Service Manual

Generator Set

with PowerCommand® 2100 Controller

DSFAA (Spec A–E)
DSFAB (Spec A–E)
DSFAC (Spec A–E)
DSFAD (Spec A–E)
DSFAE (Spec A–E)

English
Original Instructions

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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.

MEDIUM VOLTAGE GENERATOR SETS (601V to 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

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. To prevent severe scalding, let engine cool down before removing coolant pressure cap. Turn cap slowly, and do not open it fully until the pressure has been relieved.
- 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 or combustible material are not left on or near the generator set.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under or near 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 near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator system, turbo charger system 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 generator sets (gensets) listed on the front cover. Operating and maintenance instructions for the generator set are in the applicable Operator's Manual.

Engine troubleshooting, repair and maintenance information is provided in the applicable engine service 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 generator set control system consist of the PCC control and the engine control module (ECM).

The PCC is a microprocessor-based control for Cummins Power Generation generator sets. 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 setup input from the push button switches on the front panel.

The PCC circuit (Base) board provides:

- Voltage regulation,
- Alternator/genset protection and diagnostics,
- Starter control

The ECM provides:

- Fuel system/combustion control,
- Engine protection and diagnostics,
- Speed governing,
- Speed sensor processing

The ECM fault codes and engine status (oil pressure, coolant temperature, etc.) are displayed on the PCC digital display 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.
- 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)
- InSite™ service tool (PC based ECM 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 trained and experienced to perform electrical and mechanical service. Read and follow Important Safety Instructions on pages iii and iv.***

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:

- O/Manual/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 the network feature is installed, the sleep mode is not available and should not be enabled. If enabled, will cause an error condition.)

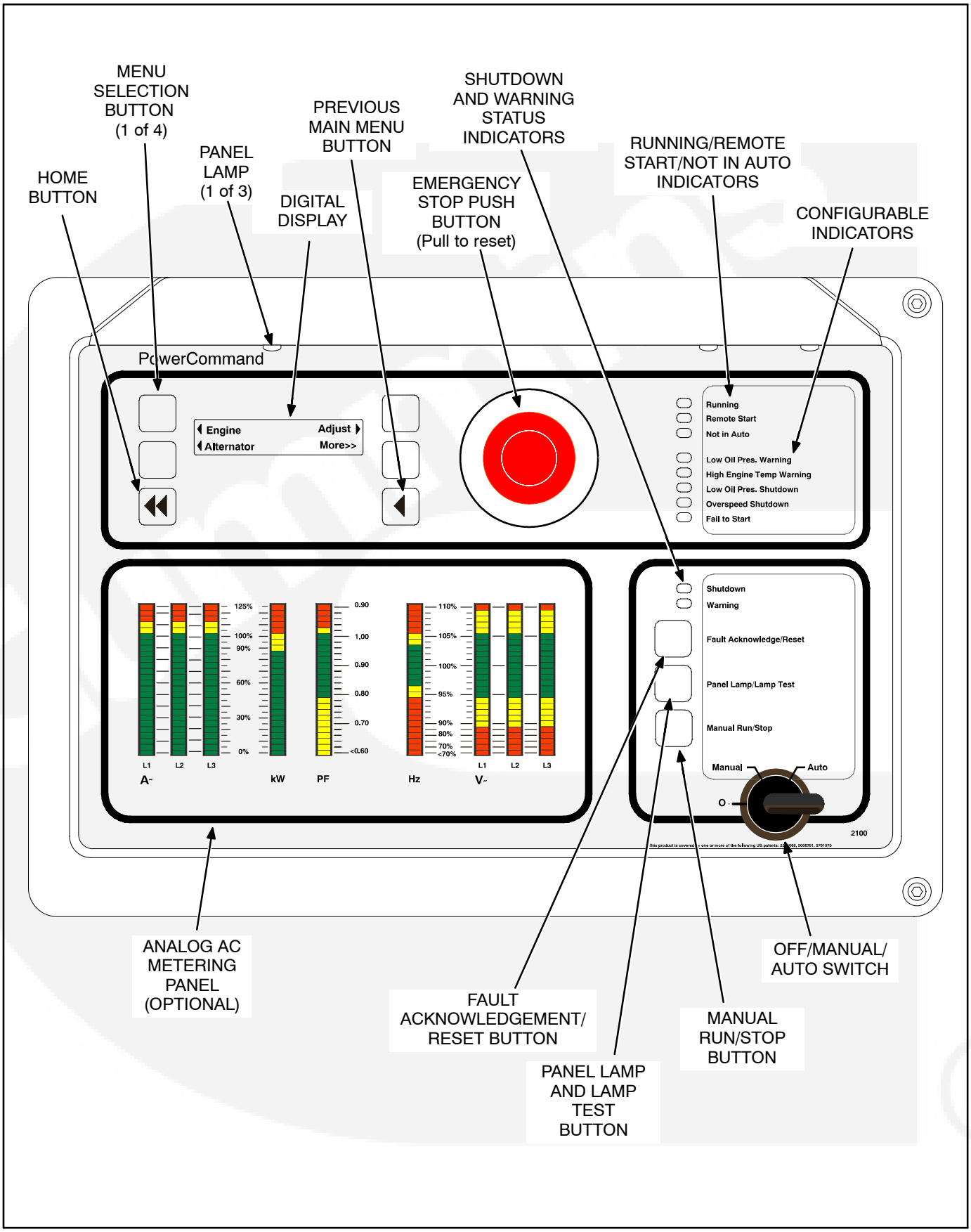

FIGURE 2-1. FRONT PANEL

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 genset 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. Return O/Manual/Auto switch to desired position.

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

Running Indicator: This green lamp is lit whenever the generator set 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~) (L1, L2 and L3); Single phase line-to-line (L1 and L2)
- Kilowatts (kW)
- Generator output frequency in hertz (Hz)
- 3-phase line-to-line AC volts (V~) (L1, L2 and L3); Single phase line-to-neutral (L1)
- 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, the warning indicators can be reset by pressing the Fault Acknowledge/Reset button. (The majority of faults can be reset without stopping generator set.) In Auto mode, the 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 a iwarning 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. (Test can be enabled during genset operation.)

Manual Run/Stop Button: This button starts and stops the genset 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 generator set (local or remote). If the switch is set to O during generator set operation, the engine will immediately shut down (cool-down timers are bypassed). If possible, hot shutdown under load should be avoided to help prolong the life of the generator set.

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 ▶).

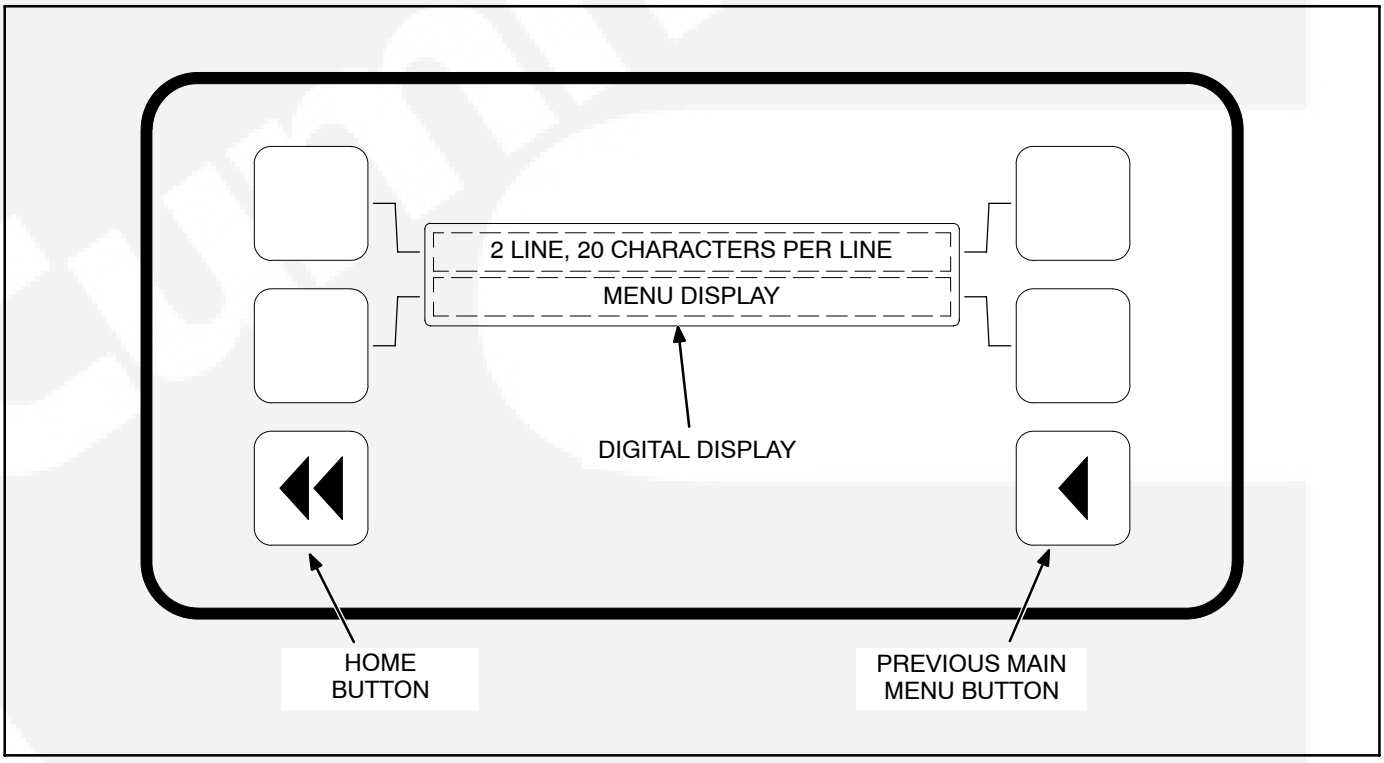

FIGURE 2-2. DIGITAL DISPLAY AND MENU SELECTION BUTTONS

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.

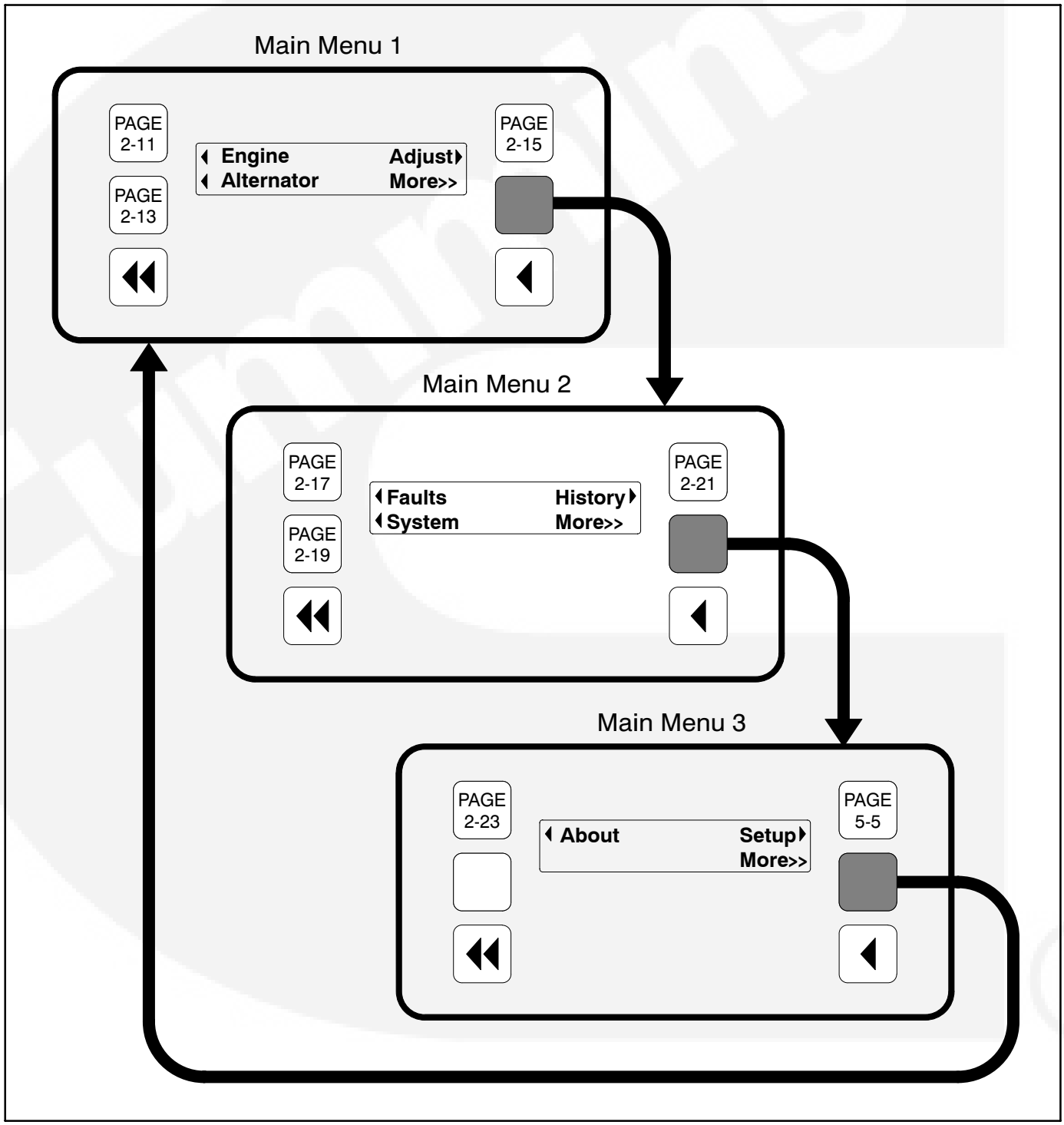

FIGURE 2-3. MAIN MENUS

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.

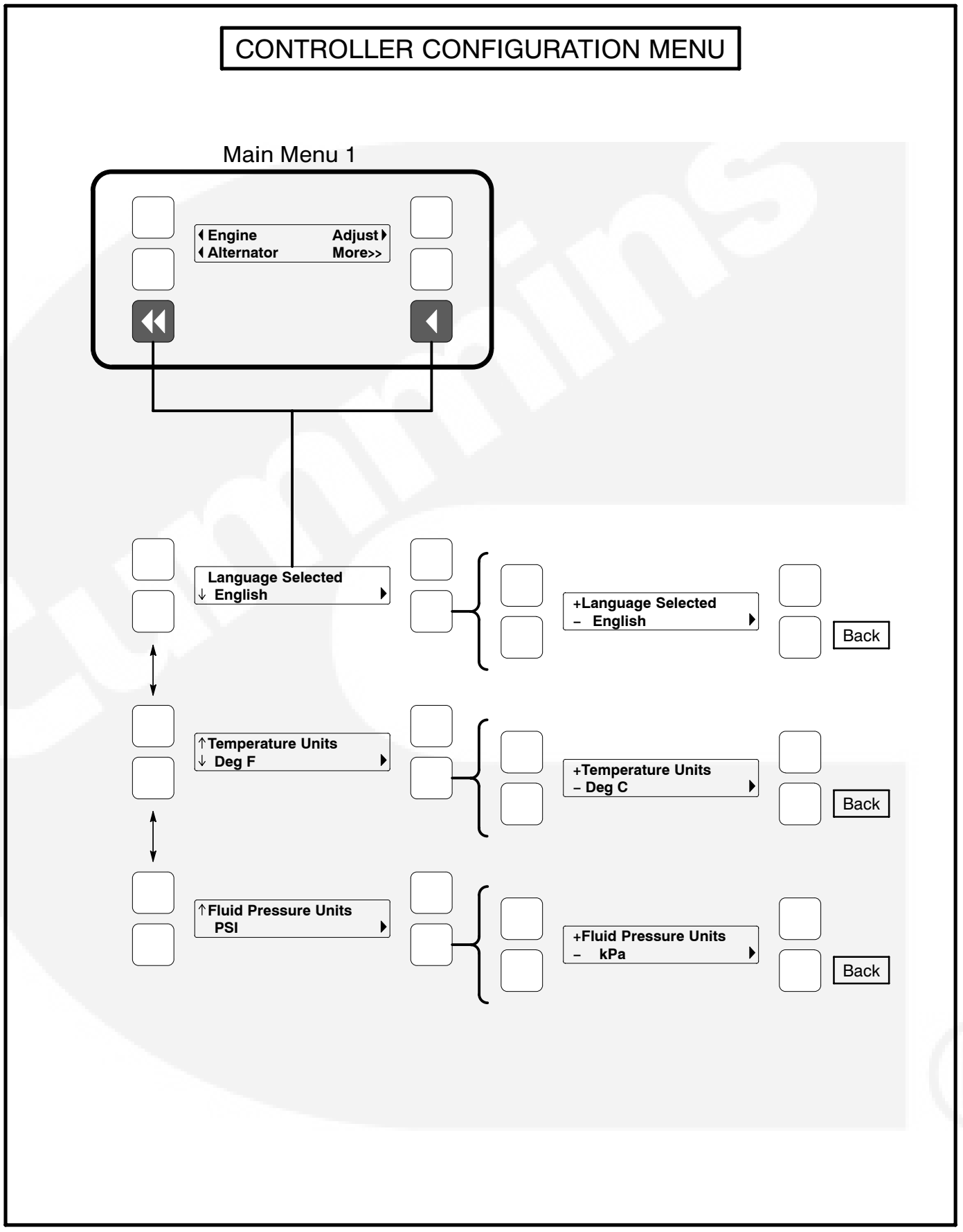

FIGURE 2-4. CONTROLLER CONFIGURATION MENU

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 fifteen 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* in this section).

Engine Speed submenu: This submenu displays the engine RPM.

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

NOT USED - *Governor Torque Command submenu:* This submenu displays the governor torque levels in percentage of maximum value.

Fuel Rate submenu: This submenu displays the fuel rate which can be displayed in gallons per hour or liters per hour (see *Controller Configuration Menu* in this section).

Fuel Supply Pressure submenu: This submenu displays the fuel supply pressure which can be viewed in PSI or kPA (see *Controller Configuration Menu* in this section).

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

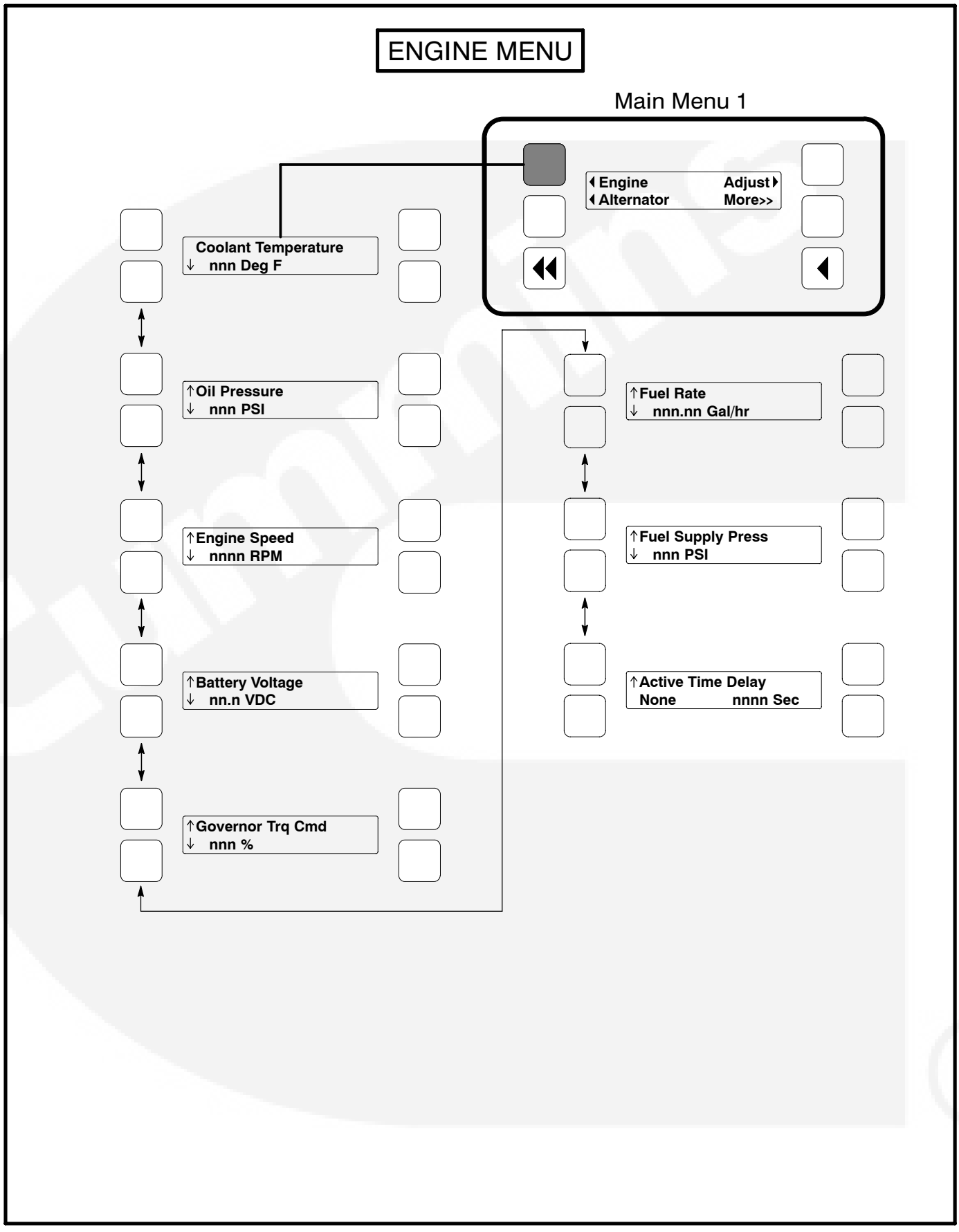

FIGURE 2-5. ENGINE MENU

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.)

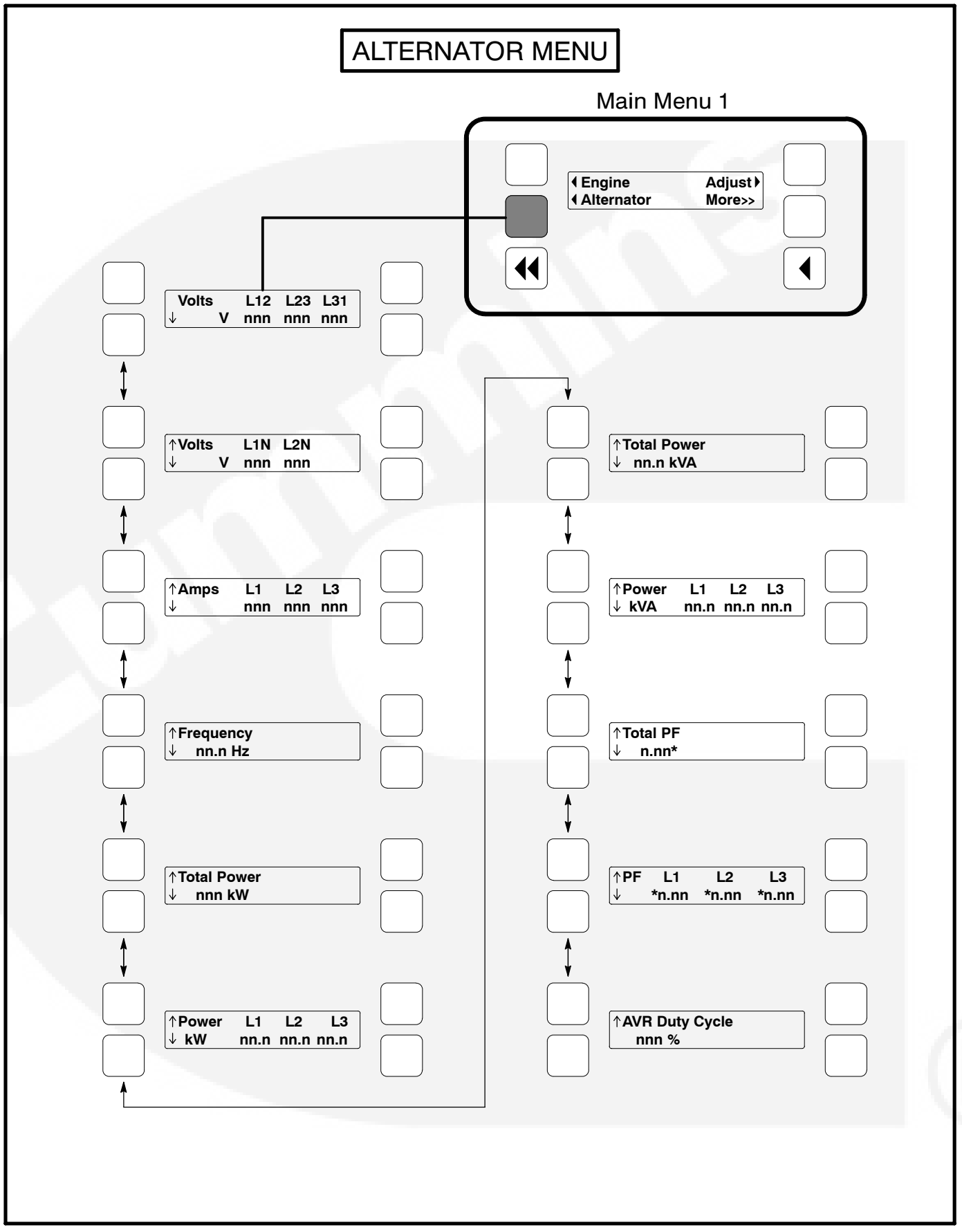

FIGURE 2-6. ALTERNATOR MENU

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 seven 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 entered value is greater or less than the allowed (5%) range, the control will not accept 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). (Enter 1 or more to enable.) 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). (Enter 1 or more to enable.) This function is bypassed during a manual start/stop sequence and engine shutdown faults.

Rated To Idle: 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 (Only available on some models): Idle Start can be enabled or disabled (default = Disable). This function can only be used in manual mode and can be enabled or disabled before or during genset operation.

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 generator set warranty.

The idle speed can be adjusted from 700 to 1100 RPM (default of 800 RPM). Refer to *Crank/Idle Set-up 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.

Keyswitch submenu: Used to turn Keyswitch power to the engine control module on/off. To select OFF, genset speed must be zero.

The keyswitch on/off control is intended to aid or be used in downloads to the engine control module, via InSite.

