CATERPILLAR®

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Service Manual

Electronic Modular Control Panel II (EMCP II)

119-6031
136-6924

For Gas Engines

Important Safety Information

Most accidents involving 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 other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "WARNING" as 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, explaining the hazard, 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 not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting 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.

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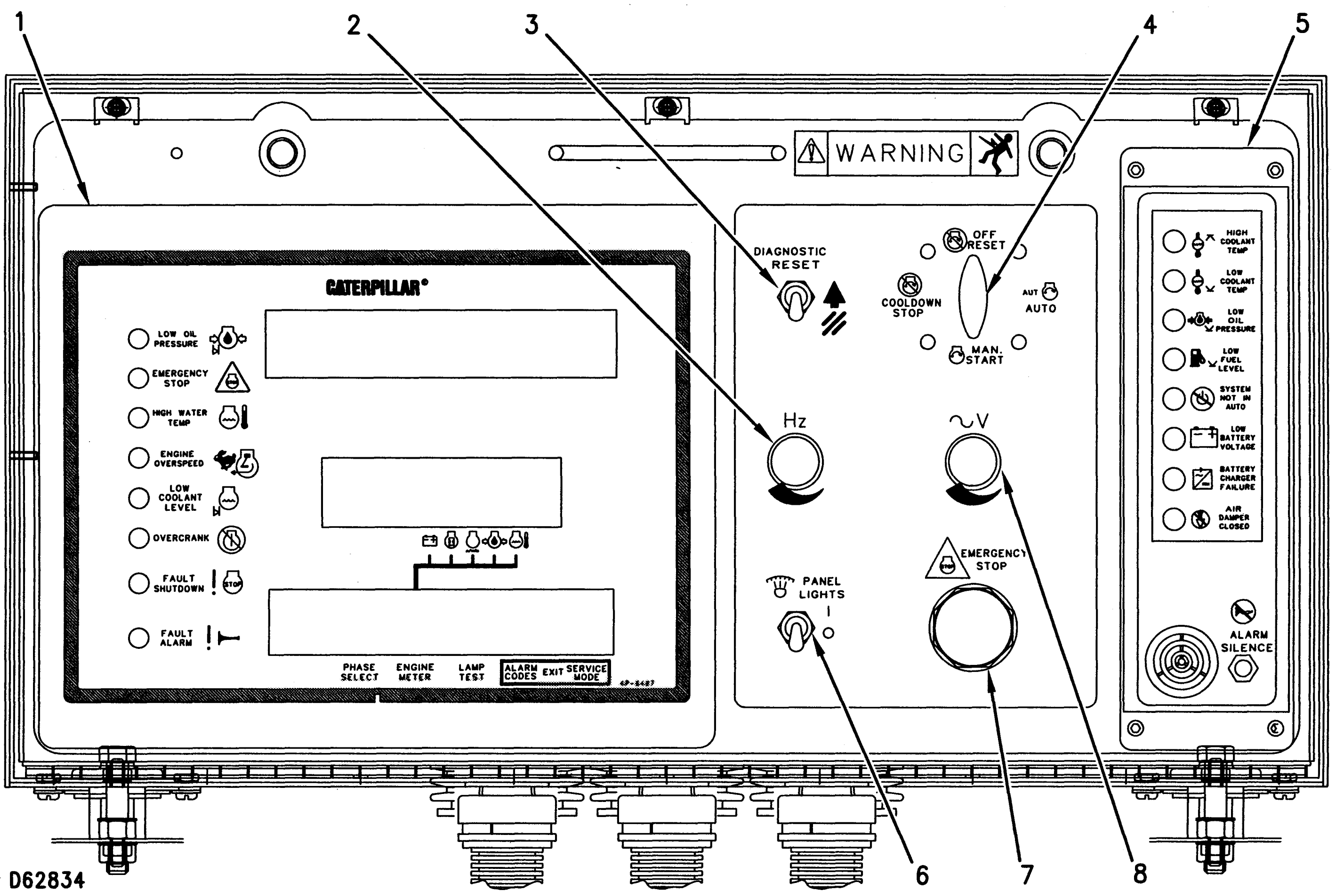
Related EMCP II+ Service Literature

- SENR4676, Service Manual, 2301A Speed Control
- SENR3585, Service Manual, 2301A Electric Governor (Load Sharing)
- SENR2928, Service Manual, 2301 Electric Governor
- SENR3028, Service Manual, Caterpillar 3161 Governor
- SENR6430, Service Manual, 524 & 1724 Electrically Powered Governor Systems
- SEBU6874, Owner's Manual, Customer Communication Module For EMCP II

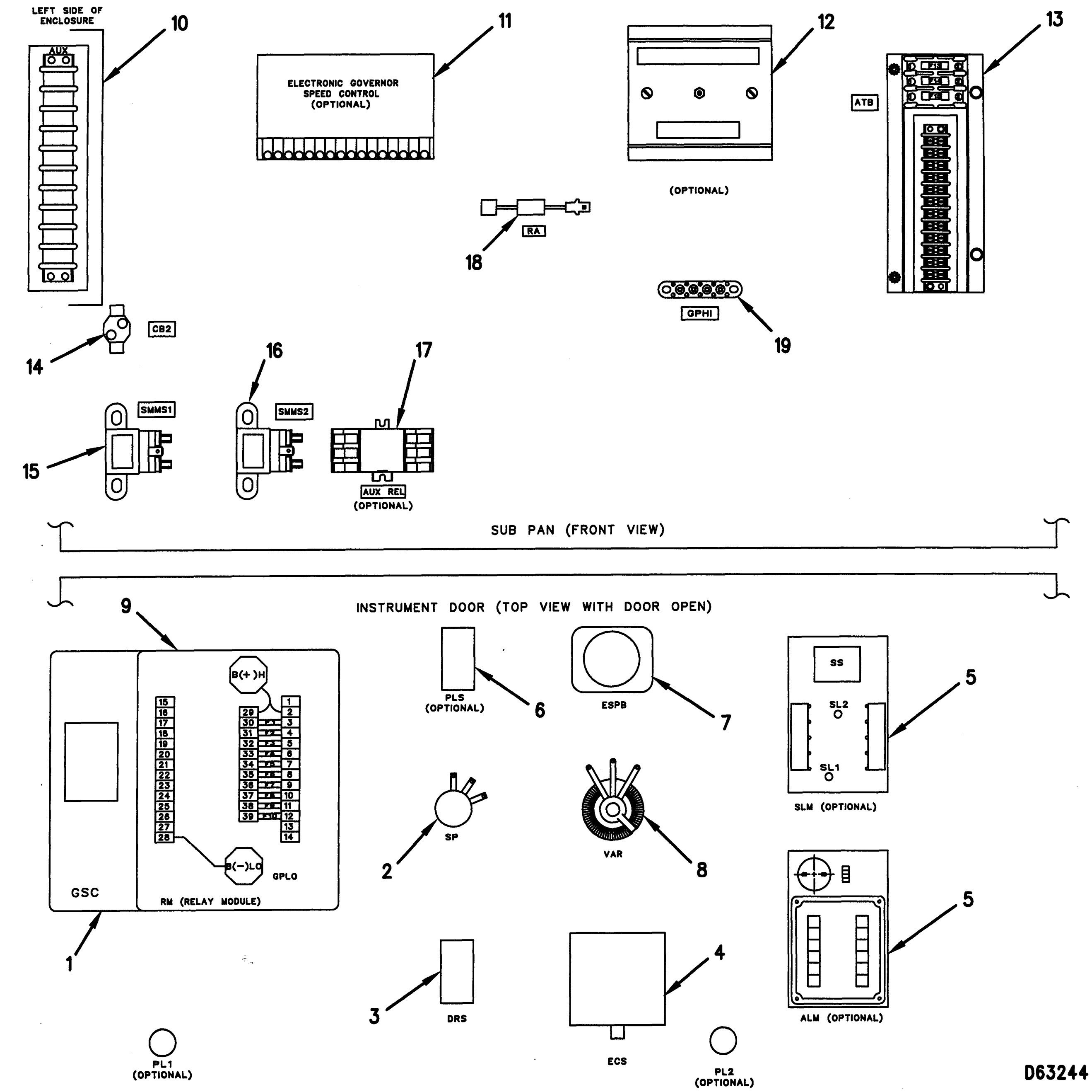
Systems Operation

Location Of EMCP II System Components



Instrument Panel
(1) GSC; generator set control.
(2) SP; speed potentiometer.
or GS; governor switch (optional).
(3) DRS; diagnostic reset switch.
(4) ECS; engine control switch.
(5) ALM; alarm module (optional)
or SLM; synchronizing lights module (optional).
(6) PLS; panel light switch (optional).
(7) ESPB; emergency stop push button.
(8) VAR; voltage adjust rheostat.

Most of the EMCP II components are located on either the instrument panel or on the sub-panel. Other EMCP II components that exist on or near the engine are: engine oil pressure sensor (EOPS), engine coolant temperature sensor (ECTS), magnetic speed pickup (MPU) and engine coolant loss sensor (ECLS) (optional).



Panel Interior - Instrument Panel and Sub-Panel
Instrument Panel:
(1) GSC; generator set control.
(2) SP; speed potentiometer.
or GS; governor switch (optional).
(3) DRS; diagnostic reset switch.
(4) ECS; engine control switch.
(5) ALM; alarm module (optional)
or SLM; synchronizing lights module (optional).
(6) PLS; panel light switch (optional).
(7) ESPB; emergency stop push button.
(8) VAR; voltage adjust rheostat.
(9) RM; relay module (part of GSC).
Sub-Panel:
(10) AUX; auxiliary terminal strip.
(11) EG; electronic governor (optional).
(12) RPR; reverse power relay (optional).
or OCR; overcurrent relay (optional).
or OVR; overvoltage relay (optional).
(13) ATB; AC transformer box.
(14) CB2; circuit breaker 2.
(15) SMMS1; starting motor magnetic switch 1.
(16) SMMS2; starting motor magnetic switch 2 (optional).
(17) AUXREL; auxiliary relay (optional).
(18) RA; Resistor assembly for Altronics Interface Box.
(19) GPHI; ground post high voltage.

Component Description

Generator Set Control (GSC)

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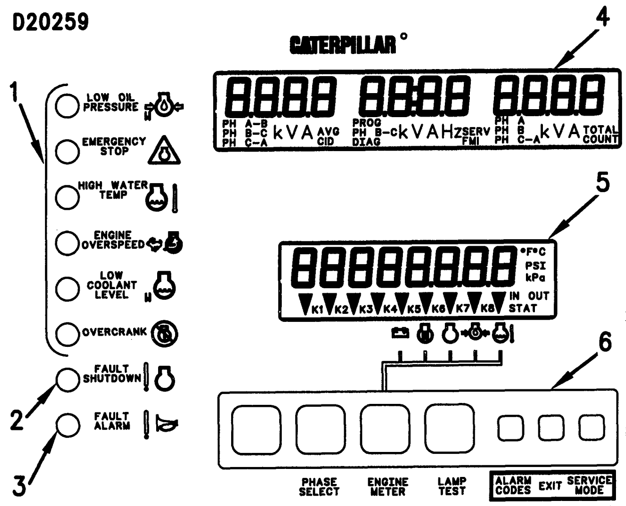


Display Area Of Generator Set Control (GSC)
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

The main component of the EMCP II system is the generator set control (GSC). The GSC is designed to operate when powered by only 24 DCV or 32 DCV battery systems. The GSC monitors and controls many of the generator set (genset) functions. The functions and features of the GSC are:

- Controls normal starting and stopping of the engine.
- Shows engine conditions and generator output information on two displays. The displays also show fault codes and GSC programming information.
- Monitors the system for faults. If a fault occurs, the GSC performs a controlled fault shutdown or provides a fault alarm annunciation. The GSC uses indicators and displays to describe the fault to the operator or service technician.
- Contains programmable features for certain applications or customer requirements.

Fault Indicators

The eight fault indicators are used to show and describe a fault that is present. The fault indicators are divided into three groups: fault alarm indicator (3), fault shutdown indicator (2) and dedicated shutdown indicators (1).

The yellow fault alarm indicator (3) FLASHES when the GSC detects a fault that is an alarm fault. The engine continues to run and start. Fault alarm indicator (3) is accompanied by an alarm fault code that is shown on upper display (4) when the alarm codes key is pressed.

The red fault shutdown indicator (2) FLASHES when the GSC detects a fault that is a shutdown fault. The engine is shut down if it is running and is not allowed to start. Fault shutdown indicator (2) is accompanied by a fault code that is immediately shown on upper display (4).

The red dedicated shutdown indicators (1) represent the following shutdown faults: low oil pressure, emergency stop, high water temperature, engine overspeed, low coolant level 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 shut down if it is running and is not allowed to start. There are no fault codes associated with the dedicated shutdown indicators because each indicator has an interpretive label. The conditions required for each dedicated fault and the results of each dedicated fault are:

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 for when the engine is at idle speed and the other for when the engine is at rated speed. The low oil pressure indicator FLASHES, the engine is shut down and is not allowed to start.

Emergency Stop - The operator presses the emergency stop push button (ESPB) on the instrument panel. The emergency stop indicator FLASHES, the engine is shut down and is not allowed to start.

High Water Temperature - The engine coolant temperature rises above the setpoint for high water temperature shutdown that is programmed into the GSC. The high water temperature indicator FLASHES, the engine is shut down and is not allowed to start.

Engine Overspeed - The engine speed exceeds the setpoint for engine overspeed that is programmed into the GSC. The engine overspeed indicator FLASHES, the engine is shut down and is not allowed to start.

Low Coolant Level - The engine coolant level drops below the probe of the coolant loss sensor (optional). The engine coolant level indicator FLASHES, the engine is shut down and is not allowed to start.

Overcrank - The engine does not start within the setpoint for total cycle crank time that is programmed into the GSC. The overcrank indicator FLASHES and the engine is not allowed to start.

NOTE: The GSC can be programmed to override the shutdown for low oil pressure, high water temperature and the low coolant level faults. When overridden, these faults are treated as alarm faults. The corresponding dedicated shutdown indicator is ON CONTINUOUSLY (instead of flashing) and the engine continues to run and start (instead of shutting down). The dedicated shutdown indicator that is ON CONTINUOUSLY means that the setpoint for shutdown has been exceeded, but the GSC is programmed to override the shutdown fault and treat the fault as an alarm fault. As provided from the factory, the GSC treats low oil pressure, high water temperature and low coolant level as shutdowns. The operator or service technician must make a conscious decision to override these shutdown faults and have the GSC treat them as alarm faults.

Display

The upper display (4) and lower display (5) of the GSC provide information about the genset.

Upper display (4) shows AC voltage, current and frequency of one phase of the generator output. Each phase can be viewed one at a time by pushing the phase select key. Upper display (4) is also used to show the various fault codes for system faults. For more information on fault codes, see the topic Fault Description.

Lower display (5) shows system battery voltage, engine hours, engine speed, engine oil pressure and engine coolant temperature. The value for one of these conditions is shown for two seconds and then the display 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, lower display (5) stops scrolling and continuously shows one particular value. Now the pointer flashes above the condition whose value is showing.

The relay status indicator is on the lower display also. When a GSC relay is activated, the corresponding indicator (K1, K2, etc.) is shown on lower display (5). When a relay is not activated, the corresponding indicator (K1, K2, etc.) is not shown.

Both displays are used for programming functions when in service mode. For more information, see the topic Service Mode.

Keypad

Keypad (6) is used to control the information that is shown on upper display (4) and lower display (5). The seven keys have two sets of functions, normal functions and service functions. For a description of the service functions of the keys; see the topic Service Mode. The normal functions of the keys are:

Leftmost Key - This key only functions when the GSC is in service mode. See the topic Service Mode.

Phase Select Key - Selects which phase of the generator output is shown on the GSC. Pressing this key allows the operator to check the voltage, current and frequency of each phase one at a time.

Engine Meter Key - Stops the scrolling of engine conditions on lower display (5) and continuously shows the value for one particular engine condition. The pointer flashes to indicate scrolling is stopped. Pressing the key again, resumes the scrolling of engine conditions.

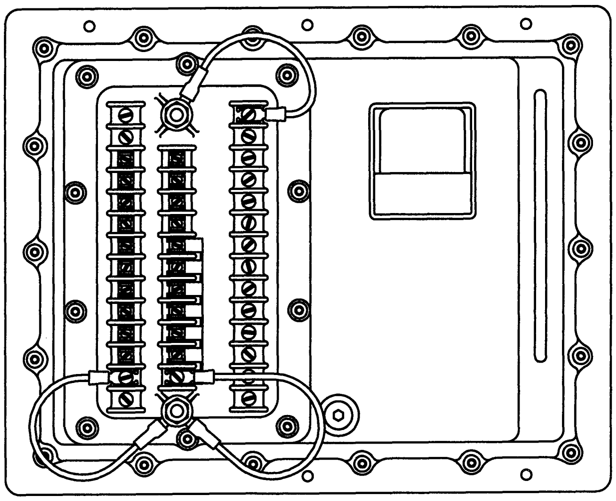
Lamp Test Key - Performs a lamp test on the GSC and the optional alarm module. On the GSC: the eight fault indicators are ON CONTINUOUSLY, every segment of upper display (4) and lower display (5) are ON. On the optional alarm module: all of the indicators are ON and the horn sounds.

Alarm Codes Key - If fault alarm indicator (3) is FLASHING, pressing this key causes upper display (4) to show the corresponding alarm fault code. Pressing this key again, resumes the showing of generator output information on upper display (4). If fault alarm indicator (3) is OFF, this key has no function. For more information on alarm fault codes, see the topic Fault Description.

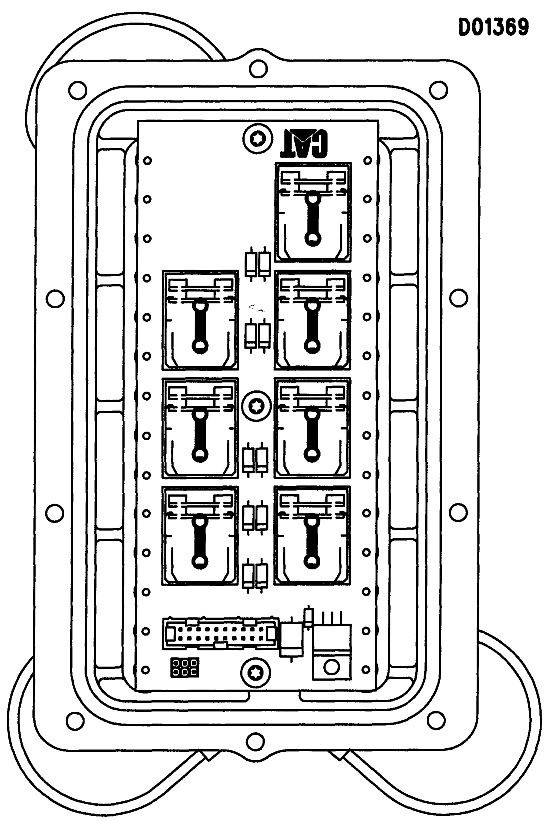
Exit Key - This key only functions when the GSC is in service mode. See the topic Service Mode.

Service Mode Key - Pressing this key causes the GSC to enter service mode. See the topic Service Mode.

Relays



Relay Module On Rear Of GSC



Relays In Relay Module

The relays are located in the relay module on the rear of the GSC. The relays are permanently attached within the relay module and are not removable. The entire relay module is replaced if a relay is faulty. For more information, see the DC Schematics in the Schematics and Wiring Diagrams section.

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

Load Specifications For GSC+ Relay Module

Relay Module Terminal No.	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 - ISR N/0 RM20 - K6 - ISR N/C RM22 - K2 - GFR N/O RM24 - K5 - RR N/O	10A at 24DCV	10A at 24DCV
RM23,36 - K5 - RR N/C	10A at 24DCV 10A at 110ACV	5A at 24DCV 7.5A at 110ACV

[1] Do NOT connect inductive loads to these terminals.

The relays and the functions are:

K1 - Electronic Governor Relay (EGR):

When the relay is active the normally open contacts close. This signals the optional 2301A governor to accelerate the engine to rated speed.

The relay has no normally closed contacts.

K2 - Generator Fault Relay (GFR):

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):

When the relay is active the normally open contacts close. This activates the optional AUX relay (customer use) and enables the optional governor switch which adjusts the governor synchronizing motor.

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. This activates the optional battery charger.

K5 - Run Relay (RR):

When the relay is active the normally open contacts close. This powers the optional 2301A governor.

When the relay is inactive the normally closed contacts close. These contacts are for customer use.

K6 - Ignition Shutoff Relay (ISR):

When the relay is active the normally open contacts close which grounds the magneto.

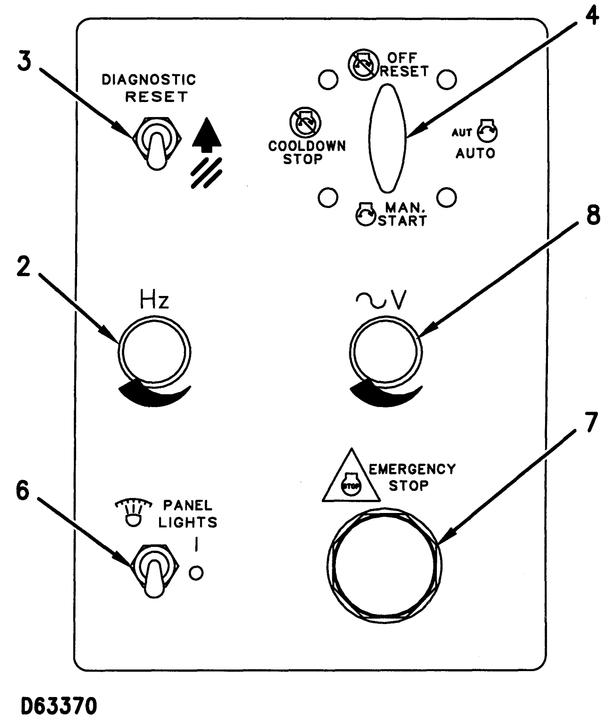
When the relay is inactive, the normally closed contacts close. This allows the engine to run.

K7 - Fuel Control Relay (FCR):

When the relay is active the normally open contacts close.
On ETR systems, this activates the fuel solenoid during starting and running. Gas engines use the energized to run (ETR) type of fuel system.
On ETS systems, this activates the fuel solenoid during shutdown. The fuel solenoid is disabled at less than 40 rpm in all modes (normal, shutdown, alarm).

The relay has no normally closed contacts.

Instrument Panel Switches



Instrument Panel Switches
(2) SP; speed potentiometer. (3) DRS; diagnostic reset switch. (4) ECS; engine control switch. (6) PLS; panel light switch (optional). (7) ESPB; emergency stop push button. (8) VAR; voltage adjust rheostat.

Engine control switch (ECS) (4) determines the status of the control panel. In the AUTO position (3 o'clock), the engine starts automatically whenever the remote initiating contact (IC) is closed. The engine also shuts down after the initiate contacts open. A selectable cooldown time is programmable to give a 0 to 30 minute cooldown period before the engine shuts down. The cooldown time is factory set at five minutes. In the MANUAL START position (6 o'clock), the engine starts and runs as long as the ECS is in this position. In the COOLDOWN/STOP position (9 o'clock), the fuel solenoid shuts the engine down after cooldown. In the OFF/RESET position (12 o'clock), the engine shuts down immediately and any fault indicators are reset (except emergency stop).

If red emergency stop push button (ESPB) (7) is pressed, the fuel is shut off. To restart: turn ESPB (7) clockwise until it releases, turn the ECS to OFF/RESET and then to START.

Voltage adjust rheostat (VAR) (8) is used to adjust generator voltage to the desired level.

Speed potentiometer (SP) (2) is used to raise and lower engine speed when the genset has an electronic governor. Optional governor switch (GS) (2) is used to raise and lower engine speed when the governor has a speed adjust motor.

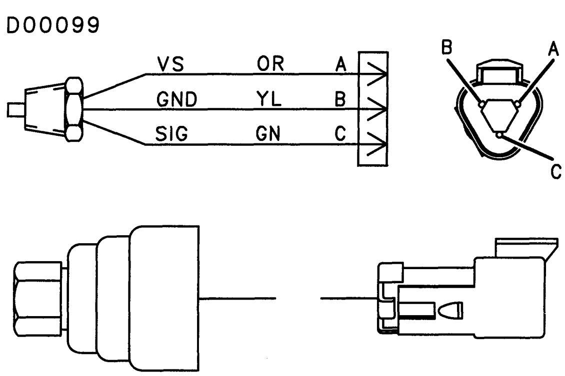
Optional panel light switch (PLS) (6) turns ON and OFF the panel lamps.

Diagnostic reset switch (DRS) (3) clears all diagnostic codes that are stored in the Electronic Ignition System (EIS). For more information, see the Electronic Troubleshooting module for the particular engine.

EMCP II Sensors

The GSC monitors four engine sensors: the engine oil pressure sensor, engine coolant temperature sensor, engine coolant loss sensor (optional) and the engine magnetic pickup (speed sensor).

Engine Oil Pressure Sensor



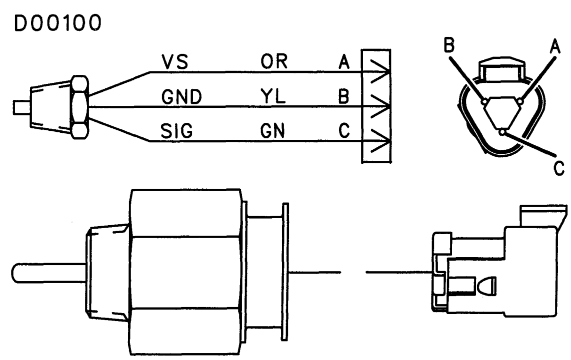
Engine Oil Pressure Sensor

The engine oil pressure sensor is an input of the GSC. The purpose of the sensor is to tell the GSC what the engine oil pressure is. The GSC shows the engine oil pressure on the lower display and also uses the sensor information to determine when a low oil pressure fault exists. The engine oil pressure sensor is mounted on the outside of one of the engine oil galleries. The exact location depends upon the engine model.

The engine oil pressure sensor is a pulse-width-modulated (PWM) type of sensor. This sensor continuously generates a PWM signal, in which the duty cycle varies from 10 to 90% in proportion to the oil pressure of the engine. The GSC receives the PWM signal and measures the duty cycle to determine the oil pressure of the engine. The base frequency of the signal is constant at 500 $\pm$ 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 related to engine oil pressure that are programmed into the GSC. The related setpoints are: P03, P04, P12, P13 and P14. See Setpoint Programming - OP5 within the topic Service Mode.

Engine Coolant Temperature Sensor



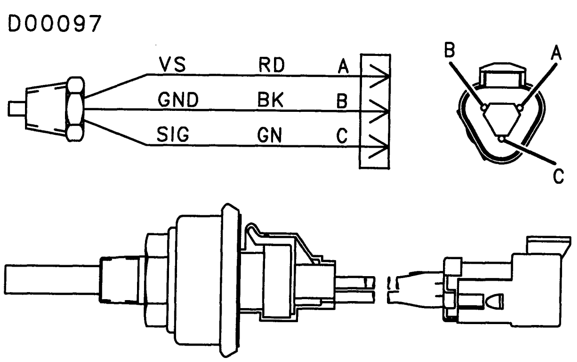
Engine Coolant Temperature Sensor

The engine coolant temperature sensor is an input of the GSC. The purpose of the sensor is to tell the GSC what the engine coolant temperature is. The GSC shows the engine coolant temperature on the lower display and also uses the sensor information to determine when a high coolant temperature fault exists. The engine coolant temperature sensor is mounted in the water jacket, usually towards the front of the engine. The exact location depends upon the engine model.

The engine coolant temperature sensor is a pulse-width-modulated (PWM) type of sensor. This sensor continuously generates a PWM signal, in which the duty cycle varies from 10 to 95% in proportion to the coolant temperature of the engine. The GSC receives the PWM signal and measures the duty cycle 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 related to engine coolant temperature that are programmed into the GSC. The related setpoints are: P03, P04, P15 and P16. See Setpoint Programming - OP5 within the topic Service Mode.

Engine Coolant Loss Sensor



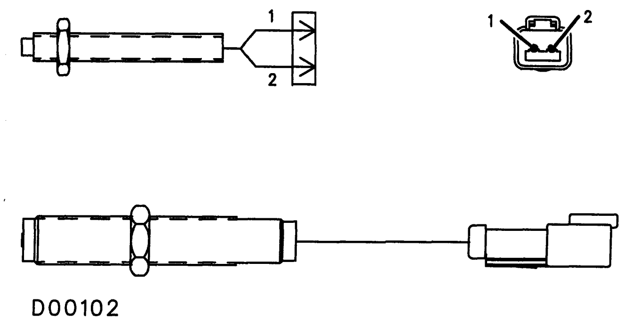
Engine Coolant Loss Sensor

The engine coolant loss sensor is optional and is an input of the GSC. The purpose of the sensor is to tell 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 loss sensor is usually mounted near the top of the engine radiator. The exact location depends upon the engine model.

The engine coolant loss sensor sends the GSC either a battery negative (B−) signal for normal level or a +5 DCV signal for low level. The signal wire (connector contact C) of the coolant loss sensor connects to connector contact 13 of the GSC. The sensor is supplied operating power (8 DCV) at connector contact A from the GSC (connector contact 9).

There are three setpoints related to engine coolant loss that are programmed into the GSC. The related setpoints are: P04, P05 and P06. See Setpoint Programming - OP5 within the topic Service Mode.

Engine Magnetic Pickup



Engine Magnetic Pickup

The engine magnetic pickup is an input of the GSC. The purpose of the sensor is to tell the GSC what the engine speed is. The GSC shows the engine speed on the lower display and also uses the sensor information for tasks such as activating an engine overspeed shutdown, terminating engine cranking and determining the oil step speed. The engine magnetic pickup 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 the GSC a sine wave signal in which the frequency is in direct proportion to the speed of the engine. The GSC receives the sine wave signal and measures the frequency (one pulse per gear tooth) to determine the speed of the engine. The wires of the sensor connect to connector contacts 1 and 2 of the GSC within a shielded cable. One wire is grounded near the GSC.

There are four setpoints related to engine speed that are programmed into the GSC. The related setpoints are: P09, P10, P11 and P12. See Setpoint Programming - OP5 within the topic Service Mode.

Modes Of Operation

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 Indicator/s	All Off	All Off	Flashing
Fault Alarm Indicator	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 Upper Display	Selects The AC Phase That Is Shown On 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 Alarm 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 alarm 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.

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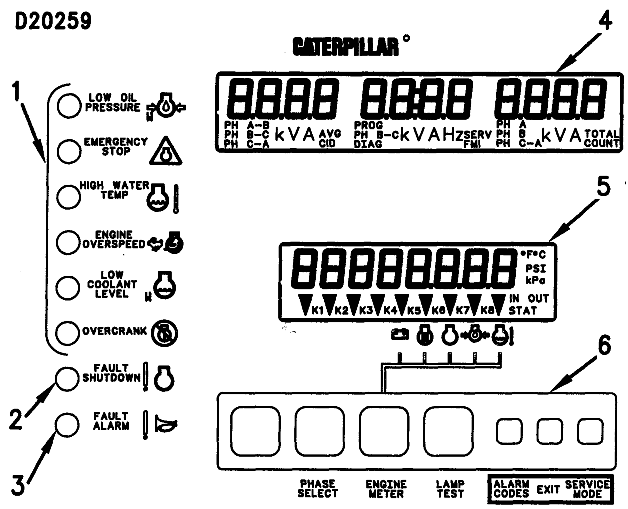


Display Area Of Generator Set Control (GSC)
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

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

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

Alarm Mode: The GSC automatically goes into alarm mode to alert the operator that an alarm fault (non-critical) is occurring. The operator can identify alarm mode by observing the display area. When in alarm mode, the fault alarm indicator is FLASHING.

Shutdown Mode: The GSC automatically goes into shutdown mode to shut the engine down and alert the operator that a shutdown fault (critical) is occurring. The operator can identify shutdown mode by observing the display area. When in shutdown mode, a dedicated or 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 or service person uses service mode to: assist with troubleshooting of diagnostic faults, to satisfy special applications, to satisfy customer needs and to verify or calibrate or adjust genset functions. The operator can identify service mode by observing the display area. When in service mode, "SERV" is SHOWING on the upper display.

Normal Mode

The purpose of normal mode is to monitor and control the genset. The GSC controls the engine according to the information received from the operator (panel switches, controls) and from the engine sensors. Some of the functions performed by the GSC while in normal mode are: engine starting, monitoring of important genset conditions, showing the operator the important genset conditions, fault detection and engine stopping. The operator can identify normal mode by observing the display area. When 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 run.

Engine Starting Sequence

1. The GSC receives an engine start signal. The possible engine start signals are:
   - ECS turned to START by the operator.
   - The remote initiate contacts (IC) close while the ECS is in the AUTO position.

2. The GSC checks the system before beginning the cranking sequence. The GSC checks that:
   - No system faults are present.
   - All previous faults have been reset (removed by turning the ECS to OFF/RESET).
   - The engine is not already running.
   - The service mode is not activated.

3. At the beginning of a crank cycle the GSC checks the crank time delay setpoint.

If the crank time delay setpoint is greater than 0 seconds, then for the setpoint amount of time (factory default is 5 seconds) The GSC will:

- Activate the ignition shutoff relay (ISR) (grounds the magneto)
- Activate the fuel control relay (FCR) on ETS fuel systems or deactivate on ETR fuel systems. Gas engines use the energized to run (ETR) type of fuel system.
- Activate the starting motor relay (SMR).

If the crank time delay setpoint is 0 seconds (or when it reaches 0 seconds), then the GSC will:

- Deactivate the ignition shutoff relay (ISR) which removes grounds from the magneto.
- Deactivates the fuel control relay (FCR) on ETS fuel systems or activates on ETR fuel systems. Gas engines use the energized to run (ETR) type of fuel system.
- Activates (or maintains active state) the starting motor relay (SMR).

4. While the starting motor is cranking, the GSC shows the status of the relays on the relay status indicators of the lower display.
   - K4, K5, K7 for ETR fuel systems. Gas engines use the energized to run (ETR) type of fuel system.
   - K4, K5 for ETS fuel systems.

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

6. The GSC activates the electronic governor (EG) relay when the oil pressure reaches the setpoint for low oil pressure at idle speed. The factory default is 70 kPa (10 psi). The EG relay signals the electronic governor (EG) to accelerate the engine to rated speed.

7. The GSC shows:
   - AC voltage, current and frequency for one phase at a time on the upper display.
   - System battery voltage, engine hours, engine rpm, oil pressure and coolant temperature on the lower display.
   - The relay status on the relay status indicators of the lower display. K1, K3, K5, K7 for ETR fuel systems and K1, K3, K5 for ETS fuel systems. Gas engines use the energized to run (ETR) type of fuel system.

Engine Stopping Sequence

1. The GSC receives an engine stop signal. The possible engine stop signals are:
   - ECS turned to STOP by the operator.
   - The remote initiate contacts (IC) open while the ECS is in the AUTO position.

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

3. The GSC begins the cooldown time (factory default is five minutes).

4. If programmed to do so, the GSC activates the spare output. This output can activate a slave relay during cooldown which in turn activates the optional circuit breaker and takes the generator off load.

5. After the cooldown time reaches the setpoint, the GSC deactivates the run relay (RR) and the electronic governor (EG) relay is deactivated after the engine oil pressure decreases to less than the setpoint for low oil pressure shutdown at idle speed (P14). Also the GSC shuts off the fuel by deactivating the fuel control relay (FCR) for ETR systems and activating the FCR for ETS systems. Gas engines use the energized to run (ETR) type of fuel system.

On ETS systems; after engine speed drops below 40 rpm and oil pressure drops below 80 kPa (12 psi), then the GSC activates the fuel control relay (FCR) for 70 seconds.

6. As soon as engine speed reaches 0 rpm, the GSC deactivates the crank terminate relay (CTR) and a restart is now allowed.

If a start signal is received before 0 rpm is reached, the fuel is turned on and the engine is allowed to run. If it 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 indicators of the lower display. All relay indicators should be OFF, except on ETS systems the K7 indicator remains ON for 70 seconds after engine speed and oil pressure are 0.

NOTE: If desired, the engine can be shutdown immediately by turning the ECS to OFF/RESET. The cooldown timer is bypassed and the spare data output is deactivated.

Alarm Mode

The purpose of alarm mode is to alert the operator that an alarm fault is occurring. An alarm fault is non-critical but potentially serious. An alarm fault precedes certain dedicated shutdown faults. When an alarm fault exists, the GSC automatically activates alarm mode and alerts the operator by FLASHING the fault alarm indicator. To identify what the alarm fault is, the operator presses the alarm codes key and then a corresponding fault code is shown on the upper display. This fault code can be an alarm fault code, spare fault code or a diagnostic fault code. For more information on fault codes, see the topic Fault Description. When the GSC is in alarm mode the engine is able to start or run.

Alarm faults depend upon certain setpoints. The GSC does not diagnose alarm faults and they are not recorded in the fault log. The alarm fault codes and the related setpoints are:

AL1 - High engine coolant temperature alarm. When coolant temperature rises to within 6°C (11°F) of the P15 setpoint, a high coolant temperature alarm is issued by the GSC. Then the GSC FLASHES the fault alarm indicator and alarm code AL1 is shown on the upper display after the alarm codes key is pressed.

> P15 is the setpoint for high water temperature shutdown. This setpoint tells the GSC at what coolant temperature to declare that a high coolant temperature shutdown fault exists. When the setpoint is reached, the GSC FLASHES the dedicated shutdown indicator for high water temperature and the engine is shutdown.

AL2 - Low engine coolant temperature alarm. When coolant temperature decreases to setpoint P16, then the GSC FLASHES the fault alarm indicator and alarm code AL2 is shown on the upper display after the alarm codes key is pressed.

> P16 is the setpoint for low water temperature alarm. This setpoint tells the GSC at what coolant temperature to declare that a low coolant temperature alarm fault (AL2) exists.

AL3 - Low engine oil pressure alarm. When oil pressure drops to within 34 kPa (5 psi) of the P13 or P14 setpoint, a low oil pressure alarm is issued by the GSC. Then the GSC FLASHES the fault alarm indicator and alarm code AL3 is shown on the upper display after the alarm codes key is pressed.

> P13 is the setpoint for low oil pressure shutdown at rated speed. This setpoint tells the GSC at what oil pressure to declare that a low oil pressure shutdown fault exists with the engine at rated speed. When the setpoint is reached, the GSC FLASHES the dedicated shutdown indicator for low oil pressure and the engine is shutdown.

P14 is the setpoint for low oil pressure shutdown at idle speed. This setpoint tells the GSC at what oil pressure to declare that a low oil pressure shutdown fault exists with the engine at idle speed. When the setpoint is reached, the GSC FLASHES the dedicated shutdown indicator for low oil pressure and the engine is shutdown.

For more setpoint information see the topic Service Mode.

Alarm faults do not have an immediate adverse effect on the genset. However, the operator should investigate the cause of the alarm fault condition at the earliest opportunity. If the operation of the genset is mandatory, the starting and stopping procedures are exactly the same as in normal mode. The GSC will respond to operator input from the panel switches and the engine sensors. The engine is able to start or run while an alarm fault is present.

NOTE: If a shutdown fault is overridden (by operator programming) to be an alarm fault, then the corresponding dedicated shutdown indicator is ON CONTINUOUSLY if the particular fault occurs. The ON CONTINUOUSLY state means that the normal shutdown response has been overridden by the operator and the shutdown fault is treated as an alarm fault. A fault code is not shown on the upper display for the overridden shutdown faults. The dedicated shutdown indicator remains ON CONTINUOUSLY until the fault is corrected and the engine control switch is turned to the OFF/RESET position. The shutdown faults that can be overridden are: low oil pressure, high coolant temperature and low coolant level. For more information, see P03 and P06 within the topic Setpoint Programming OP5. Also, see the topic Shutdown Mode.

Alarm Mode Sequence

1. An alarm fault occurs.

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

3. Pressing the alarm codes key causes the upper display to show a corresponding fault code.

4. Correct the alarm fault; see the topic Alarm Fault Troubleshooting in the Testing And Adjusting section.

5. When the alarm fault is no longer occurring (corrected), the GSC turns OFF the fault alarm indicator and removes the fault code from the upper display. The GSC now returns to normal mode.

Shutdown Mode

The purpose of shutdown mode is to prevent damage to the engine or generator 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. When in shutdown mode, the GSC shuts the engine down, prevents engine starting and alerts the operator.

The GSC alerts the operator and identifies the shutdown fault by FLASHING the corresponding shutdown indicator. The name of the shutdown indicator identifies the shutdown fault. The shutdown indicators are: low oil pressure, emergency stop, high water temperature, engine overspeed, low coolant level, engine overcrank and fault shutdown.

If the fault shutdown indicator is FLASHING, the cause is related to electrical component failure and additional diagnostic information is available. A diagnostic fault code is shown on the upper display which more precisely identifies the cause of the shutdown fault. For more information, see the topic Fault Description.

Shutdown Mode Sequence

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

2. To shut off the fuel, the GSC deactivates the fuel control relay (FCR) for ETR systems and activates the FCR for ETS systems. Gas engines use the energized to run (ETR) type of fuel system.

3. To prevent engine starting, the GSC deactivates the run relay (RR) and the starting motor relay (SMR).

4. The GSC activates the genset fault relay.

5. For an emergency stop fault, engine overspeed fault, or speed sensor fault (CID 190), the GSC activates the ignition shutoff relay (ISR) for 15 seconds.

6. As the engine comes to a stop, the GSC deactivates the crank termination relay (CTR) when engine speed reaches 0 rpm. The electronic governor (EG) relay is deactivated when the engine oil pressure reaches the setpoint [70 kPa (10 psi)] for low oil pressure shutdown at idle speed (P14).

7. For ETS fuel systems, a timer within the GSC is set to keep the fuel control relay (FCR) active for 70 seconds after engine speed decreases to 40 rpm and oil pressure decreases to 80 kPa (12 psi).

8. If engine speed does not decrease at least 100 rpm within five seconds, the GSC activates the ignition shutoff relay (ISR) for 15 seconds. (The ISR was already activated for an emergency stop fault, engine overspeed fault, or speed sensor fault).

9. The GSC FLASHES the corresponding shutdown indicator. If the fault shutdown indicator is FLASHING, the cause is related to electrical component failure and a diagnostic fault code is shown on the upper display. See the topic Fault Description.

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

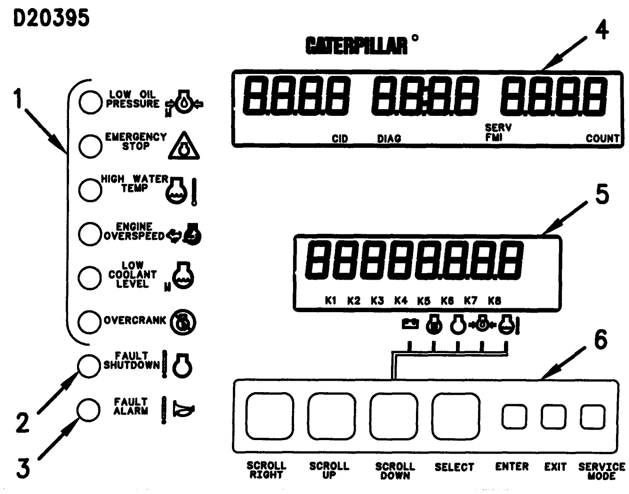
11. The relay status indicators show:
    K2
    K6 for 15 seconds - for an emergency stop fault, engine overspeed fault, speed sensor fault or if engine speed does not decrease at least 100 rpm.
    K7 (ETS fuel systems) for 70 seconds after engine speed decreases to 40 rpm and oil pressure decreases 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 topic Fault Identification in the Testing And Adjusting section.

2. Reset the GSC by turning the ECS to OFF/RESET. If no shutdown fault is active, the GSC returns to normal mode and the engine is able to start.

Service Mode



GSC Display Area With Service Mode Descriptions Of Keypad
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

The purpose of service mode is: to assist with troubleshooting of diagnostic faults, to satisfy special applications, to satisfy customer needs, and to verify or calibrate or adjust genset functions. Service mode has ten selectable options for viewing, entry, clearing, programming, verification and calibration of information by service personnel. The ten options are:

OP1 - Fault log viewing.
OP2 - Setpoint viewing.
OP3 - Password entry.
OP4 - Fault log clearing.
OP5 - Setpoint programming.
OP6 - Spare Input/Output programming.
OP7 - Hourmeter programming.
OP8 - Voltmeter/Ammeter programming.
OP9 - Engine setpoint verification.
OP10 - AC calibration.

The keypad and the display of the GSC are used for activating service mode and selecting the desired option. When in service mode the keys of the keypad have a different meaning than usual. The name of each key when in service mode is shown in the preceding illustration. Also a film (label) on the vandal door of the control panel identifies each key when in service mode. The service functions of the keys are:

Scroll Right Key - This key is used to view and scroll information. This key represents the number 1 when entering the password.

Scroll Up Key - This key is used to scroll up through information or to adjust the value of information upwards. This key represents the number 2 when entering the password.

Scroll Down Key - This key is used to scroll down through information or to adjust the value of information downwards. This key represents the number 3 when entering the password.

NOTE: To rapidly scroll through a large range of information, press and hold the appropriate scroll key.

Select Key - This key is used to select the option or the information that is to be viewed or changed. Also, this key is used to start or stop the scrolling of information.

Enter Key - This key is used to enter into the memory of the GSC, the information that has been changed with the other keys.

Exit Key - This key is used to exit service mode and return the display to normal. 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 access (enter) service mode. The "SERV" indicator on the upper display FLASHES whenever the GSC is in service mode and the keypad performs service mode functions.

Procedure To Enter Service Mode

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 can now be selected; see the following description of each option.

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To change a shutdown fault from an active shutdown fault to an inactive, the shutdown fault must no longer be occurring (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.

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

Service mode options OP4 through OP10 are password protected to reduce the possibility of information being altered by mistake. OP3 is the password entry option and the password must be correctly entered before access is gained to OP4 through OP10; see the topic Password Entry OP3. Options OP1 and OP2 are for the viewing of information and are not password protected.

Fault Log Viewing - OP1

OP1 is the option for viewing of diagnostic fault codes (CID FMI) that are recorded in the fault log of the GSC. The fault log contains a history of diagnostic faults that have occurred in the genset system since the last service call (the last clearing of diagnostic fault codes). Also, the number of occurrences are totalled and shown on the upper display with the CID and FMI codes. The purpose of the fault log is to assist service personnel when troubleshooting the genset system.

Only inactive diagnostic faults are stored in the fault log. An active diagnostic alarm fault ("DIAG" is FLASHING) becomes inactive ("DIAG" is ON CONTINUOUSLY) when the fault is no longer occurring and also for diagnostic shutdown faults the ECS must be turned to OFF/RESET. The GSC stores a maximum of 12 inactive diagnostic fault codes in the fault log. If an additional diagnostic fault becomes inactive, the GSC automatically clears the earliest inactive diagnostic fault code and puts the additional inactive diagnostic fault code in the fault log.

The GSC automatically clears any inactive diagnostic fault codes that have been stored in the fault log for more than 750 hours. For example; if a CID 190 FMI 3 fault code is logged at 10 hours and a CID 100 FMI 4 fault code is logged at 20 hours, then the GSC clears the CID 190 FMI 3 fault code when the hourmeter is at 760 hours and the CID 100 FMI 4 fault code remains logged until the hourmeter is at 770 hours. This feature prevents the fault log from becoming cluttered with fault codes that service personnel have corrected but forgot to clear.

