

Service Manual

Electronic Modular Control Panel II+ (EMCP II+) For PEEC Engines

136-9048

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.



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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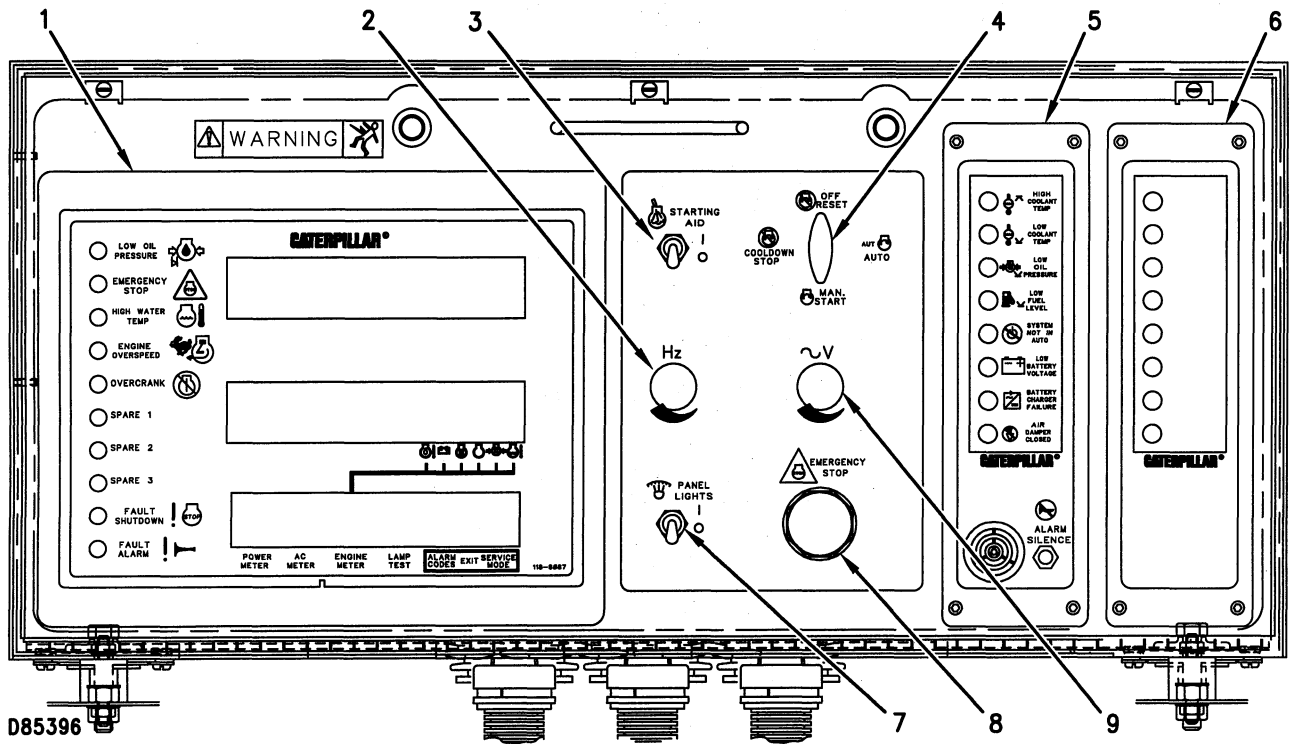
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Related EMCP II+ Service Literature

- SEBU6874, Owner's Manual, Customer Communication Module For EMCP II
- The Engine Electronic Troubleshooting Manual For The Engine Being Tested

Systems Operation

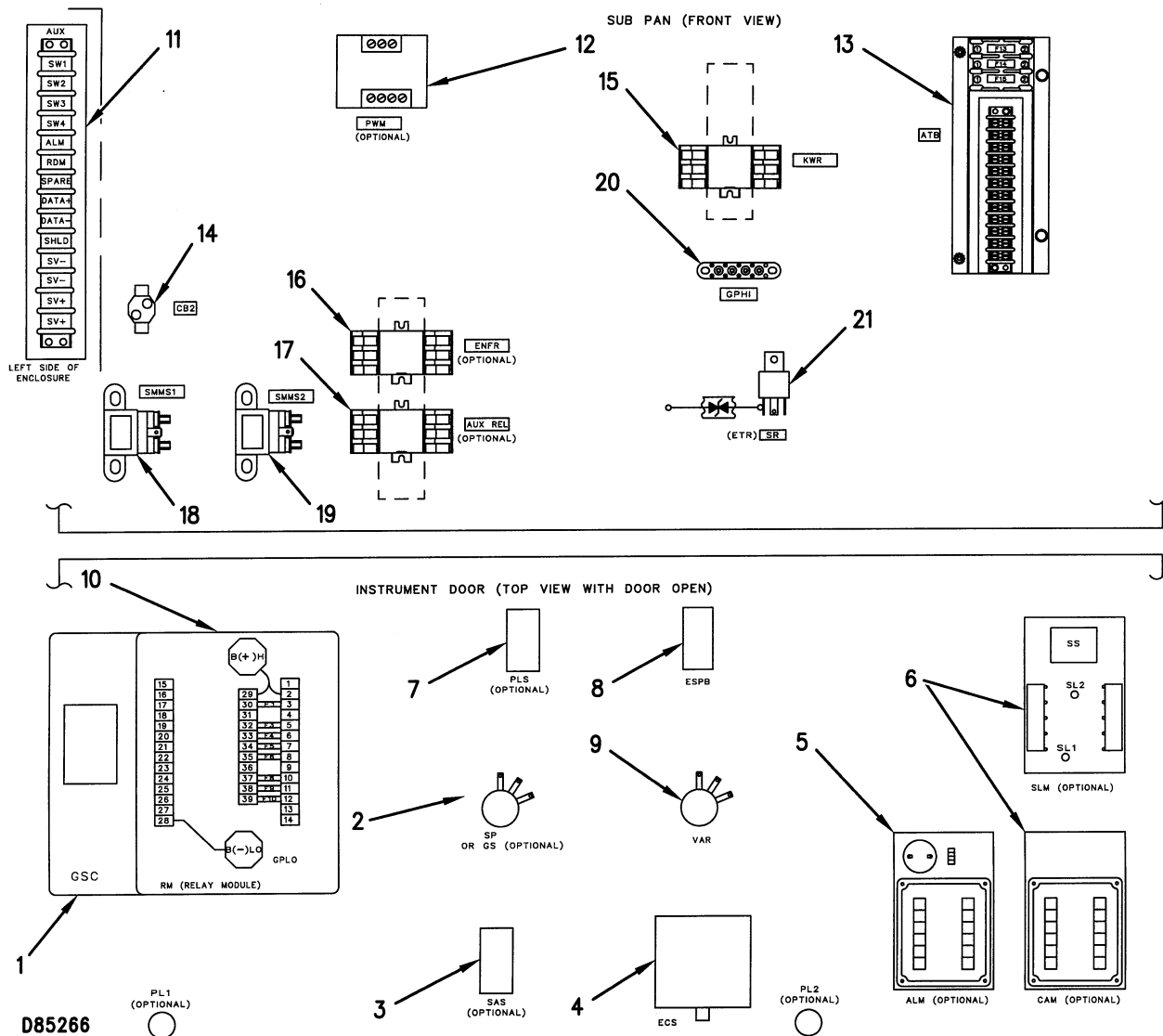
Location Of EMCP II+ System Components



Instrument Panel

- (1) GSC+; generator set control +.
- (2) SP; speed potentiometer.
or GS; governor switch (optional).
- (3) SAS; start aid switch (optional).
- (4) ECS; engine control switch.
- (5) ALM; alarm module (optional).
- (6) CAM; custom alarm module (optional).
or SLM; synchronizing lights module (optional).
- (7) PLS; panel light switch (optional).
- (8) ESPB; emergency stop push button.
- (9) VAR; voltage adjust rheostat.

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



Panel Interior – Instrument Panel and Sub-Panel

Instrument Panel:

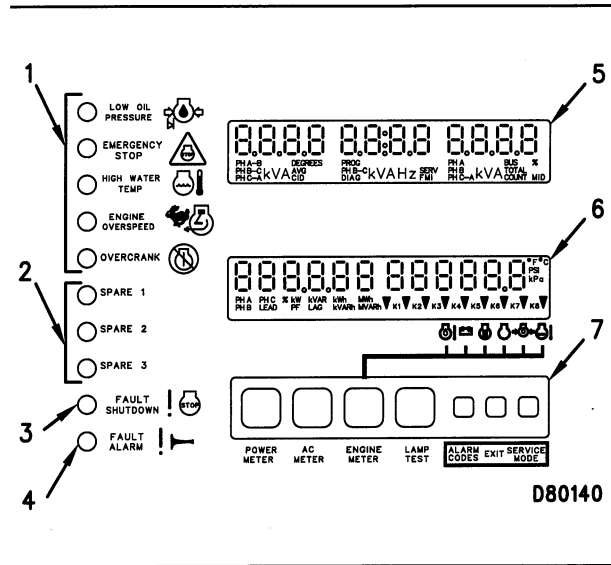
- (1) GSC+; generator set control +.
- (2) SP; speed potentiometer.
or GS; governor switch (optional).
- (3) SAS; start aid switch (optional).
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- (6) CAM; custom alarm module (optional).
or SLM; synchronizing lights module (optional).
- (7) PLS; panel light switch (optional).
- (8) ESPB; emergency stop push button.
- (9) VAR; voltage adjust rheostat.
- (10) RM; relay module (part of GSC+).

Sub-Panel:

- (11) AUX; auxiliary terminal strip.
- (12) PWM; analog to PWM converter (optional).
- (13) ATB+; AC transformer box +.
- (14) CB2; circuit breaker 2.
- (15) KWR; kilowatt level relay.
- (16) ENFR; engine failure relay (optional).
- (17) AUXREL; auxiliary relay (optional).
- (18) SMMS1; starting motor magnetic switch 1.
- (19) SMMS2; starting motor magnetic switch 2 (optional).
- (20) GPHI; ground post high voltage.
- (21) SR; slave relay (ETR only).

Component Description

Generator Set Control + (GSC+)

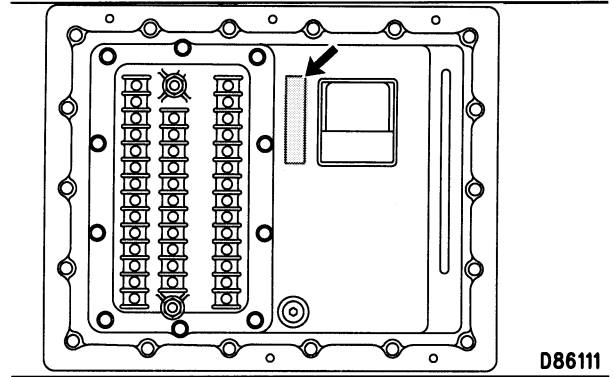


Display Area Of Generator Set Control + (GSC+)
 (1) Dedicated shutdown indicators. (2) Spare fault indicators.
 (3) Fault shutdown indicator. (4) Fault alarm indicator. (5) Upper display. (6) Lower display. (7) Keypad.

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

- Provides generator AC output information including power metering.
- Controls 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.

GSC+ Serial Number



Location of GSC+ Serial Number
 Rear View Of Gsc+

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

Fault Indicators

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

The yellow fault alarm indicator (4) FLASHES when the GSC+ detects a fault that is an alarm fault. The alarm fault does not cause the engine status to change. If the engine was running when the alarm fault occurred, it will continue to run and is able to start. Fault alarm indicator (4) is accompanied by an alarm fault code that is shown on upper display (5) when the alarm codes key is pressed.

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

The yellow spare fault indicators (2) FLASH when the conditions associated with that spare fault are active. The three spare faults are programmable to show a coolant loss, oil temperature, spare fault (customer generated switched input) or no assignment. For more information see the topic Service Mode. The yellow fault alarm indicator (4) or the red fault shutdown indicator (3) will accompany the spare fault indicators (2). This shows whether the spare fault input has been programmed to be an alarm or shutdown condition.

The red dedicated shutdown indicators (1) represent the following shutdown faults: low oil pressure, emergency stop, high water temperature, engine overspeed and engine overcrank. When the GSC+ detects a fault in one of these areas, the dedicated shutdown indicator (that corresponds to the fault) FLASHES. The engine is 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.

Many of the dedicated shutdown faults depend upon certain setpoints in the GSC+. See Engine/Generator Programming OP5-0 within the topic Service Mode. To restart the engine after a shutdown, see the topic Shutdown Mode. The conditions required for each dedicated fault and the results of each dedicated fault are:

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

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

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

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

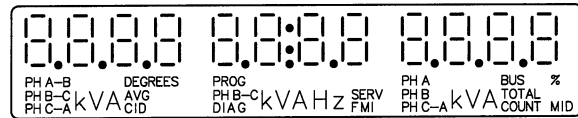
Overcrank – The engine does not start within the setpoint for total cycle crank time that is programmed into the GSC+. When this fault occurs, the overcrank indicator FLASHES and the engine is not allowed to start until the fault is corrected.

NOTE: The GSC+ can be programmed to override the shutdown for low oil pressure and high water temperature faults. When 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 and high water temperature 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.

Upper Display

D80257



Upper Display (5) With All Segments Shown

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

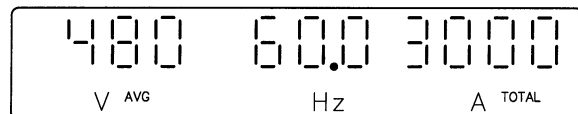
- Voltage (average), generator frequency, current (total).
- Voltage (line-line), generator frequency, current (line) for any one phase.
- Voltage (line-line) for all three phases at once.
- Current (line) for all three phases at once.

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

- Voltage (line-neutral) for all three phases at once.
- NOTE:** Line-neutral voltages are not shown when setpoint P032 is set to 1 (delta gensets).

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

D80464



Upper Display Showing:

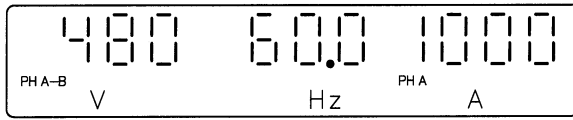
480 volts, average line-line voltage of all three phases.

60 hertz, generator frequency.

3000 amps, total line current of all three phases.

Lower Display

D80465



Upper Display Showing:

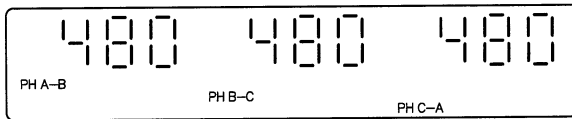
480 volts, line-line voltage of phase A-B.

60 hertz, generator frequency.

1000 amps, line current of phase A.

NOTE: The other two phases can also be viewed in a similar manner.

D80466



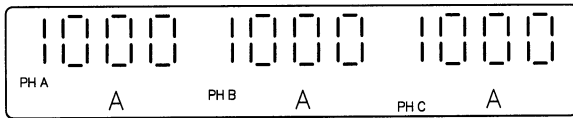
Upper Display Showing:

480 volts, line-line voltage of phase A-B.

480 volts, line-line voltage of phase B-C.

480 volts, line-line voltage of phase C-A.

D80467



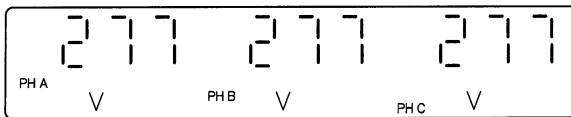
Upper Display Showing:

1000 amps, line current of phase A.

1000 amps, line current of phase B.

1000 amps, line current of phase C.

D80468



Upper Display Showing:

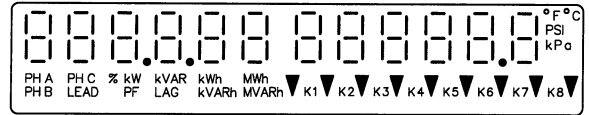
277 volts, line-neutral voltage of phase A.

277 volts, line-neutral voltage of phase B.

277 volts, line-neutral voltage of phase C.

NOTE: Line-neutral voltages are not shown when setpoint P032 is set to 1 (delta gensets).

D80260



Lower Display (6) With All Segments Shown

Lower display (6) shows values for power metering, engine parameters and the relay status.

The left side of the lower display serves as a genset power meter. The following functions are scrolled automatically:

- Total real power (kW).
- Total reactive power (kVAR).
- Percentage of rated power (% kW).
- Power factor (average).
- Total energy output (kWhr).

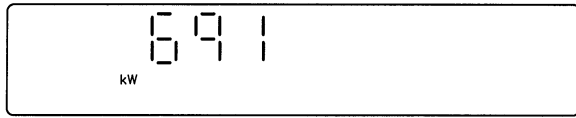
Briefly pressing the power meter key (less than five seconds) will cause the display to stop scrolling and show a particular parameter continuously. Additional power meter functions scroll if the power meter key is held for more than five seconds and then released. The functions are:

- Total real power (kW).
- Real power phase A (kW).
- Real power phase B (kW).
- Real power phase C (kW).
- Total apparent power (kVA).
- Total reactive power (kVAR).
- Percentage of rated power (% kW).
- Power factor (average).
- Power factor phase A.
- Power factor phase B.
- Power factor phase C.
- Total energy output (kWhr).
- Total reactive energy output (kVARhr).

NOTE: All real power values are signed with a "+" or a "-". A negative value indicates reverse power.

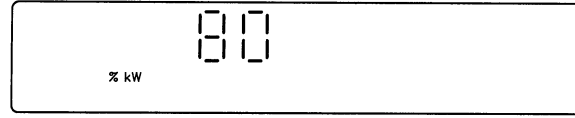
NOTE: Real power phase A, B, and C as well as power factor phase A, B, and C are not shown when setpoint P032 is set to 1 (delta gensets).

D80469



Lower Display Showing:
691 kW, total real power of generator output.

D80473



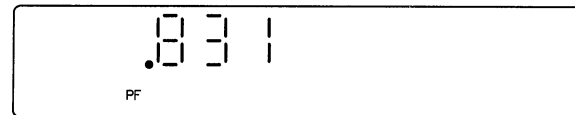
Lower Display Showing:
80 %kW, percentage of rated power of generator output.

D80470



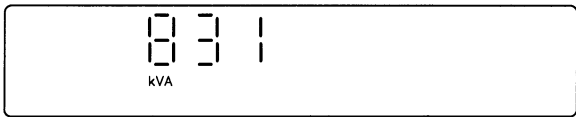
Lower Display Showing:
230 kW, real power of phase A.
NOTE: Phases B and C can also be viewed in a similar manner.

D80474



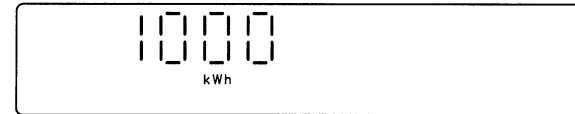
Lower Display Showing:
.831 PF, average power factor of generator output
NOTE: Power factor for individual phases are viewed in a similar manner.

D80471



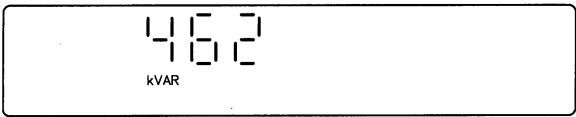
Lower Display Showing:
831 kVA, total apparent power.

D80475



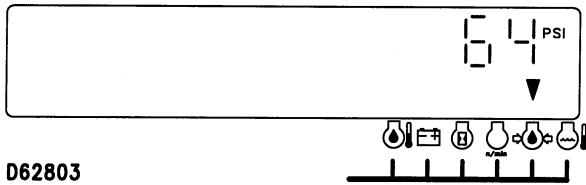
Lower Display Showing:
1000 kWh, total energy of generator output.

D80472



Lower Display Showing:
462 kVAR, total reactive power of generator output.

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

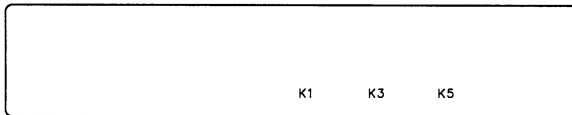


D62803

Lower Display Showing:
64 psi engine oil pressure.

The right side of lower display (6) shows the value of certain engine parameters. The parameters shown are: engine oil temperature (optional), 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 (6) stops scrolling and continuously shows one particular value. Now the pointer flashes above the condition whose value is showing.

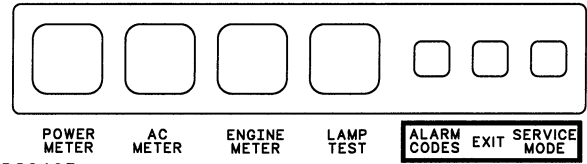
D80476



Lower Display Showing:
K1, K3 and K5 as active.
K2, K4, K6, K7 and K8 are not active.

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

Keypad



D80493

Keypad (7)

Keypad (7) is used to control the information that is shown on upper display (5) and lower display (6). The seven keys have two sets of functions, normal functions and service functions. For a description of the service functions of the keys; see the topic Service Mode. The normal functions of the keys are:

Power Meter Key – This key controls the viewing of power meter information on the lower display. Pressing the key for at least five seconds causes all the power meter data to scroll once. Then the default power meter data resumes scrolling. Briefly pressing this key (less than five seconds) will stop the scrolling of the power meter functions until the key is pressed again.

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

Engine Meter Key – This key controls the viewing of engine parameters on the lower display. Pressing the key, stops the scrolling of engine conditions 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.

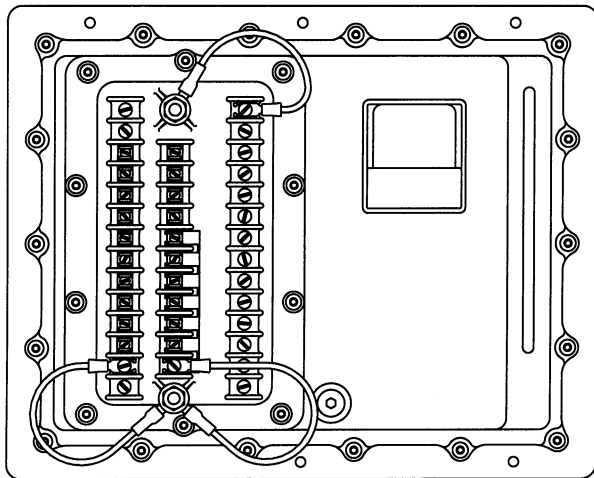
Lamp Test Key – Pressing this key performs a lamp test on the GSC+ and the optional alarm module. On the GSC+: the ten fault indicators are ON CONTINUOUSLY, every segment of upper display (5) and lower display (6) are ON. On the optional alarm module: all of the indicators are ON and the horn sounds. The lamp test function automatically turns off if this key is pressed and held for longer than 10 seconds.

Alarm Codes Key – If fault alarm indicator (4) is FLASHING, pressing this key causes upper display (5) to show the corresponding alarm fault code. Pressing this key again, resumes the showing of generator AC output information on upper display (5). If fault alarm indicator (4) 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.

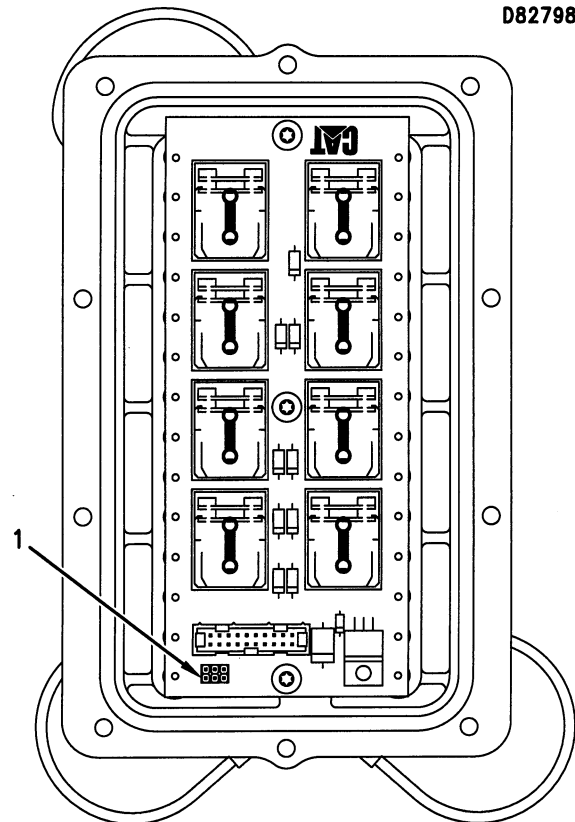
Service Mode Key – Pressing this key causes the GSC+ to enter service mode. See the topic Service Mode.

Relays



D20387

Relay Module On Rear Of GSC+



D82798

Relays In Relay Module
(1) Jumper block.

The relays are located in the relay module on the rear of the GSC+. The relays are permanently attached within the relay module 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 & 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.

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

Load Specifications For GSC+ Relay Module		
Relay Module Terminal No.	Rating For Resistive Loads	Rating For Inductive Loads
RM13,14 - K1 - OSR N/O	0.45A at 24DCV	none ¹
RM15 - K7 - FCR N/O RM16 - K3 - CTR N/O RM17 - K3 - CTR N/C RM18 - K4 - SMR N/O RM21 - K4 - SMR N/C RM19 - K6 - ASR N/O RM20 - K6 - ASR N/C RM22 - K2 - GFR N/O RM24 - K5 - RR N/O	10A at 24DCV	10A at 24DCV
RM23,36 - K5 - RR N/C RM25 - K8 - PSR N/O RM26 - K8 - PSR N/C	10A at 24DCV 10A at 110ACV	5A at 24DCV 7.5A at 110ACV

¹ Do NOT connect inductive loads to these terminals.

The relays and the functions are:

K1 – Oil Step Relay (OSR):

When the relay is active the normally open contacts close. This signals the PEEC electronic engine control 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).

When the relay is inactive the normally closed contacts close.

K4 – Starting Motor Relay (SMR):

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

When the relay is inactive the normally closed contacts close. This activates an optional battery charger.

K5 – Run Relay (RR):

When the relay is active the normally open contacts close. This activates the manual position of an optional start aid switch.

When the relay is inactive the normally closed contacts close. This provides an engine shutdown signal to the PEEC electronic engine control.

K6 – Air Shutoff Relay (ASR): Not used in PEEC applications. Relay is active during fault shutdowns.

When the relay is active the normally open contacts close.

When the relay is inactive, the normally closed contacts close.

K7 – Fuel Control Relay (FCR): Not used in PEEC applications. Relay is active during starting and running conditions.

When the relay is active the normally open contacts close.

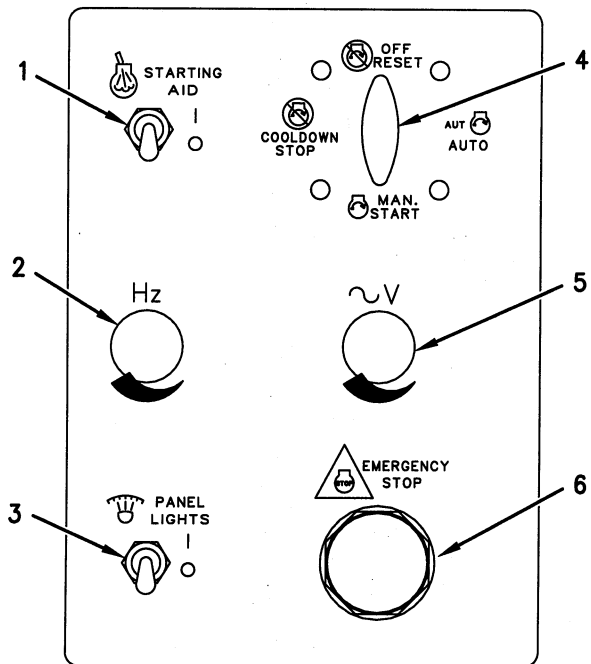
The relay has no normally closed contacts.

K8 – Programmable Spare Relay (PSR): This relay is for customer use. It is programmable to activate for a variety of conditions. For more information, see the topic Service Mode.

When the relay is active, the normally open contacts close.

When the relay is inactive, the normally closed contacts close.

Instrument Panel Switches



D85411

Instrument Panel Switches

(1) SAS; start aid switch (optional). (2) SP; speed potentiometer or GS; governor switch (optional). (3) PLS; panel light switch (optional). (4) ECS; engine control switch. (5) VAR; voltage adjust rheostat. (6) ESPB; emergency stop push button.

Engine control switch (ECS) (4) determines the status of the control panel. In the AUTO position (3 o'clock), the GSC+ allows the operator to remotely control and monitor the generator set with a Customer Communication Module (see the topic Optional Modules). The GSC+ also allows the engine to start whenever the remote initiating contact (IC) is closed. The engine also shuts down after the initiate contacts open. A cooldown time is programmable (setpoint P019) to give a 0 to 30 minute cooldown period before the engine shuts down. The cooldown time is factory set at five minutes. In the MANUAL START position (6 o'clock), the engine starts and runs as long as the ECS is in this position. In the COOLDOWN/STOP position (9 o'clock), after cooldown the PEEC electronic engine control turns OFF the fuel shutoff solenoid which shuts the engine down. In the OFF/RESET position (12 o'clock), the engine shuts down immediately and any fault indicators are reset (except emergency stop).

If red emergency stop push button (ESPB) (6) is pressed, the fuel shutoff solenoid is de-energized. To restart: turn ESPB (6) clockwise until it releases, turn the ECS to OFF/RESET and then to MANUAL START.

Voltage adjust rheostat (VAR) (5) is used to adjust generator voltage to the desired level.

Speed potentiometer (2) is used to raise or lower the engine speed. It connects to the PWM converter which then connects to the PEEC electronic engine control. The PEEC adjusts the engine speed.

Optional panel light switch (PLS) (3) turns ON and OFF the panel lamps.

Optional start aid switch (SAS) (1) is present only on required gensets. Two types of start aid systems exist:

- Manual – for metered shot start aid systems.
- Automatic – for continuous flow start aid systems.

On manual start aid types, when SAS (1) is placed and held in the ON position (momentary contact), the metered shot start aid system is activated. A specific amount of ether is metered into a holding chamber. When SAS (1) is released, a solenoid allows ether to flow to the engine. The metered shot start aid system deactivates when:

- The contacts of the crank termination relay (CTR) open at an engine speed of approximately 400 rpm.
- Or the engine coolant temperature is sufficient to open the start aid temperature switch (SATS).
- Or SAS (1) is released to the OFF position.

NOTICE

Crank the engine before activating (keep SAS in OFF position) the metered shot start aid system. Damage to the engine is possible by activating the system when the engine is not turning.

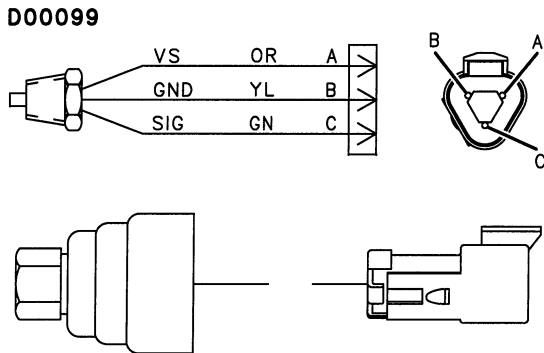
On automatic SAS types, the continuous flow start aid system operates in the automatic or the manual mode. When SAS (1) is placed in the AUTO position, the automatic mode is activated. The system automatically injects ether only during the crank cycle. When SAS (1) is placed and held in the MAN position (momentary contact), the manual mode is activated. This allows the operator to control the amount of time that ether is injected during cranking. The manual mode also allows the operator to inject additional ether after crank termination (used on cold running engines which continue to detonate). The automatic mode of the continuous flow start aid system deactivates when:

- The contacts of the crank termination relay (CTR) open at an engine speed of approximately 400 rpm (automatic mode only).
- Or the engine coolant temperature is sufficient to open the start aid temperature switch (SATS).
- Or SAS (1) is returned to the OFF position.

EMCP II+ Sensors

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

Engine Oil Pressure Sensor



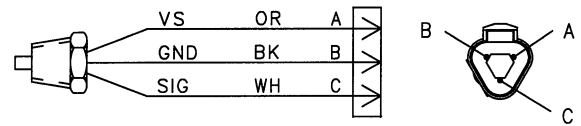
Engine Oil Pressure Sensor

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

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

There are five setpoints related to engine oil pressure that are programmed into the GSC+. The related setpoints are: P003, P004, P012, P013 and P014. See Engine/Generator Programming OP5-0 within the topic Service Mode.

Engine Coolant Temperature Sensor



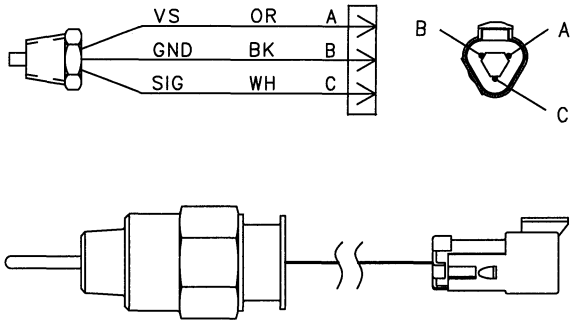
Engine Coolant Temperature Sensor

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

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

There are four setpoints related to engine coolant temperature that are programmed into the GSC+. The related setpoints are: P003, P004, P015 and P016. See Engine/Generator Programming OP5-0 within the topic Service Mode.

Engine Oil Temperature Sensor



D90549

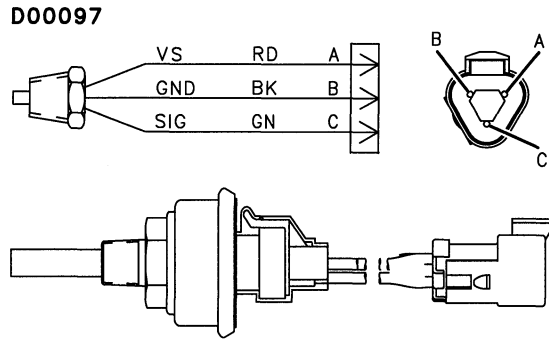
Engine Oil Temperature Sensor

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

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

There are five setpoints related to engine oil temperature that are programmed into the GSC+. The related setpoints are: P003, P004, P025, P026 and P027. See Engine/Generator Programming OP5-0 within the topic Service Mode.

Engine Coolant Loss Sensor



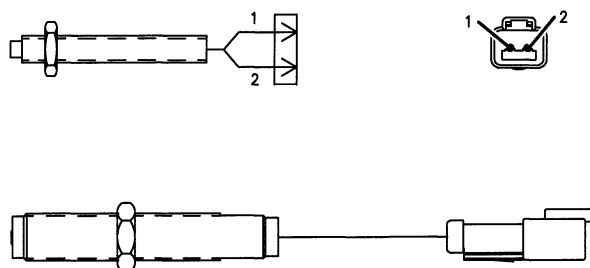
Engine Coolant Loss Sensor

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

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

There are three setpoints related to engine coolant loss that are programmed into the GSC+. The related setpoints are: P004, P005 and P006. See Engine/Generator Programming OP5-0 within the topic Service Mode.

Engine Magnetic Pickup



D00102

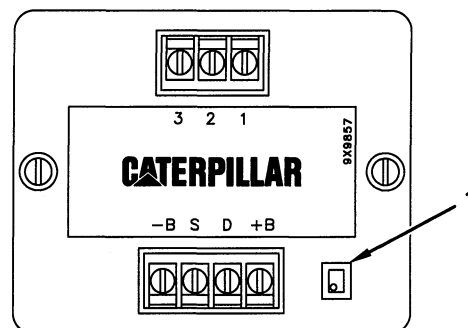
Engine Magnetic Pickup

The engine magnetic pickup is an input of the GSC+. The purpose of the sensor is to tell the GSC+ what the engine speed is. The GSC+ shows the engine speed on the lower display and also uses the sensor information for tasks such as activating an engine overspeed shutdown, terminating engine cranking and determining the oil step speed. The engine magnetic pickup is mounted on the flywheel housing of the engine.

The sensor creates a sine wave signal from passing ring gear teeth at the rate of one pulse per tooth. The sensor sends the GSC+ a sine wave signal in which the frequency is in direct proportion to the speed of the engine. The GSC+ receives the sine wave signal and measures the frequency (one pulse per gear tooth) to determine the speed of the engine. The wires of the sensor connect to connector contacts 1 and 2 of the GSC+ within a shielded cable. The drain wire of the shielded cable is connected to the AUX terminal strip.

There are four setpoints related to engine speed that are programmed into the GSC+. The related setpoints are: P009, P010, P011 and P012. See Engine/Generator Programming OP5-0 within the topic Service Mode.

PWM Converter



D00103

PWM Converter
(1) Droop potentiometer.

For stand alone applications with droop or isochronous operation or for parallel applications with droop governing, the PWM converter is provided as standard equipment. The PWM converter is used to change the analog signal of the speed potentiometer (SP) into a pulse-width-modulated PWM signal that the engine electronic control can recognize. The PWM converter is mounted on the sub-panel within the control panel.

The PWM converter continuously generates two PWM signals, speed and droop. The base frequency of the PWM signals is constant at 415 to 528 Hz. The duty cycle of the speed signal varies from 5 to 95% in proportion to the signal being received from the speed potentiometer which is adjusted by the operator. The duty cycle of the droop signal varies from 5 to 95% in proportion to the signal being received from the droop potentiometer (1) of the PWM converter which is adjusted by service personnel. Using droop potentiometer (1), droop can be adjusted from 0% to approximately 10%.

The PWM converter is supplied operating power (battery) at converter terminals -B and +B. Converter terminal 1 is an input and connects to terminal 3 of the speed potentiometer. Converter terminal 2 is an input and connects to terminal 2 (wiper) of the speed potentiometer. Converter terminal 3 is an input and connects to terminal 1 of the speed potentiometer. Converter terminal S is an output and provides a speed signal to the engine electronic control. Converter terminal D is an output and provides a droop signal to the engine electronic control.

NOTE: For isochronous operation, the droop potentiometer must be adjusted to zero (fully clockwise).

NOTE: For applications requiring load management with a utility, requiring load sharing with other generators, or requiring automatic synchronizing, a load share module must replace the PWM converter.

Programmable Outputs

The GSC+ provides 3 programmable outputs for customer use:

- kW Level Output
- Spare Output
- Programmable Spare Relay Outputs

kW Level Output

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

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

For more information on programming the setpoints for this output function, see Engine/Generator Programming OP5-0 within the topic Service Mode.

NOTE: The GSC+ diagnoses a fault in the kW level output circuit. See CID 859 within the topic Diagnostic Fault Codes of the Testing and Adjusting section.

Spare Output

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

The GSC+ must be programmed (setpoint SP13) as to 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 (sinks) 100mA maximum when in the low state. An active high state means that the output will be allowed to float high (approximately 5.0 VDC when no devices are connected to the spare output). When in the high state the spare output is floating and is capable of driving high impedance (36 000 ohm minimum) logic circuits only. When in the high state, the spare output will not drive low impedance loads such as relays.

The GSC+ must be programmed (setpoint SP14) as to what condition triggers the spare output (GSC+ connector contact 36) to the active state. The possible trigger conditions that can activate the spare output are listed in Spare Input/Output Programming OP6 within the topic Service Mode.

For more information on programming the setpoints for this output function, see Spare Input/Output Programming OP6 within the topic Service Mode.

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 within the topic Diagnostic Fault Codes of the Testing and Adjusting section.

Programmable Spare Relay Outputs

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

The GSC+ must be programmed (setpoint 15) as to whether the programmable spare relay outputs are active or inactive when triggered. In an active state, the normally open contacts will close and the normally closed contacts will open.

The GSC+ must be programmed (setpoint SP16) as to what condition triggers the programmable spare relay outputs to the active state. The possible trigger conditions that can activate the programmable spare relay outputs are listed in Spare Input/Output Programming OP6 within the topic Service Mode.

For more information on programming the setpoints for this output function, see Spare Input/Output Programming OP6 within the topic Service Mode.

NOTE: The GSC+ diagnoses a fault in the spare output circuit. See CID 448 within the topic Diagnostic Fault Codes of the Testing and Adjusting section.

Modes Of Operation

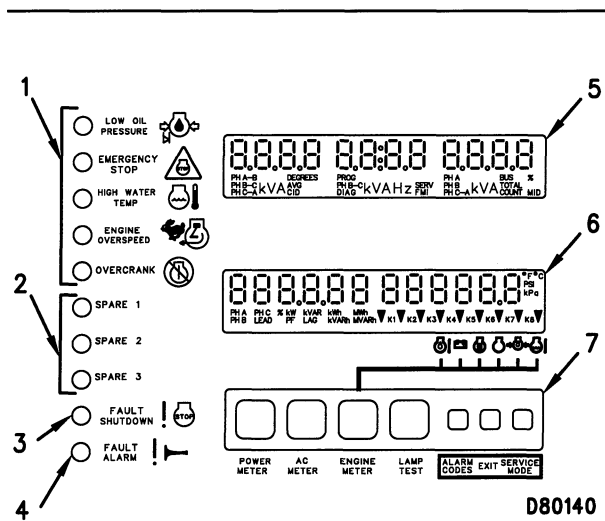
Display Area Functions When In Normal Mode, Alarm Mode Or Shutdown Mode ¹			
Item Of Display Area	Normal Mode	Alarm Mode	Shutdown Mode
Upper Display	AC Data Shown	AC Data Shown ²	Fault Code Shown
Lower Display	AC Power Data, Engine Data And Relay Status Shown	AC Power Data, Engine Data And Relay Status Shown	AC Power Data, 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
Power Meter Key	Starts And Stops The Scrolling Of Power Meter Data On Lower Display. Selects All Power Meter Data To Be Shown.	Starts And Stops The Scrolling Of Power Meter Data On Lower Display. Selects All Power Meter Data To Be Shown.	Starts And Stops The Scrolling Of Power Meter Data On Lower Display. Selects All Power Meter Data To Be Shown.
AC Select Key	Selects The AC Data That Is Shown On Upper Display	Selects The AC Data 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 ⁴	Enters The GSC+ Into Service Mode ⁴	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.

⁴ Service mode cannot be entered when the ECS is in the AUTO position.



Display Area Of Generator Set Control + (GSC+)
 (1) Dedicated shutdown indicators. (2) Spare fault indicators.
 (3) Fault shutdown indicator. (4) Fault alarm indicator. (5) Upper display. (6) Lower display. (7) Keypad.

The 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. The alarm fault code will be shown when the alarm code key is pressed.

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, satisfy special applications, 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.

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

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.

NOTE: The optional Customer Communication Module (CCM) can remotely control certain genset functions. This remote control can only occur when the ECS is in the AUTO position. For more information, see Customer Communication Module (CCM) within the topic Optional Modules.

Engine Starting Sequence

1. The GSC+ receives an engine start signal. The possible engine start signals are:
 - ECS turned to MANUAL START by the operator.
 - The remote initiate contacts (IC) close while the ECS is in the AUTO position.
 - The optional Customer Communication Module (CCM) sends a start command 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 shutdown faults have been reset (removed by turning the ECS to OFF/RESET).
 - The engine is not already running.
3. The GSC+ activates the starting motor relay (SMR) and the run relay (RR). The activated RR removes (opens) the shutdown signal from the PEEC electronic engine control.

4. The GSC+ activates the fuel control relay (FCR). Not used in PEEC applications.
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 (P017) for total cycle crank time.
6. While the starting motor is cranking, the GSC+ shows the status of the K4 (SMR), K5 (RR), K7 (FCR) relays on the relay status indicators of the lower display.
7. The GSC+ deactivates the starting motor relay (SMR) and activates the crank termination relay (CTR) when the engine speed reaches the setpoint (P011) for crank terminate speed (factory default is 400 rpm).
8. The GSC+ activates the oil step relay (OSR) when the oil pressure reaches the setpoint (P014) for low oil pressure at idle speed. The factory default is 70 kPa (10 psi). The OSR signals the PEEC electronic engine control to accelerate the engine to rated speed.

NOTE: The optional Customer Communication Module (CCM) can remotely activate or deactivate the OSR when the low oil pressure setpoint is exceeded.

9. The GSC+ shows:
 - AC information for one or more phases on the upper display.
 - Power meter information on the lower display.
 - Engine system information on the lower display.
 - The K1 (OSR), K3 (CTR), K5 (RR), and K7 (FCR) relay status on the lower display.

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.
 - The optional Customer Communication Module (CCM) sends a stop command while the ECS is in the AUTO position and the remote initiate contacts are open.
2. After receiving the stop signal, the GSC+ checks that no system faults are present.
3. The GSC+ begins the cooldown time (setpoint P019, factory default is five minutes).
4. If programmed to do so, the GSC+ activates the spare output. This output can activate a slave relay during cooldown which in turn activates the optional circuit breaker and takes the generator off load.
5. After cooldown (setpoint P019), the GSC+ deactivates the run relay (RR). The NC contacts of the RR now send a shutdown signal (ground) to the PEEC electronic engine control. The PEEC turns OFF the fuel shutoff solenoid which shuts the engine down.

The oil step relay (OSR) is deactivated, after the engine oil pressure decreases to less than the setpoint for low oil pressure shutdown at idle speed (P014).

Also the GSC+ deactivates the fuel control relay (FCR). Not used in PEEC applications.

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

If a start signal is received before 0 rpm is reached, the fuel is turned on and the engine is allowed to run. If it does not run, the starting motor relay (SMR) does not activate until the crank termination relay (CTR) is deactivated at 0 rpm.

7. The GSC+ shows the status of the relays on the relay status indicators of the lower display. All relay indicators should be OFF.

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 or can be protective relaying functions that have been enabled as an alarm fault.

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 AL fault code, a SP fault code or a diagnostic fault code. In addition to the alarm indicator, one or more of the Spare 1, Spare 2, or Spare 3 indicators may be flashing. 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.

The AL fault codes shown on the GSC+ indicate the current status of the genset. As soon as the fault is corrected or if the fault goes away, the AL fault codes are no longer shown by the GSC+. However, diagnostic fault codes are logged in the GSC+ fault log for viewing later by service personnel.

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 dedicated shutdown faults that can be overridden are: low oil pressure and high coolant temperature. For more information, see P003 within the topic Engine/Generator Programming OP5-0. Also, see the topic Shutdown 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.

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 Fault Identification in the Testing And Adjusting section.
5. When the alarm fault is no longer occurring (is 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
- Engine overcrank
- Fault shutdown
- Spare 1, Spare 2, or Spare 3 indicator (accompanied by the fault shutdown indicator)

If the fault shutdown indicator is the only indicator FLASHING, additional information is available. A fault code is shown on the upper display which more precisely identifies the cause of the shutdown fault. 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 run relay (RR). The NC contacts of the RR now send a shutdown signal (ground) to the PEEC electronic engine control. The PEEC turns OFF the fuel shutoff solenoid which shuts the engine down.

Also the GSC+ deactivates the fuel control relay (FCR). Not used in PEEC applications.

3. To prevent engine cranking, the GSC+ deactivates the starting motor relay (SMR).
4. The GSC+ activates the genset fault relay (GFR) to activate the optional shunt trip coil on the circuit breaker.

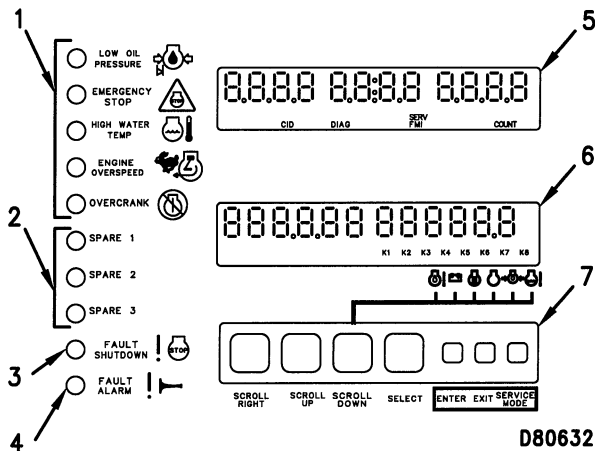
NOTE: The spare output may also be programmed to activate when a shutdown occurs. This output can drive a relay to open the circuit breaker or a transfer switch. See Spare Input/Output Programming OP6 within the topic Service Mode.

5. The GSC+ activates the air shutoff relay (ASR) for 15 seconds, for an emergency stop fault, engine overspeed fault, or speed sensor fault (CID 190).
6. As the engine comes to a stop, the GSC+ deactivates the crank termination relay (CTR) when engine speed reaches 0 rpm. The oil step relay (OSR) is deactivated when the engine oil pressure reaches the setpoint (P014) for low oil pressure shutdown at idle speed [70 kPa (10 psi)].
7. If engine speed does not decrease 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).
8. The GSC+ FLASHES the corresponding shutdown indicator. If the fault shutdown indicator is FLASHING, a fault code is shown on the upper display. See the topic Fault Description.
9. If the fault shutdown is the only indicator FLASHING, additional information is available. A fault code is shown on the upper display that more precisely identifies the cause of the shutdown fault. For more information, see the topic Fault Description
10. The lower display continues to show the engine data.
11. The relay status indicators show:
 - K2 (GFR)
 - K6 (ASR) 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.

Engine Start Sequence (After Shutdown)

1. Correct the shutdown fault. See the topic Fault Identification in the Testing And Adjusting section.
2. Reset the GSC+ by turning the ECS to OFF/RESET. If no shutdown fault is active, the GSC+ returns to normal mode and the engine is able to start.

Service Mode



GSC+ Display Area With Service Mode Descriptions Of Keypad
 (1) Dedicated shutdown indicators. (2) Spare fault indicators.
 (3) Fault shutdown indicator. (4) Fault alarm indicator. (5) Upper display. (6) Lower display. (7) 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 selectable options for viewing, entry, clearing, programming, verification and calibration of information by service personnel. The ten options are:

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

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 function and a different name. The name and location 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 right 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 increase the value of information. This key represents the number 2 when entering the password.

Scroll Down Key – This key is used to scroll down through information or to decrease the value of information. 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 information that has been changed into the memory of the GSC+.

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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: Service mode cannot be entered when the ECS is in the AUTO position.

1. Press the SERVICE MODE key on the keypad of the GSC+. The "SERV" indicator on the upper display FLASHES whenever the GSC+ is in service mode.
2. The desired option (OP1 through OP10) can now be selected. Each option is described in the topics that follow.
3. To return to normal mode, press the EXIT key a few times until the "SERV" indicator is not showing.

NOTE: To enter service mode options OP4 through OP8, the engine must be 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 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. The purpose of the fault log is to assist service personnel when troubleshooting the genset system.

Each diagnostic fault code consists of a component identifier (CID), a failure mode indicator (FMI) and an active/inactive status indicator ("DIAG") that are shown on the upper display. The CID tells which component is faulty and the FMI describes what type of the failure has occurred. "DIAG" FLASHES when the particular CID FMI fault is active.

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. An active diagnostic shutdown fault ("DIAG" is FLASHING) becomes inactive ("DIAG" is ON CONTINUOUSLY) when the fault is no longer occurring and ECS is 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. 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.

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.

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

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 values of the first and last occurrence of each fault.
3. Press SELECT key. The fault codes stop scrolling.
4. Press SELECT key. Fault codes resume scrolling.
5. Press EXIT key. "OP 1" is showing on lower display.
6. Press EXIT key. The display returns to normal.

Engine/Generator Setpoint Viewing OP2-0

OP2-0 is the option for viewing the engine/generator setpoints. The engine/generator setpoints affect the proper operation and serviceability of the engine, and the accuracy of the information shown on the display. The setpoints viewed (stored in the GSC+) should match the specified setpoints of the 136-9048 Control Panel Chart packaged within the control panel. These setpoints are from P001 through P033 and are programmable. For a description of each of these setpoints, see the topic Engine/Generator Programming OP5-0.

Protective Relaying Setpoint Viewing OP2-1

OP2-1 is the option for viewing the protective relaying setpoints. The protective relaying setpoints determine the response of the GSC+ when one or more of the protective relay functions occur. The protective relay functions are provided by the GSC+ to reduce the possibility of damage occurring to the generator or customer equipment. These setpoints are from P101 through P142 and are programmable. For a description of each of these setpoints, see the topic Protective Relaying Programming OP5-1.

AC Factory Calibration Setpoint Viewing OP2-2

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

The information shown on the display is :

- GSC+ Serial Number – The serial number of the GSC+ is a ten digit number which is unique for each GSC+. The serial number is also printed on a label on the back of the GSC+. The displayed serial number will always match the serial number on the label.
- GSC+ Software Identifier – The software identifier indicates the software level within the GSC+. The identifier is nine characters in the form of "XXXXXXXX-XX".
- Setpoints P201 through P222 – These are the AC factory calibration setpoints. They contain information used during factory calibration procedures. These setpoints are not programmable by service personnel.

