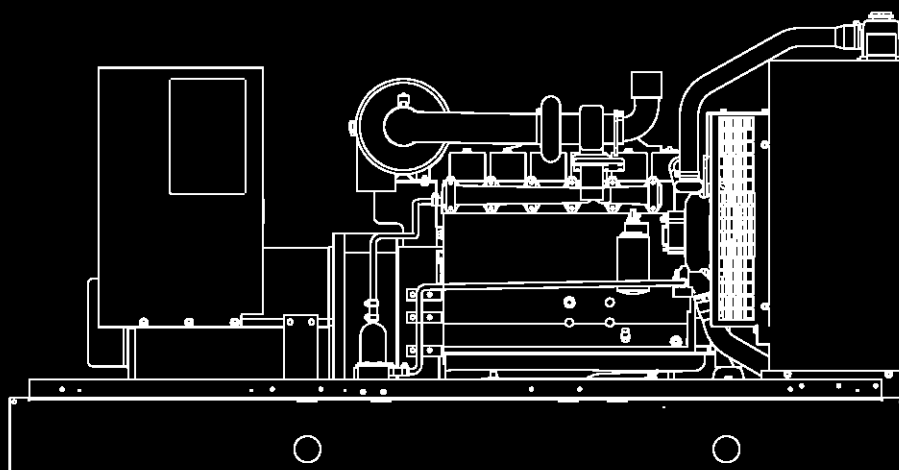


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Service Manual

PowerCommand[®] Control
2100 Series
Generator Sets



Models
DGBB, DGBC, DGCA, DGCB, DGCG, DGDA,
DGDB, DGDK, DGFA, DGFB, DGFC

Table of Contents

SECTION	TITLE	PAGE
	IMPORTANT SAFETY INSTRUCTIONS	iii
1	INTRODUCTION	
	About this Manual	1-1
	System Overview	1-1
	Test Equipment	1-1
	How To Obtain Service	1-1
2	CONTROL OPERATION	
	General	2-1
	Control Panel Power On/Off Modes	2-1
	Front Panel	2-3
	Menu Display and Buttons	2-5
	Main Menus	2-7
	Controller Configuration Menu	2-8
	Engine Menu	2-10
	Alternator Menu	2-12
	Adjust Menu	2-14
	Faults Menu	2-16
	System Menu	2-18
	History Menu	2-20
	About Menu	2-22
	Power Transfer Menu	2-24
3	CIRCUIT BOARDS AND MODULES	
	General	3-1
	Base Board	3-3
4	TROUBLESHOOTING	
	General	4-1
	InPower Service Tool	4-1
	Network Application and Customer Inputs	4-1
	Safety Considerations	4-2
	Troubleshooting Procedure	4-3

SECTION	TITLE	PAGE
5	POWER TRANSFER CONTROL (PTC) TROUBLESHOOTING	
	General	5-1
	PTC Module	5-1
	Sequence of Events	5-1
	Troubleshooting using Fault Codes	5-3
	PTC Fault Code Troubleshooting Procedure	5-3
	Troubleshooting with Symptoms	5-7
	Source 1 Power Fails, But Genset Does Not Start	5-9
	Genset Starts, But Does Not Assume Load	5-11
	PTC Module Does Not Retransfer When Source 1 Utility Power Is Restored After A Power Failure Or On Initial Installation	5-13
	Genset Continues To Run After Retransfer Of Load To S1 Utility	5-15
	Genset Starts During Normal Power Service	5-15
	Generator Test Runs But Genset Does Not Assume Load	5-15
6	CONTROL ADJUSTMENT AND SERVICE	
	General	6-1
	Circuit Board Removal/Replacement	6-2
	Modifying Setup Submenus	6-3
	Password Submenu	6-4
	Crank/Idle Setup Menu	6-6
	Governor/Regulator Setup Menu	6-8
	Power Transfer Setup Menu	6-10
	PCC Control Panel Box Components (Standard/Optional)	6-12
	Engine Sensors	6-16
	Magnetic Speed Pickup Unit (MPU)	6-18
	Current Transformer (CT) Installation	6-19
7	SERVICING THE GENERATOR	
	Testing the Generator	7-1
	Generator/Base Board Isolation Procedure	7-2
	Generator Disassembly	7-10
	Generator Reassembly	7-12
	Servicing the PMG	7-12
8	FUEL TRANSFER PUMP AND CONTROL	
	General	8-1
	Operation	8-2
	Wiring Connections	8-4
	Fuel Transfer Pump Motor Connections	8-6
	Testing the Float Switch Assembly	8-7
9	WIRING DIAGRAMS	
	General	9-1

