CATERPILLAR®

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Service Manual

Caterpillar Switchgear

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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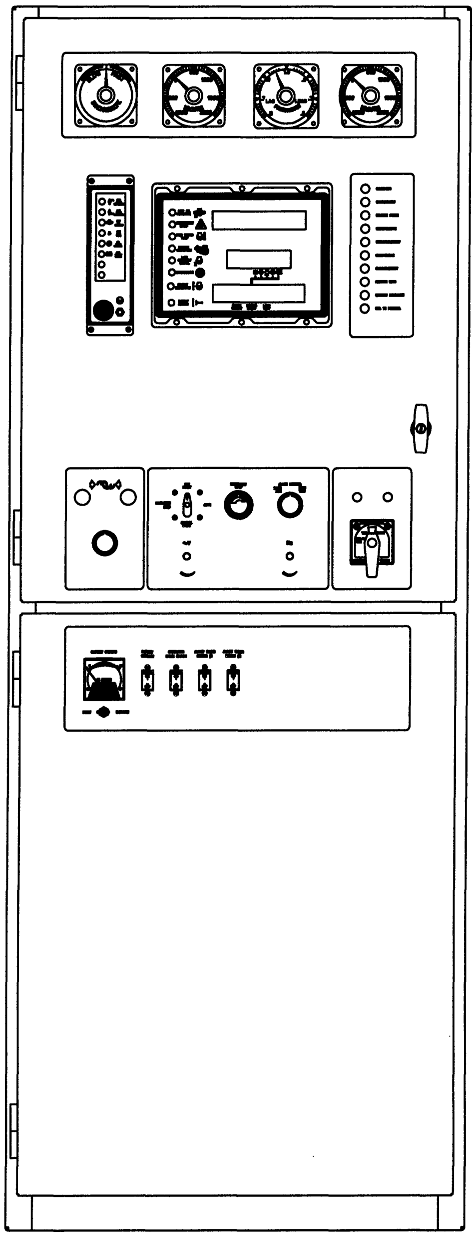
Systems Operation



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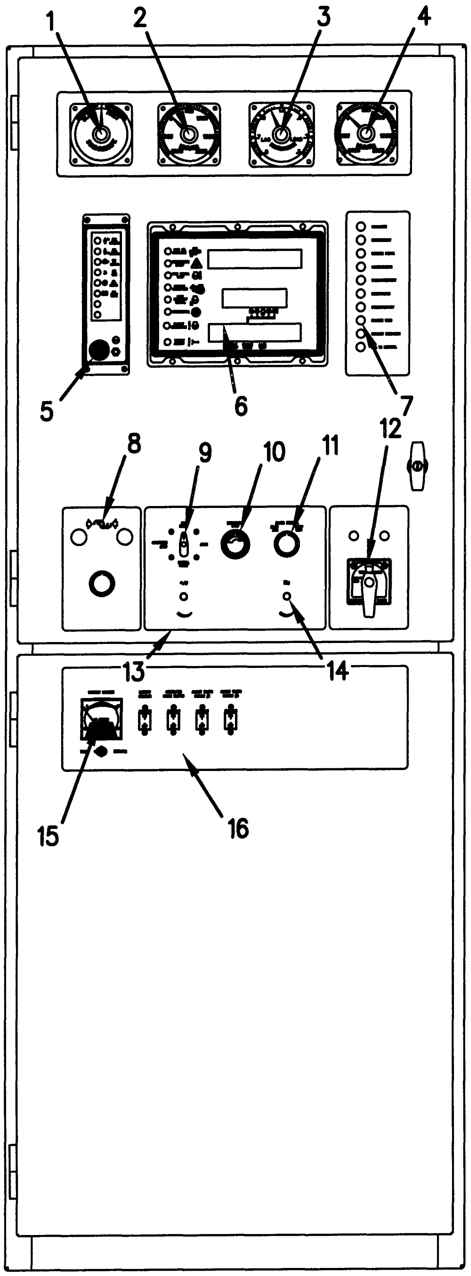
Standard floor-standing switchgear units incorporate a comprehensive system of components for generator set control, monitoring and protection. This system's approach to genset management results in unsurpassed reliability, capability and performance for many applications.

Switchgear includes:

- Caterpillar EMCP II Controls
- Fix-mounted Circuit Breaker
- Governor Controls
- NEMA 1 Floorstanding Enclosure

All these "standard" features-and the many functions they represent-are conveniently housed in a NEMA 1 cabinet for indoor use. The cabinet is fabricated with steel barriers between power and control sections.

Location of Components

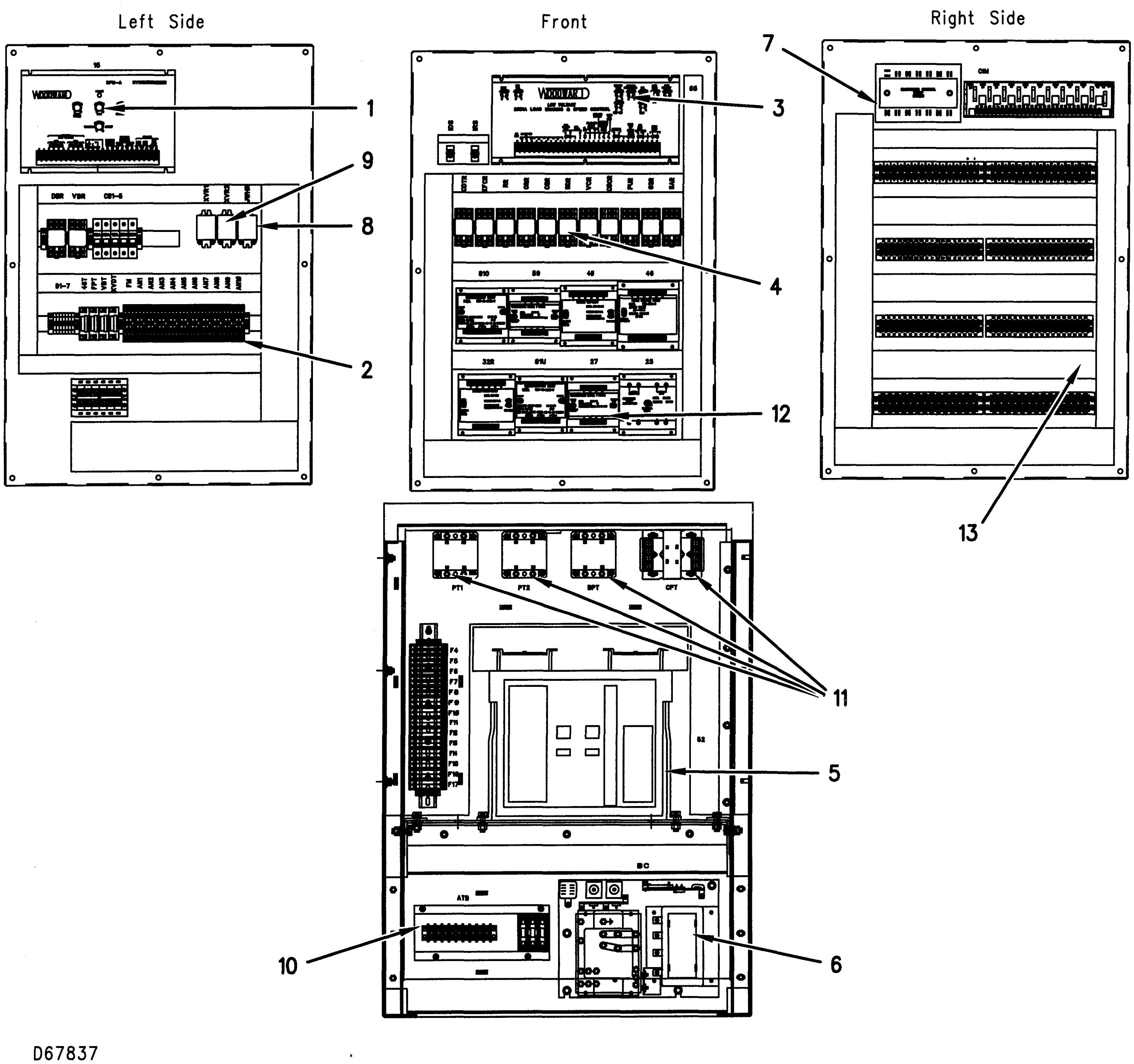


(1) Synchroscope (optional) (2) Killowatt Meter (optional) or Killowatt Hour Meter (optional) (3) Power Factor Meter (optional) (4) Kilovar Meter (optional) (5) Alarm Module (6) Generator Set Controller (7) Status Lamps (optional) (8) Synchronizing Switch & Lights (optional) (9) Engine Control Switch (10) Emergency Stop Button (11) Alarm Control Switch (12) Breaker Control Switch (optional) (13) Speed Adjust Rheostat (14) Voltage Adjust Potentiometer (15) Battery Charger Controls (optional) (16) Accessory Circuit Breakers (optional)

The Caterpillar Switchgear unit depicted on this page shows the location of externally facing components. They are:

- Generator Set Control (GSC)
- Alarm Module
- Alarm Control Switch
- Voltage Adjust Rheostat
- Engine Control Switch
- Emergency Stop Push-Button
- Speed Adjust Potentiometer
- Synchroscope*
- Synchronizing Switch & Lights*
- Kilovar Meter*
- Kilowatt Hour Meter*
- Power Factor Meter*
- Breaker Control Switch*
- Battery Charger Controls*
- Accessory Circuit Breakers*

* OPTIONAL



(1) Auto Synchronizer (optional) (2) Annunicator Modules (3) Electronic Governor (optional) (4) Control Relays (5) Insulated Case Circuit Breaker (6) Battery Charger (optional) (7) Customer Interface Module (optional) (8) Jacket Water Heater Cntrl Circuit (optional) (9) General Strip Heater Cntrl Circuit (optional) (10) AC Transformer Box (11) Potential Transformer (12) Protective Relays (13) Customer Connection Points

Inside the cabinet, you will find these components and subsystems:

- Synchronizing/Paralleling Features*
- Annunicator Modules
- Electronic Governor*
- Control Relays
- Insulated Case Circuit Breaker
- Battery Charger*
- Customer Interface Module*
- Jacket Water Heater Cntrl Circuit*
- General Strip Heater Cntrl Circuit*
- AC Transformer Box
- Potential Transformer
- Protective Relays

  * OPTIONAL

Main Components

The main components of Caterpillar Switchgear units are the Generator Set Controller, Instrument Panel Switches and the Circuit Breaker.

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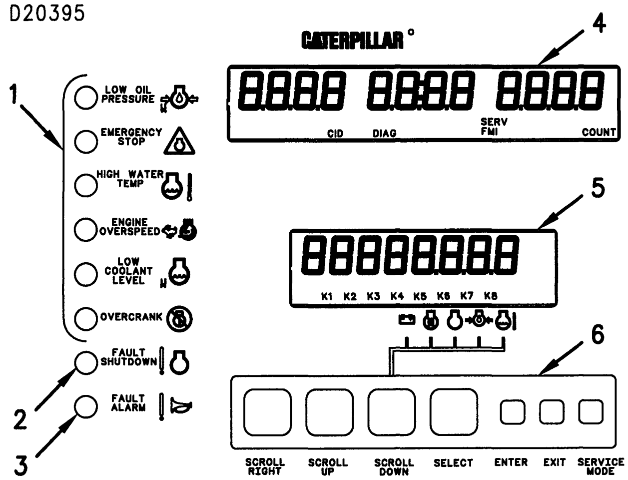


GSC Display Area With Service Mode Descriptions Of Keypad
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

Caterpillar's Electronic Modular Control Panel II (EMCP II) is at the core of switchgear operations. In turn, the EMCP II has as its main component 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 in 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 over-speed, 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 setpoint 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.

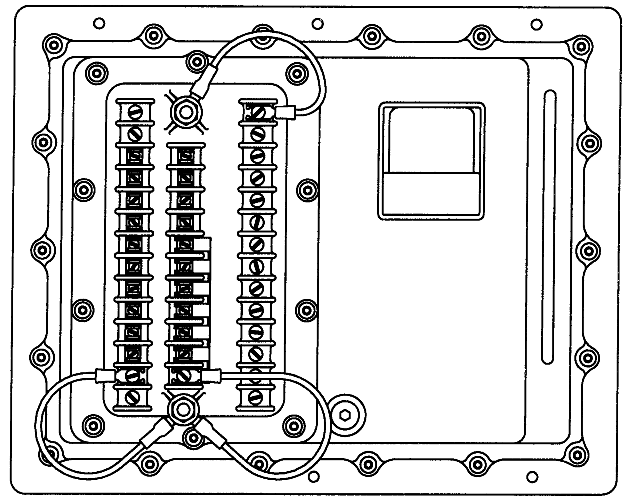
Lamp Test Key - Performs a lamp test on the GSC and the optional alarm module. On the GSC: the eight fault indicators are ON CONTINUOUSLY, every segment of upper display (4) and lower display (5) are ON. On the optional alarm module: all of the indicators are ON and the horn sounds.

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



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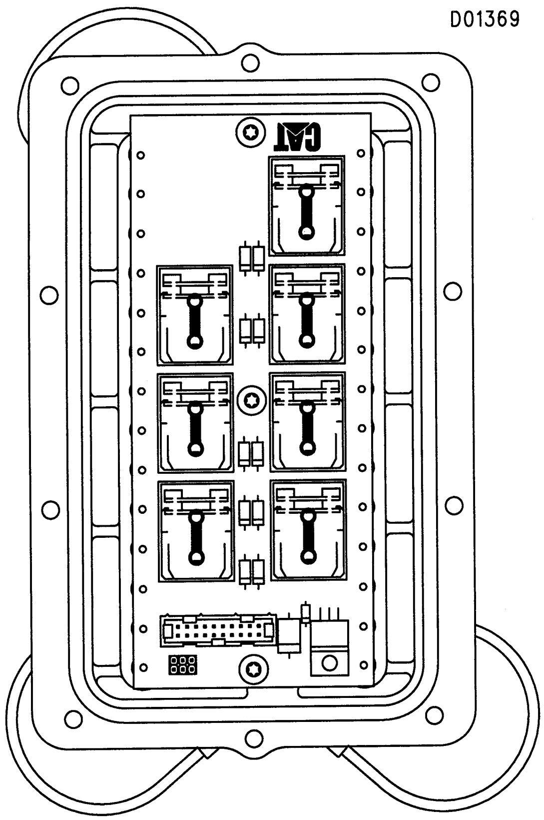
Relay Module On Rear Of GSC



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**
13, 14	1A at 24DCV	none [1]
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

[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. This enables the optional start aid switch for all engine models except 3500.

K4 - Starting Motor Relay (SMR):

When the relay is active the normally open contacts close. This activates the starting motor magnetic switch and enables the automatic position of the optional start aid switch for 3500 engines.

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 and activates the manual position of the optional start aid switch for 3500 engines.

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

K6 - Air Shutoff Relay (ASR):

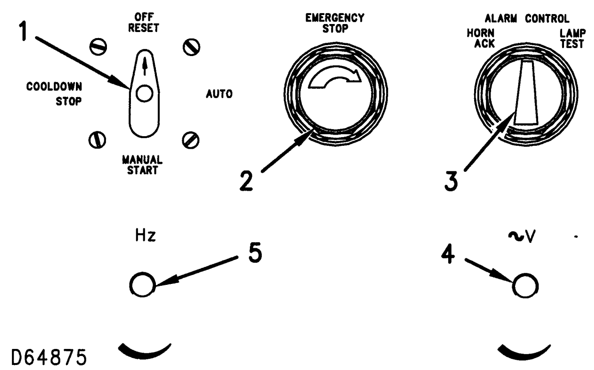
When the relay is active the normally open contacts close. This activates the optional air shutoff solenoid during fault shutdowns.

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. On ETS systems, this activates the fuel solenoid during shutdown.

The relay has no normally closed contacts.

Instrument Panel Switches

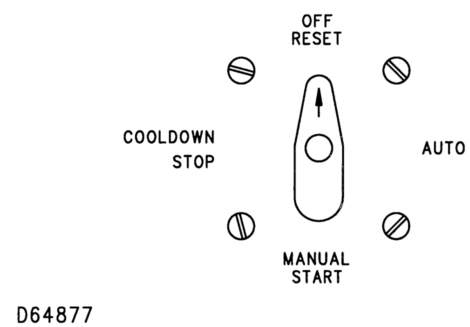


(1) Engine Control Switch (2) Emergency Stop Push Button
(3) Alarm Control Switch (4) Speed Adjust Potentiometer
(5) Voltage Adjust Rheostat

There are five Instrument Panel Switches.

- Engine Control Switch (ECS)
- Emergency Stop Push-Button
- Voltage Adjust Rheostat (VAR)
- Speed Adjust Potentiometer (SAP)
- Alarm Control Switch (ACS)

Engine Control Switch

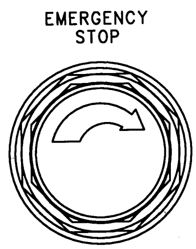


(1) Off/Reset (2) Automatic Start (3) Manual Start
(4) Cooldown/Stop

The Engine Control Switch (ECS) is used to manually control the engine by selecting the status of the control panel. The selected position connects the corresponding input of the GSC to battery negative (B-). There are four possible positions:

- OFF/RESET causes the engine to shutdown immediately and the GSC is reset. Any fault indicator (except Emergency Stop) clears.
- AUTO directs the engine to start automatically when the remote initiating Contact (IC) closes. The engine starts and runs normally until the remote IC opens. A programmable cooldown time gives a 0 to 30- minute "cooldown" before the engine shuts off. Factory default is set at 5 minutes. Faults show on the upper display and on the fault indicators as they occur.
- MANUAL START lets the engine start and run as long as the ECS is in this position. The engine stops when the operator turns the ECS to OFF/RESET or COOLDOWN/STOP.
- COOLDOWN/STOP causes the fuel solenoid to shut the engine down after cooldown. This cooldown period is programmable from 0 to 30 minutes. During cooldown, the engine maintains rated speed. The circuit breaker is tripped open when the ECS is placed in cooldown, unless the unit is configured for "Standby Mode With Transfer Switch". (See Jumper Set-up)

Emergency Stop Push-Button



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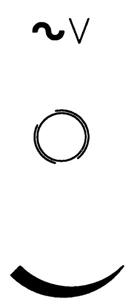
Red Emergency Stop Push Button

The Emergency Stop Push-Button (ESPB) brings genset operations to an immediate halt. If the red Emergency Stop Push Button (ESPB) is pressed, the fuel is shut off. At the same time, Air Shutoff (if equipped) is activated and the generator circuit breaker is tripped open..

To restart:

(1) Turn the Emergency Stop button clockwise until it releases.
(2) Turn the Engine Control Switch to OFF/RESET.
(3) Turn the ECS to START.

Voltage Adjust Regulator



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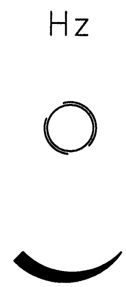
Voltage Adjust Regulator

Use the Voltage Adjust Regulator (VAR) to adjust the generator voltage to the desired level. Turn the VAR clockwise to increase voltage, counterclockwise to decrease voltage.

Speed Adjust Potentiometer



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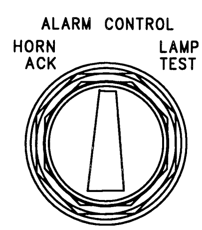
The Speed Adjust Potentiometer (SAP) controls an electronic governor to adjust engine speed. Turn the SP clockwise to increase speed, counterclockwise to decrease speed.

Alarm Control Switch



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The Alarm Control Switch silences the horn when turned left to HORN ACK. Turn it to the right to LAMP TEST and check operation of the warning lights.

Circuit Breaker

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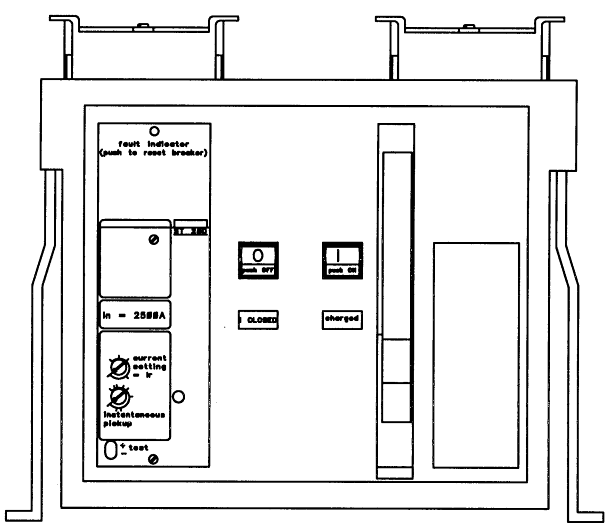

Circuit breakers are offered in nine frame sizes, from 400 to 3000 amperes.

Circuit breakers provide protection between the genset and the load line. All have both short circuit and overload trip units. Overload trips are the inverse-time type-the higher the current, the faster they open. All are solid-state adjustable. Generally the short circuit trip adjusts from 2.5 to 10 times the circuit breaker rating. The overcurrent trip adjusts from 70 to 100% of circuit breaker rating. Frame sizes include: 400, 600, 800, 1000, 1200, 1600, 2000, 2500 and 3000 amperes. Molded case circuit breakers are provided for manual paralleling and non paralleling applications. Insulated case circuit breakers are provided for semi-automatic and automatic paralleling.

Jumper Set-up

Wire jumpers are used to configure the switchgear for specific applications.

1. Standby mode with Transfer Switch:

Normally the circuit breaker is automatically tripped open whenever the engine is shutdown or in the cooldown mode. For manual circuit breakers operating with a transfer switch it is desirable for the breaker to remain closed before, during, and after a normal operating cycle. In order to accomplish this remove the wire jumper connected from TP (Terminal Point) 91 to TP 92 AND remove the wire jumpers connected from GSC Relay Module terminal 23 to GSC Relay Module terminal 22.

Refer to the schematics shipped with your switchgear to determine the exact configuration of the switchgear.

2. Lead Unit Jumpers

In a multiple unit line-up equipped with automatic paralleling precautions must be taken to prevent two generator sets circuit breakers from simultaneously closing to a "dead" load bus. This is accomplished by placing a jumper from TP (Terminal Point) 93 to TP 94 of the "Lead Unit." Only one generator control section can have this jumper installed in the line-up. Additional units are interconnected in "series" from TP 95 to TP 94. Lead unit TP 95 is connected to the next unit's TP 94. The final unit's TP 95 is connected to the lead unit's TP 94. In the event of a failure of the Lead unit to energize the load bus before it is shutdown by "Failure to Parallel" or other failure the next unit will be enabled to close to the dead bus. When a multiple unit line-up is used with automatic paralleling each unit's FPT (Fail to Parallel Timer) should be set longer than the previous unit.

For any circuit breaker to close automatically DC battery power must be on in the lead unit control section, but the lead unit does not have to be started. If the lead unit is not started the next running unit in the interconnect circuit will be enabled to close to the dead bus. If the lead unit is to be disabled and battery power removed the lead unit jumper must be disconnected and replaced in a different control compartment.

When the lead unit (or other unit) does close to a dead bus all running units will automatically synchronize and parallel with the load bus.

Refer to the schematics shipped with your switchgear to determine the exact configuration of the switchgear.

GSC 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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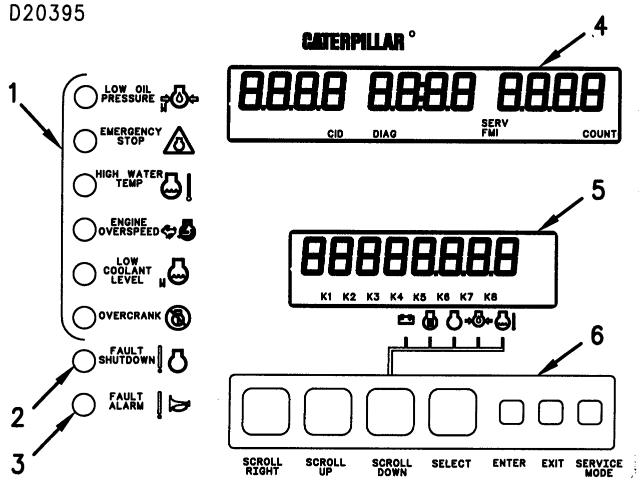

GSC Display Area With Service Mode Descriptions Of Keypad
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

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

4. The GSC activates the fuel control relay (FCR) for ETR fuel systems or the GSC leaves the fuel control relay (FCR) deactivated for ETS fuel systems.

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

6. While the starting motor is cranking, the GSC shows the status of the relays on the relay status indicators of the lower display.
   K4, K5, K7 for ETR fuel systems.
   K4, K5 for ETS fuel systems.