When a diagnostic fault changes from active to inactive, the GSC functions as follows:

a. The diagnostic fault is recorded in the fault log of the GSC.
b. The "DIAG" indicator changes from FLASHING (active diagnostic fault) to ON CONTINUOUSLY (inactive diagnostic fault) if no other active faults are present.
c. The fault alarm indicator or fault shutdown indicator changes from FLASHING to OFF.

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode and view the fault log. To change a shutdown fault from an active shutdown fault to an inactive, the shutdown fault must no longer be occurring (must be corrected) and the ECS must be turned to the OFF/RESET position.

Procedure To View The Fault Log

NOTE: For a list of all diagnostic fault codes, see the Diagnostic Fault Codes chart in the Testing And Adjusting section.

1. Press SERVICE MODE key to enter service mode. "OP 1" is showing on the lower display. For more information see the topic Service Mode.
2. Press SELECT key. The CID/FMI fault codes for diagnostic faults are scrolled on the upper display (if more than one fault code is in the log). Each fault code has the number of occurrences showing above the COUNT indicator. The lower display shows the hourmeter value of 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 particular fault code is logged, the first occurrence with it's hourmeter value 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 returns to normal.

Setpoint Viewing - OP2

OP2 is the option for viewing the setpoints of important genset conditions. The setpoints affect the proper operation and serviceability of the engine, and the accuracy of the information shown on the display. Viewing the setpoints is done with the engine running or stopped.

The setpoints viewed (stored in the GSC) should match the specified setpoints of the control panel. For more information on setpoints, see the topic Setpoint Programming OP5.

The setpoints and the default values are:

P01 - Fuel Solenoid Type. Default value is 0 (ETR).
P02 - Units Shown. Default value is 0 (English).
P03 - Shutdown Override For Engine Fault. Default value is 0 (shutdown).
P04 - Shutdown Override For Sensor Fault. Default value is 0 (override).
P05 - Coolant Loss Sensor. Default value is 0 (not installed).
P06 - Shutdown Override For Coolant Loss Fault. Default value is 0 (shutdown).
P07 - System Voltage. Default value is 0 (24V).
P08 - Upper Display Enable/Disable. Default value is 0 (enable).
P09 - Ring Gear Teeth. Default value is 136 teeth.
P10 - Engine Overspeed. Default value is 2120 rpm.
P11 - Crank Terminate Speed. Default value is 400 rpm.
P12 - Oil Step Speed. Default value is 1350 rpm.
P13 - Low Oil Pressure Shutdown At Rated Speed. Default value is 205 kPa (30 psi).
P14 - Low Oil Pressure Shutdown At Idle Speed. Default value is 70 kPa (10 psi).
P15 - High Water Temperature Shutdown. Default value is 107°C (225°F).
P16 - Low Water Temperature Alarm. Default value is 21°C (70°F).
P17 - Total Cycle Crank Time. Default value is 90 seconds.
P18 - Cycle Crank Time. Default value is 10 seconds.
P19 - Cooldown Time. Default value is five minutes.
P20 - AC Voltage Full Scale. Default value is 700 volts.
P21 - AC Current Full Scale. Default value is 600 amps.
P22 - GSC Engine Number. Default value is 01.
P23 - Engine Type. Default value is 0 (MUI diesel).
P24 - Crank Time Delay. Default value is 5 seconds.

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode and view the setpoints. To change a shutdown fault from an active shutdown fault to an inactive, the shutdown fault must no longer be occurring (must be corrected) and the ECS must be turned to the OFF/RESET position.

Procedure To View The Setpoints

1. Press SERVICE MODE key to enter service mode. "OP 1" is showing on the lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key. "OP 2" is showing.

3. Press SELECT key. "P01" followed with the value of the setpoint is showing.

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

5. Press EXIT key. "OP 1" is showing on lower display.

6. Press EXIT key. The display returns to normal.

Password Entry - OP3

OP3 is the option for entering the password that is required for accessing OP4 through OP10. Service mode options OP4 through OP10 are password protected to reduce the possibility of information being altered by mistake. Options OP1 and OP2 are for the viewing of information and are not password protected.

Password entry consists of actuating the scroll keys in the correct sequence by service personnel. The password is the same for every GSC and is not changeable. After the password is entered, the OP4 through OP10 options can be accessed. If a mistake is made during password entry, FAIL is briefly shown on the upper display and then five dashes are shown with the first one flashing. Pressing the select key starts the password entry process again.

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode and enter the password. To change a shutdown fault from an active shutdown fault to an inactive, the shutdown fault must no longer be occurring (must be corrected) and the ECS must be turned to the OFF/RESET position.

Procedure To Enter The Password

1. Press SERVICE MODE key to enter service mode. "OP 1" is showing on the lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key twice. "OP 3" is showing.

3. Press SELECT key. "PE – – – – –" is showing.

4. Press SELECT key. "PE – – – – –" with the first dash flashing is showing.

5. Press SCROLL RIGHT key. "PE 1– – – –" with the second dash flashing is showing.

6. Press SCROLL DOWN key. "PE 13– – –" with the third dash flashing is showing.

7. Press SCROLL UP key. "PE 132– –" with the fourth dash flashing is showing.

8. Press SCROLL DOWN key. "PE 1323–" with the fifth dash flashing is showing.

9. Press SCROLL RIGHT key. "PE 13231" with all digits not flashing is showing.

10. Press ENTER key. "PE PASS" is showing.

11. Press EXIT key. "OP 1" is showing.

NOTE: After the password is entered, any option can be accessed any number of times. The password remains in effect until service mode is exited. If the operator attempts to enter the password twice, "PE PASS" reappears on the lower display.

Fault Log Clearing - OP4

OP4 is the option for clearing a diagnostic fault from the fault log of the GSC. After a diagnostic fault is investigated and/or corrected, it should be cleared from the fault log to avoid 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. Also see the topic Fault Log Viewing OP1.

Procedure For Clearing Faults

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key three times. "OP 4" is showing on the lower display.

3. Press SELECT key. A CID/FMI fault code and the counts (number of occurrences) are showing. The lower display shows the hourmeter value of the last occurrence of the fault.

4. Press SELECT key. The CID/FMI fault code, count and hourmeter value all flash.

5. Press ENTER key for two seconds.

   If there is only one CID/FMI fault code, the CID/FMI that was flashing disappears and the upper display is blank except for the flashing "SERV" indicator. "OP 1" 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 and the upper display shows the next CID/FMI with it's count and hourmeter value. Repeat steps 4 and 5 until all faults are erased. The lower display then shows "OP 1". Proceed to the next step.

6. Press EXIT key. "OP 1" is showing on lower display.

7. Press EXIT key. The display returns to normal.

Setpoint Programming - OP5

OP5 is the option for programming the setpoints of important genset conditions. The setpoints affect the proper operation and serviceability of the engine, and the accuracy of the information shown on the display. The setpoints are programmed (set) in the GSC at the factory. However, the setpoints may need changed when the GSC is moved from one engine to another or to adapt to a particular situation (for example: cycle crank time and cooldown time).

The setpoints are:
P01 - Fuel Solenoid Type
P02 - Units Shown
P03 - Shutdown Override For Engine Fault
P04 - Shutdown Override For Sensor Fault
P05 - Coolant Loss Sensor
P06 - Shutdown Override For Coolant Loss Fault
P07 - System Voltage
P08 - Upper Display Enable/Disable
P09 - Ring Gear Teeth
P10 - Engine Overspeed
P11 - Crank Terminate Speed
P12 - Oil Step Speed
P13 - Low Oil Pressure Shutdown At Rated Speed
P14 - Low Oil Pressure Shutdown At Idle Speed
P15 - High Water Temperature Shutdown
P16 - Low Water Temperature Alarm
P17 - Total Cycle Crank Time
P18 - Cycle Crank Time
P19 - Cooldown Time
P20 - AC Voltage Full Scale
P21 - AC Current Full Scale
P22 - GSC Engine Number
P23 - Engine Type
P24 - Crank Time Delay

Procedure For Setpoint Programming

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key four times. "OP 5" is showing on the lower display.

3. Press SELECT key. "P01" followed with the value of the setpoint is showing.

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

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

6. Press SCROLL UP or SCROLL DOWN key to adjust the value of the setpoint.

NOTE: To adjust the value of some setpoints, it is necessary to press and release the scroll key several times in order for the value to change. 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.

Setpoint Description

P01 - Fuel Solenoid Type: This setpoint tells the GSC the type of fuel system solenoid used on the genset. The factory default is 0. The values are:

0 - for an energize to run (ETR) fuel solenoid. Gas engines use the energized to run (ETR) type of fuel system.
1 - for an energize to shutoff (ETS) fuel solenoid.

P02 - Units Shown: This setpoint tells the GSC which type of measurement units to show on the display. The factory default is 0. The values are:

0 - for English units (psi, degrees F).
1 - for metric units (kPa, degrees C).

P03 - Shutdown Override For Engine Fault: This setpoint tells the GSC how to respond to a low engine oil pressure or high coolant temperature fault. The factory default is 0. The values are:

0 - for engine shutdown.
1 - for alarm only (shutdown override, no engine shutdown).

NOTE: Shutdown override for a fault with low oil pressure or high coolant temperature is intended to be only temporary. When programmed to override these faults (P03 = 1), closely monitor the oil pressure and coolant temperature on the lower display. Do not override shutdown on a permanent basis unless regulations or codes specific to the application require it.

NOTICE

If the genset is unattended for any length of time and shutdown is overridden (P03 = 1), a low oil pressure fault or high coolant temperature fault could cause permanent damage to the engine.

P04 - Shutdown Override For Sensor Fault: This setpoint tells the GSC how to respond to a diagnostic fault with the engine oil pressure sensor, coolant temperature sensor, sensor power supply or coolant loss sensor. The factory default is 0. The values are:

0 - for alarm only (shutdown override, no engine shutdown).
1 - for engine shutdown.

P05 - Coolant Loss Sensor: This setpoint tells the GSC whether or not the optional engine coolant loss sensor is installed on the genset. The factory default is 0. The values are:

0 - for gensets without coolant loss sensor.
1 - for gensets with coolant loss sensor.

P06 - Shutdown Override For Coolant Loss Fault: This setpoint tells the GSC how to respond to an engine coolant loss fault. The factory default is 0. The values are:

0 - for engine shutdown.
1 - for alarm only (shutdown override, no engine shutdown).

NOTE: Shutdown override for a coolant loss fault is intended to be only temporary. Do not override shutdown on a permanent basis unless regulations or codes specific to the application require it.

NOTICE

If the genset is unattended for any length of time and shutdown is overridden (P06 = 1), a coolant loss fault could cause permanent damage to the engine.

P07 - System Voltage: This setpoint tells the GSC the system voltage (battery voltage) used on the genset. The factory default is 0. The values are:

0 - for 24 volts.
1 - for 32 volts.

P08 - Upper Display Enable/Disable: This setpoint tells the GSC whether to enable or disable the showing of AC values on the upper display. All other information such as diagnostic fault codes and service mode values will continue to be shown on the upper display. The factory default is 0. The values are:

0 - for upper display enabled.
1 - for upper display disabled.

P09 - Ring Gear Teeth: This setpoint tells the GSC the number of teeth on the ring gear of the engine. The factory default is 136 teeth. The value is selectable from 95 to 350 teeth in increments of one tooth.

P10 - Engine Overspeed: This setpoint tells the GSC at what engine speed to declare that an engine overspeed fault exists. The engine overspeed setpoint (for all 60 Hz applications) is 1.18 times the rated speed. The factory default is 2120 rpm. The value is selectable from 500 to 4330 rpm in increments of 10 rpm.

P11 - Crank Terminate Speed: This setpoint tells the GSC at what engine speed to disengage the starting motor during engine cranking. The factory default is 400 rpm. The value is selectable from 100 to 1000 rpm in increments of 10 rpm.

P12 - Oil Step Speed: This setpoint tells the GSC the engine speed to use for distinguishing between rated speed and idle speed when a low oil pressure fault exists. The factory default is 1350 rpm. The value is selectable from 400 to 1800 rpm in increments of 10 rpm.

Oil Step Speed		
Engine Family	**Rated Speed (rpm)**	**Setpoint (rpm)**
G3400	1500	1210
	1800	1210
G3500	1000	810
	1200	810
	1500	1210
	1500	1210

P13 - Low Oil Pressure Shutdown At Rated Speed: This setpoint tells the GSC at what oil pressure to declare that a low oil pressure shutdown fault exists with the engine at rated speed (the engine speed must have exceeded the oil step speed for nine seconds). The factory default is 205 kPa (30 psi). The value is selectable from 34 to 420 kPa (5 to 60 psi) in increments of one.

G3400 .... 275 kPa (40 psi)
G3500 .... 207 kPa (30 psi)

NOTE: When oil pressure drops to within 34 kPa (5 psi) of the P13 setpoint, an oil pressure alarm is issued by the GSC and the optional alarm module.

P14 - Low Oil Pressure Shutdown At Idle Speed: This setpoint tells the GSC at what oil pressure to declare that a low oil pressure shutdown fault exists 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 the oil step speed). The factory default is 70 kPa (10 psi). The value is selectable from 20 to 336 kPa (3 to 50 psi) in increments of one.

G3400 .... 100 kPa (15 psi)
G3500 .... 70 kPa (10 psi)

NOTE: When oil pressure drops to within 34 kPa (5 psi) of the P14 setpoint, an oil pressure alarm is issued by the GSC and the optional alarm module.

P15 - High Water Temperature Shutdown: This setpoint tells the GSC at what coolant temperature to declare that a high coolant temperature shutdown fault exists (after a 10 second delay). The factory default is 107°C (225°F). The value is selectable from 94 to 123°C (201 to 253°F) in increments of one degree.

G3400 .... 105°C (221°F)
G3500 .... 109°C (228°F)

NOTE: When coolant temperature rises to within 6°C (11°F) of the P15 setpoint, a high coolant temperature alarm is issued by the GSC and the optional Alarm Module.

P16 - Low Water Temperature Alarm: This setpoint tells the GSC (and the optional alarm module) at what coolant temperature to declare that a low coolant temperature alarm fault exists (after a two second delay). The factory default is 21°C (70°F). The value is selectable from 0 to 36°C (32 to 97°F) in increments of one degree.

P17 - Total Cycle Crank Time: This setpoint tells the GSC at what cycle crank time to declare that an overcrank fault exists. The factory default is 90 seconds. The value is selectable from 5 to 360 seconds in increments of five seconds.

P18 - Cycle Crank Time: This setpoint tells the GSC the amount of time to crank and then to rest the starting motor during a single crank cycle. The factory default is 10 seconds. The value is selectable from 5 to 300 seconds in increments of five seconds.

P19 - Cooldown Time: This setpoint tells the GSC the amount of time to allow the engine to run after a normal shutdown is initiated. The factory default is 5 minutes. The value is selectable from 0 to 30 minutes in increments of one minute.

P20 - AC Voltage Full Scale: This setpoint tells the GSC the full scale (maximum) AC voltage of the genset. The GSC measures the AC voltage and shows it on the display. The values are: 700V, 150V, 300V, 500V, 500V, 750V, 3.0kV, 4.5kV, 5.25kV, 9.0kV, 15.0kV and 18.0kV. The setpoint is factory set at 700V for all standard EMCP II equipped gensets. The factory default is 700V. The other values are for switch gear applications and require the use of external potential transformers and the removal of the AC voltage range jumper located in the relay module. See the topic AC Voltage Range Selection in the Testing And Adjusting section.

P21 - AC Current Full Scale: This setpoint tells the GSC the full (maximum) AC current of the genset. The GSC measures the AC current and shows it on the display. The values are: 75A, 100A, 150A, 200A, 300A, 400A, 600A, 800A, 1000A, 1200A, 1500A, 2000A, 2500A, 3000A and 4000A. The factory default is 600A. The generator must be equipped with the proper corresponding current transformers.

P22 - GSC Engine Number: This setpoint informs other devices on the CAT Data Link of the engine number for the GSC. The values are from 01 through 08. The factory default is 01.

P23 - Engine Type: This setpoint tells the GSC whether the genset engine is a mechanical unit injector (MUI) diesel, spark ignited (SI) or electronic unit injector (EUI) engine. The factory default is 0. The values are:

0 - for MUI diesel.
1 - for SI.
2 - for EUI diesel

P24 - Crank Time Delay: This setpoint tells the GSC the amount of time to delay activation of the FCR during a crank cycle. This setpoint is for spark ignited engines only. The P24 setpoint only functions when the P23 setpoint is set to 1 (spark ignited engine). The factory default is 5 seconds. The value is selectable from 0 to 20 seconds in increments of one second.

Spare Input/Output Programming - OP6

OP6 is the option for programming of the spare inputs and spare output. The GSC has three spare inputs and a spare output for satisfying the needs of the customer. The spare inputs and output are accessed on the auxiliary terminal strip (AUX) within the control panel on the left wall. The terminations are:

- Spare Input 1 (SP1) is marked as SW1 at terminal 1 of the auxiliary terminal strip.
- Spare Input 2 (SP2) is marked as SW2 at terminal 2 of the auxiliary terminal strip.
- Spare Input 3 (SP3) is marked as SW3 at terminal 3 of the auxiliary terminal strip.
- Spare Output is marked as SPARE at terminal 5 of the auxiliary terminal strip.

The setpoints for the spare inputs and the spare output are:

SP01 - Spare Fault 1 Active State. The value is either 0 for active low or 1 for active high. The factory default is 0.

SP02 - Spare Fault 1 Response. The value is either 0 for shutdown or 1 for alarm. The factory default is 0.

SP03 - Spare Fault 2 Active State. The value is either 0 for active low or 1 for active high. The factory default is 0.

SP04 - Spare Fault 2 Response. The value is either 0 for shutdown or 1 for alarm. The factory default is 0.

SP05 - Spare Fault 3 Active State. The value is either 0 for active low or 1 for active high. The factory default is 0.

SP06 - Spare Fault 3 Response. The value is either 0 for shutdown or 1 for alarm. The factory default is 0.

SP07 - Spare Output Active State. The value is either 0 for active low or 1 for active high. The factory default is 0.

SP08 - Spare Fault 1 Delay Time. The value is selectable from 0 to 250 seconds in increments of 1 second. The factory default is 0 seconds.

SP09 - Spare Fault 2 Delay Time. The value is selectable from 0 to 250 seconds in increments of 1 second. The factory default is 0 seconds.

SP10 - Spare Fault 3 Delay Time. The value is selectable from 0 to 250 seconds in increments of one second. The factory default is 0 seconds.

SP11 - Spare Output Response.

- 1 for spare fault 1.
- 2 for spare fault 2.
- 3 for spare fault 3.
- 4 for spare fault 1, 2, or 3.
- 5 for any alarm fault code or diagnostic alarm fault code.
- 6 for any alarm spare fault code, alarm fault code or diagnostic alarm fault code.
- 7 for engine cooldown.
- 8 for engine coolant loss.

The factory default for SP11 is 7 (cooldown).

Spare Inputs

The spare inputs are referred to as SP1, SP2 and SP3. The active 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 GSC has to be told (programmed) whether the active input state is high (+5 DCV to B+) or low (B-). When an input is programmed for a HIGH active state, a high at the input is considered a spare fault and a low at the input is considered a normal condition. When an input is programmed for a LOW active state, a low at the input is considered a spare fault and a high at the input is considered a normal condition.

NOTE: If an input is left floating (for example an open switch), the internal circuitry of the GSC pulls the input high and the GSC responds accordingly.

The GSC has to be told (programmed) how to respond to a spare fault (active). The response is to treat the condition as a fault shutdown or a fault alarm. Spare faults that are programmed to shutdown, are ignored by the GSC when engine speed is less than crank termination speed.

The GSC has to be told (programmed) how much time to delay the response to a spare fault (active input). After a spare fault occurs, the GSC does not respond (indicators are not activated, codes are not shown and engine operation is not changed) until the time delay has elapsed. The time delay is selectable from 0 to 250 seconds.

When a fault occurs in a spare input (input active) and it is programmed as an alarm:

a. The GSC waits for the time delay to elapse.
b. The fault alarm indicator FLASHES.
c. The corresponding code SP1, SP2 or SP3 is shown on the upper display of the GSC when the alarm codes key is pressed.
d. The engine continues to run or start.

When a fault occurs in a spare input (input active) and it is programmed as a shutdown:

a. The GSC waits for the time delay to elapse.
b. The fault shutdown indicator FLASHES.
c. The corresponding code SP1, SP2 or SP3 is immediately shown on the upper display of the GSC.
d. The engine is shut down or does not start.

The fault shutdown indicator remains FLASHING and the spare fault code remains shown until the ECS is turned to OFF/RESET. After turning the ECS to OFF/RESET and correcting the cause of the spare fault, the engine is able to start and run.

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

NOTE: If it is not desired to use the spare inputs, program the spare inputs for a LOW active state and connect nothing to the spare input wiring.

Spare Output

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

The GSC has to be told (programmed) whether the active state of the spare output is to be high or low. An active low state means that the output is pulled to battery negative when active. The output draws approximately 80mA when in the low state. An active high state means that the output will be allowed to float high (about 5.0 volts DC). When in the high state the spare output is floating and is capable of driving high impedance logic circuits only. When in the high state, the spare output will not drive low impedance loads such as relays.

The GSC has to be told (programmed) what condition is to trigger the spare output to the active state. The possible trigger conditions that can activate the spare output are:

a. An active SP1 fault code that is an alarm fault.
b. An active SP2 fault code that is an alarm fault.
c. An active SP3 fault code that is an alarm fault.
d. Any active SP1, SP2 or SP3 fault code that is an alarm fault.
e. Any active alarm fault code (AL1, AL2 or AL3) or diagnostic fault code (CID FMI) that is an alarm fault.
f. Any active alarm fault (SP1, SP2, SP3, AL1, AL2, AL3 or CID FMI).
g. Activate during cooldown time.
h. Activate during a coolant loss alarm or shutdown condition.

NOTE: A common use of the spare output is to activate the shunt trip coil of the AC circuit breaker during engine cooldown.

NOTE: The GSC diagnoses a fault in the spare output circuit. See CID 334 in the topic Diagnostic Faults of the Testing And Adjusting section.

Procedure For Spare Input/Output Programming

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.
2. Press SCROLL UP key five times. "OP 6" is showing on the lower display.
3. Press SELECT key. "SP01" followed with the value of the setpoint is showing.
4. Press SCROLL UP or SCROLL DOWN key. The next setpoint with it's value is showing. Repeat this step until the desired setpoint is showing.
5. Press SELECT key. The value of the setpoint is flashing.
6. Press SCROLL UP or SCROLL DOWN key to adjust the value of the setpoint.
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.

Hourmeter Programming - OP7

OP7 is the option for programming the hours shown on the hourmeter. The hours can be increased but not decreased. This allows the hours on a new GSC to exactly match the hours of the GSC it is replacing. This improves the tracking of engine maintenance (such as oil changes) when the GSC is replaced. Also, if the GSC is moved from one engine to another, the hours can be changed to match the new engine (provided the new hours are more than the old hours).
Also, if the hourmeter shows all dashes, the hours can be reprogrammed.

Procedure For Hourmeter Programming

This procedure uses as an example a new GSC with 0 hours. The hours are to be set to a value of 1234. This procedure applies to any value of hours desired (as long as the hours are increased).

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.
2. Press SCROLL UP key six times. "OP 7" is showing on the lower display.
3. Press SELECT key. The present hourmeter value (0 in this example) is showing.
4. Press SELECT key. "000000" with the first digit flashing is showing.
5. Press SCROLL RIGHT key two times. "000000" with the third digit flashing is showing.
6. Press SCROLL UP key. "001000" with the third digit flashing is showing.
7. Press SCROLL RIGHT key. "001000" with the fourth digit flashing is showing.
8. Press SCROLL UP key two times. "001200" with the fourth digit flashing is showing.
9. Press SCROLL RIGHT key. "001200" with the fifth digit flashing is showing.
10. Press SCROLL UP key three times. "001230" with the fifth digit flashing is showing.
11. Press SCROLL RIGHT key. "001230" with the sixth digit flashing is showing.
12. Press SCROLL UP key four times. "001234" with the sixth digit flashing is showing.

13. Press ENTER key. “001234” flashes on the lower display and “ArE YOU SUrE” is showing on the upper display.
    For yes, press ENTER key. “001234” stops flashing.
    For no, press SELECT key. “000000” with the first digit flashing is showing. Repeat this procedure to program the hourmeter again.

NOTE: If the original hourmeter value is to be kept in the GSC memory when the display shows “ArE YOU SUrE”, press exit key two times for a normal display. The original hourmeter value remains in the GSC.

NOTE: If the hours entered are less than that already stored in the GSC, then the upper display briefly shows “Error”. The display then shows the original hours that are stored in the GSC with the first digit flashing.

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

15. Press EXIT key. The display returns to normal. The programmed value for the hourmeter should show on the lower display as the engine data scrolls.

Voltmeter/Ammeter Programming - OP8

OP8 is the option for programming the calibration value of the voltmeter and ammeter. When either the GSC or the AC transformer box (ATB) is replaced, the calibration values, written on the ATB bar code sticker, must be programmed into the GSC to assure accurate voltage and current values. There are five transformers in the ATB that the GSC monitors for voltage and current information. Each transformer has individual characteristics that affect the voltage and current measurements by the GSC. At the factory, these characteristics are measured, assigned a calibration value and recorded on the bar code sticker which is located on the lower left side of the ATB. When the genset 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 one.

The setpoints for the calibration value of the voltmeter and ammeter are:

AC01 - A-B Voltage Calibration. The value is selectable from 0 to 255 in increments of one.

AC02 - B-C Voltage Calibration. The value is selectable from 0 to 255 in increments of one.

AC03 - C-A Voltage Calibration. The value is selectable from 0 to 255 in increments of one.

AC04 - A Current Calibration. The value is selectable from 0 to 255 in increments of one.

AC05 - B Current Calibration. The value is selectable from 0 to 255 in increments of one.

AC06 - C Current Calibration. The value is selectable from 0 to 255 in increments of one.

Procedure For Voltmeter/Ammeter Programming

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. “OP 1” is showing on lower display. For more information see the topic Service Mode.

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

3. Press SELECT key. “AC01” followed with the value (0 to 255) of the setpoint is showing.

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

5. Press SCROLL UP or SCROLL DOWN key to adjust the value of the setpoint.

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

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

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

9. Press EXIT key. The display returns to normal.

Engine Setpoint Verification - OP9

OP9 is the option for verifying that 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 the engine down. A low oil pressure or high water temperature fault causes the GSC to either shut the engine down or sound the alarm, according to the programmed setpoint P03.

The setpoints verified by this procedure are:

P03 - Shutdown Override For Engine Fault. The value is either 0 for shutdown or 1 for alarm (override). The factory default is 0.

P10 - Engine Overspeed. The value is selectable from 500 to 4330 rpm in increments of 10 rpm. The factory default is 2120 rpm.

P13 - Low Oil Pressure Shutdown At Rated Speed. The value is selectable from 34 to 420 kPa (5 to 60 psi) in increments of one. The factory default is 205 kPa (30 psi).

P14 - Low Oil Pressure Shutdown At Idle Speed. The value is selectable from 20 to 336 kPa (3 to 50 psi) in increments of one. The factory default is 70 kPa (10 psi).

P15 - High Water Temperature Shutdown. The value is selectable from 94 to 123°C (201 to 253°F) in increments of one degree. The factory default is 107°C (225°F).

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

a. The setpoints listed previously must be correct for the engine application. To view the setpoints, see Setpoint Viewing OP2 within the topic Service Mode. To program the setpoints, see Setpoint Programming OP5 within the topic Service Mode.

b. The engine is checked at idle and rated speed. No faults should be present at the initial start up. If necessary troubleshoot and correct any fault.

Procedure For Overspeed Verification

1. Start and run the engine at rated speed. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key eight times. "OP 9" is showing on the lower display.

3. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P10 is showing on the upper display. "SC1" followed with the present engine speed value is showing on the lower display.

4. Press SELECT key. The setpoint value (2120 is the default value) is flashing on the upper display.

5. Press SCROLL DOWN key to decrease the setpoint value (2120 is the default value) that is flashing on the upper display. The setpoint value decreases by 10 rpm with each press of the scroll down key. Continue pressing until the setpoint value decreases past the present engine speed value that is showing on the lower display.

When the setpoint value is less than the present engine speed value, the engine shuts down with the indicator for engine overspeed flashing. The GSC is no longer in service mode.

Procedure For Low Oil Pressure Verification

1. Start and run the engine at rated speed. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key eight times. "OP 9" is showing on the lower display.

3. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P10 is showing on the upper display. "SC1" followed with the present engine speed value is showing on the lower display.

4. Press SCROLL UP key one time. The value [205 kPa (30 psi) is the default value] of the P13 setpoint for low oil pressure shutdown at rated speed is showing on the upper display. "SC2" followed with the present oil pressure value is showing on the lower display.

5. Press SELECT key. The setpoint value [205 kPa (30 psi) is the default value] is flashing on the upper display.

6. Press SCROLL UP key to increase the setpoint value [205 kPa (30 psi) is the default value] that is flashing on the upper display. The setpoint value increases by five with each press of the scroll up key. Continue pressing until the setpoint value increases past the present oil pressure value that is showing on the lower display.

When the setpoint value is greater than the present oil pressure value, the engine shuts down with the indicator for low oil pressure flashing. The GSC is no longer in service mode.

Procedure For High Water Temperature Verification

1. Start and run the engine at rated speed. Enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key eight times. "OP 9" is showing on the lower display.

3. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P10 is showing on the upper display. "SC1" followed with the present engine speed value is showing on the lower display.

4. Press SCROLL UP key two times. The value [107°C (225°F) is the default value] of the P15 setpoint for high water temperature shutdown is showing on the upper display. "SC3" followed with the present coolant temperature value is showing on the lower display.

5. Press SELECT key. The setpoint value [107°C (225°F) is the default value] is flashing on the upper display.

6. Press SCROLL DOWN key to decrease the setpoint value [107°C (225°F) is the default value] that is flashing on the upper display. The setpoint value decreases by five degrees with each press of the scroll down key. Continue pressing until the setpoint value decreases past the present coolant temperature value that is showing on the lower display.

When the setpoint value is less than the present coolant temperature value, the engine shuts down with the indicator for high water temperature flashing. The GSC is no longer in service mode.

AC Calibration - OP10

OP10 is the option for calibrating the voltmeters of gensets operating in parallel. The AC voltage measurements of the GSC are calibrated at the factory with an accurate standard. However, when two gensets are paralleled, the application may require the paralleled gensets to have exactly the same voltage value. To do this, the AC calibration of one GSC is changed to match the voltage value of another genset.

NOTE: It is NOT recommended that the AC calibration be altered under any other circumstances. Performing this procedure takes the GSC out of factory calibration.

Procedure For Voltmeter Calibration

The paralleled gensets must be running at rated speed and adjusted to the desired voltage.

1. On the GSC to be calibrated, enter service mode and enter password. See the Procedure To Enter The Password within the topic Password Entry - OP3. "OP 1" is showing on lower display. For more information see the topic Service Mode.

2. Press SCROLL UP key nine times. "OP 10" is showing on the lower display.

3. Press SELECT key. "AC CAL" is showing on lower display. The present A-B voltage value is showing on the upper display.

4. Press SELECT key. The voltage value is flashing.

5. Press SCROLL UP or SCROLL DOWN key to adjust the voltage value to exactly match the other genset(s) running in parallel. Voltage value continues to flash.

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

7. Press SCROLL UP key. Repeat steps 3, 4, 5 and 6 for the B-C voltage and the C-A voltage.

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

9. Press EXIT key. The display returns to normal.

Fault Description

A fault is any condition that does not conform (an abnormal condition) to the rules (program) by which the GSC operates. A fault is either active (occurring now) or inactive (previously occurred). Some examples of a fault are:

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.
Broken wire in engine harness - this is a diagnostic fault.
A failed oil pressure sensor - this is a diagnostic fault.

There is a degree of severity attached to every fault, which also describes the GSC response to the fault. Faults are either an alarm (non-critical) fault or a shutdown (critical) fault. An alarm fault provides 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. For more information see the topic Alarm Mode. A shutdown fault tells the GSC to shut the engine down in order to prevent engine or generator damage. For a shutdown fault, the GSC automatically activates shutdown mode which shuts down the engine and FLASHES the corresponding shutdown indicator. For more information see the topic Shutdown Mode.

NOTE: For certain faults, the shutdown response or alarm response is selectable by service personnel. See the topic Spare Fault Codes and the topic Diagnostic Fault Codes.

Most faults have a code. There are three types of fault codes. The type is derived from the GSC input that is involved. The three types of fault codes are: alarm fault codes, spare fault codes and diagnostic fault codes. When the GSC detects a fault, a specific fault code is assigned to the fault. The fault code identifies the type of fault and the specific fault within the type. The fault code is shown on the upper display either immediately or when requested by the operator. For shutdown faults, the corresponding fault code is immediately shown on the upper display. For alarm faults, the operator must press the alarm codes key and then the fault code is shown on the upper display.

EXCEPTION: There are no fault codes for the shutdown faults that correspond to the dedicated shutdown indicators. Each of these shutdown faults are identified to the operator by the nomenclature nearest to the dedicated shutdown indicator.

Alarm Fault Codes

Alarm fault codes are associated with specific alarm faults and provide an early warning to the operator of a possible future shutdown fault. When one of the specific alarm faults occurs, the GSC activates alarm mode and the fault alarm indicator FLASHES. When the alarm codes key is pressed, the corresponding alarm fault code is shown on the upper display.

The alarm fault codes and the associated alarm faults are:

AL1 - High Water Temperature Alarm. This alarm fault occurs when the engine coolant increases to within 6°C (11°F) of setpoint P15 (high water temperature shutdown) for ten seconds. (If the temperature continues to rise and exceeds setpoint P15, then the alarm fault becomes a shutdown fault and the GSC shuts the engine down.)

AL2 - Low Water Temperature Alarm. This alarm fault occurs when the engine coolant temperature decreases to less than setpoint P16 (low water temperature alarm) for two seconds.

AL3 - Low Oil Pressure Alarm. This alarm fault occurs when the engine oil pressure decreases to within 34 kPa (5 psi) of setpoints P13 or P14 (low oil pressure shutdown) for nine seconds. (If the pressure continues decreasing to less than setpoint P13 or P14, then the alarm fault becomes a shutdown fault and the GSC shuts the engine down.)

Spare Fault Codes

Spare fault codes are associated with the spare inputs and are either alarm faults or shutdown faults. The three spare inputs and a spare output are for satisfying the needs of the customer. The spare inputs are programmable in regards to active state (high or low), severity (alarm or shutdown) and delay time. See Spare Input/Output Programming OP6 within the topic Service Mode. The spare inputs and the corresponding spare fault codes are referred to as SP1, SP2 and SP3.

For a spare input that is programmed as an alarm fault, the GSC activates alarm mode and the fault alarm indicator FLASHES. When the alarm codes key is pressed, the corresponding spare fault code (SP1, SP2 or SP3) is shown on the upper display. Also see the topic Alarm Mode.

For a spare input that is programmed as a shutdown fault: the GSC activates shutdown mode, the fault shutdown indicator FLASHES and the upper display immediately shows SP1, SP2 or SP3. When spare faults are programmed to shutdown, SP1 is ignored by the GSC when engine speed is less than crank termination speed. SP2 and SP3 are recognized by the GSC at all engine speeds. Also see the topic Shutdown Mode.

Due to the programmability of the spare faults, it is the duty of the operator, service personnel or customer to record and to inform the necessary personnel of the actual meaning of a spare fault code (SP1, SP2 or SP3).

Diagnostic Fault Codes

Diagnostic fault codes are associated with failed electrical components or circuits that provide information to or receive information from the GSC. These faults are either alarm faults or shutdown faults.

For a diagnostic fault that is an alarm fault, the GSC activates alarm mode and the fault alarm indicator FLASHES. When the alarm codes key is pressed, the corresponding diagnostic fault code is shown on the upper display. Also see the topic Alarm Mode.

For a diagnostic fault that is a shutdown fault, the GSC activates shutdown mode, the fault shutdown indicator FLASHES and the upper display immediately shows the corresponding diagnostic fault code. Also see the topic Shutdown Mode.

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

- Component Identifier (CID) – The CID is a three digit code that tells which component is faulty. The CID is shown on the upper display. For example; "190" means the circuit for the engine magnetic pickup (MPU) is faulty. For a list of CID codes, see the topic Diagnostic Faults in the Testing And Adjusting section.

- Failure Mode Identifier (FMI) – The FMI is a two digit code that tells what type of failure has occurred. The FMI is shown on the upper display at the same time as the CID. For example; "3" means the signal voltage is too high. For a list of FMI codes, see the topic Diagnostic Faults in the Testing And Adjusting section.

- "DIAG" indicator – When "DIAG" is FLASHING, the diagnostic fault code (CID FMI) shown on the upper display is active (present now). When "DIAG" is ON CONTINUOUSLY there is an inactive diagnostic fault and the CID FMI are recorded in the fault log. Also, see Fault Log Viewing OP1 within the topic Service Mode. When "DIAG" is absent (not showing), there are NO diagnostic fault codes detected or recorded.

NOTE: The alarm response or shutdown response of four diagnostic faults is programmable by service personnel. An alarm response is normal (P04 = 0), unless programmed for a shutdown response (P04 = 1). See Setpoint P04 within the topic Setpoint Programming. The diagnostic faults are: oil pressure sensor (CID 100), coolant temperature sensor (CID 110), coolant loss sensor (CID 111) and sensor power supply (CID 269).

The combination of CID, FMI and "DIAG" indicator describes one diagnostic fault. For example; if the upper display shows:

a. "190 3"
b. "DIAG" indicator is FLASHING

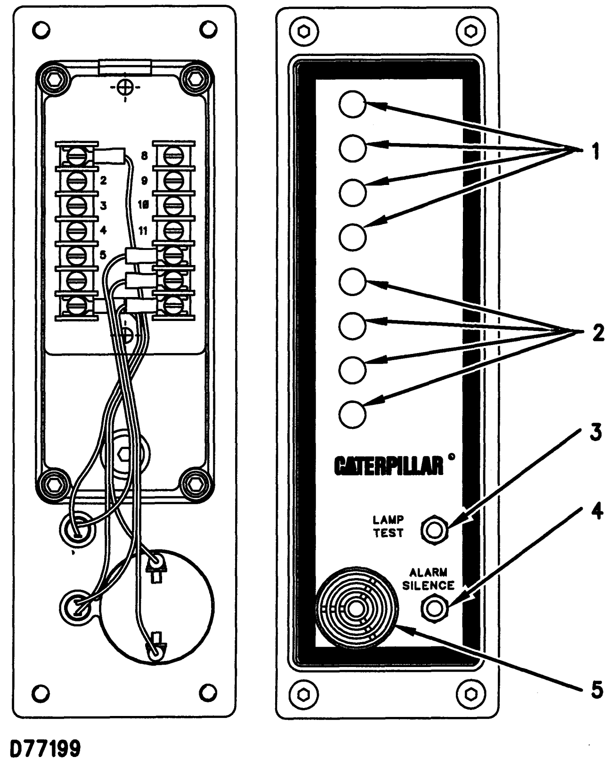
Then the signal that is being received by the GSC from the engine speed sensor (CID is 190) is too high (FMI is 3) at this time ("DIAG" is FLASHING).

The GSC has a fault log to help with troubleshooting of diagnostic faults. Inactive diagnostic fault codes (CID FMI) are recorded in the fault log for viewing at a later time. Also, the number of occurrences are totalled and shown on the upper display with the CID and FMI codes. An active diagnostic alarm fault ("DIAG" is FLASHING) becomes inactive ("DIAG" is ON CONTINUOUSLY) when the fault is no longer occurring and also for diagnostic shutdown faults the ECS must be turned to OFF/RESET. 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 diagnostic fault code and puts the additional diagnostic fault code in the fault log. Inactive diagnostic fault codes that are more than 750 engine hours old are cleared automatically by the GSC. Only diagnostic fault codes are recorded in the fault log. Alarm fault codes and spare fault codes are not recorded in the fault log. See Fault Log Viewing OP1 within the topic Service Mode.

After a diagnostic fault is investigated and/or corrected, clearing it from the fault log will avoid confusion during a future service call. When all diagnostic faults are cleared from the fault log and no active diagnostic faults exist the "DIAG" indicator is OFF (absent). See Fault Log Clearing OP4 within the topic Service Mode.

Optional Modules

Alarm Modules



Alarm Module
(1) Amber LED's. (2) Red LED's. (3) Lamp test switch. (4) Alarm silence switch. (5) Horn.

The alarm module (ALM) is an attachment located on the instrument panel. Red LED's (2) and amber LED's (1) are the visual indicators. Horn (5) is the audible indicator. The ALM is designed to operate when powered by only 24 DCV or 32 DCV battery systems.

There are five versions of the basic module. The modules are either alarm modules or a remote annunciator. The term remote annunciator is used but, it is the same basic alarm module. The versions are:

- Standby NFPA 99 alarm module.
- NFPA 99 remote annunciator, used with standby NFPA 99 alarm module.
- Standby NFPA 110 alarm module, used with NFPA 110 remote annunciator panel. See Remote Annunciator Panel (NFPA 110).
- Prime power alarm module.
- EMCP remote annunciator.

The difference between these modules is in the graphics film on the front of the panel and the jumper wires on the rear. See the DC schematic in the Schematics And Wiring Diagrams section. The NFPA 99 remote annunciator and the EMCP remote annunciator also have a lamp test switch. The following description of operation refers to the alarm/remote annunciator module as the annunciator module.

The purpose of the alarm modules (ALM) is to give a warning of conditions that are becoming a problem before conditions are bad enough to shut down the engine or keep it from starting.

If, with the ECS in the COOLDOWN/STOP or AUTO positions, an alarm fault develops prior to or while the genset is running, that fault is indicated by the optional alarm module and/or the remote annunciator.

Description Of Operation

NOTE: In the following description the word annunciator is used to mean either alarm module or remote annunciator module.

The annunciator module receives data from three sources: switch inputs, internal circuitry and a serial data link from the generator set control (GSC).

Switch Inputs

Up to four inputs are available for switch (i.e., Low Fuel Level) connections. Switch inputs are activated when connected to battery negative (–B). See Table 1.

Internal Circuitry

Internal circuitry is used to determine and annunciate if the DC battery supply voltage is below the setpoint (factory set at 24 DCV).

Data Link

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

1 - Coolant temperature has exceeded the high temperature alarm setpoint programmed into the generator set control (GSC).

2 - Oil pressure is below the low oil pressure alarm setpoint programmed into the generator set control (GSC).

3 - Coolant temperature is below the low temperature alarm setpoint programmed into the generator set control (GSC).

4 - The engine control switch (ECS) is not in the AUTO or MAN/START position.

5 - Oil pressure is below the low oil pressure shutdown setpoint programmed into the generator set control (GSC).

6 - Coolant temperature has exceeded the high water temperature shutdown setpoint programmed into the generator set control (GSC).

7 - The engine failed to start (overcrank).

8 - The engine speed exceeded the engine overspeed setpoint programmed into the generator set control (GSC).

9 - The engine 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.

Data items 1 through 8 control the operation of the LED's and the horn as indicated in Table 1. Data items 9 through 12 control the operation of the horn only.

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

LED And Horn Operation

Table 1: LED And Horn Function						
No. LED Color	NFPA 99 ALM	NFPA 110 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(4),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[1] Shutdown LI,H,TD
6 Red	Low DCV INT,TIM	Low DCV INT,TIM	Low Oil Pres Shutdown [1] LI,H	Spare SW(3)	Low DCV INT,TIM	Low Oil Press[1] Shutdown LI,H
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] SW(3),H	Overspeed Shutdown [1] LI,H	Not Used	Spare SW(4)	Overspeed Shutdown[1] LI,H
	SW(2) Not Used	SW(2) Not Used	SW(2) Not Used	SW(2) Not Used		

Key:
[1] Latched by the GSC.
[2] Air damper switch to be supplied by customer.
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 time delay occurs before the fault is annunciated.

When an alarm fault occurs, the LED corresponding to that fault flashes at two hertz and the horn sounds. If the alarm fault is NOT LATCHED, the LED and horn turn off as soon as the alarm fault ceases. If the alarm fault is LATCHED, the LED continues to flash until the acknowledge/silence input is activated. See Table 1 for LATCHED alarm faults and the LED and horn functions for each operating mode.

Normally switch input 3 (terminal 10) and switch input 4 (terminal 11) only operate LED's 7 and 8. However, it is possible for switch inputs 3 and 4 to also operate the horn. To do so, 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 LED to stay on continuously.

Data Link Malfunction

If the data link malfunctions, the LED's controlled by the data link flashes at 0.5 hertz. The switch controlled LED's function normally.

Lamp Test

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

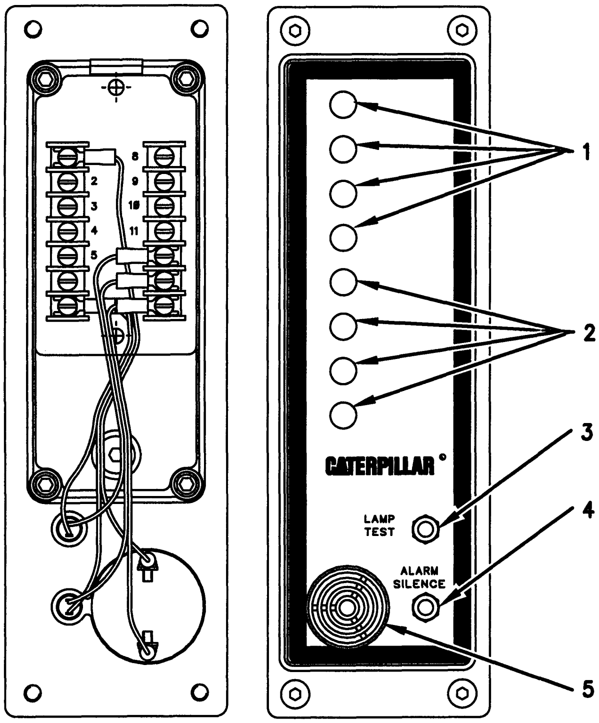
Mode Selection

Table 2: Mode Selection And Switch Input Connections						
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)

NOTE: Connections in parentheses are required to select the mode specified.

The annunciator module operates in one of the five modes described in Table 2. 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 2.

Remote Annunciator Panel - NFPA 110



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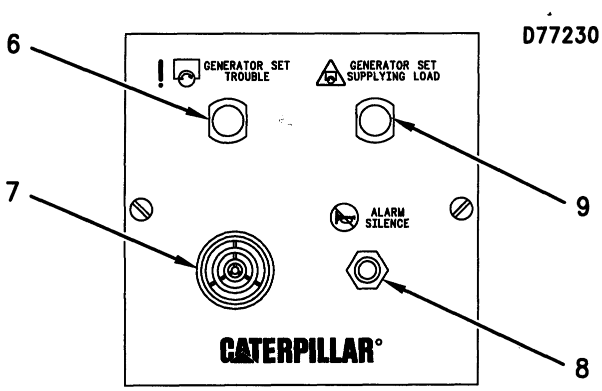
Alarm Module
(1) Amber LED's. (2) Red LED's. (3) Lamp test switch. (4) Alarm silence switch. (5) Horn.



NFPA 110 Remote Annunciator Panel
(6) Trouble light. (7) Horn. (8) Alarm silence switch. (9) Load light.

