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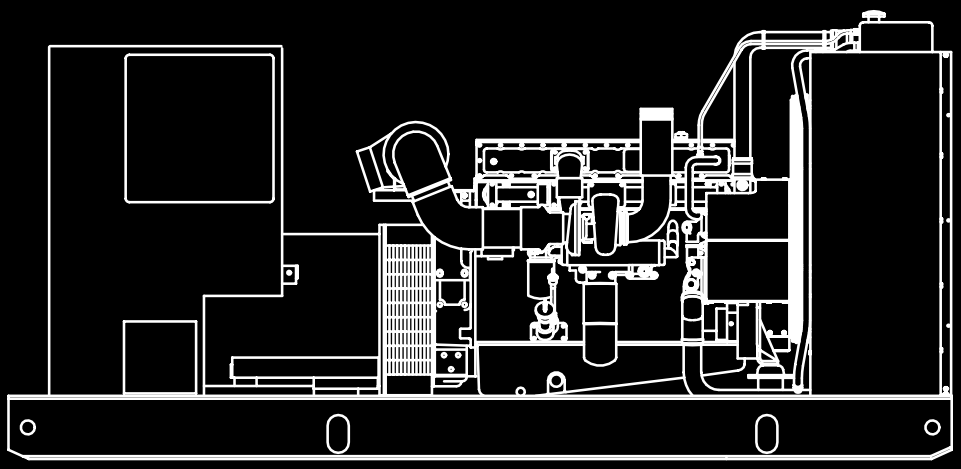
Power Generation

Service Manual

PowerCommand® Control
2100 Series
Generator Sets



Models
DFAB, DFAC, DFBF, DFCB, DFCC, DFCE
DFGB, DFGE, DFLB, DFLC, DFLE

Printed in U.S.A.

960-0519C 02-2004

Table of Contents

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries.

Before operating the generator set (genset), read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠ WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use zinc coated or copper fuel lines with diesel fuel.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (–) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Cummins Power Generation distributor for more information.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the engine.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breath or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, turbo charger and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides troubleshooting and repair information regarding the PowerCommand® 2100 Control (PCC) and generators for the gensets listed on the front cover. Engine service instructions are in the applicable engine service manual. Operating and maintenance instructions are in the applicable Operator's Manual.

This manual does not have instructions for servicing printed circuit board assemblies. After determining that a printed circuit board assembly is faulty, replace it. Do not repair it. Attempts to repair a printed circuit board can lead to costly damage to the equipment.

This manual contains basic (generic) wiring diagrams and schematics that are included to help in troubleshooting. Service personnel must use the actual wiring diagram and schematic shipped with each unit. The wiring diagrams and schematics that are maintained with the unit should be updated when modifications are made to the unit.

Read ***Safety Precautions*** and carefully observe all instructions and precautions in this manual.

SYSTEM OVERVIEW

The PCC is a microprocessor-based control for Cummins Power Generation generator sets. All generator set control functions are contained on one circuit board (Base board). The Base board provides engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring.

The operating software provides control of the generator set and its performance characteristics, and displays performance information on a digital display panel. It accepts menu-driven control and set-up input from the push button switches on the front panel.

TEST EQUIPMENT

To perform the test procedures in this manual, the following test equipment must be available

- True RMS meter for accurate measurement of small AC and DC voltages. Fluke models 87 or 8060A are good choices.
- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac
- Load Test Panel
- Megger or Insulation Resistance Meter
- PCC Service Tool Kit (Harness Tool and Sensor Tool)
- InPower Service Tool (PC based genset service tool)

HOW TO OBTAIN SERVICE

Always give the complete Model, Specification and Serial number of the generator set as shown on the nameplate when seeking additional service information or replacement parts. The nameplate is located on the side of the generator output box.

⚠WARNING ***Incorrect service or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be qualified to perform electrical and mechanical service. Read and follow Safety Precautions, on pages iii and iv.***

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2. Control Operation

GENERAL

The following describes the function and operation of the PowerCommand® 2100 Control (PCC). All indicators, control switches/buttons and digital display are located on the face of the control panel as illustrated in Figure 2-1.

CONTROL PANEL POWER ON/OFF MODES

The power on/off modes of the control panel and operating software are Power On, Screen Saver and Sleep/Awake.

Power On Mode: In this mode, power is continuously supplied to the control panel. The control's operating software and control panel LEDs/digital display will remain active until the Screen Saver mode is activated.

Screen Saver Mode: Power to the digital display is removed after 30 minutes (generator set not running or running). The 30 minute timer resets and begins after each control panel action (any button or switch selection) or signal received by the operating software. All LEDs on the control panel operate normally during Screen Saver mode, indicating that the operating software is active (Awake mode).

When a "Warning" signal is sensed by the PCC (for example, low coolant temp), the control displays the warning message.

Sleep/Awake Mode: In the Sleep mode, the control's operating software is inactive and the LEDs and the digital display on the control panel are all off. Sleep mode is a feature used to reduce battery power consumption when the control is not being used and the O/Manual/Auto switch is in the O position.

When all conditions are met (i.e., no unacknowledged faults and O/Manual/Auto switch is in the O position) the Sleep mode is activated.

The operating software is initialized and the digital display and control panel LEDs are turned on in response to moving/pressing the following control panel switch/buttons:

- OManual/Auto switch
- Emergency Stop button
- Fault Acknowledge/Reset button
- Panel Lamp/Lamp Test button

To activate the control and view the menu display without starting the generator set, press Fault Acknowledge or Panel Lamp button or move mode switch from O to Manual.

The InPower service tool is required to enable or disable the Sleep mode. When shipped from the factory, the Sleep mode is disabled. When disabled, the operating software will always remain active (Awake mode). (If network and/or power transfer control feature is installed, the sleep mode is not available and should not be enabled − will cause error condition.)

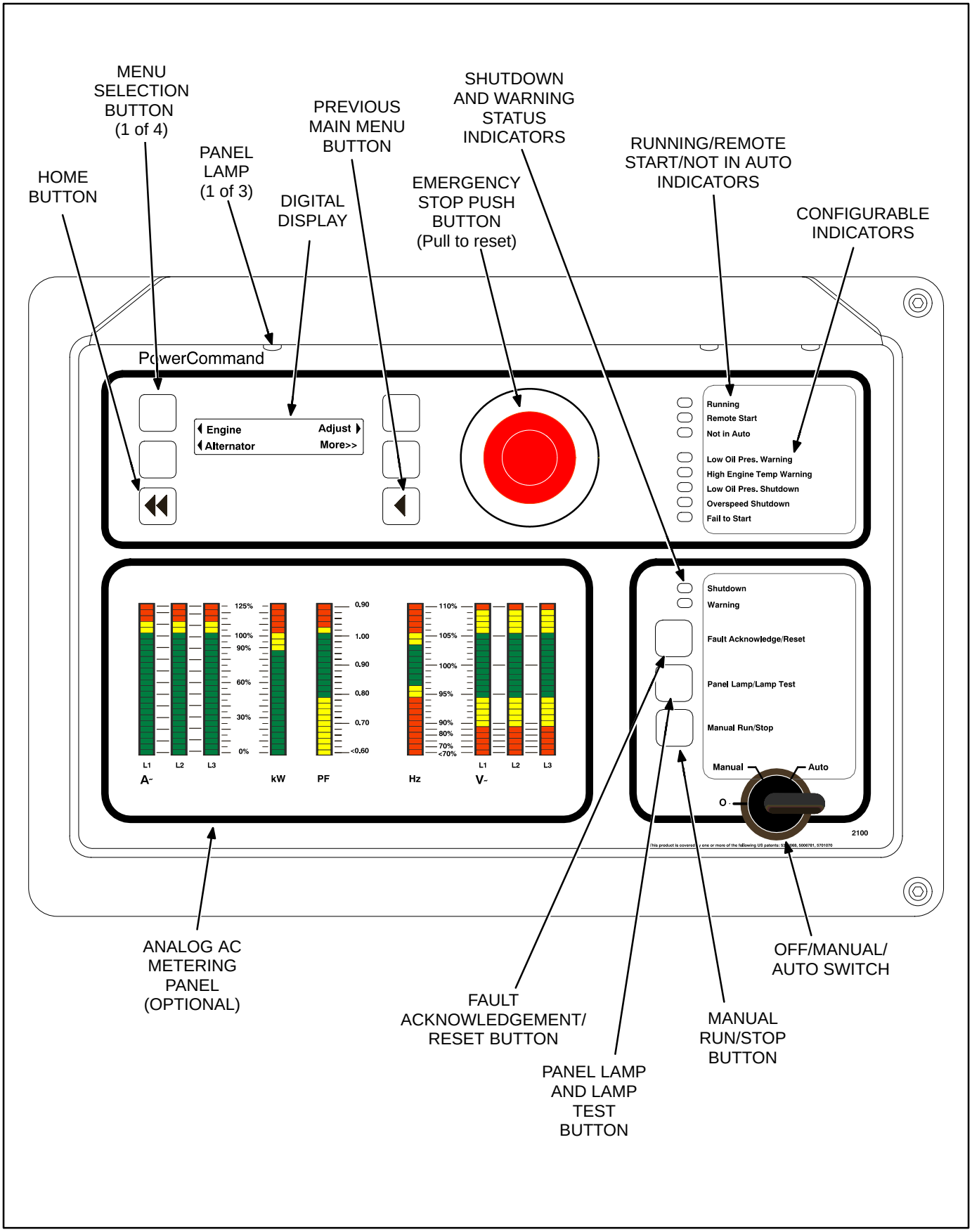

FIGURE 2-1. FRONT PANEL

FRONT PANEL

Figure 2-1 shows the features of the front panel.

Digital Display: This two-line, 20-characters per line alphanumeric display is used to view menus of the menu-driven operating system. Refer to the menu trees later in this section. The display is also used to show warning and shutdown messages.

Display Menu Selection Buttons: Four momentary buttons—two on each side of the digital display window—are used to step through the various menu options and to adjust generator set parameters. A green triangle (◀ or ▶), arrow (↑, ↓, ←, or →), >>, or plus/minus sign (+ or −) in the digital display adjacent to the button is shown when the button can be used (button is "active"). Refer to *Menu Display And Buttons* later in this section.

Home Button: Press this button (◀◀) to view the Home Menu. Refer to the menu trees later in this section.

Previous Main Menu Button: Press this button (◀) to view the previous Main Menu. All main menus include both types of green triangles (◀ and ▶). Refer to the menu trees later in this section.

NOTE: The up and down arrows (↑ and ↓) are used to navigate between submenus.

Emergency Stop Button: Push this button in for emergency shutdown of the generator set. This will stop the generator set immediately and prevent starting of the set from any location (local and remote).

To reset:

1. Pull the button and allow it to pop out.
2. Turn the O/Manual/Auto switch to O (Off).
3. Press the front panel Fault Acknowledge/Reset button.
4. Select Manual or Auto, as required.

Emergency Stop shutdown can be reset only at the PCC front panel.

Running Indicator: This green lamp is lit whenever the generator (local or remote) is running.

Remote Start Indicator: This green lamp is lit whenever the control is receiving a remote start signal.

Not in Auto Indicator: This red lamp flashes continuously when the O/Manual/Auto switch is not in the Auto position.

Analog AC Metering Panel (Optional): This panel simultaneously displays (in percent of genset rated output):

- 3-phase line-to-line AC current (A~)
- Kilowatts (kW)
- Generator output frequency in hertz (Hz)
- 3-phase line-to-line AC volts (V~)
- Power Factor (PF) (shown in 0.2 increments)

Shutdown Status Indicator: This red lamp is lit whenever the control detects a shutdown condition. The generator set cannot be started when this lamp is on. After the condition is corrected, shutdown indicators can be reset by turning the O/Manual/Auto switch to the O position and pressing the Fault Acknowledge/Reset button.

Warning Status Indicator: This yellow lamp is lit whenever the control detects a warning condition. After the condition is corrected, warning indicators can be reset by pressing the Fault Acknowledge/Reset button. (It is **not** necessary to stop the generator set.) In auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected.

Some warnings remain active after the condition is corrected and the control reset button is pressed. This will require the genset to be shutdown to reset the warning indicator.

Fault Acknowledge/Reset Button: Press this button to acknowledge warning and shutdown messages after the fault has been corrected. Pressing this button clears the fault from the current fault list.

To acknowledge a Warning message, the O/Manual/Auto switch can be in any position. (It is not necessary to stop the generator set to acknowledge an inactive Warning condition.) To acknowledge a shutdown message with this button, the O/Manual/Auto switch must be in the O position.

Panel Lamp and Lamp Test Button: Press this button to turn the control panel lamps on or off. The lights will shut off after about ten minutes. Press and hold this button to test all front panel LEDs and meters. The meters will light one bar at a time.

Manual Run/Stop Button: This button starts and stops the set locally and will bypass Time Delay to Start and Stop sequences. The O/Manual/Auto switch must be in the Manual position to enable this button.

O/Manual/Auto Switch: The Manual position enables the use of the Manual Run/Stop button.

The Auto position enables start/stop control of the engine from a remote location. (It disables the use of the Manual Run/Stop button.)

The O (Off) position prevents the starting of the set (local or remote). If the switch is set to O during set operation, the engine will immediately shut down (cool-down timers are bypassed). This hot shutdown should be avoided, if possible, to help prolong the life of the engine.

Configurable Indicators

The following configurable indicators (default values shown) can be changed with the InPower service tool. The configurable items are: change generator event and LED color (green, yellow or red), and enable/disable indicator.

Low Oil Pressure Warning Indicator: This yellow lamp indicates the oil pressure is lower than the normal range of operation.

High Engine Temperature Warning Indicator: This yellow lamp indicates the engine temperature is higher than the normal range of operation.

Low Oil Pressure Shutdown Indicator: This red lamp indicates the engine has shut down because of low oil pressure.

Overspeed Shutdown Indicator: This red lamp indicates the engine has shut down because of excessive speed.

Fail to Start Indicator: This red lamp indicates the engine failed to start.

MENU DISPLAY AND BUTTONS

Figure 2-2 shows the digital display and the menu selection buttons.

Digital Display: The two-line, 20 characters per line, digital display is used to view the menus of the menu-driven operating system. Refer to the menu trees later in this section. The display is also used to show fault messages.

Display Menu Selection Buttons: Four momentary buttons—two on each side of the digital display window—are used to step through the various menu options and to adjust generator set parameters. The button is active when a symbol adjacent to the button is displayed. The displayed symbol indicates the function of the button.

- In the digital display for main menus (Figure 2-3), the ◀ and ▶ symbols indicate that pressing the adjacent button causes the operating program to go to the selected submenu (e.g., Engine Menu in Figure 2-5).

- In the digital display, the More>> symbol indicates that pressing the adjacent button causes the operating program to go to the next main menu, as shown in Figure 2-3.

- In the digital display, the ↓ or ↑ symbols indicate that pressing the adjacent button causes the operating program to go to the next or previous submenu, as shown in the menu diagrams. Only the ↓ symbol is displayed in the first submenu. Only the ↑ is displayed in the last submenu. Both symbols are displayed in the rest of the submenus.

- In the digital display, the plus or minus symbols (+ or −) indicate that pressing the adjacent button can be used to change a parameter or value shown on the display.

  When there is a choice of two parameters, one parameter is associated with the + symbol and the other is associated with the − symbol.

  When changing values, pressing the button adjacent to the + symbol increase the value and pressing the button adjacent to the − symbol decreases the value. Only one numeric character of a field can be changed at a time.

- In the digital display, the → or ← symbol indicates that pressing the adjacent button causes the operating program to move the cursor to the next numeric character. The selected numeric character can then be changed by pressing the buttons adjacent to the + and − symbols. Only the → symbol is displayed when the cursor is on the first character of a field that can be changed. Only the ← is displayed when the cursor is on the last character. Both symbols are displayed when the cursor is on any other character.

- After adjusting values/parameters, pressing the ▶ symbol results in the changes being saved. **If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.**

Home Button: Pressing this button causes the operating system to show Main Menu 1 (Figure 2-3) in the digital display.

Previous Main Menu Button: Pressing this button causes the operating system to show the previous Main Menu in the digital display. All main menus include both types of green triangles (◀ and ▶).

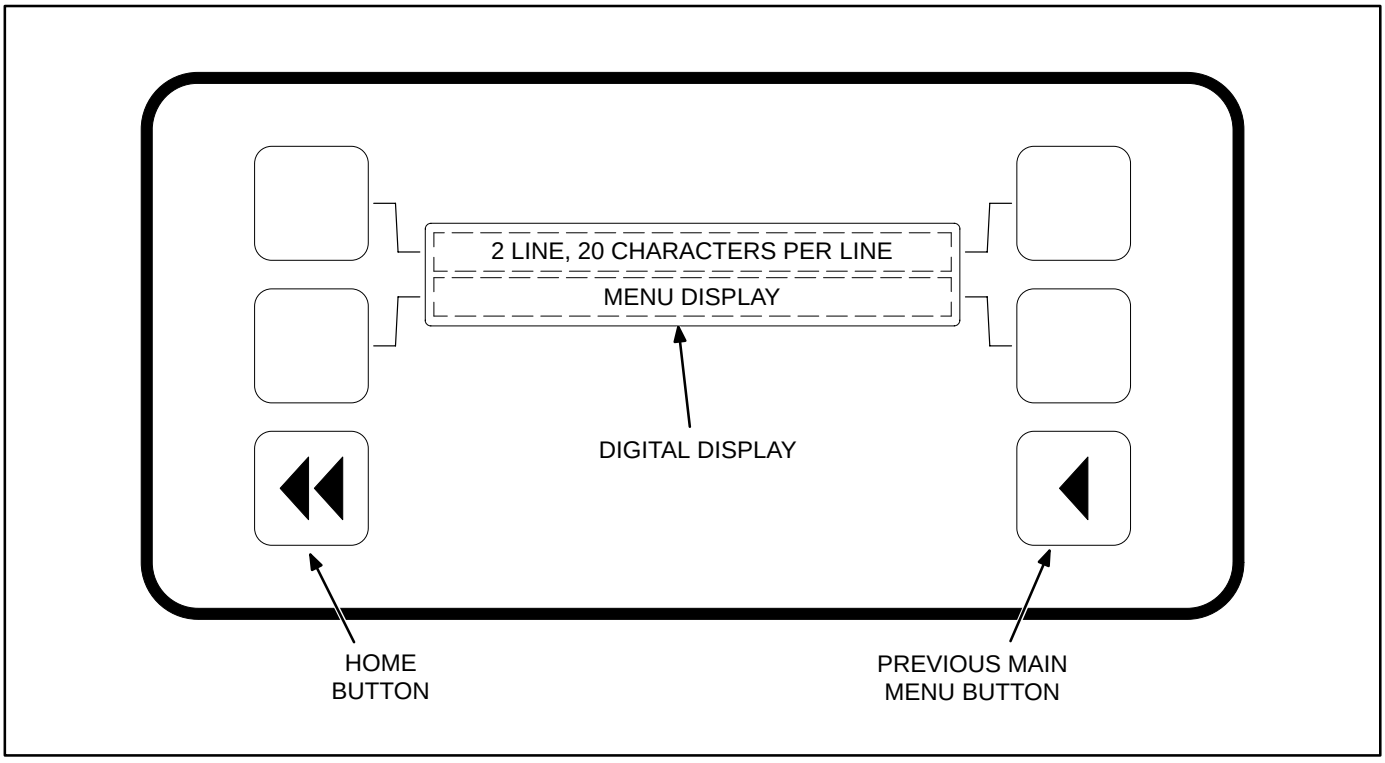

FIGURE 2-2. DIGITAL DISPLAY AND MENU SELECTION BUTTONS

MAIN MENUS

Figure 2-3 shows the three major main menus available to the user. Figure 2-3 also includes references to pages in this section where you can find additional information on submenus. When viewing a submenu, you can press the previous main menu button at any time to view its main menu.

As shown in the illustration, each main menu can branch into one of four directions. Press the button next to “More>>” in the display to view the next Main menu. Main Menu 1 is redisplayed when you press the button next to “More>>” in the Main Menu 3 display.

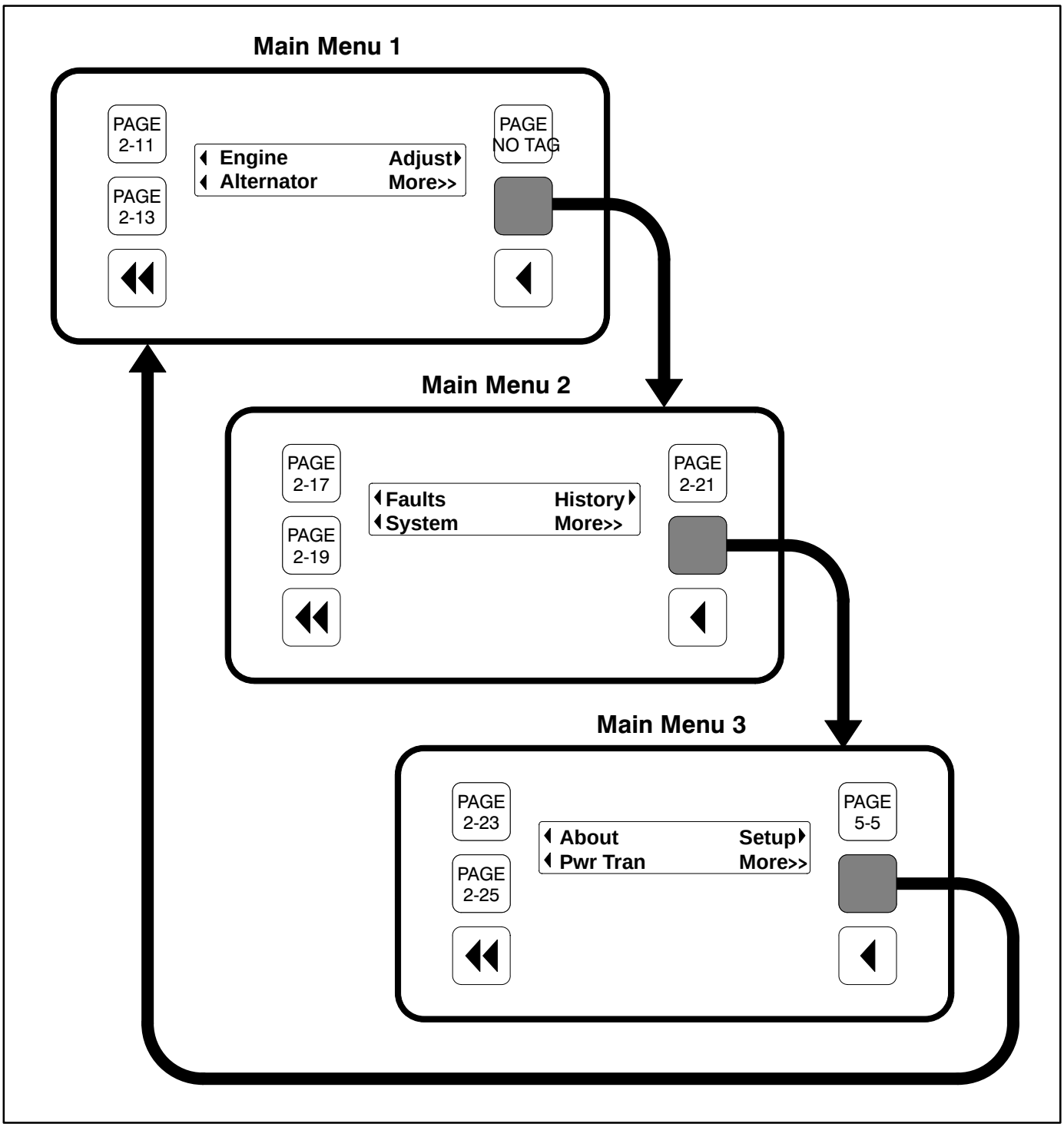

FIGURE 2-3. MAIN MENUS

CONTROLLER CONFIGURATION MENU

Figure 2-4 shows a block representation of the Controller Configuration menus. These menus are used to change the default language, temperature units, and pressure units to be displayed in menus.

To view the first Controller Configuration menu, make sure Main Menu 1 is displayed and simultaneously press the Home Menu and Previous Main Menu buttons.

As shown in the diagram, the Controller Configuration menu has three submenus.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus.

Press the button next to the ▶ symbol in the display until the + and − symbols are displayed.

Press the button next to the + or − symbol to select the desired option.

After selecting option, pressing the ▶ symbol results in the changes being saved. If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.

Language Selected submenu: Used to select desired language (default = English).

Temperature Units submenu: Used to select Fahrenheit or Centigrade for temperature readings.

Fluid Pressure Units submenu: Used to select PSI or kPA for pressure readings.

CONTROLLER CONFIGURATION MENU

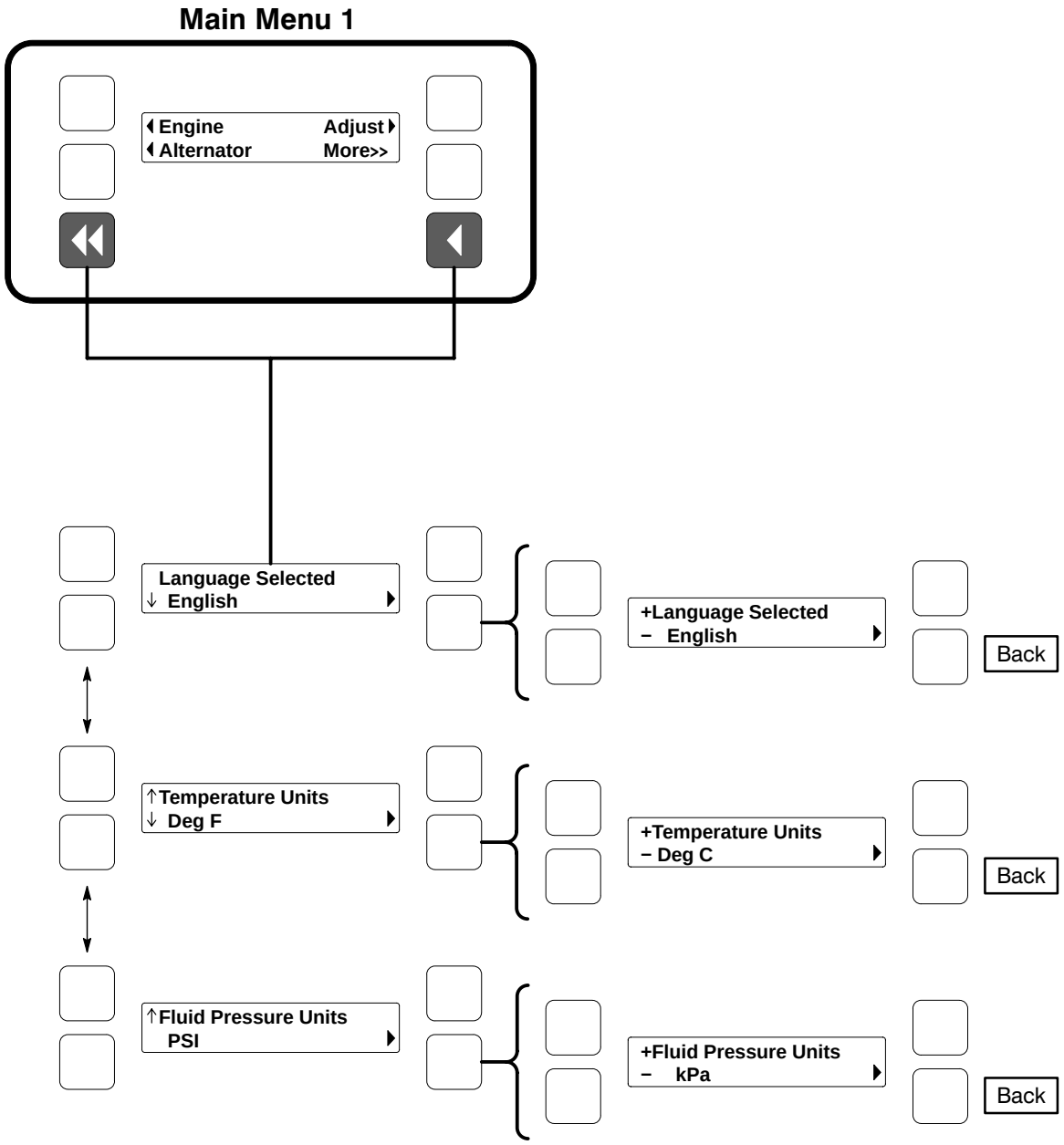

FIGURE 2-4. CONTROLLER CONFIGURATION MENU

ENGINE MENU

Figure 2-5 shows a block representation of the Engine menu. If you press the button next to the word “Engine” in the display, the first Engine submenu is displayed.

As shown in the diagram, the Engine menu has seven submenus. The data in the submenus will vary according to the type and number of sensors provided with the engine.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Home button or the Previous Main Menu button to return to Main Menu 1.

Coolant Temperature submenu: This submenu displays the engine coolant temperature which can be viewed in degrees Fahrenheit or Centigrade (see *Controller Configuration Menu* in this section).

Oil Pressure submenu: This submenu displays the engine oil pressure which can be viewed in PSI or kPA (see *Controller Configuration Menu Menu* in this section).

Oil Temperature submenu: This submenu displays the engine oil temperature which can be viewed in degrees Fahrenheit or Centigrade (see *Controller Configuration Menu* in this section).

Engine Speed submenu: This submenu displays the engine RPM.

Battery Voltage submenu: This submenu displays the engine battery voltage.

Governor Duty Cycle submenu: This submenu displays the governor duty cycle (drive) levels in percentage of maximum.

Active Time Delay submenu: This submenu displays the time delay that is currently active: warm−up, cool down, start or stop delays.

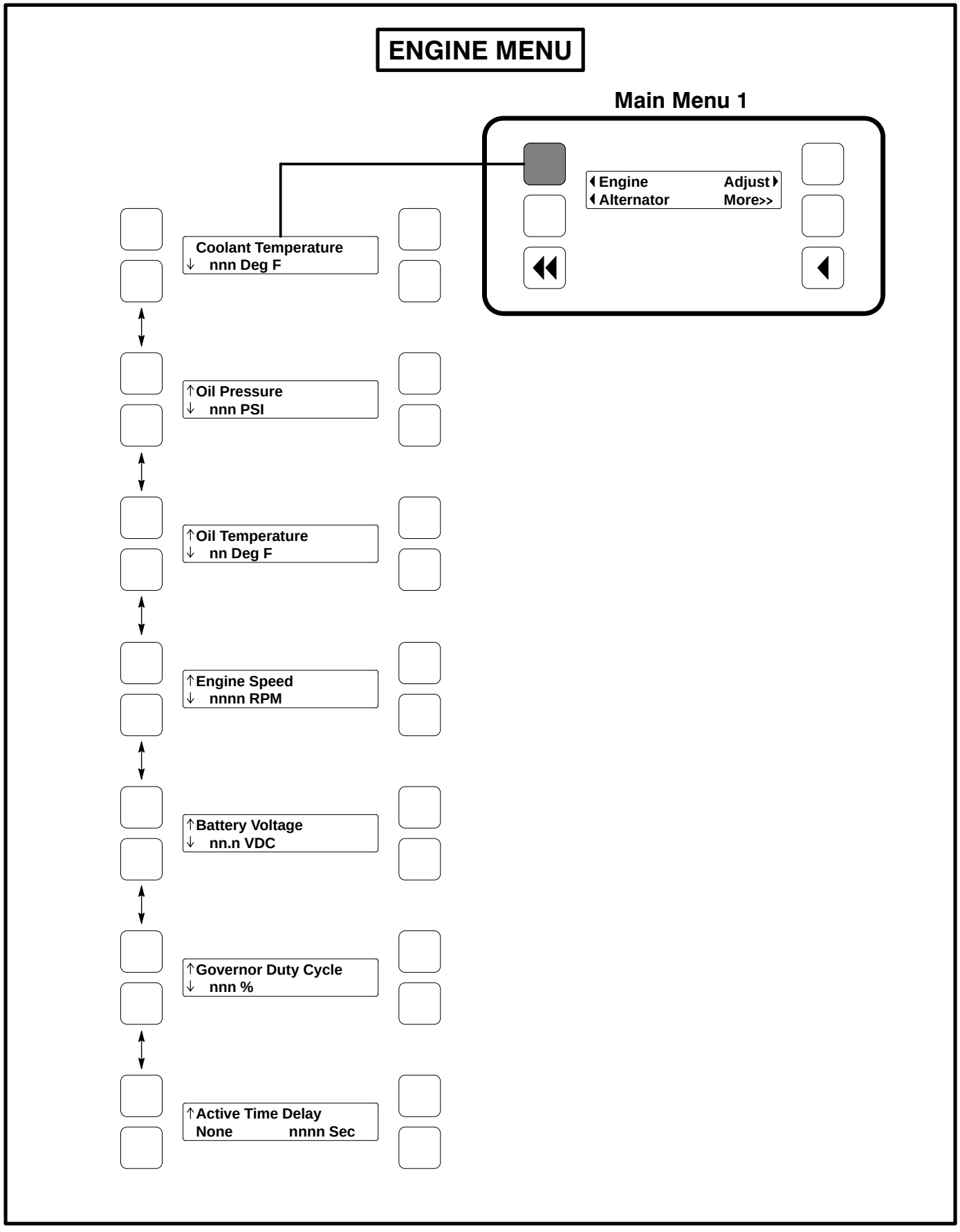

FIGURE 2-5. ENGINE MENU

ALTERNATOR MENU

Figure 2-6 shows a block representation of the Alternator menu. If you press the button next to the word “Alternator” in the display, the first Alternator submenu is displayed.

As shown in the diagram, the Alternator menu has eleven submenus.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Home button or the Previous Main Menu button to return to Main Menu 1.

Line-to-Line Voltage submenu: The voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively. (Single phase − L1 to L2 only.)

Line-to-Neutral Voltage submenu: Note that the Line-to -Neutral column will not be displayed for a 3 phase/3 wire system. Single phase − L1 to N and L2 to N.

Amps submenu: All phases. (Single phase − L1 and L2 only.)

Frequency submenu: Generator set output frequency.

Total Real Power submenu: This submenu displays the total amount of real power output, in kilowatts (kW).

Real Power submenu: This submenu displays the amount of real power output for L1, L2, and L3, in kilowatts (kW). (Single phase − L1 and L2 only.)

Total Apparent Power submenu: This submenu displays the total amount of apparent power output, in kilovolt amps (kVA).

Apparent Power submenu: This submenu displays the amount of apparent power output for L1, L2, and L3, in kilovolt amps (kVA). (Single phase − L1 and L2 only.)

Total Power Factor submenu: This submenu displays the power factor with leading/lagging indication.

The PF reading will contain an asterisk if the power factor is leading (for example, Total PF 0.9 *).

Power Factor submenu: This submenu displays a power factor value for L1, L2, and L3. (Single phase − L1 and L2 only.)

The PF reading will contain an asterisk if the power factor is leading (for example, PF L1 0.9*).

AVR Duty Cycle submenu: This submenu displays the voltage regulator (drive) level in percentage of maximum. (Where maximum is 100% Duty Cycle, software clamps Duty Cycle maximum to 60% for PMG and 90% for shunt.)

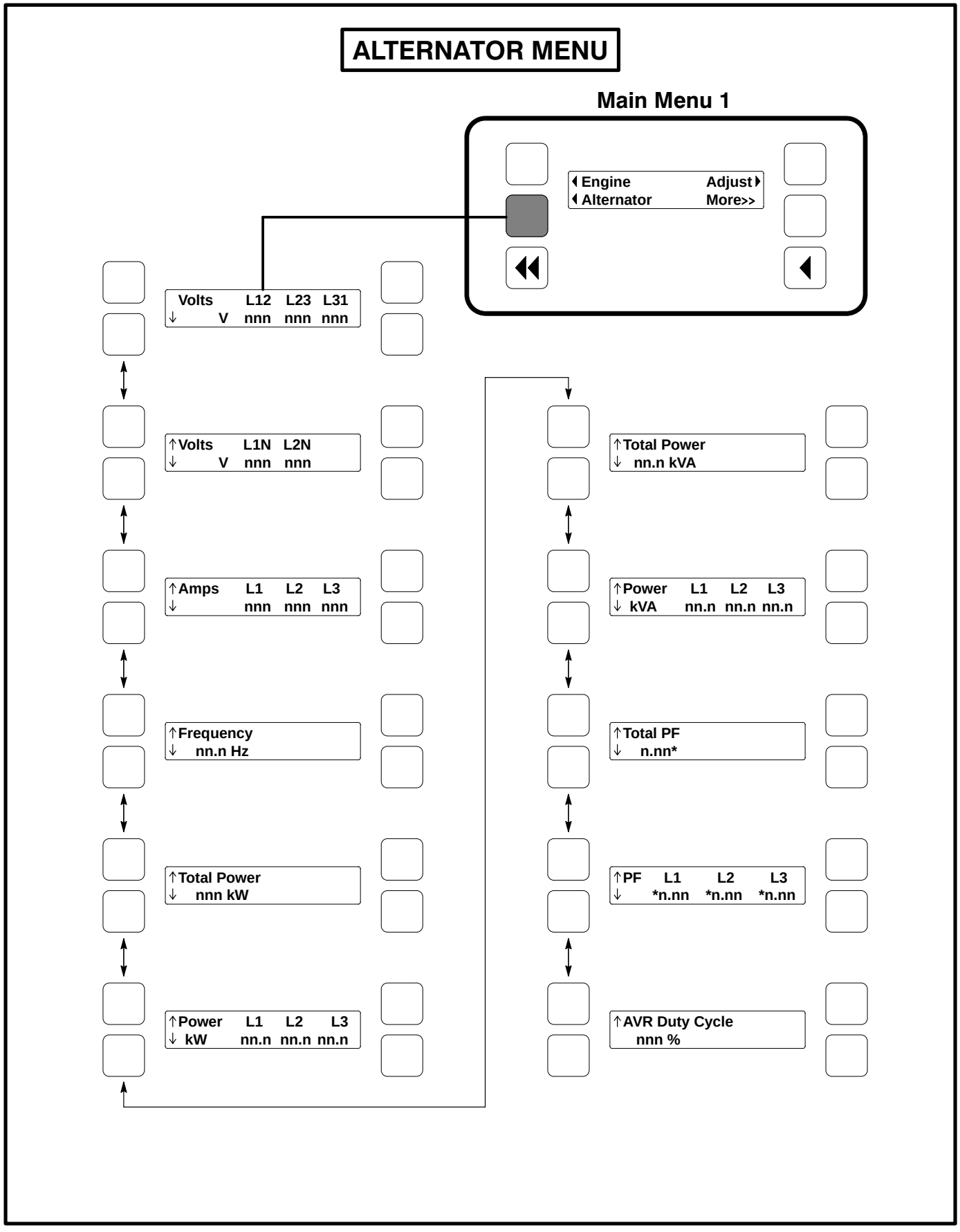

FIGURE 2-6. ALTERNATOR MENU

ADJUST MENU

Figure 2-7 shows a block representation of the Adjust menu. If you press the button next to the word “Adjust” in the display, the first Adjust submenu is displayed.

As shown in the diagram, the Adjust menu has five submenus. Each submenu includes a parameter or value that can be changed.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Home button or the Previous Main Menu button to return to Main Menu 1.

Adjusting Values/Parameters:

1.. Press the button next to the ▶ symbol in the display until the + and − symbols are displayed.

2.. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.

3.. Press the button next to the + symbol to increase the value or select parameter; press the button next to the − symbol to decrease the value or select parameter.

4.. After adjusting values/selecting parameters, pressing the ▶ symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ▶ symbol).

If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.

Voltage Adjust submenu: Voltage can be adjusted to ±5 percent of the nominal voltage. For example, if genset output voltage is 208 volts, the voltage can be adjusted from 198 to 218 volts.

If the displayed value is greater or less than the allowed (5%) range, the control will not except the entry and will return to the previous setting. Retry by entering a smaller change in one volt increments.

Frequency Adjust submenu: Frequency can be adjusted to ±5 percent of the nominal frequency. For example, if the genset frequency is 60.0 Hz, the frequency can be adjusted from 57.0 to 63.0 Hz.

Start Delay submenu: Start Delay can be set from 0 to 300 seconds (default = 0). This function is bypassed during a manual start/stop sequence.

Stop Delay submenu: Stop Delay can be set from 0 to 600 seconds (default = 0). This function is bypassed during a manual start/stop sequence and engine shutdown faults.

Rated To Idle (Beginning Version 2.303): Rated To Idle delay can be set from 0 to 10 seconds (default = 0). (Enter 1 or more to enable.) Entering a non-zero delay will cause the genset to delay the transition to Cooldown At Idle.

Idle Start submenu (Not available on all models): Idle Start can be enabled or disabled (default = Disable). This function is only enabled when the genset is started in manual mode. Idle Start can also be enabled while the set is running in manual mode.

Enabling Idle Start will cause the genset to run in idle mode until Idle Start is disabled. A warning is displayed if genset is left in idle more than 10 minutes. Long periods of engine idling can eventually affect engine performance and may void engine warranty.

The idle speed can be adjusted from 700 to 1100 RPM (default of 800 RPM). Refer to *Crank/Idle Setup Menu* in Section 5. A countdown timer is used to limit engine idle time. With InPower, idle time can be adjusted from 0 to 60 minutes in 1 minute increments.

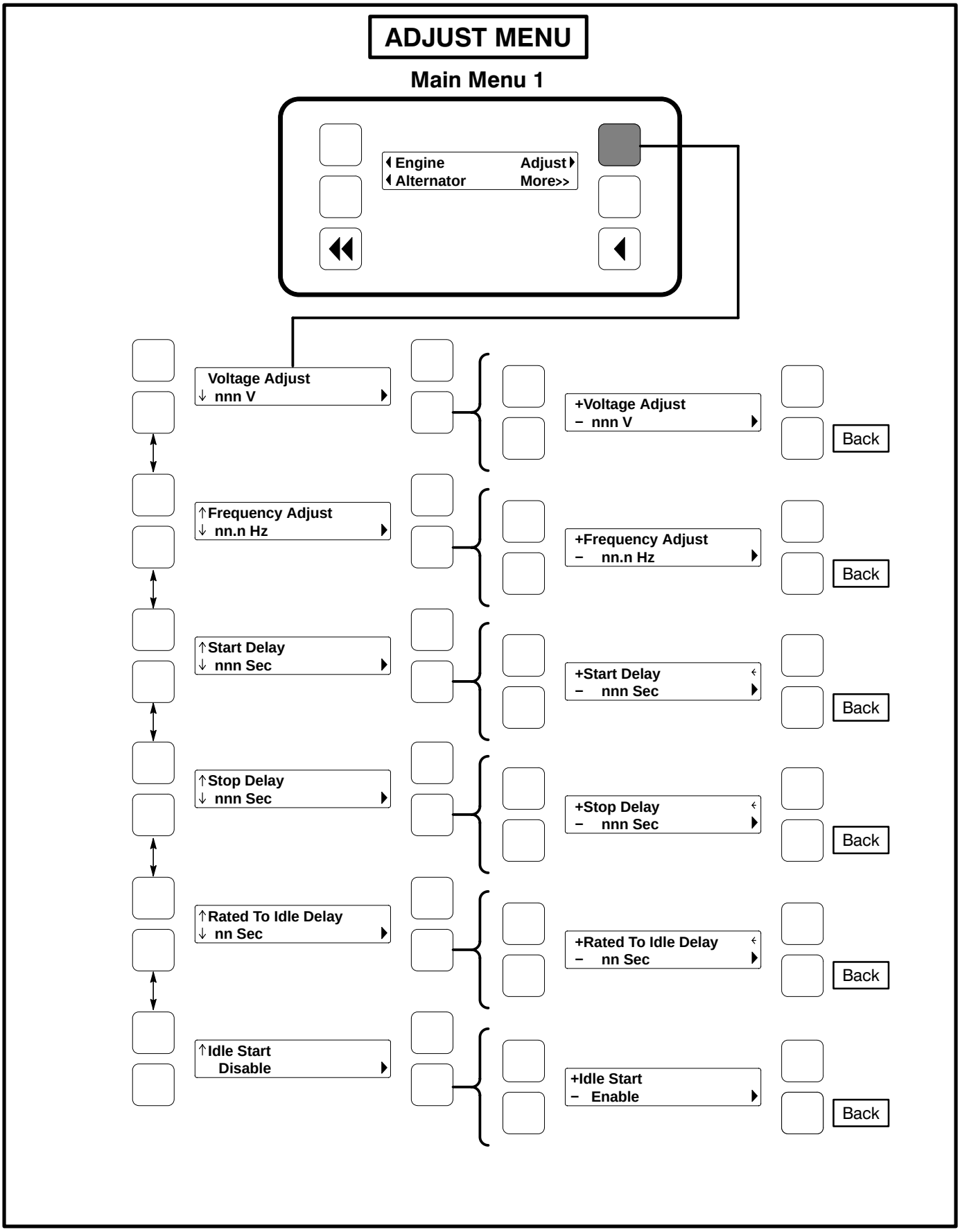

FIGURE 2-7. ADJUST MENU

FAULTS MENU

Figure 2-9 shows a block representation of the Faults menu. Up to 20 of the most recent faults can be viewed. An example of how a fault code is displayed is shown in Figure 2-8.

The available menus are dependent on the number of faults that have occurred.

- If there are *no faults*, the ◀ symbol next to the word “Faults” is not displayed and no Fault menus are available.
- If *more than one fault* has occurred, press the button next to the word “Fault” in the screen display to view the Faults Main Menu. As shown in the diagram, the Faults Main Menu has two submenus. Press the Previous Main Menu button to return to the Faults Main Menu. Press the Previous Main Menu button a second time to return to Main Menu 2.

Press the Home button at any time to return to Main Menu 1.

History submenu: From the Faults Main Menu, press the button next to the word “History” in the display to view up to twenty of the most recent acknowledged faults. Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Previous Main Menu button to return to the Faults Main Menu.

Current Fault submenu: From the Faults Main Menu, press the button next to the word “Current” in the display to view up to twenty of the most recent unacknowledged faults. Press the Previous Main Menu button to return to the Faults Main Menu.

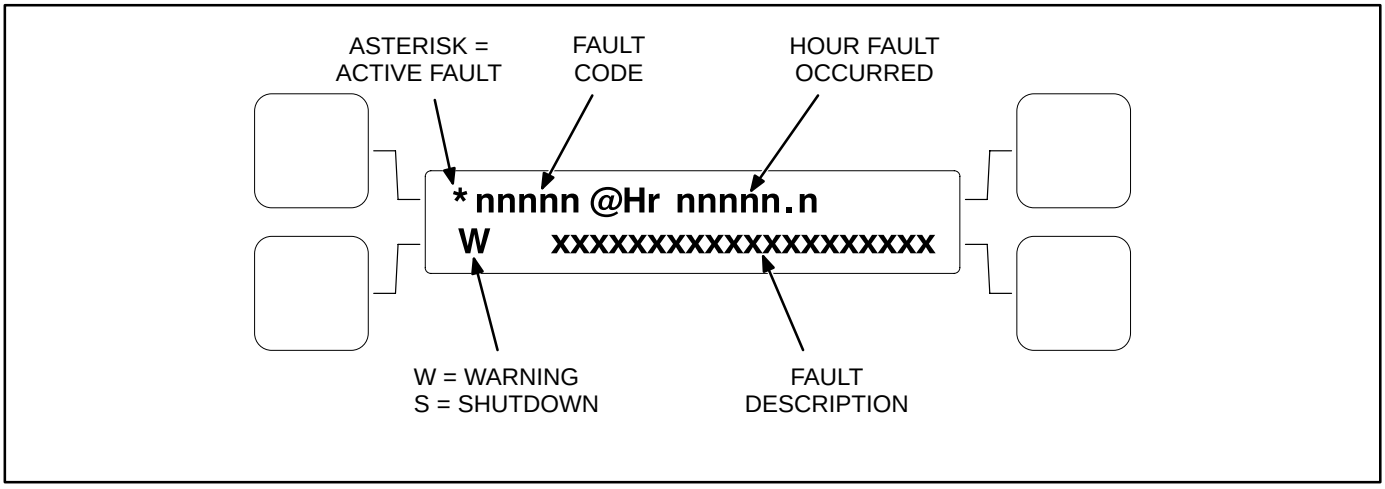

FIGURE 2-8. HISTORY/CURRENT FAULT SUBMENU

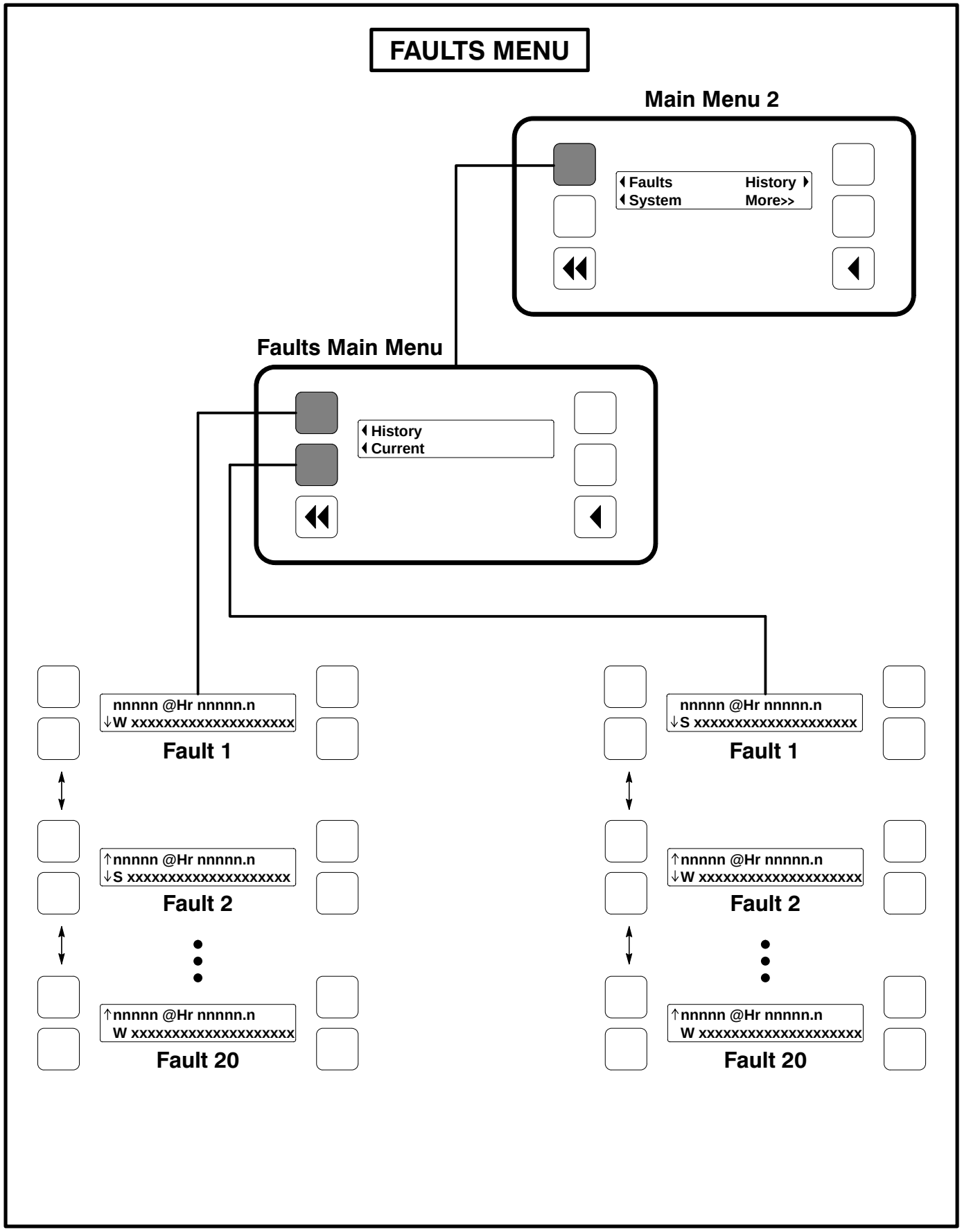

FIGURE 2-9. FAULTS MENU

SYSTEM MENU

Figure 2-10 shows a block representation of the System menu. If you press the button next to the word “System” in the display, the System Main Menu is displayed. This menu is displayed only if the network communications module (NCM) feature is installed. The System Main Menu allows you to view the status and load of other PCC equipment connected on a common network with the PCC 2100 control.

As shown in the diagram, the System Main Menu has three submenus.

When viewing ATS and Genset System submenus, press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Previous Main Menu button to return to the System Main Menu. Press the Previous Main Menu button a second time to return to Main Menu 2. Press the Home button to return to Main Menu 1.

ATS System submenus: From the System Main Menu, press the button next to the word “ATS” in the display to view the first of up to 16 ATS System submenus. An ATS system must be available in the network to display this submenu.

The ATS submenu allows viewing of the transfer switch name (configured with InPower), kW load (if monitored by the ATS system), status (e.g., not in auto), and source connected and availability (ON = source connected, OK = source available, or NA = source not available).

Master System submenu: From the System Main Menu, press the button next to the word “Master” in the display to view the Master System submenu. A master controller must be available in the network to display this submenu.

The master submenu allows viewing of the master controller name (configured with InPower), kW load and operational state.

Genset System submenus: From the System Main Menu, press the button next to the word “Genset” in the display to view the first of up to 16 Genset System submenus. One genset must be available in the network to display this submenu.

The genset submenu allows viewing of the genset name (configured with InPower), kW load and operational state.

If a PCC 2100 control genset, in the network, contains the Power Transfer Control (PTC) feature, a genset system submenu will be displayed for the genset and the ATS System submenu will be displayed for the PTC feature.

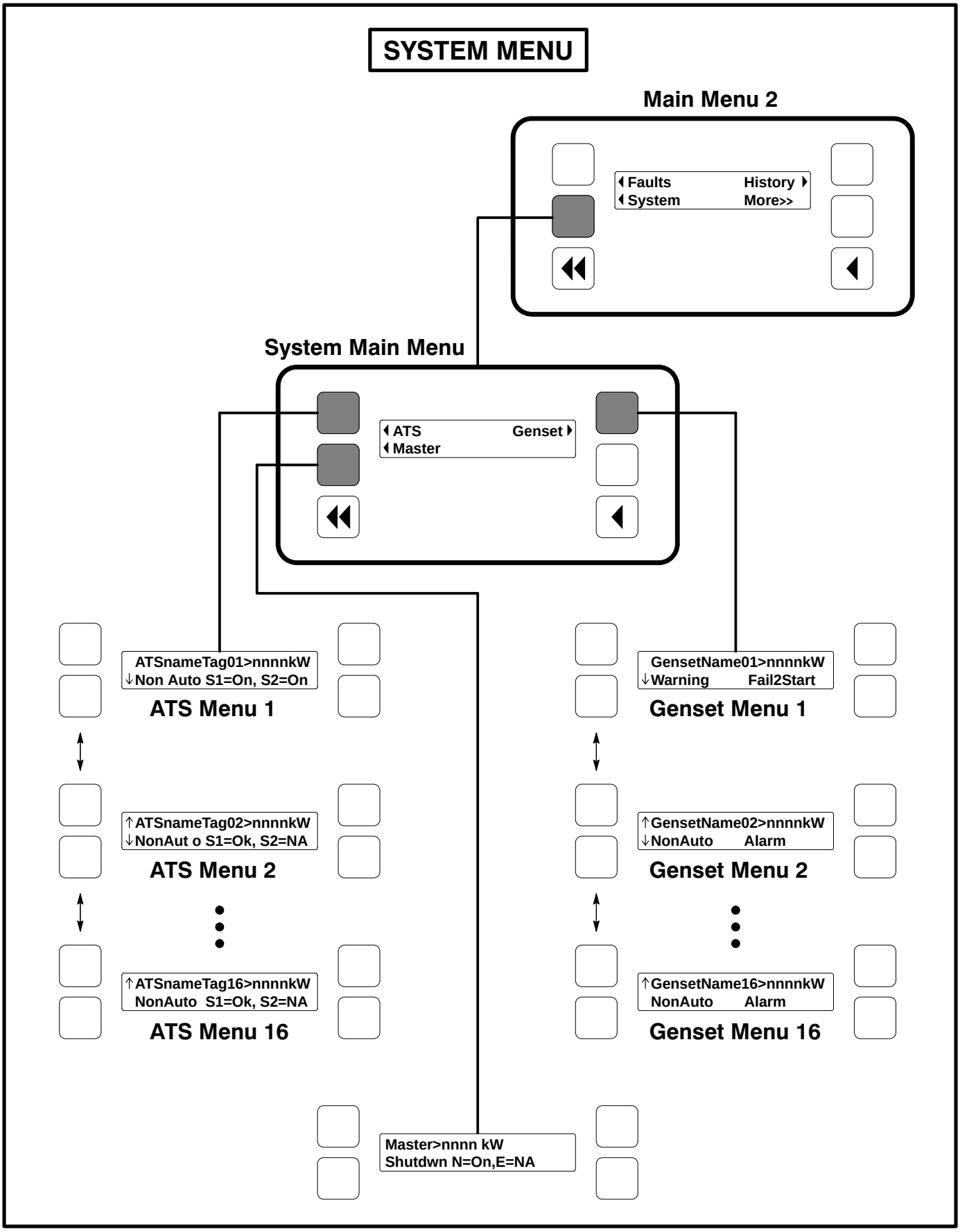

FIGURE 2-10. SYSTEM MENU

HISTORY MENU

Figure 2-11 shows a block representation of the History menu. If you press the button next to the word “History” in the display, the first History submenu is displayed.

