

Operator Manual

Our energy working for you.™



with PowerCommand® Control 2100

FOREWORD

The purpose of this manual is to provide the users with sound, general information. It is for guidance and assistance with recommendations for correct and safe procedures. Cummins Power Generation Limited cannot accept any liability whatsoever for problems arising as a result of following recommendations in this manual.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins Power Generation Limited policy of continuous development and improvement, information may change at any time without notice. The users should therefore ensure that before commencing any work, they have the latest information available.

Users are respectfully advised that it is their responsibility to employ competent persons to carry out any installation work in the interests of good practice and safety. Consult your Authorised Distributor for further installation information. It is essential that the utmost care is taken with the application, installation and operation of any diesel engine due to their potentially dangerous nature. Careful reference should also be made to other Cummins Power Generation Limited literature, in particular the Health and Safety Manual (0908-0110-00), and the engine manual.

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Supplementary Publications

The Supplementary Publications appropriate to your system will also be supplied with the system. Where appropriate the corresponding Instruction Manual(s) will also be supplied with any accessory that you order.

Title	Publication No
Lead Acid Battery	0908-0101-00
Radiator Information	0908-0107-00
Health and Safety	0908-0110-00

SCHEDULE OF ABBREVIATIONS

AC	Alternating Current	LED	Light-Emitting Diode
ACB	Air Circuit Breaker	LTP	Limited Time Power Rating
ACH	Anti-Condensation Heaters	LTA	Low Temperature Aftercooling
ATS	Automatic Transfer Switch	LV	Low Voltage
AVR	Automatic Voltage Regulator		
		MCB	Miniature Circuit Breaker
BHP	Brake Horsepower	MCCB	Moulded Case Circuit Breaker
BMS	Building Management System	MF	Mains Failed
BST	Busbar Sensing Transformer	MFSS	Master First Start Sensor
		MR	Mains Returned
CB	Circuit Breaker	MST	Mains Sensing Transformer
CCA	Cold Cranking Amps	MSU	Mains Sensing Unit
CHP	Combined Heat and Power	MV	Medium Voltage
COP	Continuous Power Rating		
CT	Current Transformer	NEC	Neutral Earthing Contact
		PCC2100	PowerCommand® Control 2100
dB(A)	Unit of noise level	PF	Power Factor
DC	Direct Current	PFC	Power Factor Controller
DIP	Dual In-line Package	PLC	Programmable Logic Controller
DMC	Digital Master Control	PMG	Permanent Magnet Generator
DMSU	Demand Load Standby Unit	PRP	Prime Power Rating
		PSU	Power Supply Unit
EMCU	Engine Monitoring and Control Unit	PTC	Power Transfer Control
EMF	Electromotive Force	PT/CT	Potential Transformer / Current Transformer
EPU	Engine Protection Unit		
		QCC	Quadrature Current Control
FSS	First Start Sensor		
		RFI	Radio Frequency Interference
GCP	Generator Control Panel	RMS	Root Mean Square
Genset	Generator Set	RPM	Revolutions Per Minute
GKWT	Global Kilowatt Transducer	RTD	Resistance Temperature Detector
HV	High Voltage	V	Volts
		VAC	Volts, Alternating Current
IC	Integrated Circuit	VCB	Vacuum Circuit Breaker
I/O	Input / Output	VDC	Volts, Direct Current
		VF	Volt-free
kVA	Apparent Power	VT	Voltage Transformer
kVAR	Reactive Power		
kW	Active / Real Power		
kWh	Unit of electrical energy or work		

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SECTION 1 – PRELIMINARY AND SAFETY

1 Safety

1.1 Warning, Caution and Note Styles Used In This Manual

The following safety styles found throughout this manual indicate potentially hazardous conditions to the operator, service personnel or the equipment.

WARNING: WARNS OF A HAZARD THAT MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

Caution: Warns of a hazard or an unsafe practice that can result in product or property damage.

Note: A short piece of text giving information that augments the current text.