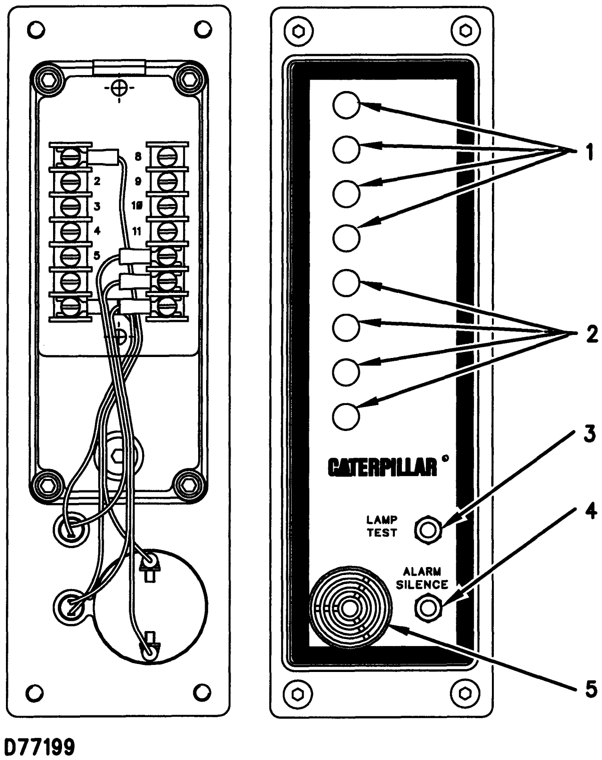
This remote panel functions in conjunction with the NFPA 110 alarm module. The alarm module is mounted in the right side of the instrument panel. When an alarm occurs on the alarm module or a fault occurs on the generator set control (GSC), horns (5) and (7) sound in both the alarm module and the remote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

When alarm silence switch (4) or (8) is pressed on either the remote panel or the alarm module, the horns on both cease sounding. Also, trouble light (6) on the remote panel goes out. The LED on the alarm module or GSC remains on. Another alarm fault reactivates the horns, LED and light as before.

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

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

Custom Alarm Module (CAM)



Custom Alarm Module (CAM)
(1) Amber LED's. (2) Red LED's. (3) Lamp test switch. (4) Alarm silence switch. (5) Horn.

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

The custom alarm module (CAM) is an attachment that can be mounted at the genset or at a remote location. The purpose of the CAM is to annunciate faults, alarms or other conditions from customer supplied inputs. The CAM operates when powered only by 24 DCV or 32 DCV battery systems. The custom alarm module (CAM) is equipped with a horn, alarm silence switch, a lamp test switch and 8 switched inputs for customer 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 is to be used with an existing fully equipped CAM or an existing alarm module (ALM).

Alarm Operation

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

When an input corresponding to one of the red shutdown LED's is activated (connected to battery negative), the LED will flash and the horn will sound. When the input is disconnected from battery negative, the horn will continue to sound and the red LED will continue to flash until the alarm silence switch is pressed.

When an input corresponding to one of the amber alarm LED's is activated, the LED will flash (the horn does NOT sound). When the input is disconnected from battery negative, the amber LED will turn off.

Alarm Silence Function

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

When an input is connected to battery negative, activating the alarm silence switch causes the horn to cease and causes the LED to change from flashing to ON continuously. The alarm silence function will be overridden if the status of any of the eight switched inputs changes causing additional inputs to be closed to battery negative.

The alarm silence function will not be overridden if the change in status is the opening of any of the inputs from battery negative. The LED's will turn off when their corresponding input is disconnected from battery negative.

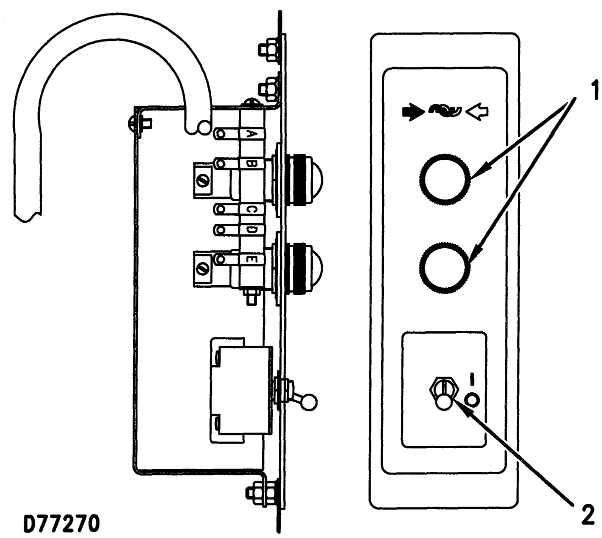
Lamp Test Function

Activating the lamp test switch results in sounding the horn and turning on all LED's 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 being monitored by each LED is determined by the customer. The 130-3326 Film provides a wide variety of labels for the customer to customize the CAM to their application.

Synchronizing Lights Module



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

The optional synchronizing lights (SL) module is located on the instrument panel (same location as for the optional alarm module). The SL module is not used when the panel is equipped with an electronic governor.

Synchronizing lights (SL) are used as an aid in manually paralleling generator units independent of load. Each of two lights are connected across the generator to the load side of the generator output circuit breaker. The voltage of two phases are measured and the lights indicate when the voltages are in phase. When the voltages are in phase, closing the circuit breaker puts the generator on-line with the other generator unit(s).

NOTE: For a complete explanation on how to parallel two units, make reference to the Operation and Maintenance Manual for SR4 Generators and Control Panels, Form No. SEBU6150 or Form No. SEBU6918.

Synchronizing Module Installation

⚠ WARNING

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

NOTE: For connection of the synchronizing light module and connection of resistor taps in the module, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagrams section.

Make an orderly shutdown of all generators connected to the system. Then connect synchronizing module wires to the terminals as follows:

a. Wire L1 to terminal L1 of TBC on the AC transformer box (ATB).

b. Wire L3 to terminal L3 of TBC on the AC transformer box (ATB).

c. Wire T11 to terminal 2 of fuse F13 on the AC transformer box (ATB).

d. Wire T13 to terminal 2 of fuse F15 on the AC transformer box (ATB).

The customer is responsible for providing proper wire and fusing to connect L1 and L3 to the load side of the generator output circuit breaker. See the AC Schematic in the Schematics And Wiring Diagrams section.

Adjust the connection of wires T11 and T13 on the taps of synchronizing resistors (SLR1) and (SLR2) respectively as required for the particular generator AC voltage.

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

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

Example: For a generator with 400 volts line to line, wire T11 connects to tap B of SLR1 and wire T13 connects to tap B of SLR2. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagrams section.

Synchronizing Lights Module – With Reverse Power Relay

NOTE: The synchronizing lights module (with reverse power relay) option looks and operates the same as the module without the reverse power relay with the exception of the reverse power relay (RPR) mounted on the sub-panel within the control panel.

For information on the synchronizing lights module, see the previous section on the Synchronizing Lights Module.

Introduction

The reverse power relay (RPR) provides system protection when the genset is in parallel with other units. If for some reason the engine loses power, the other parallel unit attempts to motorize (drive electrically) the engine and generator. As long as voltage is present at the generator leads, the voltage regulator maintains the field excitation. The engine and generator remain magnetically coupled and the generator then drives the engine. Instead of power going OUT, power flows INTO the failing generator. This reverse flow of power could possibly result in overloading of the other generators and the whole system.

The reverse power relay (RPR) is a single phase relay which is energized by power (amp-volts) in only one direction (power into generator instead of out). In a reverse power fault, the relay (RPR) (located on AC Schematic) closes its contact across RPR (5 and 6) (line 19) (located on DC Schematic). The GSC records an SP1 fault and the engine is shutdown. If the generator output breaker is equipped with shunt trip, the generator is taken off line. See the Schematics And Wiring Diagrams section.

After the reverse power fault is corrected, the generator set control (GSC) is reset by turning the engine control switch (ECS) to the OFF/RESET position. Also reset the generator output breaker if equipped with shunt trip.

The operation of the RPR is tested by pushing the test button on the RPR while the generator is on load. Depress and hold the test button for 10 to 15 seconds (until time delay elapses).

⚠ WARNING

To avoid personal injury from electrical shock, do NOT touch the high voltage terminal while adjusting the reverse power relay.

The relay trip point is field adjustable, but is normally factory set at approximately 15% of the generator rated kW (for on-line generators operating at 15% or more of rated kW).

Overvoltage Relay (OVR)

The overvoltage relay (OVR) is an option and mounts to the sub-panel within the control panel. The OVR provides system protection for line to line overvoltages. The OVR is a three phase relay with an adjustable pickup setpoint from 100 to 125% of its nominal rating. The setpoint also has an adjustable time delay from 0.5 to 20 seconds.

If system voltage exceeds the setpoint for more than the time delay setting, then contacts 7 and 8 of the OVR will close. The generator set control (GSC) will record an SP1 fault and the engine is shutdown. If the generator set is equipped with an optional circuit breaker with shunt trip, the generator is taken off line. See the Schematics And Wiring Diagrams section.

⚠ WARNING

To avoid personal injury from electrical shock, do NOT touch the high voltage terminals while adjusting the over voltage relay.

After the SP1 fault is corrected, the generator set control (GSC) is reset by turning the engine control switch (ECS) to the OFF/RESET position. If equipped with shunt trip, the generator output breaker must also be reset. The pickup setpoint and time delay are field adjustable. The pickup setpoint is factory set to the maximum value (125% of nominal relay rating).

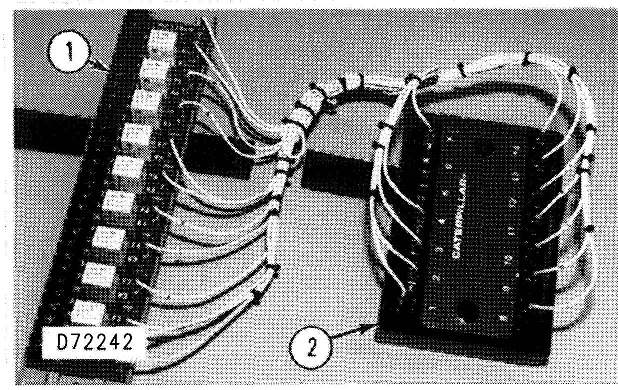
Overcurrent Relay (OCR)

The overcurrent relay (OCR) is an option and mounts to the sub-panel within the control panel. The OCR provides system protection for excessive line current. The OCR is a three phase relay which uses a solid state sensor to detect excessive line currents. The relay receives a 0 to 5 amp AC signal from the secondary of the generator current transformers (CT's). Each generator is equipped with three CT's which are sized according to the voltage and kilowatt rating of the generator. The CT provides a 5 amp AC signal when the generator is operating at approximately 115% of the generator rating. The OCR has an adjustable pickup setpoint from 1 to 5 amps. The setpoint also has an adjustable time delay which allows the standard inverse time delay to be increased from 0.5 to 20 seconds. The OCR requires DC power to operate, see the DC Schematics in the Schematics And Wiring Diagrams section.

If any one of the three phase currents exceeds the setpoint for more than the time delay setting, then contacts 11 and 12 of the OCR will close. The generator set control (GSC) will record an SP1 fault and the engine is shutdown. If the generator set is equipped with an optional circuit breaker with shunt trip, the generator is taken off line. See the Schematics And Wiring Diagrams section.

After the SP1 fault is corrected, the generator set control (GSC) is reset by turning the engine control switch (ECS) to the OFF/RESET position. If equipped with shunt trip, the generator output breaker must also be reset. The pickup setpoint and time delay are field adjustable. The pickup setpoint is factory set to the maximum value (115% of the generator rating).

Customer Interface Module (CIM)



Customer Interface Module (CIM)
(1) Relay board. (2) Electronic control.

REFERENCE: For more information, see the Schematics And Wiring Diagrams section.

The CIM provides an interface (separate relay contacts) between the GSC and switch gear. The two major components of CIM are relay board (1) and electronic control (2). Electronic control (2) connects to the same serial data link as the alarm annunciator. CIM operation is similar to the alarm annunciator except that the data link information is decoded into discrete outputs. The outputs then drive the relays located on relay board (1). The relay contacts are used to sound a horn, flash a lamp or trigger some other action. Once an output is activated, it remains energized until the initiating faults are cleared. If a malfunction in the serial data link occurs, all electronic control outputs (therefore all relays also) flash at 0.5 Hz. The CIM is designed to operate when powered by only 24 DCV or 32 DCV battery systems.

The available serial data link information is:

- High coolant temperature alarm.
- Low oil pressure alarm.
- Low coolant temperature alarm.
- Engine control switch (ECS) NOT in auto.
- Low oil pressure shutdown.
- High coolant temperature shutdown.
- Overcrank.
- Overspeed.
- Diagnostic failure (GSC).

Application Guidelines

Lamp Test

When a lamp test signal is received, the CIM activates all outputs for 10 seconds or until test signal is deactivated. Two lamp test signals are possible, the CIM lamp test is activated when:

Terminal 5 is connected to terminal 7 of electronic control (2).

The GSC lamp test signal is received over the data link.

NOTE: CIM ignores the GSC lamp test signal when terminal 6 is connected to terminal 7 of electronic control (2).

Outputs:

- The relays on relay board (1) are fuse protected. The contacts are flashed silver and are rated at 1 amp 28 DCV. The relays draw 20 mA (at 24 DCV).

- The driver outputs of electronic control (2) are intended to drive incandescent lamps or relay loads. The driver outputs draw up to 600 mA (15 - 45 DCV).

Specifications:

- For CIM installation, the maximum distance between electronic control (2) and the GSC is 305 m (1000 ft).

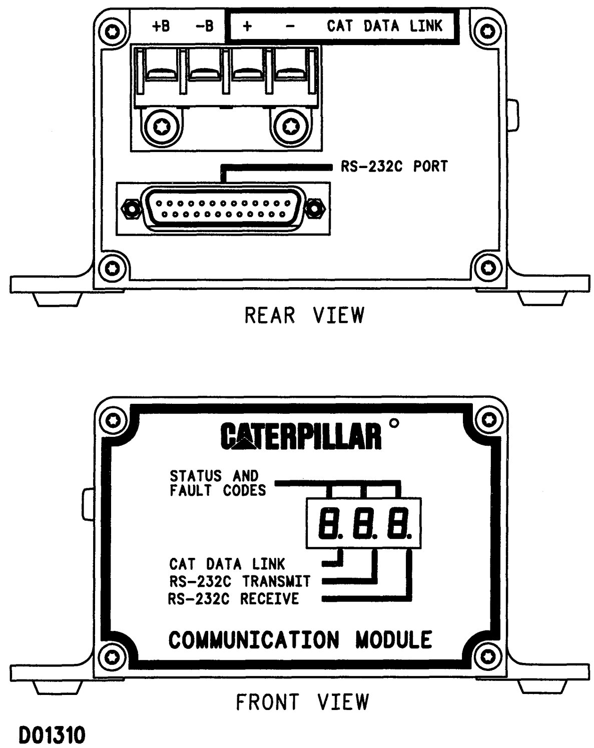
- The operating voltage range is 15 to 45 DCV (24 DCV nominal)

- CIM is capable of operating with or without earth ground.

- The terminals on electronic control (2) are 6.4 mm (.25 in) push-on connectors.

- Customer connections at relay board (1) are 6-32 screw terminals.

Customer Communication Module (CCM)



Customer Communication Module (CCM)

The customer communication module (CCM) provides a two-way communication link between the GSC and a host computer of the customer. The CCM converts data from standard RS-232 format to CAT data link format and vice versa. The purpose of the CCM is to allow an operator at the host computer to remotely control and monitor the generator set.

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

For more information regarding the CCM, see the Operation & Maintenance Manual, Customer Communication Module For EMCP II, SEBU6874.

Testing And Adjusting

⚠ WARNING

When servicing or repairing electric power generation equipment, do the following:

a. Make sure the unit is off-line (disconnected from utility power service and/or other generators) and either locked out or tagged DO NOT OPERATE.

b. Make sure the generator engine is stopped.

c. Make sure all batteries are disconnected.

d. Make sure all capacitors are discharged.

When power generation equipment is in operation to make tests and/or adjustments, high voltage and current are present. Make sure the testing equipment is designed for and correctly operated for the high voltage and current tests. Failure of improper test equipment presents a high voltage shock hazard to its user.

⚠ 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 terminals 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

Do NOT connect generator to a utility electrical distribution system, unless it is isolated from the system. Personal injury or death is possible by electrical feedback into the distribution system.

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 is NOT required. Always check with the utility as to the applicable circumstances.

Introduction

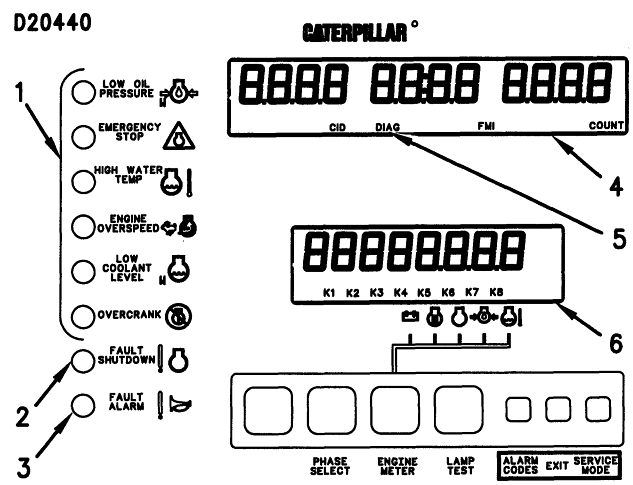
Service Tools

Tools Needed		
4C-3406	Connector Kit	1
	4mm Hex Wrench for fastener on GSC connector	1
6V-7070	Digital Multimeter	1
9U-7330	Multimeter (Optional) for frequency and duty cycle measurements	1
7X-1710	Cable Probes	1

Fault Identification

Fault Identification				
Indicator	**Fault Code**	**DIAG Indicator**	**Fault Type**	**See Topic**
Fault Alarm	CID FMI [1]	Flashing	Active Alarm	Diagnostic Fault Troubleshooting
	SP1, SP2, SP3 [1]	Absent	Active Alarm	Spare Fault Troubleshooting
	AL1, AL2, AL3 [1]	Absent	Active Alarm	Alarm Fault Troubleshooting
Dedicated Shutdown	Absent	Absent	Active Alarm	Dedicated Shutdown Indicator Troubleshooting
	Absent	Absent	Active Shutdown	
Fault Shutdown	CID FMI	Flashing	Active Shutdown	Diagnostic Fault Troubleshooting
	SP1, SP2, SP3	Absent	Active Shutdown	Spare Fault Troubleshooting
None	CID FMI [2]	On Continuously	Inactive Alarm	Diagnostic Fault Troubleshooting
	CID FMI [2]	On Continuously	Inactive Shutdown	Diagnostic Fault Troubleshooting
	SP1, SP2, SP3	Absent	Inactive Shutdown	Spare Fault Troubleshooting
	Absent	Absent	Undiagnosed Shutdown	Undiagnosed Problem Troubleshooting

[1] Fault code is shown after alarms code key is pressed.
[2] Fault code is stored in the fault log of the GSC. To view the fault code, see Fault Log Viewing - OP1 within the topic Service Mode.



GSC Display Area
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) "DIAG" indicator. (6) Lower display.

Faults that are detected and diagnosed by the genset control (GSC) are shown to service personnel in the display area of the GSC. The GSC uses dedicated shutdown indicators (1), fault shutdown indicator (2), fault alarm indicator (3), "DIAG" indicator (5), upper display (4) and lower display (6) to tell service personnel about a fault. Perform the following procedure to identify the fault detected by the GSC.

NOTE: "DIAG" indicator (5) functions (either FLASHING or ON CONTINUOUSLY) whenever diagnostic information is available from the GSC.

1. Note which of the indicators are functioning on the left side of the GSC.
2. View the fault code on upper display (4) of the GSC. If the fault alarm indicator is FLASHING and no fault code is present, press the alarm codes key to see the fault code.
3. Note whether or not "DIAG" indicator (5) is FLASHING, ON CONTINUOUSLY, or ABSENT.
4. On the Fault Identification chart, look at the first column and locate the fault indicator that is functioning.
5. Go across to the second column in the chart and find the fault code that is presently shown on upper display (4).
6. Go across to the third column in the chart which describes the status of "DIAG" indicator (5).
7. Read the last two columns to find the type of fault and the corresponding topic within this module.

Diagnostic Fault Troubleshooting

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

Each diagnostic fault code consists of a component identifier (CID) and a failure mode indicator (FMI) and an active/inactive status indicator ("DIAG") that are shown on the upper display. The CID tells which component in the system is faulty and the FMI describes the nature of the fault. When the "DIAG" indicator is FLASHING, the fault is active (present now). When the "DIAG" indicator is ON CONTINUOUSLY, the fault is inactive and the CID FMI is recorded in the fault log. To view the fault log, see Fault Log Viewing - OP1 within the topic Service Mode. When the "DIAG" indicator is absent (not showing), there are NO diagnostic fault codes detected or recorded. Service personnel interpret the identifiers to assist with troubleshooting.

When a diagnostic fault occurs (is active), the GSC FLASHES the "DIAG" indicator. 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 diagnostic fault, the CID FMI is immediately shown on the upper display. For an alarm type of diagnostic fault, the alarm codes key is pressed first and 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 fault codes (CID FMI) are recorded in the fault log for viewing at a later time. Also, the number of occurrences are totalled and shown on the upper display with the CID and FMI. An active diagnostic alarm fault ("DIAG" indicator is FLASHING) becomes inactive ("DIAG" indicator is ON CONTINUOUSLY) when the fault is no longer occurring and also for diagnostic shutdown faults the ECS must be turned to OFF/RESET. See Fault Log Viewing - OP1 within the topic Service Mode.

During troubleshooting, it is necessary to disconnect the harness connector (40 contact) from the GSC and faults are created. Because of internal circuitry, the GSC recognizes this condition (connector removed) as a FMI 03 (signal too high) fault for certain components. This fact is also used as a troubleshooting aid. Clear these created faults after the particular fault is corrected and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 336 FMI 2 Engine Control Switch

After a diagnostic fault is investigated and/or corrected, clearing it from the fault log will avoid confusion during a future service call. The "DIAG" indicator is OFF (absent) when all diagnostic faults are cleared from the fault log and no active diagnostic faults exist. See Fault Log Clearing OP4 within the topic Service Mode.

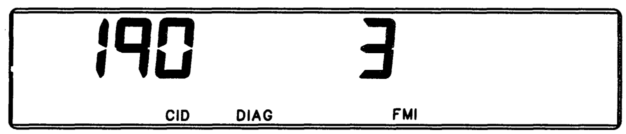
Diagnostic Faults

Diagnostic Fault Codes [1]	
CID No. / FMI No.	**Description**
CID 100 - Engine Oil Pressure Sensor:	
FMI 2	Signal out of range.
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 110 - Engine Coolant Temperature Sensor:	
FMI 2	Signal out of range.
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 111 - Engine Coolant Loss Sensor:	
FMI 3	Signal too high.
CID 168 - Battery Voltage:	
FMI 3	Voltage too high.
FMI 4	Voltage too low.
CID 190 - Engine Magnetic Pickup (MPU):	
FMI 2	Signal out of range.
FMI 3	Signal too high.
CID 248 - CAT Data Link:	
FMI 9	Abnormal update.
CID 268 - GSC Internal Memory:	
FMI 2	Signal out of range.
CID 269 - Sensor Power Supply:	
FMI 3	Voltage too high.
FMI 4	Voltage too low.
CID 333 - Alarm Module (ALM):	
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 334 - Spare Output:	
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 336 - Engine Control Switch (ECS):	
FMI 2	Undefined state.
CID 441 - Electronic Governor Relay (EGR):	
FMI 12	Faulty component.
CID 442 - Generator Fault Relay (GFR):	
FMI 12	Faulty component.
CID 443 - Crank Termination Relay (CTR):	
FMI 12	Faulty component.

Diagnostic Fault Codes [1] (Continued)	
CID No. / FMI No.	**Description**
CID 444 - Starting Motor Relay (SMR):	
FMI 12	Faulty component.
CID 445 - Run Relay (RR):	
FMI 12	Faulty component.
CID 446 - Ignition Shutoff Relay (ISR):	
FMI 12	Faulty component.
CID 447 - Fuel Control Relay (FCR):	
FMI 12	Faulty component.
CID 500 - Genset Control (GSC):	
FMI 12	Faulty component.
CID 566 - Unexpected Shutdown:	
FMI 7	Faulty Mechanical Response.

[1] For troubleshooting, see the procedure with the same CID And FMI No.

Example



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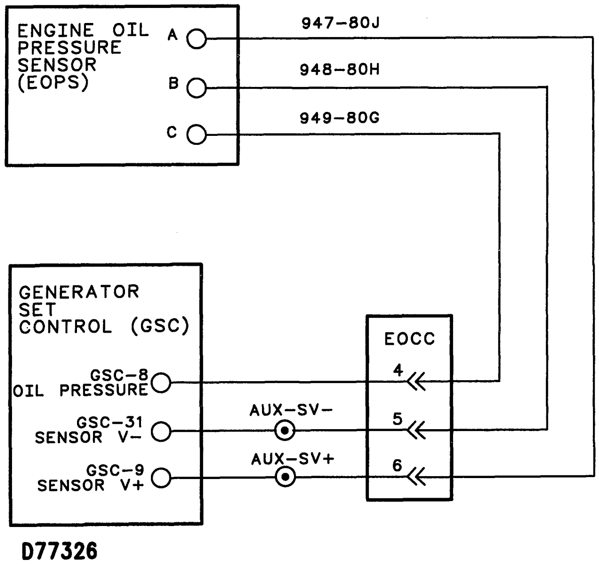
Upper Display With Diagnostic Fault Code "CID 190 FMI 3" Showing

CID 100
Engine Oil Pressure Sensor (EOPS)



System Schematic For Engine Oil Pressure Sensor (EOPS)

System Operation

The EMCP II system monitors engine oil pressure to protect the engine in case of an oil pressure problem. 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 (PWM) 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.

0 kPa (0 psi) is approximately 13% duty cycle (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 (P04 = 0). If the GSC is programmed to shutdown (P04 = 1) for an oil pressure sensor fault, then it is not necessary to press the alarm codes key to see the CID FMI. The CID FMI are automatically shown on the upper display.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 2 (Signal Out Of Range)

The possible cause of a CID 100 FMI 2 fault is the base frequency or the duty cycle of the sensor signal is beyond accepted limits. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 100 FMI 2 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. 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 ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If desired, this procedure can be replaced by troubleshooting the sensor signal with a meter capable of measuring frequency and duty cycle. See the topic PWM Sensor Test.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with this CID 110 fault.

STEP 1. CHECK GSC AND HARNESS - Make sure that CID 100 FMI 2 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key (not required for shutdown faults). Monitor the display to see if CID 100 FMI 2 is no longer showing (became inactive) and CID 100 FMI 3 is now showing (active).

- OK; a 100 03 fault is showing and the 100 02 fault is not showing. The GSC and the harness function properly. Therefore, the sensor is faulty. Replace the sensor. (If desired, more sensor testing is available; see the topic PWM Sensor Test.) STOP.

- NOT OK; the 100 02 fault remains showing. The harness or the GSC is faulty. Proceed to Step 2.

STEP 2. CHECK GSC - Turn the ECS to the OFF/RESET position. Disconnect the harness connector from the GSC. Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 100 FMI 2 is no longer showing (inactive) and CID 100 FMI 3 is now showing (active).

- OK; a 100 03 fault is showing and the 100 02 fault is not showing. 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 the topic Electrical Connector Inspection. STOP.

- NOT OK; the 100 02 fault remains showing. The GSC is faulty. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

FMI 3 (Signal Too High)

The possible cause of a CID 100 FMI 3 fault is a short to battery positive (B+) or an open circuit of the sensor signal. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 100 FMI 3 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. The GSC treats a CID 100 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with the CID 100 fault.

STEP 1. CHECK SUPPLY CIRCUIT - Turn the ECS to OFF/RESET and then to the STOP position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground). The voltage should measure 8.0 ± 0.5 DCV.

- OK; voltage is 8.0 ± 0.5 DCV. The supply circuit functions properly. Proceed to Step 2.

- NOT OK; voltage is NOT 8.0 ± 0.5 DCV. The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. 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.

STEP 2. CHECK SIGNAL CIRCUIT - The ECS remains in the STOP position and the sensor remains disconnected from the engine harness. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact C (signal) and contact B (sensor ground). The voltage should measure 7.0 ± 0.5 DCV.

- OK; voltage is 7.0 ± 0.5 DCV. The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 100 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.

- NOT OK; voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.

- NOT OK; voltage is NOT 7.0 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC or the harness is faulty. Proceed to Step 3.

STEP 3. CHECK FOR SHORTED HARNESS - When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness. Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. At the GSC harness connector, measure the resistance from signal contact 8 to all other contacts of the connector. The resistance should measure 5k ohms or greater.

- OK; all resistance measurements are correct. The harness functions properly. Proceed to Step 4.

- NOT OK; one or more of the resistance measurements are NOT correct. 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.

STEP 4. CHECK FOR OPEN HARNESS - When 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. The resistance of a single harness wire should measure 5 ohms or less. Measure the resistance of the following circuits in the harness:

a. Ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC harness connector.
b. Signal circuit, from contact C of the sensor harness connector to contact 8 of the GSC harness connector.
c. Sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC harness connector.

- OK; all harness resistance measurements are 5 ohms or less. The harness functions properly. Proceed to Step 5.

- NOT OK; one or more of the resistance measurements are greater than 5 ohms. The harness wiring with the incorrect resistance measurement is open (faulty). Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC connector. STOP.

STEP 5. CHECK ELECTRICAL CONNECTORS - Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection.

- OK; all connectors, terminals and wiring function properly. Connect all harness connectors that were previously disconnected. Start the engine. If the 100 03 fault is still showing, replace the GSC. See the topic Generator Set Control Replacement. STOP.

- NOT OK; Repair the faulty area. STOP.

FMI 4 (Signal Too Low)

The possible cause of a CID 100 FMI 4 fault is a short to battery negative (B-) of the sensor signal. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 100 FMI 4 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. The GSC treats a CID 100 FMI 4 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with the CID 100 fault.

STEP 1. CHECK GSC AND HARNESS - Make sure that CID 100 FMI 4 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 100 FMI 4 is no longer showing (inactive) and CID 100 FMI 3 is now showing (active).

- OK; a 100 03 fault is showing and the 100 04 fault is not showing. The GSC and the harness function properly. Therefore the sensor is faulty. Replace the sensor. (If desired, more sensor testing is available, see the topic PWM Sensor Test.) STOP.

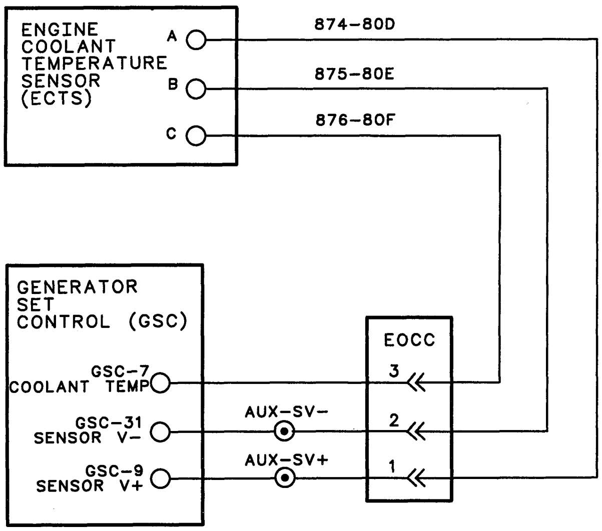
- NOT OK; the 100 04 fault remains showing. The harness or the GSC is faulty. Proceed to Step 2.

STEP 2. CHECK GSC - Turn the ECS to the OFF/RESET position. Disconnect the harness connector from the GSC. Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 100 FMI 4 is no longer showing (inactive) and CID 100 FMI 3 is now showing (active).

- OK; a 100 03 fault is showing and the 100 04 fault is not showing. 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 the topic Electrical Connector Inspection. STOP.

- NOT OK; the 100 04 fault remains showing. The GSC is faulty. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

CID 110
Engine Coolant Temperature Sensor (ECTS)



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System Schematic For Engine Coolant Temperature Sensor (ECTS)

System Operation

The EMCP II system monitors engine coolant temperature to protect the engine in case of a coolant temperature problem. The coolant temperature sensor is mounted in the water jacket, towards 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 (PWM) 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% duty cycle (approximately 1.0 DCV).
135°C (275°F) is approximately 93% duty cycle.

NOTE: The GSC is usually programmed to treat a fault with the coolant temperature sensor as an alarm fault (P04 = 0). If the GSC is programmed to shutdown (P04 = 1) for a fault with the coolant temperature sensor, then it is not necessary to press the alarm codes key to see the CID FMI. The CID FMI are automatically shown on the upper display.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 2 (Signal Out Of Range)

The possible cause of a CID 110 FMI 2 fault is the base frequency or the duty cycle of the sensor signal is beyond accepted limits. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 110 FMI 2 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. 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 ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If desired, this procedure can be replaced by troubleshooting the sensor signal with a meter capable of measuring frequency and duty cycle. See the topic PWM Sensor Test.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with this CID 110 fault.

STEP 1. CHECK GSC AND HARNESS - Make sure that CID 110 FMI 2 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 110 FMI 2 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

- OK; a 110 03 fault is showing and the 110 02 fault is not showing. The GSC and the harness function properly. Therefore, the sensor is faulty. Replace the sensor. (If desired, more sensor testing is available, see the topic PWM Sensor Test.) STOP.

- NOT OK; the 110 02 fault remains showing. The harness or the GSC is faulty. Proceed to Step 2.

STEP 2. CHECK GSC - Turn the ECS to the OFF/RESET position. Disconnect the harness connector from the GSC. Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 110 FMI 2 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

- OK; a 110 03 fault is showing and the 110 02 fault is not showing. 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 the topic Electrical Connector Inspection. STOP.

- NOT OK; the 110 02 fault remains showing. The GSC is faulty. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

FMI 3 (Signal Too High)

The possible cause of a CID 110 FMI 3 fault is a short to battery positive (B+) or an open circuit of the sensor signal. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 110 FMI 3 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. The GSC treats a CID 110 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with the CID 110 fault.

STEP 1. CHECK SUPPLY CIRCUIT - Turn the ECS to OFF/RESET and then to the STOP position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground). The voltage should measure 8.0 ± 0.5 DCV.

- OK; voltage is 8.0 ± 0.5 DCV. The supply circuit functions properly. Proceed to Step 2.

- NOT OK; voltage is NOT 8.0 ± 0.5 DCV. The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. 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.

STEP 2. CHECK SIGNAL CIRCUIT - The ECS remains in the STOP position and the sensor remains disconnected from the engine harness. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact C (signal) and contact B (sensor ground). The voltage should measure 7.0 ± 0.5 DCV.

- OK; voltage is 7.0 ± 0.5 DCV. The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 110 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.

- NOT OK; voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.

- NOT OK; voltage is NOT 7.0 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC or the harness is faulty. Proceed to Step 3.

STEP 3. CHECK FOR SHORTED HARNESS - When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness. Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. At the GSC harness connector, measure the resistance from signal contact 7 to all other contacts of the connector. The resistance should measure 5k ohms or greater.

- OK; all resistance measurements are correct. The harness functions properly. Proceed to Step 4.

- NOT OK; one or more of the resistance measurements are NOT correct. 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.

STEP 4. CHECK FOR OPEN HARNESS - When 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. The resistance of a single harness wire should measure 5 ohms or less. Measure the resistance of the following circuits in the harness:

a. Ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC harness connector.
b. Signal circuit, from contact C of the sensor harness connector to contact 7 of the GSC harness connector.
c. Sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC harness connector.

- OK; all harness resistance measurements are 5 ohms or less. The harness functions properly. Proceed to Step 5.

- NOT OK; one or more of the resistance measurements are greater than 5 ohms. The harness wiring with the incorrect resistance measurement is open (faulty). Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC connector. STOP.

STEP 5. CHECK ELECTRICAL CONNECTORS - Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection.

- OK; all connectors, terminals and wiring function properly. Connect all harness connectors that were previously disconnected. Start the engine. If the 110 03 fault is still showing, replace the GSC. See the topic Generator Set Control Replacement. STOP.

- NOT OK; Repair the faulty area. STOP.

FMI 4 (Signal Too Low)

The possible cause of a CID 110 FMI 4 fault is a short to battery negative (B-) of the sensor signal. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 110 FMI 4 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. The GSC treats a CID 110 FMI 4 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with the CID 110 fault.

STEP 1. CHECK GSC AND HARNESS - Make sure that CID 110 FMI 4 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 110 FMI 4 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

- OK; a 110 03 fault is showing and the 110 04 fault is not showing. The GSC and the harness function properly. Therefore the sensor is faulty. Replace the sensor. (If desired, more sensor testing is available, see the topic PWM Sensor Test.) STOP.

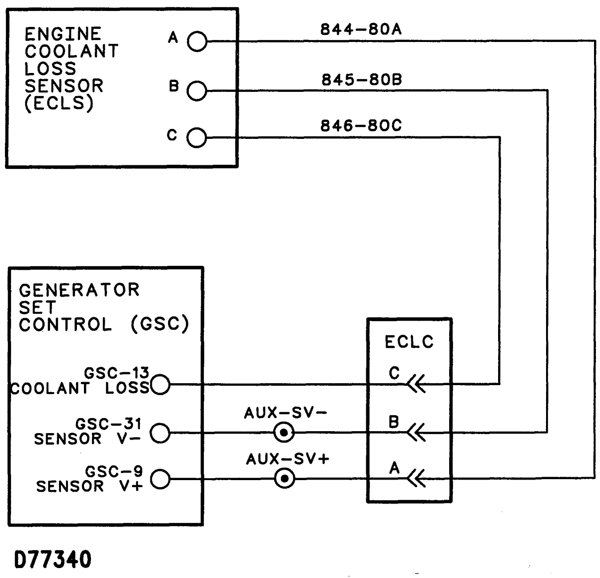
- NOT OK; the 110 04 fault remains showing. The harness or the GSC is faulty. Proceed to Step 2.

STEP 2. CHECK GSC - Turn the ECS to the OFF/RESET position. Disconnect the harness connector from the GSC. Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display to see if CID 110 FMI 4 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

- OK; a 110 03 fault is showing and the 110 04 fault is not showing. 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 the topic Electrical Connector Inspection. STOP.

- NOT OK; the 110 04 fault remains showing. The GSC is faulty. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

CID 111
Engine Coolant Loss Sensor (ECLS)



System Schematic For Engine Coolant Loss Sensor (ECLS)

System Operation

The EMCP II system monitors engine coolant for loss of coolant to protect the engine in case of a coolant temperature problem. The engine coolant loss function is an option and 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 (+5 DCV) is sent to the GSC. When coolant is present at the sensor, a low signal (B-) is sent to the GSC.

NOTE: The GSC is usually programmed to treat a coolant loss sensor fault as an alarm fault (P04 = 0). If the GSC is programmed to shutdown (P04 = 1) for a coolant loss sensor fault, then it is not necessary to press the alarm codes key to see the CID FMI. The CID FMI are automatically shown on the upper display.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 3 (Signal Too High)

The possible cause of a CID 111 FMI 3 fault is a short to battery positive (B+) or an open circuit of the sensor signal. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 111 FMI 3 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. 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 ECS switch 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 the topic Electrical Connector Inspection.

NOTE: If a sensor supply fault (CID 269) is active, correct it prior to proceeding with the CID 111 fault.

STEP 1. CHECK SUPPLY CIRCUIT - Turn the ECS to OFF/RESET and then to the STOP position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground). The voltage should measure 8.0 ± 0.5 DCV.

- OK; voltage is 8.0 ± 0.5 DCV. The supply circuit functions properly. Proceed to Step 2.

- NOT OK; voltage is NOT 8.0 ± 0.5 DCV. The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. 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.

STEP 2. CHECK SIGNAL CIRCUIT - The ECS remains in the STOP position and the sensor remains disconnected from the engine harness. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact C (signal) and contact B (sensor ground). The voltage should measure 2.5 ± 0.5 DCV.

- OK; voltage is 2.5 ± 0.5 DCV. The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then 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; voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.

- NOT OK; voltage is NOT 2.5 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC or the harness is faulty. Proceed to Step 3.

STEP 3. CHECK FOR SHORTED HARNESS - When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness. Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. At the GSC harness connector, measure the resistance from signal contact 13 to all other contacts of the connector. The resistance should measure 5k ohms or greater.

- OK; all resistance measurements are correct. The harness functions properly. Proceed to Step 4.

- NOT OK; one or more of the resistance measurements are NOT correct. 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.

STEP 4. CHECK FOR OPEN HARNESS - When 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. The resistance of a single harness wire should measure 5 ohms or less. Measure the resistance of the following circuits in the harness:

a. Ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC harness connector.
b. Signal circuit, from contact C of the sensor harness connector to contact 13 of the GSC harness connector.
c. Sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC harness connector.

- OK; all harness resistance measurements are 5 ohms or less. The harness functions properly. Proceed to Step 5.

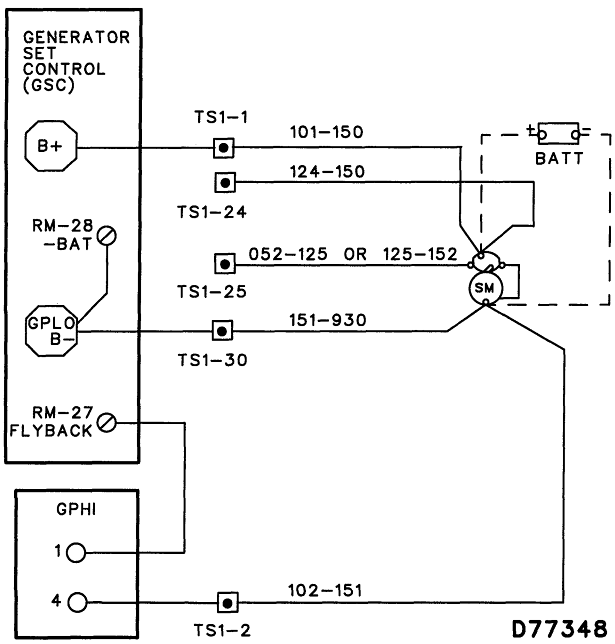
- NOT OK; one or more of the resistance measurements are greater than 5 ohms. The harness wiring with the incorrect resistance measurement is open (faulty). Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC connector. STOP.

STEP 5. CHECK ELECTRICAL CONNECTORS - Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection.

- OK; all connectors, terminals and wiring function properly. Connect all harness connectors that were previously disconnected. Start the engine. If the 111 03 fault is still showing, replace the GSC. See the topic Generator Set Control Replacement. STOP.

- NOT OK; Repair the faulty area. STOP.

CID 168
Battery Voltage



System Schematic For Battery Voltage

System Operation

The EMCP II system monitors battery voltage to protect the EMCP II system in case of a battery or charging problem. The EMCP II system operates on either 24 or 32 DCV battery systems. The GSC measures the battery voltage it is receiving at terminal RM-1 of the relay module terminal strip on the rear of the GSC. The GSC receives battery power whenever the Engine Control Switch (ECS) is turned to START, AUTO, or STOP.

NOTE: The GSC does not receive battery power when the ECS is in the OFF/RESET position unless contacts 6 and 9 of the ECS are jumpered together, see the preceding System Schematic.

The GSC treats a CID 168 fault as an alarm fault.

FMI 3 (Voltage Too High)
FMI 4 (Voltage Too Low)

Use this procedure for either a FMI 3 or FMI 4 fault. The possible cause of a CID 168 FMI 3 fault is the battery voltage is greater than 32 DCV for 24 volt systems or greater than 45 DCV for 32 volt systems. The possible cause of a CID 168 FMI 4 fault is the battery voltage is less than 18 DCV. The setpoint for system voltage (P07) specifies the genset battery voltage; 0 for 24 volts, 1 for 32 volts. Clear the fault from the fault log after troubleshooting is complete.

This procedure is used for troubleshooting an active or inactive fault. Active alarm faults are shown on the upper display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position. Inactive alarm faults are viewed in the fault log while in service mode; see Fault Log Viewing OP1 within the topic Service Mode.

STEP 1. VERIFY FAULT - View the upper display and check for active battery voltage diagnostic faults (168 03 or 168 04). Also enter service mode and check the fault log for inactive battery voltage diagnostic faults (168 03 or 168 04).

- OK; battery voltage diagnostic faults (168 03 or 168 04), active or inactive, DO NOT EXIST. STOP.

- NOT OK; battery voltage diagnostic faults (168 03 or 168 04), active or inactive, DO EXIST. Proceed to Step 2.

STEP 2. CHECK VOLTAGE - Turn the ECS to the STOP position. Measure the three following voltages. The three voltages should measure within 2.0 volt of each other.

a. Note the battery voltage that is showing on the lower display.
b. Measure the voltage (DCV) between the terminals of the battery.
c. Measure the voltage (DCV) between terminals RM-1 (B+) and RM-28 (B-) of the relay module terminal strip on the rear of the GSC.

- OK; all voltages agree (less than 2.0 DCV difference). Proceed to Step 4.

- NOT OK; voltage measured at the batteries does not agree (greater than 2.0 DCV difference) with voltage measured at relay module terminal strip. Proceed to Step 3.

- NOT OK; voltage showing on the lower display does not agree (greater than 2.0 DCV difference) with voltage measured at relay module terminal strip. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

STEP 3. CHECK HARNESS - Disconnect the B+ and B- cables from the battery. Disconnect the B+ wire from the RM-1 terminal and the B- wire from the RM-28 terminal of the relay module terminal strip on the rear of the GSC. Measure the resistance of each wire from the battery end to the terminal strip end. The resistance of a single harness wire should measure 5 ohms or less.

- OK; both resistance measurements are 5 ohms or less. An intermittent harness problem is likely. To further check the harness, go to the topic Electrical Connector Inspection. STOP.

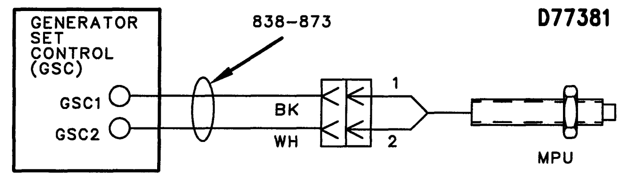
- NOT OK; a resistance measurement is greater than 5 ohms. The harness wiring with the incorrect resistance measurement is faulty. Troubleshoot and repair the faulty harness wiring between the battery and the relay module terminal strip.

STEP 4. CHECK SYSTEM VOLTAGE - With the engine off, measure the system voltage at the battery. For 24 volt systems, the battery voltage should measure from 24.8 to 29.5 DCV. For 32 volt systems, the battery voltage should measure from 33.1 to 39.3 DCV.

- OK; battery voltage is correct. This procedure did not find the cause of the fault. The GSC is an unlikely cause of this fault. If the batteries or charging system is suspect, perform the charging system test, see the topic Charging System Test. If an intermittent harness or terminal problem is suspected, go to the topic Electrical Connector Inspection. If the fault is not discovered, clear the fault log and check for another occurrence of a CID 168 fault code. If a CID 168 fault code persists, replace the GSC. See the topic Generator Set Control Replacement. STOP.

- NOT OK; battery voltage is NOT correct. The charging system and/or the batteries are faulty. Perform the charging system test, see the topic Charging System Test.

CID 190
Engine Magnetic Pickup (MPU)



System Schematic For Engine Magnetic Pickup (MPU)

System Operation

The EMCP II system monitors engine speed to use the information when needed for other tasks. Tasks such as: activating an engine overspeed shutdown, terminating engine cranking and determining the oil step speed. The EMCP II does not control engine speed. The engine magnetic pickup 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 the GSC the sine wave signal in which the frequency is in direct proportion to the speed of the engine.

The GSC treats a CID 190 fault as a shutdown fault. The engine is not allowed to crank or run when either a CID 190 FMI 2 or CID 190 FMI 3 diagnostic fault is active.