Procedure To View The Setpoints

NOTE: Viewing the setpoints is done with the engine running or stopped. Service mode cannot be entered when the ECS is in the AUTO position.

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

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 2-0" is showing.
 - a. To view the setpoints within OP2-0 go to the next step.
 - b. To view OP2-1 or OP2-2, press the SCROLL UP key once or twice more. The display will show "OP 2-1" or "OP 2-2". Go to next step.
3. Press SELECT key.

For "OP 2-0": "P001" is showing, followed with the value of the setpoint.

For "OP 2-1": "P101" is showing, followed with the value of the setpoint.

For "OP 2-2": the ten digit serial number of the GSC+ is showing.
4. Press SCROLL UP or SCROLL DOWN key. The next setpoint is showing with its value. 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, "PE FAIL" is briefly shown on the upper display and then the password entry process begins again.

Procedure To Enter The Password

NOTE: Service mode cannot be entered when the ECS is in the AUTO position. Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

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 four times. "OP 3" is showing.
3. Press SELECT key. "P E _ _ _ _" is showing with the first dash flashing.
4. Press SCROLL RIGHT key. "P E 1 _ _ _" is showing with the second dash flashing.
5. Press SCROLL DOWN key. "P E 1 3 _ _" is showing with the third dash flashing.
6. Press SCROLL UP key. "P E 1 3 2 _" is showing with the fourth dash flashing.
7. Press SCROLL DOWN key. "P E 1 3 2 3 _" is showing with the fifth dash flashing.
8. Press SCROLL RIGHT key. "P E 1 3 2 3 1" is showing.
9. Press ENTER key. "P E P A S S" is showing.
10. Press EXIT key. "OP 4" 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.

Fault Log Clearing OP4

OP4 is the option for clearing an inactive 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

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter the password. "OP 4" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SELECT key. A CID FMI fault code and the counts (number of occurrences) are showing. The lower display shows the hourmeter values of the first and last occurrences of the fault.
3. Press SELECT key. The CID FMI fault code, count and hourmeter value all flash.
4. Press and hold ENTER key for two seconds.
If there is only one CID FMI fault code, the CID FMI that was flashing disappears and the upper display is blank except for the flashing "SERV" indicator. "OP 1" is showing on the lower display. Proceed to the next step.

If there is more than one CID FMI fault code, the CID FMI that was flashing disappears and the upper display shows the next CID FMI with its count and hourmeter value. Repeat steps 3 and 4 until all faults are erased. The lower display then shows "OP 1". Proceed to the next step.
5. Press EXIT key. "OP 1" is showing on lower display.
6. Press EXIT key. The display returns to normal.

Engine/Generator Programming OP5-0

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

However, the setpoints may need to be changed when the GSC+ is moved from one engine to another or to satisfy customer requirements. The setpoints (stored in the GSC+) must match the specified setpoints of the 136-9048 Control Panel Chart packaged within the control panel. These setpoints are from P001 through P033 and are programmable. Each of the setpoints is described in the following OP5-0 Setpoint chart.

Procedure For Engine/Generator Programming

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter the password. "OP 4" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SCROLL UP key one time. "OP 5-0" is showing on the lower display.
3. Press SELECT key one time. "P001" is showing, followed with the value of the setpoint.
4. Press SCROLL UP or SCROLL DOWN key. The next setpoint is showing with its value. 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 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.

OP5-0 Setpoints ¹ - Engine/Generator Programming				
Setpoint	Name	Description	Range Of Value	Factory Default
P001	Fuel Solenoid Type	Type of fuel system solenoid used on the genset. PEEC engines are ETR fuel systems.	0 - ETR fuel solenoid 1 - ETS fuel solenoid	0
P002	Units Shown	Type of measurement units shown on the GSC+ display.	0 - English units (psi, degrees F) 1 - metric units (kPa, degrees C)	0
P003	Shutdown Override For Engine Fault	GSC+ response to a low engine oil pressure or high coolant temperature fault. (Determined by application or customer).	0 - engine shutdown 1 - alarm only (shutdown override, no engine shutdown)	0
P004	Shutdown Override For Sensor Fault	GSC+ response to a diagnostic fault with the engine oil pressure sensor, coolant temperature sensor, oil temperature sensor, sensor power supply or coolant loss sensor. (Determined by application or customer).	0 - alarm only (shutdown override, no engine shutdown) 1 - for engine shutdown	0
P005	Coolant Loss Sensor Installed	Tells whether or not the optional engine coolant loss sensor is installed on the genset.	0 - gensets without sensor 1 - gensets with sensor	0
P006	Shutdown Override For Coolant Loss Fault	GSC+ response to an engine coolant loss fault. (Determined by application or customer).	0 - engine shutdown 1 - alarm only (shutdown override, no engine shutdown)	0
P007	System Voltage 24 Or 32 Volts	System voltage (battery voltage) of the genset. (Determined by application or customer).	24 or 32	24
P008	N/A	This setpoint is not currently being used by the GSC+ and cannot be programmed.	N/A	N/A
P009	Number Of Ring Gear Teeth	Number of teeth on the ring gear of the engine. Used by the GSC+ to determine engine speed.	95 to 350 teeth in increments of 1	136 teeth
P010	Engine Overspeed	Engine speed used by the GSC+ to declare that an engine overspeed fault exists. The engine overspeed setpoint (for all 60 Hz applications) is 1.18 times the rated speed.	500 to 4330 rpm in increments of 10	2120 rpm
P011	Crank Terminate Speed	Engine speed used by the GSC+ to disengage the starting motor during engine cranking.	100 to 1000 rpm in increments of 10	400 rpm
P012 ²	Oil Step Speed	Engine speed used by the GSC+ for distinguishing between rated speed and idle speed when a low oil pressure fault exists.	400 to 1800 rpm in increments of 10	1350 rpm
P013 ³	Low Oil Pressure Shutdown At Rated Speed	Oil pressure used by the GSC+ to declare that a low oil pressure shutdown fault exists with engine at rated speed (the engine speed must have exceeded the oil step speed for nine seconds).	34 to 420 kPa (5 to 61 psi) in increments of 1	205 kPa (30 psi)
P014 ³	Low Oil Pressure Shutdown At Idle Speed	Oil pressure used by the GSC+ 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 9 seconds and the engine speed must be less than oil step speed).	20 to 336 kPa (3 to 49 psi) in increments of 1	70 kPa (10 psi)
P015 ⁴	High Water Temperature Shutdown	Coolant temperature used by the GSC+ to declare a high coolant temperature shutdown fault exists (after a 10 second delay).	85 to 123°C (185 to 253°F) in increments of 1	107°C (225°F)
P016	Low Water Temperature Alarm	Coolant temperature used by the GSC+ to declare that a low coolant temperature alarm fault exists (after a 2 second delay). (Determined by application or customer).	0 to 36°C (32 to 97°F) in increments of 1	21°C (70°F)

¹ For the correct setpoint value, refer to the control panel model number and the 136-9048 Chart packaged within the control panel.

² The specified value for oil step speed of most 3412 PEEC engines is 1350 rpm. The exceptions are: For the 3412 engine with a rated speed of 1200 rpm, the specified value is 750 rpm. For the 3412 engine with a rated speed of 1460 or 1600 rpm, the specified value is 1125 rpm. For reference, see the print 3L-0332 Switch Speed Settings.

³ When oil pressure drops to within 34 kPa (5psi) of the P013 or P014 setpoint, a low oil pressure alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).

⁴ When coolant temperature rises to within 6°C (11°F) of the P015 setpoint, a high water temperature alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).

OP5-0 Setpoints ¹ - Engine/Generator Programming (Continued)

Setpoint	Name	Description	Range Of Value	Factory Default
P017	Total Cycle Crank Time	Cycle crank time used by the GSC+ to declare that an overcrank fault exists. (Determined by application or customer).	5 to 120 seconds in increments of 1	90 seconds
P018	Cycle Crank Time	Amount of time the GSC+ cranks and then rests the starting motor during a single crank cycle. (Determined by application or customer).	5 to 60 seconds in increments of 1	10 seconds
P019	Cooldown Time	Amount of time the GSC+ allows the engine to run after a normal shutdown is initiated. (Determined by application or customer).	0 to 30 minutes in increments of 1	5 minutes
P020 ⁵	AC Voltage	Nominal AC voltage of the generator. The GSC+ measures the AC voltage and shows it on the display. (Determined by application or customer).	700, 150, 300, 500, 600, 750, 3.0k, 4.5k, 5.25k, 9.0k, 15.0k, 18.0k, 30.0k	700
P021	AC Current Full Scale	Full scale AC current of the generator. AC current full scale is a function of the ratio of the current transformers. It is not the maximum AC current of the generator. The GSC+ measures the current and shows it on the display.	75, 100, 150, 200, 300, 400, 600, 800, 1000, 1200, 1500, 2000, 2500, 3000, 4000A	600A
P022 ⁶	GSC+ Engine Number	Informs other devices on the CAT Data Link (for example, CCM) of the engine number for the GSC+. (Determined by application or customer).	01 through 08	01
P023	Engine Type	Identifies the engine as a mechanical unit injector (MUI) diesel, spark ignited (gas), or electronic unit injector (EUI) diesel engine.	0 - MUI diesel 1 - Gas 2 - EUI diesel	0
P024 ⁷	Crank Time Delay	Amount of time the GSC+ delays activation of the fuel control relay (FCR) during a crank cycle. This setpoint is for gas engines only. (Determined by application or customer).	0 to 20 seconds in increments of 1	5 seconds
P025	Oil Temperature Sensor Installed	Tells whether or not the optional engine oil temperature sensor is installed on the genset.	0 - gensets without an oil temperature sensor 1 - gensets with an oil temperature sensor	0
P026	High Oil Temperature Shutdown	Oil temperature used by the GSC+ to declare a high oil temperature shutdown fault exists (after a 10 second delay).	85 to 123°C (185 to 253°F) in increments of 1	107°C (225°F)
P027	Shutdown Override For High Oil Temperature Fault	GSC+ response to an engine high oil temperature fault. (Determined by application or customer).	0 - alarm only (shutdown override, no engine shutdown) 1 - engine shutdown	0
P028	Nameplate Voltage	Rated voltage of the generator. This setpoint is used for protective relaying functions.	100 to 25kV in increments of 1	480V
P029	Nameplate Current	Rated current output of the generator.	0 to 4000A in increments of 1	600A
P030	Nameplate Power	Rated power capability of the generator.	0 through 10MW in increments of 1kW	400kW
P031	Rated Frequency	Nominal frequency rating of genset.	50, 60 or 400 Hz	60 Hz
P032	Connection Configuration Of Generator	Wye or delta configuration of generator.	0 - wye 1 - delta	0
P033 ⁸	Number Of Generator Poles	Number of generator poles.	0 through 254 in increments of 2	4

¹ For the correct setpoint value, refer to the control panel model number and the 136-9048 Chart packaged within the control panel.

⁵ The values other than the default (700V) are for switchgear applications and require the use of external potential transformers and the removal of the AC voltage range jumper located in the relay module. See the topic AC Voltage Range Selection in the Testing and Adjusting section.

⁶ After setpoint P022 is reprogrammed, the GSC+ must be power cycled (powered down and then powered up).

⁷ The P024 setpoint only functions when the P023 setpoint is set to 1 (gas engine).

⁸ When P033 is programmed to 0 poles, the AL15 fault (GSC+ Configuration Error) is disabled.

Protective Relaying Programming OP5-1

OP5-1 is the option for the programming of the protective relaying setpoints. The protective relaying setpoints determine the response of the GSC+ when one or more of the protective relay functions occur. The protective relay functions are provided by the GSC+ to reduce the possibility of damage occurring to the generator or customer equipment. The setpoints are programmed (set) in the GSC+ at the factory to the default values. The setpoints may be changed to satisfy customer or application requirements. These setpoints are from P101 through P142 and are programmable. Each of the setpoints is described in the following OP5-1 Setpoint chart.

Procedure For Protective Relaying Programming

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter the password. "OP 4" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
 2. Press SCROLL UP key two times. "OP 5-1" is showing on the lower display.
 3. Press SELECT key one time. "P101" is showing, followed with the value of the setpoint.
 4. Press SCROLL UP or SCROLL DOWN key. The next setpoint is showing with its value. 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 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.

OP5-1 Setpoints ¹ – Protective Relaying Programming				
Setpoint	Name	Description	Range Of Value	Factory Default
P101	Overvoltage Alarm Enable	The GSC+ enables or disables the generator overvoltage alarm function.	0 - disabled 1 - enabled	1
P102	Overvoltage Alarm Threshold	Voltage the GSC+ uses to issue an overvoltage alarm.	100 to 125% of nameplate voltage in increments of 1%	105%
P103	Overvoltage Alarm Time Delay	Amount of time the GSC+ waits before issuing an overvoltage alarm.	0 to 120 seconds ² in increments of 1	10 seconds
P104	Overvoltage Shutdown Enable	The GSC+ enables or disables the generator overvoltage shutdown function.	0 - disabled 1 - enabled	1
P105	Overvoltage Shutdown Threshold	Voltage the GSC+ uses to issue an overvoltage shutdown.	100 to 125% of nameplate voltage in increments of 1%	110%
P106	Overvoltage Shutdown Time Delay	Amount of time the GSC+ waits before issuing an overvoltage shutdown.	0 to 120 seconds ² in increments of 1	10 seconds
P107	Undervoltage Alarm Enable	The GSC+ enables or disables the generator undervoltage alarm function.	0 - disabled 1 - enabled	1
P108	Undervoltage Alarm Threshold	Voltage the GSC+ uses to issue an undervoltage alarm.	60 to 100% of nameplate voltage in increments of 1%	90%
P109	Undervoltage Alarm Time Delay	Amount of time the GSC+ waits before issuing an undervoltage alarm.	0 to 120 seconds ² in increments of 1	10 seconds
P110	Undervoltage Shutdown Enable	The GSC+ enables or disables the generator undervoltage shutdown function.	0 - disabled 1 - enabled	1
P111	Undervoltage Shutdown Threshold	Voltage the GSC+ uses to issue an undervoltage shutdown.	60 to 100% of nameplate voltage in increments of 1%	85%
P112	Undervoltage Shutdown Time Delay	Amount of time the GSC+ waits before issuing an undervoltage shutdown.	0 to 120 seconds ² in increments of 1	15 seconds
P113	Overfrequency Alarm Enable	The GSC+ enables or disables the generator overfrequency alarm function.	0 - disabled 1 - enabled	1
P114	Overfrequency Alarm Threshold	Frequency the GSC+ uses to issue an overfrequency alarm.	50 to 60, for 50 Hz Gen	53 Hz
			60 to 70, for 60 Hz Gen	63 Hz
			400 to 480, for 400 Hz Gen	422 Hz
P115	Overfrequency Alarm Time Delay	Amount of time the GSC+ waits before issuing an overfrequency alarm.	0 to 120 seconds ² in increments of 1	10 seconds
P116	Overfrequency Shutdown Enable	The GSC+ enables or disables the generator overfrequency shutdown function.	0 - disabled 1 - enabled	1
P117	Overfrequency Shutdown Threshold	Frequency the GSC+ uses to issue an overfrequency shutdown.	50 to 60, for 50 Hz Gen	55 Hz
			60 to 70, for 60 Hz Gen	66 Hz
			400 to 480, for 400 Hz Gen	440 Hz
P118	Overfrequency Shutdown Time Delay	Amount of time the GSC+ waits before issuing an overfrequency shutdown.	0 to 120 seconds ² in increments of 1	10 seconds
P119	Underfrequency Alarm Enable	The GSC+ enables or disables the generator underfrequency alarm function.	0 - disabled 1 - enabled	1
P120	Underfrequency Alarm Threshold	Frequency the GSC+ uses to issue an underfrequency alarm.	30 to 50, for 50 Hz Gen	47 Hz
			36 to 60, for 60 Hz Gen	57 Hz
			240 to 400, for 400 Hz Gen	378 Hz
P121	Underfrequency Alarm Time Delay	Amount of time the GSC+ waits before issuing an underfrequency alarm.	0 to 120 seconds ² in increments of 1	10 seconds
P122	Underfrequency Shutdown Enable	The GSC+ enables or disables the generator underfrequency shutdown function.	0 - disabled 1 - enabled	1
P123	Underfrequency Shutdown Threshold	Frequency the GSC+ uses to issue an underfrequency shutdown.	30 to 50, for 50 Hz Gen	45 Hz
			36 to 60, for 60 Hz Gen	54 Hz
			240 to 400, for 400 Hz Gen	360 Hz
P124	Underfrequency Shutdown Time Delay	Amount of time the GSC+ waits before issuing an underfrequency shutdown.	0 to 120 seconds ² in increments of 1	15 seconds

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

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

OP5-1 Setpoints ¹ – Protective Relaying Programming (Continued)				
Setpoint	Name	Description	Range Of Value	Factory Default
P125	Reverse Power Shutdown Enable	The GSC+ enables or disables the generator reverse power shutdown function.	0 - disabled 1 - enabled	1
P126	Reverse Power Shutdown Threshold	Level of reverse power the GSC+ uses to issue a reverse power shutdown.	0 to 20% of nameplate power in increments of 1%	15%
P127	Reverse Power Shutdown Time Delay	Amount of time the GSC+ waits before issuing a reverse power shutdown.	0 to 30 seconds ² in increments of 1	10 seconds
P128	Overcurrent Alarm Enable	The GSC+ enables or disables the overcurrent alarm.	0 - disabled 1 - enabled	1
P129	Phase Overcurrent Alarm Threshold	Level of current the GSC+ uses to issue a phase overcurrent alarm.	100 to 160% of nameplate current in increments of 5%	100%
P130	Phase Overcurrent Alarm Time Delay	Amount of time the GSC+ waits before issuing a phase overcurrent alarm.	0 to 250 seconds ² in increments of 1	0 seconds
P131	Total Overcurrent Alarm Threshold	Level of current the GSC+ uses to issue a total overcurrent alarm.	100 to 160% of three times nameplate current in increments of 5%	100%
P132	Total Overcurrent Alarm Time Delay	Amount of time the GSC+ waits before issuing a total overcurrent alarm.	0 to 250 seconds ² in increments of 1	0 seconds
P133	Overcurrent Shutdown Enable	The GSC+ enables or disables the overcurrent shutdown.	0 - disabled 1 - enabled	1
P134	Phase Overcurrent Shutdown Threshold	Level of current the GSC+ uses to issue a phase overcurrent shutdown.	100 to 160% in increments of 5%	100%
P135	Phase Overcurrent Shutdown Time Delay	Amount of time the GSC+ waits before issuing a phase overcurrent shutdown.	0 to 250 seconds ² in increments of 1	0 seconds
P136	Total Overcurrent Shutdown Threshold	Level of current the GSC+ uses to issue a total overcurrent shutdown.	100 to 160% of three times nameplate current in increments of 5%	100%
P137	Total Overcurrent Shutdown Time Delay	Amount of time the GSC+ waits before issuing a total overcurrent shutdown.	0 to 250 seconds ² in increments of 1	0 seconds
P138	KW Level Relay Enable	The GSC+ enables or disables the kW level relay function.	0 - disabled 1 - enabled	1
P139	KW Level Relay Threshold	Level of power the GSC+ uses to activate the kW level relay function.	0 to 110% of nameplate power in increments of 1%	105%
P140	KW Level Relay Time Delay	Amount of time the GSC+ waits before activating the kW level relay function.	0 to 120 seconds ² in increments of 1	0 seconds
P141	KW Level Relay Disengage Threshold	Level of power the GSC+ uses to deactivate the kW level relay function.	0 to 110% of nameplate power in increments of 1%	100%
P142	KW Level Relay Disengage Time Delay	Amount of time the GSC+ waits before deactivating the kW level relay function.	0 to 120 seconds ² in increments of 1	10 seconds

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

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

Spare Input/Output Programming OP6

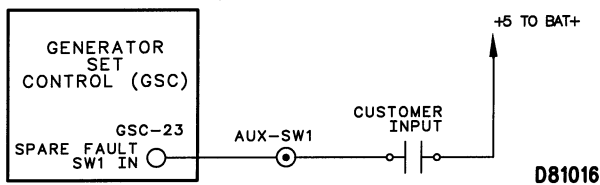
OP6 is the option for programming of the spare inputs, spare indicators, spare output, and the programmable spare relay outputs. These spare inputs and outputs are provided in order to satisfy the needs of the customer.

Spare Inputs

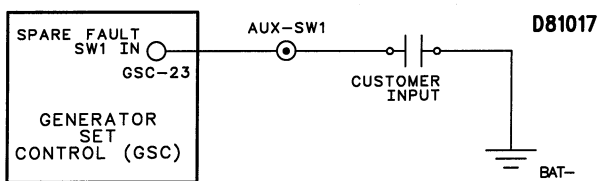
The spare inputs are referred to as SP1, SP2, SP3 and SP4. The spare inputs are accessed on the auxiliary terminal strip (AUX) within the control panel on the left wall. The terminations at the auxiliary terminal strip for the spare inputs are:

- SP1 is marked as SW1.
- SP2 is marked as SW2.
- SP3 is marked as SW3.
- SP4 is marked as SW4.

The active input state, response taken and time delay for each spare input is programmable. The GSC+ responds to the active state of an input and the response can be delayed. Setpoints SP01 through SP12 are used for the programming of the spare inputs. Each of the setpoints is described in the following OP6 Setpoints chart.



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



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

The GSC+ has to be programmed as to 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. Setpoints SP01, SP04, SP07 and SP10 are used for the programming of the active input state of the spare inputs. Each of the setpoints is described in the following OP6 Setpoints chart.

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 programmed for how to respond to an active spare fault. The response is to treat the condition as either a fault shutdown or a fault alarm. Setpoints SP02, SP05, SP08 and SP11 are used for the programming of the response. Each of the setpoints is described in the following OP6 Setpoints chart.

NOTE: 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 programmed for 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. Setpoints SP03, SP06, SP09 and SP12 are used for the programming of the time delay. The time delay is selectable from 0 to 250 seconds. Each of the setpoints is described in the following OP6 Setpoints chart.

Alarm Mode Sequence Of Operation – When a fault occurs in a spare input (input active) and it is programmed as an alarm fault:

- a. The GSC+ waits for the time delay to elapse.
- b. The fault alarm indicator FLASHES.
- c. The corresponding code SP1, SP2, SP3 or SP4 is shown on the upper display of the GSC+ when the alarm codes key is pressed.
- d. The engine continues to run or is able to start.

Shutdown Mode Sequence Of Operation – When a fault occurs in a spare input (input active) and it is programmed as a shutdown fault:

- a. The GSC+ waits for the time delay to elapse.
- b. The fault shutdown indicator FLASHES.
- c. The corresponding code SP1, SP2, SP3 or SP4 is immediately shown on the upper display of the GSC+.
- d. The engine is shut down or is disabled from starting.

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.

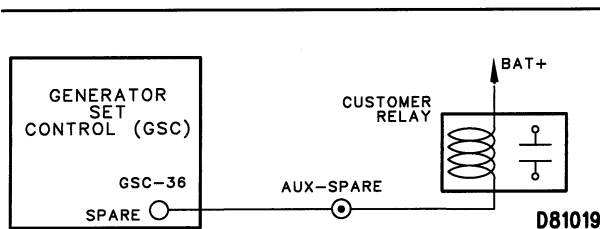
NOTE: If it is not desired to use the spare inputs, program the spare inputs for a LOW active state and connect nothing to the spare input wiring.

Spare Indicators

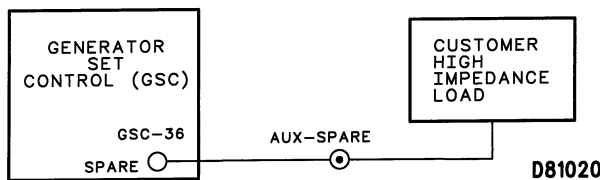
The spare indicators are located on the face of the GSC+ and are referred to as Spare 1, Spare 2, and Spare 3. The spare indicators are programmable. A large selection of trigger conditions is available to activate the spare indicators. Setpoints SP17, SP18 and SP19 are used for the programming of the trigger condition. Each of the setpoints is described in the following OP6 Setpoints chart.

Spare Output

The spare output responds (high or low) to a selected trigger condition. The response and the trigger condition are programmable. The spare output is accessed on the auxiliary terminal strip (AUX) within the control panel on the left wall. The spare output is marked as SPARE on the auxiliary terminal strip.



Typical Active Low Configuration For Spare Output.



Typical Active High Configuration For Spare Output.

The GSC+ has to be programmed as to 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 100mA when in the low state. An active high state means that the output will be allowed to float high (approximately 5.0 DCV when no devices are

connected to the spare output). When in the high state the spare output is floating and is capable of driving high impedance (36 000 ohm minimum) logic circuits only. When in the high state, the spare output will not drive low impedance loads such as relays. Setpoint SP13 is used for the programming of the active state of the spare output. The setpoint is described in the following OP6 Setpoints chart.

The GSC+ has to be programmed as to what condition triggers the spare output to the active state. A large selection of trigger conditions is available to activate the spare output. Setpoint SP14 is used for the programming of the trigger condition. The setpoint is described in the following OP6 Setpoints chart.

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 Fault Codes of the Testing And Adjusting section.

Programmable Spare Relay Outputs

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

The GSC+ must be programmed as to whether the programmable spare relay outputs are active or inactive when triggered. In an active state, the normally open contacts will close and the normally closed contacts will open. Setpoint SP15 is used for the programming of the active state of the spare relay output. The setpoint is described in the following OP6 Setpoints chart.

The GSC+ must be programmed as to what condition triggers the programmable spare relay outputs to the active state. A large selection of trigger conditions is available to activate the spare relay output. Setpoint SP16 is used for the programming of the trigger condition. The setpoint is described in the following OP6 Setpoints chart.

NOTE: The GSC+ diagnoses a fault in the programmable spare relay output circuit. See CID 448 in the topic Diagnostic Fault Codes of the Testing And Adjusting section.

Procedure For Spare Input/Output Programming

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter the password. "OP 4" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SCROLL UP key three times. "OP 6" is showing on the lower display.
3. Press SELECT key. "SP01" is showing, followed with the value of the setpoint.
4. Press SCROLL UP or SCROLL DOWN key. The next setpoint with its 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.

OP6-0 Setpoints ¹ – Spare Input/Output Programming				
Setpoint	Name	Description	Range Of Value	Factory Default
SP01	Spare Input 1 Active State	Input state used by the GSC+ to declare that a SP1 fault exists.	0 - active low 1 - active high	0
SP02	Spare Input 1 Response	GSC+ response to a SP1 fault.	0 - shutdown 1 - alarm	0
SP03	Spare Input 1 Time Delay	Amount of time the GSC+ waits before responding to a SP1 fault.	0 to 250 seconds in increments of 1	0 seconds
SP04	Spare Input 2 Active State	Input state used by the GSC+ to declare that a SP2 fault exists.	0 - active low 1 - active high	0
SP05	Spare Input 2 Response	GSC+ response to a SP2 fault.	0 - shutdown 1 - alarm	0
SP06	Spare Input 2 Time Delay	Amount of time the GSC+ waits before responding to a SP2 fault.	0 to 250 seconds in increments of 1	0 seconds
SP07	Spare Input 3 Active State	Input state used by the GSC+ to declare that a SP3 fault exists.	0 - active low 1 - active high	0
SP08	Spare Input 3 Response	GSC+ response to a SP3 fault.	0 - shutdown 1 - alarm	0
SP09	Spare Input 3 Time Delay	Amount of time the GSC+ waits before responding to a SP3 fault.	0 to 250 seconds in increments of 1	0 seconds
SP10	Spare Input 4 Active State	Input state used by the GSC+ to declare that a SP4 fault exists.	0 - active low 1 - active high	0
SP11	Spare Input 4 Response	GSC+ response to a SP4 fault.	0 - shutdown 1 - alarm	0
SP12	Spare Input 4 Time Delay	Amount of time the GSC+ waits before responding to a SP4 fault.	0 to 250 seconds in increments of 1	0 seconds
SP13	Spare Output Response	GSC+ response to the spare output trigger condition.	0 - active low 1 - active high	0
SP15	Spare Relay Output Response	GSC+ response to the spare relay trigger condition.	0 - relay inactive when triggered 1 - relay active when triggered	1
SP14	Spare Output Trigger Condition	The condition used by the GSC+ to trigger the spare output response.	0 - unused 1 - active SP1 fault ² 2 - active SP2 fault ² 3 - active SP3 fault ² 4 - active SP4 fault ² 5 - any combination of active SP1, SP2, SP3 or SP4 faults ²	8
SP16	Spare Relay Output Trigger Condition	The condition used by the GSC+ to trigger the spare relay.	6 - any active shutdown fault (AL1 - 15, SP1 - 4, or CID FMI) 7 - any active alarm or shutdown fault (AL1 - 15, SP1 - 4, or CID FMI) 8 - cooldown mode 9 - coolant loss fault ² 10 - high oil temperature fault ² 11 - CCM control ³	
SP17	Spare Indicator 1 Trigger Condition	The condition used by the GSC+ to trigger spare indicator 1.	0 - unused 1 - active SP1 fault ² 2 - active SP2 fault ² 3 - active SP3 fault ²	0
SP18	Spare Indicator 2 Trigger Condition	The condition used by the GSC+ to trigger spare indicator 2.	4 - active SP4 fault ² 5 - any combination of active SP1, SP2, SP3 or SP4 faults ²	
SP19	Spare Indicator 3 Trigger Condition	The condition used by the GSC+ to trigger spare indicator 3.	6 - coolant loss fault ² 7 - high oil temperature fault ²	

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

² Either alarm or shutdown faults are valid trigger conditions.

³ When SP14 is programmed to 11 (CCM control), the spare output is always active low.

When SP16 is programmed to 11 (CCM control), the spare relay is always active when triggered.

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 reprogrammed hours are more than the original hours).

If the hourmeter shows all dashes, the hours can not be reprogrammed. If the hourmeter shows all dashes instead of a reasonable numeric value, see CID 268 (GSC+ Internal Memory) within the topic Diagnostic Fault Codes of the Testing and Adjusting section.

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).

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

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

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.

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 six 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.

Procedure For Voltmeter/Ammeter Programming

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

NOTE: Any active shutdown fault (any shutdown indicator FLASHING) must be made inactive in order to access service mode. To temporarily change a shutdown fault from an active shutdown fault to an inactive, turn the ECS to the OFF/RESET position. To permanently 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.

1. Turn the ECS to the STOP position to shutdown the engine. Enter service mode and enter the password. "OP 4" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SCROLL UP key five times. "OP 8" is showing on the lower display.
3. Press SELECT key. "AC01" is showing, followed with the value (0 to 255) of the setpoint.
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 to match the value shown on the ATB+ for phase A voltage.
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.

OP8 Setpoints ¹ - Voltmeter/Ammeter Programming				
Setpoint	Name	Description	Range Of Value	Factory Default
AC01	Phase A Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase A voltage transformer within the ATB+.	0 to 255 in increments of 1	bar code value
AC02	Phase B Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase B voltage transformer within the ATB+.	0 to 255 in increments of 1	bar code value
AC03	Phase C Voltage Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase C voltage transformer within the ATB+.	0 to 255 in increments of 1	bar code value
AC04	Phase A Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase A current transformer within the ATB+.	0 to 255 in increments of 1	bar code value
AC05	Phase B Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase B current transformer within the ATB+.	0 to 255 in increments of 1	bar code value
AC06	Phase C Current Calibration	Calibration value used by the GSC+ to compensate for the characteristics of the phase C current transformer within the ATB+.	0 to 255 in increments of 1	bar code value

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

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 P003 (shutdown override for engine fault).

OP9 is only for verification of certain engine setpoints. OP5-0 is used for the actual programming of these setpoints. The setpoints verified by these procedures are:

P003 – Shutdown Override For Engine Fault – GSC+ response to a low engine oil pressure or high coolant temperature fault.

0 is for engine shutdown.

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

Default is 0 for engine shutdown

P010 – Engine Overspeed – Engine speed used by the GSC+ to declare that an engine overspeed fault exists. The engine overspeed setpoint (for all 60 Hz applications) is 1.18 times the rated speed.

The range of values is from 500 to 4330 rpm, in increments of 10.

Default is 2120 rpm.

P013 – Low Oil Pressure Shutdown At Rated Speed – Oil pressure used by the GSC+ to declare that a low oil pressure shutdown fault exists with engine at rated speed (the engine speed must have exceeded the oil step speed for nine seconds).

The range of values is from 34 to 420 kPa (5 to 61 psi), in increments of 1.

Default is 205 kPa (30 psi).

NOTE: When oil pressure drops to within 34 kPa (5psi) of the P013 setpoint, a low oil pressure alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).

P015 – High Water Temperature Shutdown – Coolant temperature used by the GSC+ to declare a high coolant temperature shutdown fault exists (after a 10 second delay).

The range of values is from 85 to 123°C (185 to 253°F), in increments of 1.

Default is 107°C (225°F).

NOTE: When coolant temperature rises to within 6°C (11°F) of the P015 setpoint, a high water temperature alarm is issued by the GSC+ and the optional alarm module (with the exception of the NFPA 99 RAN).

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

- The setpoints listed previously must be correct for the engine application. For the correct setpoints, check the 136-9048 Control Panel Chart packaged within the control panel. To view the setpoints, see Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode. To program the setpoints, see Engine/Generator Programming OP5-0 within the topic Service Mode.
- 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

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

1. Start and run the engine at rated speed. Enter service mode and enter the password. "OP 9" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P010 is showing on the upper display. "SC1" is showing on the lower display, followed with the present engine speed value.
3. Press SELECT key. The setpoint value is flashing on the upper display.
4. 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

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

1. Start and run the engine at rated speed. Enter service mode and enter the password. "OP 9" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P010 is showing on the upper display. "SC1" is showing on the lower display, followed with the present engine speed value.
3. Press SCROLL UP key one time. The value [205 kPa (30 psi) is the default value] of the P013 setpoint for low oil pressure shutdown at rated speed is showing on the upper display. "SC2" is showing on the lower display, followed with the present oil pressure value.
4. Press SELECT key. The setpoint value is flashing on the upper display.
5. Press SCROLL UP key to increase the setpoint 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

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

1. Start and run the engine at rated speed. Enter service mode and enter the password. "OP 9" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.
2. Press SELECT key. The value (2120 is the default value) of overspeed setpoint P010 is showing on the upper display. "SC1" is showing on the lower display, followed with the present engine speed value.
3. Press SCROLL UP key two times. The value [107°C (225°F) is the default value] of the P015 setpoint for high water temperature shutdown is showing on the upper display. "SC3" is showing on the lower display, followed with the present coolant temperature value.
4. Press SELECT key. The setpoint value is flashing on the upper display.
5. Press SCROLL DOWN key to decrease the setpoint 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 Offset Adjustment OP10

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

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

OP10 is the option for adjusting the voltmeter readings of the GSC+. The AC voltage measurements of the GSC+ are calibrated at the factory and should never require adjustment.

NOTE: It is NOT recommended that the AC voltmeter be altered. Performing this procedure reduces the accuracy of the GSC+ voltmeter.

NOTE: The adjusted voltages are for display only and will NOT be transmitted over the CAT data link to other modules (such as the Customer Communication Module). Also, the adjusted voltages are NOT used for determining the fault thresholds for protective relaying functions. In both cases, the unadjusted values for AC voltage are still determined by the GSC+ (but not shown), and will be used instead of the displayed values.

Procedure For AC Offset Adjustment

The adjusted voltages and currents are shown on the left side of the upper display, and the amount of offset (as a percent) is shown on the right side of the upper display. The user can adjust each voltage and current by up to $\pm 5.0\%$ in increments of 0.04%.

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

1. Start and run the engine at rated speed. Enter service mode and enter the password. "OP 9" is showing on lower display. For more information, see the topic Service Mode and see the Procedure To Enter The Password within the topic Password Entry OP3.

- 2.** Press SCROLL UP key one time. "OP 10" is showing on the lower display.
- 3.** Press SELECT key. "AC CAL" is showing on lower display. The present phase A (line to neutral) voltage is showing on the left side of the upper display. The offset (percentage) is showing on the right side of the upper display.
- 4.** Press SELECT key. The offset percentage value is flashing on the right side of the upper display.
- 5.** Press SCROLL UP or SCROLL DOWN key to adjust the voltage value to the desired value. The percentage value continues to flash.
- 6.** Press ENTER key. The percentage value stops flashing.
- 7.** Press SCROLL UP key. Repeat steps 3, 4, 5 and 6 for the other setpoints.
- 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.

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:

- AL Fault Codes – shown as “AL1” through “AL15” on the upper display. Includes:
 - Specific engine fault conditions (for example, low engine oil pressure alarm).
 - Protective relaying functions (for example, underfrequency fault).
- SP Fault Codes – shown as “SP1” through “SP4” on the upper display.
- Diagnostic Fault Codes – Numerous numeric values are possible, but all are identified by the illumination of “CID” and “FMI” 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 (for example, low oil pressure shutdown).

AL Fault Codes

AL Fault Codes are shown as “AL1” through “AL15” on the upper display. They include specific engine fault conditions (for example, low engine oil pressure alarm), and protective relaying functions (for example, underfrequency fault).

AL fault codes depend on certain setpoints, see the topic Service Mode for more information on setpoints. AL fault codes are not stored in the fault log of the GSC+. Many of the AL fault codes are programmable as a fault alarm or as a fault shutdown. The AL fault codes are accompanied by either the fault alarm indicator, or the fault shutdown indicator on the GSC+ to show the severity of the fault. The AL fault codes and their related setpoints are described in the paragraphs that follow.

AL1 – High Water Temperature Alarm: When the engine coolant temperature increases to within 6°C (11°F) of setpoint P015 (high water temperature shutdown), the GSC+ issues a high water temperature alarm. The fault alarm indicator will FLASH and the “AL1” fault code is shown on the upper display after the alarm codes key is pressed.

P015 is the setpoint for high water temperature shutdown. This setpoint tells the GSC+ at what coolant temperature to declare that a high water temperature shutdown fault exists. When the setpoint is reached, the dedicated shutdown indicator for high water temperature FLASHES and the engine is shutdown.

AL2 – Low Engine Coolant Temperature Alarm: When the engine coolant temperature decreases to setpoint P016 (low water temperature alarm), the GSC+ issues a low water temperature alarm. The fault alarm indicator will FLASH and the “AL2” fault code is shown on the upper display after the alarm codes key is pressed.

P016 is the setpoint for low water temperature alarm. This setpoint tells the GSC+ at what coolant temperature to declare that a low water temperature alarm fault (AL2) exists.

AL3 – Low Engine Oil Pressure Alarm: When engine oil pressure drops to within 34kPa (5psi) of the P013 or P014 setpoint, the GSC+ issues a low oil pressure alarm. The fault alarm indicator will FLASH and the “AL3” fault code is shown on the upper display after the alarm codes key is pressed.

P013 is the setpoint for low oil pressure shutdown at rated speed. This setpoint tells the GSC+ at what oil pressure to declare that a low oil pressure shutdown fault exists when the engine is at rated speed. When the setpoint is reached, the dedicated shutdown indicator for low oil pressure FLASHES and the engine is shutdown.

P014 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 when the engine is at idle speed. When the setpoint is reached, the dedicated shutdown indicator for low oil pressure FLASHES and the engine is shutdown.

AL4 – Fault Detected By Engine ECM: The AL4 fault occurs when the electronic control module (ECM) for the engine detects an alarm fault or a shutdown fault. The engine ECM tells the GSC+ whether the AL4 fault is an alarm fault or a shutdown fault. This includes faults that require derating of the engine. The engine ECM is factory programmed to NOT DERATE in genset applications. The occurrence of an AL4 fault code could mean that the engine ECM is not programmed correctly. Refer to the Troubleshooting service module for the particular engine. The AL4 fault is disabled (P023) on MUI engines and gas engines.

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

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

AL5 – Low Engine Coolant Level Fault: When the engine coolant level drops below the probe of the coolant loss sensor, the GSC+ issues a low coolant level fault (AL5). The GSC+ can be programmed (P006) to treat this fault as an alarm, a shutdown, or the fault can be disabled (P005). In addition, the GSC+ can be programmed (SP17, SP18 or SP19) to light one of the spare fault indicators on the front of the GSC+ when this fault occurs.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL5” fault code is shown on the upper display after the alarm codes key is pressed.

AL6 – High Engine Oil Temp Fault: When the engine oil temperature increases to within 6°C (11°F) of setpoint P026 (oil temperature threshold), the GSC+ issues a high engine oil temperature fault. The GSC+ can be programmed (P027) to treat this fault as an alarm, a shutdown, or the fault can be disabled (P005). In addition, the GSC+ can be programmed (SP17, SP18 or SP19) to light one of the spare fault indicators on the front of the GSC+ when this fault occurs.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL6” fault code is shown on the upper display after the alarm codes key is pressed.

AL7 – Generator Over Voltage Fault (protective relaying function): When line to line voltage between any two phases of the generator rises above the P102 or P105 setpoints, the GSC+ issues an over voltage fault. The GSC+ can be programmed (P101, P104) to enable or disable this fault as an alarm, a shutdown or both. In addition, the fault can be programmed (P103, P106) with a time delay from 0 to 120 seconds. The fault threshold (P102, P105) can be adjusted from 100 to 125 percent of the nameplate voltage (P028).

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL7” fault code is shown on the upper display after the alarm codes key is pressed.

NOTE: If the AC offset adjustment (OP10) has been performed, then the adjusted voltages are NOT used for determining the fault thresholds for protective relaying functions. The unadjusted values for AC voltage are still determined by the GSC+ (but not shown), and will be used instead of the displayed values.

AL8 – Generator Under Voltage Fault (protective relaying function): When the line to line voltage between any two phases of the generator drops below the P108 or the P111 setpoints, the GSC+ issues an under voltage fault. The GSC+ can be programmed (P107, P110) to enable or disable this fault as an alarm, a shutdown or both. In addition, the fault can be programmed (P109, P112) with a time delay from 0 to 120 seconds. The fault threshold (P108, P111) can be adjusted from 60 to 100 percent of the nameplate voltage (P028).

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL8” fault code is shown on the upper display after the alarm codes key is pressed.

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

NOTE: If the AC offset adjustment (OP10) has been performed, then the adjusted voltages are NOT used for determining the fault thresholds for protective relaying functions. The unadjusted values for AC voltage are still determined by the GSC+ (but not shown), and will be used instead of the displayed values.

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

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL9” fault code is shown on the upper display after the alarm codes key is pressed.

NOTE: The frequency shown on the GSC+ will FLASH when it is greater than or equal to 70 Hz.

AL10 – Generator Under Frequency Fault (protective relaying function): When generator frequency drops below the P120 or P123 setpoints, the GSC+ issues an under frequency fault. The GSC+ can be programmed (P119, P122) to enable or disable this fault as an alarm, a shutdown or both. In addition, the fault can be programmed (P121, P124) with a time delay from 0 to 120 seconds. The fault threshold (P120, P123) can be adjusted from 36 to 60 Hz (for 50 Hz applications, 30 to 50 Hz).

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL10” fault code is shown on the upper display after the alarm codes key is pressed.

NOTE: The AL10 fault is disabled when the engine control switch (ECS) is in the STOP/COOLDOWN position.

AL11 – Generator Reverse Power Fault (protective relaying function): When reverse power rises above the P126 setpoint, the GSC+ issues a reverse power fault. The GSC+ can be programmed (P125) to enable or disable this fault as a shutdown. In addition, the fault can be programmed (P127) with a time delay from 0 to 30 seconds. The fault threshold (P126) can be adjusted from 0 to 20 percent of the nameplate power (P030).

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

AL12 – Generator Phase Over Current Fault (protective relaying function): When any single generator phase current rises above the P129 or P134 setpoints, the GSC+ issues a phase over current fault. The GSC+ can be programmed (P128, P133) to enable or disable this fault as an alarm, a shutdown or both. In addition, the fault can be programmed (P130, P135) with a time delay from 0 to 250 seconds. The fault threshold (P129, P134) can be adjusted from 100 to 160 percent of the nameplate current (P029).

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL12” fault code is shown on the upper display after the alarm codes key is pressed.

AL13 – Generator Total Over Current Fault (protective relaying function): When generator total current (sum of three phases) rises above the P131 or P136 setpoints, the GSC+ issues a total over current fault. The GSC+ can be programmed (P128, P133) to enable or disable this fault as an alarm, a shutdown or both. In addition, the fault can be programmed (P132, P137) with a time delay from 0 to 250 seconds. The fault threshold (P131, P136) can be adjusted from 100 to 160 percent of three times the nameplate current (P029).

When enabled both as an alarm and a shutdown fault, the fault thresholds and time delays can be programmed independently to allow the alarm fault to serve as an early warning for the shutdown fault.

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

When programmed as an alarm fault, the fault alarm indicator will FLASH and the “AL13” fault code is shown on the upper display after the alarm codes key is pressed.

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

When this fault occurs, the fault alarm indicator will FLASH and the “AL14” fault code is shown on the upper display after the alarm codes key is pressed.

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

$$\text{frequency (hertz)} = \frac{\text{number of generator poles} \times \text{rpm}}{120}$$

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

When this fault occurs, the fault alarm indicator will FLASH and the “AL15” fault code is shown on the upper display after the alarm codes key is pressed.

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

SP Fault Codes

SP fault codes are associated with the spare inputs and are either alarm faults or shutdown faults. The four 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 SP fault codes are referred to as SP1, SP2, SP3 and SP4.

Alarm Mode Sequence Of Operation – When a fault occurs in a spare input (input active) and it is programmed as an alarm fault:

- a. The GSC+ waits for the time delay to elapse.
- b. The fault alarm indicator FLASHES.
- c. When the alarm codes key is pressed, the corresponding code SP1, SP2, SP3 or SP4 is shown on the upper display.
- d. The engine continues to run or is able to start.

Shutdown Mode Sequence Of Operation – When a fault occurs in a spare input (input active) and it is programmed as a shutdown fault:

- a. The GSC+ waits for the time delay to elapse.
- b. The fault shutdown indicator FLASHES.
- c. The corresponding code SP1, SP2, SP3 or SP4 is immediately shown on the upper display of the GSC+.
- d. The engine is shut down or is disabled from starting.

The fault shutdown indicator remains FLASHING and the SP 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: Spare faults that are programmed to shutdown, are ignored by the GSC+ when engine speed is less than crank terminate speed.

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 more information, see the topic Alarm Mode and the topic Shutdown Mode.

Alarm Mode Sequence Of Operation – When a diagnostic fault occurs that is an alarm fault:

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

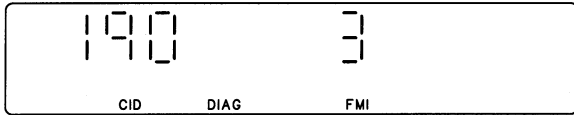
Shutdown Mode Sequence Of Operation – When a diagnostic fault occurs that is a shutdown fault:

- a. The GSC+ activates shutdown mode.
- b. The fault shutdown indicator FLASHES.
- c. The corresponding diagnostic code (CID FMI) is immediately shown on the upper display.
- d. The engine is shut down or is disabled from starting.

The diagnostic fault code (CID FMI) 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 Fault Codes 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 Fault Codes 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.



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

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

- "190 3"
- 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).

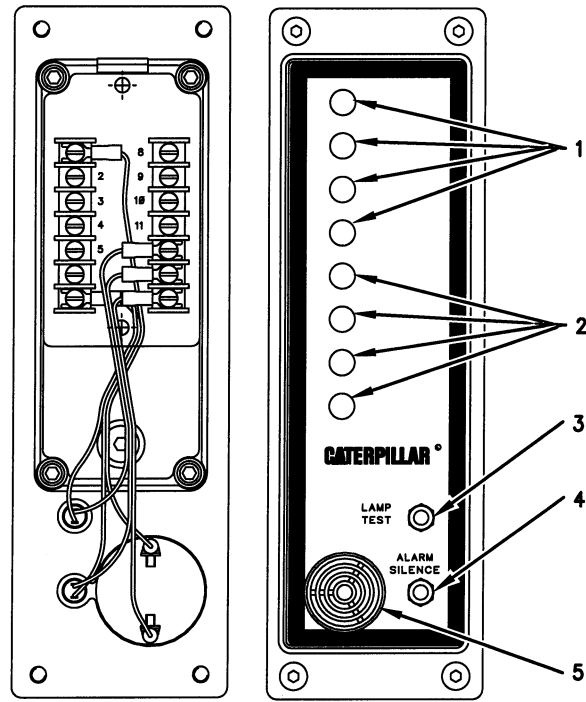
NOTE: The alarm response or shutdown response of four diagnostic faults is programmable by service personnel. An alarm response is normal (P004 = 0), unless programmed for a shutdown response (P004 = 1). See Setpoint P004 within the topic Engine/Generator Programming OP5-0. The diagnostic faults are: oil pressure sensor (CID 100), coolant temperature sensor (CID 110), coolant loss sensor (CID 111) and sensor power supply (CID 269).

The 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. AL fault codes and SP fault codes are not recorded in the fault log. See Fault Log Viewing OP1 within the topic Service Mode.

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

Optional Modules

Alarm Modules



D77199

Alarm Module

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

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

There are six 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 single engine alarm module.
- Prime power multi engine alarm module.
- EMCP II+ remote annunciator.

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

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

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

Description Of Operation

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

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

Switch Inputs

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

Internal Circuitry

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

Data Link

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

- 1 – Coolant temperature has exceeded the high temperature alarm setpoint programmed into the GSC+.
- 2 – Oil pressure is below the low oil pressure alarm setpoint programmed into the GSC+.
- 3 – Coolant temperature is below the low temperature alarm setpoint programmed into the 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 GSC+.
- 6 – Coolant temperature has exceeded the high water temperature shutdown setpoint programmed into the GSC+.
- 7 – The engine has failed to start (overcrank).
- 8 – The engine speed exceeded the engine overspeed setpoint programmed into the 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 indicators 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, CIM or RDM) connected to the serial data link is three. The maximum distance between a module and the GSC+ is 305 m (1000 ft).

Indicator And Horn Operation

Table 1: Indicator And Horn Function						
Indicator Color	NFPA 99 ALM	NFPA 110 ALM	NFPA 99 RAN	Prime Power Single Engine	Prime Power Multi Engine	EMCP RAN
1 Amber	High Coolant Temp Alarm LI,H,LAT,TD	High Coolant Temp Alarm LI,H,LAT,TD	Gen On Load SW (3)	High Coolant Temp Alarm LI,H,LAT,TD	High Coolant Temp Alarm LI,H,LAT,TD	High Coolant Temp Alarm LI,H,LAT,TD
2 Amber	Low Coolant Temp Alarm LI,H,LAT	Low Coolant Temp Alarm LI,H,LAT	Low Coolant Temp Alarm LI,H,LAT	Low Coolant Level Alarm SW(4),H	Low Coolant Level Alarm SW(2),H	Low Coolant Temp Alarm LI,H,LAT
3 Amber	Low Oil Press Alarm LI,H,LAT	Low Oil Press Alarm LI,H,LAT	Charger Malfunction SW(4),TIM	Low Oil Press Alarm LI,H,LAT	Low Oil Press Alarm LI,H,LAT	Low Oil Press Alarm LI,H,LAT
4 Amber	Low Fuel Level SW(1),H	Low Fuel Level SW(1),H	Low Fuel Level SW(1),H	Low Oil Level SW(1),H	Low Oil Level SW(1),H	Not In Auto LI,H
5 Red	Not In Auto LI,H	Not In Auto LI,H	High Coolant Temp Shutdown ¹ LI,H,TD	Low DCV INT,TIM	Not In Auto LI,H	High Coolant Temp ¹ Shutdown LI,H,TD
6 Red	Low DCV INT,TIM	Low DCV INT,TIM	Low Oil Pres Shutdown ¹ LI,H	Spare SW(3)	Low DCV INT,TIM	Low Oil Press ¹ Shutdown LI,H
7 Red	Spare SW(3)	Charger Malfunction SW(4),TIM	Overcrank Shutdown ¹ LI,H	Not Used	Spare SW(3)	Overcrank Shutdown ¹ LI,H
8 Red	Spare SW(4)	Air Damper Closed ² SW(3),H	Overspeed Shutdown ¹ LI,H	Not Used	Spare SW(4)	Overspeed Shutdown ¹ LI,H
	SW(2) Not Used	SW(2) Not Used	SW(2) Not Used	SW(2) Not Used		

Key:

¹ Latched by the GSC+.

² Air damper switch to be supplied by customer.

ALM = Alarm module.

H = Horn is sounded.