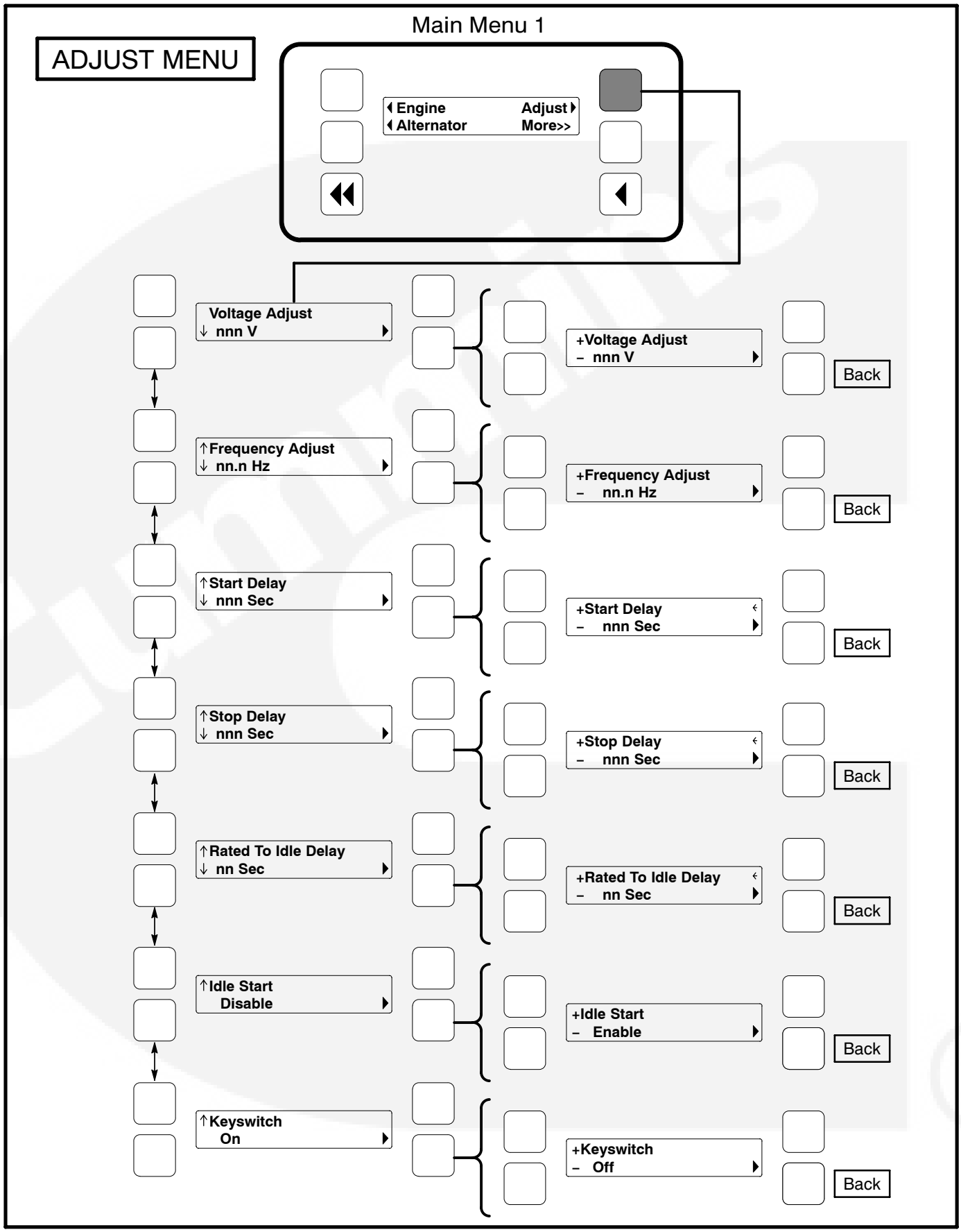

FIGURE 2-7. ADJUST MENU

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.

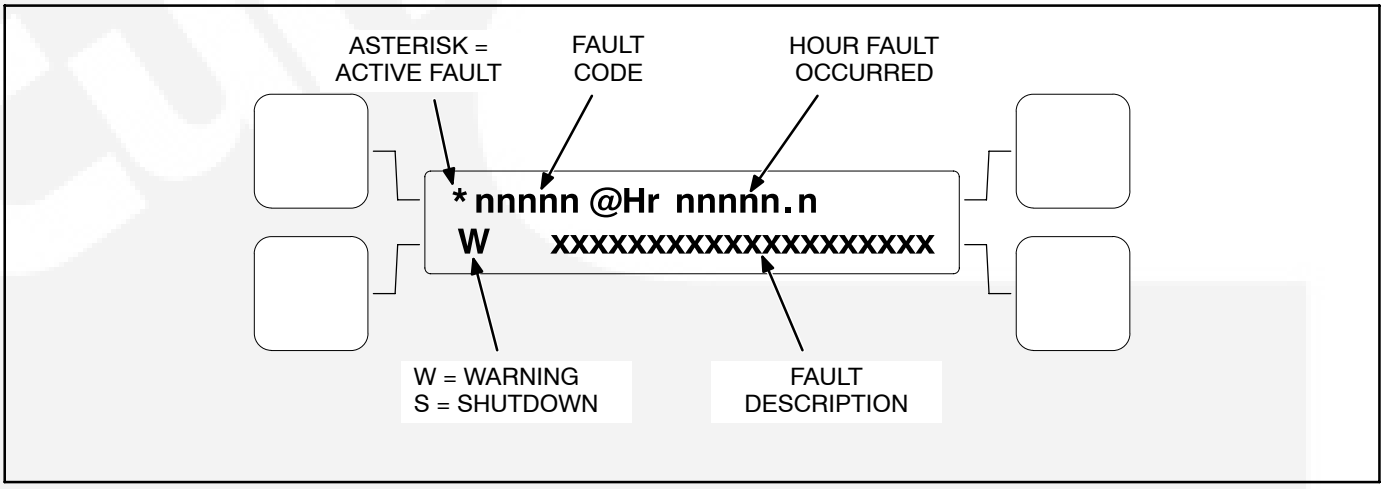

FIGURE 2-8. HISTORY/CURRENT FAULT SUBMENU

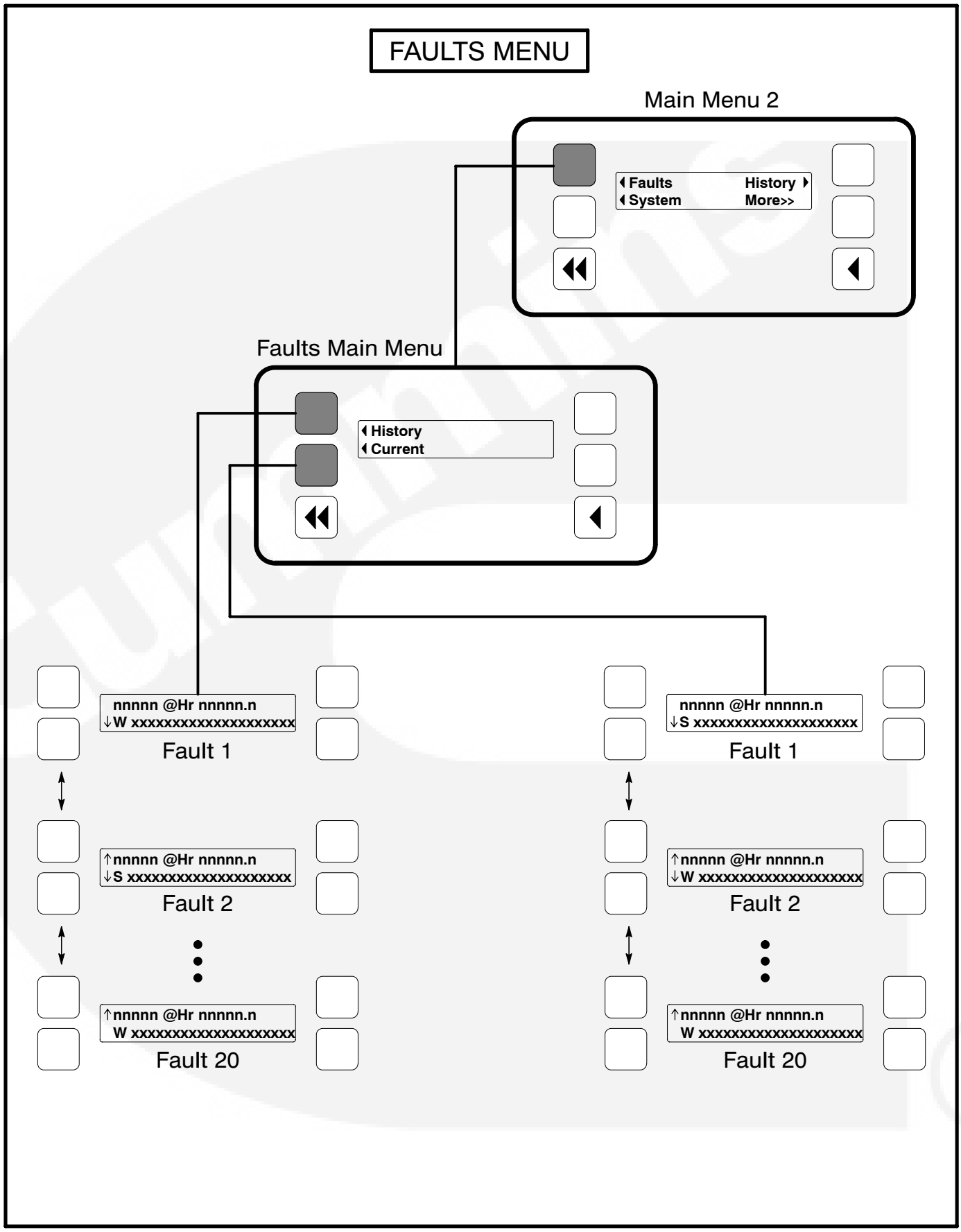

FIGURE 2-9. FAULTS MENU

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.

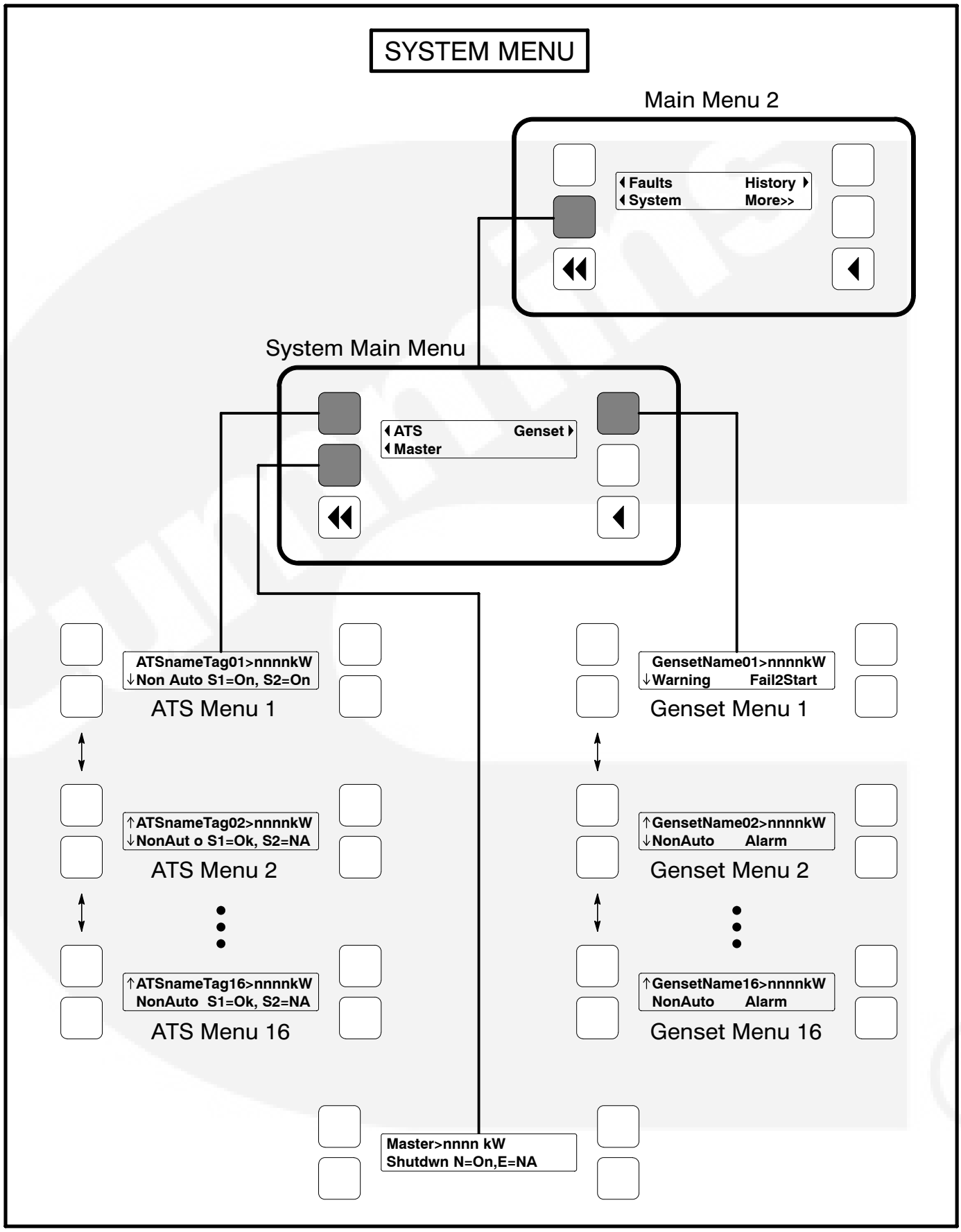

FIGURE 2-10. SYSTEM MENU

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 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.

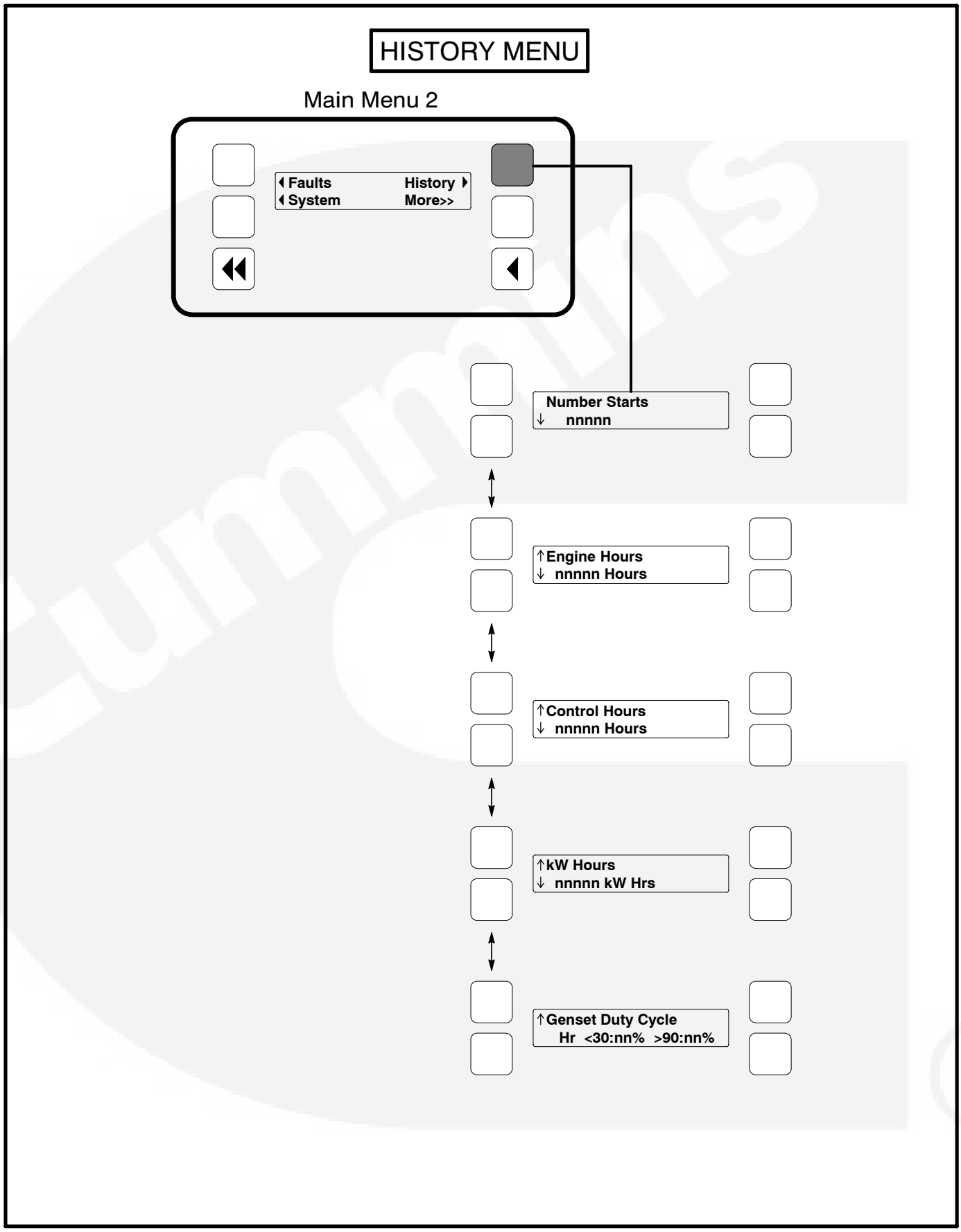

FIGURE 2-11. HISTORY MENU

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 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 configured product application type (Standby or Prime) and product rating (kW) in the application type.

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

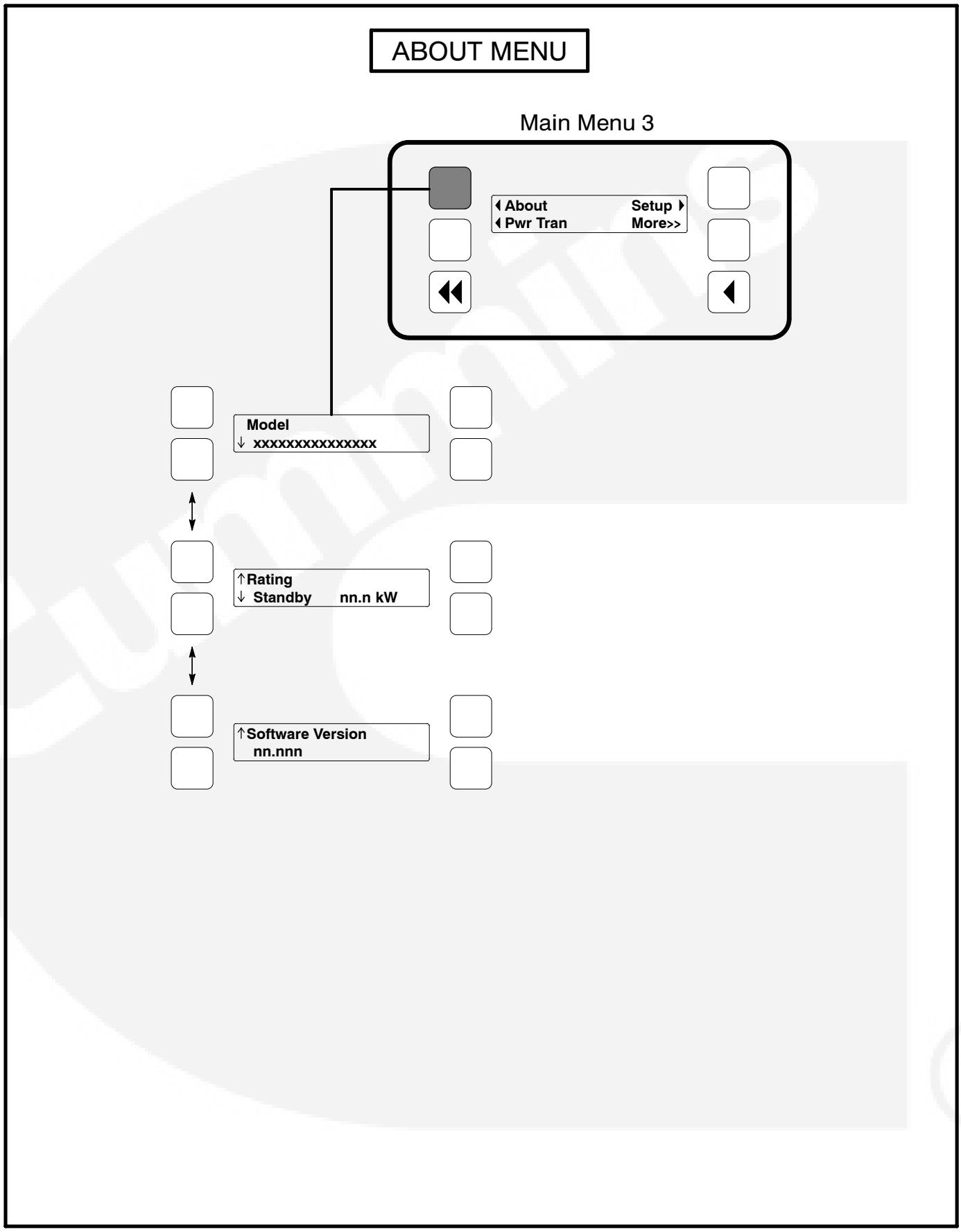

FIGURE 2-12. ABOUT MENU

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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 clean dry wooden platform or clean 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 8* of this manual.

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

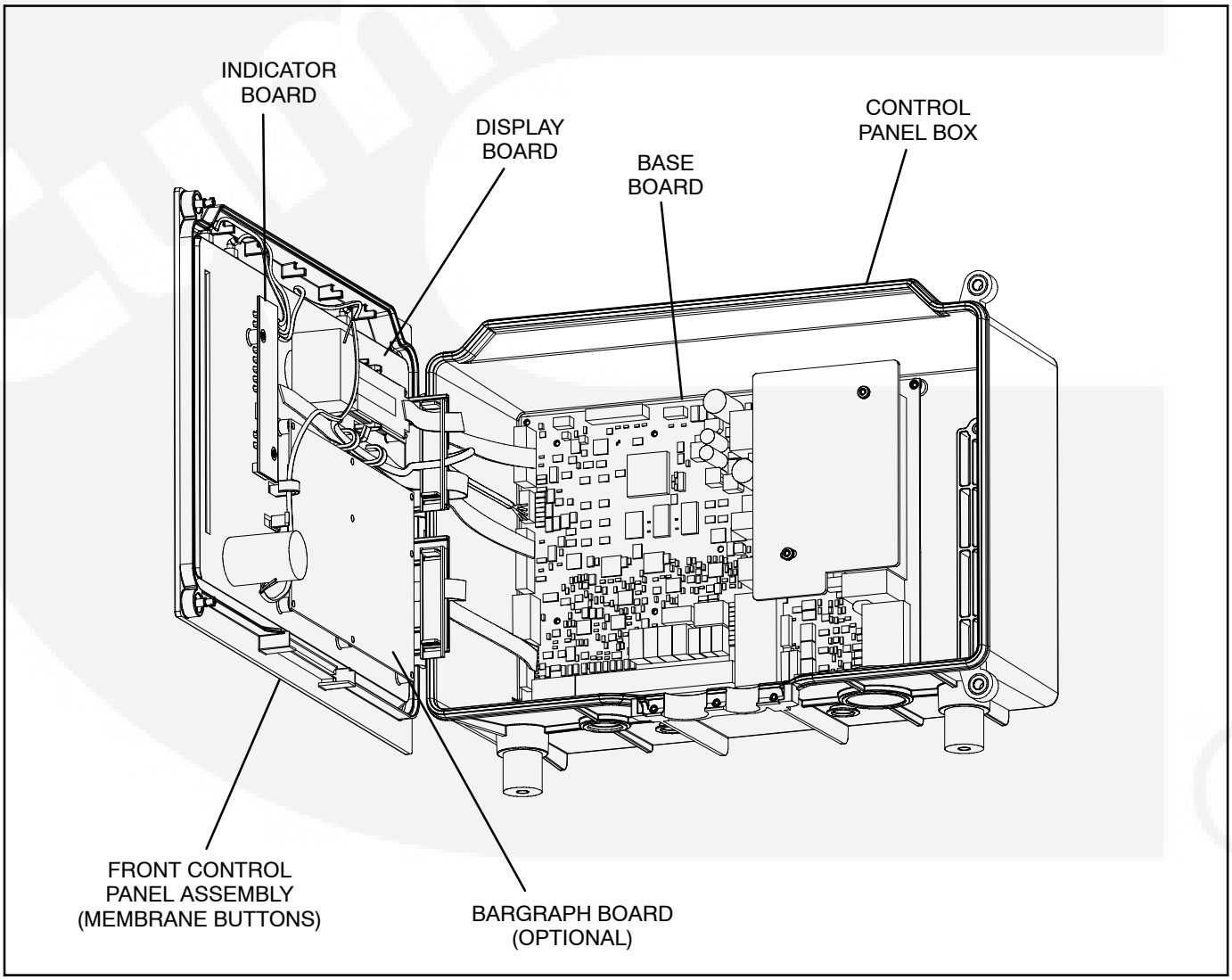

FIGURE 3-1. CIRCUIT BOARD LOCATIONS

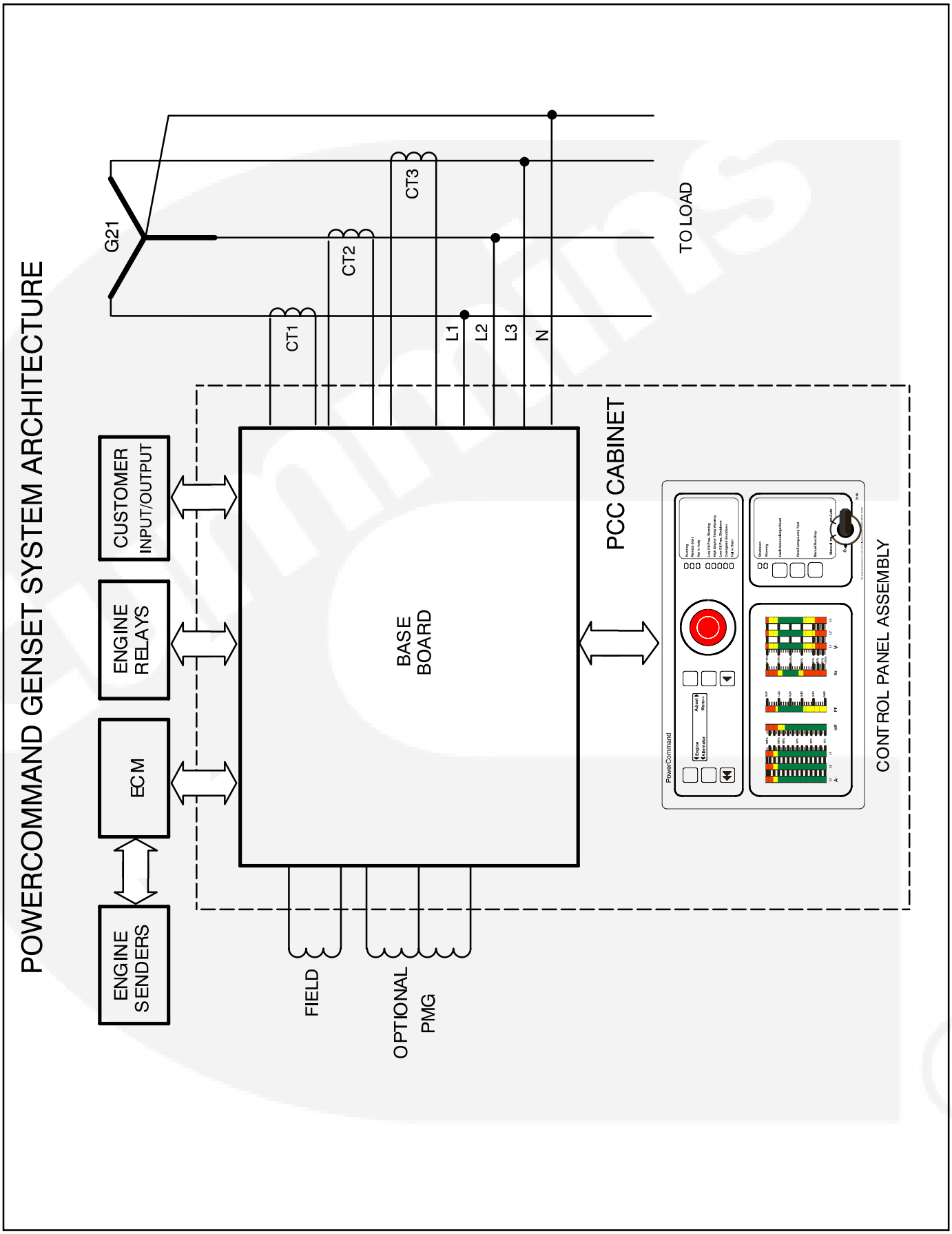

FIGURE 3-2. BLOCK DIAGRAM

CONTROL SYSTEM OVERVIEW

The generator set control system consist of the PCC control and the engine control module (ECM). The block diagram in Figure 3-3 shows the external connections between the PCC Base board and the ECM.

The PCC provides:

- Voltage regulation,
- Alternator/genset protection and diagnostics,
- Starter control

The ECM provides:

- Fuel system/combustion control,
- Engine protection and diagnostics,
- Speed governing,
- Speed sensor processing

CAN/J1939 Datalink

Information transferred over the data link is used by the PCC to display engine status (sensor, warning and shutdown conditions). The datalink must remain active at all times. If not, the PCC will detect the inactive datalink and display a datalink error shutdown condition.

