



Generator Service Manual

Our energy working for you.™



**Power
Generation**

Generator Set With Power Command[®] 1.1 Controller

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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 ANDEXPLOSIVE 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. To prevent severe scalding, let engine cool down before removing coolant pressure cap. Turn cap slowly, and do not open it fully until the pressure has been relieved.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.

- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the generator set.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under or near the unit.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause over-heating 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 breathe 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 system, turbo charger system and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

Introduction

ABOUT THIS MANUAL

This manual provides troubleshooting and repair information regarding the PowerCommand® 1301Control (PCC) and generators for the generator sets (gensets) listed on the front cover. Engine service instructions are in the applicable engine service manual. Operating and maintenance instructions are in the applicable Operator's Manual.

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

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

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

SYSTEM OVERVIEW

The PCC is a microprocessor-based control for Cummins Power Generation generator sets. All generator set control functions are contained on one circuit board (Base board). The Base board provides fuel control, main alternator voltage output regulation and complete generator set control and monitoring. The operating software provides control of the generator set and its performance characteristics, and displays performance

information on a digital display panel. It accepts menu-driven control and set-up input from the push button switches on the front panel.

TEST EQUIPMENT

To perform the test procedures in this manual, the following test equipment must be available True RMS meter for accurate measurement of small AC and DC voltages. Fluke models 87 or 8060A are good choices.

- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer.
- Jumper Leads.
- Tachometer or Frequency Meter.
- Wheatstone Bridge or Digital Ohmmeter.
- Variac.
- Load Test Panel.
- Megger or Insulation Resistance Meter.
- InPower™ Service Tool (PC based genset service tool).
- PCC1301 Interface Kit (Used with InPower Service Tool)

HOW TO OBTAIN SERVICE

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



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

2. Control Operation

GENERAL

The following describes the function and operation of the Power Command® 1301 Control. All indicators, control buttons and graphical display are located on the face of the control panel as illustrated in Figure 2-2.

CONTROL PANEL POWER ON/OFF MODES

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

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

Sleep Mode: In the Sleep mode, the control's operating software is inactive and the LEDs and the graphical 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 is in either the Off or Auto mode.

When all conditions are met (i.e., no unacknowledged faults and the control is in the

Off or Auto mode) the Sleep mode is activated after five minutes of keypad in activity.

To activate the control and view the menu display without starting the generator set, press any control button.

When shipped from the factory, Sleep mode is enabled for both modes (Off and Auto mode). Internal adjustment of the control also allows the Sleep mode to be active only during the Off mode (Baseboard switch S1) or disabled for both modes (installation of jumper). When disabled, the operating software will always remain active (Power On mode).

S1 switch setting:

OFF = Sleep mode is enabled for Auto and Off modes.

ON = Sleep mode is enabled for Off mode only.

J1/J2 jumper installation: Install jumper between J1-4 and J1-5 to disable sleep mode. (J1 and J2 are identical, either one can be used for jumper.)

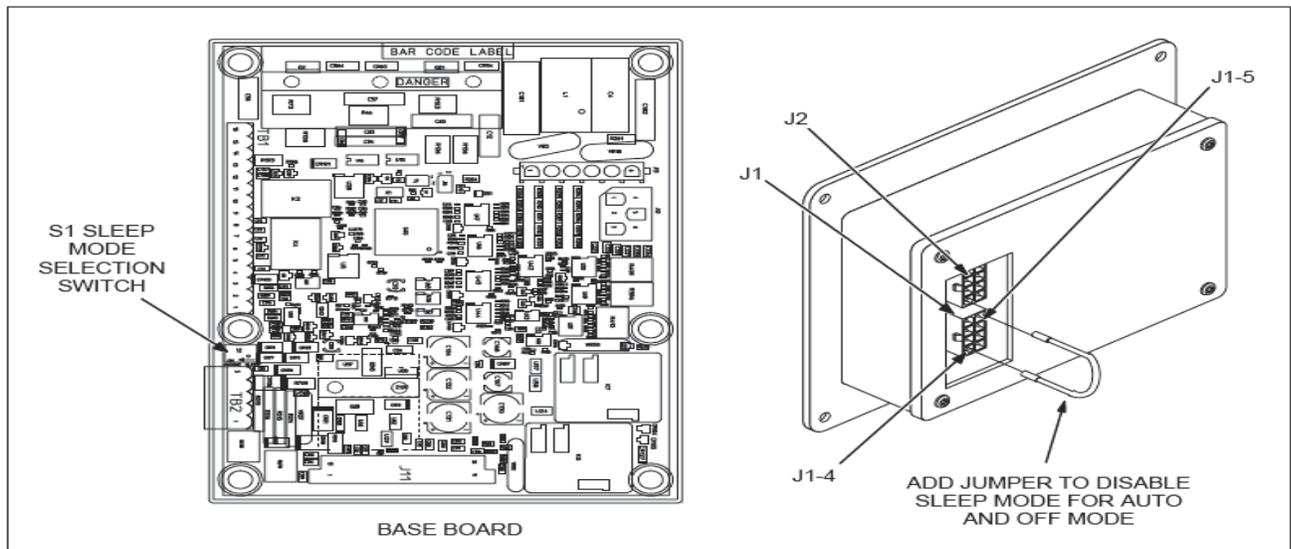


FIGURE 2-1. SLEEP MODE ACTIVATION SETTINGS

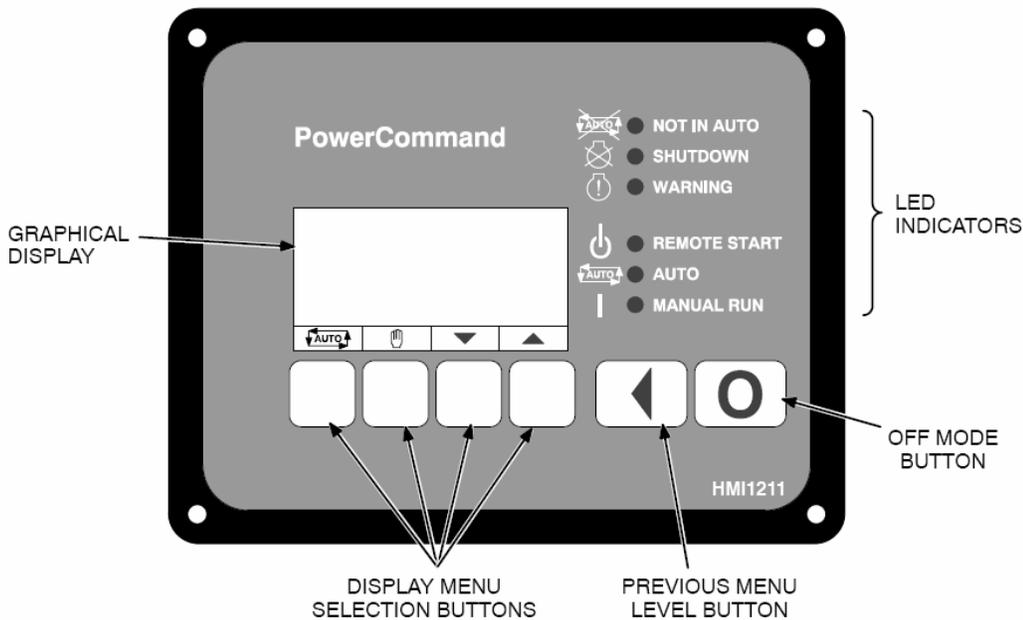


FIGURE 2-2. FRONT PANEL (WITH DISPLAY)

CONTROL PANEL

Figure 2-2 shows the features of the front panel. It includes six LED indicators, the graphical display, and six buttons used to navigate through the menus and adjust parameters.

Graphical Display

This graphical display is used to view menus of the menu-driven operating system. The bottom of the graphical display indicates the functions that are available by pressing the four selection buttons. Re-fer to the menu trees later in this section. System messages (communication, event, and fault) are also shown on the graphical display. For more information, see *System Messages* later this section.

Display Text / Symbolic Versions

This graphical display can be set up to show either text or symbolic versions for fault messages, some Operator menus, and the Mode Change menu. A description of commonly used symbols used are included in Table 2-1. Combinations of symbols are used to display some fault conditions. Additional specialized symbols are also used for some

faults(see *Section 4*).When shipped from the factory, symbolic display is selected. (Refer to Setup menu in *Section 5* to change to text or symbolic display.)

SYMBOL	DESCRIPTION
	Generator Warning Fault
	Generator Shutdown Fault
	Coolant Temperature
	Oil Pressure
	Voltage Alternating Current (VAC)
	Voltage Direct Current (VDC)
	AC Current
	Frequency
	Battery
	Out of Range
	High or Pre-High
	Low or Pre-Low
	Annunciator

Display Menu Selection Buttons

Four momentary soft-key buttons are used to step through the various menus and to adjust parameters. These selection buttons are “active” when a word or symbol in the graphical display is shown above the button. Some submenus do not include any active buttons.

The function of the four selection buttons varies with each menu.

When the  symbol is displayed, the selection button can be used to switch to Auto mode.

When the  symbol is displayed, the selection button can be used to switch to Manual Run mode.

When the up and down triangles (▲ and ▼) are displayed, the selection buttons are used to navigate between a series of submenus.

NOTE: When any Operator menu (Figure 2-12 is displayed, a series of Service menu scan be viewed by simultaneously pressing the ▲ and ▼ selection buttons for two seconds.

NOTE: When a fault is displayed, it can be cleared from the front panel by pressing the ▲ or ▼ button.

When a ◀ symbol is displayed, the selection button can be used to abort the Auto or Manual Run mode and return to the Operator menu that

was displayed before the Auto or Manual Run mode was selected.

When ADJUST is displayed, the selection button is used to display an adjustable menu.

When the ADJUST button is pressed, the first adjustable parameter or value in the sub-menu is highlighted.

When the → symbol is displayed, the selection button is used to navigate to an editable field within a menu.

When the + and – symbols are displayed, the selection buttons are used to increase or decrease a parameter or value shown on the screen

When changing values, pressing the button below the + symbol increase the value and pressing the button below the – symbol decreases the value.

When SAVE is displayed, the selection button is used to save changes made in a sub-menu. If the Previous Menu button is pressed before pressing SAVE, the changes are not saved.

Some menus include a list of numbered subjects. These menus include numbers in parenthesis (for example, (1)) displayed above the selection buttons. The selection buttons are then used to display submenus of the subjects included in the list.

When a black box  is displayed, the selection button has no function.

Previous Main Menu Button

Press the ◀ button to view the previous main menu.

NOTE: In the Screen Adjust menu, settings are not saved when the ◀ button is pressed.

The button ◀ is also used to acknowledge warning and shutdown messages after the fault has been corrected. Pressing this button clears the fault from the front panel display and the previous menu is redisplayed.

NOTE: Pressing the ▲ or ▼ button also clears the fault from the front panel display.

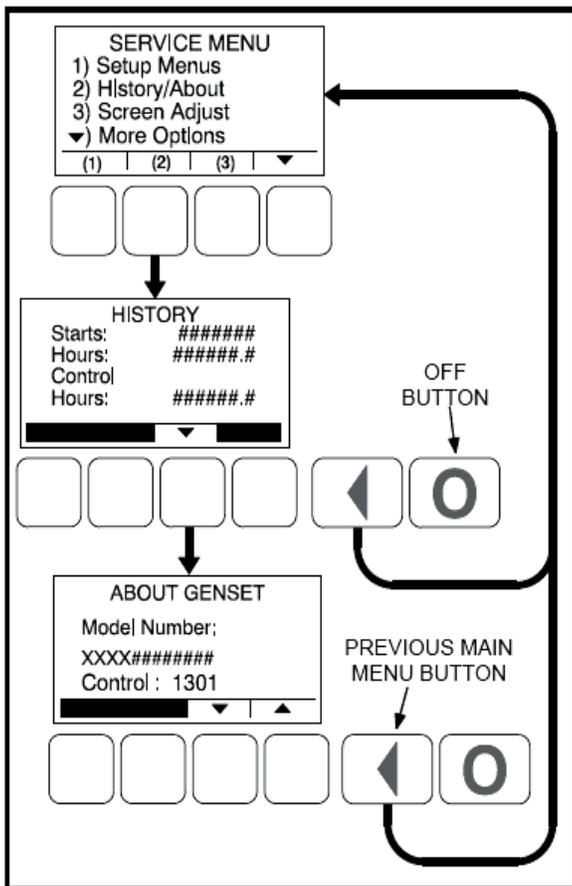


FIGURE 2-3. PREVIOUS MAIN MENU AND OFF BUTTONS

Off Button

Press the  button to switch to the **Off** mode. The Off mode will disable the control Auto or Manual modes.

If the  button is pressed during generator set operation (manual or remote start), the engine will immediately shut down. If possible, hot shutdown under load should be avoided to help prolong the reliability of the generator set.

The  button is also used to acknowledge warning and shutdown messages after the fault has been corrected. Pressing this button clears the fault from the front panel and resets the control.

Not in Auto Indicator

This red lamp is lit when the control is not in the Auto mode.

Shutdown Status Indicator

This red lamp is lit when the control detects a Shutdown condition. The generator set cannot be started when this lamp is on. After the condition is corrected, the lamp can be reset by pressing the  (off) button.

Warning Indicator

This yellow lamp is lit whenever the control detects a warning condition. This lamp is automatically shutoff when the warning condition no longer exists.

Remote Start Indicator

This green lamp indicates the control is receiving a remote run signal.

Auto Indicator

This green lamp indicates the control is in Auto mode. Auto mode can be selected by pressing the  selection button from any of the Operator menus (see Figure 2-12).

Manual Run Indicator

This green lamp indicates the control is in the Manual Run mode. Manual Run mode can be selected by pressing the selection button from any of the Operator menus (see Figure 2-12).

SYSTEM MESSAGES

A system pop-up message is displayed when the event it is displaying becomes active. These pop-up messages remain displayed until pre-empted by another pop-up message or until the ▼ or ◀ the display button is pressed. Once the ▼ or ◀ the button is pressed, the previous screen is redisplayed.

Communication Messages

System messages are displayed for initial power-up or when there is a subsequent loss of communications. Note that the Auto and Manual Run modes can be selected when communication messages are displayed.

Upon initial power-up, the message “Establishing communication with control” is displayed (see Figure 2-4).

When the display detects that it is no longer communicating with the control, the Shutdown, Warning, and Remote Start LEDs are turned off.

If communications are lost, the message “Re-establishing communication with control” is displayed until communications have been re-established (see Figure 2-5).

The LEDs then return to the state determined by the control.

If either communication message remains displayed (cannot view other menus), this indicates that communications between the control panel and the control logic is lost.

This menu also displays the screen’s software number and version.

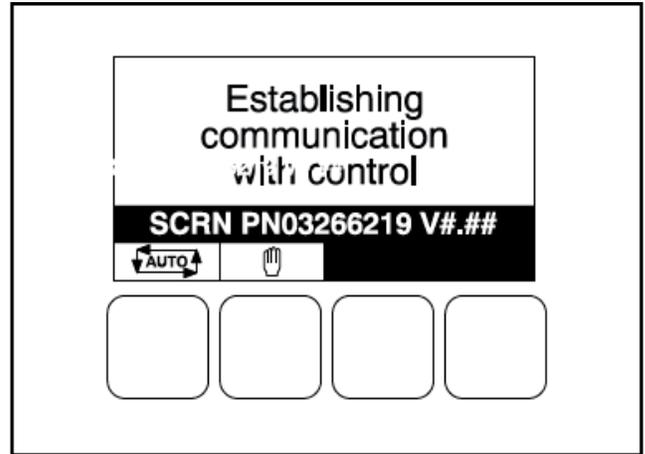


FIGURE 2-4. ESTABLISHING COMMUNICATION WITH CONTROL

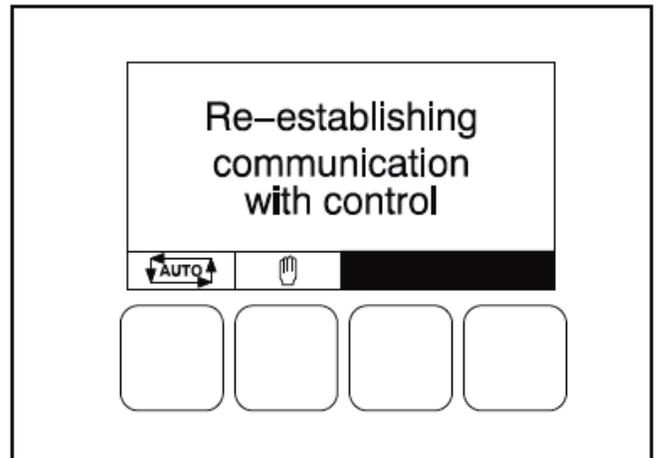


FIGURE 2-5. RE-ESTABLISHING COMMUNICATION WITH CONTROL

Event Messages

When pre-set events (time delay to start or stop) are activated, Event messages are displayed showing the time remaining until the event occurs (see Figure 2-6).

Fault Messages

A Fault message is an indicator of a Warning or Shutdown condition. It includes the fault number, a short description, and when the fault occurred (see Figure 2-7). Symbolic fault messages include the fault code number and symbols, indicating the type of fault (see Figure 2-8). With the symbolic versions of fault messages, the  and  symbols flash. Section 4 provides a list of fault codes, fault types, messages displayed, and descriptions of the faults.

Five of the most recent faults are placed in a fault history file that can be viewed using the Fault History Menu (see Figure 2-18).

Fault Acknowledgement

Shutdown faults must be acknowledged after the faults have been corrected. If in Auto or Manual Run mode, the control must be set to “O” (off). Also, faults are acknowledged when in Auto and the Remote Start command is removed. Faults are cleared from the control panel display by pressing the, , , or  button.

Faults are re-announced if they are detected again after being acknowledged.

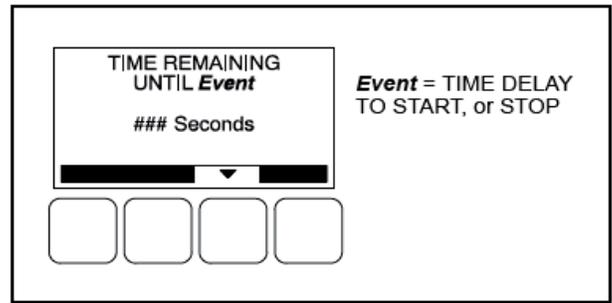


FIGURE 2-6. EVENT MESSAGE

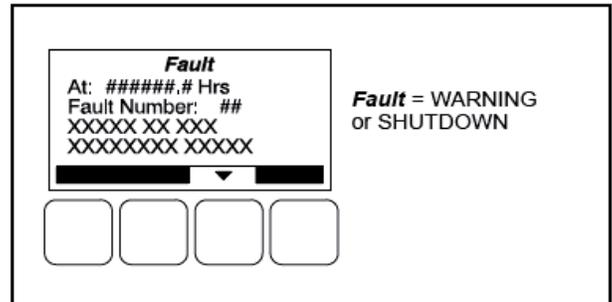


FIGURE 2-7. FAULT MESSAGE

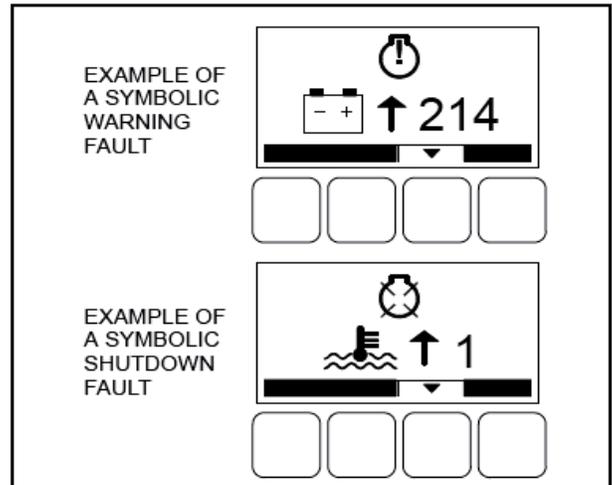


FIGURE 2-8. FAULT MESSAGES – SYMBOLIC VERSION

SELECTING AUTO, MANUAL RUN AND OFF MODES

Auto, Manual Run, and Off modes can be selected:

- From any of the Operator menus
- When the message “Establishing communication with control” is displayed
- When the message “Re-establishing communication with control” is displayed

Switching to Auto, Manual Run, or Off mode can be restricted to authorized personnel. If a control panel is set up with the mode change access code feature enabled, an access code must first be entered before the mode can be changed.

The InPower service tool or access to the Genset Service submenu is required to enable/disable the mode change “Access Code” feature. Refer to Section 5.

Entering the Mode Change Access Code

If the mode change access code feature is enabled, an access code must be entered to switch to Auto, Manual Run, or Off mode. The text and symbolic versions of the Mode Change menu are shown in Figure 2-9.

To enter the mode change access code,

1. With the first character highlighted, press the button below to the + or – symbols until the value reads “1.”
2. Press the arrow selection button → to move to the next numeric character.
3. Press the button below the + or – symbols until the value reads “2.”
4. Press the arrow selection button → to move to the next numeric character.

5. Press the button below the + or – symbols until the value reads “1.”
6. After you have completed entering the password, press the arrow selection button →.

NOTE: If an incorrect password is entered, the Operator menu that was displayed before Auto, Manual Run, or Off mode was selected is redisplayed.

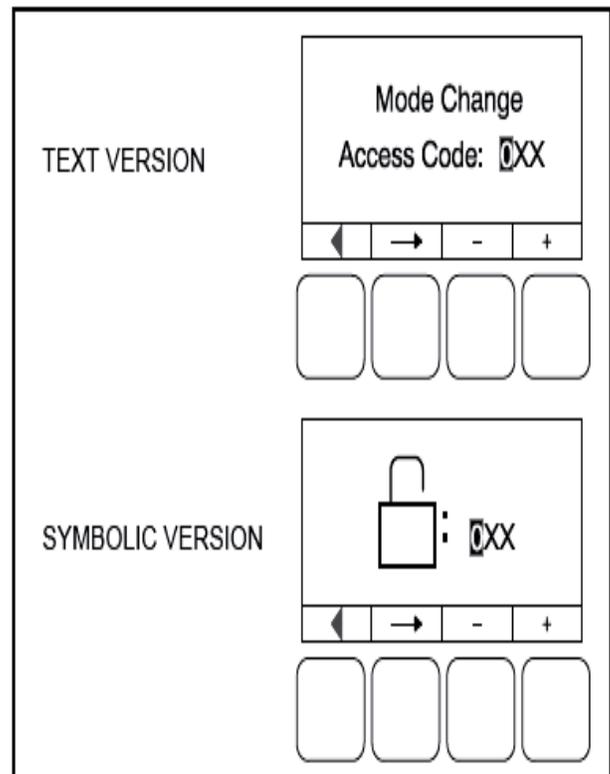


FIGURE 2-9. MODE CHANGE MENU

Selecting Auto Mode

To switch to Auto mode (see Figure 2-10):

1. Press the button on any of the Operator menus or the “Establishing/Re-establishing communication with control” menus.
2. If the mode change access code feature is enabled, the Mode Change Access Code menu is displayed. Enter the mode change access code as described above.
3. A menu with alternating arrows is displayed above a second  symbol. Press the second  button. The Operator menu that was displayed before Auto mode was selected is re-displayed and the Auto indicator is lit.
4. To disable auto mode, press the  button.

NOTE: Manual Run mode can also be selected while in Auto mode.

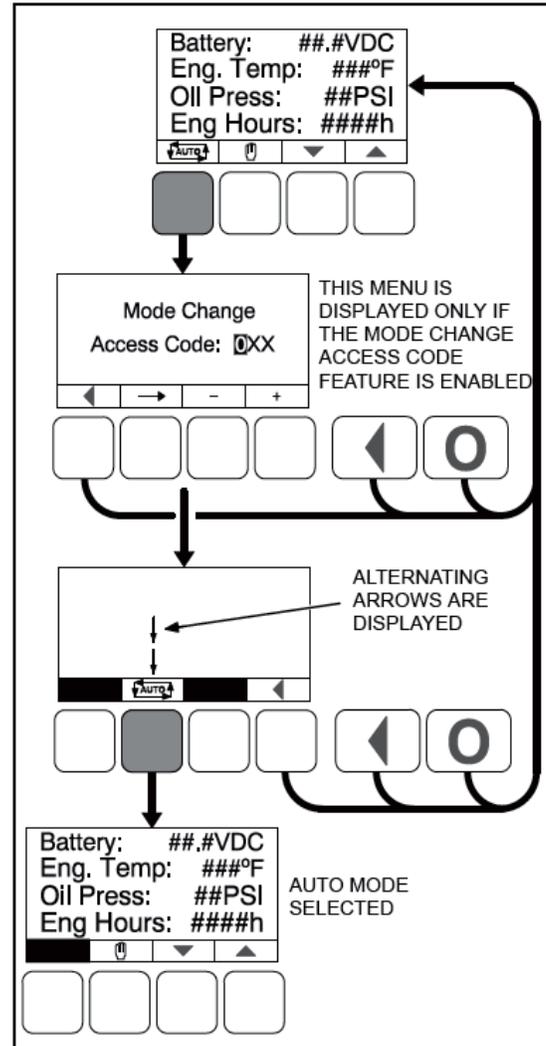


FIGURE 2-10. SELECTING AUTO MODE

Selecting Manual Run Mode

To switch to Manual Run mode (see Figure 2-11):

1. Press the  button on any of the Operator menus or if displayed, the “Establishing/Re-establishing communication with control” menus.
2. If the mode change access code feature is enabled, the Mode Change Access Code menu is displayed. Enter the mode change access code as described on the previous page.
3. A menu with alternating arrows is displayed above a second  symbol. Press the second  button to start the genset.

The Operator menu that was displayed before Manual Run mode was selected is redisplayed and the Manual Run indicator is lit.

To disable Manual Run mode, press the  button.

NOTE: Auto mode can also be selected while in Manual Run mode. Switching to Auto mode may result in the generator set shutting down.

Aborting the Transition to Auto or Manual Run Mode

If the Mode Change Access Code menu or the menu showing alternating arrows above the  or  buttons is displayed, the transition to Auto or Manual Run mode is aborted when:

- Either the, , ,  or button is pressed.
- The  or  button is not pressed within ten seconds.

If the transition to Auto or Manual Run mode is aborted, the Operator menu that was displayed before Auto or Manual Run mode was selected is re-displayed.

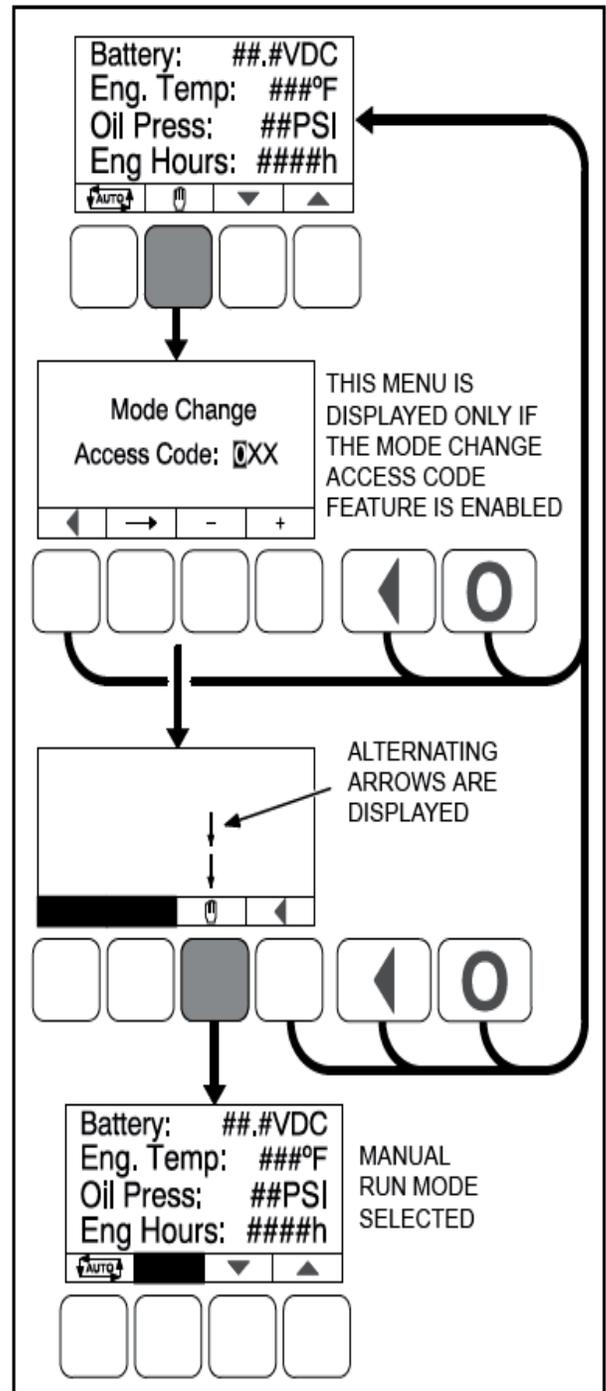


FIGURE 2-11. SELECTING MANUAL RUN MODE

OPERATOR MENUS

Figures 2-12 and 2-13 show block representations of the following Operator menus.

- Engine Status
- Alternator Status
- Line-to-Line Voltage
- Line-to-Neutral Voltage
- Alternator Amperage

To navigate between the Operator menus, press the buttons next to the ▲ and ▼ symbols in the graphical display.

The Operator menus can be used to select Auto or Manual Run modes.

Appendix A provides a block diagram that illustrates the sequence of how the Operator Menus are displayed.

Engine Status Menu

This menu displays the engine starting battery voltage, engine coolant temperature, engine oil pressure, and hours of engine operation. (Oil pressure - only available on some models)

Alternator Status Menu

This menu displays genset power (in kVA), frequency, and engine speed (RPM). (In applications with-out current transformers, the kVA is not shown.)

Alternator Line-to-Line Voltage Menu

This menu displays L1-L2, L2-L3, and L2-L1 line-to-line voltages for three phase applications only.

Alternator Line-to-Neutral Voltage Menu

This menu displays line-to-neutral voltages for L1, L2, and L3 for three phase wye configurations only. (In delta configurations, this menu is not shown.)

Alternator Single Phase Voltage Menu

This menu displays L1-N, L2-N, and L1-L2 voltages for single phase applications only.

Alternator Amperage Menu

This menu displays L1, L2, and L3 amperage. (In applications without current transformers, this menu is not shown.)

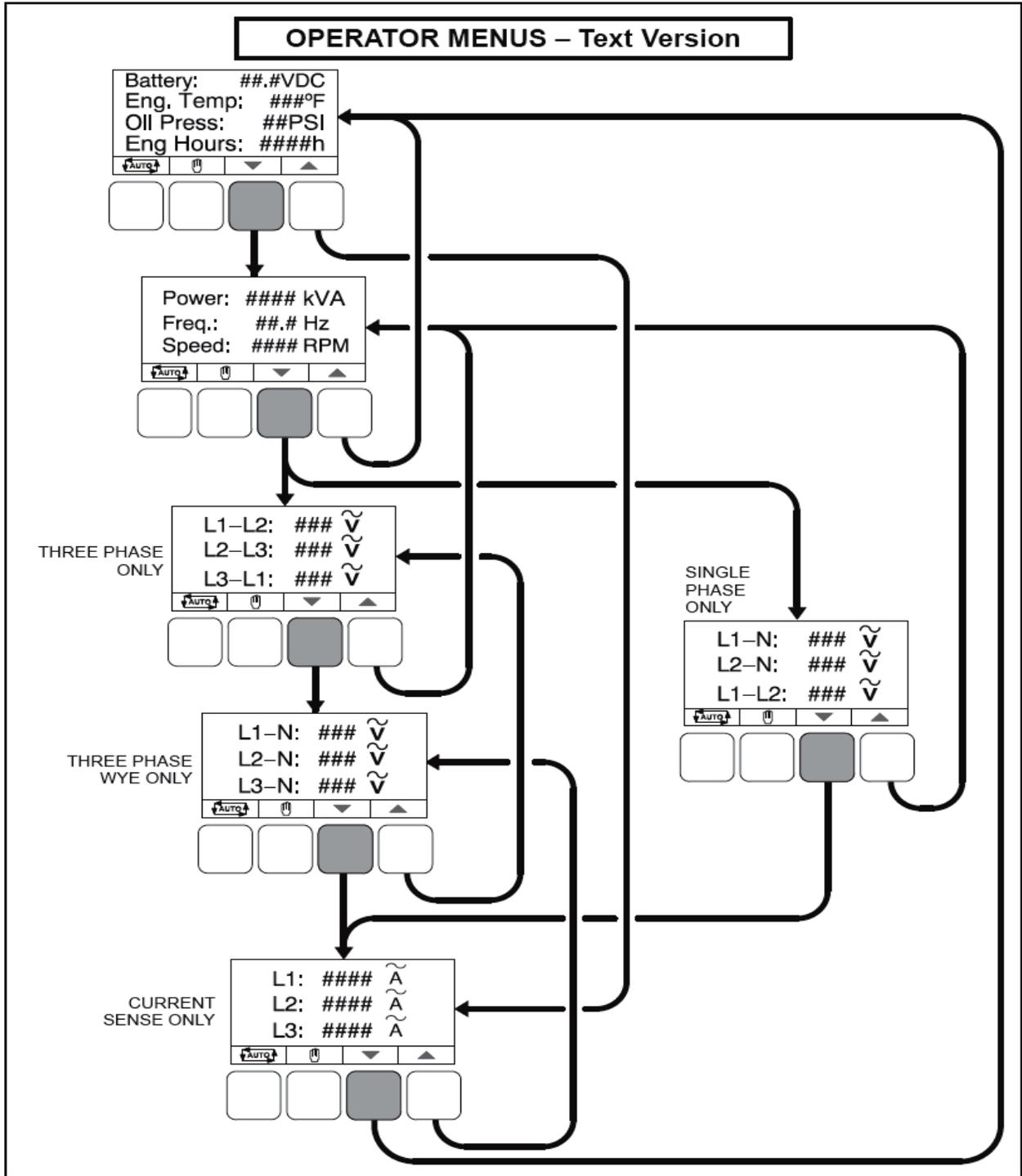


FIGURE 2-12. OPERATOR MENUS (TEXT VERSION)

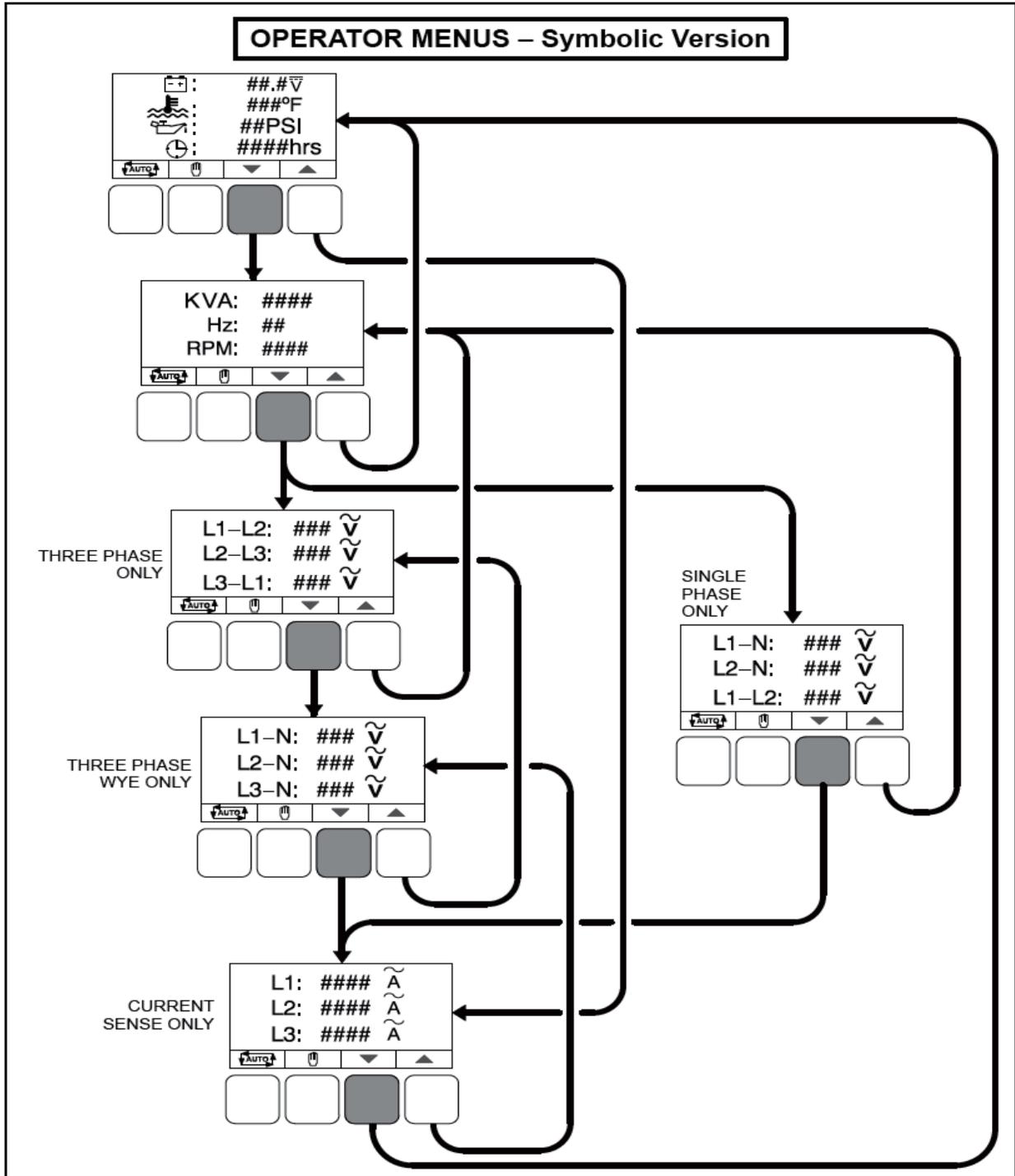


FIGURE 2-13. OPERATOR MENUS (SYMBOLIC VERSION)

SERVICE MENUS

Figure 2-14 shows a block representation of the menus available from the Service Menus.

Appendix A provides a block diagram that illustrates the sequence of how the Service Menus are displayed.

The first Service Menu can be viewed from any of the Operator menus by simultaneously pressing the ▲ and ▼ and selection buttons for two seconds. The first Service Menu provides access to the following menus:

- Setup Menu – Used by Service personnel. Adjusting the Setup menus is restricted by a password and is described in *Section 5*. To view the Setup menu only, press the VIEW button on the Setup password menu.
- History / About – see page 2-16
- Screen Adjust – see page 2-18

To return to the Operator menu that was displayed prior to viewing the Service Menu, press the button.