INT = The signal source is internal to the module.

LAT = "LATCHED" alarm fault.

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

RAN = Remote annunciator.

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

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

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

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

Normally switch input 3 (terminal 10) and switch input 4 (terminal 11) only operate indicators 7 and 8. However, it is possible for switch inputs 3 and 4 to also operate the horn. To do so, connect terminal 10 (sw input 3) to terminal 3 and connect terminal 11 (sw input 4) to terminal 4.

Alarm Silence

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

Data Link Malfunction

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

Lamp Test

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

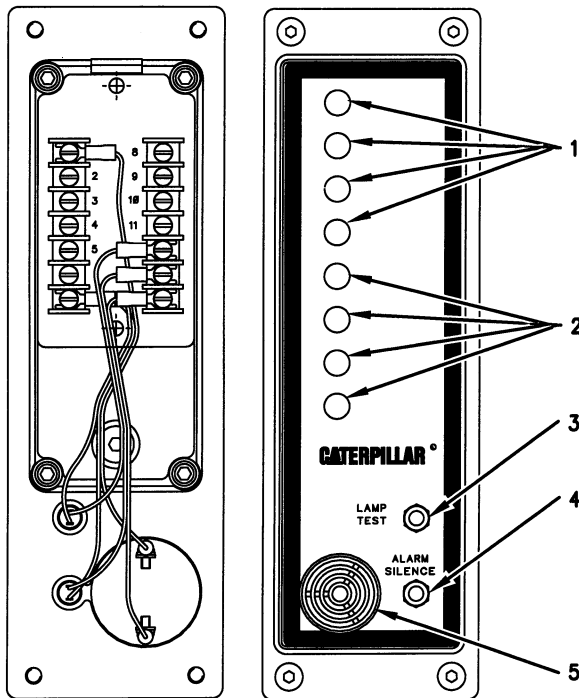
Mode Selection

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

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

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

Remote Annunciator Panel – NFPA 110



D77199

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

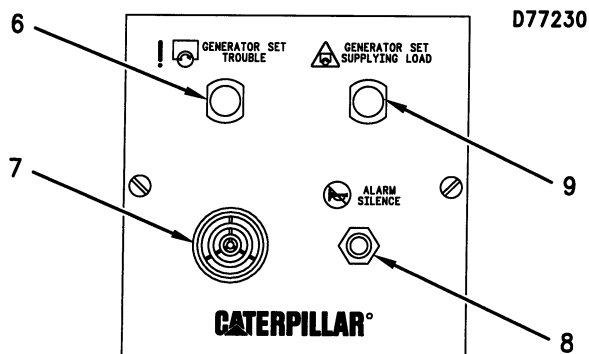
When alarm silence switch (4) or (8) is pressed on either the remote panel or the alarm module, the horns on both cease sounding. Also, trouble indicator (6) on the remote panel goes out. The indicator on the alarm module or GSC+ remains on. Another alarm fault will reactivate the horns and indicators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

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

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

Alarm Module

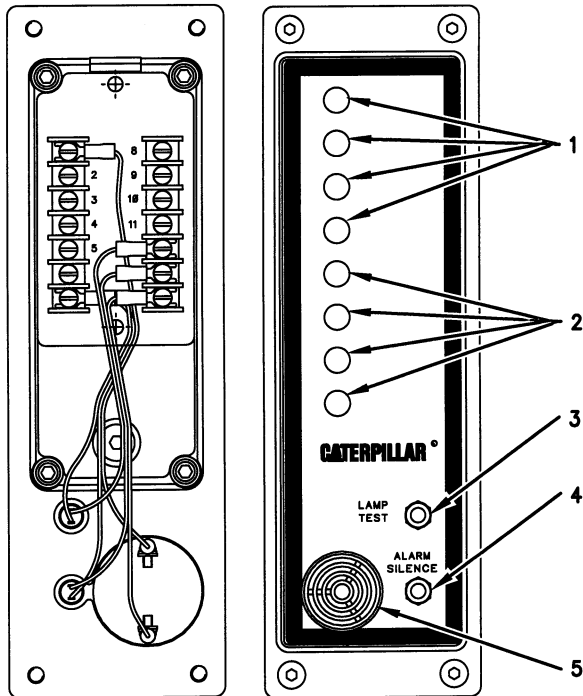
(1) Amber indicators. (2) Red indicators. (3) Lamp test switch.
(4) Alarm silence switch. (5) Horn.



NFPA 110 Remote Annunciator Panel

(6) Trouble indicator. (7) Horn. (8) Alarm silence switch. (9) Load indicator.

Custom Alarm Module (CAM)



D77199

Custom Alarm Module (CAM)

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

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

The custom alarm module (CAM) is an attachment that can be mounted at the genset or at a remote location. The purpose of the CAM is to annunciate faults, alarms or other conditions from customer supplied inputs.

The CAM operates when powered only by 24 DCV or 32 DCV battery systems. The CAM is equipped with a horn, alarm silence switch, a lamp test switch and 8 switched inputs for customer use.

NOTE: A basic version of the CAM also exists. The basic version does not have a horn, an alarm/silence switch or a lamp test switch. The basic CAM is to be used with an existing fully equipped CAM or an existing alarm module (ALM).

Alarm Operation

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

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

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

Alarm Silence Function

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

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

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

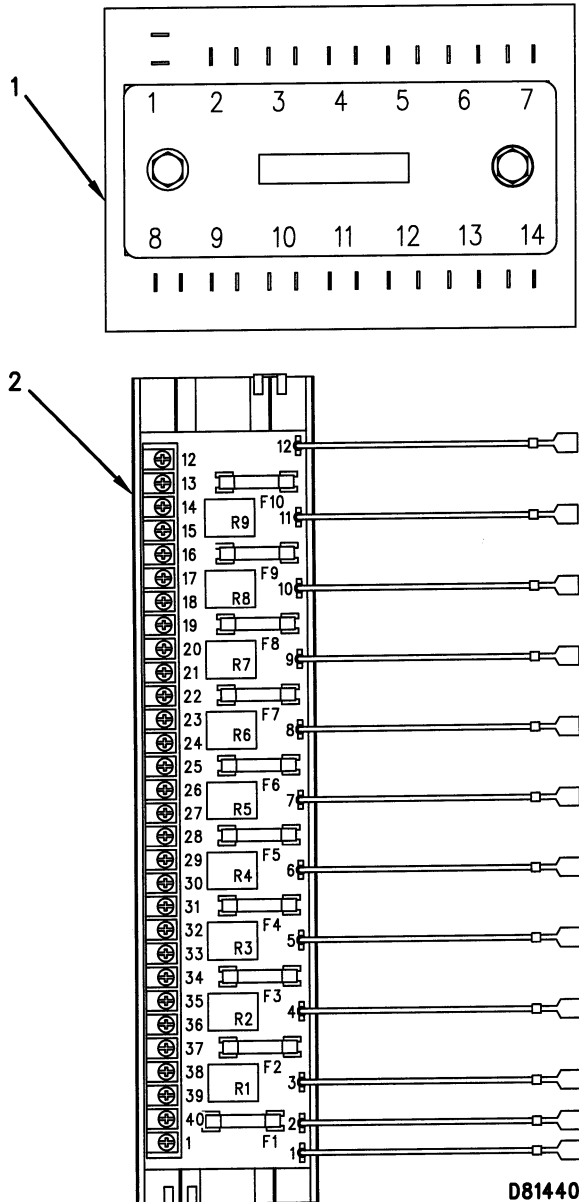
Lamp Test Function

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

Customized Labeling

The condition being monitored by each indicator is determined by the customer. The 130-3326 Film provides a wide variety of labels for the customer to customize the CAM to their application.

Relay Driver Module (RDM)



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

The relay driver module (RDM) is an optional module that can be used to expand the number of available outputs on the GSC+. The RDM outputs are controlled by the customer communication module (CCM). The RDM provides nine additional outputs for customer use. The RDM outputs are individually controlled by a serial data link from the GSC+. These outputs may drive the optional relay board, or can be directly connected to horns, lamps, or other devices. The relay board contains nine relays each with one set of NO and NC contacts for customer use. These relays are distinct from and are in addition to the seven relays contained within the relay module on the rear of the GSC+.

Output Test

When an output test signal is received, the RDM activates all outputs for 10 seconds or until the test signal is deactivated. To do an output test, connect terminal 5 of the RDM to terminal 7 of the RDM with a jumper.

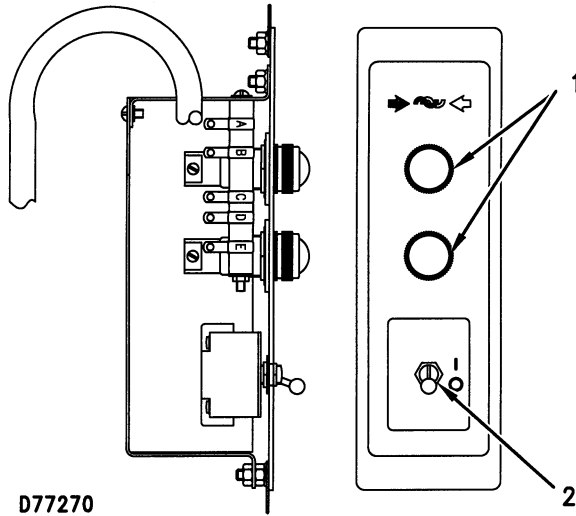
When the data link malfunctions, R1 output (terminal 2 of RDM) will FLASH at a rate of 0.5 Hz. Relays R2 through R9 will either maintain their present state or default to OFF. This is controlled by a jumper between terminals 6 and 7 of the RDM. If a jumper is NOT present when the serial data link has a fault, the relay outputs (R2 through R9) will maintain their present state. If the jumper is present, R2 through R9 will default to OFF.

Specifications:

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

NOTE: The GSC+ diagnoses a fault in the relay driver module circuit. See CID 475 in the topic Diagnostic Fault Codes of the Testing and Adjusting section. The CID 475 procedure also contains schematics for relay driver module installation purposes.

Synchronizing Lights Module



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

The optional synchronizing lights (SL) module is located on the instrument panel (same location as for the optional alarm module).

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

NOTE: For a complete explanation on how to parallel two units, make reference to the Operation and Maintenance Manual for SR4B Generators and Control Panels, Form No. SEBU6918.

Synchronizing Module Installation

WARNING

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

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

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

- Wire L1 to terminal L1 of TS1 in the generator housing.
- Wire L3 to terminal L3 of TS1 in the generator housing.
- Wire T11 to terminal 2 of fuse F13 on the AC transformer box + (ATB+).
- Wire T13 to terminal 2 of fuse F15 on the AC transformer box + (ATB+).

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

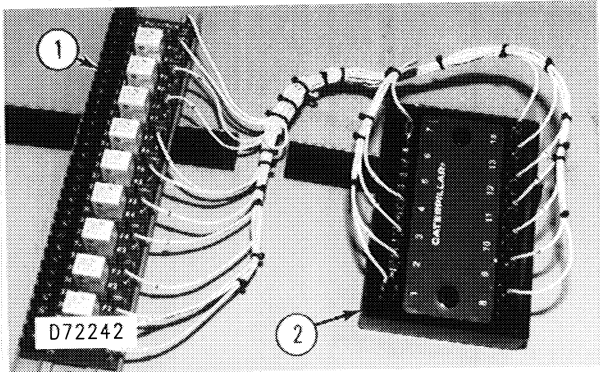
Adjust the connection of wires T11 and T13 on the taps of synchronizing resistors SLR1 and SLR2 as required for the particular generator AC voltage.

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

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

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

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 can be 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 fault (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).

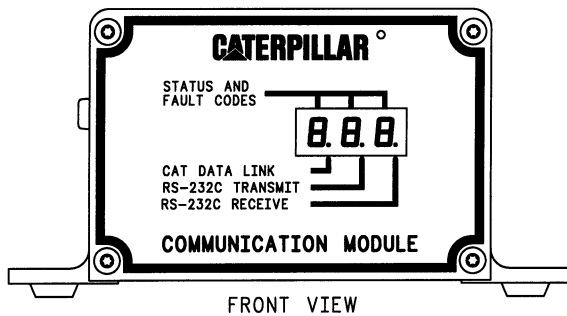
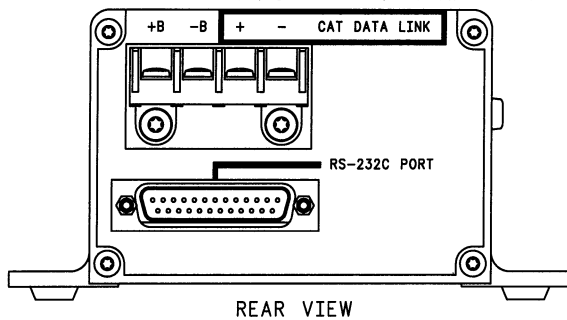
Outputs:

- 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 to 45 DCV).

Specifications:

- For CIM installation, the maximum distance between electronic control (2) and the GSC+ is 305 m (1000 ft).
- The operating voltage range is 15 to 45 DCV (24 DCV nominal)
- CIM is capable of operating with or without earth ground.
- The terminals on electronic control (2) are 6.4 mm (.25 in) push-on connectors.
- Customer connections at relay board (1) are 6-32 screw terminals.

Customer Communication Module (CCM)



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NOTE: The CCM can only control the spare output in an active low type of configuration. For more information, see Spare Input/Output Programming OP6 within the topic Service Mode.

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, SEBU6874, Customer Communication Module For EMCP II.

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-232C 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 CCM can access and monitor the same information available on the GSC+ display.

The CCM can remotely control the following functions when the GSC+ is in the normal mode with the ECS in the auto position:

- Start the engine.
- Stop the engine, provided the remote initiate contact is not closed.
- Activate or deactivate the OSR, provided the low oil pressure shutdown setpoint has been exceeded.
- Activate or deactivate the GFR, provided the GSC+ has not detected a fault. (In this case, the GSC+ will already have activated the GFR.)
- Remotely abort the cooldown time.
- Remotely control the spare output.
- Remotely control the programmable spare relay.

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.

Service Tools

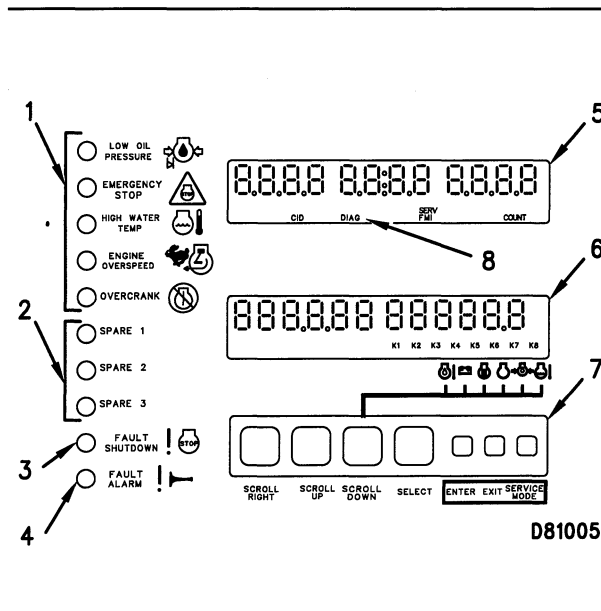
Tools Needed		
4C-3406	Connector Kit	1
	4mm Hex Wrench for fastener on GSC+ connector	1
6V-7070	Digital Multimeter	1
9U-7330	Multimeter (Optional) for frequency and duty cycle measurements	1
7X-1710	Cable Probes	1

Fault Identification

Fault Identification				
Indicator left side of GSC+	Fault Code on upper display (5)	DIAG Indicator (8)	Fault Type	See Topic
Fault Alarm (4)	CID FMI ¹	Flashing	Active Alarm	Diagnostic Fault Code Troubleshooting
	SP1, SP2, SP3, SP4 ¹	Absent	Active Alarm	SP Fault Code Troubleshooting
	AL1 thru AL15 ¹	Absent	Active Alarm	AL Fault Code Troubleshooting
Fault Shutdown (3)	CID FMI	Flashing	Active Shutdown	Diagnostic Fault Code Troubleshooting
	SP1, SP2, SP3, SP4	Absent	Active Shutdown	SP Fault Code Troubleshooting
	AL5 thru AL15 ¹	Absent	Active Alarm	AL Fault Code Troubleshooting
Dedicated Shutdown (1):				
Flashing	Absent	Absent	Active Alarm	Dedicated Shutdown Indicator Troubleshooting
On Continuously	Absent	Absent	Active Shutdown	
None	CID FMI ²	On Continuously	Inactive Alarm	Diagnostic Fault Code Troubleshooting
	CID FMI ²	On Continuously	Inactive Shutdown	Diagnostic Fault Code Troubleshooting
	SP1, SP2, SP3, SP4	Absent	Inactive Shutdown	SP Fault Code Troubleshooting
	AL5 thru AL15 ¹	Absent	Inactive Alarm	AL Fault Code Troubleshooting
	Absent	Absent	Undiagnosed Shutdown	Undiagnosed Problem Troubleshooting

¹ Fault code is shown after alarms code key is pressed.

² Fault code is stored in the fault log of the GSC+. To view the fault code, see Fault Log Viewing OP1 within the topic Service Mode.



GSC+ Display Area

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

Faults that are detected and diagnosed by the GSC+ are shown to service personnel in the display area of the GSC+. The GSC+ uses dedicated shutdown indicators (1), fault shutdown indicator (3), fault alarm indicator (4), DIAG indicator (8), upper display (5) 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 (8) functions (either FLASHING or ON CONTINUOUSLY) whenever diagnostic information is available from the GSC+.

- Note which of the indicators are functioning on the left side of the GSC+.
- View the fault code on upper display (5). If fault alarm indicator (4) is FLASHING and no fault code is present on upper display (5), press the alarm codes key to view the fault code.
- Note whether or not DIAG indicator (8) is FLASHING, ON CONTINUOUSLY, or ABSENT.
- On the Fault Identification chart, look at the first column and locate the fault indicator that is functioning.
- Go across to the second column in the chart and find the fault code that is presently shown on upper display (5).
- Go across to the third column in the chart which describes the status of DIAG indicator (8).
- Read the last two columns to find the type of fault and the corresponding topic within this module.

Diagnostic Fault Code 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), 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 175 FMI 3,	engine oil temperature 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 Fault Codes

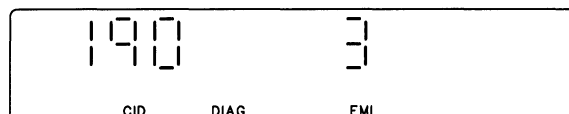
Diagnostic Fault Codes ¹	
CID No. / FMI No.	Description
CID 100 - Engine Oil Pressure Sensor:	
FMI 2	Signal out of range.
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 110 - Engine Coolant Temperature Sensor:	
FMI 2	Signal out of range.
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 111 - Engine Coolant Loss Sensor:	
FMI 3	Signal too high.
CID 168 - Battery Voltage:	
FMI 3	Voltage too high.
FMI 4	Voltage too low.
CID 175 - Engine Oil Temperature Sensor:	
FMI 2	Signal out of range.
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 190 - Engine Magnetic Pickup (MPU):	
FMI 2	Signal out of range.
FMI 3	Signal too high.
CID 248 - CAT Data Link:	
FMI 9	Abnormal update.
CID 268 - GSC+ Internal Memory:	
FMI 2	Signal out of range.
CID 269 - Sensor Power Supply:	
FMI 3	Voltage too high.
FMI 4	Voltage too low.
CID 333 - Alarm Module (ALM):	
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 334 - Spare Output:	
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 336 - Engine Control Switch (ECS):	
FMI 2	Undefined state.
CID 441 - Oil Step Relay (OSR):	
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 448 - Programmable Spare Relay (PSR):	
FMI 12	Faulty component.
CID 475 - Relay Driver Module Data Link:	
FMI 3	Signal too high.
FMI 4	Signal too low.
CID 566 - Unexpected Shutdown:	
FMI 7	Faulty Mechanical Response.
CID 770 - CCM Data Link:	
FMI 9	Abnormal update.
CID 859 - kW Level Output:	
FMI 3	Signal too high.
FMI 4	Signal too low.

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

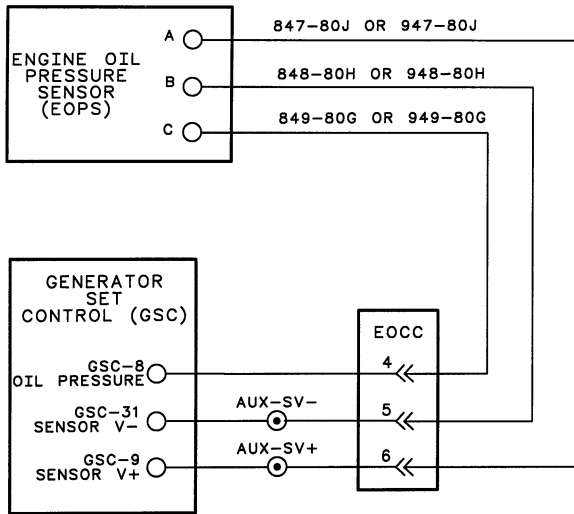
Example

D81006



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

CID 100 Engine Oil Pressure Sensor (EOPS)



D85496

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 (P004 = 0, factory default). If the GSC+ is programmed to shutdown (P004 = 1) for an oil pressure sensor fault, then it is not necessary to press the alarm codes key to view 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
- CID 190 FMI 3, Engine Magnetic Pickup
- CID 336 FMI 2, Engine Control Switch

CID 100 FMI 2 (Signal Out Of Range)

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

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

Begin performing these procedures only when CID 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. Clear the fault from the fault log after troubleshooting is complete.

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 procedure.

Step 1. Check GSC+ And Harness. Make sure that CID 100 FMI 2 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key (not required for shutdown faults).
- e. Monitor the display to see if CID 100 FMI 2 is no longer showing (inactive) and CID 100 FMI 3 is now showing (active).

Expected Result: CID 100 FMI 2 is not showing, CID 100 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 100 FMI 2 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

Step 2. Check GSC+.

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

Expected Result: CID 100 FMI 2 is not showing, CID 100 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 100 FMI 2 fault remains showing. The GSC+ is faulty. Replace the GSC+; see the topic Generator Set Control + Replacement. STOP.

CID 100 FMI 3 (Signal Too High)

The possible causes of a CID 100 FMI 3 fault are:

- A short to battery positive (B+) of the sensor signal.
- An open circuit of the sensor signal.

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Supply Circuit.

- a. Turn the ECS to OFF/RESET and then to the STOP position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground).

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

Results:

- OK – The supply circuit functions properly. Proceed to next step.
- Not OK – The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. If a sensor supply fault (CID 269) is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

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

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

Expected Result: The voltage should be 7.0 ± 0.5 DCV.

Results:

- OK – The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 100 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.
- Not OK – Voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.
- Not OK – Voltage is NOT 7.0 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC+ or the harness is faulty. Proceed to next step.

Step 3. Check For Shorted Harness. When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect the harness connector from the GSC+.
- c. At the GSC+ harness connector, measure the resistance from signal contact 8 to all other contacts of the connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

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.

- a. Measure the resistance of the ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC+ harness connector.
- b. Measure the resistance of the signal circuit, from contact C of the sensor harness connector to contact 8 of the GSC+ harness connector.
- c. Measure the resistance of the sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC+ harness connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – 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.

- a. Check the electrical connectors, terminals and wiring; proceed to the topic Electrical Connector Inspection.

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

Results:

- OK – Connect all harness connectors that were previously disconnected. Start the engine. If the CID 100 FMI 3 fault is still showing, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – Repair the faulty area. STOP.

CID 100 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.

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check GSC+ And Harness. Make sure that CID 100 FMI 4 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 100 FMI 4 is no longer showing (inactive) and CID 100 FMI 3 is now showing (active).

Expected Result: CID 100 FMI 4 is not showing and CID 100 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 100 FMI 4 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

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).

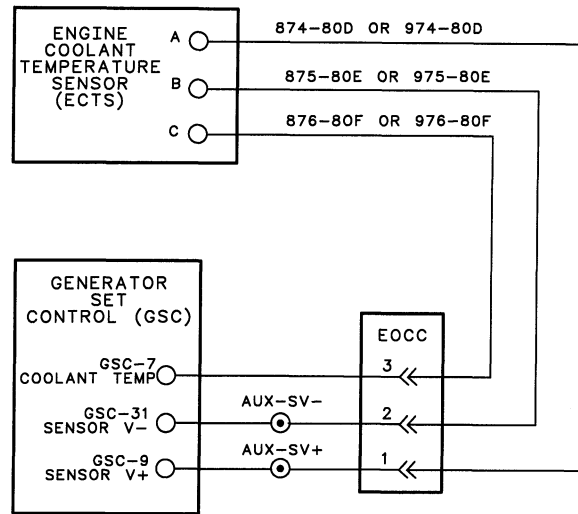
Expected Result: CID 100 FMI 4 is not showing and CID 100 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is shorted to battery negative (B-) in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 100 FMI 4 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)



D85497

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 coolant temperature sensor fault as an alarm fault (P004 = 0, factory default). If the GSC+ is programmed to shutdown (P004 = 1) for a coolant temperature sensor fault, then it is not necessary to press the alarm codes key to view 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)

CID 190 FMI 3, Engine Magnetic Pickup

CID 336 FMI 2, Engine Control Switch

CID 110 FMI 2 (Signal Out Of Range)

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

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

Begin performing these procedures only when CID 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. Clear the fault from the fault log after troubleshooting is complete.

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 procedure.

Step 1. Check GSC+ And Harness. Make sure that CID 110 FMI 2 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key (not required for shutdown faults).
- e. Monitor the display to see if CID 110 FMI 2 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

Expected Result: CID 110 FMI 2 is not showing, CID 110 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 110 FMI 2 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

Step 2. Check GSC+.

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

Expected Result: CID 110 FMI 2 is not showing, CID 110 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 110 FMI 2 fault remains showing. The GSC+ is faulty. Replace the GSC+; see the topic Generator Set Control + Replacement. STOP.

CID 110 FMI 3 (Signal Too High)

The possible causes of a CID 110 FMI 3 fault are:

- A short to battery positive (B+) of the sensor signal.
- An open circuit of the sensor signal.

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Supply Circuit.

- a. Turn the ECS to OFF/RESET and then to the STOP position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground).

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

Results:

- OK – The supply circuit functions properly. Proceed to next step.
- Not OK – The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. If a sensor supply fault (CID 269) is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

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

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

Expected Result: The voltage should be 7.0 ± 0.5 DCV.

Results:

- OK – The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 110 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.
- Not OK – Voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.
- Not OK – Voltage is NOT 7.0 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC+ or the harness is faulty. Proceed to next step.

Step 3. Check For Shorted Harness. When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect the harness connector from the GSC+.
- c. At the GSC+ harness connector, measure the resistance from signal contact 7 to all other contacts of the connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

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.

- a. Measure the resistance of the ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC+ harness connector.
- b. Measure the resistance of the signal circuit, from contact C of the sensor harness connector to contact 7 of the GSC+ harness connector.
- c. Measure the resistance of the sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC+ harness connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – 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.

- a. Check the electrical connectors, terminals and wiring; proceed to the topic Electrical Connector Inspection.

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

Results:

- OK – Connect all harness connectors that were previously disconnected. Start the engine. If the CID 110 FMI 3 fault is still showing, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – Repair the faulty area. STOP.

CID 110 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.

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check GSC+ And Harness. Make sure that CID 110 FMI 4 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 110 FMI 4 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

Expected Result: CID 110 FMI 4 is not showing and CID 110 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 110 FMI 4 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

Step 2. Check GSC+.

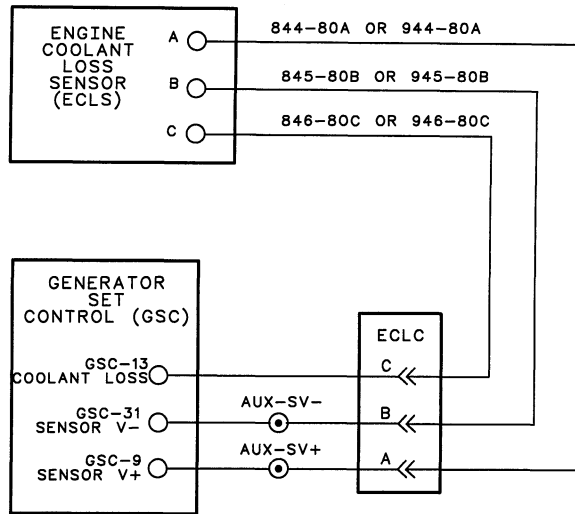
- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the harness connector from the GSC+.
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 110 FMI 4 is no longer showing (inactive) and CID 110 FMI 3 is now showing (active).

Expected Result: CID 110 FMI 4 is not showing and CID 110 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is shorted to battery negative (B-) in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 110 FMI 4 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)



D85495

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 (P004 = 0). If the GSC+ is programmed to shutdown (P004 = 1) for a coolant loss sensor fault, then it is not necessary to press the alarm codes key to view 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
 CID 190 FMI 3, Engine Magnetic Pickup
 CID 336 FMI 2, Engine Control Switch

CID 111 FMI 3 (Signal Too High)

The possible causes of a CID 111 FMI 3 fault are:

- A short to battery positive (B+) of the sensor signal.
- An open circuit of the sensor signal.

Begin performing these procedures only when CID 111 FMI 3 is showing and the DIAG indicator is FLASHING (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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Supply Circuit.

- a. Turn the ECS to OFF/RESET and then to the STOP position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground).

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

Results:

- OK – The supply circuit functions properly. Proceed to next step.
- Not OK – The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. If a sensor supply fault (CID 269) is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

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

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

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

Results:

- OK – The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 111 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.
- Not OK – Voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.
- Not OK – Voltage is NOT 2.5 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC+ or the harness is faulty. Proceed to next step.

Step 3. Check For Shorted Harness. When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect the harness connector from the GSC+.
- c. At the GSC+ harness connector, measure the resistance from signal contact 13 to all other contacts of the connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

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.

- a. Measure the resistance of the ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC+ harness connector.
- b. Measure the resistance of the signal circuit, from contact C of the sensor harness connector to contact 13 of the GSC+ harness connector.
- c. Measure the resistance of the sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC+ harness connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – 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.

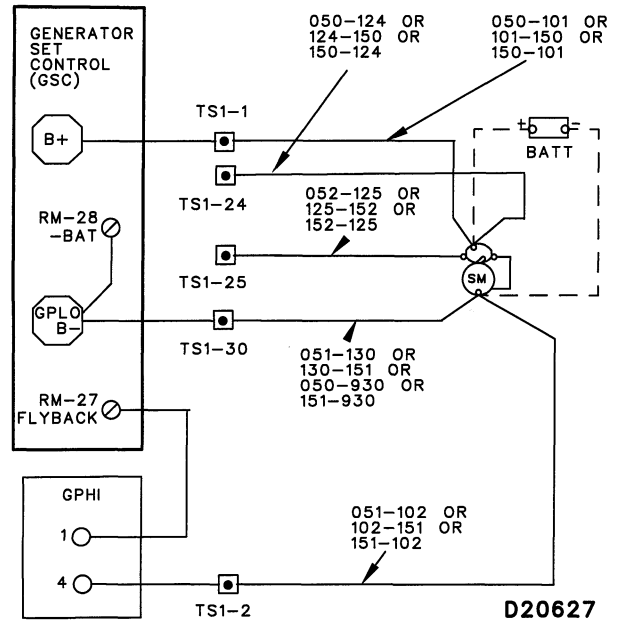
- a. Check the electrical connectors, terminals and wiring; proceed to the topic Electrical Connector Inspection.

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

Results:

- OK – Connect all harness connectors that were previously disconnected. Start the engine. If the CID 111 FMI 3 fault is still showing, replace the GSC+. See 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 RM-1 of the relay module terminal strip on the rear of the GSC+. The GSC+ receives battery power whenever the Engine Control Switch (ECS) is turned to START, AUTO, or STOP.

NOTE: The GSC+ does not receive battery power when the ECS is in the OFF/RESET position unless contacts 6 and 9 of the ECS are wired together.

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

CID 168 FMI 3 (Voltage Too High)

CID 168 FMI 4 (Voltage Too Low)

Use this procedure for either a FMI 3 or FMI 4 fault.

The possible causes of a CID 168 FMI 3 fault are:

- The battery voltage is greater than 32 DCV for 24 volt systems.
- The battery voltage is 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 (P007) specifies the genset battery voltage; 0 for 24 volts, 1 for 32 volts.

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. Clear the fault from the fault log after troubleshooting is complete.

Step 1. Verify Fault.

- a. View the upper display and check for active battery voltage diagnostic faults (CID 168 FMI 3 or CID 168 FMI 4).
- b. Enter service mode and check the fault log for inactive battery voltage diagnostic faults (CID 168 FMI 3 or CID 168 FMI 4).

Expected Result: Is a CID 168 FMI 3 or CID 168 FMI 4 diagnostic fault active or inactive.

Results:

- No – Battery voltage diagnostic faults, DO NOT EXIST. STOP.
- Yes – Battery voltage diagnostic faults, DO EXIST. Proceed to next step.

Step 2. Check Voltage.

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

Expected Result: The three voltages (preceding b, c and d) should be within 2.0 volt of each other.

Results:

- OK – All voltages agree (less than 2.0 DCV difference). Proceed to Step 4.
- Not OK – Voltage measured at the batteries does not agree (greater than 2.0 DCV difference) with voltage measured at relay module terminal strip. Proceed to Step 3.
- Not OK – Voltage showing on the lower display does not agree (greater than 2.0 DCV difference) with voltage measured at relay module terminal strip. Replace the GSC+; see the topic Generator Set Control + Replacement. STOP.

Step 3. Check Harness.

- a. Disconnect the B+ and B- cables from the battery.
- b. 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+.
- c. Measure the resistance of each wire from the battery end to the terminal strip end.

Expected Result: The resistance of a single harness wire should be 5 ohms or less.

Results:

- OK – Both resistance measurements are correct. Therefore, an intermittent harness problem is likely. To further check the harness, proceed 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.

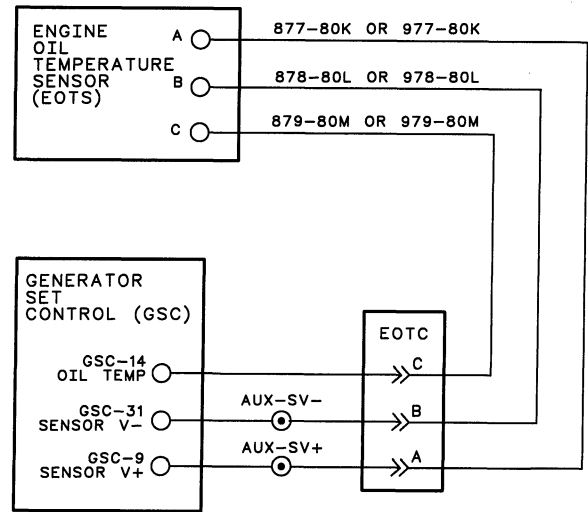
- a. With the engine off, measure the system voltage at the battery.

Expected Result: For 24 volt systems, the battery voltage should be from 24.8 to 29.5 DCV. For 32 volt systems, the battery voltage should be from 33.1 to 39.3 DCV.

Results:

- OK – 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, proceed 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. STOP.

**CID 175
Engine Oil Temperature Sensor (EOTS)**



D83865

System Schematic For Engine Oil Temperature Sensor (EOTS)

System Operation

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

The sensor is powered by an 8 volt sensor supply from the GSC+. The oil temperature signal is a pulse width modulated (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 an oil temperature sensor fault as an alarm fault (P004 = 0, factory default). If the GSC+ is programmed to shutdown (P004 = 1) for an oil temperature sensor fault, then it is not necessary to press the alarm codes key to view 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
CID 190 FMI 3, Engine Magnetic Pickup
CID 336 FMI 2, Engine Control Switch

CID 175 FMI 2 (Signal Out Of Range)

The possible causes of a CID 175 FMI 2 fault are:

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

Begin performing these procedures only when CID 175 FMI 2 is showing and the DIAG indicator is FLASHING (fault is active) on the upper display. The GSC+ treats a CID 175 FMI 2 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed 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. Clear the fault from the fault log after troubleshooting is complete.

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 procedure.

Step 1. Check GSC+ And Harness. Make sure that CID 175 FMI 2 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key (not required for shutdown faults).
- e. Monitor the display to see if CID 175 FMI 2 is no longer showing (inactive) and CID 175 FMI 3 is now showing (active).

Expected Result: CID 175 FMI 2 is not showing, CID 175 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 175 FMI 2 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

Step 2. Check GSC+.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the harness connector from the GSC+.
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 175 FMI 2 is no longer showing (inactive) and CID 175 FMI 3 is now showing (active).

Expected Result: CID 175 FMI 2 is not showing, CID 175 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is faulty in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 175 FMI 2 fault remains showing. The GSC+ is faulty. Replace the GSC+; see the topic Generator Set Control + Replacement. STOP.

CID 175 FMI 3 (Signal Too High)

The possible causes of a CID 175 FMI 3 fault are:

- A short to battery positive (B+) of the sensor signal.
- An open circuit of the sensor signal.

Begin performing these procedures only when CID 175 FMI 3 is showing and the DIAG indicator is FLASHING (fault is active) on the upper display. The GSC+ treats a CID 175 FMI 3 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed 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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Supply Circuit.

- a. Turn the ECS to OFF/RESET and then to the STOP position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. At the engine harness side of the sensor connector, measure the voltage (DCV) between contact A (supply) and contact B (sensor ground).

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

Results:

- OK – The supply circuit functions properly. Proceed to next step.
- Not OK – The supply circuit is faulty. Check the upper display for a sensor supply fault (CID 269) and correct it. If a sensor supply fault (CID 269) is not showing on the upper display, then the engine harness has an open circuit. Proceed to Step 4.

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

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

Expected Result: The voltage should be 7.0 ± 0.5 DCV.

Results:

- OK – The signal circuit functions properly. Verify this result by checking to see if the fault remains present. Reconnect the sensor. Turn the ECS to OFF/RESET and then to STOP. If the CID 175 FMI 3 fault is still showing on the upper display, the sensor is faulty. Replace the sensor. STOP.
- Not OK – Voltage is equal to battery positive (B+). The engine harness is faulty. The signal circuit within the engine harness is shorted to battery positive (B+). Troubleshoot and repair the engine harness. STOP.
- Not OK – Voltage is NOT 7.0 ± 0.5 DCV and is NOT equal to battery positive (B+). The GSC+ or the harness is faulty. Proceed to next step.

Step 3. Check For Shorted Harness. When performing this Step, see the preceding System Schematic. The sensor remains disconnected from the engine harness.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect the harness connector from the GSC+.
- c. At the GSC+ harness connector, measure the resistance from signal contact 14 to all other contacts of the connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – The harness wiring with the incorrect resistance is shorted in the harness. Troubleshoot and repair the faulty harness wiring between the sensor connector and the GSC+ connector. STOP.

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.

- a. Measure the resistance of the ground circuit, from contact B of the sensor harness connector to contact 31 of the GSC+ harness connector.
- b. Measure the resistance of the signal circuit, from contact C of the sensor harness connector to contact 14 of the GSC+ harness connector.
- c. Measure the resistance of the sensor supply circuit, from contact A of the sensor harness connector to contact 9 of the GSC+ harness connector.

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

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – 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.

- a. Check the electrical connectors, terminals and wiring; proceed to the topic Electrical Connector Inspection.

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

Results:

- OK – Connect all harness connectors that were previously disconnected. Start the engine. If the CID 175 FMI 3 fault is still showing, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – Repair the faulty area. STOP.

CID 175 FMI 4 (Signal Too Low)

The possible cause of a CID 175 FMI 4 fault is:

- A short to battery negative (B-) of the sensor signal.

Begin performing these procedures only when CID 175 FMI 4 is showing and the DIAG indicator is FLASHING (fault is active) on the upper display. The GSC+ treats a CID 175 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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check GSC+ And Harness. Make sure that CID 175 FMI 4 is showing on the display.

- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the sensor from the engine harness (the sensor remains fastened to the engine).
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 175 FMI 4 is no longer showing (inactive) and CID 175 FMI 3 is now showing (active).

Expected Result: CID 175 FMI 4 is not showing and CID 175 FMI 3 is now showing (active).

Results:

- OK – 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 – CID 175 FMI 4 fault remains showing. The harness or the GSC+ is faulty. Proceed to next step.

Step 2. Check GSC+.

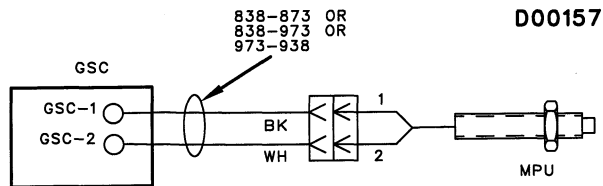
- a. Turn the ECS to the OFF/RESET position.
- b. Disconnect the harness connector from the GSC+.
- c. Turn the ECS to the STOP position.
- d. Press the alarm codes key.
- e. Monitor the display to see if CID 175 FMI 4 is no longer showing (inactive) and CID 175 FMI 3 is now showing (active).

Expected Result: CID 175 FMI 4 is not showing and CID 175 FMI 3 is now showing (active).

Results:

- OK – The GSC+ functions properly. Therefore, the signal wire is shorted to battery negative (B-) in the harness. Troubleshoot the signal wire in the harness between the sensor connector and the GSC+ connector. Also check the electrical connectors and terminals; see the topic Electrical Connector Inspection. STOP.
- Not OK – CID 175 FMI 4 fault remains showing. The GSC+ is faulty. Replace the GSC+; see the topic Generator Set Control + Replacement. STOP.

CID 190 Engine Magnetic Pickup (MPU)



System Schematic For Engine Magnetic Pickup (MPU)

System Operation

The EMCP II+ system monitors engine speed to use the information when needed for other tasks. Tasks such as: activating an engine overspeed shutdown, terminating engine cranking, 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 engine control (PEEC) have a separate magnetic pickup. The cable of the magnetic pickup used by the GSC+ is marked 838-873, 838-973 or 973-938.

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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
 CID 190 FMI 3, Engine Magnetic Pickup
 CID 336 FMI 2, Engine Control Switch

CID 190 FMI 2 (Signal Out Of Range) CID 190 FMI 3 (Signal Too High)

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

The possible causes of a CID 190 FMI 2 fault are:

- The frequency of the signal is beyond accepted limits (short to B-).
- 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.

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.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK – 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.
 - If a CID 190 fault is showing, continue with this procedure. Proceed to next step.
 - If a CID 190 fault is NOT showing, this Step has corrected the fault. STOP. (If desired, continue with this procedure. Proceed to next step.)
- Not OK – The harness wiring or the MPU is faulty. Proceed to Step 2.

Step 2. Check MPU Resistance.

- Disconnect the MPU from the engine harness (the MPU remains fastened to the engine).
- At the connector of the MPU, measure the resistance between contact 1 and contact 2.

Expected Result: The resistance should be 100 to 350 ohm.

Results:

- OK – The resistance of the MPU is correct. Proceed to next step.
- Not OK – 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.

- a. Check for open circuit, from contact 2 of the MPU harness connector to contact 2 of the GSC+ harness connector. The resistance should be 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 be 5 ohms or less.
- c. Check for short circuit, from contact 1 to contact 2, both of the GSC+ harness connector. The resistance should be greater than 5K ohms.

Expected Result: The resistance for a and b should be 5 ohms or less. The resistance for c should be greater than 5K ohms.

Results:

- OK – The harness functions properly. Proceed to next step.
- Not OK – The harness wiring with the incorrect resistance measurement is faulty. Replace the faulty harness from the 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+.

- a. Within the EMCP II+, check that the shield is securely fastened.
- b. Within the EMCP II+, measure the resistance from the shield to a metal surface within the enclosure of EMCP II+. A good reference point is any component mounting screw that directly contacts the metal enclosure. The resistance should be 5 ohms or less.
- c. Check the connector of the MPU and the mating harness connector. Proceed to the topic Electrical Connector Inspection.

Expected Result: The shield should be securely fastened, the resistance (of b) should be 5 ohms or less and the connectors should be proper.

Results:

- OK – Proceed to next step.
- Not OK – One of the items is NOT correct. Repair or replace the harness. STOP.

Step 5. Inspect And Adjust MPU.

- a. Remove the MPU from the engine flywheel housing.
- b. Inspect for damage and remove any debris from the tip.

Expected Result: No damage should be present.

Results:

- OK – Reinstall and adjust the MPU; see the topic Magnetic Pickup (MPU) Adjustment. Proceed to next step.
- Not OK – Replace the MPU. Also, see the topic Magnetic Pickup (MPU) Adjustment. STOP.

Step 6. Check Fault Status.

- a. Reconnect the harness connector to the GSC+ and the MPU.
- b. Turn the ECS to OFF/RESET and then to STOP.
- c. Check the upper display to see if a CID 190 fault remains showing (active).

Expected Result: Is a CID 190 FMI 2 or CID 190 FMI 3 diagnostic fault active.

Results:

- No – These procedures have corrected the fault. STOP. (If desired, continue with this procedure. Proceed to next step.)
- Yes – 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. This is an additional check of the circuit. Make sure all harness connectors are connected.

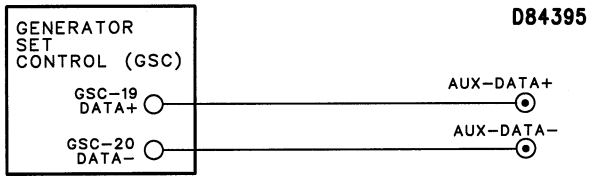
- a. Setup a multimeter with 7X-1710 Cable Probes to measure the AC signal voltage from contact 1 to contact 2 of the GSC+ connector.
- b. Start and run the engine at rated speed.
- c. Measure the AC signal voltage of the MPU.

Expected Result: The voltage should be 10 ACV or greater.

Results:

- OK – The MPU circuit checks correctly. STOP.
- Not OK – The most likely cause is improper air gap of the pickup. Repeat Step 5. STOP.

CID 248 CAT Data Link



System Schematic For CAT Data Link

System Operation

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

CID 248 FMI 9 (Abnormal Update)

The possible causes of a CID 248 FMI 9 fault are:

- A short to battery positive (B+) of either of the two CAT data link wires.
- A short to 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.

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. Clear the fault from the fault log after troubleshooting is complete.

CID 268 GSC+ Internal Memory

System Operation

A portion of memory within the GSC+ stores the setpoints of important genset conditions including engine/generator setpoint programming (OP5-0), protective relaying setpoints (OP5-1), 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. For more information regarding setpoints and default values see the following topics in the Systems Operation section of this manual:

- Engine/Generator Programming OP5-0
- Protective Relay Programming OP5-1
- Spare Input/Output Programming OP6
- Voltmeter/Ammeter Programming OP8

CID 268 FMI 2 (Signal Out Of Range)

The possible cause of a CID 268 FMI 2 fault is:

- Electrical interference.

This procedure is for an active or inactive CID 268 fault. Clear the fault from the fault log after troubleshooting is complete.

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 (P009) setpoint and the engine overspeed (P010) 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 Setpoints.

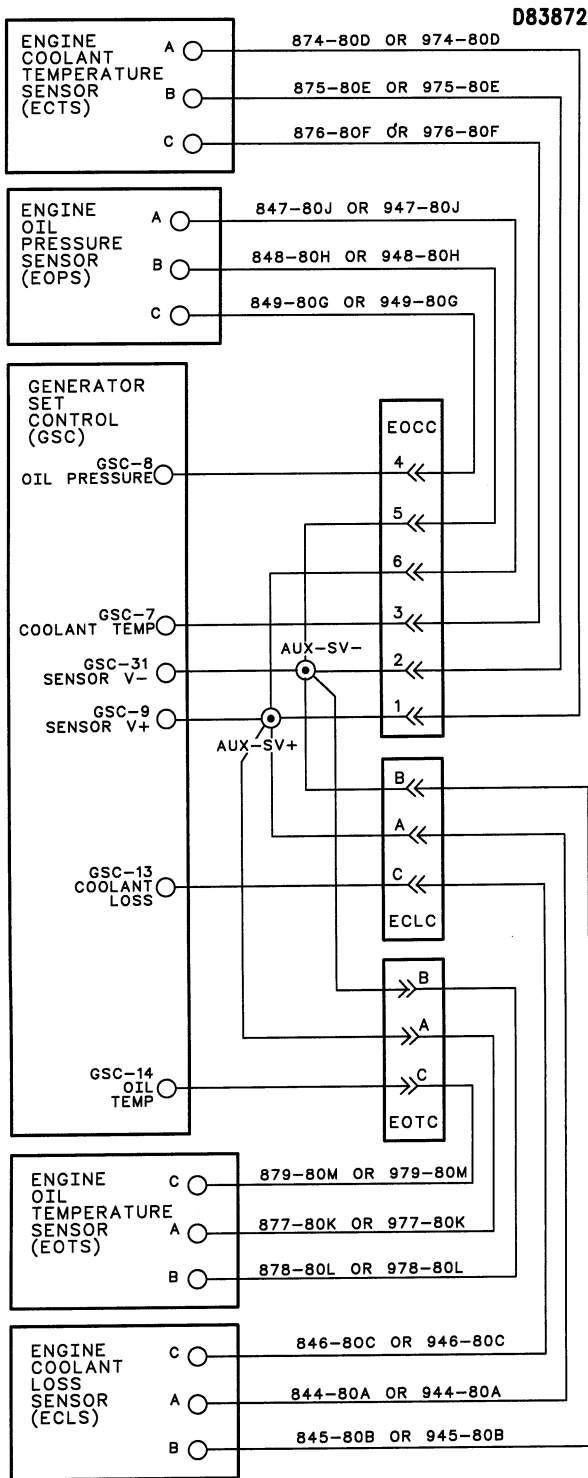
- a. View the setpoints that are stored in the memory of the GSC+; see Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- b. Also check the spare input/output programming (OP6) and the voltmeter/ammeter programming (OP8).
- c. Compare the stored setpoints to the specified setpoints of 136-9048 Control Panel Chart (packaged within the control panel).

Expected Result: The stored setpoints and specified setpoints should match.

Results:

- 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 Engine/Generator Programming OP5-0, Protective Relay Programming OP5-1, 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 four engine sensors: oil pressure, oil temperature (optional), coolant temperature and coolant loss (optional). The sensor power supply functions whenever power is applied to the GSC+.

NOTE: The GSC+ is usually programmed (factory default) to treat a fault with the sensor power supply (CID 269) as an alarm fault (P004 = 0). If the GSC+ is programmed to shutdown (P004 = 1) for a fault with the sensor power supply, then it is not necessary to press the alarm codes key to view 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
- CID 190 FMI 3, Engine Magnetic Pickup
- CID 336 FMI 2, Engine Control Switch

CID 269 FMI 3 (Voltage Too High)

The possible cause of a CID 269 FMI 3 fault is:

- The voltage of the sensor power supply is greater than 8.5 DCV.

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. Clear the fault from the fault log after troubleshooting is complete.

Step 1. Check The GSC+.

- a. Disconnect the harness connector from the GSC+.
- b. Turn the ECS to OFF/RESET and then to the STOP position.
- c. Press the alarm codes key.
- d. Observe the upper display to see if the CID 269 FMI 3 fault is showing (is active).

Expected Result: The CID 269 FMI 3 fault should NOT be showing (is inactive).

Results:

- OK – The GSC+ is functioning properly. Therefore, the engine harness has a short to B+. Repair the engine harness. STOP.
- Not OK – The GSC+ is faulty, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.

CID 269 FMI 4 (Voltage Too Low)

The possible cause of a CID 269 FMI 4 fault is:

- The voltage of the sensor power supply is less than 7.5 DCV.

Begin performing these procedures only when CID 269 FMI 4 is showing and the DIAG indicator is FLASHING (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. Clear the fault from the fault log after troubleshooting is complete.

Step 1. Check The GSC+.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect the harness connector from the GSC+.
- c. Turn the ECS to STOP.
- d. Press the alarm codes key.
- e. Observe the upper display to see if the CID 269 FMI 4 fault is showing (is active).

Expected Result: The CID 269 FMI 4 fault should NOT be showing (is inactive).

Results:

- OK – The GSC+ is functioning properly. Therefore, the engine harness or a sensor is faulty. Proceed to next step.
- Not OK – The GSC+ is faulty, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.

Step 2. Check Oil Pressure Sensors.

