Owners Manual

Operator/Installation/Service

PowerCommand® 2100 Controller

English
Original Instructions

4-2013

900–0534 (Issue 5)

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Foreword

The purpose of this manual is to provide the users with general control operation and fault code information. Refer to the equipment manufacturer's product support manuals for important safety precautions.

Manufacturers applying this control are respectfully advised that it is their responsibility to employ competent persons to carry out any installation work in the interests of good practice and safety. It is essential that the utmost care is taken with the application of this control device.

Warranty

Warranty: This manual is published solely for information purposes and should not be considered all inclusive. Sale of product shown or described in this literature is subject to terms and conditions outlined in appropriate Cummins Power Generation selling policies or other contractual agreement between the parties. This literature is not intended to and does not enlarge or add to any such contract. The sole source governing the rights and remedies of any purchaser of this equipment is the contract between the purchaser and Cummins Power Generation.

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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.

GENERAL SAFETY PRECAUTIONS

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

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides operating, troubleshooting, and repair information regarding the PowerCommand® 2100 Control (PCC). Engine service instructions are 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 PowerCommand Control (PCC) is a microprocessor-based control. All generator set control functions are contained on one circuit board (Base board). The Base board provides engine speed governing (optional), main alternator voltage output regulation, and complete generator set control and monitoring.

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

TEST EQUIPMENT

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

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

HOW TO OBTAIN SERVICE

Contact your generator set manufacturer when seeking additional service information or replacement parts. Provide model and serial number information.

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

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2. Control Installation and Connections

CONTROL WIRING

The generator set control panel box contains connection points for remote control and monitor options.

When using any PCCNet device on a genset control application, the wiring used to connected ALL devices in the network must be Belden 9729 Two Pair, Stranded, Shielded Twisted Pair Cable (24 AWG).

⚠ CAUTION ***Stranded copper wire must be used for all customer connections to the control panel. Solid copper wire may break due to genset vibration.***

Use flexible conduit for all wiring connections to the generator set. All conduit used for control wiring is attached to the control housing.

Route the control wiring through the control housing and into the access holes on the bottom of the control panel box. Figure 2-1 also shows the access holes that should be used according to where the wires are terminated inside the control box.

A compression type strain-relief connector should be used to prevent dust, insects, etc. from entering control box.

Use cable ties to keep control wiring away from sharp edges and AC power cables within the control housing.

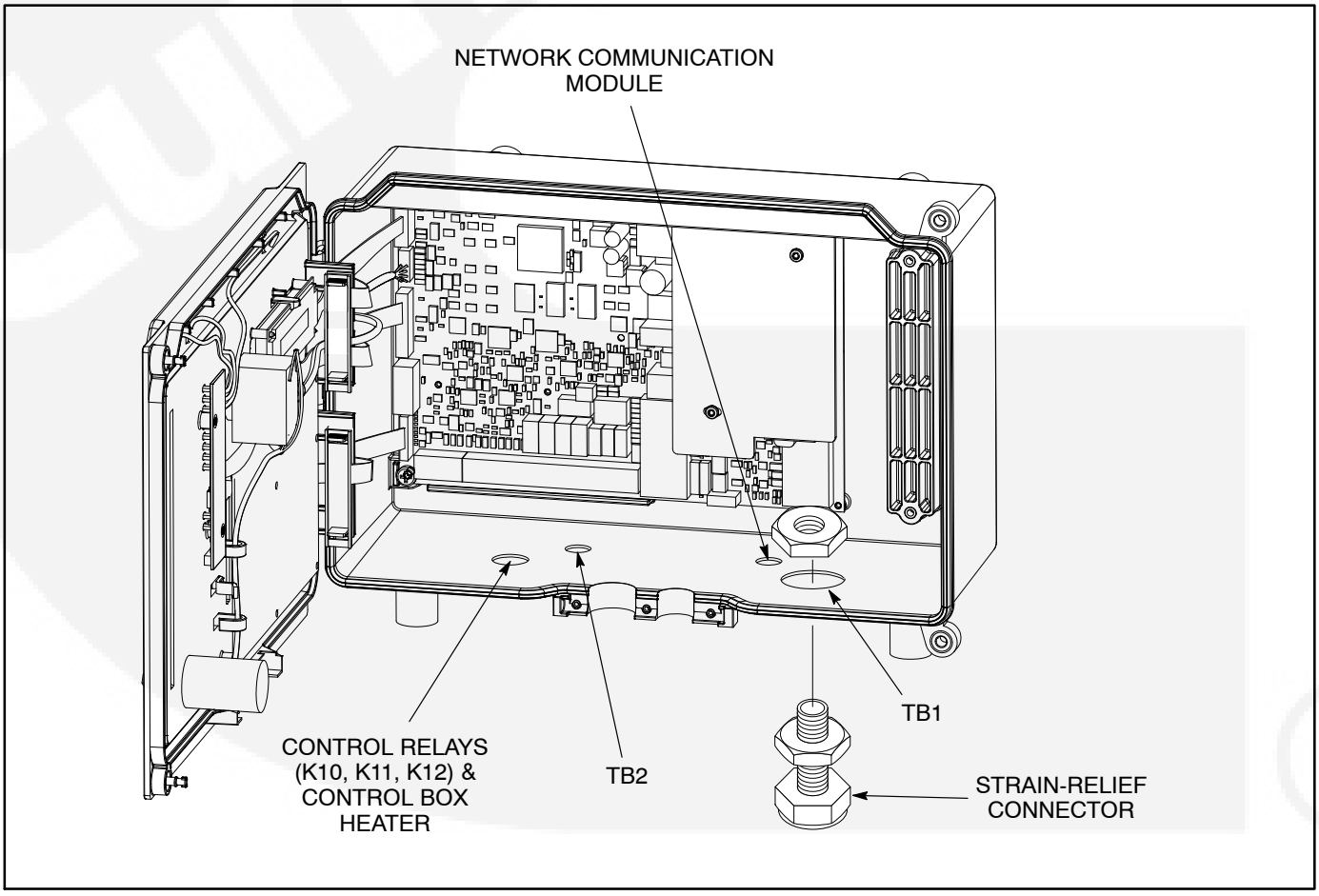

FIGURE 2-1. SUGGESTED CUSTOMER WIRE ROUTING

TB1 REMOTE MONITOR/CONTROL CONNECTIONS

Customer monitor/control connections are attached to terminal block TB1 (Figure 2-2). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, battery charger, etc. are attached to TB1. Refer to Customer Connections diagram in Section 7.

TB1 Wiring

⚠ CAUTION ***Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.***

Digital Connections: Connection points, other than relayed outputs, network, switched B+ and B+ are considered digital connections to terminal strip TB1. The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 20 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 18 gauge stranded copper wire.

Relay Connections: Due to the wide variety of devices that can be attached to the relay outputs of TB1, the electrical contractor must determine the gauge of the **stranded copper** wire that is used at this installation site. Refer to PCC Customer Connections diagram in Section 7 for the relay specifications.

Network Connections: Refer to 900-0366 *PowerCommand Network Installation and Operation* manual for the type/gauge wire to use for these connections.

Switched B+: (Fused at 5 amps.) Same as Relay Connection description.

B+: (Fused at 10 amps.) Same as Relay Connection description.

TB1 Customer Inputs

Refer to Page 7-4 for typical connections to TB1.

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

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

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

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

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

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

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

- Enable/disable input. Default setting:
  Enable **1** through **4**
- Status, Warning or Shutdown. Default setting:
  1 – None
  2 thru **4** – Warning
- Active closed or open. Default setting:
  Closed [ground] **1** through **4**
- Change display name using up to 19 characters. Default setting:
  1 – Customer Fault 1
  2 – Ground Fault
  3 – Low Fuel
  4 – Rupture Basin Fault

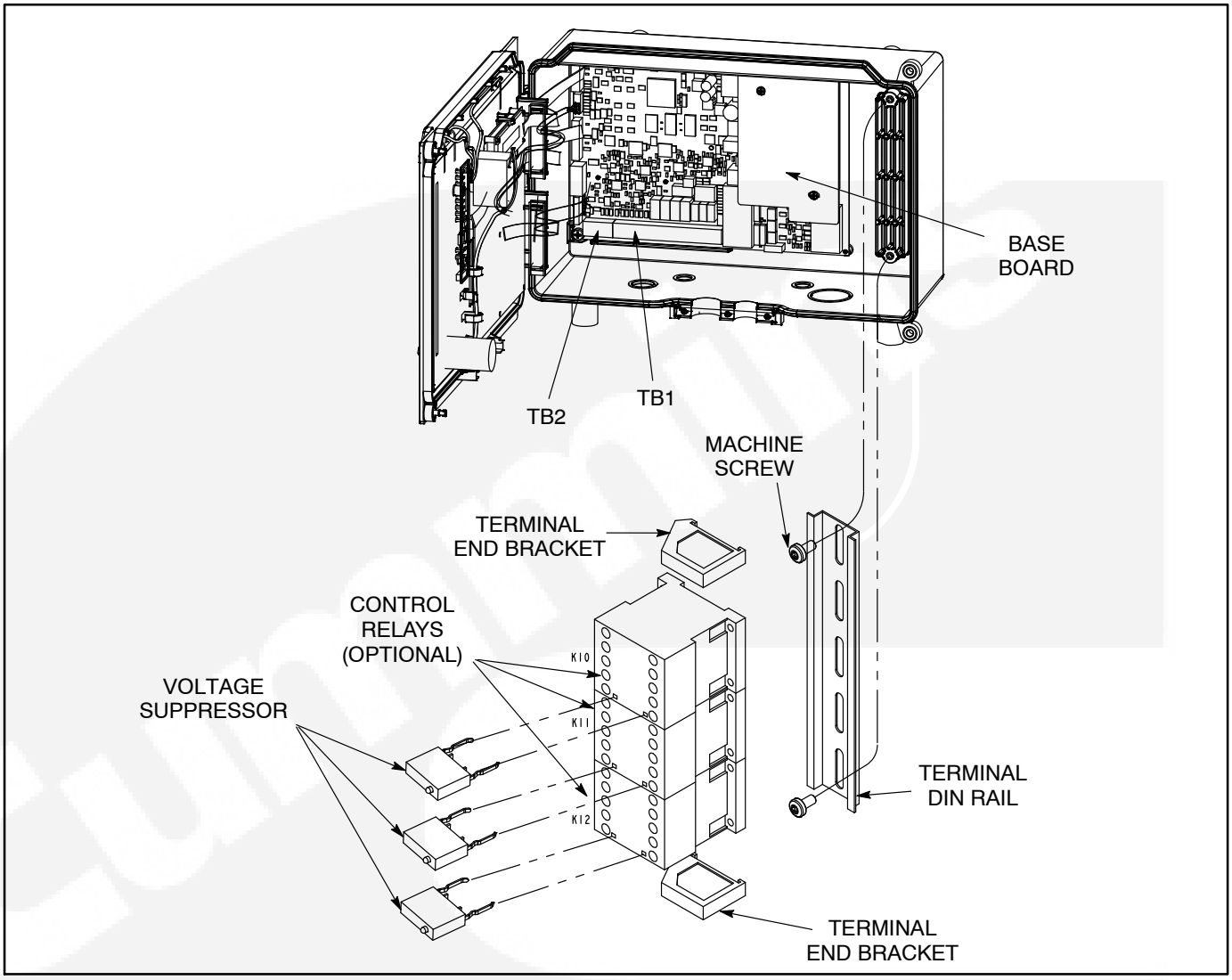

FIGURE 2-2. CONTROL PANEL BOX

TB1 Customer Outputs

Refer to Page 7-4 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.

Switched B+: 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.)

TB2 Connections

PCCNet connections are attached to terminal block TB2. Optional equipment, such as the universal annunciator and the AUX101, are attached to TB2. Refer to the cusomer connections diagram in Section 7.

Switched B+: This is a fused 5 amp, 12/24 volt switched output. This output is used to power PCCNet devices.

Gnd: This is a PCCNet connection.

RS485+: This is a PCCNet connection.

RS485–: This is a PCCNet connection.

CONTROL RELAYS (K11, K12, K13)

⚠ CAUTION ***Damage to the Base board can occur if the voltage suppressors (Figures 5-2 and 5-3) are not installed accross relay coils (A1/A2) of control relays K11, K12 and K13 before connecting genset battery cables.***

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

These relays (Figure 2-3) are used to control auxiliary equipment, such as fans, pumps and motorized air dampers. Energizing of the relays is user definable.

The contacts are rated at 10 amps at 600 VAC.

Refer to Customer Connections diagram in Section 7.

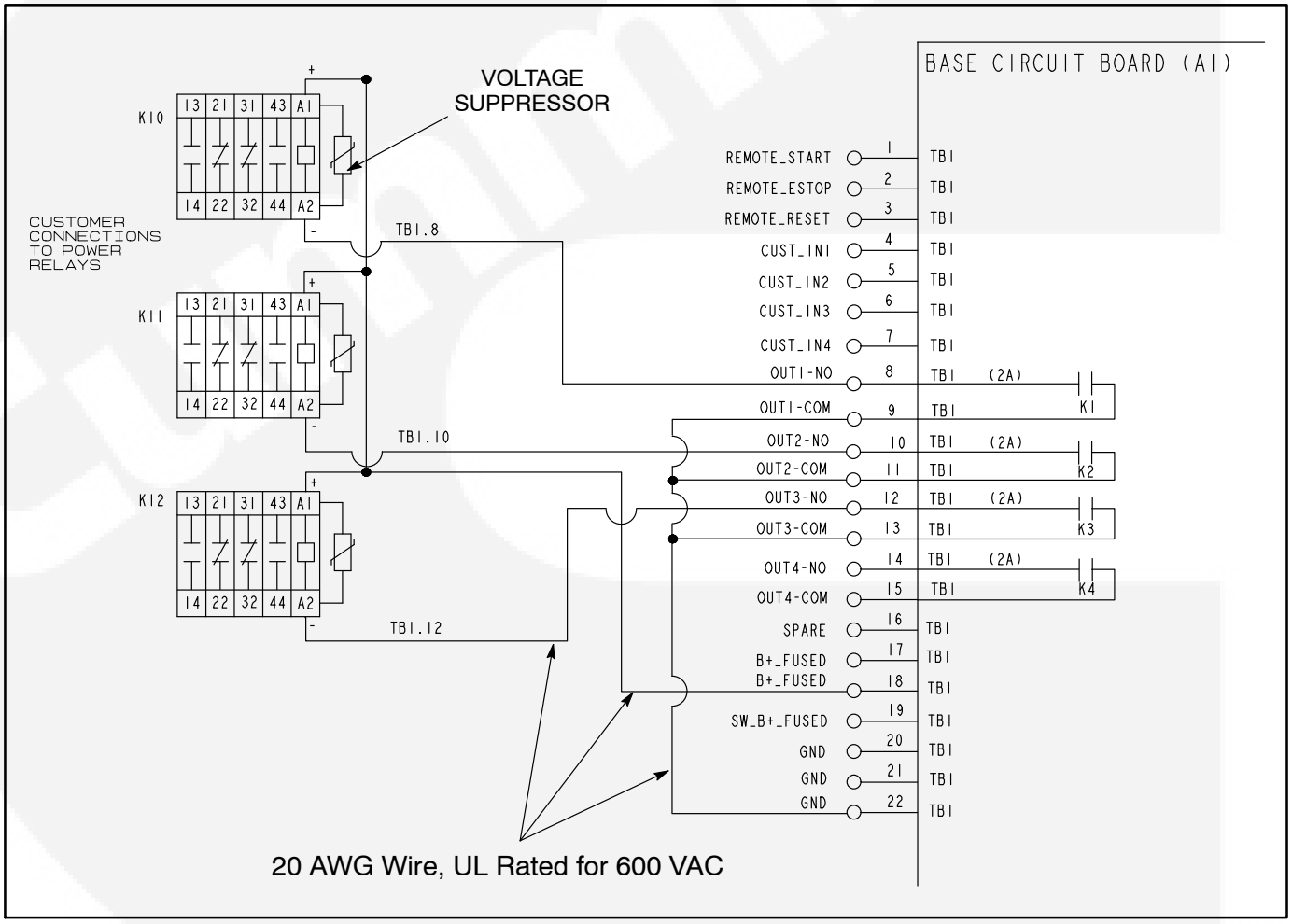

FIGURE 2-3. OPTIONAL CONTROL RELAYS (K10, K11, K12)

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3. 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 3-1.

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:

- Off/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 network and/or power transfer control feature is installed, the sleep mode is not available and should not be enabled – will cause error condition.)

BATTLE SHORT MODE (OPTIONAL)

The purpose of Battle Short mode is to satisfy local code requirements where necessary.

The Battle Short mode prevents the genset from being shutdown by all but a select few critical shutdown faults. **All shutdown faults, including those overridden by Battle Short, must be acted upon immediately to ensure the safety and well being of the operator and the genset.**

⚠WARNING ***Use of the Battle Short mode can cause a fire or electrical hazard, resulting in severe personal injury or death and/or property and equipment damage. Operation of the genset must be supervised during Battle Short mode operation.***

This feature should only be used during supervised, temporary operation of the genset. The faults that are overridden during Battle Short mode consist of faults that can affect genset performance or cause permanent **engine, alternator, or connected equipment damage. Operation may void generator set warranty if damage occurs that relates to fault condition.**

When Battle Short mode is enabled, the **Warning** status indicator is lit, along with displayed fault code **1131 – Battle Short Active**.

With Battle Short mode enabled and an overridden shutdown fault occurs, the shutdown fault is announced but the genset does not shut down, and fault code **1416 – Fail To Shut Down** is displayed.

The Fault Acknowledgement/Reset button will clear the fault message, but will remain in the Fault/History file with an asterisk sign (***** equals active fault) as long as Battle Short mode is enabled.

Battle Short is suspended and a shutdown occurs immediately if:

- Any of the following critical shutdown faults occurs:
  - Overspeed – Fault code 234
  - Emergency Stop – Fault code 1433
  - Remote Emergency Stop – Fault code 1434
  - Position Sensor – Fault code 236
  - Excitation Fault – Fault code 2335
  - CAN Datalink Failure – Fault code 781
  - CAN Engine Shutdown – Fault Code 1245
- Moving the customer installed Battle Short switch to OFF with an active but overridden shutdown fault or a shutdown fault that was overridden at any time. (Fault code **1123 – Shutdown After Battle Short** will be displayed for this type of shutdown.)

The software for the Battle Short feature must be installed at the factory or ordered and installed bu an authorized service representative. When installed, the InPower service tool is required to enable the Battle Short mode feature and to configure a Customer Input for an external switch input. This switch (customer supplied) allows the operator to enable/disable the Battle Short mode. Contact an authorized service center for assitance.

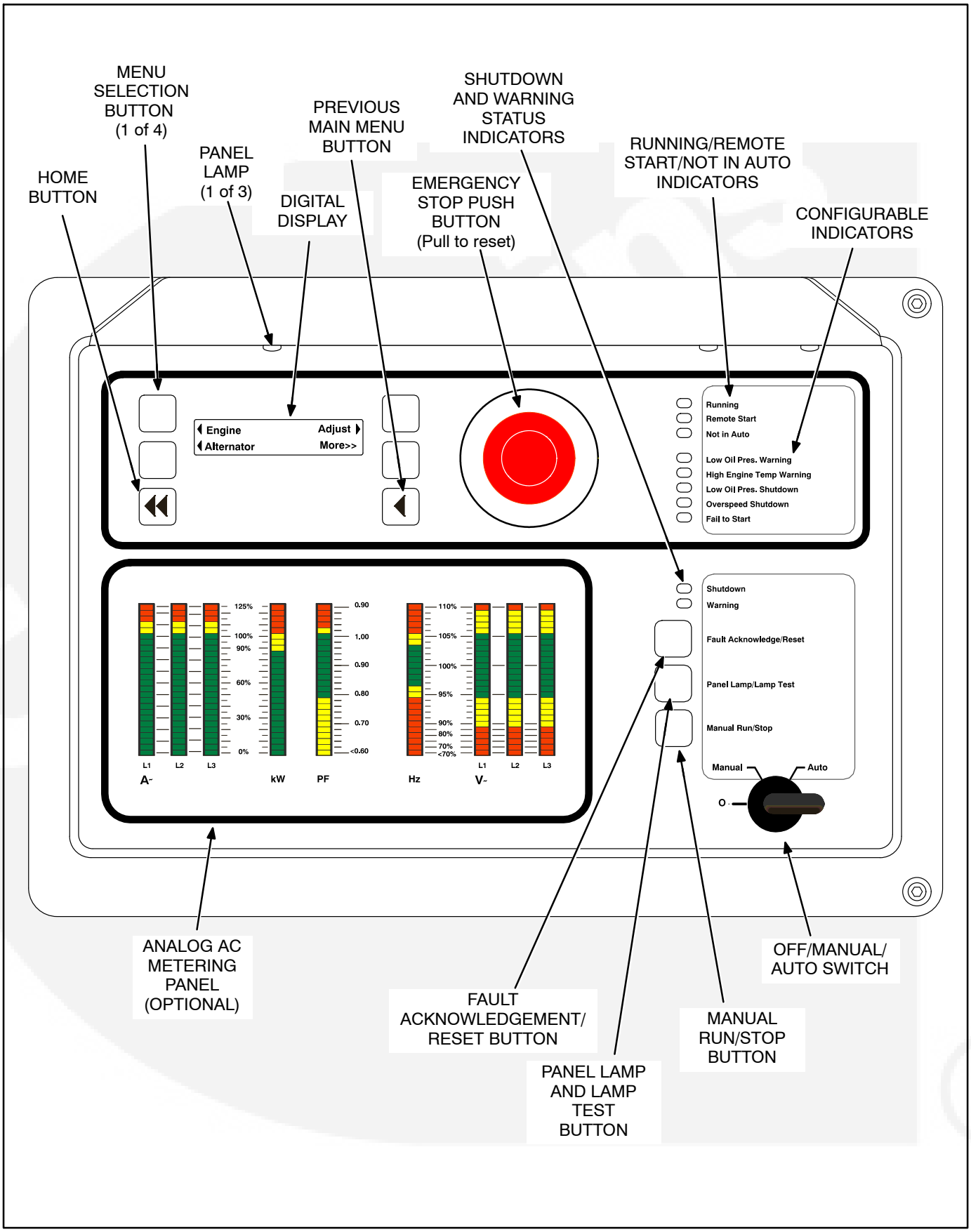

FIGURE 3-1. FRONT PANEL

FRONT PANEL

Figure 3-1 shows the features of the front panel.