The second Service Menu can be viewed by pressing the ▼ selection button on the first Service Menu. The second Service Menu provides access to the following menus:

- Fault History – see page 2-20
- Status – see below

- Lamp Test – The six LEDs on the control panel should light as long as the **(6)** button is pressed.

The third Service Menu can be viewed by pressing the ▼ selection button on the second Service Menu. The third Service Menu provides access to the Network Status menus.

Status Menu

The Status menu is displayed when the **(5)** button is pressed on the second Service Menu. The Status menu shows the following:

- Voltage regulator (drive) level, in percentage of duty cycle
- Governor regulator (drive) level, in percentage of duty cycle. This value is only displayed if the governor is enabled.

Network Status Menus

The Network Status menus are displayed when the **(7)** button is pressed on the third Service Menu. Two menus are used to display the quantity of the following devices that are connected to the network.

- Auto Mains Failure (AMF) modules
- Universal Annunciators
- Bar graphs
- Battery chargers
- Controls
- I/O modules
- Operator panels (any type)

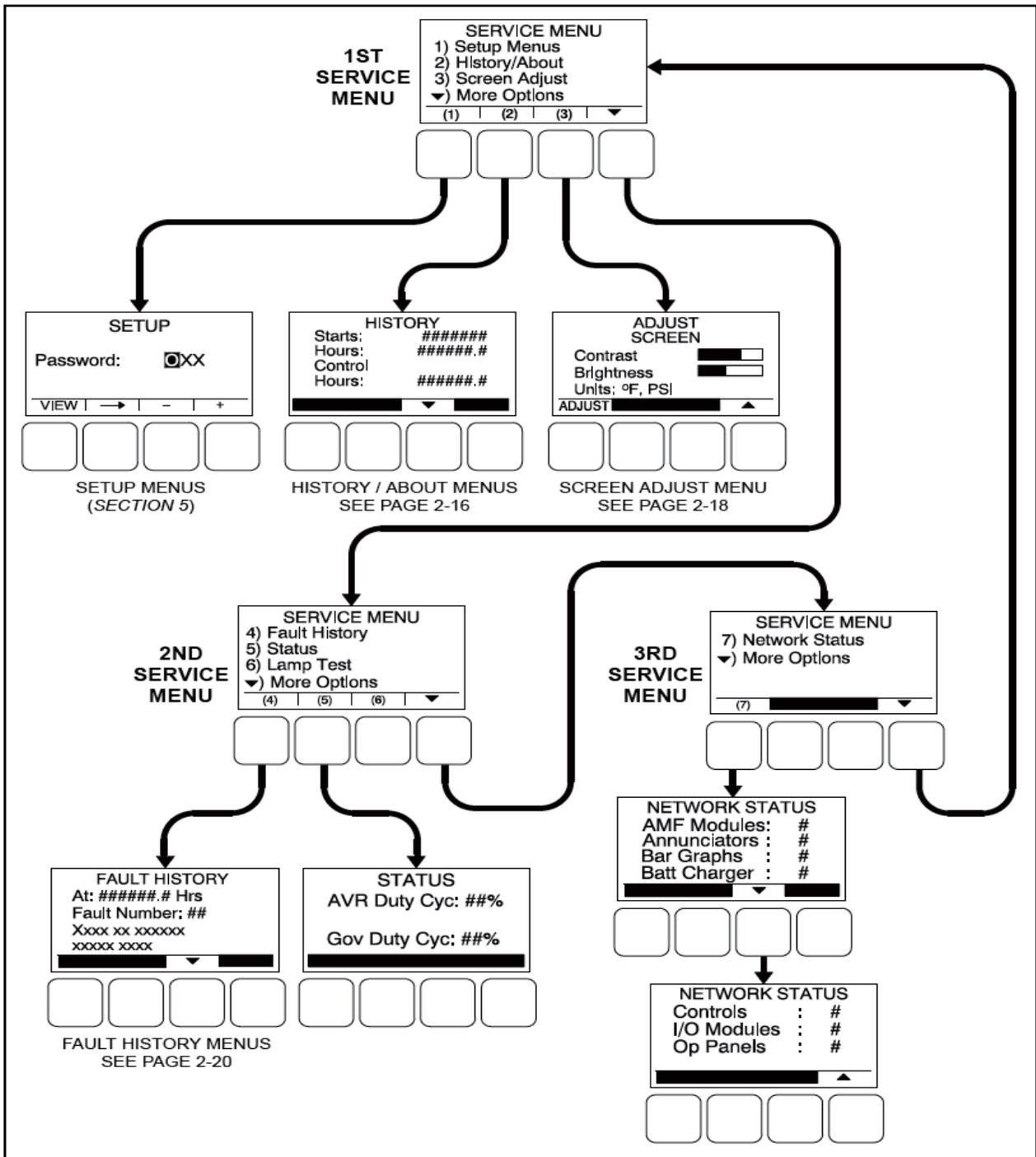


FIGURE 2-14. SERVICE MENUS

HISTORY / ABOUT MENUS

Figure 2-15 shows a block representation of the History / About menu. The first History / About submenu is displayed when the **(2)** button is pressed on the Service Menu.

Press the buttons next to the ▲ and ▼ symbols in the graphical display to navigate between the History / About submenus. Press the  button to return to the Service Menu.

History Submenu

This submenu displays the number of engine starts, hours of operation for the engine, and hours of operation for the control.

About Genset Submenu

This submenu displays the generator set model number and rating.

About Control Submenu

This submenu displays the control's part number, serial number (up to 11 characters), software part number, and software version.

About Display Submenu

This submenu displays the optional control panel software part number, software version, screen part number, and screen version of the display.

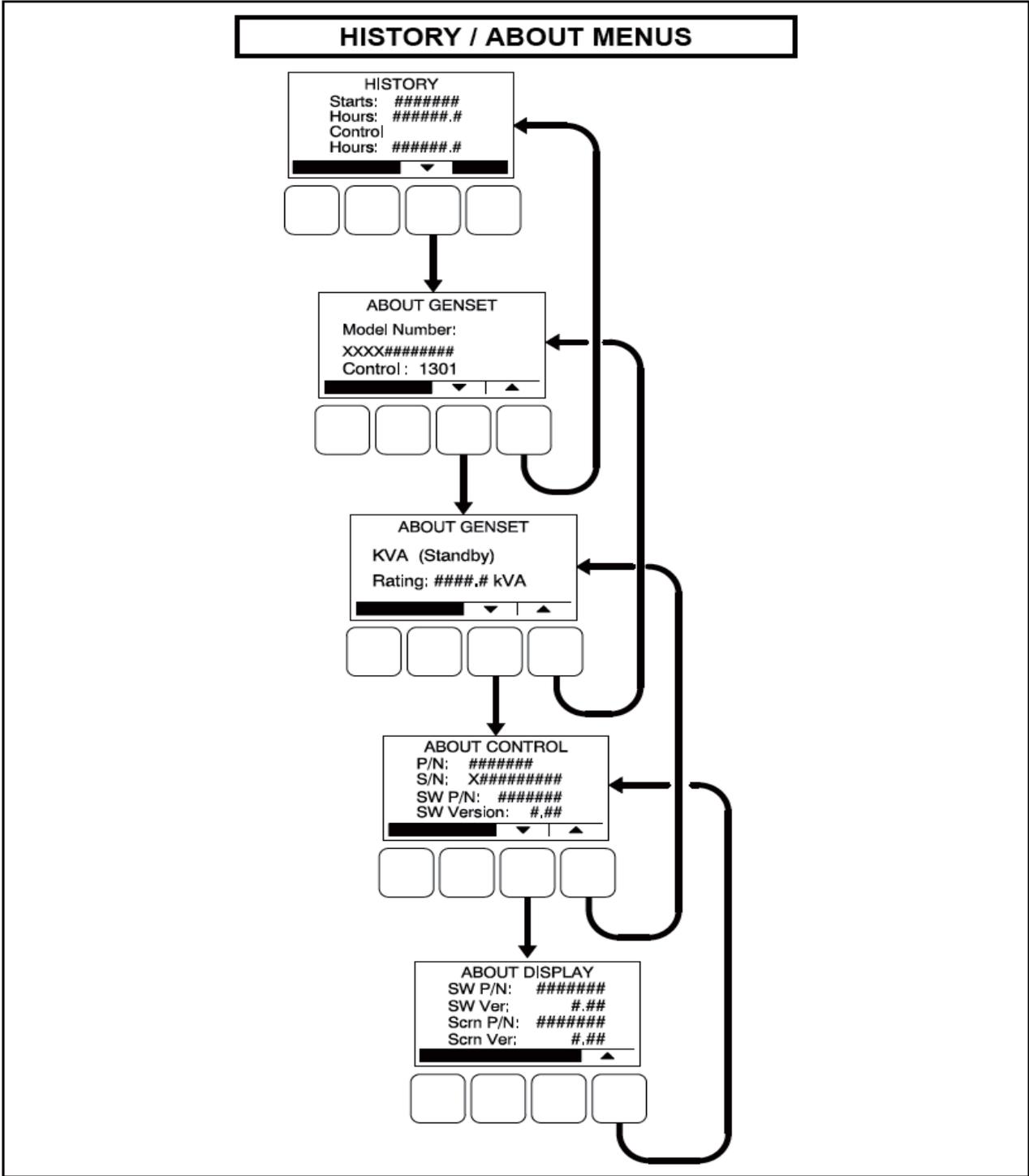


FIGURE 2-15. HISTORY / ABOUT MENUS

SCREEN ADJUST MENU

Figure 2-16 shows a block representation of the Screen Adjust menu. The Screen Adjust sub menu is displayed when the (3) button is pressed in the first Service Menu.

Adjusting Values/Parameters

1. Press the **ADJUST** selection button to select the first parameter or value to be changed.
2. Press the **+** or **-** selection buttons to adjust values or select parameters.
3. Press the arrow selection button **→** to navigate to the next or previous adjustable value or parameter.
4. After adjusting values/selecting parameters, press the **SAVE** button to save your settings.

NOTE: If the Previous Menu button **◀** is pressed before pressing the **SAVE** button, the changes are not saved.

5. Press the **◀** button to return to the Service Menu.

Screen Adjust Menu

This menu allows for adjusting the screen's contrast and brightness and for selecting the units of measurement (SAE or SI) to be displayed.

- *Contrast and Brightness:* Press the **+** or **-** selection buttons to adjust the screen's contrast and brightness. Changing the brightness setting also affects the brightness of the LEDs on the control panel.

- *Units:* Press the **+** or **-** selection buttons to select SAE (°F, PSI) or SI (C, kPa) units of measurement to be displayed.

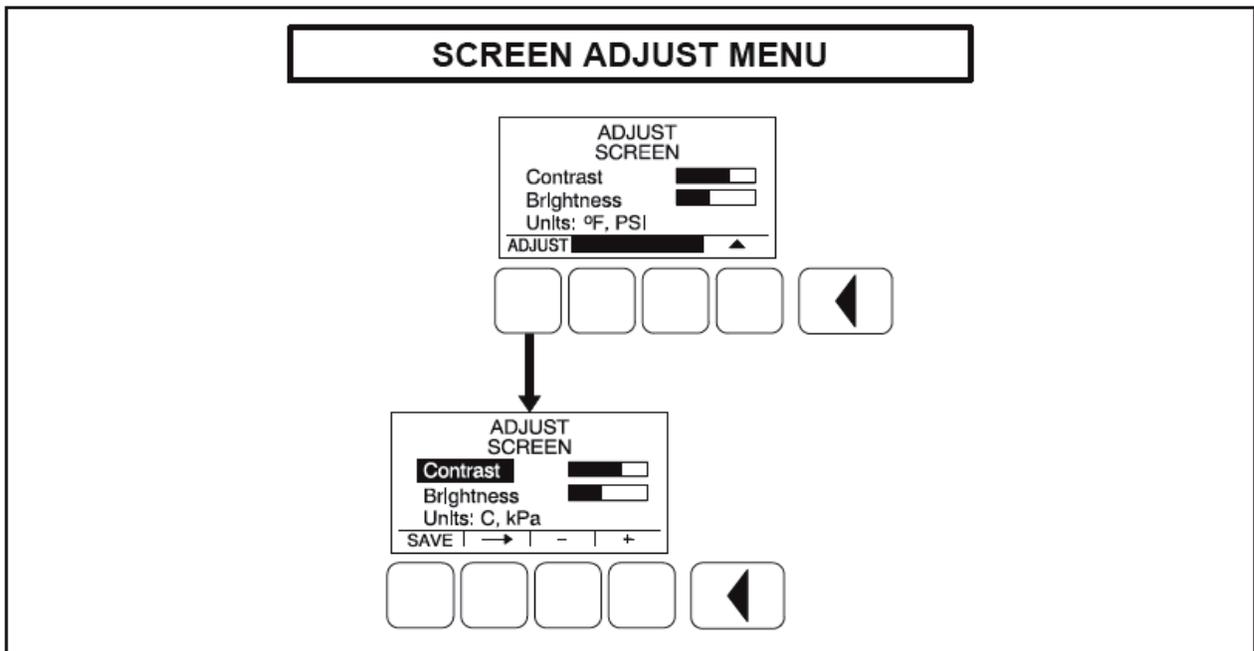


FIGURE 2-16. SCREEN ADJUST MENU

FAULT HISTORY MENU

Figure 2-18 shows a block representation of the Fault History menu. The first Fault menu is displayed when the **(4)** button is pressed on the second Service Menu. If there are any active fault sub-menus, an “Active Fault” heading is displayed for the most recent active fault. All other fault submenus display a “Fault History” heading. Five of the most recent faults can be viewed. An example of how a fault code is displayed is shown in Figure 2-17.

Press the buttons next to the ▲ and ▼ symbols in the graphical display to navigate between menus.

Press the ◀ button to return to the Service Menu.

Information on faults is found in *Section 4*.

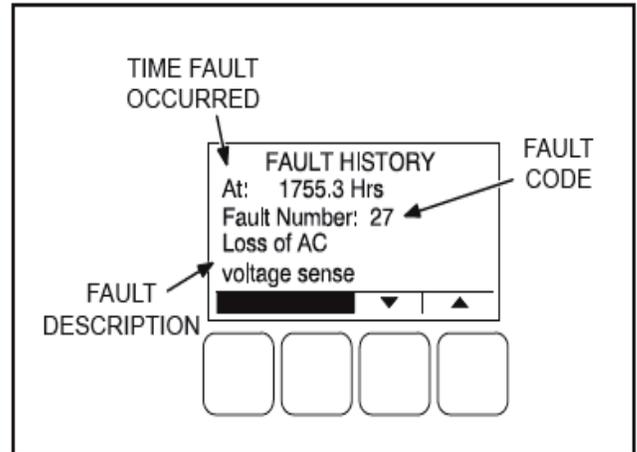


FIGURE 2-17. FAULT HISTORY MENU EXAMPLE

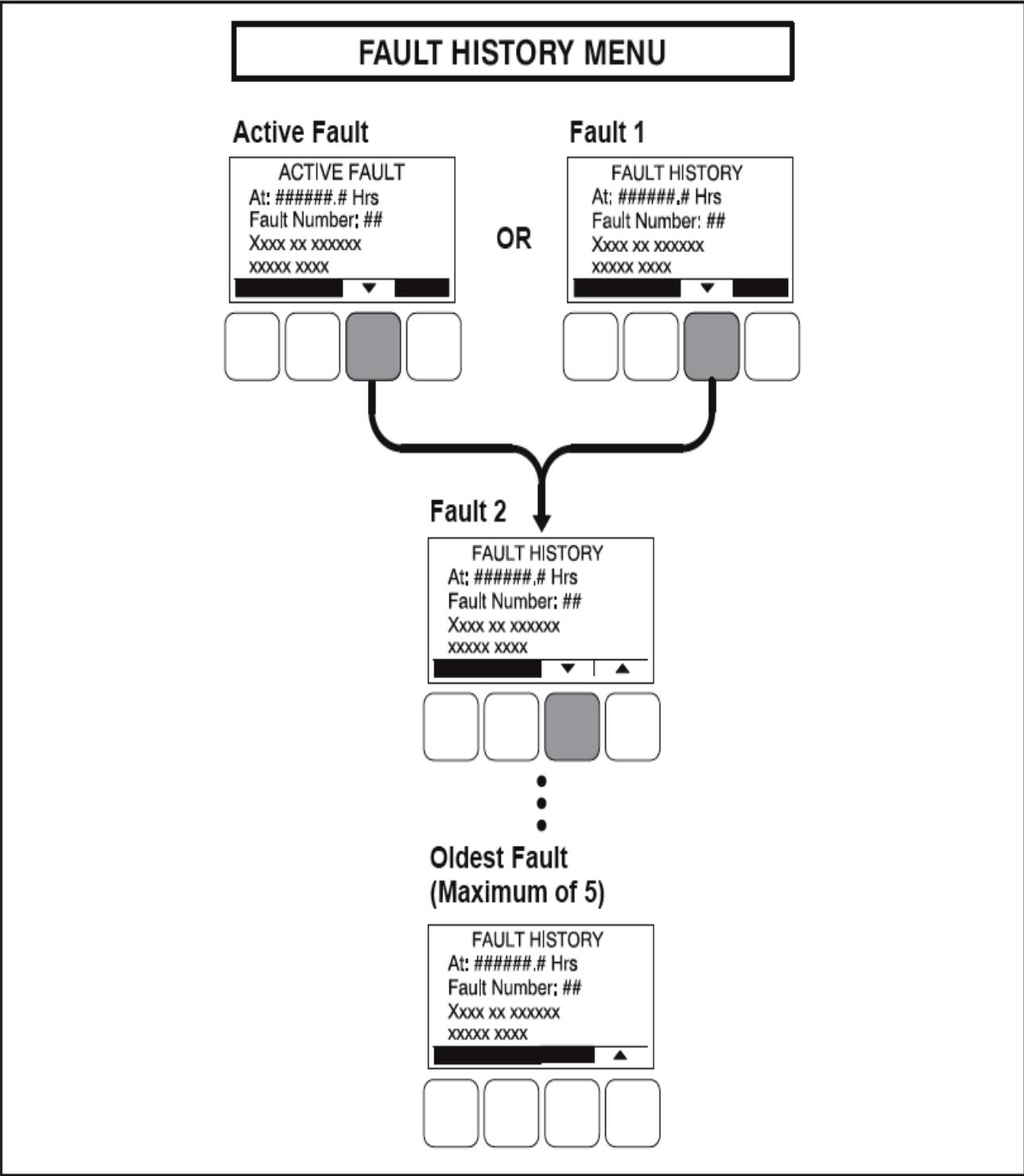


FIGURE 2-18. FAULT HISTORY MENU

3. Circuit Board

GENERAL

⚠ WARNING

HAZARDOUS VOLTAGE.

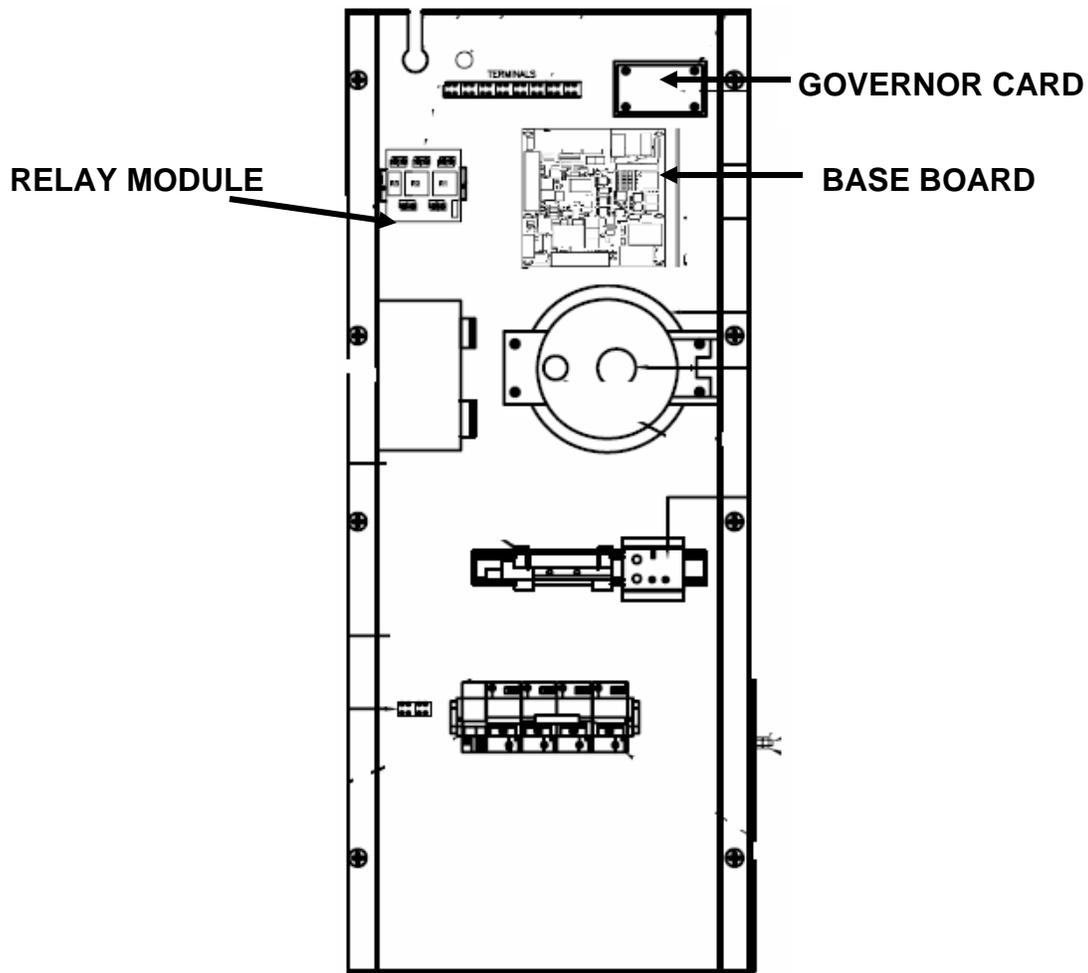
Touching uninsulated parts inside the control box can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts.

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 Power-Command ®1301 Control (PCC) Base board that is contained in the control box (Figure 3-1). The block diagram in Figure 3-2, shows the external connections of the PCC system. The system schematics are provided in Section 8 of this manual.

⚠ WARNING

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



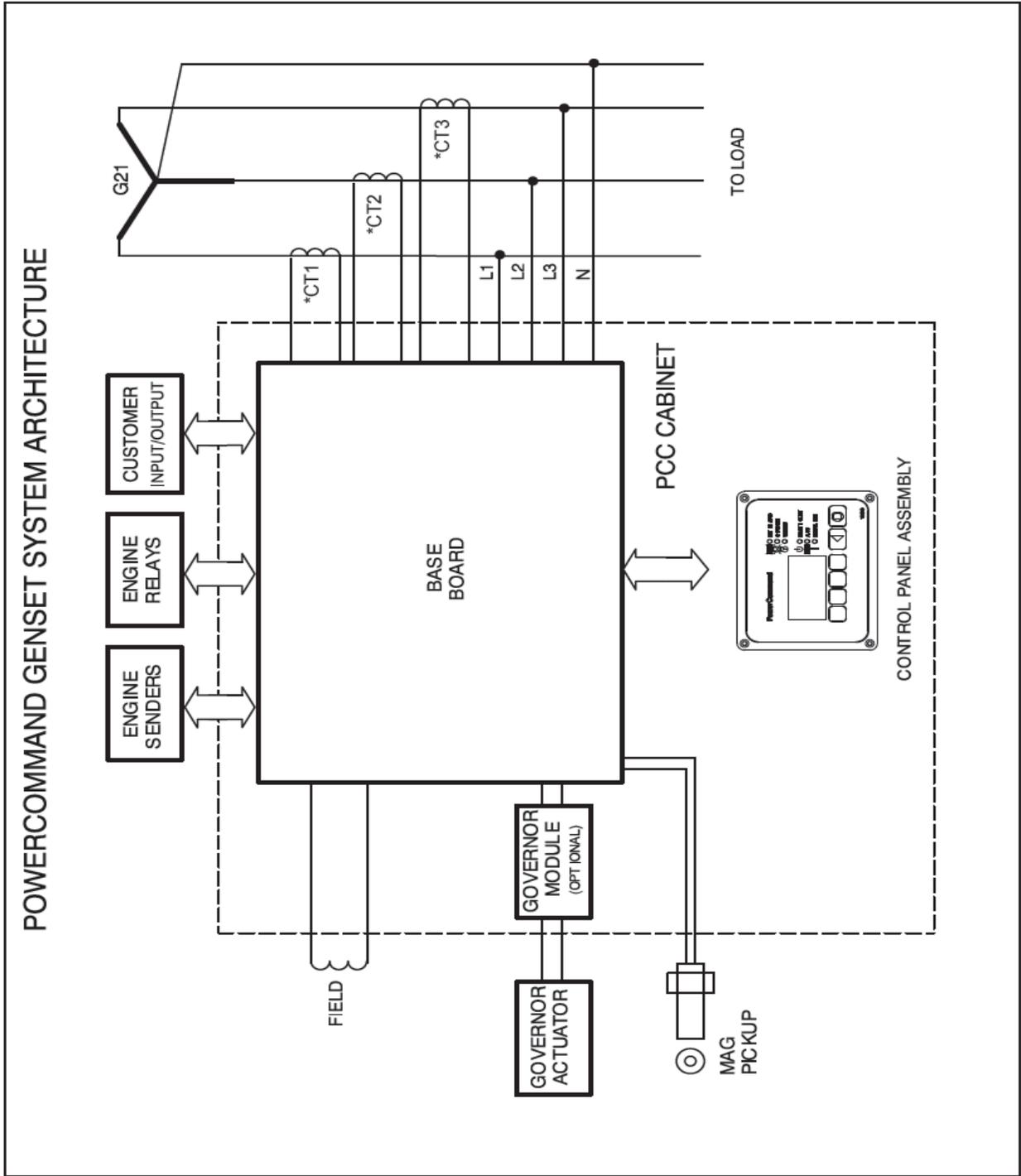


FIGURE 3-2. BLOCK DIAGRAM

BASE BOARD

The Base board (Figure 3-3) contains all of the electronic circuitry required to operate the generator set. The Base board provides fuel control, main alternator voltage output regulation and complete generator set control and monitoring. The following paragraphs describe the connectors (J), terminal board (TB), relays (R) and the LED status indicator. Figure 3-3 shows the pin locations for all Base board connectors. Refer to Block diagram in Section 8 for each connector pin input/output signal.

TB1 Customer Connections

Display panel B+/data link and 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 Block Diagram and Customer Connections diagram in Section 8 for TB1 connections.

DS1 LED Status Indicator

The status indicator lamp is illuminated when the Base board is in the Power On mode (processor is operating).

S1 Sleep Mode Selection

Refer to Control Panel On/Off Modes in Section 2.

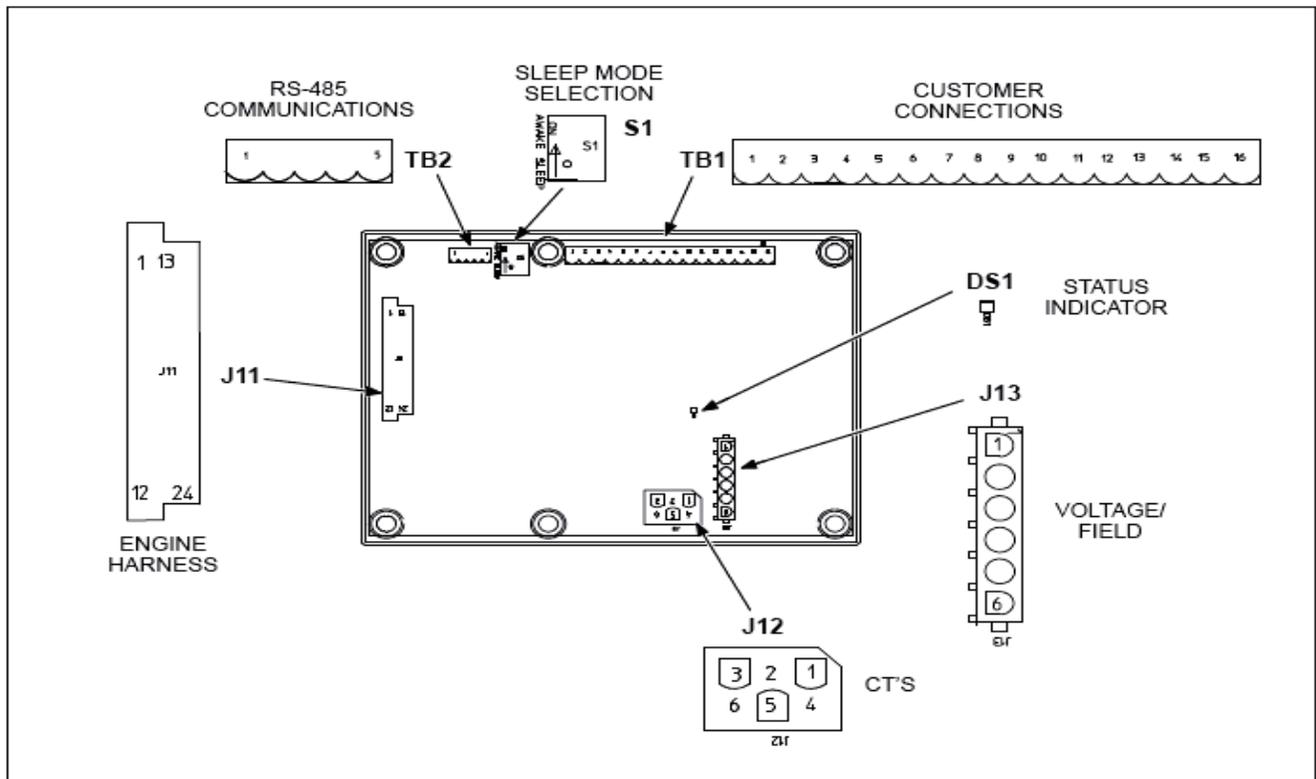


FIGURE 3-4. BASE BOARD CONNECTOR/TERMINAL PIN LOCATIONS

4. Troubleshooting

GENERAL

The PowerCommand® 1301 Control (PCC) continuously monitors engine sensors for abnormal conditions when genset is operating, such as low oil pressure and high coolant temperature. If any of these conditions occur, the control (with graphical display) will light a yellow Warning lamp or a red Shutdown lamp and display a message on the graphical display. A control without the graphical display indicates a shutdown condition by intermittent flashing of the status indicator.

INPOWER SERVICE TOOL

The InPower service tool Interface Kit 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 de-lays, 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 Proversion. 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 Baseboards 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 ANDCUSTOMER 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 shutdown, make certain the generator set cannot be accidentally restarted as follows:

Press the  button to switch to the **Off** mode.

Turnoff or remove AC power from the battery charger.

Remove the negative (–) battery cable from the generator set starting battery.

READING FAULT CODES

When a fault occurs, the graphical display will display the fault code/message.

After the fault is acknowledged and corrected, the recorded fault will be deleted from the control panel memory, but will remain in a data log to maintain a fault code history. The InPower service tool is required to view this data log. Refer to *Fault History Menu* in *Section 3*, which describes how to view fault codes.

TROUBLESHOOTING PROCEDURE

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

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

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

This section contains the following information:

- **Table 4-1 and 4-2:** Describes how to trouble-shoot a local/remote fail to crank problem when control panel does not indicate fault condition.
- **Table 4-3:** Describes how to troubleshoot engine problems that are not within the detectable range of the PCC control.
- **Table 4-4:** 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 trouble-shooting procedures. In the following tables, the fault codes are used as

the table reference number and are arranged in numeric order.

Figure 4-1 shows the location of the components within the control panel that are referenced in the following troubleshooting procedures. Connector locations for the Base board are provided in *Section 3*. The control wiring and circuit board connections are shown in *Section 8*.

 **CAUTION** *Always make sure that the PCC is in the OFF mode before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.*

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

Voltage and continuity tests are required in the following tables. In some cases, it is necessary to re-move a plug to complete the test. The following corrective actions will mention when it is necessary to remove a plug for testing. In other cases, the plug must not be removed for testing. When plug removal is not mentioned, testing must be performed by inserting a narrow meter probe into the back of the plug.

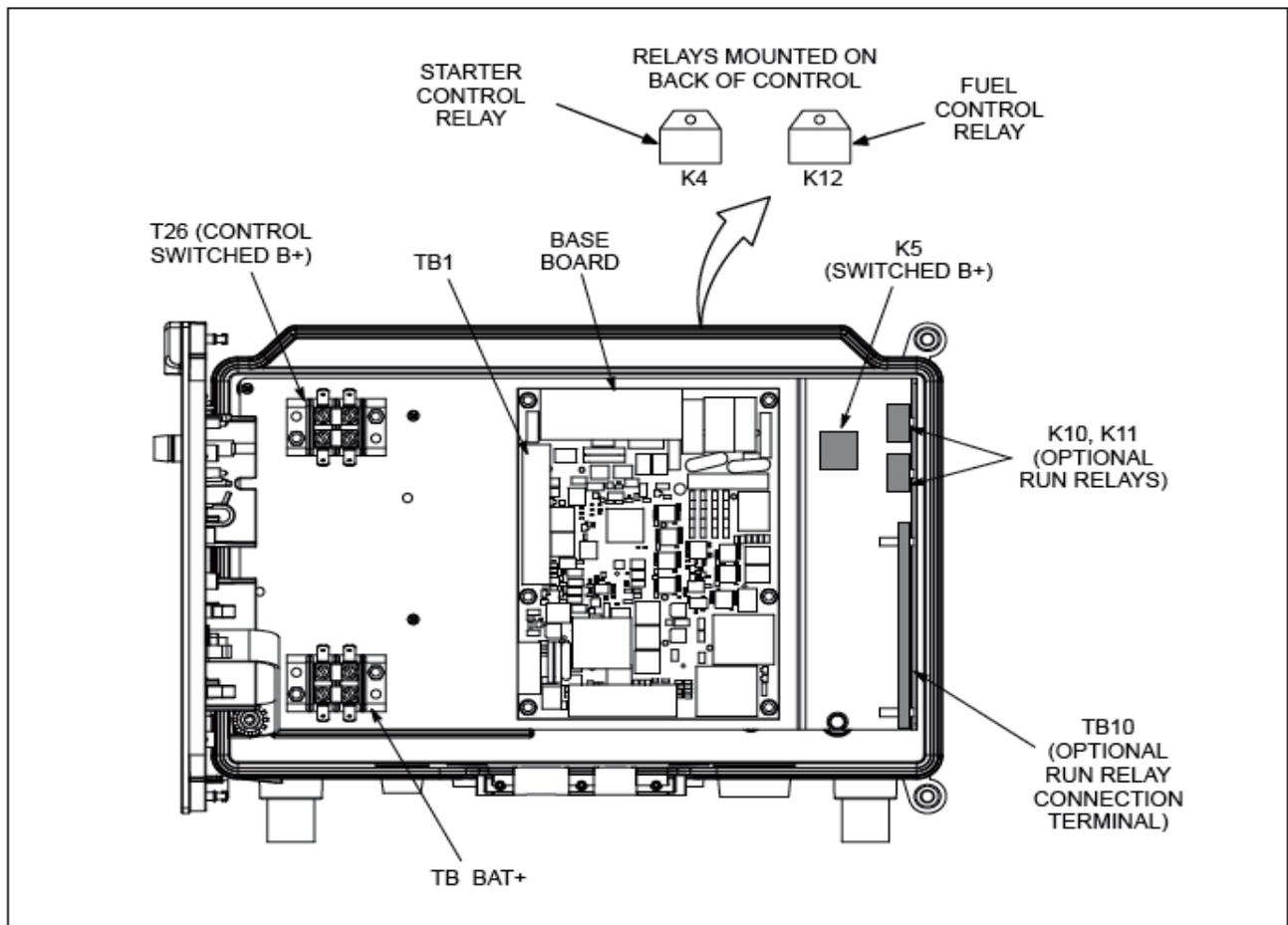


FIGURE 4-1. PCC 1301 COMPONENTS

Relay K5

This relay is used by the Base board to control switched B+ (battery voltage). The relay is energized when the control receives a run command. Customer Switched B+ is a fused 15 amp circuit (F1). SW B+ quick connect terminal for customer use is located by the engine block ground terminal. Wire color is Red/Orange stripe. Do not use T26 for customer connections (not fused). K5 is part of the engine harness jumper assembly.

Relay K4

The Starter Control relay is used by the Base board

to energize the starter solenoid. K4 is part of the engine harness assembly.

Relay K12

The Fuel Control relay is used by the Base board to control battery B+ to the fuel solenoid(s). K12 is part of the engine harness assembly.

Run Relays K10, K11

The optional Run relays are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The relays are energized when the control receives a run command.

**WARNING**

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

**TABLE 4.1. ENGINE DOES NOT CRANK IN MANUAL MODE
(NO FAULT MESSAGE)**

Reason: This indicates that the control has not received or recognized a manual start signal.

Effect: Engine will not start.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. No power supplied to control.	a. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. b. Remove connector P11 and check for B+ at P11-3 & 15 and GND at P11-9 & 10. If B+ or ground missing, isolate to harness and TB BAT terminal mounted on engine block. If B+ and ground check OK, cycle power to base board by reconnecting P11 and retry operation.
2. No power supplied to front membrane panel.	Check for B+ at TB1-1 and GND at TB1-4. If B+ or ground missing, the base board is bad. If B+ and ground check OK, remove P1 from back of front membrane panel. Check for B+ at P1-3 and ground at P1-5. If B+ or ground missing, repair harness.
3. Base board not properly calibrated or corrupt calibration.	Confirm that the installed calibration part number matches the serial plate information. Re-enter calibration file if necessary.
4. The Emergency Stop switch or wiring is defective.	With Emergency Stop push button not activated (switch closed), remove configurable leads from TB1-15 and TB1-16 and check for continuity between these two leads. If circuit is open, isolate to Emergency Stop switch and wiring. If there is continuity, go to next step.
5. Base board not properly calibrated or corrupt calibration.	Confirm that the installed calibration part number matches the serial plate information. Re-enter calibration file if necessary.
6. The menu display manual Run button, harness or the Base board is bad.	Check for continuity between P11-4 (RUN) to P11-8 (GND). If no continuity when pressing the manual Run button, isolate to front membrane panel and wiring. If there is continuity, the Base board is bad.
7. Oil Pressure switch or wiring is defective.	a. Remove P11 connection and check wiring between P11-6 and P11-7 to the switch. b. Verify control is configured for the type of switch installed. c. Verify proper operation of the switch
8. Oil Pressure sender, setup on wiring is defective.	a. Remove P11 connection and check wiring between P11-6, P11-17 and P11-5 (for 3-wire sender) to the sender. b. Verify control is configured for the type of sender. c. Verify operation of the sender

**WARNING**

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

**TABLE 4.2. ENGINE DOES NOT CRANK IN REMOTE MODE
(NO FAULT MESSAGE)**

Reason: This indicates that the 1301 series control 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 configurable wiring is faulty.	Reset the control. Attempt to start, and check for ground at TB1-11. If ground level is not present, isolate to the remote switch or configurable wiring. Repair as necessary. If ground is present, go to next step.
2. The menu display Auto button, harness or the Base board is bad.	Check for continuity between P11-16 (AUTO) to P11-8 (GND). If no continuity when pressing the menu display Auto button, isolate to front membrane panel or wiring harness. If there is continuity, the Base board is bad.

