APPLICATION AND INSTALLATION GUIDE

EMCP 3.1, 3.2, 3.3 GENERATOR SET CONTROL

CATERPILLAR®

Foreword

This section of the Application and Installation Guide generally describes Gas Engine Emissions for Caterpillar® engines listed on the cover of this section. Additional engine systems, components and dynamics are addressed in other sections of this Application and Installation Guide.

Engine-specific information and data is available from a variety of sources. Refer to the Introduction section of this guide for additional references.

Systems and components described in this guide may not be available or applicable for every engine.

Some emission levels and values in this guide are generalized and are provided only for the purpose of comparison.

Table of Contents

List of Figures

1 General Information

1.1 Companion Media Number

This document has media number, LEBE5255. It also has a companion media number, LERE5255. If only one of the media numbers is ordered, the other is shipped automatically, but separately. LERE5255 is a mini-CD that contains printable files of schematics found in this document on pages 8, 9, 10, 113, 114, and 115. The schematics are delivered in an 8.5”x11” format in this document.

1.2 Introduction

Caterpillar® has developed a new product line of Generator Set Controls for use in the Electronic Modular Control Panel 3 (EMCP 3). They are available in several versions based on different feature sets. Figure 1 shows a full view of the EMCP 3 system panel.

Figure 1: EMCP 3 Control System Panel

The EMCP 3 Generator Set Control, or GSC, is the primary controller within the EMCP 3 system panel. It contains the primary operator and service interface. The inset photo shows an up-close view of the Generator Set Control. The EMCP 3 line of Generator Set Controllers includes EMCP 3.1, EMCP 3.2, and EMCP 3.3.

This Application and Installation Guide is intended to cover the EMCP 3 Generator Set Control and its application in generator set systems. The intended audience for this guide includes Caterpillar generator set system designers, Caterpillar service support personnel, Caterpillar Dealers and Service Technicians, contractors, and customers.

1.3 Applications

The EMCP 3 product line of generator set controllers is designed for use in a wide range of applications. They can be used on standby and prime power diesel generator sets including Caterpillar®, Perkins®, and Olympian® brands. 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.

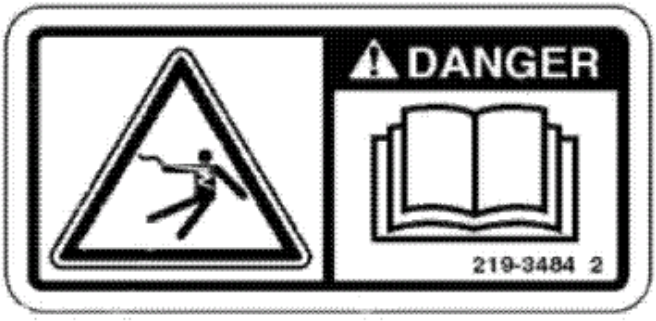
1.4 References

The following list of literature is available for EMCP 3 Generator Sets.

RENR7902	EMCP 3 Systems Operation Troubleshooting Testing and Adjusting
SEBU7898	C18 Generator Set Operation and Maintenance Manual
SEBU7509	3500 Generator Sets Operation and Maintenance Manual
SEBU7508	3500B Generator Sets Operation and Maintenance Manual

2 Safety Information

2.1 Electrical Safety



WARNING

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 Caterpillar dealer for replacement manuals. Proper care is your responsibility.

2.2 Electrostatic Discharge Awareness

EMCP 3 control contains components that are sensitive to electrostatic discharge (ESD). An electrostatic charge can damage the control resulting in EMCP 3 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 the anti-static bag for any other purpose than to enclose a product.
-

NOTICE

The 70-pin connector on the back of the control is the most vulnerable area to ESD. Make sure extra attention is addressed to this area while handling the EMCP 3. If extra care is not taken while handling this area of the control, the control may become damaged or inoperable.

If not sure about a proper procedure for particular situations, consult the Electrostatic Discharge Association, www.esda.org

3 Installation

3.1 Power Requirements

The EMCP 3 series of generator set controls require a nominal voltage of 12 Vdc or 24 Vdc. 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. Under steady state operation, the EMCP 3.1, 3.2, and 3.3 GSCs have a 1.5 amp current draw (not including any relay loads).

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 3 generator set control 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. An example is shown in Figure 2.

As shown in the figure below, 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. The chassis ground is a common Power and Transient Ground.

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

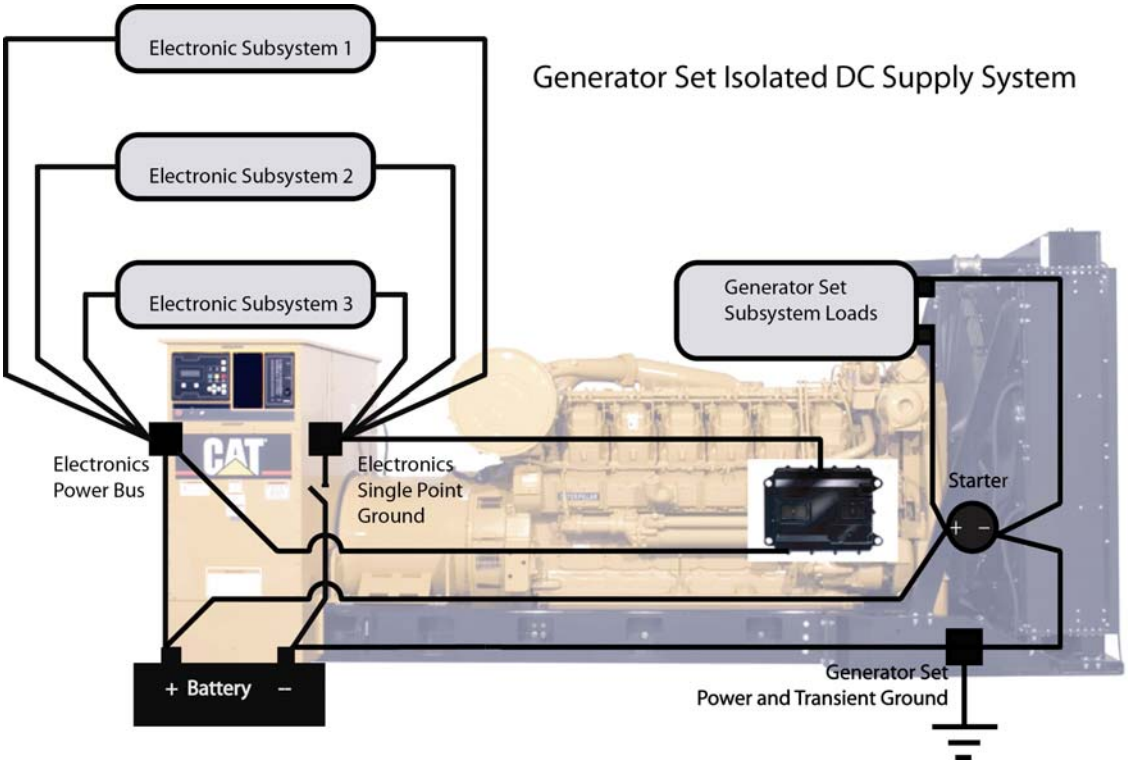


Figure 2: Generator Set Network Isolation

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

3.2 Location Considerations

When selecting a location for mounting the EMCP 3 generator set control, consider the following:

- Protection from high-voltage and high-current devices
- Protection from devices which may produce electromagnetic interference
- Protection from excessive vibration. The controls are designed to withstand normal generator set vibrations. The controls should not be mounted directly to the engine block.
- Protection from direct exposure to water. Once installed, the EMCP 3.1, 3.2, and 3.3 controls are sealed to a level of IP Level 22 for resistance to moisture.
- The continuous operating range of the EMCP 3 generator set controls is –20 to +70 °C ambient.

3.3 Electrical Connections

The EMCP 3 control has one 70-pin connector on the back of the control. Not all 70 pins are used. The following diagrams show what pins are used and what each pin should be connected to for each version of the control.

The figures below are shown with all possible connections used. For EUI engines, the passive analog inputs number 1 and 2 will not be used. These are for oil pressure and coolant temperature respectively. On EUI engines, those sensors will be wired to the engine ECM and the EMCP 3 will get that information from the engine ECM via the Primary J1939 Data Link. For more information about the passive inputs, see section 3.9, “Analog Inputs”.

The figures show two different ways to connect the analog inputs. The method shown with all of the other connections is for 2-wire sensors. At the bottom right hand side of the figures, the connections for 1-wire sensors is shown.

The discrete inputs are shown connected through normally open contacts to battery negative. These inputs can also be connected through normally closed contacts to battery negative. In order to do this the active state of the input will need to be set to active high. For information on how to program the digital inputs, see section 3.8, “Digital Inputs”.

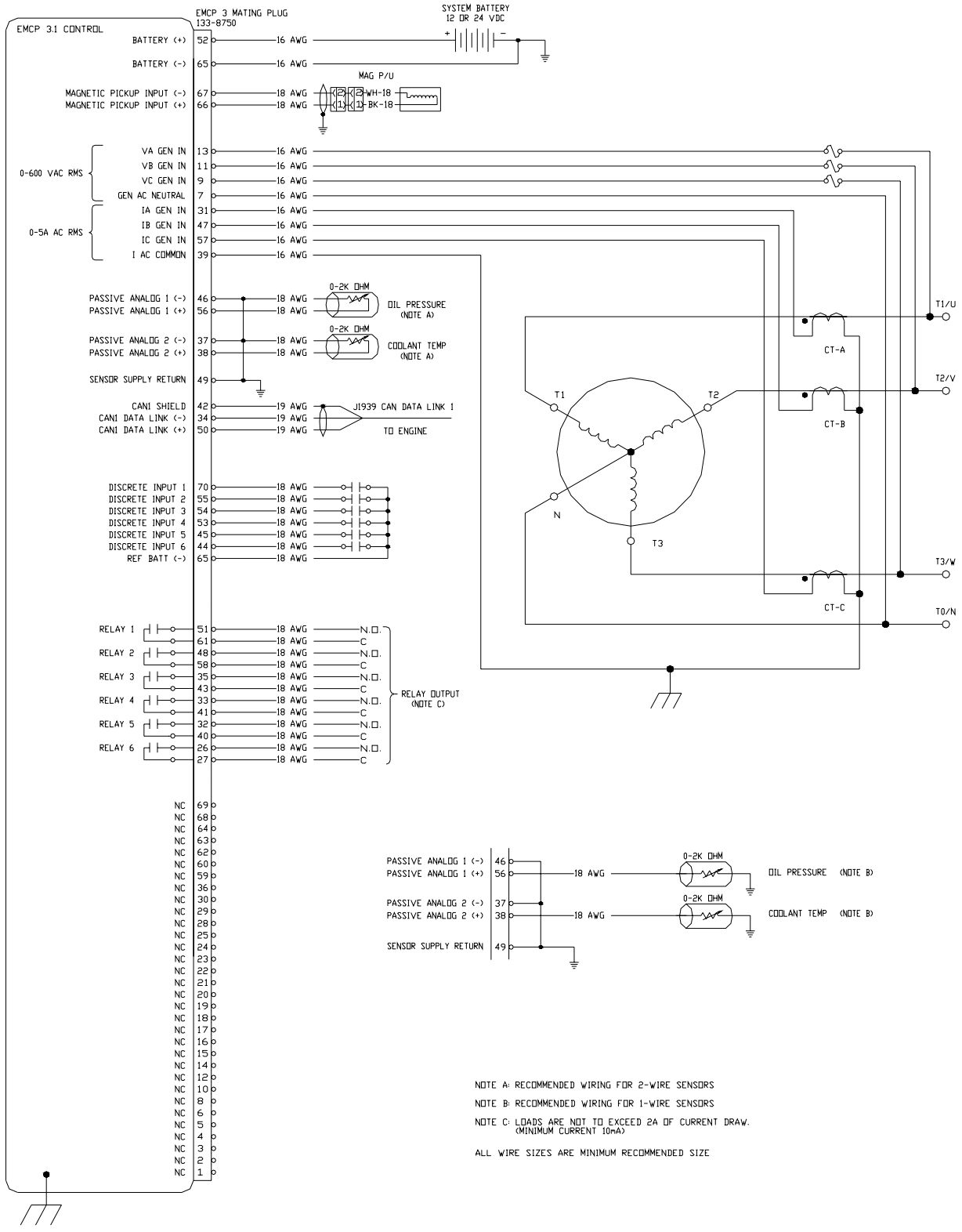


Figure 3: EMCP 3.1 Control Electrical Connections
(Refer to LERE5255 for a printable .pdf file.)

(Refer to LERE5255 for a printable .pdf file.)

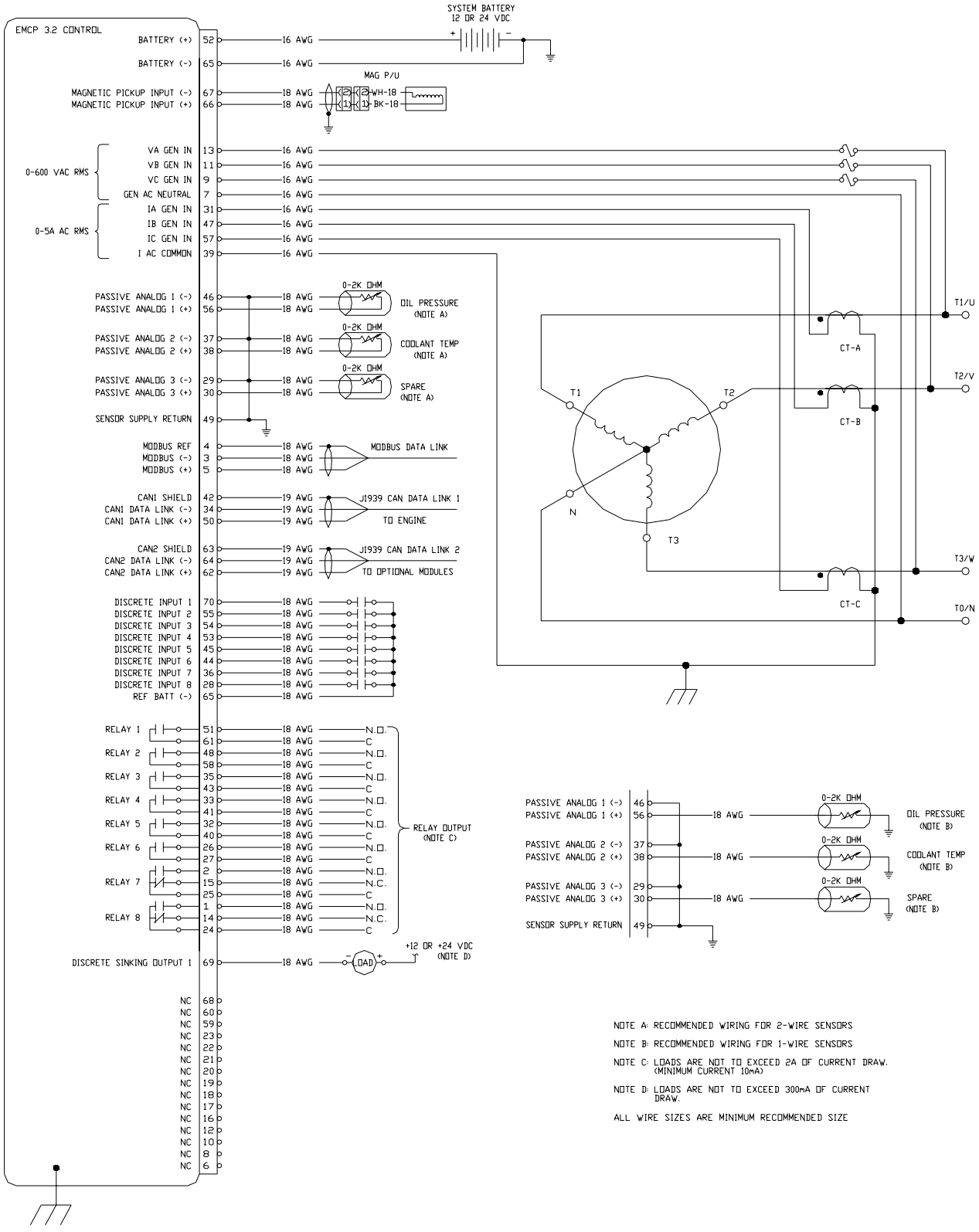


Figure 4: EMCP 3.2 Control Electrical Connections
(Refer to LERE5255 for a printable .pdf file.)

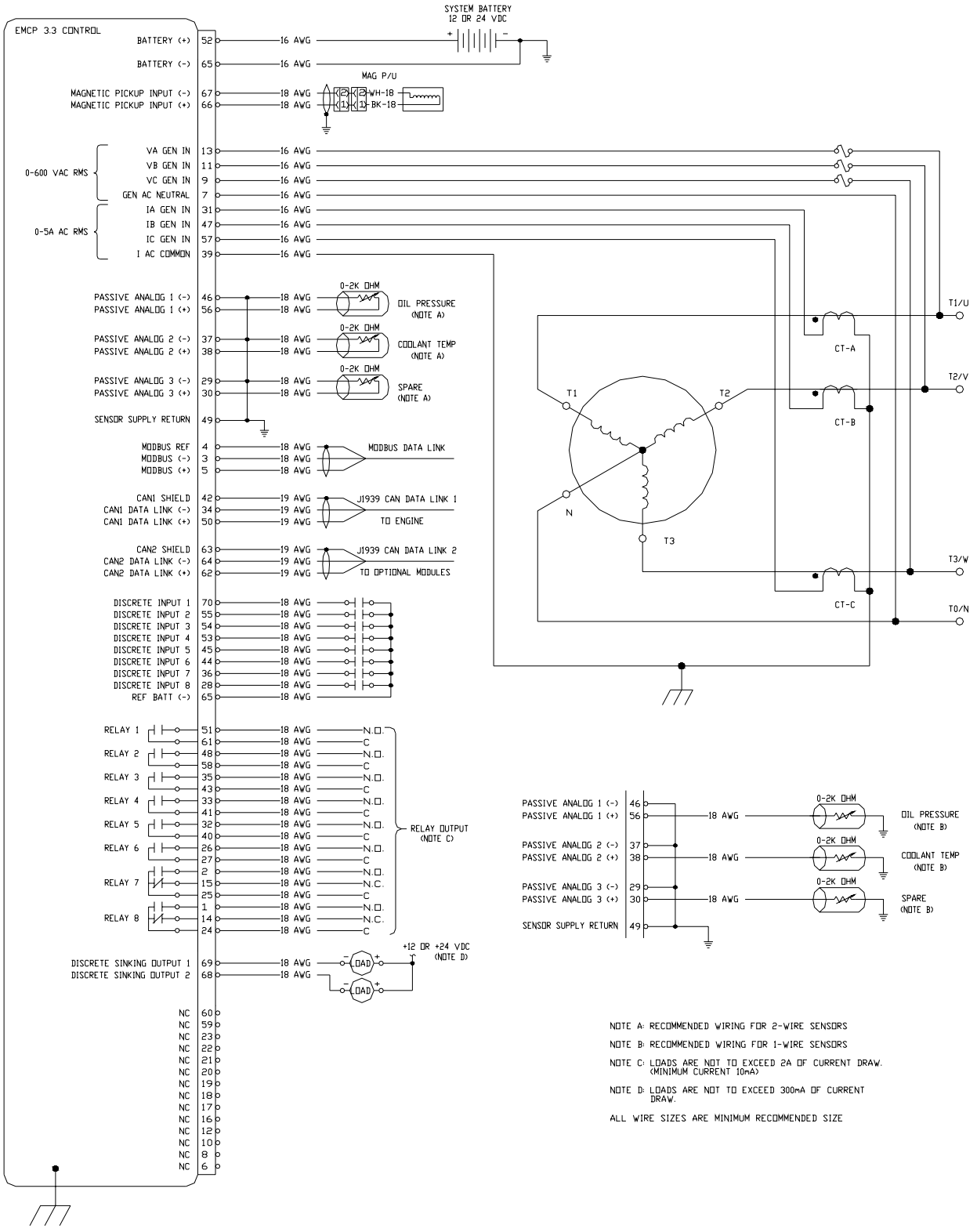


Figure 5: EMCP 3.3 Control Electrical Connections
(Refer to LERE5255 for printable .pdf)

3.4 Transformer Connections

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

	Star	3-Wire Delta	4-Wire Delta	2-Wire 1-Phase	3-Wire 1-Phase
Gen Freq (0066h)	OK	OK	OK	OK	OK
$\mathbf{V_{L\text{-}L\ AVG}}$ (0064h)	OK	OK	OK	OK	OK
$\mathbf{V_{A\text{-}B}}$ (006Ch)	OK	OK	OK	OK	OK
$\mathbf{V_{B\text{-}C}}$ (006Dh)	OK	OK	OK	Invalid	Invalid
$\mathbf{V_{C\text{-}A}}$ (006Eh)	OK	OK	OK	Invalid	Invalid
$\mathbf{V_{L\text{-}N\ AVG}}$ (0094h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_A}$ (0072h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_B}$ (0073h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_C}$ (0074h)	OK	Invalid	OK	Invalid	Invalid
$\mathbf{I_{AVG}}$ (0065h)	OK	OK	OK	OK	OK
$\mathbf{I_A}$ (006Fh)	OK	OK	OK	OK	OK
$\mathbf{I_B}$ (0070h)	OK	OK	OK	OK	OK
$\mathbf{I_C}$ (0071h)	OK	OK	OK	Invalid	Invalid

Note: The EMCP 3 must be programmed for the correct winding ratios when connecting external potential transformers. See “Setpoint Programming” for more information on how to program the winding ratios.

Note: 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.

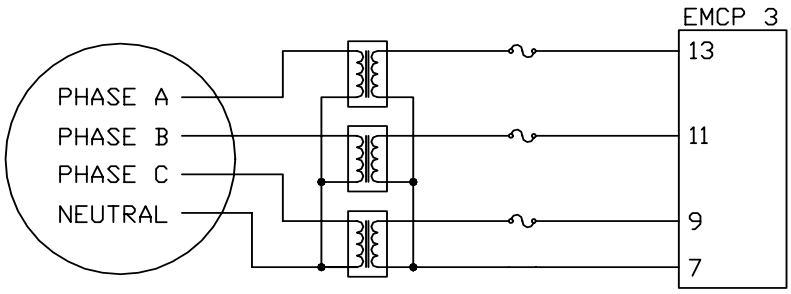


Figure 6: Wye Configuration of External Potential Transformers (PT) on the 4-Wire Wye Connected Generator

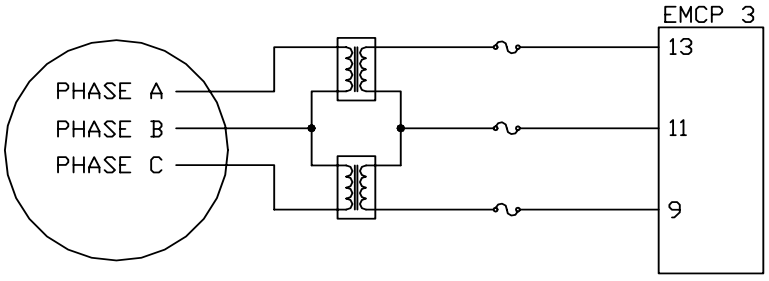


Figure 7: Open Delta Configuration of External Potential Transformers (PT) on the 3-Wire Delta Connected Generator

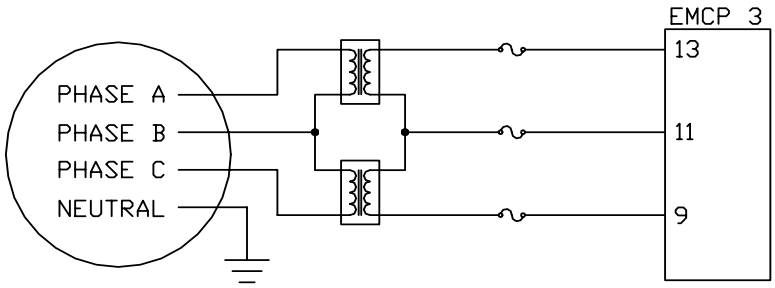


Figure 8: Open Delta Configuration Of External Potential Transformers (PT) on the 4-Wire Wye Connected Generator

3.5 Wiring Requirements

50 Foot Requirements			
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 minus 40º C (40º F) to plus 125º C (257º F).	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 and some data links)	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 minus 40º C (40º F) to plus 125º C (257º F).	
Engine Solenoids (Air Shutoff)	10	Stranded wire normally used on engine harnesses. The cable must be resistant to fuel and oil. The cable must have a temperature range of minus 40º C (40º F) to plus 125º C (257º F).	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			

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

300 Foot Requirements			
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 minus 40 C (40 F) to plus 125 C (257 F).	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 and some data links)	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 minus 40º C (40º F) to plus 125º C (257º F).	
Engine Solenoids (Air Shutoff)	8	Stranded wire normally used on engine harnesses. The cable must be resistant to fuel and oil. The cable must have a temperature range of minus 40º C (40º F) to plus 125º C (257º F).	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			

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

Shielded Wiring

The shielded twisted pair cable was selected for the J1939 data links and the magnetic speed sensor. These cables were chosen for maximum protection against inductive noise. The cables are also protected from electromagnetic interference and radio frequency interference. The shield greatly reduces the amplitude of any unwanted voltages on the signal wire. 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.

All the shields of the shielded cable must be connected to the common battery negative terminal of the generator set only. The shields should not be connected to the sheet metal. Sheet Metal connections corrode over time, increasing the resistance on the shield. When the cable terminates at junction boxes, the shields must be connected to each other in order to maintain a continuous path. Wire exposed beyond the shield should be as short as possible, and not exceeding two inches.

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.

3.6 Security

There are five levels of security access on EMCP 3 display. Level 0, Level 1, Level 2, Level 3, and “Service Tool” are the five levels. Any configurable parameter that is set to Level 0 can be changed by anyone at any time, and there will never be any security information on the display screen. Levels 1 and 2 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. Level 3 access is password protected at the factory, and requires contacting the Caterpillar® Dealer Solutions Network (DSN) 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 Caterpillar 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 changing parameters from the EMCP 3 control panel. Changing parameters with the Caterpillar service tool does not require passwords, since the service tool is already at the “Service Tool” security level. 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 3 control panel. However, the passwords themselves may differ. Further more, the EMCP 3 control panel and the SCADA data link may be at different levels of access at any given time. For more information about SCADA security please see “Data Link Security” under section 3.14.

Level 1 and Level 2 passwords are 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 that in general, when a certain level of access is requested, the control panel will always move up in security level to the highest level of access that is not password protected.

The security level and the Level 1 and Level 2 passwords can be changed from the security screen. To get to the security screen, start at the “MAIN MENU” screen.

From the main menu select “CONFIGURE”. Then select “SECURITY”.

The security screen will show the current level of security at the top of the screen. There are 6 options on the security screen.

1. DROP TO MIN LEVEL
2. ENTER LEVEL 1 OR 2
3. ENTER LEVEL 3
4. CHANGE LVL 1 PSWD
5. CHANGE LVL 2 PSWD
6. CHANGE SCADA PSWD

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 16 spaces. In each space a numbers from 0 through 9 can be entered. The password can be from 1 to 16 digits and is entirely user defined. Enter the password for either level 1 or level 2 if either of those passwords have been defined.

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. Record the 16 digit number and call the Caterpillar® Dealer Solutions Network (DSN) with this number. The DSN will reply with another 16 digit number. Press enter from the “PHONE IN WITH” screen, and a password entry screen will be displayed. Enter the password that was supplied by the DSN. Press ENTER after entering the number and the current level should be 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 DSN 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 DSN.

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 16 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 16 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 enter 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 16 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 16 digits. It is entirely up to the user. If a password has been set, but it is now desired to not have level 2 password protection, the level 2 password can be disabled by setting the password to be a single 0. Once the desired password is entered, press the enter key and the control will go back to the security screen and the level 2 password will be set.

NOTE: If a level 1 password is user defined, but a level 2 password has not been user defined, the control will go to level 2 security when a level 1 password is entered.

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. For more information about the SCADA password, please see “Data Link Security” under section 3.14.

3.7 Setpoint Programming

The EMCP 3.1, 3.2, and 3.3 have a variety of setpoints (over 500 setpoints on EMCP 3.3) that can be programmed or adjusted. The setpoints can be adjusted via the built-in display or over the SCADA data link (not available on EMCP 3.1). For more information about programming setpoints over the SCADA data link, please see “EMCP 3 Setpoints” under section 3.14. In order to program the setpoints via the display, go through the following menu options.

Main Menu ↵
Configure ↵
Setpoints ↵

In the setpoints menu there are seven submenus to choose from:

- CONTROL
- ENG MONITOR/PROTECT
- EVENTS
- GEN MONITOR/PROTECT
- I/O
- NETWORK
- OTHER

Each of those submenus has additional submenus. Those additional submenus contain the setpoints.

CONTROL

- AUTOMATIC START/STOP
- AVR DESIRED VOLTAGE
- GOV DESIRED ENG SPEED
- SHUTDOWN OVERRIDE

ENG MONITOR/PROTECT

- BATTERY VOLT MONITOR
- CRANK/START COUNTERS
- ENG COOLANT TEMP MON
- ENG OIL PRES MONITOR
- ENG SPEED MONITOR
- ENHANCE ENG MONITOR
- SERV MAINT INTERVAL

EVENTS

- EVENT I/P FUNCTIONS
- EVENT O/P FUNCTIONS
- EVENT RESPONSE CONFIG
    - DIAGNOSTICS CONFIG
    - ENG PROTECT CONFIG
    - GEN PROTECT CONFIG
    - OTHER EVENTS CONFIG
- EVENT SYSTEM

GEN MONITOR/PROTECT
- ENHANCED GEN MONITOR
- GEN AC MONITOR
- GEN AC POWER MONITOR
- GEN OVERCURRENT
- GEN OVER/UNDER FREQ
- GEN OVER/UNDER VOLT
- GEN REVERSE POWER

I/O
- DIGITAL INPUTS
- DIGITAL OUTPUTS
- RELAY OUTPUTS
- SPARE ANALOG INPUT

NETWORK
- DATA LINK – SCADA

OTHER
- DIGITAL SELECTORS
- REDUCED POWER MODE

The setpoints can be three different types; numerical entry, menu, or in the case of the event response configurations there are options with checkboxes next to them.

Numerical entry setpoints are parameters like time delays, thresholds, etc. For these setpoints the display will show the current value. If that value is to be changed, first the control must be in the proper level of security. See “Security” for more information about the level of security. Then to change the value of the setpoint, press the enter key. The current value of the setpoint will be shown with the rightmost digit highlighted. Use the up and down arrow keys to adjust that digit to the desired value. Once that digit is set to the desired value, use the left arrow key to move the cursor to the next digit. Then use the up and down arrow keys to adjust that digit to the desired value. Continue this process until the desired value for the setpoint is set. Then press the enter key to save the value.

Menu type setpoints, such as generator configuration, have options that are not numerical. For these setpoints the display will show the current setting. If that setpoint is to be changed, first the control must be in the proper level of security. See “Security” for more information about the level of security. Then to change the value of the setpoint, press the enter key. The current setting will be highlighted. Use the up and down arrows to scroll through the options that are available for that setpoint. When the desired option is displayed, press the enter key to save the setting.

The setpoints for the event response configuration are a little different from the previously discussed setpoints. Selecting “EVENT RESPONSE CONFIG” will display four more submenus. Those four submenus contain all of the possible events that can be generated by the EMCP 3. Two of the submenus, “DIAGNOSTICS CONFIG”, and “ENG PROTECT CONFIG”, each have four more submenus.

- DIAGNOSTICS CONFIG
  - PRESSURES
  - TEMPERATURES
  - LEVELS
  - OTHERS
- ENG PROTECT CONFIG
  - PRESSURES
  - TEMPERATURES
  - LEVELS
  - OTHERS
- GEN PROTECT CONFIG
- OTHER EVENTS CONFIG

Inside the submenus are the events. Use the up and down arrows to scroll through the events. For each event the display will have “VIEW” and “EDIT” at the bottom of the display. “VIEW” will be highlighted at first. In order to view the response configuration for that event, press the enter key. All of the possible event response options will be shown. There will be check boxes to the left of the options. The boxes with checkmarks in them are the options that are selected.

In order to edit the configurations, press the escape key once if the event is being viewed. Then use the right arrow key in order to select “EDIT”. The edit screen looks just like the view screen, but the highlighted option can be checked or unchecked by using the right arrow or left arrow keys. If the response configuration is changed, press enter to save the settings. NOTE: The control must be in STOP in order to edit any of the event response configurations. This applies to SCADA also.

For more information on the names, ranges, and descriptions of all of the setpoints, see Appendix C or use the RENR7902 – Systems Operation, Troubleshooting, Testing and Adjusting manual for the EMCP 3.1 through 3.3.

3.8 Digital Inputs

The EMCP 3.1 has 6 digital inputs. The EMCP 3.2 and 3.3 both have 8 digital inputs. On all three levels of controls, the first and second digital inputs are dedicated and cannot be programmed. Digital input #1 is dedicated for Emergency Stop and digital input #2 is dedicated for Remote Initiate. The other 4 or 6 inputs can be configured to trigger alarms or shutdowns in the EMCP 3.

In the EMCP 3 software, digital inputs 3 through 8 (3 through 6 on EMCP 3.1) are linked to functions that are called “EVENT INPUT FUNCTIONS”. Because digital inputs #1 and #2 are dedicated inputs, digital input #3 is linked to event input function #1, digital input #4 is linked to event input function #2, and so on. This is better illustrated in Figure 9.

The digital inputs of the EMCP 3 are tied to an internal pull-up resistor inside the control. Therefore, if a digital input is unconnected, the digital input will sit at a logical high. A ground or battery negative input should be wired to each EMCP 3 Digital Input. 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.

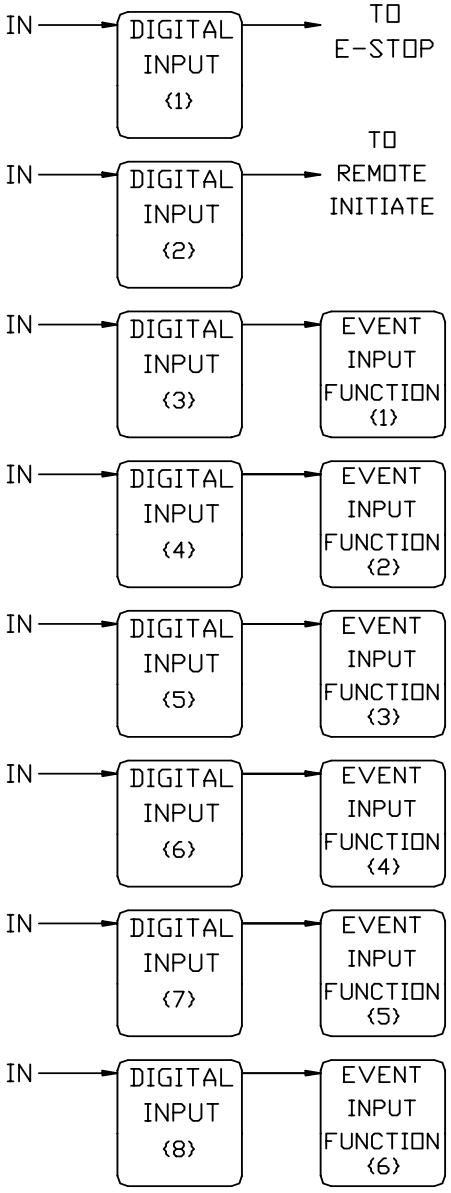


Figure 9: Relationship between Digital Inputs and Event Input Functions

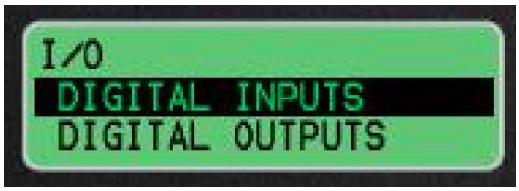
Programming the Digital Inputs

There are two parts to programming the Digital Inputs. The first part involves programming the Active State of the Digital Input (Active High or Active Low). The second part involves programming the Event Input Functions.

To program the Active State of the Digital Input, go through the following menu options:

MAIN MENU ↵
    CONFIGURE ↵

SETPOINTS ↵
I/O ↵
DIGITAL INPUTS ↵



Select the Digital Input that you want to program and press the Enter Key.

Press the Enter Key again. The current configuration will be highlighted (ACTIVE HIGH or ACTIVE LOW).

Use the Scroll Up Key and the Scroll Down Key in order to change the current configuration to the desired setting.

Press the Enter Key to save the setting.