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

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

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

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

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

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

To reset:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Configurable Indicators

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

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

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

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

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

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

MENU DISPLAY AND BUTTONS

Figure 3-2 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 3-3), 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 3-5).
- 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 3-3.
- 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 3-2) 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 ▶).

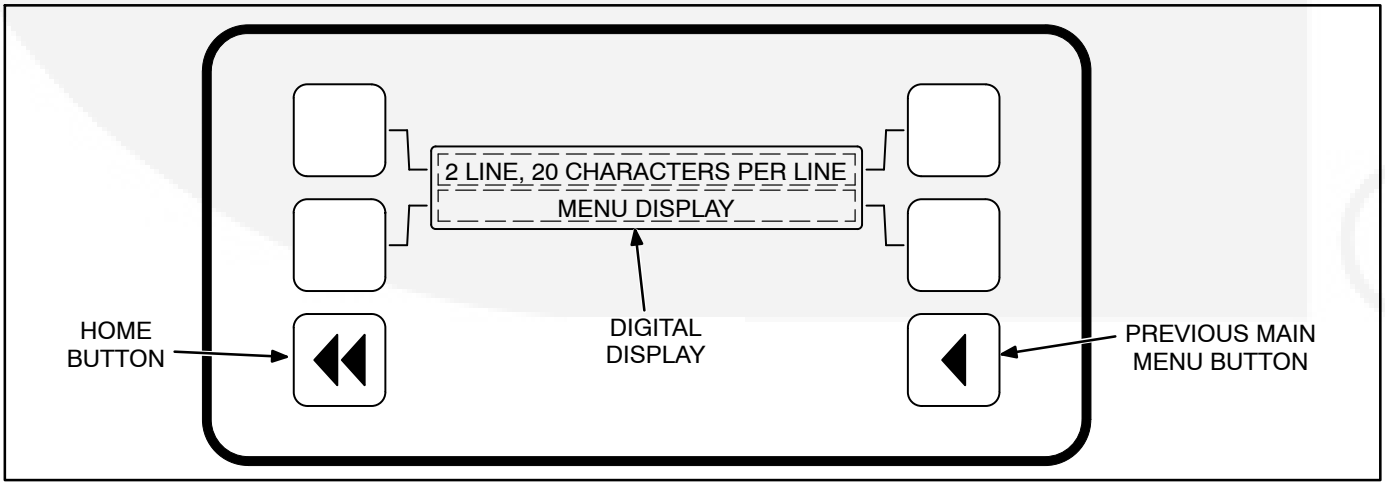

FIGURE 3-2. DIGITAL DISPLAY AND MENU SELECTION BUTTONS

MAIN MENUS

Figure 3-3 shows the three major main menus available to the user. Figure 3-3 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.

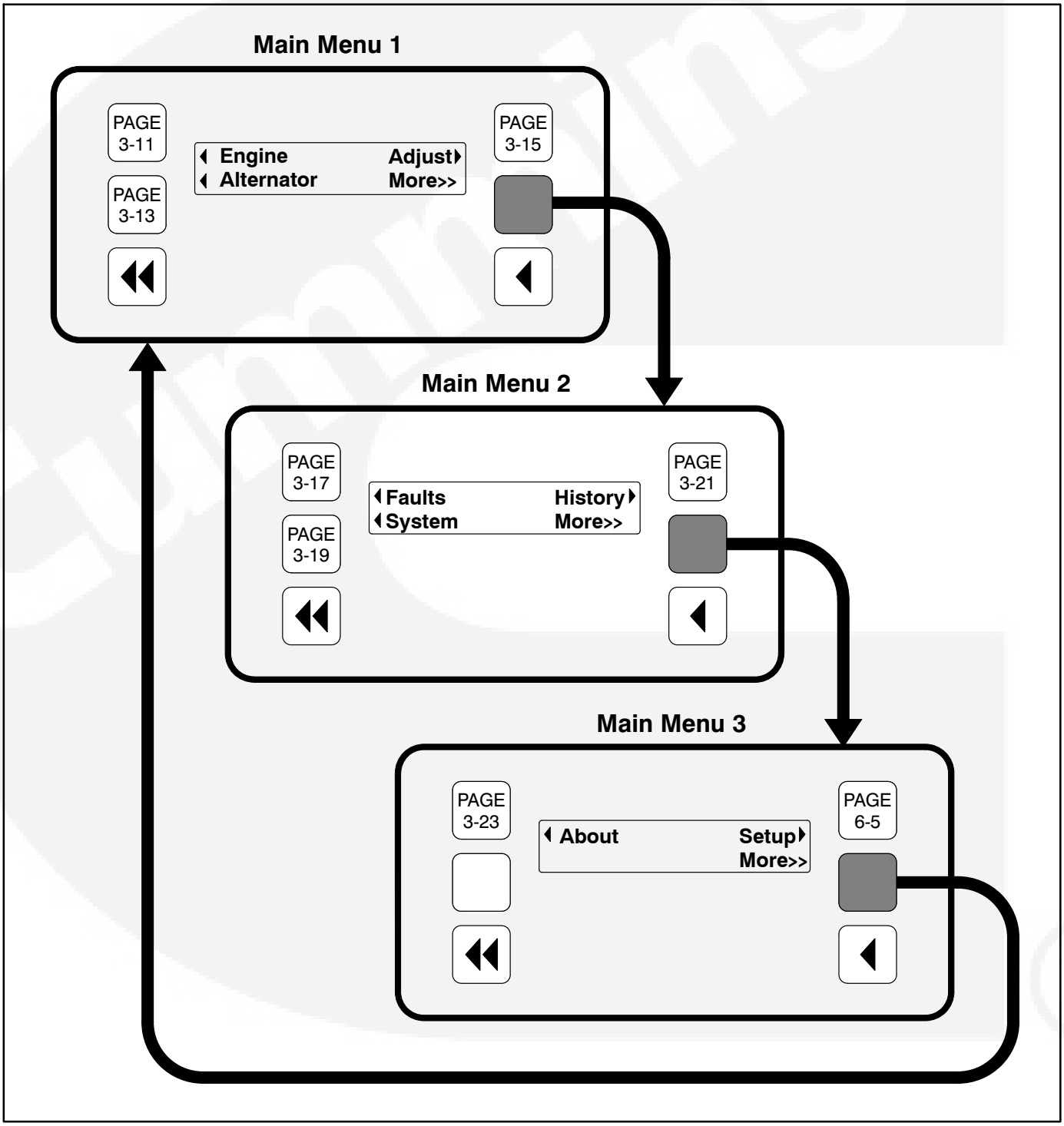

FIGURE 3-3. MAIN MENUS

CONTROLLER CONFIGURATION MENU

Figure 3-4 shows a block representation of the Controller Configuration menus. These menus are used to change the default language, temperature units, and pressure units to be displayed in menus.

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

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

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

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

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

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

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

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

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

CONTROLLER CONFIGURATION MENU

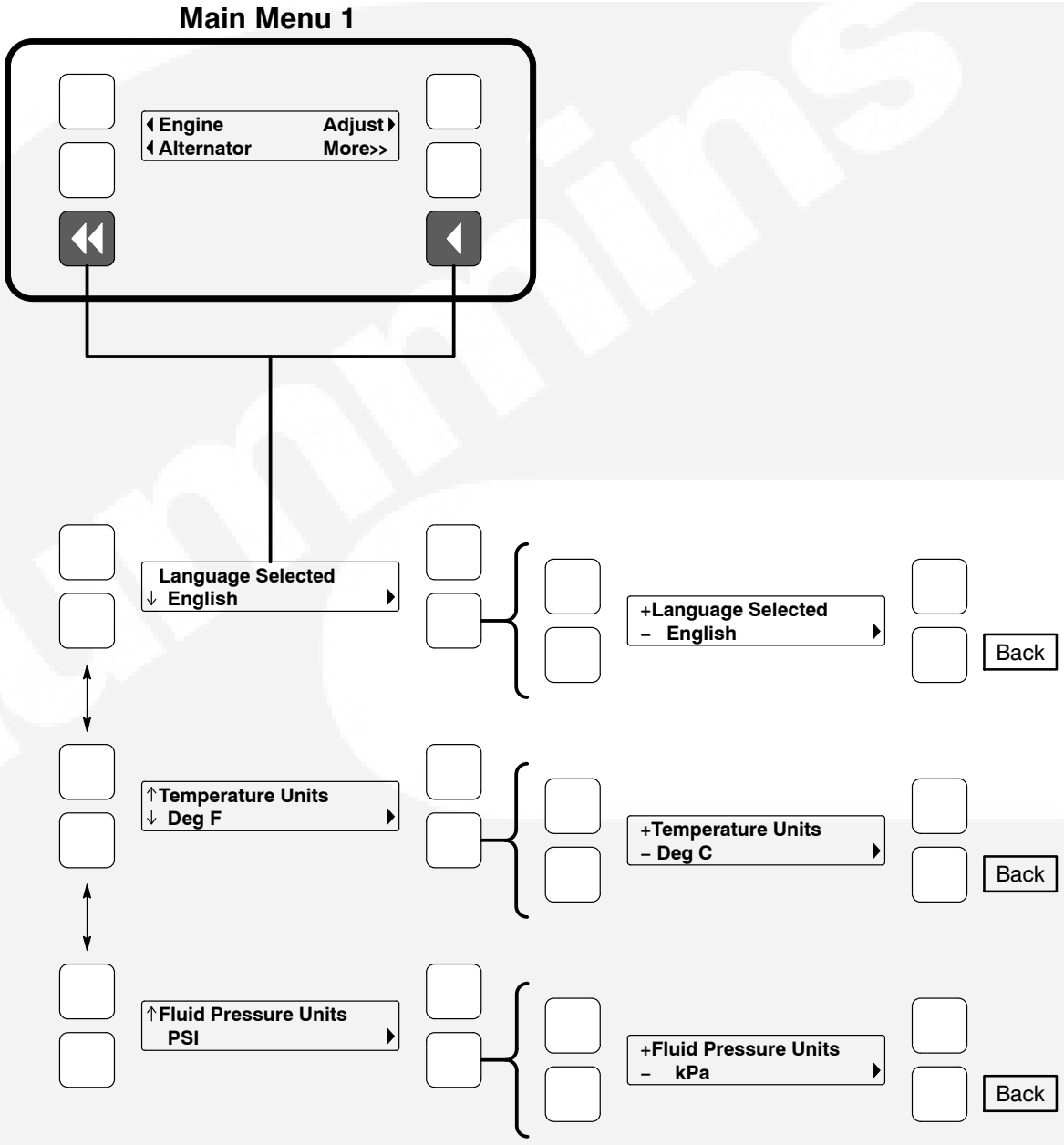

FIGURE 3-4. CONTROLLER CONFIGURATION MENU

ENGINE MENU

Figure 3-5 shows a block representation of the Engine menu. If you press the button next to the word “Engine” in the display, the first Engine submenu is displayed.

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

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

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

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

Oil Temperature or ***Fuel Level submenu:*** With early versions of software, this input was used to display engine oil temperature in degrees Fahrenheit or Centigrade (see *Controller Configuration Menu* in this section).

Starting with control software version 2.400, InPower can be used to enable the control to display either engine oil temperature or fuel level in Gallons. If both engine oil temperature and fuel level are enabled, the control will display the fuel level. Both features can be disabled. If both are disabled, this submenu will not be displayed. For more information on fuel level setup, see section 6.

Engine Speed submenu: This submenu displays the engine RPM.

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

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

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

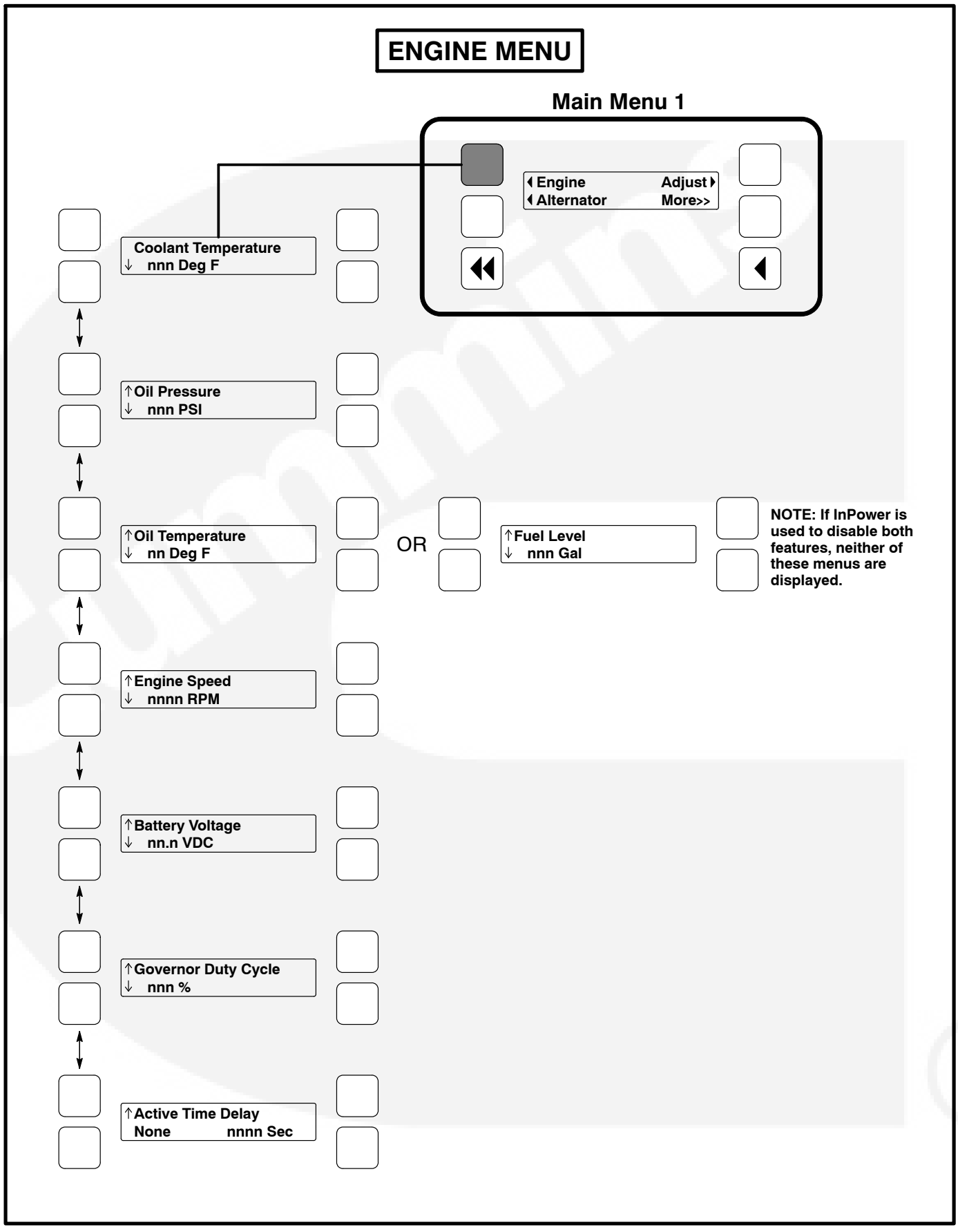

FIGURE 3-5. ENGINE MENU

ALTERNATOR MENU

Figure 3-6 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.)

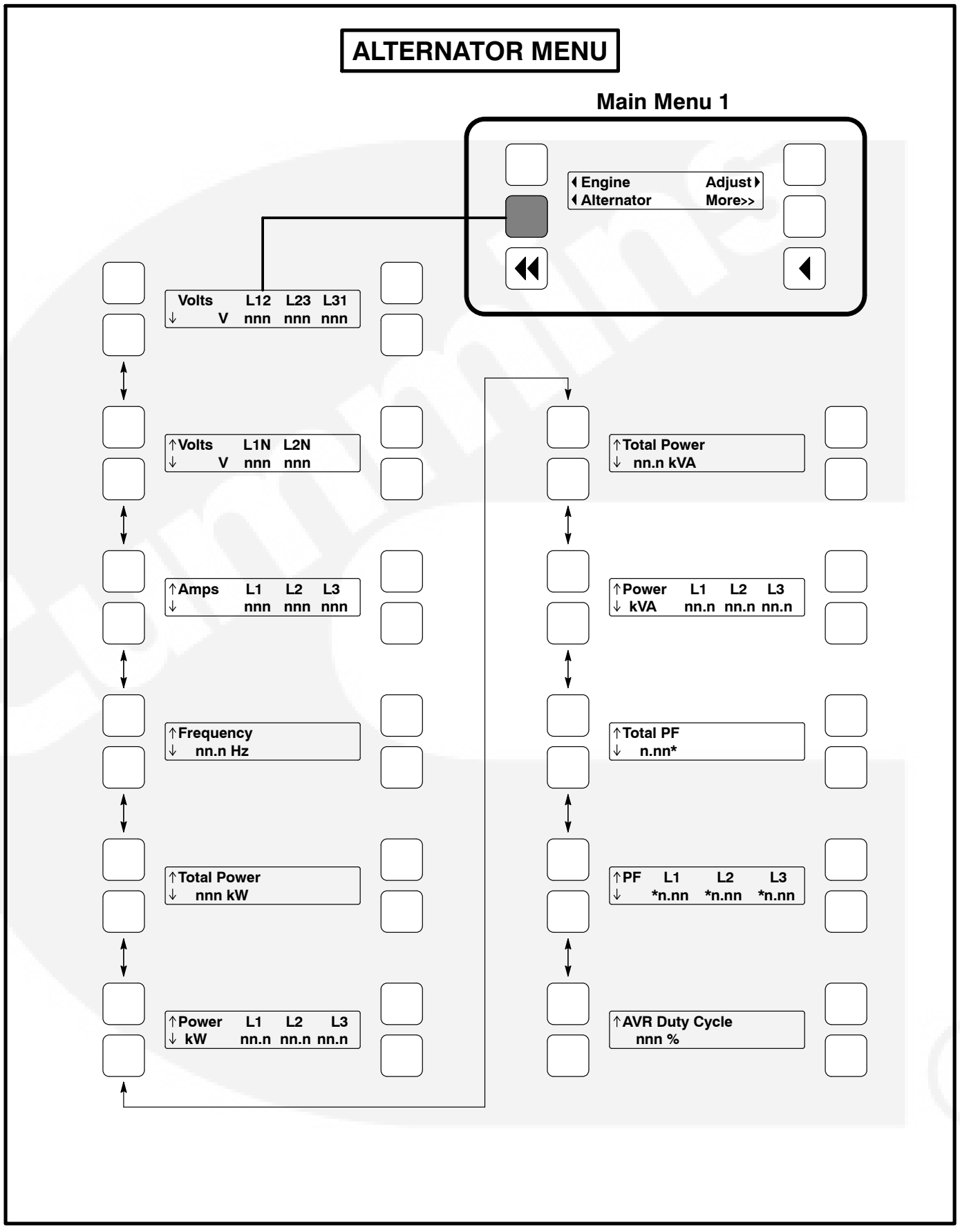

FIGURE 3-6. ALTERNATOR MENU

ADJUST MENU

Figure 3-7 shows a block representation of the Adjust menu. If you press the button next to the word "Adjust" in the display, the first Adjust submenu is displayed.

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

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

Adjusting Values/Parameters:

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

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

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

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

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

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

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

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

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

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

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

Idle Start submenu (Only available on some models): Idle Start can be enabled or disabled (default = Disable). This function is only enabled when the genset is started in manual mode. Idle Start can also be enabled while the set is running in manual mode.

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

The idle speed can be adjusted from 700 to 1100 RPM (default of 800 RPM). Refer to *Crank/Idle Setup Menu* in Section 6. A countdown timer is used to limit engine idle time. With InPower, idle time can be adjusted from 0 to 60 minutes in 1 minute increments.

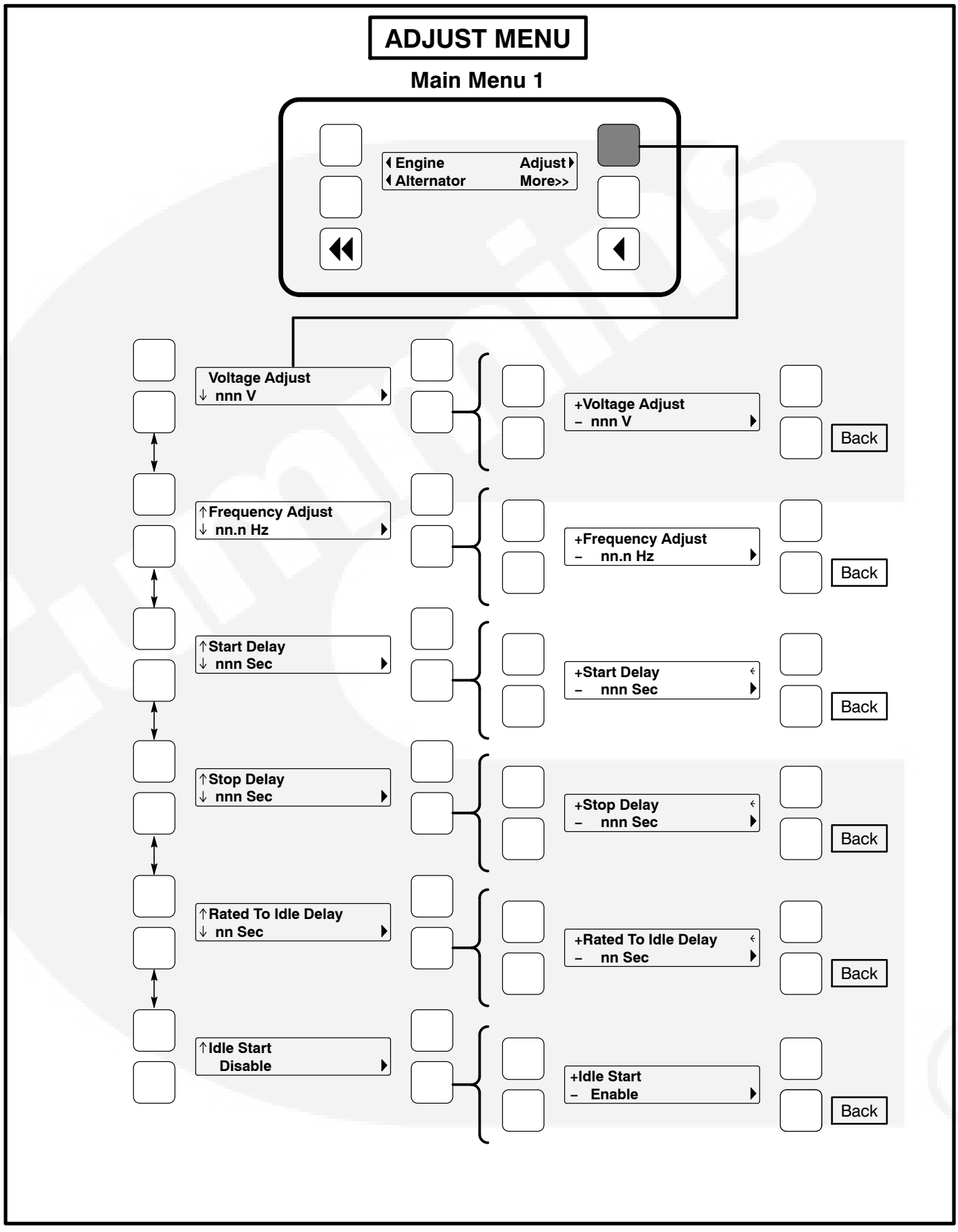

FIGURE 3-7. ADJUST MENU

FAULTS MENU

Figure 3-9 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 3-8.