NOTE: Engines equipped with an electronic governor have a separate magnetic pickup with the cable marked 973-458, 458-873, 973-407 or 873-507. The cable of the magnetic pickup used by the GSC is marked 838-873 or 838-973.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 2 (Signal Out Of Range)
FMI 3 (Signal Too High)

The possible cause of a CID 190 FMI 2 fault is that the frequency of the signal is beyond accepted limits (short to B-) or the air gap of the magnetic pickup is too large. The possible cause of a CID 190 FMI 3 fault is an open circuit of the signal. Clear the fault from the fault log after troubleshooting is complete.

The GSC treats a magnetic pickup fault as a shutdown fault. The engine is shut down and will not start when a CID 190 FMI 2 or a CID 190 FMI 3 fault is active.

This troubleshooting procedure is for a FMI 2 or a FMI 3 fault that is active or inactive.

STEP 1. CHECK HARNESS AND MPU - Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. At the GSC harness connector, measure the resistance from contact 1 to contact 2. The resistance should measure 100 to 350 ohm.

- OK; resistance measurement is correct. The fault is most likely intermittent. Reconnect the harness connector to the GSC. Turn the ECS to OFF/RESET and then to STOP. Check to see if a CID 190 fault remains showing (active) on the upper display.
  a. If a CID 190 fault is showing, continue with this procedure. Proceed to Step 2.
  b. If a CID 190 fault is NOT showing, this Step has corrected the fault. STOP. (If desired, continue with this procedure. Proceed to Step 2.)

- NOT OK; the resistance measurement is NOT correct. The harness wiring or the MPU is faulty. Proceed to Step 2.

STEP 2. CHECK MPU RESISTANCE - Disconnect the MPU from the engine harness (the MPU remains fastened to the engine). At the connector of the MPU, measure the resistance between contact 1 and contact 2. The resistance should measure 100 to 350 ohm.

- OK; resistance measurement is correct. The resistance of the MPU is correct. Proceed to Step 3.

- NOT OK; the resistance measurement is NOT correct. Replace the MPU. Also, see the topic Magnetic Pickup (MPU) Adjustment. STOP.

STEP 3. CHECK HARNESS FOR OPEN AND SHORT - The ECS remains in the OFF/RESET position. The MPU and the GSC remain disconnected from the harness. Measure the resistance of the following circuits in the harness:
  a. Check for open circuit, from contact 2 of the MPU harness connector to contact 2 of the GSC harness connector. The resistance should measure 5 ohms or less.
  b. Check for open circuit, from contact 1 of the MPU harness connector to contact 1 of the GSC harness connector. The resistance should measure 5 ohms or less.
  c. Check for short circuit, from contact 1 to contact 2, both of the GSC harness connector. The resistance should measure greater than 5K ohms.

- OK; all harness resistance measurements are correct. The harness functions properly. Proceed to Step 4.

- NOT OK; one or more of the resistance measurements are NOT correct. The harness wiring with the incorrect resistance measurement is faulty. Replace the faulty harness from the MPU to the GSC connector. STOP.

- STEP 4. CHECK SHIELD AND CONNECTORS - The ECS remains in the OFF/RESET position. The MPU and the GSC remain disconnected from the harness. The harness has a shield (bare wire) which protects the MPU signal wire from electrical interference. It is important that this shield is securely fastened and makes good electrical connection to the inside enclosure of EMCP II. Do the following checks and measurements:
  a. Within the EMCP II, check that the shield is securely fastened.
  b. Within the EMCP II, measure the resistance from the shield to the B- terminal on the relay module terminal strip. The resistance should measure 5 ohms or less.
  c. Check the connector of the MPU and the mating harness connector. Go to the topic Electrical Connector Inspection.

- OK; the shield is securely fastened, the resistance measurement is 5 ohms or less, and the connectors are proper. The shield and connectors are correct. Proceed to Step 5.

- NOT OK; one of the items is NOT correct. Repair or replace the harness. STOP.

STEP 5. INSPECT AND ADJUST MPU - Remove the MPU from the engine flywheel housing. Inspect for damage and remove any debris from the tip.

- OK; no damage is evident. Reinstall and adjust the MPU; see the topic Magnetic Pickup (MPU) Adjustment. Proceed to Step 6.

- NOT OK; the MPU is damaged. Replace the MPU. Also, see the topic Magnetic Pickup (MPU) Adjustment. STOP.

STEP 6. CHECK FAULT STATUS - Reconnect the harness connector to the GSC and the MPU. Turn the ECS to OFF/RESET and then to STOP. Check the upper display to see if a CID 190 fault remains showing (active).

- OK; If a CID 190 fault is NOT showing, these procedures have corrected the fault. STOP. (If desired, continue with this procedure. Go to Step 7.)

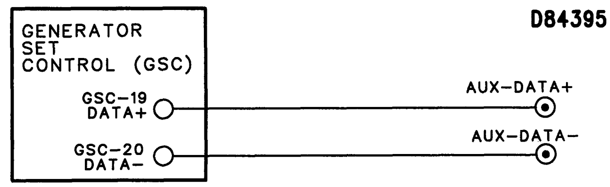
- NOT OK; If a CID 190 fault is showing, the fault is still active and the engine will not start. Use the process of elimination to find the faulty component. Stop when the fault is no longer showing. First, replace and adjust the MPU. Second, replace the harness. Third (last), replace the GSC.

STEP 7. CHECK SIGNAL VOLTAGE - As an additional check of the circuit, measure the signal voltage of the MPU. Make sure all harness connectors are connected. Setup a multimeter with 7X-1710 Cable Probes to measure the AC signal voltage from contact 1 to contact 2 of the GSC connector. Start and run the engine at rated speed. Measure the ACV. The voltage should measure 10 ACV or greater.

- OK; signal voltage is 10 ACV or greater. The MPU circuit checks correctly. STOP.

- NOT OK; signal voltage is less than 10 ACV. The most likely cause is improper air gap of the pickup. Repeat Step 5. STOP.

CID 248
CAT Data Link



System Schematic For CAT Data Link

System Operation

On gensets so equipped, the GSC uses the CAT data link to communicate with other electronic controls such as an electronic engine control or a customer electronic control. The CAT data link consists of two wires that connect the GSC to at least one other electronic control.

FMI 9 (Abnormal Update)

The possible cause of a CID 248 FMI 9 fault is a short to battery positive (B+) or battery negative (B-) of either of the two CAT data link wires. The GSC cannot detect an open in the circuit of the CAT data link. Troubleshoot and repair the wiring, see the Generator Set Wiring Diagram in the Schematic & Wiring Diagrams section.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 248 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

CID 268
GSC Internal Memory

System Operation

A portion of memory within the GSC stores the setpoints of important genset conditions including engine setpoint programming (OP5), spare input/output programming (OP6) and voltmeter/ammeter programming (OP8). The GSC detects a CID 268 fault when the setpoint data is invalid or out of range. After detecting a CID 268 fault, the GSC sets all the setpoints to the default value. The setpoints and the default values are:

P01 - Fuel Solenoid Type. Default value is 1 (ETS).
P02 - Units Shown. Default value is 0 (English).
P03 - Shutdown Override For Engine Fault. Default value is 0 (shutdown).
P04 - Shutdown Override For Sensor Fault. Default value is 0 (override).
P05 - Coolant Loss Sensor. Default value is 0 (not installed).
P06 - Shutdown Override For Coolant Loss Fault. Default value is 0 (shutdown).
P07 - System Voltage. Default value is 0 (24V).
P08 - Upper Display Enable/Disable. Default value is 0 (enable).
P09 - Ring Gear Teeth. Default value is 136 teeth.
P10 - Engine Overspeed. Default value is 2120 rpm.
P11 - Crank Terminate Speed. Default value is 400 rpm.
P12 - Oil Step Speed. Default value is 1350 rpm.
P13 - Low Oil Pressure Shutdown At Rated Speed. Default value is 205 kPa (30 psi).
P14 - Low Oil Pressure Shutdown At Idle Speed. Default value is 70 kPa (10 psi).
P15 - High Water Temperature Shutdown. Default value is 107°C (225°F).
P16 - Low Water Temperature Alarm. Default value is 21°C (70°F).
P17 - Total Cycle Crank Time. Default value is 90 seconds.
P18 - Cycle Crank Time. Default value is 10 seconds.
P19 - Cooldown Time. Default value is five minutes.
P20 - AC Voltage Full Scale. Default value is 700 volts.
P21 - AC Current Full Scale. Default value is 600 amps.
P22 - GSC Engine Number. Default value is 01.
P23 - Engine Type. Default value is 0 (MUI diesel).
P24 - Crank Time Delay. Default value is 5 seconds.

SP01 - Spare Fault 1 Active State. Default value is 0 (active low).
SP02 - Spare Fault 1 Response. Default value is 0 (shutdown).
SP03 - Spare Fault 2 Active State. Default value is 0 (active low).
SP04 - Spare Fault 2 Response. Default value is 0 (shutdown).
SP05 - Spare Fault 3 Active State. Default value is 0 (active low).
SP06 - Spare Fault 3 Response. Default value is 0 (shutdown).
SP07 - Spare Output Active State. Default value is 0 (active low).
SP08 - Spare Fault 1 Delay Time. Default value is 0 seconds.
SP09 - Spare Fault 2 Delay Time. Default value is 0 seconds.
SP10 - Spare Fault 3 Delay Time. Default value is 0 seconds.
SP11 - Spare Output Response. Default value is 7 (cooldown).

AC01 - A-B Voltage Calibration. Default value is random.
AC02 - B-C Voltage Calibration. Default value is random.
AC03 - C-A Voltage Calibration. Default value is random.
AC04 - A Current Calibration. Default value is random.
AC05 - B Current Calibration. Default value is random.
AC06 - C Current Calibration. Default value is random.

For more information on setpoints, see Setpoint Programming OP5, Spare Input/Output Programming OP6 and Voltmeter/Ammeter Programming OP8 within the topic Service Mode in the Systems Operation section.

FMI 2 (Signal Out Of Range)

The possible cause of a CID 268 FMI 2 fault is electrical interference. Clear the fault from the fault log after troubleshooting is complete. This procedure is for an active or inactive CID 268 fault.

The GSC treats a CID 268 fault as an alarm fault or a shutdown fault, depending upon the particular setpoint with corrupt data. The ring gear teeth (P09) setpoint and the engine overspeed (P10) setpoint 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.

STEP 1. CHECK HOURMETER - Place the ECS in any position other than OFF/RESET. Select and view the hourmeter on the display. The hourmeter should show a reasonable numeric value.

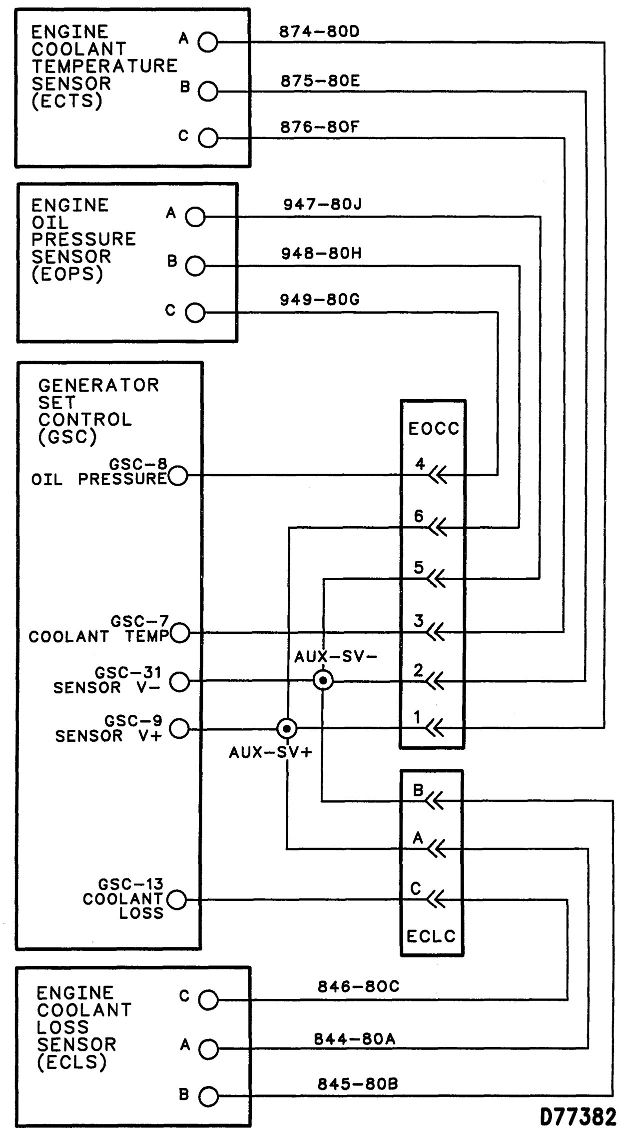
- OK; the hourmeter shows a reasonable numeric value. Proceed to Step 2.
- NOT OK; the hourmeter shows " – – ". Reset the hourmeter to the original value; see Hourmeter Programming OP7 within the topic Service Mode in the Systems Operation section. Proceed to Step 2.

NOTE: Electrical interference can also cause the hourmeter to show " – – ", but it does not cause a CID 268 FMI 2 fault.

STEP 2. CHECK SETPOINTS - View the setpoints that are stored in the memory of the GSC; see Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Also check the spare input/output programming (OP6) and the voltmeter/ammeter programming (OP8). The stored setpoints and specified setpoints should match.

- OK; all the setpoints match. Start the engine and check to see if the CID 268 FMI 02 fault is active. If the fault remains active, replace the GSC. See the topic Generator Set Control Replacement. 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 Setpoint Programming OP5, Spare Input/Output Programming OP6 and Voltmeter/Ammeter Programming OP8 within the topic Service Mode in the Systems Operation section. STOP.

CID 269
Sensor Power Supply



System Schematic For Sensor Power Supply

System Operation

The EMCP II system has an 8 volt DC sensor supply from the GSC that powers the three engine sensors: oil pressure, coolant temperature and the optional coolant loss sensor. The sensor power supply functions whenever power is applied to the GSC.

NOTE: The GSC is usually programmed to treat a fault with the sensor power supply (CID 269) as an alarm fault (P04 = 0). If the GSC is programmed to shutdown (P04 = 1) for a fault with the sensor power supply, then it is not necessary to press the alarm codes key to see the CID FMI. The CID FMI are automatically shown on the upper display.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 3 (Voltage Too High)

The possible cause of a CID 269 FMI 3 fault is that the voltage of the sensor power supply is greater than 8.5 DCV. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 269 FMI 3 is showing and the "DIAG" indicator is FLASHING (fault is active) on the upper display. The GSC treats a CID 269 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch 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 the topic Electrical Connector Inspection.

STEP 1. CHECK THE GSC - Disconnect the harness connector from the GSC. Turn the ECS to OFF/RESET and then to the STOP position. Press the alarm codes key. Observe the upper display to see if the 269 03 fault is showing (is active).

- OK; the 269 03 fault is not showing (is inactive). The GSC is functioning properly. Therefore, the engine harness has a short to B+. Repair the engine harness. STOP.

- NOT OK; the 269 03 fault is still showing (is active). The GSC is faulty, replace the GSC. See the topic Generator Set Control Replacement. STOP.

FMI 4 (Voltage Too Low)

The possible cause of a CID 269 FMI 4 fault is that the voltage of the sensor power supply is less than 7.5 DCV. Clear the fault from the fault log after troubleshooting is complete.

Begin performing these procedures only when CID 269 FMI 4 is showing and the "DIAG" indicator is FLASHING (fault is active) 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 ECS switch 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 the topic Electrical Connector Inspection.

STEP 1. CHECK THE GSC - Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. Turn the ECS to STOP. Press the alarm codes key. Observe the upper display to see if the 269 04 fault is showing (is active).

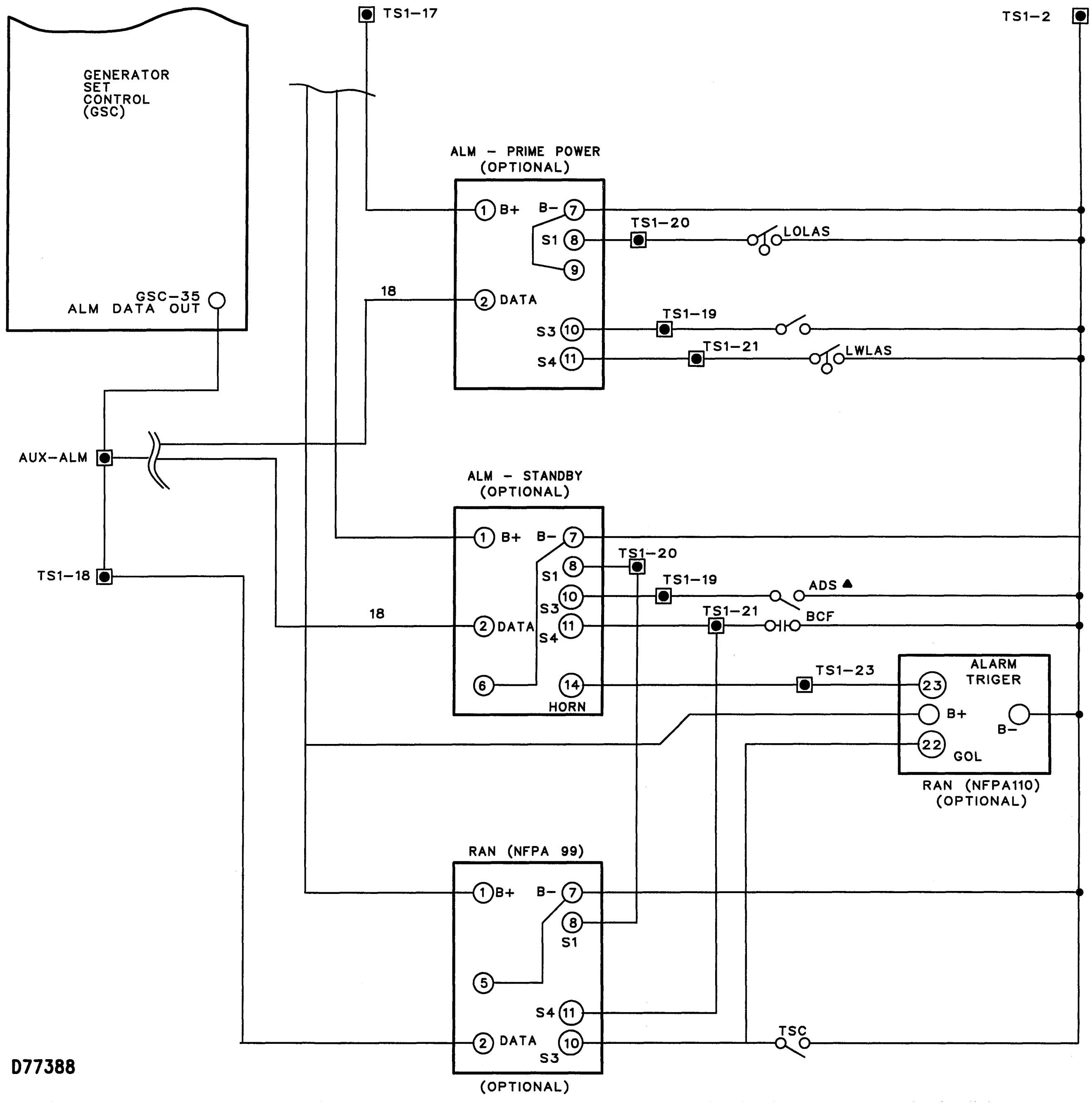
- OK; the 269 04 fault is not showing (is inactive). The GSC is functioning properly. Therefore, the engine harness or a sensor is faulty. Proceed to Step 2.

- NOT OK; the 269 04 fault is still showing (is active). The GSC is faulty, replace the GSC. See the topic Generator Set Control Replacement. STOP.

STEP 2. CHECK SENSORS AND HARNESS - Turn the ECS to OFF/RESET. Reconnect the harness connector to the GSC. Disconnect the engine harness from the oil pressure sensor. Turn the ECS to STOP. Press the alarm codes key. Observe the upper display to see if the 269 04 fault is showing (is active).

- OK; the 269 04 fault is not showing (is inactive). The oil pressure sensor is faulty. Replace the sensor. STOP.

- NOT OK; the 269 04 fault is still showing (is active). Repeat Step 2 for the coolant temperature sensor and the optional coolant loss sensor. If the 269 04 fault becomes inactive (not showing) after one of the sensors is disconnected, replace that sensor. If the 269 04 fault remains showing after all three sensors are disconnected, then the engine harness has a short to battery negative (B-). Repair the engine harness. STOP.



System Schematic For Alarm Module (ALM)

System Operation

The alarm module (ALM) is available as an option. It is either mounted on the instrument panel or at a distance as a remote annunciator. It is used to satisfy customer or National Fire Protection Association (NFPA) requirements by annunciating the presence of a fault.

The ALM communicates with the GSC by a serial data link with a baud rate of 244 bits per second. 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 modules, ALM or CIM, connected to the serial data link is three. The maximum distance between a module and the GSC is 305 m (1000 ft). If these specifications are not met, it is possible for the ALM indicators to flash and for the GSC to declare a CID 333 fault. If not in compliance with the specifications, reduce the number of modules and/or shorten the distance to them.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 3 (Signal Too High)
FMI 4 (Signal Too Low)

The possible cause of a CID 333 FMI 3 fault is a short to B+ of the data signal. The possible cause of a CID 333 FMI 4 fault is a short circuit to B- of the data signal. Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 333 FMI 3 fault or CID 333 FMI 4 fault as an alarm fault.

This troubleshooting procedure is for a FMI 3 or a FMI 4 fault that is active or inactive.

NOTE: If a CID 333 FMI 3 fault or a CID 333 FMI 4 fault is showing on the upper display and no alarm module is installed, then check for a short to B+ or B- between the auxiliary terminal strip and the GSC.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the 333 03 or 333 04 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a 333 03 or 333 04 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a 333 03 or 333 04 fault is active. Proceed to Step 2.

- NOT OK; a 333 03 or 333 04 fault is inactive. Proceed to Step 4.

STEP 2. CHECK VOLTAGE OF DATA SIGNAL - Turn the ECS to STOP. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead). The measured voltage should change constantly, within the range of 0 to 10 DCV.

- OK; voltage measurement is correct. Proceed to Step 4.

- NOT OK; voltage measurement is NOT correct. Proceed to Step 3.

STEP 3. CHECK VOLTAGE OF ALM AND GSC - Turn the ECS to STOP. At the ALM, remove wire #18 from terminal 2. Disconnect the harness connector from the GSC.

a. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead). The voltage should measure 11.6 ± 0.5 DCV.
b. Measure the DC voltage from contact 35 of the GSC, to the battery negative (B-) terminal of the relay module. The measured voltage should change constantly, within the range of 0 to 5.5 DCV.

- OK; both voltage measurements are correct. Proceed to Step 4.

- NOT OK; voltage measured at the ALM is NOT correct. Replace the ALM. STOP.

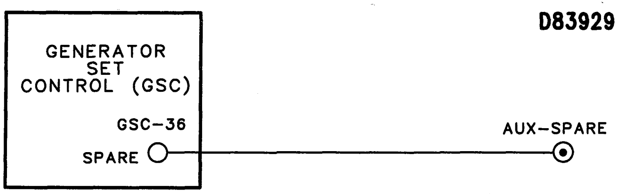
- NOT OK; voltage measured at the GSC is NOT correct. Replace the GSC. STOP.

STEP 4. CHECK FOR B+ SHORT IN HARNESS - Turn the ECS to OFF. Disconnect the harness connector from the GSC. At the ALM, remove wire #18 from terminal 2. Measure the resistance from wire #18 at the ALM to battery positive (B+) at the relay module. Also, measure the resistance from wire #18 at the ALM to battery negative (B-) at the relay module. The resistance should measure 20k ohms or greater.

- OK; both resistance measurements are correct. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. 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 20k ohms. The harness wiring with the incorrect resistance measurement is shorted (faulty). Troubleshoot and repair the faulty harness wiring between the ALM and the GSC. See the Alarm Module System Schematic.

CID 334
Spare Output



System Schematic For Spare Output

System Operation

The spare output on the GSC is strictly for customer use. The spare output is programmable to activate under a variety of conditions. The default is for the output to activate when the engine is in cooldown. For more information, see Spare Input/Output Programming OP6 within the topic Service Mode in the Systems Operation section. It is the customer's and/or the dealer's responsibility to document and troubleshoot any connections to this output.

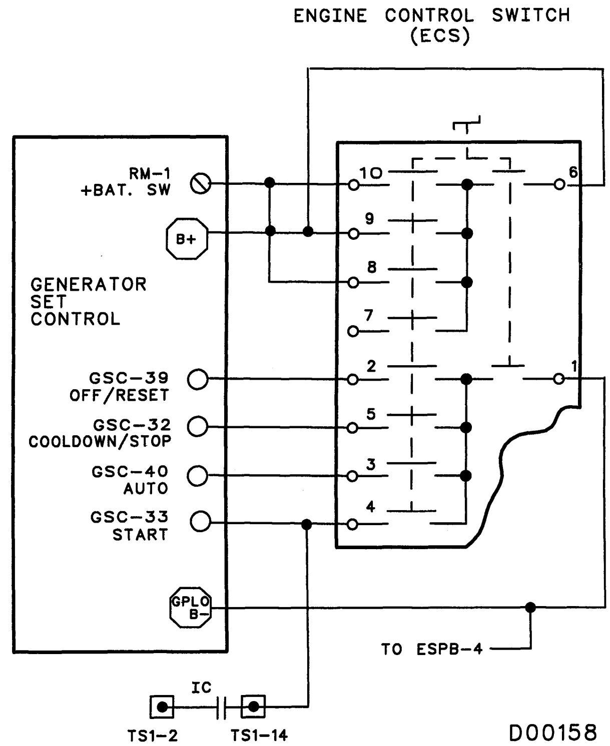
With no connections and when not active, the voltage on the spare output is approximately 3.0 volts DC. When active, the voltage on the spare output is approximately 0 volts. The spare output is capable of drawing approximately 60 mA.

FMI 3 (Signal Too High)
FMI 4 (Signal Too Low)

The possible cause of a CID 334 FMI 3 fault is a short to battery positive (B+) of the spare output signal. The possible cause of a CID 334 FMI 4 fault is a short to battery negative (B-) of the spare output signal. The GSC treats a CID 334 FMI 3 fault and a CID 334 FMI 4 fault as alarm faults.

Troubleshooting of a spare output fault is straightforward. The FMI defines the fault; FMI 3 = short to B+, FMI 4 = short to B-. Use the FMI information, spare output system schematic and the customer/dealer documentation to find the exact cause of the fault.

CID 336
Engine Control Switch (ECS)



System Schematic For Engine Control Switch (ECS)

System Operation

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 battery negative (B-). At any time, only one of these four positions (inputs) is connected to battery negative (B-).

Each position of the ECS places the engine in a different mode. The four positions and the corresponding engine modes are:

1. OFF/RESET - The engine is shut down and the GSC is reset (upper display and fault indicators on the left side are temporarily cleared). The GSC turns off unless a jumper is installed from ECS terminal 6 to 9.

2. AUTO - The engine starts and runs only when the customer's remote initiate contact closes the start input on the GSC to battery negative (B-). At this time, the GSC starts the engine and it runs normally until the remote initiate contact opens. The engine then enters a cooldown time after which the engine is shut down. The GSC shows faults on the upper display and on the fault indicators as they occur. The GSC is turned on continuously with the ECS in this position.

3. MAN/START - The engine starts and runs until the operator turns the ECS to OFF/RESET, to COOLDOWN/STOP or until the GSC detects a fault shutdown. The GSC shows faults on the upper display and on the fault indicators as they occur. The GSC is turned on continuously with the ECS in this position.

4. 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 they occur. The GSC is turned on continuously with the ECS in this position.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 2 (Undefined State)

The possible causes of a CID 336 FMI 2 fault are:

a. More than one GSC input from the ECS is connected to battery negative (B-) at the same time. The one exception is the start input. The start input of the GSC is also connected to the remote initiate contact and is controlled by the customer. The GSC accepts a battery negative (B-) state from the start input and at the same time from any other ECS input.
b. None of the GSC inputs from the ECS are connected to ground.

The CID 336 FMI 2 fault is the only ECS fault detected by the GSC. Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 336 FMI 2 fault as a shutdown fault. Use these procedures for an active or an inactive fault.

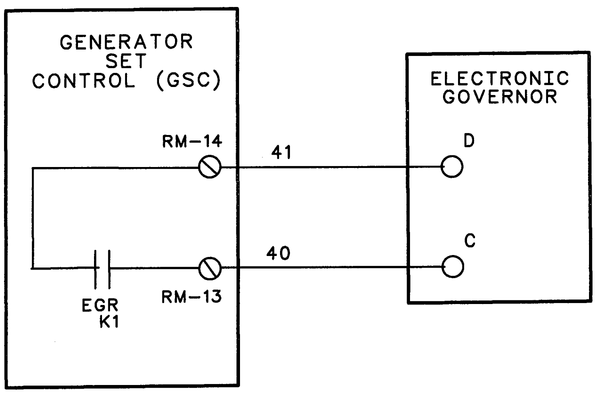
STEP 1. CHECK FOR OPEN CIRCUIT - When performing this Step, see the preceding System Schematic. If equipped, disconnect the remote initiate contacts and reconnect after troubleshooting is complete. Disconnect the harness connector from the GSC. (If equipped, disconnect the remote start contacts by removing the wires from terminal 14 of TS1.) Check that for each position of the ECS, the corresponding contact of the GSC harness connector is the only one connected to battery negative (B-). For each position of the ECS, measure the resistance from each contact (32, 33, 39 and 40) of the harness connector to battery negative (B-) of the relay module.

a. OFF/RESET position, from contact 39 to the B- terminal should measure 5 ohms or less. Contacts 32, 33 and 40 to the B- terminal should measure greater than 5k ohms.
b. AUTO position, from contact 40 to the B- terminal should measure 5 ohms or less. Contacts 32, 33 and 39 to the B- terminal should measure greater than 5k ohms.
c. MAN/START position, from contact 33 to the B- terminal should measure 5 ohms or less. Contacts 32, 39 and 40 to the B- terminal should measure greater than 5k ohms.
d. COOLDOWN/STOP position, from contact 32 to the B- terminal should measure 5 ohms or less. Contacts 33, 39 and 40 to the B- terminal should measure greater than 5k ohms.

- OK; all resistance measurements are correct. The circuits in the harness are NOT open. To further check the harness, go to the topic Electrical Connector Inspection. 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 (faulty). Troubleshoot the ECS and/or repair the faulty harness wiring between battery negative (B-) and the GSC connector. STOP.

CID 441
Electronic Governor (EG) Relay



GOVERNOR TERMINAL CHART

GOVERNOR	TERMINAL DESIGNATION CROSS REFERENCE										
	A	B	C	D	E	F	G	H	J	K	
1724 8290	2	1	10	9	5	6	3	4	7	8	
2301A SPEED	1	2	2	5	7	8	10	9	11	12	

D01314

System Schematic For Electronic Governor (EG) Relay

System Operation

The GSC uses the electronic governor relay (EGR) to activate the close-for-rated speed contacts of the electronic governor. When this occurs, the electronic governor increases the engine speed from idle to rated. The electronic governor relay output is rated at 1 amp. The EGR is located within the relay module.

When 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 now shown on the lower display.) This closes the relay contacts of the EGR and tells the electronic governor to go to rated engine speed.

When engine oil pressure is less than the setpoint for low oil pressure shutdown at idle speed (P14), the GSC does not activate the EGR. (Also, K1 is not showing on the lower display.) This opens the relay contacts of the EGR and tells the electronic governor to go to idle engine speed.

NOTE: Whenever the GSC activates or attempts to activate the EGR, K1 is shown on the lower display. When the EGR is not activated, K1 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 441 FMI 12 fault is an open or shorted coil of the EGR. The system response to this fault is:

a. If a CID 441 fault occurs while the EGR is activated, then the engine speed drops from rated to idle speed (if equipped with an electronic governor).
b. If a CID 441 fault occurs while the EGR is not activated, then the engine is able to start and run, but can not reach rated speed (if equipped with an electronic governor).

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 441 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 441 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 441 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the fault is showing (is inactive).

- OK; a CID 441 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 441 fault is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than approximately 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

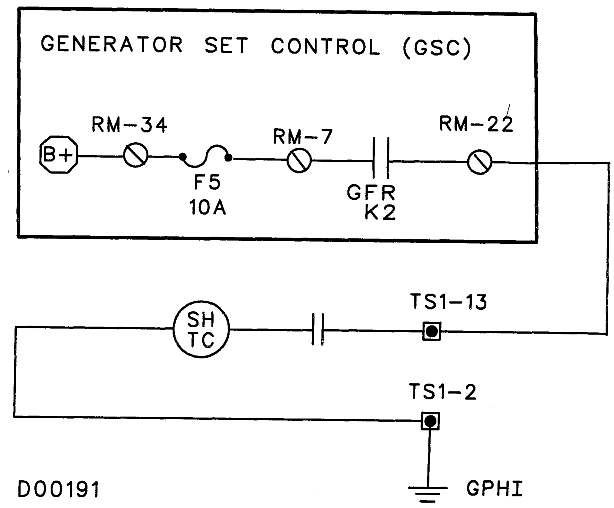
- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

STEP 3. EGR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminals 13 and 14 of the relay module. At the relay module, measure the resistance from terminal 13 to terminal 14. Resistance should measure greater than 5k ohms.

Start and run the engine. Make sure the engine oil pressure is greater than the setpoint for low oil pressure shutdown at idle speed (P14). At the relay module, measure the resistance from terminal 13 to terminal 14. Resistance should measure less than 5 ohms.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. STOP.
- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the topic Relay Module Replacement. STOP.

CID 442
Generator Fault Relay (GFR)



System Schematic For Generator Fault Relay (GFR)

System Operation

The GSC uses the generator fault relay (GFR) to activate the shunt trip coil of the optional circuit breaker during a shutdown fault. This takes the generator off-line during a shutdown fault. The GFR is located within the relay module. The optional circuit breaker is located in the generator housing.

NOTE: Whenever the GSC activates or attempts to activate the GFR, K2 is shown on the lower display. When the GFR is not activated, K2 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 442 FMI 12 fault is an open or shorted coil of the GFR. The system response to this fault is:

a. If a CID 442 fault occurs while the GFR is activated, then there is no effect on the system because the optional circuit breaker is already open and shutdown mode is functioning. The generator is already off-line.
b. If a CID 442 fault occurs while the GFR is not activated and a shutdown fault occurs, then the GFR cannot activate the shunt trip coil of the optional circuit breaker. The generator remains on-line.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 442 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 442 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 442 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 442 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 442 fault is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

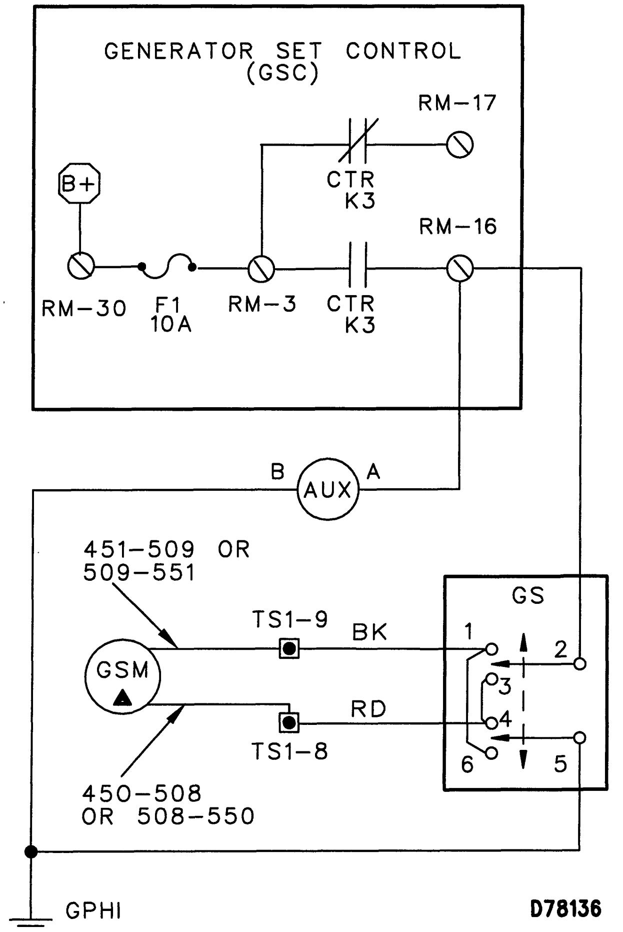
STEP 3. GFR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 22 of the relay module. At the relay module, measure the resistance from terminal 22 to terminal 7. Resistance should measure greater than 5k ohms.

Turn the ECS to STOP and push in the emergency stop button. At the relay module, measure the resistance from terminal 22 to terminal 7. Resistance should measure less than 5 ohms.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. STOP.

- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.

CID 443
Crank Termination Relay (CTR)



System Schematic For Crank Termination Relay (CTR)

System Operation

The GSC uses the crank termination relay (CTR) to activate optional components: the auxiliary relay (AUXREL) and the governor switch (GS). The CTR is located within the relay module. The AUXREL is located on the sub-panel within the control panel. The GS is located on the instrument panel.

The CTR is used to indicate that the engine is beginning to run without cranking. The GSC activates the CTR when engine speed is greater than the crank terminate setpoint (400 RPM, setpoint P11) and the starting motor relay has been deactivated. The CTR deactivates when the engine RPM reaches 0.

NOTE: Whenever the GSC activates or attempts to activate the CTR, K3 is shown on the lower display. When the CTR is not activated, K3 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 443 fault is an open or shorted coil of the CTR. The system response to this fault is:

a. If a CID 443 fault occurs while the CTR is activated, then the engine continues to run, but the AUX and GS are deactivated.
b. If a CID 443 fault occurs while the CTR is not activated, then the engine is able to start and run, but the AUX and the GS are not activated.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 443 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 443 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 443 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 443 has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 443 is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

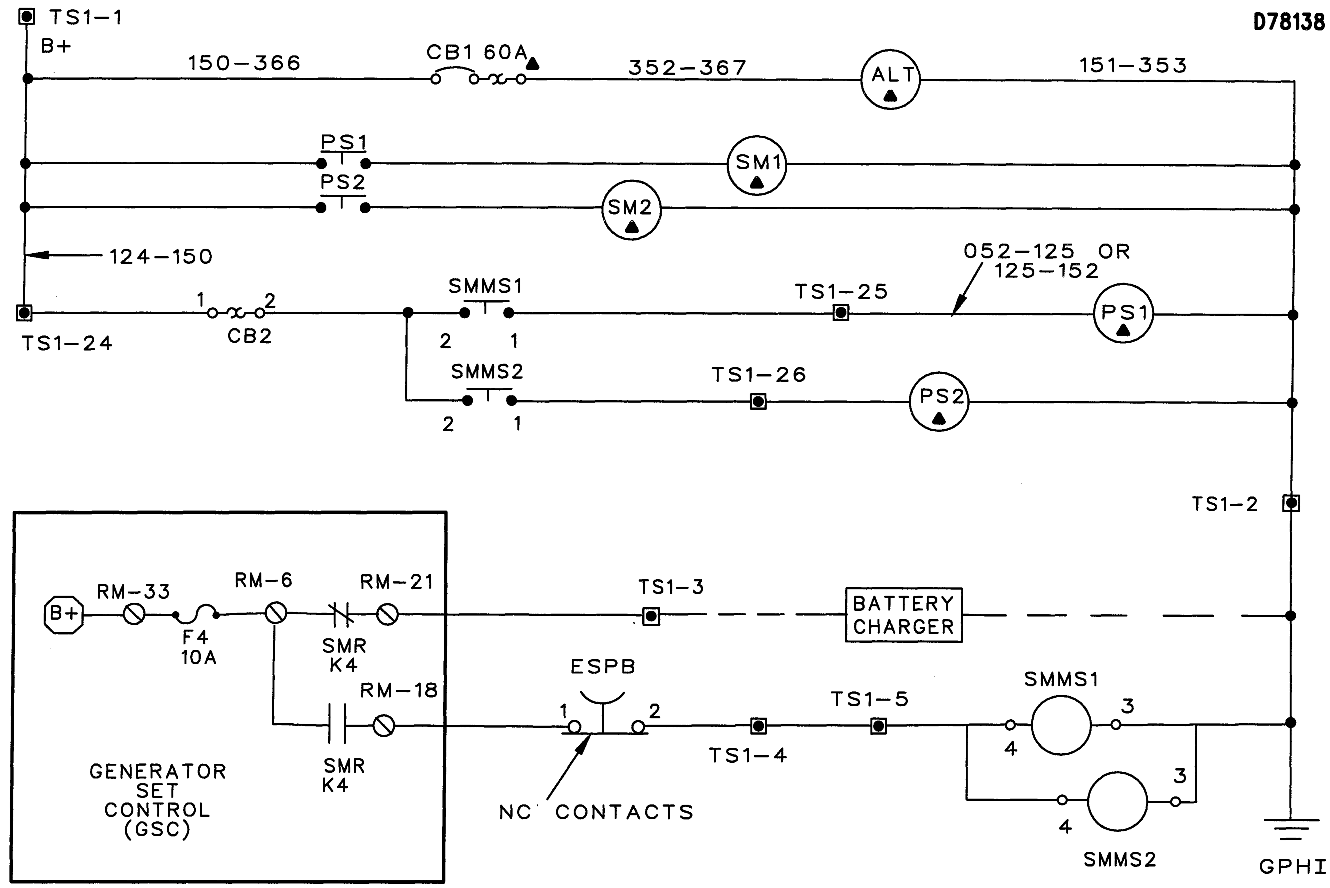
- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

STEP 3. CTR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 16 of the relay module. At the relay module, measure the resistance from terminal 16 to terminal 3. Resistance should measure greater than 5k ohms.

Start and run the engine. Make sure the engine speed is greater than the setpoint for crank terminate (P11). At the relay module, measure the resistance from terminal 16 to terminal 3. Resistance should measure less than 5 ohms.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. STOP.

- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.



System Schematic For Starting Motor Relay (SMR)

System Operation

The GSC uses the starting motor relay (SMR) to activate the starting motor magnetic switch (SMMS), the pre-lube pump and the battery charger. The SMR is located within the relay module. The pre-lube pump and the battery charger are located external to the control panel.

NOTE: Whenever the GSC activates or attempts to activate the SMR, K4 is shown on the lower display. When the SMR is not activated, K4 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 444 FMI 12 fault is an open or shorted coil of the SMR. The system response to this fault is:

a. If a CID 444 fault occurs while the SMR is activated, then the engine stops cranking and the pre-lube pump is disabled. The battery charger continues to function.
b. If a CID 444 fault occurs while the SMR is not activated, then the engine can not crank or start and the pre-lube pump is disabled. The battery charger continues to function. If the engine is already running, then it continues to run.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 444 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 444 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 444 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 444 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 444 fault is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

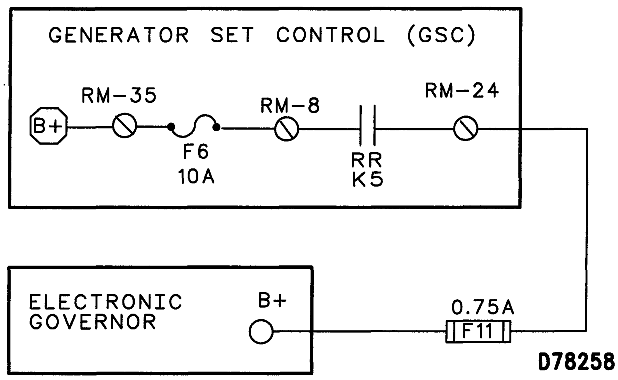
STEP 3. SMR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 18 of the relay module. Remove fuse F4 from the relay module.

a. At the relay module, measure the resistance from terminal 18 to terminal 6. Resistance should measure greater than 5k ohms.
b. Prepare to measure the resistance from terminal 18 to terminal 6 of the relay module. Resistance should measure less than 5 ohms. Turn the ECS to START and quickly measure the resistance before the starting motor relay drops out because of the cycle crank time.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. If the fault remains active, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.

CID 445
Run Relay (RR)



System Schematic For Run Relay (RR)

System Operation

The GSC uses the run relay (RR) to activate the electronic governor (EG). The GSC also provides a set of contacts of the run relay (RR1) for customer use. The RR is located within the relay module. The electronic governor (EG) is usually mounted on the sub-panel within the control panel.

The GSC activates the run relay (RR) during engine cranking and running.

NOTE: Whenever the GSC activates or attempts to activate the RR, K5 is shown on the lower display. When the RR is not activated, K5 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 445 FMI 12 fault is an open or shorted coil of the RR. The system response to this fault is:

a. If a CID 445 fault occurs while the RR is activated, then:
   On gensets with an electronic governor, the engine shuts down and does not start.
   On gensets with a mechanical governor, the engine continues to run and is able to start.
   Any customer equipment on terminal 23 of the relay module is activated.
b. If a CID 445 fault occurs while the RR is not activated, then:
   On gensets with an electronic governor, the engine can not start.
   On gensets with a mechanical governor, the engine is able to start and run.
   Any customer equipment on terminal 23 of the relay module remains activated.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 445 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 445 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 445 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 445 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 445 fault is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

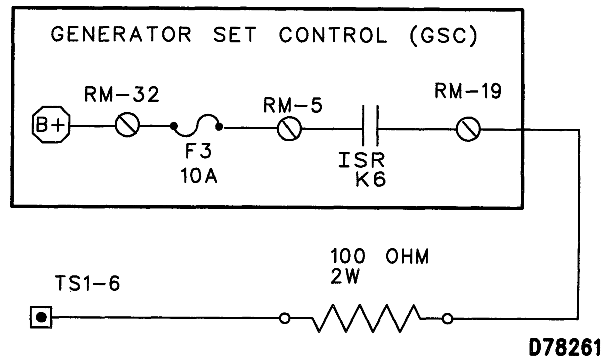
STEP 3. RR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 24 of the relay module. Remove fuse F4 from the relay module.

a. At the relay module, measure the resistance from terminal 24 to terminal 8. Resistance should measure greater than 5k ohms.
b. Turn the ECS to START. At the relay module, measure the resistance from terminal 24 to terminal 8. Resistance should measure less than 5 ohms.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. If the fault remains active, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.

CID 446
Ignition Shutoff Relay (ISR)



System Schematic For Ignition Shutoff Relay (ISR)

System Operation

The GSC uses the ignition shutoff relay (ISR) to ground the shutdown input of the electronic ignition system (EIS), during a shutdown fault. The ISR is located within the relay module.

The GSC activates the ignition shutoff relay (ISR) for some active shutdown faults.

NOTE: Whenever the GSC activates or attempts to activate the ISR, K6 is shown on the lower display. When the ISR is not activated, K6 is not shown.

FMI 12 (Faulty Component)

The possible cause of a CID 446 FMI 12 fault is an open or shorted coil of the ISR. The system response to this fault is:

a. If a CID 446 fault occurs while the ISR is activated, then there is no effect on the system because the ignition shutoff is already operating and shutdown mode is functioning.
b. If a CID 446 fault occurs while the ISR is not activated, then there is no immediate effect on the system; the engine is able to start and run.
c. If a CID 446 fault occurs while the ISR is not activated and a shutdown fault occurs, then the ISR cannot activate ignition shutoff.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 446 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 446 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 446 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 446 has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 446 fault is active or inactive. Proceed to Step 2.

STEP 2. ISR FUNCTIONAL CHECK - Disconnect all wires from terminal 19 or terminal 20 of the relay module.

a. Turn the ECS to OFF/RESET. At the relay module, measure the resistance from terminal 19 to terminal 5. Resistance should measure greater than 5k ohms. At the relay module, measure the resistance from terminal 20 to terminal 5. Resistance should measure less than 5.0 ohms.
b. Turn the ECS to STOP. Push in the emergency stop push button (ESPB). At the relay module, measure the resistance from terminal 19 to terminal 5. Resistance should measure less than 5 ohms. At the relay module, measure the resistance from terminal 20 to terminal 5. Resistance should measure greater than 5k ohms.