**WARNING**

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

TABLE 4.3. WARNING AND SHUTDOWN CODES

FAULT CODE	CORRECTIVE ACTION
1 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: <ol style="list-style-type: none"> 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.
2 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. If oil switch is used, check switch performance.
12 HIGH AC VOLTAGE Lamp: Shutdown	Indicates that one or more of the phase voltages has exceeded 130% of nominal for 0 second, or has exceeded high ac voltage threshold of nominal for time delay seconds.
13 LOW AC VOLTAGE Lamp: Shutdown	Indicates that one or more of the phase voltages has dropped below low ac voltage threshold for time delay seconds.
14 OVER FREQUENCY Lamp: Shutdown	Indicates frequency is 10% above base frequency for approximately 10 seconds.
15 UNDER FREQUENCY Lamp: Shutdown	Indicates that engine speed has dropped below 90% of nominal for approximately 10 seconds. Check fuel supply, intake air supply and load.
27 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. (Refer to Section 7.)
31 OVERSPEED Lamp: Shutdown	Indicates engine has exceeded normal operating speed. The default thresholds are 1725 RPM (50 Hz) or 2075 RPM (60 Hz). Possible causes are single step large block load removal or flammable vapors drawn into the intake air passage. Reset control and restart after locating and correcting problem.
38 FIELD OVERLOAD Lamp: Shutdown	Indicates that the Field AVR Duty Cycle has been at the maximum for at least 15 seconds.
45 SPEED SIGNAL LOST Lamp: Shutdown	Indicates that no magnetic pickup pulses are sensed for a Loss of Speed delay. If a magnetic pickup is not installed, then speed sensing is performed by monitoring AC line frequency, this fault cannot occur.

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

FAULT CODE	CORRECTIVE ACTION
46 HIGH AC CURRENT Lamp: Shutdown	Indicates that an individual phase of alternator output current has exceeded high current threshold of the rated output current continuously for more than time delay seconds. Check load and load lead connections.
61 EMERGENCY STOP Lamp: Shutdown	Indicates remote Emergency Stop. To reset the remote Emergency Stop button: <ol style="list-style-type: none"> 1. Open (disable) remote emergency stop button. 2. Move the rocker switch to the OFF position or press the OFF button. 3. Select the desired operating mode (manual or remote).
71 SPEED HZ MATCH Lamp: Shutdown	Indicates that measured speed and measured AC output frequency do not agree. Check genset setup for number of flywheel teeth.
72 FAIL TO CRANK Lamp: Shutdown	The genset has failed to sense rotation for two start attempts. Indicates possible fault with control, speed sensing or starting system. Can only occur in gensets with magnetic pickup installed and enabled.
73 FAIL TO START Lamp: Shutdown	Indicates possible fuel system or air induction problem. (Engine cranks but fails to start) <ol style="list-style-type: none"> 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.
74 FAIL TO STOP Lamp: Shutdown	Genset continues to run after receiving shutdown command from the controller.
75, 76 CONFIGURABLE INPUT #1 & #2 Lamp: Shutdown	The nature of the fault is an optional configurable selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, etc. Each of the fault functions can be programmed (using service tool or operator panel), as follows: <ul style="list-style-type: none"> • Warning or Shutdown (Default: Warning) (See fault code 204/205 for Warning) • Change display name using up to 32 characters.
77 SHUTDOWN AFTER BS Lamp: Shutdown	A shutdown fault occurred while the Battle Short mode was enabled. Check fault history for faults that may have been bypassed.
81,82,83 ANNUNCIATOR FAULT 1,2,3 Lamp: Shutdown	The nature of the annunciator fault is an optional configurable selection.
202 PRE-HIGH COOL TMP Lamp: Warning	Indicates engine is operating near cooling system capacity. Increase in load or higher ambient temperature may cause High Coolant Temp (1) shutdown. Review code 1 correction list for other possible causes.

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

FAULT CODE	CORRECTIVE ACTION
ACTION 92 – 95 AUX I/O MODULE INPUT 9 – 12 Lamp: Shutdown	The nature of the Aux I/O Module fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, etc. Each of the fault functions can be programmed (using InPower service tool or access to Setup menu), as follows: Warning, Shutdown or Event (Default = Warning) (See fault code 234–237 for Warning and code 171–174 for Event) Change display name using up to 32 characters.
96 OIL TEMP HIGH Lamp: Shutdown	Indicates that the engine oil temperature is above normal and has reached the shutdown trip point. (I/O Module option.)
98 AMBIENT TEMP HIGH Lamp: Shutdown	Indicates ambient temperature is above normal and has reached the shutdown trip point. (I/O Module option.)
99 FUEL LEVEL LOW Lamp: Shutdown	Indicates that fuel level has reached the shutdown trip point. (I/O Module option.)
102 VOLTAGE BIAS OOR Lamp: Shutdown	Indicates the voltage bias circuit output is out of range (OOR), high or low. (I/O Module option.)
103 SPEED BIAS OOR Lamp: Shutdown	Indicates the speed bias circuit output is out of range (OOR), high or low. (I/O Module option.)
106 I/O MODULE LOST Lamp: Shutdown	Indicates the data link between the I/O module and the Base board is lost.
163 – 170 BASE I/O MODULE INPUT 1 – 8 Lamp: None	The nature of the Base I/O Module event is an optional customer selection. Each event function can be programmed (using InPower service tool or access to Setup menu), as follows: Change display name using up to 32 characters. Select active low or high input.
171 – 174 AUX I/O MODULE INPUT 9 – 12 Lamp: None	The nature of the Aux I/O Module event is an optional customer selection. Each event function can be programmed (using InPower service tool or access to Setup menu), as follows: Change display name using up to 32 characters. Select active low or high input.
202 PRE-HIGH COOL TMP Lamp: Warning	Indicates engine is operating near cooling system capacity (monitor condition). Increase in load or higher ambient temperature may cause High Coolant Temp (1) shutdown. Review code 1 correction list for other

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

FAULT CODE	CORRECTIVE ACTION
<p>203 LOW COOLANT TEMP Lamp: Warning Set is not operating. Warning occurs when engine coolant temperature is 70F (21C) or lower. NOTE: In applications where the ambient temperature falls below 40F (4C), Low Coolant Temp may be indicated even though the coolant heaters are operating.</p>	<p>Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions:</p> <ol style="list-style-type: none"> Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. Open heater element. Check current draw of heater. <p>Coolant temperature must be below 70F (default setting) for one minute to activate warning and be above 70F for five minutes before the warning can be cleared.</p>
<p>204, 205 CONFIGURABLE INPUT #1, #2 Lamp: Warning</p>	<p>The nature of the fault is an optional configurable selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, etc.</p> <p>Each of the fault functions can be programmed (using service tool), as follows:</p> <ul style="list-style-type: none"> Warning or Shutdown (Default: Warning) (See fault code 75/76 for Shutdown) Change display name using up to 32 characters.
<p>212 COOL SENSOR OOR Lamp: Warning</p>	<p>Indicates that the control has sensed that the engine coolant temperature sensor output is out of range (high or low). Check sender/connectors/wires. This fault will only occur if water temperature sensor is equipped on the genset.</p>
<p>213 LOW BATTERY Lamp: Warning</p>	<p>Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation will occur.</p> <ol style="list-style-type: none"> Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. Check battery wiring/calibration. Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage is not obtained. Check battery charge voltage float level if applicable (raise float level).
<p>214 HIGH BATTERY Lamp: Warning</p>	<p>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.</p>
<p>215 PRE-LOW OIL PRESSURE Lamp: Warning</p>	<p>Indicates engine oil pressure has dropped below the warning trip point. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow code 2 procedure. This warning will only occur if genset is equipped with an oil pressure sender.</p>
<p>216 HIGH AC CURRENT Lamp: Warning</p>	<p>Indicates that one or more of the phase currents has exceeded high ac warning threshold for time delay seconds. Check load and load lead connections.</p>

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

FAULT CODE	CORRECTIVE CODE
217 OIL PRESS SENSOR OOR Lamp: Warning	Indicates that the control has sensed that the engine oil pressure sensor output is out of range (high or low). Check sender/connectors/wires. This warning will only occur if genset is equipped with an oil pressure sender.
218 BATTLE SHORT ACTIVE Lamp: Warning	Indicates that the control is in Battle Short mode - used to bypass several fault shutdowns for genset operation during emergencies.
219 CHARGER FAILURE Lamp: Warning	Indicates the battery charging alternator has not reached an acceptable voltage range within the selected period (default = 120 seconds). Refer to engine service manual if this fault occurs. If not failed, check wiring.
220 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.
221 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 213 for corrective action.
222,223,224 ANNUNCIATOR FAULT 1,2,3 :Lamp: Warning	The nature of the annunciator fault is an optional configurable selection.
225 ANNUNCIATOR OUTPUT CONFIGURATION ERROR Lamp: Warning	Indicates a mismatch in the configuration of one of the annunciator relay outputs.
226 — 233 Base I/O Module Input 1 — 8 Lamp : Warning	<p>The nature of the Base I/O Module fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water in Fuel, Ground Fault, etc.</p> <p>Each of the fault functions can be programmed (using InPower service tool or access to Setup menu), as follows:</p> <ul style="list-style-type: none"> • Warning, Shutdown or Event (Default = Warning) (See fault code 84–91 for shutdown and code 163–170 for Event) • Change display name using up to 32 characters.
234—237 AUX I/O MODULE INPUT 9–12 Lamp: Warning	<p>The nature of the Aux I/O Module fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water in Fuel, Ground Fault, etc.</p> <p>Each of the fault functions can be programmed (using InPower service tool or access to Setup menu), as follows:</p> <ul style="list-style-type: none"> • Warning, Shutdown or Event (Default = Warning) (See fault code 92–95 for shutdown and code 171–174 for Event) • Change display name using up to 32 characters.
238 OIL TEMP HIGH Lamp: Warning	Indicates engine has begun to overheat (oil temperature has risen to an unacceptable level). Increase in load or higher ambient temperature may cause High Oil Temp (code 96) shutdown. (I/O Module Option.)
239 OIL TEMP OOR Lamp: Warning	Indicates the oil temperature sensor output is out of range (OOR), high or low. (I/O Module option.)

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

FAULT CODE	CORRECTIVE ACTION
242 AMBIENT TEMP HIGH Lamp: Warning	Indicates the ambient temperature has exceeded the warning threshold for genset room temperature. Increase in load may cause Ambient Temp High (code 98) shutdown. (I/O Module Option.)
243 AMBIENT TEMP OOR Lamp: Warning	Indicates the ambient temperature sensor output is out of range (OOR), high or low. (I/O Module Option).
244 FUEL LEVEL LOW Lamp : Warning	Indicates that the fuel has dropped below the low fuel level trip point. Allows time to refill before fuel level low (code 99) shutdown occurs. (I/O Module Option).
245 FUEL LEVEL OOR Lamp : Warning	Indicates the fuel level sensor output is out of range (OOR), high or low. (I/O Module Option).
252 I/O MODULE LOST Lamp : Warning	Indicates an intermittent data link between the I/O module and the Base board.

**WARNING**

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CODE 1/202 - HIGH OR PRE-HIGH COOLANT TEMPERATURE (SHUTDOWN/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 Control for code 202. Engine will shut down for code 1.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with a PC based service tool.	1. With a PC based service tool, verify that the fault simulation is not enabled for the coolant sensor. If you do not have a PC based service tool, remove battery power from the control to disable fault simulation overrides.
2. Engine or sensor circuitry problem.	4. Check the sensor accuracy with a thermocouple or similar temperature probe. <ul style="list-style-type: none"> • If the coolant temperature reading is accurate, the engine may be overheating. Refer to the engine service manual. • If the coolant temperature reading is not accurate, go to next step.
3. The sensor could be bad.	4. 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 P11 from Base board and check resistance between pins P11-18 (H20) and P11-6 (H20 COM). <ul style="list-style-type: none"> • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

**WARNING**

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**CODE 2/215 - LOW OIL OR PRE-LOW PRESSURE (WARNING/SHUTDOWN)
OIL PRESSURE SENSOR TYPE : SENDER**

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 Control for code 215. Engine will shut down for code 2.

POSSIBLE FAULT	CORRECTIVE ACTION
1. Fault simulation was enabled with a PC based service tool.	1. With a PC based service tool, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have a PC based service tool, 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 + signal wire at the fuel solenoid, and crank the engine. Check the oil pressure reading on the digital display. <ul style="list-style-type: none"> • 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 display panel for other faults. • If the display does not show an acceptable oil pressure, replace the sensor. If the Control 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 S1). If there is no 5 VDC at the sensor: <ul style="list-style-type: none"> • Check for 5 VDC at P11-17. • 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 P11-17 (OP OUT) and P11-5 (OP COMM). If the pressure signal (.5 to 4.5 VDC) does not get to P11, isolate to the harness. If the pressure signal does go to P11, the Base board is bad.
5. Low Oil Pressure fault set points could be incorrect.	Verify set points against the normal operating pressures of the engine. Refer to engine manual.

**WARNING**

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CODE 12 - HIGH AC VOLTAGE (SHUTDOWN)

Reason: One or more of the phase voltages has exceeded 130% of nominal for 1 seconds, or has exceeded the High AC Voltage Threshold for the High AC Voltage Delay seconds.

Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with a PC based service tool.	1. With a PC based service tool, verify that the related fault simulation is not enabled. If you do not have a PC based service tool, 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 PC based service tool.	3. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
4. Base board or generator is bad.	4. Refer to Generator/Base Board Isolation Procedure in Section 7 to determine if the Base board is causing the high AC voltage shutdown fault.
5. Voltage sense connections/setup could be incorrect.	5. See Section 17 for proper corrective actions.

CODE 13 - LOW AC VOLTAGE (SHUTDOWN)

Reason: One or more of the phase voltages has dropped below the Low AC Voltage Threshold for Low AC Voltage Delay seconds.

Effect: Engine will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with a PC based service tool.	1. With a PC based service tool, verify that the related fault simulation is not enabled. If you do not have a PC based service tool, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with a PC based service tool.	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 9.
5. Voltage sense or setup wiring connection could be incorrect.	5. Check that excitation inputs P13-5 and P13-6 are connected to the correct voltage.
6. The rotating rectifier assembly (diodes CR1 through CR6) is faulty.	6. Check each diode. See genset service manual
7. Loose connector or Base board is bad.	7. Repair connections (P13) or replace the Base board if necessary.
8. Voltage sense connections/setup could be incorrect	8. See section 17 for proper connections

**WARNING**

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CODE 14 - OVER FREQUENCY (SHUTDOWN)

Reason: Generator AC output frequency is high.

Effect: Generator set will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault threshold is not set correctly with PC based service tool.	1. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
2. Fuel or air delivery problem.	2. Refer to the engine service manual.
3. Governor fault.	3. Check governor frequency adjustment (Refer to Section 7).
4. Loose connector or Base board is bad.	4. Repair connections (P12/P13) or replace the Base board if necessary.

CODE 15 - UNDER FREQUENCY (SHUTDOWN)

Reason: Generator AC output frequency is low.

Effect: Generator set will shut down.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault threshold is not set correctly with PC based service tool.	1. Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.
2. Overload.	2. Check the load and correct any overload. Check operation by disconnecting load and restarting generator set.
3. Fuel or air delivery problem.	3. Refer to the engine service manual.
4. Governor fault.	4. Check fuel shutoff solenoid adjustment.
5. Loose connector or Base board is bad.	5. Repair connections (P13) or replace the Base board if necessary.

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CODE 31 - 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 very 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 a PC based service tool.	3. With PC based service tool, verify that the fault simulation is not enabled for the coolant sensor. If you do not have PC based service tool, remove battery power from the control to disable fault simulation overrides.
4. Fault threshold is not set correctly with PC based service tool.	4. Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.
5. Monitor the engine rpm using PC based service tool.	5. If the RPM is not correct, refer to fault code 45 for corrective action.
6. Governor fault.	6a. Check fuel shutoff solenoid adjustment. 6b. Replace defective injection pump unit.
7. Flywheel tooth count incorrect.	6. For gensets with magnetic pickup installed, verify flywheel tooth count is correct for the engine type. Refer to section 7.11.1 for a table.
8. Mechanical Fuel system setup could be incorrect.	7. Verify fuel stop settings for the application.

CODE 45 - SPEED SIGNAL LOST (SHUTDOWN) (GENSET WITH MPU)

Reason: This indicates that the control 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. If 72 (Fail To Crank) is displayed, or if the engine starts, but then shuts down on 45 (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. <ul style="list-style-type: none"> • If no output, check for damage or debris. Also check for improper adjustment of the MPU. (Refer to Section 7.11.) If there is still no output, replace the MPU sender. • If the MPU output is OK, check for MPU voltage at P11-12 (MAG PICK+) to P11-24 (MAG PICK-) while cranking. If OK, replace the Base board. If not OK, use continuity checks to isolate connectors/harness. <p>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 operator panel or PC based service tool.</p> <ul style="list-style-type: none"> • Verify number of flywheel teeth has been correctly configured (see Section 7.11.1). • If they do match, multiply the frequency by 30 and compare this number to the RPM on the operator panel or PC based service tool. If these are not the same, the MPU sender may be bad. Replace the MPU sender. • If the Multimeter and control frequencies do not match, there is a frequency sensing problem within the Base board. Replace Base board.

**WARNING**

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CODE 46/216 - HIGH AC CURRENT (SHUTDOWN/WARNING)

Reason: This indicates that the indicated generator output current has exceeded 110% of rated.

Effect: No action is taken by the control for code 216. Engine will shut down for code 46.

POSSIBLE FAULT	CORRECTIVE ACTION
1. Fault threshold are not set correctly with PC based service tool.	1. Reset the threshold to the desired or correct 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 disconnection load and restarting generator set.
3. Incorrect CTs, CT Connections, or CT setup.	3. Check CTs, CT connections, correct if necessary. Refer to <i>Current Transformer Setup</i> in Section 6.6.
4. The problem may be the Base board or harness connections.	4. Remove connector P12 from Base board. Check continuity from P12 to CTs. P12-1 (CT1) to P12-4 (CT1-COM) P12-2 (CT2) to P12-5 (CT2-COM) P12-3 (CT3) to P12-6 (CT3-COM) Repair connections.
5. Incorrect rating setup.	5. Check rating setup in control. Correct if necessary.

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CODE 72 - FAIL TO CRANK (SHUTDOWN) (LOCAL OR REMOTE)

Reason: This indicates that the engine failed to crank after the control 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/K7 Starter Relay is bad.	2. Check wiring continuity/test K7 relay. 3. Remove lead from K7-COM and check for B+ at lead COM (directly connected to battery B+). <ul style="list-style-type: none">• If there is no B+, check for open circuit between K7-COM and battery B+.• If B+ is present, reconnect lead COM to K7. Remove lead from K7-N/O. Attempt to start and check for B+ at terminal K7-N/O.• If B+ is present, check for open circuit between K7-N/O and SW terminal of starter.• If B+ is not present, the Base board/K7 relay is bad.
3. The Emergency Stop switch or wiring is defective.	4. With Emergency Stop push button not activated, remove configurable leads from TB1-15 and TB1-16 and check for continuity between these two leads. If circuit is open, isolate to Emergency Stop switch and wiring. If there is continuity, go to next step.
4. MPU/circuit or Base board is bad.	5. Refer to Code 45 instructions.

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**CODE 73 - FAIL TO START (SHUTDOWN)
MECHANICAL GOVERNED ENGINE**

Reason: This indicates that the engine failed to start after expiration of last crank time.

Effect: Engine will not start.

POSSIBLE FAULT	CORRECTIVE ACTION
1. Restricted fuel supply due to: a) Fuel level below pickup tube in tank. b) Closed shutoff valve in supply line. c) Fuel injectors clogged. d) Air in fuel system.	1a. Add fuel if low. Prime the fuel system. 1b. Open any closed shutoff valve in the fuel line supplying the engine. 1c. Refer to engine service manual. 1d. Bleed air from fuel system. Refer to engine service manual.
2. Glow plugs are not heating due to: a) Glow plug(s) is bad. b) Base board is bad. c) Glow Plug Relay is bad.	The Base board determines at what temperature and duration of time that the glow plugs will be energized. Using sensed coolant temperature, the glow plugs are energized at 77 ^o F (25 ^o C) and colder. The glow plugs are energized for up to 15 seconds when the coolant temperature is -5 ^o F (-20.5 ^o C) or colder. Time duration (15-0 seconds) is linear between -5 ^o F and 77 ^o F. <i>With coolant temperature colder than 77^oF (25^oC):</i> 2a. Each glow plug should be warm to the touch if the engine has just been cranking. First clean and tighten the terminal of any cold glow plug and then replace it if necessary. 2b. Install harness tool between Base board P11 connector. Attempt to start and check for B+ at P11-2 (RELAY COIL B+) and P11-19 (GLOW PLUG SOL). (These are leads to K2 coil.) <ul style="list-style-type: none"> • If B+ is not present, the Base board is bad. • If B+ is present, go to step c. 2c. Check for B+ at glow plug relay. If not present, check for open circuit. <ul style="list-style-type: none"> • If there is B+ at glow plug relay, attempt to start and test for B+ at other end of glow plug relay. • If B+ is not present, glow plug relay is bad. • If B+ is present, check for open circuit between glow plug relay contact and glow plugs.
3. The engine fuel system is worn or malfunctioning or has lost prime (fuel lift pump, injection pump, injectors, timing).	3. Service according to the engine service manual.
4. The engine is worn or malfunctioning mechanically.	4. Service according to the engine service manual.

**WARNING**

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**CODE 73 - FAIL TO START (SHUTDOWN)
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: i. Fuel level below pickup tube in tank. ii. Closed shutoff valve in supply line. iii. Fuel injectors clogged. iv. Air in fuel system.	1a. Add fuel if low. Prime the fuel system. 1b. Open any closed shutoff valve in the fuel line supplying the engine. 1c. Refer to engine service manual. 1d. Bleed air from fuel system. Refer to engine service manual.
2. The governor linkage needs adjustment.	2. Repair and adjust the linkage as necessary (refer to <i>Section 7</i>).

**CODE 73 - FAIL TO START (SHUTDOWN) (CONT.)
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
<p>3. Injection pump actuator not energized due to the harness, governor actuator governor module or the base board is bad.</p>	<p>Isolate to harness, governor actuator or Base board.</p> <p>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 governor or output circuit of control is bad, go to step 4b. (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 control is bad, or is configured incorrectly. Check configuration.</p> <p>3b. Remove connector P11 from control and check wiring continuity of actuator circuit. P11-14 (GOV-DR+) and P11-7 (GOV-DR-) to appropriate +/- terminals of governor module and between J1-4 on governor module and actuator. If continuity is OK, go to step 4c.</p> <p>3c. 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 4d.</p> <p>3d. Remove power from control for one minute. Put power back on the control and check for B+ at J11-14. If not present, control is bad. If present, go to step 4e.</p> <p>3e. Attempt to start and check for CNTL B+ at terminal lead ACT + of governor actuator (use engine block for metering ground). If not present, check wiring or SW B+ control function and J1-3 of governor module. If CNTL B+ is present, attempt to start and check for GOV PWM (pulse wide modulated) signal (measure across terminals of actuator and across J1-2 to J1-1 of governor module). If not present on J1, control is bad. If not present on actuator, governor module is bad.</p>

**WARNING**

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**CODE 73 – FAIL TO START (SHUTDOWN) (CONT.)
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
4. The engine fuel system is worn or malfunctioning or has lost prime (fuel lift pump, injection pump, injectors, timing).	4. Service according to the engine service manual.
5. The engine is worn or malfunctioning mechanically.	5. Service according to the engine service manual.

CODE 75/76 – CONFIGURABLE INPUT (SHUTDOWN)

Reason: The nature of the fault is an optional configurable selection.

Effect: Shutdown.

POSSIBLE CAUSE	CORRECTIVE ACTION
If there is no actual fault, the problem may be an external wiring problem.	Disconnect the signal lead from TB1 and reset the control. Check the following two points. <ul style="list-style-type: none"> • CUST_IN1 – TB1-14 • CUST_IN2 – TB1-12 If the message drops out, the external wiring has a short circuit. Grounding of either input activates fault.

CODE 202 – PRE-HIGH COOLANT TEMP (WARNING)

Reason:

Effect:

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

**WARNING**

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CODE 203 - 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 control. Engine may not start due to slow cranking speed.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fault simulation was enabled with PC based service.	1. With PC based service tool, verify that the fault simulation is not enabled for the coolant sensor. If you do not have a based service tool, remove battery power from the control to disable fault simulation overrides.
2. Fault threshold is not set correctly with a PC based service tool.	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: <ul style="list-style-type: none"> • 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: <ol style="list-style-type: none"> 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 are 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 P11 from Base board and check resistance between pins P11-18 (H20) and P11-6 (H20 COM). <ul style="list-style-type: none"> • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

**WARNING**

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CODE 204/205 - CONFIGURABLE INPUT (WARNING)

Reason: The nature of the fault is an optional configurable selection.

Effect: Warning.

POSSIBLE CAUSE	CORRECTIVE ACTION
If there is no actual fault, the problem may be an external wiring problem.	Disconnect the signal lead from TB1 and reset the control. Check the following pins. <ul style="list-style-type: none"> • CUST_IN1 - TB1-14 • CUST_IN2 - TB1-12 If the message drops out, the external wiring has a short circuit. Grounding of either input activates fault.

CODE 212 - COOLANT SENSOR OOR (HIGH/LOW) (WARNING)

Reason: This indicates that the coolant temperature sensor signal is out of range - shorted high or low.

Effect: No engine protection for coolant temperature during genset operation. Possible white smoke.

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 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.
3. The harness or Base board could be bad.	3a. Remove connector P11 from Base board and disconnect sensor. Check pins P11-18 (H20) and P11-6 (H20 COM) for short circuit as follows: <ul style="list-style-type: none"> • 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 P11 from Base board and check resistance between pins P11-18 (H20) and P11-6 (H20 COM). <ul style="list-style-type: none"> • If resistance is not the same, harness is bad. • If resistance is the same, Base board is bad.

**WARNING**

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CODE 213 - LOW BATTERY (WARNING)

Reason: Low voltage has been detected for battery.

Effect: The control's 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 80F (27C).
2. Low electrolyte level in battery.	2. Replenish electrolyte and recharge battery.
3. Battery connections loose or dirty.	3. Clean and tighten or replace the battery cable connectors and cables at the battery and the set.
4. Insufficient battery charging voltage.	4. Adjust charge rate of AC powered battery charging circuit, according to manufactures instructions.
5. Engine DC alternator could be bad.	5. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained.
6. If the batteries are OK, the problem may be the harness or the Base board.	6. Remove connector P11 from Base board and check battery voltage at P11-3 & 15 (B+) to P11-9 & 10 (GND). <ul style="list-style-type: none"> • If the voltage at P11 is not the same as the battery voltage, the harness is bad. • If the voltage at P11 is OK, the Base board is bad.
7. Fault threshold could be bad.	7. Check fault threshold against requirement of the application.

CODE 214 – HIGH BATTERY VOLTAGE (WARNING)

Reason: High voltage has been detected for battery.

Effect: Control damage will occur.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Excessive battery charging voltage.	1. Adjust charge rate of AC powered battery charging circuit according to manufacturers instructions.
2. Engine DC alternator could be bad.	2. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained.
3. Fault threshold could be bad.	3. Check fault threshold against requirement of the application.

**WARNING**

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CODE 215 - PRE-LOW OIL PRESSURE (WARNING)**Reason:****Effect:**

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code 2 for oil pressure sender.	1. Refer to code 2 for oil pressure sender.

CODE 216 - HIGH AC CURRENT (WARNING)**Reason:****Effect:**

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code 46 .	1. Refer to code 46 .

CODE 217 - OIL PRESSURE SENSOR OOR (HIGH/LOW) (WARNING)**Reason:** This indicates that the engine oil pressure sensor signal is out of range - shorted high or low.**Effect:** No engine protection for oil pressure during genset operation.

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.	3. Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. "OIL PRESSURE SENSOR OOR" 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.
3. The harness could be bad.	3. Remove connector P7 from Base board and connector from sensor. Check P11-6, 17 & 21 as follows: <ul style="list-style-type: none"> • 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.
4. The Base board could be bad.	4. With all connectors attached, check pressure signal (.5 to 4.5 VDC) at P11-17 (OP OUT) and P11-6 (OP COM). If in range, replace Base board.

⚠ WARNING

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

CODE 221 - WEAK BATTERY (WARNING)**Reason:****Effect:**

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Refer to code 213.	1. Refer to code 213.

CODE 222-224 - CONFIGURABLE INPUT (WARNING)**Reason:** The nature of the fault is an optional configurable selection.**Effect:** Warning.

POSSIBLE CAUSE	CORRECTIVE ACTION
1. If there is no actual fault, the problem may be an external wiring problem.	1. Disconnect the signal lead from TB1 and reset the control. Check the following pins. These connections are on the Universal Annunciator. <ul style="list-style-type: none"> • CONF_ANNUC_IN1 - TB1-14 • CONF_ANNUC_IN2 - TB1-12 If the message drops out, the external wiring has a short circuit. Grounding of either input activates fault.

CODE 225 – ANNUNCIATOR CONFIGURATION ERROR (WARNING)**Reason:** Indicates that more then one network device is configured to activate one of the Annunciator output relays**Effect:** Warning

POSSIBLE CAUSE	CORRECTIVE ACTION
1. Network configuration is bad.	1. Check setup of devices on the network against duplicate use of the same Annunciator relay output.
2. Bad device on network.	2. Troubleshoot network for malfunctioning devices.

5. CONTROL ADJUSTMENTS AND SERVICE.

GENERAL

This section contains circuit board removal and replacement procedures and system parameter 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, magnetic speed pickup unit and current transformers. 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 PCC1301 control box must be opened only by technically qualified personnel. Voltages of upto 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 with PCC1301 Interface Kit) are required to remove a circuit board from in-side the control box. The InPower Service tool is required when replacing the Base board. Before replacing the Base board, make sure that a capture file of the genset's parameter values has been created using InPower. (During genset installation, it was suggested that a capture file be made before and after changes were made to the genset operating parameters.) After replacing the Base board, use the capture file as a template to write the previous settings to the new Base board software. Refer to INPOWER User's Guide for specifics.

Circuit Board Removal Safety Precautions 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. To prevent circuit board damage due to electrostatic discharge (ESD), a grounding wrist strap must be worn when handling circuit boards or socket-mounted IC's. (The wrist strap **does not** provide a direct short to ground, but is typically rated at approximately 1 mega ohm to ground.) Attach the clip to the chassis ground screw in the control box and place the strap around your wrist before handling a circuit board.

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

WARNING

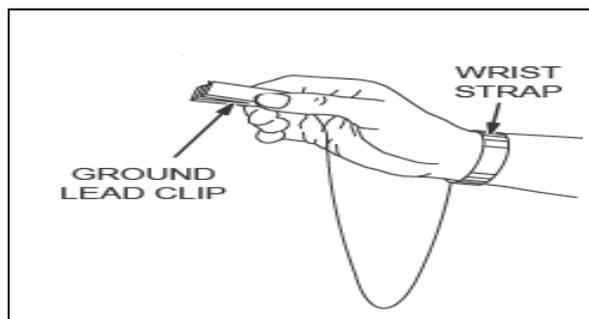
Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before 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.



SETUP MENU

The Setup Menu menu (Figure 5-2) provides access to genset menus with system parameters that can be viewed and, if a password is entered, adjusted. The Setup “Password” menu is displayed when the “1” button is pressed on the Service Menu(Figure 3-14).

Pressing the VIEW button in the Setup “Password” menu, will display the 1st Genset Service menu(see Figure 5-3). Note that when viewing the Gen-set Service menus, the ADJUST button will not be displayed as shown in Figure 5-3.After entering the password from the Setup “Pass-word” menu, a second Setup menu is displayed that provides access to the following two categories of genset adjust menus. •

- Genset Service menus –Go to page 5-4.
- Genset Setup menus – Go to page 5-27.

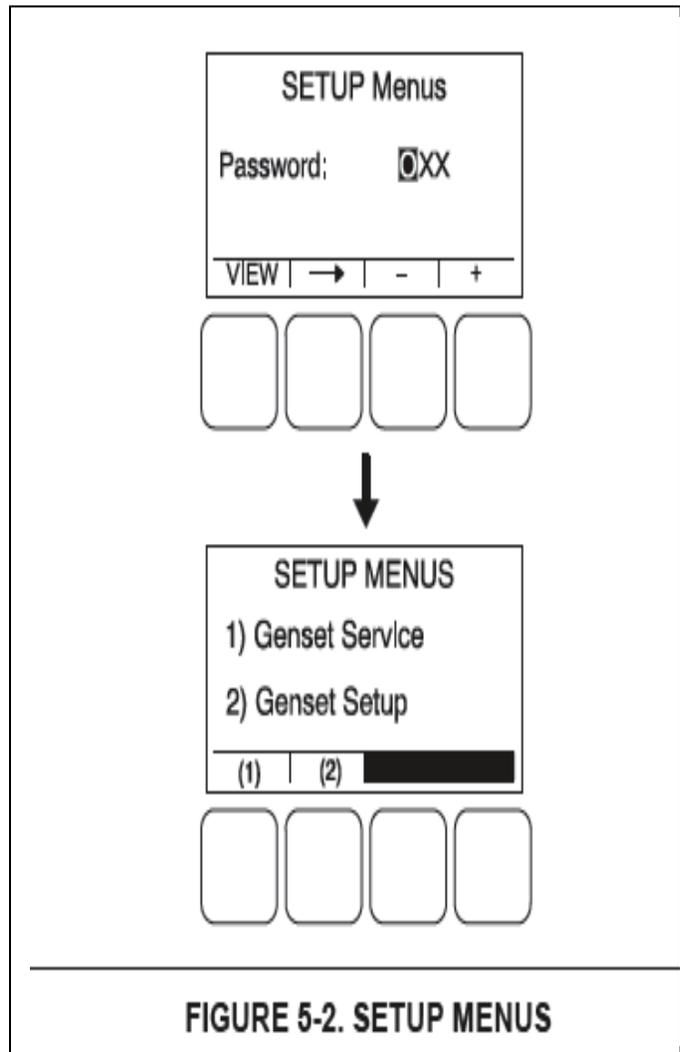


FIGURE 5-2. SETUP MENU

GENSET SERVICE MENUS

In the following menu entry descriptions, the default parameter/value is not shown because the default value is subject to change by model. Always create and refer to the initial capture file for factory default settings of system parameters/values.

The Genset Service menus are available by pressing the **(1)** button in the Setup menu (see Figure 5-3). This section covers Genset Service menus only. For information on Genset Setup menus, go to page 5-27. If a password is entered, the settings in the Genset Service menus can be adjusted. However, if a password is not entered, these menus can still be viewed.

Viewing and Adjusting

Figure 5-3 is a block representation of the two Gen-set Service menus that are available from the Setup menu after the correct password has been entered. The Genset Service menus provide access to the following categories. The first Genset Service Menu provides access to the following menus:

- Genset
- Customer I/O
- Meter Calibration

The second Genset Service Menu provides access to the following menu

- Annunciator

Setup Password Menu

Adjusting the Genset Service submenus is restricted to service personnel and a password must be entered to modify these menus. When the Password menu is displayed, the first numeric character (0) is highlighted (see Figure 5-3).

NOTE: When selected (highlighted), each character initially turns to “0” and the remaining characters turn to “X”.

NOTE: Make sure that each numeric character is correct before you move to the next character. If a wrong character is entered, you will not be able to go back and correct it. If the wrong password is entered, you will be able to view the Genset Service menus but you won’t be able to change them. To enter the Genset Service Menus password **574**:

1. With the first character highlighted, press the button below to the + or – symbols until the value reads “5.”
2. Press the arrow selection button → to move to the next numeric character.
3. Press the button below the + or – symbols until the value reads “7.”
4. Press the arrow selection button to move to the next numeric character.
5. Press the button below the + or – symbols until the value reads “4.”
6. After you have completed entering the password, press the arrow selection button → .

The first main Setup menu is displayed.

After the correct password is entered, it will be remembered until five minutes of button inactivity has elapsed. If five minutes of button inactivity has elapsed, you will have to re-enter the password to access and change the Genset Service submenus.

Adjusting Values/Parameters

Once the correct password has been entered after Genset Service **(1)** is selected on the Setup Menu menu, the first Genset Service menu is displayed.

1. Press the buttons above the ▲ and ▼ symbols in the digital display to navigate between submenus.
2. Press the **ADJUST** selection button to select the first parameter or value to be changed.
3. Press the + or – selection buttons to adjust values or select parameters.
4. Press the arrow selection → button to navigate to the next or previous adjustable value or parameter.
5. After adjusting values/selecting parameters, press the **SAVE** button to save your settings.

NOTE: If the button ◀ is pressed before pressing the SAVE button, the changes are not saved.