- a. Turn the ECS to OFF/RESET.
- b. Reconnect the harness connector to the GSC+.
- c. Disconnect the engine harness from the oil pressure sensor.
- d. Turn the ECS to STOP.
- e. Press the alarm codes key.
- f. Observe the upper display to see if the CID 269 FMI 4 fault is showing (is active).

Expected Result: If the sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK – The CID 269 FMI 4 fault is NOT showing (is inactive). The oil pressure sensor is faulty. Replace the sensor. STOP.
- Not OK – The CID 269 FMI 4 fault is still showing (is active). The oil pressure is not the cause of the CID 269 FMI 4 fault. Proceed to next step.

Step 3. Check Other Sensors And Harness.

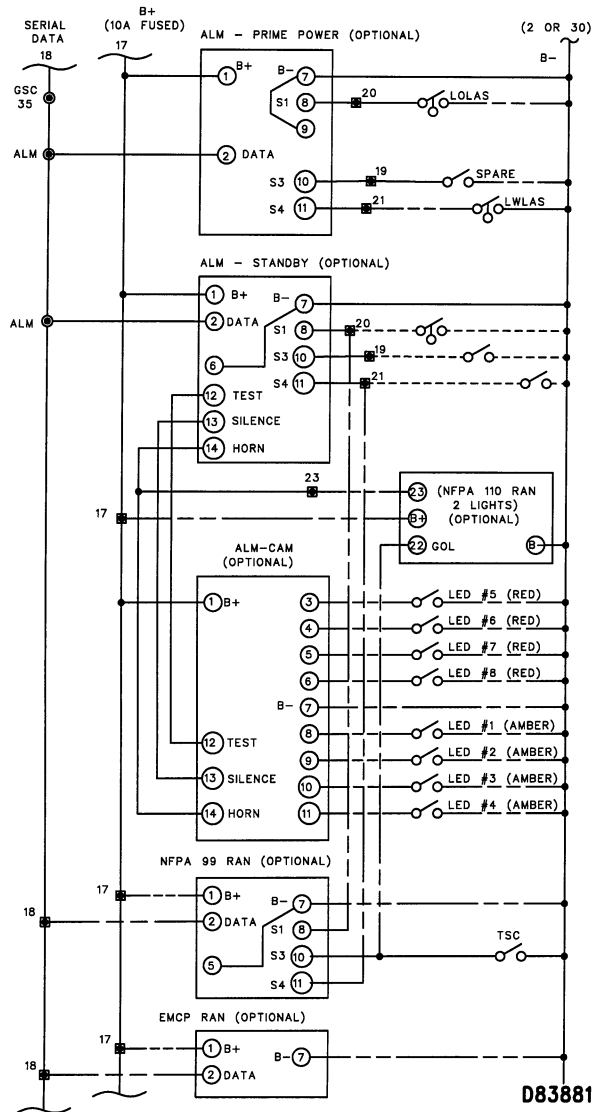
- Repeat Step 2 for the coolant temperature sensor, the optional oil temperature sensor and the optional coolant loss sensor.

Expected Result: If a sensor is the cause of the CID 269 FMI 4 fault, then CID 269 FMI 4 should NOT be showing when the sensor is disconnected.

Results:

- OK – When a sensor is disconnected, the CID 269 FMI 4 fault is NOT showing (is inactive). The sensor is faulty. Replace the sensor. STOP.
- Not OK – With all the sensors disconnected, the CID 269 FMI 4 fault is still showing (is active). The sensor are not the cause of the CID 269 FMI 4 fault. Therefore the engine harness has a short to battery negative (B-). Repair the engine harness. STOP.

**CID 333
Alarm Module (ALM)**



System Schematic For Alarm Module (ALM)

System Operation

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

The ALM communicates with the GSC+ by a serial data link. 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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
CID 190 FMI 3, Engine Magnetic Pickup
CID 336 FMI 2, Engine Control Switch

CID 333 FMI 3 (Signal Too High) CID 333 FMI 4 (Signal Too Low)

Use this procedure for either a FMI 3 or FMI 4 fault that is active or inactive.

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 to B- of the data signal.

The GSC+ treats a CID 333 FMI 3 or CID 333 FMI 4 fault as an alarm fault. Clear the fault from the fault log after troubleshooting is complete.

NOTE: If a CID 333 FMI 3 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).

- a. Turn the ECS to OFF/RESET and then to STOP.
- b. Press the alarm codes key.
- c. Observe the upper display to see if a CID 333 FMI 3 or a CID 333 FMI 4 fault is showing (is active).
- d. If the fault is not showing, enter service mode and view the fault log (OP1) to see if the faults are showing (is inactive).

Expected Result: Is a CID 333 FMI 3 or a CID 333 FMI 4 fault showing as active or inactive?.

Results:

- No – A CID 333 FMI 3 or a CID 333 FMI 4 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 333 FMI 3 or a CID 333 FMI 4 fault is active. Proceed to Step 2.
- Yes – A CID 333 FMI 3 or a CID 333 FMI 4 fault is inactive. Proceed to Step 4.

Step 2. Check Voltage Of Data Signal.

- a. Turn the ECS to STOP.
- b. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The measured voltage should change constantly, within the range of 0 to 10 DCV.

Results:

- OK – Voltage measurement is correct. Proceed to Step 4.
- Not OK – Voltage measurement is NOT correct. Proceed to Step 3.

Step 3. Check Voltage Of ALM And GSC+.

- a. Turn the ECS to STOP.
- b. At the ALM, remove wire #18 from terminal 2.
- c. Disconnect the harness connector from the GSC+.
- d. At the ALM, measure the DC voltage from terminal 2 (positive meter lead) to terminal 7 (negative meter lead). The voltage should be 11.6 ± 0.5 DCV.
- e. At the GSC+, measure the DC voltage from contact 35 of the GSC+, to the battery negative (B-) terminal of the relay module. The measured voltage should change constantly, within the range of 0 to 5.5 DCV.

Expected Result: For Step d, the voltage should be 11.6 ± 0.5 DCV. For Step e, the voltage should be changing constantly, within the range of 0 to 5.5 DCV.

Results:

- OK – Both voltage measurements are correct. Proceed to Step 4.
- Not OK – Voltage measured at the ALM (Step d) is NOT correct. Replace the ALM. STOP.
- Not OK – Voltage measured at the GSC+ (Step e) is NOT correct. Replace the GSC+. STOP.

Step 4. Check For B+ Short In Harness.

- a. Disconnect the harness connector from the GSC+.
- b. At the ALM, remove wire #18 from terminal 2.
- c. Measure the resistance from wire #18 at the ALM to battery positive (B+) at the relay module.
- d. Also, measure the resistance from wire #18 at the ALM to battery negative (B-) at the relay module.

Expected Result: For each measurement, the resistance should be 20k ohms or greater.

Results:

- OK – 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 preceding 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. The GSC+ treats a CID 334 FMI 3 fault and a CID 334 FMI 4 fault as alarm faults. For more information, see Spare Input/Output Programming OP6 within the topic Service Mode in the Systems Operation section. It is the customers and/or the dealers 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 5.0 volts DC. When active, the voltage on the spare output is approximately 0 volts. The spare output is capable of drawing (sinking) approximately 100 mA.

CID 334 FMI 3 (Signal Too High) CID 334 FMI 4 (Signal Too Low)

The possible cause of a CID 334 FMI 3 fault is:

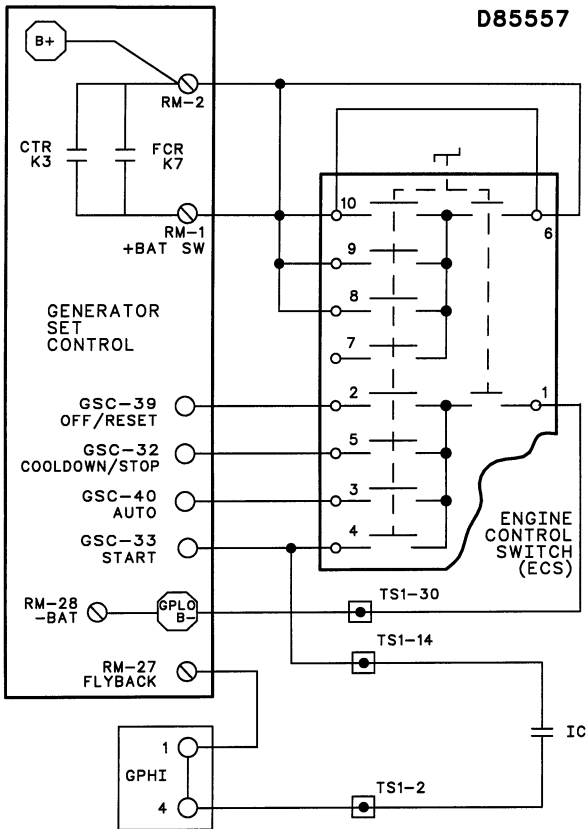
- A short to battery positive (B+) of the spare output signal.

The possible cause of a CID 334 FMI 4 fault is:

- A short to battery negative (B-) of the spare output signal.

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

CID 336 Engine Control Switch (ECS)



System Schematic For Engine Control Switch (ECS)

System Operation

The Engine Control Switch (ECS) is used by the operator for manually controlling the engine. The ECS has four positions and each position connects to a corresponding input of the GSC+. The selected position of the ECS connects the corresponding input of the GSC+ to battery negative (B-). At any time, only one of these four positions (inputs) is connected to battery negative (B-).

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

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

- **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-) or when the customer communication module (CCM) sends a remote start command. At this time, the GSC+ starts the engine and it runs normally until the remote initiate contact opens or when the customer communication module (CCM) sends a remote stop command. 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 ON with the ECS in this position.
- **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 ON with the ECS in this position.
- **COOLDOWN/STOP** – The engine maintains rated speed for the cooldown period (programmable 0 to 30 minutes). After the cooldown period elapses, the engine is shut down. The GSC+ shows faults on the upper display and on the fault indicators as they occur. The GSC+ is ON with the ECS in this position.

NOTE: The remote start contacts (if equipped) are connected to the GSC+ start input via terminal 14 of TS-1 in the generator housing. Before troubleshooting, disconnect the remote start contacts by removing the wires from terminal 14 of TS-1.

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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
 CID 190 FMI 3, Engine Magnetic Pickup
 CID 336 FMI 2, Engine Control Switch

CID 336 FMI 2 (Undefined State)

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

- None of the GSC+ inputs from the ECS are connected to ground.
- 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. Therefore the GSC+ accepts a battery negative (B-) connection at the start input in combination with any other ECS input.

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.

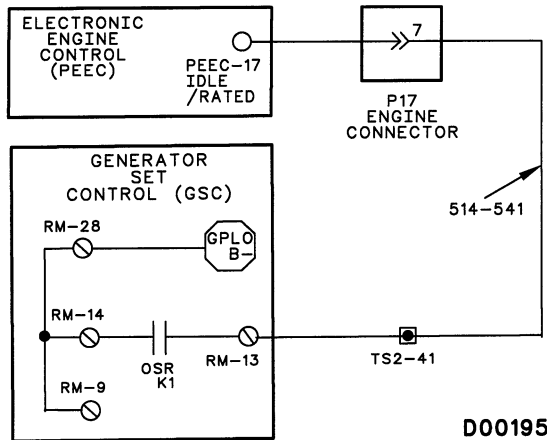
- a. If equipped, disconnect the remote start/stop initiate contacts and reconnect after troubleshooting is complete.
- b. Disconnect the harness connector from the GSC+.
- c. Check that for each position of the ECS, the corresponding contact of the GSC+ harness connector is the only one connected to battery negative (B-).
- d. Place the ECS in the OFF/RESET position. At the GSC+ harness connector, measure the resistance from contact 39 to the B- terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 33 and 40 to the B- terminal. The resistance should be greater than 5k ohms.
- e. Place the ECS in the AUTO position. At the GSC+ harness connector, measure the resistance from contact 40 to the B- terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 33 and 39 to the B- terminal. The resistance should be greater than 5k ohms.
- f. Place the ECS in the MAN/START position. At the GSC+ harness connector, measure the resistance from contact 33 to the B- terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 32, 39 and 40 to the B- terminal. The resistance should be greater than 5k ohms.
- g. Place the ECS in the COOLDOWN/STOP position. At the GSC+ harness connector, measure the resistance from contact 32 to the B- terminal of the relay module. The resistance should be 5 ohms or less. Measure the resistance from contacts 33, 39 and 40 to the B- terminal. The resistance should be greater than 5k ohms.

Expected Result: For each measurement of steps e, f, g and h; the resistance should be as stated in the step.

Results:

- 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 Oil Step Relay (OSR)



System Schematic For Oil Step Relay (OSR)

System Operation

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

When engine oil pressure is greater than the setpoint for low oil pressure shutdown at idle speed (P014), the GSC+ activates the OSR. (Also, K1 is now shown on the lower display.) This closes the relay contacts of the OSR and tells the PEEC to go to rated engine speed.

When engine oil pressure is less than the setpoint for low oil pressure shutdown at idle speed (P014), the GSC+ does not activate the OSR. (Also, K1 is not showing on the lower display.) This opens the relay contacts of the OSR and tells the PEEC to go to idle engine speed.

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

CID 441 FMI 12 (Faulty Component)

The possible cause of a CID 441 FMI 12 fault is:

- An open or shorted coil of the OSR.

The system response to this fault is:

- If a CID 441 fault occurs while the OSR is activated, then the engine speed drops from rated to idle speed.
- If a CID 441 fault occurs while the OSR is not activated, then the engine is able to start and run, but can not reach rated speed.

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. Clear the fault from the fault log after troubleshooting is complete.

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 FMI 12 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).

Expected Result: Is a CID 441 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 441 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 441 FMI 12 fault is active or inactive. Proceed to next step.

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+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. OSR Functional Check.

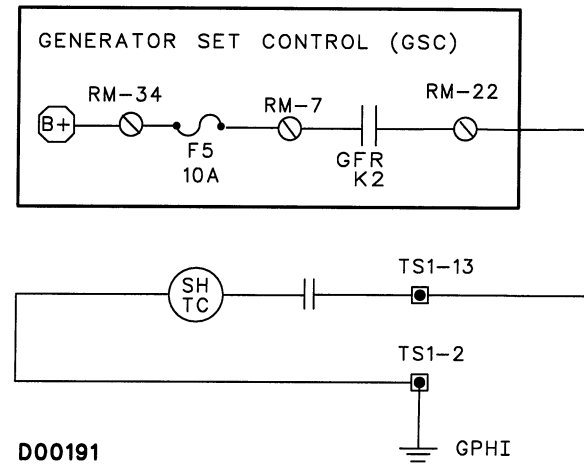
- Turn the ECS to OFF/RESET.
- Disconnect all wires from RM-13 and RM-14 of the relay module.
- At the relay module, measure the resistance from RM-13 to RM-14. Resistance should be greater than 5k ohms.
- Start and run the engine. Make sure the engine oil pressure is greater than the setpoint for low oil pressure shutdown at idle speed (P014).
- At the relay module, measure the resistance from RM-13 to RM-14. Resistance should be less than 5 ohms.

Expected Result: For Step c, the resistance should be greater than 5K ohms. For Step e, the resistance should be less than 5 ohms.

Results:

- OK – 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. 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.

CID 442 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:

- 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.
- 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.

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Fault Status (Active/Inactive).

- a. Turn the ECS to OFF/RESET and then to STOP.
- b. Press the alarm codes key.
- c. Observe the upper display to see if the CID 442 FMI 12 fault is showing (is active).
- d. If the fault is not showing, enter service mode and view the fault log (OP1) to see if the fault is showing (is inactive).

Expected Result: Is a CID 442 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 442 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 442 FMI 12 fault is active or inactive. Proceed to next step.

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.

- a. Turn the ECS to OFF/RESET.
- b. Temporarily, remove the relay module from the GSC+, see the topic Relay Module Replacement.
- c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. GFR Functional Check.

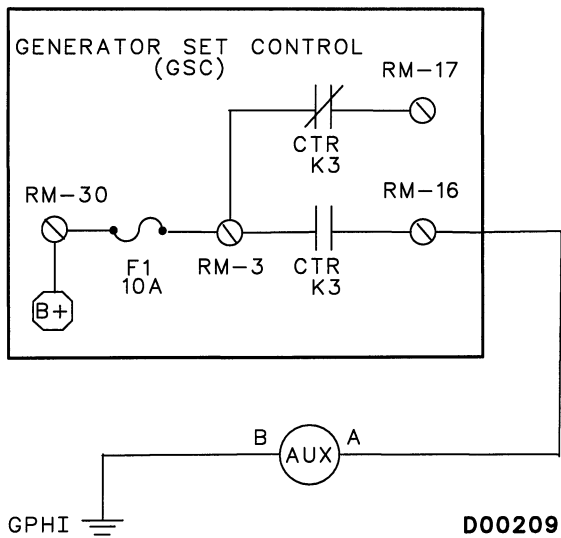
- a. Turn the ECS to OFF/RESET.
- b. Disconnect all wires from RM-22 of the relay module.
- c. At the relay module, measure the resistance from RM-22 to RM-7. Resistance should be greater than 5k ohms.
- d. Turn the ECS to STOP and push in the emergency stop button.
- e. At the relay module, measure the resistance from RM-22 to RM-7. Resistance should be less than 5 ohms.

Expected Result: For Step c, the resistance should be greater than 5K ohms. For Step e, the resistance should be less than 5 ohms.

Results:

- OK – 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 the optional auxiliary relay (AUXREL). The CTR is located within the relay module. The AUXREL is located on the sub-panel within the control panel.

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

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.

CID 443 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:

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

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Fault Status (Active/Inactive).

- a. Turn the ECS to OFF/RESET and then to STOP.
- b. Press the alarm codes key.
- c. Observe the upper display to see if the CID 443 FMI 12 fault is showing (is active).
- d. If the fault is not showing, enter service mode and view the fault log (OP1) to see if the fault is showing (is inactive).

Expected Result: Is a CID 443 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 443 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 443 FMI 12 fault is active or inactive. Proceed to next step.

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.

- a. Turn the ECS to OFF/RESET.
- b. Temporarily, remove the relay module from the GSC+, see the topic Relay Module Replacement.
- c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. CTR Functional Check.

- a. Turn the ECS to OFF/RESET.
- b. Disconnect all wires from RM-16 of the relay module.
- c. At the relay module, measure the resistance from RM-16 to RM-3. Resistance should be greater than 5k ohms.
- d. Start and run the engine. Make sure the engine speed is greater than the setpoint for crank terminate (P011).
- e. At the relay module, measure the resistance from RM-16 to RM-3. Resistance should be less than 5 ohms.

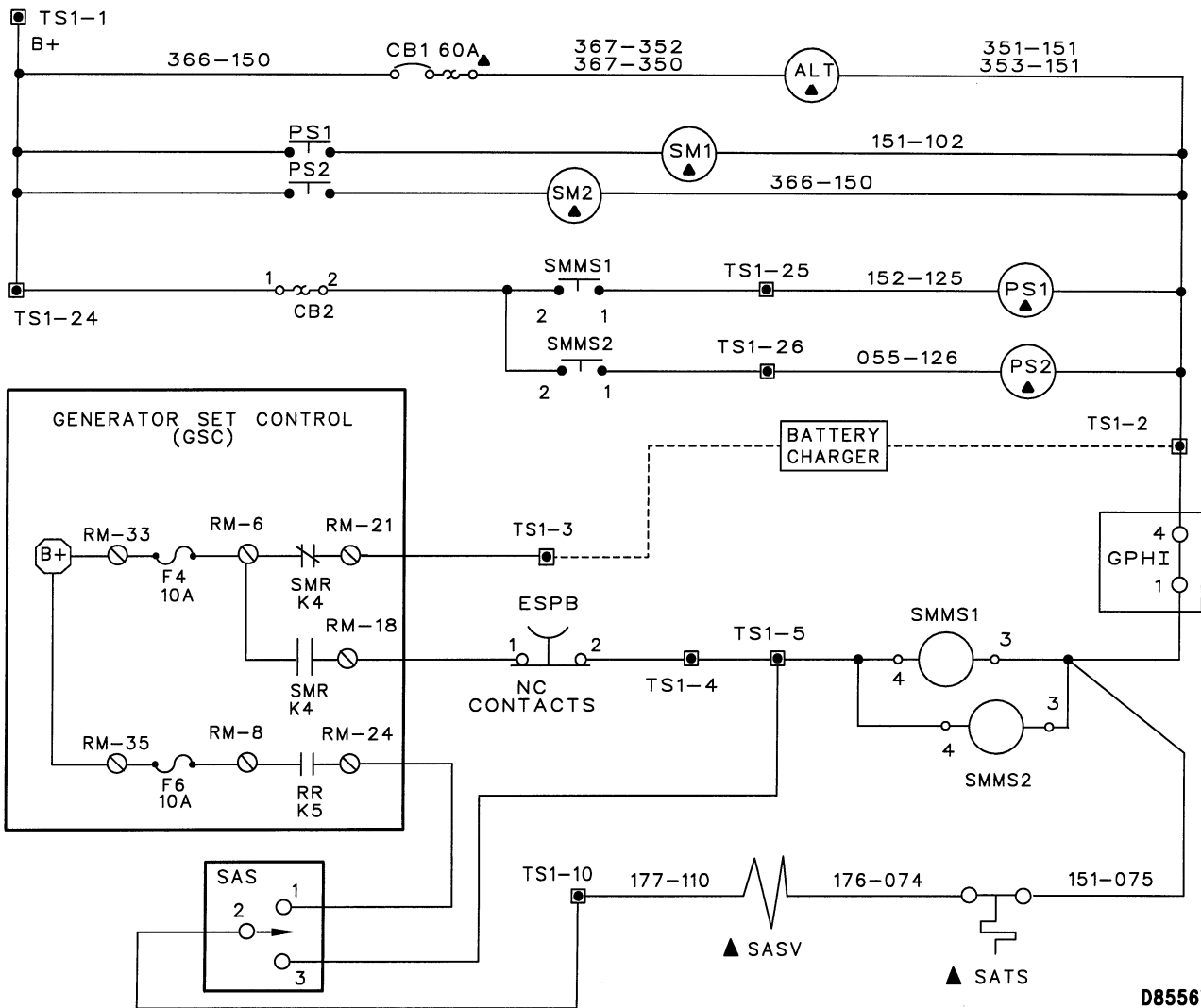
Expected Result: For Step c, the resistance should be greater than 5K ohms. For Step e, the resistance should be less than 5 ohms.

Results:

- OK – 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 444

Starting Motor Relay (SMR)



System Schematic For Starting Motor Relay (SMR)

System Operation

The GSC+ uses the starting motor relay (SMR) to activate the starting motor magnetic switch (SMMS), the AUTO position of start aid switch (SAS) and the optional pre-lube pump. Also, the SMR deactivates the optional battery charge during engine cranking. The SMR is located within the relay module. The pre-lube pump is 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.

CID 444 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:

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

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. Clear the fault from the fault log after troubleshooting is complete.

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

Step 1. Check Fault Status (Active/Inactive).

- a. Turn the ECS to OFF/RESET and then to STOP.
- b. Press the alarm codes key.
- c. Observe the upper display to see if the CID 444 FMI 12 fault is showing (is active).
- d. If the fault is not showing, enter service mode and view the fault log (OP1) to see if the fault is showing (is inactive).

Expected Result: Is a CID 444 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 444 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 444 FMI 12 fault is active or inactive. Proceed to next step.

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.

- a. Turn the ECS to OFF/RESET.
- b. Temporarily, remove the relay module from the GSC+, see the topic Relay Module Replacement.
- c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. SMR Functional Check.

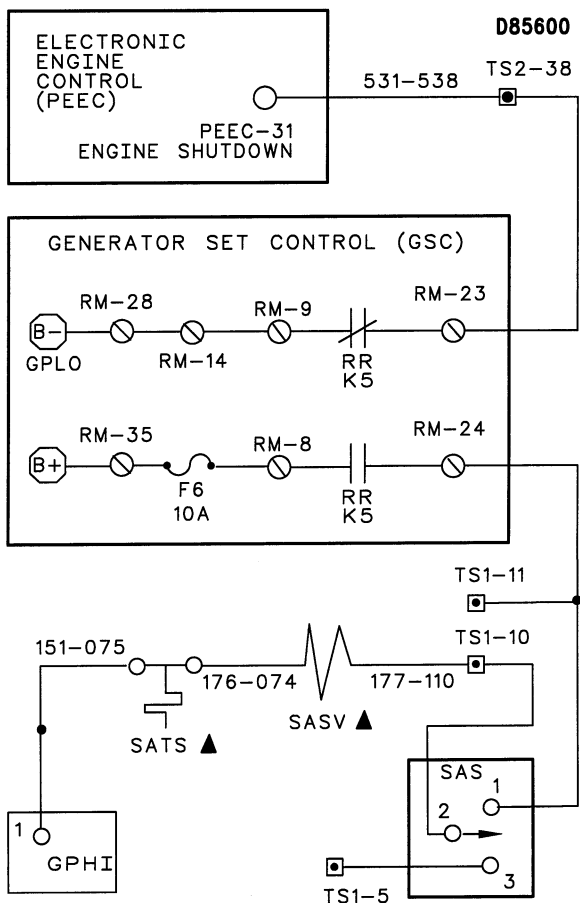
- a. Turn the ECS to OFF/RESET.
- b. Disconnect all wires from RM-18 of the relay module.
- c. Remove fuse F4 from the relay module.
- d. At the relay module, measure the resistance from RM-18 to RM-6. Resistance should be greater than 5k ohms.
- e. Prepare to measure the resistance from RM-18 to RM-6.
- f. Turn the ECS to START and quickly measure the resistance before the starting motor relay drops out because of the cycle crank time. Resistance should be less than 5 ohms.

Expected Result: For Step d, the resistance should be greater than 5K ohms. For Step f, the resistance should be less than 5 ohms.

Results:

- OK – 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 445 Run Relay (RR)



System Schematic For Run Relay (RR)

System Operation

The GSC+ uses the run relay (RR) to provide an engine shutdown signal to the electronic engine control (PEEC) and to activate the MAN position of the start aid switch (SAS). The RR is located within the relay module. 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.

CID 445 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:

- If a CID 445 fault occurs while the RR is activated, then the engine shuts down and does not start. The MAN position of the start aid switch (SAS) is disabled.
- If a CID 445 fault occurs while the RR is not activated, then the engine can not start. The MAN position of the start aid switch (SAS) is disabled.

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. Clear the fault from the fault log after troubleshooting is complete.

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 FMI 12 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).

Expected Result: Is a CID 445 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 445 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 445 FMI 12 fault is active or inactive. Proceed to next step.

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+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. RR Functional Check.

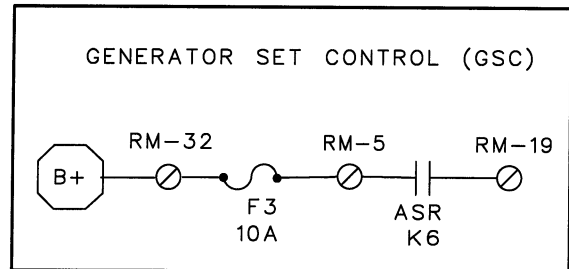
- Turn the ECS to OFF/RESET.
- Disconnect all wires from RM-23 and RM-24 of the relay module.
- Remove fuse F4 from the relay module.
- At the relay module, measure the resistance from RM-24 to RM-8. Resistance should be greater than 5k ohms.
- At the relay module, measure the resistance from RM-23 to RM-9. Resistance should be less than 5 ohms.
- Turn the ECS to START.
- At the relay module, measure the resistance from RM-23 to RM-9. Resistance should be greater than 5k ohms.
- At the relay module, measure the resistance from RM-24 to RM-8. Resistance should be less than 5 ohms.

Expected Result: For Step d and Step g, both resistances should be greater than 5K ohms. For Step e and Step h, both resistances should be less than 5 ohms.

Results:

- OK – 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 – One or more 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)



D00199

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.

CID 446 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:

- 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.
- 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.
- 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.

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. Clear the fault from the fault log after troubleshooting is complete.

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 FMI 12 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).

Expected Result: Is a CID 446 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 446 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 446 FMI 12 fault is active or inactive. Proceed to next step.

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+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. ASR Functional Check.

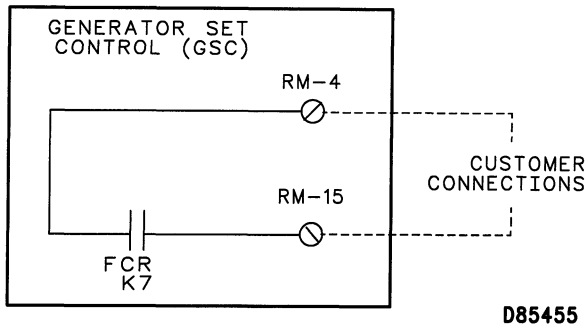
- Turn the ECS to OFF/RESET.
- Disconnect all wires from RM-19 of the relay module.
- At the relay module, measure the resistance from RM-19 to RM-5. Resistance should be greater than 5k ohms.
- Turn the ECS to STOP and push in the emergency stop push button (ESPB).
- At the relay module, measure the resistance from RM-19 to RM-5. Resistance should be less than 5 ohms.

Expected Result: For Step c, the resistance should be greater than 5K ohms. For Step e, the resistance should be less than 5 ohms.

Results:

- OK – 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 447 Fuel Control Relay (FCR)



System Schematic For Fuel Control Relay

System Operation

The status of the FCR has no effect on starting, running or stopping the PEEC engine. The contacts are not used in PEEC applications. However, the GSC+ still activates the FCR during normal engine run conditions. It is possible that customers have made connections to the FCR contacts. The FCR is located within the relay module.

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.

CID 447 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:

- If a CID 447 fault occurs while the FCR is active, any customer equipment on RM-4 and RM-15 (normally open output) will be deactivated.
- If a CID 447 fault occurs while the FCR is inactive, any customer equipment on RM-4 and RM-15 (normally open output) will remain deactivated.

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. Clear the fault from the fault log after troubleshooting is complete.

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 FMI 12 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).

Expected Result: Is a CID 447 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 447 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 447 FMI 12 fault is active or inactive. Proceed to next step.

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+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. FCR Functional Check.

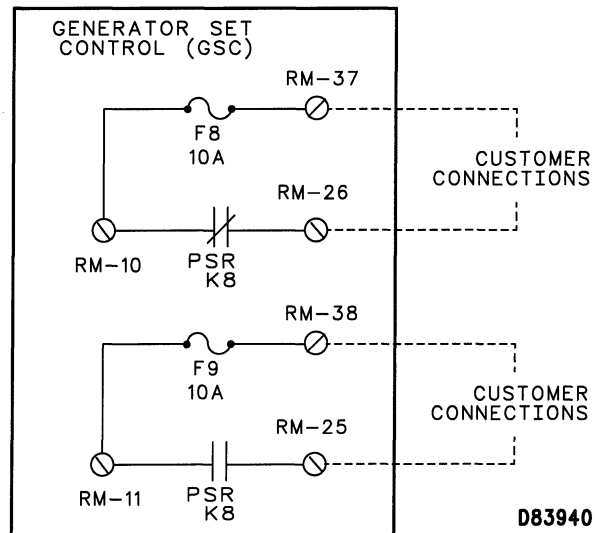
- a. Turn the ECS to OFF/RESET.
- b. Disconnect all wires from RM-15 of the relay module.
- c. Remove fuse F4 to prevent engine starting.
- d. At the relay module, measure the resistance from RM-15 to RM-4. Resistance should be greater than 5k ohms.
- e. Turn the ECS to START. Make sure that K7 is showing on the lower display.
- f. At the relay module, measure the resistance from RM-15 to RM-4. Resistance should be less than 5 ohms.

Expected Result: For Step d, the resistance should be greater than 5K ohms. For Step f, the resistance should be less than 5 ohms.

Results:

- OK – 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 448
Programmable Spare Relay (PSR)



System Schematic For Programmable Spare Relay (PSR)

System Operation

The GSC+ uses the Programmable Spare Relay (PSR) to activate customer equipment. See the topic Spare Input/Output Programming OP6 within the topic Service Mode in the System Operation section.

NOTE: Whenever the GSC+ activates or attempts to activate the PSR, K8 is shown on the lower display. When the PSR is not activated, K8 is not shown.

CID 448 FMI 12 (Faulty Component)

The possible cause of a CID 448 FMI 12 fault is:

- An open or shorted coil of the PSR.

The system response to this fault is:

- If a CID 448 fault occurs while the PSR is active, any customer equipment on RM-25 (normally open output) will be deactivated and any customer equipment on RM-26 (normally closed) will remain activated.
- If a CID 448 fault occurs while the PSR is inactive, any customer equipment on RM-25 (normally open output) will remain deactivated and any customer equipment on RM-26 (normally closed) will remain activated.

The GSC+ treats a CID 448 fault as an alarm fault. Active alarm faults are shown on the display when the alarm codes key is pressed and the ECS is in any position except the OFF/RESET position. Clear the fault from the fault log after troubleshooting is complete.

This troubleshooting procedure is for an active or inactive CID 448 fault.

Step 1. Check Fault Status (Active/Inactive).

- a. Turn the ECS to OFF/RESET and then to STOP.
- b. Press the alarm codes key.
- c. Observe the upper display to see if the CID 448 FMI 12 fault is showing (is active).
- d. If the fault is not showing, enter service mode and view the fault log (OP1) to see if the fault is showing (is inactive).

Expected Result: Is a CID 448 FMI 12 fault showing as active or inactive?.

Results:

- No – A CID 448 FMI 12 fault has not occurred (is NOT active and is NOT inactive). STOP.
- Yes – A CID 448 FMI 12 fault is active or inactive. Proceed to next step.

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.

- a. Turn the ECS to OFF/RESET.
- b. Temporarily, remove the relay module from the GSC+, see the topic Relay Module Replacement.
- c. Check the cable that attaches the relay module to the GSC+.

Expected Result: The cable should be firmly seated in the connector with the clamp in place. The cable should not be damaged.

Results:

- OK – Reassemble the relay module to the GSC+. Proceed to next step.
- Not OK – Replace the connector clamp if it is missing. If the cable is damaged, replace the GSC+. STOP.

Step 3. PSR Functional Check.

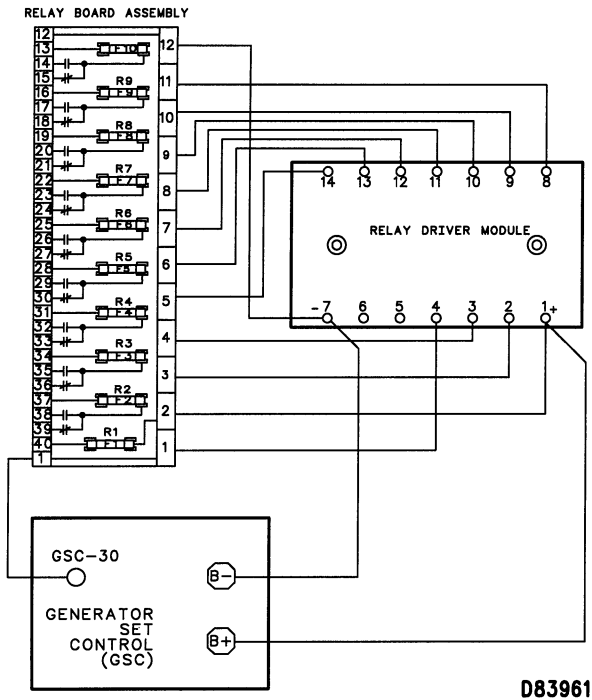
- a. Turn the ECS to OFF/RESET.
- b. Disconnect all wires from RM-25 of the relay module.
- c. At the relay module, measure the resistance from RM-25 to RM-10. Resistance should be greater than 5k ohms.
- d. Setpoint SP16 defines the trigger condition of the PSR. The factory default for SP16, is to trigger during cooldown mode. Go to the topic Spare Input/Output Programming OP6 to determine the actual trigger condition of the genset in question. Activate the PSR by satisfying the trigger condition.
- e. At the relay module, measure the resistance from RM-25 to RM-10. Resistance should be less than 5 ohms.

Expected Result: For Step c, the resistance should be greater than 5K ohms. For Step e, the resistance should be less than 5 ohms.

Results:

- OK – 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 475 Relay Driver Module (RDM) Data Link



D83961

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 175 FMI 3, Engine Oil Temperature Sensor (if equipped)
- CID 190 FMI 3, Engine Magnetic Pickup
- CID 336 FMI 2, Engine Control Switch

System Schematic For Relay Driver Module (RDM) Data Link

System Operation

The GSC+ communicates with the relay driver module (RDM) by a serial data link. When the data link malfunctions, R1 output (terminal 2 of the RDM) will be activated on and off at a rate of 0.5 Hz. Relays R2 through R9 will either maintain their current states or default to off. This is controlled by a jumper between terminals 6 and 7 of the RDM. If a jumper is NOT present when the serial data link has a fault, the relay outputs (R2 through R9) will maintain their current states. If the jumper is present, R2 through R9 will default to OFF.

NOTE: The maximum distance between a module and the GSC+ is 305m (1000 ft.). If this specification is not met, it is possible for the data link to malfunction and for the GSC+ to declare a CID 475 fault. If not in compliance with the specification, shorten the distance between the RDM and the GSC+.

CID 475 FMI 3 (Signal Too High)

CID 475 FMI 4 (Signal Too Low)

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

The possible cause of a CID 475 FMI 3 fault is:

- A short to B+ of the data signal.

The possible cause of a CID 475 FMI 4 fault is:

- A short to B– of the data signal.

The GSC+ is not able to detect an open circuit condition of the relay driver module data link. Clear the fault from the fault log after troubleshooting is complete.

Step 1. Check Voltage Of Data Signal.

- a. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead).

Expected Result: The voltage should change constantly, within the range of 0 to 10 DCV.

Results:

- OK – The voltage measurement is correct. Proceed to Step 3.
- Not OK – The voltage measurement is NOT correct. Proceed to Step 2.

Step 2. Check Voltage Of RDM And GSC+.

- a. At the RDM, disconnect all wires from terminal 4.
- b. Disconnect the harness connector from the GSC+.
- c. At the RDM, measure the DC voltage from terminal 4 (positive meter lead) to terminal 7 (negative meter lead). Voltage should be 11.6 ± 0.5 DCV.
- d. Measure the DC voltage from contact 30 of the GSC+, to the battery negative (B–) terminal of the relay module on the rear of the GSC+. The voltage should change constantly, within the range of 0 to 5.5 DCV.

Expected Result: For Step c, the voltage should be 11.6 ± 0.5 DCV. For Step d, the voltage should change constantly, within the range of 0 to 5.5 DCV.

Results:

- OK – Both voltage measurements are correct. Proceed to next step.
- Not OK – Voltage measured at the RDM (Step c) is NOT correct. Replace the RDM. STOP.
- Not OK – Voltage measured at the GSC+ (Step d) is NOT correct. Replace the GSC+. STOP.

Step 3. Check For B+ Short In Harness.

- a. Disconnect the harness connector from the GSC+.
- b. At the RDM, remove wire number 1-PK from terminal 4.
- c. Measure the resistance from wire at RDM terminal 4 to battery positive (B+) terminal of the relay module on the rear of the GSC+.
- d. Measure the resistance from wire at RDM terminal 4 to battery negative (B–) terminal of the relay module on the rear of the GSC+.

Expected Result: Both measurements (steps c and d) should be greater than 20k ohms.

Results:

- OK – Both resistance measurements are correct. Check the electrical connectors, terminals and wiring; see the topic Electrical Connector Inspection. If the fault still exists after the inspection, replace the RDM. STOP.
- Not OK – Either one or both of the resistance measurements are NOT correct. The harness wiring with the incorrect resistance measurement is shorted (faulty). Troubleshoot and repair the faulty harness wiring between the RDM and the GSC+. See the preceding System Schematic. STOP.

CID 566 FMI 7 (Faulty Mechanical Response)

The possible cause of a CID 566 FMI 7 fault is:

- A component not under the control of the GSC+ has caused an engine shutdown.

The GSC+ treats a CID 566 FMI 7 fault as a shutdown fault. Clear the fault from the fault log after troubleshooting is complete.

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 P017) elapses. The total cycle crank time is usually 90 seconds; see the topic Engine/Generator Programming OP5-0 in the Systems Operation section. 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. Service personnel 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 sending a shutdown signal to PEEC which will turn OFF the fuel shutoff solenoid and shut the engine down. 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 magnetic pickup for the PEEC electronic engine control.
- g. Check the air shutoff solenoid (if present) for activation. If the air shutoff solenoid is activated and cannot be deactivated, begin troubleshooting with Step 10. Otherwise begin troubleshooting with Step 1.

Step 1. Verify Fault.

- a. Observe the upper display to see if the CID 566 FMI 7 fault is showing (is active).

Expected Result: Is a CID 566 FMI 7 fault showing as active?.

Results:

- No – A CID 566 FMI 7 fault is NOT showing. No active CID 566 FMI 7 fault exists. STOP.
- Yes – Only a CID 566 FMI 7 fault is showing. Proceed to next step. (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 next step.)

Step 2. Check System Voltage.

- a. With the engine off, measure the system voltage at the battery. Make a note of this measurement. The system voltage measurement is used for comparison in future Steps of this procedure.

Expected Result: For 24 volt systems, the system voltage should be from 24.8 to 29.5 DCV. For 32 volt systems, the system voltage should be from 33.1 to 39.3 DCV.

Results:

- OK – Proceed to next step.
- Not OK – System voltage is NOT correct. For troubleshooting see the CID 168 procedure. STOP.

Step 3. Check Fuel System Setpoint P001. PEEC engines are ETR systems.

- a. Check setpoint P001 for proper programming (0=ETR); see Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.

Expected Result: Setpoint P001 should be programmed to 0 for ETR.

Results:

- OK – Proceed to next step.
- Not OK – Setpoint P001 is NOT programmed correctly. Reprogram setpoint P001, see Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section.

Step 4. Check Fuses.

- a. Turn the ECS to OFF/RESET.
- b. Check fuse F10 on the relay module.

Expected Result: Fuse F10 should not be blown (open).

Results:

- OK – Proceed to Step 6.
- Not OK – The fuse is blown. Proceed to next step.

Step 5. Troubleshoot Blown Fuse. For reference, see the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section.

- a. The ECS remains in the OFF/RESET position.
- b. Remove fuse F10 that is blown.
- c. Measure the resistance from RM-39 of the relay module to battery negative (B-).

Expected Result: For a fuse that is blowing, the circuit resistance should be less than 3 ohms.

Results:

- OK – Resistance is greater than 3 ohms and fuse is no longer blowing. Carefully check ALL wires connected to the appropriate terminal of the relay module for abrasion or worn spots in the insulation that could be causing the short. Check wires in the panel, generator panel, and on the engine harness itself. Refer to the various wiring diagrams as necessary. Repair or replace wiring as necessary. STOP.
- Not OK – If a resistance is less than 3 ohms, there is a short to battery negative (B-). 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.
- Not OK – If a 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 6. Check Low Voltage Condition. This Step continues troubleshooting from Step 4. 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 generator terminal strips.

Step 6A.

- a. Prepare to measure voltage at the generator housing, from TS2-40 to the TS1-2 terminal.
- b. Turn the ECS to OFF/RESET and then to START.
- c. At the generator housing, measure the voltage from TS2-40 to the TS1-2 terminal.

Expected Result: During cranking, the voltage should increase to greater than 4.0 DCV and then stabilize between 1.5 and 2.0 DCV.

Results:

- OK – Voltage is correct. The fault is with the fuel shutoff solenoid, PEEC electronic engine control, the fuel rack or an open wire between TS2-40 and the fuel solenoid. See the specific service module for Engine Electronic Troubleshooting. STOP.
- Not OK – Voltage is low. Check the wiring and proceed to Step 6B.

Step 6B.

- a. Make sure that no other faults are active.
- b. Check the upper display for any active faults.

Expected Result: Only CID 566 FMI 7 is active.

Results:

- OK – Only CID 566 FMI 7 is active. Proceed to Step 6C.
- Not OK – A fault other than CID 566 FMI 7 is active. Correct the other fault. Proceed to the corresponding troubleshooting procedure. STOP.

Step 6C.

- a. Prepare to measure voltage at the generator housing, from TS2-39 to the TS1-2 terminal.
- b. Turn the ECS to OFF/RESET and then to START.
- c. At the generator housing, measure the voltage from TS2-39 to the TS1-2 terminal.

Expected Result: During cranking, the voltage should increase to greater than 4.0 DCV and then stabilize between 1.5 and 2.0 DCV.

Results:

- OK – Voltage is correct. There is an open circuit between TS2-39 and TS2-40. Carefully check the resistance of the ESPB contacts. Check all wires for abrasion or worn spots in the insulation that could be causing the open. Check wires in the control panel and the generator housing. Refer to the various wiring diagrams. Repair or replace the wiring as necessary. STOP.
- Not OK – Voltage is low. Proceed to Step 6D.

Step 6D.

- a. Prepare to measure the voltage from contact A of the PEEC shutoff solenoid (located on the PEEC electronic engine control) to battery negative.
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage from contact A of the PEEC shutoff solenoid (located on the PEEC electronic engine control) to battery negative.

Expected Result: During cranking, the voltage should increase to greater than 4.0 DCV and then stabilize between 1.5 and 2.0 DCV.

Results:

- OK – Voltage is correct. There is an open circuit between the PEEC shutoff solenoid and TS2-39. Carefully check the resistance of the ESPB contacts. Check all wires for abrasion or worn spots in the insulation that could be causing the open. Check wires in the control panel and the generator housing. Refer to the various wiring diagrams. Repair or replace the wiring as necessary. STOP.
- Not OK – Voltage is low. Proceed to next step.

Step 7. Check Supply Voltage Of PEEC. Fuse F4 remains removed from the relay module. Prepare to make a voltage measurement at the PEEC electronic engine control.

- a. Turn the ECS to OFF/RESET and then to START.
- b. Measure the voltage from the positive supply for PEEC (PEEC connector contact 1) to the negative supply for PEEC (PEEC connector contact 21).

Expected Result: The voltage should be ± 2.0 DCV of the system voltage previously measured in Step 2.

Results:

- OK – Supply voltage is correct. The fault is in the PEEC electronic engine control or the harness is faulty (open wire between PEEC electronic engine control and TS2-39). See the specific service manual for Engine Electronic Troubleshooting. STOP.
- Not OK – Supply voltage is low. Proceed to next step.

Step 8. Check Voltage At Terminal Strip TS1. Fuse F4 remains removed from the relay module. Prepare to make a voltage measurement at terminal strip 1 (TS1) in the generator terminal box.

- a. Turn the ECS to OFF/RESET and then to START.
- b. Measure the voltage from terminal TS1-6 to terminal TS1-2.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage previously measured in Step 2.

Results:

- OK – Voltage is correct. There is an open between terminal TS1-6 and the electronic engine control (PEEC). Check the wiring. See the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.
- Not OK – Voltage is low. Proceed to next step.

Step 9. Check Voltage At Slave Relay. 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 slave relay (SR).

Step 9a.

- a. Turn the ECS to OFF/RESET and then to START.
- b. Measure the voltage from SR terminal 30 to relay module terminal B-.

Expected Result: The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2.

Results:

- OK – Voltage is correct. Proceed to next step.
- Not OK – Voltage is NOT correct, check the wiring. STOP.

Step 9b.

- a. Turn the ECS to OFF/RESET and then to START.
- b. Measure the voltage from SR terminal 87 to relay module terminal B-.

Expected Result: The voltage should measure ± 2.0 DCV of the system voltage measured in Step 2.

Results:

- OK – Voltage is correct. Proceed to next step.
- Not OK – Voltage is NOT correct, replace the slave relay. STOP.

Step 9c.

- a. Make sure that no other faults are active.
- b. Check the upper display for any active faults.

Expected Result: Only CID 566 FMI 7 is active.

Results:

- OK – Only CID 566 FMI 7 is active. Proceed to next step.
- Not OK – A fault other than CID 566 FMI 7 is active. Correct the other fault. Proceed to the corresponding troubleshooting procedure. STOP.

Step 9d.

- a. Recheck the voltage on terminal TS1-6. See preceding Step 8.

Expected Result: The voltage should be ± 2.0 DCV of the system voltage previously measured in Step 2.

Results:

- OK – Voltage is correct. There is an open between terminal TS1-6 and the electronic engine control (PEEC). Check the wiring. See the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.
- Not OK – Voltage remains low. Check the wiring. See the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.

Step 10. Check Voltage At Air Shutoff Solenoid.

This Step continues troubleshooting from the Preliminary Step. Prepare to measure the voltage across the terminals of the air shutoff solenoid.

- a. Remove fuse F4 from the relay module.
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage across the terminals of the air shutoff solenoid (air solenoid may activate for as little as 15 seconds).

Expected Result: The voltage should measure from 0 to 2.0 DCV.

Results:

- 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. Proceed to next step.

Step 11. Check Voltage At Relay Module. Fuse F4 remains removed from the relay module. Prepare to make a voltage measurement at the relay module.

- a. Turn the ECS to OFF/RESET and then to START.
- b. At the relay module, measure the voltage from RM-19 to the B– terminal of the relay module.

Expected Result: The voltage should be from 0 to 2.0 DCV.

Results:

- OK – Voltage is correct. A wire or a component between RM-19 of the relay module and the air shutoff solenoid is shorted to battery positive (B+). Repair the circuit. See the preceding System Schematic and the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section. STOP.
- Not OK – Voltage is high. Proceed to next step.

Step 12. Check ASR. Fuse F4 remains removed from the relay module.

- a. Remove fuse F3 from the relay module.
- b. Turn the ECS to OFF/RESET.
- c. Make sure that K6 is not shown on the lower GSC display. (If K6 is showing, make sure that no other faults are active.)
- d. At the relay module, measure the resistance from RM-5 to RM-19.

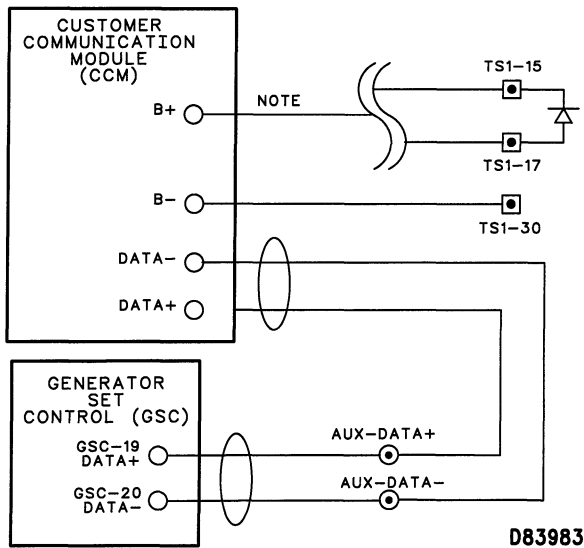
Expected Result: A measurement of less than 100 ohms indicates the air shutoff relay is shorted.

Results:

- OK – Resistance is greater than 10k ohms. Check for a short from battery positive (B+) to RM-19 of the relay module. Repair the shorted wiring. If the short is internal to the relay module, replace the relay module. See 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.

CID 770

Customer Communication Module (CCM) Data Link



System Schematic For CCM Data Link

Note: When CCM is connected to a single genset, B+ is wired directly from TS1-17. When CCM is connected to multiple gensets, the diode must be connected as shown and B+ wired to TS1-15.

System Operation

On gensets so equipped, the GSC+ uses the CCM data link to communicate with the Customer Communication Module (CCM). The CCM data link consists of two wires that connect the GSC+ to the CCM.

CID 770 FMI 9 (Abnormal Update)

The possible causes of a CID 770 FMI 9 fault are:

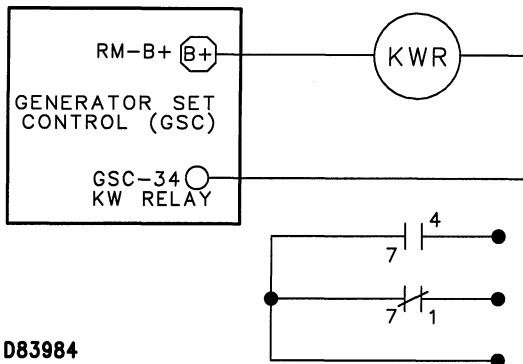
- A short to battery positive (B+) of either of the two CCM data link wires.
- A short to battery negative (B-) of either of the two CCM data link wires.

The GSC+ cannot detect an open in the circuit of the CCM data link.

The GSC+ treats a CID 770 FMI 9 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. Clear the fault from the fault log after troubleshooting is complete.

Troubleshoot and repair the wiring, see the Generator Set Wiring Diagram in the Schematics & Wiring Diagrams section.