As shown in the diagram, the History menu has five submenus. This information is stored in non-volatile memory and will not be deleted due to loss of battery power.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the the Previous Main Menu button to return to Main Menu 2. Press the Home button to return to Main Menu 1.

Number of Starts submenu: This submenu shows the number of engine starts.

Engine Hours submenu: This submenu shows the number of operating hours for the engine.

Control Hours submenu: This submenu shows the number of operating hours for the control.

Kilowatt Hours submenu: This submenu shows the number of kilowatt (kW) or megawatt (MW) hours.

Genset Duty Cycle submenu: This submenu shows the percent of genset operating hours that are less than 30 percent of rated load and percent of hours that are greater than 90 percent.

HISTORY MENU

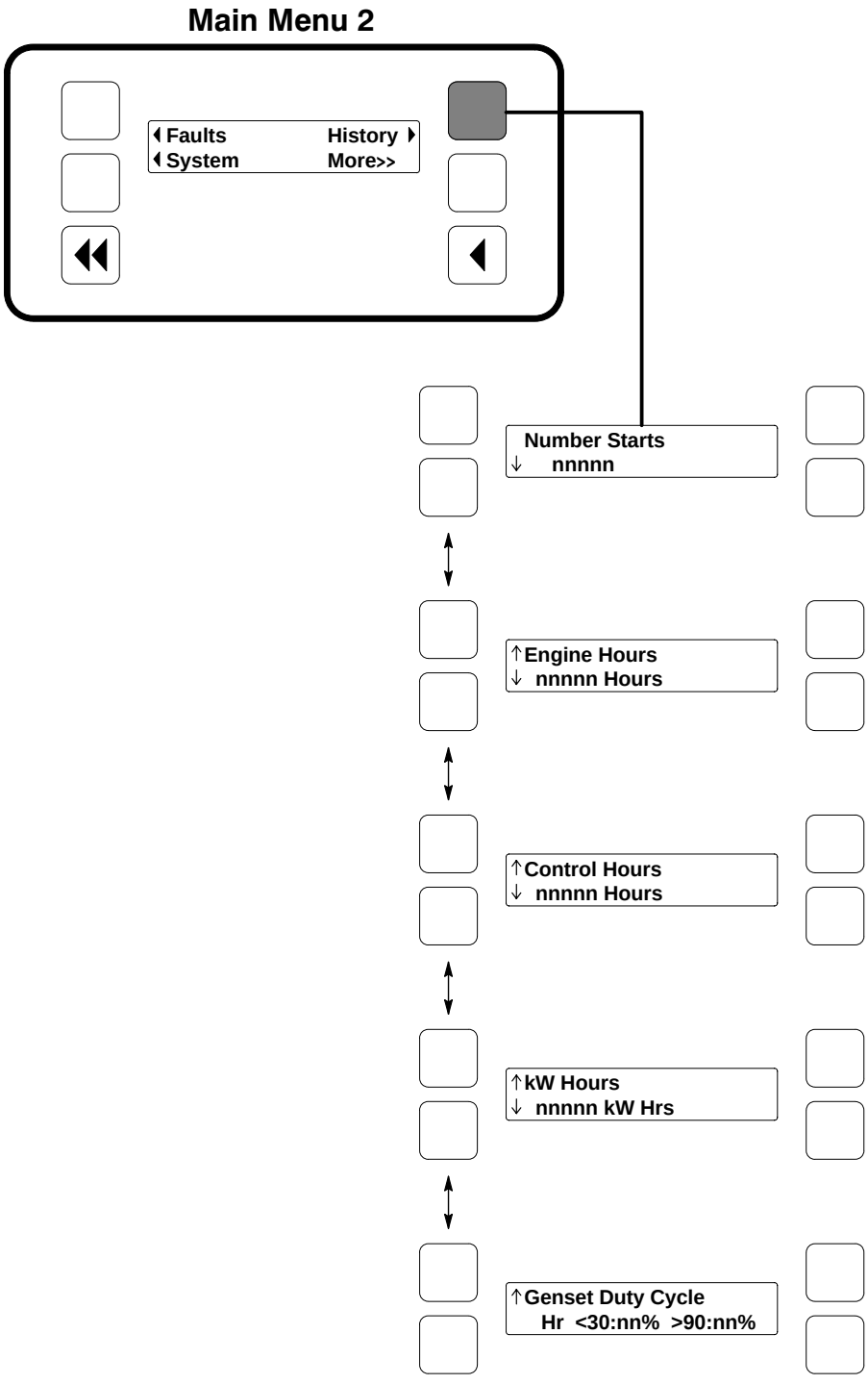

FIGURE 2-11. HISTORY MENU

ABOUT MENU

Figure 2-12 shows a block representation of the About menu. If you press the button next to the word “About” in the display, the first About submenu is displayed.

As shown in the diagram, the About menu has three submenus.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the the Previous Main Menu button to return to Main Menu 3. Press the Home button to return to Main Menu 1.

Model submenu: This submenu shows the genset model.

Rating submenu: This submenu shows the rating (Standby or Prime) and number of kilowatts (kW)).

Software Version submenu: This submenu shows the software version level. This information is required to service the generator set.

ABOUT MENU

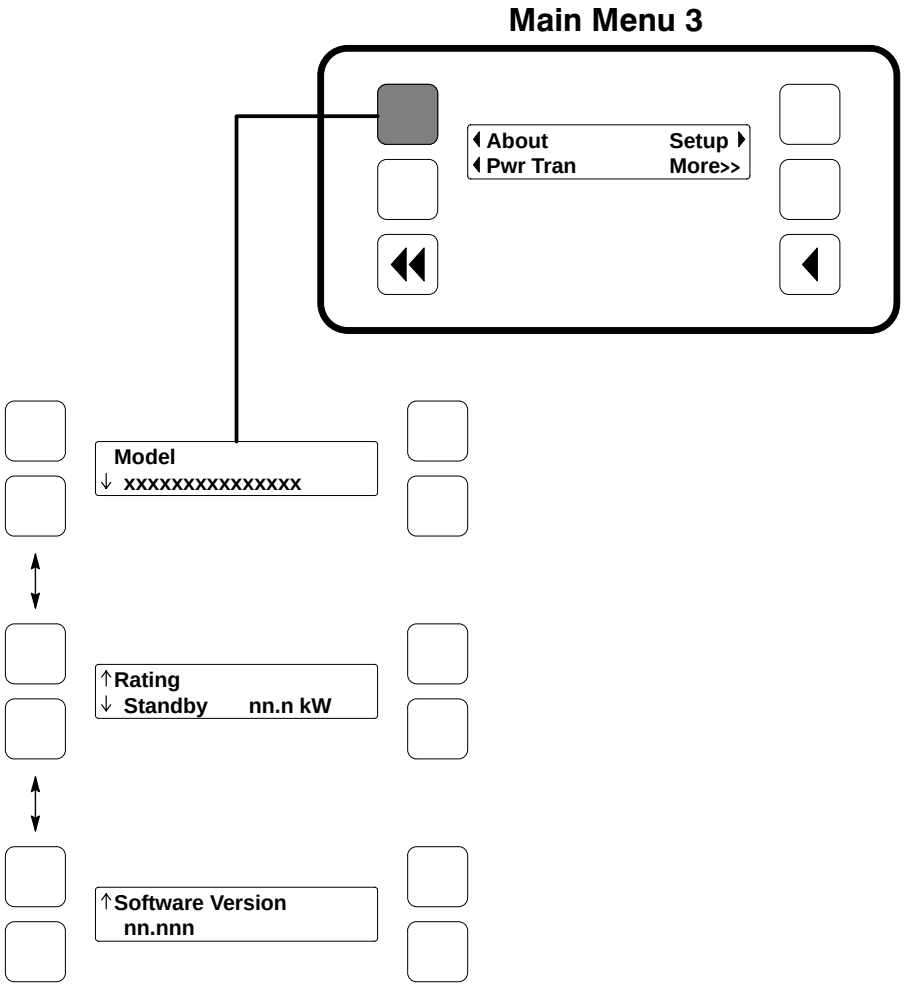

FIGURE 2-12. ABOUT MENU

POWER TRANSFER MENU

Figure 2-13 shows a block representation of the Power Transfer menu. If you press the button next to the word “Pwr Tran” in the display, the first Power Transfer submenu is displayed. (The Power Transfer Control feature must be installed to display this submenu.)

With this option installed, the control will monitor the utility voltage (mains) and frequency for failure. If power fails, the PTC control will start the generator, open the mains circuit breakers and close the generator circuit breakers.

As shown in the diagram, the Power Transfer menu has five submenus.

Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the the Previous Main Menu button to return to Main Menu 3. Press the Home button to return to Main Menu 1.

S1 (Source 1) submenu: This submenu shows power transfer source voltage. The voltages Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively. (Single phase − L1 to L2 only.)

S1 (L-N Source) submenu: This submenu is displayed only if the control system is configured for line−to−neutral voltage sensing of source 1. Single phase only − L1 to N and L2 to N.

Frequency submenu: This menu shows power transfer frequency.

Source 1 submenu: This submenu shows utility status (On, Ok, or NA). “On” means Source 1 is connected and available. “Ok” means Source 1 is available but not connected. “NA” means Source 1 is not available.

Genset submenu: This submenu shows generator status (On, Ok, or NA). “On” means the genset is connected and available. “Ok” means the genset is available but not connected. “NA” means the genset is not available.

Active Transfer Timer submenu: This submenu shows the time delay, in seconds.

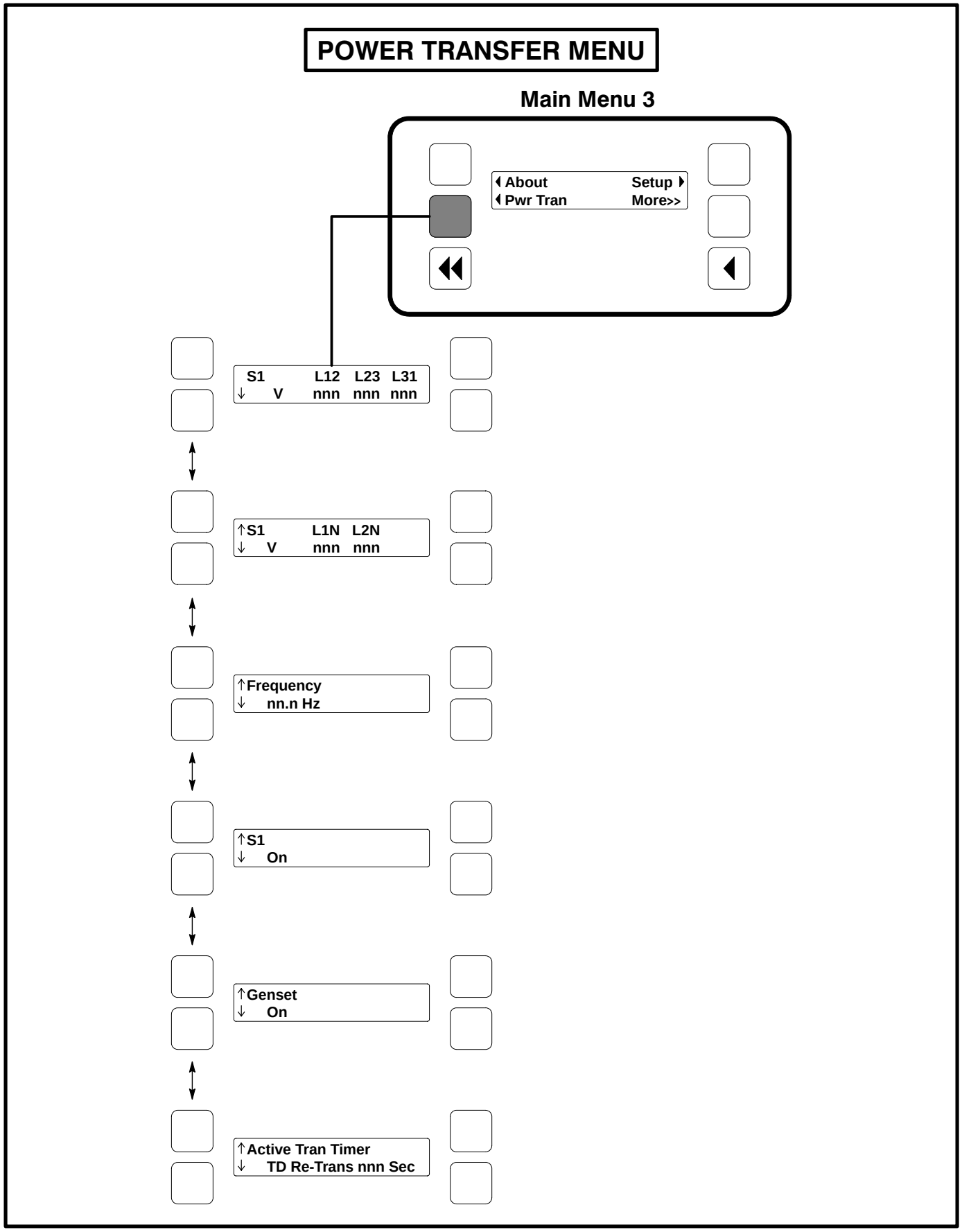

FIGURE 2-13. POWER TRANSFER MENU

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3. Circuit Boards

GENERAL

⚠WARNING ***HAZARDOUS VOLTAGE. Touching uninsulated parts inside the control panel box can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts.***

Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

This section describes the function of the PowerCommand® 2100 Control (PCC) base circuit board that is contained in the control panel box (Figure 3-1). The block diagram in Figure 3-2, shows the external connections of the PCC system. The system schematics are provided in *Section 10* of this manual.

⚠CAUTION ***Electrostatic discharge will damage circuit boards. Always wear a grounding wrist strap when touching or handling circuit boards.***

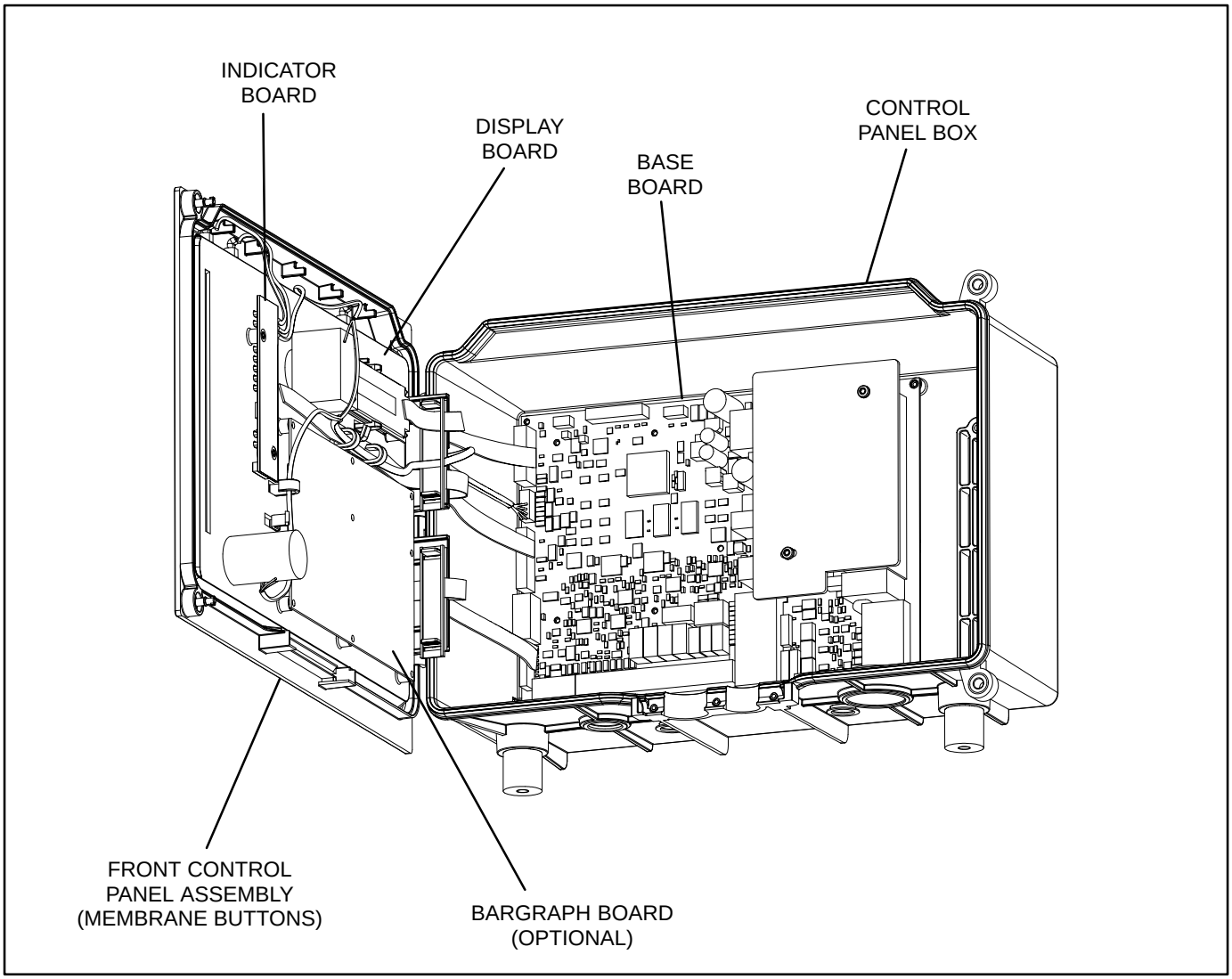

FIGURE 3-1. CIRCUIT BOARD LOCATIONS

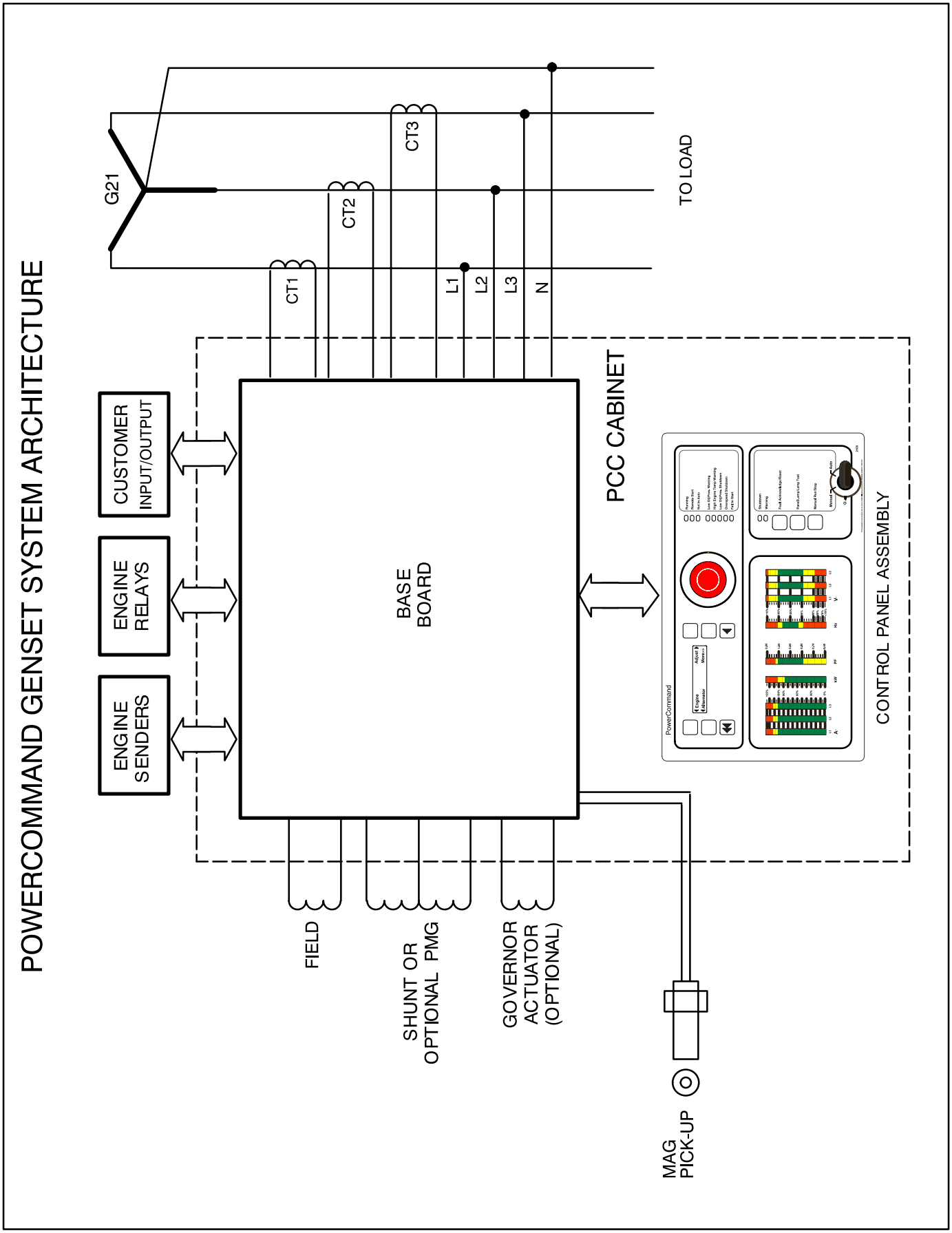

FIGURE 3-2. BLOCK DIAGRAM

BASE BOARD

The base circuit board (Figure 3-3) contains all of the electronic circuitry required to operate the generator set. The Base board provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring.

The following paragraphs describe each of the connectors (J), fuses (F) and terminal boards (TB) shown in Figure 3-3.

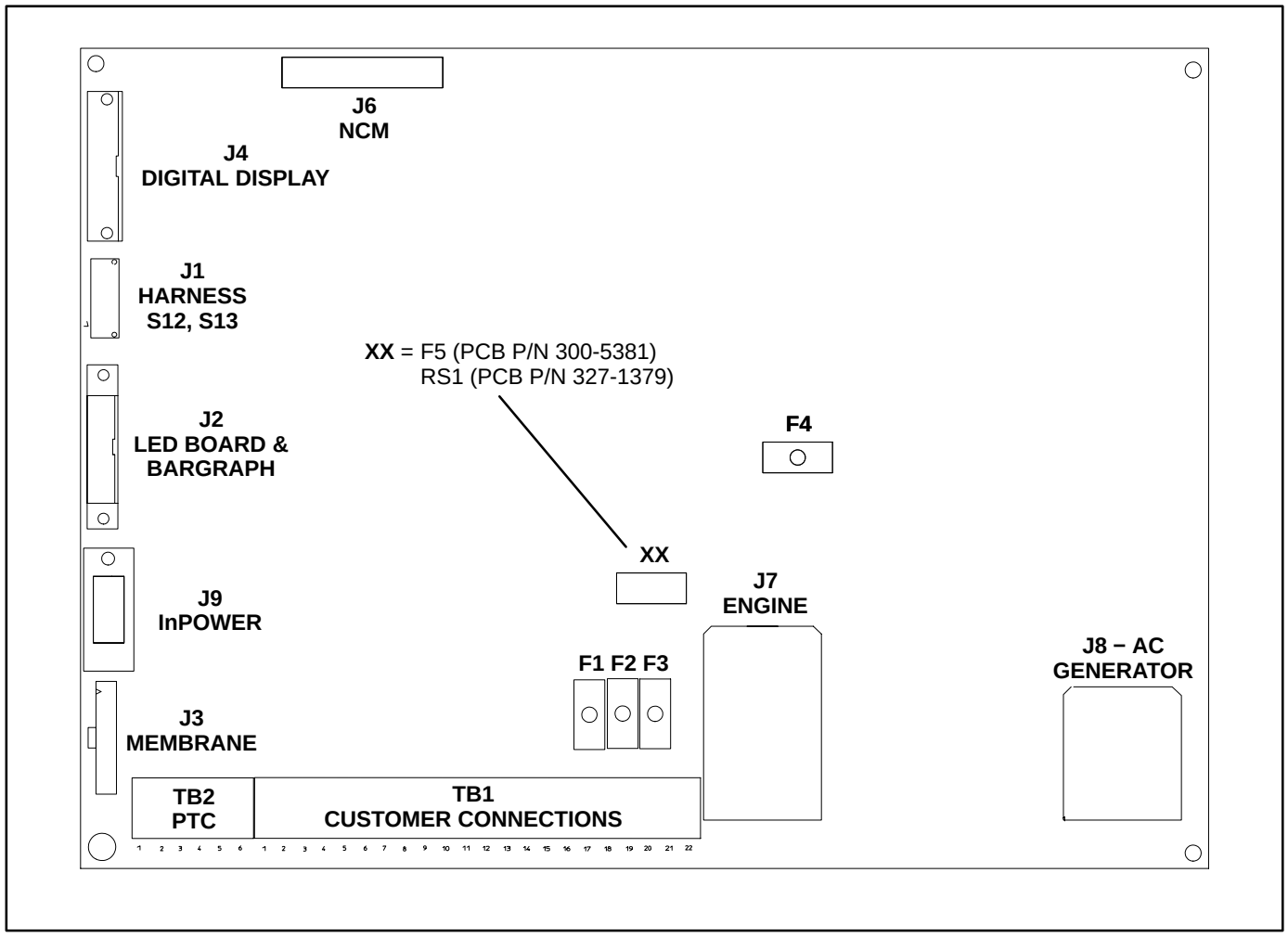

FIGURE 3-3. BASE BOARD

Connector J1

J1 connects to the Emergency Stop switch (S13) and the O/Manual/Auto control panel switch (S12).

WIRE TABULATION		
SIGNAL	**FROM**	**TO**
GND	S12-4	J1-8
OFF (O)	S12-1	J1-7
MANUAL	S12-3	J1-6
AUTO	S12-5	J1-5
ESTOP-NC1	S13-1	J1-2
ESTOP-NC2	S13-2	J1-1
ESTOP-NO1	S13-3	J1-3
ESTOP-NO2	S13-4	J1-4

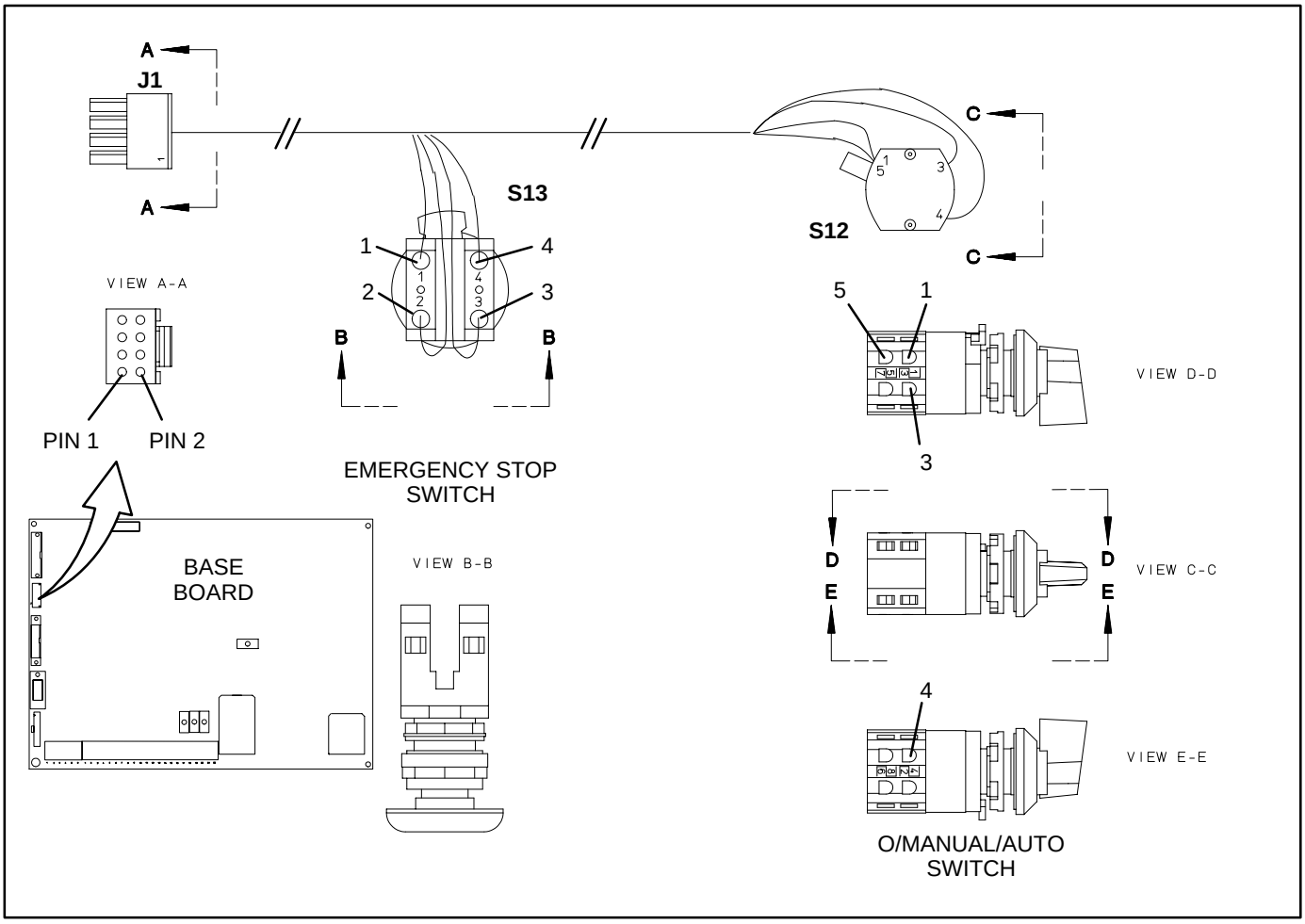

FIGURE 3-4. CONNECTOR J1 (CONTROL HARNESS)

Connector J2

J2 connects to LED (indicator) board and bargraph board of front control panel assembly.

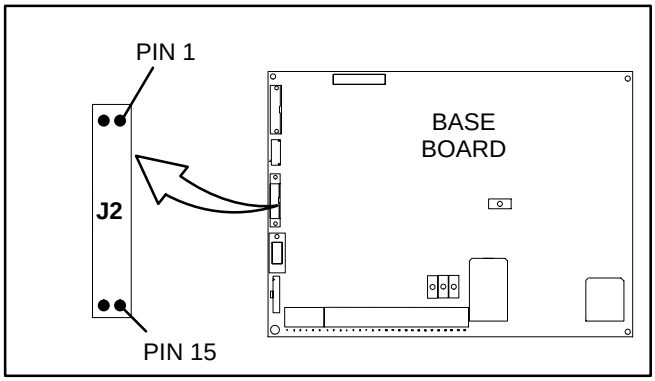

FIGURE 3-5. J2 LED/BARGRAPH CONNECTOR

CONNECTOR J2	
PIN	**SIGNAL**
1	MOSI
2, 4, 6, 16	GND
3	SCK
5	SEL_A
7	SEL_B
10, 14, 15	VCC
9	SEL_C
11	SEL_D
13	BAR_ENABLE

Connector J3

J3 connects to membrane buttons of front control panel assembly.

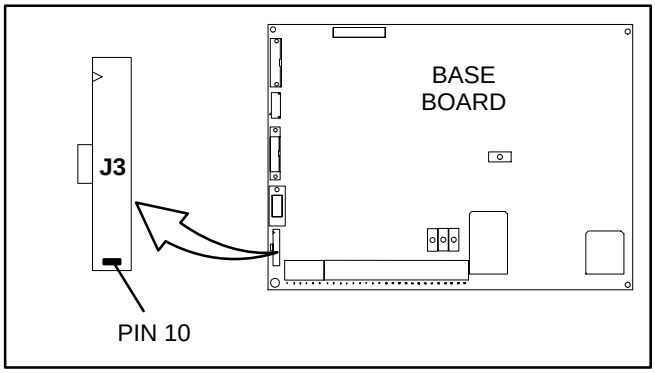

FIGURE 3-6. J3 MEMBRANE CONNECTOR

CONNECTOR J3	
PIN	**SIGNAL**
1	HOME MENU <<
2	PREVIOUS MENU <
3	UPPER LEFT
4	LOWER LEFT
5	UPPER RIGHT
6	LOWER RIGHT
7	FAULT ACK/RESET
8	PANEL LAMP
9	MANUAL RUN/STOP
10	COMMON (GND)

Connector J4

J4 connects to display menu of front control panel assembly.

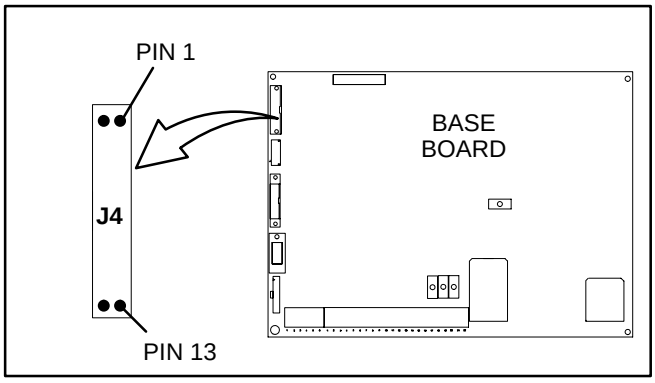

FIGURE 3-7. J4 DISPLAY MENU CONNECTOR

CONNECTOR J4	
PIN	**SIGNAL**
1	GND
2	VCC
3	N.U.
4	RS
5	R/W
6	ENABLE DISPLAY
7	D[0]
8	D[1]
9	D[2]
10	D[3]
11	D[4]
12	D[5]
13	D[6]
14	D[7]

Connector J7

J7 connects to the engine sensors, battery, starter, governor actuator and magnetic pickup.

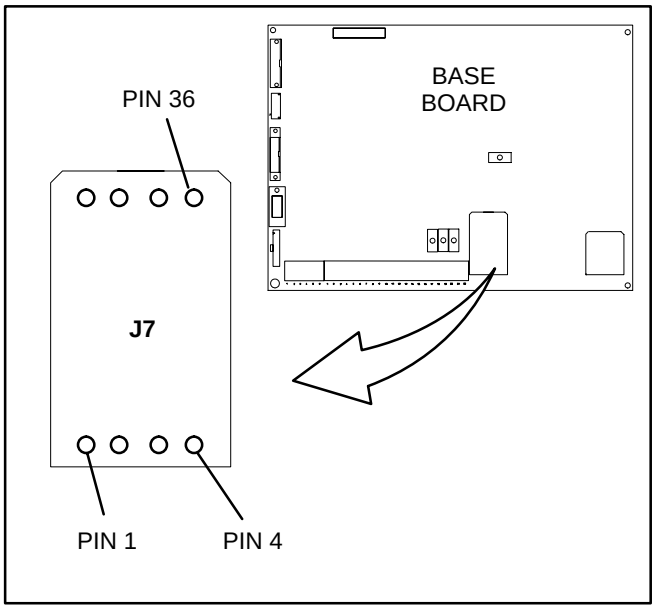

FIGURE 3-8. J7 ENGINE HARNESS CONNECTOR

CONNECTOR J7	
PIN	**SIGNAL**
5, 6, 7, 8	GND
1, 2, 3, 4	B+ IN
9 10	GEN SW B+ FUEL SOL B−
11 12	CT1 CT1−COM
13 17 21	OIL PRE OUT OIL PRE COM OIL PRE 5V
15 16	CT2 CT2−COM
18	ALT FLASHOUT
19 20	CT3 CT3−COM
22 26	OIL TEMP OIL TEMP COM
23 27	GEN SW B+ START SOL B−
24 28	ACTUATOR + ACTUATOR −
25 29 33	MAG PICKUP+ MAG PICKUP− GND
30 34	COOLANT SNDER COOLANT SNDER COM
31 32 35	COOL LVL B+ COOL LVL RTN COOL LVL GND

Connector J8

J8 connects directly to the generator to monitor and control AC output of the genset.

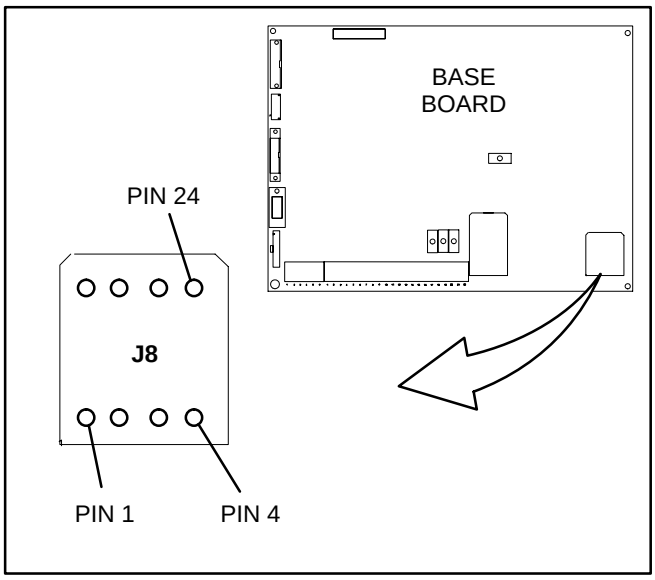

FIGURE 3-9. J8 AC GENERATOR CONNECTOR

CONNECTOR J8		
PIN	**SIGNAL**	**COMMENTS**
4 12 20 7	U1 (T1) V2 (T2) W3 (T3) N (T4)	Used for alternator voltage sensing and power factor angle sensing
13 5	FIELD + FIELD −	Excitation drive output
21 22 23	AC2 (PMG2) AC3 PMG3) AC4 (PMG4)	Used for excitation power (Shunt connection − pins 21 & 22 only)

TABLE 3-1. BASE BOARD FUSES

REFERENCE DESIGNATION	RATING	FUNCTION
F1	10A	Customer B+ (to TB1 customer terminal block)
F2	5A	Customer switched B+ (to TB1 customer terminal block)
F3	2A	Customer switched B+ (to T26 engine terminal block)
F4	5A	Base board power supply fuse
F5	2A	B+ supply to Power Transfer Control (PTC) module (optional) (PCB P/N 300-5381)
RS1 (Fuse/Auto Reset)	0.9A	B+ supply to Power Transfer Control (PTC) module (optional) (PCB P/N 327-1379)

TB1 Customer Connections

Customer monitor/control connections are attached to terminal board TB1. Optional equipment such as sensing devices used to monitor genset operation, remote start/stop switches and etc. are attached to this terminal. Refer to Customer Connections diagram in *Section 10* for TB1 connections.

TB2 Power Transfer Control (PTC) Connections

TB2 is used to connect the optional PTC module to the control. With this option installed, the control will monitor the utility voltage (mains) and frequency for failure. If power fails, the PTC control will start the generator, open the mains circuit breakers and close the generator circuit breakers. Refer to Customer Connections diagram in *Section 10* for TB2 connections.

4. Troubleshooting

GENERAL

The PowerCommand® 2100 Control (PCC) continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the PCC will light a yellow Warning lamp or a red Shutdown lamp and display a message on the digital display panel.

INPOWER SERVICE TOOL

The InPower service tool can be used in troubleshooting to perform tests, verify control inputs and outputs, and test protective functions. Refer to the InPower User's Guide, provided with the InPower software for test procedures.

InPower, when used improperly, can cause symptoms like warnings and shutdowns that appear to be a defective base board. When these problems occur, always verify that a self-test or fault simulation (override) have not been left enabled with InPower. If you do not have InPower, or the enabled fault simulation(s) can not be found using InPower, disconnect battery power to disable the test or override condition.

Make sure that parameter adjustments and time delays, related to the fault condition, have been appropriately set for the application. It may be necessary to write the initial capture file to the device or update the calibration file.

Updating a calibration file requires the InPower Pro version. Confirm that the installed calibration part number matches the serial plate information.

⚠ CAUTION ***Using the wrong calibration file can result in equipment damage. Do not swap Base boards from another genset model and only use the calibration file shown on the nameplate.***

Some features are not available until the hardware for that feature is installed and InPower Pro is used to update (enable) that feature. Confirm that the feature is installed and enabled prior to troubleshooting the base board for symptoms related to a feature.

NETWORK APPLICATIONS AND CUSTOMER INPUTS

In applications with networks and remote customer inputs, the genset may start unexpectedly or fail to crank as a result of these inputs. These symptoms may appear to be caused by the base board. Verify that the remote input is not causing the symptom or isolate the control from these inputs before troubleshooting the control.

SAFETY CONSIDERATIONS

⚠WARNING ***Contacting high voltage components can cause electrocution, resulting in severe personal injury or death. Keep the output box covers in place during troubleshooting.***

High voltages are present when the genset is running. Do not open the generator output box while the genset is running.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (−) cable first and reconnect last.

⚠CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the genset.***

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (−) cable from the battery terminal.***

When troubleshooting a generator set that is shut down, make certain the generator set cannot be accidentally restarted as follows:

1. Move the O/Manual/Auto switch on the control panel to the O position.

2. Turn off or remove AC power from the battery charger.

3. Remove the negative (**−**) battery cable from the generator set starting battery.

TROUBLESHOOTING PROCEDURE

The following tables are a guide to help you evaluate problems with the generator set. You can save time if you read through the manual ahead of time and understand the system.

Try to think through the problem. Go over what was done during the last service call. The problem could be as simple as a loose wire, an opened fuse or a tripped circuit breaker.

NOTE: Each fault code "warning" can be changed to "shutdown" using InPower. Default settings are used in this manual. It is recommended that all changes to settings be recorded at each site to aid in the troubleshooting of the genset.

This section contains the following information:

- **Table 4-1 and 4-2:** Describes how to troubleshoot a local/remote fail to crank problem when control panel does not indicate fault condition.
- **Table 4-3:** Describes each status, warning and shutdown code, warning and shutdown limits where applicable, and basic corrective actions, such as, checking fluid levels, control reset functions, battery connections, etc.
- **Fault Code Tables:** Provide detailed troubleshooting procedures. In the following tables, the fault codes are used as the table reference number and are arranged in numeric order.

Figure 4-2 shows the location of the components within the control panel that are referenced in the following troubleshooting procedures. Connector locations for each circuit board are provided in *Section 3*. The control wiring and circuit board connections are shown in *Section 10*.

⚠ CAUTION ***Always set the O/Manual/Auto switch to the O position before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.***

⚠ CAUTION ***Electrostatic discharge will damage circuit boards. Always wear a wrist strap when handling circuit boards or when disconnecting or connecting harness connectors. See Circuit Board Removal/Replacement in Section 6.***

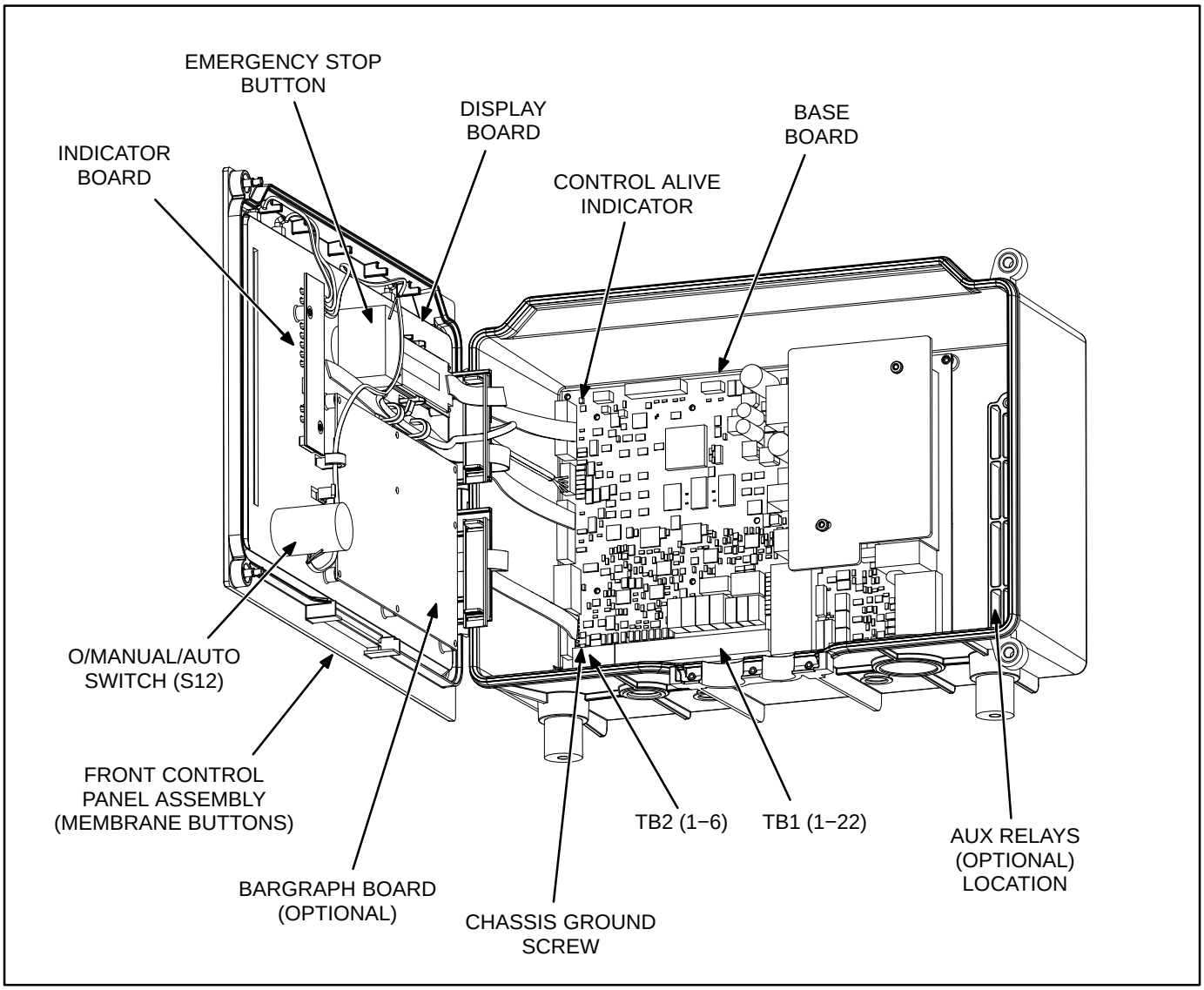

FIGURE 4-2. PCC CONTROL COMPONENTS

⚠WARNING Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.

TABLE 4-1. ENGINE DOES NOT CRANK IN MANUAL MODE (NO FAULT MESSAGE)

Reason: This indicates that the PCC has not received or recognized a manual start signal.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. No power supplied to control. (Control Alive indicator on Base board is not flashing.)	1a. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. 1b. Remove F4 and check continuity. If open, replace the fuse with one of the same type and amp rating (5 Amps). If F4 is OK, remove connector P7 and check for B+ at P7-1 through P7-4 and GND at P7-5 through P7-8. If B+ or ground missing,isolate to harness and TB BAT terminal mounted on engine block. If B+ and ground check OK, Base board may be defective. Cycle power to Base board by reconnecting P7. If Control Alive indicator does not blink, replace Base board.
2. Base board not properly calibrated or corrupt calibration. (Control Alive indicator flashes every 1/2 second.)	2. Confirm that the installed calibration part number matches the serial plate information. Re-enter calibration file if necessary. (When properly installed, Control Alive indicator flashes every second.)
3. The Emergency Stop switch or wiring is defective.	3. With Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If circuit is open, isolate to Emergency Stop switch and wiring. If there is continuity, go to next step.
4. The Manual input is not getting from the Manual select switch (S12) to the Base board indicting that S12, Base board or the harness is bad.	4. With S12 in Manual, remove connector P1 from the Base board and check for continuity from P1-6 (MAN) to P1-9 (GND). If no continuity, isolate to switch and wiring. If there is continuity, go to next step.
5. The Manual Run/Stop button, harness or the Base board is bad.	5. Remove connector P3 from the Base board and check for continuity from P3-9 (MAN RUN/STOP) to P3-10 (GND). If no continuity when pressing the Manual Run/Stop button, replace front membrane panel. If there is continuity, the Base board is bad.

⚠WARNING Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.

TABLE 4-2. ENGINE DOES NOT CRANK IN REMOTE MODE (NO FAULT MESSAGE)

Reason: This indicates that the PCC has not received or recognized a remote start signal.
Effect: Engine will not start in remote mode, but starts in manual mode.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. The remote start switch or customer wiring is faulty.	1. Reset the control. Attempt to start, and check for ground at TB1-1. If ground level is not present, isolate to the remote switch or customer wiring. Repair as necessary. If ground is present, go to next step.
2. The Auto mode input is not getting from the Auto select switch (S12) to the Base board indicting that S12, Base board or the harness is bad.	2. With S12 in Auto, remove connector P1 from the Base board and check for continuity from P1-5 (AUTO) to P1-9 (GND). If no continuity, isolate to switch or wiring harness. If there is continuity, the Base board is bad.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

TABLE 4-3. WARNING AND SHUTDOWN CODES

FAULT CODE	CORRECTIVE ACTION
121 **SPEED SIGNAL LOST** Lamp: Shutdown	Indicates mag pickup speed indication is not being sensed. Restart and check RPM on the digital display.
135 **OIL PRESSURE SENSOR H** Lamp: Warning	Indicates that the control has sensed that the engine oil pressure sender signal is shorted high. Check sender/connectors/wires.
141 **OIL PRESSURE SENSOR L** Lamp: Warning	Indicates that the control has sensed that the engine oil pressure sender signal is shorted low. Check sender/connectors/wires.
143 **PRE-LOW OIL PRES** Lamp: Warning	Indicates engine oil pressure has dropped to an unacceptable level. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow code **415** procedure.
144 **COOL SENSOR HIGH** Lamp: Warning	Indicates that the control has sensed that the engine coolant temperature signal is shorted high. Check sender/connectors/wires.
145 **COOL SENSOR LOW** Lamp: Warning	Indicates that the control has sensed that the engine coolant temperature signal is shorted low. Check sender/connectors/wires.
146 **PRE-HIGH COOL TMP** Lamp: Warning	Indicates engine has begun to overheat (coolant temperature has risen to an unacceptable level. If generator is powering non-critical and critical loads and cannot be shut down, use the following: a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow code **151** procedure.
151 **HIGH COOLANT TEMP** Lamp: Shutdown	Indicates engine has overheated (coolant temperature has risen above the shutdown trip point). Allow engine to cool down completely before proceeding with the following checks: a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Check for obstructions to cooling airflow and correct as necessary. c. Check fan belt and repair or tighten if necessary. d. Check blower fan and circulation pumps on remote radiator installations. e. Reset control and restart after locating and correcting problem.
197 **LOW COOLANT LEVEL** Lamp: Warning (Optional)	Indicates engine coolant level has fallen below the warning trip point. Allow engine to cool down completely before proceeding. a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Reset control and restart after locating and correcting problem.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
212 **OIL TEMP SENSOR H** Lamp: Warning	Indicates that the control has sensed that the engine oil temperature signal is shorted high. Check sender/connectors/wires.
213 **OIL TEMP SENSOR L** Lamp: Warning	Indicates that the control has sensed that the engine oil temperature signal is shorted low. Check sender/connectors/wires.
234 **OVERSPEED** Lamp: Shutdown	Indicates engine has exceeded normal operating speed. Possible causes are single step large block load removal, flammable vapors drawn into the intake air passage or turbocharger seals leaking oil.
235 **LOW COOLANT LEVEL** Lamp: Shutdown	Indicates engine coolant level has fallen below the shutdown trip point. Allow engine to cool down completely before proceeding. a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Reset control and restart after locating and correcting problem.
359 **FAIL TO START** Lamp: Shutdown	Indicates possible fuel system problem. (Engine cranks but fails to start) a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. b. Check for dirty fuel filter and replace if necessary. c. Check for dirty or plugged air filter and replace if necessary. d. Reset the control and restart after correcting the problem.
415 **LOW OIL PRESSURE** Lamp: Shutdown	Indicates engine oil pressure has dropped below the shutdown trip point. Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. Reset control and restart.
421 **OIL TEMP** Lamp; Warning (Optional)	Indicates engine has begun to overheat (oil temperature has risen to an unacceptable level). If generator is powering non-critical and critical loads and cannot be shut down, use the following: a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow code **151** procedure and also check engine oil level.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
441 **LOW BAT VOLTAGE** Lamp: Warning	Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation will occur. a. Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Check battery wiring/calibration. c. Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage is not obtained. d. Check battery charge voltage float level if applicable (raise float level).
442 **HIGH BAT VOLTAGE** Lamp: Warning	Indicates battery voltage supply to the control is approaching a high level at which damage to the control can occur. Check float level on battery charger if applicable (lower float level). Check battery wiring/calibration.
1123 **SHUTDOWN AFTER BS** Lamp: Shutdown	A shutdown fault occurred while Battle Short was enabled and Battle Short transitioned from enabled to disabled. Review Fault History and perform corrective action.
1124 **DELAYED SHUTDOWN** Lamp: Warning	A shutdown fault became active while the Delayed Shutdown feature was enabled. The shutdown will be delayed by the delayed shutdown time entered. Review Fault History and perform corrective action.
1131 **BATTLE SHORT ACTIVE** Lamp: Warning	Indicates that the control is in Battle Short mode − used to bypass several critical fault shutdowns for genset operation during emergencies.
1311, 1312, 1317, 1318 **CUSTOMER INPUT #1 − #4** Lamp: Warning/Shutdown or none for status message.	The nature of the fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, Low Starting Hydraulic Pressure, Low Starting Air Pressure, etc. Each of the fault functions can be programmed (using service tool), as follows: • Enable/disable input (Default: enable) • Status, Warning or Shutdown (Default: #1−None, #2 thru #4−Warning) • Active closed or open (Default: closed [ground]) • Change display name using up to 19 characters (Default: #1− Customer Fault 1, #2−Ground Fault, #3−Low Fuel, #4−Rupture Basin Fault)
1313 − 1316 **NETWORK FAULT 1 thru 4** Lamp: Warning/Shutdown or none for status message.	Indicates network input (#1−#4) is in an active state. Each of the fault functions can be programmed (using service tool), as follows: • Status, Warning or Shutdown • Change display name using up to 19 characters
1334 **CRIT SCALER OR** Lamp: Shutdown	Incorrect feature or calibration was entered into control.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
1335 **NONCRIT SCALER OR** Lamp: Warning	Incorrect feature or calibration was entered into control.
1416 **FAIL TO SHUTDOWN** Lamp: Warning	Genset continues to run after receiving shutdown command from the controller. Battle Short feature enabled − used to bypass several critical fault shutdowns for genset operation during emergencies.
1417 **POWER DOWN ERROR** Lamp: Warning	Indicates that the controller can not power down because of some unknown condition. Possible drain on battery.
1433 **EMERGENCY STOP** Lamp: Shutdown	Indicates local Emergency Stop. To reset the local/remote Emergency Stop button: 1. Pull the button out. 2. Move the O/Manual/Auto switch to O. 3. Press the front panel Fault Acknowledge/Reset button. 4. Select Manual or Auto, as required.
1434 **REMOTE E-STOP** Lamp: Shutdown	Indicates remote Emergency Stop. See code **1433** to reset.
1435 **LOW COOLANT TEMP** Lamp: Warning Set is not operating. Warning occurs when engine coolant temperature is 70° F (21° C) or lower. **NOTE: In applications where the ambient temperature falls below 40° F (4° C), Low Coolant Temp may be indicated even though the coolant heaters are operating.**	Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: a. Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. c. Open heater element. Check current draw of heater. Coolant temperature must be below 70° F (default setting) for one minute to activate warning and be above 70° F for five minutes before the warning can be cleared.
1438 **FAIL TO CRANK** Lamp: Shutdown	Indicates possible fault with control, speed sensing or starting system.
1442 **WEAK BATTERY** Lamp: Warning	Indicates that during cranking, the battery voltage is at or below the weak battery warning trip point for a time greater than or equal to the weak battery set time. See code **441** for corrective action.
1443 **BATTERY FAILED** Lamp: Shutdown	Dead battery − engine will not start. See code **441** for corrective action.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
1444 **KW OVERLOAD** Lamp: Warning	Indicates that generator output power exceeded 105% of genset rating. Check load and load lead connections.
1445 **SHORT CIRCUIT** Lamp: Shutdown	Indicates that generator output current has exceeded 175% of rated. Check load and load lead connections. (Fault may not reset for several minutes.)
1446 **HIGH AC VOLTAGE** Lamp: Shutdown	Indicates that one or more of the phase voltages has exceeded 130% of nominal, or has exceeded 110% of nominal for 10 seconds.
1447 **LOW AC VOLTAGE** Lamp: Shutdown	Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds.
1448 **UNDER FREQUENCY** Lamp: Shutdown	Indicates that engine speed has dropped below 90% of nominal for 10 seconds. Check fuel supply, intake air supply and load.
1449 **OVER FREQUENCY** Lamp: Warning	Indicates frequency is 10% above base frequency for 20 seconds.
1452 **GEN CB NOT CLOSE** Lamp: Warning	Refer to Section 5.
1453 **GEN CB NOT OPEN** Lamp: Warning	Refer to Section 5.
1459 **REVERSE POWER** Lamp: Shutdown	Indicates improper CT phasing. Check wiring to voltage sense circuit. Refer to CT Installation in *Section 6*.
1461 **LOSS OF FIELD** Lamp: Shutdown	Indicates loss of field (electric) due to reverse kVAR.
1466 **MODEM FAILURE** Lamp: Warning	Indicates that control can not communicate with the modem. Check for open, short circuit to ground, and loose connections to the modem.
1468 **NETWORK ERROR** Lamp: Warning	Indicates momentary loss of communication from the LonWorks Network. Refer to the LonWorks Network publications for more specific troubleshooting methods.
1469 **SPEED/HZ MATCH** Lamp: Shutdown	Indicates that measured speed and measured AC output frequency do not agree. Check calibration file.
1471 **OVER CURRENT** Lamp: Warning	Indicates that generator output current has exceeded 110% of rated for 60 seconds. Check load and load lead connections.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
1472 **OVER CURRENT** Lamp: Shutdown	Indicates that generator output current has exceeded 110% of rated, and that a control time/current calculation has initiated an overcurrent shutdown. Check load and load lead connections. (Fault may not reset for several minutes.)
2323 − 2326 **NETWORK FAULT 5 thru 8** Lamp: Warning/Shutdown or none for status message.	Indicates network input (#5−#8) is in an active state. See 1313−1316 fault code corrective action.
2327 **PTC FAULT** Lamp: Warning	Refer to Section 5.
2329 **LOW S1 FREQUENCY** Lamp: Warning	Refer to Section 5.
2331 Lamp: Warning	Refer to Section 5.
2335 **EXCITATION FAULT** Lamp: Shutdown	Indicates a loss of all three voltage sense leads or failure in excitation circuit. Check field wiring (X1 and X2) for shorts or opens.
2336 **MEMORY ERROR** Lamp: Shutdown	Indicates control memory error. Data corruption of critical operating parameters. Try reloading calibration file.
2337 **PWR TRAN DISABLED** Lamp: Warning	Refer to Section 5.
2338 **PWR TRAN FAILURE** Lamp: Warning	Refer to Section 5.
2339 **PWR DOWN ENABLED** Lamp: Warning	Refer to Section 5.
2341 **HIGH CONTROL TEMP** Lamp: Warning	Control temperature is above normal (158° F [70° C]) for a time greater than control temperature set time. Check genset room air flow.
2342 **TOO LONG IN IDLE** Lamp: Warning	Indicates genset has been in Idle mode too long. Exit idle mode.
2358 **HIGH S1 VOLTAGE** Lamp: Warning	Refer to Section 5.
2396 **S1 CB NOT CLOSE** Lamp: Warning	Refer to Section 5.