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.

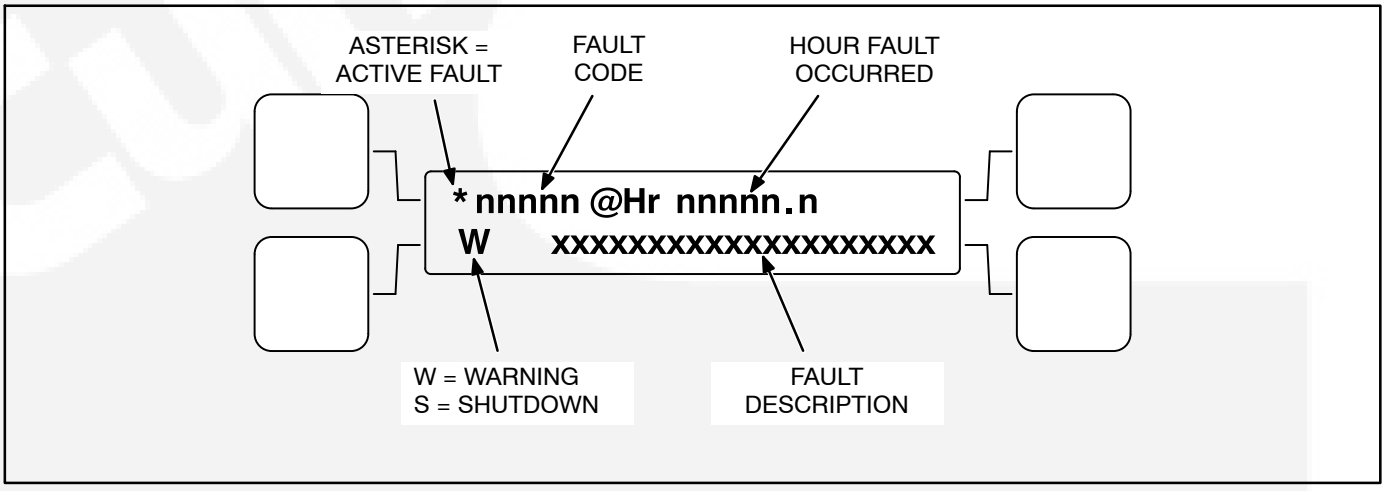

FIGURE 3-8. HISTORY/CURRENT FAULT SUBMENU

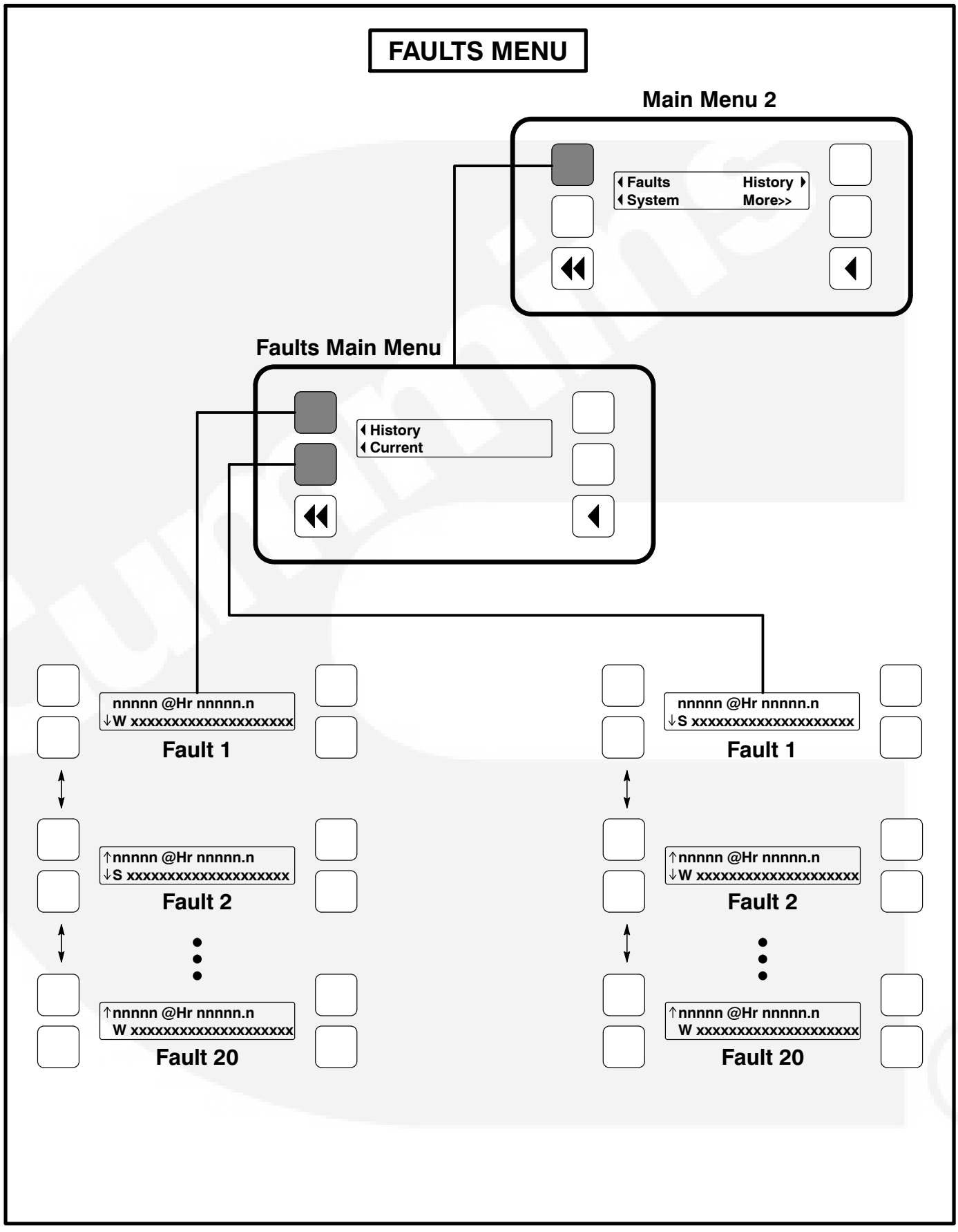

FIGURE 3-9. FAULTS MENU

SYSTEM MENU

Figure 3-10 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.

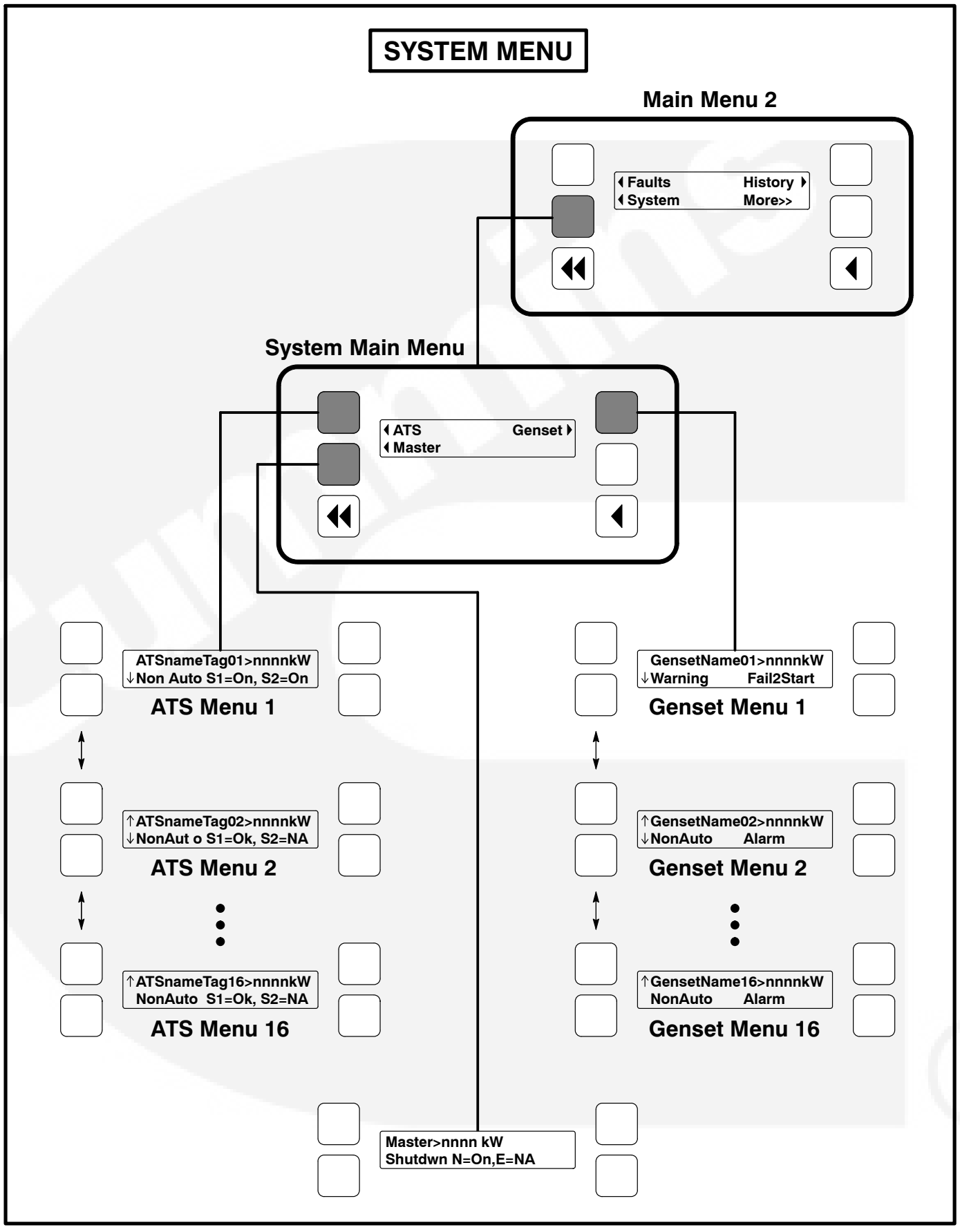

FIGURE 3-10. SYSTEM MENU

HISTORY MENU

Figure 3-11 shows a block representation of the History menu. If you press the button next to the word “History” in the display, the first History submenu is displayed.

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

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

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

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

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

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

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

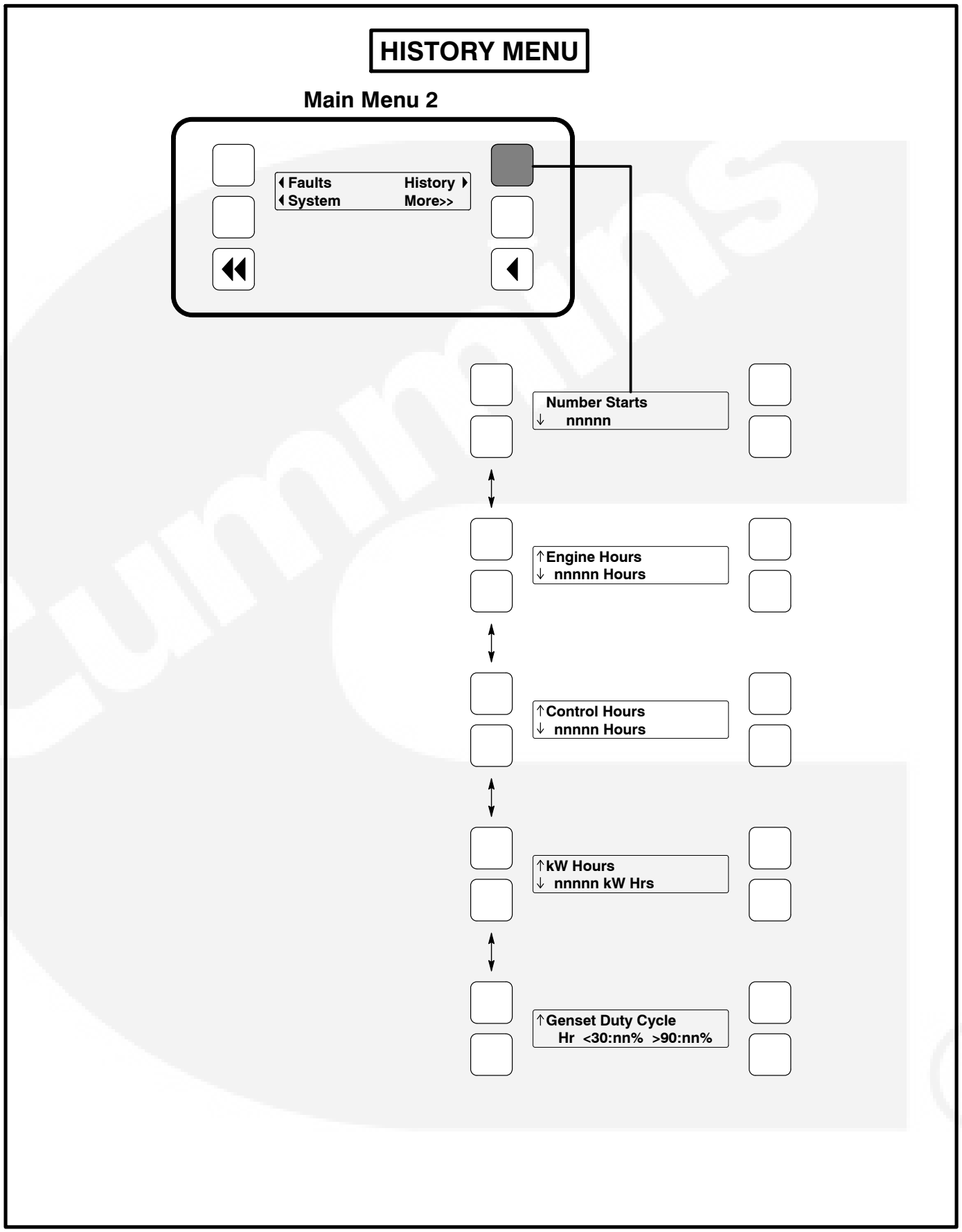

FIGURE 3-11. HISTORY MENU

ABOUT MENU

Figure 3-12 shows a block representation of the About menu. If you press the button next to the word “About” in the display, the first About submenu is displayed.

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

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

Model submenu: This submenu shows the genset model.

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

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

ABOUT MENU

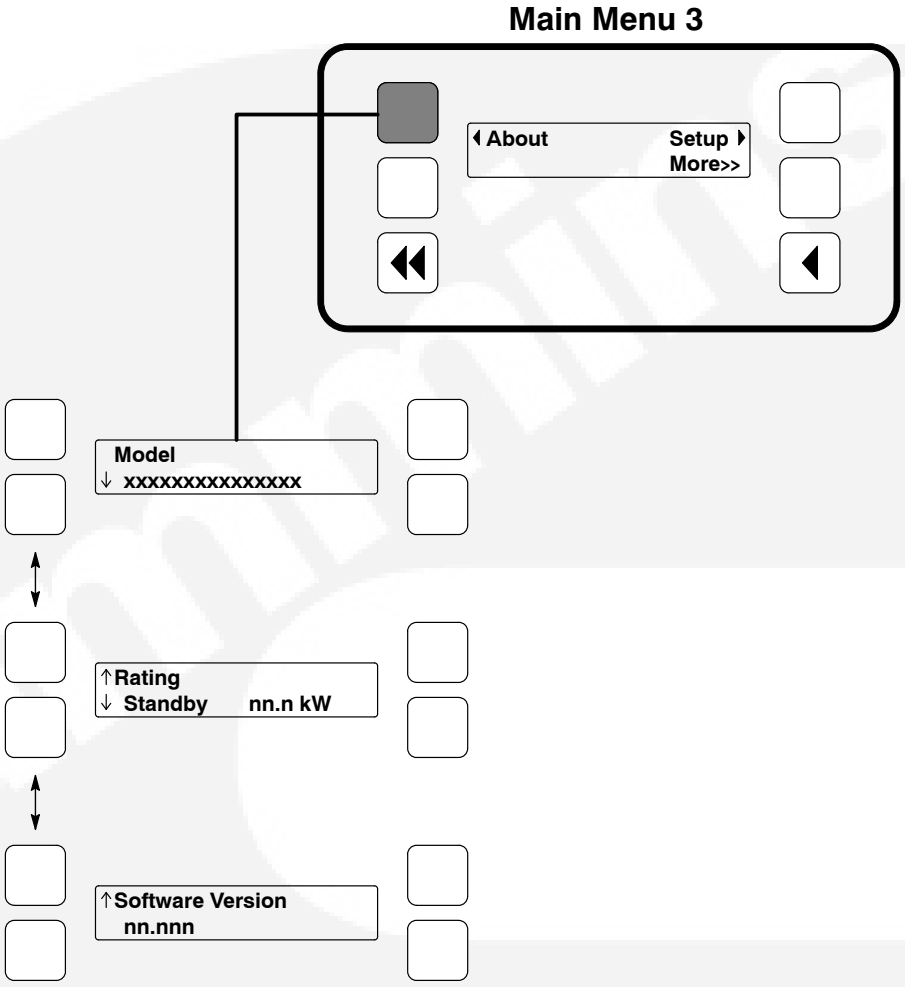

FIGURE 3-12. ABOUT MENU

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4. Circuit Boards

GENERAL

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

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

This section describes the function of the PowerCommand® 2100 Control (PCC) base circuit board that is contained in the control panel box (Figure 4-1). The block diagram in Figure 4-2, shows the external connections of the PCC system. The system schematics are provided in *Section 7* of this manual.