7. 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).

8. 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.

9. 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.

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. 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.

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.

5. 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.

6. 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.
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 air shutoff relay (ASR) 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 air shutoff relay (ASR) for 15 seconds. (The ASR 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

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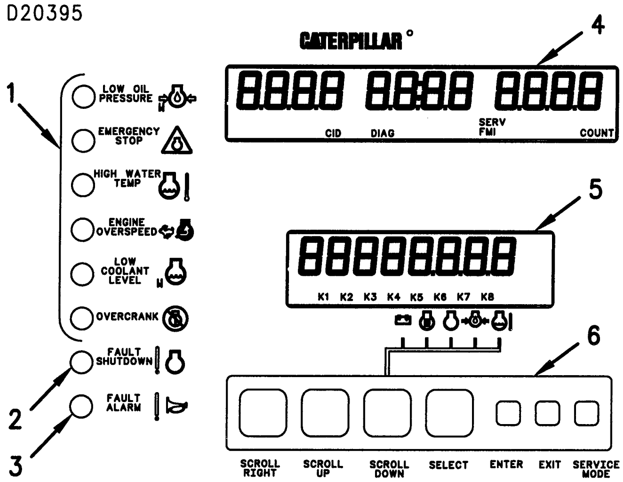


GSC Display Area With Service Mode Descriptions Of Keypad
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower display. (6) Keypad.

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 103-1582 Control Panel Chart (packaged within 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: Some changes have occurred to the identity and the quantity of setpoints:

P08 is engine type (0 = diesel, 1 = spark ignited) on former 103-6177, 113-4500 and 117-6200 GSC's.
P22, P23 and P24 are not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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– – – – –" with the second dash flashing is showing.

6. Press SCROLL DOWN key. "PE – – – – –" 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. Go 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". Go 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

NOTE: Some changes have occurred to the identity and the quantity of setpoints:
   P08 is engine type (0 = diesel, 1 = spark ignited) on former 103-6177, 113-4500 and 117-6200 GSC's.
   P22, P23 and P24 are not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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

Programming of some setpoints requires that model number of the EMCP II is known. The model number is located on the name plate which is on the inside bottom of the control panel. The model number is based on panel options and generator ratings and is explained in print 103-1582 which is included within the EMCP II. The information on print 103-1582 is necessary for programming the setpoints of the GSC. The model number has seventeen characters and is similar to "EB3CAS3A1BDSP1CE0".

NOTE: For the correct setpoints, always check print 103-1582 that is included within the EMCP II.

P01 - Fuel Solenoid Type: This setpoint tells the GSC the type of fuel system solenoid used on the genset. The 6th character of the model number specifies this setpoint. The factory default is 0. The values are:

0 - for an energize to run (ETR) fuel solenoid.
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 16th character of the model number specifies this setpoint. 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 customer or application specifies this setpoint. 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 customer or application specifies this setpoint. 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 15th character of the model number specifies this setpoint. 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 customer or application specifies this setpoint. 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 application specifies this setpoint. 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 the upper display. The application specifies this setpoint. The factory default is 0. The values are:

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

NOTE: P08 is engine type (0 = diesel, 1 = spark ignited) on former 103-6177, 113-4500 and 117-6200 GSC's.

P09 - Ring Gear Teeth: This setpoint tells the GSC the number of teeth on the ring gear of the engine. The 7th character of the model number specifies this setpoint. The application specifies this setpoint. 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 5th character of the model number specifies this setpoint. 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 5th character of the model number specifies this setpoint. 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 5th character of the model number specifies this setpoint. 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)**
3600	1000	755
	900	655
	750	555
	720	535
3500	1000 - 1300	808
	1500 - 1900	1208
3400 with 113 flywheel teeth [1]	1000 - 1600	761
	1750 - 1800	1136
	1900 - 2100	1261
3400 with 136 flywheel teeth	1000 - 1200	759
	1500	1134
	1800 - 2100	1359
3300	1400 - 1800	1133
	2000 - 2200	1258
3208	1500 - 2800	1334
3116	1500 - 2800	1334
3114	1500 - 2800	1334

[1] Exception: For 3412 engines with 113 flywheel teeth and a rated speed of 1500 or 1600 rpm, the oil step speed is 1360 rpm.

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 5th character of the model number specifies this setpoint. 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.

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 5th character of the model number specifies this setpoint. 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.

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 5th character of the model number specifies this setpoint. 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.

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 customer or application specifies this setpoint. 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 customer or application specifies this setpoint. The factory default is 90 seconds. The value is selectable from 5 to 120 seconds in increments of one second.

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 customer or application specifies this setpoint. The factory default is 10 seconds. The value is selectable from 5 to 60 seconds in increments of one second.

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 customer or application specifies this setpoint. 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 application specifies this setpoint. 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 scale (maximum) AC current of the genset. The GSC measures the AC current and shows it on the display. The 4th character of the model number specifies this setpoint and the required external current transformer. The values are: 75A, 100A, 150A, 200A, 300A, 400A, 600A, 800A, 1000A, 1200A, 1500A, 2000A, 2500A, 3000A and 4000A. The factory default is 600A.

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

NOTE: P22 is not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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 application specifies this setpoint. The factory default is 0. The values are:

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

NOTE: P23 is not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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 application specifies this setpoint. The factory default is 5 seconds. The value is selectable from 0 to 20 seconds in increments of one second.

NOTE: P24 is not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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.
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. For the correct setpoints, check print 103-1582 that is included within the EMCP II. 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. Spare faults that are programmed to shutdown are ignored by the GSC when engine speed is less than crank termination speed. 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

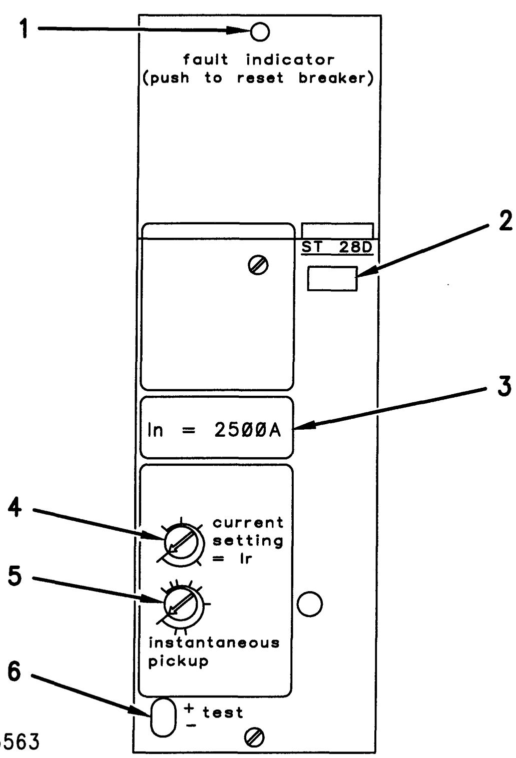
Then the signal that is being received by the GSC from the engine speed sensor (CID is 190) is too high (FMI is 3) at this time ("DIAG" is FLASHING).

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.

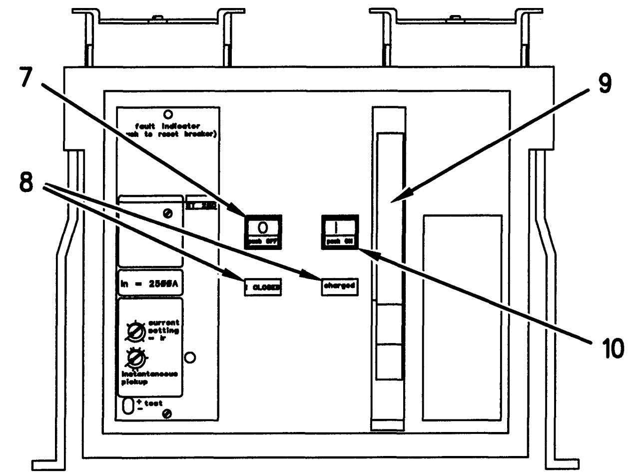
After a diagnostic fault is investigated and/or corrected, clearing it from the fault log will avoid confusion during a future service call. When all diagnostic faults are cleared from the fault log and no active diagnostic faults exist the "DIAG" indicator is OFF (absent). See Fault Log Clearing OP4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

Circuit Breaker Operation



D65563

D65564



(1) Fault trip indicator reset button. (2) Sensor rating. (3) Rating plug. (4) Long time current selector. (5) Instantaneous setting. (6) Test points. (7) Manual opening pushbutton. (8) Status & stored energy windows. (9) Charging handle. (10) Manual close pushbutton.

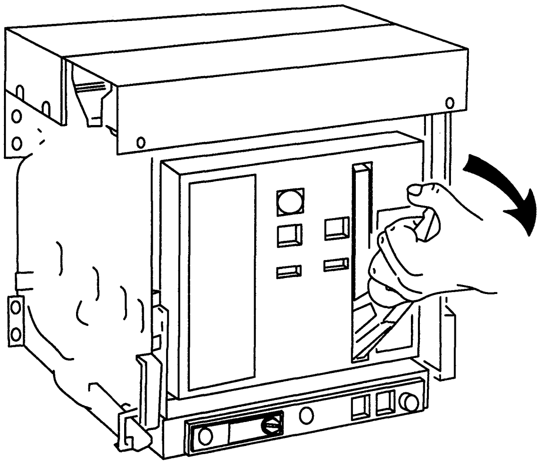
⚠ WARNING

Electrical shock can result in serious injury or death. Circuit breaker operation and servicing should be attempted only by qualified personnel familiar with the breaker unit and the switch-gear.

The Switchgear Circuit Breaker is designed to open and close the power circuit. During normal operation, the operator closes and opens the circuit breaker to energize and de-energize the connected load. During fault or overload conditions, the trip unit automatically opens the breaker. Under overcurrent conditions, the breaker automatically opens to protect the generator.

All basic breaker operations can be performed from the front of the circuit breaker.

Manual Charging



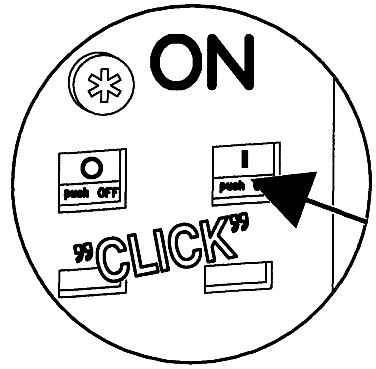
D69403

The breaker has multiple CHARGE-CLOSE provisions which permit this possible operating sequence:

CHARGE-CLOSE
RECHARGE-OPEN
CLOSE-OPEN

To manually charge the breaker, pull down on the charging handle. Pump the handle up and down for six or seven full strokes. When the spring is charged, a yellow "charged" indicator will appear in the stored energy window. For systems with electrically operated circuit breakers, the circuit breaker is automatically charged by generator power.

Closing the Breaker



D69404

To close the breaker, push the mechanical "close" button. The breaker can only be closed when these conditions exist:

•Breaker is Open.

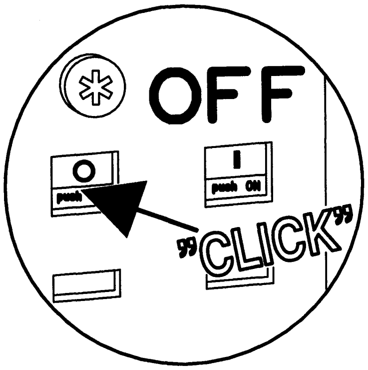
•Yellow Stored Energy Window Reads "Charged"

•Pop-out-type Fault Indicator has been Correctly Restored.

•No Tripping has been Ordered.

Electrically operated circuit breakers are closed by turning the circuit breaker control switch to the "closed" position, when conditions are correct for closing the circuit breaker.

Opening the Breaker

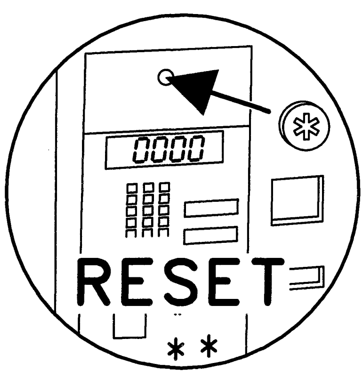


D69405

To open the breaker, push the mechanical "open" button.

Breakers may be opened remotely through a shunt trip. The shunt trip is operated by any engine fault or optional components such as circuit breaker switch and protective relays.

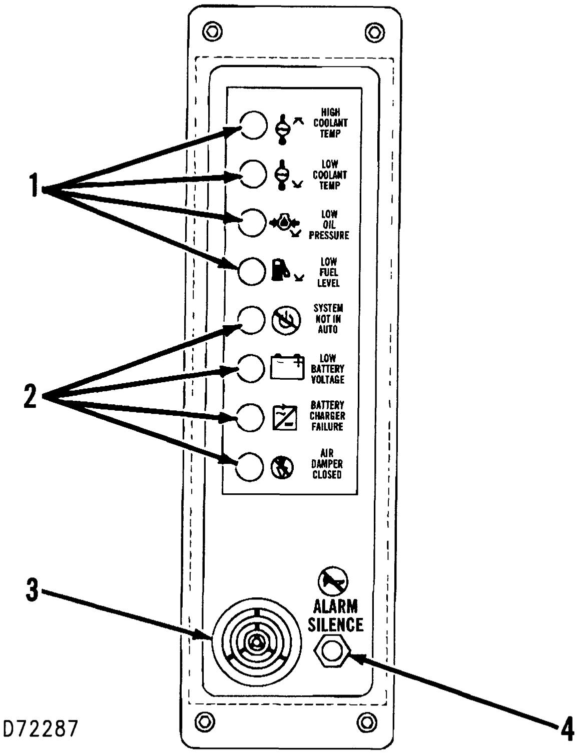
Resetting the Breaker



D69406

To reset the breaker after an over-current fault, push the fault trip reset button at the top of the control panel. In instances where the tripping is due to an overcurrent, the fault must be cleared before any attempt at resetting can be made.

Alarm Modules



D72287

Alarm Module (NFPA 110 ALM)
(1) Amber LED's. (2) Red LED's. (3) Horn.
(4) Acknowledge/silence switch.

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 (3) is the audible indicator. The ALM is designed to operate when powered by only 24 DCV or 32 DCV battery systems.

There are four 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.

The only differences 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 also has 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).

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
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
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
3 Amber	Low Oil Pres Alarm LI,H,LAT	Low Oil Pres Alarm LI,H,LAT	Charger Malfunction SW(4),TIM	Low Oil Pres Alarm LI,H,LAT	Low Oil Pres 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
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
6 Red	Low DCV INT,TIM	Low DCV INT,TIM	Low Oil Pres Shutdown [1] LI,H	Spare SW(3)	Low DCV INT,TIM
7 Red	Spare SW(3)	Charger Malfunction SW(4),TIM	Overcrank Shutdown [1] LI,H	Not Used	Spare SW(3)
8 Red	Spare SW(4)	Air Damper Closed [2] SW(3),H	Overspeed Shutdown [1] LI,H	Not Used	Spare SW(4)
	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.

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). 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.

Acknowledge/Silence

Activating the acknowledge/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 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)

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

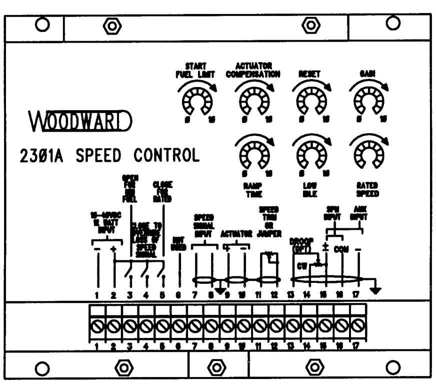
The annunciator module operates in one of the five modes described in Table 2. The modes are selected by connections made to the mode select inputs (terminals 5 and 6) and switch 2 input (terminal 9) as shown in Table 2.

Electronic Governors

Caterpillar Switchgear is fitted with an electronic governor that controls the genset's engine speed, maintaining accurate power output levels.

Four different speed controls or combinations of controls are offered, depending on the engine and the application.

2301A Speed Control



D65572

The 2301A Speed Control is part of the basic 3500A engine package. It controls the engine speed. The system includes:

- A magnetic pickup (MPU) to sense the speed of the engine, generating a AC signal proportional to the speed.
- A frequency-to-voltage converter to convert the MPU AC signal to proportional DC voltage for use in the 2301A internal circuits.
- A speed reference circuit to generate a DC reference voltage to which the speed signal voltage can be compared. The idle and rated speed references are switch-selectable by the operator.
- A speed summer/amplifier with an output proportional to the amount of fuel required to maintain the reference speed at any given load.
- An actuator to position the diesel engine's injector rack.
- And, an external 20 to 45 DCV power source.

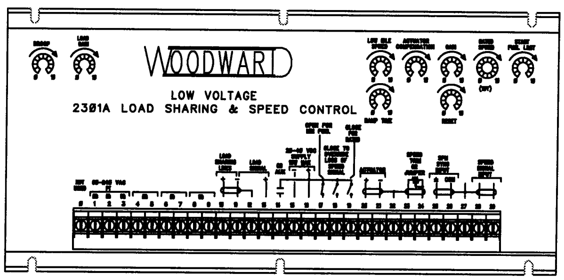
If the speed-signal voltage (compared at the summing point) is lower or higher than the reference voltage, a signal is sent by the control amplifier to increase or decrease the speed. The actuator controlled by this signal repositions the fuel valve until the speed-signal and reference voltages are equal.

The 2301A is designed for functioning in the isochronous mode, holding engine speed constant-as long as load levels can be maintained. Droop control is possible through an externally wired potentiometer. The droop potentiometer is not provided as part of the switchgear.

The control is housed in a sheet metal chassis which is mounted at the top of the switchgear sub-panel. A speed adjust potentiometer is mounted on the switchgear door.

For specific operating, adjusting and maintenance information, see the 2301 Speed Control Manual included with the Switchgear.

2301A Load Sharing & Speed Controls



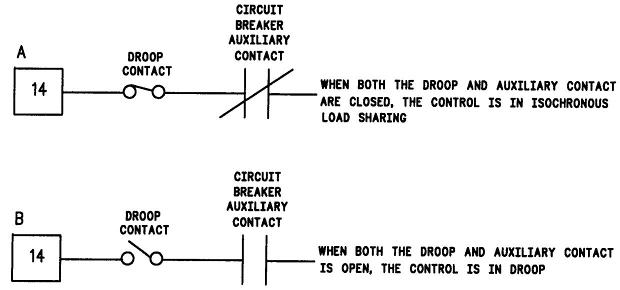
D65575

For multiple genset applications, the 2301A Electronic Load Sharing and Speed Controls package is available with 3500A generator sets. In addition to 2301A functions previously mentioned, the load sharing control facilitates operating two or more gensets in parallel.

This control senses the load carried by the generator. It then shares the load with other systems running in parallel. Two parallel methods can be used: isochronous or droop.

The Isochronous Method

Isochronous paralleling maintains a constant engine speed. The governor operates in the isochronous mode when the generator circuit breaker is closed and the isochronous/droop switch is in the isochronous position.



D77818

With only one unit on line, the genset picks up all of the load and remains at the isochronous speed. With additional units on line, the load matching circuit corrects the fuel output to proportion the load between the connected units.

Load sharing is adjusted by the LOAD GAIN potentiometer on the 2301A Load Sharing Governor. By setting the load-gain voltage on each unit to the same level at full load, proportional load sharing is achieved.

Even if generator set capacities are different, each will be loaded to the same percentage of its capacity. Final adjustment of the individual LOAD GAIN pots will compensate for minor differences in the gensets.

The Droop Method

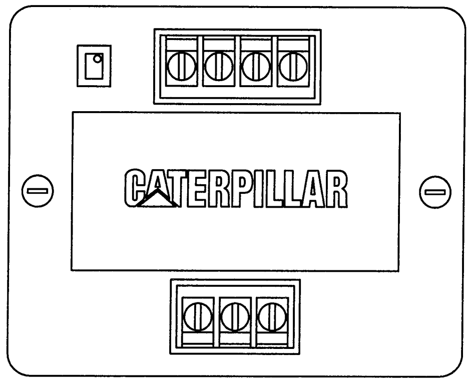
Droop paralleling changes the engine speed as the load on the generator changes. An increase in load causes a decrease in engine speed. The amount of this change is called “droop”. Measured as a percentage, this function is adjusted by the DROOP potentiometer located left of the LOAD GAIN potentiometer.

If either the generator circuit breaker is open or the isochronous/droop switch is in the droop position, the control is in the droop mode.

Operator controls for the 2301A Load Share Governor include the speed adjustment potentiometer, idle/rated speed switch and an isochronous/droop switch.

See the 2301A Electronic Load Sharing & Speed Controls manual for specific information about operation, calibration and troubleshooting.

ADEM Speed Control



D64892

Pulse-width modulator

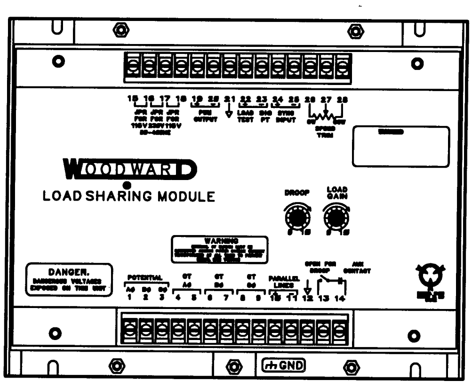
Caterpillar's ADEM II Electronic Control Module is the speed control device for the 3500 B engine generator set.

ADEM stands for: "Advanced Diesel Engine Management". This state-of-the-art computer centered ECM does more than govern the engine. Among other things, it controls injection timing, computes system diagnostics and originates data link communication.

The ADEM's microprocessor receives instructions from software stored in the "personality module". Parameter values are set to factory defaults, but can be programmed to match site-specific applications.

A pulse-width modulator and speed adjustment potentiometer are supplied as part of the engine arrangement. Both are installed in the switchgear. For further information, see the ADEM II operator's manual.

Load Sharing Module With ADEM Speed Control



D64894

The ADEM II governor must be linked to the Load Sharing Module for multiple generator sets using the Caterpillar 3500B engine.

This load sharing module replaces the pulse width modulator in the standard ADEM equipped arrangement. This permits droop load-sharing and isochronous parallel operations. Operator controls include the speed adjustment potentiometer and isochronous/droop switch.

Functions are similar to those covered under "2301A Load Sharing/2.e.2". See the Woodward Load Sharing Module manual for further information.

Optional Accessories

Optional accessories include Manual, Semi-Automatic and Automatic Paralleling. One of these option packages must be chosen for synchronizing and paralleling gensets.

Other optional accessories are: protective relays, meters, Digital Voltage Regulator (DVR) annunciator, control circuits for jacket water heater and generator strip heater, Customer Interface Module (CIM), Customer Communication Module (CCM) and Battery Charger.

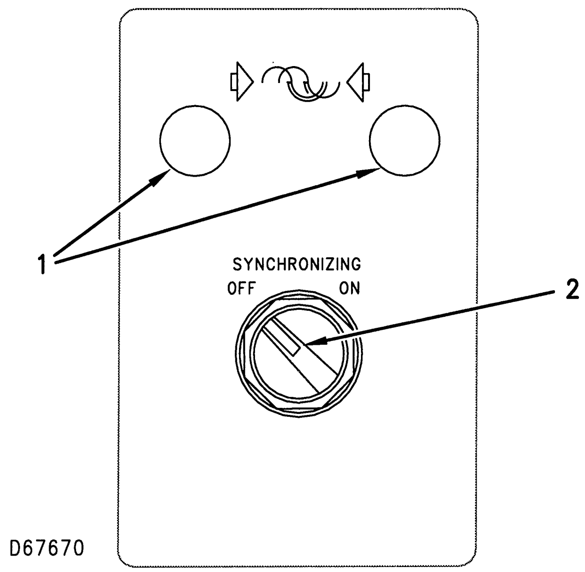
Manual Paralleling Option

This Switchgear option includes a reverse power relay, ANSI device 32 synchronizing lights and synchronizing switch. Understanding how sync lights are used in Manual Paralleling, requires an overview of the procedure.

First, all units to be paralleled must conform to these conditions:

- Same phase rotation.
- Same voltage level.
- Same voltage droop.
- Same AC frequency.
- Generator and bus voltages in phase.

Synchronizing Lights



(1) Synchronizing lights. (2) Synchronizing On/Off switch.

Units can be paralleled manually using optional Synchronizing Lights located at the lower left of the control panel.

This function can be accomplished under load or no-load conditions. The lights are used to check synchronization of the generator and load bus.