Keyswitch Control

The Keyswitch input to the ECM remains active during all controller modes (O/Manual/Auto) other than when the PCC Sleep Mode is active or when the Emergency Stop switch is activated. The Keyswitch input is controlled by the Keyswitch Relay which is energized by the PCC Keyswitch Relay Driver.

When the O (off) button is pressed or a shutdown fault occurs during genset operation, the PCC will deactivate the Keyswitch relay, stopping engine fueling. When the PCC detects zero speed, the PCC will begin a thirty second delay before activating the keyswitch relay. During this delay, the ECM will save any periodic data.

⚠WARNING ***Engine starting unexpectedly can cause severe personal injury or death. Applying external power to starter for test purposes can cause engine to start. Prevent accidental starting by pushing in the Emergency Stop button.***

After the thirty second delay, the PCC will energize the Keyswitch relay, allowing communications between the PCC and the ECM. With the Keyswitch relay energized and the ECM detects a non-zero engine speed (such as during a starter test) the engine will start with the PCC control in the O or Remote mode. As shown in Figure 3-3, the Emergency Stop switch, when enabled, will open the B+ circuit to the Keyswitch relay preventing the engine from starting during engine troubleshooting.

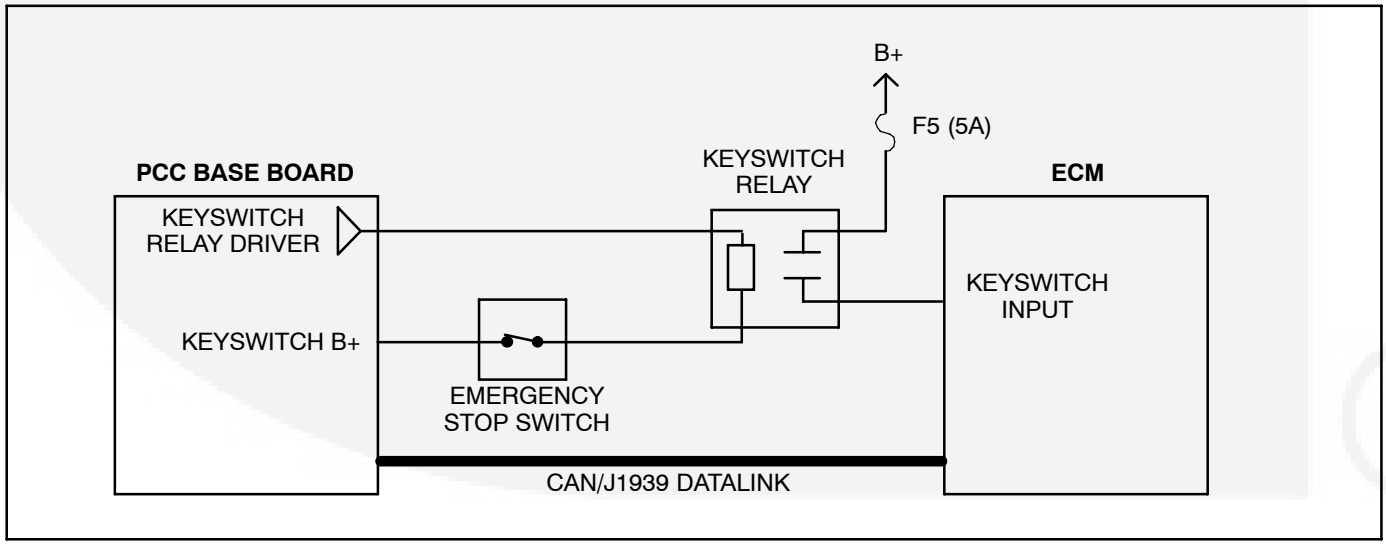

FIGURE 3-3. CONTROL SYSTEM BLOCK DIAGRAM

BASE BOARD

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

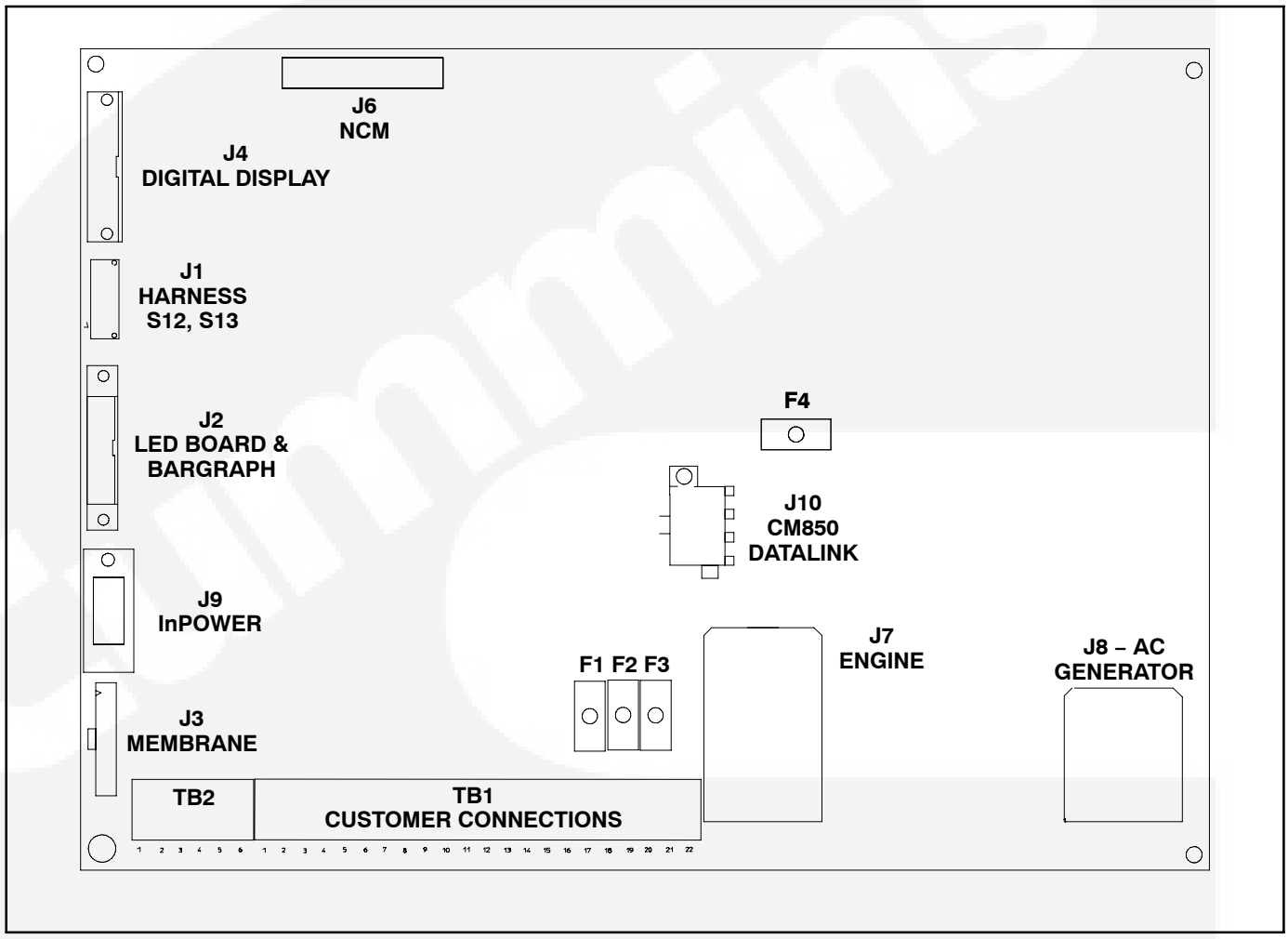

FIGURE 3-3. BASE BOARD

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
B+	S13-1	J10-4*
B+	S13-2	K15-5*

*** Genset Harness**

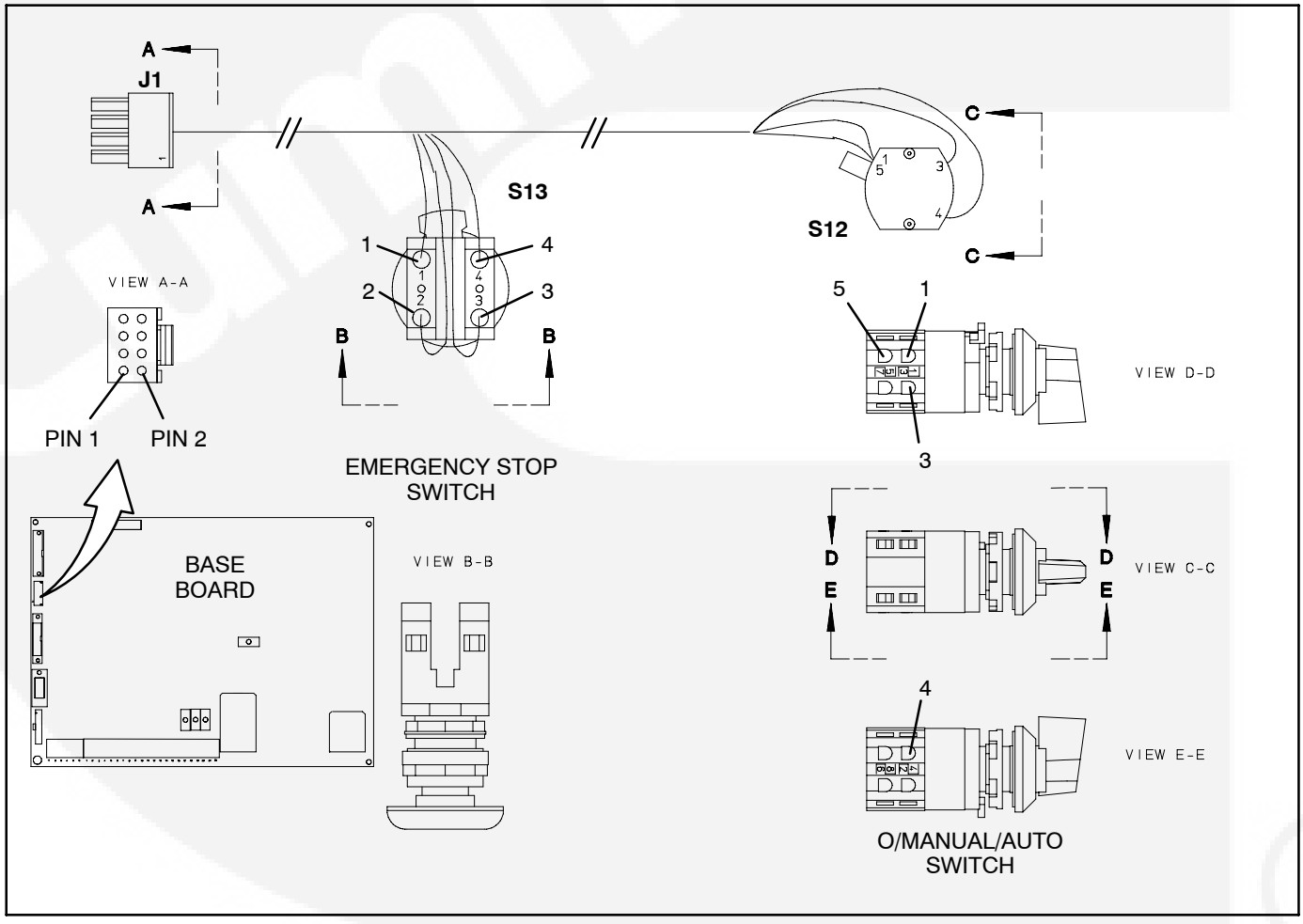

FIGURE 3-4. CONNECTOR J1 (CONTROL HARNESS)

Connector J2

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

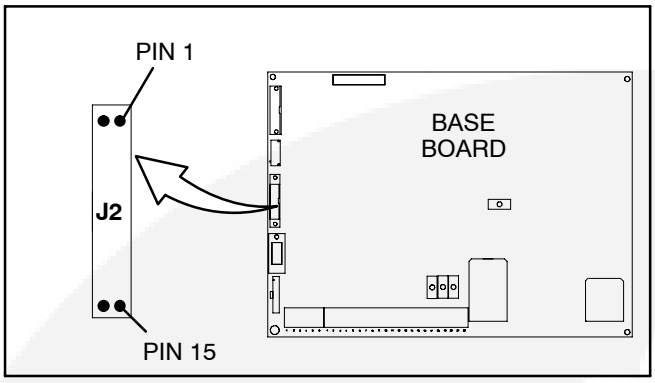

FIGURE 3-5. J2 LED/BARGRAPH CONNECTOR

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.

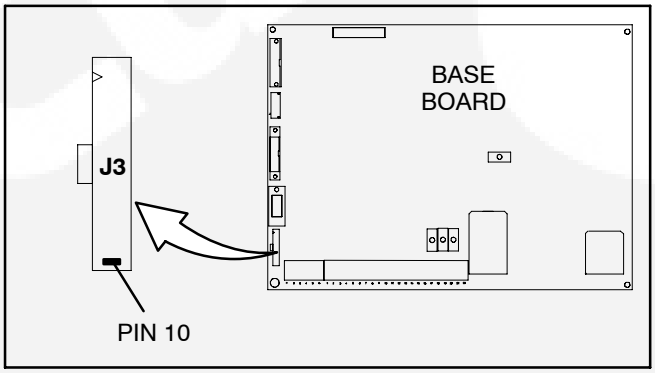

FIGURE 3-6. J3 MEMBRANE CONNECTOR

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.

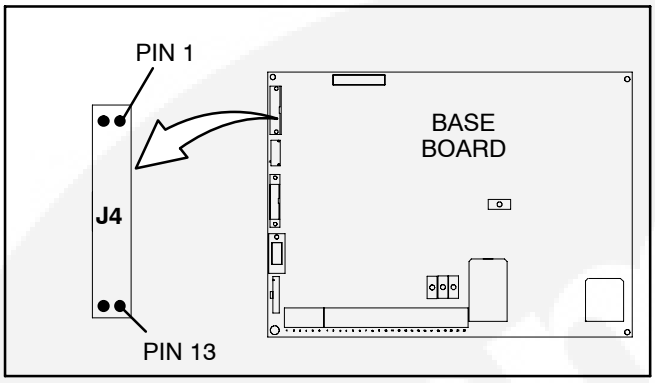

FIGURE 3-7. J4 DISPLAY MENU CONNECTOR

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 generator CT's, engine battery, K4 (starter) and K10 (fuel) pilot relays.

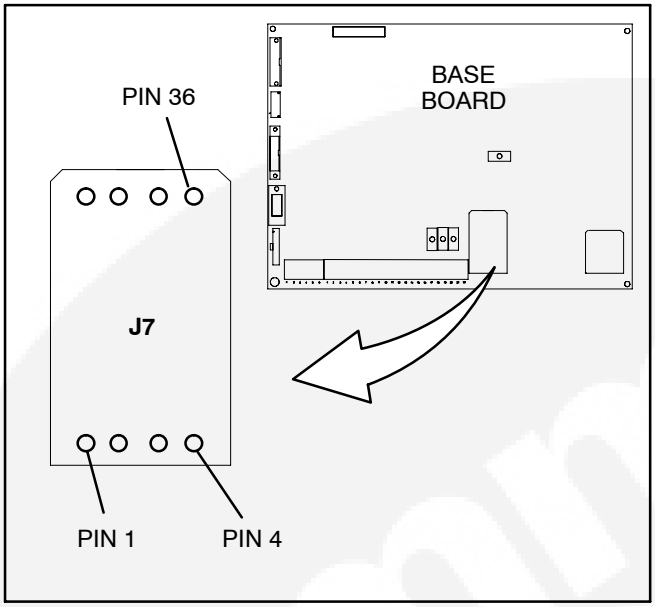

FIGURE 3-8. J7 HARNESS CONNECTOR

CONNECTOR J7	
PIN	**SIGNAL**
5, 6, 7, 8	GND (Base Bd)
1, 2, 3, 4	B+ IN (Base Bd)
9 10	Not Used
11 12	CT1 CT1–COM
15 16	CT2 CT2–COM
18	ALT FLASHOUT
19 20	CT3 CT3–COM
23 27	GEN SW B+ (K4-S1) START SOL B– (K4-S2)

Connector J8

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

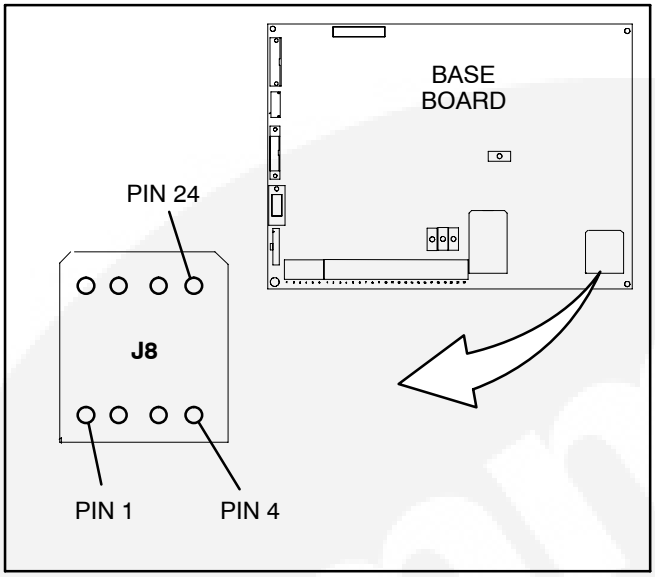

FIGURE 3-9. J8 AC GENERATOR CONNECTOR

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	AC1 (PMG2) AC2 (PMG3) AC3 (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	Switched B+ (to K4 Starter Pilot relay)
F4	5A	Base board power supply fuse

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 8* for TB1 connections.

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4. Troubleshooting

GENERAL

The PowerCommand® 2100 Control (PCC) continuously monitors the generator set for abnormal conditions, such as high or low frequency, voltage, current and also engine faults via the engine control module (ECM). 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 to correct the fault condition.

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.

InPower Calibration Procedure (PCC w/CAN Data Link)

The following procedure must be used when connecting the PC to the PCC2100 with CAN data link.

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. Press the Emergency Stop button and wait at least 30 seconds before completing Step 4.
4. Remove the negative (–) battery cable from the generator set starting battery.
5. Remove 4 pin power connector (C02) from ECM on engine.
6. Remove 6 pin (white) datalink connector (P10) from PCC2100 Base board.
7. Reconnect battery.
8. Connect PC to Base board and perform calibration. Refer to InPower User's Guide.
9. Remove PC connection from Base board when calibration is complete.
10. Disconnect battery. Complete steps 3 and 4.
11. Reconnect connectors removed in steps 5 and 6.
12. Reconnect battery and power to the battery charger (if applicable).

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.

⚠ CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Fault code 1117 may display and engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. See fault code 1117 in this section to reset ECM.***

⚠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. Press the Emergency Stop button and wait at least 30 seconds before completing Step 4.
4. 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:** Provides a list of the ECM fault codes that are sent to the PCC2100. Troubleshooting procedures for these faults are found in the engine service manual.
- **Table 4-4:** Describes each generator status, warning and shutdown code, warning and shutdown limits where applicable, and basic corrective actions, such as, control reset functions, battery connections, etc.
- **Fault Code Tables:** Provide detailed troubleshooting procedures for generator faults listed in Table 4-4. In the following tables, the fault codes are used as the table reference number and are arranged in numeric order.

Figure 4-1 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 8*.

⚠ 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 5.***

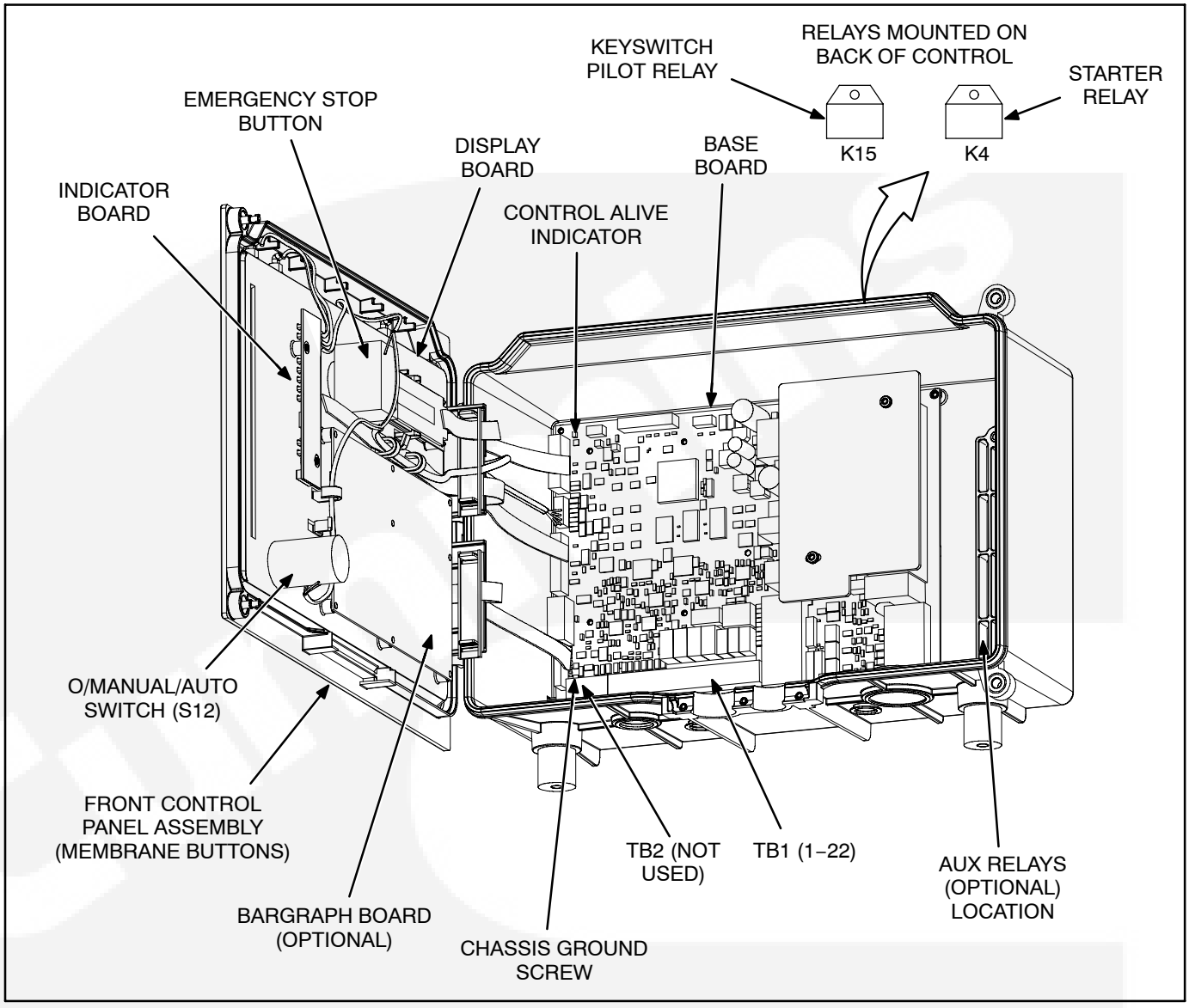

FIGURE 4-1. PCC CONTROL COMPONENTS

Relay K4

The Starter relay is used by the Base board to energize the starter solenoid. K4 is part of the genset harness assembly.

Relay K15

The Keyswitch Pilot relay, which is energized by the PCC Base board, controls the Keyswitch input to the ECM. K15 is part of the genset harness assembly.

⚠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-NC-2) and P1-2 (ESTOP-NC-1). (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 P1-8 (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 (200 ohms or less), 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 P1-8 (GND). If no continuity, isolate to switch or wiring harness. If there is continuity, the Base board is bad.

TABLE 4-3. ENGINE CONTROL MODULE FAULT CODES *

CODE	LAMP	FAULT DESCRIPTION
115	Shtdn	Speed signal lost
122	Wrng	Manifold air press sensor high
123	Wrng	Manifold air press sensor low
124	Wrng	High manifold pressure
135	Wrng	Oil pressure sensor high
141	Wrng	Oil pressure sensor low
143	Wrng	Low oil pressure
144	Wrng	Coolant temp sensor high
145	Wrng	Coolant temp sensor low
146	Wrng	High coolant temp warning
151	Shtdn	High coolant temp alarm
153	Wrng	Manifold air temp sensor high
154	Wrng	Manifold air temp sensor low
155	Shtdn	Manifold air temp alarm
187	Wrng	Sensor supply 2 low
197**	Wrng	Coolant level warning
221	Wrng	Air pressure sensor high
222	Wrng	Air pressure sensor low
227	Wrng	Sensor supply 2 high
234	Shtdn	Overspeed
235	Wrng	Coolant level alarm
238	Wrng	Sensor supply 3 low
239	Wrng	ESP main supp high
261	Wrng	H eng fuel temp warn
263	Wrng	Eng fuel temp sensor H
265	Wrng	Eng fuel temp sensor L
271	Wrng	High fuel pressure sol 1 low

CODE	LAMP	FAULT DESCRIPTION
272	Wrng	High fuel pressure sol 1 high
281	Wrng	Fuel pump stuck (mech)
285	Wrng	J1939 time out error
286	Wrng	J1939 config error
295	Wrng	Air press sens error
322	Wrng	Injector sol 1 L current
324	Wrng	Injector sol 3 L current
331	Wrng	Injector sol 2 L current
332	Wrng	Injector sol 4 L current
341	Wrng	ECM data lost
343	Shtdn	Internal ECM error
351	Wrng	Bad injector pwr supply
352	Wrng	Sensor supply 1 low
386	Wrng	Sensor supply 1 high
415	Shtdn	Low oil pressure alarm
427**	Wrng	CAN data link lost messages
435	Wrng	Oil pressure data error
441**	Wrng	Low battery voltage
442**	Wrng	High fuel supply pressure
449	Wrng	High fuel supply pressure
451	Wrng	Injector metering rail 1 high
452	Wrng	Injector metering rail 1 low
488	Wrng	High intake manifold temp
546	Wrng	Fuel pres sens high
547	Wrng	Fuel pres sens low
553	Wrng	High fuel pump pressure
554	Wrng	Fuel pressure sensor error

***** **Refer to engine service manual for troubleshooting.**
****** **Also refer to warning/shutdown code table and detailed troubleshooting procedure in this section.**

TABLE 4-3. ENGINE CONTROL MODULE FAULT CODES * (CONT.)