CID 859 kW Level Output



D83984

System Schematic For kW Level Output

System Operation

The kW level output (GSC+ connector contact 34) will be activated whenever the total power output of the generator passes the programmed threshold (setpoint P139). This threshold can be programmed from 0 to 110 percent of the nameplate power (setpoint P030) with a time delay from 0 to 120 seconds (setpoint P140). See Engine/Generator Programming OP5-0 and Protective Relaying Programming OP5-1 within the topic Service Mode.

Once activated, the kW relay level output will be deactivated when the total power output of the generator drops below a programmed threshold (setpoint P141). This threshold is different from the activation threshold and can be programmed from 0 to 110 percent of the nameplate power rating of the generator with a time delay from 0 to 120 seconds.

With no connections and when not active, the voltage on the kW level output is approximately 5.0 DCV. When active, the voltage on the kW level output is approximately 0 volts. The kW level output is capable of drawing (sinking) approximately 100 mA. It is the customers and/or the dealers responsibility to document and troubleshoot any connections to this output.

CID 859 FMI 3 (Signal Too High) CID 859 FMI 4 (Signal Too Low)

The possible cause of a CID 859 FMI 3 is:

- A short to battery positive (B+) of the kW level output signal.

The possible cause of a CID 859 FMI 4 fault is:

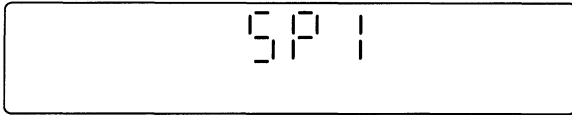
- A short to battery negative (B-) of the kW level output signal.

The GSC+ treats a CID 859 FMI 3 fault and a CID 859 FMI 4 fault as alarm faults.

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

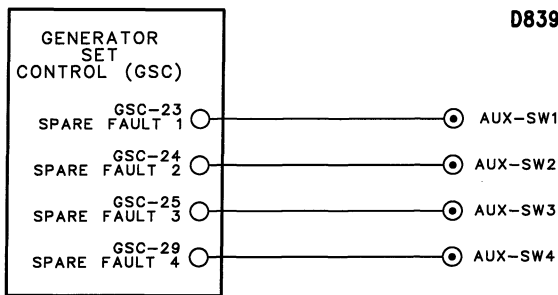
SP Fault Code Troubleshooting

D81781



Upper Display With SP Fault Code SP1 Showing

D83996



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 SP 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 (factory default). 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 SP fault code is immediately shown on the upper display. For an alarm type of fault, the alarm codes key is pressed first and then the SP fault code is shown on the upper display. After a spare fault is corrected or is not present, the SP fault code is no longer shown on the upper display.

Spare Fault Codes			
Spare Fault Code	GSC+ Connector Contact	AUX Terminal Strip	Related Setpoints ¹
SP1 Spare Fault 1	23	SW1	SP01,SP02,SP03
SP2 Spare Fault 2	24	SW2	SP04,SP05,SP06
SP3 Spare Fault 3	25	SW3	SP07,SP08,SP09
SP4 Spare Fault 4	29	SW4	SP10,SP11,SP12

¹ See Spare Input/Output Programming OP6 within the topic Service Mode in the Systems Operation section.

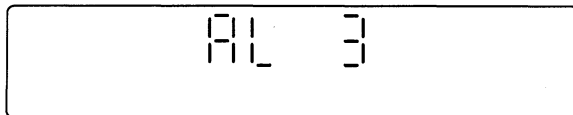
SP fault codes are associated with the spare fault inputs. The SP fault code shown on the upper display, identifies the spare fault input that caused the alarm fault or shutdown fault. The spare fault inputs are accessed on the AUX terminal strip on the inside left wall of the panel.

When a SP fault code is showing on the upper display, check the programming notes (made by the customer, operator, or service personnel) to determine the cause.

AL Fault Code Troubleshooting

AL Fault Code Troubleshooting		
AL Fault Code	Description	Troubleshooting
AL1	High Water Temperature Alarm Coolant temperature increases to within 6°C (11°F) of setpoint P015.	See Dedicated Shutdown Indicator Troubleshooting.
AL2	Low Engine Coolant Temperature Alarm Coolant temperature decreases to setpoint P016.	See Dedicated Shutdown Indicator Troubleshooting.
AL3	Low Engine Oil Pressure Alarm Oil pressure drops to within 34kPa (5psi) of the P013 or P014 setpoint.	See Dedicated Shutdown Indicator Troubleshooting.
AL4	Fault Detected By Engine ECM Engine ECM detects an alarm or a shutdown fault.	Refer to the Engine Electronic Troubleshooting manual.
AL5	Low Engine Coolant Level Fault Coolant level drops below the probe of the coolant loss sensor.	Check level of engine coolant (must be above the probe of sensor). Check for CID 111 faults. Perform the Electrical Connector Inspection test.
AL6	High Engine Oil Temp Fault Oil temperature increases to within 6°C (11°F) of setpoint P026.	Check level of engine coolant (must be above the probe of sensor). Check fan belt, etc. Check P026 setpoint.
AL7	Generator Over Voltage Fault Line to line voltage rises above the P102 or P105 setpoints.	Refer to service manual for the voltage regulator being used. Check P101 through P106 setpoints.
AL8	Generator Under Voltage Fault Line to line voltage drops below the P108 or the P111 setpoints.	Refer to service manual for the voltage regulator being used. Check P107 through P112 setpoints. Refer to engine service manual for cause of low engine speed. If engine speed is reduced and the ECS is NOT in STOP, the GSC+ will issue this fault.
AL9	Generator Over Frequency Fault Frequency rises above the P114 or P117 setpoints.	See Dedicated Shutdown Indicator Troubleshooting For Overspeed. Check P113 through P118 setpoints.
AL10	Generator Under Frequency Fault Frequency drops below the P120 or P123 setpoints.	Refer to engine service manual for cause of low engine speed. If engine speed is reduced and the ECS is NOT in STOP, the GSC+ will issue this fault. Check P119 through P124 setpoints.
AL11	Generator Reverse Power Fault Reverse power rises above the P126 setpoint.	See topic Synchronizing Lights Module. Refer to engine service manual for cause of lost engine power. Check P125 through P127 setpoints.
AL12	Generator Phase Over Current Fault Phase current rises above the P129 or P134 setpoints.	Check for cause of overcurrent. Check setpoint P029 and setpoints P128 through P135.
AL13	Generator Total Over Current Fault Total current rises above the P131 or P136 setpoints.	Check for cause of overcurrent. Check setpoint P029 and setpoints P128 through P137.
AL14	Phase A No Voltage Input Fault Phase A voltage not being received at GSC+ input.	Check for open circuit or short on wire connected to GSC+ connector contact 10. See Schematics & Wiring Diagrams section.
AL15	GSC+ Configuration Error Frequency of generator output voltage does not match engine speed.	Check setpoints P009 (number of ring gear teeth) and P033 (number of generator poles). Correct if necessary.

D81782

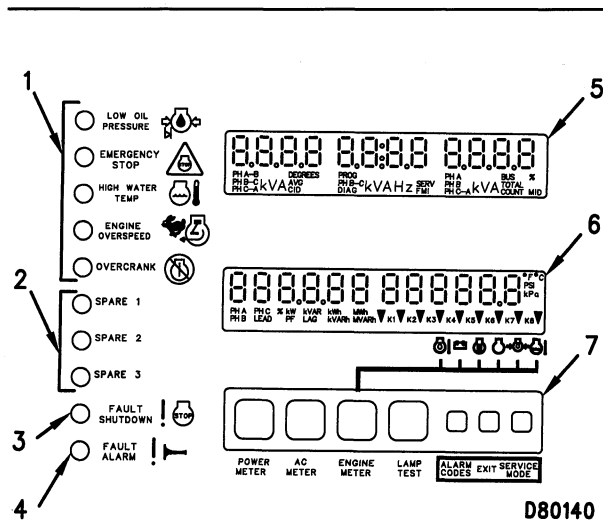


Upper Display With AL Fault Code AL3 Showing

AL Fault Codes are shown as “AL1” through “AL15” on the upper display. They include specific engine fault conditions (for example, low engine oil pressure alarm), and protective relaying functions (for example, underfrequency fault).

AL fault codes depend on certain setpoints, see the topic Service Mode for more information on setpoints. AL fault codes are not diagnosed by the GSC+ and they are not stored in the fault log. Many of the AL fault codes are programmable as a fault alarm or as a fault shutdown. The AL fault codes are accompanied by either the fault alarm indicator, or the fault shutdown indicator on the GSC+ to show the severity of the fault.

Dedicated Shutdown Indicator Troubleshooting



Display Area Of Generator Set Control + (GSC+)

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

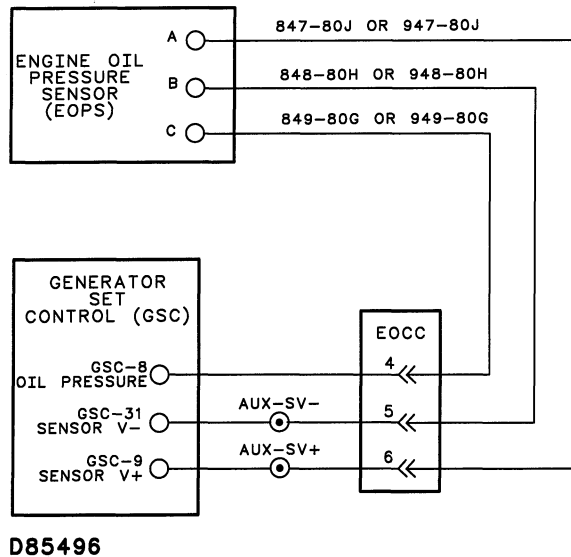
The dedicated shutdown indicators inform the operator which system is responsible for an engine shutdown. The symbol and nomenclature nearest to the indicator identifies the responsible system. Dedicated shutdown faults are activated automatically by the GSC+ and depend upon certain setpoints. When the GSC+ decides that operating conditions are critical, it FLASHES the corresponding shutdown indicator and shuts the engine down. The GSC+ does not record dedicated shutdown faults in the fault log.

The dedicated shutdown indicators (faults) are:

- Low Oil Pressure
- Emergency Stop
- High Water Temperature
- Engine Overspeed
- 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 Diagnostic Fault.

- a. Check for a CID 100 (oil pressure sensor) or CID 269 (sensor power supply) diagnostic code that is active. See the topic Diagnostic Fault Codes.

Expected Result: CID 100 or CID 269 should not be showing (active).

Results:

- OK – Proceed to next step.
- Not OK – Correct the active CID 100 or CID 269 prior to proceeding with this procedure. See the topic Diagnostic Fault Codes. STOP.

Step 2. Check Obvious Causes.

- a. Check for low oil pressure.
- b. Check oil level.
- c. Check for oil leaks.
- d. Check for other obvious causes of low oil pressure.

Expected Result: No obvious cause should exist.

Results:

- OK – Proceed to next step.
- Not OK – An obvious cause does exist. Correct the fault. Refer to the Engine Service Manual. STOP.

Step 3. Check Setpoints. This step checks the setpoints P012 (oil step speed), P013 (low oil pressure at rated speed) and P014 (low oil pressure at idle speed).

- a. View and make a note of setpoints P012, P013 and P014. See Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- b. Compare the setpoint viewed with the setpoint specified on print 136-9048.

Expected Result: The viewed setpoint value and the specified setpoint value should agree.

Results:

- OK – Proceed to next step.
- Not OK – The setpoints do not agree. Reprogram setpoints P012, P013 and P014. See Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section. STOP.

Step 4. Check Low Oil Pressure Function.

- a. Turn the ECS to OFF/RESET and then to START.
- b. Allow oil pressure to stabilize.
- c. When at idle speed, compare the actual pressure showing on the lower display with that of setpoint P014 (noted in Step 3). The actual pressure showing should be greater than setpoint P014.
- d. When at rated speed, compare the actual pressure showing on the lower display with that of setpoint P013 (noted in Step 3). The actual pressure showing should be greater than setpoint P013.

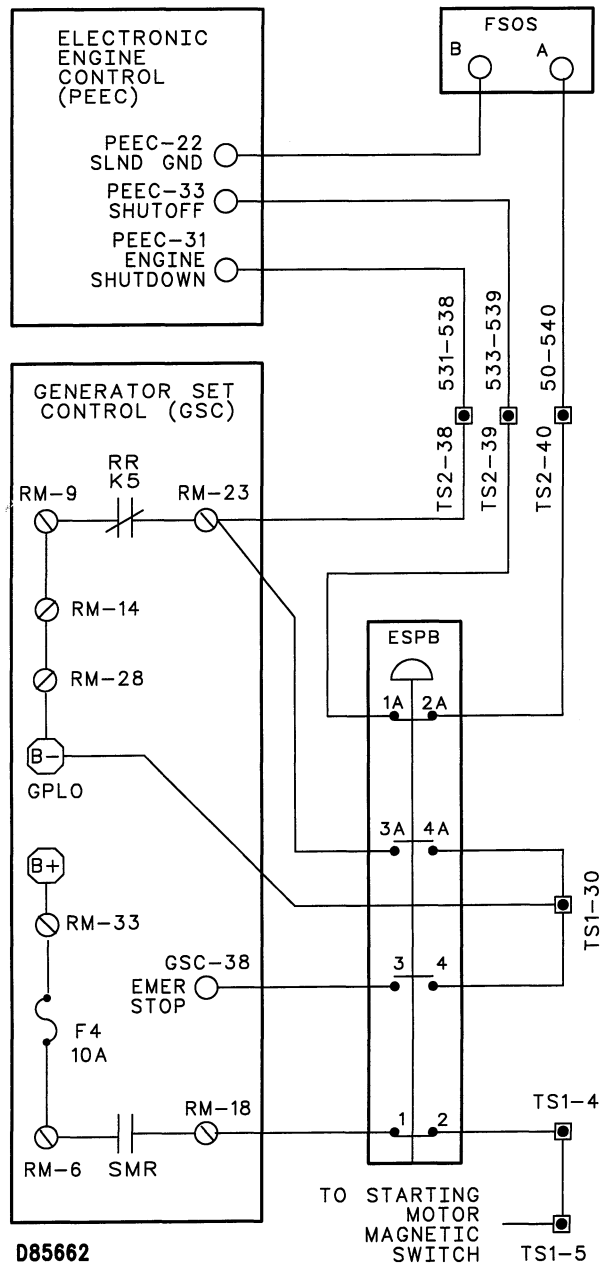
Expected Result: The actual pressure at idle speed and at rated speed should be greater than the setpoint value. These actual pressures should not cause a low oil pressure shutdown.

Results:

- OK – Both actual pressures are greater than the corresponding setpoint value and the low oil pressure indicator does not FLASH. Problem is not present now. Problem may be intermittent. Check the harness and all electrical connections of the oil pressure circuit; see the topic Electrical Connector Inspection. STOP.
- OK – Both actual pressures are greater than the corresponding setpoint value and the low oil pressure indicator remains FLASHING. Therefore the GSC+ is faulty. Replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – Actual pressure showing is less than the setpoint for rated speed or idle speed. 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.

NOTE: If desired, check the accuracy of the pressure shown on the lower display of the GSC+. Install an accurate engine oil pressure gauge as close as possible to the EMCP II+ engine oil pressure sensor.

Emergency Stop Indicator



System Schematic For Emergency Stop Circuit

To find the cause of a emergency stop shutdown, perform this procedure.

Step 1. Check ESPB.

- Deactivate the ESPB by pulling it out (some versions of ESPB must be turned clockwise before popping out).
- Turn the ECS to OFF/RESET and then to STOP.

Expected Result: The ESPB should pop out and the emergency stop indicator should be OFF.

Results:

- OK - The system is operating correctly. The problem may be intermittent. Check the harness and all electrical connections of the ESPB circuit; see the topic Electrical Connector Inspection. STOP.
- Not OK - The ESPB does not pop out, then replace the ESPB. STOP.
- Not OK - The ESPB pops out and the emergency stop indicator is FLASHING. Proceed to next step.

Step 2. Check Emergency Stop Indicator.

NOTE: This Step creates diagnostic fault codes. Clear these created diagnostic fault codes after troubleshooting is complete.

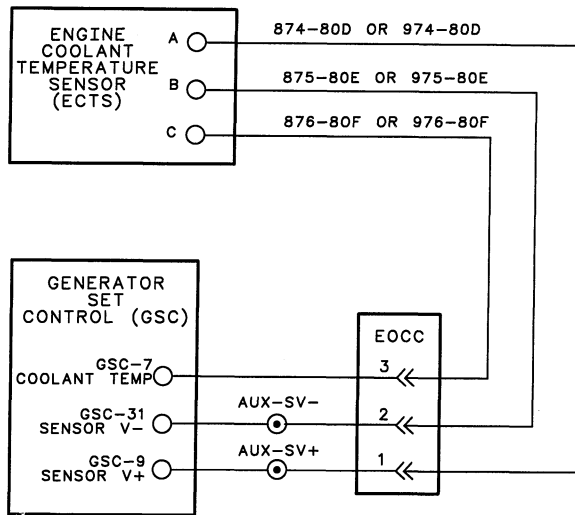
- The ECS remains in the STOP position.
- Disconnect the harness connector from the GSC+.
- Temporarily install a jumper from contact 39 of the GSC+ to B-(this simulates the OFF/RESET position of the ECS).
- Check the operation of the emergency stop indicator.

Expected Result: The emergency stop indicator should be OFF.

Results:

- OK - Therefore, the fault is with the ESPB or the related wiring. Troubleshoot the circuit. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. Repair or replace faulty components or wiring as necessary. STOP.
- Not OK - The emergency stop indicator is FLASHING. Replace the GSC+. See the topic Generator Set Control + Replacement.

High Water Temperature Indicator



D85497

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 Diagnostic Fault.

- Check for a CID 110 (coolant temperature sensor) or CID 269 (sensor power supply) diagnostic code that is active. See the topic Diagnostic Fault Codes.

Expected Result: CID 110 or CID 269 should not be showing (active).

Results:

- OK – Proceed to next step.
- Not OK – Correct the active CID 110 or CID 269 prior to proceeding with this procedure. See the topic Diagnostic Fault Codes. STOP.

Step 2. Check Obvious Causes.

- Check water level.
- Check fan belts.
- Check for other obvious causes of high water temperature.

Expected Result: No obvious cause should exist.

Results:

- OK – Proceed to next step.
- Not OK – An obvious cause does exist. Correct the fault. Refer to the Engine Service Manual. STOP.

Step 3. Check setpoint P015 (high water temperature).

- View and make a note of setpoint P015. See Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- Compare the setpoint viewed with the setpoint specified on print 136-9048.

Expected Result: The viewed setpoint value and the specified setpoint value should agree.

Results:

- OK – Proceed to next step.
- Not OK – The setpoints do not agree. Reprogram setpoint P015. See Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section. STOP.

Step 4. Check High Water Temperature Function.

- Turn the ECS to OFF/RESET and then to START.
- 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 P015 (noted in Step 3).

Expected Result: The actual temperature showing on the lower display should be less than setpoint P015. This actual temperature should not cause a high water temperature shutdown.

Results:

- OK – The actual temperature is less than the setpoint P015 and the high water temperature indicator does not FLASH. Problem is not present now. Problem may be intermittent. Check the harness and all electrical connections of the oil pressure circuit; see the topic Electrical Connector Inspection. STOP.
- OK – The actual temperature is less than the setpoint P015 and the high water temperature indicator remains FLASHING. Therefore the GSC+ is faulty. Replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – Actual temperature showing is greater than the setpoint P015. The temperature is 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 low oil pressure. 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 Setpoints. This step checks setpoints P009 (ring gear teeth) and P010 (engine overspeed).

- a. View and make a note of setpoints P009 and P010. See Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- b. Compare the setpoints viewed with the setpoints specified on print 136-9048.

Expected Result: The viewed setpoint value and the specified setpoint value should agree.

Results:

- OK – Proceed to next step.
- Not OK – The setpoints do not agree. Reprogram setpoints P009, P010 and P014. See Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section. STOP.

Step 2. Check For Possible Causes.

- a. Check for possible causes of the engine overspeed condition. Refer to the specific service module for Engine Electronic Troubleshooting.

Expected Result: No cause should be found.

Results:

- OK – Proceed to next step.
- Not OK – The cause is found. Repair or replace the necessary engine or governor components. STOP.

Step 3. Check Engine Overspeed Function.

NOTE: Take precautions to stop the engine manually when performing this Step.

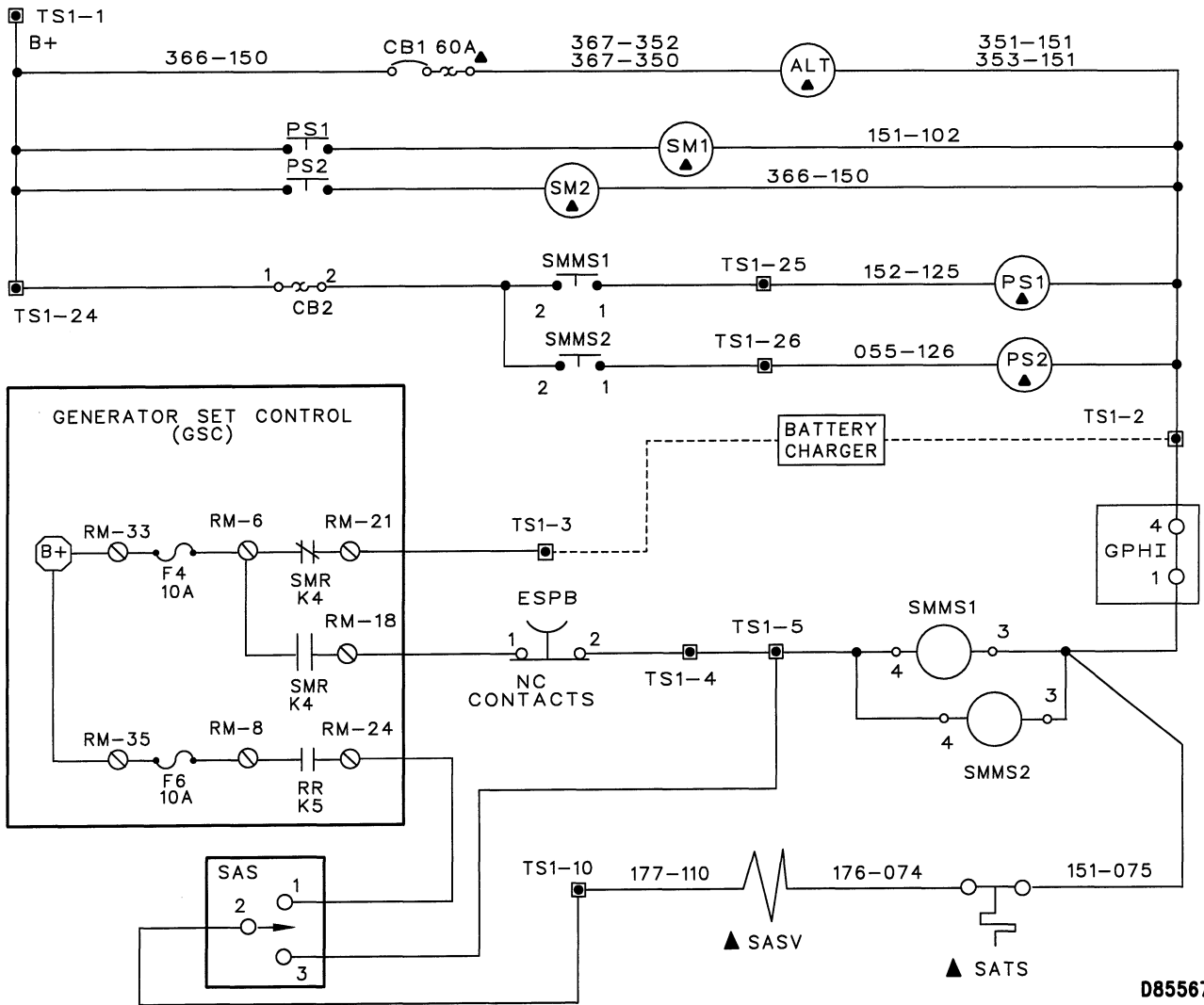
- a. If possible disable the engine from reaching rated speed.
- b. Turn the ECS to OFF/RESET and then to START.
- c. Slowly increase the RPM to rated speed.

Expected Result: The engine should not overspeed and the GSC+ should not shut down the engine or issue an overspeed fault.

Results:

- OK – The engine reaches rated speed, the GSC+ does not issue an overspeed fault and the GSC+ does not shut down the engine. The GSC+ and the system are functioning properly. Perform an overspeed verification. See Engine Setpoint Verification OP9 within the topic Service Mode in the Systems Operation section. STOP.
- Not OK – The engine overspeeds and the GSC+ issues an overspeed fault. Refer to the specific service module for Engine Electronic Troubleshooting to find the cause of the problem. STOP.

Overcrank Indicator



D85567

System Schematic For Starting Motor Relay (SMR)

To find the cause of a overcrank shutdown, perform this procedure.

Preliminary Step. Initial Check. Before proceeding with the troubleshooting procedures, do the following preliminary checks.

- a. Check for active diagnostic fault codes (with the exception of the CID 566 FMI 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 CID 566 in the topic Diagnostic Fault Codes.
- f. Check pre-lube system (if equipped) for proper operation. See the DC Schematic – Prelube Pump in the Schematics & Wiring diagrams section or refer to the Engine Service Manual.
- g. Check fuse F4 on the relay module. If either is blown, proceed to Step 9.
- h. Check the engine starting and fuel system. (To check the engine solenoid, see CID 566 within the topic Diagnostic Fault Codes.) If there is a fault, refer to the Engine Service Manual. If there is no engine or fuel system fault, proceed to Step 1 of the following procedure.

Step 1. Check Setpoints. This step checks setpoints P017 (total cycle crank time) and P018 (cycle crank time).

- a. View and make a note of setpoints P017 and P018. See Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- b. Compare the setpoints viewed with the setpoints specified on print 136-9048. The factory default values are: 90 seconds for P017 and 10 seconds for P018.

NOTE: Engines equipped with pre-lube pumps may require cycle crank times (setpoint P018) of 30 seconds or more.

Expected Result: The viewed setpoint value and the specified setpoint value should agree.

Results:

- OK – Proceed to next step.
- Not OK – The setpoints do not agree. Reprogram setpoints P017 and P018. See Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section. STOP.

Step 2. Check battery voltage.

- a. With the engine off, measure the system voltage at the batteries.

Expected Result:

For 24 volt systems, the voltage should be from 24.8 to 29.5 DCV.

For 32 volt systems, the voltage should be from 33.1 to 39.3 DCV.

Results:

- OK – Proceed to next step.
- Not OK – Further checking of the battery system is necessary. See the topic CID 168 in the Diagnostic Fault Codes section. STOP.

Step 3. Check engine starting function. Steps 3 through 8 require voltage measurements to be made during simulated engine cranking. The starting motor is disabled.

NOTE: The GSC+ is attempting to crank whenever the K4 indicator is ON (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.

- a. Disconnect the B+ wire on the pinion solenoid of the starting motor. The B+ wire remains disconnected for all of the remaining steps of this procedure.
- b. Prepare to measure the DC voltage from the disconnected B+ pinion solenoid wire to B– (ground).
- c. Turn the ECS to OFF/RESET and then to START.
- d. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore, the starting motor is faulty. Repair or replace the starting motor. Refer to the Engine or Starting Motor Service Manual. STOP.
- Not OK – Proceed to next step.

Step 4. Check engine starting function

(continued). The conditions of Step 3 remain in effect (B+ wire disconnected from pinion solenoid).

- a. Prepare to measure the DC voltage from terminal TS1-25 in the generator housing to B– (ground).
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore the engine wire harness is faulty. Repair or replace the engine wire harness. See the Generator Set Wiring Diagram in the Schematics & Wiring Diagram section. STOP.
- Not OK – Proceed to next step.

Step 5. Check engine starting function

(continued). The conditions of Step 3 remain in effect (B+ wire disconnected from pinion solenoid).

- a. Prepare to measure the DC voltage from terminal TS1-5 in the generator housing to B– (ground).
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore 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 & Wiring Diagram section. STOP.
- Not OK – Proceed to next step.

Step 6. Check engine starting function

(continued). The conditions of Step 3 remain in effect (B+ wire disconnected from pinion solenoid).

- a. Prepare to measure the DC voltage from RM-18 of the relay module to B– (ground).
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore the emergency stop push button (ESPB) or the related wiring is faulty. Troubleshoot the ESPB and the related wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. STOP.
- Not OK – Proceed to next step.

Step 7. Check engine starting function

(continued). The conditions of Step 3 remain in effect (B+ wire disconnected from pinion solenoid).

- a. Prepare to measure the DC voltage from RM-6 of the relay module to B– (ground).
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore the relay module is faulty. Replace the relay module (first make sure the K4 indicator is ON). See the topic Relay Module Replacement. STOP.
- Not OK – Proceed to next step.

Step 8. Check engine starting function

(continued). The conditions of Step 3 remain in effect (B+ wire disconnected from pinion solenoid).

- a. Prepare to measure the DC voltage from RM-33 of the relay module to B– (ground).
- b. Turn the ECS to OFF/RESET and then to START.
- c. Measure the voltage.

Expected Result: The voltage should be the same as the system voltage noted in Step 2, ± 2.0 DCV.

Results:

- OK – Therefore fuse F4 is blown. Proceed to next step.
- Not OK – Therefore the B+ terminal or the wiring to terminal RM-33 is faulty. Repair or replace the wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. STOP.

Step 9. Troubleshoot blown fuse.

- a. Remove fuse F4 from the relay module.
- b. At the relay module, measure the resistance from RM-18 to B- (ground).

Expected Result: A short to B- (ground) will measure 5 ohms or less.

Results:

- OK – Resistance is greater than 5 ohms and fuse is no longer blowing. Carefully check ALL wires connected to the appropriate terminal of the relay module for abrasion or worn spots in the insulation that could be causing the short. Check wires in the panel, generator panel, and on the engine harness itself. Refer to the various wiring diagrams as necessary. Repair or replace wiring as necessary. STOP.
- Not OK – Resistance is 5 ohms or less. There is a short to ground. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. Remove one component or wire at a time that is in series with RM-18 until the faulty component or wire is isolated. Repair or replace faulty component or wiring. 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 proceed to the corresponding procedure.

NOTE: If any fault indicator or fault code is showing on the GSC+, then proceed 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).

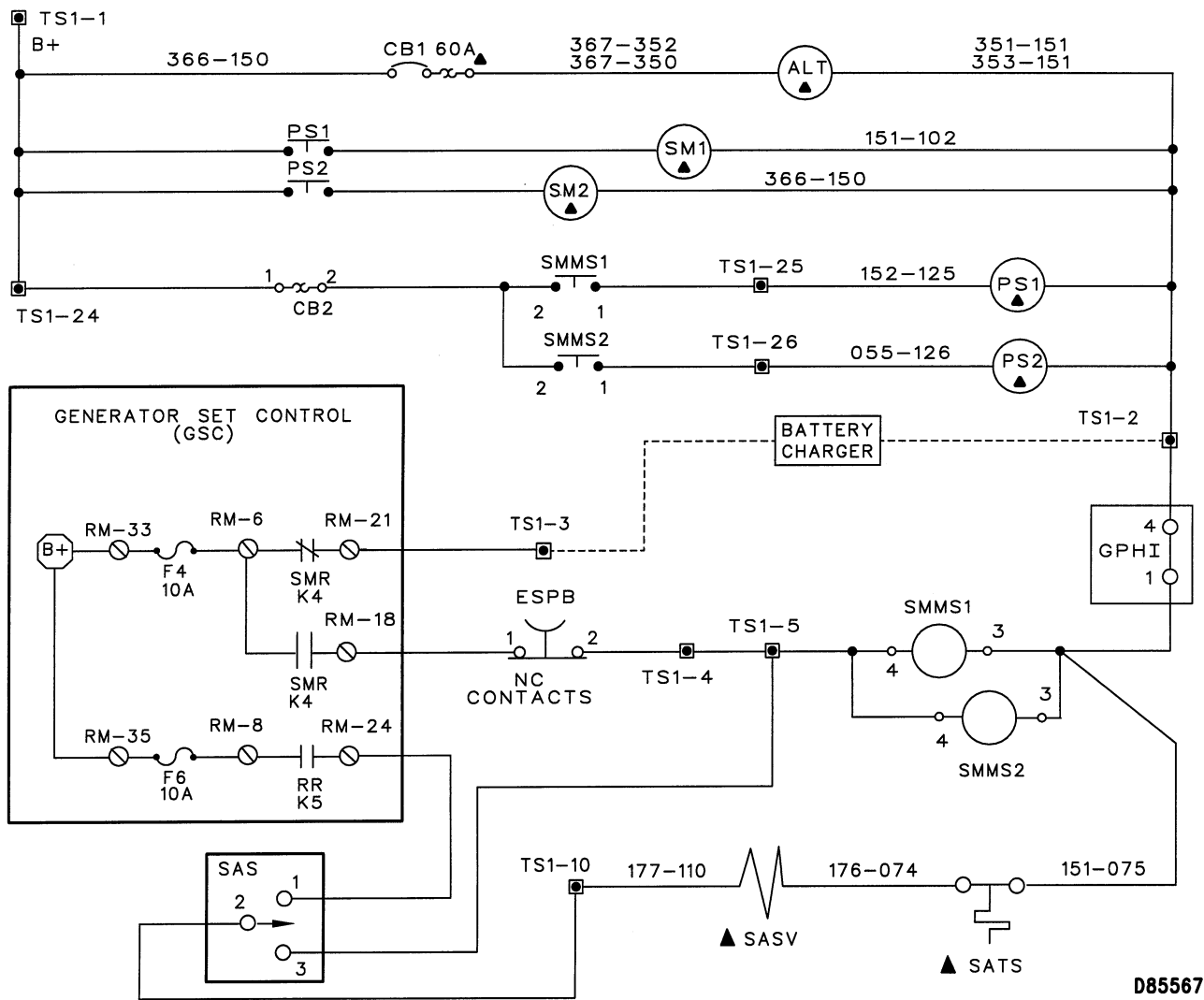
Problem D: Fault shutdown indicator on the GSC+ flashes at the rate of four to five times per second (4 to 5 Hz).

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 are inaccurate.

Problem A

Starting motor remains engaged or continues to run after engine has started.



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System Schematic For Starting Motor Relay (SMR)

Step 1. Check Setpoints. This step checks setpoints P011 (crank terminate speed), P017 (total cycle crank time) and P018 (cycle crank time).

- View and make a note of setpoints P011, P017 and P018. See Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- Compare the setpoints viewed with the setpoints specified on print 136-9048 The factory default values are: 400 rpm for P011, 90 seconds for P017 and 10 seconds for P018.

NOTE: Engines equipped with pre-lube pumps may require cycle crank times (setpoint P018) of 30 seconds or more.

Expected Result: The viewed setpoint value and the specified setpoint value should agree.

Results:

- OK – Proceed to next step.
- Not OK – The viewed setpoint does not agree with the specified setpoint. Reprogram setpoints P011, P017 and P018 per 136-9048 Control Panel Chart. See Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section. Proceed to next step.

Step 2. Check engine starting function. The remaining steps of this procedure require checks to be made during simulated engine starting. The fuel delivery system is disabled.

- Disable the fuel shutoff solenoid or the PEEC electronic engine control to prevent the engine from starting but not from cranking.
- Prepare to manually stop the engine from cranking (turn battery disconnect switch to OFF), if necessary.
- Turn the ECS to START and allow the engine to crank.
- Turn the ECS to OFF/RESET.

Expected Result: The engine should stop cranking.

Results:

- OK – Proceed to Step 6.
- Not OK – Engine continues to crank. Proceed to next step.

Step 3. Check engine starting function (continued). The conditions of Step 2 remain in effect (fuel delivery disabled and engine cranking).

- While the engine is still cranking from the preceding step, push the emergency stop push button.

Expected Result: The engine should stop cranking.

Results:

- OK – Check the wire on RM-18 of the relay module for a short to B+. If a short is not found, replace the relay module. See the topic Relay Module Replacement. STOP.
- Not OK – Engine continues to crank. Proceed to next step.

Step 4. Check engine starting function (continued). The conditions of Step 3 remain in effect (fuel delivery disabled and engine cranking).

- Stop the engine (turn the battery disconnect switch to OFF).
- Remove all wires from terminal TS1-25 in the generator housing. (For dual starting motors, also remove all wires from terminal TS1-26.)

- Turn the ECS to START and attempt to crank the engine.

Expected Result: The engine should not crank.

Results:

- OK – The engine does not crank. Therefore the 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 & Wiring Diagram section. STOP.
- Not OK – Engine continues to crank. Proceed to next step.

Step 5. Check engine starting function (continued). The conditions of Step 4 remain in effect (fuel delivery disabled and engine cranking).

- Stop the engine (turn the battery disconnect switch to OFF).
- Disconnect the B+ wire on the pinion solenoid of the starting motor.
- Turn the ECS to START and attempt to crank the engine.

Expected Result: The engine should not crank.

Results:

- OK – The engine does not crank. Therefore, wire Q52-125 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 & Wiring Diagram section. STOP.
- Not OK – Engine continues to crank. Therefore, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor and/or Engine Service Manuals. STOP

Step 6. Check Starting Motor Cycling. This step continues troubleshooting from Step 2. The conditions of Step 2 remain in effect (fuel delivery disabled).

- Turn the ECS to START.

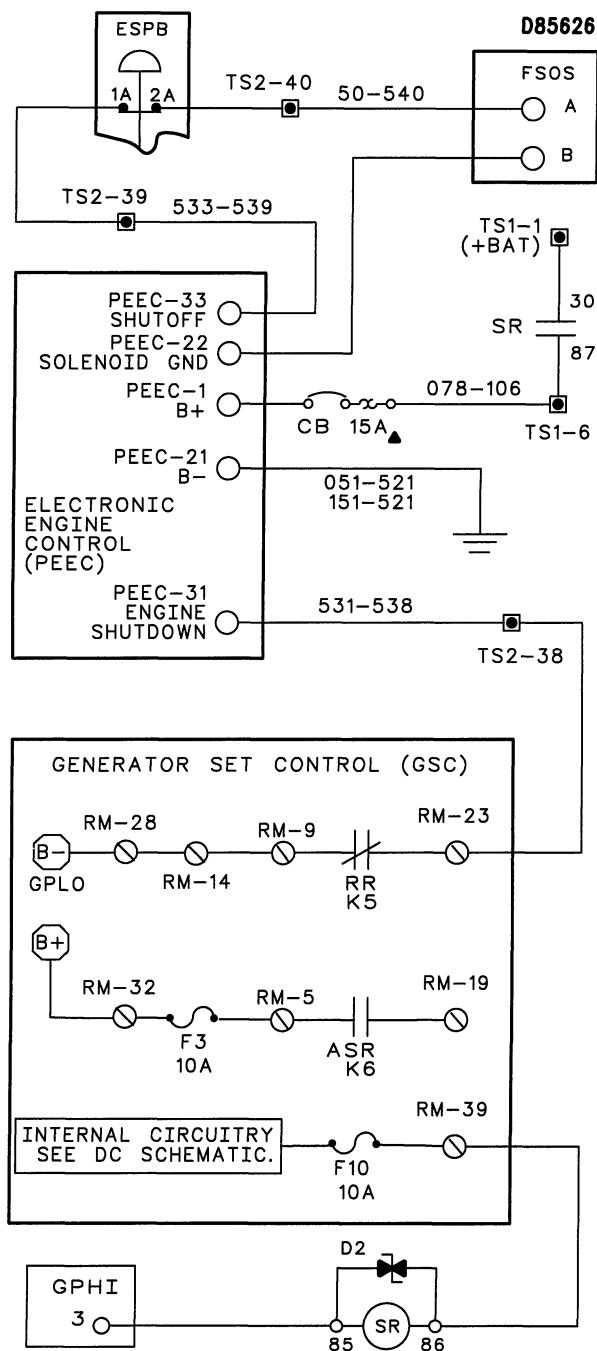
Expected Result: The starting motor should cycle on and off according to setpoint P018 (cycle crank time).

Results:

- OK – If the starting motor cycles correctly, the problem is not present. STOP.
- Not OK – If the starting motor remains ON and does not stop, the starting motor is faulty. Troubleshoot the starting motor. Refer to the Starting Motor and/or Engine Service Manuals. STOP.

Problem B

No engine shutdown when a shutdown fault occurs.



System Schematic For Unexpected Shutdown

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 and is able to start). This is not a problem. To view the setpoints, see Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section. To reprogram the setpoints, see Engine/Generator Programming OP5-0 within the topic Service Mode in the Systems Operation section.

Expected Result: Engine does not shutdown when a shutdown fault occurs.

Results:

- Not OK – If all fault indicators are OFF and a fault exists that should cause the GSC+ to shutdown the engine, then proceed to Step 6.
- Not OK – If the fault shutdown indicator is FLASHING and the engine remains running, then proceed to next step.

Step 2. System Check. The engine remains running and the fault shutdown indicator is FLASHING.

- Turn the ECS to OFF/RESET.

Expected Result: The engine should shutdown.

Results:

- OK – The engine shuts down. The system is functioning properly. Start the engine again. If the fault shutdown indicator is FLASHING and the engine does not shutdown, replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – The engine does NOT shutdown. Proceed to next step.

Step 3. System Check. The engine remains running and the fault shutdown indicator is FLASHING.

- a. Push the emergency stop push button (ESPB).

Expected Result: The engine should shutdown.

Results:

- OK – The engine shuts down. Therefore, it is likely that an unwanted battery positive (B+) voltage is present at TS2-39 of the generator terminal strip. Check the related wiring for this unwanted voltage. If no battery voltage is found in the related wiring, then refer to the specific service module for Engine Electronic Troubleshooting to find the cause of the problem. STOP.
- Not OK – The engine does NOT shutdown. Proceed to next step.

Step 4. System Check. The engine remains running and the fault shutdown indicator is FLASHING.

- a. Remove all wires from terminal TS2-40 in the generator housing.

Expected Result: The engine should shut down.

Results:

- OK – The engine shuts down. There is a wiring error or short to battery positive between terminal TS2-40 and TS2-39. Troubleshoot the ESPB and the related wiring. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. STOP.
- Not OK – If the engine does NOT shutdown, proceed to next step.

Step 5. System Check. The engine remains running and the fault shutdown indicator is FLASHING.

- a. Disconnect the fuel shutoff solenoid (connector contacts A and B of the FSOS) from the engine harness.

Expected Result: The engine should shutdown.

Results:

- OK – The engine shuts down. Therefore, wire 50A-540 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.
- Not OK – The engine does NOT shutdown. Therefore, the fuel shutoff solenoid is stuck or otherwise faulty. Refer to the engine Service Manual to troubleshoot and repair. STOP.

Step 6. Determine Fault. This step continues troubleshooting from Step 1.

NOTE: For a fault with the coolant loss sensor that does not shutdown the engine, see the topic CID 111 in the Diagnostic Fault Codes section.

- a. 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+.
- b. View the related setpoints, see Engine/Generator Setpoint Viewing OP2-0 within the topic Service Mode in the Systems Operation section.
- c. Compare the engine information showing on the lower display with the related setpoints.

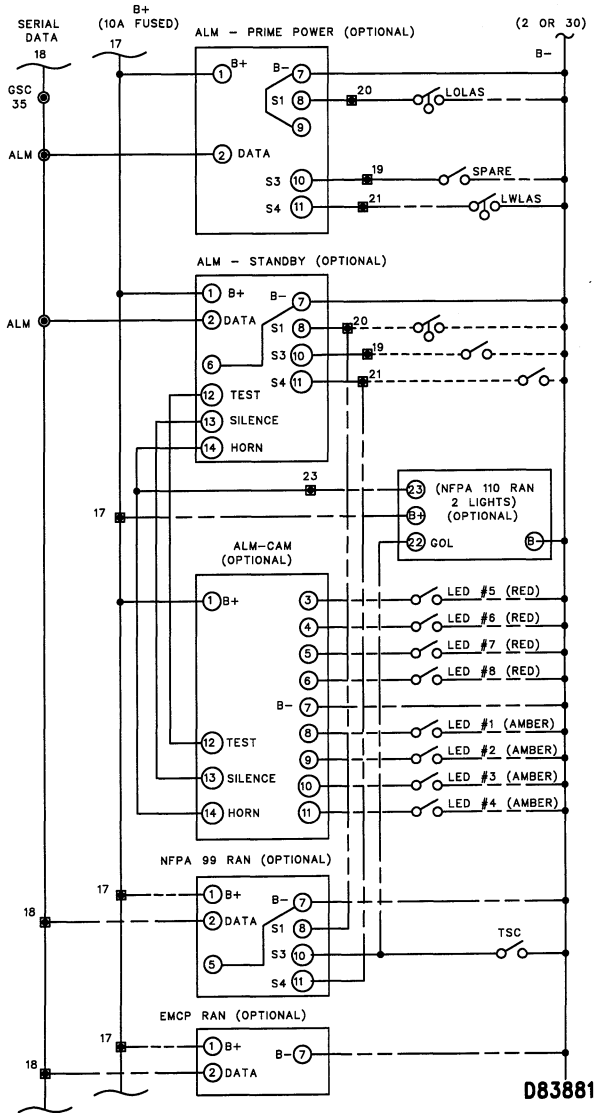
Expected Result: The information on the lower display and the related setpoint values should agree.

Results:

- OK – The information showing on the lower display is within the related setpoint, then the GSC+ is not causing the shutdown. STOP.
- Not OK – 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.

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. (There is no limit on the number of Custom Alarm Modules that can be used in an application.) The maximum distance between a module and the GSC+ is 305 m (1000 ft).

If these specifications are not met, the information on the data link can be erratic 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+.
- Check for open. Measure the resistance from terminal 2 of the alarm module to contact 35 of the GSC+ harness connector. The resistance should be 5 ohms or less.
- 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 be 5k ohms or greater.

Expected Result:

For Step c, the resistance should be 5 ohms or less. For Step d, the resistance should be 5k ohms or greater.

Results:

- OK - All resistance measurements are correct. Proceed to next step.
- Not OK - One or more of the resistance measurements are NOT correct. Therefore the harness wiring with the incorrect resistance is faulty (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+.
- At the alarm module measure the DC voltage from terminal 2 to terminal 7. The voltage will be changing, but it should be 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 b. If the voltages do not agree, the wire is faulty from terminal 2 of the alarm module to terminal TS1-18 in the generator housing.

- Disconnect all wires from terminal 2 of the alarm module. Again measure the DC voltage from terminal 2 to terminal 7 at the alarm module. The voltage should be 10.5 ± 1.0 DCV.

Expected Result:

For Step b, the voltage should be between 1 and 10 DCV.

For Step c, the voltage should be 10.5 ± 1.0 DCV.

Results:

- OK – Both voltage measurements are correct. Therefore, replace the alarm module. STOP.
- Not OK – Both voltage measurements are low. Therefore, replace the alarm module.
- Not OK – The first measurement is low and the second measurement is high. Therefore, replace the GSC+. See 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 electromagnetic or radio frequency interference. The relays in the relay module are automatically turned off when this fault occurs and this shuts down the engine.

Step 1. Reset The GSC+.

- a. Turn the ECS to OFF/RESET. If the GSC+ does not power down, remove the jumper that connects terminals 6 and 9 on the ECS.
- b. Turn the ECS to STOP.

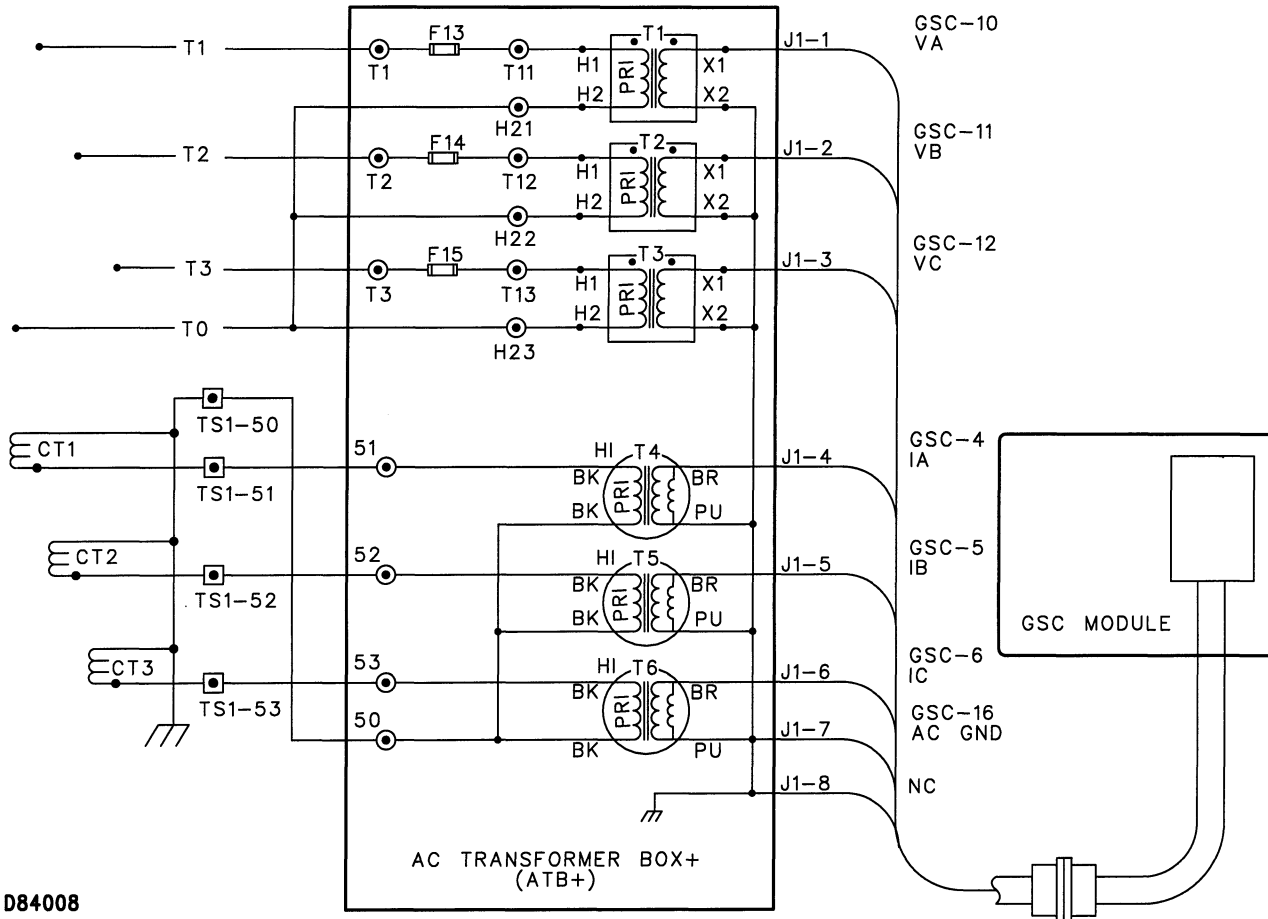
Expected Result: The GSC+ should power up with an understandable display and should now respond to the ECS switch.

Results:

- OK – The GSC+ operates correctly. Therefore, the fault is gone. STOP.
- Not OK – The GSC+ does NOT operate correctly and the fault shutdown indicator still flashes at the rate of four to five times per second (4 to 5 Hz). Therefore, the 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 load connected.



D84008

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.

- a. Check the three fuses on the AC transformer box + (ATB+). The fuses should not be blown.

Expected Result: The fuses should not be blown.

Results:

- OK – Fuses are OK. Proceed to next step.
- Not OK – One or more of the fuses are blown. Check for a shorted component or wiring error. Troubleshoot and repair the fault, see the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. STOP.

Step 2. Check Generator Output.

- a. With the engine running and the circuit breaker open or load removed, measure the voltage between all three fuses on the ATB+.

Expected Result: The line to line voltage should measure correctly for all three phases.

Results:

- OK – The voltages are correct and the problem remains. Proceed to next step.
- Not OK – One or more of the voltages are NOT correct, the wiring or connections are faulty. Check for wiring errors between the ATB+ and the generator buss, see the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. Also check the electrical connections at the ATB+ terminal, see the topic Electrical Connector Inspection. STOP.

Step 3. Check Connections.

- a. Stop the engine.
- b. Check the harness connector and crimp terminals of the ATB+.
- c. Check the GSC+ harness connector. See the topic Electrical Connection Inspection.
- d. Check for one or more broken wires between the ATB+ and the GSC+. See the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section.

Expected Result: All connectors are OK and the problem is no longer present.

