**
Auto Match Phase and Voltage	√	X	√
Auto Breaker Control	√	X	X
Sync Check for V, Hz, Phase	√	√	√

Table 16: SMS Modes and Functions

There are differences between how the breaker control buttons external to the EMCP 4.4 work. The Close button sends a request to the EMCP 4.4 to close the breaker. The Open button is typically wired both to the EMCP and directly to the breaker to trip it.

AUTOMATIC SYNCHRONIZING

The EMCP 4.4 provides a feature for 3 phase automatic matching phase angle and 3 phase average voltage. This feature also provides for automatic breaker control and includes a sync check function for frequency, phase and voltage internal to the EMCP 4.4 control. This check functionality cannot be disabled. When operating in Automatic Synchronizing mode, frequency, phase and voltage synchronizing can not be disabled. Automatic Synchronizing only occurs when the Sync Mode Switch (SMS) is in Auto.

In “Auto” mode the EMCP4.4 will take control of the fuel and voltage control to bring the engine into sync and within the voltage level as quickly as possible. When these conditions are met, the control will issue a breaker close command.

MANUAL SYNCHRONIZING

The EMCP 4.4 provides a feature for manually matching phase angle and voltage. This feature also provides for manual breaker closure signaling while maintaining a sync check function for frequency, phase, and voltage internal to the EMCP 4.4 control. This check functionality can not be disabled. Manual Synchronizing only occurs when the Sync Mode Switch (SMS) is in Manual. In manual synchronizing, speed and voltage commands can be sent from the display or a programmable input. In addition, the breaker close signal can be sent from the display or the dedicated manual close push button. The signal to close the circuit breaker can only be sent when sync check is valid. The Phase Angle Window and Dwell Time still apply for the sync check functionality.

In “Manual Mode” there is no automatic voltage or speed control, but if the phase difference and voltage are within the window a manual breaker closure request can be issued (by push-button or external signal). In this mode the operator will have total control over voltage and speed to match the bus to the generator. Internal Sync Check device is always being monitored and will only issue a close signal to the breaker when the unit is in phase.

CHECK SYNCHRONIZING

The EMCP 4.4 provides a feature for 3-phase automatic matching phase angle and 3 phase average voltage. This feature does not provide for automatic breaker control, but includes a sync check function internal to the EMCP 4.4. Automatic Synchronizing including frequency, phase and voltage occurs when the Sync Mode Switch (SMS) is in Check. A breaker close signal is not issued. The fail to parallel timer does not operate when SMS is in Check.

In “Check Mode” the EMCP4.4 will take control of the fuel and voltage control to bring in the engine into sync as quickly as possible. The sync will maintain the voltage and speed for 12:00 sync and voltage match. There is **no** command for breaker closure. This mode is used mainly for adjustment of the gain parameters. A breaker close signal may be sent externally to the EMCP.

GENERATOR SENSING FAULT

A non-adjustable and non-programmable shutdown immediately occurs when the generator breaker is closed, and a phase difference (non zero) between a phase on the generator and the corresponding phase on the bus is detected.

Maximum reliability is achieved when the circuit breaker is capable of supporting both a DC powered shunt trip and a DC powered undervoltage trip.

VIEWING PARAMETERS

Within the “View” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for viewing only. No control or configuration is available from this submenu.

The Sync Overview screen shows the current status of the generator and bus with the generator on the left hand side of the screen. Voltage and frequency are shown numerically, as well as graphically. Phase and breaker position are represented graphically only. Soft keys allow quick toggling between the Sync Overview, Load Share, Dead Bus Arbitration, and Load Sense Load Demand. See Figure 32.

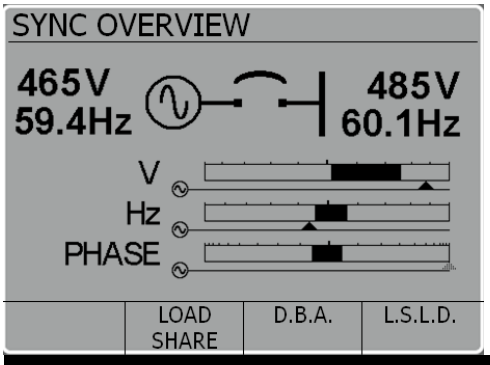


Figure 32: Sync Overview – View Screen

The arrows on the graphs of voltage, frequency, or phase show the value of that generator parameter relative to the corresponding bus value. The black bar on the graph represents the sync window for that parameter. When the arrow lines up to the black portion of the graph, then this parameter is close to the value of the same bus parameter. The width of the black bar is representative of the size of the programmed window for that parameter.

CONTROLLING PARAMETERS

Within the “Control” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for control. No configuration is available from this submenu.

The Sync Overview screen shows the current status of the generator and bus with the generator on the left hand side of the screen. Voltage and frequency are shown numerically, as well as graphically. Phase and breaker position are represented graphically only. This screen also shows the Sync Mode Switch position at the top. Soft keys will vary depending on the SMS position. See Figure 33.

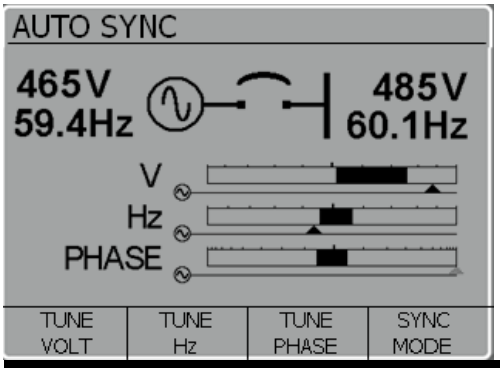


Figure 33: Sync Overview – Control Screen

The arrows on the graphs of voltage, frequency, or phase show the value of that generator parameter relative to the corresponding bus value. The black bar on the graph represents the sync window for that parameter. When the arrow lines up to the black portion of the graph, then this parameter is close to the value of the same bus parameter. The width of the black bar is representative of the size of the programmed window for that parameter.

Table 17 describes the soft keys in each SMS position for the Sync Overview screen within the Control submenu.

SMS Position	F1	F2	F3	F4
Auto	Tune Volt	Tune Hz	Tune Phase	Sync Mode
Check	Tune Volt	Tune Hz	Tune Phase	Sync Mode
Off		Load Share	HWDBA	HWLSLD
Manual	<V	V>	<Hz	Hz>

Table 17: Sync Overview Screen Soft Keys

Note: When the SMS is in the Off position, the Sync Overview screen within the Control submenu is the same screen as in the View submenu.

When the SMS is in Auto, or Check positions, the gain adjustment screens for Voltage, Frequency, and Phase become accessible.

TO CHANGE THE SYNC GAIN SETTINGS:

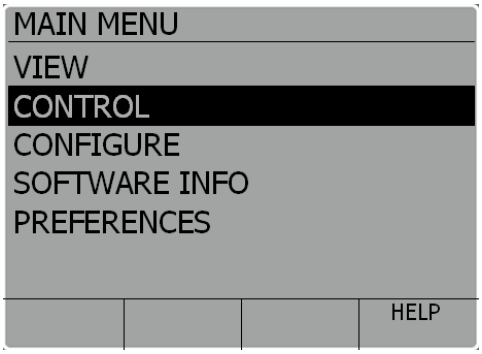
Ensure the SMS is in the Auto, or Check position.

At the **MAIN MENU**

SCROLL DOWN to:

CONTROL

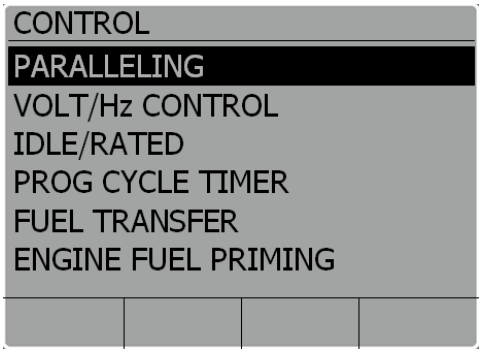
Press **OK KEY**



SCROLL DOWN to:

PARALLELING

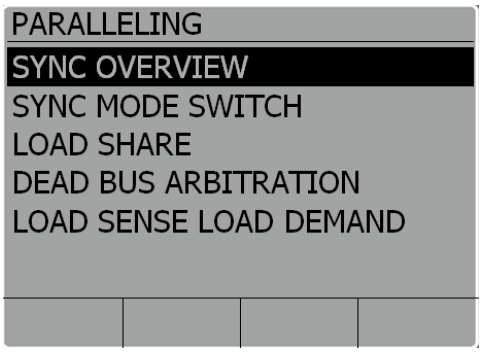
Press **OK KEY**



SCROLL DOWN to:

SYNC OVERVIEW

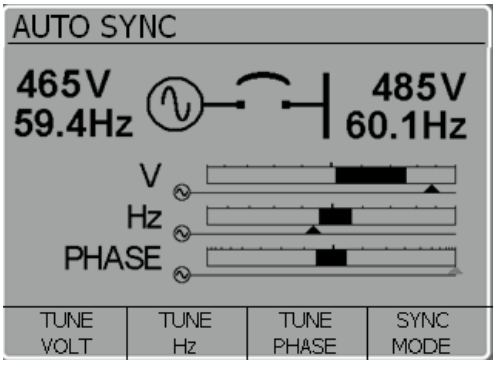
Press **OK KEY**



The Sync Overview screen shows.

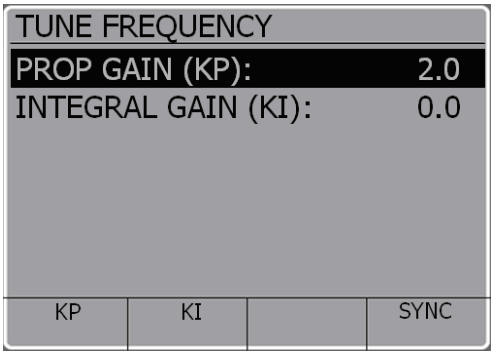
Press the desired soft key.

(In this example, “Tune Hz” is selected)



Select the desired gain to adjust by pressing the corresponding soft key, or using the **DOWN ARROW** and pressing the **OK KEY**

(In this example, “Prop Gain” is selected)



To edit the **GAIN**:

Select a digit using the **LEFT ARROW** or **RIGHT ARROW**

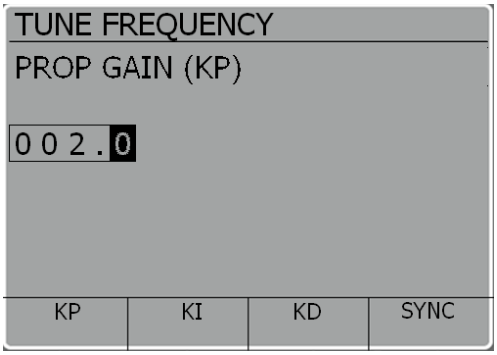
To change the selected digit use the **UP ARROW** or **DOWN ARROW**

To accept the change:

Press the **OK KEY**.

To reject the change:

Press the **ESCAPE KEY**.



Note that using the soft keys to switch between gains will not save any changes made to the gains at this point.

SYNC MODE SWITCH

The Sync Mode Switch is a four-position software switch. It can be placed in the “Auto”, “Check”, “Off”, and “Manual” positions. These modes are described below. The Sync Mode Switch screen allows for placement of this switch into any of these positions, as well as allowing quick access to the Sync Overview screen. See Figure 34.

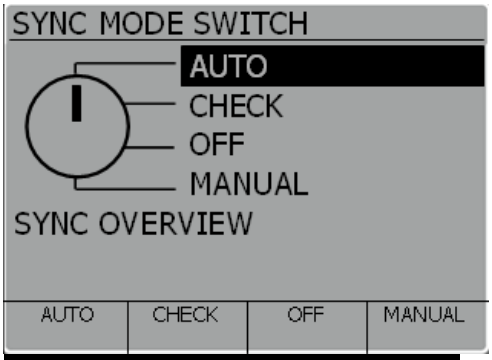


Figure 34: Sync Mode Switch Screen

Selection of the Sync mode is made with the corresponding soft keys or pressing the up or down arrow keys, then pressing the OK key. To select Sync Overview, press the down arrow until the Sync Overview text is highlighted, and then press the OK key. See Section 13.2.1 for more details.

Note: If the EMCP 4.4 is set to “AUTO” then the Sync Mode is automatically set to “AUTO”. If the EMCP 4.4 is set to “RUN” then the Sync Mode is automatically set to “MANUAL”.

AUTO SYNC

The Auto Sync feature of the EMCP 4.4 allows the EMCP to monitor both generator and bus voltage, current, and phase. The EMCP then adjusts these parameters and automatically closes the generator breaker when they fall within the programmed windows.

CHECK SYNC

The Check Sync feature of the EMCP 4.4 allows the EMCP to monitor both generator and bus phase voltage, current, and phase. The EMCP then adjusts these parameters until they fall within the programmed windows, but does not automatically close the generator breaker. An external signal can close the breaker.

OFF

When the Sync Mode Switch is set to the Off position, the EMCP does not monitor generator and bus voltage, current, or phase. The EMCP 4 will not issue a breaker close signal even if a breaker close request is issued to the EMCP 4, provided the breaker close signal is wired only to the EMCP 4.

MANUAL SYNC

The Manual Sync feature of the EMCP 4.4 allows the user to monitor both generator and bus phase voltage, current. The user may then adjust these parameters until they fall within the programmed windows, and manually close the generator breaker. The EMCP only offers indication of the parameters adjusted by the user.

CONFIGURING PARAMETERS

Within the “Configuration” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for configuration. These parameters may also be accessed through the “All Setpoints” submenu.

The Sync configuration screen contains the parameters necessary to set up the functions related to synchronization with a live bus. The following paralleling functions are configurable within the “Sync” submenu of the EMCP 4.4 “Configure” submenu (see Figure 35):

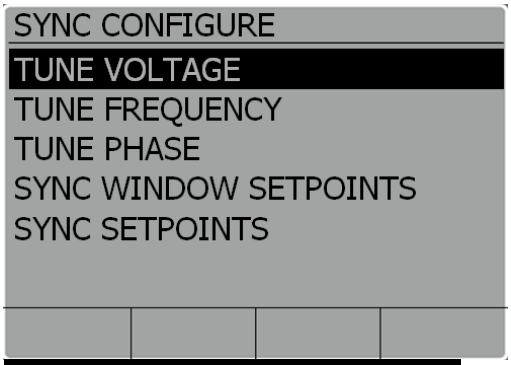


Figure 35: Sync - Configure Submenu

The “Sync” submenu allows for configuration of the following parameters:

TUNE VOLTAGE
This submenu determines how the generator voltage should behave in order to be in sync with the bus.

The following parameters are available within this submenu:

Parameter	Range/Choices
Gen to Bus Sync Automatic Voltage Match Enable Status	Disabled/Enabled
Gen to Bus Max Voltage Difference % Thresh	1-15%
Gen to Bus Sync Voltage Match Rate Configuration	1-100%/sec

TUNE FREQUENCY
This submenu determines how the generator frequency should behave in order to be in sync with the bus.

The following parameters are available within this submenu:

Parameter	Range/Choices
Prop Gain (Kp)	0-100%
Integral Gain (Ki)	0-100%

TUNE PHASE
This submenu determines how the generator phase should behave in order to be in sync with the bus.

The following parameters are available within this submenu:

Parameter	Range/Choices
Prop Gain (Kp)	0-100%
Integral Gain (Ki)	0-100%

SYNC WINDOW SETPOINTS
This submenu determines how close the generator voltage, frequency, and phase need to be to the bus in order to be considered in sync with the bus in preparation for a breaker closure.

The following parameters are available within this submenu:

Parameter	Range/Choices
Phase Deg Window (+)	0-30 degrees
Phase Deg Window (-)	0-30 degrees
Min Dwell Time (Sec)	0.1-1 Sec

SYNC SETPOINTS
This submenu determines how the generator handles a failure to synchronize to the bus.

The following parameters are available within this submenu:

Parameter	Range/Choices
Gen to Bus Sync Negative Slip Freq Enable Status	Disabled/Enabled
Gen to Bus Sync Failure Warning Event Threshold	0-99 seconds
Gen to Bus Sync Failure Shutdown Event Threshold	0-99 seconds

SYNCHRONIZATION GAIN TUNING PROCEDURE

Each system and configuration has different synchronization needs. This section is intended to aid in properly tuning the system.

Background

While the AVR matches voltage, the synchronizing control algorithm looks at frequency and phase angle across the generator breaker. If the frequency difference is greater than 0.1 Hz, then only frequency is considered. This is the **Frequency Match** control. Once the frequency difference is less than 0.1 Hz, then the phase angle is added to the control loop set point. This is the **Phase Match** control.

Proportional gain has the largest overall effect on tuning. If Proportional gain is set too high, the unit will overshoot the desired point and have trouble maintaining stability. If it is set too low, the unit will have difficulty reaching the desired window in a reasonable amount of time. In this case, Integral gain may be used. Integral gain will provide the extra push needed when the Proportional gain is just short of what is needed to bring the unit to within the desired window after a large change was needed.

General Considerations

1. Ensure the genset to be tuned has proper engine governor and voltage regulator tuning and runs with stable voltage and frequency prior to adjusting the synchronization setpoints.
2. The engine governor and voltage regulator tuning may affect this tuning procedure. Setting those module gains lower may aid this procedure.
3. For engines with electronic governors, adjusting fewer gain settings in the EMCP 4.4 (only adjusting Ki, for example) will cause a less complicated interaction with the engine gains.
4. The temperature of the equipment to be tuned, ambient temperature, and altitude will affect the gain tuning and response of the system. A more cautious tuning of slow and stable vs. fast and unstable is recommended.
5. For the genset to be tuned, ensure there are no inputs that can put the genset, or the SMS into Auto. Do not press the Auto button. A Digital Input could be programmed to force the SMS to be in Check. If the unit is in Auto during the gain tuning procedure, then a Fail to Parallel event will occur after a predefined time.
6. If applicable, ensure the genset and 3-phase source “Load Share” setpoints are properly tuned. See Section 13.6.
7. Disable HWLSLD on the genset and the 3-phase source (if applicable), or ensure HWLSLD setpoints are not set in a manner that will cause nuisance breaker tripping.
8. If the 3-phase source is another EMCP 4.4 genset, you may put that unit in Auto with its SMS in Auto and enable HWDBA to ensure its breaker will close.
9. If a Group start signal is used, ensure that both genset packages are in Auto and HWDBA is enabled on the first genset (the one not being tuned).

Strategy

When synchronizing, the EMCP 4.4 matches Voltage, Frequency, and Phase. The Voltage matching does not require a tuning procedure but does have setpoints associated with it to be considered. See Section 13.5.

This tuning procedure will first explain how to tune the Frequency matching, then the Phase matching. In order to properly tune, the procedure should be done multiple times. If tuning against a 3-phase source with load share capability, the tuning procedure variations should be done in order of the most stable to least stable. The iterations from most stable to least stable are as follows:

1. 3-phase source or Load Share disabled with load on bus
2. 3-phase source or Load Share disabled with no load on bus
3. 3-phase source or Load Share enabled with no load on bus
4. 3-phase source or Load Share enabled with load on bus

In order to see a proper response from the genset, there needs to be a way to create a frequency difference between the genset being tuned and the 3-phase source. In general the best method is to tune to a source that has a lower frequency first, then tune to a source with a higher frequency. Tuning to a source with a higher frequency usually will provide a better response that may provide false confidence if not tuned to a source with a slower frequency first.

Procedure

1. Ensure a 3-phase source is on the bus.
2. Start the genset to be tuned, but NOT from Auto.
3. Tune Frequency Match – Phase arrow will be gray, not solid.
    a. Put SMS into the Check position.
    b. Go to the Sync Overview Screen and verify there is the proper voltage on the bus.
    c. Press the Tune Hz soft key.
    d. Set Kp, Ki to 0.
    e. Press the Sync Screen softkey.
    f. Watch the arrow for generator Frequency.
    g. Look for a rapid approach to the frequency band with a long dwell time within the band. The long dwell time is the more important characteristic.
    h. Create a frequency on the bus that is lower than the genset by either changing the frequency of the 3-phase source (load step, frequency setting), or adjusting the genset frequency to a value above the bus frequency. Adjusting the genset frequency is the preferred method. Ensure an electronic engine governor is not driving frequency match or else a kW/kVAr shutdown may occur.
    i. On the Sync Screen, look for a rapid approach to the frequency band with a long dwell time within the band. The long dwell time is the more important characteristic.
    j. If the arrow does not show the behavior above, adjust the PI settings until the above behavior is seen (repeat steps e through i). Start by adjusting Ki first, and change gains settings one at a time.
    k. Repeat steps e through i again, but with a frequency on the bus that is higher than the genset in step h.

l. When the frequency seems stable within the band, watch for the numeric value of the frequency to be stable.

m. Watch that the phase arrow also stays black at this point.

n. The better the frequency is tuned, the easier phase matching will be.

o. Instability in frequency may be an indicator that engine tuning is not suitable.

4. Tune Phase Match

   a. Verify the phase arrow is solid black. Gray indicates the controller is still in the Tune Frequency Match mode.

   b. Adjusting the phase settings will affect the frequency response of the genset.

   c. Notice that the measurement marks on the phase bar are not linear.

   d. With the SMS still in the Check position, press the Tune Phase soft key.

   e. Set Kp, Ki, Kd to 0.

   f. Press the Sync Screen softkey.

   g. Watch the arrow for generator Phase.

   h. On the Sync Screen, look for a rapid approach to the phase band with a long dwell time within the band. The long dwell time is the more important characteristic. If the phase arrow goes gray, then Hz gain is not optimal.

   i. Create a frequency on the bus that is lower than the genset by either changing the frequency of the 3-phase source (load step, frequency setting), or adjusting the genset frequency to a value above the bus frequency. Adjusting the genset frequency is the preferred method. Ensure an electronic engine governor is not driving frequency match or else a kW/kVAr shutdown may occur.

   j. On the Sync Screen, look for a rapid approach to the phase band with a long dwell time within the band. The long dwell time is the more important characteristic. Sync Window setpoints may affect this tuning. See Section 13.5.

   k. If the arrow does not show the behavior above, adjust the PI until above behavior is seen (repeat steps e through i). Start by adjusting Ki first, and change settings one at a time.

   l. Repeat steps e through i again, but by creating a frequency on the bus that is higher than the genset in step h.

   m. The better the frequency is tuned, the easier phase matching will be.

   n. Phase tuning can be more aggressive than frequency match since once the breaker closes, the phase will stay matched.

5. Ensure any Digital Inputs placing the SMS into any state other than Auto are not active.

6. Put the SMS in Auto to see if the unit synchronizes.

7. If a successful synchronization occurs, then open the breaker and resynchronize a few more times to ensure an acceptable, repeatable synchronization time.

8. If a Reverse kW shutdown occurs, this is an indication that gains are not programmed for appropriate stability.
9. If the unit takes too long to synchronize, check that the start time is acceptable. The time to sync from Auto with the genset running is the start time plus the sync time.
10. Repeat steps 1 through 7 for the next iteration of Load Share enabled vs load on the bus as described in the Strategy Section.

13.6 REAL AND REACTIVE LOAD SHARING IN ISLAND MODE DETAILS

PURPOSE

The purpose of Real and Reactive Load Sharing is to share the real and reactive load proportionally among all of the online units in an island mode type configuration. This island mode configuration can be prime power, standby, or peak shaving (disconnected from the mains/utility).

WIRING

These wires should consist of a shielded twisted triad, or equivalent. Wire size should be 18 AWG or larger. The connections between generator sets are described in Figure 36.

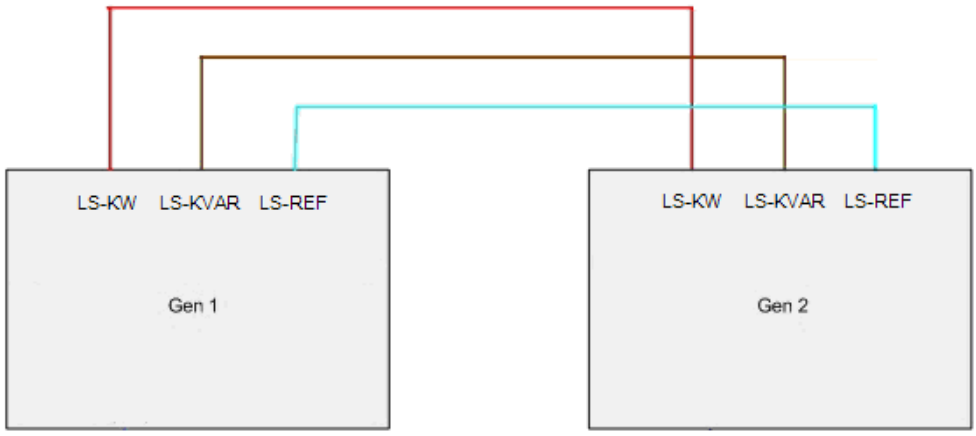


Figure 36: Load Sharing Wiring

BASIC OPERATION

EMCP 4.4 controllers can operate in an island mode sharing load via load sharing lines. Separate lines are used for both real power (kW) and reactive power (kVAr). When the generator breaker is closed and the load sharing is set to HW, the unit controls load until the internally generated load signal matches the externally measure load signal.

As the externally measured signal changes, the EMCP 4.4 changes the generator set speed or voltage control to match the signal. If Generator Reactive Load Sharing is turned off, no signals are sent to the AVR to control the voltage. This allows customers to implement voltage droop or cross current separate from the EMCP 4 controller. As different units enter or leave the system, or the load changes, the units need to adjust their contribution to contribute equal amounts.

The kW (real load) sharing line can operate at either a 0-10VDC or 0-3VDC level. The 0-10VDC level is preferred, unless other devices on the loadsharing network require the lower voltage level.

The kVAr (reactive load) sharing line will only operate at a 0-10VDC level. It is not designed to interface to other devices.

The loadsharing lines are isolated signals reference to the 3rd line (reference). This reference must be connected between all of the units. This reference is not connected to battery negative by the EMCP 4.4.

SHARING LINES (KW & KVAR)

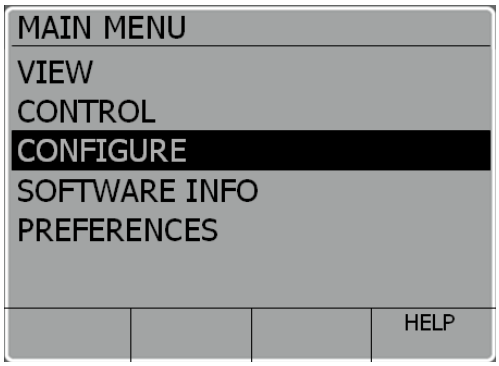
The EMCP 4.4 supports one 3-wire (plus shield) load sharing line (Analog Input and Output on a single pin for each signal). The real power (kW) is compatible with Woodward Load (LSM) sharing line (0-3VDC) systems. The reactive power (kVAr) operates in a similar manner to the real power lines, but is based upon reactive power and is not compatible with SPMD systems (0-4VDC). This hardware operates at a higher voltage (0-10VDC) for improved resolution when not being used with legacy Woodward components. A reference pin is provided on the EMCP for this sharing line.

ENABLING LOAD SHARING

In order to enable Load Sharing, go through the following menu options:

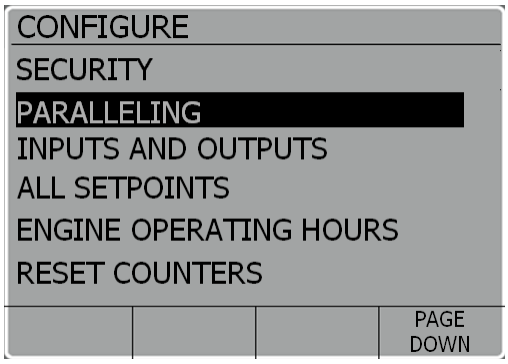
At the **MAIN MENU,** scroll **DOWN**  to **CONFIGURE**

Press the **OK KEY**  .



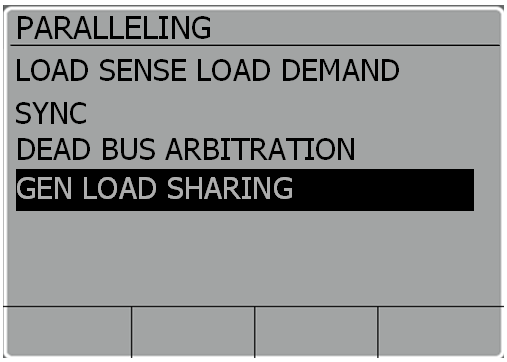
Scroll **DOWN**  to **PARALLELING**

Press the **OK KEY**  .



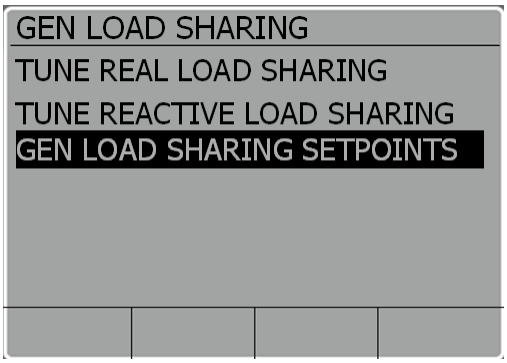
Scroll **DOWN**  to **GEN LOAD SHARING**

Press the **OK KEY**  .

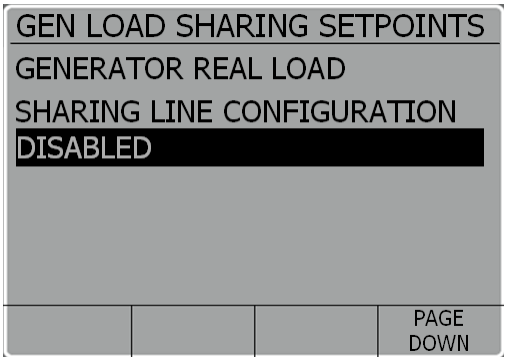


Scroll **DOWN**  to **GEN LOAD SHARING SETPOINTS**

Press the **OK KEY**  .

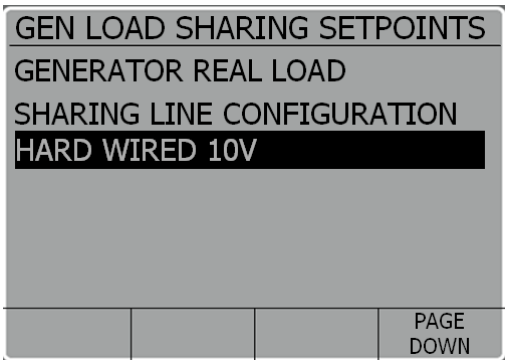


Press the **OK KEY**  to highlight the **GENERATOR REAL LOAD SHARING LINE CONFIGURATION** setting.



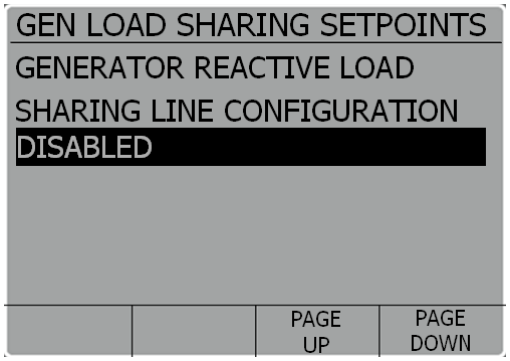
Select either **HARDWIRED 10V**, or **WIRED 3V LEGACY MODE**

Press the **OK KEY**  .



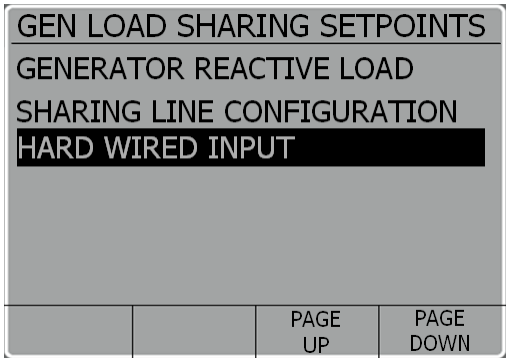
Press the **PAGE DOWN** PAGE DOWN soft key to access **GENERATOR REACTIVE LOAD SHARING LINE CONFIGURATION**

Press the **OK KEY** OK to highlight the **GENERATOR REACTIVE LOAD SHARING LINE CONFIGURATION** setting.



Select **HARDWIRED INPUT**

Press the **OK KEY** OK.



Viewing Parameters

Within the “View” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for viewing only. No control or configuration is available from this submenu.

The Load Share screen shows the current status of the generator power and load target with the generator on the left hand side of the screen. Real and Reactive load are shown as a percentage, as well as graphically. Breaker position is represented graphically only. Soft keys allow quick toggling between the Sync Overview, Load Share, Dead Bus Arbitration, and Load Sense Load Demand. See Figure 37.

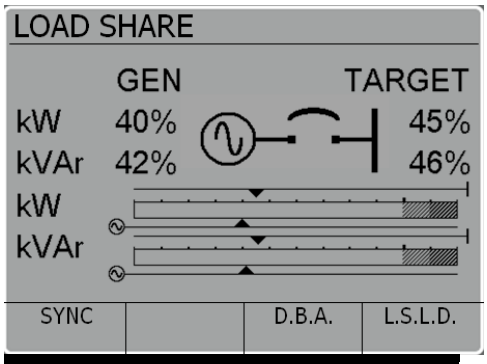


Figure 37: Load Share – View Screen

The arrows on the graphs of kW and kVAr connected to the generator symbol indicate the percentage of full generator capacity. The arrows connected to Target kW and kVAr indicate the desired percentage of generator capacity via the load sharing lines. When the generator and target values line up, the generator is sharing load. The light gray shaded area of the graph represents the 100-110% rating of the generator. The dark gray shaded area of the graph represents the 110-120% rating of the generator.

CONTROLLING PARAMETERS

Within the “Control” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for control. No configuration is available from this submenu.

The Load Share screen allows for control of the kW and kVAr settings and shows the current status of the generator power and load target with the generator on the left hand side of the screen. Real and Reactive load are shown as a percentage, as well as graphically. Breaker position is represented graphically only. Soft keys allow quick toggling to the Tune kW and Tune kVAr screens. See Figure 38.

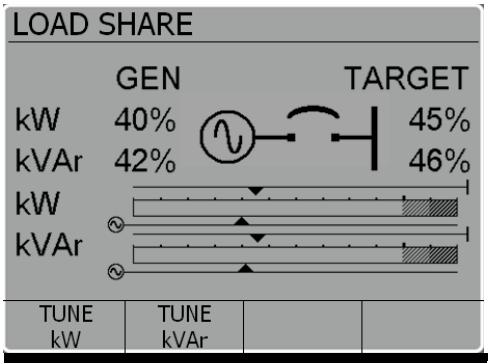


Figure 38: Load Share – Control Screen

The arrows on the graphs of kW and kVAr connected to the generator symbol indicate the percentage of full generator capacity. The arrows connected to Target kW and kVAr indicate the desired percentage of generator capacity via the load sharing lines. When the generator and target values line up, the generator is sharing load. The light gray shaded area of the graph represents the 100-110% rating of the generator. The dark gray shaded area of the graph represents the 110-120% rating of the generator.

To adjust the kW or kVAr gains, press the corresponding soft key.

Within the gain adjustment screens for kW and kVAr, the Proportional and Integral, gains can be individually selected and changed. A soft key allows quick access back to the Load Share screen. See Figure 39.

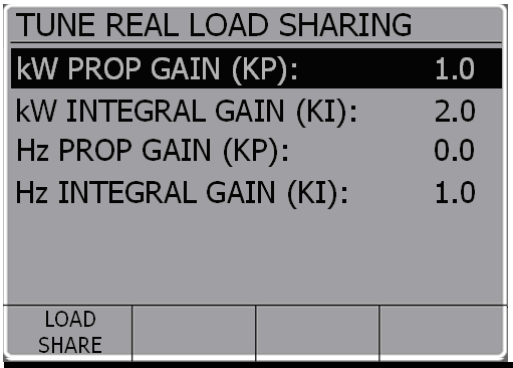


Figure 39: Tune Real Load Share Gains Screen

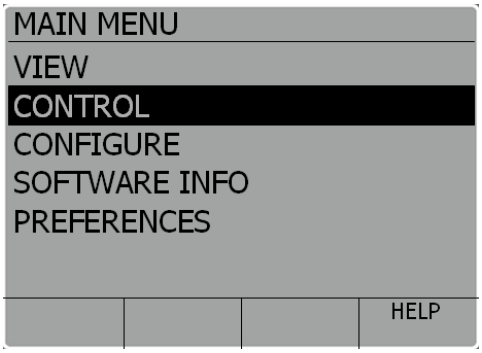
TO CHANGE THE LOAD SHARING GAIN SETTINGS:

At the **MAIN MENU**

SCROLL DOWN to:

CONTROL

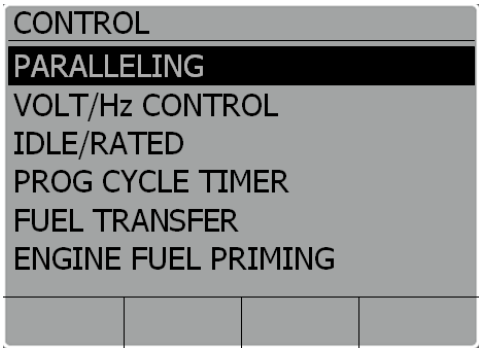
Press **OK KEY**



Scroll **DOWN** to:

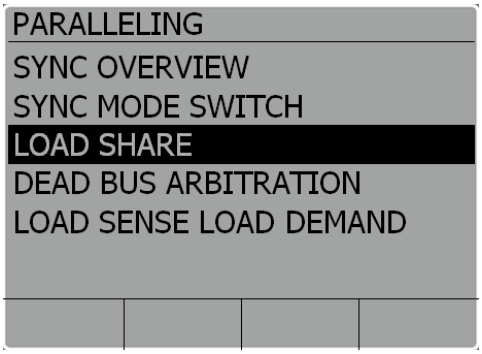
PARALLELING

Press **OK KEY**

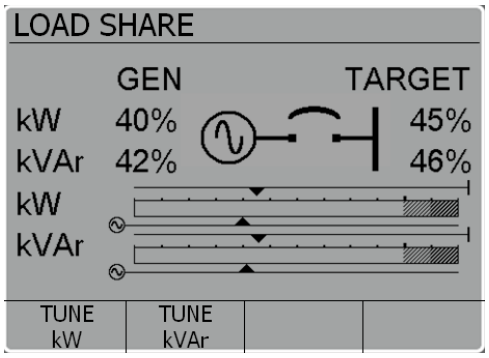


SCROLL DOWN to **LOAD SHARE**

Press the **OK KEY**.