IMPORTANT SAFETY INSTRUCTIONS

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

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

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

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

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

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

FUEL AND FUMES ARE FLAMMABLE

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

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

EXHAUST GASES ARE DEADLY

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

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

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

GENERAL SAFETY PRECAUTIONS

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

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

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

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

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

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

SYSTEM OVERVIEW

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

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

TEST EQUIPMENT

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

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

HOW TO OBTAIN SERVICE

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

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

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2. Control Operation

GENERAL

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

CONTROL PANEL POWER ON/OFF MODES

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

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

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

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

Sleep/Awake Mode: In the Sleep mode, the control's operating software is inactive and the LEDs

and the digital display on the control panel are all off. Sleep mode is a feature used to reduce battery power consumption when the control is not being used and the O/Manual/Auto switch is in the O position.

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

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

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

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

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

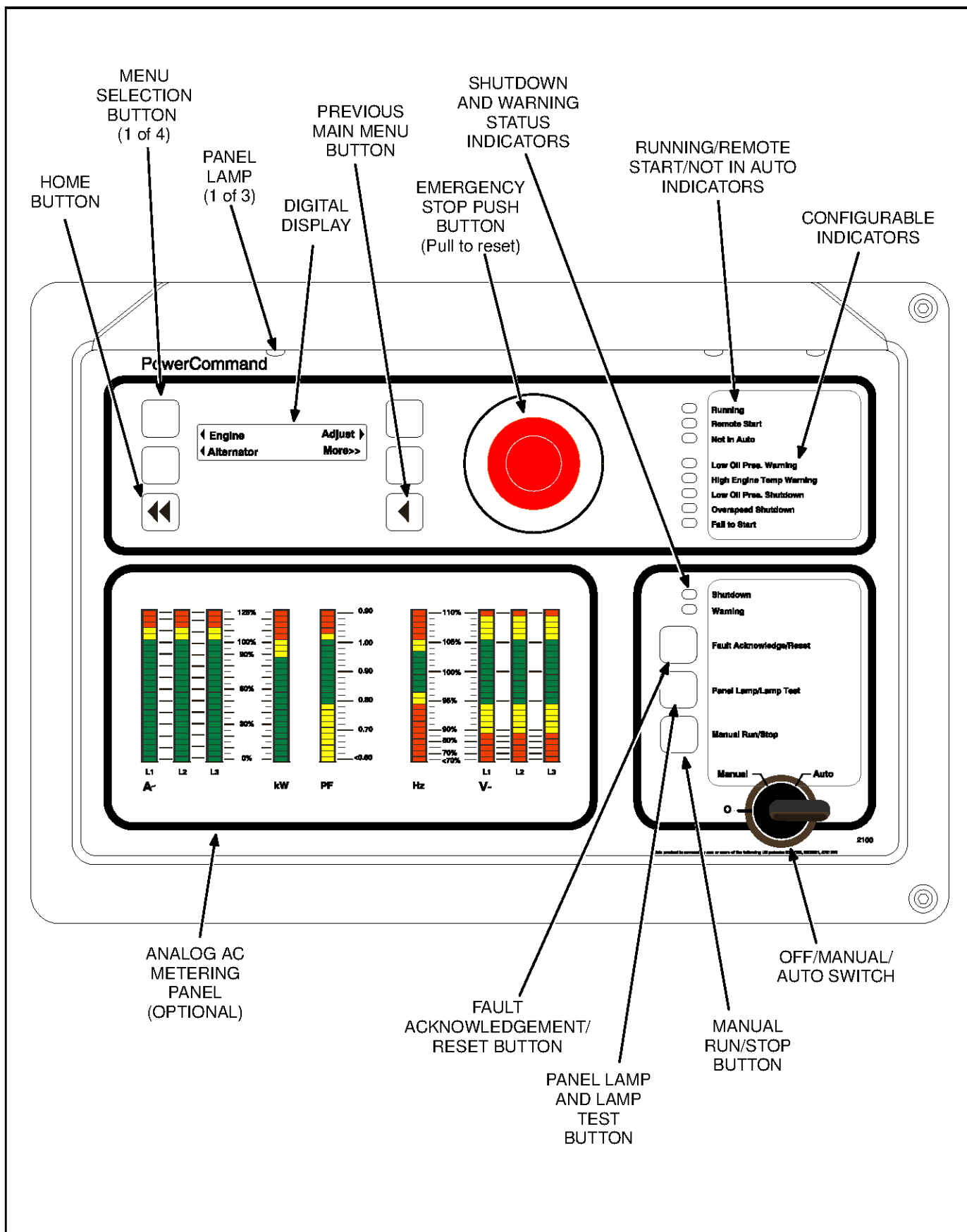


FIGURE 2-1. FRONT PANEL

FRONT PANEL

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

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

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

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

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

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

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

To reset:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Configurable Indicators