To program the Active State of the Event Input, go through the following menu options:

MAIN MENU ↵
CONFIGURE ↵
SETPOINTS ↵
EVENTS ↵

EVENT I/P FUNCTIONS ↵

Once in the Event Input Function menu, the first setting is the Active State. The Active State should always be set to Active High. The next setting is the Time Delay. While on the Time Delay Setting, press Enter and use the arrow keys to enter the desired value.

Note: Event Input Function #1 corresponds to Digital Input #3, Event Input Function #2 corresponds to Digital Input #4, etc. See the diagram above.

The next setting is the Suspect Parameter Number (SPN). Press the Enter Key in order to choose the SPN. The available options will be similar to the following:

Pressures

- Air Filter Differential Pressure
- Engine Oil Pressure
- Fire Extinguisher Pressure
- Fuel Filter Differential Pressure
- Oil Filter Differential Pressure
- Starting Air Pressure

Levels

- Engine Coolant Level

- Engine Oil Level
- Fuel Level
- External Tank Fuel Level

Temperatures

- Ambient Air Temperature
- Engine Coolant Temperature
- Engine Oil Temperature
- Exhaust Temperature
- Rear Bearing Temperature
- Right Exhaust Temperature
- Left Exhaust Temperature

Others

- Air Damper Closed
- ATS in Normal Position
- ATS in Emergency Position
- Battery Charger Failure
- Generator Breaker Closed
- Utility Breaker Closed
- Fuel Leak Detected
- Custom Event

After the SPN is chosen, the Failure Mode Identifier (FMI) is the next setting. The following FMI are available:

- High Warning (example: High Temperature Warning)
- Low Warning (example: Low Temperature Warning)
- High Shutdown
- Low Shutdown
- Status (example: Fuel Leak Detected condition exists)

3.9 Analog Inputs

The EMCP 3.1 has two analog inputs. The EMCP 3.2 and 3.3 both have three analog inputs. Each input consists of two connector pins for use with two-wire resistive senders. One-wire senders can be used if the passive analog return pin is connected to the common chassis ground. See “Electrical Connections” for illustrations on how to connect the sensors to the control.

On all three levels of controls, the first and second analog inputs have dedicated sensors and cannot be programmed for other functions. Analog input #1 is dedicated for Engine Oil Pressure and analog input #2 is dedicated for Engine Coolant Temperature. The third analog input on EMCP 3.2 and 3.3 is called the Spare Analog Input, and is set up to monitor Engine Oil Temperature by default.

On all three levels of controls, the first and second analog inputs will not be used for electronic engines that use ADEM™ A3, 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. For these engines the EMCP 3 must be programmed to receive the information for engine oil pressure and engine coolant temperature from the J1939 data link. If the EMCP 3 control is not programmed for data link input, the control will show diagnostics for the sensors.

The spare analog input has a sensor map in the software for Engine Oil Temperature. The input can be programmed to monitor other parameters such as:

Temperatures

- Ambient Air Temperature
- Exhaust Temperature
- Right Exhaust Temperature
- Left Exhaust Temperature
- Rear Bearing Temperature

Pressures

- Air Filter Differential Pressure
- Fire Extinguisher Pressure
- Fuel Filter Differential Pressure
- Oil Filter Differential Pressure
- Starting Air Pressure

Levels

- Engine Coolant Level
- Engine Oil Level
- Fuel Level
- External Tank Fuel Level

However, there is only one sensor map in the software. If a parameter is desired other than Engine Oil Temperature, the factory must be contacted in order to create a custom flash file that contains the desired sensor map.

All three inputs are designed to accept an input from a resistive sender with a range of 0 to 2000 ohms. If the resistance goes all the way down to zero, or above 2000 ohms, the control will give diagnostics for the sensors. In case of the spare analog input, the bounds are defined by the sensor map, and are limited to a minimum of 0 ohms and maximum of 2000 ohms.

Each of the inputs also has configurable thresholds for high and low warnings and shutdowns. There are also programmable time delays for all of the events associated with the analog inputs. For information on how to program these thresholds and time delays, see “Setpoint Programming”.

3.10 Relay Outputs

The EMCP 3.1 has six relay outputs. The EMCP 3.2 and 3.3 both have eight relay outputs. Each relay is capable of handling 2A @ 30 VDC. On EMCP 3.1 all six relays are type-A. On EMCP 3.2 and 3.3 six relays are type-A and two relays are type-C. Type-A relays are defined as one normally-open contact and a common. Type-C relays

are defined as two contacts, one normally-open contact and one normally-closed contact and a common. The relays are “volt free” meaning that the commons are not referenced to anything within the control. The relay contacts are not protected against shorts to battery or ground.

Relay Output #1 is dedicated to control the starter motor. Relay Output #2 is dedicated to fuel enable. The six remaining Relay Outputs on the EMCP 3.3 and EMCP 3.2 (four remaining Relay Outputs on EMCP 3.1) can be programmed for various other applications.

Relays three through eight on EMCP 3.2 and 3.3 and relays three through six on EMCP 3.1 are programmable and can be set to operate based on different conditions. In order to do this, there are functions called digital selectors associated with each relay output. The digital selector is a software function that acts like a 10 position switch. For each relay there are 10 different options of conditions that can operate the relay. The digital selector is used to determine which one of those conditions will actually be associated with each relay output.

EMCP 3.1 has 4 digital selectors, EMCP 3.2 has seven digital selectors, and EMCP 3.3 has eight digital selectors. On EMCP 3.2 and 3.3, only the first six digital selectors are for the relay outputs. The remaining digital selectors are for the digital outputs.

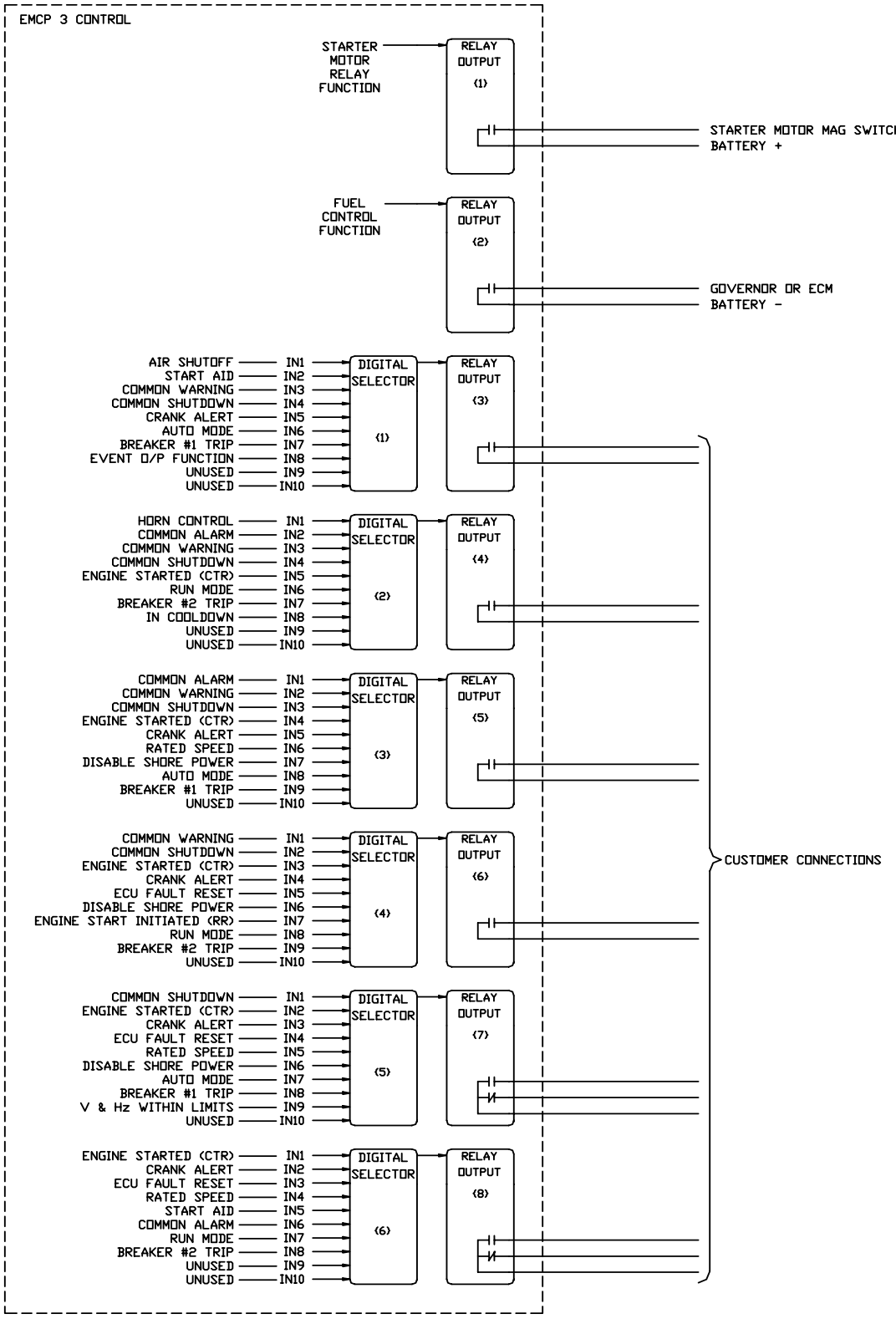


Figure 10: How digital selectors configure relay outputs

In order to program the Digital Selectors, go through the following menu options

Main Menu ↵
Configure ↵
Other ↵
Digital Selectors ↵

Select the Digital Selector that you want to program and press the Enter Key.

Press the Enter Key again. The current configuration will be highlighted.

Use the Scroll Up Key and the Scroll Down Key in order to change the current configuration to the desired setting.

Press the Enter Key to save the setting.

Description of Digital Selector Inputs Used to configure relay outputs

Air Shutoff

- Activated by Emergency Stop condition
- Activated by Overspeed condition
- Automatically deactivates after 5 second delay

Start Aid
- Requires setpoint “Start Aid Activation Time” set greater than zero
- Activated when engine start is initiated
- Deactivates after Start Aid Activation Timer expires

Common Warning
- Activated anytime the EMCP 3 initiates and/or detects a warning event
- Deactivates when no warnings are present

Common Shutdown
- Activated anytime the EMCP 3 initiates and/or detects a shutdown event
- Deactivates when no shutdowns are present or active

Common Alarm
- Activated anytime the EMCP 3 initiates and/or detects a shutdown or a warning event
- Deactivates when no warnings or shutdowns are present or active

Crank Alert
- Requires setpoint “Crank Alert Activation Time” set greater than zero
- Activated when engine start is initiated
- Deactivates after Crank Alert Activation Timer expires

Engine Start Initiated
- Activated when engine start is initiated
- Deactivates when engine stop is initiated

Engine Started
- Activated when engine has reached crank terminate speed
- Deactivates when engine is stopped

Rated Speed
- Activated when engine has reached crank terminate speed and sufficient oil pressure is detected

NOTE: Intended to give a rated speed permissive signal to a governor on a MUI engine

Horn Control
- Activated when any event occurs that has an event response configuration set for “audible alert”
- Deactivates when event is neither present or active or when the alarm acknowledge key is pressed

ECU Fault Reset
- Activated when the EMCP 3 is in STOP mode and any event reset is being initiated

Disable Aux AC Supply
- Activated when engine start is initiated
- Deactivates when engine is stopped

Breaker Trip 1

- Activated when any event occurs that has an event response configuration set for “breaker trip 1”
- Deactivates when the event is neither present nor active

NOTE: This output does not control a circuit breaker unless the user makes the connections to do so.

Breaker Trip 2

- Activated when any event occurs that has an event response configuration set for “breaker trip 2”
- Deactivates when the event is neither present nor active

NOTE: This output does not control a circuit breaker unless the user makes the connections to do so.

Event Output Function

- Requires setpoint configuration for Event Output Function #1
- Activated while Event Output 1 is active

V&Hz Within Limits

- Activated when measured generator voltage and frequency are both within the event thresholds for their respective parameters
- Deactivates when either measured generator voltage or frequency are outside of the event thresholds for their respective parameters

In Cooldown

- Requires setpoint “Cooldown Duration” set greater than zero
- Activated when engine stop has been initiated and cooldown cycle begins
- Deactivates when cooldown timer has expired

Auto Mode

- Activated after the Auto Key has been pressed and while the EMCP 3 remains in the auto mode

Run Mode

- Activated after the Run Key has been pressed and while the EMCP 3 remains in the run mode

Digital Selector #1 is associated with Relay Output #3. The available configuration options for Digital Selector #1 are shown in the following table.

Digital Selector #1 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Air Shutoff	USE INPUT #1
Start Aid	USE INPUT #2
Common Warning	USE INPUT #3
Common Shutdown	USE INPUT #4
Crank Alert	USE INPUT #5

Auto Mode	USE INPUT #6
Breaker #1 Trip	USE INPUT #7
Event Output Function	USE INPUT #8
Unused	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

Digital Selector #2 is associated with Relay Output #4. The available configuration options for Digital Selector #2 are shown in the following table.

Digital Selector #2 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Horn Control	USE INPUT #1
Common Alarm	USE INPUT #2
Common Warning	USE INPUT #3
Common Shutdown	USE INPUT #4
Engine Started (CTR)	USE INPUT #5
Run Mode	USE INPUT #6
Breaker #2 Trip	USE INPUT #7
In Cooldown	USE INPUT #8
Unused	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

Digital Selector #3 is associated with Relay Output #5. The available configuration options for Digital Selector #3 are shown in the following table.

Digital Selector #3 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Common Alarm	USE INPUT #1
Common Warning	USE INPUT #2
Common Shutdown	USE INPUT #3
Engine Started (CTR)	USE INPUT #4
Crank Alert	USE INPUT #5
Rated Speed	USE INPUT #6
Disable Shore Power	USE INPUT #7
Auto Mode	USE INPUT #8
Breaker #1 Trip	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

Digital Selector #4 is associated with Relay Output #6. The available configuration options for Digital Selector #4 are shown in the following table.

Digital Selector #4 Configuration Options	
Condition	Display Text
Disabled	DISABLED

Common Warning	USE INPUT #1
Common Shutdown	USE INPUT #2
Engine Started (CTR)	USE INPUT #3
Crank Alert	USE INPUT #4
ECU Fault Reset	USE INPUT #5
Disable Shore Power	USE INPUT #6
Engine Start Initiated (RR)	USE INPUT #7
Run Mode	USE INPUT #8
Breaker #2 Trip	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

Digital Selector #5 is associated with Relay Output #7 on EMCP 3.2 and 3.3 controls. The available configuration options for Digital Selector #5 are shown in the following table.

Digital Selector #5 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Common Shutdown	USE INPUT #1
Engine Started (CTR)	USE INPUT #2
Crank Alert	USE INPUT #3
ECU Fault Reset	USE INPUT #4
Rated Speed	USE INPUT #5
Disable Shore Power	USE INPUT #6
Auto Mode	USE INPUT #7
Breaker #1 Trip	USE INPUT #8
Volts & Hz within Limits	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

Digital Selector #6 is associated with Relay Output #8 on EMCP 3.2 and 3.3 controls. The available configuration options for Digital Selector #6 are shown in the following table.

Digital Selector #6 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Engine Started (CTR)	USE INPUT #1
Crank Alert	USE INPUT #2
ECU Fault Reset	USE INPUT #3
Rated Speed	USE INPUT #4
Start Aid	USE INPUT #5
Common Alarm	USE INPUT #6
Run Mode	USE INPUT #7
Breaker #2 Trip	USE INPUT #8
Unused	USE INPUT #9
Unused	USE INPUT #10

Use SCADA Data Link Command	USE DATA LINK INPUT

3.11 Digital Outputs

The EMCP 3.1 does not have any digital outputs. The EMCP 3.2 has one digital output, and the EMCP 3.3 has two digital outputs. Each output is a discrete 300mA sinking driver output.

Digital outputs on EMCP 3.2 and 3.3 are programmable and can be set to operate based on different conditions. In order to do this, there are functions called digital selectors associated with each digital output. The digital selector is a software function that acts like a 12 position switch. For each output there are 11 different options of conditions that can make the output go active, and one condition to disable the output altogether. The digital selector is used to determine which one of those conditions will actually be associated with each digital output. This is best described using Figure 11. In addition to the ten options shown in the figure, the digital selectors can be configured to receive their activation commands over the SCADA data link.

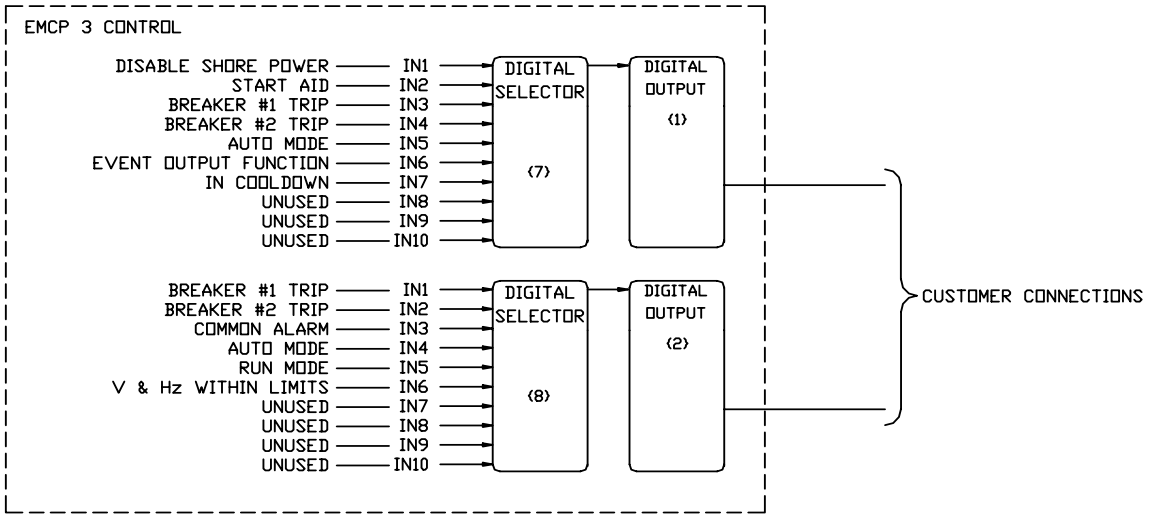


Figure 11: How Digital Selectors Configure Digital Outputs

In order to program the Digital Selectors, go through the following menu options

Main Menu ↵
Configure ↵
Setpoints ↵
Other ↵
Digital Selectors ↵

Select the Digital Selector that you want to program and press the Enter Key.

Press the Enter Key again. The current configuration will be highlighted.

Use the Scroll Up Key and the Scroll Down Key in order to change the current configuration to the desired setting.

Press the Enter Key to save the setting.

Description of Digital Selector Inputs Used to configure digital outputs

Start Aid

- Requires setpoint “Start Aid Activation Time” set greater than zero
- Activated when engine start is initiated
- Deactivates after Start Aid Activation Timer expires

Common Alarm

- Activated anytime the EMCP 3 initiates and/or detects either a shutdown or warning event
- Deactivates when no warnings or shutdowns are present or active

Disable Aux AC Supply

- Activated when engine start is initiated
- Deactivates when engine is stopped

Breaker Trip 1

- Activated when any event occurs that has an event response configuration set for “breaker trip 1”
- Deactivates when the event is neither present nor active

NOTE: This output does not control a circuit breaker unless the user makes the connections to do so.

Breaker Trip 2

- Activated when any event occurs that has an event response configuration set for “breaker trip 2”
- Deactivates when the event is neither present nor active

NOTE: This output does not control a circuit breaker unless the user makes the connections to do so.

Event Output Function

- Requires setpoint configuration for Event Output 1
- Activated while Event Output 1 is active

V&Hz Within Limits

- Activated when measured generator voltage and frequency are both within the event thresholds for their respective parameters
- Deactivates when either measured generator voltage or frequency are outside of the event thresholds for their respective parameters

Auto Mode

- Activated after the Auto Key has been pressed and while the EMCP 3 remains in the auto mode

Run Mode

- Activated after the Run Key has been pressed and while the EMCP 3 remains in the run mode

Digital Selector #7 is associated with Digital Output #1. The available configuration options for Digital Selector #7 are shown in the following table.

Digital Selector #7 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Disable Shore Power	USE INPUT #1
Start Aid	USE INPUT #2
Breaker #1 Trip	USE INPUT #3
Breaker #2 Trip	USE INPUT #4
Auto Mode	USE INPUT #5
Event Output Function	USE INPUT #6
In Cooldown	USE INPUT #7
Unused	USE INPUT #8
Unused	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

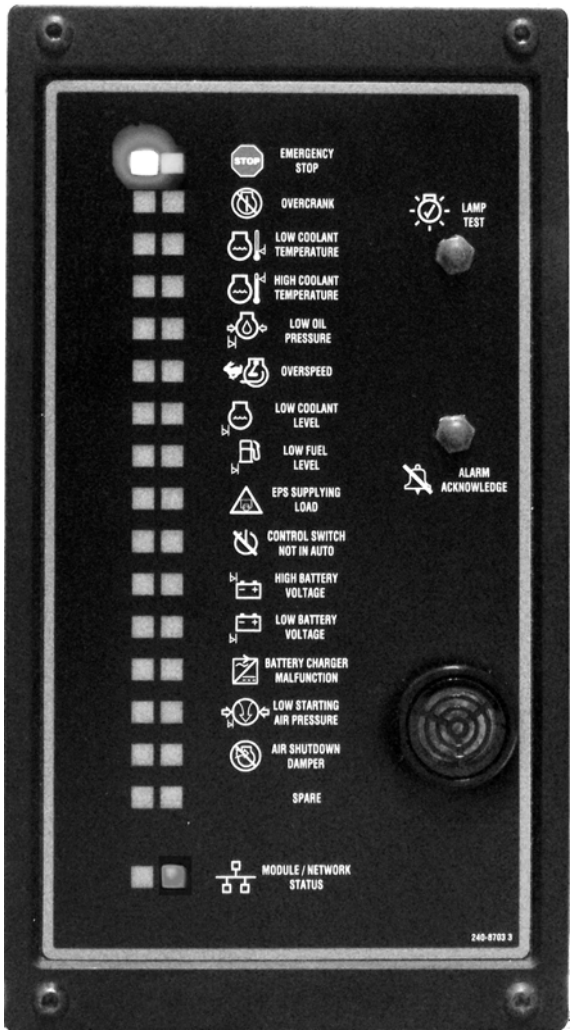
Digital Selector #8 is associated with Digital Output #2. The available configuration options for Digital Selector #8 are shown in the following table.

NOTE: Digital Output #2 and Digital Selector #8 are only available on EMCP 3.3

Digital Selector #8 Configuration Options	
Condition	Display Text
Disabled	DISABLED
Breaker #1 Trip	USE INPUT #1
Breaker #2 Trip	USE INPUT #2
Common Alarm	USE INPUT #3
Auto Mode	USE INPUT #4
Run Mode	USE INPUT #5
Volts & Hz within Limits	USE INPUT #6
Unused	USE INPUT #7
Unused	USE INPUT #8
Unused	USE INPUT #9
Unused	USE INPUT #10
Use SCADA Data Link Command	USE DATA LINK INPUT

3.12 Optional Modules

Annunciator



The EMCP 3 Annunciator serves to display genset system alarm conditions and status indications. The Annunciator has been designed for use on the EMCP 3.3 J1939 Communication Network and may be used in either Local or Remote applications, providing customers with enhanced site flexibility.

In Local application, the Annunciator may be mounted on the Package genset with the EMCP 3.3 Controller to provide a complete package-mounted monitoring solution.

The Annunciator may also be mounted separate from the genset to provide Remote indication of system operating and alarm conditions.

The EMCP 3 Annunciator is configurable to the standards of NFPA 99/110.

Annunciator Features

- Each Annunciator includes sixteen (16) LED pairs for annunciation of up to 32 system events.
- An additional pair of LEDs provides status indication of the J1939 data link connection
- Can annunciate alarm conditions received from any module on the J1939 data link, including the EMCP 3, engine ECM, RTD module, DIO module, and Thermocouple module
- Includes 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)
- Provides superior visibility of the LEDs in direct sunlight
- Graphic symbols are provided next to each LED pair to indicate various alarms and events
- The Annunciator can be mounted either locally, on the package generator set, or Remotely (up to 800 feet) on the Accessory J1939 Data Link.
- Designed and Tested to meet stringent Impulse Shock and Operating Vibration requirements

Annunciator Specifications

Electrical

- Control Power 12 VDC & 24VDC
- Communication J1939 (EMCP 3 CAN2 Accessory Data Link)
- Single, 6-pin connector

Dimensions

- 286 mm (11.26 in) High
- 157 mm (6.18 in) Wide
- 141 mm (5.55 in) Deep

Environmental

- Operating Temperature –40° C to 70° C (–40° F to 158° F)
- Storage Temperature –50° C to 70° C (–58° F to 158° F)
- Relative Humidity 90%

Annunciator LED Color Scheme

Each pair of LEDs on the Annunciator consists of two of the following three colors: Green, Yellow and Red, which allows for custom configuration of Status, Warning and Shutdown conditions. The available colors and combinations are as follows:

Row	LED 1	LED 2
1	Red	Yellow
2	Red	Yellow
3	Red	Yellow
4	Red	Yellow
5	Red	Yellow
6	Red	Yellow
7	Red	Yellow
8	Red	Yellow
9	Red	Yellow
10	Red	Yellow
11	Red	Yellow
12	Red	Yellow
13	Green	Yellow
14	Green	Yellow
15	Red	Green
16	Red	Green

Annunciator Configuration

The Annunciator is field programmable using the Caterpillar service tool. It is also flash programmable to update software using the Caterpillar service tool.

The service tool software must be installed on a Windows PC. The Caterpillar® communication adapter must be connected between the PC and the J1939 data link on which the target Annunciator is connected. (The service tool may be connected to the EMCP 3 Accessory Data Link service connector.)

When connecting to the Annunciator, the user will first see the Module Summary screen shown in Figure 12.

This screen shows module information such as Serial Number, Part Number, Software Group Number, and Software Release Date.

The Module Description will also indicate which of the 3 possible Annunciators the service tool is connected with. In this example, the service tool is connected to “Alarm Module #2”. This number is called the “ECU Instance” and it is programmable. To program the Annunciator to a different ECU Instance, enter the Configuration Screen by selecting the Service → Configuration menu item, as shown in the figure.

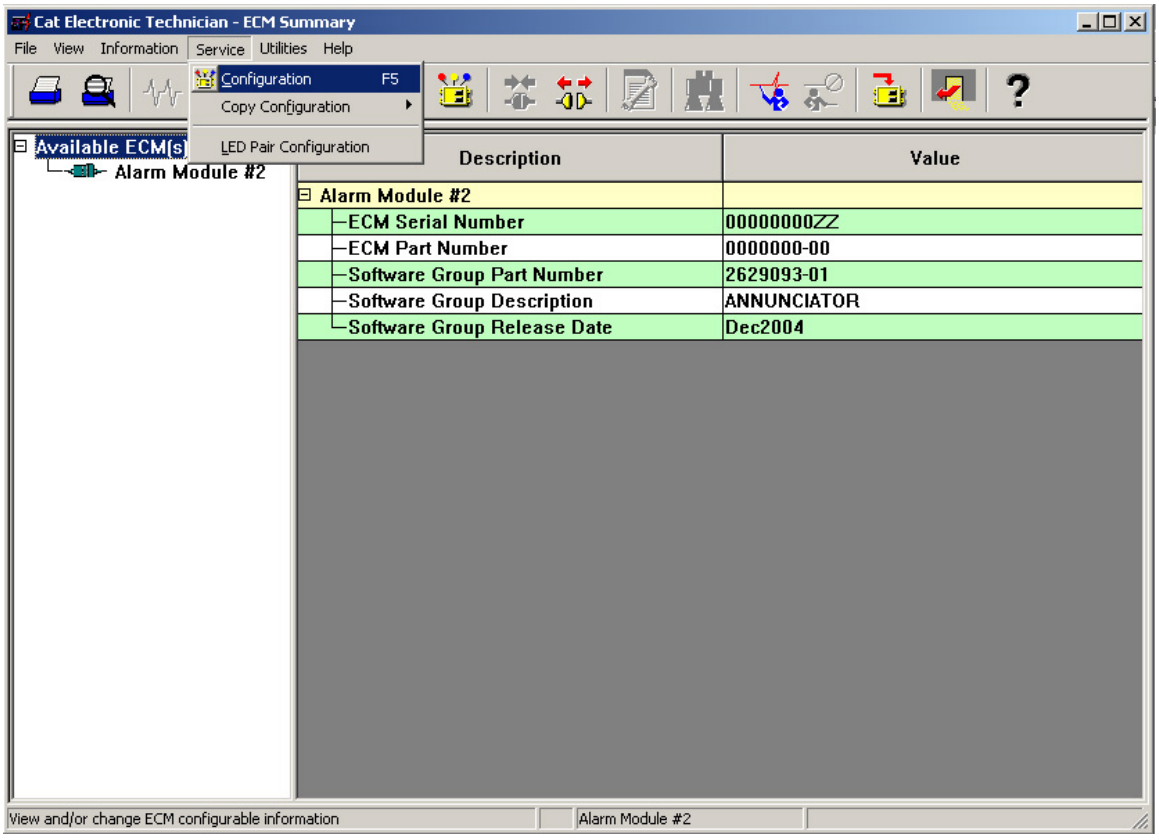


Figure 12: Caterpillar® Service Tool Annunciator Summary screen

The service tool configuration screen, shown in Figure 13, identifies the serial number of the Annunciator that is connected. This is important in matching the desired ECU Instance to the actual hardware. In this example, the Annunciator will be programmed to ECU Instance #1. To do this, select the ECU Instance row, and double click on the current ECU Instance. A dialog box will open, allowing entry of the new ECU Instance. Type a numeric value, 1, 2, or 3 and click OK.

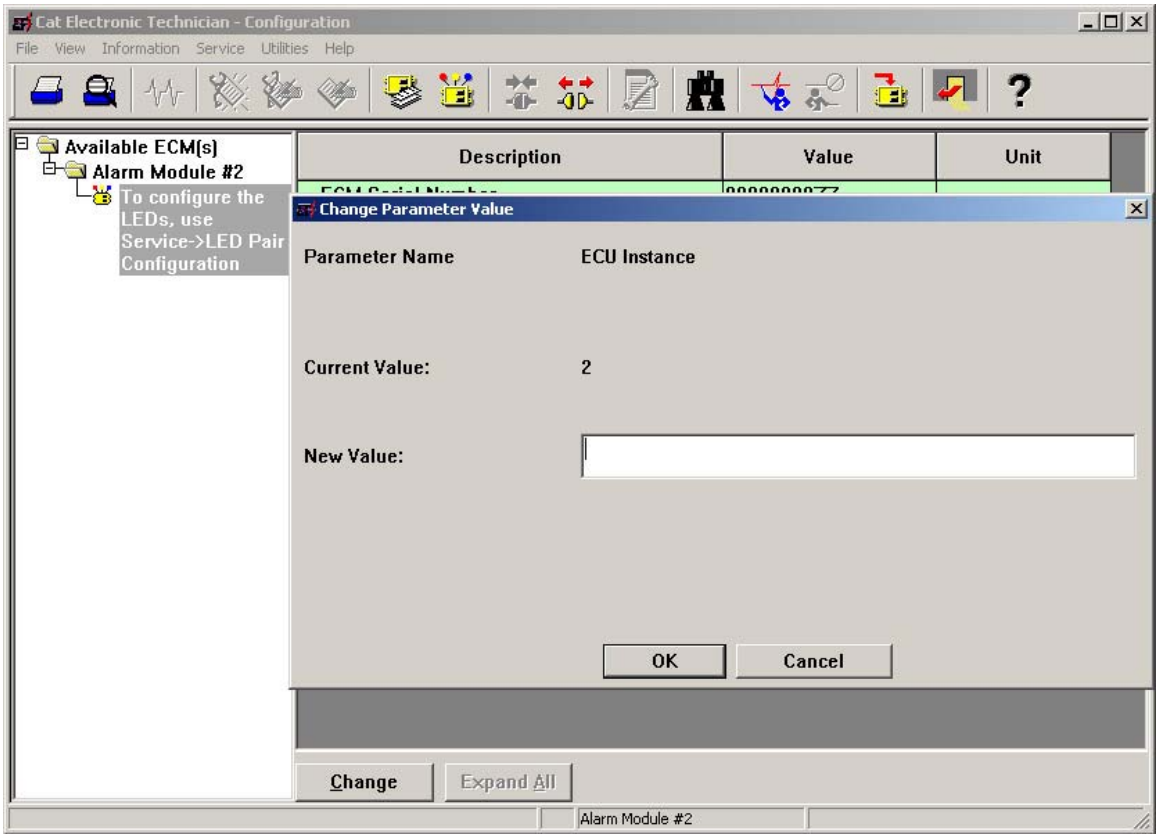


Figure 13: Caterpillar® Service Tool Annunciator Configuration screen

When you click OK, the service tool software will automatically restart and reconnect to the data link. Upon reconnecting, the summary screen will now show the new module name, based on the ECU Instance. In this example, the new module name will be "Alarm Module #1".

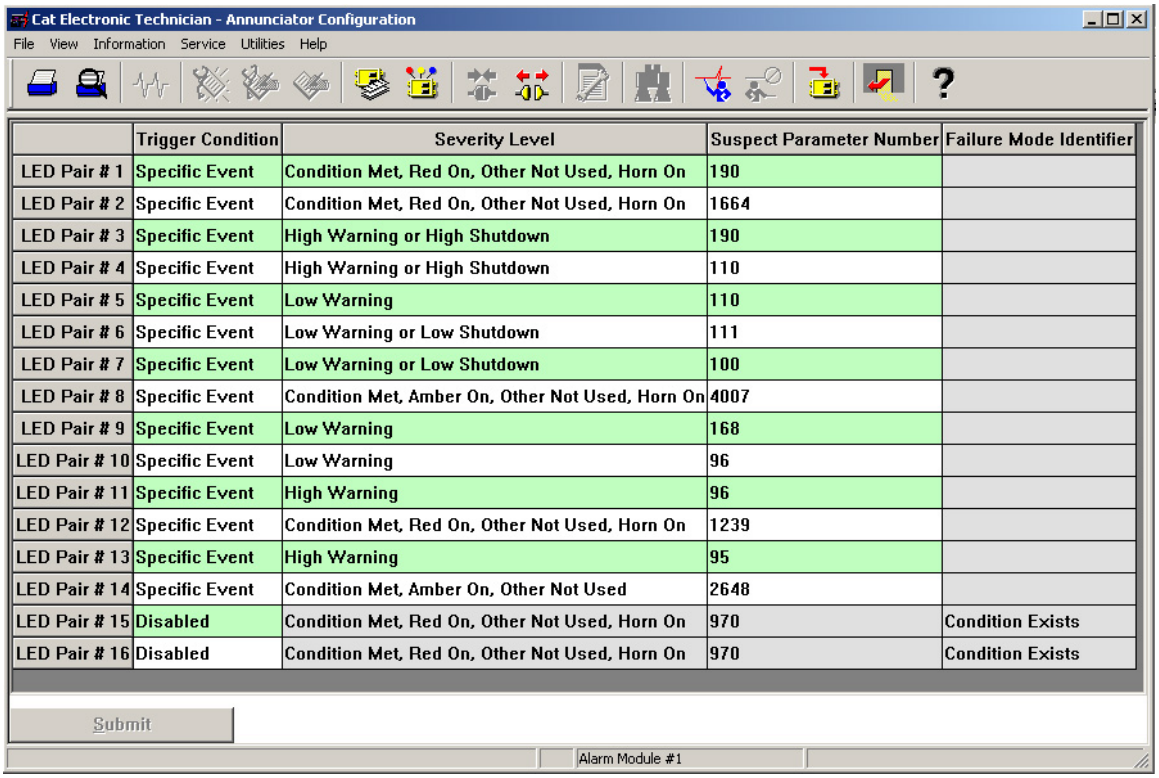
Annunciator Global Acknowledge

The Annunciator can be configured to both initiate and respond to an Event Acknowledge message over the J1939 data link. If this setpoint is enabled, the Annunciator events may be acknowledged remotely by pressing the Alarm Acknowledge button on an EMCP 3 or by pressing the Acknowledge button on another Annunciator that is on the same data link. The default setting for this setpoint is DISABLED, but it can be enabled from the Service → Configuration menu item.

Configuring Annunciator LED Behavior

To configure the behavior of the LED pairs, enter the LED Pair Configuration screen by selecting the Service → LED Pair Configuration menu item.

An example of the LED Pair Configuration screen is shown in Figure 14.