1.2 General Information

This manual should form part of the documentation package supplied by Cummins Power Generation Limited with specific generator sets. In the event that this manual has been supplied in isolation please refer to other Cummins Power Generation Limited literature, in particular the Health and Safety Manual (0908-0110-00) and the engine manual relevant to your generator set.

Note: It is in the user's interest to read and understand all Health and Safety information together with all Warnings and Cautions contained within the documentation relevant to the generator set and its operation and maintenance.

1.3 Generator Plant Safety Code

Before operating the generator set, read the Health and Safety manual (0908-0110-00) and the engine manual, and become familiar with them 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.

WARNING: IMPROPER OPERATION AND MAINTENANCE CAN LEAD TO SEVERE PERSONAL INJURY OR LOSS OF LIFE AND PROPERTY BY FIRE, ELECTROCUTION, MECHANICAL BREAKDOWN OR EXHAUST GAS ASPHYXIATION. READ AND FOLLOW ALL SAFETY PRECAUTIONS, WARNINGS AND CAUTIONS THROUGHOUT THIS MANUAL AND THE HEALTH AND SAFETY MANUAL 0908-0110-00.

WARNING: LIFTING AND REPOSITIONING ON THE GENERATOR SET MUST ONLY BE CARRIED OUT USING SUITABLE LIFTING EQUIPMENT, SHACKLES AND SPREADER BARS IN ACCORDANCE WITH LOCAL GUIDELINES AND LEGISLATION BY SUITABLY TRAINED AND EXPERIENCED PERSONNEL. INCORRECT LIFTING CAN RESULT IN SEVERE PERSONAL INJURY, DEATH AND/OR EQUIPMENT DAMAGE. FOR MORE INFORMATION CONTACT YOUR AUTHORISED DISTRIBUTOR.

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SECTION 2 - INTRODUCTION

2 Introduction

2.1 General

Before any attempt is made to operate the generator set, the user should take time to read this manual and to familiarise him or herself with the Warnings and Operating Procedures.

A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The manual includes a maintenance schedule and a troubleshooting guide.

The engine manual is included with the set. Where there is conflicting information, this manual takes precedence over the engine manual.

2.2 Generating Set Identification

Each generating set is provided with a Generating Set Rating Plate as shown below. This provides information unique to the generator.

Model No. C80 D5

Serial No. I03K357450

IMPORTANT !
Model & Serial No. Required When Ordering Parts.

Cummins

Power Generation

Manston Park, Columbus Avenue,
Ramsgate, Kent. England. CT12 5BF

Made in the United Kingdom

YEAR OF MANUFACTURE	2003
RATED POWER	STANDBY
RATED (kW)	64
RATED (kVA)	80
POWER FACTOR	0.8
RATED CURRENT (A)	115
VOLTAGE	400
FREQUENCY (Hz)	50
ROTATING SPEED (RPM)	1500
BATTERY VOLTS	12
GENSET MAX MASS (kg)	1217
CONTROL SYSTEM	PCC2100
ALTITUDE REFERENCE	150mASL
AMBIENT TEMPERATURE REFERENCE	27°C
CUSTOMER CARE REFERENCE	DGCC

OPTIONS:

KAC01

KEX06

R029

H074

KBC01

H536

B240

A322

H670

D041

E074

H643

KEX01

KMC02

A356

KN60

KPB01

KPB02

KM66

Figure 2-1 Typical Generator Set Rating Plate

2.3 After Sales Services

We offer a full range of after sales services as follows:

2.3.1 Maintenance

WARNING: INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

For customers who wish to have their generator sets expertly serviced at regular intervals the Customer Service Department offers a complete maintenance contract package. This covers all items subject to routine maintenance and includes a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing assistance 365 days a year if necessary. Specialist engineers are available to maintain optimum performance levels from customer's generator sets, and it is recommended that maintenance tasks are only undertaken by trained and experienced engineers provided by the Customer Service Department.