Results:

- OK – All connectors are OK and the problem is no longer present. This procedure has fixed the fault. STOP.
- Not OK – Problem remains and concerns AC voltage. It is unlikely the GSC+ is faulty. Replace the ATB+ and if the problem persists, then replace the GSC+. STOP.
- Not OK – Problem remains and concerns AC current. Proceed to next step.

Step 4. Check Current Transformers.

- a. Stop the engine.
- b. At terminals 51, 52 and 53 of the ATB+, disconnect only the wires that lead away from the ATB+. These disconnected wires go to the current transformers (CT1, CT2, CT3).
- c. Measure the resistance from terminal 50 to each of the disconnected wires.

Expected Result: The resistance should be less than 5 ohms.

Results:

- OK – The resistance is correct. Therefore, the current transformers check good. Proceed to next step.
- Not OK – One or more of the resistance measurements are NOT correct. A current transformer or related wire is open. Check for an open CT or wiring, see the Generator Set Wiring Diagram in the Schematics & Wiring Diagram section. STOP.

Step 5. Check ATB+.

- a. Stop the engine.
- b. Remove the harness connector from the GSC+.
- c. At the GSC+ harness connector, measure the resistance:
 - from contact 4 to contact 16
 - from contact 5 to contact 16
 - From contact 6 to contact 16

Allow each measurement to stabilize.

Expected Result: Each of the three resistances should be 120 ± 20 ohms.

Results:

- OK – Proceed to next step.
- Not OK – One or more of the resistance measurements at the GSC+ harness connector is NOT correct. Therefore, the ATB+ or the related wiring is faulty. Check for an open or short in the wiring from the GSC+ harness connector to the ATB+ harness connector, see the Main Chassis Wiring Diagram in the Schematics & 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.

Step 6. Check ATB+. 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+.

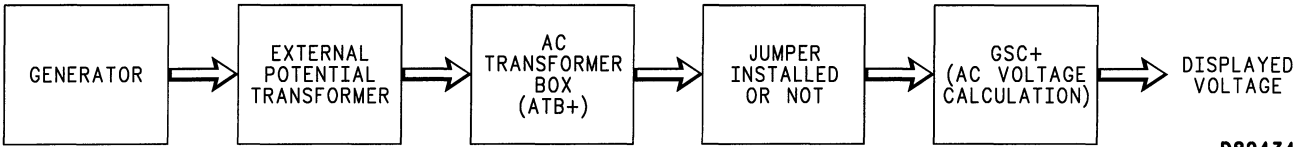
- a. At the terminal strip of the ATB+ measure the resistance:
 - from terminal 51 to 50
 - from terminal 52 to 50
 - from terminal 53 to 50

Expected Result: All resistances should be less than 1 ohm.

Results:

- OK – All resistances are correct, then the ATB+ checks good. The fault is in the GSC+ or the GSC+ harness connector. Check the GSC+ harness connector, see the Main Chassis Wiring Diagram in the Schematics & Wiring Diagram section. If the connector checks good and the fault remains, then replace the GSC+. See the topic Generator Set Control + Replacement. STOP.
- Not OK – One or more of the resistance measurements are NOT correct. The ATB+ is faulty. Replace the ATB+. STOP.

Problem F
The AC voltage and/or current values are inaccurate.



D82434

Functional Block Diagram Of AC Voltage Display in EMCP II+

AC Voltage Range Selection				
GSC+ P020 Setpoint	External Potential Transformer	AC Transformer Box (ATB+) Input Voltage Range	GSC+ Internal Multiplier	Jumper
700	None	0 - 700	5	Required
150	None	0 - 150	1	None
300	2:1	0 - 150	2	None
500	3.33:1	0 - 150	3.33	None
600	4:1	0 - 150	4	None
750	5:1	0 - 150	5	None
3000	20:1	0 - 150	20	None
4500	30:1	0 - 150	30	None
5250	35:1	0 - 150	35	None
9000	60:1	0 - 150	60	None
15 000	100:1	0 - 150	100	None
18 000	120:1	0 - 150	120	None
30 000	200:1	0 - 150	200	None

NOTE: For the system schematic see the preceding Problem E.

NOTE: For related information, see the topic AC Voltage Range Selection.

The P020 setpoint determines the proper AC voltage range and the internal multiplier that are used by the GSC+ for calculating AC voltage. The GSC+ uses the internal multiplier to compensate for the turns ratio of the external potential transformers (if present). The turns ratio of the external potential transformer must match this internal multiplier to ensure accurate AC voltage calculation by the GSC+.

The jumper block (located in the relay module) connects a divide-by-five circuit to the AC voltage input of the GSC+. The divide-by-five circuit reduces the AC voltage input to a manageable level for the GSC+ when P020 is 700. When setpoint P020 is 700, a multiplier of five is needed to compensate for the presence of the divide-by-five circuit (jumper installed) even though no external potential transformer is present.

NOTE: To prevent inaccurate voltage calculation by the GSC+, the jumper block should NOT be installed when P020 is programmed to a value other than 700. The other values (150 through 30 000) are used with an external potential transformer and result in input voltages from 0 to 150 ACV at the AC Transformer Box + (ATB+). No further reduction of the input voltage is required.

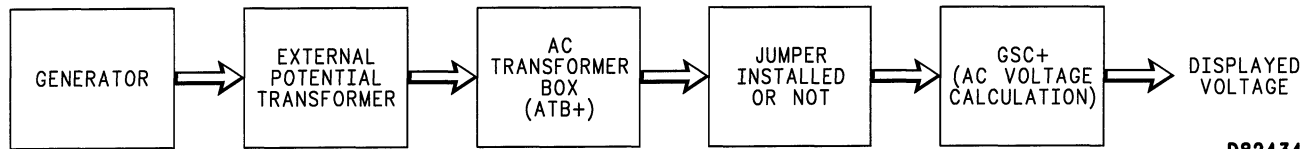
Do the following procedure to determine the cause of inaccurate AC voltage and/or current values on the GSC+.

1. Check setpoints P020 (full scale voltage) and P021 (full scale current). See Engine/Generator Setpoint Viewing OP2-0 and Engine/Generator Programming OP5-0 within the topic Service Mode. Typical factory setpoints are: 700V for P020 and 600A for P021. The setpoints should be correct for the genset application.
2. Refer to the AC Voltage Range Selection chart and the Functional Block Diagram Of AC Voltage Display In EMCP II+ to help determine the proper setpoints and any necessary external potential transformers.
3. 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 (P020 = 700). The jumper should NOT be installed for systems with 150 volts full scale AC inputs (P020 is a value other than 700) or for any unit with external potential transformers. For information regarding the installation of the jumper, see the topic AC Voltage Range Selection.
4. Check the Voltmeter/Ammeter Programming OP8 within the topic Service Mode in the Systems Operation section. OP8 is the option for programming the calibration value of the voltmeter and ammeter. The calibration values, written on the ATB+ bar code sticker, must be programmed into the GSC+ to assure accurate voltage and current values.

5. Check the AC offset adjustment, see AC Offset Adjustment OP10 within the topic Service Mode in the Systems Operation section. If necessary, set the voltage offsets back to 0%.

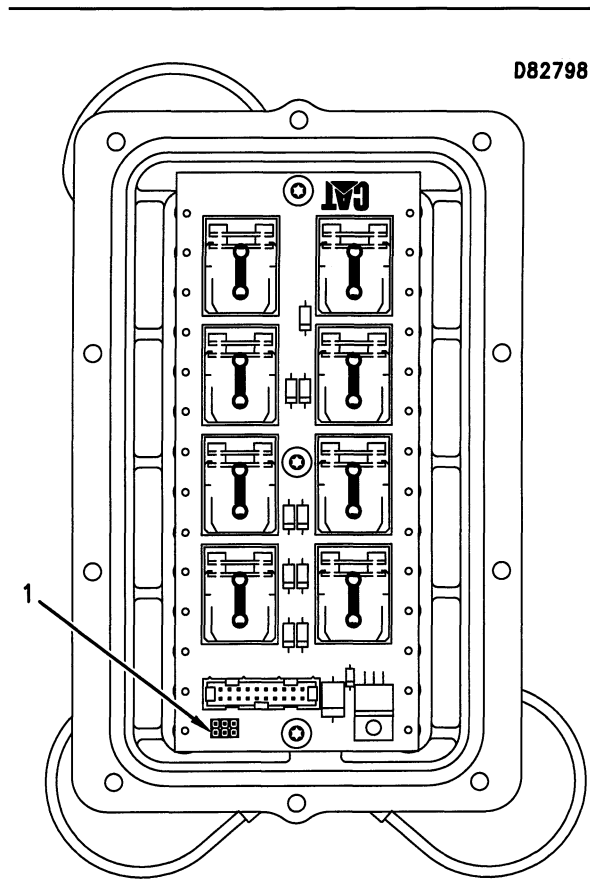
NOTE: The adjusted voltages are for display only and will NOT be transmitted over the CAT data link to other modules (such as the Customer Communication Module). Also, the adjusted voltages are NOT used for determining the fault thresholds for protective relaying functions. In both cases, the unadjusted values for AC voltage are still determined by the GSC+ (but not shown), and will be used instead of the displayed values.

AC Voltage Range Selection



D82434

Functional Block Diagram Of AC Voltage Display In EMCP II+



Relays In Relay Module
(1) Jumper block.

AC Voltage Range Selection				
GSC+ P020 Setpoint	External Potential Transformer	AC Transformer Box + (ATB+) Input Voltage Range	GSC+ Internal Multiplier	Jumper
700	None	0 - 700	5	Required
150	None	0 - 150	1	None
300	2:1	0 - 150	2	None
500	3.33:1	0 - 150	3.33	None
600	4:1	0 - 150	4	None
750	5:1	0 - 150	5	None
3000	20:1	0 - 150	20	None
4500	30:1	0 - 150	30	None
5250	35:1	0 - 150	35	None
9000	60:1	0 - 150	60	None
15 000	100:1	0 - 150	100	None
18 000	120:1	0 - 150	120	None
30 000	200:1	0 - 150	200	None

Jumper block (1) is used to select the voltage range of the voltmeter of the GSC+. Jumper block (1) is installed for systems with 700 volts full scale AC inputs. Jumper block (1) is NOT installed for systems with 150 volts full scale AC inputs or for any unit with external potential transformers. The relay module comes factory equipped with jumper block (1) installed.

Jumper block (1) is easily removed or installed by grasping and pulling it. If a jumper block is required but is not available, three separate jumpers can be substituted. Each of the three manufactured jumpers connect a pair of pins. A pair of pins must not touch another pair of pins.

The relay module must be removed from the GSC+ to gain access to the circuit board and jumper block (1). See the topic Relay Module Replacement.

The P020 setpoint determines the proper AC voltage range and the internal multiplier that are used by the GSC+ for calculating AC voltage. The GSC+ uses the internal multiplier to compensate for the turns ratio of the external potential transformers (if present). The turns ratio of the external potential transformer must match this internal multiplier to ensure accurate AC voltage calculation by the GSC+.

The jumper block (located in the relay module) connects a divide-by-five circuit to the AC voltage input of the GSC+. The divide-by-five circuit reduces the AC voltage input to a manageable level for the GSC+ when P020 is 700. When setpoint P020 is 700, a multiplier of five is needed to compensate for the presence of the divide-by-five circuit (jumper installed) even though no external potential transformer is present.

NOTE: To prevent inaccurate voltage calculation by the GSC+, the jumper block should NOT be installed when P020 is programmed to a value other than 700. The other values (150 through 30 000) are used with an external potential transformer and result in input voltages from 0 to 150 ACV at the AC Transformer Box + (ATB+). No further reduction of the input voltage is required.

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 contaminants.
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.

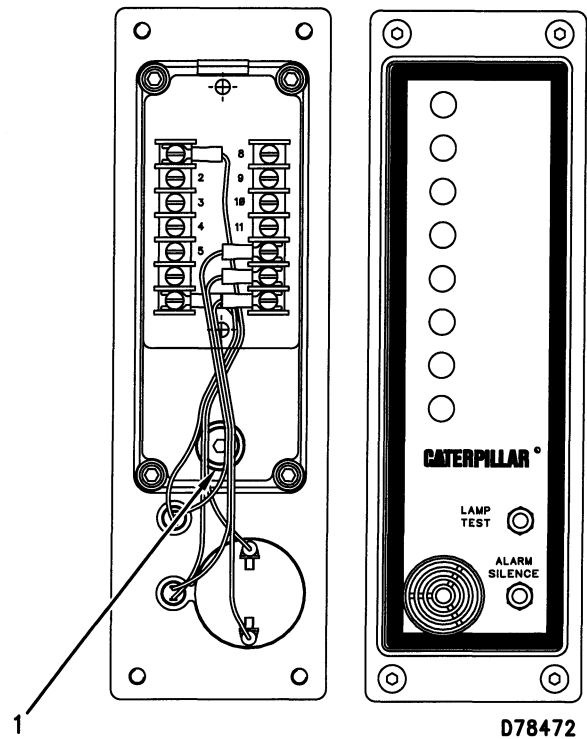
Also do the pull test for the pre-insulated crimp terminals on the terminal strips. Repair as needed. When replacing crimp terminals, use the proper crimping tool and techniques for the type and brand of crimp terminal. Use an appropriately sized terminal for the wire gauge. If desired, crimp-on spade 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.

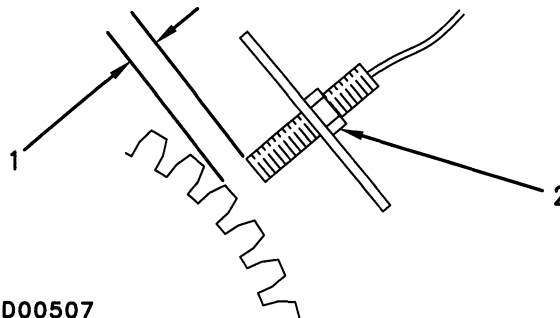
For all alarm applications, the low DC volts alarm setpoint is adjusted by a potentiometer located under access plug (1) on the rear of the module. The adjustment range is 8 to 38 volts. The alarm setpoint is factory set at 24 DCV.

Adjustment Procedure

1. Gain access to the rear of the ALM. It is not necessary to remove the ALM unless necessary for access. All wiring remains connected to the terminals of the ALM unless otherwise noted.
2. Remove plug (1) to gain access to the adjustment potentiometer. It is possible for moisture to enter the ALM when plug (1) is removed. Remove plug (1) in a dry environment. Remove the plug in an air conditioned area if the relative humidity exceeds 60%.

3. Disconnect the wires on terminals 1 and 7. Secure these wires so that they do not touch each other, ground or other electrical connections.
4. Connect a variable DC power supply to the alarm module (positive to terminal 1, negative to terminal 7). Set the power supply voltage to the desired low DCV alarm setpoint (between 8 and 38 volts).
5. Turn the adjustment pot fully clockwise.
6. After one minute, the indicator on the ALM for low battery voltage FLASHES. Press the alarm silence switch. The low battery voltage indicator should change from FLASHING to ON CONTINUOUSLY.
7. Turn the adjustment potentiometer counterclockwise slowly until the low battery voltage indicator turns OFF.
8. Replace the plug.
9. Disconnect the variable DC power supply and reconnect the wires to terminals 1 and 7.

Magnetic Pickup (MPU) Adjustment



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

This adjustment procedure is for the engine magnetic pickup.

1. Remove the magnetic pickup from the flywheel housing. Remove all debris from the tip of the magnetic pickup. Align a ring gear tooth directly in the center of the threaded opening.
2. By hand, screw the pickup into the hole until the end of the pickup just makes contact with the gear tooth.
3. Turn the pickup back out three-fourths turn (270 degrees in the counterclockwise direction).
4. Tighten locknut (2) to $25 \pm 5 \text{ N}\cdot\text{m}$ ($18 \pm 4 \text{ lb ft}$).

NOTE: Do not allow the pickup to turn as locknut (2) is tightened.

Charging System Test

Fault Conditions And Possible Causes			
Current At Start-Up ¹	Voltage After About 10 Min Is Below Spec.	Voltage After About 10 Min Is In Spec.	Voltage After About 10 Min Is Above Spec.
Below Specification.	Repair alternator (defective regulator, open stator phase and/or rectifier).	Turn on all accessories. If voltage drops below spec., repair alternator (open rectifier and/or stator phase).	
Reached Specification and then tapered off.	Repair alternator (defective regulator).	Alternator and battery in spec. Turn on all accessories to verify. Voltage must stay in spec.	Repair alternator (shorted regulator).
Exceeds Specification and stays high.	Check battery per Form SEHS7633. Do alternator test again if necessary.	Alternator in spec. Check battery per Form SEHS7633.	Repair alternator (shorted regulator). Also check battery for possible damage.

¹ All electrical accessories off.

Tools Needed		
6V-7070	Digital Multimeter or Equivalent	1
8T-0900	AC/DC Clamp-On Ammeter	1

Test Procedure

STEP 1. Put the multimeter positive (+) lead on the BAT terminal of the alternator. Put the negative (-) lead on the ground terminal or the frame of the alternator. Put a clamp-on ammeter around the positive output wire of the alternator.

NOTE: Cranking the engine for 30 seconds partially discharges the battery in order to do a charging test. If the battery is already low in charge, skip Step 2 and proceed to Step 3.

STEP 2. Disable the fuel shutoff solenoid or governor to shut the fuel off and prevent the engine from starting. Do not disable the starting motor. Turn the engine control switch (ECS) to OFF/RESET. To activate the starting motor, temporarily place a jumper from the B+ terminal to the RM-18 terminal, at the relay module terminal strip. Crank the engine for 30 seconds. Wait for two minutes to cool the starting motor. Crank the engine again for 30 seconds.

STEP 3. Enable the fuel shutoff solenoid or governor that was disabled in Step 2. Start the engine and run at full throttle. If necessary, jump-start the engine or charge the batteries as required in order to start the engine.

STEP 4. Immediately check the output current of the alternator. For correct operation, this initial charging current is equal to or slightly greater than the full rated output current of the alternator. The specified full rated output current of some alternators is:

100-5047 (24V)	50A
3E-7577 (24V)	75A
3E-7578 (24V)	50A
3T-6352 (24V)	60A
4N-3986 (24V)	60A
6N-9294 (24V)	35A
6T-1395 (24V)	35A
7N-9720 (24V)	35A
7T-2095 (24V)	35A
9G-4574 (24V)	35A
9W-3043 (24V)	55A
4N-3987 (32V)	60A

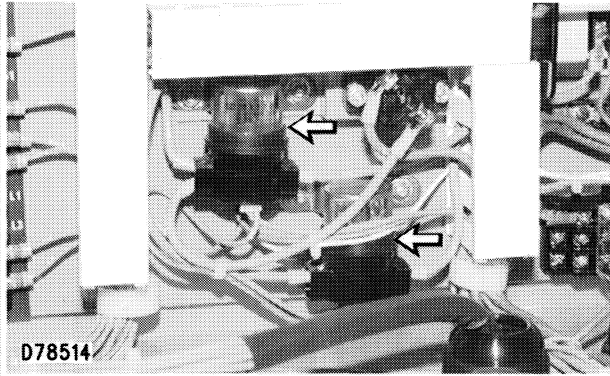
STEP 5. For correct operation, within approximately 10 minutes at full throttle (possibly longer depending upon battery size, condition and alternator rating), the specified alternator output voltage is:

24V system	26.5 to 29.0 DCV.
32V system	35.8 to 38.8 DCV.

See the Fault Conditions And Possible Causes chart.

STEP 6. The charging current during this period should taper off to less than approximately 10 amps with accessories turned OFF, depending again upon battery and alternator capacities. See the Fault Conditions And Possible Causes chart.

Magnetic Switch Test (24V)



Magnetic Switches On Sub-Panel
(Two Switches Shown For Dual Starting Motor System)

The starting motor magnetic switch (SMMS) for 24V systems is mounted on the sub-panel within the control panel. Two switches are used in dual starting motor systems, one for each starting motor.

Test Procedure

1. Disconnect the jumper wire between terminals TS1-4 and TS1-5 in the generator housing. Measure the resistance between TS1-5 and TS1-2. The resistance should measure:
26 to 33 ohms for single starting motor systems.
13 to 17 ohms for dual starting motor systems.

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

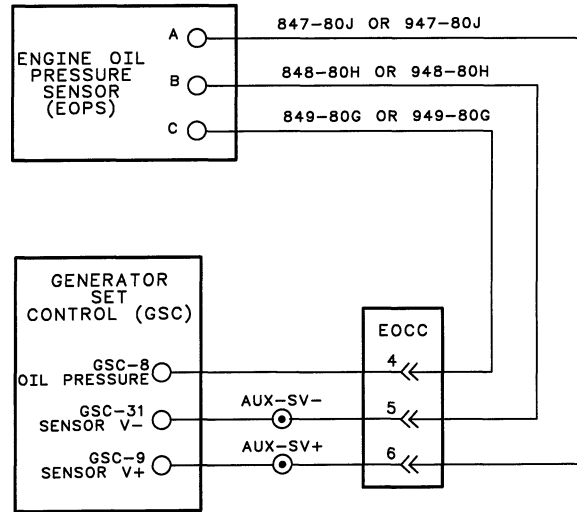
2. Disconnect the cable going from the pinion solenoid to the starting motor. Do this on both starting motors of a dual starting motor system.
3. Connect a DC voltmeter: positive to TS1-24 and negative to TS1-25 in the generator housing. (If second magnetic switch is tested in a dual starting motor system, then connect negative to TS1-26.)

NOTE: The jumper wire of Step 4 can remain connected for only ten seconds.

4. Connect a jumper wire from TS1-1 to TS1-5 in the generator housing. Disconnect this wire immediately after the voltage is measured (no more than 10 seconds). The correct measurement changes from approximately 24 DCV to approximately 2 DCV.

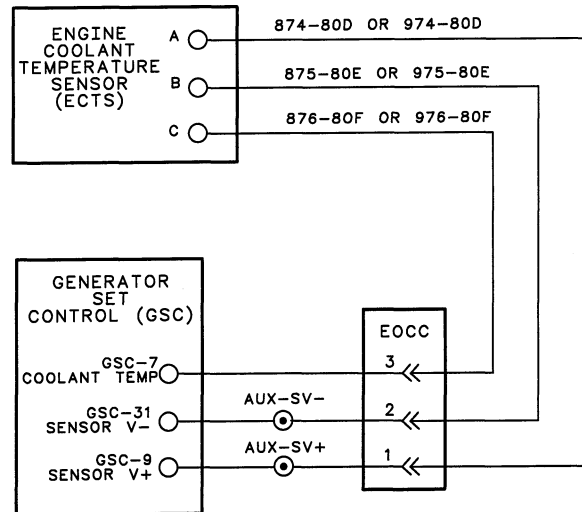
If voltage is greater than 2.0 DCV, then replace the magnetic switch. If the switch passes the requirements of Step 1 and 4, it is functioning correctly. Reconnect the wires and cables that were removed in this procedure.

PWM Sensor Test



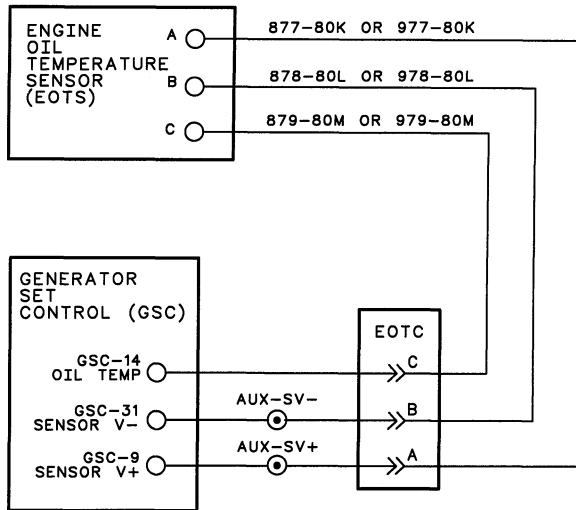
D85496

System Schematic For Engine Oil Pressure Sensor (EOPS)



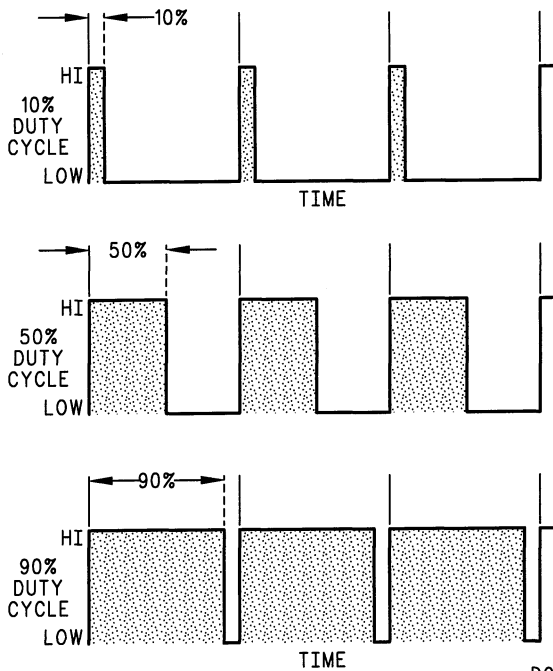
D85497

System Schematic For Engine Coolant Temperature Sensor (ECTS)



D83865

System Schematic For Engine Oil Temperature Sensor (EOTS)



D04215

Pulse Width Modulated (PWM) Signal

This test is provided in addition to the CID 100, CID 110 and CID 175 troubleshooting procedures; see the topic Diagnostic Fault Codes. The oil pressure sensor, coolant temperature sensor and oil temperature sensor are pulse width modulated (PWM) sensors. These sensors produce a digital signal in which the duty cycle varies as the condition changes. The frequency remains constant.

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 And Engine Oil Temperature Sensor (EOTS) 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 $\pm 10\%$.

³ The base frequency is 370 to 550 Hz.

The engine coolant temperature sensor and the engine oil temperature sensor are the same Caterpillar part but used in different applications. The sensor specifications are the same for both of these sensors.

Test Procedure

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. Preparations.

- Locate the suspect sensor.
- Identify the sensor wires and connector contacts; see the preceding System Schematics.
- DO NOT DISCONNECT ANY HARNESS CONNECTORS AT THIS TIME.
- Use the 7X-1710 Cable Probe (Spoons) to make future 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).

Expected Result: The voltage should be from 7.5 to 8.5 DCV.

Results:

- OK – The voltage is from 7.5 to 8.5 DCV. Proceed to next step.
- 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.

- If a CID 269 fault code is active, then go to that procedure in the Diagnostic Fault Troubleshooting section. STOP.
- 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.

Expected Result: The measured frequency and duty cycle should agree with the values listed in the Sensor Specifications chart.

Results:

- OK – The measurements agree. The sensor is functioning correctly. Proceed to next step.
- Not OK – The measurements DO NOT agree. Proceed to Step 5.

Step 4. Check Engine Harness Signal.

- Measure the frequency and duty cycle of the signal at the GSC+ harness connector.
 - For the oil pressure signal, measure from contact 8 to contact 31.
 - For the coolant temperature signal, measure from contact 7 to contact 31.
 - For the oil temperature signal, measure from contact 14 to contact 31.

Expected Result: The measured frequency and duty cycle should agree with the values measured in Step 3.

Results:

- OK – The measurements agree. The sensor is functioning correctly. Proceed to next step.
 - If sensor fault codes are still active, the GSC+ is faulty. Replace the GSC+, see the topic Generator Set Control + Replacement. STOP.
 - If sensor fault codes are NOT active, check the connectors and wiring. See the topic Electrical Connector Inspection. STOP.
- Not OK – The measurements DO NOT agree. The harness is defective. Troubleshoot and repair the engine harness. STOP.

Step 5. Check Engine Harness.

- a. Disconnect the engine harness from the sensor.
- b. Disconnect the GSC+ from the harness.
- c. Check the harness for an open circuit. A correct circuit will be 5 ohms or less.
- d. Check the signal wire for a short to battery positive, battery negative and sensor supply. A correct circuit will be greater than 5k ohms.

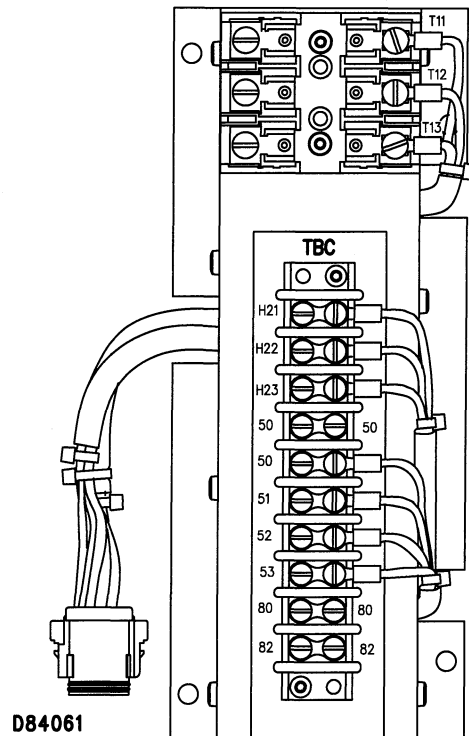
Expected Result:

For Step c, the resistance should be 5 ohms or less.
For Step d, the resistance should be greater than 5k ohms

Results:

- OK – All resistance measurements are correct. Therefore, replace the sensor. STOP.
- Not OK – One or more resistance measurements are NOT correct. Troubleshoot and repair the engine harness. STOP.

AC Transformer Box + (ATB+) Replacement



AC Transformer Box + (ATB+)

The ATB+ is located on the sub-panel within the control panel.

Replacement Procedure

1. Shutdown the engine. Remove the positive lead wire from the battery.
2. Make sure that all wires at the terminal strip of the ATB+ are marked with the respective termination point. During reassembly these wires must be reattached to the correct terminal. Remove all external wires from the terminal strip.
3. Disconnect the ATB+ connector from the harness connector.
4. Remove all mounting nuts/screws that fasten the ATB+ to the sub-panel. Remove the ATB+.
5. Place the new ATB+ in the sub-panel. Install and tighten the mounting nuts/screws.

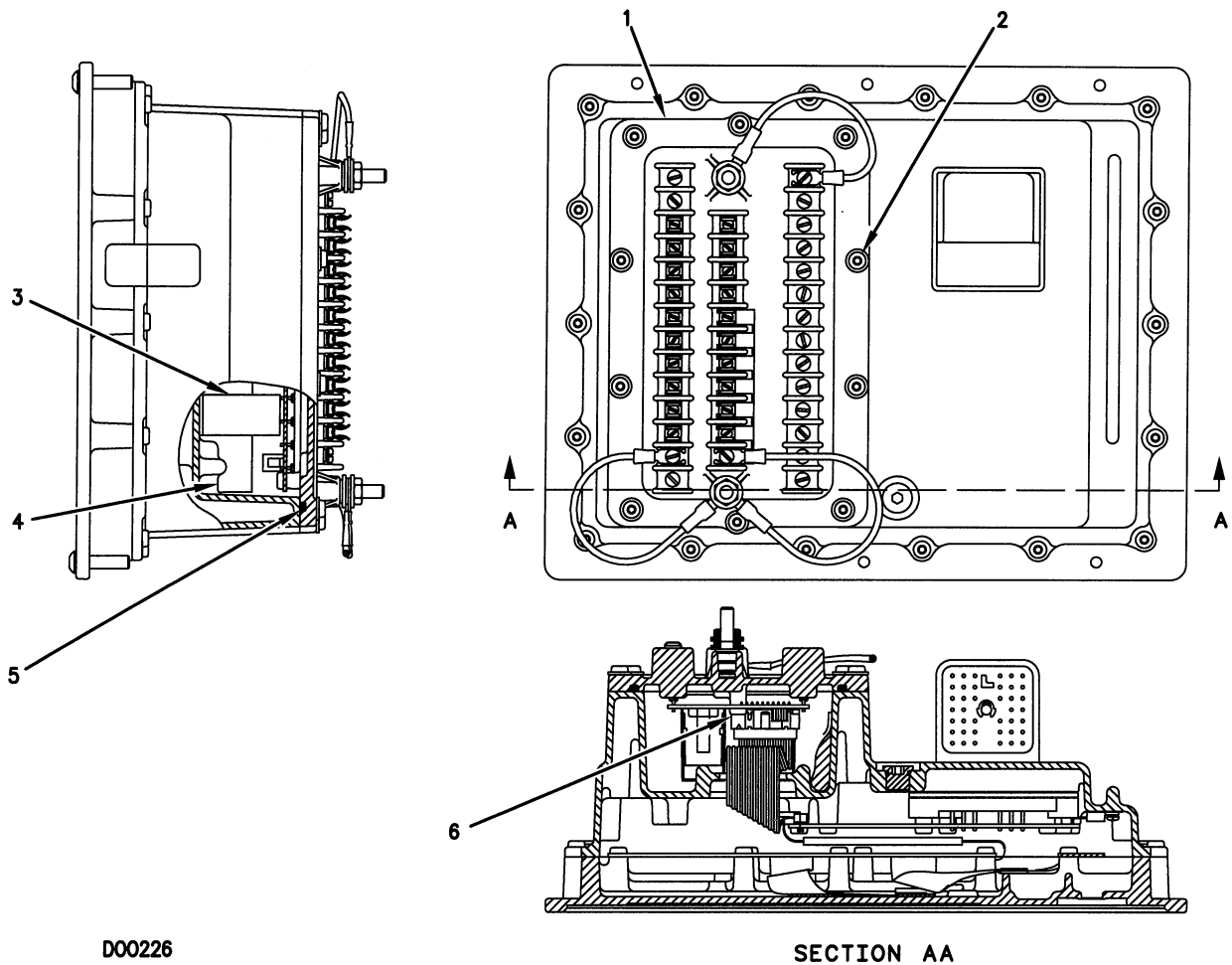
6. Reconnect the harness connector to the ATB+. Reconnect all the wires to the terminal strip that were removed. Reconnect the positive lead wire to the battery. If necessary, see the Main Chassis Wiring Diagram in the Schematics & Wiring Diagrams section.
7. Program the bar code (calibration value) for the voltmeter/ammeter into the GSC+. See the topic Voltmeter/Ammeter Programming OP8 in the Service Mode section.
8. If the genset is operating in parallel with another genset and the voltmeter values must match, then reprogram the AC offset. See the topic AC Offset Adjustment OP10 in the Service Mode section.

Generator Set Control + (GSC+) Replacement

Replacement Procedure

1. The new GSC+ must be reprogrammed after it is installed. If the GSC+ being replaced is functional, then make a note of the hourmeter value, all engine setpoints and any spare inputs/outputs that are programmed. See the topics Engine/Generator Setpoint Viewing OP2-0 and Protective Relaying Setpoint Viewing OP2-1 in the Service Mode section.
2. Shut down the engine. Remove the positive lead wire from the battery.
3. Remove the harness connector from the GSC+. A 4mm hex wrench is required to turn the fastening screw.
4. Make sure that all wires at the terminal strips 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 & Wiring Diagrams section.
8. Reprogram the setpoints, the spare inputs/outputs, the hourmeter, the voltmeter/ammeter and the AC offset adjustment. 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 136-9048 Control Panel Chart.

Relay Module Replacement



D00226

SECTION AA

Relay Module Replacement (Rear of GSC+)

(1) Relay Module. (2) Screws. (3) Tape. (4) Desiccant package. (5) O-ring seal. (6) Cable connector.

Relay module (1) contains the relays, fuses and terminals that are used to operate external devices of the EMCP II+ system. Relay module (1) is a component of the GSC+.

REFERENCE: Special Instruction, SEHS9710, Relay Module Replacement.

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).

On the pc board of the original relay module and the replacement relay module, check that the small jumper block (near the ribbon cable) is the same. See the topic AC Voltage Range Selection.

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). 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 & Wiring Diagrams section.

Schematics & Wiring Diagrams





















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Abbreviations

A	Ammeter	L	Load Leads
ACT	Actuator	LFB	Low Fuel Basin
ADS	Engine Combustion Air Damper Position Switch	LFL	Low Fuel Level Light
AFCR	AAuxiliary Fuel Control Relay	LFLAS	Low Fuel Level Alarm Switch
ALM	Alarm Module	LFS	Latching Fuel Control Solenoid
ALS	Alarm Silence Push Button	LOLAS	Low Oil Level Alarm Switch
ALT	Alternator	LSM	Load Share Module
AR	Arming Relay	LWLAS	Low Water Level Alarm Switch
ASOS	Air Shut-Off Solenoid	LWTL	Low Water Temperature Light
ASR	Air Shut-Off Relay	MAN	Manual
ASSV	Air Start Solenoid Valve	MPU	Magnetic Speed Pickup
ATB+	AC Transformer Box +	NC	Normally Closed
AUX	Auxiliary Terminal Strip	NO	Normally Open
AUXREL	Auxiliary Relay (Crank Termination)	OSR	Oil Step Relay
AWG	American Wire-Gage	PEEC	Programmable Electronic Engine Control
BATT	Battery	PL	Panel Illumination Light
BCF	Battery Charger Failure Switch	PLS	Panel Light Switch
C	Common	POS	Positive
CAM	Custom Alarm Module	POT	Potentiometer
CAR	Custom Alarm Relay	PP	Prelube Pump
CB	Circuit Breaker	PPMS	Prelube Pump Magnetic Switch
CCM	Customer Communication Module	PPPS	Prelube Pump Oil Pressure Switch
CIM	Customer Interface Module	PS	Pinion Solenoid
CT	Current Transformer	PWM	Analog To PWM Converter
CTR	Crank Termination Relay	RAN	Remote Annunciator
D	Diode	RDM	Relay Driver Module
DCV	DC Voltmeter	RR	Run Relay
ECLC	EMCP Coolant Loss Sensor Connector	SASV	Start Aid Solenoid Valve
ECLS	EMCP Coolant Loss Sensor	SATS	Start Aid Temperature Switch
ECS	Engine Control Switch	SAS	Start Aid Switch
ECTS	EMCP Coolant Temperature Sensor	SEC	Second
EFCR	Emergency Fuel Control Relay	SHTC	Circuit Breaker Shunt Trip Coil
EG	Electronic Governor (Speed Sensing)	SL	Synchronizing Light
EGA	Electronic Governor Actuator	SLM	Synchronizing Light Module
EGR	Electronic Governor Relay	SLR	Synchronizing Light Resistor
ENFR	Engine Failure Relay	SM	Starting Motor
EOCC	EMCP Oil Coolant Sensor Connector	SMMS	Starting Motor Magnetic Switch
EOPS	EMCP Oil Pressure Sensor	SMR	Starting Motor Relay
EOTC	EMCP Oil Temperature Sensor Connector	SP	Speed Adjust Potentiometer
EOTS	EMCP Oil Temperature Sensor	SPM	Synchronizing Parallel Module
ESPB	Emergency Stop Push Button	SR	Slave Relay
F	Fuse	SS	Synchronizing Switch
FCR	Fuel Control Relay	T	Generator Line Leads
FCTM	Fuel Control Timer Module	TD	Time Delay Relay
FRB	Fuel Rupture Basin	TSC	Transfer Switch Position Indicating Contact
FS	Fuel Solenoid	V	AC Voltmeter
FSOS	Fuel Shut-Off Solenoid	VAR	Voltage Adjust Rheostat
GFR	Genset Fault Relay	VR	Voltage Regulator
GOL	Generator On Load		
GOV	Governor		
GPHI	Ground Post - High Voltage		
GPLO	Ground Post - Low Voltage		
GS	Governor Switch		
GSC+	Generator Set Control +		
GSM	Governor Synchronizing Motor		
GSOV	Gas Shut-Off Valve		
HZ	Frequency Meter		
KWR	Kilowatt Level Relay		
IC	Remote Start/Stop Initiate Contact		

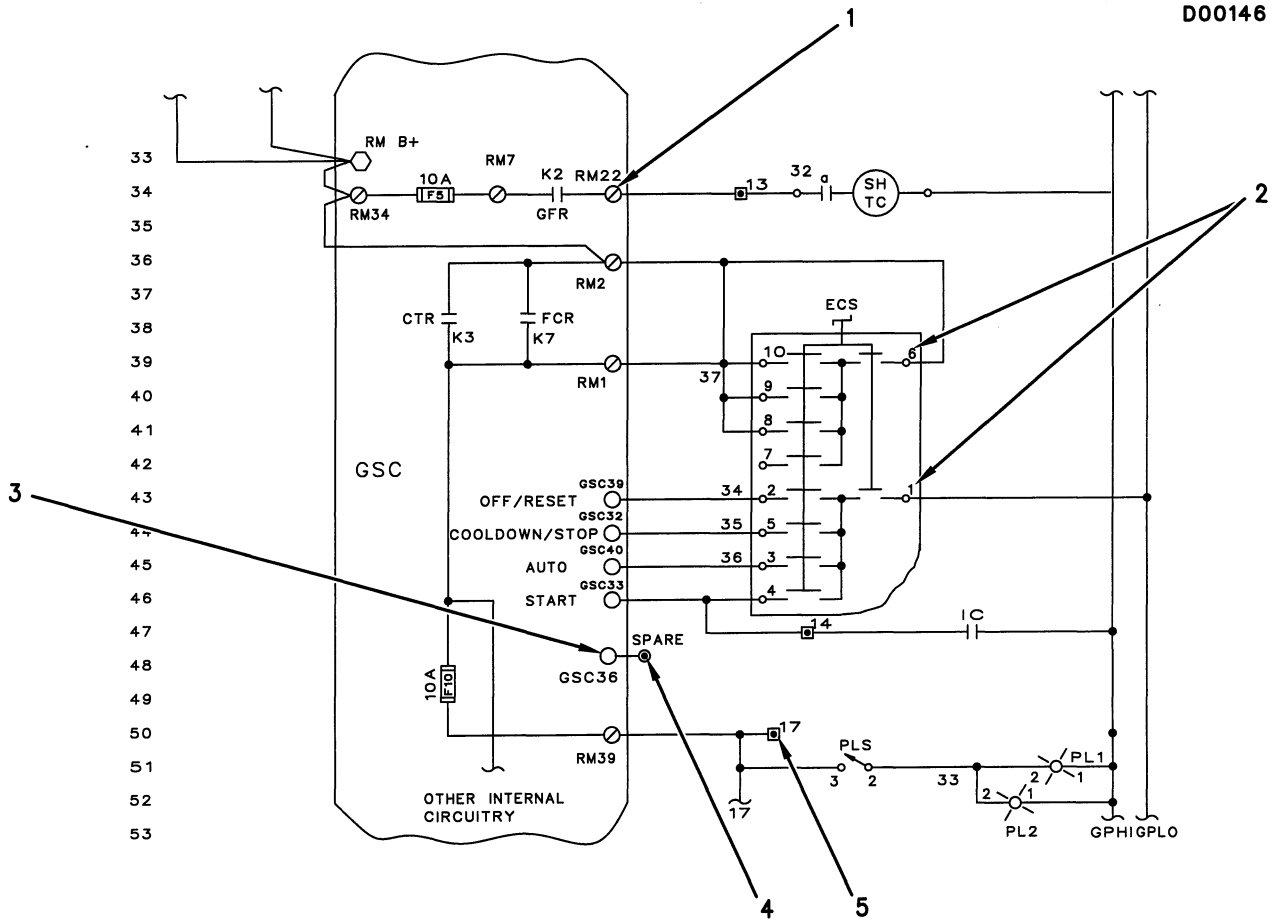
Symbols

	RELAY MODULE TERMINAL POINT		AUTOMATIC RESET
	GSC CONNECTOR CONTACT		NON-AUTO RESET
	ENGINE GENERATOR TERMINAL POINT		AUTOMATIC START-STOP MODE
	CONTROL PANEL TERMINAL POINT		SYSTEM NOT IN AUTOMATIC START-STOP MODE
	VOLTAGE REGULATOR TERMINAL POINT		CRANK
	STANDARD WIRING		ADJUSTABLE LOW-HI
	OPTIONAL WIRING		AC VOLTS
	CUSTOMER WIRING		LOW OIL PRESSURE
	ALTERNATIVE WIRING		OVERSPEED
	SHIELDED WIRE		EMERGENCY STOP
	ENGINE MOUNTED COMPONENT		FAIL TO START (OVER CRANK)
	TIMED CLOSED CONTACT		LOW FUEL LEVEL
	TIMED OPENED CONTACT		LOW COOLANT TEMPERATURE
	TIMED CLOSED TIMED OPENED CONTACT		HIGH COOLANT TEMPERATURE
	RELAY CONTACT (NORMALLY OPEN)		STARTING AID-ETHER
	RELAY CONTACT (NORMALLY OPEN)		HORN
	RELAY CONTACT (NORMALLY CLOSED)		HORN SILENCE/ACKNOWLEDGE SWITCH
	RELAY CONTACT (NORMALLY CLOSED)		RAISE
	GENERATOR FRAME (CHASSIS) GROUND		LOWER
	EARTH GROUND		ON
	PRESSURE SWITCH		OFF
	PRESSURE SWITCH		LIQUID LEVEL SWITCH
	TEMPERATURE SWITCH		LAMP
	TEMPERATURE SWITCH		LAMP
			PANEL ILLUMINATION LIGHT
			ENGINE INTAKE AIR DAMPER CLOSED
			SYSTEM BATTERY VOLTAGE
			SERVICE HOURS
			ENGINE-STOP
			ENGINE RPM
			LAMP/DISPLAY TEST
			GENERATOR SYNCHRONIZING INDICATOR
			AMMETER VOLTMETER PHASE SELECTOR SWITCH
			REVERSE POWER
			BATTERY CHARGER MALFUNCTION
	MANUALLY OPERATED CONTROL		
	OPERATED BY TURNING		
	SPEED SWITCH CONTACT		
	SPEED SWITCH CONTACT		
	BREAKDOWN DIODE BIDIRECTIONAL		
	BREAKDOWN DIODE BIDIRECTIONAL		
	DIODE		
	DIODE		
	FUSE		
	FUSE		
	EMERGENCY SWITCH		
	RELAY COIL		
	RELAY COIL		
	CIRCUIT BREAKER		
	CIRCUIT BREAKER		

D00090

How To Read Control Panel DC Schematics

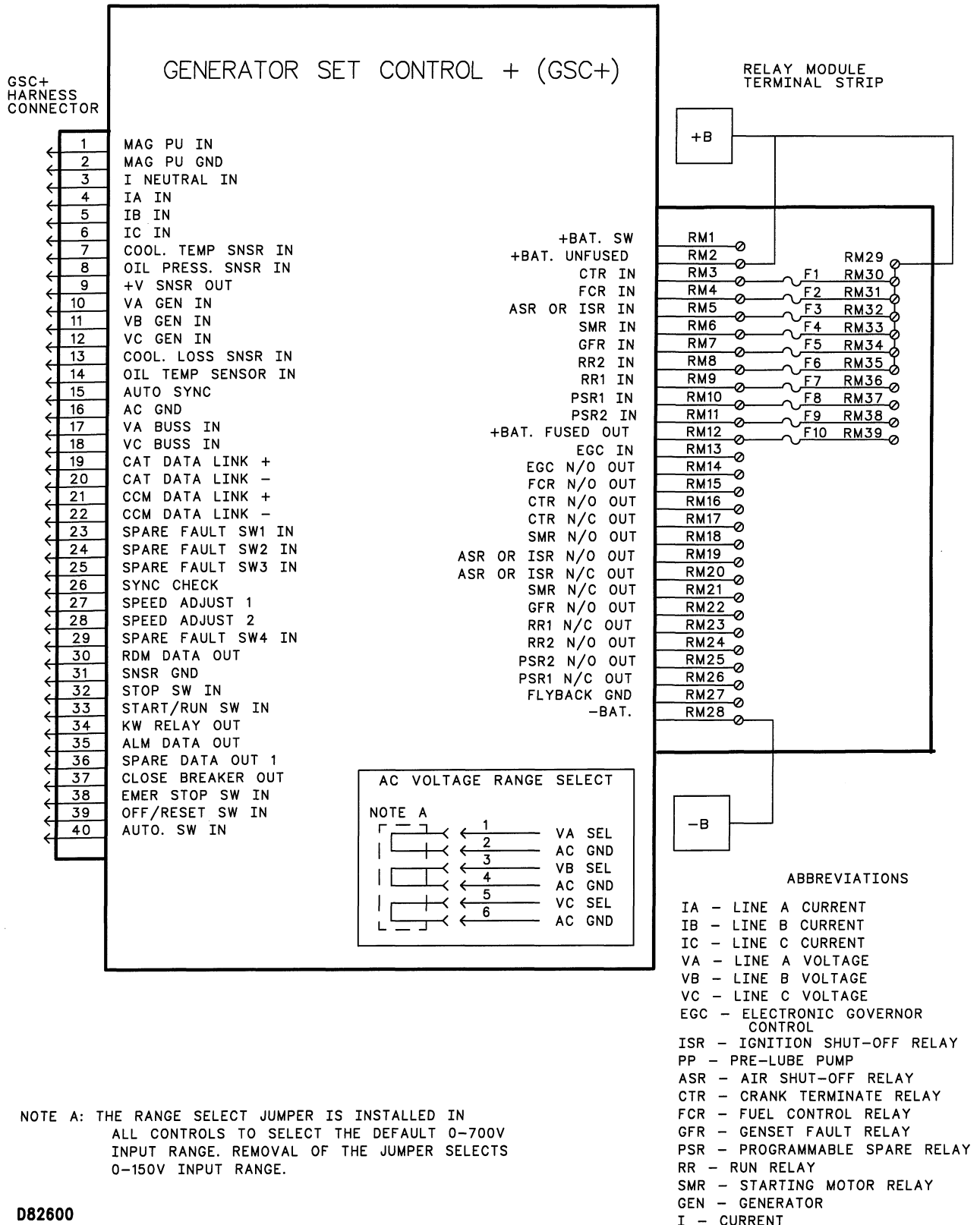
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Typical DC Schematic

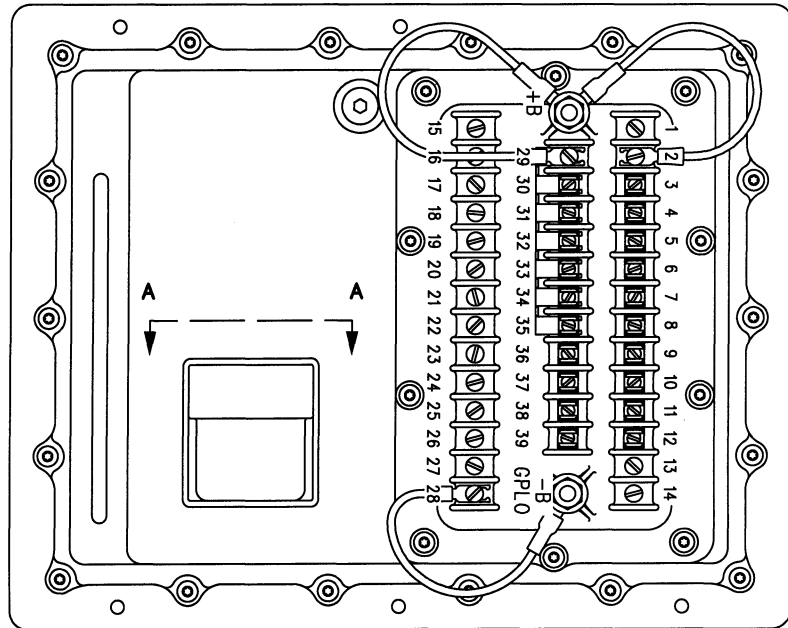
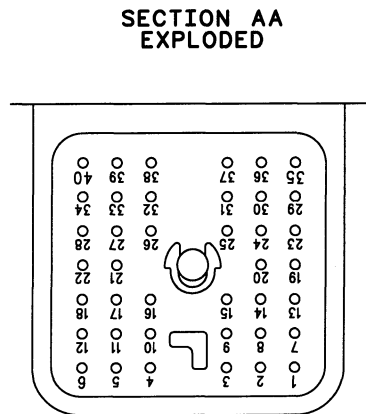
- (1) Symbol for terminal on relay module.
- (2) Pin identification on engine control switch.
- (3) Symbol for contact of GSC+ connector.
- (4) Symbol for terminal on terminal strip within control panel.
- (5) Symbol for terminal on terminal strip within generator.