6. Press the button ◀ to return to the Service Menu.

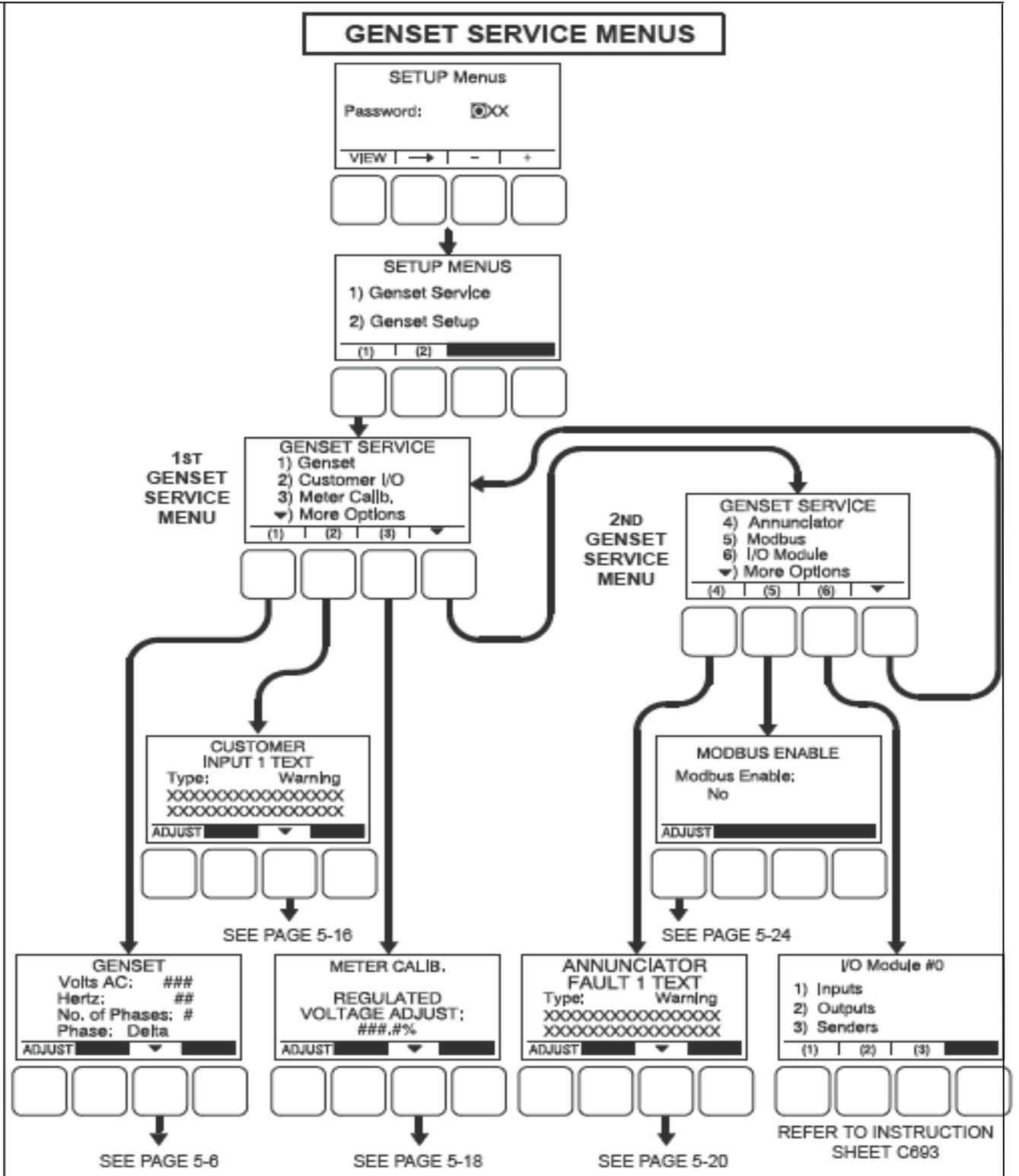


FIGURE 5-3. GENSET SERVICE MENUS

GENSET SERVICE SUBMENUS

The Genset Service submenus are available by pressing the **(1)** button on the first Genset Service menu (see Figure 5-3).

Appendix A provides a block diagram that illustrates the sequence of how the Genset Service Submenus are displayed. The Genset Service submenus consist of ten basic menus.

- Genset, Part 1
- Genset, Part 2
- Fuel System
- Start/Stop Time Delays
- Cycle Crank
- Battle Short
- Automatic Voltage Regulator Setup*
- Electronic Governor*
- Genset Model and Serial Number
- Display Setup

Genset Menu, Part 1

The first genset menu displays the preset AC Voltage, genset frequency, number of phases, and phase type.

- *Volts AC:* Displays the AC voltage (190, 200, 208, 220, 230, 240, 380, 400, 416, 440, 460, or 480 VAC).
- *Hertz:* Displays the genset frequency (50 or 60 Hz). The control selects limits, gains, and frequency values based upon this selection.
- *No. of Phases:* Displays the number of phases (1 or 3).
- *Phase:* Displays the phase type (Delta or Wye).

Genset Menu, Part 2

The second genset menu allows for enabling or disabling charging alternators.

- *Charging Alt. Enable:*

A starter disconnect will occur whenever anyone of the following three possible signals reaches its disconnect set point.

- The average engine speed (if a magnetic pickup unit is installed)
- The average frequency
- The charging alternator voltage (if the Charging Alt feature is enabled)

The Charging Alt. Enable menu is used to enable or disable the Charging Alt feature. This menu provides a means to disable the control's charging alternator logic if it is not supported by the alternator. If the alternator does not support this functionality, the Charger Failure warning (fault code 219) will constantly be displayed unless this setting is changed to "No." When disabled (set to "No"), the start disconnect signal is based only on the average engine speed or frequency and the Charger Failure warning is disabled.

Fuel System

The Fuel System menu allows for selecting fuel type and, depending on the type selected, enabling/disabling glow plugs or setting a fuel burn time delay.

- *Fuel System:* Allows for selecting the fuel type (Diesel or Gas).

If Fuel System is set to "Diesel"

- *Glow Plug Enable:* Allows control of Glow Plugs for a particular genset (Yes or No).
- X3.3 Gensets are not provided with Glow Plug.

If Fuel System is set to "Gas"

- *Fuel Burn Delay:* After the genset receives a stop signal, this feature allows for setting a fuel time delay from 0 to 10 seconds in which the ignition remains on so that any fuel downstream of the intake manifold is burned.

Start/Stop Delay Menu

The time delay after receiving a valid start signal, until the genset starts, can be adjusted. The time delay that the genset is allowed to run at rated speed after receiving a stop signal, until the genset stops, can also be adjusted. These time delays do not apply to manual start/runs

- *Start:* The genset start time delay can be adjusted from 0 to 300 seconds.
- *Stop:* The genset stop time delay can be adjusted from 0 to 600 seconds.

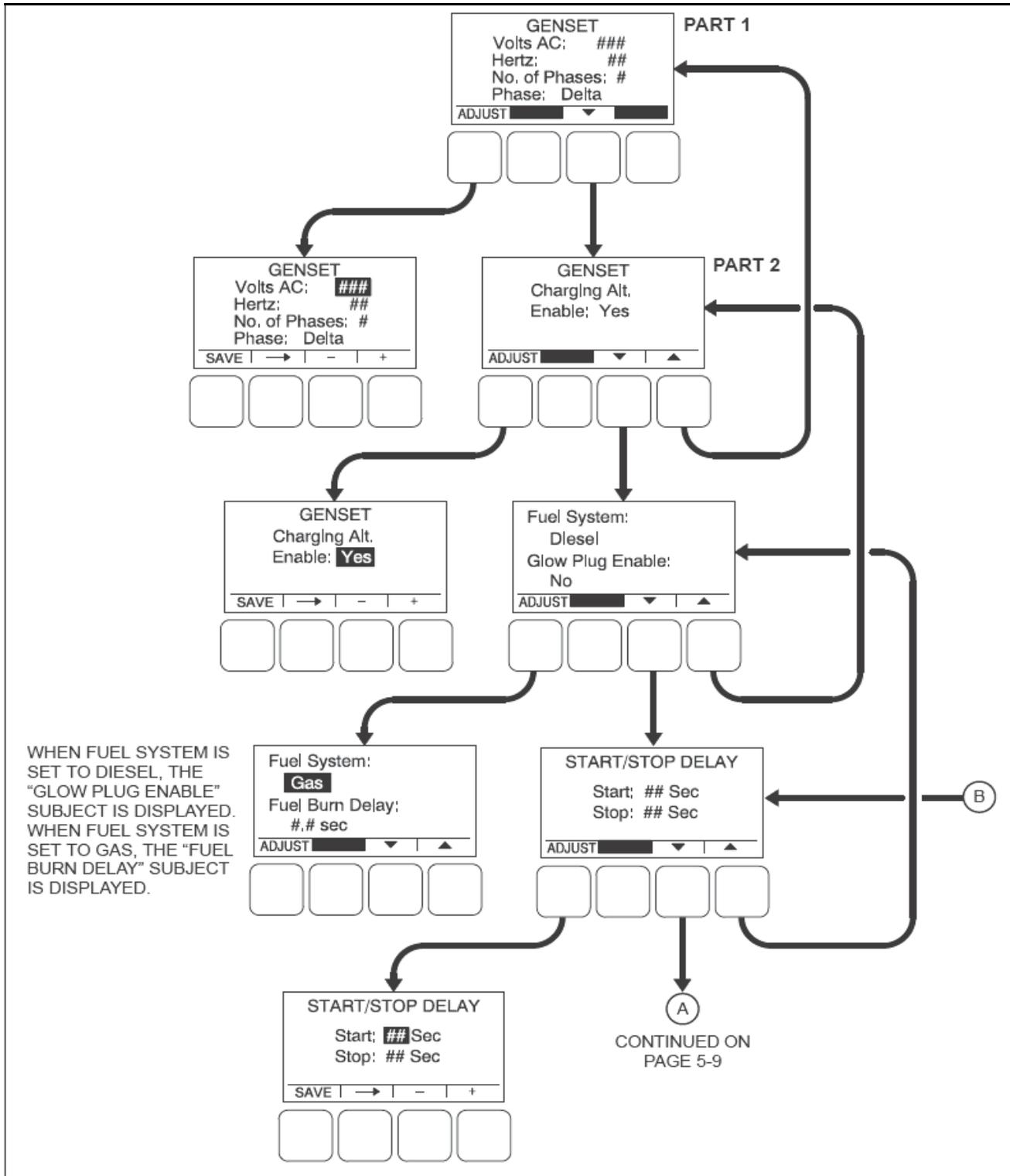


FIGURE 5-4. GENSET SERVICE SUBMENU (SHEET 1 OF 3)

Cycle Crank Menu

The Cycle Crank menu allows for configuring the generator for all starting modes (manual and remote), as follows:

- *Crank*: The cranking period can be set from 3 to 30 seconds. This time limit is used to determine a Fail to Start status.
- *Rest*: The minimum amount of time between crank attempts can be set from 0 to 60 seconds.

- *Attempts*: The maximum number of times the starter can be engaged when attempting to start the engine with cycle cranking can be set from 1 to 7 attempts.

AVR Setup Menu

The AVR Setup menu is used to enable or disable the automatic voltage regulator. If enabled, two additional menus are displayed that can be used to adjust the AVR settings (see page 5-13).

GENSET SERVICE SUBMENUS (Continued)

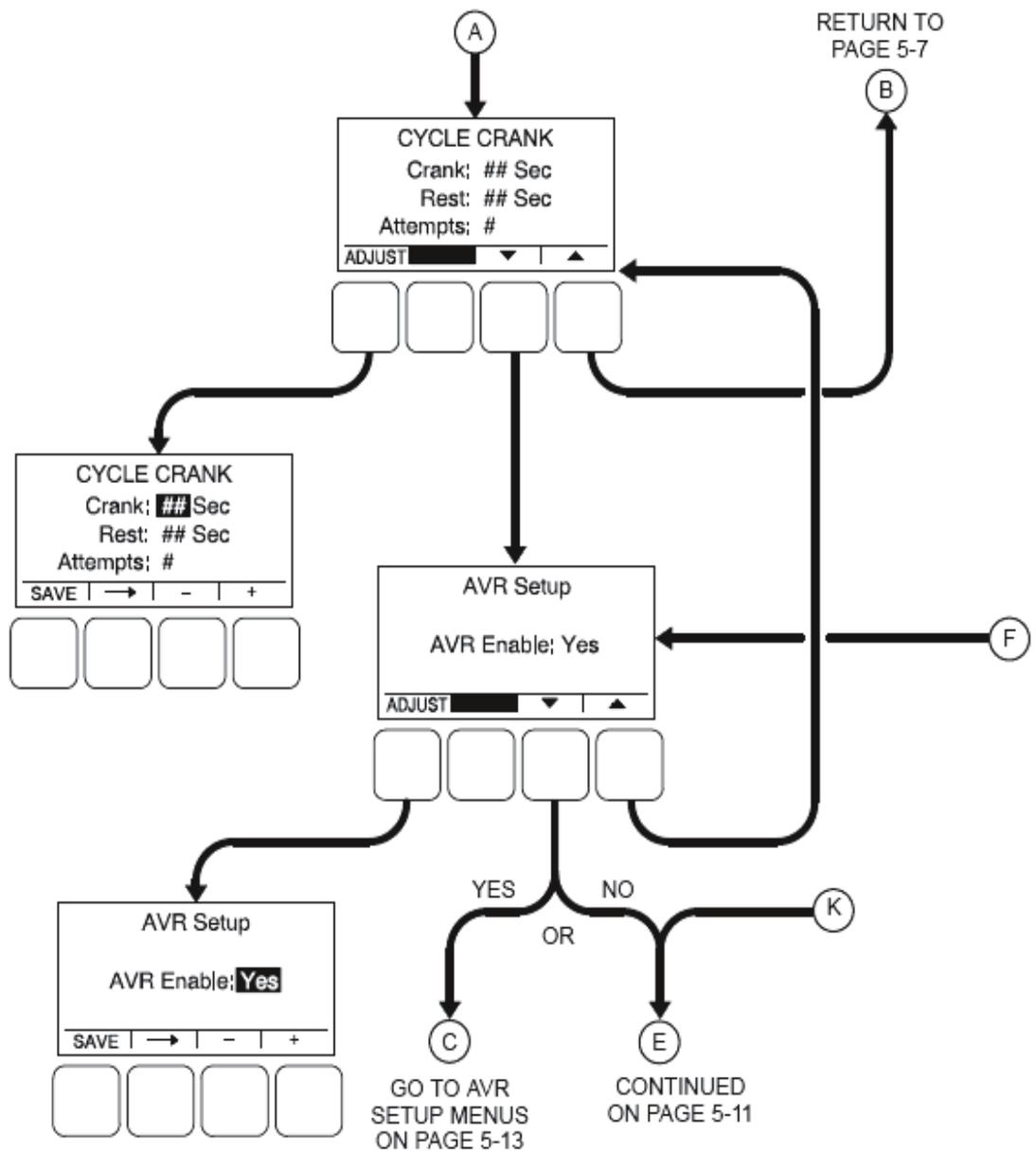


FIGURE 5-4. GENSET SERVICE SUBMENUS (SHEET 2 OF 3)

Electronic Governor Menu

The engine Electronic Governor Enable menu is used to enable or disable the electronic governor on genset's with electronic governors and magnetic pickup sensors. If enabled (set to "Yes"), four additional menus are displayed that can be used to adjust governor settings (see page 5-15).

Genset Number Menu

The Genset Number menu is used to enter the genset's model and serial numbers. Each allows up to 16 characters to be entered.

Display Setup Menu The Display Setup menu is used to set the display for **Local** (Auto/Off/Manual Run switch functions on the

operator panel are turned on) or **Remote** (Auto/Off/Manual Run switch functions on the operator panel are turned off).

- *Connection:* A display can be set up to be local or remote.
- *Access Code:* A display can be set up to require or not require entering the mode change access code. If enabled, an access code must be entered to change genset mode of operation (Auto, Manual Run or Off).
- *Symbols:* A display can be set up to display international symbols on the Operator menus.

GENSET SERVICE SUBMENUS (Continued)

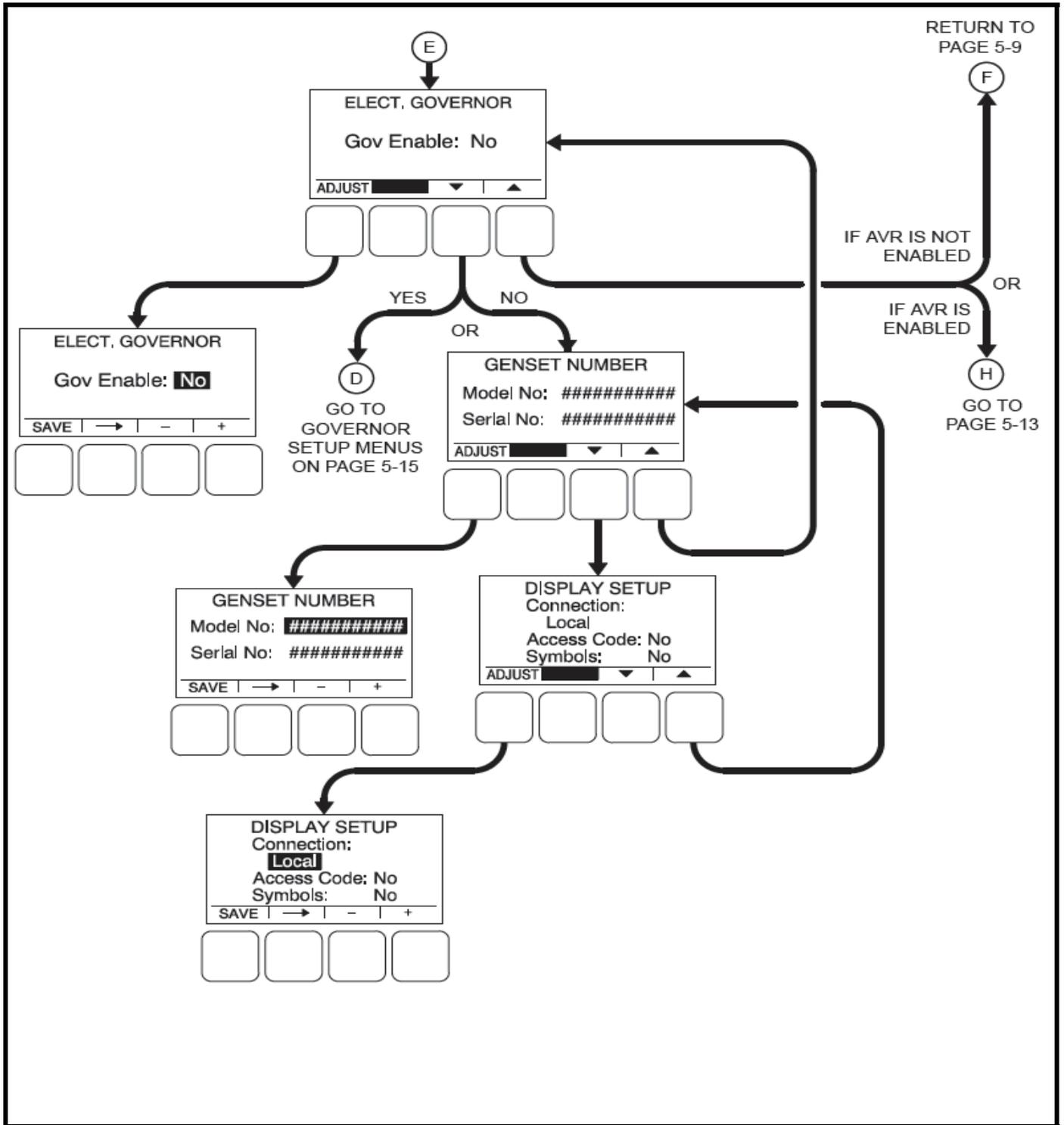


FIGURE 5-4. GENSET SERVICE SUBMENUS (SHEET 3 OF 3)

AUTOMATIC VOLTAGE REGULATOR SUBMENUS

The Automatic Voltage Regulator (AVR) sub menus are available only if the AVR is enabled (see page 5-9). Two Automatic Voltage Regulator (AVR) submenus (see Figure 5-6) can be used to adjust Volts/Hz Roll off and Regulator Gains settings.

Volts/Hz Roll off Menu

The Volts/Hz Roll off function helps optimize the genset's response to added load. If the engine speed drops below nominal frequency, the control automatically drops the voltage until the engine speed starts to recover.

This menu allows for adjusting the knee frequency and voltage set point slope parameters. The knee frequency is the value below nominal frequency at which the roll off function begins. For example, if the knee frequency is set to 5 Hz on a 60 Hz genset, this function begins when the frequency drops below 55 Hz.

Slope refers to how fast the voltage is rolled off below the knee frequency. The voltage is rolled off the slope percent setting for every 1 Hz below the knee. For example, on a 60 Hz genset, if the slope is set to 5% and the knee frequency is set to 5 Hz, then if the frequency drops to 54 Hz, the voltage set point is reduced 5%. If the frequency drops to 53 Hz, the voltage set point is reduced 10%, etc.

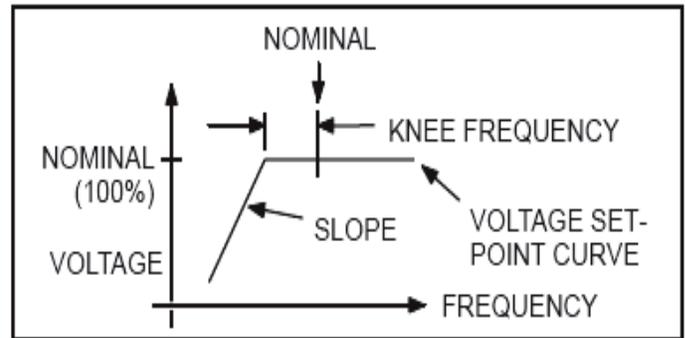


FIGURE 5-5. KNEE FREQUENCY AND SLOPE

- *V/Hz Knee:* The Knee Frequency can be adjusted from 0.0 to 10.0 Hertz in 0.1 Hz increments. When generator set speed decreases by more than the value of the knee frequency, the generator set voltage decreases by the %/Hz value.
- *V/Hz Roll off:* The Roll off setting can be adjusted from 0.0 to 5.0 percent of rated voltage, in 0.1% increments.

Regulator Gains Menu

The Regulator menu allows for setting proportional Gain, Integral Gain, and Damping values.

- *Gain:* The proportional Gain (K1) multiplier can be set from 5 to 1000%. This allows for a scale factor of 0.05 to 10.0
- *Int:* The Integral Gain (K2) multiplier can be set from 5 to 1000%
- *D:* The Damping adjustment can be set from 95 to 105%.

AUTOMATIC VOLTAGE REGULATOR SUBMENUS

NOTE: These menus are only available if the Automatic Voltage Regulator (AVR) is enabled (see page 5-9).

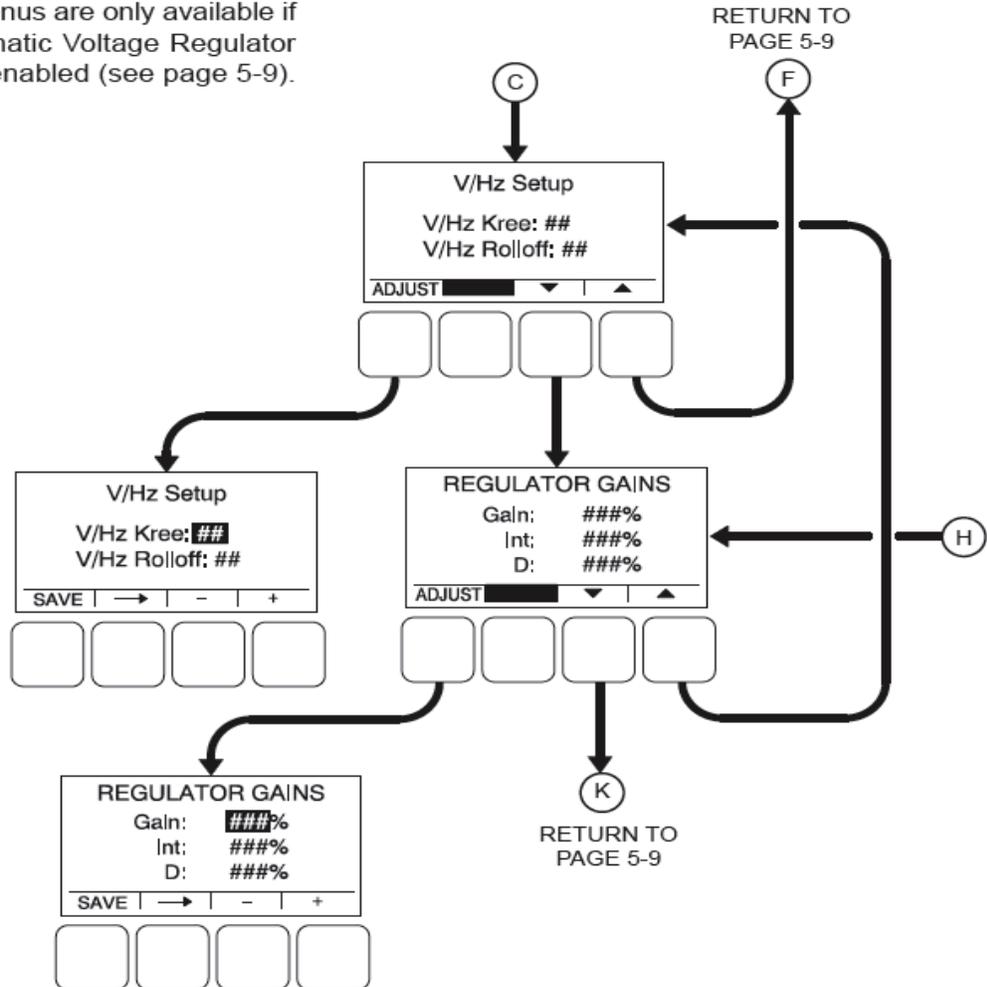


FIGURE 5-6. AUTOMATIC VOLTAGE REGULATOR SUBMENUS

ELECTRONIC GOVERNOR SUBMENU

The Electronic Governor submenus are available only if the governor is enabled (see page 5-9). Four Electronic Governor submenus (see Figure 5-7) can be used to adjust governor settings.

Governor Crank Fuel Menu The Governor Crank Fuel menu allows for setting the Initial Crank Fuel Duty Cycle, the Initial Crank Fueling Period, the Crank Fuel Ramp Rate, and the Maximum Crank Fuel Duty Cycle.

- **Initial DC:** The Initial Crank Fuel Duty Cycle is the initial value assigned to the Governor Duty Cycle parameter when cranking begins. This value can be set from 0 to 50 percent.
- **Initial Time:** The Initial Crank Fueling Period is the amount of time for which the value of Initial Crank Fuel Duty Cycle is assigned to the governor duty cycle after cranking begins. This value can be set from 0 to 10 seconds.
- **Ramp Rate:** The Crank Fuel Ramp Rate is the rate at which the value of the Governor Duty Cycle is ramped up by during the Crank State, after expiration of the Initial Crank Fueling Period. This value can be set from 5 to 100.
- **Max DC:** The Maximum Crank Fuel Duty Cycle is the maximum level to which the Governor Duty Cycle should be limited to during a crank state. This value can be set from 50 to 100%.

Electronic Governor Regulator Menu

The Electronic Governor Regulator menu allows for setting proportional Gain, Integral Gain, and Damping values.

- **Gain:** The proportional governor gain (K1) multiplier can be set from 5 to 1000%. This allows for a scale factor of 0.05 to 10.0.

- **Int:** The integral governor gain (K2) multiplier can be set from 5 to 1000%
- **D:** The governor Damping adjustment can be set from 95 to 105%.

Electronic Governor Menu The Electronic Governor menu allows for setting Crank Exit Fuel DC, Dither Factor, and Damping values. This menu is displayed only if the governor has been enabled with the Engine Electronic Governor Enable menu.

- **Crank Exit Fuel DC:** The Crank Exit Fuel Duty Cycle is the value at which the governor duty cycle is held after disengaging the starter until the governor is enabled. This value can be set from 0 to 100%.
- **Dither Factor:** Dither is a signal that is super-imposed on the PWM (pulse width modulation) duty cycle to prevent the actuator valve from sticking. The Dither Factor is the dither percent added to the current duty cycle. The Dither Factor can be set from 0 to 30%. The dither function is disabled when the dither factor is set to 0%.
- **Ramp Time:** This feature is used to set the minimum governor speed reference ramp rate. The governor Ramp Time can be set from 0.00 to 30.0 seconds, in 0.01 second increments.

Electronic Governor Enable Speed Menu

The Electronic Governor Enable Speed menu allows for setting the minimum and maximum governor duty cycle.

- **Min. Gov DC:** The Minimum Governor Duty Cycle can be set from 0 to 100%.
- **Max. Gov DC:** The Maximum Governor Duty Cycle (with dithered value) can be set from 0 to 100%.

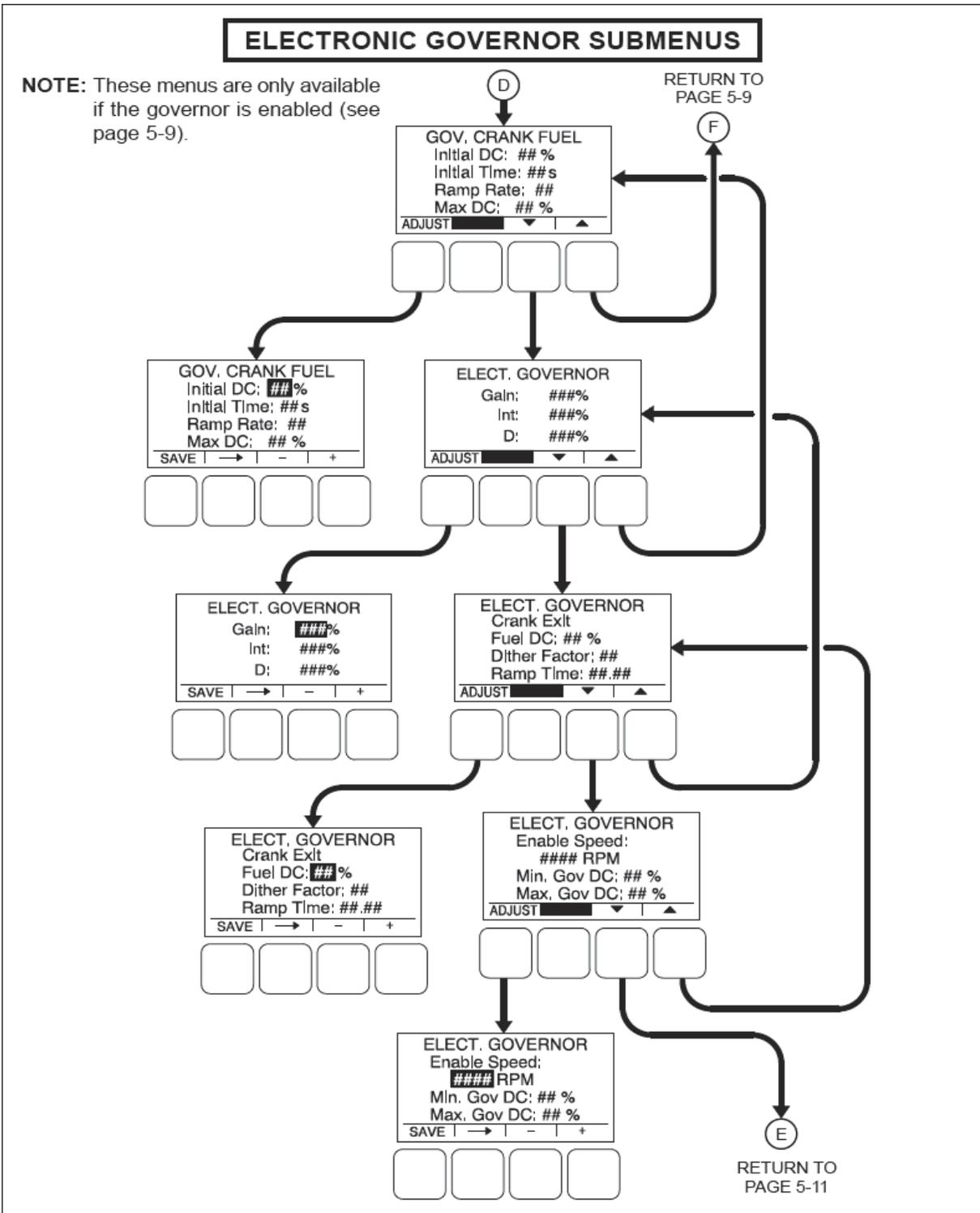


FIGURE 5-7. ELECTRONIC GOVERNOR SUBMENUS

CUSTOMER I/O SUB MENUS

The Customer I/O submenus are available by pressing the **(2)** button on the first Genset Service menu (see Figure 5-3). Four Customer I/O submenus (see Figure 5-8) can be used to define customer input messages and output maps.

Customer Inputs The Customer Input Text message menus are used to enter an event type and description for two events.

- *Type:* Enter the event type (Warning, Shut-down or Event).
- Enter a brief description of the event (up to 32 characters). Example inputs: Low Coolant Level, Low Fuel Pressure, Ground Fault, etc.

Customer Outputs Two Customer Outputs are configurable to display common warning alarms. The two Customer Out-put Map menus allow for entering a fault number and fault name to be displayed for the two configurable customer outputs.

- *Number:* Enter a code number 0 to 255 for the event. Refer to *Table 5-3* which provides a list of all warning and shutdown codes. The following list contains event codes that are not shown in *Table 5-3*.
- A brief description of the event is automatically displayed.

EVENT CODES

CODE	DESCRIPTION
150	READY TO LOAD
151	UTILITY CONNECTIONS
152	GENSET CONNECTED
153	NOT IN AUTO
155	COMMON ALARM
156	COMMON WARNING
157	COMMON SHUTDOWN
158	CUSTOMER FAULT INPUT 1
159	CUSTOMER FAULT INPUT 2
160	ANNUNCIATOR FAULT 1
161	ANNUNCIATOR FAULT 2
162	ANNUNCIATOR FAULT 3

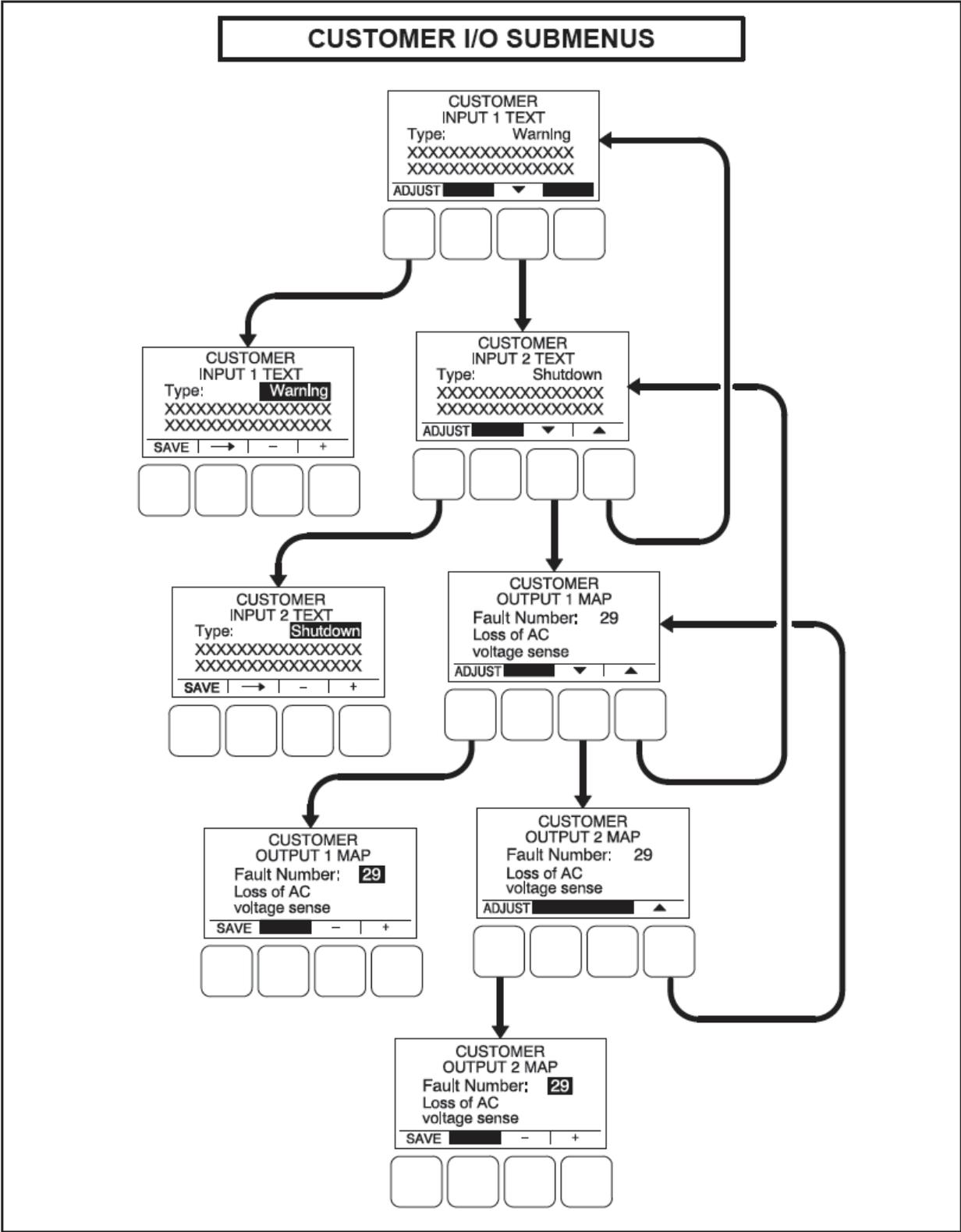


FIGURE 5-8. CUSTOMER I/O SUBMENUS

METERING SUBMENUS

The Metering submenus are available by pressing the **(3)** button on the first Genset Service menu (see Figure 5-3). Four Metering submenus (see Figure 5-9) can be used to adjust regulated voltage, frequency, line-to-neutral voltage, and line current settings .

Meter Calib Menu

The Meter Calib menu allows for adjusting the actual output voltage of the genset. The percentage can be set from 90 to 110%. The alternator voltage is also shown on this menu.

Freq. Adjust Menu

The Frequency Adjust menu allows for adjusting the genset frequency. The frequency can be adjust from -6.0 to +6.0 Hz. The actual frequency is also shown on this menu.

Metering Voltage Adjust Menu

The Metering Voltage Adjust menu allows for adjusting metered genset line voltage.

1. With the genset OFF, attach a calibrated volt-meter to the AC output from L1 to L2. (L1 to Neutral for single phase alternators.)
2. Start the genset and allow it to reach normal operating speed.

3. Display the *Metering Voltage Adjust* menu.
4. Calibrate voltage reading for L1 so that the reading on the display agrees with the calibrated voltmeter.
5. After adjusting, press the **SAVE** button to save the setting.
6. Shut the generator set OFF.
7. Repeat steps 1 through 6 for L2 and L3. (In step1, attach meter to the AC output from L2 to L3 to calibrate L2, and L3 to L1 to calibrate L3.)

Metering Current Adjust Menu

The Metering Current Adjust menu allows for adjusting metered amps.