2.3.2 Warranty

All generator sets have a twelve months warranty from the commissioning date as standard. Extended warranty coverage is also available. In the event of a breakdown prompt assistance can normally be given by factory trained service engineers with facilities to undertake all minor and many major repairs to equipment on site.

For further warranty details contact your authorised distributor.

2.3.3 Spares

An extensive Spare Parts Department is available for any emergency breakdown and for the engineer who carries out his own routine maintenance.

Please quote Plant Nos., Serial Nos., and Part Nos. when ordering spares.

2.3.4 Overseas

Agents and representatives in almost 100 countries throughout the world offer installation and after sales service for the equipment provided. We can provide the name and address of the agent for your specific location.

For details on any of the above services contact your distributor.

2.3.5 Additional Literature

Should you require further, more detailed information regarding the engine or alternator please contact your authorised distributor.

Please quote Plant Nos. and Serial Nos.

SECTION 3 – SYSTEM DESCRIPTION

3 System Description

3.1 Generator Components

The main components of a typical Generator System (C40 to C250 systems) are shown below and referred to within this section. Refer to the engine manual for location of other components.

Various options are listed although they may not be available for all models.

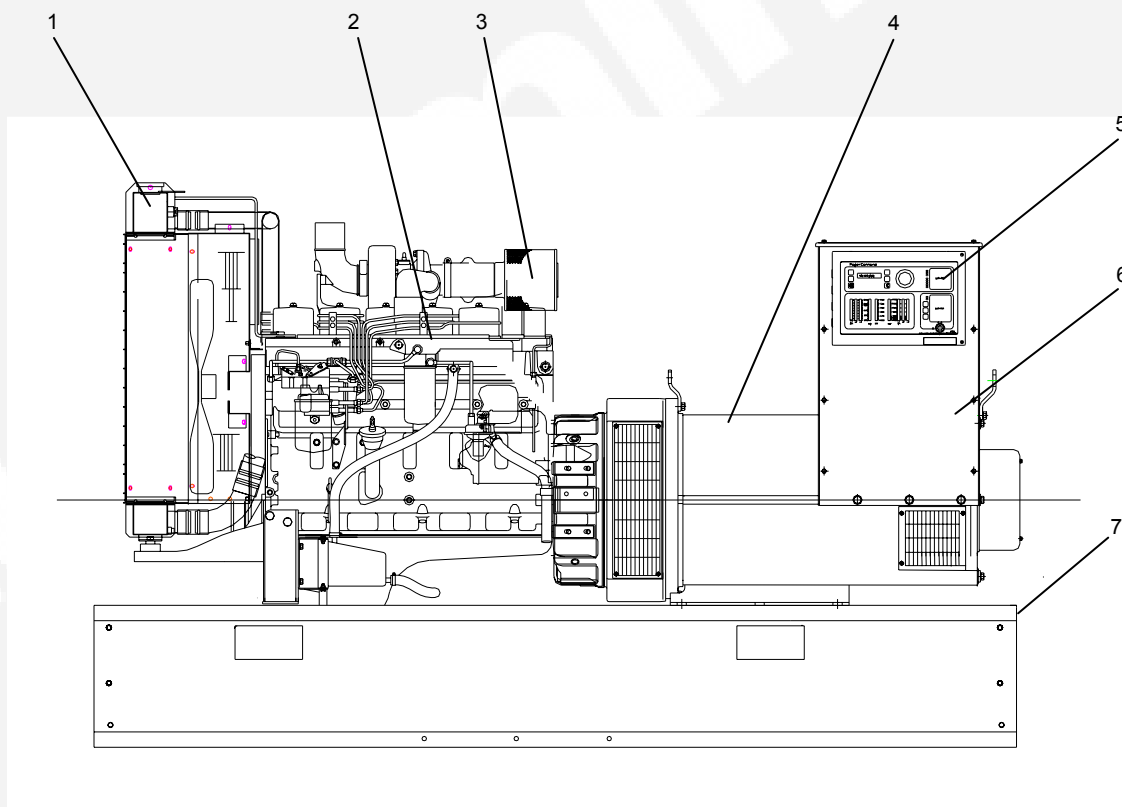


Figure 3-1 Typical Generator Set (C40 to C250)