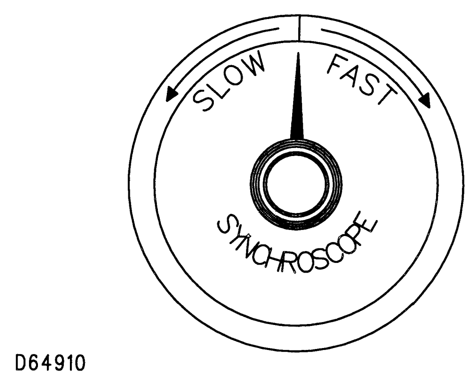
The two lights are connected across the generator circuit breaker from the generator side to the load side. As the generator phase matches the load bus the lights go dim.

For generator set protection, a Reverse Power Relay is included. If an engine loses power, the relay senses incoming power from other units in parallel attempting to motorize the failed genset. This "reverse" flow of power could result in overload at the other generators and damage to the motored genset. The relay operates to shutdown the engine and take the generator off line by tripping the generator circuit breaker open.

Paralleling Multiple Units

1. Start the unit following normal procedures.
2. Turn the synchronizer lights on from On/Off switch.
3. After the engine runs for a few minutes, match the frequency with the unit on line. The synchronizing lights will blink.
4. Using the governor control, adjust the engine speed until the lights blink very slowly.
5. The frequency of the incoming unit should be slightly greater than the line frequency. This allows the unit to assume some of the load instead of adding it to the system.
6. When the voltages of the two units are in phase, the lights go off. Quickly close the breaker at this time.
7. Use governor controls to share kW load between engines.

Synchroscope

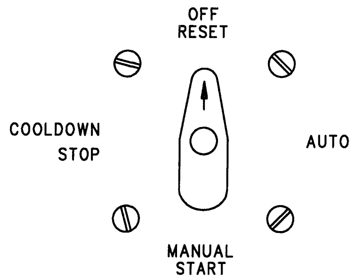


An optional synchroscope provides monitoring of voltage phase utilizing a rotating pointer in proximity to a single scale mark. When the pointer is rotating counter clock-wise, the generator is “slow”. When the pointer is rotating clock-wise, the generator is “fast”. When the pointer is “on the mark”, the genset is matched in phase and frequency with the bus.

The synchroscope can be used IN PLACE of synchronizing lights. But more commonly, the scope is used IN ADDITION to the lights, providing a visual representation of equality of frequency and coincidence of phase on a continuing basis.

The synchroscope can be added to any paralleling package: Manual, Semi-Automatic or Automatic.

Semi-Automatic Paralleling Option



D64877

Semi-Automatic Paralleling is similar to Manual Paralleling with these two major exceptions:

- The circuit breaker is ELECTRICALLY CHARGED AND CLOSED. This precludes manually charging the breaker by pumping the charging handle six or seven times.
- Switchgear adds a Synchronizing Check Relay for PERMISSIVE SUPERVISION of the system. This protective feature prevents gensets from coming on line unless they are "in synch".

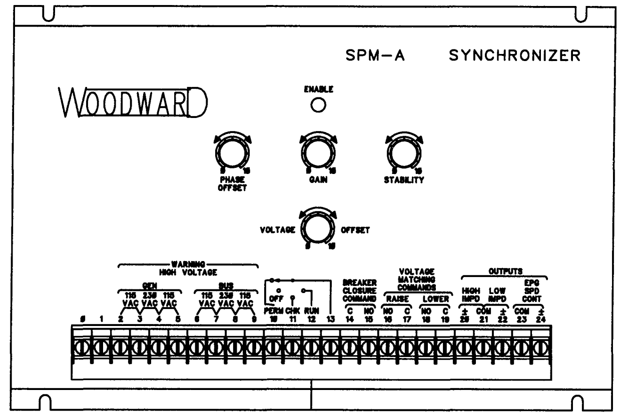
The Semi-Automatic Paralleling option incorporates all manual features along with: the circuit breaker electric operator, circuit breaker control switch and control power transformer for breaker charging and closing.

To close the circuit breaker:

- Start the engine.
- Turn the synchronizing switch on.
- When the synchronizing lights go off, turn the breaker switch to close, the circuit breaker will close.

If load bus is not energized, the circuit breaker will close when the circuit breaker switch is operated.

Automatic Paralleling Option



D67868

Automatic Paralleling is accomplished through control logic and a speed matching synchronizer. The operator is relieved of matching phases and bringing the unit into parallel with the load bus. This is done electronically.

The automatic option includes several additional safeguards:

- In the event of a dead bus, the circuit breaker is automatically closed.
- As part of a multiple unit system, simultaneous closing of two or more circuit breakers to a dead generator load bus is prevented.

The speed-matching synchronizer biases the speed of the off line generator set striving to perfectly match the phase and frequency of the load bus in a parallel system.

Automatic Paralleling Breaker Closing

Manual Operation.

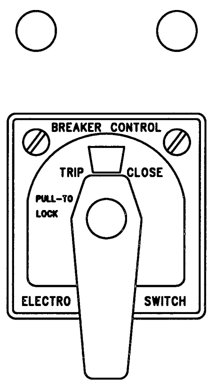
To manually bring the unit on line:

- Turn the ECS Switch set to MANUAL/START to start the engine.
- Turn the Synchronizing Switch to ON.
- When the Synchronizing Lights dim, turn the Circuit Breaker Switch to CLOSE. The unit is now on line.

To take the unit off line:

- Turn the Circuit Breaker Switch to TRIP, opening the breaker.
- Turn the ECS Switch to COOLDOWN/STOP. The engine enters Cooldown and Shutdown phases.

Automatic Operation



D64912

To automatically bring the unit on line:

- Turn the ECS Switch to AUTO.
- Turn the Circuit Breaker Switch to Close. The target area turns RED.

The rest of the operation is automatic: When the remote initiate contact closes. The engine starts and synchronizes with the bus. Once In sync, the breaker closes, putting the unit on line.

The unit AUTOMATICALLY comes off line when:

- The remote initiate contact opens.
- The circuit breaker opens.
- The engine enters its Cooldown and Shutdown phases.

Closing To A Dead Bus

To automatically close to a "dead" bus in a multiple unit line-up:

" Install a jumper between TB 93 and TB 94 in the control section of the "lead" unit only.

- Other controls sections should be interconnected in a loop with terminals 94 and 95.
- Make sure DC power is ON at the lead unit. The lead unit need not be started for another unit to automatically close to a dead bus.

Refer to schematics for details on Dead Bus and Multiple Unit Automatic Paralleling.

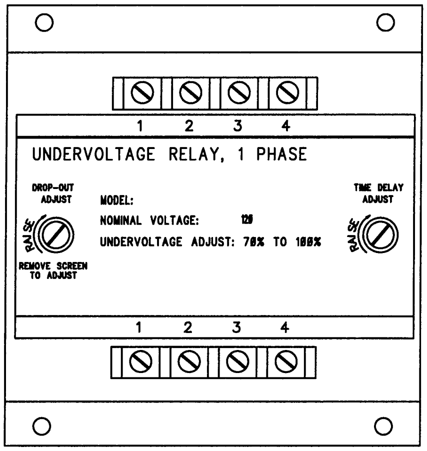
Optional Protective Relays

Any of the following protective relays can be selected for inclusion within Caterpillar Floorstanding Switchgear. Some are already incorporated in other options.

Synchronizing Check Relay

The Synchronizing Check Relay (Device 25) provides "permissive supervision" over circuit breaker closing in paralleling applications. Sensing both the load bus lines and the genset lines, the relay is energized under dead load bus conditions when both sources are in sync. This also allows electrical closure of the genset's circuit breaker only when the off line genset is synchronized with the load bus, or the load bus is de-energized. This relay is included with Semi-Automatic Paralleling Packages.

Under Voltage Relay



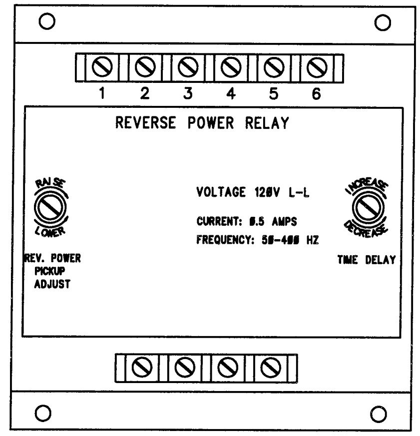
D67839

The Under Voltage Relay (Device 27) is enabled on Engine Start after expiration of the field-adjustable voltage build-up timer. If generator voltage falls below the relay setting, for longer than the relay T.D. setting, after it is enabled:

- The generator circuit breaker automatically trips off line.
- An indicating lamp flashes.
- The alarm horn sounds.
- After a cooldown period, the engine shuts down.

Set point and time delay are field adjustable.

Reverse Power Relay



D67851

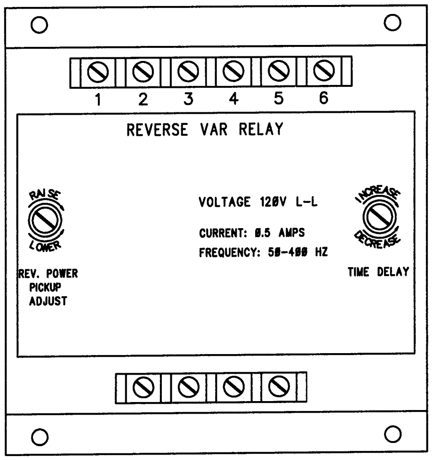
The Reverse Power Relay (Device 32) protects the system when power flows into a failing generator from other parallel units. If power flow into a generator is detected the RPR causes the following:

- Tripping of the gen circuit breaker.
- Immediate engine shutdown.
- Activation of SP1 fault on GSC.
- Initiation of warning light and horn.

Set point and time delay are field-adjustable.

NOTE: ANSI Device 32 is included in ALL paralleling options.

Reverse VAR Relay



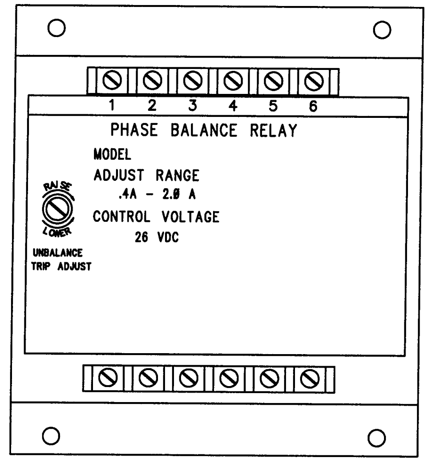
D67852

The Reverse VAR Relay (acting as Device 40) operates when reverse VAR flow (leading power factor) into the generator is detected. This automatically causes:

- The generator circuit breaker automatically trips off line.
- An indicating lamp flashes.
- The alarm horn sounds.
- After a cooldown period, the engine shuts down.

Set point and time delay are field-adjustable.

Current Balance Relay



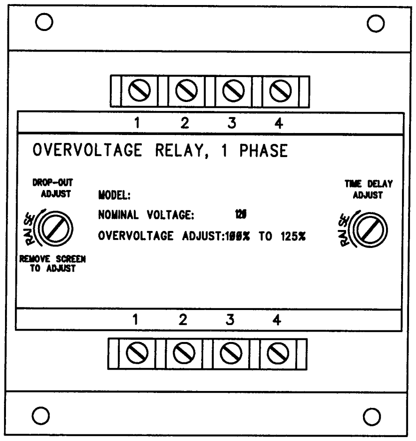
D67854

The Current Balance Relay (Device 46) operates when generator phase currents are not evenly balanced. Relay activation automatically causes:

- The generator circuit breaker automatically trips off line.
- An indicating lamp flashes.
- The alarm horn sounds.
- After a cooldown period, the engine shuts down.

Set point and time delay are field-adjustable, the time delay is provided by a separate solid state timer.

Over Voltage Relay



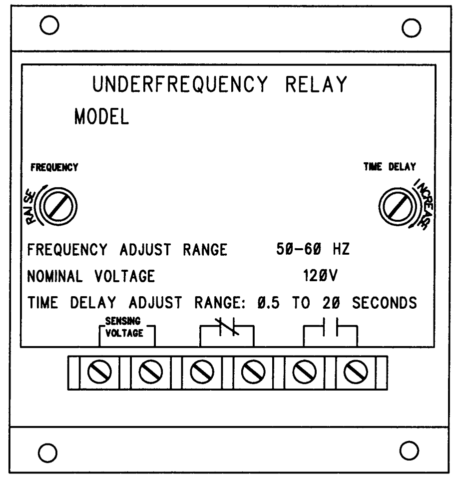
D67859

The Over Voltage Relay (Device 59) senses an over-voltage condition and trips the generator circuit breaker. Activation of this relay automatically causes:

- Tripping of the gen circuit breaker.
- Immediate engine shutdown.
- Activation of SP1 fault on GSC.
- Initiation of warning light and horn.

Set point and time delay are both field-adjustable.

Under Frequency Relay



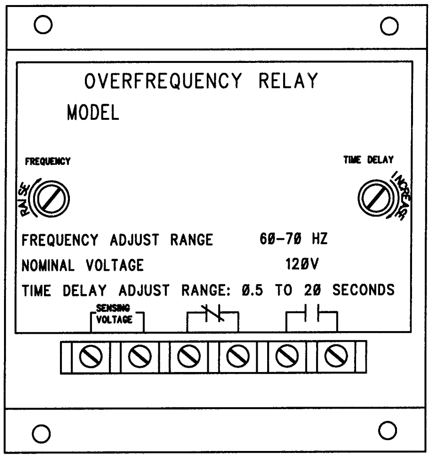
D67863

The Under Frequency Relay (Device 81U) is armed by the field adjustable voltage build-up timer. The relay operates when generator frequency drops below the relay setting for longer than the time delay setting. The relay causes the following:

- The generator circuit breaker automatically trips off line.
- An indicating lamp flashes.
- The alarm horn sounds.
- After a cooldown period, the engine shuts down.

Set point and time delay are both field-adjustable.

Over Frequency Relay



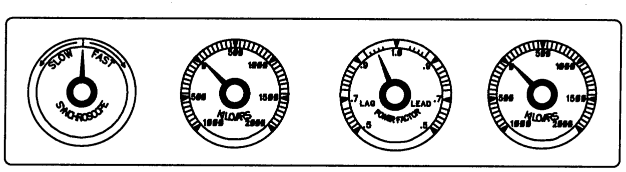
D67865

When the Over Frequency Relay senses an over-frequency condition, it triggers the following response:

- Tripping of the gen circuit breaker.
- Immediate engine shutdown.
- Activation of SP1 fault on GSC.
- Initiation of warning light and horn.

Set point and time delay are both field-adjustable.

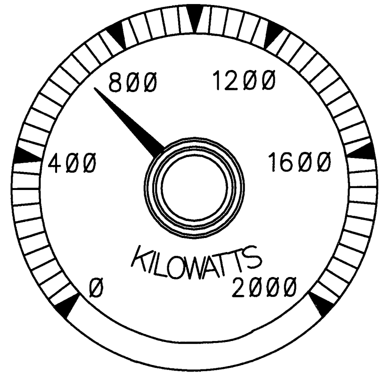
Optional Metering



D68687

The standard Generator Set Control module includes three-phase monitoring of generator amperes, line-to-line volts and frequency, with a phase-select push button. In addition, any four of the following meters may be ordered.

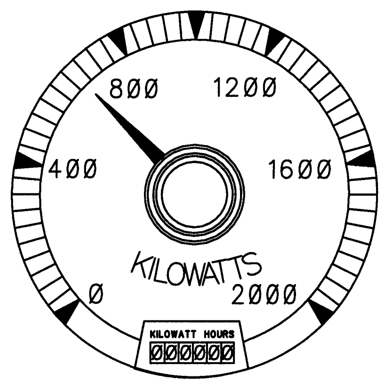
Watt Meter



D64916

The switchboard-style Watt Meter measures the power output of the generator in kilowatts with 1% tolerance for accuracy. The meter is calibrated for switchgear transformer ratios and generator full-load capacity.

Watt/Watt-Hour Meter

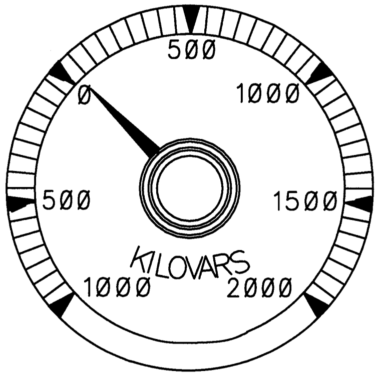


D64916

The Watt/Watt-Hour Meter may be chosen in place of the Watt Meter.
The Watt and the Watt/Watt-Hour meters CANNOT be used together.

This option makes the same, accurate kilowatt measurements-in exactly the same manner-as the Watt Meter previously described. But in addition, the Watt/Watt-Hour Meter performs a second important metering function. It measures the TOTAL AMOUNT of watt-hours generated. Total watt-hours are displayed on a 6-digit counter at the bottom of the meter.

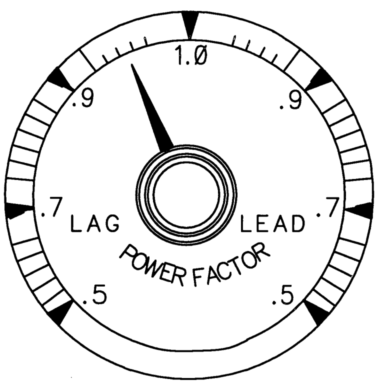
VAR Meter



D64928

The optional VAR Meter measures reactive power in terms of kilovars. Needle deflection in the "out" direction reflects lagging VARs. Deflection in the "in" direction reflects leading VARs.

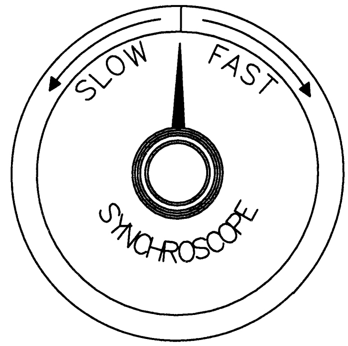
Power Factor Meter



D64943

The Power Factor Meter indicates the power factor at which the generator is operating. PF is an important component with voltage and current in the power equation.

Synchroscope



D64910

The Synchroscope, discussed earlier, is a fifth meter option. This easy to read switchboard style meter displays a rotating pointer to indicate SLOW or FAST deviations from the load bus frequency. This is done by measuring equality of frequency and coincidence of phase on a continuing basis.

The Synchroscope is used in conjunction with the Manual, Semi-Automatic or Manual Paralleling option package.

When the needle is stationary at the 12 o'clock position, the generator is matched with the load bus in phase angle and frequency.

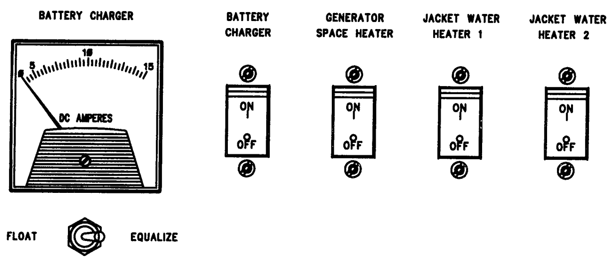
Other Accessories

Other accessories include the Customer Communications Module, the Customer Interface Module, a battery charger, control circuits for a jacket water heater and generator strip heater, and a lamp annunciator for the Digital Voltage Regulator.

Digital Voltage Regulator Annunciation

This lamp flashes to enunciate an alarm or shutdown signal that warns of a problem within the Digital Voltage Regulator. A shut down fault from the digital voltage regulator will trip the circuit breaker and place the engine in cooldown mode.

Control Circuits for Jacket Water Heater & Generator Strip Heater



D64944

Heater Distrubution

These optional circuits distribute customer provided power to Jacket Water Heaters and the Generator Strip Heater.

The circuits include:

- Terminal points for connecting customer power.
- Circuit breakers for protection.
- Relay contacts to de-energize the heaters while the engine is running.

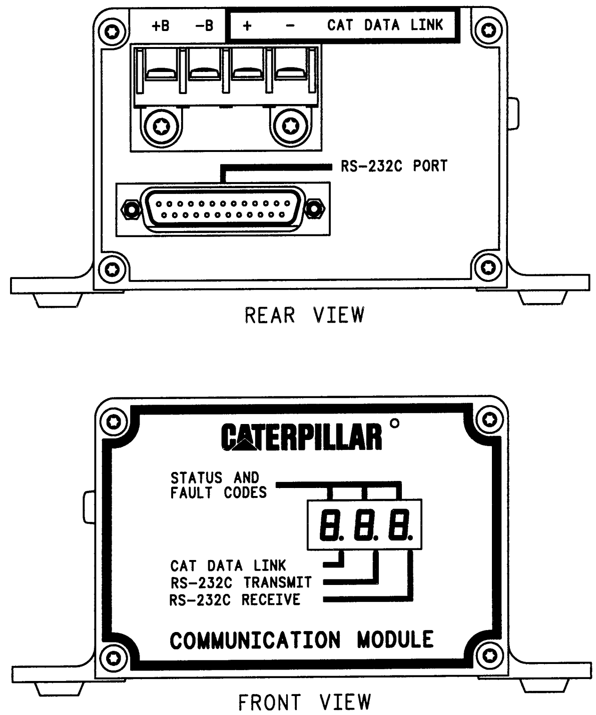
Circuits are rated as follows:

Generator Space Heater
 120V or 230V, single phase
 10A maximum

Jacket Water Heater

Two circuits, each rated:
- 120V or 230V, single phase
- 30A maximum

Customer Communication Module (CCM)



D01310

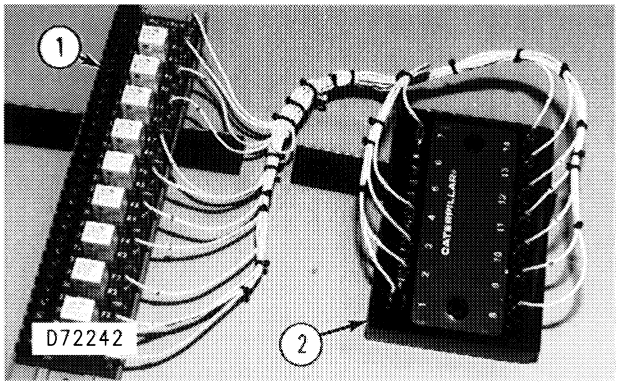
Customer Communication Module (CCM)

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.

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:

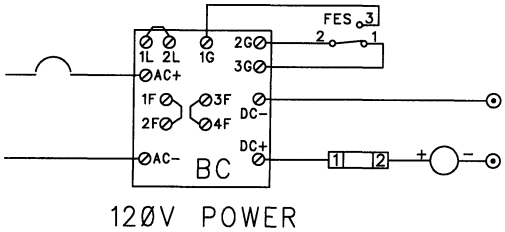
- For CIM installation, the maximum distance between electronic control (2) and the GSC is 305 m (1000 ft).

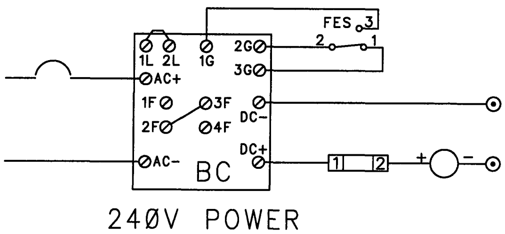
- The operating voltage range is 15 to 45 DCV (24 DCV nominal)

- 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.





D65578

The optional Battery Charger provides a charging source for engine batteries. This option includes:

- 10 or 20 Ampere-Rated Battery Charger
- Float/Equalize Charge Switch
- Charger Ammeter
- Circuit Breaker & Control Circuit

The battery charger requires customer provided 120V or 240V power to operate. For 120V operation terminals 1F and 2F are jumpered together and terminals 3F and 4F are jumpered together. For 240V operation the 120V jumpers are removed and terminals 2F and 3F are jumpered together. Refer to the Charger Manual for detailed information

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

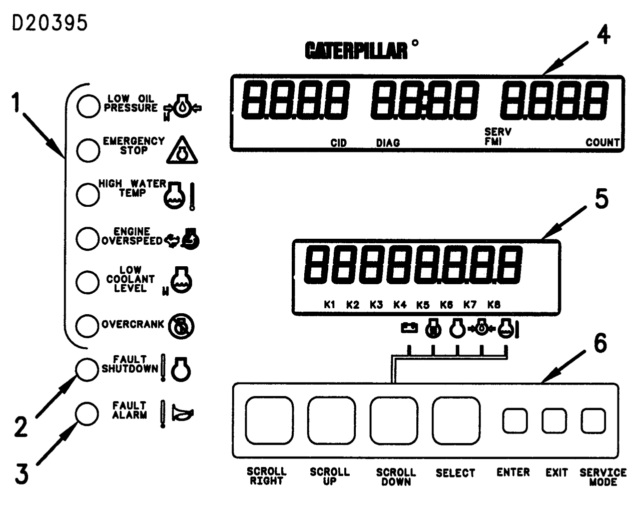
Service Tools

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 With Service Mode Descriptions Of Keypad
(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.