CODE	LAMP	FAULT DESCRIPTION
559	Wrng	Low fuel pump pressure
689	Wrng	Crankshaft sensor error
697	Wrng	ECM internal temp sen high
698	Wrng	ECM internal temp sen low
731	Wrng	Cam/Crank misalignment
757	Wrng	Persist data lost error
1139	Wrng	UFD injector 1 error
1141	Wrng	UFD injector 2 error
1142	Wrng	UFD injector 3 error
1143	Wrng	UFD injector 4 error
1244	Shtdn	CAN – Engine normal shutdown
1246	Wrng	CAN – Unknown engine fault
1247	Wrng	CAN – Engine unannounced fault
1248	Wrng	CAN - Engine warning condition
1256	Wrng	Harness key error
1257	Shtdn	Control module error
1411	Wrng	Gen freq adj high
1412	Wrng	Droop pot adj high
1417	Wrng	Power down error
1418	Wrng	Gain pot adj high
1435**	Wrng	Low coolant temp
1695	Wrng	Sens supl 5 OOR high
1696	Wrng	Sens supl 5 OOR low
1852	Wrng	Water in fuel high
1911	Wrng	Injector meter rail 1 pres H
1978	Wrng	Gen speed/load gov cir H

CODE	LAMP	FAULT DESCRIPTION
1979	Wrng	Gen speed/load gov cir L
1992	Wrng	Overspeed
2185	Wrng	Sensor supply cir H
2186	Wrng	Sensor supply cir L
2215	Wrng	L fuel supl press
2217	Wrng	ECM data lost
2249	Wrng	Diesel low 2 pressure error
2263	Wrng	Battery temp H
2264	Wrng	Battery temp L
2265	Wrng	Fuel priming pump circuit high
2266	Wrng	Fuel priming pump circuit low
2292	Wrng	Diesel flow high error
2293	Wrng	Diesel flow low error
2311	Wrng	EFC resistance error
2425	Wrng	GHC high volt error 2
2426	Wrng	GHC low volt error 2
2555	Wrng	Intake air heater #1 circuit high
2556	Wrng	Intake air heater #1 circuit low
2973	Wrng	Intake manifold pressure sen error
9947	Wrng	Injector 4 circuit error
9948	Wrng	Injector 3 circuit error
9949	Wrng	Injector 2 circuit error
9951	Wrng	Injector 1 circuit error
9981	Wrng	APC dsl bld open error
9982	Wrng	APC dsl bid short error

*** Refer to engine service manual for troubleshooting.**
**** Also refer to warning/shutdown code table and detailed troubleshooting procedure in this section.**

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TABLE 4-4. WARNING AND SHUTDOWN CODES

FAULT CODE	CORRECTIVE ACTION
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.
235 **LOW COOLANT LEVEL** Lamp: Shutdown	Indicates engine coolant level has fallen below the shutdown trip point. See code **197** for corrective action.
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.
427 **CAN DATALINK LOST MESSAGES** Lamp: Warning	Datalink fault. Indicates that important data was lost between the Base board and the ECM. (Refer to detailed troubleshooting procedure in this section.)
441 **LOW BAT VOLTAGE** Lamp: Warning	Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation will occur. (Refer to detailed troubleshooting procedure in this section.)
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.
781 **CAN DATALINK LOST** Lamp: Shutsown	Communications lost between control and ECM. Reset control by pressing Fault Reset button with O/Manual/Auto switch in O (Off) position. If “Keyswitch Reset Required” is displayed after clearing fault, repeat control reset sequence. (Refer to detailed troubleshooting procedure in this section.)
1117 **ECM POWER LOST** Lamp: Warning	Indicates that “Keyswitch” to the ECM was NOT removed for 30 seconds before removing battery power to the ECM (removing connectors or battery cable). To reset, place the O/Manual/Auto switch in the O position and press E-Stop and wait 30 seconds. Remove E-Stop and press the Fault Reset button.
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.
1245 **CAN–ENGINE SHUTDOWN** Lamp: Shutdown	The ECM indicated to the PCC that it is shutting down the engine but did not send a recognized fault condition over the datalink. (Refer to detailed troubleshooting procedure in this section.)

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

FAULT CODE	CORRECTIVE ACTION
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
1417 **POWER DOWN ERROR** Lamp: Warning	Indicates that the controller can not power down because of some unknown condition. Possible drain on battery. Replace Base board.
1433 **EMERGENCY STOP** Lamp: Shutdown	Indicates local Emergency Stop. To reset the local/remote Emergency Stop button: 1. Pull the Emergency Stop button out. 2. Move the O/Manual/Auto switch to O. 3. Press the front panel Fault Acknowledge/Reset button. 4. Return O/Manual/Auto switch to desired position.
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.

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

FAULT CODE	CORRECTIVE ACTION
1438 **FAIL TO CRANK** Lamp: Shutdown	Indicates possible fault with control, speed sensing or starting system. (Refer to detailed troubleshooting procedure in this section.)
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.
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. (Refer to detailed troubleshooting procedure in this section.)
1447 **LOW AC VOLTAGE** Lamp: Shutdown	Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds. (Refer to detailed troubleshooting procedure in this section.)
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. (Refer to detailed troubleshooting procedure in this section.)
1459 **REVERSE POWER** Lamp: Shutdown	Indicates improper CT phasing. Check wiring to voltage sense circuit. Refer to CT Installation in *Section 5*.
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.

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

FAULT CODE	CORRECTIVE ACTION
1471 **OVER CURRENT** Lamp: Warning	Indicates that generator output current has exceeded 110% of rated for 60 seconds. Check load and load lead connections.
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.
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.
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.
2968 **AVR FAULT** Lamp: Warning	Indicates AVR hardware contains a fault condition.
2969 **LON FAILURE** Lamp: Warning	Indicates no communications with LonWorks board.
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 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 427 – CAN DATALINK LOST MESSAGES (WARNING)

Reason: Important data was lost between the Base board and the ECM or keyswitch to ECM was removed during genset operation.
Effect: Engine will not start (If fault occurred during genset operation, genset may continue to operate).

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Power removed from ECM (keyswitch) during genset operation. O pressed on control during genset operation. (This is a nuisance fault only, not a critical fault.)	1. Reset control by pressing Fault Reset button with O/Manual/Auto switch in O (Off) position.
2. Defective Datalink harness assembly.	2a. Inspect the Datalink harness P10 and C1 connector pins. Repair or replace as necessary. 2b. Check for resistive circuit in lead P10-1 to C1-46 and P10-2 to C1-47 (10 ohms or less OK). 2c. Check terminating resistors. With connectors P10 and C1 removed, measure resistance between pins P10-1 and P10-2 (60 ohms OK).

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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 AC powered 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 P7–1 through P7-4 (B+) to P7-5 through 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 AC powered 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.

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CODE 781 – CAN DATALINK LOST MESSAGES (SHUTDOWN)

Reason: Important data was lost between the Base board and the ECM or keyswitch to ECM was removed during genset operation.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Power removed from ECM (keyswitch) during genset operation. O pressed on control during genset operation. (This is a nuisance fault only, not a critical fault.)	1. Reset control by pressing Fault Reset button with O/Manual/Auto switch in O (Off) position.
2. Defective Datalink harness assembly.	2a. Inspect the Datalink harness P10 and C1 connector pins. Repair or replace as necessary. 2b. Check for resistive circuit in lead P10-1 to C1-46 and P10-2 to C1-37 (10 ohms or less OK). 2c. Check terminating resistors. With connectors P10 and C1 removed, measure resistance between pins P10-1 and P10-2 (60 ohms OK).

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CODE 1245 – CAN ENGINE SHUTDOWN (SHUTDOWN)

Reason: The PCC received a shutdown message from the ECM.
Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
ECM/engine fault.	Refer to engine service 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).

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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 genset harness connector pins. Repair or replace as necessary. Refer to engine service manual for troubleshooting.

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CODE 1438 – FAIL TO CRANK (SHUTDOWN)

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.	⚠WARNING ***Engine starting unexpectedly can cause severe personal injury or death. Applying external power to starter for test purposes can cause engine to start. Prevent accidental starting by pushing in the Emergency Stop button before beginning maintenance procedures.*** 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+ at K4-1 (directly connected to battery B+). If not present, check for open circuit. If there is B+, attempt to start and test for B+ at K4-4. • If there is no B+ at K4-4, K4 is bad. • If there is B+ at K4-4, check for open circuit between K4-4 and K3-S1. B+ at K3-S1, go to next step.
4. Starter Relay K3 or starter circuitry could be bad.	3. Check for B+ at K3 lead BATT (directly connected to battery B+). If not present, check for open circuit. If there is B+, attempt to start and test for B+ at K3 lead SW. • If there is no B+ at K3 lead SW, K3 is bad. • If there is B+ at K3 lead SW, check for open circuit between K3 lead SW 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.
5. CAN Datalink error.	5. CAN Datalink error was detected prior to genset receiving start command. Review fault codes. Refer to code **427** instructions.

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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 AC powered battery charging circuit, according to manufacturers instructions.
5. If the batteries are OK, the problem may be the harness or the Base board.	5. Remove connector P7 from Base board and check battery voltage at P7–1 through P7-4 (B+) to P7-5 through 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 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.

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CODE 1444 – KW OVERLOAD (WARNING)

Reason: The indicated kW load has reached overload. The threshold for indicated 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 5*.
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**.

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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. Improper connections have been made at the generator output terminals.	4. Reconnect according to the appropriate reconnection diagram. See *Section 8*.
5. AC harness wiring connections could be incorrect.	5. Check all AC harness connections (*refer to Section 8*).
6. Base board or generator is bad.	6. Refer to *Generator/Base Board Isolation Procedure* in *Section 6* 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 8*.
5. AC harness wiring connections could be incorrect.	5. Check all AC harness connections (*refer to Section 8*).
6. The rotating rectifier assembly (diodes CR1 through CR6) is faulty.	6. Check each diode (*refer to Section 6*).
7. Loose connector or Base board is bad.	7. 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 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.

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.

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

Reason: This indicates that the indicated 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**.

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5. 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. Site power for optional equipment and genset 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

⚠ CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Fault code 1117 may display and engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. See fault code 1117 in Section 4 to reset ECM.***

⚠ 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.***

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

Before starting, disconnect the negative (–) cable from the battery. This is to make sure 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.

1. Move the O/Manual/Auto switch on the control panel to the O (off) position.
2. Turn off or remove AC power from the battery charger.
3. Press the Emergency Stop button and wait at least 30 seconds before completing Step 4.
4. Remove the negative (–) battery cable from the generator set starting battery.
5. 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.)
6. Attach the clip to the chassis ground screw in the control box and place the strap around your wrist before handling a circuit board.

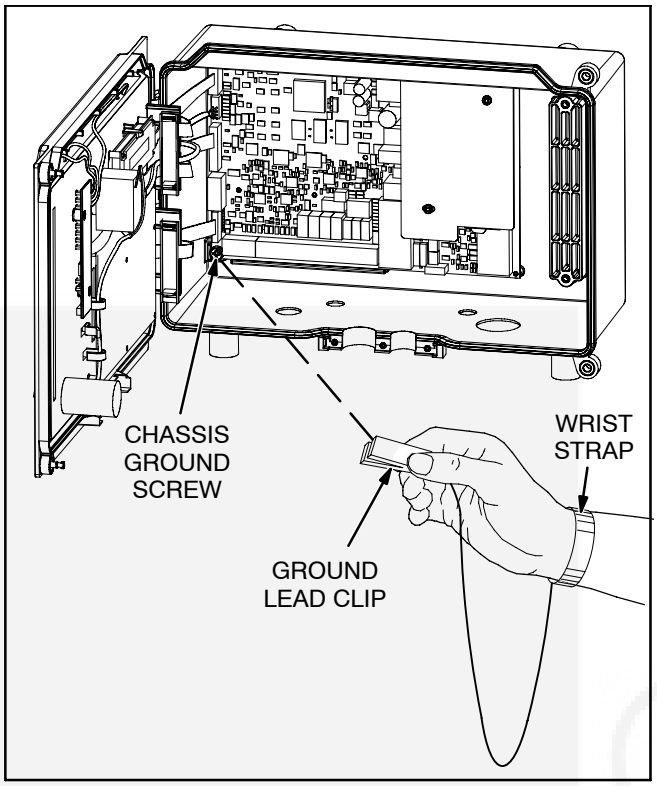

FIGURE 5-1. WRIST STRAP

MODIFYING SETUP SUBMENUS

The Setup submenus allow you to adjust system parameters.

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

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

These two 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 5-2 shows a block representation of the Set-up 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.

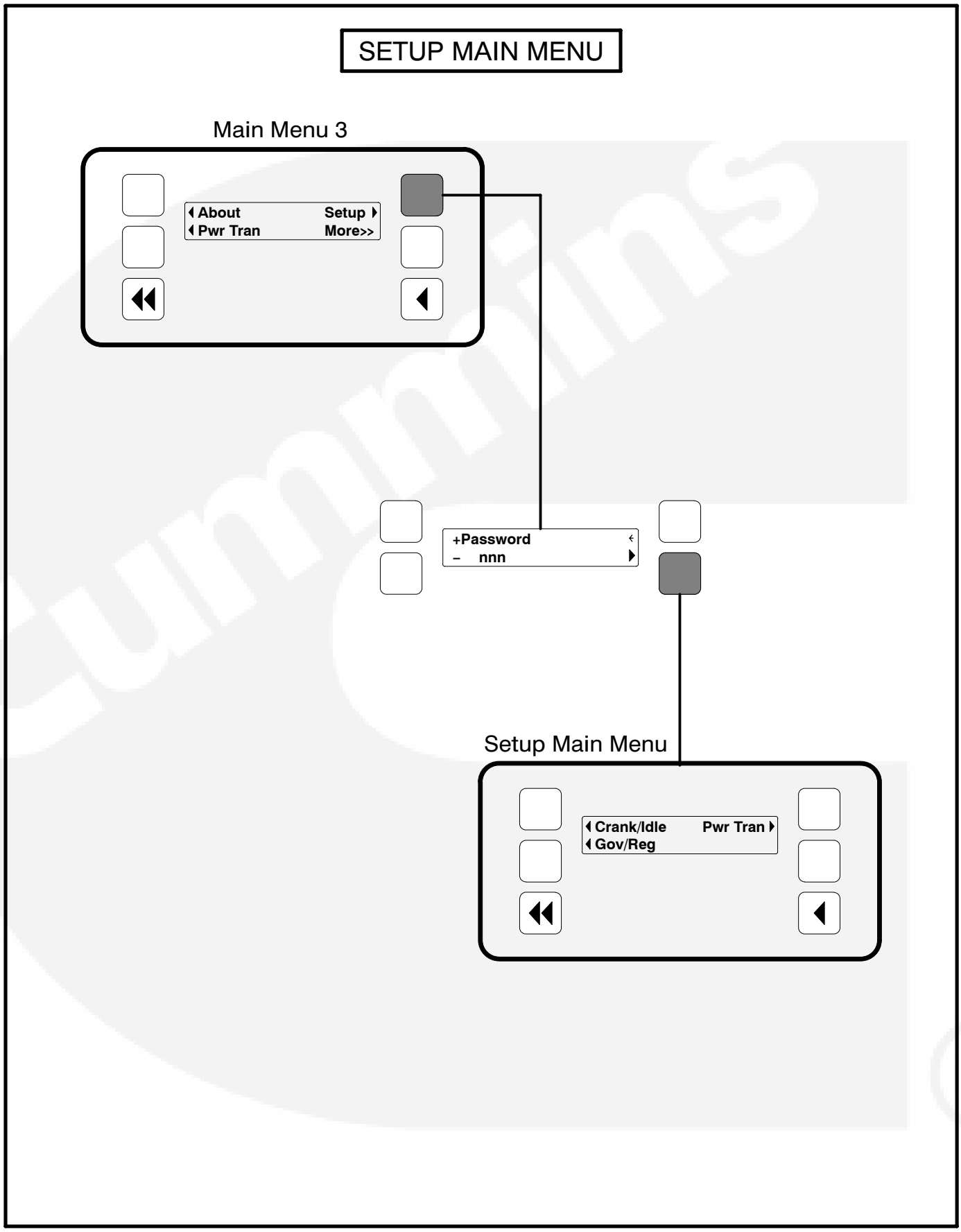

FIGURE 5-2. SETUP MAIN MENU

CRANK/IDLE SETUP MENU

Figure 5-3 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).

NOT USED *Idle Speed Adjust submenu:* This value can be adjusted from 700 to 1100 RPM (default = 800 RPM).

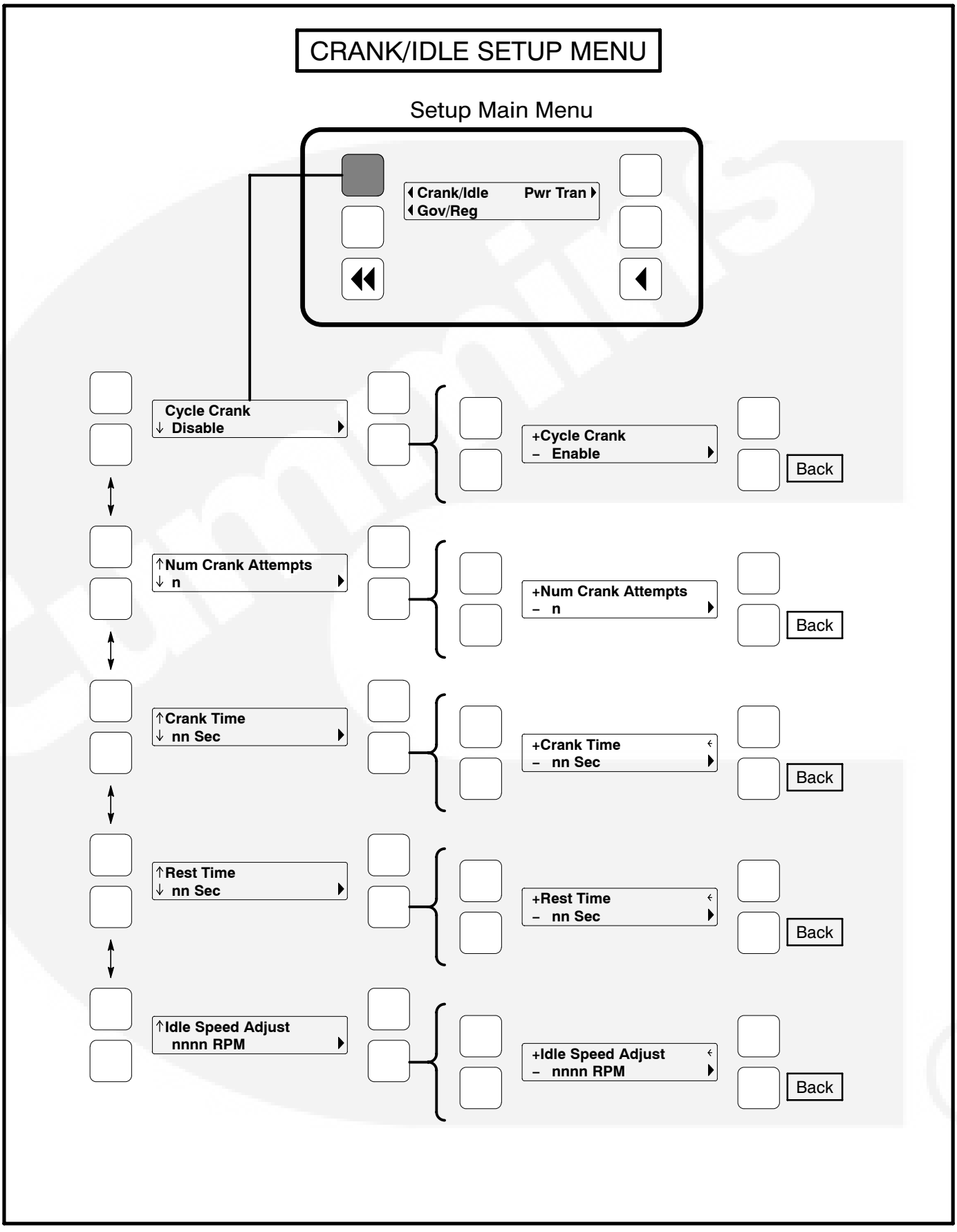

FIGURE 5-3. CRANK/IDLE SETUP MENU

GOVERNOR/REGULATOR SETUP MENU

Figure 5-4 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 and voltage 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 genset start up and does not affect the product performance with load changes.

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.

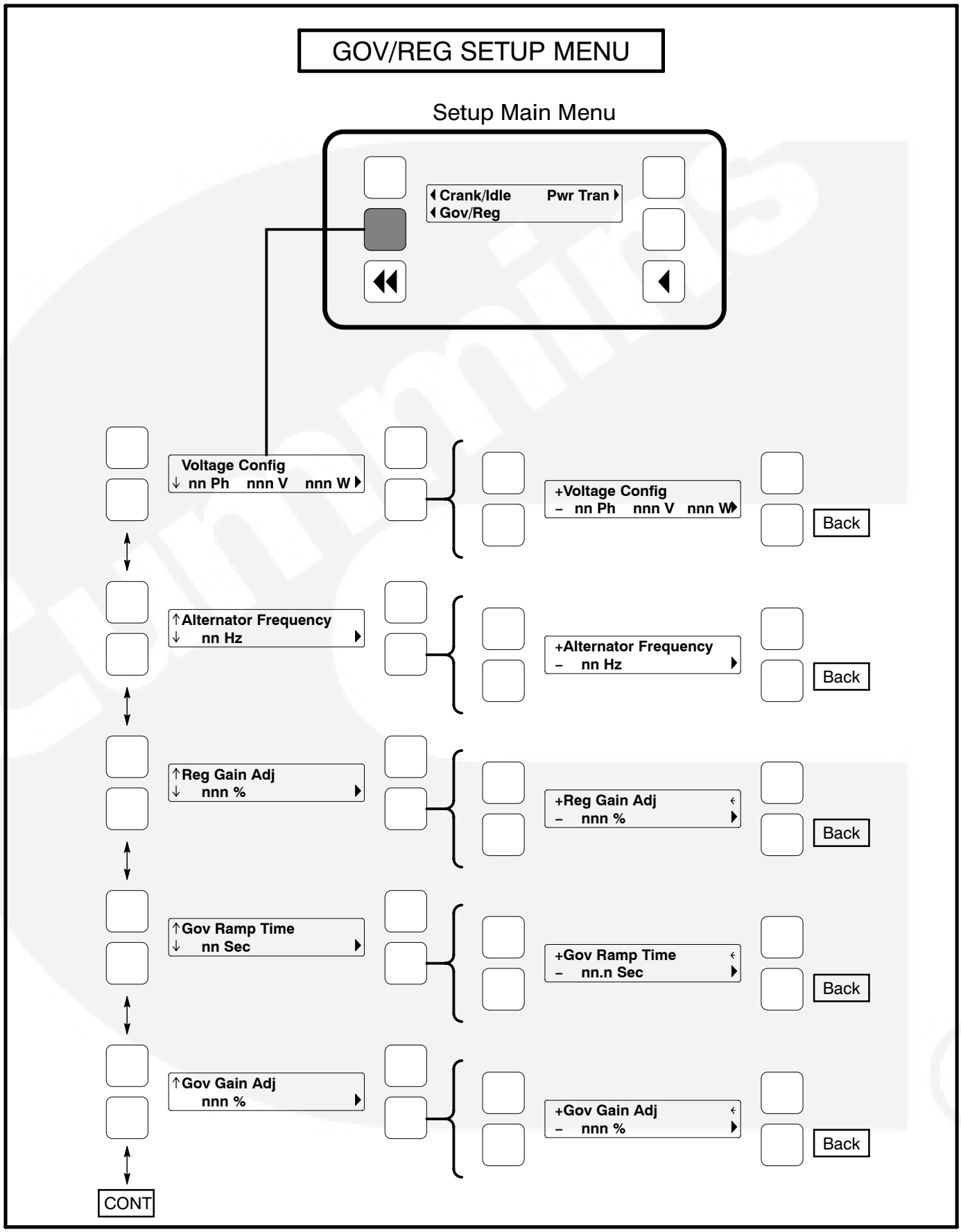

FIGURE 5-4. GOVERNOR/REGULATOR SETUP MENU

GOVERNOR/REGULATOR SETUP MENU (CONT)

NOT USED - *Speed Droop Mode submenu:* Select between Isochronous and Droop kW Sharing droop modes (default = Isochronous).

NOT USED - *Speed Droop Percent submenu:* 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: Select between Constant and Droop kVAR Sharing Droop modes (default = Constant).

Voltage Droop Percent submenu): 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.

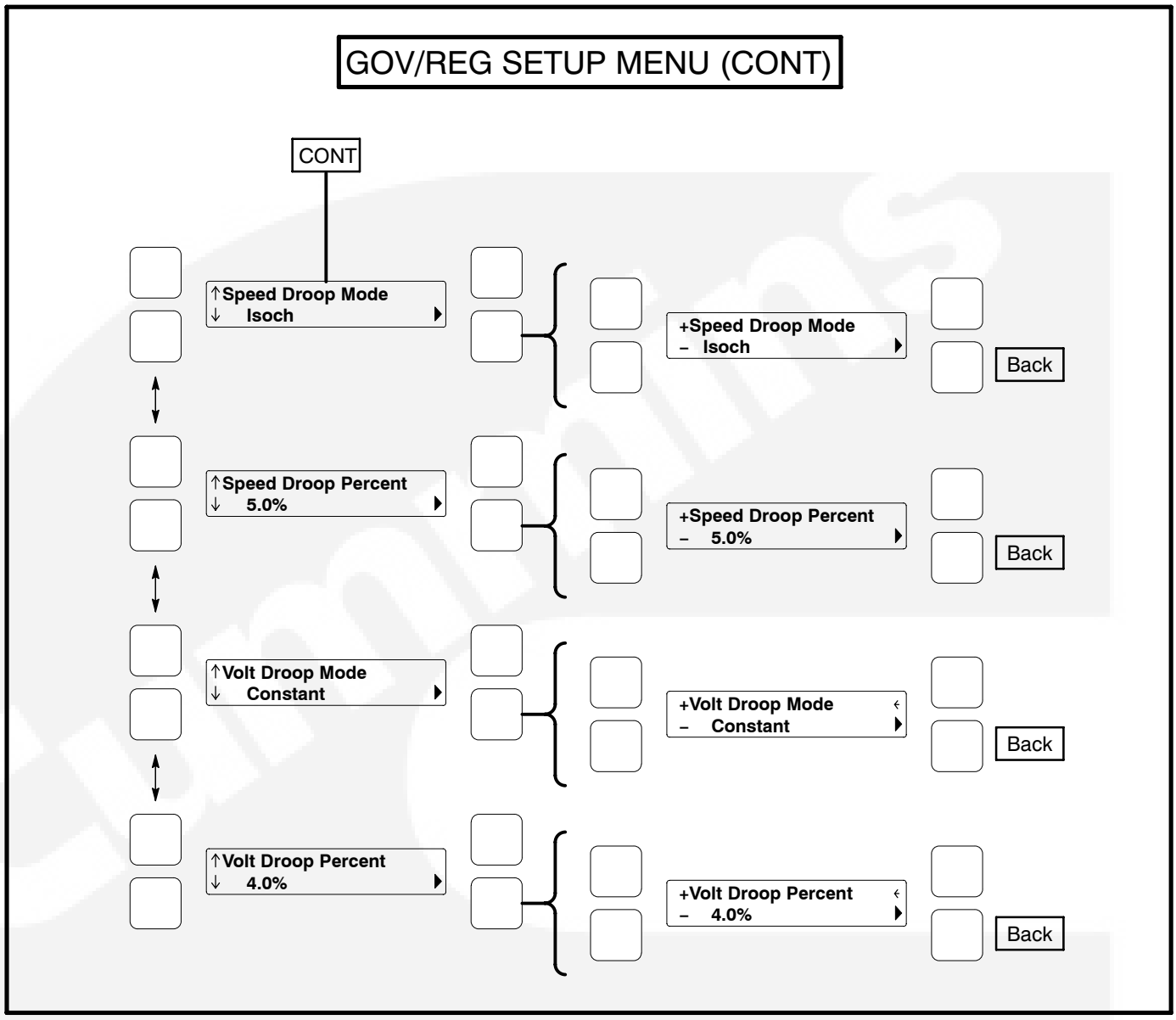

FIGURE 5-4. GOVERNOR/REGULATOR SETUP MENU (CONT)

PCC CONTROL PANEL BOX COMPONENTS (STANDARD/OPTIONAL)

The PCC control panel box (Figure 5-6) 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

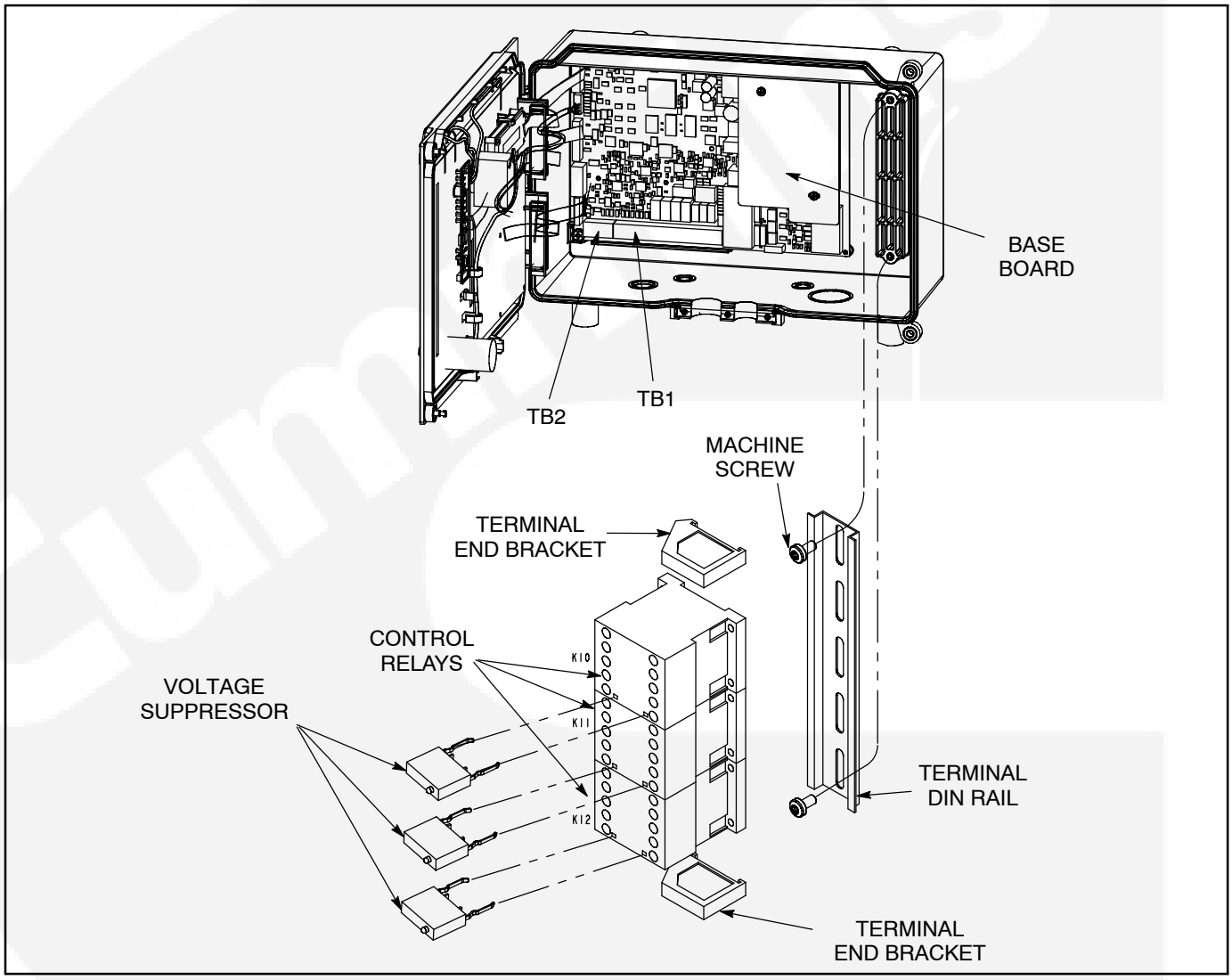

FIGURE 5-6. CONTROL PANEL BOX

Network Communications 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.