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TABLE 4-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
2397 **S1 CB NOT OPEN** Lamp: Warning	Refer to Section 5.
2966 **PTC TIMEOUT** Lamp: Warning	Refer to Section 5.
2967 **GOVERNOR FAULT** Lamp: Warning	Governor hardware drive circuitry contains a fault condition.
2968 **AVR FAULT** Lamp: Warning	Indicates AVR hardware contains a fault condition.
2969 **LON FAILURE** Lamp: Warning	Indicates no communications with LonWorks board.
2971 Lamp: None	Refer to Section 5.
2972 **FIELD OVERLOAD** Lamp: Shutdown	AVR Field has been at Max Field for a time greater than the allowed Max Field Time.

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CODE 121 − SPEED SIGNAL LOST (SHUTDOWN)

Reason: This indicates that the PCC is not sensing the magnetic pickup signal.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Loose or damaged magnetic pickup (MPU) wires/connector pins.	1. Inspect the wires/connector pins, and repair or replace as necessary.
2. The magnetic pickup, harness or Base board could be bad.	2. To isolate the problem, reset the control and attempt to start the set in Idle mode (select Idle Mode − Enable menu). a. If **1438** (Fail To Crank) is displayed, or if the engine starts, but then shuts down on **121** (Speed Signal Lost), the MPU sender could be bad. Remove the MPU connectors and check for 3.5 to 15 VAC at the MPU while cranking. • If no output, check for damage or debris. Also check for improper adjustment of the MPU. (Refer to *Section 6*.) If there is still no output, replace the MPU sender. • If the MPU output is OK, check for MPU voltage at P7−25 (MAG PICK+) to P7-29 (MAG PICK−) while cranking. If OK, replace the Base board. If not OK, use continuity checks to isolate connectors/harness. b. If the engine starts and idles, and does not display a fault, then there could be a frequency mismatch problem. Measure generator output frequency with a digital multimeter and compare to the frequency on the PCC display. • If they do match, multiply the frequency by 30 and compare this number to the RPM on the PCC display. If these are not the same, the MPU sender may be bad. Replace the MPU sender. • If the multimeter and PCC frequencies do not match, there is a frequency sensing problem within the Base board. Replace Base board.

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CODE 135 − OIL PRESSURE SENSOR HIGH (WARNING)

Reason: This indicates that the engine oil pressure sensor signal is shorted high.
Effect: No engine protection for oil pressure during genset operation.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. The sensor connections could be bad.	2. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
3. The sensor could be bad.	3. Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. **"OIL PRESSURE SENSOR H" warning is displayed after the fault condition is sensed for 10 seconds.** If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness could be bad.	4. Remove connector P7 from Base board and connector from sensor. Check P7-13, 17 & 21 as follows: • Check for a short circuit from pin to pin (more than 200k ohms OK). • Check for an open circuit (10 ohms or less OK). Repair or replace as necessary.
5. The Base board could be bad.	5. With all connectors attached, check pressure signal (.5 to 4.5 VDC) at P7-13 (OP OUT) and P7-17 (OP COM). If in range, replace Base board.

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CODE 141 − OIL PRESSURE SENSOR LOW (WARNING)

Reason: This indicates that the engine oil pressure sensor signal is shorted low.
Effect: No engine protection for oil pressure during genset operation.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. The sensor connections could be bad.	2. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
3. The sensor could be bad.	3. Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. **"OIL PRESSURE SENSOR L" warning is displayed after the fault condition is sensed for 10 seconds.** If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness could be bad.	4. Remove connector P7 from Base board and connector from sensor. Check P7-13, 17 & 21 as follows: • Check for an open circuit (10 ohms or less OK). • Check for a short circuit to the engine block ground (more than 200k ohms OK). • Check for a short circuit from pin to pin (more than 200k ohms OK). Repair or replace as necessary.
5. The Base board could be bad.	5. With all connectors attached, check pressure signal (.5 to 4.5 VDC) at P7-13 (OP OUT) and P7-17 (OP COM). If in range, replace Base board.

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CODE 143/415 − PRE-LOW OR LOW OIL PRESSURE (WARNING/SHUTDOWN)

Reason: Engine oil pressure has dropped below the warning/shutdown threshold for low/high oil pressure.
Effect: Calibration-dependent. No action is taken by the PCC for code **143**. Engine will shut down for code **415**.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Low oil level. Clogged lines or filters.	2. Check oil level, lines and filters. If oil system is OK but oil level is low, replenish.
3. Sensor or oil pump could be bad. Or the generator set may be shutting down on another fault.	3. Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. a. If the control responds to the simulator, reconnect the sensor, disconnect the ACT− signal wire at the fuel pump actuator, and crank the engine. Check the oil pressure reading on the digital display. • If the display shows an acceptable oil pressure, the problem may not be in the oil or oil sensing system. The genset may be shutting down on another fault (out of fuel, intermittent connector). Restart the genset and monitor the PCC display panel for other faults. • If the display does not show an acceptable oil pressure, replace the sensor. If the PCC still doesn't display an oil pressure while cranking, the oil pump may be bad. Refer to the engine service manual. If the control does not respond to the simulator, go to next step.
4. Harness or Base board could be bad.	4. If the control does not respond to the simulator, the Base board or the harness is bad. Check for +5 VDC at the sensor (lead marked E1-A). If there is no 5 VDC at the sensor: • Check for 5 VDC at P7-21. • If yes, harness is bad. If no, Base board is bad. If there is 5 VDC at the sensor, use the sensor simulator to generate a signal to P7-13 (OP OUT) and P7-17 (OP COMM). If the pressure signal (.5 to 4.5 VDC) does not get to P7, isolate to the harness. If the pressure signal does go to P7, the Base board is bad.

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CODE 144 − COOLANT SENSOR HIGH (WARNING)

Reason: This indicates that the coolant temperature sensor signal is shorted high.
Effect: No engine protection for coolant temperature during genset operation. Possible white smoke.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. The sensor connections could be bad.	2. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
3. The sensor could be bad.	3. Disconnect the sensor, and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness or Base board could be bad.	4. Measure the resistance of the coolant sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

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CODE 145 − COOLANT SENSOR LOW (WARNING)

Reason: This indicates that the coolant temperature sensor signal is shorted low.
Effect: No engine protection for coolant temperature during genset operation. Possible white smoke.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. The sensor connections could be bad.	2. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
3. The sensor could be bad.	3. Disconnect the sensor, and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness or Base board could be bad.	4a. Remove connector P7 from Base board and disconnect sensor. Check pins P7-30 (IH20) and P7-34 (IH20 COM) for short circuit as follows: • Check for a short circuit to the engine block ground (more than 200k ohms OK). • Check for a short circuit from pin to pin (more than 200k ohms OK). Repair or replace as necessary. 4b. Measure the resistance of the coolant sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

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CODE 146/151 − PRE-HIGH OR HIGH COOLANT TEMPERATURE (WARNING/SHUTDOWN)

Reason: Engine coolant temperature has exceeded the warning threshold for pre-high/high coolant temperature.
Effect: Calibration-dependent. No action is taken by the PCC for code **146**. Engine will shut down for code **151**.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Engine or sensor circuitry problem.	2. Isolate to the engine or sensor circuitry. Check the sensor accuracy with a thermocouple or similar temperature probe. • If the PCC ambient coolant temperature reading is accurate, the engine may be overheating. Refer to the engine service manual. • If the PCC ambient coolant temperature reading is not accurate, go to next step.
3. The sensor could be bad.	3. Disconnect the sensor and connect a coolant temperature sensor simulator to the harness. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness or Base board could be bad.	4. Measure the resistance of the coolant sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

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CODE 197/235 − LOW COOLANT LEVEL (WARNING/SHUTDOWN)

Reason: Engine coolant level has dropped below the warning/shutdown threshold for low/high coolant level.
Effect: No action is taken by the PCC for code **197**. Engine will shut down for code **235**.

POSSIBLE CAUSE	CORRECTIVE ACTION
The sensor, harness or Base board could be bad.	If the coolant level is normal, isolate the source of the low coolant signal. (This is a ground signal.) Disconnect the signal lead at the sender and reset the control. 1. If the **197/235** message drops out and does not reappear, replace the sender. 2. If the **197/235** message reappears and remains after control reset, remove connector P7 from Base board and check continuity from P7-32 to ground. • If there is continuity, replace the harness. • If there is not continuity, replace the Base board.

CODE 212 − OIL TEMPERATURE SENSOR HIGH (WARNING)

Reason: This indicates that the oil temperature sensor signal is shorted high.
Effect: No engine protection for oil temperature during genset operation. No effect on performance.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. The sensor connections could be bad.	1. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
2. The sensor could be bad.	2. Disconnect the sensor, and plug in the simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
3. The the harness or Base board could be bad.	3. Measure the resistance of the oil sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-22 (OIL TEMP) and P7-26 (OIL TEMP COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

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CODE 213 − OIL TEMPERATURE SENSOR LOW (WARNING)

Reason: This indicates that the oil temperature sensor signal is shorted low.
Effect: No engine protection for oil temperature during genset operation. No effect on performance.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. The sensor connections could be bad.	1. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
2. The sensor could be bad.	2. Disconnect the sensor, and plug in the simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
3. The harness or Base board could be bad.	3a. Remove connector P7 from Base board and disconnect sensor. Check pins P7-22 (OIL TEMP) and P7-26 (OIL TEMP COM) for short circuit as follows: • Check for a short circuit to the engine block ground (more than 200k ohms OK). • Check for a short circuit from pin to pin (more than 200k ohms OK). Repair or replace as necessary. 3b. Measure the resistance of the coolant sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-22 (OIL TEMP) and P7-26 (OIL TEMP COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

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CODE 234 − OVERSPEED (SHUTDOWN)

Reason: Engine speed signal indicates an engine speed greater than shutdown threshold.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Cold engine (no coolant heaters)	1. Overspeed can occur when starting a vary cold engine. Clear fault and restart genset.
2. Single step large block load removal.	2. Clear fault and restart genset.
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with InPower.	2. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
3. Monitor the engine rpm using InPower.	3. If the RPM is not correct, refer to fault code 121 for corrective action.
4. The electronic governor actuator could be bad.	4. Binding in actuator assembly of injection pump. Disassembly of injection pump may be required to inspect/repair O-rings, pump, etc. Refer to the engine service manual.

CODE 235 − LOW COOLANT LEVEL (SHUTDOWN)

Reason:
Effect:

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code **197**.	1. Refer to code **197**.

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 359 − FAIL TO START (SHUTDOWN)

Reason: This indicates that the engine failed to start after expiration of last crank time.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Restricted fuel supply due to: a. Fuel level below pickup tube in tank. b. Closed shutoff valve in supply line. c. Fuel injectors clogged. d. Air in fuel system.	1a. Add fuel if low. Prime the fuel system. 1b. Open any closed shutoff valve in the fuel line supplying the engine. 1c. Refer to engine service manual. 1d. Bleed air from fuel system. Refer to engine service manual.
2. Fuel solenoid not energized due to: a. Fuse F1 of harness assembly may be opened. b. Fuse F3 on Base board may be open. c. Base board is bad. d. K1 Fuel Pilot Relay is bad. e. Fuel solenoid is bad.	Isolate to F1, F3, K1 relay, fuel solenoid or Base board. 2a. Remove fuse F1 (located near TB BATT terminal on engine block) and check continuity. If open, replace the fuse with one of the same type and amp rating (3 Amps.) If fuse reopens, check wiring continuity of fuel solenoid circuit/test fuel solenoid. (Go to step 2e for solenoid test.) 2b. Remove fuse F3 (located on Base board) and check continuity. If open, replace the fuse with one of the same type and amp rating (2 Amps.) If fuse reopens, check wiring continuity/test K12 fuel pilot relay coil. 2c. Install harness tool between Base board P7 connector. Attempt to start and check for B+ at P9-9 (GEN SW B+) and P7-10 (FUEL SOL−). (These are the leads to the K1 coil.) • If there is no B+, the Base board is bad. • If there is B+, K1 or the harness is bad. Go to step 2d. 2d. Attempt to start and check for B+ IN (K1-30) and OUT (K1-87) • If there is no B+ IN, check for open circuit. • If There is B+ IN and not OUT, K1 is bad. • If there is B+ OUT, fuel solenoid or the harness is bad. Check circuit between K1-87 and fuel solenoid. Repair as necessary. If OK, go to step 2e. 2e. Disconnect lead to fuel solenoid. Measure the resistance of the fuel solenoid between fuel solenoid terminal and the engine block. A reading of 30 ohms indicates that the solenoid coil is OK. If coil resistance is OK, check mechanical operation of solenoid by connecting B+ to solenoid terminal. Solenoid should click when energized.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 359 − FAIL TO START (SHUTDOWN)(CONT.)

Reason: This indicates that the engine failed to start after expiration of last crank time.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
3. Injection pump actuator not energized due to the harness, governor actuator or the Base board is bad.	Isolate to harness, governor actuator or Base board. 3a. Display “Governor Duty Cycle” menu. Attempt to start and check for duty cycle (44% is about average). If percentage of duty cycle is displayed before shutdown, the harness, actuator or output circuit of Base board is bad, go to step 3b. (Duty cycle displayed indicates processor is functioning, but output circuitry of Base board could still be defective.) If the duty cycle is not displayed, the Base board is bad. 3b. Remove connector P7 from Base board and check wiring continuity of actuator circuit. P7-24 (ACT +) and P7-28 (ACT −) to appropriate +/− terminals of governor actuator. Repair as necessary. If continuity is OK, go to step 3c. 3c. Disconnect the two leads attached to the injection pump actuator. Measure the resistance across the two actuator terminals. A reading of 7.5 ohms indicates that the actuator circuit is OK. (This test only shows that the actuator circuit is not opened or shorted, but not if there is binding.) Replace actuator assembly if open or short is measured. If actuator is OK, go to step 3d. 3d. Attempt to start and check for CNTL B+ at terminal lead ACT + of governor actuator (use engine block for meter ground). If not present, Base board is bad. If CNTL B+ is present, attempt to start and check for GOV PWM (pulse width modulated) signal (measure across terminals of actuator). If not present, Base board is bad. If GOV PWM signal is present, governor actuator is bad (binding in actuator assembly of injection pump). Disassembly of injection pump may be required to inspect/repair O-rings, pump, etc. (Refer to engine service manual.)

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 415 − LOW OIL PRESSURE (SHUTDOWN)

Reason: Engine oil pressure has dropped below the shutdown threshold for high oil pressure.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code **143**.	1. Refer to code **143**.

CODE 421 − OIL TEMPERATURE (WARNING)

Reason: Engine oil temperature has exceeded the warning threshold for high oil temperature.
Effect: No action is taken by the PCC. Possible loss of performance.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault threshold is not set correctly with InPower.	1. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
2. Engine or sensor circuitry problem.	2. Isolate to the engine or sensor circuitry. Check the sensor accuracy with a thermocouple or similar temperature probe. • If the PCC ambient oil temperature reading is accurate, the engine may be overheating. Refer to the engine service manual. • If the PCC ambient oil temperature reading is not accurate, go to next step.
3. The sensor could be bad.	3. Disconnect the sensor and connect an oil temperature sensor simulator to the harness. If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.
4. The harness or Base board could be bad.	4. Measure the resistance of the oil sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-22 (OIL TEMP) and P7-26 (OIL TEMP COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 441 − LOW BATTERY VOLTAGE (WARNING)

Reason: Low voltage has been detected for battery.
Effect: PCC voltage supply approaching level at which unpredictable operation may occur.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Weak or discharged battery.	1. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).
2. Low electrolyte level in battery.	2. Replenish electrolyte and recharge battery.
3. Battery connections loose or dirty.	3. Clean and tighten or replace the battery cable connectors and cables at the battery and the set.
4. Wrong battery voltage.	4. Verify that battery voltage 12 or 24 matches calibration.
5. Insufficient battery charging voltage.	5. Adjust charge rate of battery charging circuit, according to manufactures instructions.
6. Engine DC alternator could be bad.	6. Replace engine DC alternator if normal battery charging voltage (12 to 14 or 24 to 26 VDC) is not obtained.
7. If the batteries are OK, the problem may be the harness or the Base board.	7. Remove connector P7 from Base board and check battery voltage at P7−3 (B+) to P7-7 (GND) and P7−4 (B+) to P7-8 (GND). • If the voltage at P7 is not the same as the battery voltage, the harness is bad. • If the voltage at P7 is OK, the Base board is bad.

CODE 442 − HIGH BATTERY VOLTAGE (WARNING)

Reason: High voltage has been detected for battery.
Effect: PCC damage will occur.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Excessive battery charging voltage.	1. Adjust charge rate of battery charging circuit according to manufacturers instructions.
2. Engine DC alternator could be bad.	2. Replace engine DC alternator if normal battery charging voltage (12 to 14 or 24 to 26 VDC) is not obtained.
3. Wrong battery voltage.	3. Verify that battery voltage 12 or 24 matches calibration.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1311, 1312, 1317, 1318 − CUSTOMER INPUT (WARNING/SHUTDOWN)

Reason: The nature of the fault is an optional customer selection.
Effect: Status, warning or shutdown.

POSSIBLE CAUSE	CORRECTIVE ACTION
If there is no actual fault, the problem may be an external wiring problem, active input (closed or open) selection is incorrect.	Disconnect the signal lead from TB1 and reset the control. • CUST_IN1 − TB1-4 • CUST_IN2 − TB1-5 • CUST_IN3 − TB1-6 • CUST_IN4 − TB1-7 If the message drops out, the external wiring has a short or open circuit, or the active input selection (closed/open) is not correct for customer input (use service tool to check selection).

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1435 − LOW COOLANT TEMPERATURE (WARNING)

Reason: Engine coolant temperature has dropped below the warning threshold for low coolant temperature.
Effect: No action is taken by the PCC. Engine may not start due to slow cranking speed.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with InPower.	2. Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.
3. The engine coolant heater could be bad. (Radiant heat should be felt with hand held close to outlet hose.)	3. Coolant heater not operating due to: • Coolant heater not connected to power. Check for blown fuse, or disconnected heater cord and correct as required. • Low coolant level. Look for possible coolant leakage points and repair as required. • Defective heater element/thermostat. With coolant heater removed from engine and power disconnected, flush with cold tap water for two minutes to close internal heater thermostat (opens at 100° F and closes at 80° F). Check resistance across input power leads: a. Open − replace coolant heater. b. Closed − coolant heater OK (coil resistance of 10 to 60 ohms)
4. The sensor connections could be bad.	4. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
5. The sensor could be bad.	5. Disconnect the sensor, and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If control does not respond, harness or Base board is bad.
6. The harness or Base board could be bad.	6. Measure the resistance of the coolant temperature sensor and reconnect harness to sensor. Remove connector P7 from Base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM). • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1438 − FAIL TO CRANK (SHUTDOWN) (LOCAL OR REMOTE)

Reason: This indicates that the engine failed to crank after the PCC received a start signal.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Starter is bad.	1. Reset the control. Attempt to start, and test for B+ at the starter. If there is B+ at the starter, the starter could be bad. Test starter (see engine service manual). Replace the starter. If B+ is not present at the starter, go to next step.
2. Base board is bad or fuse F3 on the Base board may be open.	2. Remove F3 and check continuity. If open, replace the fuse with one of the same type and amp rating (2 Amps). If F3 is OK, install harness tool between Base board P7 connector. Attempt to start and check for B+ at P7-23 (GEN SW B+) and P7-27 (START SOL−). (These are leads to the K4 coil.) • If there is no B+ signal, the Base board is bad. • If there is a B+ signal, the Start Pilot Relay K4 or starter circuitry is bad. Go to next step.
3. Start Pilot Relay K4 or starter circuitry could be bad.	3. Check for B+ IN at K4-1 (directly connected to battery B+). If not present, check for open circuit. If there is B+ IN, attempt to start and test for B+ OUT at K4-4. • If there is no B+ OUT at K4-4, K4 is bad. • If there is B+ OUT at K4-4, check for open circuit between K4-4 and starter.
4. The Emergency Stop switch or wiring is defective.	4. With Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If circuit is open, isolate to Emergency Stop switch and wiring. If there is continuity, go to next step.
5. MPU/circuit is bad.	5. Refer to Code **121** instructions.

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1442 − WEAK BATTERY (WARNING)

Reason: Battery is weak.
Effect: No action is taken by the PCC.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Weak or discharged battery.	1. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).
2. Low electrolyte level in battery.	2. Replenish electrolyte and recharge battery.
3. Battery connections loose or dirty.	3. Clean and tighten or replace the battery cable connectors and cables at the battery and the set.
4. Insufficient battery charging voltage.	4. Adjust charge rate of battery charging circuit, according to manufacturers instructions.
5. If the batteries are OK, the problem may be the harness.	5. Remove connector P7 from Base board. Check battery voltage at: P7-3 (CNTL) to P7-7 (GND) and P7-4 (CNTL) to P7-8 (GND) If voltage is not OK, repair defective harness.

CODE 1443 − BATTERY FAILED (SHUTDOWN)

Reason: Battery is dead.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code **1438**.	1. Refer to code **1438** instructions.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1444 − KW OVERLOAD (WARNING)

Reason: The kW has reached overload. The threshold for kW overload is 3 seconds at 110 percent of rated power output.
Effect: No action taken by the PCC.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault threshold is not set correctly with InPower.	1. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
2. Short or overload.	2. Check the load and load cables. Repair if necessary. Check operation by disconnecting load and restarting generator set.
3. Incorrect CTs or CT connections.	3. Check CTs and CT connections. Correct if necessary. Refer to *Current Transformer Installation* in *Section 6*.
4. The problem may be the Base board or harness connections.	4. Remove connector P7 from Base board. Check continuity from P7 to CTs. P7-11 (CT1) to P7-12 (CT1-COM) P7-15 (CT2) to P7-16 (CT2-COM) P7-19 (CT3) to P7-20 (CT3-COM) Repair connections.

CODE 1445 − SHORT CIRCUIT (SHUTDOWN)

Reason: This indicates that the generator output current has exceeded 175% of rated.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code **1444**.	1. Refer to code **1444**.

CODE 1471/1472 − OVER CURRENT (WARNING/SHUTDOWN)

Reason: This indicates that the generator output current has exceeded 110% of rated.
Effect: No action is taken by the PCC for code **1471**. Engine will shut down for code **1472**.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code **1444**.	1. Refer to code **1444**.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1446 − HIGH AC VOLTAGE (SHUTDOWN)

Reason: One or more of the phase voltages has exceeded 130% of nominal, or has exceeded 110% of nominal for 10 seconds.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Single step large block load removal.	2. Clear fault and restart genset.
3. Fault threshold is not set correctly with InPower.	3. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
4. Base board or generator is bad.	4. Refer to *Generator/Base Board Isolation Procedure* in *Section 7* to determine if the generator or the Base board is causing the high AC voltage shutdown fault.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1447 − LOW AC VOLTAGE (SHUTDOWN)

Reason: One or more of the phase voltages has dropped below 85% of nominal for 10 seconds.
Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with InPower.	2. Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.
3. Overload.	3. Check the load and correct any overload. Check operation by disconnecting load and restarting generator set.
4. Improper connections have been made at the generator output terminals.	4. Reconnect according to the appropriate reconnection diagram. See *Section 10*.
5. PMG or field wiring could be bad.	5. Check and repair the PMG or field wiring (*refer to Section 10*).
6. Shunt wiring connection could be incorrect.	6. Check that excitation inputs P8-21 and P8-22 are connected to the correct voltage. If misconnected to a high voltage, the AVR fault will shut down excitation and cause Low AC Voltage condition. (*refer to Section 10*).
7. The rotating rectifier assembly (diodes CR1 through CR6) is faulty.	7. Check each diode (*refer to Section 7*).
8. Loose connector or Base board is bad.	8. Repair connections (P8) or replace the Base board if necessary.

CODE 1448 − UNDER FREQUENCY (SHUTDOWN)

Reason: Generator AC output frequency is low.
Effect: Generator set will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with InPower.	2. Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.
3. Overload.	3. Check the load and correct any overload. Check operation by disconnecting load and restarting generator set.
4. Fuel or air delivery problem.	4. Refer to the engine service manual.
5. Loose connector or Base board is bad.	5. Repair connections (P8) or replace the Base board if necessary.

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

CODE 1449 − OVER FREQUENCY (WARNING)

Reason: Generator AC output frequency is high.
Effect: No action taken by the PCC.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with InPower.	2. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
3. Fuel or air delivery problem.	3. Refer to the engine service manual.
4. Loose connector or Base board is bad.	4. Repair connections (P7/P8) or replace the Base board if necessary.

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5. PTC Troubleshooting

GENERAL

This section describes the optional Power Transfer Control (PTC module) and the related Fault Codes and troubleshooting procedures.

The PTC troubleshooting procedures use fault codes, from the PCC 2100 diagnostics, and symptoms. Conditional schematics are used with the symptoms to help diagnose problems, including those not covered by the fault codes.

⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***AC power at the PTC Module or at the breakers or contactors present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

PTC MODULE

The optional PTC module is used to transfer the customer load between Source 1 (S1 utility) and Source 2 (S2 genset) as needed in the event that the utility power is unstable. The PTC module measures source 1 (Utility) voltage and frequency. The value of S1 voltage and frequency is monitored by the base board where the PCC 2100 control determines if the voltage and frequency are within limits. The system, controlled by the PCC 2100, attempts to maintain a power source for the customer load.

The PCC 2100 actively performs monitoring and control of the power source to the customer load. The PCC 2100 contains the logic and timing circuits that control the transfer sequence. This control also contains many of the customer interface circuits (including the genset start signal and network port), the RS-232 communications port for the service tool, and drivers for the control panel indicators, switches, and meters.

Utility voltage is monitored by the PCC 2100 control via voltage sensing transformers on the PTC module. The PTC module contains relays that are used to drive external relays (K20 thru K23) to perform the transfer function.

Two versions of the PTC module are available based on the application voltage. Four optional external power relays are also required. The relays must be selected based on the power rating of the switching mechanism (circuit breaker or contactor), coil voltage and mounting type. Refer to the PTC kit instructions for relay selection.

SEQUENCE OF EVENTS

The control executes a prescribed sequence of events for all PTC operations. The genset must set to the Auto position for the following sequence of events to occur. The operations for a typical loss of S1 utility power and a return of S1 utility power are:

Transfer from Source 1 (Utility) to Source 2 (Genset)

This sequence of events includes a programmed transition and begins with Source 1 (utility) available and connected. The sequence ends with Source 2 (generator) assuming the load. (See Figure 2.)

1. Source 1 fails. The control senses that Source 1 voltage and frequency are not within the specified limits with the under-voltage, over-voltage, or frequency.
2. Source 1 (Utility) is no longer within specified limits (high or low voltage, or low frequency).
3. The control initiates an engine start time delay (TDES), that delays engine start up for Source 2.

4. If TDES expires without a return to acceptable Source 1 power, the control energizes the K4 genset start pilot relay.

5. As soon as the control senses that the generator output reaches 90% (ready to load), it initiates a Transfer Time Delay (Source 1 to Source 2 transfer) to give the genset time to stabilize. The transfer time delay counts down.

6. When the transfer time delay expires, the control momentarily energizes the K22 Open Utility Relay. The K22 relay contacts close energizing S1-1, the S1 Open Coil. The S1 breaker (or contactor) opens and the S1-3 auxiliary contact opens to indicate that S1 is open.

7. The control verifies that the Source 1 breaker (or contactor) is open.

8. The control initiates a programmed transition time delay (or recharge delay), so that residual voltage from an inductive load can decay. The delay counts down.

9. When the delay expires, the control momentarily energizes K21, the Close Genset Relay. K21 contacts close energizing S2-2, the S2 Close Coil. The S2 breaker (or contactor) closes and the S2-3 contacts close to indicate that S2 is closed. The generator assumes the load. The status changes to *Genset* Connected.

Transfer from Source 2 to Source 1

This sequence of events includes a programmed transition and begins with Source 2 (generator) available and connected. The sequence ends with Source 1 assuming the load and the generator cooling down.

10. Source 1 is restored and within specified voltage and frequency limits.

11. The control senses when Source 1 output is within the specified voltage and frequency limits. The status changes to Source 1 *Utility Available*.

12. The control initiates a Retransfer Time Delay (Source 2 to Source 1) to give Source 1 time to stabilize. The Retransfer time counts down.

13. When the Retransfer time expires, the control momentarily energizes the K20 Open Genset Relay. The K20 relay contacts close energizing S1-2, the S2 Open Coil. The S2 breaker (or contactor) opens and the S2-3 contacts opens to indicate that S2 is open.

14. The control verifies that the Source 2 breaker (or contactor) is open.

15. The control initiates programmed transition time delay (or recharge delay), so that residual voltage from an inductive load can decay. The delay time counts down.

16. When the delay expires, the control momentarily energizes K23, the Close Utility Relay. K23 contacts close, energizing S2-1, the S1 Close Coil. The S1 breaker (or contactor) closes and the S1-3 contacts close to indicate that S1 is closed. The utiltiy assumes the load. The status changes to *S1 (Utility)* Connected.

17. The control initiates a TDEC (time delay, engine cool-down) to allow the engine to cool down under no load conditions. When the time delay ends the engine shuts down.

TROUBLESHOOTING USING FAULT CODES

The Digital Display shows only fault events (warnings and shutdowns). The last 20 faults can be viewed with the Digital Display. You can also read the events in the event history file by using the PC Service Tool.

Fault Events

Fault events should be considered alarms for the genset operator. They indicate that one of the power sources or the PTC is not operating correctly. Table 5-1 lists the fault codes and fault message and Table 5-2 gives corrective actions for each fault code.

The controller displays the fault message on the Digital Display and flashes the asterisk indicator. You must press the Reset button on the control panel to acknowledge a fault and clear the display.

TABLE 5-1. PTC FAULT CODES AND MESSAGES

1452	Genset CB Not Closed
1453	Genset CB Not Open
2327	PTC Fault
2329	Low S1 Frequency
2331	Low S1 Voltage
2337	PWR Tran Disabled
2338	PWR Tran Failure
2339	PWR Down Enabled
2358	High S1 Voltage
2396	S1 CB Not Close
2397	S1 CB Not Open
2966	PTC Timeout
2971	No message (PTC Test Mode Active)

TABLE 5-2. PTC FAULT CODE TROUBLESHOOTING

⚠ WARNING ***Some PTC service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of electricity and machinery hazards should perform service. See Safety Precautions.***

GENSET CB NOT CLOSED (1452)

The genset circuit breaker (S2) failed to close when PTC is enabled.

Corrective Action:

1. Refer to Toubleshooting Chart 5-4 for a listing of all the possible causes.

GENSET CB NOT OPEN (1453)

The genset circuit breaker (S2) failed to open when PTC is enabled.

Corrective Action:

1. Refer to Toubleshooting Chart 5-5 for a listing of all the possible causes.

TABLE 5-2. PTC FAULT CODE TROUBLESHOOTING (CONT.)

⚠ WARNING ***Some PTC service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of electricity and machinery hazards should perform service. See Safety Precautions.***

PTC FAULT (2327)

The PTC module or the communication link to the PTC module is not working properly when PTC is enabled.

Corrective Action:

1. Check for blinking light on the PTC module to indicate that it has power (Figure 5-1). If off, check for B+ between TB3-3 and TB3-4. Check PTC status voltage between TB3-5 and TB3-6, 0.2 VDC, if not present, see steps 2 and 3.
2. Check to make sure cable ground shield, on the cable from the PTC module is properly grounded at the PCC2100.
3. Repower the PCC2100 control to see if fault clears. (Remove power from the control for 5 seconds, then repower).

LOW S1 FREQUENCY (2329)

Low utility (S1) frequency.

Corrective Action:

1. Check S1 AC inputs and wiring to PTC at TB5.
2. Check sensor set points at PCC 2100 control.

LOW S1 VOLTAGE (2331)

Low utility (S1) voltage.

Corrective Action:

1. Utility (S1) low voltage. This is a common fault at initial startup due to a delay in sending the S1 voltage status from the PTC module, via the network connection, to the control. Clear the fault and it should not reoccur until the next S1 failure.
1. Check S1 AC inputs and wiring to PTC at TB5.
2. Check S1 pickup and dropout set points at PCC 2100 control.

POWER TRAN DISABLED (2337)

The PTC module is available, but the PTC feature is not enabled.

Corrective Action:

1. Use the InPower service tool to enable the PTC feature. After enabling the feature, cycle power off at the control for 5 seconds, then repower control.

TABLE 5-2. PTC FAULT CODE TROUBLESHOOTING (CONT.)

⚠ WARNING ***Some PTC service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of electricity and machinery hazards should perform service. See Safety Precautions.***

POWER TRAN FAILURE (2338)

The PTC module trim is enabled, but the control could not communicate with the PTC module.

Corrective Action:

1. PTC module does not have power or is not installed. Check for blinking light on the PTC module to indicate that it has power (Figure 5−1). If off, check for B+ between TB3-3 and TB3-4. Check PTC status voltage between TB3-5 and TB3-6, 0.2 VDC.
2. Reverse battery connections.
3. Cycle power off at the PCC 2100 control for 5 seconds, then repower control.

POWER DOWN ENABLED (2339)

The Power Down Mode (sleep) function is enabled, but either the PTC module or the network board is active.

Corrective Action: None required, the message indicates that the control will not go to sleep under these conditions.

HIGH S1 VOLTAGE (2358)

Indicates utility (S1) voltage has increased above the over voltage threshold.

Corrective Action:

1. Meaure S1 AC inputs at PTC module. Compare with value read using InPower. Check utility nominal voltage matches measured value.
2. Check sensor set points at PCC 2100 control.

S1 CB NOT CLOSE (2396)

Utility contact (S1) fail to close, with PTC enabled.

Corrective Action:

1. Refer to Toubleshooting Chart 5-5 for a listing of all the possible causes.

S1 CB NOT OPEN (2397)

Utility contact (S1) fail to open with PTC enabled.

Corrective Action:

1. Refer to Toubleshooting Chart 5-4 for a listing of all the possible causes.

TABLE 5-2. PTC FAULT CODE TROUBLESHOOTING (CONT.)

⚠ WARNING ***Some PTC service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of electricity and machinery hazards should perform service. See Safety Precautions.***
PTC TIMEOUT (2966) PTC module is not responding. PTC Status may be okay, but the PTC module is no longer communicating. **Corrective Action:** 1. Check PTC status light, if not flashing see steps two and three. 2. Check cable connections between PTC module and PCC 2100 control. 3. Cycle power off at the PCC 2100 control for 5 seconds, then repower control.
(2971) NO MESSAGE PTC Test Mode active. (Fault code only displayed in InPower) **Corrective Action:None required**

TROUBLESHOOTING WITH SYMPTOMS

Use the following troubleshooting guide to help diagnose PTC module problems. It is divided into sections based on the symptom. Common problems are listed with their possible causes. Refer to the corrective action column for the appropriate test or adjustment procedure.

Conditional schematics are used to highlight the circuit that is energized during the sequence of the events. Always refer to the schematic and wiring diagram package that was shipped with the equipment for specific information about its configuration.

Make a thorough inspection of the PTC installation-wiring to make sure that good wire harness and ground connections are made. Correct any wiring problems before performing tests or replacing any components.

Test Settings

The Test mode can be set to one of four different settings for use with the PTC module:

- Start at idle without load
- Start at idle with load
- Start at rated speed without load
- Start at rated speed with load

During an actual power outage the genset will start and run at rated speed with load.

Circuit Breaker Applications

When using circuit breakers as a transfer pair, make sure you find out the recharge time and enter it into the Gen. CB and S1 CB recharge delay time settings.

Troubleshooting Warnings

⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***AC power at the PTC Module or at the breakers or contactors present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

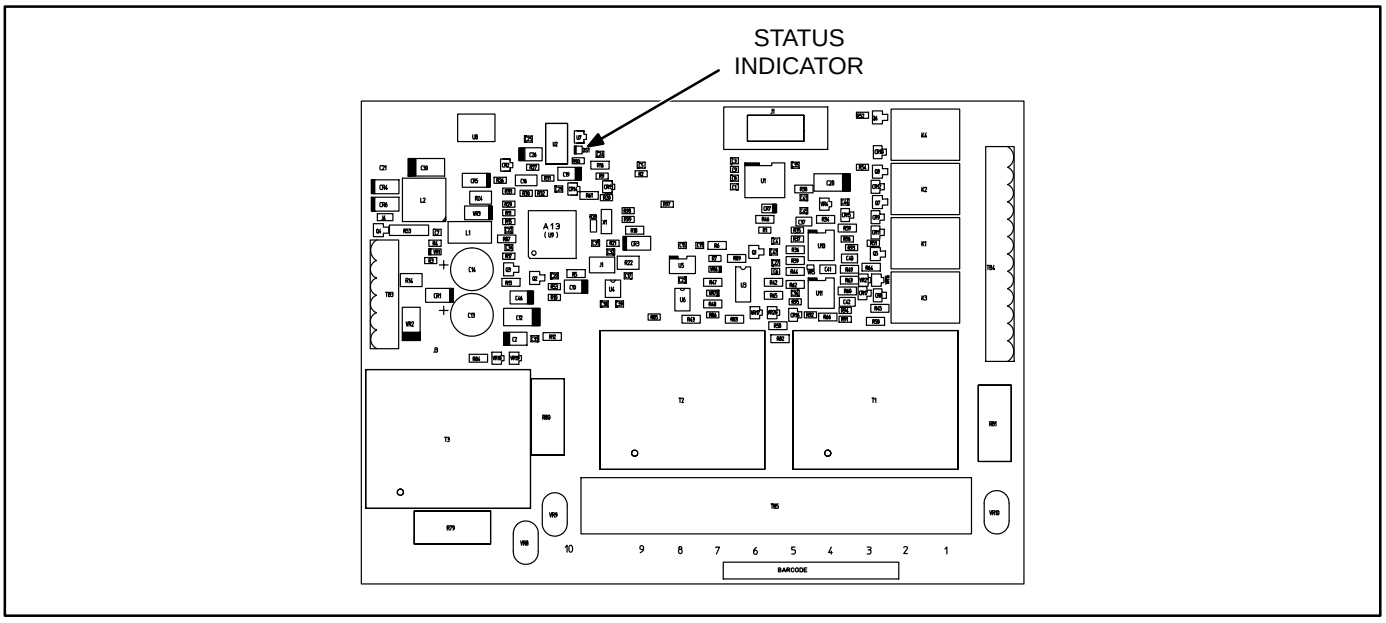

FIGURE 5-1. PTC STATUS LIGHT

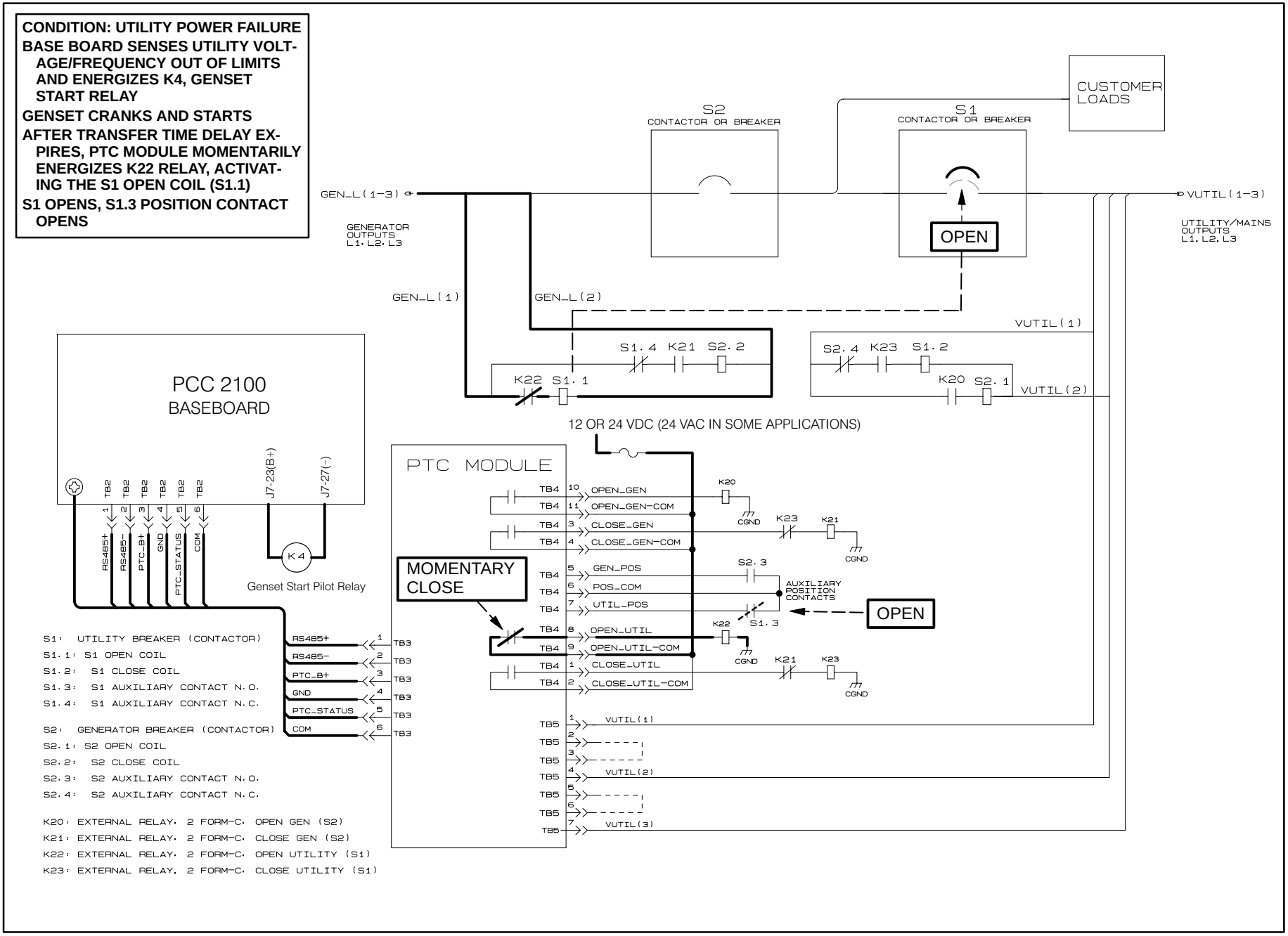

FIGURE 5-2. CONDITIONAL SCHEMATIC - LOSS OF SOURCE 1 POWER (UTILITY), GENSET STARTS, S1 OPENS

⚠WARNING ***AC power at the PTC Module or at the breakers (or contactors) present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

TABLE 5-3. SOURCE 1 (UTILITY) POWER FAILS, BUT GENSET DOES NOT START

Trouble and/or Fault Code	Possible Cause	Corrective Action
PTC Fault − 2327, 2338	1. The PTC module or the communication link to the PTC module is not working properly.	1. Check for blinking light on PTC module to indicate that it has power. If not, check for B+ between TB3-3 and TB3-4, if present, check PTC status voltage between TB3-5 and TB3-6 of approx. 0.2 VDC. If no status voltage see steps 2 and 3. 2. Make sure cable ground shield, on the cable from the PTC module is properly grounded at the PCC 2100. 3. Cycle PCC 2100 control power off for 5 seconds.
Not in Auto	1. Selector Switch on genset Not in Auto position.	1. Set selector switch on genset to Auto position. (The PTC is disabled when the switch is in the Manual position).
Start/TDES mode	1. Engine start time delay active.	1. Wait for engine start time delay to expire.
Genset cranks but does not start	1. Genset problem.	1. Check fuel system. Refer to genset troubleshooting section.
Genset does not crank	1. Wiring, Battery, or Genset problem	1a. Select Manual start on genset control. If genset starts, check wiring between the PTC module and the PCC control. If it is OK, go to next possible cause − *No genset start signal*. 1b. If it does not crank, check batteries and cable connections. 1c. If it cranks but does not start, check fuel supply and refer to genset troubleshooting section.
No Genset Start Signal (TDES expired) Fault − 1438 (Fail to Crank)	1. No genset start signal.	1. Check for start signal to the genset start pilot relay K4. Attach a voltmeter across the K4 coil and check for B+. If voltage is present, check relay K4. 2. If voltage is not present, check continuity between J7-23 and the K4 coil and between J7-27 and the K4 coil. 3. Check fuse on base board. 4. Check for open or poor wire connection to E−Stop switch on PCC 2100. 5. If the wiring and connections are good, the base board is defective.

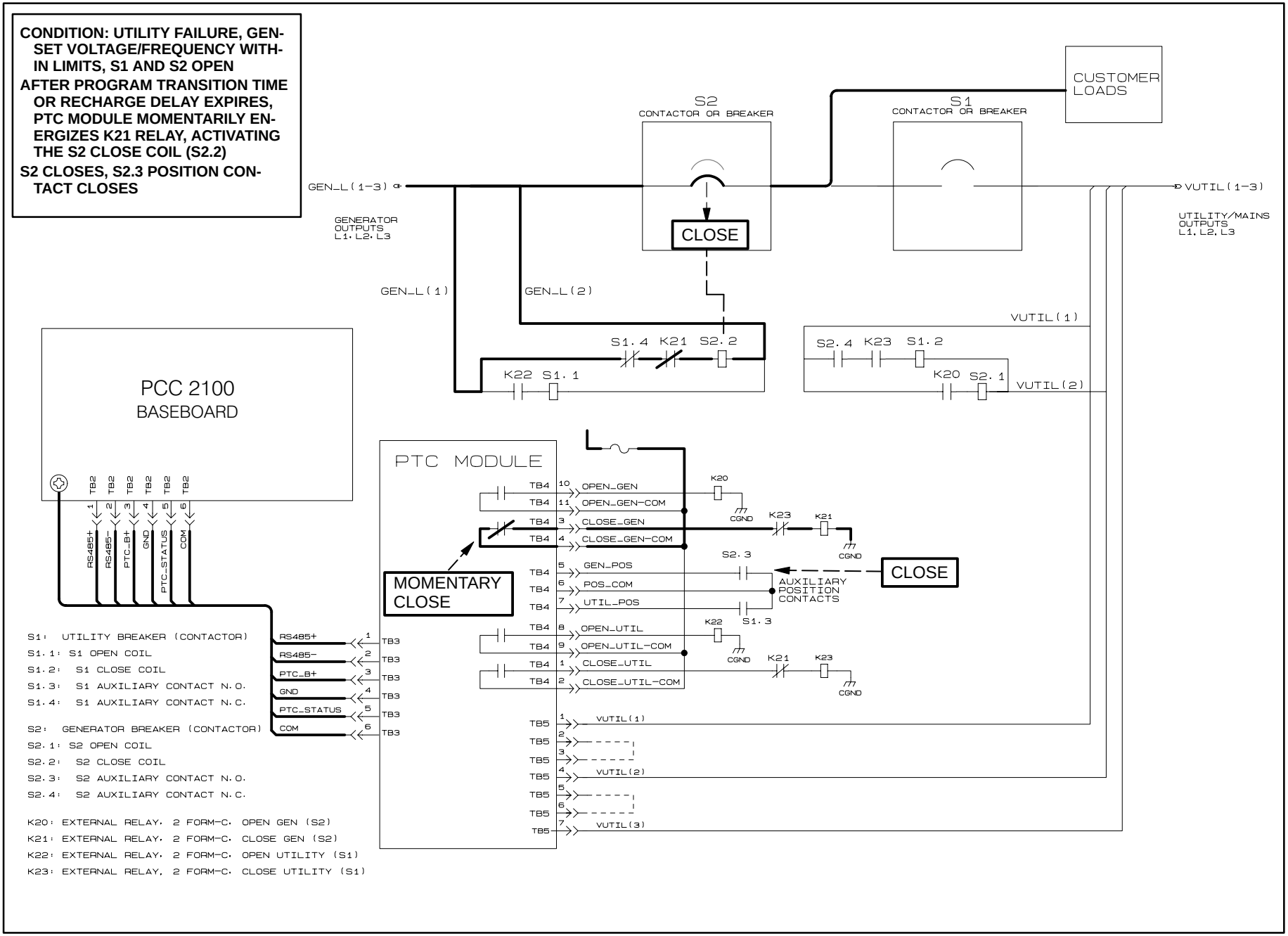

FIGURE 5-3. CONDITIONAL SCHEMATIC - GENSET AVAILABLE, S2 CLOSES

⚠WARNING ***AC power at the PTC Module or at the breakers (or contactors) present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

TABLE 5-4. GENSET STARTS, BUT DOES NOT ASSUME LOAD

Trouble and/or Fault Code	Possible Cause	Corrective Action
No S2 (Genset) Available status.	1. Genset output voltage not acceptable or Source 2 voltage settings do not match the application. 2. Genset is running at idle.	1a. Measure genset output voltage and frequency. 1b. Verify voltage settings in control display or service tool. Verify that genset ready to load status is active. 1c. Start genset manually and verify Ready to Load status goes active. 2. Verify Source 2 voltage input to base board. If input to base board matches voltage settings, base board is not calibrated correctly or is defective.
S2 (Genset) Available status displayed but genset does not assume load.	1. Transfer time delay active. 2. Program transition time delay active.	1. Wait for transfer time delay to expire. 2. Wait for program transition time to expire.
S2 (Genset) Available, S1 (Utility) remains connected "S1 CB Not Open" (Fault 2397) Refer to Figure 5-2	1. No S1 Open utility signal. K22 Open Utility external relay not energized or defective. 2. S1-1 Open coil not energized or defective. 3. S1-3 Position indicator auxiliary contacts defective.	1. Check for momentary voltage pulse at K22 relay coil between TB4-8 and ground. 2. Check for momentary source 2 voltage at S1-1 coil. If not present, check K22 contacts (should be closed during transfer). If present, check breaker or contactor. 3. Check S1-3 auxiliary contact (TB4-6 to TB4-7), with the utility breaker or contactor open, S1-3 should be open.
S2 Genset, not connected to load. "Genset CB Not Closed" (Fault 1452) Refer to Figure 5-4	1. No S2 Close genset signal. K21 Close Genset external relay not energized or defective. 2. S2-2 Close coil not energized or defective. 3. S2-3 Position indicator auxiliary contacts defective.	1. Check for momentary voltage pulse at K22 relay coil. If voltage is available between TB4-3 and ground, but not at K22 coil, check K23 NC contacts that are in series with K21 coil. 2. Check for momentary source 2 voltage at S2-2 coil. If not present, check S1-4 and K22 contacts (should be closed during transfer). If present, check breaker or contactor. 3. Check S2-3 auxiliary contact (TB4-5 to TB4-6), with the genset breaker or contactor closed, S2-3 should be closed.
Note: Transfer signals have a very short duration of 10- to 20-milliseconds. Voltage to the relay may be difficult to measure with some meters. The relays make an audible click when momentarily energized by a transfer signal.		

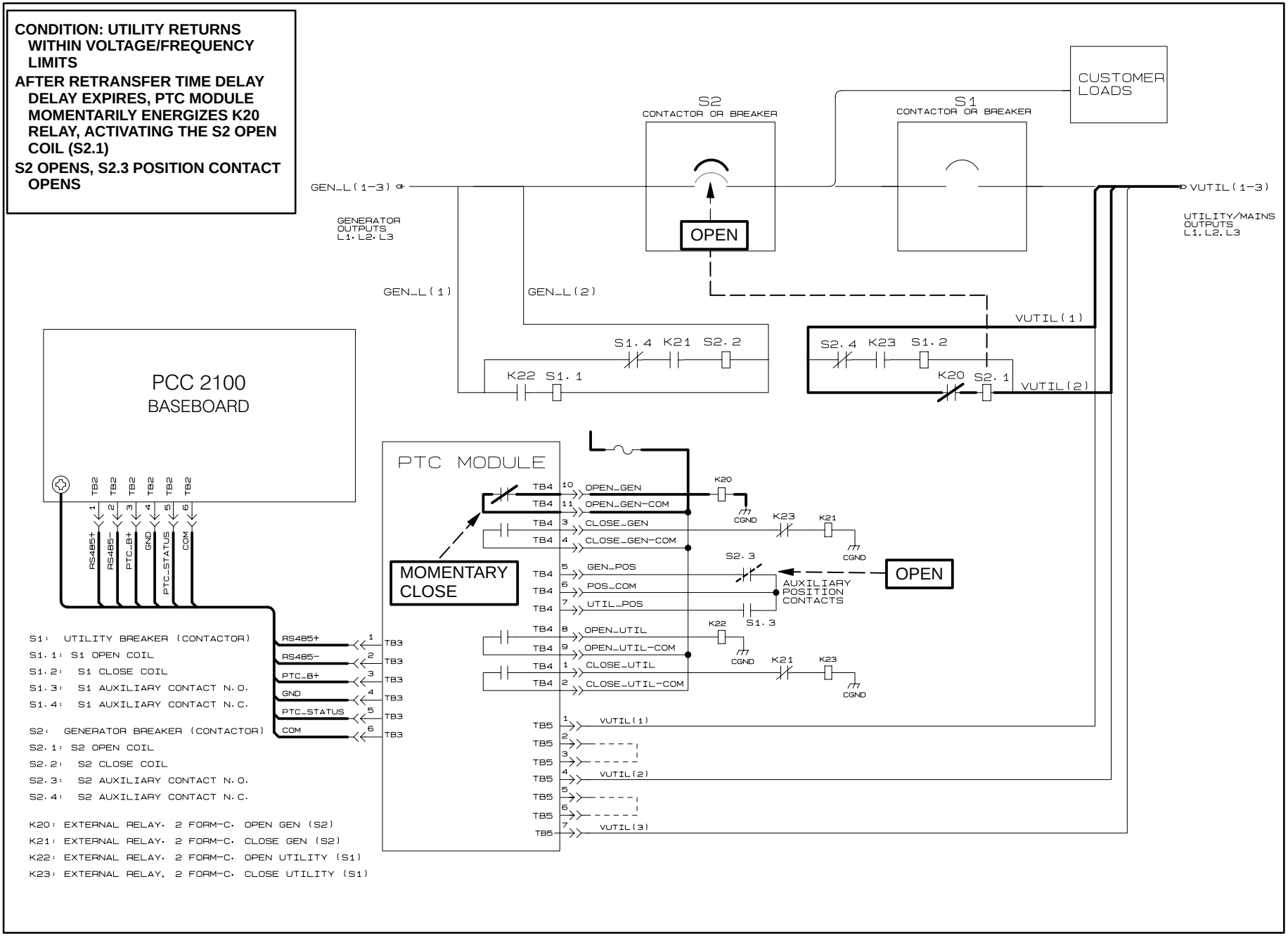

FIGURE 5-4. CONDITIONAL SCHEMATIC - SOURCE 1 AVAILABLE, S2 OPENS

⚠WARNING ***AC power at the PTC Module or at the breakers (or contactors) present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

TABLE 5-5. PTC MODULE DOES NOT RETRANSFER WHEN SOURCE 1 UTILITY POWER IS RESTORED AFTER A POWER FAILURE OR ON INITIAL INSTALLATION

Trouble and/or Fault Code	Possible Cause	Corrective Action
No S1 (Utility) Available status.	1. Not in Auto. 2. Utility output voltage not acceptable or Source 1 voltage settings do not match the application. 3. Defective PTC module.	1. Set selector switch on genset to Auto position. 2a. Measure utiltiy output voltage. 2b. Verify voltage settings in control with digital display or service tool. 3. Verify Source 1 voltage input to PTC module. If input to PTC module matches voltage settings, PTC module is defective.
S1 (Utility) Available status displayed but utility does not assume load.	1. Transfer time delay active. 2. Program transition time delay active.	1. Wait for transfer time delay to expire. 2. Wait for program transition time to expire.
S1 (Utility) Available, Genset remains connected “CB Not Open” (Fault 1453) Refer to Figure 5-4	1. No S2 Open genset signal. K20 Open Genset external relay not energized or defective. 2. S2-1 Open coil not energized or defective. 3. S2-3 Position indicator auxiliary contacts defective.	1. Check for momentary voltage pulse at K20 relay coil between TB4-10 and ground. 2. Check for momentary source 1 voltage at S2-1 coil. If not present, check K20 contacts (should be closed during transfer). If present, check breaker or contactor. 3. Check S2-3 auxiliary contact (TB4-5 to TB4-6), with the genset breaker or contactor open, S2-3 should be open.
S1 (Utility) Available, S1 open, S2 Genset, not connected to load. “S1 CB Not Closed” (Fault 2396) Refer to Figure 5-5	1. No S1 Close utility signal. K23 Close Utility external relay not energized or defective. 2. S1-2 Close coil not energized or defective. 3. S1-3 Position indicator auxiliary contacts defective.	1. Check for momentary voltage pulse at K23 relay coil. If voltage is available between TB4-1 and ground, but not at K22 coil, check K21 NC contacts that are in series with K21 coil. 2. Check for momentary source 1 voltage at S1-2 coil. If not present, check S2-4 and K23 contacts (should be closed during transfer). If present, check breaker or contactor. 3. Check S1-3 auxiliary contact (TB4-6 to TB4-7), with the utility breaker or contactor closed, S2-3 should be closed.
Test with Load Active	1. Test with load active.	1. Wait for Test to complete or deactivate remote start to end test.
Note: Transfer signals have a very short duration of 10- to 20-milliseconds. Voltage to the relay may be difficult to measure with some meters. The relays make an audible click when momentarily energized by a transfer signal.		