1. With the genset OFF, attach a calibrated ammeter to L1.
2. Start the genset and allow it to reach normal operating speed.
3. Display the *Metering Current Adjust* menu.
4. Load the genset to maximum rated kVA at rated voltage.
5. Calibrate the reading for L1 current so that the reading on the display agrees with calibrated ammeter.
6. After adjusting, press the **SAVE** button to save the setting.
7. Shut the generator set OFF.
8. Repeat steps 1 through 7 for L2 and L3. (In step1, attach meter to L2 to calibrate L2 current, and L3 to calibrate L3 current.)

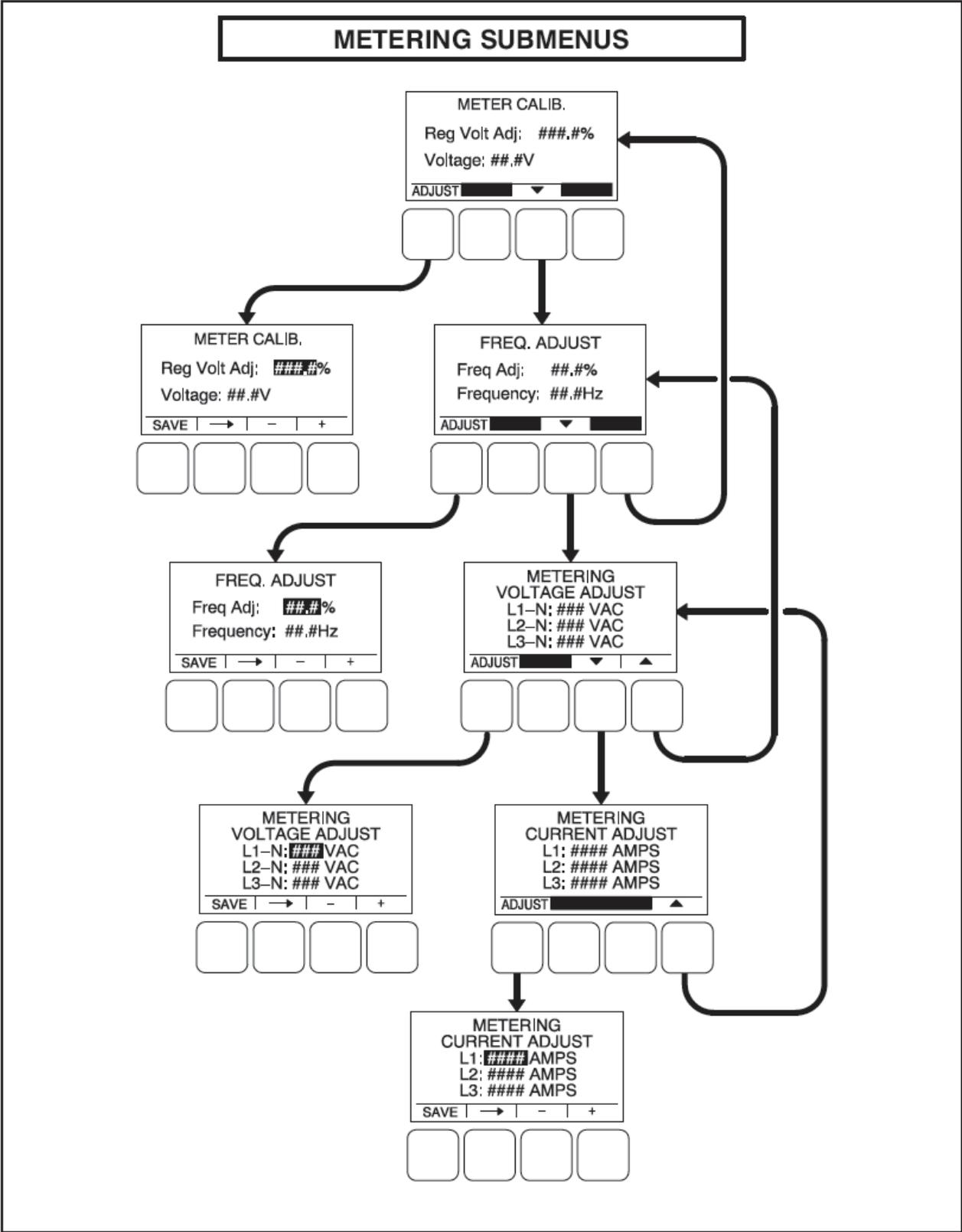


FIGURE 5-9. METERING SUBMENUS

ANNUNCIATOR SUBMENUS

The Annunciator submenus are available by pressing the **(4)** button on the second Genset Service menu (see Figure 5-3).

Seven annunciator submenus (see Figure 5-10) can be used to define three Annunciator Fault Text messages and four Annunciator Output Maps.

Annunciator Inputs

The annunciator has three possible customer-defined fault conditions that can be shown on the PCC1301 display.

The Annunciator Fault Text message menus are used to enter an event type and description for those three customer-defined Annunciator faults.

- *Type*: Enter the event type (Warning, Shut-down or Event).
- Enter a brief description of the event (up to 32 characters).

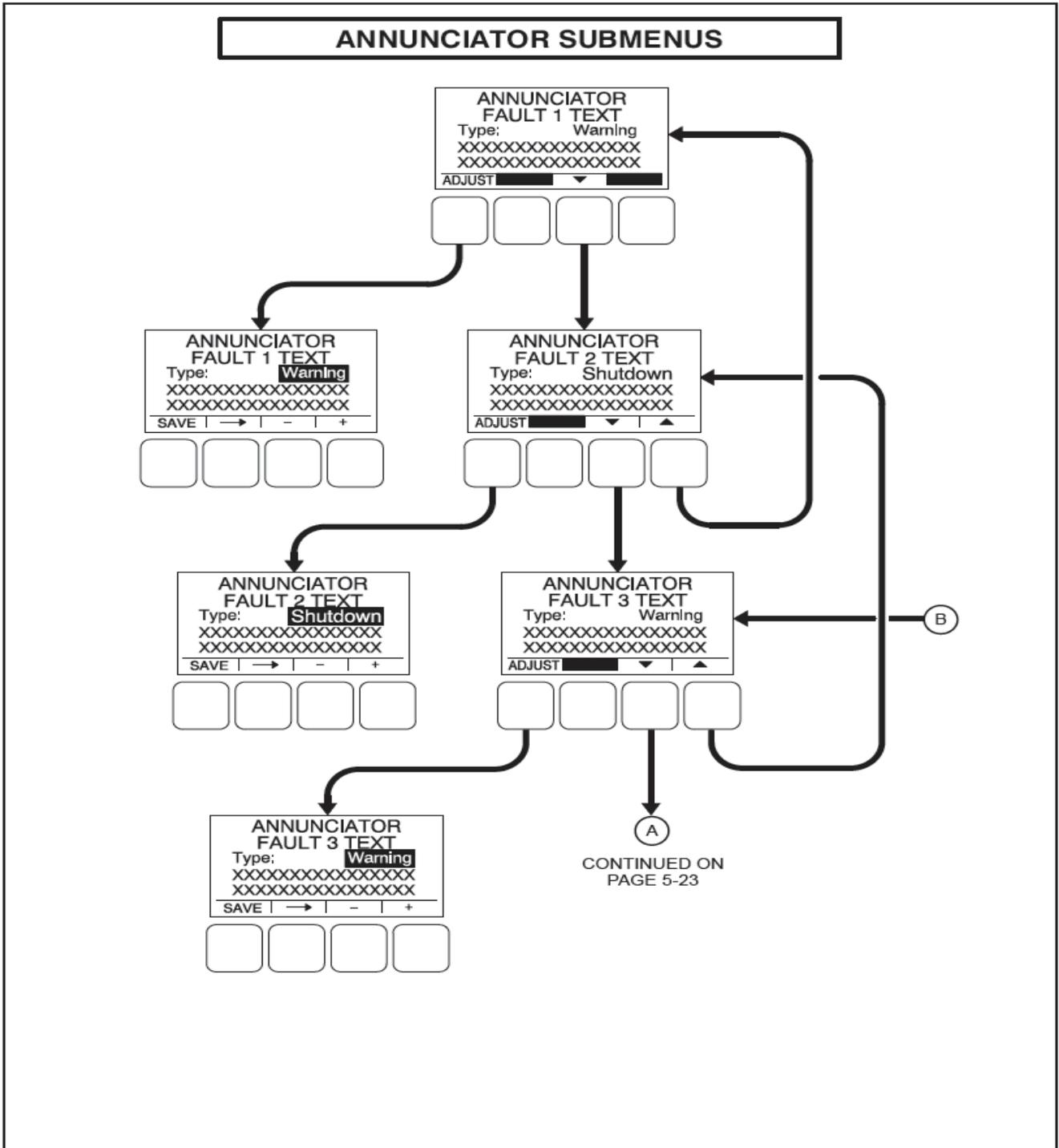


FIGURE 5-10. ANNUNCIATOR SUBMENUS (SHEET 1 OF 2)

Annunciator outputs

An annunciator has four custom (N.O.) relays that can be controlled by the PCC 1301. When a specified event becomes active, a message can be sent by the PCC 1301 to the annunciator to turn the relay on or off. Only one event per relay is allowed.

The four annunciator outputs of the PCC 1301 are configurable to display common warning alarms.

The four Annunciator Output Map menus allow for entering a fault number and fault name to be displayed for the configurable annunciator outputs.

- *Number:* Enter a code number 0 to 255 for the event. Refer to *Table 5-3* which provides a list of all warning and shutdown codes. The following list contains event codes that are not shown in *Table 5-3*
- *Description:* A brief description of the event is automatically displayed.

EVENT CODES

Code	Description
150	READY TO LOAD
151	UTILITY CONNECTIONS
152	GENSET CONNECTED
153	NOT IN AUTO
155	COMMON ALARM
156	COMMON WARNING
157	COMMON SHUTDOWN
158	CUSTOMER FAULT INPUT 1
159	CUSTOMER FAULT INPUT 2
160	ANNUNCIATOR FAULT 1
161	ANNUNCIATOR FAULT 2
162	ANNUNCIATOR FAULT 3

ANNUNCIATOR SUBMENUS (Continued)

RETURN TO PAGE 5-21

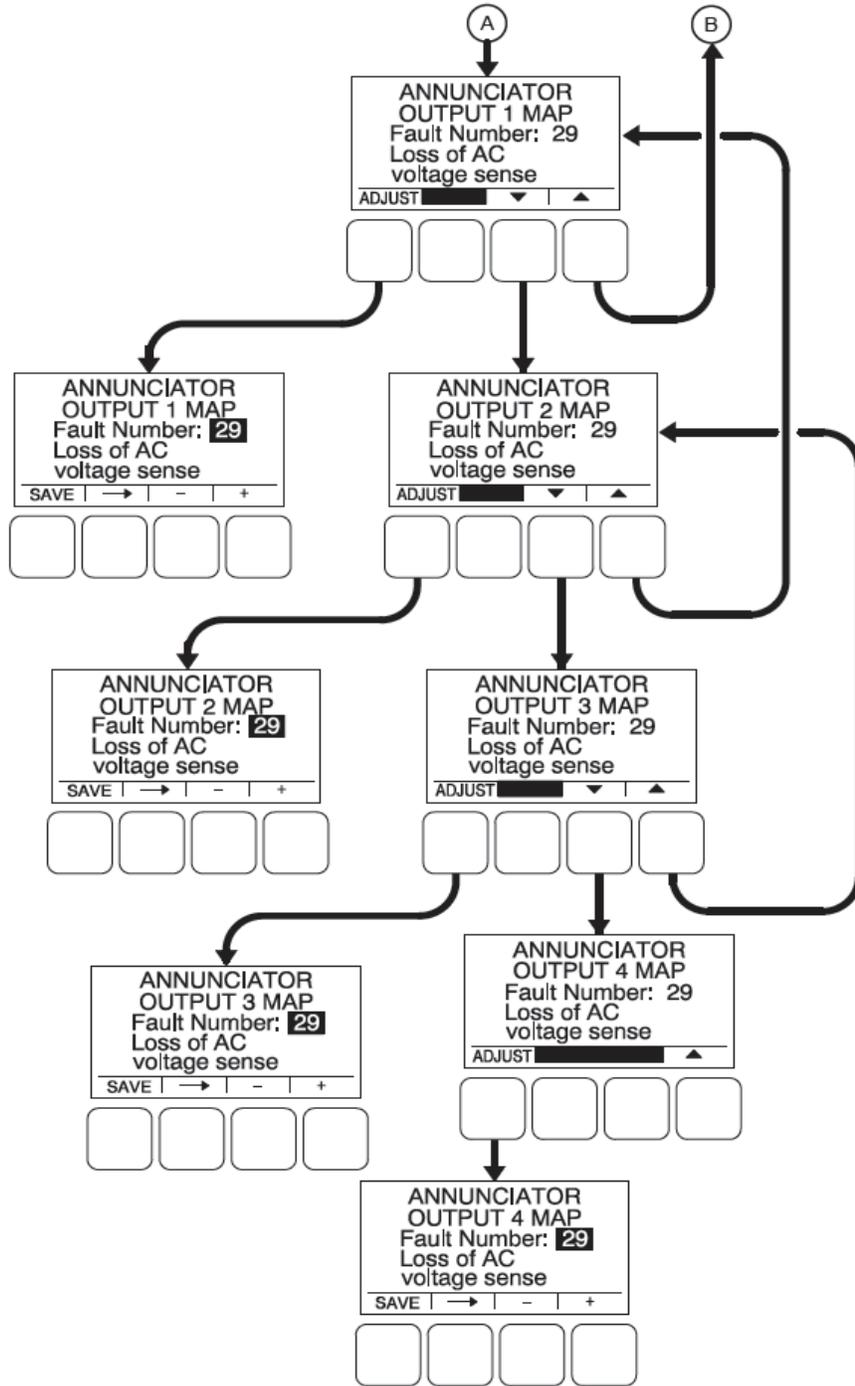


FIGURE 5-10. ANNUNCIATOR SUBMENUS (SHEET 2 OF 2)

Modbus Submenus

The Modbus submenus are available by pressing the **(5)** button on the second Genset Service menu(see Figure 5-3).

Modbus Enable Menu

The Modbus Enable menu allows for enabling or disabling the Modbus feature. If set to “Yes,” the Modbus Setup menu is made available.

Modbus Setup Menu

The Modbus Setup menu allows for setting a numeric address and a baud rate. The parity value is automatically displayed.

- *Address:* Enter a numerical value (up to three digits) for the address.
- *Baud Rate:* Select one of the four available baud rates (2400, 4800, 9600, or 19200).
- *Parity:* This value is automatically displayed.

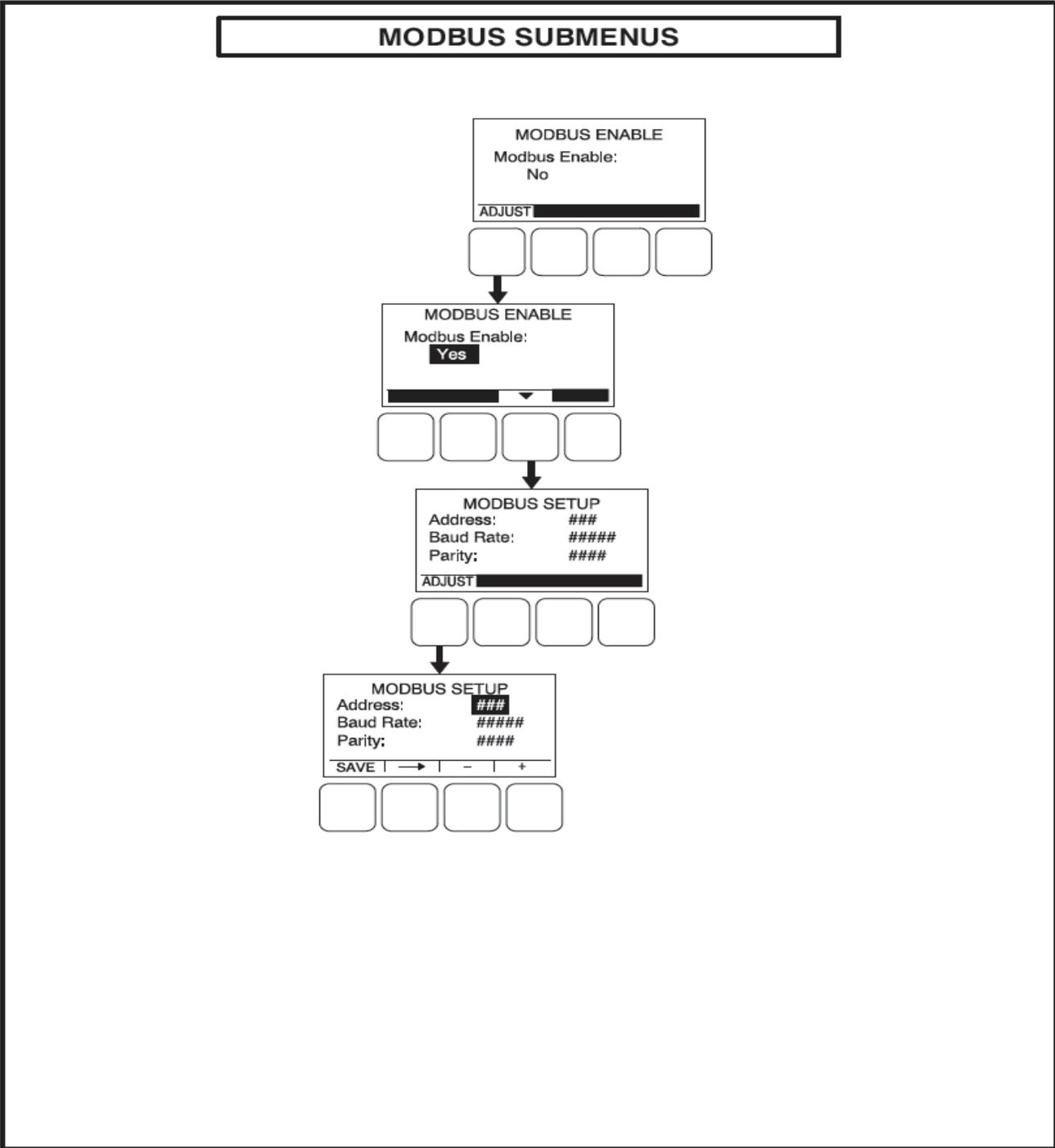


FIGURE 11. MODBUS SUBMENUS

GENSET SETUP SUBMENUS

In the following menu entry descriptions, the default parameter/value is not shown because the default value is subject to change by model. Always create and refer to the initial capture file for factory default settings of system parameters/values.

The first Setup “Password” menu is displayed when the **(1)** button is pressed on the Service Menu. From the Setup Password menu, a Setup Menu menu is displayed that provides access to the following two categories of genset adjust menus.

- Genset Service menus – Go to page 5-4
- Genset Setup menus This section covers Genset Setup menus only. To access the Genset Setup menus :
 1. Enter the password into the Setup Password Menu. Refer to page 5-4 to enter password.
 2. Press the **2** button in the Setup Menus to display the Genset Setup Password Menu.
 3. Enter the password into the Genset Setup menu – go to page 5-28 or press the View only button.

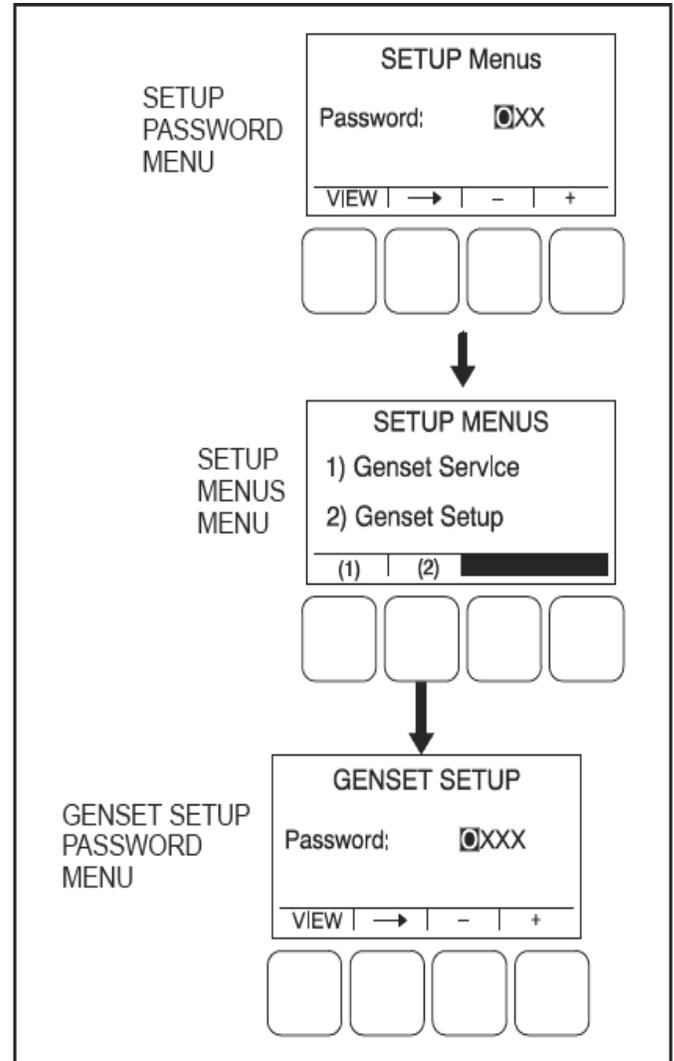


FIGURE 5-12. SETUP PASSWORD MENUS

Viewing and Adjusting

Figure 5-13 is a block representation of the two Genset Setup menus that are available after the correct password has been entered or the View button is pressed in the Genset Setup Password menu. The Genset Setup menus provide access to the following categories. The first Genset Setup Menu provides access to the following menus:

- Genset
- Voltage Protection
- Current Protection

The second Genset Setup Menu provides access to the following menu:

- Engine Protection

Genset Setup Password Menu

Adjusting the Genset Setup menus is restricted to service personnel and a password must be entered to modify these menus. Once the Genset Setup button (2) is selected on the Setup Menus menu (see Figure 5-12), the Genset Setup Password menu is displayed. When the Genset Setup Password menu is displayed, the first numeric character (0) is highlighted (see Figure 5-13).

NOTE: When selected (highlighted), each character initially turns to “0” and the remaining characters turn to “X”.

NOTE: Make sure that each numeric character is correct before you move to the next character. If a wrong character is entered, you will not be able to go back and correct it. If the wrong password is entered, you will be able to view the Genset Setup menus but you won't be able to change them.

To enter the Genset Setup password **1209**:

1. With the first character highlighted, press the button below to the + or – symbols until the value reads “1”

2. Press the arrow selection button → to move to the next numeric character.
3. Press the button below the + or – symbols until the value reads “2.”
4. Press the arrow selection button → to move to the next numeric character.
5. Press the button below the + or – symbols until the value reads “0.”
6. Press the arrow selection → button to move to the next numeric character.
7. Press the button below the + or – symbols until the value reads “9.”
8. After you have completed entering the password, press the arrow selection button →. The first main Setup menu is displayed.

After the correct password is entered, it will be remembered until five minutes of button inactivity has elapsed. If five minutes of button inactivity has elapsed, you will have to re-enter the password to access and change Genset Setup menus.

Adjusting Values/Parameters

Once the correct password has been entered on the Genset Setup Password menu, the first Genset Setup submenu is displayed.

1. Press the buttons above the ▲ and ▼ symbols in the digital display to navigate between submenus.
2. Press the **ADJUST** selection button to select the first parameter or value to be changed.
3. Press the + or – selection buttons to adjust values or select parameters
4. Press the arrow selection button → to navigate to the next or previous adjustable value or parameter.
5. After adjusting values/selecting parameters, press the **SAVE** button to save your settings.

NOTE: If the ◀ button is pressed before pressing the SAVE button, the changes are not saved.

6. Press the button ◀ to return to the genset Setup Menus menu.
7. To return to the Service Menu from the genset Setup Menus menu, press the ◀ button.

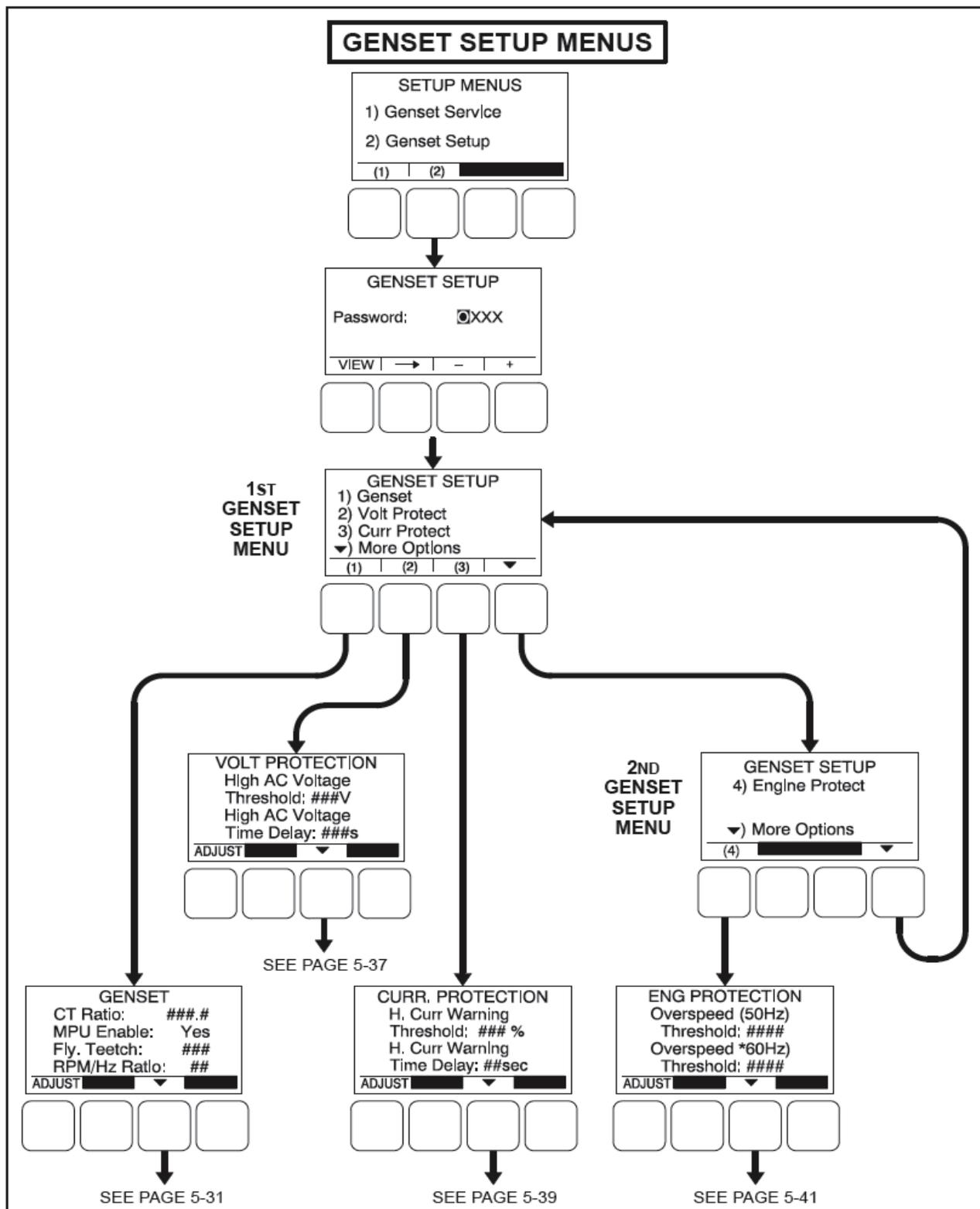


FIGURE 5-13. GENSET SETUP MENUS

GENSET SUBMENUS

The Genset submenus are available by pressing the **(1)** button on the first Genset Setup menu (see Figure 5-13).

Appendix A provides a block diagram that illustrates the sequence of how the Genset Setup Submenus are displayed.

Figure 5-14 (3 sheets) is a block representation of the Genset Submenus.

Genset Menu

The Genset menu is used to set the CT Ratio, enable the Magnetic Pickup Unit (MPU), set the number of teeth pulses per revolution on the Flywheel, and set the Speed/Frequency Ratio.

- *CT Ratio:* The CT Ratio value must be set to match the CT Ratio of the current transformers on the genset.
- *MPU Enable:* Displays whether or not the Magnetic Pickup Unit is installed (Yes or No).
- *Fly. Teeth:* The total number of teeth pulses per revolution on the flywheel (used for electronic governed systems) can be set from 0 to 256.
- *RPM/Hz Ratio:* Allows for setting the Speed/Frequency Ratio to 20, 30, or 60 RPM/Hz.

Application Rating Select Menu The genset application rating can be set to either Standby or Prime.

Standby kVA Rating Menu

The kVA Rating menu displays the kVA rating of single-phase or three-phase, 50 or 60 hertz standby genset systems.

These values are used by the control to determine what 100% load is. The values must match the kVA rating of the genset application and cannot be more than 2000 kVA.

- *3Ph/50Hz:* The three phase, 50 Hertz rating can be set from 0 to 2000 kVA.
- *3Ph/60Hz:* The three phase, 60 Hertz rating can be set from 0 to 2000 kVA.
- *1Ph/50Hz:* The single phase, 50 Hertz rating can be set from 0 to 2000 kVA.
- *1Ph/60Hz:* The single phase, 60 Hertz rating can be set from 0 to 2000 kVA.

Prime kVA Rating Menu

The kVA Rating menu displays the kVA rating of single-phase or three-phase, 50 or 60 hertz prime genset systems. These values are used by the control to determine what is 100% load. The values must match the kVA rating of the genset application and cannot be more than 2000 kVA.

- *3Ph/50Hz:* The three phase, 50 Hertz rating can be set from 0 to 2000 kVA.
- *3Ph/60Hz:* The three phase, 60 Hertz rating can be set from 0 to 2000 kVA.
- *1Ph/50Hz:* The single phase, 50 Hertz rating can be set from 0 to 2000 kVA.
- *1Ph/60Hz:* The single phase, 60 Hertz rating can be set from 0 to 2000 kVA.

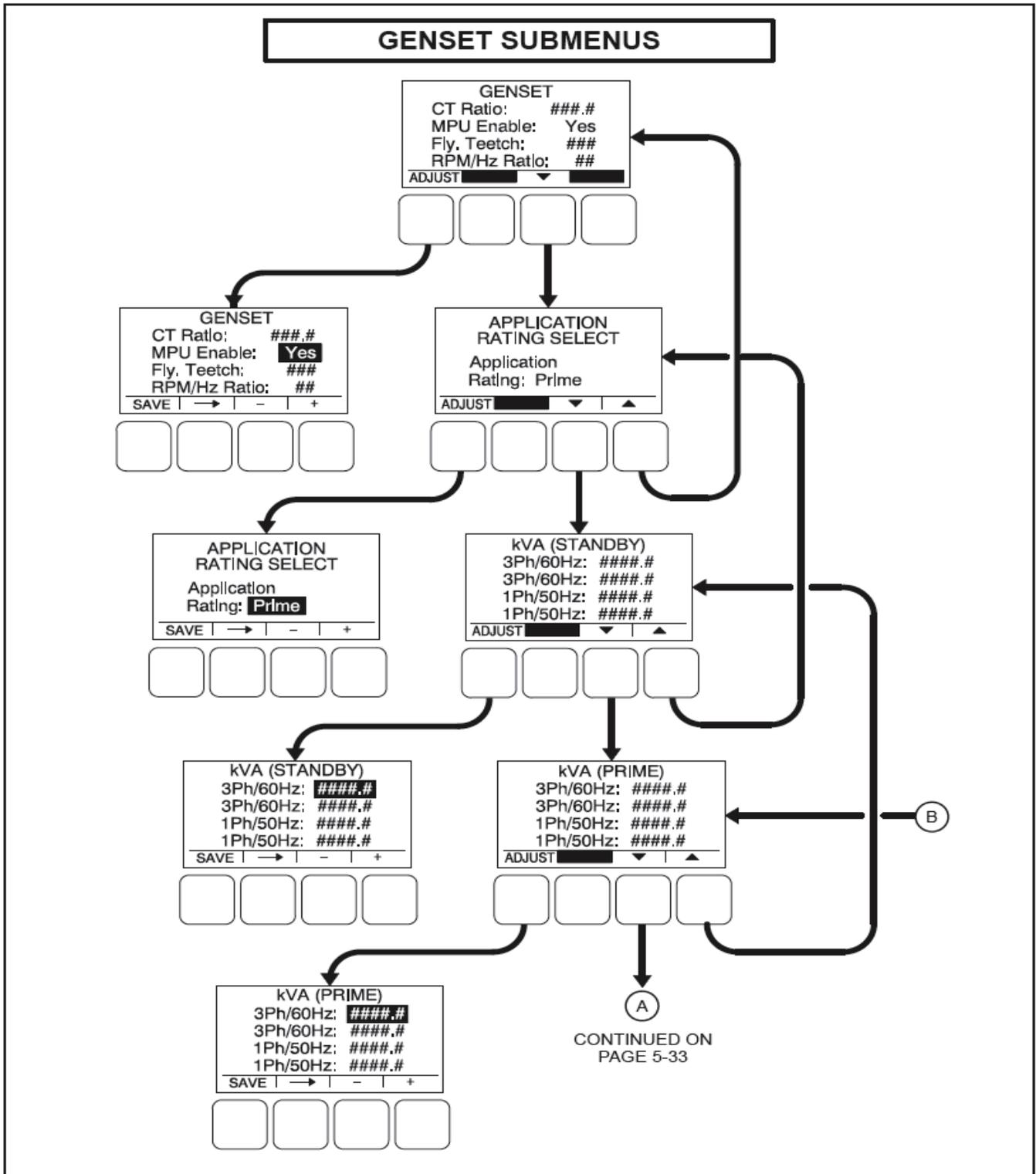


FIGURE 5-14. GENSET SETUP SUBMENU (SHEET 1 OF 3)

Battery Select Menu

The Battery Select menu is used to set the nominal battery voltage.

- *Nominal Battery Voltage:* Allows for setting the nominal battery voltage (12 or 24V).

Battery Thresholds Menus

The Battery Thresholds menu is used to set the low and high voltage values to determine when the battery voltage is out of the set range during normal operation.

This menu is also used to determine when the battery voltage is below weak battery thresholds during cranking.

The Battery Thresholds menu that is displayed is dependent upon the battery voltage entered in the Battery Select menu.

- *Low Batt:* The low battery voltage threshold can be set from 11.0 to 13.0 VDC for 12 volt batteries and from 22.0 to 27.0 VDC for 24volt batteries, in 0.1 VDC increments.
- *High Batt:* The high battery voltage threshold can be set from 14.0 to 17.0

VDC for 12 volt batteries and from 28.0 to 34.0 VDC for 24volt batteries, in 0.1 VDC increments.

- *Weak Batt:* The weak battery voltage thresh-old can be set from 6.0 to 10.0 VDC for 12volt batteries and from 12.0 to 16.0 VDC for24 volt batteries, in 0.1 VDC increments.

Battery Delay Setup Menu

This menu is used to determine when, after determining that the battery condition is out of the preset operating range, a warning message is announced.

- *L. Batt TD:* A time delay from 2 to 60 seconds can be set before the Low Battery warning message (fault code 213) is announced.
- *H. Batt TD:* A time delay from 2 to 60 seconds can be set before the High Battery warning message (fault code 214) is announced.
- *Wk Batt TD:* A time delay from 1 to 5 seconds can be set before the Weak Battery warning message (fault code 221) is announced.

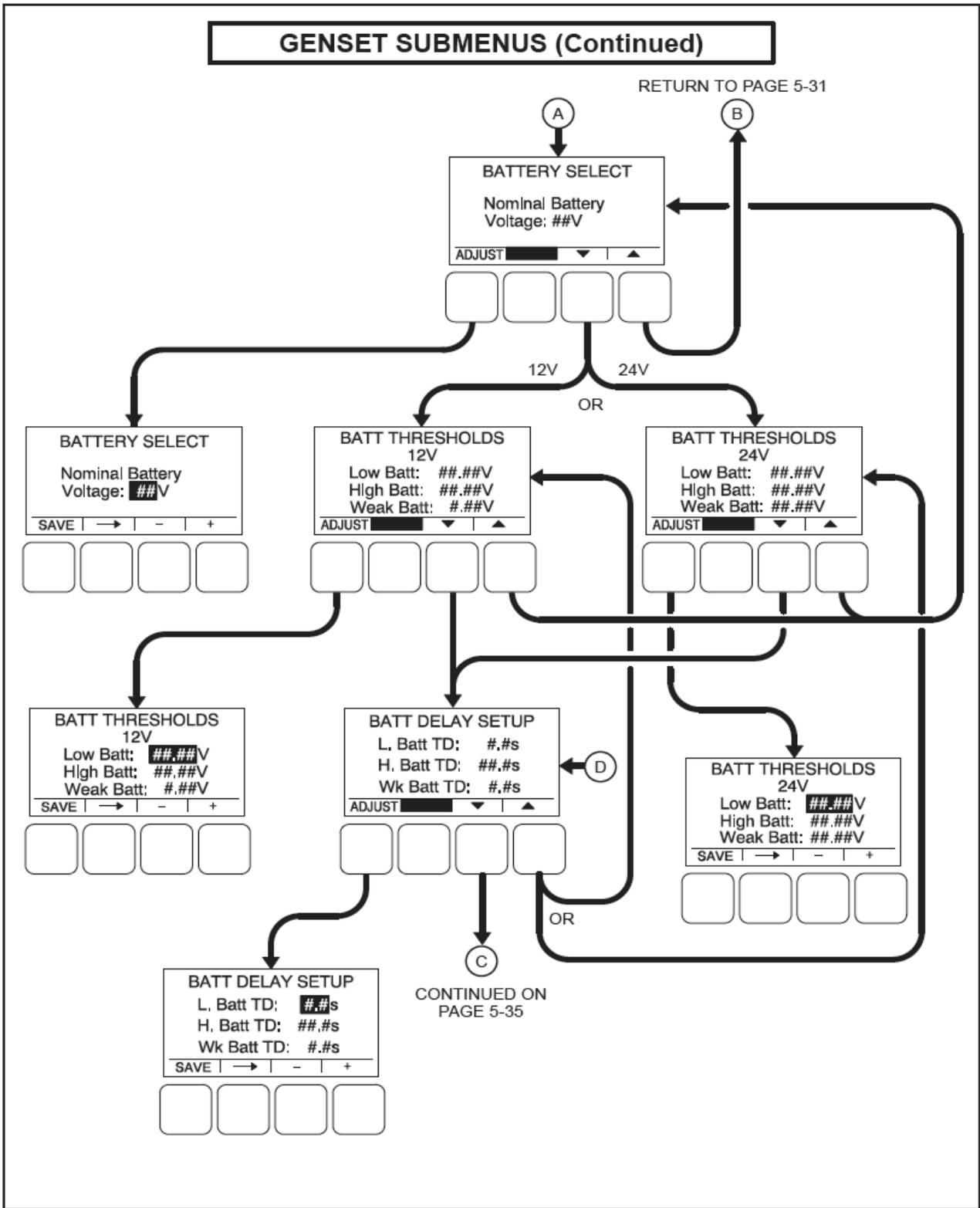


FIGURE 5-14. GENSET SETUP SUBMENUS (SHEET 2 OF 3)

Oil Pressure Setup Menus

A menu is available to set the sensor type.