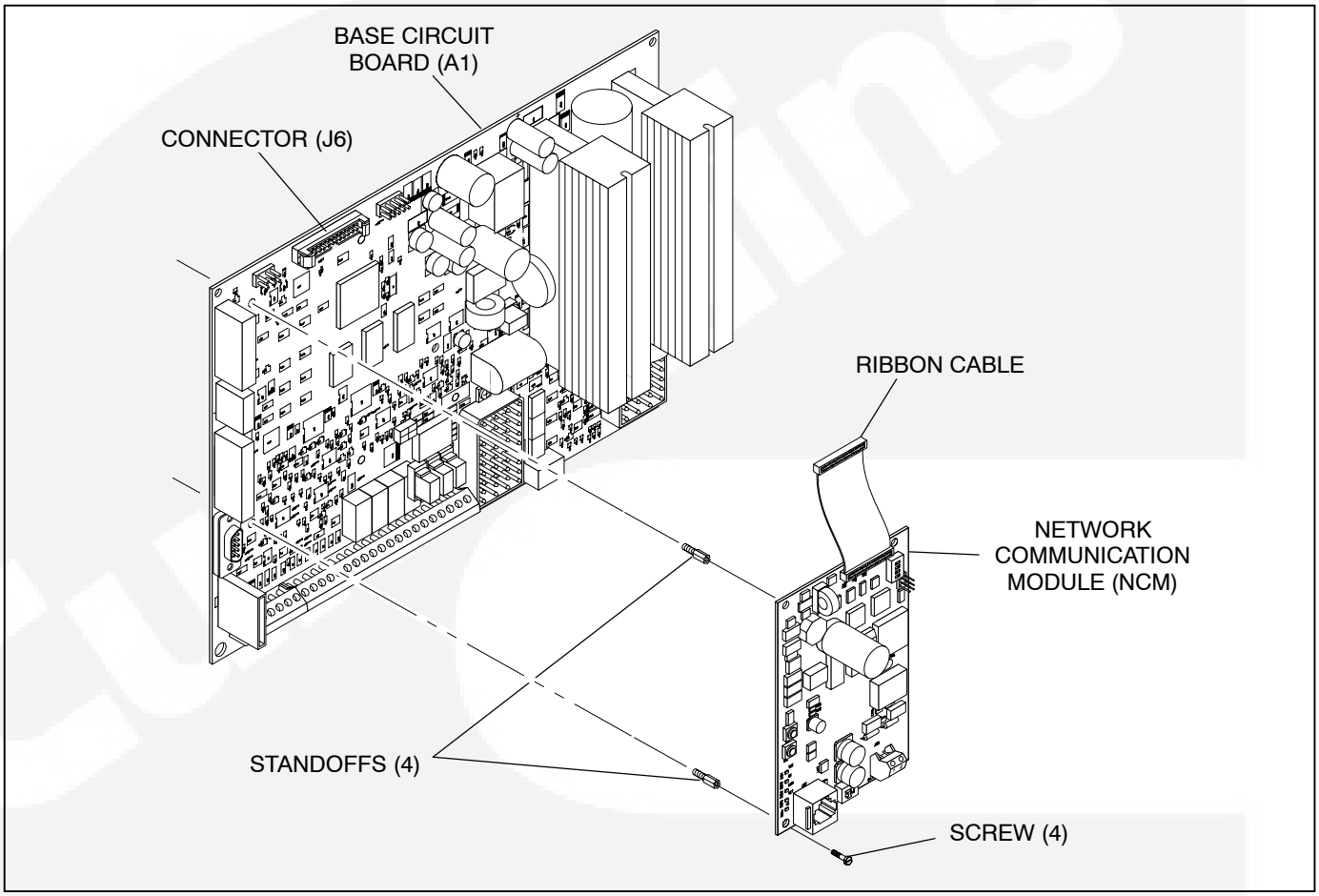

FIGURE 5-7. NETWORK COMMUNICATION MODULE

TB1 Customer Inputs

Refer to Page 8-7 for typical connections to TB1 and terminal torque specifications.

Remote Start: When the O/Manual/ Auto switch is in the Auto position, grounding this input initiates the generator set 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 8-7 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 (TB1-17 and -18) 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 5-8) are not installed across relay coil terminals A1/A2, before connecting genset battery cables.***

The three optional control relays are rail mounted inside the control panel box.

These relays (Figure 5-8) 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.

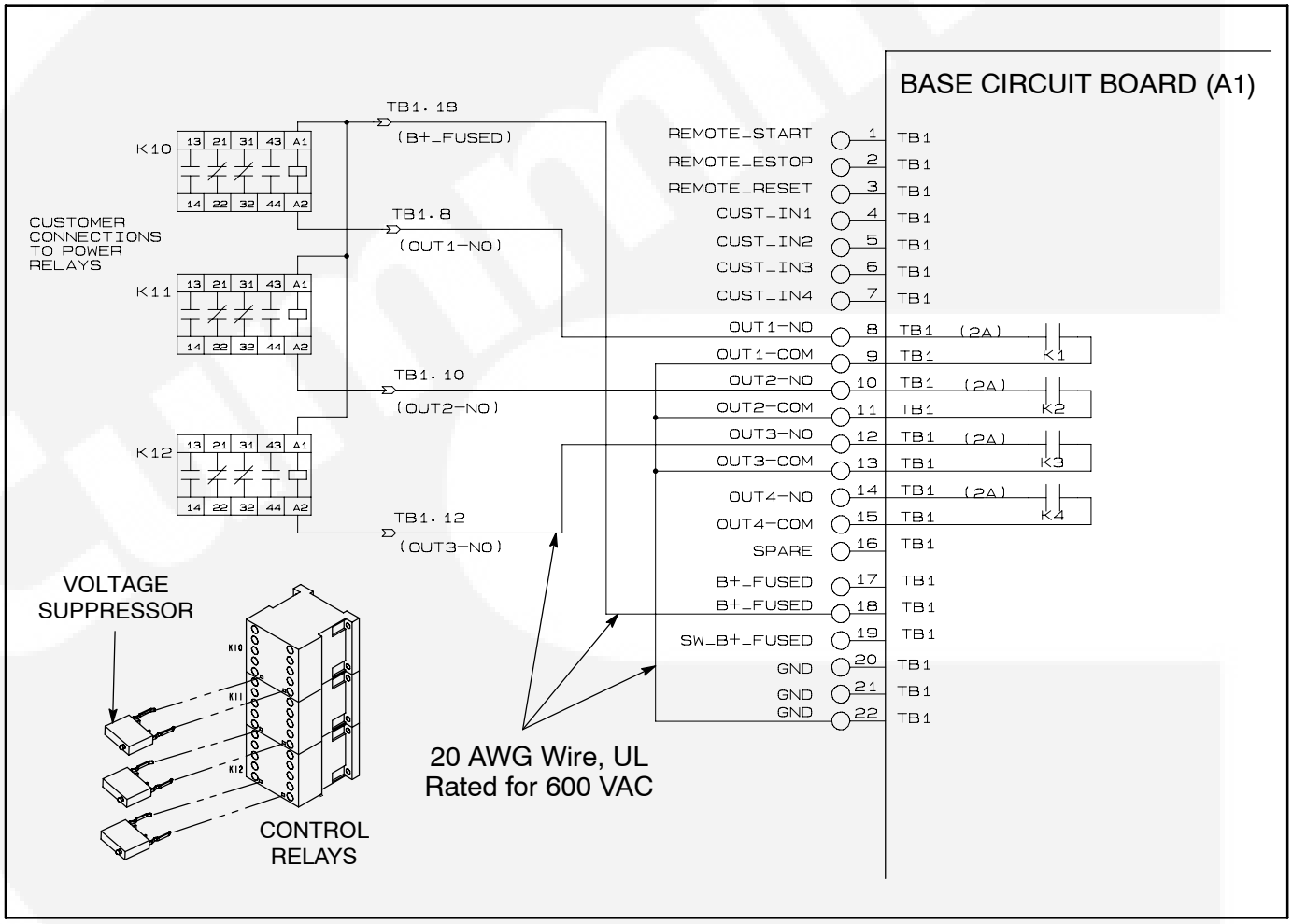

FIGURE 5-8. OPTIONAL CONTROL RELAYS (K10, K11, K12)

CURRENT TRANSFORMER (CT) INSTALLATION

Current transformers (CT's) are required on gensets for AC metering. 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. 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. The CT's have dual secondaries (3 pins marked X1, X2 & X3). (Refer to Reconnection Diagram.)
   - X1 & X2 for above 300 volts L–L
   - X1 & X3 for below 300 volts L–L

   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.

LOW COOLANT LEVEL SENSOR

Figure 5-10 shows the location of the low coolant level sensor. If replacing the sensor, apply Loctite – Plastic Pipe Sealant (P/N 80724) and thread in sensor. Hand tighten only.

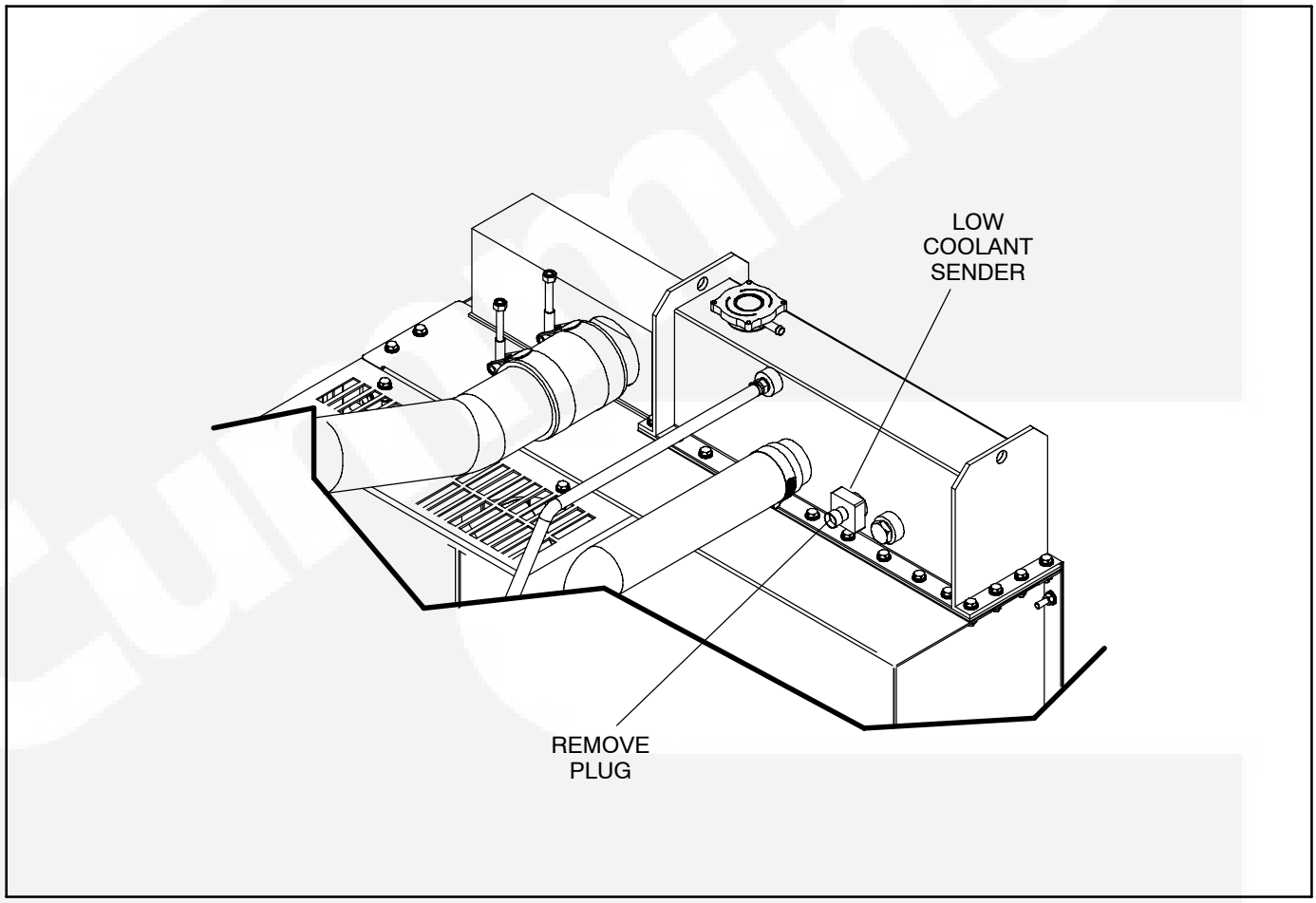

FIGURE 5-10. LOW ENGINE COOLANT SENSOR

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6. Servicing the Generator

GENERAL

This section describes how to isolate a voltage fault to the Base board or generator, test the generator windings, and disassemble and reassemble the generator (Figure 6-1).

⚠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 PCC 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.***

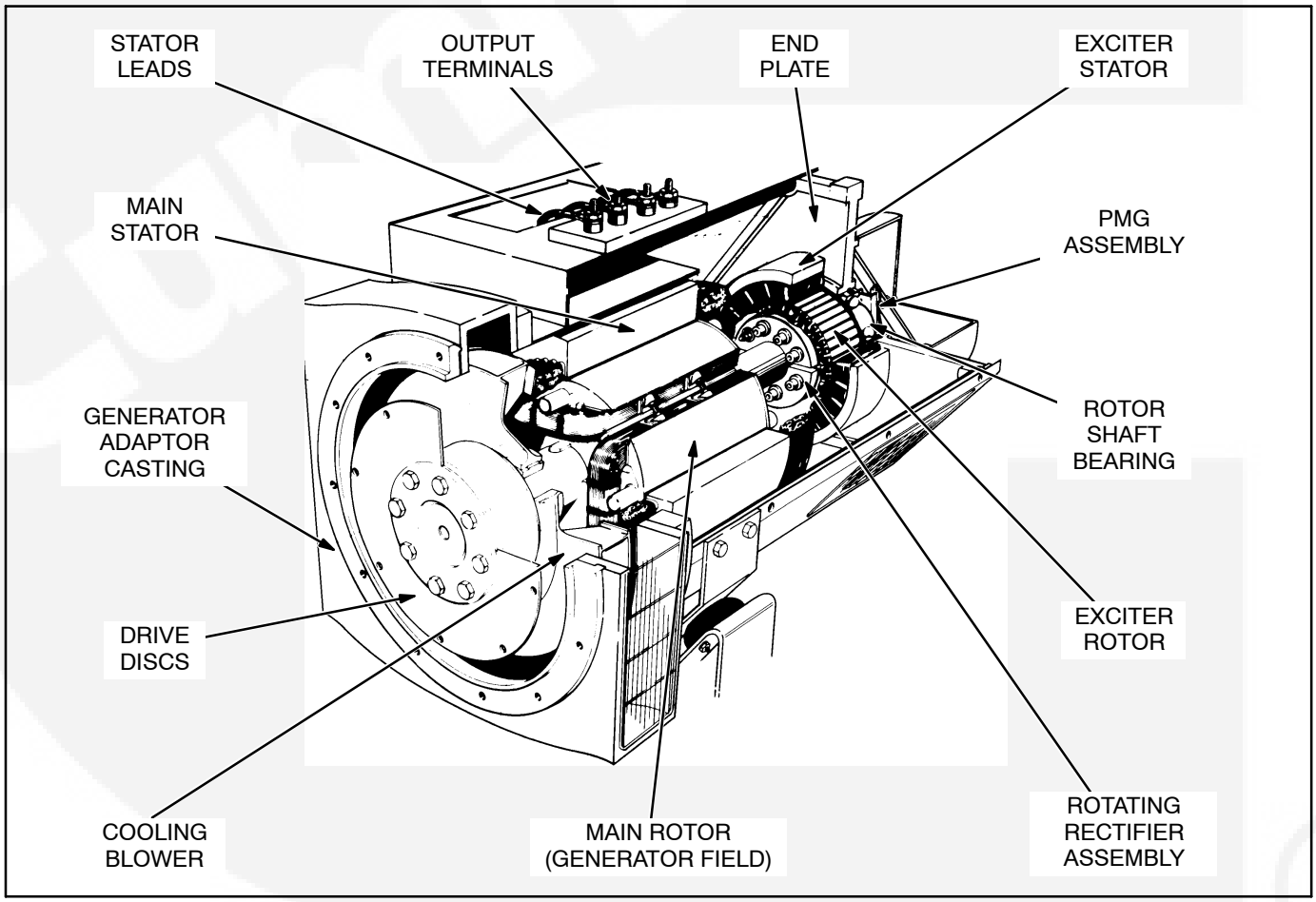

FIGURE 6-1. GENERATOR

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.
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. Perform the *Winding Resistance Test* procedure for the desired windings as noted in this section.

TESTING THE GENERATOR

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

⚠CAUTION ***Before disconnecting battery cable(s), press the Emergency Stop button and wait at least 30 seconds. Fault code 1117 may display and engine performance may be affected (e.g., engine dying or hard starting) if battery cable(s) is removed during the 30 second waiting period. See fault code 1117 in Section 4 to reset ECM.***

⚠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.***

Before starting, disconnect the negative (–) cable from the battery to make sure the set will not start while working on it.

1. Move the O/Manual/Auto switch on the control panel to the O (off) position.
2. Turn off or remove AC power from the battery charger.
3. Press the Emergency Stop button and wait at least 30 seconds before completing Step 4.
4. Remove the negative (–) battery cable from the generator set starting battery.

Insulation Resistance Testing

The insulation resistance test should be performed when low winding insulation is suspected, e.g. damp or wet windings.

A 500 VAC megger is recommended for insulation testing. A test consists of applying the test potential between the winding and ground (winding laminations).

Resistance values of at least 5 megohms should be obtained for a new generator with dry windings. For a generator that has been in service, the resistance reading should not be less than 1 megohm.

If low readings are obtained, the cause should be investigated and corrected before the generator set is returned to service.

If moisture is determined to be the cause of low test readings, a winding drying process will be required.

Megger Testing:

1. Disconnect plug **P8** from the Base board.
2. Disconnect the AC control input leads from the generator output terminals. The AC control leads are marked 5, 6, 7 and 8. Refer to the appropriate *Reconnection Diagram* in *Section 8*.
3. If the RTD (resistive thermal device) option is installed, ground all six RTD temperature leads. Each RTD has three leads, one red and two white leads. Total of 18 leads must be grounded. Refer to *Customer Connections Diagram* in *Section 8*.
4. Perform the *Insulation Resistance Test* procedure for the desired windings as noted in this section.

Drying the Windings: If low readings are obtained or the set has been in standby for a long time in high humidity conditions, the windings should be dried out and the test repeated. Use the generator heaters (if so equipped) or blow warm air through the generator from front (exciter end) to back with a fan.

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 6-1.

Testing Winding Insulation Resistance: Disconnect the exciter stator leads **X** and **XX** from their connectors in the AC 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)

Flashing the Field (Self-Excited Generators Only): If necessary, flash the exciter field before or after installation. Apply 110 to 220 VAC for one to two seconds to the **X** and **XX** leads of the exciter stator. **The generator must be shut down, the Base board disconnected, a diode used to establish correct polarity and a 3 amp fuse to prevent over-excitation.** See the diagram.

Alternatively, while the set is running and disconnected from all loads, apply a 12 VDC battery for one to two seconds as shown in the diagram. **Polarity must be correct: + to X, – to XX**.

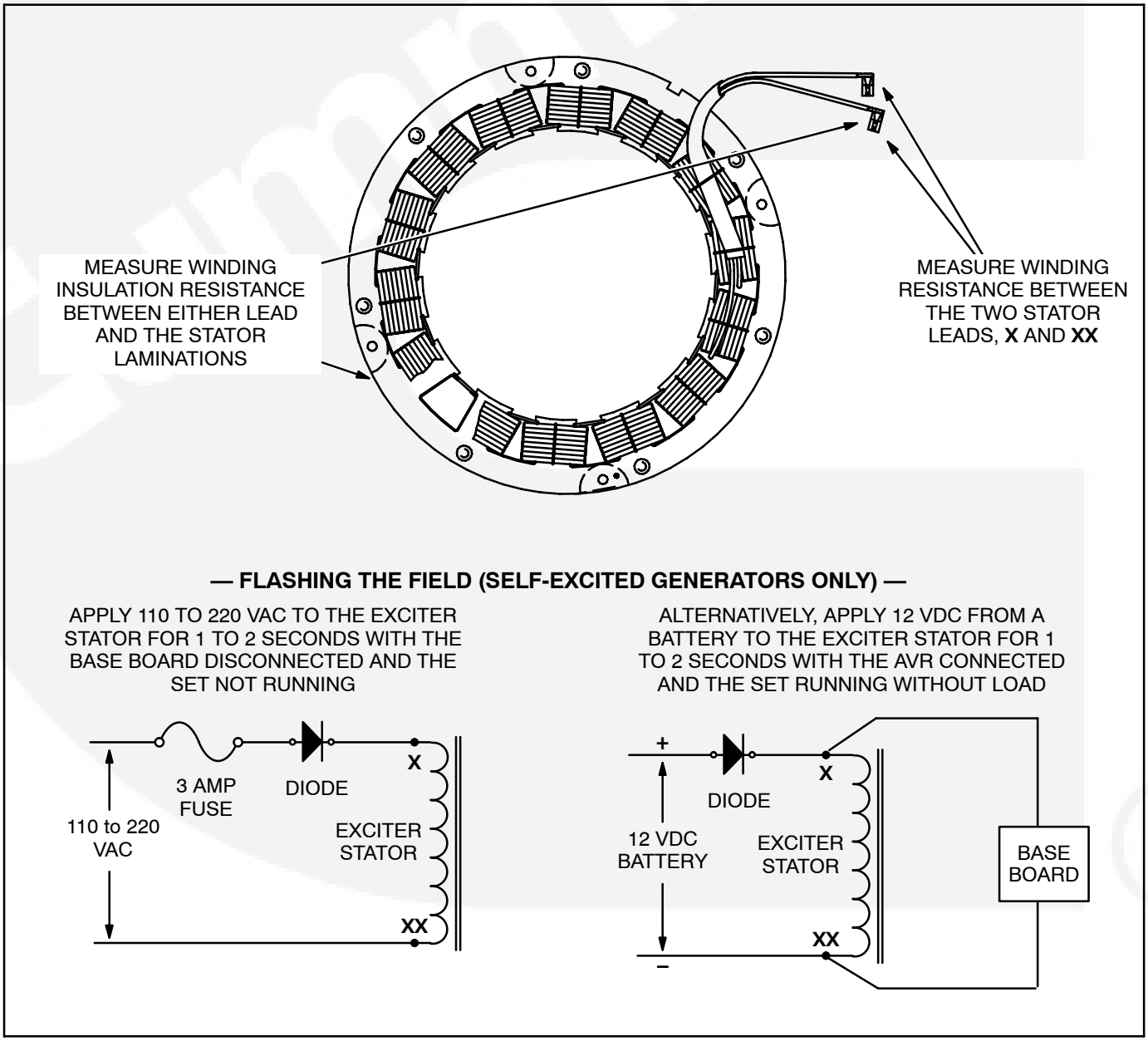

FIGURE 6-2. TESTING AND FLASHING THE EXCITER STATOR

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. Inspect diodes during generator maintenance and clean if necessary, using a brush or dust remover spray.***

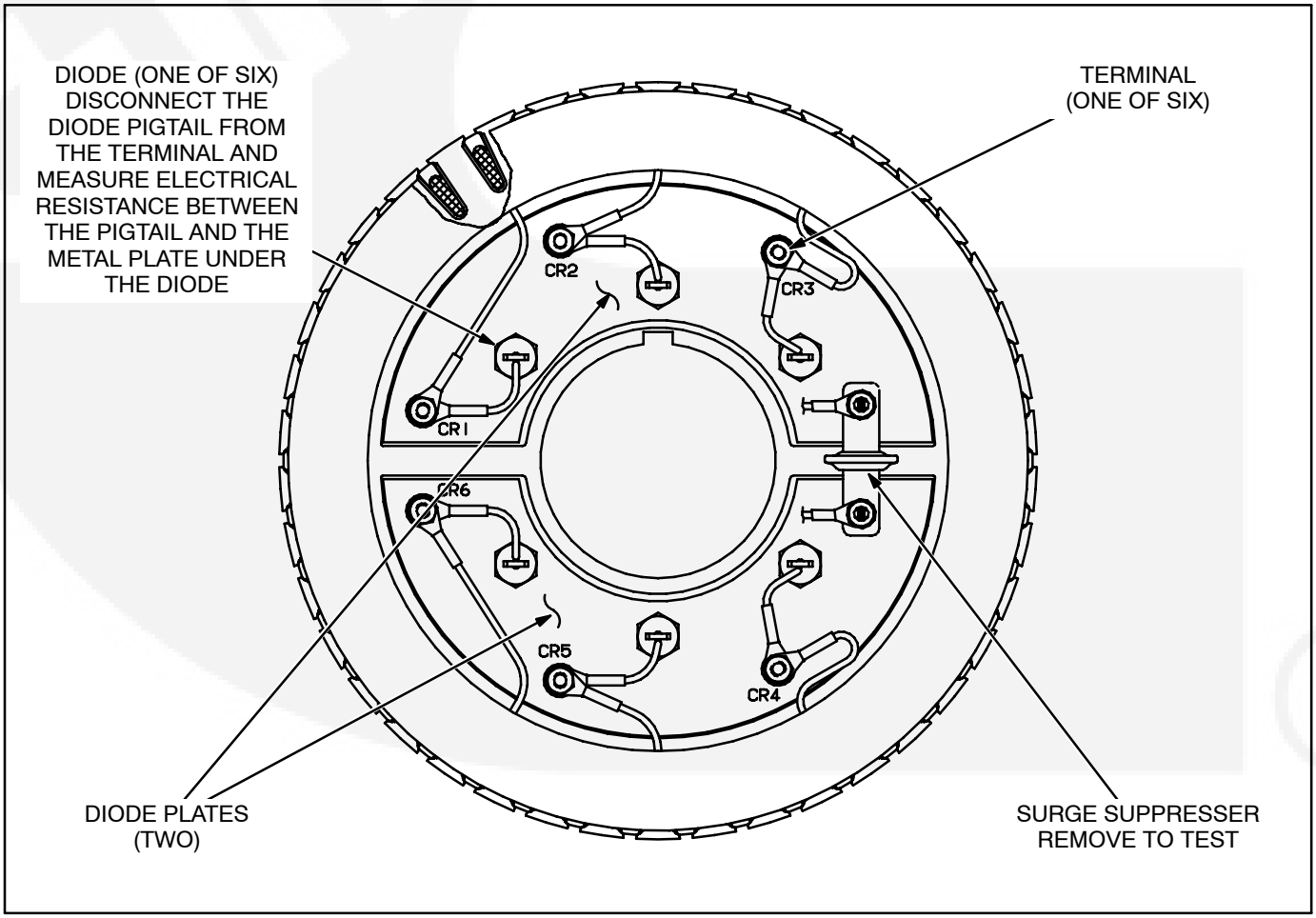

FIGURE 6-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

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 6-1.