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

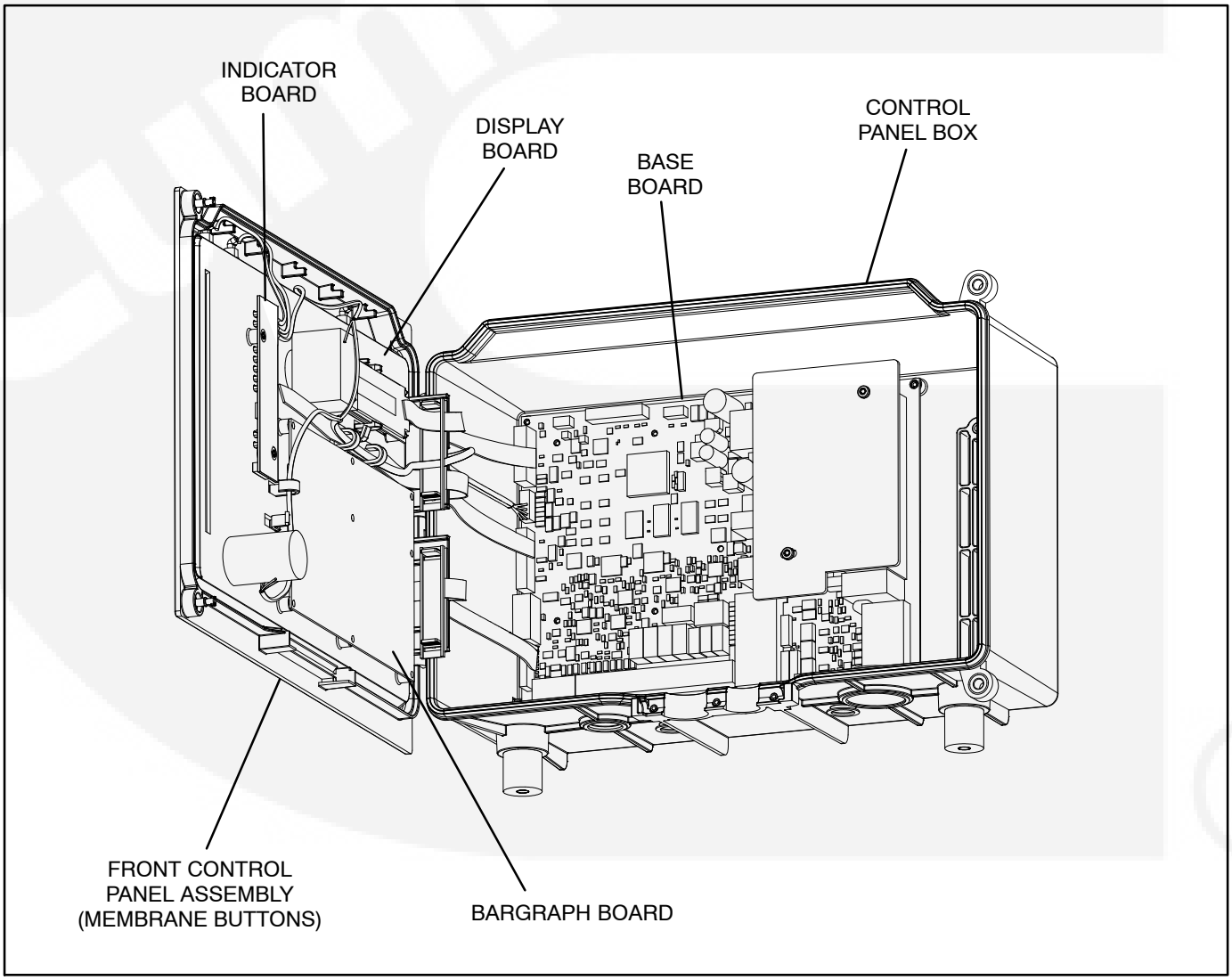

FIGURE 4-1. CIRCUIT BOARD LOCATIONS

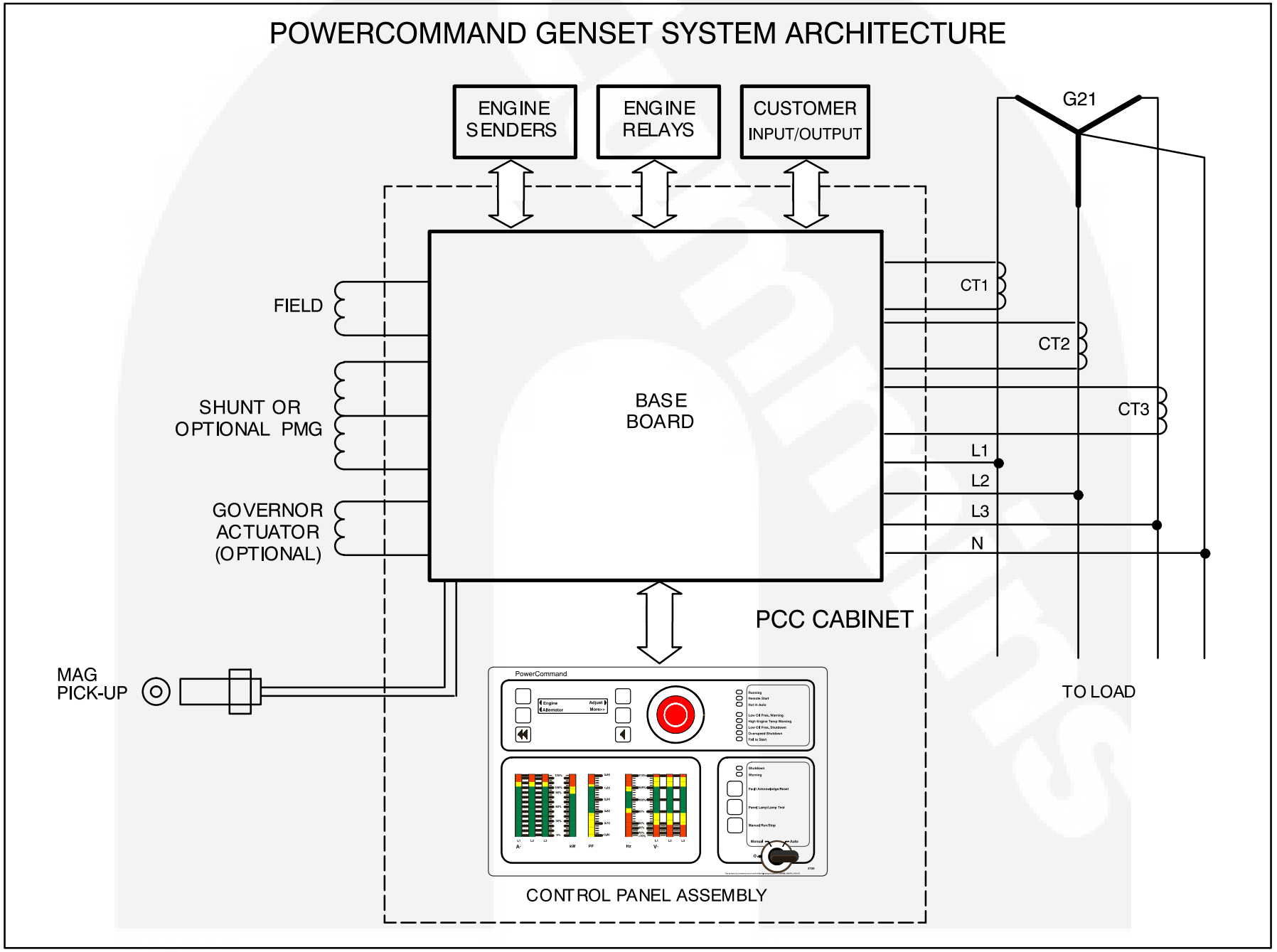

FIGURE 4-2. BLOCK DIAGRAM

BASE BOARD

The base circuit board (Figure 4-3) contains all of the electronic circuitry required to operate the generator set. The Base board provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring.

The following paragraphs describe each of the connectors (J), fuses (F) and terminal boards (TB) shown in Figure 4-3.

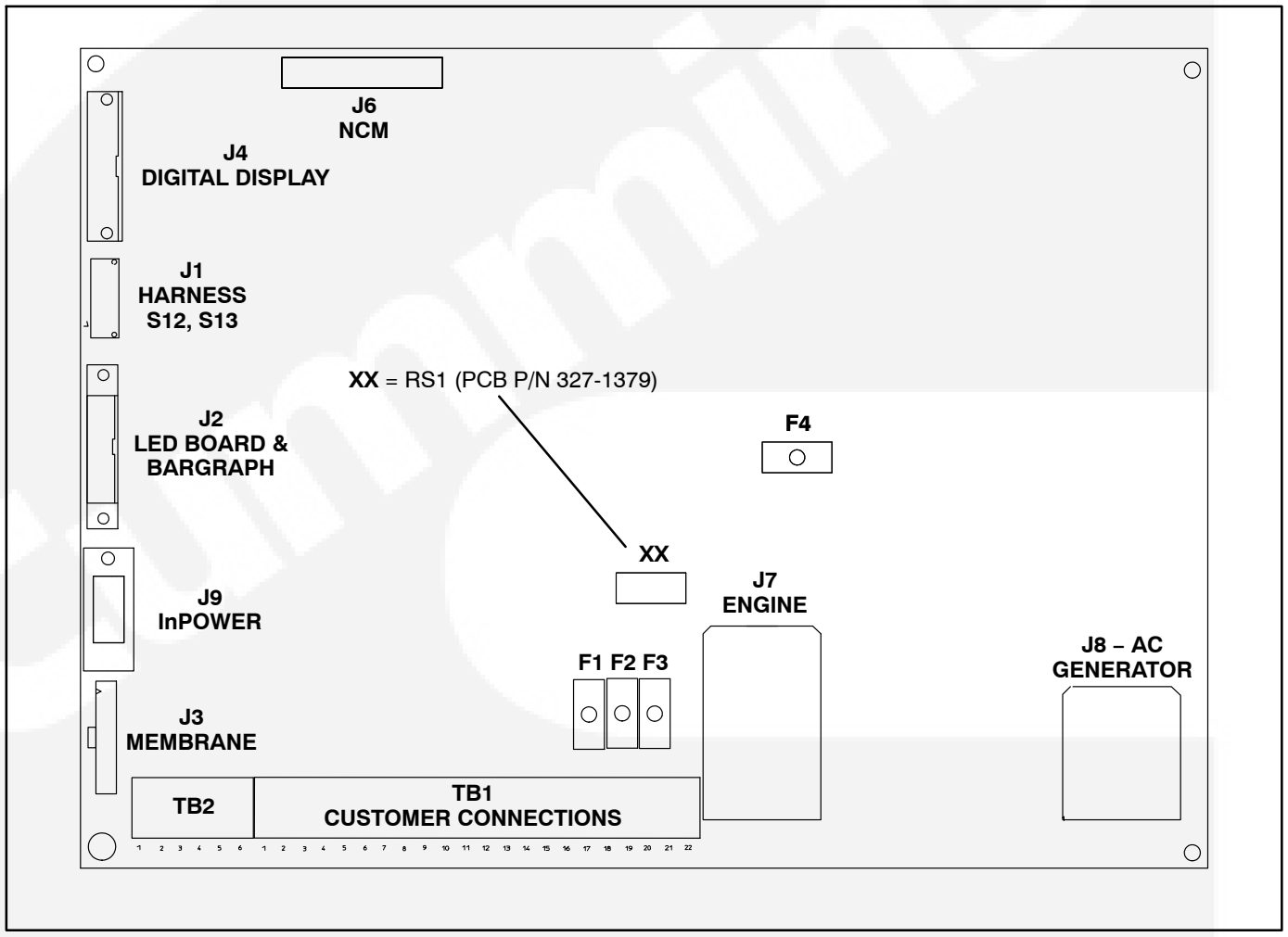

FIGURE 4-3. BASE BOARD

Connector J1

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

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

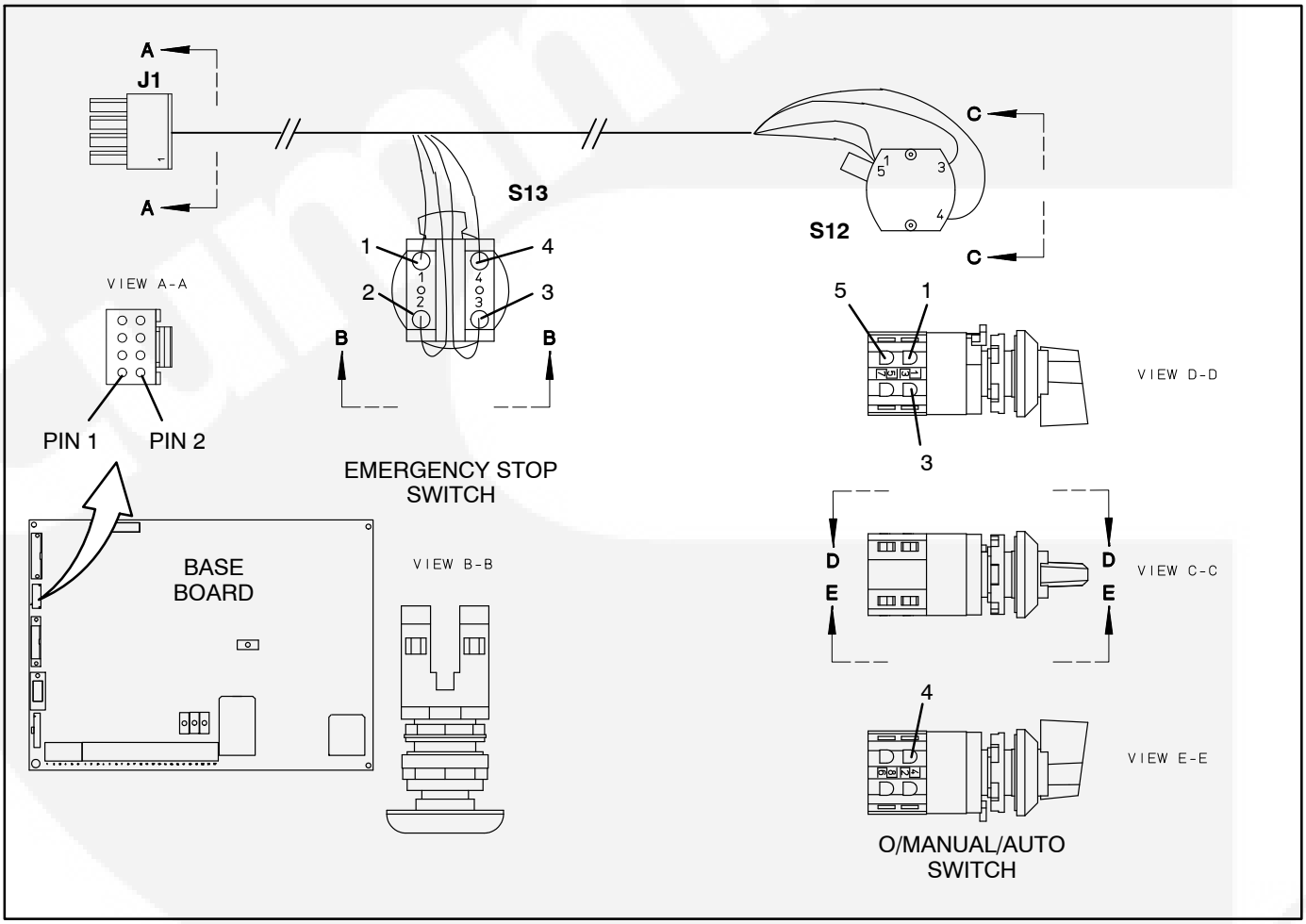

FIGURE 4-4. CONNECTOR J1 (CONTROL HARNESS)

Connector J2

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

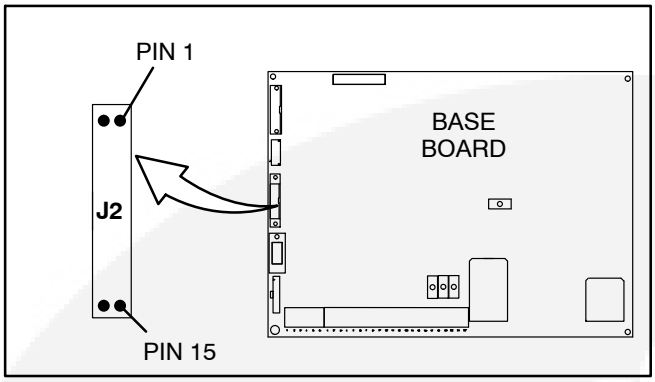

FIGURE 4-5. J2 LED/BARGRAPH CONNECTOR

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.

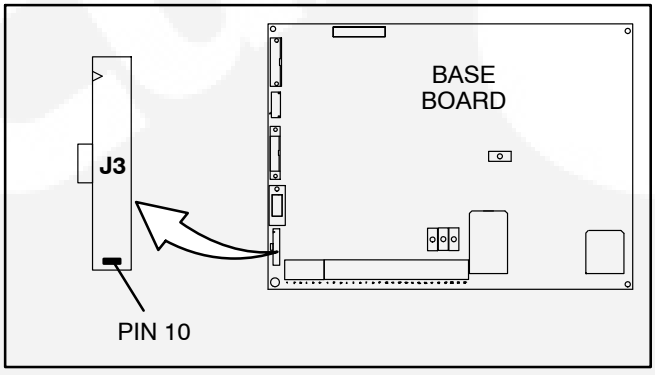

FIGURE 4-6. J3 MEMBRANE CONNECTOR

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.

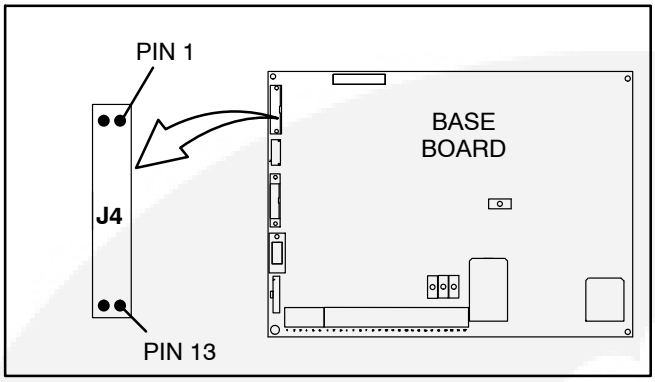

FIGURE 4-7. J4 DISPLAY MENU CONNECTOR

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

Connector J7

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

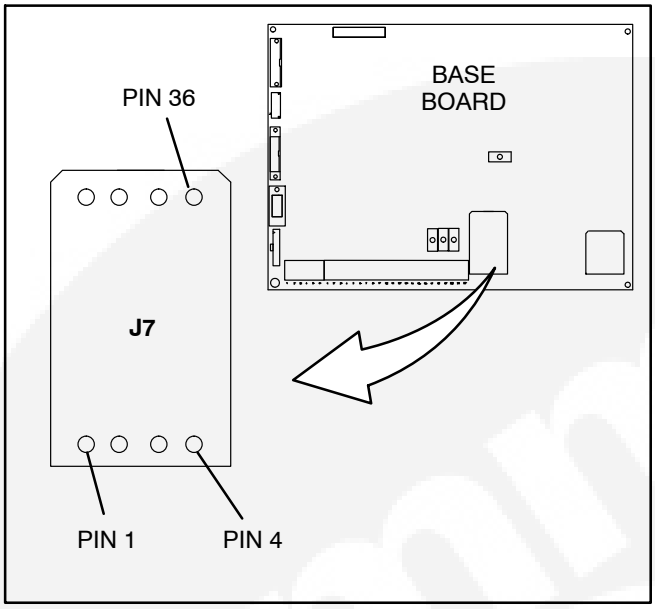

FIGURE 4-8. J7 ENGINE HARNESS CONNECTOR

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

Connector J8

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

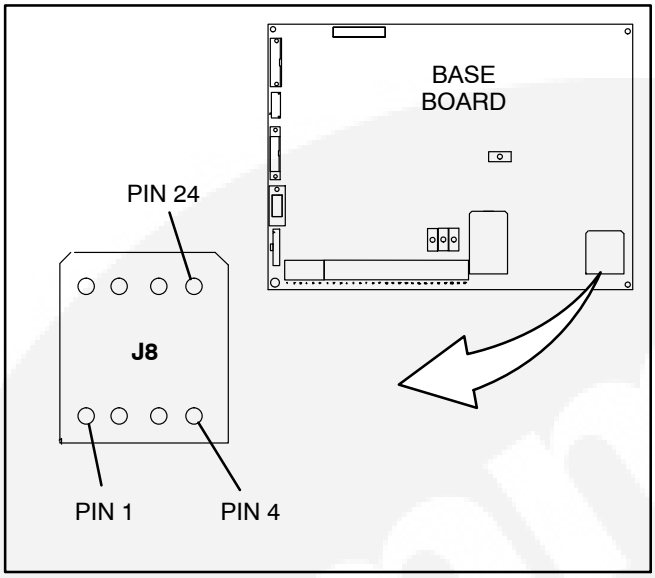

FIGURE 4-9. J8 AC GENERATOR CONNECTOR

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

TABLE 4-1. BASE BOARD FUSES

REFERENCE DESIGNATION	RATING	FUNCTION
F1	10A	Customer B+ (to TB1 customer terminal block)
F2	5A	Customer switched B+ (to TB1 customer terminal block)
F3	2A	Customer switched B+ (to T26 engine terminal block)
F4	5A	Base board power supply fuse
RS1 (Fuse/Auto Reset)	0.9A	B+ supply to future optional features

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 7* for TB1 connections.

5. Troubleshooting

GENERAL

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

INPOWER SERVICE TOOL

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

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

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

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

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

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

NETWORK APPLICATIONS AND CUSTOMER INPUTS

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

SAFETY CONSIDERATIONS

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

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

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

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

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

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

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

1. Move the O/Manual/Auto switch on the control panel to the O position.
2. Turn off or remove AC power from the battery charger.
3. Remove the negative (–) battery cable from the generator set starting battery.

TROUBLESHOOTING PROCEDURE

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

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

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

This section contains the following information:

- **Table 5-1 and 5-2:** Describes how to troubleshoot a local/remote fail to crank problem when control panel does not indicate fault condition.
- **Table 5-3:** Describes each status, warning and shutdown code, warning and shutdown limits where applicable, and basic corrective actions, such as, checking fluid levels, control reset functions, battery connections, etc.
- **Fault Code Tables:** Provide detailed troubleshooting procedures. In the following tables, the fault codes are used as the table reference number and are arranged in numeric order.

Figure 5-1 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 7*.

⚠ 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.***

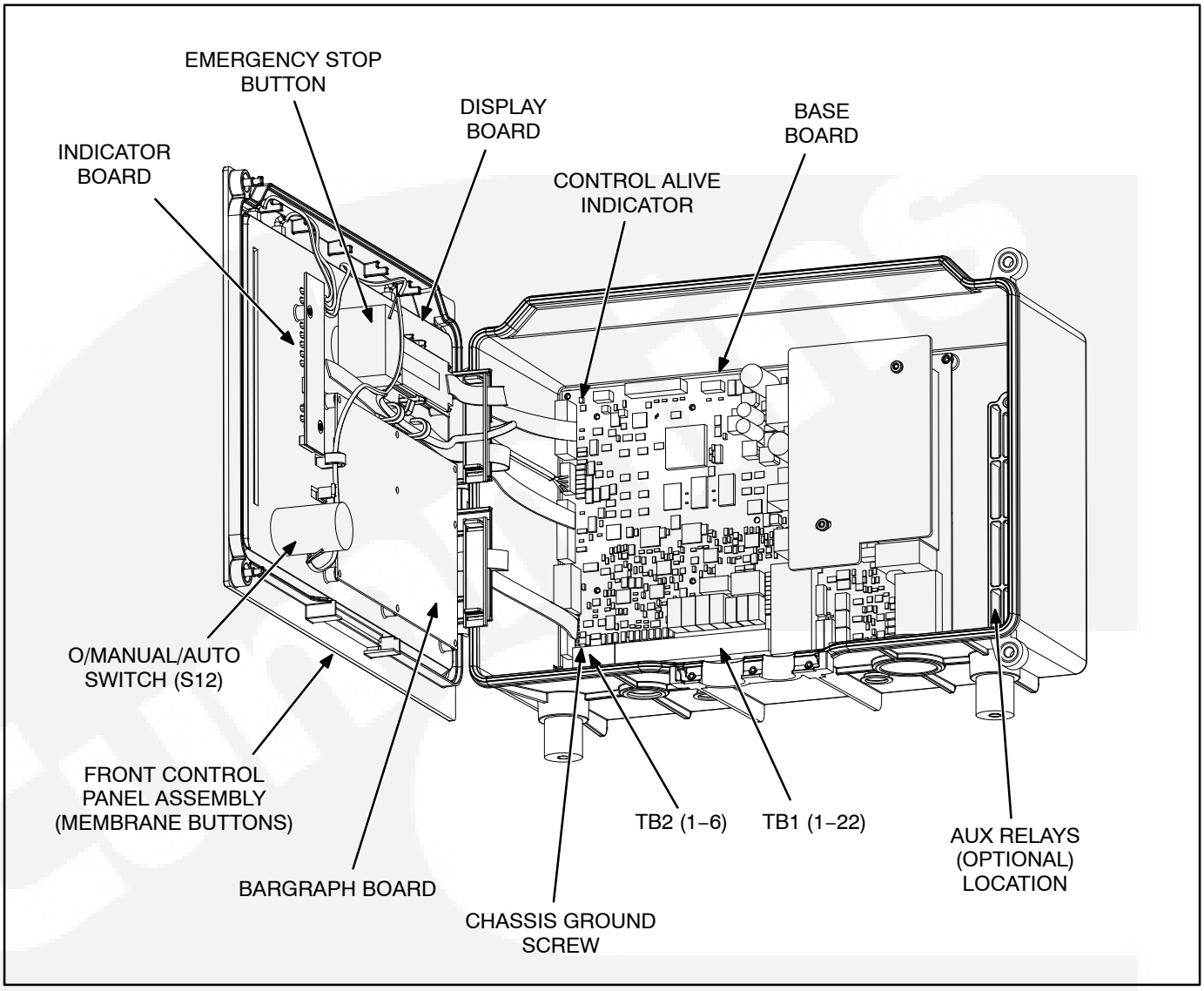

FIGURE 5-1. PCC CONTROL COMPONENTS

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

TABLE 5-1. ENGINE DOES NOT CRANK IN MANUAL MODE (NO FAULT MESSAGE)

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

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

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TABLE 5-2. ENGINE DOES NOT CRANK IN REMOTE MODE (NO FAULT MESSAGE)

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

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

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TABLE 5-3. WARNING AND SHUTDOWN CODES

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

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TABLE 5-3. WARNING AND SHUTDOWN CODES (CONT.)