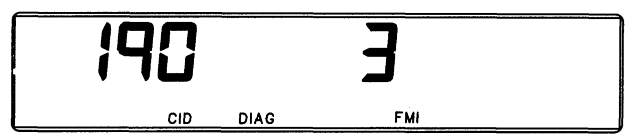
Diagnostic Faults

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: [2] (former CID 560)	
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 330 - Unexpected Shutdown: [2] (replaced by CID 566)	
FMI 7	Faulty Mechanical Response.
CID 331 - Engine Control Switch (ECS): [2] (replaced by CID 336)	
FMI 2	Undefined state.
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): [2] (former CID 331)	
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 - Air Shutoff Relay (ASR):	
FMI 12	Faulty component.
CID 447 - Fuel Control Relay (FCR):	
FMI 12	Faulty component.
CID 500 - Genset Control (GSC):	
FMI 12	Faulty component.
CID 560 - CAT Data Link: [2] (replaced by CID 248)	
FMI 11	Failure mode not identified.
CID 566 - Unexpected Shutdown: [2] (former CID 330)	
FMI 7	Faulty Mechanical Response.

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

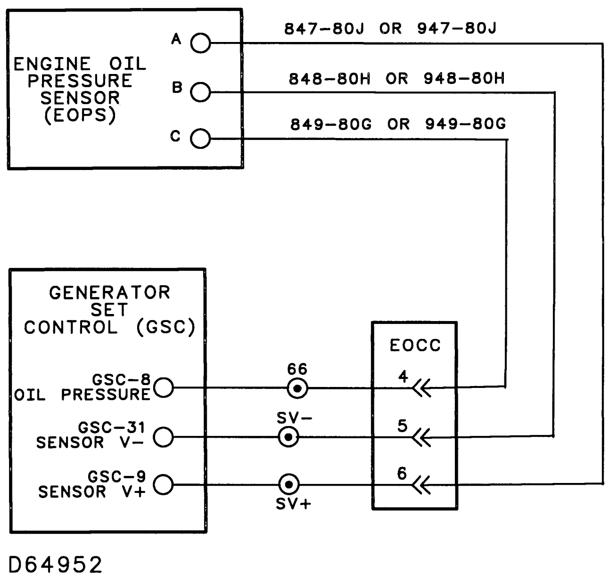
[2] The CID No. for this fault has changed (has been corrected), due to an error when the original CID No.'s where assigned. The former CID No.'s apply to former 103-6177, 113-4500, 117-6200 and 118-2121 GSC's. The former GSC's were built prior to approximately 04-01-95. At that time the version 08 software update was implemented and a new part number was assigned to the GSC. The troubleshooting procedures for the former CID and the replacement CID are the same.



D20553

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. Go 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. Go 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. Go 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. Go 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. Go 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. Go 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.

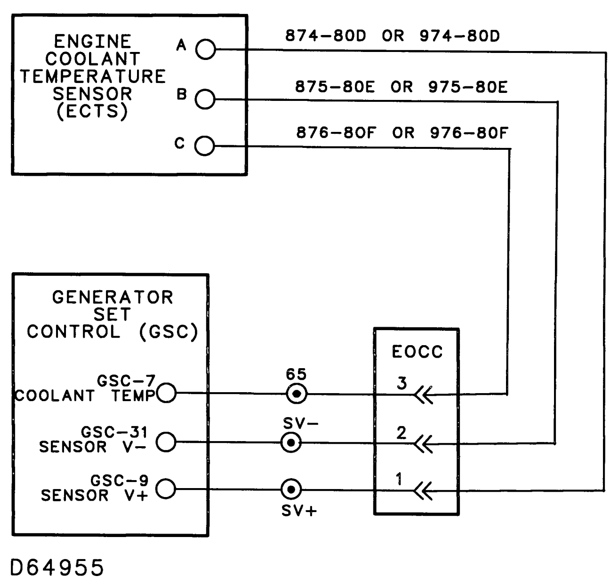
STEP 1. CHECK GSC AND HARNESS - Make sure that CID 100 FMI 4 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display 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. Go 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)



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. Go 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. Go 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. Go 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. Go 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. Go 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. Go 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.

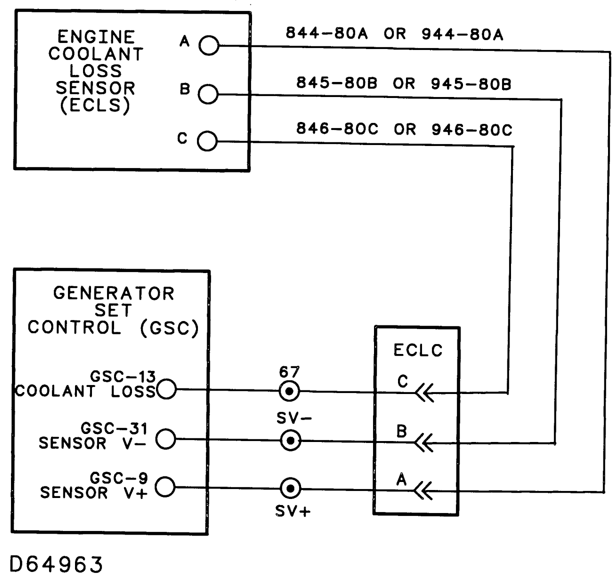
STEP 1. CHECK GSC AND HARNESS - Make sure that CID 110 FMI 4 is showing on the display. Turn the ECS to the OFF/RESET position. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine). Turn the ECS to the STOP position. Press the alarm codes key. Monitor the display 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. Go 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. Go 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. Go 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. Go 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. Go 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. Go to Step 5.

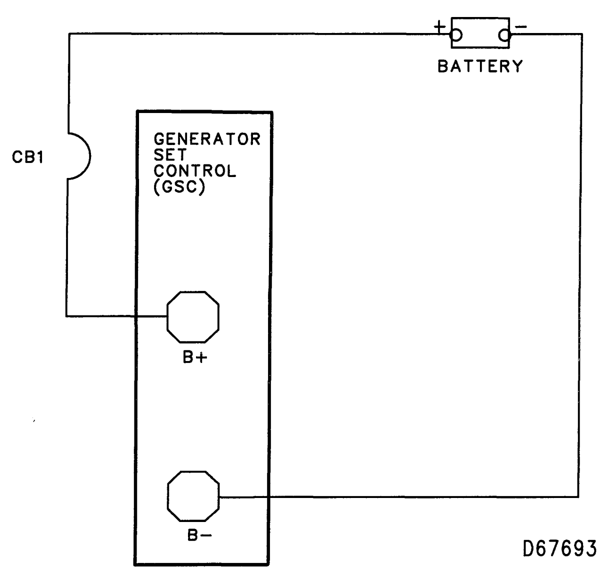
- NOT OK; one or more of the resistance measurements are greater than 5 ohms. The harness wiring with the incorrect resistance measurement is open (faulty). Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC connector. STOP.

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 circuit breaker 1 (CB1) is closed.

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. Go 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). Go 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. Go 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.

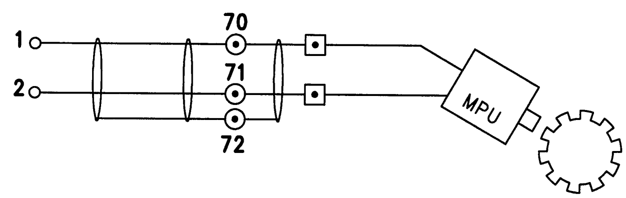
STEP 3. CHECK HARNESS - Disconnect the B+ and B- cables from the battery. Disconnect the B+ wire from the RM-1 terminal and the B- wire from the RM-28 terminal of the relay module terminal strip on the rear of the GSC. Measure the resistance of each wire from the battery end to the terminal strip end. 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)



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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, determining the oil step speed and causing the air shut off solenoid to engage during some fault shutdowns. 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. Go 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. Go to Step 2.)

- NOT OK; the resistance measurement is NOT correct. The harness wiring or the MPU is faulty. Go 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. Go 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. Go 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. Go 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. Go 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.)

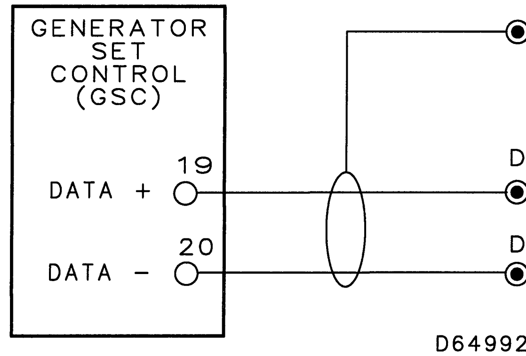
- NOT OK; If a CID 190 fault is showing, the fault is still active and the engine will not start. Use the process of elimination to find the faulty component. Stop when the fault is no longer showing. First, replace and adjust the MPU. Second, replace the harness. Third (last), replace the GSC.

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

NOTE: CID 248 FMI 9 replaces the former CID 560 FMI 11 for a CAT data link fault. Former CID 560 FMI 11 was mistakenly assigned to the CAT data link. These procedures apply to both CID's for the CAT data link: CID 248 FMI 9 and CID 560 FMI 11. When using these procedures for troubleshooting a former CID 560 fault, replace the number 248 with the number 560.

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.

NOTE: Some changes have occurred to the identity and the quantity of setpoints:

P08 is engine type (0 = diesel, 1 = spark ignited) on former 103-6177, 113-4500 and 117-6200 GSC's.
P22, P23 and P24 are not present on former 103-6177, 113-4500 and 117-6200 GSC's.

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. Go 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. Go to Step 2.

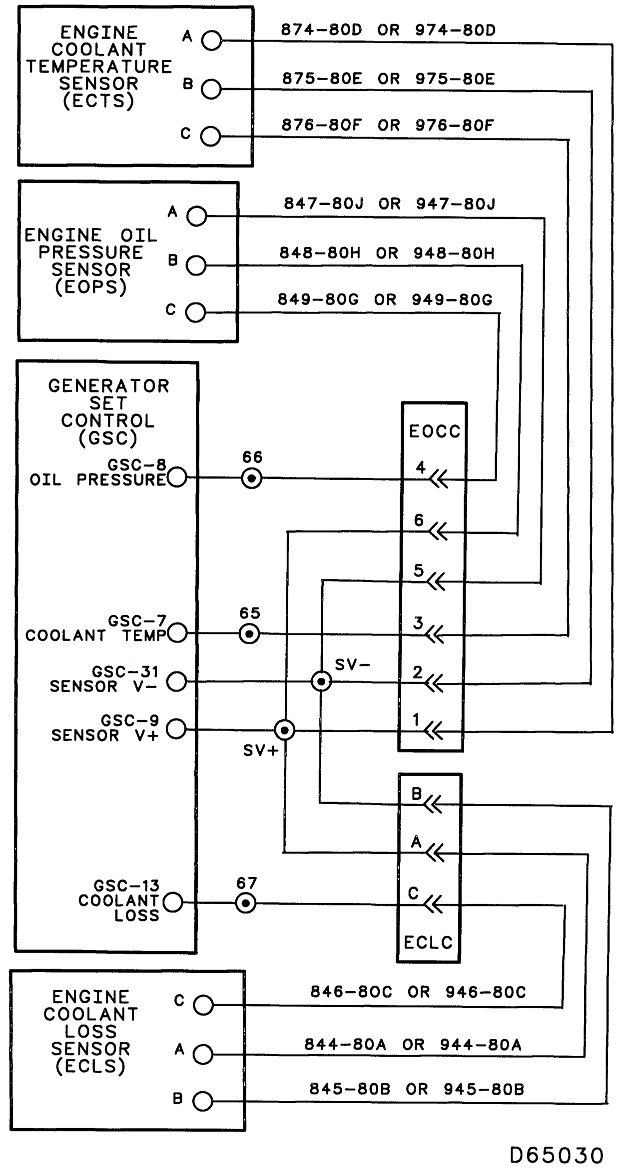
NOTE: Electrical interference can also cause the hourmeter to show " – – ", but it does not cause a CID 268 FMI 2 fault.

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). Compare the stored setpoints to the specified setpoints of 103-1582 Control Panel Chart (packaged within the control panel). 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. Go 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.

CID 330
Unexpected Shutdown

NOTE: CID 566 FMI 7 replaces the former CID 330 FMI 7 for an unexpected shutdown fault. Former CID 330 FMI 7 was mistakenly assigned as an unexpected shutdown fault. The troubleshooting procedure for a CID 330 FMI 7 fault is the same as the procedure for CID 566 FMI 7 fault. Go to the CID 566 procedure.

CID 331
Engine Control Switch (ECS)

NOTE: CID 336 FMI 2 replaces the former CID 331 FMI 2 for an ECS fault. Former CID 331 FMI 2 was mistakenly assigned as an ECS fault. The troubleshooting procedure for a CID 331 FMI 2 fault is the same as the procedure for CID 336 FMI 2 fault. Go to the CID 336 procedure.

CID 333
Alarm Module (ALM)

System Operation

A National Fire Protection Association (NFPA) 99 alarm module (ALM) standard with other configurations available as an option. 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. Go to Step 2.
- NOT OK; a 333 03 or 333 04 fault is inactive. Go 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. Go to Step 4.
- NOT OK; voltage measurement is NOT correct. Go 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.

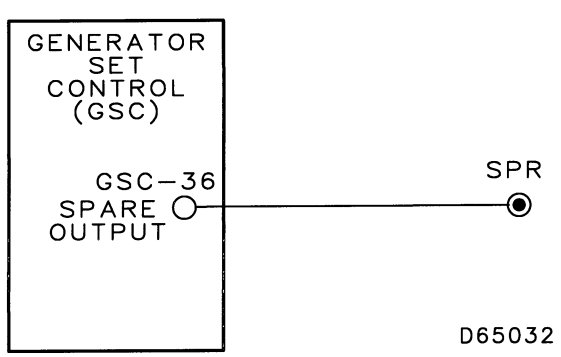
b. Measure the DC voltage from contact 35 of the GSC, to the battery negative (B-) terminal of the relay module. The measured voltage should change constantly, within the range of 0 to 5.5 DCV.

- OK; both voltage measurements are correct. Go 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

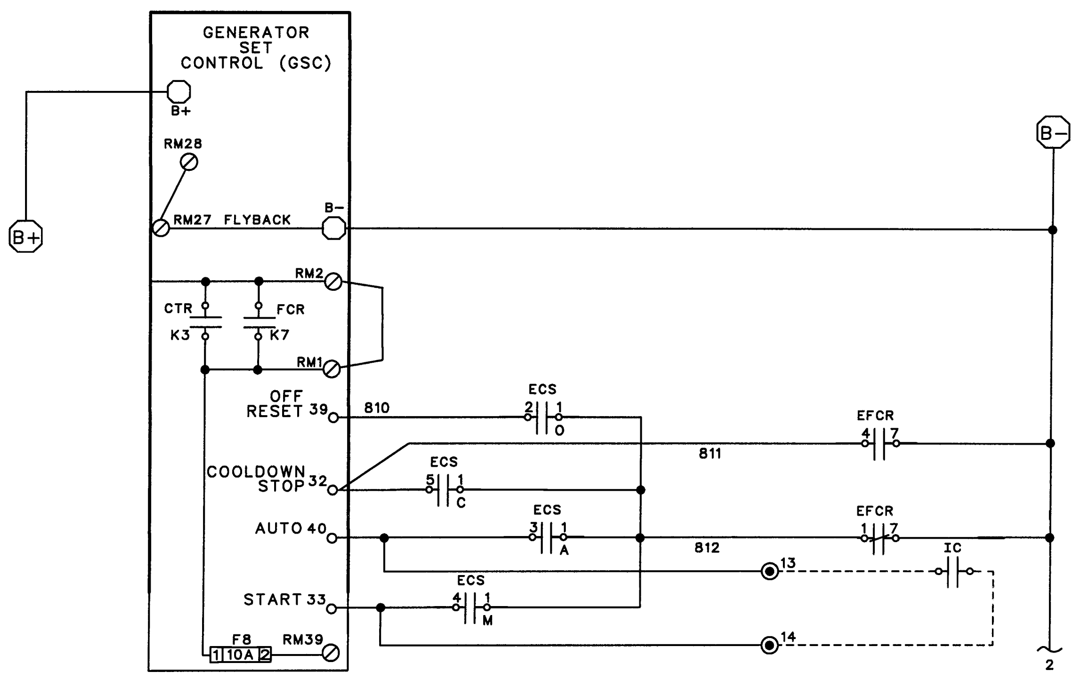
The spare output on the GSC is strictly for customer use. The spare output is programmable to activate under a variety of conditions. The default is for the output to activate when the engine is in cooldown. For more information, see Spare Input/Output Programming OP6 within the topic Service Mode in 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.



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System Schematic For Engine Control Switch (ECS)

NOTE: CID 336 FMI 2 replaces the former CID 331 FMI 2 for an ECS fault. Former CID 331 FMI 2 was mistakenly assigned to the ECS. These procedures apply to both CID's for the ECS: CID 336 FMI 2 and CID 331 FMI 2. When using these procedures for troubleshooting a former CID 331 fault, replace the number 336 with the number 331.

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).

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.

5. The EFCR (Electrical Fault Cooldown Relay) is used to bypass the ECS when an optional protective relay detects a fault. This relay disconnects the ECS and places the GSC in the cooldown mode. The fault condition is annunciated by an indicating lamp and sounding of the alarm horn. The ECS must be placed in OFF/RESET prior to restarting the engine.

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

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. Go 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.

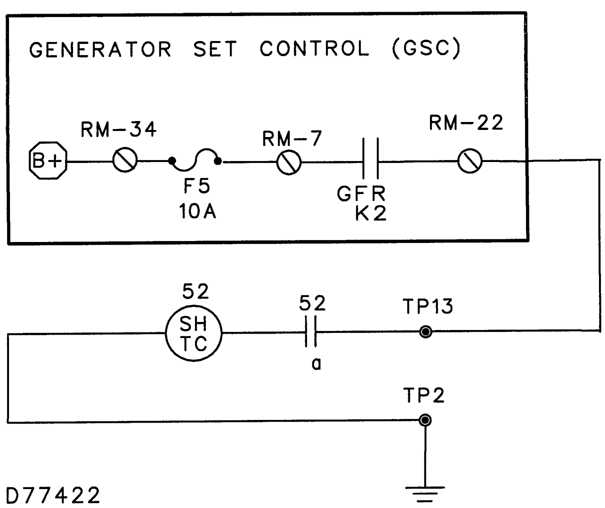
- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

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. Go 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.

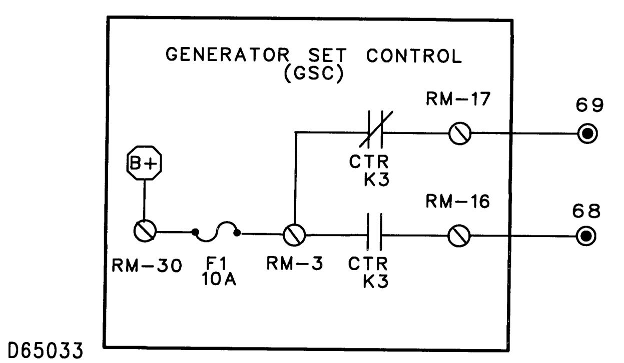
STEP 3. GFR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 22 of the relay module. At the relay module, measure the resistance from terminal 22 to terminal 7. Resistance should measure greater than 5k ohms.

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), the governor switch (GS) and the start aid switch (SAS). The CTR is located within the relay module. The AUXREL is located on the sub-panel within the control panel. The GS and SAS are 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. The SAS continues to function.
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. The SAS continues to function.

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. Go 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.

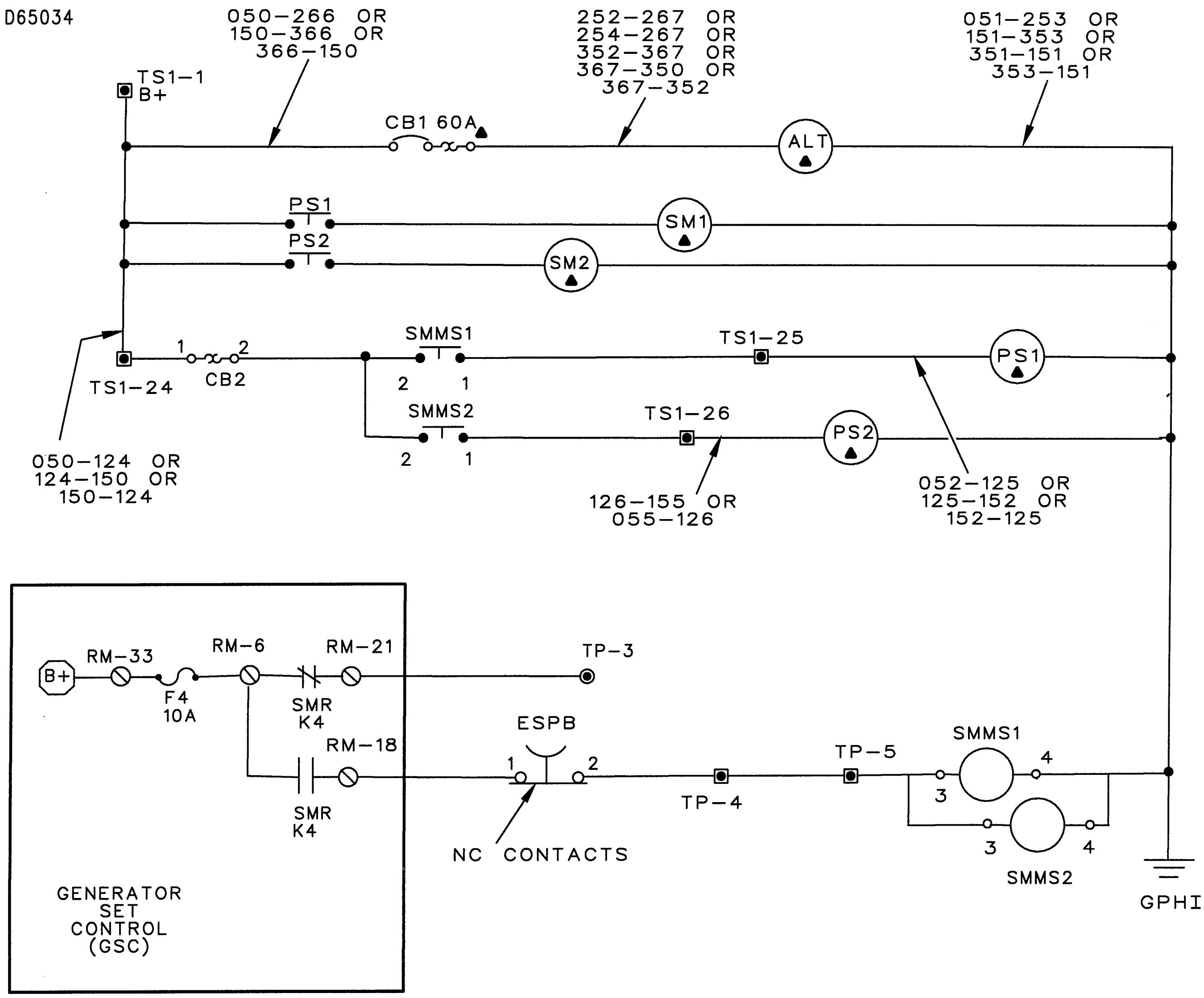
- NOT OK; Cable or clamp are NOT correct. Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC. STOP.

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), start aid switch (SAS) (3500 product only), the prelube pump and the battery charger. The SMR is located within the relay module and the SAS (3500 product only) is located on the instrument door of the control panel. The prelube 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, the prelube pump is disabled and the AUTO position of the start aid switch 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, the prelube pump is disabled and the AUTO position of the start aid switch 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. Go 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.