KEY

1. Radiator
2. Engine
3. Air Cleaner
4. Alternator
5. Control Panel
6. Control Housing
7. Bed Frame

OPTIONS

- Batteries and Tray
- Circuit Breaker Entrance Box
- Electric Fuel Transfer Pump
- Engine Coolant Heater
- Sump Drain Pump

3.1.1 AC Supply and Isolation

It is the sole responsibility of the Customer to provide the AC power supply and the means to isolate the AC input to the terminal box. Refer to the wiring diagram supplied with the generator set.

Note: A separate disconnecting device is required by BS EN 12601:2001.

WARNING: THE DISCONNECTING DEVICE IS NOT PROVIDED AS PART OF THE GENERATOR SET, AND CUMMINS POWER GENERATION LIMITED ACCEPTS NO RESPONSIBILITY FOR PROVIDING THE MEANS OF ISOLATION.

3.1.2 Alternator

All generator types use AC alternators of a brushless, rotating field design, which eliminates the maintenance associated with slip rings and brushes. Refer to the Generating Set Rating Plate for alternator type and rating details.

For further information please contact your authorised distributor.

3.1.3 Control System

The PCC2100 is a microprocessor-based control for generator sets. It provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring. The control also monitors the health of the engine, alternator and auxiliary systems continuously, and will affect an Automatic Shutdown if a serious fault occurs.

The main control panel and its associated equipment are located in the Control Housing, which is at the rear of the generator set. See Figure 3-1.

3.1.4 Emergency Stop Button

The Emergency Stop Button is situated centrally in the upper half of the Control Panel. Push this button in for an Emergency Shutdown of the engine. If the engine is not running, pushing the button in will prevent the starting of the engine, regardless of the start signal source (Manual or Auto-remote).

To reset:

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

Caution: Do not use an emergency stop control for a normal shutdown. When an emergency stop is initiated all generator set load is dumped immediately, and the engine is stopped without a cooling down run.

3.1.5 Engine

All generators employ a 4-stroke, water-cooled engine and incorporate a governor control and full engine protection system. Refer to the Generating Set Rating Plate for engine type and rating details.

For further information refer to the engine manual supplied with this generator set.

3.1.6 Generator Rating

For details of your generator rating refer to the Generating Set Rating Plate.

Refer to Section 5.4 for operation at temperatures or altitudes above those stated on the Rating Plate.

3.1.7 Generator Construction

Generator sets are constructed as a single module with the engine and alternator connected through a coupling chamber with resilient mountings to form one unit. The engine and alternator are mounted on a bedframe on resilient mountings. This results in one unit of immense strength and rigidity, with accurate alignment between the engine and alternator, and effective damping of engine vibration.

3.2 Fuel System

A moulded, plastic base fuel tank is provided as standard on the C40 to C250 range, although a steel base fuel tank can be provided as an option. The tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eight hours operation at a nominal 100% load.

Free standing main tanks with stands providing 450, 900 and 1350 litre capacity are available as options.

Note: *Where spillage containment is not part of Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water course/sources.*

3.2.1 Fuel/Water Separators

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system where water-free fuel supplies cannot be guaranteed.

3.3 Cooling System

The engine cooling system consists of a radiator and pusher fan, mechanically driven water pump and a thermostat. The fan drives air through the radiator and removes surface heat from the engine and alternator. The alternator has its own internal cooling fan.

3.4 Engine Exhaust (Option)

Exhaust systems, which are optional and supplied in loose form, reduce engine noise to acceptable levels and pipe exhaust gases to an area where they will not present a hazard. Industrial and residential types are available as options. Flexible bellows are also available as an option.

WARNING:	EXHAUST PIPES AND CHARGE AIR PIPES ARE HOT AND THEY CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM DIRECT CONTACT OR FROM FIRE HAZARD.
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3.5 DC Electrical System

A 12 or 24 volt battery system (determined by generator type) provides multi-attempt engine starting and DC power for the generator control system.