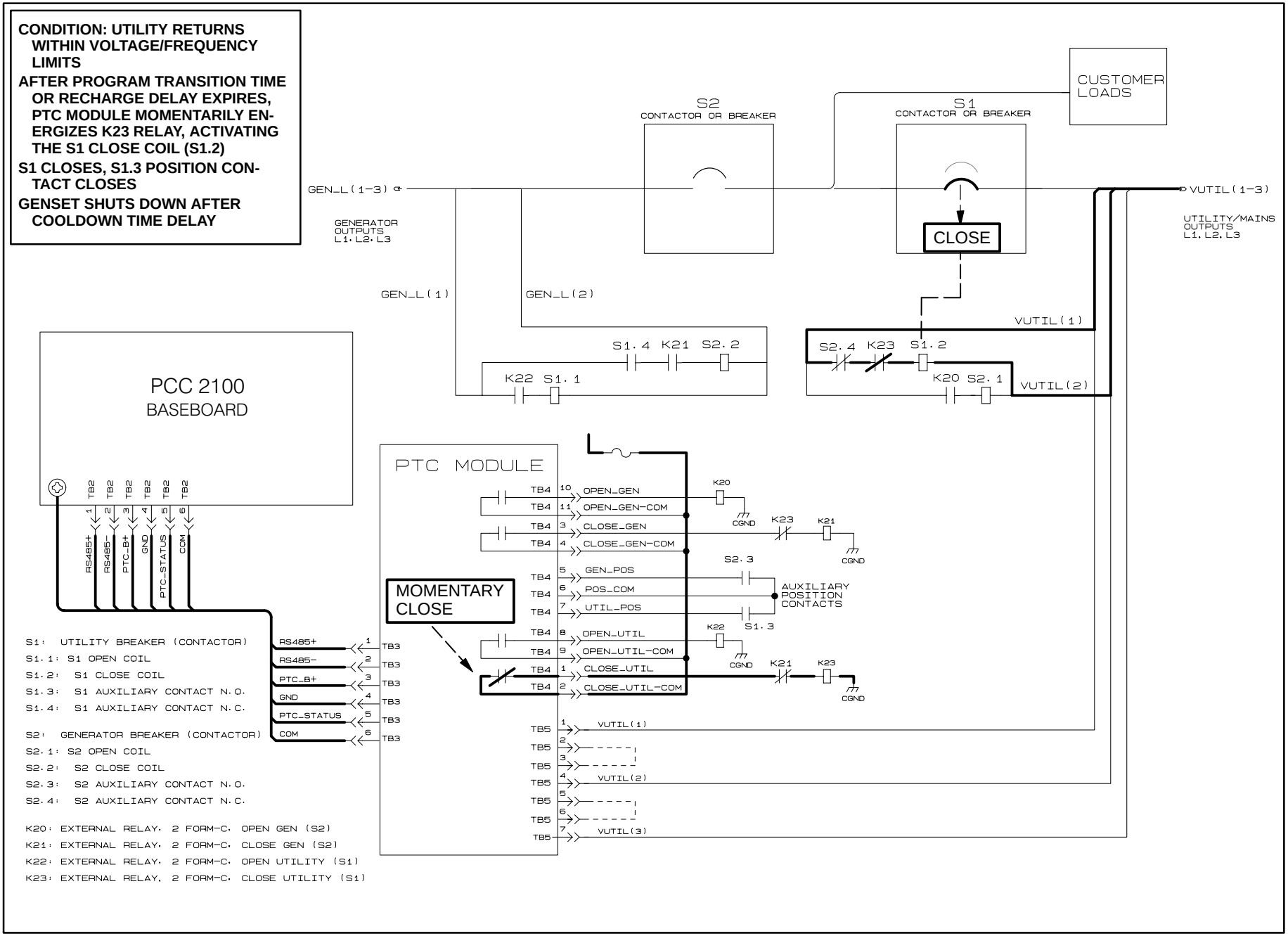

FIGURE 5-5. CONDITIONAL SCHEMATIC - SOURCE 1 AVAILABLE, S1 CLOSES

⚠WARNING ***AC power at the PTC Module or at the breakers (or contactors) present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts with body, tools, jewelry, hair, clothes, etc. Remove power from both source 1 and source 2 before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

TABLE 5-6. GENSET CONTINUES TO RUN AFTER RETRANSFER OF LOAD TO S1 UTILITY

Trouble	Possible Cause	Corrective Action
Genset continues to operate after retransfer	1. Time Delay Engine Cool-down (TDEC) still active. 2. Cool down idle running	1. Wait for TDEC to expire. 2. Wait for cool down idle to expire.
Remote Start Active	1. RMT signal still active.	1. Measure voltage between TB1-1 and TB1-20 (GND.). Zero VDC indicates an active RMT signal that holds the genset ON.

TABLE 5-7. GENSET STARTS DURING NORMAL POWER SERVICE

Trouble	Possible Cause	Corrective Action
Genset starts during normal power service.	1. Remote test customer input. 2. Momentary source 1 utility voltage dip. 3. Customer supplied exercise clock active. 4. PTC Module no longer sensing Source 1 voltage.	1. Check for remote test input at J4-5. 2. Check undervoltage settings, adjust if needed. 3. Refer to customer supplied exerciser clock settings. 4. Verify Source 1 voltage input to PTC Module.

TABLE 5-8. GENERATOR TEST RUNS BUT GENSET DOES NOT ASSUME LOAD

Trouble	Possible Cause	Corrective Action
Genset test runs but does not assume load.	1. Control programmed to test without load.	1. Check or change program with Digital Display or PC Service tool to Test with load.

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6. Control Adjustment and Service

GENERAL

This section contains circuit board removal and replacement procedures and adjustment procedures for the genset control.

This section also describes the function and operation of engine sensors, genset options, and other special features of the genset control system, such as, customer connection points, optional run relays, etc. Installation information is also provided for these items where necessary.

⚠WARNING ***Incorrect service or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical service.***

⚠WARNING ***HAZARDOUS VOLTAGE. The PCC2100 control box must be opened only by technically qualified personnel. Voltages of up to 600 VAC are present in the PCC box. These voltages can cause electrical shock, resulting in personal injury.***

CIRCUIT BOARD REMOVAL/REPLACEMENT

No special tools (other than a grounding wrist strap and InPower Service tool) are required to remove a circuit board from inside the control box. The InPower Service tool is required when replacing the Base board.

Before replacing the Base board, make sure that a capture file of the genset's parameter values has been created using InPower. (During genset installation, it was suggested that a capture file be made before and after changes were made to the genset operating parameters.)

After replacing the Base board, use the capture file as a template to write the previous settings to the new Base board software.

Refer to INPOWER User's Guide for specifics.

Circuit Board Removal Safety Precautions

To prevent circuit board damage due to electrostatic discharge (ESD), a grounding wrist strap must be worn when handling circuit boards or socket-mounted IC's. (The wrist strap **does not** provide a direct short to ground, but is typically rated at approximately 1 megohm to ground.)

Attach the clip to the chassis ground screw in the control box and place the strap around your wrist before handling a circuit board.

⚠ CAUTION ***Electrostatic discharge will damage circuit boards. Always wear a grounding wrist strap when handling circuit boards or socket-mounted IC's.***

Turn off or remove AC power from the battery charger and then remove the negative (**–**) battery cable from the set starting battery. This is to make sure that the set will not start while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (−) cable first and reconnect last.

⚠ CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (−) cable from the battery terminal.***

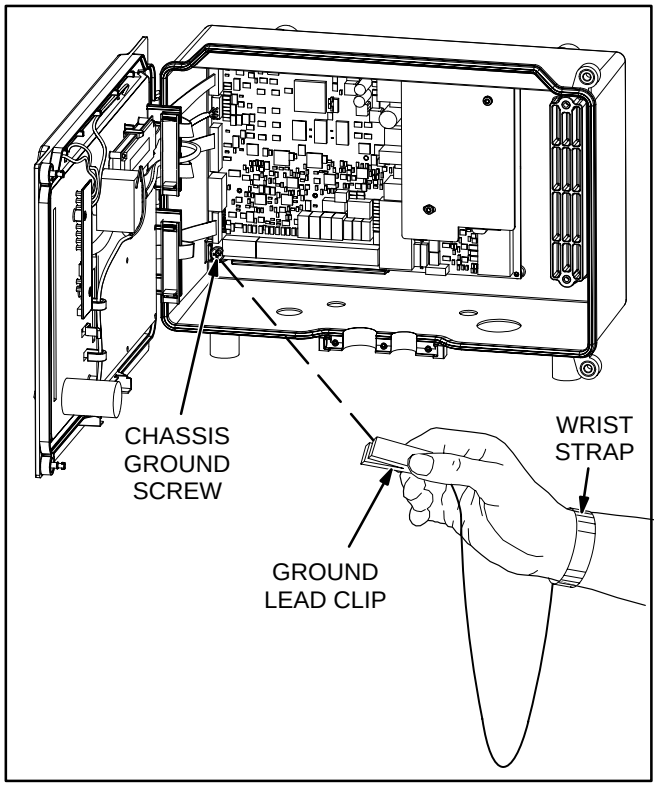


FIGURE 6-1. WRIST STRAP

MODIFYING SETUP SUBMENUS

The Setup submenus allow you to adjust system parameters.

There are three setup menus that are selectable from the Setup Main Menu:

- Crank/Idle Setup Menu
- Governor/Regulator Setup Menu
- Power Transfer Setup Menu

These three menus are intended for qualified service personnel only. For this reason, a three-digit access code (password) must be entered before you can proceed to those menus.

⚠ CAUTION ***Improper adjustment of the control can cause equipment malfunction or damage. Adjustment must be performed by technically qualified personnel only.***

PASSWORD SUBMENU

Figure 6-2 shows a block representation of the Setup Main menu. If you press the button next to the word “Setup” in the display, the Setup Password submenu is displayed. Use of Setup menus is restricted to service personnel.

Press the Previous Main Menu button to return to Main Menu 3. Press the Home button to return to Main Menu 1.

Password submenu: If you enter the correct password, the Setup Main Menu is displayed. When the Password submenu is displayed, the first numeric character (0) is flashing. The access code for your PCC is: **574**. To enter the password:

1.. Press the button next to the + symbol until the value reads “5.”

2.. Press the button next to the → symbol to move to the next numeric character.

3.. Press the button next to the + symbol until the value reads “7.”

4.. Press the button next to the → symbol to move to the next numeric character.

5.. Press the button next to the + symbol until the value reads “4.”

6.. After you have completed entering the password, press the button next to the ▶ symbol. The Setup Main Menu is displayed.

If a wrong number is entered into any of the numeric character fields, use the buttons next to the ↓ and ↑ symbols until the correct value is entered.

If the wrong character field is selected, use the buttons next to the ← and → symbols to move to the character field you wish to change.

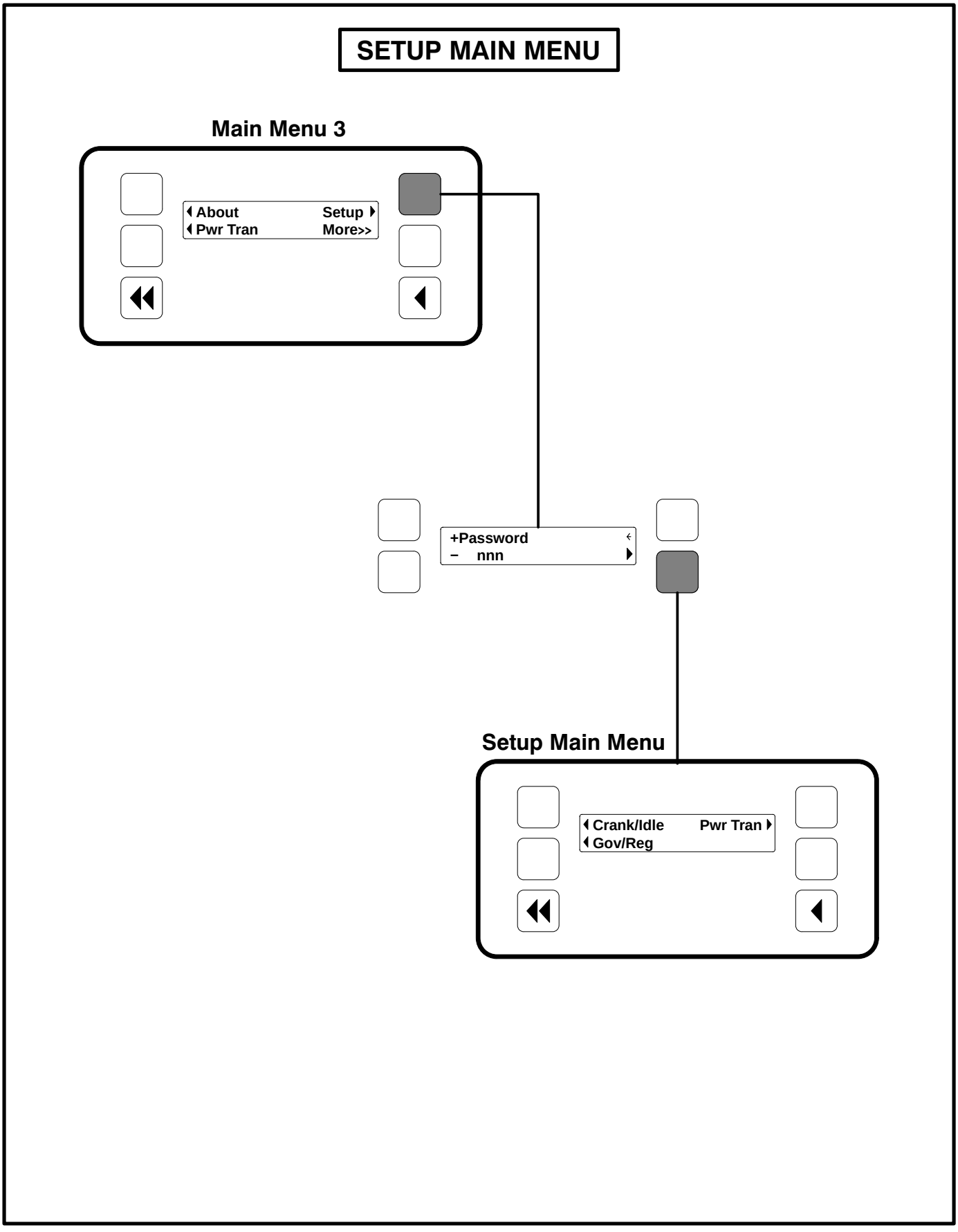


FIGURE 6-2. SETUP MAIN MENU

CRANK/IDLE SETUP MENU

Figure 6-3 shows a block representation of the Crank/Idle Setup menu. If you press the button next to the word “Crank/Idle” in the display, the first Crank/Idle Setup submenu is displayed.

As shown in the diagram, the Crank/Idle menu has five submenus. Each submenu includes a parameter or value that can be changed.

Press the buttons next to the ↓ and ↑ symbols in the graphical display to navigate between the menus. Press the Previous Main Menu button to return to the Setup Main Menu. Press the Previous Main Menu button again to return to Main Menu 3. Press the Home button to return to Main Menu 1.

Adjusting Values/Parameters:

1.. Press the button next to the ▶ symbol in the display until the + and − symbols are displayed.
2.. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.
3.. Press the button next to the + symbol to increase the value or select parameter; press the button next to the − symbol to decrease the value or select parameter.
4.. After adjusting values/selecting parameters, pressing the ▶ symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ▶ symbol).

    If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.

Cycle Crank submenu: Cycle Crank can be enabled or disabled (default = Disable).

Number of Crank Attempts submenu: This value can be adjusted from 2 to 7 attempts (default = 3 attempts).

Crank Time submenu: This value can be adjusted from 2 to 20 seconds (default = 15 seconds).

Rest Time submenu: This value can be adjusted from 7 to 40 seconds (default = 15 seconds).

Idle Speed Adjust submenu: This value can be adjusted from 700 to 1100 RPM (default = 800 RPM).

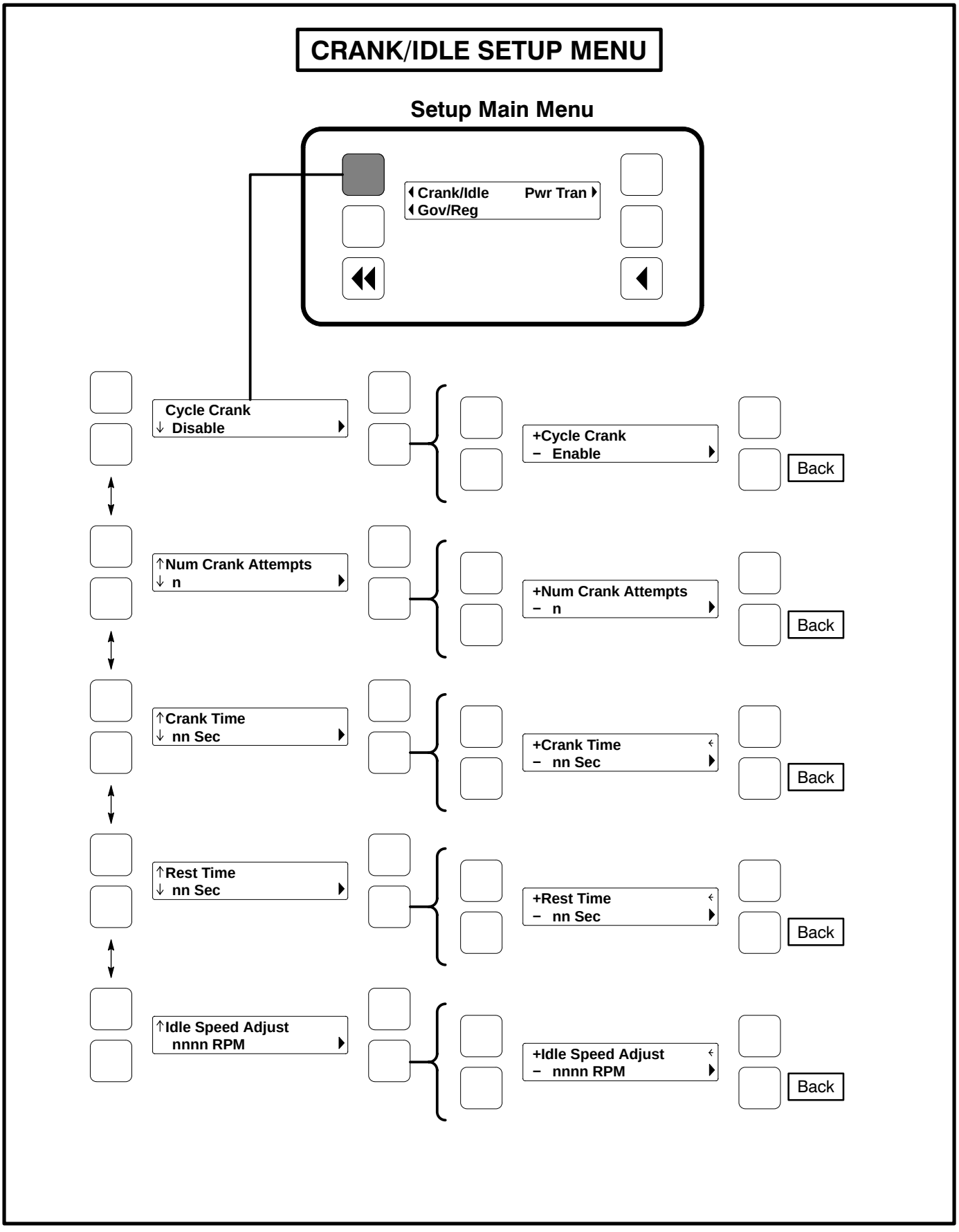


FIGURE 6-3. CRANK/IDLE SETUP MENU

GOVERNOR/REGULATOR SETUP MENU

Figure 6-4 shows a block representation of the Governor/Regulator Setup menu. If you press the button next to the word “Gov/Reg” in the display, the first Governor/Regulator Setup submenu is displayed.

The GOV/REG menu values will display “100%”. The expression “100%” represents the factory setting (default value) for the selected set. When increasing or decreasing the value, you are increasing or decreasing from the factory default value. (For example, entering “200%” will double the value; “50%” will decrease the value by one half.)

Default values are preset by the factory. Due to site variables, the default values may need to be adjusted to attain peak performance.

As shown in the diagram, the Gov/Reg menu has five submenus. Each submenu includes a parameter or value that can be changed.

⚠ CAUTION ***Improper adjustment of the PowerCommand control can cause equipment malfunction or damage. Adjustment must be performed by technically qualified personnel only.***

Press the buttons next to the ↓ and ↑ symbols in the graphical display to navigate between the menus. Press the Previous Main Menu button to return to the Setup Main Menu. Press the Previous Main Menu button again to return to Main Menu 3. Press the Home button to return to Main Menu 1.

Adjusting Values/Parameters:

1.. Press the button next to the ▶ symbol in the display until the + and − symbols are displayed.

2.. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.

3.. Press the button next to the + symbol to increase the value or select parameter; press the button next to the − symbol to decrease the value or select parameter.

4.. After adjusting values/selecting parameters, pressing the ▶ symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ▶ symbol).

If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.

Voltage Configuration submenu: The phase, voltage, and wire fields can simultaneously be adjusted. If phase = 1, the line-to-line voltage can be 200, 220, 230, or 240 volts with 3 wires. If phase = 3, the line-to-line voltage can be 190, 200, 208, 220, 230, 240, 380, 416, 440, 460, or 600 volts with either 3 or 4 wires. The default = 3Ph 208V 4W.

Alternator Frequency submenu: This value can either be 50 or 60 Hz (default = 60 Hz).

Regulator Gain Adjustment submenu: This value can be adjusted from 5 to 1000 percent (default = 100 percent).

If the gain adjustment is set too high, output voltage will be unstable. If gain is set too low, the output voltage will respond sluggishly to changes in load − overshoot may result.

Governor Ramp Time submenu: This value can be adjusted from 0 to 30 seconds (default = 0 seconds).

This adjustment sets the time for the engine to ramp to full operating speed. This adjustment applies only to set start up and does not affect the transient response.

Governor Gain Adjustment submenu: This value can be adjusted from 5 to 1000 percent (default = 100 percent).

If the gain adjustment is set too high, engine speed will “hunt” or oscillate. If gain is set too low, the engine will respond too slowly to changes in load − overspeed may result.

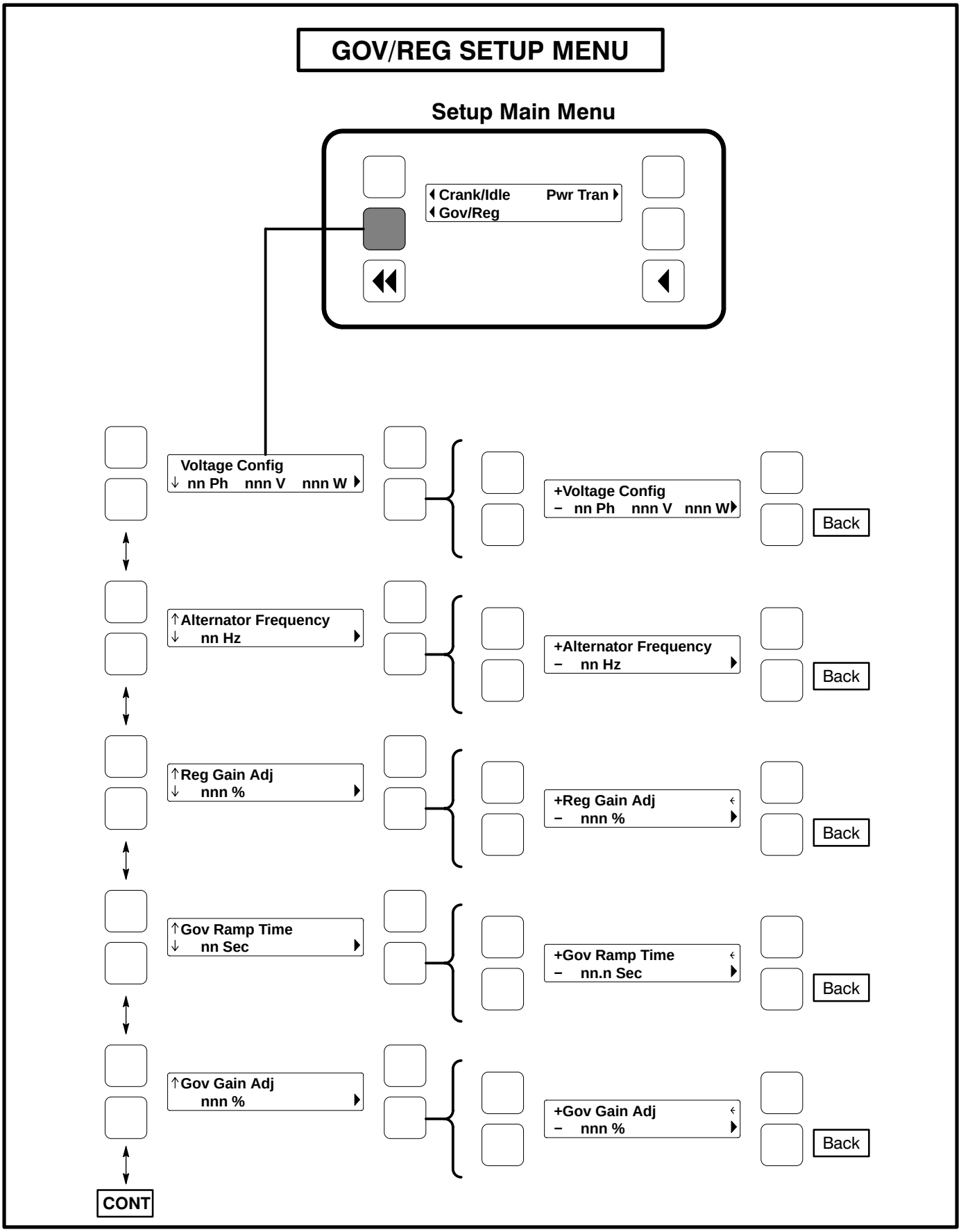


FIGURE 6-4. GOVERNOR/REGULATOR SETUP MENU

GOVERNOR/REGULATOR SETUP MENU (CONT)

Speed Droop Mode submenu (Begin Version 2.303): Selects between Isochronous and Droop kW Sharing droop modes (default = Isochronous).

Speed Droop Percent submenu (Begin Version 2.303): This value can be adjusted from 0 to 10 percent (default = 5%). This adjustment sets the amount of speed droop for a full standby/prime rated kW load.

Voltage Droop Mode submenu (Begin Version 2.303): Select between Constant and Droop kVAR Sharing Droop modes (default = Constant).

Voltage Droop Percent submenu (Begin Version 2.303): This value can be adjusted from 0 to 10 percent (default = 4%). This adjustment sets the amount of voltage droop for a 0.8 pf full standby rated load.

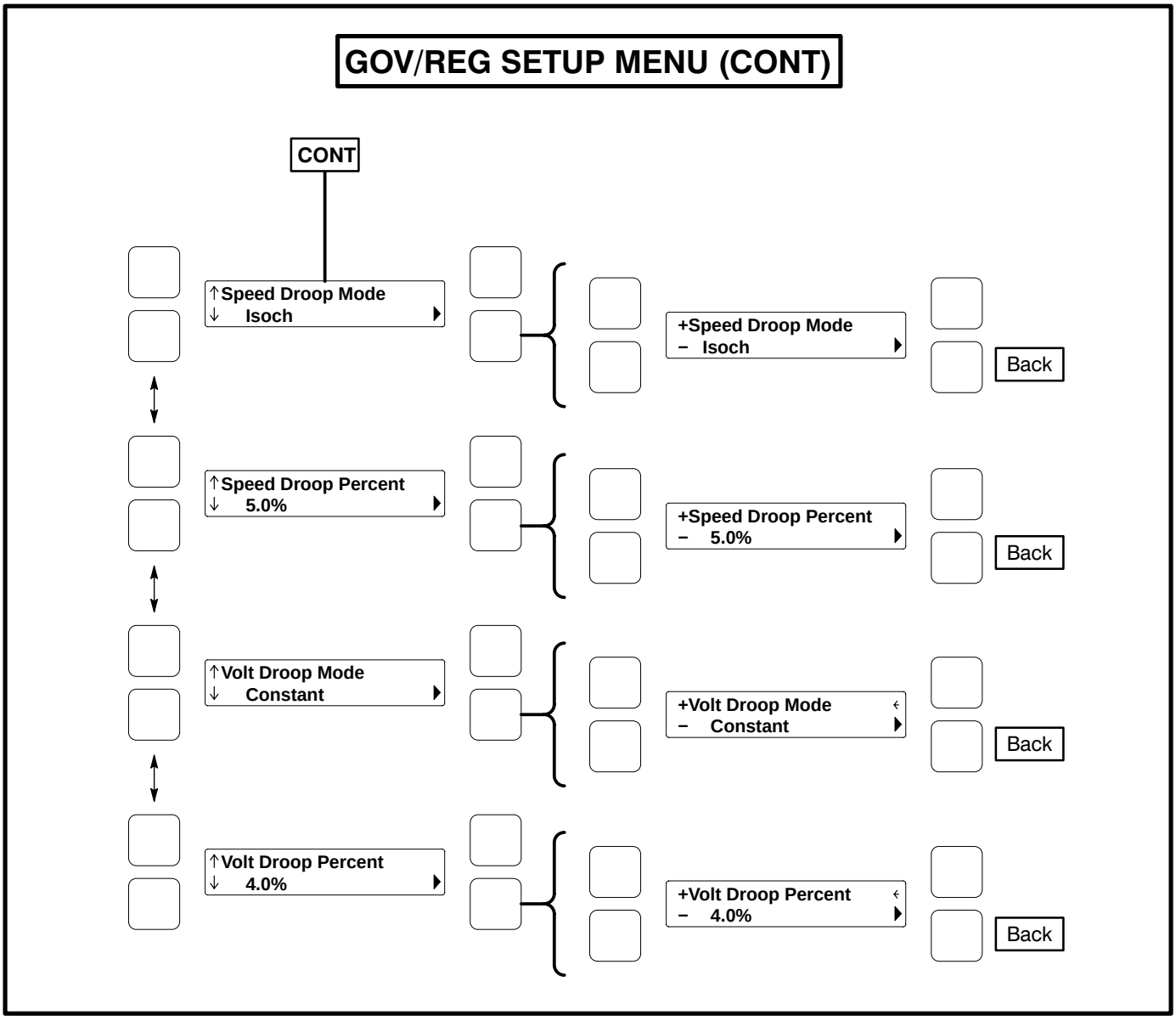


FIGURE 6-4. GOVERNOR/REGULATOR SETUP MENU (CONT)

POWER TRANSFER SETUP MENU

Figure 6-5 shows a block representation of the Power Transfer menu. If you press the button next to the word “Pwr/Tran” in the display, the first Power Transfer Setup submenu is displayed.

As shown in the diagram, the Power Transfer menu has seven submenus. Each submenu includes a parameter or value that can be changed.

Press the buttons next to the ↓ and ↑ symbols in the graphical display to navigate between the menus. Press the Previous Main Menu button to return to the Setup Main Menu. Press the Previous Main Menu button again to return to Main Menu 3. Press the Home button to return to Main Menu 1.

Adjusting Values/Parameters:

1.. Press the button next to the ▶ symbol in the display until the + and − symbols are displayed.

2.. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.

3.. Press the button next to the + symbol to increase the value or select parameter; press the button next to the − symbol to decrease the value or select parameter.

4.. After adjusting values/selecting parameters, pressing the ▶ symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ▶ symbol).

If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.

Remote Start Configuration submenu: Used to select the test mode to be executed when a PTC test is initiated (default = Start-Rated). The four selection are:

- Start−Idle = Idle/Rated w/o load
- Start−Rated = Rated w/o load
- Start−Idle = Idle/Rated w/load
- Start−Idle = Rated w/load

Time Delay Transfer submenu: This value can be adjusted from 0 to 120 seconds (default = 10 seconds).

Sets the time delay from the time the genset is ready to load to the time the utility contactor is opened.

Time Delay Re-Transfer submenu: This value can be adjusted from 0 to 1800 seconds (default = 10 seconds).

Sets the time delay from the time the utility is back on line to the time the genset contactor is opened.

Time Delay Program Transfer submenu: This value can be adjusted from 0 to 60 seconds (default = 1 second).

Sets the time delay from the time the genset contactor is opened to the time the utility contactor is closed and visa-versa.

S1 Under Voltage Sensor Pickup submenu: This value can be adjusted from 85% to 100% (default = 95%).

Sets the utility voltage threshold above which the utility voltage is considered valid.

S1 Sensor Dropout submenu: This value can be adjusted from 75% to 95% (default = 85%).

Sets the utility voltage threshold as a percentage of the utility under voltage pick-up percentage below which the utility voltage is considered invalid (subject to a time delay).

S1 Under Frequency Pickup Percent submenu: This value can be adjusted from 85% to 100% (default = 90%).

Sets the utility frequency threshold above which the utility frequency is considered valid.

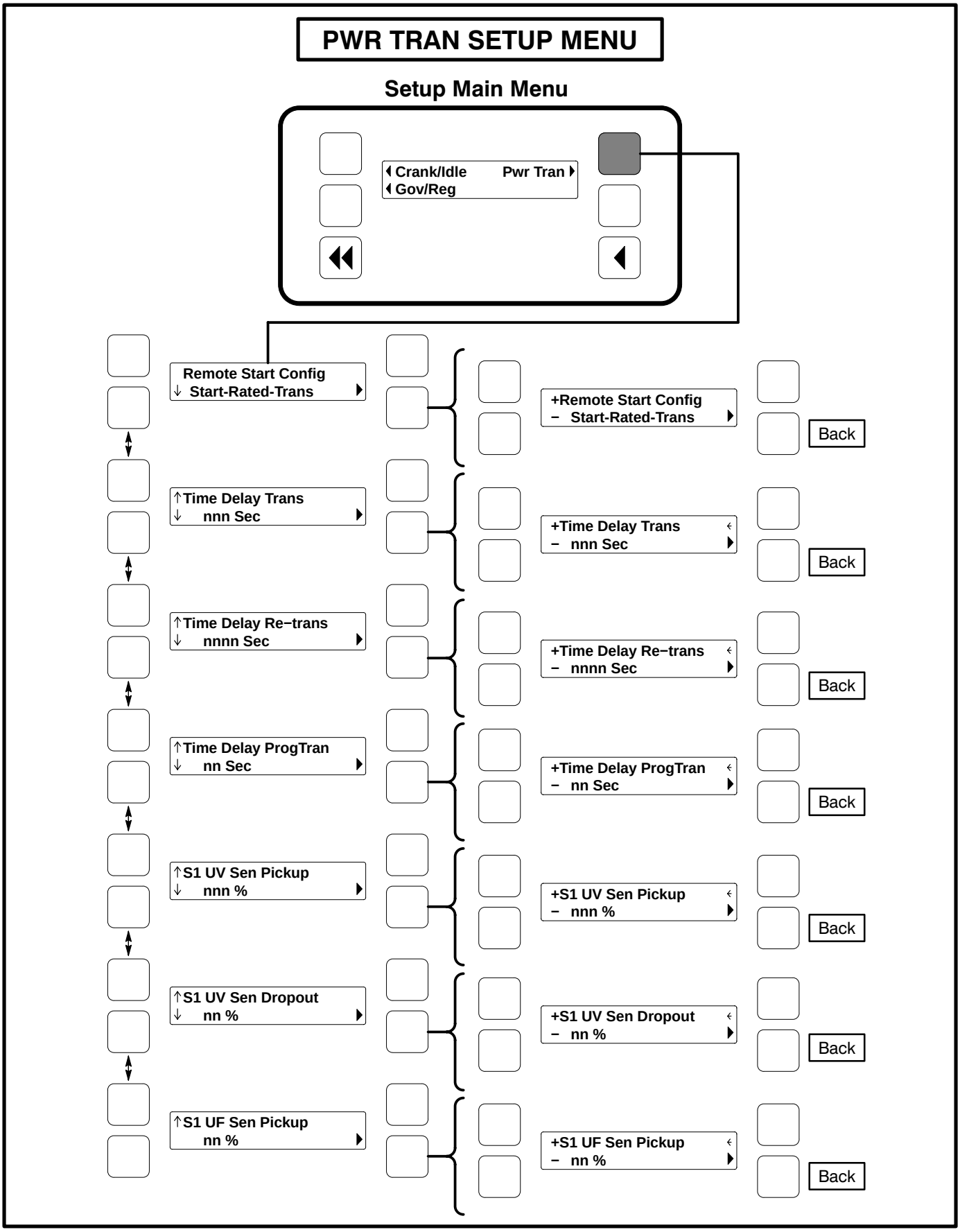


FIGURE 6-5. POWER TRANSFER SETUP MENU

PCC CONTROL PANEL BOX COMPONENTS (STANDARD/OPTIONAL)

The PCC control panel box (Figure 6-6) contains components that provide connection points for remote control and monitor options. The control panel box can be equipped with one or more of the following components.

Relay K4

Relay K4 is the Starter Pilot relay that is used to energize the starter solenoid. K4 is part of the engine harness assembly.

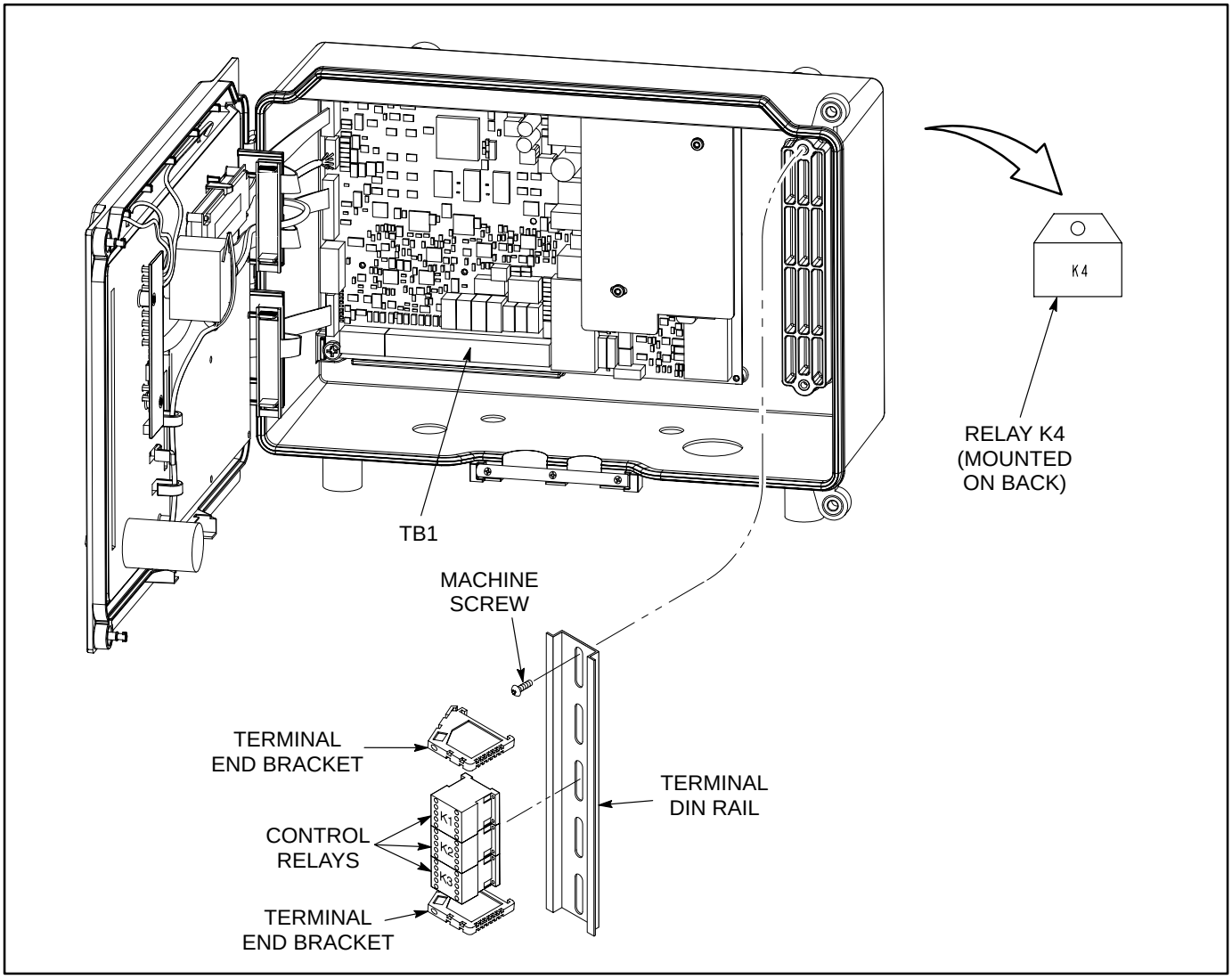


FIGURE 6-6. CIRCUIT BOARD LOCATIONS

Network Communicaitons Module (Optional)

The Network Communications Module (NCM) provides an interface for data from the genset to other modules on the network. It communicates with the PCC 2100 baseboard providing complete monitoring and control of the genset. Refer to the *PowerCommand Network Installation and Operator's Manual (900−0529)* for instructions on network wiring and network software information.

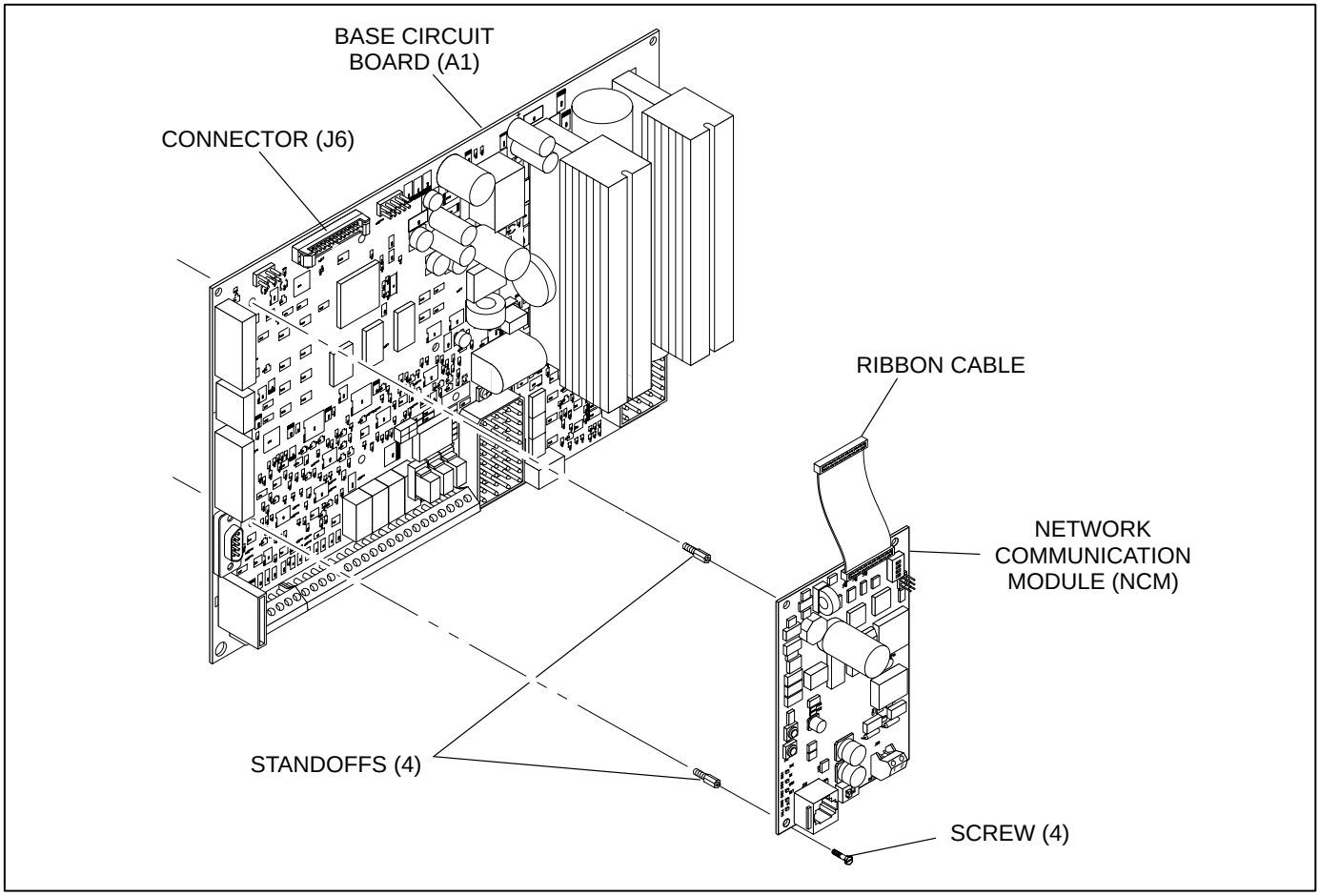


FIGURE 6-7. NETWORK COMMUNICATION MODULE

TB1 Customer Inputs

Refer to Page 9-7 for typical connections to TB1.

Remote Start: When the O/Manual/ Auto switch is in the Auto position, grounding this input initiates the engine cranking and start sequence. This circuit must be opened to permit resetting a shutdown condition with the Reset input.

Remote Emergency Stop: Grounding this input causes an immediate shutdown. Emergency stop must be reset at the front panel.

Remote Reset: When the O/Manual/ Auto switch is in the Auto position and the remote start switch is open, grounding this input resets any warning and shutdown fault (except Emergency Stop, which must be reset at the genset front panel.)

Customer Fault Inputs 1 through 4: Grounding any one of these inputs activates the corresponding warning or shutdown sequence.

External sensing equipment must be connected to the designated digital input.

The nature of the fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, Low Starting Hydraulic Pressure, Low Starting Air Pressure, etc.

Each of the four fault functions can be programmed (using InPower), as follows:

- Enable/disable input. Default setting:

  Enable **1** through **4**
- Status, Warning or Shutdown. Default setting:

  1 − None
  2 thru **4** − Warning
- Active closed or open. Default setting:

  Closed [ground] **1** through **4**
- Change display name using up to 19 characters. Default setting:

  1 − Customer Fault 1
  2 − Ground Fault
  3 − Low Fuel
  4 − Rupture Basin Fault

TB1 Customer Outputs

Refer to Page 9-7 for typical connections to TB1.

Customer Outputs 1 through 4: One set of normally open (NO) contacts, rated for 2 amps at 30 VDC for each of the four output signals. The relays can be used to control small devices and indicator lamps.

The nature of the customer output signal (contacts closed) is an optional customer selection. Example outputs: Genset running, common warning, common fault, load shed, ready to load, etc.

Each relay can be independently programmed (using InPower) to energize as follows.

- Enable/disable output. Default setting:

  Enable **1** through **4**
- Status, Warning or Shutdown. Default setting:

  1 − Common warning
  2 − Common shutdown
  3 − Not in Auto
  4 − Ready to Load

The customer outputs can also be connected to three control relays (optional) to operate larger equipment, such as, fans, pumps and motorized air dampers. Refer to *Control Relays* in this section for additional information.

B+: This is a fused 10 amp, 12/24 volt output. (Fuse F1 is located on Base board.) Two terminals (TB1-16 and -17) are connected to this 10 amp circuit.

B+ Switched: This is a fused 5 amp, 12/24 volt switched output. This output is activated when the control receives a run command. (Fuse F2 is located on Base board.)

Control Relays (K10, K11, K12) (Optional)

⚠ CAUTION ***Damage to the Base board can occur if the voltage suppressors (Figure 6-8) are not installed across relay coils (A1/A2) before connecting genset battery cables.***

The three optional control relays are rail mounted inside the control panel box. Each relay is a 4-pole relay with 2 poles normally open and two poles normally closed.

These relays (Figure 6-8) are used to control auxiliary equipment, such as fans, pumps and motorized air dampers. Energizing of the relays is user definable (refer to *TB1 Customer Outputs* in this section for customizing information.)

The contacts are rated at 10 amps at 600 VAC.

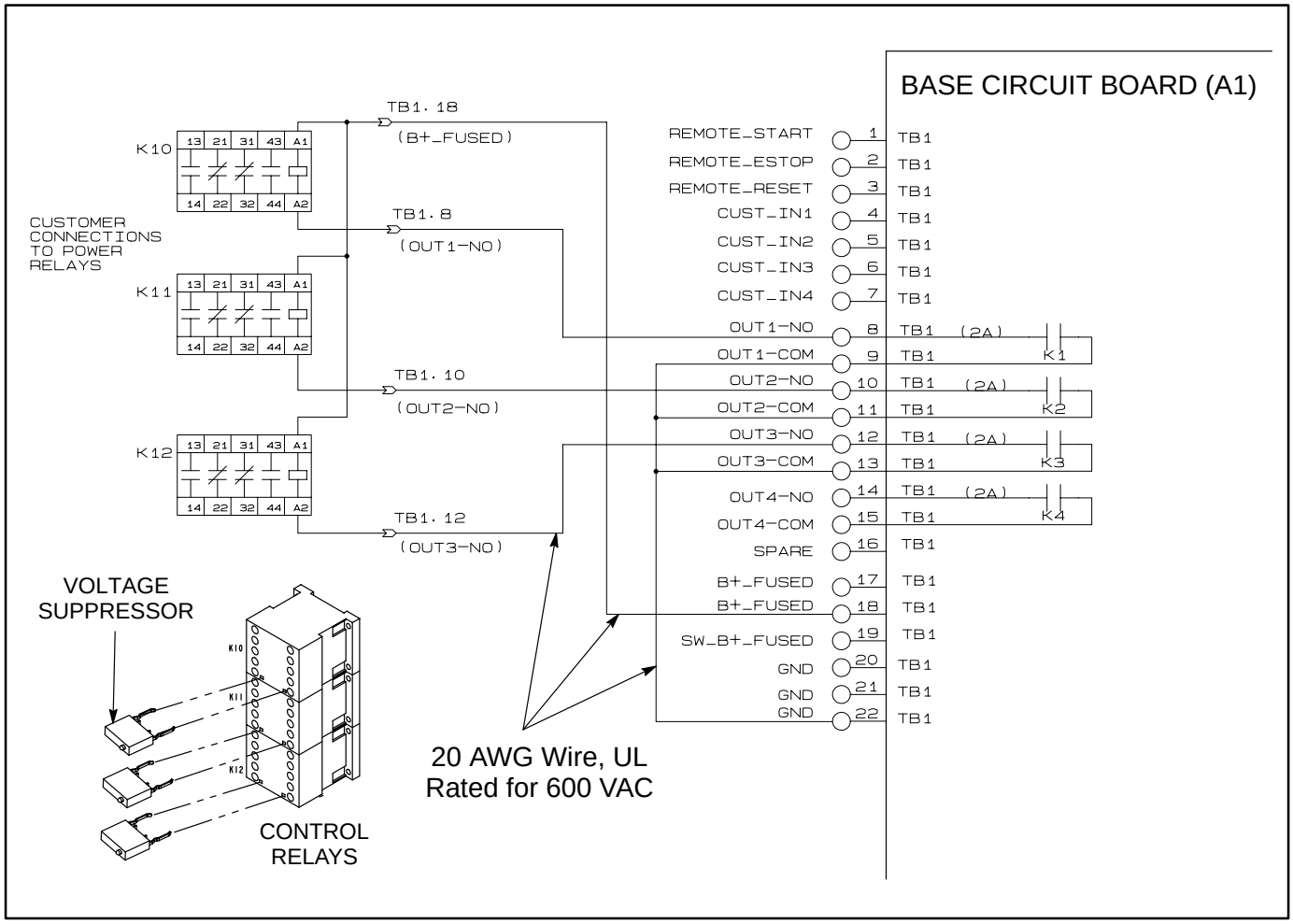


FIGURE 6-8. OPTIONAL CONTROL RELAYS (K10, K11, K12)

ENGINE SENSORS

Figure 6-9 shows the locations of the oil and coolant temperature and oil pressure senders to which the PCC responds for the engines shown in Figures 6-9 and 6-10.

The oil and coolant temperature senders function by varying the resistance with the coolant and oil temperature. With 5VDC supplied to the sensors, the output signal (which varys with temperature) is supplied to the Base board. The coolant sender enables the Base board to detect low, pre-high and high coolant temperatures and the oil sender, pre-high oil temperature.

The oil pressure sender functions by converting the sensed oil pressure to voltage which varies the supplied 5 VDC to the sender. The output signal of the sender is approximately 0.5 VDC at 0 psi and 4.5 VDC at 100 psi.

The low coolant level switch functions by closing the circuit to the engine chassis ground (battery negative [−]).