	Trigger Condition	Severity Level	Suspect Parameter Number	Failure Mode Identifier
LED Pair # 1	Specific Event	Condition Met, Red On, Other Not Used, Horn On	190	
LED Pair # 2	Specific Event	Condition Met, Red On, Other Not Used, Horn On	1664	
LED Pair # 3	Specific Event	High Warning or High Shutdown	190	
LED Pair # 4	Specific Event	High Warning or High Shutdown	110	
LED Pair # 5	Specific Event	Low Warning	110	
LED Pair # 6	Specific Event	Low Warning or Low Shutdown	111	
LED Pair # 7	Specific Event	Low Warning or Low Shutdown	100	
LED Pair # 8	Specific Event	Condition Met, Amber On, Other Not Used, Horn On	4007	
LED Pair # 9	Specific Event	Low Warning	168	
LED Pair # 10	Specific Event	Low Warning	96	
LED Pair # 11	Specific Event	High Warning	96	
LED Pair # 12	Specific Event	Condition Met, Red On, Other Not Used, Horn On	1239	
LED Pair # 13	Specific Event	High Warning	95	
LED Pair # 14	Specific Event	Condition Met, Amber On, Other Not Used	2648	
LED Pair # 15	Disabled	Condition Met, Red On, Other Not Used, Horn On	970	Condition Exists
LED Pair # 16	Disabled	Condition Met, Red On, Other Not Used, Horn On	970	Condition Exists

Figure 14: Caterpillar® Service Tool Annunciator LED Configuration Screen

Each LED pair has four parameters required to configure it. It is best to configure the four columns in order from left to right; first Trigger Condition, next Severity Level, then Suspect Parameter Number, and finally Failure Mode Identifier (if required). The reason for the order is because the value set in one column affects the choices available in the subsequent columns. If a field is grayed out, it is not available due to conditions set in previous columns.

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.

“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, 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. The remaining three parameters will be grayed out when Disabled is selected.

Severity Level: Severity Level defines how the LED pair will react to various levels of event conditions. Selections that begin with “Condition Exists” will respond to J1939 Event messages for FMI 31 “Condition Present”. For example, LED pair #2 is

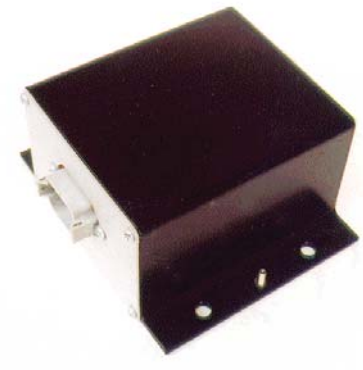
configured for “Condition Exists, Red On, Other Not Used, Horn On” with SPN 190 (Emergency Stop Active). This means that when the Annunciator received a J1939 message indicating Emergency Stop with FMI 31, the Red LED will turn on and the Horn will also turn on. “Other Not Used” indicates that the other LED color in the pair is never used. “Green Off” indicates that the green LED (for example) lights when the condition chosen for this LED pair is NOT active.

The Severity Level selections imply a J1939 Failure Mode Identifier (FMI) code. “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. 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 Code”.

Suspect Parameter Number: The SPN column is used to type in the Suspect Parameter Number for the parameter assigned to the LED pair. Refer to the SAE J1939 literature or the EMCP 3 Systems Operation Testing and Adjusting Manual RENR7902 for a complete list of supported SPNs.

NOTE: Remember to click the Submit button at the bottom of the LED Pair Configuration screen after making the selections for each LED pair. Only then will the new settings take effect.

Thermocouple, RTD, and Discrete I/O Modules



EMCP 3 uses a common design approach for the three modules known as the **Thermocouple, RTD** (Resistance Temperature Device) and **Discrete I/O** modules. The same hardware design is used for the power supply and CAN network communications board. Individual circuit board assemblies are used for the 20-channel thermocouple interface or 8-channel RTD interface board.

The Thermocouple module, RTD module and DIO module feature identical rugged packaging and watertight Deutsch IPD connectors. Applications can include networked power generator set control systems.

Thermocouple module – General Specifications

- Reads up to 20 Type J or K thermocouple inputs
- Burden is limited to less than 200 mA. Inrush does not exceed 800 mA.
- 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. 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.
- Common mode rejection is -80 db@ 5V p-p (50-60 Hz)
- Common mode input range is +/- 4 V minimum
- Isolation voltage is 1500 Vac (rms) or 2550V for 1 sec.
- System throughput has all 20 channels scanned in 2 seconds (100 ms/channel).
- Overall drift with temperature is 0.015% / °C of span (maximum)
- Cold junction compensation is provided
- Three way isolation is provided for the CAN line, inputs and power supply.
- Monitored parameters and diagnostics as well as setpoints are supplied by customer specification
- Module is fully functional during configuration and communications
- Parameter values and diagnostic error codes are retained when the modules are de-energized

RTD module – General Specifications

- Reads up to eight (8) Platinum RTD inputs with 2, 3, and 4 wire configurations
- Burden is limited to less than 200 mA. Inrush does not exceed 800 mA.
- Isolation voltage is 1500 Vac (rms) or 2550V for 1 sec.
- System throughput has all 8 channels scanned in 2 seconds (250 ms/channel).
- Overall drift with temperature is 15mOhm/°C (maximum)
- Optical isolation is 500VDC from input to ground. Three way isolation is provided for the CAN line, inputs and power supply.
- Monitored parameters and diagnostics as well as setpoints are supplied by customer specification.
- Module is fully functional during configuration and communications
- Parameter values and diagnostic error codes are retained when the modules are de-energized

Discrete I/O module – General Specifications

- Modules are designed for mounting on power generator sets or remotely. Up to 2 DIO modules can be used on a single CAN bus communications network given that they are programmed to unique ECU Instance numbers.
- Reads twelve (12) discrete inputs and sets eight (8) Form C relay outputs rated for rated for resistive loads of 3A@30Vdc, 3A@125Vac and 2A@277Vac for Normally Closed (NC) relays or 5A@30Vdc, 5A@125Vac and 2A@277Vac for Normally Open (NO) relays. For inductive loads, the ratings are 0.5A@250Vac cosϕ=0.4, 1A@250Vac cosϕ=0.8, 0.8A@250Vac cosϕ=0.9.
- Converts between physical I/O and CAN (J1939) data link commands
- Maximum level of current draw of 400mA + 50mA per energized relay @ 12Vdc
- Isolation voltage: 4000 Vac (rms), 50/60 Hz for 1 min. between coil and contacts, 750 Vac, 50/60 Hz for 1 min. between contacts of the same polarity
- System throughput: All channels are scanned in 100 ms.
- Input level characteristics:
- Low-Level input voltage: 0 to 0.8 V
- High-Level input voltage: 3.75 to 24V
- Inputs have internal pull-up resistors.
- For each input the programmed SPN & FMI combination is broadcast to the J1939 Data Link, via DM1 message.
- Inputs that generate a warning message auto-reset whenever the input returns to non-active state. Inputs that generate a shutdown message continue to broadcast that message until the input returns to non-active state and a reset message is received on the J1939 Data Link.
- Allowed FMI codes for inputs are customer specific.
- Each output is configured to activate based upon the DM1 message that is received on the J1939 data link by filtering out SPN & FMI codes contained in that message. Each output is configured for either general or specific events.
- For “GENERAL” events, each output could activate on Alarm, Shutdown, or Diagnostics and combination of these. This would be determined by what FMI’s exist in the DM1 message. When the FMI’s are no longer found in the DM1 message then the output will be de-activated.
- For specific events each output will be activated when the diagnostic message “DM1 – Active Events” contains the SPN & FMI combination that matches the SPN & FMI combination that is programmed for that particular output. When this SPN & FMI combination is no longer found in the DM1 message then the output will be de-activated.
- Each output could activate on Alarm or Shutdown (Low or High), Diagnostics, “Condition Exists” and combination of these.

Discrete I/O module – Configuration

The DIO module is field programmable using the Caterpillar service tool. It is also flash programmable to update software using the Caterpillar service tool.

The service tool software must be installed on a Windows PC. The Caterpillar® communication adapter must be connected between the PC and the J1939 data link on

which the target DIO module is connected. (The service tool may be connected to the EMCP 3 Accessory Data Link service connector.)

When connecting to the DIO, the user will first see the Module Summary screen shown in Figure 15.

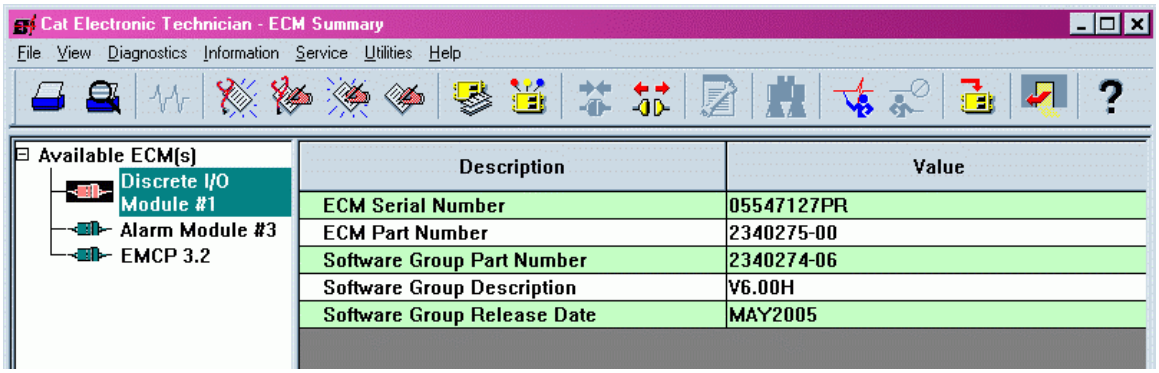


Figure 15: Caterpillar® Service Tool DIO summary screen

The service tool configuration tool, accessed by pressing F5 or clicking the configuration tool icon on the toolbar, contains setpoints for configuring the DIO identification, as well as the inputs and outputs.

Figure 16 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. 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 Caterpillar service tool will automatically reconnect to the data link, and the DIO module name should reflect the new ECU instance. In this example, 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 17).

Configuring Digital Inputs

The Discrete Input #1 Configuration list of the service tool configuration tool is shown in Figure 18. All twelve discrete inputs have identical parameters and options.

The *active state configuration* determines which state (high or low) triggers the event, and depends on the sensor/switch wiring configuration.

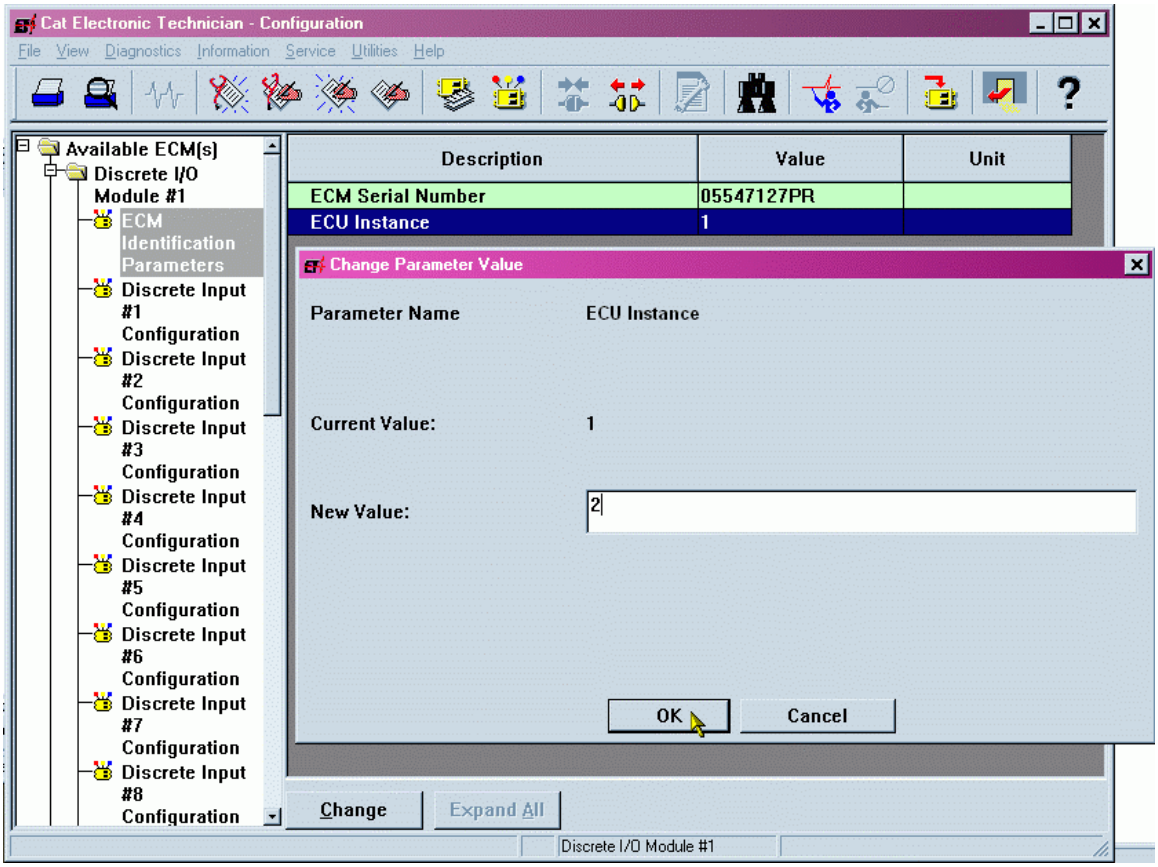


Figure 16: Caterpillar® Service Tool DIO identification parameters

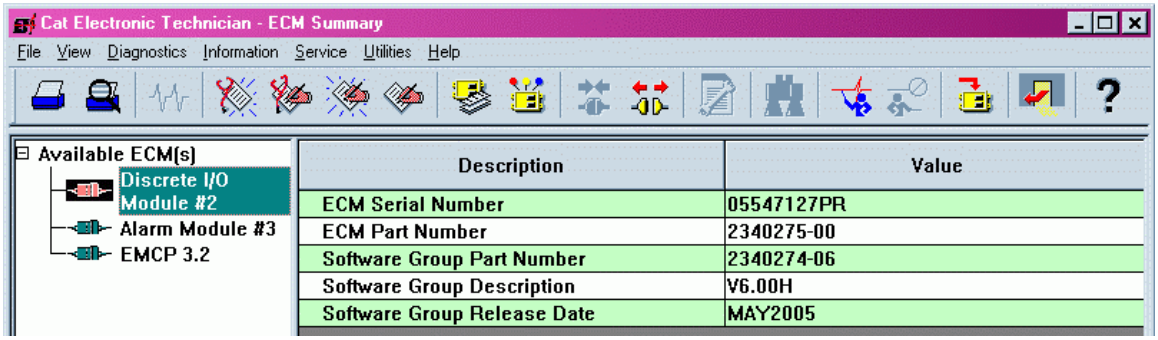


Figure 17: Caterpillar® Service Tool DIO after ECU Instance change

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.

The *suspect parameter number* (SPN) is a choice between 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.

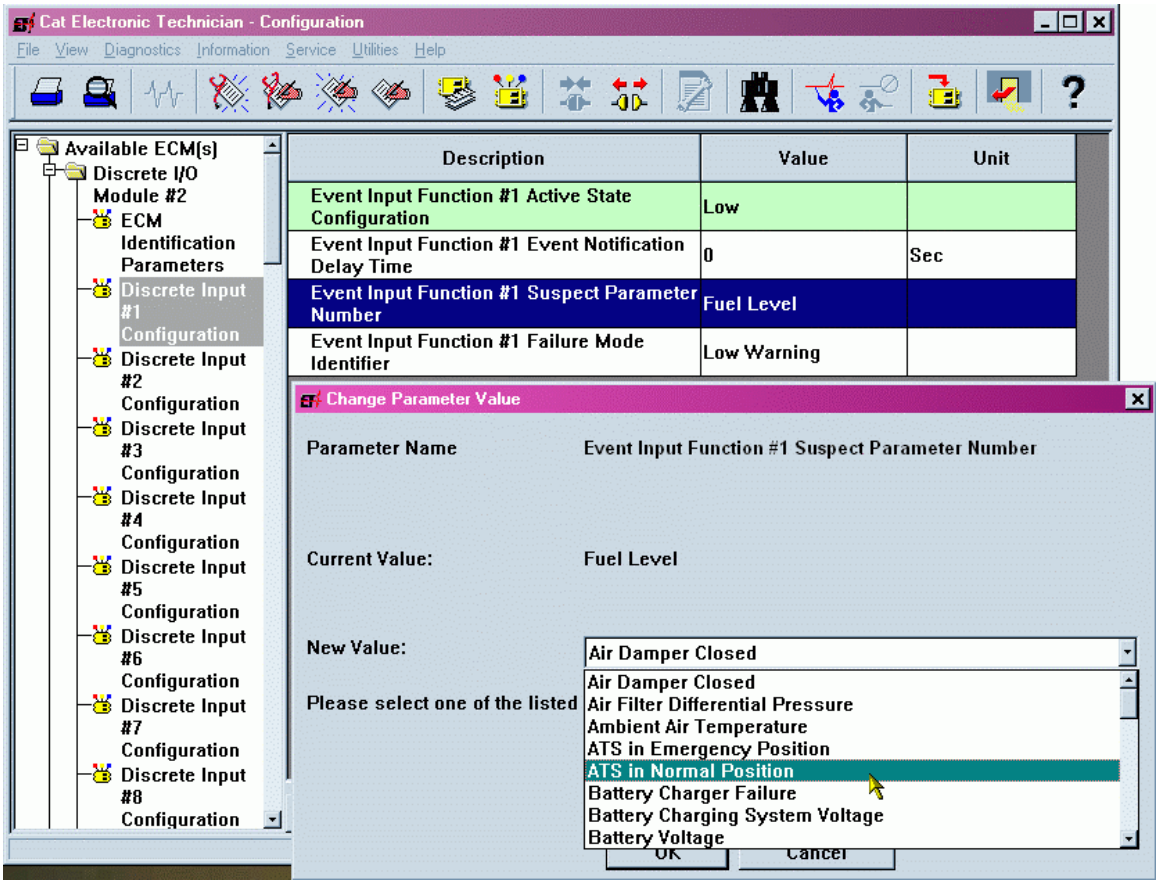


Figure 18: Caterpillar® Service Tool DIO digital input configuration

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 3 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 3 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 19. All eight relay outputs have identical parameters and options.

The *suspect parameter number* (SPN) is a choice between 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.

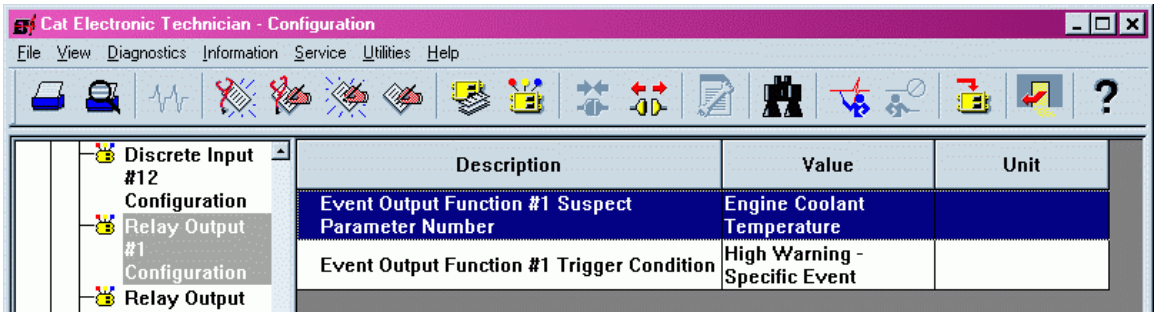


Figure 19: Caterpillar® Service Tool DIO relay output configuration

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 FMI's) 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 FMI's) 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.

Optional Modules Power Supply Specifications

Annunciator

- Accepts 9 - 32VDC power (12 or 24VDC nominal)
- Overvoltage capability is 32VDC for 1 hour @ 85°C

Thermocouple, RTD, and DIO

- Accept 5-32VDC power (12 or 24VDC nominal)
- Overvoltage capability is 32VDC for 1 hour @ 85°C
- Power supply input sections protect against transient surges and short circuits and are isolated from I/O

Packaging and Dimensions

Annunciator

- Can be mounted directly on the generator set panel or remotely
- -40 to 85°C (-40 to 185°F) operating temperature range (for ambient temperatures exceeding 85°C, the temperature scanner may deviate in accuracy an additional ±1°C. Note also that 120°C is a failure point. If the ambient temperature were to exceed 120°C, the device would NOT be expected to return to proper operation.)
- 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 (Third party testing is being pursued.)

Thermocouple, RTD, and DIO (see Figure 20 below)

- Only physical difference in packages between these three optional modules is that the DIO module has an LED to indicate communication network status.

- Can be mounted directly on the generator set panel or remotely
- Compact size (see mechanical drawing)
- Encapsulated in a rugged aluminum housing with watertight Deutsch connectors (IP65 rating)
- Suitable for moist, high shock and vibration environments
- -40 to 85°C (-40 to 185°F) operating temperature range (for ambient temperatures exceeding 85°C, the temperature scanner may deviate in accuracy an additional ±1°C. Note also that 120°C is a failure point. If the ambient temperature were to exceed 120°C, the device would NOT be expected to return to proper operation.)
- 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 (Third party testing is being pursued.)

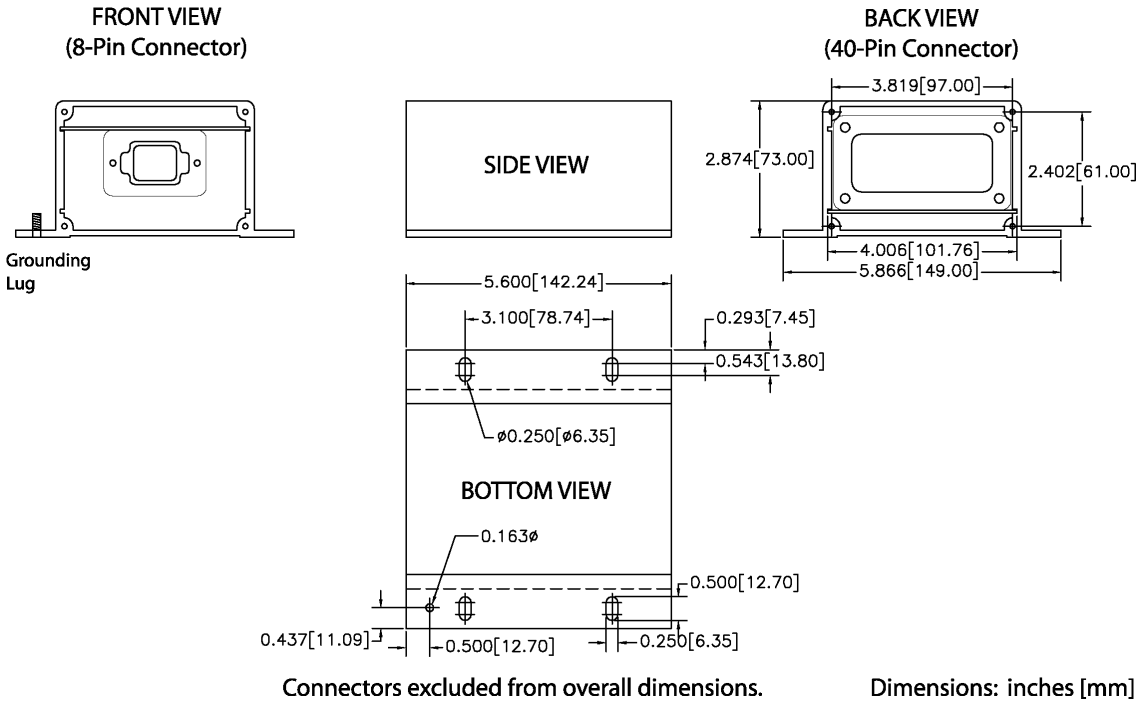


Figure 20: Thermocouple, RTD, and Discrete I/O module Physical Layout

Optional Modules Network Communications Interface

Annunciator

- Incorporates an SAE J1939 communications port
- Node address is auto configurable as per J1939-81.
- Optical isolation is provided for the CAN line
- Module operates normally with loss of communication link, retaining configured setpoints in non-volatile memory.

- Configuration is accomplished with customer proprietary service tools over the J1939 network.

Thermocouple, RTD, and DIO

- Incorporates an SAE J1939 communications port with software selectable slew rate on the transceiver
- Has two configurable “slew rates” to accommodate different CAN (SAE J1939) connections (capable of working on both the EMCP 3 Primary and Accessory J1939 data links).
- Node address is auto configurable as per J1939-81.
- 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 master I/O (provided by others) or service tool when master I/O is not available – synchronization time is accurate to within 1 sec.
- Includes a watchdog timer to require a reboot when the microprocessor locks
- Monitored parameters and diagnostics as well as setpoints are supplied by customer specification
- Monitored parameters and alarms are read-only over the network
- All parameter locations have default values that do not conflict.
- Module operates normally with loss of communication link, retaining configured values and error codes in non-volatile memory. (Note: An error log is only available in the Thermocouple and RTD modules.)
- The Discrete I/O module is designed to remain powered up during engine cranking.
- Configuration is accomplished with customer proprietary service tools over the J1939 network.

Optional Modules SAE J1939 Profile

For J1939 compliance, all modules comply with the applicable portions of the following:

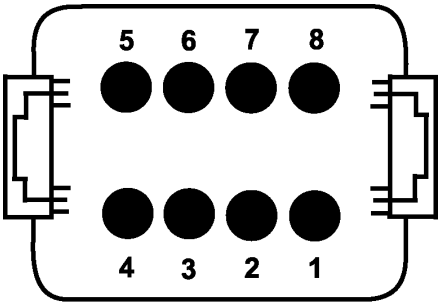
- SAE J1939-21, July 1998, Data Link Layer
- SAE J1939-71, January 2002, Application Layer
- SAE J1939-73, May 2000, Application Layer – Diagnostic
- SAE J1939-81, July 1997, Network Management

Customer specific proprietary extensions are also included in the SAE J1939 profile.

All module functionality can be divided into three distinctive parts: basic functionality, extended functionality and auxiliary functionality.

Refer to the Data Links section for further communications information.

Typical Connections for Optional Modules – Power and CAN bus

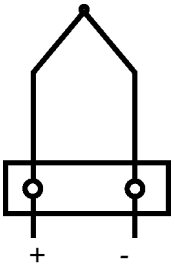


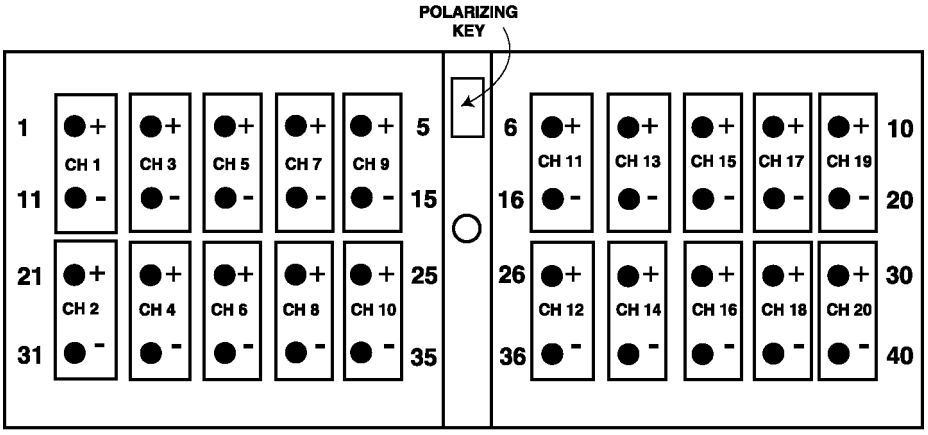
FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

1 = PWR+ 5 = SHIELD
2 = CAN-H 6,7,8 = NOT USED
3 = CAN-L
4 = PWR-

Typical Connections – Thermocouple Module:

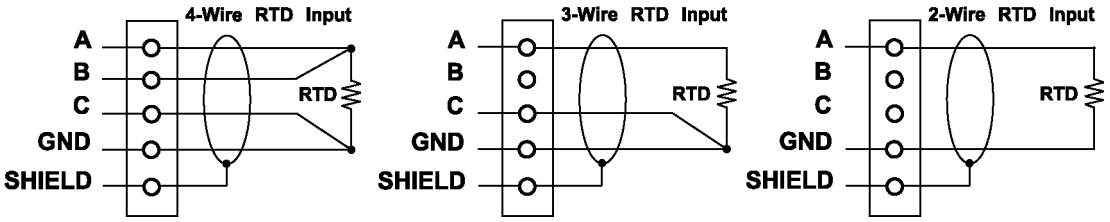
Type J or K



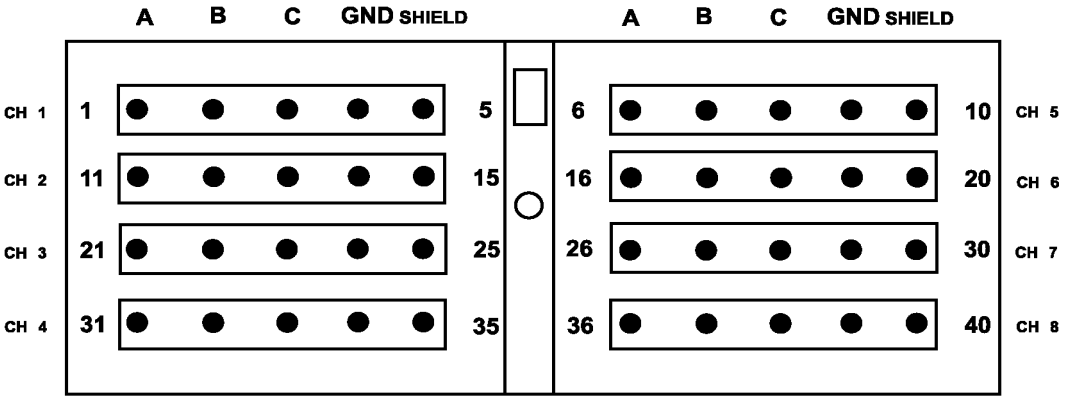


FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PA

Typical Connections – RTD Module:



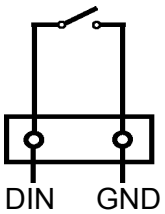
RTD MODULE - PIN OUT



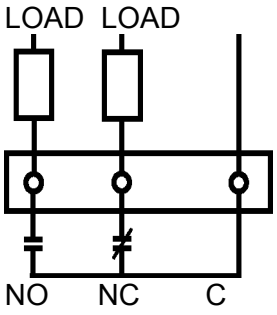
FRONT VIEW OF
MODULE MOUNTED CONNECTOR

Typical Connections – Discrete I/O Module:

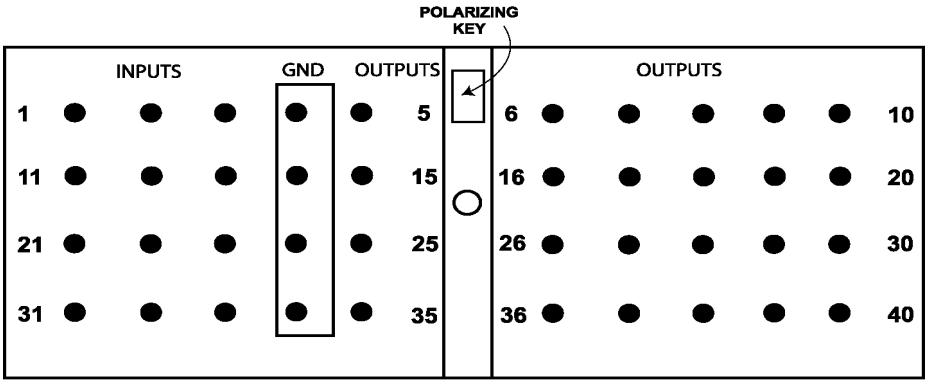
Input



Output



FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PB



NO - Normally Open
NC - Normally Closed
C - Common

INPUTS	Pin	OUTPUTS	Pin
DIN1	1	NC_1	5
DIN2	11	C_1	6
DIN3	21	NO_1	7
DIN4	31	NC_2	15
DIN5	2	C_2	16
DIN6	12	NO_2	17
DIN7	22	NC_3	25
DIN8	32	C_3	26
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
		C_6	19
		NO_6	20
		NC_7	28
		C_7	29
		NO_7	30
		NC_8	38
		C_8	39
		NO_8	40

EMCP 3 Support of Optional Modules

Annunciator:

Note: CAN1 indicates the connection for the EMCP 3 Primary J1939 data link, and CAN2 indicates the connection for the EMCP 3 Accessory J1939 data link. The EMCP 3.1 only supports the Primary J1939 data link. For more information on the Primary and Accessory data links, refer to the Data Links section.

EMCP 3.1: Supports one Annunciator module using CAN1.

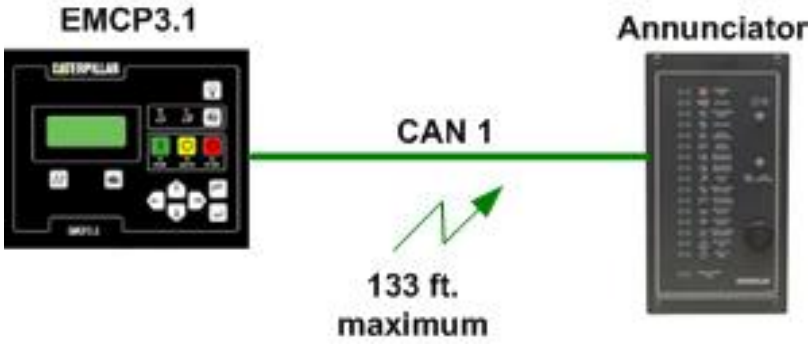


Figure 21: EMCP 3.1 and Annunciator Connection

EMCP 3.2: Supports one Annunciator module using CAN1 and up to three Annunciators using CAN2
EMCP 3.3: Supports one Annunciator module using CAN1 and up to three Annunciators using CAN2

DIO:

EMCP 3.1: No support
EMCP 3.2: Supports up to 2 DIO modules using CAN2
EMCP 3.3: Supports up to 2 DIO modules using CAN2

RTD:

EMCP 3.1: No support
EMCP 3.2: No support
EMCP 3.3: Supports one RTD module using CAN2
- Type supported: 2-wire, 3-wire, 4-wire
- Temp Coefficient Configurations Supported:
  - IEC Platinum
  - JIS Platinum
    - US Platinum
    - Legacy US Platinum
  - SAMA Platinum

Thermocouple:

EMCP 3.1: No support
EMCP 3.2: No support
EMCP 3.3: Supports one Thermocouple using CAN1 and one using CAN2
Types supported: J and K

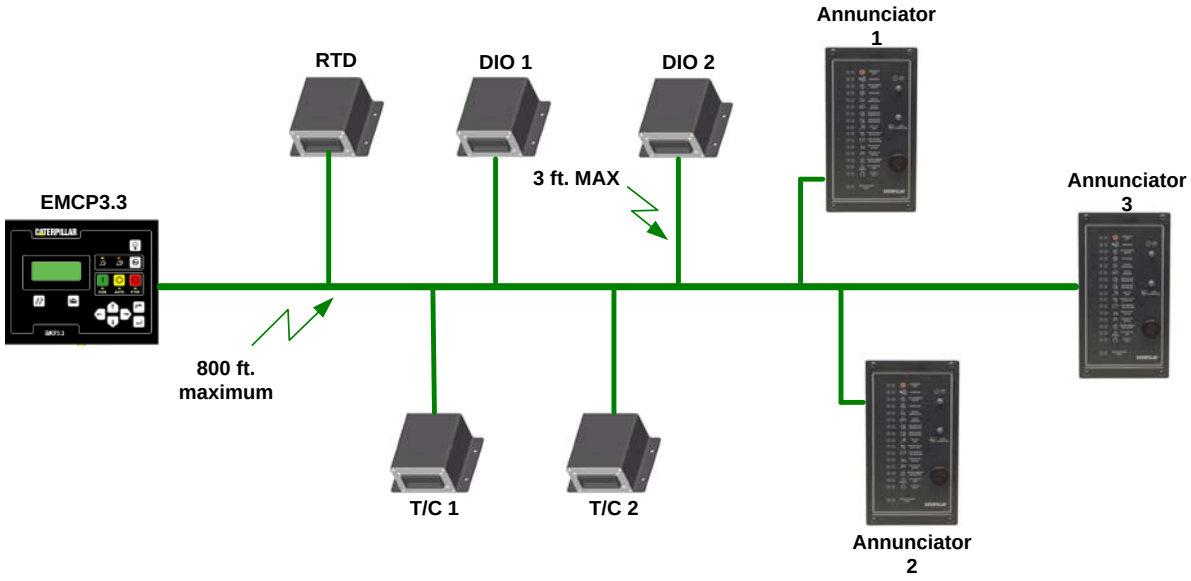


Figure 22: Example Illustration of Accessory Data Link Modules and Wire Lengths

3.13 Data Links

The EMCP 3 supports up to 3 different data links:

- One Primary J1939 Data Link
- One Accessory J1939 Data Link (EMCP 3.2 and 3.3 only)
- One System Control and Data Acquisition (SCADA) Data Link (EMCP 3.2 and 3.3 only)

Primary J1939 Data Link

The Primary J1939 Data Link is supported by all of the EMCP 3 controls.