- OK; all resistance measurements are correct. Proceed to Step 3.

- NOT OK; any one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.

STEP 3. CHECK INTERNAL CABLE OF RELAY MODULE -

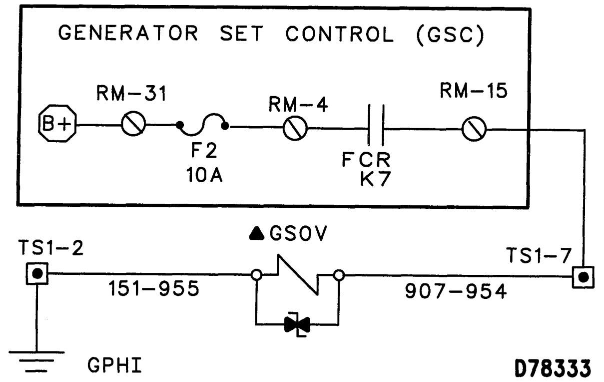
NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. If the fault remains active, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

CID 447
Fuel Control Relay (FCR)



System Schematic For Fuel Control Relay

System Operation

The GSC uses the fuel control relay (FCR) to activate the fuel solenoid (FS). The FCR is located within the relay module. The fuel solenoid is located in the fuel system of the engine. The GSC activates the FCR which energizes the fuel solenoid to run the engine.

NOTE: Whenever the GSC activates or attempts to activate the FCR, K7 is shown on the lower display. When the FCR is not activated, K7 is not shown. Also, setpoint P01 selects the fuel solenoid type: 0 = ETR or 1 = ETS. Gas engines use the energized to run (ETR) type of fuel system.

FMI 12 (Faulty Component)

The possible cause of a CID 447 FMI 12 fault is an open or shorted coil of the FCR. The system response to this fault is:

a. With the FCR activated - If a CID 447 fault occurs while the engine is running, then a CID 566 (unexpected shutdown) fault is declared and shutdown mode is functioning (the engine stops).

b. With the FCR not activated - If a CID 447 fault occurs, then the engine can not start or run.

NOTE: With an electronic governor, the status of the FCR has no effect on starting or running the engine.

Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 447 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS switch is in any position except the OFF/RESET position.

This troubleshooting procedure is for an active or inactive CID 447 fault.

STEP 1. CHECK FAULT STATUS (ACTIVE/INACTIVE) - Turn the ECS to OFF/RESET and then to STOP. Press the alarm codes key. Observe the upper display to see if the CID 447 fault is showing (is active). If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

- OK; a CID 447 fault has not occurred (is NOT active and is NOT inactive). STOP.

- NOT OK; a CID 447 fault is active or inactive. Proceed to Step 2.

STEP 2. CHECK INTERNAL CABLE OF RELAY MODULE -

NOTE: Only open the relay module in a dry environment. If the inspection and repair takes more than 20 minutes, replace the desiccant bag in the GSC housing. See the topic Relay Module Replacement.

Turn the ECS to OFF/RESET. Temporarily, remove the relay module from the GSC, see the topic Relay Module Replacement. Check the cable that attaches the relay module to the GSC. The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

- OK; cable is correct. Reassemble the relay module to the GSC. Proceed to Step 3.

- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

STEP 3. FCR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 15 of the relay module. Remove fuse F4 to prevent engine starting.

a. At the relay module, measure the resistance from terminal 15 to terminal 4. Resistance should measure greater than 5k ohms.
b. For ETR systems, turn the ECS to START. For ETS systems, turn the ECS to START and then to OFF/RESET. Make sure that K7 is showing on the lower display. At the relay module, measure the resistance from terminal 15 to terminal 4. Resistance should measure less than 5 ohms.

- OK; both resistance measurements are correct. It is likely that a temporary bad electrical connection existed and this troubleshooting procedure corrected it. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. If the fault remains active, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; either one of the resistance measurements are NOT correct. The relay module is faulty. Replace the relay module; see the Topic Relay Module Replacement. STOP.

CID 500
Generator Set Control (GSC)

System Operation

A CID 500 FMI 12 fault means that the GSC is no longer able to accurately measure AC voltage and current. The engine remains able to run or start.

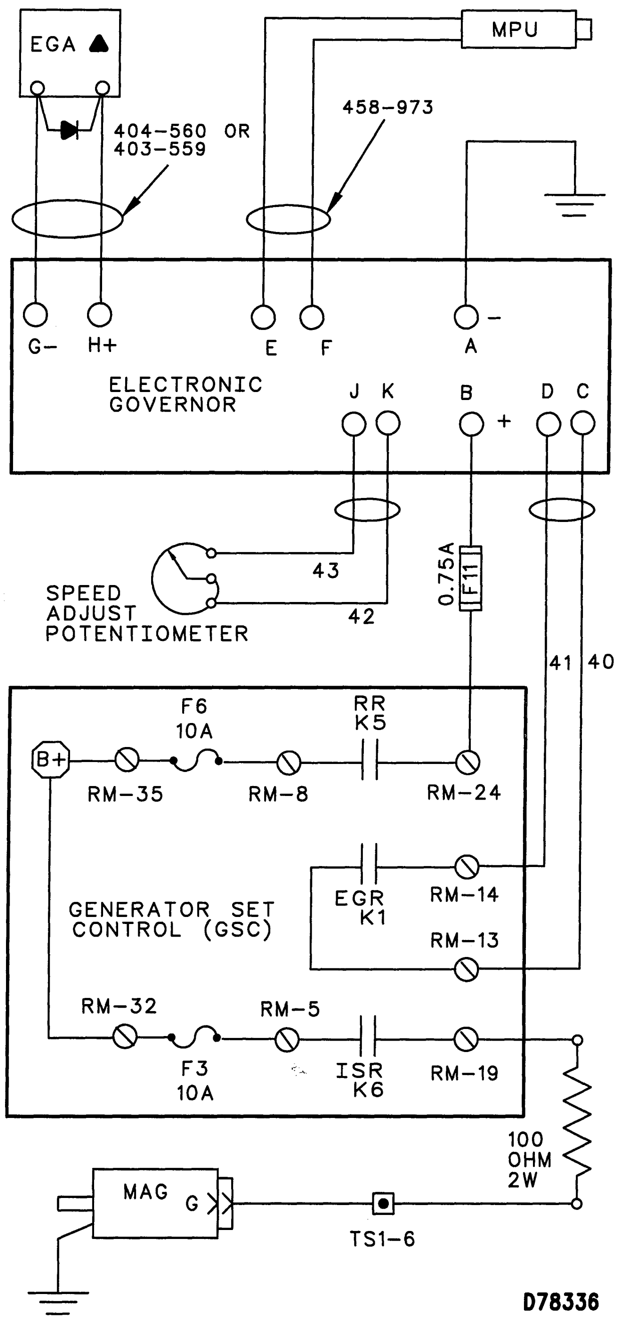
FMI 12 (Faulty Component)

If a CID 500 FMI 12 fault occurs, replace the GSC. See the topic Generator Set Control Replacement.

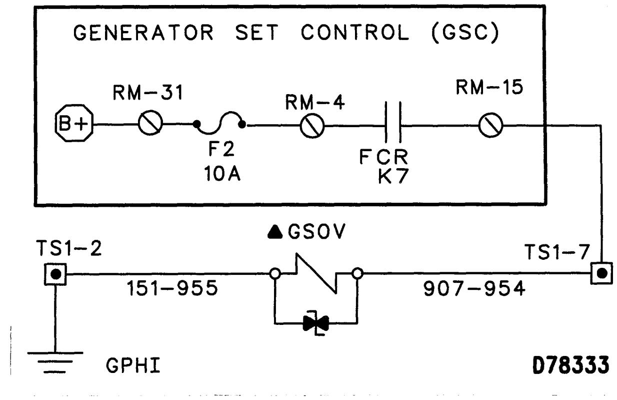
NOTICE

If a CID 500 FMI 12 fault occurs and the engine is running, the generator output may be at full voltage potential even if the GSC display is showing 0 AC volts and 0 AC current for all three phases.

CID 566
Unexpected Shutdown



System Schematic For Unexpected Shutdown



System Schematic For Fuel Control Relay

System Operation

The purpose of the CID 566 diagnostic code is to alert the operator that the GSC did not control the engine shutdown. The GSC usually controls all engine shutdowns. If an outside influence causes engine shutdown, the GSC declares a CID 566 fault. There is only one failure mode for a CID 566 fault and it is FMI 7 (faulty mechanical response).

The sequence of events for this fault are:

1. On a running engine, the GSC detects that engine speed has dropped from rated to 0 rpm when the GSC has not called for a shutdown.
2. The GSC determines that no engine speed sensor fault is present that explains the drop in speed signal.
3. The GSC declares a CID 566 FMI 7 fault and disables the engine from running or starting.

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 and 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 Engine Oil Pressure Sensor
CID 110 FMI 3 Engine Coolant Temperature Sensor
CID 111 FMI 3 Engine Coolant Loss Sensor (if equipped)
CID 190 FMI 3 Engine Magnetic Pickup
CID 331 FMI 2 Engine Control Switch
CID 336 FMI 2 Engine Control Switch

FMI 7 (Faulty Mechanical Response)

The possible cause of a CID 566 FMI 7 fault is a mechanical portion of a component that is not responding properly. The CID 566 FMI 7 fault is the only ECS fault detected by the GSC. Clear the fault from the fault log after troubleshooting is complete. The GSC treats a CID 566 FMI 7 fault as a shutdown fault.

NOTE: This procedure requires many voltage measurements during simulated engine cranking. Starting motor fuse F4 on the relay module is removed to prevent activating the starting motor and actual engine cranking does not occur. Voltage measurements must be made quickly before the total cycle crank time (setpoint P17) elapses. The total cycle crank time is usually 90 seconds; see the topic P17 within Setpoint Programming. If a voltage measurement takes too long (more than 90 seconds) the GSC declares an overcrank fault and the overcrank shutdown indicator will FLASH. To continue with a voltage measurement, the overcrank fault must be reset by turning the ECS to OFF/RESET and then to START.

PRELIMINARY STEP. INITIAL CHECK - Before proceeding with the troubleshooting procedures, do the following:

a. Make sure that there are NO OTHER ACTIVE FAULTS (no fault codes showing on upper display, no shutdown or alarm indicators are flashing). Failure to do so may result in erroneous troubleshooting and needless replacement of parts. The operator will make many voltage measurements while the GSC is attempting to crank the engine. If the GSC detects other faults, it will prevent starting by shutting off the fuel and air to the engine. The resulting voltage measurements would then be the exact opposite of what is expected in the procedures.

b. Check the fuel level and 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 or fuel system fault.

NOTE: If genset is equipped with an electronic governor, also check it's magnetic pickup.

STEP 1. VERIFY FAULT - Check the GSC for an active CID 566 FMI 7 fault. (If other faults are active, correct the other faults before proceeding).

- OK; a CID 566 FMI 7 fault is NOT showing. No active CID 566 FMI 7 fault exists. STOP.

- NOT OK; only a CID 566 FMI 7 fault is showing. Proceed to Step 2. If desired and if an inactive CID 566 FMI 7 fault is showing in the fault log, check the fuel/engine problem history of the genset and proceed to Step 2.

STEP 2. CHECK SYSTEM VOLTAGE - With the engine off, measure the system voltage at the battery. For 24 volt systems, the system voltage should measure from 24.8 to 29.5 DCV. For 32 volt systems, the system voltage should measure from 33.1 to 39.3 DCV. Make a note of this measurement. The system voltage measurement is used for comparison in future Steps of this procedure.

- OK; system voltage is correct. Proceed to Step 3.

- NOT OK; system voltage is NOT correct. For troubleshooting see the CID 168 procedure. STOP.

STEP 3. CHECK GOVERNOR AND RACK - Remove fuse F4 from the relay module. Prepare to monitor the movement of the governor linkage and the fuel rack. Turn the ECS to OFF/RESET and then to START. Observe the governor and the fuel rack.

- OK; governor linkage and fuel rack move in the "fuel on" direction. The fault is in the engine or fuel system. Refer to the corresponding Engine Service Manual. STOP.

- NOT OK; cannot see the governor linkage and fuel rack move in the "fuel on" direction. Proceed to Step 4.

STEP 4. CHECK SETPOINT P01 - Gas engines use the energized to run (ETR) type of fuel system. Check that setpoint P01 is 0 (ETR). See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section.

NOTE: For 3500 product only, if an electronic governor is present and a fuel solenoid is not present, go directly to Step 10.

- OK; setpoint P01 is programmed to 0 (for ETR). Proceed to Step 5.

- NOT OK; setpoint P01 is NOT programmed correctly. Reprogram setpoint P01, see Setpoint Programming - OP5 within the topic Service Mode in the Systems Operation section.

STEP 5. CHECK VOLTAGE AT FUEL SOLENOID - Fuse F4 remains removed from the relay module. Prepare to measure the voltage across the terminals of the fuel solenoid on the engine. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

For ETR fuel solenoids, the voltage should measure ± 2.0 DCV of the system voltage measured in Step 2.

- OK; voltage is correct. The fault is with the governor or fuel rack. If an electronic governor is present, go to Step 10. Refer to the appropriate Service Manual. STOP.

- NOT OK (ETR type); voltage is low. Proceed to Step 6.

STEP 6. CHECK FUSES - Turn the ECS to OFF/RESET. Check fuses F2 and F10 on the relay module. Also, if the engine is a 3408 or 3412 and has the auxiliary fuel control relay (AFCR) installed, check F16 on the rear inside wall of the panel. None of these fuses should be blown (open).

- OK; none of these fuses are blown. Proceed to Step 7.

- NOT OK; one or more of the fuses are blown. Proceed to Step 8.

STEP 7. CHECK VOLTAGE AT RELAY MODULE - Fuse F4 remains removed from the relay module. Prepare to measure the voltage from terminal 15 to the B- terminal of the relay module. The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; voltage is correct. There is an open circuit between terminal 15 of the relay module and the fuel solenoid. Repair the circuit. See the preceding System Schematic. STOP.

- NOT OK; voltage is low. Proceed to Step 9.

STEP 8. TROUBLESHOOT BLOWN FUSE - This Step continues troubleshooting from Step 6. For reference, see the preceding System Schematics and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. The ECS remains in the OFF/RESET position. Remove the fuse that is blown.

If the blown fuse is F2, measure the resistance from terminal 15 of the relay module to battery negative (B-).
If the blown fuse is F10, measure the resistance from terminal 39 of the relay module to battery negative (B-).
If the blown fuse is F16 (on the sub-panel), measure the resistance from terminal 2 (load side) of the fuse holder to battery negative (B-).

For a fuse that is blowing, the circuit resistance should measure less than 3 ohms.

- If resistance is less than 3 ohms, there is a short to battery negative (B-). (NOTE: On some ETR fuel systems with a dual coil fuel solenoid, the correct normal resistance can measure less than 1 ohm.) Remove one component or wire at a time that is in series with the load side of the fuse terminal until the faulty component or wire is isolated. Repair or replace faulty component or wiring. STOP.

- If resistance is greater than 3 ohms and the fuse still blows when all wires are removed from the appropriate terminal, replace the relay module. See the topic Relay Module Replacement. STOP.

STEP 9. CHECK LOW VOLTAGE CONDITION - This Step continues troubleshooting from Step 7. Fuse F4 remains removed from the relay module. For reference, see the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. Prepare to make voltage measurements at the relay module. Turn the ECS to OFF/RESET and then to START.

a. At the relay module, measure the voltage from terminal 4 to the B- terminal and from terminal 31 to the B- terminal. The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2.
   - If voltage is NOT correct, check the wiring and recheck the fuse F2. STOP.
   - If voltage is correct, go to Step b.

b. Make sure that no other faults are active. Check the GSC display for any active faults.
   - If no faults are active, go to Step c.
   - If a fault other than CID 566 FMI 7 is active, correct the fault. Go to the corresponding troubleshooting procedure. STOP.

c. Recheck the voltage on terminal 15 of the relay module. See Step 7.
   - If the voltage is correct. There is an open circuit between terminal 15 of the relay module and the fuel solenoid. Repair the wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.
   - If the voltage remains low, replace the relay module. See the topic Relay Module Replacement. STOP.

STEP 10. CHECK SUPPLY VOLTAGE OF ELECTRONIC GOVERNOR - This Step continues troubleshooting from Step 4. Fuse F4 remains removed from the relay module. Prepare to measure the voltage from the positive supply terminal of the electronic governor to the B- terminal of the relay module. The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; supply voltage is correct. The fault is in the electronic governor or actuator system. For the 2301A governor, see module SENR4676. For the 2301A load sharing governor, see module SENR3585. For 524 and 1724 electrically powered governor systems, see module SENR6430. STOP.

- NOT OK; supply voltage is low. Check fuses F6 and F11 on the relay module. If blown, go to Step 8. If fuse is OK, go to Step 11.

STEP 11. CHECK VOLTAGE AT RELAY MODULE - Fuse F4 remains removed from the relay module. Prepare to measure the voltage from terminal 24 to the B- terminal of the relay module. The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; voltage is correct. There is an open between terminal 24 of the relay module and the electronic governor. Check the wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.

- NOT OK; voltage is low. Proceed to Step 12.

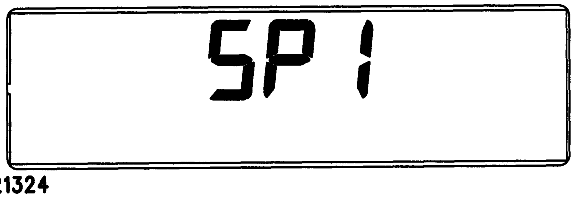
STEP 12. CHECK LOW VOLTAGE CONDITION - Fuse F4 remains removed from the relay module. For reference, see the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. Prepare to make voltage measurements at the relay module. Turn the ECS to OFF/RESET and then to START.

a. At the relay module, measure the voltage from terminal 8 to the B- terminal and from terminal 35 to the B- terminal. The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2.
   - If voltage is NOT correct, check the wiring and recheck the fuse F6. STOP.
   - If voltage is correct, go to Step b.

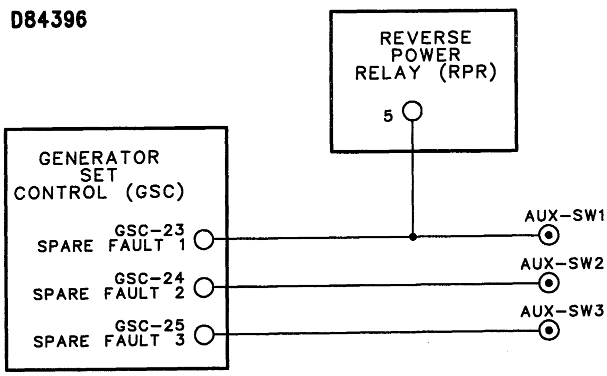
b. Make sure that no other faults are active. Check the GSC display for any active faults.
   - If only the CID 566 FMI 7 is active, go to Step c.
   - If a fault other than CID 566 FMI 7 is active, correct the fault. Go to the corresponding troubleshooting procedure. STOP.

c. Recheck the voltage on terminal 24 of the relay module. See Step 11.
   - If the supply voltage is correct. There is an open between terminal 24 of the relay module and the electronic governor. Check the wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.
   - If the supply voltage remains low, replace the relay module. See the topic Relay Module Replacement. STOP.

Spare Fault Troubleshooting



Upper Display With Spare Fault Code SP1 Showing



System Schematic For Spare Fault Inputs

A spare fault informs the operator of an undesirable condition (fault) that exists. The spare fault inputs are programmed into the GSC to meet the requirements of the customer or application. An active spare fault input causes an alarm fault or shutdown fault. For programming of the spare fault inputs, see Spare Input/Output Programming OP6 within the topic Service Mode in the Systems Operation section. It is the responsibility of the programmer (customer, operator, or service personnel) to make a note of the actual conditions that cause a spare fault code to be shown on the upper display. The GSC does not diagnose the spare fault inputs and spare faults are not recorded in the fault log.

The GSC treats an active high input state as a fault. The active state is programmable on the GSC to be either a high or low 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 spare 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 spare fault code is shown on the upper display. After a spare fault is corrected or is not present, the spare fault code is no longer shown on the upper display.

Spare fault codes are associated with the spare fault inputs. The spare fault code shown on the upper display, identifies the spare fault input that caused the alarm fault or shutdown fault. The spare fault codes are:

SP1 for spare fault 1 input.
SP2 for spare fault 2 input.
SP3 for spare fault 3 input.

When a spare fault code is showing on the upper display, check the programming notes to determine the cause. If no notes are available use the following information to help find the cause.

The SP1 fault code corresponds to contact 23 of the GSC connector which is wired to terminal SW1 of the AUX terminal strip.

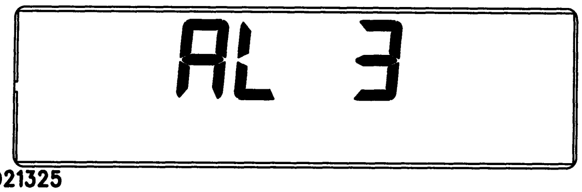
The SP2 fault code corresponds to contact 24 of the GSC connector which is wired to terminal SW2 of the AUX terminal strip.

The SP3 fault code corresponds to contact 25 of the GSC connector which is wired to terminal SW3 of the AUX terminal strip.

The AUX terminal strip is located on the left side wall within the control panel.

NOTE: On gensets equipped with the optional reverse power relay, the relay is always connected to the spare fault 1 input of the GSC. And an SP1 fault code is shown when the reverse power relay has operated.

Alarm Fault Troubleshooting



D21325

Upper Display With Alarm Fault Code AL3 Showing

An alarm fault informs the operator of a condition that is about to cause a dedicated fault shutdown. An alarm fault precedes certain dedicated shutdown faults. Alarm faults are activated automatically by the GSC and depend upon certain setpoints. The GSC does not record alarm faults in the fault log.

When an alarm fault occurs (is active), the GSC FLASHES the fault alarm indicator and 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.

The alarm fault codes and the related setpoints are:

AL1 - High engine coolant temperature alarm. When coolant temperature rises to within 6°C (11°F) of the P15 setpoint, a high coolant temperature alarm is issued by the GSC. Then the GSC FLASHES the fault alarm indicator and alarm code AL1 is shown on the upper display after the alarm codes key is pressed.

AL2 - Low engine coolant temperature alarm. When coolant temperature decreases to setpoint P16, then the GSC FLASHES the fault alarm indicator and alarm code AL2 is shown on the upper display after the alarm codes key is pressed.

AL3 - Low engine oil pressure alarm. When oil pressure drops to within 34 kPa (5 psi) of the P13 or P14 setpoint, a low oil pressure alarm is issued by the GSC. Then the GSC FLASHES the fault alarm indicator and alarm code AL3 is shown on the upper display after the alarm codes key is pressed.

For more information on alarm faults, see the topics Alarm Mode and Alarm Fault Codes.

Troubleshooting Procedure

If the operation of the alarm codes is suspected to be faulty perform this procedure.

STEP 1. Check for a CID 110 (temperature sensor) or CID 269 (sensor power supply) diagnostic code that is active. See the topic Diagnostic Faults.

- If one of these diagnostic codes is active, correct it prior to proceeding with this procedure.
- If neither of these diagnostic codes is active, go to Step 2.

STEP 2. Identify the alarm code suspected to be faulty.

- If alarm code AL1 or AL3 is suspected to be faulty, go to and use the procedures of the topic Dedicated Shutdown Indicator Troubleshooting.

If alarm code AL2 is suspected to be faulty, go to Step 3.

STEP 3. Functional check of the AL2 alarm code. Check and note setpoint P16 (low water temperature alarm), see Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Check and note the actual coolant temperature showing on the lower display. Compare the two temperatures. The actual coolant temperature showing on the lower display should be greater than setpoint P16.

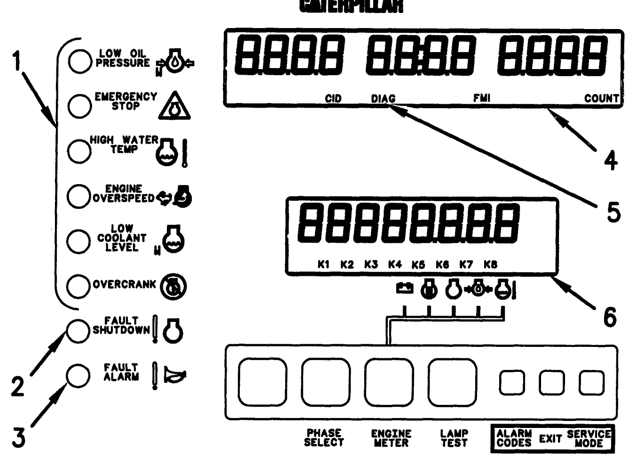
- If the temperature showing on the lower display is greater than setpoint P16, then the temperatures are not correct for an AL2 alarm code. If the AL2 alarm code remains active, replace the GSC. See the topic Generator Set Control Replacement. STOP.
- If the temperature showing on the lower display is less than setpoint P16, then the temperatures are correct for an AL2 alarm code. Make sure setpoint P16 is reasonable for the local climate. Adjust if necessary or proceed to Step 4 if the setpoint is reasonable.

STEP 4. Check accuracy of temperature showing 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 and as close as possible to the EMCP II coolant temperature sensor. Start and run the engine. Allow coolant temperature to stabilize. Compare the temperature showing on the gauge with that showing on the lower display. The temperatures should agree within 5°C (10°F).

- Temperatures agree. The engine is running cold. Refer to the Engine Service Manual to find the cause. STOP.
- Temperatures do not agree. If the gauge is accurate, replace the engine coolant temperature sensor. STOP.

Dedicated Shutdown Indicator Troubleshooting

D20440



GSC Display Area
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) "DIAG" indicator. (6) Lower display.

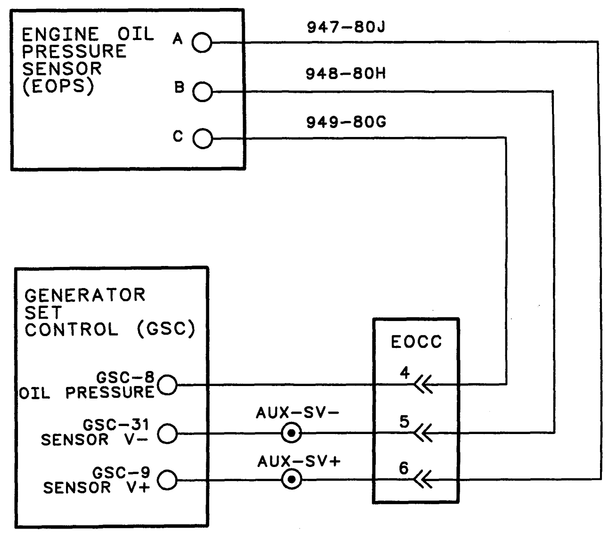
The dedicated shutdown indicators inform the operator which system is responsible for an engine shutdown. The symbol and nomenclature nearest to the indicator identifies the responsible system. Dedicated shutdown faults are activated automatically by the GSC and depend upon certain setpoints. When the 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:

Low Oil Pressure
Emergency Stop
High Water Temperature
Engine Overspeed
Low Coolant Level
Overcrank

To find the cause of a dedicated shutdown fault, perform the following corresponding procedure.

Low Oil Pressure Indicator



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System Schematic For Engine Oil Pressure Sensor (EOPS)

To find the cause of a low oil pressure shutdown, perform this procedure.

STEP 1. Check for a CID 100 (oil pressure sensor) or CID 269 (sensor power supply) diagnostic code that is active. See the topic Diagnostic Faults.

- If any one of these diagnostic codes is active, correct it prior to proceeding with this procedure. STOP.
- If none of these diagnostic codes is active, go to Step 2.

STEP 2. Check for obvious causes of low oil pressure. Check oil level, oil leaks and other obvious causes of low oil pressure.

- If no obvious causes exist, then go to Step 3.
- If obvious causes do exist, then correct the fault. Refer to the Engine Service Manual. STOP.

STEP 3. Check setpoints P12 (oil step speed), P13 (low oil pressure at rated speed) and P14 (low oil pressure at idle speed). View and make a note of setpoints P12, P13 and P14. See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Compare the setpoint viewed with the specified setpoint. The setpoints should agree. The factory setpoints are: 1350 RPM for P12, 205 kPa (30 psi) for P13 and 70 kPa (10 psi) for P14.

- If the setpoints agree, then go to Step 4.
- If the setpoints do not agree, then reprogram setpoints P12, P13 and P14. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. STOP.

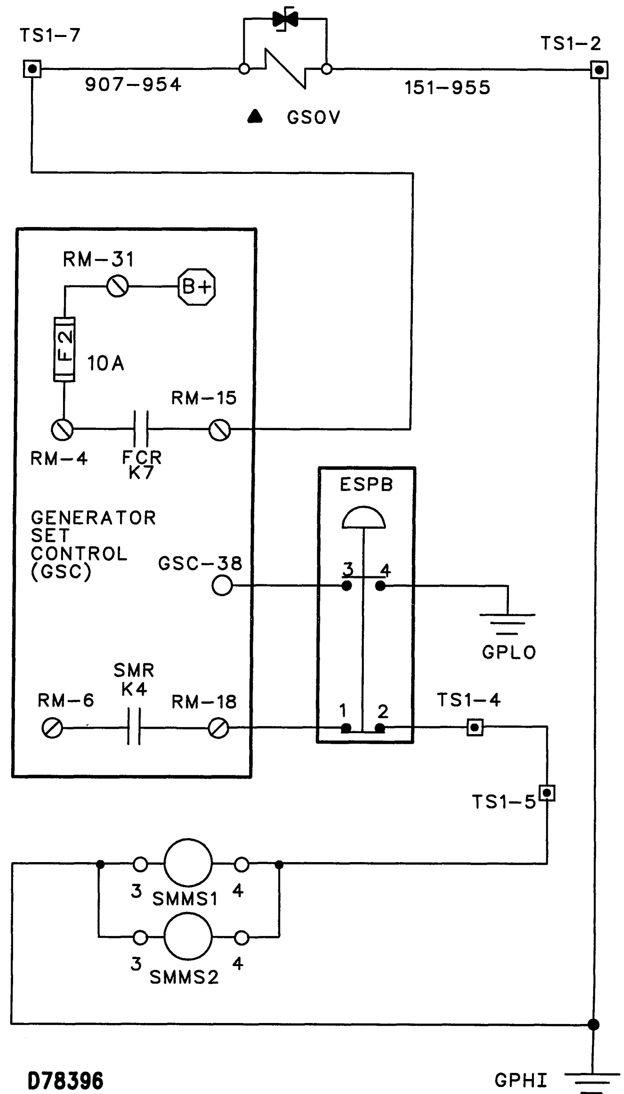
STEP 4. Check of the low oil pressure function. Turn the ECS to OFF/RESET and then start and run the engine. Allow oil pressure to stabilize. Check and note the oil pressure showing on the lower display with the engine at idle speed and rated speed.

a. When at idle speed, compare the actual pressure showing on the lower display with that of setpoint P14 (noted in Step 3). The actual pressure showing should be greater than setpoint P14.
b. When at rated speed, compare the actual pressure showing on the lower display with that of setpoint P13 (noted in Step 3). The actual pressure showing should be greater than setpoint P13.

- If the actual pressure showing is less than the setpoint for rated speed or idle speed, then the pressures are correct for a low oil pressure shutdown. Therefore the engine should shutdown and the low oil pressure indicator should FLASH. The GSC is operating properly. Refer to the Engine Service Manual to find the cause of low oil pressure. STOP.
- If the actual pressure showing on the lower display is greater than the setpoint for rated speed or idle speed, then the pressures are not correct for a low oil pressure shutdown.
  a. If the low oil pressure indicator remains FLASHING, replace the GSC. See the topic Generator Set Control Replacement. STOP.
  b. If the low oil pressure indicator does not FLASH, then the problem may be intermittent. Check the harness and all electrical connections of the oil pressure circuit; see the topic Electrical Connector Inspection. STOP.

NOTE: If desired, check the accuracy of the pressure shown on the lower display of the GSC. Install an accurate engine oil pressure gauge as close as possible to the EMCP II engine oil pressure sensor.

Emergency Stop Indicator



System Schematic For Emergency Stop Circuit

To find the cause of a emergency stop shutdown, perform this procedure.

STEP 1. Check emergency stop push button (ESPB) and engine control switch (ECS). Turn the ESPB clockwise. The ESPB should pop out and the emergency stop indicator should be OFF. Turn the ECS to OFF/RESET and then to STOP.

- If the ESPB pops out and the emergency stop indicator is OFF, then the system is operating correctly. The problem may be intermittent. Check the harness and all electrical connections of the ESPB circuit; see the topic Electrical Connector Inspection. STOP.

- If the ESPB pops out and the emergency stop indicator is FLASHING, then go to Step 2.

- If the ESPB does not pop out, then replace the ESPB. STOP.

STEP 2. Check emergency stop indicator.

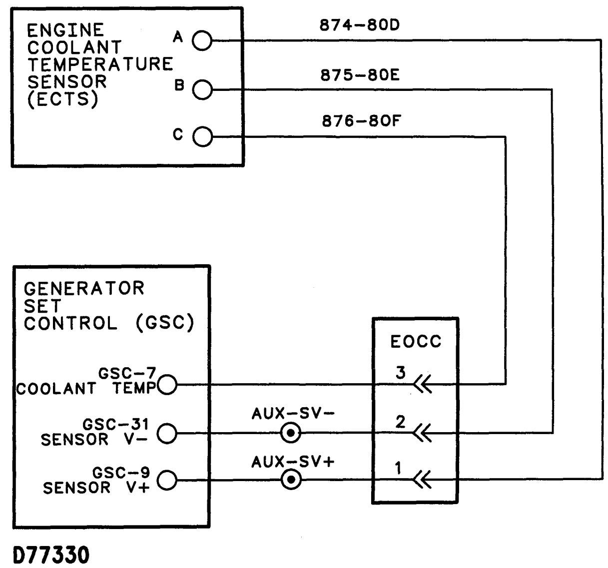
NOTE: This Step creates diagnostic fault codes. Clear these created diagnostic fault codes after troubleshooting is complete.

The ECS remains in the STOP position. Disconnect the harness connector from the GSC. Temporarily install a jumper from contact 39 of the GSC to B-(this simulates the OFF/RESET position of the ECS). Check the operation of the emergency stop indicator. The emergency stop indicator should be OFF.

- If the emergency stop indicator is OFF, then the fault is with the ESPB or the related wiring. Troubleshoot the circuit. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. Repair or replace faulty components or wiring as necessary. STOP.

- If the emergency stop indicator is FLASHING, then replace the GSC. See the topic Generator Set Control Replacement.

High Water Temperature Indicator



System Schematic For Engine Coolant Temperature Sensor (ECTS)

To find the cause of a high water temperature shutdown, perform this procedure.

STEP 1. Check for a CID 110 (temperature sensor) or CID 269 (sensor power supply) diagnostic code that is active. See the topic Diagnostic Faults.

- If any one of these diagnostic codes is active, correct it prior to proceeding with this procedure. STOP.

- If none of these diagnostic codes is active, go to Step 2.

STEP 2. Check for obvious causes of high water temperature. Check water level, fan belts and other obvious causes of high water temperature.

- If no obvious causes exist, then go to Step 3.

- If obvious causes do exist, then correct the fault. Refer to the Engine Service Manual. STOP.

STEP 3. Check setpoint P15 (high water temperature). View setpoint P15 and make a note. See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Compare the setpoint viewed with the specified setpoint. The setpoints should agree.

- If the setpoints agree, then go to Step 4.
- If the setpoints do not agree, then reprogram setpoint P15. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. STOP.

STEP 4. Check of the high water temperature function. Start and run the engine. Allow water temperature to stabilize. Check and note the actual water temperature showing on the lower display. Compare the actual temperature showing on the lower display with that of setpoint P15 (noted in Step 3). The actual temperature showing on the lower display should be less than setpoint P15.

- If the actual temperature showing on the lower display reaches or is greater than setpoint P15, then the temperatures are correct for a high water temperature shutdown. Therefore the engine should shutdown and the high water temperature indicator should FLASH. The GSC is operating properly. Refer to the Engine Service Manual to find the cause of high coolant temperature. STOP.
- If the actual temperature showing on the lower display is less than setpoint P15, then the temperatures are not correct for a high water temperature shutdown.
    a. If the high water temperature indicator remains FLASHING, replace the GSC. See the topic Generator Set Control Replacement. STOP.
    b. If the high water temperature indicator does not FLASH, then the fault may be intermittent. Check the harness and all electrical connections of the coolant temperature circuit; see the topic Electrical Connector Inspection. STOP.

NOTE: If desired, check the accuracy of the temperature 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 and as close as possible to the EMCP II coolant temperature sensor.

Engine Overspeed Indicator

To find the cause of a engine overspeed shutdown, perform this procedure.

STEP 1. Check setpoint P09 (ring gear teeth) and P10 (engine overspeed). View setpoint P09 and P10 and make a note. See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Compare the setpoints viewed with the specified setpoints. The setpoints should agree.

- If the setpoints agree, then go to Step 2.
- If the setpoints do not agree, then reprogram setpoints P09 and P10. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. STOP.

STEP 2. Check for possible causes of the engine overspeed condition; see the Engine and/or Governor Service Manuals.

- If the cause is not found, then go to Step 3.
- If the cause is found, repair or replace the necessary engine or governor components. STOP.

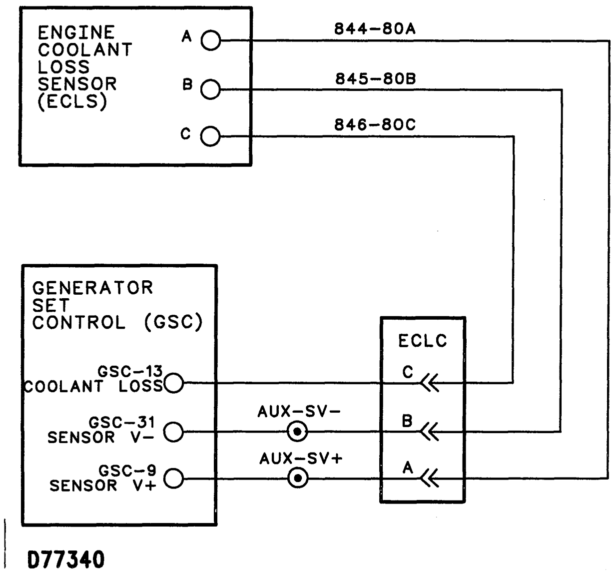
STEP 3. Check of the engine overspeed function.

NOTE: Take precautions to stop the engine manually when performing this Step.

If possible disable the engine from reaching rated speed. Start the engine and slowly increase the RPM to rated speed. The engine should not overspeed and the GSC should not shut down the engine or issue an overspeed fault.

- If the engine reaches rated speed and the GSC does not issue an overspeed fault and shut down the engine, then the GSC and the system are functioning properly. Perform an overspeed verification. See Engine Setpoint Verification OP9 within the topic Service Mode in the Systems Operation section. STOP.
- If the engine overspeeds and the GSC issues an overspeed fault, then see the Engine and/or Governor Service Manuals to find the cause of the problem.
- If the engine does not overspeed but the GSC issues an overspeed fault and shuts down the engine, then re-check the setpoints of Step 1. If the setpoints are correct, then replace the GSC. See the topic Generator Set Control Replacement.

Low Coolant Level Indicator



System Schematic For Engine Coolant Loss Sensor (ECLS)

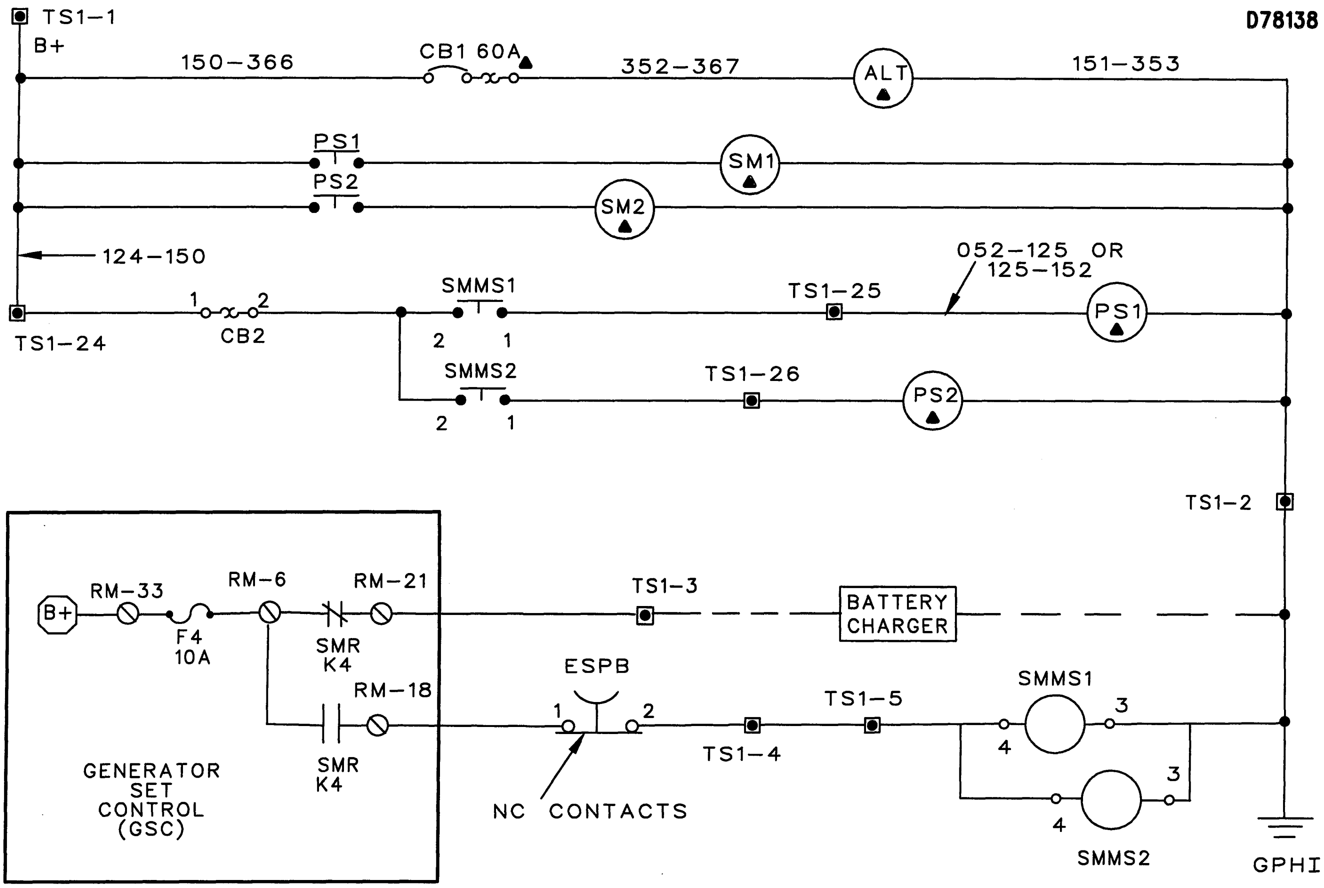
To find the cause of a low coolant level shutdown, perform this procedure.

Step 1. Check the level of the engine coolant; see the Operations & Maintenance Manual for the engine. The coolant level should be at the proper level and should be above the probe of the coolant loss sensor.

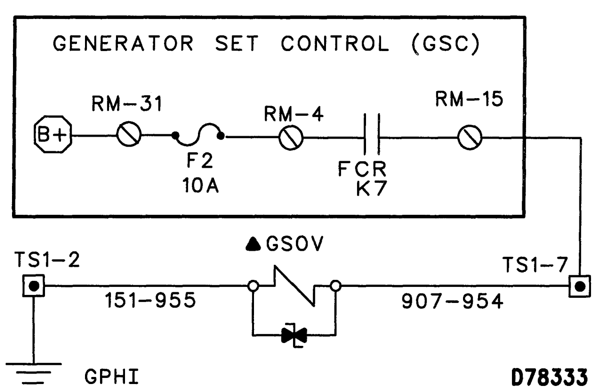
- If the coolant level is correct, then go to Step 2.
- If the coolant level is not correct, then find and correct the cause. Refer to the Engine Service Manual. STOP

STEP 2. Check for a CID 111 (coolant loss sensor) diagnostic code that is active. Turn the ECS to OFF/RESET and then to STOP. Wait 10 seconds. Check for CID 111 diagnostic code. See the topic Diagnostic Faults. The low coolant level indicator should not be FLASHING and there should be no active CID 111 diagnostic codes.

- If a CID 111 diagnostic code is active, troubleshoot the diagnostic fault. See the topic Diagnostic Fault Troubleshooting. STOP.
- If no CID 111 diagnostic codes are active and the low coolant level indicator is OFF, then the fault may be intermittent. Check the harness and all electrical connections of the low coolant level; see the topic Electrical Connector Inspection. STOP.
- If no CID 111 diagnostic codes are active and the low coolant level indicator is FLASHING, then the sensor is faulty. Replace the coolant loss sensor. STOP.



System Schematic For Starting Motor Relay (SMR)



System Schematic For Fuel Control Relay

To find the cause of a overcrank shutdown, perform this procedure.

Before beginning the troubleshooting procedure, do the following preliminary checks.

a. Check for active diagnostic fault codes (with the exception of the 330-7 or 566-7 code) and other flashing indicators on the GSC. If either are present, then correct them 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 pre-lube system (if equipped) for proper operation. See the DC Schematic - Prelube Pump in the Schematics And Wiring diagrams section or refer to the Engine Service Manual.

f. Check fuse F2 and F4 on the relay module. If either is blown, proceed to Step 4.

g. Check the engine starting and fuel system. (To check the fuel solenoid, see CID 566 within the topic Diagnostic Faults.) If there is a fault, refer to the Engine Service Manual. If there is no engine or fuel system fault, go to Step 1 of the following procedure.

STEP 1. Check setpoints P17 (total cycle crank time) and P18 (cycle crank time). View and make a note setpoints P17 and P18. See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. The factory setpoints are: 90 seconds for P17 and 10 seconds for P18.

NOTE: Engines equipped with pre-lube pumps may require crank cycle times (setpoint P18) of 30 seconds or more.

- If setpoints P17 and P18 are correct for the engine application, then go to Step 2.

- If setpoint P17 or P18 is NOT correct for the engine application, reprogram the setpoints. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. STOP.

STEP 2. Check voltage at battery. With the engine off, measure the system voltage at the batteries. The voltage should measure from 24.8 to 29.5 DCV for 24 volt systems or 33.1 to 39.3 DCV for 32 volt systems.

- If the system voltage is correct, then go to Step 3.

- If the system voltage is NOT correct, then further checking of the battery system is necessary. See the topic CID 168 in the Diagnostic Fault Troubleshooting section. STOP.

STEP 3. Check of the engine starting function. Disconnect the B+ wire on the pinion solenoid of the starting motor. Prepare to make the following DC voltage measurements while the engine is attempting to crank. All measurements are to B- (ground). Attach the black lead of the multimeter to B- (ground). Turn the ECS to START. Measure the voltage from B- (ground) to each of the following points in the order listed. Each of the voltages should measure the same as the system voltage noted in Step 2 ± 2.0 DCV.

NOTE: The GSC is attempting to crank whenever the K4 indicator is ON (on the lower display). Be aware of the 10 second crank cycle that is factory set and be sure that the K4 indicator is ON while making the following measurements. Have a helper observe the GSC display if necessary. More than one start may be required to complete this test.

3a. Measure at the B+ pinion solenoid wire that was previously disconnected.
- If the voltage is correct, then the starting motor is faulty. Repair or replace the starting motor. Refer to the Engine or Starting Motor Service Manual. STOP.
- If the voltage is NOT correct, then go to Step 3b.