The Load Share screen shows.

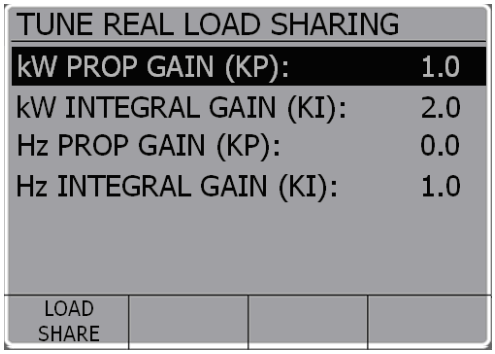


Press the desired soft key.

(In this example, “Tune kW” is selected)

Select the desired gain to adjust by pressing the corresponding soft key, or using the **DOWN ARROW** and pressing the **OK KEY**.

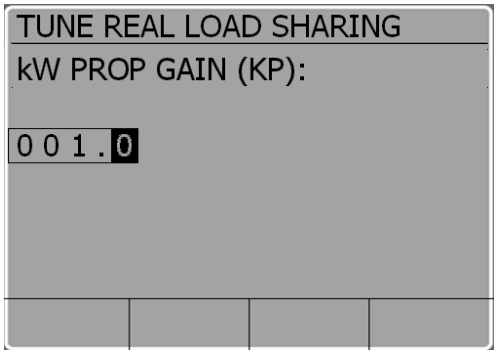
(In this example, “Prop Gain” is selected)



To edit the **GAIN**:

Select a digit using the **LEFT ARROW** or **RIGHT ARROW**

To change the selected digit use the **UP ARROW** or **DOWN ARROW**



To accept the change, press the **OK KEY**.

To reject the change, press the **ESCAPE KEY**.

CONFIGURING PARAMETERS

Within the “Configuration” submenu, the Paralleling selection allows navigation to the parameters specific to paralleling that are for configuration. These parameters may also be accessed through the “All Setpoints” submenu.

The Gen Load Sharing configuration screen contains the parameters necessary to set up the Gen Load Sharing functions. The following paralleling functions are configurable within the “Gen Load Sharing” submenu of the EMCP 4.4 “Configure” submenu (see Figure 40):

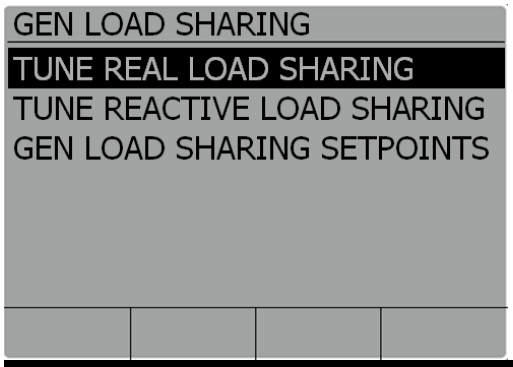


Figure 40: Gen Load Sharing – Configure Submenu

The “Gen Load Sharing” submenu allows for configuration of the following parameters:

TUNE REAL LOAD SHARING

These setpoints determine the generator response while in Real Load Sharing mode.

The following parameters are available within this submenu:

Parameter	Range/Choices
kW Prop Gain (Kp)	0-100%
kW Integral Gain (Ki)	0-100%
Hz Prop Gain (Kp)	0-100%
Hz Integral Gain (Ki)	0-100%

TUNE REACTIVE LOAD SHARING

These setpoints determine the generator response while in Reactive Load Sharing mode.

The following parameters are available within this submenu:

Parameter	Range/Choices
kVAr Prop Gain (Kp)	0-100%
kVAr Integral Gain (Ki)	0-100%
Volt Prop Gain (Kp)	0-100%
Volt Integral Gain (Ki)	0-100%

GEN LOAD SHARING SETPOINTS

These setpoints enable Load Sharing and determine the generator Real Load Sharing time delays and thresholds.

The following parameters are available within this submenu:

Parameter	Range/Choices
Gen Real Load Sharing Line Config	Disabled/Hard Wired 10V/Hard Wired 3V legacy Mode
Gen Reactive Load Sharing Line Config	Disabled/Hard Wired Input
Gen Real Load Control Max Gen Soft Load Time Config - The amount of time used to calculate a ramp rate (kW/second) to go from no load (0% of kW) to full load (100% of kW).	0-600 seconds
Gen Real Load Control Max Gen Soft Unload Time Config - The amount of time used to calculate a ramp rate (kW/second) to go from full load (100% of kW) to no load (0% of kW).	0-600 seconds
Gen Real Load Control Soft Unload Complete % Threshold - The percentage of real load (kW) at which the EMCP 4 will disconnect the load by sending a command to open the generator circuit breaker.	1-50%

LOAD SHARING GAIN TUNING

Each system and configuration has different load share gain tuning needs. This section is intended to aid in properly tuning the system.

Background

Load sharing is the process of sharing the real power (kW) and reactive power (kVAr) between gensets while still maintaining proper frequency and voltage.

General Considerations

The controlling factors for kW and frequency is the same. Both are based upon the torque or power being provided by the engine. Increasing the power from the engine will either increase the kW being provided, which must be consumed, or the frequency will increase. The kVAr and voltage is based on the excitation of the generator. Increasing the excitation will provide additional kVArs which must be consumed, or the voltage will increase. For these reasons, the tuning of Load Sharing is more difficult since multiple factors are driving a single control point.

Strategy

Since each of these factors have multiple controlling factors, a means of approaching the tuning of load sharing is required. One item to keep in mind is that full concentration on any portion of the load sharing is not possible since these different factors interact with each other. For example, any instability in the voltage/kVAr sharing affects the frequency/kW since the power consumed by the load is usually affected by the voltage. For this reason, multiple items must be considered simultaneously.

Guidelines

Be sure to be familiar with navigation of the screens and setpoints before attempting to develop a set of gains. Read through and become familiar with how to view the information about the load status along with information on the electrical output of the generator set. Since load sharing affects multiple units in the system, it is easy for the system to become unstable.

All protective relay settings such as reverse power and reverse kVAr should be reviewed and possibly tightened for commissioning in order to protect the generator set. It is recommended to use a resistive and reactive load bank to tune generator load sharing. While it is possible to tune the real power sharing with just a resistive load bank, tuning of both parameters require kW and kVAr control. If customer load is going to be used for tuning, care must be taken to ensure that the voltage and frequency variations will not cause damage to the load.

The process of load sharing tuning is an iterative procedure. It is NOT possible to arrive at optimum settings for 1 setting before tuning the other settings. In addition, it is NOT possible to tune 1 genset without tuning the other generator sets with which it is load sharing. If the generator sets are equivalent power ratings, tuning is easier since the setpoints can be copied from one unit to the next. The use of multiple people or use of ET on 1 unit with the laptop near the second unit will help in modifying the setpoints of multiple units.

In order to keep the frequency (voltage) gains from overpowering kW (kVAr) gains, the frequency and voltage gains are turned off when the generators are close to nominal frequency and voltage. This may cause a slight ripple in frequency and voltage while it oscillates around the nominal frequency or voltage.

Regardless of the amount of units at a site, it is recommend to first develop initial gains only using 2 units. These gains may need to be adjusted as part of an iterative process when additional units are added, but it easier to tweak gains once a stable set has been arrived at.

The units may ship with starting point gains. If they do, start with these gains and adjust them as needed. If there are no usable gains to start with, perform the following steps to develop initial gains:

1. Zero out the Hz and Voltage gains (Kp and Ki). This will allow the units to concentrate on sharing kVAr and kW, regardless of the voltage or frequency of the system. If different generator sets are being used, these may not be able to be zeroed out since the governor or regulator may influence frequency (speed) or voltage.
2. Start with a very small integral gain or even zero, but have a medium size proportional gain for kW and kVAr. Pay close attention to what is going on with the system. While working with the proportional gain, do NOT expect the units to share equally, but some sharing should be occurring.
3. Increase the integral gain to improve the process. Keep in mind a slightly slower response keeps you further from instability as parts of the system change due to ambient conditions, loading conditions, fuel quality, etc.

4. Once you have some gains that allow reasonable (+/-10%) sharing to occur, start bringing in the Voltage and Hertz gains in order to correct the voltage and frequency to the nominal values. These gains will be processed simultaneously with kW and kVAr loop, and may drive changes. While adjusting these gains, the system should be looked at for response to load changes, adding and removing generator sets, etc. Make sure to watch for response as a single unit load sharing with itself, along with the second unit on the bus.

There is no single right set of gains, but an iterative process to develop gains. Any changes in governor software or settings or voltage regulator software or settings will have an effect on optimum gains. If you are running into instability problems, lowering the gains of the governor or voltage regulator may allow for an improved system performance. The optimum settings of a single unit against a load are NOT the optimum settings for a unit as part of a system.

13.7 LOAD SHED

PURPOSE

The Load Shed feature provides a method to disconnect loads from the system based upon user configuration. This can be used for multiple or single gensets.

BASIC OPERATION

Load Shed is a configurable function that can be used to activate one or more Digital Outputs. These outputs can be configured to activate based upon user defined criteria. When one, or more, of the criteria are met, the associated Digital Output will activate.

CONFIGURING PARAMETERS

Within the “All Setpoints” submenu within the “Configuration” menu, the “Control” submenu provides access to the parameters specific to Load Shed that can be configured.

The Load Shed Conditions configuration screen contains the parameters necessary to set up the Load Shed functions. The following functions are configurable within the “Gen Load Sharing” submenu of the EMCP 4.4 “Configure” submenu (see Figure 41):

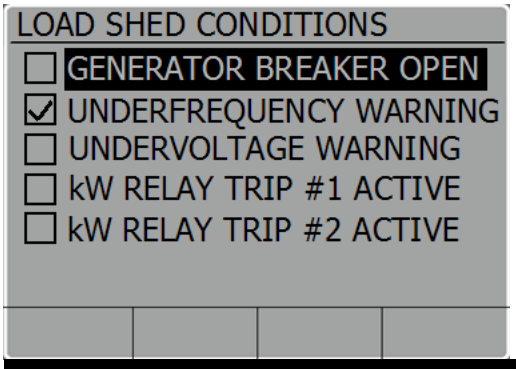


Figure 41: Load Shed Conditions – Configure Submenu

Load Shed will activate when all of the following conditions are met:

1. A Digital Output is programmed for Load Shed,
2. Any, or all of the Load Shed conditions are selected in the Load Shed Conditions screen, and
3. Any of the selected Load Shed conditions occurs

13.8 BREAKER SELECTION

Care must be taken in the selection of Circuit Breakers for EMCP 4.4 paralleling controller. The breaker must be sized appropriately for the generator current capability, along with interrupting capability for fault currents from paralleled sources.

The capability of meeting industry 5 to 6 cycle close capability is required, along with the ability to electrically open and close the circuit breaker. Aux contacts (A and B) from the circuit breaker are also required. An electrically operated breaker is required for the paralleling system.

For maximum reliability, both a DC powered shunt trip and a DC powered undervoltage trip shall be used when the circuit breaker is capable of supporting both. If the circuit breaker can support only one of these, the DC undervoltage release shall be used. An undervoltage release will open the circuit breaker upon the loss of DC power to the circuit breaker.

If a circuit breaker stays closed upon loss of control to the generator set, the generator will act as a motor and damage to the generator set will result. Care should be taken in the design of the package wiring when multiple disconnect means exist on the DC voltage system.

All electrically controlled breakers used with the paralleling EMCP 4.4 controller must have a cover that disables the close button on the circuit breaker. The circuit breaker must only be able to be closed after verification by the EMCP 4.4 that the bus is dead or that the generator set is in phase with the bus.

14 MODIFIABLE TEXT STRINGS

The EMCP 4 supports the renaming of Custom Events for the event log. This feature is called **MODIFIABLE TEXT STRINGS**. This is useful when an existing SPN and text string do not exist for the required event. These events can be configured and triggered similar to other events. However, these events are unique in that their displayed text strings can be customized via the Cat Service Tool using any character in the supported character set of the EMCP 4 software flash file. Furthermore, the Cat Service Tool has the capability to upload a Modifiable Text Strings configuration file (containing previously saved custom event text strings) from the computer, or download a configuration from the EMCP 4 to the computer.

In order to display a custom text string for an event, the following steps must be taken:

1. One of the Digital Inputs must be configured as a Custom Event with a Failure Mode Identifier of Status (or Condition Exists). For more information on configuring Digital Inputs, see Section 8.1.
2. A custom string must be entered, using the Modifiable Text Strings tool in the Cat Service Tool, as described in Chapter 4.
3. The language must be set to the customer language, *not* to Technician English.

An example of entering a modifiable text string for Custom Event #1 is given in Figure 42.

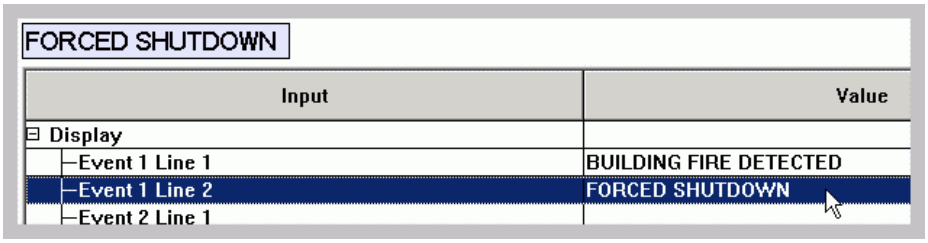


Figure 42 : Customizing A Text String With the Cat Service Tool

The EMCP 4 supports one Modifiable text string per Custom Event on each programmable Digital Input.

14.1 LANGUAGE SUPPORT

The primary language for the EMCP 4 control will always be Technician English. The user will always be able to revert back to Technician English from the selected language that is supported by the flash file. However, when the EMCP 4 display is viewed in Technician English, the user will not be able to view the custom text strings and will only be able to view the default strings (Custom Event #X) for a given input.

The EMCP 4 has the capability of supporting one flash file containing one secondary language at any particular time. If the user is interested in having a new secondary language, a new flash file to configure the new language must be installed. Therefore, the user is not able to install multiple flash files supporting different languages simultaneously.

The EMCP 4 supports Unicode characters from the English character set, as well as the character set from the local language supported by the file. It is the user's responsibility to install the preferred flash file with the correct language support that will allow the modification of text strings.

The user is also responsible for choosing the appropriate operating system or Unicode text entry system for the chosen language. The Cat Service Tool software accepts input from the PC keyboard settings. If, for example, the PC keyboard setting is for U.S. English, it may be difficult to enter Russian (or other non-English) characters.

Different language software support different sets of characters. Therefore, Modifiable Text String configuration files created in one language will not become translated if new language software is flashed into the EMCP 4. The original text string will still show as originally entered.

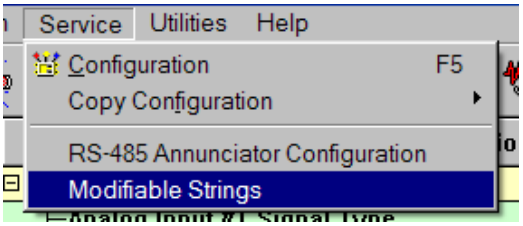
14.2 PROGRAMMING MODIFIABLE TEXT STRINGS USING THE CAT SERVICE TOOL

To configure a Modifiable Text String using the Cat Service Tool, go through the following menu options:

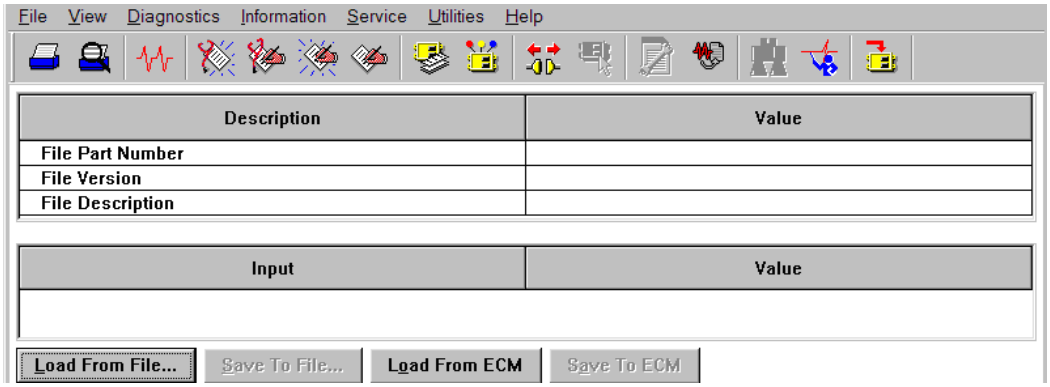
1. Connect the EMCP to the Cat Electronic Technician as described in Section 4.2.

Note: The Service Tool must be connected to CAN 1.

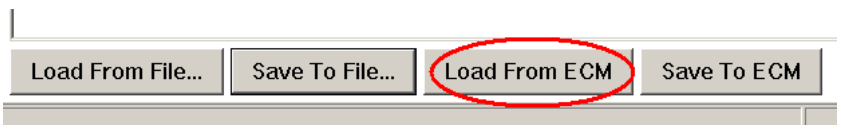
2. Select "Modifiable Strings" under "Service" from the choices at the top of the software screen.



3. The "Modifiable Strings" screen will appear.



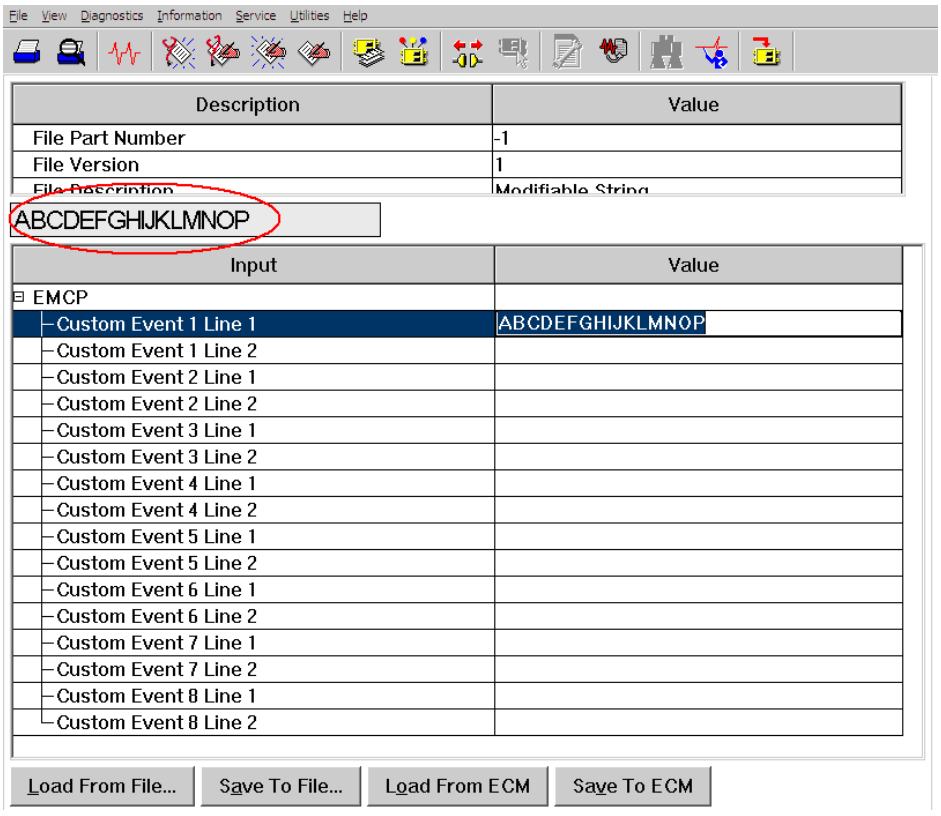
4. In order to load the existing text string file from the ECM, click the "Load From ECM" button on the bottom of the screen.



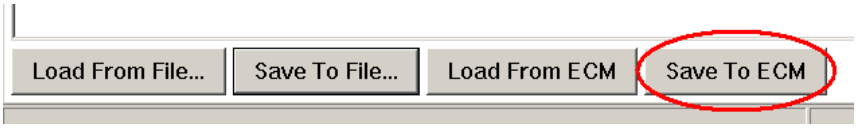
5. The stored strings, if any, will appear. For first time configuration, the strings will be blank.

Input	Value
⊟ EMCP	
├Custom Event 1 Line 1	
├Custom Event 1 Line 2	
├Custom Event 2 Line 1	
├Custom Event 2 Line 2	
├Custom Event 3 Line 1	
├Custom Event 3 Line 2	
├Custom Event 4 Line 1	
├Custom Event 4 Line 2	
├Custom Event 5 Line 1	
├Custom Event 5 Line 2	
├Custom Event 6 Line 1	
├Custom Event 6 Line 2	
├Custom Event 7 Line 1	
├Custom Event 7 Line 2	
├Custom Event 8 Line 1	
└Custom Event 8 Line 2	

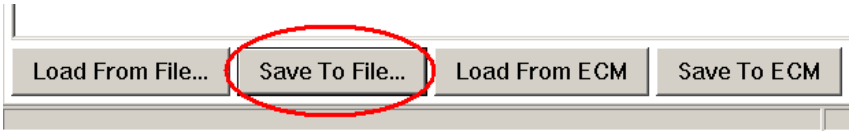
6. Click in the Value column next to the event to be modified. Type the desired text string. The Modifiable Text String is considered a pair of text strings, and the user has the option of customizing the pair of text strings. The second line has less available space, because the event log index is also displayed on that line.



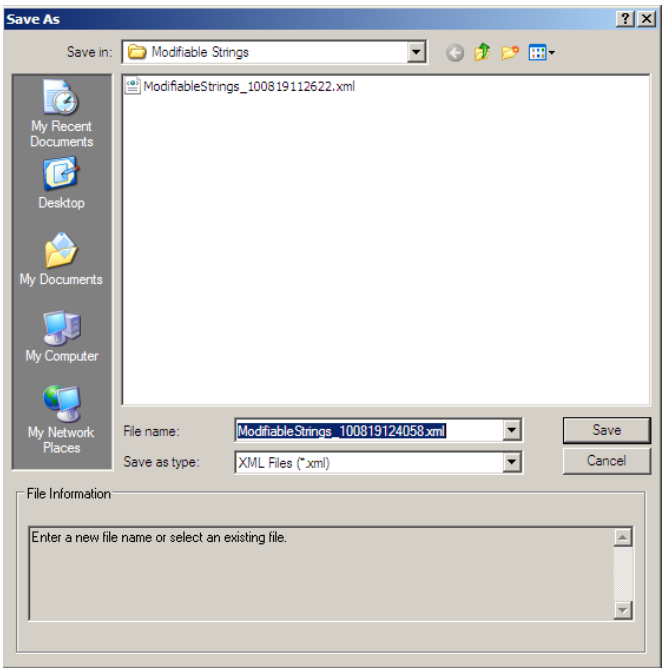
7. Once all text strings are entered for all events desired, click on the “Save to ECM” button on the bottom of the screen.



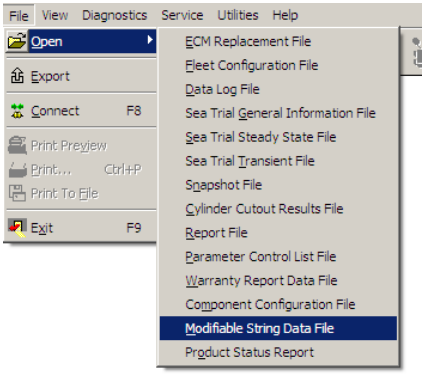
8. To then save the same file to the hard disk, click on the “Save to File...” and browse to the appropriate folder.



9. Once the file destination is found, click ”Save”.



10. To edit a saved text string in ET while not connected to the ECM, navigate to File>Open>Modifiable String Data File. This is equivalent to clicking on the “Load From File...” button on the bottom left side of the “Modifiable Strings” screen.



11. Select the desired string data and click “Open”. This opens the “Modifiable Strings” screen again.
12. Edit as desired, then save to ECM, or save to a file.

Note: The Modifiable Text String parameter value’s field is initially blank until it is replaced with a custom text string parameter value. The custom text string parameter value entered will replace the default strings.

The user’s Custom Text Strings are displayed in the user’s preferred language. If the service tool doesn’t support the user’s preferred language, US English will be used.

Note: The user must save any offline changes before attempting to connect the Service Tool to the EMCP 4, or the changes will not be saved.

15 SAVING AND RESTORING SETPOINTS

The EMCP 4 supports the saving and uploading of the EMCP 4 setpoints through a setpoint configuration file. This file, called the ECM Replacement File, or Fleet Replacement File, is accessible via the ECM Replacement tool of the Cat Service Tool software. The file contains information specific to the EMCP 4, and includes the setpoint values that are specific to a given EMCP 4 module. The user has the option of saving the data to an ECM Replacement File from an EMCP 4 module or uploading the data from the ECM Replacement File to another EMCP 4 module. The user also has the option of uploading general configuration data to several EMCP 4 modules by means of a similar tool called Fleet Configuration. Both of these options are accomplished through the Cat Service Tool software.

Note: This chapter only addresses setpoints residing in the EMCP 4. To save and restore setpoints for other (optional) modules on the EMCP 4 CAN data links, a similar procedure must be followed for each individual module.

15.1 SAVING EMCP 4 CONFIGURATION DATA

The Cat Service Tool is used to save an EMCP 4 configuration.

The EMCP 4 configuration should be saved upon initial access or after any configuration change. This will be required for future accessibility when exchanging or replacing the EMCP 4 module.

After connecting to the EMCP 4, navigate to Service > Copy Configuration. (See Figure 43). There are two options:

- Fleet Configuration
- ECM Replacement

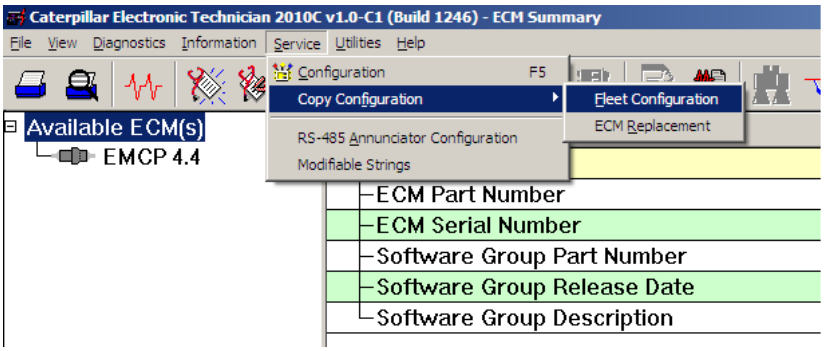


Figure 43: Cat Service Tool EMCP 4 GSC Summary Screen

The loading of EMCP 4 configuration data is very similar between **ECM REPLACEMENT** and **FLEET CONFIGURATION**. For illustration purposes, the **ECM REPLACEMENT** option will be described here.

FLEET CONFIGURATION OPTION

Select the **FLEET CONFIGURATION** option when there is a need to save and copy **GENERAL DATA** to several ECMs (non-module-specific).

The **FLEET CONFIGURATION** tool works very similar to the ECM Replacement tool, with the exception of ignoring module-specific data such as **ENGINE SERIAL NUMBER** and **ENGINE OPERATING HOURS.**

ECM REPLACEMENT OPTION

To save EMCP 4 configuration data to an ECM Replacement file:

1. From the Service Tool menu, select the following: Service > Copy Configuration > ECM Replacement. See Figure 43.
2. The software will prompt the user to open a previously saved ECM Replacement file. Click “Cancel”.
3. The following message is displayed: “**No Data Is Available. Load From ECM Now**?” Press “No”.
4. Click “**Load from ECM**” from the bottom left of the ECM Replacement screen to bring up the setpoints. See Figure 44.

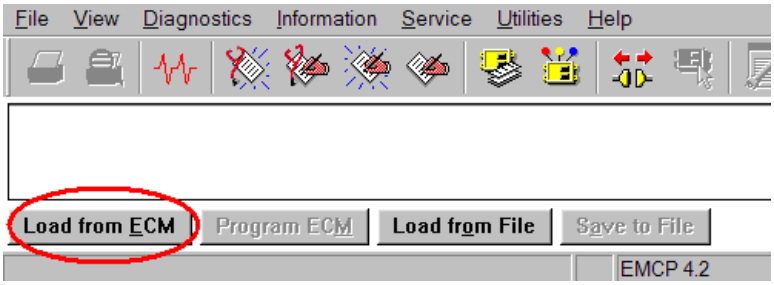


Figure 44: Load from ECM

5. After the software loads the data, the replacement file parameters will be shown. See Figure 45.

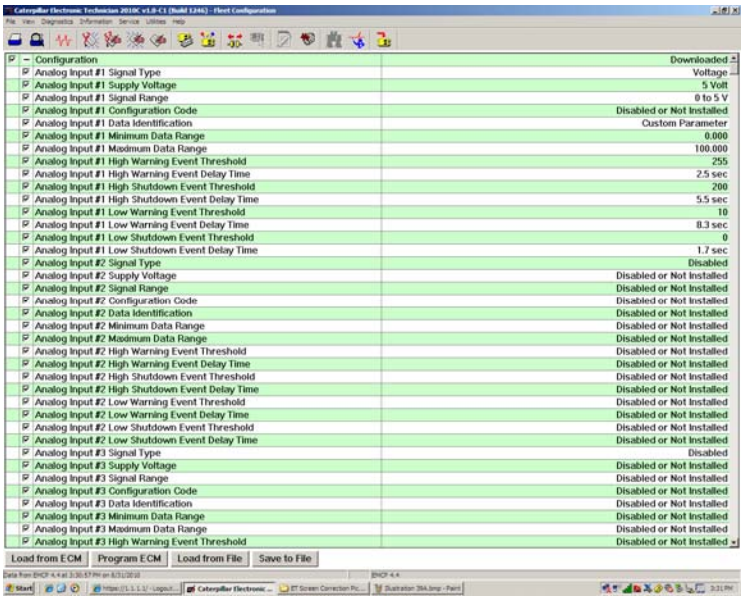


Figure 45: ECM Replacement File Parameters

6. Select which ECM's configuration data is to be viewed and/or saved for future use by adding, or removing check boxes from the side of the parameters.
7. After any selection changes are completed, click "**Save to File**" from the bottom of the ECM Replacement screen to save the file. See Figure 46. Make sure to note where the file is stored.

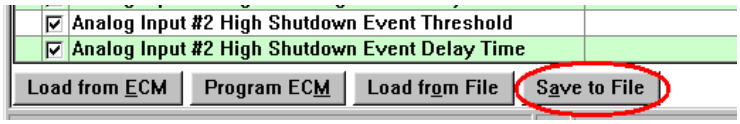


Figure 46: Save to File

Note: The configuration data must be saved to a file before disconnecting from the service tool or the data **WILL BE LOST** and must be re-loaded from the source module again.

15.2 LOADING EMCP 4 CONFIGURATION DATA

The loading of EMCP 4 configuration data is very similar between **ECM REPLACEMENT** and **FLEET CONFIGURATION**. For illustration purposes, the **ECM REPLACEMENT** option will be described here.

Warning: When loading an ECM Replacement File, the engine operating hours will increase to the newly loaded value (if larger than the old value). To avoid this, deselect the Engine Operating Hours setting.

To load an ECM Replacement file to an EMCP 4:

1. From the Service Tool menu, select the following: Service > Copy Configuration > ECM Replacement. See Figure 43.
2. The software will prompt the user to open a previously saved ECM Replacement file.
3. Navigate to the location where the file is stored and click “Open”.
4. The software will confirm opening the file. See Figure 47. Click “OK”.

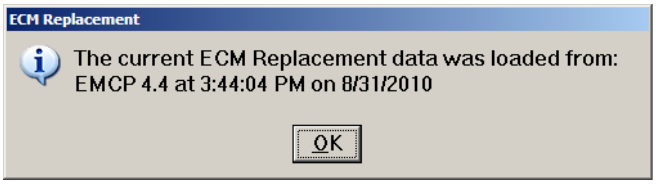


Figure 47: Load from File

5. The replacement file parameters will be shown. See Figure 48.

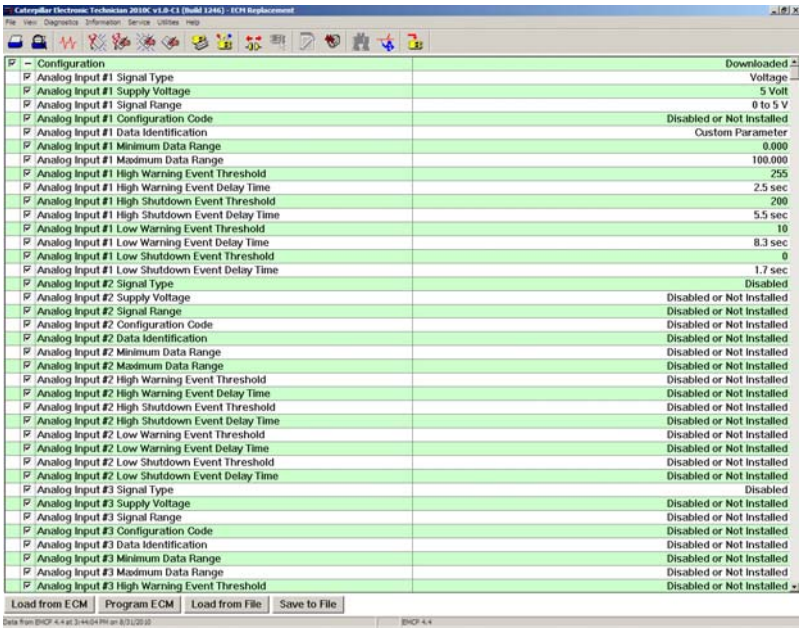


Figure 48: ECM Replacement File Parameters

6. Select which ECM's configuration data is to be programmed into the EMCP 4 by adding, or removing check boxes from the side of the parameters.
7. After any selection changes are completed, click "**Program ECM**" from the bottom of the ECM Replacement screen to load the file into the EMCP 4. See Figure 49.

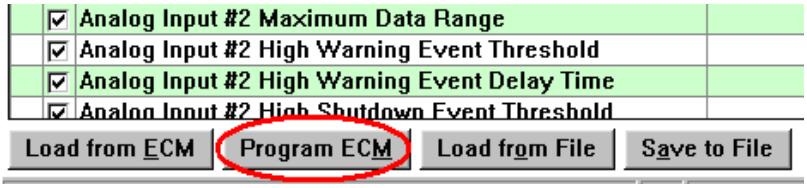


Figure 49: Program ECM

8. If another replacement file is to be programmed or if the user is already at the ECM Replacement screen prior to opening a replacement file, press the "Load from File" button at the bottom of the screen and follow steps 3 through 7 above. See Figure 50.

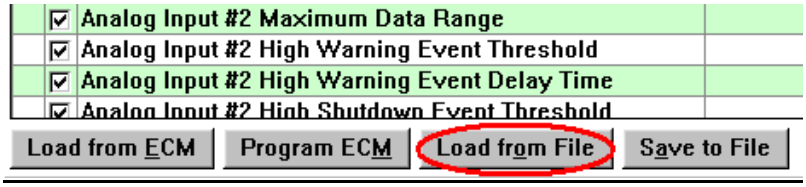


Figure 50: Load ECM Replacement File

Note: By default, ECM Replacement files are stored in the ECM Replacement folder, while Fleet Configuration files are stored in the Fleet Configuration folder.

The above steps, for uploading saved configuration data, will need to be repeated for each EMCP 4 module needing same or similar setpoint configurations. For programming multiple units with the same setpoints, it is recommended to use Fleet Configuration files.

Note: When programming **EVENT RESPONSE CONFIGURATION** setpoints, the control must be in **STOP** mode. If the control is not in **STOP**, there will be a message after the programming is complete. The message will show that none of the Event Response Configuration setpoints were changed.

16 PROGRAMMABLE CYCLE TIMER

The Programmable Cycle Timer (PCT) feature allows the operator to program seven independent times, when tasks (called PCT Outputs), will be activated or deactivated automatically during the week. This is useful for exercising gensets, or cases where two or more generators are required to automatically share the duty of supplying a load throughout the week.

Using the PCT, each genset can be programmed to start and stop at pre-set times. The PCT is capable of handling a seven day sequence with seven independent starts happening one or more times each week. The timing of these start/stop cycles may be programmed in advance, either locally or via the service tool.

For example, if a standby set does not have access to a utility supply to power a trickle charger, the PCT can be set for an hour a week to keep the battery charged.