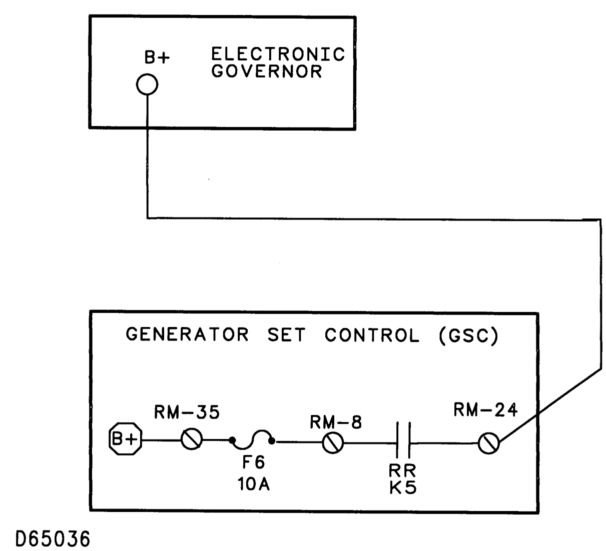
STEP 3. SMR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 18 of the relay module. Remove fuse F4 from the relay module.

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) and the separate switchgear logic. The RR is located within the relay module. The electronic governor (EG) is usually mounted on the sub-panel within the control panel. The SAS is mounted on the instrument 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.
   And 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.
   And 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. Go 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.

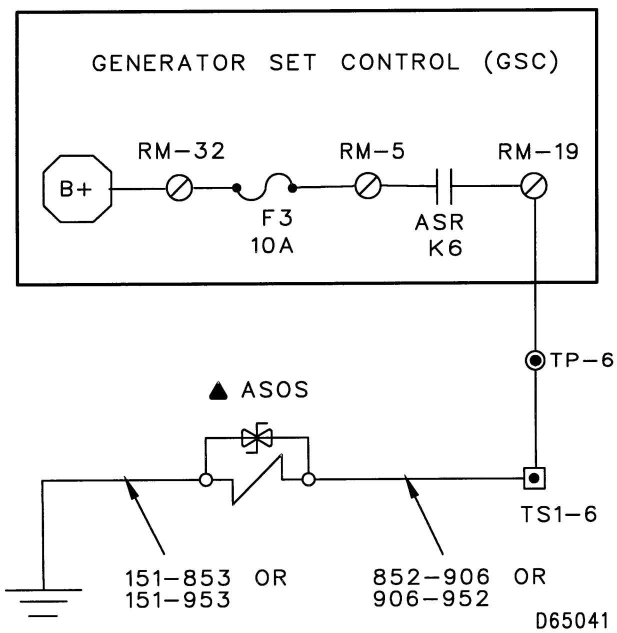
STEP 3. RR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 24 of the relay module. Remove fuse F4 from the relay module.

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
Air Shutoff Relay (ASR)



System Schematic For Air Shutoff Relay (ASR)

System Operation

The GSC uses the air shutoff relay (ASR) to activate the air shutoff solenoid during a shutdown fault. The ASR is located within the relay module. The air shutoff solenoid is located within the air inlet system of the engine.

The GSC activates the air shutoff relay (ASR) for some active shutdown faults.

NOTE: Whenever the GSC activates or attempts to activate the ASR, K6 is shown on the lower display. When the ASR 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 ASR. The system response to this fault is:

a. If a CID 446 fault occurs while the ASR is activated, then there is no effect on the system because the air shutoff is already operating and shutdown mode is functioning.
b. If a CID 446 fault occurs while the ASR 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 ASR is not activated and a shutdown fault occurs, then the ASR cannot energize the air shutoff solenoid.

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. Go 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. ASR FUNCTIONAL CHECK - Turn the ECS to OFF/RESET. Disconnect all wires from terminal 19 of the relay module.

a. At the relay module, measure the resistance from terminal 19 to terminal 5. Resistance should measure greater than 5k 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.

- 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 447
Fuel Control Relay (FCR)

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.

There are two types of fuel system solenoids: energized to run (ETR) and energized to shutdown (ETS).

For ETR systems, the GSC activates the FCR which energizes the fuel solenoid to run the engine.

For ETS systems, the GSC activates the FCR which energizes the fuel solenoid to shutdown 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.

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. For ETR systems 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. For ETR systems with the FCR not activated - If a CID 447 fault occurs, then the engine can not start or run.

c. For ETS systems with the FCR activated - If a CID 447 fault occurs, then the engine is able to run and start but the fuel solenoid will not shutdown the engine.

d. For ETS systems with the FCR not activated - If a CID 447 fault occurs, then the engine is able to run and start but the fuel solenoid will not shutdown the engine.

NOTE: On 3500 engines equipped 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. Go 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.

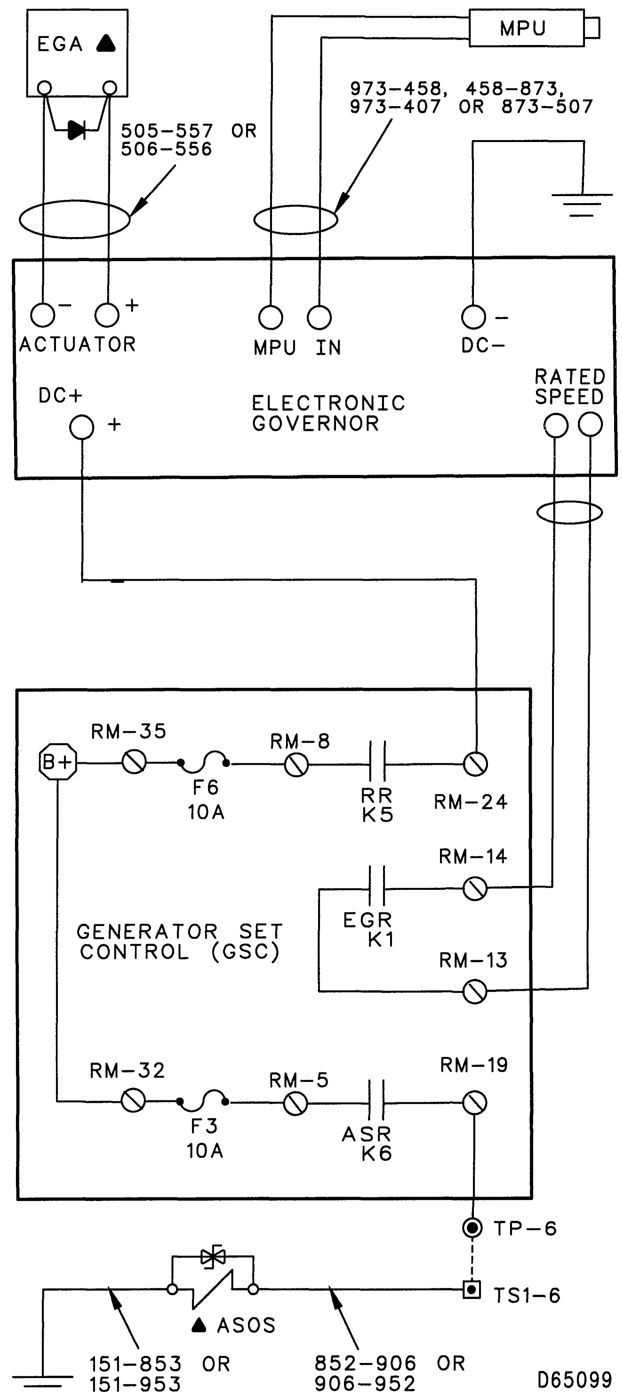
NOTICE

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 560
CAT Data Link

NOTE: CID 248 FMI 9 replaces the former CID 560 FMI 11 for a CAT data link fault. Former CID 560 FMI 11 was mistakenly assigned to the CAT data link. The troubleshooting procedure for a CID 560 FMI 11 fault is the same as the procedure for CID 248 FMI 9 fault. Go to the CID 248 procedure.

CID 566
Unexpected Shutdown



System Schematic For Unexpected Shutdown

NOTE: CID 566 FMI 7 replaces the former CID 330 FMI 7 for an unexpected shutdown fault. Former CID 330 FMI 7 was mistakenly assigned to the unexpected shutdown fault. These procedures apply to both CID's for an unexpected shutdown fault: CID 566 FMI 7 and CID 330 FMI 7. When using these procedures for troubleshooting a former CID 330 fault, replace the number 566 with the number 330.

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.

f. Check the air shutoff solenoid (if present) for activation. If the air shutoff solenoid is activated and cannot be deactivated, begin troubleshooting with Step 15. Otherwise begin troubleshooting with Step 1.

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. Go 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. Go 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. Go to Step 4.

STEP 4. IDENTIFY FUEL SYSTEM - Determine the type of fuel solenoid used on the genset: ETR (energize to run) or ETS (energize to shutoff). Check setpoint P01 for proper programming (0=ETR, 1=ETS); 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 12.

- OK; setpoint P01 is programmed correctly (0 for ETR, 1 for ETS). Go 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.

For ETS fuel solenoids, the voltage should measure from 0 to 2.0 DCV.

- OK; voltage is correct. The fault is with the governor or fuel rack. If an electronic governor is present, go to Step 12. Refer to the appropriate Service Manual. STOP.

- NOT OK (ETR type); voltage is low. Go to Step 6.

- NOT OK (ETS type); voltage is high. Go to Step 10.

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.

- OK; none of these fuses are blown. Go to Step 7.

- NOT OK; one or more of the fuses are blown. Go to Step 8.

STEP 7 (ETR). 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. Go 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 (ETS). CHECK VOLTAGE AT RELAY MODULE - This Step continues troubleshooting from Step 5. 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 from 0 to 2.0 DCV. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; voltage is correct. A wire or a component between terminal 15 of the relay module and the fuel solenoid is shorted to battery positive (B+). Repair the circuit. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.

- NOT OK; voltage is high. Go to Step 11.

STEP 11. CHECK FCR - Fuse F4 remains removed from the relay module. Remove fuse F2 from the relay module. Turn the ECS to OFF/RESET and then to START. Make sure that K7 is not shown on the lower GSC display. (If K7 is showing, make sure that no other faults are active.)

a. At the relay module, measure the resistance from terminal 4 to terminal 15. A measurement of less than 100 ohms indicates there is a faulty component shorting terminal 15 to terminal 4.

b. Disconnect the wire from terminal 4 of the relay module and watch for a change in resistance.

- OK; resistance is greater than 10k ohms. Check for a short from battery positive (B+) to terminal 15 of the relay module. Repair the shorted wiring. If the short is internal to the relay module, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; resistance increases to greater than 10k ohms as the wire on terminal 4 of the relay module is removed. Repair the shorted wiring to the emergency fuel control relay (EFCR) or replace the EFCR as necessary. STOP.

- NOT OK; resistance remains less than 100 ohms. The short is internal to the relay module. Replace the relay module, see the topic Relay Module Replacement. STOP.

STEP 12. 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 13.

STEP 13. 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. Go to Step 14.

STEP 14. 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 13.
   - 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.

STEP 15. CHECK VOLTAGE AT AIR SHUTOFF SOLENOID - Remove fuse F4 from the relay module. Prepare to measure the voltage across the terminals of the air shutoff solenoid (air solenoid may activate for as little as 15 seconds). The voltage should measure from 0 to 2.0 DCV. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; voltage is correct. If the air shutoff remains tripped or cannot be reset, the fault is in the air shutoff. Refer to the Engine Service Manual. STOP.

- NOT OK; voltage is high. Go to Step 16.

STEP 16. CHECK VOLTAGE AT RELAY MODULE - Fuse F4 remains removed from the relay module. Prepare to measure the voltage from terminal 19 to the B- terminal of the relay module. The voltage should measure 0 to 2.0 DCV when the ECS is turned to START. Turn the ECS to OFF/RESET and then to START. Measure the voltage.

- OK; voltage is correct. A wire or a component between terminal 19 of the relay module and the air shutoff solenoid is shorted to battery positive (B+). Repair the circuit. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.

- NOT OK; voltage is high. Go to Step 17.

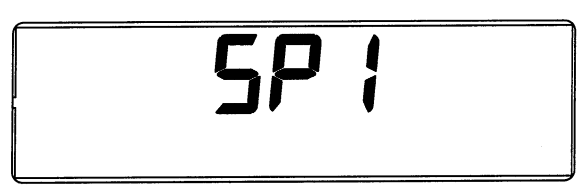
STEP 17. CHECK ASR - Fuse F4 remains removed from the relay module. Remove fuse F3 from the relay module. Turn the ECS to OFF/RESET. Make sure that K6 is not shown on the lower GSC display. (If K6 is showing, make sure that no other faults are active.)

At the relay module, measure the resistance from terminal 5 to terminal 19. A measurement of less than 100 ohms indicates the air shutoff relay is shorted.

- OK; resistance is greater than 10k ohms. Check for a short from battery positive (B+) to terminal 19 of the relay module. Repair the shorted wiring. If the short is internal to the relay module, replace the relay module. See the topic Relay Module Replacement. STOP.

- NOT OK; resistance is less than 100 ohms. The short is internal to the relay module. Replace the relay module, see the topic Relay Module Replacement. STOP.

Spare Fault Troubleshooting



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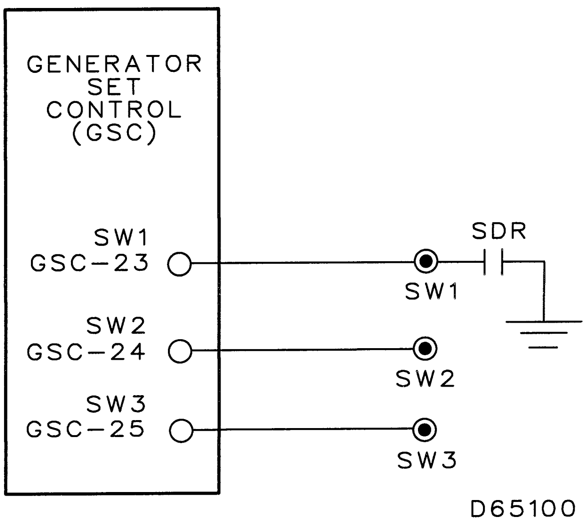
Upper Display With Spare Fault Code SP1 Showing



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.

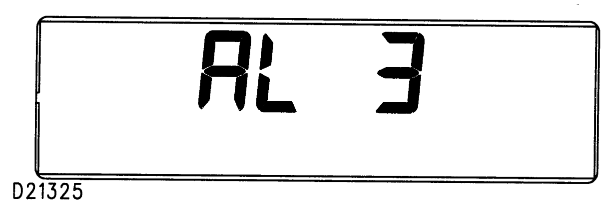
The SP1 fault code corresponds to contact 23 of the GSC connector which is wired to the shutdown relay.

The SP2 fault code corresponds to contact 24 of the GSC connector which is wired to terminal 25.

The SP3 fault code corresponds to contact 25 of the GSC connector which is wired to terminal 26.

NOTE: On gensets equipped with the optional protective relays, such as reverse power and over voltage, the shutdown relay (SDR) is connected to the spare fault 1 input of the GSC. And an SP1 fault code is shown when the relays have operated.

Alarm Fault Troubleshooting



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. Check the jacket water heater circuit breaker on switchgear door (if equipped). STOP.
- Temperatures do not agree. If the gauge is accurate, replace the engine coolant temperature sensor. STOP.

Dedicated Shutdown Indicator Troubleshooting

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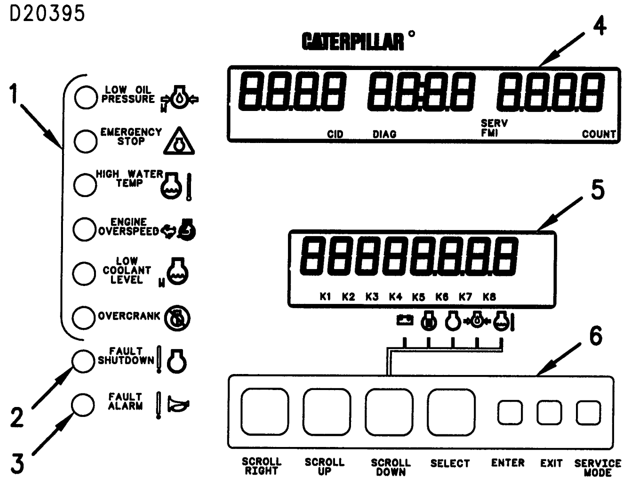


GSC Display Area With Service Mode Descriptions Of Keypad
(1) Dedicated shutdown indicators. (2) Fault shutdown indicator. (3) Fault alarm indicator. (4) Upper display. (5) Lower Display. (6) Keypad.

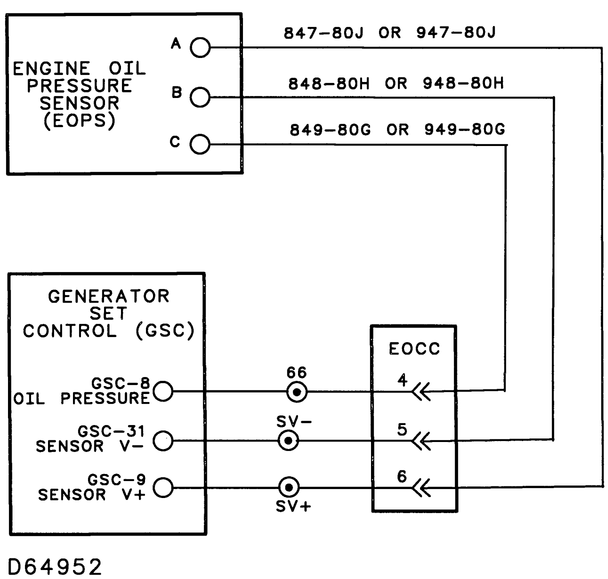
The dedicated shutdown indicators inform the operator which system is responsible for an engine shutdown. The symbol and nomenclature nearest to the indicator identifies the responsible system. Dedicated shutdown faults are activated automatically by the GSC and depend upon certain setpoints. When the 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



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 setpoint specified on print 103-1582. 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

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.

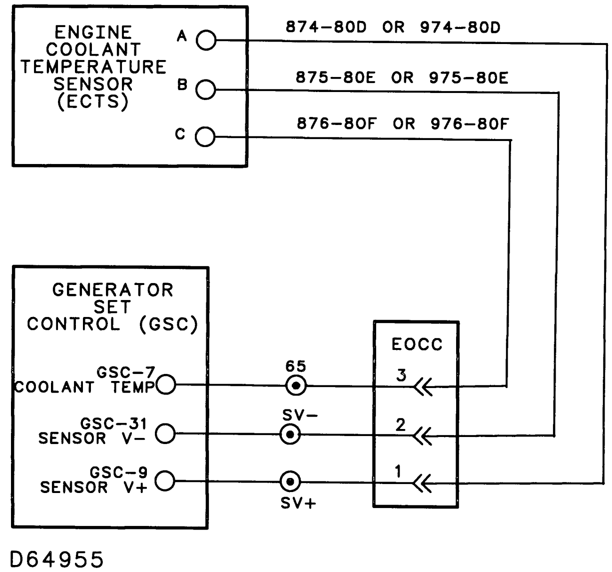
STEP 2. Check emergency stop indicator.

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 setpoint specified on print 103-1582. 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 setpoints specified on print 103-1582. 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.

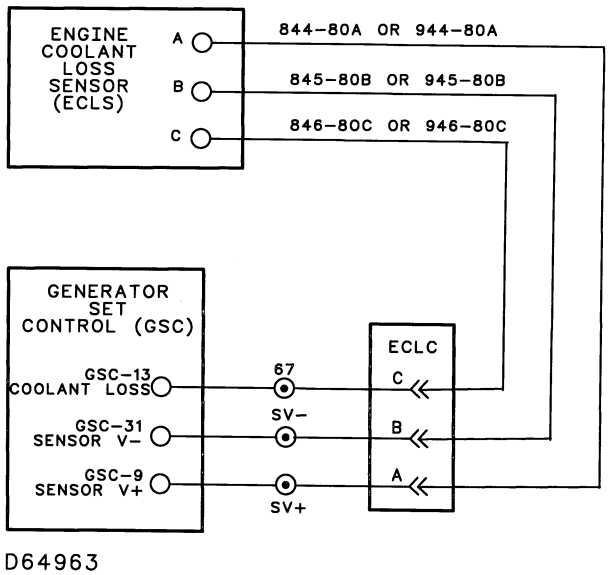
If possible disable the engine from reaching rated speed. Start the engine and slowly increase the RPM to rated speed. The engine should not overspeed and the GSC should not shut down the engine or issue an overspeed fault.

- 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.

Overcrank Indicator

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 air shutoff solenoid (if equipped) for activation. The solenoid must be deactivated for the engine to start or run. See the topic CID 566 in the Diagnostic Fault Section.

f. Check prelube 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.

g. Check fuse F2 and F4 on the relay module. If either is blown, proceed to Step 4.

h. 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 prelube 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 related wiring is faulty. Troubleshoot the wiring. See the system schematics. 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. Go 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.

STEP 1. CHECK RELATED SETPOINTS - Check setpoints P11 (crank terminate speed), P17 (total cycle crank time) and P18 (cycle crank time). See print 103-1582 and 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 prelube 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 per print 103-1582 Chart. See Setpoint Programming OP5 within the topic Service Mode in the Systems Operation section. Go 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. Check the SMR output.

- 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.

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 ETS fuel systems, go to Step 3.
  For 3500 engines with electronic governor, go to Step 6.

- 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 7.

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 continues to run, 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 still 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 system schematic 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 850-907 or 907-950 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. ETS SYSTEMS. CHECK SYSTEM VOLTAGE - Shut the engine down, manually if necessary. Turn the ECS to STOP. Measure the DC voltage of the batteries. Voltage should measure from 24.8 to 29.5 volts DC for 24 volt systems or 33.1 to 39.3 volts DC for 32 volt systems.

- If voltage is correct. Go to Step 4.

- If voltage is NOT correct. See the topic CID 168 in the Diagnostic Fault Codes section to check the system voltage.

NOTE: On ETS fuel systems, if the GSC is entirely turned off (the display area is blank), then the GSC is not able to shutdown the engine. Check for wiring errors in the power connections to the GSC open circuit breakers, and for discharged batteries.

STEP 4. ETS SYSTEMS. CHECK FOR CAUSE OF PROBLEM - The engine remains shutdown. The ECS remains in the STOP position. Push in the emergency stop push button. Prepare to make the following DC voltage measurements. All measurements are to B- (ground). Attach the black lead of the multimeter to B- (ground). 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 3 $\pm$ 2.0 DCV.

4a. Voltage across the fuel solenoid terminals.

- If the voltage is correct, the fuel solenoid is stuck or otherwise faulty. Troubleshoot and repair the faulty solenoid, see the Engine Service Manual. STOP.

- If the voltage is NOT correct, go to Step 4b.

4b. Voltage from terminal 7 of TS1 in the generator housing to battery negative (ground).

- If the voltage is correct, there is an open in the engine wire harness. Troubleshoot and repair the engine harness, see the Generator Set Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

- If the voltage is NOT correct, go to Step 4c.

4c. Voltage from terminal 15 of the relay module to battery negative (ground).

- If the voltage is correct, there is an open in the wiring between terminal 15 of the relay module and terminal 7 of TS1. Troubleshoot and repair the wiring, see the Main Chassis Wiring Diagram in the Schematics And Wiring Diagram section. STOP.

- If the voltage is NOT correct, go to Step 4d.

4d. Voltage from terminal 31 of the relay module to battery negative (ground).

- If the voltage is correct, it is most likely that fuse F2 is open (blown). Replace fuse F2. If fuse blows again, go to Step 5.

- If the voltage is NOT correct, there is an open in the wiring between terminal 31 of the relay module and battery positive (B+). Troubleshoot and repair the wiring, see the system schematic in the Schematics And Wiring Diagram section. STOP.

STEP 5. TROUBLESHOOT BLOWN FUSE – Remove fuse F2. At the relay module, measure the resistance from terminal 15 to B- (ground). The resistance will measure 5 ohms or less if a short to ground exists.

Remove one component or wire at a time that is in series with terminal 15 until the faulty component or wire is isolated. See the system schematic in the Schematics And Wiring Diagram section. Repair or replace the faulty component or wiring. STOP.

STEP 6. 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 system schematic 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 7. 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 protective relay that does not shutdown the engine:

NOTE: Not all protective relays cause immediate engine shutdown. Refer to system operation for expected results.

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.