3b. Terminal 25 of TS1 in the generator housing.
- If the voltage is correct, then the engine wire harness is faulty. Repair or replace the engine wire harness. See the Generator Set Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the voltage is NOT correct, then go to Step 3c.

3c. Terminal 5 of TS1 in the generator housing.
- If the voltage is correct, then the starting motor magnetic switch (SMMS) or the related wiring is faulty. Troubleshoot the SMMS and the related wiring. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the voltage is NOT correct, then go to Step 3d.

3d. Terminal 18 of the relay module.
- If the voltage is correct, then the emergency stop push button (ESPB) or the related wiring is faulty. Troubleshoot the ESPB and the related wiring. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the voltage is NOT correct, then go to Step 3e.

3e. Terminal 6 of the relay module.
- If the voltage is correct, then the relay module is faulty. Replace the relay module (first make sure the K4 indicator is ON). See the topic Relay Module Replacement. STOP.
- If the voltage is NOT correct, then go to Step 3f.

3f. Terminal 33 of the relay module.
- If the voltage is correct, then fuse F4 is blown. Proceed to Step 4.
- If the voltage is NOT correct, then the B+ terminal or the wiring to terminal 33 is faulty. Repair or replace the wiring. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

STEP 4. Troubleshoot blown fuse, check for a short to B- (ground). Remove fuse F4 from the relay module. At the relay module, measure the resistance from terminal 18 to B- (ground). For fuse F2, measure the resistance from terminal 15 to B- (ground). A short to B- (ground) will measure 5 ohms or less.

See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. Remove one component or wire at a time that is in series with terminal 18 until the faulty component or wire is isolated. Repair or replace faulty component or wiring. STOP.

NOTE: If a fuse still blows when all wires are removed from relay module terminal 18, replace the Relay Module. STOP.

Undiagnosed Problem Troubleshooting

Undiagnosed problems are NOT accompanied by any type of fault indicator or fault code on the GSC. To troubleshoot an undiagnosed problem, find the description that best fits the problem in the Undiagnosed Problem List and go to the corresponding procedure.

NOTE: If any fault indicator or fault code is showing on the GSC, then go to the appropriate procedure for that fault.

Undiagnosed Problem List

Problem A: Starting motor remains engaged or continues to run after engine has started.

Problem B: No engine shutdown when a shutdown fault occurs.

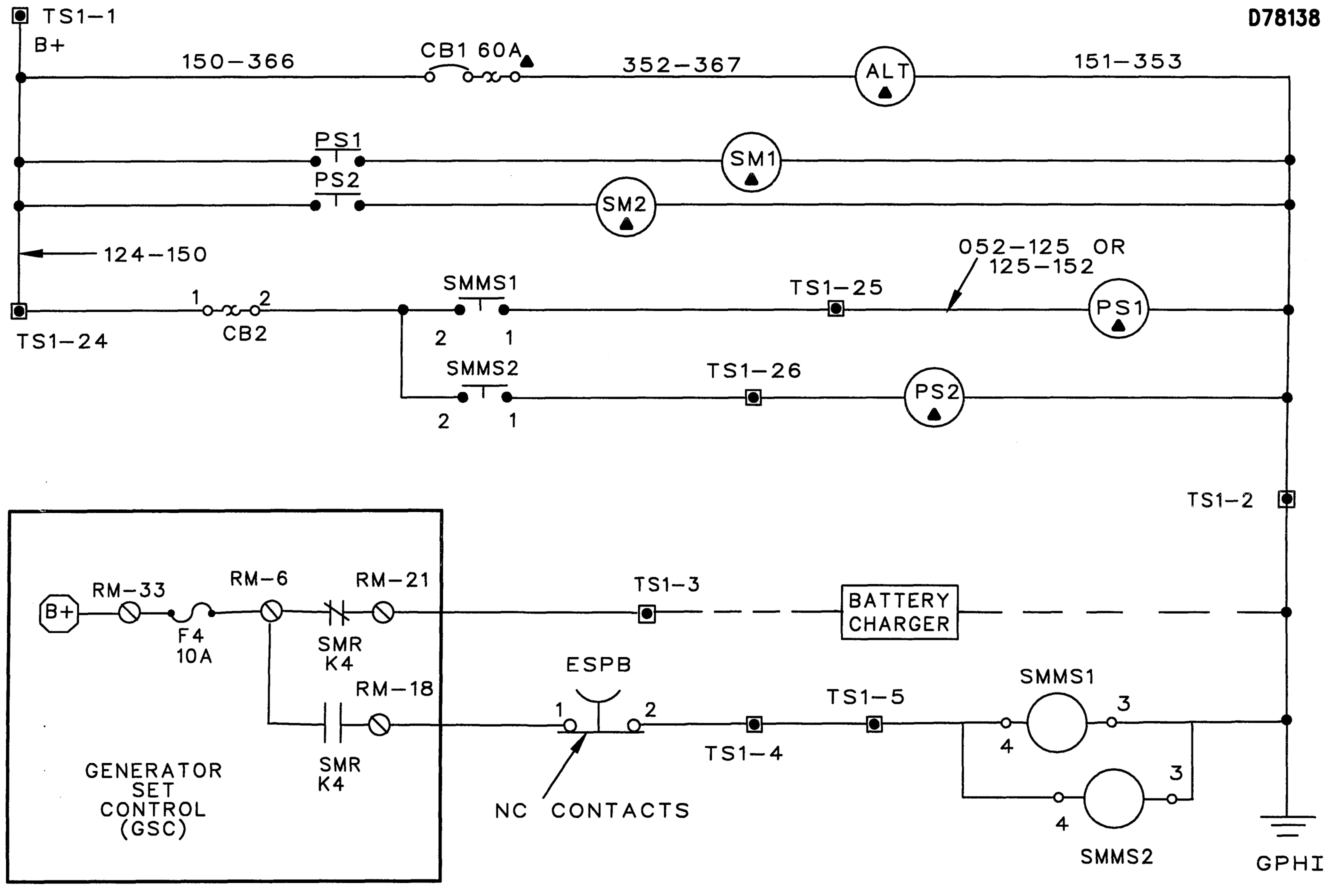
Problem C: Fault indicators of the remote annunciator or control panel alarm module (that are controlled by the data link) all flash at a rate of once per two seconds (0.5 Hz).

Problem D: Fault shutdown indicator on the GSC flashes at the rate of four to five times per second (4 to 5 Hz).

Problem E: 0 volts or 0 amps are showing on the display of the GSC for one or more AC phases with the genset running and the load connected.

Problem F: The AC voltage and/or current values on the GSC are inaccurate.

Problem A
Starting motor remains engaged or continues to run after engine has started.



System Schematic For Starting Motor Relay (SMR)

STEP 1. CHECK RELATED SETPOINTS - Check setpoints P11 (crank terminate speed), P17 (total cycle crank time) and P18 (cycle crank time). See Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. The factory setpoints are: 400 rpm for P11, 90 seconds for P17 and 10 seconds for P18. The setpoints should be correct for the engine application.

NOTE: Engines equipped with pre-lube pumps may require crank cycle times (setpoint P18) of 30 seconds or more.

- If the setpoints are correct, then go to Step 2.
- If any setpoint is NOT correct, reprogram the setpoints. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. Proceed to Step 2.

STEP 2. CHECK FOR CAUSE OF PROBLEM - Disable the fuel solenoid or the governor to prevent the engine from starting but not from cranking. Perform each of the following steps in the order listed until the cause of the problem is found. Turn the ECS to START and allow the engine to crank.

2a. Turn the ECS to OFF/RESET.
- If the engine stops cranking, go to Step 3.
- If the engine continues to crank, go to Step 2b.

2b. Push the emergency stop push button.
- If the engine stops cranking and no fault indicator or fault code is showing on the GSC, then check the wire on terminal 18 of the relay module for a short to B+. If a short is not found, replace the relay module. See the topic Relay Module Replacement. STOP.
- If the engine continues to crank, go to Step 2c.

2c. Stop the engine. Remove all wires from terminal 25 of TS1 in the generator housing. (For dual starting motors, also remove all wires from terminal 26.) Attempt to start the engine.
- If the engine stops cranking, the starting motor magnetic switch (SMMS) or related wiring is faulty. Troubleshoot the SMMS and the related wiring. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the engine continues to crank, go to Step 2d.

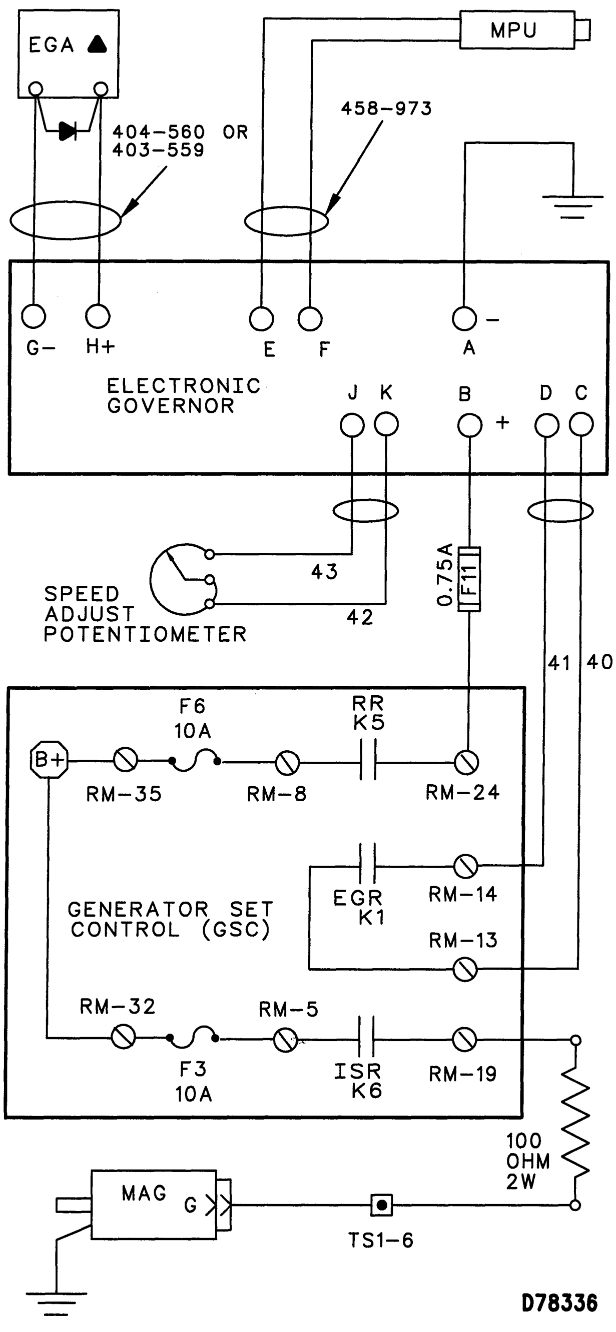
2d. Stop the engine. Remove the positive wire on the pinion solenoid of the starting motor. Attempt to start the engine.
- If the engine stops cranking, wire 052-125 or 125-152 in the engine harness is shorted to battery positive (B+). Troubleshoot the wiring. See the Generator Set Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the engine continues to crank, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor and/or Engine Service Manuals. STOP

STEP 3. CHECK STARTING MOTOR CYCLING - The engine remains disabled from starting. Turn the ECS to START. The starting motor should cycle on and off according to setpoint P18 (cycle crank time).

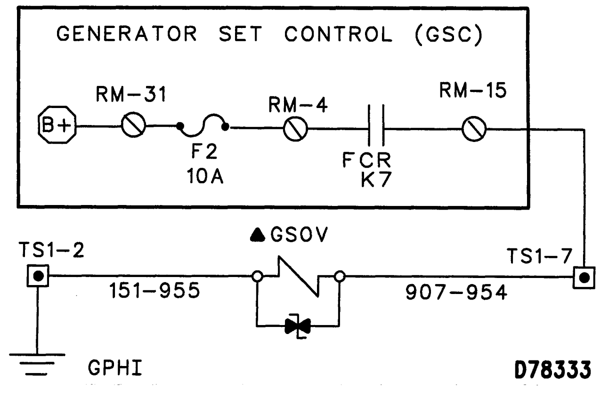
- If the starting motor cycles correctly, the problem is not present. STOP.

- If the starting motor remains ON and does not stop, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor and/or Engine Service Manuals. STOP.

Problem B
No engine shutdown when a shutdown fault occurs.



System Schematic For Unexpected Shutdown



System Schematic For Fuel Control Relay

STEP 1. CHECK FOR DIAGNOSED FAULTS - Check the display area of the GSC for a fault indicator that is FLASHING and 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 treats the condition as an alarm fault (engine continues to run). This is not a problem. To view the setpoints, see Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. To reprogram the setpoints, see Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section.

- If the fault shutdown indicator is FLASHING and the engine remains running, then:
  For ETR fuel systems, go to Step 2.
  For 3500 engines with electronic governor, go to Step 3.
- If the fault alarm indicator is OFF, the fault shutdown indicator is OFF and a fault exists that should cause the GSC to shutdown the engine, then go to Step 4.

STEP 2. ETR SYSTEMS. CHECK FOR CAUSE OF PROBLEM - The engine remains running and the fault shutdown indicator is FLASHING. Perform each of the following steps in the order listed until the cause of the problem is found.

2a. Turn the ECS to OFF/RESET.
- If 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 shutdown, replace the GSC. See the topic Generator Set Control Replacement. STOP.
- If the engine does NOT shutdown, go to Step 2b.

2b. Push the emergency stop push button.
- If the engine shuts down, it is most likely that an unwanted battery positive (B+) voltage is present at terminal 15 of the relay module. Check the related wiring for this unwanted voltage. If no battery voltage is found in the related wiring, then replace the relay module. See the topic Relay Module Replacement.
- If the engine does NOT shutdown, go to Step 2c.

2c. Remove all wires from terminal 7 of TS1 in the generator housing.
- If the engine shuts down, there is a wiring error or short to battery positive between terminal 7 of TS1 and the relay module. On 3408 and 3412 engines, the auxiliary fuel control relay (AFCR) on the sub-panel could be faulty. Troubleshoot and repair the wiring, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the engine does NOT shutdown, go to Step 2d.

2d. Remove both wires from the fuel solenoid.
- If the engine shuts down, wire 907-954 is shorted to battery positive (B+) in the engine harness. Troubleshoot and repair the wiring, see the Generator Set Wiring Diagram in the Schematics And Wiring Diagram section. STOP.
- If the engine does NOT shutdown, the fuel solenoid is stuck or otherwise faulty. Refer to the engine Service Manual to troubleshoot and repair. STOP.

STEP 3. 3500 ENGINES WITH ELECTRONIC GOVERNOR. CHECK FOR CAUSE OF PROBLEM - The engine is running with the fault shutdown indicator FLASHING. Remove fuse F6 from the relay module. The engine should shutdown. At the relay module, measure the resistance from terminal 8 to terminal 24. The resistance should measure 5k ohms or greater.

- If the engine shuts down and the resistance is correct, the electronic governor is incorrectly being supplied battery positive (B+). Troubleshoot and repair the related wiring, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

- If the engine shuts down and the resistance is NOT correct, there is a wiring error or the relay module is faulty. Check the wiring to terminals 8 and 24 of the relay module, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. Repair any wiring errors. If the wiring is correct, then replace the relay module; see the topic Relay Module Replacement. STOP.

- If the engine continues to run, the rack or electric actuator are stuck in the ON position. Troubleshoot and repair the rack or electric actuator; see the Service Manual for the particular electronic governor. STOP.

  For the 2301A Speed Control, see Service Manual SENR4676.
  For the 2301A Load Share, see Service Manual SENR3585.
  For 524 and 1724 Electrically Powered Governor Systems, see Service Manual SENR6430.

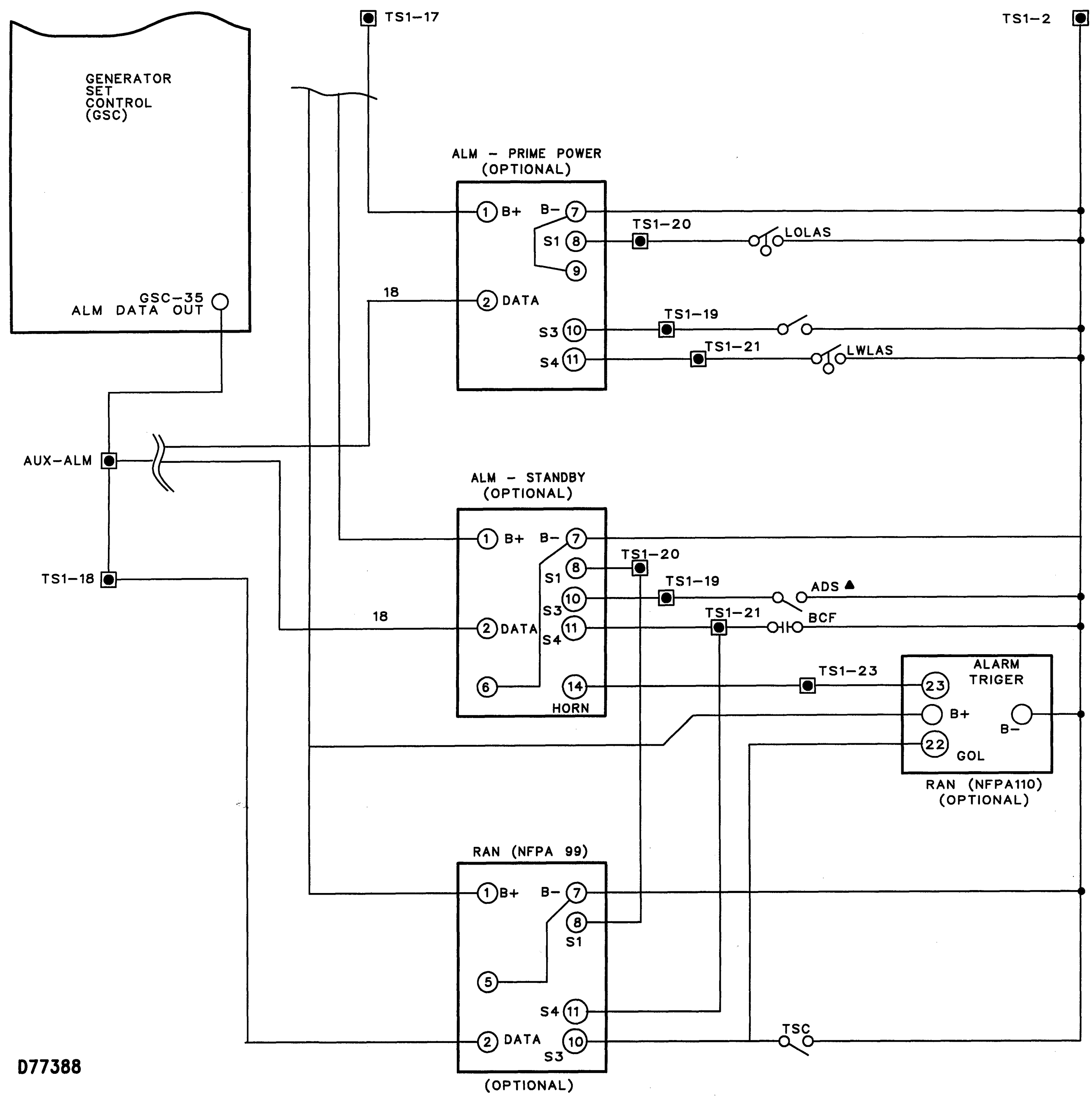
STEP 4. Determine the fault that causes the engine to shutdown. Perform the following procedure (1, 2 or 3) that corresponds to the fault.

1. For a fault with the coolant loss sensor that does not shutdown the engine, see the topic CID 111 in the Diagnostic Fault Code section.

2. For a fault with engine overspeed, low oil pressure, or high water temperature that does not shutdown the engine - Make a note of all the engine information showing on the lower display of the GSC. View the related setpoints, see Setpoint Viewing OP2 within the topic Service Mode in the Systems Operation section. Compare the engine information showing on the lower display with the related setpoints.
   - If the information showing on the lower display is within the related setpoint, then the GSC is not causing the shutdown. STOP.
   - If the information showing on the lower display is beyond the related setpoint, then the GSC is faulty. Replace the GSC; see the topic Generator Set Control Replacement. STOP.

3. For a fault with reverse power that does not shutdown the engine:
   a. Install a multimeter to monitor the DC voltage from contact 23 of the GSC connector to B- (ground). Probe the rear of the harness connector at contact 23 with the 7X-1710 Cable Probes. Do not disconnect the harness from the GSC. With the ECS in OFF/RESET, the voltage should measure 10.5 ± 1.0 DCV.
   b. Start and run the engine. Apply a load to the generator which is at least 15% of the rated load. Press the test button on the reverse power relay. The reverse power relay is located on the sub-panel within EMCP II.
   c. The engine should shutdown and SP1 should show on the upper display of the GSC. The fault shutdown indicator should be FLASHING.
   d. The DC voltage at contact 23 should measure 0 ± 1.0 DCV.
   e. If the voltage at contact 23 does not drop to 0 volts, then the reverse power relay is faulty or there is an open wire between the reverse power relay and the GSC. Troubleshoot and repair the system, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

Problem C
Fault indicators of the remote annunciator or control panel alarm module (that are controlled by the data link) all flash at a rate of once per two seconds (0.5 Hz).



System Schematic For Alarm Module (ALM)

NOTE: The maximum number of modules (Alarm, Remote Annunciator, or Customer Interface Module), that can be connected to the GSC is three. 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 and cause the indicators on the alarm module to flash. If not in compliance with the specifications, reduce the number of modules and/or shorten the distance to the GSC.

STEP 1. CHECK DATA WIRE - Turn the ECS to OFF/RESET. Disconnect the harness connector from the GSC. Measure the resistance of the following circuits in the harness:

a. Check for open. Measure the resistance from terminal 2 of the alarm module to contact 35 of the GSC harness connector. The resistance should measure 5 ohms or less.
b. Check for short. Measure the resistance from contact 35 of the GSC harness connector to both battery positive (B+) and negative (B-) at the relay module. The resistance should measure 5k ohms or greater.

- If all resistance measurements are correct, go to Step 2.

- If one or more of the resistance measurements are NOT correct, then the harness wiring with the incorrect resistance is faulty (open or shorted). Troubleshoot and repair the faulty harness wiring. STOP.

STEP 2. MEASURE VOLTAGE AT ALARM MODULE - The ECS remains in the OFF/RESET position. Reconnect the harness connector to the GSC. Make the following voltage measurements.

a. At the alarm module measure the DC voltage from terminal 2 to terminal 7. The voltage will be changing, but it should measure between 1 and 10 DCV.

NOTE: If troubleshooting a remote annunciator, measure the DC voltage (with the 7X-1710 Cable Probes) from contact 35 to contact 31 of the GSC harness connector. Do not disconnect the harness from the GSC. This voltage measurement should agree with the preceding measurement of step a. If the voltages do not agree, the wire is faulty from terminal 2 of the alarm module to terminal 18 of TS1 in the generator housing.

b. 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 measure 10.5 ± 1.0 DCV.

- If both voltage measurements are correct, replace the alarm module. STOP.

- If both voltage measurements are low, replace the alarm module.

- If the first measurement is low and the second high, replace the GSC. See the topic Generator Set Control Replacement. STOP.

Problem D
Fault shutdown indicator on the GSC flashes at the rate of four to five times per second (4 to 5 Hz). The displays of the GSC may be unintelligible. 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 or by extremely severe electro-magnetic 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.

For engines with 2301A governor, the engine shuts down.

For engines with 8290 governor, the engine runs at idle speed. The ESPB will stop the engine.

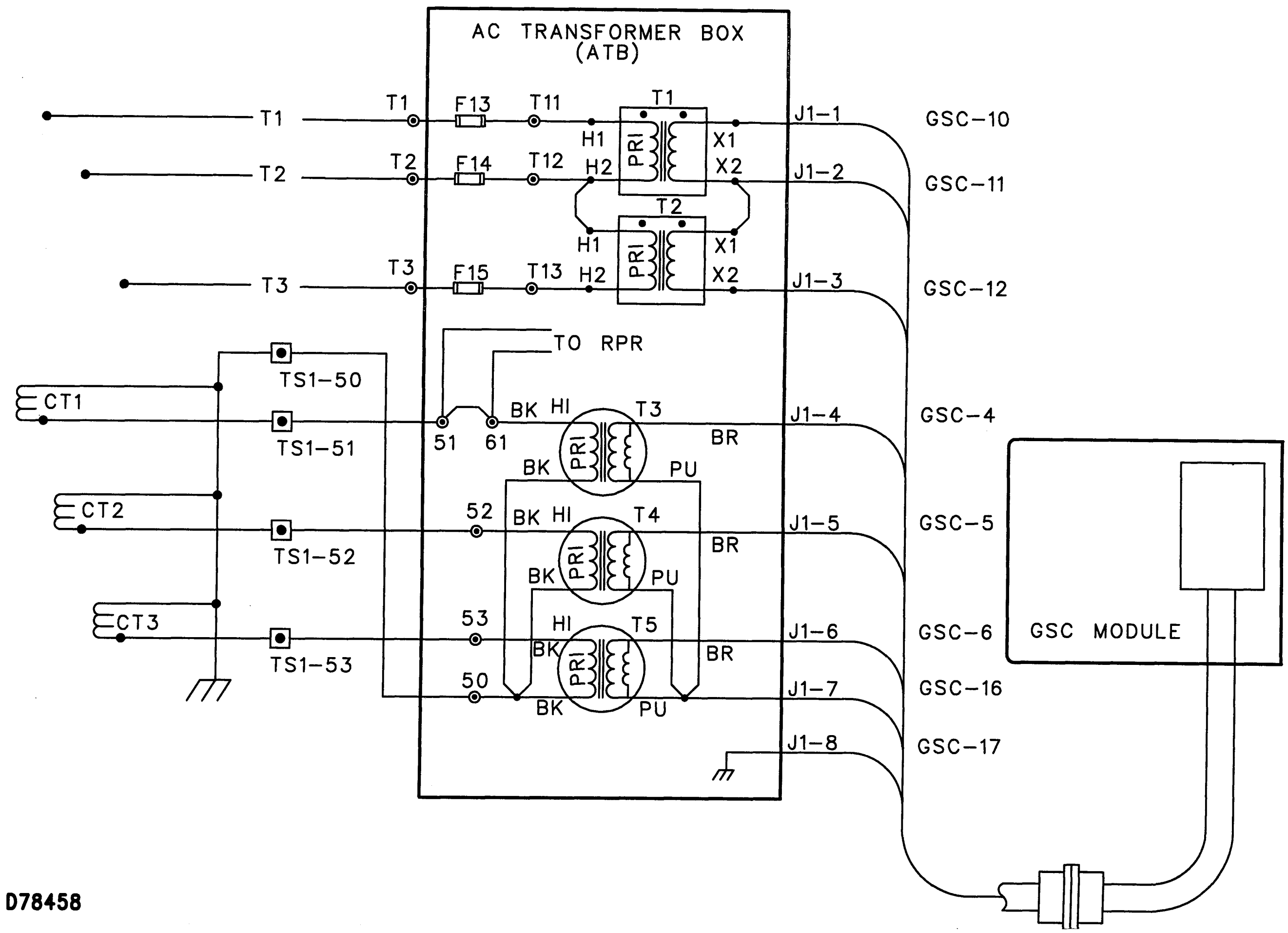
For ETR engines with mechanical governor, the engine shuts down.

STEP 1. RESET THE GSC - 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. Turn the ECS to STOP. The GSC should power up with an understandable display and should now respond to the ECS switch.

- If the GSC operates correctly, then the fault is gone. STOP.

- If the GSC does NOT operate correctly and the fault shutdown indicator still flashes at the rate of four to five times per second (4 to 5 Hz), then the GSC is faulty. Replace the GSC, see the topic Generator Set Control Replacement. STOP.

Problem E
0 volts or 0 amps are showing on the display of the GSC for one or more AC phases with the genset running and the circuit breaker closed.



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 terminals 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.

For AC voltage problems begin troubleshooting at Step 1.

For AC current problems begin troubleshooting at Step 4.

STEP 1. CHECK FUSES - Check the three fuses on the AC transformer box (ATB). The fuses should not be blown.

- If the fuses are OK, then go to Step 2.
- If one or more of the fuses are blown, then check for a shorted component or wiring error. Troubleshoot and repair the fault, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

STEP 2. CHECK GENERATOR OUTPUT - With the engine running and the circuit breaker open or load removed, measure the voltage between all three fuses on the ATB. The line to line voltage should measure correctly for all three phases.

- If the voltages are correct and the problem remains, go to Step 3.
- If one or more of the voltages are NOT correct, the wiring or connections are faulty. Check for wiring errors between the ATB and the generator buss, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. Also check the electrical connections at the ATB terminal, see the topic Electrical Connector Inspection. STOP.

Step 3. Stop the engine. Check ATB and GSC Connectors. Check the harness connector and crimp terminals of the ATB. Check the GSC harness connector. See the topic Electrical Connection Inspection. Also check for one or more broken wires between the ATB and the GSC. See the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section.

- If the fault concerns AC voltage and the fault remains, then it is unlikely that the GSC is faulty. Replace the ATB and If the problem still persists replace the GSC. STOP.
- If the fault concerns AC current and the fault remains, then go to Step 4.

STEP 4. CHECK CURRENT TRANSFORMERS - Stop the engine. 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 (CT). On gensets equipped with a reverse power relay, disconnect the wire on terminal 61 of the ATB. Measure the resistance from terminal 50 to each of the disconnected wires. The resistance should measure less than 5 ohms.

- If the resistance is correct, then the current transformers check good. Proceed to Step 5.
- If one or more of the resistance measurements are NOT correct, then a current transformer or related wire is open. Check for an open CT or wiring, see the Generator Set Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

STEP 5. CHECK ATB - Stop the engine.

a. Remove the harness connector from the GSC. At the GSC harness connector, measure the resistance from contact 4 to contact 16, contact 5 to contact 16, and contact 6 to contact 16. Allow the measurement to stabilize. Each of the three resistances should measure 120 ± 20 ohms.

b. The wires disconnected in Step 4 on terminals 61, 51, 52, & 53 remain disconnected. The only wires connected to these terminals should lead into the ATB. At the terminal strip of the ATB measure the resistance from terminal 51 to 50, from terminal 52 to 50, and from terminal 53 to 50. All resistances should measure less than 1 ohm.

- If all resistances are correct, then the ATB checks good. The fault is in the GSC or the GSC harness connector. Check the GSC harness connector, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. If the connector checks good and the fault remains, then replace the GSC. See the topic Generator Set Control Replacement. STOP.
- If one or more of the resistance measurements at the GSC harness connector (step a) are NOT correct, then 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 the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. Check the electrical connections at the GSC and ATB harness connectors and at the ATB terminal strip, see the topic Electrical Connector Inspection. Repair or replace the wiring as necessary. If the fault is not found, replace the GSC. STOP.
- If one or more of the resistance measurements at the ATB terminal strip (step b) are NOT correct, then the ATB is faulty. Replace the ATB. STOP.

Problem F
The AC voltage and/or current values on the GSC are inaccurate.

NOTE: For the system schematic see the preceding Problem E.

Check setpoints P20 (full scale voltage) and P21 (full scale current). See Setpoint Viewing - OP2 within the topic Service Mode. Typical factory setpoints are: 700V for P20 and 600A for P21. The setpoints should be correct for the genset application.

If only the voltage is inaccurate, check the AC voltage range jumper for correct installation. The jumper should be installed for systems with a full scale AC voltage input of 700 volts. The jumper should not be installed for systems with 150 volts full scale AC inputs or for any unit with external potential transformers. For information regarding the installation of the jumper, see the topic AC voltage Range Selection.

Check the AC calibration, see AC Calibration OP10 within the topic Service Mode in the Systems Operation section.

If the preceding checks do not correct the inaccuracy and the meters used for comparison are known to be highly reliable, then replace the ATB. If the fault remains, replace the GSC. See the topic Generator Set Control Replacement.

Electrical Connector Inspection

Many of the troubleshooting procedures in this Testing And Adjusting section require the inspection of electrical connectors and crimp terminals. Do the following steps to test an electrical connector or crimp terminal. If a faulty connection is found, repair the connection. Then return to the original troubleshooting procedures and check to see if the original fault is resolved and/or continue with the original troubleshooting procedure.

NOTE: Avoid unnecessary disconnecting and connecting of connector halves in order to troubleshoot system faults. This practice can cause the connector contacts within the connector to wear out prematurely.

1. Check Connector Hex Screw. Make sure that the 40-pin harness 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 harness connector should be plugged to keep out dirt, water and other contaminates.

2. Pull Test Each Wire. Each connector contact and wire in the various harness connectors should easily withstand 10 pounds of pull and remain in the connector body. This test checks to see if the wire in each connector contact was crimped properly, and also that the connector contact was inserted into the connector body completely. Repair as needed. When replacing connector contacts, use only the 1U-5804 Crimp Tool and make sure that the connector contact and tool are matched to the wire gauge. 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. Repair as needed. When replacing crimp terminals, use the proper crimping tool and techniques for the type and brand of crimp terminal. Use an appropriately sized terminal for the wire gage. If desired, crimp-on spade and ring terminals may be soldered to the wire for an improved electrical connection.

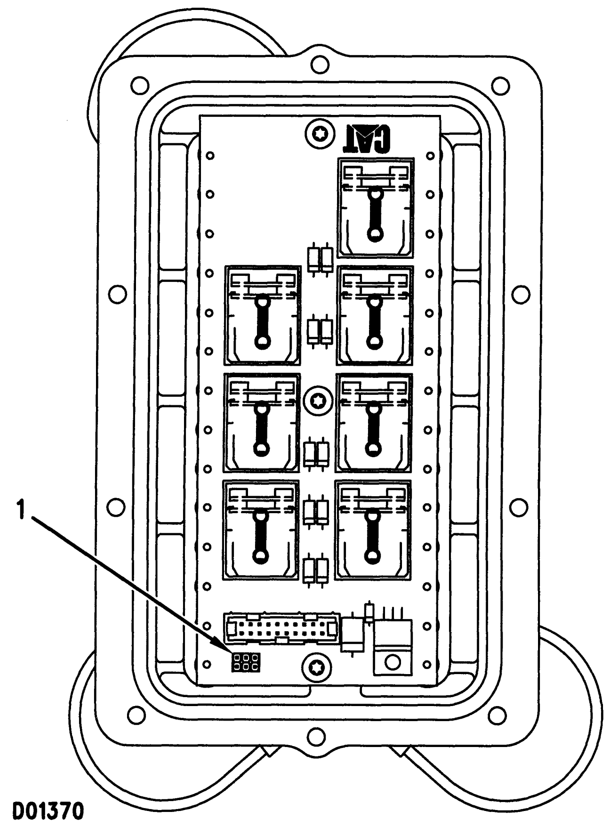
3. Visually Inspect Wiring. Look for worn or abraded wires. Check for pinched or damaged harnesses.

4. Visually Inspect Connectors And Crimp Terminals. Verify that connector contacts within the connectors are not corroded or damaged. Verify proper alignment and location of connector contacts within the connector. Verify that the two connector halves are seated and locked together.

Check all crimp terminals for corrosion and damage. When wiggling each wire on a crimp terminal, the ends of the bare wires on the open end of the terminal barrel should be tight and not move. Check tightness of terminal strip screws also. Repair as needed.

5. Check Individual Connector Contacts. This is especially important for intermittent problems. Using a new connector contact, insert it into each of mating connector contacts. Check for a snug fit between the mating connector contacts. Repeat this procedure for the other connector half, using a new connector contact of the correct type.

AC Voltage Range Selection



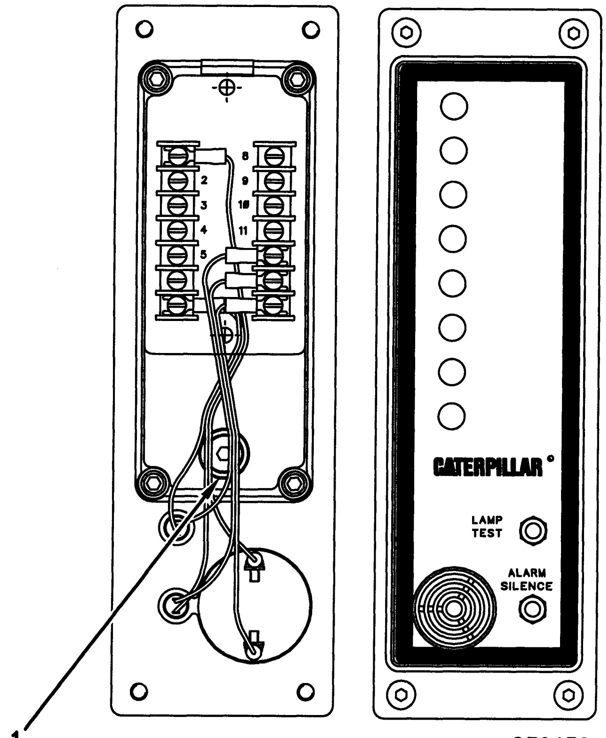
Circuit Board Of The Relay Module
(1) Jumper block.

Jumper block (1) is used to select the voltage range of the voltmeter of the GSC. 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 comes factory equipped with jumper block (1) installed.

Jumper block (1) is easily removed or installed by grasping and pulling it. If a jumper block is required but 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 to gain access to the circuit board and jumper block (1). See the topic Relay Module Replacement.

Alarm Module (ALM) Adjustment



Alarm Module
(1) Plug.

For all alarm applications, the low DC volts alarm setpoint is adjusted by a potentiometer located under access plug (1) on the rear of the module. The adjustment range is 8 to 38 volts. The alarm setpoint is factory set at 24 DCV.

Adjustment Procedure

1. Gain access to the rear of the ALM. It is not necessary to remove the ALM unless necessary for access. All wiring remains connected to the terminals of the ALM unless otherwise noted.

2. Remove plug (1) to gain access to the adjustment potentiometer. It is possible for moisture to 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 they do not touch each other, ground or other electrical connections.

4. Connect a variable DC power supply to the alarm module (positive to terminal 1, negative to terminal 7). Set the power supply voltage to the desired low DCV alarm setpoint (between 8 and 38 volts).

5. Turn the adjustment pot fully clockwise.

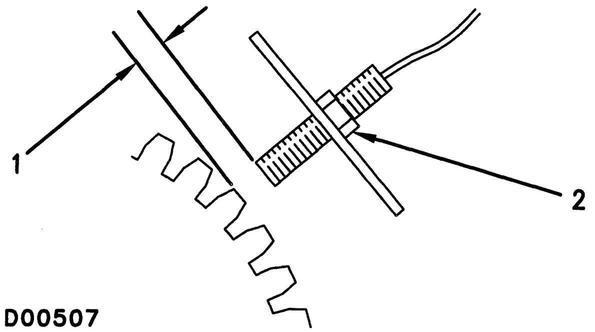
6. After one minute, the indicator on the ALM for low battery voltage FLASHES. Press the alarm silence switch. The low battery voltage indicator should change from FLASHING to ON CONTINUOUSLY.

7. Turn the adjustment potentiometer counterclockwise slowly 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.

Magnetic Pickup (MPU) Adjustment



Magnetic Pickup (MPU)
(1) Air gap. (2) Locknut.

This adjustment procedure is for the engine magnetic pickup.

1. Remove the magnetic pickup from the flywheel housing. Remove all debris from the tip of the magnetic pickup. Align a ring gear tooth directly in the center of the threaded opening.
2. By hand, screw the pickup into the hole until the end of the pickup just makes contact with the gear tooth.
3. Turn the pickup back out three-fourths turn (270 degrees in the counterclockwise direction).
4. Tighten locknut (2) to 25 ± 5 N•m (18 ± 4 lb ft).

NOTE: Do not allow the pickup to turn as locknut (2) is tightened.

Charging System Test

Fault Conditions And Possible Causes			
Current At Start-Up [1]	**Voltage After About 10 Min Is Below Spec.**	**Voltage After About 10 Min Is In Spec.**	**Voltage After About 10 Min Is Above Spec.**
Below Specification.	Repair alternator (defective regulator, open stator phase and/or rectifier).	Turn on all accessories. If voltage drops below spec., repair alternator (open rectifier and/or stator phase).	
Reached Specification and then tapered off.	Repair alternator (defective regulator).	Alternator and battery in spec. Turn on all accessories to verify. Voltage must stay in spec.	Repair alternator (shorted regulator).
Exceeds Specification and stays high.	Check battery per Form SEHS7633. Do alternator test again if necessary.	Alternator in spec. Check battery per Form SEHS7633.	Repair alternator (shorted regulator). Also check battery for possible damage.

[1] All electrical accessories off.

Tools Needed		
6V-7070	Digital Multimeter or Equivalent	1
8T-0900	AC/DC Clamp-On Ammeter	1

NOTE: These procedures are for gensets equipped with an alternator. Battery chargers are the customers responsibility to maintain. To test only the batteries refer to Special Instruction SEHS7633, Battery Test Procedure.

Test Procedure

STEP 1. Put the multimeter positive (+) lead on the BAT terminal of the alternator. Put the negative (–) lead on the ground terminal or the frame of the alternator. Put a clamp-on ammeter around the positive output wire of the alternator.

NOTE: Cranking the engine for 30 seconds partially discharges the battery in order to do a charging test. If the battery is already low in charge, skip Step 2 and go to Step 3.

STEP 2. Disable the fuel solenoid or governor to shut the fuel off and prevent the engine from starting. Do not disable the starting motor. Turn the engine control switch (ECS) to OFF/RESET. To activate the starting motor, temporarily place a jumper from the B+ terminal to the R-18 terminal, at the relay module terminal strip. Crank the engine for 30 seconds. Wait for two minutes to cool the starting motor. Crank the engine again for 30 seconds.

STEP 3. Enable the fuel solenoid or governor that was disabled in Step 2. Start the engine and run at full throttle. If necessary, jump-start the engine or charge the batteries as required in order to start the engine.

STEP 4. Immediately check the output current of the alternator. For correct operation, this initial charging current is equal to or slightly greater than the full rated output current of the alternator. The specified full rated output current of some alternators is:

100-5047 (24V) 50A
3E-7577 (24V) 75A
3E-7578 (24V) 50A
4N-3986 (24V) 60A
6N-9294 (24V) 35A
6T-1395 (24V) 35A
7T-2095 (24V) 35A
9W-3043 (24V) 55A
4N-3987 (32V) 60A

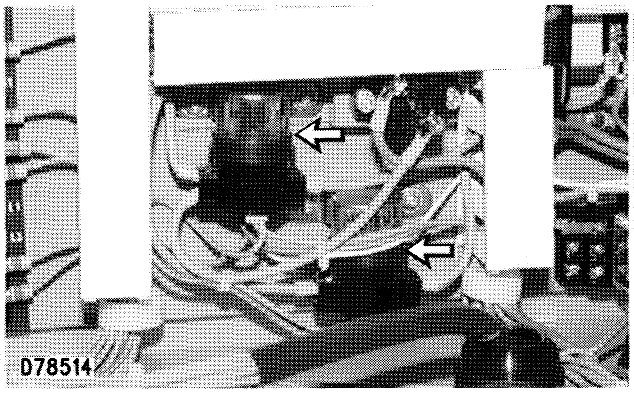
STEP 5. For correct operation, within approximately 10 minutes at full throttle (possibly longer depending upon battery size, condition and alternator rating), the specified alternator output voltage is:

24V system .... 26.5 to 29.0 DCV.
32V system .... 35.8 to 38.8 DCV.

See the Fault Conditions And Possible Causes chart.

STEP 6. The charging current during this period should taper off to less than approximately 10 amps with accessories turned OFF, depending again upon battery and alternator capacities. See the Fault Conditions And Possible Causes chart.

Magnetic Switch Test (24V)



Magnetic Switches On Sub-Panel
(Two Switches Shown For Dual Starting Motor System)

The starting motor magnetic switch (SMMS) for 24V systems is mounted on the sub-panel within the control panel. Two switches are used in dual starting motor systems, one for each starting motor.

Test Procedure

1. Disconnect the jumper wire between terminals 4 and 5 of TS1 in the generator housing. Measure the resistance between terminal 5 and terminal 2. The resistance should measure:

26 to 33 ohms for single starting motor systems.
13 to 17 ohms for dual starting motor systems.

If resistance is NOT correct, replace the defective magnetic switch. If the resistance is correct, go to Step 2.

2. Disconnect the cable going from the pinion solenoid to the starting motor. Do this on both starting motors of a dual starting motor system.

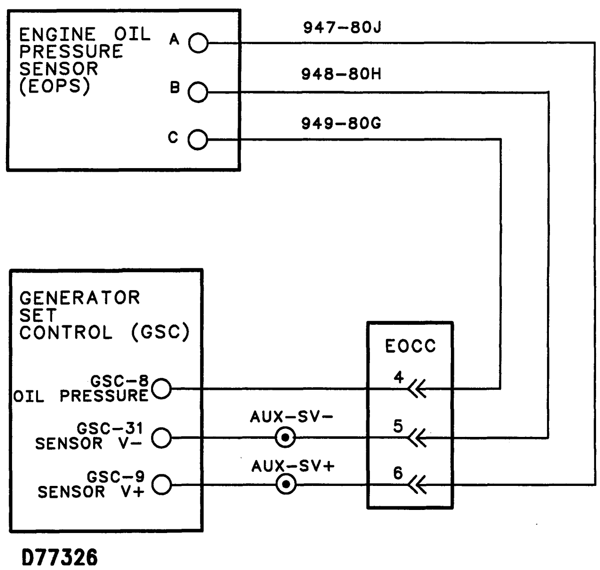
3. Connect a DC voltmeter: positive to terminal 24 and negative to terminal 25 of TS1 in the generator housing. (If second magnetic switch is tested in a dual starting motor system, then connect negative to terminal 26.)

NOTE: The jumper wire of Step 4 can remain connected for only ten seconds.

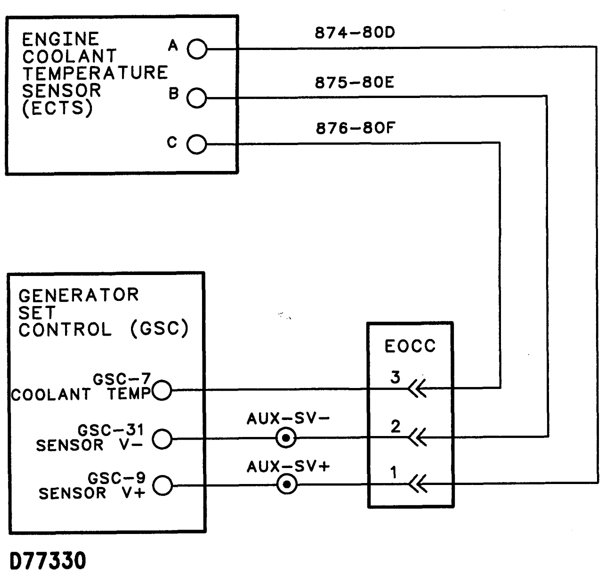
4. Connect a jumper wire from terminal 1 to terminal 5 of TS1 in the generator housing. Disconnect this wire immediately after the voltage is measured (no more than 10 seconds). The correct measurement changes from approximately 24 DCV to approximately 2 DCV.

If voltage is greater than 2.0 DCV, then replace the magnetic switch. If the switch passes the requirements of Step 1 and 4, it is functioning correctly. Reconnect the wires and cables that were removed in this procedure.