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

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

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

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

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

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

MENU DISPLAY AND BUTTONS

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

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

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

- In the digital display for main menus (Figure 2-3), the ◀ and ▶ symbols indicate that pressing the adjacent button causes the operating program to go to the selected submenu (e.g., Engine Menu in Figure 2-5).
 - In the digital display, the More>> symbol indicates that pressing the adjacent button causes the operating program to go to the next main menu, as shown in Figure 2-3.
 - In the digital display, the ↓ or ↑ symbols indicate that pressing the adjacent button causes the operating program to go to the next or previous submenu, as shown in the menu diagrams. Only the ↓ symbol is displayed in the first submenu. Only the ↑ is displayed in the last submenu. Both symbols are displayed in the rest of the submenus.
 - In the digital display, the + or – symbols (+ or –) indicate that pressing the adjacent button can be used to change a parameter or value shown on the display.
- When there is a choice of two parameters, one parameter is associated with the + symbol and the other is associated with the – symbol.
- When changing values, pressing the button adjacent to the + symbol increase the value and pressing the button adjacent to the – symbol decreases the value. Only one numeric character of a field can be changed at a time.
- In the digital display, the → or ← symbol indicates that pressing the adjacent button causes the operating program to move the cursor to the next numeric character. The selected numeric character can then be changed by pressing the buttons adjacent to the + and – symbols. Only the → symbol is displayed when the cursor is on the first character of a field that can be changed. Only the ← is displayed when the cursor is on the last character. Both symbols are displayed when the cursor is on any other character.
 - After adjusting values/parameters, pressing the ▶ symbol results in the changes being saved. **If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.**