3.5.1 DC Power

The PCC2100 system is powered by the generator set's battery system. The control system will function over a voltage range between 8 and 34VDC.

3.5.2 Battery System

Battery type, size and voltage are selected to suit the generator capacity and application on ordering.

3.5.3 Charge Alternator

An engine driven charge alternator is provided as standard to maintain the battery in a charged condition when the engine is running.

3.5.4 Mains Powered Battery Charger (Option)

Two styles of mains powered battery chargers are available to maintain the battery in a charged condition when the generator set is not running. One style is wall mounted, and the other is set mounted within the Bed Frame or within the Control Housing dependent on the generator set configuration. Refer to manuals 0908-0102-00 for the wall mounted style, or 0908-0109-00 for the built-in option.

3.6 Sensors / Senders

Various generator set parameters are measured by sensors, senders, RTDs etc. and the resulting signals are applied to the PCC2100.

Engine-mounted sensors are able to monitor the following systems:

- Fuel Options
- Lube Oil Pressure
- Cooling System Temperature and Level
- Miscellaneous Areas

Alternator-mounted sensors are able to monitor the following parameter (option):

- Winding Temps

3.7 Alarm Module (Option)

The Alarm Module provides audible warnings. The front panel has a warning horn, two indicator lights and one spring-loaded push-switch. The two indicator lights, Alarm and Horn Silenced, show respectively that the horn has been activated and that the adjacent Push-to-Silence-Horn push-switch has been pressed.

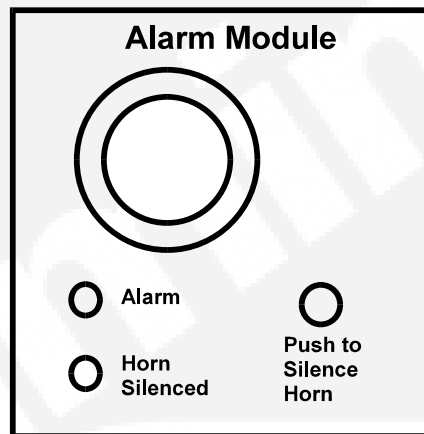


Figure 3-2

Typical Alarm Module Front Panel

3.8 Heaters

Caution: *Heater(s) must not be energised if the coolant system has been drained.*

3.8.1 Heater Supply and Isolation

A heater supply is required for operation of the engine and alternator heaters. See Section 3.1.1.

A separate disconnecting device is required by BS EN 12601:2001.

Note: *This disconnecting device is not provided as part of the generator set.*

Note: *It is the sole responsibility of the Customer to provide the power supply and the means to isolate the AC input to the terminal box. Cummins Power Generation Limited accepts no responsibility for providing the means of isolation.*

WARNING: THE AC SUPPLY TO THE TERMINAL BOX MUST BE ISOLATED BEFORE ATTEMPTING TO GAIN ACCESS TO THE TERMINAL BOX.

3.8.2 Engine Heater (Option)

The engine heater is designed to keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine, reducing start-up time and engine wear caused by cold starts. The heater is controlled by an associated thermostat, but is locked out at engine start.

WARNING: ALWAYS ISOLATE THE SUPPLY TO THE ENGINE HEATER / THERMOSTAT BEFORE CARRYING OUT ANY MAINTENANCE ON THE ENGINE. USING THE CUSTOMER'S DISCONNECTING DEVICE, ALWAYS ISOLATE THE GENERATOR SET PRIOR TO ANY MAINTENANCE.

Caution: *The engine heater is in no way intended to protect the engine and cooling system from freezing in sub zero conditions. If there is any danger from freezing, then a suitable antifreeze agent must be added to the cooling system.*

3.8.3 Alternator Heater (Option)

The alternator heater is designed to keep the alternator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within the alternator, which can result in insulation degradation, leading to failure and a possible shock hazard. The heater is locked out at engine start.

