CATERPILLAR®

RENR1200-01
October 1999

Systems Operation Testing and Adjusting

Electronic Modular Control Panel II+ (EMCP II+) for EUI Engines

4GM1-Up (Engine)
5XM1-Up (Engine)
6PM1-Up (Engine)
7KM1-Up (Engine)
8RM1-Up (Engine)
6HN1-Up (Engine)
6PN1-Up (Engine)
6WN1-Up (Engine)
7RN1-Up (Engine)
3LS1-Up (Engine)
3MS1-Up (Engine)
3NS1-Up (Engine)
1NW1-Up (Engine)
2HW1-Up (Engine)
4AW1-Up (Engine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

⚠ WARNING

When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

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Systems Operation Section

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General Information

SMCS Code: 4490; 7451

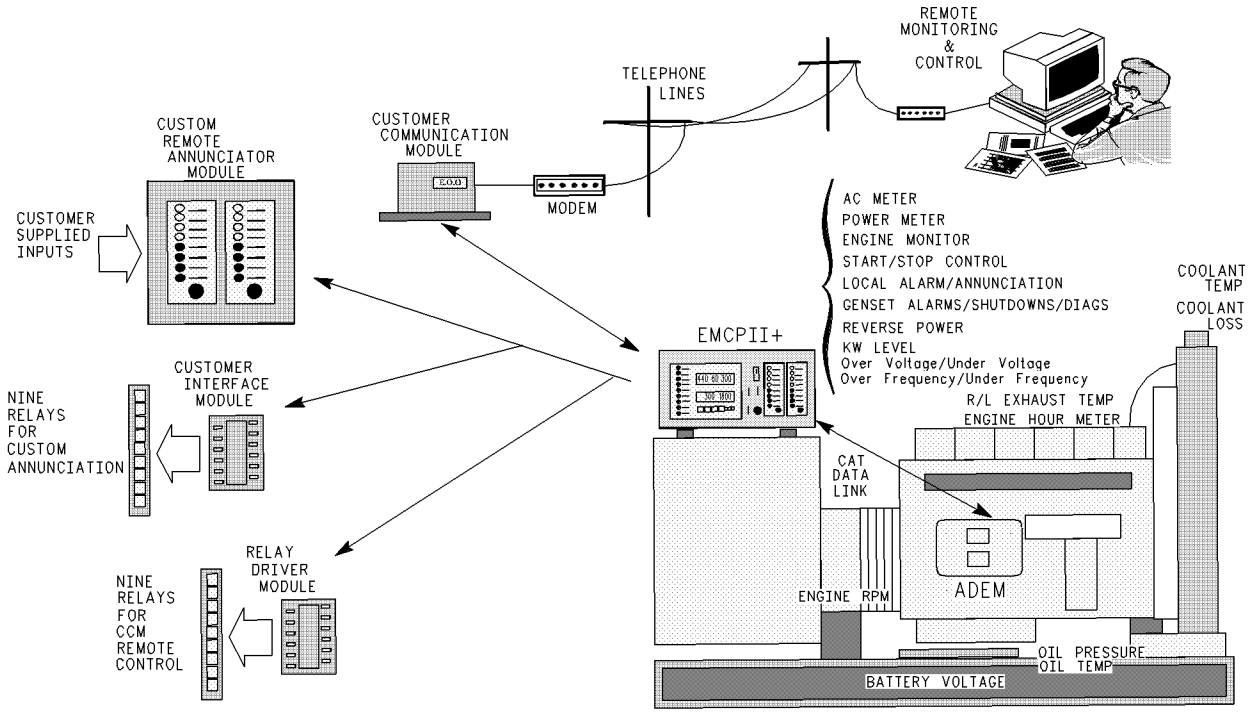

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Illustration 1

Block Diagram of a Generator Set With EMCPII+

Table 1

Service Literature for EMCP II+
Systems Operation/Testing And Adjusting, SENR6565, “EPG Load Sensor and Load Sharing Module”
Systems Operation/Testing And Adjusting, SENR3473, “VR3 Voltage Regulator for 10/12 Lead Self-Excited SR4 Generators”
Systems Operation/Testing And Adjusting, SENR3905, “VR3 Voltage Regulator for Permanent Magnet Excited SR4 Generators”
Systems Operation/Testing And Adjusting, SENR5205, “VR3F Flat Top Voltage Regulator for 4/6 and 10/12 Lead Self-Excited SR4 Generators”
Systems Operation/Testing And Adjusting, SENR5829, “VR3F Flat Top Voltage Regulator for Permanent Magnet Excited SR4 Generators”
Systems Operation/Testing And Adjusting, SENR5833, “Digital Voltage Regulator”
Operation and Maintenance Manual, SEBU6874, “Customer Communication Module for EMCPII”
Operation and Maintenance Manual, SEBU6918, “SR4B Generators and Control Panels”

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Component Location

SMCS Code: 4490; 7451

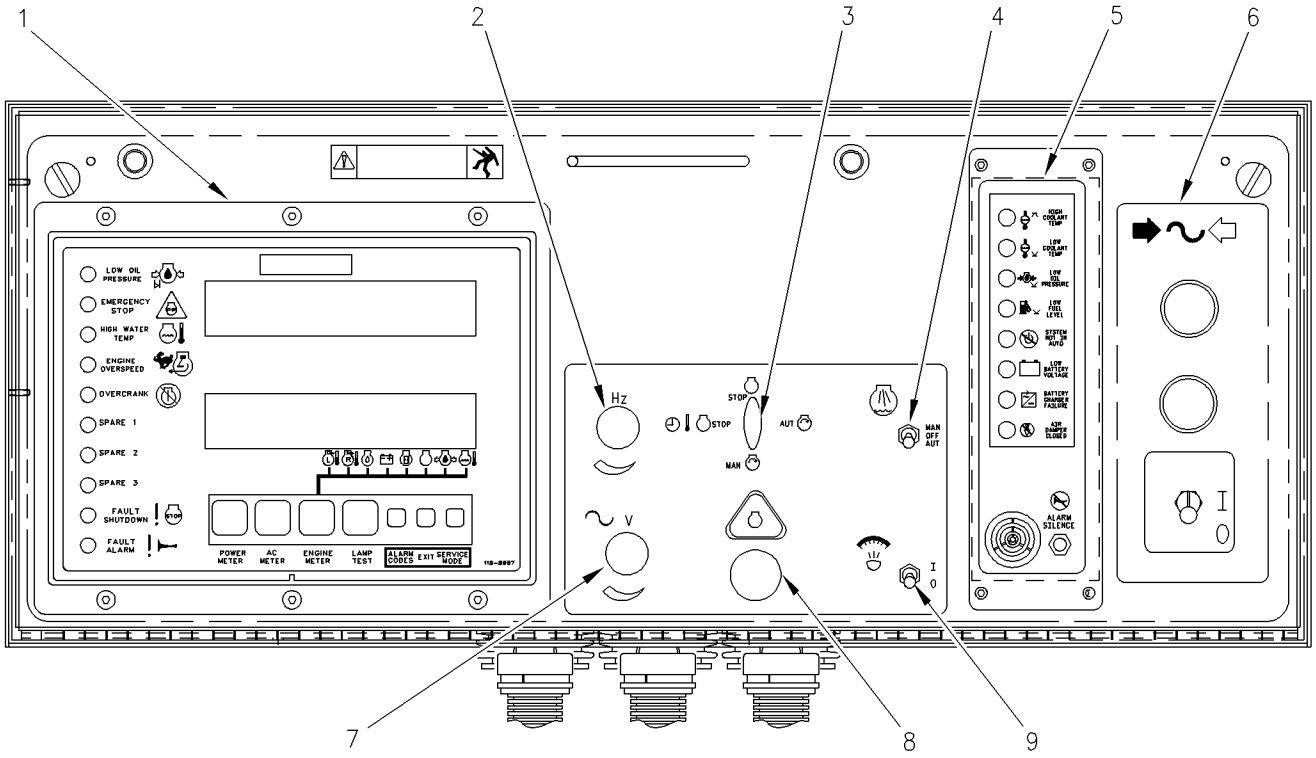

Illustration 2 g00633960

(1) Generator Set Control (GSC+)
(2) Speed Potentiometer (SP)
(3) Engine Control Switch (ECS)
(4) Starting Aid Switch (SAS)
(5) Alarm Module (ALM) - Optional
(6) Synchronizing Light Module - Optional
(7) Voltage Adjust Rheostat (VAR)
(8) Emergency Stop Push Button (ESPB)
(9) Panel Light Switch (PLS)

Most of the EMCP II+ components are located on the instrument panel. Other EMCP II+ components that exist near the engine are as follows:

- Engine Oil Pressure Sensor (EOPS)
- Engine Coolant Temperature Sensor (ECTS)
- Fuel Solenoid (FS)
- Magnet Speed Pickup (MPU)
- Engine Coolant Loss Sensor (ECLS) - Optional

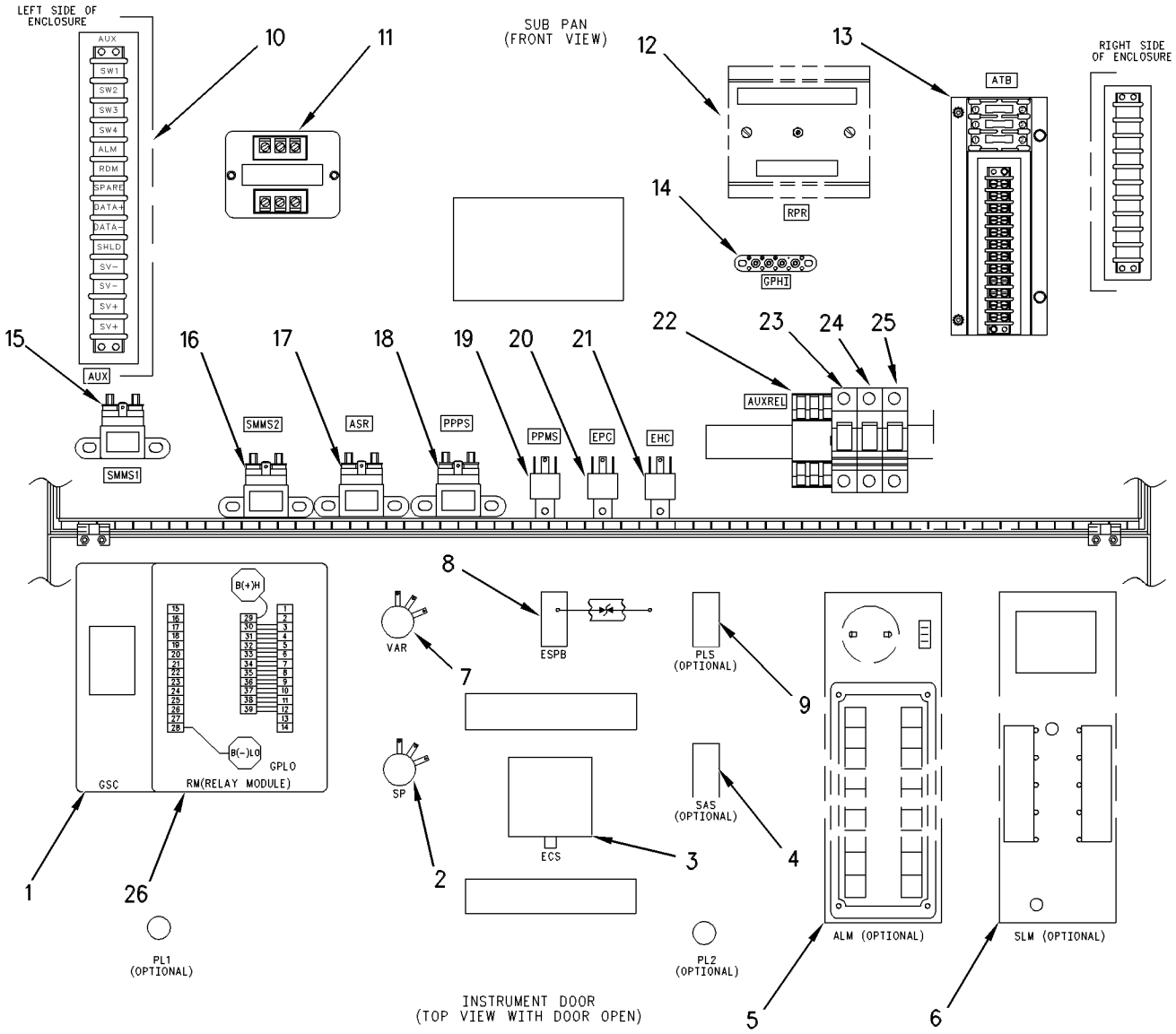

Illustration 3 g00474193

(1) Generator Set Control+ (GSC+)
(2) Speed Potentiometer (SP) - Optional
(3) Engine Control Switch (ECS)
(4) Start Aid Switch (SAS) - Optional
(5) Alarm Module (ALM) - Optional
(6) Synchronizing Lights Module (SLM) - Optional
(7) Voltage Adjust Rheostat (VAR)
(8) Emergency Stop Push Button (ESPB)
(9) Panel Light Switch (PLS) - Optional
(10) Auxiliary Terminal Strip (AUX)
(11) Analog to Pulse Width Modulated Convertor (PWM)
(12) Reverse Power Relay (RPR) - Optional
(13) AC Transformer Box (ATB)
(14) Ground Post High Voltage (GPHI)
(15) Starting Motor Magnetic Switch 1 (SMMS1)
(16) Starting Motor Magnetic Switch 2 (SMMS2)
(17) Air Shut Off Relay (ASR) - Optional
(18) Prelube Pump Relay Slave (PPPS) - Optional
(19) Prelube Pump Relay Master (PPPM) - Optional
(20) Ether Pull In Coil (EPC) - Optional
(21) Ether Hold In Coil (EMC) - Optional
(22) Auxiliary Relay (AUXREL) - Optional
(23) Starting Motor Circuit Breaker
(24) Air Shut Off Circuit Breaker
(25) Prelube Pump Circuit Breaker - Optional
(26) Relay Module (RM) - (Part of GSC+)

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EMCP Electronic Control (Generator Set)

SMCS Code: 4490; 7451

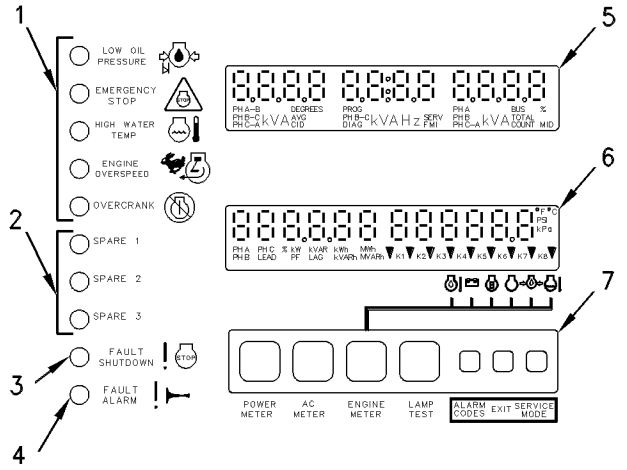

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Illustration 4

Display Area Of Generator Set Control + (GSC+)

(1) Dedicated shutdown indicators
(2) Spare fault indicators
(3) Fault shutdown indicator
(4) Fault alarm indicator
(5) Upper display
(6) Lower display
(7) Keypad

The main component of the EMCP II+ is the generator set control + (GSC+). The GSC+ is designed to operate when the GSC+ is powered by 24 DCV. The GSC+ will also power up when the GSC+ is powered by 32 DCV. The GSC+ monitors many of the functions of the generator set. The GSC+ controls many of the functions of the generator set. The functions and features of the GSC+ are listed below.

- The GSC+ provides the generator AC output information. The information includes the metering of power. The GSC+ controls starting and stopping of the engine.
- The GSC+ shows engine conditions and generator output information on two displays.
- The displays show the fault codes. The displays also show the information for programming that is used by the GSC+.
- The GSC+ monitors the system for faults. If a fault occurs, the GSC+ performs a controlled fault shutdown. The GSC+ begins to provide annunciation of the fault alarm. The GSC+ uses indicators and displays in order to describe the fault to the operator or the service technician.
- The GSC+ contains programmable features for certain applications. The programmable features are also used by the GSC+ in order to meet the requirements of the customers.

Note: Setting P023 to 0 ensures proper operation on MUI engines. Failure to set setpoint P023 can result in improper engine operation, incorrect display of engine parameters, and logging an erroneous CID 590 fault. For more information on the P023 setpoint and other GSC+ setpoints, see Systems Operation, “Engine-Generator Programming OP5-0”.

GSC+ Part Number

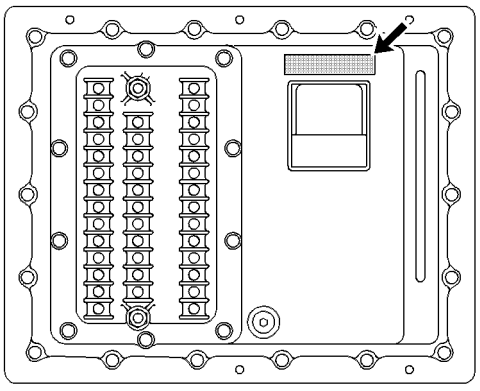

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Illustration 5

Location Of GSC+ Part Number

Rear View Of GSC+

The part number is stamped into the rear housing of every GSC+ above the harness connector. When the GSC+ is updated internally, the part number also changes. The part number can be used to identify the effectivity of any changes.

GSC+ Serial Number

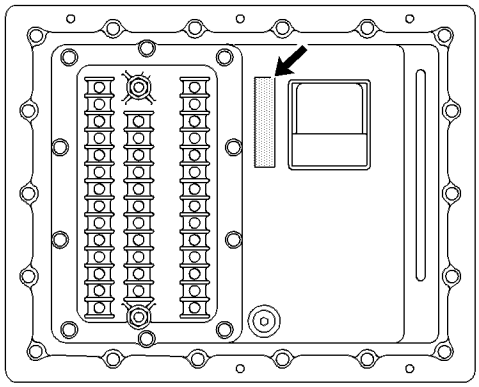

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Illustration 6

Location Of GSC+ Serial Number

Rear View Of GSC+

The serial number of the GSC+ is a ten digit number which is unique for each GSC+. The preceding illustration shows the location of the serial number on the back of the GSC+. The serial number is also shown to service personnel when the GSC+ is in option OP2-2. The serial number which is shown on the display and the actual serial number will always match. See Systems Operation, “AC Factory Calibration Setpoint Viewing OP2-2”.

Fault Indicators

The ten fault indicators are used in order to show a fault that is present. The ten fault indicators are also used to describe a fault that is present. The fault indicators are divided into four groups. The four groups are the fault alarm indicator (4), the spare fault indicators (2), the fault shutdown indicator (3) and the dedicated shutdown indicators (1).

The yellow fault alarm indicator (4) FLASHES when the GSC+ detects a fault that is an alarm fault. The alarm fault does not cause the engine status to change. The engine is able to start. The engine will continue operating, only if the engine is running at the time of the alarm fault. Fault alarm indicator (4) is accompanied by an alarm fault code that is shown on upper display (5) when the alarm codes key is pressed.

The red fault shutdown indicator (3) FLASHES when the GSC+ detects a fault that is a shutdown fault. The engine is shutdown if the engine is running and the engine is not allowed to start. Fault shutdown indicator (3) is accompanied by a fault code that is immediately shown on the upper display (5).

The yellow spare fault indicators (2) FLASH when the conditions that are associated with that spare fault are active. The three spare faults can be programmed to show coolant loss, oil temperature, spare fault condition or no assignment. The spare fault condition may be a customer generated switch input. See Systems Operation, “SP Fault Codes” for more information. The yellow fault alarm indicator (4) or the red fault shutdown indicator (3) will accompany the spare fault indicators (2). The spare fault indicators will tell whether the spare fault input is programmed to be an alarm condition or a shutdown condition.

The red dedicated shutdown indicators (1) represent the following shutdown faults: low oil pressure, emergency stop, high water temperature, engine overspeed and engine overcrank. When the GSC+ detects a fault in one of these areas, the dedicated shutdown indicator (that corresponds to the fault) FLASHES. The engine is shutdown if the engine is running, and the engine is not allowed to start. No fault codes are associated with the dedicated shutdown indicators because each indicator has a descriptive label.

Many of the dedicated shutdown faults depend on certain setpoints in the GSC+. See Systems Operation, “Setpoint Programming OP5” for more information. To restart the engine after a shutdown, see Systems Operation, “Shutdown Mode”.

The conditions that are required to activate the dedicated fault shutdowns are in the following list. The results of each dedicated fault are in the following list.

Low Oil Pressure – The engine oil pressure drops below the setpoints for low oil pressure shutdown that are programmed into the GSC+. There are two low oil pressure setpoints. One setpoint is used when the engine is at idle speed. The other setpoint is used when the engine is at rated speed. When a low oil pressure fault occurs, the low oil pressure indicator FLASHES, and the engine is shut down. The engine is not allowed to start until the fault is corrected.

Emergency Stop – The operator presses the emergency stop push button (ESPB) on the front panel. When an emergency stop condition occurs, the emergency stop indicator FLASHES and the engine is shut down. The engine is not allowed to start until the condition is corrected.

High Water Temperature – The engine coolant temperature rises above the setpoint for high water temperature shutdown that is programmed into the GSC+. When the high water temperature fault occurs, the high water temperature indicator FLASHES. The engine is shutdown and the engine is not allowed to start until the fault is corrected.

Engine Overspeed – The engine speed exceeds the setpoint for engine overspeed that is programmed into the GSC+. When the engine overspeed fault occurs, the engine overspeed indicator FLASHES. The engine is shutdown and the engine is not allowed to start until the fault is corrected.

Overcrank – The engine does not start within the setpoint for total cycle crank time that is programmed into the GSC+. When the overcrank fault occurs, the overcrank indicator FLASHES. The engine is not allowed to start until the fault is corrected.

Note: The GSC+ can be programmed to override the shutdown for low oil pressure and high water temperature faults. When the operator overrides the shutdown faults, the GSC+ responds to the faults as though the faults are alarm faults. The corresponding dedicated shutdown indicator is ON CONTINUOUSLY. The corresponding dedicated shutdown indicator will not be flashing. The engine continues to run and the engine continues to start instead of shutting down. When the dedicated shutdown indicator is ON CONTINUOUSLY, the setpoint for shutdown has been exceeded, but the GSC+ is programmed to override the shutdown fault. The GSC+ does not treat the shutdown fault as a shutdown fault. The GSC+ treats the shutdown fault as an alarm fault. At the factory, the GSC+ is programmed to treat a low oil pressure fault and a high water temperature fault as shutdown faults. The operator or the service technician must decide to override these shutdown faults. The operator or the service technician must program the GSC+ to treat the shutdown faults as alarm faults.

Upper Display

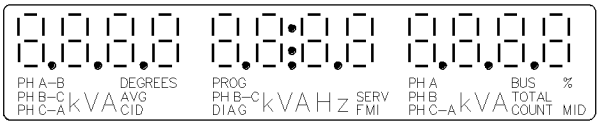

Illustration 7 g00521435

Upper Display (5) With All Segments

The primary function of the upper display (5) is showing the following information of the generator output: AC voltage, current, and frequency. Several options are available on the upper display for AC metering. These options can be viewed one at a time by pressing the AC Meter key on the keypad. The options are listed below.

- Voltage (average), generator's frequency, and current (total)
- Voltage (average), generator's frequency, and current (line) for any one phase
- Voltage (line to line) for all three phases
- Current (line) for all three phases

Note: When total current increases above "9999A", the GSC+ will show current in "kA" units.

- Voltage (neutral line) for all three phases

Note: Neutral line voltages are not shown when setpoint "P032" is set to 1 (delta generator sets).

Upper display (5) is also used to show the various fault codes for system faults. For more information on fault codes, see Systems Operation, "Fault Description".

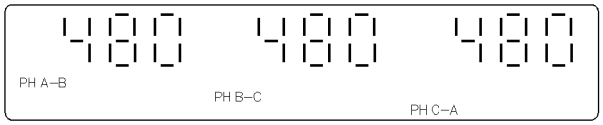

Illustration 8 g00394497

Upper Display Is Showing:

480 volts, line to line voltage, (A-B)

480 volts, line to line voltage (B-C)

480 volts, line to line voltage (C-A)

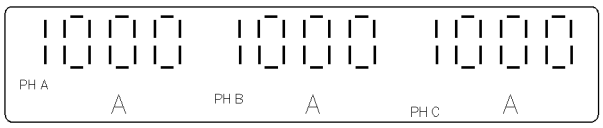

Illustration 9 g00394503

Upper Display Is Showing:

1000 Amps, line current of phase A

1000 Amps, line current of phase B

1000 Amps, line current of phase C

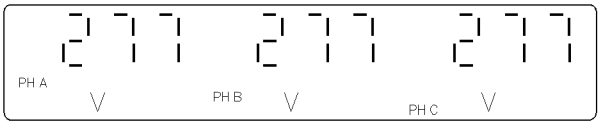

Illustration 10 g00394505

Upper Display Is Showing:

277 Volts, line to neutral voltage of phase A

277 Volts, line to neutral voltage of phase B

277 Volts, line to neutral voltage of phase C

Note: Line to neutral voltages are not shown when the setpoint P032 is set to 1 for delta generator sets.

Lower Display

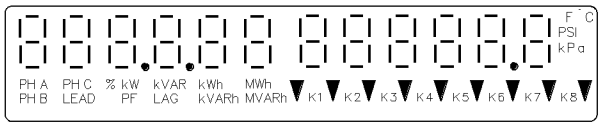

Illustration 11 g00394557

Lower Display (6) With All Segments

The lower display (6) shows values for power metering, engine parameters and the relay status. The left side of the lower display serves as a power meter for the generator set. The following functions will scroll automatically.

- Total real power (kW)
- Total reactive power (KVAR)
- Percentage of rated power (%kW)
- Power factor (average)
- Total energy output (kW/h)

The display will stop scrolling when the operator presses the power meter key for less than five seconds. The display will show a particular parameter continuously. Additional power meter functions will scroll, if the power meter key is held for more than five seconds and then released. The additional functions are shown below.

- Total real power (kW)
- Real power phase A (kW)
- Real power phase B (kW)
- Real power phase C (kW)
- Total apparent power (kVA)
- Total reactive power (KVAR)
- Percentage of rated power (%kW)
- Power factor (average)
- Power factor phase A
- Power factor phase B
- Power factor phase C
- Total energy output (kW/h)
- Total reactive energy output (kvar)

Note: All real power values are signed with a “+” or a “–”. A negative value indicates reverse power.

Note: When the setpoint P032 is set to 1 for delta generator sets, the real power phases are not shown.

Note: When the setpoint P032 is set to 1 for delta generator sets, the power factor phases are not shown.

Illustration 12 g00394559

Lower Display Showing:

691 kW, total real power of generator output

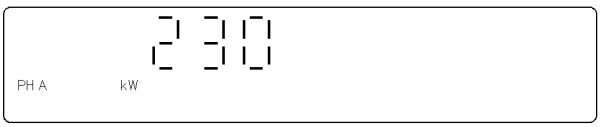

Illustration 13 g00394561

Lower Display Showing:

230 kW, real power of phase A

Note: Phase B and phase C can be viewed in a similar manner.

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Illustration 14

Lower Display Showing:

831 kVA, total apparent power.

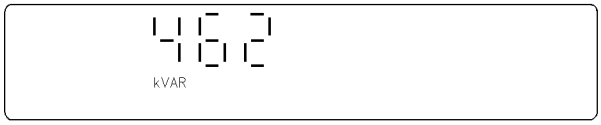

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Illustration 15

Lower Display Showing:

462 KVAR, total reactive power of generator output.

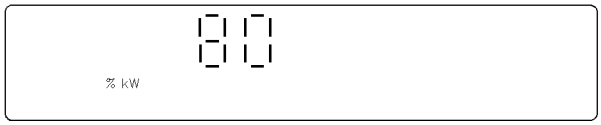

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Illustration 16

Lower Display Showing:

80 %kW, percentage of rated power of generator output

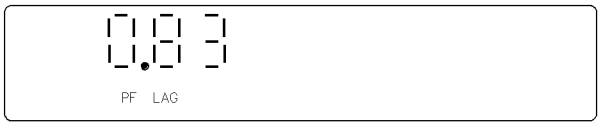

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Illustration 17

Lower Display Showing:

.83 PF, average power factor of generator output

Lead – Indicates that the current is leading voltage.

Lag – Indicates that the current is lagging voltage.

Note: You may view the power factor for the individual phases in a similar manner.

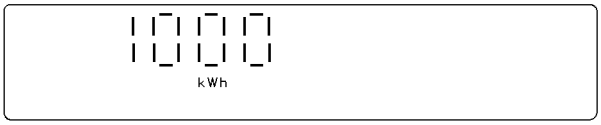

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Illustration 18

Lower Display Showing:

1000 kW/h, total energy of generator output

Note: Total energy output that is greater than 999,999 kW/h will be shown as MW/h in two steps in order to maintain a resolution of 1 kW/h. The first step will show MW/h as a whole number up to six places. The second step will show MW/h as a decimal to three places. For example: 1,000,001 kW/h will be shown as 1000 MW/h (first step), followed by .001 MW/h (second step).

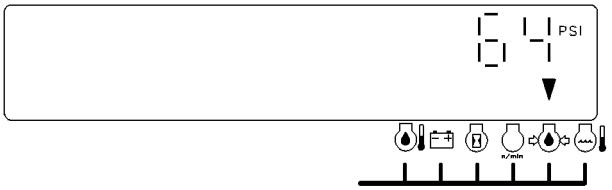

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Illustration 19

Lower Display Showing:

64 psi engine oil pressure.

The right side of lower display (6) shows the value of certain engine parameters. The parameters are listed below.

- engine oil temperature (optional)
- system battery voltage
- engine hours
- engine speed
- engine oil pressure
- engine coolant temperature

The value for one of these conditions is shown on the display for two seconds. The display then scrolls to the value for the next condition. A small pointer identifies the engine condition that corresponds to the value that is showing. When the engine meter key is pressed, the lower display (6) stops scrolling. The lower display continuously shows one particular value. The pointer flashes above the value that is showing on the display.

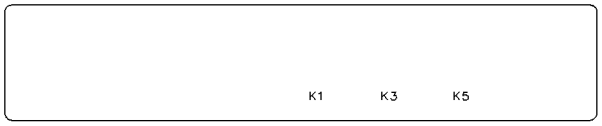

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Illustration 20

Lower Display Showing:

K1, K3 and K5 are active.

K2, K4, K6, K7 and K8 are not active.

The relay status indicators are on the bottom of the lower display. When a GSC+ relay is activated, the corresponding indicator (K1, K2, etc) is shown on lower display (6). When a relay is not activated, the corresponding indicator (K1, K2, etc) is not shown.

Keypad

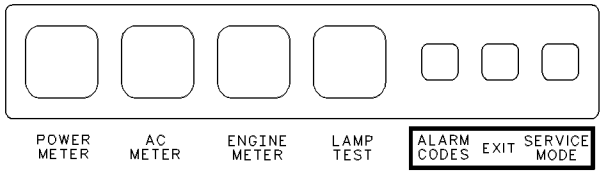

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Illustration 21

Keypad (7)

Keypad (7) is used to control the information that is shown on upper display (5) and lower display (6). The seven keys have two sets of functions, normal functions and service functions. See the topic Systems Operation, “Service Mode” for a description of the service functions of the keys. The normal functions of the keys are described in the following paragraphs.

Power Meter Key – This key controls the viewing of power meter information. This information is shown on the lower display. Pressing the key for at least five seconds causes all the power meter data to scroll once. The default power meter data then resumes scrolling. Pressing the key for five seconds will stop the scrolling of the power meter functions until the key is pressed again.

AC Meter Key – The AC meter key controls the viewing of the AC parameters on the upper display. Pressing the key causes the display to show a different set of parameters.

Engine Meter Key – This key controls the viewing of engine parameters on the lower display. Pressing the key stops the scrolling of engine conditions. The value for one particular engine condition will show continuously. The pointer flashes indicating that the scrolling is stopped. The scrolling of the engine conditions will resume when the engine meter key is pressed again.

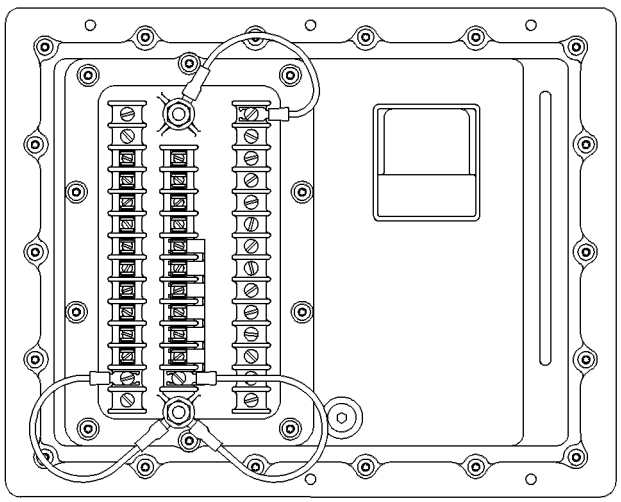
Lamp Test Key – Pressing this key performs a lamp test on the GSC+ and the optional alarm module. On the GSC+, the ten fault indicators are ON CONTINUOUSLY. Every segment of upper display (5) and lower display (6) are ON. On the optional alarm module, all of the indicators are ON and the horn sounds. When an operator presses the key for ten seconds, the lamp test function automatically turns off.

Alarm Codes Key – If fault alarm indicator (4) is FLASHING, pressing this key causes upper display (5) to show the corresponding alarm fault code. Pressing the key again will resume the showing of the AC generator output information on the upper display (5). If fault alarm indicator (4) is OFF, this key has no function. For more information on alarm fault codes, see Systems Operation, “Fault Description”.

Exit Key – This key only functions when the GSC+ is in Service Mode. See Systems Operation, “Service Mode”.

Service Mode Key – Pressing this key causes the GSC+ to enter service mode. See Systems Operation, “Service Mode” for more information.

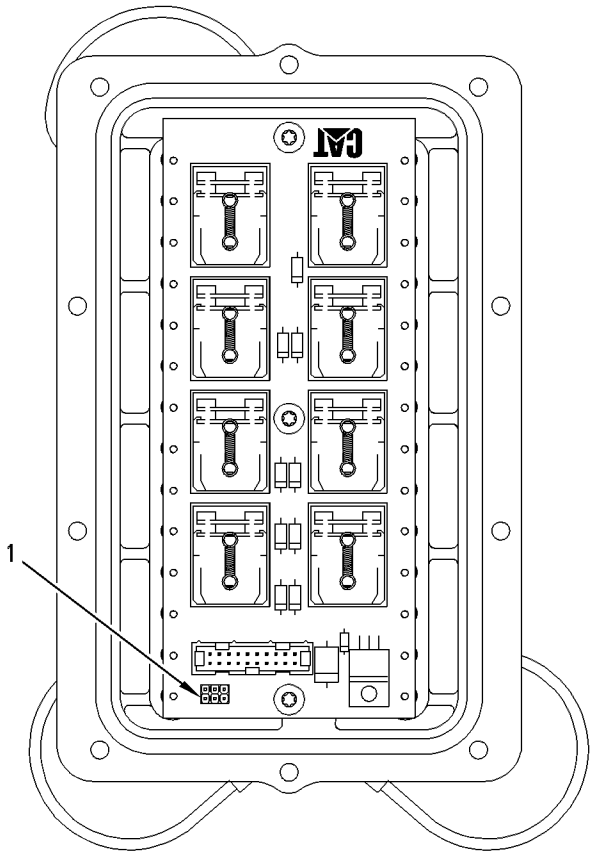
Relays



g00521482

Illustration 22

Relay Module On Rear Of GSC+



g00436699

Illustration 23

Relays In Relay Module

(1) Jumper block

The relays are located in the relay module on the rear of the GSC+. The relays are permanently attached within the relay module. The relays are not removable. The entire relay module is replaced if a relay is faulty. For more information, see Schematics And Wiring Diagrams, “Generator Set Wiring Diagram”.

Some of the contacts of the relays are internally connected to the terminals of the relay module. The contacts are available for the customer’s use. The voltage specifications and the current specifications are listed in the following chart.

Note: Jumper block (1) is used to select the voltage range of the voltmeter of the GSC+. A jumper block (1) is installed for systems with 700 volts full scale AC inputs. A jumper block (1) is NOT installed for systems with 150 volts full scale AC inputs or for any unit with external potential transformers. The relay module comes with the jumper block (1). See Testing And Adjusting, “AC Voltage Range Selection”.

Table 2

Load Specifications For GSC+ Relay Module		
Relay Module Terminal Number	**Rating For Resistive Loads**	**Rating For Inductive Loads**
RM13,14 - K1 - EGR N/O	0.45A at 24DCV	none(1)
RM15 - K7 - FCR N/O RM16 - K3 - CTR N/O RM17 - K3 - CTR N/C RM18 - K4 - SMR N/O RM21 - K4 - SMR N/C RM19 - K6 - ASR N/O RM20 - K6 - ASR N/C RM22 - K2 - GFR N/O RM24 - K5 - RR N/O	10A at 24DCV	10A at 24DCV
RM36,23 - K5 - RR N/C RM37,26 - K8 - PSR N/C RM38,25 - K8 - PSR N/O	10A at 24DCV	5A at 24DCV

(1) Do NOT connect inductive loads to these terminals.

The relays and the functions are listed below.

K1 – Electronic Governor Relay (EGR)

This relay is not used for any factory installed devices.

- When the relay is active, the normally open contacts close.
- The relay has no normally closed contacts.

K2 – Generator Fault Relay (GFR)

The GSC+ uses the generator fault relay (GFR) to activate the shunt trip coil of the optional circuit breaker during a shutdown fault. The optional circuit breaker is located in the generator housing.

- When the relay is active, the normally open contacts close. This trips the optional circuit breaker when a shutdown fault occurs.
- The relay has no normally closed contacts.

K3 – Crank Termination Relay (CTR)

The CTR is used to indicate that the engine is beginning to run without cranking. The GSC+ activates the CTR when the engine speed is greater than the crank terminate setpoint (400 RPM, setpoint P011) and the starting motor relay has been deactivated. The CTR deactivates when the engine RPM reaches 0.

- When the relay is active, the normally open contacts close. This activates the optional generator running relay (GRR) and enables an optional governor switch (GS) and the governor synchronizing motor. The GRR is located in the customer connection box. The GS is located on the front panel.
- When the relay is inactive, the normally closed contacts close.

K4 – Starting Motor Relay (SMR)

- When the relay is active, the normally open contacts close. This activates the starting motor magnetic switch.
- When the relay is inactive, the normally closed contacts close.

K5 – Run Relay (RR)

- When the relay is active, the normally open contacts close. This provides power to the optional start aid switch (SAS).
- When the relay is inactive, the normally closed contacts close. This contacts are for customer use.

K6 – Air Shutoff Relay (ASR)

- When the relay is active, the normally open contacts close. This activates an optional air shutoff solenoid during fault shutdowns.
- When the relay is inactive, the normally closed contacts close.

K7 – Fuel Control Relay (FCR)

- When the relay is active, the normally open contacts close. This activates the fuel control solenoid via the fuel control relay in the junction box. Also, power is supplied to the optional electronic governor.
- The relay has no normally closed contacts.

K8 – Programmable Spare Relay (PSR)

This relay is for customer use. It is programmable to activate for a variety of conditions. For more information, see Systems Operation, “Service Mode”.

- When the relay is active, the normally open contacts close.
- When the relay is inactive, the normally closed contacts close.

i01174755

Instrument Panel

SMCS Code: 4490; 7451

Instrument Panel Switches

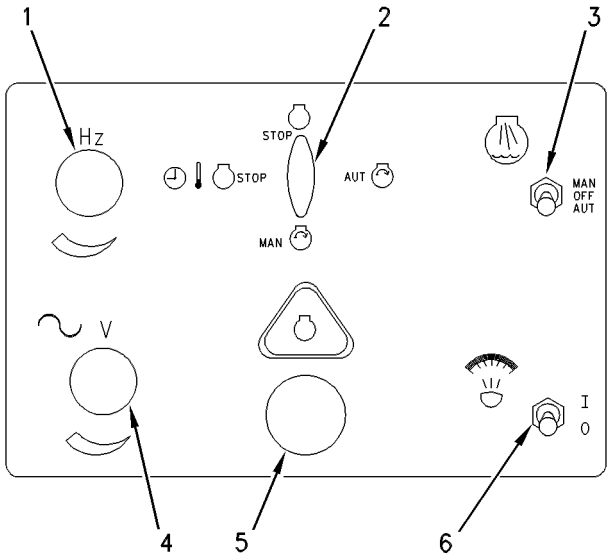


Illustration 24 g00474506

Instrument Panel Switches

(1) Speed potentiometer (SP)
(2) Engine control switch (ECS)
(3) Optional starting aid switch (SAS)
(4) Voltage adjust rheostat (VAR)
(5) Emergency stop push button (ESPB)
(6) Optional panel light switch (PLS)

The engine control switch (ECS) (2) determines the status of the control panel. When the ECS is in the AUTO position and the remote starting contacts are closed, the GSC allows the engine to start. The engine also shuts down after the initiate contacts open. The cooldown period is programmable in order to give a 0 to 30 minute cooldown period before the engine shuts down. The cooldown period is factory set at five minutes. In the MANUAL START position, the engine starts and runs as long as the ECS is in this position. When the ECS is in the COOLDOWN/STOP position and the cooldown is completed, the engine is turned off. In the OFF/RESET position, the engine shuts down immediately and any fault indicators are reset, except emergency stop.

When the emergency stop push button (ESPB) (5) is pressed, the fuel is shut off. Restart the engine by turning the ESPB (5) clockwise, until the switch releases. Turn the ECS to the OFF/RESET position. Then turn the ECS to the MANUAL START position.

The voltage adjust rheostat (VAR) (4) is used to adjust the generator voltage to the desired level.

The speed adjust potentiometer (SP) (1) controls the engine speed.

The optional panel light switch (PLS) (6) turns the panel lamps ON and OFF.

The starting aid switch (SAS) (3) allows the engine ECM to control the ether injection system. The ether injection system improves the cold starting capability of the engine. The AUTO position is the normal position of the switch. The system is always in AUTOunless the switch is in MANUAL. Two operation modes of the ether injection system exist:

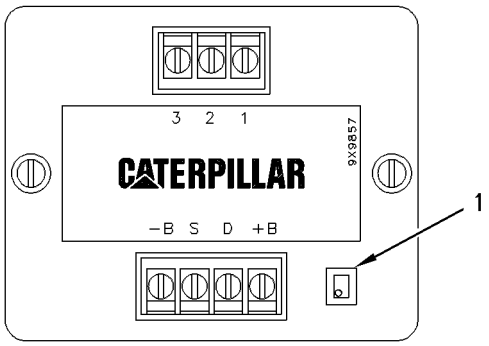
Manual – The manual position is momentary and the SAS must be held in this position in order to allow the ether system to operate in manual mode. Manual mode allows ether to be injected for a maximum of 130 seconds whenever the engine coolant temperature is less than 30°C (86°F) and the engine speed is greater than 50 rpm.

Automatic – This is the normal position of the SAS. The ether system is in automatic mode without operator input whenever the engine is started. In automatic mode, ether will be injected for a minimum of 15 seconds whenever the engine coolant temperature is less than 30°C (86°F) and the maximum of 130 seconds at –50°C (–58°F). The automatic ether injection system is disabled whenever the engine rpm exceeds 400 rpm or the engine coolant temperature exceeds 30°C (86°F).

i01174806

Electrical Converter (Pulse Width Modulated)

SMCS Code: 4490; 7451



g00474634

Illustration 25

Analog to PWM Converter

(1) Droop potentiometer.

The electrical converter is used to change the analog signal of the speed potentiometer into a pulse width modulated signal. The engine electronics can now recognize the PWM signal. The electrical converter is mounted on the subpanel within the control panel.

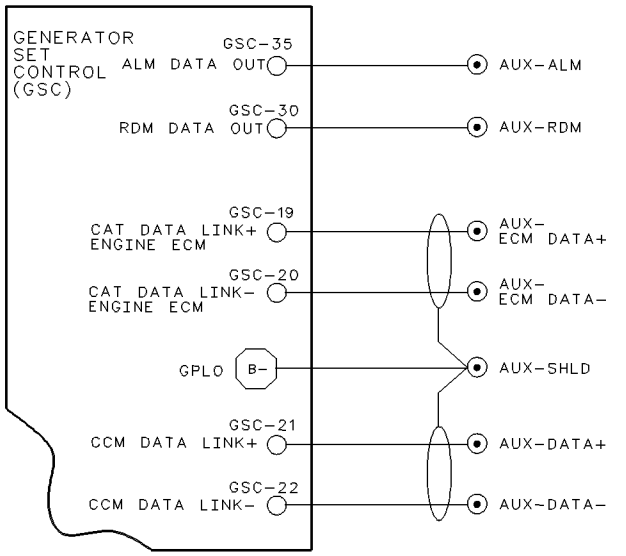
The electrical converter continuously generates two PWM signals, speed and droop. The duty cycle of the speed cycle varies from 2% to 95% in proportion to the signal that is being received from the speed potentiometer. This is adjusted by the operator. The duty cycle of the droop signal varies from 2 to 95% in proportion to the signal that is being received from the droop potentiometer on the electrical converter. This is adjusted by the service personnel. The base frequency of the PWM signals are constant at 415 to 528 Hz.

The electrical converter is supplied by the operating power at the throttle position sensor terminals. The terminal “1” is an input and the terminal connects to terminal “3” of the speed potentiometer. The terminal “2” is an input and the terminal connects to terminal “2” (wiper) of the speed potentiometer. The terminal “3” of the electrical converter is an input and the terminal connects to terminal “1” of the speed potentiometer. The terminal “S” of the electrical converter is an output and the terminal provides a speed signal to the engine electronic control. The terminal “D” of the electrical converter is an output and the terminal provides a droop signal to the engine electronic control.

i01175985

Data Link

SMCS Code: 4490; 7451



g00490405

Illustration 26

Connection Points For The Data Link

Note: These descriptions are for the EMCP II+ for applications with the EUI.

There are four serial data links. The preceding illustration shows the connection points at the GSC+. The data links provide the means for the GSC+ in order to communicate with other devices. The data links are defined in the following list:

ALM Data Out – This serial data link is a single directional link. The GSC+ uses this data link for one-way communication with the optional Alarm Modules (ALM) or with the optional Customer Interface Module (CIM). The data link for the ALM consists of a single wire that connects the GSC+ (connector contact 35) to an ALM or CIM. A return connection between the GSC+ and the module is also required. For more information, see Systems Operation, “Alarm Modules” or Systems Operation, “Customer Interface Module”.

RDM Data Out – This serial data link is a single directional link. The GSC+ uses this data link for one-way communication with the optional Relay Driver Module (RDM). The RDM data link consists of a single wire that connects the GSC+ (connector contact 30) to the RDM. A return connection between the GSC+ and the module is also required. An RDM is used in conjunction with the optional Customer Communication Module (CCM). For more information, see Systems Operation, “Relay Driver Module”.

CAT Data Link (ECM) – This serial data link is bidirectional. The GSC+ uses this data link for two-way communication with the engine ECM. The CAT data link consists of a cable that connects the GSC+ (connector contacts 19 and 20) to the engine ECM. The GSC+ expects to receive the data from the engine ECM on these pins.

Customer Communication Module (CCM) Data Link – This data link is also bidirectional and the data link connects the GSC+ to the Customer Communication Module (CCM). The second CAT data link allows eight generator set controls to be connected. The GSC+ expects to receive data from the CCM on these pins.

i01174846

Sensors

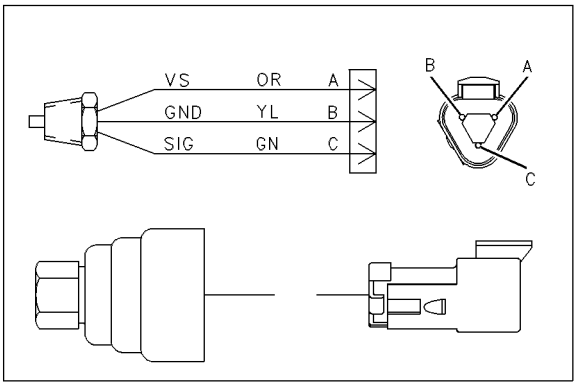
SMCS Code: 4490; 7451

The GSC+ monitors the following engine sensors:

- Engine oil pressure sensor
- Engine coolant temperature sensor
- Engine coolant level sensor
- Engine oil temperature sensor
- Engine speed sensor

Note: The engine coolant level sensor and the engine oil temperature sensor are optional.

Engine Oil Pressure Sensor



g00311286

Illustration 27

Engine Oil Pressure Sensor

The engine oil pressure sensor is an input of the GSC+. The sensor tells the GSC+ the current engine oil pressure. The GSC+ shows the engine oil pressure on the lower display and the GSC+ also uses the sensor information to determine when a low engine oil pressure fault exists. The engine oil pressure sensor is mounted on the outside of one of the engine oil galleries. The engine model determines the exact location of the engine oil pressure sensor.

The engine oil pressure sensor is a pulse width modulated sensor. This sensor continuously generates a PWM signal. The duty cycle of the PWM signal varies from 10 to 90%. The duty cycle varies proportionally to the oil pressure of the engine. The GSC+ receives the PWM signal. The GSC+ measures the duty cycle in order to determine the oil pressure of the engine. The base frequency of the signal is constant at 500 ± 150 Hz. The signal wire (connector contact “C”) of the oil pressure sensor connects to connector contact “8” of the GSC+. The sensor is supplied operating power (8 DCV) at connector contact “A” from the GSC+ (connector contact “9”).

There are five setpoints that are related to engine oil pressure. The setpoints that are programmed into the GSC+ are listed below.

- P003
- P004
- P012
- P013
- P014

See Systems Operation, “Engine Generator Programming OP5-0”.

Engine Coolant Temperature Sensor

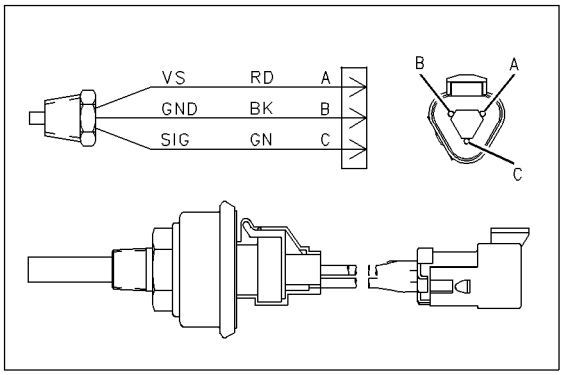


Illustration 28 g00311256

Engine Coolant Temperature Sensor

The engine coolant temperature sensor is an input of the GSC+. The engine coolant temperature sensor tells the GSC+ the engine coolant temperature. The GSC+ shows the engine coolant temperature on the lower display. The GSC+ uses the sensor information in order to determine when a high coolant temperature fault exists or a low coolant temperature fault exists. The engine coolant temperature sensor is mounted in the water jacket which is usually toward the front of the engine. The exact location depends on the engine model.

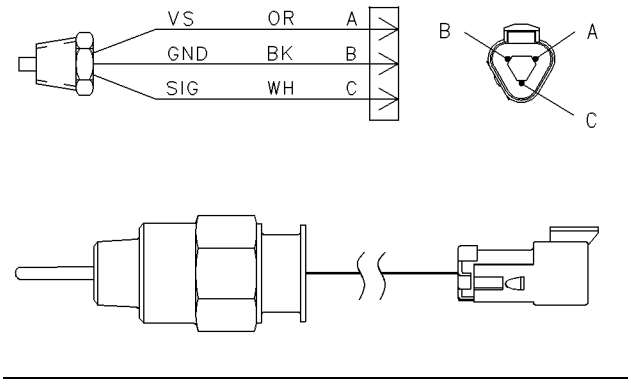
The engine coolant temperature sensor is a pulse width modulated type of sensor (PWM). This sensor continuously generates a PWM signal. The PWM duty cycle varies from 10% to 95%. This variation is in a proportion with the engine coolant temperature. The GSC+ receives the PWM signal. Then, the GSC+ measures the duty cycle in order to determine the coolant temperature of the engine. The base frequency of the signal is constant at 455 Hz (370 to 550 Hz). The signal wire (connector contact “C”) of the coolant temperature sensor connects to connector contact “7” of the GSC+. The sensor is supplied operating power (8 DCV) at connector contact “A” from the GSC+ (connector contact “9”).

There are four setpoints that are related to engine coolant temperature. These points are programmed into the GSC+. The related setpoints are listed below.

- P003
- P004
- P015
- P016

See Systems Operation, “Engine/Generator Programming OP5-0”.

Engine Oil Temperature Sensor



g00310269

Illustration 29

Engine Oil Temperature Sensor

The engine oil temperature sensor is optional. This sensor is an input of the GSC+. The sensor tells the value of the engine oil temperature to the GSC+. The GSC+ shows the engine oil temperature on the lower display. The GSC+ uses the sensor information in order to determine when a high oil temperature fault exists. The engine oil temperature sensor is mounted on the outside of one of the engine oil galleries. The exact location depends on the engine model.

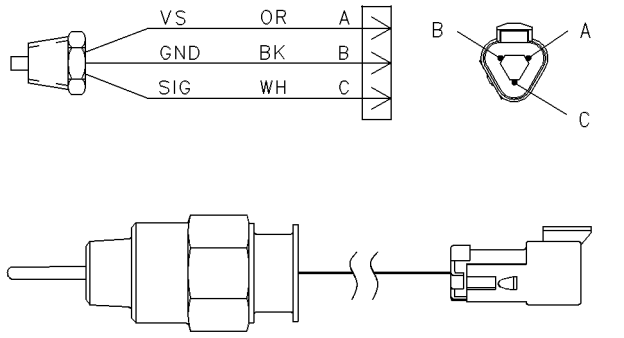
The engine oil temperature sensor is a pulse width modulated type of sensor (PWM). This sensor continuously generates a PWM signal. The duty cycle in this signal varies from 10% to 95% in proportion to the oil temperature of the engine. The GSC+ receives the PWM signal. Then, the GSC+ measures the duty cycle in order to determine the oil temperature of the engine. The base frequency of the signal is constant at 455 Hz (370 to 550 Hz). The signal wire (connector contact “C”) of the oil temperature sensor connects to connector contact “14” of the GSC+. The sensor is supplied operating power (8 DCV) at connector contact “A” from the GSC+ (connector contact “9”).

There are five setpoints that are related to engine oil temperature. These points are programmed into the GSC+. The related setpoints are listed below.

- P003
- P004
- P025
- P026
- P027

See Systems Operation, “Engine/Generator Programming OP5-0”.

Engine Coolant Fluid Level Sensor



g00310269

Illustration 30

Note: Engine Coolant Fluid Level Sensor is commonly referred as the engine coolant loss sensor.

The engine coolant fluid level sensor is optional. The engine coolant fluid level sensor is an input of the GSC+. The sensor tells the GSC+ when the engine has lost coolant. The GSC+ uses the sensor information to determine when a low coolant level fault exists. The engine coolant fluid level sensor is usually mounted near the top of the engine radiator. The exact location depends on the engine model.

The engine coolant fluid level sensor sends one of the following signals to the GSC+.

- A battery negative signal (“B-”) for normal level
- +5 DCV signal for a low level

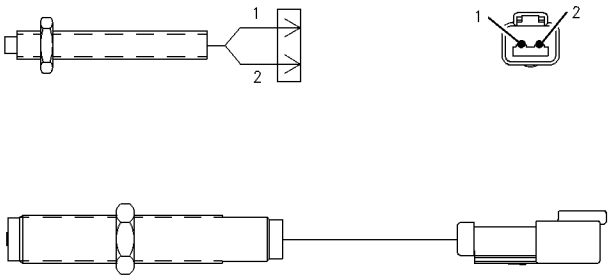
The signal wire of the coolant fluid level sensor connects to connector contact “13” of the GSC+. The signal wire is connector contact “C” of the coolant fluid level sensor. The sensor is supplied operating power (8 DCV) at connector contact “A” from the GSC+ (connector contact “9”).

There are three setpoints that are related to engine coolant fluid level. These setpoints are programmed into the GSC+. The related setpoints are listed below.

- P004
- P005
- P006

See Systems Operation, “Engine/Generator Programming OP5-0”.

Engine Speed Sensor



g00311291

Illustration 31

Engine Speed Sensor

Note: The engine Speed Sensor is commonly referred as a magnetic pickup sensor.

The engine speed sensor is an input of the GSC+. The sensor tells the engine speed to the GSC+. The GSC+ shows the engine speed on the lower display. The GSC+ uses the sensor information for the following tasks: activating an engine overspeed shutdown, terminating engine cranking, and determining the oil step speed. The engine speed sensor is mounted on the flywheel housing of the engine.

The sensor creates a sine wave signal from passing ring gear teeth at the rate of one pulse per tooth. The sensor sends a sine wave signal to the GSC+. The frequency of this signal is directly proportionate to the engine speed. The GSC+ receives the sine wave signal. The GSC+ measures the frequency (one pulse per gear tooth) in order to determine the speed of the engine. The wires of the sensor connect to connector contact “1” and connector contact “2” of the GSC+ within a shielded cable.

There are four setpoints that are related to the engine speed. These setpoints are programmed into the GSC+. The related setpoints are listed below.

- P009
- P010
- P011
- P012

See Systems Operation, “Engine/Generator Programming OP5-0”.

i01174888

Electronic Control Module (Engine)

SMCS Code: 1901; 4490; 7451

The engine ECM controls the engine speed on a 3500B EPG engine. The engine speed is based on the operator input from the speed potentiometer (SP). The engine speed is also based on the feedback from the sensors for the engine ECM .

The GSC receives the following information from the engine ECM:

- engine oil pressure
- engine coolant temperature
- engine hours
- system battery voltage

The above information is shown on the lower display of the GSC. The engine ECM is used by the GSC in order to monitor system faults such as low engine oil pressure or high engine coolant temperature.

The GSC receives the diagnostic codes from the engine ECM. The GSC displays the diagnostic codes as a convenience to the operator. The GSC does not interpret the codes and the GSC does not react to the codes. For more information on the management of diagnostic codes by the GSC and the engine ECM, see Testing And Adjusting, “Fault Identification”.

i01174908

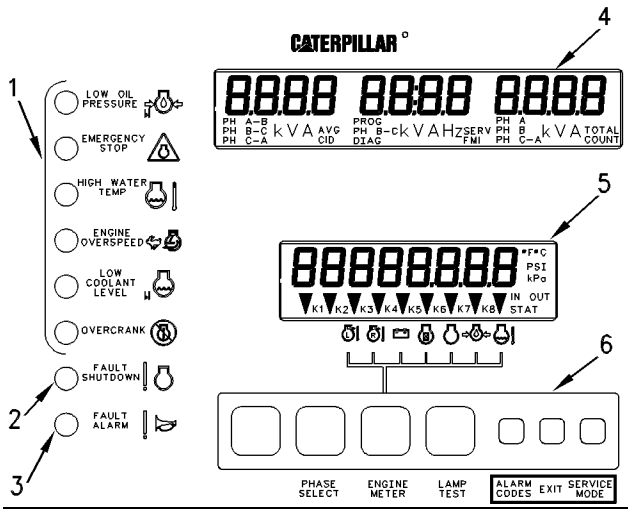
Modes Of Operation

SMCS Code: 4490; 7451

Table 3

Display Area Functions When In Normal Mode, Alarm Mode Or Shutdown Mode(1)			
Item Of Display Area	**Normal Mode**	**Alarm Mode**	**Shutdown Mode**
Upper Display	AC Data Shown	AC Data Shown(2)	Fault Code Shown
Lower Display	Engine Data And Relay Status Shown	Engine Data And Relay Status Shown	Engine Data And Relay Status Shown
Shutdown Indicators	All Off	All Off	Flashing
Fault Alarm Indicators	Off	Flashing(2)	Off
Key Function	**Normal Mode**	**Alarm Mode**	**Shutdown Mode**
Left Most Key(3)	No Function	No Function	No Function
Phase Select Key	Selects The AC Phase That Is Shown On The Upper Display	Selects The AC Phase That Is Shown On The Upper Display	No Function
Engine Meter Key	Stops And Starts The Scrolling Of Engine Conditions On Lower Display	Stops And Starts The Scrolling Of Engine Conditions On Lower Display	Stops And Starts The Scrolling Of Engine Conditions On Lower Display
Lamp Test Key	Performs A Lamp Test	Performs A Lamp Test	Performs A Lamp Test
Alarms Code Key	No Function	Shows The Fault Code On The Upper Display	No Function
Exit Key(3)	No Function	No Function	No Function
Service Mode Key	Enters The GSC Into Service Mode	Enters The GSC Into Service Mode	No Function

(1) For a description of the display area functions when in service mode, see the topic Service Mode.
(2) When an alarm fault is present, the fault code is shown on the upper display when the alarm codes key is pressed.
(3) This key only functions when in service mode, see the topic Service Mode.



g00474240

Illustration 32

Display Area Of Generator Set Control (GSC)

(1) Dedicated Shutdown Indicators
(2) Fault Shutdown Indicator
(3) Fault Alarm Indicator
(4) Upper Display
(5) Lower Display
(6) Keypad

The GSC has four modes of operation. A brief description of each mode follows this paragraph. See the individual topic for more detailed information.

Normal Mode – The GSC uses normal mode for the normal operation of the generator set. The operator can identify the normal mode by observing the display area. When the GSC is in the normal mode, all dedicated shutdown indicators are OFF. The fault shutdown indicator is OFF . The fault alarm indicator is OFF and “SERV ”is NOT SHOWING on the upper display.

Alarm Mode – If there is an alarm fault, the GSC will automatically go into alarm mode in order to alert the operator. The operator can identify the alarm mode by observing the display area. When the GSC is in alarm mode, the fault alarm indicator is FLASHING. When the alarm code key is pressed, the fault code will be shown.

Shutdown Mode – If there is a shutdown fault, the GSC will automatically go into shutdown mode in order to alert the operator. The operator can identify the shutdown mode by observing the display area. When the GSC is in shutdown mode, a dedicated shutdown indicator is FLASHING, or the fault shutdown indicator is FLASHING.

Service Mode – The GSC goes into service mode when the operator presses the service mode key on the keypad. The operator can use service mode for the following purposes.

- Assist with troubleshooting diagnostic faults.
- Calibrate generator set functions.
- Adjust generator set functions.
- Verify generator set functions.
- Satisfy special applications.
- Satisfy the needs of the customer.

The operator can identify service mode by observing the display area. When the generator set is in service mode, “SERV” is SHOWN on the upper display.

Note: Service mode can not be entered when the ECS is in the AUTO position.

i01174913

Normal Mode

SMCS Code: 4490; 7451

Normal mode is used in order to monitor the generator set. Normal mode is also used to control the generator set. The GSC+ controls the engine according to the information which is received from the operator and the information that is received from the engine sensors. The GSC+ performs the following functions in normal mode:

- Engine starting function
- Monitoring of the important GSC+ conditions
- Showing the important GSC+ conditions to the operator
- Fault detection
- Engine stopping

The operator can identify normal mode by observing the display area. When the GSC+ is in normal mode, all shutdown indicators are OFF. The fault alarm indicator is OFF and “SERV” is NOT SHOWING on the upper display. When the GSC+ is in normal mode, the engine is able to start or the engine is able to run.

Note: The optional Customer Communication Module (CCM) can remotely control certain generator set functions. This remote control can only occur when the engine control switch (ECS) is in the AUTO position. See Systems Operation, “System Communication Module (Customer)”for more information.

Engine Starting Sequence

1. The GSC+ receives an engine start signal. The signal will be one of three.

- The operator turns the ECS to the Manual Start position.
- The ECS is in the AUTO position and the remote initiate contacts (IC) close.
- The ECS is in the AUTO position and a start command is sent by the optional Customer Communication Module (CCM).

2. The GSC+ checks the system before the cranking sequence has begun. The GSC+ checks that no system faults are present. The GSC+ checks that all previous shutdown faults have been reset. Note that shutdown faults are removed by turning the ECS to OFF/RESETposition. The GSC+ also checks that the engine is not already running.

3. The GSC+ activates the starting motor relay (SMR) and the run relay (RR).

4. The GSC+ activates the fuel control relay (FCR).

5. The GSC+ cycle cranks the engine until the cycle crank time reaches the setpoint (P017) for total crank time or until the engine starts. The factory setpoint of the setpoint (P017) is 10 seconds of crank time and 10 seconds of rest time.

6. While the starting motor is cranking, the GSC+ shows the status of the relays on the relay status indicators of the lower display.

- ETR fuel systems: K4 (SMR), K5 (RR), K7 (FCR)
- ETS fuel systems: K4 (SMR), K5 (RR)

7. The GSC+ deactivates the starting motor relay (SMR) and the GSC+ activates the crank termination relay (CTR) when the engine speed reaches the setpoint P011 for crank terminate speed. The factory default of setpoint P011 is 400 rpm.

8. The GSC+ activates the electronic governor relay (EGR) when the oil pressure reaches setpoint P014. Setpoint P014 is for low oil pressure at idle speed. The factory default of setpoint P014 is 70 kPa (10 psi). The EGR signals the electronic governor (EG) in order to accelerate the engine to the rated speed. This happens if the machine is equipped with the EG.

Note: The electronic governor relay (EGR) is not used on “8NS” or “9ES” generator sets.

Note: The optional customer communication module (CCM) can remotely activate the EGR when the low oil pressure setpoint is exceeded. The optional customer communication module can remotely deactivate the EGR when the low oil pressure setpoint is exceeded.

9. The GSC+ shows the following information.

- Information for one or more phases on the upper display
- Information for power meter on the lower display
- Information for the engine system on the lower display
- The relay status of K1 (EGR), K3 (CTR), K5 (RR), and K7 (FCR) on the lower display

Engine Stopping Procedure

1. The GSC+ will receive an engine stop signal. The signal will be one of three.

- The operator turns the ECS to the STOP position.
- The ECS is in the AUTO position and the remote initiate contacts (IC) open.
- The optional customer communication module (CCM) sends a stop command to the GSC+ while the ECS is in the AUTO position and while the remote initiate contacts are open.

2. After receiving the stop signal, the GSC+ checks that there are no present system faults.

3. The GSC+ begins the cooldown time. The cooldown time is the setpoint P019. The factory default of setpoint P019 is five minutes.

4. The GSC+ may now activate the spare output. The spare output is activated only if the spare output SP07 has been programmed. The spare output can activate the slave relay during the cooldown cycle. The optional circuit breaker is then activated and this takes the generator off load.

5. After the cooldown cycle (setpoint P019), the GSC+ deactivates the run relay (RR). The electronic governor relay is deactivated after the engine oil pressure decreases to less than the setpoint for low oil pressure shutdown at idle speed (SP14). The GSC+ shuts off fuel by deactivating the fuel control relay (FCR).

6. When the engine speed reaches zero rpm, the GSC+ deactivates the crank terminate relay (CTR) and a restart is now allowed.

   Before the engine speed reaches 0 rpm, a restart of the engine is possible. When the GSC+ receives an engine start signal, the GSC+ turns on the fuel and the GSC+ allows the engine to run. If the engine does not run, the starting motor relay (SMR) does not activate until the crank termination relay (CTR) is deactivated at 0 rpm.

7. The GSC+ shows the status of the relays on the relay status indicator of the lower display. All relay indicators should be “OFF” except the ETS systems. On the ETS systems, the “K7” indicator remains active for 70 seconds after the engine speed and oil pressure are at zero.

Note: The engines can be shut down immediately by turning the ECS to the OFF/RESET. The cooldown timer is bypassed and the spare data output is deactivated.

i01174918

Alarm Mode

SMCS Code: 4490; 7451

The alarm mode alerts the operator when an alarm fault is occurring. An alarm fault is not critical but an alarm fault is potentially serious. An alarm fault precedes certain dedicated shutdown faults. An alarm fault can be protective relaying functions that have been enabled as an alarm fault.

When an alarm fault exists the GSC+ automatically activates alarm mode. The operator is alerted by the FLASHING fault alarm indicator. Press the “ALARM CODES” key in order to identify the alarm fault. A corresponding fault code is then shown on the upper display. This fault code can be an AL fault code, a SP fault code or a diagnostic fault code. “Spare 1” indicator, “Spare 2” indicator or “Spare 3” indicator may be flashing. The fault alarm indicator may also be flashing. For more information on fault codes, see System Operation, “Fault Description”. When the GSC+ is in alarm mode, the engine is able to start or the engine is able to run.

The AL fault codes that are shown on the GSC+ indicate the current status of the generator set. The GSC+ does not show the AL fault codes after the fault has been corrected. Diagnostic fault codes are logged in the GSC+ fault log for viewing by service personnel.

Note: When the operator overrides a shutdown fault to be an alarm fault, the corresponding dedicated fault shutdown indicator is on continuously. The fault shutdown indicator stays on continuously if the particular fault occurs. When the fault shutdown indicator is ON CONTINUOUSLY, the normal shutdown response has been overridden by the operator. The shutdown fault is treated as an alarm fault. For shutdown faults that are overridden, the fault is not displayed on the wall. The dedicated shutdown indicator remains ON CONTINUOUSLY until the fault is corrected and the engine control switch (ECS) is turned to the “OFF/RESET” position. The dedicated shutdown faults that can be overridden are low oil pressure and high coolant temperature. See Systems Operation, “Setpoint Programming OP5 (P03)”. For more information, see System Operation, “Shutdown Mode”.

Alarm faults do not have an immediate adverse effect on the generator set. However, the operator should investigate the cause of the alarm fault condition at the earliest opportunity. If the operation of the generator set is mandatory then the procedure to start and stop is identical to normal mode. The GSC+ will respond to the operator input that is from the instrument panel and the engine sensors.

Alarm Mode Sequence

1. An alarm fault occurs.

2. The GSC+ detects the alarm fault and the GSC+ FLASHES the fault alarm indicator. The GSC+ does not change the status or operation of the generator set.

3. Pressing the “ALARM CODES” key causes the upper display to show a corresponding fault code.

4. Correct the alarm fault. See Testing And Adjusting, “Fault Identification”.

5. After the alarm fault has been corrected, the GSC+ turns OFF the fault alarm indicator and the GSC+ removes the fault code from the upper display. The GSC+ now returns to normal mode.

i01174924

Shutdown Mode

SMCS Code: 4490; 7451

Shutdown mode prevents damage to the generator set when a shutdown fault is occurring. A shutdown fault is critical. When a shutdown fault occurs, the GSC+ automatically activates shutdown mode until the shutdown fault is corrected. The GSC+ shuts down the engine when the GSC+ is in shutdown mode. The GSC+ prevents starting of the engine and the GSC+ alerts the operator.

The GSC+ alerts the operator and the GSC+ identifies the shutdown fault by FLASHING the corresponding shutdown indicator. The name of the shutdown indicator identifies the shutdown fault.

Shutdown Indicators

- Low oil pressure
- Emergency stop
- High water temperature
- Engine overspeed
- Engine overcrank
- Fault shutdown
- Spare 1 (that are accompanied by the fault shutdown indicator)
- Spare 2 (that are accompanied by the fault shutdown indicator)
- Spare 3 (that are accompanied by the fault shutdown indicator)

If the fault shutdown indicator is the only indicator FLASHING, additional information is available. A fault code is shown on the upper display which more precisely identifies the cause of the shutdown fault. See System Operation, “Fault Description” for more information.

Shutdown Mode Sequence

1. A shutdown fault occurs and the GSC+ detects the shutdown fault.

2. To shut off the fuel, the GSC+ deactivates the fuel control relay (FCR).

3. In order to prevent the engine from starting, the GSC+ deactivates the run relay (RR), and the GSC+ deactivates the starting motor relay (SMR).

4. In order to remove the generator load, the GSC+ activates the genset fault relay (GFR). This activates the optional circuit breaker shunt trip coil.

Note: The spare output may also be programmed to activate when a shutdown occurs. This output can drive a relay in order to open the circuit breaker, or the output can open a transfer switch. See System Operation, “Spare Input/Output Programming OP6”.

5. The GSC+ activates the air shutoff relay (ASR) for 15 seconds during an emergency stop fault, during an engine overspeed fault, or during an speed sensor fault (CID 190).

6. When engine speed reaches 0 rpm, the GSC+ deactivates the crank termination relay (CTR). The electronic governor relay (EGR) is deactivated when the engine oil pressure reaches the setpoint P014 for low oil pressure shutdown at idle speed 70 kPa (10 psi).

7. If engine speed does not decrease by at least 100 rpm within five seconds, the GSC+ activates the ASR for 15 seconds.

Note: The ASR would already be activated for an emergency stop fault, engine overspeed fault, or speed sensor fault.

8. The GSC+ FLASHES the corresponding shutdown indicator. If the fault shutdown indicator is FLASHING, a fault code is shown on the upper display. See Systems Operation, “Fault Description”.

9. If the fault shutdown indicator is the only indicator FLASHING, additional information is available. A fault code is shown on the upper display that better identifies the cause of the shutdown fault. See the Systems Operation, “Fault Description”.

10. The lower display continues to show the engine data.

11. The relay status indicators show.

    - K2 (GFR)

- K6 (ASR) will show for 15 seconds for an emergency stop fault, engine overspeed fault, or speed sensor fault. K6 (ASR) will also show if engine speed does not decrease at least 100 rpm.
- K7 (FCR) - (ETS fuel systems) for 70 seconds after engine speed decreases to 40 rpm and oil pressure decreases to 80 kPa (12 psi). (K7 is not shown for ETR fuel systems.)