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

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

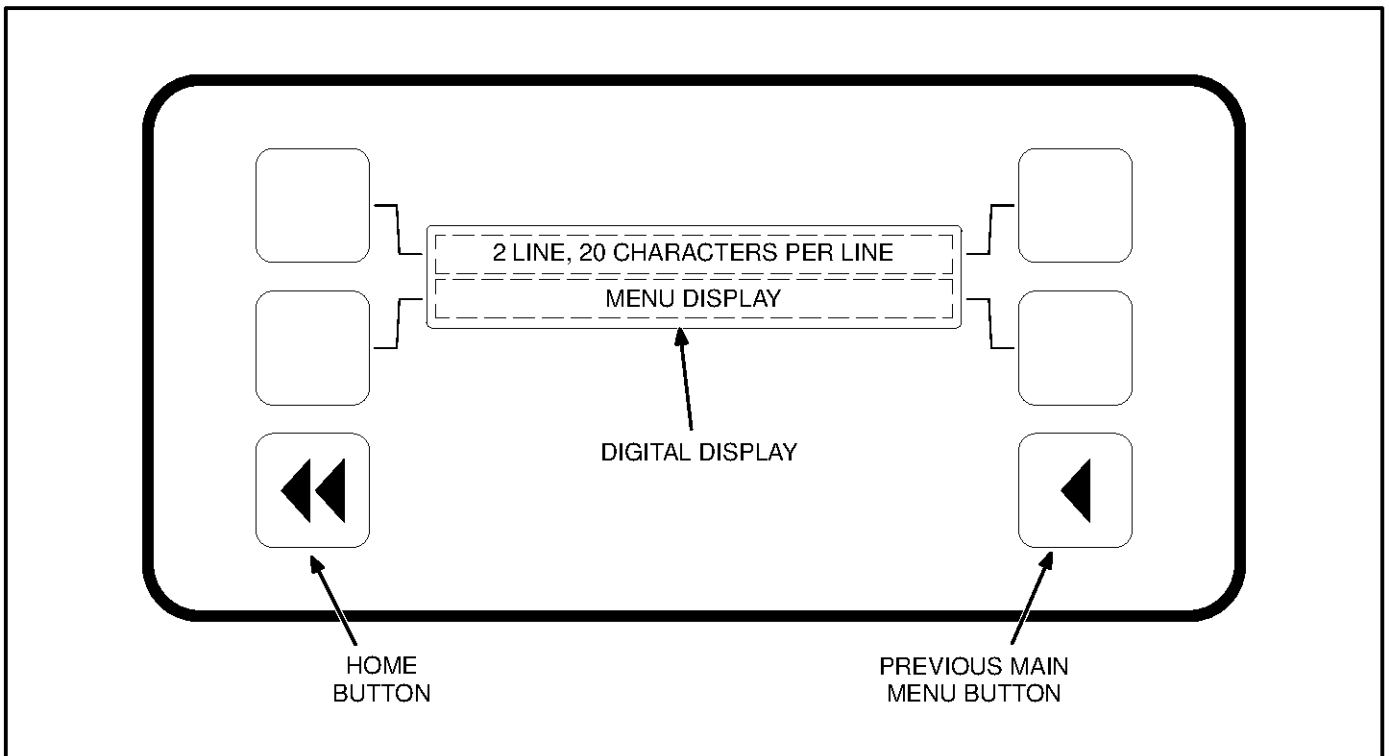


FIGURE 2-2. DIGITAL DISPLAY AND MENU SELECTION BUTTONS

MAIN MENUS

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

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

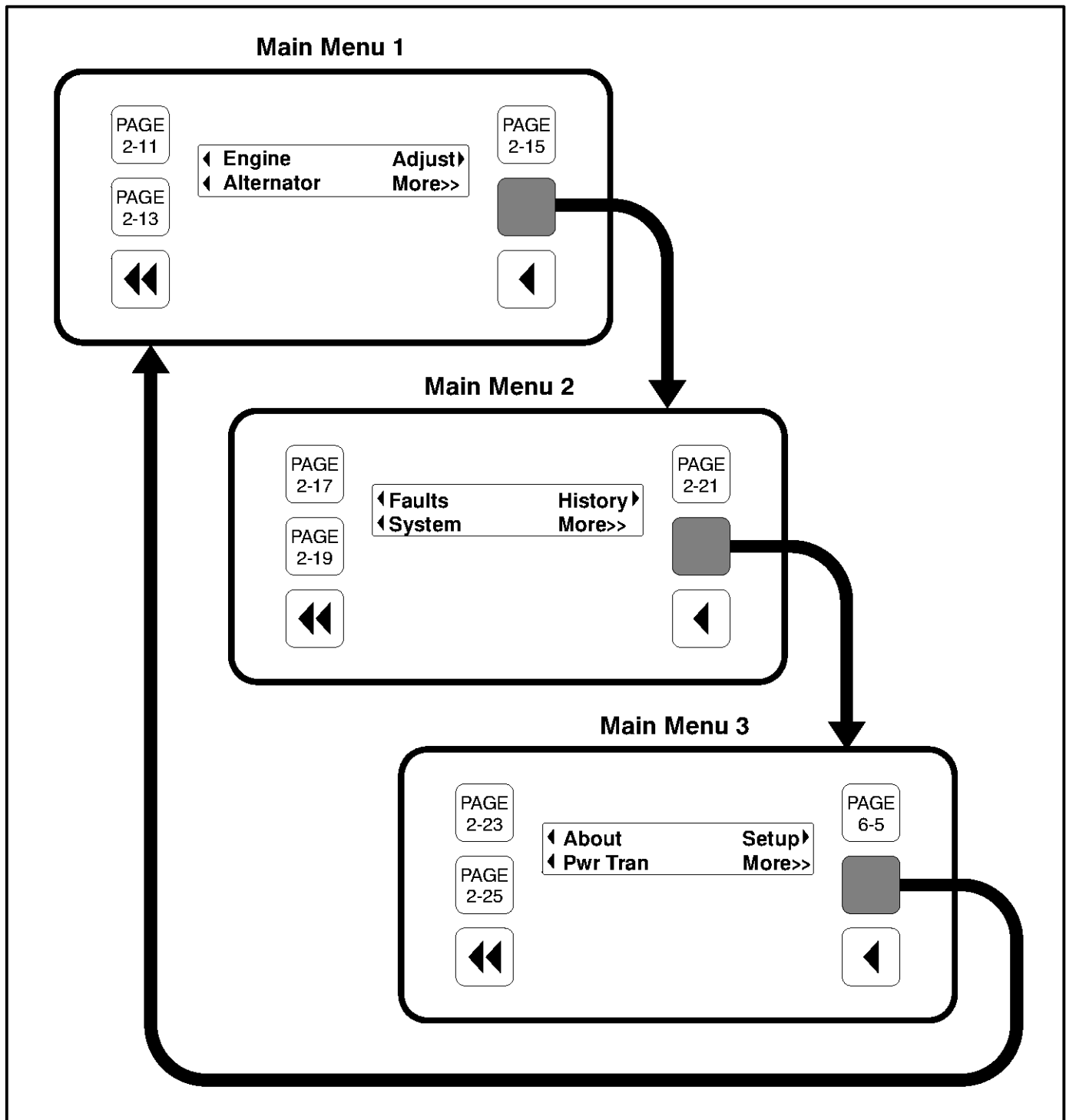


FIGURE 2-3. MAIN MENUS

CONTROLLER CONFIGURATION MENU

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

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

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

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

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

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