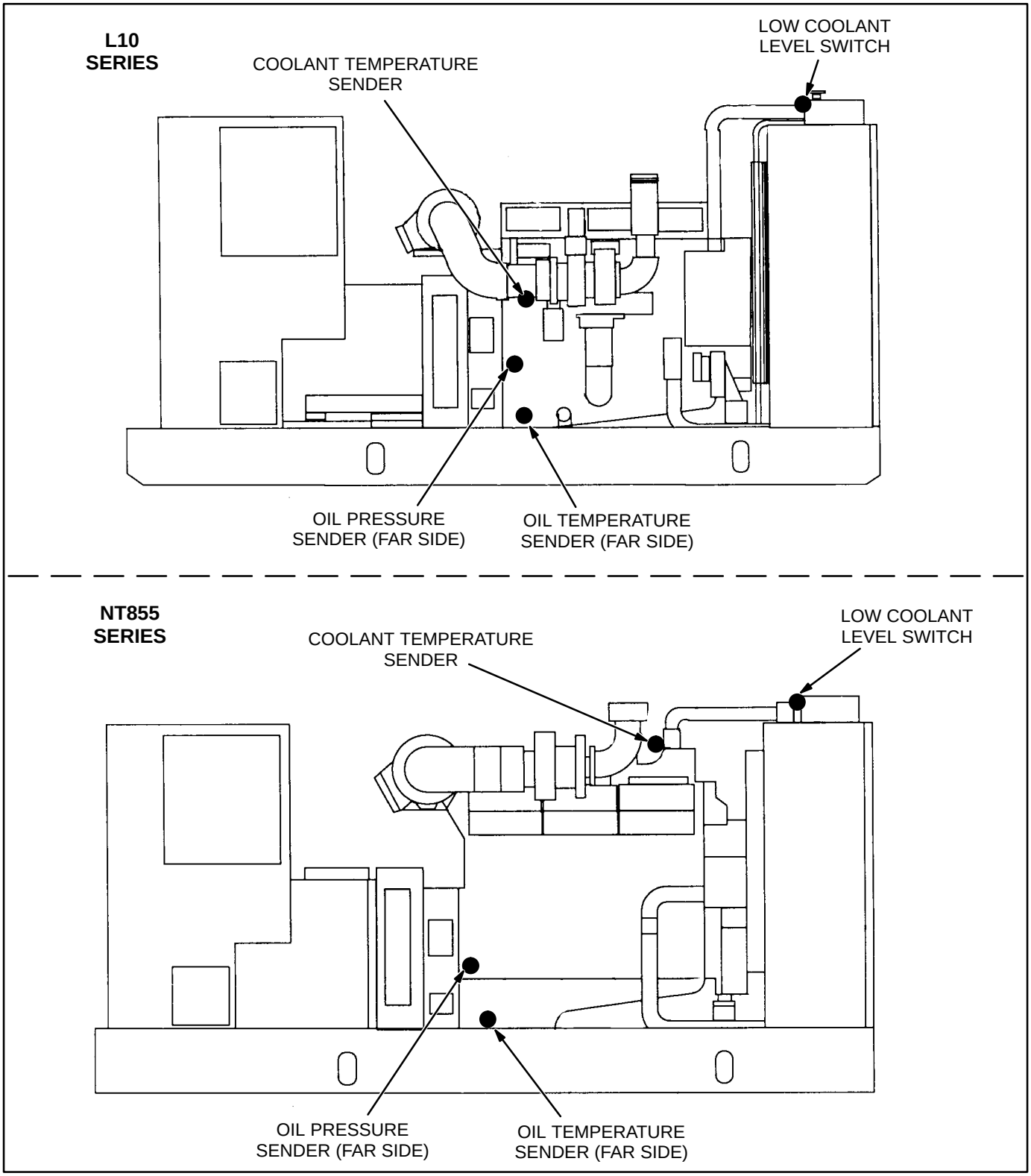


FIGURE 6-9. ENGINE SENSOR LOCATIONS (L10 & NT855 SERIES ENGINES)

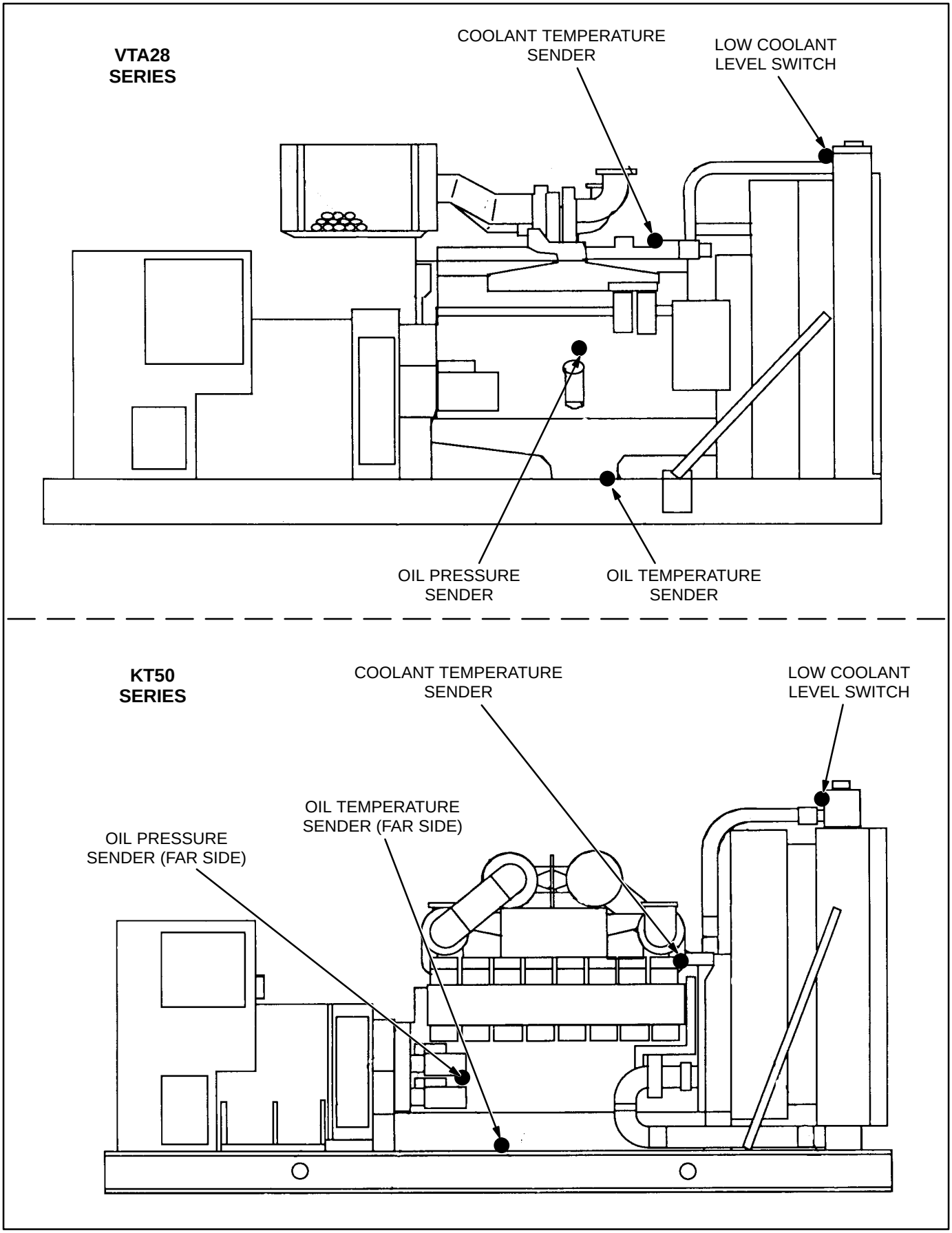


FIGURE 6-10. ENGINE SENSOR LOCATIONS (VTA28 & KT50 SERIES ENGINES)

MAGNETIC SPEED PICKUP UNIT (MPU) INSTALLATION

To install the MPU sensor, bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the sensor in gently by hand until it just touches the gear tooth. Back it out one quarter turn and set the locknut.

⚠ CAUTION ***Do not use fan blade to bar over engine. That can damage blades and cause property damage and personal injury.***

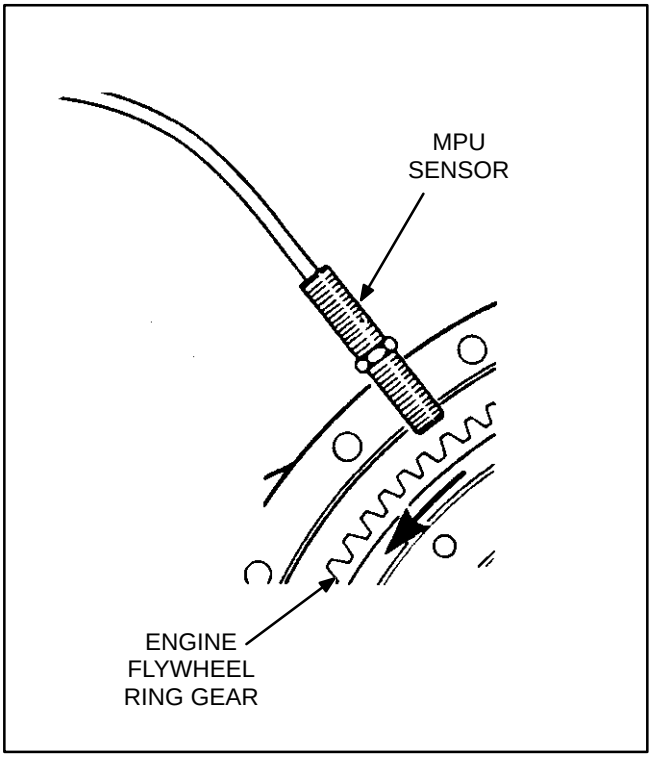


FIGURE 6-11. MPU SENSOR

CURRENT TRANSFORMER (CT) INSTALLATION

Current transformers (CT's) are required on gensets that contain AC meters. The CT's must be installed as noted in the following *CT Installation Requirements*. Improper installation of CT's will cause a "1459 Reverse Power" shutdown error.

Refer to the Reconnection Diagram to identify the output leads/phase that must be routed through each CT, and also appropriate transformer post selection for meter sensing leads. The transformers are labeled CT1, CT2 and CT3 on the reconnection wiring diagram. (The Reconnection Diagram is located on the upper side cover of the control housing.)

CT Installation Requirements

A. The CT has a dot on one side. This dot must be facing toward the generator (conventional current flowing into the dot). A dot is also used to indicate pin 1 of the CT.

B. CT1 − U load leads (A phase)
CT2 − V load leads (B phase)
CT3 − W load leads (C phase)

C. Route the appropriate leads through each CT.
   - 6 lead generator sets − generator output leads are routed through the CT's.
   - 12 lead generator sets − load wires are routed through the CT's.

D. Reconnectable gensets (12 leads) have dual secondary CT's (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 2 for high voltage gensets or to pin 3 for low voltage gensets. (Refer to Reconnection Diagram.)

   Non-reconnectable gensets (6 leads) have single secondary CT's (2 pins).
   - The lead from CT terminal #1 connects to the metering circuitry.
   - The lead from CT terminal #2/3 connects to ground.

7. Servicing the Generator

TESTING THE GENERATOR

These tests can be performed without removing the generator. Before starting tests, disconnect the negative (−) cable from the battery to make sure the engine will not start while performing these tests.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (−) cable first and reconnect last.

⚠CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (−) cable from the battery terminal.***

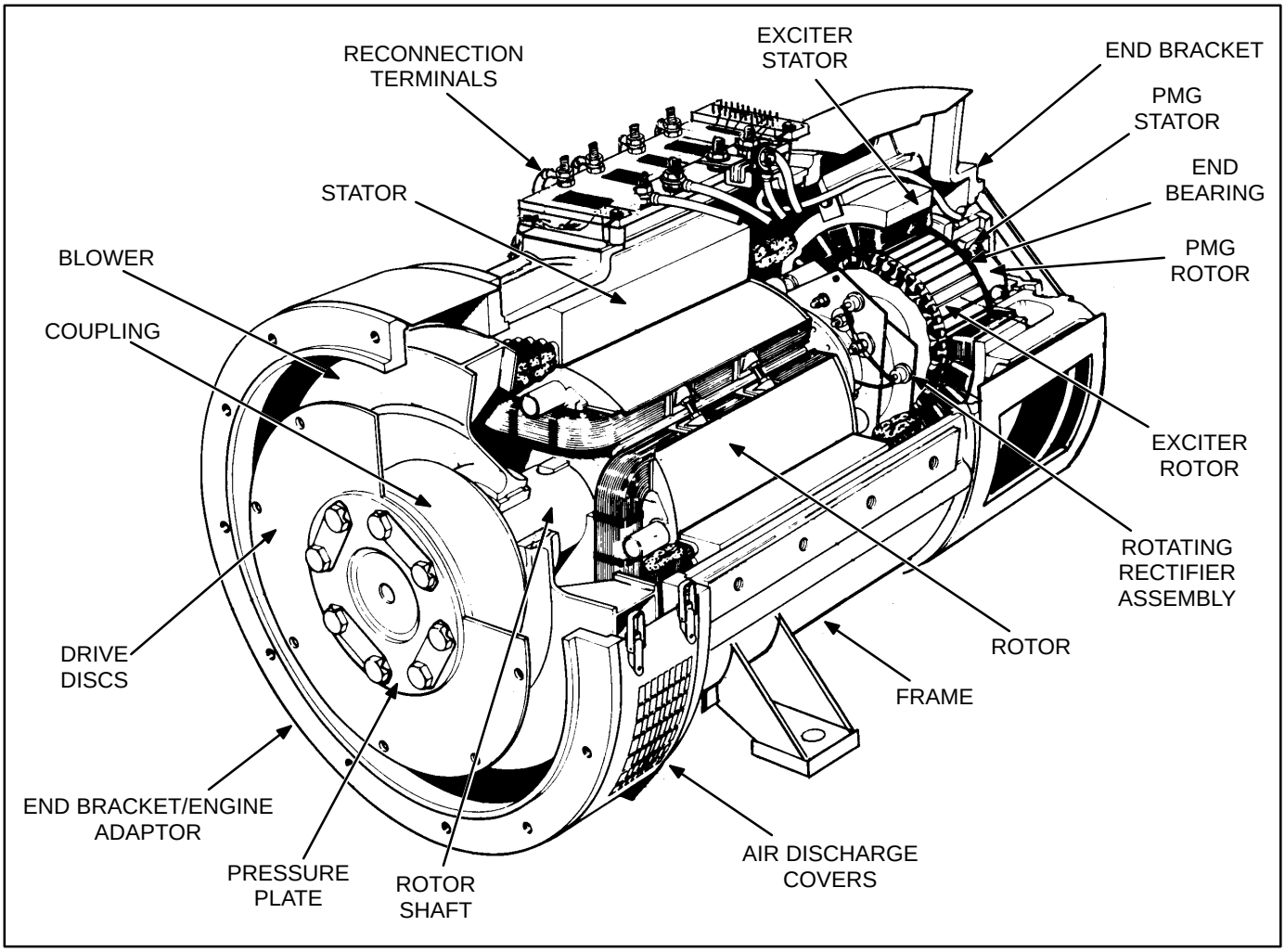


FIGURE 7-1. GENERATOR

GENERATOR/BASE BOARD ISOLATION PROCEDURE

The following procedure is used to determine if the generator or the control Base board is causing a high AC voltage shutdown fault.

1. Throw the line circuit breaker **OFF** and shut down the set.

   ⚠ CAUTION ***This test involves unregulated excitation of the generator. To prevent damage to the generator due to overcurrent, make sure that all loads have been disconnected and that all faults have been cleared from the power output terminals of the generator.***

   ⚠ WARNING ***HAZARDOUS VOLTAGE. Touching uninsulated parts inside the control housing and power output boxes can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts.***

   Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

2. Remove the side access cover of the control housing to access the exciter stator leads (**X** and **XX**). Disconnect the **X** and **XX** leads from the AC harness (quick connect type connectors).
3. Prepare to measure output voltage across the generator terminals while the set is running.
4. Bring two jumpers from a 12 volt battery for connection to the excitor stator **X** (Field +) and **XX** (Field −) leads.

   Connect the jumper from the positive (**+**) post of the battery to the **X** lead. Be prepared to connect the jumper from the negative (**−**) post of the battery to the **XX** lead. If one of the 12 volt cranking batteries is used, bring the jumpers from the battery connected on the grounded side of the system to avoid inadvertently imposing 24 volts on the system.
5. Check polarity again. Polarity must be correct or this test will be inconclusive because the induced and residual magnetic polarities in the exciter stator will be opposed.

   Genset may shut down on a fault condition within 5 to 15 seconds due to the excitor stator leads being disconnected from the Base board. Clear fault and start genset to check next phase.

6. Start the set and connect the jumper from the battery negative (**−**) terminal to the **XX** lead.
7. The generator circuitry is probably okay if rated output voltage or higher is obtained and the voltages for all phases are balanced when the exciter is powered by a 12 volt battery. Refer to *Section 4* to troubleshoot the PCC control circuitry. (Normal excitation voltage ranges from approximately 10 VDC at no-load to approximately 40 VDC at full−load.)
8. If the voltages are unbalanced, troubleshoot the main stator first. If the voltages are uniformly low, troubleshoot the exciter and field circuits first.

Exciter Stator

Testing Winding Resistance: Measure winding resistance with a Wheatstone bridge or digital ohmmeter. Replace the stator if winding resistance is not as specified by Table 7-1.

Testing Winding Insulation Resistance: Disconnect exciter stator leads **F1** and **F2** from their connectors in the AC wiring harness and isolate them from ground. Using an ohmmeter, measure resistance between either lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm (1,000,000 ohms).

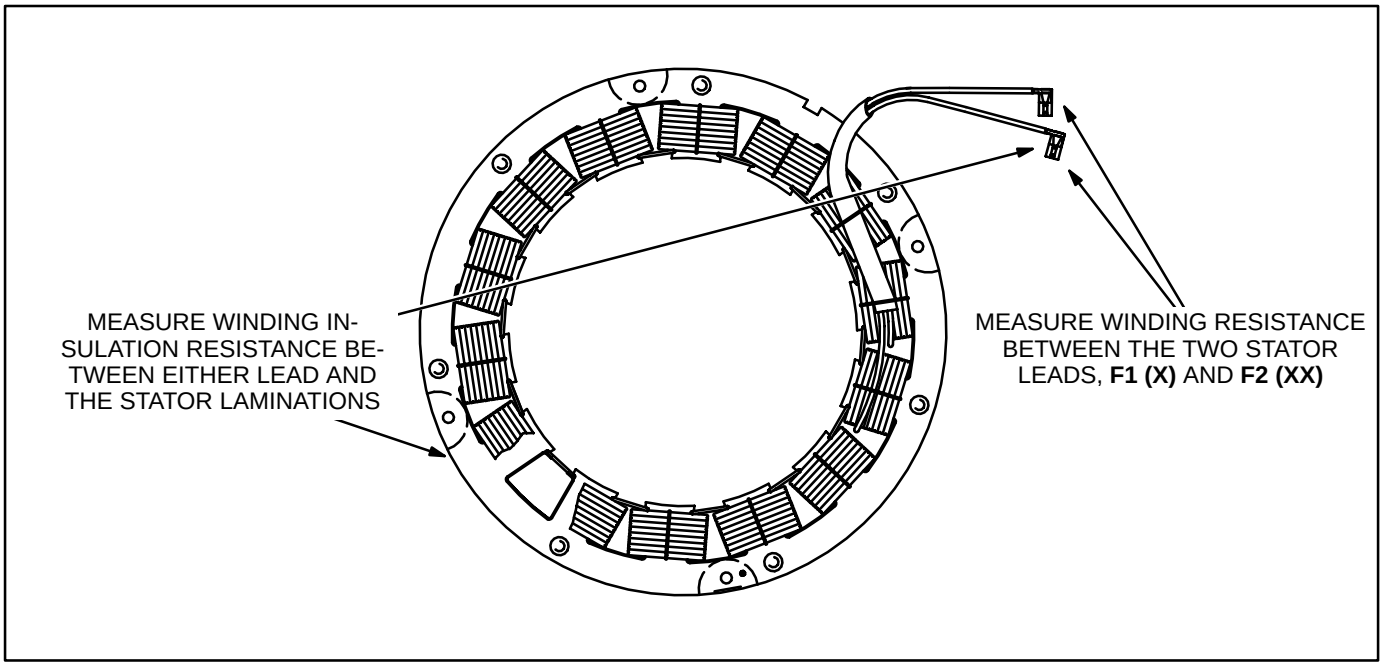


FIGURE 7-2. TESTING THE EXCITER STATOR

Exciter Rectifier Bridge (Rotating Rectifier Assembly)

The exciter rectifier bridge is mounted on the exciter rotor, inboard, facing the main rotor. It consists of a positive plate and a negative plate, split diametrically. Each carries three diodes, three terminal posts for connecting exciter rotor leads to the diode pigtails and a terminal for the main rotor (generator field) lead. A surge suppresser is connected across the two plates to prevent transient voltages that could damage the diodes.

Testing Diodes: Disconnect the diode pigtails from the terminal posts. Using an ohmmeter, measure electrical resistance between each diode pigtail and the plate on which the diode is mounted. Reverse the meter test probes and repeat the tests. The electrical resistance across each diode should be high in one direction and low in the other. If the resistance is high or low in both directions, replace the diode.

Replacing Diodes: Make sure the replacement diode is of the correct polarity. Disconnect the pigtail from the terminal post and unscrew the old diode. Apply heat-sink compound under the head of the diode. Make sure the compound does not get on the threads. Torque the diodes to 36 to 42 in-lbs (4 to 4.8 Nm) and the pigtail terminals to 24 in-lbs (2.7 Nm) when reassembling.

Surge Suppresser Testing and Replacement: Remove the suppresser. Replace the suppresser if it appears to have overheated or if ohmmeter readings indicate less than infinite resistance (end of scale) in both directions. Torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

⚠ CAUTION ***Layers of dust can cause diodes to overheat and fail. Brush dust off regularly.***

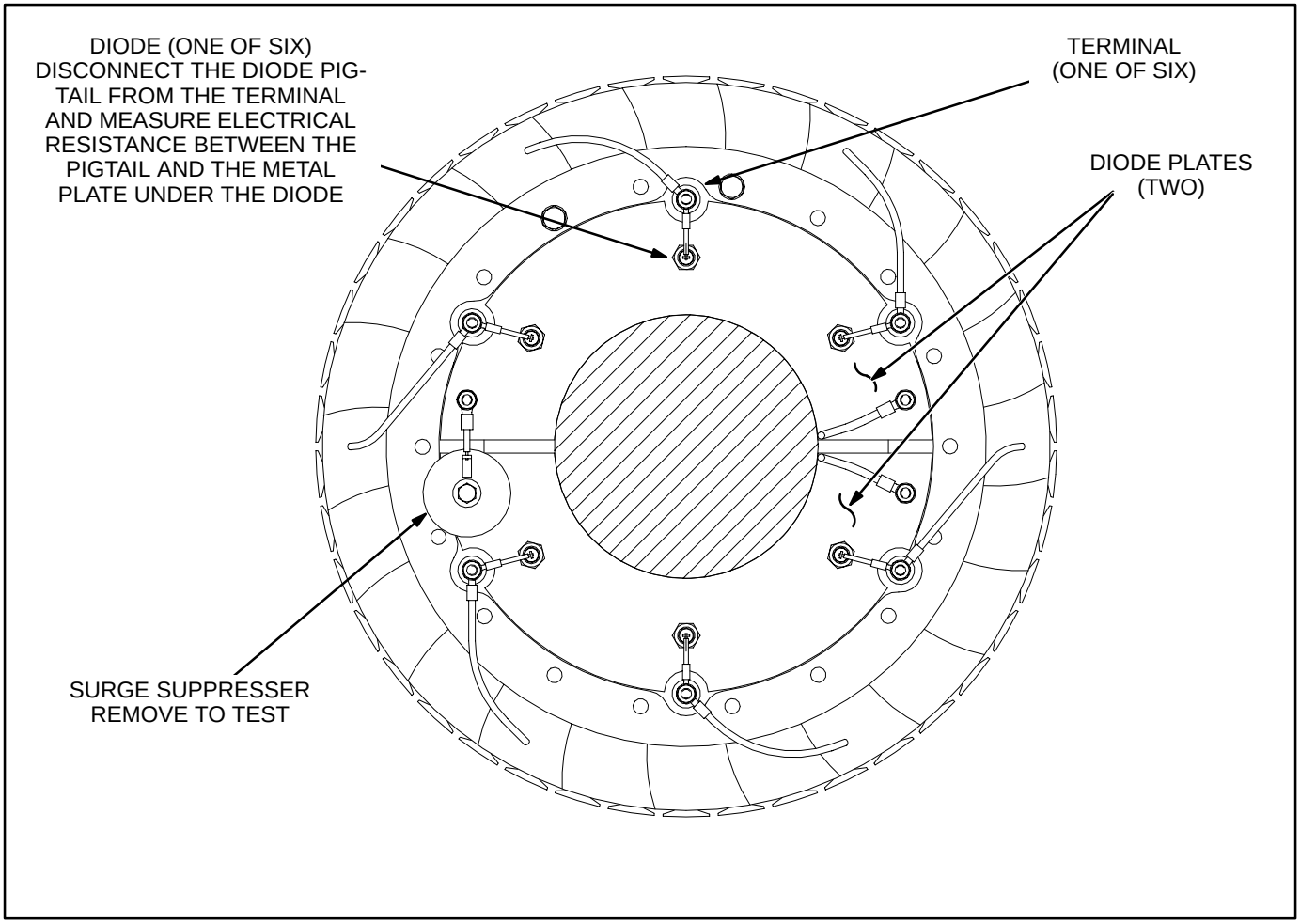


FIGURE 7-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

Exciter Rotor

Testing Winding Resistance: Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly. With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: **U** (CR1 or CR4) and **V** (CR2 or CR5), **V** (CR2 or CR5) and **W** (CR3 or CR6), **W** (CR3 or CR6) and **U** (CR1 or CR4). See the winding schematic. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 7-1.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between any rotor winding lead or the terminal to which it is connected and the rotor laminations. Replace the whole rotor shaft assembly if insulation resistance is less than 1 megohm.

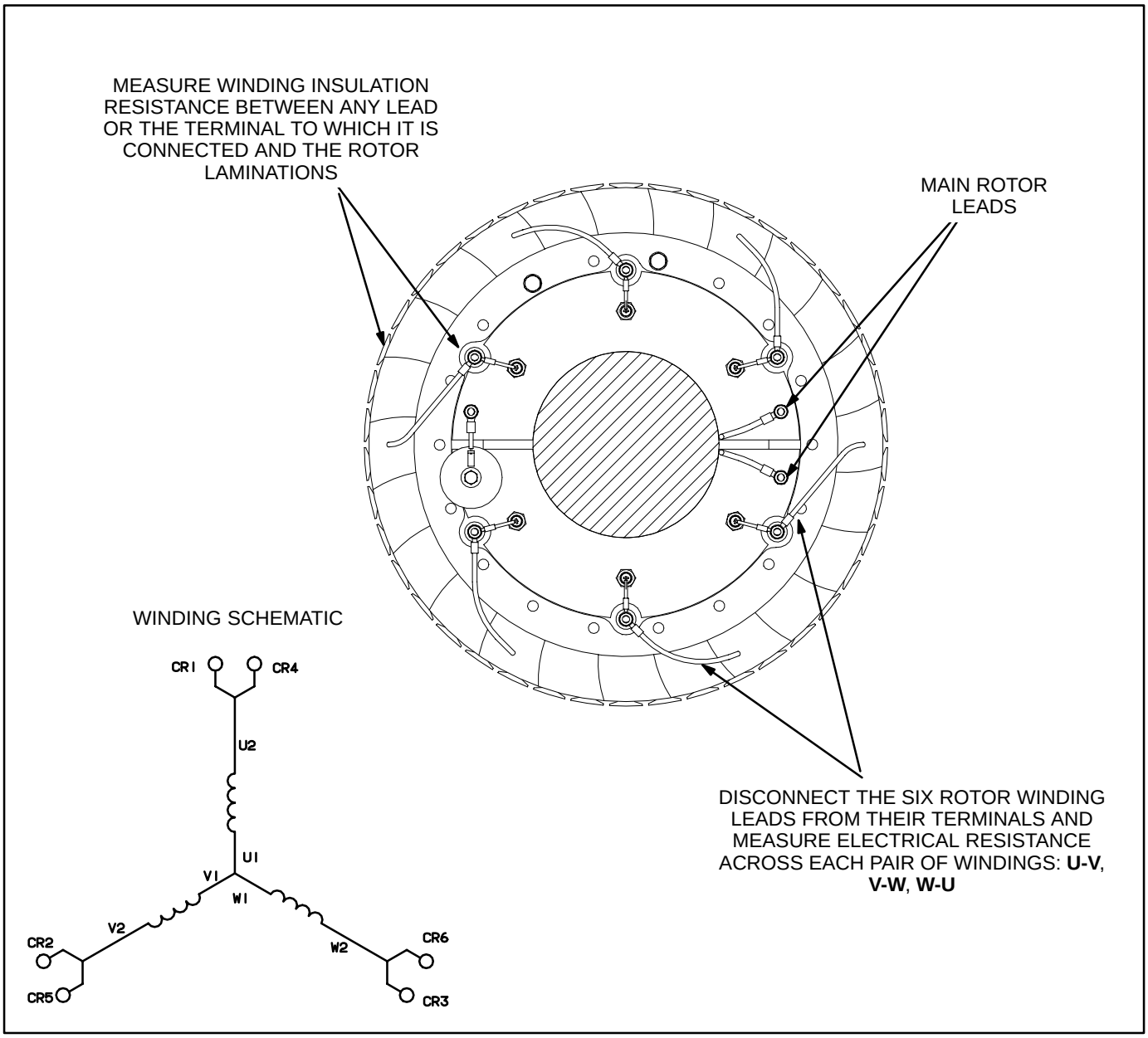


FIGURE 7-4. TESTING THE EXCITER ROTOR

Main Rotor (Generator Field)

Testing Winding Resistance: Disconnect the two leads of the main rotor from the terminals on the rotating rectifier assembly. See Figure 7-4. Measure electrical resistance between the two leads with a Wheatstone bridge or digital ohmmeter. Replace the rotor if the resistance is not as specified in Table 7-1. Connect the rotor leads and torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between either lead of the main rotor windings, or the terminal to which it is connected, and the main rotor laminations. Replace the rotor if insulation resistance is less than 1 megohm.

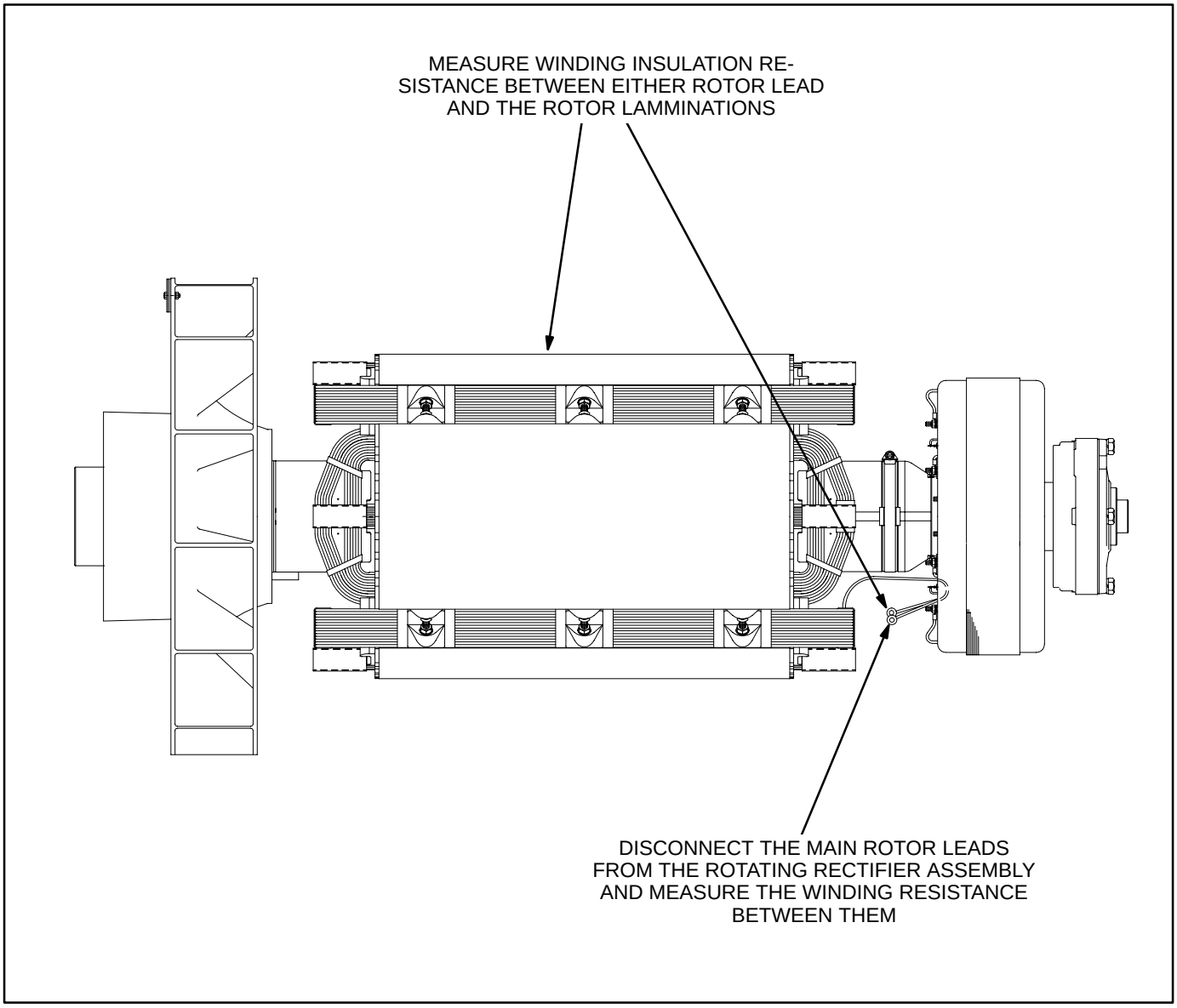


FIGURE 7-5. TESTING THE MAIN ROTOR

Main Stator

Testing Winding Resistance: Measure electrical resistance across each pair of stator leads (U1-U2, U5-U6, VI-V2, V5-V6, W1-W2 and W5-W6) with a Wheatstone bridge or ohmmeter having at least 0.001 ohm precision. Replace the stator if the resistance of any winding is not as specified in Table 7-1.

Testing Winding Insulation Resistance: Disconnect all stator leads and winding taps from their respective terminals and make sure the ends do not touch the generator frame. Using an ohmmeter, measure electrical resistance between any stator lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm.

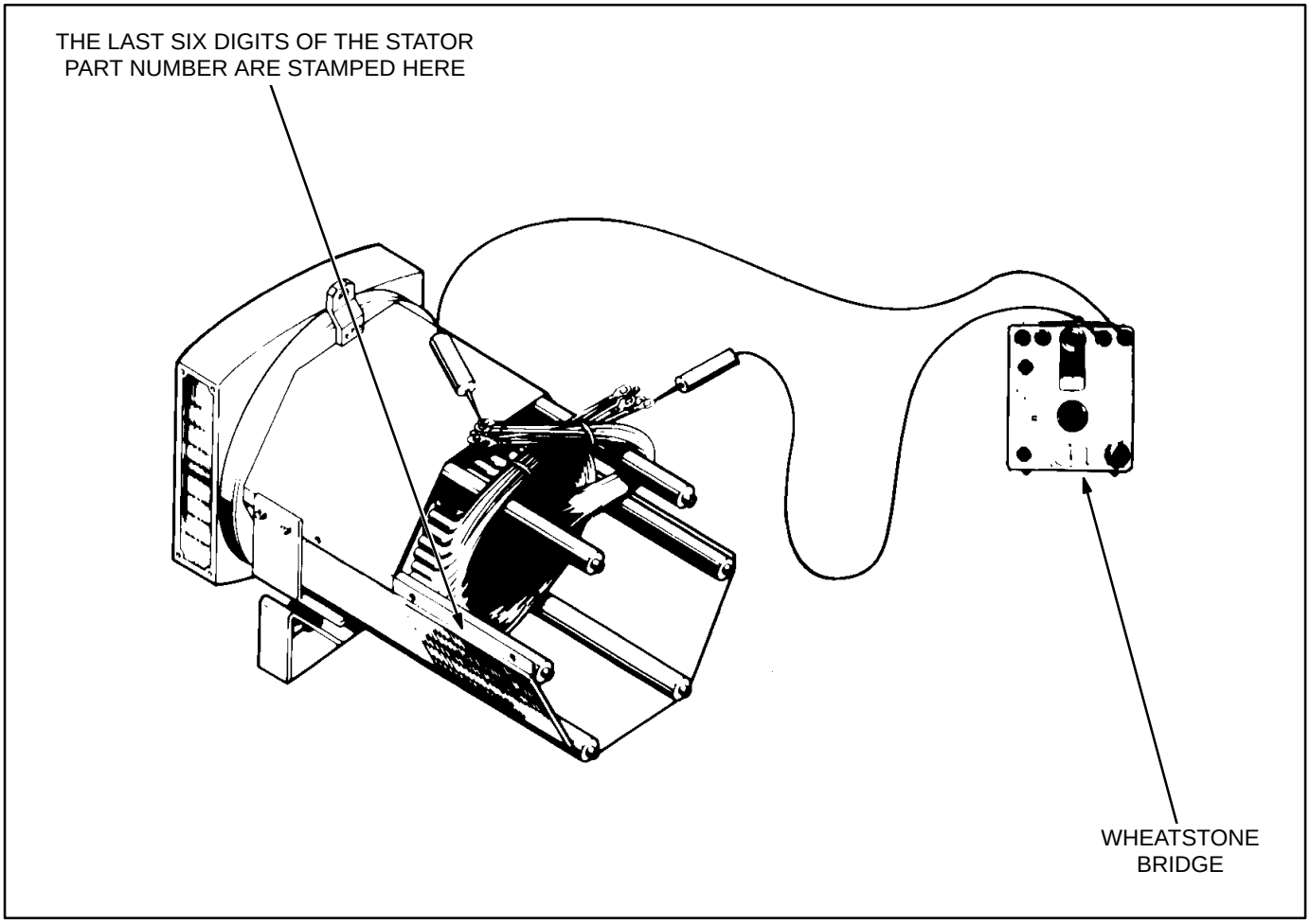


FIGURE 7-6. TESTING THE GENERATOR STATOR

TABLE 7-1. WINDING RESISTANCE VALUES*

FRAME SIZE	EXCITER STATOR	EXCITER ROTOR	MAIN ROTOR	MAIN STATOR			
				WINDING 11	WINDING 12	WINDING 17	WINDING 07
4C	18	0.136	0.91	0.0085	N/A	0.0115	N/A
4D	18	0.136	1.04	0.007	N/A	0.01	N/A
4E	18	0.136	1.17	0.0055	N/A	0.0075	N/A
4F	18	0.136	1.35	0.005	N/A	0.0052	N/A
5C	17	0.174	1.55	0.0068	N/A	0.0105	N/A
5D	17	0.174	1.77	0.0057	N/A	0.0079	N/A
5E	17	0.174	1.96	0.0043	N/A	0.0068	N/A
5F	17	0.174	2.16	0.0037	N/A	0.0049	N/A
6G	17	0.158	1.44	0.0037	0.0148	N/A	0.011
6H	17	0.158	1.54	0.0027	0.0108	N/A	0.0072
6J	17	0.158	1.73	0.0024	0.0096	N/A	0.006
6K	17	0.158	1.95	0.0019	0.0076	N/A	0.0052
7E	17	0.096	1.25	N/A	0.0076	N/A	0.0104
7F	17	0.096	1.4	N/A	0.0056	N/A	0.008
7G	17	0.096	1.64	N/A	0.0044	N/A	0.006
7H	17	0.096	1.75	N/A	0.0036	N/A	0.0044

***** Resistance figures are approximates, at 68° F (20° C) ± 10%.

TESTING THE PMG

1. Disconnect PMG leads **PMG 2**, **PMG 3** and **PMG 4** from their connectors in the AC harness. (AC harness quick connect terminals are located inside control housing.)
2. Start the engine at the set and let the speed stabilize.

   ⚠WARNING ***HAZARDOUS VOLTAGE. Touching uninsulated parts inside the control housing and power output boxes can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts.***

   Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.
3. Measure voltage across lead pairs **PMG 2 & PMG 3**, **PMG 3 & PMG 4** and **PMG 4 & PMG 2**. Voltage should be at least 150 VAC for 50 Hz sets and at least 180 VAC for 60 Hz sets, and should be approximately the same for each set of leads. If the voltages are low or uneven, check all the leads and connections between the voltage regulator and the PMG and repair as necessary before disassembling the PMG. Note the connections at the auxiliary terminal board in the power output box. See Figure 2-3.
4. Stop the set and measure electrical resistance across lead pairs **PMG 2 & PMG 3**, **PMG 3 & PMG 4** and **PMG 4 & PMG 2** with a Wheatstone bridge or digital ohmmeter. Refer to Table 7-2 for resistance values.

TABLE 7-2 PMG STATOR RESISTANCE

FRAME SIZE	PMG STATOR RESISTANCE
HC4	4.6
HC5/HC6/HC7	2/6

GENERATOR DISASSEMBLY

The following procedures provide information for removal and reassembly of the PMG, exciter, control housing, and stator/rotor assemblies. Be sure to read through this section first, before performing procedures listed, to determine the steps most appropriate for the service attention required.

Permanent Magnet Generator (PMG) Removal

1. Disconnect the negative (-) battery cable to prevent accidental starting of the generator set while servicing.

   ⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

   Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

   ⚠CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

   ⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.***

2. Remove the control housing grille and access covers (see Figure 7-7).

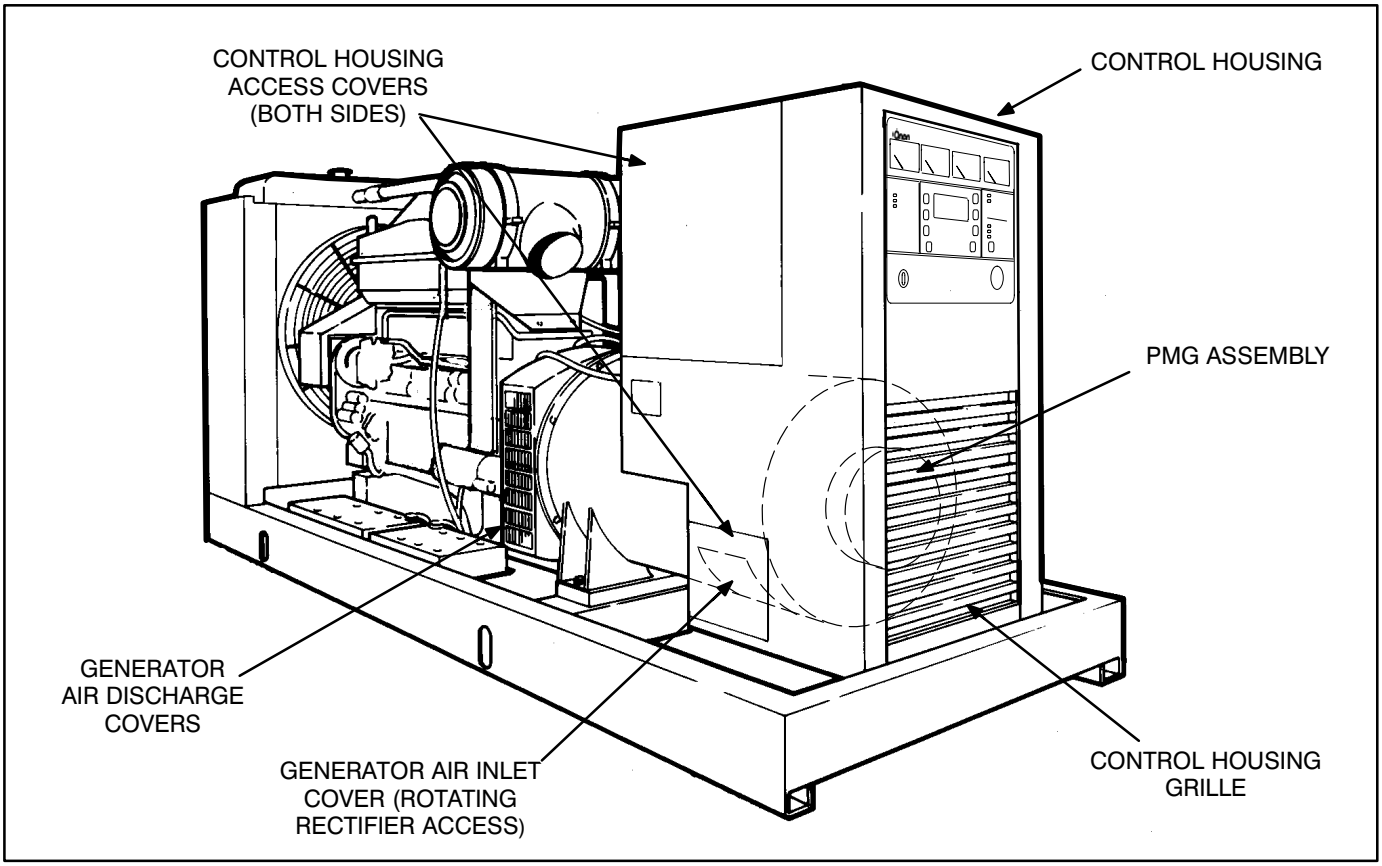


FIGURE 7-7. GENERATOR AND CONTROL HOUSING ASSEMBLY

3. Remove the three M5X12mm capscrews and lockwashers from the PMG cover, and remove cover.
4. Disconnect the PMG wiring harness connector.
5. Remove the four bolts and clamps retaining the exciter stator housing to the endbracket.
6. Tap the stator housing out of its spigot, and carefully remove from generator endbracket.

The highly magnetic rotor will attract the stator core; care must be taken to avoid any contact which may damage the windings.

7. Remove the hex head through-bolt from the rotor shaft and firmly pull the complete rotor assembly from its location. Keep the rotor clean by avoiding contact with metal dust or particles.

⚠ CAUTION ***The rotor assembly must not be dismantled, or the magnetic properties will be destroyed.***

Main Stator and Rotor Removal

1. Remove the PMG, refer to *Permanent Magnet Generator Removal,* earlier this section.
2. Remove the air inlet and discharge panels and access covers from control housing and generator (see Figure 7-7).
3. Crank or bar the engine/generator to position the rotor such that a full pole face is at the bottom of the main stator core. Proper positioning can be viewed through the generator access openings. Refer to engine service manual for proper cranking or barring procedure.
4. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
5. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
6. Disconnect all engine wiring harness connections in the generator control and output boxes. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
7. Disconnect all generator control leads (winding taps) from connections in the terminal box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
8. If the set has a mounted line circuit breaker, disconnect the cables to the circuit breaker. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.

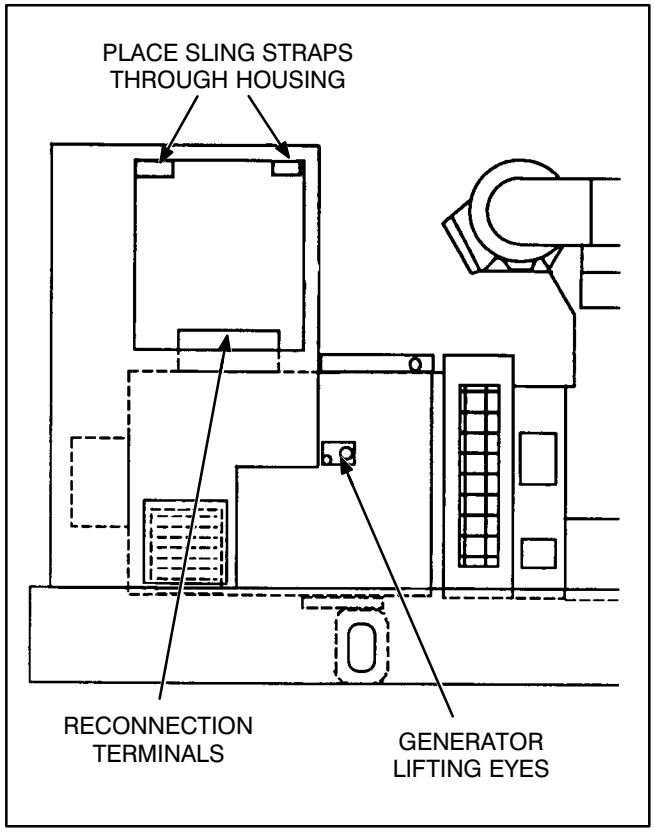


FIGURE 7-8. REMOVING CONTROL HOUSING

9. Use a hoist or similar lifting device to support the control housing assembly (see Figure 7-8).

⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

10. Loosen the fasteners that secure the control housing side and bottom panels to generator. Make sure that hoisting device is controlling weight of control housing assembly.
11. Remove control housing fasteners, and remove the control housing assembly from the generator. Replace panel fasteners to their respectable positions for safe keeping, and tighten finger-tight.
12. Remove control housing mounting brackets from both sides of generator, and assemble lifting eyes to generator.
13. Remove as necessary, air intake components to engine that may interfere with disassembly and reassembly of generator.

To remove the stator and rotor at the same time, refer to *Generator Assembly Removal*, later this section. To remove the stator and rotor individually, continue with step 14.

14. Remove the four bolts retaining the bearing cartridge housing in the endbracket (outer four bolts).
15. Remove the eight bolts holding the endbracket to the generator housing.
16. Insert two bolts (M10) in the two holes provided for “jacking” purposes, on the endbracket center line. Screw bolts in until endbracket spigot is clear of locating recess.
17. Carefully tap the whole assembly off the bearing cartridge housing, ensuring the endbracket is supported to prevent the exciter stator from damaging the windings on the exciter rotor.

⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

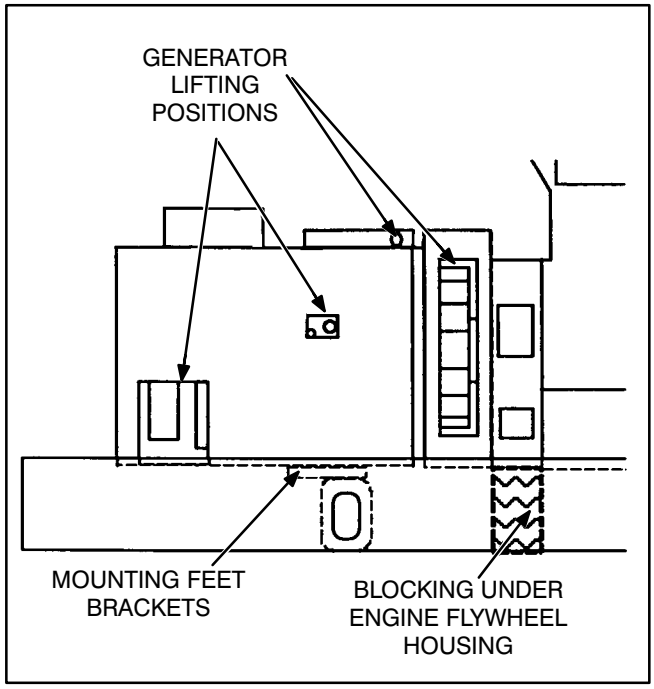


FIGURE 7-9. GENERATOR LIFTING POSITIONS

18. The exciter stator is now accessible for inspection and removal from endbracket/engine adaptor.
19. The end bearing can now be removed if required. Refer to Bearing Removal.
20. Remove the fasteners from the two generator mounting feet brackets.
21. Using an adequate lifting device, lift the generator (at lifting eyes provided, and main stator housing) until the mounting feet brackets are clear of the frame member (see Figures 7-9 and 7-10).

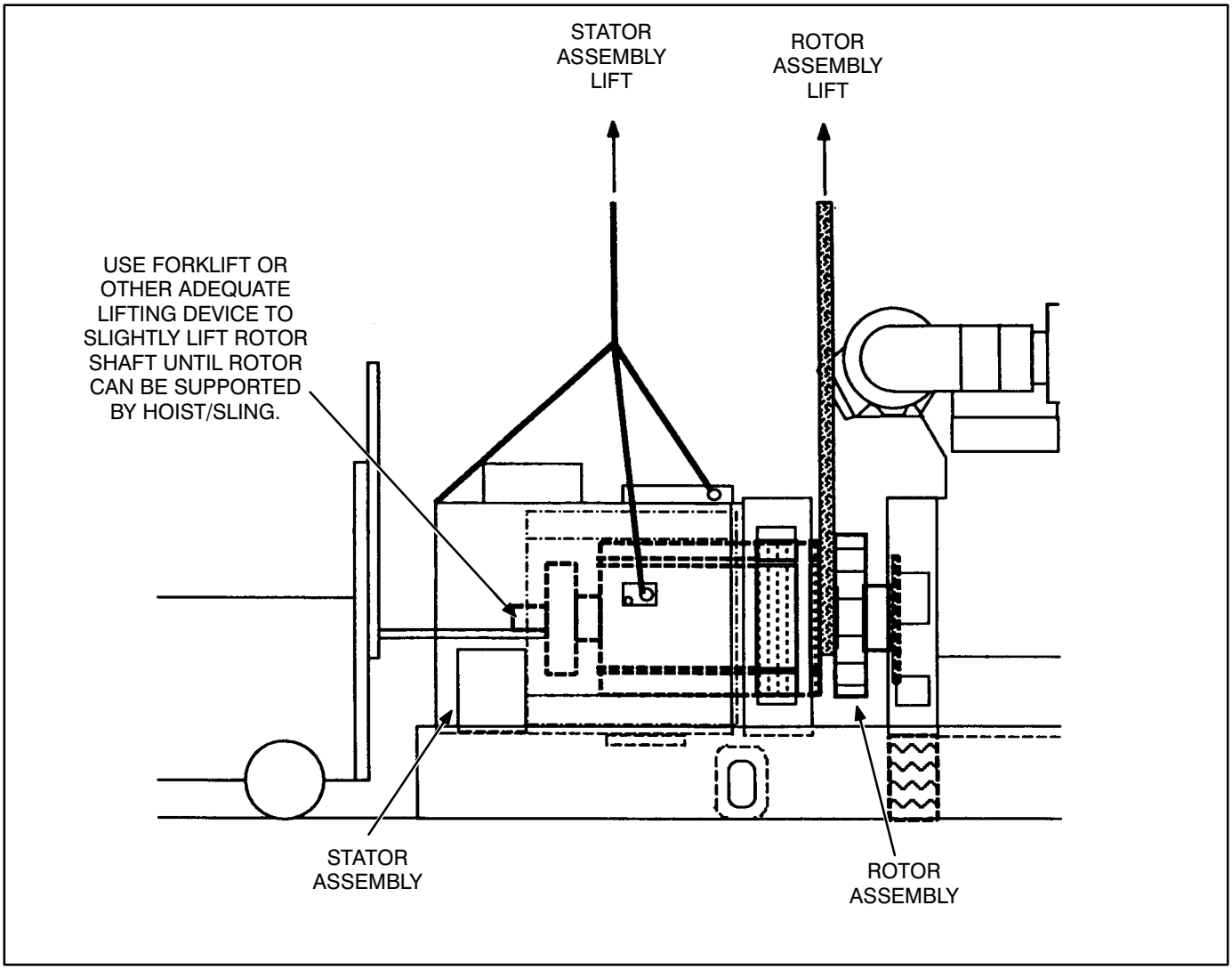


FIGURE 7-10. REMOVING STATOR ASSEMBLY

22. If the engine does not have chassis mounts at generator end, block the rear of the engine in place by supporting the flywheel housing. A length of steel channel and wooden blocking is required to support the rear of the engine. Place the channel and blocking under the flywheel housing. Lower the generator until most of the set weight is supported by the blocking (see Figure 7-10).
23. Disconnect the grounding strap from the flywheel housing.
24. Using a forklift, position a lifting bar of the forklift (inside and inline with the generator) under the rotor shaft. Lift the rotor shaft slightly so that rotor is not resting on inside of stator assembly. See Figure 7-11.
25. Verify that the stator is adequately supported and then carefully remove the capscrews from the stator attachment ring.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

    ⚠ CAUTION ***Improper stator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the stator assembly alone, by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the stator is adequately hooked/strapped to maintain level control of stator assembly while lifting and moving.***

26. Being careful not to drag the windings on the rotor, move the stator assembly sufficiently away from engine to sling and support the rotor assembly. Do not allow rotor assembly to hang on engine flywheel.

    ⚠ CAUTION ***Drive disc damage can be caused by allowing the rotor assembly to hang on flywheel. Use adequate hoist and sling to support the rotor assembly.***

27. Reposition or add hoist and sling support for the main rotor, and remove the forklift. See Figure 7-11, Rotor Lift detail.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

28. Remove the stator assembly, being careful not to drag the windings on the rotor. Place stator assembly away from the chassis in the horizontal position.
29. Using the hoist and sling to support the rotor, carefully remove the capscrews and flat washers that secure the drive discs to the engine flywheel.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

30. Remove the rotor assembly and place it on wood blocks in the horizontal position. To avoid possible distortion, do not allow the drive discs and fan to rest on anything.