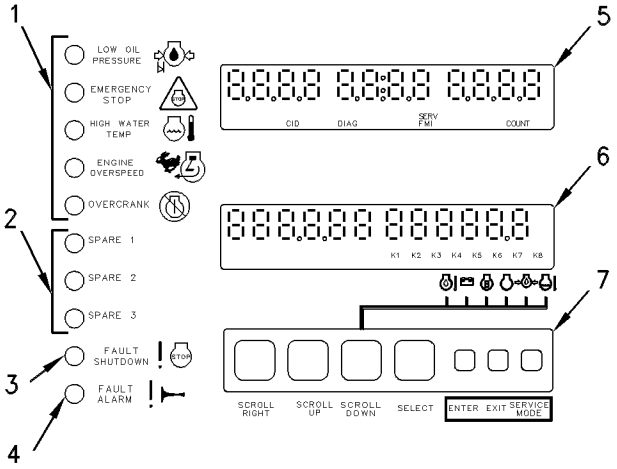
Engine Start Sequence (After Shutdown)

1. Correct the shutdown fault. See the System Operation, “Fault Identification”.
2. Turning the engine control switch (ECS) to the OFF/RESET position resets the GSC+. If no shutdown fault is active, the GSC+ returns to normal mode and the engine is able to start.

i01175019

Service Mode

SMCS Code: 4490; 7451



g00398567

Illustration 33

GSC+ Display Area With The Service Mode Descriptions Of The Keypad

(1) Dedicated shutdown indicators
(2) Spare fault indicators
(3) Fault shutdown indicator
(4) Fault alarm indicator
(5) Upper display
(6) Lower display
(7) Keypad

Service mode is used for the following purposes.

- Assist with troubleshooting of diagnostic faults.
- Satisfy special applications.
- Satisfy customer needs.
- Verify generator set functions.
- Calibrate or adjust generator set functions.

Service Mode has ten options that can be selected. Service personnel use the options to obtain information about the generator set, and the operator can program functions of the generator set.

Table 4

Service Mode Options	
OP1	Fault log viewing
OP2-0	Engine/Generator setpoint viewing
OP2-1	Protective relaying setpoint viewing
OP2-2	AC factory calibration setpoint viewing
OP3	Password entry
OP4	Fault log clearing
OP5-0	Engine/Generator programming
OP5-1	Protective relaying programming
OP6	Spare Input/Output programming
OP7	Hourmeter programming (1)
OP8	Voltmeter/Ammeter programming
OP9	Engine setpoint verification
OP10	AC offset adjustment

(1) OP7 is not available for EUI engines.

The keypad and the display of the GSC+ are used for activating service mode and selecting the desired option. In service mode, the keys on the keypad have different functions, and the keys on the keypad have different names. The preceding illustration shows the name of each key in service mode. Also, there is a film (label) on the control panel door that identifies each key. The service functions of the keys are listed below.

Scroll Right Key – This key is used in viewing information. This key scrolls right through the information. When you are entering the password, this key represents the number 1.

Scroll Up Key – This key is used to scroll up information or this key is used to increase the value of information. When you are entering the password this key represents the number 2.

Scroll Down Key – This key is used to scroll down through information or this key is used to decrease the value of information. When you are entering the password, this key represents the number 3.

Note: Scrolling rapidly through information requires holding down the scroll key.

Select Key – To view an option, use the Select key. To change an option, use the “Select” key. To start the scrolling of information, use the “Select” key.

Enter Key – This key is used to enter information that has been changed into the GSC+ memory.

Exit Key – This key is used to exit service mode. The display now returns to normal mode. The “SERV” indicator on the upper display is NOT SHOWING when the GSC+ is NOT in service mode.

Service Mode Key – This key is used to enter service mode. The “SERV” indicator on the upper display FLASHES when the GSC+ is in service mode. The “SERV” indicator on the upper display FLASHES when the keypad performs service mode functions.

Procedure To Enter Service Mode

Note: Any active shutdown fault must be made inactive in order to access service mode. A FLASHING shutdown indicator means that a shutdown fault exists. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. To permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the fault must not be occurring. Also, the ECS must be turned to the OFF/RESET position. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, then the GSC+ will not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

Note: Service mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

1. Press the “SERVICE MODE” key on the keypad of the GSC+. The “SERV” indicator on the upper display FLASHES whenever the GSC+ is in service mode.

2. The desired option (OP1 through OP10) can now be selected. Each option is described in the topics that follow.

3. To return to normal mode, press the “EXIT” key a few times until the “SERV” indicator is not showing.

Note: To enter service mode options OP4 through OP8, the engine must be shut down. Turn the ECS to the STOP position.

Service mode options OP4 through OP10 are password protected. Password protection reduces the possibility of changing information by mistake. The password entry option (OP3) must be entered correctly before access is gained to OP4 through OP10. See System Operation, “Password Entry OP3”. Options OP1 and OP2 are not password protected.

i01175025

Fault Log Viewing OP1

SMCS Code: 4490; 7451

OP1 is the option that is used for viewing diagnostic fault codes. The fault log contains a history of the diagnostic faults. These diagnostic faults are the faults that have occurred in the generator set system since the last clearing. Also, the total number of occurrences are shown on the upper display. The fault log assists when service personnel are troubleshooting the generator set system.

The diagnostic fault codes consist of the following items: a component identifier (CID), a failure mode identifier (FMI), and a DIAG indicator. These diagnostic fault codes are shown on the upper display. The CID informs the operator of faulty components. The FMI describes the type of failure that has occurred. When the CID FMI fault is active the DIAG indicator FLASHES.

Only inactive diagnostic faults are stored in the fault log. An active diagnostic alarm fault becomes inactive when the fault is no longer occurring. An active diagnostic shutdown fault becomes inactive when the fault is no longer occurring and the engine control switch (ECS) is turned to OFF/RESET. Active diagnostic alarm faults and diagnostic shutdown faults are indicated when “DIAG” is FLASHING. When the faults become inactive “DIAG” is ON CONTINUOUSLY. The GSC+ stores a maximum of 12 diagnostic fault codes in the fault log. If an additional diagnostic fault becomes inactive, the GSC+ automatically clears the earliest inactive diagnostic fault code. The GSC+ then places the newinactive diagnostic fault code in the fault log.

The GSC+ automatically clears any inactive diagnostic fault codes that have been stored in the fault log longer than 750 hours. For example, if a CID FMI fault code is logged at 10 hours, then the GSC+ clears the fault code when the hour meter is at 760 hours. If a CID FMI fault code is logged at 20 hours, then the fault code remains logged until the hour meter is at 770 hours. This feature prevents old fault codes from clogging the fault log, if service personnel have forgotten to clear the log after correcting faults.

When an active diagnostic fault changes to an inactive diagnostic fault, the GSC+ will function in the following manner.

1. The diagnostic fault is recorded in the fault log of the GSC+.
2. If no other active faults are present the DIAG indicator will stop FLASHING and the DIAG indicator remains on CONTINUOUSLY.
3. The fault alarm indicator or the shutdown fault is turned OFF.

Procedure To View The Fault Log

Note: For a list of all diagnostic fault codes, seeTesting And Adjusting, “Diagnostic Fault Codes”.

Note: Service Mode cannot be entered when the ECS is in the AUTO position.

Note: Any active shutdown fault must be made inactive in order to access service mode. A FLASHING shutdown indicator indicates that a shutdown fault exists. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. To permanently change a shutdown fault from an active shutdown fault to an inactive fault, the fault must not be occurring. The ECS must also be turned to the OFF/RESET position. If the jumper that electrically connects terminal 6 to terminal 9 is not installed on the ECS, then the GSC+ will not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Press the “SERVICE MODE” key in order to enter Service Mode. “OP 1” is showing on the lower display. See Systems Operation, “Service Mode”for more information.
2. Press “SELECT” key. If more than one fault code is present then the fault codes begin scrolling on the display. The number of occurrences is shown above the “COUNT” indicator. The lower display shows the hour meter data of the first occurrence and the last occurrence of each fault.
3. Press “SELECT” key. The fault codes stop scrolling.
4. Press “SCROLL RIGHT” key. If more than one count of a fault code is logged then the first occurrence with a corresponding hour meter data is showing on the lower display.
5. Press “SELECT” key. Fault codes continue scrolling.
6. Press “EXIT” key. “OP 1” is showing on lower display.
7. Press “EXIT” key. The display is now in normal mode.

i01175067

Engine/Generator Setpoint Viewing OP2-0

SMCS Code: 4490; 7451

OP2-0 is the option for viewing the engine/generator setpoints. The engine/generator setpoints affect the proper operation and serviceability of the engine. The engine/generator setpoints also affect the accuracy of the information that is shown on the display. The setpoints that are viewed or the setpoints that are stored in the GSC+ should match the specified setpoints of the particular generator set. The setpoints are from P001 through P033 and the setpoints are programmable. See System Operation, “Engine/Generator Programming OP5-0”.

i01175097

Protective Relaying Setpoint Viewing OP2-1

SMCS Code: 4490; 7451

OP2-1 is the option for viewing the protective relaying setpoints. The protective relaying setpoints determine the response of the GSC+ when one or more of the protective relaying functions occur. The protective relaying functions reduce the possibility of damaging the generator or the customer's equipment. These setpoints are from P101 through P142 and the setpoints are programmable. For a description of each of these setpoints, see System Operation, "Protective Relaying Programming OP5-1".

i01175107

AC Factory Calibration Setpoint Viewing OP2-2

SMCS Code: 4490; 7451

The option for the AC factory calibration setpoint viewing is OP2-2. OP2-2 is also used for viewing other specific data. None of these items are programmable by service personnel.

The following information is shown on the display.

GSC+ Serial Number – The serial number of the GSC+ has ten digits. This number is unique for each GSC+. The serial number is stamped on a label on the back of the GSC+. The displayed serial number will always match the number on the label.

GSC+ Software Level Identifier – The software level identifier indicates the level of the software that is included within the GSC+. The identifier has nine characters. "XXXXXXX-XX" is the form of the identifier.

Setpoints P201 through P222 – The setpoints are the AC factory calibration setpoints. The AC factory calibration setpoints contain information that is used during the factory calibration procedures. These setpoints are not programmable by service personnel.

Procedure To View The Setpoints

Note: The engine may be running or the engine may be stopped while the operator is viewing the setpoints.

Note: Service mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

Note: An active shutdown fault must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. The shutdown fault must be corrected, and the ECS must be turned to the OFF/RESET position in order to permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Press "SERVICE MODE" key in order to enter service mode. "OP 1" is showing on the lower display. See System Operation, "Service Mode" for more information.

2. Press "SCROLL UP" key. "OP2-0" is showing.

   a. Go to Step 3 in order to view the setpoints that are within OP2-0.

   b. Press the "SCROLL UP" key once or press the "SCROLL UP" key twice in order to view OP2-1 or OP2-2. The display will show OP2-1 or OP2-2. Go to Step 3.

3. Press "SELECT" key. "P001" is showing for OP2-0 which is followed by the value of the setpoint. "P101" is showing for OP2-1 which is followed by the value of the setpoint. The ten digit serial number is showing on the display for OP2-2.

4. Press the "SCROLL UP" key or the "SCROLL DOWN" key. The next setpoint value is showing. Repeat this step until all the desired setpoints and the setpoint values are viewed.

5. Press "EXIT" key. "OP1" is showing on the lower display.

6. Press "EXIT" key. The display returns to the normal mode.

i01175135

Password Entry OP3

SMCS Code: 4490; 7451

OP3 is the option for entering the password that is required for accessing OP4 through OP10. Password protection reduces the possibility of mistakenly altering information . The service mode options OP4 through OP10 are password protected. Options OP1 and OP2 are used to view information. Options OP1 and option OP2 are not password protected.

Password entry requires entering the scroll keys in the correct sequence. The password is identical for every GSC+. The password cannot be changed. After the password is entered, the OP4 through OP10 options can be accessed. Incorrectly entering the password causes the “PE FAIL” to be briefly shown on the upper display. Pressing the “SELECT” key will start the password entry procedure again.

Procedure To Enter The Password

Note: Service mode cannot be entered when the engine control switch (ECS) is in the “AUTO” position.

Note: An active shutdown fault will show a FLASHING shutdown indicator. Any active shutdown fault must be deactivated in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. To permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the fault must not be occurring. Also, the ECS must be turned to the OFF/RESET position. If the jumper that electrically connects terminal 6 to terminal 9 is not installed on the ECS, then the GSC+ will not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Press “Service Mode” key in order to enter service mode. “OP1” is showing on the lower display. See Systems Operation, “Service Mode” for more information.
2. Press the “SCROLL UP” key four times.“OP3” is showing.
3. Press the “SELECT” key. “P E _ _ _ _ _” is showing on the display. The first dash is flashing.
4. Press “SCROLL RIGHT” key. “P E 1 _ _ _ _” is showing on the display. The second dash is flashing.
5. Press “SCROLL DOWN” key. “P E 1 3 _ _ _” is showing on the display. The third dash is flashing.
6. Press “SCROLL UP” key. “P E 1 3 2 _ _ ” is showing on the display. The fourth dash is flashing.
7. Press “SCROLL DOWN” key. “P E 1 3 2 3 _” is showing on the display. The fifth dash is flashing.
8. Press “SCROLL RIGHT” key. “P E 1 3 2 3 1” is showing.
9. Press “ENTER” key. “P E PASS” is showing.
10. Press “EXIT” key. “OP 4” is showing.

Note: Once the password is entered, any option can be accessed until service mode is exited.

i01175154

Fault Log Clearing OP4

SMCS Code: 4490; 7451

Fault Log Clearing OP4

OP4 is the option for clearing an inactive fault from the fault log of the GSC+. After a diagnostic fault is investigated and/or the fault is corrected, the fault should be cleared from the fault log. Fault log clearing helps prevent confusion during future service calls. After all diagnostic faults are cleared and the GSC+ is in normal mode, the “DIAG” indicator is not shown on the upper display. See Systems Operation, “Fault Log Viewing OP1” for more information.

Procedure for Clearing Faults

Note: Service Mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

Note: A active shutdown indicator will be FLASHING. Active shutdown indicators must be deactivated in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. Permanently changing a shutdown fault from an active shutdown fault requires correcting the active shutdown fault. The ECS must be turned to the OFF/RESET position in order to correct the active shutdown fault. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Turn the ECS to the STOP position in order to shut down the engine. Enter service mode and enter the password. “OP 4” is showing on the lower display. See Systems Operation, “Password Entry OP3” for more information on entering the password.

2. Press “SELECT” key. The CID FMI fault code and the number of occurrences are showing. The lower display shows the hour meter data of the first occurrence of the fault and the last occurrence of the fault.

3. Press “SELECT” key. The CID FMI fault code, the hour meter data, and the number of faults will flash.

4. Press and hold “ENTER” key for two seconds. If there is only one CID FMI fault code, the CID FMI fault that was flashing disappears and the upper display is blank except for the flashing “SERV” indicator. “OP1” is showing on the lower display. Proceed to the next step. If there is more than one CID FMI fault code, the CID FMI that was flashing disappears. The upper display shows the next CID FMI fault code, the number of faults, and the hour meter data. Repeat steps 3 and 4 until all faults are erased. The lower display then shows OP 1. Proceed to step 5 .

5. Press “EXIT” key. “OP 1” is showing on the lower display.

6. Press “EXIT” key. The display is now in normal mode.

i01175191

Engine/Generator Programming OP5-0

SMCS Code: 4490; 7451

OP5-0 is the option for programming the engine/generator setpoints. The engine/generator setpoints affect the proper operation and serviceability of the engine, and the accuracy of information shown on the display. The setpoints are programmed in the GSC+ at the factory.

The setpoints may require changing when the GSC+ is moved from one engine to another engine. The setpoints may also require changing in order to satisfy the customer’s requirements. The setpoints that are stored in the GSC+ must match the specified setpoints of the particular generator set. The setpoints are P001 to P033 and the setpoints are programmable. The setpoints are described in the OP5-0 Setpoints. Refer to Table 5.

Procedure For Engine/Generator Programming

Note: Service Mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

Note: Any active shutdown fault must be made inactive in order to access service mode. When a shutdown fault is active, a shutdown indicator is FLASHING. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. To permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the shutdown fault must be no longer occurring. The fault must be corrected and the ECS must be turned to the OFF/RESET position. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in the OFF/RESET position and any active shutdown fault must be corrected before entering service mode.

1. Turn the ECS to the STOP position in order to shut down the engine. Enter service mode and enter the password. “OP4” is showing on the lower display. For more information, see Systems Operation, “Password Entry OP3”.

2. Press “SCROLL UP” key again. “OP5-0” is showing on the lower display.

3. Press “SELECT” key again. “P001” is showing on the display. “P001” is followed by the value of the setpoint.

4. Press the “SCROLL UP” key or the “SCROLL DOWN” key. The next setpoint is showing with the value of the setpoint. Repeat this step until the desired setpoint is showing.

5. Press the “SELECT” key. The value of the setpoint is flashing.

6. Press the “SCROLL UP” key or press the “SCROLL DOWN” key in order to adjust the value of the setpoint.

Note: Press and hold the appropriate “SCROLL” key in order to rapidly scroll through a large range of values.

7. Press the “ENTER” key. The value of the setpoint stops flashing. Repeat steps 4, 5, 6, and 7 until all the desired setpoints are adjusted.

8. Press “EXIT” key. “OP 1” is showing on the lower display.

9. Press “EXIT” key. The display will return to the normal mode.

Table 5

OP5-0 Setpoints for Engine/Generator Programming[1]				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P001	Fuel Solenoid Type	Type of fuel system solenoid that is used on the generator set.	0 - ETR fuel solenoid 1 - ETS fuel solenoid	0
P002	Units Shown	Type of measurement units shown on the GSC+ display.	0 - English units (psi, degrees F) 1 - Metric units (kPa, degrees C)	0
P003	Shutdown Override For Engine Fault	GSC+ responds to a low engine oil pressure or high coolant temperature fault. (Determined by application or customer.)	0 - engine shutdown 1 - alarm only (shutdown override, no engine shutdown)	0
P004	Shutdown Enable For Sensor Fault	GSC+ responds to a diagnostic fault with the engine oil pressure sensor, coolant temperature sensor, oil temperature sensor, sensor power supply or coolant loss sensor. (Determined by application or customer.)	0 - alarm only (shutdown override, no engine shutdown) 1 - for engine shutdown	0
P005	Coolant Loss Sensor Installed	Tells whether or not the optional engine coolant loss sensor is installed on the generator set.	0 - generator sets without sensor 1 - generator sets with sensor	0
P006	Shutdown Override For Coolant Loss Fault	GSC+ responds to an engine coolant loss fault. (Determined by application or customer.)	0 - engine shutdown 1 - alarm only (shutdown override, no engine shutdown.)	0
P007	System Voltage 24 Or 32 Volts	System voltage (battery voltage) of the generator set. (Determined by application or customer.)	24 or 32	24
P008	N/A	This setpoint is not currently being used by the GSC+ and cannot be programmed.	N/A	N/A
P009	Number Of Ring Gear Teeth	Number of teeth on the ring gear engine. Used by the GSC+ to determine engine speed.	95 to 350 teeth in increments of 1	136 teeth
P010	Engine Overspeed	Engine speed used by the GSC+ to declare that an engine overspeed fault exists. The engine overspeed setpoint (for all 60 Hz applications) is 1.18 times the rated speed.	500 to 4330 rpm in increments of 10	2120 rpm
P011	Crank Terminate Speed	Engine speed used by the GSC+ to disengage the starting motor during engine cranking.	100 to 1000 rpm in increments of 10	400 rpm
P012	Oil Step Speed	Engine speed used by the GSC+ for distinguishing between rated speed and idle speed when a low oil pressure fault exists.	400 to 1800 rpm in increments of 10	1350 rpm
P013[2]	Low Oil Pressure Shutdown At Rated Speed	Oil pressure used by the GSC+ to declare that a low oil pressure shutdown fault exists with engine at rated speed (the engine must have exceeded the oil step speed for at least nine seconds).	34 to 420 kPa (5 to 61 psi) in increments of 1	205 kPa (30 psi)

(continued)

(Table 5, contd)

OP5-0 Setpoints for Engine/Generator Programming[1]				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P014[2]	Low Oil Pressure Shutdown At Idle Speed	Oil pressure used by the GSC+ to declare that a low oil pressure shutdown fault exist with the engine at idle speed (the engine must have been running for at least nine seconds and the engine speed must be less than oil step speed).	20 to 336 kPa (3 to 49 psi) in increments of 1	70 kPa (10 psi)
P015[3]	High Water Temperature Shutdown	Coolant temperature used by the GSC+ to declare a high coolant temperature shutdown fault exists (after a 10 second delay).	85 to 123°C (185 to 253°F) in increments of 1	107°C (225°F)
P016	Low Water Temperature Alarm	Coolant temperature used by the GSC+ to declare that a low temperature alarm fault exists (after a 2 second delay). (Determined by application or customer.)	0 to 36°C (32 to 97°F) in increments of 1	21°C (70°F)
P017	Total Cycle Crank Time	Cycle crank time used by the GSC+ to declare that an overcrank fault exists. (Determined by application or customer.)	5 to 360 seconds in increments of 1	90 seconds
P018	Cycle Crank Time	Amount of time the GSC+ cranks and then rests the starting motor during a single crank cycle. Determined by application of customer.)	5 to 300 seconds in increments of 1	10 seconds
P019	Cooldown Time	Amount of time the GSC+ allows the engine to run after a normal shutdown is initiated. (Determined by application or customer.)	0 to 30 minutes in increments of 1	5 minutes
P020[4]	AC Voltage	Full scale AC voltage of the generator. The GSC+ measures the AC voltage and shows it on the display. (Determined by application or customer.)	700, 150, 300, 500, 600, 750, 3.0k, 4.5k, 5.25k, 9.0k, 15.0k, 18.0k, 30.0k	700
P021	AC Current Full Scale	AC current full scale is the ratio of the current transformers (CT) based on a 5A secondary. It does not represent the maximum AC current of the generator. The GSC+ measures the current and shows it on the display.	75, 100, 150, 200, 300, 400, 600, 800, 1000, 1200, 1500, 2000, 2500, 3000, 4000A	600A
P022[5]	GSC+ Engine Number	Informs other devices on the CAT Data Link (for example, CCM) of the engine number for the GSC+ (Determined by application or customer).	01 through 08	01
P023	Engine Type	Identifies the engine as a mechanical unit injector (MUI) diesel, spark ignited (gas), or electronic unit injector (EUI) diesel engine.	0 - MUI diesel 1 - Gas 2 - EUI diesel	0
P024[6]	Crank Time Delay	Amount of time the GSC+ delays activation of the fuel control relay (FCR) during a crank cycle. This setpoint is for gas engines only. (Determined by application or customer.)	0 to 20 seconds in increments of 1	5 seconds
P025	Oil Temperature Sensor Installed	Tells whether or not the optional engine oil temperature sensor is installed on the generator set.	0 - generator sets without an oil temperature sensor 1 - generator sets with an oil temperature sensor	0
P026	High Oil Temperature Shutdown	Oil temperature used by the GSC+ to declare a high oil temperature shutdown fault exists (after a 10 second delay).	85 to 123°C (185 to 253°F) in increments of 1	107°C (225°F)

(continued)

(Table 5, contd)

OP5-0 Setpoints for Engine/Generator Programming[1]				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P027	Shutdown Override For High Oil Temperature Fault	GSC+ responds to an engine high oil temperature fault. (Determined by application or customer.)	0 - alarm only (shutdown override, no engine shutdown) 1 - engine shutdown	0
P028	Nameplate Voltage	Rated voltage of the generator. This setpoint is used for protective relaying functions.	100V to 25kV in increments of 1	480V
P029	Nameplate Current	Rated current output of the generator.	0 to 4000A in increments of 1	600A
P030	Nameplate Power	Rated power capability of the generator.	0 through 10MW in increments of 1kW	400kW
P031	Rated Frequency	Nominal frequency rating of generator set.	50, 60 or 400Hz	60Hz
P032	Connection Configuration Of Generator	Wye or delta configuration of generator.	0 - wye 1 - delta	0
P033[7]	Number Of Generator Poles.	Number of generator poles.	0 through 254 in increments of 2	4

(1) The setpoints that are stored or the setpoints that are being programmed must match the specified setpoints of the particular generator set.
(2) When oil pressure drops to within 34 kPA (5 psi) of the “P013” or “P014”setpoint, a low oil pressure alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).
(3) When coolant temperature rises to within 6°C (11°F) of the “P015 ”setpoint, a high water temperature alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).
(4) The values other than the default (700V) are for switchgear applications and require the use of external potential transformers and the removal of the AC voltage range jumper located in the relay module. See Testing And Adjusting, “AC Voltage Range Selection”.
(5) After setpoint P022 is reprogrammed, the GSC+ must be power cycled (powered down and then powered up).
(6) The P024 setpoint only functions when the P023 setpoint is set to 1 (gas engine).
(7) When P033 is programmed to 0 poles, the AL15 fault (GSC+ Configuration Error) is disabled.

i01175207

Protective Relaying Programming OP5-1

SMCS Code: 4490; 7451

Protective Relaying Programming

OP5-1 is the option for the programming of the protective relaying setpoints. When one or more of the protective relay functions occur, the protective relaying setpoints determine the response of the GSC+. The GSC+ provides the protective relaying function in order to reduce the possibility of damage to the generator. The protective relaying functions are used in order to reduce the possibility of damage to the customer’s equipment. The setpoints are programmed in the GSC+ at the factory to the default values. The setpoints may be changed in order to satisfy the requirements of the customer. The setpoints are from P101 to P142 and the setpoints are programmable. Each of the setpoints is described in Table 6.

Procedure For Protective Relaying Programming

Note: Service Mode cannot be accessed when the engine control switch (ECS) is in the AUTO position.

Note: An active shutdown fault is indicated by a FLASHING shutdown indicator . An active shutdown fault must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the shutdown fault must no longer be occurring. The fault must be corrected. The ECS must be returned to the OFF/RESET position. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Turn the ECS to the STOP position in order to shut down the engine. Enter service mode and enter the password. “OP 4” is showing on the lower display. For more information, see System Operation, “Password Entry OP3”.

2. Press “CROLL UP” key two times. “OP5-1” is showing on the lower display.

3. Press “SELECT” key once. “P101” is showing. “P101” is followed by the value of the setpoint.

4. Press the “SCROLL UP” key or the “SCROLL DOWN” key. The next setpoint is showing with the setpoint value. Repeat this step until the desired setpoint is showing.

5. Press “SELECT” key. The value of the setpoint is flashing.

6. Press the “SCROLL UP” or the “SCROLL DOWN” key in order to adjust the value of the setpoint.

Note: In order to rapidly scroll through a large range of values, press and hold the appropriate “SCROLL” key.

7. Press “ENTER” key. The value of the setpoint stops flashing. Repeat steps 4 , 5, 6 and 7 until all the desired setpoints are adjusted.

8. Press “EXIT” key. “OP 1” is showing on the lower display.

9. Press “EXIT” key. The display returns to normal mode.

Table 6

OP5-1 Setpoints (1) - Protective Relaying Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P101	Overvoltage Alarm Enable	The GSC+ enables the generator alarm function or the GSC+disables the generator alarm function.	0 - disabled 1 - enabled	1
P102	Overvoltage Alarm Threshold	Voltage the GSC+ uses to issue an overvoltage alarm.	100 to 125% of nameplate voltage in increments of 1%	105%
P103	Overvoltage Alarm Time Delay	Amount of time the GSC+ waits before issuing an overvoltage alarm.	0 to 120 seconds(2) in increments of 1	10 seconds
P104	Overvoltage Shutdown Enabled	The GSC+ enables or disables the generator overvoltage shutdown function.	0 - disabled 1 - enabled	1
P105	Overvoltage Shutdown Threshold	Voltage the GSC+ uses to issue an overvoltage shutdown.	100 to 125% of nameplate voltage in increments of 1%	110%
P106	Overvoltage Shutdown Time Delay	Amount of time the GSC+ waits before inssuing an overvoltage shutdown.	0 to 120 seconds(2) in increments of 1	10 seconds
P107	Undervoltage Alarm Enable	The GSC+ enables or disables the generator undervoltage alarm function.	0 - disabled 1 - enabled	1
P108	Undervoltage Alarm Threshold	Voltage the GSC+ uses to issue an undervoltage alarm.	60 to 100% of nameplate voltage in increments of 1%	90%
P109	Undervoltage Alarm Time Delay	Amount of time the GSC+ waits before inssuing an undervoltage alarm.	0 to 120 seconds(2) in increments of 1	10 seconds

(continued)

(Table 6, contd)

OP5-1 Setpoints (1) - Protective Relaying Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P110	Undervoltage Shutdown Enable	The GSC+ enables or disables the generator undervoltageshutdown function.	0 - disabled 1 - enabled	1
P111	Undervoltage Shutdown Threshold	Voltage the GSC+ uses to issue an undervoltage shutdown.	60 to 100% of nameplate voltage in increments of 1%	85%
P112	Undervoltage Shutdown Time Delay	Amount of time the GSC+ waits before issuing an undervoltage shutdown.	0 to 120 seconds(2) in increments of 1	15 seconds
P113	Overfrequency Alarm Enable	The GSC+ enables or disables the generator overfrequency alarm function.	0 - disabled 1 - enabled	1
P114	Overfrequency Alarm Threshold	Frequency that the GSC+ uses to issue an overfrequency alarm.	50 to 60, for 50 Hz GEN 60 to 70 , for 60 Hz Gen 400 to 480, for 400 Hz Gen	53 Hz 63 Hz 422 Hz
P115	Overfrequency Alarm Time Delay	Amount of time the GSC+ waits before issuing an overfrequency alarm.	0 to 120 seconds(2) in increments of 1	10 seconds
P116	Overfrequency Shutdown Enable	The GSC+ enables or disables the generator overfrequency shutdown function.	0 - disabled 1 - enabled	1
P117	Overfrequency Shutdown Threshold	Frequency the GSC+ uses to issue an overfrequency shutdown.	50 to 60, for 50 Hz Gen 60 to 70, for 60 Hz Gen 400 to 480, for 400 Hz Gen	55Hz 63 Hz 422 Hz
P118	Overfrequency Shutdown Time Delay	Amount of time the GSC+ waits before issuing an overfrequency shutdown.	0 to 120 seconds(2) in increments of 1	10 seconds
P119	Underfrequency Alarm Enable	The GSC+ enables or disables the generator underfrequency alarm function.	0 - disabled 1 - enabled	1
P120	Underfrequency Alarm Threshold	Frequency the GSC+ uses to issue an underfrequency alarm.	30 to 50, for 50 Hz Gen 60 to 70, for 60 Hz Gen 240 to 400, for 400 Hz Gen	45 Hz 54 Hz 360 Hz
P121	Underfrequency Alarm Time Delay	Amount of time the GSC+ waits beforeissuing an underfrequency alarm.	0 to 120 seconds(2) in increments of 1	10 seconds
P122	Underfrequency Shutdown Enable	The GSC+ enables or disables the generator underfrequency shutdown function.	0 - disabled 1 - enabled	1
P123	Underfrequency Shutdown Threshold	Frequency the GSC+ uses to issue an underfrequency shutdown.	30 to 50, for 50 Hz Gen 36 to 60, for 60 Hz Gen 240 to 400, for 400 Hz Gen	45 Hz 54 Hz 360 Hz
P124	Underfrequency Shutdown Time Delay	Amount of time the GSC+ waits before issuing an underfrequency shutdown.	0 to 120 seconds(2) in increments of 1	15 seconds
P125	Reverse Power Shutdown Enable	The GSC+ enables or disables the generatorreverse power shutdown function.	0 - disabled 1 - enabled	1
P126	Reverse Power Shutdown Threshold	Level of reverse power the GSC+ uses to issue a reverse power shutdown.	0 to 20% of nameplate power in increments of 1%	15%
P127	Reverse Power Shutdown Time Delay	Amount of time the GSC+waits before issuing a reverse power shutdown.	0 to 30 seconds(2) in increments of 1	10 seconds

(continued)

(Table 6, contd)

OP5-1 Setpoints (1) - Protective Relaying Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
P128	Overcurrent Alarm Enable	The GSC+ enables or disables the overcurrent alarm.	0 - disabled 1 - enabled	1
P129	Phase Overcurrent Alarm Threshold	Level of current the GSC+ uses to issue a phase overcurrent alarm.	100 to 160% of nameplate current in increments of 5%	105%
P130	Phase Overcurrent Alarm Time Delay	Amount of time the GSC+ waits before issuing a phase overcurrent alarm.	0 to 250 seconds(2) in increments of 1	20 seconds
P131	Total Overcurrent Alarm Threshold	Level of current the GSC+ uses to issue a total overcurrent alarm.	100 to 160% of three times nameplate current in increments of 5%	105%
P132	Total Overcurrent Alarm Time Delay	Amount of time the GSC+ waits before issuing a total overcurrent alarm.	0 to 250 seconds(2) in increments of 1	20 seconds
P133	Overcurrent Shutdown Ecable	The GSC+ enables or disables the overcurrent shutdown.	0 - disabled 1 - enabled	1
P134	Phase Overcurrent Shutdown Threshold	Level of current the GSC+ uses to issue a phase overcurrent shutdown.	100 to 160% in increments of 5%	110%
P135	Phase Overcurrent Shutdown Time Delay	Amount of time the GSC+ waits before issuing a phase overcurrent shutdown.	0 to 250 seconds(2) in increments of 1	30 seconds
P136	Total Overcurrent Shutdown Threshold	Level of current the GSC+ uses to issue a total overcurrent shutdown.	100 to 160% of three times nameplate current in increments of 5%	110%
P137	Total Overcurrent Shutdown Time Delay	Amount of time the GSC+ waits before issuing a total overcurrent shutdown.	0 to 250 seconds(2) in increments of one.	30 seconds
P138	KW Level Relay Enable	The GSC+ enables or disables the kW level relay function.	0 - disabled 1 - enabled	1
P139	KW Level Relay Threshold	Level of power the GSC+ uses to activate the kW level relay function.	0 to 110% of nameplate power in increments of 1%	105%
P140	KW Level Relay Time Delay	Amount of time the GSC+ waits before activating the kW relay function.	0 to 120 seconds(2) in increments of 1	0 seconds
P141	KW Level Relay Disengage Threshold	Level of power the GSC+ uses deactivate the kW level relay function.	0 to 110% of nameplate power in increments of 1%	100%
P142	KW Level Relay Disengage Time Delay	Amount of time the GSC+ waits before deactivating the kW level relay function.	0 to 120 seconds(2) in increments of 1	10 seconds

(1) The setpoints are programmed at the factory to the default value. The setpoints may be changed in order to satisfy the customer or the application's requirements.

(2) When programmed to 0 seconds, the actual time is from 0.5 to 1.0 seconds.

i01175243

Spare Input/Output Programming OP6

SMCS Code: 4490; 7451

OP6 is the option for programming of the spare inputs. OP6 is the option for programming the spare output. These spare inputs and spare outputs are provided in order to satisfy the needs of the customer.

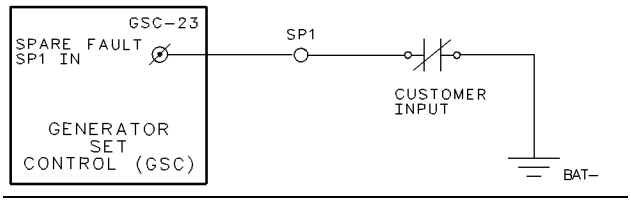
Spare Inputs

The spare inputs are referred to as SP1, SP2, SP3, and SP4. The spare inputs are accessed on the terminal strip within the control panel on the rear wall. The terminations at the terminal strip for the spare inputs are listed below.

- SP1 Shown as SW1
- SP2 Shown as SW2

- SP3 Shown as SW3
- SP4 Shown as SW4

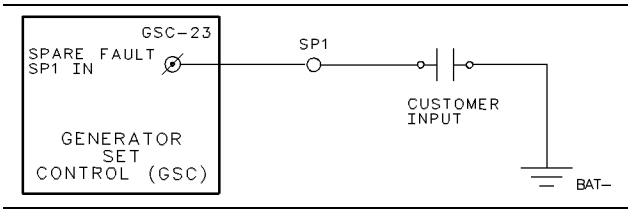
The active input state, response taken and time delay for each spare input is programmable. The GSC+ responds to the active state of an input and the response can be delayed. The setpoints SP01 through SP12 are used for the programming of the spare inputs. Table 7 describes each of the setpoints.



g00525961

Illustration 34

Typical Active High Input Configuration For Spare Input 1 (SP1)



g00525969

Illustration 35

Typical Active Low Input Configuration For Spare Input 1 (SP1)

Setpoints SP01, SP04, SP07 and SP10 are used for programming the active input state of the spare inputs. Table 7 describes each of the setpoints.

Note: If an input is left floating, the internal circuitry of the GSC+ pulls the input high and the GSC+ responds accordingly. An example of a floating input is an open switch.

The GSC+ must be programmed for a response to an active spare fault. The GSC+ responds by treating the condition as either a fault shutdown or a fault alarm. Setpoints SP02, SP05, SP08 and SP11 are used for the programming of the response. Table 7 describes each of the setpoints.

Note: Spare faults that are programmed to shutdown are ignored by the GSC+ when engine speed is less than crank termination speed.

The GSC+ must be programmed for the amount of time to delay the response to a spare fault (active input). After a spare fault occurs, the GSC+ does not respond until the time delay has elapsed. Indicators are not activated and codes are not shown. Engine operation does not change. Setpoints SP03, SP06, SP09 and SP12 are used for the programming of the time delay. The time delay is selectable from 0 to 250 seconds. Table 7 describes the setpoints.

Alarm Mode Sequence Of Operation – When a fault occurs in a spare input and the fault is programmed as an alarm fault, the GSC+ will respond in the following manner:

Shutdown Mode Sequence Of Operation – The following sequence occurs when a fault occurs in a spare input (input active) and the fault is programmed as a shutdown fault.

1. The GSC+ waits for the time delay.
2. The fault shutdown indicator FLASHES.
3. The corresponding code SP1, SP2, SP3 or SP4 is immediately shown on the upper display of the GSC+.
4. The engine is shutdown or the engine is disabled from starting.

The fault shutdown indicator remains FLASHING and the spare fault code remains shown until the engine control switch (ECS) is turned to OFF/RESET. After the ECS is turned to OFF/RESET and after the cause of the spare fault is corrected, the engine is able to start and the engine is able to run.

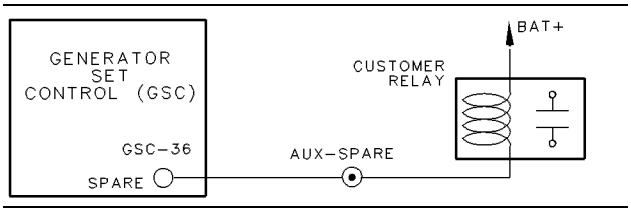
Note: Spare faults are not logged into the GSC+ fault log.

Note: If you do not want to use the spare inputs, program the spare inputs for a LOW active state. Connect nothing to the spare input wiring.

Spare Indicators

The spare indicators are located on the face of the GSC+. The spare indicators are Spare 1, Spare 2, and Spare 3. The spare indicators are programmable. A large selection of trigger conditions is available to activate the spare indicators. Setpoints SP17, SP18, and SP19 are used for the programming of the trigger condition. Table 7 describes all of the setpoints.

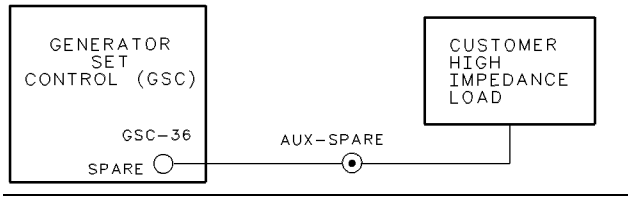
Spare Output



g00307942

Illustration 36

Typical Active Low Configuration For Spare Output



g00308023

Illustration 37

Typical Active High Configuration For Spare Output

The spare output responds to a selected trigger condition. The response and the trigger condition are programmable. The spare output is accessed on the terminal strip in the customer connection box on the side of the control panel. The spare output is marked as “SPARE” on the auxiliary terminal strip.

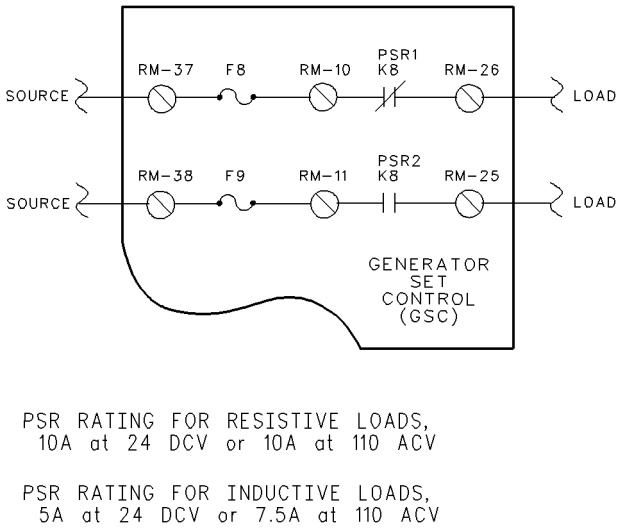
The GSC+ must be programmed to accept a high input or a low input for the active state of the spare output. An active low state means that the output is pulled to battery negative when the output is active. The output draws approximately 100 mA when the output is in the low state. An active high state means that the output will be allowed to float high. This is approximately 5.0 DCV when no devices are connected to the spare output. When the spare output is in the high state, the spare output is floating. The spare output is capable of driving high impedance logic circuits only. High impedance logic circuits are the circuits with the 36000 ohm minimum resistance. When the spare output is in the high state, the spare output will not drive low impedance loads such as relays. Setpoint SP13 is used for the programming of the active state of the spare output. Table 7 describes the setpoints.

The GSC+ must be programmed to accept the condition that triggers the spare output to the active state. A large selection of trigger conditions is available to activate the spare output. Setpoint SP14 is used for the programming of the trigger condition. Table 7 describes the setpoints.

Note: The spare output is usually used in order to activate the circuit breaker shunt trip coil during the engine cooldown.

Note: The GSC+ diagnoses a fault in the spare output circuit. See Testing And Adjusting, “CID 334 Spare Output”.

Programmable Spare Relay Outputs



g00633869

Illustration 38

Programmable Spare Relay (PSR)

The programmable spare relay outputs respond to a selected trigger condition. The response and the trigger condition are programmable. The programmable spare relay (K8) is located in the relay module on the rear of the GSC+. RM-25 is the termination for the programmable spare relay (PSR) that is normally open. RM-26 is the termination for PSR which is normally closed.

The GSC+ must be programmed to make the active state high or low. In a active state, the normally open contacts will close and the normally closed contacts will open. Setpoint SP15 is used for the programming of the active state of the programmable spare relay output. The setpoint is described in Table 7.

The condition that activates the spare output must be programmed in the GSC+. A large selection of trigger conditions is available in order to activate the programmable spare relay output. Setpoint SP16 is used for the programming of the trigger condition. The setpoint is described in Table 7.

Note: The GSC+ diagnoses a fault in the programmable spare relay output circuit. See Testing And Adjusting, “CID 448 FMI 12 Programmable Spare Relay Failed - Test”.

Procedure For Spare Input/Output Programming

Note: Service Mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

Note: Any active shutdown fault must be made inactive in order to access service mode. A shutdown fault is active when a shutdown indicator is FLASHING. In order to temporarily change a shutdown fault from an active shutdown fault to an inactive shutdown fault, turn the ECS to the OFF/RESET position. In order to permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the shutdown fault must no longer be occurring. The shutdown fault must be corrected and the ECS must be turned to the OFF/RESET position. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in OFF/RESET and any active shutdown fault must be corrected before entering Service Mode.

1. Turn the ECS to the STOP position in order to shut down the engine. Enter service mode and enter the password. “OP 4” is showing on lower display. For more information, see Systems Operation, “Password Entry OP3”.

2. Press the “SCROLL UP” key three times. “OP 6” is showing on the lower display.

3. Press the “SELECT” key. “SP01” is showing. “SP01” is followed with the value of the setpoint.

4. Press the “SCROLL UP” or the “SCROLL DOWN” key. The next setpoint with the value of the setpoint is showing. Repeat this step until the desired setpoint is showing.

5. Press the “SELECT” key. The value of the setpoint is flashing.

6. Press the “SCROLL UP” key or the “SCROLL DOWN” key in order to adjust the value of the setpoint.

7. Press the “ENTER” key. The value of the setpoint stops flashing. Repeat steps 4, 5, 6 and 7 until all the desired setpoints are adjusted.

8. Press the “EXIT” key. “OP 1” is showing on the lower display.

9. Press the “EXIT” key. The display returns to the normal state.

Table 7

OP6-0 Setpoints(1) - Spare Input/Output Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
SP01	Spare Input 1 Active State	Input state used by the GSC+ to declare that a SP1 fault exists.	0 - active low 1 - active high	0
SP02	Spare input 1 Response	GSC+ response to a SP1 fault.	0 - shutdown 1 - alarm	0
SP03	Spare Input 1 Time Delay	Amount of time the GSC+ waits before responding to a SP1 fault.	0 to 250 seconds in increments of 1	0 seconds
SP04	Spare Input 2 Active State	Input state used by the GSC+ to declare that a SP2 fault exists.	0 - active low 1 - active high	0
SP05	Spare Input 2 Response	GSC+ response to a SP2 fault	0 - shutdown 1 - alarm	0
SP06	Spare Input 2 Time Delay	Amount of time the GSC+ waits before responding to a SP2 fault.	0 to 250 seconds in increments of 1	0
SP07	Spare Input 3 Active State	Input state used by the GSC+ to declare that a SP3 fault exists.	0 - active low 1 - active high	0
SP08	Spare Input 3 Response	GSC+ response to a SP3 fault.	0 - shutdown 1 - alarm	0
SP09	Spare Input 3 Time Delay	Amount of time the GSC+ waits before responding to a SP3 fault.	0 to 250 seconds in increments of 1	0 seconds
SP10	Spare Input 4 Active State	Input state used by the GSC+ to declare that a SP4 fault exist.	0 - active low 1 - active high	0
SP11	Spare Input 4 Response	GSC+ response to a SP4 fault.	0 - shutdown 1 - alarm	0
SP12	Spare Input 4 Time Delay	Amount of time the GSC+ waits before responding to a SP4 fault.	0 to 250 seconds in increments of 1	0 seconds
SP13	Spare Output Response	GSC+ response to the spare output trigger condition.	0 - active low 1 - active high	0
SP15	Spare Relay Output Response	GSC+ response to the spare relay trigger condition.	0 - relay inactive when triggered 1 - relay active when triggered	1

(continued)

(Table 7, contd)

OP6-0 Setpoints[1] - Spare Input/Output Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
SP14	Spare Output Trigger Condition	The condition used by the GSC+ to trigger the spare output trigger response.	0 - unused 1 - active SP1 fault[2] 2 - active SP2 fault[2] 3 - active SP3 fault[2] 4 - active SP4 fault[2] 5 - any combination of active SP1, SP2, SP3 or SP4 faults[2] 6 - any active shutdown fault (AL1 - AL14, SP1 - 4, or CID FMI) 7 - any active alarm or shutdown fault (AL1 - 15, SP1 - 4, or CID FMI) 8 - cooldown mode 9 - coolant loss fault[2] 10 - high oil temperature fault[2] 11 - CCM control[3]	8
SP16	Spare Relay Output Trigger Condition	The condition used by the GSC+ to trigger the spare relay.		
SP17	Spare Indicator 1 Trigger Condition	The condition used by the GSC+ to trigger spare indicator 1.	0 - unused 1 - active SP1 fault[2] 2 - active SP2 fault[2] 3 - active SP3 fault[2] 4 - active SP4 fault[2] 5 - any combination of active SP1, SP2, SP3 or SP4 faults[2] 6 - coolant loss fault[2] 7 - high oil temperature fault[2]	0
SP18	Spare Indicator 2 Trigger Condition	The condition used by the GSC+ to trigger Spare Indicator 2.		
SP19	Spare Indicator 3 Trigger Indicator	The condition used by the GSC+ to trigger spare indicator 3.		

(1) The setpoints are programmed at the factory to the default value. The setpoints may be changed to satisfy customer or applicationrequirements.
(2) Either alarm or shutdown faults are valid trigger conditions.
(3) When SP14 is programmed to 11 (CCM control), the spare output is always active low. When SP16 is programmed to 11 (CCM control), the spare relay is always active when triggered.

i01175519

Hourmeter Programming OP7

SMCS Code: 4490; 7451

The hourmeter programming (OP7) is not available for programming on EUI engines. The engine setpoint (P23) is programmable to one of the setpoints that follows:

- MUI engine (0)
- Gas Engine (1)
- EUI engine (2)

When the engine setpoint (P23) is programmed as an EUI engine (2), the value for the hourmeter on the display is determined by the engine electronic control module (ECM) instead of by the GSC+.

i01175531

Voltmeter/Ammeter Programming OP8

SMCS Code: 4490; 7451

Table 8

OP8 Setpoints[1] - Voltmeter Ammeter Programming				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
AC01	Phase A (VA) Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase A voltage transformer within the ATB+.	0 to 255 in increments of 1	0
AC02	Phase B (VB) Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase B voltage transformer within the ATB+.	0 to 255 in increments of 1	0
AC03	Phase C (VC) Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase C voltage transformer within the ATB+.	0 to 255 in increments of 1	0
AC04	Phase A (IA) Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase A current transformer within the ATB+.	0 to 255 in increments of 1	0
AC05	Phase B (IB) Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase B current transformer within the ATB+.	0 to 255 in increments of 1	0
AC06	Phase C (IC) Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase C current transformer within the ATB+.	0 to 255 in increments of 1	0

[1] The setpoints are programmed at the factory to the calibration value listed on the bar code sticker of the ATB+.

OP8 is the option for programming the calibration value of the voltmeter and ammeter. When the GSC+ or the AC transformer box (ATB) is replaced, the calibration values must be programmed into the GSC+. The calibration values are written on the ATB bar code. This ensures accurate voltage values and accurate current values.

There are six transformers in the ATB. TheGSC+ monitors the transformers for information on voltage and current. Each transformer has individual characteristics that affect the voltage and current measurements by the GSC+. At the factory, these characteristics are measured. A value is then recorded on the bar code. This is located on the lower left side of the ATB. When the generator set is assembled at the factory, the calibration values on the bar code sticker are programmed into the GSC+. The calibration value of a transformer is from 0 to 255 in increments of 1.

Procedure For Voltmeter/Ammeter Programming

Note: Service Mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

Note: Any active shutdown fault must be made inactive in order to access Service Mode. To temporarily change a shutdown fault from an active shutdown to an inactive shutdown fault, turn the ECS to the OFF/RESET position. To permanently change a shutdown fault from an active shutdown fault to an inactive shutdown fault, the fault must not be occurring. Also, the ECS must be turned to the OFF/RESET position. If the jumper from terminal 6 to terminal 9 is not installed on the ECS, the GSC+ does not power up in OFF/RESET and any active shutdown fault must be corrected before entering service mode.

1. Turn the ECS to the STOP position in order to shut down the engine. Enter service mode and enter the password. OP 4 is showing on the lower display. For more information, see Systems Operation, “Service Mode”for more information. See the Systems Operation, “Password Entry OP3”for more information.

2. Press the “SCROLL UP” key five times. “OP 8” is showing on the lower display.

3. Press the “SELECT” key. “AC01” is showing. The value of the setpoint is also showing. The value will be between 0 to 255.

4. Press the “SELECT” key. The value of the setpoint is flashing.

5. Press the “SCROLL UP” or the “SCROLL DOWN” key in order to adjust the value of the AC01 setpoint. Match the value that is shown on the ATB+ with the line voltage (A) to the line voltage (B).

6. Press the “ENTER” key. The value of the setpoint stops flashing.

7. Press the “SCROLL UP” key. Repeat steps **3**, **4**, **5** and **6** for setpoints AC02 through AC06.

8. Press the “EXIT” key. “OP 1” is showing on the lower display.

9. Press the “EXIT” key. The display will return to the Normal Mode.

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Engine Setpoint Verification OP9

SMCS Code: 4490; 7451

OP9 is the option for verifying that the EMCP II+ operates correctly when a fault occurs with low oil pressure, high coolant temperature or engine overspeed. An engine overspeed fault causes the GSC+ to shut off the engine. When a low oil pressure fault or a high water temperature fault is detected the GSC+ will shut off the engine or the GSC+ will sound the alarm according to the programmed setpoint P003. Setpoint P003 is the shutdown override setpoint for an engine fault.

OP9 is only for verification of certain engine setpoints. OP5-0 is used for the actual programming of these setpoints. The setpoints that are verified by this procedure are listed below.

P003 Shutdown Override For Engine Fault – P003 is the GSC+ response to a low engine oil pressure. P003 is also the response to a high coolant temperature fault. 0 is for engine shutdown. If P003 is set to 1 then the alarm responds only. The GSC+ will override engine shutdown. The default value for P003 is 0.

P010 Engine Overspeed – The GSC+ uses setpoint P010 in order to show an engine overspeed fault. The engine overspeed setpoint is 1.18 times the rated speed for all 60 Hz applications. The values vary from 500 to 4330 rpm. The values are changed in increments of 10. The default value for P010 is 2120.

P013 Low Oil Pressure Shutdown At Rated Speed – The oil pressure is used by the GSC+ to declare that a low oil pressure shutdown fault exists with the engine at rated speed. The speed must have exceeded the oil step speed setting for at least nine seconds. The values vary from 34 to 420 kPa (5 to 61 psi). The increments increase with a value of 1. The default value for P013 is 205 kPa (30 psi).

Note: When the oil pressure drops to a level that is within 34 kPa (5 psi) of the P013 setpoint, a low oil pressure alarm is issued by the GSC+ and the optional alarm module.

P015 High Water Temperature Shutdown – The coolant temperature is used by the GSC+ to declare that a high coolant temperature shutdown fault exists after a 10 second delay. The values vary from 85 to 123°C (185 to 253°F). The increments increase with a value of 1. The default value for setpoint P015 is 107°C (225°F).

Note: A high water coolant temperature alarm is issued by the GSC+ when the coolant temperature rises to a level that is within 6°C (11°F) of the P015 setpoint.

The following conditions are required before the engine setpoints are verified.

- The previously listed setpoints must be correct for the engine application. See System Operation, “Service Mode” in order to view a list of the setpoints. See System Operation, “Setpoint Programming OP5” in order to program the setpoints.

- The engine is checked at rated speed. No faults should be present at the initial starting. If necessary, troubleshoot and correct any fault.

Procedure For Overspeed Verification

Note: Service mode cannot be accessed when the engine control switch (ECS) is in the AUTO position.

1. Start the engine and run the engine at rated speed. Enter service mode and enter the password. “OP 9” is showing on the lower display. See System Operation, “Password Entry OP3”.

2. Press the “SELECT” key. The value of the overspeed setpoint “P010” is showing on the upper display. The default value for P010 is 2120. “SC1” is showing on the lower display. “SC1” is followed with the present engine speed value.

3. Press “SELECT” key. The setpoint value is flashing on the upper display.

4. Decrease the setpoint value by pressing the “SCROLL DOWN” key. The default setpoint value is 2120. The default value is flashing on the upper display. The setpoint value decreases by 10 rpm with each press of the scroll down key. Press the “SCROLL DOWN” key until the setpoint value is past the present engine speed value that is showing on the display.

When the setpoint value is less than the present engine speed value, the engine will shut down. The engine overspeed indicator will flash. The GSC+ will no longer be in the service mode.

Procedure For Oil Pressure Verification

Note: Service mode cannot be entered when the ECS is in the AUTO position.

1. Start the engine and run the engine at rated speed. Enter service mode and enter the password. “OP 9” is showing on the lower display. See System Operation, “Password Entry OP3” for more information about entering the password.

2. Press “SELECT” key. The value of the overspeed setpoint P010 is showing on the upper display. The default value for P010 is 2120. “SC1” is showing on the lower display. The present engine speed value is then shown on the display.

3. Press the “SCROLL UP” key once. The value of the P013 setpoint for low oil pressure shutdown at rated speed is showing on the upper display. 205 kPa (30 psi) is the default value. The present oil pressure value is shown on the display.

4. Press “SELECT” key. The setpoint value is flashing on the upper display.

5. The setpoint value that is flashing on the upper display is increased by pressing the “SCROLL UP” key. With each press of the “SCROLL UP” key, the setpoint value increases by five. Press the “SCROLL UP” key until the setpoint value is past the present value that is showing on the lower display.

When the setpoint value is greater than the present oil pressure value, the engine shuts down. The indicator for low oil pressure should be flashing. The GSC+ should not be in service mode.

Procedure For High Water Temperature Verification

Note: Service mode cannot be entered when the ECS is in the AUTO position.

1. Start the engine and run the engine at rated speed. Enter service mode and enter the password. “OP 9” is showing on the lower display. See System Operation, “Password Entry OP3”.

2. Press “SELECT” key. The value of overspeed setpoint “P010” is showing on the upper display. The default value of the overspeed setpoint is 2120. “SC1” is showing on the lower display. “SC1” is followed with the present engine speed value.

3. Press the “SCROLL UP” key two times. The value of the P015 setpoint for high water temperature shutdown is showing on the upper display. The default value for setpoint P015 is 107°C (225°F). “P015” is showing on the upper display. “SC3” is then shown on the lower display which is followed by the present coolant temperature value.

4. Press the “SELECT” key. The setpoint value is flashing on the upper display.

5. The setpoint value that is flashing on the upper display is decreased by pressing the “SCROLL DOWN” key. With each press of the “SCROLL DOWN” key, the setpoint value decreases by five degrees. Continue pressing the “SCROLL DOWN” key until the setpoint value decreases past the present coolant temperature value that is showing on the lower display.

The engine shuts down and the high water temperature indicator begins flashing when the setpoint value is less than the present coolant temperature value. The GSC+ is no longer in service mode.

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AC Offset Adjustment OP10

SMCS Code: 4490; 7451

Table 9

OP10 Setpoints[1] - AC Offset Adjustment				
Setpoint	**Name**	**Description**	**Range Of Value**	**Factory Default**
PH A	Phase A Voltage Adjustment	Value used by the GSC+ in order to offset the voltmeter (for the phase A to neutral reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0
PH B	Phase B Voltage Adjustment	Value used by the GSC+ to offset the voltmeter (for the phase B to neutral reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0
PH C	Phase C Voltage Adjustment	Value used by the GSC+ to offset the voltmeter (for the phase C to neutral reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0
PH A-B	Phase A-B Voltage Adjustment	Value used by the GSC+ to offset the voltmeter (for the phase A to phase B reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0
PH B-C	Phase B-C Voltage Adjustment	Value used by the GSC+ to offset the voltmeter (for the phase B to phase C reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0
PH C-A	Phase C-A Voltage Adjustment	Value used by the GSC+ to offset the voltmeter (for the phase C to phase A reading) from the actual voltage measurement.	–5.0% to +5.0% of measured voltage in increments of 0.04%	0

(1) The setpoints are programmed to the default value at the factory. The setpoints may be changed in order to satisfy the requirements of the customer or the requirements of the application.

OP10 is used in order to adjust the voltmeter readings of the GSC+. The GSC+ AC voltages are calibrated at the factory. The measurements of AC voltage should never require adjustment.

Note: Caterpillar does NOT recommend altering the AC voltmeter. Performing this procedure reduces the accuracy of the GSC+ voltmeter.

Note: The adjusted voltages are used for the display only. The adjusted voltages will not be sent over the CAT Data Link to other modules. The customer communication module is another module that may receive information over the CAT Data Link. The adjusted voltages are not used in order to determine the fault thresholds for the protective relaying function. The GSC+ determines the values that are not adjusted in both cases. The values that are not adjusted for AC voltage are not shown in both cases. The values that are not adjusted will be used instead of the displayed values.

Procedure For AC Offset Adjustment

The adjusted voltages and the adjusted currents are shown on the left side of the upper display. The percentage of the offset is shown on the right side of the upper display. The user can adjust each voltage and current up to ±5.0% in increments of 0.04%.

Note: Service Mode cannot be entered when the engine control switch (ECS) is in the AUTO position.

1. Start and run the engine at rated speed. Enter service mode and enter the password. “OP9” is showing on the lower display. See System Operation, “Password Entry OP3” for more information.
2. Press the “SCROLL UP” key once. “OP 10” is showing on the lower display.
3. Press “SELECT” key. “AC CAL” is showing on the lower display. The voltage in phase “A” is showing on the left side of the upper display. The voltage in phase “A” is line to neutral voltage.
4. Press “SELECT” key. The offset percentage value is flashing on the right side of the upper display.
5. Press the “SCROLL UP” key or press the “SCROLL DOWN” key in order to adjust the voltage value to the desired value. The percentage value continues flashing.
6. Press “ENTER” key. The percentage value display will stop flashing.
7. Press “SCROLL UP” key. Repeat steps 3, 4, 5 and 6 for the other setpoints.
8. Press the “EXIT” key. “OP 1” is showing on the lower display.
9. Press the “EXIT” key. The display returns to the normal mode.

i01175651

Fault Description

SMCS Code: 4490; 7451

A fault is any condition that does not conform to the rules that the GSC+ operates. A fault can be active or a fault can be inactive. An active fault is a fault that is occurring now. An inactive fault is a fault that has previously occurred. Some examples of faults are listed below.

- Coolant temperature is 123°C (254°F). This is a high water temperature fault.
- Engine speed is 4500 rpm. This is an engine overspeed fault.
- There is a broken wire in the engine harness. This is a diagnostic fault.
- There is a failed oil pressure sensor. This is a diagnostic fault.

An amount of severity is attached to every fault. The amount of severity also describes the GSC+ response to a fault. Faults are either alarm faults or shutdown faults. Alarm faults are not critical. Shutdown faults are critical.

An alarm fault provides the operator with an early warning to the operator of a possible future shutdown fault. For an alarm fault, the GSC+ automatically activates alarm mode and the fault alarm indicator FLASHES. See System Operation, “Alarm Mode” for further information.

A shutdown fault tells the GSC+ to shutdown the engine in order to prevent engine damage. The GSC+ automatically activates shutdown mode which shuts down the engine. The GSC+ then flashes the corresponding indicator. See System Operation, “Shutdown Mode” for more information.

Most faults have a code. There are three types of fault codes. The type is obtained from the GSC+ input that is involved. The three types of fault codes are listed below.

AL Fault Codes – The AL fault codes are shown as AL1 through AL15 on the upper display. The AL fault codes include specific engine conditions. An example of an AL fault code is the low engine oil pressure alarm. AL fault codes also include protective relaying functions. Another example of an AL fault code is the underfrequency fault.

SP Fault Codes – The SP fault codes are shown as SP1 through SP4 on the upper display.

Diagnostic Fault Codes – Diagnostic fault codes are shown as numeric values. Diagnostic fault codes are identified by the illumination of the letters CID and the letters FMI on the upper display.

There is an exception. There are no fault codes for the shutdown faults that correspond to the dedicated shutdown indicators. The shutdown faults are identified to the operator by the nearest dedicated fault shutdown indicator. Low oil pressure is an example of a dedicated shutdown indicator.

i01175659

AL Fault Codes

SMCS Code: 4490; 7451

AL fault codes are shown as AL1 through AL15 on the upper display. The fault codes include specific engine fault conditions. An example of an engine fault condition is the low engine oil pressure fault. The fault codes also include protective relaying functions. The underfrequency fault is an example of a protective relaying function.

AL fault codes rely upon certain setpoints. See System Operation, “Service Mode” for more information on setpoints. AL fault codes are not stored in the fault log of the GSC+. Many of the AL fault codes are programmable as a fault alarm or as a shutdown fault. In order to show the severity of the fault, the AL fault codes are accompanied by a fault alarm indicator. Also, the fault shutdown indicator on the GSC+ can accompany an AL Fault Code. The AL fault codes and the related setpoints are described in the paragraphs that follow.

AL1 High Water Temperature Alarm – The GSC+ issues a high water temperature shutdown when the engine coolant temperature signal rises within 6°C (11°F) of setpoint P015. The fault alarm indicator will FLASH. The AL1 fault code is shown on the upper display after the “Alarm Fault Codes” key is pressed.

P015 is the setpoint for a high water temperature shutdown. This setpoint sets the coolant level temperature. The GSC+ uses the temperature in order to declare that a high water temperature shutdown fault is present. When the setpoint is reached, the dedicated shutdown indicator for high water temperature FLASHES and the engine is shutdown.

AL2 Low Water Temperature Alarm – When the engine coolant temperature decreases to setpoint P16, the GSC+ issues a low water temperature alarm. Setpoint P016 is the setpoint for the low water temperature alarm. The fault alarm indicator will FLASH and the AL2 fault code is shown on the upper display after the “Alarm Codes” key is pressed.

P016 is the setpoint for a low water temperature alarm. P016 alerts the GSC+ that a low water temperature alarm fault (AL2) exists.

AL3 Low Engine Oil Pressure Alarm – The GSC+ issues a low oil pressure alarm when the engine oil pressure drops within 34 kPa (5 psi) of the P013 setpoint or the P04 setpoint. The fault alarm indicator will FLASH and the “AL3” fault code is shown on the upper display after the “Alarm Codes” key is pressed.

P013 is the setpoint for low oil pressure shutdown at engine rated speed. This setpoint alerts the GSC+ when a low oil pressure fault exists at the rated speed of the engine. When the setpoint is reached, the dedicated shutdown indicator for low oil pressure flashes and the engine is shut down.

P014 is the setpoint for low oil pressure shutdown at idle speed. Setpoint P014 tells the GSC+ when a low oil pressure shutdown fault exists at idle speed of the engine. When the setpoint is reached, the dedicated shutdown indicator for low oil pressure FLASHES and the engine is shutdown.

AL4 Fault Detected By Engine ECM – The AL4 fault occurs when the electronic control module (ECM) for the engine detects an alarm fault or a shutdown fault. The engine ECM tells the GSC+ whether the AL4 fault is an alarm fault or a shutdown fault. This includes faults that derate the engine. The engine ECM is programmed so that the engine will not lower the engine horsepower. The occurrence of an AL4 fault code could mean that the engine ECM is not programmed correctly. Proceed to Troubleshooting Service Module. The AL4 fault (P023) is disabled on MUI engines and gas engines.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the “AL4” fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL4” fault code is shown on the upper display after the alarm codes key is pressed.

AL5 Low Engine Coolant Level Fault – The GSC+ issues a low coolant level warning AL5 when the engine coolant level is below the coolant loss sensor. The GSC+ can be programmed to treat this fault as an alarm, or a shutdown P006. The GSC+ can be programmed to treat this fault as disabled P005. The GSC+ can be programmed to light one of the spare fault indicators when this fault occurs. The spare fault indicators are located on the front of the GSC+. The GSC+ waits for 10 seconds before a low coolant level fault is issued.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL5" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL5" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

AL6 High Engine Oil Temperature Fault – When the engine's oil temperature increases above the setpoint P026 (oil temperature threshold), the GSC+ issues a high engine oil temperature fault. The GSC+ can be programmed to treat this fault as an alarm (P027), a shutdown, or the fault can be disabled (P025). The GSC+ can be programmed for SP17, SP18, or SP19 to light one of the spare fault indicators on the GSC+ when this fault occurs.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL6" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL6" fault is shown on the upper display after the "Alarm Codes" key is pressed.

AL7 Generator Overvoltage Fault (protective relaying function) – When the line to line voltage between any two phases of the generator rises above the P102 or the P105 setpoints, the GSC+ issues an overvoltage fault. The GSC+ can be programmed as P101 to enable this fault as an alarm. The GSC+ can be programmed as P104 to enable this fault as shutdown. The fault is programmable with a time delay of 0 to 120 seconds P103, P106 . The fault threshold (P102, P103) is adjustable. This is adjustable within 100 percent to 125 percent of the nameplate voltage. (P028).

The fault thresholds and time delays can be independently programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL7" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL7" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

Note: If the AC offset adjustment OP10 has been performed, then the adjusted voltages are NOT used for determining the protective relaying funtion fault thresholds. The values that are not adjusted for AC voltage are still determined by the GSC+ but not displayed. The displayed values will not be used.

AL8 Generator Undervoltage Fault (protective relaying function) – The GSC+ issues an undervoltage fault when the line to line voltage between any two phases of the generator drop below the setpoints P108 or the P111. The GSC+ can be programmed to enable this fault as an alarm P107. The GSC+ can also be programmed to enable this fault as a shutdown P110. The fault can be programmed with a 0 to 120 seconds delay P109, P112. The fault threshold (P108, P111) is adjustable. This can be adjusted within 60 to 100 percent of the nameplate voltage (P028).

The fault thresholds and time delays can be programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL8" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault the fault alarm indicator will FLASH and "AL8" is shown on the upper display after the "Alarm Codes" key is pressed.

Note: The AL8 fault is disabled when the engine control switch (ECS) is in the STOP/COOLDOWN position.

Note: If the AC offset adjustment OP10 has been performed, then the adjusted voltages are NOT used for determining the protective relaying funtion fault thresholds. The values that are not adjusted for AC voltage are still determined by the GSC+ but not displayed. The displayed values are not used.

AL9 Generator Over Frequency Fault (protective relaying function) – When the generator's frequency rises above the setpoints P113 or P117, the GSC+ issues an overfrequency fault. The GSC+ can be programmed to enable this fault as an alarm P113. The GSC+ can be programmed to enable this fault as a shutdown P116. The fault can be programmed with a 0 to 120 seconds delay P115, P118. The fault threshold can be adjusted from 60 to 72 Hz in 60 Hz applications P114, P117. The fault threshold can be adjusted from 50 to 60 Hz in 50 Hz applications P114, P117.

The fault thresholds and time delays can be independently programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL9" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault shutdown indicator will FLASH and the "AL9" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

Note: The frequency displayed on the GSC+ will FLASH when the generator's frequency is greater than 70 Hz or equal to 70 Hz .

AL10 Generator Underfrequency Fault (protected relaying function) – When the generator's frequency drops below the P120 or the P123 setpoints, the GSC+ issues an underfrequency fault. The GSC+ can be programmed to enable this fault as an alarm P121. The GSC+ can be programmed to enable this fault as a shutdown P124. The fault can be programmed with a 0 to 120 seconds delay. The fault threshold can be adjusted from 36 to 60 Hz in 60 Hz applications P114, P117. The fault threshold can be adjusted from 30 to 50 Hz in 50 Hz applications P120, P123.

The fault thresholds and time delays can be independently programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL10" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL10" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

Note: The AL10 fault is disabled when the ECS is in the STOP/COOLDOWN position.

AL11 Generator Reverse Power Fault (protective relaying function) – When reverse power rises above the P126 setpoint, the GSC+ issues a reverse power fault. The GSC+ can also be programmed to enable this fault as a shutdown P125. The fault can be programmed with a 0 to 30 seconds delay P127. The fault threshold (P126) is adjustable within 0 to 20 percent of the nameplate power (P130).

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL11" fault code is immediately shown on the upper display.

AL12 Generator Phase Overcurrent Fault (protective relaying function) – When any current rises above the P129 or the P134 setpoints, the GSC+ issues a phase overcurrent fault. The GSC+ can be programmed to enable this fault as an alarm P128. The GSC+ can also be programmed to enable this fault as a shutdown P133. The fault can be programmed with a 0 to 250 seconds delayP130, P135. The fault thresholds (P129, P134) are adjustable within 100 to 160 percent of the nameplate current (P029).

The fault thresholds and time delays can be independently programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL12" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL12" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

AL13 Generator Total Overcurrent Fault (protective relaying function) – The GSC+ issues a total over current fault when the sum of all the phase's current rises above the setpoints P131, P136. The GSC+ can be programmed to enable this fault as an alarm P128. The GSC+ can also be programmed to enable this fault as a shutdown P133. The fault can be programmed with a 0 to 120 seconds delay P132, 137. The fault thresholds (P131, P136) are adjustable within 100 to 160 percent of the nameplate current rating (P029).

The fault thresholds and time delays can be independently programmed in order to allow the alarm fault to serve as an early warning and a shutdown fault. This requires enabling the fault as both an alarm fault and a shutdown fault.

When the fault is programmed as a shutdown fault, the fault shutdown indicator will FLASH and the "AL13" fault code is immediately shown on the upper display.

When the fault is programmed as an alarm fault, the fault alarm indicator will FLASH and the "AL13" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

AL14 Phase A No Voltage Input Fault (protective relaying function) – When the phase A voltage is not received at the GSC+ input connector (GSC+ contact 10), the GSC+ issues a phase A no voltage input fault. The phase A voltage input is needed to accurately measure the generator's output. The power metering functions and the AC frequency measurement may be reduced. GSC+ treats a lost voltage input on phase A as an alarm fault. This response is not programmable.

When this fault occurs, the fault alarm indicator will FLASH and the "AL14" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

AL15 GSC+ Configuration Error – The GSC+ checks the relationship between the frequency of the generator output voltage and the engine speed. This relationship is shown in the formula below.

frequency (hertz) = (number of generator poles X rpm) / 120

The GSC+ treats a configuration error as an alarm fault. This response is not programmable. This fault is corrected by programming the proper values into setpoints P009 (number of ring gear teeth) and P033 (number of generator poles).

When this fault occurs, the fault alarm indicator will FLASH and the "AL15" fault code is shown on the upper display after the "Alarm Codes" key is pressed.

Note: If setpoint P033 (number of generator poles) is set to 0, the AL15 fault is disabled.

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SP Fault Codes

SMCS Code: 4490; 7451

SP fault codes are associated with the spare inputs. SP fault codes are either alarm faults or shutdown faults. The four spare inputs and a spare output are provided in order to meet the needs of the customer. The spare inputs are programmable to the active state, to the severity, and to the delay time. See System Operation, "Spare Input/Output Programming OP6". The spare inputs and the corresponding SP fault codes are referred to as SP1, SP2, SP3, and SP4.