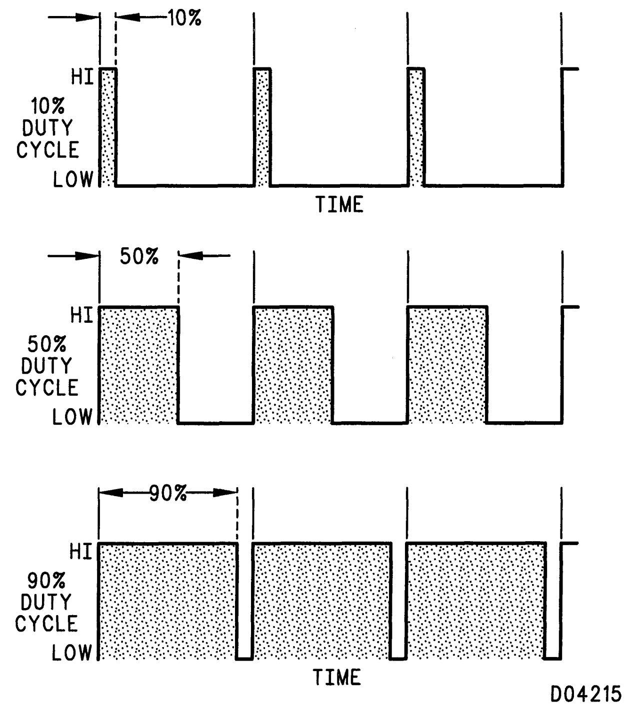
PWM Sensor Test



System Schematic For Engine Oil Pressure Sensor (EOPS)



System Schematic For Engine Coolant Temperature Sensor (ECTS)



Pulse Width Modulated (PWM) Signal

This test is provided in addition to the CID 100 and CID 110 troubleshooting procedures; see the topic Diagnostic Fault Troubleshooting. The oil pressure sensor and the coolant temperature sensor are pulse width modulated (PWM) sensors. These sensors produce a digital signal in which the duty cycle varies as the condition changes. The frequency remains constant.

Test Procedure

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
Engine Coolant Temperature Sensor (ECTS) [3]		
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 1.42	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 350 to 650 Hz.
[2] The voltages and duty cycles are guidelines for troubleshooting and are not considered exact. Tolerance is ± 10%.
[3] The base frequency is 370 to 550 Hz.

Tools Needed		
9U-7330	Multimeter (Optional) for frequency and duty cycle measurements	1
7X-1710	Cable Probes	1

This procedure requires the measurement of the frequency and duty cycle of the sensor signal. Use the 9U-7330 Digital Multimeter for measuring frequency and duty cycle. To measure frequency, turn the rotary switch to AC volts and press the HZ button once. To measure duty cycle, turn the rotary switch to AC volts and press the HZ button twice.

NOTE: The 6V-7070 Digital Multimeter does not measure frequency or duty cycle. However, the DC voltages are listed in the Sensor Specifications chart as an alternative to measuring the frequency and duty cycle. The 6V-7070 Digital Multimeter can be used for DC voltage measurements.

STEP 1. Locate the suspect sensor. Identify the sensor wires and connector contacts; see the preceding System Schematic. DO NOT DISCONNECT ANY HARNESS CONNECTORS AT THIS TIME. Use the 7X-1710 Cable Probe (Spoons) to make measurements by probing through the back of the harness connectors.

STEP 2. CHECK SENSOR SUPPLY VOLTAGE - Turn the ECS to OFF/RESET and then to STOP. Measure the sensor supply DC voltage at the sensor connector (from contact A to contact B on the sensor connector). The voltage should measure from 7.5 to 8.5 DCV.

- OK; the voltage is from 7.5 to 8.5 DCV. Proceed to Step 3.
- 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 is not equal to battery positive. Observe the GSC display.
  a. If a CID 269 fault code is active, go to that procedure in the Diagnostic Fault Troubleshooting section. STOP.
  b. If a CID 269 fault code is NOT active, then the harness is faulty. Troubleshoot and repair the harness. STOP.

STEP 3. CHECK SENSOR SIGNAL - The ECS remains in the STOP position. Measure the frequency and duty cycle of the signal at the sensor connector (from contact C to contact B of the sensor connector). Make a note of the measurements. The measured frequency and duty cycle should agree with the values listed in the Sensor Specifications chart.

- OK; the measurements agree with the values listed in the Sensor Specifications chart. The sensor is functioning correctly. Proceed to Step 4.
- NOT OK; the measurements DO NOT agree with the values listed in the Sensor Specifications chart. Proceed to Step 5.

STEP 4. CHECK ENGINE HARNESS SIGNAL - Measure the frequency and duty cycle of the signal at the GSC harness connector. For the oil pressure signal, measure from contact 8 to contact 31. For the coolant temperature signal, measure from contact 7 to contact 31. The measured frequency and duty cycle should agree with the values measured in Step 3.

- OK; the frequency and duty cycle are the same as measured in Step 3. The sensor and harness are functioning correctly.
    a. If sensor fault codes are still active, the GSC is faulty. Replace the GSC, see the topic Generator Set Control Replacement. STOP.
    b. If sensor fault codes are NOT active, check the connectors and wiring. See the topic Electrical Connector Inspection. STOP.

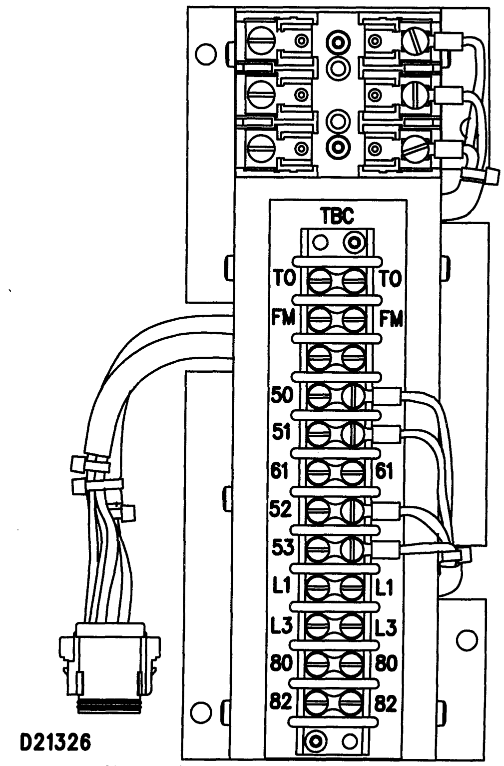
- NOT OK; the frequency or the duty cycle are NOT the same as measured in Step 3. The harness is defective. Troubleshoot and repair the engine harness. STOP.

STEP 5. CHECK ENGINE HARNESS - Disconnect the engine harness from the sensor. Disconnect the GSC from the harness. Check the harness for an open circuit (greater than 5 ohms). Check the signal wire for a short (5k ohms or less) to battery positive, battery negative and sensor supply.

- OK; all resistance measurements are correct. Replace the sensor. STOP.

- NOT OK; one or more resistance measurements are NOT correct. Troubleshoot and repair the engine harness. STOP.

AC Transformer Box (ATB) Replacement



AC Transformer Box (ATB)

The AC transformer box (ATB) is located on the sub-panel within the control panel.

Replacement Procedure

1. Shutdown 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/screws that fasten the ATB to the sub-panel. Remove the ATB.

5. Place the new ATB in the sub-panel. Install and tighten the mounting nuts/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 Main Chassis Wiring Diagram in the Schematics And Wiring Diagrams section.

7. Program the bar code (calibration value) for the voltmeter/ammeter into the GSC. See the topic Voltmeter/Ammeter Programming (OP8) in the Service Mode section.

8. If the genset is operating in parallel with another genset and the voltmeter values must match, then reprogram the AC calibration. See the topic AC Calibration (OP10) in the Service Mode section.

Generator Set Control (GSC) Replacement

Replacement Procedure

1. The new GSC must be reprogrammed after it is installed. If the GSC being replaced is functional, then make a note of the hourmeter value, all engine setpoints and any spare inputs/outputs that are programmed. See the topic Setpoint Viewing in the Service Mode Section.

2. Shut down the engine. Remove the positive lead wire from the battery.

3. Remove the harness connector from the GSC. A 4mm hex wrench is required to turn the fastening screw.

4. Make sure that all wires at the terminal strips of the relay module are marked with the respective termination point. During reassembly these wires must be reattached to the correct terminal. Remove all wires from the terminals and posts of the relay module.

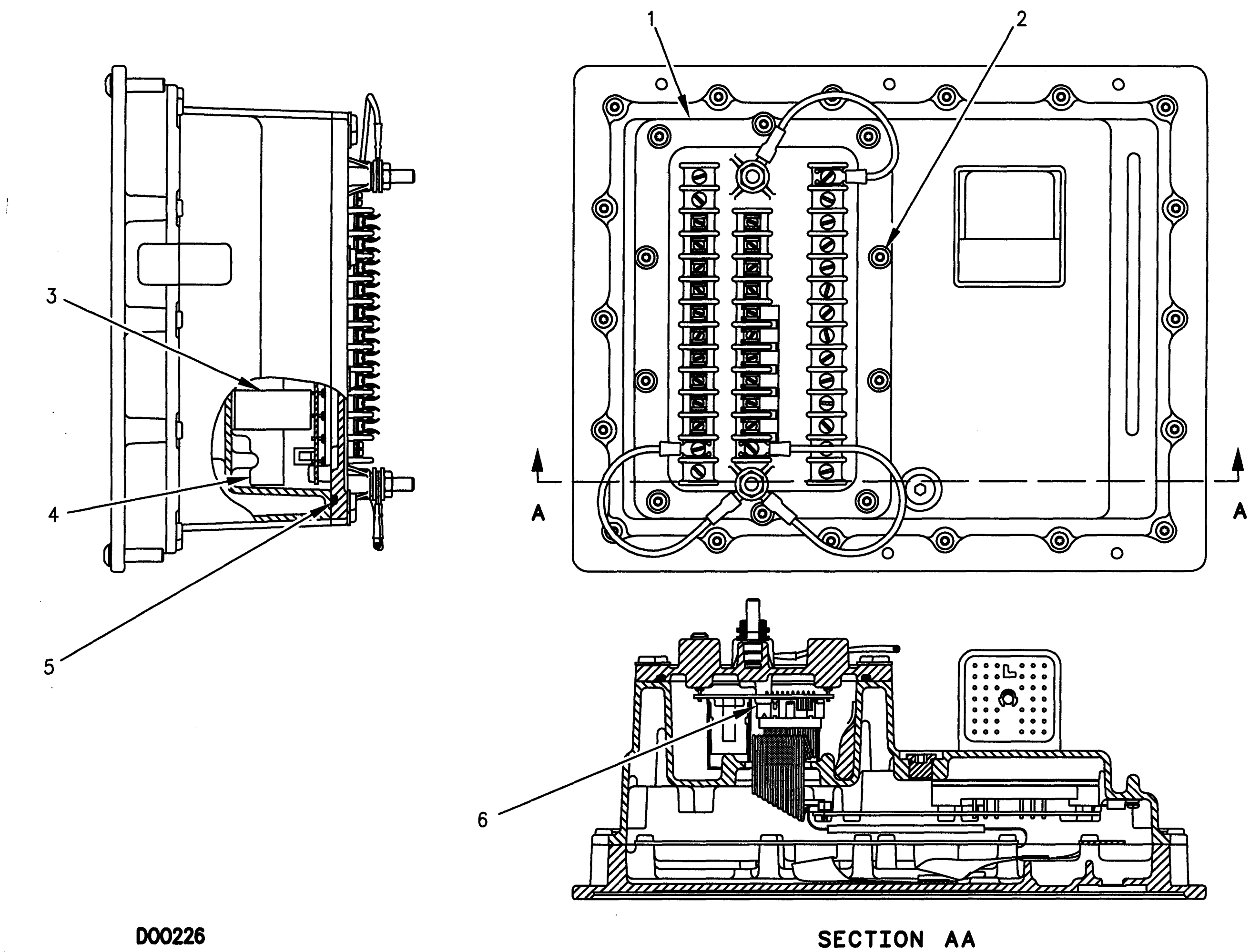
5. Remove the six nuts that fasten the GSC to the instrument door. Remove the GSC.

6. Place the new GSC in the instrument door. Install and tighten the six 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 Main Chassis Wiring Diagram in the Schematics And Wiring Diagrams section.

8. Reprogram the setpoints, the spare inputs/outputs, the hourmeter, the voltmeter/ammeter and the AC calibration; see the related topics in the Service Mode section. Use the values from the original GSC.

Relay Module Replacement



Relay Module Replacement (Rear of 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 external devices of the EMCP II system. Relay module (1) is a component of the GSC.

Replacement Procedure

1. Remove the positive lead wire from the battery.

2. Make sure that all wires at the terminal strips of relay module (1) are marked with the respective 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).

5. Replace desiccant package (4) with the new desiccant package and tape that is included with the replacement relay module. Attach the new desiccant package in the same manner as the one removed.

NOTE: Do not remove the new desiccant package from the protective container until immediately before it is installed into the GSC. Installing the replacement relay module should take approximately 20 minutes. Longer periods of time will cause the desiccant package to become saturated with moisture, particularly if in a humid environment.

6. Install new O-ring seal (5) in the groove of relay module (1). (For removal and installation jobs, reuse the existing O-ring.) Make sure O-ring seal (5) is seated properly. Align and reconnect cable connector (6) to relay module (1) and 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 and tighten ten screws (2).

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 Main Chassis Wiring Diagram in the Schematics And Wiring Diagrams section.

Schematics & Wiring Diagrams

Contents

Abbreviations

A	Ammeter
ACT	Actuator
ADS	Engine Combustion Air Damper Position Switch
AFCR	AAuxiliary Fuel Control Relay
ALM	Alarm Module
ALS	Alarm Silence Push Button
ALT	Alternator
AR	Arming Relay
ASSV	Air Start Solenoid Valve
ATB	AC Transformer Box
AUX	Auxiliary Terminal Strip
AUXREL	Auxiliary Relay (Crank Termination)
AWG	American Wire Gage
BATT	Battery
BCF	Battery Charger Failure Switch
C	Common
CB	Circuit Breaker
CCM	Customer Communication Module
CDM	Engine Cooldown Timer Module
CIM	Customer Interface Module
CT	Current Transformer
CTR	Crank Termination Relay
D	Diode
DCV	DC Voltmeter
DRS	Diagnostic Reset Switch
ECLC	EMCP Coolant Loss Sensor Connector
ECLS	EMCP Coolant Loss Sensor
ECS	Engine Control Switch
ECTS	EMCP Coolant Temperature Sensor
EFCR	Emergency Fuel Control Relay
EFL	Engine Failure Light
EG	Electronic Governor (Speed Sensing)
EGA	Electronic Governor Actuator
EGR	Electronic Governor Relay
EOCC	EMCP Oil Coolant Sensor Connector
EOPS	EMCP Oil Pressure Sensor
ESL	Emergency Stop Light
ESPB	Emergency Stop Push Button
F	Fuse
FCR	Fuel Control Relay
FCTM	Fuel Control Timer Module
FRB	Fuel Rupture Basin
FS	Fuel Solenoid
GFR	Genset Fault Relay
GOV	Governor
GPHI	Ground Post - High Voltage
GPLO	Ground Post - Low Voltage
GS	Governor Switch
GSC	Generator Set Control
GSM	Governor Synchronizing Motor
GSOV	Gas Shut-Off Valve
HZ	Frequency Meter
IC	Remote Start/Stop Initiate Contact
ISR	Ignition Shutoff Relay
L	Load Leads
LFB	Low Fuel Basin
LFLAS	Low Fuel Level Alarm Switch
LOLAS	Low Oil Level Alarm Switch
LVA	Low Voltage Alarm
LWLAS	Low Water Level Alarm Switch
LWTAS	Low Water Temperature Alarm Switch
LWTL	Low Water Temperature Light
MAG	Magneto
MAN	Manual
MPU	Magnetic Speed Pickup
NC	Normally Closed
NEG	Negative
OCL	Overcrank Light
OCR	Overcurrent Relay
OCT	Overcrank Timer
OP	Oil Pressure
OPG	Oil Pressure Gage
OPL	Oil Pressure Light
OSL	Overspeed Light
OVR	Overvoltage Relay
PL	Panel Illumination Light
PLS	Panel Light Switch
POS	Positive
POT	Potentiometer
PP	Prelube Pump
PPMS	Prelube Pump Magnetic Switch
PPPS	Prelube Pump Oil Pressure Switch
PR	Pre-Regulator
PS	Pinion Solenoid
PWR	Power
RA	Resistor Assembly
RAN	Remote Annunciator
RPL	Reverse Power Light
RPR	Reverse Power Relay
RR	Run Relay
SD	Shut-down
SEC	Second
SHTC	Circuit Breaker Shunt Trip Coil
SIG	Signal
SL	Synchronizing Light
SLM	Synchronizing Light Module
SLR	Synchronizing Light Resistor
SM	Starting Motor
SMMS	Starting Motor Magnetic Switch
SMR	Starting Motor Relay
SP	Speed Adjust Potentiometer
SS	Synchronizing Switch
STTS	Shunt Trip Terminal Strip
T	Generator Line Leads
TD	Time Delay Relay
TSC	Transfer Switch Position Indicating Contact
V	AC Voltmeter
VAR	Voltage Adjust Rheostat
WT	Water Temperature
WTG	Water Temperature Gage
WTL	Water Temperature Light
XDUCER	Transducer
Z	Zener Diode

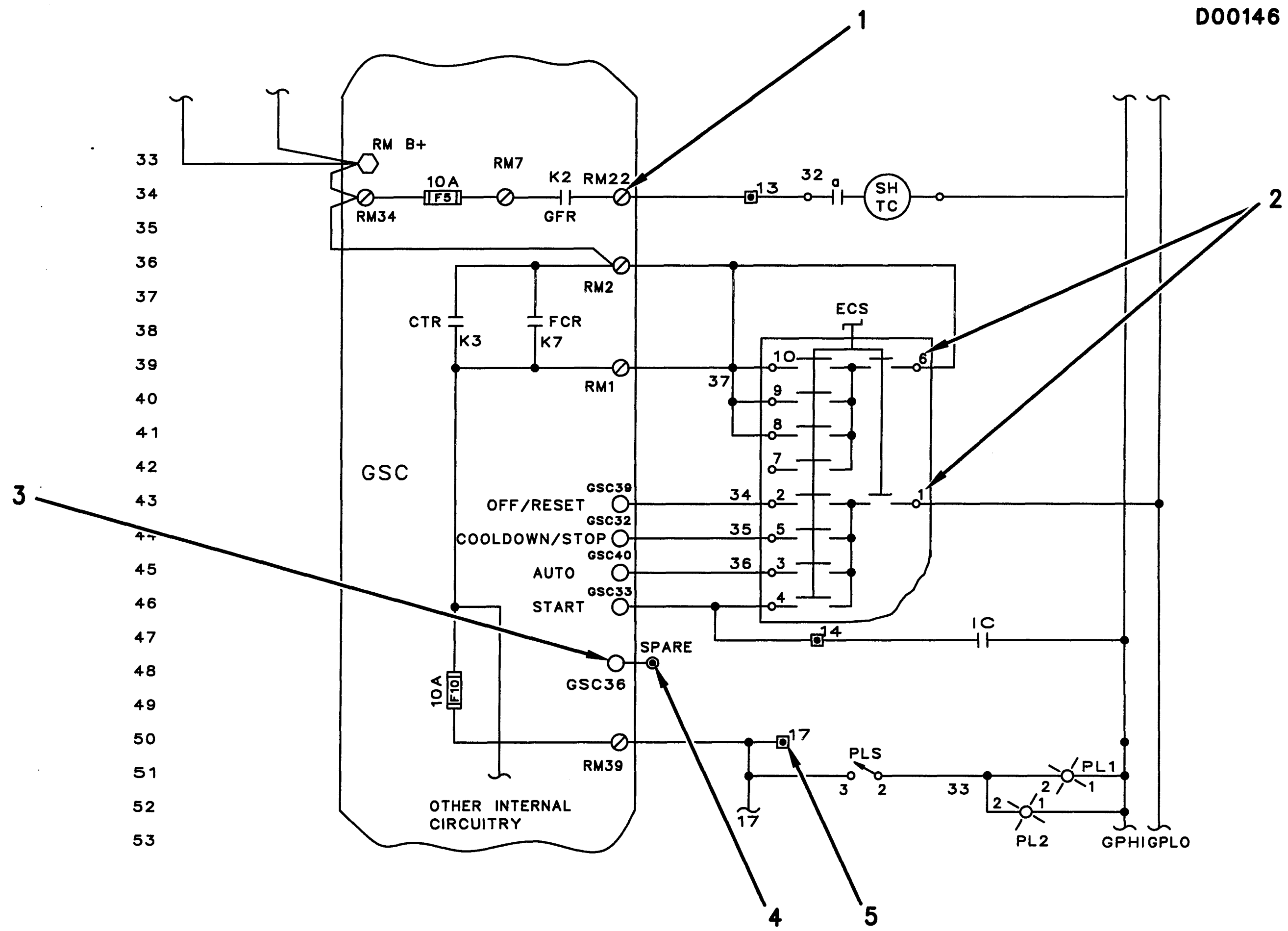
Symbols

- RELAY MODULE TERMINAL POINT
- GSC CONNECTOR CONTACT
- ENGINE GENERATOR TERMINAL POINT
- CONTROL PANEL TERMINAL POINT
- VOLTAGE REGULATOR TERMINAL POINT
- STANDARD WIRING
- OPTIONAL WIRING
- CUSTOMER WIRING
- ALTERNATIVE WIRING
- SHIELDED WIRE
- ENGINE MOUNTED COMPONENT
- TIMED CLOSED CONTACT
- TIMED OPENED CONTACT
- TIMED CLOSED TIMED OPENED CONTACT
- RELAY CONTACT (NORMALLY OPEN)
- RELAY CONTACT (NORMALLY OPEN)
- RELAY CONTACT (NORMALLY CLOSED)
- RELAY CONTACT (NORMALLY CLOSED)
- GENERATOR FRAME (CHASSIS) GROUND
- EARTH GROUND
- PRESSURE SWITCH
- PRESSURE SWITCH
- TEMPERATURE SWITCH
- TEMPERATURE SWITCH
- MANUALLY OPERATED CONTROL
- OPERATED BY TURNING
- SPEED SWITCH CONTACT
- SPEED SWITCH CONTACT
- BREAKDOWN DIODE BIDIRECTIONAL
- BREAKDOWN DIODE BIDIRECTIONAL
- DIODE
- DIODE
- FUSE
- FUSE
- EMERGENCY SWITCH
- RELAY COIL
- RELAY COIL
- CIRCUIT BREAKER
- CIRCUIT BREAKER

- AUTOMATIC RESET
- NON-AUTO RESET
- AUTOMATIC START-STOP MODE
- SYSTEM NOT IN AUTOMATIC START-STOP MODE
- CRANK
- ADJUSTABLE LOW-HI
- AC VOLTS
- LOW OIL PRESSURE
- OVERSPEED
- EMERGENCY STOP
- FAIL TO START (OVER CRANK)
- LOW FUEL LEVEL
- LOW COOLANT TEMPERATURE
- HIGH COOLANT TEMPERATURE
- STARTING AID-ETHER
- HORN
- HORN SILENCE/ACKNOWLEDGE SWITCH
- RAISE
- LOWER
- ON
- OFF
- LIQUID LEVEL SWITCH
- LAMP
- LAMP
- PANEL ILLUMINATION LIGHT
- ENGINE INTAKE AIR DAMPER CLOSED
- SYSTEM BATTERY VOLTAGE
- SERVICE HOURS
- ENGINE-STOP
- ENGINE RPM
- LAMP/DISPLAY TEST
- GENERATOR SYNCHRONIZING INDICATOR
- V-A AMMETER VOLTMETER PHASE SELECTOR SWITCH
- REVERSE POWER
- BATTERY CHARGER MALFUNCTION
- DIAGNOSTIC RESET SWITCH

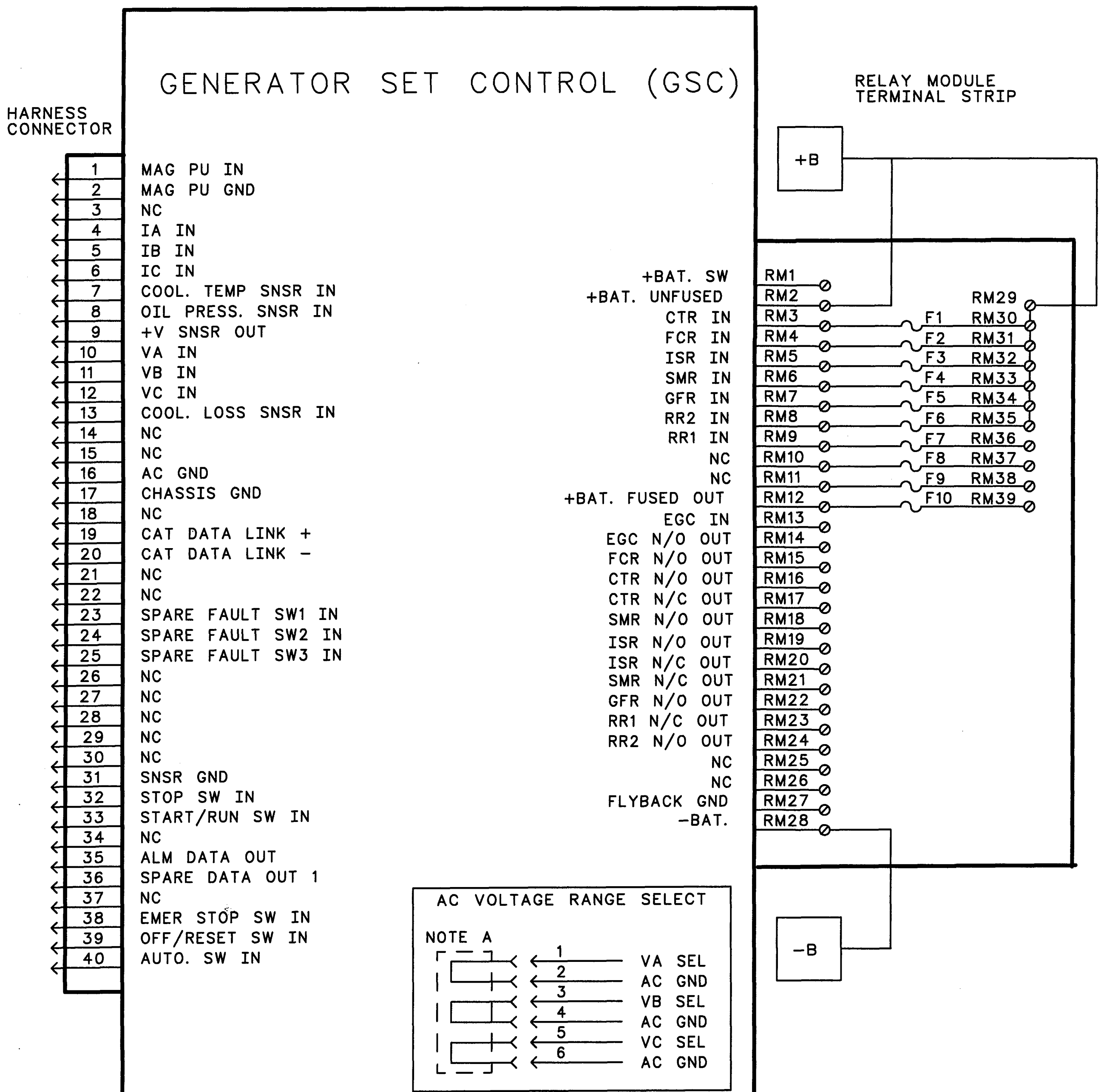
D84228

How To Read Control Panel DC Schematics



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.

Block Diagram - GSC



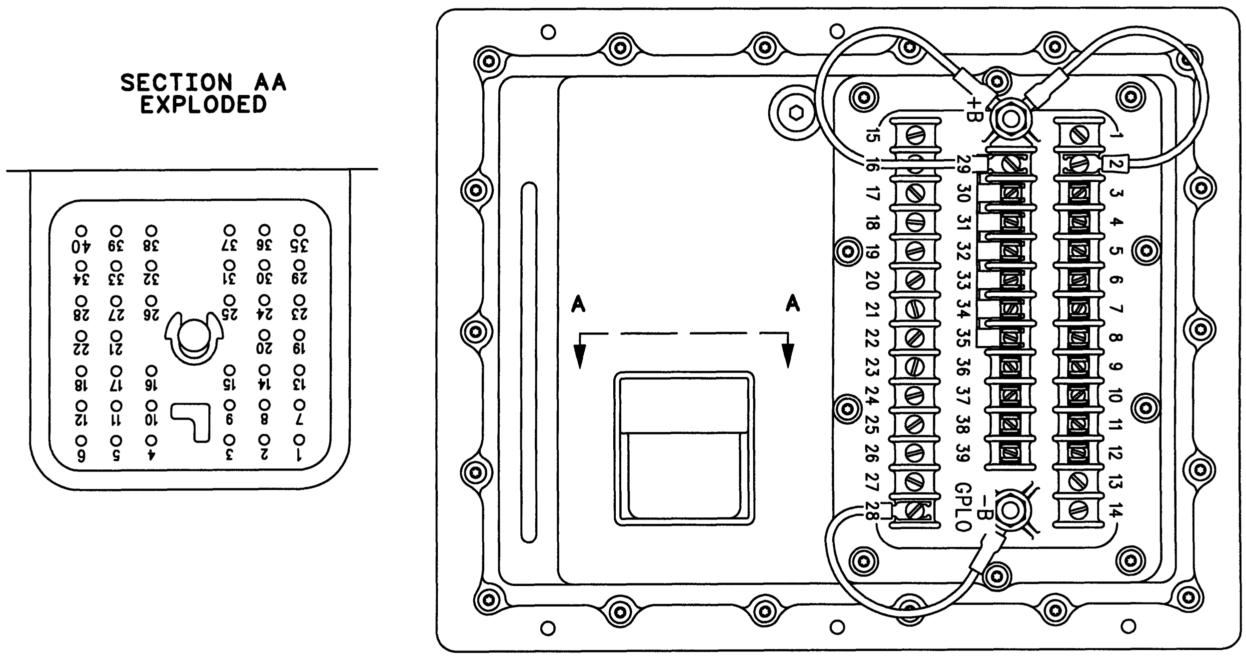
ABBREVIATIONS

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
CTR	–	CRANK TERMINATE RELAY
FCR	–	FUEL CONTROL RELAY
GFR	–	GENSET FAULT RELAY
RR	–	RUN RELAY
SMR	–	STARTING MOTOR RELAY

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.

D78796

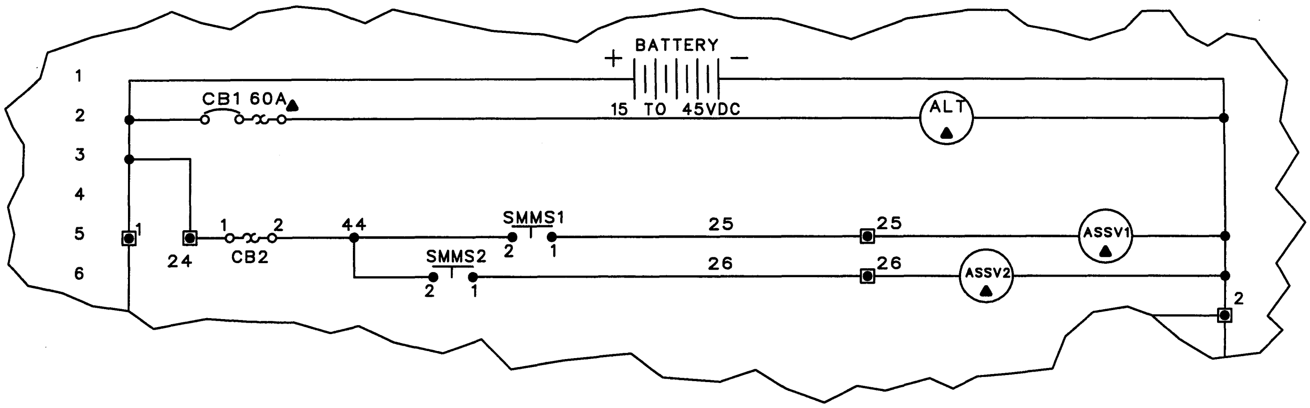
GSC Connector/Terminal Identification

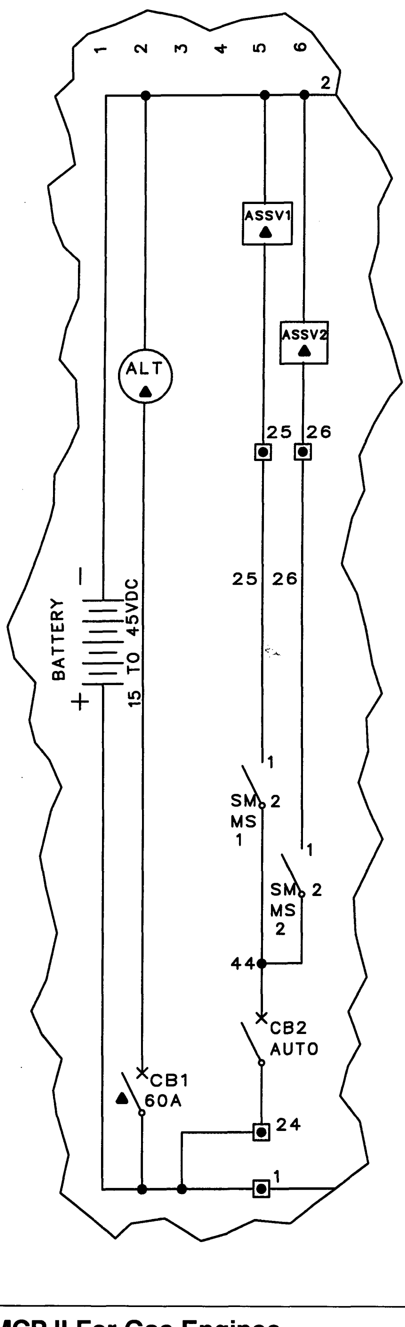


D78527

Back Of GSC – top view as mounted with instrument door open

DC Schematic - Air Start Option





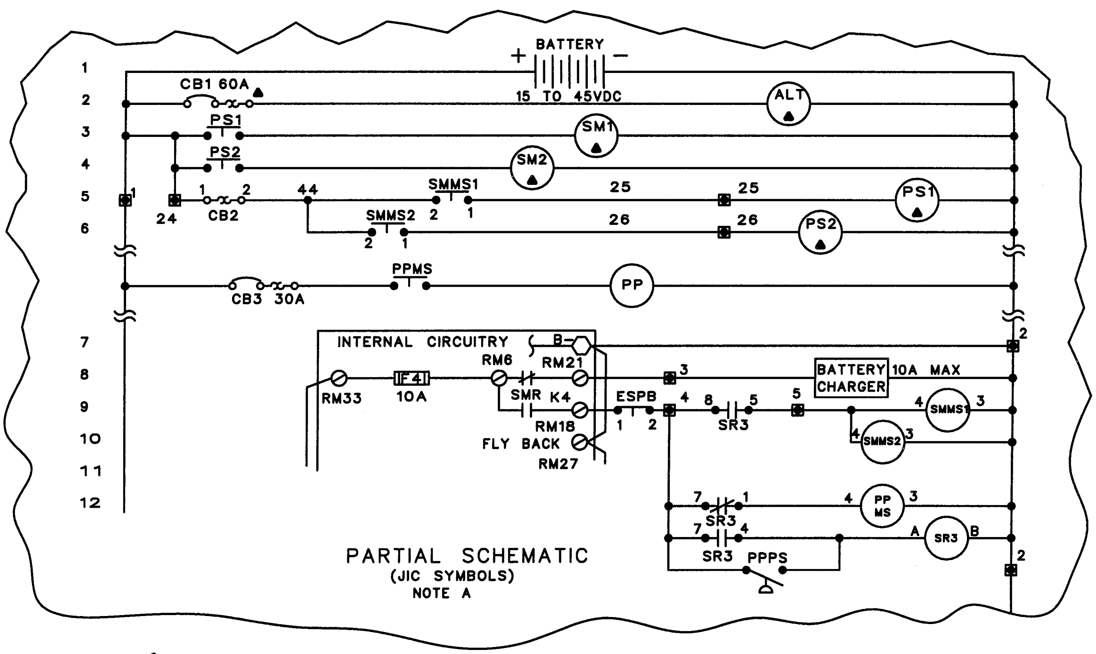
PARTIAL SCHEMATIC
(JIC SYMBOLS)
NOTE A

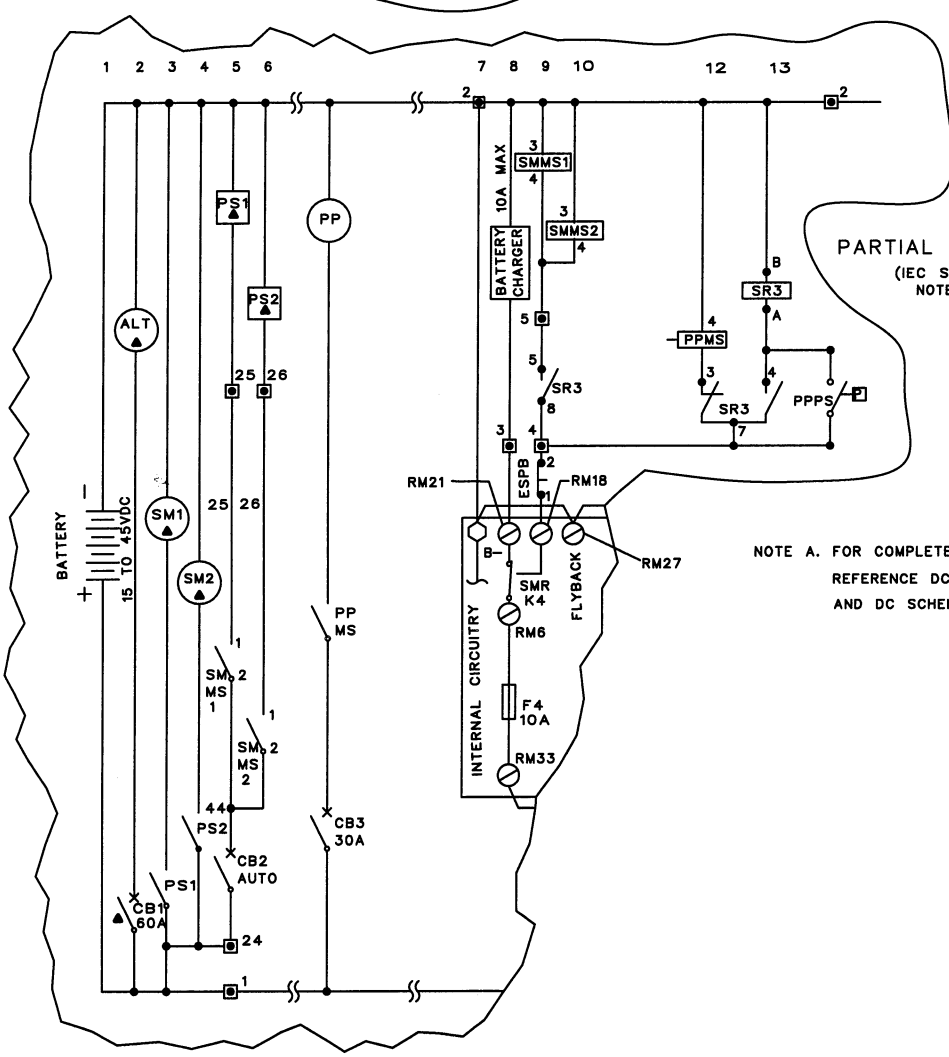
PARTIAL SCHEMATIC
(IEC SYMBOLS)
NOTE A

NOTE A. FOR COMPLETE SCHEMATICS REFERENCE DC SCHEMATIC (JIC) AND DC SCHEMATIC (IEC)

D00091

DC Schematic - Prelube Pump Option

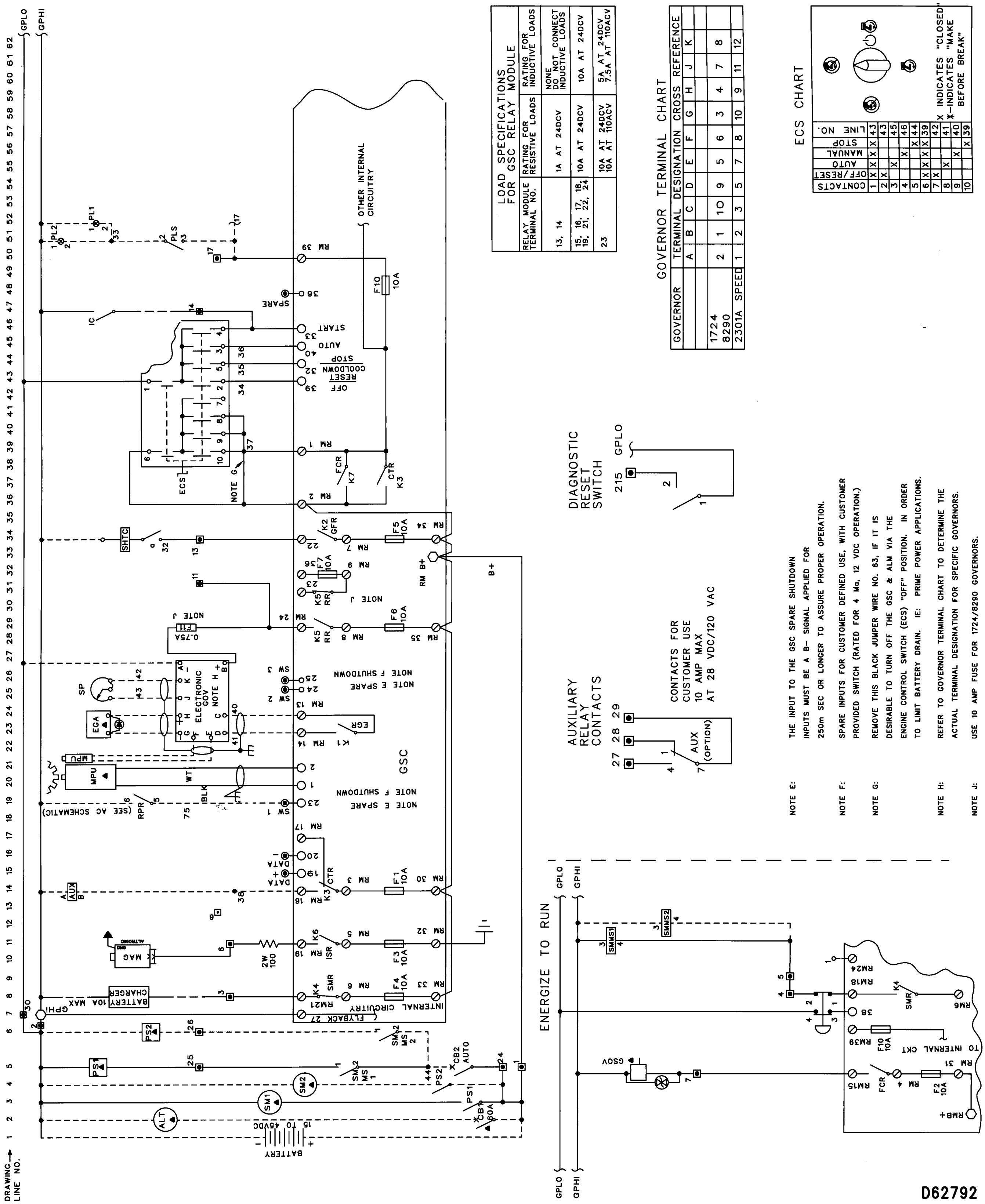




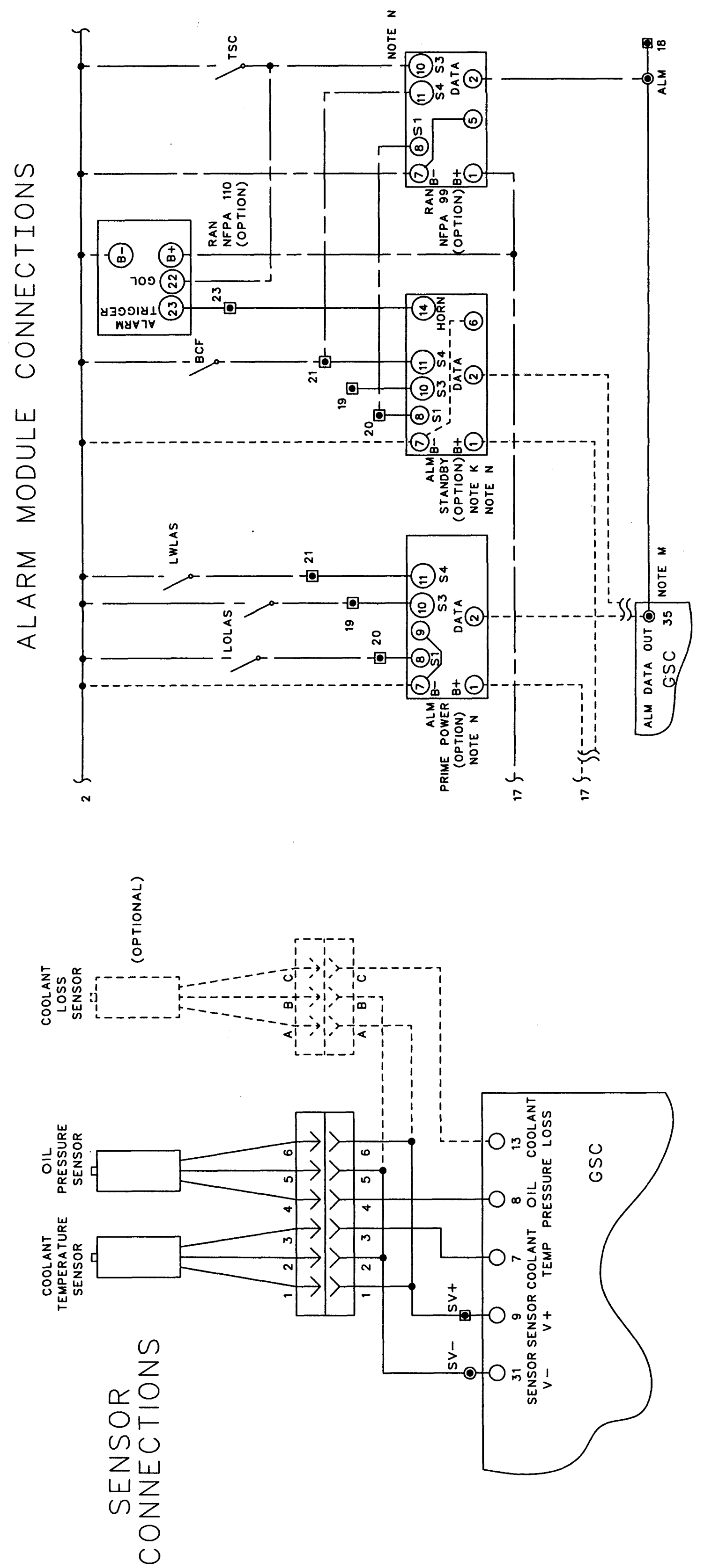
NOTE A. FOR COMPLETE SCHEMATICS REFERENCE DC SCHEMATIC (JIC) AND DC SCHEMATIC (IEC)

D00094

DC Schematic - IEC (one of two)



DC Schematic - IEC (two of two)



NOTE K: CONNECT ALM TERMINAL POINT 7 TO POINT 6 FOR NFPA110 ALARM MODULE OPERATING MODE. NO CONNECTION REQUIRED FOR NFPA99 OPERATION.