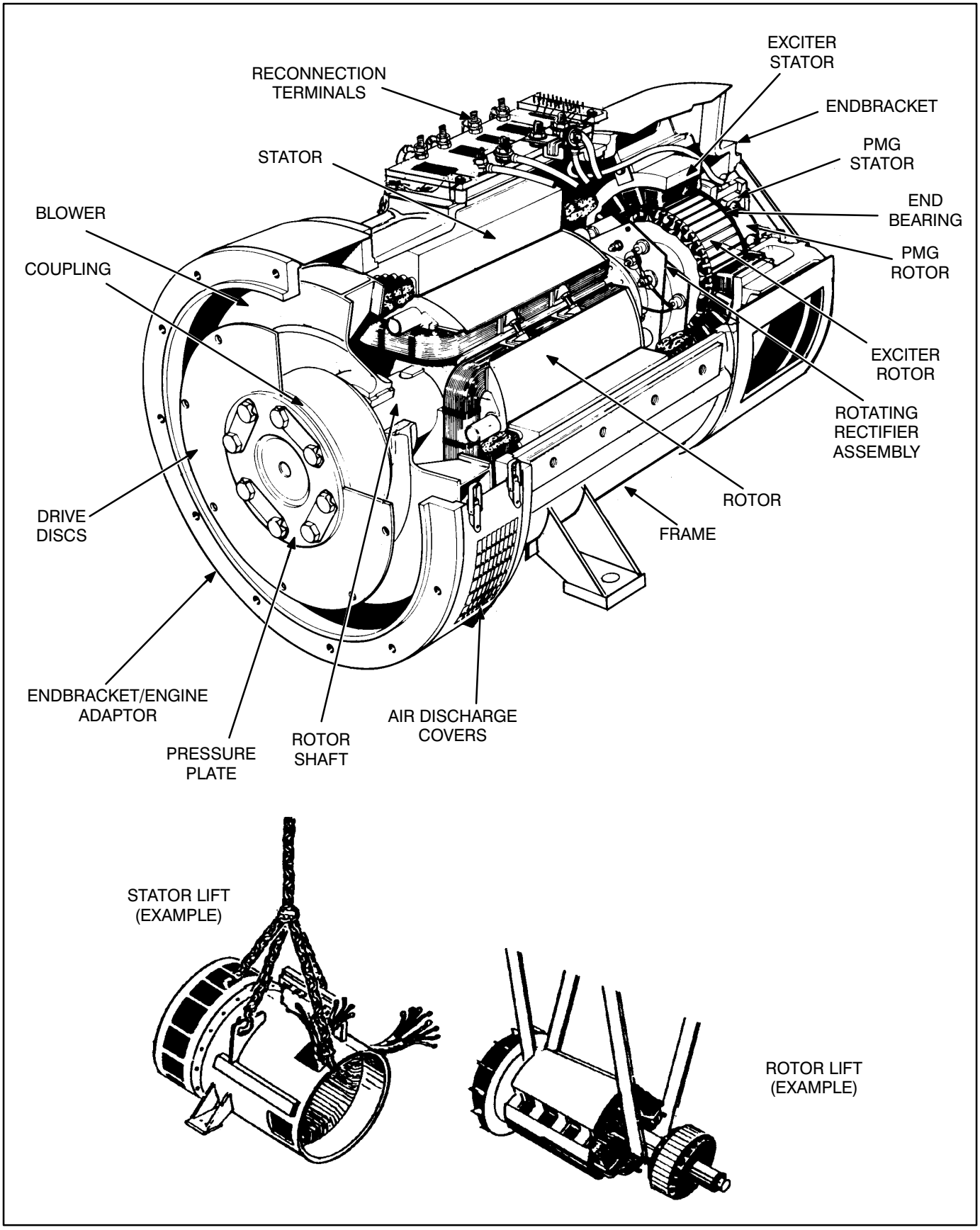


FIGURE 7-11. TYPICAL GENERATOR ASSEMBLY

Generator Assembly Removal

31. Remove the fasteners from the two generator mounting feet brackets.
32. Using an adequate lifting device, lift the generator (at lifting eyes provided, and main stator housing) until the mounting feet brackets are clear of the frame member (see Figures 7-11 and 7-12).
33. If the engine does not have chassis mounts at generator end, block the rear of the engine in place by supporting the flywheel housing. A length of steel channel and wooden blocking is required to support the rear of the engine. Place the channel and blocking under the flywheel housing. Lower the generator until most of the set weight is supported by the blocking (see Figure 7-12).
34. Disconnect the grounding strap from the flywheel housing.
35. Carefully remove the capscrews and flat washers that secure the drive discs to the engine flywheel.
36. Verify that the generator assembly is adequately supported. Carefully remove the capscrews securing the engine adaptor endbracket to the engine flywheel housing.

⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

⚠ CAUTION ***Improper generator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the generator by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the generator is adequately hooked/strapped to maintain level control of assembly while lifting and moving.***

37. Remove the generator assembly away from engine. Place generator assembly on floor with a piece of wood beneath the stator housing (toward PMG end) to allow for endbracket removal, if desired.

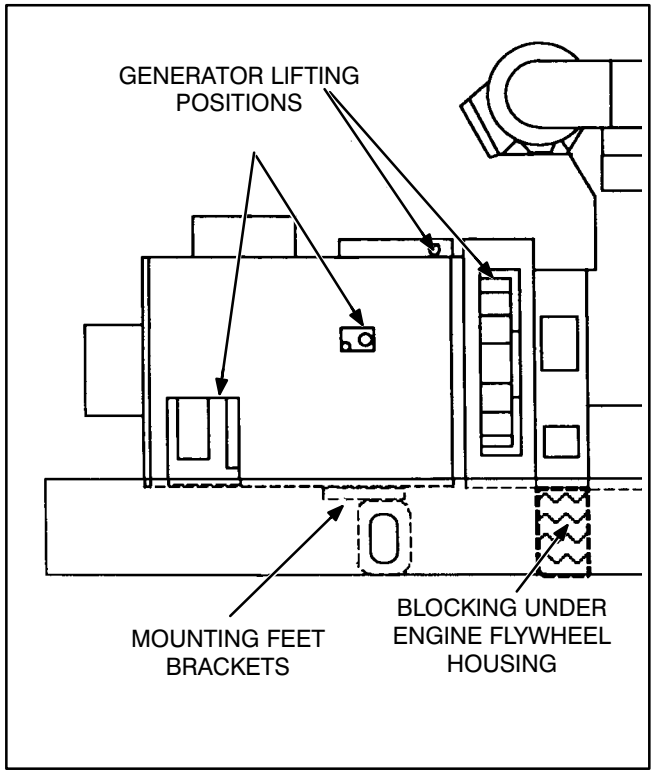


FIGURE 7-12. GENERATOR LIFTING POSITIONS

Bearing Removal

The end bearing is enclosed in a pre-packed cartridge housing and must only be dismantled as necessary for relubrication, replacement, or when a major overhaul is carried out on the generator set.

Removal of the bearing can only be accomplished after removal of the endbracket, as follows:

1. Remove the four screws holding bearing cap.
2. Remove cap.
3. Remove circlip.
4. Remove bearing cartridge housing complete with bearing.

When replacing bearing onto rotor shaft, be sure to apply pressing force to the inner face of the bearing only.

Bearing Lubrication: When re-lubricating or replacing the bearing, review the following.

- Recommended Lubricant: Lithium based grease, Mobilux No. 2 or Shell Alvania R3.
- Temperature Range: -22°F to +248°F (-30°C to +120°C).
- Quantity: 2.74 oz. (81 ml). The grease should be equally divided between the bearing, the bearing cap cavity, and the bearing cartridge cavity.

GENERATOR REASSEMBLY

Generator reassembly is the reverse of disassembly procedure.

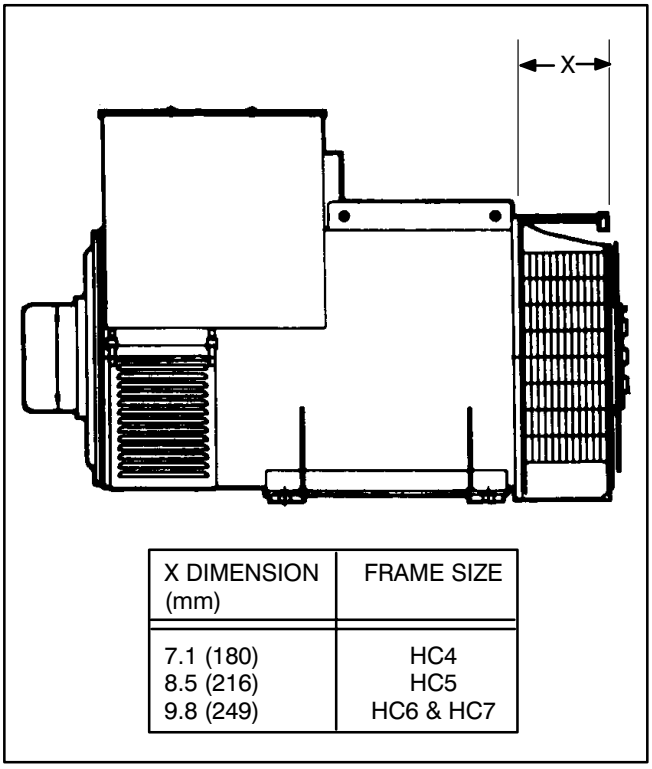
To assemble the stator and rotor at the same time, continue with step 1. To assemble the stator and rotor individually, skip to step 16.

1. Using an adequate lifting device, locate the generator assembly into position near the engine flywheel housing. Align the holes of the rotor drive discs with the holes of the engine flywheel. Install the capscrews and flat washers that secure the drive discs to the engine flywheel, hand tighten.

   ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

   ⚠ CAUTION ***Improper generator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the generator by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the generator is adequately hooked/strapped to maintain level control of assembly while lifting and moving.***

2. Align the holes of the engine adaptor endbracket with the holes in the flywheel housing and install the capscrews and lock washers. Refer to Figure 7-13 and Table 7-3 for torque specifications.
3. Secure the rotor assembly to the flywheel. Refer to Figure 7-13 and Table 7-3 for torque specifications.
4. Lift the generator slightly and remove any blocking from under the flywheel housing. Lower the generator (see Figure 7-12).



X DIMENSION (mm)	FRAME SIZE
7.1 (180) 8.5 (216) 9.8 (249)	HC4 HC5 HC6 & HC7

FIGURE 7-13. GENERATOR FRAME SIZE

TABLE 7-3. GENERATOR MOUNTING TORQUE

FRAME SIZE	ROTOR ASSEM. TO FLYWHEEL	FLYWHEEL HSG. ENDBRACKET TO ENGINE ADAPTER
HC4	85 ft-lbs. (115 N•m)	35-38 ft-lbs. (47-52 N•m)
HC5	150-170 ft-lbs. (203-230 N•m)	75-85 ft-lbs. (101-115 N•m)
HC6	190-200 ft-lbs. (257-271 N•m)	95-105 ft-lbs. (129-142 N•m)
HC7	190-200 ft-lbs. (257-271 N•m)	95-105 ft-lbs. (129-142 N•m)

5. Connect the grounding strap to the flywheel housing using a capscrew and EIT locking washer; and tighten securely.
6. Install the mounting feet bracket fasteners; and tighten securely.

   If endbracket has been removed, continue with step 7, otherwise skip to step 15.

7. Lift slightly on end of rotor shaft and install wooden shims to hold rotor on center with stator.
8. Press bearing onto rotor shaft, applying force to the inner face of the bearing. Install two threaded studs into end bearing cartridge to aid subsequent procedures. Position the end bearing cartridge assembly close to proper position for hole alignment with endbracket.
9. Assemble exciter stator, if removed, to inside of endbracket. Tighten fasteners to 4.5 ft-lbs. (6 N•m) torque.
10. Install endbracket to the stator frame using the proper capscrews and lock washers, but do not tighten securely as yet.
11. Insert and start the threads of the bearing cartridge fasteners, and remove threaded alignment studs, through the endbracket into the cartridge housing.
12. Lift slightly on endbracket and remove wooden shims holding rotor on center with stator.
13. Securely tighten the endbracket fasteners.
14. Tighten the bearing cartridge fasteners to 4.5 ft-lbs. (6 N•m) torque.
15. Install the PMG assembly, if removed. Refer to Permanent Magnet Exciter Installation, later this section.

    Perform the 'Aligning Generator with Engine' procedures, later in this section, then return to the following steps.

    To assemble the control housing, skip to step 34.

    To assemble the stator and rotor individually begin here.

16. If removed, replace exciter rotor and rotating rectifier assembly to main rotor shaft. Reconnect main rotor wire leads to positive and negative terminals of rectifier assembly.
17. If removed, install the drive disc spacer, drive disc and pressure plate on the rotor shaft. Install the cap screws and flat washers and tighten to 352 ft-lbs. (476 N•m) on discs with eight cap screws or 607 ft-lbs. (822 N•m) on discs with 12 capscrews. Typically frame size HC4 and HC5 use eight cap screws and frame size HC6 and HC7 use 12 cap screws.
18. Using a hoist and sling to support the rotor, align the holes in the drive disc with the corresponding holes in the flywheel.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

19. Secure the rotor assembly drive disc to the flywheel using appropriate capscrews and flat washers. Refer to Figure 7-13 and Table 7-3 for torque specifications. Do not allow rotor assembly to hang on engine flywheel. (Refer to Figure 7-11.)

    ⚠CAUTION ***Drive disc damage can be caused by allowing the rotor assembly to hang on flywheel. Use adequate hoist and sling to support the rotor assembly.***

20. Reassemble engine adaptor endbracket to stator frame if removed. Using an adequate lifting device, carefully move the stator into position over the rotor assembly, being careful not to drag the windings on the rotor.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

    ⚠CAUTION ***Improper stator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the stator assembly alone, by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the stator is adequately hooked/strapped to maintain level control of stator assembly while lifting and moving.***

21. Using a forklift, position a lifting bar of the forklift (inside and inline with the generator) under the rotor shaft. Lift the rotor shaft slightly so that rotor is not resting on inside of stator assembly. See Figure 7-11.

22. Remove the hoist/sling support of the rotor assembly. Align the holes of the engine adaptor endbracket with the holes in the flywheel housing and install the capscrews and lock washers. Refer to Figure 7-13 and Table 7-3 for torque specifications.
23. Using an adequate lifting device, slightly raise the generator so that the wooden blocking and steel channel can be removed from under the flywheel housing; then lower the generator so the full weight is resting on the generator mounting feet brackets.

    Perform the 'Aligning Generator with Engine' procedures, later in this section, then return to step 24.

24. Reassemble the covers over the generator air discharge openings and fasten securely.
25. Connect the grounding strap to the flywheel housing using a capscrew and EIT locking washer; and tighten securely.
26. Install the mounting feet bracket fasteners; and tighten securely.
27. Press bearing onto rotor shaft, applying force to the inner face of the bearing. Install two threaded studs into end bearing cartridge to aid subsequent procedures. Position the end bearing cartridge assembly close to proper position for hole alignment with endbracket.
28. Assemble exciter stator, if removed, to inside of endbracket. Tighten fasteners to 4.5 ft-lbs. (6 N•m) torque.
29. Install endbracket to the stator frame using the proper capscrews and lock washers, but do not tighten securely as yet.
30. Insert and start the threads of the bearing cartridge fasteners, and remove threaded alignment studs, through the endbracket into the cartridge housing.
31. Lift slightly on endbracket and remove wooden shims holding rotor on center with stator.
32. Securely tighten the endbracket fasteners.
33. Tighten the bearing cartridge fasteners to 4.5 ft-lbs. (6 N•m) torque.
34. Remove generator lifting eyes. Reassemble control housing mounting brackets to sides of generator and fasten securely.
35. Use an adequate lifting device to lift the control housing in position for mounting to the stator frame. Replace the capscrews and lock washers and tighten to 20 ft-lbs. (27 N•m) torque.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

36. Reassemble any engine air intake components removed during generator disassembly.
37. Connect all control wires and generator leads using the proper generator set AC and DC wiring diagram/schematic.
38. Refer to Permanent Magnet Installation.
39. If equipped with the circuit breaker option, reconnect load wires to circuit breaker. Reconnect all lead wires to the terminal block assembly using proper reconnection diagram in *Section 8*.
40. Verify that all connections are proper and secure and then install the air inlet panel and access covers to control housing (see Figure 7-7).
41. Connect the negative (-) battery cable and test the generator set for operation.

Permanent Magnet Generator (PMG) Installation

1. Install the complete rotor assembly to the end of the main rotor shaft using the hex head through-bolt. Keep the rotor clean by avoiding contact with metal dust or particles.
2. Carefully locate the stator housing to position on the generator endbracket. Fasten in place using the 4 bolts and clamps, and tighten securely.

   The highly magnetic rotor will attract the stator core, care must be taken to avoid any contact which may damage the windings.

3. Connect the PMG wiring harness connector.
4. Install the PMG assembly cover using the three M5x12mm capscrews and lockwashers, and tighten securely.

Aligning Generator with Engine

Proper alignment of the generator and engine assemblies is necessary to avoid premature wear and improper operation of the genset. Review the following alignment conditions and procedures for aligning the generator assembly to engine flywheel housing.

Angular Misalignment: Is the result of the generator bearing center axis not aligning with axis of the engine crankshaft. This condition creates an angle between the generator shaft axis and the crankshaft axis. The cause of this type of misalignment is usually shimming error.

Axial Misalignment: Is the result of the generator shaft axis not aligning with engine crankshaft axis. The tolerances in the bolted flywheel and drive disc connection may add up to displace the generator axially relative to the crankshaft axis.

Misalignment Symptoms: If the assembly is allowed to run under these conditions, the discs must flex in alternate directions twice for each engine revolution. It is important to minimize the amount of disc flexing since, if it is excessive, the drive disc will crack. Although perfect bearing alignment is desirable, it is more important to keep disc deflection to the minimum possible. This procedure assumes that the pilot bore of the drive discs are in the exact center and the flywheel counterbore (pilot) has no practical runout. Under these conditions, perfect Angular alignment will be attained when no deflection of the disks is measured.

Excessive Axial misalignment will cause more generator vibration than Angular misalignment.

Axial misalignment needs to be checked only when an objectionable vibration is present.

Either type of misalignment may be present in a generator set assembly, with angular misalignment being the most common problem. Angular alignment may also be effected by set installation conditions and/or mishandling during shipping of the genset.

Angular Alignment Procedure (V28 and larger engine gensets):

⚠WARNING ***Accidental starting of the generator set during this procedure presents the hazard of severe personal injury or death. Make sure to disconnect the negative (-) battery cable(s) before beginning.***

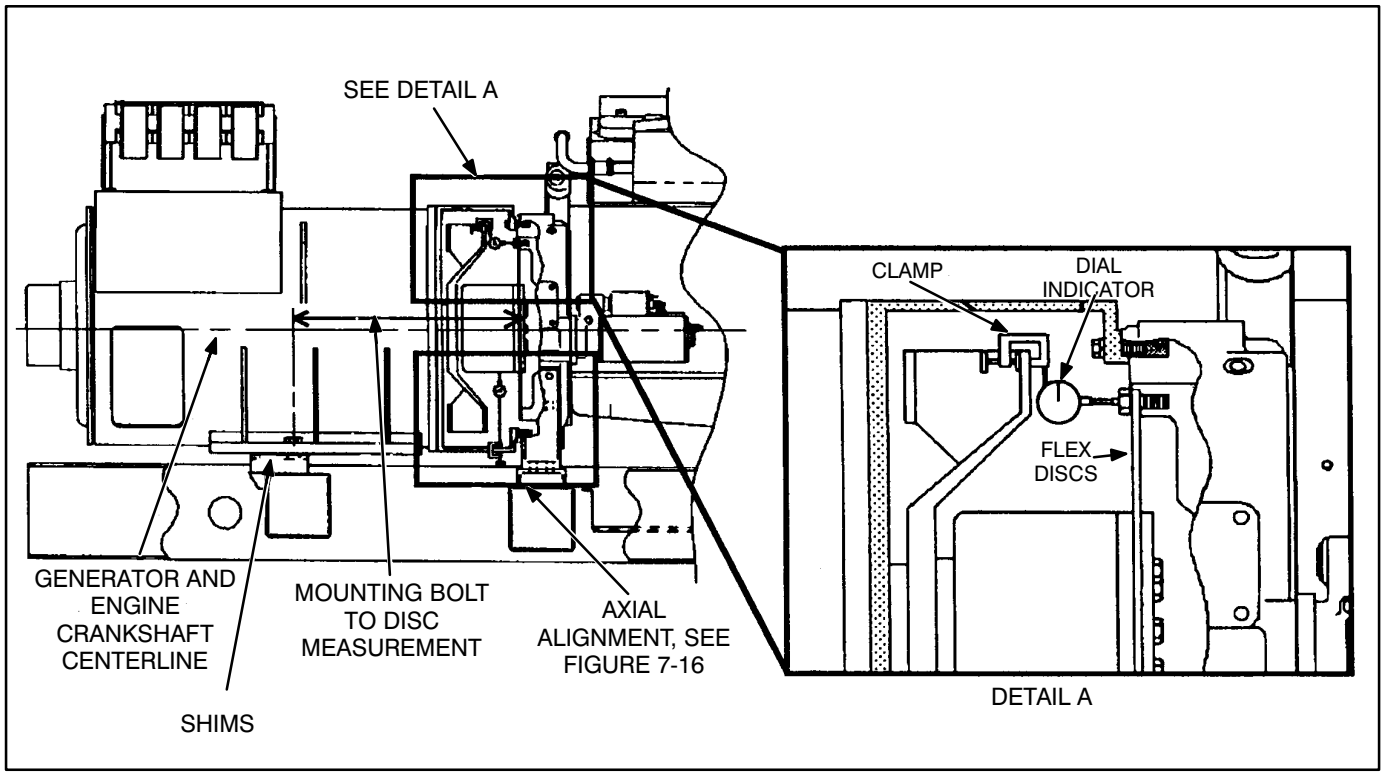


FIGURE 7-14. ANGULAR ALIGNMENT MEASUREMENT

Fasten a dial indicator to either the generator shaft or the cooling fan with the sensing point resting on the capscrew head or the flat surface of the drive disc at the bolt circle diameter, see Figure 7-14. Bar the engine over in a clockwise rotation as viewed from engine flywheel. Do not allow it to roll back on compression at the end of the travel of each reading. It is unnecessary to zero the indicator since the total indicator reading (T.I.R.) of the deflection measurement to the bolt heads is what is required. T.I.R. will be the sum of the maximum positive and negative dial indicator readings as the engine completes one revolution.

Sample Generator Runout Readings: When taking the deflection readings described, make a diagram similar to the example shown in Figure 7-15, where a total indicator reading of .025". (The highest positive value of +.010 and the largest negative value of -.015".) The indicator is closer to the top and further away at the bottom. This example indicates that the generator bearing is high. Since the side readings are equal, the generator is centered side to side. To lower the generator, remove equal shims from under both generator mounting feet. To approximate the amount of shims to remove or add:

1. Measure the distance between the center of the generator shaft to the point the indicator is measuring at. (For example; a SAE 18 Disc coupling distance is 10.7").
2. Measure the distance from the generator side of the flex discs to the center of the generator mounting bolt, refer to Figure 7-14. (For example; a HC6 Frame's distance is 28.4".)
3. Compare the distance measured in steps 1 and 2. (28.4" vs 10.7" or a 2.65 to 1 ratio.) Multiply this ratio times one half the T.I.R. (In our example, .025" divided by 2 is .0125". This, times 2.65 equals .033". Therefore, remove .033" of shims from under both mounting feet.)

In general, the T.I.R. should not be more than .001" for each inch of radius (center of shaft to indicator axis). If we use our example of 10.7", then the maximum T.I.R. would be .011". This would only require a correction of .014" from the T.I.R. of .025". (A reading of +.002 at the top and -.009 at the bottom would fall within the satisfactory range.)

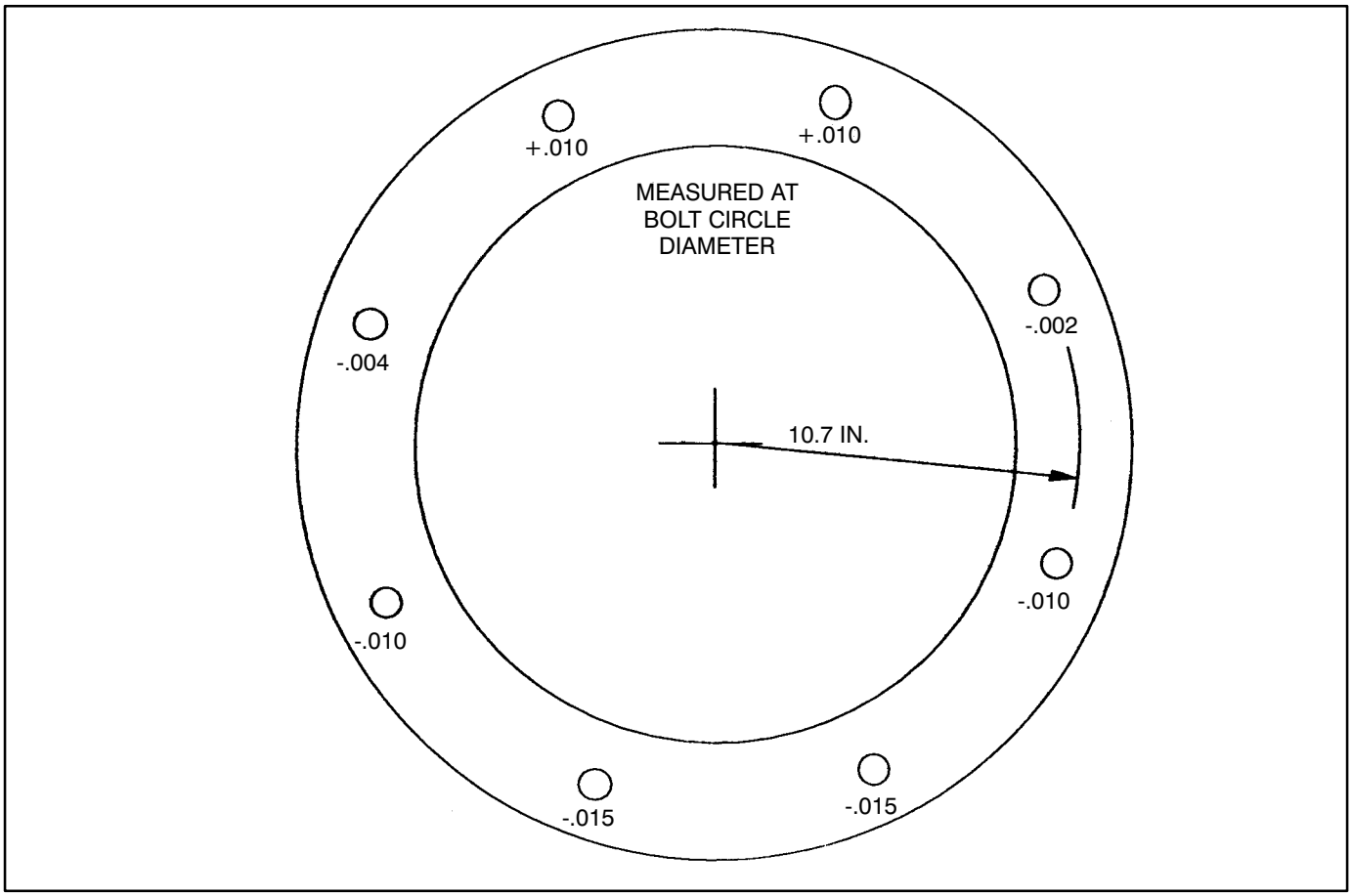


FIGURE 7-15. ANGULAR ALIGNMENT MEASUREMENT READINGS (Example)

Axial Alignment Procedure (all gensets):

Axial misalignment needs to be checked only when an objectionable vibration is present.

If excessive vibration remains after the angular alignment, check for concentric alignment of the generator shaft/engine crankshaft axes.

Fasten dial indicator holding device to skid base, engine block, or generator shell with a magnetic base or clamp and position so the sensor point of indicator rests on the generator shaft hub, see Figure 7-16. Bar the engine over in a clockwise rotation as viewed from engine flywheel, through a couple of rotations. Record indicator readings in eight equally spaced points around the shaft diameter. This will provide a T.I.R. for Axial shaft misalignment.

The maximum allowable T.I.R. runout is subjective, the optimal T.I.R. for runout would be .000", however, that may not be attainable. The recommendation of this procedure will be to reduce the measured T.I.R. runout by one half. Specific out-of-tolerance runout levels are difficult to establish due to the varying surface quality of the generator shaft's drive disc mountain hub.

The goal of the Axial realignment is to reduce the vibration level of the genset while it is operating. A small improvement in the T.I.R. runout may have dramatic effects in the mechanically measured or physically observed vibration levels.

To correct for an out of tolerance T.I.R. indication, remove the capscrews connecting drive discs and flywheel. Mark the drive discs and flywheel with respect to each other. Rotate either the engine or generator so that drive discs holes are repositioned 180 degrees from their original location. Put the drive discs capscrews back in and retorque. Recheck shaft alignment as before. If shaft T.I.R. runout remains unchanged then the discs should be rotated to either 30, 60, or 90 degrees from original location to correct the out of tolerance condition. If the T.I.R. does not improve after repositioning, a closer inspection of the flywheel pilot and drive disc runouts is required. This will help determine the cause of the Axial misalignment.

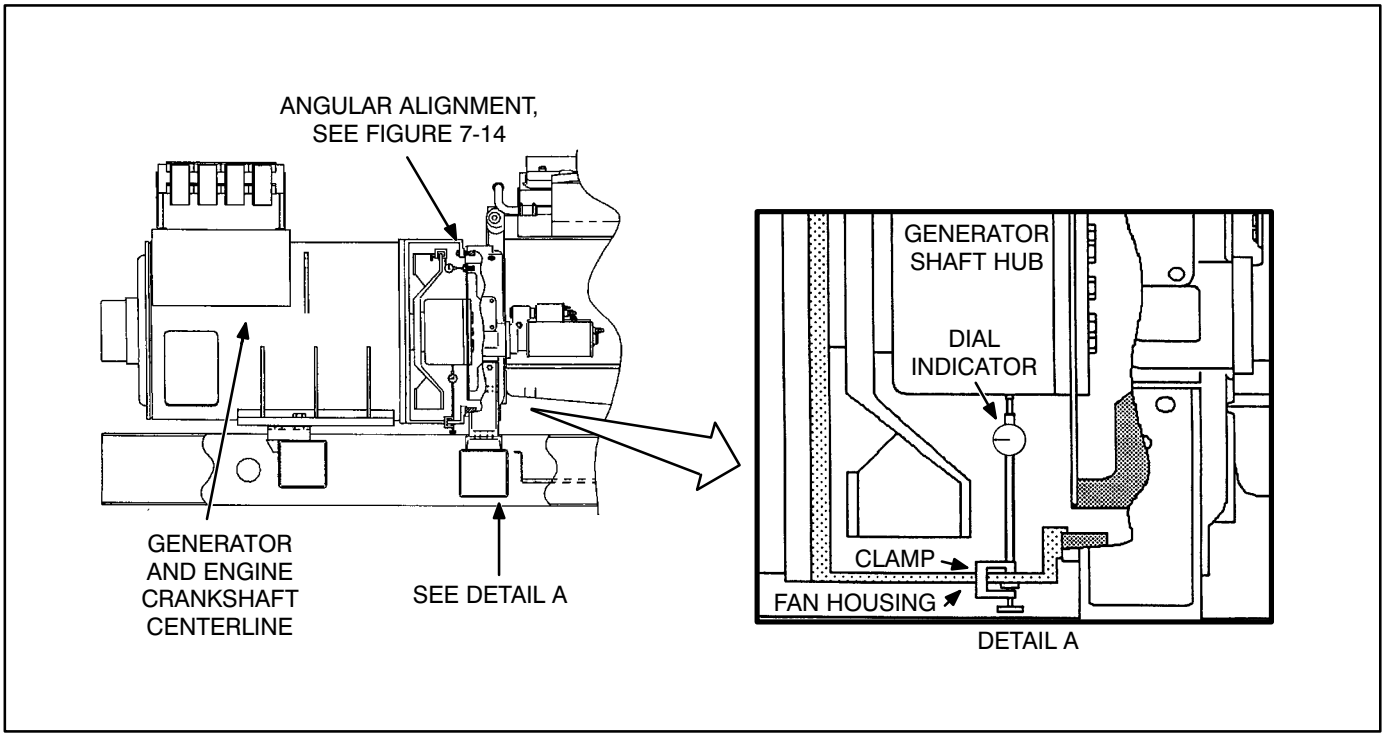


FIGURE 7-16. AXIAL ALIGNMENT MEASUREMENT

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8. Fuel Transfer Pump and Control

GENERAL

A fuel transfer pump and control are available when a sub-base or in-skid day tank are provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the sub-base or in-skid day tank. Figure 8-1 illustrates a typical sub-base installation.

⚠WARNING Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited. Installation and service must be performed by qualified persons in accordance with the applicable codes.

Do not smoke near fuel and keep flames, pilot lights, sparks, arcing switches or equipment and other sources of ignition well away.

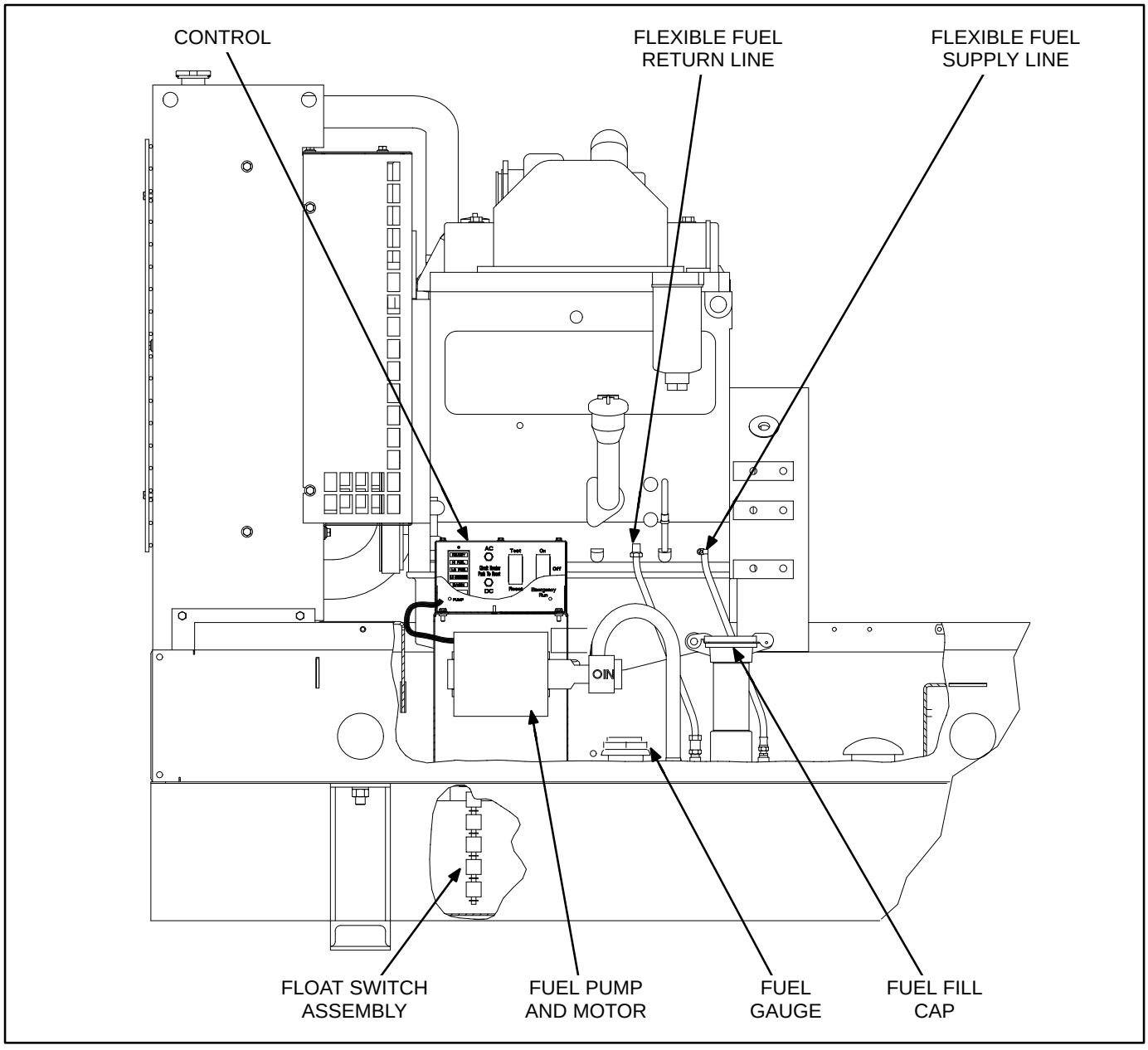

FIGURE 8-1. TYPICAL SUB-BASE INSTALLATION

OPERATION

1. Push the control switch to the **ON** position for automatic operation. The green **SYSTEM READY** light will come on and the pump will fill the tank if AC power is available for pumping and DC power is available for the internal logic circuits. The level of fuel in the tank will be automatically kept between a set of pump-on and pump-off float switches.

   When filling an empty tank, the red LO SHUTDOWN and LO FUEL lights will come on when the control switch is pushed to the ON position. This is normal. Push the panel RESET switch to turn off the red lights after the tank has been filled.

   If the SYSTEM READY light does not come on, check for correct AC and DC power connections. See Wiring Connections and Fuel Pump Motor Connections below.

2. The green **PUMP ON** light indicates when the pump is running. It will come on and go off as fuel is pumped to maintain the proper level in the tank.

3. Push the control switch to the **EMERGENCY RUN** position (momentary contact) to pump fuel into the tank if the control fails to operate the pump automatically. (The pump may continue to run after enabling the Emergency Run Switch to complete the filling cycle of the tank.)

   The green PUMP ON light does not come on when the switch is in the EMERGENCY RUN position.

4. The red lights indicate fault conditions and the need for service. The control panel includes the following lights:

   A. ***HI FUEL:*** The fuel in the tank has reached an abnormally high level, indicating possible failure of the pump-off float switch. The high-fuel float switch takes over as the automatic pump-off switch. The **HI FUEL** light stays on. The light can be **RESET** with the panel switch when the fuel level drops to normal, but will come back on again during the next pumping cycle if the fault remains.

   ⚠WARNING ***Continued operation with a HI FUEL fault present can lead to spillage of large quantities of fuel if the high-fuel float switch fails. Spilled fuel can cause loss of life and property if it is accidentally ignited, or environmental damage.***

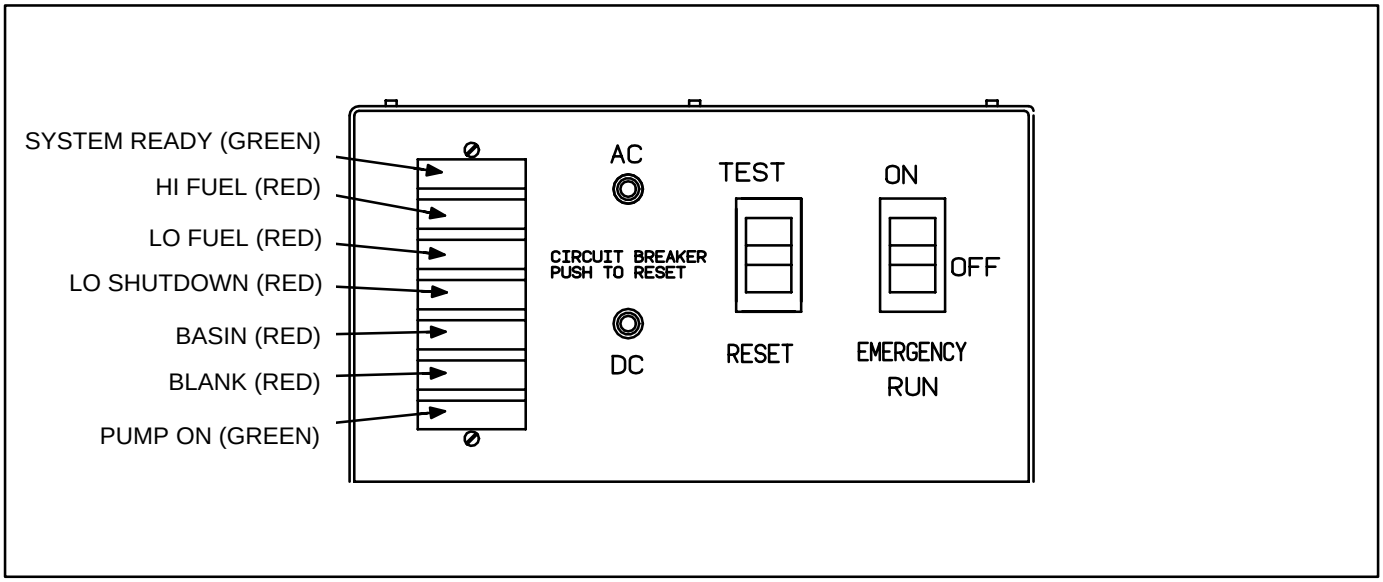

FIGURE 8-2. FUEL PUMP CONTROL PANEL

B. ***LO FUEL:*** The fuel in the tank has dropped to an abnormally low level, indicating possible failure of the pump-on float switch. The lo-fuel float switch takes over as the automatic pump-on switch. The **LO FUEL** light stays on. The light can be **RESET** with the panel switch when the fuel level rises to normal, but will come back on again during the next pumping cycle if the fault remains.

⚠ CAUTION ***Continued operation with a LO FUEL fault present can lead to low-fuel shutdown if the low-fuel float switch fails.***

C. ***LO SHUTDOWN:*** The fuel has dropped to a level near the bottom of the tank, indicating an empty main fuel tank, pump failure or possible failure of both the pump-on and low-fuel level float switches. Further operation will allow air to enter the engine fuel unit, causing shutdown and the necessity to bleed the fuel unit to start up the engine again. If the light comes on, check the fuel level in the main fuel tank and fill it if necessary. As the day tank is refilling, **RESET** the light with the panel switch.

To restore engine operation following this fault, both the pump control and the engine control have to be RESET.

D. ***BASIN:*** Fuel has overflowed into the rupture basin (if provided), indicating possible failure of both the pump-off and hi-fuel level float switches, or a leak in the day tank. **RESET** the control after the fuel in the basin has been safely disposed of and the cause of the overflow corrected.

E. ***BLANK:*** For customer use.

The control fault circuits will trip and latch, requiring RESET, even if AC power is lost.

5. Press the **TEST** switch to test the indicator lights and pump operating circuits. Replace any light that does not come on. The pump will stop automatically after it has filled the tank to the normal pump-off fuel level.

6. Press the reset button of the **AC** or **DC** circuit breaker if either has tripped.

WIRING CONNECTIONS

See Day Tank Pump Control Wiring, *Section 10*, when making connections at the control box terminal board. The following should be noted.

1. The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC.

   To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps.

   A. Remove the two jumpers between terminals **TB1-6** and **TB1-7** in the control box and connect one between terminals **TB1-5** and **TB1-6** and the other between terminals **TB1-7** and **TB1-8**.

   B. Move selector switch **S103** on the control PCB to the up position for 120V.

   C. On the control transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

   To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps.

   A. Remove the jumpers between terminals **TB1-5** and **TB1-6**, and **TB1-7** and **TB1-8** in the control box and connect the two jumpers between terminals **TB1-6** and **TB1-7.**

   B. Move selector switch S103 on the control PCB to the down position for 240 VAC.

   C. On the control transformer, remove the jumpers between terminals **H1** and **H3**, and **H2** and **H4** and connect the two jumpers between **H2** and **H3**.

2. Attach a tag to the control box indicating the supply voltage.

3. To immediately shut down the engine when the **LO SHUTDOWN** light comes on, jumper TB1-14 to GND at TB1-12 and connect TB1-15 to one of the programmable PCC customer fault inputs (Fault 1, 2, 3, or 4) at the Customer Terminal Block TB1-16, 17, 18, or 19. Program this fault for a shutdown.

4. Terminals **TB1-10** through **TB1-17** and **TB2-23** through **TB2-27** are available for connections to remote annunciators.

5. Terminals **TB1-8** and **TB1-5** are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump. See Item 2 above.

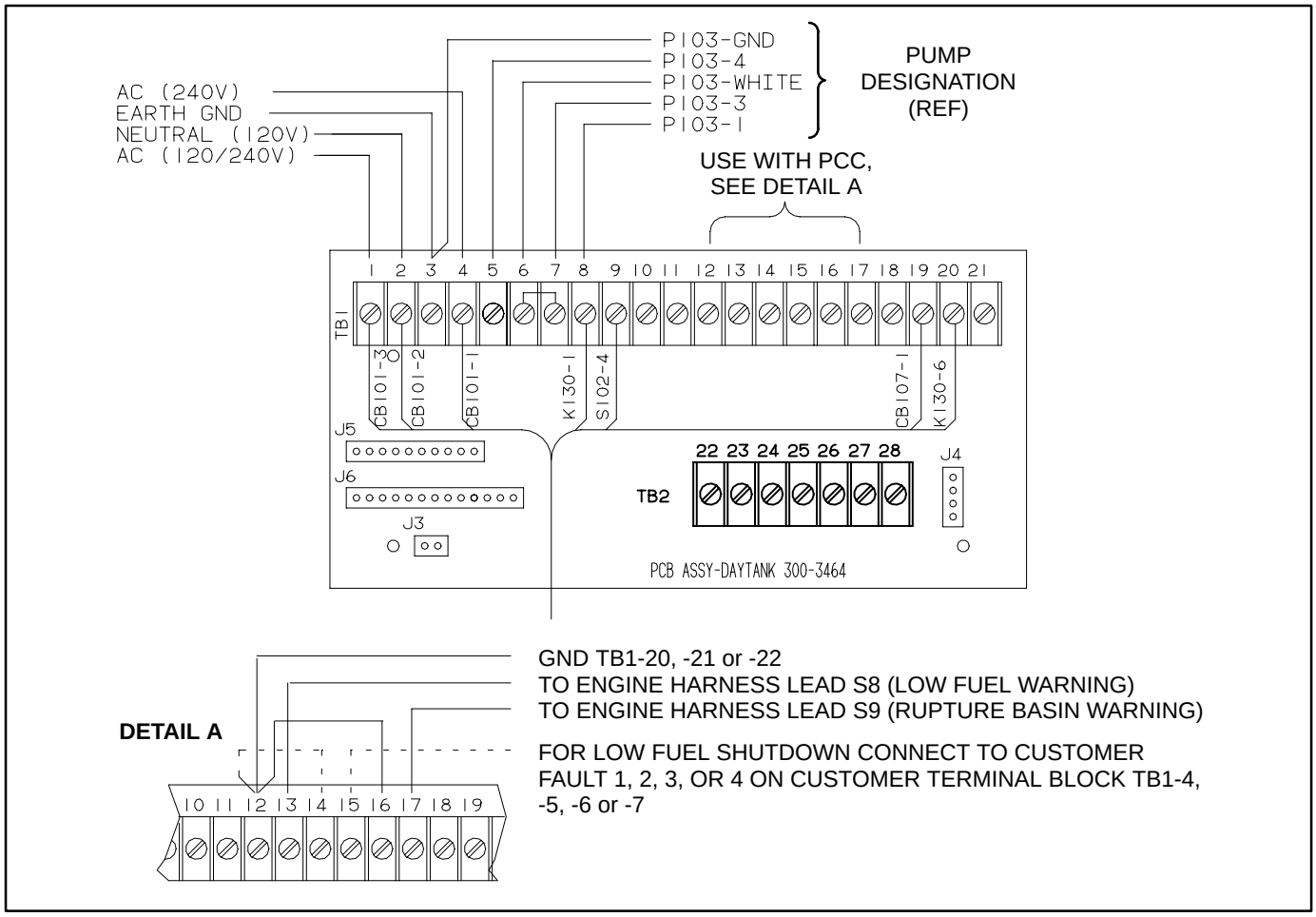

FIGURE 8-3. FUEL PUMP CONTROL TERMINAL BOARD

FUEL TRANSFER PUMP MOTOR CONNECTIONS

Connect a replacement fuel transfer pump motor as follows.

1. Remove the end bell cover for access to the motor wiring terminals.
2. Disconnect the brown lead from motor terminal **P103-3** and connect it to terminal **P103-6**. (Terminal **P103-6** is an insulated receptacle for securing the end of the lead so that it cannot move and touch the motor frame or a live terminal and cause a short circuit.)
3. Disconnect the red lead from motor terminal **P103-2**. It will be connected to the piggy-back terminal on the lead connected at motor terminal **P103-3**.
4. Cut the white lead from its ring connector at motor terminal **P103-4**. Strip 1/2 inch (12 mm) of insulation from the end of the white motor lead for splicing to the wire harness lead marked **P103-WHITE**.
5. Connect each lead of the five-lead wiring harness to the motor terminal or lead marked on it.
6. Connect the red motor lead to the piggy-back terminal at motor terminal **P103-3**.
7. Secure the end bell cover.

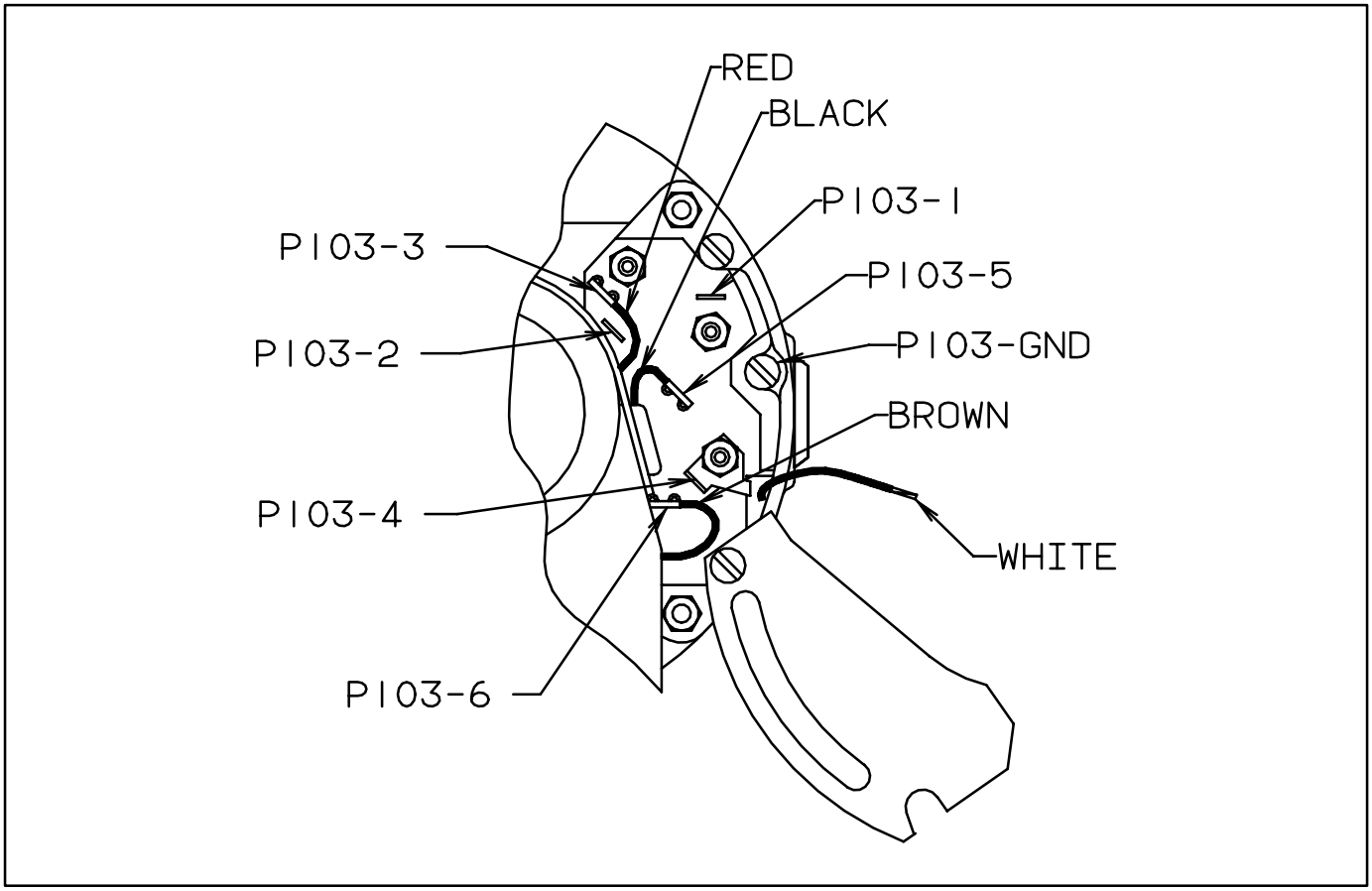

FIGURE 8-4. FUEL TRANSFER PUMP MOTOR CONNECTIONS

TESTING THE FLOAT SWITCH ASSEMBLY

The float switch assembly consists of 5 switches. Each switch has a pair of color coded leads connected to a common jack.

To test the float switches, remove the fuel pump control cover, disconnect the wiring jack and unscrew the assembly from the top of the day tank. Test as follows:

1. With an ohmmeter, test for electrical continuity (switch closed) between each pair of colored leads, while holding the assembly vertical. Replace the assembly if any switch is open (all the readings should be zero).

2. Lift each float, in turn, to 1/8 inch (3 mm) below the C-clip stop above it (use a feeler gauge) and test for electrical continuity. Replace the assembly if any switch does not open (all the readings should be infinity).

3. Use pipe thread sealant when replacing the assembly.

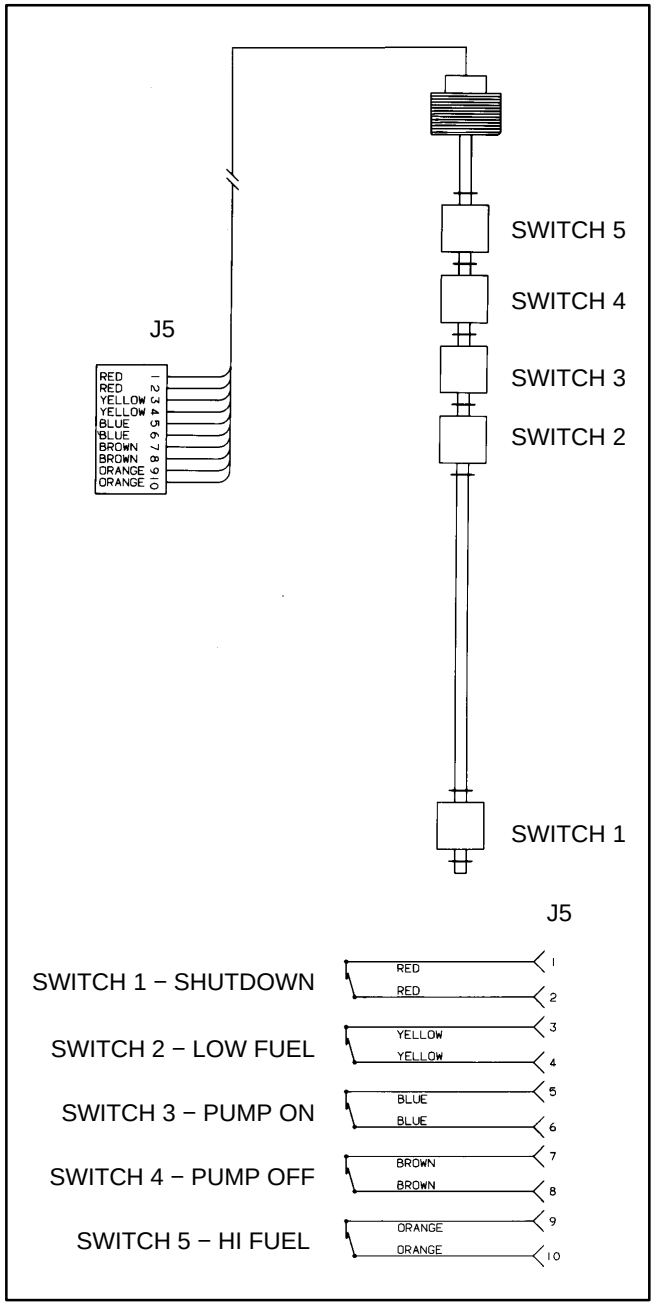

FIGURE 8-5. FLOAT SWITCH ASSEMBLY

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9. Optional Enclosure Fuel Tank System

GENERAL

This section describes the operation and testing of the optional components of the fuel tank system shown in Figure 9-1.

When a sub-base fuel tank is provided, a fuel transfer pump with control, an external fuel alarm panel and external fuel fill box are available as an option.

WIRING CONNECTIONS

Fuel Transfer Control Customer Outputs

See *Enclosure/Options Wiring Diagrams* in Section 10 for customer connections to remote annunciators.

PCC Customer Inputs

PCC Customer Fault Inputs 3 (Low Fuel) and 4 (Rupture Basin) are prewired to the sub-base fuel tank when shipped from the factory.

The “Low Fuel” warning message, when displayed by the PCC, indicates that the fuel level has dropped below the low fuel level (approximately 62%).

The “Rupture Basin” warning message is used to indicate that fuel is detected in the fuel tank basin.