Alarm Mode Sequence Of Operation – The following procedure happens when a fault occurs in a spare input (the active input) and the fault is programmed as an alarm fault.

1. The GSC+ waits for the time delay.
2. The fault alarm indicator FLASHES.
3. When the alarm codes key is pressed, the corresponding code SP1, SP2, SP3, or SP4 is shown on the upper display.
4. The engine continues to run or the engine is able to start.

Shutdown Mode Sequence Of Operation – The following sequence happens when a fault occurs in a spare input and the fault is programmed as a shutdown fault.

1. The GSC+ waits for the time delay.
2. The fault shutdown indicator FLASHES.
3. The corresponding code SP1, SP2, SP3, or SP4 is immediately SHOWN on the upper display of the GSC+.
4. The engine is shut down or the engine is disabled from starting.

Note: Spare faults are not logged into the GSC+ fault log.

Note: Spare faults that are programmed to shutdown are ignored by the GSC+ when the engine speed is less than crank terminate speed.

i01175797

Diagnostic Codes

SMCS Code: 4490; 7451

Diagnostic codes are associated with failed electrical components or circuits. These components or circuits provide information to the GSC+ or the components or circuits receive information from the GSC+. The diagnostic codes are designated as alarm faults or shutdown faults. See Systems Operation, “Shutdown Mode”for more information. See Systems operation, “Alarm Mode”for more information.

Alarm Mode Sequence Of Operation – When an alarm fault occurs, the GSC+ performs the following steps.

- The GSC+ activates the alarm mode.
- The fault alarm indicator FLASHES.
- When the alarm codes key is pressed, the corresponding diagnostic code (CID FMI) is shown on the upper display.
- The engine continues to run or the engine is able to start.

Shutdown Mode Sequence Of Operation – When a shutdown fault occurs, the GSC+ performs the following steps.

1. The GSC+ activates shutdown mode.

2. The fault shutdown indicator FLASHES.

3. The corresponding diagnostic code (CID FMI) is immediately shown on the upper display.

4. The engine is shut down or the engine cannot be started.

The diagnostic code (CID FMI) closely identifies the cause of the fault. Each diagnostic code consists of two identifiers and an indicator. The identifiers are shown on the upper display. Service personnel interpret the identifiers in order to assist with troubleshooting.

The indicators are listed below.

Component Identifier (CID) – The CID is a three digit code. The code that is indicated corresponds to a faulty component. The CID is shown on the upper display. For example, a “190” is the code for the engine magnetic speed sensor’s circuit. See the Testing And Adjusting, “Troubleshooting Diagnostic Codes” for a list of diagnostic codes.

Control System Identifier – The control system identifier is a single digit. The possible control systems that can generate a diagnostic code are the engine ECM and the GSC+. An “E” shows that the engine ECM has generated the diagnostic code. If no “E” is present, the diagnostic code was generated by the GSC+.

Failure Mode Identifier (FMI) – The FMI is a two digit code. The FMI tells the type of failure that has occurred. The FMI is shown on the upper display at the same time as the CID. For example, FMI “3” means that the signal voltage is too high. See Testing And Adjusting, “Troubleshooting Diagnostic Codes” for a list of failure mode identifiers.

DIAG indicator – When “DIAG” is FLASHING, the diagnostic code (CID FMI) that is shown on the upper display is active. When “DIAG” is ON CONTINUOUSLY, there is an inactive diagnostic fault. The diagnostic codes are recorded in the fault log. Also, see Systems Operation, “Fault Log Viewing OP1”. When “DIAG” is not showing, there are NO diagnostic codes that have been detected.

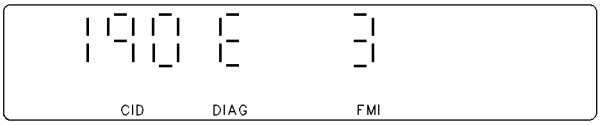


Illustration 39 g00475773

Upper Display That Is Showing A “CID 190 E FMI 3” Diagnostic Code

The above example shows that the engine ECM has diagnosed a fault. Also, that fault is sending the information to the GSC+ for display. The engine ECM is receiving a signal from the engine speed sensor (CID 190). The signal is too high so the FMI is 3. The signal is being received at this time so “DIAG” is FLASHING. If the diagnostic code is an “E”, refer to Troubleshooting, SENR1003, “3500B EPG Engines”.

Note: The GSC+ response (alarm or shutdown) to four diagnostic faults is programmable by service personnel. The response that is usually programmed into the GSC+ is for an alarm. P04 would then be “0”. When a shutdown response is programmed, P04 would be “1”. See Setpoint P04 within Systems Operation, “Engine/Generator Programming OP5”. The following diagnostic codes are diagnostic faults: pressure sensor (engine oil) (CID 100), temperature sensor (engine coolant) (CID 110), fluid level sensor (engine coolant) (CID 111), and sensor power supply (CID 269).

The GSC+ has a fault log to help with troubleshooting of diagnostic faults. Inactive diagnostic codes (CID FMI) are recorded in the fault log for viewing at a later time. Also, the number of occurrences are totalled. The number of occurrences are shown on the upper display. The diagnostic codes are also shown on the upper display. An active diagnostic alarm fault is signified by “DIAG” FLASHING on the upper display. When a diagnostic alarm fault becomes inactive, “DIAG” is ON CONTINUOUSLY. When the fault is no longer occurring, the ECS must be turned to “OFF/RESET”. When a diagnostic shutdown fault becomes inactive, “DIAG” is ON CONTINUOUSLY. When the fault is no longer occurring, the ECS must be turned to “OFF/RESET”. The GSC+ stores a maximum of 12 diagnostic codes in the fault log.

If an additional diagnostic fault becomes inactive, the GSC+ automatically clears the earliest diagnostic code. The GSC+ puts the additional diagnostic code in the fault log. Inactive diagnostic codes that are more than 750 engine hours old are cleared automatically by the GSC+. Only diagnostic codes are recorded in the fault log. AL fault codes and SP fault codes are not recorded in the fault log. See Systems Operation, “Fault Log Viewing OP1”.

Clear diagnostic codes from the fault log after correcting the fault. Clearing old codes will help avoid confusion. When all diagnostic faults are cleared from the fault log and no active diagnostic faults exist, the DIAG indicator is OFF. See Systems Operation, “Fault Log Clearing OP4” .

i01175832

Programmable Spare Relay Outputs

SMCS Code: 4490; 7451

The programmable spare relay is one of the relays that is located in the relay module that is on the rear of the GSC+. The programmable spare relay outputs respond to a selected trigger condition. The response and the trigger condition are programmable.

The GSC+ (setpoint SP15) must be programmed. The programmable spare relay outputs are active or inactive. In an active state, the normally open contacts will close and the normally closed contacts will open.

The condition that triggers the programmable spare relay outputs to the active state must be programmed in the GSC+ (setpoint SP16). The possible trigger conditions that can activate the programmable spare relay outputs are listed in System Operation, “Spare Input/Output Programming OP6”.

See System Operation, “Spare Input/Output Programming OP6” for more information on programming the setpoints for this output.

Note: The GSC+ diagnoses a fault in the spare output circuit. See Testing and Adjusting, “CID 448, FMI 12 Programmable Spare Relay Failed-Test” for more information.

i01175838

Programmable Spare Output

SMCS Code: 4490; 7451

The spare output responds to a selected trigger condition. The response is high or low. The response and the trigger condition are programmable.

The GSC+ spare outputs response must be programmed as a active high or as active low (setpoint SP13). When the output is active, an active low pulls the output. The output is pulled toward the B-. The output draws a maximum of 100 mA when the output is in the low state. The active high is approximately 5.0 DCV when no devices are connected to the spare output. The spare output is able to drive logic circuits with high impedance (36 000 ohm minimum). The spare output will not drive low impedance loads such as relays.

The setpoint SP14 must be programmed to the condition that triggers the spare output to the active state. The possible trigger conditions that can activate the spare output are listed in System Operation, “Spare Input/Output Programming OP6”.

See System Operation, “Spare Input/Output Programming OP6” for more information on programming the setpoints for the output.

Note: Using the spare output to activate the shunt trip coil of the AC circuit breaker during engine cooldown is common.

Note: The GSC+ diagnoses a fault in the spare output circuit. See Testing And Adjusting, “CID 334 Spare Output”.

i01175850

Programmable Kilowatt Level Output

SMCS Code: 4490; 7451

g00633889

Illustration 40

Typical Circuit for kW Level Output

The programmable kilowatt level output is a feature that can be enabled by programming setpoint P138. The programmable kilowatt level output can be disabled by programming setpoint P138. The programmable kilowatt level output draws a maximum of 100 mA when the programmable kilowatt level output is active. When the programmable kilowatt level output is inactive, the programmable kilowatt level output is pulled to B+. The programmable kilowatt level output (GSC+ connector contact 34) will be activated whenever the total power output of the generator passes the programmed threshold (setpoint P139). This threshold can be programmed from 0 percent to 110 percent of the nameplate power setpoint (P030). A time delay can be programmed from 0 seconds to 120 seconds (setpoint P140).

Once the programmable kilowatt level output is activated, the programmable kilowatt level output will be deactivated when the total power output of the generator drops below a programmed threshold (setpoint P141). The programmed threshold and the activation threshold are different. The threshold can be programmed from 0 percent to 110 percent of the total power rating of the generator. A deactivation time delay can be programmed from 0 seconds to 120 seconds (setpoint P140).

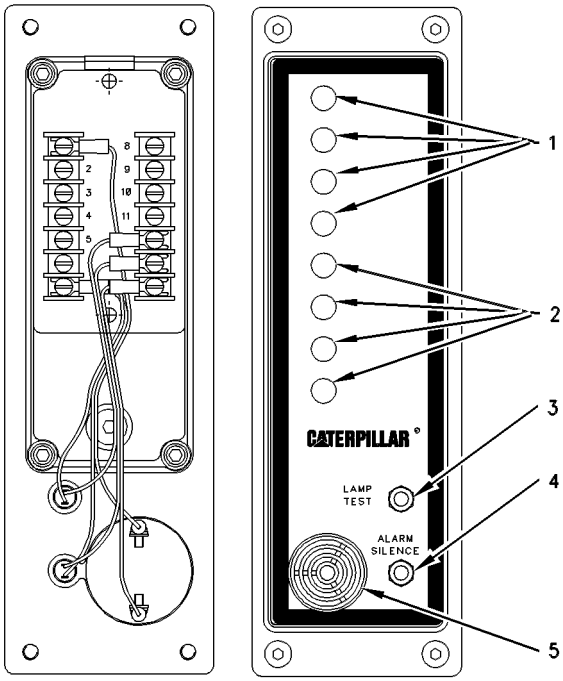
See System Operation, “Engine/Generator Programming OP5-0” for more information.

Note: The GSC+ diagnoses faults in the programmable kilowatt level output circuit. See Testing And Adjusting, “Diagnostic Codes”.

i01175888

Alarm Modules

SMCS Code: 4490; 7451



g00321237

Illustration 41

Alarm Module

(1)Amber indicators. (2)Red indicators.(3)Lamp test switch.(4)Alarm silence switch.(5)Horn.

The alarm module (ALM) is an attachment. The ALM is located on the instrument panel. Red indicators (2) and amber indicators (1) are the visual indicators. The horn (5) is the audible indicator. The ALM is designed to be powered by only a 24 DCV battery system or a 32 DCV battery system.

There are six versions of the basic module. The modules are either alarm modules or a remote annunciator. The term “remote annunciator” is used but the annunciator is the same basic alarm module. The versions are listed below.

- NFPA 99 Standby alarm module.
- NFPA 99 Remote annunciator which is used with a standby NFPA 99 Alarm module.
- NFPA 110 Standby alarm module which is used with NFPA 110 Remote annunciator panel. See Systems Operation, “Alarm Module Control (NFPA 110)”.

- Prime power single engine alarm module .
- Prime power multiple engine alarm module.
- EMCP II+ remote annunciator.

The only difference between these modules is in the graphics film on the front of the panel and the jumper wires on the rear. See the Testing And Adjusting, “DC Schematic”. The NFPA 99 remote annunciator and the remote annunciator for the EMCP II have a lamp test switch.

The alarm module (ALM) gives a warning of conditions that are becoming a problem. The warning occurs before conditions are severe enough to shut down the engine.

If an alarm fault develops with the ECS in the COOLDOWN/STOP or AUTO positions, then the fault is indicated by the optional alarm module and/or the remote annunciator.

Description of Change

Note: In the following description, the word “annunciator” may mean “alarm module” or “remote annunciator module”.

The annunciator module receives data from switch inputs, internal circuitry, and a serial data link from the GSC.

Switch Inputs

Four inputs are available as connections for the switch inputs. Switch inputs are activated when the inputs are connected to the “B–”. See Table 10.

Internal Circuitry

Internal circuitry is used in order to determine if the DC battery supply voltage is too low. The setpoint is set at the factory at 24 DCV.

Data Link

The annunciator module receives data from the generator set control (GSC) by a serial data link. The items that are included in this data stream of information are listed below.

1. Coolant temperature has exceeded the high temperature alarm setpoint that is programmed into the GSC.
2. Oil pressure is below the low oil pressure alarm setpoint that is programmed into the GSC.
3. Coolant temperature is below the setpoint for the low temperature alarm that is programmed into the GSC.
4. The engine control switch (ECS) is not in the MAN/START position or the AUTO position.
5. Oil pressure is below the setpoint for the low oil pressure shutdown that is programmed into the GSC.
6. Coolant temperature has exceeded the setpoint for the high water temperature shutdown that is programmed into the GSC.
7. The engine has failed to start.
8. The engine speed exceeded the setpoint for the engine overspeed that is programmed into the GSC.
9. The engine is shut down due to a coolant loss fault.
10. The engine shut down due to a spare fault.
11. The engine shut down due to an emergency stop fault.
12. The engine shut down due to a diagnostic fault.

The first eight items control the operation of the indicators and horn. See Table 10 for more information. The last four items control the operation of the horn only.

A maximum of three modules are connected to the serial data link: alarm, CIM, and RDM. The maximum distance between a module and the GSC is 305 m (1000 ft).

The data link will malfunction under the following conditions with multiple modules:

- One of the modules is powered down.
- The module that is powered down remains connected to the data link.

If the two conditions that are above are present, the indicators that are controlled by the data link of the other modules will flash at 0.5 Hz.

Indicator And Horn Operation

Table 10

Indicator And Horn Function						
Indicator Color	**NFPA 99 ALM**	**NFPA 100 ALM**	**NFPA 99 RAN**	**Prime Power Single Engine**	**Prime Power Multi Engine**	**EMCP RAN**
1 Amber	High Coolant Temp Alarm LI, H, LAT, TD	High Coolant Temp Alarm LI, H, LAT, TD	Gen On Load SW(3)	High Coolant Temp Alarm LI, H, LAT, TD	High Coolant Temp Alarm LI, H, LAT, TD	High Coolant Temp Alarm LI, H, LAT, TD
2 Amber	Low Coolant Temp Alarm LI, H, LAT	Low Coolant Temp Alarm LI, H, LAT	Low Coolant Temp Alarm LI, H, LAT	Low Coolant Level Alarm SW(2), H	Low Coolant Level Alarm SW(2), H	Low Coolant Temp Alarm LI, H, LAT
3 Amber	Low Oil Press Alarm LI, H, LAT	Low Oil Press Alarm LI, H, LAT	Charger Malfunction SW(4), TIM	Low Oil Press Alarm LI, H, LAT	Low Oil Press Alarm LI, H, LAT	Low Oil Press Alarm LI, H, LAT
4 Amber	Low Fuel Level SW(1), H	Low Fuel Level SW(1), H	Low Fuel Level SW(1), H	Low Oil Level SW(1), H	Low Oil Level SW(1), H	Not In Auto LI, H
5 Red	Not In Auto LI, H	Not In Auto LI, H	High Coolant Temp Shutdown(1) LI, H, TD	Low DCV INT, TIM	Not In Auto LI, H	High Coolant Temp Shutdown(1) LI, H, TD
6 Red	Low DCV INT, TIM	Low DCV INT, TIM	Low Oil Press Shutdown(1) LI, H	Spare SW(3)	Low DCV INT, TIM	Low DCV INT, TIM
7 Red	Spare SW(3)	Charger Malfunction SW(4), TIM	Overcrank Shutdown(1) LI, H	Not Used	Spare SW(3)	Overcrank Shutdown(1) LI, H
8 Red	Spare SW(4)	Air Damper Closed(2)	Overspeed Shutdown(1) LI, H	Not Used	Spare SW(4)	Overspeed Shutdown(1) LI, H

(1) Latched by the GSC
(2) Air Damper Switch to be supplied by customer.

Table 11

ALM = Alarm Module

H = Horn is sounded

INT = The signal source is internal to the module

LAT = LATCHED alarm fault

LI = The data link from the GSC is the signal source

RAN = Remote Annunciator

SW = One of 4 switches is the signal source (the number in parentheses indicates which switch is the signal source

TD = A 10 second delay occurs before the fault is annunciated

TIM = A 60 second delay occurs before the fault is annunciated

When an alarm fault occurs, the corresponding indicator flashes. The indicator flashes at two hertz and the horn sounds. If the alarm fault is NOT LATCHED, the indicator turns off when the alarm fault ceases. The horn also turns off when the alarm fault ceases. If the alarm fault is LATCHED, the indicator continues to flash until the “acknowledge/silence” input is activated. See Table 10 for LATCHED alarm faults as well as the indicator and horn functions for each operating mode.

Normally switch input 3 (terminal 10) and switch input 4 (terminal 11) only operate indicators 7 and 8. However, switch inputs 3 and 4 can be made to also operate the horn. Connect terminal 10 (“sw input 3”) to terminal 3 and connect terminal 11 (“sw input 4”) to terminal 4.

Alarm Silence

Activating the alarm silence switch (4) causes the horn to cease and the indicator to stay on continuously.

Data Link Malfunction

If the data link malfunctions, the indicators that are controlled by the data link flash at 0.5 hertz. The switch controlled indicators function normally.

Lamp Test

Activating the lamp test switch (3) results in sounding the horn and turning on all indicators continuously for 10 seconds or until the switch is deactivated.

Mode Selection

Table 12

Mode Selection And Switch Input Connections[1]						
Input	**Mode SEL1**	**Mode SEL2**	**Switch 1**	**Switch 2**	**Switch 3**	**Switch 4**
Terminal	**5**	**6**	**8**	**9**	**10**	**11**
Mode						
NFPA 99 Alarm	(Float)	(Float)	Low Fuel Level	(Float)	Spare	Spare
NFPA 110 Alarm	(Float)	(B-)	Low Fuel Level	(Float)	Air Damper Closed	Charger Malfunction
NFPA 99 Remote Annunciator	(B-)	(Float)	Low Fuel Level	(Float)	Gen On Load	Charger Malfunction
Prime Power Single Engine	(Float)	(Float)	Low Oil Level	(B-)	(Spare)	Low Coolant Level
Prime Power Multi Engine	(B-)	(B-)	Low Oil Level	Low Coolant Level	(Spare)	(Spare)
EMCP RAN	(Float)	(B-)	(Float)	(B-)	(Float)	(Float)

[1] NOTE: Connections in parentheses are required to select the mode specified

The annunciator module operates in one of the six modes described in Table 12. The modes are selected by connections made to the mode select inputs (terminals 5 and 6) and switch 2 input (terminal 9) as shown in Table 12.

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Alarm Module Control (NFPA 110)

SMCS Code: 4490; 7451

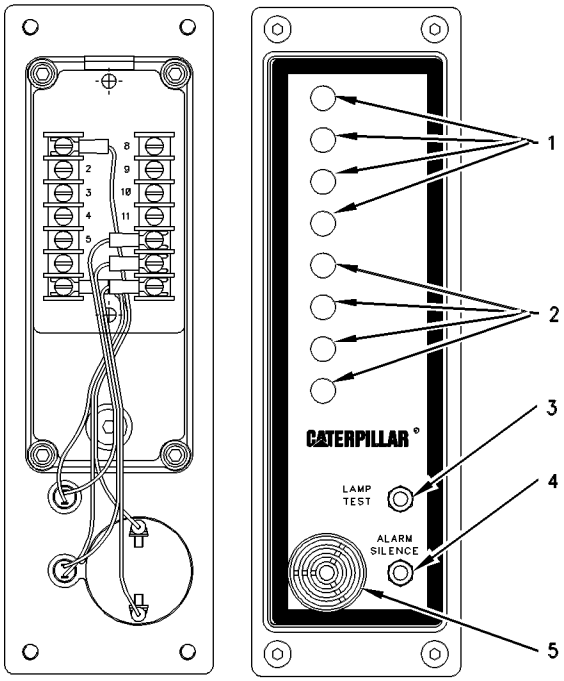

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Illustration 42

Alarm Module

(1) Amber Indicators
(2) Red Indicators
(3) Lamp Test Switch
(4) Alarm Silence Switch
(5) Horn

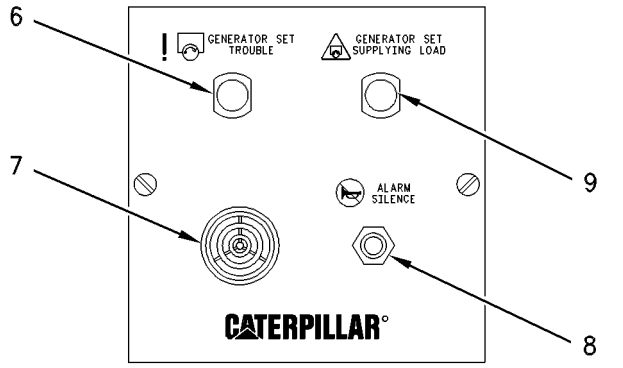

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Illustration 43

NFPA 110 Remote Annunciator Panel

(6) Alarm Indicator
(7) Horn
(8) Alarm Silence Switch
(9) Load Indicator

This remote panel functions in conjunction with the NFPA 110 alarm module. The alarm module is mounted in the right side of the instrument panel. When an alarm occurs on the alarm module or a fault occurs on the GSC+, horns (5) and (7) sound in both the alarm module and the remote annunciator. The alarm indicator (6) lights on the remote annunciator panel. The appropriate alarm indicator also lights in the alarm module or the appropriate fault indicator flashes in the GSC+. The remote annunciator is powered by 24 DCV battery systems or by 32 DCV battery systems.

The horns stop sounding when alarm silence switch (8) is pressed on the remote panel. Also, the horns stop sounding when alarm silence switch (4) is pressed on the alarm module. The alarm indicator (6) on the remote panel also goes out. The indicator on the alarm module or the indicator in the GSC+ remains on. Another alarm fault will reactivate the horns and indicators.

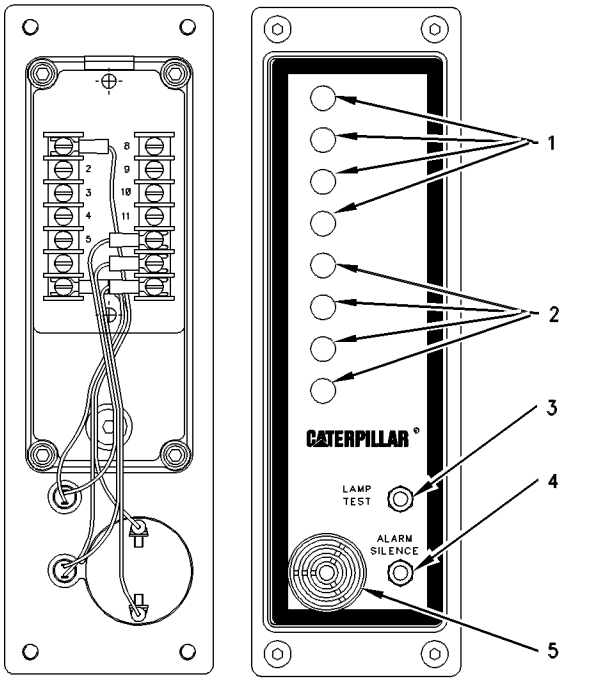
The alarm indicator (6) also acts as a test switch on the remote panel. When indicator (6) is pressed, horn (7) and indicator (6) turn on. The alarm module is not affected by the test switch.

Load indicator (9) is triggered by a transfer switch or by a similar device. When the transfer switch provides a ground signal, load indicator (9) is ON.

i01175945

Alarm Module Control (Custom)

SMCS Code: 4490; 7451



g00321237

Illustration 44

Custom Alarm Module (CAM)

(1) Amber indicators. (2) Red indicators. (3) Lamp test switch. (4) Alarm silence switch. (5) Horn.

Table 13

Connections For Customer Alarm Module	
Screw Terminal	**Signal**
1	“B+”
2	Not Used
3	Input 5 - Indicator 5 (Red)
4	Input 6 - Indicator 6 (Red)
5	Input 7 - Indicator 7 (Red)
6	Input 8 - Indicator 8 (Red)
7	“B–”
8	Input 1 - Indicator 1 (Amber)
9	Input 2 - Indicator 2 (Amber)
10	Input 3 - Indicator 3 (Amber)
11	Input 4 - Indicator 4 (Amber)
12	Lamp Test
13	Horn Silence
14	Horn output

The CAM is an attachment that can be mounted at the generator set or at a remote location. The CAM annunciates faults, alarms or other conditions. Customer supplied inputs give the CAM this information.

The CAM operates when the CAM is powered by a 24 DCV battery system or a 32 DCV battery system. The CAM is equipped with a horn, an alarm silence switch and a lamp test switch. 8 switched inputs are also provided for the customer to use.

Note: A basic version of the CAM also exists. The basic version does not have a horn, an alarm silence switch or a lamp test switch. The basic CAM should be used with an existing fully equipped CAM or an ALM.

Alarm Operation

A given switch input will correspond to 1 of 8 indicators on the face of the CAM. The indicators will FLASH at a rate of 2 hertz when the corresponding input is closed to the battery negative terminal. The red indicators are used to display shutdown conditions, and the amber indicators are used to display alarm conditions.

When an input that is corresponding to one of the red indicators is activated, the indicator will flash and the horn will sound. When the input is disconnected from the battery negative terminal, the horn will continue to sound and the red indicator will continue to flash until the alarm silence switch is pressed.

When an input that is corresponding to one of the amber indicators is activated, the indicator will flash but the horn does NOT sound. When the input is disconnected from the battery negative terminal, the amber indicator will turn off.

Alarm Silence Function

The alarm silence switch is activated by connecting the corresponding input to the battery negative terminal.

When an input is connected to the battery negative terminal, activating the alarm silence switch causes the horn to cease. The indicator stops flashing and the indicator changes to being ON continuously. The alarm silence function will be overridden if the following event occurs. The status of any of the eight switched inputs change. The change of status will cause additional inputs to be closed to the battery negative terminal.

The Alarm Silence Function will not be overridden if the change in status is the opening of any of the inputs from the battery negative terminal. The indicators will turn OFF when the corresponding input is disconnected from the battery negative terminal.

Lamp Test Function

Activating the “Lamp Test” switch results in sounding the horn and turning on all indicators continuously for 10 seconds or until the switch is deactivated. The “Lamp Test” input can be wired to the switch of another alarm module.

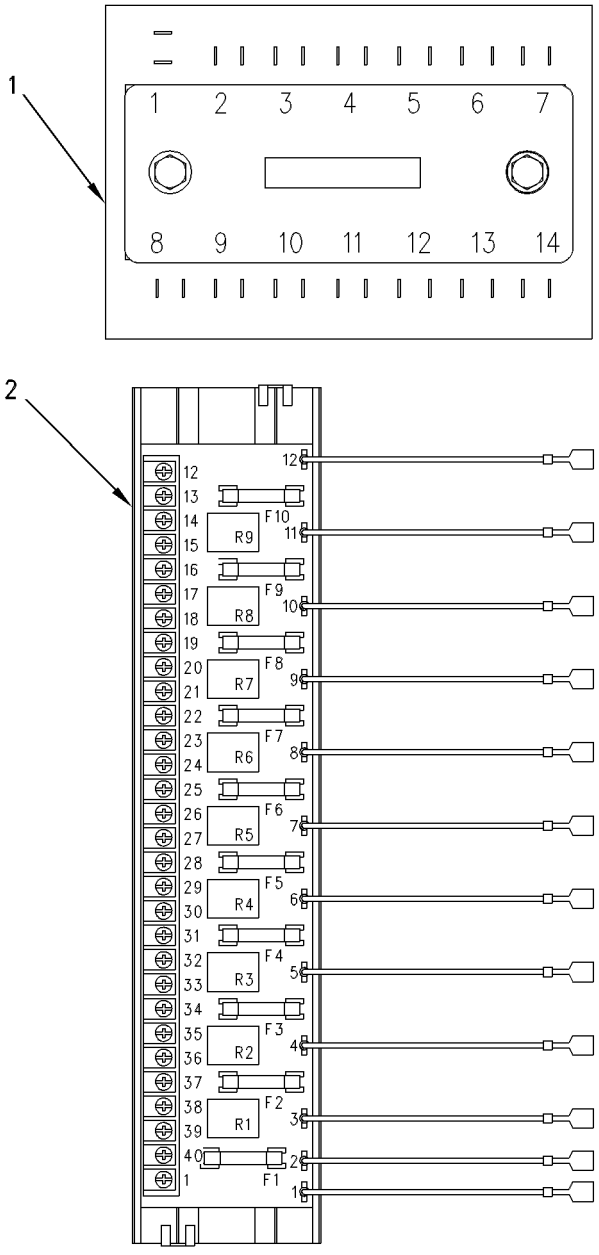
Customized Labeling

The condition that is being monitored by each indicator is determined by the customer. The **130-3326** Film provides a wide variety of labels in order to customize the CAM to an application.

i01175954

Relay Driver Module

SMCS Code: 4490; 7451



g00327305

Illustration 45

(1) Relay driver module
(2) Relay board (optional)

The relay driver module (RDM) is an optional module that can be used to expand the number of available outputs on the GSC+. The RDM outputs are controlled by the customer communication module (CCM). The RDM provides nine additional outputs for the customer. The RDM outputs are individually controlled by a serial data link from the GSC+. The outputs may drive the optional relay board, or the outputs can be directly connected to horns, lamps, or other devices. The relay board contains nine relays. Each of the relays have one set of Normally Opened contacts and one set of Normally Closed contacts that are used for customers.

Output Test

If an output test signal is received by the RDM, then the RDM activates all outputs for ten seconds. The outputs remain active until the output test signal is deactivated. To perform an output test, connect terminal 5 of the RDM to terminal 7 of the RDM with a jumper.

When the data link malfunctions, R1 output (terminal 2 of RDM) will FLASH at a rate of 0.5 Hz. Relays R2 through R9 will maintain the present state or relays R2 through R9 will default to the OFF position.

Specifications

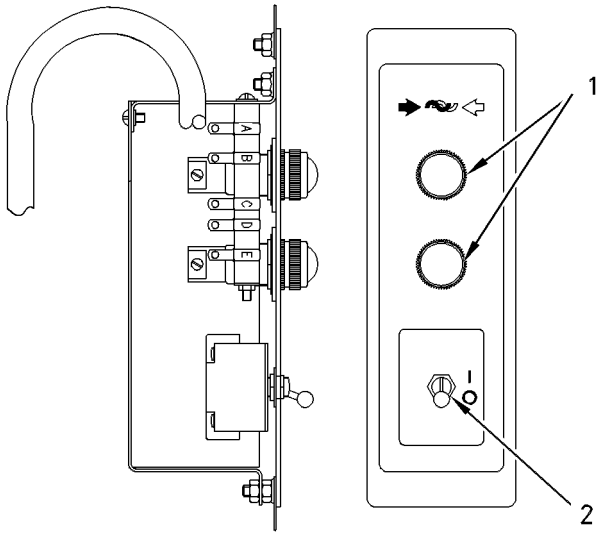
- The maximum distance between the RDM and the GSC+ is 305 m (1000 ft).
- The operating voltage range is from 15 to 45 DCV. The RDM is designed to operate when the RDM is powered by 24 DCV or when the RDM is powered by 32 DCV.
- The RDM is capable of operating with an earth ground or without an earth ground.
- The RDM must share a common ground with the GSC+ and the relay board.
- The terminals that are on the RDM are push on blade type connectors (6.4 mm (.25 inch)).
- The terminals on the relay board are 6-32 screw terminals.
- The driver outputs of the RDM are intended to power incandescent lamps. Also, the driver outputs of the RDM are intended to power relay loads. The driver outputs sink up to 600 mA at 15 DCV to 45 DCV. The driver outputs are protected against short circuits to “B+”.
- The relay outputs of the relay board are protected by 1 amp fuses. The contacts are flashed with silver. The contact is rated as 1 Amp at 28 DCV. The relay coils draw 20 mA at 24 DCV.

Note: The GSC+ diagnoses a fault in the Relay Driver Module circuit. See Testing and Adjusting, “CID 475 Relay Driver Module” for more information. The CID 475 procedure contains schematics for relay driver module installation purposes.

i01175956

Synchronizing Lights Module

SMCS Code: 4490; 7451



g00327824

Illustration 46

Synchronizing Lights Module

(1) Synchronizing lights. (2) Synchronizing switch.

The synchronizing lights module is optional. The synchronizing lights module is located on the instrument panel (right side).

The synchronizing lights module is not used when the panel is equipped with an electronic governor.

Synchronizing lights (SL) are used as an aid for paralleling the generators that are independent of the load. Two lights are in the module. Each light is connected to the side with the load of the generator output circuit breaker. The voltage of two phases are measured. The lights are used to indicate to the operator when the voltages are in-phase. Close the circuit breaker now. The generator is on the line with the other generators.

Note: For a complete explanation on the procedure to parallel two units, make reference to the Operation And Maintenance Manual, SEBU6918, “SR4B Generators and Control Panels”.

Installation Of The Synchronizing Module

⚠ WARNING

To avoid electrical shock and personal injury, shutdown all on-line gensets before installing or repairing the synchronizing module.

Note: For the connection of the synchronizing light module, see the Testing And Adjusting, “Schematic and Wiring Diagrams”.

Make an orderly shutdown of all generators connected to the system. Connect the wires of the synchronizing light module to the terminals, as shown below.

1. Connect wire L1 to terminal L1 of TS1 in the generator housing.
2. Wire L3 to terminal L3 of TS1 in the generator housing.
3. Wire T11 to terminal 2 of fuse F13 on the AC transformer box (ATB).
4. Wire T13 to terminal 2 of fuse F15 on the AC transformer box (ATB).

The customer is responsible for providing the proper electrical material that is needed to connect L1 and L3. L1 and L3 connect to the side of the generator output circuit breaker with the load. See the Testing And Adjusting, “Schematics And Wiring Diagrams”.

Adjust the connection of the wires on the taps of the synchronizing resistors. Adjust the connection for the particular AC voltage for the generator to the requirements below.

208 ACV line to line ..... taps E to D (1760Ω)
240 ACV line to line ..... taps E to C (2400Ω)
300 ACV line to line ..... taps E to B (5600Ω)
380 ACV line to line ..... taps E to B (5600Ω)
400 ACV line to line ..... taps E to B (5600Ω)
416 ACV line to line ..... taps E to A (7200Ω)
480 ACV line to line ..... taps E to A (7200Ω)

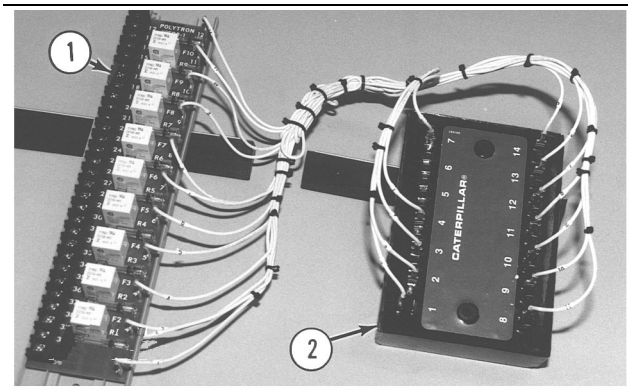
Note: Remove the synchronizing module cover for access to the resistor taps.

Example – The following connection is for a generator with a line voltage of 400 volts. Connect wire T11 to tap B of SLR1. Also, connect wire T13 to tap B of SLR2. See the Testing And Adjusting, “Schematics And Wiring Diagrams”.

i01175976

Customer Interface Module

SMCS Code: 4490; 7451



g00328626

Illustration 47
Customer Interface Module (CIM)
(1) Relay Board
(2) Electronic Control

See Testing And Adjusting, “Schematics And Wiring Diagrams” for more information about the Customer Interface Module (CIM).

The CIM provides an interface between the GSC+ and the switchgear. Separate relay contacts are the interface that is between the GSC+ and the switchgear. The two major components of CIM are the relay board (1) and the electronic control (2). The electronic control (2) and the alarm annunciator connect to the same serial data link. The operation of the CIM is similar to the operation of the alarm annunciator. The information on the data link is decoded into discrete outputs. The outputs then drive the relays that are located on the relay board (1). The relay contacts can be used to sound a horn. The relay contacts can be used to flash a lamp or the relay contacts can be used to trigger another procedure. Once an output is activated, the output remains energized until the faults that initiated the alarm are cleared. All electronic control outputs cycle at 0.5 Hz if a malfunction in the serial data link occurs. This includes the relays as well. The CIM is designed for operation when the CIM is powered by a battery system that supplies 24 DCV. The CIM is also designed for operation when the CIM is powered by a battery system that supplies 32 DCV.

The available serial data link information is listed below.

- High coolant temperature alarm
- Low oil pressure alarm
- Low coolant temperature alarm

- Low oil pressure shutdown
- High coolant temperature shutdown
- Overcrank
- Overspeed
- Diagnostic fault (GSC+)
- The engine control switch (ECS) is NOT in AUTO.

Application Guidelines

Lamp Test

When a lamp test signal is received, the CIM activates all outputs for 10 seconds. The CIM deactivates the outputs early if the lamp test signal is deactivated. Two lamp test signals are possible. When either of the following conditions are present, the lamp test of the CIM is activated.

- Terminal 5 is connected to terminal 7 of electronic control (2).
- The GSC+ lamp test signal is received over the data link.

Note: When terminal 6 is connected to terminal 7 of the electronic control (2), the CIM ignores the GSC+ lamp test signal.

Outputs

- The relays that are on the relay board (1) are protected by fuses. The contacts are flashed with silver. The contacts are rated at 1 amp 28 DCV. The relays draw 20 mA at 24 DCV.
- The outputs that are from the driver of the electronic control (2) are intended to drive the incandescent lamps or the driver outputs are intended to drive the relay loads. The driver outputs will consume a maximum of 600 mA when the voltage is 15 DCV to 45 DCV.

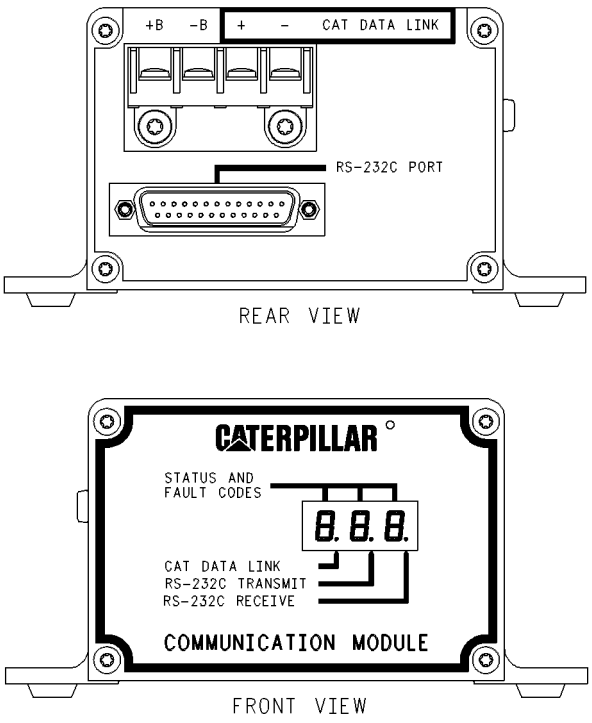
Specifications

- For installation of the CIM, the maximum distance that is between the electronic control (2) and the GSC+ is 305 m (1000 ft).
- The operating voltage range is from 15 DCV to 45 DCV. 24 DCV is the nominal voltage.
- The CIM is capable of operating with earth ground or operating without earth ground.
- The terminals are blade type connectors. The terminal's size is 6.4 mm (0.25 inch).
- Connections that may be used by the customers at the relay board (1) are 6-32 screw terminals.

i01175979

System Communication Module (Customer)

SMCS Code: 1926; 4490; 7451



g00329183

Illustration 48

Customer Communication Module (CCM)

The customer communication module (CCM) provides a communication link between the GSC+ and the host computer of the customer. The CCM converts data from the standard RS-232C format to the CAT Data Link format. The CCM can also convert data from the CAT Data Link format to the standard RS-232C format. The CCM allows an operator to remotely control the same information that is available on the GSC+ display at the host computer.

The CCM can remotely control the following functions when the GSC+ is in the normal mode with the engine control switch (ECS) in the AUTO position.

- Start the engine.

- Stop the engine if the remote start/stop contact is not closed.
- Activate the electronic governor relay (EGR) or deactivate the EGR, provided that the low oil pressure shutdown setpoint has been exceeded.
- Activate the GFR or deactivate the GFR, provided that the GSC+ has not detected a fault. In this case, the GSC+ will already have activated the GFR.
- Remotely abort the cooldown.
- Remotely control the spare output.
- Remotely control the programmable spare relay.

Note: The CCM can only control the spare output in an active low type of configuration. See System Operation, “Spare Input/Output Programming OP6” for more information.

The addition of a specified modem allows two-way communication when the generator set and the host computer are separated by great distances.

For more information regarding the CCM, see the Operations And Maintenance Manual, SEBU6874, “Customer Communication Module For EMCPII”.

Testing and Adjusting Section

Testing and Adjusting

i01176181

General Information

SMCS Code: 4490

WARNING

Do not connect generator to a utility electrical distribution system unless it is isolated from the system. Electrical feedback into the distribution system can occur and could cause personal injury or death.

Open and secure main distribution system switch, or if the connection is permanent, install a double throw transfer switch to prevent electrical feedback. Some generators are specifically approved by a utility to run in parallel with the distribution system and isolation may not be required. Always check with your utility as to the applicable circumstances.

WARNING

When the engine-generator, or any source to which the engine-generator is synchronized to, is operating, voltages up to 600V are present in the control panel.

Do not short these terminal with line voltage to ground with any part of the body or any conductive material. Loss of life or injury could result from electrical shock or injury from molten metal.

WARNING

When servicing or repairing electric power generation equipment:

- **Make sure the unit is either locked out or tagged DO NOT OPERATE.**
- **Remove all fuses.**
- **Make sure the generator engine is stopped.**
- **Make sure all batteries are disconnected.**
- **Make sure all capacitors are discharged.**
- **Make sure residual voltage in the rotor, stator and the generator is discharged.**

Failure to do so could result in personal injury or death.

i01176182

Service Tools

SMCS Code: 0785; 4490

Table 14

Tools Needed		
4C-3406	Connector Repair Kit (DT)	1
6V-3000	Connector Repair Kit (Sure Seal)	1
9U-7246	Connector Repair Kit (DT)	1
NA	4 mm Hex Wrench	1
6V-7070	Digital Multimeter	1
9U-7330	Multimeter	1
146-4080	Digital Multimeter (RS-232)	1
7X-1710	Multimeter Probe Group	1

i01176183

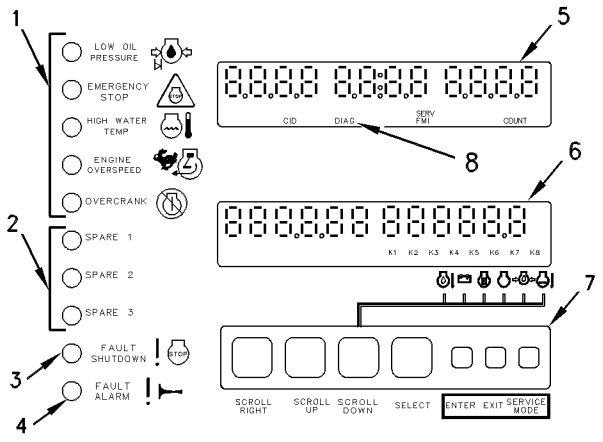
Fault Identification

SMCS Code: 4490-038

Table 15

Fault Identification				
Indicator left side of GSC+	**Fault Code on upper display**	**DIAG Indicator**	**Fault Type**	**See Topic**
Fault Alarm	CID FMI(1)	Flashing	Active Alarm	Troubleshooting Diagnostic Codes
	SP1, SP2, SP3, SP4(1)	None	Active Alarm	SP Fault Code - Troubleshoot
	AL1 thru AL15(1)	None	Active Alarm	AL Fault Codes - Troubleshoot
Fault Shutdown	CID FMI	Flashing	Active Shutdown	Troubleshooting Diagnostic Codes
	SP1, SP2, SP3, SP4	None	Active Shutdown	SP Fault Code - Troubleshoot
	AL5 thru AL15(1)	None	Active Alarm	AL Fault Code - Troubleshoot
Dedicated Shutdown: Flashing On Continuously	None	None	Active Alarm	Troubleshooting Dedicated Shutdown Indicators
	None	None	Active Shutdown	
None	CID FMI(2)	On Continuously	Inactive Alarm	Troubleshooting Diagnostic Codes
	CID FMI(2)	On Continuously	Inactive Shutdown	Troubleshooting Diagnostic Codes
	SP1, SP2, SP3, SP4	None	Inactive Shutdown	SP Fault Code - Troubleshoot
	AL5 through AL15(1)	None	Inactive Alarm	AL Fault Code - Troubleshoot
	None	None	Undetermined Shutdown	Troubleshooting Undetermined Problems

(1) The fault code is shown after alarm codes key is pressed.
(2) Fault Code is stored in the fault log of the GSC+. To view the fault code, see Systems Operation, “Fault Log Viewing OP1” within the topic Service Mode.



g00614724

Illustration 49

GSC+ Display Area

(1) Dedicated shutdown indicators
(2) Spare fault indicators
(3) Fault shutdown indicator
(4) Fault alarm indicator
(5) Upper display
(6) Lower display
(7) Keypad
(8) DIAG indicator

Faults that are diagnosed by the GSC+ are shown to service personnel in the display area of the GSC+. The GSC+ uses the following information to tell service personnel about a fault: dedicated following shutdown indicators(1), fault shutdown indicator (3), , fault alarm indicator (4), “DIAG” indicator (8), upper display (5), and lower display (6). Perform the following procedure in order to identify the fault that is detected by the GSC+.

Note: The “DIAG” indicator (8) functions when diagnostic information is available from the GSC+.

1. Make a note of the indicators that are functioning on the left side of the “GSC+”.

2. View the fault code on the upper display (5). If the fault alarm indicator (4) is FLASHING and no fault code is present on the upper display (5), press the alarm codes key in order to view the fault code.

3. Note the condition of the “DIAG” indicator (8). The “DIAG” indicator will flash CONTINUOUSLY or the “DIAG” indicator will NOT flash.

4. Locate the fault indicator that is functioning on Table 15.

5. Go to the second column in Table 15. Find the fault code that is presently shown on the upper display (5).

6. Go to the third column in Table 15 which describes the status of “DIAG” indicator (8).

7. Read the last two columns in Table 15 in order to find the type of fault and corresponding topic within this module.

i01176190

Troubleshooting Diagnostic Codes

SMCS Code: 4490-038; 7569

Diagnostic codes are associated with failed electrical components or circuits, that provide information to the GSC+. Diagnostic codes are also associated with failed electrical components or circuits, that receive information from the GSC+. The diagnostic fault code closely identifies the cause of the fault.

Each diagnostic fault code consists of the following items: a component identifier (CID), a failure mode identifier (FMI), and a fault indicator (“DIAG”). These items are shown on the upper display. A fault indicator can be active or inactive. The CID identifies the faulty component in the system. The FMI describes the nature of the fault. When the “DIAG” indicator is FLASHING, the fault is active. This means that the fault is present. When the “DIAG” indicator is ON CONTINUOUSLY, the fault is inactive and the CID FMI is recorded in the fault log. See Systems Operation, “Fault Log Viewing OP1” in order to view the fault log. When the “DIAG” indicator is not showing, there are NO diagnostic codes that are detected or recorded. Service personnel interpret the identifiers in order to assist with troubleshooting.

When a diagnostic fault occurs, the GSC+ FLASHES the “DIAG” indicator. The GSC+ determines the type of a fault. There are two types of a fault: an alarm fault and a shutdown fault. Then, the GSC+ FLASHES the corresponding fault alarm indicator or fault shutdown indicator. The CID FMI is immediately shown on the upper display when there is a shutdown fault. When there is an alarm fault, the alarm codes key is pressed first. Then, the CID FMI is shown on the upper display.

The GSC+ has a fault log to help with troubleshooting of diagnostic faults. Inactive diagnostic codes (CID FMI) are recorded in the fault log for viewing at a later time. Also, the number of occurrences are totalled. The number of occurrences is shown on the upper display. The CID FMI is also shown on the upper display. An active alarm fault becomes inactive when the fault is no longer occurring. Also, the engine control switch (ECS) should be turned to the OFF/RESET position for shutdown faults. The “DIAG” indicator is FLASHING when the alarm fault is active. The “DIAG” indicator is ON CONTINUOUSLY when the alarm fault is inactive. See Testing And Adjusting, “Fault Log Viewing OP1”.

During troubleshooting, it is sometimes necessary to disconnect the harness connector from the GSC+ and faults are created. Because of internal circuitry, the GSC+ recognizes this condition as a FMI 03 fault for certain components. An FMI 03 describes the voltage that is above normal. This fact is also used as an aid in the troubleshooting process. Clear these created faults after the particular fault is corrected and the fault is cleared. The following diagnostic codes are recorded in a properly operating system when the harness connector is removed from the GSC+.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

An FMI 2 describes an incorrect signal.

Note: A CID 111 FMI 3 and a CID 175 FMI 3 will only be recorded if the machine is equipped with the proper sensors.

Clear diagnostic faults after the fault is investigated or the fault is corrected. This will avoid a confusion during a future service call. The “DIAG” indicator is OFF when all diagnostic faults are cleared from the fault log and no active diagnostic faults exist. See Testing And Adjusting, “Fault Log Clearing OP4”.

Diagnostic Codes

Table 16

Diagnostic Codes[1]	
CID/FMI	**Description**
CID 100 - Pressure Sensor (Engine Oil):	
FMI 2	Incorrect signal
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 110 - Temperature Sensor (Engine Coolant):	
FMI 2	Incorrect signal
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 111 - Fluid Level Sensor (Engine Coolant):	
FMI 3	Voltage above normal
CID 168 - Electrical System Voltage:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 175 - Temperature Sensor (Engine Oil):	
FMI 2	Incorrect signal
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 190 - Speed Sensor (Engine):	
FMI 2	Incorrect signal
FMI 3	Voltage above normal
CID 248 - CAT Data Link:	
FMI 9	Abnormal update
CID 268 - EMCP II+ Electronic Control (Generator Set):	
FMI 2	Incorrect signal
CID 269 - Sensor Power Supply:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 333 - Alarm Module Control:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 334 - Spare Output:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal

(continued)

(Table 16, contd)

Diagnostic Codes[1]	
CID/FMI	**Description**
CID 336 - Switch (Engine Control):	
FMI 2	Unknown state
CID 441 - Electronic Governor Relay:	
FMI 12	Faulty component
CID 442 - Generator Fault Relay:	
FMI 12	Faulty component
CID 443 - Crank Termination Relay:	
FMI 12	Faulty component
CID 444 - Starting Motor Relay:	
FMI 12	Faulty component
CID 445 - Run Relay:	
FMI 12	Faulty component
CID 446 - Air Shutoff Relay:	
FMI 12	Faulty component
CID 447 - Fuel Control Relay:	
FMI 12	Faulty component
CID 448 - Programmable Spare Relay:	
FMI 12	Faulty component
CID 475 - Relay Driver Module:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal
CID 500 - EMCP Electronic Control (Generator Set):	
FMI 12	Faulty component
CID 566 - Unexpected Shutdown:	
FMI 3	Voltage above normal
FMI 7	Improper mechanical response
CID 590 - Engine Electronic Control Module:	
FMI 9	Abnormal update
CID 770 - Customer Communication Module Data Link:	
FMI 9	Abnormal update
CID 859 - Kilowatt Level Output:	
FMI 3	Voltage above normal
FMI 4	Voltage below normal

(1) See the procedure with the same CID/FMI.

Example

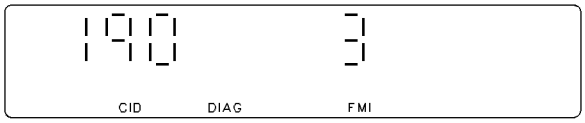


Illustration 50 g00615969

Upper Display Showing A “CID 190 FMI 3” Diagnostic Code

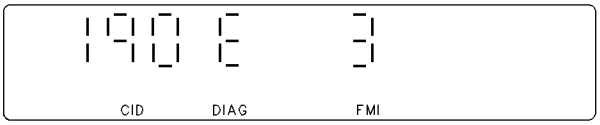


Illustration 51 g00475773

Upper Display Showing A “CID 190 DIAG E FMI 3”Diangostic Code

If the DIAG “E” is present, the ECM has generated the diagnostic code. Proceed to Troubleshooting, SENR1003, “3500B EPG Engines”.

i01176206

CID 100 FMI 2 Pressure Sensor (Engine Oil) Incorrect Signal - Test

SMCS Code: 1924-038; 4490-038-NS

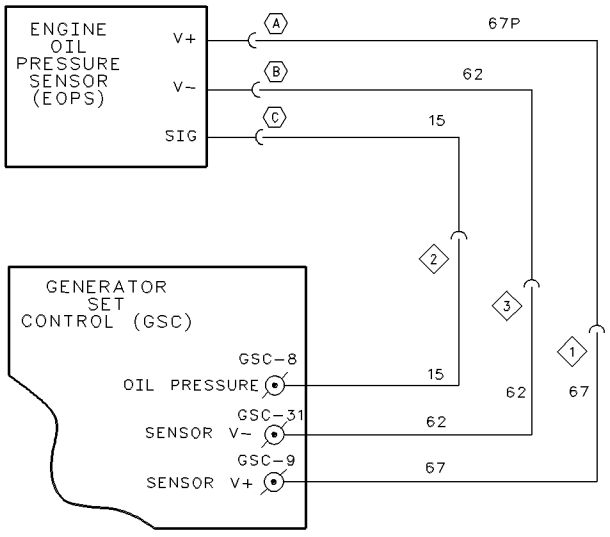


Illustration 52 g00527056

System Schematic For Engine Oil Pressure Sensor (EOPS)

The EMCP II+ monitors the engine oil pressure in order to protect the engine in case of a problem with the oil pressure. The oil pressure sensor is mounted on an oil gallery of the engine. The exact location of the engine oil pressure sensor varies depending on the engine model.

The sensor is powered by an 8 volt sensor supply from the GSC+. The oil pressure signal is a pulse width modulated signal. The base frequency of the signal is 500 ± 150 Hz. As pressure changes, the duty cycle of the signal varies from 10 to 95 percent.

- The 0 kPa (0 psi) is approximately 13% duty cycle. The voltage will be approximately 1.0 DCV.
- 690 kPa (100 psi) is approximately 85% duty cycle.

Note: The GSC+ is usually programmed to treat an oil pressure sensor fault as an alarm fault. The factory default for P004 is 0. If the GSC+ is programmed to shutdown for an oil pressure sensor fault, then it is not necessary to press the alarm codes key in order to view the CID FMI. P004 is equal to 1 for a shutdown fault. The CID FMI is automatically shown on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded:

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible causes of a CID 100 FMI 2 fault are listed below:

- The base signal of the sensor is beyond accepted limits.
- The duty cycle of the sensor signal is beyond accepted limits.

Begin performing these procedures only when CID 100 FMI 2 is showing and the “DIAG” indicator is FLASHING on the upper display. The flashing indicator means that the fault is active. The GSC+ treats a CID 100 FMI 2 fault as an alarm fault. Active alarm faults are shown on the display when the “Alarm Codes” key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. Use Illustration 52, and see Testing And Adjusting, “Electrical Connector - Inspect” in order to troubleshoot an inactive fault. Clear the fault from the fault log after troubleshooting is complete.

Note: The operator may choose to replace this procedure by troubleshooting the sensor signal with a meter that is capable of measuring frequency. The meter must also measure a duty cycle.

Note: If fault CID 269 is present, then correct the fault prior to starting the procedure.

1. Check the GSC+ and the harness.

a. Make sure that CID 100 FMI 2 is showing on the display.

b. Turn the ECS to the OFF/RESET.

c. Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.

d. Turn the ECS to the STOP position.

e. Press the “Alarm Codes” key. The “Alarm Codes” key does not need to be pressed for a shutdown fault.

f. Monitor the display. Check whether the CID 100 FMI 2 is showing on the display. If CID 100 FMI 2 is not showing, then CID 100 FMI 2 is inactive. Now, the CID 100 FMI 3 should be showing. CID 100 FMI 3 is active.

Expected Result: The voltage should be 8.0 ± 0.5 DCV.

Results:

- OK: The GSC+ and the harness function properly. Therefore, the sensor is faulty. Replace the sensor. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test” for more sensor testing. STOP.

- NOT OK: The CID 100 FMI 2 fault is still showing. The harness or the GSC+ is faulty. Proceed to Step 2.

2. Check the GSC+.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the harness connector from the GSC+. Turn the GSC+ to the STOP position.

c. Press the “Alarm Codes” key.

d. Check if the CID 100 FMI 2 is not showing. This means that the CID 100 FMI 2 is inactive. CID 100 FMI 3 is now showing. CID 100 FMI 3 is now active.

Expected Result: CID 100 FMI 2 is not showing. The CID 100 FMI 3 is now showing. The CID 100 FMI 3 is now active.

Results:

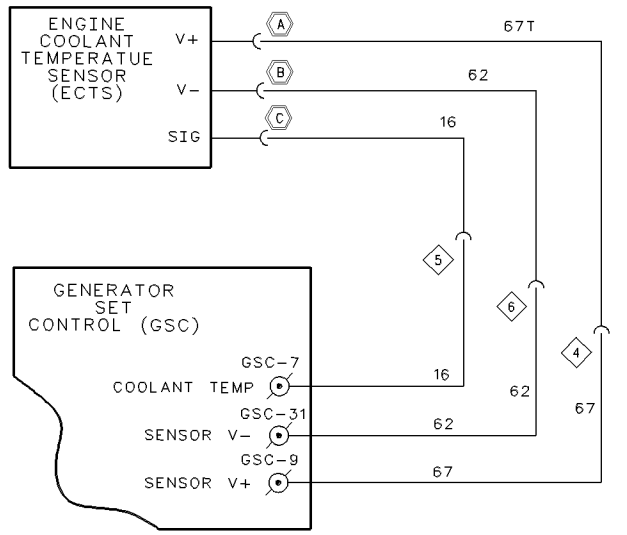
- OK: The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. See Testing And Adjusting, “Electrical Connector - Inspect” for procedures on checking the electrical connectors and terminals. STOP.

- NOT OK: The CID 100 FMI 2 fault is still showing. The GSC+ is faulty. Replace the GSC+. For information on replacing the GSC+, see Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01176219

CID 110 FMI 2 Temperature Sensor (Engine Coolant) Incorrect Signal - Test

SMCS Code: 1906-038; 4490-038-NS



g00527377

Illustration 53

System Schematic For Engine Coolant Temperature Sensor

The EMCP II+ monitors engine coolant temperature in order to protect the engine in case of a coolant temperature problem. The coolant temperature sensor is mounted in the water jacket, close to the front of the engine. The exact location of the engine coolant temperature sensor varies depending on the engine model.

The sensor is powered by an 8 volt sensor supply from the GSC+. The coolant temperature signal is a pulse width modulated signal. The base frequency of the signal is 455 Hz (370 to 550 Hz). As temperature changes, the duty cycle of the signal varies from 10 to 95 percent.

- –40°C (–40°F) is approximately 10% of the duty cycle. This is approximately 1.0 DCV.
- 135°C (275°F) is approximately 93% of the duty cycle.

Note: The GSC+ is usually programmed to treat a coolant temperature sensor fault as an alarm fault. P004 = 0 is the factory default. If the GSC+ is programmed to shutdown for a coolant temperature sensor fault, then it is not necessary to press the “Alarm Codes” key in order to view the CID 110 FMI 2. P004 = 1 is a shutdown. The CID 110 FMI 2 is automatically shown on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

An FMI 2 describes an incorrect signal.

Note: A CID 111 FMI 3 and a CID 175 FMI 3 will only be recorded if the machine is equipped with the proper sensors.

The possible causes of a CID 110 FMI 2 fault are listed below:

- The base frequency of the sensor signal is beyond accepted limits.
- The duty cycle of the sensor signal is beyond accepted limits.

Begin to perform these procedures only when the CID 110 FMI 2 is showing and when the “DIAG” indicator is FLASHING on the upper display. The fault is active when the “DIAG” indicator is FLASHING. The GSC+ treats a CID 110 FMI 2 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. To troubleshoot an inactive fault, use the preceding system schematic and see Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after troubleshooting is complete.

Note: This procedure can be replaced by troubleshooting the sensor signal with a meter that is capable of measuring frequency and duty cycle. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test”.

Note: If a sensor supply fault (CID 269) is active, correct the fault prior to proceeding with this procedure.

1. Check the GSC+ and the harness.

Make sure that CID 110 FMI 2 is showing on the display.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.

c. Turn the ECS to the STOP position.

d. Press the “Alarm Codes” key. Pressing the “Alarm Codes” key is not required for shutdown faults.

e. Check if the CID 110 FMI 2 is not showing. The CID 110 FMI 2 is inactive. Check if the CID 110 FMI 3 is now showing. The CID 110 FMI 3 is now active.

Expected Result: The CID 110 FMI 2 is not showing. The CID 110 FMI 3 is now showing. The CID 110 FMI 3 is now active.

Results

- OK: The GSC+ and the harness function properly. Therefore, the sensor is faulty. Replace the sensor. More testing for the sensor is available. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test”. STOP.
- NOT OK: The CID 110 FMI 2 fault is still showing. The harness or the GSC+ is faulty. Proceed to Step 2.

2. Check the GSC+.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the harness connector from the GSC+.

c. Turn the ECS to the STOP position.

d. Press the “Alarm Codes” key.

e. Check if the CID 110 FMI 2 is not showing. The CID 110 FMI 2 is inactive. Check if the CID 110 FMI 3 is now showing. The CID 110 FMI 3 is active.

Expected Result: CID 110 FMI 2 is not showing. The CID 110 FMI 3 is now showing. The CID 110 FMI 3 is now active.

Results:

- OK: The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: The CID 110 FMI 2 fault is still showing. The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01176231

CID 111 FMI 3 Fluid Level Sensor (Engine Coolant) Voltage Above Normal - Test

SMCS Code: 1395-038-NS; 4490-038-NS

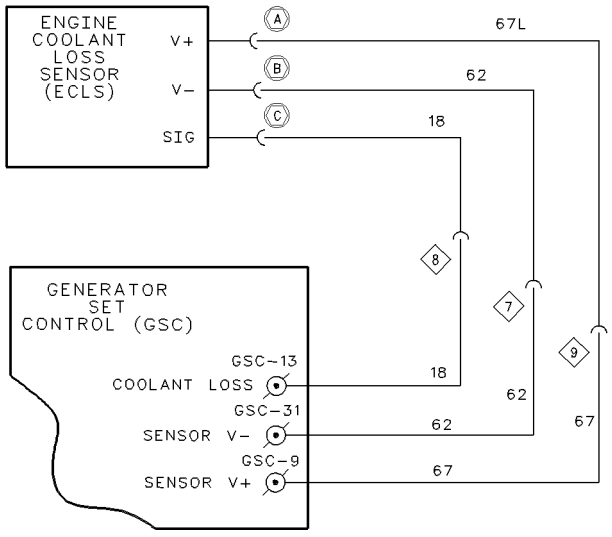


Illustration 54 g00527487

System Schematic For Engine Coolant Loss Sensor(ECLS)

The EMCP II+ monitors engine coolant for loss of coolant in order to protect the engine in case of a coolant temperature problem. The engine coolant loss function is optional. The engine coolant loss function requires the presence of the optional coolant loss sensor. The coolant loss sensor is usually mounted near the top of the radiator.

The sensor is powered by an 8 volt sensor supply from the GSC+. When coolant is NOT present at the sensor, a high signal (approximately +5 DCV) is sent to the GSC+. When coolant is present at the sensor, a low signal (battery negative) is sent to the GSC+.

Note: The GSC+ is usually programmed to treat a coolant loss sensor fault as an alarm fault. P004 is equal to 0. If the GSC+ is programmed to shutdown, P004 is equal to 1. The operator is not required to press the “Alarm Codes” key in order to view the CID 111 FMI 3. The CID 111 FMI 3 is automatically shown on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear the created faults after the particular fault is corrected and after the particular fault is cleared. In a system that is operating properly, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible causes of a CID 111 FMI 3 fault are listed below.

- A short circuit to battery positive of the sensor signal.
- An open circuit of the sensor signal.

Begin performing these procedures only when CID 111 FMI 3 is showing and the “DIAG” indicator is FLASHING on the upper display. The flashing indicator means that the fault is active. The GSC+ treats a CID 111 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. See Testing And Adjusting, “Electrical Connector - Inspect” in order to troubleshoot an inactive fault. Also use the preceding system schematic. Clear the fault from the fault log after troubleshooting is complete.

Note: If a sensor supply fault (CID 269) is active, correct the sensor supply fault prior to proceeding with this procedure.

1. **Check the Sensor Voltage Supply Circuit.**

   a. Turn the ECS to OFF/RESET. Then, turn the ECS to the STOP position.

   b. Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.

   c. At the engine harness side of the sensor connector, measure the voltage (DCV) that is between contact “A” and contact “B”. Contact “A” is the supply for the sensor. Contact “B” is the sensor ground.

   Expected Result: The voltage should be 8.0 ± 0.5 DCV.

   Results:

   - OK: The sensor voltage supply circuit functions properly. Proceed to Step 2.
   - NOT OK: The sensor voltage supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269). Correct this fault. If a sensor supply fault (CID 269) is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

2. **Check the Signal Circuit.** The ECS remains in the STOP position and the sensor remains disconnected from the engine harness.

   a. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact “C” and contact “B”. Contact “C” is the signal. Contact “B” is the sensor ground.

   Expected Result: The voltage should be 2.5 ± 0.5 DCV.

   Results:

   - OK: The signal circuit functions properly. Verify this result by checking if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET. Then, turn the ECS to STOP. If the CID 111 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.

- NOT OK: The voltage is equal to the battery positive. The engine harness is faulty. The signal circuit within the engine harness is shorted to the battery positive. Troubleshoot and repair the engine harness. STOP.

- NOT OK: Voltage is NOT 2.5 ± 0.5 DCV. Voltage is NOT equal to the battery positive. The GSC+ or the harness is faulty. Proceed to Step 3.

3. **Check for a Shorted Harness.** When you are performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness.

   a. Turn the ECS to OFF/RESET.

   b. Disconnect the harness connector from the GSC+.

   c. At the GSC+ harness connector, measure the resistance from signal contact “13” to all other contacts of the connector.

   Expected Result: For each measurement, the resistance should be greater than 5000 ohms.

   Results:

   - OK: The harness functions properly. Proceed to Step 4.

   - NOT OK: The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

4. **Check for an Open Harness.** When you are performing this Step, see the preceding System Schematic. The ECS remains in the OFF/RESET position. The sensor remains disconnected from the engine harness and the GSC+ remains disconnected from the harness connector.

   a. Measure the resistance of the ground circuit. The ground circuit is from contact “B” of the sensor harness connector to contact “31” of the GSC+ harness connector.

   b. Measure the resistance of the signal circuit. The signal circuit is from contact “C” of the sensor harness connector to contact “13” of the GSC+ harness connector.

   c. Measure the resistance of the sensor voltage supply circuit. The sensor voltage supply circuit is from contact “A” of the sensor harness connector to contact “9” of the GSC+ harness connector.

   Expected Result: For each measurement, the resistance should be 5 ohms or less.

   Results:

   - OK: The harness functions properly. Proceed to Step 5.

   - NOT OK: The harness wiring with the incorrect resistance measurement is open. The harness wiring is faulty. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

5. **Check the Electrical Connectors.**

   a. Check the electrical connectors, terminals and wiring. Proceed to Testing And Adjusting, “Electrical Connector - Inspect”.

   Expected Result: All connectors, terminals and wiring should function properly.

   Results:

   - OK: Connect all harness connectors that were previously disconnected. Start the engine. If the CID 111 FMI 3 fault is still showing, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”for more information. STOP.

   - NOT OK: Repair the faulty area. STOP.

i01217244

CID 168 FMI 3 Electrical System Voltage Above Normal - Test

SMCS Code: 1406-038; 4490-038

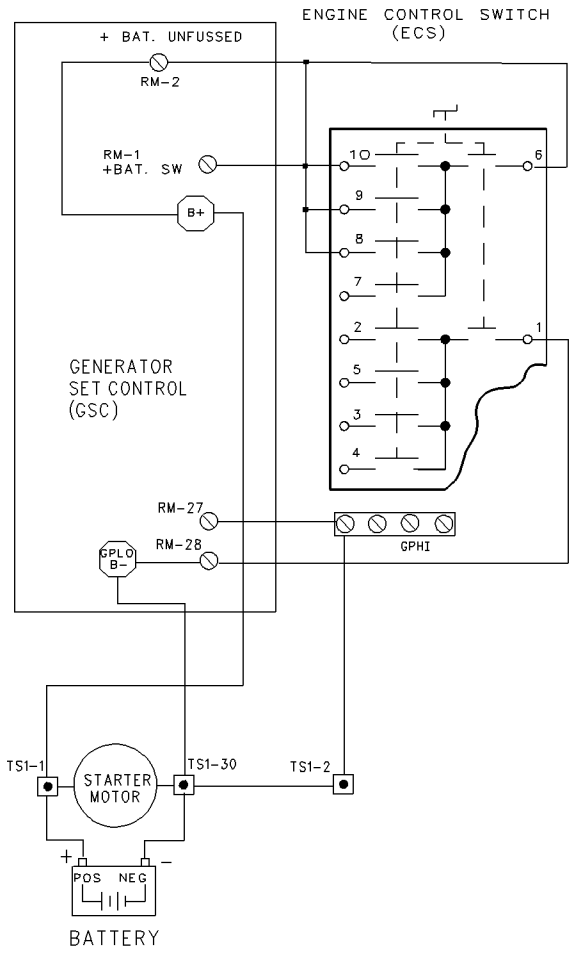


Illustration 55 g00650545

The EMCP II+ monitors the battery voltage in order to protect the EMCP II+ from a battery problem or from a charging problem. The battery voltage is received from the engine electronic control module (ECM) by the CAT data link. If you receive an CID 168 E fault, see the Troubleshooting, “3500B Generator Set Engines Troubleshooting”. The GSC+ treats a CID 168 fault as an alarm fault. The threshold for a CID 168 FMI 03 fault for battery voltage is greater than 32 DCV for 24 volt system. The threshold for a CID 168 FMI 03 fault for battery voltage is greater than 45 DCV for a 32 volt system.

Table 17

Possible Causes for CID 168 Faults			
Location that the Fault is Displayed On	**Diagnostic Code**	**Battery Voltage Thresholds (24 Volt System)**	**Battery Voltage Thresholds (32 Volt Systems)**
Engine ECM	CID 168 E 00	The engine is running and the battery voltage is greater than 32 DCV more than two seconds.	-
Engine ECM	CID 168 E 01	The engine is not running and the battery voltage is less than 9 DCV for more than two seconds.	-
Engine ECM	CID 168 E 02	The engine is not running and the battery voltage is less than 9 DCV for a period of .07 seconds and then returns to 9 DCV or above. The other possible cause of the fault is the battery voltage is was less than 9 DCV three times in seven seconds.	
GSC+	CID 168 FMI 03	-	Regardless of engine status, the battery voltage is greater than the P007 limit.
GSC+	CID 168 FMI 04	-	Regardless of the engine status, the battery voltage is less than 18 DCV.

The setpoint for the system voltage (P007) specifies the battery voltage.

24 – 24 Volt System

32 – 32 Volt System

Note:

Note: The GSC+ does not receive battery power when the ECS is in the OFF/RESET position. When contact 6 is connected to one of the contacts (8, 9, 10), the GSC+ receives battery power when the ECS is in the OFF/RESET position.

1. Initial Procedure.

Make sure that the CID 168 FMI 03 is shown on the display.

a. Enter service mode.

b. Turn the ECS to the STOP position.

c. Program setpoint P023 to 0. This programs the GSC+ for an MUI engine. This eliminates the engine electronic control module (ECM) as a possibility of the fault. For more information, see System Operation, “Protective Relaying Programming OP5-1”.

d. Turn the ECS to the OFF/RESET position. Disconnect the jumper wire on the ECS that is between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9. Proceed to Step 2.

2. Check the system’s voltage.

a. Turn the ECS to the STOP.

b. Measure the voltage across the battery terminals.

Expected Result: For a 24 volt system, the voltage should be between 24.8 DCV and 29.5 DCV. For 32 volt system, the voltage should be between 33.1 DCV and 39.3 DCV.