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.

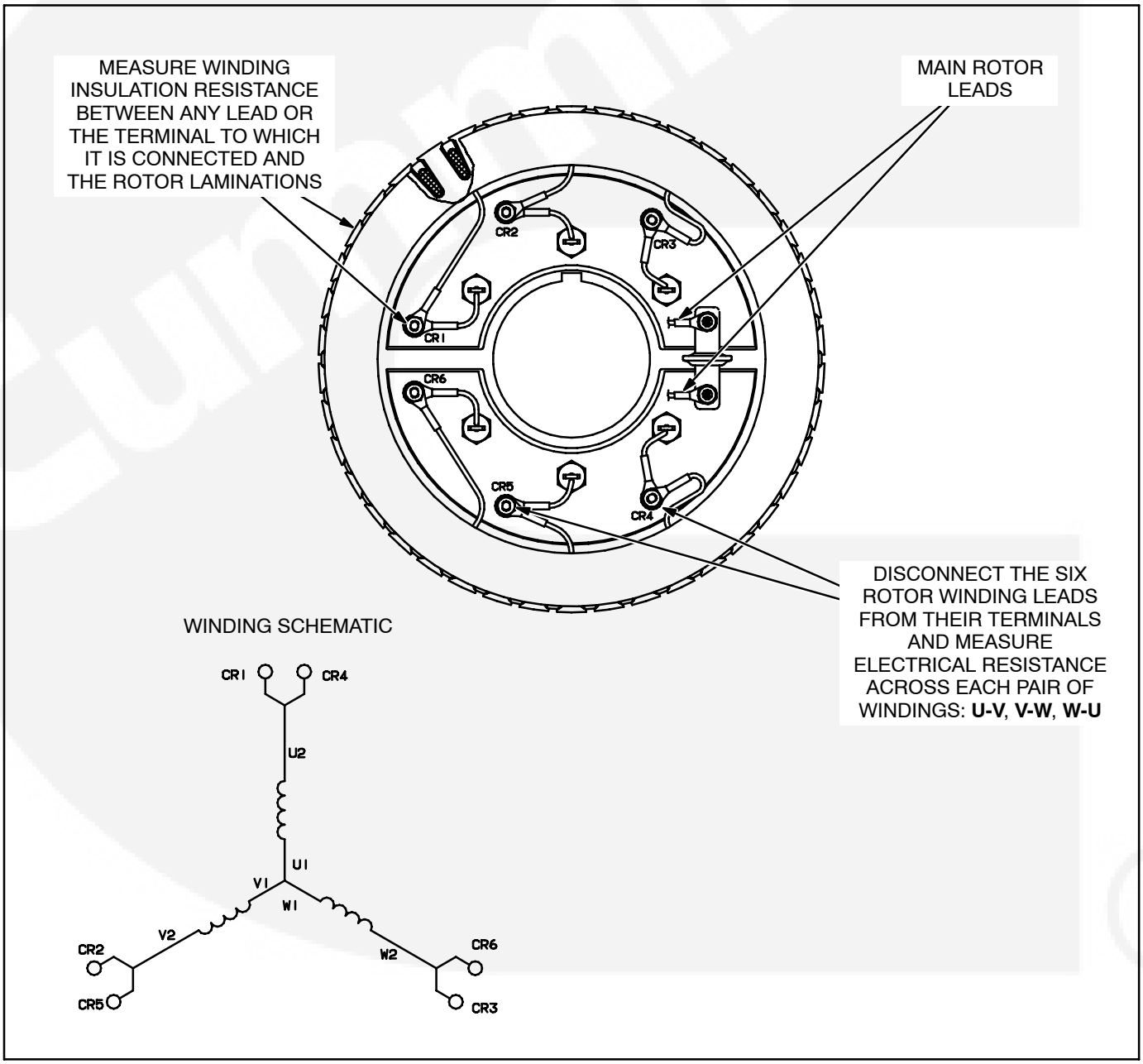

FIGURE 6-4. TESTING THE EXCITER ROTOR

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 6-4. 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 6-1. 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.

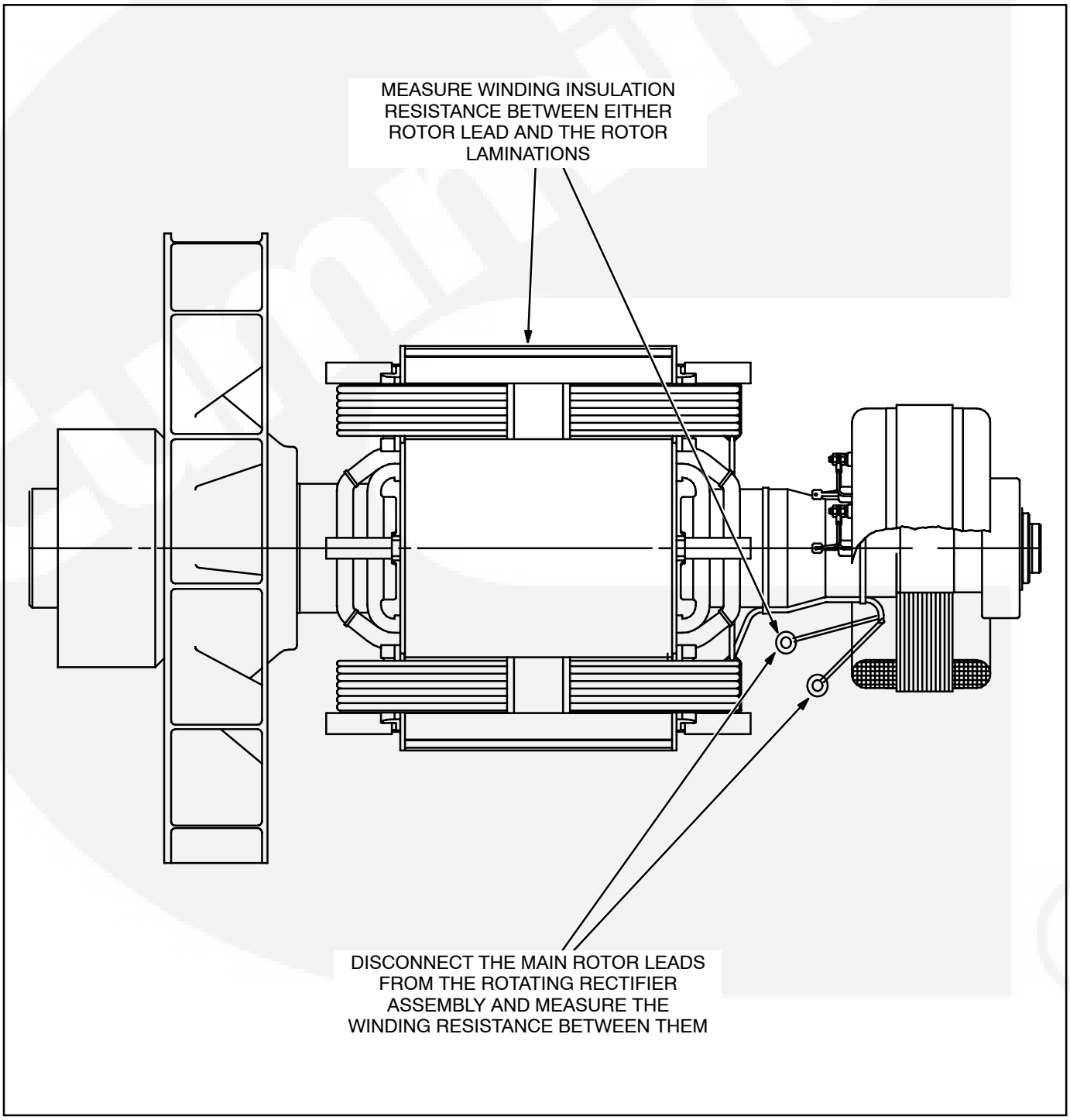

FIGURE 6-5. TESTING THE MAIN ROTOR

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 6-1.

Alternatively, winding resistance can be measured line-to-line at the generator terminals (U-V, V-W, W-U) on "star" connected generators. On a 600 volt generator, line-to-line resistance should be twice the table value (two winding elements in series). On a "series star" connected generator, line-to-line resistance should be four times the table value (four winding elements in series). On a "parallel star" connected generator, line-to-line resistance should be the same as the table value (two sets of two winding elements in series). Single phase only windings can be measured at W-V and should be twice the table value.

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.

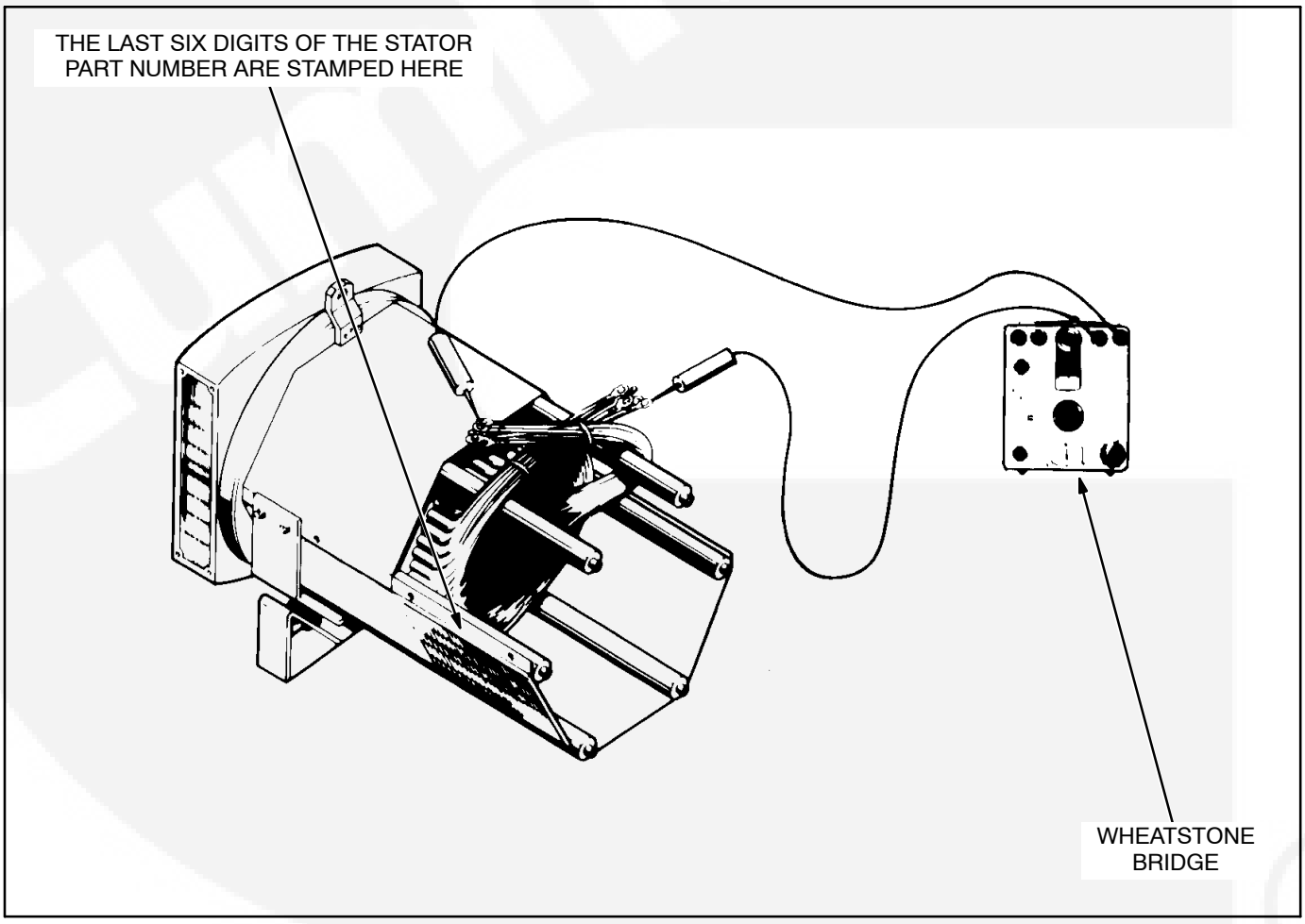

FIGURE 6-6. TESTING THE GENERATOR STATOR

TABLE 6-1. GENERATOR WINDING RESISTANCES

MAIN STATOR PART NUMBER***	MAIN STATOR (OHMS*)	MAIN ROTOR (OHMS**)	EXCITER STATOR (OHMS**)	EXCITER ROTOR (OHMS*)
220-4447-06	0.0561–0.0620	0.57	20.3	0.167
220-4447-07	0.0466–0.0515	0.64	20.3	0.167
220-4447-08	0.0371–0.0410	0.67	19.5	0.180
220-4447-09	0.0228–0.0252	0.80	19.5	0.180
220-4447-10	0.0181–0.0200	0.93	19.5	0.180
220-4447-11	0.0860–0.0950	0.57	20.3	0.167
220-4447-12	0.0613–0.0677	0.64	20.3	0.167
220-4447-13	0.0480–0.0530	0.67	19.5	0.180
220-4447-14	0.0309–0.0341	0.80	19.5	0.180
220-4447-15	0.0261–0.0289	0.93	19.5	0.180
220-4447-16	0.0561–0.0620	0.57	20.3	0.167
220-4447-17	0.0428–0.0473	0.64	20.3	0.167
220-4447-18	0.0333–0.0368	0.67	19.5	0.180
220-4447-19	0.0228–0.0252	0.80	19.5	0.180
220-4447-20	0.0171–0.0189	0.93	19.5	0.180
220-4447-26	0.1354–0.1496	0.57	20.3	0.167
220-4447-27	0.0960–0.1050	0.64	20.3	0.167
220-4447-28	0.0713–0.0788	0.67	19.5	0.180
220-4447-29	0.0485–0.0536	0.80	19.5	0.180
220-4447-30	0.0404–0.0446	0.93	19.5	0.180
220-4448-07	0.0209–0.0231	1.11	19.5	0.180
220-4448-08	0.0162–0.0179	1.20	19.5	0.180
220-4448-09	0.0143–0.0158	1.31	19.5	0.210
220-4448-10	0.0095–0.0105	1.50	19.5	0.210
220-4448-11	0.0076–0.0084	1.66	19.5	0.210
220-4448-12	0.0066–0.0072	1.80	19.5	0.210
220-4448-13	0.0260–0.0310	1.11	19.5	0.180
220-4448-14	0.0214–0.0236	1.20	19.5	0.180
220-4448-15	0.0147–0.0163	1.31	19.5	0.210
220-4448-16	0.0114–0.0126	1.50	19.5	0.210
220-4448-17	0.0100–0.0110	1.66	19.5	0.210
220-4448-18	0.0071–0.0079	1.80	19.5	0.210
220-4448-19	0.0204–0.0226	1.11	19.5	0.180
220-4448-20	0.0152–0.0168	1.20	19.5	0.180
220-4448-21	0.0105–0.0116	1.31	19.5	0.210
220-4448-22	0.0090–0.0100	1.50	19.5	0.210
220-4448-23	0.0076–0.0084	1.66	19.5	0.210
220-4448-24 (CONT.)	0.0062–0.0068	1.80	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68°F (20° C).
** - These values are approximate, plus or minus 10 percent at 77°F (25° C).
*** - See Figure 6-6 for the location of the stator part number.

TABLE 6-1. GENERATOR WINDING RESISTANCES (CONT.)

MAIN STATOR PART NUMBER***	MAIN STATOR (OHMS*)	MAIN ROTOR (OHMS**)	EXCITER STATOR (OHMS**)	EXCITER ROTOR (OHMS*)
220-4448-31	0.0413–0.0457	1.11	19.5	0.180
220-4448-32	0.0229–0.0331	1.20	19.5	0.180
220-4448-33	0.0238–0.0263	1.31	19.5	0.210
220-4448-34	0.0181–0.0200	1.50	19.5	0.210
220-4448-35	0.0124–0.0137	1.66	19.5	0.210
220-4448-36	0.0133–0.0147	1.80	19.5	0.210
220-4448-37	0.0085–0.0095	2.05	19.5	0.210
220-4448-38	0.0095–0.0105	2.05	19.5	0.210
220-4448-39	0.0074–0.0082	2.05	19.5	0.210
220-4448-40	0.0066–0.0074	2.05	19.5	0.210
220-4448-41	0.0065–0.0073	2.05	19.5	0.210
220-4448-42	0.0131–0.0145	2.05	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68°F (20° C).
** - These values are approximate, plus or minus 10 percent at 77°F (25° C).
*** - See Figure 6-6 for the location of the stator part number.

GENERATOR DISASSEMBLY

The generator is heavy. You will need an assistant and a hoist of sufficient capacity to remove and service the generator.

⚠WARNING ***Accidentally dropping the generator can damage it and cause severe personal injury and death. The hoist, straps and chains must have sufficient capacity and be attached properly so that the load cannot shift.***

Before starting, disconnect the negative (–) cable from the battery to make sure the set will not start while working on it.

⚠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.***

Removing The Generator Control Housing

5. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
6. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
7. 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.
8. Disconnect all generator control leads (winding taps) from connections in the output box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
9. 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.
10. Attach a hoist to the generator output box, loosen the mounting bolts on the sides of the generator and remove the box.

Withdrawing The Generator From The Set

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

1. The rotor will be carried inside the stator when the generator is withdrawn from the engine. Bar the engine until one of the four poles of the rotor points straight down so that the rotor will rest on the face of the pole when the generator is withdrawn.

   ⚠ CAUTION ***The rotor can be damaged if it rests on the edges of the winding slot between two poles.***

2. Attach lifting eyes and a hoist of sufficient capacity (Figure 6-7).
3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts.
4. Raise the generator end approximately one inch (25 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.
5. Remove the bolts securing the generator drive discs to the flywheel.
6. Loosen all the bolts securing the generator adapter casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

   ⚠ CAUTION ***Never withdraw the generator leaving the rotor to hang by the drive discs. The weight of the rotor will damage the drive discs.***

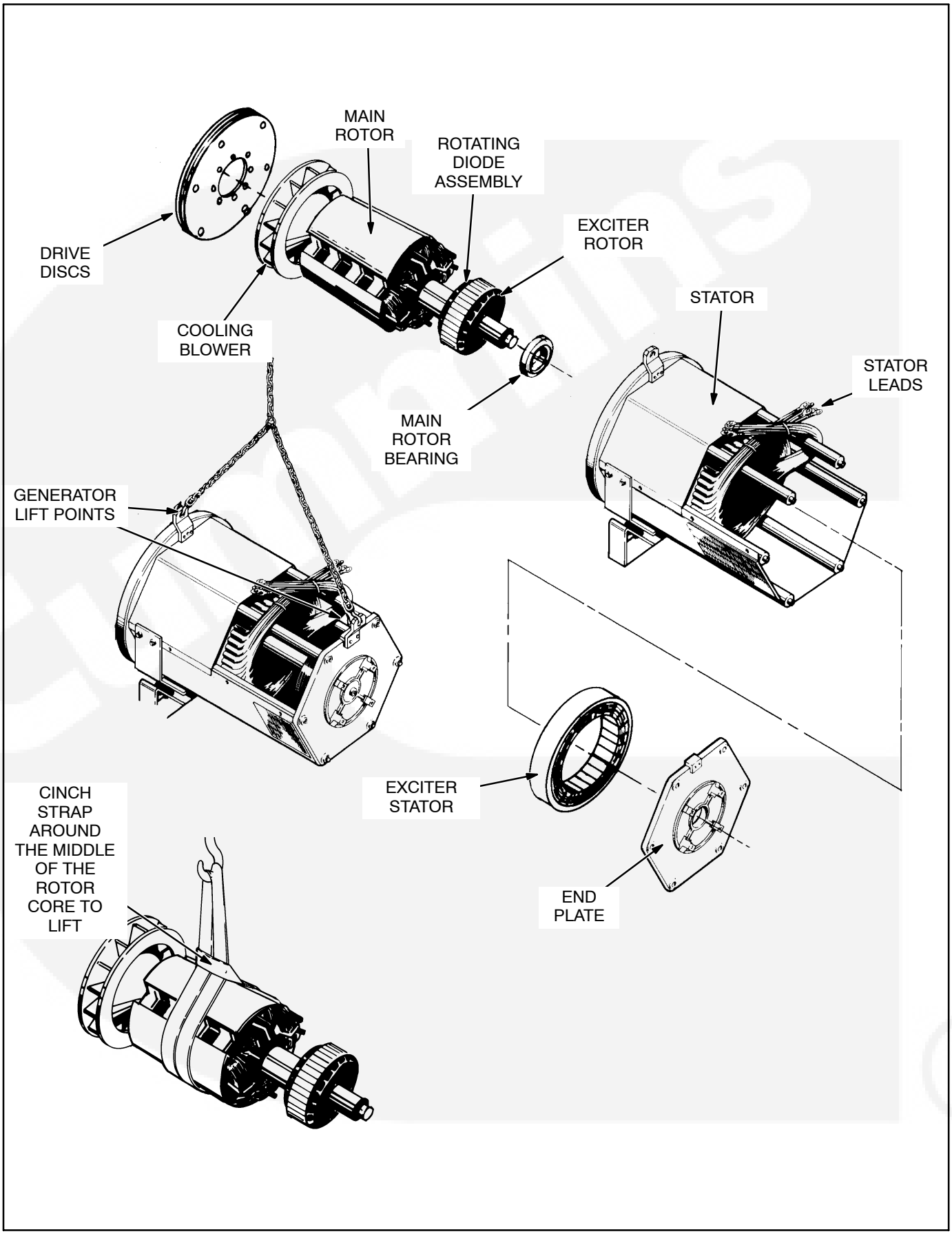

FIGURE 6-7. GENERATOR ASSEMBLY

Withdrawing the Rotor From the Generator

1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.
2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by hand and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and recinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on both ends to prevent contact with the stator windings
3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, blower or exciter.
4. Remove the retaining clip if the rotor shaft bearing is to be removed.

GENERATOR REASSEMBLY

Reassembling is the reverse of disassembling. Note the following.

1. Apply force to the inner race of the rotor bearing when pressing it onto the shaft, otherwise, it will be damaged. Be sure to secure the retaining clip.
2. The drive disc-to-rotor bolts should be torqued to 112 ft-lbs (152 Nm) if M12 or 190 ft-lbs (257 Nm) if M16.
3. The drive disc-to-flywheel bolts should be torqued to 45 ft-lbs (61 Nm).
4. The exciter stator mounting screws should be torqued to 7 ft-lbs (10 Nm).
5. The generator end plate mounting bolts should be torqued to 20 ft-lbs (27 Nm) if M8 or 40 ft–lbs (55 Nm) if M10.
6. Make sure the rubber O-ring is in place in the bearing bore in the generator endplate.
7. The generator mounting bracket bolts should be torqued to 65 ft-lbs (88 Nm) if M12 or 35 ft-lbs (47 Nm) if M10.
8. The generator-to-adaptor bolts should be torqued to 20 ft-lbs (27 Nm) if M8 or 40 ft-lbs (55 Nm) if M10.
9. The adaptor-to-engine bolts should be torqued to 35 ft-lbs (48 Nm).
10. Reconnect the generator as required. See Page 10-3 or 10-4.

SERVICING THE PMG

The following is applicable if the generator is equipped with a PMG (permanent magnet) exciter.

Testing

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 high voltage 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 and repair as necessary before disassembling the PMG.
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. Each winding should have a resistance of approximately 4.4 ohms.

Disassembling the PMG

1. Disconnect the negative (–) cable from the battery to make sure the set will not start while working on it.

   ⚠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 PMG cover and disconnect the leads at the connector.
3. Remove the bolts and clamps that secure the PMG stator to the generator frame and carefully pull away the stator.

   The rotor is magnetic and will attract the stator. Hold the stator firmly so that the windings are not damaged by striking the stator support lugs.

4. Remove the rotor center bolt and pull away the rotor. The rotor is magnetic and will attract iron filings. Put it in a clean plastic bag until it is remounted. Do not take it apart or it will lose its magnetism. Also, if the dowel pin in the end of the shaft is loose, stow it in a safe place until it is time to reassemble the PMG.

Reassembling the PMG

Reassembling is the reverse of disassembling. Torque the rotor center bolt to 40 ft-lbs (54 Nm). The stator leads must be at 12 o'clock.

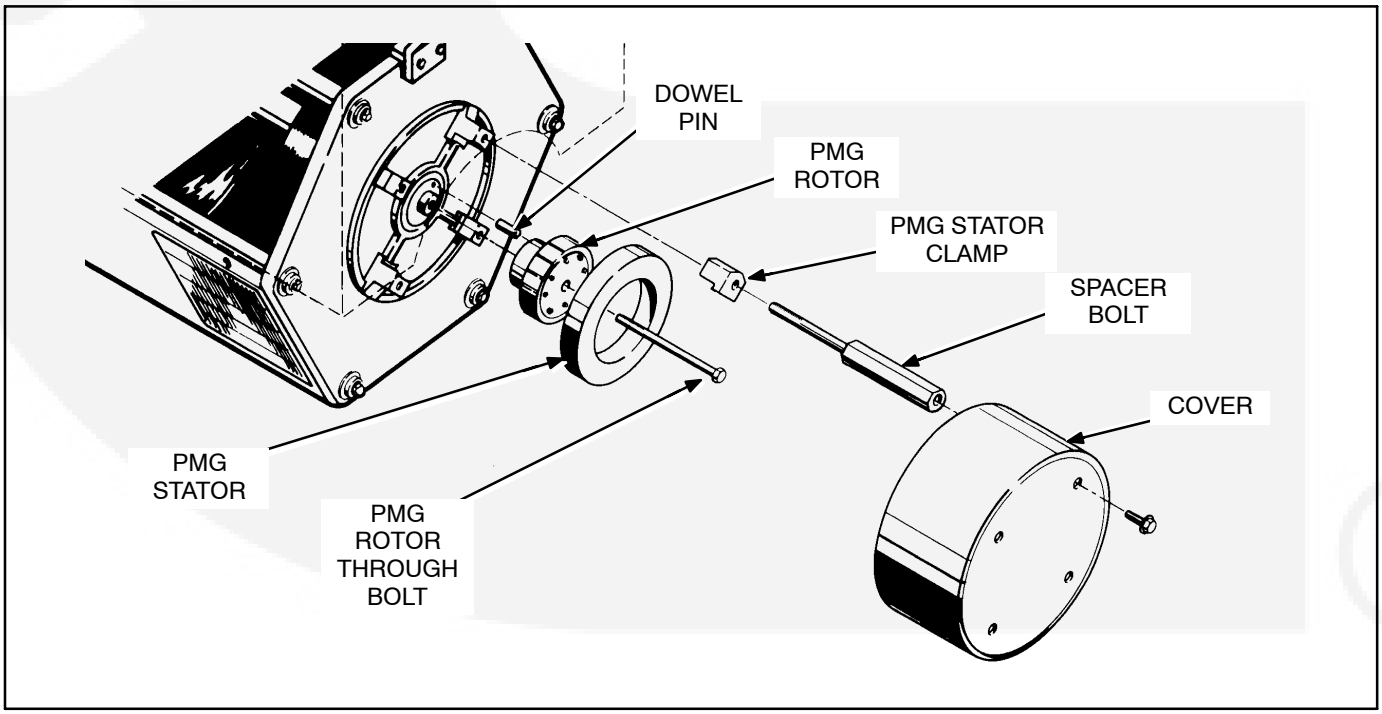

FIGURE 6-8. PMG ASSEMBLY

7. 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 7-1 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.