The Primary J1939 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 Caterpillar® Digital Voltage Regulator (CDVR), and a Thermocouple Module. The EMCP 3 can interface with both EUI and MUI engines; in MUI engines, the engine sensors are wired directly to the EMCP 3. The Primary J1939 Data Link utilizes the Society of Automotive Engineers (SAE) J1939 protocol and requires hardware compliant to the high-speed Controller Area Network (CAN) 2.0B protocol defined in the International Standards Organization (ISO) 11898-2 document, running at 250k bits per second.

The Primary J1939 Data Link supports appropriate SAE J1939 Broadcast Parameter Group Numbers (PGN) and Suspect Parameter Numbers (SPN) for engine and genset data and diagnostics.

Wiring

The Primary J1939 communication wires are brought out of the EMCP 3 as part of the 70-pin AMP connector. The pins, as designated on the AMP connector, are shown in Table 1.

Table 1: Primary J1939 Data Link on 70-pin connector

Pin #	Name	Description
34	CAN1 -	Differential (-) for CAN
42	CAN1 SH	Shield for CAN
50	CAN1 +	Differential (+) for CAN

Network Topology

The physical topology of the CAN network used in the Primary J1939 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 termination resistor on the extreme ends of the main trunk. The topology for the EMCP 3.1 is illustrated in Figure 23. The topology for the EMCP 3.2 and EMCP 3.3 is illustrated in Figure 24 and Figure 25.

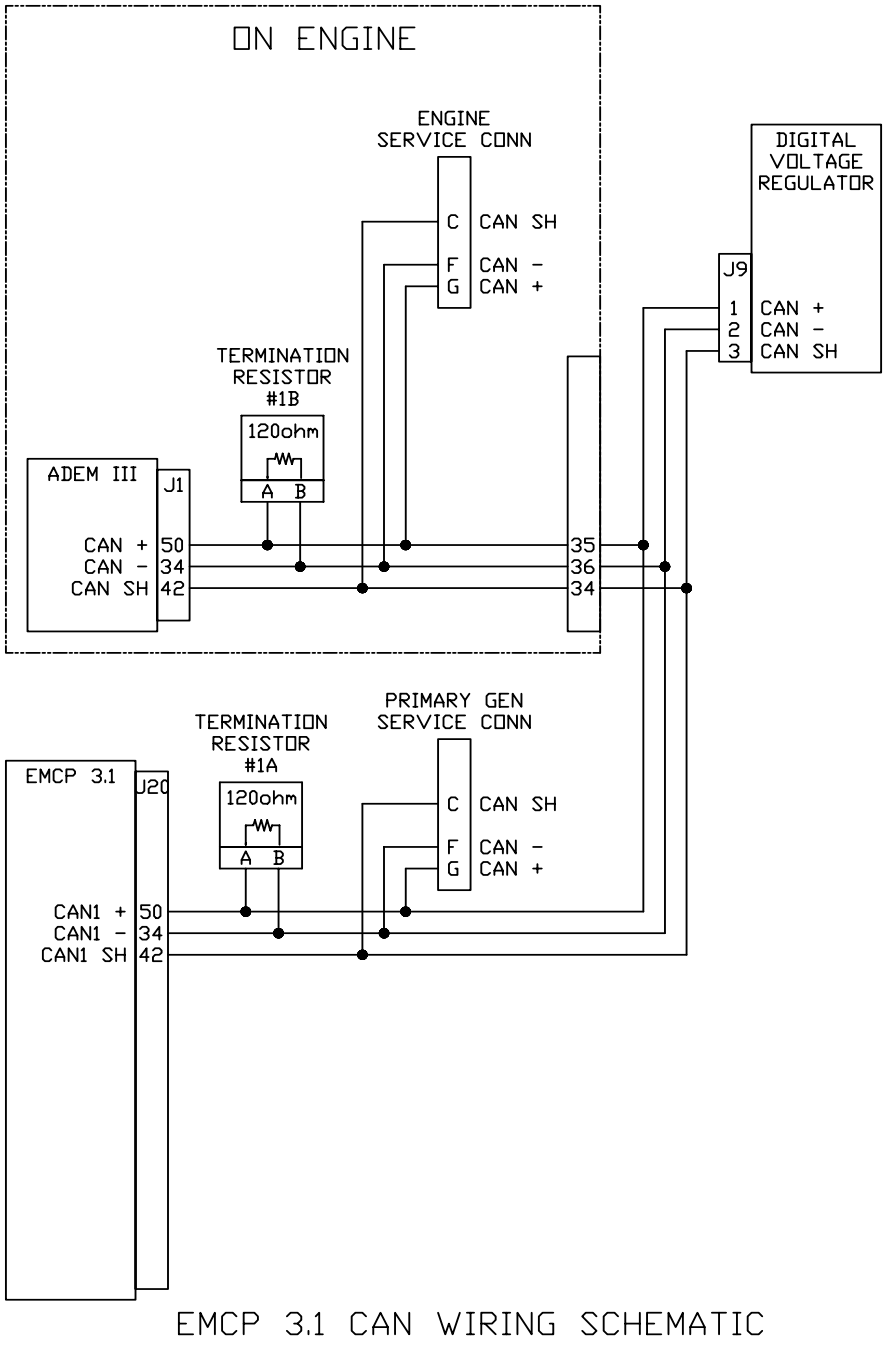


Figure 23: EMCP 3.1 CAN Wiring Diagram

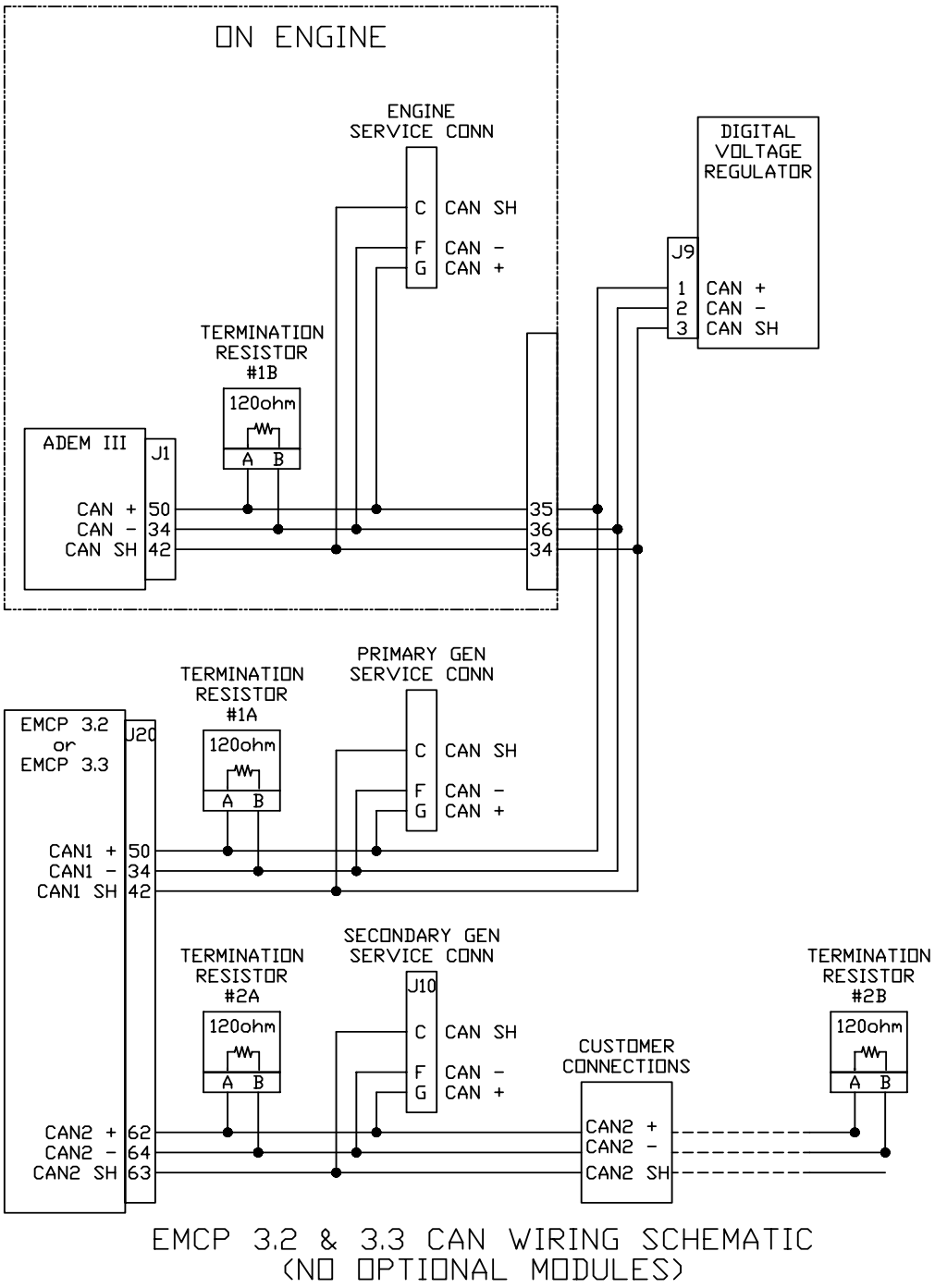


Figure 24: EMCP 3.2 and EMCP 3.3 CAN Wiring Diagram
(with no optional modules)

Accessory J1939 Data Link

The Accessory J1939 Data Link is supported by the EMCP 3.2 and EMCP 3.3.

The Accessory Data Link 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 three Annunciators. The Accessory J1939 Data Link utilizes the Society of Automotive Engineers (SAE) J1939 protocol and requires hardware compliant to the high-speed Controller Area Network (CAN) 2.0B protocol defined in the International Standards Organization (ISO) 11898-2 document, running at 250k bits per second.

The Accessory J1939 Data Link supports appropriate SAE J1939 Broadcast Parameter Group Numbers (PGN) and Suspect Parameter Numbers (SPN) for engine and genset data and diagnostics.

Wiring

The Accessory J1939 communication wires are brought out of the EMCP 3 as part of the 70-pin AMP connector. The pins, as designated on the AMP connector, are shown in Table 1.

Table 1: Accessory J1939 Data Link on 70-pin connector

Pin #	Name	Description
62	CAN2 +	Differential (+) for CAN
63	CAN2 SH	Shield for CAN
64	CAN2 -	Differential (-) for CAN

Network Topology

The physical topology of the CAN network used in the Accessory J1939 Data Link is a bus topology, consisting of a main trunk and small drops. The maximum allowable trunk length is 800 ft (approx. 250 m), and the maximum drop length is 3 ft (approx. 1 m). The CAN network requires a termination resistor on the extreme ends of the main trunk. The topology for the EMCP 3.2 and EMCP 3.3 in the default configuration, with no remote devices connected, is illustrated in Figure 24 above.
The topology for the EMCP 3.2 and EMCP 3.3 with some remote devices connected is illustrated in Figure 25. Note that 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.

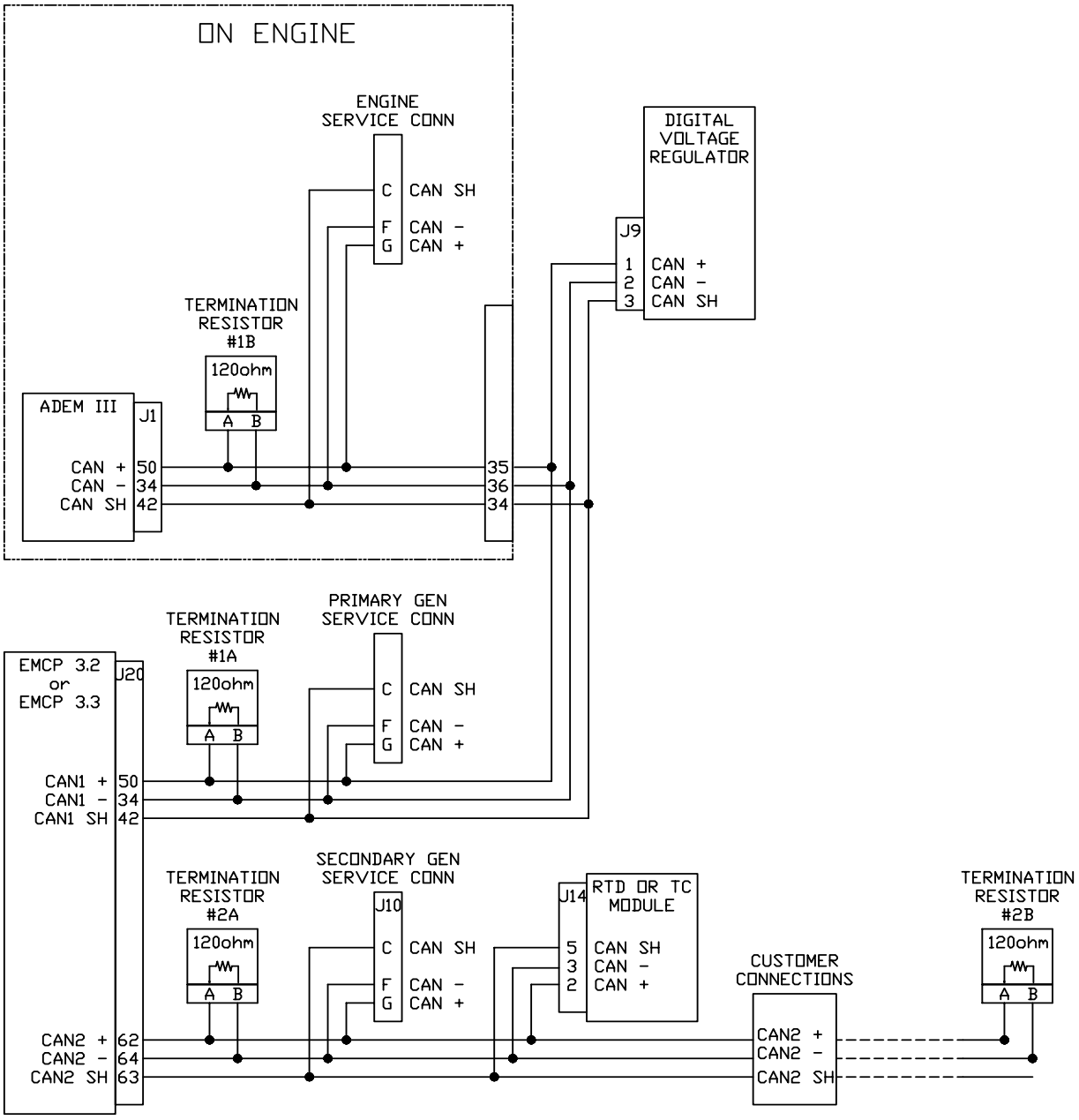


Figure 25: EMCP 3.2 and EMCP 3.3 CAN Wiring Diagram (with optional modules)

SCADA Data Link

Introduction

The SCADA Data Link is supported by the EMCP 3.2 and EMCP 3.3. Therefore, all the information in this section applies to EMCP 3.2 and EMCP 3.3 only, unless otherwise noted.

The EMCP 3.2 and EMCP 3.3 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 3 control panel in much the same way an operator does from the panel.

The host device connects to the EMCP through a half-duplex RS-485 serial link. The data is transmitted in a binary format over the serial connection. The host device acts as Modbus Master, and the EMCP 3 electronic controller 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 3. The EMCP 3 then takes action based on the query and/or sends a response to the query over Modbus.

Various data rates are available, and can be configured on the EMCP 3 control panel. See the Software Configuration section below for instructions. The options are the following: 2400, 4800, 9600, 14400, 19200, 28800, 38400, and 57600 baud.

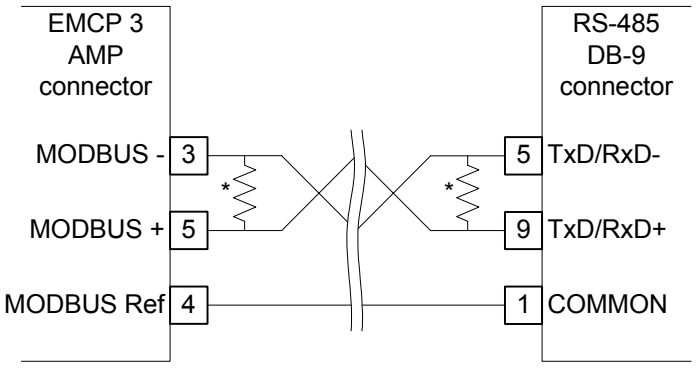
Wiring

The SCADA communication wires are brought out of the EMCP 3 as part of the 70-pin AMP connector. The pins, as designated on the AMP connector, are shown in Table 1.

Table 1: Modbus Pins on 70-pin Connector

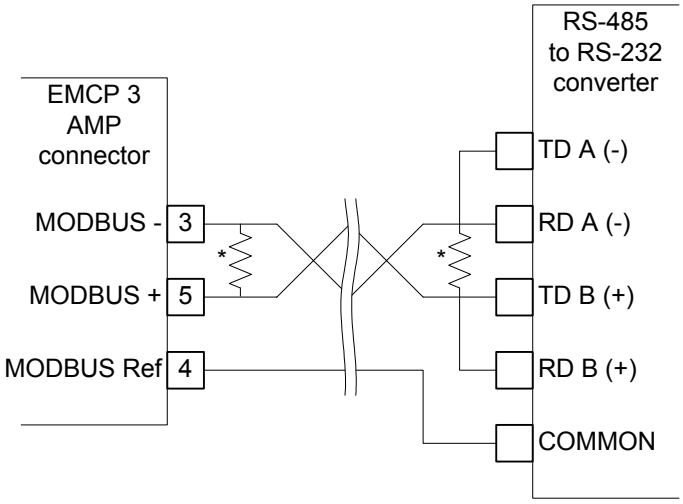
Pin #	Name	Description
3	MODBUS –	Optically isolated half-duplex differential (-) for Modbus
4	MODBUS Reference	Half-duplex RS-485 Reference for Modbus
5	MODBUS +	Optically isolated half-duplex differential (+) for Modbus

Modbus data transmission over RS-485 is accomplished over a single twisted pair for differential signaling with transmit and receive alternating over the same wire pair (MODBUS+ and MODBUS-). The Reference should be connected to the shield, to prevent ground loop currents. Figure 26 shows a possible wiring configuration to a RS-485 device. Figure 27 shows a possible wiring configuration to a RS-485 to RS-232 converter. See documentation of connected device to verify wiring configuration.



* - For multipoint network, terminate with 180ohm resistors at ends of network trunk

Figure 26: Possible wiring configuration to an RS-485 device



* - For multipoint network, terminate with 180ohm resistors at ends of network trunk

Figure 27: Possible wiring configuration to an RS-485 to RS-232 converter

Line Termination

Both ends of the Modbus lines (or the extreme ends of the trunk, for a multipoint network) should have termination between MODBUS+ and MODBUS-. A 0.5W 150Ω resistor may be adequate. If line polarization (see Software Configuration section below) is implemented, a better choice is a 10 nF capacitor (10V minimum) in series with a 0.25W 120Ω resistor. 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 below for instructions on enabling line polarization.

Software Configuration

The SCADA data link may require software configuration. The configuration parameters are accessible on the EMCP 3 control panel via the following menu options:

Main Menu ↵
Configure ↵
Setpoints ↵
Network ↵
Data Link - SCADA ↵

Baud rate options are the following: 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, and 115200 baud. (115200 baud not currently supported.)

Parity can be set to None, Even, or Odd parity.

The **Slave Address** the unique address for each slave on the Modbus data link. This address is referenced in the data messages, described in the Data Link Layer section

below. The slave (EMCP 3) will only respond to messages addressed to its particular slave address, or to global requests. This address can be set to any integer from 1 to 247.

The **Connect Timeout Interval** is the amount of time the EMCP 3 will wait between message transmissions before it resets the SCADA security level. If a SCADA password has been set, this timeout will disallow any further SCADA reads/writes until the proper password is written.

The **RS-485 Bias Resistor** provides line polarization. Line polarization helps prevent noise and external interference. The data terminals of the EMCP 3 are internally optocoupled, and therefore line polarization is not required for the EMCP 3. However, other devices may require line polarization. To polarize the line, the EMCP 3 Modbus terminals have hardware-selectable passive pull-up / pull-down lines. Only a single device on a Modbus network should have line polarization.

In addition to these setpoints, SCADA access can be restricted by means of assigning a SCADA password. For more information, see the Data Link Security subsection of section 3.14.

Data Link Layer

Data Structure

Modbus registers are 2 bytes long. A register is the smallest block that can contain a single piece of data. Larger pieces of data occupy consecutive registers, with the most significant word (pair of bytes) in the lowest register, and the least significant word (pair of bytes) in the highest register.

Modbus register addresses are referenced starting with register 1, whereas data link requests begin at 0. This results in an offset of 1 bit in the register address. For example, to request the parameter “Generator Overall Power Factor”, which resides in Modbus register number 103 ($67), a register address of $66 must be sent.

Table 2: Modbus Packet Format

Byte offset	Field	Field description
0	Address	Slave address, for both query and response. Every control on the network has a unique slave address between 1 and 247. Use 0 to make a broadcast query, which is supported for Function Codes 6 and 16. The EMCP 3 will always respond with it’s own slave address.
1	Function Code	Function Code for both query and response. See Supported Function Codes for a list and syntax of supported function codes.
2	Data	Data or exception responses. See Supported Function Codes for the format of address, counts, and data. See Exception Responses for the format of exception responses.
…		
(n-3)		

(n-2)	CRC	Cyclic Redundancy Check to catch transmission errors. The low byte is transmitted first, then the high byte.
(n-1)		

Communication

Modbus communication is comprised of data packets. A packet is a set of bytes transmitted consecutively and interpreted as one message, and can vary in length. A packet is sent with byte offset 0 first, and the data is sent with the most significant byte first. Every packet shares a common structure, which is shown in Table 2. Only the Data field has a variable length, depending on the function being performed and the amount of data being transmitted.

Supported Function Codes

Three normal function codes are supported by the EMCP 3. If the EMCP 3 receives an erroneous request, it can also generate an error function code, called an exception response. See Exception Responses section for descriptions of exception responses.

3 ($03) – Read Registers

Send this Function Code to read data, single or up to 123 contiguous registers, from the EMCP 3. Note that the query will contain the register count, while the response will contain the byte count (byte count = register count x 2). Note also that the query has a fixed length of 4 bytes, whereas the response has a variable length depending on the number of registers requested.

Table 3: “Read Registers” Query Data

data link register address (high byte)
data link register address (low byte)
register count (high byte)
register count (low byte)

Table 4: “Read Registers” Response Data

byte count
data (Big Endian)

6 ($06) – Write Single Register

Send this Function Code to write data to a single register on the EMCP 3. Note that the EMCP 3 will attempt to write the data, and then respond with the new value in the register. If the query inadvertently attempted to write data to a read-register, the response data bytes will not match the query data bytes. This Function Code may be broadcast, in which case no response will be sent.

Table 5: “Write Single Register” Query Data

data link register address (high byte)
data link register address (low byte)
data (high byte)
data (low byte)

Table 6: “Write Single Register” Response Data

data link register address (high byte)
data link register address (low byte)
data (high byte)
data (low byte)

16 ($10) – Write Multiple Registers

Send this Function Code to write data to up to 123 contiguous registers on the EMCP 3. Note that the query will contain both the register count and the byte count (byte count = register count x 2). Note also that the query has a variable length depending on the number of registers being written, whereas the response has a fixed length of 4 bytes. The EMCP 3 will not respond with any data, only the starting address and the register count as sent in the query. The entire Write will fail, and the slave will return an Exception Response, if any register in this span is a Read register. This Function Code may be broadcast, in which case no response will be sent.

Table 7: "Write Multiple Registers" Query Data

data link register address (high byte)
data link register address (low byte)
register count (high byte)
register count (low byte)
byte count
data (Big Endian)

Table 8: "Write Multiple Registers" Response Data

data link register address (high byte)
data link register address (low byte)
register count (high byte)
register count (low byte)

Error Checking

In EMCP 3 SCADA communications, various levels of error-checking are performed.

The Modbus data link protocol allows for byte-level error checking and packet-level error checking. For byte-level error-checking, parity checking may be done. For packet-level error-checking, the Modbus protocol dictates that a Cyclic Redundancy Check be performed to catch transmission errors; that is, verify that the packet received is identical to the packet that was sent. These occur in the Modbus data link layer. More information on the CRC is given below.

Once the packet is verified, the addresses and function codes are checked. This is handled using simple logic, determining whether the function code is supported and determining whether or not the address range or count is within range. If not, an exception response is sent. This occurs in the Modbus application layer. More information on exception responses is given below.

Once the addresses and function codes are checked, the data is ready to be handled by the EMCP 3 application software. There is error-checking at this level to determine whether there are any application-specific errors. For example, if you are attempting to write 101% into a register that is defined to hold 0-100%, then even though the data may fit into the register (and therefore passes the previous error-checking), the application does not accept an input of 101%, and therefore a fault response is sent. This fault response is called a Fault Identifier, or FID. A fault response is data that is "valid" over the Modbus data link, but the EMCP 3 and the Modbus Master device agree to reserve for use as an FID. More information on Fault Identifiers is given below in the Fault Identifiers section.

Parity Check

Parity checking uses standard even or odd parity. The parity can be set in the EMCP 3 to even, odd, or none. Parity checking occurs at the byte-level. Upon successful parity check, the checked byte is accepted as part of the transmitted message. If the parity check fails, the byte is discarded.

Cyclic Redundancy Check

The Cyclic Redundancy Check (CRC) algorithm checks the contents of the entire message. The CRC field consists of a 16–bit value, and is appended to the end of the message. When this is done, the low–order byte of the field is appended first, followed by the high–order byte. The CRC high–order byte is the last byte to be sent in the message. The CRC value is calculated by the sending device, which appends the CRC to the message. The receiving device recalculates a CRC using the same algorithm during receipt of the message, and as it receives the CRC field, compares the calculated value to the received value. If the two values are not equal, the message is discarded.

A detailed description as well as sample code and a calculation example are given in the Modbus Serial Line Implementation Guide version 1.0 or the most current version, available at www.modbus.org.

Exception Responses

Upon a parity or CRC error, the byte or message (respectively) is discarded. If neither of these errors occur, the read/write status is checked. An Exception Response will be sent if there is a read/write error.

If the register cannot be read from or written to at a particular time due to some application software state, it will not generate an Exception Response. Instead, the application layer will respond with data that is in the Fault Identifiers (FID) range. See Fault Identifiers (FID) section for more information.

An Exception Response contains a function code that is related to the function code the EMCP 3 is responding to; it's value is [128 + Function Code for Query]. Any function code 128 ($80) or higher is an Exception Response. If the Exception Response is not listed below, it is in response to an unsupported function code in a query, and should contain an exception code of 01.

131 ($83) – Exception Response to Read Registers Query

The exception response contains only 1 byte of data, which is comprised of the exception code.

Exception Code	*Reason*
02	Starting or ending (starting + count) register address invalid
03	Register Count was less than 1 or greater than 123
04	Read error possibly due to some register(s) in the span not being Read registers

134 ($86) – Exception Response to Write Single Register Query

The exception response contains only 1 byte of data, which is comprised of the exception code.

Exception Code	*Reason*
02	Register address invalid
03	Register value out of range perhaps because longer than 2 bytes
04	Read error possibly due to not being a Write register

144 ($90) – Exception Response to Write Multiple Registers Query

The exception response contains only 1 byte of data, which is comprised of the exception code.

Exception Code	*Reason*
02	Starting or ending (starting + count) register address invalid
03	Register Count was less than 1 or greater than 123, or byte count was not (Register Count x 2)
04	Write error possibly due to some register(s) in the span not being Write registers

Fault Identifiers (FID)

Fault Identifiers (FIDs) are based on the concept that the entire data space within the register(s) is partitioned in a predefined manner, irrespective of the specific type of data in the register(s). The range of data in the EMCP 3 response allows the master device to interpret the data as valid or as an indication of a fault.

The following chart shows the transmitted signal ranges, including the ranges that comprise Fault Identifiers (FIDs).

Table 9: Transmitted Signal Ranges

Range Name	Boolean Data†	1-Register Data	2-Register Data	Notes
Valid Data	0, 1	0 – 64,255	0 – 4,211,081,215	See individual Parameter Descriptions for units, offset, and scaling to convert to physical units
	$0000 or $0001	$0000 –$FAFF	$00000000 – $FAFFFFFF	
Not Used	2-65532	65,256 – 65,023	4,211,081,214	These data ranges are not used.
	$0010 - $FFFC	$FB00 –$FDFF	$FB000000 – $FDFFFFFF	
Error	65533	65,024 – 65,279	4,261,412,864h – 4,278,190,079h	FID: Signal saturated, out of range, or error from source transmitter
	$FFFD	$FE00 –$FEFF	$FE000000 – $FEFFFFFF	
Not Available / Not Requested	65535	65280 – 65535	4,278,190,080 – 4,294,967,294	FID: Parameter is not applicable in the current state, not available from the controller, or not requested
	$FFFF	$FF00 –$FFFF	$FF000000 – $FFFFFFFF	

† Note that 2-bit data is not transmitted individually, but rather within a register.

3.14 SCADA Parameter Information by Function

Data Link Security

Data link security uses a different set of passwords than the EMCP 3 control panel local security. The passwords grant access to the same levels of functionality and setpoints, however.

The EMCP 3 supports five levels of security, which corresponds to Level 0 (basic access, without a password), and four levels of passwords: SCADA (not available on EMCP 3.1), Level 1, Level 2, and Level 3. The SCADA password is used to disable/enable any SCADA access. If SCADA access is not granted, the control will return all FFh data for READ requests, and fail with an exception response for WRITE requests. Level 1, Level 2, and Level 3 passwords are used to disable/enable corresponding levels of access to the control. Each level grants functionality that is a subset of that granted by the higher levels of access. The Level 3 password uses the same system as the EMCP 3 control panel level 3 password. The Caterpillar® Dealer Solutions Network (DSN) must be contacted to acquire a level 3 password.

The SCADA, Level 1, or Level 2 password can be changed by writing the new password to the SCADA Password, Level 1 Password, or Level 2 Password register, as long as the SCADA data link is at a sufficient level of access. In order to change the Level 1 password, Level 1 access must be obtained. In order to change the SCADA or Level 2 passwords, Level 2 access must be obtained. A higher level of access can be requested by writing the password of the desired level to the Write Access Password register. A lower level of access can be requested simply by entering the desired security level number into the Write Current Security Level register.

All of the passwords, as well as the phone-in prompt, use the 1-byte ASCII format and character set. Each string is variable in length, so in order to enter a shorter password, the rest of the field may be padded with the space character ($20). All other characters are invalid data, and will result in a FID response.

There are a couple of built in timeout features to reset the security level after a period of inactivity. One is the *Level 0 Timeout*, which resets the SCADA access level to level 0 (or the lowest unprotected level above level 0) after 10 minutes without any successful **write** commands over the SCADA data link. To prevent this fixed timer from expiring without risking affecting the functions of the EMCP 3 by writing to a critical register, writing to the “Key Press” register will reset this timer.

The second is the *SCADA Timeout*, which resets SCADA access completely below the SCADA security level (or the lowest unprotected level). The timeout for this is configurable from 0.1 seconds to 1 hour – it is the “SCADA Data Link Connection Timeout Interval” setpoint, and will only trigger after a period without **any** activity on the SCADA data link.

Write Access Password

$02BC (700) - 8 registers (16 bytes) long - Write
Modbus register to which the desired security level password is written.

ASCII data, numbers (characters $30 through $39) valid. If the password is less than 16 characters long, pad the end with space characters ($20).

Level 1 Password

$02C4 (708) - 8 registers (16 bytes) long - Write
Modbus register to which the new Level 1 password is written.
This is applicable only if current security level is 1 or higher. Write to this register to set a new password for level 1.

ASCII data, numbers (characters $30 through $39) valid. To disable this password, enter a single zero. If a password is less than 16 characters long, pad the end with space characters ($20).

Level 2 Password

$02CC (716) - 8 registers (16 bytes) long - Write
Modbus register to which the new Level 2 password is written.
This is applicable only if current security level is 2 or higher. Write to this register to set a new password for level 2.

ASCII data, numbers (characters $30 through $39) valid. To disable this password, enter a password of a single zero. If a password is less than 16 characters long, pad the end with space characters ($20).

SCADA Password

$02D4 (724) - 8 registers (16 bytes) long - Write
Modbus register to which a new SCADA password is written.
This is applicable only if the current security level is 2 or higher. Write to this register to set a new password to obtain SCADA access to the EMCP 3.

ASCII data, numbers (characters $30 through $39) valid. The SCADA password may be a maximum of 8 characters long. The last 8 characters should be set to NULL ($00) or space ($20). To disable this password, enter a password of a single zero. Pad the end of a password with space characters ($20).

This password is stored as a numerical data. Therefore, any leading zeros will be removed.

Current Security Level

$02DC (732) - 1 register (2 bytes) long - Read
Current security level of the SCADA Data Link.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Write Current Security Level

$02DD (733) - 1 register (2 bytes) long - Write
Write a security level value into this register to change to a lower security level. In order to change to a higher security level, write a password to the Write Access Password register.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Level 3 Password Phone In Prompt

$02DE (734) - 8 registers (16 bytes) long - Read
Numerical key that needs to be communicated to the factory support operator who can provide a Level 3 password. This is the same prompt as on the EMCP 3 control panel in the Configure – Security – Enter Level 3 menu.

ASCII data, characters $30 through $39 valid.

Key Press

$0136 (310) - 1 register (2 bytes) long - Write
Triggers a key press event on the control.
The key press event is useful to reset the SCADA security level reset timer, which resets the SCADA access to level 0 after 10 minutes of inactivity. Reading from other Modbus registers will not reset the above timers, but writing to any other Modbus register will also reset this timer.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Spare Analog Input

The EMCP 3.2 and higher have a Spare Analog Input. It is factory-configured as one of three types of input: a Level, Temperature, or Pressure. Based on the type configuration, it can be assigned to a particular Suspect Parameter Number (SPN), and the percentage (level), temperature, or pressure can be read over SCADA with the appropriate units.

If the configuration is set to a specific sensor type and SPN, but a request is made over SCADA for a different type or SPN, then $FFFF will be sent in the response. For example, if Type Configuration is set to “Temperature”, and “Spare Analog Input Pressure” is queried, the response will be $FFFF; if Suspect Parameter Number is set to “Oil Filter Differential Pressure”, and “Air Filter 1 Differential Pressure from I/O Pin” is queried, $FFFF will be returned.

Spare Analog Input Percentage

$00CF (207) - 1 register (2 bytes) long - Read
Percentage of full scale measured by auxiliary level sensor #1.

This is applicable only when the Enable Status is Enabled, and the Type Configuration is set to Level.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Fuel Level from I/O Pin

$0324 (804) - 1 register (2 bytes) long - Read
Ratio of volume of fuel to the total volume of fuel storage container, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Level, and the SPN is set to Fuel Level.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

External Tank Fuel Level from I/O Pin

$0325 (805) - 1 register (2 bytes) long - Read
Ratio of volume of fuel to the total volume of fuel storage container, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Level, and the SPN is set to External Tank Fuel Level.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Engine Oil Level from I/O Pin

$0326 (806) - 1 register (2 bytes) long - Read
Ratio of current volume of engine sump oil to maximum required volume, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Level, and the SPN is set to Engine Oil Level.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Engine Coolant Level from I/O Pin

$0327 (807) - 1 register (2 bytes) long - Read
Ratio of volume of liquid found in engine cooling system to total cooling system volume, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Level, and the SPN is set to Engine Coolant Level.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Spare Analog Input Temperature

$00D0 (208) - 1 register (2 bytes) long - Read
Temperature measured by auxiliary temperature sensor #1.
This is applicable only when the Enable Status is Enabled, and the Type Configuration is set to Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Rear Bearing Temperature from I/O Pin

$00A2 (162) - 1 register (2 bytes) long - Read
Temperature of the bearing inside the alternator, as measured by the auxiliary analog input. Bearing 1 is the left or rear bearing.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Generator Rear Bearing Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Engine Oil Temperature from I/O Pin

$0320 (800) - 1 register (2 bytes) long - Read
Temperature of the engine lubricant, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Engine Oil Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Exhaust Temperature from I/O Pin

$0321 (801) - 1 register (2 bytes) long - Read
Temperature of combustion byproducts leaving the engine, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Exhaust Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Left Manifold Exhaust Temperature from I/O Pin

$0322 (802) - 1 register (2 bytes) long - Read
Temperature of combustion byproducts within the left engine exhaust manifold, as measured by the auxiliary analog input.