Results:

- OK: For a 24 volt system, the voltage should be from 24.8 DCV to 29.5 DCV. For a 32 volt system, the voltage should be from 33.1 DCV to 39.3 DCV. Proceed to Step 3.
- NOT OK: For 24 volt systems, the voltage is not between 24.8 DCV to 29.5 DCV. For a 32 volt system, the voltage is not between 33.1 DCV to 39.3 DCV. The fault is in the charging system. Proceed to Testing and Adjusting, “Charging System - Test”. STOP.

3. Compare the voltage between TS1-1 and the battery voltage.

a. Turn the ECS to the STOP position.

b. Measure the battery voltage across the terminals. Take note of the battery voltage.

c. Measure the voltage between TS1-1 and TS1-30. Take note of the voltage.

d. Compare the voltage from Step 3.b with the voltage that was noted in Step 3.c.

Expected Result: The voltages that are measured in Step 3.b and Step 3.c are within 2.0 DCV of each other.

Results:

- OK: The voltages that are measured in Step 3.b and Step 3.c are within 2.0 DCV of each other. Proceed to Step 4.
- NOT OK: The voltages that are measured in Step 3.b and Step 3.c are not within 2.0 DCV of each other. The wiring harness is not correct. Repair the wiring harness or replace the wiring harness. Proceed to Step 8.

4. Compare the voltage between the TS1-1 and the ECS.

a. Turn the ECS to the STOP position.

b. Measure the voltage between TS1-1 and TS1-30. Take note of the voltage.

c. Measure the voltage at terminal 6 on the ECS. Take note of the voltage.

d. Compare the measured voltage from Step 4.b with the voltage that was measured in Step 4.c.

Expected Result: The voltages that are measured in Step 4.b and Step 4.c are within 2.0 DCV of each other.

Results:

- OK: The voltages that are measured in Step 4.b and Step 4.c are within 2.0 DCV of each other. Proceed to Step 5.
- NOT OK: The voltages that are measured in Step 4.b and Step 4.c are not within 2.0 DCV of each other. The wiring harness is not correct. Repair the wiring harness or replace the wiring harness. Proceed to Step 8.

5. Check the continuity of the ECS.

Table 18

Engine Control Switch (ECS)[1][2]				
Terminal	**OFF/ RESET**	**AUTO**	**MANUAL**	**STOP**
7	X	O	O	O
8	O	X	O	O
9	O	O	X	O
10	O	O	O	X

(1) X = Less than 5 Ohms resistance from this terminal to terminal 6 (ECS).
(2) O = Greater than 5000 Ohms resistance from this terminal to terminal 6 (ECS).

a. Disconnect the jumper from 6 to jumper 9 from the ECS.

b. Place the ECS in the OFF/RESET.

c. Place the one lead on terminal 6 of the ECS.

d. Measure the resistance from terminal 6 to each of the terminals (7, 8, 9, and 10).

e. Use the same procedure for each switch position.

f. Compare the measured resistances with Table 18.

Expected Result: The measured resistances match Table 18.

Results:

- OK: The measured resistances match Table 18. The ECS is not faulty. Proceed to Step 6.
- NOT OK: The measured resistances match Table 18. The ECS is faulty. Replace the ECS. Reinstall the jumper wire. Proceed to Step 8.

6. Compare the voltage between RM-1 and the ECS.

a. Turn the ECS to the STOP position.

b. Check the voltage between RM- 1 and RM-28. Take note of the voltage.

c. Check the voltage on contact 10 of the ECS. Take note of the voltage.

d. Compare the voltage between Step 6.b and Step 6.c.

Expected Result: The voltages that were measured in Step 6.b and Step 6.c are within 2.0 DCV of each other.

Results:

OK: The voltages that were measured in Step 6.b and Step 6.c are within 2.0 DCV of each other. The harness is correct. Proceed to Step 7.

NOT OK: The voltages that were measured in Step 6.b and Step 6.c are not equal ± 2.0 DCV. The wiring harness is faulty. Repair the harness or replace the harness. Proceed to Step 8.

7. Compare the voltage between RM-1 and the lower display.

a. Turn the ECS to the STOP position.

b. Check the voltage between RM- 1 and RM-28. Take note of the voltage.

c. Check the voltage that is shown on the lower display. Take note of the voltage.

d. Compare the voltage between Step 7.b and Step 7.c.

Expected Result: The voltages that were measured in Step 7.b and Step 7.c are within 2.0 DCV of each other.

Results:

OK: The voltages that were measured in Step 7.b and Step 7.c are within 2.0 DCV of each other. The fault is probably an intermittent fault which is caused by a faulty connector. Inspect the electrical connectors. See Testing and Adjusting, “Electrical Connector - Inspect”. If the faulty connector can not be found, repeat this test procedure. If the fault still remains, replace the GSC+. STOP.

NOT OK: The voltages that were measured in Step 7.b and Step 7.c are not equal ± 2.0 DCV. The GSC+ is faulty. Replace the GSC+. STOP.

8. Reprogram the GSC+.

a. Turn the ECS to the STOP position.

b. Program the setpoint P023 to 2 (EUI). See System Operation, “Engine Generator Programming OP5-0”.

c. Turn the ECS to the OFF/RESET position. Disconnect the jumper wire on the ECS that is between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9.

d. Verify that the diagnostic code is no longer present.

e. Replace the jumper between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9. STOP.

i01215276

CID 168 FMI 4 Electrical System Voltage Below Normal - Test

SMCS Code: 1406-038; 4490-038

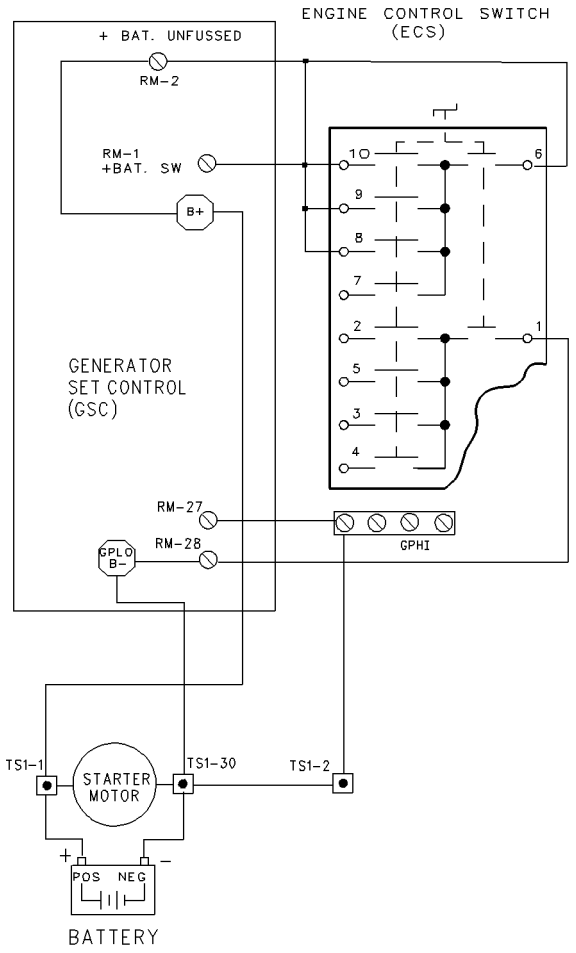


Illustration 56 g00650545

The EMCP II+ monitors the battery voltage in order to protect the EMCP II+ from a battery problem or from a charging problem. The battery voltage is received from the engine electronic control module (ECM) by the CAT data link. If you receive an CID 168 E fault, see the Troubleshooting, “3500B Generator Set Engines Troubleshooting”. The GSC+ treats a CID 168 fault as an alarm fault. The threshold for a CID 168 FMI 04 fault for battery voltage is less than 18 DCV for 24 volt system and for a 32 volt system.

Table 19

Possible Causes for CID 168 Faults			
Location that the Fault is Displayed On	**Diagnostic Code**	**Battery Voltage Thresholds (24 Volt System)**	**Battery Voltage Thresholds (32 Volt Systems)**
Engine ECM	CID 168 E 00	The engine is running and the battery voltage is greater than 32 DCV more than two seconds.	-
Engine ECM	CID 168 E 01	The engine is not running and the battery voltage is less than 9 DCV for more than two seconds.	-
Engine ECM	CID 168 E 02	The engine is not running and the battery voltage is less than 9 DCV for a period of .07 seconds and then returns to 9 DCV or above. The other possible cause of the fault is the battery voltage is was less than 9 DCV three times in seven seconds.	
GSC+	CID 168 FMI 03	-	Regardless of engine status, the battery voltage is greater than the P007 limit.
GSC+	CID 168 FMI 04	-	Regardless of the engine status, the battery voltage is less than 18 DCV.

The setpoint for the system voltage (P007) specifies the battery voltage.

24 – 24 Volt System

32 – 32 Volt System

Note:

Note: The GSC+ does not receive battery power when the ECS is in the OFF/RESET position. When contact 6 is connected to one of the contacts (8, 9, 10), the GSC+ receives battery power when the ECS is in the OFF/RESET position.

1. Initial Procedure.

Make sure that the CID 168 FMI 04 is shown on the display.

a. Enter service mode.

b. Turn the ECS to the STOP position.

c. Program setpoint P023 to 0. This programs the GSC+ for an MUI engine. This eliminates the engine electronic control module (ECM) as a possibility of the fault. For more information, see System Operation, “Protective Relaying Programming OP5-1”.

d. Turn the ECS to the OFF/RESET position. Disconnect the jumper wire on the ECS that is between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9. Proceed to Step 2.

2. Check the system’s voltage.

a. Turn the ECS to the STOP.

b. Measure the voltage across the battery terminals.

Expected Result: For a 24 volt system, the voltage should be between 24.8 DCV and 29.5 DCV. For 32 volt system, the voltage should be between 33.1 DCV and 39.3 DCV.

Results:

- OK: For a 24 volt system, the voltage should be from 24.8 DCV to 29.5 DCV. For a 32 volt system, the voltage should be from 33.1 DCV to 39.3 DCV. Proceed to Step 3.
- NOT OK: For 24 volt systems, the voltage is not between 24.8 DCV to 29.5 DCV. For a 32 volt system, the voltage is not between 33.1 DCV to 39.3 DCV. The fault is in the charging system. Proceed to Testing and Adjusting, “Charging System - Test”. STOP.

3. Compare the voltage between TS1-1 and the battery voltage.

a. Turn the ECS to the STOP position.

b. Measure the battery voltage across the terminals. Take note of the battery voltage.

c. Measure the voltage between TS1-1 and TS1-30. Take note of the voltage.

d. Compare the voltage from Step 3.b with the voltage that was noted in Step 3.c.

Expected Result: The voltages that are measured in Step 3.b and Step 3.c are within 2.0 DCV of each other.

Results:

- OK: The voltages that are measured in Step 3.b and Step 3.c are within 2.0 DCV of each other. Proceed to Step 4.
- NOT OK: The voltages that are measured in Step 3.b and Step 3.c are not within 2.0 DCV of each other. The wiring harness is not correct. Repair the wiring harness or replace the wiring harness. Proceed to Step 8.

4. Compare the voltage between the TS1-1 and the ECS.

a. Turn the ECS to the STOP position.

b. Measure the voltage between TS1-1 and TS1-30. Take note of the voltage.

c. Measure the voltage at terminal 6 on the ECS. Take note of the voltage.

d. Compare the measured voltage from Step 4.b with the voltage that was measured in Step 4.c.

Expected Result: The voltages that are measured in Step 4.b and Step 4.c are within 2.0 DCV of each other.

Results:

- OK: The voltages that are measured in Step 4.b and Step 4.c are within 2.0 DCV of each other. Proceed to Step 5.
- NOT OK: The voltages that are measured in Step 4.b and Step 4.c are not within 2.0 DCV of each other. The wiring harness is not correct. Repair the wiring harness or replace the wiring harness. Proceed to Step 8.

5. Check the continuity of the ECS.

Table 20

Engine Control Switch (ECS)[1][2]				
Terminal	**OFF/ RESET**	**AUTO**	**MANUAL**	**STOP**
7	X	O	O	O
8	O	X	O	O
9	O	O	X	O
10	O	O	O	X

(1) X = Less than 5 Ohms resistance from this terminal to terminal 6 (ECS).
(2) O = Greater than 5000 Ohms resistance from this terminal to terminal 6 (ECS).

a. Disconnect the jumper from 6 to jumper 9 from the ECS.

b. Place the ECS in the OFF/RESET.

c. Place the one lead on terminal 6 of the ECS.

d. Measure the resistance from terminal 6 to each of the terminals (7, 8, 9, and 10).

e. Use the same procedure for each switch position.

f. Compare the measured resistances with Table 20.

Expected Result: The measured resistances match Table 20.

Results:

- OK: The measured resistances match Table 20. The ECS is not faulty. Proceed to Step 6.
- NOT OK: The measured resistances match Table 20. The ECS is faulty. Replace the ECS. Reinstall the jumper wire. Proceed to Step 8.

6. Compare the voltage between RM-1 and the ECS.

a. Turn the ECS to the STOP position.

b. Check the voltage between RM- 1 and RM-28. Take note of the voltage.

c. Check the voltage on contact 10 of the ECS. Take note of the voltage.

d. Compare the voltage between Step 6.b and Step 6.c.

Expected Result: The voltages that were measured in Step 6.b and Step 6.c are within 2.0 DCV of each other.

Results:

OK: The voltages that were measured in Step 6.b and Step 6.c are within 2.0 DCV of each other. The harness is correct. Proceed to Step 7.

NOT OK: The voltages that were measured in Step 6.b and Step 6.c are not equal ± 2.0 DCV. The wiring harness is faulty. Repair the harness or replace the harness. Proceed to Step 8.

7. Compare the voltage between RM-1 and the lower display.

a. Turn the ECS to the STOP position.

b. Check the voltage between RM- 1 and RM-28. Take note of the voltage.

c. Check the voltage that is shown on the lower display. Take note of the voltage.

d. Compare the voltage between Step 7.b and Step 7.c.

Expected Result: The voltages that were measured in Step 7.b and Step 7.c are within 2.0 DCV of each other.

Results:

OK: The voltages that were measured in Step 7.b and Step 7.c are within 2.0 DCV of each other. The fault is probably an intermittent fault which is caused by a faulty connector. Inspect the electrical connectors. See Testing and Adjusting, “Electrical Connector - Inspect”. If the faulty connector can not be found, repeat this test procedure. If the fault still remains, replace the GSC+. STOP.

NOT OK: The voltages that were measured in Step 7.b and Step 7.c are not equal ± 2.0 DCV. The GSC+ is faulty. Replace the GSC+. STOP.

8. Reprogram the GSC+.

a. Turn the ECS to the STOP position.

b. Program the setpoint P023 to 2 (EUI). See System Operation, “Engine Generator Programming OP5-0”.

c. Turn the ECS to the OFF/RESET position. Disconnect the jumper wire on the ECS that is between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9.

d. Verify that the diagnostic code is no longer present.

e. Replace the jumper between pin 6 and pin 9. Not all generators will have a jumper wire between pin 6 and pin 9. STOP.

i01176269

CID 175 FMI 2 Temperature Sensor (Engine Oil) Incorrect Signal - Test

SMCS Code: 1929-038; 4490-038-NS

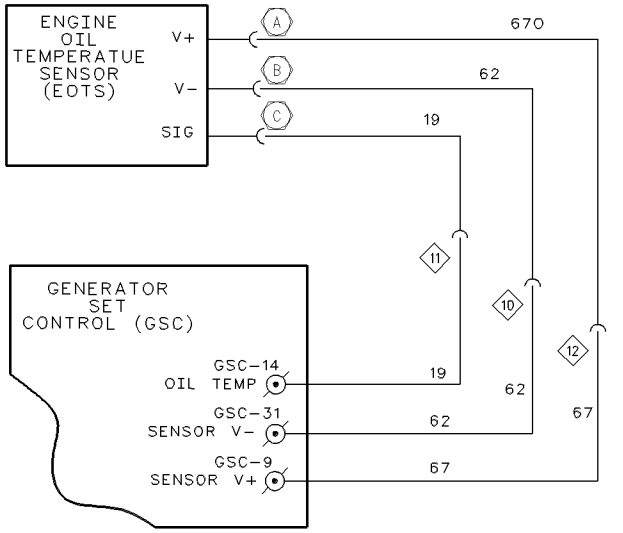


Illustration 57 g00529671

System Schematic For Engine Oil Temperature Sensor (EOTS)

The EMCP II+ monitors engine oil temperature in order to protect the engine in case of a problem with the oil temperature. The oil temperature sensor is mounted in an oil gallery of the engine. The exact location of the engine oil temperature sensor varies depending on the engine model.

The sensor is powered by an 8 volt sensor supply from the GSC+. The oil temperature signal is a pulse width modulated signal. The base frequency of the signal is 455 Hz (370 to 550 Hz). As temperature changes, the duty cycle of the signal varies from 10 to 95 percent.

- –40°C (–40°F) is approximately 10% of the duty cycle, which is approximately 1.0 DCV.
- 135°C (275°F) is approximately 93% of the duty cycle.

Note: The GSC+ is usually programmed to treat an oil temperature sensor fault as an alarm fault. The factory default for P004 is 0. The GSC+ may be programmed to shutdown for an oil temperature sensor fault. P004 is 1 for a shutdown. The operator is not required to press the Alarm Codes key in order to view the CID 175 FMI 2. The CID 175 FMI 2 is automatically shown on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a system that is operating properly, the following list of diagnostic fault codes are created when the harness connector is removed from the GSC+.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible causes of a CID 175 FMI 2 are listed below.

- The base frequency of the sensor signal is beyond accepted limits.
- The duty cycle of the sensor signal is beyond accepted limits.

Begin performing these procedures only when CID 175 FMI 2 is showing and the “DIAG” indicator is FLASHING on the upper display. The GSC+ treats a CID 175 FMI 2 fault as an alarm fault. Active alarm faults are shown on the display when the “Alarm Codes” key is pressed. The engine control switch (ECS) must be in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. In order to troubleshoot an inactive fault, use the preceding system schematic. See Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after troubleshooting is complete.

Note: This procedure can be replaced by troubleshooting the sensor signal with a meter that is capable of measuring frequency and duty cycle. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test”.

Note: If a Sensor Supply fault (CID 269) is active, correct the fault prior to proceeding with this procedure.

1. **Check The GSC+ And The Harness.** Make sure that CID 175 FMI 2 is showing on the display.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.

c. Turn the ECS to the STOP position.

d. Press the “Alarm Codes” key. The “Alarm Codes” key does not need to be pressed for shutdown faults.

e. Check if the CID 175 FMI 2 is not showing. This means that the CID 175 FMI 2 is inactive. Check if the CID 175 FMI 3 is now showing. CID 175 FMI 3 is now active.

Expected Result: CID 175 FMI 2 is not showing. The fault is inactive. CID 175 FMI 3 is now showing. The fault is active.

Results:

- OK: The GSC+ and the harness function properly. Therefore, the sensor is faulty. Replace the sensor. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test” for more testing. STOP.
- NOT OK: The CID 175 FMI 2 fault is showing. The harness or the GSC+ is faulty. Proceed to Step 2.

2. Check The GSC+.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the harness connector from the GSC+.

c. Turn the ECS to the STOP position.

d. Press the “Alarm Codes” key.

e. Check if the CID 175 FMI 2 is no longer showing. Check if the CID 175 FMI 3 is now showing.

Expected Result: CID 175 FMI 2 is not showing. The fault is inactive. CID 175 FMI 3 is now showing. The fault is active.

Results:

- OK: The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: The CID 175 FMI 2 is still showing. The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01176288

CID 175 FMI 3 Temperature Sensor (Engine Oil) Voltage Above Normal - Test

SMCS Code: 1929-038; 4490-038-NS

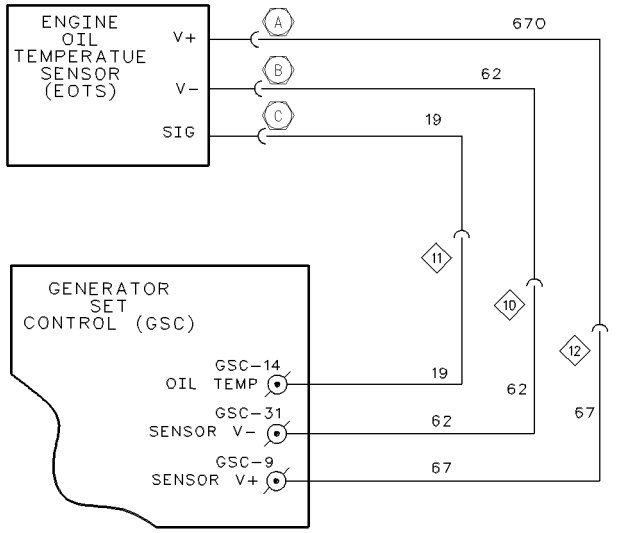


Illustration 58 g00529671

System Schematic For Engine Oil Temperature Sensor (EOTS)

The EMCP II+ monitors engine oil temperature in order to protect the engine in case of a problem with the oil temperature. The oil temperature sensor is mounted in an oil gallery of the engine. The exact location of the engine oil temperature sensor varies depending on the engine model.

The sensor is powered by an 8 volt sensor supply from the GSC+. The oil temperature signal is a pulse width modulated signal. The base frequency of the signal is 455 Hz (370 to 550 Hz). As temperature changes, the duty cycle of the signal varies from 10 to 95 percent.

- –40°C (–40°F) is approximately 10% of the duty cycle, which is approximately 1.0 DCV.

- 135°C (275°F) is approximately 93% of the duty cycle.

Note: The GSC+ is usually programmed to treat an oil temperature sensor fault as an alarm fault. The factory default for P004 is 0. The GSC+ may be programmed to shutdown for an oil temperature sensor fault. P004 is 1 for shutdown. The operator is not required to press the “Alarm Codes” key in order to view the CID 175 FMI 3. The CID 175 FMI 3 are automatically shown on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a system that is operating properly, the following list of diagnostic fault codes are created when the harness connector is removed from the GSC+.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible causes of a CID 175 FMI 3 fault are listed below.

- A short to the battery positive terminal of the sensor signal.

- An open circuit of the sensor signal.

Begin performing these procedures, only when CID 175 FMI 3 is showing and the “DIAG” indicator is FLASHING on the upper display. The GSC+ treats a CID 175 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the “Alarm Codes” key is pressed. The engine control switch (ECS) must be in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. To troubleshoot an inactive fault, use the preceding system schematic. See Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after troubleshooting is complete.

Note: If a Sensor Supply fault (CID 269) is active, correct the fault prior to proceeding with this procedure.

1. Check The Supply Circuit.

a. Turn the ECS to the OFF/RESET position and then turn the ECS to the STOP position.

b. Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.

c. At the engine harness side of the sensor connector, measure the voltage (DCV) that is between contact “A” and contact “B”. Contact “A” is the supply. Contact “B” is the sensor ground.

Expected Result: The voltage should be 8.0 ± 0.5 DCV.

Results:

- OK: The supply circuit functions properly. Proceed to Step 2.

- NOT OK: The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct the sensor supply fault. If a sensor supply fault is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

2. Check The Signal Circuit. The ECS remains in the STOP position and the sensor remains disconnected from the engine harness.

a. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact “C” and contact “B”. Contact “C” is the signal. Contact “B” is the sensor ground.

Expected Result: The voltage should be 7.0 ± 0.5 DCV.

Results:

- OK: The signal circuit functions properly. Verify this result by checking the status of the fault on the upper display. Reconnect the sensor. Turn the ECS to OFF/RESET and then turn the ECS to the STOP position. If the CID 175 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.

- NOT OK: The voltage is equal to the B+. The engine harness is faulty. The signal circuit within the engine harness is shorted to B+. Troubleshoot and repair the engine harness. STOP.

- NOT OK: Voltage is NOT 7.0 ± 0.5 DCV. Voltage is not equal to B+. The GSC+ or the harness is faulty. Proceed to Step 3.

3. **Check For A Shorted Harness.** The operator should see the preceding System Schematic when the operator is performing this step. The sensor remains disconnected from the sensor harness.

   a. Turn the ECS to OFF/RESET.

   b. Disconnect the harness connector from the GSC+.

   c. At the GSC+ harness connector, measure the resistance from signal contact “14” to all other contacts of the connector.

   Expected Result: The resistance should be greater than 5000 ohms for the measurements.

   Results:

   - OK: The harness functions properly. Proceed to Step 4.

   - NOT OK: The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

4. **Check For An Open Harness.** See the preceding System Schematic when the operator is performing this step. The ECS remains in the OFF/RESET position. The sensor remains disconnected from the harness connector.

   a. Measure the resistance of the ground circuit. The measurement should be taken from contact “B” of the sensor harness connector to contact “31” of the GSC+ harness connector.

   b. Measure the resistance of the signal circuit. The measurement should be taken from contact “C” of the sensor harness connector to contact “14” of the GSC+ harness connector.

   c. Measure the resistance of the sensor’s supply circuit. The measurement should be taken from contact “A” of the sensor harness connector to contact “9” of the GSC+ harness connector.

   Expected Result: For each measurement, the resistance should be 5 ohms or less.

   Results:

   - OK: The harness functions properly. Proceed to Step 5.

   - NOT OK: The harness wiring with the incorrect resistance measurement is open or faulty. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

5. **Check The Electrical Connectors.**

   a. Check the electrical connectors, terminals and wiring. Proceed to Testing And Adjusting, “Electrical Connector - Inspect”.

   Expected Result: All connectors, terminals and wiring should function properly.

   Results:

   - OK: Connect all harness connectors that were previously disconnected. Start the engine. If the CID 175 FMI 3 fault is still showing, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

   - NOT OK: Repair the faulty area. STOP.

i01176289

CID 175 FMI 4 Temperature Sensor (Engine Oil) Voltage Below Normal - Test

SMCS Code: 1929-038; 4490-038-NS

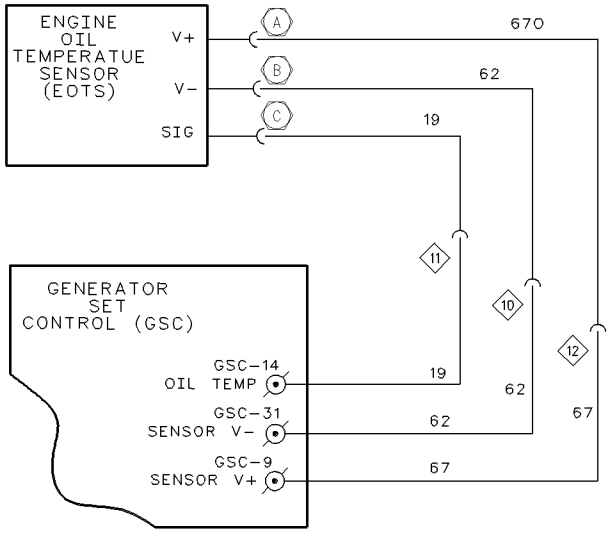


Illustration 59 g00529671

System Schematic For Engine Oil Temperature Sensor (EOTS)

The EMCP II+ monitors engine oil temperature in order to protect the engine in case of a problem with the oil temperature. The oil temperature sensor is mounted in an oil gallery of the engine. The exact location of the engine oil temperature sensor varies depending on the engine model.

The sensor is powered by an 8 volt sensor supply from the GSC+. The oil temperature signal is a pulse width modulated signal. The base frequency of the signal is 455 Hz (370 to 550 Hz). As temperature changes, the duty cycle of the signal varies from 10 to 95 percent.

- –40°C (–40°F) is approximately 10% of the duty cycle, which is approximately 1.0 DCV.
- 135°C (275°F) is approximately 93% of the duty cycle.

Note: The GSC+ is usually programmed to treat an oil temperature sensor fault as an alarm fault. The factory default for P004 is 0. The GSC+ may be programmed to shutdown. P004 is 1 for an oil temperature sensor fault. The operator is not required to press the “Alarm Codes” key in order to view the CID 175 FMI 04. The CID 175 FMI 04 is shown automatically on the upper display.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, the following list of diagnostic fault codes are created when the harness connector is removed from the GSC+.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

A possible cause of a CID 175 FMI 4 is listed below:

- A short to battery negative of the sensor signal.

Begin performing these procedures only when CID 175 FMI 4 is showing and the “DIAG” indicator is FLASHING on the upper display. The GSC+ treats a CID 175 FMI 4 as an alarm fault. Active alarm faults are shown on the upper display when the “Alarm Codes” key is pressed. The engine control switch (ECS) must be in any position except the OFF/RESET position. For an inactive fault, use the preceding system schematic. See Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after the troubleshooting is complete.

Note: If a Sensor Supply falt (CID 269) is active, correct the fault prior to proceeding with this procedure.

1. **Check The GSC+ And The Harness.** Make sure that CID 175 FMI 4 is showing on the display.
   - **a.** Turn the ECS to the OFF/RESET position.
   - **b.** Disconnect the sensor from the engine harness. The sensor remains fastened to the engine.
   - **c.** Turn the ECS to the STOP position.
   - **d.** Press the “Alarm Codes” key.
   - **e.** Check if CID 175 FMI 4 is not showing and CID 175 FMI 3 is now showing.

Expected Result: CID 175 FMI 4 is not showing and CID 175 FMI 3 is now showing.

Results:

- OK: The GSC+ and the harness function properly. The sensor is faulty. Replace the sensor. See Testing And Adjusting, “Pulse Width Modulated (PWM) Sensor - Test” for more testing. STOP.
- NOT OK: The CID 175FMI 4 fault remains on the upper display. The harness or the GSC+ is faulty. Proceed to Step 2.

2. Check The GSC+.

a. Turn the ECS to the OFF/RESET position.

b. Disconnect the harness connector from the GSC+.

c. Turn the ECS to the STOP position.

d. Press the “Alarm Codes” key.

e. Check if CID 175 FMI 4 is not showing. Check if CID 175 FMI 3 is now showing.

Expected Result: CID 175 FMI 4 is not showing. CID 175 FMI 3 is now showing.

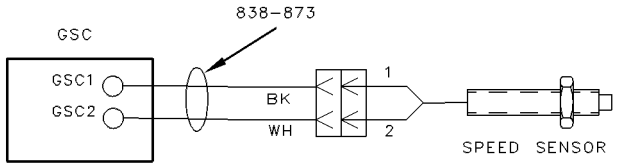
Results:

- OK: The GSC+ functions properly. Therefore, the signal wire is shorted to battery negative (“B–”) in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: The CID 175 FMI 4 fault remains on the upper display. The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01176290

CID 190 FMI 2 Speed Sensor (Engine) Incorrect Signal - Test

SMCS Code: 1907-038; 4490-038-NS



g00485064

Illustration 60

System Schematic For Speed Sensor (Engine)

Note: This speed sensor is sometimes referred to as a magnetic pickup (MPU).

The EMCP II+ monitors engine speed in order to use the information when the information is needed for other tasks. The EMCP II+ does not control engine speed. The engine speed sensor is mounted on the flywheel housing of the engine. The EMCP II+ activates an engine overspeed shutdown. The EMCP II+ terminates the engine cranking. The EMCP II+ determines the oil step speed. If a fault shutdown is present, the solenoid is energized.

The sensor creates a sine wave signal from passing ring gear teeth at the rate of one pulse per tooth. The sensor’s sine wave signal is directly proportional to the engine speed.

The GSC+ treats a CID 190 as a shutdown fault. The engine is not allowed to crank when this diagnostic code is active.

Note: Engines that are equipped with an electronic governor have an additional speed sensor.

Note: Faults are created when the harness connector (40 contact) is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic codes are recorded:

- CID 100 FMI 2 pressure sensor (engine oil)
- CID 110 FMI 2 temperature sensor (engine coolant)

- CID 111 FMI 3 fluid level sensor (engine coolant)
- CID 190 FMI 3 speed sensor (engine)
- CID 336 FMI 2 switch (engine control)
- CID 590 FMI 9 engine ECM

Procedure

The following conditions could be the cause of a CID 190 FMI 2:

- The frequency of the signal is beyond accepted limits (short to “B-”).
- The air gap of the speed sensor is too large.

Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the harness and the sensor.

a. Turn the ECS to OFF/RESET.

b. Disconnect the harness connector from the GSC+.

c. At the GSC+ harness connector, measure the resistance from contact 1 to contact 2.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK: The fault is probably an intermittent fault. Reconnect the harness connector to the GSC+. Turn the ECS to OFF/RESET and then turn the ECS to STOP. Verify that a CID 190 remains active on the upper display.
- If a CID 190 is showing, continue with this procedure. Proceed to next step.
- If a CID 190 is NOT showing, this step has corrected the fault. STOP. If you are desired then continue with this procedure. Proceed to next step.
- NOT OK: The harness wiring or the speed sensor is faulty. Proceed to 2.

2. Check the resistance of the sensor.

a. Disconnect the speed sensor from the engine harness. The speed sensor remains fastened to the engine.

b. At the connector of the speed sensor, measure the resistance between contact “1” and contact “2”.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK: The resistance of the speed sensor is correct. Proceed to next step.
- NOT OK: Replace the speed sensor. Also, see Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. STOP.

3. Check the harness for an open and a short.

The ECS remains in the OFF/RESET position. The speed sensor and the GSC+ remains disconnected from the harness.

a. Check for an open circuit. Measure the resistance from contact “2” of the speed sensor harness connector to contact “2” of the GSC+ harness connector. The resistance should be 5 ohms or less.

b. Check for an open circuit. Measure the resistance from contact “1” of the speed sensor harness connector to contact “1” of the GSC+ harness connector. The resistance should be 5 ohms or less.

c. Check for a short circuit. Measure the resistance from contact “1” of the GSC+ harness connector to contact “2” of the GSC+ harness connector. The resistance should be greater than 5000 ohms.

Expected Result: The resistance for 3.a and 3.b should be 5 ohms or less. The resistance for step 3.c should be greater than 5000 ohms.

Results:

- OK: The harness functions properly. Proceed to next step.
- NOT OK: The harness wiring with the incorrect resistance measurement is faulty. Replace the faulty harness from the speed sensor to the GSC+ connector. STOP.

4. Check the shield and the connectors.

The ECS remains in the OFF/RESET position. The speed sensor and the GSC+ remain disconnected from the harness. The harness has a shield (bare wire) which protects the signal wire for the speed sensor from electrical interference. Ensure that the shield is securely fastened.

a. Within the EMCP II +, check that the shield is securely fastened to a GSC+ mounting stud.

b. Within the EMCP II +, measure the resistance from the shield to a metal surface within the enclosure of EMCP II +. A good reference point is a mounting screw for a component that directly contacts the metal enclosure. The resistance should be 5 ohms or less.

c. Check the connector of the speed sensor and the mating harness connector. Proceed to Testing And Adjusting, “Electrical Connector - Inspect”.

Expected Result: The shield should be securely fastened. The resistance in 4.b should be 5 ohms or less. Also, the connectors should be proper.

Results:

- OK: Proceed to next step.
- NOT OK: One of the items is NOT correct. Repair the harness or replace the harness. STOP.

5. Inspect the sensor and adjust the sensor.

a. Remove the speed sensor from the engine flywheel housing.

b. Inspect the speed sensor for damage. Remove any debris from the tip.

Expected Result: No damage should be present.

Results:

- OK: Reinstall the speed sensor and adjust the speed sensor. See Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. Proceed to next step.
- Not OK: Replace the speed sensor. Also, see Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. STOP.

6. Check the status of the fault.

a. Reconnect the harness connector to the GSC+ and the speed sensor.

b. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

c. Verify that CID 190 is showing on the upper display.

Expected Result: A CID 190 FMI 2 is active.

Results:

- OK: These procedures have corrected the fault. STOP. If you are desired then continue with this procedure. Proceed to next step.
- Not OK: A CID 190 is showing. The diagnostic code is still active and the engine will not start. Use the process of elimination to find the faulty component. Stop when the diagnostic code is no longer showing. First, replace the speed sensor and adjust the speed sensor. Then replace the harness. Finally, replace the GSC+.

7. Check The Signal Voltage.

This is an additional check of the circuit. Make sure that all harness connectors are connected.

a. Set up a multimeter with 7X-1710 Multimeter Probe Group in order to measure the ACV from contact “1” to contact “2” of the GSC+ connector.

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

c. Measure the ACV of the speed sensor.

Expected Result: The voltage should be greater than 2 ACV.

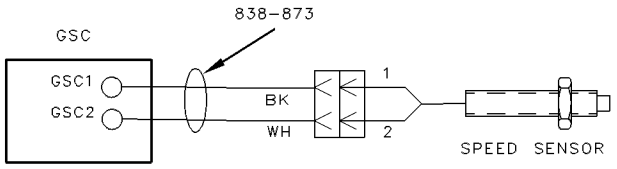
Results:

- OK: The speed sensor circuit is correct. STOP.
- NOT OK: The most likely cause is improper air gap of the speed sensor. Repeat step 5. STOP.

i01176293

CID 190 FMI 3 Speed Sensor (Engine) Voltage Above Normal - Test

SMCS Code: 1907-038; 4490-038-NS



g00485064

Illustration 61

System Schematic For Speed Sensor (Engine)

Note: This speed sensor is sometimes referred to as a magnetic pickup (MPU).

The EMCP II+ monitors engine speed in order to use the information when the information is needed for other tasks. The EMCP II+ activates the engine overspeed shutdown. The EMCP II+ terminates engine cranking. The EMCP II+ determines the oil step speed. The air shutoff is energized by the EMCP II+. The EMCP II+ does not control engine speed. The engine speed sensor is mounted on the flywheel housing of the engine.

The sensor creates a sine wave signal from passing ring gear teeth at the rate of one pulse per tooth. The sensor sends a sine wave signal which is in direct proportion to the speed of the engine.

The GSC+ treats a CID 190 as a shutdown fault. The engine is not allowed to crank when this diagnostic code is active.

Note: Engines that are equipped with an electronic governor have an additional speed sensor.

Note: Faults are created when the harness connector (40 contact) is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic codes are recorded:

- CID 100 FMI 2 pressure sensor (engine oil)
- CID 110 FMI 2 temperature sensor (engine coolant)
- CID 111 FMI 3 fluid level sensor (engine coolant)
- CID 190 FMI 3 speed sensor (engine)
- CID 336 FMI 2 switch (engine control)
- CID 590 FMI 9 engine ECM

Procedure

The following condition could be the cause of a CID 190 FMI 3:

- The signal circuit is open.

Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the harness and the sensor.

a. Turn the ECS to OFF/RESET.

b. Disconnect the harness connector from the GSC+.

c. At the GSC+ harness connector, measure the resistance from contact 1 to contact 2.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK: The fault is probably an intermittent fault. Reconnect the harness connector to the GSC+. Turn the ECS to OFF/RESET and then turn the ECS to STOP. Verify that a CID 190 remains active on the upper display.
- If a CID 190 is showing, continue with this procedure. Proceed to next step.
- If a CID 190 is NOT showing, this step has corrected the fault. STOP. If you are desired then continue with this procedure. Proceed to next step.
- NOT OK: The harness wiring or the speed sensor is faulty. Proceed to 2.

2. Check the resistance of the sensor.

a. Disconnect the speed sensor from the engine harness. The speed sensor remains fastened to the engine.

b. At the connector of the speed sensor, measure the resistance between contact “1” and contact “2”.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK: The resistance of the speed sensor is correct. Proceed to next step.
- NOT OK: Replace the speed sensor. Also, see Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. STOP.

3. Check the harness for an open and a short.

The ECS remains in the OFF/RESET position. The speed sensor and the GSC+ remain disconnected from the harness.

a. Check for an open circuit. Measure the resistance from contact “2” of the speed sensor harness connector to contact “2” of the GSC+ harness connector. The resistance should be 5 ohms or less.

b. Check for an open circuit. Measure the resistance from contact “1” of the speed sensor harness connector to contact “1” of the GSC+ harness connector. The resistance should be 5 ohms or less.

c. Check for a short circuit. Measure the resistance from contact “1” of the GSC+ harness connector to contact “2” of the GSC+ harness connector. The resistance should be greater than 5000 ohms.

Expected Result: The resistance for 3.a and 3.b should be 5 ohms or less. The resistance for step 3.c should be greater than 5000 ohms.

Results:

- OK: The harness functions properly. Proceed to next step.
- NOT OK: The harness wiring with the incorrect resistance measurement is faulty. Replace the faulty harness from the speed sensor to the GSC+ connector. STOP.

4. Check the shield and the connectors.

The ECS remains in the OFF/RESET position. The speed sensor and the GSC+ remain disconnected from the harness. The harness has a shield (bare wire) which protects the signal wire for the speed sensor from electrical interference. Ensure that the shield is securely fastened.

a. Within the EMCP II+, check that the shield is securely fastened to a GSC+ mounting stud.

b. Within the EMCP II+, measure the resistance from the shield to a metal surface within the enclosure of EMCP II+. A good reference point is a mounting screw for a component that directly contacts the metal enclosure. The resistance should be 5 ohms or less.

c. Check the connector of the speed sensor and the mating harness connector. Proceed to Testing And Adjusting, “Electrical Connector - Inspect”.

Expected Result: The shield should be securely fastened. The resistance in 4.b should be 5 ohms or less. Also, the connectors should be proper.

Results:

- OK: Proceed to next step.
- NOT OK: One of the items is NOT correct. Repair the harness or replace the harness. STOP.

5. Inspect the sensor and adjust the sensor.

a. Remove the speed sensor from the engine flywheel housing.

b. Inspect the speed sensor for damage. Remove any debris from the tip.

Expected Result: No damage should be present.

Results:

- OK: Reinstall the speed sensor and adjust the speed sensor. See Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. Proceed to next step.
- NOT OK: Replace the speed sensor. Also, see Testing And Adjusting, “Speed Sensor (Engine) - Adjust”. STOP.

6. Check the status of the fault.

a. Reconnect the harness connector to the GSC+ and the speed sensor.

b. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

c. Verify that CID 190 is showing on the upper display.

Expected Result: A CID 190 FMI 2 is active.

Results:

- OK: These procedures have corrected the fault. STOP.
- NOT OK: A CID 190 is showing. The diagnostic code is still active and the engine will not start. Use the process of elimination to find the faulty component. Stop when the diagnostic code is no longer showing. First, replace the speed sensor and adjust the speed sensor. Then replace the harness. Finally, replace the GSC+.

7. Check the signal voltage.

This is an additional check of the circuit. Make sure that all harness connectors are connected.

a. Set up a multimeter with 7X-1710 Multimeter Probe Group in order to measure the ACV. Measure the ACV from contact “1” of the GSC+ connector to contact “2” of the GSC+ connector.

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

c. Measure the ACV of the speed sensor.

Expected Result: The voltage should be greater than 2 ACV.

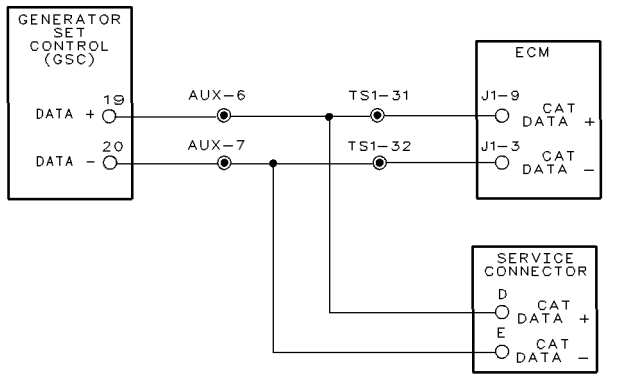
Results:

- OK: The speed sensor circuit is correct. STOP.
- NOT OK: The most likely cause is improper air gap of the speed sensor. Repeat step 5. STOP.

i01176296

CID 248 FMI 9 CAT Data Link Abnormal Update - Test

SMCS Code: 1408-038; 4490-038



g00485981

Illustration 62

System Schematic For CAT Data Link

On 3500B gensets, the GSC+ uses the CAT data link to communicate with the engine ECM. The CAT data link consists of two wires that connect the GSC+ to the engine ECM. See Testing And Adjusting, “Block Diagram of Generator Set Control”.

Procedure

The following conditions will cause a CID 248 FMI 9:

- There is a short from the wire that connects to contact “19” of the CAT data link to the battery (“B+”).
- There is a short from the wire that connects to contact “20” of the CAT data link to the battery (“B+”).
- There is a short from the wire that connects to contact “19” of the CAT data link to ground (“B-”).
- There is a short from the wire that connects to contact “20” of the CAT data link to ground (“B-”).

The GSC+ cannot detect an open in the circuit of the CAT data link. Troubleshoot the wiring and repair the wiring. See Testing And Adjusting, “Schematic and Wiring Diagrams”.

The GSC+ treats a CID 248 as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. Also, the ECS is in any position except the OFF/RESET position. Clear the fault from the fault log after troubleshooting is complete.

i01176419

CID 268 FMI 2 EMCP Electronic Control (Generator Set) Incorrect Signal - Test

SMCS Code: 4490-038

A portion of the memory within the GSC+ stores the setpoints of important conditions of the genset. The setpoints are found in the following service modes: “Engine/Generator Programming” (OP5), “Spare Input/Output Programming” (OP6), and “Voltmeter/Ammeter Programming” (OP8). The GSC+ detects a CID 268 when the data for the setpoint is invalid or out of range. After detecting a CID 268, the GSC+ sets the affected setpoints to the default value. For more information regarding setpoints and default values, see the following topics:

- Systems Operation, “Engine/Generator Programming OP5”
- Systems Operation, “Spare Input/Output Programming OP6”
- Systems Operation, “Voltmeter/Ammeter Programming OP8”

Procedure

Electrical interference is a possible cause of a CID 268 FMI 2.

This procedure is for a CID 268 that is active or inactive. Clear the diagnostic code from the fault log after troubleshooting is complete.

The GSC+ treats a CID 268 as an alarm fault or as a shutdown fault. This will depend on the particular setpoint with the incorrect data. The setpoint for the ring gear teeth (P09) and the setpoint for the engine overspeed (P10) are treated as shutdown faults when the particular data is corrupted. All other setpoints are treated as alarm faults when the particular data is corrupted.

Note: If the fault shutdown indicator is FLASHING and the 6 to 9 jumper is NOT installed on the ECS, then the jumper must be temporarily installed. The GSC+ setpoints must be programmed in OFF/RESET when a fault shutdown is active. If the fault alarm indicator is FLASHING, the GSC+ can be programmed with the ECS in any position.

1. Check the setpoints.

a. View the setpoints that are stored in the memory of the GSC+. See Systems Operation, “Engine/Generator Setpoint Viewing OP2”.

b. Also check the spare input/output programming (OP6) and the voltmeter/ammeter programming (OP8).

c. Compare the stored setpoints to the specified setpoints of the particular genset.

Expected Result: The stored setpoints and specified setpoints should match.

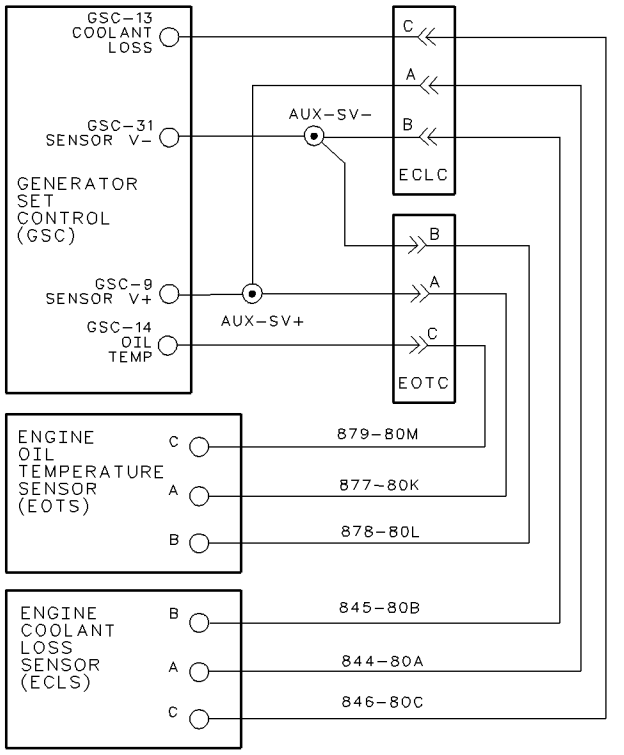
Results:

- OK: All the setpoints match. Start the engine. Verify that the CID 268 FMI 2 is active. If the fault remains active, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. If the fault was inactive prior to performing this procedure, then these steps should have corrected the fault. STOP.
- NOT OK: One or more of the setpoints do not match. Program the setpoints. See Systems Operation, “Engine/Generator Programming OP5”, Systems Operation, “Spare Input/Output Programming OP6”, and Systems Operation, “Voltmeter/Ammeter Programming OP8”. STOP.

i01176450

CID 269 FMI 3 Sensor Power Supply Voltage Above Normal - Test

SMCS Code: 1408-038; 4490-038



g00629679

Illustration 63

System Schematic For Sensor Power Supply

The EMCP II+ has a sensor supply that is 8 DCV. The sensor supply from the GSC+ powers the following engine sensors:

- oil pressure
- oil temperature
- coolant temperature
- coolant fluid level

The engine oil temperature sensor is an optional item. The engine coolant level sensor is an optional item.

The sensor power supply functions whenever power is applied to the GSC+.

The GSC+ is usually programmed in the factory to treat a fault with the sensor power supply CID 269 as an alarm fault. P004 = 0. If the GSC+ is programmed to shutdown, P004 is equal to 1 for a fault with the sensor power supply. It is not necessary to press the “Alarm Codes” key in order to view the CID 269 FMI 4. The CID 269 FMI 4 is automatically shown on the upper display.

Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine Electronic Control Module (ECM)

The possible cause of a CID 269 FMI 4 fault occurs when the voltage of the sensor supply is less than 7.5 DCV.

Begin performing these procedures only when CID 269 FMI 4 is showing and the “DIAG” indicator is FLASHING on the upper display. The GSC+ treats a CID 269 FMI 4 fault as an alarm fault. Active alarm faults are shown on the display when the “Alarm Codes” key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. In order to troubleshoot an inactive fault, use the preceding system schematic and see Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after troubleshooting is complete.

1. Check The GSC+.

a. Turn the ECS to OFF/RESET.

b. Disconnect the harness connector from the GSC+.

c. Turn the ECS to STOP.

d. Press the “Alarm Codes” key.

e. Observe the upper display for the CID 269 FMI 4 fault. If the fault is showing then the fault is active.

Expected Result: The CID 269 FMI 4 fault should NOT be showing on the upper display.

Results:

- OK: The GSC+ is functioning properly. Therefore, the engine harness or a sensor is faulty. Proceed to Step 2.
- NOT OK: The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

2. Check The Oil Pressure Sensors.

a. Turn the ECS to OFF/RESET.

b. Reconnect the harness connector to the GSC+.

c. Disconnect the engine harness from the oil pressure sensor.

d. Turn the ECS to STOP.

e. Press the “Alarm Codes” key.

f. Observe the upper display for the CID 269 FMI 4 fault.

Expected Result: If the sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK: The CID 269 FMI 4 fault is NOT showing. The oil pressure sensor is faulty. Replace the sensor. STOP.
- NOT OK: The CID 269 FMI 4 fault is still showing. The oil pressure is not the cause of the CID 269 FMI 4 fault. Proceed to Step 3.

3. Check Other Sensors And The Harness.

a. Repeat Step 2 for the coolant temperature sensor, the optional oil temperature sensor and the optional coolant loss sensor.

Expected Result: If a sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK: When a sensor is disconnected, the CID 269 FMI 4 fault is NOT showing. The sensor is faulty. Replace the sensor. STOP.
- NOT OK: With all the sensors that are disconnected, the CID 269 FMI 4 fault is still showing on the upper display. The sensors are not the cause of the CID 269 FMI 4 fault. Therefore, the engine harness has a short to the battery negative terminal “B–”. Repair the engine harness. STOP.

i01176643

CID 269 FMI 4 Sensor Power Supply Voltage Below Normal - Test

SMCS Code: 1408-038; 4490-038

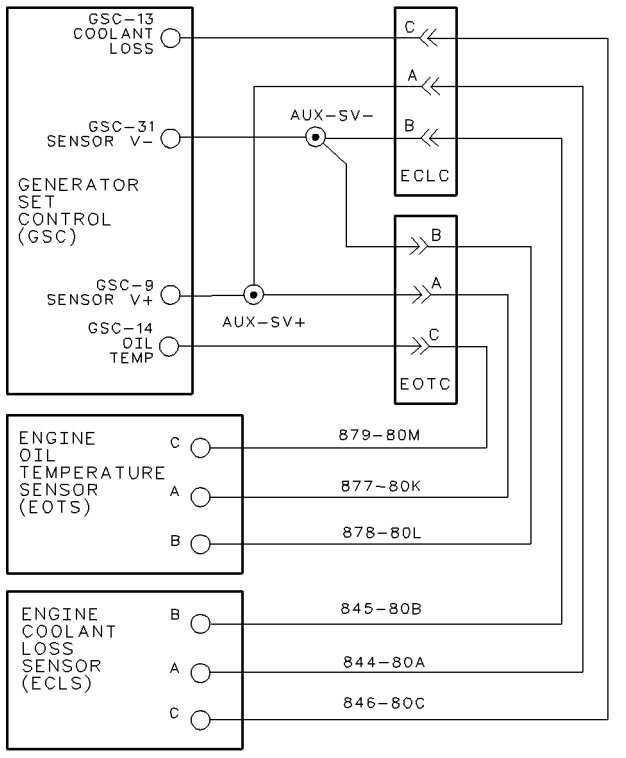


Illustration 64 g00629679

The EMCP II+ has an sensor supply that is 8 DCV. The sensor supply from the GSC+ powers the following engine sensors:

- oil pressure
- oil temperature
- coolant temperature
- coolant fluid level

The engine oil temperature sensor is optional. The engine coolant level sensor is an optional item.

The sensor power supply functions whenever power is applied to the GSC+.

The GSC+ is programmed in the factory to treat a fault with the sensor power supply CID 269 as an alarm fault P004. P004 = 0. If the GSC+ is programmed to shutdown, P004 is equal to 1 for a fault with the sensor power supply. It is not necessary to press the “Alarm Codes” key in order to view the CID 269 FMI 4. The CID 269 FMI 4 is automatically shown on the upper display.

Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible cause of a CID 269 FMI 4 fault occurs when the voltage of the sensor supply is less than 7.5 DCV.

Begin performing these procedures only when CID 269 FMI 4 is showing and the “DIAG” indicator is FLASHING on the upper display. The GSC+ treats a CID 269 FMI 4 fault as an alarm fault. Active alarm faults are shown on the display when the “Alarm Codes” key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. For an inactive fault, the problem may be intermittent. In order to troubleshoot an inactive fault, use the preceding system schematic and see Testing And Adjusting, “Electrical Connector - Inspect”. Clear the fault from the fault log after troubleshooting is complete.

1. Check The GSC+.

a. Turn the ECS to OFF/RESET.

b. Disconnect the harness connector from the GSC+.

c. Turn the ECS to STOP.

d. Press the “Alarm Codes” key.

e. Observe the upper display for the CID 269 FMI 4 fault. If the fault is showing then the fault is active.

Expected Result: The CID 269 FMI 4 fault should NOT be showing on the upper display.

Results:

- OK: The GSC+ is functioning properly. Therefore, the engine harness or a sensor is faulty. Proceed to Step 2.
- NOT OK: The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

2. Check The Oil Pressure Sensors.

a. Turn the ECS to OFF/RESET.

b. Reconnect the harness connector to the GSC+.

c. Disconnect the engine harness from the oil pressure sensor.

d. Turn the ECS to STOP.

e. Press the “Alarm Codes” key.

f. Observe the upper display for the CID 269 FMI 4 fault.

Expected Result: If the sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK: The CID 269 FMI 4 fault is NOT showing. The oil pressure sensor is faulty. Replace the sensor. STOP.
- NOT OK: The CID 269 FMI 4 fault is still showing. The oil pressure is not the cause of the CID 269 FMI 4 fault. Proceed to Step 3.

3. Check Other Sensors And The Harness.

a. Repeat Step 2 for the coolant temperature sensor, the optional oil temperature sensor and the optional coolant loss sensor.

Expected Result: If a sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK: When a sensor is disconnected, the CID 269 FMI 4 fault is NOT showing. The sensor is faulty. Replace the sensor. STOP.
- NOT OK: With all the sensors that are disconnected, the CID 269 FMI 4 fault is still showing on the upper display. The sensors are not the cause of the CID 269 FMI 4 fault. Therefore, the engine harness has a short to the battery negative terminal “B–”. Repair the engine harness. STOP.

i01176663

CID 333 FMI 3 Alarm Module Control Voltage Above Normal - Test

SMCS Code: 4490-038

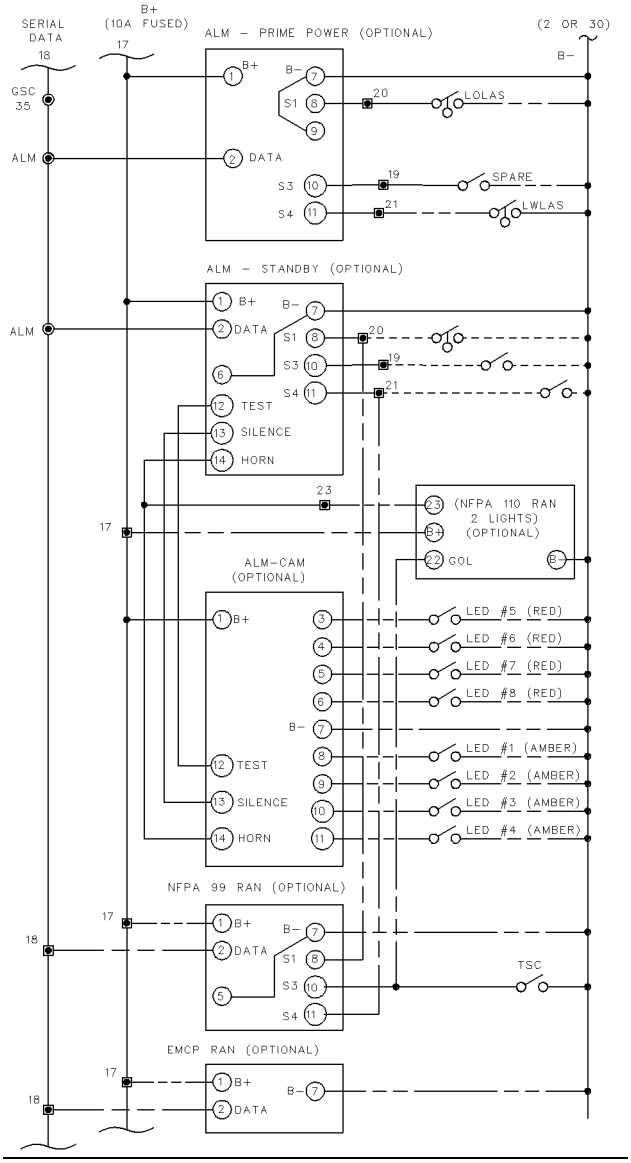


Illustration 65 g00481278

System Schematic For Alarm Module (ALM)

The alarm module (ALM) is available as an option. The alarm module may be mounted on the front panel. Also, the alarm module may be placed at a distance from the control panel as a remote annunciator. The alarm module is used in order to satisfy the requirements of the customer. The alarm module may be used in order to satisfy National Fire Protection Association (NFPA) requirements by annunciating the presence of a fault.

The ALM communicates with the GSC+ by a serial data link. When the data link malfunctions, all of the indicators on the ALM, that are controlled by the data link, flash at a rate of .5 Hz.

Note: The maximum number of the ALM or the Customer Interface Module (CIM) that may be connected to the serial data link is equal to three. The maximum distance between a module and the GSC+ is 305 m (1000 ft). If these specifications are not met, the ALM indicators may begin to flash. The GSC+ shows a CID 333 fault. If the setup is not in compliance with the specifications, reduce the number of modules and/or shorten the distance to the modules.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the diagnostic fault codes that are listed below are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine (ECM)

The possible cause of a CID 333 FMI 3 fault is a short to “B+”.

The GSC+ treats a CID 333 FMI 3 fault as an alarm fault. Clear the fault from the fault log after troubleshooting is complete.

Note: If a CID 333 FMI 3 fault is showing on the upper display and no alarm module is installed, then check the terminal strips on the subpanel for a short. Perform the check from the signal wire to “B+”. Check the customer connection box for a short from the alarm data signal wire to “B+”.

1. Check The Status Of The Fault.

a. Turn the engine control switch (ECS) to OFF/RESET and then turn the ECS to STOP.

b. Press the “Alarm Codes” key.

c. Observe the upper display for a CID 333 FMI 3. The fault is active if the upper display shows a CID 333 FMI 3.

d. If the fault is not showing, enter the service mode and view the fault log (OP1). Check the upper display if the fault is showing.

Expected Result: A CID 333 FMI 3 fault is active or inactive.

Results:

- OK: A CID 333 FMI 3 fault is active. Proceed to Step 2.
- OK: A CID 333 FMI 3 fault is inactive. Proceed to Step 4.
- NOT OK: A CID 333 FMI 3 fault has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

2. Check The Voltage Of The Data Signal.

a. Turn the ECS to STOP.

b. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The measured voltage should change constantly. The range of values should be from 0 to 10 DCV.

Results:

- OK: The voltage measurement is correct. Proceed to Step 4.
- NOT OK: The voltage measurement is not correct. Proceed to Step 3.

3. Check The Voltage Of The ALM And The GSC+.

a. Turn the ECS to STOP.

b. At the ALM, remove wire number 90 from terminal 2.

c. Disconnect the harness connector from the GSC+.

d. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead). The voltage should be 11.6 ± 0.5 DCV.

e. Measure the DC voltage from contact “35” of the GSC+ to “B–” of the relay module. The measured voltage should change constantly. The range of values should be from 0 to 5.5 DCV.

Expected Result: The voltage for Step 3.d should be 11.6 ± 0.5 DCV. The voltage for Step 3.e should be constantly changing. The range of values should be from 0 to 5.5 DCV.

Results:

- OK: Both voltage measurements are correct. Proceed to Step 3.e.
- NOT OK: The voltage that is measured at the ALM in Step 3.d is NOT correct. Replace the ALM. STOP.
- NOT OK: The voltage that is measured at the GSC+ in Step 3.e is not correct. Replace the GSC+. STOP.

4. Check For A “B+” Short In The Harness.

a. Disconnect the harness connector from the GSC+.

b. At the ALM, remove wire number 90 from terminal 2.

c. Measure the resistance from wire number 90 at the ALM to “B+” at the relay module.

d. Also, measure the resistance from wire number 90 at the ALM to “B–” at the relay module.

Expected Result: For each measurement, the resistance should be greater than 20000 ohms.

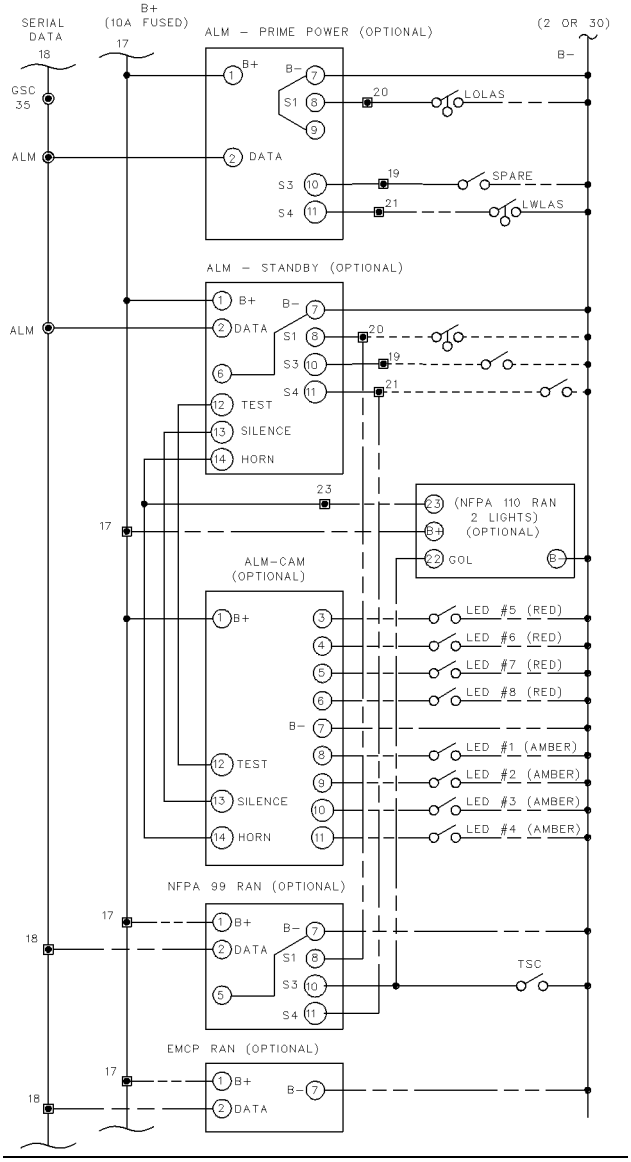
Results:

- OK: Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. If the indicators on the ALM still flash after the inspection, replace the ALM. STOP.
- NOT OK: One or both of the resistance measurements are less than 20000 ohms. The harness wiring that has the incorrect resistive measurement is shorted or faulty. Troubleshoot and repair the faulty harness wiring between the ALM and the GSC+. See the preceding System Schematic.

i01176731

CID 333 FMI 4 Alarm Module Control Voltage Below Normal - Test

SMCS Code: 4490-038



g00481278

Illustration 66

System Schematic For Alarm Module (ALM)

The alarm module (ALM) is available as an option. The alarm module may be mounted on the front panel. Also, the alarm module may be placed at a distance from the control panel as a remote annunciator. The alarm module is used in order to satisfy the requirements of the customer. The alarm module may be used in order to satisfy National Fire Protection Association (NFPA) requirements by annunciating the presence of a fault.

The ALM communicates with the GSC+ by a serial data link. When the data link malfunctions, all of the indicators on the ALM, that are controlled by the data link, flash at a rate of .5 Hz.

Note: The maximum number of the ALM or the Customer Interface Module (CIM) that may be connected to the serial data link is equal to three. The maximum distance between a module and the GSC+ is 305 m (1000 ft). If these specifications are not met, the ALM indicators may begin to flash. The GSC+ may show a CID 333 fault. If the setup is not in compliance with the specifications, reduce the number of modules and/or shorten the distance to the modules.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the diagnostic fault codes that are listed below are recorded.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 560 FMI 9 – Engine Electronic Control Module (ECM)

The possible cause of a CID 333 FMI 3 fault is a short to “B+”.

The GSC+ treats a CID 333 FMI 3 fault as an alarm fault. Clear the fault from the fault log after troubleshooting is complete.

Note: If a CID 333 FMI 3 fault is showing on the upper display and no alarm module is installed, then check the terminal strips on the subpanel for a short. Perform the check from the signal wire to “B+”. Also, check the customer connection box for a short from the alarm data signal wire to “B+”.

1. Check The Status Of The Fault.

a. Turn the engine control switch (ECS) to OFF/RESET and then turn the ECS to STOP.

b. Press the “Alarm Codes” key.

c. Observe the upper display for a CID 333 FMI 3. The fault is active if the upper display shows a CID 333 FMI 3.

d. If the fault is not showing, enter the service mode and view the fault log (OP1). Check the upper display if the fault is showing.

Expected Result: A CID 333 FMI 3 fault is active or inactive.

Results:

- OK: A CID 333 FMI 3 fault is active. Proceed to Step 2.
- OK: A CID 333 FMI 3 fault is inactive. Proceed to Step 4.
- NOT OK: A CID 333 FMI 3 fault has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

2. Check The Voltage Of The Data Signal.

a. Turn the ECS to STOP.

b. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The measured voltage should change constantly. The range of values should be from 0 to 10 DCV.

Results:

- OK: The voltage measurement is correct. Proceed to Step 4.
- NOT OK: The voltage measurement is not correct. Proceed to Step 3.

3. Check The Voltage Of The ALM And The GSC+.

a. Turn the ECS to STOP.

b. At the ALM, remove wire number 90 from terminal 2.

c. Disconnect the harness connector from the GSC+.

d. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead). The voltage should be 11.6 ± 0.5 DCV.

e. At the GSC+, measure the DC voltage from contact “35” of the GSC+ to the “B-” of the relay module. The measured voltage should change constantly. The range of values should be from 0 to 5.5 DCV.

Expected Result: The voltage for Step 3.d should be 11.6 ± 0.5 DCV. The voltage for Step 3.e should be constantly changing. The range of values should be from 0 to 5.5 DCV.

Results:

- OK: Both voltage measurements are correct. Proceed to Step 3.e.
- NOT OK: The voltage that is measured at the ALM in Step 3.d is NOT correct. Replace the ALM. STOP.
- NOT OK: The voltage that is measured at the GSC+ in Step 3.e is not correct. Replace the GSC+. STOP.

4. Check For A “B+” Short In The Harness.

a. Disconnect the harness connector from the GSC+.

b. At the ALM, remove wire number 90 from terminal 2.

c. Measure the resistance from wire number 90 at the ALM to“B+” at the relay module.

d. Also, measure the resistance from wire number 90 at the ALM to “B–” at the relay module.

Expected Result: For each measurement, the resistance should be greater than 20000 ohms.

Results:

- OK: Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. If the indicators on the ALM still flash after the inspection, replace the ALM. STOP.
- NOT OK: One or both of the resistance measurements are less than 20000 ohms. The harness wiring that has the incorrect resistive measurement is shorted or faulty. Troubleshoot and repair the faulty harness wiring between the ALM and the GSC+. See the preceding System Schematic.

i01176758

CID 334 FMI 3 Spare Output Voltage Above Normal - Test

SMCS Code: 4490-038

Illustration 67 g00487533

System Schematic For A Spare Output

The spare output on the GSC+ is strictly used for the customer. The spare output is programmed to activate under a variety of conditions. The spare output’s default activates when the engine is in cooldown mode. The GSC+ treats a CID 334 FMI 3 fault as an alarm fault. The default is set for the output to activate when the engine is in the cooldown (SP11=7). For more information, see System Operation, “Spare Input/Output Programming OP6”. The responsibility of documenting any connections to this spare output falls on the customer and/or the dealer. Also, The responsibility of troubleshooting any connections to this spare output falls on the customer and/or the dealer.

The voltage on the spare output is approximately 5.0 DCV when the spare output is not active. The voltage is approximately 5.0 DCV when there are no connections to the spare output. When the spare output is active, the voltage on the spare output is approximately 0 volts. The spare output is capable of drawing (sinking) approximately 100 mA.

Procedure

The following condition could be a possible cause of a CID 334 FMI 3.

- A short to the battery (“B+”) of the signal for the spare output is present.

Troubleshooting of a spare output fault is direct. The FMI defines the diagnostic code. FMI 3 is a short to the +battery. In order to find the exact cause of the diagnostic code, use the following information: the FMI, the system schematic for the spare output, and the documentation that is provided by the dealer and/or the customer

i01176794

CID 334 FMI 4 Spare Output Voltage Below Normal - Test

SMCS Code: 4490-038

g00487533

Illustration 68

System Schematic For Spare Output

Used as a high/low logic circuit

The spare output on the GSC+ is strictly used for the customer. The spare output is programmed to activate under a variety of conditions. The default is set for the output to activate when the engine is in the cooldown (SP11 = 7). The GSC+ treats this diagnostic code as an alarm fault. For more information, see Systems Operation, “Spare Input/Output Programming OP6”. The responsibility of documenting any connections to this spare output falls on the customer and/or the dealer. Also, The responsibility of troubleshooting any connections to this spare output falls on the customer and/or the dealer.

The voltage on the spare output is approximately 5.0 DCV when the spare output is not active. The voltage is approximately 5.0 DCV when there are no connections to the spare output. When the spare output is active, the voltage on the spare output is approximately 0 volts. The spare output is capable of drawing (sinking) approximately 100 mA.

Procedure

The following condition could be a possible cause of a CID 334 FMI 4.

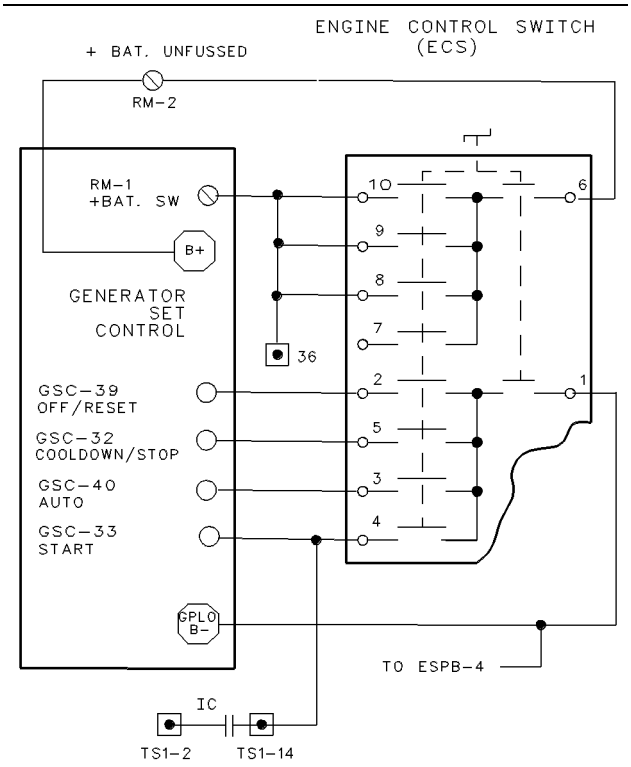
- A short to the ground of the signal for the spare output is present.