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

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TABLE 5-3. WARNING AND SHUTDOWN CODES (CONT.)

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

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TABLE 5-3. WARNING AND SHUTDOWN CODES (CONT.)

FAULT CODE	CORRECTIVE ACTION
1335 **NONCRIT SCALER OR** Lamp: Warning	Incorrect feature or calibration was entered into control.
1416 **FAIL TO SHUTDOWN** Lamp: Warning	Genset continues to run after receiving shutdown command from the controller. Battle Short feature enabled – used to bypass several critical fault shutdowns for genset operation during emergencies.
1417 **POWER DOWN ERROR** Lamp: Warning	Indicates that the controller can not power down because of some unknown condition. Possible drain on battery.
1433 **EMERGENCY STOP** Lamp: Shutdown	Indicates local Emergency Stop. To reset the local/remote Emergency Stop button: 1. Pull the button out. 2. Move the O/Manual/Auto switch to O. 3. Press the front panel Fault Acknowledge/Reset button. 4. Select Manual or Auto, as required.
1434 **REMOTE E-STOP** Lamp: Shutdown	Indicates remote Emergency Stop. See code **1433** to reset.
1435 **LOW COOLANT TEMP** Lamp: Warning Set is not operating. Warning occurs when engine coolant temperature is 70° F (21° C) or lower. **NOTE: In applications where the ambient temperature falls below 40° F (4° C), Low Coolant Temp may be indicated even though the coolant heaters are operating.**	Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: a. Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. c. Open heater element. Check current draw of heater. Coolant temperature must be below 70° F (default setting) for one minute to activate warning and be above 70° F for five minutes before the warning can be cleared.
1438 **FAIL TO CRANK** Lamp: Shutdown	Indicates possible fault with control, speed sensing or starting system.
1441 **LOW FUEL LEVEL** Lamp: Warning	Indicates the fuel level has fallen below the warning trip point. Allow the engine to cool down completely before proceeding. a. Check the fuel level and replenish if getting low. b. Reset the control and restart after correcting the problem.
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.

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TABLE 5-3. WARNING AND SHUTDOWN CODES (CONT.)	
FAULT CODE	**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.
1447 **LOW AC VOLTAGE** Lamp: Shutdown	Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds.
1448 **UNDER FREQUENCY** Lamp: Shutdown	Indicates that engine speed has dropped below 90% of nominal for 10 seconds. Check fuel supply, intake air supply and load.
1449 **OVER FREQUENCY** Lamp: Warning	Indicates frequency is 10% above base frequency for 20 seconds.
1452 **GEN CB NOT CLOSE** Lamp: Warning	Refer to Section 6.
1453 **GEN CB NOT OPEN** Lamp: Warning	Refer to Section 6.
1459 **REVERSE POWER** Lamp: Shutdown	Indicates improper CT phasing. Check wiring to voltage sense circuit. Refer to CT Installation in *Section 6.*
1461 **LOSS OF FIELD** Lamp: Shutdown	Indicates loss of field (electric) due to reverse kVAR.
1466 **MODEM FAILURE** Lamp: Warning	Indicates that control can not communicate with the modem. Check for open, short circuit to ground, and loose connections to the modem.
1468 **NETWORK ERROR** Lamp: Warning	Indicates momentary loss of communication from the LonWorks Network. Refer to the LonWorks Network publications for more specific troubleshooting methods.
1469 **SPEED/HZ MATCH** Lamp: Shutdown	Indicates that measured speed and measured AC output frequency do not agree. Check calibration file.

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TABLE 5-3. 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.)
1853 thru **1855** **ANNUNCIATOR FAULT 1 thru 3** Lamp: None	Indicates that Universal Annunciator Input (#1 – #3) is an active state. The Service Tool can be used to program each of the fault functions and change the response from None to Warning or Shutdown.
1917 **HIGH FUEL LEVEL** Lamp: Warning	Indicates the fuel level has risen above the warning trip point. Allow the engine to cooldown completely before proceeding. a. Check fuel level. b. Reset the control and restart after correcting the problem.
1918 **VERY LOW FUEL LEVEL** Lamp: Shutdown	Indicates that the fuel level has fallen below the shutdown trip point. a.Check the fuel level and replenish if low. Look for possible leakage points and repair if necessary. b. Reset the control and restart after correcting the problem
1978 **SPEED BIAS OOR HIGH** Lamp: Warning	Indicates the control has sensed the signal into the AUX101 (if installed) speed bias input is shorted high. Check connection/wires.
1979 **SPEED BIAS OOR LOW** Lamp: Warning	Indicates the control has sensed the signal into the AUX101 (if installed) speed bias input is shorted low. Check connection/wires.
2222 **FUEL LEVEL SENSOR HIGH** Lamp: Warning	Indicates the control has sensed the fuel level signal is shorted high. Check sender/connectors/wires.
2223 **FUEL LEVEL SENSOR LOW** Lamp: Warning	Indicates the control has sensed the fuel level signal is shorted low. Check sender/connectors/wires.
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 a control memory error. Data corruption of critical operating parameters. Try reloading the calibration file.

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TABLE 5-3. WARNING AND SHUTDOWN CODES (CONT.)	
FAULT CODE	**CORRECTIVE ACTION**
2341 **HIGH CONTROL TEMP** Lamp: Warning	The control temperature is above normal (158° F [70° C]) for a time greater than control temperature set time. Check the genset room air flow.
2342 **TOO LONG IN IDLE** Lamp: Warning	Indicates the genset has been in Idle mode too long. Exit idle mode.
2539 **VOLTAGE BIAS OOR HIGH** Lamp: Warning	Indicates the control has sensed the signal into the AUX101 (if installed) voltage bias input is shorted high. Check connection/wires.
2541 **VOLTAGE BIAS OOR LOW** Lamp: Warning	Indicates the control has sensed the signal into the AUX101 (if installed) voltage bias input is shorted low. Check connection/wires.
2542 **BIAS SIGNAL LOST** Lamp: Shutdown	Indicates the control has sensed that the speed or voltage bias signals coming from the AUX101 (if installed) are lost. a. Check PCCNet connections/wires. b. Reset the control and restart after correcting the problem.
2967 **GOVERNOR FAULT** Lamp: Warning	The governor hardware drive circuitry contains a fault condition.
2968 **AVR FAULT** Lamp: Warning	Indicates the AVR hardware contains a fault condition.
2969 **LON FAILURE** Lamp: Warning	Indicates there are no communications with the LonWorks board.
2972 **FIELD OVERLOAD** Lamp: Shutdown	The AVR Field has been at Max Field for a time greater than the allowed Max Field Time.

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CODE 121 – SPEED SIGNAL LOST (SHUTDOWN)

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

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

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CODE 135 – OIL PRESSURE SENSOR HIGH (WARNING)

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

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

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CODE 141 – OIL PRESSURE SENSOR LOW (WARNING)

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

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

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

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

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

CODE 144 – COOLANT SENSOR HIGH (WARNING)

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

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

CODE 145 – COOLANT SENSOR LOW (WARNING)

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

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

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

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

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

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

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

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

CODE 212 – OIL TEMPERATURE SENSOR HIGH (WARNING)

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

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

CODE 213 – OIL TEMPERATURE SENSOR LOW (WARNING)

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

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

CODE 234 – OVERSPEED (SHUTDOWN)

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Cold engine (no coolant heaters)	1. Overspeed can occur when starting a vary cold engine. Clear fault and restart genset.
2. Single step large block load removal.	2. Clear fault and restart genset.
3. Fault simulation was enabled with InPower.	3. 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.
4. Fault threshold is not set correctly with InPower.	4. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
5. Monitor the engine rpm using InPower.	5. If the RPM is not correct, refer to fault code 121 for corrective action.
6. The electronic governor actuator could be bad.	6. Binding in actuator assembly of injection pump. Disassembly of injection pump may be required to inspect/repair O-rings, pump, etc. Refer to the engine service manual.

CODE 235 – LOW COOLANT LEVEL (SHUTDOWN)

Reason: Engine coolant level has dropped below shutdown threshold.
Effect: Engine will shut down.

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

CODE 359 – FAIL TO START (SHUTDOWN)
4B OR 6B MECHANICAL GOVERNED ENGINE

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Restricted fuel supply due to:	
a. Fuel level below pickup tube in tank.	1a. Add fuel if low. Prime the fuel system.
b. Closed shutoff valve in supply line.	1b. Open any closed shutoff valve in the fuel line supplying the engine.
c. Fuel injectors clogged.	1c. Refer to engine service manual.
d. Air in fuel system.	1d. Bleed air from fuel system. Refer to engine service manual.
2. Fuel solenoid (K1) on the injection pump not energized due to:	Isolate to harness, K1 fuel solenoid or Base board.
a. Fuel solenoid (K1) is bad.	2a. Attempt to start and check for CNTL B+ at the fuel solenoid coil. • If CNTL B+ is present, fuel solenoid may be defective. (To test solenoid, connect B+ to fuel solenoid terminal. Replace the fuel solenoid if it does not “click” when energized.) • If CNTL B+ is not present, harness or Base board is bad (go to step 2b).
b. Harness or Base board is bad.	2b. Install harness tool between Base board P7 connector. Attempt to start and check for CNTL B+ at P7-24 (K1+). • If there is no CNTL B+, the Base board is bad. • If there is CNTL B+, repair harness as necessary.

CODE 359 – FAIL TO START (SHUTDOWN)
4B, 6B OR 6C–NON TIER II ELECTRONIC GOVERNED ENGINE

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Restricted fuel supply due to:	
a. Fuel level below pickup tube in tank.	1a. Add fuel if low. Prime the fuel system.
b. Closed shutoff valve in supply line.	1b. Open any closed shutoff valve in the fuel line supplying the engine.
c. Fuel injectors clogged.	1c. Refer to engine service manual.
d. Air in fuel system.	1d. Bleed air from fuel system. Refer to engine service manual.
2. Injection pump actuator not energized due to the harness, governor actuator or the Base board is bad.	Isolate to harness, governor actuator or Base board. 2a. Display "Governor Duty Cycle" menu. Attempt to start and check for duty cycle (44% is about average). If percentage of duty cycle is displayed before shutdown, the harness, actuator or output circuit of Base board is bad, go to step 2b. (Duty cycle displayed indicates processor is functioning, but output circuitry of Base board could still be defective.) If the duty cycle is not displayed, the Base board is bad. 2b. Remove connector P7 from Base board and check wiring continuity of actuator circuit. P7-24 (ACT +) and P7-28 (ACT –) to appropriate +/– terminals of governor actuator. Repair as necessary. If continuity is OK, go to step 2c. 2c. Disconnect the two leads attached to the injection pump actuator. Measure the resistance across the two actuator terminals. A reading of 2.3 ohms indicates that the actuator circuit is OK. (This test only shows that the actuator circuit is not opened or shorted, but not if there is binding.) Replace actuator assembly if open or short is measured. If actuator is OK, go to step 2d. 2d. Attempt to start and check for CNTL B+ at terminal lead ACT + of governor actuator (use engine block for meter ground). If not present, Base board is bad. If CNTL B+ is present, attempt to start and check for GOV PWM (pulse width modulated) signal (measure across terminals of actuator). If not present, Base board is bad. If GOV PWM signal is present, governor actuator is bad (binding in actuator assembly of injection pump). Disassembly of injection pump may be required to inspect/repair O-rings, pump, etc. (Refer to engine service manual.)

CODE 359 – FAIL TO START (SHUTDOWN) (6C MECHANICAL GOVERNED ENGINE)

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Restricted fuel supply due to:	
a. Fuel level below pickup tube in tank.	1a. Add fuel if low. Prime the fuel system.
b. Closed shutoff valve in supply line.	1b. Open any closed shutoff valve in the fuel line supplying the engine.
c. Fuel injectors clogged.	1c. Refer to engine service manual.
d. Air in fuel system.	1d. Bleed air from fuel system. Refer to engine service manual.
2. Fuel solenoid (K1) on the injection pump not energized due to: a. Fuse F1 of harness assembly may be open. b. Fuse F3 on Base board may be open. c. K12 Fuel Pilot Relay or fuel solenoid (K1) is bad. d. Base board is bad.	Isolate to F1, F3, K12 relay, K1 solenoid or Base board. 2a. Remove fuse F1 (located near TB BAT terminal on engine block) and check continuity. If open, replace the fuse with one of the same type and amp rating (15 Amps.) If fuse reopens, check wiring continuity of fuel solenoid circuit/test fuel solenoid. Binding in the solenoid linkage can prevent activation of the hold coil circuitry in the solenoid. Not switching from pull to hold will cause extended high current drain and opening of fuse F1. Make sure solenoid shaft moves completely in and out freely. 2b. Remove fuse F3 (located on Base board) and check continuity. If open, replace the fuse with one of the same type and amp rating (2 Amps.) If fuse reopens, check wiring continuity/test K12 relay. 2c. Attempt to start and check for B+ at the fuel solenoid coil. • If B+ is present, fuel solenoid may be bad. (To test solenoid, measure the resistance of the solenoid coils as follows. (Manually move the shaft in and out to open/close internal hold/pull winding switch for this test.) With shaft in extended position (free state) (switch in pull position) – OK if approximately 0.5 ohms. With shaft manually pushed in (simulated energized state) (switch in hold position) – OK if approximately 11.5 ohms. • If B+ is not present, check wiring continuity/test K12 relay or the Base board is bad, go to step 2d. 2d. Install harness tool between Base board P7 connector. Attempt to start and check for B+ at P7-9 and ground at P7-10. If there is no B+/GND, the Base board is bad.

CODE 359 – FAIL TO START (SHUTDOWN)
6C–TIER II ELECTRONIC GOVERNED ENGINE

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Restricted fuel supply due to:	
a. Fuel level below pickup tube in tank.	1a. Add fuel if low. Prime the fuel system.
b. Closed shutoff valve in supply line.	1b. Open any closed shutoff valve in the fuel line supplying the engine.
c. Fuel injectors clogged.	1c. Refer to engine service manual.
d. Air in fuel system.	1d. Bleed air from fuel system. Refer to engine service manual.

CODE 359 – FAIL TO START (SHUTDOWN)
6C–TIER II ELECTRONIC GOVERNED ENGINE (CONT.)

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

POSSIBLE CAUSE	CORRECTIVE ACTION
2. Fuel solenoid (K1) not energized due to:	Isolate to F1, F3, K12 relay, K1 solenoid or Base board. (K1 solenoid shaft should pull completely in and remain in this position during genset start/run.)
a. Fuse F1 of harness assembly may be open. b. Fuse F3 on Base board may be open. c. Base board is bad. d. K12 Fuel Pilot Relay is bad. e. Timer module is bad. f. Fuel solenoid (K1) is bad.	2a. Remove fuse F1 (located near TB BAT terminal on engine block) and check continuity. If open, replace the fuse with one of the same type and amp rating (15 Amps.) If fuse reopens, check wiring continuity of fuel solenoid circuit/test fuel solenoid. (Go to step for solenoid test.) 2b. Remove fuse F3 (located on Base board) and check continuity. If open, replace the fuse with one of the same type and amp rating (2 Amps.) If fuse reopens, check wiring continuity/test K12 relay coil. 2c. Install harness tool between Base board P7 connector. Attempt to start and check for B+ at P9-9 (GEN SW B+) and P7-10 (FUEL SOL–). (These are the leads to the K12 coil.) • If there is no B+, the Base board is bad. • If there is B+, K12 or the harness is bad. Go to step 2d. 2d. Attempt to start and check for B+ IN (K12-1) and OUT (K12-4) • If there is no B+ IN, check for open circuit. • If There is B+ IN and not OUT, K1 is bad. • If there is B+ OUT, timer module, fuel solenoid or the harness is bad. Check circuit between K12-4 and timer module. Go to step 2e. 2e. Disconnect plug leading from the timer module to fuel solenoid (K1). Attempt to start and check for B+ at output connector of timer module. • Connect meter leads between pin C (GND) and pin B (PULL COIL). B+ should be present for approximately 1/2 second during initial start. If not, timer module is bad. • Connect meter leads between pin C (GND) and pin A (HOLD COIL). If there is no B+ (during start and run), timer module is bad. If there is B+, solenoid is bad. Go to step 2f. 2f. Disconnect plug leading from the timer module to fuel solenoid (K1). Measure the resistance of the fuel solenoid coils as follows. • Measure the resistance from pin A (HOLD COIL) to pin C (GND). OK if approximately 14.2 ohms. • Measure the resistance from pin B (PULL COIL) to pin C (GND). OK if approximately 0.5 ohms.

CODE 359 – FAIL TO START (SHUTDOWN)
6C–TIER II ELECTRONIC GOVERNED ENGINE (CONT.)

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

POSSIBLE CAUSE	CORRECTIVE ACTION
3. Injection pump actuator not energized due to the harness, governor actuator or the Base board is bad.	Isolate to harness, governor actuator or Base board. 3a. Display "Governor Duty Cycle" menu. Attempt to start and check for duty cycle (44% is about average). If percentage of duty cycle is displayed before shutdown, the harness, actuator or output circuit of Base board is bad, go to step 3b. (Duty cycle displayed indicates processor is functioning, but output circuitry of Base board could still be defective.) If the duty cycle is not displayed, the Base board is bad. 3b. Remove connector P7 from Base board and check wiring continuity of actuator circuit. P7-24 (ACT +) and P7-28 (ACT –) to appropriate +/– terminals of governor actuator. Repair as necessary. If continuity is OK, go to step 3c. 3c. Disconnect the two leads attached to the injection pump actuator. Measure the resistance across the two actuator terminals. A reading of 1.6 ohms indicates that the actuator circuit is OK. (This test only shows that the actuator circuit is not opened or shorted, but not if there is binding.) Replace actuator assembly if open or short is measured. If actuator is OK, go to step 3d. 3d. Attempt to start and check for CNTL B+ at terminal lead ACT + of governor actuator (use engine block for meter ground). If not present, Base board is bad. If CNTL B+ is present, attempt to start and check for GOV PWM (pulse width modulated) signal (measure across terminals of actuator). If not present, Base board is bad. If GOV PWM signal is present, governor actuator is bad (binding in actuator assembly of injection pump). Disassembly of injection pump may be required to inspect/repair O-rings, pump, etc. (Refer to engine service manual.)

CODE 415 – LOW OIL PRESSURE (SHUTDOWN)

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

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

CODE 421 – OIL TEMPERATURE (WARNING)

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

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

CODE 441 – LOW BATTERY VOLTAGE (WARNING)

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

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

CODE 442 – HIGH BATTERY VOLTAGE (WARNING)

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

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

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).

CODE 1435 – LOW COOLANT TEMPERATURE (WARNING)

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

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

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

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

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

CODE 1442 – WEAK BATTERY (WARNING)

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

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

CODE 1443 – BATTERY FAILED (SHUTDOWN)

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

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

CODE 1444 – KW OVERLOAD (WARNING)

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

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

CODE 1445 – SHORT CIRCUIT (SHUTDOWN)

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

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

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

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

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

CODE 1446 – HIGH AC VOLTAGE (SHUTDOWN)

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

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with InPower.	1. With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.
2. Single step large block load removal.	2. Clear fault and restart genset.
3. Fault threshold is not set correctly with InPower.	3. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
4. Base board or generator is bad.	⚠ 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.*** 4a. Isolate the power output from the generator set by opening the generator main circuit breaker or using similar appropriate means. 4b. If possible, check the voltage on the output terminals of the machine with the machine running at rated speed. Verify that the AC metering in the generator set control correctly displays generator output voltage. 4c. If incorrect voltage is displayed, troubleshoot voltage sensing harness and circuitry. 4d. If correct voltage is displayed, but it is high, verify that the generator set can operate at proper voltage when exciter is powered from a suitable external source. (Consult alternator documentation for voltage levels and process.) 4e. If voltage is near normal, troubleshoot and replace main circuit board. If voltage is unbalanced, troubleshoot main stator. If voltage is balanced but abnormal, troubleshoot main stator. If voltage is balanced but abnormal, troubleshoot exciter and main field windings.
5. Improper connections have been made at the generator terminals	5. Verify proper alternator connections by referring to the manufacturers documentation and making any necessary corrections.
6. PCC2100 output voltage setting is incorrect.	6. Verify that PCC2100 control voltage selection matches alternator winding voltage selection.
7. The rotating rectifier assembly is faulty.	7. Check each diode according to alternator manufacturer's recommended practice.

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 7*.
5. PMG or field wiring could be bad.	5. Check and repair the PMG or field wiring (*refer to Section 7*).
6. Shunt wiring connection could be incorrect.	6. Check that excitation inputs P8-21 and P8-22 are connected to the correct voltage. If misconnected to a high voltage, the AVR fault will shut down excitation and cause Low AC Voltage condition. (*refer to Section 7*).
7. The rotating rectifier assembly (diodes CR1 through CR6) is faulty.	7. Check each diode (*refer to Section 7*).
8. Loose connector or Base board is bad.	8. Repair connections (P8) or replace the Base board if necessary.

CODE 1448 – UNDER FREQUENCY (SHUTDOWN)

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

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

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.

6. Control Adjustment and Service

GENERAL

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

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

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

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

CIRCUIT BOARD REMOVAL/REPLACEMENT

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

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

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

Refer to the InPower User's Guide for specifics.