If the sensor type is Switch, then another menu is available to set the sensor polarity. If the sensor type is Sender, then another menu is available to set the sender type.

- *Sensor Type:* The sensor type can be set for either Switch or Sender.
- *Sensor Polarity:* This menu is displayed only if the sensor type is set to Switch. Sensor polarity can be set to either Active Low or Active High.
- *Sender Type:* This menu is displayed only if the sensor type is set to Sender. The sender type can be set to either 2 Wire or 3 Wire.
- *OOR Startup Delay:* This menu is displayed only if the sensor type is set to Sender. This menu allows for setting a time delay (0 to 400seconds, default = 0 seconds) that prevents the oil pressure out-of-range fault warning (fault code 217) from being displayed for the specified time period when the genset is starting. Setting this time delay is useful with genset's that build up more than 100 psi oil pressure during start-up and warm-up.

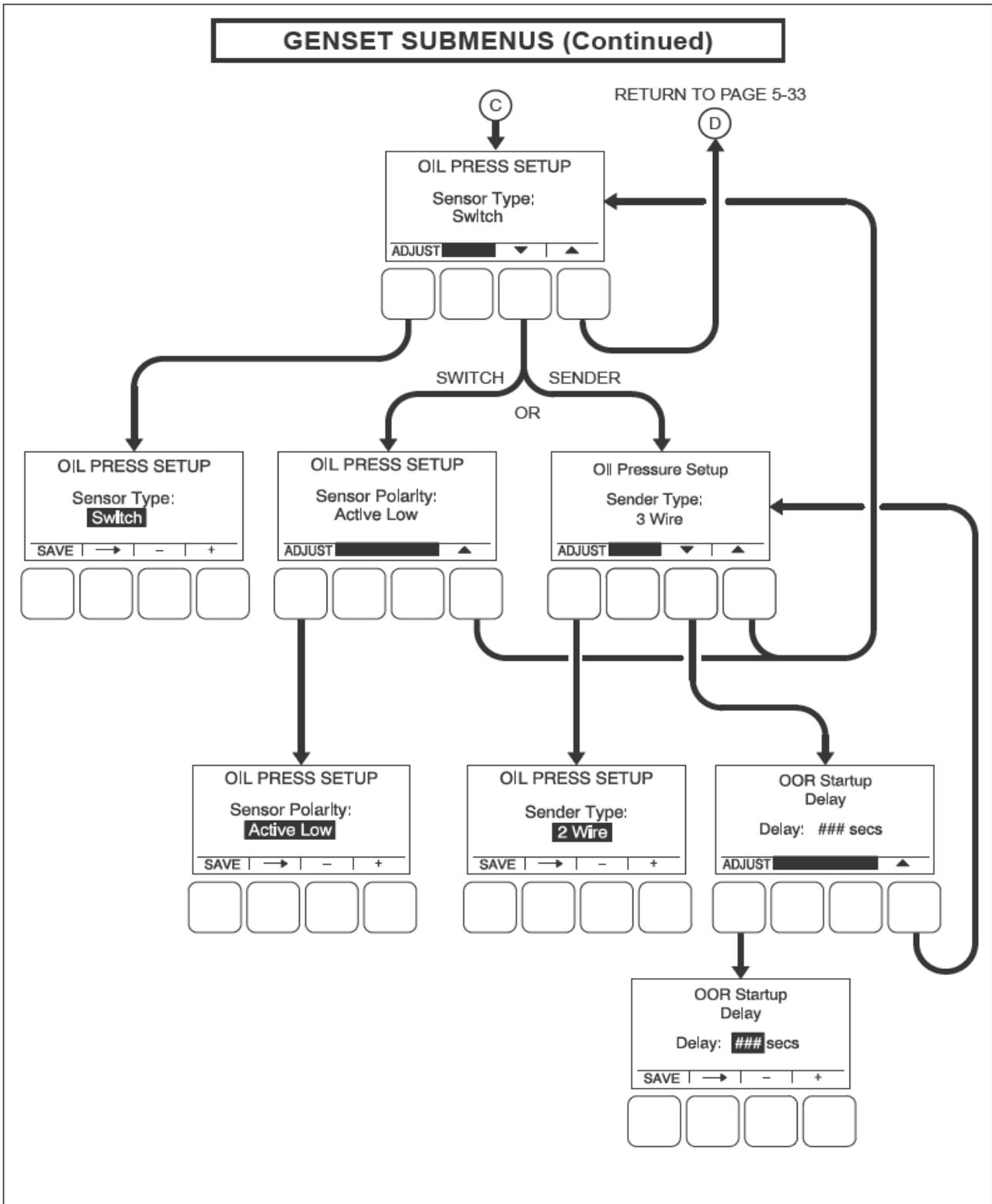


FIGURE 5-14. GENSET SETUP SUBMENU (SHEET 3 OF 3)

VOLTAGE PROTECTION SUBMENUS

The Voltage Protection submenus are available by pressing the **(2)** button on the first Genset Setup menu (see Figure 5-13). Figure 5-15 is a block representation of the four Voltage Protection submenus that are available.

High AC Voltage Menu

This menu is used to determine when a high AC voltage fault condition exists and for how long the fault condition should be present before the engine is shut down.

High AC Voltage Threshold: This threshold is used to set the percentage of desired voltage necessary to activate a High AC Voltage fault condition. This value can be set from 105 to 125%.

High AC Voltage Time Delay: A time delay of 1 to 10 seconds must expire before the engine shuts down because of a high AC voltage fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the High AC Voltage shutdown message (fault code 12) is announced.

Low AC Voltage Menu

This menu is used to determine when a low AC voltage fault condition exists and for how long the fault condition should be present before the engine is shut down.

- *Low AC Voltage Threshold:* This threshold is used to set the percentage of desired voltage necessary to activate a Low AC Voltage fault condition. This value can be set from 50 to 95%.
- *Low AC Voltage Time Delay:* A time delay of 2 to 20 seconds must expire before the engine shuts down because of a low AC voltage fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the

Low AC Voltage shut-down message (fault code 13) is announced.

Over frequency Menu This menu is used to determine when an over frequency fault condition exists and for how long the fault condition should be present before the engine is shut down.

- *Over frequency Threshold:* This threshold is used to set the amount of Hertz that the alternator line frequency can be over to activate an Over frequency fault condition. This value can be set from 2 to 10 Hz.
- *Over frequency Delay:* A time delay of 100 to 2000 half cycles must expire before the engine shuts down because of an over frequency fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the Over frequency shutdown message (fault code 14) is announced.

Under frequency Menu

This menu is used to determine when an under frequency fault condition exists and for how long the fault condition should be present before the engine is shut down

- *Under frequency Threshold:* This threshold is used to set the Hertz number that the alternator line frequency can be under to activate an Under frequency fault condition. This value can be set from 2 to 10 Hz.
- *Under frequency Time Delay:* A time delay of 500 and 2000 half cycles must expire before the engine shuts down because of an under-frequency fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the Under frequency shutdown message (fault code 15) is announced.

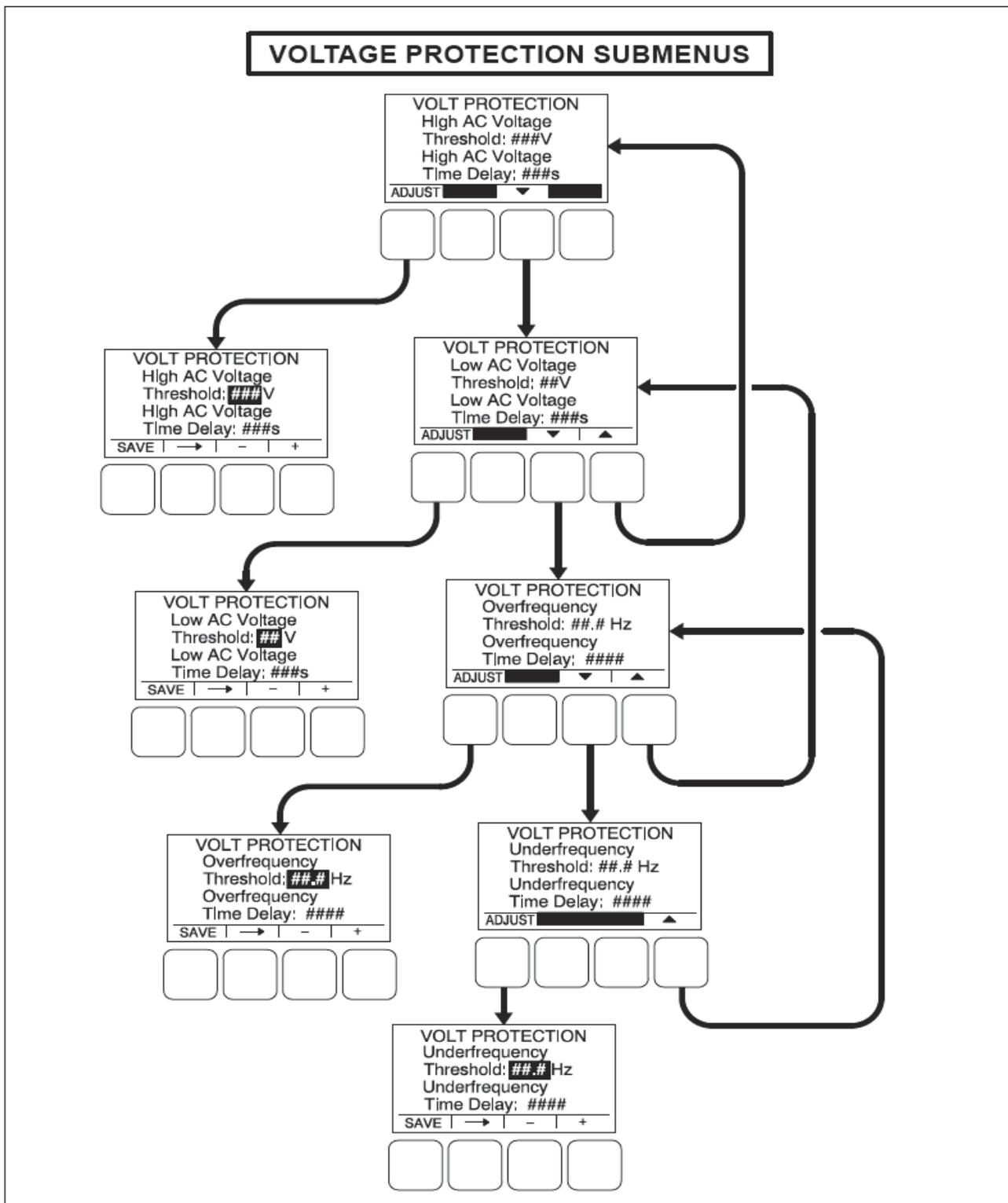


FIGURE 5-15. VOLTAGE PROTECTION SUBMENUS

CURRENT PROTECTION SUBMENUS

The Current Protection submenus are available by pressing the **(3)** button on the first Genset Setup menu (see Figure 5-13). Figure 5-16 is a block representation of the two Current Protection submenus.

High AC Current Warning Menu

This menu is used to determine when a high AC current warning fault condition exists and for how long the fault condition should be present before the High AC Current warning message is announced.

- *H. Curr Warning Threshold:* This threshold is used to set the percentage of rated AC current at which the High AC Current warning fault condition becomes active. This value can be set from 110 to 130%.
- *H. Curr Warning Time Delay:* A time delay of 10 to 60 seconds must expire before a warning message is announced. If the fault condition is active for the duration of this time delay, the High AC Current warning message (fault code 216) is announced.

High AC Current Shutdown Menu

This menu is used to determine when a high AC current shutdown fault condition exists and for how long the fault condition should be present before the engine is shut down.

- *H. Curr Shutdown Threshold:* This threshold is used to set the percentage of rated AC current at which the High AC Current shut-down fault condition becomes active. This value can be set from 130 to 190%
- *H. Curr Shutdown Time Delay:* A time delay of 2 to 60 seconds must expire before the engine shuts down because of a high AC current fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the High AC Current shutdown message (fault code 46) is announced.

ENGINE PROTECTION SUBMENUS

The Engine Protection submenus are available by pressing the **(4)** button on the second Genset Setup menu (see Figure 5-13).

The Engine Protection submenus (see Figure 5-17) are used to set thresholds to determine when engine fault conditions exist and time delays to determine how long a fault condition is present before the fault message is announced and, if necessary, shutdown the engine.

Engine Protection Overspeed Menu

This menu is used to set the value necessary to shutdown the genset and activate an Overspeed shut-down message (fault code 31) on 50 and 60 Hz gensets, indicating that the engine has exceeded normal operating speed.

- ***Overspeed (50Hz) Threshold:*** This threshold is used to set the overspeed value necessary to activate an Overspeed shutdown fault condition on 50 Hz gensets. This value can be set from 0 to 8192 RPM, in 25 RPM increments.
- ***Overspeed (60Hz) Threshold:*** This threshold is used to set the overspeed value necessary to activate an Overspeed shutdown fault condition on 60 Hz gensets. This value can be set from 0 to 24,096 RPM, in 25 RPM increments.

Engine Protection Speed/Frequency Menu

This menu is used to determine when a speed/frequency conflict shutdown fault condition exists and for how long the fault condition should be present before the engine is shut down.

- ***Speed/Freq Fault Threshold:*** This threshold is used to set the value necessary to activate the speed/frequency conflict shutdown fault condition. This value can be set from 0.1 to 20.0 Hz.
- ***Speed/Freq Fault Time Delay:*** A time delay of 0.2 to 10.0 seconds must expire before the warning message is announced because of a speed/frequency conflict shutdown fault condition. If the fault condition is active for the duration of this time delay, the genset is shutdown and the Speed Hz Match shutdown message (fault code 71) is announced.

Low Oil Pressure Warning Menu This menu is used to determine when a low oil pressure warning fault condition exists and for how long the fault condition must be present before the warning message is announced.

- ***LOP Warning Threshold:*** This threshold is used to set the oil pressure value necessary to activate a Pre-Low Oil Pressure warning fault condition. This value can be set from 0 to 100 psi.
- ***LOP Warning Time Delay:*** A time delay of 2 to 15 seconds must expire before the warning message is announced because of a low oil pressure warning fault condition. If the fault condition is active for the duration of this time delay, the Pre-Low Oil Pressure warning message (fault code 215) is announced.

ENGINE PROTECTION SUBMENUS (Continued)

RETURN TO PAGE 5-41

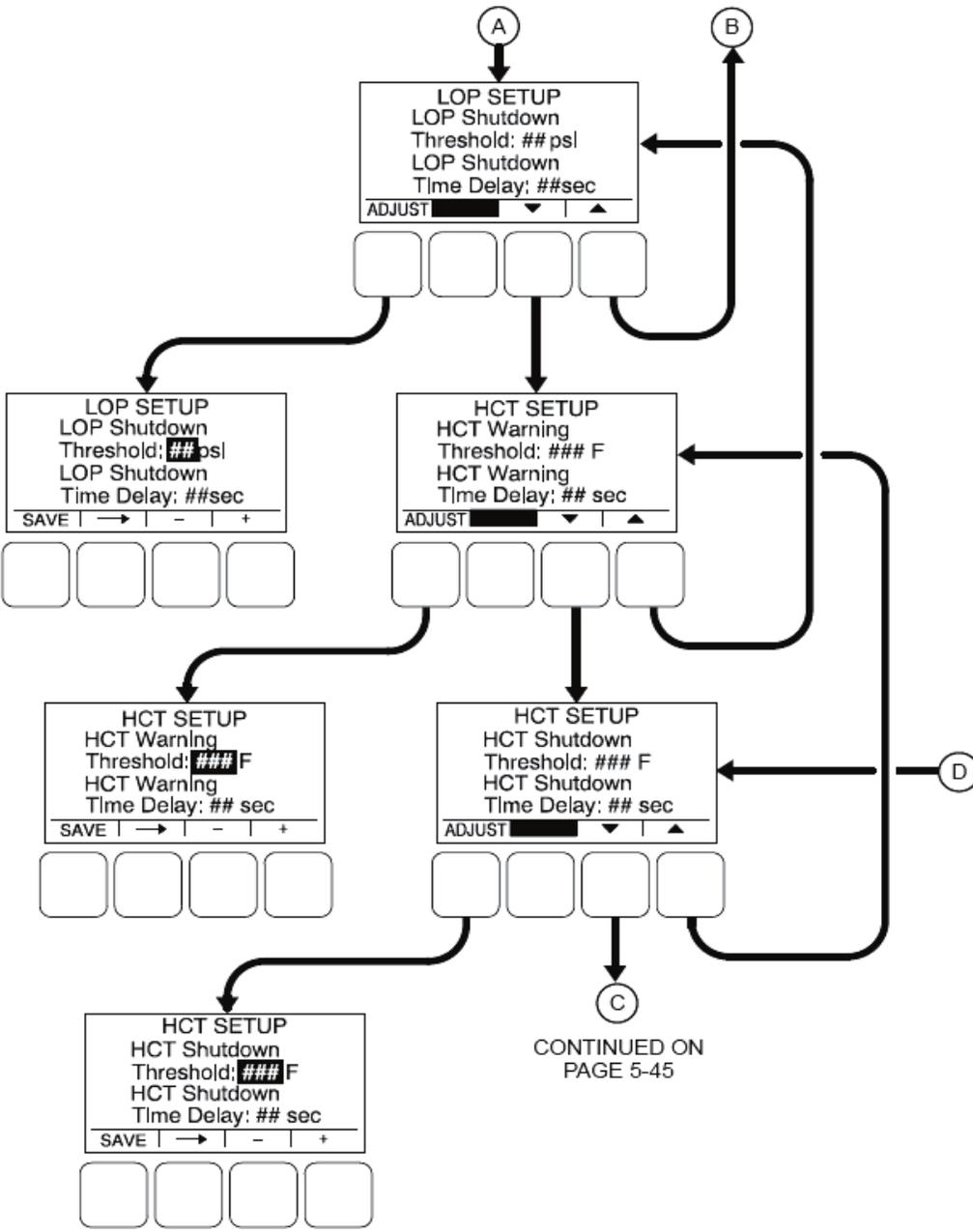


FIGURE 5-17. ENGINE PROTECTION SUBMENUS (SHEET 1 OF 3)

Low Oil Pressure Shutdown Menu

This menu is used to determine when a low oil pressure shutdown fault condition exists and for how long the fault condition should be present before the engine is shut down.

- *LOP Shutdown Threshold:* This threshold is used to set the oil pressure value necessary to activate a Low Oil Pressure Shutdown fault condition. This value can be set from 0 to 100 psi.
- *LOP Shutdown Time Delay:* A time delay of 2 to 15 seconds must expire before the engine shuts down because of a low oil pressure fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the Low Oil Pressure shut-down message (fault code 2) is announced.

High Coolant Temperature Warning Menu

This menu is used to determine when a high coolant temperature warning fault condition exists and for how long the fault condition should be present before the warning message is announced.

- *HCT Warning Threshold:* This threshold is used to set the temperature value necessary to activate a High Coolant Temperature Warning fault condition. This

value can be set from 180 to 220 degrees F.

- *HCT Warning Time Delay:* A time delay of 2 to 10 seconds must expire before the warning message is announced. If the fault condition is active for the duration of this time delay, the High Coolant Temperature warning message (fault code 202) is announced.

High Coolant Temperature Shutdown Menu

This menu is used to determine when a high coolant temperature shutdown fault condition exists and for how long the fault condition should be present before the engine is shut down.

- *HCT Shutdown Threshold:* This threshold is used to set the temperature value necessary to activate a High Coolant Temperature Shut-down fault condition. This value can be set from 200 to 230 degrees F.
- *HCT Shutdown Time Delay:* A time delay of 2 to 10 seconds must expire before the engine shuts down because of a high coolant temperature fault condition. If the fault condition is active for the duration of this time delay, the engine shuts down and the High Coolant Temperature shutdown message (fault code 1) is announced.

ENGINE PROTECTION SUBMENUS (Continued)

RETURN TO PAGE 5-41

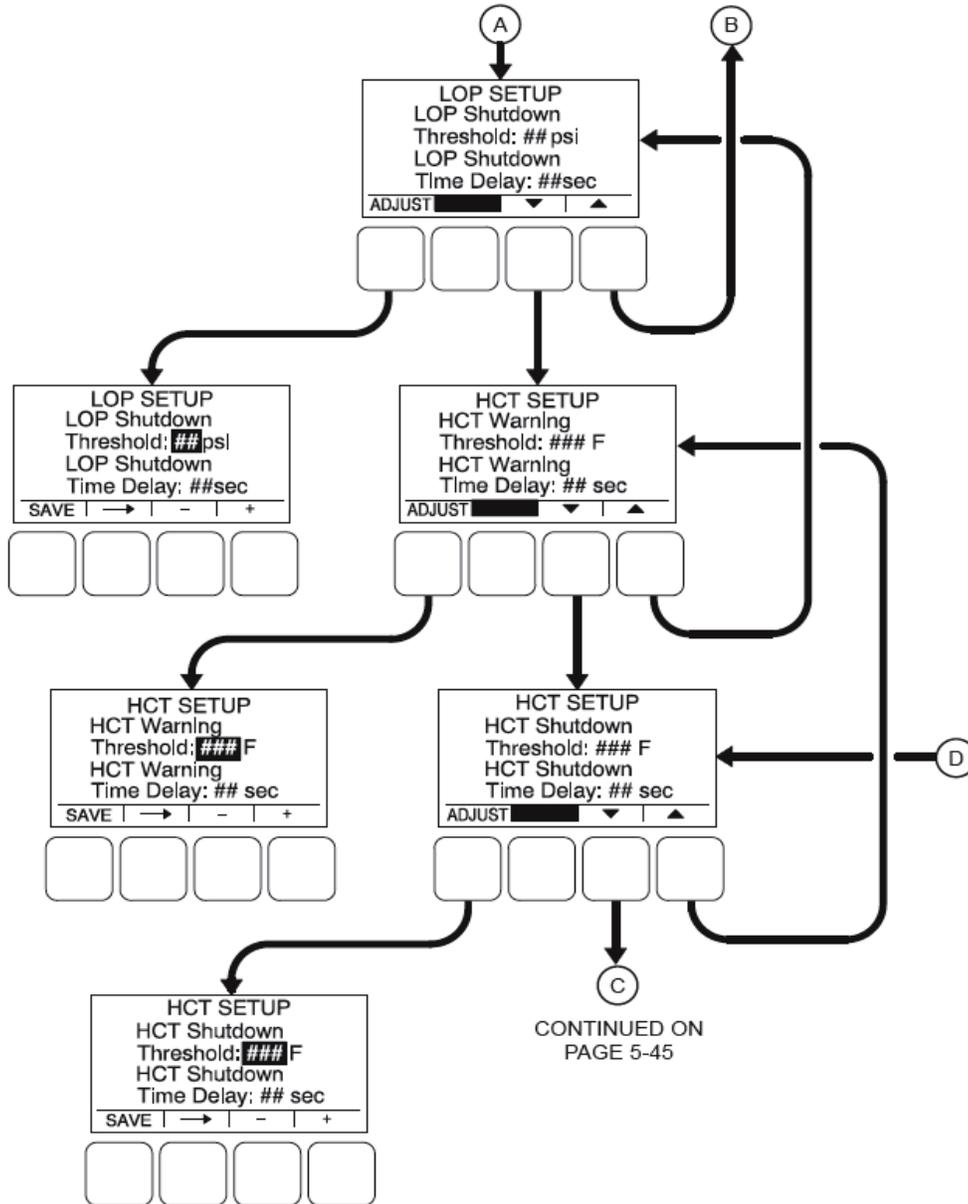


FIGURE 5-17. ENGINE PROTECTION SUBMENUS (SHEET 2 OF 3)

Engine Protection Low Coolant Temperature and Battery Charger Menus

The low coolant temperature menu is used to determine when the genset's coolant temperature is too low and a Low Coolant Temperature warning message (fault code 203) is announced.

This warning message is not announced unless the coolant temperature has been determined to be low for one minute.

- *LCT Warning Threshold:* This threshold is used to set the temperature value necessary to activate a Low Coolant Temperature Warning fault condition. This value can be set from 32 to 100 degrees F.

The battery charger menu is used to determine when the alternator charger failure condition exists and when the warning message should be

announced. The fault condition exists when either the low or high threshold is reached

- *Charger Failed H Threshold:* This threshold is used to set the high charging alternator voltage value. This value can be set from 13.0 to 20.0 VDC for 12V units and from 25.0 to 40.0 VDC for 24V units
- *Charger Failed L Threshold:* This threshold is used to set the low charging alternator voltage value. This value can be set from 2.0 to 13.0 VDC for 12V units and from 2.0 to 25.0 VDC for 24V units.
- *Charger Failed Time Delay:* A time delay of 2 to 300 seconds must expire before the warning message is announced. If the fault condition is active for the duration of this time delay, the Charger Failure warning message (fault code 219) is announced.

ENGINE PROTECTION SUBMENUS (Continued)

RETURN TO PAGE 5-43

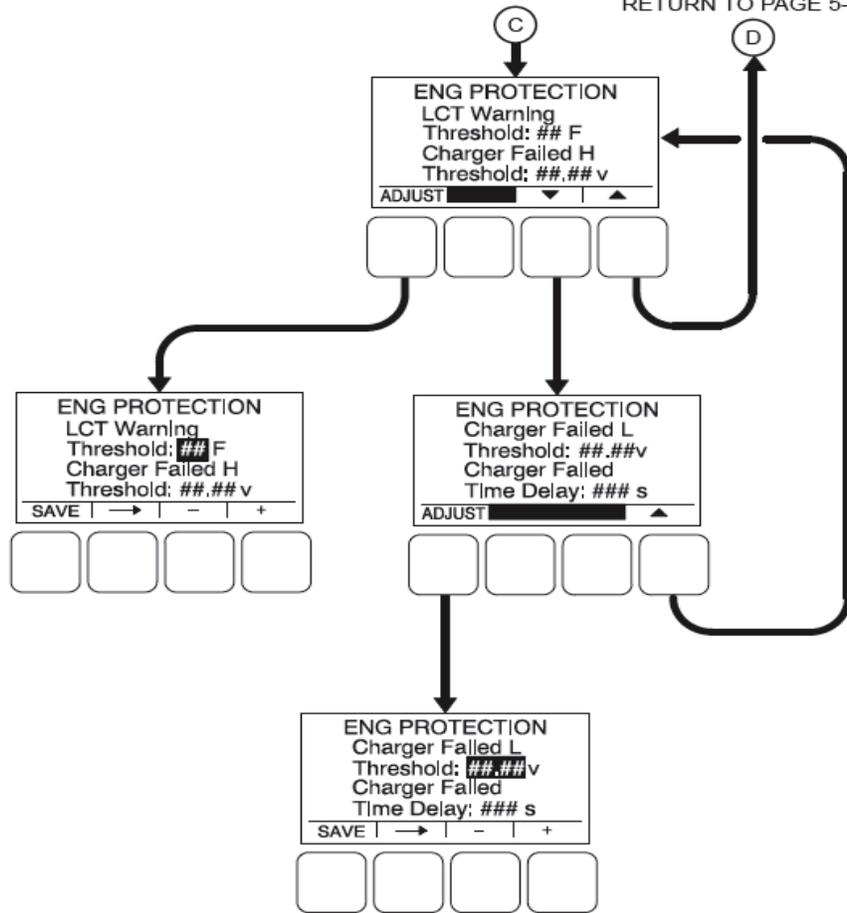


FIGURE 5-17. ENGINE PROTECTION SUBMENUS (SHEET 3 OF 3)

TB1 BASE BOARD CUSTOMER CONNECTIONS

The PCC Base board (Figure 5-18) provides connection points (TB1) for remote control and monitor options.

TB1 Customer Inputs

Available options will vary between PCC1301 control models (PCC with or without display).

X3.3 Genset Models are provided with Display unit.

Refer to Page 9-6 for typical connections to TB1.

Remote Start: When the control is in Auto/Remote mode, 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. (The remote stop is actually the removal of the remote start signal to the control.)

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

Customer Fault Inputs 1 and 2: Grounding anyone 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 Coolant Level, Low Fuel Pressure, Ground Fault, etc.

Each of the two fault functions can be programmed as follows:

- Status, Warning or Shutdown. Default = Warning.
- Enter a brief description of the event (up to 32characters).

The InPower service tool or access to the Genset Service Menu is required to modify the customer fault inputs.

TB1 Customer Outputs

Available options will vary between PCC1301 control models (PCC with or without display). X3.3 Genset Models are provided with Display unit.

Refer to Page 9-6 for typical connections to TB1.

Customer Outputs 1 and 2: One set of normally open (NO) contacts, rated for 2 amps at 30 VDC for each of the two 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 (event), common warning, common shutdown, etc. (Refer to Table 5-3 for the warning and shutdown code listing and page 5-3 for the event code listing.)

Each relay can be independently programmed to energize by entering the a code number (0 through 255, default = 0) for the desired event.

The InPower service tool or access to the Genset Service Menu is required to modify the customer outputs

Ready To Load: Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off mode(B+ signal output).

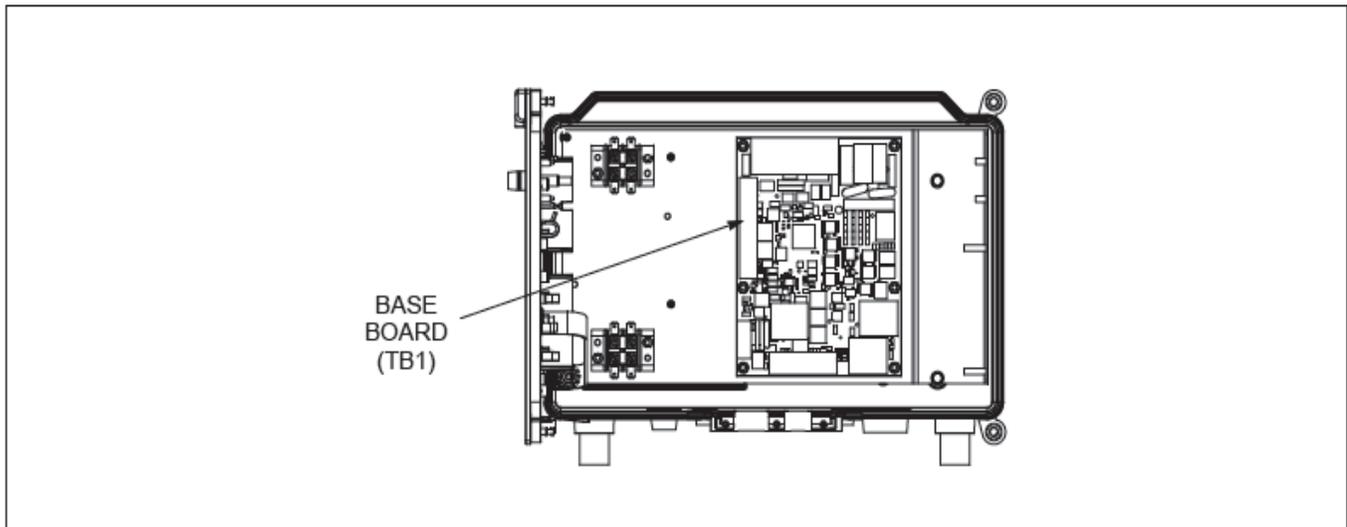


FIGURE 5-18. CONTROL BOX

ENGINE SENSORS

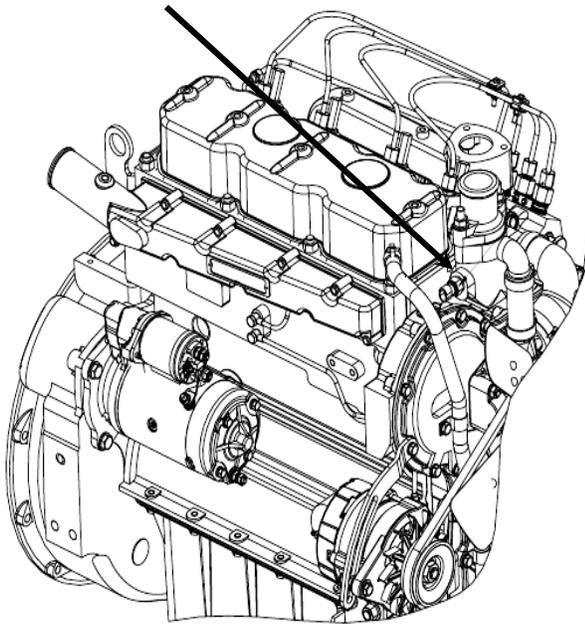
Figure 5-19 shows the locations of the coolant temperature and oil pressure sender to which the PCC responds

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

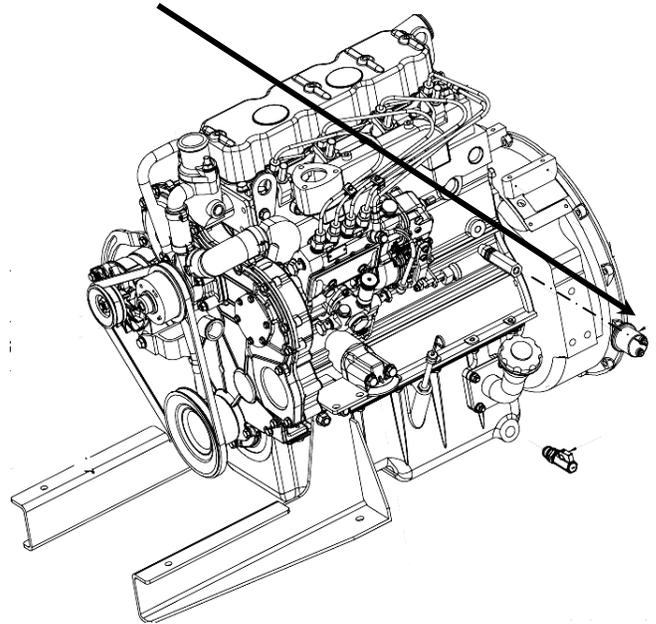
The oil pressure sender functions by converting the sensed oil pressure to voltage which varies the supplied 5 VDC to the sender. The output signal of the sender is approximately 0.5 VDC at 0 psi and 4.5 VDC at 100 psi.

The low coolant level switch functions by closing the circuit to the engine chassis ground (battery negative [-]). The low coolant level switch is not shown in Figure 5-9; this switch is located on the Top Tank of the radiator.

Coolant Sender



Oil pressure sender



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 lock nut.

To troubleshoot the MPU, refer to fault code **45** in Section 4.

CAUTION

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

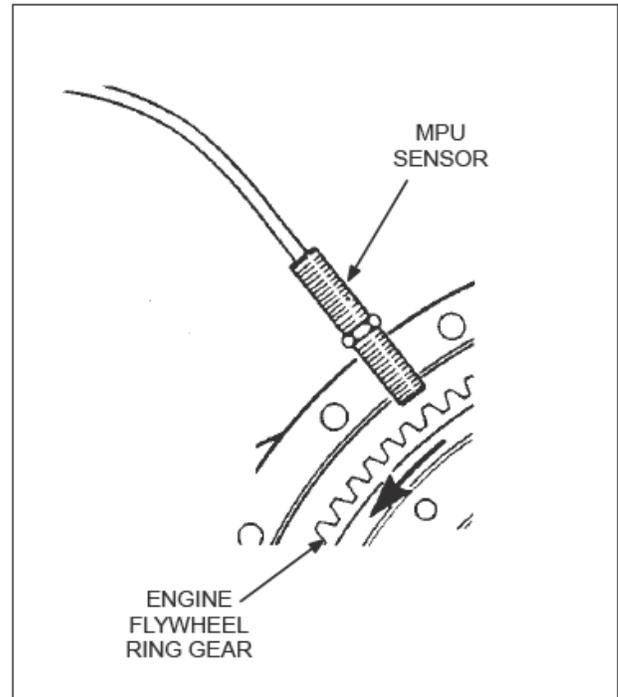


FIGURE 5-20. MPU SENSOR

CURRENT TRANSFORMER (CT) INSTALLATION

The current transformers (CT's) are used to display genset load in kVA and alternator amperage. The CT's are installed in the Main Terminal Box.

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

CT Installation Requirements:

- A. The CT has a dot on one side. This dot must be facing toward the generator reconnection terminal block. A dot is also used to indicate pin 1 of the CT.
- B. Route the load lead (U, V or W) through the appropriate CT (refer to Reconnection Diagram).
- C. The CT's have dual secondaries (3 pins marked X1, X2 & X3). (Refer to Reconnection Diagram.)