T This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Left Exhaust Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Right Manifold Exhaust Temperature from I/O Pin

$0323 (803) - 1 register (2 bytes) long - Read
Temperature of combustion byproducts within the right engine exhaust manifold, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Right Exhaust Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Ambient Air Temperature from I/O Pin

$032E (814) - 1 register (2 bytes) long - Read
Temperature of the air surrounding the genset, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Temperature, and the SPN is set to Ambient Air Temperature.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Spare Analog Input Pressure

$00D1 (209) - 1 register (2 bytes) long - Read
Pressure measured by auxiliary pressure sensor #1.
This is applicable only when the Enable Status is Enabled, and the Type Configuration is set to Pressure.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Fire Extinguisher Pressure from I/O Pin

$0328 (808) - 1 register (2 bytes) long - Read

Pressure of fire extinguisher contents, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Pressure, and the SPN is set to Fire Extinguisher Pressure.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Oil Filter Differential Pressure from I/O Pin

$0329 (809) - 1 register (2 bytes) long - Read

Change in engine oil pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid material on or in the filter, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Pressure, and the SPN is set to Oil Filter Differential Pressure.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Air Filter 1 Differential Pressure from I/O Pin

$032A (810) - 1 register (2 bytes) long - Read

Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter, as measured by the auxiliary analog input to the control.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Pressure, and if the Suspect Parameter Number configured for the Spare Analog Input is set to Air Filter Differential Pressure.

Resolution	Offset	Data Range
1 / 128 kPa / bit	-250 kPa	-250 to 251.99 kPa

Fuel Filter Differential Pressure from I/O Pin

$032B (811) - 1 register (2 bytes) long - Read

Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filter element, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Pressure, and the Suspect Parameter Number configured for the Spare Analog Input is set to Fuel Filter Differential Pressure.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Starting Air Pressure from I/O Pin

$032D (813) - 1 register (2 bytes) long - Read
Gage pressure of air in an engine starting system that utilizes compressed air to provide the force required to rotate the crankshaft, as measured by the auxiliary analog input.

This is applicable only when the Enable Status is Enabled, the Type Configuration is set to Pressure, and the Suspect Parameter Number configured for the Spare Analog Input is set to Starting Air Pressure.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Discrete Inputs and Outputs

EMCP 3 digital inputs, digital outputs, and relay outputs can be monitored over the SCADA data link. Table 10 shows the number of each available on each level of control. If an input is queried that is not available on a particular control, then an FID or an exception response will be sent in the response.

Table 10: Discrete I/O For Each Level of EMCP 3

	EMCP 3.1 †	EMCP 3.2	EMCP 3.3
Number of Digital Inputs	6	8	8
Number of Digital Outputs	0	1	2
Number of Relay Outputs	6	8	8
Number of Digital Selectors	4	7	8

† Note that although discrete I/O counts are given for the EMCP 3.1 for completeness, the EMCP 3.1 does not have SCADA functionality, and therefore is not within the scope of this document.

On the EMCP 3 control panel, the Source Configuration for each digital selector can be configured to input 1 through 10, or Data Link. Each Digital Selector has one Modbus register to read the Digital Selector #n Commanded Value, and one to write a Digital Selector #n Activate Command. These queries will only affect or reflect the outputs if the “Digital Selector #n Source Configuration” setpoint is set to Data Link. Otherwise, these queries will set or read the SCADA command, but the EMCP 3 will not use that command, and therefore the values will be meaningless.

Digital Input #1 Active State

(through)

Digital Input #8 Active State

$0258 (600) through $025F (607) - 1 register (2 bytes) long - Read
Indicates that Digital Input #n is active.

Digital Input	Register Address (Hex)	Register Address (Decimal)
1	$0258	600
2	$0259	601
3	$025A	602
4	$025B	603
5	$025C	604
6	$025D	605
7	$025E	606
8	$025F	607

All of these registers have the same data structure and bit definitions.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Relay Output #1 Active State

(through)

Relay Output #8 Active State

$0268 (616) through $026F (623) - 1 register (2 bytes) long - Read
Relay Output #n is active.

Relay Output	Register Address (Hex)	Register Address (Decimal)
1	$0268	616
2	$0269	617
3	$026A	618
4	$026B	619
5	$026C	620
6	$026D	621
7	$026E	622
8	$026F	623

All of these registers have the same data structure and bit definitions.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Digital Output #1 Active State

$0270 (624) - 1 register (2 bytes) long - Read
Digital Output #1 is active.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Digital Output #2 Active State

$0271 (625) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Digital Output #2 is active.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Digital Selector #1 Activate Command

(through)

Digital Selector #10 Activate Command

$0274 (628) through $027D (637) - 1 register (2 bytes) long - Write
SCADA command to activate Digital Selector #n.

This will affect an output only if the Source Configuration of the desired digital selector is set to Data Link.

Digital Selector	Register Address (Hex)	Register Address (Decimal)
1	$0274	628
2	$0275	629
3	$0276	630
4	$0277	631
5	$0278	632
6	$0279	633
7	$027A	634
8	$027B	635
9	$027C	636

Digital Selector	Register Address (Hex)	Register Address (Decimal)
10	$027D	637

All of these registers have the same data structure and bit definitions.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Digital Selector #1 Commanded Value

(through)

Digital Selector #10 Commanded Value

$027E (638) through $0287 (647) - 1 register (2 bytes) long - Read
Value of current Activate Command being applied to Digital Selector #n.

This will reflect the active state of an output only if the Source Configuration of the corresponding digital selector is set to Data Link.

Digital Selector	Register Address (Hex)	Register Address (Decimal)
1	$027E	638
2	$027F	639
3	$0280	640
4	$0281	641
5	$0282	642
6	$0283	643
7	$0284	644
8	$0285	645
9	$0286	646
10	$0287	647

All of these registers have the same data structure and bit definitions.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Generator AC Parameters

The SCADA data link allows remote monitoring of various generator AC quantities. These include per-phase as well as average or overall parameters; voltages, currents, powers, and power factors; real, reactive, and apparent powers.

Some AC quantities are not valid for every setting of the “Generator Connection Configuration” setpoint. If a parameter is queried while it is invalid, an FID will be sent in the response. Table 11 shows which parameters are invalid under which wiring configurations.

Table 11: AC Quantities Dependent on Wiring Configuration

	Star	3-Wire Delta	4-Wire Delta	2-Wire 1-Phase	3-Wire 1-Phase
Gen Freq (0066h)	OK	OK	OK	OK	OK
$\mathbf{V_{L\text{-}L\ AVG}}$ (0064h)	OK	OK	OK	OK	OK
$\mathbf{V_{A\text{-}B}}$ (006Ch)	OK	OK	OK	OK	OK
$\mathbf{V_{B\text{-}C}}$ (006Dh)	OK	OK	OK	Invalid	Invalid
$\mathbf{V_{C\text{-}A}}$ (006Eh)	OK	OK	OK	Invalid	Invalid
$\mathbf{V_{L\text{-}N\ AVG}}$ (0094h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_A}$ (0072h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_B}$ (0073h)	OK	Invalid	OK	Invalid	OK
$\mathbf{V_C}$ (0074h)	OK	Invalid	OK	Invalid	Invalid
$\mathbf{I_{AVG}}$ (0065h)	OK	OK	OK	OK	OK
$\mathbf{I_A}$ (006Fh)	OK	OK	OK	OK	OK
$\mathbf{I_B}$ (0070h)	OK	OK	OK	OK	OK
$\mathbf{I_C}$ (0071h)	OK	OK	OK	Invalid	Invalid

Generator Average AC RMS Frequency

$0066 (102) - 1 register (2 bytes) long - Read

Average AC frequency measured at the generator output.

Resolution	Offset	Data Range
1/128 Hz / bit	0 Hz	0 to 501.9922 Hz

Generator Average Line-Line AC RMS Voltage

$0064 (100) - 1 register (2 bytes) long - Read

Average Line to Line RMS voltage measured at the generator output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase A Line-Line AC RMS Voltage

$006C (108) - 1 register (2 bytes) long - Read

Line to Line RMS voltage measured at the generator phase AB output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase B Line-Line AC RMS Voltage

$006D (109) - 1 register (2 bytes) long - Read

Line to Line RMS voltage measured at the generator phase BC output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase C Line-Line AC RMS Voltage

$006E (110) - 1 register (2 bytes) long - Read

Line to Line RMS voltage measured at the generator phase CA output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Average Line-Neutral AC RMS Voltage

$0094 (148) - 1 register (2 bytes) long - Read

The average Line to Neutral AC RMS voltage measured at the generator output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase A Line-Neutral AC RMS Voltage

$0072 (114) - 1 register (2 bytes) long - Read

Line to Neutral RMS voltage measured at the generator phase A output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase B Line-Neutral AC RMS Voltage

$0073 (115) - 1 register (2 bytes) long - Read

Line to Neutral RMS voltage measured at the generator phase B output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Phase C Line-Neutral AC RMS Voltage

$0074 (116) - 1 register (2 bytes) long - Read

Line to Neutral RMS voltage measured at the generator phase C output.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

Generator Average AC RMS Current

$0065 (101) - 1 register (2 bytes) long - Read

Average RMS current measured at the generator output.

Resolution	Offset	Data Range
1 A / bit	0 A	0 to 64255 A

Generator Phase A AC RMS Current

$006F (111) - 1 register (2 bytes) long - Read
RMS current measured at the generator phase A output.

Resolution	Offset	Data Range
1 A / bit	0 A	0 to 64255 A

Generator Phase B AC RMS Current

$0070 (112) - 1 register (2 bytes) long - Read
RMS current measured at the generator phase B output.

Resolution	Offset	Data Range
1 A / bit	0 A	0 to 64255 A

Generator Phase C AC RMS Current

$0071 (113) - 1 register (2 bytes) long - Read
RMS current measured at the generator phase C output.

Resolution	Offset	Data Range
1 A / bit	0 A	0 to 64255 A

Generator Overall Power Factor

$0067 (103) - 1 register (2 bytes) long - Read
The average power factor of the generator.

Resolution	Offset	Data Range
1/16384 / bit	-1.0	-1.0 to 1.0

Generator Overall Power Factor Lagging

$0068 (104) - 1 register (2 bytes) long - Read
Lead/lag status for generator average power factor.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Bit Definitions:
00 = Power factor leading
01 = Power factor lagging
10 = Error
11 = Not available

Generator Total Percent kW

$0069 (105) - 1 register (2 bytes) long - Read
Total real power delivered by the generator, as a percentage of generator rated power.

Resolution	Offset	Data Range
0.0078125 % / bit	-251 %	-251 to 250.99 %

Generator Total Real Power

$006A (106) - 2 registers (4 bytes) long - Read

Total real power delivered by the generator.

Resolution	Offset	Data Range
1 W / bit	-2000000000 W	-2000000000 to +2211081215 W

Generator Phase A Real Power

$0075 (117) - 2 registers (4 bytes) long - Read

The real power delivered by phase A of the generator.

Resolution	Offset	Data Range
1 W / bit	-2000000000 W	-2000000000 to +2211081215 W

Generator Phase B Real Power

$0077 (119) - 2 registers (4 bytes) long - Read

The real power delivered by phase B of the generator.

Resolution	Offset	Data Range
1 W / bit	-2000000000 W	-2000000000 to +2211081215 W

Generator Phase C Real Power

$0079 (121) - 2 registers (4 bytes) long - Read

The real power delivered by phase C of the generator.

Resolution	Offset	Data Range
1 W / bit	-2000000000 W	-2000000000 to +2211081215 W

Generator Phase A Apparent Power

$007B (123) - 2 registers (4 bytes) long - Read

The apparent power delivered by phase A of the generator.

Resolution	Offset	Data Range
1 VA / bit	-2000000000 VA	-2000000000 to +2211081215 VA

Generator Phase B Apparent Power

$007D (125) - 2 registers (4 bytes) long - Read

The apparent power delivered by phase B of the generator.

Resolution	Offset	Data Range
1 VA / bit	-2000000000 VA	-2000000000 to +2211081215 VA

Generator Phase C Apparent Power

$007F (127) - 2 registers (4 bytes) long - Read

The apparent power delivered by phase C of the generator.

Resolution	Offset	Data Range
1 VA / bit	-2000000000 VA	-2000000000 to +2211081215 VA

Generator Phase A Reactive Power

$0081 (129) - 2 registers (4 bytes) long - Read

The reactive power delivered by phase A of the generator.

Resolution	Offset	Data Range
1 VAr / bit	-2000000000 VAr	-2000000000 to +2211081215 VAr

Generator Phase B Reactive Power

$0083 (131) - 2 registers (4 bytes) long - Read

The reactive power delivered by phase B of the generator.

Resolution	Offset	Data Range
1 VAr / bit	-2000000000 VAr	-2000000000 to +2211081215 VAr

Generator Phase C Reactive Power

$0085 (133) - 2 registers (4 bytes) long - Read

The reactive power delivered by phase C of the generator.

Resolution	Offset	Data Range
1 VAr / bit	-2000000000 VAr	-2000000000 to +2211081215 VAr

Generator Phase A Power Factor

$0087 (135) - 1 register (2 bytes) long - Read

The power factor of phase A of the generator.

Resolution	Offset	Data Range
1/16384 / bit	-1.0	-1.0 to 1.0

Generator Phase B Power Factor

$0088 (136) - 1 register (2 bytes) long - Read

The power factor of phase B of the generator.

Resolution	Offset	Data Range
1/16384 / bit	-1.0	-1.0 to 1.0

Generator Phase C Power Factor

$0089 (137) - 1 register (2 bytes) long - Read

The power factor of phase C of the generator.

Resolution	Offset	Data Range
1/16384 / bit	-1.0	-1.0 to 1.0

Generator Total Apparent Power

$008A (138) - 2 registers (4 bytes) long - Read
The total apparent power delivered by the generator.

Resolution	Offset	Data Range
1 VA / bit	-2000000000 VA	-2000000000 to +2211081215 VA

Generator Total Percent kVA

$008C (140) - 1 register (2 bytes) long - Read
The total apparent power delivered by the generator, as a percentage of generator rated apparent power.

Resolution	Offset	Data Range
0.0078125 % / bit	-251 %	-251 to 250.99 %

Generator Total Reactive Power

$008D (141) - 2 registers (4 bytes) long - Read
The total reactive power delivered by the generator.

Resolution	Offset	Data Range
1 VAr / bit	-2000000000 VAr	-2000000000 to +2211081215 VAr

Generator Total Percent kVAr

$008F (143) - 1 register (2 bytes) long - Read
The total reactive power delivered by the generator, as a percentage of generator rated reactive power.

Resolution	Offset	Data Range
0.0078125 % / bit	-251 %	-251 to 250.99 %

Generator Total kW Hours Export

$0090 (144) - 2 registers (4 bytes) long - Read
The total kilowatt-hours that have been exported by the generator.

Resolution	Offset	Data Range
1 kWh / bit	0 kWh	0 to 4211081215 kWh

Generator Total kVAr Hours Export

$0092 (146) - 2 registers (4 bytes) long - Read
The total kilovar-hours that have been exported by the generator.

Resolution	Offset	Data Range
1 kVArh / bit	0 kVArh	0 to 4211081215 kVArh

Generator Phase A Power Factor Lagging

$009F (159) - 1 register (2 bytes) long - Read
Lead/lag status for generator phase A power factor.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Bit Definitions:
00 = Power factor leading
01 = Power factor lagging
10 = Error
11 = Not available

Generator Phase B Power Factor Lagging

$00A0 (160) - 1 register (2 bytes) long - Read
Lead/lag status for generator phase B power factor.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Bit Definitions:
00 = Power factor leading
01 = Power factor lagging
10 = Error
11 = Not available

Generator Phase C Power Factor Lagging

$00A1 (161) - 1 register (2 bytes) long - Read
Lead/lag status for generator phase C power factor.

Resolution	Offset	Data Range
1 / bit	0	0 to 3

Bit Definitions:
00 = Power factor leading
01 = Power factor lagging
10 = Error
11 = Not available

Generator Average Line-Line AC RMS Voltage Percent

$00A3 (163) - 1 register (2 bytes) long - Read
Average Line to Line RMS voltage at the generator, as a percentage of nominal generator voltage.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99%

External Device Parameters

The SCADA data link allows monitoring of not only parameters internally generated or sensed by the EMCP 3, but also of parameters transmitted from other devices over the J1939 data link. These may include the engine ECM, the thermocouple module, or any other supported module on the J1939 network(s).

Furthermore, there are parameters available from the EMCP 3 to indicate what optional modules are currently in communication with the EMCP 3 via the Primary or Accessory J1939 data link. These parameters could be monitored, for example, to determine which event logs to read.

Genset Control Online

$0442 (1090) - 1 register (2 bytes) long - Read
Indicates whether the EMCP 3 is on the communication network. This will always be True.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Engine Control Online

$0443 (1091) - 1 register (2 bytes) long - Read
Indicates whether the engine ECM is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Secondary Engine Control Online

$0444 (1092) - 1 register (2 bytes) long - Read
Indicates whether the secondary engine ECM is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

External I/O #1 Online

$0445 (1093) - 1 register (2 bytes) long - Read
Indicates whether the DIO module instance #1 is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

External I/O #2 Online

$0446 (1094) - 1 register (2 bytes) long - Read
Indicates whether the DIO module instance #2 is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Digital AVR Online

$0449 (1097) - 1 register (2 bytes) long - Read
Indicates whether the digital AVR module is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

RTD Module Online

$044A (1098) - 1 register (2 bytes) long - Read
Indicates whether the RTD module is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Thermocouple #1 Online

$044B (1099) - 1 register (2 bytes) long - Read
Indicates whether the thermocouple module instance #1 is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Thermocouple #2 Online

$044C (1100) - 1 register (2 bytes) long - Read
Indicates whether the thermocouple module instance #2 is in communication with the EMCP 3 via J1939.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE
Applies to EMCP 3.3 only
Temperature of the bearing inside the alternator. Bearing 2 is the right or front bearing.

Generator Front Bearing Temperature from Data Link

$0095 (149) - 1 register (2 bytes) long - Read

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Rear Bearing Temperature from Data Link

$0096 (150) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Temperature of the bearing inside the alternator. Bearing 1 is the left or rear bearing.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Phase A Winding Temperature from Data Link

$0097 (151) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Temperature of the Phase A winding inside the alternator.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Phase B Winding Temperature from Data Link

$0098 (152) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Temperature of the Phase B winding inside the alternator.

Resolution	Offset	Data Range

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Phase C Winding Temperature from Data Link

$0099 (153) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of the Phase C winding inside the alternator.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Engine Oil Pressure from Data Link

$00D9 (217) - 1 register (2 bytes) long - Read

Gage pressure of oil in engine lubrication system as broadcast on the J939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Engine Coolant Temperature from Data Link

$00DB (219) - 1 register (2 bytes) long - Read

Temperature of liquid found in engine cooling system, as broadcast on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Cylinder #1 Exhaust Port Temperature from Data Link

(through)

Cylinder #20 Exhaust Port Temperature from Data Link

$00DD (221) through $00F0 (240) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature at the cylinder exhaust port of the engine, as received from another module on the J1939 Data Link.

Cylinder Number	Register Address (Hex)	Register Address (Decimal)
1	$00DD	221
2	$00DE	222
3	$00DF	223
4	$00E0	224
5	$00E1	225
6	$00E2	226
7	$00E3	227
8	$00E4	228
9	$00E5	229
10	$00E6	230
11	$00E7	231

Cylinder Number	Register Address (Hex)	Register Address (Decimal)
12	$00E8	232
13	$00E9	233
14	$00EA	234
15	$00EB	235
16	$00EC	236
17	$00ED	237
18	$00EE	238
19	$00EF	239
20	$00F0	240

All have same data structure.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Exhaust Manifold #1 Temperature from Data Link

$00F1 (241) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of combustion byproducts within the left engine exhaust manifold, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Exhaust Manifold #2 Temperature from Data Link

$00F2 (242) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of combustion byproducts within the right engine exhaust manifold, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Intake Manifold #1 Temperature from Data Link

$00F3 (243) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of pre-combustion air found in intake manifold #1 of engine air supply system, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Intake Manifold #2 Temperature from Data Link

$00F4 (244) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of pre-combustion air found in intake manifold #2 of engine air supply system, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Engine Oil Temperature from Data Link

$00F5 (245) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Temperature of the engine lubricant, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Fuel Pressure from Data Link

$00F7 (247) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Gage pressure of fuel in system as delivered from supply pump to the injection pump, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Crankcase Pressure from Data Link

$00F8 (248) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Gage pressure inside engine crankcase, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
1 / 128 kPa / bit	-250 kPa	-250 to 251.99 kPa

Boost Pressure from Data Link

$00F9 (249) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Gage pressure of air measured downstream on the compressor discharge side of the turbocharger, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Oil Filter Differential Pressure from Data Link

$00FB (251) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

Change in engine oil pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid material on or in the filter, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Fuel Filter Differential Pressure from Data Link

$00FC (252) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filter element, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Air Filter 1 Differential Pressure from Data Link

$00FD (253) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
1 / 128 kPa / bit	-250 kPa	-250 to 251.99 kPa

Total Fuel Consumption from Data Link

$00FE (254) - 2 registers (4 bytes) long - Read
Applies to EMCP 3.3 only
Accumulated amount of fuel used during engine operation, as received from another module on the J1939 Data Link..

Resolution	Offset	Data Range
0.5 L / bit	0 L	0 to 2105540607.5 L

Instantaneous Fuel Consumption from Data Link

$0100 (256) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Amount of fuel used by engine per unit time, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.05 L / h per bit	0 L/h	0 to 3212.75 L/h

Atmospheric Pressure from Data Link

$0101 (257) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Absolute air pressure of the atmosphere, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Fuel Level from Data Link

$0102 (258) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only
Ratio of volume of fuel to the total volume of fuel tank, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Net Battery Current from Data Link

$0103 (259) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Net flow of electrical current into or out of the battery or batteries, as received from another module on the J1939 Data Link.

Resolution	Offset	Data Range
1 A / bit	-125 A	-125 to 125 A

Auxiliary Temperature #2 from Data Link

$04EB (1259) - 1 register (2 bytes) long - Read
Applies to EMCP 3.3 only
Auxiliary temperature used for special applications, as received from another module over the J1939 data link.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Generator Set State Control

Remote control of the generator set is accomplished by reading from a set of status registers, and writing to a set of control registers.

Automatic Start/Stop State

$00CE (206) - 1 register (2 bytes) long - Read
Current state of the Automatic Start/Stop sequence.

Resolution	Offset	Data Range
1 / bit	0	0 to 7

Bit Definitions:
000 ($0000) = INIT
001 ($0001) = PRE_CRANK
010 ($0002) = STARTING
011 ($0003) = RUNNING
100 ($0004) = PRE_COOLDOWN
101 ($0005) = COOLDOWN
110 ($0006) = STOPPING
111 ($0007) = STOPPED

Bypass Cooldown

$012C (300) - 1 register (2 bytes) long - Write
Command to bypass remaining cooldown duration and immediately stop engine.

This is applicable only when the engine is in the Cooldown state. Setting this has the same functionality as pressing and holding the STOP key (and verifying with Enter) on the EMCP 3 control panel. The cooldown bypass command is retained until cooldown is re-enabled by writing 00 to this register. If the EMCP 3 undergoes a power cycle, that will also clear this register and re-enable the cooldown.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Engine Operating Mode

$012D (301) - 1 register (2 bytes) long - Read

Indicates current desired mode of operation of the engine generator set. This parameter indicates the status corresponding to the Run, Auto, and Stop keys on the EMCP 3 control panel. To change the operating mode, see the Engine Operating Mode Command parameter.

Resolution	Offset	Data Range
1 / bit	0	0 to 2

Bit Definitions:
00 ($0000) = STOP
01 ($0001) = AUTO
10 ($0002) = RUN

Engine Operating Mode Command

$012E (302) - 1 register (2 bytes) long - Write

SCADA command to change of desired mode of operation of the engine generator set. Writing to this register has the same functionality as pressing the corresponding key (Run, Auto, or Stop) on the EMCP 3 control panel. To read the current mode, see the Engine Operating Mode parameter.

Resolution	Offset	Data Range
1 / bit	0	0 to 2

Bit Definitions:
00 ($0000) = STOP
01 ($0001) = AUTO
10 ($0002) = RUN

Engine Status

$041D (1053) - 1 register (2 bytes) long - Read

Current operating state of the engine generator set.

Resolution	Offset	Data Range
1 / bit	0	0 to 5

Bit Definitions:
000 ($0000) = NOT READY TO GO
001 ($0001) = GOING IN AUTO
010 ($0002) = GOING IN RUN
011 ($0003) = READY IN AUTO
100 ($0004) = STOPPING IN AUTO
101 ($0005) = STOPPING NOT READY TO GO

Engine Protection has Shut Down Engine from Data Link

$04FB (1275) - 1 register (2 bytes) long - Read

Indicates that the engine protection system has shut down the engine, as opposed to the engine shutting down based on a command from the EMCP 3 control panel.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Cooldown Duration Remaining

$041E (1054) - 1 register (2 bytes) long - Read

Time remaining in cooldown until engine is stopped. This value is only meaningful while the engine is in the “Cooldown” state.

Resolution	Offset	Data Range
1 second / bit	0 seconds	0 to 64255 seconds

Remote Initiate Command

$041F (1055) - 1 register (2 bytes) long - Write

When the control is in Auto mode, this commands the engine to Run when TRUE and Stop when FALSE.
The Remote Initiate is also assigned to a digital input switch. Either the digital input going active or this SCADA command going TRUE will trigger an automatic start if the Engine Operating Mode is Auto. This SCADA command is unaffected by the digital input state configuration.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Emergency Stop Command

$0420 (1056) - 1 register (2 bytes) long - Write

Will cause the engine to immediately stop without cooling down.

Emergency Stop is also assigned to a switch for digital input. Either the digital input going active or this SCADA command going TRUE will trigger an emergency stop event. This SCADA command is unaffected by the digital input state configuration.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Desired Genset Output Voltage

$0421 (1057) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

The desired RMS voltage to be delivered by the genset.

Resolution	Offset	Data Range
1 V / bit	0 V	0 to 64255 V

AVR Bias Percent

$0422 (1058) - 1 register (2 bytes) long - Read

Applies to EMCP 3.3 only

The percentage bias being applied to the Automatic Voltage Regulator, as a percentage of the Maximum Engine Speed Bias. This percentage will increment by 0.5% each time the Voltage Adjust up or down arrow is pressed on the EMCP 3 control panel.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

AVR Bias Percent Increment Command

$0423 (1059) - 1 register (2 bytes) long - Write

Applies to EMCP 3.3 only

Increments the percentage bias to be applied to the Automatic Voltage Regulator, as a percentage of the Maximum Engine Speed Bias. For more information on these commands, refer to the Programming Examples section.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Requested Engine Speed

$0424 (1060) - 1 register (2 bytes) long - Read

Engine speed currently being requested by the EMCP 3 genset control.

Resolution	Offset	Data Range
0.125 rpm / bit	0 rpm	0 to 8031.875 rpm

Speed Bias Percent

$0425 (1061) - 1 register (2 bytes) long - Read

Read the percentage bias being applied to the speed command output.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Speed Bias Percent Command

$0426 (1062) - 1 register (2 bytes) long - Write

Change or set the percentage bias being applied to the speed command output.

Resolution	Offset	Data Range
0.0078125 % / bit	-251%	-251 to 250.99 %

Generator Frequency within Limits

$042B (1067) - 1 register (2 bytes) long - Read

Indicates whether the generator frequency is below the threshold for a generator over frequency warning and above the threshold for a generator under frequency warning.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Generator Voltage within Limits

$042C (1068) - 1 register (2 bytes) long - Read

Indicates whether the generator voltage is below the threshold for a generator over voltage warning and above the threshold for a generator under voltage warning.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Generator Circuit Breaker Trip Request Command

$04F9 (1273) - 1 register (2 bytes) long - Write

Used to force the generator circuit breaker to trip.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Timers and Counters

The EMCP 3.2 and 3.3 have a real-time clock and counters that provide energy-related and service-related information.

The EMCP 3 calculates real and reactive energy provided by the generator set by measuring the power provided by the generator set over the amount of time the generator set is providing the power.

The EMCP 3 provides service-related information such as the number of crank and start attempts and successes, and allows resetting of these counters. It also counts down to a recommended service interval, and reports the countdown in weeks, days, and hours. Service personnel can reset the service interval counter to restart the countdown at the end of a service call.

Engine Operating Hours

$00CC (204) - 2 registers (4 bytes) long - Read

Accumulated time that the engine is running.

Resolution	Offset	Data Range
0.05 hour / bit	0 hr	0 to 210554060.75 hour

Service Maintenance Interval Hours Remaining

$00D2 (210) - 1 register (2 bytes) long - Read

Maximum time in operation until the next service inspection is required; negative if the service inspection time has been passed.

Resolution	Offset	Data Range
1 hr / bit	-32127 hr	-32127 to 32128 hr

Service Maintenance Interval Days Remaining

$00D4 (212) - 1 register (2 bytes) long - Read

Maximum calendar days until the next service inspection is required; negative if the service inspection time has been passed.

Resolution	Offset	Data Range
1 day / bit	-32127 days	-32127 to 32128 days

Number of Crank Attempts

$00D5 (213) - 2 registers (4 bytes) long - Read

Accumulated number of crank attempts made by the engine.

Resolution	Offset	Data Range
1 / bit	0	0 to 4211081215

Number of Successful Starts

$00D7 (215) - 2 registers (4 bytes) long - Read

Accumulated number of successful starts of the engine.

Resolution	Offset	Data Range
1 / bit	0	0 to 4211081215

Service Maintenance Interval Weeks Remaining

$012B (299) - 1 register (2 bytes) long - Read

The number of full calendar weeks until the next service inspection is required. A negative value is transmitted if the service inspection time has been passed.

Resolution	Offset	Data Range
1 week / bit	-125 weeks	-125 to 125 weeks

Real Time Clock

$0384 (900) - 3 registers (6 bytes) long - Read

Clock containing year, month, day, hour, minute, and second information.

Byte	Resolution	Offset	Data Range
5	1 year / bit	1985 years	1985 to 2235 years
4	0.25 days / bit	0.75 days (12:00-6:00am on day 1 = $01)	0 to 62.5 days
3	1 month / bit	1 month (Jan = $01)	0 to 250 months
2	1 hour / bit	0 hours (midnight = $00)	0 to 250 hours
1	1 minute / bit	0 minutes (HH:00 = $00)	0 to 250 minutes
0	0.25 seconds / bit	0 seconds (HH:MM:00 = $00)	0 to 62.5 seconds

Data interpretation example:

The 1985 year offset implies that $14 in byte 5 translates to 20 years past 1985, or year 2005. The day offset implies that $1F (31) in byte 4 translates to the 8th day of the month (and the third quarter of the day – noon to 6pm). One month offset implies that $07 in byte 3 translates to the seventh month, July.

Zero hour offset implies that $00 in byte 2 translates to 12:00 midnight, and with the 24-hour format, $0D translates to 13:00 or 1:00 pm. Zero minute offset implies that $05 in byte 1 translates to 5 minutes past the hour (i.e. 12:05pm). Zero second offset implies that $4D (77) in byte 0 translates to 19 and a quarter seconds past the minute (i.e. 12:05:19 pm). Therefore, $4D 05 0D 07 1F 14 is 1:05:19pm on July 8, 2005.

Update Real Time Clock Command

$0387 (903) - 3 registers (6 bytes) long - Write

SCADA command to change the real time clock information.
Date and time data is entered in the same format as the Real Time Clock read parameter.

Reset Crank Attempt Counter

$0404 (1028) - 1 register (2 bytes) long - Write
Resets the accumulated number of crank attempts made by the engine.
Write $AA55 followed by $55AA within 1 second to reset the counter to zero.

Reset Successful Start Counter

$0405 (1029) - 1 register (2 bytes) long - Write
Resets the accumulated number of successful starts of the engine.
Write $AA55 followed by $55AA within 1 second to reset the counter to zero.

Reset kW Hour Meter

$0406 (1030) - 1 register (2 bytes) long - Write
Resets the total kilowatt-hours that have been exported by the generator.
Write $AA55 followed by $55AA within 1 second to reset the meter to zero.

Reset kVAr Hour Meter

$0407 (1031) - 1 register (2 bytes) long - Write
Resets the total kilovar-hours that have been exported by the generator.
Write $AA55 followed by $55AA within 1 second to reset the meter to zero.

Reset Service Interval Counter

$0408 (1032) - 1 register (2 bytes) long - Write
Resets the countdown until the next service inspection is required. This is usually performed at the end of a service call.
Write $AA55 followed by $55AA within 1 second to reset the counter to zero. This is usually performed at the end of a service call.

Event System

The EMCP 3 displays both internal events and those transmitted over the J1939 data link. Over SCADA, the status of the warning and shutdown lamps on the display can be viewed, and events can be acknowledged. Events can be acknowledged individually or as a group, and the event count can be read. Details of both EMCP 3 and supported optional module events can be read over SCADA.

Acknowledge All Events Command

$0130 (304) - 1 register (2 bytes) long - Write
SCADA command to acknowledge all events, similar to pressing the Alarm Acknowledge key on the control.
Each time a TRUE is written to this register, all of the events are momentarily acknowledged.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

System Event Count

$014E (334) - 1 register (2 bytes) long - Read

Number of system events (present or active).

Bits 15:8 UNUSED
Bits 7:0 Count of Present and Active Events

Resolution	Offset	Data Range
1 / bit	0	0 to 99

System Event Lamp Status

$014F (335) - 1 register (2 bytes) long - Read

Indicates the status of the amber and red event status lamps on the control. The Amber lamp being on signifies a warning event, and the Red lamp being on signifies a shutdown event. This status parameter does not distinguish between a flashing lamp and a solid lamp.

Bits 15:4 UNUSED
Bits 3:2 Amber Lamp Status: Bits 00 = off, 01 = on
Bits 1:0 Red Lamp Status: Bits 00 = off, 01 = on

Log Entry Index

$0409 (1033) - 1 register (2 bytes) long - Write

Selects the index of the genset control event log to be read from Log Entry Modbus register.
This parameter is supported for legacy support, but has been superseded by the “Module Event Log Entry #” parameters.

Resolution	Offset	Data Range
1 / bit	0	0 to 19

Log Entry

$040A (1034) - 14 registers (28 bytes) long - Read

Reads the entry of the Genset Control Log as specified by the Log Entry Index Modbus register.
For a list of the SPN/FMI combinations supported, please refer to the Systems Operation, Troubleshooting, Testing and Adjusting manual.
(Register numbers listed below are offsets from the starting register number of this parameter, given above.)
This parameter is supported for legacy support, but has been superseded by the “Module Event Log Entry #” parameters.

Register 13 = Log Entry Index (for data format, see Log Entry Index parameter)
Register 12:11 = SPN/FMI
- Bits 31:24 = UNUSED
- Bits 23:5 = SPN
- Bits 4:0 = FMI

Register 10 = Flags / Count

Bits 15:12 UNUSED
Bits 11:8 Event Status:
Bits 0000 = Inactive, 0100 = Active, 0101 = Present, 1111 = Unavailable
Bits 7:0 Occurrence Count

Register 9:8 = First Hourmeter

Resolution	Offset	Data Range
0.05 hour / bit	0 hr	0 to 210554060.75 hour

Register 7:6 = Last Hourmeter

Resolution	Offset	Data Range
0.05 hour / bit	0 hr	0 to 210554060.75 hour

Register 5:3 = First Timestamp
(for data format, see Real Time Clock parameter under Timers and Counters section)
Register 2:0 = Last Timestamp
(for data format, see Real Time Clock parameter under Timers and Counters section)

Reset Event

$0418 (1048) - 2 registers (4 bytes) long - Write
SCADA command to reset a single EMCP 3 interval event, identified by the SPN and FMI numbers.
For a list of the SPN/FMI combinations supported, please refer to the Systems Operation, Troubleshooting, Testing and Adjusting manual.

Bits 31:24 = UNUSED
Bits 23:5 = SPN
Bits 4:0 = FMI

Event Log Module Selection Command

$05DA (1498) - 1 registers (2 bytes) long - Write
Write a value to this register to select a module for which you can read the “Module Event Log Entry #” parameters.