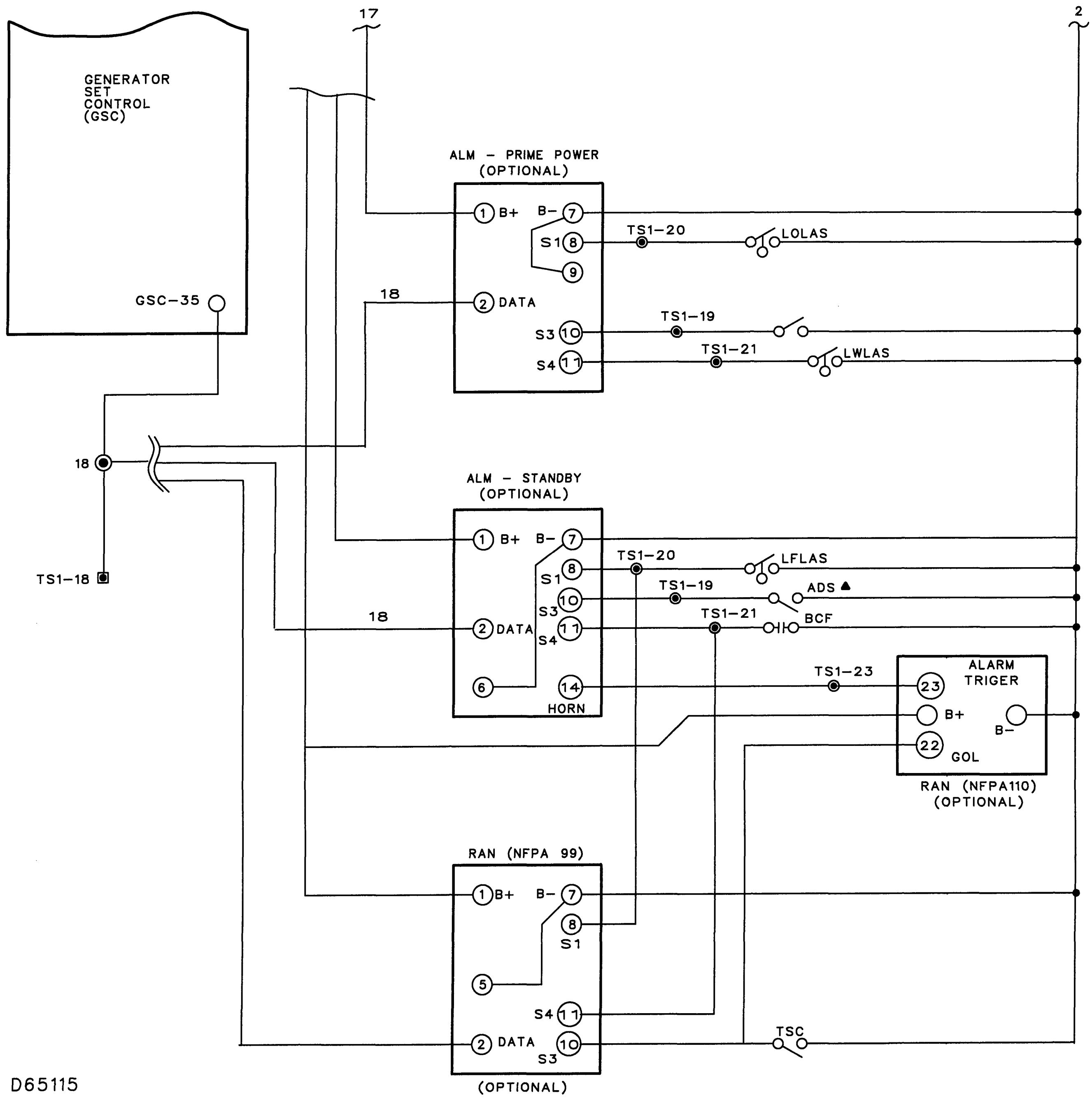
b. Start and run the engine. Apply a load to the generator which is at least 15% of the rated load. Press the test button on the reverse power relay. The reverse power relay is located on the sub-panel within the switchgear.

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 a fault component in the shut-down circuit. Troubleshoot and repair the system, see the system schematic 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.

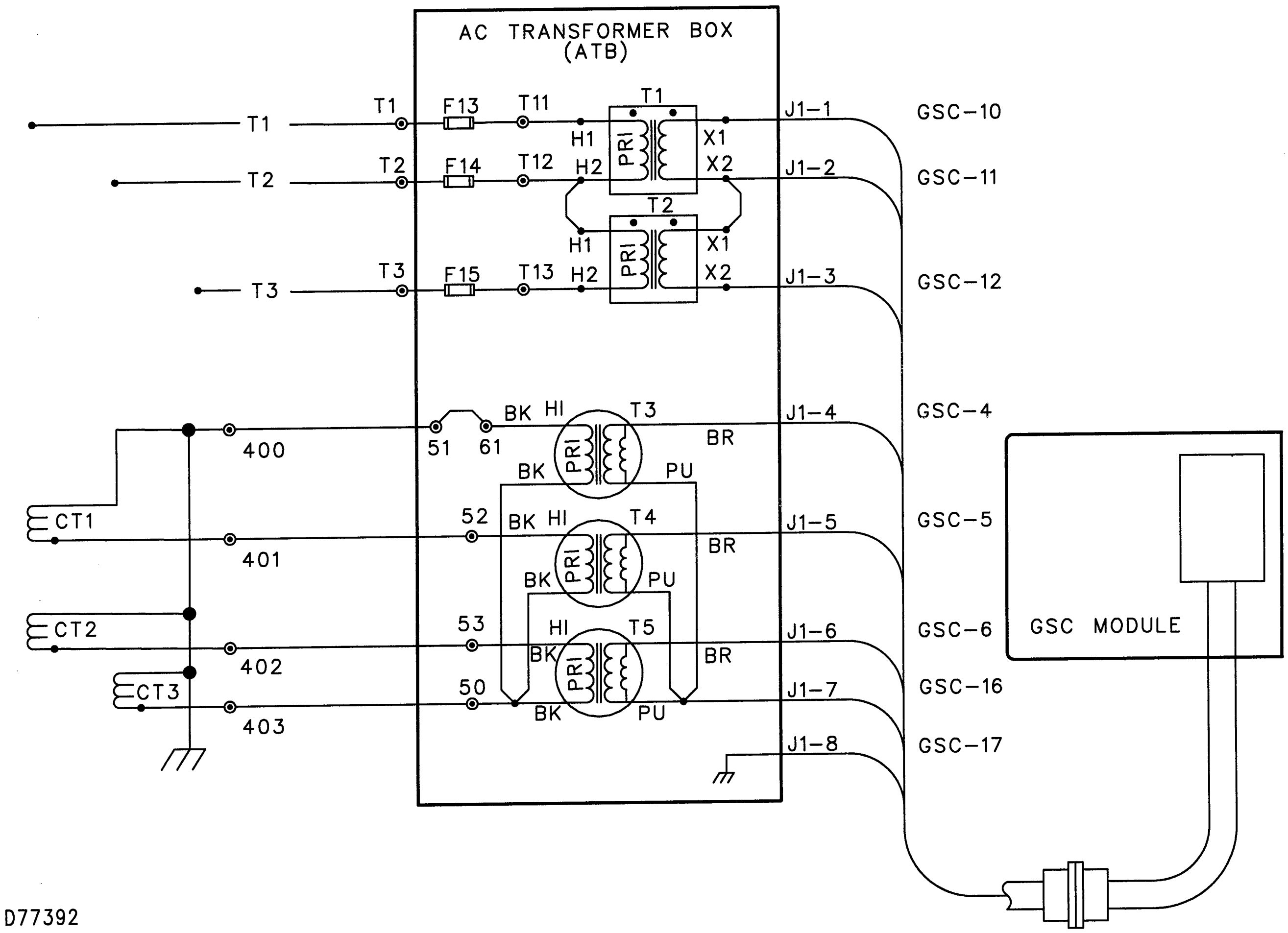
For ETS engines with mechanical governor, the engine runs at rated speed.

STEP 1. RESET THE GSC – Cycle circuit breaker 1, momentarily open the circuit breaker then close it, 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 system schematics 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 system schematic 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. Make sure that the shorting screws on the shorting terminal block are removed. 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). 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. Go 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 system schematic 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 $\pm$ 20 ohms.

- 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 system schematics 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.

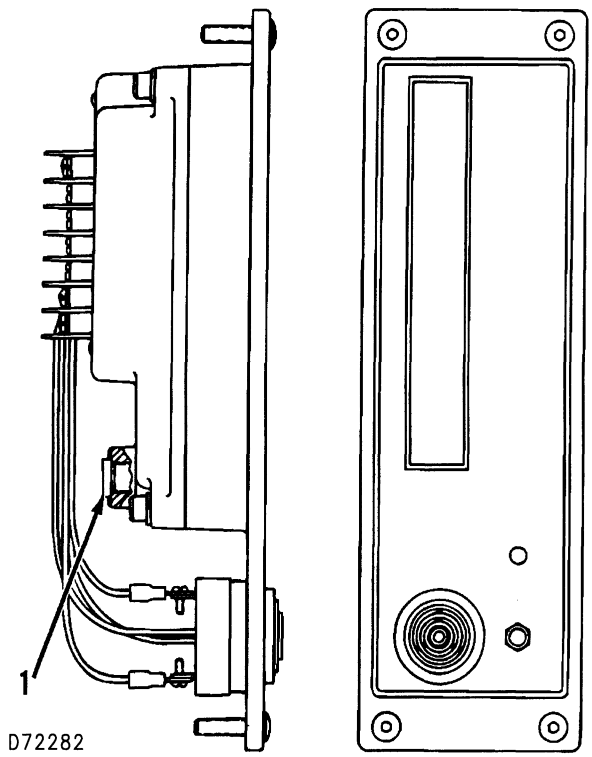
3. Visually Inspect Wiring. Look for worn or abraded wires. Check for pinched or damaged harnesses.

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.

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 the 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. Access the rear of the Alarm Module. (It is not necessary to remove the ALM unless removal is needed for access.) Do not disconnect terminal wires unless otherwise noted.

2. Remove the plug (1) to access the adjustment potentiometer. Because moisture can enter the ALM, remove the plug in a dry environment. If relative humidity exceeds 60%, remove the plug in an air conditioned area.

3. Disconnect the wires on terminals 1 and 7. Secure them so they can't touch each other, a ground or other electrical connection.

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.

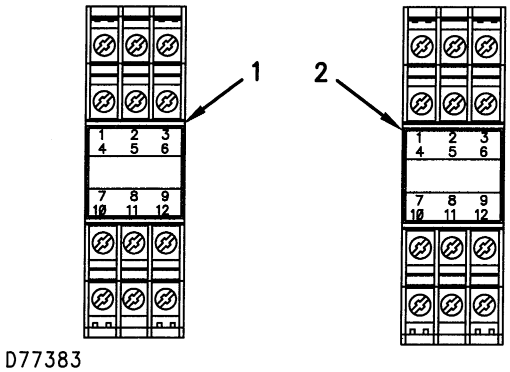
6. After a minute, the indicator on the ALM for low battery voltage flashes. Press the alarm silence switch. The low battery voltage indicator should now remain ON continuously.

7. Turn the adjustment potentiometer counterclockwise slowly until the low battery voltage indicator goes OFF.

8. Replace the plug.

9. Disconnect the variable PC power supply and reconnect the wires to terminals 1 and 7.

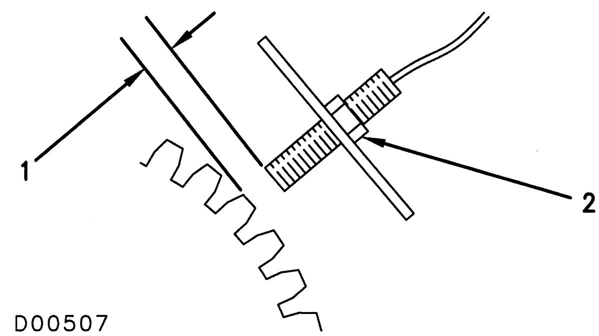
Annunciator and Flasher Modules



(1) Flasher module. (2) Annunciator module.

The annunciator and flasher modules work together to create an alarm and lamp alert condition. When an alarm condition occurs, an alarm latch is set in the annunciator, which creates a flashing signal. At this time, the horn driver relay is energized to sound the alarm horn. Once the signal is acknowledged, a second latch provides an electrical path to steadily illuminate the alarm lamp until the condition is rectified. When the condition no longer exists, both latches are reset.

Magnetic Pickup (MPU) Adjustment



Magnetic Pickup (MPU)
(1) Air gap. (2) Locknut.

The Magnetic Pickup adjustment can be completed following these steps:

1. Remove the magnetic pickup from the flywheel housing. Remove all debris from the tip of the magnetic pickup, and 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. Back the pickup out ¾ turn (270° counterclockwise).

4. Tighten locknut (2) to 25± 5 N•m (18± 4 lb ft).

NOTE: Do not allow the pickup to turn as the locknut 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: The Charging System Test procedures discussed on this page are for gensets equipped with alternators.

Test Procedure

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 alternator's positive output wire.

STEP 1. If the battery is already low in charge, skip Step 2 and go to Step 3. If not, disable the fuel solenoid or governor, shutting the fuel off and preventing the engine from starting. DO NOT disable the starting motor. Turn the engine control switch 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 two minutes to cool the starting motor. Crank the engine again for 30 seconds.

STEP 2. First, enable the fuel solenoid or governor disabled in Step 2. Then, start the engine and run at full throttle. If necessary, jump-start the engine or charge the batteries to start the engine.

STEP 3. 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 4. At full throttle, the specified alternator output voltage-after ten minutes-should be:

24V system 26.5 to 29.0 DCV
32V system 35.8 to 38.8 DCV (It could take more than ten minutes, depending on alternator rating, battery size and condition.)

STEP 5. With accessories turned OFF, the charging current should decrease to less than 10 amps (depending again upon battery and alternator capacities).

Magnetic Switch Test (24V)

The Starting Motor Magnetic Switch (SMMS) for 24V systems is mounted in a small enclosure on the engine. Two switches are employed in dual starting motor systems, one for each starting motor.

Test Procedure

Disconnect the jumper wire between terminals 4 and 5 in the switchgear. Measure the resistance between terminal 5 and terminal 2. The resistance should be:

26-33 ohms-single starter system 13-17 ohms-dual starter systems.

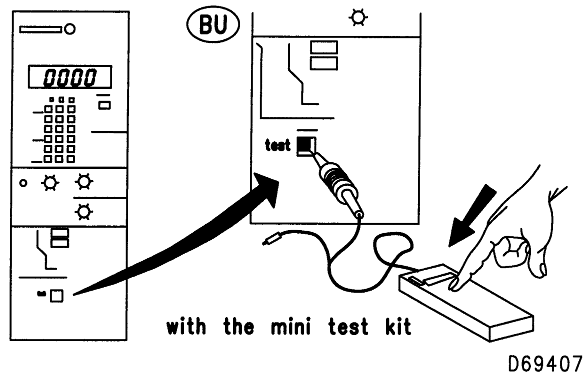
If the resistance is NOT correct, replace the defective magnetic switch. If resistance is correct, go to Step 2.

1. Disconnect the cable from the pinion solenoid to the starting motor. Disconnect from both motors of a dual system.
2. Connect a DC voltmeter. The positive goes to terminal 24, the negative to terminal 25 of TS1 in the generator housing. To test the second magnetic switch a dual starting motor system, connect the negative to terminal 26.
3. Connect a jumper wire from terminal 1 to terminal 5 of TS1. The correct measurement changes from ± 24 DCV to ± 2 DCV. Disconnect this wire immediately after the voltage is measured. DO NOT leave it connected for more than ten seconds.

If the voltage is greater than 2.0 DCV, replace the magnetic switch. If the switch passes the requirements of Step 1 and 4, it is functioning correctly.

Finally, reconnect the wires and cables that were removed in this procedure.

Circuit Breaker



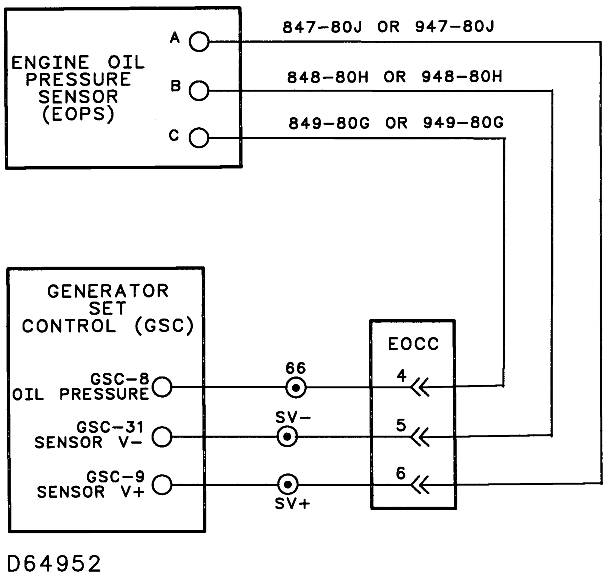
Test points on the front panel provide convenient access for monitoring probes. Setpoints for both the Long-Time Delay and the Instantaneous Delay selectors can be altered from the factory settings.

For further information about circuit breaker testing and adjustment, see the breaker manufacturer's manual included with Caterpillar Switchgear.

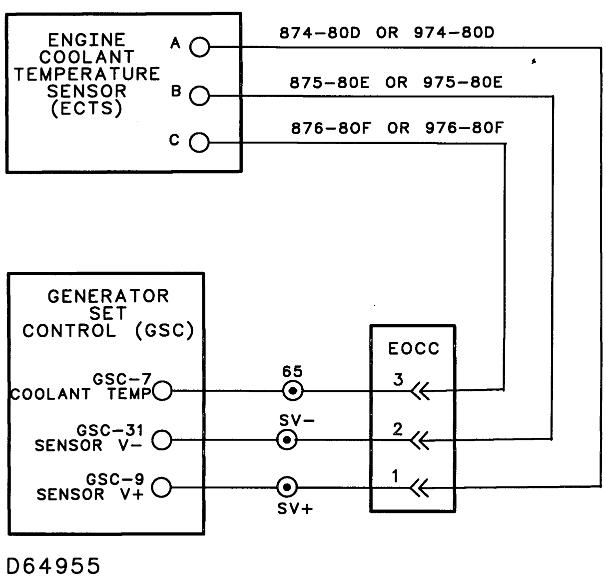
Protective Relay Adjustment

Protective relays have all been adjusted to operating standards at the factory, but each relay can be readjusted in the field when circumstances dictate. Refer to information specific to each relay in the documentation packet shipped with each switchgear.

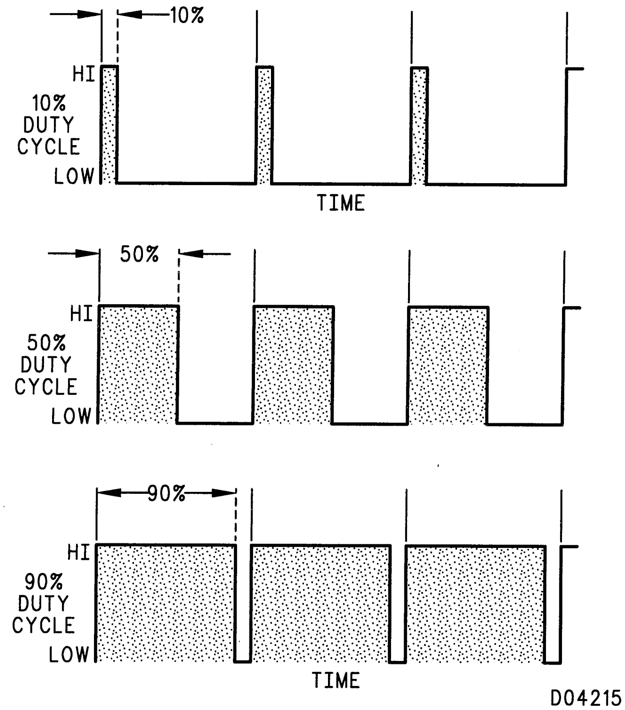
EMCP II PWM Sensor Adjustment



System Schematic For Engine Oil Pressure Sensor (EOPS)



System Schematic For Engine Coolant Temperature Sensor (ECTS)



Pulse Width Modulated (PWM) Signal

In addition to CID 100 and CID 110 troubleshooting (see Diagnostic Fault Code chart), you can measure the frequency and duty cycle of sensor signals for accuracy.

The Oil Pressure Sensor and the Coolant Temperature Sensor are pulse width (PWM) sensors. They produce a digital signal in which the duty cycle varies as conditions change. Meanwhile, 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. Go 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. Go to Step 4.
- NOT OK; the measurements DO NOT agree with the values listed in the Sensor Specifications chart. Go to Step 5.

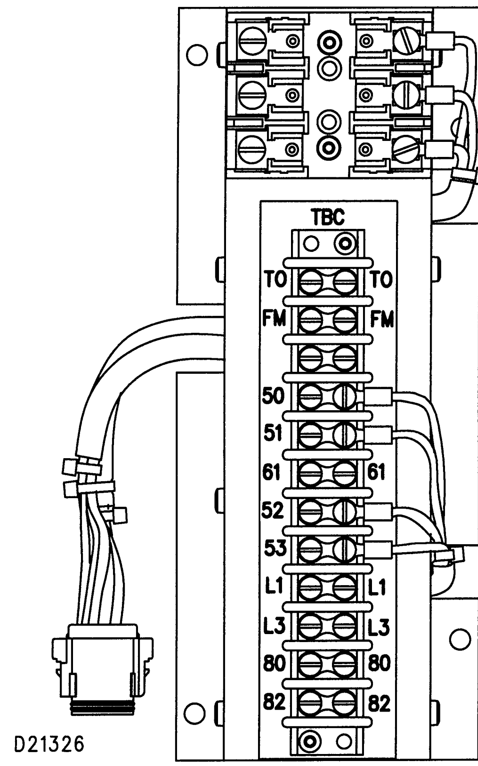
STEP 4. CHECK ENGINE HARNESS SIGNAL - Measure the frequency and duty cycle of the signal at the GSC harness connector. For the oil pressure signal, measure from contact 8 to contact 31. For the coolant temperature signal, measure from contact 7 to contact 31. The measured frequency and duty cycle should 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 Replacement



AC Transformer Box (ATB)

The AC Transformer Box is located on the sub-panel in the lower half of the switchgear. To replace the ATB, follow these procedures:

1. Shutdown the engine. Remove the positive lead wire from the battery.
2. Make sure that each wire at the terminal strip of the ATB is marked the respective terminal 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.

7. Program the bar code (calibration value) for the voltmeter/ammeter into the GSC. (See 5.a.1.)

8. If the genset is operating in parallel with another genset, reprogram the AC calibration to make the voltmeter values match.

Generator Set Control 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 4 mm 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.

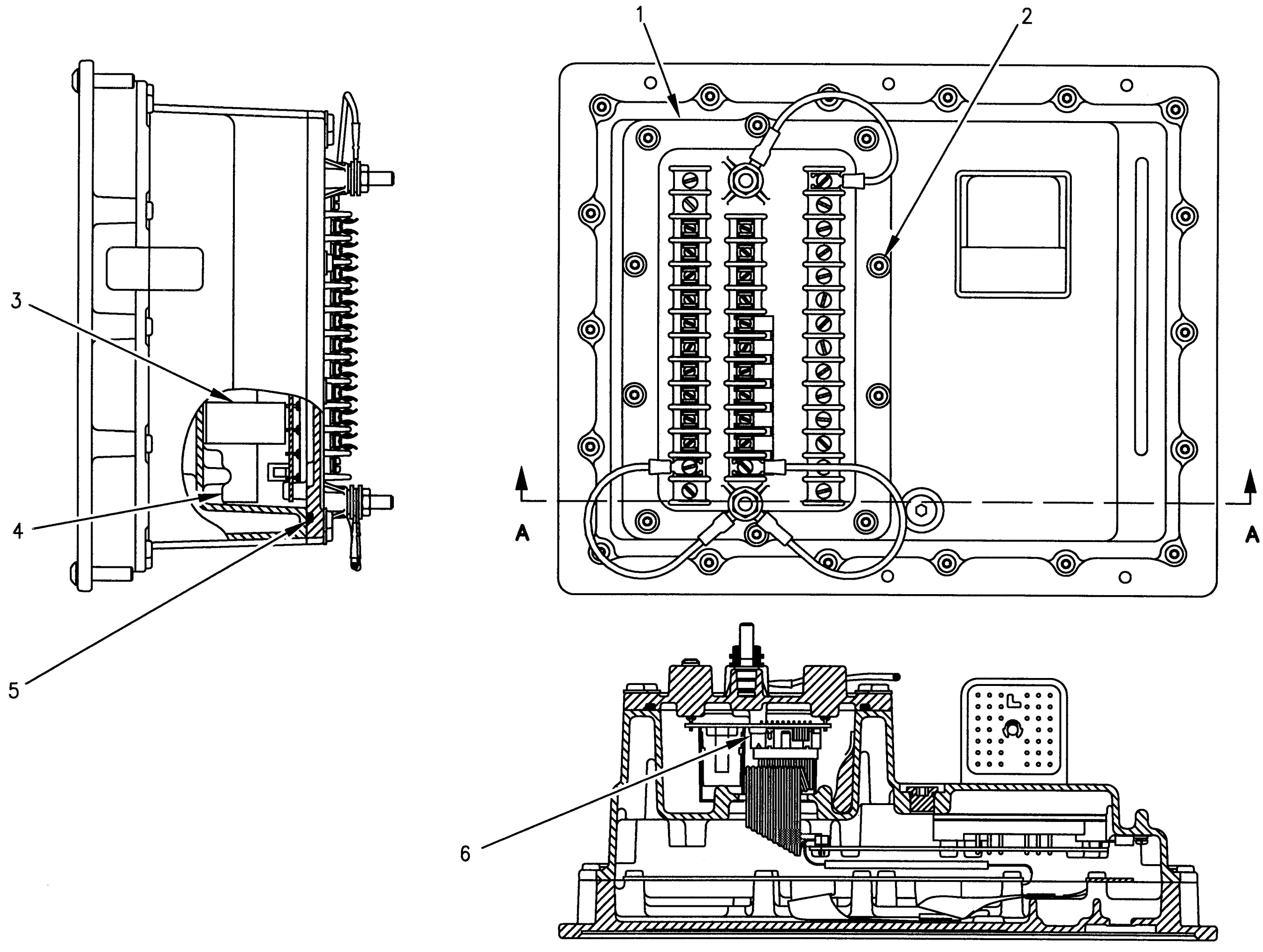
5. Remove the six nuts that fasten the GSC to the instrument door. Remove the GSC.