WARNING: ALWAYS ISOLATE THE ALTERNATOR HEATER FROM THE AC SUPPLY BEFORE WORKING ON THE ALTERNATOR OR HEATER.

3.8.4 Control Panel Heater (Option)

The control panel heater provides a means of humidity/temperature control within the control box interior. It protects the components and ensures their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use. The heater is locked out at engine start.

WARNING: ALWAYS ISOLATE THE CONTROL PANEL HEATER FROM THE AC SUPPLY BEFORE WORKING ON THE CONTROL PANEL OR HEATER.

3.9 Communications Network (Option)

The PCC2100 system includes a Generator Control Module (GCM) which provides for communications over the PCC2100 Communications Network. The network is suitable for local or remote control and monitoring functions using PCC Software for Windows™.

3.10 Remote Start / Stop Scheduling (Option)

PCC2100 Software for Windows™ provides for remote monitoring of the generator set, or set of generator sets, using a laptop PC. The software provides detailed information on the status of the generator sets and their associated accessories.

A remote access, single-site version of PCC2100 is provided for each site. Alternatively, one remote access, multi-site version of PCC2100 can be provided for a host monitoring computer.

3.11 Earth Fault (Option)

The Earth Fault option, which employs an earth fault unit, is designed to detect current flow in the neutral earth and provide a Shutdown alarm on the detection of an earth fault.

A separate Earth Fault Reset button is provided on the control housing to allow resetting of an earth fault alarm. The resulting Shutdown indication on the control unit must be reset, using the Reset membrane switch on the front panel - see Section 4.3.

3.12 Circuit Breakers and Change-over Contactors

3.12.1 Circuit Breakers (Option)

All generator sets can be equipped with optional, mechanically operated, 3 or 4-pole circuit breakers (MCCBs), mounted in the Load Terminal Box. The circuit breaker is used to isolate the generator set output from the load.

Up to 1250 amp generator rating circuit breakers are installed in a set-mounted load box which is close coupled to the alternator output terminal box. Customer cables are fed to the circuit breaker via a bottom or side exit gland plate.

Above 1250 amp generator rating circuit breakers are installed in a free-standing enclosure. With this arrangement the control panel remains set-mounted using resilient mountings to reduce vibration.

3.12.2 Change-over Panel (Option)

Change-over panels, fitted with either 3 or 4-pole contactors, are available as options.

Up to 1250 amp generator rating change-over panels are wall mounted.

Above 1250 amp generator rating change-over panels are free standing.

3.13 Starting Control System

The PCC2100 uses a multi-function control system, which integrates fuel ramping and field excitation to minimise frequency and voltage overshoot, and to limit black smoke emission on starting. Used with electronically governed generator sets, this control system includes the following functions:

1. **Fuel Ramping** - Upon receiving the Start signal, the digital control system energises the engine fuel system sufficiently to allow the engine to start. When the control system senses that the engine has reached start disconnect speed, it gradually increases fuel flow to ramp up engine speed, for controlled acceleration up to rated operating conditions. This minimises black smoke emission and frequency overshoot, as well as improving cold starting capability.
2. **Fail to Crank** - As the Start signal is initiated, the control system checks the speed monitoring pick-up to check that the engine is rotating. If the engine is not rotating, the control system switches off the starter and then makes two further start attempts. If the final attempt fails, a Shutdown message is signalled on the alphanumeric display and the generator set cannot be started until the fault is cleared. This process helps prevent starter or ring gear damage.
3. **Temperature Dynamic Governing** - A temperature dynamic adjustment capability enhances cold starting ability, and improves stability when the engine is cold starting, by automatically adjusting governing characteristics based on engine temperature. It also helps limit black smoke emission on cold starting.
4. **Digital Excitation Control** - The generator set voltage regulation system is 3-phase sensing and includes torque matching to provide enhanced load pick-up capability. During starting, the control system ramps output voltage to rated value to minimise voltage overshoot.
5. **Cycle Cranking** - The PCC2100 system includes a standard cycle cranking system, which allows the operator to select continuous or cycle cranking mode. The operator can select between one and seven cranking cycles, and adjust the crank/rest times between seven and twenty seconds. The standard setting is three cranking cycles, with fifteen seconds crank duration followed by fifteen seconds rest.
6. **Battery Monitoring System** - The PCC2100 system continuously monitors the battery charging system for low and high DC voltage. Functions and messages include:
 - **Low DC voltage** - battery voltage less than 24VDC for 24V battery (12VDC for 12V battery).
 - **High DC voltage** - battery voltage greater than 32VDC for 24V battery (16VDC for 12V battery).
 - **Weak battery** - main battery droop is monitored at start-up and, if the voltage drops below 60% of nominal for more than two seconds, the indication will be given.