Circuit Board Removal Safety Precautions

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

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

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

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

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

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

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

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

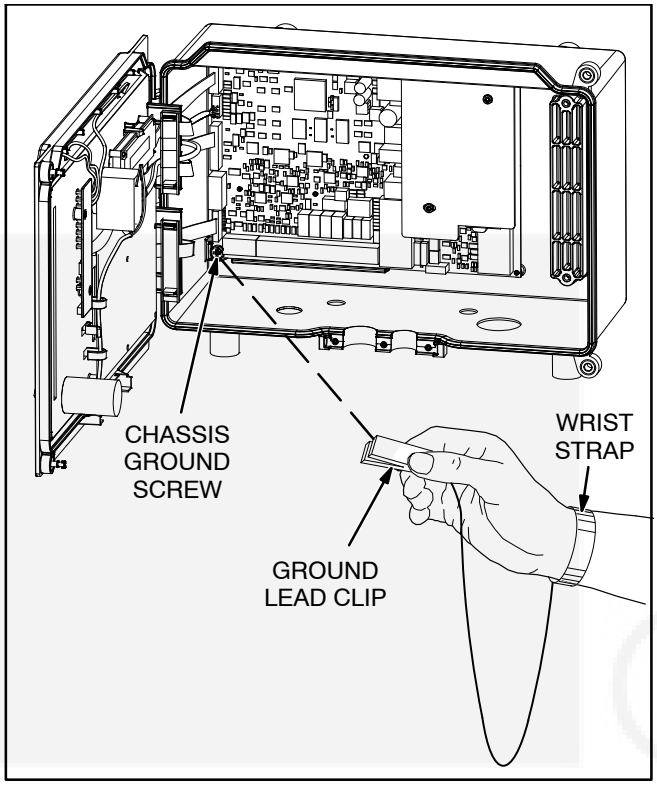

FIGURE 6-1. WRIST STRAP

MODIFYING SETUP SUBMENUS

The Setup submenus allow you to adjust system parameters.

There are 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 6-2 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.

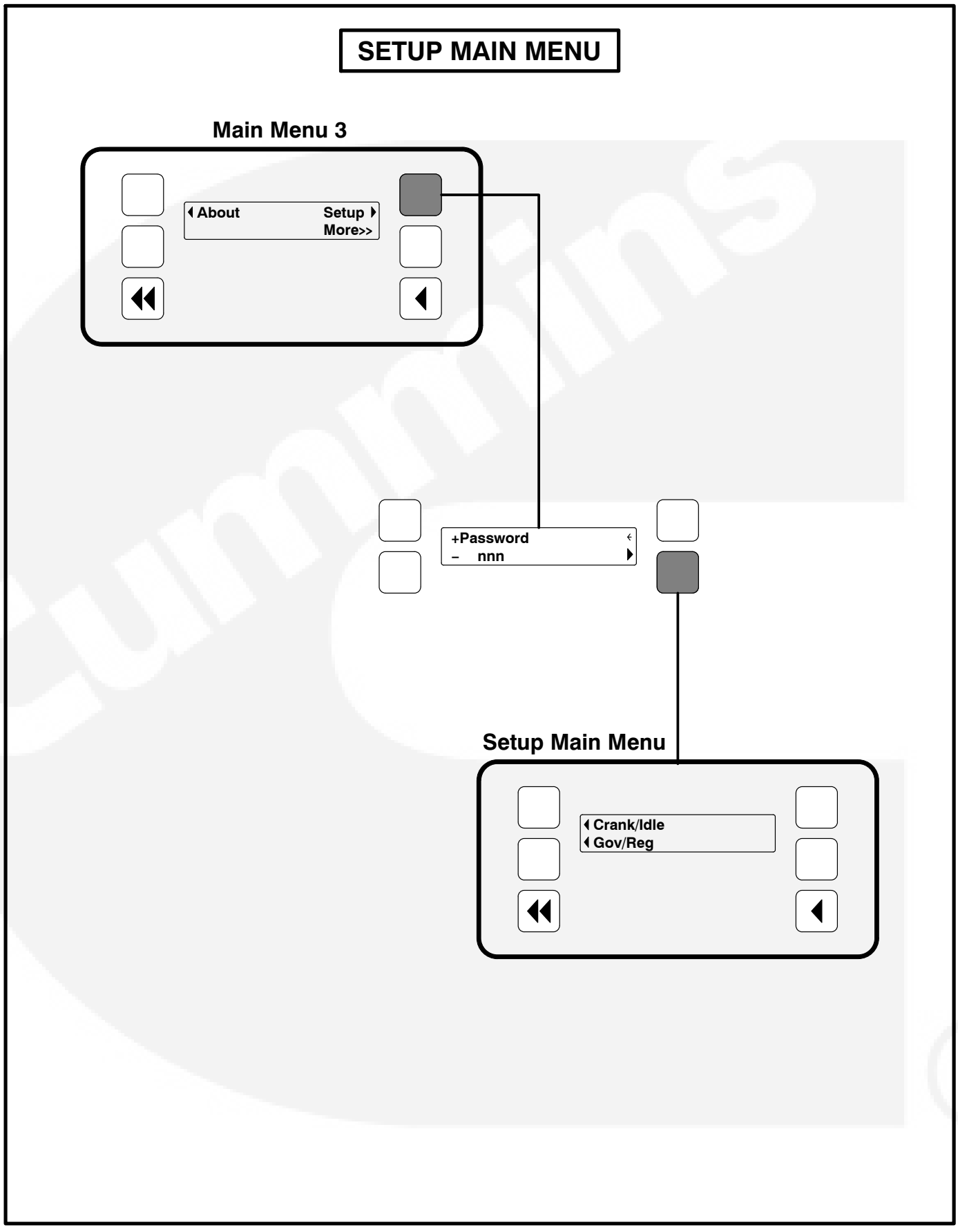

FIGURE 6-2. SETUP MAIN MENU

CRANK/IDLE SETUP MENU

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

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

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

Adjusting Values/Parameters:

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

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

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

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

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

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

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

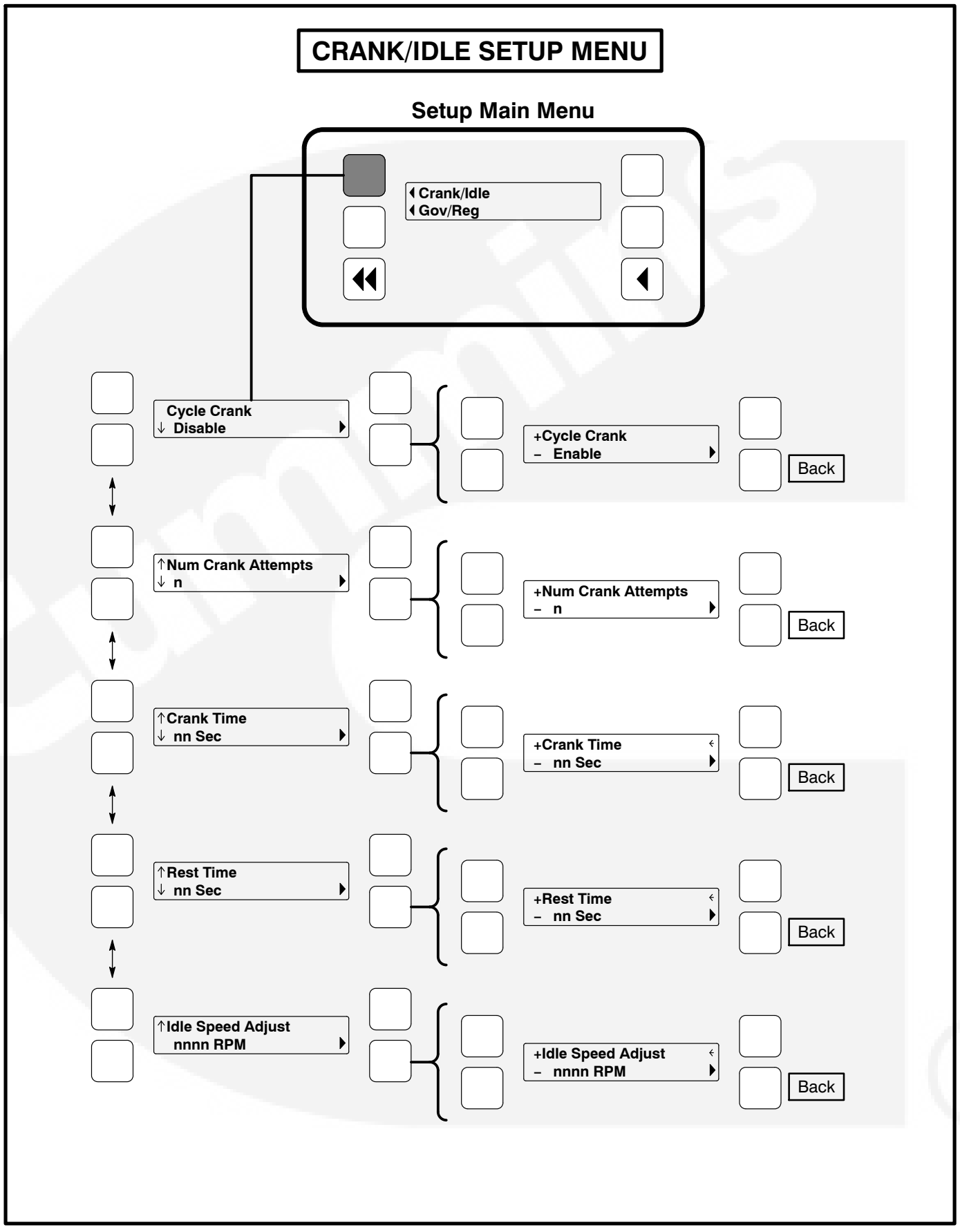

FIGURE 6-3. CRANK/IDLE SETUP MENU

GOVERNOR/REGULATOR SETUP MENU

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

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

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

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

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

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

Adjusting Values/Parameters:

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

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

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

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

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

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

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

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

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

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

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

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

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

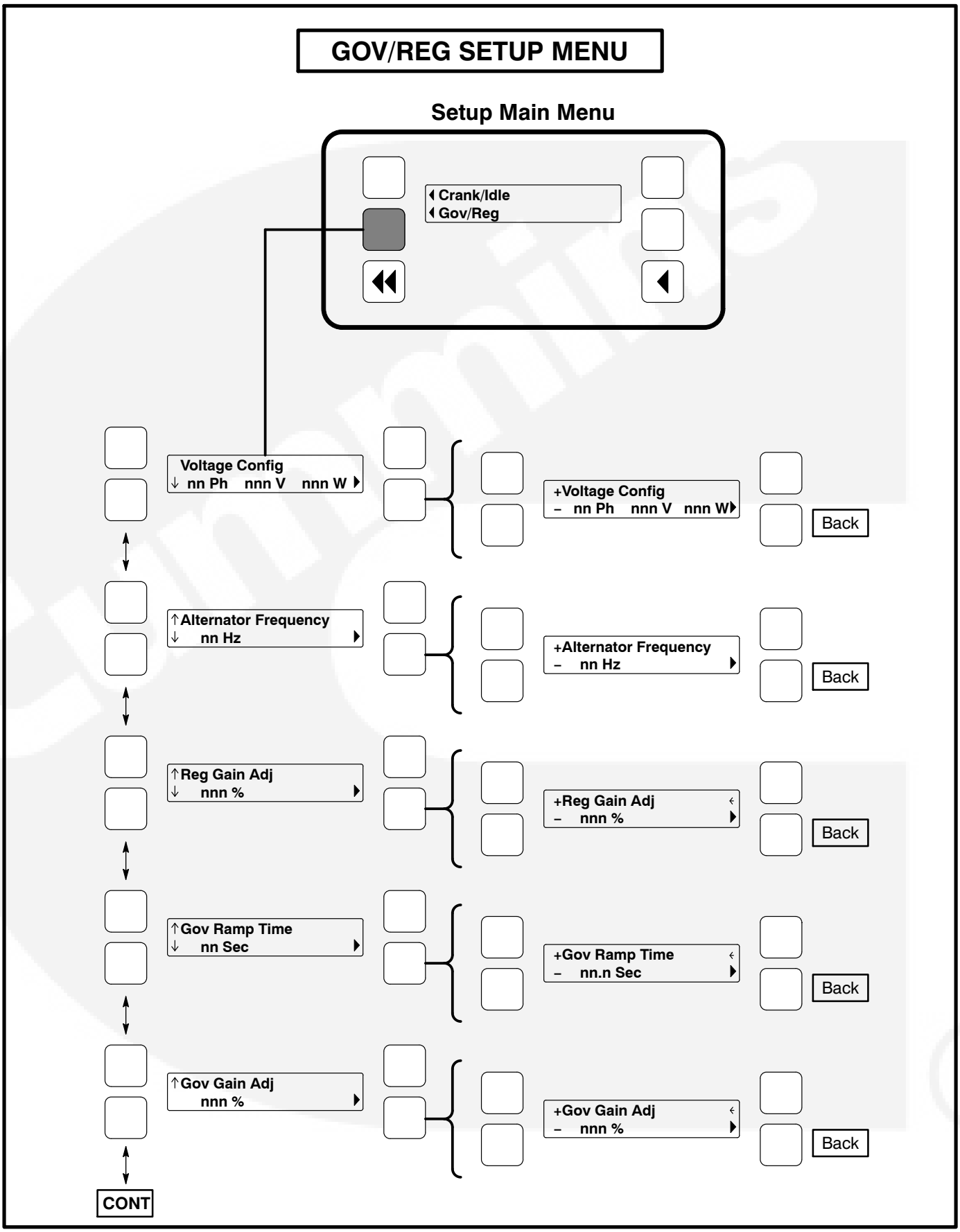

FIGURE 6-4. GOVERNOR/REGULATOR SETUP MENU

GOVERNOR/REGULATOR SETUP MENU (CONT)

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

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

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

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

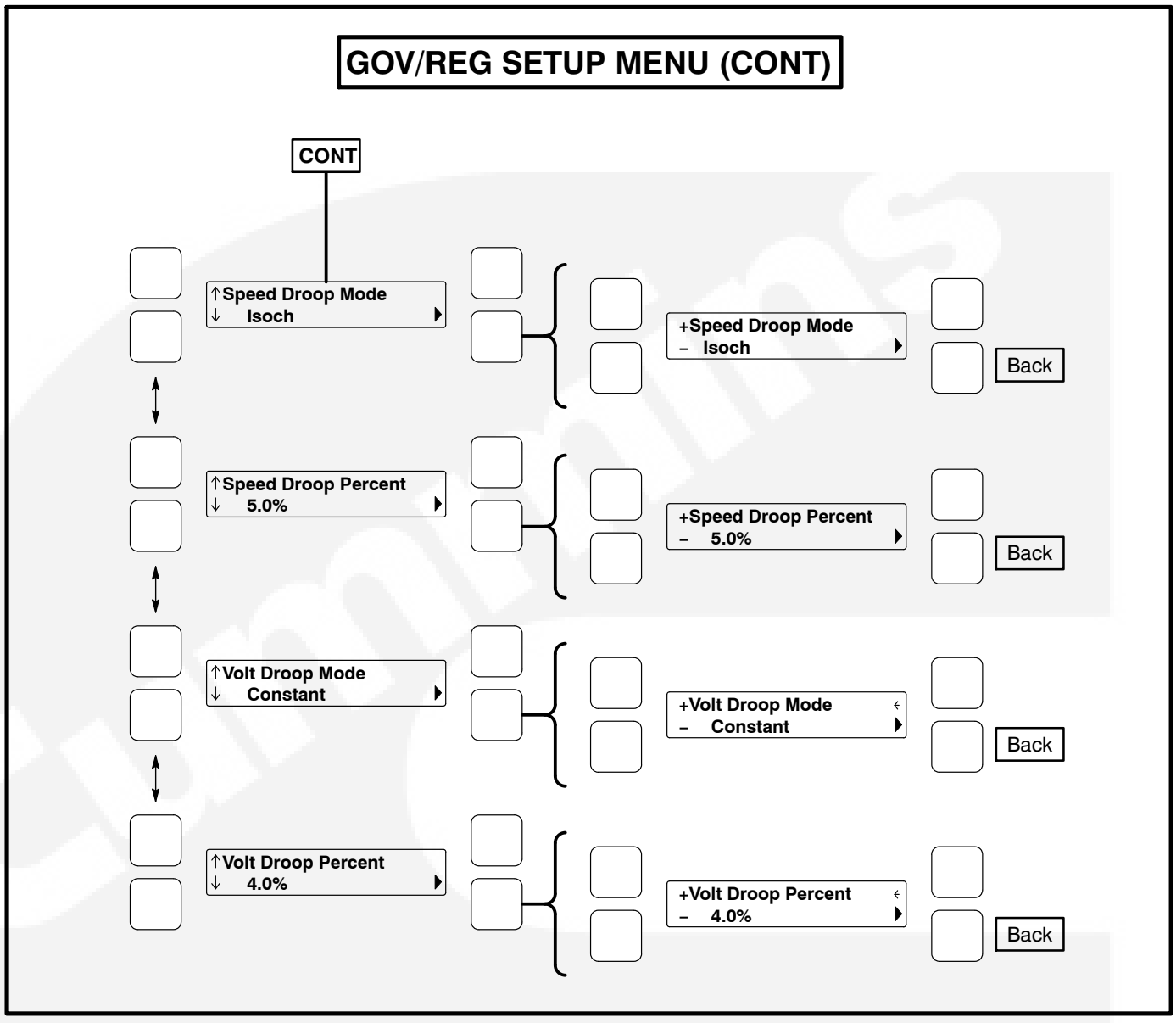

FIGURE 6-4. GOVERNOR/REGULATOR SETUP MENU (CONT)

PCC CONTROL PANEL BOX COMPONENTS (STANDARD/OPTIONAL)

The PCC control panel box (Figure 6-5) contains components that provide connection points for remote control and monitor options. The control panel box can be equipped with one or more of the following components.

Relay K4

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

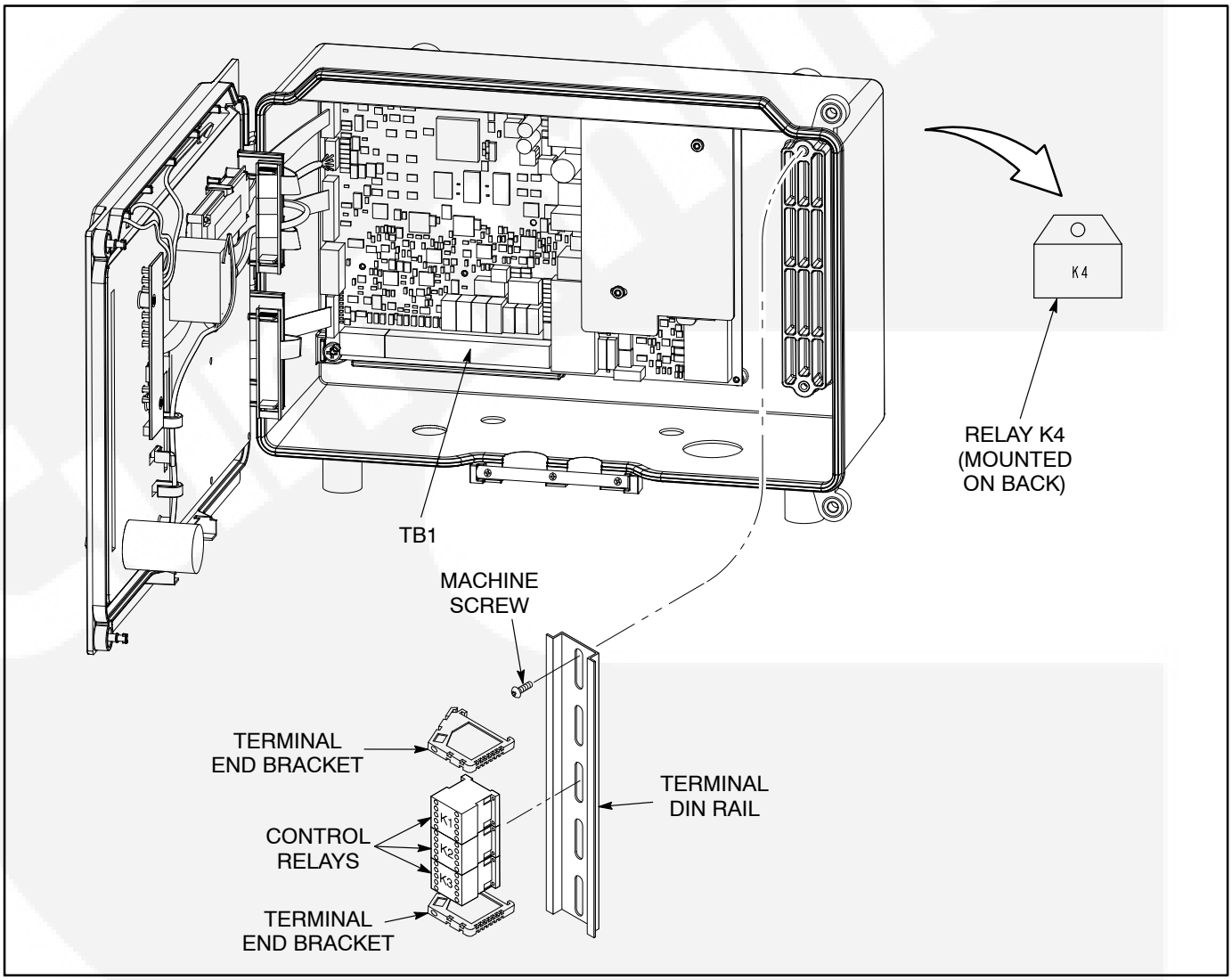

FIGURE 6-5. CIRCUIT BOARD LOCATIONS

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.