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. If the original values are not available, reprogram using the setpoints of the 103-1582 Chart.

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.

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

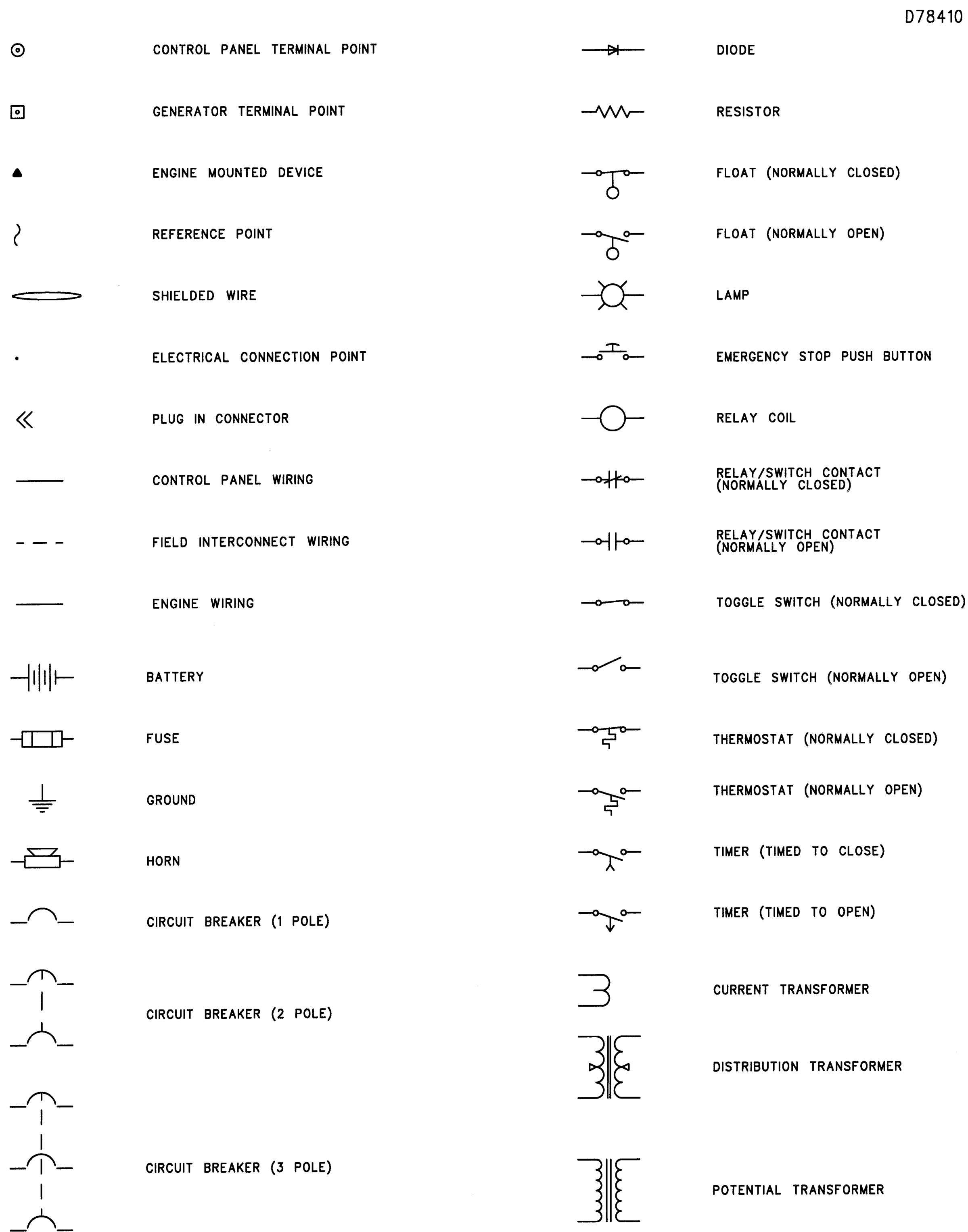
15	AUTOMATIC SYNCHRONIZER
25	SYNCHRONIZATION CHECK RELAY
27	UNDER VOLTAGE RELAY
27L	UNDER VOLTAGE LAMP
32	REVERSE POWER RELAY
32L	REVERSE POWER LAMP
4Ø	LOSS OF EXCITATION RELAY
4ØL	LOSS OF EXCITATION LAMP
46	CURRENT IMBALANCE RELAY
46L	CURRENT IMBALANCE LAMP
46T	CURRENT IMBALANCE TIMER
47	UNDERVOLTAGE/PHASE SEQUENCE RELAY
51G	GROUND OVER CURRENT RELAY
51L	OVER CURRENT LAMP
51X	UTILITY BRKR OVER CURRENT AUX RELAY
52	MAIN CIRCUIT BREAKER
59	OVER VOLTAGE RELAY
59L	OVER VOLTAGE LAMP
65	GOVERNOR
81	UNDER FREQUENCY RELAY
81O	OVER FREQUENCY RELAY
81OL	OVER FREQUENCY LAMP
81O/U	OVER/UNDER FREQUENCY RELAY
81UL	UNDER FREQUENCY LAMP
86	LOCK-OUT RELAY
87	MACHINE DIFFERENTIAL RELAY
9Ø	VOLTAGE REGULATOR
9ØL	VOLTAGE REGULATOR FAULT LAMP
A	AMPERE
ACK	ACKNOWLEDGE
ACM	AC METER
ACNT	ANALOG CONNECTOR
ACS	ALARM CONTROL SWITCH
ADS	AIR DAMPER SWITCH
ASL	AUTO START LAMP
ALM	ALARM MODULE
ALT	ALTERNATOR
AN	ANNUNCIATOR MODULE
ASOS	AIR SHUT-OFF SOLENOID
ASR	AIR SHUT-OFF RELAY
ASSS	AUTO START-STOP SWITCH
ASTR	AUTO START RELAY
ATB	AC TRANSFORMER BLOCK
BC	BATTERY CHARGER
BCA	BATTERY CHARGER AMMETER
BCF	BATTERY CHARGER FAILURE
BPT	BUS POTENTIAL TRANSFORMER
C	CAPACITOR
CAR	COMMON ALARM RELAY
CB	CIRCUIT BREAKER
CBCL	CIRCUIT BREAKER CLOSE LAMP
CBCR	CIRCUIT BREAKER CLOSE RELAY
CBOL	CIRCUIT BREAKER OPEN LAMP
CBR	CIRCUIT BREAKER RELAY
CBS	CIRCUIT BREAKER SWITCH
CCM	CUSTOMER COMMUNICATION MODULE
CDL	COOL DOWN LAMP
CDTR	COOL DOWN TRIP RELAY
CIM	CUSTOMER INTERFACE MODULE
CLFLS	CRITICAL LOW FUEL LEVEL SWITCH
CPT	CIRCUIT BREAKER POWER TRANSFORMER
CT	CURRENT TRANSFORMER
CTR	CRANK TERMINATE RELAY
D	DIODE
DBR	DEAD BUS RELAY
DC LTS	DC LIGHTS
DCPS	DC POWER SUPPLY
DCT	DROOP CURRENT TRANSFORMER
DIS	BASE LOAD MODULE
DT	DISTRIBUTION TRANSFORMER
DTCB	DISTRIBUTION TRANSFORMER CIRCUIT BREAKER
ECS	ENGINE CONTROL SWITCH
EFCR	ELECTRICAL FAULT COOL DOWN RELAY
EFCRX	ELECTRICAL FAULT COOL DOWN RELAY
EGA	ENGINE GOVERNOR ACTUATOR
EGR	ENGINE GOVERNOR RELAY
ESPB	EMERGENCY STOP PUSH-BUTTON
ESR	ENABLE SENSOR RELAY
F	FUSE
FCR	FUEL CONTROL RELAY
FES	FLOAT EQUALIZE SWITCH
FL	FLASH SIGNAL
FM	FLASHER MODULE
FPL	FAILED PARALLEL LAMP
FPT	FAILED PARALLEL TIMER
FSOS	FUEL SHUT-OFF SOLENOID
GFR	GENSET FAULT RELAY
GND	GROUND
GSC	GENERATOR SET CONTROL
GSR	GENERATOR SYNCHRONIZE RELAY
HRN	HORN SIGNAL
IC	INITIATE START
IDS	ISOC/DROOP SWITCH
IRS	IDLE/RATED SWITCH
JWHR	JACKET WATER HEATER RELAY
LCS	LOUVER CONTROL SWITCH
LCT	LOUVER CLOSE TIMER
LDR	LOUVER DRIVER RELAY
LFLAS	LOW FUEL LEVEL ALARM SWITCH
LOAL	LOW OIL ALARM LAMP
LOLAS	LOW OIL LEVEL ALARM SWITCH
LOLS	LOW OIL LEVEL SWITCH

D78399

LOT	LOUVER OPEN TIMER
LPR	LOUVER POSITION RELAY
LTR	LAMP TEST RELAY
LWLAS	LOW WATER LEVEL ALARM SWITCH
MFM	MULTI FUNCTION METER
MLP	MANUAL LOADING POT
MLPS	MANUAL LOADING POWER SUPPLY
MPU	MAGNETIC SPEED PICKUP
MRUS	MANUAL RETURN TO UTILITY SWITCH
NEU	NEUTRAL
OFHL	OIL FIRED HEATER ON LAMP
OFHS	OIL FIRED HEATER SWITCH
OIU	OPERATOR INTERFACE UNIT
ORR	OFF/RESET RELAY
P	PLUG-IN CONNECTOR
PAR	UTILITY PARALLELING RELAY
PFM	POWER FACTOR METER
PFTD	POWER FACTOR TRANSDUCER
PLBL	PLC BATTERY LOW LAMP
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLCL	PLC RUNNING LAMP
PLCR	PLC RUNNING RELAY
PP	PRELUBE PUMP
PPMS	PRELUBE PUMP MAGNETIC SWITCH
PPPS	PRELUBE PUMP PRESSURE SWITCH
PS	PINION SOLENOID
PT	POTENTIAL TRANSFORMER
PUR	PRIMARY UNIT RELAY
R	RESISTOR
RCP	RECEPTACLE
RCS	REMOTE CONTROL SWITCH
REA	REACTOR
RR	RUN RELAY
RRX	RUN RELAY
RUL	RETURN TO UTILITY LAMP
SA	SURGE ARRESTOR
SAP	SPEED ADJUST POTENTIOMETER
SAR	SYSTEM IN AUTO RELAY
SBS	STAND BY SWITCH
SDL	SENSORS DISABLED LIGHT
SDR	SHUT DOWN RELAY
SDRX	SHUT DOWN RELAY
SH	SPARE HEATER
SL	SYNCHRONIZING LAMP
SM	STARTER MOTOR
SMMS	STARTER MOTOR MAGNETIC SWITCH
SMR	STARTER MOTOR RELAY
SPR	SPARE
SR	SLAVE RELAY
SS	SYNCHRONIZING SWITCH
SSR	SYNCHRONIZER SELECT RELAY
STPR	STOP RELAY
SYNC	SYNCHRONIZING SCOPE

TB	TERMINAL BLOCK
TDBCR	TIME-DELAY BRKR CLOSE RELAY
TDUBC	TIME-DELAY UTILITY BRKR CLOSE
THM	THERMOSTAT
TMR	TIMER
TP	TERMINAL POINT, TRIM POTENTIOMETER
TR	TRIP RELAY
TRP	TRIM POT
TST	TEST SIGNAL
UBCL	UTILITY BREAKER CLOSED LAMP
UBOL	UTILITY BREAKER OPEN LAMP
UCBR	UTILITY CIRCUIT BREAKER RELAY
UCR	UTILITY CLOSE RELAY
ULOL	UTILITY LOCK-OUT LAMP
ULOR	UTILITY LOCK-OUT RELAY
UPT	UTILITY POTENTIAL TRANSFORMER
USL	UTILITY SYNC LIGHTS
USS	UTILITY SYNC SWITCH
UTR	UTILITY TRIP RELAY
UTTL	UTILITY TRANSFER TRIP LAMP
UTTR	UTILITY TRANSFER TRIP RELAY
UTTS	UTILITY TRANSFER TRIP RESET SWITCH
VAP	VOLTAGE ADJUST POTENTIOMETER
VARM	VOLT-AMP REACTIVE METER
VARTD	VOLT-AMP REACTIVE TRANSDUCER
VBR	VOLTAGE BUILD-UP RELAY
VBT	VOLTAGE BUILD-UP TIMER
VCR	VOLTAGE CONTROL RELAY
VDC	VOLTS DC
VDR	VOLTAGE DROOP RHEOSTAT
VPAP	VAR/PWR FACTOR ADJUST POT
VPC	VAR/PWR FACTOR CONTROLLER
VRAR	VOLTAGE REGULATOR ALARM RELAY
VRFR	VOLTAGE REGULATOR FAULT RELAY
WHI	WATT-HOUR INTEGRATOR
WM	WATT METER
WTD	WATT TRANSDUCER
XVR	CHANGE OVER RELAY
XVTD	CHANGE OVER TIME DELAY

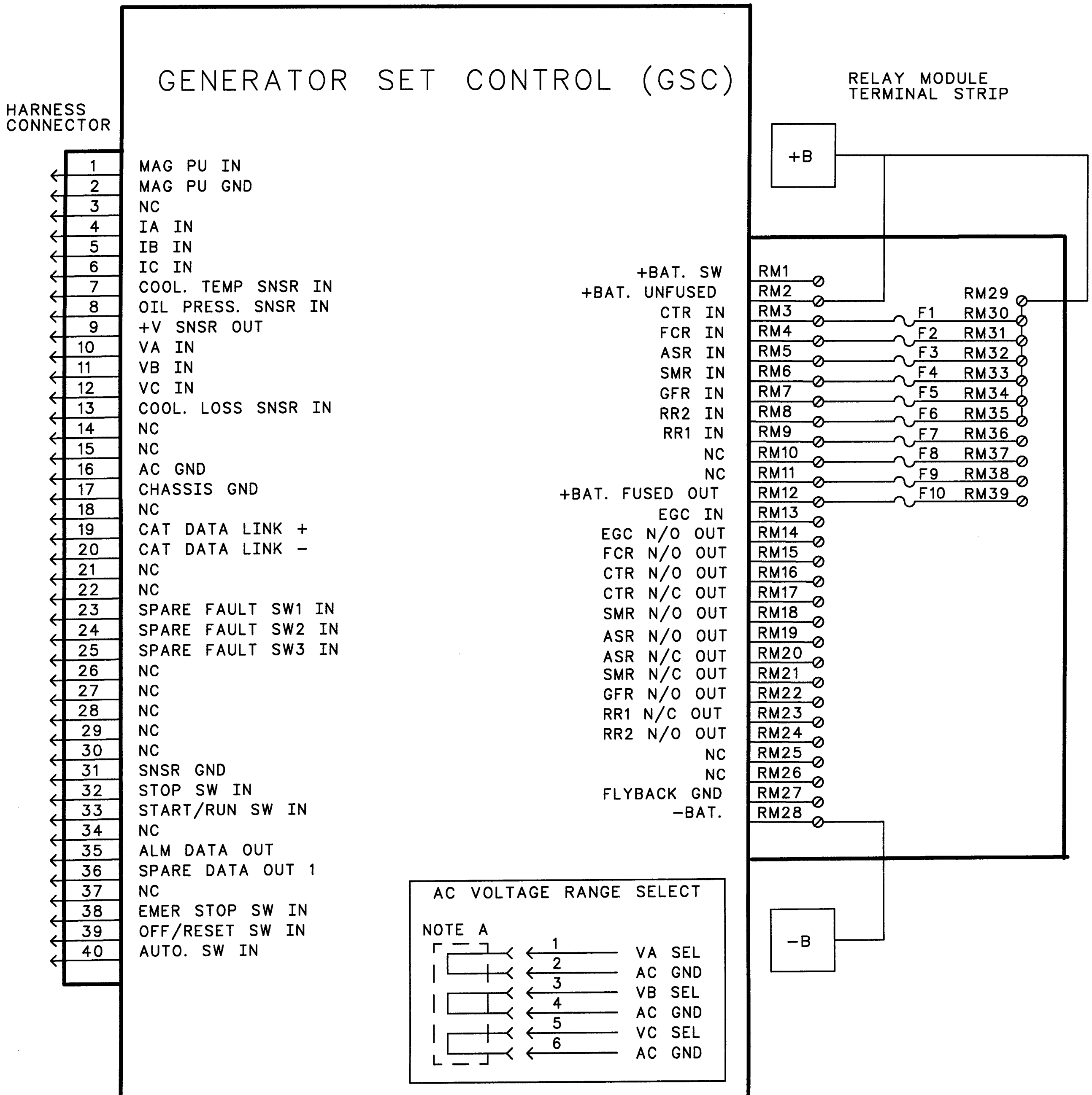
D78400


D78410
CONTROL PANEL TERMINAL POINT
GENERATOR TERMINAL POINT
ENGINE MOUNTED DEVICE
REFERENCE POINT
SHIELDED WIRE
ELECTRICAL CONNECTION POINT
PLUG IN CONNECTOR
CONTROL PANEL WIRING
FIELD INTERCONNECT WIRING
ENGINE WIRING
BATTERY
FUSE
GROUND
HORN
CIRCUIT BREAKER (1 POLE)
CIRCUIT BREAKER (2 POLE)
CIRCUIT BREAKER (3 POLE)
DIODE
RESISTOR
FLOAT (NORMALLY CLOSED)
FLOAT (NORMALLY OPEN)
LAMP
EMERGENCY STOP PUSH BUTTON
RELAY COIL
RELAY/SWITCH CONTACT (NORMALLY CLOSED)
RELAY/SWITCH CONTACT (NORMALLY OPEN)
TOGGLE SWITCH (NORMALLY CLOSED)
TOGGLE SWITCH (NORMALLY OPEN)
THERMOSTAT (NORMALLY CLOSED)
THERMOSTAT (NORMALLY OPEN)
TIMER (TIMED TO CLOSE)
TIMER (TIMED TO OPEN)
CURRENT TRANSFORMER
DISTRIBUTION TRANSFORMER
POTENTIAL TRANSFORMER

SERVICE TABLE – RECORD OF SETPOINT VALUES					
Generator Description: Site, Serial No., EMCP II Model 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 [3]			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 40000A	600A
P22 [4]			GSC Engine Number	01 to 08	01
P23 [4]			Engine Type	0 = MUI diesel, 2 = EUI diesel, 1 = spark ignited	0
P24 [4]			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. Photocopy this table. Using the EMCP II Model No. and the Chart Print within the EMCP II, write the specified value of the setpoints in the appropriate space of this table. Then, store this table with the Chart Print within the EMCP II.

[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.
[3] P08 is engine type (0 = diesel, 1 = spark ignited) on former 103-6177, 113-4500 and 117-6200 GSC's.
[4] Not present on former 103-6177, 113-4500 and 117-6200 GSC's.

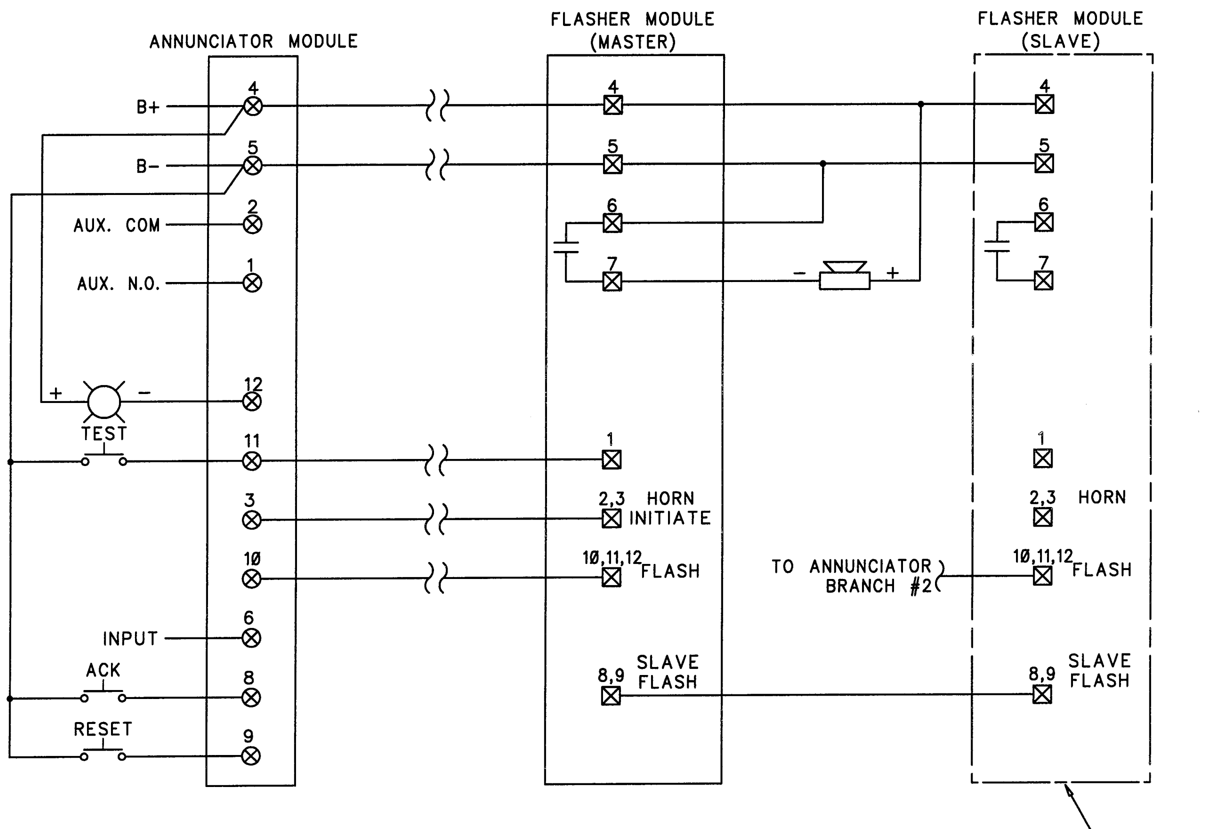


ABBREVIATIONS

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
ASR – AIR 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.