Module definitions:
0 = GENSET CONTROL
1 = ENGINE CONTROL
2 = SECONDARY ENGINE CONTROL
3 = EXTERNAL I/O #1
4 = EXTERNAL I/O #2
7 = DIGITAL AVR
8 = RTD MODULE
9 = THERMOCOUPLE MODULE #1
10 = THERMOCOUPLE MODULE #2

Event Log Module Selection

$05DB (1499) - 1 registers (2 bytes) long - Read

Read this register to determine which module events are currently accessible via the “Module Event Log Entry #” parameters.

Module definitions are the same as for the ”Event Log Module Selection Command” parameter.

Module Event Log Entry 1

Through

Module Event Log Entry 20

$05DC (1500) through $06E6 (1766) - 14 registers (28 bytes) long - Read

Reads the corresponding entry of the Event Log for the module specified in the “”Event Log Module Selection” register.

Module Event Log Entry number	Register Address (Hex)	Register Address (Decimal)
1	$05DC	1500
2	$05EA	1514
3	$05F8	1528
4	$0606	1542
5	$0614	1556
6	$0622	1570
7	$0630	1584
8	$063E	1598
9	$064C	1612
10	$065A	1626
11	$0668	1640
12	$0676	1654
13	$0684	1668
14	$0692	1682
15	$06A0	1696
16	$06AE	1710
17	$06BC	1724
18	$06CA	1738
19	$06D8	1752
20	$06E6	1766

All of these parameters have the same data structure. Register numbers are offsets from the base register address given above:

Register 13 = Log Entry Index (0 through 19)
Register 12:11 = SPN/FMI
- Bits 31:24 = UNUSED
- Bits 23:5 = SPN
- Bits 4:0 = FMI

Register 10 = Flags / Count

Bits 15:12 UNUSED
Bits 11:8 Event Status: 0000 = Inactive, 0100 = Active, 0101 = Present, 1111 = Unavailable
Bits 7:0 Occurrence Count

Register 9:8 = First Hourmeter

Resolution	Offset	Data Range
0.05 hour / bit	0 hr	0 to 210554060.75 hours

Register 7:6 = Last Hourmeter
(same data format as First Hourmeter)

Register 5:3 = First Timestamp
(same data format as Real Time Clock parameter)

Byte	Resolution	Offset	Data Range
5	1 year / bit	1985 years	1985 to 2235 years
4	0.25 days / bit	0.75 days	0 to 62.5 days
3	1 month / bit	0 months	0 to 250 months
2	1 hour / bit	0 hours	0 to 250 hours
1	1 minute / bit	0 minutes	0 to 250 minutes
0	0.25 seconds / bit	0 seconds	0 to 62.5 seconds

Register 2:0 = Last Timestamp
(same data format as First Timestamp)

For an example of the use of the “Event Log Module Selection” parameter and the “Module Event Log Entry #” parameters, see Appendix A.

Engine Monitoring

The EMCP 3 can communicate some standard engine parameters over the data link.

Engine Oil Pressure

$00C8 (200) - 1 register (2 bytes) long - Read
Gage pressure of oil in engine lubrication system as provided by oil pump.

Resolution	Offset	Data Range
0.125 kPa / bit	0 kPa	0 to 8031.875 kPa

Engine Coolant Temperature

$00C9 (201) - 1 register (2 bytes) long - Read
Temperature of liquid found in engine cooling system.

Resolution	Offset	Data Range
0.03125 C / bit	-273 C	-273 to 1735 C

Engine rpm

$00CB (203) - 1 register (2 bytes) long - Read
Actual engine speed, calculated over a minimum crankshaft angle of 720 degrees divided by the number of cylinders.

Resolution	Offset	Data Range
0.125 rpm / bit	0 rpm	0 to 8031.875 rpm

EMCP 3 Setpoints

All of the configuration possible at the EMCP 3 control panel can be done over the data link, by reading from and writing to EMCP 3 setpoints. As on the display, each setpoint has a minimum security level required to change it associated with it. That required security level can be read by reading the Setpoint Information register for a particular setpoint.

Setpoints are grouped in the EMCP 3 into Blocks. These Blocks are actually pieces of software that, in some cases, may occur more than once in the software. Blocks are uniquely identified by the combination of their Block Number and Instance Number, and this unique identifier is called the Block ID. This, in combination with a Setpoint Number that identifies the setpoint within that block, is called the Setpoint ID. This Setpoint ID uniquely identifies a setpoint in the EMCP 3. See Figure 28 for a sample illustration of this concept.

Note that Instance Number and Setpoint Number start from zero. Therefore, the 1st setpoint, shown in the figure as Setpoint #1, actually has the hexadecimal address of 00h. The same holds for instance numbers, where the first instance is enumerated as 00h.

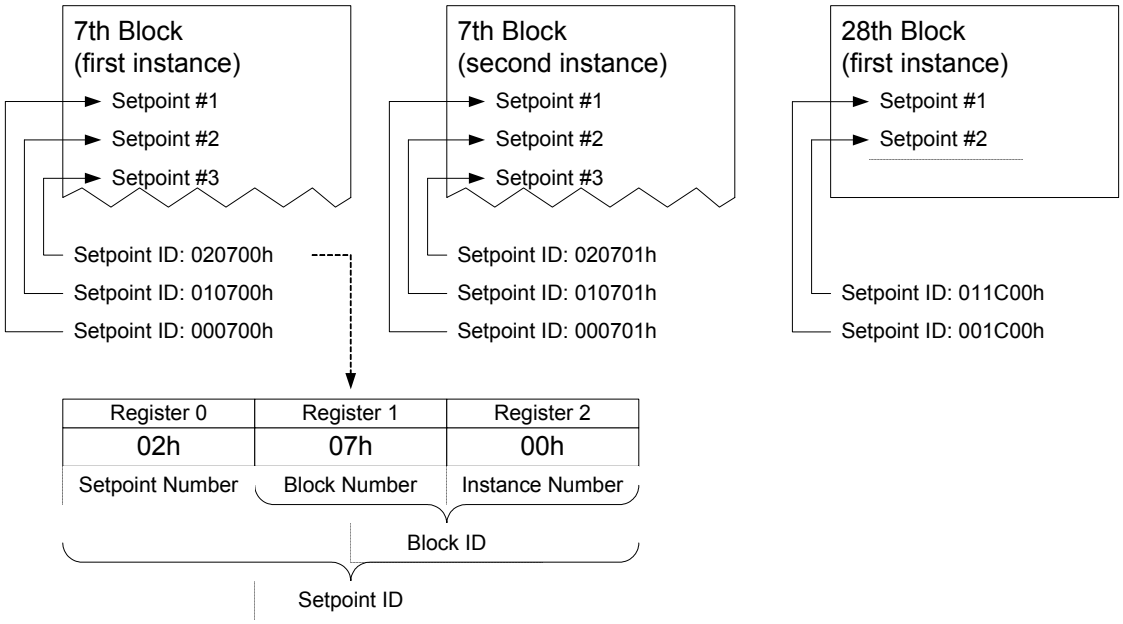


Figure 28: Structure of Setpoint ID

To read a setpoint data or related information, first the Setpoint ID for Read parameter must be set to the appropriate Setpoint ID. Then, either the Setpoint Information parameter or Setpoint Data Value parameter can be read. Setpoint Information contains various pieces of information regarding the setpoint, as detailed below. In order to write to a setpoint, the Setpoint Write parameter must be sent, which contains both the Setpoint ID and the data value. Immediately prior to reading setpoint information, the Setpoint ID field should be checked to verify that the correct setpoint is being read.

The “Setpoint ID” and “Setpoint Information” parameters contain multiple pieces of information, and span multiple Modbus registers. The registers may be read separately, but caution should be taken to maintain integrity of the data being read.

The list of blocks supported on the EMCP 3 are given in Appendix B.
The list of setpoints as well as security and data format information are given in Appendix C.
The list of values and their meanings for the setpoints which use Setpoint Value Lists is given in Appendix D.

Setpoint Data Type

Setpoints have minimum and maximum engineering values, as given in the MIN and MAX fields of the table in Appendix C. They are stored with a maximum resolution as listed in the RESOLUTION field. The parameters can take on noninteger values in some cases, so in order to be stored as integer data types, are scaled (bit-shifted) by the number of bits listed in the SCALING field.

Setpoints are stored as a 32-bit signed integer value, using 2’s complement to represent negative values. This is a standard data type in computer programming, termed INT32. It can represent integer values from negative 2,147,483,648 to positive 2,147,483,647; that is, hexadecimal $ 80 00 00 00 to $ 7F FF FF FF. Other conversion examples:
Decimal -1 = $ FF FF FF FF
Decimal 0 = $ 00 00 00 00
Decimal 1000 = $ 00 00 03 E8
Decimal -1000 = $ FF FF FC 18

$REGISTER\_VALUE = 2^{RESOLUTION} * ENGINEERING\_VALUE$
$ENGINEERING\ VALUE = (0.5)^{RESOLUTION} * REGISTER\_VALUE$

For a setpoint interpretation and calculation example, see Appendix A.

Setpoint ID for Read

$03EA (1002) - 3 registers (6 bytes) long - Write
Specifies the ID for the setpoint to be read by the Setpoint Information Modbus register or the Setpoint Data Value Modbus register.
(Register numbers listed below are offsets from the starting register number of this parameter, given above.)

Register 2:1 = Block ID
Register 0 = Setpoint Number

Setpoint Information

$03ED (1005) - 12 registers (24 bytes) long - Read
Reads the setpoint information structure associated with the setpoint specified by the Setpoint ID for Read Modbus register.
(Register numbers listed below are offsets from the starting register number of this parameter, given above.)

Register 11:9 = Setpoint ID
Register 8 = Access Level needed to modify
Register 7:6 = Value
Register 5:4 = Minimum
Register 3:2 = Maximum
Register 1:0 = Resolution

Setpoint Write

$03F9 (1017) - 5 registers (10 bytes) long - Write
Writes a specific Setpoint ID and value to change a setpoint.
(Register numbers listed below are offsets from the starting register number of this parameter, given above.)

Register 4:2 = Setpoint ID
Register 1:0 = New Value

Setpoint Data Value

$03FE (1022) - 2 registers (4 bytes) long - Read
Reads the value of the setpoint specified by the Setpoint ID for Read Modbus register.

Miscellaneous

Battery Voltage

$00CA (202) - 1 register (2 bytes) long - Read
Measured electrical potential of the battery voltage at the control.
The EMCP 3 can report the voltage of the supply that is powering it over the data link by means of the Battery Voltage parameter. This is usually the cranking battery or batteries. Note that the voltage is read at the EMCP, not at the battery terminals. For high power draw cases, this voltage may be noticeably lower than the voltage at the battery terminals.

Resolution	Offset	Data Range
0.05 V / bit	0 V	0 to 3212.75 V

Lamp Test Command

$012F (303) - 1 register (2 bytes) long - Write
Commands the control to conduct a lamp/display test of the EMCP 3 control panel. Writing TRUE turns on all of the LEDs, but does not darken the LCD display on the control panel, as the Lamp Test button on the control panel does. To end the lamp test, a FALSE must be written to this register.

Resolution	Offset	Data Range
1 / bit	0	0 to 1

Bit Definitions:
00 = FALSE
01 = TRUE

Control Serial Number

$04FC (1276) - 6 registers (12 bytes) long - Read
Reads the serial number of the EMCP 3 control panel. This is the number that is label printed on the back cover of the control panel. See Figure 29 for a picture.

Byte 0: Character count
Bytes 1-11: ASCII data, characters $30 through $5A valid (numbers and capital letters). String terminates with a NULL character ($00).

Figure 29: Control Serial Number on EMCP 3 label

Example: In the above example, reading the Control Serial Number would return the following:
$0A31 3738 3342 3030 3648 5100

4 Initial Operation and User Orientation

4.1 Starting and Stopping the Generator

Once the control is configured correctly and the generator set is ready to be operated, the generator set can be started. There are two ways the generator set can be started from the control panel. First the control panel must be powered up. When the control is first powered up, the LED under the STOP key should be illuminated. To start the engine, press the RUN key. Or, press the AUTO key and then activate digital input number two, which is the remote initiate input.

When the control panel initiates a start command, relay output number one will close which will activate the starter motor magnetic switch. At the same time, relay output number two will close which will close the fuel enable circuit. On electronic engines with ADEM™ A3 or new engine ECM, the fuel enable signal will be sent via the J1939 data link. So relay output number two will not be used on those engines. On some newer engines, the engine ECM will operate the starter motor magnetic switch after receiving a start command over the J1939 data link. In this case neither relay output number one nor two will be used. Consult the Operation and Maintenance Manual for your engine to determine what the exact starting sequence is for your engine.

Relay number one will remain active until the engine crank time has been reached, or until the engine speed has reached the crank terminate value.

Once the engine is started, the engine can be stopped by pressing the STOP key on the control panel. If the control is in AUTO, the engine can also be stopped by deactivating digital input number two (Remote Initiate).

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 for. If the cooldown time is set for zero minutes, the engine will stop immediately.

When the stop command is initiated, relay output number two will open. The stop command will also be sent over the J1939 data link for those engines that require it. At that point, the fuel injection will be disabled and the engine will stop.

4.2 Handling Events

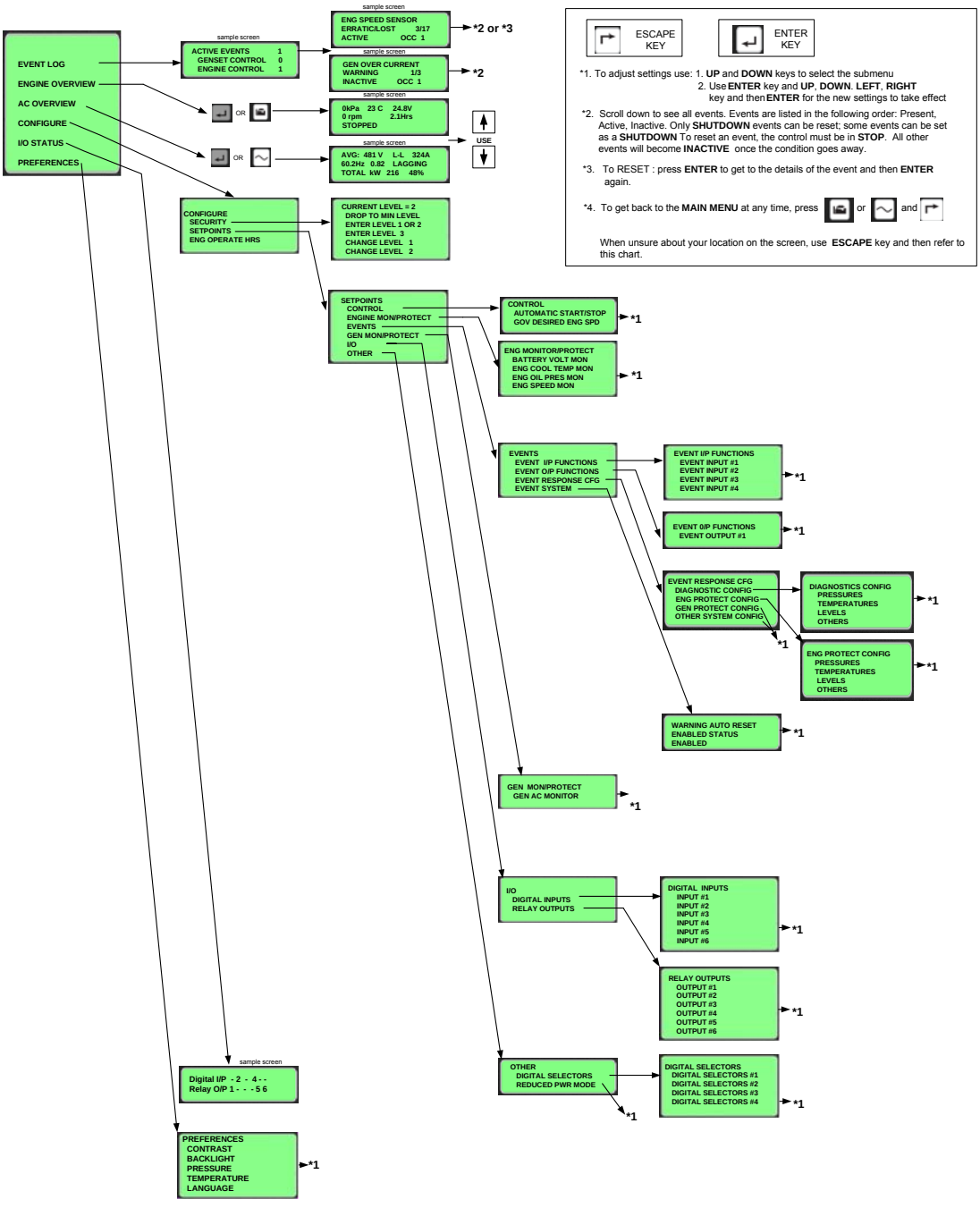
When an event occurs in the EMCP 3, it could be shown as “PRESENT”, “ACTIVE”, or “INACTIVE”. If the control shows that an event is “PRESENT”, the condition that caused the event is still present. The condition needs to be addressed before the event can be cleared. If the control shows that an event is “ACTIVE”, the condition that caused the event is no longer present, but the event must be manually reset in order to clear the event. If the control shows that an event is “INACTIVE”, the event has happened at some time in the past but is no longer an issue.

There are two types of events that can occur, warnings and shutdowns. If a warning occurs, the amber LED on the control will flash and the warning will appear in the event log. The engine will not shutdown. The warning will clear itself as soon as the condition that caused it goes away. The LED will flash until the acknowledge key is pressed on the control. If a shutdown event occurs, the engine will shutdown, and the red LED will flash on the control. The shutdown will not clear itself. The condition that caused the shutdown must first be fixed, and then the event must be reset from the event log on the control. To reset the event, the control must be in stop. Then while viewing the event, press the enter key. If the control is in stop, reset will be highlighted. Pressing enter will reset the event.

(Refer to LERE5255 for a printable .pdf file.)

4.3 Menu Structure

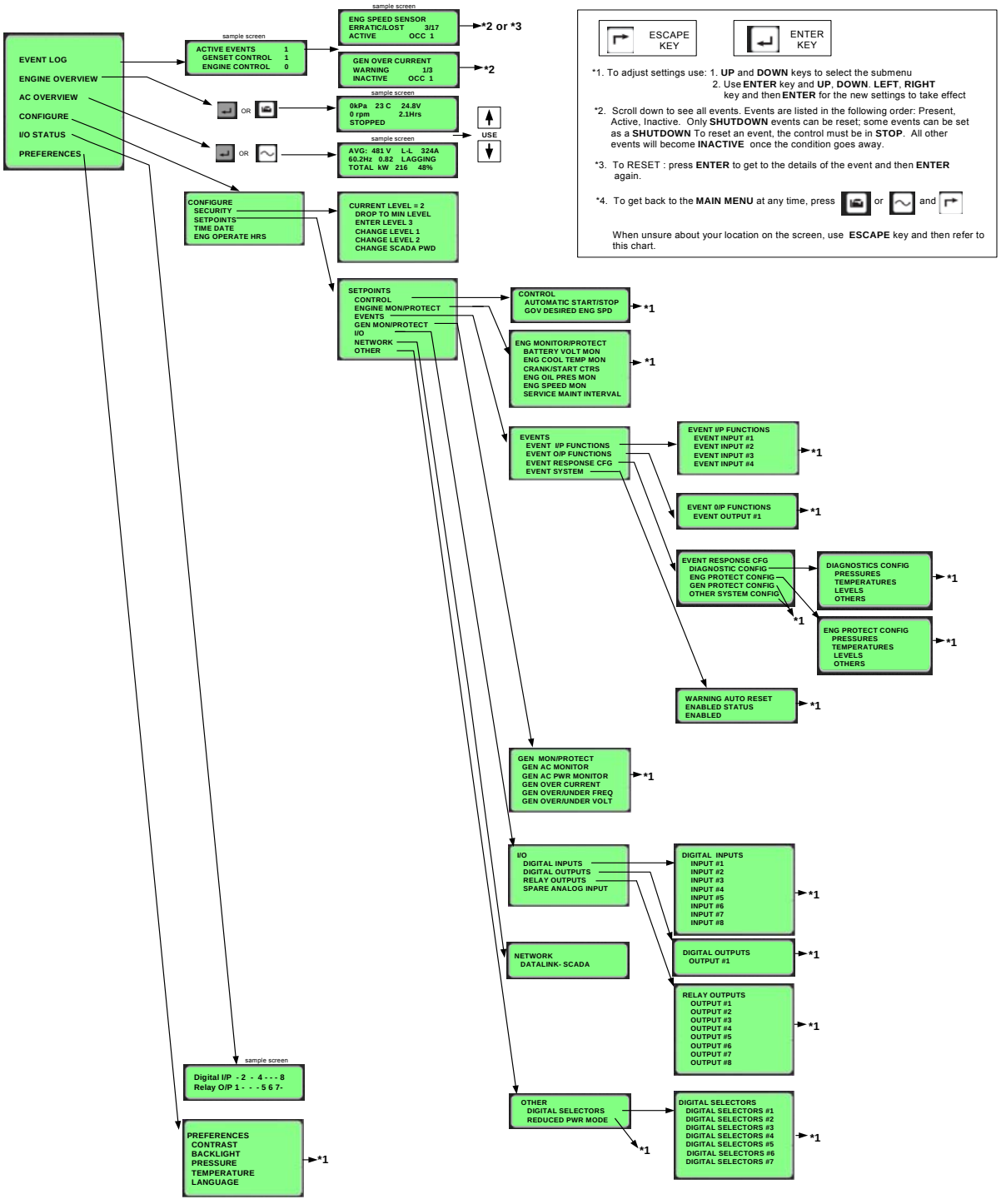
EMCP 3.1 Generator Set Control Menu Structure



(Refer to LERE5255 for a printable .pdf file.)

(Refer to LERE5255 for a printable .pdf file.)

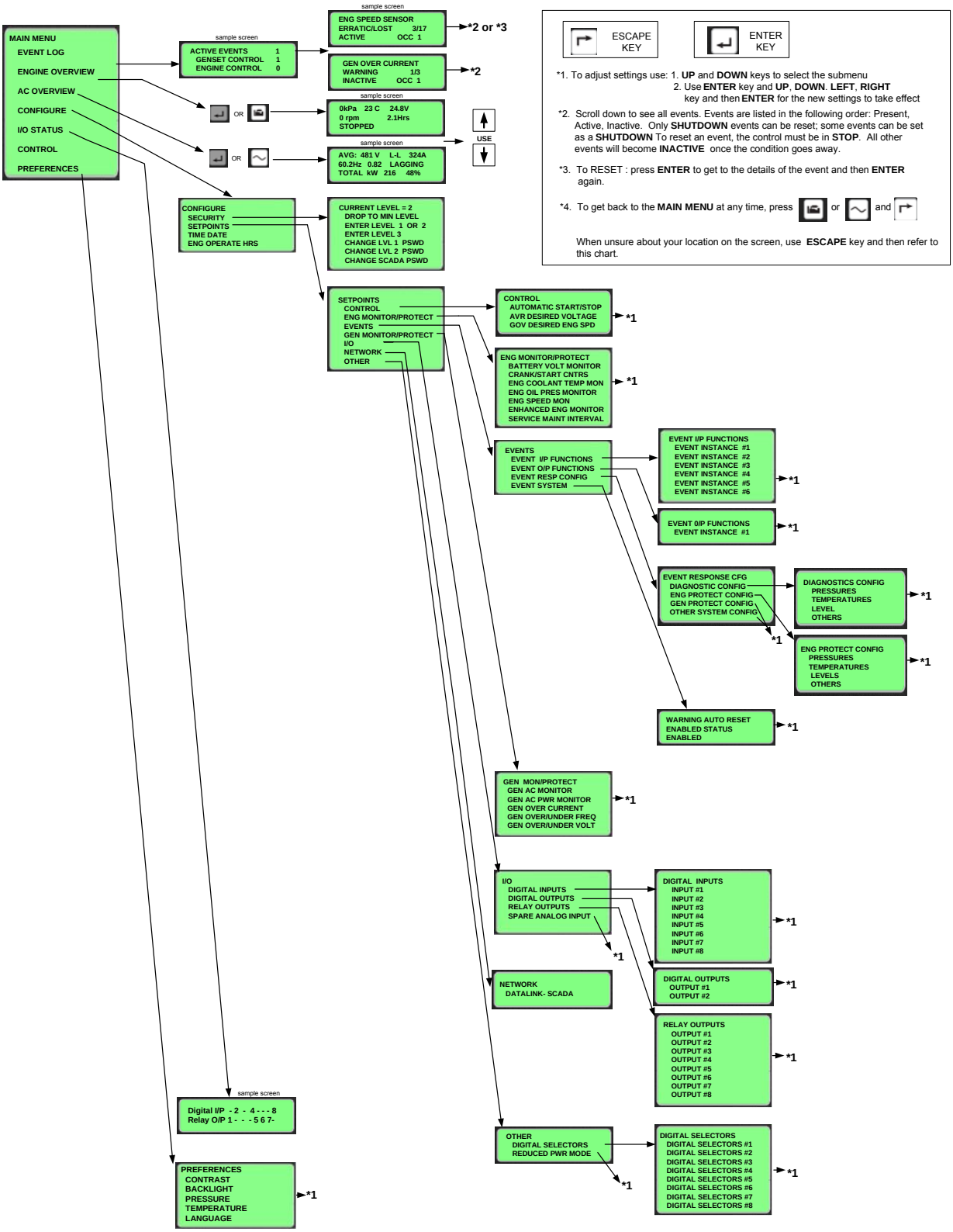
EMCP 3.2 Generator Set Control Menu Structure



(Refer to LERE5255 for a printable .pdf file.)

(Refer to LERE5255 for a printable .pdf file.)

EMCP 3.3 Generator Set Control Menu Structure



(Refer to LERE5255 for a printable .pdf file.)

5 Appendices

Appendix A SCADA Programming Examples

In the following examples, the EMCP 3 SCADA Data Link Slave Address setpoint is assumed to be set to 01. The last 2 bytes (shown as “xx xx” in this section) of each message consist of the CRC. The CRC is typically automatically generated or checked by SCADA communication software, and therefore is not discussed below. These are only examples of specific conditions and the responses from the control under those conditions, and are not intended to represent the complete functionality of the control or all the possible conditions that can result in these responses. In particular, Exception Responses or other error conditions are not considered here.

Reading Data Registers

Battery Voltage

Request: **$ 01 03 00 C9 00 01 xx xx**

$ 01 = slave address of EMCP 3
$ 03 = function code (Read Registers).
$ 00 C9 → (1 bit offset) → $ 00 CA = Battery Voltage.
$ 00 01 = register count (1 register).

Reply: **$ 01 03 02 01 FD xx xx**

$ 01 = slave address of EMCP 3
$ 03 = function code (Read Registers).
$ 02 = byte count (2 bytes – 1 register).
$ 01 FD = 509. 509 * 0.05 V/bit = 25.45V.

Generator Overall Power Factor

Request: **$ 01 03 00 66 00 01 xx xx**

$ 01 = slave address of EMCP 3
$ 03 = function code (Read Registers)
$ 00 66 → (1 bit offset) → $00 67 = Generator Overall Power Factor.
$ 00 01 = register count (1 register)

Reply: **$ 01 03 02 80 00 xx xx**

$ 01 = slave address of EMCP 3
$ 03 = function code (Read Registers)
$ 02 = byte count (2 bytes = 1 register)
$ 80 00 = 32768. 32768 * (1 / 16384) - 1.0 = 1.0 PF.

It may be convenient to consider these equations when converting between engineering units and stored data:

ENGINEERING_DATA = (STORED_DATA * RESOLUTION) + OFFSET
STORED_DATA = (ENGINEERING_DATA - OFFSET) / RESOLUTION

Engine Status

Let’s consider the reply under two different conditions to the following request for Engine Status.

Request: **$ 01 03 04 1C 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 04 1C → (1 bit offset) → $ 04 1D → Engine Status

Condition 1: If we set the engine RPM to 15 and the mode to “Stop”, then the EMCP 3 display reads “Stopping”, and the following is the reply to the above Modbus request:
Reply (1): **$ 01 03 02 00 03 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (Read Register)
$ 02 = byte count (2 bytes = 1 register)
$ 00 03 = 3 = Ready in Auto

The Engine Status is Ready in Auto because the engine RPM is below the Crank Terminate RPM setpoint. (The minimum value of the Crank Terminate setpoint is 100 rpm).

Condition 2: If we set the engine RPM to zero and the mode to “Stop” and the oil pressure below 80kPa, then the EMCP 3 display reads “Stopped”, and the following is the reply to the above Modbus request.
Reply (2): **$ 01 03 02 00 00 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (Read Register)
$ 02 = byte count (2 bytes = 1 register)
$ 00 00 = 0 = Not Ready to Go

The Engine Status is Not Ready to Go, which indicates that the control is in Stop mode, and is not ready to be started via a Remote Initiate command.

SCADA Security Levels

This example demonstrates setting a password, and then entering the password to gain access to a certain SCADA security level. There are also some examples given of valid versus invalid passwords.

First let us assume that we are using an EMCP 3 control panel that contains default values. By default, all three passwords (SCADA, Level 1, and Level 2) are disabled. First we read and verify the current security level.

Step 1: Verify current security level
Request: **$ 01 03 02 DB 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 02 DB → (1 bit offset) → $ 02 DC → Current Security Level
Reply: **$ 01 03 02 00 02 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 00 02 = security access level 2.

This is correct. We should be at level 2, because no passwords exist. Now, we enter a SCADA password as well as a new level 1 password. We will set the SCADA password to 123, which is $313233. We will set the new level 1 password to 1, which is $31.

Step 2: Set a new level 1 password
Request: **$ 01 10 02 C3 00 08 10 31 20 20 20 20 20 20 20 20 20 20 20 20 20 xx xx**
$ 01 = slave address of EMCP 3
$ 10 = function code (write multiple registers)
$ 02 C3 → (1 bit offset) → $ 02 C4 → Level 1 Password
$ 00 08 = register count (8)
$ 10 = byte count (16)
$ 31 20 20 20 20 20 20 20 20 20 20 20 20 20 20 = data ("1", followed by 15 spaces)
Reply: $ **01 10 02 C3 00 08 xx xx**
$ 02 C3 → (1 bit offset) → $ 02 C4 → Level 1 Password
$ 00 08 = register count (8)

Step 3: Set a new SCADA password
Request: **$ 01 10 02 D3 00 08 10 31 32 33 20 20 20 20 20 20 20 20 20 20 20 xx xx**
$ 01 = slave address of EMCP 3
$ 10 = function code (write multiple registers)
$ 02 D3 → (1 bit offset) → $ 02 D4 → SCADA Password
$ 00 08 = register count (8)
$ 10 = byte count (16)
$ 31 32 33 20 20 20 20 20 20 20 20 20 20 20 20 = data ("123", followed by 13 spaces)
Reply: $ **01 10 02 C3 00 08 xx xx**
$ 02 C3 → (1 bit offset) → $ 02 C4 → Level 1 Password
$ 00 08 = register count (8)

Now we wait the duration of the Level 0 Timeout, which is 10 minutes, without doing any *writes* over SCADA. Repeat step 1 to verify that the current security level is now zero. The reply should be as follows:
Reply: **$ 01 03 02 00 00 xx xx**

The level is now zero. Now we disconnect from SCADA completely (i.e. no reads nor writes) for the duration of the SCADA Timeout, which depends on the SCADA Data Link Connect Timeout Interval setpoint. If the timeout interval is set to the default of 30 seconds, then wait for 30 seconds, and then reconnect. Repeating step 1, the reply should be as follows:
Reply: **$ 01 03 02 FF FF xx xx**

This is the correct response. Since we have timed out of SCADA access, we can no longer read or write to any register with a couple of exceptions. One is the Write Access Password register. Therefore, if we know the password to any level, we can enter it and be granted access to SCADA. Let us now enter the SCADA password that we set in step 3:

Step 4: Enter SCADA password to gain level 0 access
Request: **$ 01 10 02 BB 00 08 10 31 32 33 20 20 20 20 20 20 20 20 20 20 20 xx xx**
$ 01 = slave address of EMCP 3

$ 10 = function code (write multiple registers)
$ 02 D3 → (1 bit offset) → $ 02 D4 → Write Access Password
$ 00 08 = register count (8)
$ 10 = byte count (16)
$ 31 32 33 20 20 20 20 20 20 20 20 20 20 20 20 20 = data ("123", followed by 13 spaces)

Reply: $ **01 10 02 BB 00 08 xx xx**
$ 02 C3 → (1 bit offset) → $ 02 C4 → Write Access Password
$ 00 08 = register count (8)

Now we again repeat step 1 to verify the current security level.
Reply: **$ 01 03 02 00 00 xx xx**

This verifies that the SCADA password worked, and did indeed give us access to level 0 security. Notice that the level did not increase to 1 or 2 because we have a level 1 password set. If we were to enter the level 1 password, access level 2 would be granted because there is no level 2 password set.

More notes on SCADA passwords

Note that the SCADA password is stored as a numeric value. The password is right-justified in the field shown on the EMCP 3 control panel, and left-justified when set/written over SCADA, but it is numerically the same (00000001 is the same as 1_____ -- 1 with seven spaces after it). Just as with any number, leading zeros get dropped, and trailing zeros are kept (so "01" is stored as "1", but "10" is stored as "10").

Also, the first space terminates the string, so an entry of "12 3" (space between the 2 and the 3) will return an exception because only spaces (or nulls, after the first 8 bytes) are accepted after the first space.

Setpoint Interpretation and Calculation

This example lays out the method of reading and writing to setpoints, including the data conversion between the register data and engineering value.

Let us consider Block # 1 Setpoint # 2, Low Engine Oil Pressure Warning Event Threshold.

Reading the value, you may get:
$ 00 A0 00 00

That corresponds to a decimal value of 655,360.
Now look at the SCALING and divide by 2^{12} to get a decimal value of 360.
The current setpoint for Low Engine Oil Pressure Warning Event Threshold is then 360 kPa.

Now let's say you would like to change that to 327.8 kPa. First, check the RESOLUTION, and you will find that the setpoint will be rounded to the nearest 1 kPa. Therefore, we might as well round the value ourselves. We round it to 328 kPa.

Next, we make sure it is within the MIN and MAX range (34 to 690). It is.
We look at the SCALING and multiply by 2^{12} to get a decimal value of 1,343,488.
Now convert it to 32-bit signed integer (see Setpoint Data Type subsection) to get: $ 00 14 80 00
We would write this value to the New Value registers of the Setpoint Write parameter.

Reading and Writing AVR Registers and Setpoints

This example demonstrates the data link commands for reading setpoints, and reading and writing registers. Furthermore, it illustrates the functionality of integration with an external Automatic Voltage Regulator.

First we should check the Maximum Generator Voltage Output Bias Percentage setpoint. This could be done via the display, but let's read the setpoint via Modbus instead. We begin by selecting the setpoint that we wish to read, by writing the Setpoint ID to the Setpoint ID for Read register.

Request: **$ 01 06 03 E9 00 03 06 00 6C 00 xx xx**
- $ 01 = slave address of EMCP 3
- $ 06 = function code (write multiple registers)
- $ 03 E9 → (1 bit offset) → $ 03 EA → Setpoint ID for Read
- $ 00 03 = register count
- $ 06 = byte count (2 bytes = 1 register)
- $ 00 6C 00 = setpoint # 1, block # 108, instance # 1 = Maximum Generator Voltage Output Bias Percentage

Reply: **$ 01 06 03 E9 00 03 xx xx**
- $ 03 E9 → (1 bit offset) → $ 03 EA → Setpoint ID for Read
- $ 00 03 = register count

The reply confirms that the write was successful. Next we read the portion of the Setpoint Information register span that contains the Value. This is register offsets 7:6 of the Setpoint Information register, or registers 1011 and 1012.

Request: **$ 01 03 03 F2 00 02 xx xx**
- $ 01 = slave address of EMCP 3
- $ 03 = function code (read registers)
- $ 03 F2 → (1 bit offset) → $ 03 F3 → Setpoint Information: Value
- $ 00 02 = register count (Setpoint Information: Value is 2 registers long)

Reply: **$ 01 03 04 00 14 00 00 xx xx**
- $ 04 = byte count (2 bytes = 1 register)
- $ 00 14 00 00 → 1,310,720 → (divide by 2^16) → 20% max bias

So the Maximum Generator Voltage Output Bias Percentage is 20%. Now, let's read the AVR Bias Percent and the Desired Genset Output Voltage before any bias is applied.