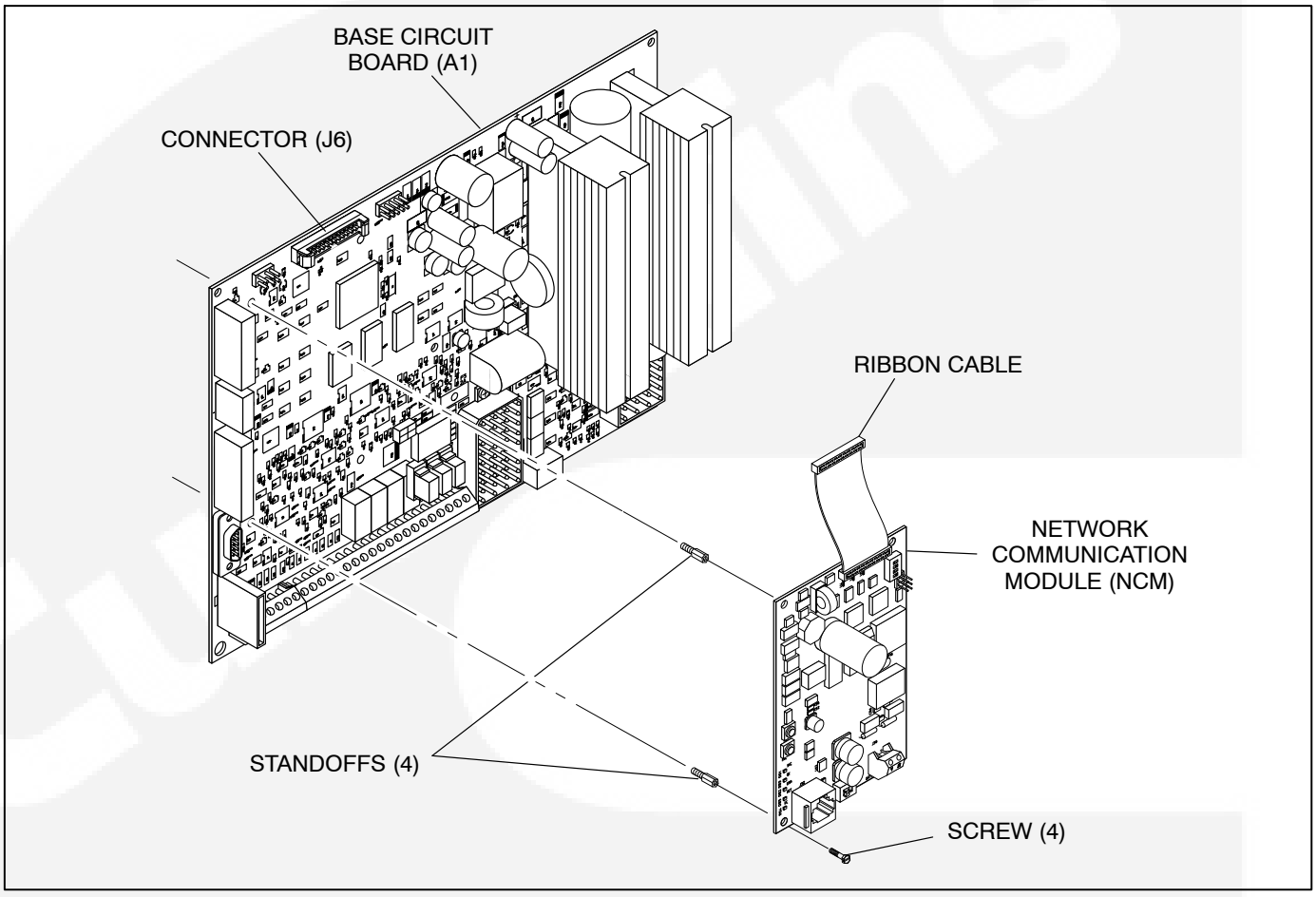

FIGURE 6-6. NETWORK COMMUNICATION MODULE

TB1 Customer Inputs

Refer to Page 8-7 for typical connections to TB1.

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

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

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

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

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

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

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

- Enable/disable input. Default setting:

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

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

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

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

TB1 Customer Outputs

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

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

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

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

- Enable/disable output. Default setting:

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

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

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

B+: This is a fused 10 amp, 12/24 volt output. (Fuse F1 is located on Base board.) Two terminals (TB1-17 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 6-7) are not installed across relay coils (A1/A2) before connecting genset battery cables.***

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

These relays (Figure 6-7) are used to control auxiliary equipment, such as fans, pumps and motorized air dampers. Energizing of the relays is user definable (refer to *TB1 Customer Outputs* in this section for customizing information.)

The contacts are rated at 10 amps at 600 VAC.

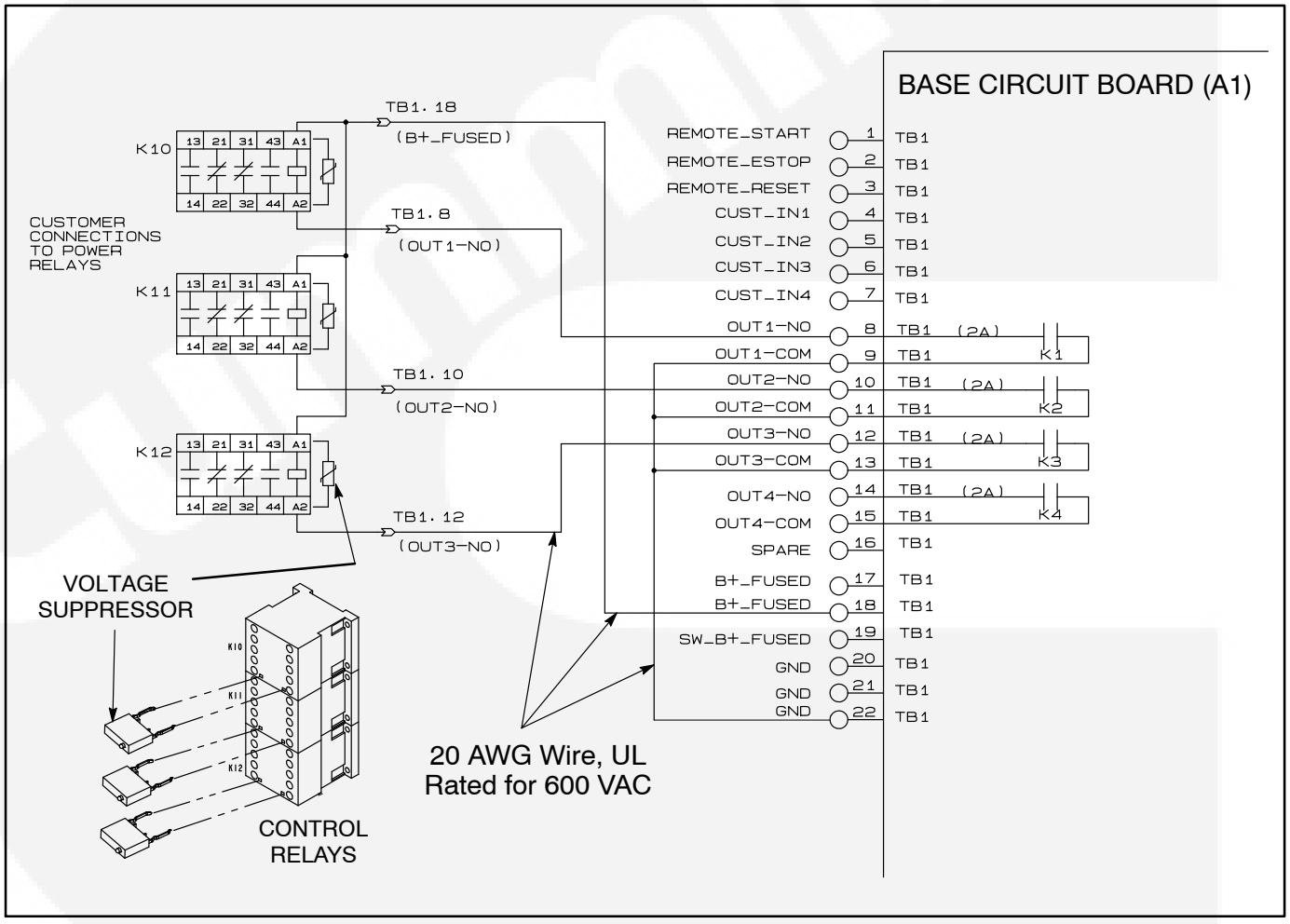

FIGURE 6-7. OPTIONAL CONTROL RELAYS (K10, K11, K12)

PCCNET DEVICES

This subsection covers the optional PCCNet devices are available for use with a PCC2100 control. Wiring connections for these devices are shown in Section 7.

Universal Annunciator

The universal annunciator (see Figure 6-8) provides for remote monitoring of genset data per NFPA110 requirements. The three discrete inputs and four relay outputs of the annunciator can be used and set up using the Service tool.

Information on using InPower to set up the Universal Annunciator is included in Appendix B. For more information on the Universal Annunciator, including instructions on wiring, refer to Operator's Manual 900–0301.

FIGURE 6-8. UNIVERSAL ANNUNCIATOR PANEL

Low Oil Pressure and High Engine Temperature LEDs

If the PCC2100 control shuts down the genset because of a Low Oil Pressure (Fault Code 415) or a High Engine Temperature (Fault Code 151) condition, the corresponding LED(s) on the Universal Annunciator will light, along with the "Check Genset" LED. When the fault is acknowledged on the PCC2100, the "Check Genset" LED goes out but the Low Oil Pressure and/or High Engine Temperature remain lit because the faults are still in an active state and acknowledged in the PCC2100. Although the shutdown LED on the PCC2100 goes out, an asterisk (*) is still displayed with the fault in the Fault History section, indicating the fault is still active. After the genset has been at idle or at the rated engine speed for ten seconds, the PCC2100 reevaluates the condition and, if the control determines that these faults are no longer active, the "Low Oil Pressure" and "High Engine Temp" LEDs will go out on the Universal Annunciator.

I/O Module

The PCC2100 control, starting with software version 2.500, supports up to two Base I/O Modules (see Figure 6-9) and two Expansion I/O Modules.

If your installation includes both the Base I/O Module (AUX101) and the optional Expansion I/O Module (AUX102), sixteen relay outputs and two discrete analog inputs are available for auxiliary control and monitoring of the power system.

Relay outputs can be used for controlling equipment such as motors, louvers, fans, and pumps. The relays can be configured individually by using InPower software.

This I/O module is only available in a kit. For more information on I/O modules, refer to Instruction Sheet C698.

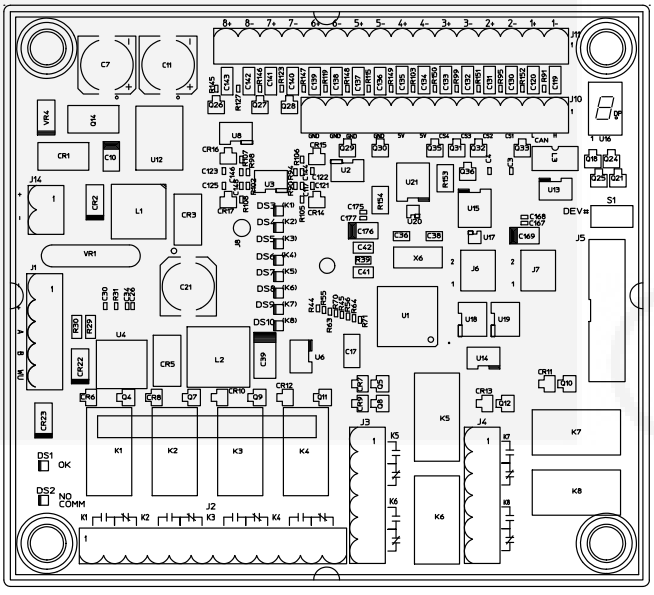

FIGURE 6-9. BASE I/O MODULE (AUX101)

ENGINE SENSORS

Refer to the genset documentation for sensor locations.

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

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

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

Oil Temperature / Fuel Level Input

The PCC2100 control's Oil Temperature Input can be used as a Fuel Level Input. To enable this feature using InPower, "Fuel Level Trim Enable" needs to be set to Enabled and the "Oil Temp Input Trim Enable" needs to be set to Disabled. The parameters shown in the screen shot below may need to be adjusted from their defaults.

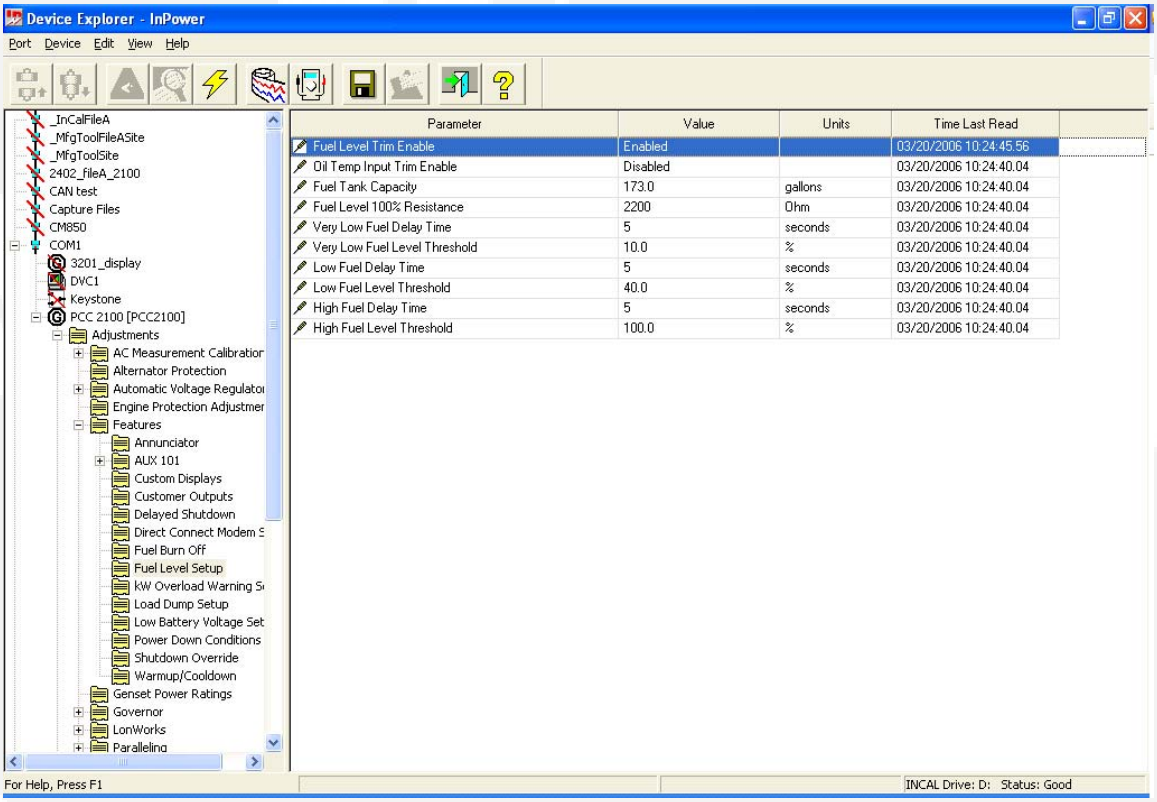

FIGURE 6-10. FUEL LEVEL TRIM ENABLE

MAGNETIC SPEED PICKUP UNIT (MPU) INSTALLATION

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

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

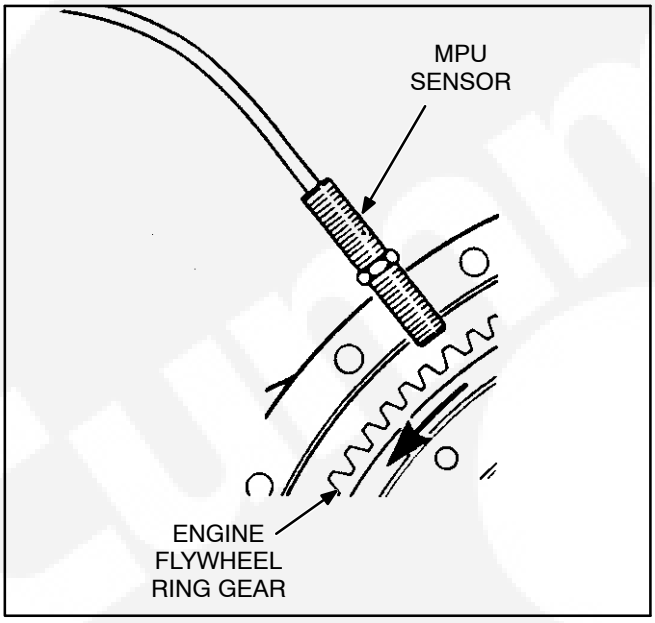

FIGURE 6-11. MPU SENSOR

CURRENT TRANSFORMER (CT) INSTALLATION

Current transformers (CTs) are required on gensets that contain AC meters. The CTs must be installed as noted in the following *CT Installation Requirements*. Improper installation of CTs 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.)

Information on selecting CTs is provided in Appendix A.

CT Installation Requirements

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

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

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

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

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

7. Wiring Diagrams

GENERAL

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

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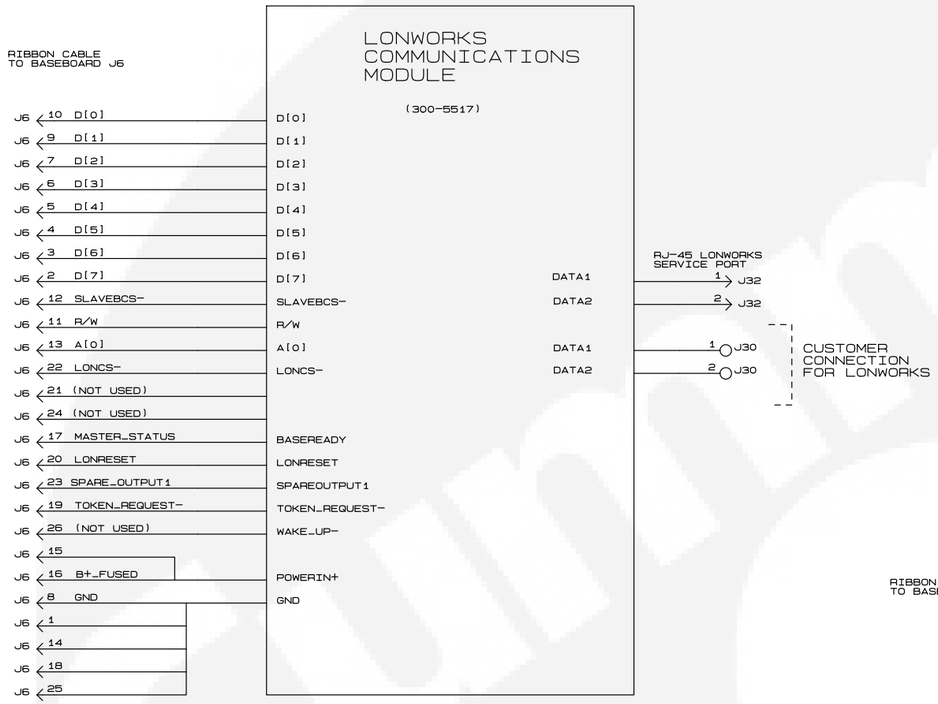
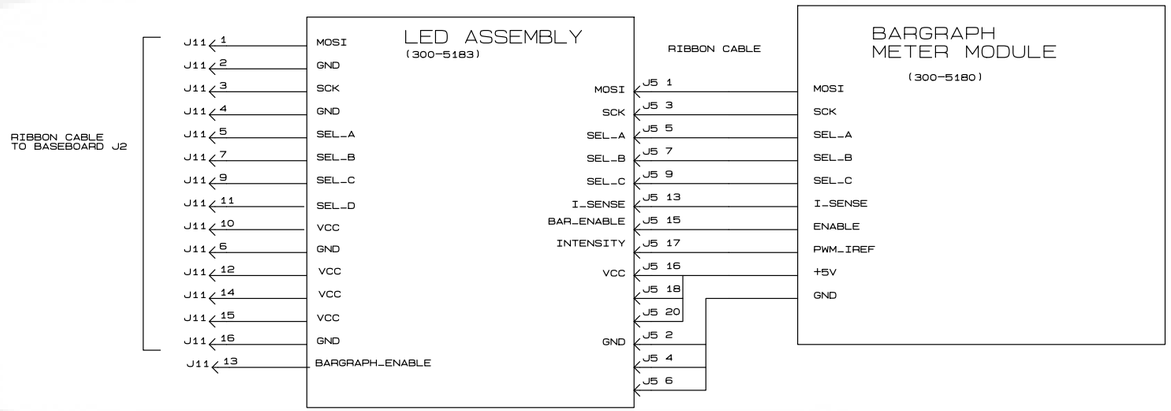
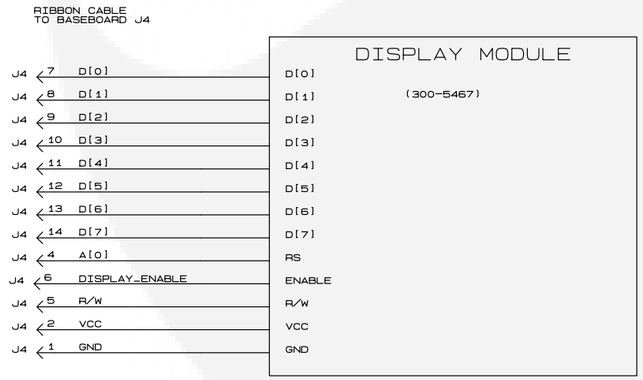
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.