Troubleshooting of a spare output fault is direct. The FMI defines the diagnostic code. FMI 4 is a short to ground. In order to find the exact cause of the diagnostic code, use the following information: the FMI, the system schematic for the spare output, and the documentation that is provided by the dealer and/or the customer

i01176839

CID 336 FMI 2 Switch (Engine Control) Incorrect Signal - Test

SMCS Code: 4490-038-ZS; 7332-038



g00481066

Illustration 69

System Schematic For Engine Control Switch (ECS)

The Engine Control Switch (ECS) is used by the operator for manually controlling the engine. The ECS has four positions and each position connects to a corresponding input of the GSC+. The selected position of the ECS connects the corresponding input of the GSC+ to ground (“B-”). At any time, only one of these four positions is connected to ground.

Each position of the ECS places the engine in a different mode. The following information contains the four positions and the corresponding engine modes.

OFF/RESET – The engine is shut down and the GSC+ is reset. The upper display and the fault indicators on the left side are temporarily cleared. The GSC+ turns OFF unless a jumper is installed from terminal 6 of the ECS to terminal 9 of the ECS.

AUTO – The engine will start when the customer's remote start/stop contact closes the start input on the GSC+ to ground. the engine will start. The engine starts when the customer communication module (CCM) sends a remote start command. At this time, the GSC+ starts the engine and the engine runs normally until the remote start/stop contact opens. The engine stops when the customer communication module (CCM) sends a remote signal to stop. Then, the engine enters a time of cooldown before the engine is shut down. The GSC+ shows faults on the upper display and on the fault indicators as the faults occur. The GSC+ is ON with the ECS in this position.

MAN/START – The engine starts unless the operator turns the ECS to OFF/RESET. The engine starts unless the operator turns the ECS to COOLDOWN/STOP or until the GSC+ detects a fault shutdown. The engine runs until the operator turns the ECS to OFF/RESET. The engine runs until the operator turns the ECS to COOLDOWN/STOP. The engine runs until the GSC+ detects a fault shutdown. The GSC+ shows faults on the upper display and on the fault indicators as the faults occur. The GSC+ is ON with the ECS in this position.

COOLDOWN/STOP – The engine maintains rated speed for the cooldown period (programmable 0 to 30 minutes). After the cooldown period elapses, the engine is shut down. The GSC+ shows faults on the upper display and on the fault indicators as the faults occur. The GSC+ is ON with the ECS in this position.

Note: The remote start/stop contacts are connected to the GSC+ start input via the terminal TS1-14 in the generator housing. Before troubleshooting, disconnect the remote start contacts by removing the wire from terminal TS1-14.

Note: Diagnostic codes are created when the harness connector (40 contact) is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded:

- CID 100 FMI 2 pressure sensor (engine oil)
- CID 110 FMI 2 temperature sensor (engine coolant)
- CID 111 FMI 3 fluid level sensor (engine coolant)
- CID 190 FMI 3 speed sensor (engine)
- CID 336 FMI 2 switch (engine control)
- CID 590 FMI 9 engine ECM

Procedure

The following conditions could be a possible cause of this diagnostic code:

- None of the GSC+ inputs from the ECS are connected to ground.
- More than one of the GSC+ inputs from the ECS is connected to ground at the same time.

The one exception is the start input. The start input of the GSC+ is also connected to the remote start/stop contact. The start input is controlled by the customer. Therefore, the GSC+ accepts a connection to ground at the start input. This connection is accepted with a combination of any other input for the ECS.

The CID 336 FMI 2 is the only fault for the ECS that is detected by the GSC+. Clear the diagnostic code from the fault log after troubleshooting is complete. The GSC+ treats this diagnostic code as a shutdown fault. Use these procedures for an active fault or an inactive fault.

1. Check for an open circuit.

When you are performing this step, see the preceding System Schematic.

a. If equipped, disconnect the remote start/stop contacts by removing the wire from terminal TS1-14. Reconnect after troubleshooting is complete.

b. Disconnect the harness connector from the GSC+.

c. For each position of the ECS, the corresponding contact of the GSC+ harness connector is the only contact that is connected to ground.

d. Place the ECS in the OFF/RESET position. At the GSC+ harness connector, measure the resistance from contact 39 to the "B-" terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 33 and 40 to the "B-" terminal. The resistance should be greater than 5000 ohms.

e. Place the ECS in the AUTO position. At the GSC+ harness connector, measure the resistance from contact 40 to the “B-” terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 33 and 39 to the “B-” terminal. The resistance should be greater than 5000 ohms.

f. Place the ECS in the MAN/START position. At the GSC+ harness connector, measure the resistance from contact 33 to the “B-” terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 39 and 40 to the “B-” terminal. The resistance should be greater than 5000 ohms.

g. Place the ECS in the COOLDOWN/STOP position. At the GSC+ harness connector, measure the resistance from contact 32 to the “B-” terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 33, 39 and 40 to the “B-” terminal. The resistance should be greater than 5000 ohms.

Expected Result:The resistance matches the resistance in each step: Step 1.d, Step 1.e, Step 1.f, and Step 1.g.

Results:

- OK: All resistance measurements are correct. The circuits in the harness are NOT open. To further check the harness, go to Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

- NOT OK: One or more of the resistance measurements are NOT correct. The ECS is faulty or the harness wiring with the incorrect resistance measurement is open. Troubleshoot the ECS and/or repair the faulty harness wiring between ground (“B-”) and the GSC+ connector. STOP.

i01176885

CID 441 FMI 12 Electronic Governor Relay Failed - Test

SMCS Code: 1908-038-R7; 4490-038-R7

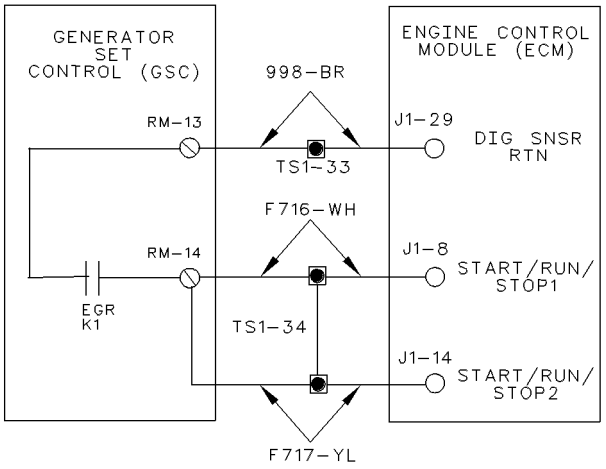


Illustration 70 g00479969

System Schematic For Electronic Governor Relay (EGR)

The GSC+ uses the electronic governor relay (EGR) to signal the engine ECM to begin injection. The GSC+ activates the EGR when the engine oil pressure is greater than the setpoint for low oil pressure shutdown at idle speed (P14). The GSC+ activates the EGR. (Also, “K1” is showing on the lower display.) This closes the relay contacts of the EGR. The output for the electronic governor relay is rated at 1 amp. The EGR is located within the relay module.

Note: Whenever the GSC+ activates the EGR, “K1” is shown on the lower display. “K1” is also shown on the lower display when the GSC+ attempts to activate the EGR. When the EGR is not activated, “K1” is not shown.

Procedure

The following condition is a possible cause of a CID “441” FMI “12”.

- A coil is open on the EGR.

- A coil is shorted on the EGR.

The following response is the system response to this fault while the EGR is activated:

- If a CID 441 FMI 12 occurs, then the engine ECM stops the fuel injection. Also, the engine will shut down immediately.

The following response is the system response to this fault while the EGR is not activated:

- If a CID 441 FMI 12 occurs, then the engine is unable to start or the engine is unable to run.

The GSC+ treats this diagnostic code as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. Also, the active alarm faults are shown when the ECS is in any position except the OFF/RESET position. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that the diagnostic code is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 441 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 441 FMI 12 has not occurred. STOP.
- NOT OK: A CID 441 FMI 12 is active or inactive. Proceed to 2.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module - Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module - Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.
- NOT OK: If the connector clamp is missing, replace the clamp. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the EGR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-13 and RM-14 of the relay module.

c. At the relay module, measure the resistance from RM-13 to RM-14. Resistance should be greater than 5000 ohms.

d. Start the engine. Make sure that the engine oil pressure is greater than the setpoint for low oil pressure shutdown at idle speed (P14).

e. At the relay module, measure the resistance from RM-13 to RM-14. Resistance should be less than 5 ohms.

Expected Result: For 3.c, the resistance should be greater than 5000 ohms. For 3.e, the resistance should be less than 5 ohms.

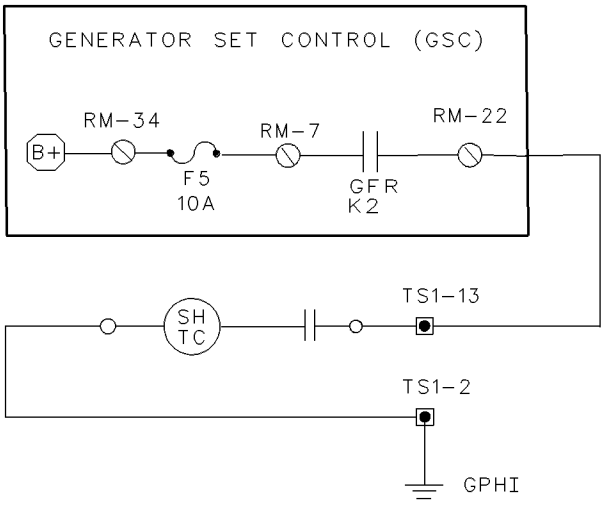
Results:

- OK: There was a poor connection and this procedure corrected the connection. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01176946

CID 442 FMI 12 Generator Fault Relay Failed - Test

SMCS Code: 4490-038-R7



g00487968

Illustration 71

System Schematic For Generator Fault Relay (GFR)

The GSC+ uses the generator fault relay (GFR) to activate the shunt trip coil of the optional circuit breaker during a shutdown fault. This circuit breaker takes the generator off the line during a shutdown fault. The GFR is located within the relay module. The optional circuit breaker is located in the generator housing and the shunt trip coil is located within the circuit breaker.

Note: Whenever the GSC+ activates the GFR, “K2” is shown on the lower display. “K2” is also shown on the lower display when the GSC+ attempts to activate the GFR. When the GFR is not activated, “K2” is not shown.

Procedure

The possible cause of this diagnostic code is an open coil or a shorted coil of the GFR.

The following response is the system response to this fault while the GFR is activated:

- If a CID 442 occurs, then there is no effect on the system because the optional circuit breaker is already open. Also, the shutdown mode is functioning. The generator is already off the line.

The following response is the system response to this fault while the GFR is not activated and a shutdown fault occurs:

- If a CID 442 occurs, then the GFR cannot activate the shunt trip coil of the optional circuit breaker. The generator remains on-line.

The GSC+ treats a CID 442 as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. When the ECS is in any position except the OFF/RESETposition, the active alarm faults are shown. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that the diagnostic code is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 442 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 442 FMI 12 has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

- NOT OK: A CID 442 FMI 12 is active or inactive. Proceed to 2.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module - Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.
- NOT OK: If the connector clamp is missing, replace the connector clamp. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the GFR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-22 of the relay module.

c. At the relay module, measure the resistance from RM-22 to RM-7. Resistance should be greater than 5000 ohms.

d. Turn the ECS to STOP and push in the emergency stop button.

e. At the relay module, measure the resistance from RM-22 to RM-7. Resistance should be less than 5 ohms.

Expected Result: For 3.c, the resistance should be greater than 5000 ohms. For 3.e, the resistance should be less than 5 ohms.

Results:

- OK: There was probably a poor connection.and this procedure corrected it. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01176965

CID 443 FMI 12 Crank Termination Relay Failed - Test

SMCS Code: 1453-038-R7; 4490-038-R7

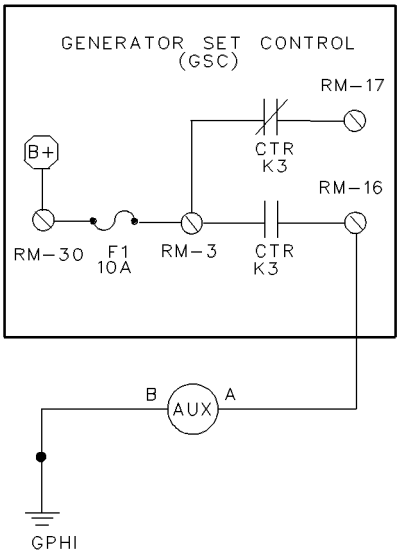


Illustration 72 g00488088

System Schematic For Crank Termination Relay (CTR)

The GSC+ uses the crank termination relay (CTR) to activate the optional auxiliary relay (AUXREL). The CTR is located within the relay module. The AUXREL is located on the subpanel within the control panel.

The CTR is used to indicate that the engine is beginning to run without cranking. The GSC+ activates the CTR when the engine speed is greater than the crank terminate setpoint. (Setpoint P11 should be 400 RPM.) Also, the GSC+ activates the CTR when the starting motor relay has been deactivated. The CTR deactivates when the engine RPM reaches 0.

Note: Whenever the GSC+ activates the CTR, “K3” is shown on the lower display. “K3” is also shown on the lower display when the GSC+ attempts to activate the crank terminate relay. When the CTR is not activated, “K3” is not shown.

Procedure

The possible cause of this diagnostic code is an open coil or a shorted coil of the CTR.

The following response is the system response to this fault while the CTR is activated:

- If a CID 443 occurs, then the engine continues to run and the AUXREL is deactivated.

The following response is the system response to this fault while the CTR is not activated:

- If a CID 443 occurs, then the engine is able to start and the engine can run. The AUXREL is not activated.

The GSC+ treats a CID 443 as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. Also, the active alarm faults are shown when the ECS is in any position except the OFF/RESET position. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that aCID 443 FMI 12 is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 443 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 443 FMI 12 has not occurred. STOP.
- NOT OK: A CID 443 FMI 12 is active or inactive. Proceed to 2.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.
- NOT OK: If the connector clamp is missing, replace the clamp. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the CTR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-16 of the relay module.

c. At the relay module, measure the resistance from RM-16 to RM-3. Resistance should be greater than 5000 ohms.

d. Start the engine. Make sure that the engine speed is greater than the setpoint for crank termination (P11).

e. At the relay module, measure the resistance from RM-16 to RM-3. Resistance should be less than 5 ohms.

Expected Result: For 3.c, the resistance should be greater than 5000 ohms. For 3.e, the resistance should be less than 5 ohms.

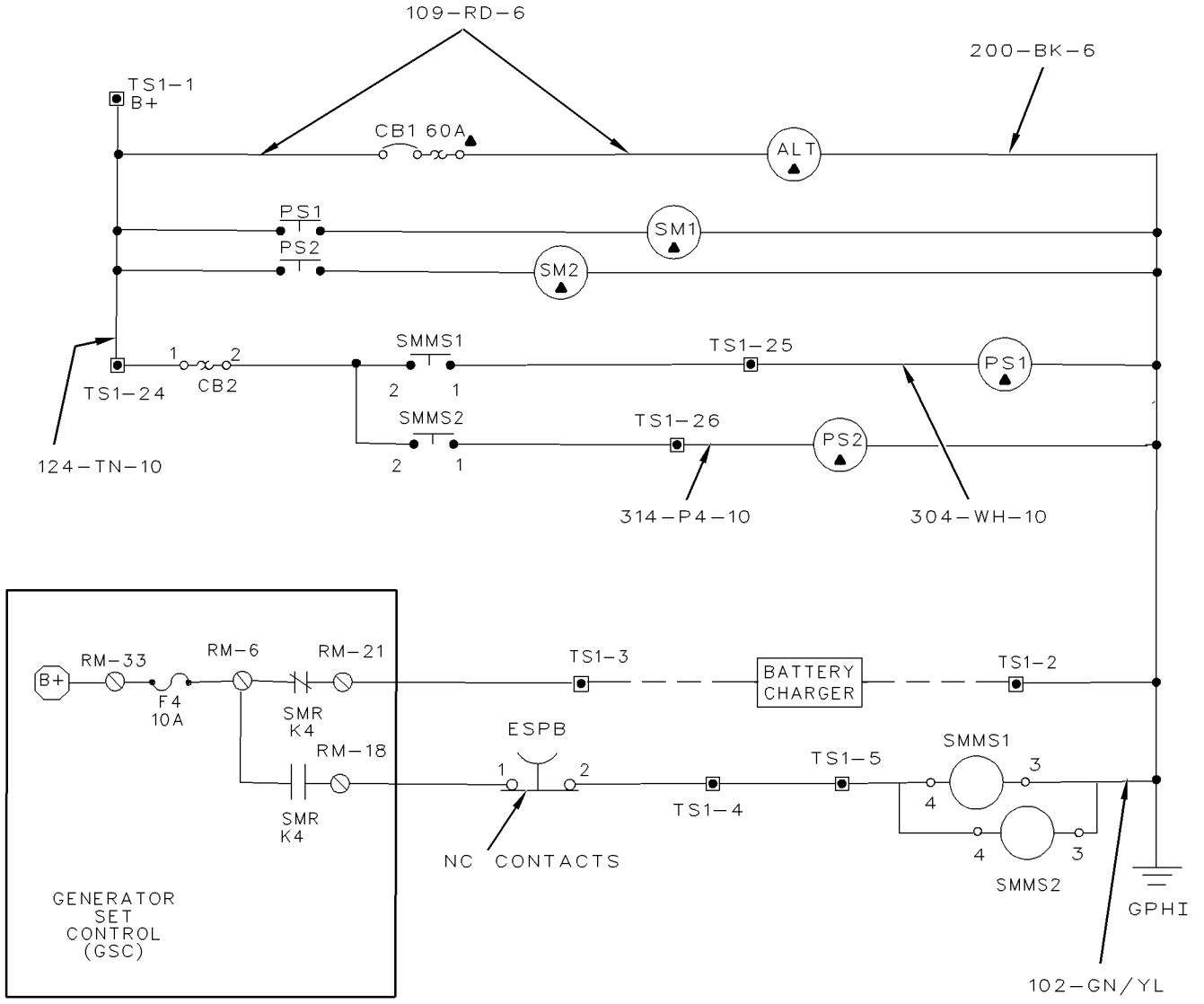
Results:

- OK: There was probably a poor electrical connection and the procedure corrected the problem. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01176970

CID 444 FMI 12 Starting Motor Relay Failed - Test

SMCS Code: 1453-038-R7; 4490-038-R7



g00479965

Illustration 73

System Schematic For Starting Motor Relay (SMR)

The GSC+ uses the starting motor relay (SMR) to activate the starting motor magnetic switches (“SMMS1” and “SMMS2”) and the battery charger. The SMR is located within the relay module. “SMMS1” and “SMMS2” are located on the subpanel within the control panel.

Note: Whenever the GSC+ activates the SMR, “K4” is shown on the lower display. “K4” is also shown on the lower display when the GSC+ attempts to activate the crank terminate relay. When the SMR is not activated, “K4” is not shown.

Procedure

The possible cause of this diagnostic code is an open coil or a shorted coil of the SMR.

The following response is the system response to this fault while the SMR is activated:

- If a CID 444 occurs, then the engine stops cranking.

The following response is the system response to this fault while the SMR is not activated:

- If a CID 444 occurs, then the engine cannot crank or the engine cannot start. If the engine is already running, then the engine continues to run.

The GSC+ treats a CID 444 as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. Also, the active alarm faults are shown when the ECS is in any position except the OFF/RESET position. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that a CID 444 FMI 12 is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 444 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 444 FMI 12 has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

- NOT OK: A CID 444 FMI 12is active or inactive. Proceed to 2.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module - Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module - Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.

- NOT OK: Replace the connector clamp if the clamp is missing. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the SMR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-18 of the relay module.

c. Remove the fuse “F4” from the relay module.

d. At the relay module, measure the resistance from RM-18 to RM-6. Resistance should be greater than 5000 ohms.

e. Prepare to measure the resistance from RM-18 to RM-6 of the relay module.

f. Turn the ECS to the START position. Quickly measure the resistance before the starting motor relay deactivates because of the crank time. Resistance should be less than 5 ohms.

Expected Result: For 3.d, the resistance should be greater than 5000 ohms. For 3.f, the resistance should be less than 5 ohms.

Results:

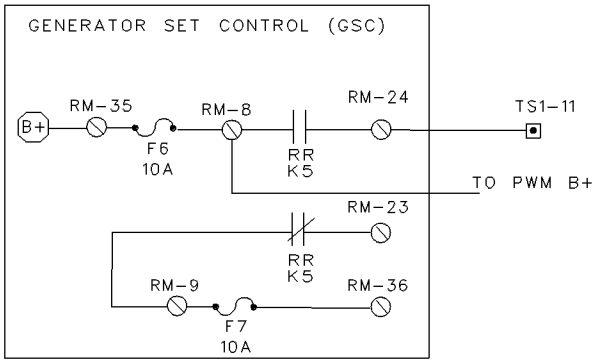
- OK: There was probably a poor electrical connection and performing this procedure corrected the poor connection. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01177276

CID 445 FMI 12 Run Relay Failed - Test

SMCS Code: 4490-038-R7



g00488507

Illustration 74

System Schematic For Run Relay (RR)

The contacts for the run relay (RR) are available for use by the customer. The RR is located within the relay module. The GSC+ activates the RR during engine cranking and running.

Note: Whenever the GSC+ activates the RR, “K5” is shown on the lower display. “K5” is also shown on the lower display when the GSC+ attempts to activate the crank terminate relay. When the RR is not activated, “K5” is not shown.

Procedure

The possible cause of this diagnostic code is an open coil or a shorted coil of the RR.

The following response is the system response to this fault while the RR is activated:

- If a CID 445 occurs, then any equipment that is connected to RM-24 is deactivated. Also, any equipment that is connected to RM-23 is activated.

The following response is the system response to this fault while the RR is not activated:

- If a CID 445 occurs, then any equipment that is connected to RM-24 is not activated. Also, any equipment that is connected to RM-23 remains activated.

The GSC+ treats this diagnostic code as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. The active alarm faults are shown when the ECS is in any position except OFF/RESET. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that a CID 445 FMI 12 is showing.

d. If this diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 445 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 445 FMI 12 has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.
- NOT OK: A CID 445 FMI 12 is active or inactive. Proceed to 2.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module - Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.

- NOT OK: Replace the connector clamp if the clamp is missing. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the RR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-24 of the relay module. Remove the fuse “F4” from the relay module.

c. At the relay module, measure the resistance from RM-24 to RM-8. Resistance should be greater than 5000 ohms.

d. Turn the ECS to the START position. Make sure that “K5” is showing on the lower display.

e. At the relay module, measure the resistance from RM-24 to RM-8. Resistance should be less than 5 ohms.

Expected Result: For 3.c, the resistance should be greater than 5000 ohms. For 3.e, the resistance should be less than 5 ohms.

Results:

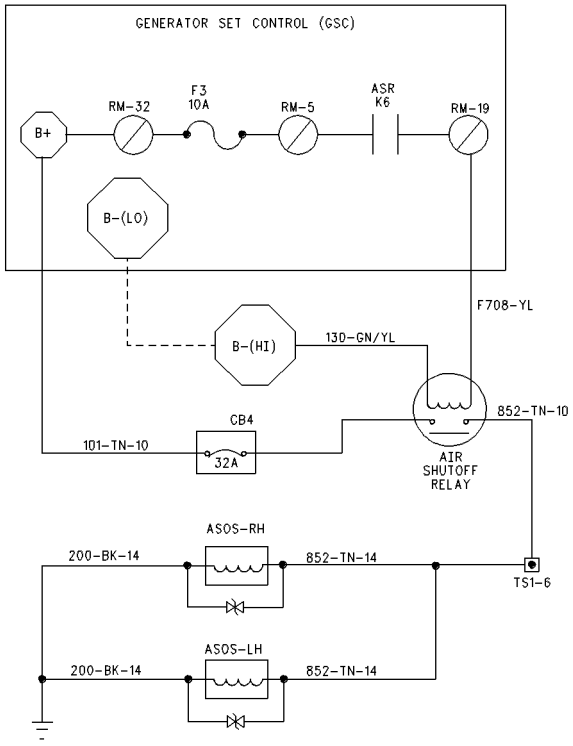
- OK: There was probably a poor connection and this procedure corrected the poor connection. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01177421

CID 446 FMI 12 Air Shutoff Relay Failed - Test

SMCS Code: 1078-038-R7; 4490-038-R7



g00488518

Illustration 75

System Schematic For Air Shutoff Relay (ASR)

The GSC+ uses the air shutoff relay (ASR) to activate the air shutoff solenoids during a shutdown fault. The ASR is located within the relay module. The air shutoff solenoids are located within the air inlet system of the engine.

The GSC+ activates the air shutoff relay (ASR) for some active shutdown faults.

Note: Whenever the GSC+ activates the ASR, “K6” is shown on the lower display. “K6” is also shown on the lower display when the GSC+ attempts to activate the crank terminate relay. When the ASR is not activated, “K6” is not shown.

Procedure

The possible case of diagnostic code is an open coil or a shorted coil of the ASR.

The following response is the system response to this fault while the ASR is activated:

- If a CID 446 occurs, then there is no effect on the system because the air shutoff is already operating and the shutdown mode is functioning.

The following response is the system response to this fault while the ASR is not activated:

- If a CID 446 occurs, then there is no immediate effect on the system. The engine is able to start and the engine is able to run.

The following response is the system response to this diagnostic code while the ASR is not activated and a shutdown fault occurs:

- If a CID 446 occurs, then the ASR cannot energize the air shutoff solenoids.

The GSC+ treats this diagnostic code as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. The active alarm faults are shown when the ECS is in any position except the OFF/RESET. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that a CID 446 FMI 12 is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 446 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 446 FMI 12 is active or inactive. Proceed to 2.
- NOT OK: A CID 446 FMI 12 has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module - Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module - Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.
- NOT OK: Replace the connector clamp if the clamp is missing. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the ASR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-19 of the relay module.

c. At the relay module, measure the resistance from RM-19 to RM-5. Resistance should be greater than 5000 ohms.

d. Turn the ECS to the STOP position and push in the emergency stop push button (ESPB).

e. At the relay module, measure the resistance from RM-19 to RM-5. Resistance should be less than 5 ohms.

Expected Result:For 3.c, the resistance should be greater than 5000 ohms. For 3.e, the resistance should be less than 5 ohms.

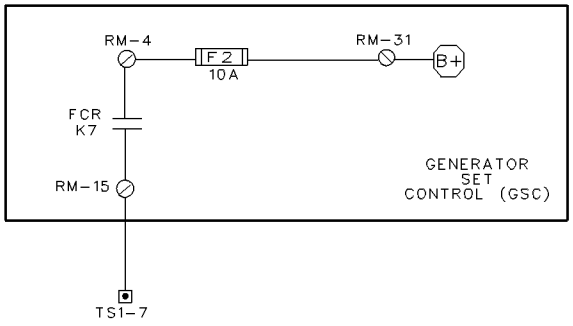
Results:

- OK: There was probably a poor electrical connection and this procedure corrected the connection. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01177443

CID 447 FMI 12 Fuel Control Relay Failed - Test

SMCS Code: 4490-038-R7



g00488810

Illustration 76

System Schematic For Fuel Control Relay

The contacts for the fuel control relay (FCR) are available for use by the customer. The FCR is located within the relay module. The GSC+ activates the FCR according to the value of setpoint P01. If setpoint P01 is set to 0, the GSC+ activates the FCR. The FCR activates during the engine cranking. The FCR activates when the engine is running. If setpoint P01 is set to 1 (ETS), the GSC+ activates the FCR when the engine is stopped.

Note: Whenever the GSC+ activates the FCR, “K7” is shown on the lower display. “K7” is also shown when the GSC+ attempts to activate the FCR. When the FCR is not activated, “K7” is not shown. Also, setpoint P01 selects the type of fuel control solenoid:

0 – Energized To Run (ETR)

1 – Energized To Stop (ETS)

Procedure

The possible cause of this diagnostic code is an open coil or a shorted coil of the FCR.

The following response is the system response to this fault while the engine is running:

- If a CID 447 occurs, then any equipment that is connected to RM-15 is deactivated.

The following response is the system response to this fault while the engine is NOT running:

- If a CID 447 occurs, then any equipment that is connected to RM-15 is not activated.

The GSC+ treats this diagnostic code as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed. Also, the active alarm faults are shown when the ECS is in any position except the OFF/RESET position. Clear the diagnostic code from the fault log after troubleshooting is complete.

1. Check the status of the diagnostic code (Active/Inactive).

a. Turn the ECS to OFF/RESET and then turn the ECS to STOP.

b. Press the alarm codes key.

c. Observe the upper display. Check that a CID 447 FMI 12 is showing.

d. If the diagnostic code is not showing, enter the service mode. View the fault log (OP1). Check that the diagnostic code is showing.

Expected Result: A CID 447 FMI 12 is showing as a active fault or an inactive fault.

Results:

- OK: A CID 447 FMI 12 is active or inactive. Proceed to 2.

- NOT OK: A CID 447 FMI 12 has not occurred. The fault is NOT active and the fault is NOT inactive. STOP.

2. Check internal cable of relay module.

Note: Only open the relay module in a dry environment. If the inspection takes more than twenty minutes replace the desiccant bag in the GSC+ housing. See Testing And Adjusting, “Relay Module - Replace”.

a. Turn the ECS to OFF/RESET.

b. Temporarily, remove the relay module from the GSC+. See Testing And Adjusting, “Relay Module Replace”.

c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector. The clamp should be in place. The cable should not be damaged.

Results:

- OK: Reassemble the relay module to the GSC+. Proceed to 3.

- NOT OK: Replace the connector clamp if the clamp is missing. If the cable is damaged, replace the GSC+. STOP.

3. Perform a functional check for the ASR.

a. Turn the ECS to OFF/RESET.

b. Disconnect all wires from RM-15 of the relay module.

c. At the relay module, measure the resistance from RM-15 to RM-4. Resistance should be greater than 5000 ohms.

d. For ETR systems, turn the ECS to the START position. For ETS systems, turn the ECS to START and then turn the ECS to the OFF/RESET position. Make sure that “K7” is showing in the lower display.

e. At the relay module, measure the resistance from RM-15 to RM-4. Resistance should be less than 5 ohms.

Expected Result: For **3.c**, the resistance should be greater than 5000 ohms. For **3.e**, the resistance should be less than 5 ohms.

Results:

- OK: There was probably a poor connection and this troubleshooting procedure corrected the connection. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

- NOT OK: Either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01177458

CID 448 FMI 12 Programmable Spare Relay Failed - Test

SMCS Code: 4490-038-R7

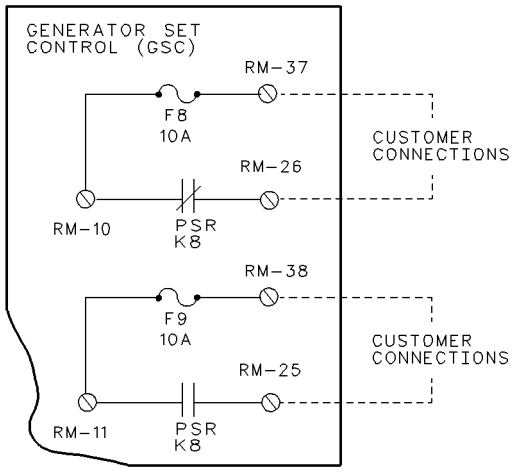


Illustration 77 g00630884

The GSC+ communicates with the relay driver module (RDM) by a serial data link. When the data link malfunctions, R1 output (terminal 2 of the RDM) will be activated on and off at a rate of 0.5 Hz. Relays R2 through R9 may maintain the current state. Also, the relays may default to the OFF position. These steps are controlled by a jumper between terminals 6 and 7 of the RDM. If the serial data link has a fault and a jumper is NOT present, then the relay outputs will not change. If the jumper is present, R2 through R9 will default to OFF.

Note: The maximum distance between a module and the GSC+ is 305 m (1000 ft). If this specification is not met, the data link may malfunction. The GSC+ may show a CID 475 fault. If the distance is not in compliance with the specification, shorten the distance between the RDM and the GSC+.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded:

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine ECM

The possible cause of a CID 475 FMI 3 is a short to the battery positive terminal.

The GSC+ is not able to detect an open circuit condition of the relay driver module's data link. Clear the fault from the fault log after the troubleshooting is complete.

1. Check The Data Signal Voltage.

a. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The voltage should change constantly. The range will vary from 0 DCV to 10 DCV.

Results:

- OK: The voltage measurement is correct. Proceed to Step 3.
- NOT OK: The voltage measurement is NOT correct. Proceed to Step 2.

2. Check The Voltage Of The RDM And Check The Voltage Of The GSC+.

a. At the RDM, disconnect all wires from terminal 4.

b. Disconnect the harness connector from the GSC+.

c. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead). Voltage should be 11.6 ± 0.5 DCV.

d. Measure the DC voltage from contact 30 of the GSC+ to the battery negative terminal of the relay module. The relay module is located on the rear of the GSC+. The voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Expected Result: For Step 2.c, the voltage should be 11.6 ± 0.5 DCV. For Step 2.d, the voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Results:

- OK: Both voltage measurements are correct. Proceed to Step 3.
- NOT OK: The voltage that was measured at the RDM (Step 2.c) is NOT correct. Replace the RDM. STOP.
- NOT OK: The voltage that was measured at the GSC+ (Step 2.d) is NOT correct. Replace the GSC+. STOP.

3. Check For A "B+" Short In The Harness.

a. Disconnect the harness connector from the GSC+.

b. At the RDM, disconnect all wires from terminal 4.

c. Measure the resistance between the wires on terminal 4 on the RDM and B+. The relay module is located on the rear of the GSC+.

d. Measure the resistance between the wires on terminal 4 on the RDM to B- on the RDM. The relay module is located on the rear of the GSC+.

Expected Result: Both measurements (Step 3.c and Step 3.d) should be greater than 20000 ohms.

Results:

- OK: Both the resistance measurements are correct. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, "Electrical Connector - Inspect". If the fault still exists after the inspection, replace the RDM. STOP.
- NOT OK: Either one or both of the resistance measurements are NOT correct. The harness wiring with the incorrect measurement for resistance is shorted. Repair the faulty harness wiring between the RDM and the GSC+. See the preceding System Schematic. STOP.

i01178651

CID 475 FMI 3 Relay Driver Module Voltage Above Normal - Test

SMCS Code: 4490-038

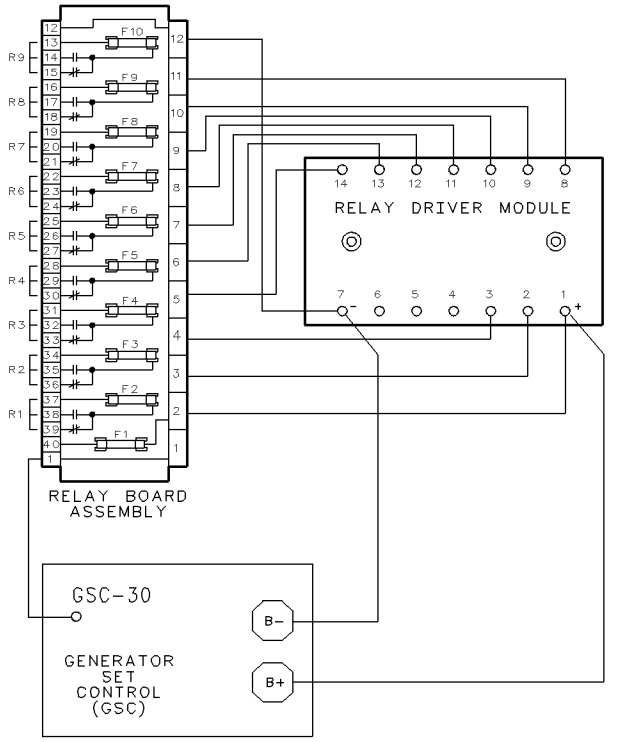


Illustration 78 g00630930

The GSC+ communicates with the relay driver module (RDM) by a serial data link. When the data link malfunctions, R1 output (terminal 2 of the RDM) will be activated on and off at a rate of 0.5 Hz. Relays R2 through R9 may maintain the current state. Also, the relays may default to the OFF position. These steps are controlled by a jumper between terminals 6 and 7 of the RDM. If the jumper is present, R2 through R9 will default to OFF.

Note: The maximum distance between a module and the GSC+ is 305 m (1000 ft). If this specification is not met, the data link may malfunction. The GSC+ may show a CID 475 fault. If the distance is not in compliance with the specification, shorten the distance between the RDM and the GSC+.

Note: Faults are created when the harness connector is disconnected from the GSC+ during these troubleshooting procedures. Clear these created faults after the particular fault is corrected and the particular fault is cleared. In a properly operating system, when the harness connector is removed from the GSC+, the following diagnostic fault codes are recorded:

CID 100 FMI 3 – Pressure Sensor (Engine Oil)

CID 110 FMI 3 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

The possible cause of a CID 475 FMI 3 is a short to the battery positive terminal.

The GSC+ is not able to detect an open circuit condition on the relay driver module data link. Clear the fault from the fault log after the troubleshooting is complete.

1. Check The Voltage Of The Data Signal.

a. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The voltage should change constantly. The range will vary from 0 DCV to 10 DCV.

Results:

- OK: The voltage measurement is correct. Proceed to Step 3.
- NOT OK: The voltage measurement is NOT correct. Proceed to Step 2.

2. Check The Voltage Of The RDM And Check The Voltage Of The GSC+.

a. At the RDM, disconnect all wires from terminal 4.

b. Disconnect the harness connector from the GSC+.

c. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead). Voltage should be 11.6 ± 0.5 DCV.

d. Measure the DC voltage from contact 30 of the GSC+ to the battery negative terminal of the relay module. The relay module is located on the rear of the GSC+. The voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Expected Result: For Step 2.c, the voltage should be 11.6 ± 0.5 DCV. For Step 2.d, the voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Results:

- OK: Both voltage measurements are correct. Proceed to Step 3.
- NOT OK: The voltage that was measured at the RDM (Step 2.c) is NOT correct. Replace the RDM. STOP.
- NOT OK: The voltage that was measured at the GSC+ (Step 2.d) is NOT correct. Replace the GSC+. STOP.

3. Check For A “B+” Short In The Harness.

a. Disconnect the harness connector from the GSC+.

b. At the RDM, disconnect all wires from terminal 4.

c. Check the resistance between the wires on the terminal 4 and the relay module B+. The relay module is located on the rear of the GSC+.

d. Check the resistance between the wires on the terminal 4 and the relay module B-. The relay module is located on the rear of the GSC+.

Expected Result: Both measurements (Step 3.c and Step 3.d) should be greater than 20000 ohms.

Results:

- OK: Both the resistance measurements are correct. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. If the fault still exists after the inspection, replace the RDM. STOP.
- NOT OK: Either one or both of the resistance measurements are NOT correct. The harness wiring with the incorrect measurement for resistance is shorted. Troubleshoot and repair the faulty harness wiring between the RDM and the GSC+. See the preceding System Schematic. STOP.

i01178958

CID 475 FMI 4 Relay Driver Module Voltage Below Normal - Test

SMCS Code: 4490-038

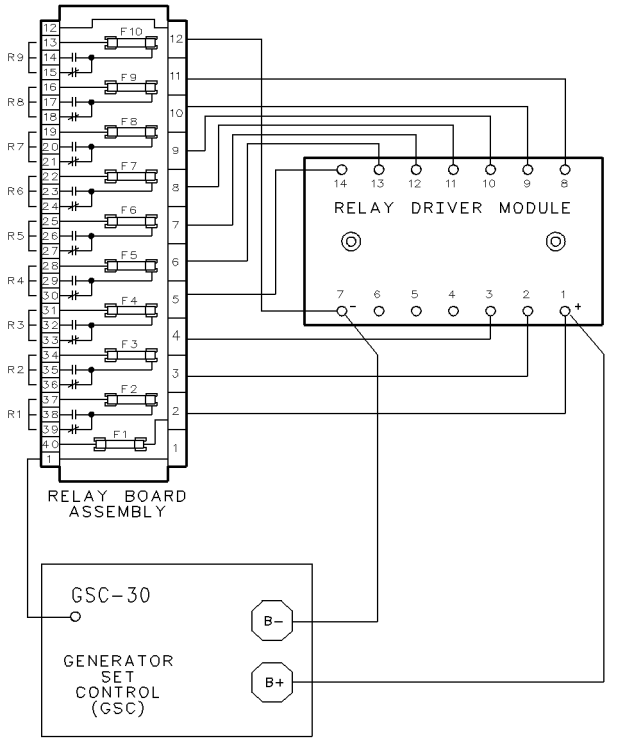


Illustration 79 g00630930

System Schematic For The Relay Driver Module Data Link

The GSC+ communicates with the relay driver module (RDM) by a serial data link. When the data link malfunctions, R1 output (terminal 2 of the RDM) will be activated on and off at a rate of 0.5 Hz. Relays R2 through R9 may maintain the current state. Also, the relays may default to the OFF position. These steps are controlled by a jumper between terminals 6 and 7 of the RDM. If the jumper is present, R2 through R9 will default to OFF.

Note: The maximum distance between a module and the GSC+ is 305 m (1000 ft). If this specification is not met, the data link may malfunction. The GSC+ may show a CID 475 fault. If the distance is not in compliance with the specification, shorten the distance between the RDM and the GSC+.

CID 100 FMI 2 – Pressure Sensor (Engine Oil)

CID 110 FMI 2 – Temperature Sensor (Engine Coolant)

CID 111 FMI 3 – Fluid Level Sensor (Engine Coolant)

CID 175 FMI 3 – Temperature Sensor (Engine Oil)

CID 190 FMI 3 – Speed Sensor (Engine)

CID 336 FMI 2 – Switch (Engine Control)

CID 590 FMI 9 – Engine ECM

The possible cause of a CID 475 FMI 4 is a short to the battery negative terminal.

The GSC+ is not able to detect an open circuit condition of the relay driver module data link. Clear the fault from the fault log after the troubleshooting is complete.

1. Check The Voltage Of The Data Signal.

a. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The voltage should change constantly. The range will vary from 0 DCV to 10 DCV.

Results:

- OK: The voltage measurement is correct. Proceed to Step 3.
- NOT OK: The voltage measurement is NOT correct. Proceed to Step 2.

2. Check The Voltage Of The RDM And Check The Voltage Of The GSC+.

a. At the RDM, disconnect all wires from terminal 4.

b. Disconnect the harness connector from the GSC+.

c. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead). Voltage should be 11.6 ± 0.5 DCV.

d. Measure the DC voltage from contact 30 of the GSC+ to the battery negative terminal of the relay module. The relay module is located on the rear of the GSC+. The voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Expected Result: For Step 2.c, the voltage should be 11.6 ± 0.5 DCV. For Step 2.d, the voltage should change constantly. The range of change is between 0 DCV to 5.5 DCV.

Results:

- OK: Both voltage measurements are correct. Proceed to Step 3.
- NOT OK: The voltage that was measured at the RDM (Step 2.c) is NOT correct. Replace the RDM. STOP.
- NOT OK: The voltage that was measured at the GSC+ (Step 2.d) is NOT correct. Replace the GSC+. STOP.

3. Check For A "B+" Short In The Harness.

a. Disconnect the harness connector from the GSC+.

b. At the RDM, disconnect all wires from terminal 4.

c. Measure the resistance from the wires of terminal 4 at the RDM to battery positive of the relay module. The relay module is located on the rear of the GSC+.

d. Measure the resistance from the wires of terminal 4 at the RDM to battery negative of the relay module. The relay module is located on the rear of the GSC+.

Expected Result: Both measurements (Step 3.c and Step 3.d) should be greater than 20000 ohms.

Results:

- OK: Both the resistance measurements are correct. Check the electrical connectors, terminals and wiring. See Testing And Adjusting, "Electrical Connector - Inspect". If the fault still exists after the inspection, replace the RDM. STOP.

- NOT OK: Either one or both of the resistance measurements are NOT correct. The harness wiring with the incorrect measurement for resistance is shorted. Troubleshoot and repair the faulty harness wiring between the RDM and the GSC+. See the preceding System Schematic. STOP.

i01178992

CID 500 FMI 12 EMCP Electronic Control (Generator Set) Failed - Test

SMCS Code: 4490-038

A CID 500 FMI 12 fault means that the GSC+ is unable to accurately measure the AC voltage and the AC current. The engine remains able to run. The engine also remains able to start.

Note: On the GSC+, the CID 500 FMI 12 service code will be shown even when the engine control switch (ECS) is in the OFF/RESET position.

If a CID 500 FMI 12 fault occurs, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”.

NOTICE

If a CID 500 FMI 12 occurs and the engine is running, the generator output may be at full voltage potential. This could occur even if the GSC display is showing 0 AC volts and 0 AC current for all three phases.

i01179037

CID 566 FMI 7 Unexpected Shutdown Improper Mechanical Response - Test

SMCS Code: 4490-038

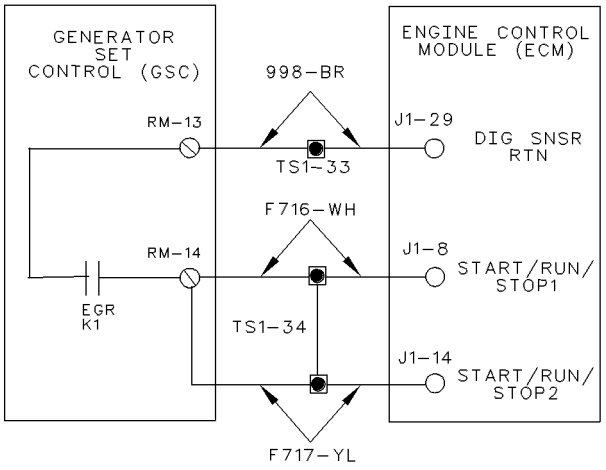


Illustration 80 g00479969

System Schematic For Electronic Governor Relay (EGR)

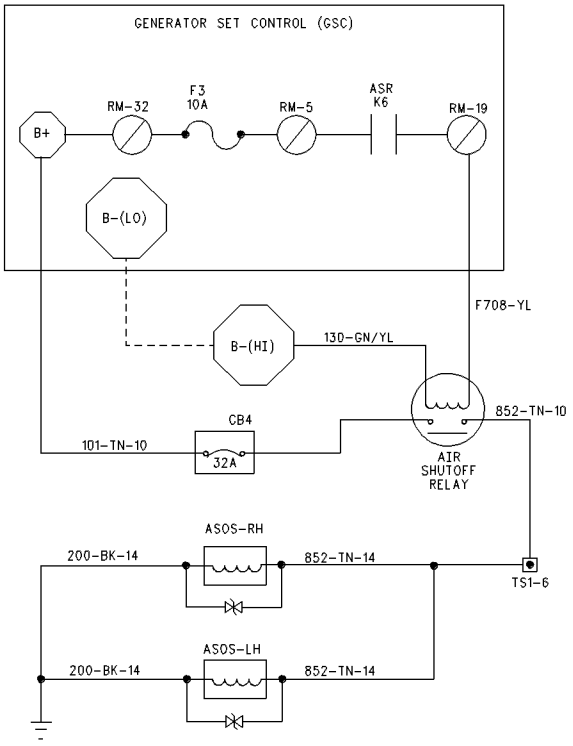


Illustration 81 g00488518

System Schematic For Air Shutoff Relay (ASR)

The CID 566 alerts the operator that the GSC+ did not control the engine shutdown. Any fault shutdown that is initiated solely by the engine ECM will result in a CID 566 on the GSC+. If an outside influence causes the engine to shut down, the GSC+ indicates a CID 566. There is only one failure mode for a CID 566 and the mode is FMI 7 (faulty mechanical response).

The diagnostic code causes the following sequence of events:

- The engine is running.
- The engine speed drops to 0 rpm.
- The GSC+ detects the drop to 0 rpm.
- The GSC+ has not called for a shutdown.
- The GSC+ determines that no fault for the engine speed sensor is present.
- The GSC+ indicates a CID 566 FMI 7 and the GSC+ disables the engine from running.

Procedure

A component which is not controlled by the GSC+ could possibly cause a CID 566 FMI 7. This component would need to have caused an engine shutdown.

The GSC+ treats this diagnostic code as a shutdown fault. Clear the diagnostic code from the fault log after troubleshooting is complete.

Note: This procedure requires many voltage measurements during simulated engine cranking. The fuse for the starting motor “F4” on the relay module is removed in order to prevent the activation of the starting motor. Voltage measurements must be made quickly before the total cycle crank time (setpoint P17) elapses. The total cycle crank time is set to the default. The default time is ninety seconds. See Systems Operation, “Engine/Generator Programming OP5”. The time that is required to take a voltage measurement is only 90 seconds. If this time is exceeded, the GSC+ indicates an overvoltage fault. The indicator for the overcrank shutdown will FLASH. In order to continue with a voltage measurement, the overcrank fault must be reset by turning the ECS to OFF/RESET. Then turn the ECS to START.

1. Perform an initial check.

Before you perform the troubleshooting procedures, perform the following steps:

a. Make sure that there are NO OTHER ACTIVE FAULTS. Erroneous troubleshooting and needless replacement of parts can be caused by a failure to check for other diagnostic codes. The operator will make many voltage measurements while the GSC+ is attempting to crank the engine. The GSC+ detects other diagnostic codes. If the GSC+ detects other diagnostic codes, the GSC+ will prevent the starting of the engine by shutting off the fuel and the air.

b. Check the fuel level and the fuel quality.

c. Check for a plugged fuel filter.

d. Check for a plugged air filter.

e. Refer to the Engine Service Manual if there is an obvious engine fault. Also, refer to the Engine Service Manual if there is an obvious fault with the fuel system.

f. Check the air shutoff solenoid for activation. If the air shutoff solenoid is activated and the air shutoff solenoid cannot be deactivated, begin troubleshooting with 15. Otherwise begin troubleshooting with 2.

2. Verify the diagnostic code.

a. Observe the upper display. Check that the CID 566 FMI 7 is showing.

Expected Result: A CID 566 FMI 7 is showing as an active fault.

Results:

- OK: Only a CID 566 FMI 7 is showing. Proceed to 3. If an inactive CID 566 FMI 7 is showing in the fault log, check the history of the genset and proceed to 3.
- NOT OK: A CID 566 FMI 7 is NOT showing. No active CID 566 FMI 7 exists. STOP.

3. Check the system voltage.

a. Ensure that the engine is off. Measure the system voltage at the battery. Make a note of this measurement. The measurement for the system voltage is used for comparison in future steps of this procedure.

Expected Result: For 24 volt systems, the system voltage should be from 24.8 to 29.5 DCV. For 32 volt systems, the system voltage should be from 33.1 to 39.3 DCV.

Results:

- OK: Proceed to 4.
- NOT OK: System voltage is NOT correct. For troubleshooting, see the procedure for system voltage. STOP.

4. Check the setpoint P01.

a. Check the setpoint P01 for proper programming. For an ETR, the P01 is set at "0". For an ETS, the PO1 should be "1". See Systems Operation, "Setpoint Viewing OP2".

Expected Result: Setpoint P01 should be programmed to match the type of fuel control solenoid that is used on the genset.

Results:

- OK: Proceed to 5.
- NOT OK: Setpoint P01 is NOT programmed correctly. Reprogram setpoint P01. See Systems Operation, "Engine/Generator Programming OP5".

5. Check the fuses.

a. Turn the ECS to OFF/RESET.

b. Check fuses "F2" and "F10" on the relay module.

Expected Result: None of these fuses should be blown.

Results:

- OK: Proceed to 6.
- NOT OK: One or more of the fuses are blown. Proceed to 7.

6. Check the voltage at the relay module.

Fuse "F4" remains removed from the relay module.

a. Prepare to measure the voltage from RM-15 to the B- terminal of the relay module.

b. Turn the ECS to OFF/RESET and then turn the ECS to START.

c. At the relay module, measure the voltage from RM-15 to the B- terminal.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: Therefore, there is an open circuit between RM-15 of the relay module and the fuel control solenoid. Repair the circuit. See the preceding System Schematic. STOP.
- NOT OK: Voltage is low. Proceed to 8.

7. Troubleshoot the blown fuse.

This test continues troubleshooting from 5. For reference, see the preceding System Schematics and Testing And Adjusting, "Schematics and Wiring Diagrams".

a. The ECS remains in the OFF/RESET position.

b. Remove the fuse that is blown.

- If the blown fuse is "F2", measure the resistance from RM-15 of the relay module to ground (B-).
- If the blown fuse is "F10", measure the resistance from RM-39 of the relay module to ground (B-).

Expected Result: The resistance of the circuit should be less than 3 ohms for the circuit with the fuse that is blown.

Results:

- OK: The resistance is greater than 3 ohms and the fuse is no longer blowing. Carefully check ALL wires that are connected to the appropriate terminal of the relay module for abrasion or worn spots in the insulation that could be causing the short. Check the wires in the panel. Check the generator panel. Also check the wires on the engine harness. Refer to the various wiring diagrams. Repair the wiring or replace wiring, if necessary. STOP.

- NOT OK: If a resistance is less than 3 ohms, there is a short to ground (B-). The resistance on a ETR fuel system with a dual coil fuel control solenoid is less than 1 ohm. Remove the wires one at a time. Remove a component or wire until the faulty component or wire is isolated. Repair the faulty component or wiring. If necessary, replace the faulty component or wiring. STOP.

- NOT OK: The resistance is greater than 3 ohms and the fuse is blown. This means that the relay module is faulty. replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

8. Check the condition of the low voltage.

This test continues troubleshooting from 6. Fuse “F4” remains removed from the relay module. For reference, see the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. Prepare to make voltage measurements at the relay module.

a. Turn the ECS to OFF/RESET and then turn the ECS to START.

b. At the relay module, measure the voltage from RM-4 to the B- terminal and from RM-31 to the B- terminal.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was measured previously in 3.

Results:

- OK: Proceed to 9.

- NOT OK: Voltage is NOT correct. Check the wiring and recheck the fuse “F2”. STOP.

9. Check that the diagnostic code exists.

a. Make sure that no other diagnostic codes are active.

b. Check the upper display for any active diagnostic codes.

Expected Result: Only CID 566 FMI 7 is active.

Results:

- OK: Only CID 566 FMI 7 is active. Proceed to 10.

- NOT OK: A diagnostic code except the CID 566 FMI 7 is active. Correct the other diagnostic code. Proceed to the corresponding troubleshooting procedure. STOP.

10. Check the system voltage.

a. Recheck the voltage on RM-15 of the relay module. See 6.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: The voltage is correct. There is an open circuit between RM-15 of the relay module and the fuel control solenoid. Repair the wiring. See the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. STOP.

- NOT OK: If the voltage remains low, replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

11. Check the voltage at the relay module.

Fuse “F4” remains removed from the relay module. Prepare to make a voltage measurement at the relay module.

a. Turn the ECS to OFF/RESET and then turn the ECS to START.

b. At the relay module, measure the voltage from RM-15 to the B- terminal of the relay module.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: Voltage is correct. There could be an open between RM-15 of the relay module and the electronic governor. There could also be an open between the B- terminal of the relay module and the electronic governor. Check the slave relay and the wiring. See the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. STOP.

- NOT OK: Voltage is low. Proceed to 12.

12. Check the condition of the low voltage.

Fuse “F4” remains removed from the relay module. For reference, see the preceding System Schematic and the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. Prepare to make voltage measurements at the relay module.

a. Turn the ECS to OFF/RESET and then turn the ECS to START.

b. At the relay module, measure the voltage from RM-4 to the B- terminal.

c. At the relay module, measure the voltage from RM-31 to the B- terminal.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: Voltage is correct. Proceed to 13.

- NOT OK: Voltage is not correct. Check the wiring and recheck the fuse “F2”. STOP.

13. Check that the diagnostic code exists.

a. Make sure that no other diagnostic codes are active.

b. Check the upper display for any active diagnostic codes.

Expected Result: Only CID 566 FMI 7 is active.

Results:

- OK: Only CID 566 FMI 7 is active. Proceed to 14.

- NOT OK: A diagnostic code except the CID 566 FMI 7 is active. Correct the other diagnostic code. Proceed to the corresponding troubleshooting procedure. STOP.

14. Check the system voltage.

a. Recheck the voltage on RM-15 of the relay module. See 11.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: The voltage is correct. There is an open circuit between RM-15 of the relay module and the fuel control solenoid. Check the slave relay, the fuel control relays (“1FCR” and “2FCR”) and the wiring. See the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. STOP.

- NOT OK: If the voltage remains low, replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

15. Check the voltage at the air shutoff solenoid.

This test continues troubleshooting from the preliminary step (initial check). Prepare to make a voltage measurement at the air shutoff solenoid. (The air shutoff solenoid may be active for 15 seconds.)

a. Remove fuse “F4” from the relay module.

b. Turn the ECS to OFF/RESET and then turn the ECS to START.

c. At the air shutoff solenoid, measure the voltage across the terminals of solenoid.

Expected Result: The voltage should be from 0 to 2.0 DCV.

Results:

- OK: Voltage is correct. If the air shutoff solenoid cannot be reset then the fault is in the air shutoff solenoid. Refer to the Engine Service Manual. STOP.

- NOT OK: Voltage is high. Proceed to 16.

16. Check the voltage at the relay module.

Fuse “F4” remains removed from the relay module. Prepare to make a voltage measurement at the relay module.

a. Turn the ECS to OFF/RESET and then turn the ECS to START.

b. At the relay module, measure the voltage from RM-19 to the B- terminal.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage that was previously measured in 3.

Results:

- OK: The voltage is correct. A wire or a component that is located between RM-19 of the relay module and the air shutoff solenoid is shorted to the battery (B+). Repair the circuit. See the “Generator Set Wiring Diagram” in the Testing And Adjusting, “Schematics & Wiring Diagrams”. STOP.
- NOT OK: The voltage is high. Proceed to 17.

17. Check the ASR.

Fuse “F4” remains removed from the relay module.

a. Remove fuse “F3” from the relay module.

b. Turn the ECS to OFF/RESET.

c. Make sure that “K6” is not shown on the lower GSC+ display. (If “K6” is showing, make sure that no other diagnostic codes are active.)

d. At the relay module, measure the resistance from RM-5 to RM-19. A measurement of less than 100 ohms indicates that the air shutoff relay is shorted.

Expected Result: The resistance should be greater than 10000 ohms.

Results:

- OK: Resistance is greater than 10000 ohms. Check for a short from the battery (B+) to RM-19 of the relay module. Repair the shorted wiring. If the short is internal to the relay module, replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.
- NOT OK: Resistance is less than 100 ohms. The short is internal to the relay module. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

i01179544

CID 590 FMI 9 Engine Electronic Control Module Abnormal Update - Test

SMCS Code: 1901-038; 4490-038

The CID 590 indicates that the engine ECM has stopped responding to periodic information that has been requested by the GSC+.

The possible cause of a CID 590 FMI 9 is an open circuit of the two CAT data link wires that connect to contacts 19 and 20. Another cause is an engine ECM that is faulty or an engine ECM that is disconnected from the GSC+.

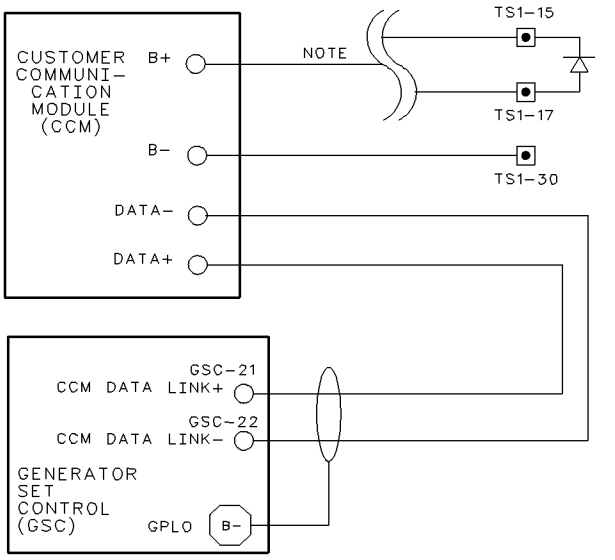
Troubleshoot and repair the wiring or the engine ECM. Refer to Troubleshooting, SENR1003, “3500B EPG Engines” for further information.

Clear the diagnostic code from the fault log after troubleshooting is complete. The GSC+ is usually programmed to treat a CID 590 as an alarm fault (P04 = 0). If the GSC+ is programmed to shut down the engine (P04 = 1) for a fault with the engine ECM, then it is not necessary to press the alarm codes key in order to see the CID FMI. The diagnostic codes are automatically shown on the upper display.

i01179560

CID 770 FMI 9 Customer Communication Module Data Link Abnormal Update - Test

SMCS Code: 1926-038; 4490-038



g00633950

Illustration 82

System Schematic For CCM Data Link

This CCM data link is not used for MUI applications. It is unlikely for a CID 770 fault to occur. However, the connector contacts 21 and 22 are present. Therefore, a fault is possible.

The possible causes of a CID 770 FMI 9 fault are listed below.

- A short to the battery positive (“B+”) of either one of the two contacts, 21 or 22
- A short to battery negative (“B-”) of either of the two connector contacts, 21 or 22

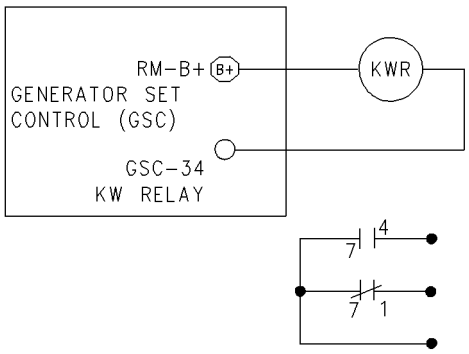
The GSC+ cannot detect an open in the circuit of the CCM data link. Troubleshoot and repair the wiring. See Testing And Adjusting, “Schematic And Wiring Diagrams”.

The GSC+ treats a CID 770 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the engine control switch (ECS) is in any position except the OFF/RESET position. Clear the fault from the fault log after the troubleshooting is complete.

i01179571

CID 859 FMI 3 Kilowatt Level Output Voltage Above Normal - Test

SMCS Code: 4490-038



g00631565

Illustration 83

System Schematic For kW Level Output

The kW level output will be activated whenever the total power output of the generator exceed the setpoint P139. The kW level output is the connector contact “34” of the GSC+. This setpoint can be programmed from 0 to 110 percent of the nameplate power (setpoint P030). This setpoint can be programmed with a time delay from 0 to 120 seconds (setpoint P140). See System Operation, “Engine/Generator Programming OP5-0”. Also, see System Operation, “Service Mode”. Once the output is activated, the kW level output will be deactivated when the total power output of the generator drops below a programmed setpoint (setpoint P141). This setpoint is different from the activation setpoint. This setpoint can be programmed from 0 to 110 percent of the nameplate power rating of the generator. This setpoint can be programmed with a time delay from 0 to 120 seconds.

When kW relay is disconnected from the GSC+, the voltage on the kW level output is approximately 5.0 DCV. When kW relay is connected to the GSC+, the voltage on the kW level output is approximately 0 volts. The kW level output is capable of drawing (sinking) approximately 100 mA. Documenting and troubleshooting any connections to this output is the responsibility of the customers and the dealers.

The possible cause of a CID 859 FMI 3 is a short to battery positive (“B+”). The source of battery positiveis the kW level output signal.

The GSC+ treats a CID 859 FMI 3 fault as an alarm fault.

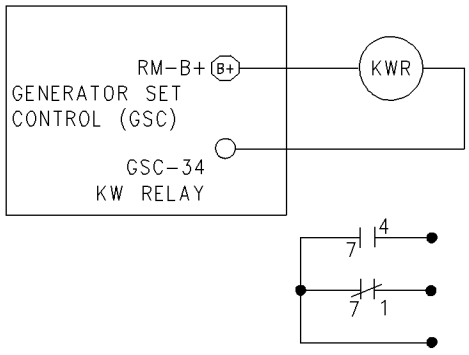
The troubleshooting of a kW level output fault is straight forward. The FMI 3 defines the fault as a short to “B+”. Use the following information in order to find the exact cause of the fault.

- FMI information
- kW level output system schematic
- customer’s documentation
- dealer’s documentation

i01179801

CID 859 FMI 4 Kilowatt Level Output Voltage Below Normal - Test

SMCS Code: 4490-038



g00631565

Illustration 84

The kW level output will be activated whenever the total power output of the generator exceed the setpoint P139. The kW level output is the connector contact 34 of the GSC+. This setpoint can be programmed from 0 to 110 percent of the nameplate power (setpoint P030). This setpoint can be programmed with a time delay from 0 to 120 seconds (setpoint P140). See System Operation, “Engine/Generator Programming OP5-0”. Also, see System Operation, “Service Mode”. Once the output is activated, the kW level output will be deactivated when the total power output of the generator drops below a programmed setpoint (setpoint P141). This setpoint is different from the activation setpoint. This setpoint can be programmed from 0 to 110 percent of the nameplate power rating of the generator. This setpoint can be programmed with a time delay from 0 to 120 seconds.

When kW relay is disconnected from the GSC+, the voltage on the kW level output is approximately 5.0 DCV. When kW relay is connected to the GSC+, the voltage on the kW level output is approximately 0 volts. The kW level output is capable of drawing (sinking) approximately 100 mA. Documenting and troubleshooting any connections to this output is the responsibility of the customers and the dealers.

The possible cause of a CID 859 FMI 4 is a short to battery negative (“B-”) of the kW level output signal.

The GSC+ treats a CID 859 FMI 4 fault as an alarm fault.

The troubleshooting of a kW level output fault is straight forward. The FMI 4 defines the fault as a short to “B-”. Use the following information in order to find the exact cause of the fault.

- FMI information
- kW level output system schematic
- customer’s documentation
- dealer’s documentation

i01099409

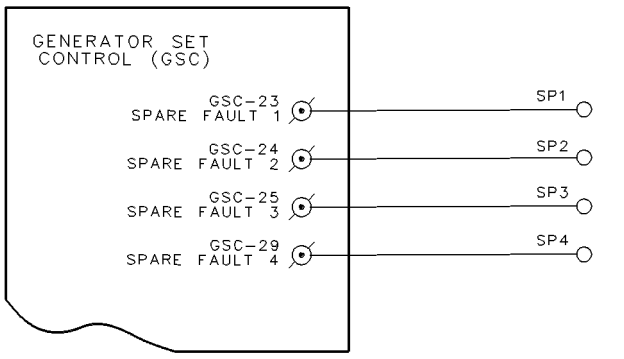
SP Fault Code - Troubleshoot

SMCS Code: 4490-035

g00578242

Illustration 85

Upper Display With SP Fault Code “SP1” Showing



g00578243

Illustration 86

System Schematic For Spare Fault Inputs

A spare fault informs the operator of an undesirable condition (fault) that exists. The spare inputs are programmed into the GSC+ to meet the requirements of the customer or application. An active spare input causes an alarm fault or shutdown fault. For programming of the spare inputs, see System Operation, “Spare Input/Output Programming OP6”. It is the responsibility of the programmer (customer, operator, or service personnel) to make a note of the actual conditions that cause an SP fault code to be shown on the upper display. The GSC+ does not diagnose the spare inputs. Spare faults are not recorded in the fault log.

The GSC+ treats an active input state as a fault. The active state is programmable on the GSC+ to be either a high or low (factory default) voltage level. A high level is within the range of +5 DCV to battery positive. If the input is left floating (for example an open switch), the GSC+ pulls the input voltage up to 10.5 DCV and the input is treated as high level. A low level on the input is “B-” (ground).

When a spare fault occurs (is active), the GSC+ determines the type of fault (alarm or shutdown) and FLASHES the corresponding fault alarm indicator or fault shutdown indicator. For a shutdown type of fault, the SP fault code is immediately shown on the upper display. For an alarm type of fault, the alarm codes key is pressed first and then the SP fault code is shown on the upper display. After a spare fault is corrected or is not present, the SP fault code is no longer shown on the upper display.

Table 21

Spare Fault Codes			
Spare Fault Code	**GSC+ Connector Contact**	**Terminal Strip**	**Related Setpoints(1)**
SP1 Spare Fault 1	23	SP1	SP01, SP02, SP03
SP2 Spare Fault 2	24	SP2	SP04, SP05, SP06
SP3 Spare Fault 3	25	SP3	SP07, SP08, SP09
SP4 Spare Fault 4	29	SP4	SP10, SP11, SP12

(1) See System Operation, “Spare Input/Output Programming OP6”.

SP fault codes are associated with the spare inputs. The SP fault code shown on the upper display, identifies the spare input that caused the alarm fault or shutdown fault. The spare inputs are accessed on the terminal strip within the control panel on the rear wall.

When an SP fault code is showing on the upper display, check the programming notes (made by the customer, operator, or service personnel) to determine the cause.

The spare fault inputs can be used with factory and/or customer installed options. The factory options for the spare fault input are: ground fault, low fuel level, high fuel level, high generator winding temperature and high generator bearing temperature. Each of these options will include a dedicated indicator and a label on the custom alarm module.

Troubleshooting Procedure

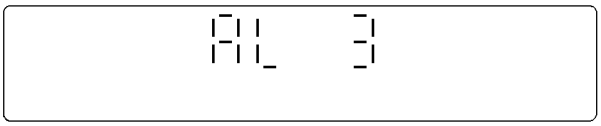
In order to troubleshoot spare faults, use the following general procedure.

1. Check for obvious causes which are related to the device that is responsible for the spare fault.
2. Verify that the programming of the spare fault (alarm or shutdown) is appropriate for the application.
3. Check the function of the responsible device. Reset the fault by turning the engine control switch (ECS) to the OFF/RESET position. Verify that the fault is still present.
4. Disconnect the responsible device from the spare fault input and verify if the fault still exists.
5. Check the wiring to the corresponding spare fault input for an unwanted short to either battery negative (“B-”) or battery positive (“B+”).

i01213571

AL Fault Code - Troubleshoot

SMCS Code: 4490-035



g00515350

Illustration 87

Upper Display With AL Fault Code “AL3”

An alarm fault informs the operator of a condition that could cause a dedicated fault shutdown. An alarm fault precedes certain dedicated shutdown faults. Alarm faults are activated automatically by the GSC+ and the faults depend on certain setpoints. The GSC+ does not record alarm faults in the fault log.

When an alarm fault occurs, the GSC+ FLASHES the fault alarm indicator. The corresponding alarm code is shown on the upper display after the alarm codes key is pressed. When the alarm fault is no longer active, the alarm fault code is no longer shown on the upper display.

Table 22

Troubleshooting AL Fault Codes		
AL Fault Code	**Description**	**Troubleshooting**
AL1	High Water Temperature Alarm Coolant temperature increases to within 6°C (11°F)of setpoint P15	See Testing And Adjusting, “Troubleshooting Dedicated Shutdown Indicators”.
AL2	Alarm for Low Engine Coolant Temperature Coolant temperature decreases to setpoint P16.	See Testing And Adjusting, “Troubleshooting Dedicated Shutdown Indicators”.
AL3	Alarm for Low Engine Oil Pressure Oil pressure drops to within 34 kPa (5 psi) of the P13 or P14 setpoint	See Testing And Adjusting, “Troubleshooting Dedicated Shutdown Indicators”.

Troubleshooting Procedure

If the operation of the AL fault codes is suspected to be incorrect, perform this procedure.

1. Check For A Diagnostic Fault.

a. Check for an active CID 110 diagnostic code or a CID 269 diagnostic code. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”.

Expected Result: CID 110 or CID 269 should not be showing.

Results:

- OK: Proceed to next step.
- NOT OK: Correct the active CID 110 or CID 269 prior to proceeding with this procedure. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”. STOP.

2. Identify The AL Fault Code That Is Suspected To Be Incorrect.

- If AL fault code AL1 or AL3 is suspected to be incorrect, then see Testing And Adjusting, “Troubleshooting Dedicated Shutdown Indicators”.
- If AL fault code AL2 is suspected to be incorrect, go to 3.

3. Check The Function Of The Low Engine Coolant Temperature.

a. Note the setpoint P16 (low water temperature alarm), see Systems Operation, “Setpoint Viewing OP2”.

b. Check and note the actual coolant temperature that is showing on the lower display.

c. Compare the two temperatures.

Expected Results: The actual coolant temperature that is showing on the lower display should be greater than setpoint P16. This actual temperature should not cause an AL2 fault code.

Results:

- OK: The actual temperature is greater than the setpoint P16 and the alarm fault indicator does not FLASH and AL2 fault code is not showing on the upper display when the alarm code key is pressed. The problem is not present now. The problem may be intermittent. Check the harness and the electrical connections of the circuit for the coolant temperature. See Testing And Adjusting, “Electrical Connector - Test”. STOP.

- OK: The temperature that is showing on the lower display is greater than setpoint P16. Therefore, the temperatures are not correct for an AL2 fault code. If the AL2 fault remains active, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace” for more information. STOP.

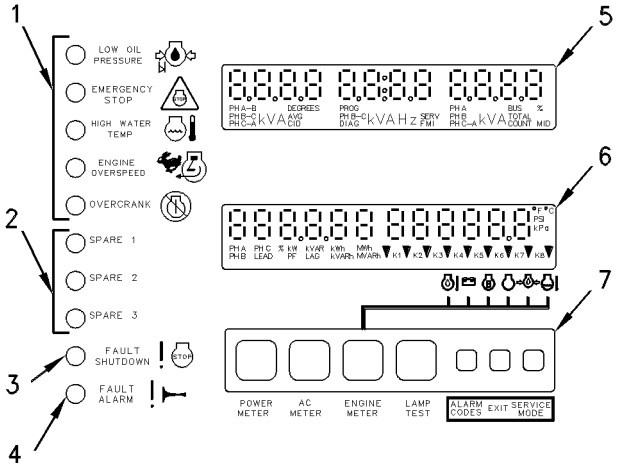
- NOT OK: The temperature that is showing on the lower display is less than setpoint P16. Therefore, the temperatures are correct for an AL2 fault code. The GSC+ is operating properly. Make sure that the setpoint P16 is reasonable for the local climate. Adjust, if necessary. Refer to the Engine Service Manual in order to find the cause of the low engine coolant temperature. STOP.