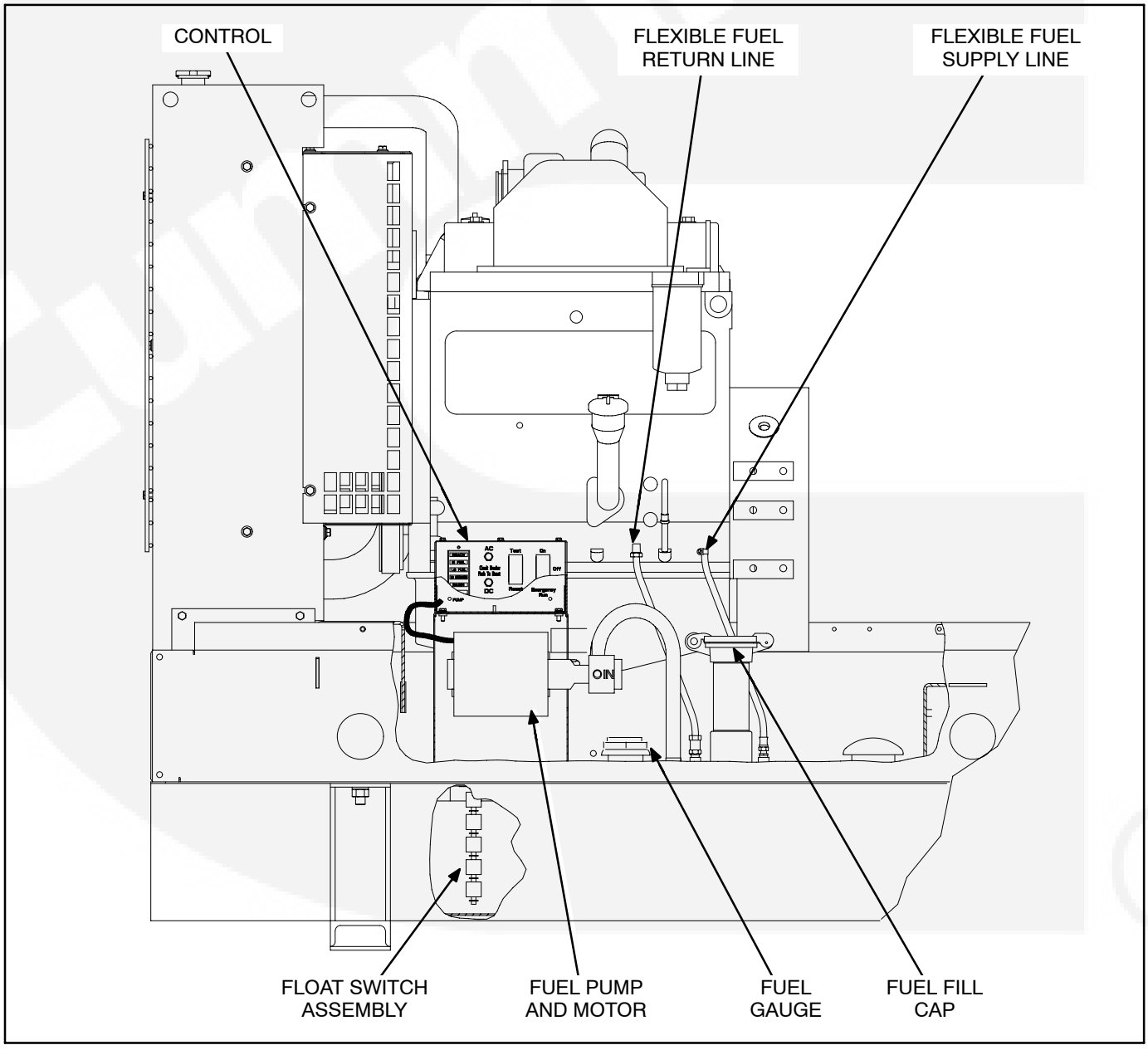

FIGURE 7-1. TYPICAL SUB-BASE INSTALLATION

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.***

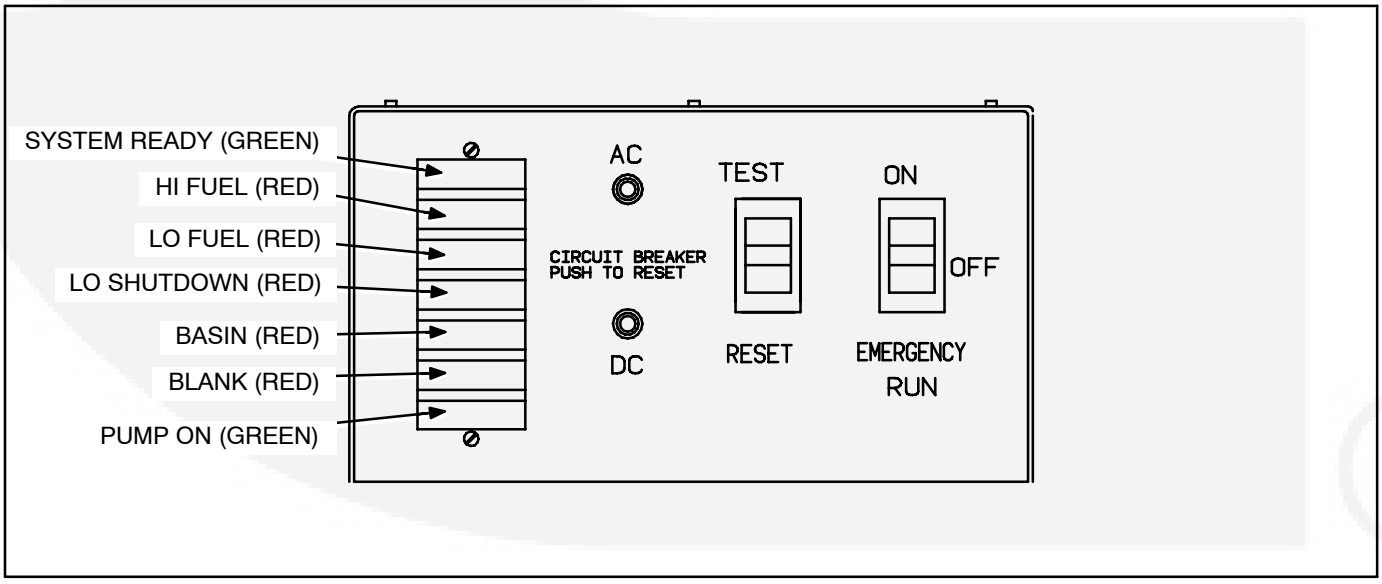

FIGURE 7-2. FUEL PUMP CONTROL PANEL

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 8*, 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.

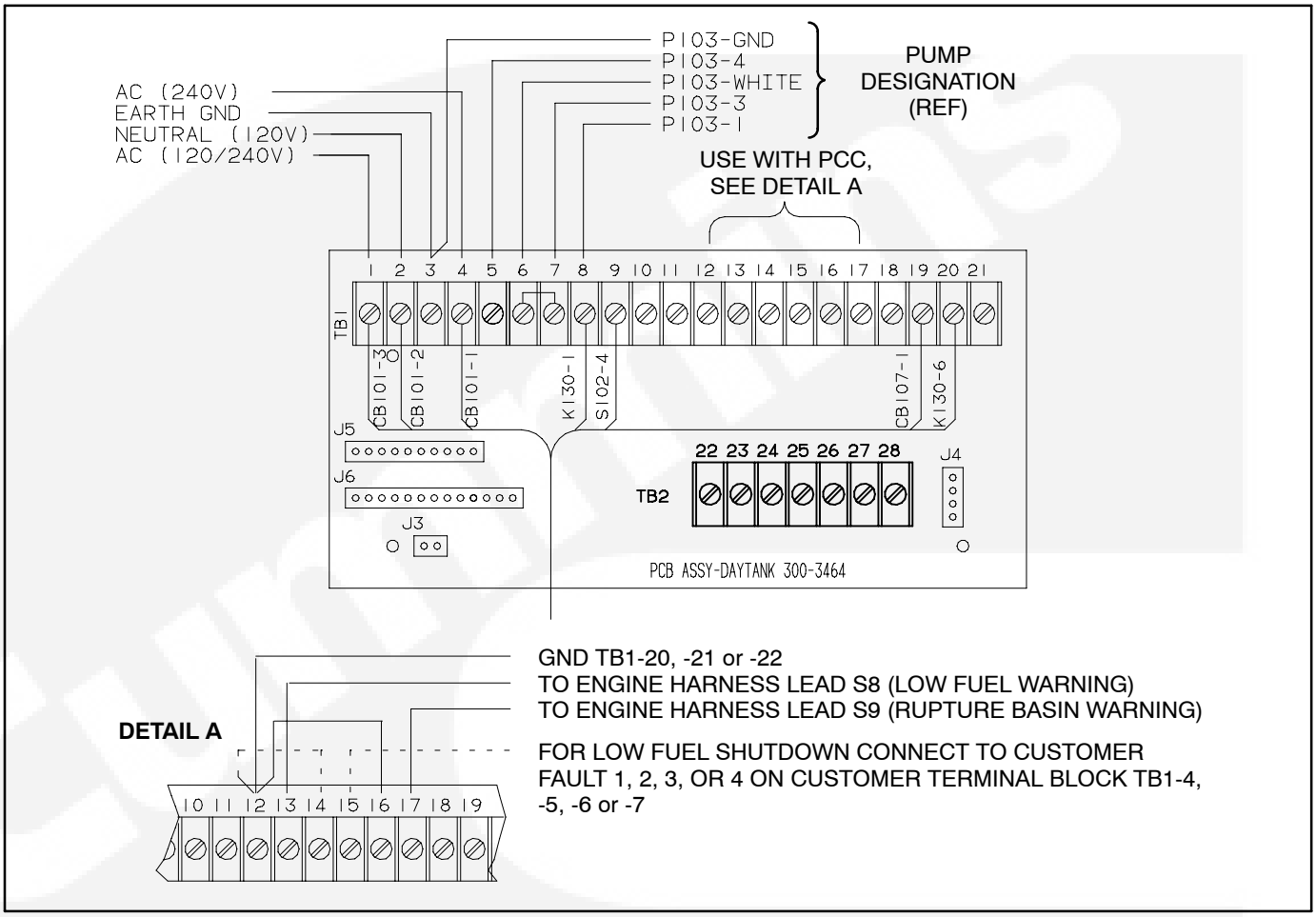

FIGURE 7-3. FUEL PUMP CONTROL TERMINAL BOARD

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.

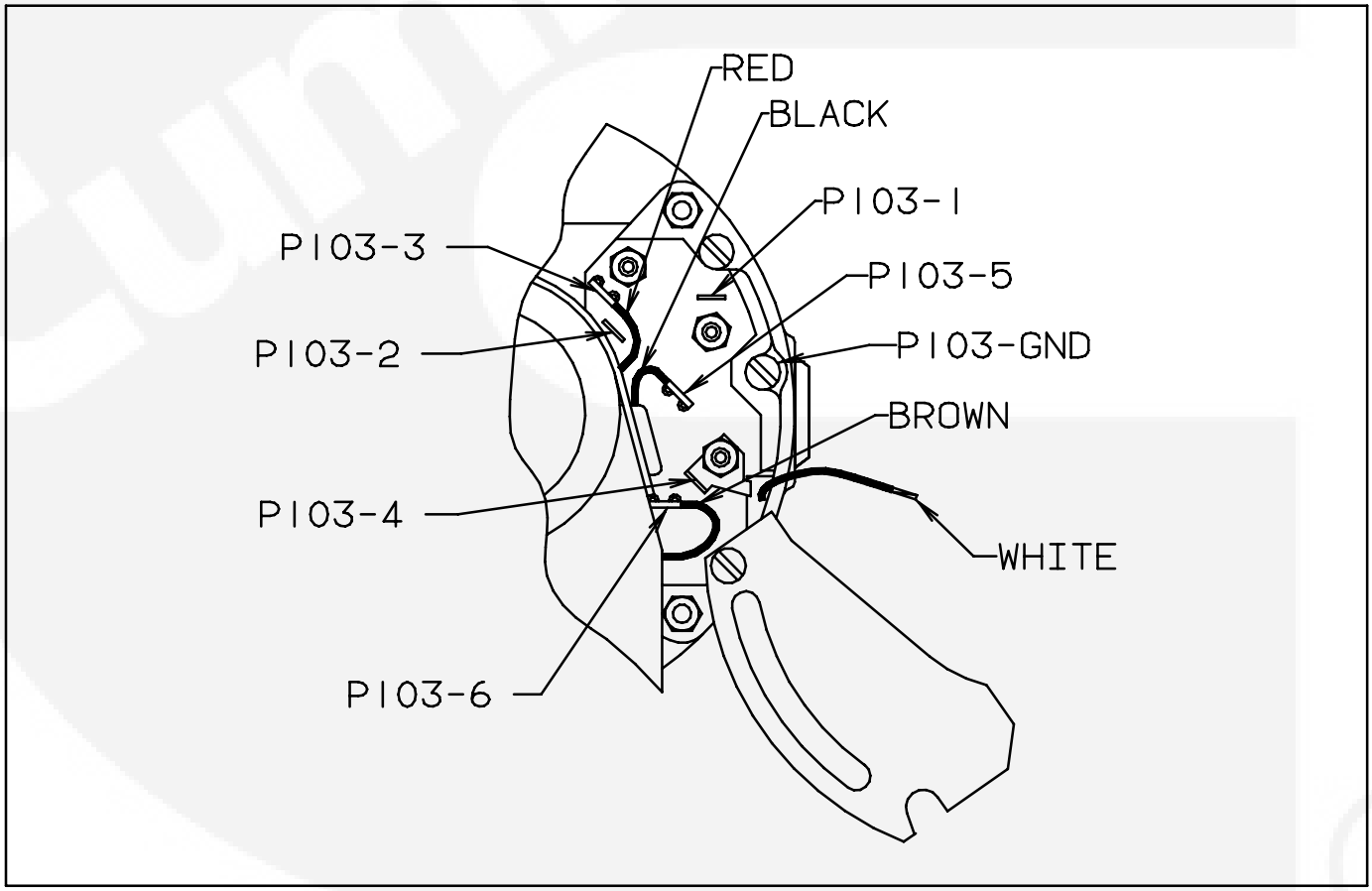

FIGURE 7-4. FUEL TRANSFER PUMP MOTOR CONNECTIONS

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.

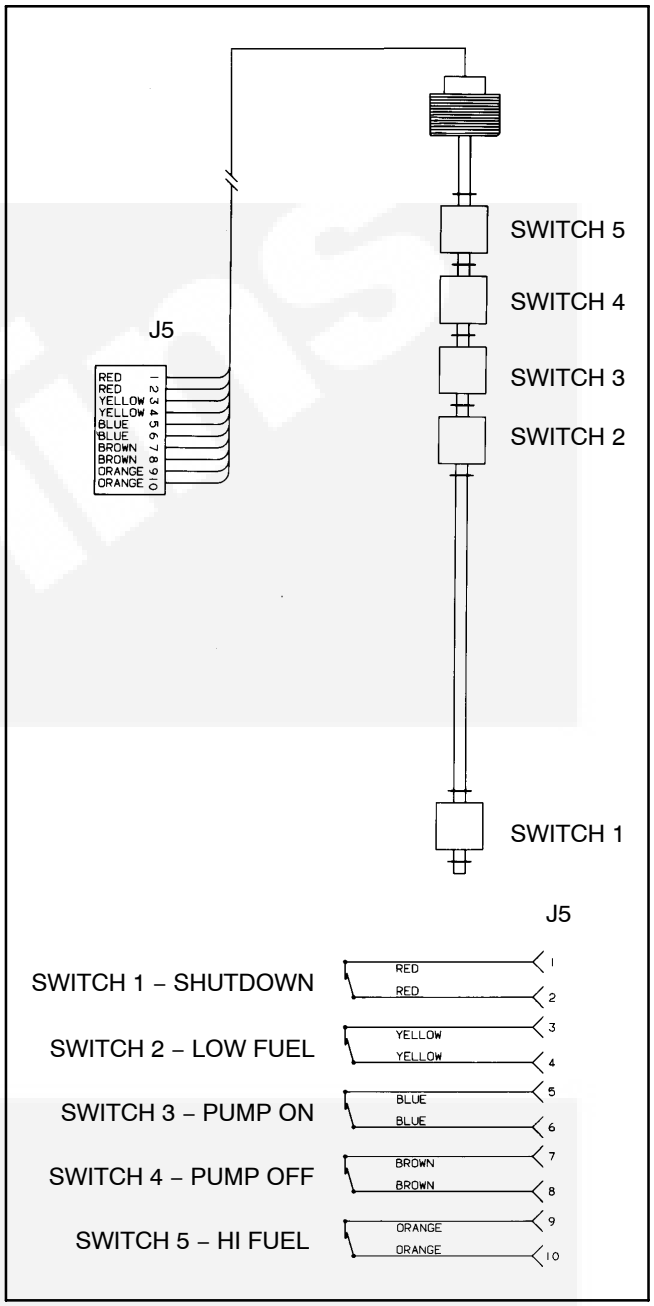

FIGURE 7-5. FLOAT SWITCH ASSEMBLY

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8. Wiring Diagrams

GENERAL

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

UC GENERATORS

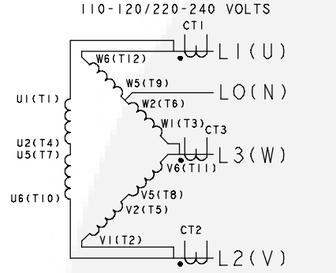
THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.

3 PHASE RECONNECTABLE, 12 LEAD

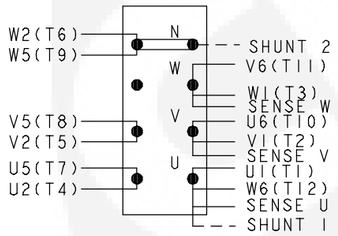
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

* RANGE *
110-120/220-240 VOLTS



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

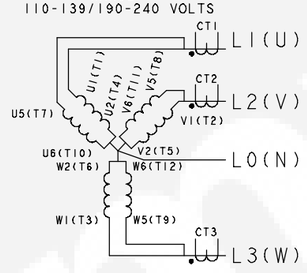


-01

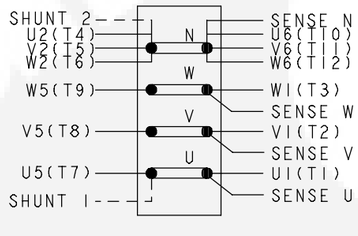
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

* RANGE *
110-139/190-240 VOLTS



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

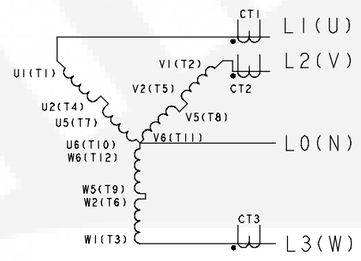


-02

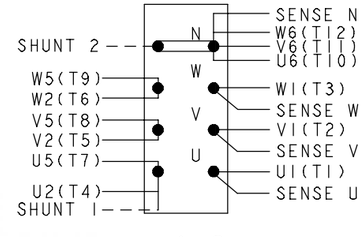
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X2

* RANGE *
220-277/380-480 VOLTS



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



-03

FEATURE CODE	VOLTAGE	50HZ	60HZ	
		WINDING 11	WINDING 11	WINDING 14
R028	110/220	X	-	X
R071	115/230	X	-	X
R106	120/240	X	X	X

NOTE: SENSE LEAD N IS NOT USED.
TAPE END AND TIE BACK.

FEATURE CODE	VOLTAGE	50HZ	60HZ	
		WINDING 11	WINDING 11	WINDING 14
R004	110/190	X	-	X
R050	115/200	X	-	X
R098	120/208	X	X	X
R020	127/220	X	X	-
R067	139/240	-	X	-

FEATURE CODE	VOLTAGE	50HZ	60HZ	
		WINDING 11	WINDING 11	WINDING 14
R099	220/380	X	-	X
R029	230/400	X	-	X
R003	240/416	X	X	X
R023	255/440	X	X	-
R002	277/480	-	X	-

NOTES:

1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.
2. WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 22 0942 FT-LBS.

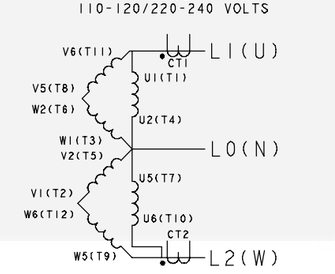
TABULATION	
0630_2404_01	FRD11979
0630_2404_02	FRD11979
0630_2404_03	FRD11979
0630_2404_04	FRD13797
0630_2404_05	FRD13797
0630_2404_06	FRD13996
0630_2404_07	FRD18982

1 PHASE RECONNECTABLE, 12 LEAD

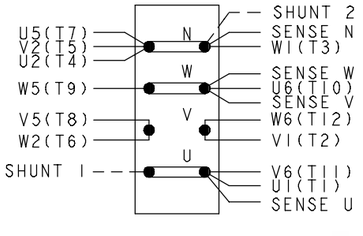
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

* RANGE *
110-120/220-240 VOLTS



DOUBLE DELTA
1 PHASE 3 WIRE
OUTPUT TERMINALS
U,W, CENTER TAP N.



-04

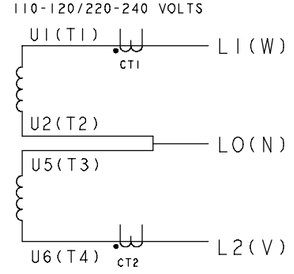
FEATURE CODE	VOLTAGE	50HZ		60HZ			
		WINDING 11		WINDING 11		WINDING 14	
		2/3 OUTPUT	FULL OUTPUT	2/3 OUTPUT	FULL OUTPUT	2/3 OUTPUT	FULL OUTPUT
R046	110/220	X	X	-	-	X	-
R041	115/230	X	X	-	-	X	-
R104	120/240	X	X	X	X	X	-

1 PHASE NON-RECONNECTABLE, 4 LEAD

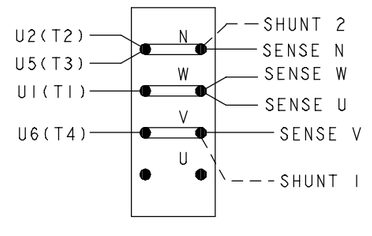
CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X3

* RANGE *
110-120/220-240 VOLTS



1 PHASE 3 WIRE
OUTPUT TERMINALS
W, V, CENTER TAP N



-05

FEATURE CODE	VOLTAGE	50HZ	60HZ
		-	WINDING 6
R046	110/220	-	X
R041	115/230	-	X
R104	120/240	-	X

No. 630-2404 sh 1 of 2
Rev. D
Modified 1-04

AC RECONNECT WIRING DIAGRAM (SHEET 1 OF 2)

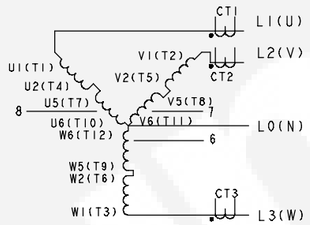
THIS IS A REPRESENTATIVE DRAWING.
FOR SERVICE, USE DRAWING SUPPLIED
WITH GENSET, IF AVAILABLE.