Caution: External equipment such as a transfer switch is required to ensure that the gensets are not stopped on load.

The **PCT FEATURE** consists of seven independent timers; each timer has the following setpoints (setpoints shown are for PCT #1):

PROGRAMMABLE CYCLE TIMER #1: Activation Day of the Week:
This permits independent selection of each day (Sun -> Sat) that the timer will activate. All seven days can be selected, if desired.

PROGRAMMABLE CYCLE TIMER #1: Activation Start Time
The time of day (in hours and minutes) that the timer will activate. The time must be programmed using a 24-hour clock.

PROGRAMMABLE CYCLE TIMER #1: Active Time
The duration (in hours and minutes) for which the timer will be active (up to 24 hours).

PROGRAMMABLE CYCLE TIMER #1: Output #1 Activation Configuration
The Programmable Cycle Timer's first output will be activated when this timer is active and will allow the genset to start if in Auto. This will not close the generator breaker.

PROGRAMMABLE CYCLE TIMER #1: Output #2 Activation Configuration
The Programmable Cycle Timer's second output will be activated when this timer is active. Output # 2 can be assigned to a programmable output for connection to an external device. This external device can be used to control a load bank, transfer switch or other device.

PROGRAMMABLE CYCLE TIMER #1: Output #3 Activation Configuration (EMCP 4.4 only)
The Programmable Cycle Timer's third output will be activated when this timer is active. The EMCP 4 will not close the generator circuit breaker unless Output # 3 is configured and all other required conditions are met. Output # 3 will signal the EMCP 4 controller to synchronize and close the generator circuit breaker if the Sync Mode Switch (SMS) is in Auto, ECS is in Auto, and Hardwired Dead Bus Arbitration (HWDBA) is enabled (if a live bus does not exist).

The PCT has two internal outputs (three for EMCP 4.4); these should not be confused with the physical outputs of the control. The outputs are connected internally to the control module. In the standard configuration, **PCT OUTPUT #1** is connected to a Remote Initiate command. **OUTPUT #2** is customer configurable via a discrete output. **OUTPUT #3** is connected to breaker control. This allows the operator to configure a timed relay, for external connectivity.

Note: The outputs of all seven timers are tied together in an "OR" fashion. This means that if any one, or more, timer is activated, then any output will activate (depending on programming).

The status of each output is indicated by a **1**, **0**, or **-** in the **PROG CYCLE** column under #1 through #7. See Figure 51.

A - programmed to be TRUE at another time.

A **DASH** (**-**) means that this PCT is **NOT** programmed to activate this output.

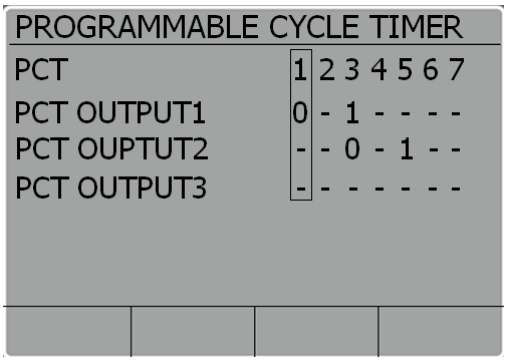


Figure 51: PCT Main Screen

In Figure 51, **PCT #1** is **INACTIVE** on Output #1. Outputs #2 and #3 are **NOT** enabled and will never activate, as programmed.

PCT #3 is **ACTIVE** on Output #1, and **INACTIVE** on Output #2. Output #3 is **NOT** enabled and will never activate, as programmed.

PCT #5 is **NOT** enabled and will never activate, as programmed, on Outputs #1 and #3. Output #2 is **ACTIVE.**

PCT #2, PCT #4, PCT #6, and **PCT #7** are **DISABLED.** They **NEVER** activate Output #1, Output #2, or Output #3, as programmed.

To select a specific Programmable Cycle Timer, use the **LEFT**  and **RIGHT**  buttons until the desired PCT is within the selection box and then press the **OK KEY** 

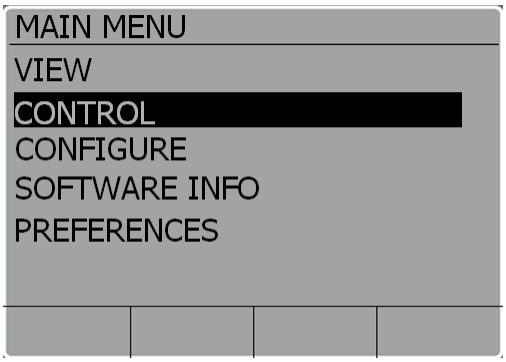
.

16.1 CONFIGURING THE PROGRAMMABLE CYCLE TIMER USING THE DISPLAY

To configure a Programmable Cycle Timer with the display, go through the following menu options:

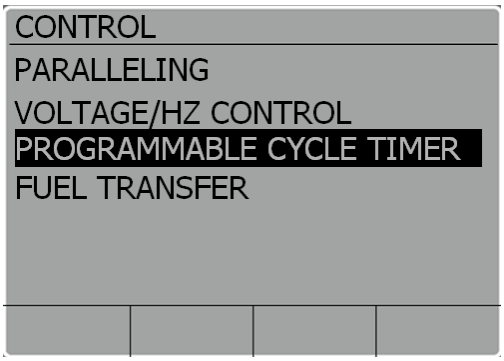
At **MAIN MENU,** scroll down to **CONTROL**

Press the **OK KEY**.



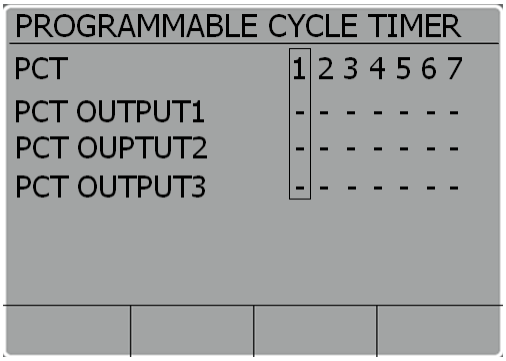
Scroll **DOWN** to **PROG CYCLE TIMER**

Press the **OK KEY**.



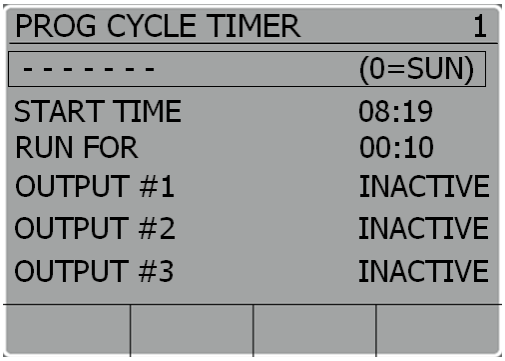
The box surrounding the first column outlines the first of seven timers.

Press the **OK KEY** to program this timer.



The box surrounding the first row outlines the day selection.

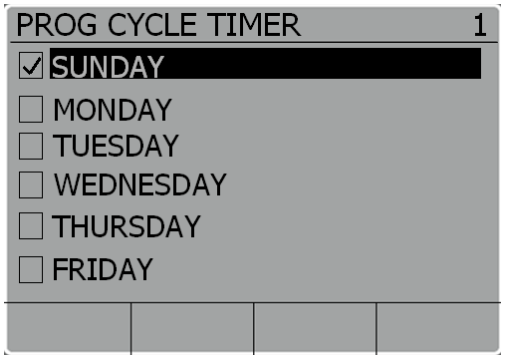
Press the **OK KEY** to select the day(s) for this timer.



Use the **UP** and **DOWN** arrow keys along with the **LEFT** and **RIGHT** arrow keys to select the days that this timer will activate.

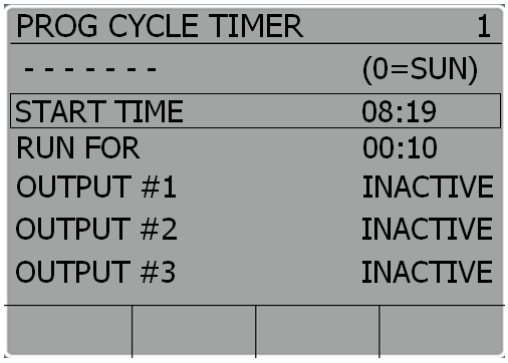
Press the **OK KEY** when done.

To program Saturday, continue scrolling down past Friday.



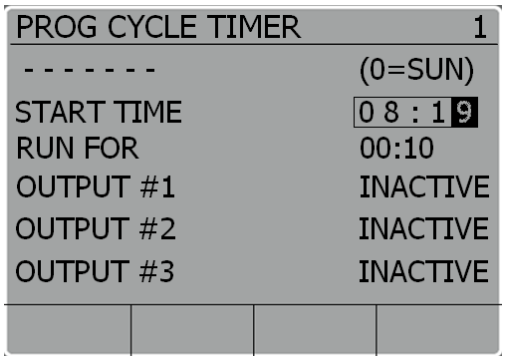
Scroll **DOWN** to select the **START TIME**

Press the **OK KEY**.



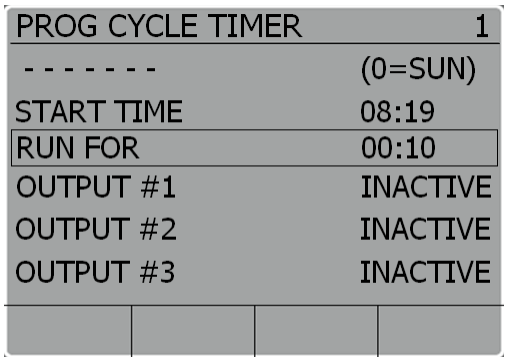
Use the arrow keys to enter the **START TIME**

Press the **OK KEY** when done.



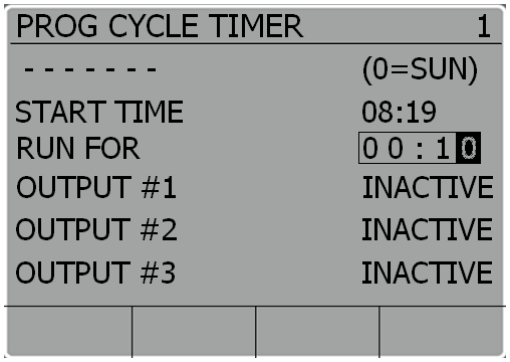
Scroll **DOWN** to select the **RUN FOR** time

Press the **OK KEY**.



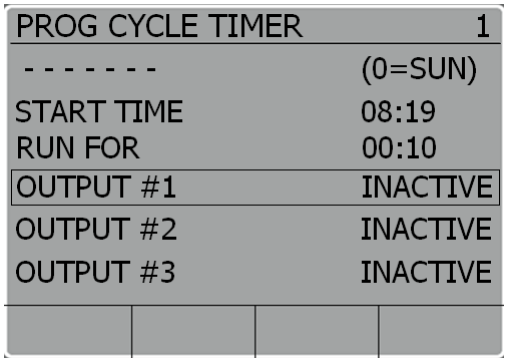
Use the arrow keys to enter the **RUN FOR** time

Press the **OK KEY** when done.



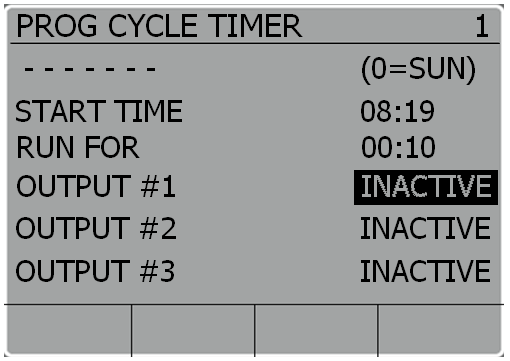
Scroll **DOWN** to select the **OUTPUT STATE** for Output #1

Press the **OK KEY**.



Select the **OUTPUT STATE** that you want to program

Press the **OK KEY** when done.



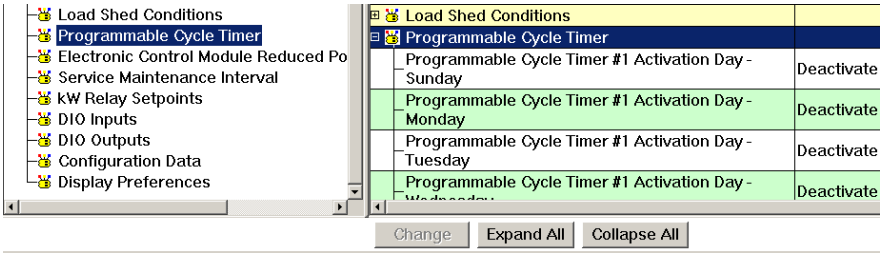
Scroll **DOWN** to select the **OUTPUT STATE** for Output #2 and #3 to program with the same steps as Output #1.

Press the **ESCAPE KEY** to return to the Programmable Cycle Timer main screen. Use the **LEFT** and **RIGHT** buttons to select the other timers and repeat the above steps.

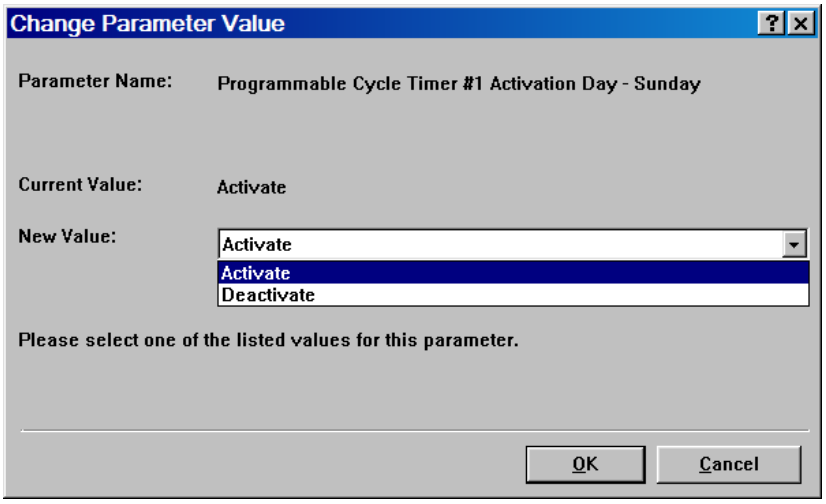
16.2 CONFIGURING THE PROGRAMMABLE CYCLE TIMER USING THE CAT SERVICE TOOL

To configure a Programmable Cycle Timer with the Cat Service Tool, go through the following menu options:

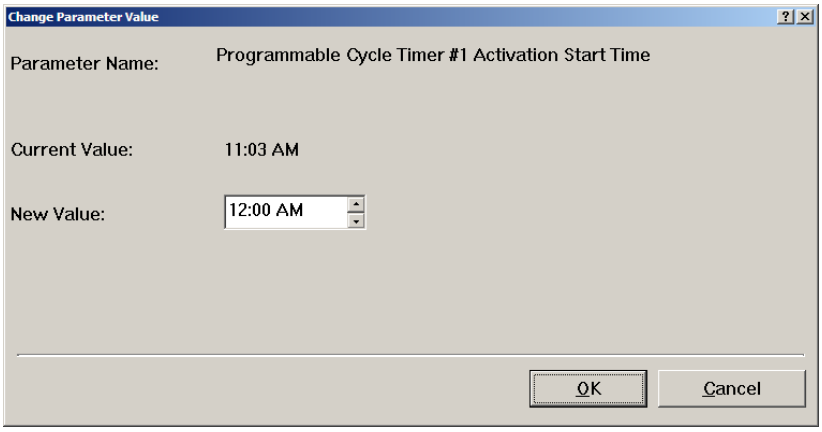
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Programmable Cycle Timer on the left.



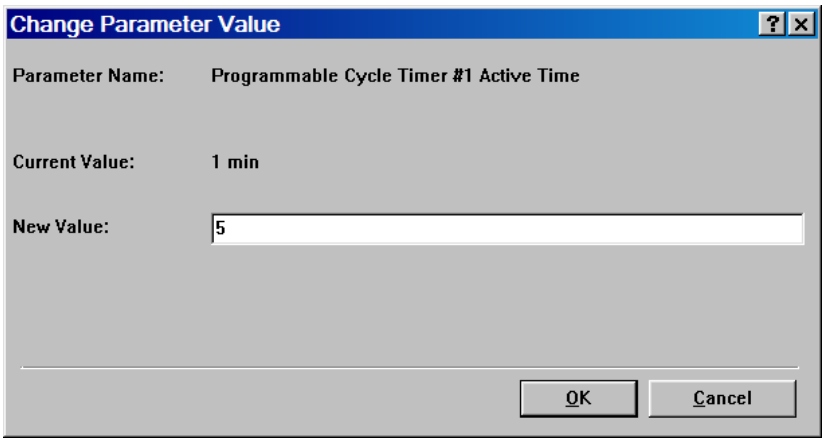
3. Double click the Programmable Cycle Timer #N Activation Day setpoint for a given day to change this value from the drop down menu. Click the OK button to program.



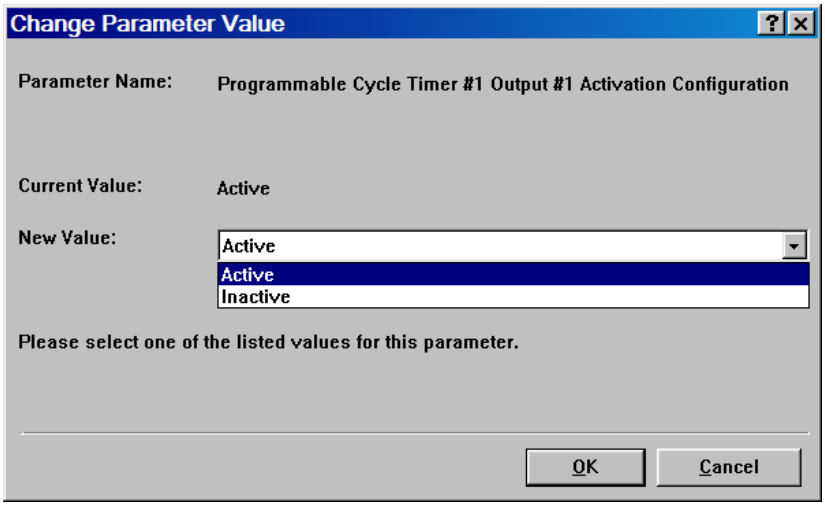
4. Double click the Programmable Cycle Timer #N Activation Start Time setpoint to change this value. Click the OK button to program.



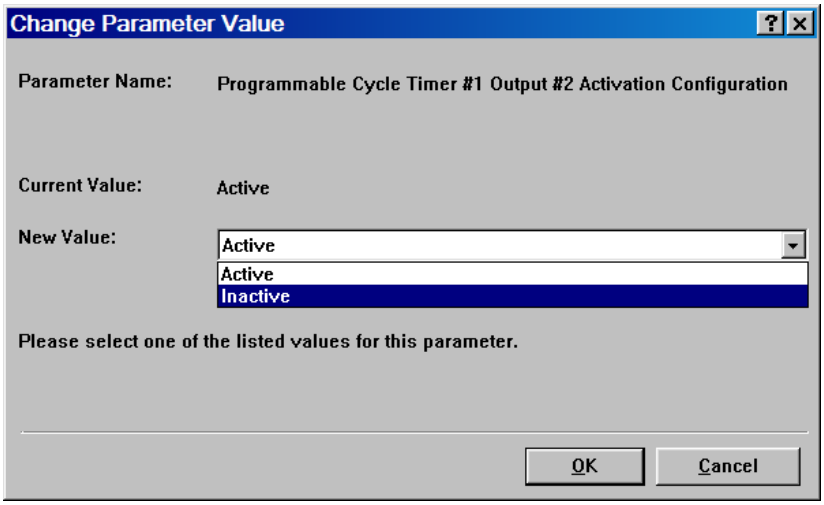
5. Double click the Programmable Cycle Timer #N Active Time setpoint to change this value. Click the OK button to program.



6. Double click the Programmable Cycle Timer #N Output #1 Active Configuration setpoint to change this value from the drop down menu. Click the OK button to program.



7. Double click the Programmable Cycle Timer #N Output #2 Active Configuration setpoint to change this value from the drop down menu. Click the OK button to program.



8. Repeat the above steps to program additional timers.

17 REDUCED POWER MODE

REDUCED POWER MODE (RPM) is a feature that puts the control into a state where the power consumption is reduced. RPM is intended to extend the amount of time the generator can sit between runs before the control drains the batteries too low to crank the generator in cases where a battery trickle charger is not fitted.

In order to reduce the power consumed when in RPM, many functions within the control are turned **OFF**.

TURNED OFF DURING RPM

- ☑ The display
- ☑ The communication lines, including Annunciator communication
- ☑ All inputs except Remote Initiate
- ☑ All outputs
- ☑ LEDs (lamps) on the front of the control blink briefly every second (rather than being on continuously).

When RPM is enabled, the control will only enter RPM after a programmable time delay provided the generator is stopped and no keys have been pressed during the delay time.

Note: If using Group Start, Reduced Power Mode should NOT be used.

The control will wake from RPM on any one of the following conditions:

WAKE FROM RPM

- ☑ Sending a hardwired remote start signal to the controller (Group Start signal will not wake the EMCP)
- ☑ Cycling power to the controller
- ☑ A key on the keypad is pressed
- ☑ The Programmable Cycle Timer is about to enter a period when it will activate an output.

ACTIONS TO ENABLE RPM

1. Change the setpoint Reduced Power Mode Enable Status to **ENABLED**. This can be done with either ET or using a level 3 password to navigate Configure -> Setpoints -> Other -> Reduced Power Mode.
2. The setpoint Reduced Power Mode Delay Time should be checked. It should be at a desirable value. This value is the amount of time (once the generator is at rest and after the last key-press) before the control will go into Reduced Power Mode.

The following conditions must be met in order for the EMCP 4 to enter Reduced Power Mode:

1. Engine speed must be 0
2. Remote Initiate signal cannot be active
3. Must not be within 15 min of a Programmed Cycle Timer
4. Group start signal must be inactive

SEMI-AWAKE

The EMCP 4 becomes **SEMI-AWAKE** when in Reduced Power Mode. Approximately every 30 minutes it will do status checks of the control for about 40 seconds. During **SEMI-AWAKE** the display remains off and the LEDs (lamps) continue to blink. The EMCP will start up to check for Analog Input faults, engine speed sensor diagnostics, and AC faults. If any of these faults become active at this time, the system will respond accordingly (warning or shutdown LED indicators may turn on). During the semi-awake time any active relays (such as common alarm) will energize.

Once the **SEMI-AWAKE** time is completed the control will return to full RPM (deactivating any relays that are active). An active event will not prevent the control from entering reduced power mode. If a programmable cycle timer is set to become active in the near future, the timer before waking will be adjusted to ensure the controller wakes in time to process the programmable cycler timer.

18 PROGRAMMABLE KW RELAY FUNCTION

The EMCP 4.3 and EMCP 4.4 have two Programmable kW Relay functions configured to respond to the %KW of the genset. These functions can be mapped to the EMCP Outputs.

The setpoints within the Programmable kW Relay functions can be changed from the display, and are as follows:

PROGRAMMABLE KW RELAY #N TRIGGER CONDITION
Choices: Disabled, Trip Above Threshold, Trip Below Threshold

This selects whether the output will be active if the value is above or below the threshold.

PROGRAMMABLE KW RELAY #N PERCENTAGE THRESHOLD
Range: -100-100%

This is the threshold of rated kW that the function must pass in order to change the state of the output.

PROGRAMMABLE KW RELAY #N HYSTERESIS PERCENTAGE
Range: -100-100%

Once the output is on, the value must return by this much *past* the Threshold before the output turns off again. For example, if this value is 5% and the Percentage Threshold is 90%, then the relay will activate at 90% but not turn off again until 85% of rated kW (90-5). This hysteresis is used to ensure that a value close to the threshold does not cause the output to oscillate.

PROGRAMMABLE KW RELAY #N TRIP ACTIVATION DELAY TIME
Range: 0-120 seconds

This is the time that the value must exceed the threshold before the relay becomes active. It is used to ensure that the momentary transients are ignored.

PROGRAMMABLE KW RELAY #N TRIP DEACTIVATION DELAY TIME
Range: 0-120 seconds

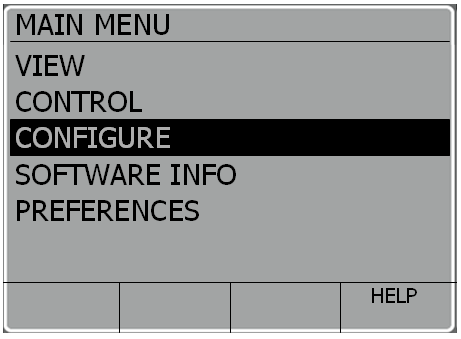
This is the time that the value must return past the threshold before the relay becomes inactive again. It is used to ensure that the momentary transients are ignored.

18.1 CONFIGURING THE PROGRAMMABLE KW RELAY FROM THE DISPLAY

To configure a Programmable kW Relay with the display, go through the following menu options:

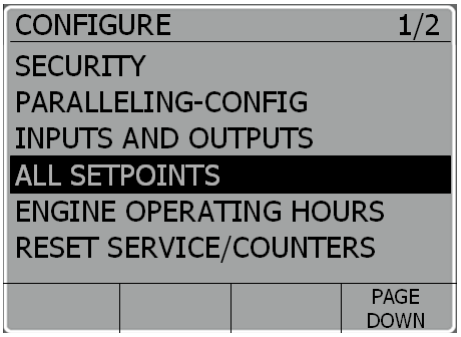
At **MAIN MENU,** scroll **DOWN** to **CONFIGURE**

Press the **OK KEY**.



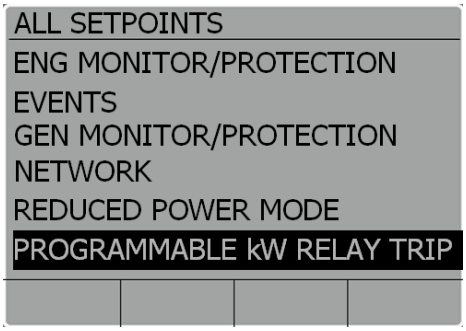
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



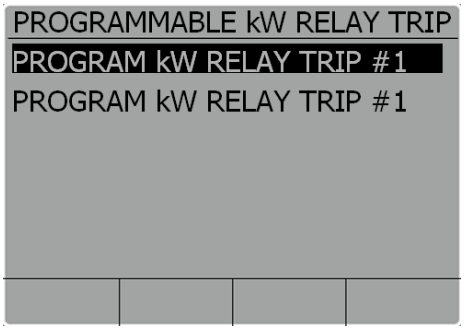
SCROLL DOWN to **PROGRAMMABLE KW RELAY**

Press the **OK KEY**.

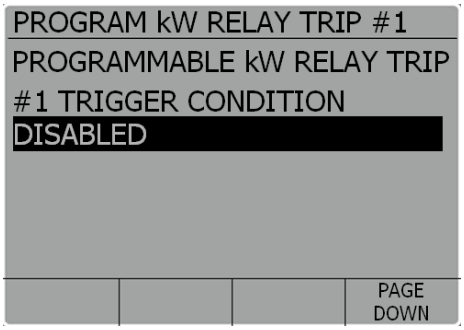


Select the **PROG KW RELAY** that you want to program

Press the **OK KEY**.



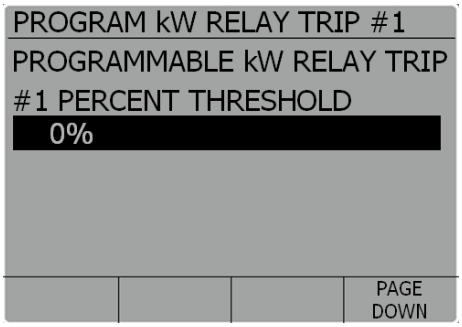
Press the **OK KEY** to highlight the current configuration (**DISABLED,TRIP BELOW THRESH, TRIP ABOVE THRESH)**.



Select the type of **PROGRAMMABLE KW RELAY #N TRIGGER CONDITION** that you want to program

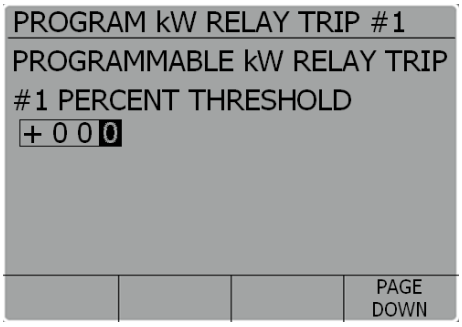
Press the **OK KEY**.

Scroll **DOWN** to **PROGRAMMABLE KW RELAY #N PERCENTAGE THRESHOLD**



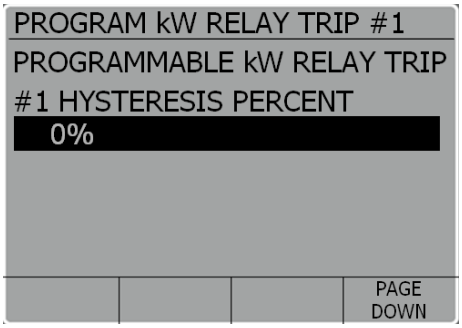
Press the **OK KEY** to edit the current **PROGRAMMABLE KW RELAY #N PERCENTAGE THRESHOLD.**

Select the **PROGRAMMABLE KW RELAY #N PERCENTAGE THRESHOLD** that you want to program



Press the **OK KEY**.

Scroll **DOWN** to **PROGRAMMABLE KW RELAY #N HYSTERESIS PERCENTAGE**

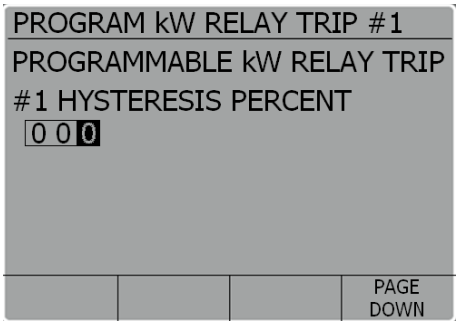


Press the **OK KEY** to edit the current **PROGRAMMABLE KW RELAY #N HYSTERESIS PERCENTAGE.**

Select the **PROGRAMMABLE kW RELAY #N HYSTERESIS PERCENTAGE** that you want to program

Press the **OK KEY** 

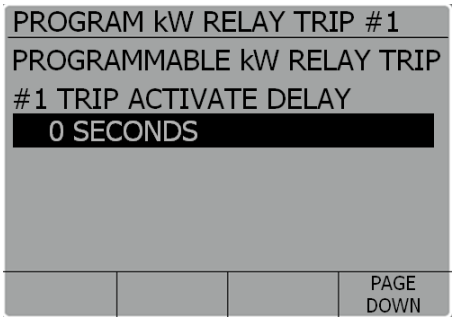
.



Scroll **DOWN**  to **PROGRAMMABLE kW RELAY #N TRIP ACTIVATION DELAY TIME**

Press the **OK KEY** 

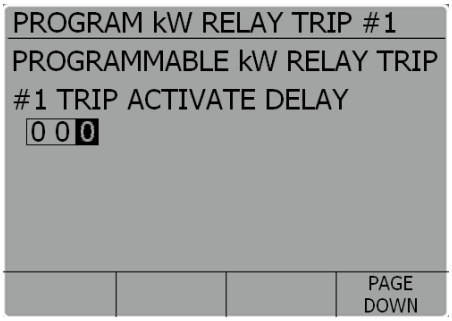
to edit the current **PROGRAMMABLE kW RELAY #N TRIP ACTIVATION DELAY TIME.**



Select the **PROGRAMMABLE kW RELAY #N TRIP ACTIVATION DELAY TIME** that you want to program

Press the **OK KEY** 

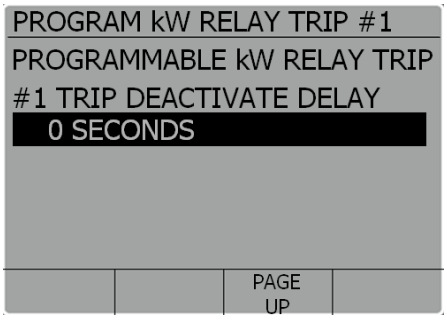
.



Scroll **DOWN**  to **PROGRAMMABLE kW RELAY #N TRIP DEACTIVATION DELAY TIME**

Press the **OK KEY** 

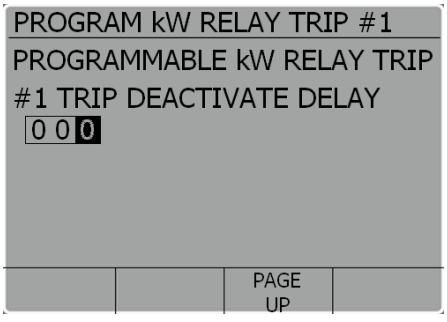
to edit the current **PROGRAMMABLE kW RELAY #N TRIP DEACTIVATION DELAY TIME.**



Select the **PROGRAMMABLE kW RELAY #N TRIP DEACTIVATION DELAY TIME** that you want to program

Press the **OK KEY** 

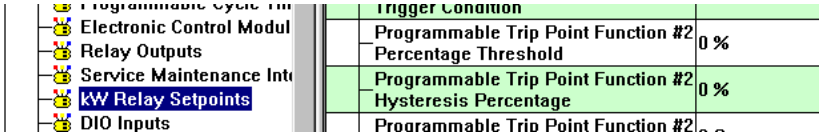
.



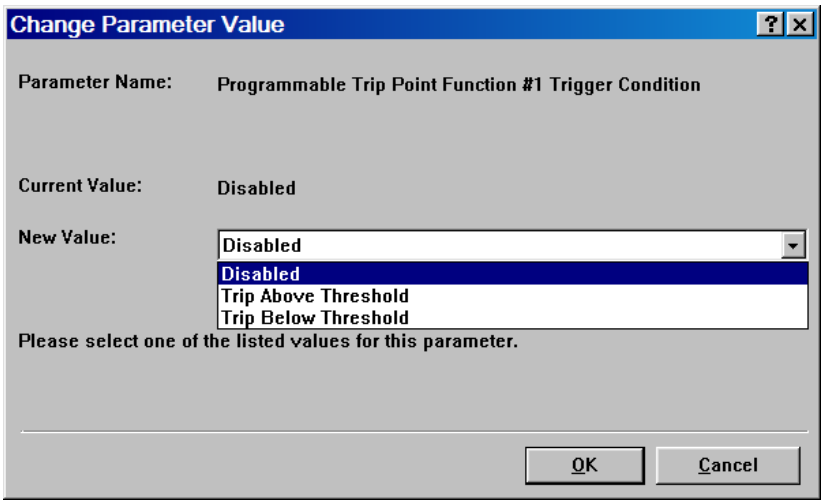
18.2 CONFIGURING THE PROGRAMMABLE KW RELAYS USING THE CAT SERVICE TOOL

To configure a Programmable kW Relay with the Cat Service Tool, go through the following menu options:

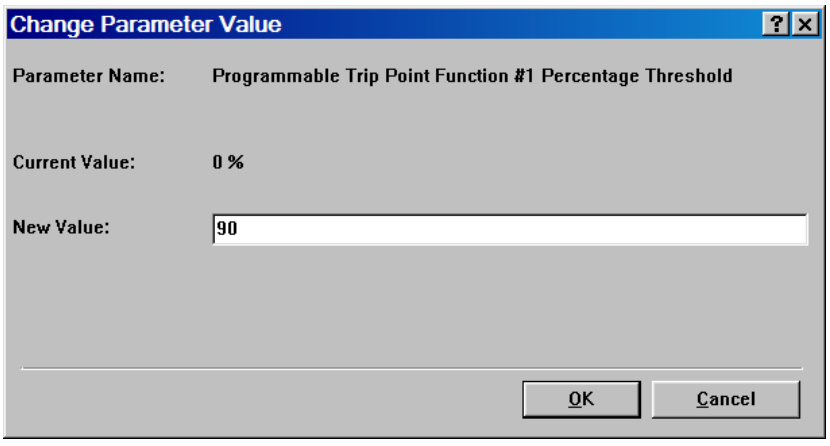
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select kW Relay Setpoints on the left.



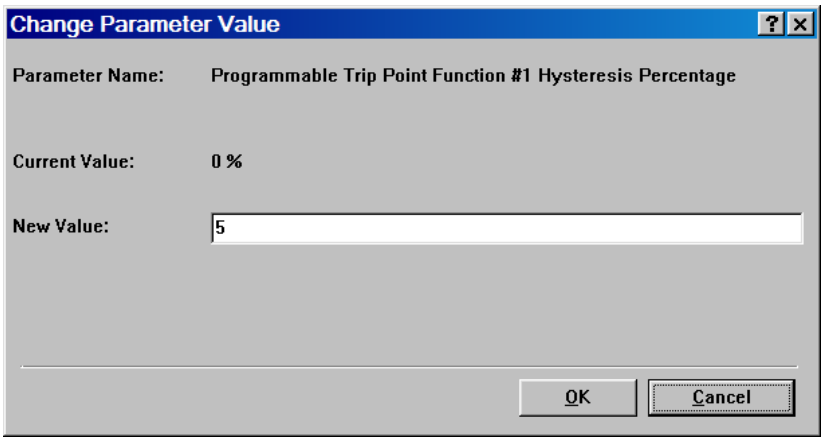
3. Double click the Programmable Trip Point #N Trigger Condition setpoint to change this value from the drop down menu. Click the OK button to program.