Note: If desired, check the accuracy of the temperature that is shown on the lower display of the GSC+. Install an accurate engine coolant temperature gauge with the sensing element in an area of high coolant flow. Also, install the gauge as close as possible to the coolant temperature sensor for the EMCP II+.

i01100067

Troubleshooting Dedicated Shutdown Indicators

SMCS Code: 4490-035-IND



g00394077

Illustration 88

Display Area Of Generator Set Control + (GSC+)

(1) Dedicated shutdown indicators
(2) Spare fault indicators
(3) Fault shutdown indicator
(4) Fault alarm indicator
(5) Upper display
(6) Lower display
(7) Keypad

The dedicated shutdown indicators inform the operator which system is responsible for an engine shutdown. The symbol and nomenclature nearest to the indicator identifies the responsible system. Dedicated shutdown faults are activated automatically by the GSC+ and depend upon certain setpoints. When the GSC+ decides that operating conditions are critical, it FLASHES the corresponding shutdown indicator and shuts the engine down. The GSC+ does not record dedicated shutdown faults in the fault log.

The dedicated shutdown indicators (faults) are listed below.

- Low Oil Pressure
- Emergency Stop
- High Water Temperature
- Engine Overspeed
- Overcrank

To find the cause of a dedicated shutdown fault, perform the correct procedure.

i01179849

Indicator for Low Oil Pressure - Troubleshoot

SMCS Code: 4490-035-IND

To find the cause of a low oil pressure shutdown, perform this procedure.

1. Check For A Diagnostic Code.

a. Check for a CID 100 diagnostic code that is active. Check for a CID 269 diagnostic code that is active. See System Operation, “Diagnostic Codes”.

Expected Result: The CID 100 or the CID 269 should not be active.

Results:

- OK: Proceed to Step 2.
- NOT OK: Correct the active CID 100 or CID 269 prior to proceeding with this procedure. See System Operation, “Diagnostic Codes”. STOP.

2. Check obvious causes.

a. Check for low oil pressure.

b. Check the oil level.

c. Check for oil leaks.

d. Check for other obvious causes of low oil pressure.

Expected Result: No obvious cause should exist.

Results:

- OK: Proceed to Step 3.
- NOT OK: An obvious cause exists. Correct the fault. Refer to the Engine Service Manual. STOP.

3. Check Setpoints.

This step checks the setpoints P012 (oil step speed), P013 (low oil pressure at rated speed) and P014 (low oil pressure at idle speed).

a. Make a note of setpoints P012, P013 and P014. See System Operation, “Engine/Generator Setpoint Viewing OP2-0”.

b. Compare the setpoints with the setpoints of the particular generator set.

Expected Result: The setpoint’s value and the specified setpoint value should agree.

Results:

- OK: Proceed to Step 4.
- NOT OK: The setpoints do not agree. Reprogram setpoints P012, P013 and P014. See System Operation, “Engine/Generator Programming OP5-0”. STOP.

4. Check The Low Oil Pressure Function.

a. Turn the engine control switch (ECS) to OFF/RESET. Turn the ECS to START.

b. Allow oil pressure to stabilize.

c. When the engine is at idle speed, compare the actual pressure that is shown on the lower display with setpoint P014. This setpoint is noted in Step 3. The actual pressure that is shown should be greater than setpoint P014.

d. Operate the engine at rated speed. Compare the actual pressure that is shown on the lower display with setpoint P013. P013 is noted in Step 3. The actual pressure that is shown should be greater than setpoint P013.

Expected Results: The actual pressure at idle speed and at rated speed should be greater than the respective setpoint value. These actual pressures should not cause a low oil pressure shutdown.

Results:

- OK: Both actual pressures are greater than the corresponding setpoint value and the low oil pressure indicator does not FLASH. The problem may be intermittent. Check the harness and all electrical connections of the oil pressure circuit. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

- OK: Both actual pressures are greater than the corresponding setpoint value and the low oil pressure indicator remains FLASHING. The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

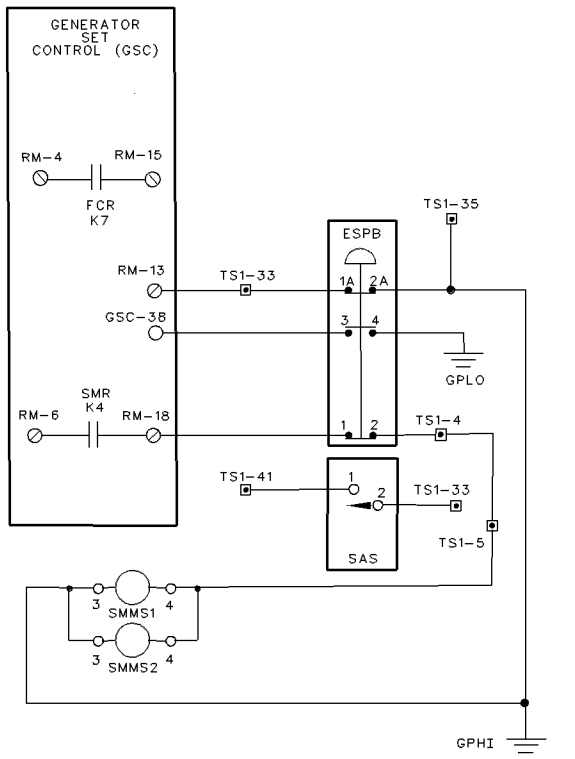
- NOT OK: Actual pressure that is shown is less than the setpoint for the rated speed or for the idle speed. The pressures are correct for a low oil pressure shutdown. The engine should be shutdown and the low oil pressure indicator should FLASH. The GSC+ is operating properly. Refer to the Engine Service Manual in order to find the cause of low oil pressure. STOP.

Note: Check the accuracy of the pressure that is shown on the GSC+. Install an engine oil pressure gauge as near as possible to the engine oil pressure sensor.

i01179884

Indicator for Emergency Stop - Troubleshoot

SMCS Code: 4490-035-IND



g00479362

Illustration 89

System Schematic For Emergency Stop Circuit On ETR Systems

In order to find the cause of an emergency stop shutdown, perform the following procedure.

1. Check The Emergency Stop Push Button (ESPB).

a. Deactivate the ESPB by pulling on the ESPB. Some versions of ESPB must be turned clockwise before popping out.

b. Turn the engine control switch (ECS) to STOP.

Expected Result: The ESPB should pop out. The emergency stop indicator should be turned OFF.

Results:

- OK: The system is operating correctly. The problem may be intermittent. Check the harness and all electrical connections of the ESPB circuit. See Testing And adjusting, “Electrical Connector - Inspect”. STOP.

- NOT OK: The ESPB does not pop out. Replace the ESPB. STOP.

- NOT OK: The ESPB pops out and the emergency stop indicator is FLASHING. Proceed to Step 2.

2. Check The Emergency Stop Indicator.

Note: This Step creates diagnostic codes. Clear these created diagnostic codes after troubleshooting is complete.

a. The ECS remains in the STOP position.

b. Disconnect the harness connector from the GSC+.

c. Temporarily install a jumper from contact “39” of the GSC+ to “B-”. This simulates the OFF/RESET position of the ECS.

d. Check the operation of the emergency stop indicator.

Expected Result: The emergency stop indicator should be OFF.

Results:

- OK: Therefore, the fault is with the ESPB or the related wiring. Troubleshoot the circuit. See the Generator Set Wiring Diagram. Refer to Testing And Adjusting, “Schematics And Wiring Diagrams”. Repair the faulty components or wiring. Replace faulty components or wiring. STOP.

- NOT OK: The emergency stop indicator is FLASHING. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”.

i01179911

Indicator for High Water Temperature - Troubleshoot

SMCS Code: 4490-035-IND

In order to find the cause of a high water temperature shutdown, perform the following procedure.

1. Check For The Diagnostic Fault.

a. Check for a CID 110 or CID 269 diagnostic code that is active. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”.

Expected Result: CID 110 or CID 269 should not be showing. This means that CID 110 or CID 269 are not active.

Results:

- OK: Proceed to Step 2.
- NOT OK: Correct the active CID 110 or CID 269 prior to proceeding with this procedure. See the topic Testing And Adjusting, “Troubleshooting Diagnostic Codes”. STOP.

2. Check Obvious Causes.

a. Check the water level.

b. Check fan drive belts.

c. Check for other obvious causes of high water temperature.

Expected Result: No obvious cause should exist.

- OK: Proceed to Step 3.
- NOT OK: An obvious cause exists. Correct the fault. Refer to the Engine Service Manual. STOP.

3. Check Setpoint P015.

Note: Setpoint P015 describes high water temperature.

a. View setpoint P015. Make a note of setpoint P015. See System Operation, “Engine/Generator Setpoint Viewing OP2-0”.

b. Compare the setpoints which are viewed with the specified setpoints of the particular generator set.

Expected Result: The value of the setpoint that is viewed and the specified setpoint value should agree.

Results:

- OK: Proceed to Step 4.
- NOT OK: The setpoints do not agree. Reprogram setpoint P015. See System Operation, “Engine/Generator Programming OP5-0”. STOP.

4. Check The High Water Temperature Function.

a. Turn the engine control switch (ECS) to OFF/RESET. Then, turn the ECS to START.

b. Allow water temperature to stabilize.

c. Check and note the actual water temperature which is showing on the lower display.

d. Compare the temperature that is viewed on the lower display with setpoint P015. P015 is noted in Step 3.

Expected Result: The actual temperature which is showing on the lower display should be less than setpoint P015. This actual temperature should not cause a high water temperature shutdown.

Results:

- OK: The actual temperature is less than the setpoint P015 and the high water temperature indicator does not FLASH. The problem is not present now. The problem may be intermittent. Check the harness. Check all of the electrical connections on the water temperature circuit. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- OK: The actual temperature is less than the setpoint P015 and the high water temperature indicator remains FLASHING. Therefore, the GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

- NOT OK: Actual temperature is greater than the setpoint P015. The temperature is correct for a high water temperature shutdown. The engine should be shutdown and the high water temperature indicator should FLASH. The GSC+ is operating properly. Refer to the Engine Service Manual in order to find the cause of high water temperature. STOP.

Note: Check the accuracy of the temperature which is shown on the lower display of the GSC+. Install a temperature gauge as close as possible to the coolant temperature sensor. The temperature gauge must be in a high coolant flow.

i01219908

Indicator for Engine Overspeed - Troubleshoot

SMCS Code: 4490-035-IND

In order to find the cause of an engine overspeed shutdown, perform the procedure that follows.

1. Check setpoints.

This step checks setpoints P009 (ring gear teeth) and P010 (engine overspeed).

a. View the setpoints and note the setpoints P009 and P010. See Systems Operation, “Engine/Generator Setpoint Viewing OP2”.

b. Compare the setpoints that are viewed with the specified setpoints of the particular generator set.

Expected Result: The setpoint value that is viewed and the setpoint value that is specified should agree.

Results:

- OK: Proceed to Step 2.
- NOT OK: The setpoints do not agree. Reprogram setpoints P009, P010 and P014. See Systems Operation, “Engine/Generator Programming OP5”. STOP.

2. Check for possible causes.

a. Check for the possible causes of the engine overspeed condition. Refer to the Engine Service Manual and/or the Governor Service Manuals.

Expected Result: No cause should be found.

Results:

- OK: Proceed to Step 3.
- NOT OK: The cause is found. Repair engine components or replace engine components. If necessary, repair governor components or replace governor components. STOP.

3. Check the engine overspeed function.

Note: Take precautions in order to stop the engine manually when you are performing this step.

a. When possible, disable the engine from reaching rated speed.

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Slowly increase the RPM to rated speed.

Expected Result: The engine should not overspeed. The GSC+ should not shut down the engine. The GSC+ should not issue an overspeed fault.

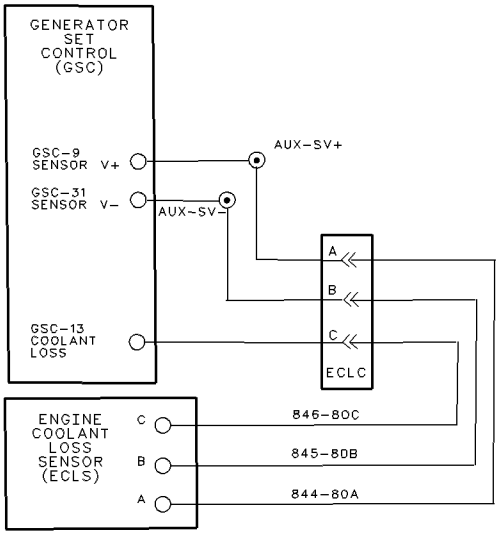
Results:

- OK: The engine reaches rated speed. The GSC+ does not issue an overspeed fault and the GSC+ does not shut down the engine. The GSC+ and the system are functioning properly. Perform a verification of an overspeed. See Systems Operation, “Engine Setpoint Verification OP9”. STOP.
- NOT OK: The engine overspeeds and the GSC+ issues an overspeed fault. Refer to the Engine Service Manual and/or the Governor Service Manual in order to find the cause of the problem. STOP.

i01179985

Indicator for Low Coolant Level - Troubleshoot

SMCS Code: 4490-035-IND



g00479560

Illustration 90

System Schematic For Engine Coolant Loss Sensor (ECLS)

In order to find the cause of a low level shutdown, perform this procedure.

1. Check The Coolant Level.

a. Check the level of the engine coolant. See the Operation And Maintenance Manual for the engine.

Expected Result: The coolant level should be at the proper level. The coolant level should be above the probe of the coolant loss sensor.

Result:

- OK: Proceed to Step 2.
- NOT OK: Coolant level is not correct. Find the cause and correct the cause. Refer to the Engine Service Manual. STOP.

2. Check For A Diagnostic Fault.

a. Turn the engine control switch (ECS) to the OFF/RESET position and then turn the ECS to the STOP position.

b. Wait for ten seconds.

c. Check for an active CID 111 diagnostic code. CID 111 describes the coolant loss sensor. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”.

Expected Result: CID 111 should not be showing. The indicator for the low coolant level should not be FLASHING.

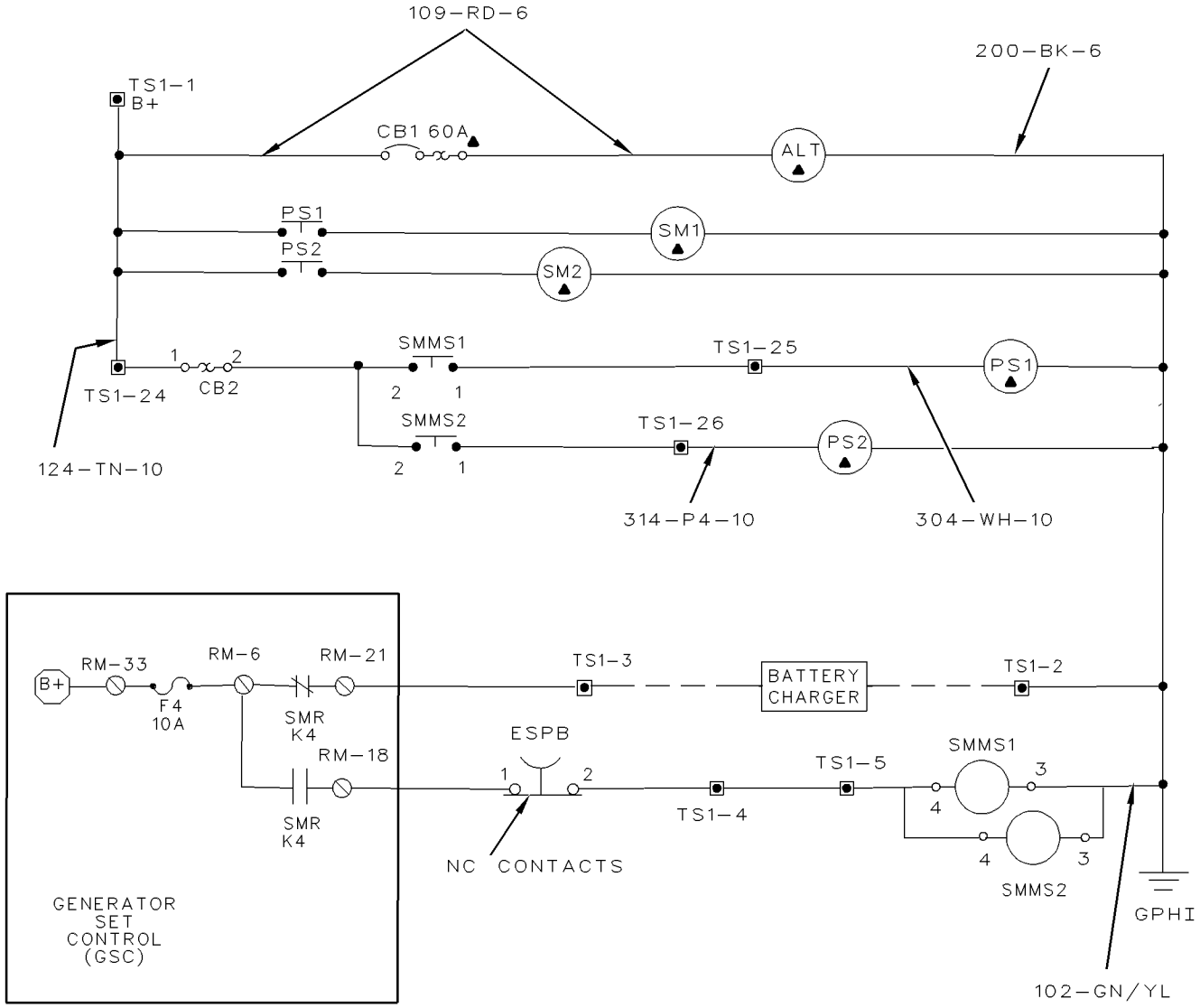
Results:

- OK: No CID 111 diagnostic codes are active. The indicator for the low coolant level is OFF. Therefore, the fault may be intermittent. Check the harness and all the electrical connections of the circuit for the low coolant level. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.
- NOT OK: CID 111 is active. Correct the active CID 111. See Testing And Adjusting, “Troubleshooting Diagnostic Fault Codes”. STOP.
- NOT OK: No CID 111 is active. The indicator for the low coolant level is FLASHING. Therefore, the sensor is faulty. Replace the coolant loss sensor. STOP.

i01179997

Indicator for Overcrank - Troubleshoot

SMCS Code: 4490-035-IND



g00479965

Illustration 91

System Schematic For Starting Motor Relay (SMR)

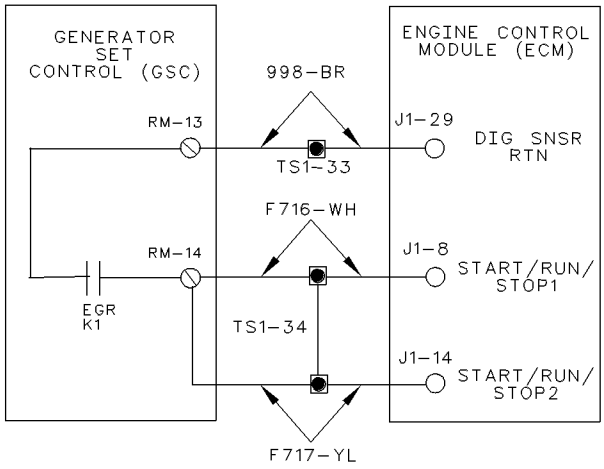


Illustration 92 g00479969

System Schematic For Electronic Governor Relay

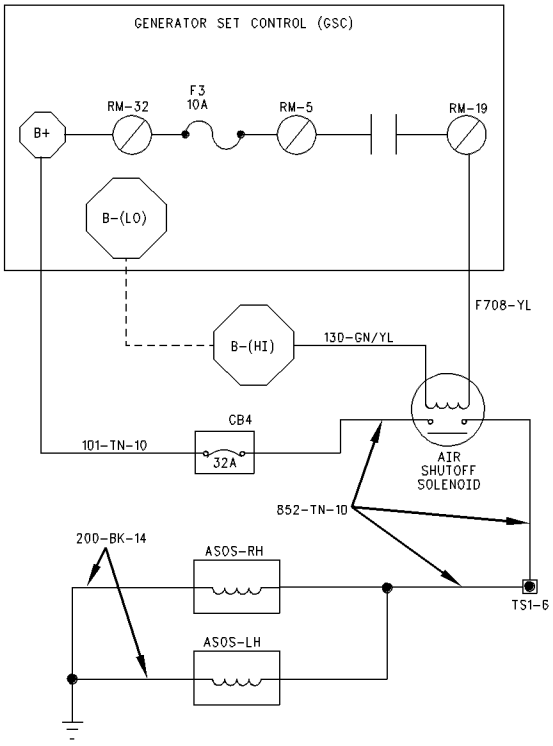


Illustration 93 g00479971

System Schematic For Air Shutdown Relay (ASR)

To find the cause of an overcrank shutdown, perform this procedure.

1. Initial Check

Before you proceed with the troubleshooting procedures, perform the following preliminary checks.

a. Check for active diagnostic codes and other flashing indicators on the GSC+. The only exception is the CID 566 FM 7. If the fault is present, then correct the fault first. Go to the appropriate procedure for that fault.

b. Check the fuel level and quality. Refer to the Engine Service Manual.

c. Check for a plugged fuel filter. Refer to the Engine Service Manual.

d. Check for a plugged air filter. Refer to the Engine Service Manual.

e. Check the air shutoff solenoid (if equipped) for activation. The solenoid must be deactivated in order for the engine to start. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”.

f. Check fuse “F2” and “F4” on the relay module. If either fuse is blown, proceed to **10**.

g. Check the engine starting system and the fuel system. (To check the fuel control solenoid, see Testing And Adjusting, “Troubleshooting Diagnostic Codes”.) If there is a fault, refer to the Engine Service Manual. If there is no engine fault or fuel system fault, proceed to **2**.

2. Check setpoints.

This step checks setpoints P17 (total cycle crank time) and P18 (cycle crank time).

a. Note setpoints P17 and P18. See Systems Operation, “Engine/Generator Setpoint Viewing OP2”.

b. Compare the setpoints that are viewed with the specified setpoints. The default value for a P17 is 90 seconds. The default value for a P18 is 10 seconds.

Expected Result: The setpoint value that is viewed and the specified setpoint value should agree.

Results:

- OK: Proceed to Step **3**.
- NOT OK: The setpoints do not agree. Reprogram setpoints P17 and P18. See Systems Operation, “Engine/Generator Programming OP5”. STOP.

3. Check the battery voltage.

a. Make sure that the engine is off. Measure the system voltage at the batteries.

Expected Result:

For 24 volt systems, the voltage should be from 24.8 to 29.5 DCV.

For 32 volt systems, the voltage should be from 33.1 to 39.3 DCV.

Results:

- OK: Proceed to Step 3.
- NOT OK: Further checking of the battery system is necessary. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”. STOP.

4. Check the engine starting function.

Steps 4 through 9 require voltage measurements to be made during simulated engine cranking. The starting motor is disabled.

Note: The GSC+ is attempting to crank whenever the K4 indicator is ON. The K4 indicator is on the lower display. Be aware of the 10 second crank cycle that is factory set. Ensure that the K4 indicator is ON while you are making the following measurements. An assistant should observe the GSC+ , if necessary. More than one start may be required to complete this test.

a. Disconnect the pinion solenoid wire of the starting motor. The pinion solenoid wire remains disconnected for all of the remaining steps of this procedure.

b. Prepare to measure the DC voltage from the disconnected “B+” pinion solenoid wire to “B–” (ground).

c. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

d. Measure the voltage.

Expected Result: The voltage that is measured voltage should equal the system voltage (± 2.0 DCV). The system voltage is noted in 3.

Results:

- OK: Therefore, the starting motor is faulty. Repair the starting motor or replace the starting motor. Refer to the Engine’s Service Manual. Refer to the Starting Motor’s Service Manual. STOP.
- NOT OK: Proceed to Step 5.

5. Check the engine starting function.

“B+” wire is disconnected from the pinion solenoid.

a. In the junction box, prepare to measure the DC voltage from “B–” (ground) to the output terminal of SMMS.

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Measure the voltage.

Expected Result: The voltage that is measured voltage should equal the system voltage (± 2.0 DCV). The system voltage is noted in 3 ±2.0 DCV.

Results:

- OK: Therefore, the engine wire harness is faulty. Repair the engine wire harness or replace the engine wire harness. See the Testing And Adjusting, “Schematics And Wiring Diagram”. STOP.
- NOT OK: Proceed to Step 6.

6. Check the engine starting function.

“B+” wire is disconnected from the pinion solenoid.

a. Prepare to measure the voltage from terminal TS1-5 in the generator housing to “B–” (ground).

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage ±2.0 DCV. The system voltage is noted in step 3.

Results:

- OK: Therefore, the starting motor magnetic switch (SMMS) is faulty. Also, the wiring could be faulty. Troubleshoot the SMMS and the wiring. See the Testing And Adjusting, “Schematics And Wiring Diagram”. STOP.

- NOT OK: Proceed to Step 7.

7. Check the engine starting function.

“B+” wire is disconnected from the pinion solenoid.

a. Prepare to make a voltage measurement from RM-18 of the relay module to “B–” (ground).

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage ±2.0 DCV. The system voltage is noted in 3.

Results:

- OK: The emergency stop push button (ESPB) is faulty. The wiring to the ESPB is faulty. Troubleshoot the ESPB and the related wiring. See the Testing And Adjusting, “Schematics And Wiring Diagram”. STOP.

- NOT OK: Proceed to Step 8.

8. Check the engine starting function.

Results:

a. Prepare to measure the DC voltage from RM-6 of the relay module to “B–” (ground).

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage ±2.0 DCV. The system voltage is noted in 3.

Results:

- OK: Therefore, the relay module is faulty. Ensure that the K4 indicator is ON. Replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.

- NOT OK: Proceed to Step 9.

9. Check the engine starting function.

“B+” wire is disconnected from the pinion solenoid.

a. Prepare to measure the DC voltage from RM-33 of the relay module to “B–” (ground).

b. Turn the ECS to the OFF/RESET position and then turn the ECS to the START position.

c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage ±2.0 DCV. The system voltage is noted in 3.

Results:

- OK: Therefore, fuse “F4” is blown. Proceed to Step 10.

- NOT OK: The B+ terminal is faulty or the wiring to RM-33 is faulty. Repair the wiring or replace the wiring. See the Testing And Adjusting, “Schematics And Wiring Diagram”. STOP.

10. Troubleshoot a blown fuse.

a. Remove fuse “F4” from the relay module.

b. Measure the resistance from RM-18 to B–.

c. Measure the resistance from RM-15 to B–.

Expected Result:A short to “B–” (ground) will measure 5 ohms or less.

Results:

- OK: The resistance is greater than 5 ohms. The fuse is no longer blown. Carefully check ALL the wires that are connected to the appropriate terminal of the relay module for abrasion or worn spots in the insulation. These wires could cause a short. Check the wires: the panel, the generator panel, and the engine harness. Refer to the various wiring diagrams. If necessary, repair the wiring or replace the wiring. STOP.

- NOT OK: Resistance is 5 ohms or less. There is a short to ground. See the Testing And Adjusting, “Schematics And Wiring Diagram”. Remove one component or wire at a time that is in series with RM-18 until the faulty component or wire is isolated. Repair the faulty component or replace the faulty component. Repair wiring or replace wiring. STOP.

i01219910

Troubleshooting Undiagnosed Problems

SMCS Code: 4490-038

Undiagnosed problems are NOT accompanied by any type of fault indicator or fault code on the GSC+. In order to troubleshoot an undiagnosed problem, find the description that best fits the problem in the Undiagnosed Problem List. Proceed to the corresponding procedure.

Note: If any fault indicator is showing on the GSC+, then proceed to the appropriate procedure for the fault.

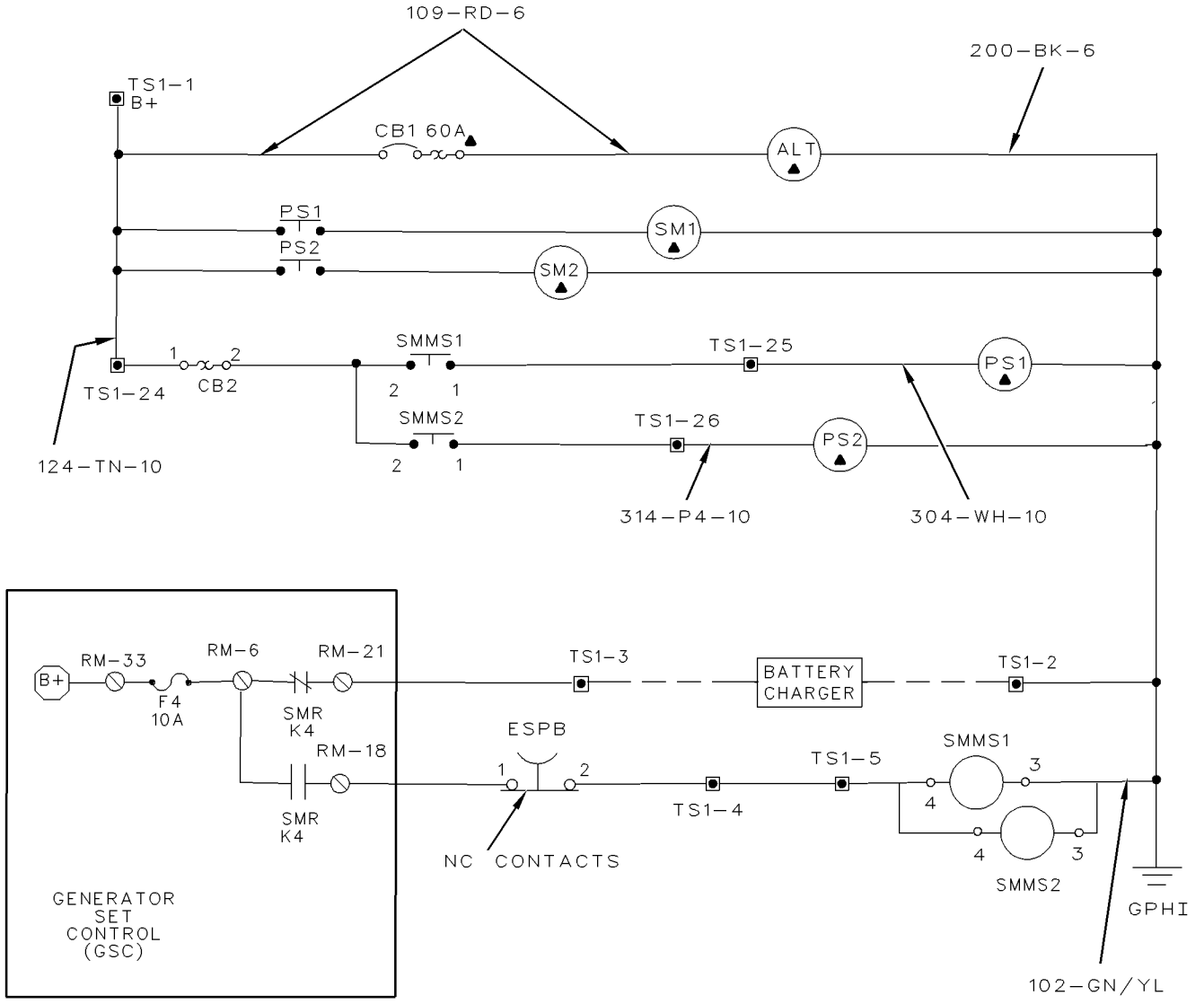
Undiagnosed Problem List

- The starting motor remains engaged or the starting motor continues to run after the engine has started.
- There is no engine shutdown when a shutdown fault occurs.
- All the fault indicators of the remote annunciator flash and/or all the fault indicators of the control panel alarm module flash. The indicators flash once per two seconds (0.5 Hz).
- Fault shutdown indicator on the GSC+ flashes four to five times per second (4 to 5 Hz).
- The display of the GSC+ shows 0 volts for one of the AC phases. This happens when the generator is running and when the load is connected.
- The display of the GSC+ is showing 0 amperes for one of the AC phases. This happens when the generator is running and when the load is connected.
- The AC voltage and/or current values are inaccurate.

i01180185

Engaged Starting Motor - Troubleshoot

SMCS Code: 1453-035; 4490-035



g00479965

Illustration 94

System Schematic For Starting Motor Relay (SMR)

The starting motor remains engaged or the starting motor continues to run after the engine has started.

1. Check setpoints.

This step checks setpoints P11 (crank terminate speed), P17 (total cycle crank time) and P18 (cycle crank time).

a. Make a note of setpoints P11, P17 and P18. See Systems Operation, “Engine/Generator Setpoint Viewing OP2”.

b. Compare the setpoints that are viewed with the specified setpoints of the particular generator set. The default value for P11 is 400 rpm. The default value for P17 is 90 seconds. The default value for P18 is 10 seconds.

Note: Engines that are equipped with prelube pumps may require cycle crank times of 30 seconds or more.

Expected Result: The setpoint value that is viewed and the specified setpoint value should agree.

Results:

- OK: Proceed to next Step 2.
- NOT OK: The setpoint that is viewed does not agree with the specified setpoint. Reprogram setpoints P11, P17 and P18. See Systems Operation, "Engine/Generator Programming OP5". Proceed to next step.

2. Check the engine starting function.

For the steps that remain in this procedure, the fuel system must be disabled.

a. Disable the engine ECM in order to prevent the engine from starting but not from cranking. Remove the "C key" on the J1 40-pin connector.

b. Prepare to manually stop the engine from cranking. Turn the battery disconnect switch OFF or manually stop the engine.

c. Turn the ECS to START and allow the engine to crank.

d. Turn the ECS to OFF/RESET.

Expected Result: The engine should stop cranking.

Results:

- OK: Proceed to 6.
- NOT OK: The engine continues to crank. Proceed to next step.

3. Check the engine starting function.

The conditions of 2 remain. The fuel delivery is disabled and the engine is cranking.

a. While the engine is still cranking from the preceding step, push the emergency stop push button.

Expected Result: The engine should stop cranking.

Results:

- OK: Check the wire on RM-18 of the relay module. RM-18 could be shorted to B+. If a short is not found, replace the relay module. See Testing And Adjusting, "Relay Module - Replace". STOP.
- NOT OK: The engine continues to crank. Proceed to next Step 4.

4. Check the engine starting function.

The conditions of 3 remain. The fuel delivery is disabled and the engine is cranking.

a. Stop the engine. Turn the battery disconnect switch to the OFF position or manually stop the engine.

b. Remove all wires from terminals TS1-25 in the generator housing. For dual starting motors, remove all the wires from terminal TS1-26.

c. Turn the ECS to the START position and attempt to crank the engine.

Expected Result: The engine should not crank.

Results:

- OK: The engine does not crank. Therefore, the starting motor magnetic switch (SMMS) or related wiring is faulty. Troubleshoot the SMMS and the related wiring. See Testing And Adjusting, "Schematics & Wiring Diagram". STOP.
- NOT OK: The engine continues to crank. Proceed to next Step 5.

5. Check the engine starting function.

The conditions of 4 remain. The fuel delivery is disabled and the engine is cranking.

a. Stop the engine. Turn the battery disconnect switch to the OFF position or manually stop the engine.

b. Disconnect the B+ wire on the pinion solenoid of the starting motor.

c. Turn the ECS to START and attempt to crank the engine.

Expected Result: The engine should not crank.

Results:

- OK: The engine does not crank. Therefore, the wire 304-WH-10 and/or the wire 314-PU-10 in the engine harness are shorted to the battery B+. Troubleshoot the wiring. See the “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics And Wiring Diagrams”. If this does not fix the problem, proceed to Step 6.

- NOT OK: The engine continues to crank. Therefore, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor Manual. Refer to Engine Service Manuals. If this does not fix the problem, proceed to Step 6.

6. Check the starting motor cycling.

This step continues troubleshooting from 2. The conditions of 2 remain. The fuel delivery is disabled.

Turn the ECS to the START position.

a. Expected Result: The starting motor should cycle on and off according to setpoint P18 (cycle crank time).

Results:

- OK: If the starting motor cycles correctly, the problem is not present. STOP.

- NOT OK: If the starting motor remains ON, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor and/or Engine Service Manuals. STOP.

i01180366

No Engine Shutdown - Troubleshoot

SMCS Code: 4490-035

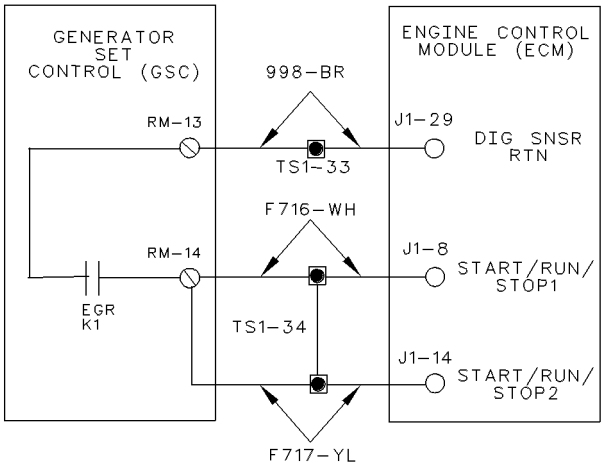


Illustration 95 g00479969

System Schematic For Electronic Governor Relay (EGR)

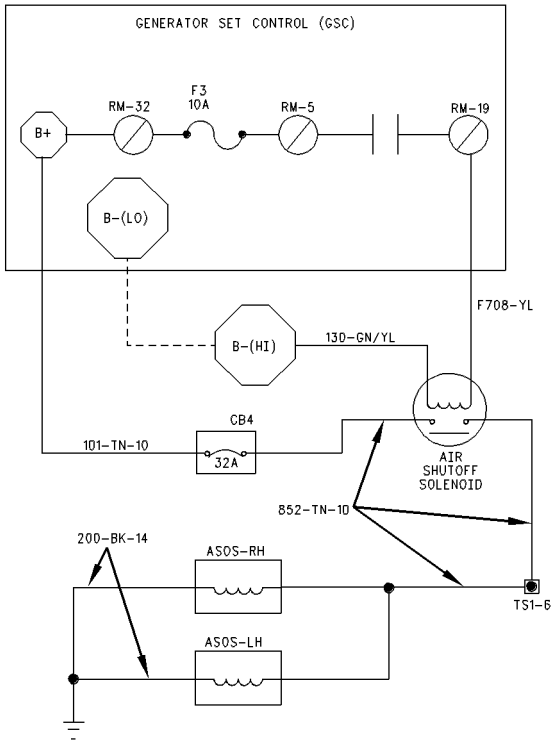


Illustration 96 g00479971

System Schematic For Air Shutoff Relay (ASR)

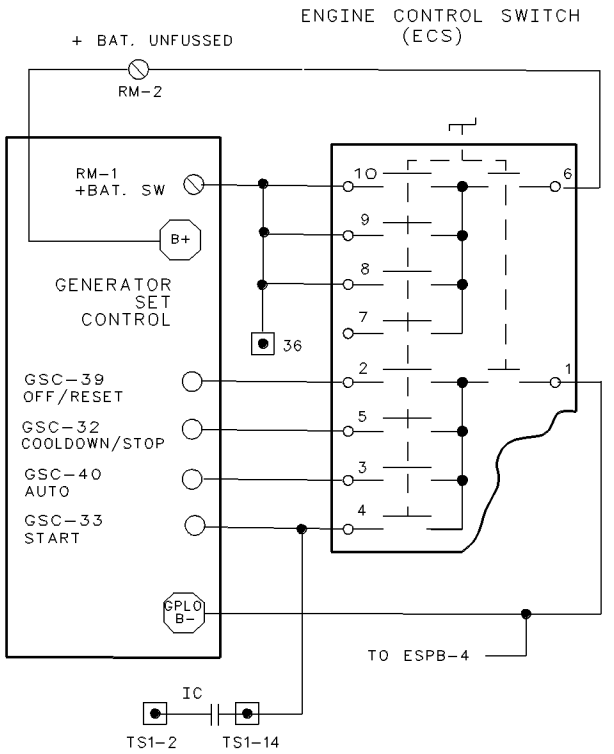


Illustration 97 g00481066

System Schematic For Engine Control Switch (ECS)

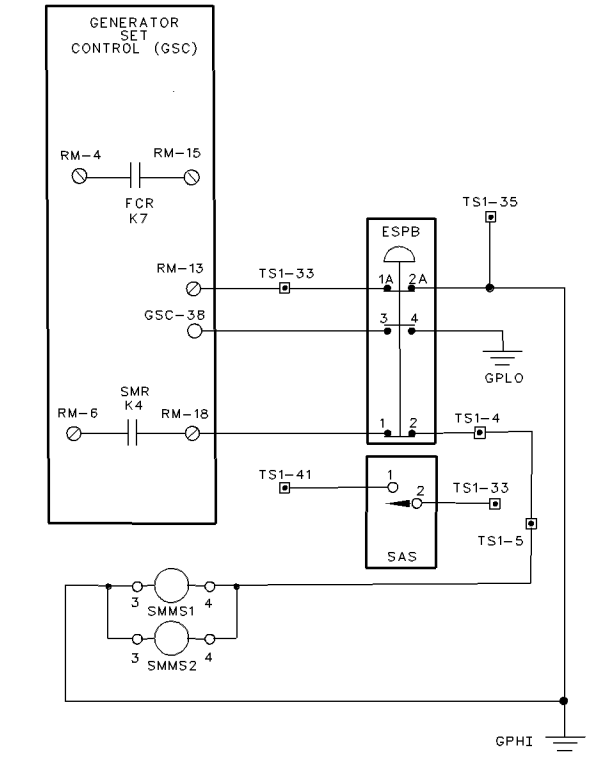


Illustration 98 g00479362

System Schematic For Emergency Stop Circuit On ETR Systems

The engine does not shut down when a shutdown fault occurs.

1. Check for any diagnosed faults.

a. Check the display area of the GSC+ for a fault indicator that is FLASHING. Check for a fault code on the upper display.

Note: If the fault alarm indicator is ON CONTINUOUSLY, then the GSC+ is programmed to override the normal shutdown response and the GSC+ is programmed to treat the condition as an alarm fault. The engine continues to run and the engine is able to start. This is not a problem. To view the setpoints, see Systems Operation, “Engine/Generator Setpoint Viewing OP2”. To reprogram the setpoints, see Systems Operation, “Engine/Generator Programming OP5”.

Expected Result: The engine does not shut down when a shutdown fault occurs.

Results:

- NOT OK: If all of the fault indicators are OFF, the faults that could shut down the engine are not present. If a shutdown fault is present, proceed to Step 5.

- NOT OK: If the fault shutdown indicator is FLASHING and the engine remains running, then proceed to Step 2.

2. Check the system.

The engine remains running and the fault shutdown indicator is FLASHING.

a. Turn the ECS to OFF/RESET.

Expected Result: The engine should shut down.

Results:

- OK: The engine shuts down. The system is functioning properly. Start the engine again. If the fault shutdown indicator is FLASHING and the engine does not shut down, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

- NOT OK: The engine does NOT shut down. Proceed to Step 3.

3. Check the system.

The engine remains running and the fault shutdown indicator is FLASHING.

a. Push the emergency stop push button (ESPB).

Expected Result: The engine should shut down.

Results:

- OK: The engine shuts down. Therefore, it is likely that a short to ground (B–) is present at RM-14 of the relay module. Check the related wiring for this unwanted short. If no short to ground (B–) is found in the related wiring, then replace the relay module. See Testing And Adjusting, “Relay Module - Replace”. STOP.
- NOT OK: The engine does NOT shut down. Proceed to Step 4.

4. Check the system.

The engine remains running and the fault shutdown indicator is FLASHING.

a. Stop the engine. Turn the battery disconnect switch to the OFF position or shut down the engine by mechanical means.

b. The following two possibilities could be causing the problem.

- A wiring error exists with the emergency stop push button.
- A wiring error exists between RM-14 and the engine ECM (pins 8 and 14).

c. Troubleshoot the possible wiring errors. Refer to Testing And Adjusting, “Schematics and Wiring Diagrams”.

d. Check if the problem is still present.

Expected Result: The original problem should no longer occur.

Results:

- OK: The original problem should no longer occur. STOP.
- NOT OK: The original problem still occurs. Refer to the Engine Service Manual in order to troubleshoot.

5. Determine the fault.

This step continues troubleshooting from step 1.

Note: For a fault with the coolant loss sensor that does not shut down the engine, see Testing And Adjusting, “Troubleshooting Diagnostic Codes”.

a. For the following faults, make a note of all the engine information that is showing on the lower display of the GSC+.

- engine overspeed
- low oil pressure
- high water temperature fault that does not shut down the engine

b. View the related setpoints. See Systems Operation, “Engine/Generator Setpoint Viewing OP2”.

c. Compare the engine information that is showing on the lower display with the related setpoints.

Expected Result: The information on the lower display and the related setpoint values should agree.

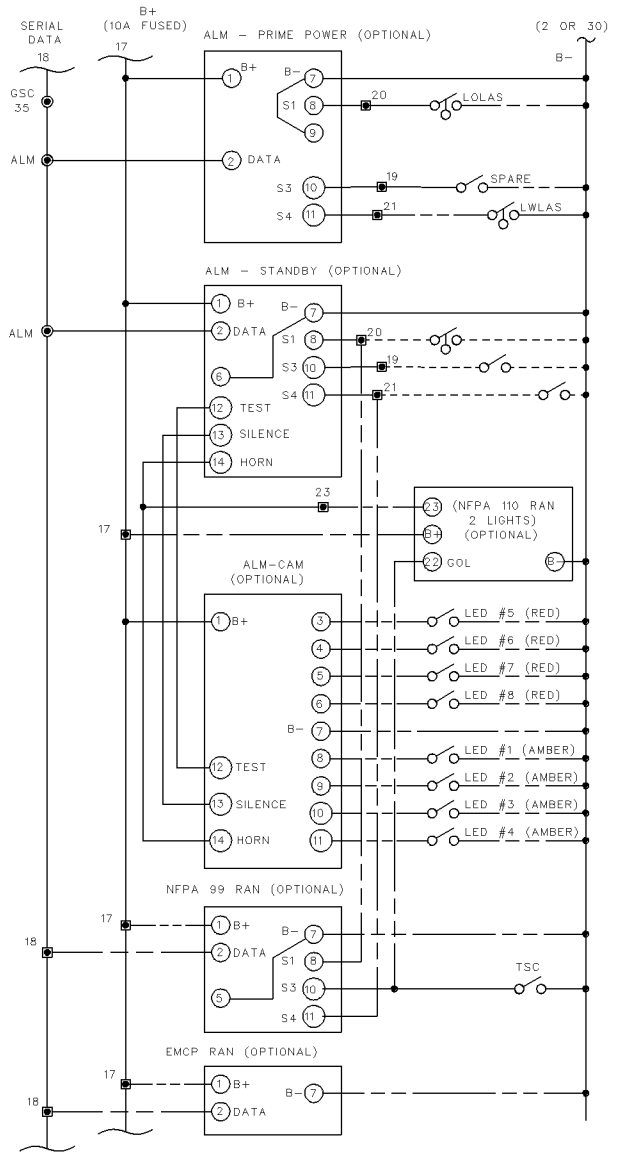
Results:

- OK: The information that is showing on the lower display is within the related setpoint. The GSC+ is not causing the shutdown. STOP.
- NOT OK: The information that is showing on the lower display is beyond the related setpoint. Then, the GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01177469

Alarm Module or Remote Annunciator - Troubleshoot

SMCS Code: 4490-035



g00481278

Illustration 99

System Schematic For Alarm Module (ALM)

All the fault indicators of the remote annunciator flash and/or all the fault indicators of the control panel alarm module flash. The indicators flash once per two seconds (0.5 Hz).

Note: The maximum number of modules (Alarm, Remote Annunciator, or Customer Interface Module), that can be connected to the GSC+ is three. (There is no limit on the number of Custom Alarm Modules that can be used in an application.) The maximum distance between a module and the GSC+ is 305 m (1000 ft). If these specifications are not met, the information on the data link can be erratic. Also, the indicators on the alarm module could flash. If the conditions are not in compliance with the specifications, reduce the number of modules and/or shorten the distance to the GSC+.

1. Check the data wire.

a. Turn the ECS to OFF/RESET.

b. Disconnect the harness connector from the GSC+.

c. Check for an open. Measure the resistance from terminal 2 of the alarm module to contact 35 of the GSC+ harness connector. The resistance should be 5 ohms or less.

d. Check for a short. Measure the resistance from contact 35 of the GSC+ harness connector to the battery (B+) and ground (B–) at the relay module. The resistance should be greater than 5000 ohms.

Expected Result: For 1.c, the resistance should be 5 ohms or less. For 1.d, the resistance should be greater than 5000 ohms.

Results:

- OK: All resistance measurements are correct. Proceed to next step.
- NOT OK: One or more of the resistance measurements are NOT correct. Therefore, the harness wiring with the incorrect resistance is faulty. Troubleshoot the faulty wiring and repair the faulty harness wiring. STOP.

2. Measure the voltage at the alarm module.

The ECS remains in the OFF/RESET position.

a. Reconnect the harness connector to the GSC+.

b. At the alarm module, measure the DC voltage from terminal 2 to terminal 7. The voltage will be changing. The voltage should be between 1 and 10 DCV.

Note: If you are troubleshooting a remote annunciator, measure the DC voltage from contact 35 to contact 31 of the GSC+ harness connector. Make the measurement by using the 7X-1710 Multimeter Probe Group. Do not disconnect the harness from the GSC+. This voltage measurement should agree with the preceding measurement of 2.b. If the voltages do not agree, the wire is faulty. The wire is faulty from terminal 2 of the remote annunciator to the terminal in the internal panel.

c. Disconnect all wires from terminal 2 of the alarm module. Again measure the DC voltage from terminal 2 to terminal 7 at the alarm module. The voltage should be 10.5 ± 1.0 DCV.

Expected Result: For 2.b, the voltage should be between 1 and 10 DCV. For 2.c, the voltage should be 10.5 ± 1.0 DCV.

Results:

- OK: Both voltage measurements are correct. Therefore, replace the alarm module. STOP.
- NOT OK: Both voltage measurements are low. Therefore, replace the alarm module.
- NOT OK: The first measurement is low and the second measurement is high. Therefore, replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01180487

Erratic GSC Operation - Troubleshoot

SMCS Code: 4490-035

The fault indicator on the GSC+ flashes four to five times per second (4 to 5 Hz). The displays of the GSC+ may be unclear. The GSC+ does not respond to any position of the engine control switch (ECS).

This is an internal fault of the GSC+ that can be temporary or permanent. The fault is caused by a component failure in the GSC+. The fault could also be caused by extremely severe electromagnetic interference or radio frequency interference. The relays in the relay module are automatically turned off when this fault occurs. The effect of this fault on the engine depends on the type of fuel system.

1. Reset the GSC+.

a. Turn the ECS to OFF/RESET. If the GSC+ does not power down, remove the jumper that connects terminals 6 and 9 on the ECS.

b. Turn the ECS to STOP.

Expected Result: The GSC+ should power up with an identifiable display. The GSC+ should respond to the ECS.

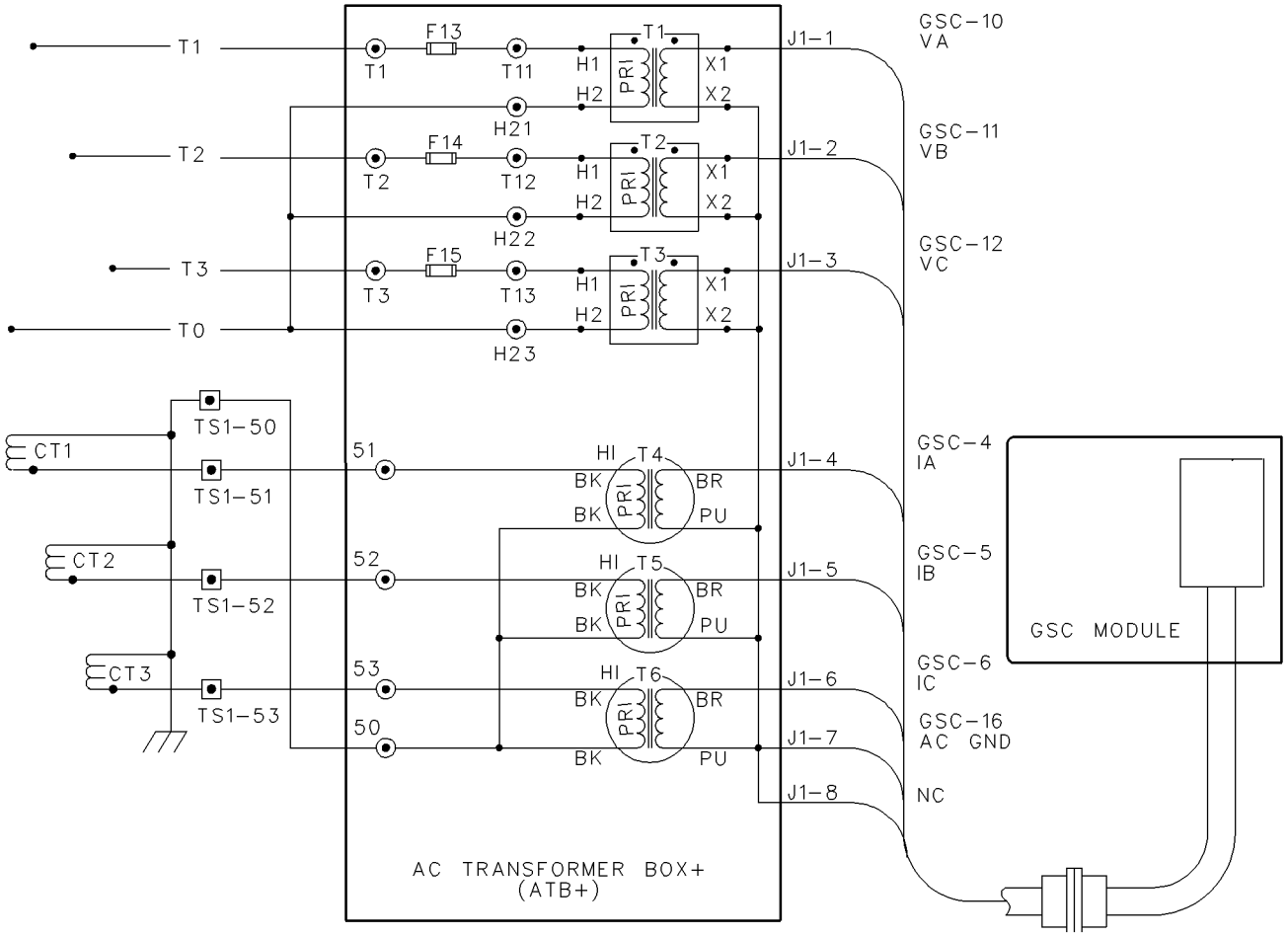
Results:

- OK: The GSC+ operates correctly. Therefore, the fault is gone. STOP.
- NOT OK: The GSC+ does NOT operate correctly and the fault shutdown indicator still flashes at a rate of four to five times a second (4 to 5 Hz). Therefore, the GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

i01180495

Zero Display of Voltage or Current - Troubleshoot

SMCS Code: 4490-035



g00633979

Illustration 100

System Schematic For AC Transformer Box + (ATB+)

⚠ WARNING

When the engine-generator, or any source to which the engine-generator is synchronized to, is operating, voltages up to 600V are present in the control panel.

Do not short these terminal with line voltage to ground with any part of the body or any conductive material. Loss of life or injury could result from electrical shock or injury from molten metal.

The engine is running. The load is connected. One of the AC phases on the GSC+ is showing 0 volts or 0 amperes.

If there is a problem with AC voltage, begin troubleshooting at Step 1.

If there is a problem with AC current, begin troubleshooting at Step 4.

1. Check the fuses.

a. Check the three fuses on the AC transformer box (ATB+).

The fuses should not be blown.

Expected Result: The fuses should not be blown.

Results:

- OK: Fuses are OK. Proceed to Step 2.
- NOT OK: One or more of the fuses are blown. Check for a shorted component or wiring error. Troubleshoot the fault and repair the fault. See the “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics and Wiring Diagram”. STOP.

2. Check the generator output.

a. Run the engine. Open the circuit breaker or remove the load. Measure the voltage between all three fuses on the ATB+.

Expected Result: The line to line voltage is correct for all three phases.

Results:

- OK: The voltages are correct and the problem remains. Proceed to Step 3.
- NOT OK: One or more of the voltages are NOT correct. The wiring is faulty or connections are faulty. Check the wiring between the ATB+ and the generator’s bus. See the “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics And Wiring Diagram”. Also check the electrical connections at the ATB+ terminal. See Testing And Adjusting, “Electrical Connector Inspection”. STOP.

3. Check the connections.

a. Stop the engine.

b. Check the harness connector and crimp terminals of the ATB+.

c. Check the GSC+ harness connector. See Testing And Adjusting, “Electrical Connector - Inspect”.

d. Check for one or more broken wires between the ATB+ and the GSC+. See “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics And Wiring Diagrams”.

Expected Result: All connectors are OK and the problem is no longer present.

Results:

- OK: All connectors are OK and the problem is no longer present. This procedure has fixed the fault. STOP.
- NOT OK: The AC voltage still has a problem. It is unlikely that the GSC+ is faulty. Replace the ATB+. If the problem persists, then replace the GSC+. STOP.
- NOT OK: The AC current still has a problem. Proceed to Step 4.

4. Check the current transformers.

a. Stop the engine.

b. At terminals 51, 52 and 53 of the ATB+, disconnect only the wires that lead away from the ATB+. These disconnected wires go to the current transformers (CT1, CT2, and CT3).

c. Measure the resistance from terminal 50 to each of the disconnected wires.

Expected Result: The resistance should be less than 5 ohms.

Results:

- OK: The resistance is correct. Therefore, the current transformers are good. Proceed to Step 5.

- NOT OK: One or more of the resistance measurements are NOT correct. A current transformer or related wire is open. Check for an open CT or wiring. See “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics And Wiring Diagrams”. STOP.

5. Check the ATB+.

a. Stop the engine.

b. Remove the harness connector from the GSC+.

c. At the GSC+ harness connector, measure the resistance: contact 4 to contact 16, contact 5 to contact 16, and contact 6 to contact 16. Allow each measurement to stabilize.

Expected Result: Each of the three resistances should be 120 ± 20 ohms.

Results:

- OK: Proceed to Step 6.

- NOT OK: One or more of the resistance measurements at the GSC+ harness connector is NOT correct. Therefore, the ATB+ or the related wiring is faulty. Check for an open or short in the wiring from the GSC+ harness connector to the ATB+ harness connector. See “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics And Wiring Diagram”. Check the electrical connections at the GSC+ and ATB+ harness connectors and at the ATB+ terminal strip. See Testing And Adjusting, “Electrical Connector - Inspect”. If necessary, repair the wiring or replace the wiring. If the fault is not found, replace the GSC+. STOP.

6. Check the ATB+.

The wires that were disconnected in step 4 remain disconnected. The only wires that are connected to these terminals should lead into the ATB+.

a. At the terminal strip of the ATB+, measure the resistance: terminal 51 to 50, terminal 52 to 50, and terminal 53 to 50 .

Expected Result: All resistances should be less than 1 ohm.

Results:

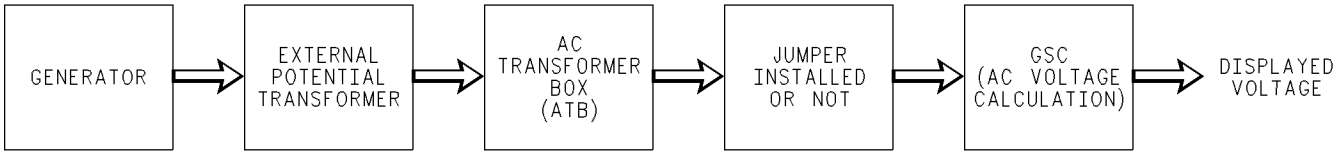
- OK: All resistances are correct. The ATB+ is OK. The fault is in the GSC+ or the GSC+ harness connector. Check the GSC+ harness connector. See “Generator Set Wiring Diagram” in Testing And Adjusting, “Schematics and Wiring Diagram”. If the connector is good and the fault remains, then replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.

- NOT OK: One or more of the resistance measurements are NOT correct. The ATB+ is faulty. Replace the ATB+. STOP.

i01180681

Inaccurate Display of Voltage or Current or Power - Troubleshoot

SMCS Code: 4490-035



g00481725

Illustration 101

Functional Block Diagram Of AC Voltage Display in EMCP II+

Table 23

AC Voltage Range Selection				
GSC+ P20 Setpoint	**External Potential Transformer**	**AC Transformer Box (ATB+) Input Voltage Range**	**GSC+ Internal Multiplier**	**Jumper**
700	None	0 - 700	5	Required
150	None	0 - 150	1	None
300	2:1	0 - 150	2	None
500	3.33:1	0 - 150	3.33	None
600	4:1	0 - 150	4	None
750	5:1	0 - 150	5	None
3000	20:1	0 - 150	20	None
4500	30:1	0 - 150	30	None
5250	35:1	0 - 150	35	None
9000	60:1	0 - 150	60	None
15000	100:1	0 - 150	100	None
18000	120:1	0 - 150	120	None
30000	200:1	0 - 150	200	None

The AC voltage and/or current values are inaccurate.

Note: See Testing And Adjusting, “AC Voltage Range - Adjust”.

The P20 setpoint determines the proper AC voltage range. P20 determines the internal multiplier that are used by the GSC+ for calculating AC voltage. The GSC+ uses the internal multiplier in order to compensate for the turn ratio of the external potential transformers. The turn ratio of the external potential transformers must match the internal multiplier in order to ensure an accurate AC voltage calculation by the GSC+.

The jumper block is located in the relay module. The jumper block connects a “divide-by-five circuit” to the AC voltage input of the GSC+. The “divide-by-five circuit” reduces the AC voltage input to a controllable level for the GSC+ when P20 is 700. When setpoint P20 is 700, a multiplier of five is needed to compensate for the presence of the “divide-by-five circuit”. This is done even though no external potential transformer is present.

Note: When P20 is programmed to a value that is other than 700, the jumper block should NOT be installed. This prevents an inaccurate voltage calculation by the GSC+. The other values (150 through 30,000) are used with an external potential transformer. The values result in input voltages from 0 to 150 ACV at the AC Transformer Box (ATB+). No further reduction of the input voltage is required.

Do the following procedure to determine the cause of inaccurate AC voltage and/or current values on the GSC+.

1. Check the setpoints P20 and P21. In order for the GSC+ to operate correctly, the current transformers (CT) must have 5 amp secondary winding. See Testing And Adjusting, “Engine/Generator Setpoint Viewing OP2” and Testing And Adjusting, “Engine/Generator Programming OP5”. The factory setpoints are: 700 V P20 and 600 A P21. The setpoints should be correct for the generator set application.

2. Refer to table 23 and illustration 101 in order to help determine the proper setpoints and any necessary external potential transformers.

3. If only the voltage is inaccurate, check the jumper for the AC voltage range for correct installation. The jumper should be installed for systems with an AC voltage input of 700 volts. (P20 = 700). The jumper should NOT be installed for systems with 150 volt AC voltage inputs. Also, the jumper should be NOT installed for any unit with external potential transformers. For information regarding the installation of the jumper, see Testing And Adjusting, “AC Voltage Range - Adjust”.

4. Check Systems Operation, “Voltmeter/Ammeter Programming OP8”. OP8 is the option for programming the calibration value of the voltmeter and the ammeter. The calibration values that are written on the ATB+ bar code sticker must be programmed into the GSC+. This ensures accurate voltage values and current values.

5. Check the AC offset adjustment. See Systems Operation, “AC Offset Adjustment OP10”. If necessary, set the voltage offsets to 0%.

Note: The adjusted voltages are only displayed on the GSC+. The adjusted voltages will NOT be transmitted over the CAT data link to other modules. The adjusted voltages are NOT used for determining the fault thresholds for protective relaying functions. In both cases, the values that are not adjusted for AC voltage are still determined by the GSC+. These values will be used instead of the displayed values.

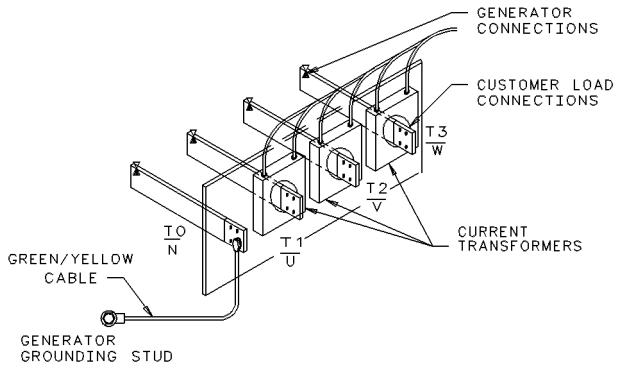


Illustration 102 g00481733

Polarity Of Current Transformers

Note: If the readings of the power meter on the GSC+ are inaccurate, check the power factor. Also check the power for each individual phase. Hold the power meter key for more than five seconds. If the readings for any individual phase are inaccurate, check the polarity of the current transformers (CT) in the generator housing. If the polarity of the current transformers is correct, replace the ATB+.

i01180745

Electrical Connector - Inspect

SMCS Code: 1408-040-CY; 7553-040

Many of the troubleshooting procedures in the Testing And Adjusting section require inspecting the electrical connectors and the crimp terminals. Do the following steps in order to test an electrical connector or crimp terminal. These steps can be especially helpful when you are troubleshooting an intermittent problem. If a faulty connection is found, repair the connection. Then return to the original troubleshooting procedures. Check if the original fault is resolved.

Note: Avoid unnecessary disconnecting and connecting of connectors in order to troubleshoot system faults. This practice can cause the connector contacts within the connector to wear out prematurely.

1. Check the hex head screw of the connector. Make sure that the 40-pin connector on the rear of the GSC+ is aligned and seated properly and that the hex screw is tight. Any unused locations in the 40-pin connector should be plugged in order to keep out dirt, water and contamination.

2. Perform a pull test on each wire. Each connector contact and wire in the various harness connectors should easily withstand 10 pounds of pull. The wire should remain in the connector body. This test checks if the wire in each connector contact was crimped properly. Also, this test checks that the connector contact was inserted into the connector body completely. Perform repair, as needed. When you are replacing connector contacts, use only the 1U-5804 Crimp Tool. Make sure that the connector contact and the tool are matched to the gauge of the wire. Connector contacts should always be crimped onto the wire, never soldered.

Also do the pull test for the pre-insulated crimp terminals on the terminal strips. Perform repair, as needed. When you are replacing crimp terminals, use the proper crimping tool and techniques for the type and the brand of crimp terminal. Use a terminal that is proper for the gauge of the wire. Spade terminals and ring terminals may be soldered to the wire for an improved electrical connection.

3. Visually inspect the wiring. Look for worn out wires. Check for pinched harnesses or damaged harnesses.

4. Visually inspect connectors and crimp terminals. Verify that connector contacts within the connectors are not corroded or damaged. Verify that the alignment of the contacts and the location of connector contacts are proper. Verify that the two connectors are seated and locked together.

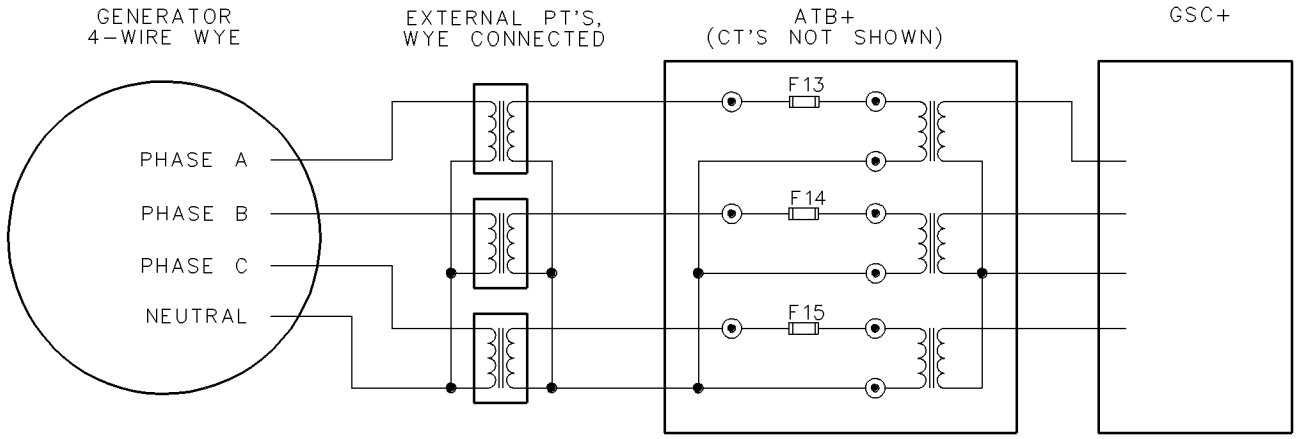
Check all crimp terminals for corrosion and damage. When you are wiggling each wire on a crimp terminal, the ends of the bare wires on the open end of the terminal barrel should be tight. Check the tightness of screws on the terminal strips also. Perform repair, as needed.

5. Check individual connector contacts. This is especially important for intermittent problems. When you are using a new connector contact, insert this contact into each of the mating connectors. Check for a snug fit between the mating connectors. Repeat this procedure for the other connector by using a new connector contact of the correct type.

i01180752

External Potential Transformer Connections

SMCS Code: 1409-077; 4490-077

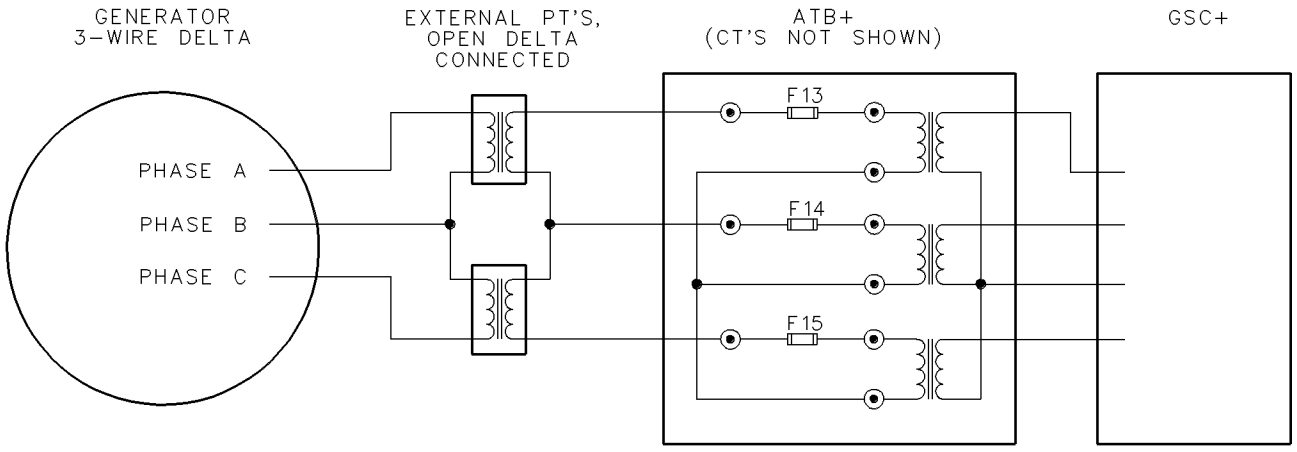


g00584152

Illustration 103

Wye Configuration Of External Potential Transformers (PT) On 4-Wire Wye Generator

This configuration allows the accurate measurement of all power parameters by the GSC+ including when the loads are unbalanced and neutral current is present. All power parameters are shown on the display of the GSC+.



g00584153

Illustration 104

Open Delta Configuration Of External Potential Transformers (PT) On The 3-Wire Delta Generator

This configuration allows the accurate measurement of power parameters by the GSC+ including when the loads are unbalanced and circulating current is present. The real power phasecan not be determined. The power factor phase can not be determined. The phases are not shown on the GSC+ display.

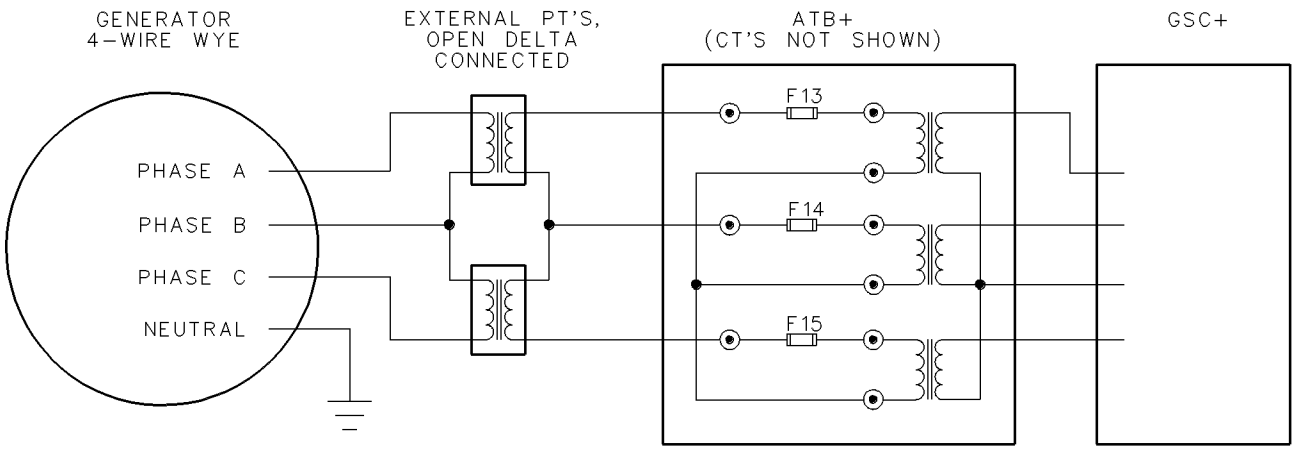


Illustration 105 g00584154

Open Delta Configuration Of External Potential Transformers (PT) On The 4-Wire Wye Generator

This configuration results in less accurate measurement of all power parameters by the GSC+ when the loads are unbalanced and neutral current is present. Real power phase and power factor phase are not shown on the GSC+ display.