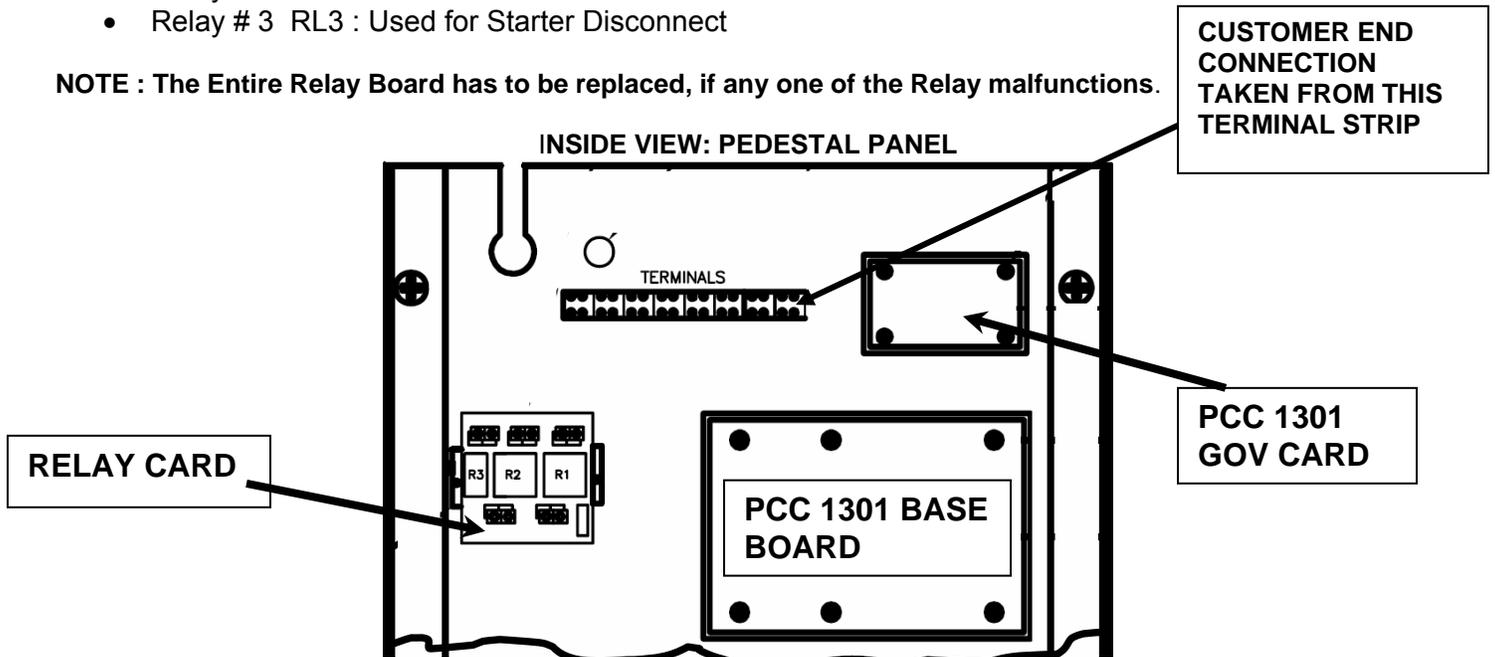
X1 & X2 for above 300 volts L-L
X1 & X3 for below 300 volts L-L.

RELAY INSTALLTION:

The PCC 1301 pedestal panel comes fitted with 1 Nos relay module Board, 12V, 70 Amps. Each Relay module consists of two and Half Channel relays. Thus PCC 301 uses four Relays whose function is given below :

- Relay # 1 RL1 : Used for Starter & Pull Coil.
- Relay # 2 RL2 : Used for fuel solenoid hold.
- Relay # 3 RL3 : Used for Starter Disconnect

NOTE : The Entire Relay Board has to be replaced, if any one of the Relay malfunctions.



6. SERVICING THE GENERATOR

TESTING THE GENERATOR

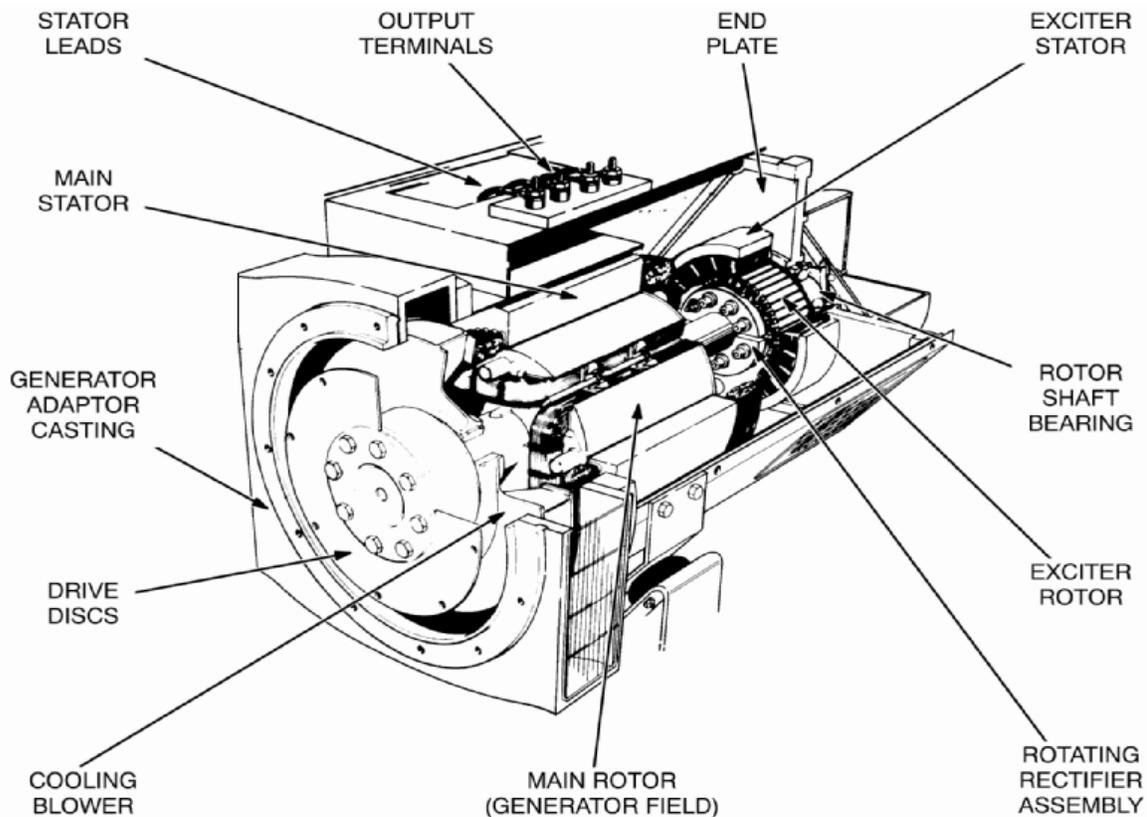
These tests can be performed without removing the generator. Before starting tests, disconnect the negative (-) cable from the battery to make sure the engine will not start while performing these tests.

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

goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last

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

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



GENERATOR/BASE BOARD ISOLATION PROCEDURE

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

1. Throw the line circuit breaker **OFF** and shutdown the set.



CAUTION

This test involves unregulated excitation of the generator. To prevent damage to the generator due to over current, 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 Un-insulated parts inside the control housing and power output boxes can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts.

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

2. Remove the side access cover of the control housing to access the exciter stator leads (**X** and **XX**). Disconnect the **X** and **XX** leads from the AC harness (quick connect type connectors).
3. Prepare to measure output voltage across the generator terminals while the set is running.

4. Bring two jumpers from a 12 volt battery for connection to the exciter stator **X** (Field +) and **XX** (Field -) leads.

Connect the jumper from the positive (+) post of the battery to the **X** lead. Be prepared to connect the jumper from the negative (-) post of the battery to the **XX** leads. If one of the 12 volt cranking batteries is used, bring the jumpers from the battery connected on the grounded side of the system to avoid inadvertently imposing 24 volts on the system.

5. Check polarity again. Polarity must be correct or this test will be inconclusive because the induced and residual magnetic polarities in the exciter stator will be opposed.

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

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

Exciter Stator

Testing Winding Resistance:

Measure winding resistance with a stone bridge or digital ohm-meter. Replace the stator if winding resistance is not as specified by Table6-1.

Testing Winding Insulation Resistance:

Disconnect the exciter stator leads **X** and **XX** from their connectors in the AC harness and isolate them from ground. Using an ohmmeter, measure resistance between either lead and the stator laminations. Re-place the stator if insulation resistance is less than 1megohm (1,000,000 ohms)

Flashing the Field (Self-Excited Generators Only): If necessary, flash the exciter field before or after installation. Apply 110 to 220 VAC for one to two seconds to the **X** and **XX** leads of the exciter stator.

The generator must be shut down, the Baseboard disconnected, a diode used to establish correct polarity and a 3 amp fuse to prevent over-excitation. See the diagram.

Alternatively, while the set is running and disconnected from all loads, apply a 12 VDC battery for one to two seconds as shown in the diagram.

Polarity must be correct: + to X, – to XX.

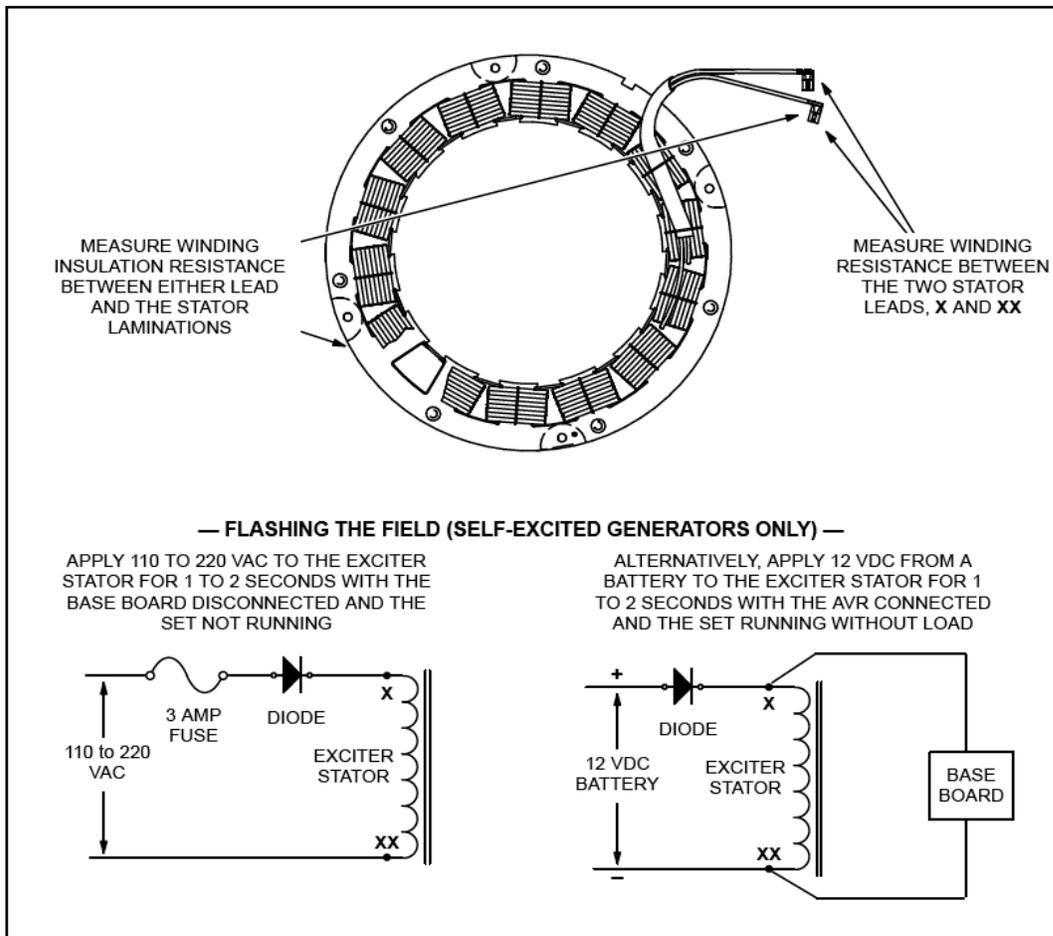


FIGURE 6-2. TESTING AND FLASHING THE EXCITER STATOR

Exciter Rectifier Bridge (Rotating Rectifier Assembly)

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

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

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

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

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

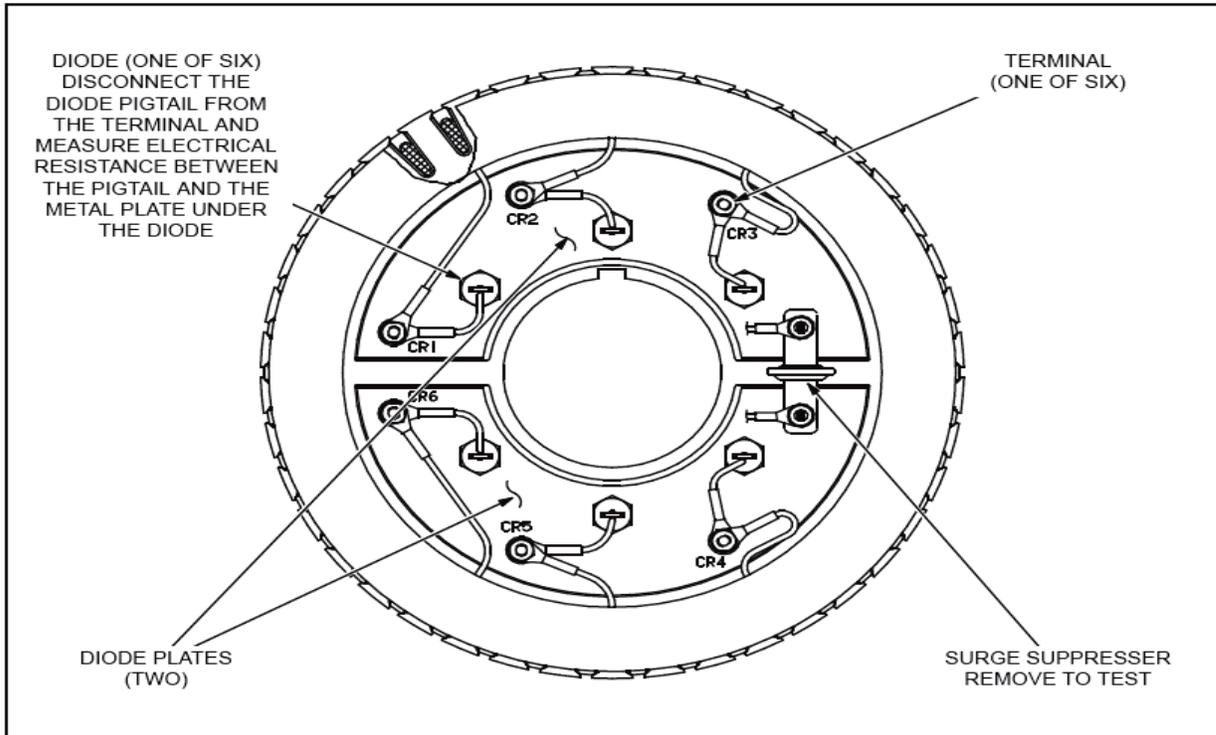


FIGURE 6-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

Exciter Rotor

Testing Winding Resistance:

Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly. With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: U (CR1 or CR4) and V (CR2 or CR5), V (CR2 or CR5) and W (CR3 or CR6), W (CR3 or CR6) and U (CR1 or CR4). See the winding schematic.

Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 6-1.

Testing Winding Insulation Resistance:

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

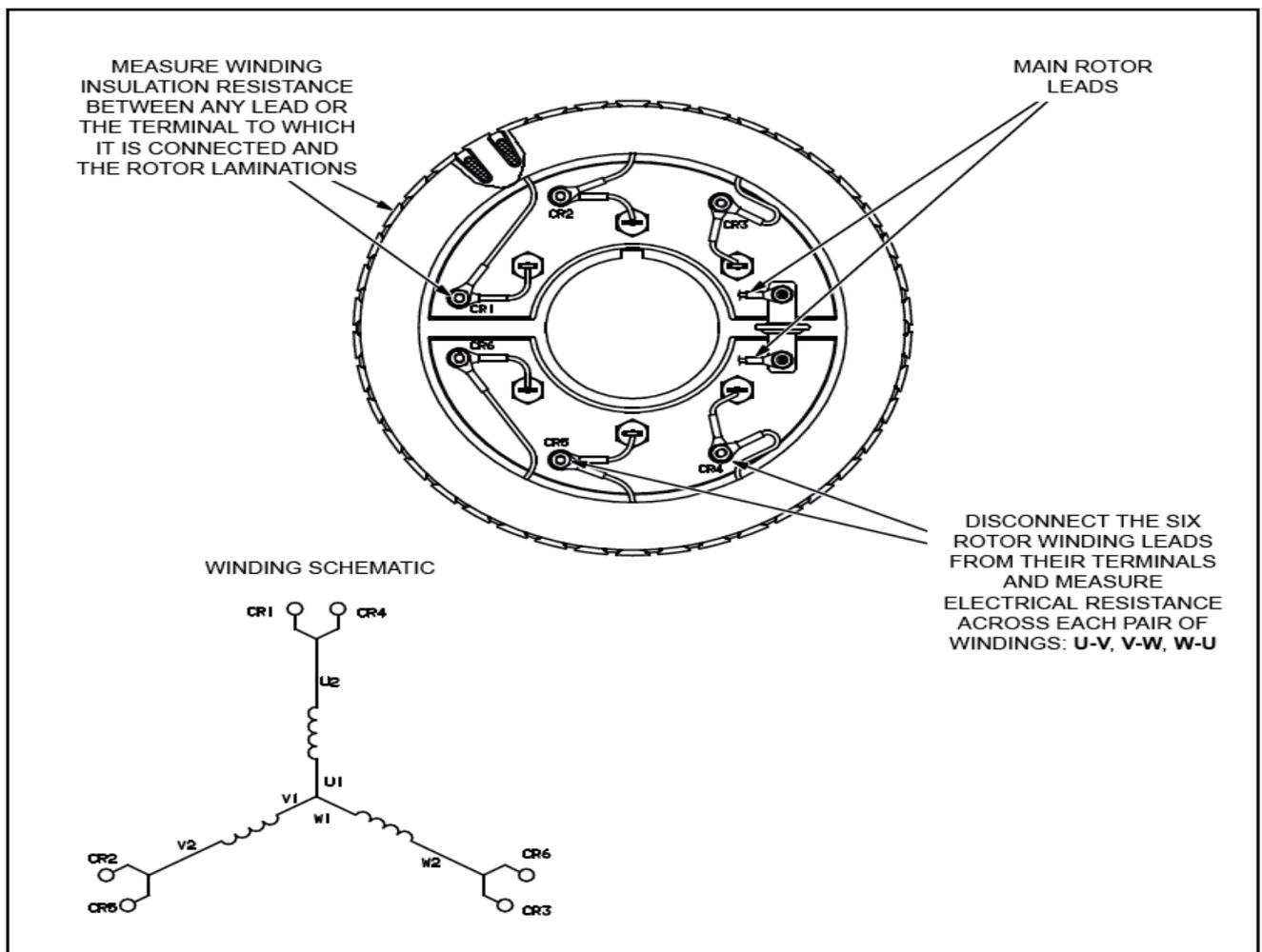


FIGURE 6-4. TESTING THE EXCITER ROTER

Main Rotor (Generator Field)

Testing Winding Resistance:

Disconnect the two leads of the main rotor from the terminals on the rotating rectifier assembly. See Figure 6-4. Measure electrical resistance between the two leads with a Wheatstone bridge or digital ohmmeter. Replace the rotor if the resistance is not as specified in Table 6-1. Connect the rotor leads and torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

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

NOTE : Incorrect resistances indicate faulty windings and component replacement is necessary.

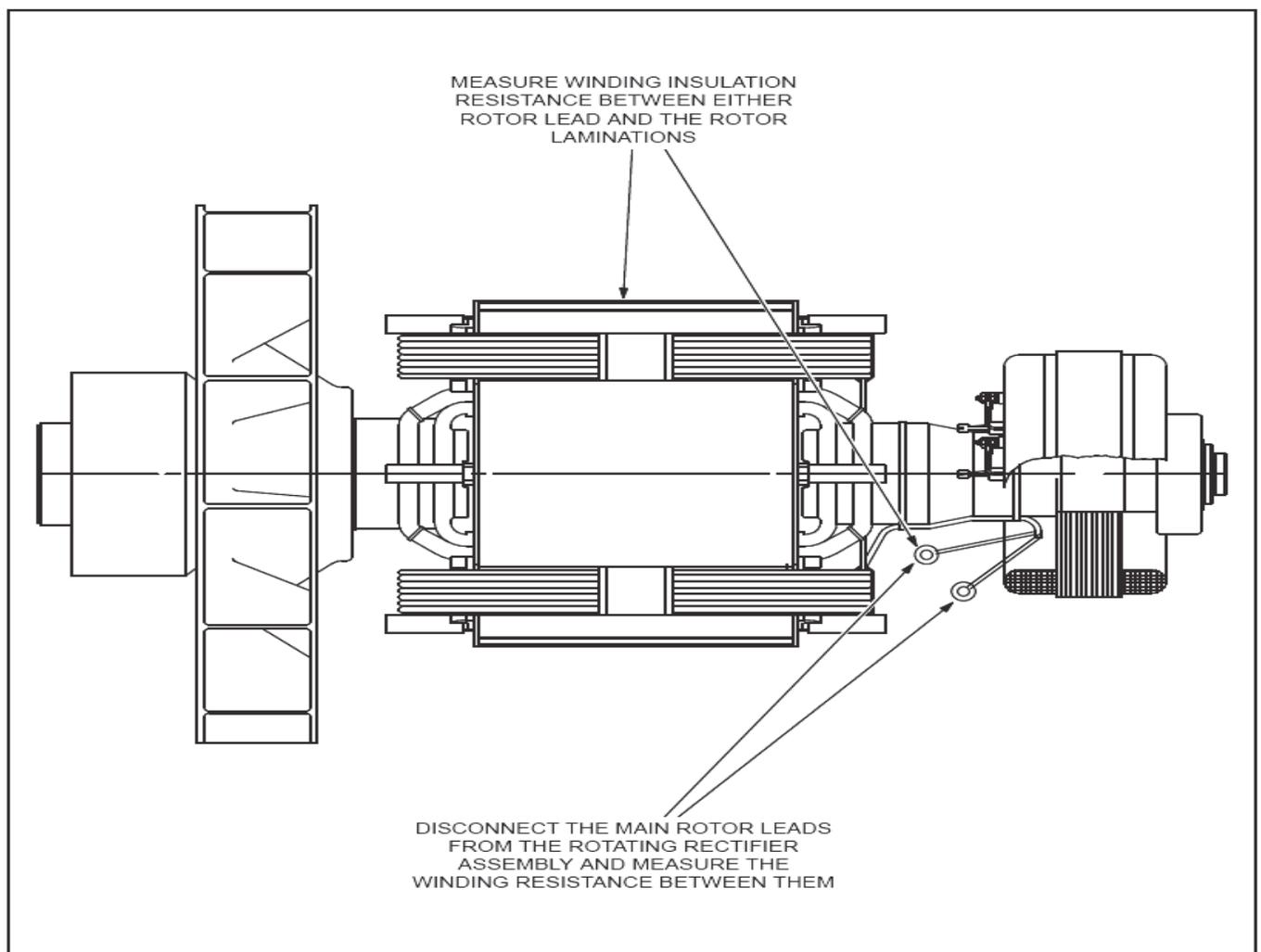


FIGURE 6-5. TESTING THE MAIN ROTOR

Main Stator

Testing Winding Resistance:

Measure electrical resistance across each pair of stator leads (U1-U2, U5-U6, V1-V2, V5-V6, W1-W2 and W5-W6) with a Wheatstone bridge or ohmmeter having at least 0.001 ohm precision. Replace the stator if the resistance of any winding is not as specified in Table 6-1.

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

value (two sets of two winding elements in series). Single phase only windings can be measured at W-V and should be twice the table value.

Testing Winding Insulation Resistance:

Disconnect the AVR completely, (AT THE AVR), before carrying out this test. Disconnect any connections from Neutral to Earth. The Stator insulation should be checked with an Insulation tester. The test instrument should be 500 or 1000 volts for low voltage Generators (up to 690V). For low voltage machines (up to 690V), the MINIMUM insulation value is 1.0 Meg-Ohm to Earth (Ground). WINDINGS MUST BE DRIED OUT IF BELOW 1.0 MEG-OHM.

NOTE Faults on the stator winding or cables may also cause noticeable load increase on the engine when excitation is applied.

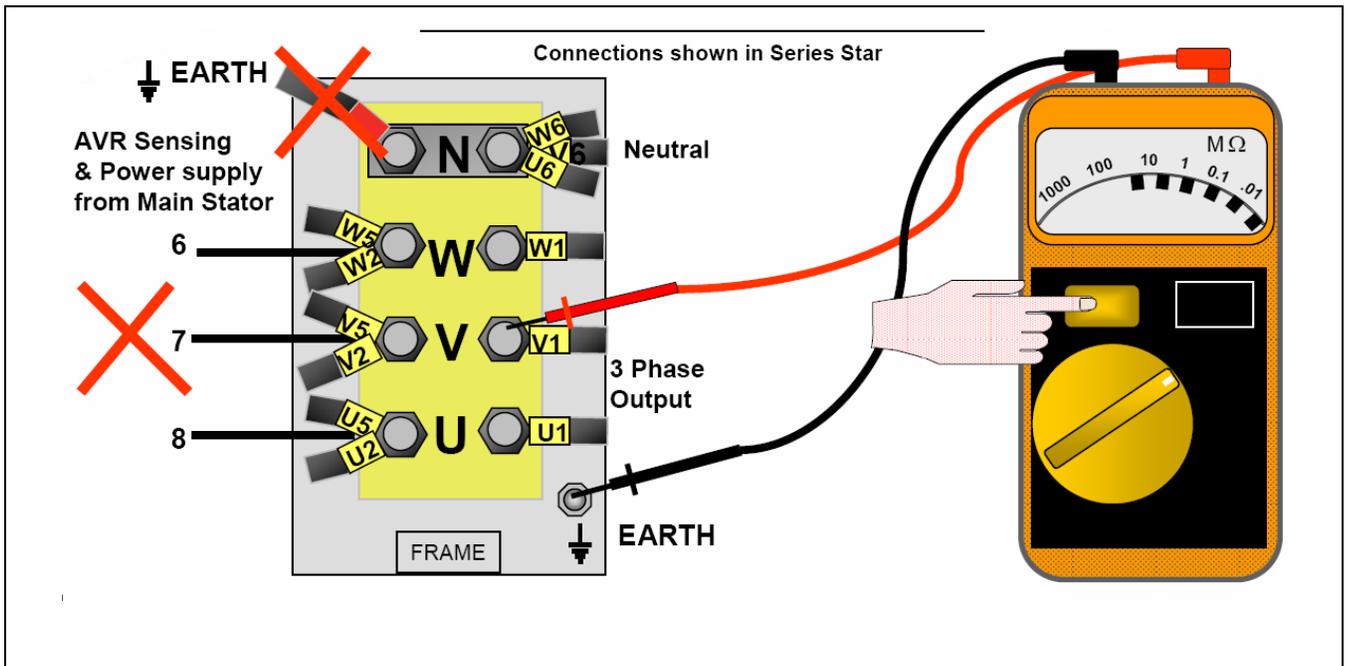


FIGURE 6-6. TESTING THE GENERATOR STATOR

Main Excitation Windings:

If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Resistance Charts), as the fault must be in one of these windings. The exciter stator resistance is measured across leads F1 and F2. The exciter rotor is connected to six studs, which also carry the diode lead terminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

Resistance values should be within 10% of the values given in the table below:

ALTERNATOR FRAME SIZE	Main Rotor (Ohms)	Exciter stator (Ohms)	Exciter Rotor (Ohms)
P044D	0.437	17.5	0.211
P044E	0.415	17.7	0.211
P044F	0.465	18.5	0.228
P044G	0.551	18.5	0.228
P044H	0.545	18.5	0.228
P144D	0.657	18.5	0.228
P144E	0.67	19.36	0.215
P144F	0.708	20.25	0.201
P144G	0.857	22.25	0.201
P144H	0.89	22.9	0.21
P144J	0.983	22.9	0.21
P144K	0.99	22.9	0.21

Main Stator Resistance:

ALTERNATOR FRAME SIZE	Main stator winding resistances (Ohms)
Windings	*
	12 Lead Reconnect able
P044D	1.908
P044E	1.33
P044F	0.95
P044G	0.625
P044H	0.51
P144D	0.353
P144E	0.3

*- Note :These Windings are referred by the alternator Manufacturer as "311" Winding no.

GENERATOR DISASSEMBLY

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

WARNING

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

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

WARNING

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

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

CAUTION

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

WARNING

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

Removing The Generator Control Housing

1. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
2. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.

3. Disconnect all engine wiring harness connections in the generator control and output boxes. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
4. Disconnect all generator control leads (winding taps) from connections in the output box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
5. If the set has a mounted line circuit breaker, disconnect the cables to the circuit breaker. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
6. Attach a hoist to the generator output box, loosen the mounting bolts on the sides of the generator and remove the box.

Withdrawing The Generator From The Set

CAUTION

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

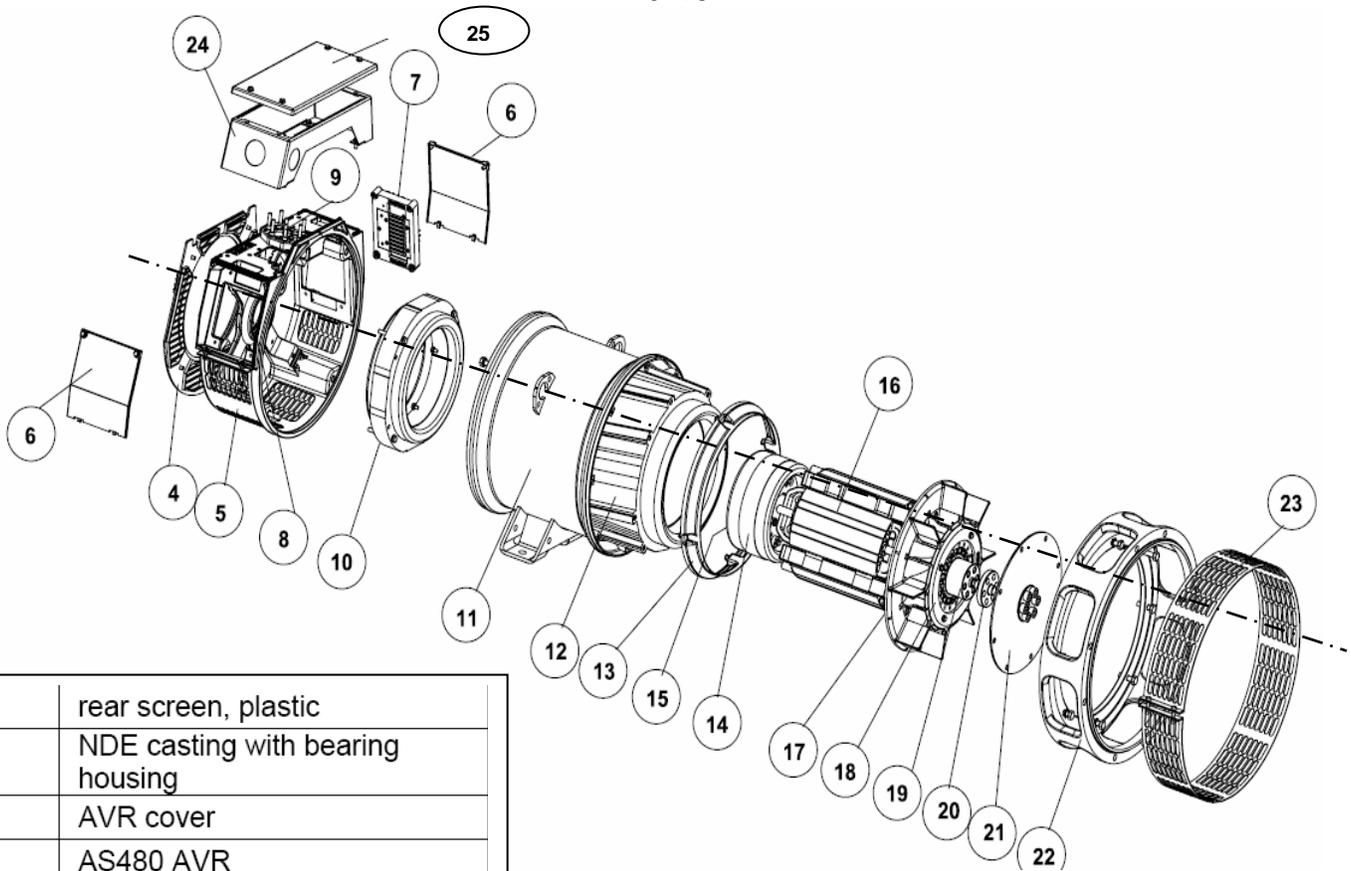
1. The rotor will be carried inside the stator when the generator is withdrawn from the engine. Bar the engine until one of the four poles of the rotor points straight down so that the rotor will rest on the face of the pole when the generator is withdrawn.

CAUTION

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

2. Attach lifting eyes and a hoist of sufficient capacity (Figure 6-7).
3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts.
4. Raise the generator end approximately one inch (12 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.
5. Remove the bolts securing the generator drive discs to the flywheel.
6. Loosen all the bolts securing the generator adapter casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

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



4	rear screen, plastic
5	NDE casting with bearing housing
6	AVR cover
7	AS480 AVR
8	NDE bearing, 'o' ring
9	terminal block
10	exciter stator
11	frame
12	main stator
13	air flow baffle
14	exciter rotor
15	rotating rectifier assembly
16	main rotor assembly
17	fan, removable
18	fan hub, fixed
19	shaft
20	shaft spacer
21	coupling disc
22	DE adapter
23	DE screen
24	standard terminal box
25	standard terminal box lid

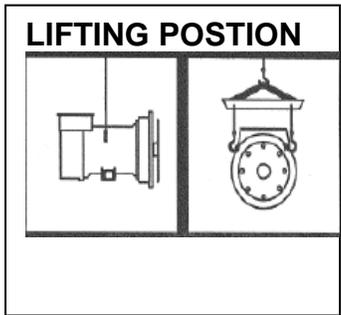
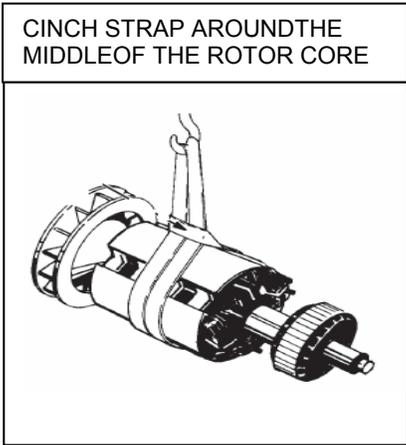


FIGURE 6-7. GENERATOR ASSEMBLY

With drawing the Rotor From The Generator

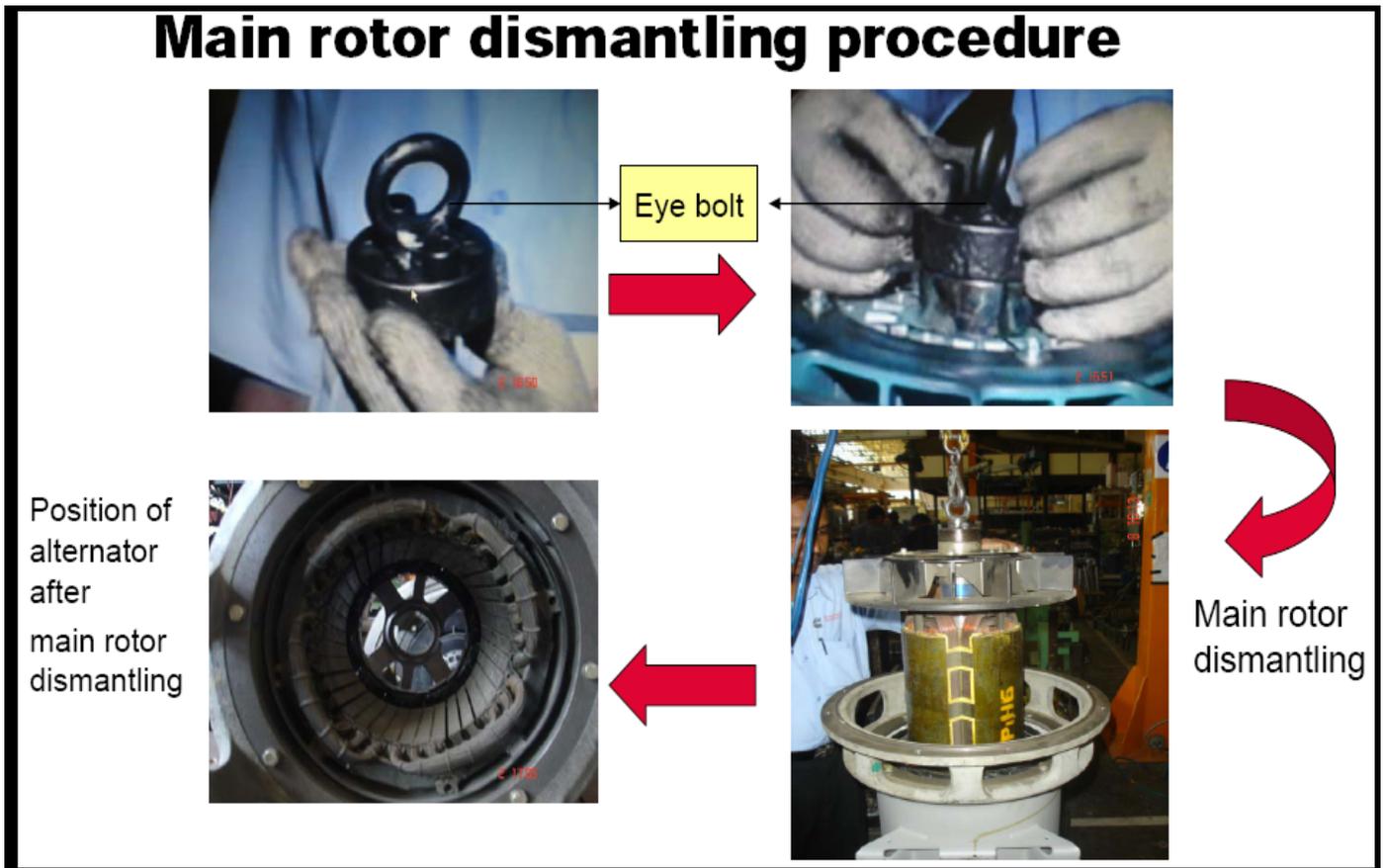
1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.
2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by a Eye Bolt and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and recinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on

both ends to prevent contact with the stator windings

3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, blower or exciter.
4. Remove the retaining clip if the rotor shaft bearing is to be removed.

GENERATOR REASSEMBLY

Reassembling is the reverse of disassembling. Note the following. The Assembly Torques are specified in the succeeding page.