Block Diagram - GSC+



D82600

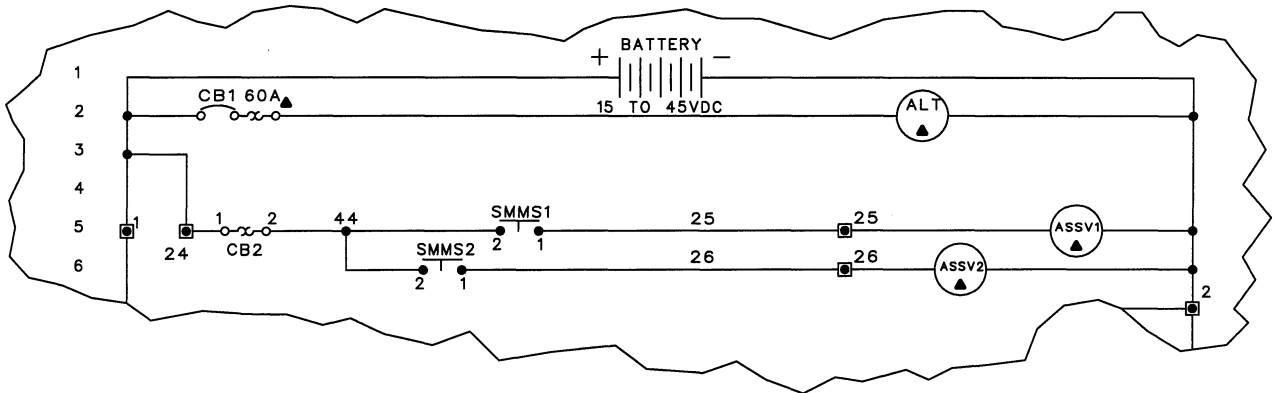
GSC+ Connector/Terminal Identification



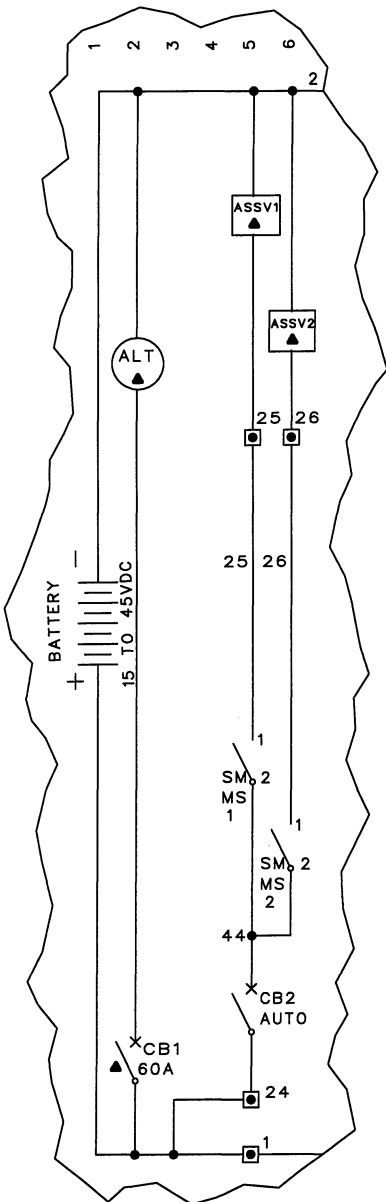
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Back Of GSC+
Top View As Mounted, With Instrument Door Open

DC Schematic – Air Start Option



PARTIAL SCHEMATIC
(JIC SYMBOLS)
NOTE A

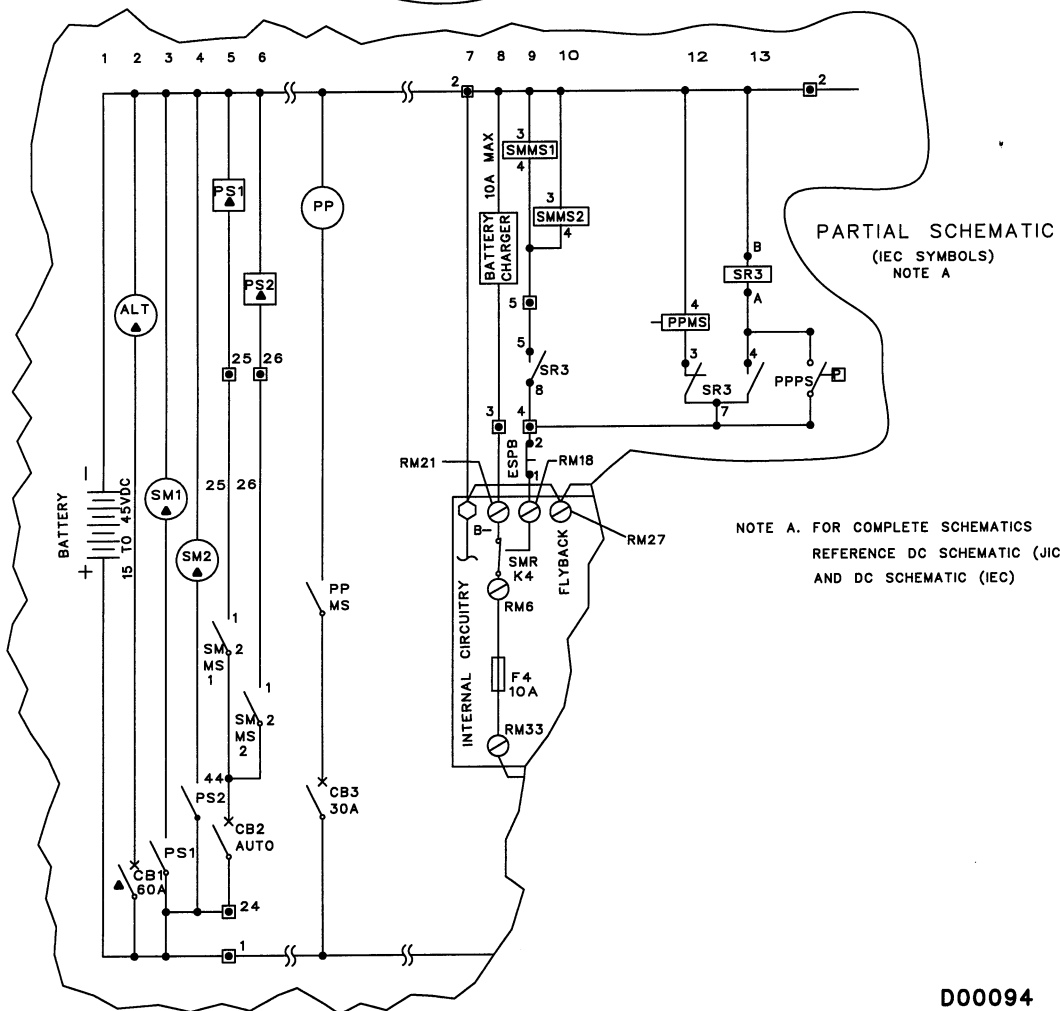
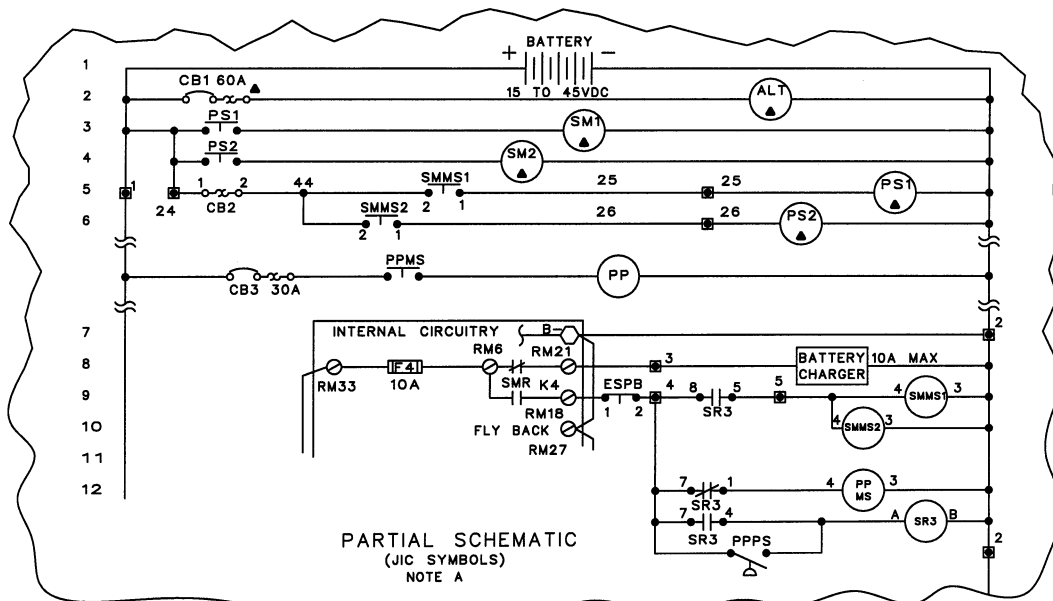


PARTIAL SCHEMATIC
(IEC SYMBOLS)
NOTE A

NOTE A. FOR COMPLETE SCHEMATICS
REFERENCE DC SCHEMATIC (JIC)
AND DC SCHEMATIC (IEC)

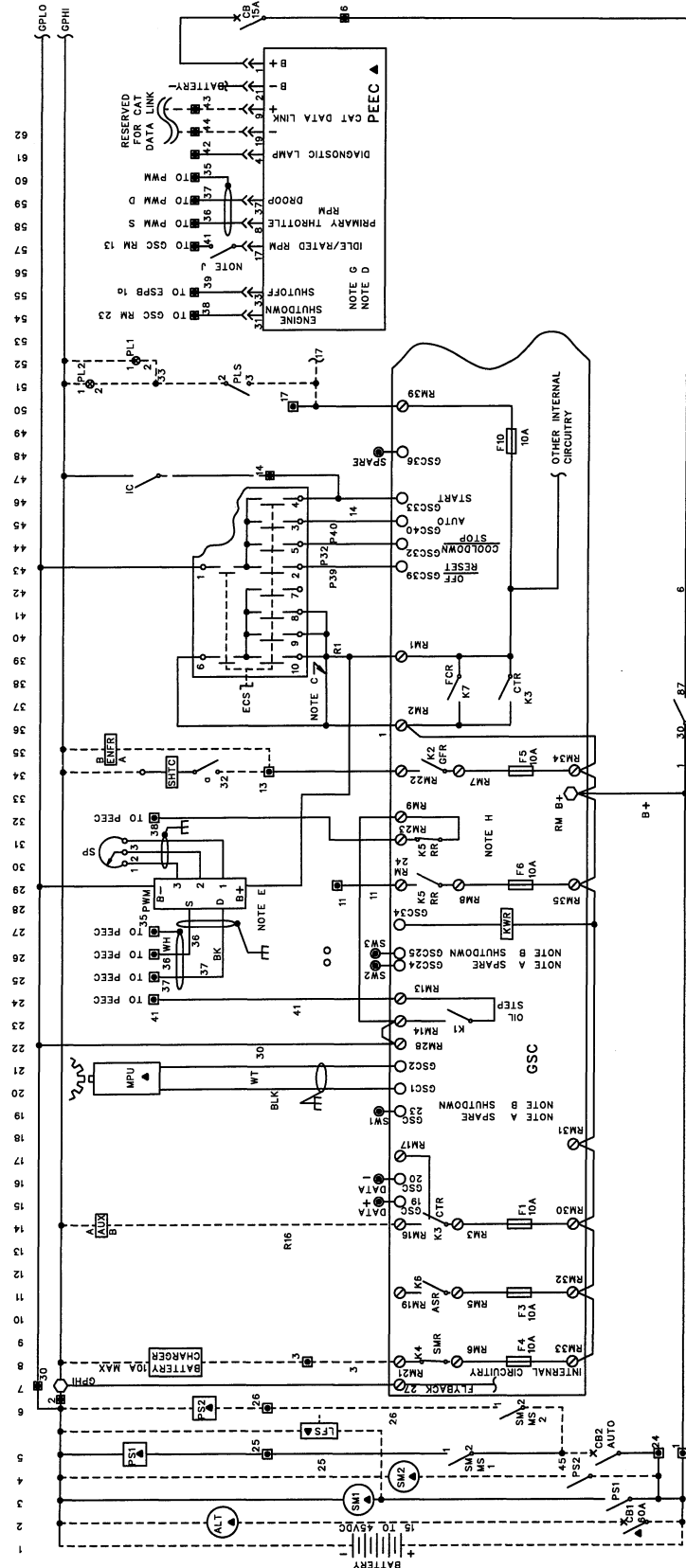
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DC Schematic – Prelube Pump Option



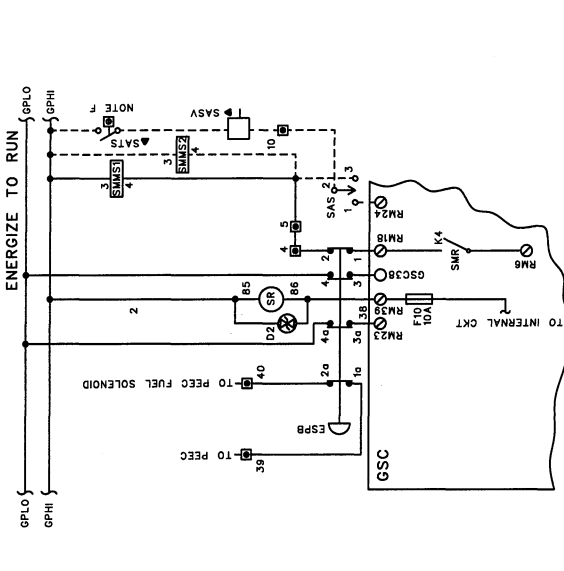
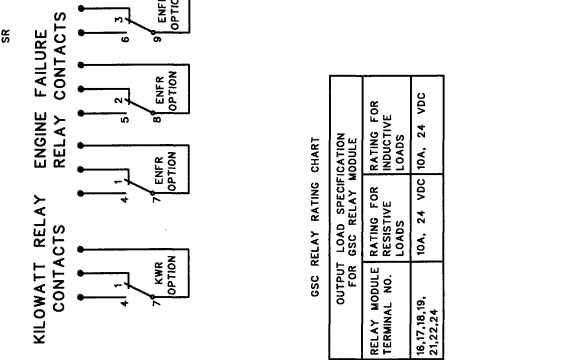
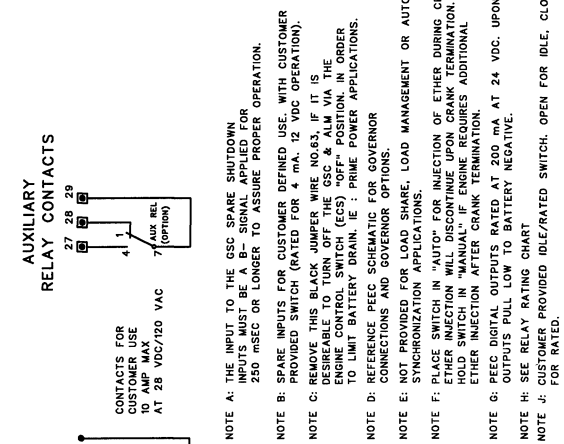
D00094

DC Schematic - IEC (one of two)



ECS CHART

CONTACTS	OFF/RESET	AUTO	MANUAL	STOP	START	LINE NO.
1	X	X	X	X	X	1
2	X	X	X	X	X	2
3	X	X	X	X	X	3
4	X	X	X	X	X	4
5	X	X	X	X	X	5
6	X	X	X	X	X	6
7	X	X	X	X	X	7
8	X	X	X	X	X	8
9	X	X	X	X	X	9
10	X	X	X	X	X	10
11	X	X	X	X	X	11
12	X	X	X	X	X	12
13	X	X	X	X	X	13
14	X	X	X	X	X	14
15	X	X	X	X	X	15
16	X	X	X	X	X	16
17	X	X	X	X	X	17
18	X	X	X	X	X	18
19	X	X	X	X	X	19
20	X	X	X	X	X	20
21	X	X	X	X	X	21
22	X	X	X	X	X	22
23	X	X	X	X	X	23
24	X	X	X	X	X	24
25	X	X	X	X	X	25
26	X	X	X	X	X	26
27	X	X	X	X	X	27
28	X	X	X	X	X	28
29	X	X	X	X	X	29
30	X	X	X	X	X	30
31	X	X	X	X	X	31
32	X	X	X	X	X	32
33	X	X	X	X	X	33
34	X	X	X	X	X	34
35	X	X	X	X	X	35
36	X	X	X	X	X	36
37	X	X	X	X	X	37
38	X	X	X	X	X	38
39	X	X	X	X	X	39
40	X	X	X	X	X	40
41	X	X	X	X	X	41



NOTE A: THE INPUT TO THE GSC SPARE SHUTDOWN MUST BE A B- SIGNAL APPLIED FOR 250 msec OR LONGER TO ASSURE PROPER OPERATION.

NOTE B: SPARE INPUTS FOR CUSTOMER DEFINED USE. WITH CUSTOMER PROVIDED SWITCH (RATED FOR 4 ma, 12 VDC OPERATION).

NOTE C: REMOVE THIS BLACK JUMPER WIRE NO.63, IF IT IS DESIREABLE TO TURN OFF THE GSC & ALM VIA THE ENGINE CONTROL SWITCH (ECS) "OFF" POSITION. IN ORDER TO LIMIT BATTERY DRAIN, IE: PRIME POWER APPLICATIONS.

NOTE D: REFERENCE PEEC SCHEMATIC FOR GOVERNOR CONNECTIONS AND GOVERNOR OPTIONS.

NOTE E: NOT PROVIDED FOR LOAD SHARE, LOAD MANAGEMENT OR AUTOMATIC SYNCHRONIZATION APPLICATIONS.

NOTE F: PLACE SWITCH IN "AUTO" FOR INJECTION OF EITHER DURING CRANKING. OPERATION WILL DISCONTINUE UPON CRANK TERMINATION. HOLD SWITCH IN "MANUAL" POSITION FOR ADDITIONAL EITHER INJECTION AFTER CRANK TERMINATION.

NOTE G: PEEC DIGITAL OUTPUTS RATED AT 200 mA AT 24 VDC. UPON ENERGIZATION OUTPUTS PULL LOW TO BATTERY NEGATIVE.

NOTE H: SEE RELAY RATING CHART.

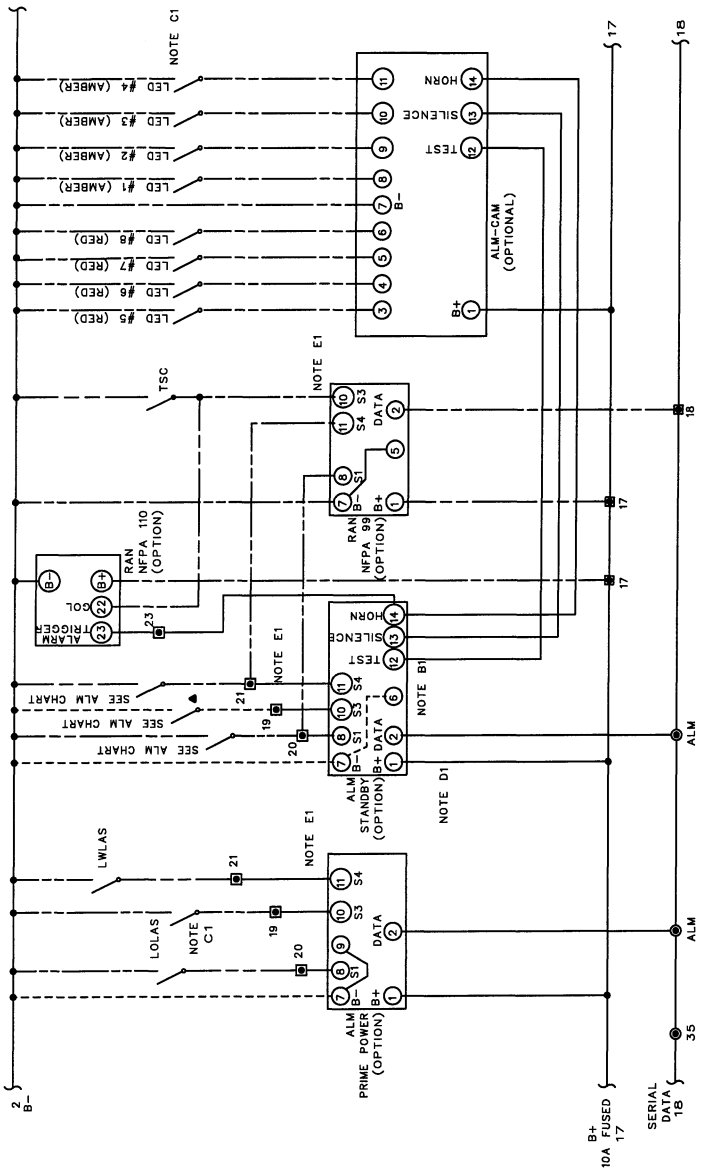
NOTE J: CUSTOMER PROVIDED IDLE/RATED SWITCH. OPEN FOR IDLE, CLOSED FOR RATED.

GSC RELAY RATING CHART

OUTPUT LOAD SPECIFICATION FOR GSC RELAY MODULE	RELAY MODULE RATING FOR RESISTIVE LOADS	RELAY MODULE RATING FOR INDUCTIVE LOADS
TERMINAL NO.	16,17,18,19, 21,22,24	10A, 24 VDC 10A, 24 VDC

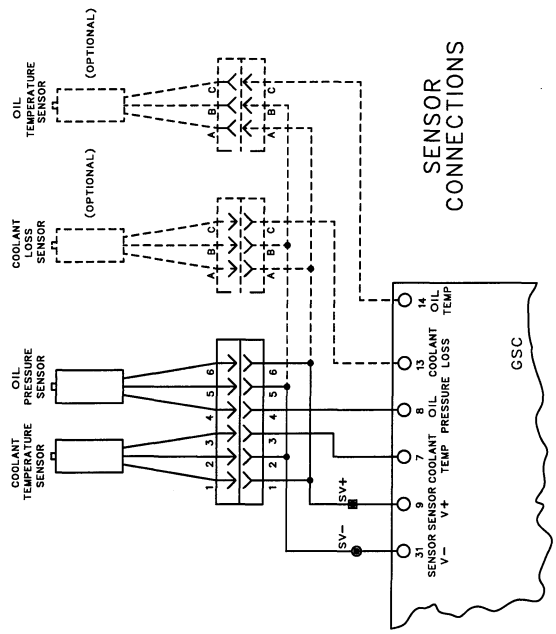
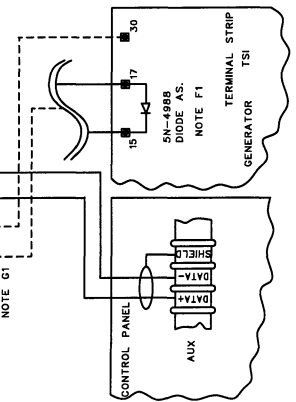
D85269

DC Schematic – IEC (two of two)



D82603

CUSTOMER COMMUNICATION MODULE CONNECTIONS



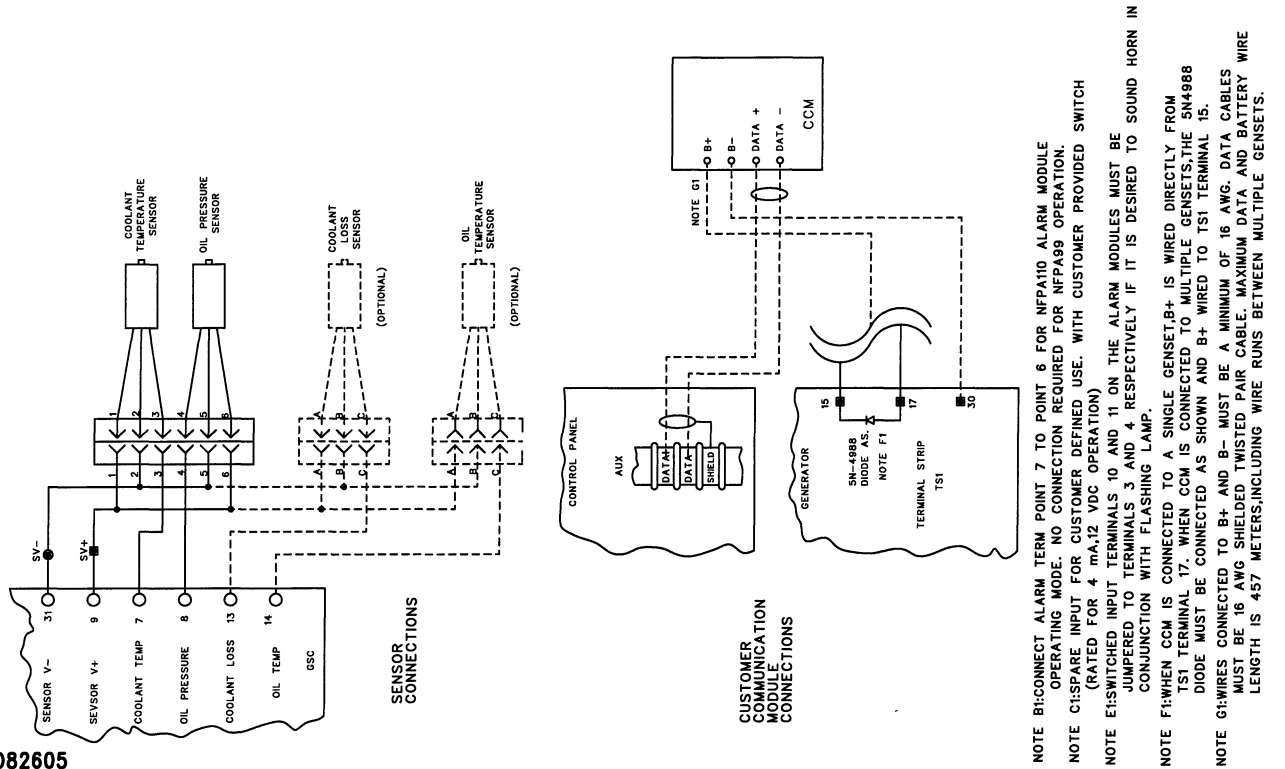
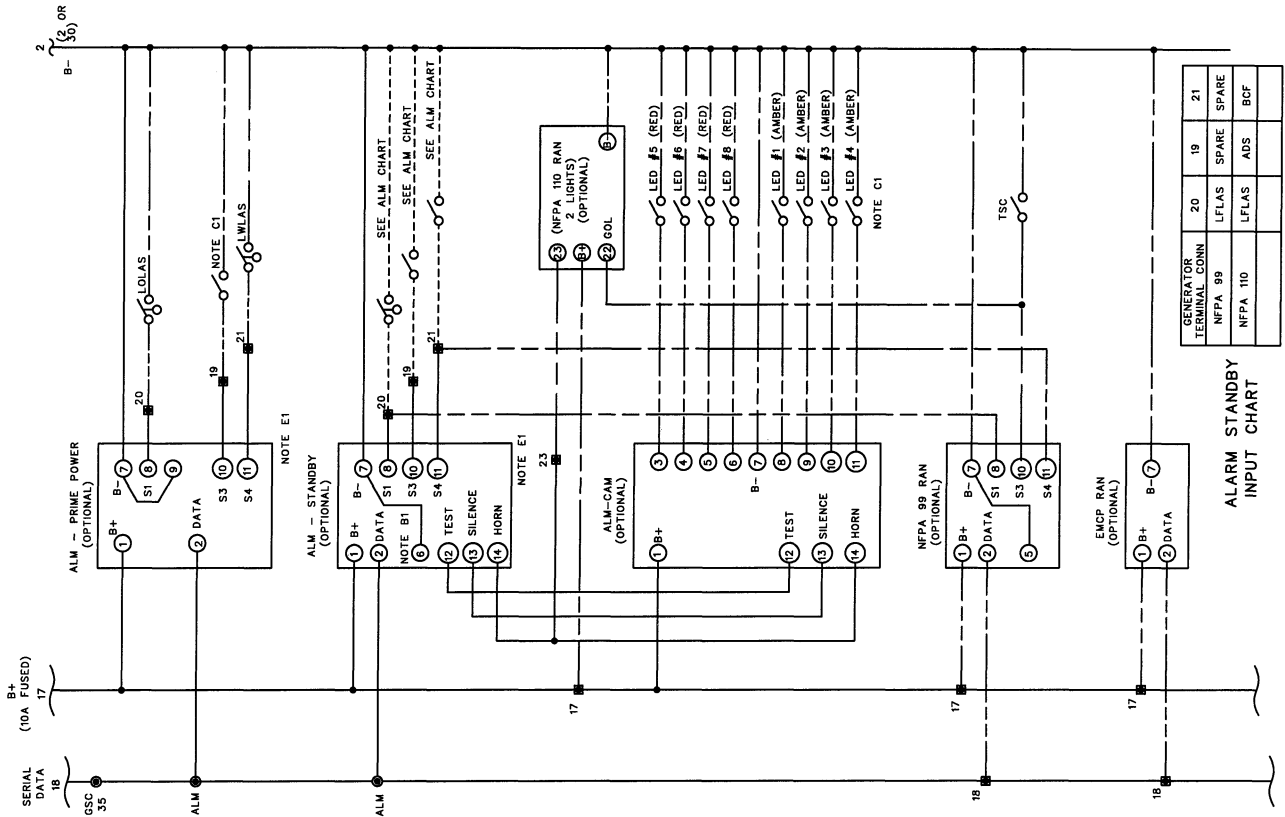
SENSOR CONNECTIONS

ALARM STANDBY INPUT CHART

GENERATOR TERMINAL CONN.	20	19	21
NFPA 99	LFLAS	SPARE	SPARE
NFPA 110	LFLAS	ADS	BCF

- NOTE B: CONNECT ALARM TERM POINT 7 TO POINT 6 FOR NFPA110 ALARM MODULE OPERATING MODE. NO CONNECTION REQUIRED FOR NFPA99 OPERATION.
- NOTE C: SPARE INPUT FOR CUSTOMER DEFINED USE. WITH CUSTOMER PROVIDED SWITCH (RATED FOR 4 mA, 12 VDC OPERATION)
- NOTE D: UP TO 3 ALARM MODULES WITH A COMBINED WIRE LENGTH OF 300 METERS MAY BE DRIVEN FROM THE DATA LINK. WIRE NO. 2 AND WIRE NO. 17 TO BE MINIMUM WIRE SIZE 12 AWG. ALL OTHER WIRES TO BE MINIMUM 16 AWG.
- NOTE E: SWITCHED INPUT TERMINALS 10 AND 11 ON THE ALARM MODULES MUST BE JUMPED TO TERMINALS 3 AND 4 RESPECTIVELY IF IT IS DESIRED TO SOUND HORN IN CONJUNCTION WITH FLASHING LAMP.
- NOTE F: WHEN CCM IS CONNECTED TO A SINGLE GENSET, B+ IS WIRED DIRECTLY FROM TS1 TERMINAL 17. WHEN CCM IS CONNECTED TO MULTIPLE GENSETS, THE 5N4988 DIODE MUST BE CONNECTED AS SHOWN AND B+ WIRED TO TS1 TERMINAL 15.
- NOTE G: WIRES CONNECTED TO B+ AND B- MUST BE A MINIMUM OF 16 AWG. DATA CABLES MUST BE 16 AWG SHIELDED TWISTED PAIR CABLE. MAXIMUM DATA AND BATTERY WIRE LENGTH IS 457 METERS, INCLUDING WIRE RUNS BETWEEN MULTIPLE GENSETS.

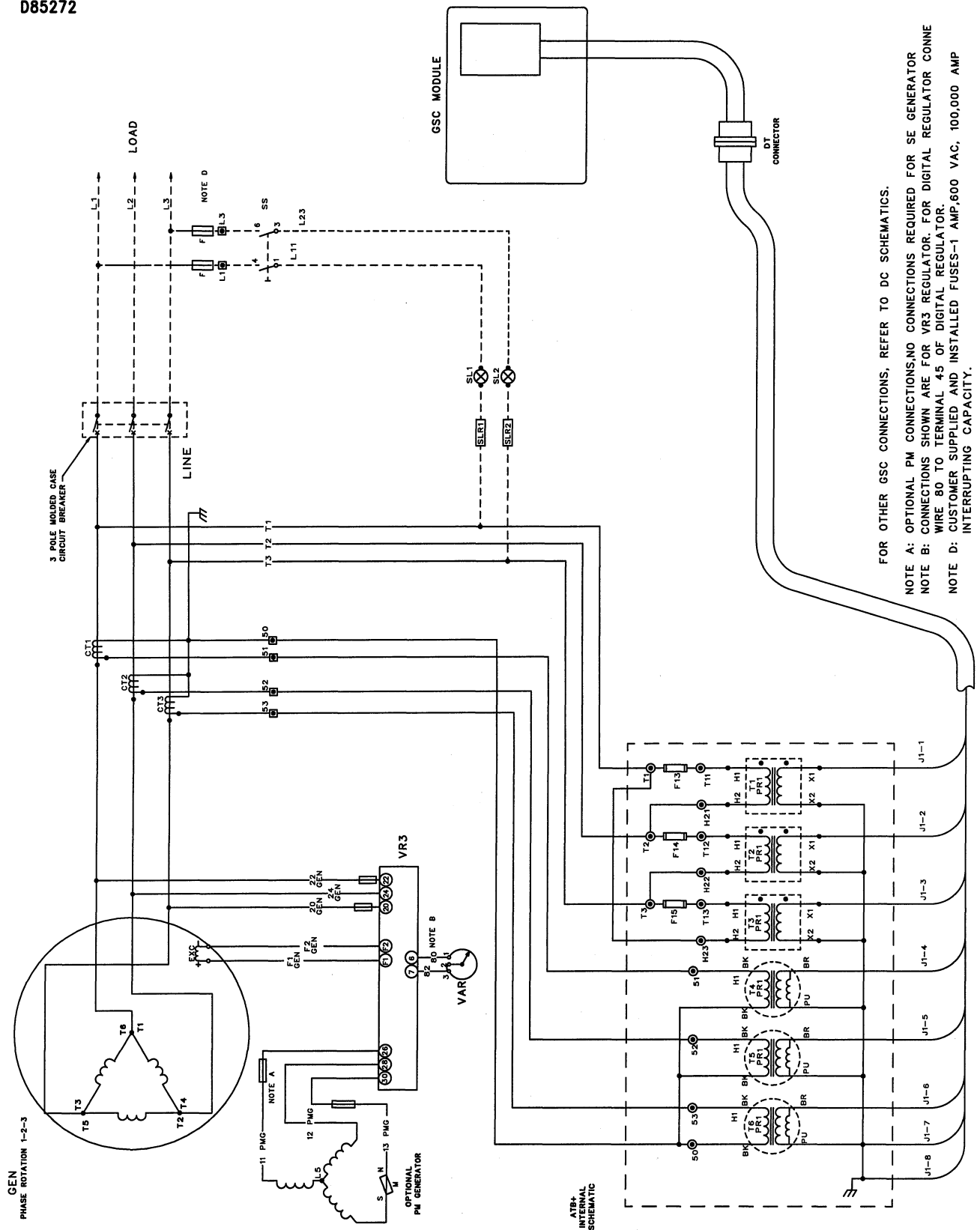
DC Schematic - JIC (two of two)



D82605

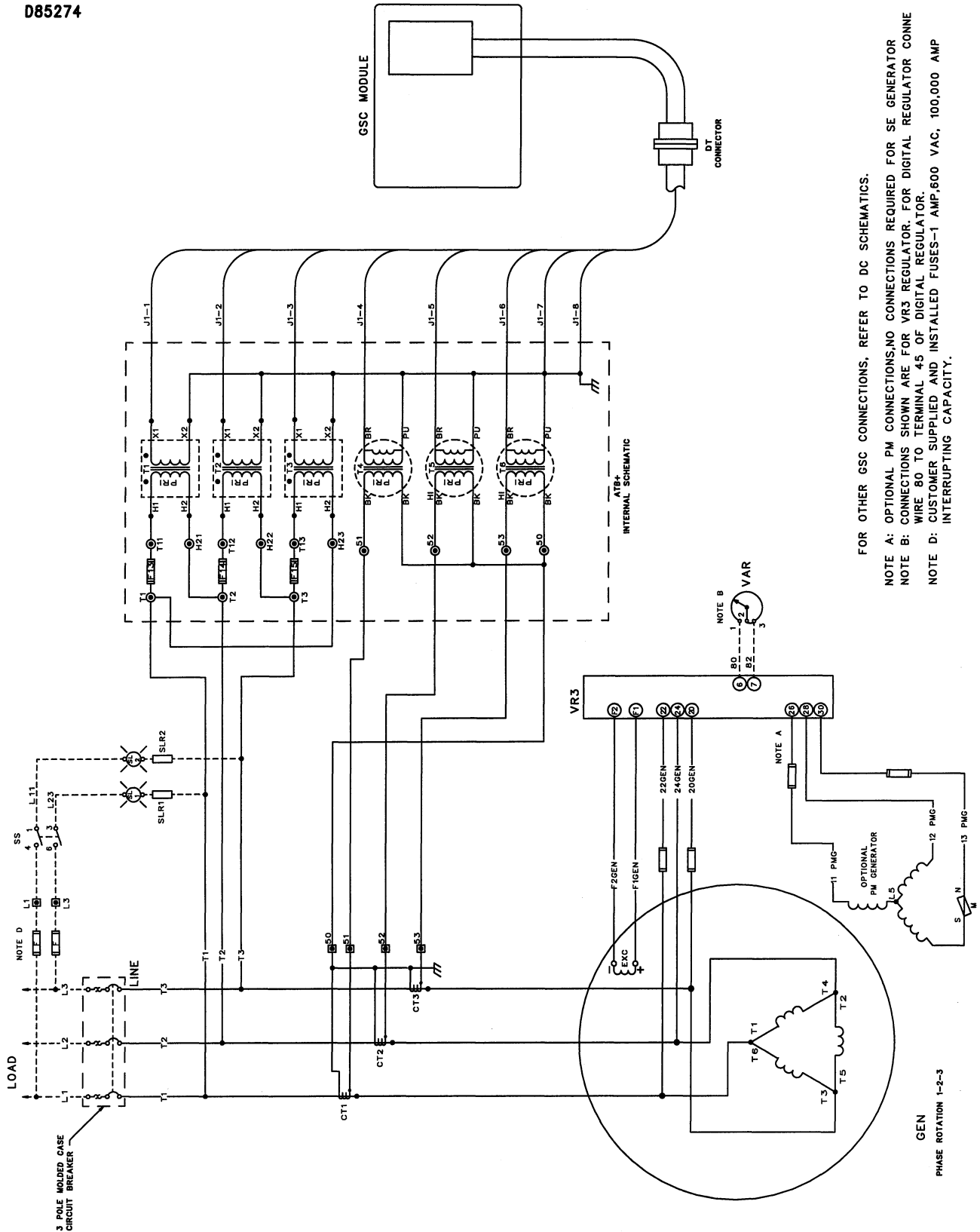
AC Schematic Delta - IEC

D85272



AC Schematic Delta - JIC

D85274



FOR OTHER GSC CONNECTIONS, REFER TO DC SCHEMATICS.

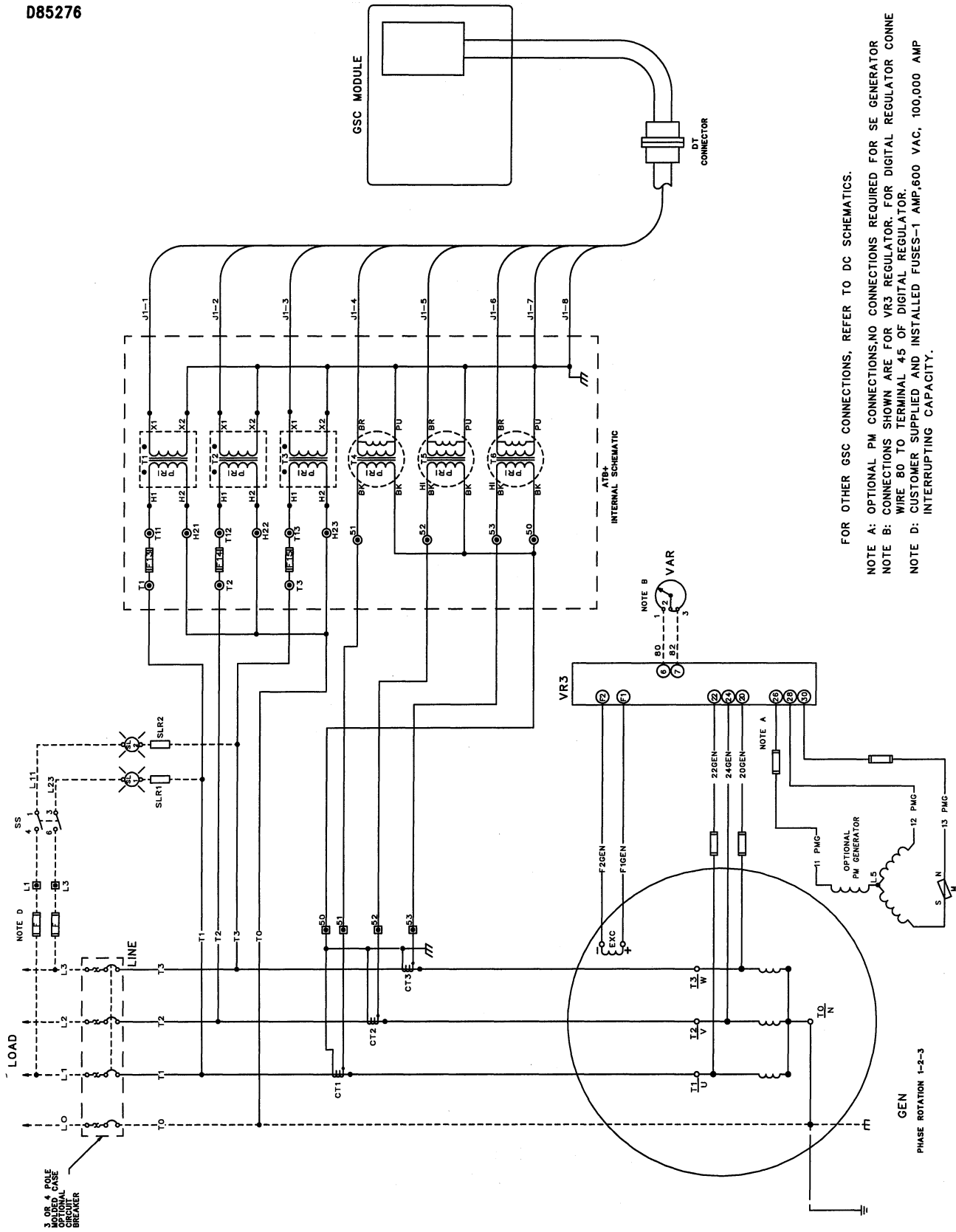
NOTE A: OPTIONAL PM CONNECTIONS, NO CONNECTIONS REQUIRED FOR SE GENERATOR.

NOTE B: CONNECTIONS SHOWN ARE FOR VR3 REGULATOR. FOR DIGITAL REGULATOR CONNE WIRE 80 TO TERMINAL 45 OF DIGITAL REGULATOR.

NOTE D: CUSTOMER SUPPLIED AND INSTALLED FUSES-1 AMP, 600 VAC, 100,000 AMP INTERRUPTING CAPACITY.

AC Schematic Wye - JIC

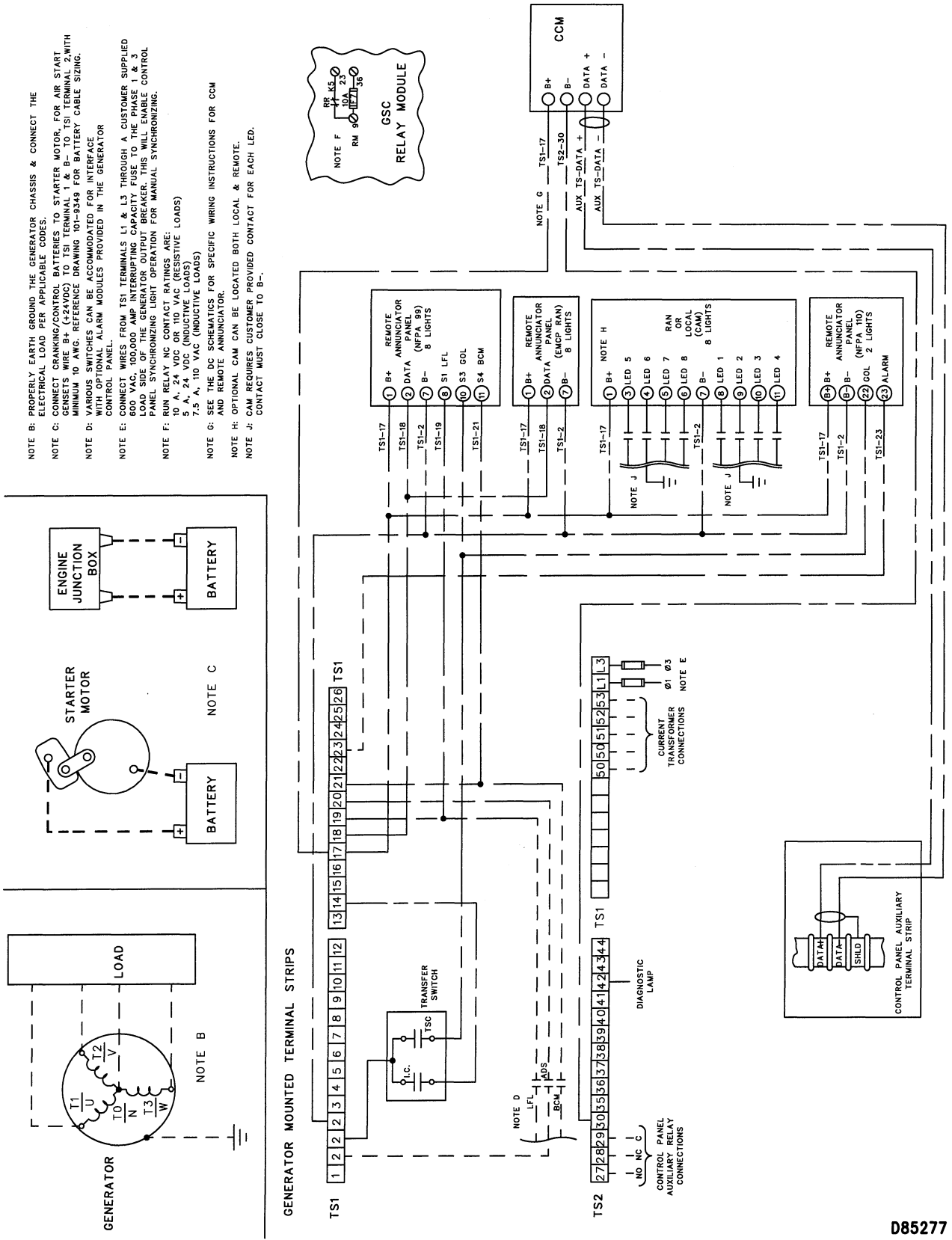
D85276



FOR OTHER GSC CONNECTIONS, REFER TO DC SCHEMATICS.

NOTE A: OPTIONAL PM CONNECTIONS, NO CONNECTIONS REQUIRED FOR SE GENERATOR
 NOTE B: CONNECTIONS SHOWN ARE FOR VR3 REGULATOR. FOR DIGITAL REGULATOR CONNE
 WIRE 80 TO TERMINAL 45 OF DIGITAL REGULATOR.
 NOTE D: CUSTOMER SUPPLIED AND INSTALLED FUSES-1 AMP, 600 VAC, 100,000 AMP
 INTERRUPTING CAPACITY.

Wiring Diagram - Customer/Contractor



NOTE B: PROPERLY EARTH GROUND THE GENERATOR CHASSIS & CONNECT THE ELECTRICAL LOAD PER APPLICABLE CODES.

NOTE C: CONNECT CRANKING/CONTROL BATTERIES TO STARTER MOTOR. FOR AIR START GENSETS WIRE B+ (+24VDC) TO TSI TERMINAL 1 & B- TO TSI TERMINAL 2. WITH MINIMUM 10 AVG. REFERENCE DRAWING 101-9349 FOR BATTERY CABLE SIZING.

NOTE D: VARIOUS SWITCHES CAN BE ACCOMMODATED FOR INTERFACE WITH THE CONTROL PANEL ALARM MODULES PROVIDED IN THE GENERATOR.

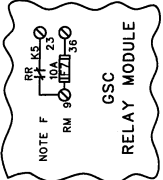
NOTE E: CONNECT WIRES FROM TSI TERMINALS 11, & 13 THROUGH A CUSTOMER SUPPLIED 600 VAC, 100,000 AMP INTERRUPTING CAPACITY FUSE TO THE PHASE CONTROL LOAD SIDE OF THE GENERATOR OUTPUT BREAKER. THIS WILL ENABLE CONTROL PANEL SYNCHRONIZING LIGHT OPERATION FOR MANUAL SYNCHRONIZING.

NOTE F: RUN RELAY NC CONTACT RATINGS ARE:
 10 A, 24 VDC OR 10 VAC (RESISTIVE LOADS)
 5 A, 24 VDC (INDUCTIVE LOADS)
 7.5 A, 110 VAC (INDUCTIVE LOADS)

NOTE G: SEE THE DC SCHEMATICS FOR SPECIFIC WIRING INSTRUCTIONS FOR CCM AND REMOTE ANNUNCIATOR.

NOTE H: OPTIONAL CAM CAN BE LOCATED BOTH LOCAL & REMOTE.

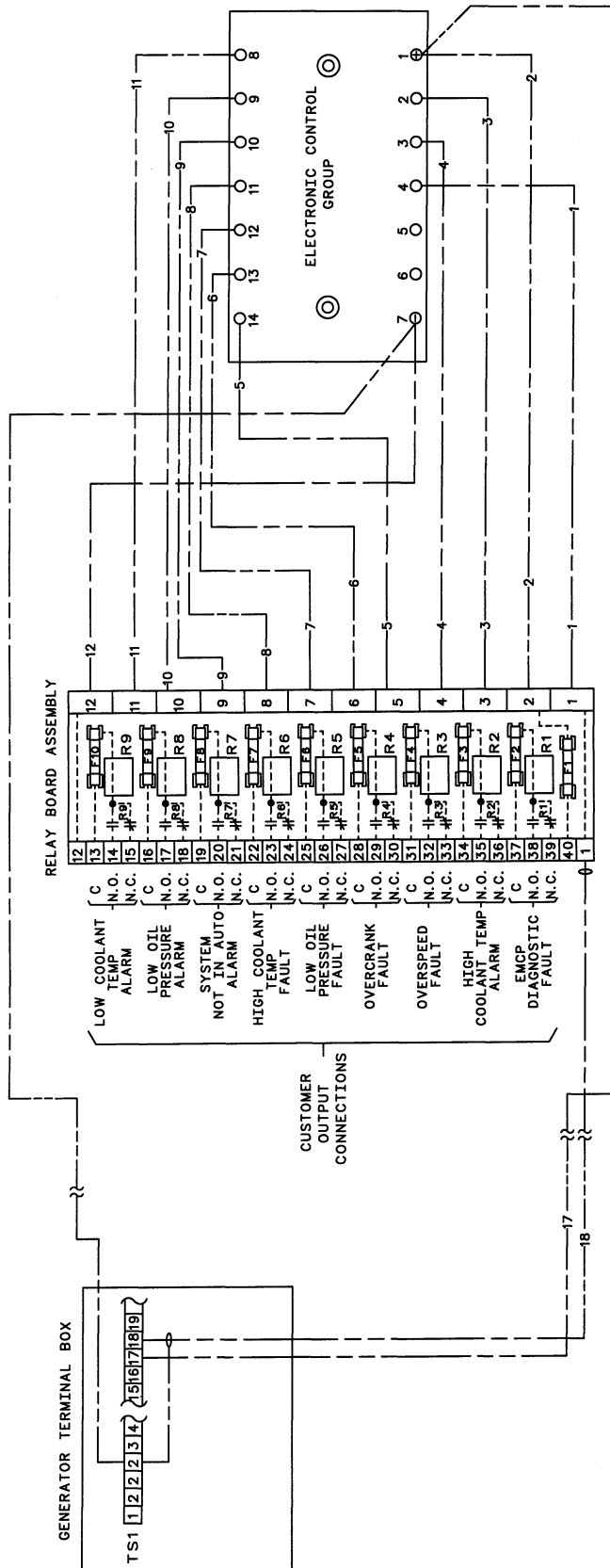
NOTE J: CAM REQUIRES CUSTOMER PROVIDED CONTACT FOR EACH LED.
 NOTE J: CONTACT MUST CLOSE TO B-.