UC GENERATORS

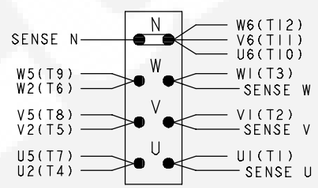
3 PHASE RECONNECTABLE

CURRENT TRANSFORMER
SECONDARY CONNECTION

X1 X2



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



NOTE: FOR SHUNT OPERATION, CONNECT AC HARNESS LEADS:
PMG2 TO GENERATOR TAP LEAD 8
PMG3 TO GENERATOR TAP LEAD 7

(C1) PMG4 NOT CONNECTED
TAPE & TIE BACK PMG4 AND LEAD 6

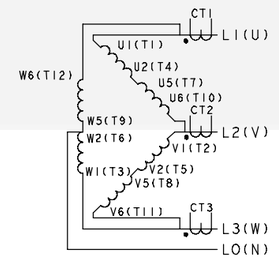
-06

FEATURE CODE	VOLTAGE	50HZ	60HZ
R114	600	-	X

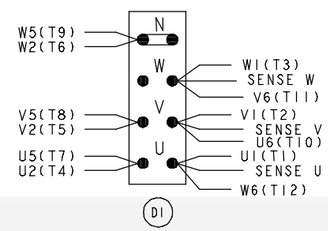
3 PHASE NON-RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONNECTION

X1 X2



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



(D1)

NOTES:
1. SENSE LEAD N IS NOT USED.
TAPE END AND TIE BACK.
(D2) 2. PMG MUST BE USED.
SHUNT NOT ALLOWED

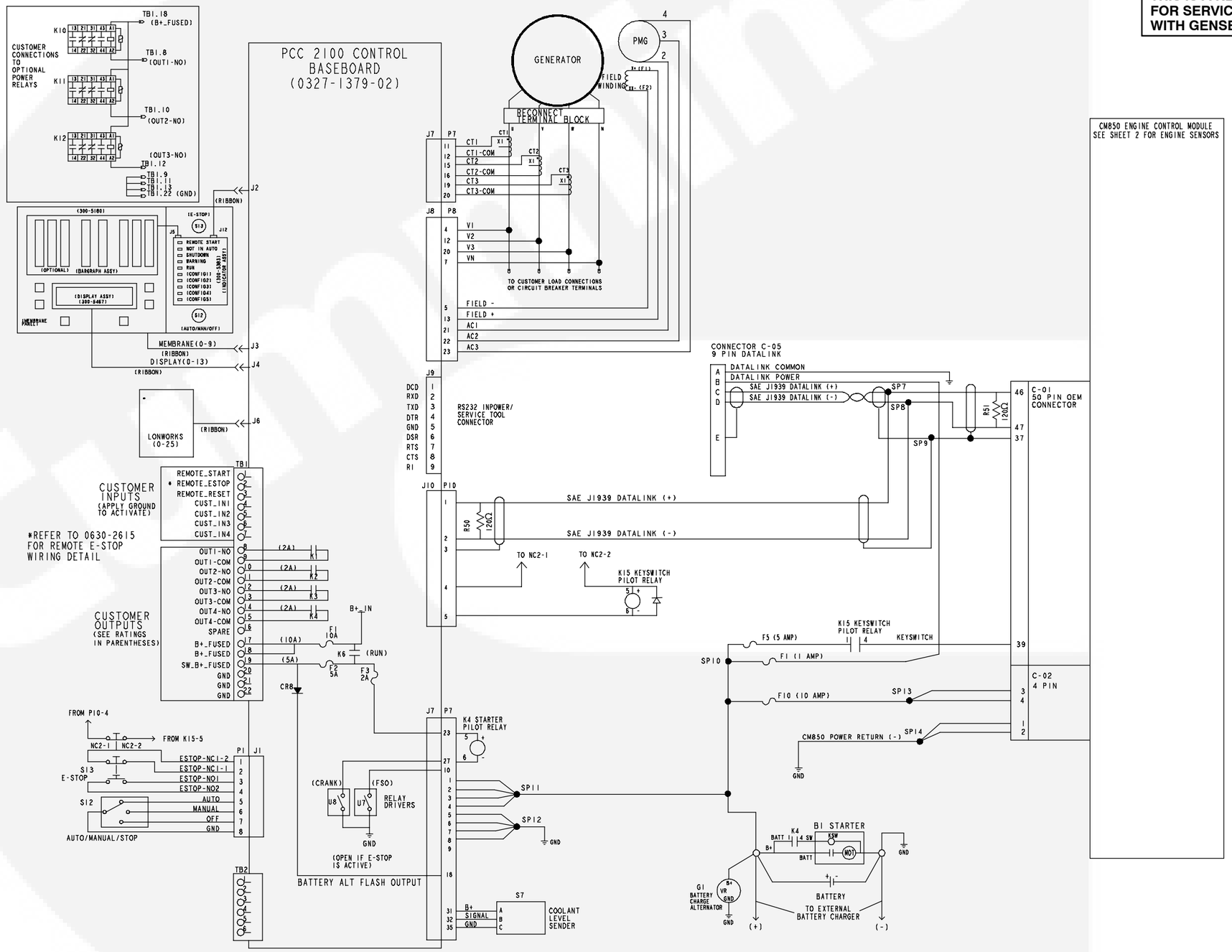
-07

FEATURE CODE	VOLTAGE	50HZ	60HZ
R019	120/240	X	-
R119	240/480	-	X

No. 630-2404 sh 2 of 2
Rev. D
Modified 1-04

AC RECONNECT WIRING DIAGRAM (SHEET 2 OF 2)

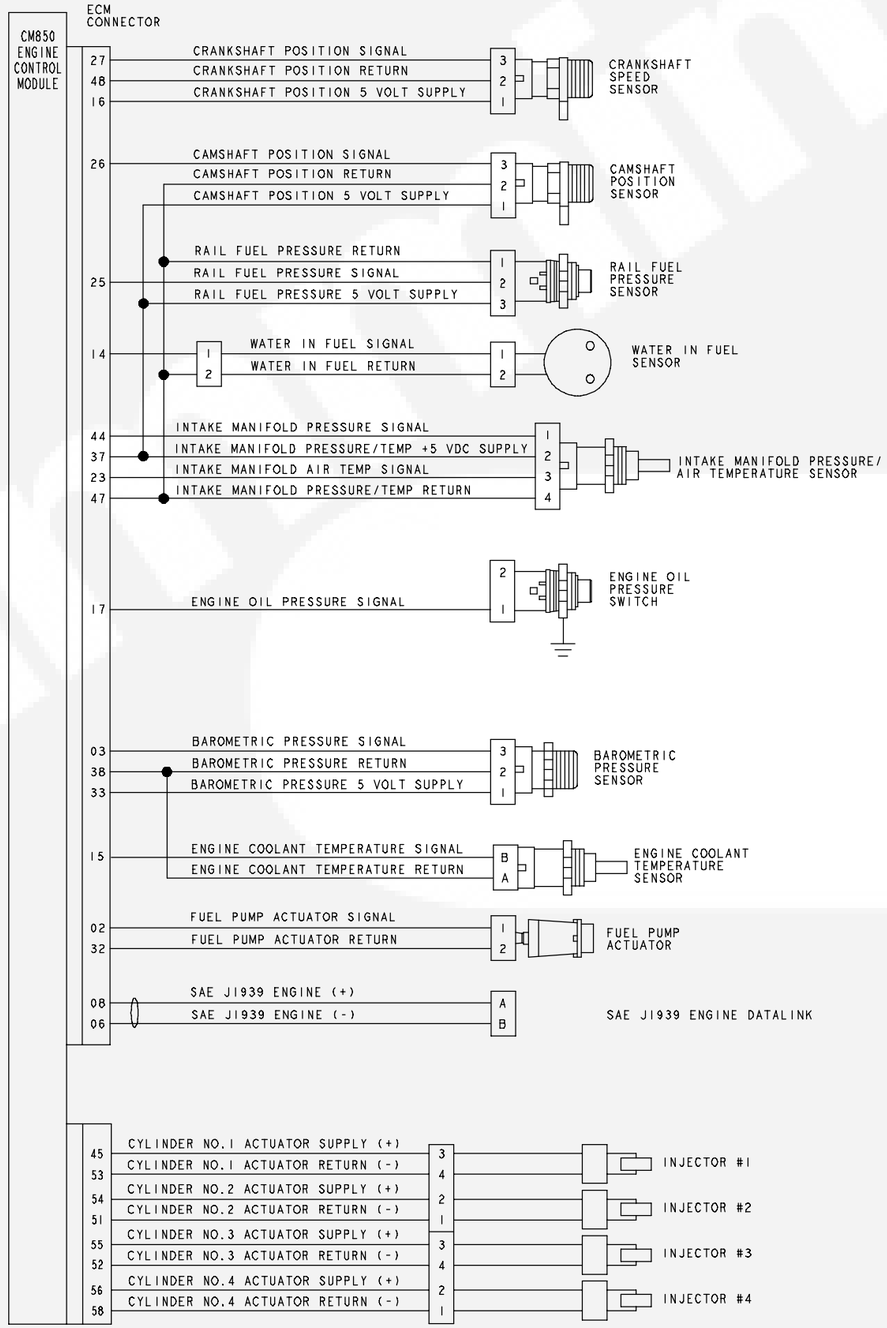
THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.



No. 630-3413 sh 1 of 2
Rev. A
Modified 8-06

CONTROL WIRING DIAGRAM (SHEET 1 OF 2)

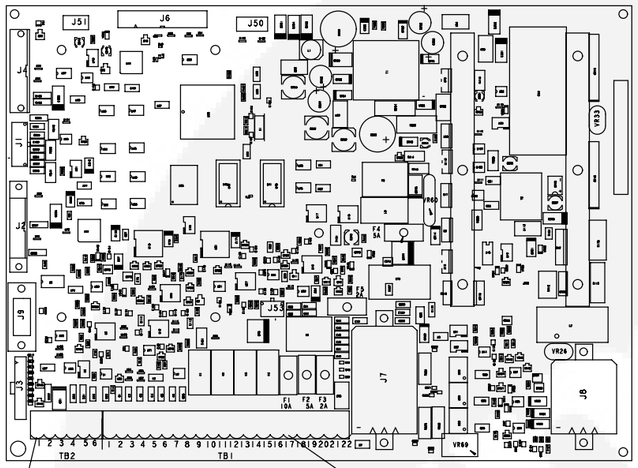
THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.



No. 630-3413 sh 2 of 2
Rev. A
Modified 8-06

CONTROL WIRING DIAGRAM (SHEET 2 OF 2)

THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.



TB2 **NOT USED**

TERMINAL/WIRE SPECIFICATION

1) TORQUE TERMINALS TO 4.4 IN/LBS (0.5 Nm)
2) WIRE SIZE, 30-12 AWG (0.14-2.5MM) (TB1)
3) WIRE TYPE, USE 60°C RATED MINIMUM, COPPRER WIRE (TB1)
4) TERMINAL SCREWS ARE SLOTTED (0.6MM)
5. USE FLAT-BLADED SCREWDRIVER WITH 2.5MM BLADE
6) STRIP WIRE LENGTH TO 6.0MM

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

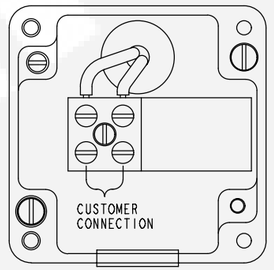
TB1-CUSTOMER FAULTS:
1 CUSTOMER FAULT 1
2 GROUND FAULT
3 LOW FUEL
4 RUPTURE BASIN FAULT

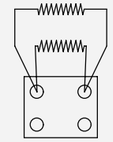
TB1-CUSTOMER RELAYS:
1 COMMON WARNING
2 COMMON SHUTDOWN
3 NOT IN AUTO
4 READY TO LOAD

TERMINAL SPECIFICATION

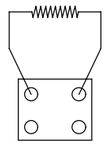
1) TORQUE TERMINALS TO 4.4 IN/LBS (0.5 Nm)
2) USE FLAT-BLADED SCREWDRIVER WITH 2.5MM BLADE

ALTERNATOR HEATER





DUAL HEATER



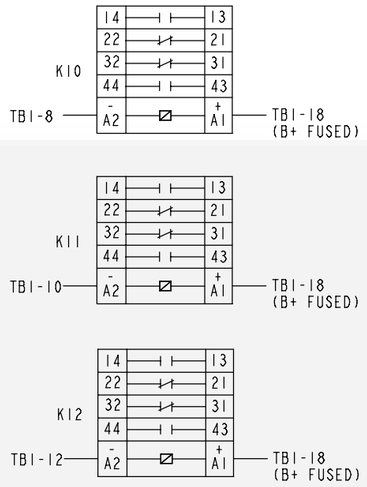
SINGLE HEATER

TERMINAL/WIRE SPECIFICATIONS

1. USE 60°C RATED MINIMUM COPPER WIRE.
2. WIRE SIZE: #12 - 18 AWG .
3. TORQUE TO 7.7 IN-Lb (0.9 Nm)
4. STRIP WIRE TO 0.32 INCHES (8.0 mm).
5. USE SLOTTED SCREWDRIVER WITH 3.0 mm BLADE
6. TERMINALS RATED AT 150V/20A AND 300V/10A.

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

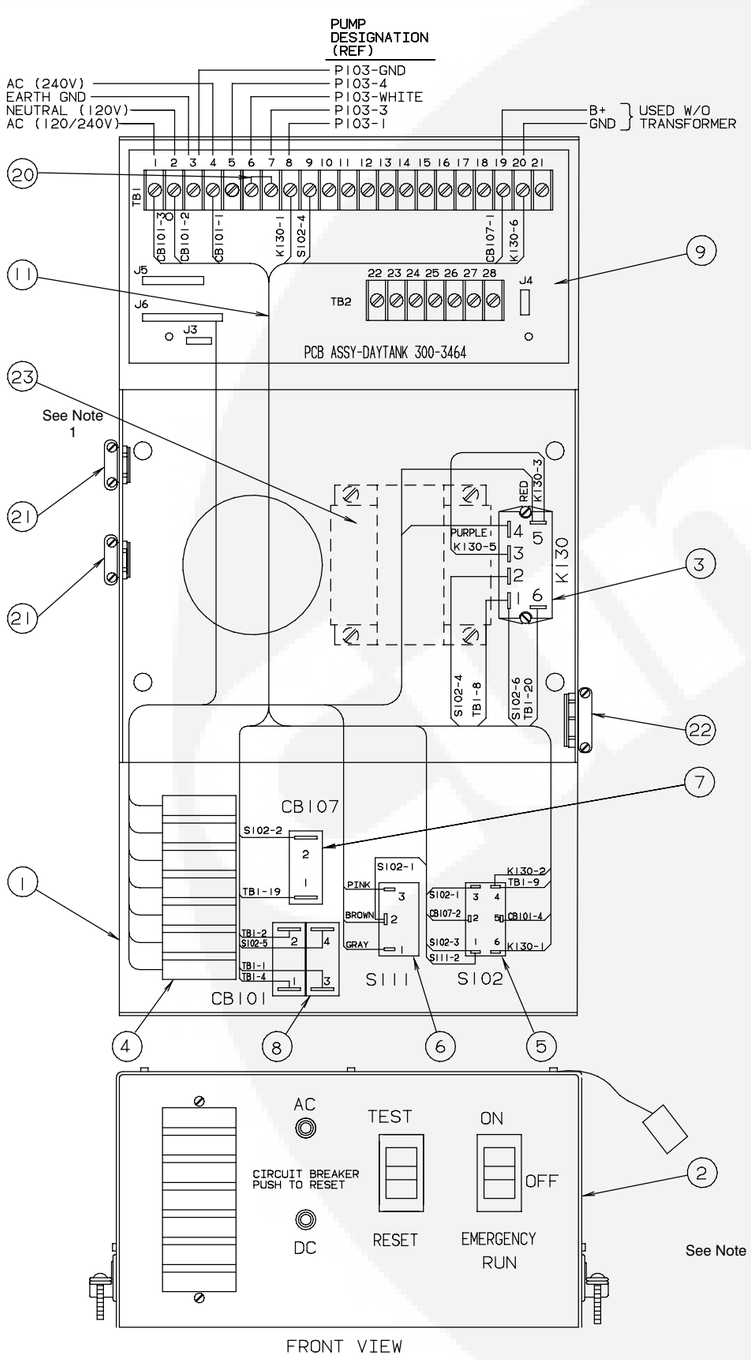
CUSTOMER RELAYS

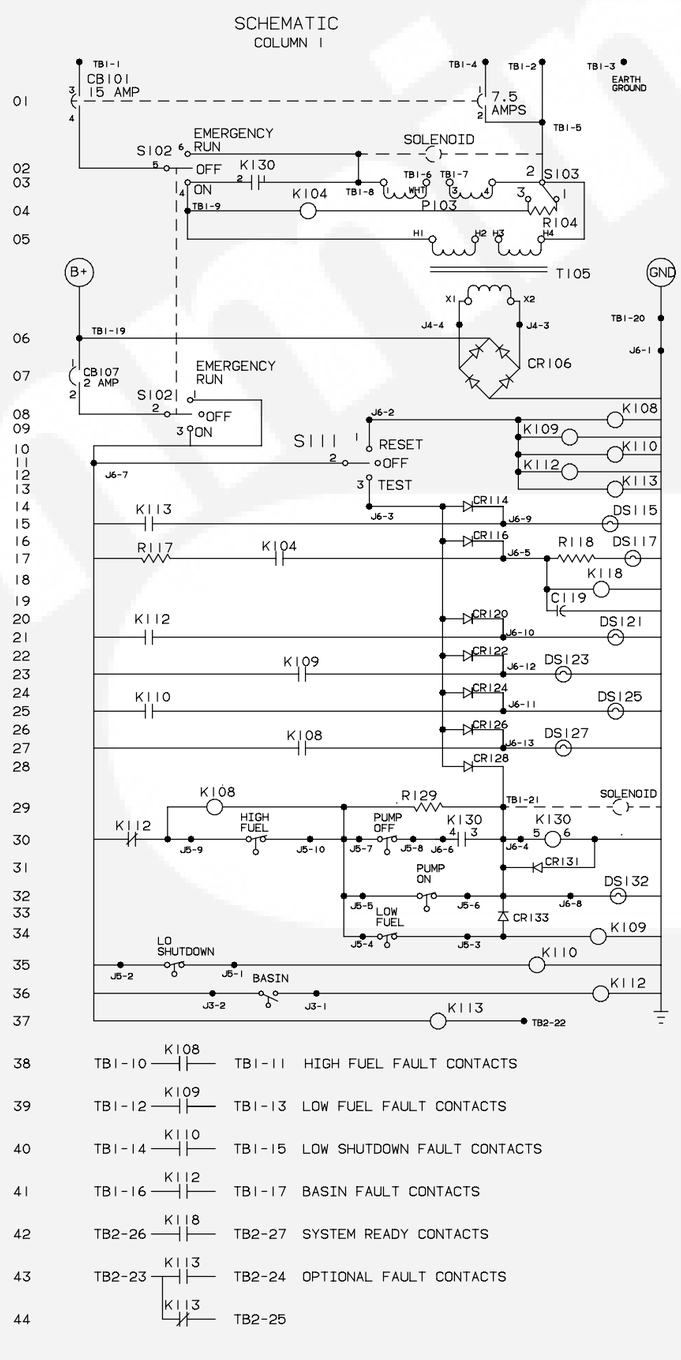


TERMINAL/WIRE SPECIFICATIONS

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) WIRE SIZE 1-18 AWG MIN (0.75MM²)
2-14 AWG MAX (2.5MM²)
1-12 AWG MAX (4.0MM²)
4) USE 60°C RATED MINUMUM, COPPER WIRE, 600VAC
5) TERMINAL SCREWS ARE PHIL SLOT
6) USE SLOTTED SCREWDRIVER WITH 5.0 MM BLADE OR NO. 2 PHILIPS
7) CONTACT RATINGS: 600VAC, 10 AMPS MAX
8) STRIP WIRE LENGTH TO 7.0 MM

No. 620-0247 sh 1 of 1
Rev. C
Modified 06-04





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

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

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 ASS'Y.
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.**

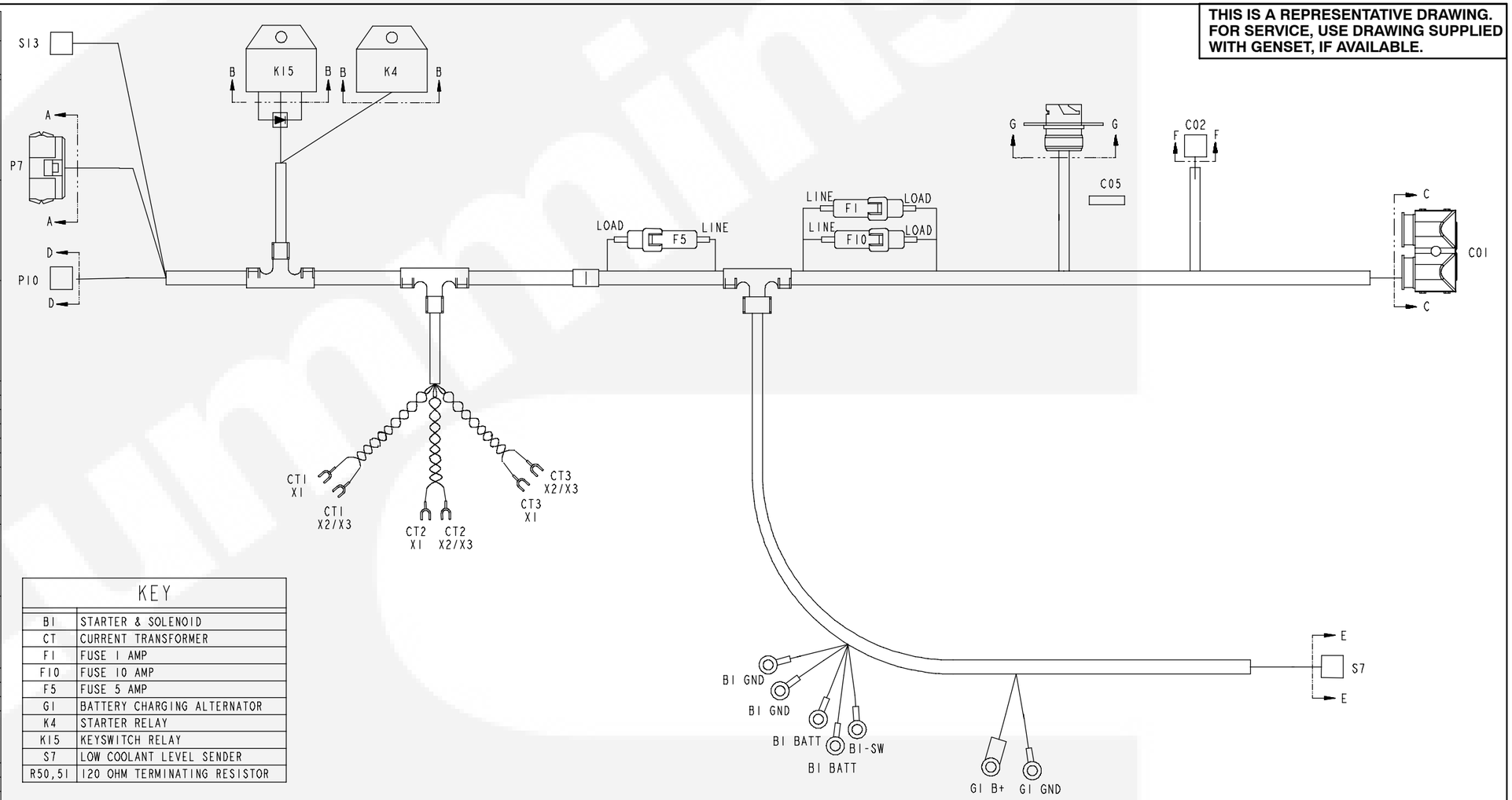
No. 625-2141 sh 1 of
Rev. H
Modified

DAY TANK PUMP CONTROL WIRING

THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.

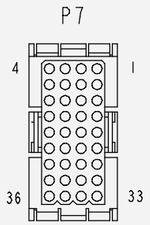
LEAD TABULATION

FROM	TO	WIRE COLOR
P10-1	SP1 (IN)	WHITE
P50-A	SP1 (OUT)	
SP2 (IN)		
SP2 (OUT)	C05-C	
	SP3 (IN)	
P51-A	SP3 (OUT)	
C01-46		
P10-2	SP4 (IN)	BLACK
P50-B	SP4 (OUT)	
SP5 (IN)		
SP5 (OUT)	C05-D	
	SP6 (IN)	
P51-B	SP6 (OUT)	
C01-47		
P10-3	SP7 (IN)	SHIELD
-	SP7 (OUT)	
SP8 (IN)		
SP8 (OUT)	C05-E	
	SP9 (IN)	
-	SP9 (OUT)	
C01-37		
B1 BATT	SP10 (IN)	RED
F5 (LINE)	SP10 (OUT)	RED
F1 (LINE)		RED
S7-A	P7-31	RED
K15-1	F5 (LOAD)	RED
K15-4	C01-39	RED/ORANGE
K15-5	S13-2	WHITE
	CR1-C	WHITE
K15-6	P10-5	WHITE
	CR1-A	WHITE
SP11 (IN)	B1 BATT	RED
SP11 (OUT)	P7-1	RED
	P7-2	RED
	P7-3	RED
	P7-4	RED
SP12 (IN)	B1 GND	BLACK
SP12 (OUT)	P7-5	BLACK
	P7-6	BLACK
	P7-7	BLACK
	P7-8	BLACK
C05-B	F1 (LOAD)	RED
C05-A	B1 GND	BLACK
B1 BATT	F10 (LINE)	RED
SP13 (IN)	F10 (LOAD)	RED
SP13 (OUT)	C02-3	RED
	C02-4	RED
B1 GND	SP14 (IN)	BLACK
C02-1	SP14 (OUT)	BLACK
C02-2		BLACK
B1 BATT	G1-B+	RED
B1 GND	G1-GND	BLACK
P7-11	CT1 X1	PINK
P7-12	CT1 X2/X3	GREY
P7-15	CT2 X1	PURPLE
P7-16	CT2 X2/X3	GREY
P7-19	CT3 X1	ORANGE
P7-20	CT3 X2/X3	GREY
P7-32	S7-B	WHITE
P7-35	S7-C	BLACK
P7-23	K4-5	WHITE
P7-27	K4-6	WHITE
B1-BATT	K4-1	RED
B1-SW	K4-4	BROWN
P10-4	S13-1	WHITE



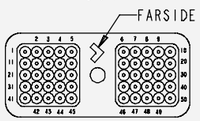
KEY

B1	STARTER & SOLENOID
CT	CURRENT TRANSFORMER
F1	FUSE 1 AMP
F10	FUSE 10 AMP
F5	FUSE 5 AMP
G1	BATTERY CHARGING ALTERNATOR
K4	STARTER RELAY
K15	KEYSWITCH RELAY
S7	LOW COOLANT LEVEL SENDER
R50,51	120 OHM TERMINATING RESISTOR

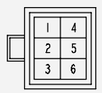


VIEW A-A

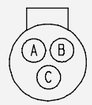
VIEW B-B



VIEW C-C

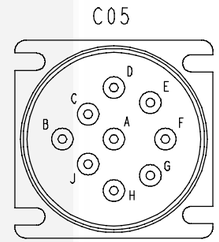


VIEW D-D



VIEW E-E

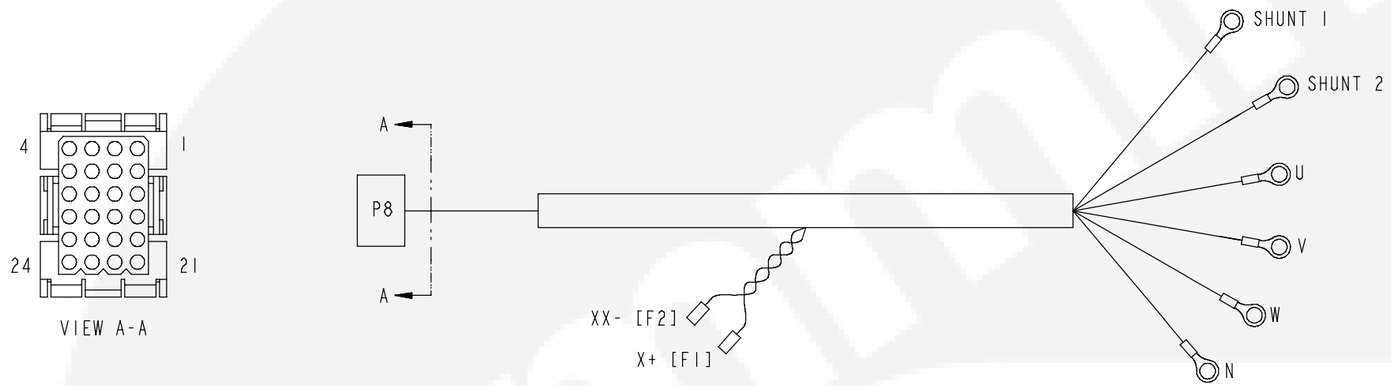
VIEW F-F



VIEW G-G

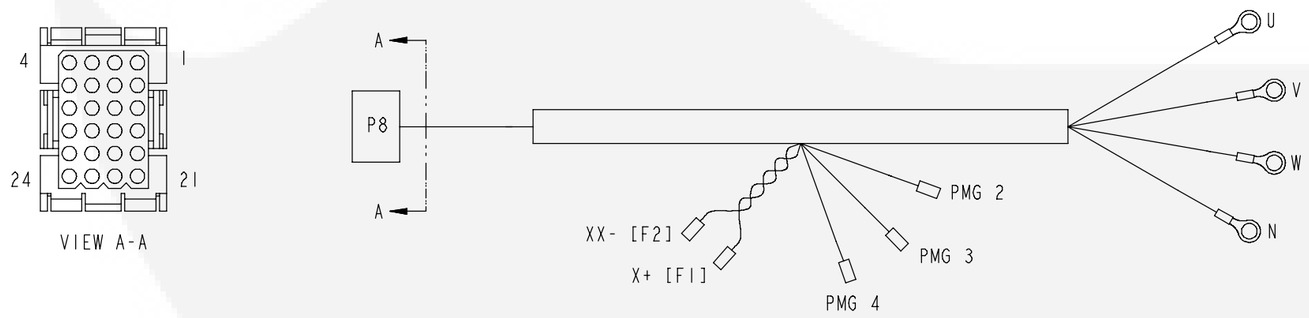
No. 338-4884 sh 1 of
Rev. C
Modified 12-06

THIS IS A REPRESENTATIVE DRAWING. FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, IF AVAILABLE.



LEAD TABULATION		
FROM STATION	TO STATION	WIRE COLOR
P8-4	U	BLACK
P8-12	V	RED
P8-20	W	DARK BLUE
P8-7	N	WHITE
P8-21	SHUNT 1	BROWN
P8-22	SHUNT 2	WHITE
P8-13	X+ [FI]	WHITE
P8-5	XX- [F2]	WHITE

SHUNT (338-4185)



LEAD TABULATION		
FROM STATION	TO STATION	WIRE COLOR
P8-4	U	BLACK
P8-12	V	RED
P8-20	W	DARK BLUE
P8-7	N	WHITE
P8-21	PMG 2	WHITE
P8-22	PMG 3	WHITE
P8-23	PMG 4	WHITE
P8-13	X+ [FI]	WHITE
P8-5	XX- [F2]	WHITE

PMG (338-4180)

No. 338-41XX
Rev. B
Modified 1-04

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