Request: **$ 01 03 04 21 00 01 xx xx**
- $ 01 = slave address of EMCP 3
- $ 03 = function code (read register)

$ 04 21 → (1 bit offset) → $ 04 22 → AVR Bias Percent
$ 00 01 = register count

Reply: **$ 01 03 02 7D 80 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 7D 80 → 32128 → 251% → (-251% offset) → 0.0% bias

Request: **$ 01 03 04 20 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 04 20 → (1 bit offset) → $ 04 21 → Desired Genset Output Voltage
$ 00 01 = register count

Reply: **$ 01 03 02 01 E0 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 01 E0 → 480V desired

Now suppose we navigate to the Control menu, and press the up arrow *ten* times to adjust the voltage, and re-read the AVR Bias Percent register.

Request: **$ 01 03 04 21 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 04 21 → (1 bit offset) → $ 04 22 → AVR Bias Percent
$ 00 01 = register count

Reply: **$ 01 03 02 80 00 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 80 00 → 32768 → 256% → (-251% offset) → 5.0% bias

This verifies that each keypress adjusts the percentage by 0.5% (since we did ten keypresses). Now we can check the actual voltage command that is sent to the AVR by reading the Desired Genset Output Voltage register.

Request: **$ 01 03 04 20 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 04 20 → (1 bit offset) → $ 04 21 → Desired Genset Output Voltage
$ 00 01 = register count

Reply: **$ 01 03 02 01 E5 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 01 E5 → 485V desired

This is correct, because recall that the AVR Bias Percent represents a percentage *of the Maximum Engine Speed Bias*, which was 20%. Therefore the overall bias percentage is 5% (AVR Bias Percent) of 20% (Maximum Engine Speed Bias), which is 1%. 101% of 480V is 484.8V, which rounds up to 485V.

Now let us re-adjust the desired voltage to nominal, which is 480V. However, this time we will use the AVR Bias Percent Increment Command Modbus register. Since the current bias is 1%, we want to *increment* the bias by -1% (negative one percent).

Request: **$ 01 06 04 22 7D 00 xx xx**
$ 01 = slave address of EMCP 3
$ 06 = function code (write single register)
$ 04 22 → (1 bit offset) → $ 04 23 → AVR Bias Percent Increment Command
$ 7D 00 = 32000 → (divide by 128) = 250 → (-251 offset) → -1%

Reply: **$ 01 06 04 22 7D 00 xx xx**
$ 04 22 – echo of address
$ 7D 00 – echo of data

And finally we re-check the AVR Bias Percent to verify that the bias has returned to zero.

Request: **$ 01 03 04 21 00 01 xx xx**
$ 01 = slave address of EMCP 3
$ 03 = function code (read register)
$ 04 21 → (1 bit offset) → $ 04 22 → AVR Bias Percent
$ 00 01 = register count

Reply: **$ 01 03 02 7D 80 xx xx**
$ 02 = byte count (2 bytes = 1 register)
$ 7D 80 → 32128 → 251% → (-251% offset) → 0.0% bias

Appendix B Blocks for Setpoint Configuration

This appendix contains information on the various software blocks in the EMCP 3 control. Blocks are functional groups of setpoints. Blocks can occur in multiple instances, and in order to program a setpoint, the block number as well as the instance number must be referenced.

Table 12: Blocks for Setpoint Configuration

Block #	Block Name	EMCP 3.2 Number of Instances	EMCP 3.3 Number of Instances
1	Engine Oil Pressure Monitor	1	1
4	Engine Coolant Temperature Monitor	1	1
6	Engine Speed Monitor	1	1
7	Battery Voltage Monitor	1	1
8	Engine Operating Hours Monitor	1	1
9	Crank Attempt/Successful Start Counter	1	1
10	Engine Protection Events Configuration	1	1
11	Generator Protection Events Configuration	1	1
12	Other System Events Configuration	1	1
17	Diagnostics Configuration	1	1
18	Automatic Start/Stop	1	1
19	Generator AC Monitor	1	1
21	Generator Over/Under Voltage	1	1
22	Generator Over/Under Frequency	1	1
23	Generator Over Current	1	1
24	Generator Reverse Power	0	1
34	Utility Breaker Control	1	1
35	Generator Breaker Control	1	1
53	Digital Inputs	8	8
56	Relay Outputs	8	8
72	Event System	1	1
75	Electronic Control Module Reduced Power Mode	1	1
88	Digital Outputs	1	2
94	Data Link - SCADA	1	1
96	Enhanced Engine Monitor	0	1
97	Event Output Functions	30	30
98	Generator AC Power Monitor	1	1
100	Service Maintenance Interval	1	1
102	Governor Desired Engine Speed Request	1	1
104	Digital Selectors	10	10

Block #	Block Name	EMCP 3.2 Number of Instances	EMCP 3.3 Number of Instances
105	Event Input Functions	8	8
106	Spare Analog Input	1	1
108	AVR Desired Voltage Request	0	1
109	Enhanced Generator Monitor	0	1

Appendix C Setpoint Information for Setpoint Configuration

This table contains information regarding the data format of individual setpoints. This table defines how to interpret the engineering units from the stored values. For more information on the setpoint data types, see the Setpoint Data Type section.

Table 13: Setpoint Information for Setpoint Configuration

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
1	1	Engine Oil Pressure Sensor Configuration	Lvl 3	0	Setpoint Value List			
	2	Low Engine Oil Pressure Warning Event Threshold	Lvl 2	12	34	690	1	kPa
	3	Low Idle Low Engine Oil Pressure Warning Event Threshold	Lvl 2	12	34	690	1	kPa
	4	Low Engine Oil Pressure Warning Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
	5	Low Engine Oil Pressure Shutdown Event Threshold	Lvl 2	12	34	690	1	kPa
	6	Low Idle Low Engine Oil Pressure Shutdown Event Threshold	Lvl 2	12	34	690	1	kPa
	7	Low Engine Oil Pressure Shutdown Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
	8	Low Engine Oil Pressure Step Speed	Lvl 2	12	400	1800	1	rpm
4	1	Engine Coolant Temperature Sensor Configuration	Lvl 3	0	Setpoint Value List			
	2	High Engine Coolant Temperature Warning Event Threshold	Lvl 2	12	49	120	1	deg. C
	3	High Engine Coolant Temperature Warning Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
	4	High Engine Coolant Temperature Shutdown Event Threshold	Lvl 2	12	49	120	1	deg. C
	5	High Engine Coolant Temperature Shutdown Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
	6	Low Engine Coolant Temperature Warning Event Threshold	Lvl 2	12	0	36	1	deg. C
	7	Low Engine Coolant Temperature Warning Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
6	1	Flywheel Teeth	Lvl 3	0	95	350	1	N/A
	2	Engine Over Speed Shutdown Threshold	Lvl 3	12	400	4330	1	rpm
	3	Engine Under Speed Warning Event Threshold	Lvl 3	12	400	4330	1	rpm
	4	Engine Under Speed Warning Event Notification Delay Time	Lvl 2	4	0.0	20.0	0.1	seconds
	5	Engine Under Speed Shutdown Event Threshold	Lvl 3	12	400	4330	1	rpm
	6	Engine Under Speed Shutdown Event Notification Delay Time	Lvl 2	4	0.0	20.0	0.1	seconds
	7	Engine Speed Sensor Configuration	Svc Tool	0	Setpoint Value List			

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
7	1	High Battery Voltage Warning Event Threshold	Lvl 1	12	12	50	0.1	VDC
	2	High Battery Voltage Warning Event Notification Delay Time	Lvl 1	4	0	240	1	seconds
	3	High Battery Voltage Shutdown Event Threshold	Lvl 1	12	12.0	50.0	0.1	VDC
	4	High Battery Voltage Shutdown Event Notification Delay Time	Lvl 1	4	0	240	1	seconds
	5	Low Battery Voltage Warning Event Threshold	Lvl 1	12	0.0	25.0	0.1	VDC
	6	Low Battery Voltage Warning Event Notification Delay Time	Lvl 1	4	0	240	1	seconds
	7	Low Battery Charging System Voltage Warning Event Threshold	Lvl 1	12	0.0	30.0	0.1	VDC
	8	Low Battery Charging System Voltage Warning Event Notification Delay Time	Lvl 1	4	0	240	1	seconds
9	1	Customer Password Security Level to Reset Crank/Start Counters	Lvl 3	0	0	4	1	N/A
10	1	Air Damper Closed Event Response Configuration	Lvl 2	0	0	266	N/A	BitMask
	2	High Air Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	3	High Air Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	4	Low Air Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	5	Low Air Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	6	Emergency Stop Activated Event Response Configuration	Lvl 2	0	8	106	N/A	BitMask
	7	High Engine Coolant Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	8	High Engine Coolant Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	9	Low Engine Coolant Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	10	Low Engine Coolant Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	11	High Engine Coolant Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	12	High Engine Coolant Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	13	Low Engine Coolant Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	14	Engine Failure to Start Shutdown Event Response Configuration	Lvl 2	0	8	106	N/A	BitMask
	15	High Engine Oil Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	16	High Engine Oil Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	17	Low Engine Oil Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	18	Low Engine Oil Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	19	Low Engine Oil Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	20	Low Engine Oil Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	21	High Engine Oil Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	22	High Engine Oil Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	23	Low Engine Oil Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	24	Low Engine Oil Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	25	Unexpected Engine Shutdown Event Response Configuration	Lvl 2	0	8	106	N/A	BitMask
	26	Engine Over Speed Shutdown Event Response Configuration	Lvl 2	0	8	106	N/A	BitMask
	27	Engine Under Speed Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	28	Engine Under Speed Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	29	High Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	30	High Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	31	Low Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	32	Low Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	33	High Right Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	34	High Right Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	35	Low Right Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	36	Low Right Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	37	High Left Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	38	High Left Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	39	Low Left Exhaust Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	40	Low Left Exhaust Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	41	High Fuel Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	42	High Fuel Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	43	Low Fuel Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	44	Low Fuel Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	45	High Fuel Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	46	High Fuel Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	47	Low Fuel Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	48	Low Fuel Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	49	External Tank High Fuel Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	50	External Tank High Fuel Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	51	External Tank Low Fuel Level Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	52	External Tank Low Fuel Level Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	53	Fuel Tank Leak Event Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	54	High Engine Oil Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	55	High Engine Oil Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	56	Low Engine Oil Filter Differential Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	57	Low Engine Oil Filter Differential Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	58	Service Maintenance Interval Warning Event Response Configuration	Svc Tool	0	0	3	N/A	BitMask
	59	High Starting Air Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	60	High Starting Air Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	61	Low Starting Air Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	62	Low Starting Air Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	63	High Gas Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	64	High Gas Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	65	Low Gas Pressure Warning Event Response Configuration	Lvl 2	0	3	99	N/A	BitMask
	66	Low Gas Pressure Shutdown Event Response Configuration	Lvl 2	0	10	110	N/A	BitMask
11	1	High Generator Bearing #1 Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	2	High Generator Bearing #1 Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	3	Low Generator Bearing #1 Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	4	Low Generator Bearing #1 Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	5	Generator Over Current (Amp) Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	6	Generator Over Current (Amp) Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	7	Generator Over Frequency Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	8	Generator Over Frequency Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	9	Generator Under Frequency Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	10	Generator Under Frequency Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	11	Generator Reverse Power Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	12	Generator Reverse Power Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	13	Generator Over Voltage Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	14	Generator Over Voltage Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	15	Generator Under Voltage Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	16	Generator Under Voltage Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	17	Earth Fault Event Response Configuration	Lvl 2	0	0	111	N/A	BitMask
12	1	High Ambient Air Temperature Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	2	High Ambient Air Temperature Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	3	Low Ambient Air Temperature Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	4	Low Ambient Air Temperature Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	5	Automatic Transfer Switch in Normal Position Event Response Configuration	Lvl 2	0	0	259	N/A	BitMask
	6	Automatic Transfer Switch in Emergency Position Event Response Configuration	Lvl 2	0	0	259	N/A	BitMask
	7	High Battery Voltage Warning Event Response Configuration	Lvl 1	0	0	99	N/A	BitMask
	8	High Battery Voltage Shutdown Event Response Configuration	Lvl 1	0	0	110	N/A	BitMask
	9	Low Battery Voltage Warning Event Response Configuration	Lvl 1	0	0	227	N/A	BitMask
	10	Low Battery Charging System Voltage Warning Event Response Configuration	Lvl 1	0	0	227	N/A	BitMask
	11	Generator Breaker Failure to Open Event Response Configuration	Lvl 3	0	0	107	N/A	BitMask
	12	Generator Breaker Failure to Close Event Response Configuration	Lvl 3	0	0	107	N/A	BitMask
	13	Generator Breaker Open Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	14	Generator Breaker Closed Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	15	Utility Breaker Failure to Open Event Response Configuration	Lvl 3	0	0	107	N/A	BitMask
	16	Utility Breaker Failure to Close Event Response Configuration	Lvl 3	0	0	107	N/A	BitMask
	17	Utility Breaker Open Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	18	Utility Breaker Closed Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	19	Emergency Shutdown Override Mode Active Warning Event Response Configuration	Lvl 2	0	1	3	N/A	BitMask
	20	Engine in Cooldown Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	21	Engine Speed-Generator Output Frequency Mismatch Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	22	Custom Event #1 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	23	Custom Event #1 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	24	Custom Event #1 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	25	Custom Event #1 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	26	Custom Event #1 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	27	Custom Event #2 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	28	Custom Event #2 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	29	Custom Event #2 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	30	Custom Event #2 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	31	Custom Event #2 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	32	Custom Event #3 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	33	Custom Event #3 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	34	Custom Event #3 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	35	Custom Event #3 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	36	Custom Event #3 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	37	Custom Event #4 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	38	Custom Event #4 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	39	Custom Event #4 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	40	Custom Event #4 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	41	Custom Event #4 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	42	Custom Event #5 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	43	Custom Event #5 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	44	Custom Event #5 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	45	Custom Event #5 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	46	Custom Event #5 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	47	Custom Event #6 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	48	Custom Event #6 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	49	Custom Event #6 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	50	Custom Event #6 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	51	Custom Event #6 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	52	Custom Event #7 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	53	Custom Event #7 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	54	Custom Event #7 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	55	Custom Event #7 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	56	Custom Event #7 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	57	Custom Event #8 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	58	Custom Event #8 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	59	Custom Event #8 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	60	Custom Event #8 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	61	Custom Event #8 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	62	High Fire Extinguisher Pressure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	63	High Fire Extinguisher Pressure Shutdown Event Response Configuration	Lvl 2	0	0	110	N/A	BitMask
	64	Low Fire Extinguisher Pressure Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	65	Low Fire Extinguisher Pressure Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	66	Generator Control Not in Automatic Warning Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	67	Loss of Utility Event Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	68	Utility to Generator Transfer Failure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	69	Utility to Generator Transfer Failure Shutdown Event Response Configuration	Lvl 2	0	0	102	N/A	BitMask
	70	Generator to Utility Transfer Failure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	71	Dead Bus Inconsistent Sensing Warning Event Response Configuration	Lvl 2	0	1	355	N/A	BitMask
	72	Generator to Bus Synchronization Failure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	73	Generator to Bus Synchronization Failure Shutdown Event Response Configuration	Lvl 2	0	0	106	N/A	BitMask
	74	Generator-Bus Phase Sequence Mismatch Warning Event Response Configuration	Lvl 2	0	1	355	N/A	BitMask
	75	Generator Not Ready to Automatically Parallel Warning Event Response Configuration	Lvl 2	0	0	259	N/A	BitMask
	76	Generator Soft Unload Failure Warning Event Response Configuration	Lvl 2	0	0	99	N/A	BitMask
	77	Generator Soft Unload Failure Shutdown Event Response Configuration	Lvl 2	0	0	106	N/A	BitMask
	78	Custom Event #9 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	79	Custom Event #9 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	80	Custom Event #9 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	81	Custom Event #9 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	82	Custom Event #9 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	83	Custom Event #10 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	84	Custom Event #10 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	85	Custom Event #10 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	86	Custom Event #10 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	87	Custom Event #10 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	88	Custom Event #11 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	89	Custom Event #11 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	90	Custom Event #11 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	91	Custom Event #11 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	92	Custom Event #11 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	93	Custom Event #12 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	94	Custom Event #12 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	95	Custom Event #12 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	96	Custom Event #12 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	97	Custom Event #12 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	98	Custom Event #13 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	99	Custom Event #13 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	100	Custom Event #13 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	101	Custom Event #13 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	102	Custom Event #13 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	103	Custom Event #14 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	104	Custom Event #14 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	105	Custom Event #14 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	106	Custom Event #14 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	107	Custom Event #14 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	108	Custom Event #15 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	109	Custom Event #15 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	110	Custom Event #15 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	SP #	SETPOINT NAME	SECURITY LEVEL	SCALE	MIN	MAX	RESO-LUTION	UNITS
	111	Custom Event #15 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	112	Custom Event #15 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	113	Custom Event #16 High Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	114	Custom Event #16 High Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	115	Custom Event #16 Low Warning Event Response Configuration	Lvl 2	0	0	227	N/A	BitMask
	116	Custom Event #16 Low Shutdown Event Response Configuration	Lvl 2	0	0	238	N/A	BitMask
	117	Custom Event #16 Event Response Configuration	Lvl 2	0	0	511	N/A	BitMask
	118	Generator Breaker Locked Out Warning Event Response Configuration	Lvl 2	0	0	355	N/A	BitMask
	119	Utility Breaker Locked Out Warning Event Response Configuration	Lvl 2	0	0	355	N/A	BitMask
	120	Earth Leakage Event Response Configuration	Lvl 2	0	0	111	N/A	BitMask
17	1	Accessory Data Link Diagnostic Response Configuration	Svc Tool	0	0	111	N/A	BitMask
	2	Air Filter Differential Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	3	Ambient Air Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	4	Digital Output #1 Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	5	Digital Output #2 Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	6	Engine Coolant Level Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	7	Engine Coolant Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	8	Engine Oil Level Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	9	Engine Oil Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	10	Engine Oil Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	11	Engine Speed Sensor Diagnostic Response Configuration	Lvl 2	0	8	106	N/A	BitMask
	12	Exhaust Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	13	Right Exhaust Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	14	Left Exhaust Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	15	Fire Extinguisher Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	16	Fuel Filter Differential Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	17	Fuel Level Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	18	External Tank Fuel Level Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	19	Generator Bearing #1 Temperature Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
	20	Generator Output Sensing System Diagnostic Response Configuration	Svc Tool	0	0	111	N/A	BitMask
	21	Engine Oil Filter Differential Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	22	Primary Data Link Diagnostic Response Configuration	Lvl 3	0	0	111	N/A	BitMask
	23	SCADA Data Link Diagnostic Response Configuration	Lvl 2	0	0	239	N/A	BitMask
	24	Starting Air Pressure Sensor Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	25	Battery Charger Failure Diagnostic Response Configuration	Lvl 1	0	0	259	N/A	BitMask
	26	Multiple Genset Control Data Link Communication Failure Diagnostic Response Configuration	Lvl 2	0	1	363	N/A	BitMask
	27	Multiple Genset Control Data Link Configuration Error Diagnostic Response Configuration	Lvl 2	0	1	363	N/A	BitMask
	28	Control is Offline Multiple Genset Control Data Link Diagnostic Response Configuration	Lvl 2	0	1	259	N/A	BitMask
	29	Digital Output #3 Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	30	Digital Output #4 Diagnostic Response Configuration	Lvl 2	0	0	111	N/A	BitMask
	31	Engine Controller Not Responding Diagnostic Response Configuration	Lvl 3	0	0	111	N/A	BitMask
18	1	Engine Start Fault Protection Activation Delay Time	Lvl 2	4	0	300	1	seconds
	2	Crank Duration	Lvl 2	4	5	300	1	seconds
	3	Crank Cycle Rest Interval	Lvl 2	4	5	300	1	seconds
	4	Engine Purge Cycle Time	Lvl 2	4	0	20	1	seconds
	5	Maximum Number of Crank Cycles	Lvl 2	0	1	20	1	N/A
	6	Cooldown Duration	Lvl 2	12	0	30	1	minutes
	7	Start Aid Activation Time	Lvl 2	4	0	240	1	seconds
	8	Crank Alert Activation Time	Lvl 1	4	0	60	1	seconds
	9	Crank Terminate RPM	Lvl 3	12	100	1000	1	rpm
	10	Engine Fuel Type Configuration	Svc Tool	0	Setpoint Value List			
	11	Fuel Shutoff Solenoid Type Configuration	Svc Tool	0	Setpoint Value List			
	12	Engine Type Configuration	Svc Tool	0	Setpoint Value List			
	13	Engine Controller J1939 Data Link Support Configuration	Svc Tool	0	Setpoint Value List			
	14	Engine Cooldown Speed Configuration	Lvl 2	0	Setpoint Value List			

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
	15	Engine Operating State Input Configuration	Svc Tool	0	Setpoint Value List			
19	1	Generator Connection Configuration	Lvl 3	0	Setpoint Value List			
	2	Generator Potential Transformer Primary Winding Rating	Lvl 3	12	1	50000	1	V
	3	Generator Potential Transformer Secondary Winding Rating	Lvl 3	12	1	240	1	V
	4	Generator Current Transformer Primary Winding Rating	Lvl 3	12	1	7000	1	A
	5	Generator Current Transformer Secondary Winding Rating	Lvl 3	12	1	5	4	A
	6	Number of Generator Poles	Svc Tool	0	0	200	2	N/A
	7	Generator Rated Frequency	Lvl 3	0	Setpoint Value List			
	8	Generator Rated Voltage	Lvl 2	12	100	50000	1	V
	9	Generator Rated Power	Lvl 3	12	1	50000	1	kW
	10	Generator Rated Apparent Power	Lvl 3	12	1	50000	1	kVA
21	1	Generator Over Voltage Warning Event Percentage Threshold	Lvl 2	16	100	125	1	%
	2	Generator Over Voltage Warning Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	3	Generator Over Voltage Shutdown Event Percentage Threshold	Lvl 2	16	100	125	1	%
	4	Generator Over Voltage Shutdown Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	5	Generator Under Voltage Warning Event Percentage Threshold	Lvl 2	16	60	100	1	%
	6	Generator Under Voltage Warning Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	7	Generator Under Voltage Shutdown Event Threshold	Lvl 2	16	60	100	1	%
	8	Generator Under Voltage Shutdown Event Notification Delay Time	Lvl 2	4	0	120	N/A	seconds
22	1	Generator Over Frequency Warning Event Percentage Threshold	Lvl 2	16	80	120	0.1	%
	2	Generator Over Frequency Warning Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	3	Generator Over Frequency Shutdown Event Percentage Threshold	Lvl 2	16	80.0	120.0	0.1	%
	4	Generator Over Frequency Shutdown Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	5	Generator Under Frequency Warning Event Percentage Threshold	Lvl 2	16	80.0	120.0	0.1	%
	6	Generator Under Frequency Warning Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
	7	Generator Under Frequency Shutdown Event Percentage Threshold	Lvl 2	16	80.0	120.0	0.1	%
	8	Generator Under Frequency Shutdown Event Notification Delay Time	Lvl 2	4	0	120	1	seconds
23	1	Generator Definite Time Over Current (Amp) Warning Event Percentage Threshold	Lvl 2	16	80	130	1	%

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
	2	Generator Inverse Time Over Current (Amp) Shutdown Event Time Multiplier	Lvl 2	16	0.05	10.00	0.01	seconds
	3	Generator Definite Time Over Current (Amp) Shutdown Event Percentage Threshold	Lvl 2	16	100	300	1	%
	4	Generator Definite Time Over Current (Amp) Shutdown Event Notification Delay Time	Lvl 2	4	0.1	20.0	0.1	seconds
24	1	Generator Reverse Power Warning Event Percentage Threshold	Lvl 2	16	1	20	1	%
	2	Generator Reverse Power Warning Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
	3	Generator Reverse Power Shutdown Event Percentage Threshold	Lvl 2	16	1	20	1	%
	4	Generator Reverse Power Shutdown Event Notification Delay Time	Lvl 2	4	0	30	1	seconds
34	1	Utility Breaker Closing Pulse Active Time	Lvl 3	4	0.1	10	0.1	seconds
	2	Utility Breaker Closing Pulse Rest Interval	Lvl 3	4	0	60	1	seconds
	3	Utility Breaker Maximum Closing Time	Lvl 3	4	1	120	1	seconds
	4	Utility Breaker Maximum Opening Time	Lvl 3	4	1	20	1	seconds
	5	Utility Breaker Lockout Configuration	Lvl 2	0	Setpoint Value List			
	6	Utility Breaker Type Configuration	Lvl 3	0	Setpoint Value List			
	7	Automatic Utility Breaker Control Source Configuration	Lvl 3	0	Setpoint Value List			
35	1	Generator Breaker Closing Pulse Active Time	Lvl 3	4	0.1	10	0.1	seconds
	2	Generator Breaker Closing Pulse Rest Interval	Lvl 3	4	0	60	1	seconds
	3	Generator Breaker Maximum Closing Time	Lvl 3	4	1	120	1	seconds
	4	Generator Breaker Maximum Opening Time	Lvl 3	4	1	20	1	seconds
	5	Generator Breaker Lockout Configuration	Lvl 2	0	Setpoint Value List			
	6	Generator Breaker Type Configuration	Lvl 3	0	Setpoint Value List			
	7	Automatic Generator Breaker Control Source Configuration	Lvl 3	0	Setpoint Value List			
53	1	Digital Input #NN Active State Configuration	Lvl 2	0	Setpoint Value List			
56	1	Relay Output #N Active State Configuration	read-only	0	Setpoint Value List			
72	1	Event Warning Condition Response Auto Reset Enable Status	Svc Tool	0	Setpoint Value List			
	2	Event Audible Alert Response Auto Reset Enable Status	Svc Tool	0	Setpoint Value List			
	3	Event Loss of Utility Response Auto Reset Enable Status	Svc Tool	0	Setpoint Value List			
	4	Event Breaker #1 Trip Response Auto Reset Enable Status	Svc Tool	0	Setpoint Value List			
	5	Event Breaker #2 Trip Response Auto Reset Enable Status	Svc Tool	0	Setpoint Value List			

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
75	1	Electronic Control Module Reduced Power Mode Enable Status	Lvl 3	0	Setpoint Value List			
	2	Electronic Control Module Reduced Power Mode Delay Time	Lvl 2	4	1	120	1	minutes
88	1	Digital Output #N Active State Configuration	Lvl 2	0	Setpoint Value List			
94	1	SCADA Data Link Baud Rate	Lvl 2	0	Setpoint Value List			
	2	SCADA Data Link Parity	Lvl 2	0	Setpoint Value List			
	3	SCADA Data Link Slave Address	Lvl 2	0	1	247	1	N/A
	4	SCADA Data Link Access Password	Lvl 2	0	0	0xffffffff	1	N/A
	5	SCADA Data Link Connection Timeout Interval	Lvl 2	4	0.1	3600.0	0.1	seconds
	6	RS-485 Bias Resistor Enable Status	Lvl 2	0	Setpoint Value List			
96	1	Engine Cylinder Temperature Sensor Installation Status	Lvl 2	0	Setpoint Value List			
	2	Number of Engine Cylinders	Lvl 2	0	1	20	1	N/A
97	1	Event Output Function #NN Trigger Condition	Lvl 2	0	Setpoint Value List			
	2	Event Output Function #NN Suspect Parameter Number	Lvl 2	0	Setpoint Value List			
98	1	Customer Password Security Level to Reset Generator Energy Meters	Lvl 3	0	0	3	1	N/A
100	1	Service Maintenance Interval Hours	Svc Tool	0	0	2000	1	hours
	2	Service Maintenance Interval Days	Svc Tool	0	0	365	1	days
	3	Customer Password Security Level to Reset Service Maintenance Interval	Lvl 3	0	0	4	1	N/A
102	1	Maximum Engine Speed Bias	Lvl 2	12	0	400	1	rpm
	2	Generator Nominal Output Frequency	Lvl 2	12	40	500	0.1	Hz
104	1	Digital Selector #NN Source Configuration	Lvl 2	0	Setpoint Value List			
105	1	Event Input Function #NN Active State Configuration	Lvl 2	0	Setpoint Value List			
	2	Event Input Function #NN Event Notification Delay Time	Lvl 2	4	0	250	1	seconds
	3	Event Input Function #NN Suspect Parameter Number	Lvl 2	0	Setpoint Value List			
	4	Event Input Function #NN Failure Mode Identifier	Lvl 2	0	Setpoint Value List			
106	1	Spare Analog Input Enable Status	Lvl 2	0	Setpoint Value List			
	2	Spare Analog Input Type Configuration	read-only	0	Setpoint Value List			
	3	Spare Analog Input Suspect Parameter Number	Lvl 2	0	Setpoint Value List			
	4	Spare Analog Input High Percentage Warning Event Threshold	Lvl 2	16	0	100	1	%

SETPOINT INFORMATION FOR SETPOINT CONFIGURATION								
BLOCK #	**SP #**	**SETPOINT NAME**	**SECURITY LEVEL**	**SCALE**	**MIN**	**MAX**	**RESO-LUTION**	**UNITS**
	5	Spare Analog Input High Temperature Warning Event Threshold	Lvl 2	12	-273	1735	1	deg. C
	6	Spare Analog Input High Pressure Warning Event Threshold	Lvl 2	12	-250	10000	1	kPa
	7	Spare Analog Input High Warning Event Notification Delay Time	Lvl 2	4	0	60	1	seconds
	8	Spare Analog Input High Percentage Shutdown Event Threshold	Lvl 2	16	0	100	1	%
	9	Spare Analog Input High Temperature Shutdown Event Threshold	Lvl 2	12	-273	1735	1	deg. C
	10	Spare Analog Input High Pressure Shutdown Event Threshold	Lvl 2	12	-250	10000	1	kPa
	11	Spare Analog Input High Shutdown Event Notification Delay Time	Lvl 2	4	0	60	1	seconds
	12	Spare Analog Input Low Percentage Warning Event Threshold	Lvl 2	16	0	100	1	%
	13	Spare Analog Input Low Temperature Warning Event Threshold	Lvl 2	12	-273	1735	1	deg. C
	14	Spare Analog Input Low Pressure Warning Event Threshold	Lvl 2	12	-250	10000	1	kPa
	15	Spare Analog Input Low Warning Event Notification Delay Time	Lvl 2	4	0	60	1	seconds
	16	Spare Analog Input Low Percentage Shutdown Event Threshold	Lvl 2	16	0	100	1	%
	17	Spare Analog Input Low Temperature Shutdown Event Threshold	Lvl 2	12	-273	1735	1	deg. C
	18	Spare Analog Input Low Pressure Shutdown Event Threshold	Lvl 2	12	-250	10000	1	kPa
	19	Spare Analog Input Low Shutdown Event Notification Delay Time	Lvl 2	4	0	60	1	seconds
108	1	Maximum Generator Voltage Output Bias Percentage	Lvl 2	16	0	100	1	%
	2	Generator Nominal Output Voltage	Lvl 2	12	100	50000	1	V
109	1	Generator Winding Temperature Sensor Installation Status	Lvl 2	0	Setpoint Value List			
	2	Generator Bearing Temperature Sensor Installation Configuration	Lvl 2	0	Setpoint Value List			

Appendix D Setpoint Value Lists

Some setpoints in Appendix C refer to Setpoint Value Lists. Those setpoints are programmed with integer values with each integer having a specific definition. These integer values and representations are given here.

Table 14: Setpoint Value Lists

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
1	1	Engine Oil Pressure Sensor Configuration	0 1	Sensor Data Link
4	1	Engine Coolant Temperature Sensor Configuration	0 1	Sensor Data Link
6	7	Engine Speed Sensor Configuration	0 1	Sensor Data Link
18	10	Engine Fuel Type Configuration	0 1	Diesel Natural Gas
	11	Fuel Shutoff Solenoid Type Configuration	0 1	Energized to Run Energized to Stop
	12	Engine Type Configuration	0 1	Mechanical Electronic
	13	Engine Controller J1939 Data Link Support Configuration	0 1 2	No J1939 Support Basic J1939 Support Enhanced J1939 Support
	14	Engine Cooldown Speed Configuration	0 1	Rated Speed Low Idle
	15	Engine Operating State Input Configuration	0 1	Hard Wired Input CAN Input
19	1	Generator Connection Configuration	0 1 2 3 4	Wye (or Star) Delta (3-Wire) Delta (4-Wire) Single Phase (2-Wire) Single Phase (3-Wire)
	7	Generator Rated Frequency	0 1 2	50 Hz 60 Hz 400 Hz
34	5	Utility Breaker Lockout Configuration	0 1	Not Locked Out Locked Out
	6	Utility Breaker Type Configuration	0 1 2	Not Installed Manual Automatic
	7	Automatic Utility Breaker Control Source Configuration	0 1	Supervisory Controlled Externally Controlled
35	5	Generator Breaker Lockout Configuration	0 1	Not Locked Out Locked Out
	6	Generator Breaker Type	0	Manual

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
		Configuration	1	Automatic
	7	Automatic Generator Breaker Control Source Configuration	0	Genset Controlled
			1	Externally Controlled
53	1	Digital Input #NN Active State Configuration	0	Low
			1	High
56	1	Relay Output #N Active State Configuration	0	Low
			1	High
72	1	Event Warning Condition Response Auto Reset Enable Status	0	Disabled
			1	Enabled
	2	Event Audible Alert Response Auto Reset Enable Status	0	Disabled
			1	Enabled
	3	Event Loss of Utility Response Auto Reset Enable Status	0	Disabled
			1	Enabled
	4	Event Breaker #1 Trip Response Auto Reset Enable Status	0	Disabled
			1	Enabled
	5	Event Breaker #2 Trip Response Auto Reset Enable Status	0	Disabled
			1	Enabled
75	1	Electronic Control Module Reduced Power Mode Enable Status	0	Disabled
			1	Enabled
88	1	Digital Output #N Active State Configuration	0	Low
			1	High
94	1	SCADA Data Link Baud Rate	0	2400 baud
			1	4800 baud
			2	9600 baud
			3	14400 baud
			4	19200 baud
			5	28800 baud
			6	38400 baud
			7	57600 baud
			8	115200 baud
	2	SCADA Data Link Parity	0	None
			1	Odd
			2	Even
	6	RS-485 Bias Resistor Enable Status	0	Disabled
			1	Enabled
96	1	Engine Cylinder Temperature Sensor Installation Status	0	Not Installed
			1	Installed
97	1	Event Output Function #NN Trigger Condition	0	Disabled
			8320	General Event - High or Low Warning
			8352	General Event - High or Low Shutdown
			8448	General Event - High or Low Warning or High or Low Shutdown
			8480	General Event - High or Low Warning or High or Low Shutdown or Diagnostic
			8512	General Diagnostic
			16384	Specific Event - Low Warning

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
			16416	Specific Event - Low Shutdown
			16448	Specific Event - High Warning
			16480	Specific Event - High Shutdown
			16512	Specific Event - High or Low Warning
			16544	Specific Event - High or Low Shutdown
			16576	Specific Event - Low Warning or Low Shutdown
			16608	Specific Event - High Warning or High Shutdown
			16640	Specific Event - High or Low Warning or High or Low Shutdown
			16672	Specific Event - High or Low Warning or High or Low Shutdown or Diagnostic
			16738	Specific Diagnostic - Data Erratic, Intermittent, or Incorrect
			16739	Specific Diagnostic - Voltage Above Normal, or Shorted to High Source
			16740	Specific Diagnostic - Voltage Below Normal, or Shorted to Low Source
			16741	Specific Diagnostic - Current Below Normal or Open Circuit
			16742	Specific Diagnostic - Current Above Normal or Grounded Circuit
			16743	Specific Diagnostic - Mechanical System Not Responding or Out of Adjustment
			16744	Specific Diagnostic - Abnormal Frequency or Pulse Width or Period
			16745	Specific Diagnostic - Abnormal Update Rate
			16746	Specific Diagnostic - Abnormal Rate of Change
			16747	Specific Diagnostic - Root Cause Not Known
			16748	Specific Diagnostic - Bad Intelligent Device or Component
			16749	Specific Diagnostic - Out of Calibration
			16750	Specific Diagnostic - Special Instructions
			16755	Specific Diagnostic - Received Network Data In Error
			16768	Specific Event - Condition Exists
	2	Event Output Function #NN Suspect Parameter Number	38	External Tank Fuel Level
			82	Starting Air Pressure
			95	Fuel Filter Differential Pressure
			96	Fuel Level
			98	Engine Oil Level
			99	Engine Oil Filter Differential Pressure
			100	Engine Oil Pressure