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

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

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

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

CONTROLLER CONFIGURATION MENU

Main Menu 1

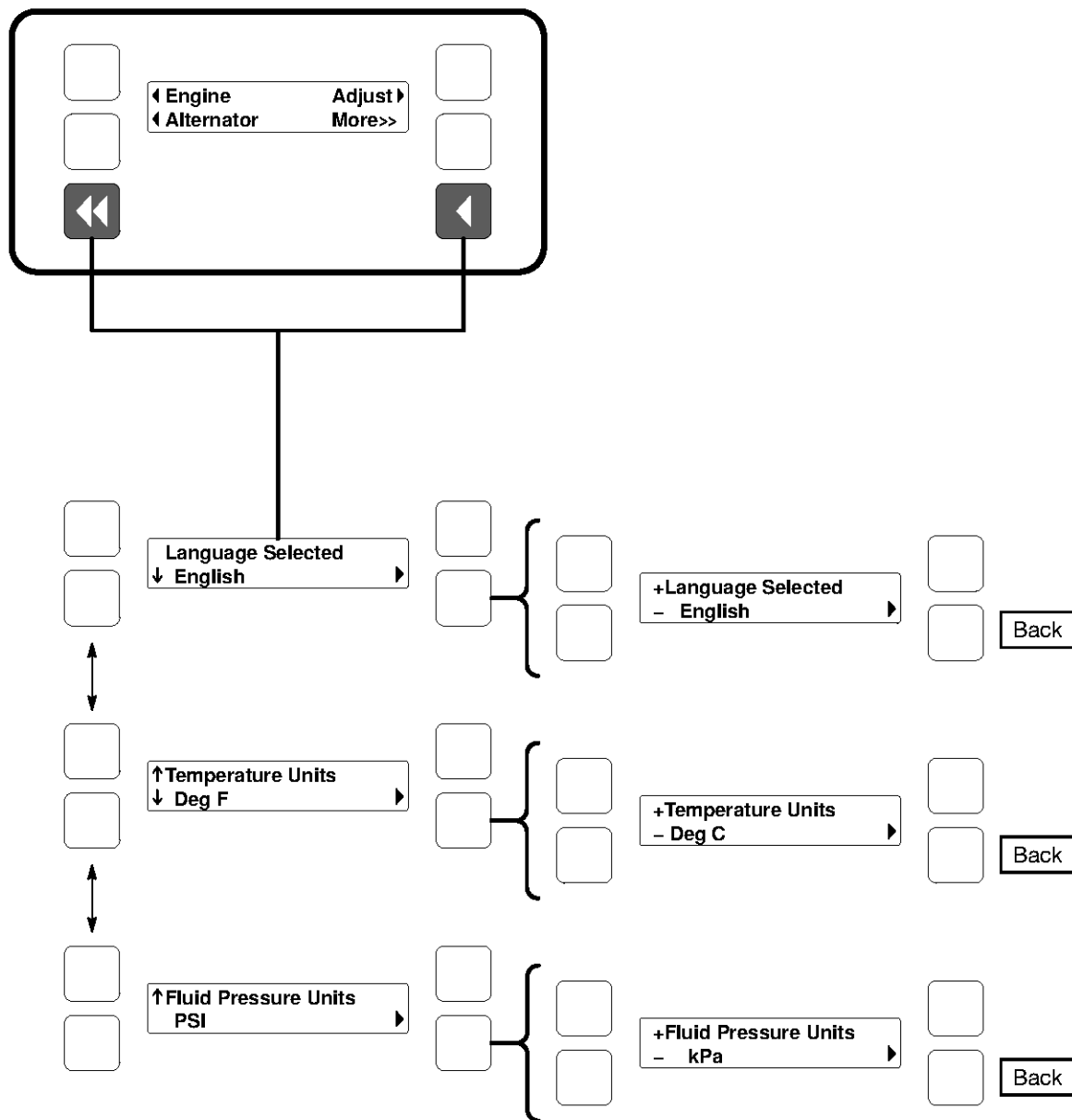


FIGURE 2-4. CONTROLLER CONFIGURATION MENU

ENGINE MENU

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

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

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

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

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

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

Engine Speed submenu: This submenu displays the engine RPM.