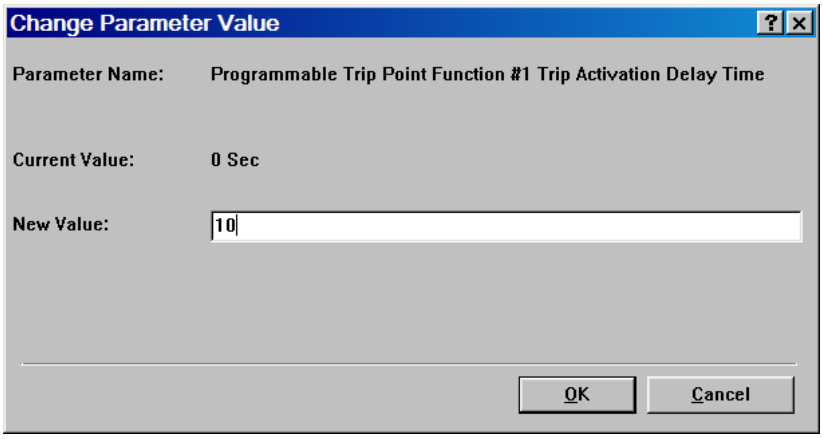
4. Double click the Programmable Trip Point #N Percentage Threshold setpoint to change this value. Click the OK button to program.



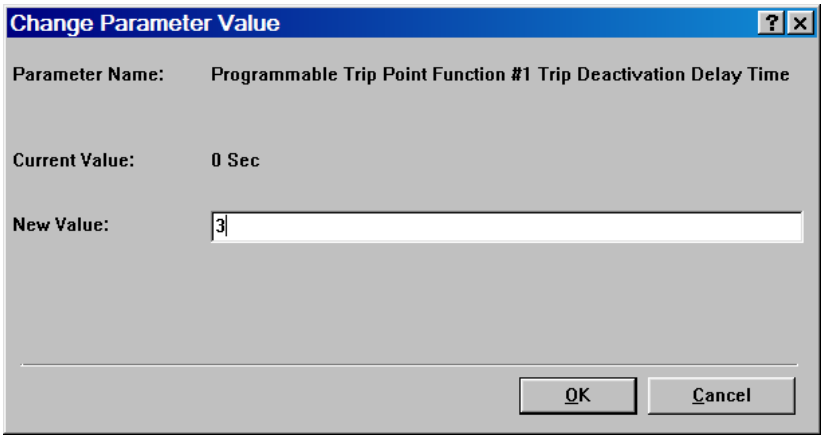
5. Double click the Programmable Trip Point #N Hysteresis Percentage setpoint to change this value. Click the OK button to program.



6. Double click the Programmable Trip Point #N Output #1 Trip Activation Delay Time setpoint to change this value from the drop down menu. Click the OK button to program.



7. Double click the Programmable Trip Point #N Output #2 Trip Activation Delay Time setpoint to change this value from the drop down menu. Click the OK button to program.



8. Repeat the above steps to program an additional timer.

19 CAN DATA LINKS

19.1 PRIMARY CAN DATA LINK (CAN 1)

The Primary CAN Data Link is supported by all levels of the EMCP 4.

The Primary CAN Data Link is used for local communication among modules associated with a single genset. These include one or two engine Electronic Control Modules (ECM), the Cat Digital Voltage Regulator (Cat DVR), a Thermocouple Module, and the Cat Clean Emissions Module System. The EMCP 4 can interface with both EUI and MUI engines; in MUI engines, the engine sensors are wired directly to the EMCP 4.

For the expansion modules, logs are not kept if power is cycled.

PRIMARY CAN WIRING

The Primary CAN communication wires are brought out of the EMCP 4 as part of the 120-pin connector. The pins, as designated on the EMCP 4 connector, are shown in Table 18.

PRIMARY CAN COMMUNICATION WIRES		
Pin #	**Name**	**Description**
43	CAN 1 -	Differential (-) for CAN
30	CAN 1 SH	Shield for CAN
32	CAN 1 +	Differential (+) for CAN

Table 18: Primary CAN Data Link on the 120-pin EMCP 4 connector

NETWORK TOPOLOGY

The physical topology of the CAN network used in the Primary CAN Data Link is a bus topology, consisting of a main trunk and small drops.

- The maximum allowable trunk length is 130 ft (40 m), and the maximum drop length is 3 ft (1 m).
- The CAN network requires a 120 ohm termination resistor on the extreme ends of the main trunk.

An example of the topology for the EMCP 4.3 and 4.4 is illustrated in Figure 52.

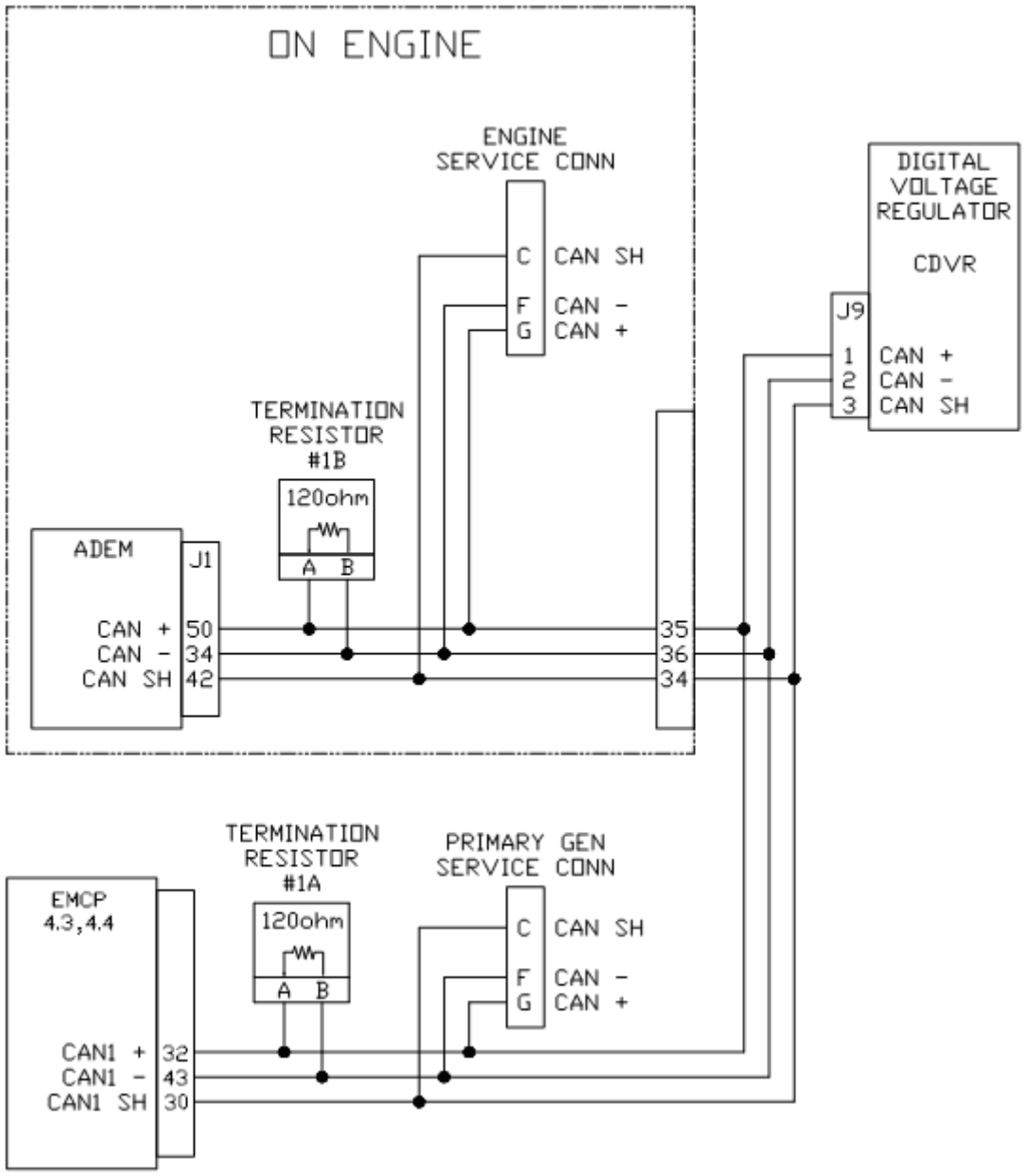


Figure 52: EMCP 4.3 and 4.4 Can 1 Wiring Diagram

19.2 ACCESSORY CAN DATA LINK (CAN 2)

The Accessory CAN Data Link is supported by the EMCP 4.3 and 4.4.

The Accessory Data Link (CAN 2) is used for local or remote communication among modules associated with a single genset. These include a Resistance Temperature Device (RTD) Module, a Thermocouple Module, up to four Digital Input/Output Modules, and up to four Annunciators.

ACCESSORY CAN WIRING

The Accessory CAN communication wires are brought out of the EMCP 4.3 and 4.4 as part of the 120-pin connector. The pins, as designated on the EMCP 4 connector, are shown in Table 19.

ACCESSORY CAN COMMUNICATION WIRES		
Pin #	**Name**	**Description**
42	CAN 2 -	Differential (-) for CAN
41	CAN 2 SH	Shield for CAN
31	CAN 2 +	Differential (+) for CAN

Table 19: Accessory CAN Data Link on the 120-pin EMCP 4 connector

NETWORK TOPOLOGY

The physical topology of the CAN network used in the Accessory CAN Data Link is a bus topology, consisting of a main trunk and small drops.

- The maximum allowable trunk length is 800 ft (250 m), and the maximum drop length is 9 ft (3 m).
- The CAN network requires a 120 ohm termination resistor on the extreme ends of the main trunk.

The topology for the EMCP 4.3 and 4.4 in the default configuration, with no remote devices connected, is illustrated in Figure 52.

The topology for the EMCP 4.3 and 4.4 with some remote devices connected is illustrated in Figure 53.

Note: The devices shown in Figure 53 are only representative; more remote devices can be connected, as long as the proper lengths are maintained, and the termination resistor is placed at the end of the trunk. Refer to Table 18 in Chapter 20 for the maximum number of devices supported on each level.

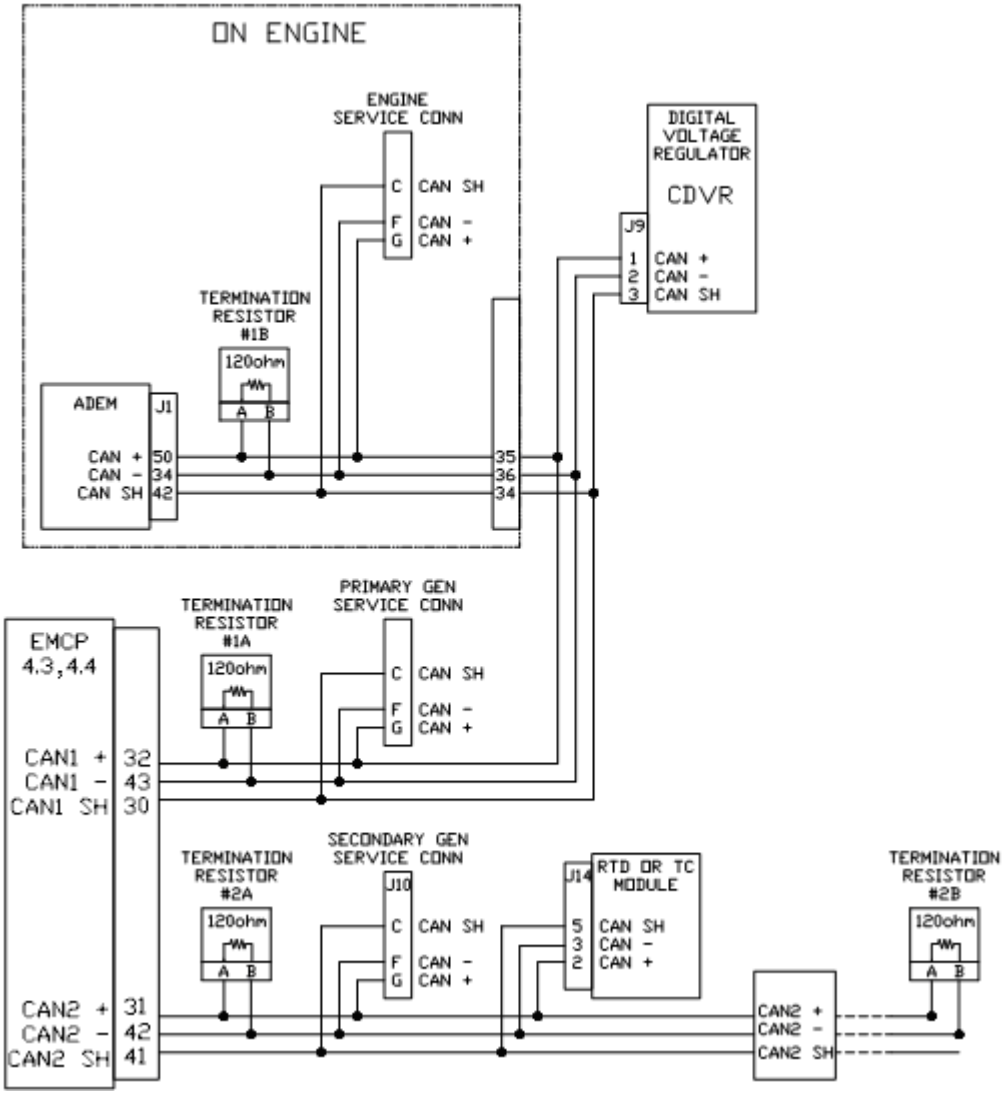


Figure 53: EMCP 4.3 and 4.4 CAN 1 and CAN 2 Wiring Diagram (With Optional Modules)

20 OPTIONAL MODULES

The EMCP 4 consists of the EMCP 4 Genset Controller, as well as some optional auxiliary modules. These modules connect to the EMCP 4 via either the Primary or Accessory CAN data link, or an RS-485 SCADA Data Link (Modbus RTU, Half Duplex). The EMCP 4 can also communicate with a Cat electronic engine controller on the CAN network (though this is not considered an optional module).

Different numbers of modules are supported for different levels of EMCP 4. The numbers of modules supported on the CAN networks are given in Table 20.

MODULE	EMCP 4.3		EMCP 4.4	
	Primary CAN	Accessory CAN	Primary CAN	Accessory CAN
Electronic Engine Controller	1 or 2	0	1 or 2	0
Cat DVR	1	0	1	0
CAN Annunciator	0	4	0	4
Thermocouple	1	1	1	1
RTD	0	1	0	1
DIO	0	4	0	4

Table 20: Number of Optional Modules Supported on CAN Networks

Note: The number of RS-485 Annunciators is only limited by the RS-485 standard.

For more information about connecting modules to the CAN data links, refer to Section 19.2 Accessory CAN Data Link.

THE ANNUNCIATORS

The CAN Annunciator module is an auxiliary alarm indication device, consisting of 16 pairs of indicator LEDs, and an audible horn. Each pair can be individually configured based for an application, and a custom film kit is available to customize the graphic/text indication. For further information see Section 20.1.

The RS-485 Annunciator module is an auxiliary alarm indication device, consisting of 16 pairs of indicator LEDs, and an audible horn. Each annunciator can be mapped to one of four predefined group of alarms (including custom groups) based on application needs. A custom film kit is available to customize the graphic/text indication. For further information see Section 20.2.

THE THERMOCOUPLE, RTD, & DIO

EMCP 4 uses a common form factor for the three modules known as the Thermocouple, RTD (Resistance Temperature Detector) and DIO (Discrete I/O) modules. The same case design is used for all three.

The Thermocouple module, RTD module and DIO module feature identical rugged packaging and Deutsch IPD connectors. The only physical difference in packages between these three optional modules is that the DIO module has an LED to indicate communication network status.

Applications can include networked power generator set control systems.

For further information on the Thermocouple module see Section 20.2, for the RTD module see Section 20.4, and for the DIO module see Section 20.5.

THE CAT DIGITAL VOLTAGE REGULATOR

The Cat Digital Voltage Regulator (Cat DVR) module is an auxiliary voltage regulator device, regulating the generator voltage and engine speed to provide optimal response to various load types and changes in load. It is connected to the generator exciter and field, and communicates with the EMCP 4 for monitoring purposes. For further information see RENR7941 Cat Digital Voltage Regulator.

20.1 CAN ANNUNCIATOR

The EMCP CAN Annunciator serves to display system alarm conditions and status indications. The CAN Annunciator has been designed for use on the EMCP 4 Accessory CAN data link and may be used in either Local or Remote applications, providing customers with enhanced site flexibility.

In Local application, the CAN Annunciator may be mounted on the Package generator set with the EMCP 4 to provide a complete package-mounted monitoring solution.

The CAN Annunciator may also be mounted separately from the generator set to provide Remote indication of system operating and alarm conditions.

A maximum of four CAN Annunciators can be mounted locally or remotely and connected to the Accessory CAN 2 data link.

ANNUNCIATOR FEATURES

The Annunciator includes:

Sixteen (16) LED pairs for annunciation of up to 32 system events

An additional pair of LEDs provides status indication of the CAN data link connection

Can annunciate alarm conditions received from any module on the CAN data link

Alarm Horn with Lamp Test and Alarm Acknowledge pushbuttons

Configurable to NFPA 99/110 requirements for local and remote annunciation on Emergency Standby Generator Systems

Provides a simple means to change the labels for the annunciation LEDs for site specific requirements (Custom Label Kit purchased separately)

Superior visibility of the LEDs in direct sunlight

Graphic symbols along with text labels are provided next to each LED pair to indicate various alarms and events.

Can be Mounted either locally on the package generator set or remotely (up to 800 feet) on the Accessory CAN Data Link.

Designed and tested to meet stringent Impulse Shock and Operating Vibration requirements

288 mm (11.34 in) High x 158 mm (6.22 in) Wide x 66 mm (2.37 in) Deep

ANNUNCIATOR SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Control Power 12 VDC & 24 VDC nominal (9 – 32 VDC acceptable)

Over voltage capability is 80 VDC for 2 minutes @ 70°C

Reverse voltage capability is –32 VDC for 1 hour @ 70°C

Single, 6-pin connector provides both power and communication

Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering (Third party testing is being pursued). UL testing to take place with production units.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature -40 to 70°C

Storage Temperature -50°C to +85°C.

Relative Humidity 90%, non-condensing, 30°C to 60°C.

Failure Point 85°C. If the ambient temperature were to exceed 85°C, the device would **NOT** be expected to return to proper operation.

Can be mounted directly on the generator set panel or remotely

NETWORK COMMUNICATIONS INTERFACE

Incorporates a communications port, able to operate on the EMCP 4 Accessory CAN data link

Node address is auto configurable

Optical isolation is provided for the CAN line

Module operates normally with loss of communication link, retaining configured setpoints in non-volatile memory

Configuration and firmware updates are accomplished with the Cat Service Tool over the CAN 2 network

ANNUNCIATOR WIRING

The back of the CAN Annunciator module contains an 8-terminal screw terminal block. Attached to the block is a 6-pin Deutsch adapter. The pin outs for both are shown in Figure 1 and Table 21.

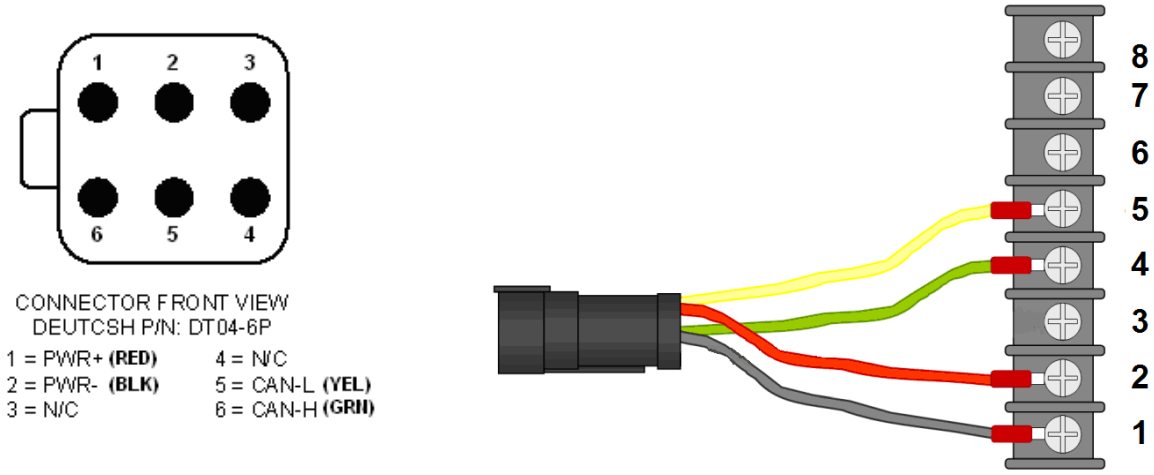


Figure 1: Annunciator Deutsch Connector Pin Configuration and Terminal Block

ANNUNCIATOR TERMINAL BLOCK PIN CONFIGURATION		
Terminal #	**Function**	**Description**
1	PWR-	- Battery Input
2	PWR+	+ Battery Input, connects to Horn(+)
3	N/C	Not Connected
4	CAN2-H	CAN Data Link HI
5	CAN2-L	CAN Data Link LOW
6	Lamp Test	Lamp Test
7	Alarm Ack	Alarm Acknowledge
8	Horn Driver	Connects to negative terminal of Horn

Table 21: Annunciator Terminal Block Pin Configuration

LED COLORS

Each pair of LEDs on the Annunciator consists of two of the following three colors: Green, Amber, and Red, which allows for custom configuration of **STATUS**, **WARNING** and **SHUTDOWN** conditions. The available colors and combinations are listed in Table 22, LED Colors:

LED COLORS					
ROW	**LED 1**	**LED 2**	**ROW**	**LED 1**	**LED 2**
1	Red	Amber	9	Red	Amber
2	Red	Amber	10	Red	Amber
3	Red	Amber	11	Red	Amber
4	Red	Amber	12	Red	Amber
5	Red	Amber	13	Green	Amber
6	Red	Green	14	Green	Amber
7	Red	Amber	15	Red	Green
8	Red	Amber	16	Red	Amber

Table 22: LED Colors

MODULE STATUS LED

A red/green pair located at the bottom of the CAN Annunciator, is used to report Module/Network Status. The various states indicated are explained in Table 23.

BEHAVIOR	EXPLANATION
Red solid	CAN 2 data link diagnostic. For example: the module is wired wrong (Data Link), wrong cable, or no terminating resistor.
Green solid	CAN 2 data link OK
Green flashing	No CAN 2 data link diagnostic, but no communication detected. Hooking the Annunciator up with the power on.
Red/Green alternating	No application software loaded

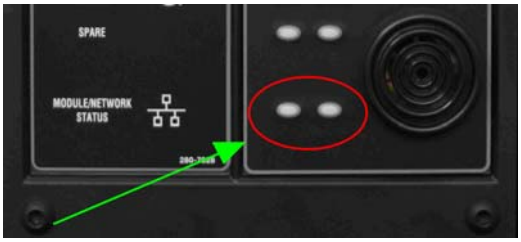


Table 23: CAN Annunciator Module / Network Status LED Behavior

CAN ANNUNCIATOR SOFTWARE CONFIGURATION

The CAN Annunciator is field-programmable using the Cat Service Tool. It is also flash programmable to update software using the Cat Service Tool.

The service tool software must be installed on a Windows PC. The Cat communication adapter must be connected between the PC and the CAN 2 Accessory data link on which the target CAN 2 Annunciator is connected.

GLOBAL ACKNOWLEDGE

The CAN Annunciator can be configured to both initiate and respond to an Event Acknowledge message over the CAN Accessory data link. If this setpoint is enabled, the CAN Annunciator events may be acknowledged locally on the CAN Annunciator by pressing the Alarm Acknowledge button or remotely by pressing the Alarm Acknowledge button on the EMCP 4 or by pressing the Acknowledge button on another CAN Annunciator configured for Global Acknowledge that is on the same data link. Acknowledging events also silences the horn.

The default setting for this setpoint is DISABLED, but it can be enabled from the Configuration tool within Cat Electronic Technician.

ECU INSTANCE NUMBER

The Module Description will also indicate a number that identifies the CAN Annunciator uniquely from any other CAN Annunciator modules on the Accessory CAN data link.

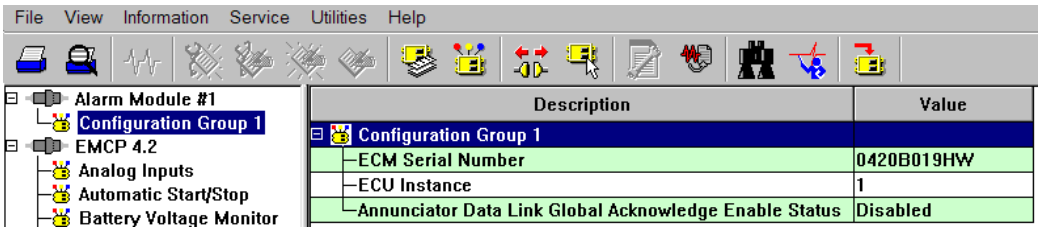
This number is called the **ECU INSTANCE** and it is programmable.

The service tool configuration screen identifies the serial number of the CAN Annunciator that is connected. This is important in matching the desired ECU Instance to the actual hardware.

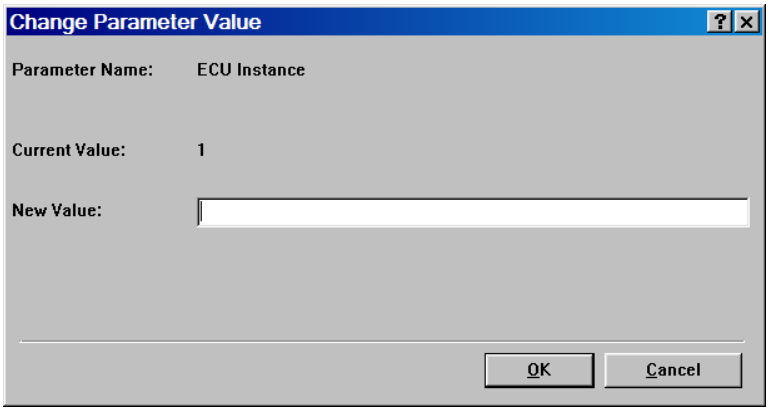
Note: If two CAN Annunciators on the same communications network are programmed for the same ECU Instance number, neither will communicate.

CONFIGURING ANNUNCIATOR LED BEHAVIOR

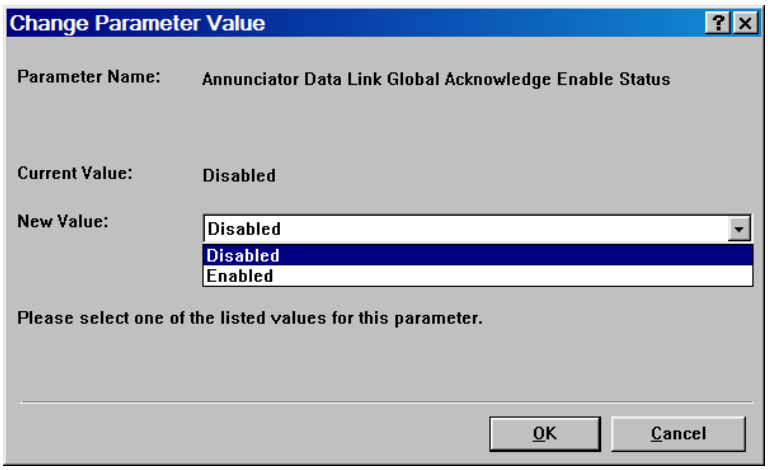
1. Connect to the Annunciator using the Cat Service Tool as stated in Section 4.2.
2. Select Configuration Group #N from the left pane.



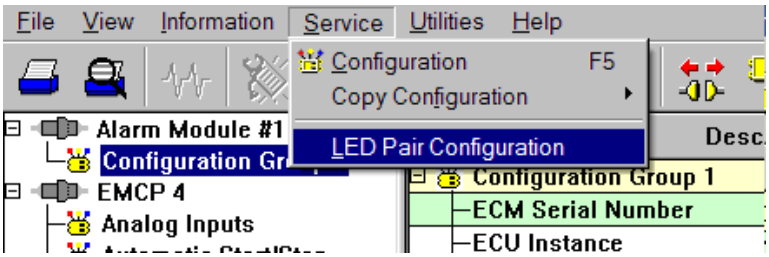
3. Double click ECU Instance Number to enter a new ECU Instance Number.



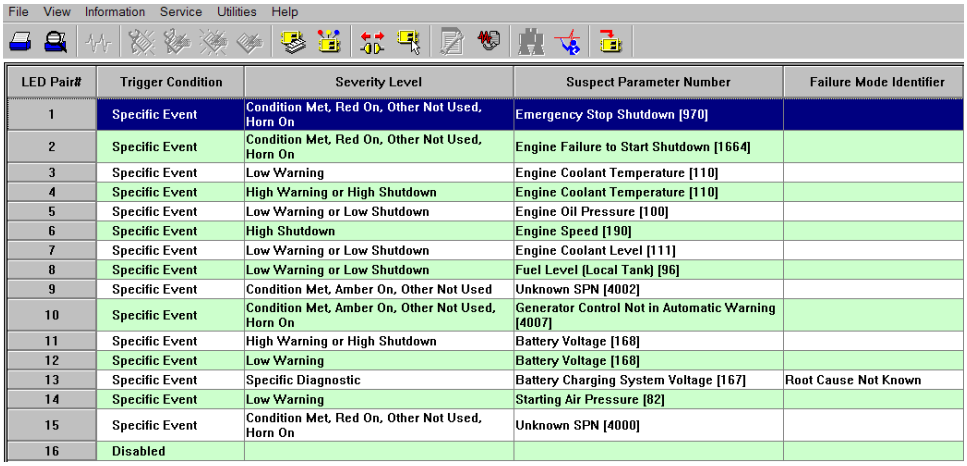
4. Double click Annunciator Data Link Global Acknowledge Enable Status to change this value from the drop down menu.



5. Select Service > LED Pair Configuration.



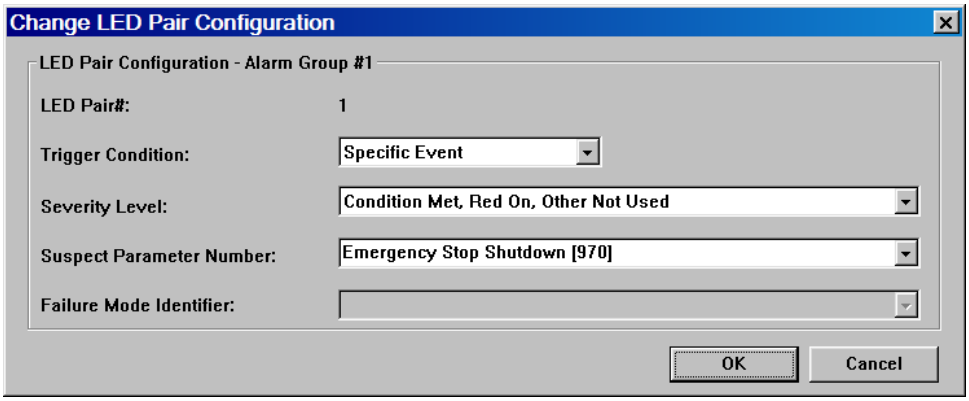
6. The LED pairs will become visible in a new window.



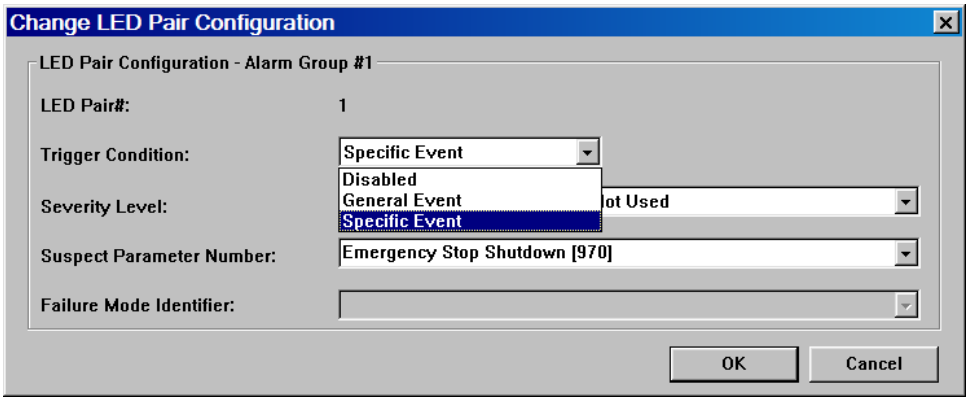
File View Information Service Utilities Help

LED Pair#	Trigger Condition	Severity Level	Suspect Parameter Number	Failure Mode Identifier
1	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Emergency Stop Shutdown [970]	
2	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Engine Failure to Start Shutdown [1664]	
3	Specific Event	Low Warning	Engine Coolant Temperature [110]	
4	Specific Event	High Warning or High Shutdown	Engine Coolant Temperature [110]	
5	Specific Event	Low Warning or Low Shutdown	Engine Oil Pressure [100]	
6	Specific Event	High Shutdown	Engine Speed [190]	
7	Specific Event	Low Warning or Low Shutdown	Engine Coolant Level [111]	
8	Specific Event	Low Warning or Low Shutdown	Fuel Level (Local Tank) [96]	
9	Specific Event	Condition Met, Amber On, Other Not Used	Unknown SPN [4002]	
10	Specific Event	Condition Met, Amber On, Other Not Used, Horn On	Generator Control Not in Automatic Warning [4007]	
11	Specific Event	High Warning or High Shutdown	Battery Voltage [168]	
12	Specific Event	Low Warning	Battery Voltage [168]	
13	Specific Event	Specific Diagnostic	Battery Charging System Voltage [167]	Root Cause Not Known
14	Specific Event	Low Warning	Starting Air Pressure [82]	
15	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Unknown SPN [4000]	
16	Disabled			

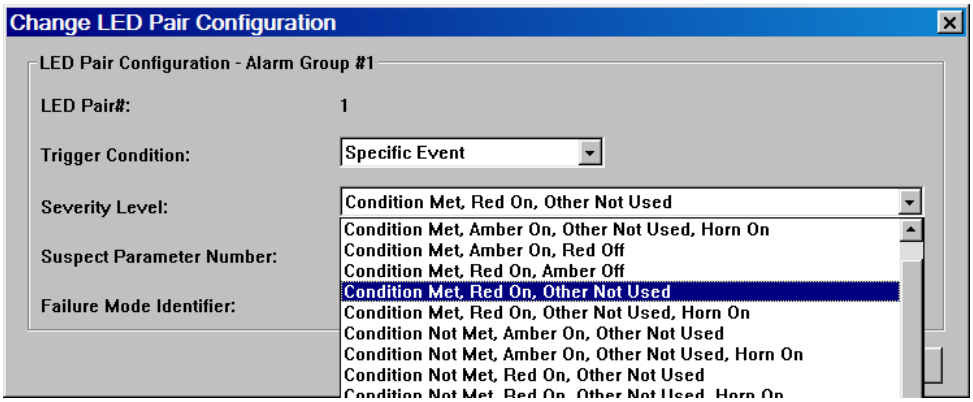
7. Double click on an LED pair to configure the pair.



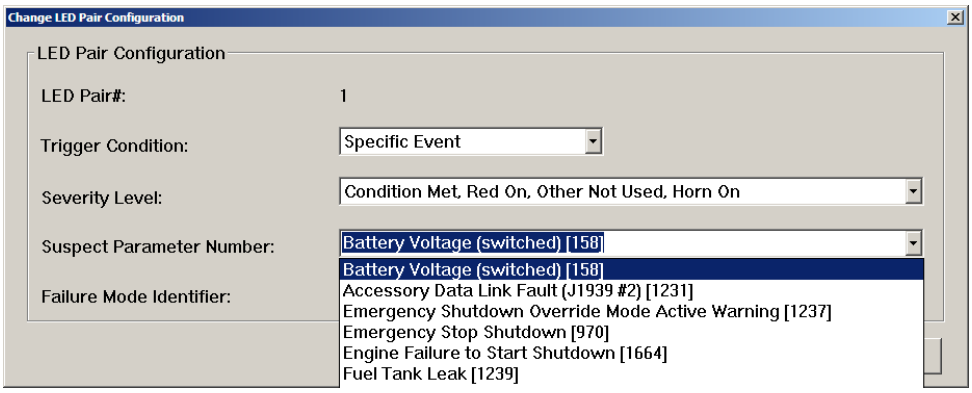
8. Select the Trigger condition for the pair in the drop down menu.



9. Select the Severity Level for the pair in the drop down menu.



10. Select the Suspect Parameter Number for the pair in the drop down menu.



11. The Failure Mode Identifier does not normally need to be programmed since the Severity Level typically has this information embedded.

To configure the behavior of the LED pairs, enter the LED Pair Configuration screen by selecting Service → LED Pair Configuration.

Each LED pair has four parameters associated with it. Each parameter is dependent on the parameter(s) preceding it (to the left); first Trigger Condition, next Severity Level, then Suspect Parameter Number, and finally Failure Mode Identifier (if required).

TRIGGER CONDITION

There are three possible selections for Trigger Condition: **SPECIFIC EVENT**, **GENERAL EVENT**, and **DISABLED**.

SPECIFIC EVENT is used to assign an LED pair to a specific data link parameter, such as Oil Pressure, Engine Speed, Coolant Temperature, etc. The desired parameter must be chosen in the Suspect Parameter Number column.

GENERAL EVENT is used to assign an LED pair as a general alarm or shutdown indicator. When configured as General Event, the LED will not be assigned to a particular parameter. It will respond to any event with a severity level chosen in the Severity Level column, regardless of the Suspect Parameter Number.