D85277

Wiring Diagram - Customer Interface Module (CIM)

D23054



ABBREVIATIONS & SYMBOLS

- CUSTOMER WIRING
- (PARTIAL) INTERNAL WIRING
- ⊖ SHIELDED WIRING
- ||| NORMALLY OPEN CONTACT
- ||/|| NORMALLY CLOSED CONTACT
- C COMMON CONNECTION
- N.C. NORMALLY CLOSED CONTACT
- N.O. NORMALLY OPEN CONTACT
- R RELAY
- F FUSE

APPLICATION INFORMATION

1. MOUNTING: THE RELAY BOARD ASSEMBLY AND THE ELECTRONIC CONTROL GROUP SHALL BE MOUNTED ON A SOLID, NON-VIBRATING SURFACE. A VERTICAL MOUNTING SURFACE IS RECOMMENDED, TO PREVENT OBJECTS FROM FALLING ON THE TERMINALS.
2. ENVIRONMENT: THE RELAY BOARD & ELECTRONIC CONTROL GROUP MUST BE MOUNTED IN A CLEAN, DRY, VIBRATION FREE ENVIRONMENT; WHERE THE AMBIENT TEMPERATURE IS BETWEEN -30 TO +85 C (-22 TO 149 F).
3. OPERATING VOLTAGE: 24 VOLTS DC, NOMINAL
4. RELAY CONTACTS: GOLD PLATED, RATED 1 AMP AT 24 VOLTS DC
5. FUSES: FUSES F1 THRU F10 ARE RATED 1 AMP, CATERPILLAR PART NO. 8K4644
6. DIAGNOSTICS: THIS SYSTEM IS EQUIPPED WITH A LOSS OF SERIAL DATA LINK DIAGNOSTICS. THE DIGITAL SERIAL DATA LINK SIGNAL IS COMMUNICATED FROM THE GENERATOR TERMINAL BOX TERMINAL STRIP T51 TO THE RELAY BOARD ASSEMBLY VIA WIRE #18. THE SIGNAL IS THEN CONNECTED FROM THE RELAY BOARD ASSEMBLY TO THE ELECTRONIC CONTROL GROUP VIA WIRE #19. THE ELECTRONIC CONTROL GROUP WILL RECEIVE THE SIGNAL IT WILL RESPOND BY TURNING ALL THE RELAYS ON & OFF EVERY TWO (2) SECONDS.
7. TEST MODE: THE RELAYS CAN BE ENERGIZED VIA THE SERIAL DATA LINK, BY ACTUATING THE LAMP TEST SWITCH ON THE EMCP. THIS FEATURE CAN BE DISABLED BY ADDING A JUMPER ON THE ELECTRONIC CONTROL GROUP BETWEEN TERMINALS 6 & 7.
8. WIRING: WIRING BETWEEN THE GENERATOR TERMINAL BOX TERMINAL STRIP T51 AND THE RELAY BOARD ASSEMBLY SHALL BE STRANDED CONDUCTOR TYPE WITH A MAXIMUM LENGTH OF 1000 FEET. WIRES #2 & 17 SHALL BE A MINIMUM SIZE OF 12 AWG. THE SERIAL DATA LINK WIRE #18 IS RECOMMENDED TO BE A SHIELDED TYPE, 18 AWG MINIMUM. IT IS RECOMMENDED THAT THE ROUTING OF THESE WIRES AVOID SOURCES OF ELECTRICAL NOISE (P-3: MOTORS, POWER CABLES, ETC.) WHERE POSSIBLE.
9. ELECTRONIC CONTROL GROUP TERMINAL DESCRIPTION

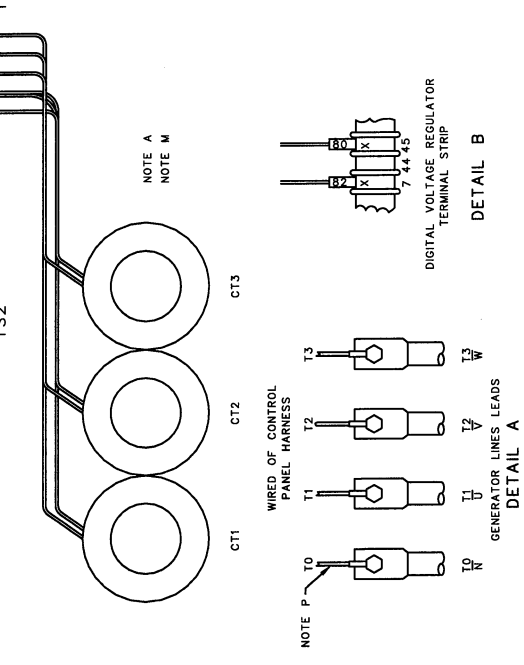
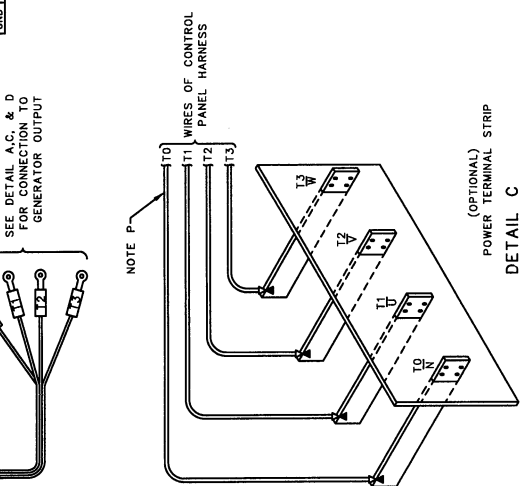
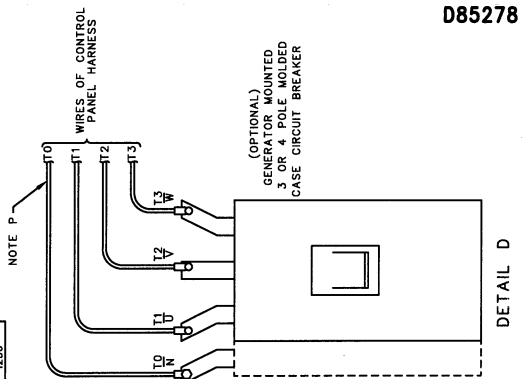
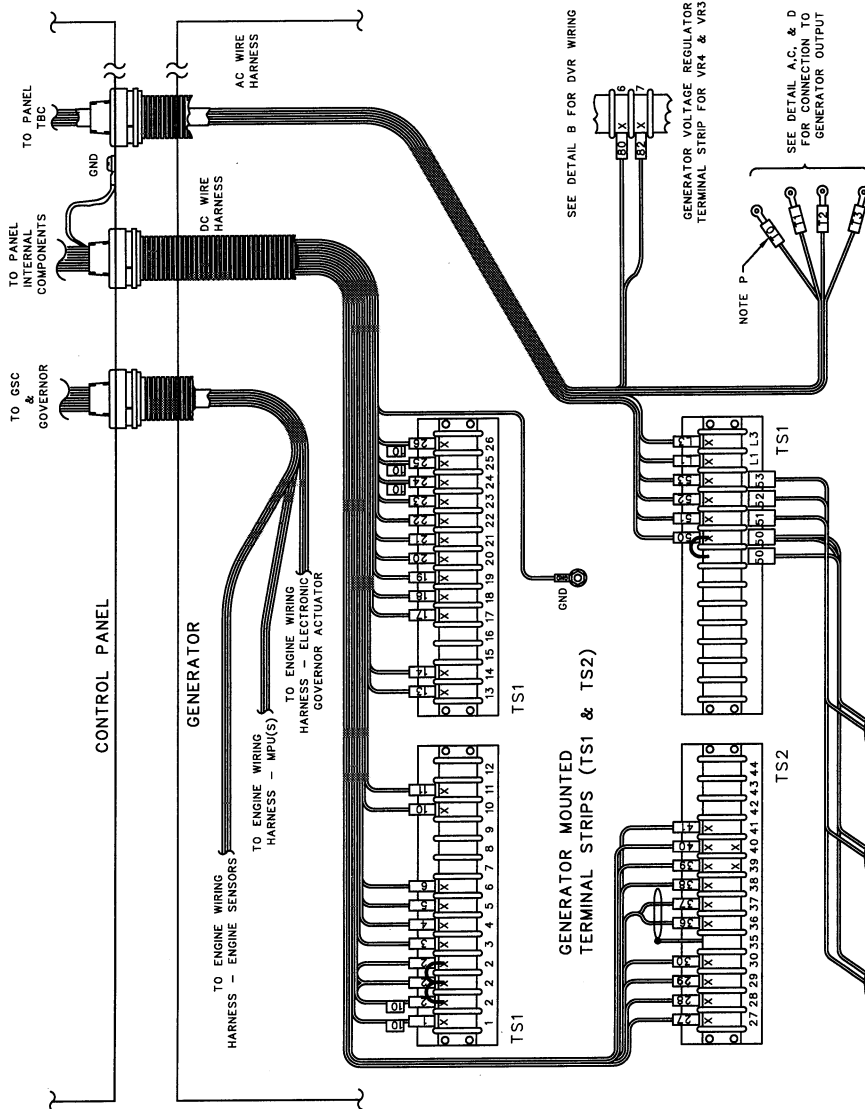
TERMINAL NO.	DESCRIPTION
1	+ BATTERY INPUT
2	EMCP DIAGNOSTIC FAULT OUTPUT
3	HIGH COOLANT TEMPERATURE ALARM OUTPUT
4	SERIAL DATA LINK SIGNAL INPUT
5	RELAY TEST
6	RELAY TEST VIA DATA LINK
7	- BATTERY INPUT
8	LOW COOLANT TEMPERATURE ALARM OUTPUT
9	LOW OIL PRESSURE ALARM OUTPUT
10	SYSTEM NOT IN AUTO ALARM OUTPUT
11	HIGH COOLANT TEMPERATURE FAULT OUTPUT
12	LOW OIL PRESSURE FAULT OUTPUT
13	OVERCRANK FAULT OUTPUT
14	ENGINE OVERSPEED FAULT OUTPUT

Wiring Diagram – Harness

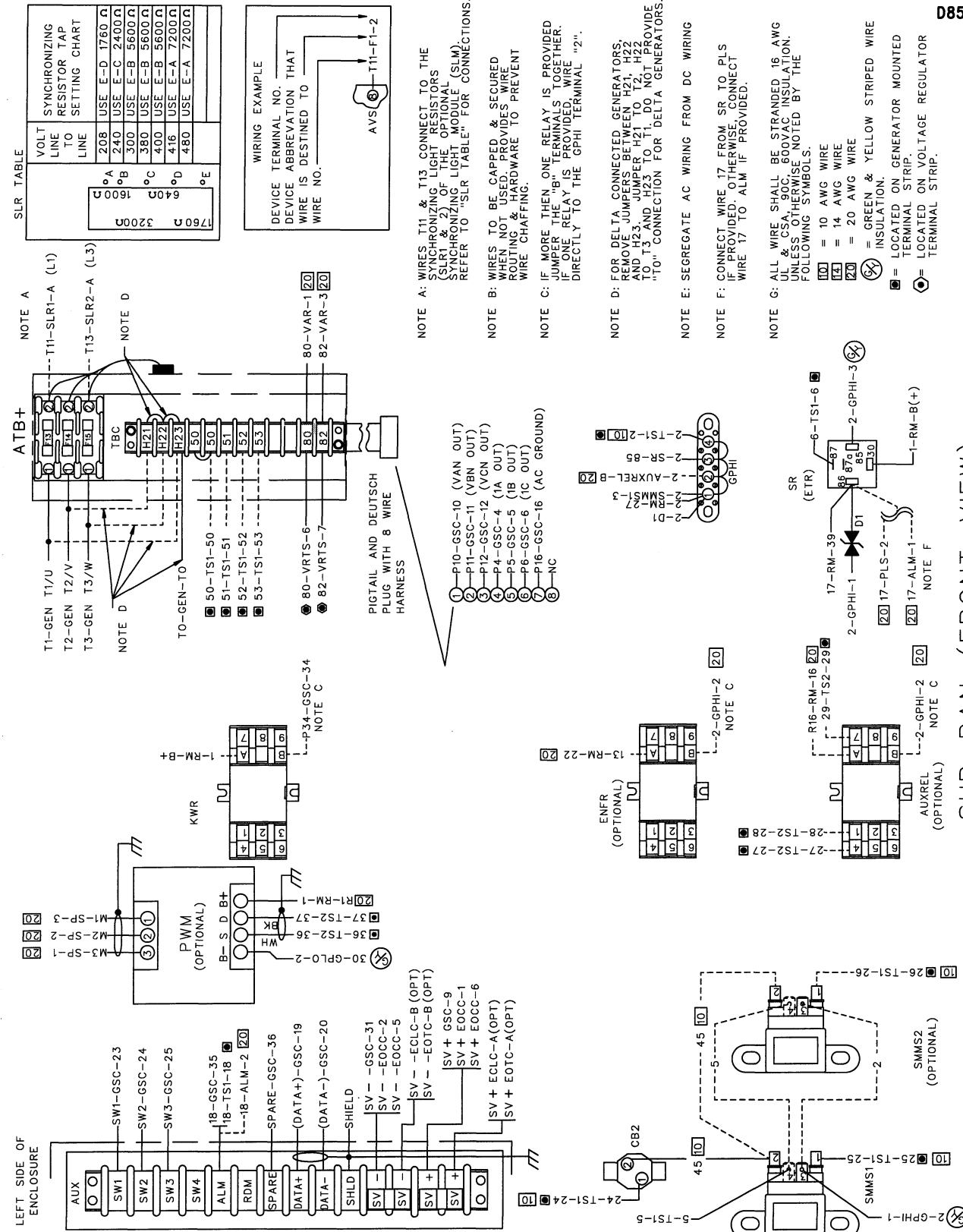
D85278

NOTE F, H, & J
HARNESS WIRE LENGTH CHART

WIRE NO	RH MOUNTED PANELS	REAR MOUNTED PANELS
1	1874	1231
2	1874	1230
3	1786	1188
4	1782	1172
5	1788	1158
6	1740	1130
7	1726	1116
8		1080
9	1670	1048
10	1556	1048
11	1552	982
12	1592	982
13	1578	988
14		936
15	1536	936
16	1508	898
17	1484	884
18	1488	858
19	1452	842
20	1438	828
21	1438	828
22	1410	800
23	1410	800
24	1410	800
25	1410	800
26	1410	800
27	2080	1450
28	2074	1484
29	2102	1492
30	2102	1492
31	2116	1508
32	2130	1520
33	2148	1544
34	2172	1582
35	2188	1576
36	2200	1590
37	1880	1270
38	1868	1256
39	1852	1242
40	1830	1220
41	1830	1220
42	1830	1220
43	1830	1220
44	1830	1220
45	1830	1220
46	1830	1220
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97	1830	1220
98	1830	1220
99	1830	1220
100	1830	1220

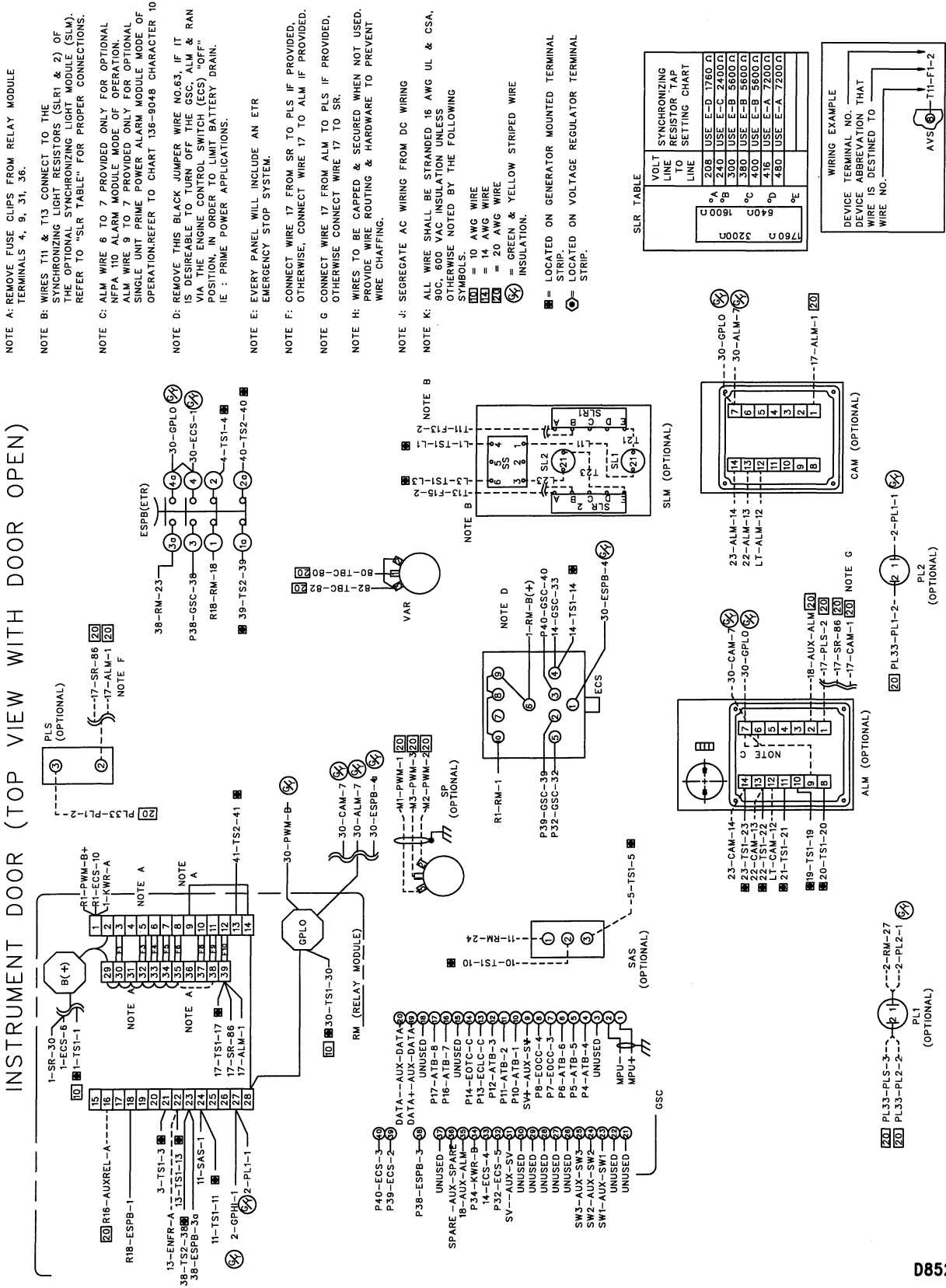


Wiring Diagram - Main Chassis (one of two)

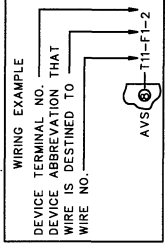


Wiring Diagram - Main Chassis (two of two)

INSTRUMENT DOOR (TOP VIEW WITH DOOR OPEN)

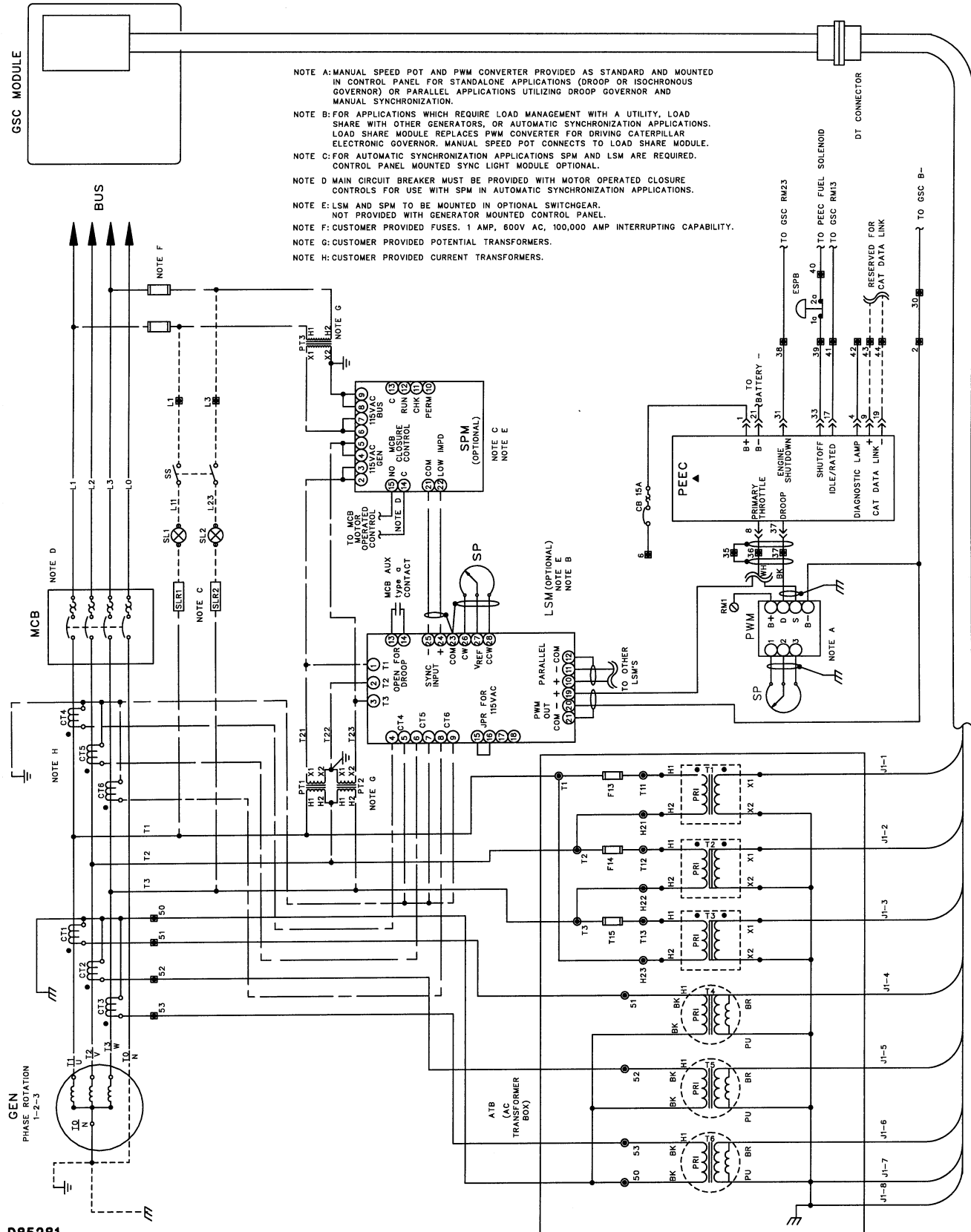


LINE	VOLT	SYNCHRONIZING
208	USE E-D 1760 Ω	
240	USE E-C 2400 Ω	
300	USE E-B 5600 Ω	
360	USE E-B 5600 Ω	
400	USE E-B 5600 Ω	
416	USE E-A 7200 Ω	
480	USE E-A 7200 Ω	



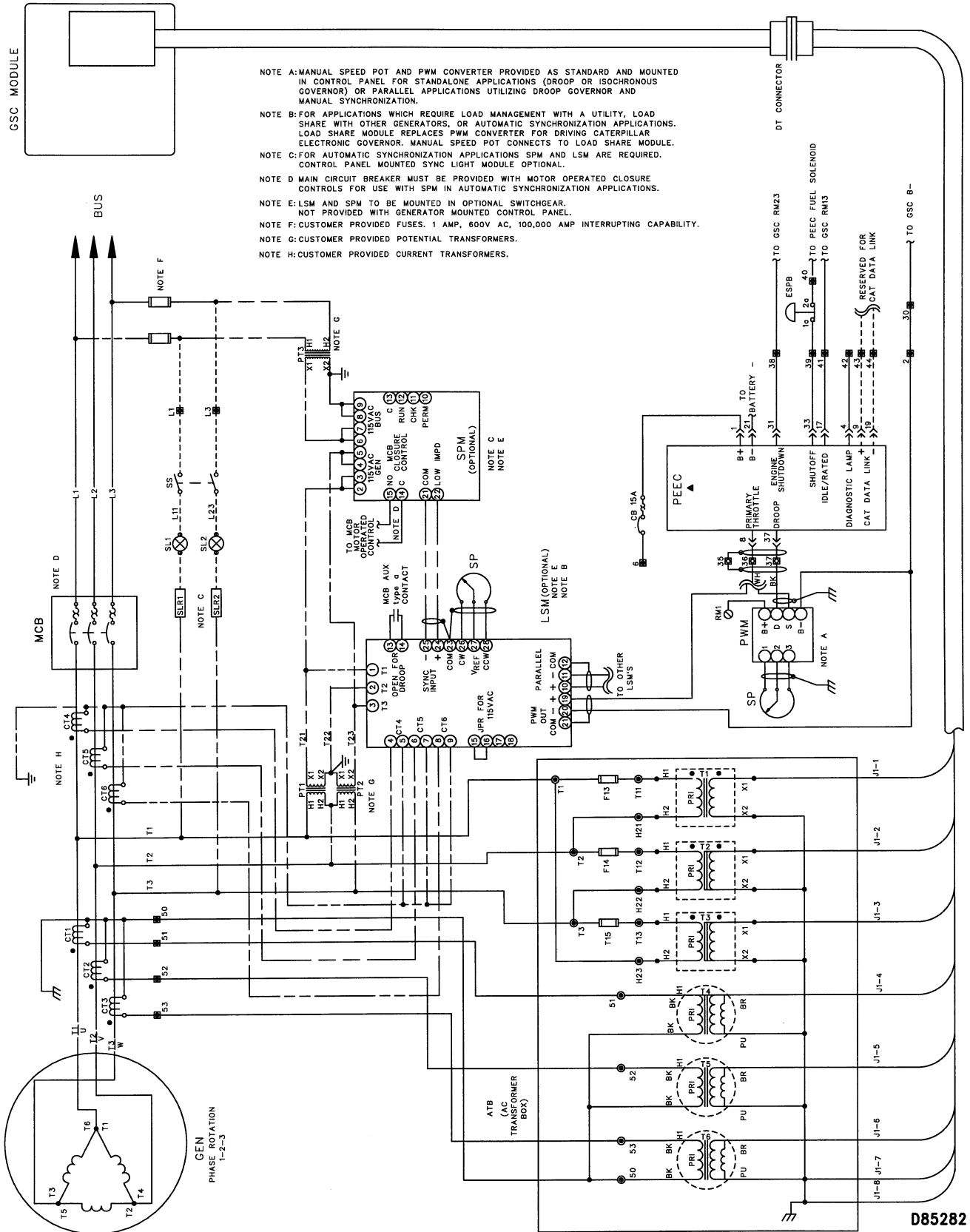
D85280

PEEC Schematic For Wye Connected Generators



D85281

PEEC Schematic For Delta Connected Generators



NOTE A: MANUAL SPEED POT AND PWM CONVERTER PROVIDED AS STANDARD AND MOUNTED IN CONTROL PANEL FOR STANDALONE APPLICATIONS (DROOP OR ISOSYNCHRONOUS GOVERNOR) OR PARALLEL APPLICATIONS UTILIZING DROOP GOVERNOR AND MANUAL SYNCHRONIZATION.

NOTE B: FOR APPLICATIONS WHICH REQUIRE LOAD MANAGEMENT WITH A UTILITY, LOAD SHARE WITH OTHER GENERATORS, OR AUTOMATIC SYNCHRONIZATION APPLICATIONS. LOAD SHARE MODULE REPLACES PWM CONVERTER FOR DRIVING CATERPILLAR ELECTRONIC GOVERNOR. MANUAL SPEED POT CONNECTS TO LOAD SHARE MODULE.

NOTE C: FOR AUTOMATIC SYNCHRONIZATION APPLICATIONS SPM AND LSM ARE REQUIRED. CONTROL PANEL MOUNTED SYNC LIGHT MODULE OPTIONAL.

NOTE D MAIN CIRCUIT BREAKER MUST BE PROVIDED WITH MOTOR OPERATED CLOSURE CONTROLS FOR USE WITH SPM IN AUTOMATIC SYNCHRONIZATION APPLICATIONS.

NOTE E: LSM AND SPM TO BE MOUNTED IN OPTIONAL SWITCHGEAR. NOT PROVIDED WITH GENERATOR MOUNTED CONTROL PANEL.

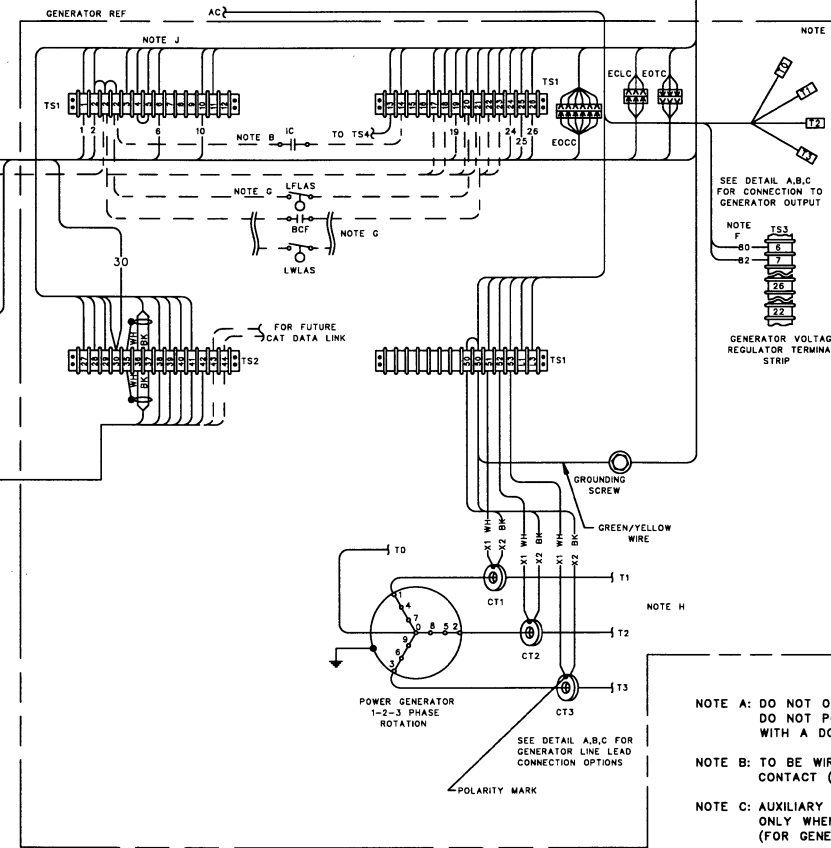
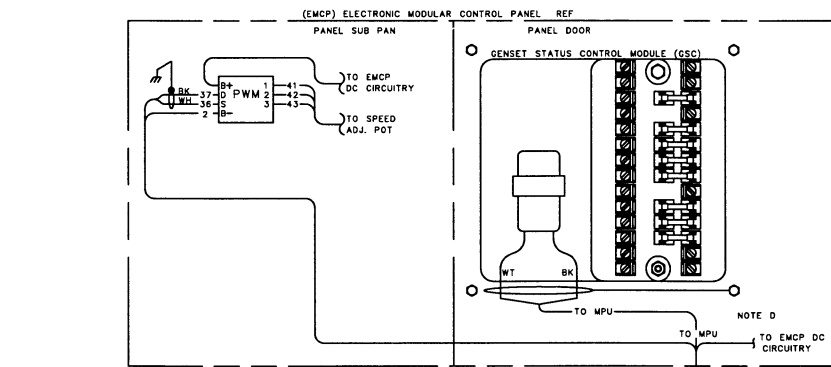
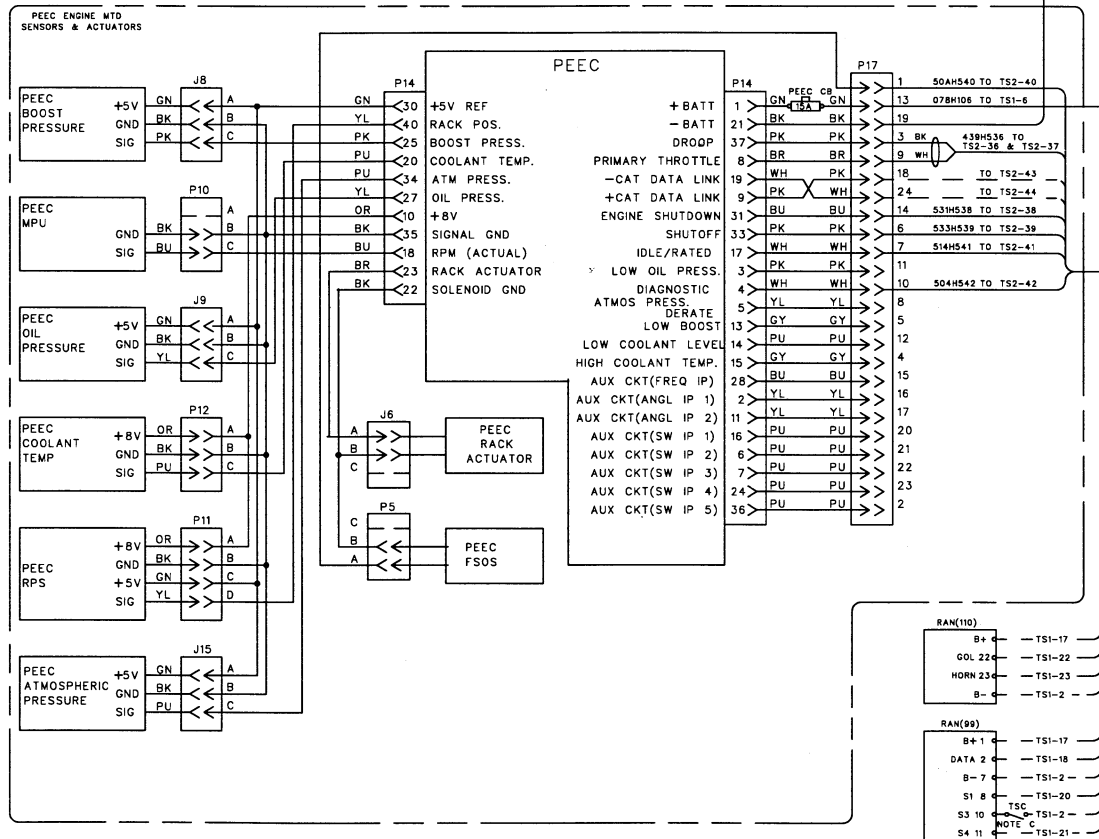
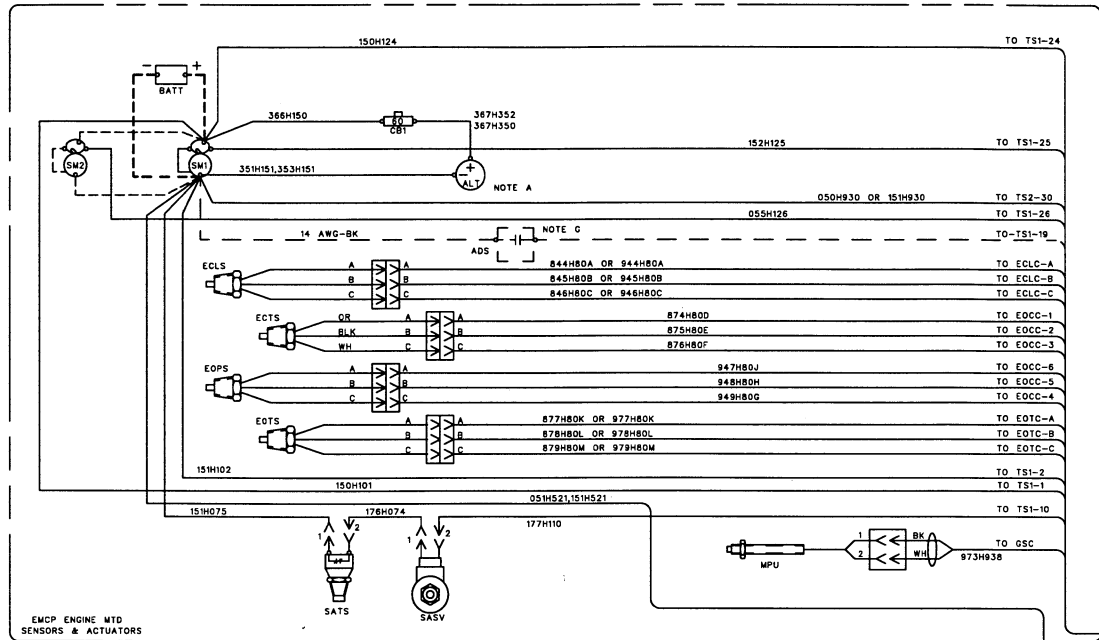
NOTE F: CUSTOMER PROVIDED FUSES. 1 AMP, 600V AC, 100,000 AMP INTERRUPTING CAPABILITY.

NOTE G: CUSTOMER PROVIDED POTENTIAL TRANSFORMERS.

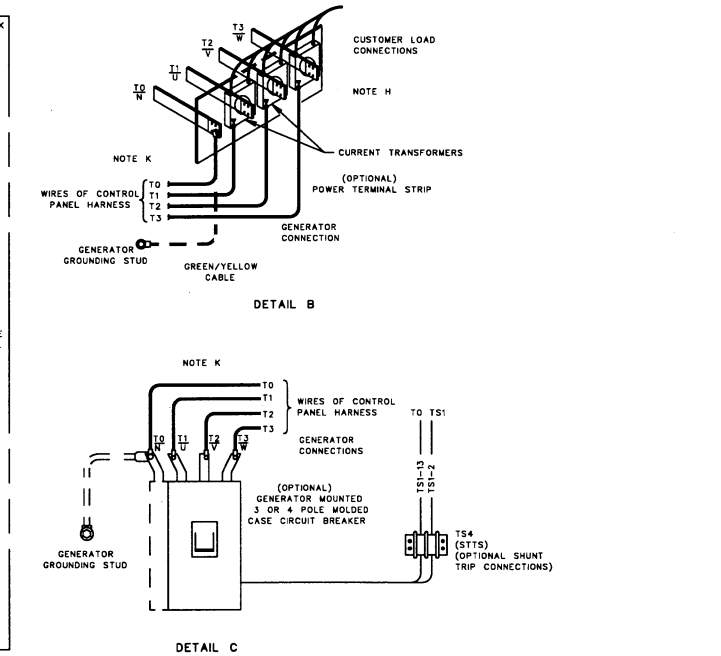
NOTE H: CUSTOMER PROVIDED CURRENT TRANSFORMERS.

D85282

Wiring Diagram – Generator Set



- ABBREVIATIONS**
- AC ALTERNATING CURRENT
 - ADS AIR DAMPER POSITION SWITCH
 - ALT ALTERNATOR
 - BATT BATTERY
 - BCF BATTERY CHARGER MALFUNCTION
 - CB CIRCUIT BREAKER
 - CT CURRENT TRANSFORMER
 - DC DIRECT CURRENT
 - ECLC EMCP COOLANT LOSS SENSOR CONNECTOR
 - ECLS EMCP COOLANT LOSS SENSOR
 - ECTS EMCP COOLANT TEMPERATURE SENSOR
 - EOCC EMCP COOLANT SENSOR CONNECTOR
 - EOPS EMCP OIL PRESSURE SENSOR
 - FSOS FUEL SHUT-OFF SOLENOID
 - GSC GENSET STATUS CONTROL
 - IC REMOTE START INITIATE CONTACT
 - LWLAS LOW WATER LEVEL ALARM SWITCH
 - LFLAS LOW FUEL LEVEL ALARM SWITCH
 - MPU MAGNETIC PICKUP (GOVERNOR)
 - PEEC PROGRAMMABLE ELECTRONIC ENGINE CONTROL
 - PWM ANALOG TO PWM CONVERTER
 - RAN REMOTE ANNUNCIATOR
 - RPS (FOR NFPA 110 OR NFPA 99) RACK POSITION SENSOR (PEEC)
 - SASV START AID SOLENOID VALVE
 - SATS START AID TEMPERATURE SWITCH
 - SM STARTING MOTOR
 - STTS SHUNT TRIP TERMINAL STRIP
 - TSC TRANSFER SWITCH POSITION CONTACT
 - CUSTOMER WIRING



- NOTE A:** DO NOT OPERATE ALTERNATOR WITHOUT A BATTERY CONNECTED TO THE SYSTEM. DO NOT POLARIZE ALTERNATOR. DO NOT OPERATE ALTERNATOR SIMULTANEOUSLY WITH A DC GENERATOR TO CHARGE A COMMON BATTERY.
- NOTE B:** TO BE WIRED BY CUSTOMER TO ENGINE REMOTE STARTING INITIATE CONTACT (N.O.) IN AUTO TRANSFER SWITCH.
- NOTE C:** AUXILIARY CONTACT (N.O.) ON EMERGENCY SIDE OF TRANSFER SWITCH REQUIRED ONLY WHEN OPTIONAL GENERATOR SET REMOTE ANNUNCIATOR PANEL IS PROVIDED. (FOR GENERATING INDICATION)
- NOTE D:** GROUND MPU SHIELDED CABLE AT GOVERNOR CONTROL MOUNTING SCREW/STUD ONLY.
- NOTE E:** REFER TO 5N9532 CHART FOR WIRE IDENTIFICATION CODES.
- NOTE F:** CONNECT CONTROL PANEL HARNESS WIRE NO. 80 TO TERMINAL NO. 6 WHEN THE VR3 (COMPLETELY ENCLOSED) OR VR4 VOLTAGE REGULATOR IS PROVIDED. REMOVE THE JUMPER BETWEEN VOLTAGE REGULATOR TERMINALS 4 AND 7. CONNECT CONTROL PANEL HARNESS WIRE NO. 82 TO TERMINAL NO. 7.
- NOTE G:** VARIOUS CUSTOMER SWITCHES CAN BE ACCOMMODATED FOR INTERFACE WITH VARIOUS OPTIONAL ALARM MODULES PROVIDED IN THE GENERATOR CONTROL PANEL.
- NOTE H:** MOUNT CURRENT TRANSFORMERS WITH POLARITY MARK FACING GENERATOR.
- NOTE J:** REMOVE JUMPER BETWEEN TS1-04 AND TS1-05 WHEN A PRELUBE PUMP IS USED.
- NOTE K:** PROVIDED ON WYE CONNECTED GENERATORS WITH EMCP II + CONTROL PANEL ONLY.

BATTERY CABLE SIZE
MAX ONE WAY LENGTH (25°C)

GAGE	SINGLE STARTING MOTOR	DUAL STARTING MOTOR
0000	5m	2.5m
000	4m	2m
00	3.25m	1.5m
0	2.5m	1.25m

D85087

Service Table – Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part No., etc..					
Engine/Generator Programming OP5-0					
Setpoint	Specified Value	Actual Value ¹	Setpoint Description	Possible Values	Default Value
P001			Fuel Solenoid Type	0 = ETR, 1 = ETS	0
P002			Units Shown	0 = Eng, 1 = metric	0
P003			Shutdown Override For Engine Fault	0 = shutdown, 1 = alarm	0
P004			Shutdown Override For Sensor Fault	0 = alarm, 1 = shutdown	0
P005			Coolant Loss Sensor Installed	0 = w/o sensor, 1 = w/sensor	0
P006			Shutdown Override For Coolant Loss Fault	0 = shutdown, 1 = alarm	0
P007			System Voltage	24 volts or 32 volts	24
P008			This Setpoint Is Not Used.	NA	NA
P009			Number Of Ring Gear Teeth	95 to 350 teeth	136 teeth
P010			Engine Overspeed	500 to 4330 rpm	2120 rpm
P011			Crank Terminate Speed	100 to 1000 rpm	400 rpm
P012			Oil Step Speed	400 to 1800 rpm	1350 rpm
P013			Low Oil Pressure Shutdown At Rated Speed	34 to 420 kPa (5 to 61 psi)	205 kPa (30 psi)
P014			Low Oil Pressure Shutdown At Idle Speed	20 to 336 kPa (3 to 49 psi)	70 kPa (10 psi)
P015			High Water Temperature Shutdown	85 to 123°C (185 to 253°F)	107°C (225°F)
P016			Low Water Temperature Alarm	0 to 36°C (32 to 97°F)	21°C (70°F)
P017			Total Cycle Crank Time	5 to 120 seconds	90 seconds
P018			Cycle Crank Time	5 to 60 seconds	10 seconds
P019			Cooldown Time	0 to 30 minutes	5 minutes
P020			AC Voltage	150V to 30.0kV	700V
P021			AC Current Full Scale	75A to 4000A	600A
P022			GSC+ Engine Number	01 to 08	01
P023			Engine Type	0 = MUI, 1 = gas, 2 = EUI	0
P024			Crank Time Delay	0 to 20 seconds	5 seconds
P025			Oil Temperature Sensor Installed	0 = w/o sensor, 1 = w/sensor	0
P026			High Oil Temperature Shutdown	85 to 123°C (185 to 253°F)	107°C (225°F)
P027			Shutdown Override For High Oil Temperature	0 = alarm, 1 = shutdown	0
P028			Nameplate Voltage	100 to 25kV	480V
P029			Nameplate Current	0 to 4000A	600A
P030			Nameplate Power	0 to 10MW	400kW
P031			Rated Frequency	50 Hz or 60 Hz	60
P032			Connection Configuration Of Generator	0 = wye, 1 = delta	0
P033			Number Of Generator Poles	0 to 254	4

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. Use the EMCP II+ Model No., the Chart Print, the nameplate ratings and the customer requirements in order to determine the specified value of the setpoints. Record 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.

Service Table – Record Of Setpoint Values

Generator Description: Site, Serial No., EMCP II+ Part No., etc..

Protective Relaying Programming OP5-1

Setpoint	Specified Value	Actual Value ¹	Setpoint Description	Possible Values	Default Value
P101			Overvoltage Alarm Enable	0 = disabled, 1 = enabled	1
P102			Overvoltage Alarm Threshold	100 to 125% of nameplate voltage	105%
P103			Overvoltage Alarm Time Delay	0 to 120 seconds	10 seconds
P104			Overvoltage Shutdown Enable	0 = disabled, 1 = enabled	1
P105			Overvoltage Shutdown Threshold	100 to 125% of nameplate voltage	110%
P106			Overvoltage Shutdown Time Delay	0 to 120 seconds	10 seconds
P107			Undervoltage Alarm Enable	0 = disabled, 1 = enabled	1
P108			Undervoltage Alarm Threshold	60 to 100% of nameplate voltage	90%
P109			Undervoltage Alarm Time Delay	0 to 120 seconds	10 seconds
P110			Undervoltage Shutdown Enable	0 = disabled, 1 = enabled	1
P111			Undervoltage Shutdown Threshold	60 to 100% of nameplate voltage	85%
P112			Undervoltage Shutdown Time Delay	0 to 120 seconds	15 seconds
P113			Overfrequency Alarm Enable	0 = disabled, 1 = enabled	1
P114			Overfrequency Alarm Threshold	50 to 60, 60 to 70, or 400 to 480 Hz	53, 63, or 422 Hz
P115			Overfrequency Alarm Time Delay	0 to 120 seconds	10 seconds
P116			Overfrequency Shutdown Enable	0 = disabled, 1 = enabled	1
P117			Overfrequency Shutdown Threshold	50 to 60, 60 to 70, or 400 to 480 Hz	55, 66, or 440 Hz
P118			Overfrequency Shutdown Time Delay	0 to 120 seconds	10 seconds
P119			Underfrequency Alarm Enable	0 = disabled, 1 = enabled	1
P120			Underfrequency Alarm Threshold	30 to 50, 36 to 60, or 240 to 400 Hz	47, 57, or 378 Hz
P121			Underfrequency Alarm Time Delay	0 to 120 seconds	10 seconds
P122			Underfrequency Shutdown Enable	0 = disabled, 1 = enabled	1
P123			Underfrequency Shutdown Threshold	30 to 50, 36 to 60, or 240 to 400 Hz	45, 54, or 360 Hz
P124			Underfrequency Shutdown Time Delay	0 to 120 seconds	15 seconds
P125			Reverse Power Shutdown Enable	0 = disabled, 1 = enabled	1
P126			Reverse Power Shutdown Threshold	0 to 20% of nameplate power	15%
P127			Reverse Power Shutdown Time Delay	0 to 30 seconds	10 seconds
P128			Overcurrent Alarm Enable	0 = disabled, 1 = enabled	1
P129			Phase Overcurrent Alarm Threshold	100 to 160% of nameplate current	100%
P130			Phase Overcurrent Alarm Time Delay	0 to 250 seconds	0 seconds
P131			Total Overcurrent Alarm Threshold	100 to 160% of 3 X nameplate current	100%
P132			Total Overcurrent Alarm Time Delay	0 to 250 seconds	0 seconds
P133			Overcurrent Shutdown Enable	0 = disabled, 1 = enabled	1
P134			Phase Overcurrent Shutdown Threshold	100 to 160%	100%
P135			Phase Overcurrent Shutdown Time Delay	0 to 250 seconds	0 seconds
P136			Total Overcurrent Shutdown Threshold	100 to 160%	100%
P137			Total Overcurrent Shutdown Time Delay	0 to 250 seconds	0 seconds
P138			KW Level Relay Enable	0 = disabled, 1 = enabled	1
P139			KW Level Relay Threshold	0 to 110% of nameplate power	105%
P140			KW Level Relay Time Delay	0 to 120 seconds	0 seconds
P141			KW Level Relay Disengage Threshold	0 to 110% of nameplate power	100%
P142			KW Level Relay Disengage Time Delay	0 to 120 seconds	10 seconds

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. Use the EMCP II+ Model No., the Chart Print, the nameplate ratings and the customer requirements in order to determine the specified value of the setpoints. Record 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.

Service Table – Record Of Setpoint Values					
Generator Description: Site, Serial No., EMCP II+ Part No., etc..					
Setpoint	Specified Value	Actual Value ¹	Setpoint Description	Possible Values	Default Value
Spare Input/Output Programming OP6					
SP01			Spare Input 1 Active State	0 = active low, 1 = active high	0
SP02			Spare Input 1 Response	0 = shutdown, 1 = alarm	0
SP03			Spare Input 1 Time Delay	0 to 250 seconds	0 seconds
SP04			Spare Input 2 Active State	0 = active low, 1 = active high	0
SP05			Spare Input 2 Response	0 = shutdown, 1 = alarm	0
SP06			Spare Input 2 Time Delay	0 to 250 seconds	0 seconds
SP07			Spare Input 3 Active State	0 = active low, 1 = active high	0
SP08			Spare Input 3 Response	0 = shutdown, 1 = alarm	0
SP09			Spare Input 3 Time Delay	0 to 250 seconds	0 seconds
SP10			Spare Input 4 Active State	0 = active low, 1 = active high	0
SP11			Spare Input 4 Response	0 = shutdown, 1 = alarm	0
SP12			Spare Input 4 Time Delay	0 to 250 seconds	0 seconds
SP13			Spare Output Response	0 = shutdown, 1 = alarm	0
SP14			Spare Output Trigger Condition	Numerous ³ 8 = cooldown mode	8
SP15			Spare Relay Output Response	0 = inactive, 1 = active	1
SP16			Spare Relay Output Trigger Condition	Numerous ³ 8 = cooldown mode	8
SP17			Spare Indicator 1 Trigger Condition	Numerous ³ 0 = unused	0
SP18			Spare Indicator 2 Trigger Condition	Numerous ³ 0 = unused	0
SP19			Spare Indicator 3 Trigger Condition	Numerous ³ 0 = unused	0
Voltmeter/Ammeter Programming OP8					
AC01			Phase A Voltage Calibration	0 to 255	bar code value ²
AC02			Phase B Voltage Calibration	0 to 255	bar code value ²
AC03			Phase C Voltage Calibration	0 to 255	bar code value ²
AC04			Phase A Current Calibration	0 to 255	bar code value ²
AC05			Phase B Current Calibration	0 to 255	bar code value ²
AC06			Phase C Current Calibration	0 to 255	bar code value ²
AC Offset Adjustment OP10					
PH A			Phase A Voltage Adjustment	-5.0 to +5.0% of measured voltage	0
PH B			Phase B Voltage Adjustment	-5.0 to +5.0% of measured voltage	0
PH C			Phase C Voltage Adjustment	-5.0 to +5.0% of measured voltage	0
PH A-B			Phase A-B Voltage Adjustment	-5.0 to +5.0% of measured voltage	0
PH B-C			Phase B-C Voltage Adjustment	-5.0 to +5.0% of measured voltage	0
PH C-A			Phase C-A Voltage Adjustment	-5.0 to +5.0% of measured voltage	0

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. Use the EMCP II+ Model No., the Chart Print, the nameplate ratings and the customer requirements in order to determine the specified value of the setpoints. Record 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 setpoints are programmed at the factory to the calibration value which is listed on the bar code sticker of the ATB+.

³ Numerous possible values exist. See the topic Spare Input/Output Programming in the Systems Operation section.

Wiring Diagram - Relay Driver Module (RDM)

D92591