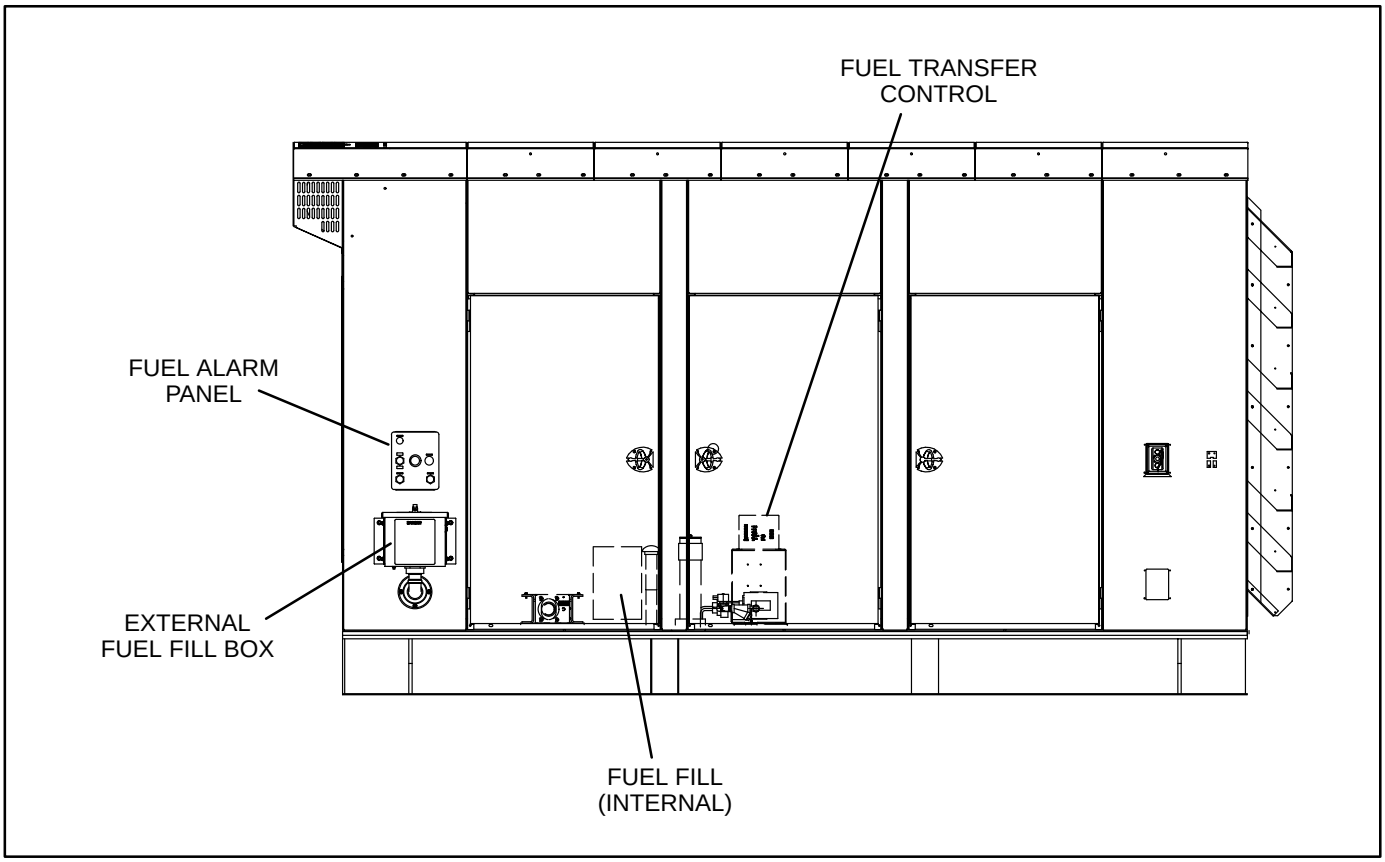


FIGURE 9-1. FUEL TANK SYSTEM OPTIONAL COMPONENTS

FUEL TRANSFER PUMP

The fuel transfer pump and control are available as an option when a sub-base fuel tank is provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the sub-base tank.

This section explains functions of the control panel lamps, components and operation/testing of the day tank fuel control system. All red color lamps indicate a fault condition.

Control Panel Switches and Indicators

The following paragraphs describe the operation of the control switches and indicators.

Indicators:

- **FUEL LEVEL** (green): indicates in percent the amount of fuel that is contained in the sub-base tank.
- **HIGH FUEL** (red): indicates that the fuel has reached an abnormally high level. It indicates a possible failure of the ”pump-off” float gauge in the sub-base tank. The lamp will turn off when the fuel level drops to normal.

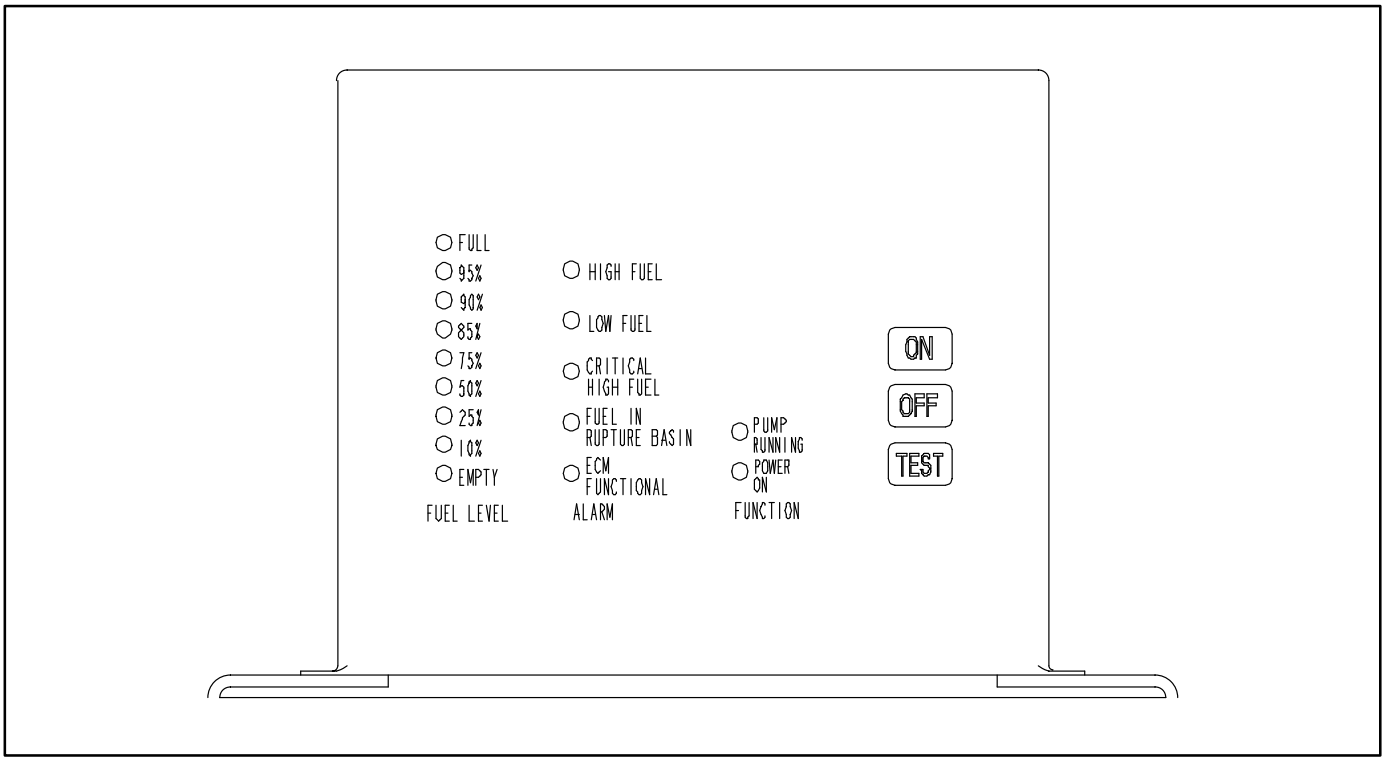


FIGURE 9-2. TRANSFER PUMP CONTROL FRONT PANEL

- **LOW FUEL** (red): indicates that the fuel level has dropped below the low fuel level. This warning enables the operator time to react to a potential problem before low fuel shutdown occurs. It indicates a possible empty main fuel tank, fuel line restriction, pump failure, or failure of the float gauge.
- **CRITICAL LOW FUEL** (red): indicates that the fuel level has dropped to tank bottom. This warning enables the operator time to shut down generator set before fuel runs out, preventing loss of prime or engine damage. It indicates a possible empty main fuel tank, fuel line restriction, pump failure, or failure of the float gauge.

  The control should be wired to shut down the genset (optional) as continued operation will allow air to enter the engine injection pump necessitating bleeding to restart the engine. The control will reset after restoring the tank fuel level. This will also restore engine operation if the tank control has been connected to shut down the engine.

  ⚠ CAUTION ***Continued operation with a CRITICAL LOW FUEL fault can lead to a low fuel shutdown if the fuel level float switch fails.***

- **FUEL IN RUPTURE BASIN** (red): indicates that the fuel has flooded the safety basin surrounding the fuel tank. The basin float switch turns off the fuel pump. The pump cannot function again until the basin is drained of fuel. Possible cause, leak in fuel tank.
- **PUMP** (green): indicates that the fuel pump is running. It will come on and go off as fuel is pumped to maintain the fuel tank level.
- **ECM FUNCTIONAL** (green): indicates no faults are detected within the control circuitry (including float gauge). If a fault occurs, the lamp will go out and de-energize the control relay. It is suggested that the customer wire to the normally closed contact to provide a signal if a fault does occur.
- **POWER ON** (green): indicates that AC power is available to the control.

Switches:

- **ON:** This pushbutton activates the control after the OFF pushbutton has been pressed.
- **OFF:** This pushbutton disables the control for routine maintenance to the tank system without disrupting the control. **NOTE: This also de-energizes the ECM FUNCTIONAL relay which will activate a customer alarm wired to this relay.**
- **TEST:** This pushbutton will test all front panel lamps for three seconds and activate pump/motor for as long as the button is pressed. All alarm relays will not activate but will maintain their original state.

Operation

The following steps describe how to operate the day tank controller.

NOTE: When power is applied to the control or is restored after a power interruption, the control will automatically go to the power on mode (functions the same as pressing the ON switch). The pump will start if the control detects low fuel in tank.

1. Press the control ON switch for automatic operation. The green PUMP light will come on and the pump will fill the tank. The level of fuel in the tank will be automatically kept between a set of pump-on and pump-off float gauge.

   When filling an empty tank, the red CRITICAL LOW FUEL and LOW FUEL lights will come on when the control switch is pushed to the ON position. This is normal. The red lights will turn off as the tank is filled.

2. The green PUMP light indicates when the pump is running. It will come on and off as fuel is pumped to maintain the proper level in the tank.

EXTERNAL FUEL FILL BOX

The external fuel fill box plumping may contain the optional overflow preventive valve (OFPV), which is used to prevent the overfilling of the fuel tank. The valve will energize (close) when a Critical High fuel condition (95% full) is detected/displayed by the External Alarm panel.

If the valve remains closed after correcting the critical high fuel condition, check the following possible causes before replacing the valve.

- Defective Critical High switch mounted on fuel tank. (Critical High switch remains closed with fuel gauge indicating less than 95% full.)
- Defective External Alarm panel (refer to *Enclosure/Options Wiring Diagrams* in Section 10).

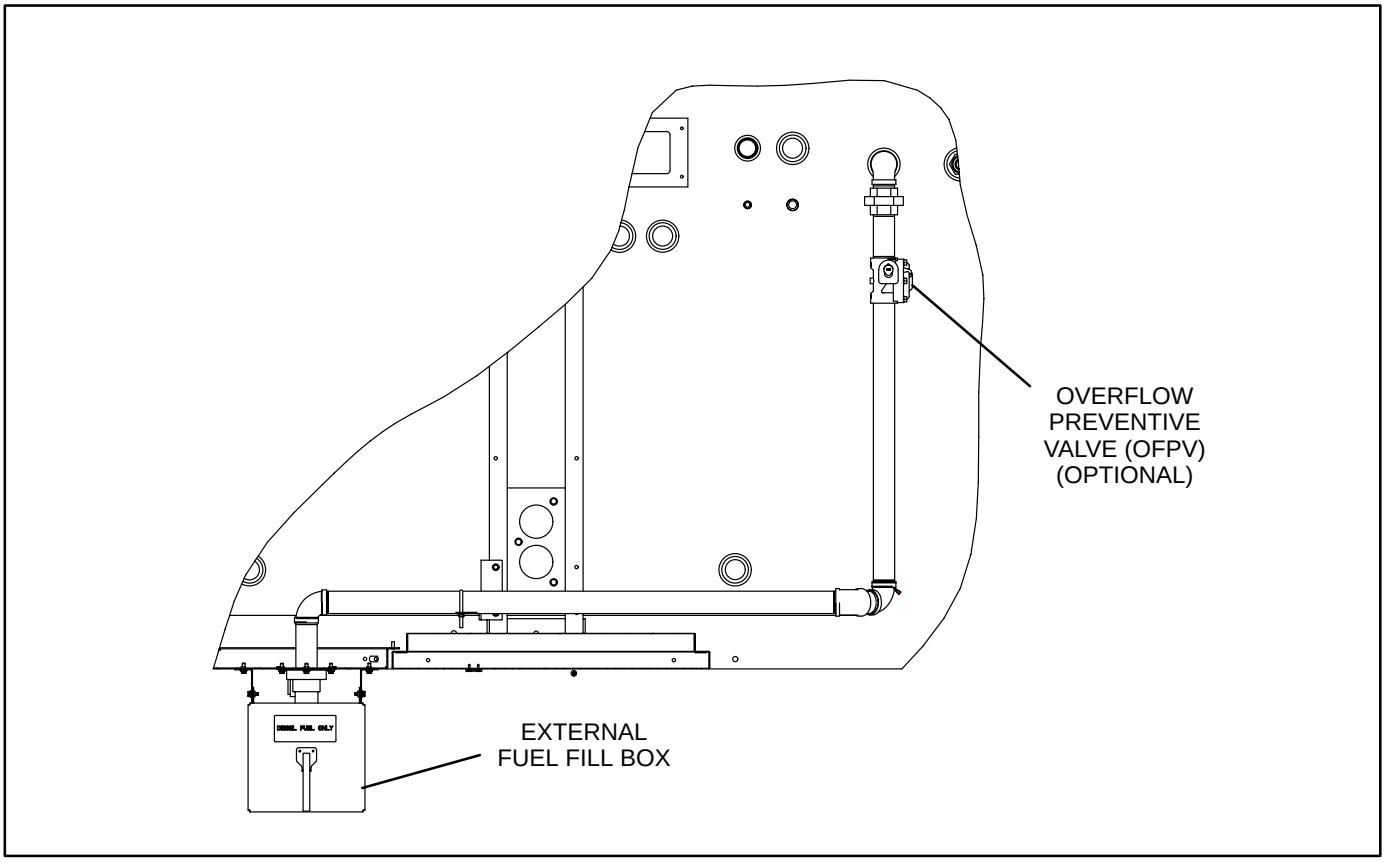


FIGURE 9-3. OPTIONAL FUEL (SPILL) FILL BOX

EXTERNAL ALARM PANEL

The following paragraphs describe the operation of the external alarm panel components.

Overfill Indicator/Horn/Mute Button

The overfill alarm Indicates that the fuel has reached an abnormally high level (95%). Immediately stop adding fuel. It also indicates a possible failure of the “pump-off” float gauge for fuel systems that contain the fuel transfer pump.

The horn can be turned off by pressing the mute button. The indicator will turn off when the fuel level drops to normal.

Fuel Gauge

Indicates the amount of fuel that is contained in the sub-base tank.

Solenoid Override Button

The Solenoid Override Button is only provided on the Alarm Panel when the optional overflow preventive valve (Figure 9-3) is provided with the external fill box feature.

This switch is used to release the delivery hose pressure caused by the closing of the overflow preventive valve. This valve automatically closes during an overfill alarm, stopping the filling of the tank and creating pressure between the valve and the delivery hose. Before disconnecting the delivery hose, always press this button after an overfill warning to release fuel back pressure into the sub-base tank.

Test Button

Press the TEST switch to test the indicator light and the horn. The test will remain active for as long as the button is pressed.

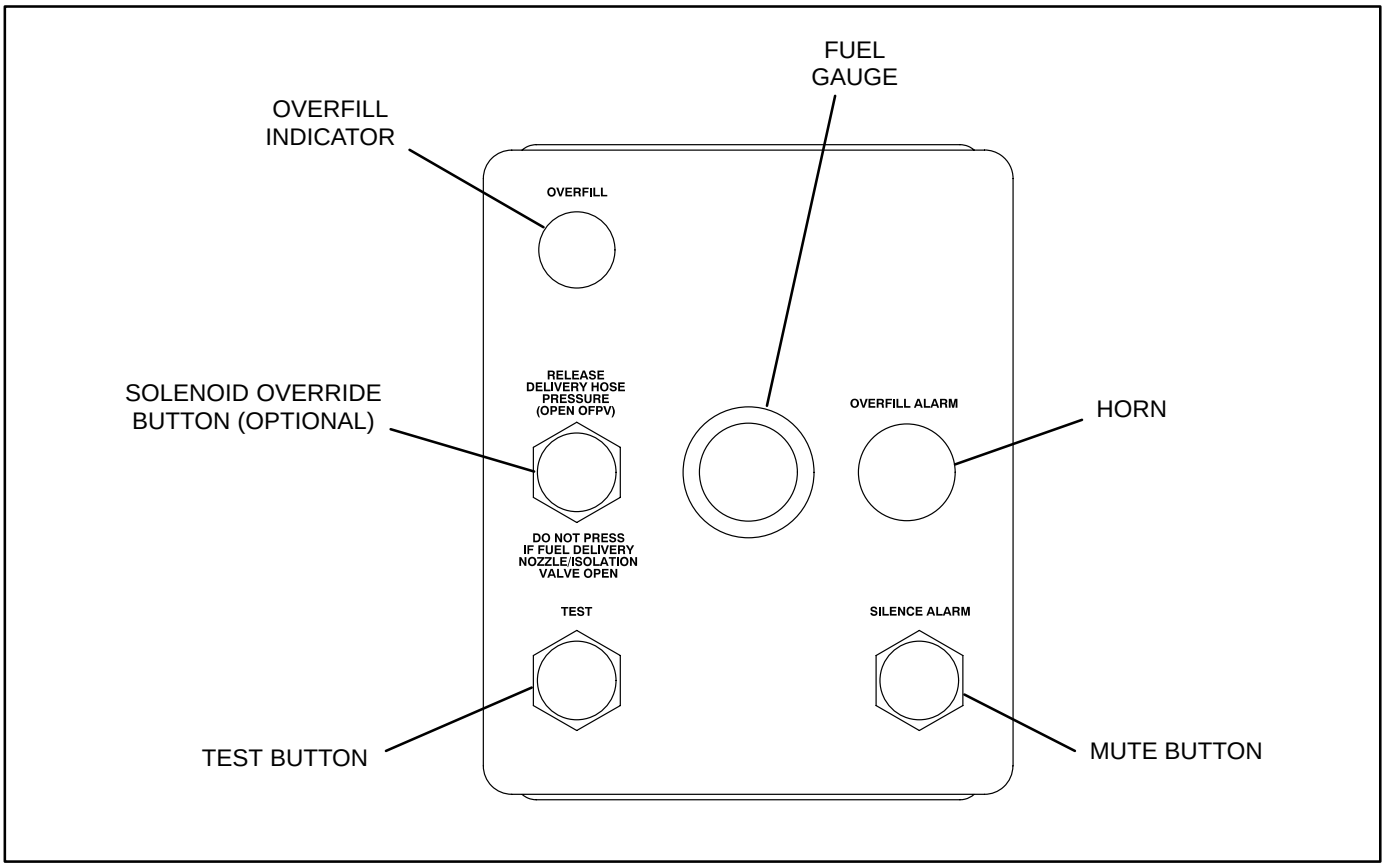


FIGURE 9-4. EXTERNAL ALARM PANEL

RUPTURE BASIN LEAK DETECT SWITCH TEST

The rupture basin leak detect switch (Figure 9-5) is provided with sub-base fuel tanks used with the optional enclosure. This switch should be checked once a year to make sure switch is properly operating. In some areas, weekly inspections may be required by safety code regulations.

To test the leak detect switch:

1. Remove the pipe fitting/switch assembly from the rupture basin tank.
2. Move the O/Manual/Auto switch to the MANUAL position.
3. Activate leak detect switch (move float upward).
4. Check control display for Rupture Basin fault message. If no indication of fault, repair defective circuit. Refer to *Enclosure/Options Wiring Diagrams* in Section 10.
5. Apply thread sealant to pipe fitting and install switch assembly.

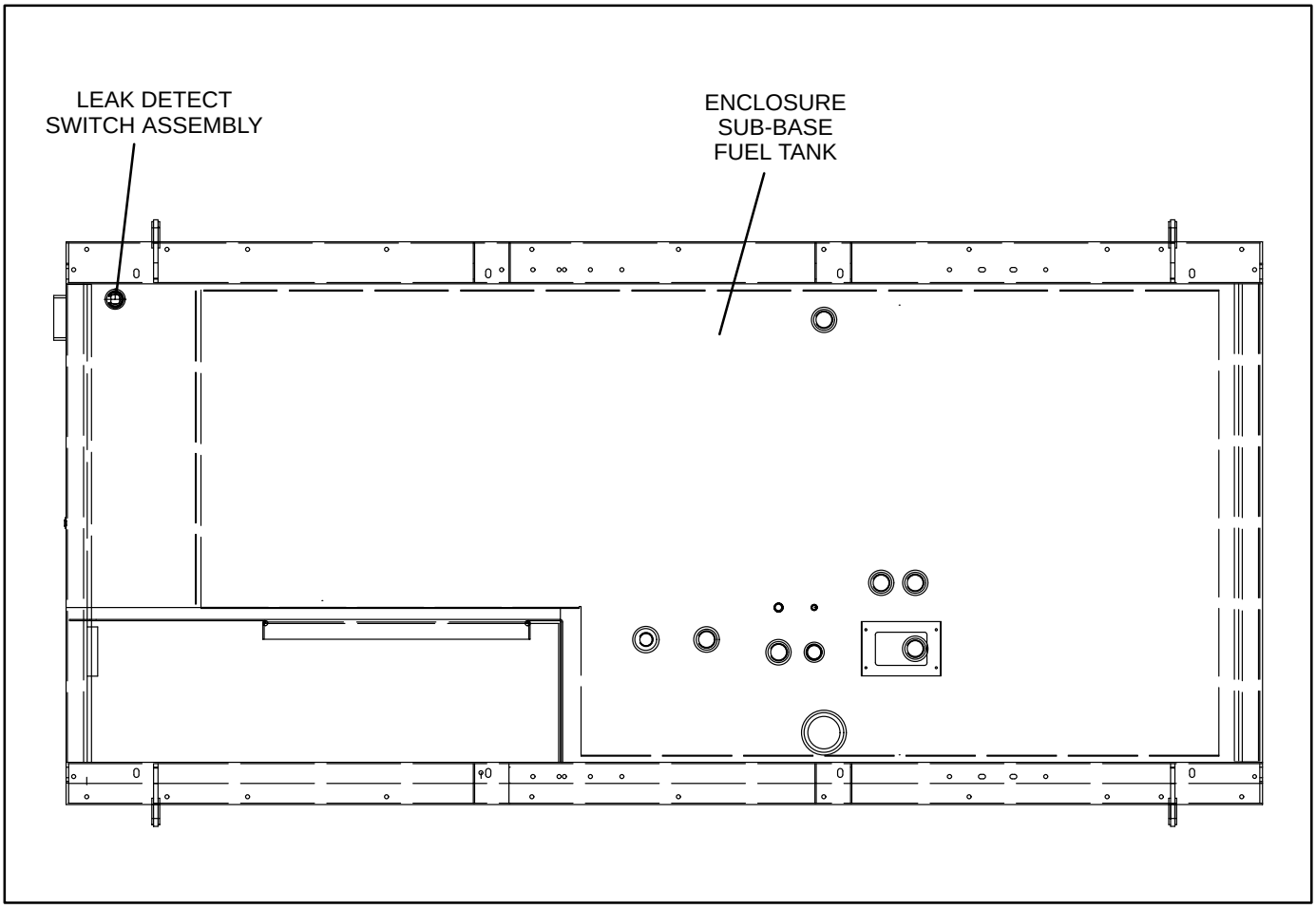


FIGURE 9-5. RUPTURE BASIN LEAK DETECT SWITCH

10. Wiring Diagrams

GENERAL

This section consists of the schematic and connection wiring diagrams referenced in the text. The following drawings are included.

3 PHASE RECONNECTABLE, 12 LEAD

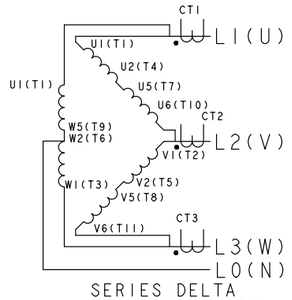
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

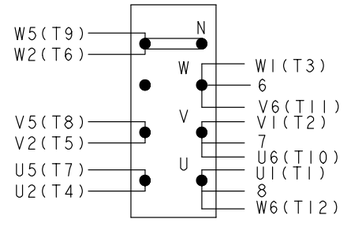
110/220V, (R028)
115/230V, (R071)
120/240, (R106)

* RANGE *
110 - 120/220 - 240V

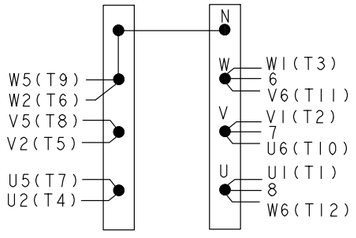


SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

FRAME 4



FRAME 5,6, & 7



△5 NO NEUTRAL SENSE
(LEAD 5)

-01

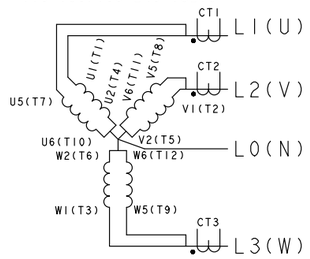
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

110/190V, (R004)
120/208V, (R098)
127/220V, (R020)

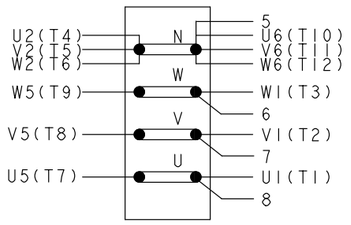
115/200V, (RO50)
139/240V, (R067)

* RANGE *
110-139/190-240 VOLTS

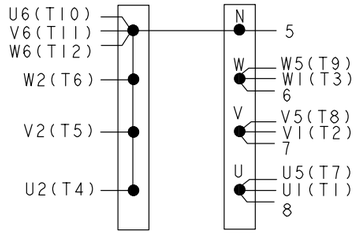


PARALLEL STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U,V,W,N

FRAME 4



FRAME 5,6, & 7



-02

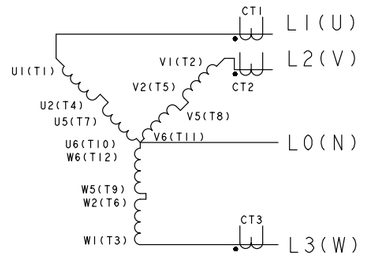
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X2

220/380V, (R099)
230/400V, (R029)
240/416V, (R003)
255/440V, (R023)

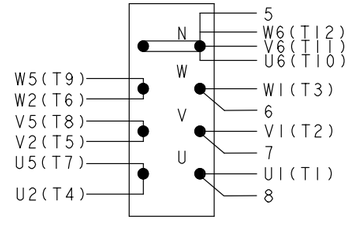
277/480V, (R002)

* RANGE *
220-277/380-480 VOLTS

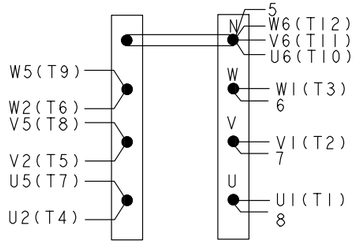


SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U,V,W,N

FRAME 4



FRAME 5,6, & 7



-03

NOTES:

1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.
2. TIE BACK UNUSED LEADS.
3. WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 68 ±6 FT-LBS. FOR FRAMES 5,6 AND 7.
4. WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 22 ±2 FT-LBS. FOR FRAMES 4.

△5 NEUTRAL SENSE FLOATED FOR DELTA CONFIGURATION. TIE LEAD 5 BACK INTO HARNESS.

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AC RECONNECT WIRING DIAGRAM (SHEET 1 OF 2)

3 PHASE NON-RECONNECTABLE

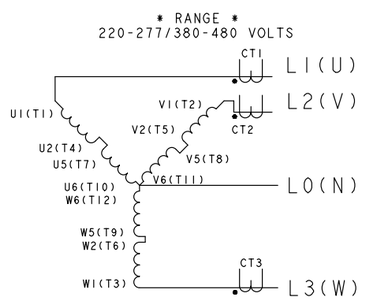
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

CURRENT TRANSFORMER SECONDARY CONNECTION

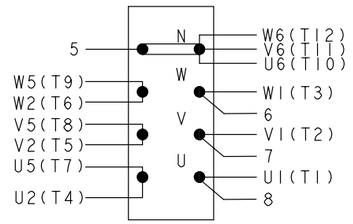
X1 X2

346/600V, 60HZ (R114)

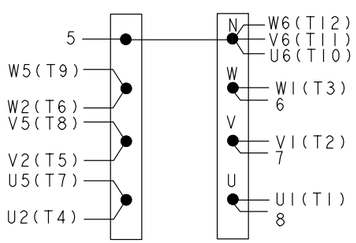
* RANGE *
220-277/380-480 VOLTS



FRAME 4



FRAME 5 & 6



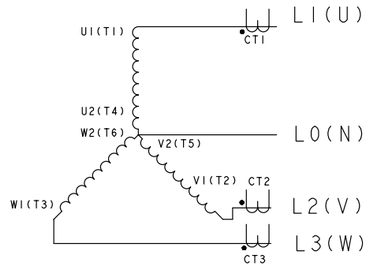
-04

CURRENT TRANSFORMER SECONDARY CONNECTION

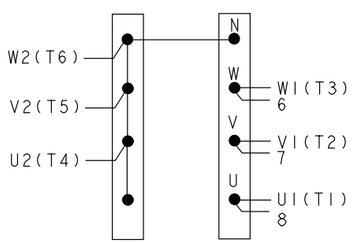
X1 X2

220/380V, (RO99)
240/416V, (RO03)
277/480V, (R002)
347/600V, (R114)
120/208V, (R098)
127/220V, (R020)

230/400V, (R029)
254/440V, (R023)



FRAME 5,6 & 7

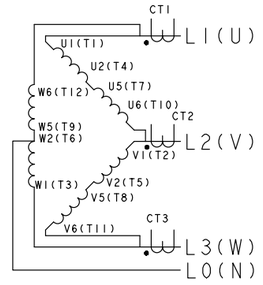


-05

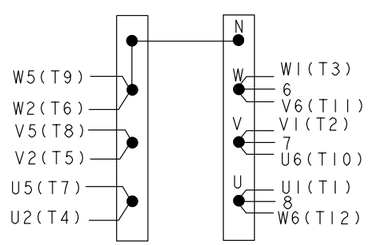
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X2

220/440V, (R019)
240/480V, (R119)



FRAME 5,6 & 7



⚠5 NO NEUTRAL SENSE (LEAD 5)

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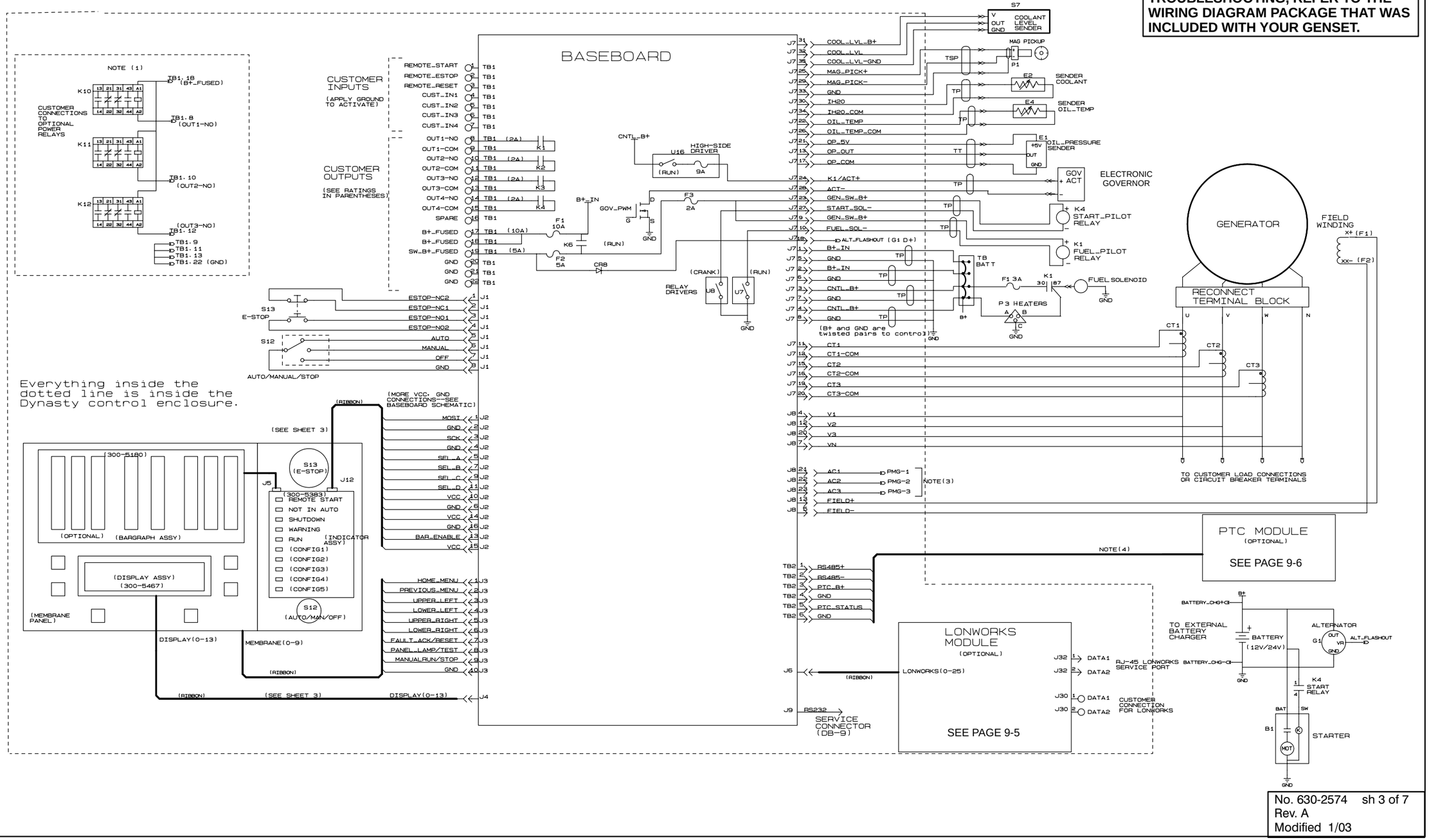
AC RECONNECT WIRING DIAGRAM (SHEET 2 OF 2)

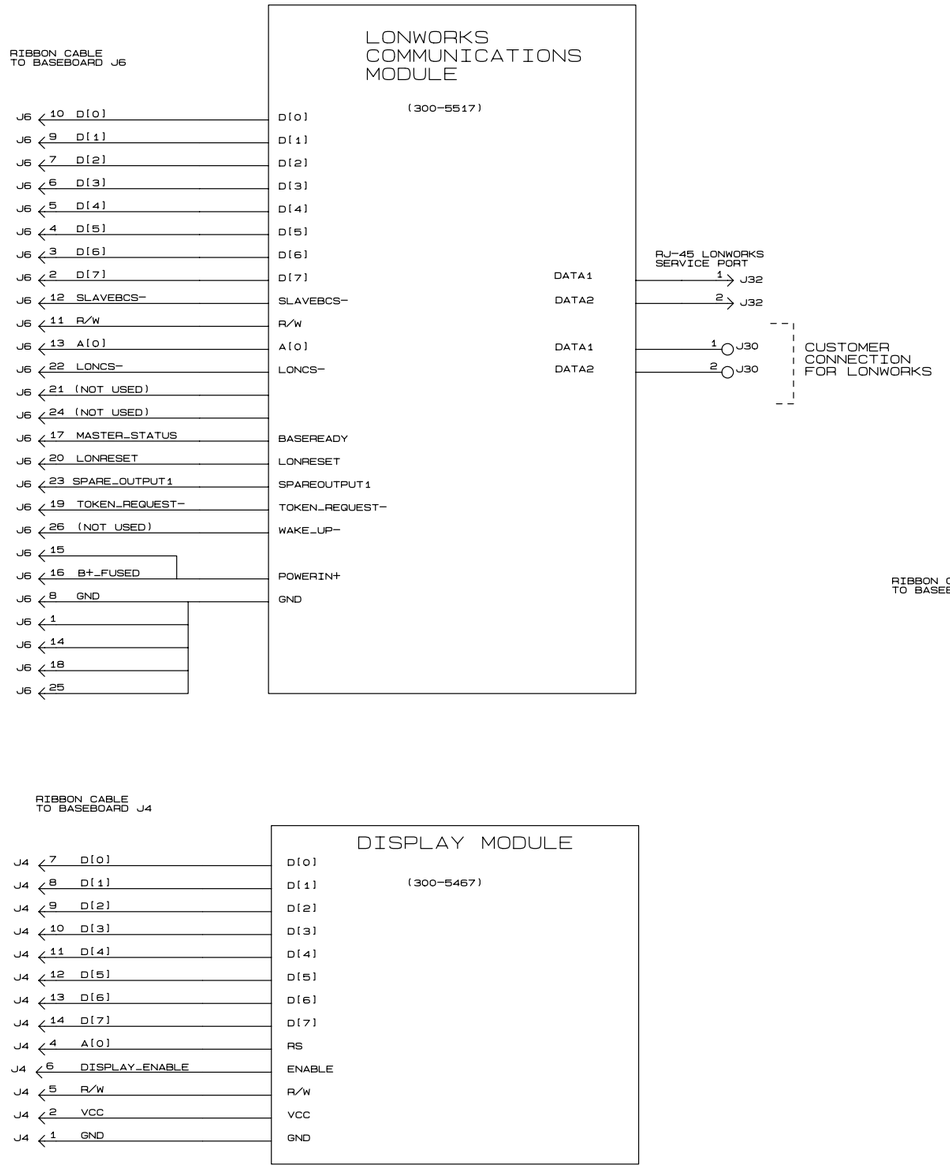
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

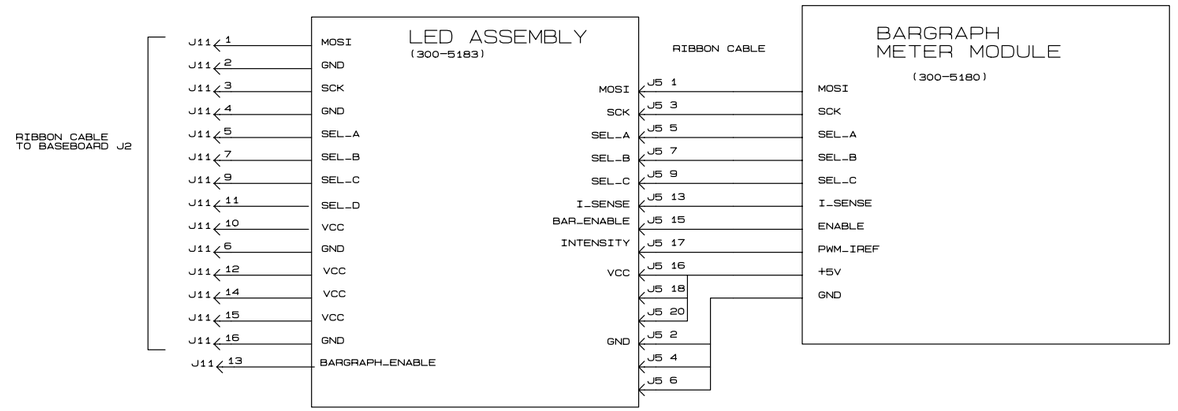


No. 630-2574 sh 3 of 7
Rev. A
Modified 1/03

BLOCK DIAGRAM (L10, NT855, V28, K50)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

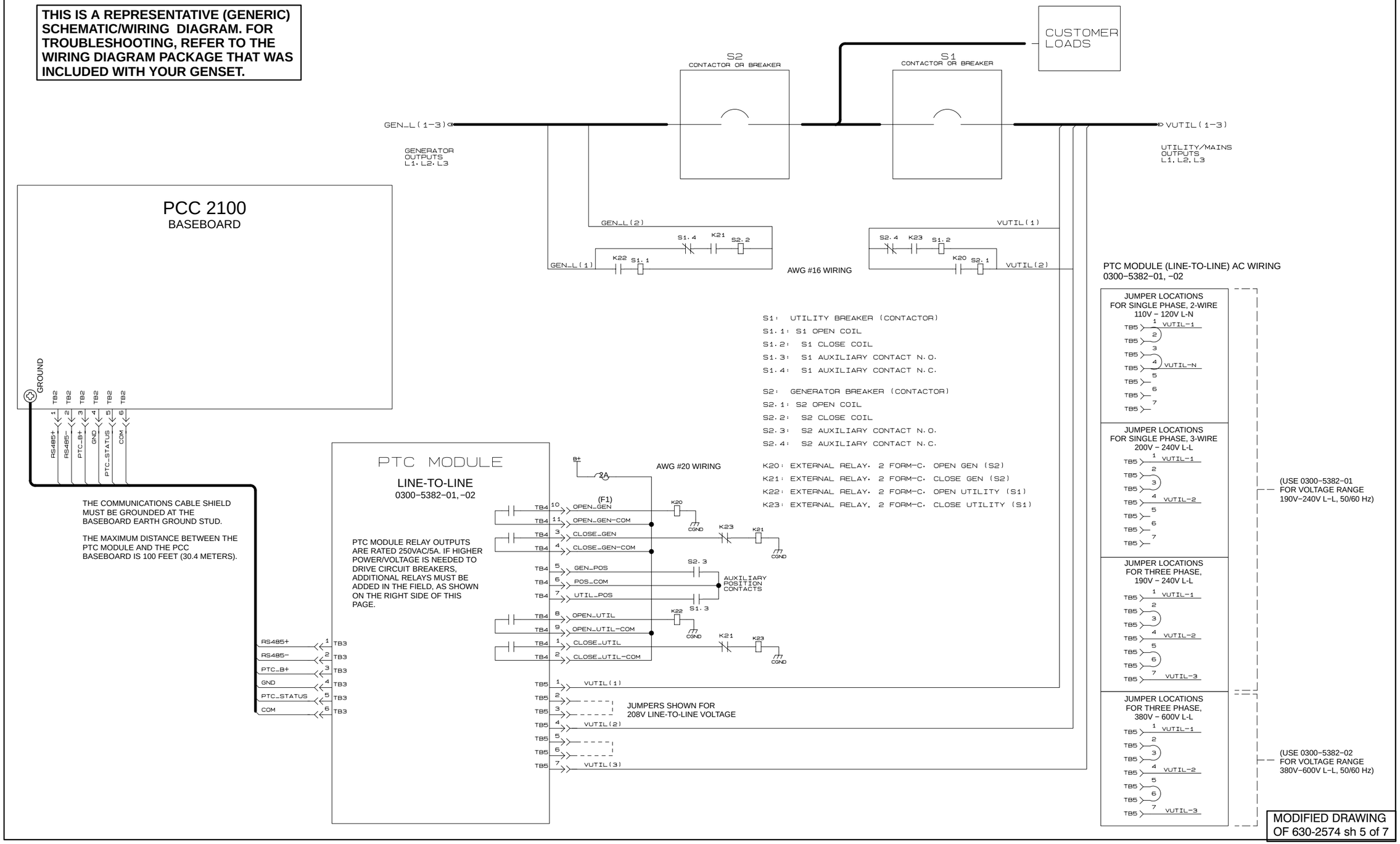




No. 630-2574 sh 7 of 7
Rev. A
Modified 1/03

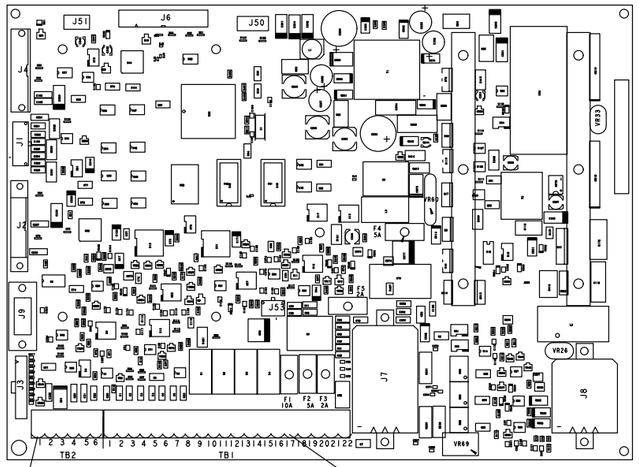
CONTROL DIAGRAM

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



POWER TRANSFER CONTROL MODULE INTERFACE (LINE-LINE APPLICATIONS)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



TB2

1	RS485+
2	RS485-
3	PTC B+
4	PTC GND
5	PTC STATUS
6	COM

TO REMOTE UTILITY VOLTAGE SENSING MODULE.

TB1

1	REMOTE START	APPLY GROUND TO ACTIVATE
2	REMOTE E-STOP	
3	REMOTE RESET	
4	CUSTOMER FAULT 1	
5	CUSTOMER FAULT 2	
6	CUSTOMER FAULT 3	
7	CUSTOMER FAULT 4	
8	CUSTOMER RELAY 1	RATED 2A @ 30VDC (MAX)
9	COM	
10	CUSTOMER RELAY 2	
11	COM	
12	CUSTOMER RELAY 3	
13	COM	
14	CUSTOMER RELAY 4	
15	COM	
16	(NOT USED)	
17	B+ FUSED OUT	10A FUSED
18	B+ FUSED OUT	
19	SWITCHED B+	5A FUSED
20	GND	
21	GND	
22	GND	

DEFAULT SETTING

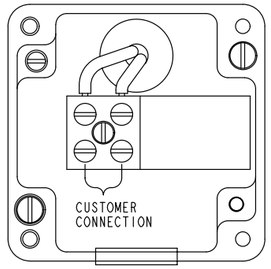
TB1-CUSTOMER FAULTS:
1. CUSTOMER FAULT 1
2. GROUND FAULT
3. LOW FUEL
4. RUPTURE BASIN FAULT

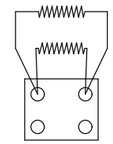
TB1-CUSTOMER RELAYS:
1. COMMON WARNING
2. COMMON SHUTDOWN
3. NOT IN AUTO
4. READY TO LOAD

TERMINAL SPECIFICATION

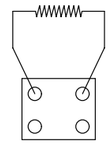
1) TORQUE TERMINALS TO 4.4 IN/LBS (0.5 Nm)
2) USE FLAT-BLADED SCREWDRIVER WITH 2.5MM BLADE

ALTERNATOR HEATER





DUAL HEATER



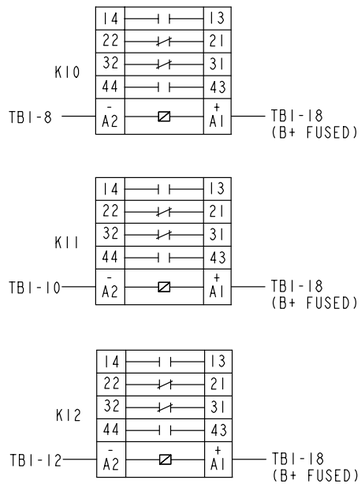
SINGLE HEATER

TERMINAL SPECIFICATIONS

1. TORQUE TO 7.7 IN-Lb (0.9 Nm)
2. USE SLOTTED SCREWDRIVER WITH 3.0 mm BLADE

HEATER RATING	
100 WATT	110 -125VAC 220 -260VAC
150 WATT	110 -125VAC 220 -260VAC
300 WATT	110 -125VAC 220 -260VAC

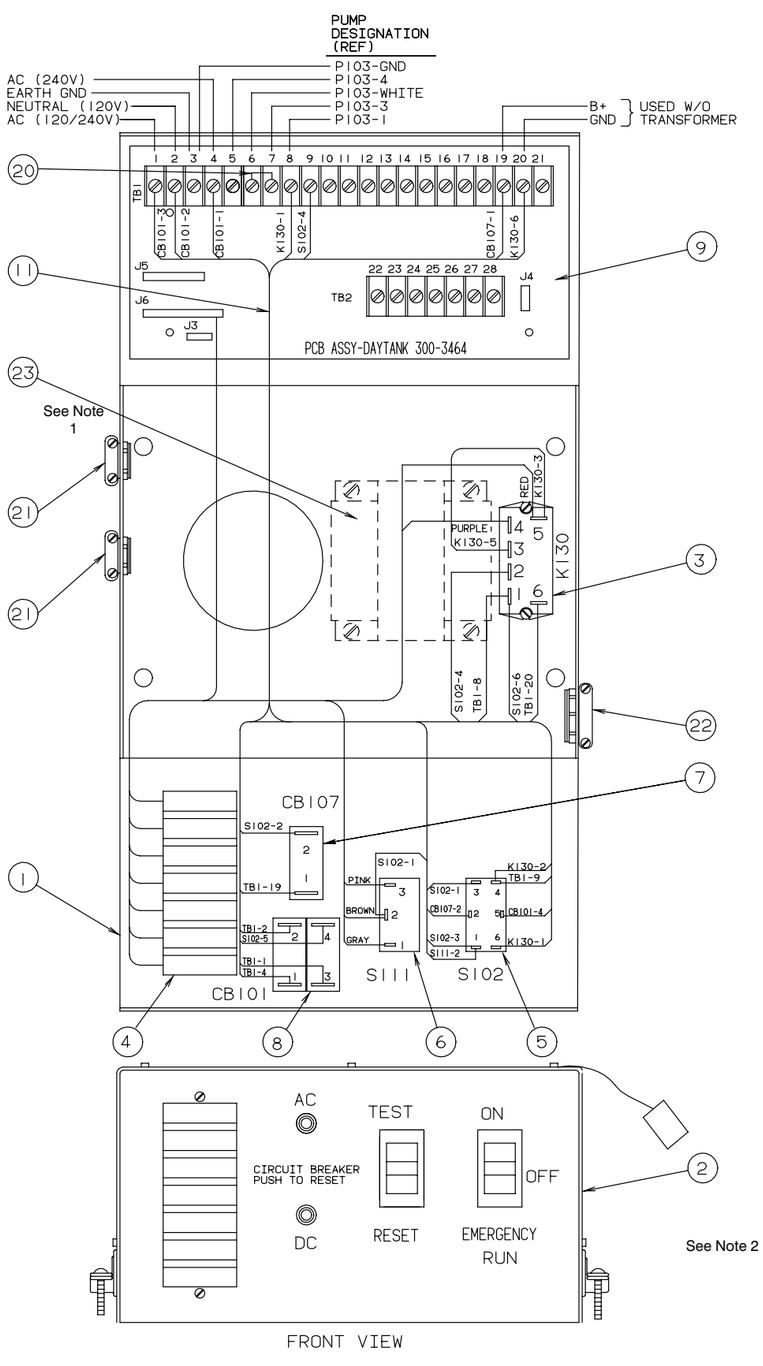
CUSTOMER RELAYS

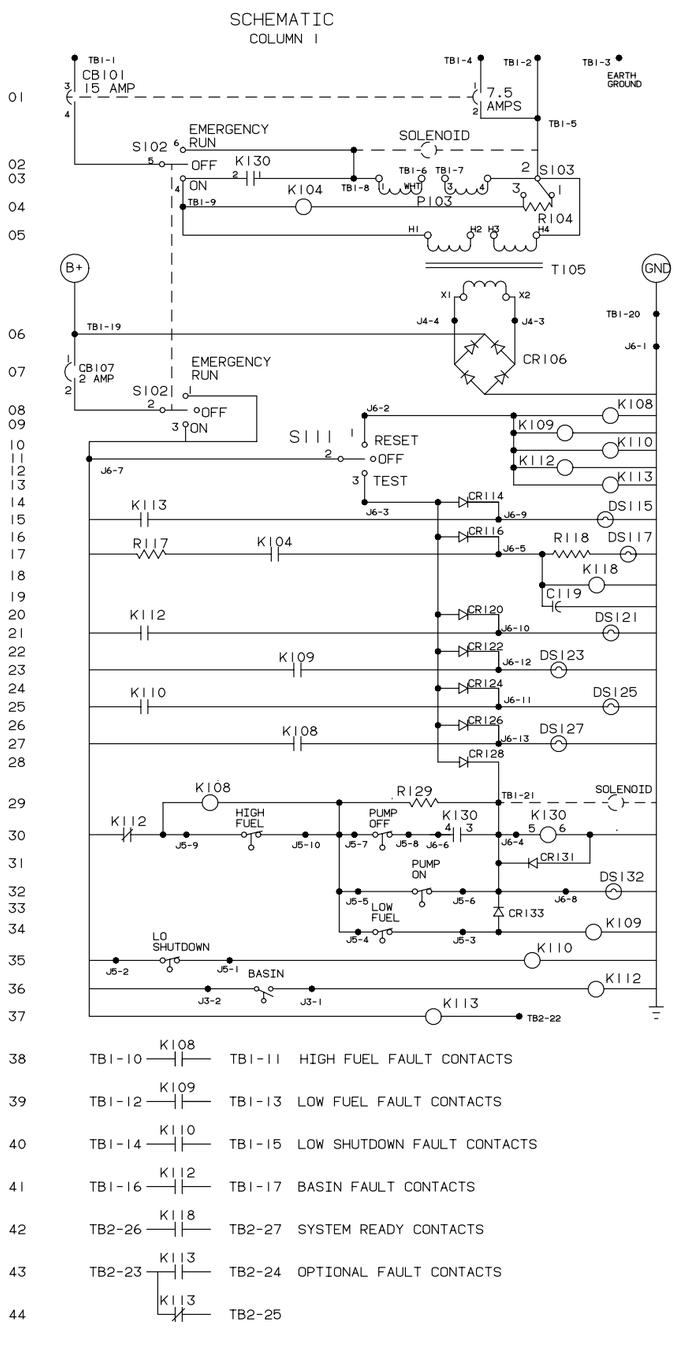


TERMINAL SPECIFICATIONS

1) NORMALLY OPEN (NO) TERMINALS: 13,14 43,44
   NORMALLY CLOSED (NC) TERMINALS: 21,22 31,32
2) TORQUE TERMINALS TO 7 INCH LBS (0.8Nm)
3) TERMINAL SCREWS ARE PHIL SLOT
4) USE SLOTTED SCREWDRIVER WITH 5.0 MM BLADE OR NO. 2 PHILIPS
5) CONTACT RATINGS: 600VAC, 10 AMPS MAX

No. 620-0247 sh 1 of 1
Rev. A
Modified 4-02





01	TB1-1	CB101 15 AMP	TB1-4 TB1-2 TB1-3 EARTH GROUND; 7.5 AMPS; TB1-5
02		EMERGENCY RUN	SOLENOID
03	S102 6	OFF K130	TB1-6 TB1-7 2 S103
04	4	ON K104	TB1-8 P103 3 3 1 R104
05	TB1-9		H1 H2 H3 H4
	B+		T105 GND
			X1 X2
06	TB1-19		J4-4 J4-3 TB1-20 J6-1 CR106
07	CB107 2 AMP	EMERGENCY RUN	
08	S102 1	OFF	J6-2 K108
09	2 3	ON	K109
10		S111 1 RESET	K110
11		2 OFF	K112
12	J6-7	3 TEST	K113
13			CR114 DS115
14	K113		J6-3 J6-9
15			CR116
16	R117 K104		J6-5 R118 DS117
17			K118
18			C119
19			
20	K112		CR120 DS121
21			J6-10
22			CR122
23	K109		J6-12 DS123
24			CR124
25	K110		J6-11 DS125
26			CR126
27	K108		J6-13 DS127
28			CR128
29	K108	R129	TB1-21 SOLENOID
30	K112	HIGH FUEL J5-9 J5-10	PUMP OFF J5-7 J5-8 J6-6 K130 4 3 J6-4 K130 5 6
31			CR131
32		PUMP ON J5-5 J5-6	J6-8 DS132
33		LOW FUEL J5-4 J5-3	CR133
34			K109
35	LO SHUTDOWN J5-2	J5-1	K110
36		BASIN J3-2 J3-1	K112
37			K113 TB2-22

38	TB1-10	K108	TB1-11	HIGH FUEL FAULT CONTACTS
39	TB1-12	K109	TB1-13	LOW FUEL FAULT CONTACTS
40	TB1-14	K110	TB1-15	LOW SHUTDOWN FAULT CONTACTS
41	TB1-16	K112	TB1-17	BASIN FAULT CONTACTS
42	TB2-26	K118	TB2-27	SYSTEM READY CONTACTS
43	TB2-23	K113	TB2-24	OPTIONAL FAULT CONTACTS
44		K113	TB2-25	

CB101-2 POLE AC CIRCUIT BREAKER, 15 AMP, 7.5 AMP

S102-2 POLE SWITCH
P103 - 120/240V PUMP MOTOR

K104 - SYSTEM READY INTERLOCK 17

T105 - 120/240V TRANSFORMER

CR106- RECTIFIER BRIDGE

CB107 - 2 AMP CIRCUIT BREAKER

K108-HIGH FUEL RESET 27, (29), 38
K109-LOW FUEL RESET 23, (34), 39
K110-LO SHUTDOWN RESET 25, (35), 40
S111-SINGLE POLE SWITCH
K112-BASIN FAULT RESET 21, (36), 41, 30
K113-OPTIONAL FAULT RESET 15, (37), 43, 44

DS115-OPTIONAL FAULT LAMP

DS117-SYSTEM READY LAMP

K118-SYSTEM READY RELAY 42

DS121-BASIN FAULT LAMP

DS123-LOW FUEL FAULT LAMP

DS125-LO SHUTDOWN FAULT LAMP

DS127-HIGH FUEL FAULT LAMP

K108-HIGH FUEL SET (08), 27, 38

K130-PUMP RELAY 03, 30

DS132-PUMP RUN LAMP

K109-LOW FUEL SET (09), 23, 39

K110-LO SHUTDOWN SET (10), 25, 40

K112-BASIN FAULT SET (12), 21, 41, 30

K113-OPTIONAL FAULT SET (13), 15, 43, 44

SCHEMATIC KEY:
EACH COMPONENT IS LOCATED BY PART NUMBER. ON THE RIGHT HAND SIDE, A DESCRIPTION IS GIVEN OF THE PART AND ITS FUNCTIONAL LOCATIONS.