For this reason, when General Event is selected, the Suspect Parameter Number cannot be changed.

LED Pair#	Trigger Condition	Severity Level	Suspect Parameter Number	Failure Mode Identifier
1	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Emergency Stop Shutdown [970]	
2	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Engine Failure to Start Shutdown [1664]	
3	Specific Event	Low Warning	Engine Coolant Temperature [110]	
4	Specific Event	High Warning or High Shutdown	Engine Coolant Temperature [110]	
5	Specific Event	Low Warning or Low Shutdown	Engine Oil Pressure [100]	
6	Specific Event	High Shutdown	Engine Speed [190]	
7	Specific Event	Low Warning or Low Shutdown	Engine Coolant Level [111]	
8	Specific Event	Low Warning or Low Shutdown	Fuel Level (Local Tank) [96]	
9	Specific Event	Condition Met, Amber On, Other Not Used	Unknown SPN [4002]	
10	Specific Event	Condition Met, Amber On, Other Not Used, Horn On	Generator Control Not in Automatic Warning [4007]	
11	Specific Event	High Warning or High Shutdown	Battery Voltage [168]	
12	Specific Event	Low Warning	Battery Voltage [168]	
13	Specific Event	Specific Diagnostic	Battery Charging System Voltage [167]	Root Cause Not Known
14	Specific Event	Low Warning	Starting Air Pressure [82]	
15	Specific Event	Condition Met, Red On, Other Not Used, Horn On	Unknown SPN [4000]	
16	Disabled			

Figure 55: Cat Service Tool CAN 2 Annunciator Led Configuration Screen

DISABLED is used to disable the LED pair. When Disabled is selected, the other three parameters cannot be changed.

SEVERITY LEVEL

Severity Level defines which types of events the LED pair will react to. Selections that begin with Condition Exists will respond to CAN Event messages for Failure Mode Identifier (FMI) 31 Condition Exists.

For example, LED pair #2 is configured for Condition Exists, Red On, Other Not Used, Horn On with SPN 190 (Emergency Stop Active). This means that when the Annunciator received a CAN message indicating Emergency Stop with FMI 31, the Red LED will turn on and the Horn will also turn on.

Other Not Used indicates that the other LED color in the pair is never used.

Green Off (for example) indicates that the green LED lights when the condition chosen for this LED pair is NOT active.

Most Severity Level selections imply (a) CAN Failure Mode Identifier (FMI) code(s):

CONDITION EXISTS is equivalent to FMI 31

HIGH WARNING can be FMI 15 or FMI 16

LOW WARNING can be FMI 17 or FMI 18

HIGH SHUTDOWN is equivalent to FMI 0

LOW SHUTDOWN is equivalent to FMI 1

HIGH OR LOW SHUTDOWN is equivalent to FMI 0 or FMI 1

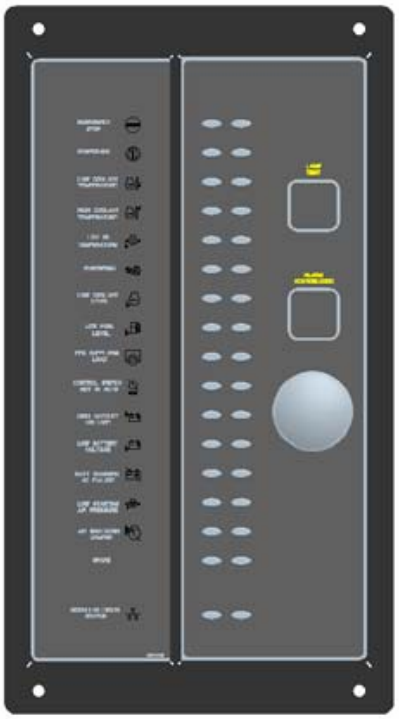
Since the FMI codes are implied by this column, the FMI column is grayed out for any of these selections.

The only option that will allow an FMI to be configured is **SPECIFIC DIAGNOSTIC**.

SUSPECT PARAMETER NUMBER

The Suspect Parameter Number column is used to select or type in the SPN for the parameter assigned to the LED pair. Most supported SPNs can be selected from the list. Refer to the UENR1210 Systems Operation Testing and Adjusting Manual for a complete list of supported SPNs.

20.2 RS-485 ANNUNCIATOR



The EMCP RS-485 Annunciator serves to display system alarm conditions and status indications. The RS-485 Annunciator has been designed for use on a dedicated EMCP 4 fully isolated two wire RS-485 SCADA Data Link (Half Duplex), and may be used in either Local or Remote applications, providing customers with enhanced site flexibility. The RS-485 Annunciator uses a custom master-slave communication protocol. The EMCP 4.2 controller will be the Master, and the RS-485 Annunciator(s) will be the slave(s). Configuration takes place within the EMCP 4.

In Local application, the RS-485 Annunciator may be mounted on the Package generator set with the EMCP 4 to provide a complete package-mounted monitoring solution.

The RS-485 Annunciator may also be mounted separately from the generator set to provide Remote indication of system operating and alarm conditions.

The number of RS-485 Annunciators is limited by the RS-485 standard.

ANNUNCIATOR FEATURES

The Annunciator includes:

Sixteen (16) LED pairs for annunciation of up to 32 system events

An additional pair of LEDs provides status indication of the dedicated RS-485 Annunciator Network communication connection

Ability to annunciate alarm conditions sent from the EMCP 4 within preconfigured alarm groups

Alarm Horn with Lamp Test and Alarm Acknowledge pushbuttons

Configurable to NFPA 99/110 requirements for local and remote annunciation on Emergency Standby Generator Systems

Provides a simple means to change the labels for the annunciation LEDs for site specific requirements (Custom Label provided with Custom Alarm Group #1 and #2 RS-485 Annunciator)

Superior visibility of the LEDs in direct sunlight

Graphic symbols along with text labels are provided next to each LED pair to indicate various alarms and events.

Configurable with Cat ET via settings within the EMCP 4

Can be mounted either locally on the package generator set or remotely (up to 4000 feet)

Designed and tested to meet stringent Impulse Shock and Operating Vibration requirements

286 mm (11.26 in) High x 157 mm (6.18 in) Wide x 68 mm (2.67 in) Deep

ANNUNCIATOR SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Control Power 12 VDC & 24 VDC nominal (9 – 32 VDC acceptable)

Reverse voltage capability is -32 VDC for 1 hour @ 70°C

Over voltage capability is 80 VDC for 2 minutes @ 70°C

Single, 8-pin connector provides both power and communication

Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature -40 to 70°C

Storage Temperature -50°C to +85°C.

Relative Humidity 90%, non-condensing, 30°C to 60°C.

Failure Point 85°C. If the ambient temperature were to exceed 85°C, the device would **NOT** be expected to return to proper operation.

Can be mounted directly on the generator set panel or remotely

NETWORK COMMUNICATIONS INTERFACE

EMCP 4 provides a dedicated, fully isolated RS-485 SCADA Data Link (Modbus RTU, Half Duplex) separate from the MODBUS port used on the EMCP 4

Operates at 19200 bits per second

Configuration is accomplished with the Cat Service Tool by connecting to the EMCP 4

RS-485 ANNUNCIATOR WIRING

The back of the RS-485 Annunciator module contains an 8-terminal screw terminal block. Attached to the block is an 8-pin Deutsch receptacle, Cat part number 3E-3388 (Deutsch DT04-08PA-E005). The mating plug is Cat part number 155-2264 (Deutsch DT06-08SA-EP08, or equivalent). The pin outs for both the receptacle and terminal block are shown in Figure 56 and Table 24 and 25.

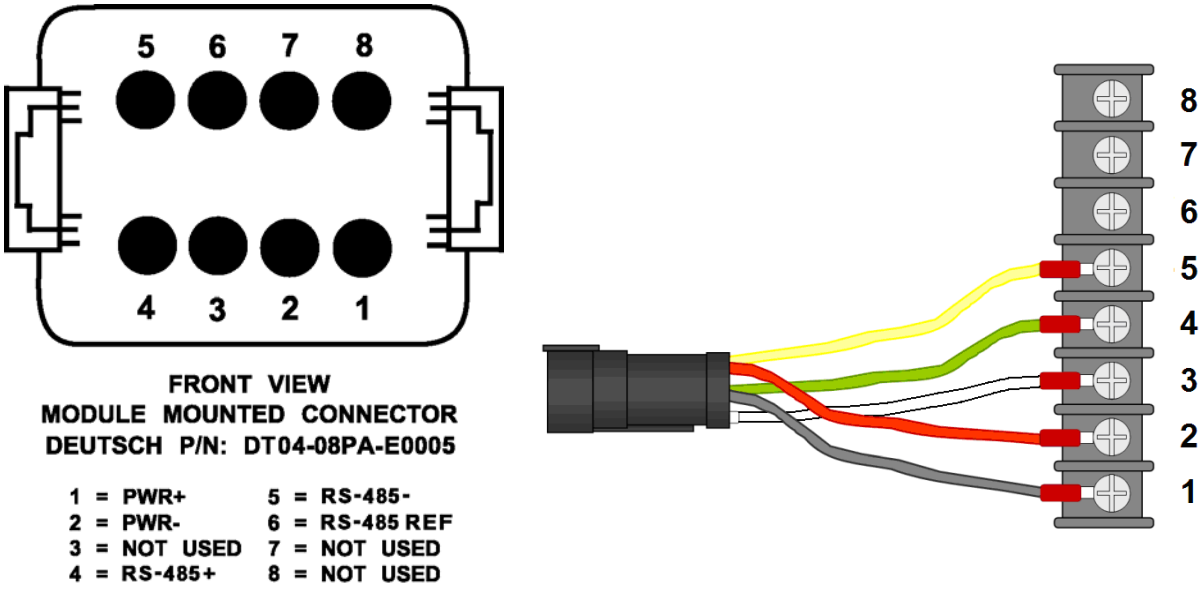


Figure 56: RS-485 Annunciator Deutsch Connector Pin Configuration and Terminal Block

RS-485 ANNUNCIATOR DEUTSCH CONNECTOR PIN CONFIGURATION		
Pin #	**Function**	**Comments**
1	BATT +	+ Battery input
2	BATT -	- Battery input
3	NA	NA
4	RS-485 B (+)	+ Non-Inverting Positive RS-485 input signal
5	RS-485 A (-)	- Inverting Negative RS-485 input signal
6	RS-485 R	RS-485 Reference
7	NA	NA
8	NA	NA

Table 24: RS-485 Annunciator Deutsch Connector Pin Configuration

RS-485 ANNUNCIATOR TERMINAL BLOCK PIN CONFIGURATION		
Terminal #	**Function**	**Description**
1	BATT -	- Battery input
2	BATT +	+ Battery input
3	RS-485 R	RS-485 Reference
4	RS-485 B (+)	+ Non-Inverting Positive RS-485 input signal
5	RS-485 A (-)	- Inverting Negative RS-485 input signal
6	Lamp Test SW	Lamp Test
7	Alarm ACK	Alarm Acknowledge
8	Horn Drive	Conects to negative terminal on Horn

Table 25: RS-485 Annunciator Terminal Block Pin Configuration

LED COLORS

Each pair of LEDs on the RS-485 Annunciator consists of two of the following three colors: Green, Amber, and Red, which allows for custom configuration of **STATUS**, **WARNING** and **SHUTDOWN** conditions. The available colors and combinations are listed in Table 26, LED Colors:

LED COLORS					
ROW	**LED 1**	**LED 2**	**ROW**	**LED 1**	**LED 2**
1	Red	Amber	9	Red	Amber
2	Red	Amber	10	Red	Amber
3	Red	Amber	11	Red	Amber
4	Red	Amber	12	Red	Amber
5	Red	Amber	13	Green	Amber
6	Red	Green	14	Green	Amber
7	Red	Amber	15	Red	Green
8	Red	Amber	16	Red	Amber

Table 26: LED Colors

MODULE STATUS LED

A red/green pair located at the bottom of the RS-485 Annunciator, is used to report Module/Network Status. The various states indicated are explained in Table 27.

BEHAVIOR	EXPLANATION
Red solid	Data Link diagnostic. For example: the module is wired wrong (Data Link), or no terminating resistor.
Green solid	Data is being received from the EMCP 4
Green flashing	Loss of communication
Red/Green flashing	No application software loaded, or Alarm Group Selection Mode is active

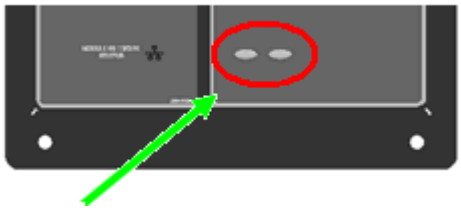


Table 27: Annunciator Module / Network Status LED Behavior

LAMP TEST FUNCTION

The Annunciator supports a lamp test function from a button press on the EMCP 4.

The lamp test function cycles continuously through two test modes while pressing and holding in the Lamp Test button. The first mode is a column test mode. The left column of LED's will be lit for one second while the right column is off. Then the right column of LED's will be lit for one second, while the left column is off. This will occur twice. During the second run of this test mode (during the first cycle only), the horn will be on.

The second test mode is an individual LED test mode. In this mode, the LED's will light one at a time, starting from the top left LED, down to the left hand module status LED, then over to the right hand module status LED, then up to the top right LED. Each LED will be lit for ½ second, after which it will turn off and the next LED will be lit. At the

completion of this test mode, the cycle will restart with the first test mode. However, on subsequent runs of the first test mode, the horn will not turn on.

The RS-485 Annunciator returns to normal operation once the lamp test button is released.

ALARM ACKNOWLEDGE

The RS-485 Annunciator supports an acknowledge event/silence horn function from a button press on the RS-485 Annunciator or from the EMCP 4. Both cases have different behavior and are outlined below.

When an active event is received from the EMCP 4 and is acknowledged locally with a button press on the RS-485 Annunciator module, any flashing LED tied to that event will stop flashing and maintain a steady illumination and the horn will be silenced.

Note: Only the local RS-485 Annunciator module that acknowledges the active event will change the state of its flashing LED(s) and silence the horn. The acknowledge signal of the annunciation is not broadcast to any other units on the RS-485 Annunciator Data Link.

When an active event is received from the EMCP 4 and is acknowledged globally with a button press on the EMCP 4 controller, it is transmitted to the RS-485 Annunciator(s) module(s). Any flashing LED tied to that event will stop flashing and maintain a steady illumination and the horn will be silenced.

Note: In this case, the EMCP 4 may acknowledge active events on multiple RS-485 Annunciators simultaneously.

The horn silence / acknowledge function will cause the local horn to be silenced until another event causes an LED to be activated.

RS-485 ANNUNCIATOR ALARM GROUPS

The RS-485 Annunciator supports four different Alarm Groups. Alarm Group 01, 02, 03, and Alarm Group 04. Two of these Alarm Groups, 03 and 04, are fixed and are not configurable and two Alarm Groups, 01 and 02, are reserved for custom event settings and are fully configurable.

Selecting which of the four Alarm Groups to configure the RS-485 Annunciator is determined by the film that is placed on the front left panel. The Alarm Groups and the events that make up the films for each of the Alarm Groups are detailed below in Tables 31 to 33. Configuring the RS-485 Annunciator to one of the four Alarm Groups is accomplished through the front panel of the RS-485 Annunciator and is described further in Alarm Group Selection Mode below.

ALARM GROUP SELECTION MODE (AGSM)

The RS-485 Annunciator supports an Alarm Group Selection Mode (AGSM) that provides the ability to configure the RS-485 Annunciator to monitor a predetermined set of 32 events communicated by the EMCP 4 through the dedicated RS-485 Annunciator Data Link.

Alarm Group selection and assignment are determined by the desired functions of the RS-485 Annunciator (Custom or non-configurable) and the film that is placed on the front left panel that reflects the predefined events monitored by the RS-485 Annunciator.

When in AGSM, the top first four rows of LED's will indicate which Alarm Group the RS-485 Annunciator has been assigned to by powering 'on' both LED's in each row, i.e. row 1 for Alarm Group 01, row 2 for Alarm Group 02, row 3 for Alarm Group 03, and row 4 for Alarm Group 04. (Note: The RS-485 Annunciator will be preprogrammed to Alarm Group 04.)

The RS-485 Annunciator will continue to communicate to the EMCP 4 while in AGSM. Events received from the EMCP 4 while in AGSM will not be annunciated until AGSM has been exited only if the event that is received is an event in the selected Alarm Group.

Once the RS-485 Annunciator has successfully been assigned to an Alarm Group, it shall receive and process any Event transmitted from the EMCP 4 to the assigned Alarm Group without power cycling the module.

The Network Status LED's will alternate flashing at a 2Hz rate at all times while in AGSM.

ENTERING AGSM

The RS-485 Annunciator shall enter AGSM by depressing the two buttons on the front panel of the RS-485 Annunciator (Lamp Test and Alarm ACK) for 3 seconds. The RS-485 Annunciator shall acknowledge entrance of AGSM by flashing the top 4 rows of LED's 4 times at a 1 second rate.

After the 3 second period has timed out, the row representing the currently assigned alarm group address will be powered on, the remaining 11 rows of LED's will not be powered on. See Table 28 AGSM LED Behavior.

Row	Column 1	Column 2
1	Solid if Assigned to Alarm Group 01, else off	Solid if Selected to Alarm Group 01, else off
2	Solid if Assigned to Alarm Group 02, else off	Solid if Selected to Alarm Group 02, else off
3	Solid if Assigned to Alarm Group 03, else off	Solid if Selected to Alarm Group 03, else off
4	Solid if Assigned to Alarm Group 04, else off	Solid if Selected to Alarm Group 04, else off
5	Off	Off
6	Off	Off
7	Off	Off
8	Off	Off
9	Off	Off
10	Off	Off
11	Off	Off
12	Off	Off
13	Off	Off
14	Off	Off
15	Off	Off
16	Off	Off

Table 28: AGSM LED Behavior

RE-CONFIGURING/SELECTING ALARM GROUP ADDRESS

While the RS-485 Annunciator is still in AGSM it will cycle through the four Alarm Groups by pressing one of the two buttons on the front panel. Pressing the Lamp Test button will cycle up through the 4 Alarm Groups and pressing the Alarm ACK button will cycle down through the 4 Alarm Groups.

Upon reaching Alarm Group 04 (row 4) while cycling down through the Alarm Groups with the Alarm ACK button, an additional Alarm ACK button press will bring the selection to Alarm Group 01 (row 1). Upon reaching the Alarm Group 01 (row 1) while cycling up through the Alarm Groups with the Lamp Test button, an additional Lamp Test button press will bring the selection to Alarm Group 04 (row 4).

When selecting a new Alarm Group address, the left column (red LED) will represent the previously configured Alarm Group selection. The right column (amber LED) will represent the currently selected Alarm Group. When AGSM is exited, the currently selected register address will be configured as the new Alarm Group.

EXITING AGSM

The Annunciator will exit AGSM under two possible conditions:

• A time out period without any button presses

• Pressing and holding the two buttons (ACK and Horn buttons) for 3 seconds

After a period of 15 seconds without any button presses, the RS-485 Annunciator will automatically exit AGSM and disregard any changes made to the Alarm Group selection and remain configured to the Alarm Group prior to entering AGSM.

When an Alarm Group selection has been made and the two buttons are pressed (Lamp Test and Alarm ACK) and held in continuously for 3 seconds, the RS-485 Annunciator will update the current configured Alarm Group to the current selected Alarm Group and then exit AGSM.

After exiting AGSM under either one of the two exit conditions listed, the RS-485 Annunciator will flash all 16 rows of LED’s for 3 seconds at which time the RS-485 Annunciator will enter regular annunciation mode.

RS-485 ANNUNCIATOR CUSTOM ALARM GROUP CONFIGURATION

The RS-485 Annunciator is field-programmable by the EMCP 4 via the Cat Service Tool when configured for Alarm Group’s 01 and 02. Alarm Group’s 01 and 02 support customization of the 32 events for the 16 LED’s.

The service tool software must be installed on a Windows PC. The Cat communication adapter must be connected between the PC and the CAN Primary data link on which the target EMCP 4 is connected.

CUSTOM ALARM GROUP SELECTION

When the Cat Service Tool is communicating, the EMCP 4 shall be selected as the target module. Located at the top of the Cat Service Tool screen is the tool bar, select Service → RS-485 Annunciator. The RS-485 Annunciator configuration screen will be displayed with the Alarm Group Select at the top left of the screen. There are two possible selections for Alarm Groups: #1 and #2.

To configure the RS-485 Annunciator LED's, select each of the LED's individually. With the selected LED window displayed the initial selection is for Trigger Condition. There are three possible selections for Trigger Condition: **SPECIFIC EVENT**, **GENERAL EVENT**, and **Disabled**.

SPECIFIC EVENT is used to assign an LED pair to a specific data link parameter, such as Oil Pressure, Engine Speed, Coolant Temperature, etc. The desired parameter must be chosen in the Suspect Parameter Number column.

GENERAL EVENT is used to assign an LED pair as a general alarm or shutdown indicator. When configured as General Event, the LED will not be assigned to a particular parameter. It will respond to any event with a severity level chosen in the Severity Level column, regardless of the Suspect Parameter Number.

For this reason, when General Event is selected, the Suspect Parameter Number cannot be changed.

DISABLED is used to disable the LED pair. When Disabled option is selected, the other three parameters cannot be changed.

SEVERITY LEVEL

Severity Level defines which types of events the LED pair will react to. Selections that begin with Condition Exists will respond to CAN Event messages for Failure Mode Identifier (FMI) 31 Condition Exists.

For example, LED pair #1 is configured for Condition Exists, Red On, Other Not Used, Horn On with SPN 190 (Emergency Stop Active). This means that when the RS-485 Annunciator receives a data from the EMCP 4 over the RS-485 Annunciator Data Link indicating Emergency Stop with FMI 31, the Red LED will turn on and the Horn will also turn on.

> Other Not Used indicates that the other LED color in the pair is never used.
>
> Green Off (for example) indicates that the green LED lights when the condition chosen for this LED pair is NOT active.

Most Severity Level selections imply (a) Failure Mode Identifier (FMI) code(s):

> **CONDITION EXISTS** is equivalent to FMI 31
>
> **HIGH WARNING** can be FMI 15 or FMI 16
>
> **LOW WARNING** can be FMI 17 or FMI 18
>
> **HIGH SHUTDOWN** is equivalent to FMI 0
>
> **LOW SHUTDOWN** is equivalent to FMI 1
>
> **HIGH OR LOW SHUTDOWN** is equivalent to FMI 0 or FMI 1

Since the FMI codes are implied by the choice made in the Severity Level column, the FMI column is grayed out for any of these selections.

The only option that will allow a specific FMI to be configured is **SPECIFIC DIAGNOSTIC**.

SUSPECT PARAMETER NUMBER

The Suspect Parameter Number column is used to select one of the listed SPN's in the drop down menu or type in a specific SPN number for an SPN that may not be listed in the drop down menu for the parameter assigned to the LED pair. Most supported SPNs can be selected from the list.

ENGINE RUNNING

When configuring the RS-485 Annunciator for ENGINE RUNNING, special consideration must be taken to trigger the event. The SPN shall be configured for Auxiliary I/O #1 (SPN 701) and it shall have a Severity Level configured for any one of the Condition Met setpoints. Digital Input #1 shall be physically wired to the active status signal that is to be used to trigger this programmed LED. If it is only to be based upon the status of the generator set controlled by the EMCP, then an output such as Relay Output #2, Fuel Control Relay, or Engine Start Initiated for Common Engine Interface generator sets on the EMCP 4 can be used. The Fuel Control Relay or Engine Start Initiated active status signal is continually active only while the engine is in running.

Alarm Group #3 has LED #15 pre-configured for Auxiliary I/O #1 and requires the actions above to trigger an Engine Running event on the RS-485 Annunciator.

ALARM GROUPS

The RS-485 Annunciator is capable of being configured for one of four Alarm Groups. Two of these Alarm Groups are fixed, two are configurable. Selection of the Alarm Group to be used is accomplished by using the front panel of the RS-485 Annunciator module as explained above in Alarm Group Selection Mode (AGSM).

The assignment of films for each of the Alarm Groups is outlined below:
Alarm Group # 1 (Custom Configurable 1) - Film #1 (see Table 29) and custom film
Alarm Group # 2 (Custom Configurable 2) - Film #1 (see Table 29) and custom film
Alarm Group # 3 (Fixed) - Film #1 (see Table 29)
Alarm Group # 4 (Fixed) - Film #2, or Film #3 (see Tables 30 and 31)

Note: Alarm Groups #1 and #2 are blank until configured.

Row	LED Colors	Default LED and Setpoint Assignments	Horn
1	Red	E-Stop Shutdown	Y
	Amber	Not Used	NA
2	Red	Overcrank	Y
	Amber	Not Used	NA
3	Red	High Coolant Temp Shutdown	Y
	Amber	High Coolant Temp Warning	Y
4	Red	Not Used	NA
	Amber	Low Coolant Temp Warning	Y
5	Red	Low Oil Pressure Shutdown	Y
	Amber	Low Oil Pressure Warning	Y
6	Red	Overspeed Shutdown	Y
	Green	Not Used	NA
7	Red	Low Coolant Level Shutdown	Y
	Amber	Low Coolant Level Warning	Y
8	Red	Low Fuel Level Shutdown	Y
	Amber	Low Fuel Level Warning	Y
9	Red	Not Used	NA
	Amber	Generator Not in Auto Warning	Y
10	Red	High Battery Voltage Shutdown	Y
	Amber	High Battery Shutdown Warning	Y
11	Red	Not Used	NA
	Amber	Low Battery Voltage Warning	Y
12	Red	Not Used	NA
	Amber	Low Cranking Voltage Warning	Y
13	Green	Not Used	NA
	Amber	Battery Charger AC Failure	Y
14	Green	Not Used	NA
	Amber	EPS Supplying Load	N
15	Red	Not Used	NA
	Green	Engine Running	N
16	Red	SCR – Tier 4	Y
	Amber	SCR – Tier 4	Y

Table 29: Film #1. Alarm Group 01 & 02 default film and Alarm Group 03 film assignments. NFPA 99/110 events. Includes Fuel Level, Engine Running, and Tier 4 SCR events

Row	LED Colors	Default LED and Setpoint Assignments	Horn
1	Red	E-Stop Shutdown	Y
	Amber	Not Used	NA
2	Red	Overcrank	Y
	Amber	Not Used	NA
3	Red	High Coolant Temp Shutdown	Y
	Amber	High Coolant Temp Warning	Y
4	Red	Not Used	NA
	Amber	Low Coolant Temp Warning	Y
5	Red	Low Oil Pressure Shutdown	Y
	Amber	Low Oil Pressure Warning	Y
6	Red	Overspeed Shutdown	Y
	Green	Not Used	NA
7	Red	Low Coolant Level Shutdown	Y
	Amber	Low Coolant Level Warning	Y
8	Red	Low Fuel Level Shutdown	Y
	Amber	Low Fuel Level Warning	Y
9	Red	Not Used	NA
	Amber	Generator Not in Auto Warning	Y
10	Red	High Battery Voltage Shutdown	Y
	Amber	High Battery Shutdown Warning	Y
11	Red	Not Used	NA
	Amber	Low Battery Voltage Warning	Y
12	Red	Not Used	NA
	Amber	Low Cranking Voltage Warning	Y
13	Green	Not Used	NA
	Amber	Battery Charger AC Failure	Y
14	Green	Not Used	NA
	Amber	EPS Supplying Load	N
15	Red	Air Damper Shutdown	Y
	Green	Not Used	NA
16	Red	SCR – Tier 4	Y
	Amber	SCR – Tier 4	Y

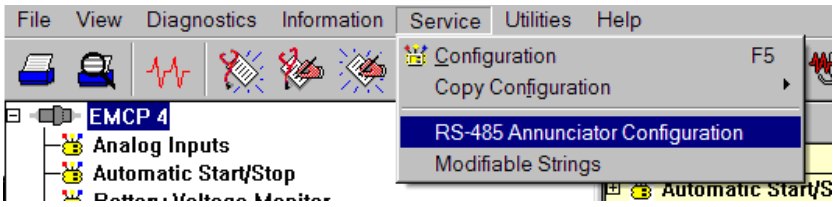
Table 30: Film #2. Alarm Group 04. NFPA 99/110 events. Includes Fuel Level, Air Damper Shutdown, and Tier4 SCR events.

Row	LED Colors	Default LED and Setpoint Assignments	Horn
1	Red	E-Stop Shutdown	Y
	Amber	Not Used	NA
2	Red	Overcrank	Y
	Amber	Not Used	NA
3	Red	High Coolant Temp Shutdown	Y
	Amber	High Coolant Temp Warning	Y
4	Red	Not Used	NA
	Amber	Low Coolant Temp Warning	Y
5	Red	Low Oil Pressure Shutdown	Y
	Amber	Low Oil Pressure Warning	Y
6	Red	Overspeed Shutdown	Y
	Green	Not Used	NA
7	Red	Low Coolant Level Shutdown	Y
	Amber	Low Coolant Level Warning	Y
8	Red	Low Fuel Level Shutdown	Y
	Amber	Low Fuel Level Warning	Y
9	Red	Not Used	NA
	Amber	Generator Not in Auto Warning	Y
10	Red	High Battery Voltage Shutdown	Y
	Amber	High Battery Shutdown Warning	Y
11	Red	Not Used	NA
	Amber	Low Battery Voltage Warning	Y
12	Red	Not Used	NA
	Amber	Low Cranking Voltage Warning	Y
13	Green	Not Used	NA
	Amber	Battery Charger AC Failure	Y
14	Green	Not Used	NA
	Amber	EPS Supplying Load	N
15	Red	Air Damper Shutdown	Y
	Green	Not Used	NA
16	Red	Not Used	NA
	Amber	Not Used	NA

Table 31: Film #3. Alarm Group 04 film assignments. NFPA 99/110 events. Includes Fuel Level and Air Damper Shutdown. Does not include Tier 4 SCR

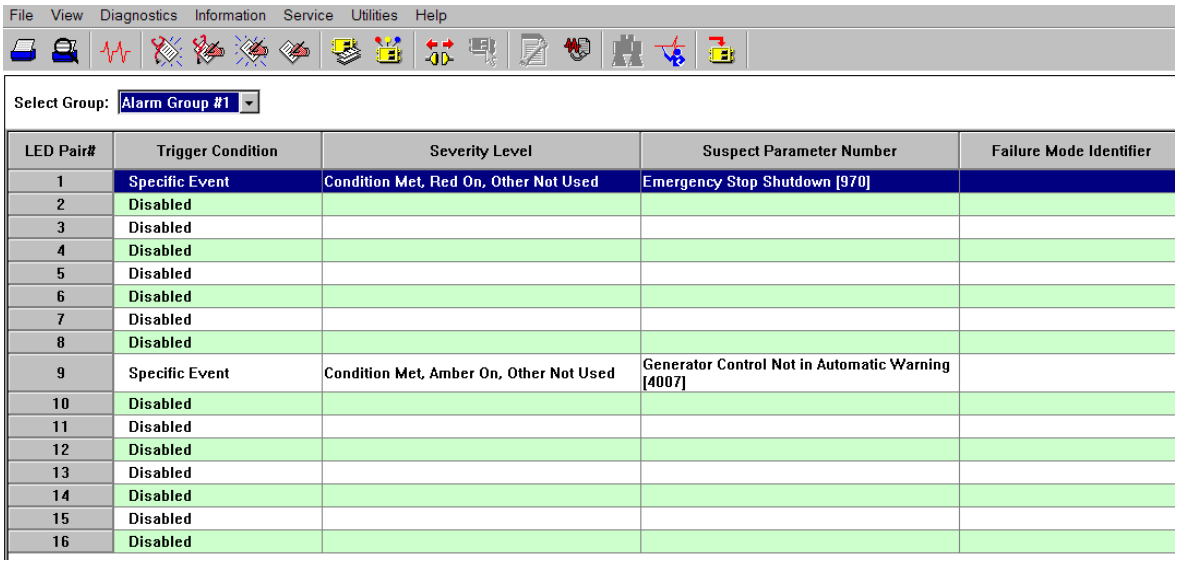
CONFIGURING CUSTOM ALARM GROUPS USING CAT SERVICE TOOL

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select Service > RS-485 Annunciator Configuration.



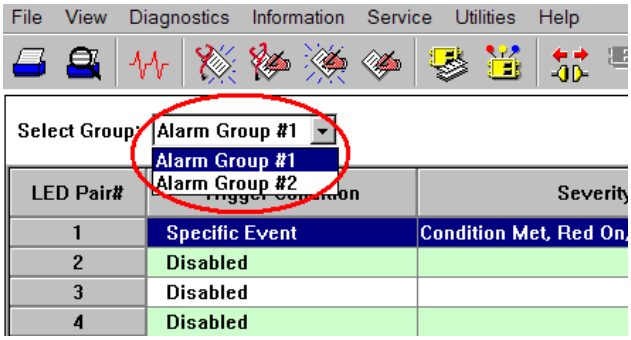
Note: This option will not appear if the EMCP 4 was not selected in the ECM Summary Screen when connecting to Cat ET.

3. The LED pairs will become visible in a new window.

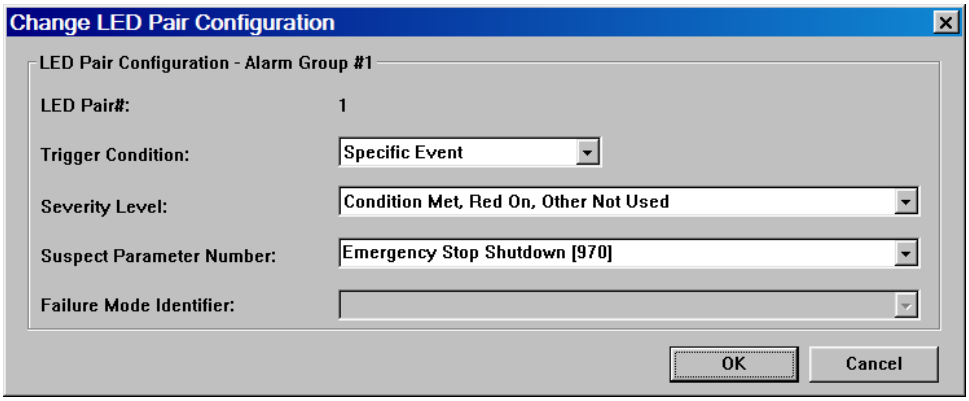


LED Pair#	Trigger Condition	Severity Level	Suspect Parameter Number	Failure Mode Identifier
1	Specific Event	Condition Met, Red On, Other Not Used	Emergency Stop Shutdown [970]	
2	Disabled			
3	Disabled			
4	Disabled			
5	Disabled			
6	Disabled			
7	Disabled			
8	Disabled			
9	Specific Event	Condition Met, Amber On, Other Not Used	Generator Control Not in Automatic Warning [4007]	
10	Disabled			
11	Disabled			
12	Disabled			
13	Disabled			
14	Disabled			
15	Disabled			
16	Disabled			

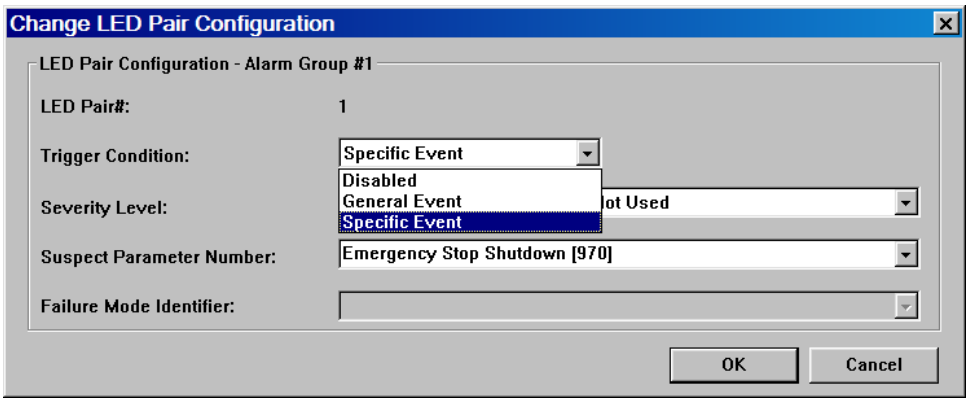
4. Select the Alarm Group for the Annunciator by choosing from the drop down menu.



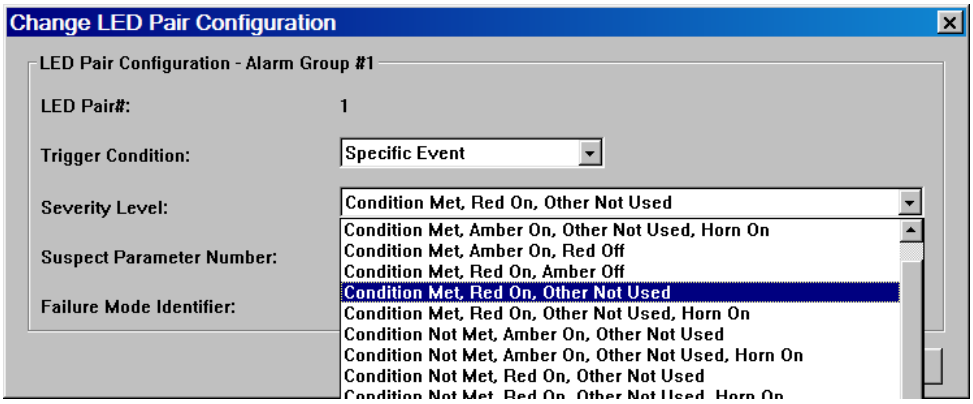
5. Double click on an LED pair to configure the pair.