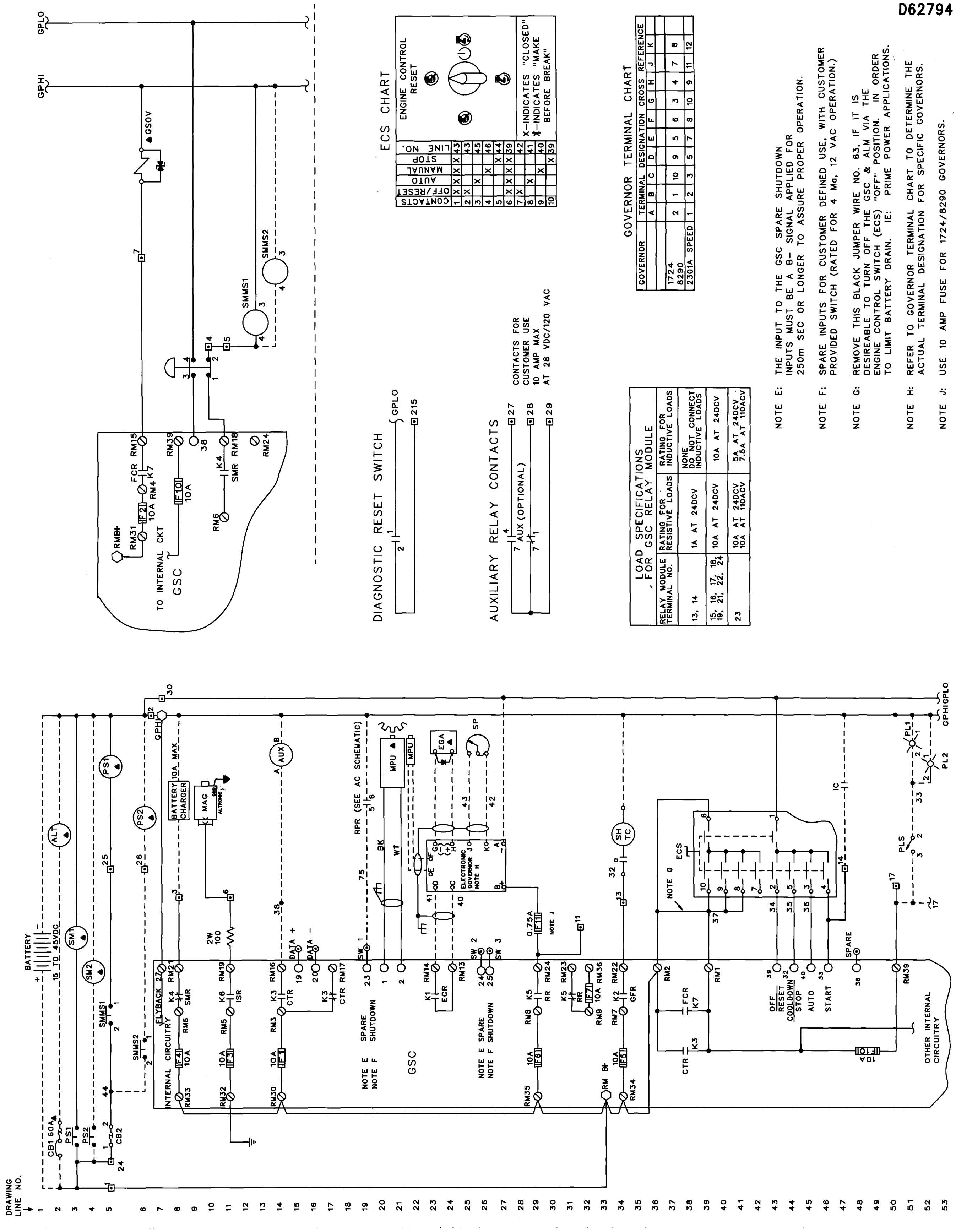
NOTE L: SPARE INPUT FOR CUSTOMER DEFINED USE. WITH CUSTOMER PROVIDED SWITCH (RATED FOR 4 Ma. 12 VDC OPERATION).

NOTE M: UP TO 3 ALARM MODULES WITH A COMBINED WIRE LENGTH OF 300 METERS MAY BE DRIVEN FROM THE DATA LINK.

NOTE N: SWITCHED INPUT TERMINALS 10 AND 11 ON THE ALARM MODULES MUST BE JUMPERED TO TERMINALS 3 AND 4 RESPECTIVELY, IF IT IS DESIRED TO SOUND HORN IN CONJUNCTION WITH FLASHING LAMP.

D62793

DC Schematic - JIC (one of two)



ECS CHART

CONTACTS	OFF/RESET	AUTO	MANUAL	STOP	LINE NO.
1	X	X	X	X	43
2	X				43
3		X			45
4			X		46
5				X	44
6	X	X	X	X	39
7	X				42
8		X			41
9			X		40
10				X	39

X-INDICATES "CLOSED"
X-INDICATES "MAKE BEFORE BREAK"

LOAD SPECIFICATIONS FOR GSC RELAY MODULE

RELAY MODULE TERMINAL NO.	RATING FOR RESISTIVE LOADS	RATING FOR INDUCTIVE LOADS
13, 14	1A AT 24DCV	NONE DO NOT CONNECT INDUCTIVE LOADS
15, 16, 17, 18, 19, 21, 22, 24	10A AT 24DCV	10A AT 24DCV
23	10A AT 24DCV 10A AT 110ACV	5A AT 24DCV 7.5A AT 110ACV

GOVERNOR TERMINAL CHART

GOVERNOR	A	B	C	D	E	F	G	H	J	K
1724 8290	2	1	10	9	5	6	3	4	7	8
2301A SPEED	1	2	3	5	7	8	10	9	11	12

NOTE E: THE INPUT TO THE GSC SPARE SHUTDOWN INPUTS MUST BE A B- SIGNAL APPLIED FOR 250m SEC OR LONGER TO ASSURE PROPER OPERATION.

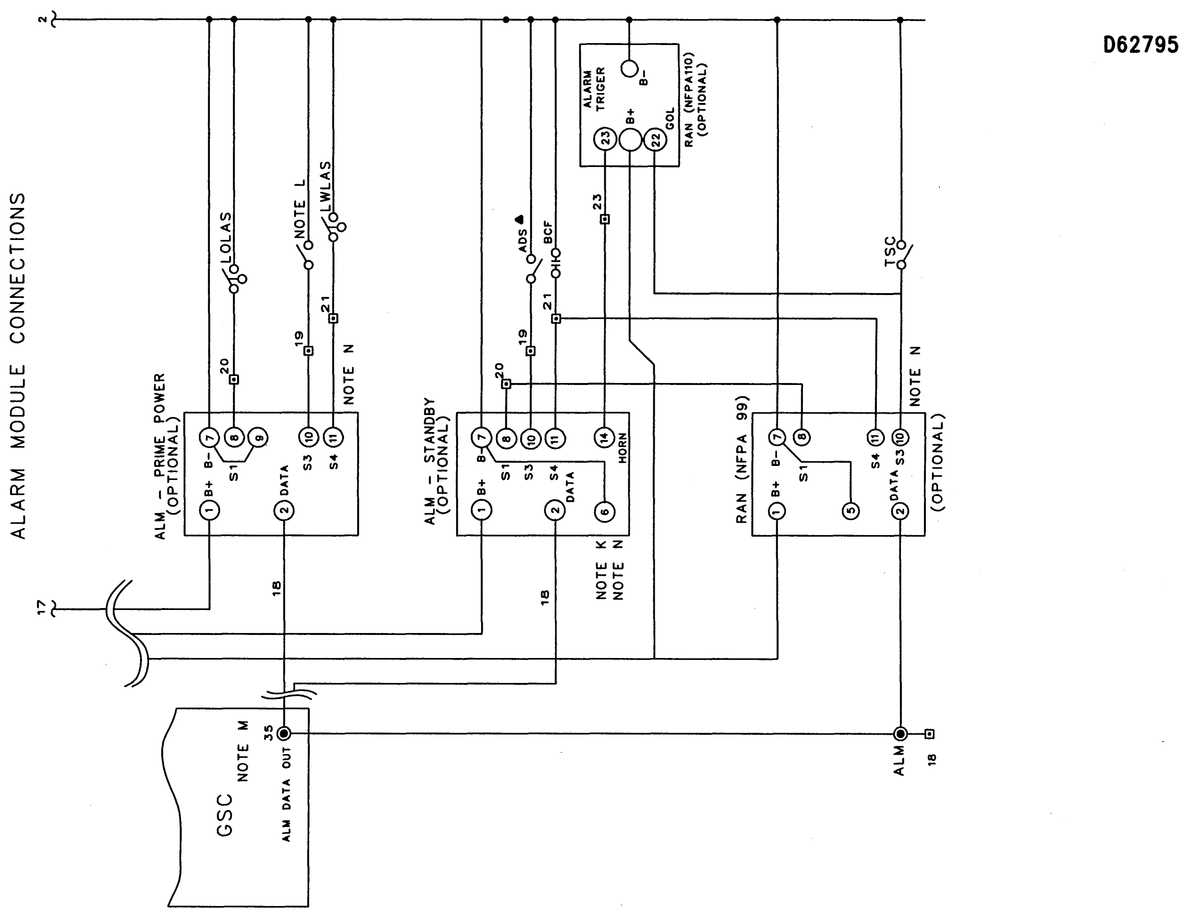
NOTE F: SPARE INPUTS FOR CUSTOMER DEFINED USE, WITH CUSTOMER PROVIDED SWITCH (RATED FOR 4 Ma, 12 VAC OPERATION.)

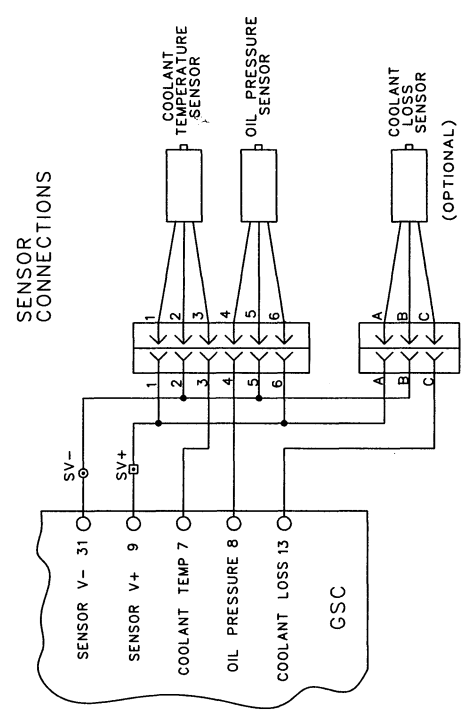
NOTE G: REMOVE THIS BLACK JUMPER WIRE NO. 63, IF IT IS DESIREABLE TO TURN OFF THE GSC & ALM VIA THE ENGINE CONTROL SWITCH (ECS) "OFF" POSITION. IN ORDER TO LIMIT BATTERY DRAIN. IE: PRIME POWER APPLICATIONS.

NOTE H: REFER TO GOVERNOR TERMINAL CHART TO DETERMINE THE ACTUAL TERMINAL DESIGNATION FOR SPECIFIC GOVERNORS.

NOTE J: USE 10 AMP FUSE FOR 1724/8290 GOVERNORS.

DC Schematic - JIC (two of two)





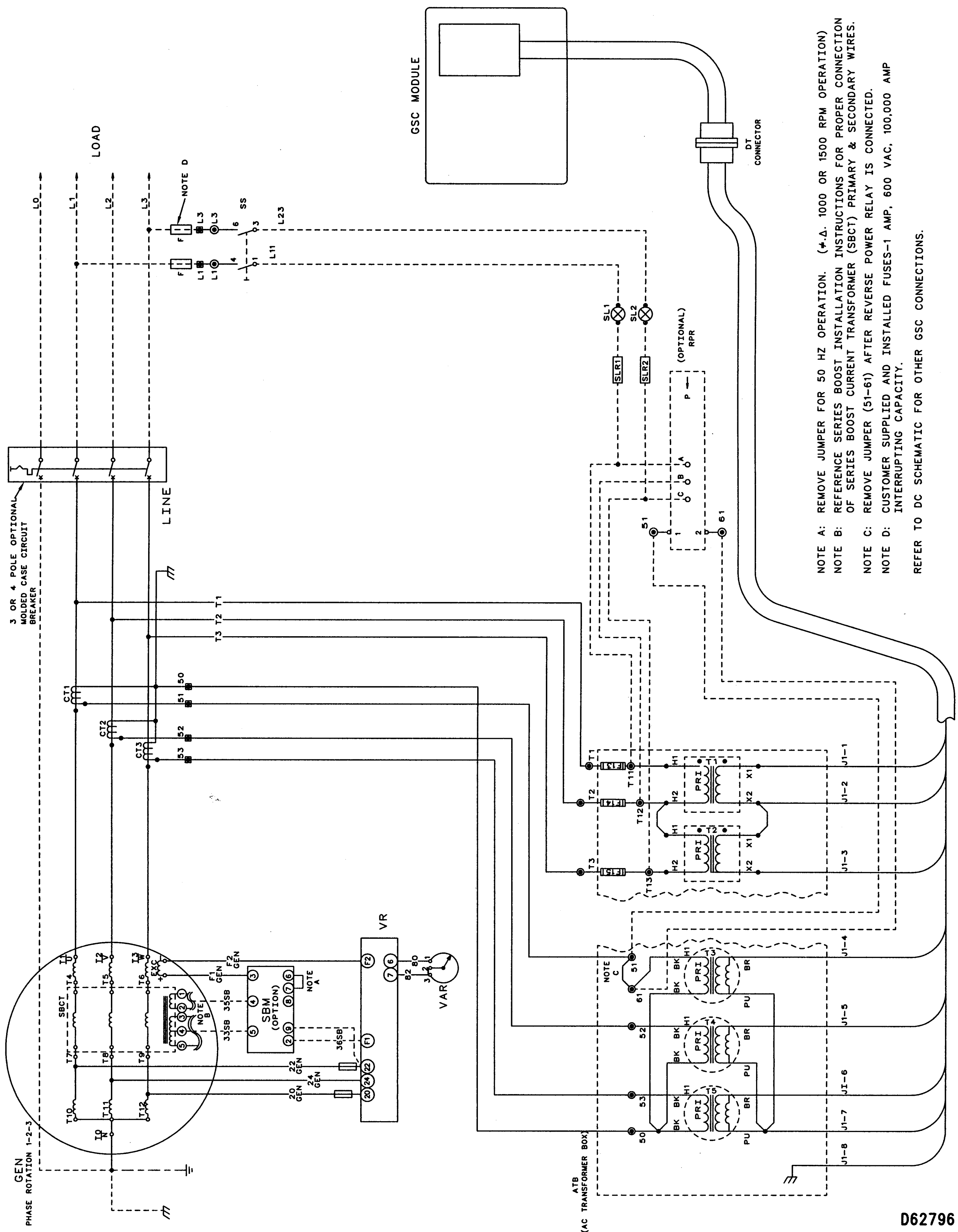
NOTE K: CONNECT ALM TERMINAL POINT 7 TO POINT 6 FOR NFPA110 ALARM MODULE OPERATING MODE. NO CONNECTION REQUIRED FOR NFPA99 OPERATION.

NOTE L: SPARE INPUT FOR CUSTOMER DEFINED USE. WITH CUSTOMER PROVIDED SWITCH (RATED FOR 4 Ma. 12 VDC OPERATION).

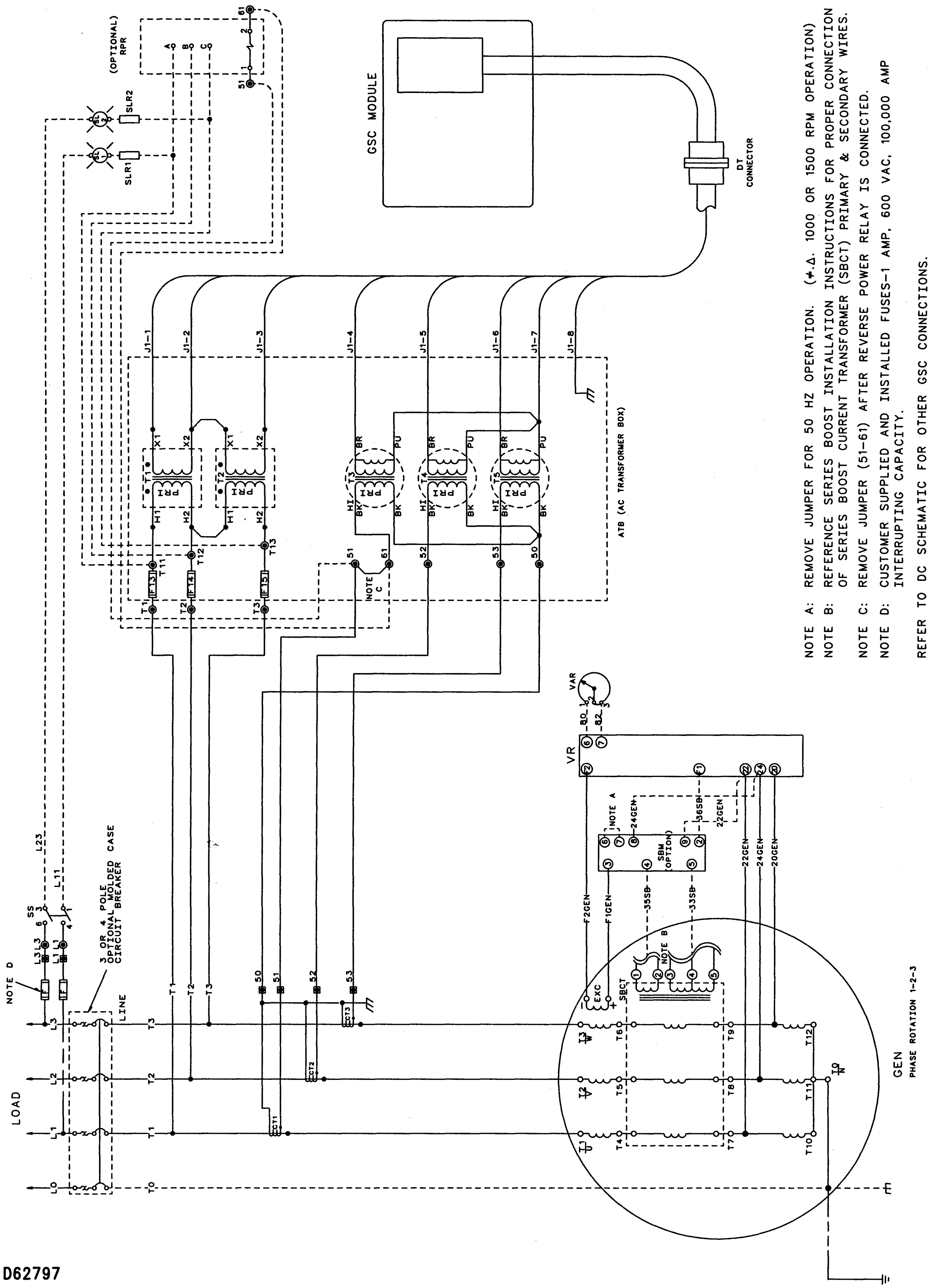
NOTE M: UP TO 3 ALARM MODULES WITH A COMBINED WIRE LENGTH OF 300 METERS MAY BE DRIVEN FROM THE DATA LINK.

NOTE N: SWITCHED INPUT TERMINALS 10 AND 11 ON THE ALARM MODULES MUST BE JUMPERED TO TERMINALS 3 AND 4 RESPECTIVELY, IF IT IS DESIRED TO SOUND HORN IN CONJUNCTION WITH FLASHING LAMP.

AC Schematic - IEC



AC Schematic - JIC



NOTE A: REMOVE JUMPER FOR 50 HZ OPERATION. (Y.Δ. 1000 OR 1500 RPM OPERATION)

NOTE B: REFERENCE SERIES BOOST INSTALLATION INSTRUCTIONS FOR PROPER CONNECTION OF SERIES BOOST CURRENT TRANSFORMER (SBCT) PRIMARY & SECONDARY WIRES.

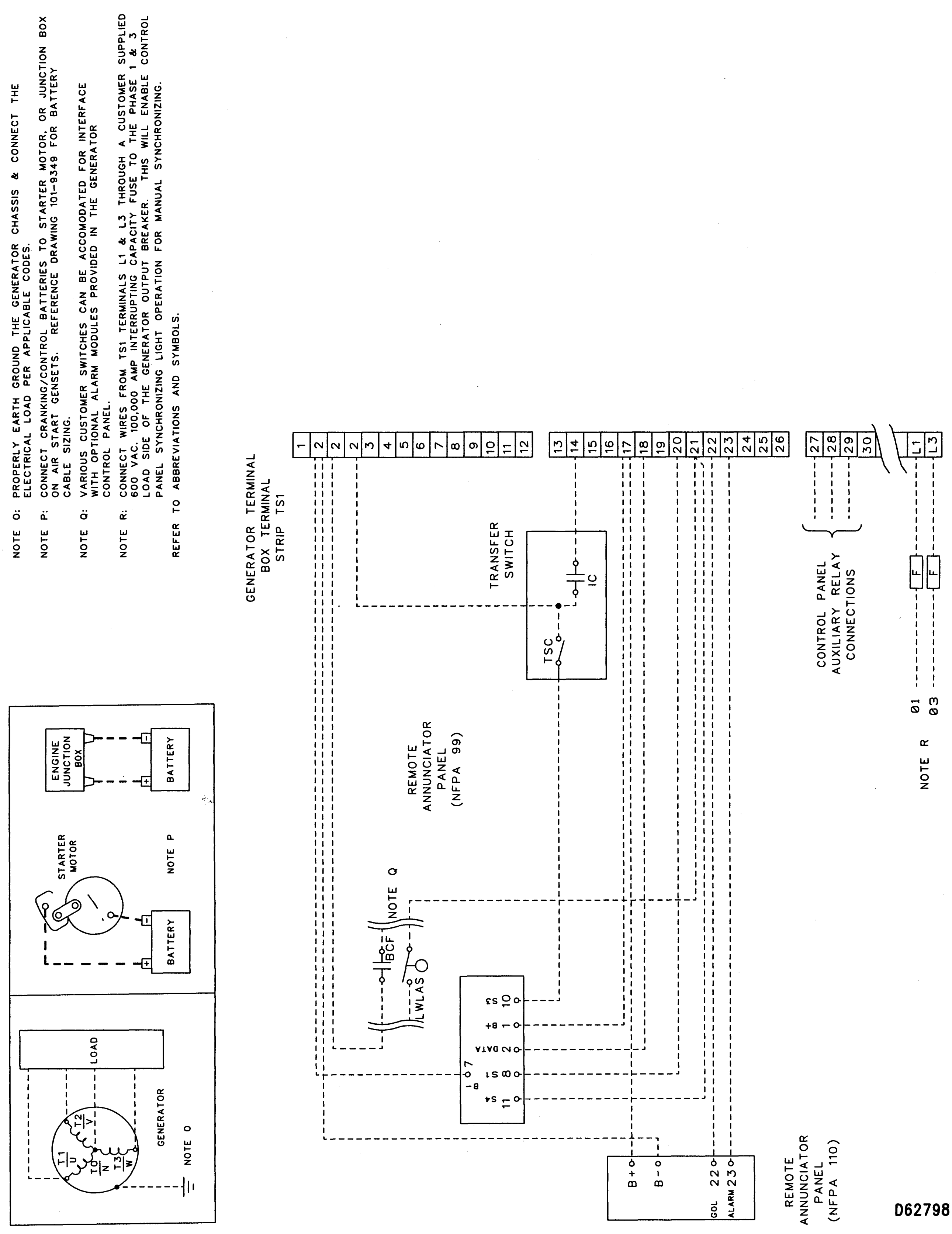
NOTE C: REMOVE JUMPER (51-61) AFTER REVERSE POWER RELAY IS CONNECTED.

NOTE D: CUSTOMER SUPPLIED AND INSTALLED FUSES-1 AMP, 600 VAC, 100,000 AMP INTERRUPTING CAPACITY.

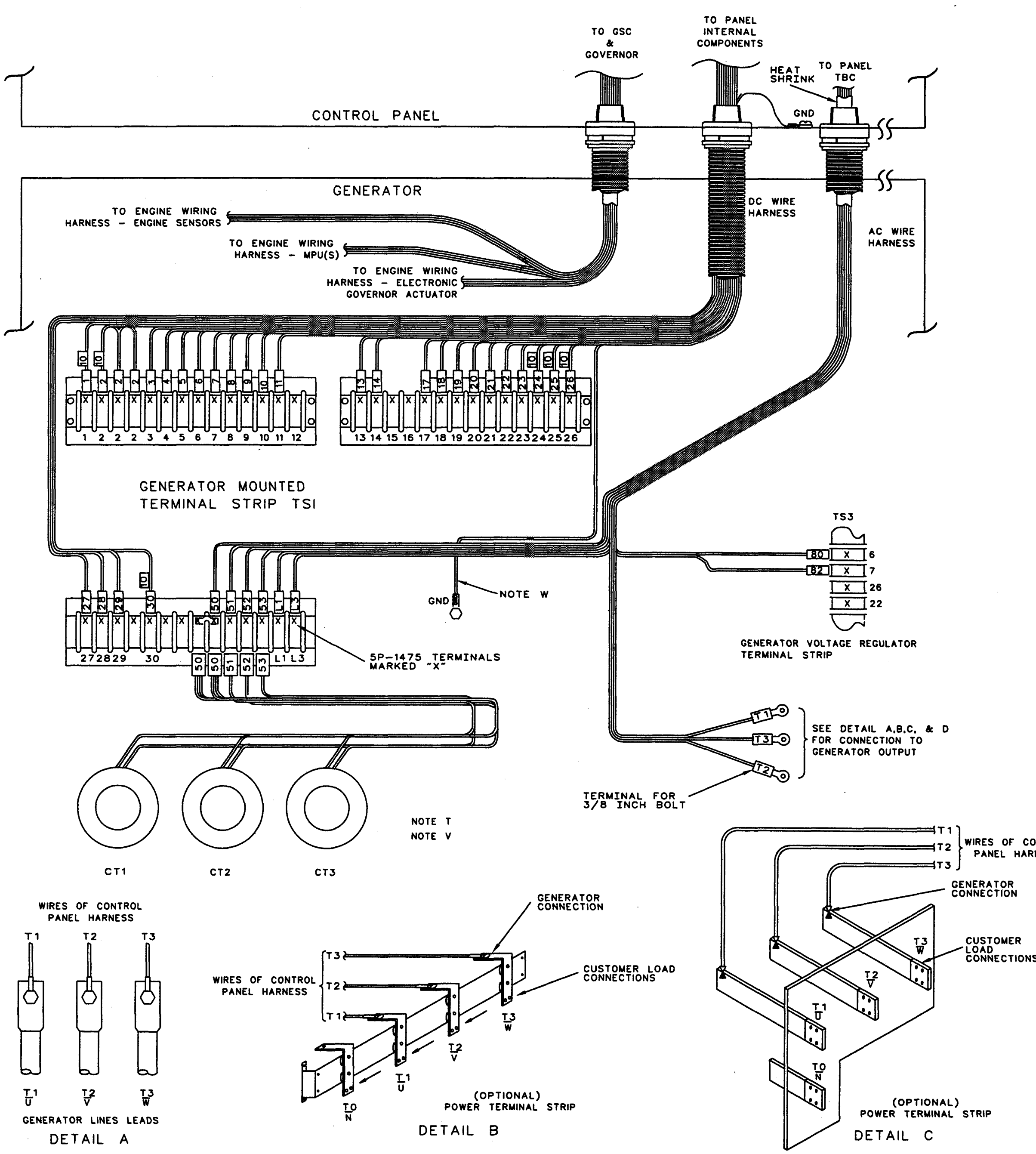
REFER TO DC SCHEMATIC FOR OTHER GSC CONNECTIONS.

D62797

Wiring Diagram - Customer/Contractor



Wiring Diagram - Harness



NOTE T: NUMBER CT WIRES AT BOTH ENDS.

NOTE V: MOUNT CURRENT TRANSFORMERS WITH POLARITY MARK FACING GENERATOR.

NOTE W: CONTROL PANEL GROUND WIRE SHALL BE 12 AWG WITH GREEN & YELLOW STRIPED INSULATION RATED 90 C, 600 VAC, UL & CSA. WIRE SHALL BE LABELED "GND" & SHALL HAVE AN APPROPRIATELY SIZED RING TERMINAL FOR AN 10-32 SCREW.

ALL HARNESS SHALL BE NO. 16 AWG, STRANDED WIRE, 90°C 600 VAC INSULATION, UL & CSA LISTED. UNLESS OTHERWISE INDICATED
$\boxed{10}$ = 10 AWG WIRE.

USE TIES AT BRANCHES AND EVERY 76.2.

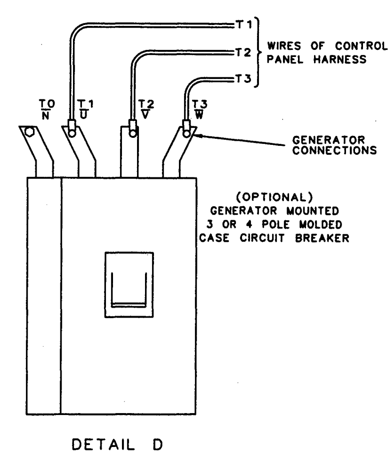
IDENTIFY WIRES BY TERMINAL NUMBERS.

WIRE IDENTIFICATION TO BE LOCATED ON WIRE 6.35 FROM TERMINAL, HOT STAMPED AND/OR ADHESIVE MARKER.

CONTROL PANEL DOOR TO TERMINAL STRIP INTERCONNECT WIRE ROUTING. SHALL AVOID SHARP EDGES THAT MAY DAMAGE WIRE INSULATION.

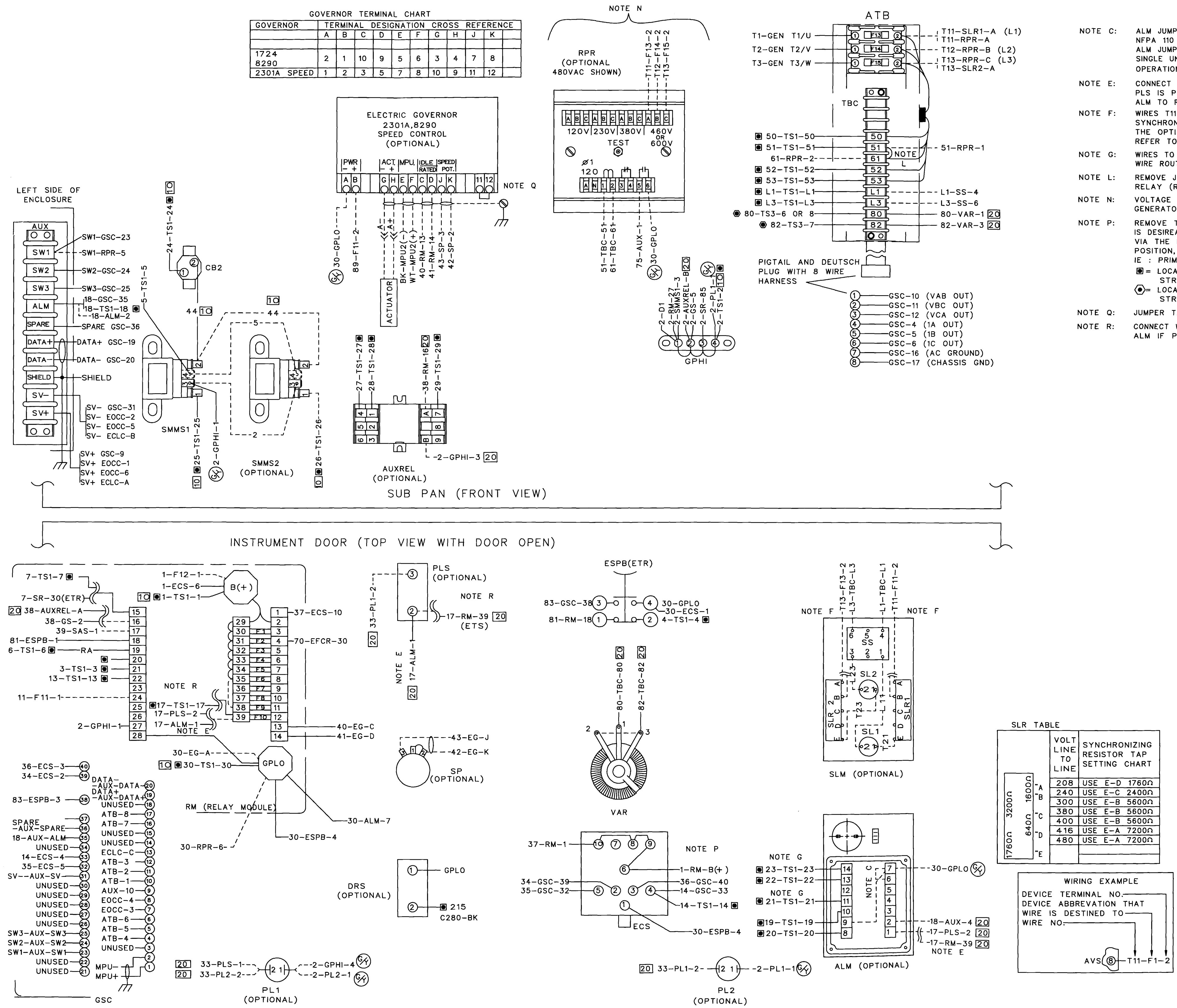
CONTROL PANEL AC AND DC WIRING HARNESS SHALL BE ROUTED WITHIN A PROTECTIVE CONVOLUTED TUBING JACKET AS SPECIFIED

ENGINE SENSOR HARNESS LENGTHS ARE 1067.



D62799

Wiring Diagram - Main Chassis



GOVERNOR TERMINAL CHART

GOVERNOR	A	B	C	D	E	F	G	H	J	K
1724 8290	2	1	10	9	5	6	3	4	7	8
2301A SPEED	1	2	3	5	7	8	10	9	11	12

(Header row spanning columns A–K: TERMINAL DESIGNATION CROSS REFERENCE)

NOTE C: ALM JUMPER 6 TO 7 PROVIDED ONLY FOR OPTIONAL NFPA 110 ALARM MODULE MODE OF OPERATION. ALM JUMPER 9 TO 7 PROVIDED ONLY FOR OPTIONAL SINGLE UNIT PRIME POWER ALARM MODULE MODE OF OPERATION.

NOTE E: CONNECT WIRE 17 FROM ALM TO PLS IF PLS IS PROVIDED. OTHERWISE CONNECT ALM TO RM-39.

NOTE F: WIRES T11 & T13 CONNECT TO THE SYNCHRONIZING LIGHT RESISTORS (SLR1 & 2) OF THE OPTIONAL SYNCHRONIZING LIGHT MODULE (SLM). REFER TO "SLR TABLE" FOR PROPER CONNECTIONS.

NOTE G: WIRES TO BE CAPPED & SECURED WHEN NOT USED. PROVIDE WIRE ROUTING & HARDWARE TO PREVENT WIRE CHAFFING.

NOTE L: REMOVE JUMPER IF REVERSE POWER RELAY (RPR) OPTION IS PROVIDED.

NOTE N: VOLTAGE CONNECTIONS DETERMINED BY GENERATOR LINE TO LINE VOLTAGE.

NOTE P: REMOVE THIS BLACK JUMPER WIRE NO.63, IF IT IS DESIREABLE TO TURN OFF THE GSC, ALM & RAN VIA THE ENGINE CONTROL SWITCH (ECS) "OFF" POSITION, IN ORDER TO LIMIT BATTERY DRAIN. IE : PRIME POWER APPLICATIONS.
■= LOCATED ON GENERATOR MOUNTED TERMINAL STRIP.
◈= LOCATED ON VOLTAGE REGULATOR TERMINAL STRIP.

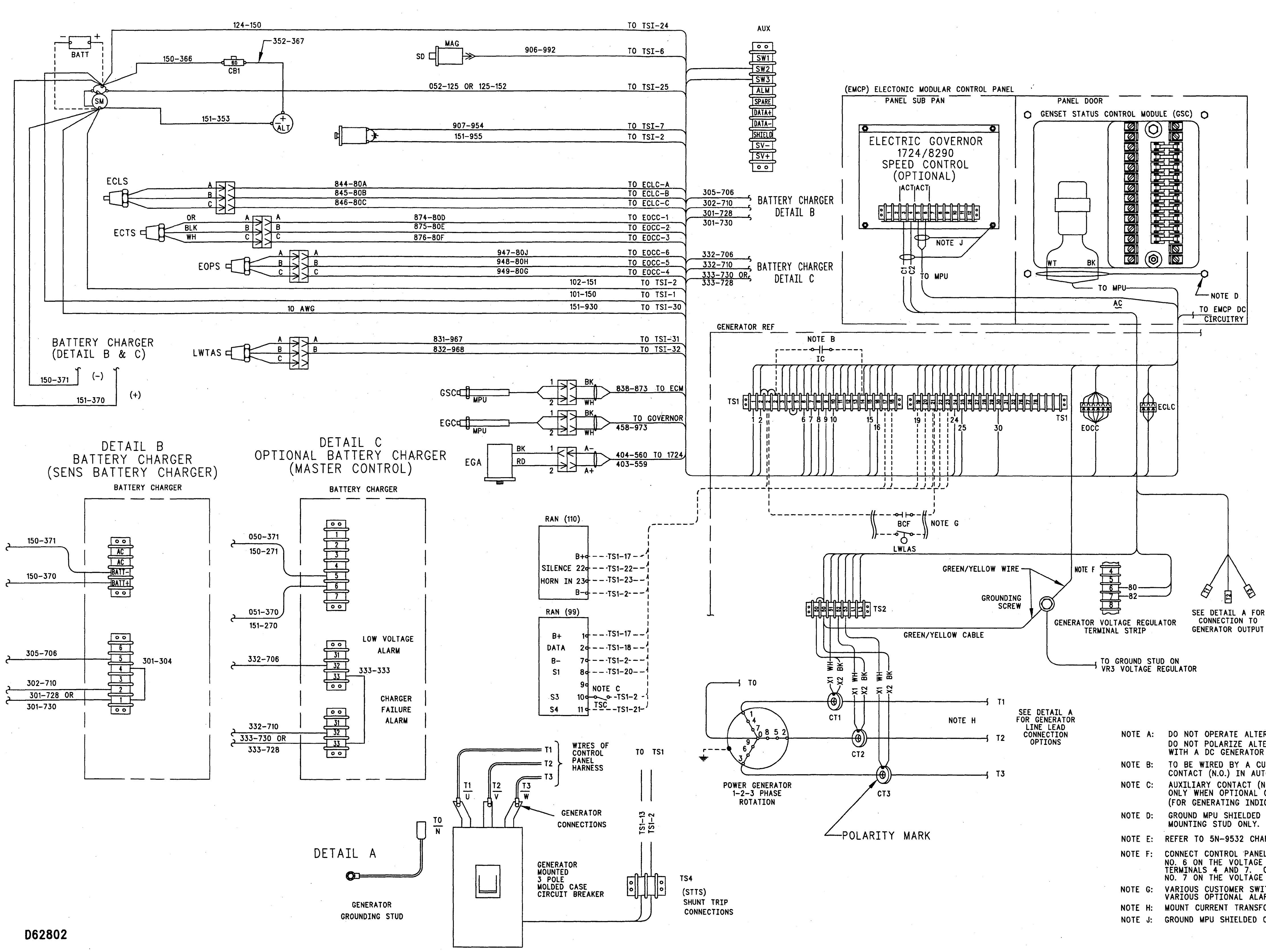
NOTE Q: JUMPER TERMINALS 11,12 FOR 8290 CONTROL ONLY.

NOTE R: CONNECT WIRE 17 FROM ESPB TO PLS AND/OR ALM IF PROVIDED.

SLR TABLE

VOLT LINE TO LINE	SYNCHRONIZING RESISTOR TAP SETTING CHART
208	USE E-D 1760Ω
240	USE E-C 2400Ω
300	USE E-B 5600Ω
380	USE E-B 5600Ω
400	USE E-B 5600Ω
416	USE E-A 7200Ω
480	USE E-A 7200Ω

D62800



ABBREVIATIONS

AC	ALTERNATING CURRENT
ACT	ACTUATOR
ADS	AIR DAMPER POSITION SWITCH
ALT	ALTERNATOR
ASOS	AIR SHUT-OFF SOLENOID
BATT	BATTERY
BCF	BATTERY CHARGER MALFUNCTION
CB	CIRCUIT BREAKER
CFA	CHARGER FAILURE ALARM
CT	CURRENT TRANSFORMER
ECLC	EMCP COOLANT LOSS SENSOR CONNECTOR
ECLS	EMCP COOLANT LOSS SENSOR
ECTS	EMCP COOLANT TEMPERATURE SENSOR
EGA	ELECTRONIC GOVERNOR SENSOR
EOCC	EMCP OIL COOLANT SENSOR PROTECTOR
EOPS	EMCP OIL PRESSURE SENSOR
FRB	FUEL RUPTURE BASIN
FS	FUEL SOLENOID
GSOV	GAS SHUT-OFF VALVE
GSC	GENSET STATUS CONTROL
GSM	GOVERNOR SYNC MOTOR
IC	REMOTE START INITIATIVE CONTACT
LFB	LOW FUEL BASIN
LFLAS	LOW FUEL LEVEL ALARM SWITCH
LVA	LOW VOLTAGE ALARM
LWLAS	LOW WATER LEVEL ALARM SWITCH
LWTAS	LOW WATER TEMPERATURE ALARM SWITCH
MAG	MAGNETO
MPU	MAGNETIC PICKUP
NEG	NEGATIVE
POS	POSITIVE
PWR	POWER
RAN	REMOTE ANNUNCIATOR (FOR NFPA 110 OR NFPA 99)
SASV	START AID SOLENOID VALVE
SATS	START AID TEMPERATURE SWITCH
SD	SHUT-DOWN
SM	STARTING MOTOR
STTS	SHUNT TRIP TERMINAL STRIP
SPD POT	SPEED SETTING POTENTIOMETER
TSC	TRANSFER SWITCH POSITION CONTACT
-------	CUSTOMER WIRING

BATTERY CABLE SIZE
MAX ONE WAY LENGTH (25° C)

GAGE	SINGLE STARTING MOTOR	DUAL STARTING MOTOR
0000	5m	2.5m
000	4m	2m
00	3.25m	1.5m
0	2.5m	1.25m

NOTE A: DO NOT OPERATE ALTERNATOR WITHOUT A BATTERY CONNECTED TO THE SYSTEM. DO NOT POLARIZE ALTERNATOR. DO NOT OPERATE ALTERNATOR SIMULTANEOUSLY WITH A DC GENERATOR TO CHARGE A COMMON BATTERY.

NOTE B: TO BE WIRED BY A CUSTOMER TO ENGINE REMOTE STARTING INITIATE CONTACT (N.O.) IN AUTO TRANSFER SWITCH.

NOTE C: AUXILIARY CONTACT (N.O.) ON EMERGENCY SIDE OF TRANSFER SWITCH REQUIRED ONLY WHEN OPTIONAL GENERATOR SET REMOTE ANNUNCIATOR PANEL IS PROVIDED. (FOR GENERATING INDICATION)

NOTE D: GROUND MPU SHIELDED CABLE AT GENSET STATUS CONTROL MODULE MOUNTING STUD ONLY.

NOTE E: REFER TO 5N-9532 CHART FOR WIRE IDENTIFICATION CODES.

NOTE F: CONNECT CONTROL PANEL HARNESS WIRE NO. 80 TO TERMINAL NO. 6 ON THE VOLTAGE REGULATOR. REMOVE THE JUMPER BETWEEN VOLTAGE REGULATOR TERMINALS 4 AND 7. CONNECT CONTROL PANEL HARNESS WIRE NO. 82 TO TERMINAL NO. 7 ON THE VOLTAGE REGULATOR.

NOTE G: VARIOUS CUSTOMER SWITCHES CAN BE ACCOMODATED FOR INTERFACE WITH VARIOUS OPTIONAL ALARM MODULES PROVIDED IN THE GENERATOR CONTROL PANEL.

NOTE H: MOUNT CURRENT TRANSFORMERS WITH POLARITY MARK FACING GENERATOR.

NOTE J: GROUND MPU SHIELDED CABLE AT GOVERNOR CONTROL MOUNTING SCREW/STUD ONLY.

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
Setpoint Programming - OP5					
P01			Fuel Solenoid Type	0 = ETR, 1 = ETS	0
P02			Units Shown	0 = Eng, 1 = metric	0
P03			Shutdown Override For Engine Fault	0 = shutdown, 1 = alarm	0
P04			Shutdown Override For Sensor Fault	0 = alarm, 1 = shutdown	0
P05			Coolant Loss Sensor	0 = w/o sensor, 1 = w/sensor	0
P06			Shutdown Override For Coolant Loss Fault	0 = shutdown, 1 = alarm	0
P07			System Voltage	0 = 24 volts, 1 = 32 volts	0
P08			Upper Display	0 = enable, 1 = disable	0
P09			Ring Gear Teeth	95 to 350 teeth	136 teeth
P10			Engine Overspeed	500 to 4330 rpm	2120 rpm
P11			Crank Terminate Speed	100 to 1000 rpm	400 rpm
P12			Oil Step Speed	400 to 1800 rpm	1350 rpm
P13			Low Oil Pressure Shutdown At Rated Speed	34 to 420 kPa (5 to 60 psi)	205 kPa (30 psi)
P14			Low Oil Pressure Shutdown At Idle Speed	20 to 336 kPa (3 to 50 psi)	70 kPa (10 psi)
P15			High Water Temperature Shutdown	94 to 123°C (201 to 253°F)	107°C (225°F)
P16			Low Water Temperature Alarm	0 to 36°C (32 to 97°F)	21°C (70°F)
P17			Total Cycle Crank Time	5 to 120 seconds	90 seconds
P18			Cycle Crank Time	5 to 60 seconds	10 seconds
P19			Cooldown Time	0 to 30 minutes	5 minutes
P20			AC Voltage Full Scale	150V to 18.0kV	700V
P21			AC Current Full Scale	75A to 4000A	600A
P22			GSC Engine Number	01 to 08	01
P23			Engine Type	0 = MUI diesel, 2 = EUI diesel, 1 = spark ignited	0
P24			Crank Time Delay	0 to 20 seconds	5 seconds
Spare Input/Output Programming - OP6					
SP01			Spare Fault 1 Active State	0 = Low, 1 = High	0
SP02			Spare Fault 1 Response	0 = Shutdown, 1 = Alarm	0
SP03			Spare Fault 2 Active State	0 = Low, 1 = High	0
SP04			Spare Fault 2 Response	0 = Shutdown, 1 = Alarm	0
SP05			Spare Fault 3 Active State	0 = Low, 1 = High	0
SP06			Spare Fault 3 Response	0 = Shutdown, 1 = Alarm	0
SP07			Spare Output Active State	0 = Low, 1 = High	0
SP08			Spare Fault 1 Delay Time	0 to 250 seconds	0 seconds
SP09			Spare Fault 2 Delay Time	0 to 250 seconds	0 seconds
SP10			Spare Fault 3 Delay Time	0 to 250 seconds	0 seconds
SP11			Spare Output Response	See Service Manual	7 = cooldown
Voltmeter/Ammeter Programming - OP8					
AC01			A-B Voltage Calibration	0 to 255	NA [2]
AC02			B-C Voltage Calibration	0 to 255	NA [2]
AC03			C-A Voltage Calibration	0 to 255	NA [2]
AC04			A Current Calibration	0 to 255	NA [2]
AC05			B Current Calibration	0 to 255	NA [2]
AC06			C Current Calibration	0 to 255	NA [2]

This table provides a record of setpoint values for a singular genset. The table is intended to be an easy reference for future servicing or troubleshooting of a particular genset.

[1] The actual value space is provided for recording and comparing values during future servicing or troubleshooting of the particular genset.

[2] The default value is not applicable (NA). A random value is assigned to the setpoint when a GSC internal memory fault (CID 268) occurs.

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