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
			107	Air Filter Differential Pressure
			110	Engine Coolant Temperature
			111	Engine Coolant Level
			137	Fire Extinguisher Pressure
			167	Battery Charging System Voltage
			168	Battery Voltage
			171	Ambient Air Temperature
			173	Exhaust Temperature
			175	Engine Oil Temperature
			190	Engine Speed
			625	SCADA Data Link
			639	Primary Data Link
			701	Custom Event #1
			702	Custom Event #2
			703	Custom Event #3
			704	Custom Event #4
			705	Custom Event #5
			706	Custom Event #6
			707	Custom Event #7
			708	Custom Event #8
			709	Custom Event #9
			710	Custom Event #10
			711	Custom Event #11
			712	Custom Event #12
			713	Custom Event #13
			714	Custom Event #14
			715	Custom Event #15
			716	Custom Event #16
			924	Digital Output #1
			925	Digital Output #2
			926	Digital Output #3
			970	Auxiliary Engine Shutdown Switch
			1122	Generator Rear Bearing Temperature
			1231	Accessory Data Link
			1237	Emergency Shutdown Override Switch
			1383	Unexpected Engine Shutdown
			1390	Gas Pressure
			1664	Engine Failure to Start
			2433	Right Exhaust Temperature
			2434	Left Exhaust Temperature
			2436	Generator Output Frequency
			2440	Generator Output Voltage
			2448	Generator Current (Amp)
			2452	Generator Output Power
			2646	Digital Output #4
			2648	Maintenance Lamp

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
			3543	Engine Controller
			4000	Air Damper Closed
			4001	ATS in Normal Position
			4002	ATS in Emergency Position
			4003	Battery Charger Failure
			4004	Generator Circuit Breaker Closed
			4005	Utility Breaker Closed
			4006	Engine in Cooldown
			4007	Generator Control Not in Automatic
			4009	Generator Circuit Breaker Failure to Open
			4010	Utility Breaker Failure to Open
			4011	Generator Circuit Breaker Failure to Close
			4012	Utility Breaker Failure to Close
			4013	Generator Circuit Breaker Open
			4014	Utility Breaker Open
			4015	Utility to Generator Transfer Failure
			4016	Generator to Utility Transfer Failure
			4017	Loss of Utility
			4018	Generator Circuit Breaker Locked Out
			4019	Utility Breaker Locked Out
			4028	Earth Fault
			4029	Earth Leakage
104	1	Digital Selector #NN Source Configuration	0	Disabled
			1	Use Input #1
			2	Use Input #2
			3	Use Input #3
			4	Use Input #4
			5	Use Input #5
			6	Use Input #6
			7	Use Input #7
			8	Use Input #8
			9	Use Input #9
			10	Use Input #10
			11	Data Link
105	1	Event Input Function #NN Active State Configuration	0	Low
			1	High
	3	Event Input Function #NN Suspect Parameter Number	38	External Tank Fuel Level
			82	Starting Air Pressure
			95	Fuel Filter Differential Pressure
			96	Fuel Level
			98	Engine Oil Level
			99	Engine Oil Filter Differential Pressure
			100	Engine Oil Pressure
			107	Air Filter Differential Pressure
			110	Engine Coolant Temperature
			111	Engine Coolant Level

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
			137	Fire Extinguisher Pressure
			167	Battery Charging System Voltage
			168	Battery Voltage
			171	Ambient Air Temperature
			173	Exhaust Temperature
			175	Engine Oil Temperature
			701	Custom Event (Instance #1)
			702	Custom Event (Instance #2)
			703	Custom Event (Instance #3)
			704	Custom Event (Instance #4)
			705	Custom Event (Instance #5)
			706	Custom Event (Instance #6)
			707	Custom Event (Instance #7)
			708	Custom Event (Instance #8)
			709	Custom Event (Instance #9)
			710	Custom Event (Instance #10)
			711	Custom Event (Instance #11)
			712	Custom Event (Instance #12)
			713	Custom Event (Instance #13)
			714	Custom Event (Instance #14)
			715	Custom Event (Instance #15)
			716	Custom Event (Instance #16)
			1122	Generator Rear Bearing Temperature
			1239	Fuel Tank Leak
			1390	Gas Pressure
			2433	Right Exhaust Temperature
			2434	Left Exhaust Temperature
			2436	Generator Frequency
			2440	Generator Voltage
			2448	Generator Current
			2452	Generator Power
			4000	Air Damper Closed
			4001	ATS in Normal Position
			4002	ATS in Emergency Position
			4003	Battery Charger Failure
			4004	Generator Circuit Breaker Closed
			4005	Utility Circuit Breaker Closed
			4013	Generator Circuit Breaker Open
			4014	Utility Circuit Breaker Open
			4017	Loss of Utility
			4028	Earth Fault
			4029	Earth Leakage
	4	Event Input Function #NN Failure Mode Identifier	0	High Shutdown
			1	Low Shutdown
			15	High Warning
			17	Low Warning

SETPOINT VALUE LISTS				
BLK #	**SP #**	**SETPOINT NAME**	**VALUE**	**VALUE NAME**
			31	Status
106	1	Spare Analog Input Enable Status	0	Disabled
			1	Enabled
	2	Spare Analog Input Type Configuration	0	Pressure
			1	Temperature
			2	Level
	3	Spare Analog Input Suspect Parameter Number	38	External Tank Fuel Level
			82	Starting Air Pressure
			95	Fuel Filter Differential Pressure
			96	Fuel Level
			98	Engine Oil Level
			99	Oil Filter Differential Pressure
			107	Air Filter Differential Pressure
			111	Engine Coolant Level
			137	Fire Extinguisher Pressure
			171	Ambient Air Temperature
			173	Exhaust Temperature
			175	Engine Oil Temperature
			1122	Generator Rear Bearing Temperature
			2433	Right Exhaust Temperature
			2434	Left Exhaust Temperature
109	1	Generator Winding Temperature Sensor Installation Status	0	Not Installed
			1	Installed
	2	Generator Bearing Temperature Sensor Installation Configuration	0	Not Installed
			1	Rear
			2	Front & Rear

Appendix E BitMask Value Lists

Some setpoints in Appendix C can take on multiple values simultaneously. This is particularly true for event response configurations, where an event can trigger multiple responses, such as a shutdown as well as a breaker tripping. In these cases, the setpoints are assigned bit-mask values, where different factors of two represent different optional responses. This guarantees that every combination of possible event responses will have a unique value. These possible values are given here.

In order to decode a BitMask value, simply mask it with the value in question and compare it to zero, to determine whether the value is present in the setpoint.

Table 15: BitMask Value Lists

Value	Value Name
1	Warning
2	Audible Alert
4	Soft Shutdown
8	Hard Shutdown
16	Utility Failure
32	Breaker #1 Trip
64	Breaker #2 Trip
128	Fault Protection Timer Enabled
256	Active Only

Appendix F Quick Reference Chart of Modbus Registers

Below is a quick-reference chart of the Modbus parameters detailed in this document. It contains the decimal register address, number of registers the parameter spans, parameter name, parameter description, and subsection within section 3.14 which contains the information for that parameter.

Table 16: Quick Reference Chart of Modbus Registers

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
100 1	**Generator Average Line-Line AC RMS Voltage** Average Line to Line RMS voltage measured at the generator output.	Generator AC Parameters
101 1	**Generator Average AC RMS Current** Average RMS current measured at the generator output.	Generator AC Parameters
102 1	**Generator Average AC RMS Frequency** Average AC frequency measured at the generator output.	Generator AC Parameters
103 1	**Generator Overall Power Factor** The average power factor of the generator.	Generator AC Parameters
104 1	**Generator Overall Power Factor Lagging** Lead/lag status for generator average power factor.	Generator AC Parameters
105 1	**Generator Total Percent kW** Total real power delivered by the generator, as a percentage of generator rated power.	Generator AC Parameters
106 2	**Generator Total Real Power** Total real power delivered by the generator.	Generator AC Parameters
108 1	**Generator Phase A Line-Line AC RMS Voltage** Line to Line RMS voltage measured at the generator phase AB output.	Generator AC Parameters
109 1	**Generator Phase B Line-Line AC RMS Voltage** Line to Line RMS voltage measured at the generator phase BC output.	Generator AC Parameters
110 1	**Generator Phase C Line-Line AC RMS Voltage** Line to Line RMS voltage measured at the generator phase CA output.	Generator AC Parameters
111 1	**Generator Phase A AC RMS Current** RMS current measured at the generator phase A output.	Generator AC Parameters
112 1	**Generator Phase B AC RMS Current** RMS current measured at the generator phase B output.	Generator AC Parameters
113 1	**Generator Phase C AC RMS Current** RMS current measured at the generator phase C output.	Generator AC Parameters
114 1	**Generator Phase A Line-Neutral AC RMS Voltage** Line to Neutral RMS voltage measured at the generator phase A output.	Generator AC Parameters
115 1	**Generator Phase B Line-Neutral AC RMS Voltage** Line to Neutral RMS voltage measured at the generator phase B output.	Generator AC Parameters

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
116 1	**Generator Phase C Line-Neutral AC RMS Voltage** Line to Neutral RMS voltage measured at the generator phase C output.	Generator AC Parameters
117 2	**Generator Phase A Real Power** The real power delivered by phase A of the generator.	Generator AC Parameters
119 2	**Generator Phase B Real Power** The real power delivered by phase B of the generator.	Generator AC Parameters
121 2	**Generator Phase C Real Power** The real power delivered by phase C of the generator.	Generator AC Parameters
123 2	**Generator Phase A Apparent Power** The apparent power delivered by phase A of the generator.	Generator AC Parameters
125 2	**Generator Phase B Apparent Power** The apparent power delivered by phase B of the generator.	Generator AC Parameters
127 2	**Generator Phase C Apparent Power** The apparent power delivered by phase C of the generator.	Generator AC Parameters
129 2	**Generator Phase A Reactive Power** The reactive power delivered by phase A of the generator.	Generator AC Parameters
131 2	**Generator Phase B Reactive Power** The reactive power delivered by phase B of the generator.	Generator AC Parameters
133 2	**Generator Phase C Reactive Power** The reactive power delivered by phase C of the generator.	Generator AC Parameters
135 1	**Generator Phase A Power Factor** The power factor of phase A of the generator.	Generator AC Parameters
136 1	**Generator Phase B Power Factor** The power factor of phase B of the generator.	Generator AC Parameters
137 1	**Generator Phase C Power Factor** The power factor of phase C of the generator.	Generator AC Parameters
138 2	**Generator Total Apparent Power** The total apparent power delivered by the generator.	Generator AC Parameters
140 1	**Generator Total Percent kVA** The total apparent power delivered by the generator, as a percentage of generator rated apparent power.	Generator AC Parameters
141 2	**Generator Total Reactive Power** The total reactive power delivered by the generator.	Generator AC Parameters
143 1	**Generator Total Percent kVAr** The total reactive power delivered by the generator, as a percentage of generator rated reactive power.	Generator AC Parameters
144 2	**Generator Total kW Hours Export** The total kilowatt-hours that have been exported by the generator.	Generator AC Parameters
146 2	**Generator Total kVAr Hours Export** The total kilovar-hours that have been exported by the generator.	Generator AC Parameters
148 1	**Generator Average Line-Neutral AC RMS Voltage** The average Line to Neutral AC RMS voltage measured at the generator output.	Generator AC Parameters

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
149 1	**Generator Front Bearing Temperature from Data Link** Temperature of the bearing inside the alternator. Bearing 2 is the right or front bearing.	External Device Parameters
150 1	**Generator Rear Bearing Temperature from Data Link** Temperature of the bearing inside the alternator. Bearing 1 is the left or rear bearing.	External Device Parameters
151 1	**Generator Phase A Winding Temperature from Data Link** Temperature of the Phase A winding inside the alternator.	External Device Parameters
152 1	**Generator Phase B Winding Temperature from Data Link** Temperature of the Phase B winding inside the alternator.	External Device Parameters
153 1	**Generator Phase C Winding Temperature from Data Link** Temperature of the Phase C winding inside the alternator.	External Device Parameters
159 1	**Generator Phase A Power Factor Lagging** Lead/lag status for generator phase A power factor.	Generator AC Parameters
160 1	**Generator Phase B Power Factor Lagging** Lead/lag status for generator phase B power factor.	Generator AC Parameters
161 1	**Generator Phase C Power Factor Lagging** Lead/lag status for generator phase C power factor.	Generator AC Parameters
162 1	**Generator Rear Bearing Temperature from I/O Pin** Temperature of the bearing inside the alternator. Bearing 1 is the left or rear bearing.	Spare Analog Input
163 1	**Generator Average Line-Line AC RMS Voltage Percent** Average Line to Line RMS voltage at the generator, as a percentage of nominal generator voltage.	Generator AC Parameters
200 1	**Engine Oil Pressure** Gage pressure of oil in engine lubrication system as provided by oil pump.	Engine Monitoring
201 1	**Engine Coolant Temperature** Temperature of liquid found in engine cooling system.	Engine Monitoring
202 1	**Battery Voltage** Measured electrical potential of the battery at the control.	Miscellaneous
203 1	**Engine rpm** Actual engine speed, calculated over a minimum crankshaft angle of 720 degrees divided by the number of cylinders.	Engine Monitoring
204 2	**Engine Operating Hours** Accumulated time that the engine is running.	Timers and Counters
206 1	**Automatic Start/Stop State** Current state of the Automatic Start/Stop sequence.	Generator Set State Control
207 1	**Spare Analog Input Percentage** Percentage of full scale measured by auxiliary analog input.	Spare Analog Input
208 1	**Spare Analog Input Temperature** Temperature measured by auxiliary temperature sensor #1.	Spare Analog Input
209	**Spare Analog Input Pressure**	Spare Analog

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Pressure measured by auxiliary pressure sensor #1.	Input
210 1	**Service Maintenance Interval Hours Remaining** Maximum time in operation until the next service inspection is required; negative if the service inspection time has been passed.	Timers and Counters
212 1	**Service Maintenance Interval Days Remaining** Maximum calendar days until the next service inspection is required; negative if the service inspection time has been passed.	Timers and Counters
213 2	**Number of Crank Attempts** Accumulated number of crank attempts made by the engine.	Timers and Counters
215 2	**Number of Successful Starts** Accumulated number of successful starts of the engine.	Timers and Counters
217 1	**Engine Oil Pressure from Data Link** Gage pressure of oil in engine lubrication system as broadcast on the J939 Data Link.	External Device Parameters
219 1	**Engine Coolant Temperature from Data Link** Temperature of liquid found in engine cooling system, as broadcast on the J1939 Data Link.	External Device Parameters
221 1	**Cylinder #1 Exhaust Port Temperature from Data Link** Temperature at the cylinder #1 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
222 1	**Cylinder #2 Exhaust Port Temperature from Data Link** Temperature at the cylinder #2 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
223 1	**Cylinder #3 Exhaust Port Temperature from Data Link** Temperature at the cylinder #3 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
224 1	**Cylinder #4 Exhaust Port Temperature from Data Link** Temperature at the cylinder #4 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
225 1	**Cylinder #5 Exhaust Port Temperature from Data Link** Temperature at the cylinder #5 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
226 1	**Cylinder #6 Exhaust Port Temperature from Data Link** Temperature at the cylinder #6 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
227 1	**Cylinder #7 Exhaust Port Temperature from Data Link** Temperature at the cylinder #7 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
228 1	**Cylinder #8 Exhaust Port Temperature from Data Link** Temperature at the cylinder #8 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
229 1	**Cylinder #9 Exhaust Port Temperature from Data Link** Temperature at the cylinder #9 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
230 1	**Cylinder #10 Exhaust Port Temperature from Data Link** Temperature at the cylinder #10 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
231 1	**Cylinder #11 Exhaust Port Temperature from Data Link** Temperature at the cylinder #11 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
232 1	**Cylinder #12 Exhaust Port Temperature from Data Link** Temperature at the cylinder #12 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
233 1	**Cylinder #13 Exhaust Port Temperature from Data Link** Temperature at the cylinder #13 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
234 1	**Cylinder #14 Exhaust Port Temperature from Data Link** Temperature at the cylinder #14 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
235 1	**Cylinder #15 Exhaust Port Temperature from Data Link** Temperature at the cylinder #15 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
236 1	**Cylinder #16 Exhaust Port Temperature from Data Link** Temperature at the cylinder #16 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
237 1	**Cylinder #17 Exhaust Port Temperature from Data Link** Temperature at the cylinder #17 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
238 1	**Cylinder #18 Exhaust Port Temperature from Data Link** Temperature at the cylinder #18 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
239 1	**Cylinder #19 Exhaust Port Temperature from Data Link** Temperature at the cylinder #19 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
240 1	**Cylinder #20 Exhaust Port Temperature from Data Link** Temperature at the cylinder #20 exhaust port of the engine, as received from another module on the J1939 Data Link.	External Device Parameters
241 1	**Exhaust Manifold #1 Temperature from Data Link** Temperature of combustion byproducts within the left engine exhaust manifold, as received from another module on the J1939 Data Link.	External Device Parameters
242 1	**Exhaust Manifold #2 Temperature from Data Link** Temperature of combustion byproducts within the right engine exhaust manifold, as received from another module on the J1939 Data Link.	External Device Parameters
243 1	**Intake Manifold #1 Temperature from Data Link** Temperature of pre-combustion air found in intake manifold #1 of engine air supply system, as received from another module on the J1939 Data Link.	External Device Parameters
244	**Intake Manifold #2 Temperature from Data Link**	External Device

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Temperature of pre-combustion air found in intake manifold #2 of engine air supply system, as received from another module on the J1939 Data Link.	Parameters
245 1	**Engine Oil Temperature from Data Link** Temperature of the engine lubricant, as received from another module on the J1939 Data Link.	External Device Parameters
247 1	**Fuel Pressure from Data Link** Gage pressure of fuel in system as delivered from supply pump to the injection pump, as received from another module on the J1939 Data Link.	External Device Parameters
248 1	**Crankcase Pressure from Data Link** Gage pressure inside engine crankcase, as received from another module on the J1939 Data Link.	External Device Parameters
249 1	**Boost Pressure from Data Link** Gage pressure of air measured downstream on the compressor discharge side of the turbocharger, as received from another module on the J1939 Data Link.	External Device Parameters
251 1	**Oil Filter Differential Pressure from Data Link** Change in engine oil pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid material on or in the filter, as received from another module on the J1939 Data Link.	External Device Parameters
252 1	**Fuel Filter Differential Pressure from Data Link** Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filter element, as received from another module on the J1939 Data Link.	External Device Parameters
253 1	**Air Filter 1 Differential Pressure from Data Link** Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter, as received from another module on the J1939 Data Link.	External Device Parameters
254 2	**Total Fuel Consumption from Data Link** Accumulated amount of fuel used during engine operation, as received from another module on the J1939 Data Link..	External Device Parameters
256 1	**Instantaneous Fuel Consumption from Data Link** Amount of fuel used by engine per unit time, as received from another module on the J1939 Data Link.	External Device Parameters
257 1	**Atmospheric Pressure from Data Link** Absolute air pressure of the atmosphere, as received from another module on the J1939 Data Link.	External Device Parameters
258 1	**Fuel Level from Data Link** Ratio of volume of fuel to the total volume of fuel tank, as received from another module on the J1939 Data Link.	External Device Parameters
259	**Net Battery Current from Data Link**	External Device

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Net flow of electrical current into or out of the battery or batteries, as received from another module on the J1939 Data Link.	Parameters
299 1	**Service Maintenance Interval Weeks Remaining** The number of calendar weeks until the next service inspection is required. A negative value is transmitted if the service inspection time has been passed.	Timers and Counters
300 1	**Bypass Cooldown** Command to bypass remaining cooldown duration and immediately stop engine.	Generator Set State Control
301 1	**Engine Operating Mode** Indicates current desired mode of operation of the engine.	Generator Set State Control
302 1	**Engine Operating Mode Command** SCADA command to change of desired mode of operation of the engine.	Generator Set State Control
303 1	**Lamp Test Command** Commands the control to conduct a lamp/display test.	Miscellaneous
304 1	**Acknowledge All Events Command** SCADA command to acknowledge all events, same as pressing the Alarm Acknowledge key on the control.	Event System
310 1	**Key Press** Triggers a key press event on the control, which resets the level 0 timeout timer.	Miscellaneous
334 1	**System Event Count** Number of system events (present or active).	Event System
335 1	**System Event Lamp Status** Indicates the status of the amber and red event status lamps on the control.	Event System
600 1	**Digital Input #1 Active State** Digital Input #1 is active.	Discrete Inputs and Outputs
601 1	**Digital Input #2 Active State** Digital Input #2 is active.	Discrete Inputs and Outputs
602 1	**Digital Input #3 Active State** Digital Input #3 is active.	Discrete Inputs and Outputs
603 1	**Digital Input #4 Active State** Digital Input #4 is active.	Discrete Inputs and Outputs
604 1	**Digital Input #5 Active State** Digital Input #5 is active.	Discrete Inputs and Outputs
605 1	**Digital Input #6 Active State** Digital Input #6 is active.	Discrete Inputs and Outputs
606 1	**Digital Input #7 Active State** Digital Input #7 is active.	Discrete Inputs and Outputs
607 1	**Digital Input #8 Active State** Digital Input #8 is active.	Discrete Inputs and Outputs
616 1	**Relay Output #1 Active State** Relay Output #1 is active.	Discrete Inputs and Outputs

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
617 1	**Relay Output #2 Active State** Relay Output #2 is active.	Discrete Inputs and Outputs
618 1	**Relay Output #3 Active State** Relay Output #3 is active.	Discrete Inputs and Outputs
619 1	**Relay Output #4 Active State** Relay Output #4 is active.	Discrete Inputs and Outputs
620 1	**Relay Output #5 Active State** Relay Output #5 is active.	Discrete Inputs and Outputs
621 1	**Relay Output #6 Active State** Relay Output #6 is active.	Discrete Inputs and Outputs
622 1	**Relay Output #7 Active State** Relay Output #7 is active.	Discrete Inputs and Outputs
623 1	**Relay Output #8 Active State** Relay Output #8 is active.	Discrete Inputs and Outputs
624 1	**Digital Output #1 Active State** Digital Output #1 is active.	Discrete Inputs and Outputs
625 1	**Digital Output #2 Active State** Digital Output #2 is active.	Discrete Inputs and Outputs
628 1	**Digital Selector #1 Activate Command** SCADA command to activate Digital Selector #1.	Discrete Inputs and Outputs
629 1	**Digital Selector #2 Activate Command** SCADA command to activate Digital Selector #2.	Discrete Inputs and Outputs
630 1	**Digital Selector #3 Activate Command** SCADA command to activate Digital Selector #3.	Discrete Inputs and Outputs
631 1	**Digital Selector #4 Activate Command** SCADA command to activate Digital Selector #4.	Discrete Inputs and Outputs
632 1	**Digital Selector #5 Activate Command** SCADA command to activate Digital Selector #5.	Discrete Inputs and Outputs
633 1	**Digital Selector #6 Activate Command** SCADA command to activate Digital Selector #6.	Discrete Inputs and Outputs
634 1	**Digital Selector #7 Activate Command** SCADA command to activate Digital Selector #7.	Discrete Inputs and Outputs
635 1	**Digital Selector #8 Activate Command** SCADA command to activate Digital Selector #8.	Discrete Inputs and Outputs
636 1	**Digital Selector #9 Activate Command** SCADA command to activate Digital Selector #9.	Discrete Inputs and Outputs
637 1	**Digital Selector #10 Activate Command** SCADA command to activate Digital Selector #10.	Discrete Inputs and Outputs
638 1	**Digital Selector #1 Commanded Value** Value of current Activate Command being applied to Digital Selector #1.	Discrete Inputs and Outputs
639 1	**Digital Selector #2 Commanded Value** Value of current Activate Command being applied to Digital Selector #2.	Discrete Inputs and Outputs
640	**Digital Selector #3 Commanded Value**	Discrete Inputs

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Value of current Activate Command being applied to Digital Selector #3.	and Outputs
641 1	**Digital Selector #4 Commanded Value** Value of current Activate Command being applied to Digital Selector #4.	Discrete Inputs and Outputs
642 1	**Digital Selector #5 Commanded Value** Value of current Activate Command being applied to Digital Selector #5.	Discrete Inputs and Outputs
643 1	**Digital Selector #6 Commanded Value** Value of current Activate Command being applied to Digital Selector #6.	Discrete Inputs and Outputs
644 1	**Digital Selector #7 Commanded Value** Value of current Activate Command being applied to Digital Selector #7.	Discrete Inputs and Outputs
645 1	**Digital Selector #8 Commanded Value** Value of current Activate Command being applied to Digital Selector #8.	Discrete Inputs and Outputs
646 1	**Digital Selector #9 Commanded Value** Value of current Activate Command being applied to Digital Selector #9.	Discrete Inputs and Outputs
647 1	**Digital Selector #10 Commanded Value** Value of current Activate Command being applied to Digital Selector #10.	Discrete Inputs and Outputs
700 8	**Write Access Password** Modbus register to which the desired security level password is written.	Data Link Security
708 8	**Level 1 Password** Modbus register to which a new Level 1 password is written.	Data Link Security
716 8	**Level 2 Password** Modbus register to which a new Level 2 password is written.	Data Link Security
724 8	**SCADA Password** Modbus register to which a new SCADA password is written.	Data Link Security
732 1	**Current Security Level** Current security level of the SCADA Data Link.	Data Link Security
733 1	**Write Current Security Level** Modbus register to which a lower security level (lower than current security level) is written.	Data Link Security
734 8	**Level 3 Password Phone In Prompt** Numerical key that needs communicated to the factory support operator who can provide a Level 3 password.	Data Link Security
800 1	**Engine Oil Temperature from I/O Pin** Temperature of the engine lubricant, as measured by the auxiliary analog input to the control.	Spare Analog Input
801 1	**Exhaust Temperature from I/O Pin** Temperature of combustion byproducts leaving the engine, as measured by the auxiliary analog input to the control.	Spare Analog Input

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
802 1	**Left Manifold Exhaust Temperature from I/O Pin** Temperature of combustion byproducts within the left engine exhaust manifold, as measured by the auxiliary analog input to the control.	Spare Analog Input
803 1	**Right Manifold Exhaust Temperature from I/O Pin** Temperature of combustion byproducts within the right engine exhaust manifold, as measured by the auxiliary analog input to the control.	Spare Analog Input
804 1	**Fuel Level from I/O Pin** Ratio of volume of fuel to the total volume of fuel storage container, as measured by the auxiliary analog input to the control.	Spare Analog Input
805 1	**External Tank Fuel Level from I/O Pin** Ratio of volume of fuel to the total volume of fuel storage container, as measured by the auxiliary analog input to the control.	Spare Analog Input
806 1	**Engine Oil Level from I/O Pin** Ratio of current volume of engine sump oil to maximum required volume, as measured by the auxiliary analog input to the control.	Spare Analog Input
807 1	**Engine Coolant Level from I/O Pin** Ratio of volume of liquid found in engine cooling system to total cooling system volume, as measured by the auxiliary analog input to the control.	Spare Analog Input
808 1	**Fire Extinguisher Pressure from I/O Pin** Pressure of fire extinguisher contents, as measured by the auxiliary analog input to the control.	Spare Analog Input
809 1	**Oil Filter Differential Pressure from I/O Pin** Change in engine oil pressure, measured across the filter, due to the filter and any accumulation of solid or semisolid material on or in the filter, as measured by the auxiliary analog input to the control.	Spare Analog Input
810 1	**Air Filter 1 Differential Pressure from I/O Pin** Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter, as measured by the auxiliary analog input to the control.	Spare Analog Input
811 1	**Fuel Filter Differential Pressure from I/O Pin** Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filter element, as measured by the auxiliary analog input to the control.	Spare Analog Input
813	**Starting Air Pressure from I/O Pin**	Spare Analog

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Gage pressure of air in an engine starting system that utilizes compressed air to provide the force required to rotate the crankshaft, as measured by the auxiliary analog input to the control.	Input
814 1	**Ambient Air Temperature from I/O Pin** Temperature of the air surrounding the genset, as measured by the auxiliary analog input to the control.	Spare Analog Input
900 3	**Real Time Clock** Clock containing year, month, day, hour, minute, and second information.	Timers and Counters
903 3	**Update Real Time Clock Command** SCADA command to change the real time clock information.	Timers and Counters
1002 3	**Setpoint ID for Read** Specifies the ID for the setpoint to be read by the Setpoint Information modbus register or the Setpoint Data Value modbus register.	EMCP 3 Setpoints
1005 12	**Setpoint Information** Reads the setpoint information structure associated with the setpoint specified by the Setpoint ID for Read modbus register.	EMCP 3 Setpoints
1017 5	**Setpoint Write** Writes a specific Setpoint ID and value to change a setpoint.	EMCP 3 Setpoints
1022 2	**Setpoint Data Value** Reads the value of the setpoint specified by the Setpoint ID for Read modbus register.	EMCP 3 Setpoints
1028 1	**Reset Crank Attempt Counter** Resets the accumulated number of crank attempts made by the engine.	Timers and Counters
1029 1	**Reset Successful Start Counter** Resets the accumulated number of successful starts of the engine.	Timers and Counters
1030 1	**Reset kW Hour Meter** Resets the total kilowatt-hours that have been exported by the generator.	Timers and Counters
1031 1	**Reset kVAr Hour Meter** Resets the total kilovar-hours that have been exported by the generator.	Timers and Counters
1032 1	**Reset Service Interval Counter** Resets the countdown until the next service inspection is required. This is usually performed at the end of a service call.	Timers and Counters
1033 1	**Log Entry Index** Selects the index of the genset control event log to be read from Log Entry modbus register.	Event System
1034	**Log Entry**	Event System

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
14	Reads the entry of the Genset Control Log as specified by the Log Entry Index modbus register.	
1048 2	**Reset Event** SCADA command to reset a single genset control generated event.	Event System
1053 1	**Engine Status** Current operating state of the engine.	Generator Set State Control
1054 1	**Cooldown Duration Remaining** Time remaining in cooldown until engine is stopped.	Generator Set State Control
1055 1	**Remote Initiate Command** When the control is in Auto mode, this commands the engine to Run when active and Stop when inactive.	Generator Set State Control
1056 1	**Emergency Stop Command** Will cause the engine to immediately stop without cooling down.	Generator Set State Control
1057 1	**Desired Genset Output Voltage** The desired RMS voltage to be delivered by the genset.	Generator Set State Control
1058 1	**AVR Bias Percent** Read the percentage bias being applied to the Automatic Voltage Regulator, as a percentage of the Maximum Generator Voltage Output Bias.	Generator Set State Control
1059 1	**AVR Bias Percent Command** Increments the percentage bias to be applied to the Automatic Voltage Regulator, as a percentage of the Maximum Generator Voltage Output Bias.	Generator Set State Control
1060 1	**Requested Engine Speed** Engine speed currently being requested by the control.	Generator Set State Control
1061 1	**Speed Bias Percent** Read the percentage bias being applied to the governor, as a percentage of the Maximum Engine Speed Bias.	Generator Set State Control
1062 1	**Speed Bias Percent Command** Increments the percentage bias to be applied to the governor, as a percentage of the Maximum Engine Speed Bias.	Generator Set State Control
1067 1	**Generator Frequency within Limits** Indicates whether the generator frequency is below the threshold for a generator over frequency shutdown and above the threshold for a generator under frequency shutdown.	Generator Set State Control
1068 1	**Generator Voltage within Limits** Indicates whether the generator voltage is below the threshold for a generator over voltage shutdown and above the threshold for a generator under voltage shutdown.	Generator Set State Control
1090 1	**Genset Control Online** Indicates whether the EMCP 3 is on the communication network. This will always be True.	External Device Parameters
1091	**Engine Control Online**	External Device

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1	Indicates whether the engine ECM is in communication with the EMCP 3 via J1939.	Parameters
1092 1	**Secondary Engine Control Online** Indicates whether the secondary engine ECM is in communication with the EMCP 3 via J1939.	External Device Parameters
1093 1	**External I/O #1 Online** Indicates whether the DIO module instance #1 is in communication with the EMCP 3 via J1939.	External Device Parameters
1094 1	**External I/O #2 Online** Indicates whether the DIO module instance #2 is in communication with the EMCP 3 via J1939.	External Device Parameters
1097 1	**Digital AVR Online** Indicates whether the digital AVR module is in communication with the EMCP 3 via J1939.	External Device Parameters
1098 1	**RTD Module Online** Indicates whether the RTD module is in communication with the EMCP 3 via J1939.	External Device Parameters
1099 1	**Thermocouple #1 Online** Indicates whether the thermocouple module instance #1 is in communication with the EMCP 3 via J1939.	External Device Parameters
1100 1	**Thermocouple #2 Online** Indicates whether the thermocouple module instance #2 is in communication with the EMCP 3 via J1939.	External Device Parameters
1275 1	**Engine Protection has Shut Down Engine** Indicates that the engine protection system has shut down the engine, as opposed to the engine shutting down based on an external command.	Generator Set State Control
1276 6	**Control Serial Number** Reads the serial number of the control. This is the number that is label printed on the back cover of the control.	Miscellaneous
1498 1	**Event Log Module Selection** Write to this register to select a module for which the event log is to be available in the Module Event Log Entry # Modbus registers.	Event System
1499 1	**Event Log Module Selection** This register indicates the module for which the event log is available in the Module Event Log Entry # modbus registers.	Event System
1500 14	**Module Event Log Entry 1** This is log entry #1 for the module selected in the Event Log Module Selection modbus register.	Event System
1514 14	**Module Event Log Entry 2** This is log entry #2 for the module selected in the Event Log Module Selection modbus register.	Event System
1528	**Module Event Log Entry 3**	Event System

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
14	This is log entry #3 for the module selected in the Event Log Module Selection modbus register.	
1542 14	**Module Event Log Entry 4** This is log entry #4 for the module selected in the Event Log Module Selection modbus register.	Event System
1556 14	**Module Event Log Entry 5** This is log entry #5 for the module selected in the Event Log Module Selection modbus register.	Event System
1570 14	**Module Event Log Entry 6** This is log entry #6 for the module selected in the Event Log Module Selection modbus register.	Event System
1584 14	**Module Event Log Entry 7** This is log entry #7 for the module selected in the Event Log Module Selection modbus register.	Event System
1598 14	**Module Event Log Entry 8** This is log entry #8 for the module selected in the Event Log Module Selection modbus register.	Event System
1612 14	**Module Event Log Entry 9** This is log entry #9 for the module selected in the Event Log Module Selection modbus register.	Event System
1626 14	**Module Event Log Entry 10** This is log entry #10 for the module selected in the Event Log Module Selection modbus register.	Event System
1640 14	**Module Event Log Entry 11** This is log entry #11 for the module selected in the Event Log Module Selection modbus register.	Event System
1654 14	**Module Event Log Entry 12** This is log entry #12 for the module selected in the Event Log Module Selection modbus register.	Event System
1668 14	**Module Event Log Entry 13** This is log entry #13 for the module selected in the Event Log Module Selection modbus register.	Event System
1682 14	**Module Event Log Entry 14** This is log entry #14 for the module selected in the Event Log Module Selection modbus register.	Event System
1696 14	**Module Event Log Entry 15** This is log entry #15 for the module selected in the Event Log Module Selection modbus register.	Event System
1710 14	**Module Event Log Entry 16** This is log entry #16 for the module selected in the Event Log Module Selection modbus register.	Event System
1724 14	**Module Event Log Entry 17** This is log entry #17 for the module selected in the Event Log Module Selection modbus register.	Event System

QUICK REFERENCE CHART OF MODBUS REGISTERS		
ADDRESS / LENGTH	**PARAMETER NAME / DESCRIPTION**	**SECTION**
1738 14	**Module Event Log Entry 18** This is log entry #18 for the module selected in the Event Log Module Selection modbus register.	Event System
1752 14	**Module Event Log Entry 19** This is log entry #19 for the module selected in the Event Log Module Selection modbus register.	Event System
1766 14	**Module Event Log Entry 20** This is log entry #20 for the module selected in the Event Log Module Selection modbus register.	Event System

Appendix G Glossary of Terms

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 3, 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).

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 3 can function as an RTU on a SCADA system.

CRC – Cyclic Redundancy Check. This is an algorithm used to catch transmission errors. The CRC is generated and transmitted at the source, then re-generated and compared at the target. The EMCP 3 performs a 16-bit CRC check, which is often called a CRC16 algorithm.

FID – Fault Identifier. This is a term for a range of data that represents an application-level fault. For example, this may communicate that the requested operation is not currently applicable, or that a value requested is out of range.

FMI – Failure Mode Indicator. The J1939 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.

J1939 – A communication protocol with widespread use in the transportation and power generation industry. The EMCP 3.1 supports a J1939 data link, termed the Primary Data Link. The EMCP 3.2 and 3.3 support the Primary Data Link, and a second J1939 data link, termed the Accessory Data Link.

NULL character – The name for the ASCII character represented by $00 (1 byte of binary zeroes). This character is commonly used to mark the termination of an ASCII string.

SPN – Suspect Parameter Number. The J1939 term for any parameter whose data is transmitted over a J1939 network, such as the EMCP 3 primary or accessory data link. For a complete list of SPNs supported by the EMCP 3, refer to the Diagnostic Trouble Code List in the Systems Operation Troubleshooting Testing and Adjusting guide.

RMS – a mathematical approach of representing a useful “average” for varying quantities; this is useful to indicate AC quantities.

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