K 1 12 - BASIN FAULT RESET 21, 41 (36), 30
- LINE 12 / COLUMN 1 / RELAY
- WRITTEN DESCRIPTION
- N/C CONTACTS ON LINE 30
- RELAY SET COIL ON LINE 36
- N/O CONTACTS ON LINES 21 AND 41

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

ITEM	DESCRIPTION OR MATERIAL
23	TRANSFORMER
22	CONNECTOR-KNOCKOUT
21	CONNECTOR-ROMEX
20	JUMPER-TERMINAL
19	
18	
17	
16	
15	
14	
13	
12	
11	HARNESS-CONTROL
10	
9	CIRCUIT BOARD ASSY.
8	CIRCUIT BREAKER 2 POLE
7	CIRCUIT BREAKER 1 POLE
6	SWITCH-ROCKER
5	SWITCH-ROCKER
4	LAMP ASSY.-7 LITE
3	RELAY-2PST
2	COVER-CONTROL
1	CONTROL BOX

NOTES:

1. **Item 23, transformer, is not included for kits where battery connections will be made at TB1-19 and TB1-20.**
2. **Tag the control box to indicate supply voltage.**

No. 625-2141 sh 1 of
Rev. H
Modified

DAY TANK PUMP CONTROL WIRING

KEY	
ACT	GOVERNOR ACTATOR
BI	STARTER & SOLENOID
BATT	ENGINE BATTERY
CT	CURRENT TRANSFORMER
EI	OIL PRESSURE SENDER
E2	COOLANT TEMPERATURE SENDER
E4	OIL TEMPERATURE SENDER
GI	BATTERY CHARGING ALTERNATOR
KI	FUEL SOLENOID
K4	STARTER RELAY
MPU	MAGNETIC PICK-UP SENSOR
P3	COOLANT HEATER CONTROL
S7	COOLANT LEVEL SWITCH
S8	LOW FUEL SWITCH
S9	RUPTURE BASIN SWITCH
TB BATT	TERMINAL BLOCK ENGINE BATTERY

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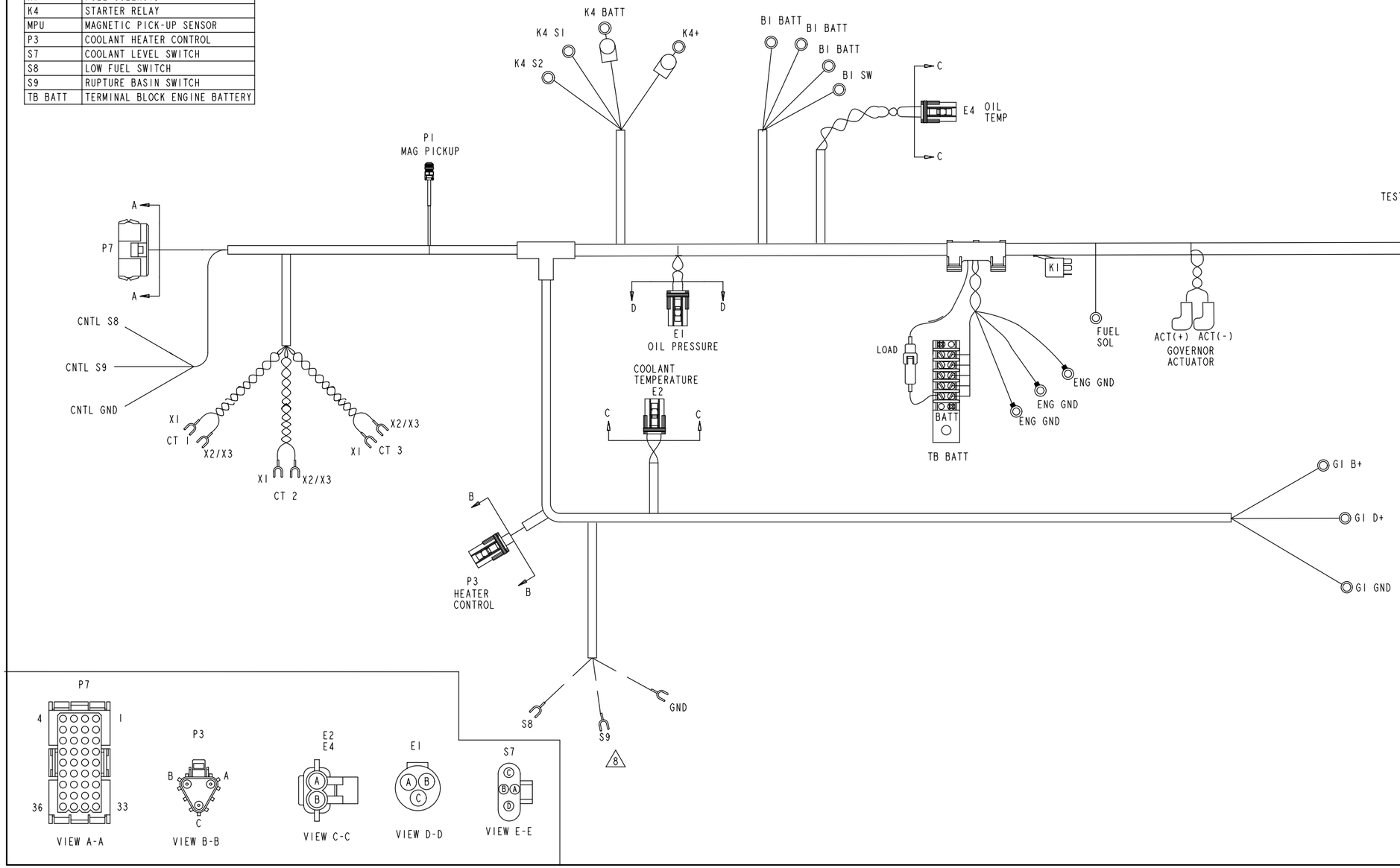

LEAD TABULATION	
FROM	TO
P7-1	TB BATT
P7-2	
P7-3	
P7-4	
P7-5	ENG GND
P7-6	
P7-7	ENG GND
P7-8	
GI GND	ENG GND
	P3-C
P7-11	CT 1 X1
P7-12	CT 1 X2/X3
P7-15	CT 2 X1
P7-16	CT 2 X2/X3
P7-19	CT 3 X1
P7-20	CT 3 X2/X3
P7-24	ACT (+)
P7-28	ACT (-)
P7-30	E2-A
P7-34	E2-B
P7-22	E4-A
P7-26	E4-B
P7-23	K4-S1
P7-27	K4-S2
P7-13	E1-C
P7-17	E1-A
P7-21	E1-B
P7-31	S7-C
P7-32	S7-D
P7-35	S7-B
P7-25	P1-A
P7-29	P1-B
P7-33	P1-SHIELD
FUEL SOL	K1-87
P3-B	
BI SW	K4+
BI BATT	K4 BATT
BI BATT	GI B+
P3-A	
BI BATT	TB BATT
CNTL S8	S8
CNTL S9	S9
CNTL GND	GND
P7-9	K1-86
S7-A	TEST
P7-18	GI D+
P7-10	K1-85
F1 (IN)	TB BATT
F1 (OUT)	K1-30

No. 338-4201 sh 2
Rev. D
Modified 12-03

L10 ENGINE HARNESS DIAGRAM

KEY	
ACT	GOVERNOR ACTATOR
BI	STARTER & SOLENOID
BATT	ENGINE BATTERY
CT	CURRENT TRANSFORMER
EI	OIL PRESSURE SENDER
E2	COOLANT TEMPERATURE SENDER
E4	OIL TEMPERATURE SENDER
GI	BATTERY CHARGING ALTERNATOR
KI	FUEL SOLENOID
K4	STARTER RELAY
MPU	MAGNETIC PICK-UP SENSOR
P3	COOLANT HEATER CONTROL
S7	COOLANT LEVEL SWITCH
S8	LOW FUEL SWITCH
S9	RUPTURE BASIN SWITCH
TB BATT	TERMINAL BLOCK ENGINE BATTERY

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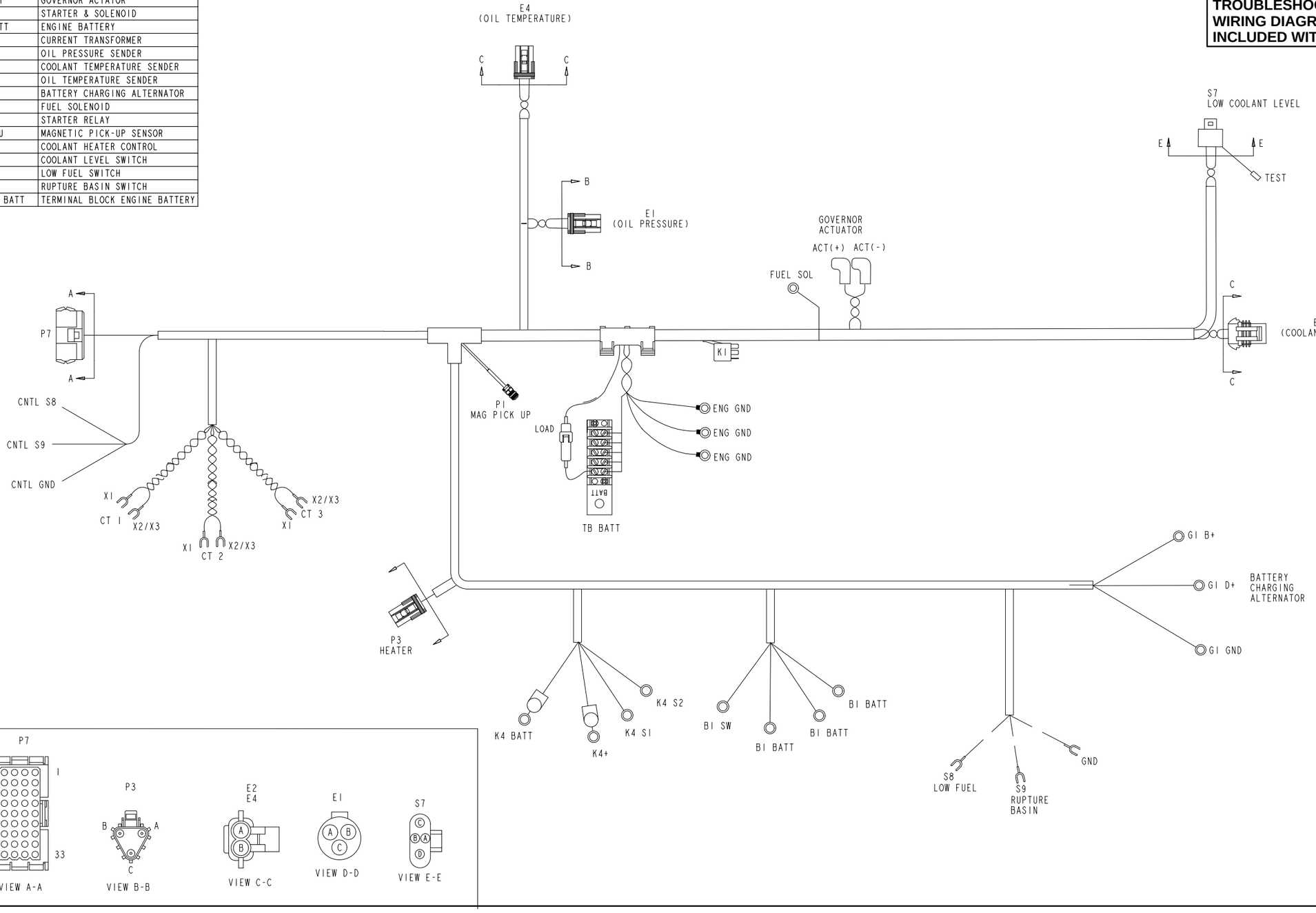

LEAD TABULATION	
FROM	TO
P7-1	TB BATT
P7-2	
P7-3	
P7-4	
P7-5	ENG GND
P7-6	
P7-7	ENG GND
P7-8	
GI GND	ENG GND
	P3-C
P7-11	CT 1 X1
P7-12	CT 1 X2/X3
P7-15	CT 2 X1
P7-16	CT 2 X2/X3
P7-19	CT 3 X1
P7-20	CT 3 X2/X3
P7-24	ACT (+)
P7-28	ACT (-)
P7-30	E2-A
P7-34	E2-B
P7-22	E4-A
P7-26	E4-B
P7-23	K4-S1
P7-27	K4-S2
P7-13	E1-C
P7-17	E1-A
P7-21	E1-B
P7-31	S7-C
P7-32	S7-D
P7-35	S7-B
P7-25	P1-A
P7-29	P1-B
P7-33	P1-SHIELD
FUEL SOL	KI-87
P3-B	
BI SW	K4+
BI BATT	K4 BATT
BI BATT	GI B+
P3-A	
BI BATT	TB BATT
CNTL S8	S8
CNTL S9	S9
CNTL GND	GND
P7-9	KI-86
S7-A	TEST
P7-18	GI D+
P7-10	KI-85
FI (IN)	TB BATT
FI (OUT)	KI-30

No. 338-4194 sh 2
Rev. D
Modified 12-03

KEY	
ACT	GOVERNOR ACTATOR
BI	STARTER & SOLENOID
BATT	ENGINE BATTERY
CT	CURRENT TRANSFORMER
EI	OIL PRESSURE SENDER
E2	COOLANT TEMPERATURE SENDER
E4	OIL TEMPERATURE SENDER
GI	BATTERY CHARGING ALTERNATOR
KI	FUEL SOLENOID
K4	STARTER RELAY
MPU	MAGNETIC PICK-UP SENSOR
P3	COOLANT HEATER CONTROL
S7	COOLANT LEVEL SWITCH
TB BATT	TERMINAL BLOCK ENGINE BATTERY

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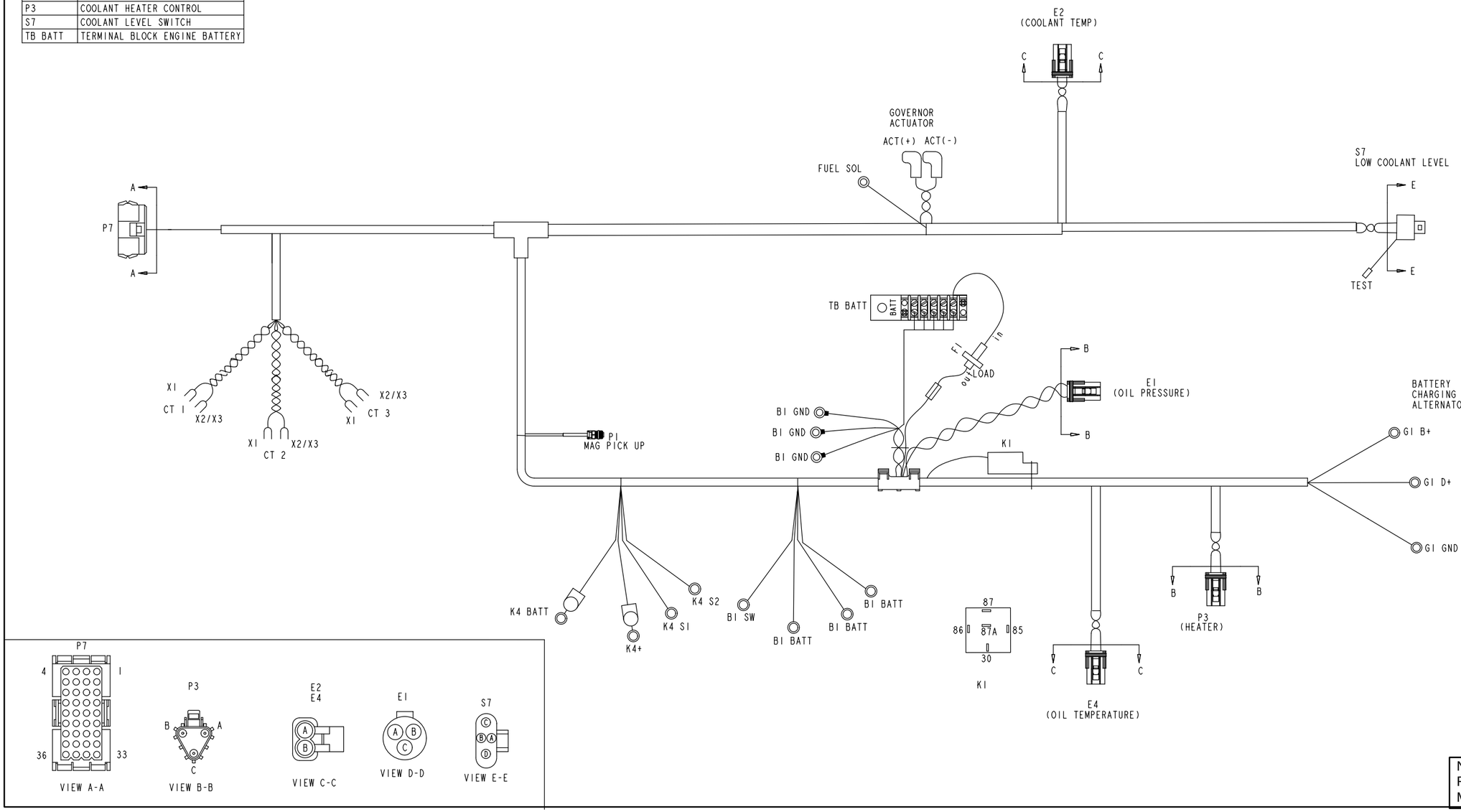

LEAD TABULATION	
FROM	TO
P7-1	TB BATT
P7-2	
P7-3	
P7-4	
P7-5	BI GND
P7-6	
P7-7	BI GND
P7-8	
GI GND	BI GND
	P3-C
P7-11	CT 1 X1
P7-12	CT 1 X2/X3
P7-15	CT 2 X1
P7-16	CT 2 X2/X3
P7-19	CT 3 X1
P7-20	CT 3 X2/X3
P7-24	ACT (+)
P7-28	ACT (-)
P7-30	E2-A
P7-34	E2-B
P7-22	E4-A
P7-26	E4-B
P7-23	K4-S1
P7-27	K4-S2
P7-13	EI-C
P7-17	EI-A
P7-21	EI-B
P7-31	S7-C
P7-32	S7-D
P7-35	S7-B
P7-25	PI-A
P7-29	PI-B
P7-33	PI-SHIELD
FUEL SOL	KI-87
P3-B	
BI SW	K4+
BI BATT	K4 BATT
BI BATT	GI B+
P3-A	
BI BATT	TB BATT
P7-9	KI-86
S7-A	TEST
P7-18	GI D+
P7-10	KI-85
FI (in)	TB BATT
FI (out)	KI-30

No. 338-4234 sh 2
Rev. D
Modified 12-03

V28 ENGINE HARNESS DIAGRAM

KEY	
ACT	GOVERNOR ACTATOR
B1	STARTER & SOLENOID
B2	STARTER & SOLENOID
BATT	ENGINE BATTERY
CT	CURRENT TRANSFORMER
E1	OIL PRESSURE SENDER
E2	COOLANT TEMPERATURE SENDER
E4	OIL TEMPERATURE SENDER
G1	BATTERY CHARGING ALTERNATOR
K1	FUEL SOLENOID
K4	STARTER RELAY
MPU	MAGNETIC PICK-UP SENSOR
P3	COOLANT HEATER CONTROL
S7	COOLANT LEVEL SWITCH
TB BATT	TERMINAL BLOCK ENGINE BATTERY

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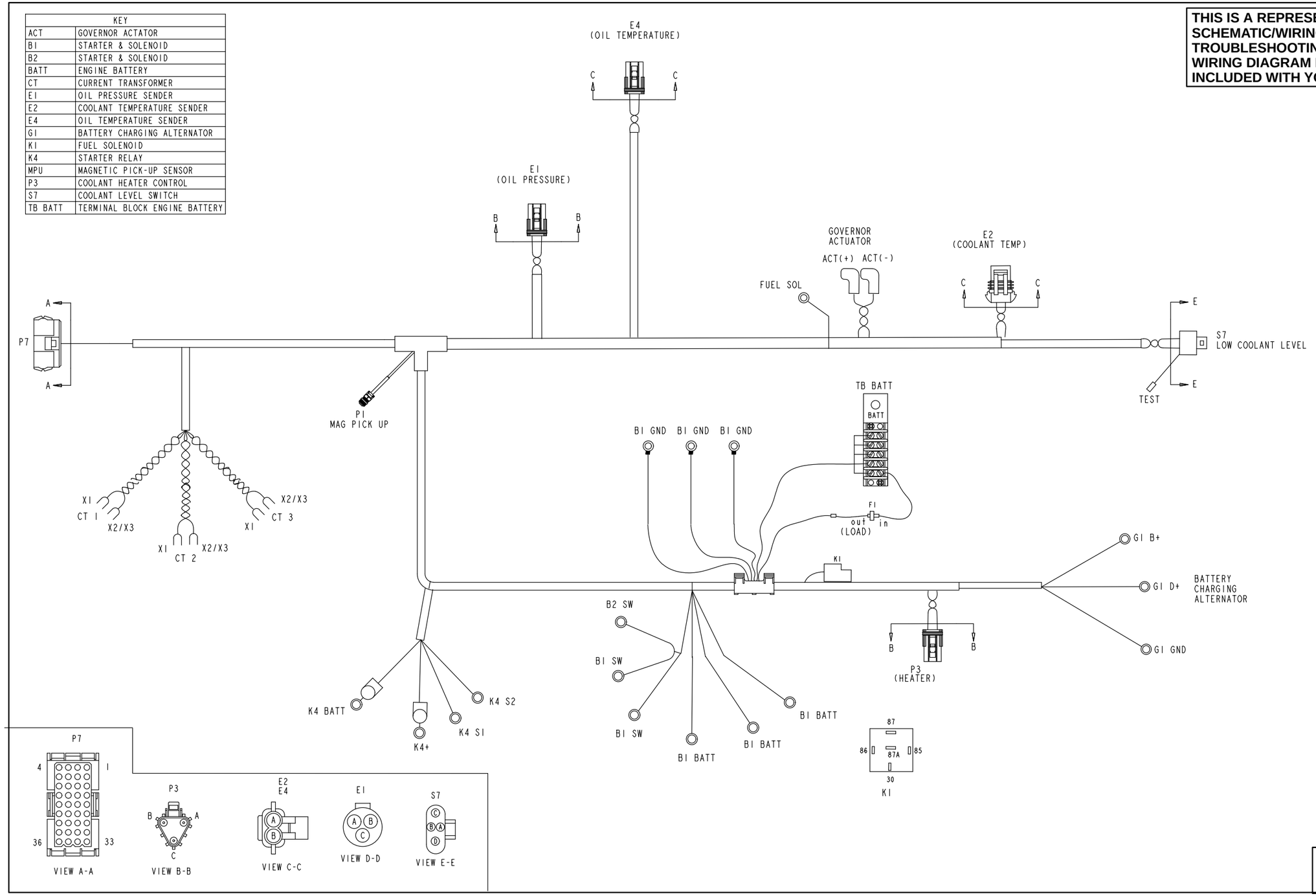


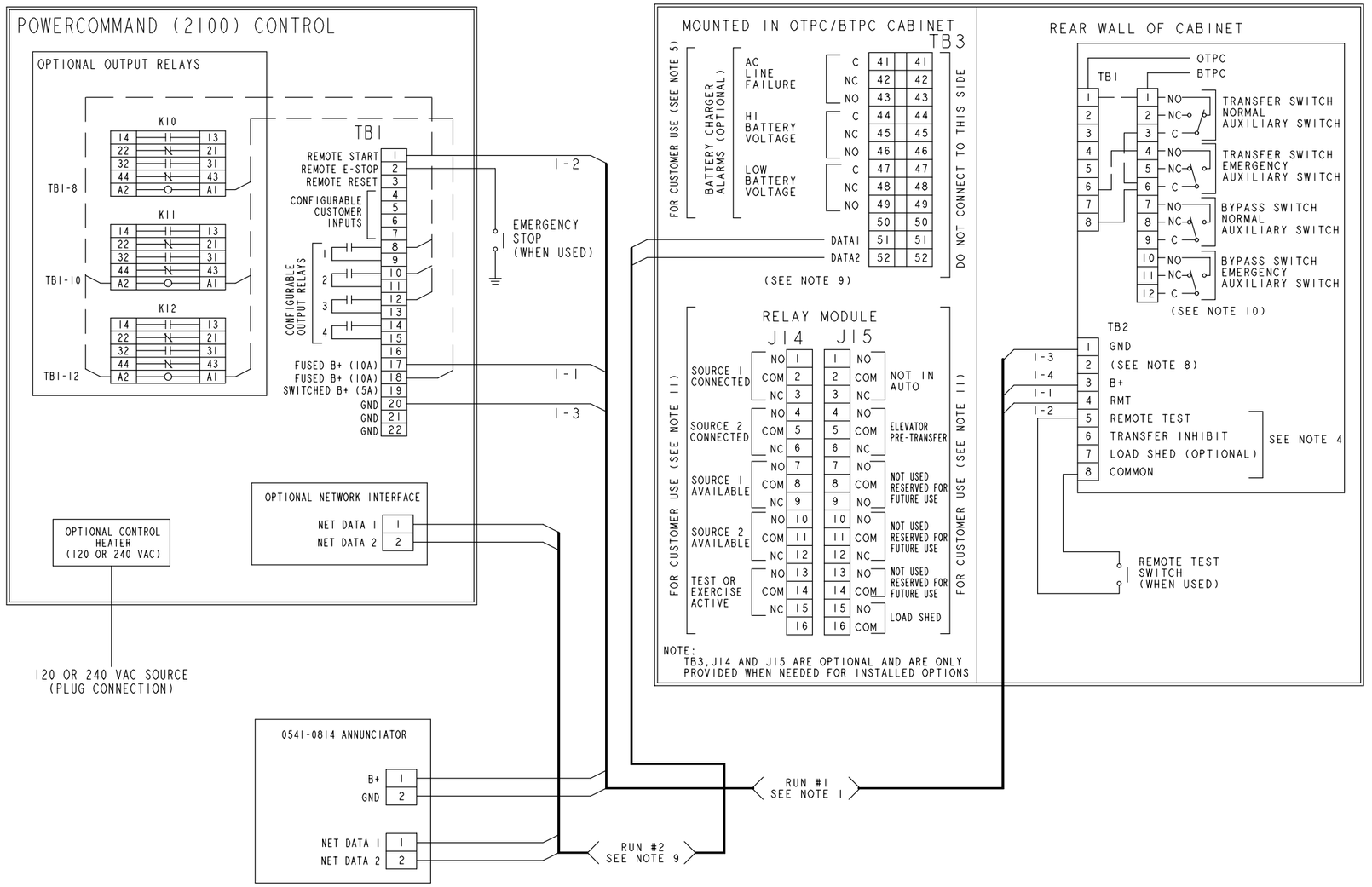
LEAD TABULATION	
FROM	TO
P7-1	TB BATT
P7-2	
P7-3	
P7-4	
P7-5	B1 GND
P7-6	
P7-7	B1 GND
P7-8	
G1 GND	B1 GND
	P3-C
P7-11	CT 1 X1
P7-12	CT 1 X2/X3
P7-15	CT 2 X1
P7-16	CT 2 X2/X3
P7-19	CT 3 X1
P7-20	CT 3 X2/X3
P7-24	ACT (+)
P7-28	ACT (-)
P7-30	E2-A
P7-34	E2-B
P7-22	E4-A
P7-26	E4-B
P7-23	K4-S1
P7-27	K4-S2
P7-13	E1-C
P7-17	E1-A
P7-21	E1-B
P7-31	S7-C
P7-32	S7-D
P7-35	S7-B
P7-25	P1-A
P7-29	P1-B
P7-33	P1-SHIELD
FUEL SOL	K1-87
P3-B	
B1 SW	K4+
B1 BATT	K4 BATT
B1 BATT	G1 B+
P3-A	
B1 BATT	TB BATT
P7-9	K1-86
S7-A	TEST
B1 SW	B2 SW
P7-18	G1 D+
P7-10	K1-85
F1 (in)	TB BATT
F1 (out)	K1-30

No. 338-4232 sh 2
Rev. D
Modified 12-03

K50 ENGINE HARNESS DIAGRAM

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

OTPC & BTPC
UTILITY TO GENSET



NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL A.
   WITH 2 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. C
2.
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. CONNECT AN OPEN DRY CONTACT BETWEEN THE APPLICABLE TERMINAL AND COMMON (TB2-8). FOR REMOTE TEST, TRANSFER INHIBIT AND LOAD SHED. CLOSE TO ACTIVATE.
5. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
6. REFER TO ONAN 900-0529 POWERCOMMAND NETWORK INSTALLATION & OPERATION MANUAL FOR WIRING INSTRUCTIONS.
7. INPUTS FOR CUSTOMER FAULTS, GROUNDED SIGNAL REQUIRED TO ACTIVATE INPUT (MAX 50 MA.)
8. INSTALL JUMPER BETWEEN TB2-1 & TB2-2.
9. USE STRANDED TWISTED PAIR WIRES (PART# 334-1350 OR EQUAL) WHEN CONNECTING DATA1 AND DATA 2 TO THE NETWORK.
10. TRANSFER SWITCH SHOWN CLOSED TO NORMAL BYPASS SWITCH SHOWN NEUTRAL POSITION.
11. CONTACTS RATED: 2 AMPS AT 30 VDC OR 0.60 AMPS AT 120 VAC.
12. OPEN CONNECTION TO INITIATE EMERGENCY STOP. THESE TERMINALS MUST BE SHORTED TOGETHER IF REMOTE EMERGENCY STOP OPTION NOT USED.
13. 120VAC OR 240VAC AT 50W.
14. CUSTOMER SUPPLIED EITHER 12 OR 240VDC RELAYS OUTPUT SIGNAL 20ma @ 24VDC MAX.

WIRE SIZE (AWG)	DISTANCE IN FEET. ONE WAY (MULTIPLY BY 0.3 FOR METERS)		
	A	B	C
16	1000	125	25
14	1600	200	40
12	2400	300	60
10	4000	500	100

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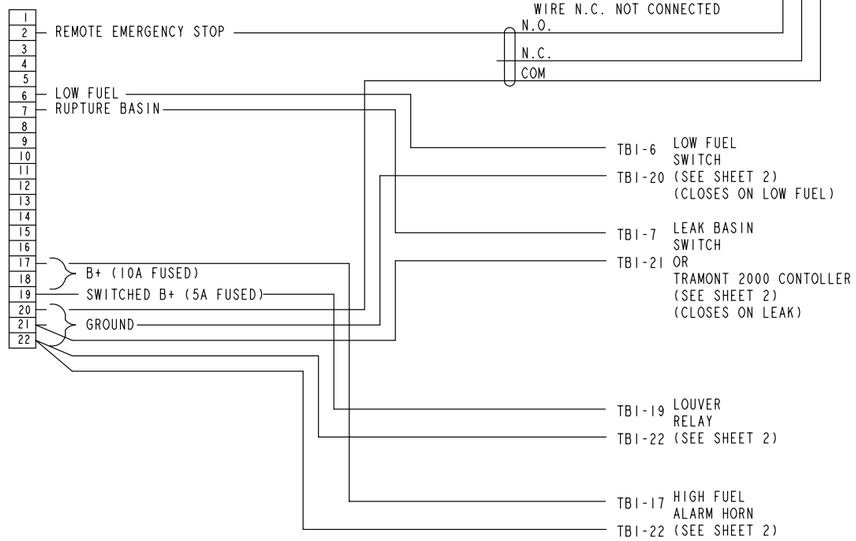
ACCESSORY INTERCONNECT DIAGRAM

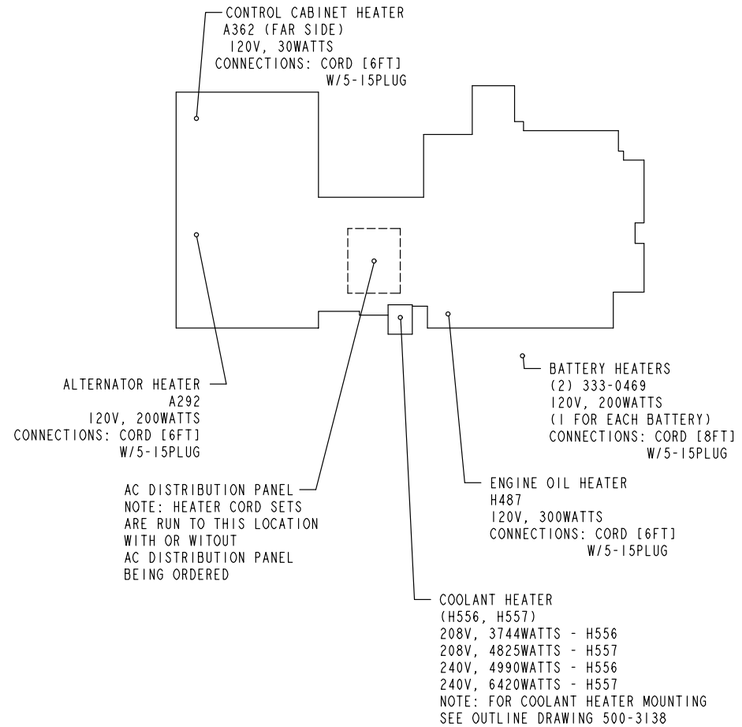
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

CUSTOMER CONNECTIONS TERMINAL STRIP

TB1



OPTIONAL GENSET HEATERS AND AC DISTRIBUTION PANEL LOCATIONS



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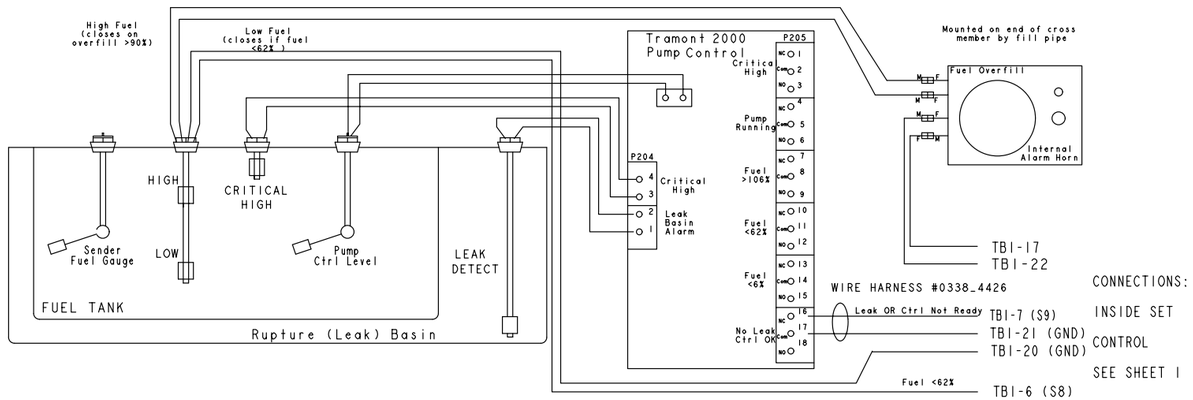
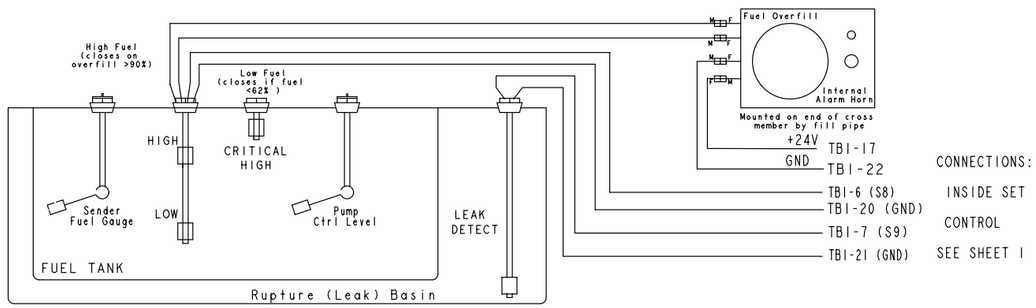
Modified 10-03

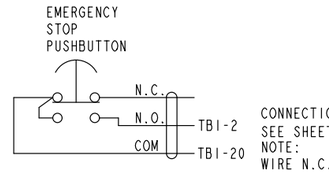
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

FUEL OVERFILL ALARM WITH TRANSFER PUMP CONTROLLER W/ CRITICAL ALARM AND LEAK BASIN ALARM



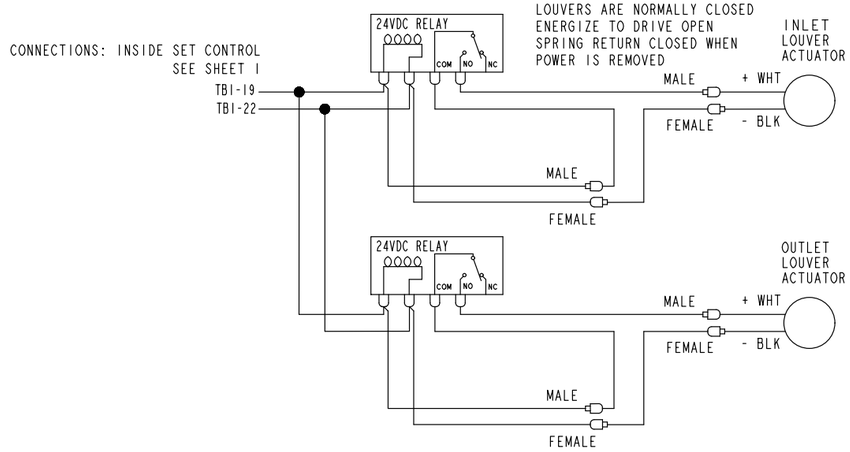
FUEL OVERFILL ALARM WITHOUT TRANSFER PUMP CONTROLLER



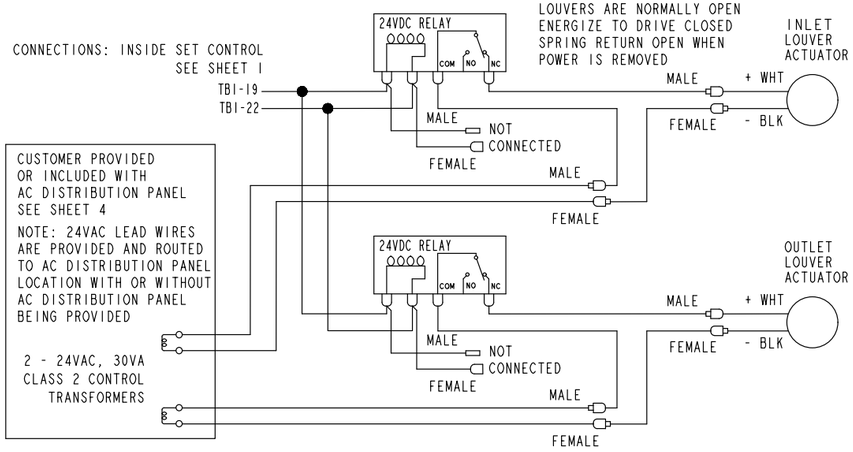


CONNECTIONS: INSIDE SET CONTROL
SEE SHEET 1
NOTE:
WIRE N.C. NOT CONNECTED

INLET AND OUTLET LOUVER CONNECTIONS (DC)



INLET AND OUTLET LOUVER CONNECTIONS (AC)



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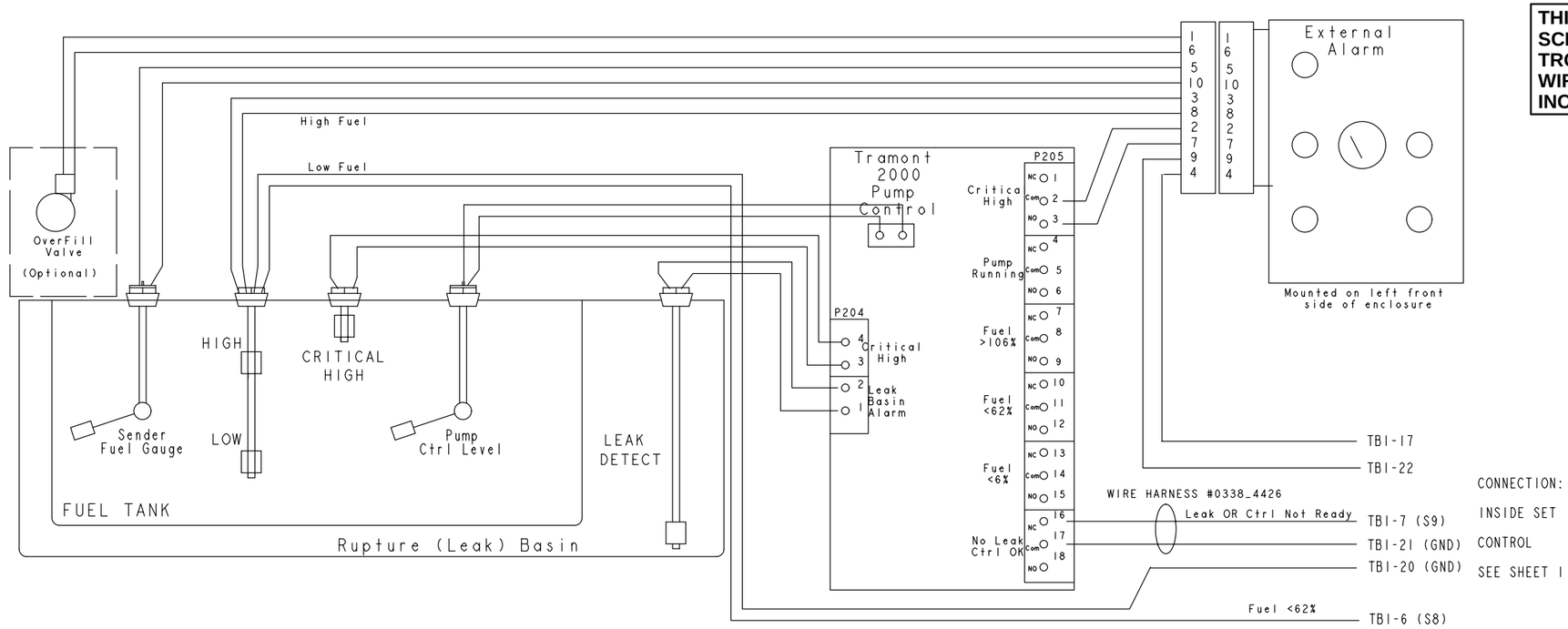
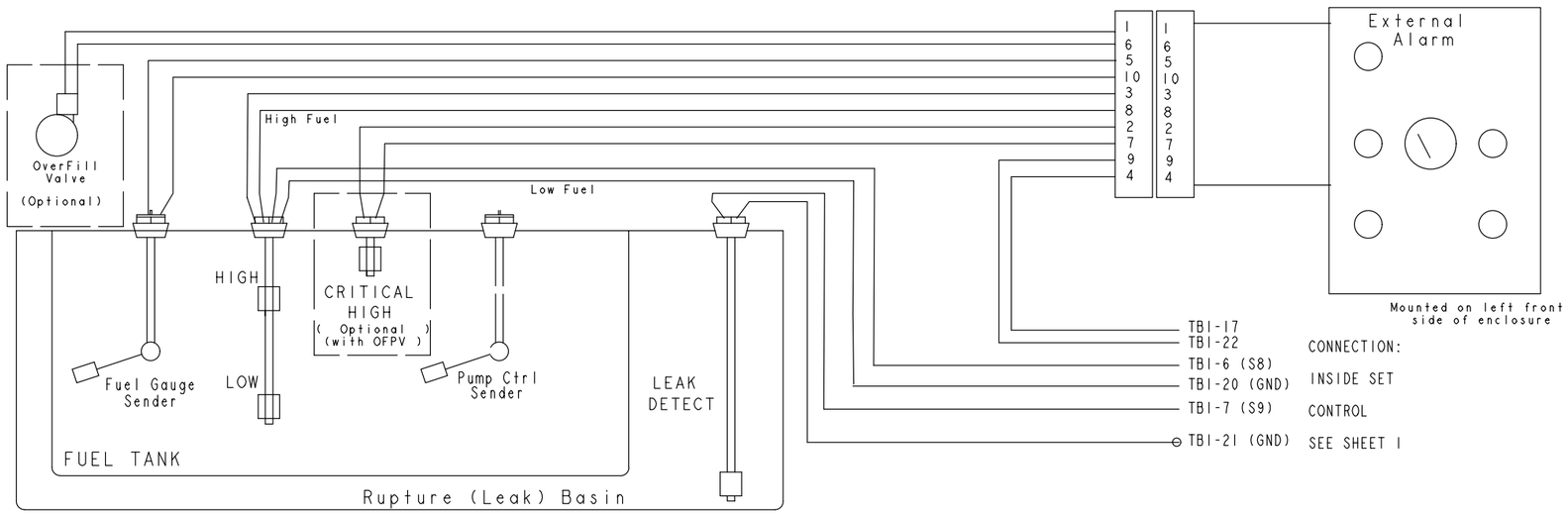
Modified 10-03

ENCLOSURE/OPTIONS WIRING DIAGRAMS (SHEET 2 OF 5)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.





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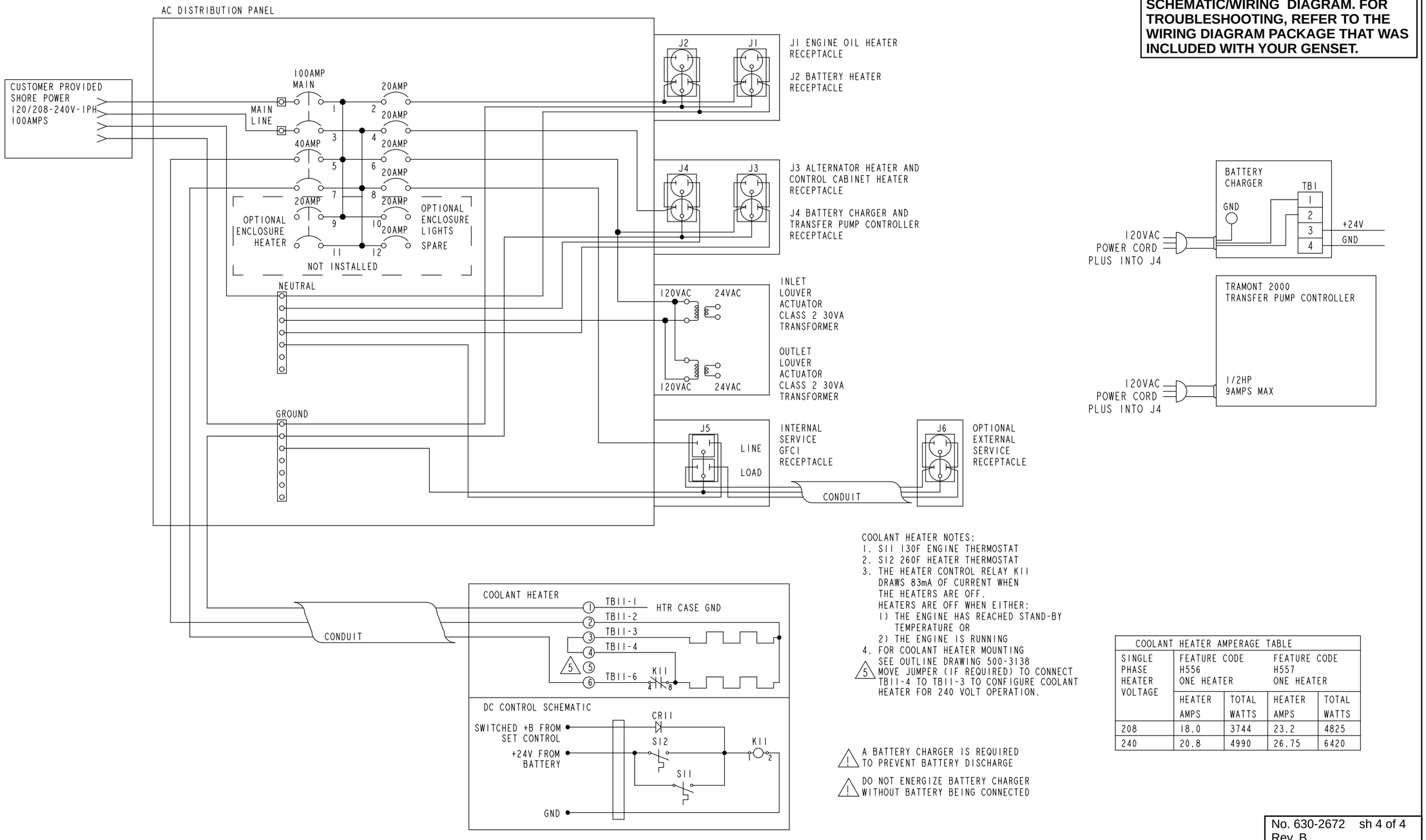
ENCLOSURE/OPTIONS WIRING DIAGRAMS (SHEET 3 OF 5)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



COOLANT HEATER NOTES:
1. S11 130F ENGINE THERMOSTAT
2. S12 260F HEATER THERMOSTAT
3. THE HEATER CONTROL RELAY K11 DRAWS 83mA OF CURRENT WHEN THE HEATERS ARE OFF.
   HEATERS ARE OFF WHEN EITHER:
   1) THE ENGINE HAS REACHED STAND-BY TEMPERATURE OR
   2) THE ENGINE IS RUNNING
4. FOR COOLANT HEATER MOUNTING SEE OUTLINE DRAWING 500-3138

⚠5 MOVE JUMPER (IF REQUIRED) TO CONNECT TB11-4 TO TB11-3 TO CONFIGURE COOLANT HEATER FOR 240 VOLT OPERATION.

⚠ A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE

⚠ DO NOT ENERGIZE BATTERY CHARGER WITHOUT BATTERY BEING CONNECTED

COOLANT HEATER AMPERAGE TABLE				
SINGLE PHASE HEATER VOLTAGE	FEATURE CODE H556 ONE HEATER		FEATURE CODE H557 ONE HEATER	
	HEATER AMPS	TOTAL WATTS	HEATER AMPS	TOTAL WATTS
208	18.0	3744	23.2	4825
240	20.8	4990	26.75	6420

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ENCLOSURE/OPTIONS WIRING DIAGRAMS (SHEET 4 OF 5)

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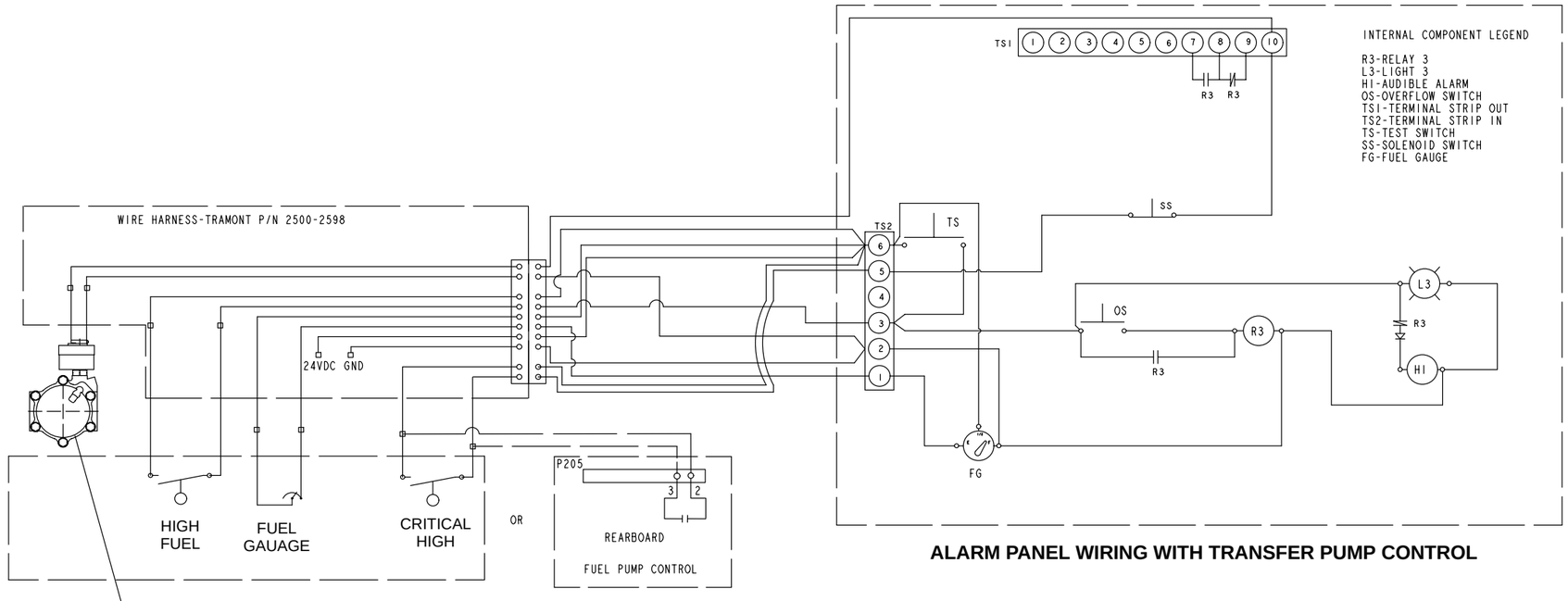
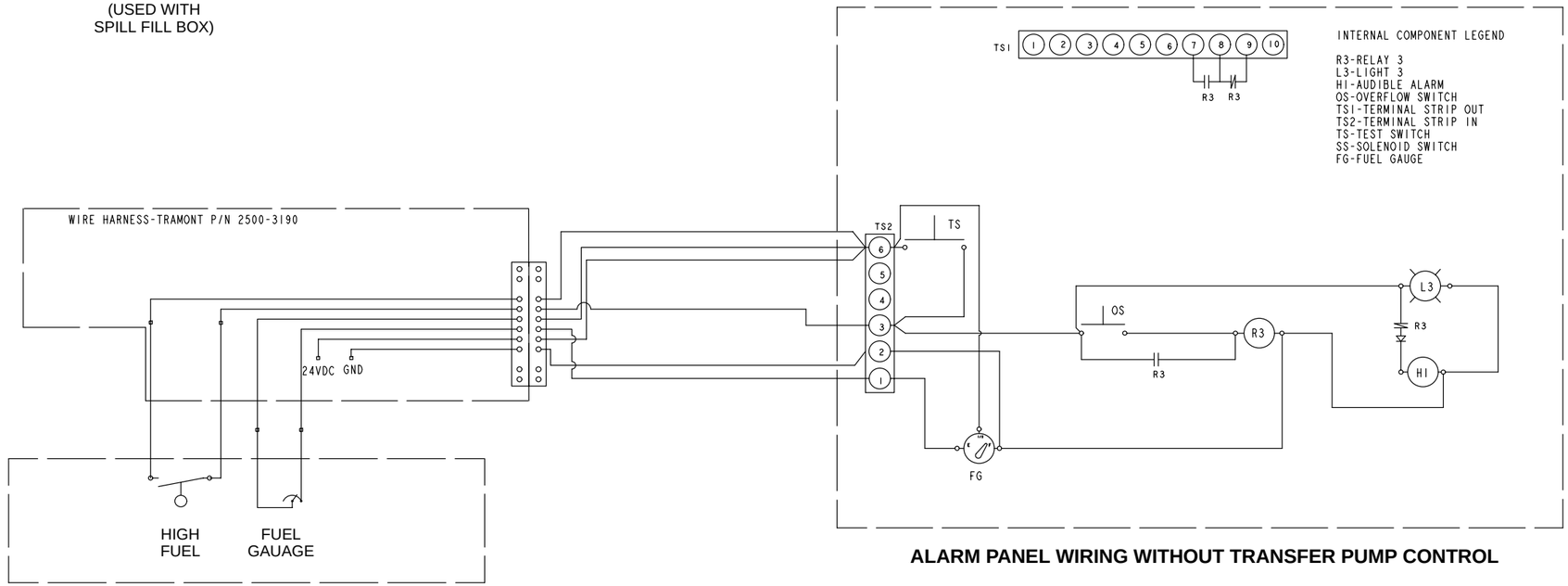


ALARM PANEL WIRING WITH TRANSFER PUMP CONTROL



ALARM PANEL WIRING WITHOUT TRANSFER PUMP CONTROL

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