D01491



DESCRIPTION:

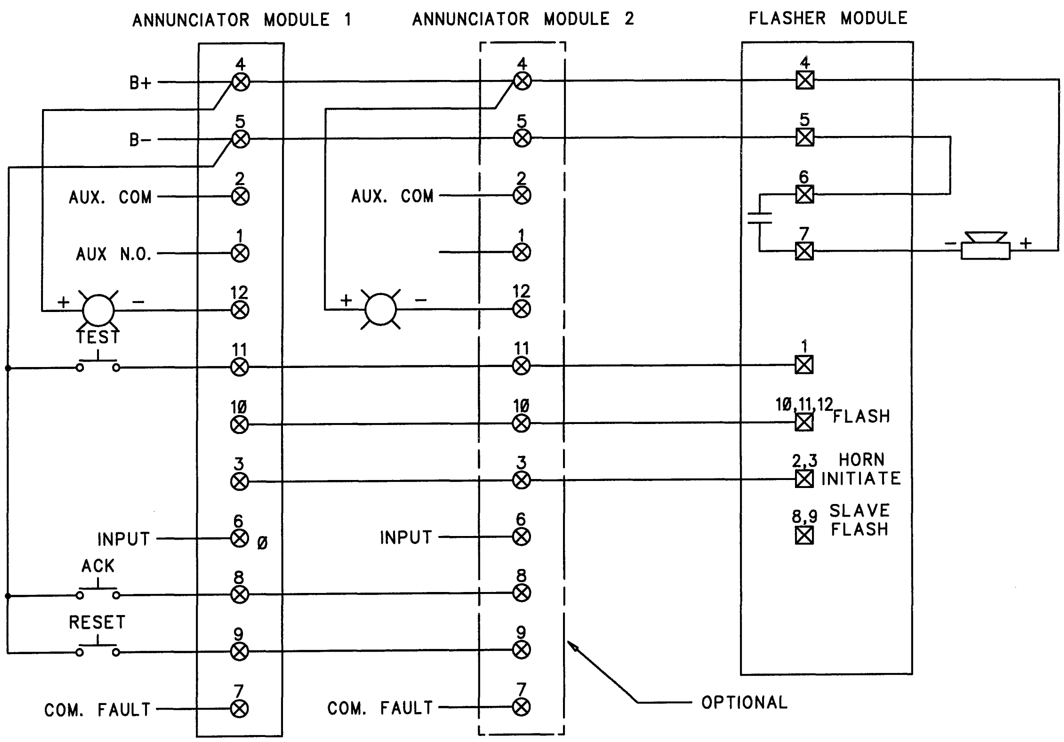
WHEN POWER IS APPLIED TO THIS UNIT, THE OUTPUT FLASHES AT A 2HZ RATE. THIS OUTPUT PROVIDES A GROUND PATH FOR THE LOAD. THE INPUT REQUIRES A GROUND SIGNAL WHICH ENERGIZES THE HORN RELAY TO DRIVE THE ALARM HORN. WHEN THE GROUND PATH IS LOST, THE ALARM HORN WILL DISENGAGE.
NOTE: FOR PROPER OPERATION, INTERNAL DIP SWITCHES MUST BE CONFIGURED CORRECTLY.

DIP SWITCH SETTINGS

SENSE	S1	S2
SLAVE OPERATION	O	–
MASTER OPERATION	X	–

X = CLOSED
Ø = OPEN
– = UNUSED

D78444



DESCRIPTION:

UPON RECEIPT OF THE ALARM CONDITION, AN ALARM LATCH IS SET. THIS ALLOWS A 2 HERTZ GROUND SIGNAL TO BE PROVIDED TO THE LOAD AND THE HORN DRIVER RELAY WILL ENERGIZE. ONCE THE SIGNAL IS ACKNOWLEDGED, A SECOND LATCH WILL ALLOW A CONSTANT PATH TO GROUND FOR THE LOAD. WHEN THE SYSTEM IS RESET, BOTH LATCHES ARE RESET. IF AN ALARM CONDITION NO LONGER EXISTS, THE LOAD WILL NO LONGER HAVE A PATH TO GROUND. A LAMP TEST WILL PROVIDE A CONSTANT PATH TO GROUND FOR FOR THE LOAD. NOTE: FOR PROPER OPERATION, INTERNAL DIP SWITCHES MUST BE CONFIGURED CORRECTLY.

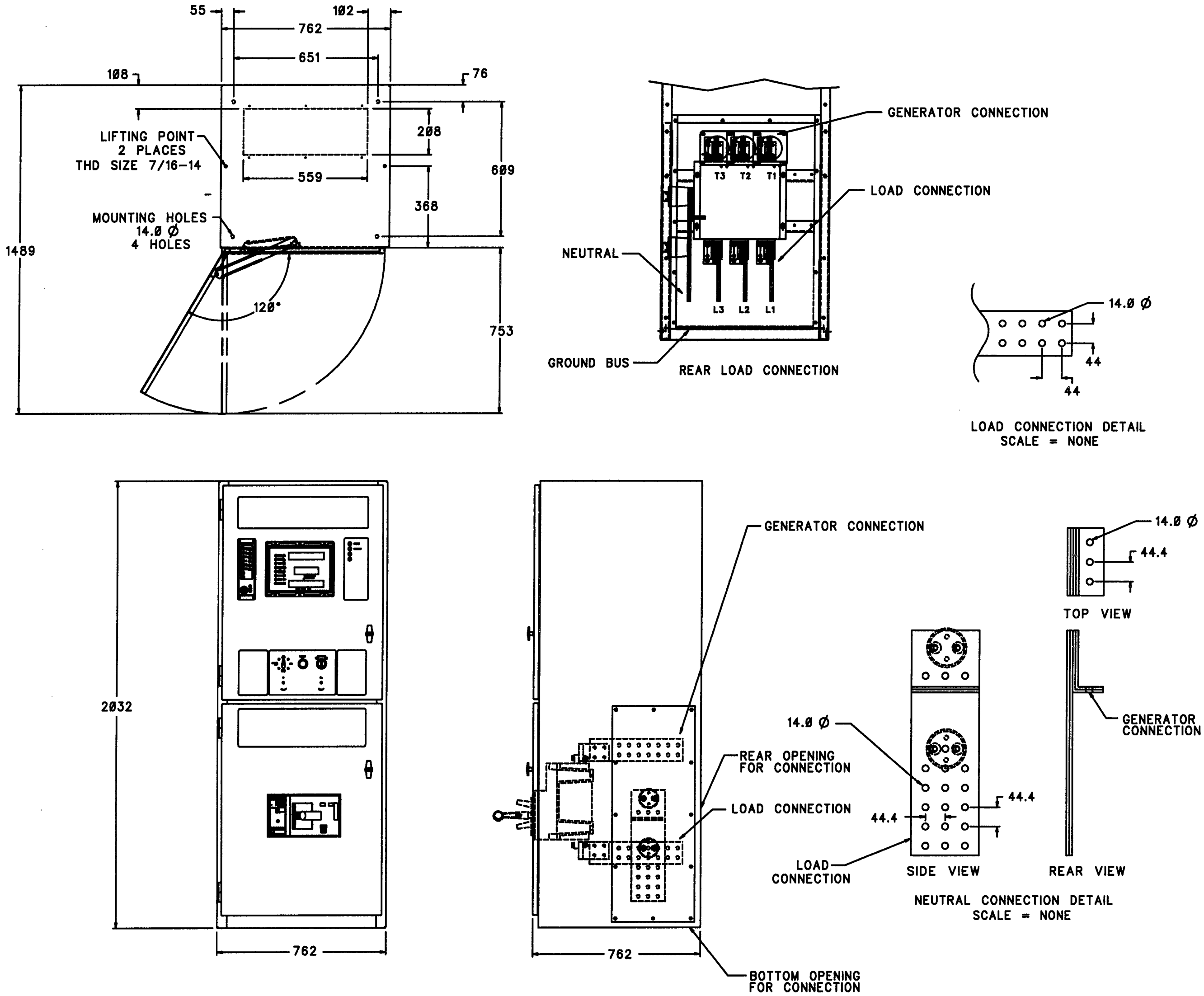
DIP SWITCH SETTINGS

SENSE		S1	S2	S3	S4	S5
B+ ⊗6	POS. N.O. LOGIC	Ø	X	X	Ø	X
B− ⊗6	NEG. N.O. LOGIC	X	Ø	Ø	X	Ø
B+ ⊗6	POS. N.C. LOGIC	X	Ø	X	Ø	Ø

X = CLOSED
Ø = OPEN

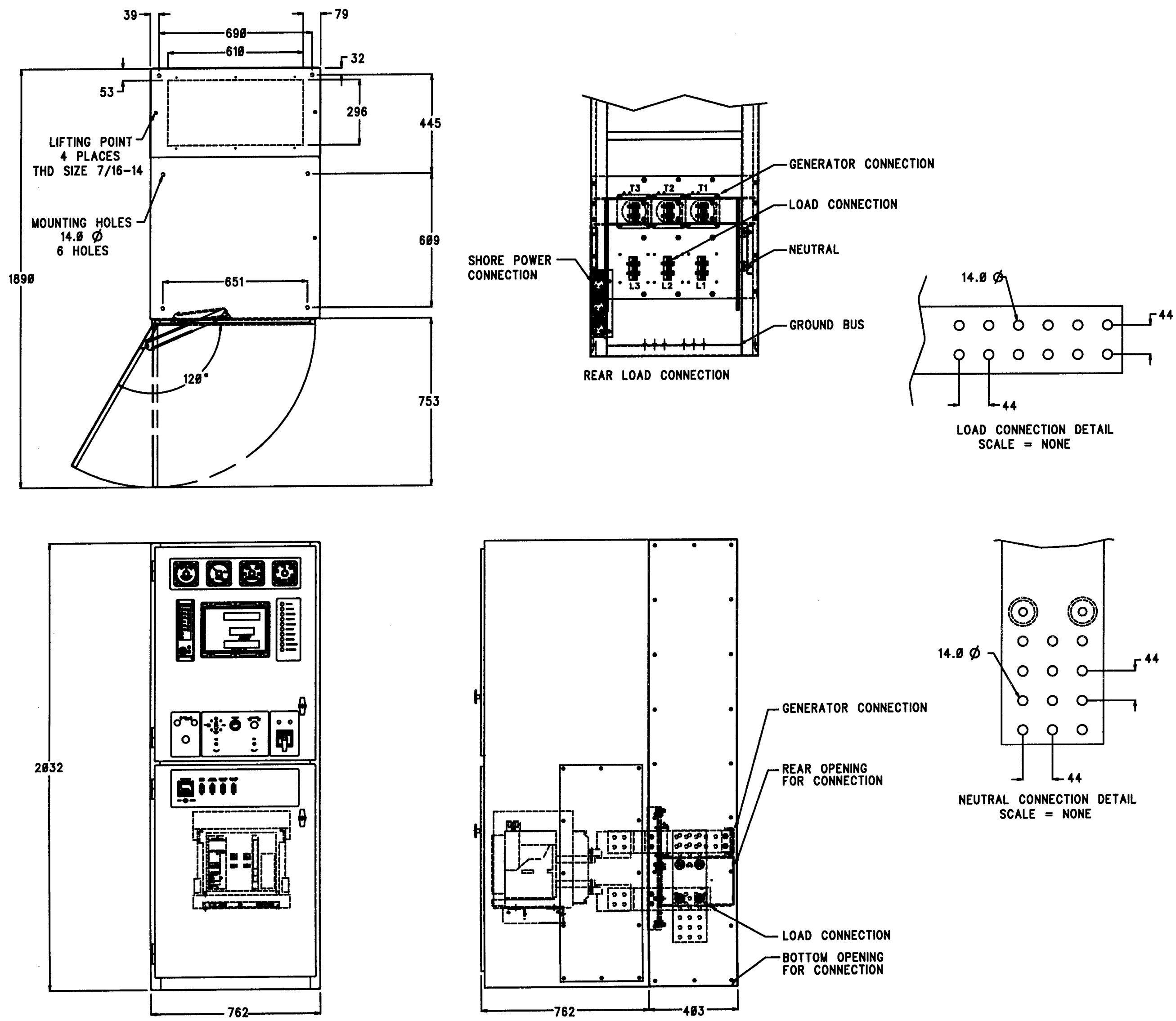
D78446

Base Unit Drawing



D78750

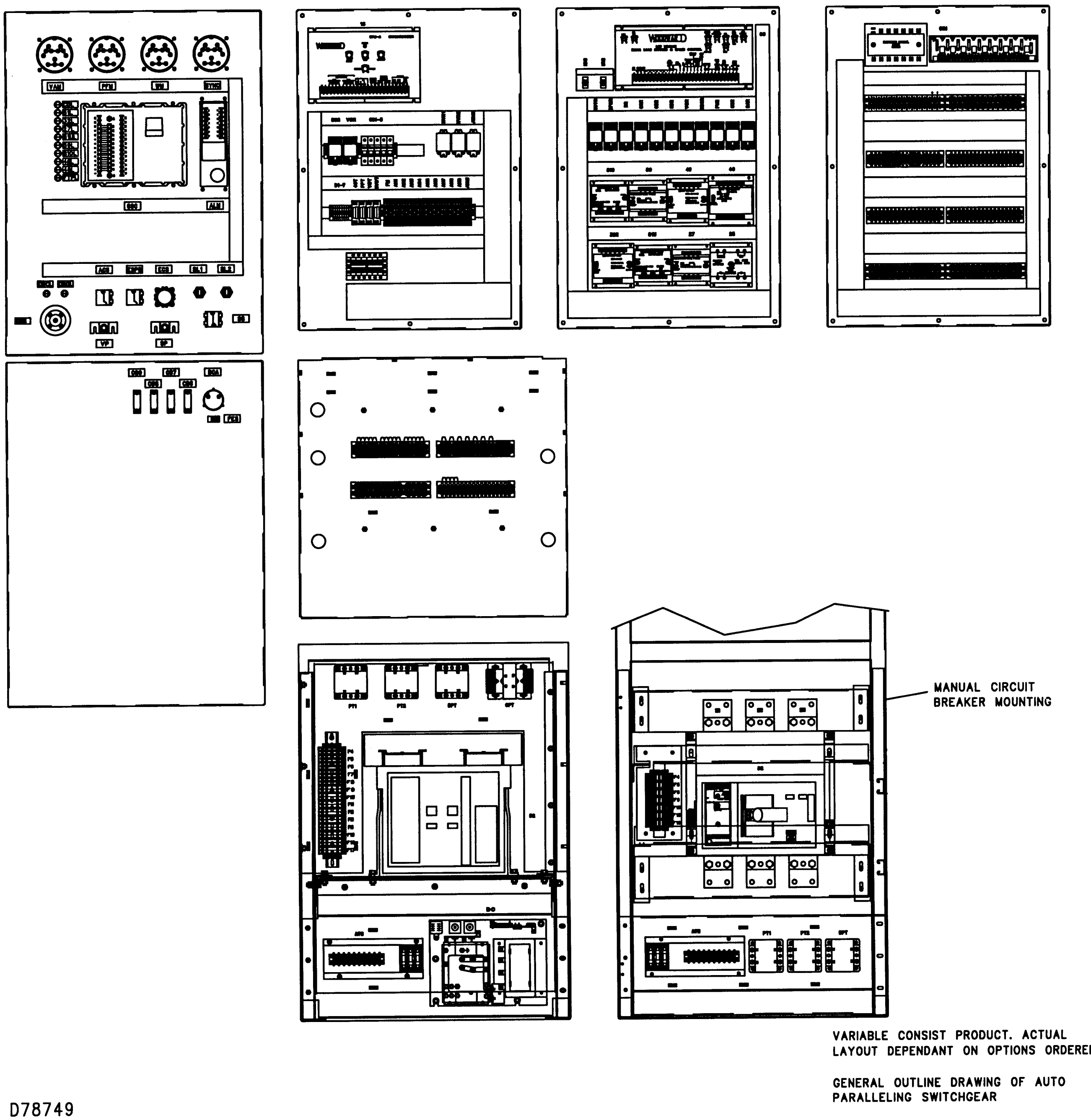
GENERAL OUTLINE DRAWING OF BASIC SWITCHGEAR
NOT TO BE USED FOR CONSTRUCTION PURPOSES

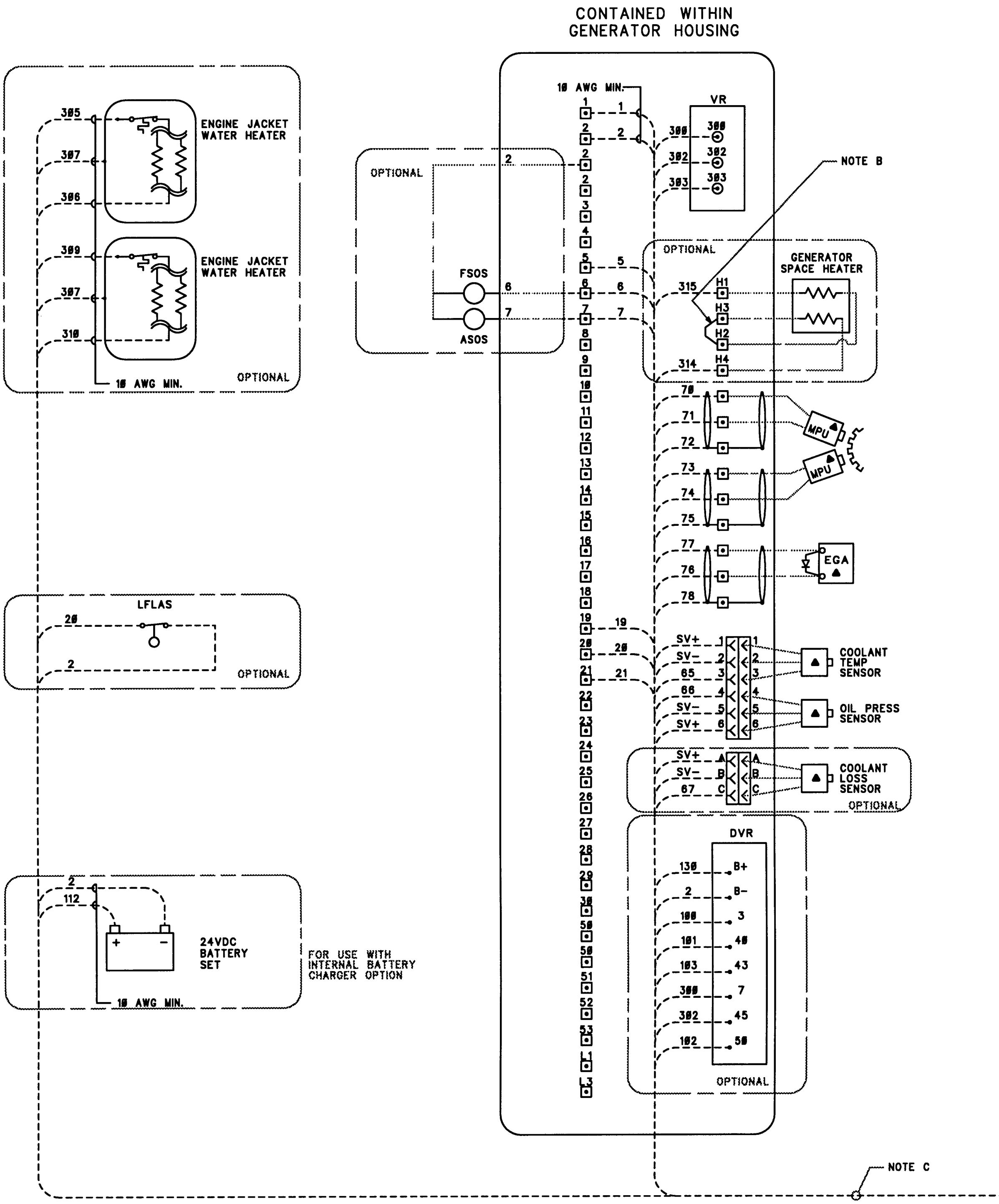


D78751

GENERAL OUTLINE DRAWING OF LOADED
AUTO PARALLELING SWITCHGEAR
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Internal View

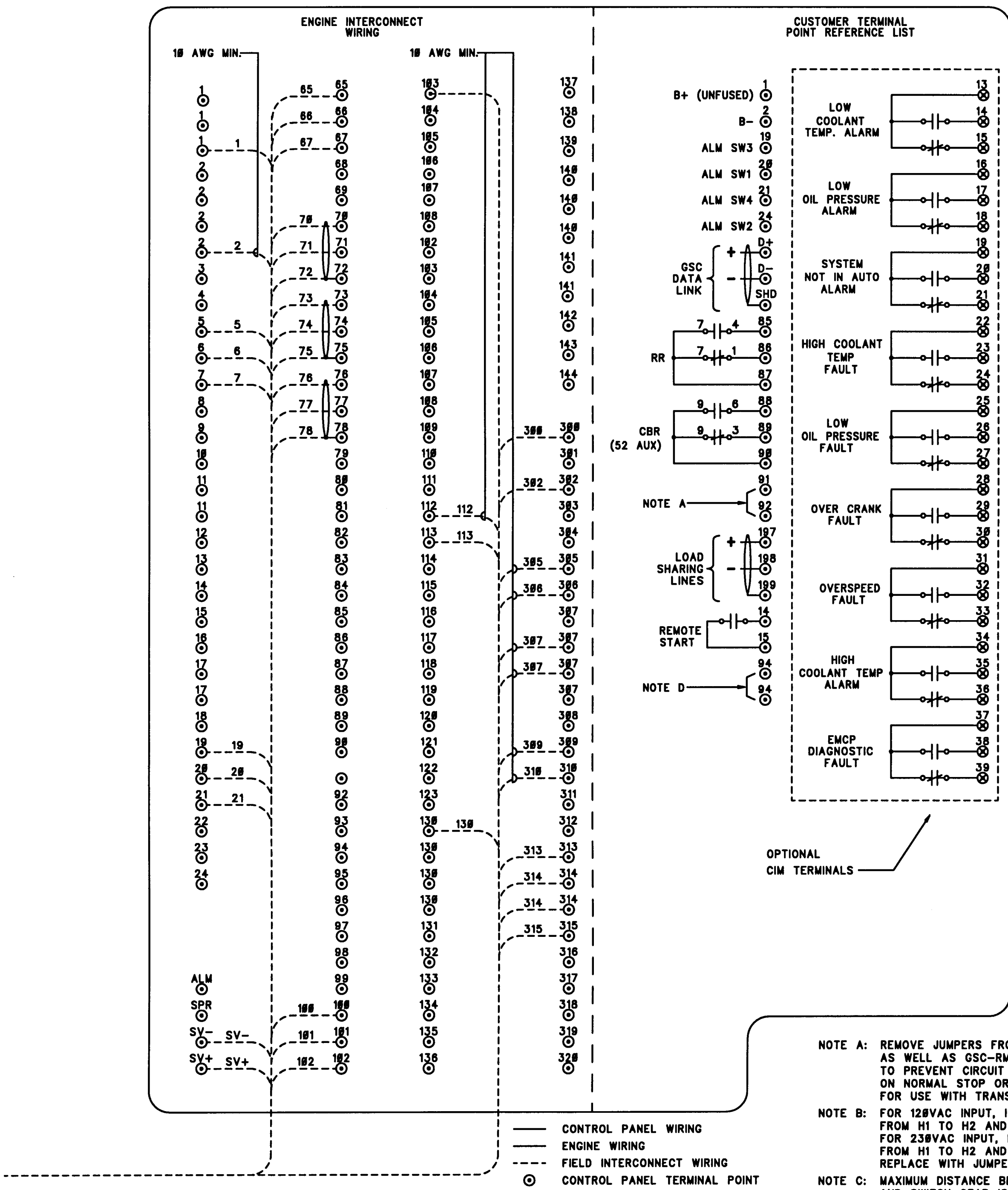



CONTAINED WITHIN GENERATOR HOUSING
ENGINE JACKET WATER HEATER
ENGINE JACKET WATER HEATER
OPTIONAL
10 AWG MIN.
LFLAS
OPTIONAL
24VDC BATTERY SET
FOR USE WITH INTERNAL BATTERY CHARGER OPTION
OPTIONAL
FSOS
ASOS
VR
NOTE B
GENERATOR SPACE HEATER
MPU
MPU
EGA
COOLANT TEMP SENSOR
OIL PRESS SENSOR
COOLANT LOSS SENSOR
DVR
NOTE C

D70542

D70543

CONTAINED WITHIN SWITCHGEAR



——— CONTROL PANEL WIRING
——— ENGINE WIRING
- - - - FIELD INTERCONNECT WIRING
⊙ CONTROL PANEL TERMINAL POINT
⊡ GENERATOR TERMINAL POINT
▲ DENOTES ENGINE MOUNTED DEVICES

NOTE A: REMOVE JUMPERS FROM TB91 TO TB92 AS WELL AS GSC-RM22 TO GSC-RM23 TO PREVENT CIRCUIT BREAKER TRIP ON NORMAL STOP OR COOLDOWN FOR USE WITH TRANSFER SWITCH

NOTE B: FOR 120VAC INPUT, INSTALL JUMPERS FROM H1 TO H2 AND H3 TO H4. FOR 230VAC INPUT, REMOVE JUMPERS FROM H1 TO H2 AND H3 TO H4 AND REPLACE WITH JUMPER FROM H2 TO H3.

NOTE C: MAXIMUM DISTANCE BETWEEN GENERATOR AND SWITCH GEAR IS 50 FEET

NOTE D: PRIMARY UNIT JUMPER

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