Note: The wye configuration of external potential transformers (PT) 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 the real power phase (A, B, C) and power factor phase (A, B, C). For maximum accuracy, use the open delta configuration of the external potential transformers. This should be used only for 3-wire delta generators.

On 4-wire wye generators, three separate potential transformers (PT) are required for accurate power metering unless the loads are continually balanced. Even if the loads are balanced, some power parameters can not be determined. The following parameters are not shown on the GSC+ display: the real power phase and power factor phase. The ATB+ contains three potential transformers in order to accommodate 4-wire wye generators. The full capabilities of the ATB+ are not utilized when an open delta PT configuration is used for 4-wire wye generators.

On 3-wire delta generators, two potential transformers allow maximum accuracy for all load conditions. The real power phase can not be determined. The power factor phase can not be determined. The previous two phases are not shown on the GSC+ display.

When you are connecting an external potential transformers to a ATB+, the GSC+ must be programmed.

Procedure For Programming When Potential Transformers Are Used

1. Program setpoint P032 in order to match the configuration of the external potential transformer. Setpoint P032 must always match the configuration of the external potential transformer. This should be done regardless of the configuration of the generator. This is necessary because the ATB+ is connected only to the external potential transformers. The ATB+ cannot sense the generator's connections.

   - For external potential transformers that are connected in a wye configuration, program setpoint P032 to 0 (wye). Setpoint P032 is also programmed to 0 when no potential transformers are present on wye configurations.

   - For external potential transformers that are connected in a delta configuration, program setpoint P032 to 1 (delta). Setpoint P032 is also programmed to 1 when no potential transformers are present on delta configuration.

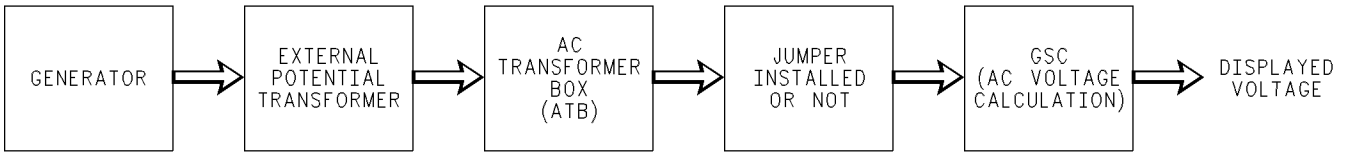
Note: When setpoint P032 is programmed to 1 (delta), the real power phase and the power factor phase can not be determined. The real power phase and the power factor phase are not shown on the GSC+ display.

2. Program the setpoint P020 to match the external potential transformer's turn ratio. See Testing And Adjusting, "AC Voltage Range - Adjust". Setpoint P020 should match the external potential transformer's turn ratio. The ratio should match the setpoint P032 regardless of the generator's configuration.

i01181196

AC Voltage Range - Adjust

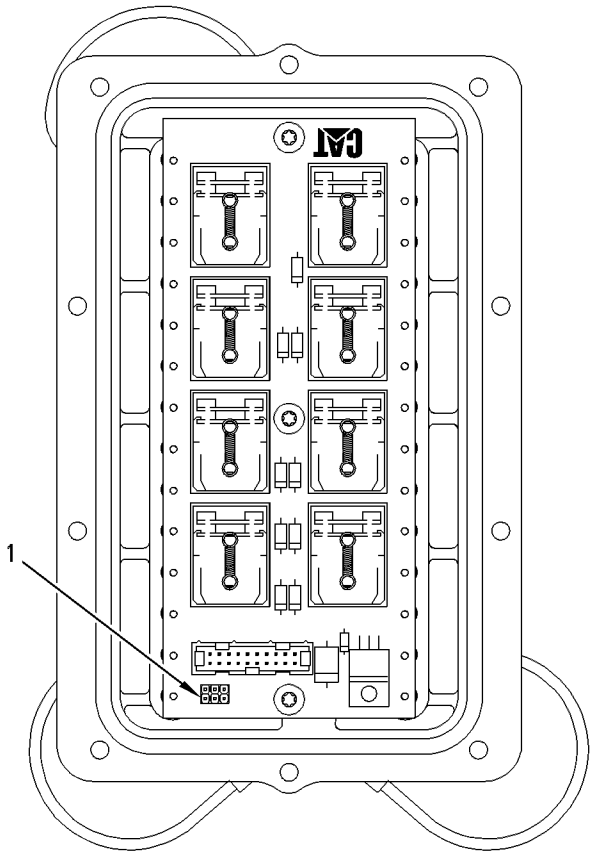
SMCS Code: 4490-025



g00481725

Illustration 106

Functional Block Diagram Of The AC Voltage Display In EMCP II+



g00436699

Illustration 107

Relays In Relay Module

(1) Jumper block

Table 24

AC Voltage Range Selection				
GSC+ P020 Setpoint	**External Potential Trans-former**	**AC Trans-former Box (ATB+) Input Voltage Range**	**GSC+ Internal Multiplier**	**Jumper**
700	None	0 - 700	5	Required
150	None	0 - 150	1	None
300	2:1	0 - 150	2	None
500	3.33:1	0 - 150	3.33	None
600	4:1	0 - 150	4	None
750	5:1	0 - 150	5	None
3000	20:1	0 - 150	20	None
4500	30:1	0 - 150	30	None
5250	35:1	0 - 150	35	None
9000	60:1	0 - 150	60	None
15000	100:1	0 - 150	100	None
18000	120:1	0 - 150	120	None
30000	200:1	0 - 150	200	None

Jumper block (1) is used to select the voltage range of the voltmeter of the GSC+. The jumper block (1) is installed for systems with 700 volts full scale AC inputs. Jumper block (1) is NOT installed for systems with 150 volts full scale AC inputs or for any unit with external potential transformers. The relay module is factory equipped with the jumper block (1).

Jumper block (1) is easily removed by pulling out. Jumper block (1) is easily installed by aligning and then pushing in. If a jumper block is not available, three separate jumpers can be substituted. Each of the three manufactured jumpers connect a pair of pins. A pair of pins must not touch another pair of pins.

The relay module must be removed from the GSC+ in order to gain access to the circuit board and jumper block (1). See Testing And Adjusting, “Relay Module - Replace”.

The setpoint P020 sets the AC voltage range and the internal multiplier. This is used by the GSC+ for calculating AC voltage. The GSC+ uses the internal multiplier to compensate for the turns ratio of the external potential transformers. The turns ratio of the external potential transformer must match this internal multiplier in order to ensure accurate AC voltage calculation by the GSC+.

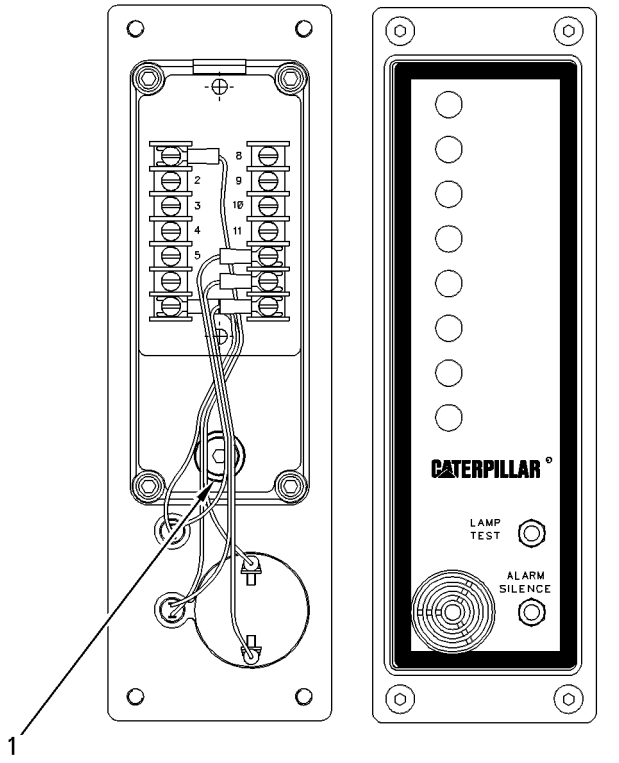
The jumper block connects a divide-by-five circuit to the AC voltage input of the GSC+. The divide-by-five circuit reduces the AC voltage input to a controllable level for the GSC+ when P020 is 700. When setpoint P020 is 700, a multiplier of five is needed to compensate for the presence of the divide-by-five. This is required even though no external potential transformer is present.

Note: When the setpoint P020 is not equal to 700, the jumper block should NOT be installed. This prevents inaccurate calculations of the voltage by the GSC+. The other values (150 through 30, 000) are used with an external potential transformer. The input voltages at the AC Transformer Box + are from 0 ACV to 150 ACV. No further reduction of the input voltage is required.

i01181242

Alarm Module Control - Adjust

SMCS Code: 4490-025



g00482185

Illustration 108

Alarm Module

(1)Plug

For all alarm applications, the low DC volts alarm setpoint is adjusted by a potentiometer that is located under access plug (1) on the rear of the module. The adjustment range is from 8 to 38 volts. The factory setting of the alarm setpoint is 24 DCV.

Adjustment Procedure

1. Gain access to the rear of the ALM. Removal of the ALM is not necessary unless removing the ALM is needed for access. Unless you are directed to disconnect the wires from the terminals, all wiring remains connected to the ALM.

2. Remove plug (1) in order to gain access to the adjustment potentiometer. Moisture may enter the ALM when plug (1) is removed. Remove plug (1) in a dry environment. Remove the plug in an air conditioned area if the relative humidity exceeds 60%.

3. Disconnect the wires on terminals 1 and 7. Secure these wires so that the wires do not contact each other, ground or other electrical connections.

4. Connect a variable DC power supply to the alarm module. The positive lead connects to terminal 1. The negative lead connects to terminal 7. Set the power supply voltage to the desired low DCV alarm setpoint. The setpoint must be between 8 and 38 volts.

5. Turn the adjustment potentiometer clockwise until the potentiometer stops.

6. After one minute, the indicator on the ALM for low battery voltage FLASHES. Press the alarm silence switch. The low battery voltage indicator should change from FLASHING to ON CONTINUOUSLY.

7. Slowly turn the adjustment potentiometer counterclockwise until the low battery voltage indicator turns OFF.

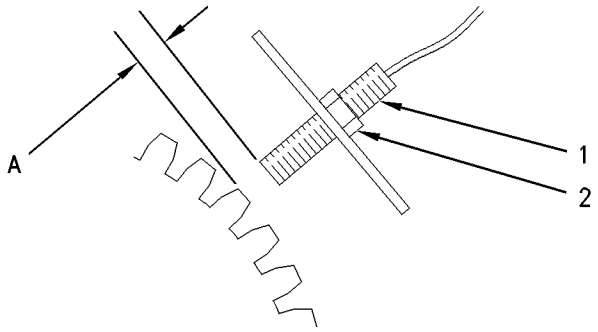
8. Replace the plug.

9. Disconnect the variable DC power supply and reconnect the wires to terminals 1 and 7.

i01181250

Speed Sensor (Engine) - Adjust

SMCS Code: 1907-025; 4490-025



g00289497

Illustration 109

Speed Sensor

(1) Speed sensor
(2) Locknut
(A) Air gap

Note: The engine speed sensor is commonly referred as a magnetic pickup sensor.

This adjustment procedure is for the engine speed sensor.

1. Remove the speed sensor (1) from the flywheel housing. Remove all debris from the tip of the speed sensor. Align a ring gear tooth directly in the center of the threaded sensor opening.

2. By hand, screw the speed sensor (1) into the hole until the end of the sensor contacts the gear tooth.

3. Turn the sensor (1) in the counterclockwise direction through 270 degrees (three-fourths turn).

4. Tighten locknut (2) to 25 ± 5 N·m (18 ± 4 lb ft).

Note: Do not allow speed sensor (1) to turn as locknut (2) is tightened.

i01180468

Charging System - Test

SMCS Code: 1406-081; 4490-081

Often when problems with the charging system are being investigated, the alternator is not the problem. If a low battery condition is present test the batteries first. See Special Instruction, SEHS7633, “Battery Test Procedure” for more information. If the engine cranks slowly, then test the starting system. See Service Magazine, SEPD0020, “Testing The Starter On The Engine” for more information. If a warning indicator for the charging system is ON, see Service Magazine, SEBD1751, “Difference Between Alternator Indicator In Electronic Monitoring System (EMS) And Low Voltage Indicator In Operating Monitoring System (OMS)”. When a problem with the charging system is suspected, then complete the testing that is outlined in this Special Instruction. See “Initial Troubleshooting Procedure” in order to begin troubleshooting. The procedures in this Special Instruction are designed to guide you to the problem with as little testing as possible. In most cases, you will only use a few of the tests to diagnose a problem. The tests are labelled as T1 - T8 for easy reference. A descriptive title for each test is included as well.

Initial Troubleshooting Procedure

1. Check The Resistance In Excitation Circuit.

This step is only for alternators with external excitation when the terminal for excitation is labelled: “1”, “REG”, and “D+”. See “Alternator Specifications” if the method of excitation is unknown. Go to Step 3 if your alternator is self-excited. If the alternator terminal for excitation is labelled with “IG”, go to Step 2 .

a. If the generator set is equipped with a disconnect switch then turn the disconnect switch to the ON position.

b. Verify voltage at the excitation terminal. Connect the red lead from a multimeter to the excitation terminal. Connect the black lead to a ground source. The ground source is the alternator's case ground.

c. Read the voltage that is shown on the multimeter.

Expected Result: The voltage reads at least 0.2 volts.

Results:

- OK: The voltage reads 0.2 volts or more. The excitation circuit is correct. Proceed to Step 3.
- NOT OK: The voltage is less than 0.2 volts. There is a fault in the wiring harness to the alternator or there is a poor electrical connection. Correct the problem. Watch for a recurrence of the problem.

2. Check The Resistance In Excitation Curcuit.

This step is only for alternators with external excitation when the terminal for excitation is labelled: "IG". See "Alternator Specifications" if the method of excitation is unknown. Go to Step 3 if your alternator is self-excited.

a. Turn the disconnect switch to the ON position.

b. Verify voltage at the excitation terminal. Connect the red lead from a multimeter to the excitation terminal. Connect the black lead to ground.

c. Read the voltage that is shown on the multimeter.

Expected Result: The voltage is within 0.5 volts of the battery voltage.

Results:

- YES: The voltage reads battery voltage. The excitation circuit is correct. Proceed to Step 3.
- NO: The voltage is not within 0.5 volts of the battery voltage. There is a fault in the wiring harness to the alternator or there is a poor electrical connection. Correct the problem. Watch for a recurrence of the problem.

3. Check The System Voltage.

a. Before you start the generator set, connect a voltmeter between the "B+" terminal and the case of the alternator. Disconnect all loads from the battery. Disconnect the battery voltage to the EMCP II+.

b. Turn the disconnect switch to the ON position but do not start the engine.

Expected Result: This voltage should be system voltage.

Results:

- YES: The voltage is system voltage. Go to Step 4.
- NO: The voltage is less than system voltage. Verify that the batteries are good and verify that battery connections are good. Go to "T4 Alternator Drive System - Check" if the batteries are good.

4. Perform The Initial Check Of Alternator Operation.

a. The voltmeter remains connected in the configuration from Step 3.

b. Start the engine. Set the throttle to at least 75%. Read the voltage on the voltmeter.

Expected Result: The voltage is higher than the voltage recorded in the previous Step 3.

Results:

- YES: The voltage is higher than the voltage observed in the previous Step 3. The voltage is also lower than the maximum voltage that is listed in the specifications for the alternator. The alternator is partially charging the battery. See the following diagnostic flow chart for reference in continued testing. Proceed to "T1 Alternator Output - Test".
- YES: The voltage is higher than the voltage observed in the previous Step 3. The voltage is also higher than the maximum voltage that is listed in the specifications for the alternator. The alternator is over charging. Proceed to "T 8 Alternator Overcharging - Test".
- NO: The voltage is not higher than the voltage which was observed in Step 3. Proceed to "T4 Alternator Drive System - Check".

Note: Severely discharged batteries can cause low system voltage. This can occur even while the engine is running above idle, and the alternator is working properly. Proper low engine idle is also important. Most of the alternators in Caterpillar applications are self-excited. These alternators must exceed a turn-on speed before charging will begin. Alternator output can be very low at idle.

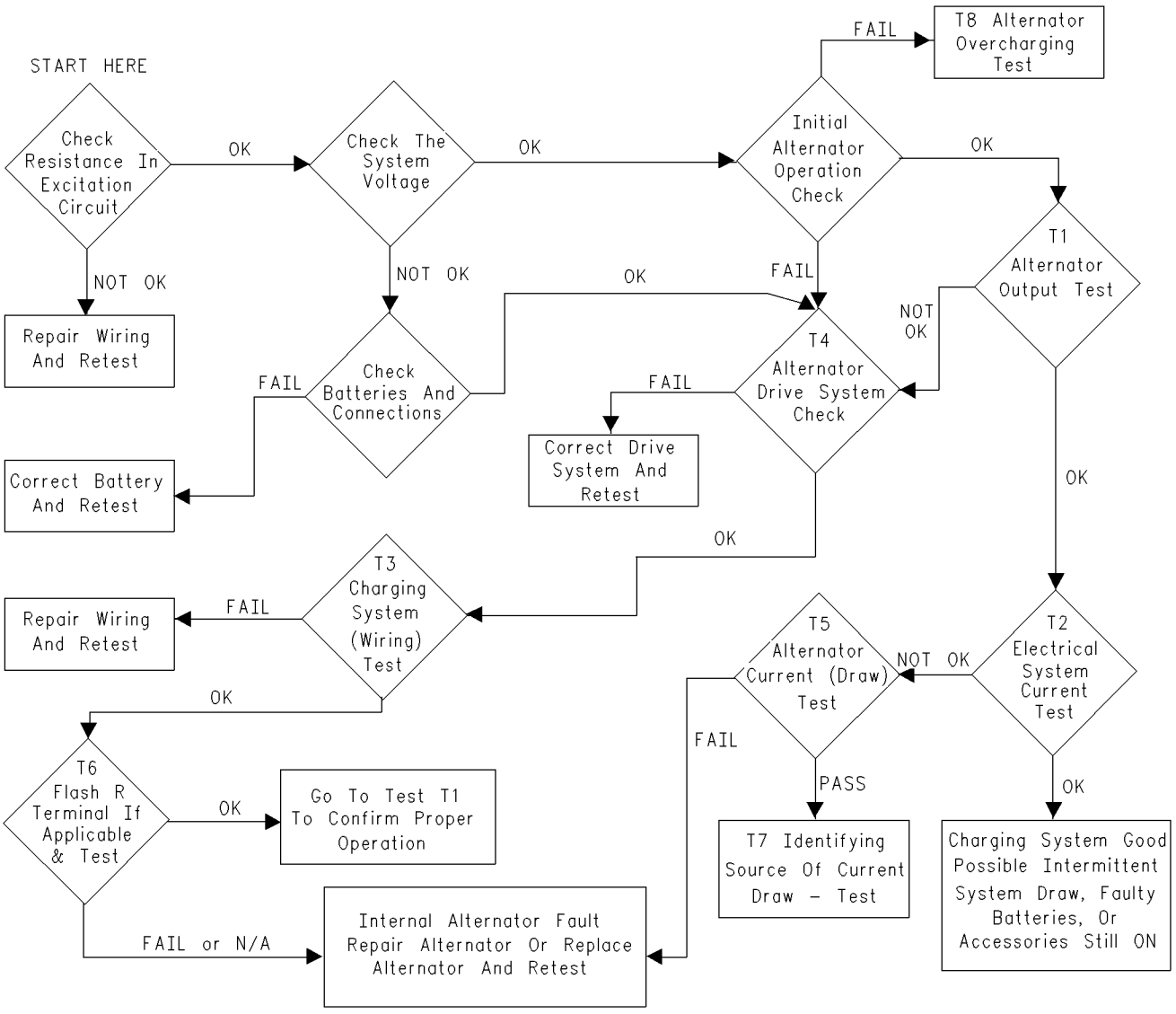


Illustration 110 g00508188

T1 Alternator Output - Test

1. Ensure that the batteries are NOT fully charged.

a. Fully charged batteries have open circuit voltage of 25 volts on 24 volt systems.

b. If the batteries are fully charged then crank the engine for 30 seconds. This action reduces the battery voltage. Operate the lights for 10 minutes while the engine is off as an alternative.

2. Connect the 9U-5795 Current Probe or 8T-0900 Ammeter to a DMM (digital multimeter). The multimeter must have a peak hold feature. Clamp the probe around alternator output wire ("B+"). Before you clamp the probe around the wire, ensure that the probe is "zeroed".

3. Set the digital multimeter to "peak hold" or "max mode" on the "mV" scale.

4. Start the engine, and immediately set the throttle to at least 75%. The peak current will appear on the voltmeter in "peak hold" or "max" mode.

   Expected Result: This current reading should be at least 90% of the specified peak output.

   Results:

   - OK: The current is at least 90% of the specified peak output. See "Alternator Specifications" for exact numbers. Go to "T2 Electrical System Current - Test".

   - NOT OK: The current is less than 90% of the specified peak output. Go to "T4 Alternator Drive System - Check".

T2a - Test For Generator Set Equipped With A Main Disconnect Switch

1. Turn off all of the accessories. Also, disconnect the battery supply voltage to the EMCP II+.

2. Clamp a 9U-5795 Current Probe or 8T-0900 Ammeter around the main ground cable. Clamp the tool with the positive side away from the battery. Reset the probe (zero) before you clamp the probe around the wire. Read the current.

   Expected Result: The current is below 2 amperes.

   Results:

   - YES: The current is below 2 amperes. Continue to Step 3.

   - NO: The current is above 2 amperes. There is a current draw in the system. Go to "T5 Alternator Current - Test".

3. Turn the disconnect switch to the ON position. Connect an ammeter across the disconnect switch terminals. Connect the red lead to the terminal on the frame side. Connect the black lead to the terminal on the battery side. If a multimeter is being utilized for this test, use the 10A connections in order to avoid damage.

4. Turn off the disconnect switch and read the current.

   Expected Result: The current is below 0.050 amperes (50 milliamperes).

Note: The standard acceptable current draw is 50 milliamperes. A current draw above 50 milliamperes usually indicates a problem. Contact a Caterpillar dealer for more information.

Results:

- YES: The current is below 0.050 amperes. The charging system is currently good. The fault is possibly an intermittent draw in the system. The batteries may be faulty. Check that NO accessories were ON during the test.

- NO: The current is above 0.050 amperes. There is a draw in the system. Go to "T5 Alternator Current - Test".

T2b - Test For Any Generator Set

1. Turn off all accessories. Also, disconnect the battery supply voltage to the EMCP II+.

2. Clamp a 9U-5795 Current Probe or 8T-0900 Ammeter around the main ground cable. Clamp the tool with the positive side away from the battery. Reset the probe (zero) before you clamp around the wire. Read the current.

   Expected Result: The current is below 2 amperes.

   Results:

   - YES: The current is below 2 amperes. Continue to Step 3.

   - NO: The current is above 2 amperes. There is a current draw in the system. Go to "T5 Alternator Current - Test".

3. Remove the ground cable from the battery terminal. For systems with 4 batteries, disconnect the ground cables from both negative batteries.

4. Connect an ammeter between the disconnected battery ground cable and one of the negative battery terminals. Connect the red positive lead of the ammeter to the cable. The negative lead should be connected to the battery terminal. If a multimeter is being utilized for this test, use the 10 ampere connections in order to avoid damage.

Expected Result: The current is below 0.050 amperes (50 milliamperes).

Note: The standard acceptable current draw is 50 milliamperes. A current draw above 50 milliamperes usually indicates a problem.

Results:

- YES: The current is below 0.050 amperes. The charging system is currently good. The fault is possibly an intermittent draw in the system. The batteries may be faulty. Check that NO accessories were ON during the test.
- NO: The current is above 0.050 amperes. There is a draw in the system. Go to "T5 Alternator Current - Test".

Note: The following alternators have a connector for a regulator: 6T-1196 and 9G-6081. Disconnect the regulator connector from the alternator. Recheck the current that was found in the previous Step. If the current is below 0.050 amperes (50 milliamperes) the regulator is faulty.

T3 Charging System - Test

1. Verify that the alternator B+ terminal nut is tight and verify that the wire has a good connection to the "B+" terminal.

2. Start the engine and set the throttle to at least 75 percent. Allow the engine to run for at least 3 minutes before continuing to Step 3. The following table will assist in making calculations during this test.

Table 25

Test Step	Voltage Reading	Voltage should be below this for 24 volt system
3		
4		
3 minus 4 =		2.0 volts
5		
6		
5 minus 6 =		1.0 volt
7		1.0 volt

3. Measure the voltage between the alternator B+ terminal and the alternator case ground.

4. Measure the voltage across the battery. Put the red lead on the + battery terminal, and put the black lead on the negative battery terminal. Step 4 should be completed as quickly as possible after Step 3.

   Expected Result: On 24 volt systems, the voltage is within 2 volts.

   Results:

   - YES: If the voltage in Step 3 is not more than 2 volts higher than the voltage in Step 4, the test is complete and the related wiring is correct at this time. Replace the alternator or disassemble the alternator and repair.
   - NO: If the voltage in Step 3 is more than 2 volts higher than the voltage in Step 4, there is high circuit resistance: corrosion, loose connections, and damaged wiring. Continue to Step 5.

5. Check the voltage between the frame and the alternator B+ terminal. Record the voltage.

6. Check the voltage between the frame and the + battery post. Step 6 should be completed as quickly as possible after Step 5.

   Expected Result: The voltage difference between Step 5 and Step 6 does not exceed 1 volt on 24 volt systems.

   Results:

   - YES: The voltage difference does not exceed the tolerance. The charging circuit is good. Go to Step 7.
   - NO: The voltage difference exceeds the tolerance. There is high resistance in the charging circuit: loose cables, corroded cables, damaged cables, and faulty circuit breaker. Correct the problem and retest the system.

7. Check the voltage between the negative battery post and the alternator case ground.

   Expected Result: The voltage does not exceed 1 volt on 24 volt systems.

   Results:

   - YES: The voltage difference does not exceed the tolerance. The ground circuit is good. There is an internal problem with the alternator. Go to "T6 Residual Magnetism Restoration".

- NO: The voltage difference exceeds the tolerance. There is high resistance in the ground circuit: loose cables, corroded cables, loose alternator mounting, and poor engine ground. Correct the problem and retest the system.

T4 Alternator Drive System - Check

1. Check the condition of the alternator drive belt. If the drive belt is oily, clean the pulleys. Replace the drive belt, and retest the system. If the drive belt is wet, dry the belt and retest the system. If the drive belt is worn, replace the belt and retest the system.

2. Check the tension of the alternator drive belt. If the tension is off, adjust the tension.

3. Check the nut on the alternator pulley. If the nut is loose, tighten the nut and retest the system.

4. If all of the previous steps find no problems go to “T3 Charging System - Test”.

T5 Alternator Current - Test

1. Disconnect all the loads from the battery. Disconnect the battery supply voltage to the EMCP II+.

2. Connect the 9U-5795 Current Probe or 8T-0900 Ammeter to a DMM (digital multimeter). Clamp the probe around the alternator output wire (“B+”). Before you clamp the probe around the wire, ensure that the probe is “zeroed” .

3. Read the current.

   Expected Result: The current is under 2 amperes.

   Results:

   - YES: The current is under 2 amperes. Continue to Step 4.

   - NO: The current is over 2 amperes. There is an internal problem with the alternator. Go to “T6 Residual Magnetism Restoration”.

4. Disconnect the “B+” wire from the alternator. Connect the red lead of the multimeter to the wire that was just disconnected. Connect the black lead of the multimeter to the alternator B+ terminal. Set the multimeter on the 10 amp scale. Read the current.

   Expected Result: The current is under 0.015 amperes.

   Results:

   - YES: The current is under 0.015 amperes. The alternator is operating correctly. There is a current draw on the generator set. Go to “T7 Identifying Source Of Current Draw - Test”.

   - NO: The current is over 0.015 amperes. There is an internal problem with the alternator. Go to “T6 Residual Magnetism Restoration”.

T6 Residual Magnetism Restoration

This test is only for self-excited alternators. See Service Magazine, SEBD1672, July 1986, “Brushless Alternators May Not Charge In Certain Conditions” for additional information.

1. Start the engine and set the throttle to at least 75%.

2. Connect a voltmeter between the “B+” terminal and the alternator case ground.

3. If a wire is connected, disconnect the wire from the “R” terminal.

   Expected Result: The voltage does not change.

   Results:

   - YES: The voltage does not change. Continue to Step 4.

   - NO: The voltage rises and the alternator begins charging. The wire to the “R” terminal is shorted. Repair the wiring or replace the wiring. Go to “Initial Troubleshooting Procedure” and retest the system.

4. Connect one end of a jumper wire to the “B+” terminal of the alternator.

5. Connect the other end of the jumper wire to the “R” terminal of the alternator for two seconds.

   Expected Result: The voltage output rises on the “B+” terminal.

   Results:

   - OK: The voltage output rises. The alternator is now charging. Go to “Initial Troubleshooting Procedure” and retest the system.

   - NOT OK: The voltage output does not rise. Repair the alternator or replace the alternator.

6. Remove the wire that is connected to the “I” terminal. Check for a rise in voltage on the “B+” terminal.

Expected Result: The voltage rises.

Results:

- YES: The voltage rises. There is a short in the wiring to the terminal. Repair the wiring or replace the wiring. Go to “Initial Troubleshooting Procedure” and retest the system.
- NO: The voltage output does not rise. Repair the alternator or replace the alternator.

T7 Identifying Source Of Current Draw - Test

1. Disconnect all the loads from the battery. Disconnect the system battery voltage from the EMCP II+.

2. Clamp a 9U-5795 Current Probe or 8T-0900 Ammeter around the main ground cable. Clamp the tool with the positive side away from the battery. Reset the probe (zero) before you clamp the probe around the wire. Use the current probe if the draw is above approximately 2 amperes. Use the Ammeter if the draw is below approximately 2 amperes.

3. Monitor the current. Remove the following fuses one at a time: “F1”, “F4”, “F7”, and “F8”. Check the current after each fuse is removed. After you remove a fuse, observe the current. Reinstall the fuse. Start with the main fuses first, and proceed to smaller circuits.

4. If a removal of a fuse causes the current to drop, then the problem is in that circuit.

a. Check if any components on the circuit are ON.

b. If everything is OFF, disconnect electrical components on that circuit one at a time and monitor current.

c. After all of the components in that circuit have been disconnected, check the current. If the problem still exists, then check the wiring for corrosion or shorts to ground.

Note: The standard acceptable current draw is 50 milliamperes. A current draw above 50 milliamperes usually indicates a problem.

T8a - Alternator Overcharging - Test

This test is for alternators with one of the following types of terminals:“IG”, “S”, and sensing terminal.

1. Clean the connection and tighten the connection to the wiring terminal on the alternator.

2. Verify that the alternator B+ terminal nut is tight and verify that the wire has a good connection to the “B+” terminal.

3. Start the engine and set the throttle to at least 75 percent. Turn ON all electrical accessories for all test steps below. Allow the engine to run for at least 3 minutes before continuing to Step 4. The following table will assist in making calculations during this test.

Table 26

Test Step	Voltage Reading	Voltage should be below this for 24 volt system
4		
5		
4 minus 5 =		2.0 volts
6		
7		
6 minus 7 =		1.0 volt

4. Measure the voltage between the alternator B+ terminal and the alternator case ground.

5. Measure the voltage across the battery. Put the red lead on the positive battery terminal, and put the black lead on the negative battery terminal. Step 5 should be completed as quickly as possible after Step 4.

Expected Result: On 24 volt systems, the voltage is within 2 volts.

Results:

- YES: If the voltage in Step 4 is not more than 2 volts higher than the voltage in Step 5, this step is complete and the related wiring is correct at this time. Go to Step 8.
- NO: If the voltage in Step 4 is more than 2 volts higher than the voltage in Step 5, there is high circuit resistance: corrosion, loose connections, and damaged wiring. Go to Step 6.

6. Check the voltage between the frame and the alternator B+ terminal. Record the voltage.

7. Check the voltage between the frame and the + battery post. Step 7 should be completed as quickly as possible after Step 6.

Expected Result: The voltage difference between Step 6 and Step 7 does not exceed 1 volt on 24 volt systems.

Results:

- YES: The voltage difference does not exceed the tolerance. The charging circuit is good. Go to Step 8.
- NO: The voltage difference exceeds the tolerance. There is high resistance in the charging circuit: loose cables, corroded cables, damaged cables, faulty circuit breaker, and faulty main relay. Correct the problem. Go to "Initial Troubleshooting Procedure" and retest the system.

8. Start the engine and set the throttle to at least 75 percent.

9. Measure the voltage between the sense terminal and the case of the alternator.

Expected Result: The voltage at the sense terminal is above the specification.

Results:

- YES: The voltage is over the specification. The alternator is faulty or the regulator is faulty. Replace the alternator or repair the alternator.
- NO: The voltage is below the voltage of the initial test. The sense circuit in the generator set has high resistance. Correct the problem and retest the system . Go to "Initial Troubleshooting Procedure" at the beginning of this test.

T8b - Alternator Overcharging - Test (Continued)

This test is for alternators without an "IG", "S", or other sense terminal.

1. Clean the connection to the wiring terminal on the alternator and tighten the connection to the wiring terminal on the alternator.

2. Verify that the alternator B+ terminal nut is tight and verify that the wire has a good connection to the "B+" terminal.

3. Run the engine at 75 percent. Allow the engine to run for at least 3 minutes before continuing to Step 4. The following table shows the measurements to be taken during this test.

Table 27

Test Step	Voltage Reading	Voltage should be below this for 24 volt system
4		
5		
4 minus 5 =		2.0 volts
6		
7		
6 minus 7 =		1.0 volt

4. Measure the voltage between the alternator "B+" terminal and the alternator case ground.

5. Measure the voltage across the battery. Put the red lead on the + battery terminal, and put the black lead on the negative battery terminal. Step 5 should be completed as quickly as possible after Step 4.

Expected Result: On 24 volt systems, the voltage is within 2 volts.

Results:

- YES: If the voltage in Step 4 is not more than 2 volts higher than the voltage in Step 5, this step is complete and the related wiring is correct at this time. Go to Step 8.
- NO: If the voltage in Step 4 is more than 2 volts higher than the voltage in Step 5, there is high circuit resistance: corrosion, loose connections, and damaged wiring. Go to Step 6.

6. Check the voltage between the frame and the alternator B+ terminal. Record the voltage.

7. Check the voltage between the frame and the + battery post. Step 7 should be completed as quickly as possible after Step 6.

Expected Result: The voltage difference between Step 6 and Step 7 does not exceed 1 volt on 24 volt systems.

Results:

- YES: The voltage difference does not exceed the tolerance. The charging circuit is good. The regulator is faulty or the alternator is faulty. Replace the faulty component, and retest the system.

- NO: The voltage difference exceeds the tolerance. There is high resistance in the charging circuit: loose cables, corroded cables, damaged cables, faulty circuit breaker, and faulty main relay. Correct the problem. Go to “Initial Troubleshooting Procedure” and retest the system.

Alternator Specifications

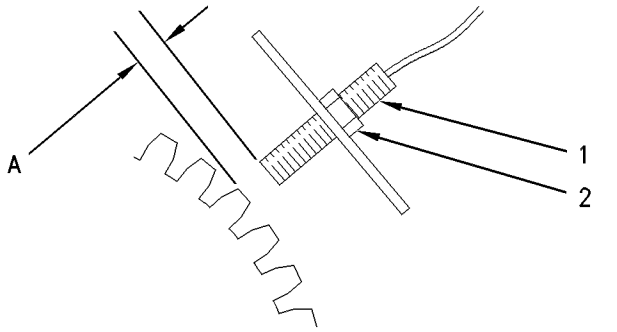
Table 28

Alternator Specifications		
	Peak Current Rating (Amps)	**Minimum Peak Current (Amps)**
24 Volt Alternators		
2P-1204, 3Y-8200	19	17
2Y-8310	21	19
6T-1395, 7T-2095, OR-3653	33	30
6N-9294, OR-5217, OR-3482	35	32
5N-5692, OR-2698	45	41
5S-9088, 100-5047, 112-5041, OR-5206, OR-3667, OR-3668	50	45
109-2362, 9W-3043, OR-3652(D+), 112-8032	55	50
3E-7772(IG), OR-9437(IG), 105-3132(IG), 4N-3986, OR-5203	60	54
155-7434, 132-2156(I), 107-7977(I), OR-8279(I)	70	63
107-7976, 114-2401, OR-8997, 3E-7577, OR-3615	75	68
9X-7803, OR-3749, 122-6657100	100	90
Parts-Service Only Discontinued 24 Volt Alternators		
9G-6081, 6T-1196	40	36
D+ - Diode trio output. Alternator requires external excitation.		
REG - Regulator Terminal. Alternator requires external excitation.		
I - Ignition Terminal. Alternator can be externally excited through this terminal.		
IG - Ignition Terminal. System voltage must be supplied to this terminal to turn on the alternator. Some of these alternators use the IG terminal as a sense terminal.		

i01181401

Starting Motor Magnetic Switch - Test

SMCS Code: 1426-081; 4490-081



g00289497

Illustration 111

Speed Sensor

(1) Speed sensor
(2) Locknut
(A) Air gap

This adjustment procedure is for the engine speed sensor.

1. Remove the speed sensor (1) from the flywheel housing. Remove all debris from the tip of the speed sensor. Align a ring gear tooth directly in the center of the threaded sensor opening.

2. By hand, screw the speed sensor (1) into the hole until the end of the sensor contacts the gear tooth.

3. Turn the sensor (1) in the counterclockwise direction through 270 degrees (three-fourths turn).

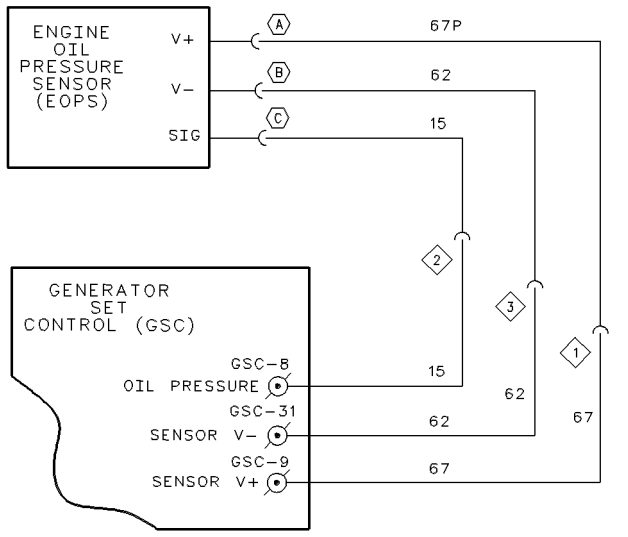
4. Tighten locknut (2) to 25 ± 5 N·m (18 ± 4 lb ft).

Note: Do not allow speed sensor (1) to turn as locknut (2) is tightened.

i01181405

Pulse Width Modulated (PWM) Sensor - Test

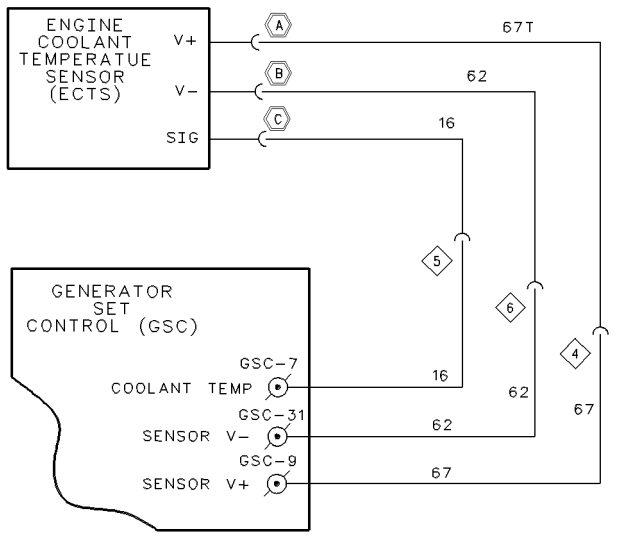
SMCS Code: 1408-081; 4490-081



g00537438

Illustration 112

System Schematic For Engine Oil Pressure Sensor (EOPS)



g00527377

Illustration 113

System Schematic For Engine Coolant Temperature Sensor (ECTS)

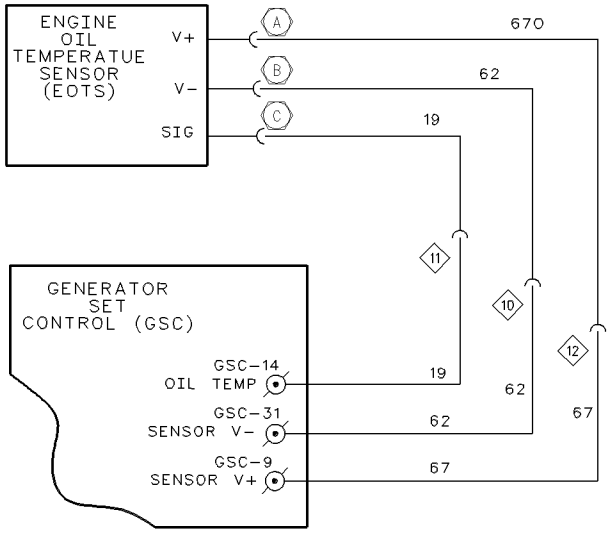


Illustration 114 g00529671

System Schematic For Engine Oil Temperature Sensor (EOTS)

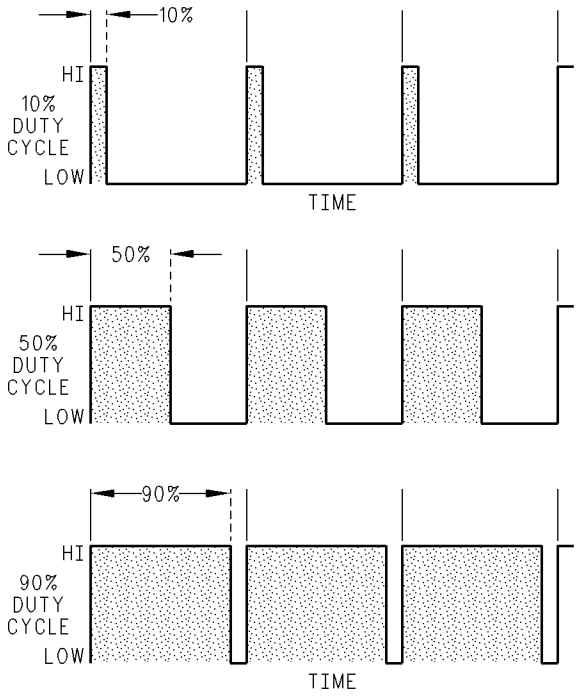


Illustration 115 g00288430

Pulse Width Modulated Signal

This test is provided in addition to the CID 100, CID 110 and CID 175 troubleshooting procedures. See Testing And Adjusting, “Troubleshooting Diagnostic Codes”. The pulse width modulated sensors are listed below.

- oil pressure sensor
- coolant temperature sensor
- oil temperature sensor

These PWM sensors produce a digital signal. In a digital signal, the duty cycle varies as the condition changes. The frequency remains constant.

Table 29

Sensor Specifications		
Engine Oil Pressure Sensor (EOPS)[1]		
Pressure kPa (psi)	**Signal Voltage[2] DCV**	**Signal Duty Cycle[2] %**
0 to 69 (0 to 10)	0.92 to 1.44	12.8 to 20.8
69 to 138 (10 to 20)	1.44 to 1.92	20.8 to 28.1
138 to 207 (20 to 30)	1.92 to 2.40	28.1 to 35.4
207 to 276 (30 to 40)	2.40 to 2.89	35.4 to 42.6
276 to 345 (40 to 50)	2.89 to 3.34	42.6 to 49.6
345 to 414 (50 to 60)	3.34 to 3.89	49.6 to 56.6
414 to 483 (60 to 70)	3.89 to 4.29	56.6 to 64.0
483 to 552 (70 to 80)	4.29 to 4.74	64.0 to 70.5
552 to 621 (80 to 90)	4.74 to 5.25	70.5 to 78.1
621 to 690 (90 to 100)	5.25 to 5.74	78.1 to 85.0

(1) The base frequency is 350 to 650 Hz.
(2) The voltages and currents are guidelines for troubleshooting and are not considered exact. Tolerance is ±10%.

Table 30

Sensor Specifications		
Engine Coolant Temperature Sensor (ECTS)[1] And Engine Oil Temperature Sensor (EOTS)[1]		
Temperature °C (°F)	**Signal Voltage[2] DCV**	**Signal Duty Cycle[2] %**
–40 to –29 (–40 to –20)	1.18 to 1.23	10.0 to 10.6
–29 to –18 (–20 to 0)	1.23 to 1.30	10.6 to 11.6
–18 to –7 (0 to 20)	1.30 to 142	11.6 to 13.3
–7 to 4 (20 to 40)	1.42 to 1.63	13.3 to 16.2
4 to 16 (40 to 60)	1.63 to 1.97	16.2 to 21.1
16 to 27 (60 to 80)	1.97 to 2.43	21.1 to 27.5
27 to 38 (80 to 100)	2.43 to 3.00	27.5 to 35.6
38 to 49 (100 to 120)	3.00 to 3.67	35.6 to 45.0
49 to 60 (120 to 140)	3.67 to 4.35	45.0 to 54.7
60 to 71 (140 to 160)	4.35 to 5.00	54.7 to 63.9
71 to 82 (160 to 180)	5.00 to 5.58	63.9 to 72.0
82 to 93 (180 to 200)	5.58 to 6.05	72.0 to 78.6
93 to 104 (200 to 220)	6.05 to 6.42	78.6 to 83.8
104 to 116 (220 to 240)	6.42 to 6.72	83.8 to 88.1
116 to 125 (240 to 257)	6.72 to 6.90	88.1 to 90.6
125 to 135 (257 to 275)	6.90 to 7.05	90.6 to 92.7

(1) The Base frequency is 370 to 550 Hz.
(2) The voltages and currents are guidelines for troubleshooting and are not considered exact. Tolerance is ±10%.

The engine coolant temperature sensor and the engine oil temperature sensor are the same Caterpillar part. The only difference is the application of the part. Both of the sensor's specs are identical.

Test Procedure

Table 31

Tools Needed		
9U-7330	Multimeter Multimeter is optional for frequency and duty cycle measurements.	1
7X-170	Multimeter Probe Group	1
146-4080	Digital Multimeter (RS-232)	1

This procedure requires the measurement of the frequency and duty cycle of the sensor signal. Use the 9U-7330 Digital Multimeter in order to measure the frequency and the duty cycle. In order to measure frequency, turn the rotary switch to AC volts. Then, press the “HZ” button once. In order to measure the duty cycle, turn the rotary switch to AC volts and press the “HZ” button twice.

Note: The 6V-7070 Digital Multimeter does not measure the frequency or the duty cycle. The DC voltages are listed in Table 30 as an alternative to measuring the frequency and the duty cycle. The 6V-7070 Digital Multimeter can be used for measurements of the DC voltage.

1. Perform Initial Preparations.

a. Locate the suspect sensor.

b. Identify the sensor wires and connector contacts. See the preceding System Schematics.

c. DO NOT DISCONNECT ANY HARNESS CONNECTORS AT THIS TIME.

d. Use the 7X-1710 Multimeter Probe in order to make future measurements by penetrating through the back of the harness connectors.

2. Check Sensor Supply Voltage.

a. Turn the engine control switch (ECS) to OFF/RESET. Then, turn the ECS to STOP.

b. Measure the sensor supply voltage at the sensor connector. Perform the measurement from contact “A” to contact “B” on the sensor connector.

Expected Result: The voltage should be from 7.5 to 8.5 DCV.

Results:

- OK: The voltage is from 7.5 to 8.5 DCV. Proceed to Step 4.
- NOT OK: The voltage is equal to battery positive. The sensor supply is shorted to battery positive in the engine harness. Troubleshoot and repair the engine harness. STOP.
- NOT OK: The voltage is not from 7.5 to 8.5 DCV and the voltage is not equal to battery positive. Proceed to Step 3.

3. Check The Status Of The Fault.

Observe the GSC+ display.

Expected Result: A CID 269 fault code is active.

Results:

- OK: A CID 269 fault code is active. Go to the procedure in Testing And Adjusting, “Troubleshooting Diagnostic Codes”. STOP.
- NOT OK: A CID 269 fault code is NOT active. The harness is faulty. Troubleshoot and repair the harness. STOP.

4. Check The Sensor Signal.

The ECS remains in the STOP position.

a. Measure the frequency and the duty cycle of the signal at the sensor connector. Conduct the measurements from contact “C” to contact “B” of the sensor connector.

b. Make a note of the measurements.

Expected Result: The frequency that is measured should agree with the values that are listed in the Sensor Specifications chart and the duty cycle should agree with the values that are listed in the Sensor Specifications chart.

Results:

- OK: The measurements agree. The sensor is functioning correctly. Proceed to Step 5.
- NOT OK: The measurements DO NOT agree. Proceed to Step 7.

5. Check The Signal At The GSC+ Harness Connector.

a. Measure the frequency and the duty cycle of the signal at the GSC+ harness connector.

- For the oil pressure signal, measure the resistance from contact 8 to contact 31.

- For the coolant temperature signal, measure the resistance from contact 7 to contact 31.
- For the oil temperature signal, measure the resistance from contact 14 to contact 31.

Expected Result: The measured frequency should agree with the values that were measured in Step 4. The duty cycle should agree with the values that were measured in Step 4.

Results:

- OK: The measurements agree. The sensor is functioning correctly. Proceed to Step 7.
- NOT OK: The measurements DO NOT agree. The harness is faulty. Troubleshoot and repair the engine harness. STOP.

6. Check The Status Of The Fault.

a. Check if sensor fault codes are still active.

Expected Result: Sensor fault codes are still active.

Results:

- OK: The GSC+ is faulty. Replace the GSC+. See Testing And Adjusting, “EMCP Electronic Control (Generator Set) - Replace”. STOP.
- NOT OK: If sensor fault codes are NOT active, check the connectors and wiring. See Testing And Adjusting, “Electrical Connector - Inspect”. STOP.

7. Check The Engine Harness.

a. Disconnect the engine harness from the sensor.

b. Disconnect the GSC+ from the harness.

c. Check the harness for an open circuit. A correct circuit will be approximately 5 ohms or less.

d. Check the signal wire for a short to battery positive, battery negative and sensor supply. A correct circuit will be greater than 5000 ohms.

Expected Result: For Step 7.c, the resistance should be 5 ohms or less. For Step 7.d, the resistance should be greater than 5000 ohms.

Results:

- OK: All resistance measurements are correct. Therefore, replace the sensor. STOP.
- NOT OK: One or more resistance measurements are NOT correct. Troubleshoot and repair the engine harness. STOP.

i01181559

EMCP Electronic Control (AC Transformer Box) - Replace

SMCS Code: 1409-510; 4490-510

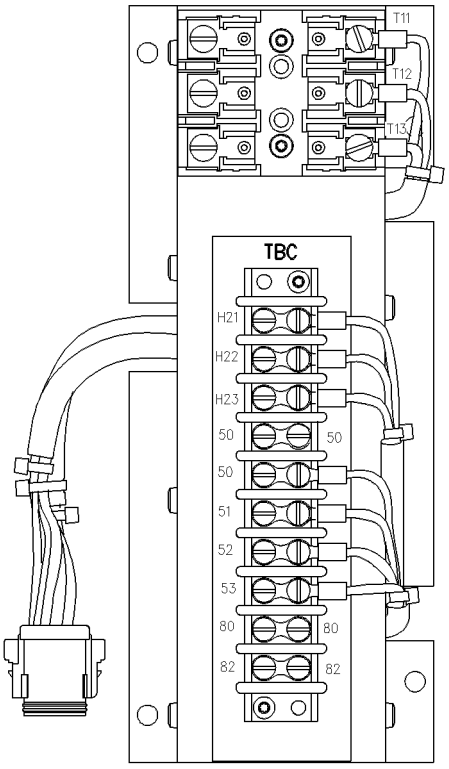


Illustration 116 g00436522

AC Transformer Box + (ATB+)

The ATB+ is located on the subpanel within the control panel.

Replacement Procedure

1. Shut down the engine. Remove the positive lead wire from the battery.

2. Make sure that all wires at the terminal strip of the ATB+ are marked with the respective termination point. During reassembly, these wires must be reattached to the correct terminal. Remove all external wires from the terminal strip.

3. Disconnect the ATB+ connector from the harness connector.

4. Remove all mounting nuts and mounting screws that fasten the ATB+ to the subpanel. Remove the ATB+.

5. Place the new ATB+ in the subpanel. Install the mounting nuts and mounting screws. Tighten the mounting nuts and mounting screws.

6. Reconnect the harness connector to the ATB+. Reconnect all the wires to the terminal strip that were removed. Reconnect the positive lead wire to the battery. If necessary, see the Generator Set Wiring Diagram in Testing And Adjusting, “Schematics and Wiring Diagrams”.

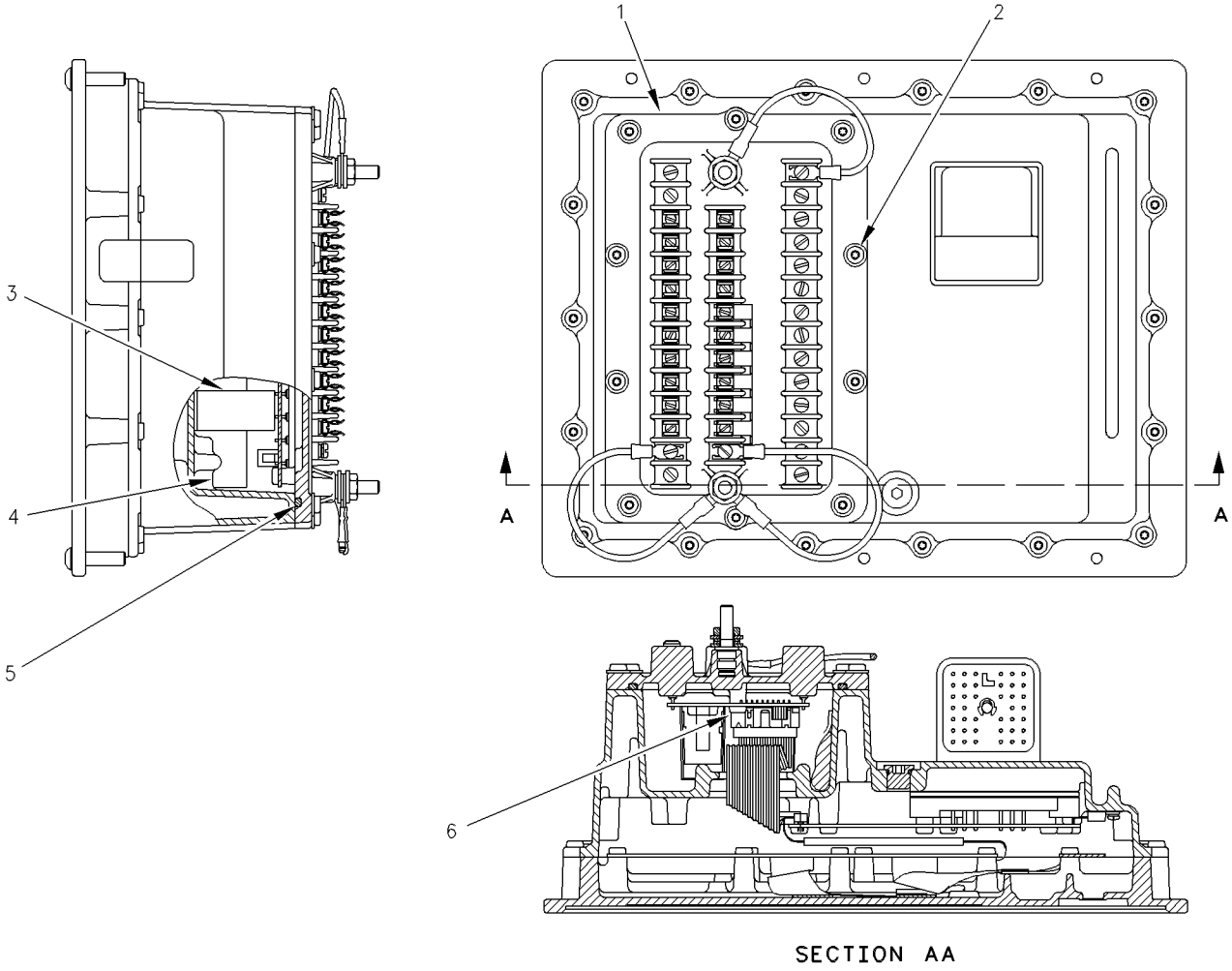
7. Program the bar code (calibration value) for the voltmeter/ammeter into the GSC+. See System Operation, “Voltmeter/Ammeter Programming OP8”.

8. If the generator set is operating in parallel with another generator set and the voltmeter values must match, then reprogram the AC offset. See System Operation, “AC Offset Adjustment OP10”.

i01181571

Relay Module - Replace

SMCS Code: 4490-510



g00583564

Illustration 117

Replacement Of The Relay Module

The Rear View of the GSC+

(1) Relay Module
(2) Screws
(3) Tape
(4) Desiccant Package
(5) O-Ring Seal
(6) Cable connector

Relay module (1) contains the relays, fuses and terminals that are used to operate the external devices of the EMCP II+. Relay module (1) is a component of the GSC+.

Reference: Special Instruction, SEHS9710, “Relay Module Replacement”.

Replacement Procedure

1. Remove the positive lead wire from the battery.

2. Be sure that all wires at the terminal stripsm(1) are marked with the correct termination point. During reassembly, these wires must be reattached to the correct terminal. Remove all wires from the terminals and posts of relay module (1).

3. Remove ten screws (2) that fasten relay module (1) to the GSC+.

4. Be aware that O-ring seal (5) exists. Partially separate relay module (1) from the GSC+. Carefully disconnect cable clamp and cable connector (6) from relay module (1).

Check that the small jumper block matches the replacement's relay module. The relay's small jumper block is located near the ribbon cable. See Testing And Adjusting, "AC Voltage Range - Adjust".

5. Replace the desiccant package (4). The replacement is provided with the new relay module. Attach the new package in the same location as the former package.

Note: The desiccant package should not be removed from the container until you are ready to install the desiccant package. The amount of time that is required to remove the relay module is 20 minutes. Longer periods of time will cause the desiccant package to become saturated with moisture. This is especially true in a humid environment.

6. Install new O-ring seal (5) in the groove of relay module (1). Make sure that O-ring seal (5) is seated properly. Align and reconnect cable connector (6) to the relay module (1). Install the cable clamp.

7. Place relay module (1) on the GSC+. Check that O-ring (5) remains seated. Align the screw holes of relay module (1) and the GSC+. Install the ten screws. Tighten the ten screws (2) to 1.70 ± 0.25 N·m (15 ± 2 lb in).

8. Reconnect all the wires to the terminals of the relay module that were removed. Reconnect the positive lead wire to the battery. If necessary, see the Generator Set Wiring Diagram in Testing And Adjusting, "Schematics And Wiring Diagrams".

i01181600

EMCP Electronic Control (Generator Set) - Replace

SMCS Code: 4490-510

Replacement Procedure

1. The new GSC+ must be reprogrammed after the new GSC+ is installed. If the GSC+ that is being replaced is functional, then make a note of the following items: hourmeter value, all engine setpoints, and any spare inputs/outputs that are programmed. See System Operation, "Engine/Generator Setpoint Viewing OP2-0" and System Operation, "Protective Relaying Setpoint Viewing OP2-1".

2. Shut down the engine. Remove the positive lead wire from the battery.

3. Remove the harness connector from the GSC+. A 4 mm hex wrench is required to turn the fastening screw.

4. Make sure that all wires at the terminal strips are marked with the respective termination point. During installation, the wires must be reattached to the correct terminal. Remove all wires from the terminals and from the posts of the relay module.

5. Remove the six nuts that fasten the GSC+ to the front panel. Remove the GSC+.

6. Place the new GSC+ in the front panel. Install the six nuts. Tighten the nuts.

7. Reconnect the harness connector to the GSC+. Reconnect all the wires to the terminals of the relay module that were removed. Reconnect the positive lead wire to the battery. If necessary, see the Generator Set Wiring Diagram Testing And Adjusting, "Schematics And Wiring Diagrams".

8. Reprogram the following items: the setpoints, the spare inputs/outputs, the hourmeter, the voltmeter, ammeter, and the AC offset adjustment. See System Operation, "Service Mode". Use the values from the original GSC+. Refer to Step 1.

i01181922

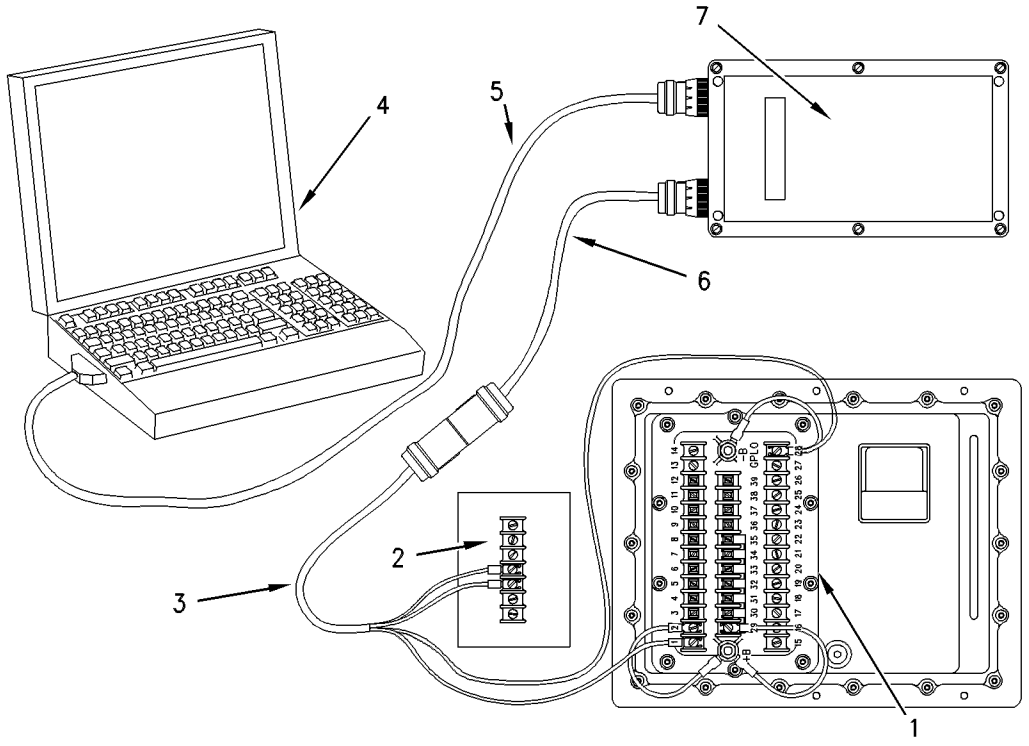
EMCP Electronic Control (Generator Set) - Flash Program

SMCS Code: 4490-591

Table 32

Tools Needed	
Part Number	**Description**
7X-1700	Communication Adapter (Includes the 7X-1701 Communication Adapter and the 7X-1425 Data Link Cable)
139-4166	Data Link Cable
152-7143	GSC+ Data Cable (Connects the Service Tool cable to the EMCP II+ terminal strip by using the spade terminals)
REHS0494	Special Instruction, REHS0494, “Accessing Flash Software For Machines.”
	An IBM compatible PC that is capable of running Caterpillar Electronic Technician (ET) software version 2.0 or later

Connection Procedure



g00615494

Illustration 118

Connection Diagram

(1) Relay module on the GSC+ control.

(2) AUX terminal strip.

(3) 152-7143 GSC+ Data Cable.

(4) Personal Computer.

(5) 7X-1425 Data Link Cable.

(6) 139-4166 Data Link Cable.

(7) 7X-1701 Communication Adapter.

Note: 24 VDC must be available from the panel.

1. Verify that the generator set is not running. Turn OFF the power to the EMCP II+ panel by disconnecting the negative terminal of the battery.

2. Connect the communication adapter to the PC by using the **7X-1425** Data Link Cable. The metal Deutsch connector should be connected to the “SERVICE TOOL” port on the communication adapter.

3. Connect the **139-4166** Data Link Cable to the “CONTROL” port on the communication adapter.

4. Connect **152-7143** GSC+ Data Cable to the opposite end of the **139-4166** Data Link Cable.

5. Connect the “Data+” and “Data-” spade terminals of the cable to the appropriate terminals in the AUX terminal strip. The AUX terminal strip is located inside the EMCP II+ panel. Connect the “Power+” spade terminal to “RM1” of the relay module on the GSC+. Connect the “Power-” spade terminal to “RM28” of the relay module on the GSC+.

Note: For a switchgear conversion that contains the GSC+ control, the connection point for the “Data+” wire is GSC-19 on the 40 pin connector of the GSC+. The connection point for the “Data-” wire is at GSC-20 on the 40 pin connector of the GSC+. The spade terminals that are on the harness for these wires need to be replaced with two **8T-8730** Connector Sockets. After the terminals have been replaced, the modified portion of the harness can be removed from the 40 pin connector by using the **121-9588** Wire Removal Tool.

6. Set the engine control switch (ECS) to OFF/RESET. Connect the battery to the electrical system again. Then, turn the ECS to the COOL/STOP position.

7. Verify that the GSC+ and the communication adapter are receiving power.

Note: Power loss to the GSC+ is unacceptable once the process for the update of the software begins. The loss of power may render the GSC+ unusable.

8. Turn on the PC. The operating system on the computer must finish loading.

Flash Update Procedure

1. Obtain a flash file on a floppy disk or a CD-ROM. See Special Instruction, REHS0494, "Accessing Flash Software For Machines".

2. Find the ET directory by using the "File Manager". Open ET.

3. Start "WinFlash" by double clicking on the "WinFlash" icon with the pointer of the mouse. "WinFlash" is part of the ET software package.

4. After the start-up is complete, ET will automatically try to connect to the GSC+ through the communication adapter.

5. The "WinFlash" program will display the serial numbers of any modules that are found on the data link.

6. Select the serial number of the unit that needs the software update. Click on "OK". The serial number of the GSC+ that is desired can be obtained by looking at the first value under OP2-2 in service mode. In order to obtain the value, press the "service mode" key on the GSC+ once. Then, press the "SCROLL UP" key once. The "SCROLL UP" key is also the "LAMP-TEST" key. All GSC+ units have a serial number suffix of "HA". This can be used for verification.

7. Insert the floppy disk or the CD-ROM that contains the flash file. Click on the "select file" button and open the contents of the appropriate drive. Select the appropriate ".fls" file. If the flash file is already on the hard drive, select the file from the appropriate drive.

8. If the generator set has an energize-to-run solenoid, proceed to **9**. If the generator set has an energize-to-shutoff solenoid, wait for at least 70 seconds before proceeding to **9**.

9. Click on the "Begin" button. The flash process should begin. A bar that shows the progress of the update will be displayed on the screen.

Note: Power loss to the GSC+ is unacceptable once the process for the update of the software begins. The loss of power may render the GSC+ unusable. Ensure that the power that is supplied to the control is available for the entire process. If the process is aborted, do not remove the power from the GSC+. The process will start reprogramming. Wait until the process is finished.

10. The display of the GSC+ will be blank and the "Fault Shutdown" indicator will be blinking while the software update is in progress.

11. Do not disturb the process until the process is finished. Once the process is finished, the GSC+ will automatically start working again. Exit the "WinFlash" software.

12. The GSC+ should now have the new software. In order to verify the version of the software, go to the display at OP2-2. Scroll up one time. Read the part number that is displayed. This update will not affect the setpoints or the calibration.

13. Turn the engine control switch (ECS) back to the "OFF/RESET" position and disconnect the negative terminal of the battery from the electrical system again. Disconnect the cables for the service tool and close the panel.