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

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

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

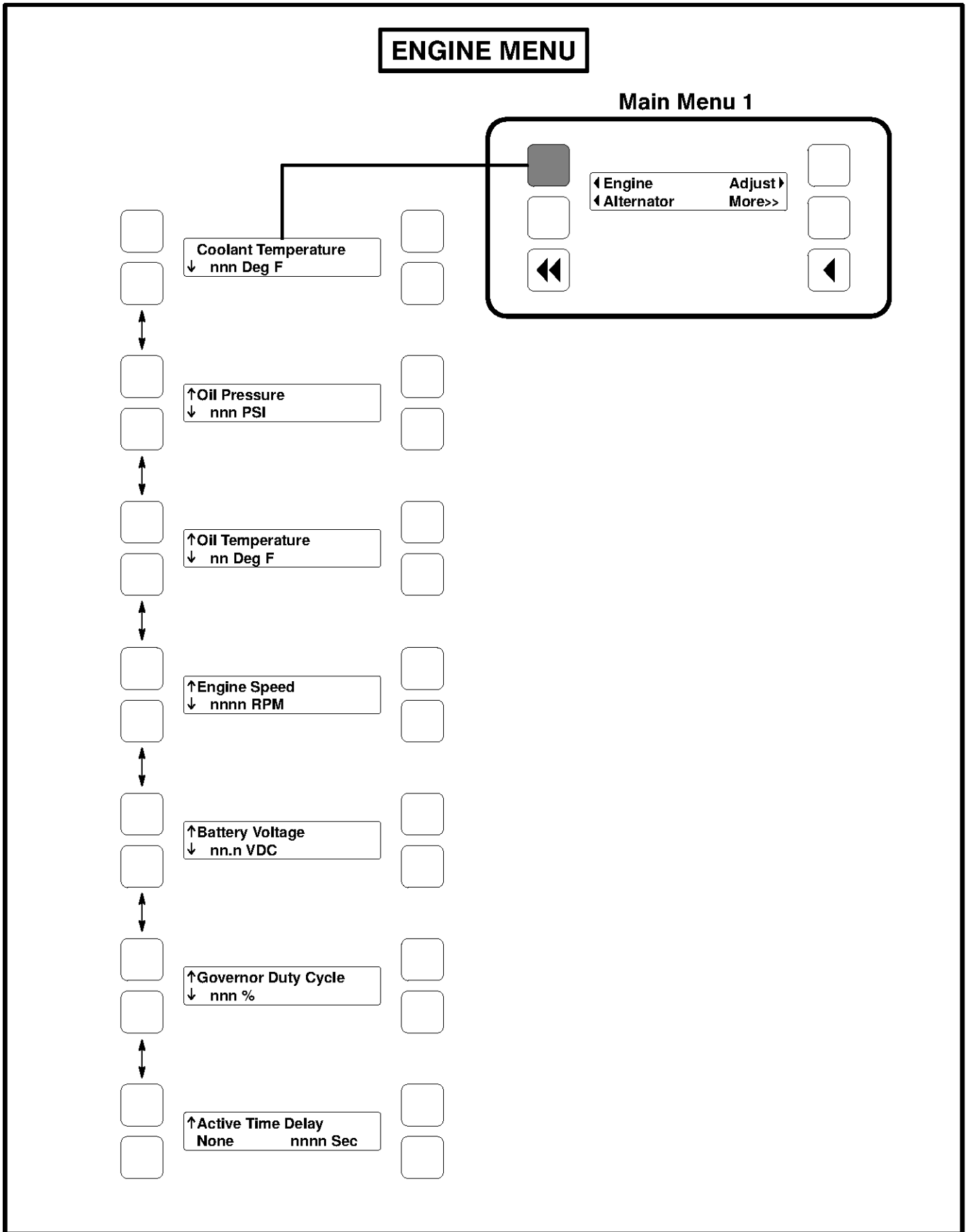


FIGURE 2-5. ENGINE MENU

ALTERNATOR MENU

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

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

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

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

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

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

Frequency submenu: Generator set output frequency.

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

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

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

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

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

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

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

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

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