6. Select the Trigger condition for the pair in the drop down menu.

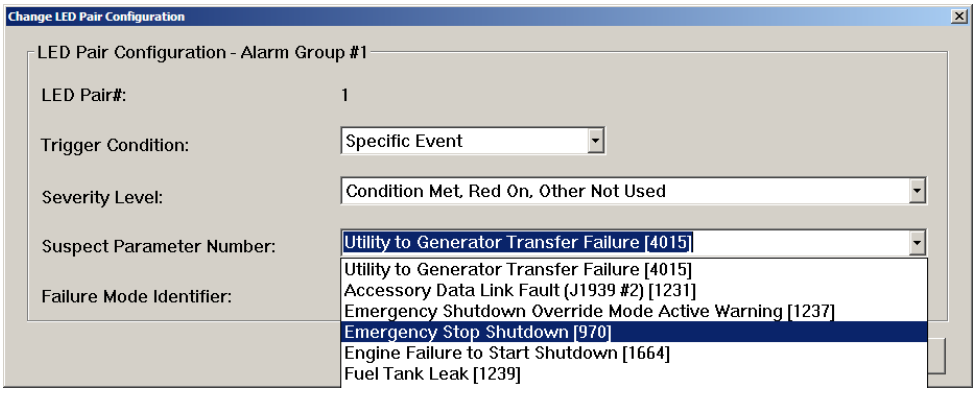


7. Select the Severity Level for the pair in the drop down menu.



For a complete list of choices for Severity Level, see Tables 34 and 35..

8. Select the Suspect Parameter Number for the pair in the drop down menu.



For a complete list of choices refer to Suspect Parameter Number Text on pages 279 to 281.

9. The Failure Mode Identifier does not normally need to be programmed since the Severity Level typically has this information embedded.

If the LED Trigger Condition is configured as General Event, the Severity Level can be configured according to Table 32.

Trigger Condition Severity Level	Allowed for LED Pairs…		
	1-5, 7-12, 16	13-14	6, 15
Low Warning	√	√	
Low Shutdown	√		√
High Warning	√	√	
High Shutdown	√		√
High or Low Warning	√	√	
High or Low Shutdown	√		√
Low Warning or Low Shutdown	√		
High Warning or High Shutdown	√		
High or Low Warning, High or Low Shutdown	√		
High or Low Warning, High or Low Shutdown or Diagnostic	√	√	√
Diagnostic Other Than Warning / Shutdown / Condition Exists	√	√	

Table 32: General Event Severity Levels

If the LED Trigger Condition is configured as Specific Event, the Severity Level can be configured according to Table 35.

Trigger Condition Severity Level	Allowed for LED Pairs…		
	1-5, 7-12, 16	13-14	6, 15
Low Warning	√	√	
Low Shutdown	√		√
High Warning	√	√	
High Shutdown	√		√
High or Low Warning	√	√	
High or Low Shutdown	√		√
Low Warning or Low Shutdown	√		
High Warning or High Shutdown	√		
High or Low Warning, High or Low Shutdown	√		
High or Low Warning, High or Low Shutdown or Diagnostic	√	√	√
Diagnostic Other Than Warning / Shutdown / Condition Exists	√	√	
Specific Diagnostic	√	√	√
Condition Exists, Red On, Other Not Used	√		√
Condition Exists, Amber On, Other Not Used	√	√	
Condition Exists, Green On, Other Not Used		√	√
Condition Exists, Red On, Amber Off	√		
Condition Exists, Red On, Green Off			√
Condition Exists, Amber On, Red Off	√		
Condition Exists, Amber On, Green Off		√	
Condition Exists, Green On, Red Off			√
Condition Exists, Green On, Amber Off		√	
Condition Does Not Exist, Red On, Other Not Used	√		√
Condition Does Not Exist, Amber On, Other Not Used	√	√	
Condition Does Not Exist, Green On, Other Not Used		√	√
Condition Exists, Red On, Other Not Used, Horn On	√		√
Condition Exists, Amber On, Other Not Used, Horn On	√	√	
Condition Exists, Green On, Other Not Used, Horn On		√	√
Condition Does Not Exist, Red On, Other Not Used, Horn On	√		√
Condition Does Not Exist, Amber On, Other Not Used, Horn On	√	√	
Condition Does Not Exist, Green On, Other Not Used, Horn On		√	√

Table 33: Specific Event Severity Levels

For Trigger Condition Severity Level listed in the table above from ‘Low Warning’ to ‘Specific Diagnostic the following Suspect Parameter Number options can be us:

Suspect Parameter Number Text	Value
Fuel Level (External Tank)	38
Aftercooler Temperature	52
Starting Air Pressure	82
Fuel Filter Differential Pressure	95
Fuel Level (Local Tank)	96
Engine Oil Level	98
Oil Filter Differential Pressure	99
Engine Oil Pressure	100
Crankcase Pressure	101
Air Filter Differential Pressure	107
Barometric Pressure	108
Engine Coolant Temperature	110
Engine Coolant Level	111
Battery Voltage (switched)	158
Battery Charging System Voltage	167
Battery Voltage	168
Ambient Air Temperature	171
Inlet Air Temperature	172
Exhaust Temperature	173
Engine Oil Temperature	175
Engine Speed	190
Long Distance Annunciator Data Link Fault (Root Cause Not Known)	625
Primary Data Link Fault (Root Cause Not Known)	639
Emergency Stop Shutdown	970
Analog Input #1 Custom Parameter	1083
Analog Input #2 Custom Parameter	1084
Generator Rear Bearing Temperature	1122
Generator Front Bearing Temperature	1123
Generator Winding Temperature #1	1124
Generator Winding Temperature #2	1125
Generator Winding Temperature #3	1126
Accessory Data Link Fault (Root Cause Not Known)	1231
Unexpected Engine Shutdown (Root Cause Not Known)	1383
Right Exhaust Temperature	2433
Left Exhaust Temperature	2434
Generator Frequency	2436
Generator AC Voltage	2440
Generator AC Current	2448
Generator Real Power (kW)	2452
Generator Reactive Power (kVAr)	2456
Generator to Bus Synchronization Failure (Low)	2529

Suspect Parameter Number Text	Value
Dead Bus Arbitration Failure (Low)	2530
Engine Controller (Abnormal Update Rate)	3543
Modbus Data Link	3581
Generator Breaker Closed	4004
Generator Breaker Open	4013
Utility to Generator Transfer Failure (High)	4015
Analog Input #4 Custom Parameter	4157
Analog Input #3 Custom Parameter	4158
Cranking Voltage	4256

For the Trigger Condition Severity Levels listed in the table above from ‘Condition Exists, Red On, other Not Used’ to ‘Condition Does Not Exists, Green On, other Not used, Horn On’ the following Suspect Parameter Number options can be used:

Suspect Parameter Number Text	Value
Digital Input # 1 Custom Event	701
Digital Input # 2 Custom Event	702
Digital Input # 3 Custom Event	703
Digital Input # 4 Custom Event	704
Digital Input # 5 Custom Event	705
Digital Input # 6 Custom Event	706
Digital Input # 7 Custom Event	707
Digital Input # 8 Custom Event	708
Isolated Digital Input #1 Custom Event	3920
Isolated Digital Input #2 Custom Event	3921
Isolated Digital Input #3 Custom Event	3922
Isolated Digital Input #4 Custom Event	3923
Emergency Stop Shutdown	970
Emergency Shutdown Override Mode Active	1237
Fuel Tank Leak	1239
Engine Failure to Start	1664
Service Interval Warning	2648
Generator Unavailable to Start/Run	3677
EPS Supplying Load	3829
Air Damper Closed	4000
ATS in Normal Position	4001
ATS in Emergency Position	4002
Battery Charger Failure	4003
Generator Breaker Closed	4004
Utility Breaker Closed	4005
Engine in Cooldown	4006
Generator Control Not in Automatic Warning	4007
Generator Breaker Failure to Open	4009
Generator Breaker Failure to Close	4011

Suspect Parameter Number Text	Value
Generator Breaker Open	4013
Loss of Utility	4017
Generator Breaker Locked Out	4018
Utility Breaker Locked Out	4019
Bus Phase Sequence Incorrect	4024
Generator Phase Sequence Incorrect	4025
Earth Fault	4028
Earth Leakage	4029

If the Trigger Condition Severity Level is programmed for Diagnostic, then the Failure Mode Identifier for any pair of LEDs can be configured as any of the following:

Data Erratic, Intermittent, or Incorrect	Abnormal Rate of Change
Voltage Above Normal, or Shorted to High Source	Root Cause Not Known
Voltage Below Normal, or Shorted to Low Source	Bad Intelligent Device or Component
Current Below Normal or Open Circuit	Out Of Calibration
Current Above Normal or Grounded Circuit	Special Instructions
Mechanical System Not Responding or Out of Adjustment	Received Network Data In Error
Abnormal Frequency or Pulse Width or Period	Data Drifted High
Abnormal Update Rate	Data Drifted Low

20.3 THERMOCOUPLE MODULE

THERMOCOUPLE FEATURES

Reads up to 20 Type J or K thermocouple inputs

Temperatures are configured to indicate the SAE J1939 SPN to be transmitted by that temperature input. Suspect Parameter Numbers (SPNs) for configuration of temperature inputs are customer specific. Resolution: One byte parameters have a resolution of 1 °C / bit and a range of -40 °C to 210 °C. Two byte parameters have resolution of 0.03125 °C / bit and a range of -273 °C to 1735 °C

Cold junction compensation is provided

System throughput has all 20 channels scanned in 2 seconds (100 ms/channel)

Overall drift with temperature is 0.015% / °C of span (maximum)

Module is fully functional during configuration and communications

Parameter values and diagnostic error codes are retained when the modules are de-energized

Open-circuit and short-circuit diagnostics are supported

Can be mounted directly on the generator set panel or remotely

Suitable for moist, high shock and vibration environments

Compact size (see mechanical drawing, Figure 57)

THERMOCOUPLE SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Accept 5-32 VDC power (12 or 24 VDC nominal)

Over voltage capability is 32 VDC for 1 hour @ 85°C

Power supply inputs are protected against transient surges and short circuits and are isolated from I/O

Three way isolation is provided for the CAN line, inputs and power supply; isolation voltage is 1500 V AC (rms) or 2550 V for 1 sec

Burden is limited to less than 200 mA; inrush not to exceed 800 mA

Common mode rejection is -80 db@ 5V p-p (50-60 Hz)

Common mode input range is +/- 4 V minimum

Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering

ENVIRONMENTAL SPECIFICATIONS

Encapsulated in a rugged aluminum housing with watertight Deutsch connectors (IP65 rating)

Operating temperature range -40 to 85°C (-40 to 185°F) (for ambient temperatures exceeding 85°C, the temperature scanner may deviate in accuracy an additional ±1°C)

The ambient storage temperature range is -50°C to +120°C

It is protected against 95% humidity non-condensing, 30°C to 60°C

NETWORK COMMUNICATIONS INTERFACE

Capable of operating on the EMCP 4 Accessory CAN (2) data link

Node address is auto configurable

Optical isolation is provided for the CAN line

Retains current date and time relative to synchronization every 24 hours (or upon boot up) with equipment system time via an explicit command from the EMCP 4 or Service Tool when the GSC is not available; synchronization time is accurate to within 1 sec

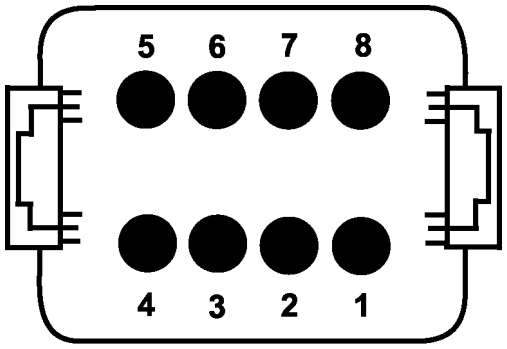
Includes a watchdog timer to automatically reboot should the microprocessor lock

Module operates normally with loss of communication link, retaining configured values and error codes in non-volatile memory

Configuration and firmware updates are accomplished with the Cat Service Tool over the CAN network

THERMOCOUPLE WIRING

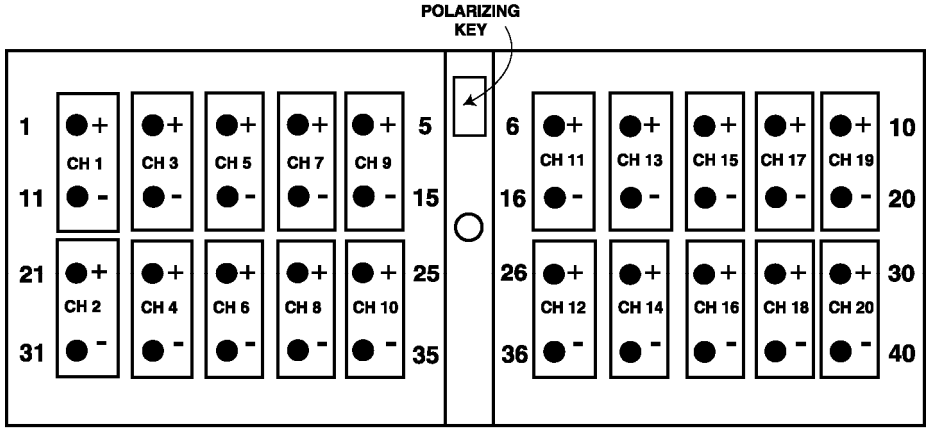
POWER AND CAN BUS WIRING



FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

1 = PWR+ 5 = SHIELD
2 = CAN-H 6,7,8 = NOT USED
3 = CAN-L
4 = PWR-

THERMOCOUPLE SENSOR WIRING



FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PA

THERMOCOUPLE PHYSICAL LAYOUT

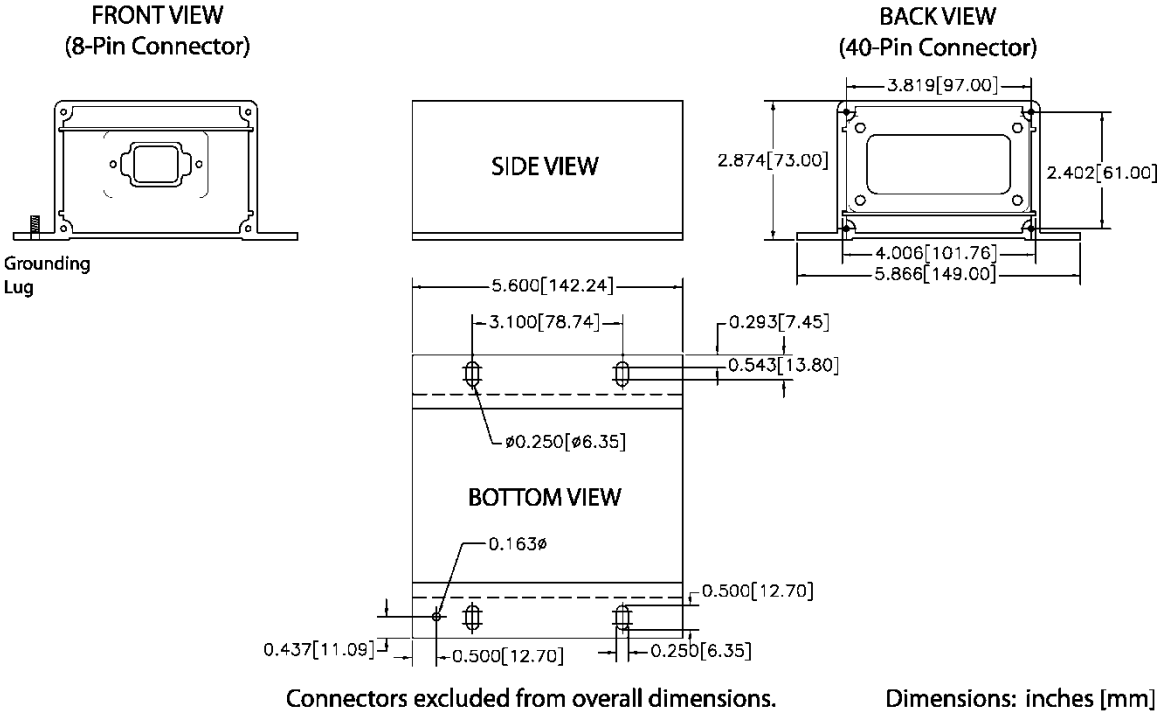


Figure 57: Thermocouple, RTD, And Discrete I/O Module Physical Layout

THERMOCOUPLE MODULE – CONFIGURATION

The Thermocouple module is field programmable using the Cat Service Tool. It is also flash programmable to update software using the Cat Service Tool.

The service tool software must be installed on a Windows PC. The Cat communication adapter must be connected between the PC and the CAN data link on which the target Thermocouple module is connected. When connecting the Thermocouple module, the user will first see the Module Summary screen shown in Figure 58.

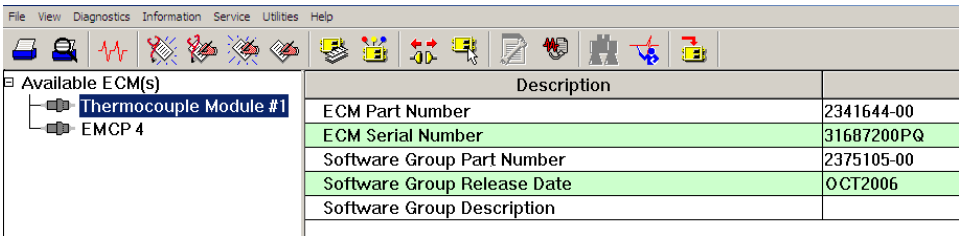


Figure 58: Cat Service Tool Thermocouple Module Summary Screen

The service tool configuration tool contains setpoints for configuring the Thermocouple module identification, as well as the thermocouple inputs.

Figure 59 shows the ECM Identification Parameters list. This list shows the ECM serial number (read-only) of the module that is connected, and allows for configuration of the ECU instance. Each thermocouple module on the data link must have a unique ECU instance. If ECU instances are duplicated, one of the modules must be disconnected and the other reconfigured to a different ECU instance.

Note: ECU Instance #1 is reserved for the Accessory Data Link (CAN 2), while ECU Instance #2 is reserved for the Primary Data Link (CAN 1).

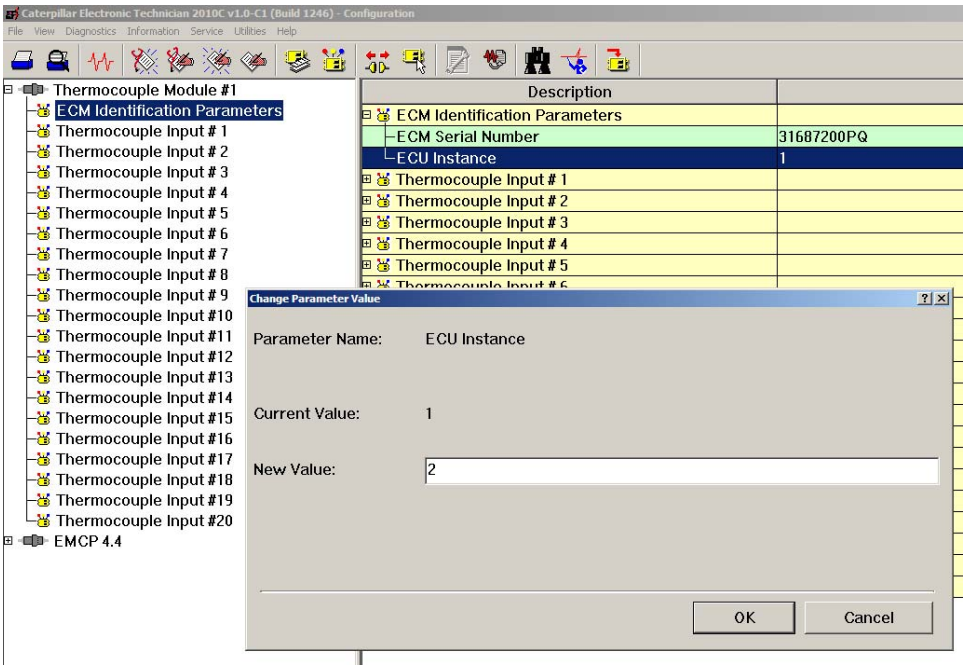


Figure 59: Cat Service Tool Thermocouple Module Identification Parameters

Upon changing the ECU instance, the Cat Service Tool will automatically reconnect to the data link, and the Thermocouple module name should reflect the new ECU instance. In this example, as shown in Figure 60, the module was previously named Thermocouple Module #1, and after the ECU instance is changed to 2 and the service tool reconnects, the name reads Thermocouple Module #2.

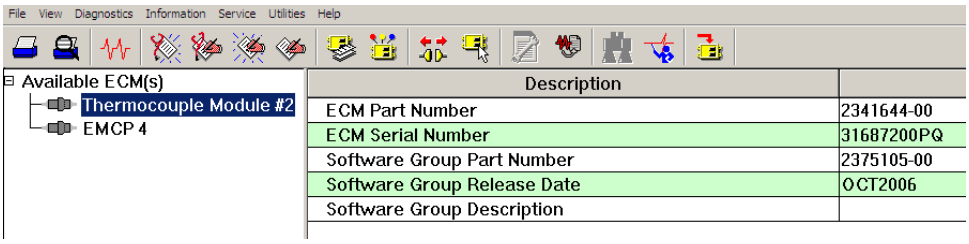


Figure 60: Cat Service Tool Thermocouple Module After ECU Instance Change

CONFIGURING THERMOCOUPLE INPUTS

Figure 61 shows the **THERMOCOUPLE INPUT #1** Configuration list, when using the Cat Service Tool. All twenty thermocouple inputs have identical parameters and options.

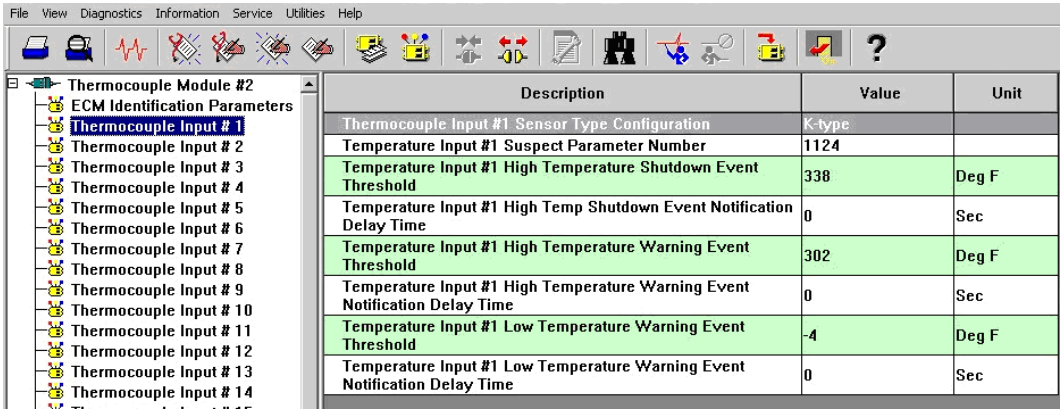


Figure 61: Cat Service Tool Thermocouple Input Configuration

The **SENSOR TYPE CONFIGURATION** selects either a J or K type configuration. Select the appropriate configuration based on the type of thermocouple installed. Reference the TC Module specsheet (LEHE0126) for available Temperature Inputs.

The **SUSPECT PARAMETER NUMBER** (**SPN**) is a numerical entry between a predetermined list of SPNs that are supported by the Thermocouple module. All of the thermocouple inputs support the same list of SPNs. To change the SPN, type in the number that corresponds with the desired parameter as shown in Figure 62. See RENR7902 for specific information on what possible SPN values can be used.

The **HIGH TEMPERATURE SHUTDOWN EVENT THRESHOLD** sets the high temperature at which a high shutdown event will occur.

The **HIGH TEMPERATURE WARNING EVENT THRESHOLD** sets the high temperature at which a high warning event will occur.

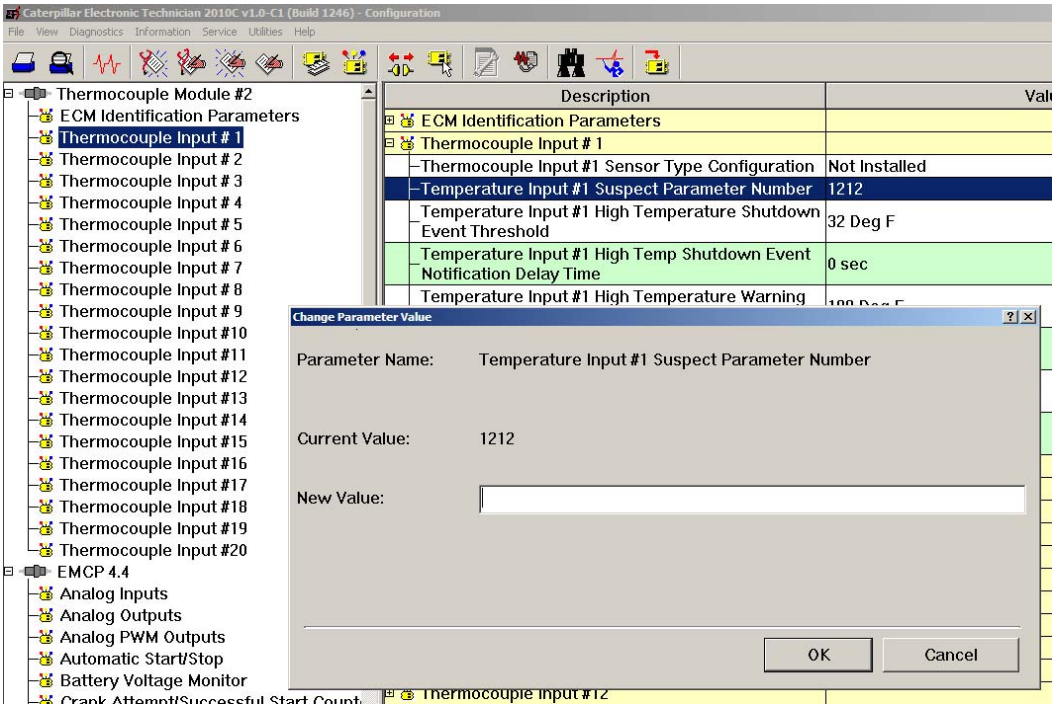


Figure 62: Cat Service Tool Thermocouple Module Suspect Parameter Number

The **LOW TEMPERATURE WARNING EVENT THRESHOLD** sets the low temperature at which a low warning event will occur.

The **EVENT NOTIFICATION DELAY TIME** sets the amount of time the threshold must be exceeded until the Thermocouple module triggers that particular event on the data link. Each of the delay time options corresponds with a particular event type.

20.4 RTD MODULE

RTD FEATURES

Reads up to eight (8) Platinum RTD inputs with 2, 3, and 4 wire configurations

System throughput has all 8 channels scanned in 2 seconds (250 ms/channel).

Overall drift with temperature is 15mOhm/°C (maximum)

Module is fully functional during configuration and communications

Parameter values and diagnostic error codes are retained when the modules are de-energized

Suitable for moist, high shock and vibration environments

Compact size (see mechanical drawing, Figure 63)

RTD SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Accept 5-32 VDC power (12 or 24 VDC nominal)

Over voltage capability is 32 VDC for 1 hour @ 85°C

Power supply inputs are protected against transient surges and short circuits and are isolated from I/O

Optical isolation is 500 VDC from input to ground. Three way isolation is provided for the CAN line, inputs and power supply.

Burden is limited to less than 200 mA; inrush not to exceed 800 mA

Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering

ENVIRONMENTAL SPECIFICATIONS

Encapsulated in a rugged aluminum housing with watertight Deutsch connectors (IP65 rating)

Operating temperature range -40 to 85°C (-40 to 185°F) (for ambient temperatures exceeding 85°C, the temperature scanner may deviate in accuracy an additional ±1°C)

The ambient storage temperature range is -50°C to +120°C

It is protected against 95% humidity non-condensing, 30°C to 60°C

NETWORK COMMUNICATIONS INTERFACE

Operates on the EMCP 4 Accessory CAN data links

Node address is auto configurable

Optical isolation is provided for the CAN line

Retains current date and time relative to synchronization every 24 hours (or upon boot up) with equipment system time via an explicit command from the EMCP 4 or Service Tool when the GSC is not available; synchronization time is accurate to within 1 sec

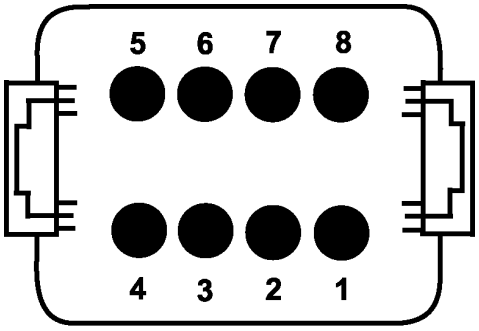
Includes a watchdog timer to automatically reboot should the microprocessor lock

Module operates normally with loss of communication link, retaining configured values and error codes in non-volatile memory

Configuration and firmware updates are accomplished with the Cat Service Tool over the CAN network

RTD WIRING

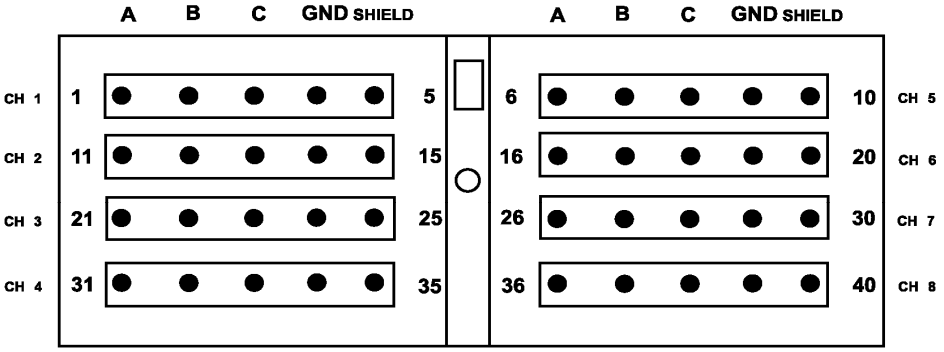
POWER AND CAN BUS WIRING



FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

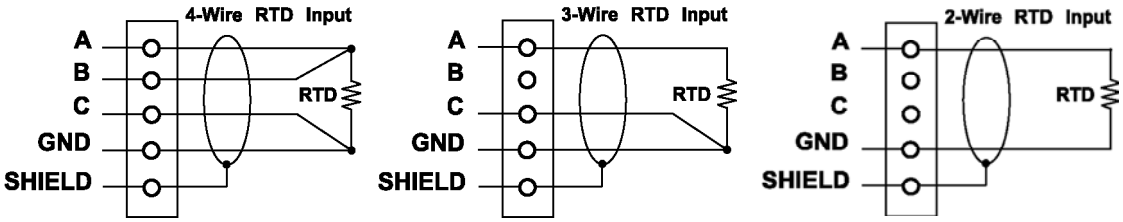
1 = PWR+ 5 = SHIELD
2 = CAN-H 6,7,8 = NOT USED
3 = CAN-L
4 = PWR-

RTD SENSOR WIRING



FRONT VIEW OF
MODULE MOUNTED CONNECTOR

RTD WIRING TYPICAL CONNECTIONS



RTD PHYSICAL LAYOUT

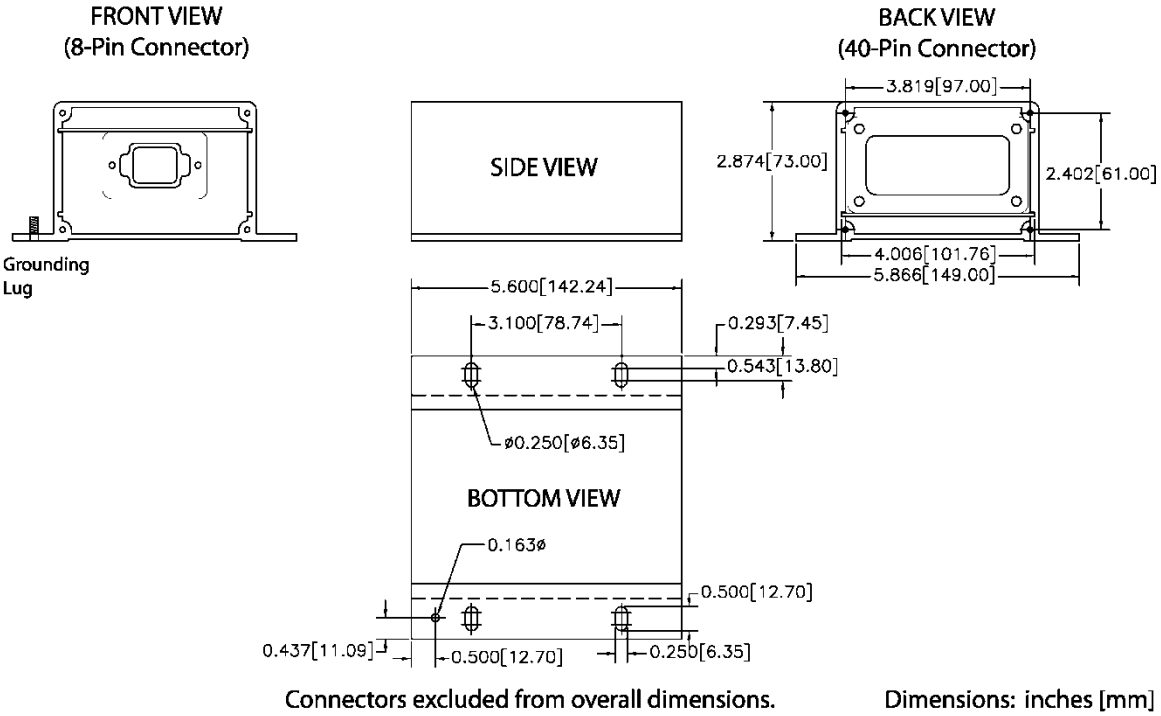


Figure 63: Thermocouple, RTD, And Discrete I/O Module Physical Layout

RTD MODULE – CONFIGURATION

The RTD (Resistance Temperature Detector) module is field programmable using the Cat Service Tool. It is also flash programmable to update software using the Cat Service Tool.

The service tool software must be installed on a Windows PC.

The Cat communication adapter must be connected between the PC and the CAN data link on which the target RTD module is connected.

When connecting to the RTD module, the user will first see the Module Summary screen shown in Figure 64.

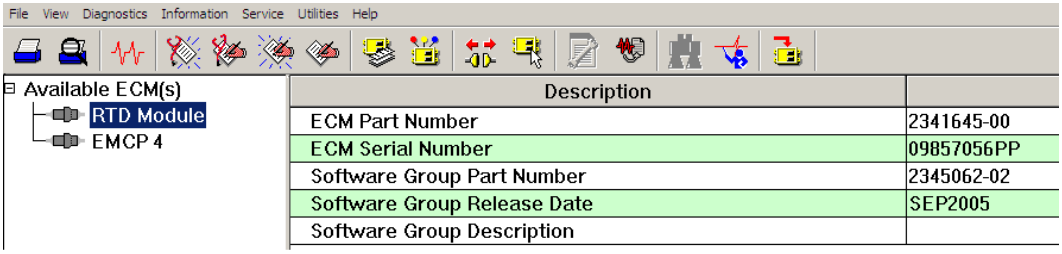


Figure 64: Cat Service Tool RTD Module Summary Screen

The service tool configuration tool, accessed by pressing F5 or clicking the configuration tool icon on the toolbar, contains setpoints for configuring the RTD module identification, as well as the RTD inputs.

CONFIGURING RTD INPUTS

The RTD Input #1 Configuration list of the service tool configuration tool is shown in Figure 65. All eight RTD inputs have identical parameters and options.

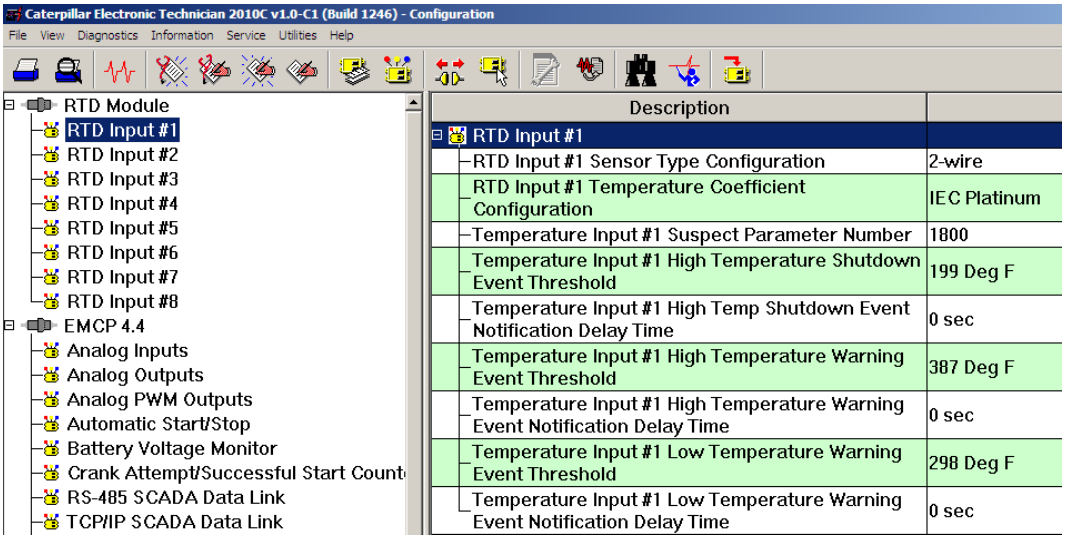


Figure 65: Cat Service Tool RTD Module Digital Input Configuration

The **SENSOR TYPE CONFIGURATION** selects between a 2, 3, or 4 wire configuration. Select the appropriate configuration based on the type of RTD sensor installed. Reference the RTD Module specsheet (LEHE0124) for available Temperature Inputs.