Generator Assembly Tools and Torque Values

Part Description	Tool	Torque value Nm	
Earth lead to NDE bracket	10mm socket head box screw driver or 10mm socket	6	
EBG Str Hsg to NDE bracket		10	
EBG Str to EBG Str Hsg		10	
Excitor stator to NDE bracket		10	
Stator Lead to terminal studs		6.5	
Diode fitting	11mm socket head box screw driver / Crimping Tool	2.8/3.6	
Small Terminal box to NDE bracket	150mm long x 8mm socket or 8mm socket head box screw driver	5	
EBG Rtr to shaft	17mm socket	50	
Coupling disc to flywheel	17mm socket x 60mm long(non-standard)	51	
DE Adaptor to Flywheel housing	17mm socket x 75mm long(STD.)	51	
Clamping spacer to rectifier hub	8 mm socket	2.8/3.6	
Rectifier hub to excitor rotor		2.8/3.6	
Rotor leads to Clamping spacer	8mm open type spanner	2.8/3.6	
EBG Housing cover to housing	8mm socket head box screw driver or 8mm socket	6.5	
Terminal block to NDE bracket		5	
Varistor to rectifier hub		2.8/3.6	
AVR cover to NDE bracket		5	
AVR to NDE bracket		5	
Axial air inlet cover to NDE bracket		5	
DE Air outlet cover		6.5	
Fan to fan hub 290 and 344		5	
Radial Inlet cover to Nde bracket		5	
Terminal box lid to terminal box		5	
Coupling disc to shaft		8mm socket with Allen key bit.	75
DE Adaptor to frame blocks		T' type wrench with extension rod and 13mm socket	26
NDE bracket to Frame blocks	T' type wrench with extension rod and 13mm socket	26	

7. GENSET SPECIFICATIONS

3-Phase Ratings

Model	Standby rating		Prime rating	
	60 Hz	50 Hz	60 Hz	50 Hz
	kW (kVA)	kW (kVA)	kW (kVA)	kW (kVA)
C33D5		26.4(33)		24(30)
C38D5		30.4(38)		28(35)
C30D6	30(37.5)		27(33.75)	
C35D6	35(43.75)		32(40)	

1-Phase Ratings

Model	Standby rating		Prime rating	
	60 Hz	50 Hz	60 Hz	50 Hz
	kW (kVA)	kW (kVA)	kW (kVA)	kW (kVA)
C33D5		21(26.2)		19(23.8)
C38D5		24(30.6)		22(27.2)
C30D6	30(37.5)		24(30)	
C35D6	32(40)		29(36.4)	

Governor regulation class	ISO8528 Part 1 Class G2
Voltage regulation, no load to full load	± 1%
Random voltage variation	± 1%
Frequency regulation	Droop
Random frequency variation	± 0.25%

Engine specifications

Design	4 cycle, in-line, naturally aspirated
Bore	91.7mm (3.6 in.)
Stroke	127mm (5 in.)
Displacement	3.3 liter (201 in. ³)
Cylinder block	Alloy Cast iron, In-line, 4 cylinder
Battery capacity	88 Ampere-Hour
Battery charging alternator	36amps
Starting voltage	12 volt, negative ground
Fuel system	Direct injection: Number 2 diesel fuel
Fuel filter	Single element, Spin-on fuel filter cum Water Separator, Filtration efficiency 25 micron 99%(min) ,Water Separation efficiency 90% (min)
Air cleaner type	Dry replaceable element
Lube oil filter type(s)	Spin on full flow filter , Filtration efficiency 25 micron 99%(min)
Standard cooling system	122°F (50°C) ambient radiator with coolant Recovery System

Alternator specifications

Design	Brushless, 4 pole, revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible disc
Insulation system	Class H
Standard temperature rise	163 °C standby @ 27 °C ambient
Exciter type	Torque match (shunt) standard, EBS optional EBS(Excitation Boost System)
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform total harmonic distortion	< 5% no load to full linear load, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50 per NEMA MG1-22.43
Telephone harmonic factor (THF)	< 3

Available voltages

60 Hz line-neutral/line-line				50 Hz line-neutral/line-line (Std Voltage -)				
127/220 (STD)	120/208	133/230	138/240	230/400 (STD)	240/416	220/380	127/220	138/240
220/380	240/416	255/440	277/480 265/460	254/440	265/460	277/480	120/208	133/230

Generator set options and accessories

Engine	Alternator	Control panel	Generator set
<input type="checkbox"/> 208/240/480 Volt coolant heater.	<input type="checkbox"/> 105 °C Temp Rise Alternator <input type="checkbox"/> 125°C Temp Rise Alternator <input type="checkbox"/> 150°C Temp Rise Alternator <input type="checkbox"/> EBS (Excitation Boost System) <input type="checkbox"/> 120/240 V, 25 W, anti-condensation heater.	<input type="checkbox"/> Shunt Trip <input type="checkbox"/> Auxiliary Contacts <input type="checkbox"/> Earth Fault Relay	<input type="checkbox"/> Heavy Duty Air Cleaner <input type="checkbox"/> Electronic Governing <input type="checkbox"/> Battery Charger <input type="checkbox"/> 1500 /3000 hours Maintenance Kit
Exhaust system <input type="checkbox"/> Standard Residential grade exhaust silencer			

8. WIRING DIAGRAMS

GENERAL

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

- Page 8–2, AC Reconnect Wiring Diagram.
- Page 8–3 & 8–4, Block Diagram.
- Page 8–5 AC Harness.
- Page 8–6 Engine Harness (Electronic or Mechanical Governor).
- Page 8–7, Engine Harness Jumper (PCC2100 to PCC1301)
- Page 8–8, Customer Connections.

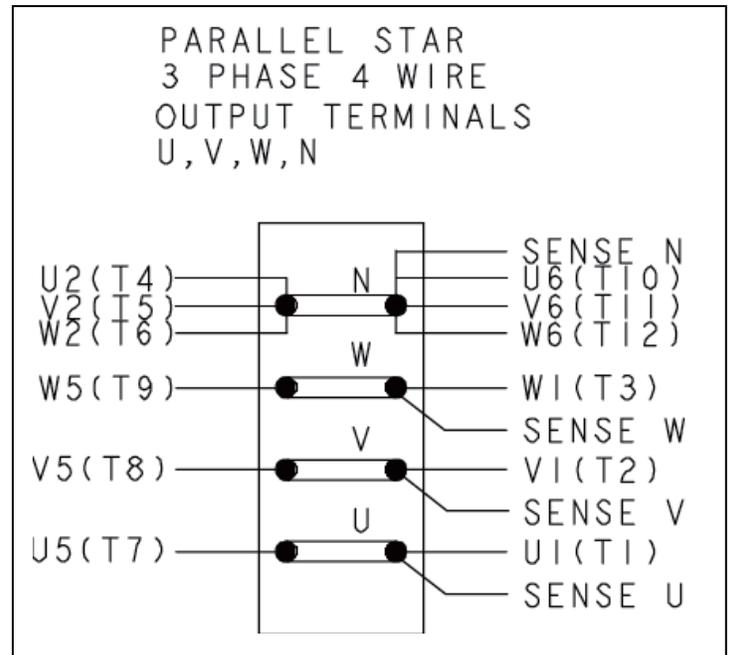
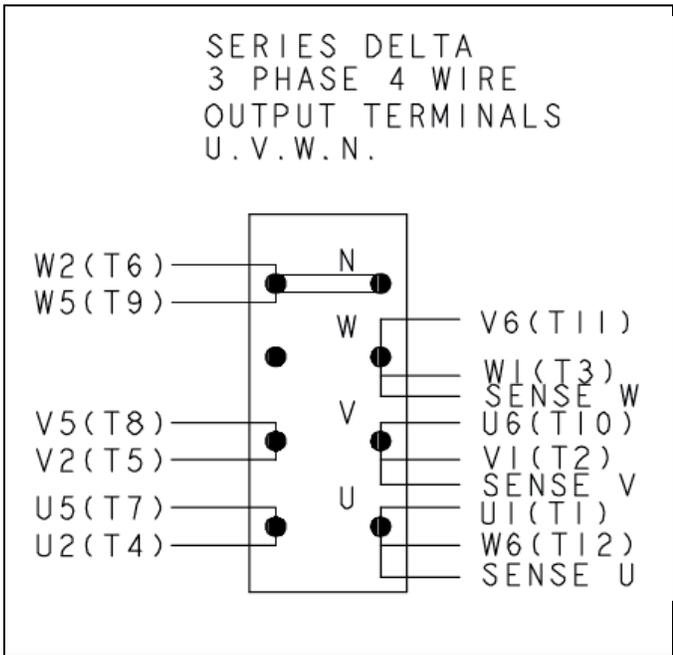
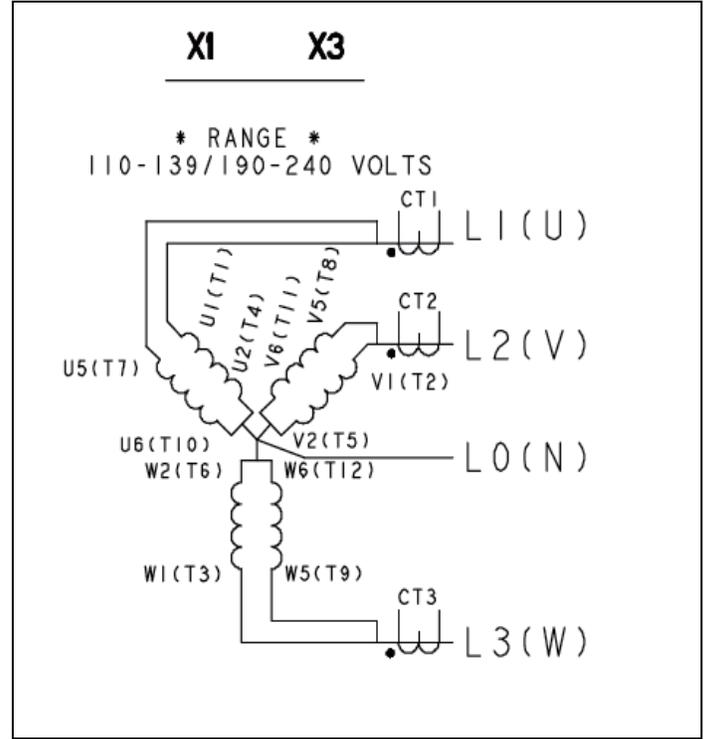
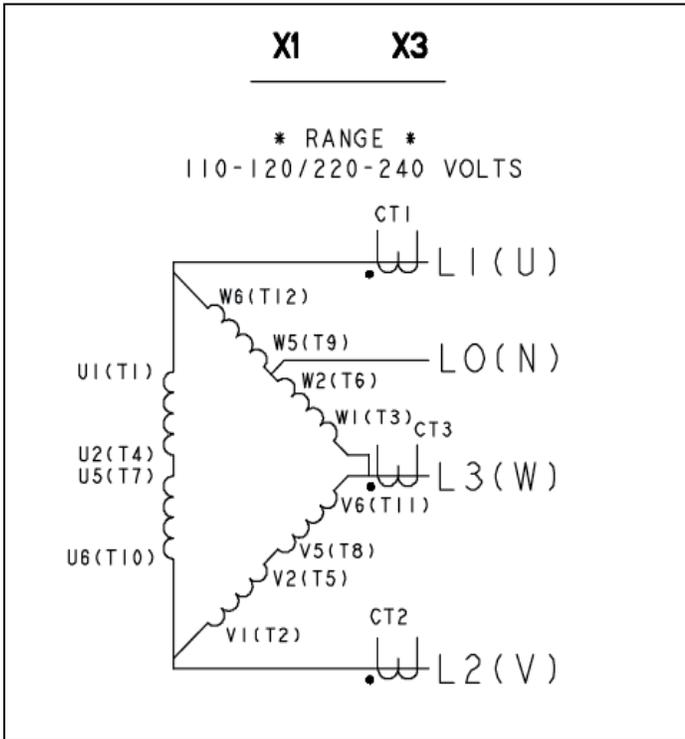
NOTE: P1 Alternators for X3.3 have Winding 311 for 3 phase for 50 and 60 Hz and 05/06 Winding for 50/60 Hz Single phase respectively.

NOTE: The Wiring Drawings are REPRESENTATIVE DRAWINGS.

FOR SERVICE, USE DRAWING SUPPLIED WITH GENSET, PASTED ON THE BACKSIDE OF THE DOOR OF THE PEDESTAL PANEL

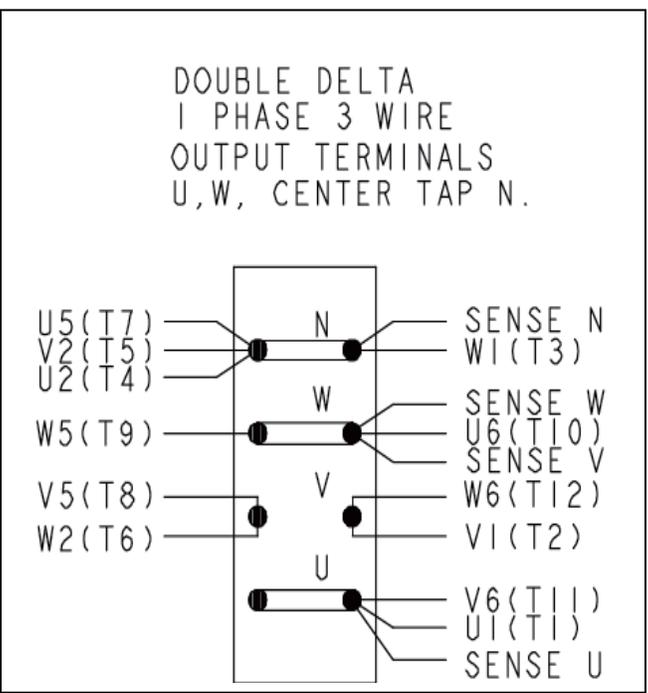
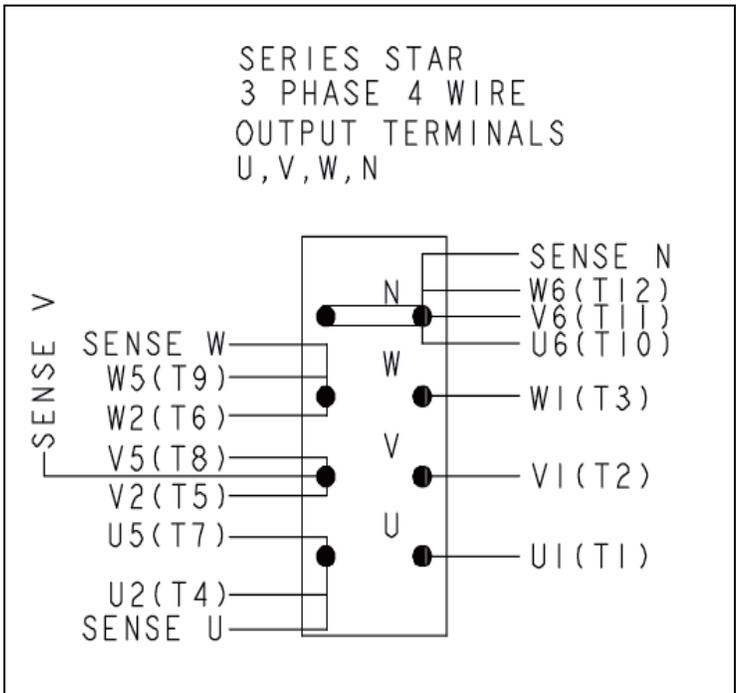
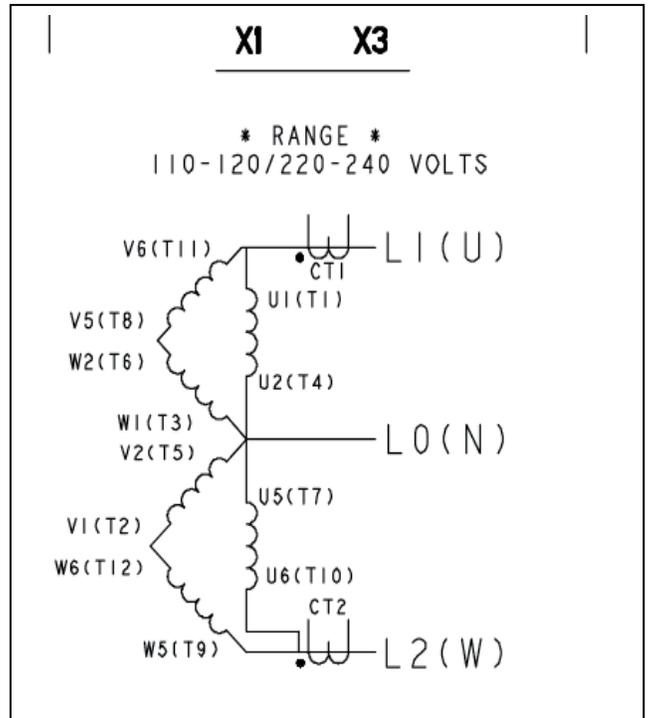
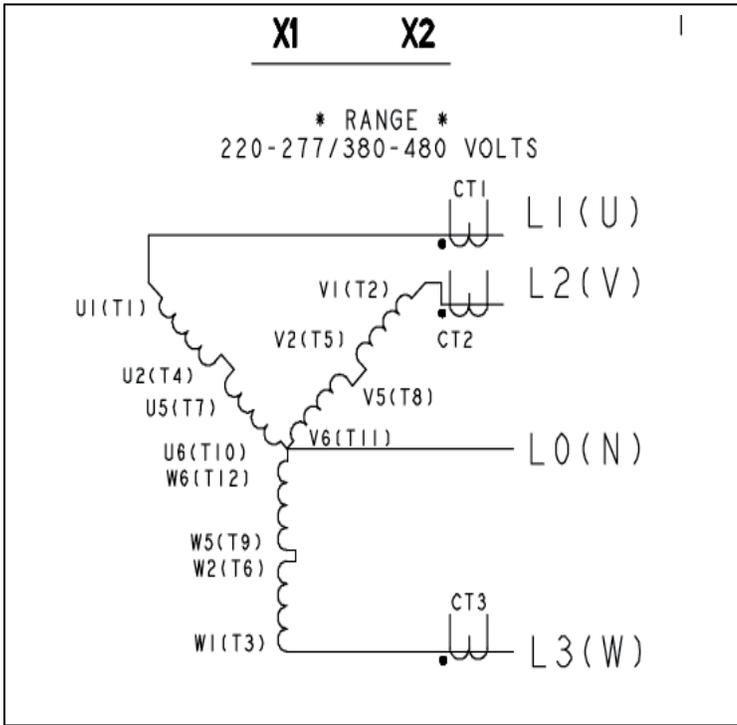
The Drawings can be downloaded from the PGBU Engineering Database.

3 Phase Reconnect able, 12 Lead CT Secondary Connection

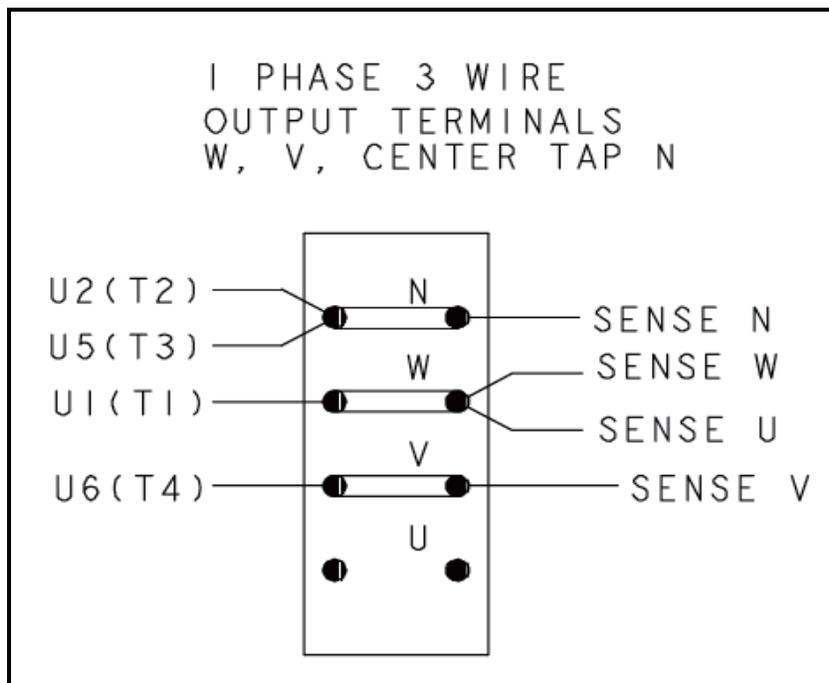
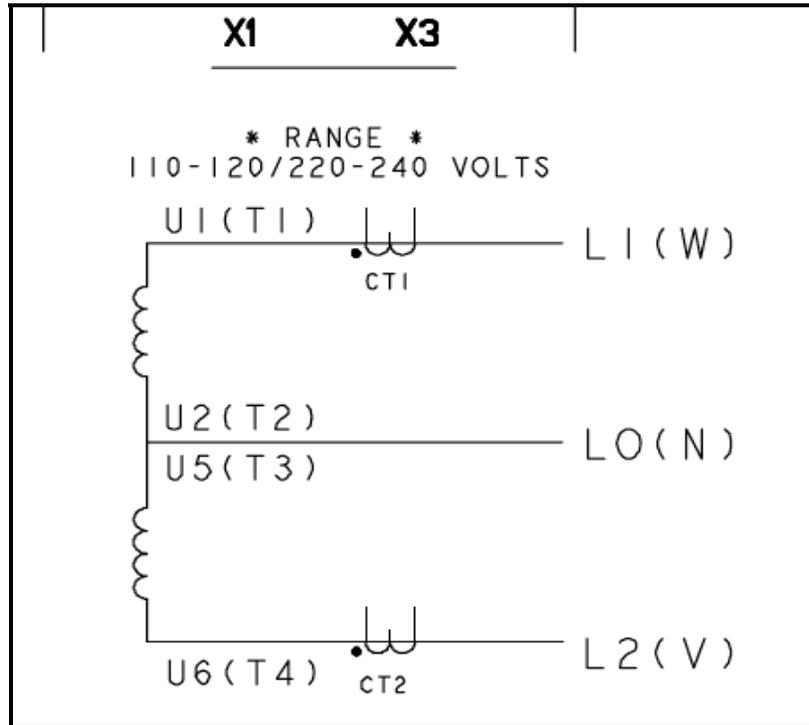


NOTE: Sense Lead N is Not Used. Tape End and Tie Back .

3 Phase Reconnect able, 12 Lead CT Secondary Connection

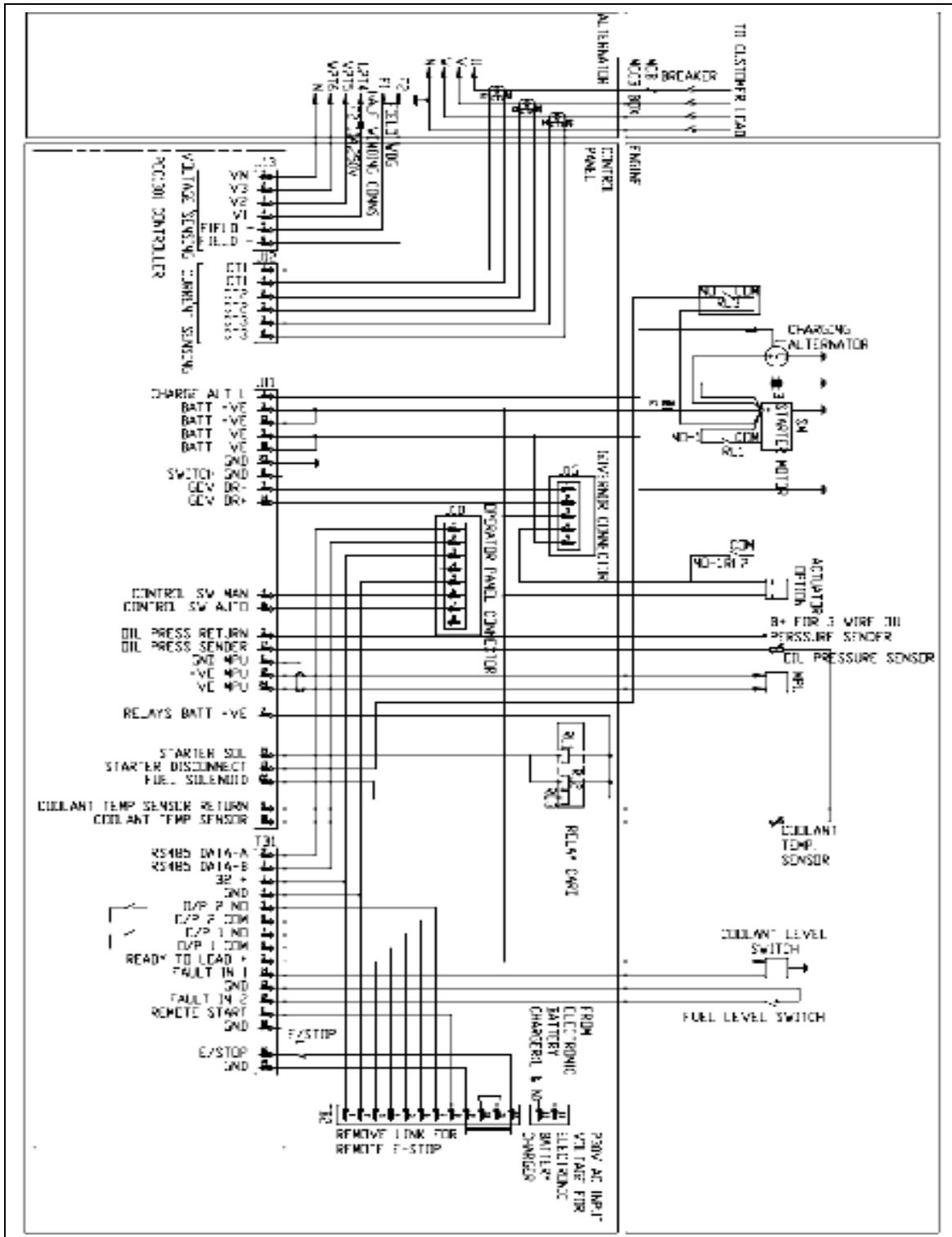


1 Phase NON -Reconnect able, 4 Lead CT Secondary Connection



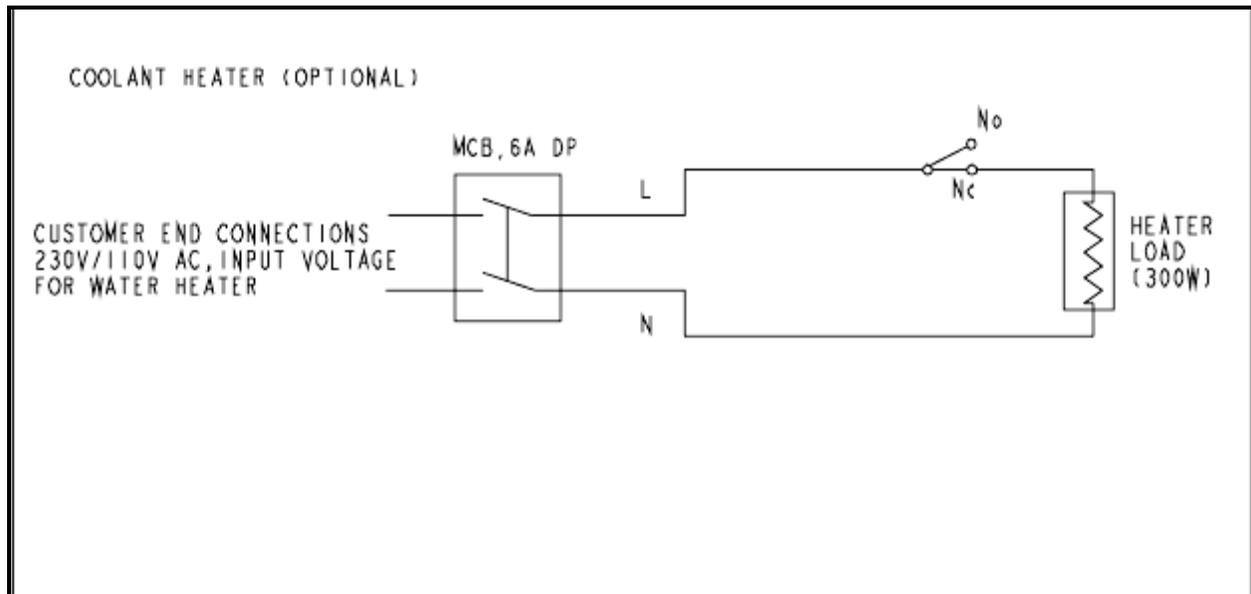
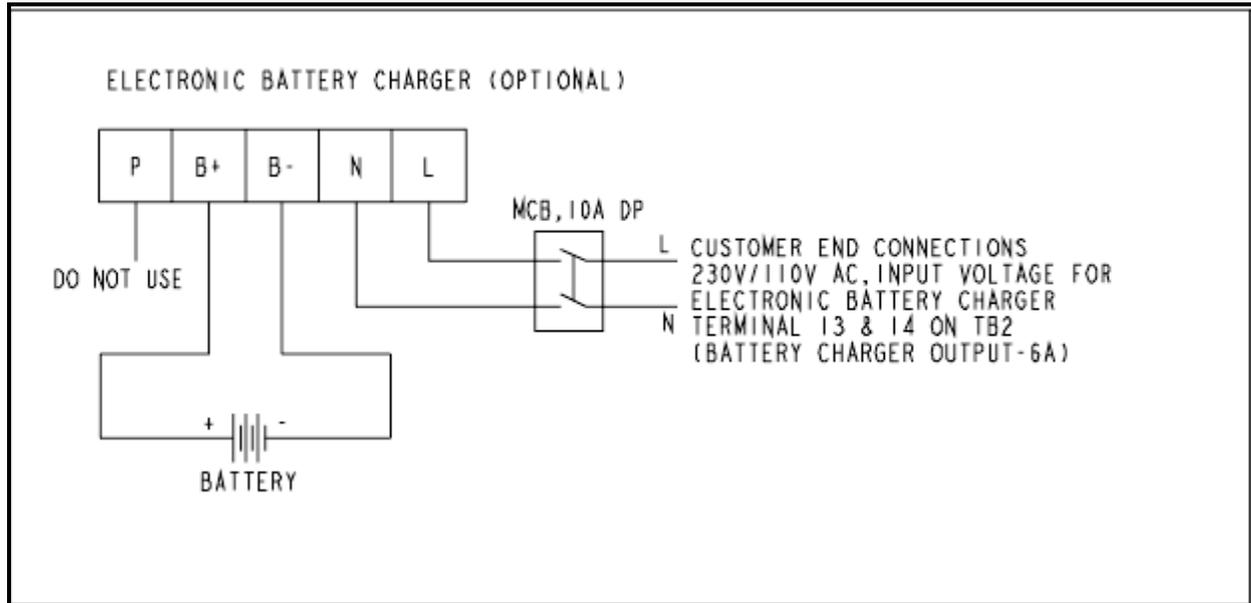
WIRING DIAGRAM

Ref. Drg. 0620-0300 rev1 Sheet 1 (2) :- Single Phase – Mech Governor



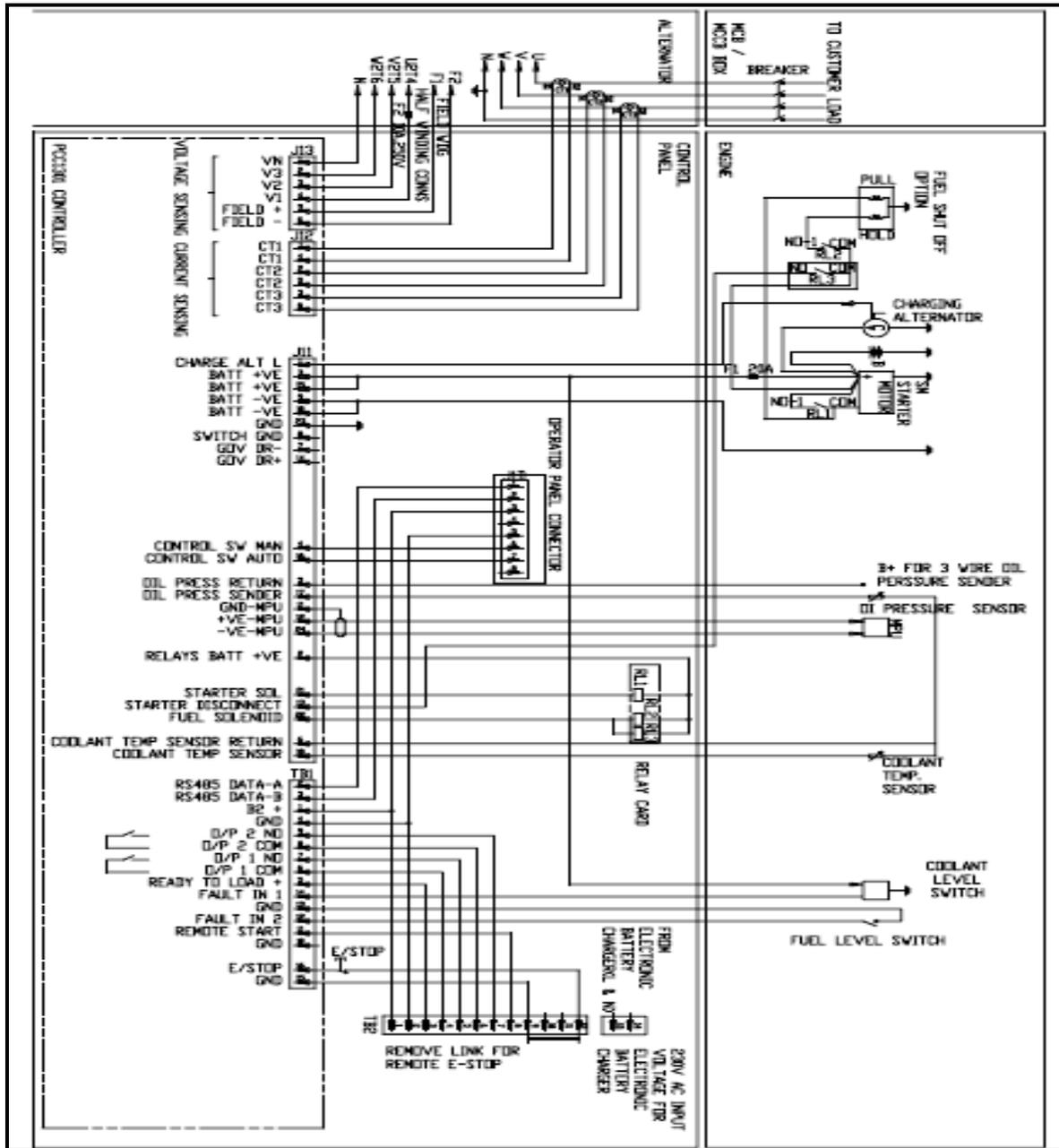
WIRING DIAGRAM

Ref. Drg. 0620-0300 rev1 Sheet 2 (2) :- Single Phase – Mech Governor



WIRING DIAGRAM

Ref Drg 0620-0302 rev1 Sheet 1 (2) :- Three Phase – Mech Governor



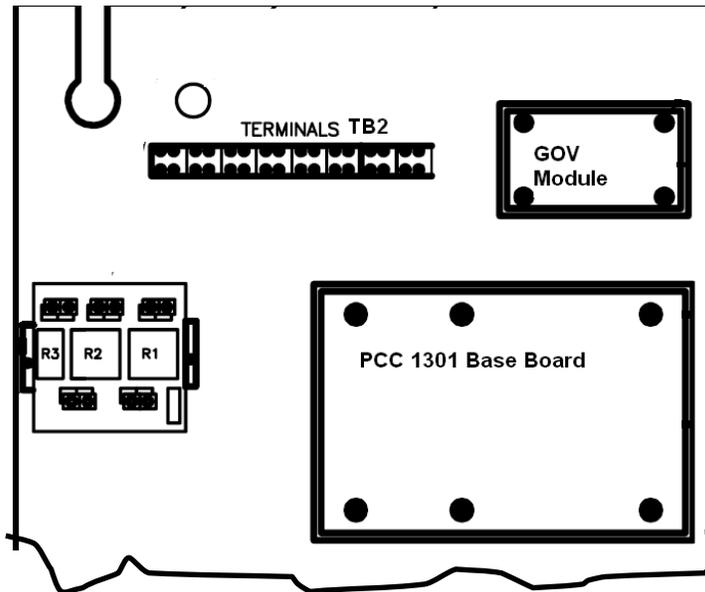
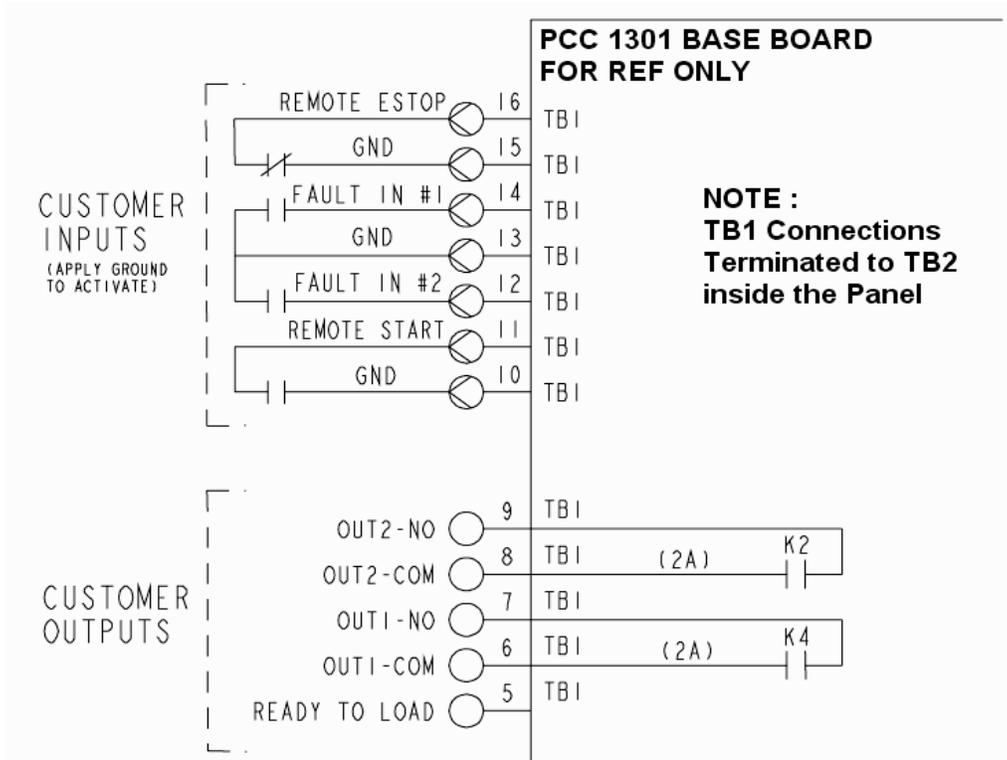
WIRING HARNESS.

Part Nos.

Mechanical Governor with PCC 1301 :- 0338-5018

Electronic Governor with PCC 1301 :- 0338-5116

CUSTOMER CONNECTIONS



Cummins India Limited

Power Generation Business Unit

35 A/1/2, Erandawana,

Pune 411 038 – India

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www.cumminsindia.com

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