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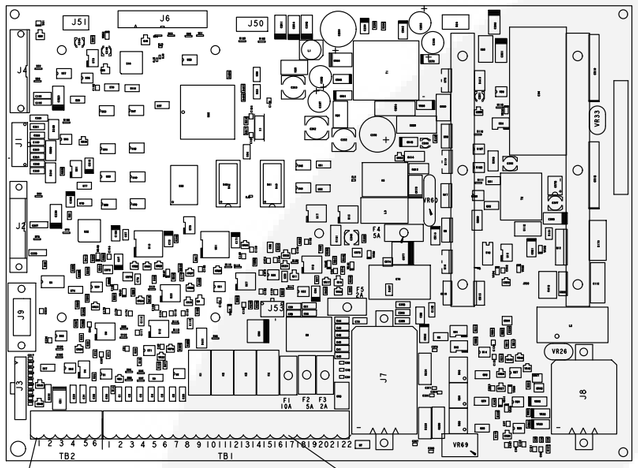
Rev. A
Modified 1-2003

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



TB2

1	RS485+	TO REMOTE UTILITY VOLTAGE SENSING MODULE.
2	RS485-	
3	PTC B+	
4	PTC GND	
5	PTC STATUS	
6	COM	

TERMINAL SPECIFICATION

1) TORQUE TERMINALS TO 4.4 IN/LBS (0.5 Nm)

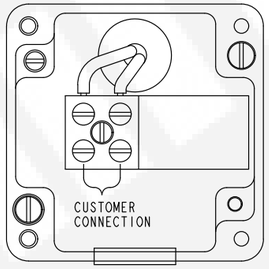
2) USE FLAT-BLADED SCREWDRIVER WITH 2.5MM BLADE

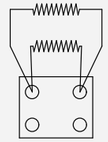
TB1

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	

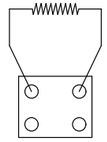
VOLTAGE SUPPRESSORS MUST BE INSTALLED BEFORE POWER IS APPLIED TO THE CONTROL OR GENSET TO PREVENT DAMAGE TO BASE BOARD

ALTERNATOR HEATER





DUAL HEATER



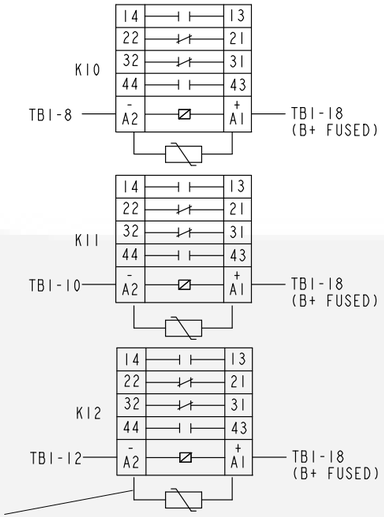
SINGLE HEATER

TERMINAL SPECIFICATIONS

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

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

CUSTOMER RELAYS

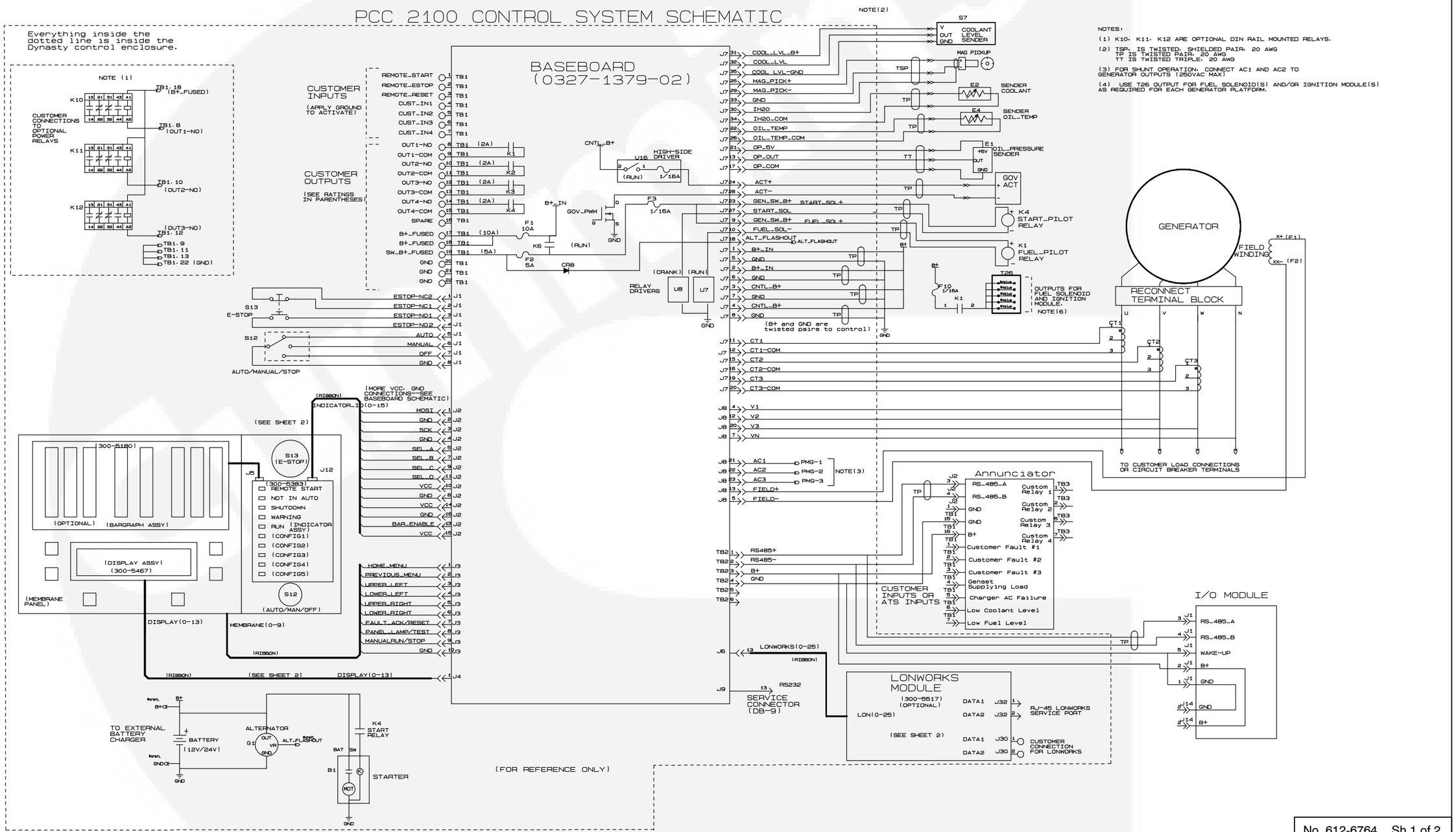


TERMINAL SPECIFICATIONS

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

No. 620-0247 Sh 1 of 1
Rev. A
Modified 4–2002

PCC 2100 CONTROL SYSTEM SCHEMATIC



NOTES:

(1) K10. K11. K12 ARE OPTIONAL DIN RAIL MOUNTED RELAYS.

(2) TSP. IS TWISTED. SHIELDED PAIR. 20 AWG
TP IS TWISTED PAIR. 20 AWG
TT IS TWISTED TRIPLE. 20 AWG

(3) FOR SHUNT OPERATION, CONNECT AC1 AND AC2 TO GENERATOR OUTPUTS (250VAC MAX)

(4) USE T26 OUTPUT FOR FUEL SOLENOID(S) AND/OR IGNITION MODULE(S) AS REQUIRED FOR EACH GENERATOR PLATFORM.

No. 612-6764 Sh 1 of 2
Rev. E Mod Sys: HP
Modified 1/2006

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Appendix A. CT Determination

INTRODUCTION

The information provided in this section uses the relationship between Power (P), Voltage (V) and Current (I) to determine the correct CT for an application. The relationship is P = V * I.

If there is just one voltage level (for example, 300 V only), complete Section 1 and use this voltage in line 2 of the “CT Worksheet”.

If the application has a voltage range (for example, 190–240/380–480 reconnectable), then the CT must be selected to cover this range; therefore, Section 1 and 2 of the “CT Worksheet” will need to be filled out. For this example, 190 would be used for lower limit voltage and 480 would be used as high limit voltage.

If the application has 50 Hz and 60 Hz capability, repeat Section 1 and Section 2, depending on the voltage range/level, as described above.

CT WORKSHEET

Section 1 (Lower Voltage Limit)	3 Phase 50 or 60 Hz	Line	1 Phase 50 or 60 Hz	Line
Enter the standby power rating for the genset, in KW.	KW	1	KW	1
Enter the lower limit of the voltage range OR the voltage level for this application.	V	2	V	2
Multiply line 2 by the power factor (typically 0.8 for 3 phase or 1 for 1 phase).		3		3
Multiply line 3 by the square root of 3 (1.732) for 3 phase or 1 if 1 phase.		4		4
If the line-to-line voltage range or voltage level is less than or equal to 240 V, multiply line 4 by 2; else by 1.		5		5
Divide line 1 by line 5, multiply by 1000, and then divide by 0.55.		6		6
Choose an available CT that has x1 – x2 less than or equal to the value in line 6 (see Note 1). This same CT will be used for both phases, frequencies, and voltages, if applicable. Contact your distributor for available CTs (see Note 2).		7		7
Divide line 7 by line 6.		8		8
The Value of line 8 must be greater than 0.9 and less than 1.85; if it is not, choose a different CT in line 7.				

Section 2 (Upper Voltage Limit)				
Enter the standby power rating for the genset, in KW.	KW	9	KW	9
Enter the upper limit of the voltage range for this application.	V	10	V	10
Multiply line 10 by the power factor (typically 0.8 for 3 phase or 1 for 1 phase).		11		11
Multiply line 11 by the square root of 3 (1.732) for 3 phase or 1 if 1 phase.		12		12
If the line-to-line voltage range or voltage level is less than or equal to 240 V, multiply line 12 by 2; else by 1.		13		13
Divide line 9 by line 13, multiply by 1000, and then divide by 0.55.		14		14
Use the same CT that was used in line 7.		15		15
Divide line 15 by line 14.		16		16
The value of line 16 must also be greater than 0.9 and less than 1.85; if it is not, choose a different CT in line 7 and recalculate lines 7–8 and 15–16.				

Note 1: Use the smaller of the two CT where applicable. (for example, 138/1 and 276/1 – use 138/1 for calculation). However, if the voltage is less than or equal to 240 V, connect using pin 1 and 3 (x1 – x3). If the voltage is larger than 240 V, connect using pin 1 and 2 (x1 – x2). This is assuming a 3 pin connection. If there are only 2 pins, use them. See *CT Installation Requirements* on page 6-18 for a further description.

Note 2: There may be instances when one CT will not work for both 3 phase and 1 phase applications. If this is the case, choose the CT based on the primary application. If for instance, it is required that the application switch from 3 phase to 1 phase, a different CT feature code will need to be downloaded and a new CT kit will need to be selected.

CT Example

A 250 KW Genset at 60 Hz, 3 phase, having a voltage range of 190−240/380−480 reconnectable is needed. What CT should be chosen? Assume that the 3 phase power factor is 0.8.

Section 1 (Lower Voltage Limit)	**3 Phase** 50 or 60 Hz	Line	**1 Phase** *50 or 60 Hz*	Line
Enter the standby power rating for the genset, in KW.	250 KW	1	KW	1
Enter the lower limit of the voltage range OR the voltage level for this application.	190 V	2	V	2
Multiply line 2 by the power factor (typically 0.8 for 3 phase or 1 for 1 phase).	152	3		3
Multiply line 3 by the square root of 3 (1.732) for 3 phase or 1 if 1 phase.	263.3	4		4
If the line-to-line voltage range or voltage level is less than or equal to 240 V, multiply line 4 by 2; else by 1.	526.54	5		5
Divide line 1 by line 5, multiply by 1000, and then divide by 0.55.	863.26	6		6
Choose an available CT that has x1 − x2 less than or equal to the value in line 6 (see Note 1). This same CT will be used for both phases, frequencies, and voltages, if applicable. Contact your distributor for available CTs (see Note 2).	863	7		7
Divide line 7 by line 6.	1.00	8		8
The Value of line 8 must be greater than 0.9 and less than 1.85; if it is not, choose a different CT in line 7.	OK			

Section 2 (Upper Voltage Limit)				
Enter the standby power rating for the genset, in KW.	250 KW	9	KW	9
Enter the upper limit of the voltage range for this application.	480 V	10	V	10
Multiply line 10 by the power factor (typically 0.8 for 3 phase or 1 for 1 phase).	384	11		11
Multiply line 11 by the square root of 3 (1.732) for 3 phase or 1 if 1 phase.	665.01	12		12
If the line-to-line voltage range or voltage level is less than or equal to 240 V, multiply line 12 by 2; else by 1.	665.01	13		13
Divide line 9 by line 13, multiply by 1000, and then divide by 0.55.	683.43	14		14
Use the same CT that was used in line 7.	863	15		15
Divide line 15 by line 14.	1.26	16		16
The value of line 16 must also be greater than 0.9 and less than 1.85; if it is not, choose a different CT in line 7 and recalculate lines 7−8 and 15−16.	OK			

Conclusion

The CT kit needed is based upon the CT picked in line 7. This CT will connect using pins 1 and 3 (x1 – x3) if range 190–240 V is used or pins 1 and 2 (x1 – x2) if the unit is reconnected to 380–480 V.

The CT feature code needed is based upon the CT picked in line 7. For the above example, 863/1 CT Ratio is needed. This is the primary current value.

Appendix B. Universal Annunciator Setup

Starting with software version 2.400, the PCC2100 supports the PowerCommand Universal Annunciator (300–5929).

By default, the customer inputs and relay outputs of the Universal Annunciator are ‘enabled’ (see Figure B-1). They can be changed to ‘disabled’ with InPower. The severity of the four inputs (faults 1853–1855) can be set under the InPower ‘Event and Faults’ menu. They are defaulted to a response of ‘None.’

Any event can be mapped to one of the four relay outputs of the Universal Annunicator. If it is desired for relay output 1 of the annuciator to be active after a Low Coolant Fault (235), it is necessary to enter 235 into the “Annunicator Ouput 1 Mapping” (see Figure B-2).

The status of the Annunciator I/O can be viewed in the directory shown in Figure B-3.

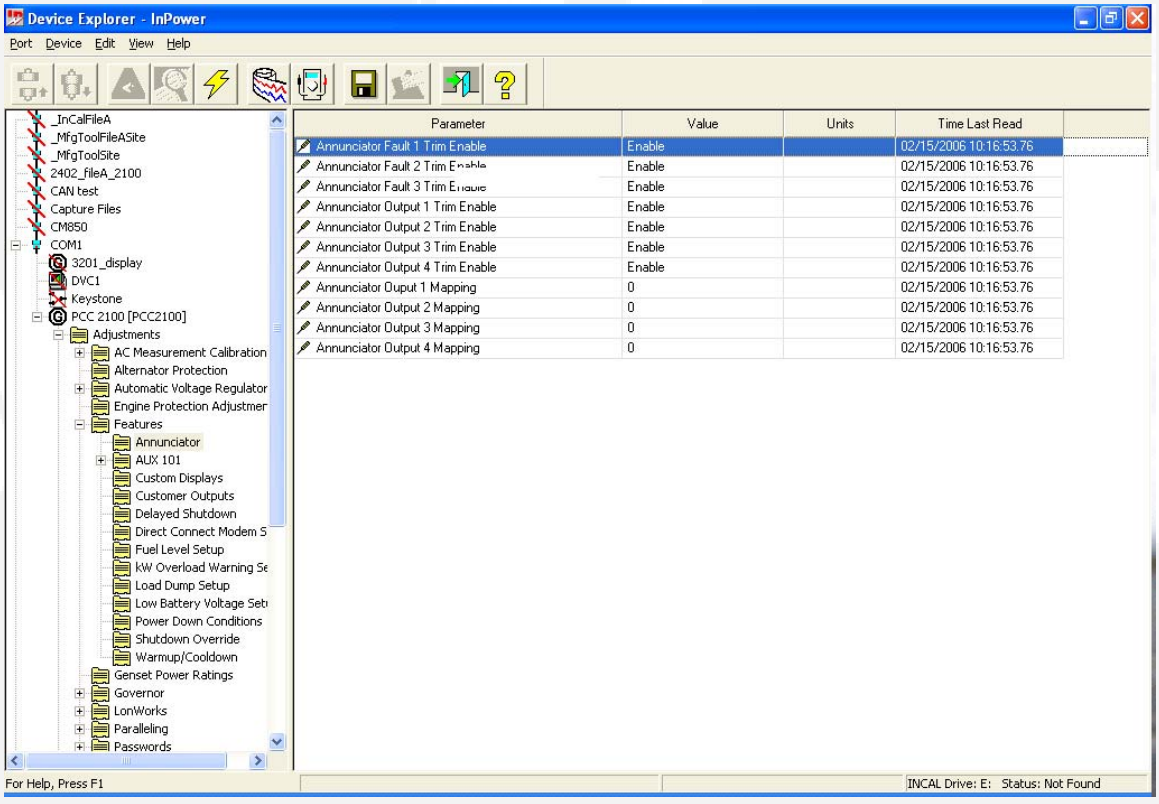

FIGURE B-1. ENABLING ANNUNCIATOR INPUTS AND OUTPUTS

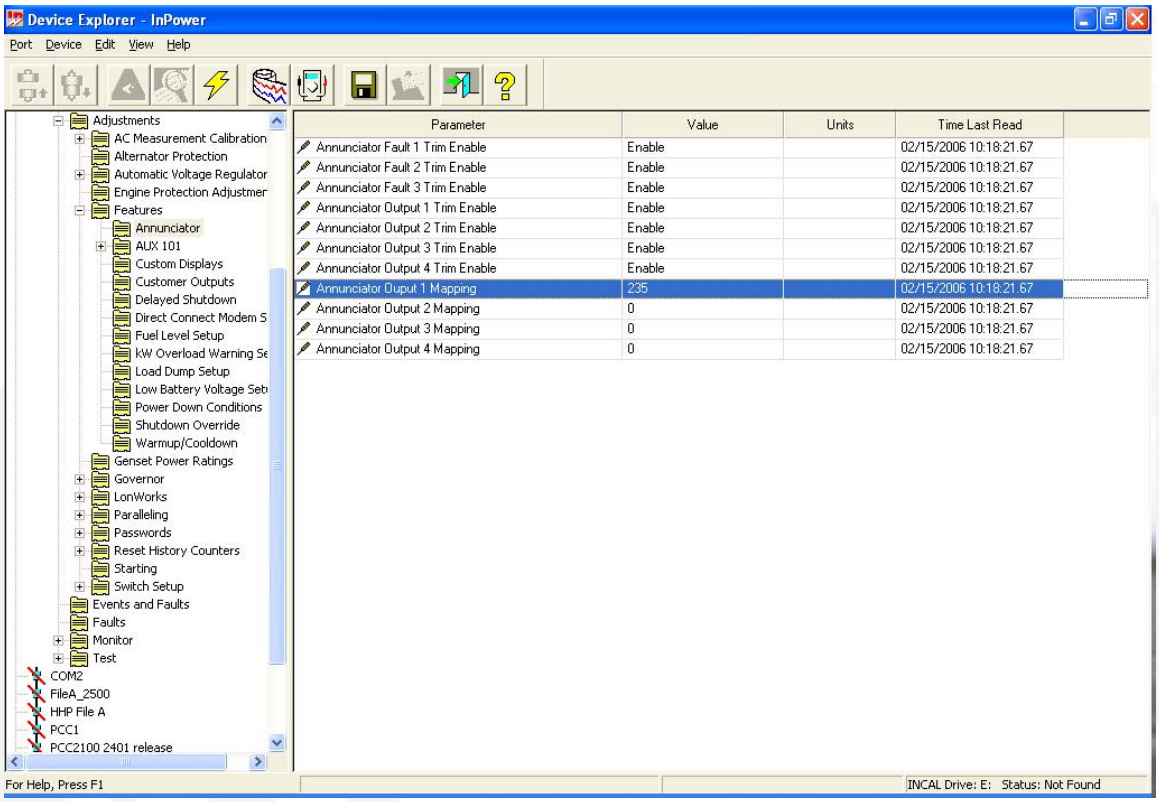

FIGURE B-2. MAPPING THE ANNUNCIATOR OUTPUTS

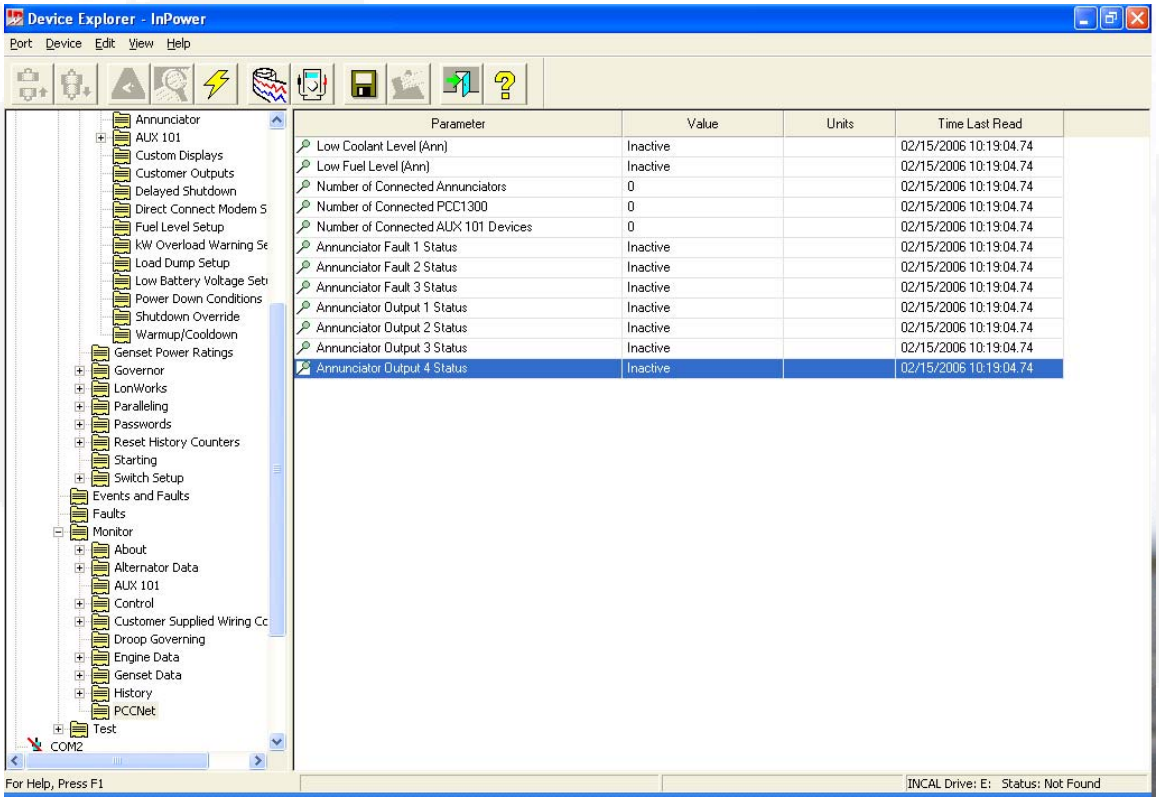

FIGURE B-3. ANNUNCIATOR STATUS

Cummins Power Generation
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Minneapolis, MN 55432 USA

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Email ask.powergen@cummins.com
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