The **TEMPERATURE COEFFICIENT CONFIGURATION** selects between an IEC Platinum, JIS Platinum, Legacy US Platinum, SA MA Platinum or US Platinum type of RTD sensor. Select the appropriate configuration based on the type of RTD sensor installed.

The **SUSPECT PARAMETER NUMBER** (**SPN**) is a choice between a predetermined list of SPNs that are supported by the RTD module. All of the RTD inputs support the same list of SPNs. To change the SPN, type in the number that corresponds to the desired parameter as shown in Figure 66. See UENR1210 for specific information on what possible SPN values can be used.

The **HIGH TEMPERATURE SHUTDOWN EVENT THRESHOLD** sets the high temperature at which a shutdown event will occur.

The **HIGH TEMPERATURE WARNING EVENT THRESHOLD** sets the high temperature at which a high warning event will occur.

The **LOW TEMPERATURE WARNING EVENT THRESHOLD** sets the low temperature at which a low warning event will occur.

The **EVENT NOTIFICATION DELAY TIME** sets the amount of time the threshold must be reached until the RTD module triggers that particular event on the data link. Each of the delay time options corresponds with a particular event type.

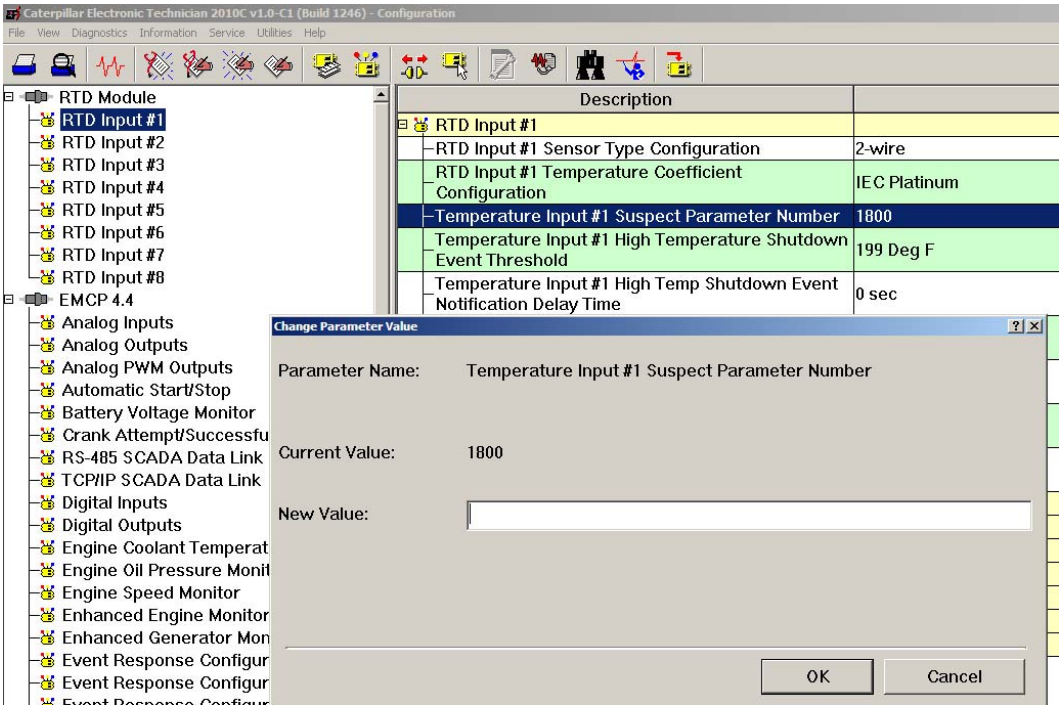


Figure 66: Cat Service Tool RTD Module Suspect Parameter Number

20.5 DISCRETE I/O MODULE

The EMCP Discrete I/O (DIO) module is designed for mounting on generator sets or remotely, to provide auxiliary switch inputs or relay contact outputs. Up to 4 DIO modules can be used on the EMCP 4.2 Accessory CAN data link, given that they are programmed to unique ECU Instance numbers.

DISCRETE I/O FEATURES

Reads twelve (12) discrete inputs and sets eight (8) Form C Relay Outputs

Converts between physical I/O and CAN data link commands

System throughput: All channels are scanned in 100 ms

Low-Level input voltage range: 0 to 0.8 V

High-Level input voltage range: 3.75 to 24V

Inputs have internal pull-up resistors

LED to indicate communication network status

Compact size (see mechanical drawing, Figure 67)

DISCRETE I/O SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Accept 5-32 VDC power (12 or 24VDC nominal)

Over voltage capability is 32 VDC for 1 hour @ 85°C

Resistive Loads rated for 3A@30 VDC

Normally Closed (NC) relay contacts rated for 2A@125 V AC / 2A@30 VDC

Normally Open (NO) relay contacts rated for 2A@125 V AC / 2A@30 VDC

Inductive Loads rated for 0.5A@250 V AC $\cos\phi$=0.4

Maximum current draw of 400mA + 50mA per energized relay @ 12VDC

Power supply inputs are protected against transient surges and short circuits and are isolated from I/O

ENVIRONMENTAL SPECIFICATIONS

Encapsulated in a rugged aluminum housing with watertight Deutsch connectors (IP65 rating)

Operating temperature range -40 to 85°C (-40 to 185°F)

The ambient storage temperature range is -50°C to +120°C.

It is protected against 95% humidity non-condensing, 30°C to 60°C.

Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering

NETWORK COMMUNICATIONS INTERFACE

Operates on the EMCP 4.2 Accessory CAN data link

Node address is auto configurable

Optical isolation is provided for the CAN line

Retains current date and time relative to synchronization every 24 hours (or upon boot up) with equipment system time via an explicit command from the EMCP 4 or Service Tool when the GSC is not available; synchronization time is accurate to within 1 sec

Includes a watchdog timer to automatically reboot should the microprocessor lock

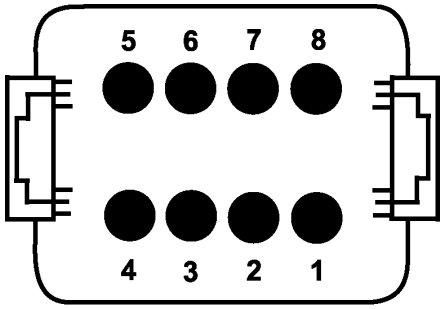
Module operates normally with loss of communication link, retaining configured values and error codes in non-volatile memory

Configuration and firmware updates are accomplished with the Cat Service Tool over the CAN network

Monitored parameters and alarms are read-only over the network

DISCRETE I/O WIRING

POWER AND CAN BUS WIRING

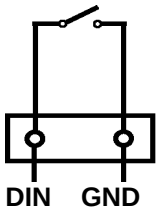


FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

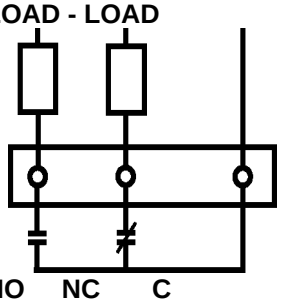
1 = PWR+ 5 = SHIELD
2 = CAN-H 6,7,8 = NOT USED
3 = CAN-L
4 = PWR-

I/O WIRING TYPICAL CONNECTIONS

INPUT



OUTPUT
LOAD - LOAD



INPUTS	PIN		OUTPUTS	PIN		OUTPUTS	PIN
DIN1	1		NC_1	5		C_6	19
DIN2	11		C_1	6		NO_6	20
DIN3	21		NO_1	7		NC_7	28
DIN4	31		NC_2	15		C_8	29
DIN5	2		C_2	16		NO_7	30
DIN6	12		NO_2	17		NC_8	38
DIN7	22		NC_3	25		C_8	39
DIN8	32		C_3	26		NO_8	40
DIN9	3		NO_3	27			
DIN10	13		NC_4	35			
DIN11	23		C_4	36			
DIN12	33		NO_4	37			
GND	4		NC_5	8			
GND	14		C_5	9			
GND	24		NO_5	10			
GND	34		NC_6	18			

NO = Normally Open
NC = Normally Closed
C = Common

Table 34: Discrete I/O

Note: The GND pin is not the package ground, but the Isolated Reference for the module.

DISCRETE I/O PHYSICAL LAYOUT

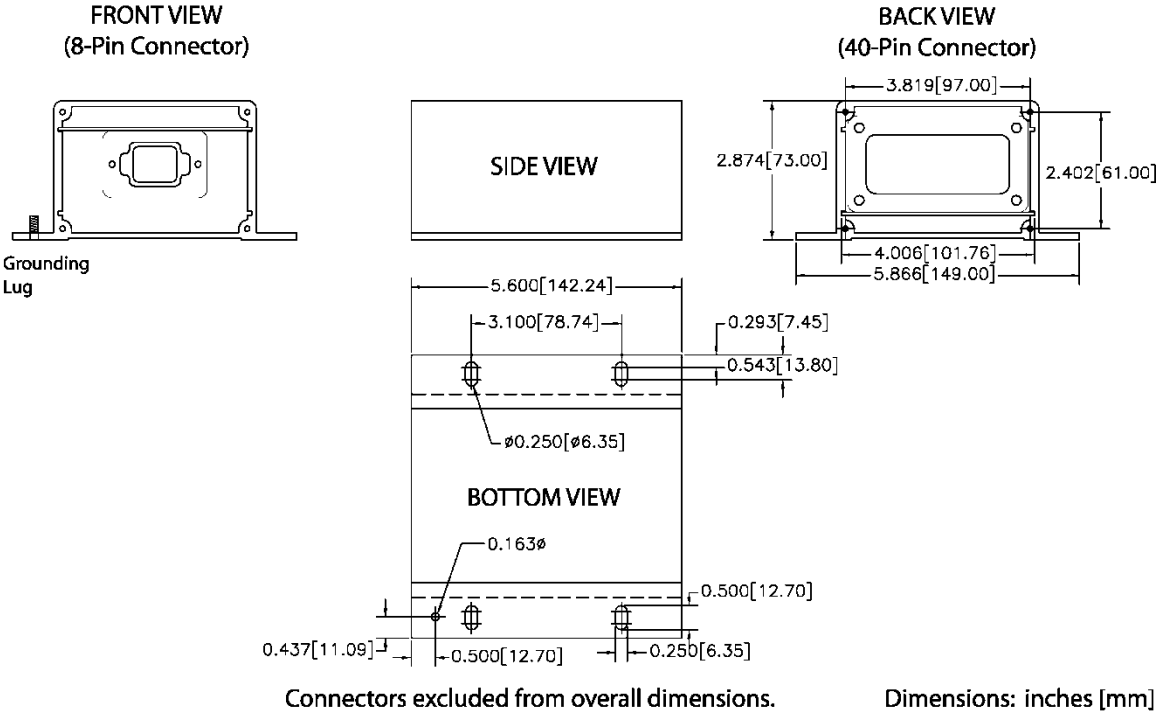


Figure 67: Thermocouple, RTD, And Discrete I/O Module Physical Layout

DISCRETE I/O - CONFIGURATION

The DIO module is field-programmable using the Cat Service Tool. It is also flash programmable to update software using the Cat Service Tool.

The service tool software must be installed on a Windows PC. The Cat communication adapter must be connected between the PC and the CAN data link on which the target DIO module is connected. (The service tool may be connected to the EMCP 4 Accessory Data Link service connector).

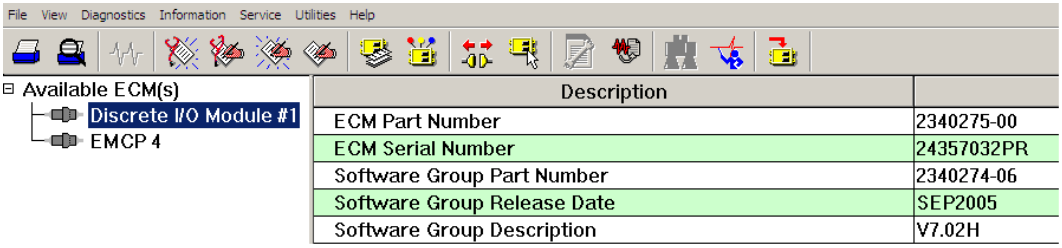


Figure 68: Cat Service Tool DIO Summary Screen

When connecting to the DIO, the user will first see the Module Summary screen shown in Figure 68. The service tool configuration tool, accessed by pressing F5 or clicking the configuration tool icon on the toolbar, contains setpoints for configuring the DIO identification, as well as the inputs and outputs.

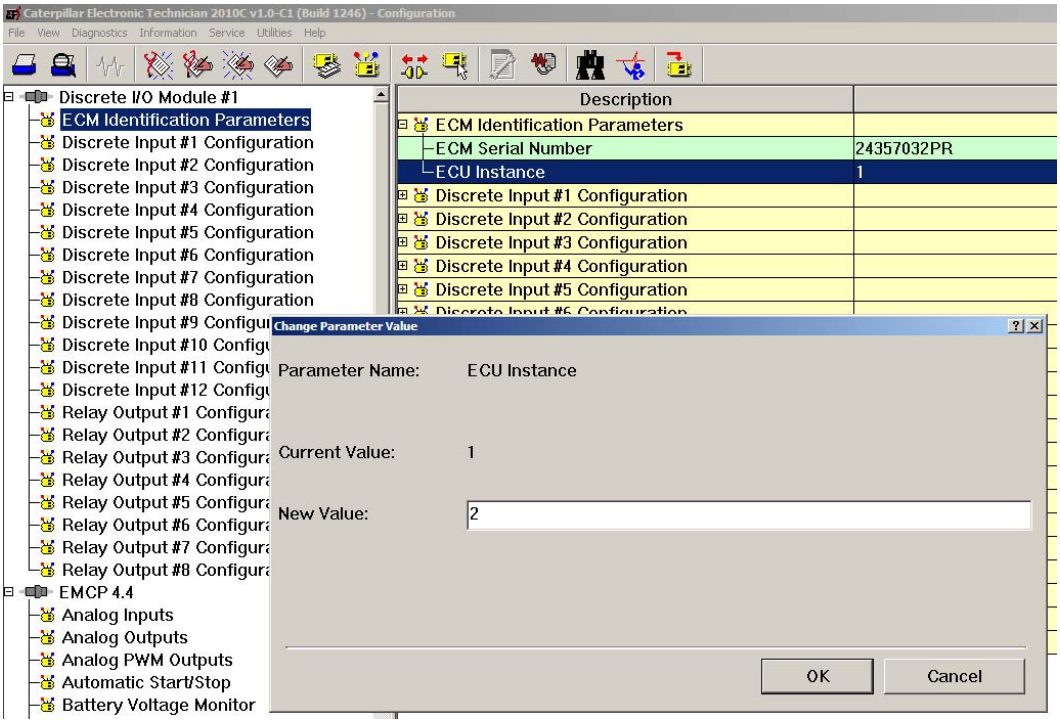


Figure 69: Cat Service Tool DIO Identification Parameters

Figure 69 shows the ECM Identification Parameters list. This list shows the ECM serial number (read-only) of the module that is connected, and allows for configuration of the ECU instance.

Note: It is important to match a specific module to a certain ECU Instance. The system will not function properly if ECU instances are duplicated.

Upon changing the ECU instance, the Cat Service Tool will automatically disconnect and reconnect to the data link, and the DIO module name should reflect the new ECU instance.

In the example shown in Figure 70, the module was previously named Discrete I/O Module #1, and after the ECU instance is changed to 2 and the service tool reconnects, the name reads Discrete I/O Module #2.

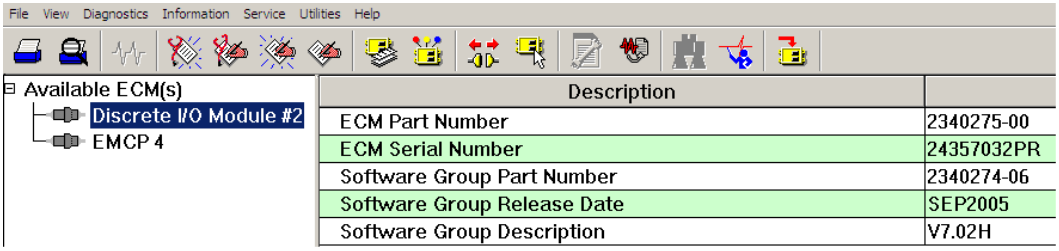


Figure 70: Cat Service Tool DIO After ECU Instance Change

CONFIGURING DIGITAL INPUTS

Figure 71 shows the Discrete Input #1 Configuration list using the service tool configuration tool. All twelve discrete inputs have identical parameters and options.

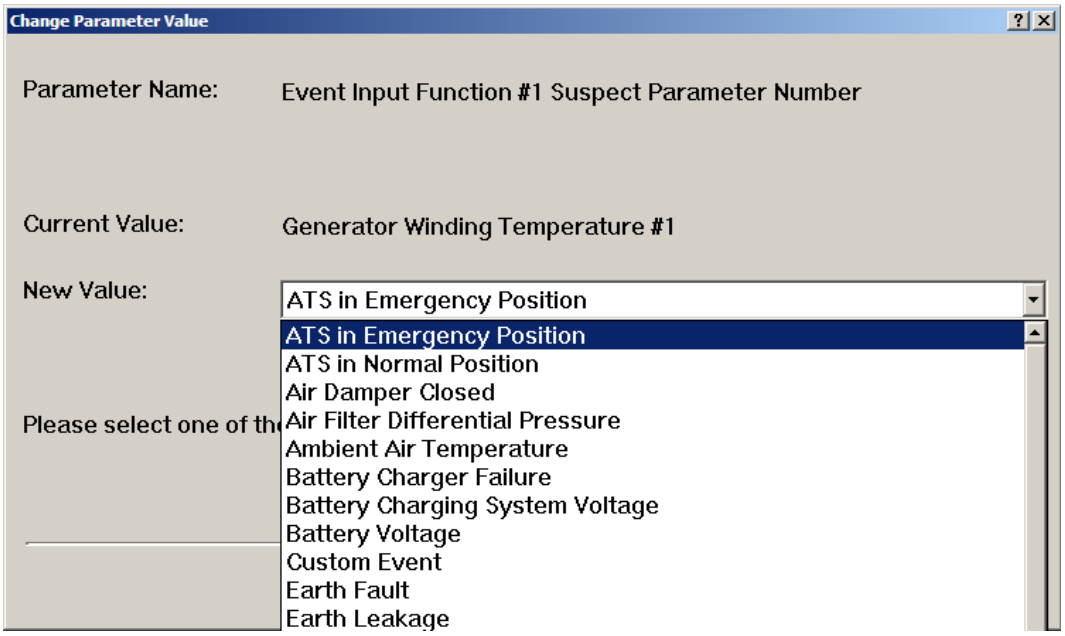


Figure 71: Cat Service Tool DIO Digital Input Configuration

The *active state configuration* determines which state (high or low) triggers the event, and depends on the sensor/switch wiring configuration.

The *event notification delay time* sets the amount of time the input must remain active until the DIO module triggers an event on the data link.

SUSPECT PARAMETER NUMBER (SPN)

The *suspect parameter number* (SPN) is a choice from a predetermined list of SPNs that are supported by the DIO module. All of the discrete inputs support the same list of SPNs, except Custom Event.

Discrete Input #1, when set to Custom Event, will trigger an event for Custom Event #1. Discrete Input #2, when set to Custom Event, will trigger an event for Custom Event #2; likewise for all twelve discrete inputs.

FAILURE MODE IDENTIFIER (FMI)

The **FAILURE MODE IDENTIFIER** (FMI) configures what type of failure this event will represent. The technician is free to configure any FMI for any SPN, but discretion must be used. Certain combinations may not be meaningful (i.e. the EMCP 4 may not be configurable to display or trigger a response for certain combinations of SPN and FMI).

For example, a Fuel Level SPN with a Condition Exists FMI is not meaningful; the EMCP 4 can be configured to display or react to only fuel level low or high warnings or shutdowns.

CONFIGURING RELAY OUTPUTS

The Relay Output #1 Configuration list of the service tool configuration tool is shown in Figure 72. All eight Relay Outputs have identical parameters and options.

The *suspect parameter number* (SPN) is a choice from a predetermined list of SPNs that are supported by the DIO module. If you wish to configure the DIO to trigger an output based on an event on the data link related to a specific SPN, the SPN must be selected here.

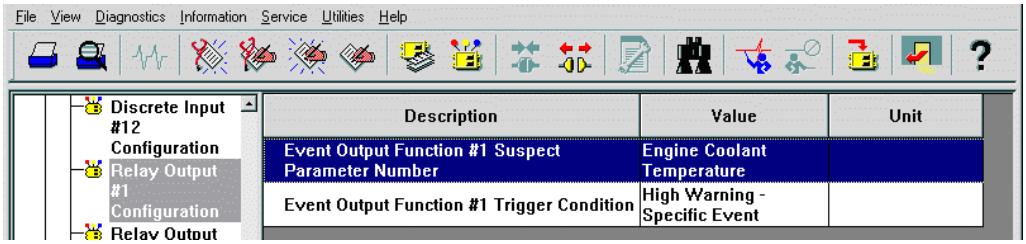


Figure 72: Cat Service Tool DIO Relay Output Configuration

The *trigger condition* is a list of conditions that will trigger this output. For the conditions labeled specific event, the relay will be activated upon receiving a category of events (either a single FMI or a set of FMIs) for the SPN selected in the *suspect parameter number* parameter. For the conditions labeled general event, the relay will be activated upon receiving a category of events (either a single FMI or a set of FMIs) for *any* SPN. In this case, the DIO module will ignore the entry in the *suspect parameter number* parameter. If the disabled condition is chosen, the Relay Output will not activate on any condition.

21 SCADA (MODBUS) DATA LINK

The **SCADA DATA LINK** or **MODBUS** is supported on the EMCP 4.3 and 4.4.

The EMCP 4.3 and 4.4 have a **SUPERVISORY CONTROL AND DATA ACQUISITION** (SCADA) communications link between the controller and a host device using the **MODBUS** protocol. The host device is able to remotely monitor or control the genset package equipped with the EMCP 4 in much the same way an operator does from the panel.

- The host device connects to the EMCP GSC through an RS-485 SCADA Data Link (Modbus RTU, Half Duplex).
- The data is transmitted in a binary format over the serial connection.
- The host device acts as Modbus Master, and the EMCP 4 acts as the Modbus Slave, also called a **REMOTE TRANSMITTER UNIT** (**RTU**).
- The host device initiates all communication, sending commands or requests for information to the EMCP 4.
- The EMCP 4 then takes action based on the query and/or sends a response to the query over Modbus.

Baud rates can be configured on the EMCP 4. Various data rates between 9600 bits/second (baud) and 57,600 bits/second are available. See the BOTH ENDS of the Modbus lines (or the extreme ends of the trunk, for a multipoint network) should have termination between MODBUS+ (B) and MODBUS- (A).

A 0.5W 150Ω resistor may be adequate.

If line polarization is implemented (see Software Configuration Section), a better choice is a 10 µF capacitor (10V minimum) in series with a 0.25W 120Ω resistor.

Note: For more details on setting up a Modbus network over a serial line, please refer to RS-485 specifications or Modbus specifications. See the Software Configuration Section for instructions on enabling line polarization.

Software Configuration Section for instructions.

Note: This port may be required to be used to communicate to switchgear or other monitoring device. Only a single device can be used with this port.

21.1 WIRING

SCADA COMMUNICATION wires are brought out of the EMCP 4 as part of the 120-pin connector. The pins, as designated on the EMCP connector, are shown in Table 35.

SCADA COMMUNICATION WIRES		
Pin #	**Name**	**Description**
90	MODBUS –	Optically isolated half-duplex differential (-) for Modbus
101	MODBUS Reference	Half-duplex RS-485 Reference for Modbus
100	MODBUS +	Optically isolated half-duplex differential (+) for Modbus

Table 35: SCADA Pins on Amp Connector

MODBUS DATA TRANSMISSION over RS-485 is accomplished over a single shielded twisted pair for differential signaling with transmit and receive alternating over the same wire pair (**MODBUS+** and **MODBUS-**). The Reference (**MODBUS REF**) should be connected to the shield, to prevent ground loop currents.

- Figure 73 shows a possible wiring configuration to a RS-485 device.
- Figure 74 shows a possible wiring configuration to a RS-485 to RS-232 converter.

Note: See documentation of connected device to verify wiring configuration.

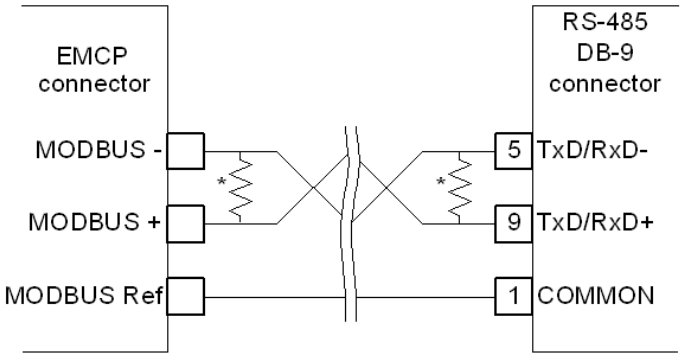


Figure 73: Possible Wiring Configuration To An RS-485 Device

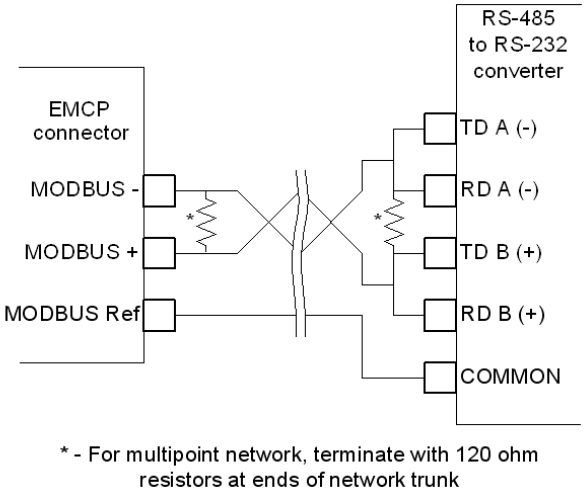


Figure 74: Possible Wiring Configuration To An Rs-485 To RS-232 Converter

21.2 LINE TERMINATION

Both ends of the Modbus lines (or the extreme ends of the trunk, for a multipoint network) should have termination between MODBUS+ (B) and MODBUS- (A).

A 0.5W 150Ω resistor may be adequate.

If line polarization is implemented (see Software Configuration Section), a better choice is a 10 µF capacitor (10V minimum) in series with a 0.25W 120Ω resistor.

Note: For more details on setting up a Modbus network over a serial line, please refer to RS-485 specifications or Modbus specifications. See the Software Configuration Section for instructions on enabling line polarization.

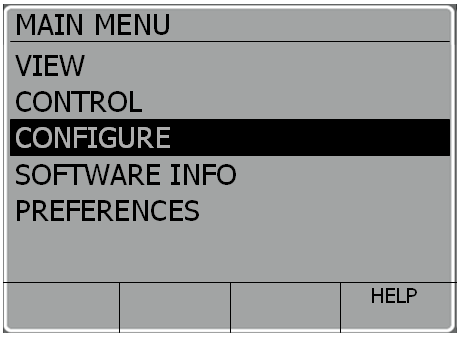
21.3 SOFTWARE CONFIGURATION

CONFIGURING THE SCADA DATA LINK USING THE DISPLAY

The **SCADA DATA LINK** may require software configuration. The configuration parameters are accessible on the EMCP 4 via the following menu options:

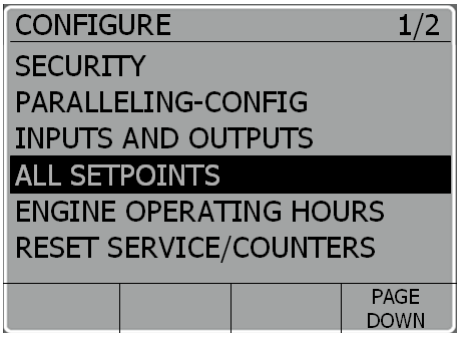
At **MAIN MENU,** scroll **DOWN** to **CONFIGURE**

Press the **OK KEY**.



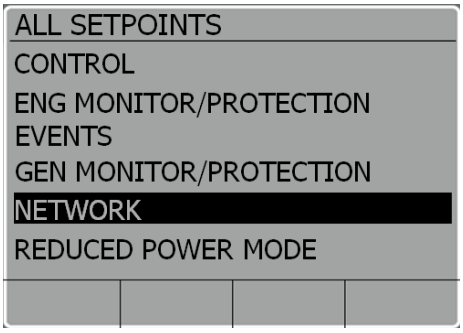
Scroll **DOWN** to **ALL SETPOINTS**

Press the **OK KEY**.



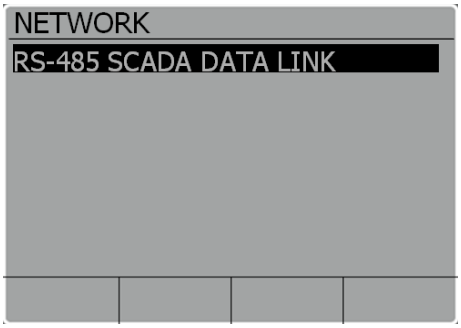
Scroll **DOWN** to **NETWORK**

Press the **OK KEY**.

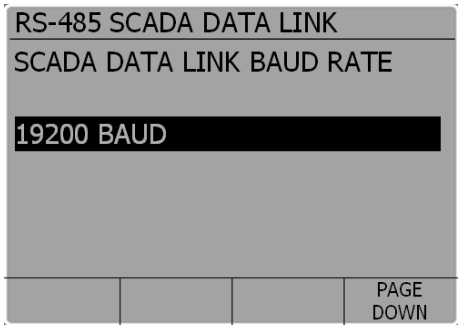


Scroll **DOWN** to **RS-485 SCADA DATA LINK**

Press the **OK KEY**.



Press the **OK KEY** to edit the current **SCADA DATA LINK BAUD RATE.**

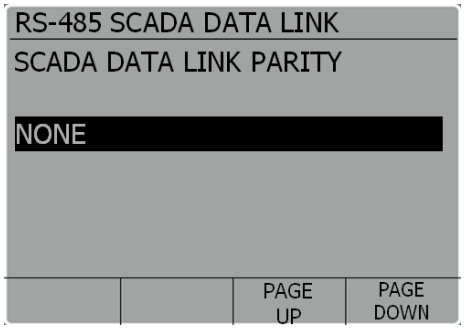


Select the **SCADA DATA LINK BAUD RATE** that you want to program

Press the **OK KEY**.

Scroll **DOWN** to **SCADA DATA LINK PARITY**

Press the **OK KEY** to edit the current **SCADA DATA LINK PARITY.**

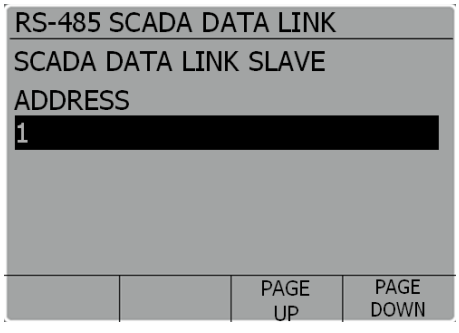


Select the **SCADA DATA LINK PARITY** that you want to program

Press the **OK KEY**.

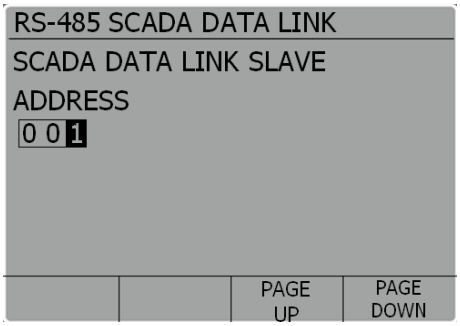
Scroll **DOWN** to **SCADA DATA LINK SLAVE ADDRESS**.

Press the **OK KEY** to highlight the current **SCADA DATA LINK SLAVE ADDRESS**.



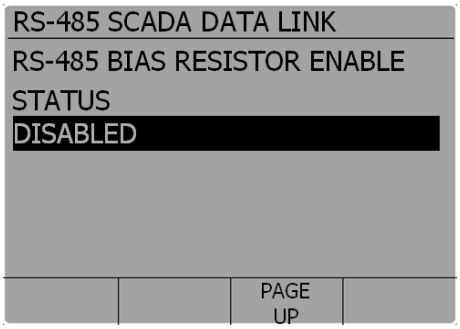
Select the **SCADA DATA LINK SLAVE ADDRESS** that you want.

Press the **OK KEY** OK.



Scroll **DOWN** to **RS-485 BIAS RESISTOR ENABLE STATUS**

Press the **OK KEY** OK to edit the current **RS-485 BIAS RESISTOR ENABLE STATUS.**



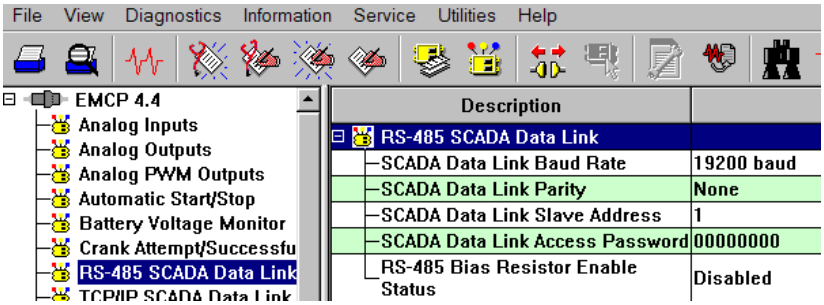
Select the **RS-485 BIAS RESISTOR ENABLE STATUS** that you want to program

Press the **OK KEY** OK.

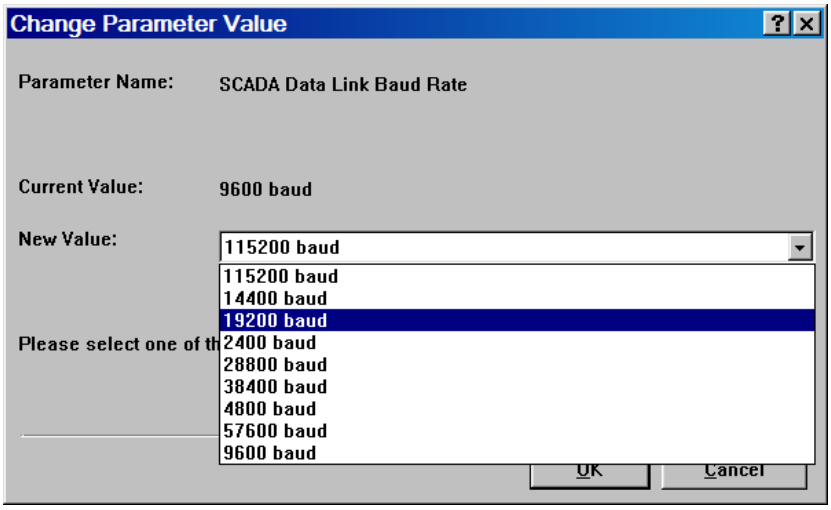
CONFIGURING THE SCADA DATA LINK USING THE CAT SERVICE TOOL

The EMCP 4 SCADA Data Link can be configured using the Cat Service Tool. To program this Data Link, do the following steps:

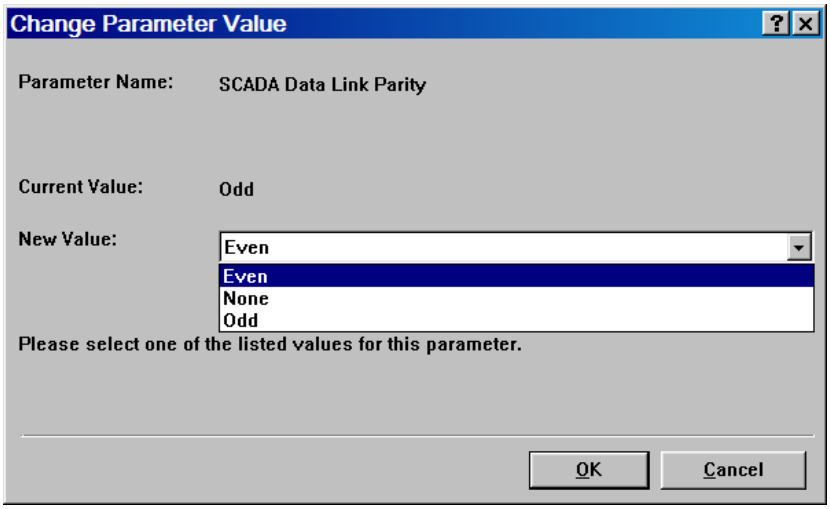
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select RS-485 SCADA Data Link on the left.