14. Reconnect the battery to the electrical system and return the generator set back to service.

i01181611

Typical Generator Abbreviations

SMCS Code: 4490

ALM – Alarm Module

ALS – Alarm Silence Push Button

ALT – DC Charging Alternator

ALR – Alarm Relay (General Alarm)

ALMR – Alarm Mute Relay

ASR – Air Shutoff Relay

AR – Arming Relay

ATB+ – AC Transformer Box +

BATT – Battery

BV – Battery Voltage

CAM – Custom Alarm Module

CAR – Custom Alarm Relay

CB – Circuit Breaker

CCM – Customer Communication Module

CIM – Customer Interface Module

CTR – Crank Termination Relay

ECS – Engine Control Switch

ECTS – Engine Coolant Temperature Sensor

EG – Electronic Governor (Speed Sensing)

EGR – Electronic Governor Relay

EOPS – Engine Oil Pressure Sensor

ESPB – Emergency Stop Push Button

FCR – Fuel Control Relay

FCS – Fuel Control Solenoid

G – AC Generator

GFR – Generator Fault Relay

GOV – Governor

HC – Heater Contactor

I/P – Input

KWR – Kilowatt Level Relay

MAN – Manual

MPU – Magnetic Speed Pickup

MV – Motorized Valve

NC – Normally Closed

NO – Normally Open

O/L – Overload Contactor

OPSU – Oil Pressure Sending Unit

PC – Pump Contactor

PR – Pump Relay

PS – Pinion Solenoid

RR – Run Relay

S1 – Engine Oil Pressure Sender

S2 – Engine Coolant Temperature Sender

SF1 – Spare Fault 1

SAS – Start Aid Switch

SASV – Start Aid Solenoid Valve

SATS – Start Aid Temperature Switch

SM – Starting Motor

SMMS – Starting Motor Magnetic Switch

SMR – Starting Motor Relay

ST – Shunt Trip

–VE – Battery Negative

+VE – Battery Positive

VM – AC Voltmeter

WTSU – Water Temperature Sending Unit

i01181614

Symbols

SMCS Code: 4490

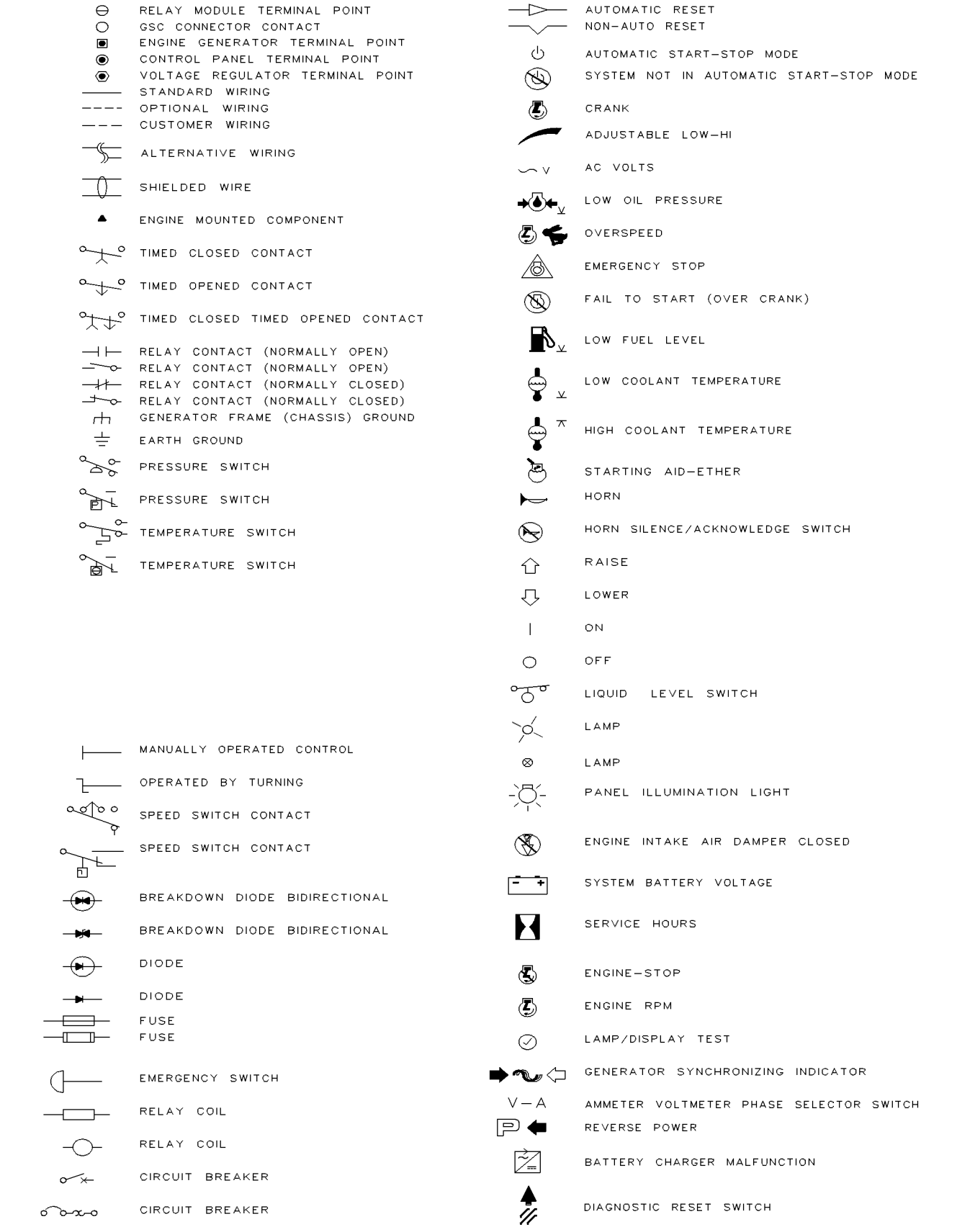


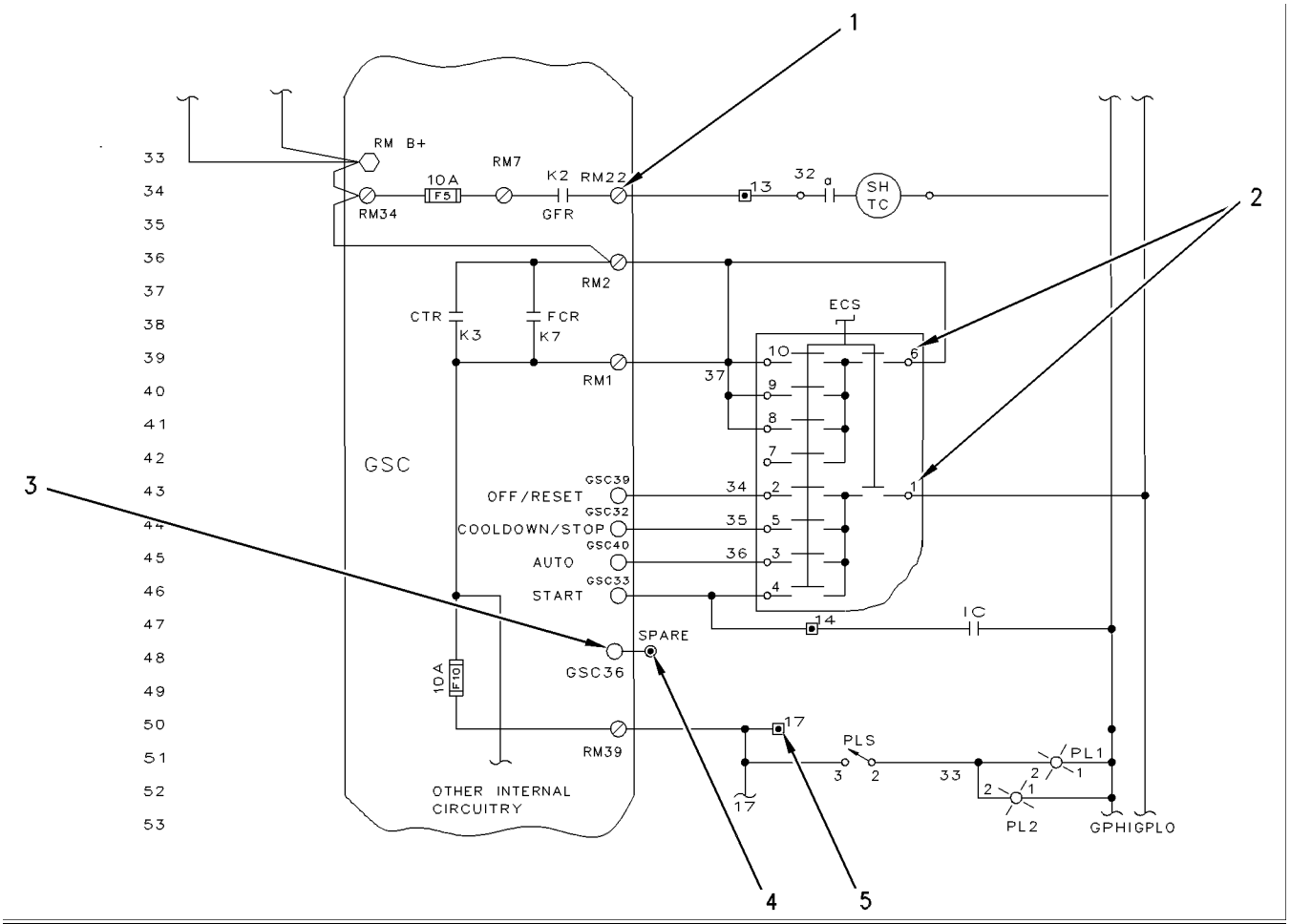
Illustration 119

g00489852

i01181616

Reading DC Schematics

SMCS Code: 4490; 7566



g00489928

Illustration 120

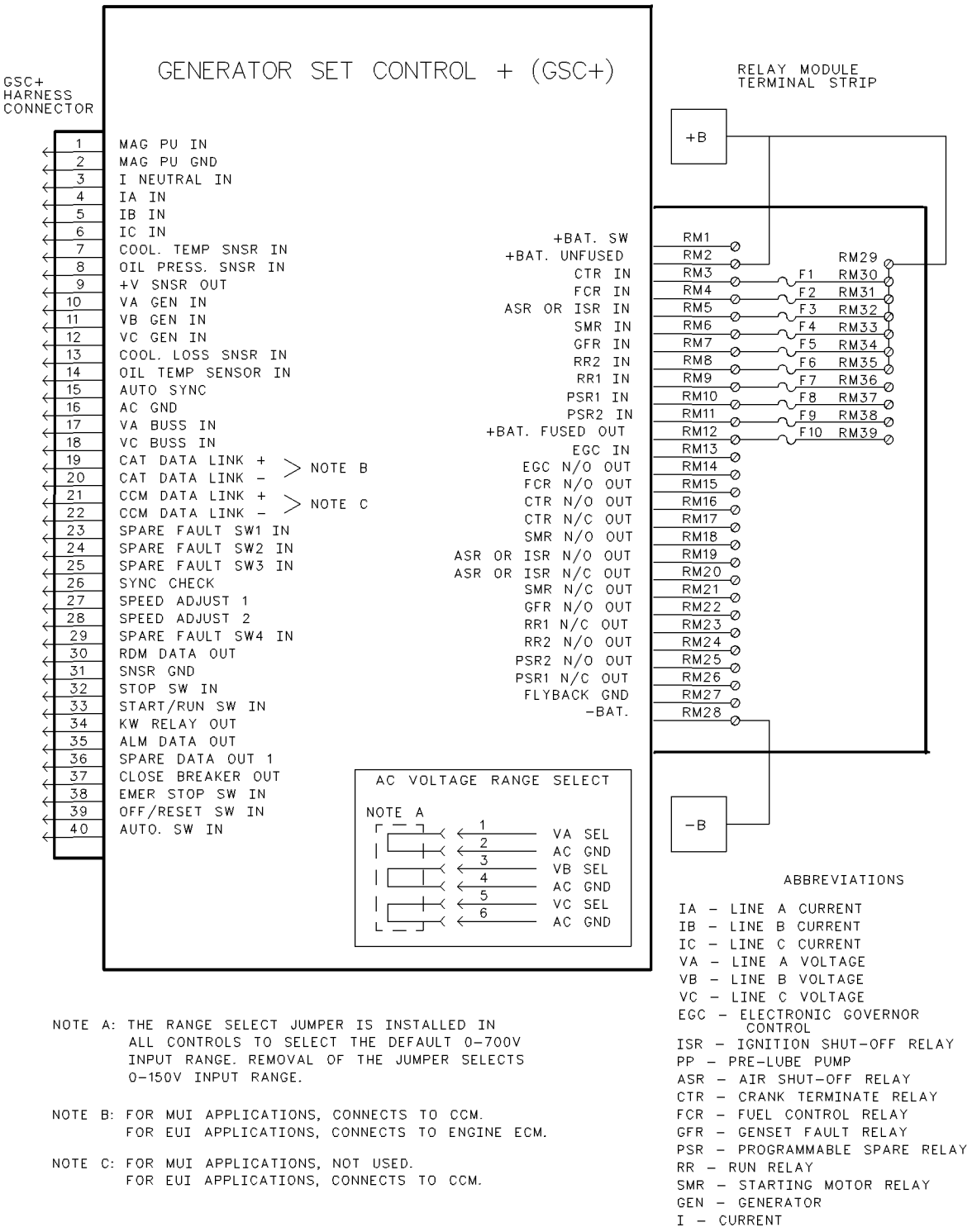
Typical DC Schematic

(1) Symbol for terminal on relay module.
(2) Pin identification on engine control switch.
(3) Symbol for contact of GSC connector.
(4) Symbol for terminal on terminal strip within control panel.
(5) Symbol for terminal on terminal strip within generator.

i01181486

Block Diagram of Generator Set Control

SMCS Code: 4490; 7566



NOTE A: THE RANGE SELECT JUMPER IS INSTALLED IN ALL CONTROLS TO SELECT THE DEFAULT 0−700V INPUT RANGE. REMOVAL OF THE JUMPER SELECTS 0−150V INPUT RANGE.

NOTE B: FOR MUI APPLICATIONS, CONNECTS TO CCM. FOR EUI APPLICATIONS, CONNECTS TO ENGINE ECM.

NOTE C: FOR MUI APPLICATIONS, NOT USED. FOR EUI APPLICATIONS, CONNECTS TO CCM.

ABBREVIATIONS

IA − LINE A CURRENT
IB − LINE B CURRENT
IC − LINE C CURRENT
VA − LINE A VOLTAGE
VB − LINE B VOLTAGE
VC − LINE C VOLTAGE
EGC − ELECTRONIC GOVERNOR CONTROL
ISR − IGNITION SHUT−OFF RELAY
PP − PRE−LUBE PUMP
ASR − AIR SHUT−OFF RELAY
CTR − CRANK TERMINATE RELAY
FCR − FUEL CONTROL RELAY
GFR − GENSET FAULT RELAY
PSR − PROGRAMMABLE SPARE RELAY
RR − RUN RELAY
SMR − STARTING MOTOR RELAY
GEN − GENERATOR
I − CURRENT

Illustration 121 g00508636

i01181915

Connector Contact Identification of Generator Set Control

SMCS Code: 4490; 7553

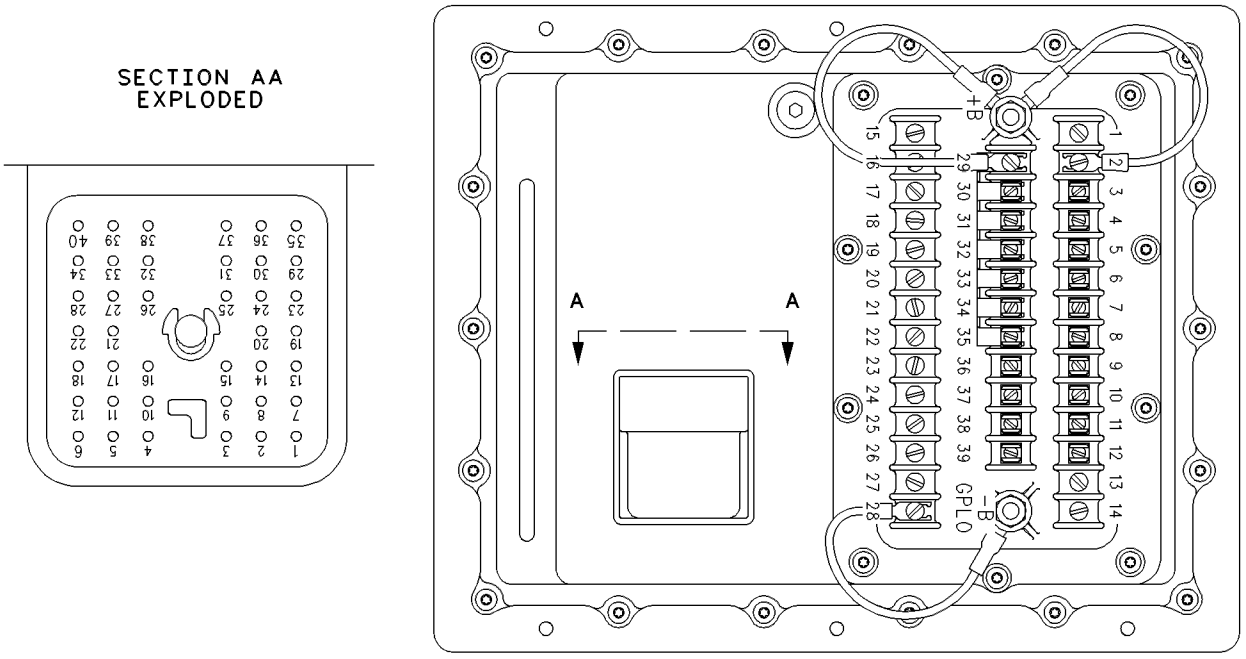


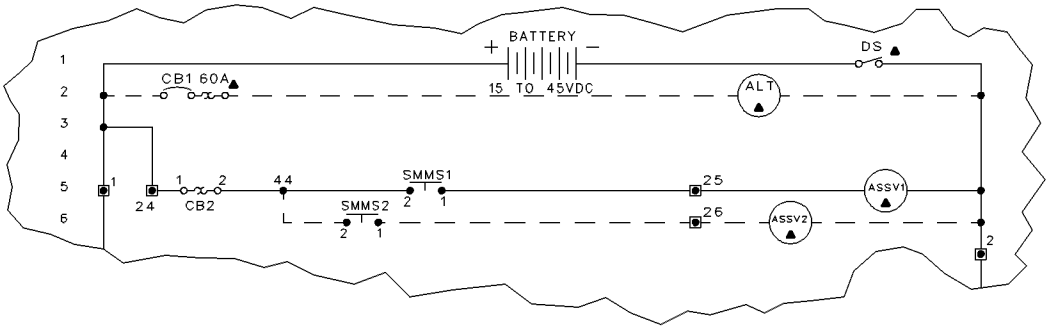
Illustration 122 g00438305

i01182002

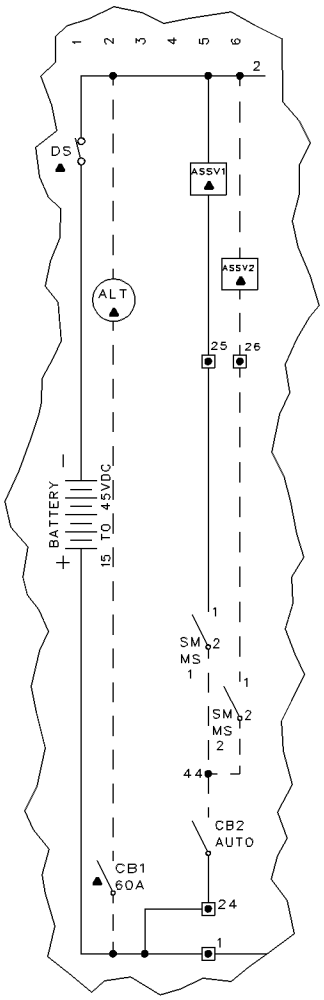
Schematics and Wiring Diagrams

SMCS Code: 4490; 7566

DC Schematic - Air Start



PARTIAL SCHEMATIC
(JIC SYMBOLS)



PARTIAL SCHEMATIC
(IEC SYMBOLS)

OPTIONAL AIR STARTING MOTOR(S)
SUPPLEMENTAL SCHEMATICS

Illustration 123

g00491218

DC Schematic - Prelube Pump

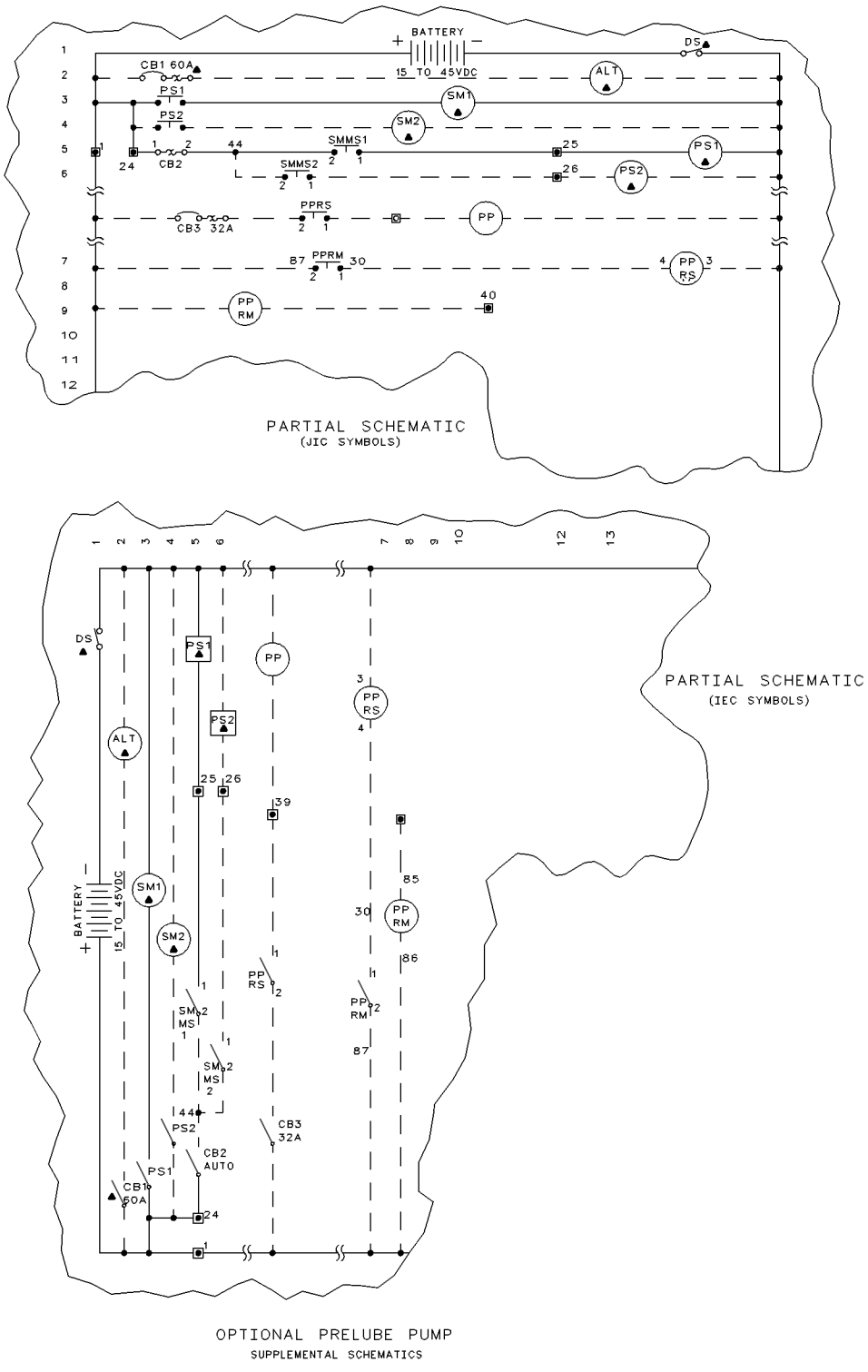


Illustration 124

g00490882

DC Schematic - IEC (1 of 2)

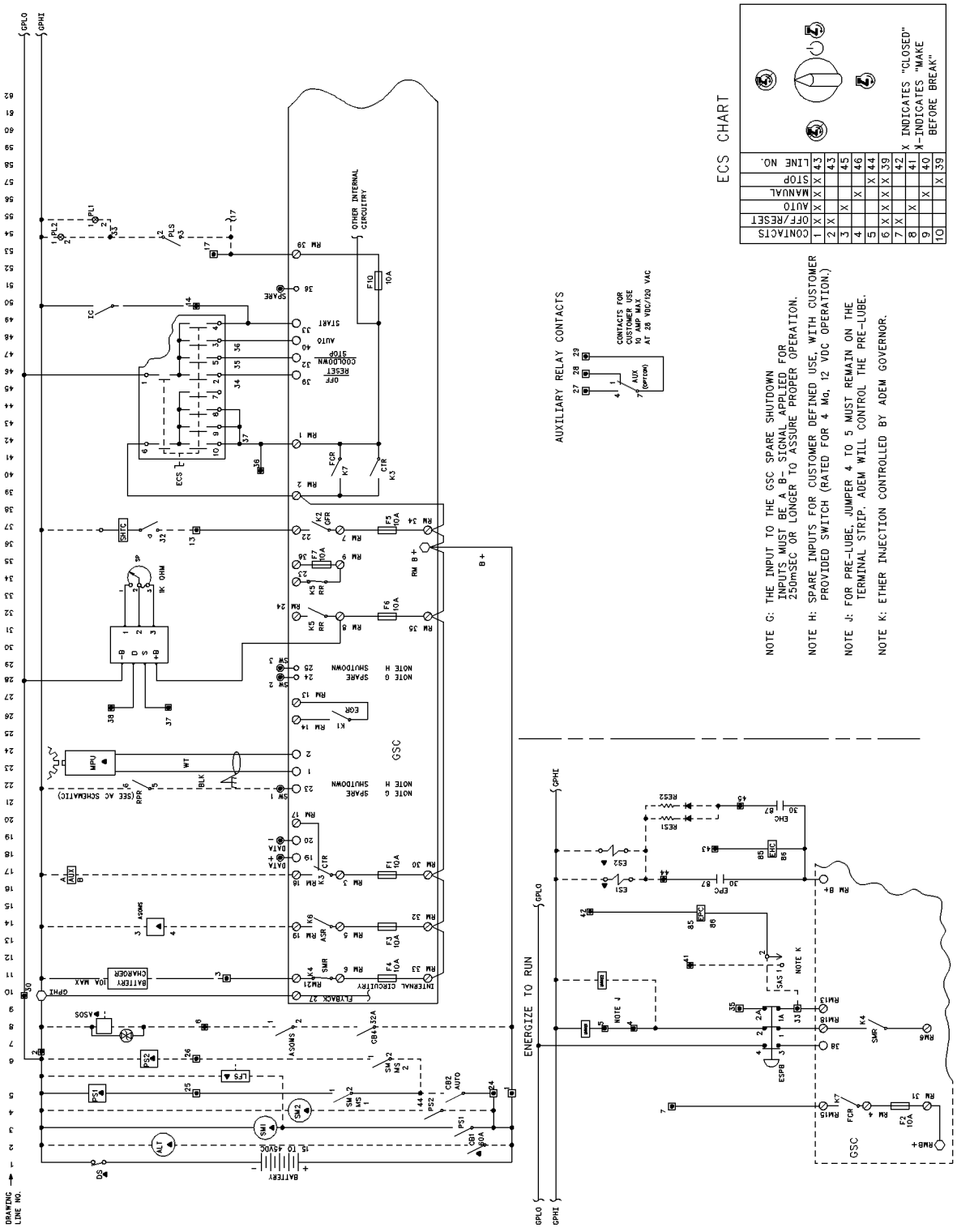


Illustration 125 g00490804

DC Schematic - IEC (2 of 2)

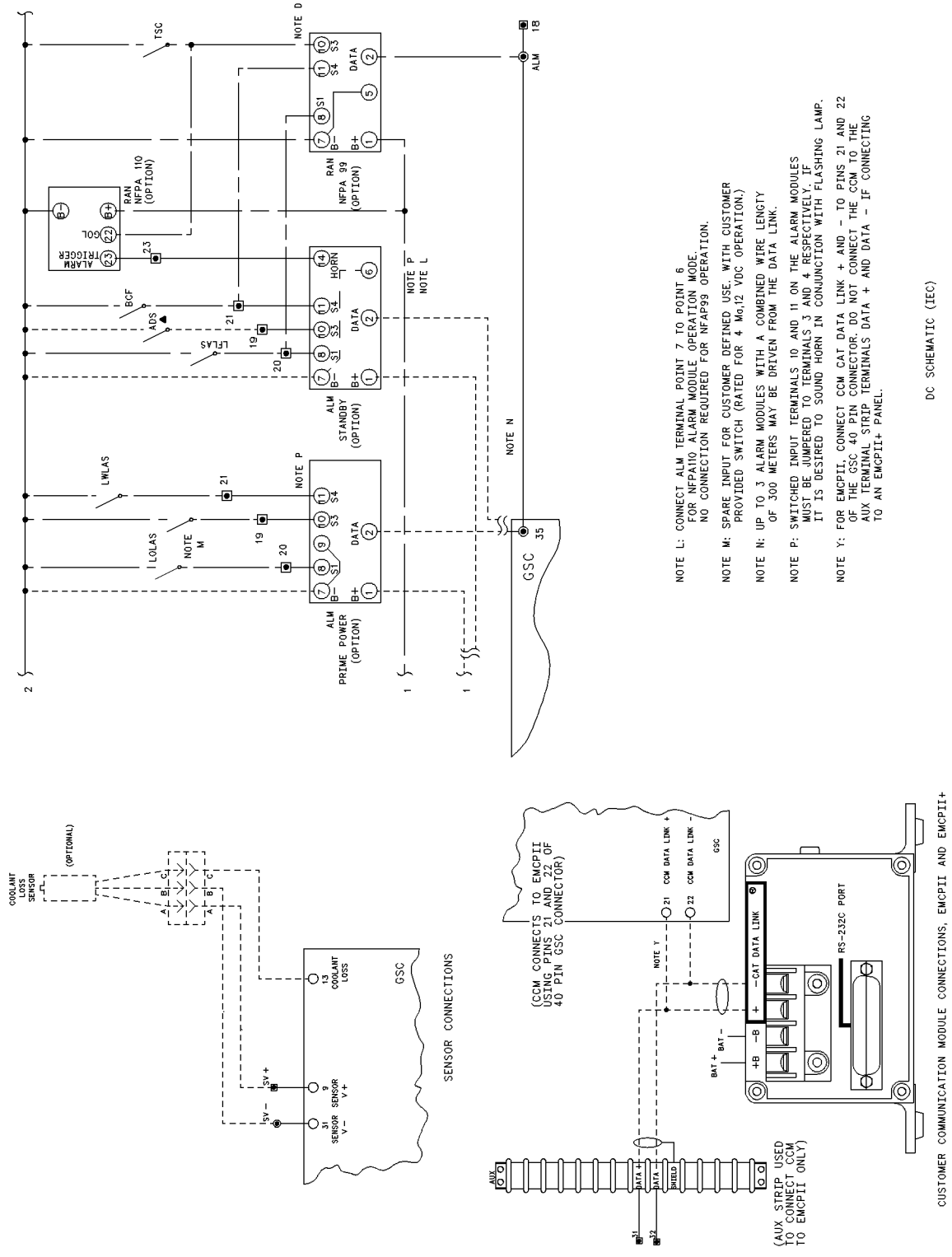


Illustration 126

g00490812

DC Schematic - JIC (1 of 2)

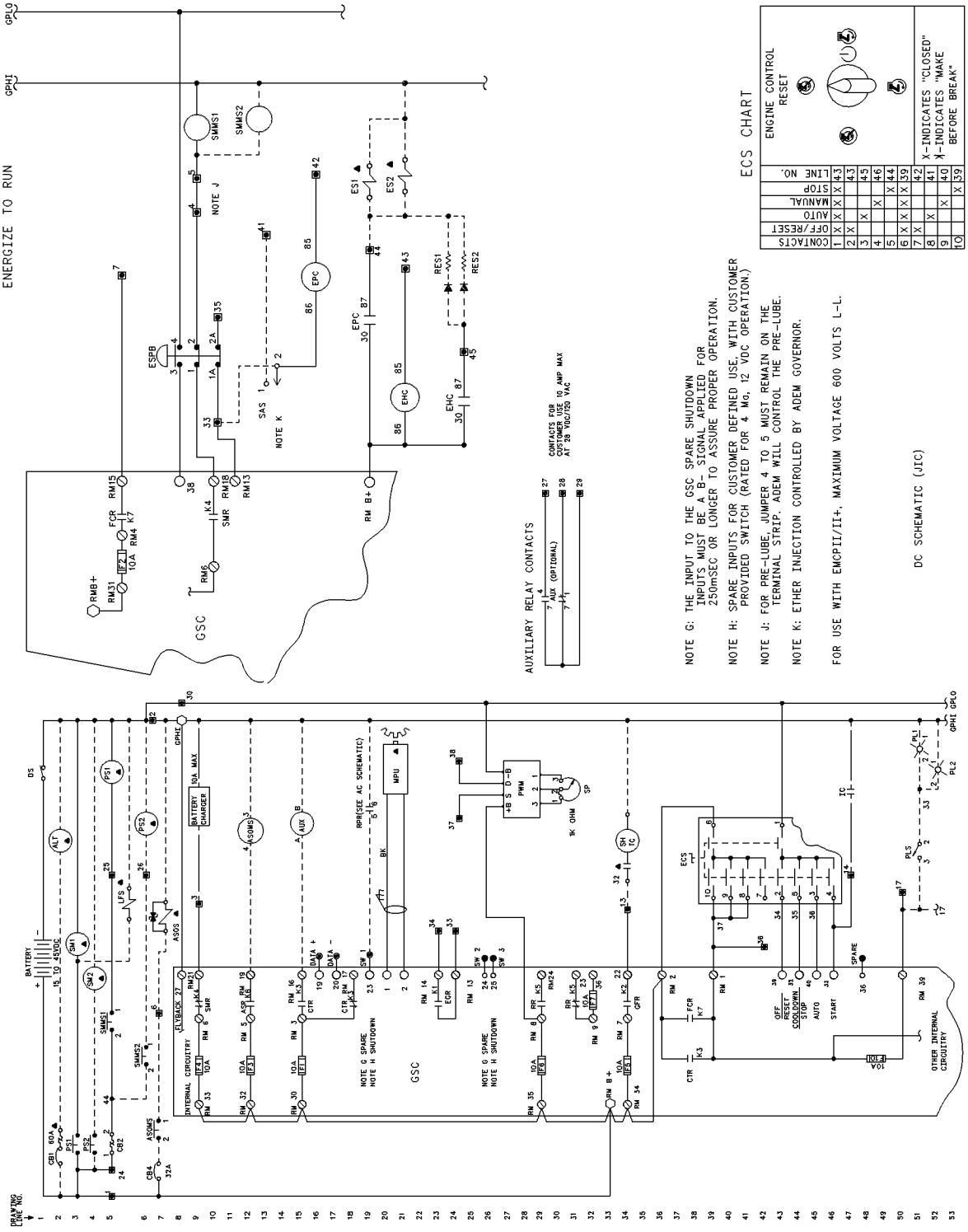


Illustration 127

g00490885

DC Schematic - JIC (2 of 2)

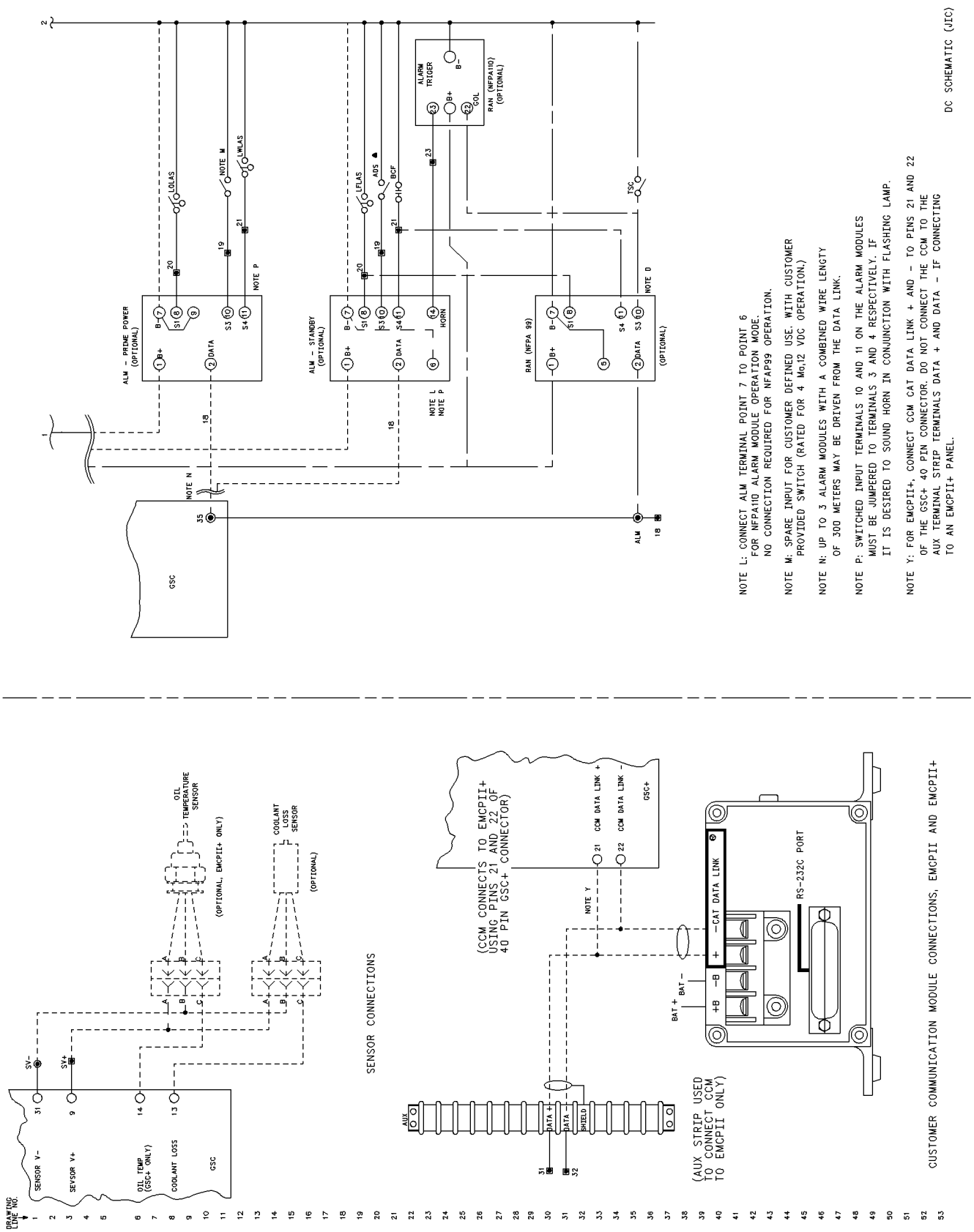


Illustration 128

g00633010

AC Schematic - IEC

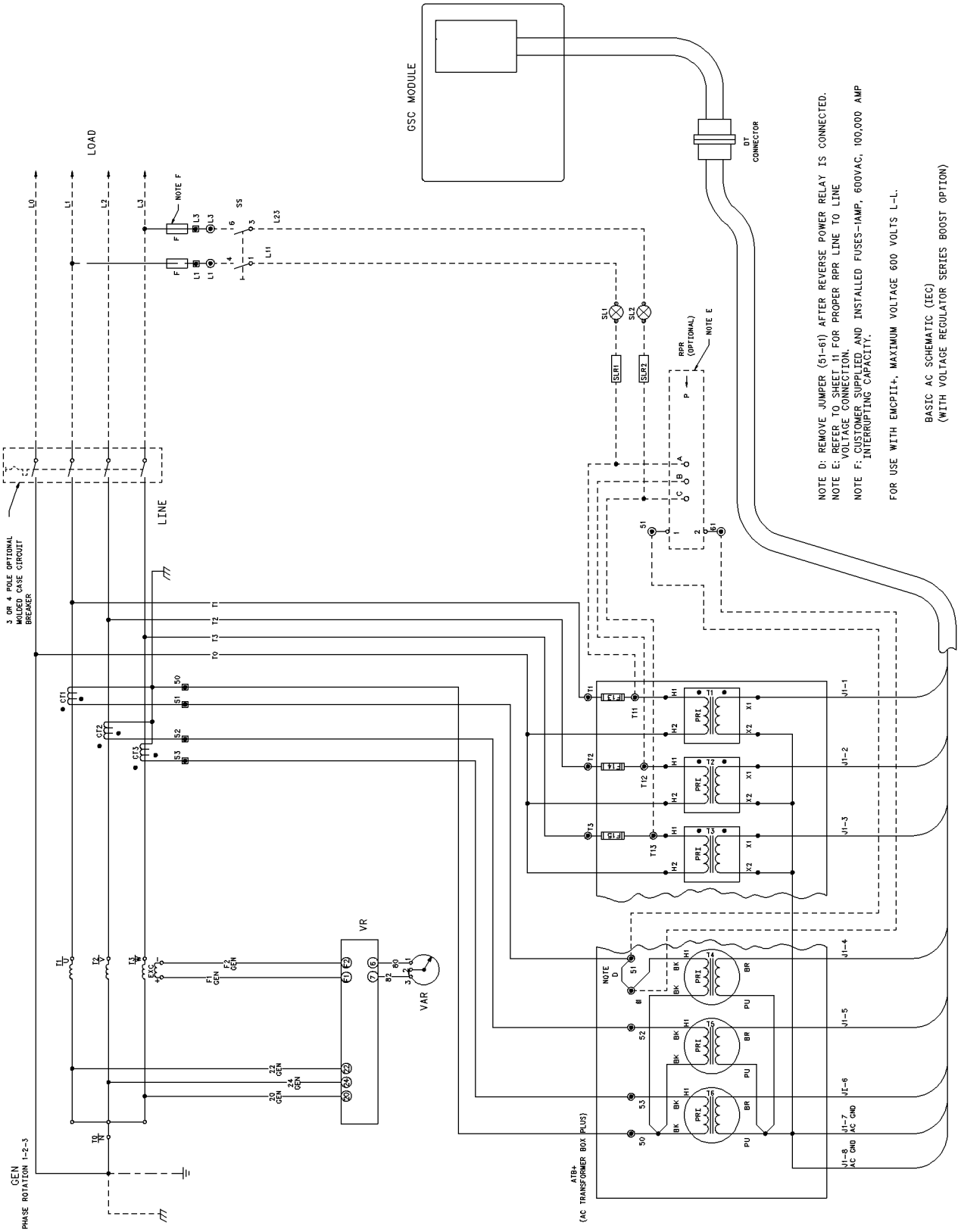
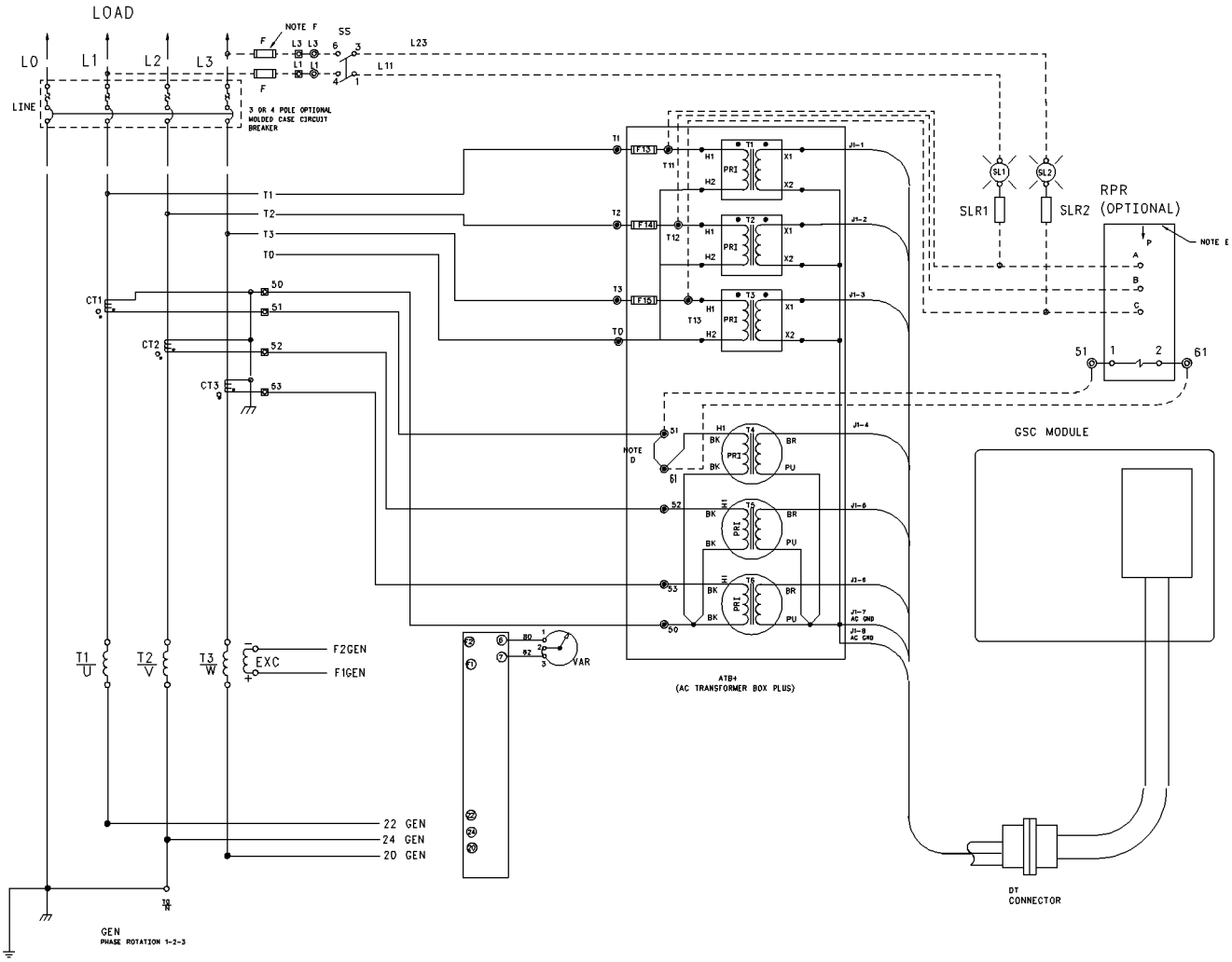


Illustration 129

g00633020

AC Schematic - JIC



NOTE D: REMOVE JUMPER (51-61) AFTER REVERSE POWER RELAY IS CONNECTED.
NOTE E: REFER TO SHEET 11 FOR PROPER RPR LINE TO LINE VOLTAGE CONNECTION.
NOTE F: CUSTOMER SUPPLIED AND INSTALLED FUSES-1AMP, 600VAC, 100,000 AMP INTERRUPTING CAPACITY.

FOR USE WITH EMCPII+, MAXIMUM VOLTAGE 600 VOLTS L-L.

BASIC AC SCHEMATIC (IEC)
(WITH VOLTAGE REGULATOR SERIES BOOST OPTION)

Wiring Diagram - Relay Driver Module (RDM)

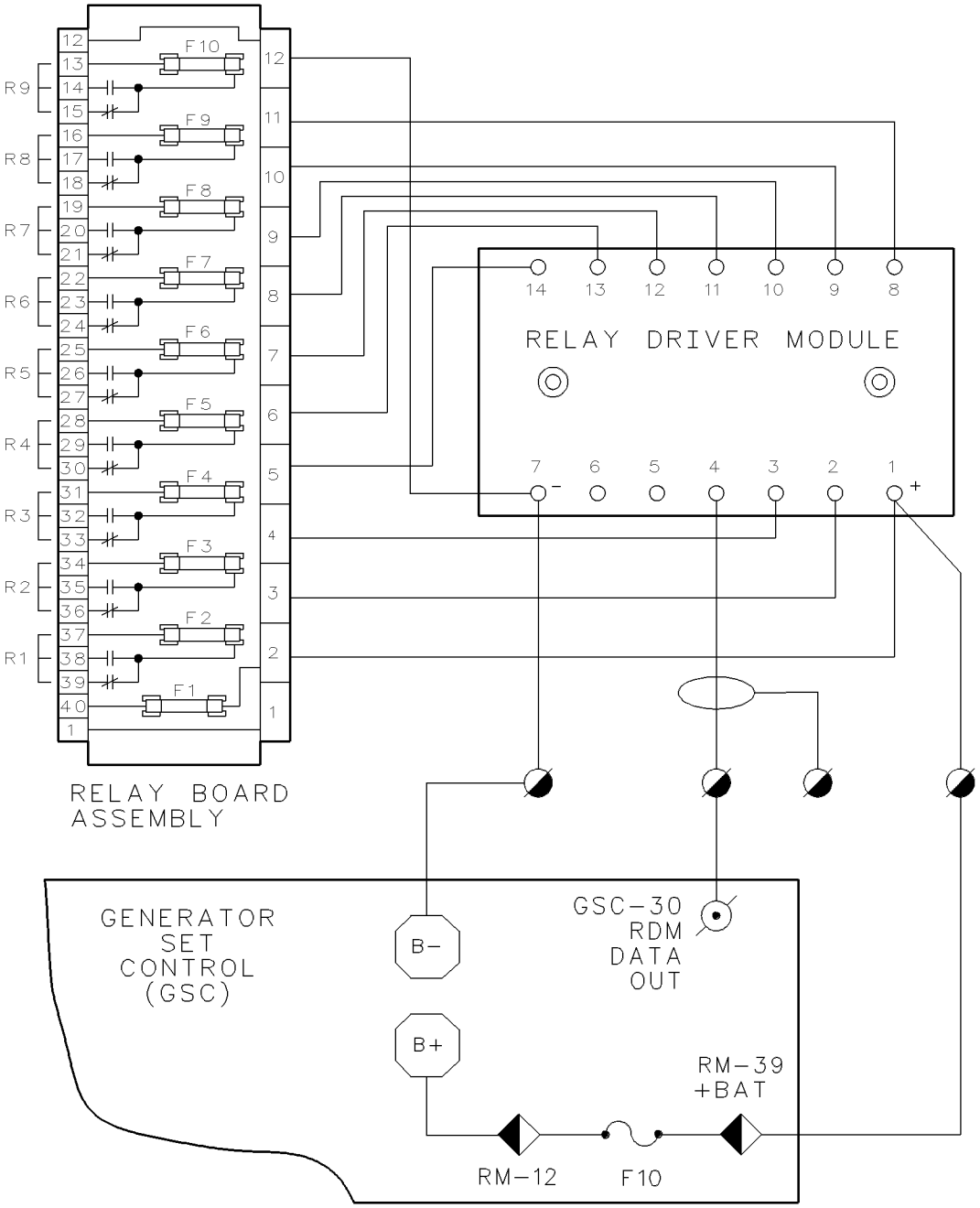


Illustration 131

g00546228

Wiring Diagram - Customer/ Contract

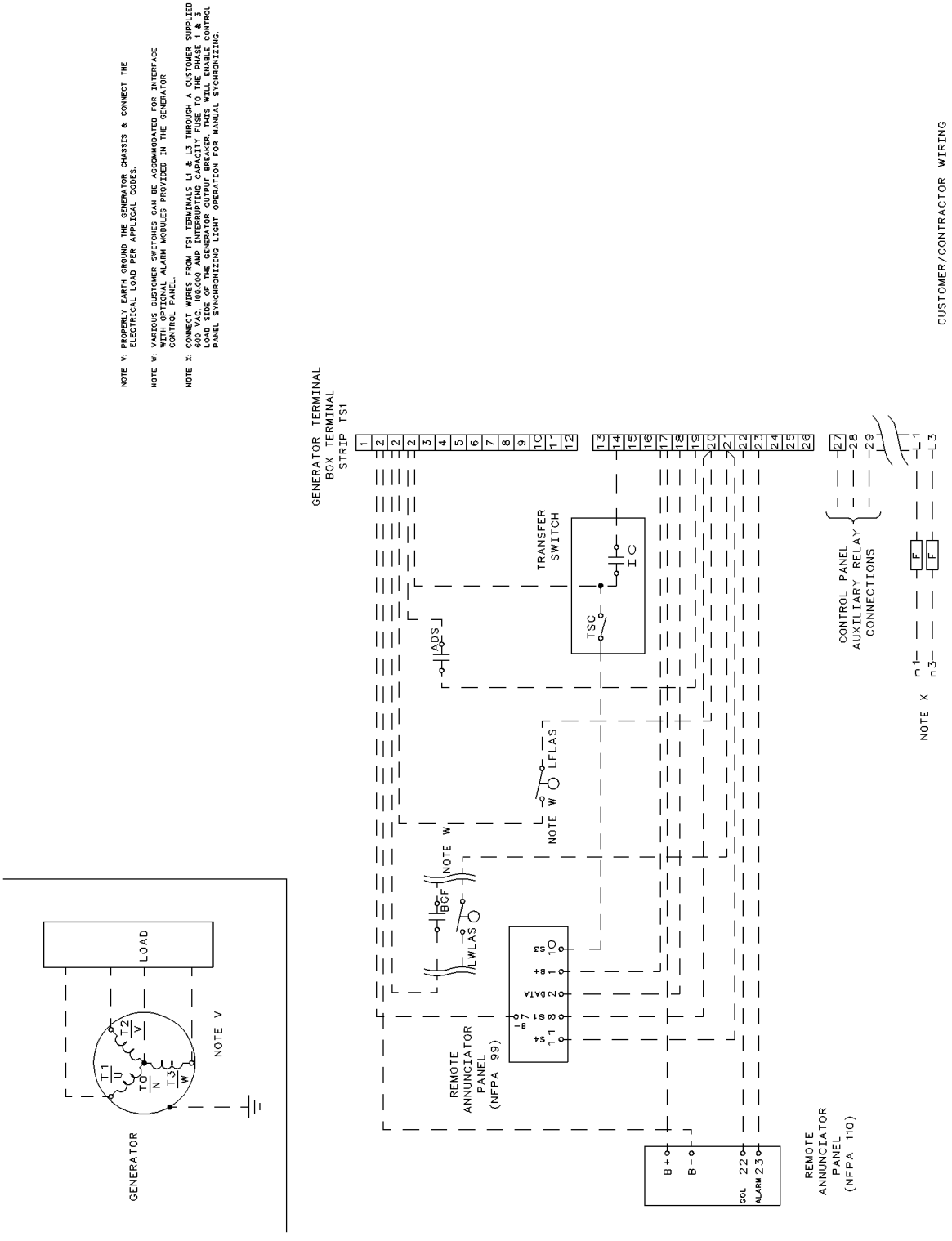


Illustration 132 g00490999

Wiring Diagram - Customer Interface Module (CIM)

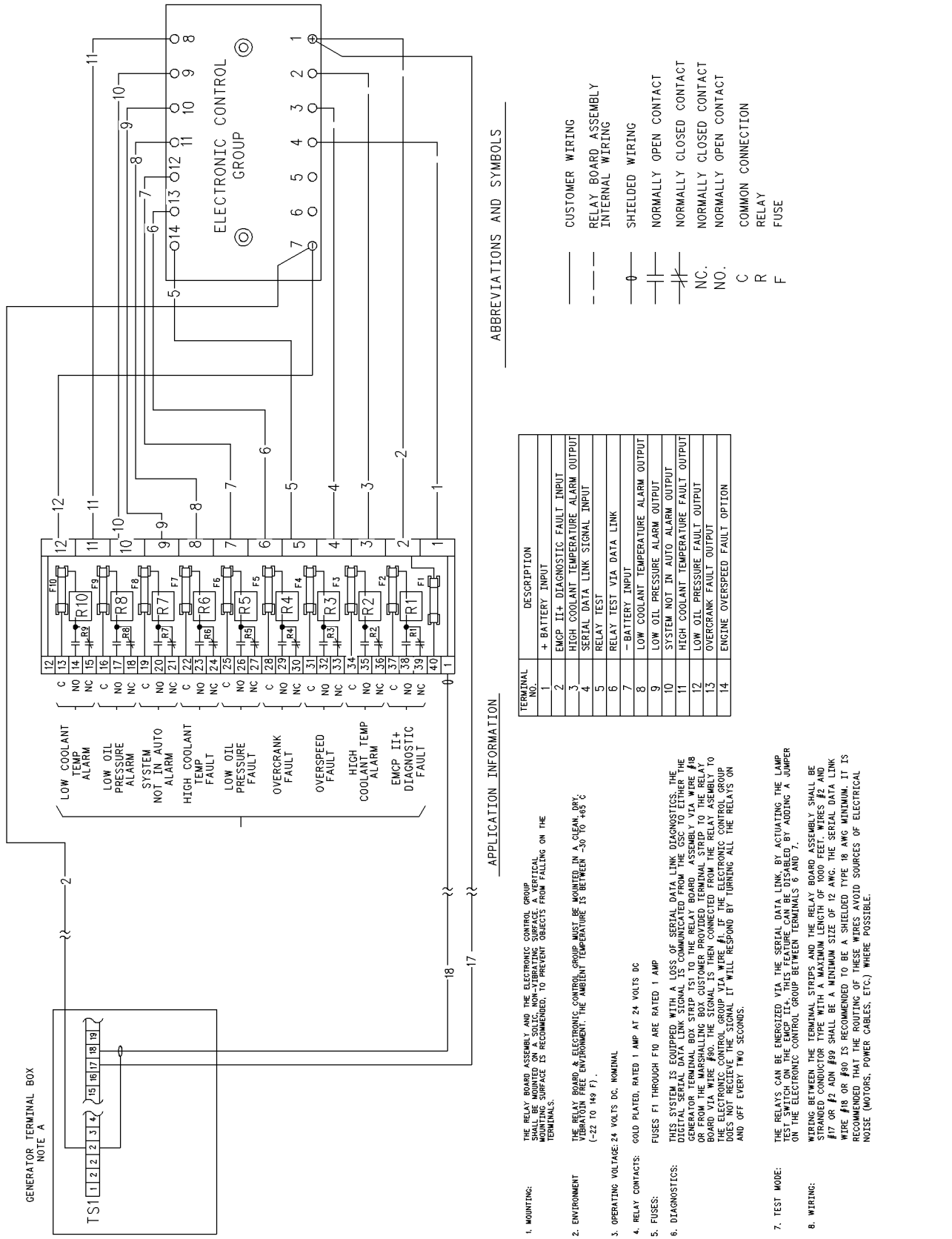


Illustration 133

g00633572

Wiring Diagram - Harness

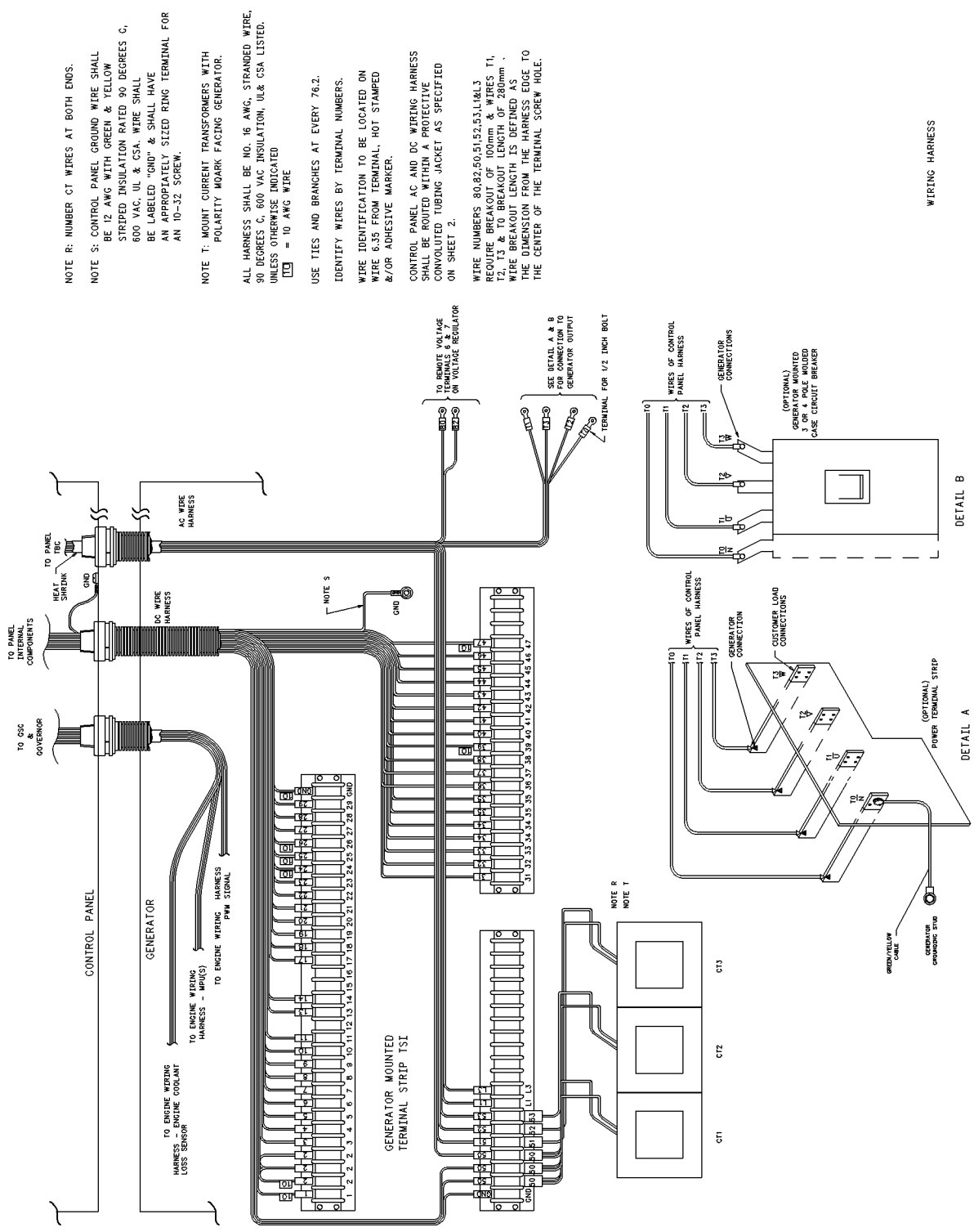
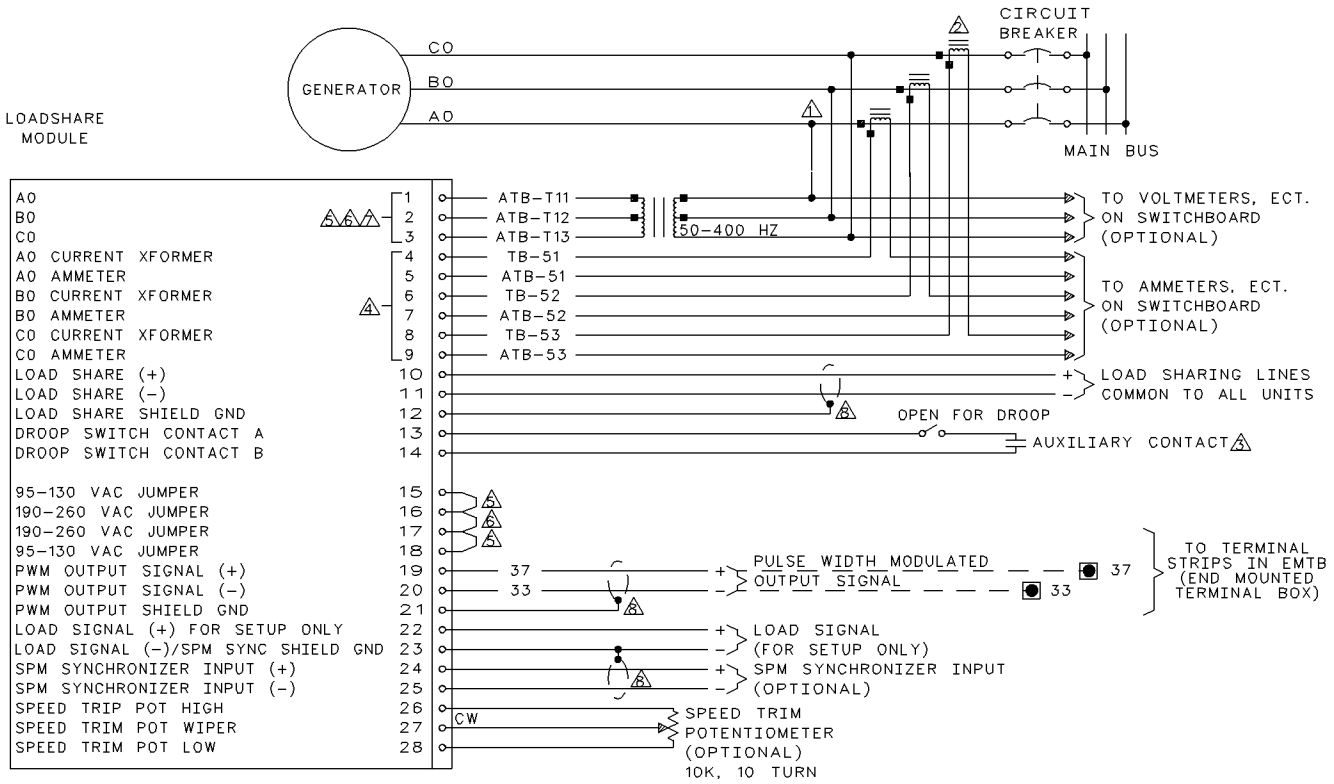


Illustration 134

g00491212

Wiring Diagram - Loadshare Module



NOTES:

1. WITH A BALANCED THREE PHASE LOAD AND UTILITY POWER FACTOR, THE CURRENT TRANSFORMERS SHOULD BE WIRED IN THE CORRECT POTENTIAL LEG AND MUST BE PHASED AT THE CONTROL AS FOLLOWS:

   PHASE A: POTENTIAL TERMINAL 1, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 4 TO 5.
   PHASE B: POTENTIAL TERMINAL 2, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 6 TO 7.
   PHASE C: POTENTIAL TERMINAL 3, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 8 TO 9.

2. POWER SOURCE CURRENT TRANSFORMERS SHOULD BE SIZED TO PRODUCE 5A SECONDARY CURRENT WITH MAXIMUM GENERATOR CURRENT. CT BURDEN IS ESSENTIALLY 0 VA.

3. CONTACTS TO CLOSE WHEN BREAKER CLOSES.

4. THIS CONTROL CONTAINS INTERNAL BURDEN RESISTORS. THESE BURDEN RESISTORS MUST BE CONNECTED ACROSS POWER SOURCE CURRENT TRANSFORMERS WHENEVER UNIT IS RUNNING TO PREVENT LETHAL HIGH VOLTAGE FROM DEVELOPING ON LEADS TO THESE TERMINALS.

5. JUMPER 15 TO 16 AND 17 TO 18 WHEN POTENTIAL INPUT AT TERMINALS 1 THRU 3 IS 95 TO 130VAC PHASE TO PHASE (50-400HZ).

6. JUMPER 16 TO 17 WHEN POTENTIAL INPUT AT TERMINALS 1 THRU 3 IS 190 TO 260VAC PHASE TO PHASE (50-400HZ).

7. POTENTIAL TRANSFORMER BURDEN IS 5VA PER PHASE WITH 230VAC INPUT AND 2.5VA PER PHASE WITH 115VAC INPUT.

8. CONTROL SIGNAL LINES SHOULD BE TWISTED PAIRS. SHIELD IS TO BE TIED TO GROUND AT MODULE END ONLY.

Illustration 135

g00633591

i01181716

Service Record

SMCS Code: 4490

Table 33

Service Table - Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part Number., etc..					
Engine /Generator Programming OP5-0					
Setpoint	**Specified Value**	**Actual Value**(1)	**Setpoint Description**	**Possible Values**	**Default Value**
P001			Fuel Solenoid Type	0 = ETR, 1 = ETS	0
P002			Units Shown	0 = Eng, 1 = metric	0
P003			Shutdown Override For Engine Fault	0 = shutdown, 1 = alarm	0
P004			Shutdown Enable For Sensor Fault	0 = alarm, 1 = shutdown	0
P005			Coolant Loss Sensor Installed	0 = w/o sensor, 1 = w/sensor	0
P006			Shutdown Override For Coolant Loss Fault	0 = shutdown, 1 = alarm	0
P007			System Voltage	24 volts or 32 volts	24
P008			This Setpoint Is Not Used.	NA	NA
P009			Number Of Ring Gear Teeth	95 to 350 teeth	136 teeth
P010			Engine Overspeed	500 to 4330 rpm	2120 rpm
P011			Crank Terminate Speed	100 to 1000 rpm	400 rpm
P012			Oil Step Speed	400 to 1800 rpm	1350 rpm
P013			Low Oil Pressure Shutdown At Rated Speed	34 to 420 kPa (5 to 61 psi)	205 kPa (30 psi)
P014			Low Oil Pressure Shutdown At Idle Speed	20 to 336 kPa (3 to 49 psi)	70 kPa (10 psi)
P015			High Water Temperature Shutdown	85 to 123°C (185 to 253°F)	107°C (225°F)
P016			Low Water Temperature Alarm	0 to 36°C (32 to 97°F)	21°C (70°F)
P017			Total Cycle Crank Time	5 to 360 seconds	90 seconds
P018			Cycle Crank Time	5 to 300 seconds	10 seconds
P019			Cooldown Time	0 to 30 minutes	5 minutes
P020			AC Voltage	150V to 30.0 kV	700V
P021			AC Current Full Scale	75A to 4000A	600A
P022			GSC+ Engine Number	01 to 08	01
P023			Engine Type	0 = MUI, 1 = gas, 2 = EUI	0
P024			Crank Time Delay	0 to 20 seconds	5 seconds

(continued)

(Table 33, contd)

Service Table - Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part Number., etc..					
Engine /Generator Programming OP5-0					
Setpoint	**Specified Value**	**Actual Value(1)**	**Setpoint Description**	**Possible Values**	**Default Value**
P025			Oil Temperature Sensor Installed	0 = w/o sensor, 1 = w/sensor	0
P026			High Oil Temperature Shutdown	85 to 123°C (185 to 253°F)	107°C (225°F)
P027			Shutdown Override For High Oil Temperature	0 = alarm, 1 = shutdown	0
P028			Nameplate Voltage	100 to 25kV	480V
P029			Nameplate Current	0 to 4000A	600A
P030			Nameplate Power	0 to 10MW	400kW
P031			Rated Frequency	50, 60 or 400 Hz	60
P032			Connection Configuration Of Generator	0 = wye, 1 = delta	0
P033			Number Of Generator Poles	0 to 254	4

(1) The actual value space is provided for recording and comparing values during future servicing or troubleshooting of the particular generator set.

Note: This table provides a record of setpoint values for a singular generator set. The table is intended to be an easy reference for future servicing or troubleshooting of a particular generator set.

Table 34

Service Table - Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part No., etc..					
Setpoint	**Specified Value**	**Actual Value(1)**	**Setpoint Description**	**Possible Values**	**Default Value**
Spare Input/Output Programming OP6					
SP01			Spare Input 1 Active State	0 = active low, 1 = active high	0
SP02			Spare Input 1 Response	0 = shutdown, 1 = alarm	0
SP03			Spare Input 1 Time Delay	0 to 250 seconds	0 seconds
SP04			Spare Input 2 Active State	0 = active low, 1 = active high	0
SP05			Spare Input 2 Response	0 = shutdown, 1 = alarm	0
SP06			Spare Input 2 Time Delay	0 to 250 seconds	0 seconds
SP07			Spare Input 3 Active State	0 = active low, 1 = active high	0

(continued)

(Table 34, contd)

Service Table - Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part No., etc..					
Setpoint	**Specified Value**	**Actual Value**(1)	**Setpoint Description**	**Possible Values**	**Default Value**
Spare Input/Output Programming OP6					
SP08			Spare Input 3 Response	0 = shutdown, 1 = alarm	0
SP09			Spare Input 3 Time Delay	0 to 250 seconds	0 seconds
SP10			Spare Input 4 Active State	0 = active low, 1 = active high	0
SP11			Spare Input 4 Response	0 = shutdown, 1 = alarm	0
SP12			Spare Input 4 Time Delay	0 to 250 seconds	0 seconds
SP13			Spare Output Response	0 = shutdown, 1 = alarm	0
SP14			Spare Output Trigger Condition	Numerous(2) 8 = cooldown mode	8
SP15			Spare Relay Output Response	0 = inactive, 1 = active	1
SP16			Spare Relay Output Trigger Condition	Numerous(2) 8 = cooldown mode	8
SP17			Spare Indicator 1 Trigger Condition	Numerous(2) 0 = unused	0
SP18			Spare Indicator 2 Trigger Condition	Numerous(2) 0 = unused	0
SP19			Spare Indicator 3 Trigger Condition	Numerous(2) 0 = unused	0
Voltmeter/Ammeter Programming OP8					
AC01			Phase A Voltage Calibration	0 to 255	bar code value(3)
AC02			Phase B Voltage Calibration	0 to 255	bar code value(3)
AC03			Phase C Voltage Calibration	0 to 255	bar code value(3)
AC04			Phase A Current Calibration	0 to 255	bar code value(3)
AC05			Phase B Current Calibration	0 to 255	bar code value(3)
AC06			Phase C Current Calibration	0 to 255	bar code value(3)
AC Offset Adjustment OP10					
PH A			Phase A Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0
PH B			Phase B Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0

(continued)

(Table 34, contd)

Service Table - Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part No., etc..					
Setpoint	**Specified Value**	**Actual Value**(1)	**Setpoint Description**	**Possible Values**	**Default Value**
Spare Input/Output Programming OP6					
PH C			Phase C Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0
PH A-B			Phase A-B Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0
PH B-C			Phase B-C Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0
PH C-A			Phase C-A Voltage Adjustment	–5.0 to +5.0 % of measured voltage	0

(1) The actual value space is provided for recording and comparing values during future servicing or troubleshooting of the particular generator set.
(2) Numerous possible values exist. See System Operation, “Spare Input/Output Programming OP6”.
(3) The setpoints are programmed at the factory to the calibration value which is listed on the bar code sticker of the ATB+.

Note: This table provides a record of setpoint values for a singular generator set. The table is intended to be an easy reference for future servicing or troubleshooting of a particular generator set.

Table 35

Service Table- Record of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part Number., etc..					
Setpoint	**Specified Value**	**Actual Value**	**Setpoint Description**	**Possible Values**	**Default Value**
P101			Overvoltage Alarm Enable	0 = Disabled, 1 = Enabled	1
P102			Overvoltage Alarm Threshold	100 to 125% of Nameplate Voltage	105%
P103			Overvoltage Alarm Time Delay	0 to 120 Seconds	10 Seconds
P104			Overvoltage Shutdown Enable	0 = Disabled, 1 = Enabled	1
P105			Overvoltage Shutdown Threshold	100 to 125% of Nameplate Voltage	110%
P106			Overvoltage Shutdown Time Delay	0 to 120 Seconds	10 Seconds
P107			Undervoltage Alarm Enable	0 = Disabled, 1 = Enabled	1
P108			Undervoltage Alarm Threshold	60 to 100% of Nameplate Voltage	90%
P109			Undervoltage Alarm Time Delay	0 to 120 Seconds	10 Seconds

(continued)

(Table 35, contd)

Service Table- Record of Setpoint Values					
P110			Undervoltage Shutdown Enable	0 = Disabled, 1 = enabled	1
P111			Undervoltage Shutdown Threshold	60 to 100% of Nameplate Voltage	85%
P112			Undervoltage Shutdown Time Delay	0 to 120 Seconds	15 Seconds
P113			Overfrequency Alarm Enable	0 = Disabled, 1 = Enabled	1
P114			Overfrequency Alarm Threshold	50-60 Hz, 60-70 Hz, or 400-480 Hz	53 Hz, 63 Hz, or 422 Hz
P115			Overfrequency Alarm Time Delay	0 to 120 Seconds	10 Seconds
P116			Overfrequency Shutdown Enable	0 = Disabled, 1 = Enabled	1
P117			Overfrequency Shutdown Threshold	50-60 Hz, 60-70 Hz, or 400-480 Hz	53 Hz, 66 Hz, or 440 Hz
P118			Overfrequency Shutdown Time Delay	0 to 120 Seconds	10 Seconds
P119			Underfrequency Alarm Enable	0 = Disabled, 1 = Enabled	1
P120			Underfrequency Alarm Threshold	30-50 Hz, 36-60 Hz, 240-400 Hz	47 Hz, 57 Hz, or 378 Hz
P121			Underfrequency Alarm Time Delay	0 to 120 Seconds	10 Seconds
P122			Underfrequency Shutdown Enable	0 = Disabled, 1 = Enabled	1
P123			Underfrequency Shutdown Threshold	30-50 Hz, 36-60 Hz, 240-400 Hz	45 Hz, 54 Hz, or 360 Hz
P124			Underfrequency Shutdown Time Delay	0 to 120 Seconds	10 Seconds
P125			Reverse Power Shutdown Enable	0 = Disabled, 1 = Enabled	1
P126			Reverse Power Shutdown Threshold	0 to 20% of Nameplate Power	15%
P127			Reverse Power Shutdown Time Delay	0 to 30 Seconds	10 Seconds
P128			Overcurrent Alarm Enable	0 = Disabled, 1 = Enabled	1
P129			Phase Overcurrent Alarm Threshold	100 to 160% of Nameplate Current	105%
P130			Phase Overcurrent Alarm Time Delay	0 to 250 Seconds	0 Seconds
P131			Total Overcurrent Alarm Threshold	100 to 160% of 3 X Nameplate Current	105%
P132			Total Overcurrent Alarm Time Delay	0 to 250 Seconds	0 Seconds

(continued)

(Table 35, contd)

Service Table- Record of Setpoint Values					
P133			Overcurrent Shutdown Enable	0 = Disabled, 1= Enabled	1
P134			Phase Overcurrent Shutdown Threshold	100 to 160%	110%
P135			Phase Overcurrent Shutdown Time Delay	0 to 250 Seconds	0 Seconds
P136			Total Overcurrent Shutdown Threshold	100 to 160%	110%
P137			Total Overcurrent Shutdown Time Delay	0 to 250 Seconds	0 Seconds
P138			KW Level Relay Enable	0 = Disabled, 1 = Enabled	1
P139			KW Level Relay Threshold	0 to 110% of Nameplate Power	105%
P140			KW Level Relay Time Delay	0 to 120 Seconds	0 Seconds
P141			KW Level Relay Disengage Threshold	0 to 110% of Nameplate Power	100%
P142			KW Level Relay Disengage Time Delay	0 to 120 Seconds	10 Seconds

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