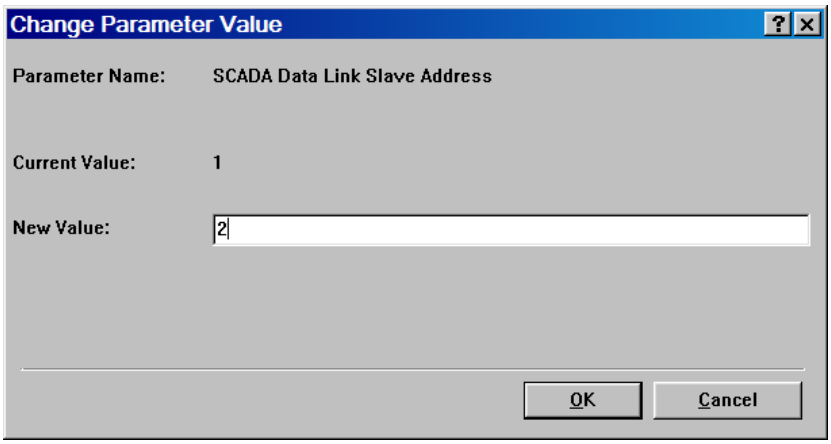
3. Double click SCADA Data Link Baud Rate to change this to the desired value from the drop down menu. Click the OK button to program.



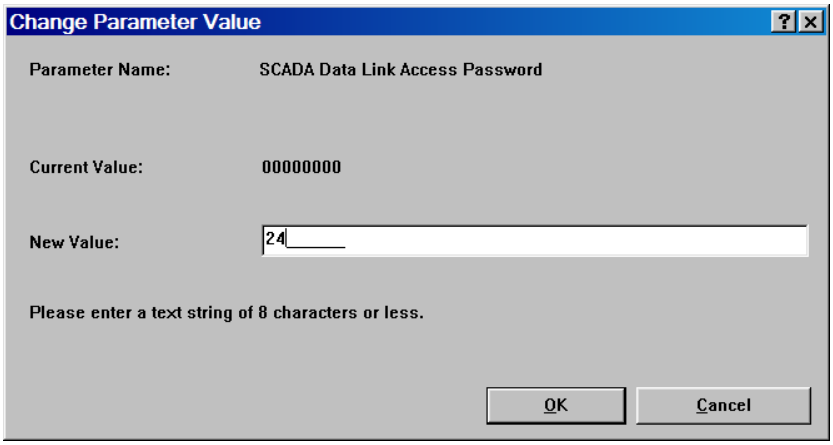
4. Double click SCADA Data Link Parity to change this value from the drop down menu. Click the OK button to program.



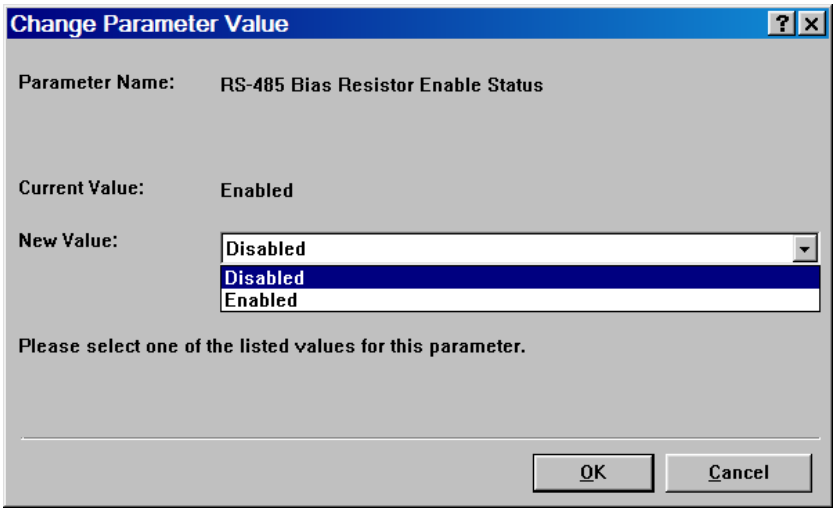
5. Double click SCADA Data Link Slave Address. Change this value by typing a new value. Click the OK button to program.



6. Double click SCADA Data Link Access Password. Change this value by typing a new value. Click the OK button to program.



7. Double click RS-485 Bias Resistor Enable Status to change this value from the drop down menu. Click the OK button to program.

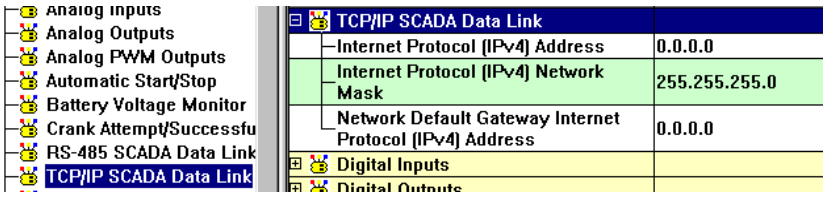


22 MODBUS TCP/IP DATA LINK COMMUNICATIONS

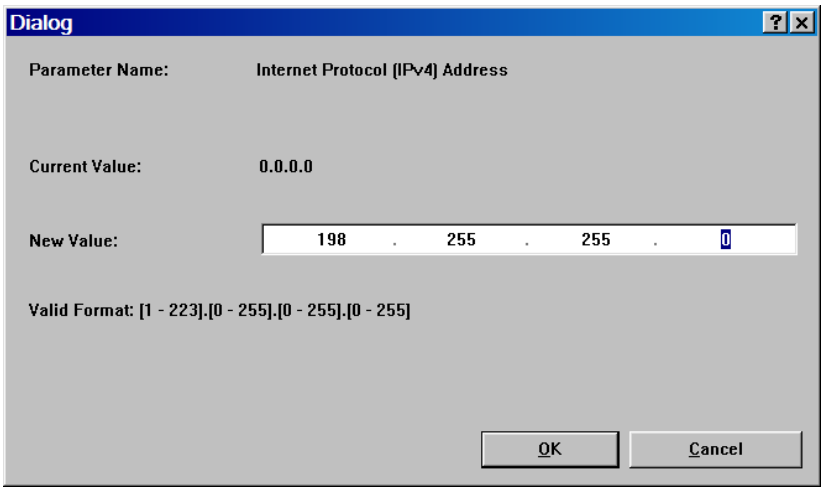
The EMCP 4.3 and 4.4 have a Modbus TCP/IP data link for customer monitoring and control. This data link allows for remote monitoring of all parameter data visible on the display and the service tool. It also allows for data link based control of outputs. The Modbus TCP/IP functionality is similar to the Modbus RTU data link, but with much higher speed capability. All UDP messages are automatically filtered out.

In addition, this data link can be used for interfacing with Cat Switchgear.
In order to configure the Modbus TCP/IP data link, the service tool is required. To program this Data Link, do the following steps:

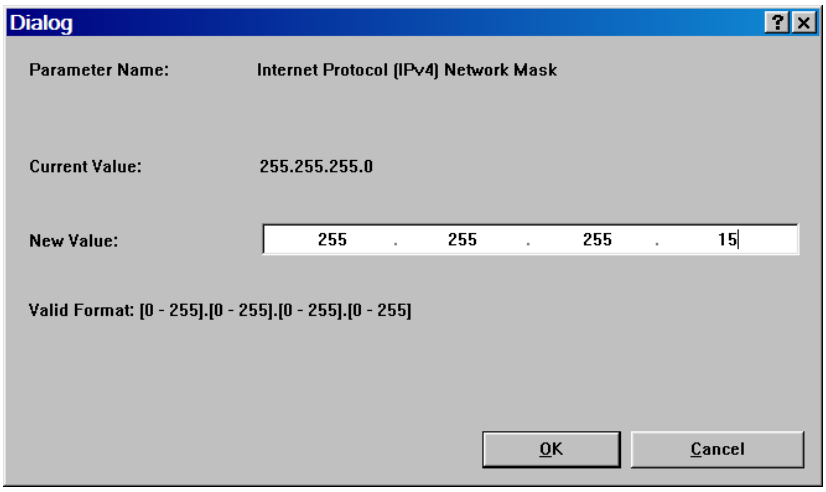
1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Select TCP/IP Data Link on the left.



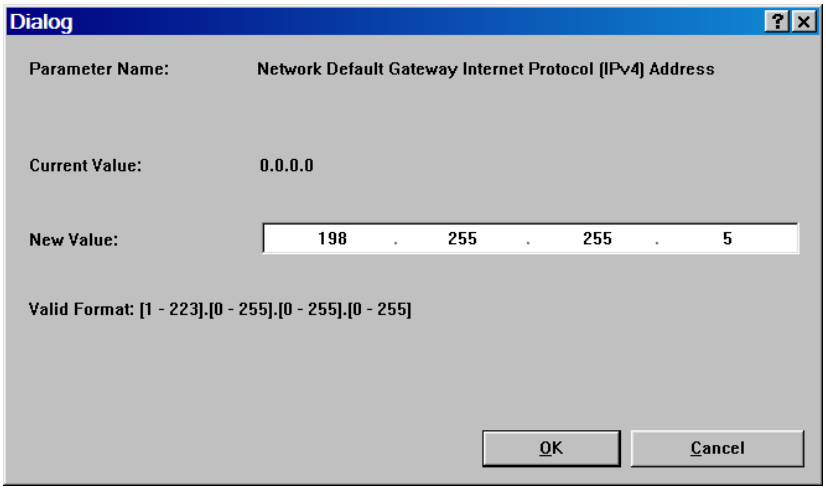
3. Double click Internet Protocol Address to change this to the desired value. Click the OK button to program.



4. Double click Internet Protocol Network Mask to change this to the desired value. Click the OK button to program.



5. Double click Network Default Gateway Internet Protocol Address to change this to the desired value. Click the OK button to program.



These setpoints will need to be changed from 0.0.0.0 prior to first use.

23 INSTALLING & UPGRADING SOFTWARE

The EMCP 4 supports field-programming (called flashing) of software for all of the modules. This is done by using the Cat Service Tool software and a Cat Communication Adapter. The Primary Data Link (CAN 1) service connector must be used for modules connected to the Primary Data Link. The Accessory Data Link (CAN 2) service connector must be used for modules connected to the Accessory Data Link. Refer to your generator set package documentation for the location of the service connectors.

To flash the EMCP 4 requires the following hardware and software:

SOFTWARE AND HARDWARE REQUIRED

- ☑ The Cat Service Tool software installed and licensed on a PC
- ☑ A Cat Communication Adapter
- ☑ A 9-pin Deutsch service connection to the Primary Data Link (CAN 1)
- ☑ The new application software flash file for the EMCP 4

In order to install software into the EMCP 4, the genset must be stopped. If upgrading software, it may be important to back up the current configuration (see Chapter 15). Flashing application software does not affect the setpoints. However, if a problem occurs during flashing, this backup can be used to quickly configure a replacement module.

Record the current software version information. This is seen in the ECM Summary screen. See Figure 75. This is information is useful to obtain the correct flash file if it is desired to return to the previous version of software after flashing.

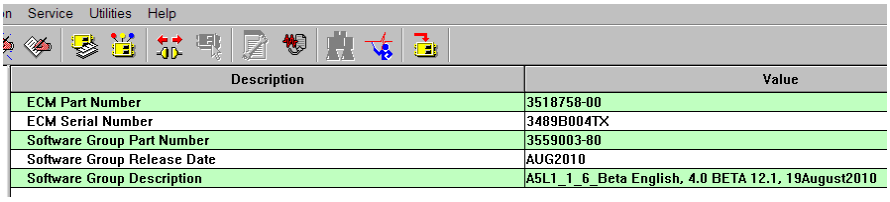
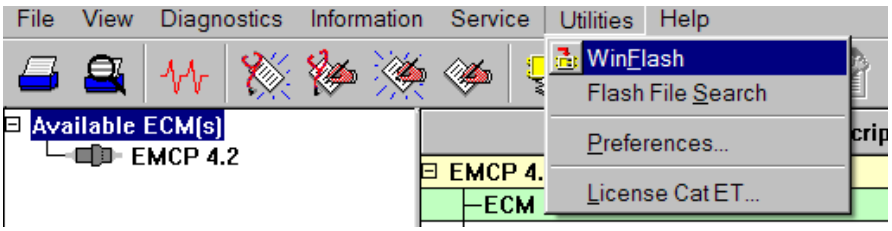


Figure 75: ECM Summary Information

Flashing of modules other than the EMCP 4 follow similar steps as the ones outlined below.

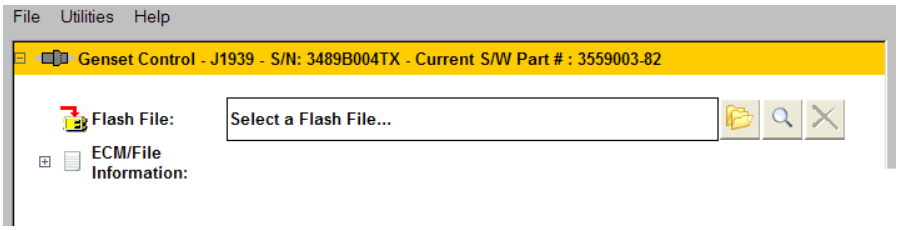
In order to flash an EMCP 4 module, do the following steps:

1. Connect to the EMCP 4 using the Cat Service Tool as stated in Section 4.2.
2. Enter the WinFlash Utility by selecting Utilities > WinFlash,



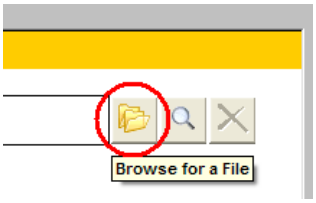
or by clicking the WinFlash Icon.

3. The WinFlash screen will appear.

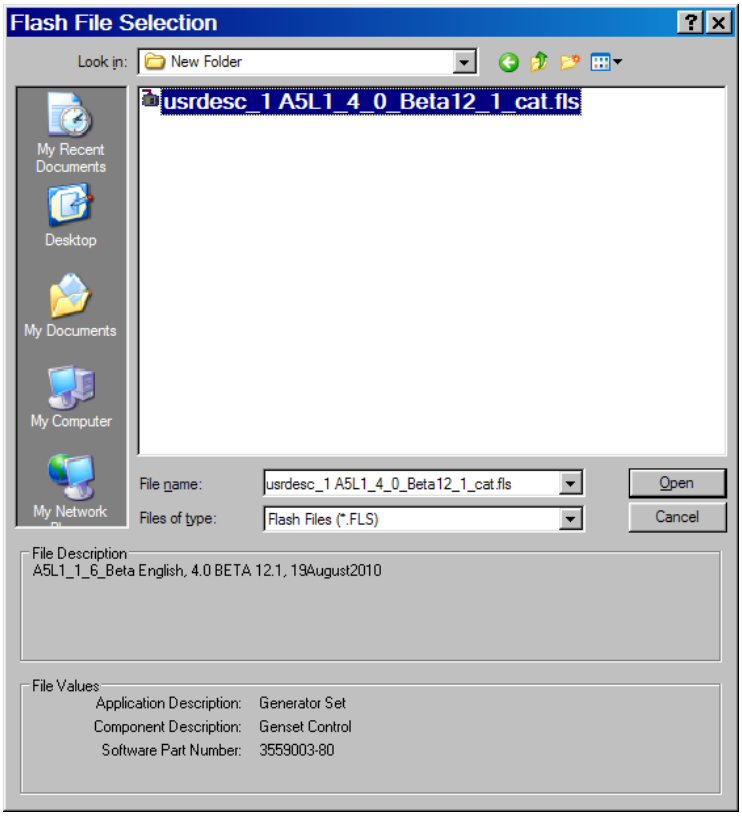


Note: If WinFlash does not find all of the modules on the J1939 data link to which it is connected, re-scan the data link by pressing F8 (or selecting File > Update ECM List).

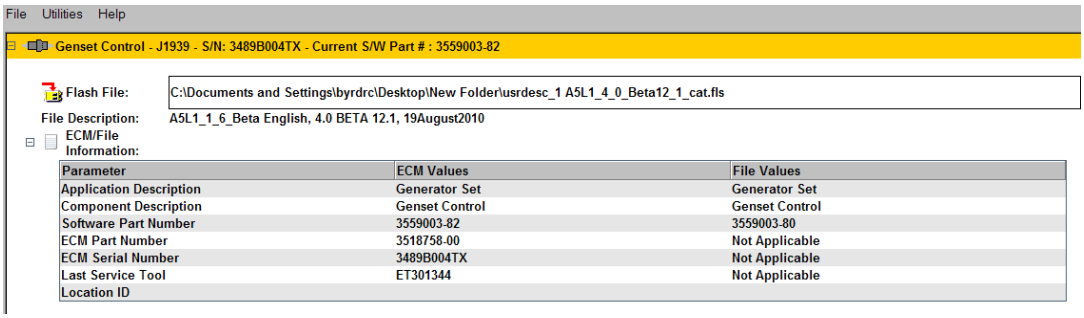
4. Select the Genset Control if multiple modules are listed, then click the “Browse for a File” button on the right hand side.



5. Browse to the appropriate file and click “Open”.

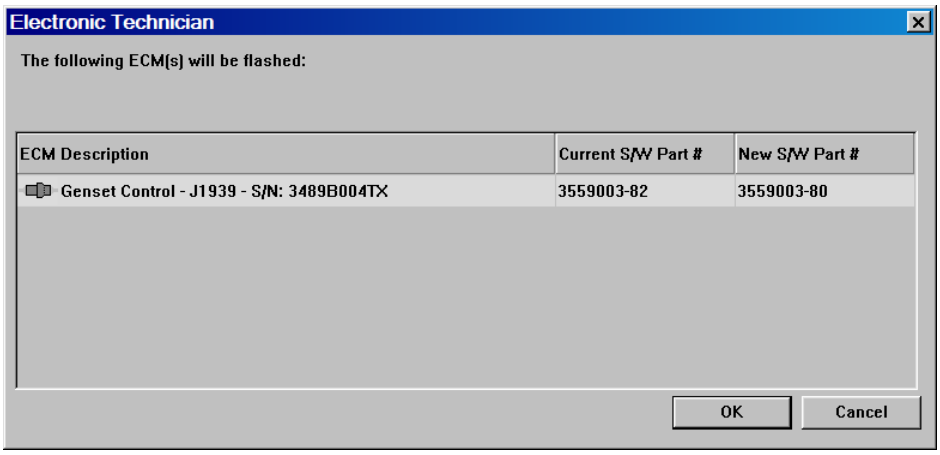


6. The new file information will be displayed.

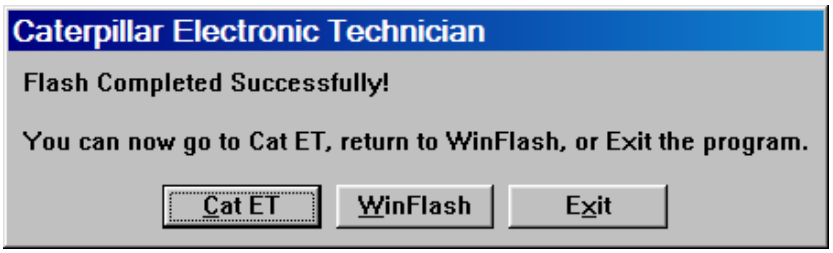


7. Click “Begin Flash” in the lower left corner.

8. A confirmation screen will appear. Click “OK”.



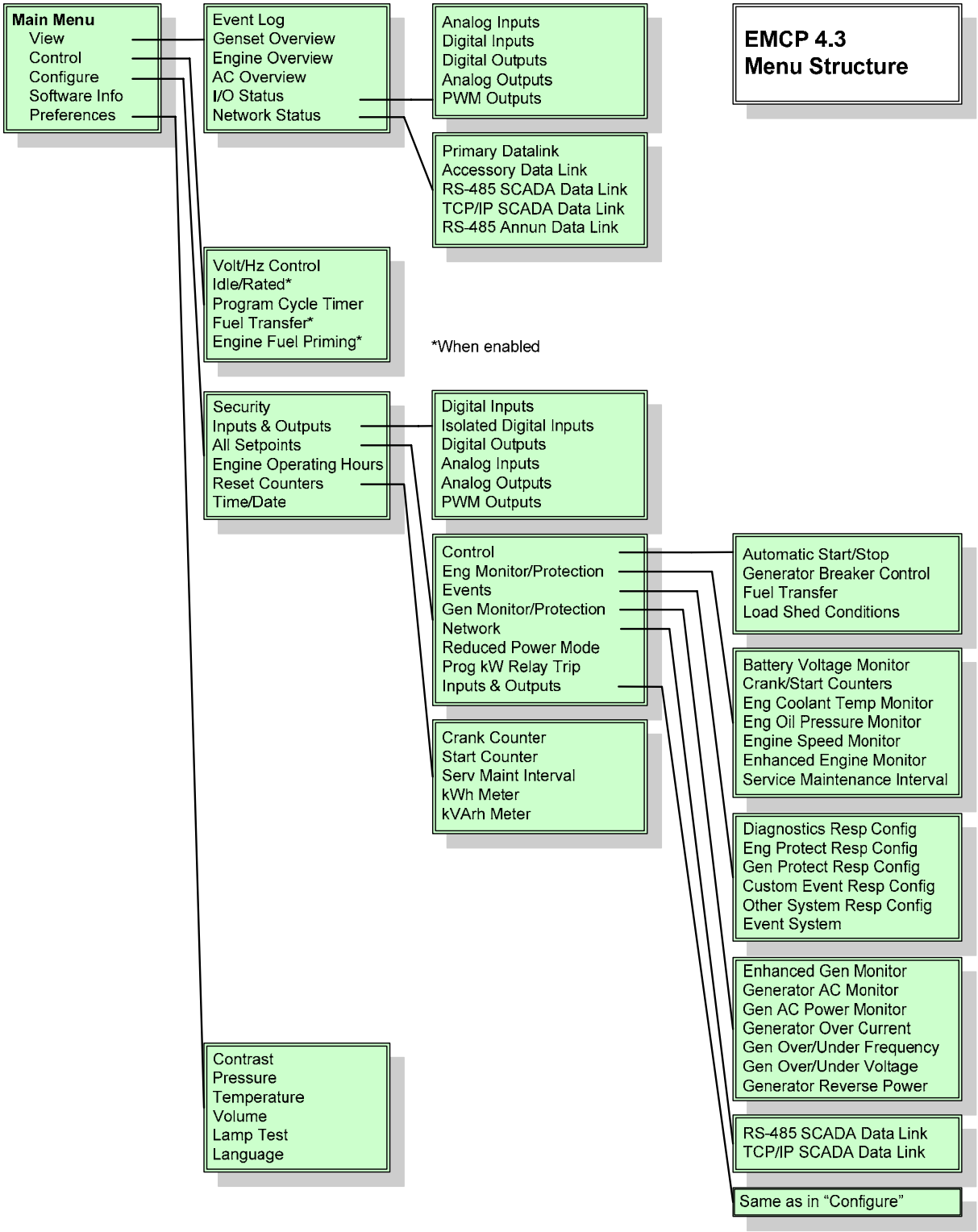
9. A progress meter will show the status of the flash and the EMCP display will show that software installation is occurring.
10. When the flashing process is complete, the ECM that was flashed will reboot. Also, WinFlash will bring up a window giving options for what to do next. This indicates that the software has finished flashing, and is ready to use.

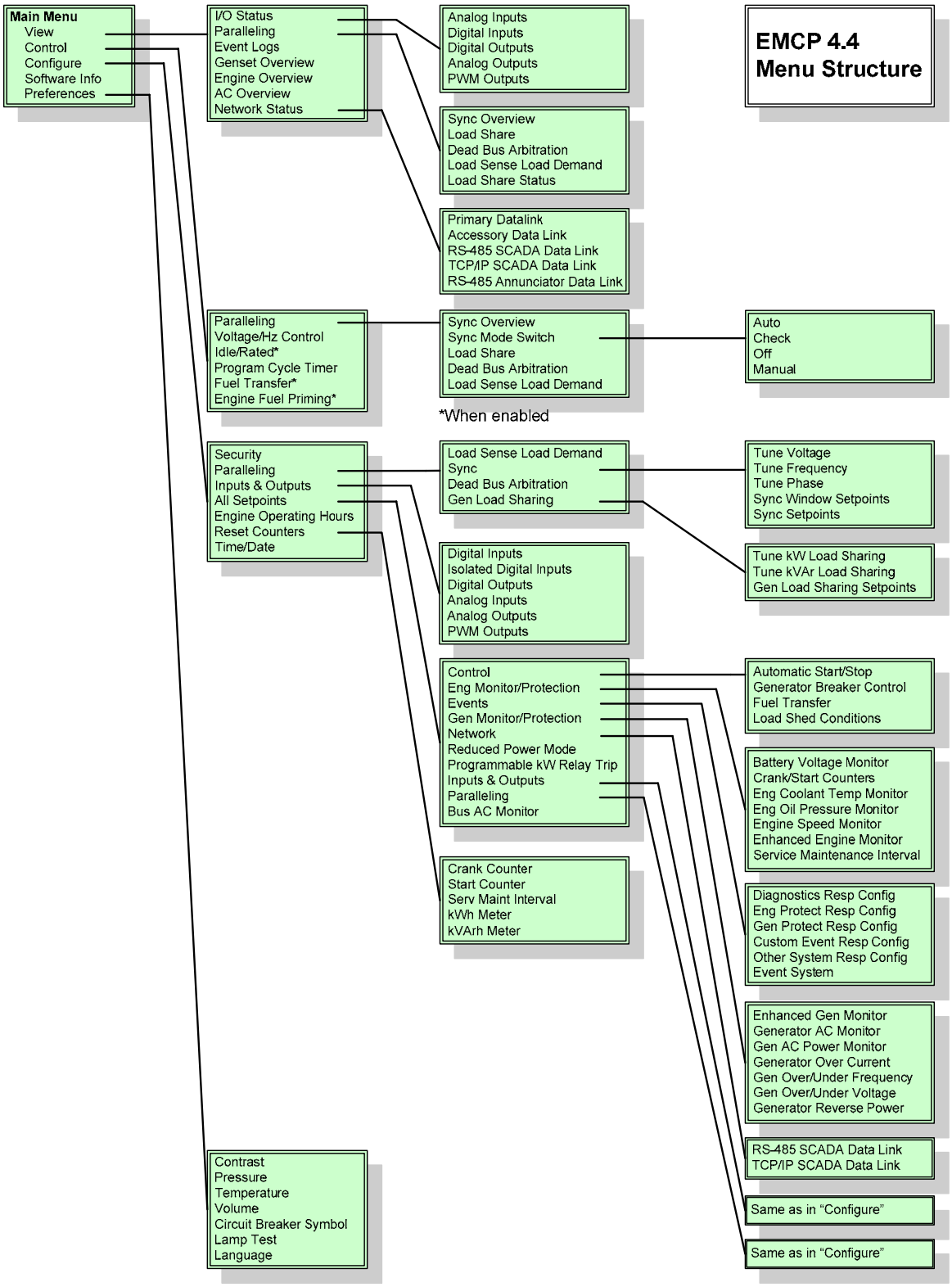


11. On startup, the EMCP 4 shows the software part number. Verify the software part number matches the new application software that was flashed.

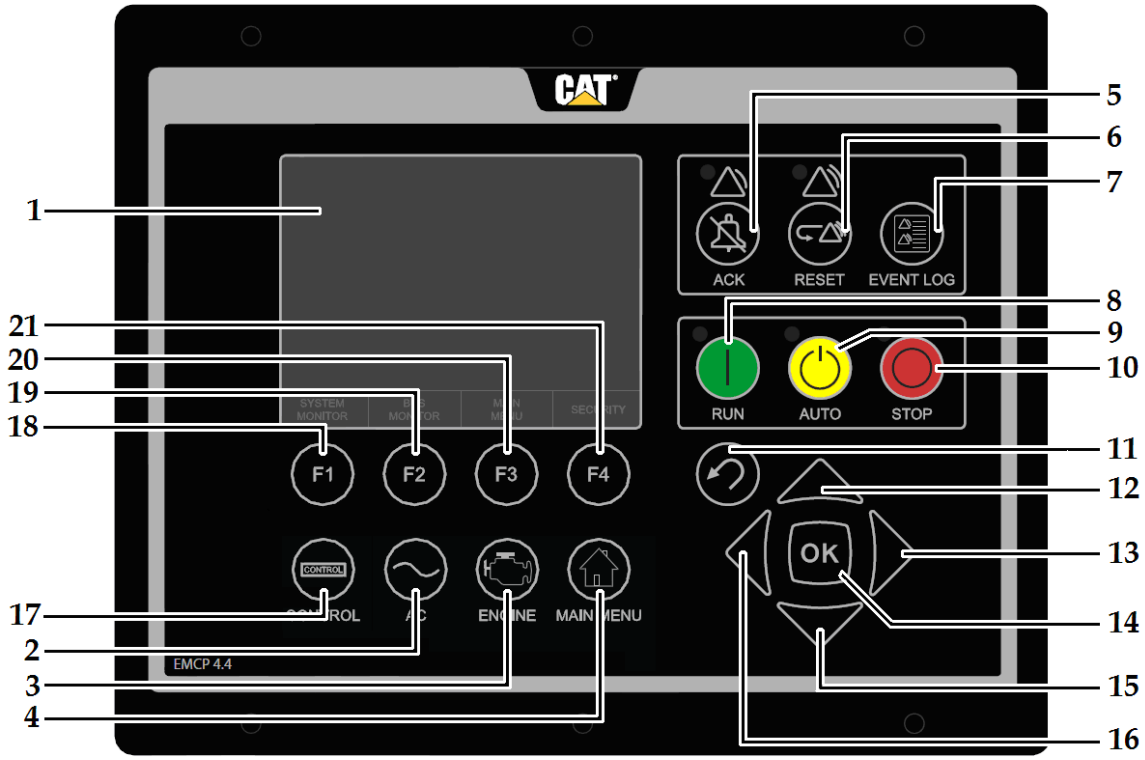
APPENDIX A MENU STRUCTURES

For details on the setpoints available within each submenu, refer to the appropriate section above.





APPENDIX B EMCP 4 FRONT VIEW & NAVIGATION KEYS



EMCP 4.3 AND 4.4

(1) Display Screen
(2) AC Overview Key
(3) Engine Overview Key
(4) Main Menu Key
(5) Alarm Acknowledge/Silence Key with Yellow Warning Lamp
(6) Event Reset Key with Red Shutdown Lamp
(7) Event Log Key
(8) Run Key
(9) Auto Key
(10) Stop Key
(11) Escape Key
(12) Scroll Up Key
(13) Scroll Right Key
(14) OK Key
(15) Scroll Down Key
(16) Scroll Left Key
(17) Control Key
(18) F1 Soft Key
(19) F2 Soft Key
(20) F3 Soft Key
(21) F4 Soft Key

(1) SCREEN Displays various genset information and parameters.

(2) AC OVERVIEW The AC Overview Key will navigate the display to the first screen of AC information. The AC Overview Key information contains various AC parameters that summarize the electrical operation of the generator set.

(3) ENGINE OVERVIEW The Engine Overview Key will navigate the display to the first screen of engine information. The Engine Overview information contains various engine parameters that summarize the operation of the generator set.

(4) MAIN MENU The Main Menu key will navigate the display to the main menu

directly without having to navigate out of menus.

(5) ALARM ACKNOWLEDGE / SILENCE Pressing the Alarm Acknowledge/Silence Key will cause the horn Relay Output to turn off and silence the horn. Pressing the key will also cause any amber or red flashing lights to turn off or to become solid depending on the active status of the alarms. The Alarm Acknowledge/Silence Key may also be configured to send out a global alarm silence on the CAN Data Link which will silence horns on Annunciators, if the CAN Annunciator is configured to respond.

(6) EVENT RESET The Event Reset button will clear all inactive fault conditions.

(7) EVENT LOG The Event Log button will navigate the display to the list of event logs.

(8) RUN Pressing the RUN Key will cause the EMCP to enter the RUN mode.

Note: If a Digital Input is programmed for ECS in Auto, or Stop, and a maintained switch latches that input to make it active, the front panel RUN key will not have any effect.

(9) AUTO Pressing the AUTO Key will cause the EMCP to enter the AUTO mode.

Note: If a Digital Input is programmed for ECS in RUN, or Stop, and a maintained switch latches that input to make it active, the front panel AUTO key will not have any effect.

(10) STOP Pressing the STOP Key will cause the EMCP to enter the STOP mode.

Note: If a Digital Input is programmed for ECS in Auto, or RUN, and a maintained switch latches that input to make it active, the front panel STOP key will not have any effect.

(11) ESCAPE The Escape Key is used during menu navigation in order to navigate up through the menu/sub-menu structure. Each key press causes the user to move backwards/upwards through the navigation menus. The Escape Key is also used to cancel out of data entry screens during setpoint programming. If the Escape Key is pressed during setpoint programming, none of the changes made on screen will be saved to memory. Pressing this key will bring the user back one menu/submenu.

(12) SCROLL UP The Scroll Up Key is used to navigate up through the various menus or monitoring screens. The Scroll Up Key is also used during setpoint entry. During numeric data entry the Scroll Up Key is used in order to increment the digits (0-9). If the setpoint requires selection from a list, the Scroll Up Key is used to navigate through the list.

(13) SCROLL RIGHT The Scroll Right Key is used during setpoint adjustment. During numeric data entry, the Scroll Right Key is used to choose which digit is being edited. The Scroll Right Key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside the box, pressing the Scroll Right Key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside the box, pressing the Scroll Right Key will cause a check mark to appear, enabling the function.

(14) OK The OK Key is used during menu navigation to select menu items in order to navigate forward/downward in the menu/sub-menu structure. The OK Key is also used during setpoint programming in order to save setpoints changes. Pressing the OK Key during setpoint programming causes setpoint changes to be saved to memory.

(15) SCROLL DOWN The Down Key is used to navigate down through the various menus or monitoring screens. The Down Key is also used during setpoint entry. During numeric data entry the Down Key is used in order to decrement the digits (0-9). If the setpoint requires selection from a list, the Down Key is used to navigate down through the list.

(16) SCROLL LEFT The Scroll Left Key is used during setpoint adjustment. During numeric data entry, the Scroll Left Key is used to choose which digit is being edited. The Scroll Left Key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside the box, pressing the Scroll Left Key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside the box, pressing the Scroll Left Key will cause a check mark to appear, enabling the function.

(17) CONTROL The Control key will navigate the display to the screen that allows the user to monitor and/or adjust various special control features.

(18) F1 Pressing the F1 key will enable the function that is described on the screen directly above this key. When this key is defined on screen to scroll the screen up or down, the Scroll Up and Scroll Down keys will also function in that same capacity.

(19) F2 Pressing the F2 key will enable the function that is described on the screen directly above this key. When this key is defined on screen to scroll the screen up or down, the Scroll Up and Scroll Down keys will also function in that same capacity.

(20) F3 Pressing the F3 key will enable the function that is described on the screen directly above this key. When this key is defined on screen to scroll the screen up or down, the Scroll Up and Scroll Down keys will also function in that same capacity.

(21) F4 Pressing the F4 key will enable the function that is described on the screen directly above this key. When this key is defined on screen to scroll the screen up or down, the Scroll Up and Scroll Down keys will also function in that same capacity.

ALARM INDICATORS

AMBER WARNING LIGHT

The Amber Warning Light is located directly above the Alarm Acknowledge/Silence Key (5). A flashing amber light indicates that there are unacknowledged active warnings. A solid amber light indicates that there are acknowledged warnings active. If there are any active warnings, the amber light will change from flashing amber to solid amber after the Alarm Acknowledge/Silence Key (5) is pressed. If there are no longer any active warnings, the amber light will turn off after the Alarm Acknowledge/Silence Key (5) is pressed.

RED SHUTDOWN LIGHT

The Red Shutdown Light is located directly above the Event Reset Key (6). A flashing red light indicates that there are unacknowledged active shutdown events. A solid red light indicates that there are acknowledged shutdown events active. If there are any active shutdown events the red light will change from flashing red to solid red after the Alarm Acknowledge/Silence Key (5) is pressed. Any condition that has caused an EMCP shutdown event must be manually reset. If there are no longer any active shutdown events, the red light will turn off.

Glossary of Terms

EMCP 4	Electronic Modular Control Panel 4. This is the Cat generator set control panel, consisting of a generator set control (GSC).
ECM	Electronic Control Module. This is a general term and can refer to any microprocessor-based module that is part of a control system. The engine ECM is an ECM dedicated to the task of engine timing and air/fuel control.
FMI	Failure Mode Indicator. The CAN term for a failure code associated with a particular Suspect Parameter Number. For a complete list of FMI codes, refer to the Systems Operation Troubleshooting Testing and Adjusting guide.
GSC	Generator Set Controller. This is the module responsible for the overall generator protection and control functions. It is the master module on the generator set, interfacing with the user as well as the engine ECM and any other accessory modules.
RMS	A mathematical approach of representing a useful average for varying quantities; this is useful to indicate AC quantities.
RS-232	Recommended Standard 232, maintained by the Electronics Industries Alliance (EIA). Also known as EIA-232.
RS-485	Recommended Standard 485, maintained by the Electronics Industries Alliance (EIA). Also known as EIA-485.
RTU	Remote Transmitter Unit. This term refers to a Slave device in a MODBUS network that merely responds to requests from the Master. The EMCP 4.2 can function as an RTU on a SCADA system via the RS-485 SCADA port.
SCADA	Supervisory Control And Data Acquisition. This term represents any computing system designed to perform high-level control and monitoring over various subsystems. On the EMCP 4, we provide a MODBUS interface to allow any SCADA systems to connect and collect data about the operations of the control and the generator set(s).
SPN	Suspect Parameter Number. The CAN term for any parameter whose data is transmitted over a CAN network, such as the EMCP 4 primary or accessory data link. For a complete list of SPNs supported by the EMCP 4, refer to the Diagnostic Trouble Code List in the Systems Operation Troubleshooting Testing and Adjusting guide.

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