Note: *On generator sets that are mechanically governed the Fuel Ramping, and Temperature Dynamic Governing aspects are not applicable.*

3.13.1 Customer Connections

Customer connections to the PCC2100 are made in the control housing. Connections are made via large, clearly labelled, terminal blocks.

3.13.2 Output Contacts

The PCC2100 provides control, alarm and status output signals, which are used to energise/de-energise associated relays. The relays are located within the control panel and contacts are provided for customer use. Signals are provided for the following relays, which are all rated at 2A, 30VDC:

- **Common Warning alarm**
- **Common Shutdown alarm**
- **Ready to load** - Operates when the generator set reaches 90% of rated voltage and frequency.
- **Not in Auto**

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SECTION 4 – CONTROL SYSTEM

4 Control System

4.1 Control System Description

This manual covers the PowerCommand® Control 2100 (PCC2100) control module for single generator sets. All indicators, control switches/buttons and digital display are located on the face of the control panel as illustrated in Figure 4–1.

The main control panel and its associated equipment are located in the Control Housing, which is mounted at the rear of the generator set. A Load Terminal Box may be mounted on either the left or right side of the housing, as required for the site.

The PCC2100 is a microprocessor-based control for generator sets. It provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring. The control also monitors the health of the engine, alternator and auxiliary systems continuously, and will affect an Automatic Shutdown if a serious fault occurs.

The PCC2100 operates in conjunction with an array of sensors and senders located on the engine, alternator and auxiliary systems. Data is passed between components over a digital data link.

An important function of the control system is to continuously monitor the generator set for faults. If a fault occurs during engine running, the control will provide an indication for the operator and, if the fault is serious, affect an automatic, fully programmed, shutdown. There are two fault level signals generated by the PCC2100. These two fault levels are:

1. **Warning:** signals an imminent or non-critical engine fault. The PCC2100 provides an indication only for this condition.
2. **Shutdown:** signals a potentially critical fault for the engine. The PCC2100 will automatically take the engine off-load and shut it down immediately, without a cool-down run.

The control systems operate on 12 or 24VDC battery power. Data backup is taken care of by a small rechargeable battery installed within the PCC2100 enclosure. Auxiliary equipment operates on LV AC power.

4.2 Control Mode Definitions

The following Control Mode Definitions are used in this manual:

Control Mode	Definition	Initiating Condition / Reset	Generator Set Load
Normal Stop	A stop initiated manually during normal generator set running.	Stop with PCC2100 Manual Stop button. Manually reset any alarm at PCC2100 before restart.	Auto ramping down of load before stopping.
Alarm	Alarm condition with alarm indication.	Non critical alarm condition. Alarm reset at PCC2100.	Loading maintained.
Immediate Shutdown	Critical alarm condition with immediate engine stop. Alarm indication.	Critical alarm condition. Switch off & manually reset at PCC2100 before restart.	All of load dumped with immediate engine shutdown.
Lockout	Engine inhibited from starting with alarm indication.	Start inhibit due to critical fault condition. Reset at PCC2100 when alarm condition is clear.	Load previously removed. Engine stopped.

Table 4-1

Control Mode Definitions

4.2.1 Control Panel 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 running or not 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 PCC2100 (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 Off (O) position.

The Sleep mode is activated when all conditions are met (i.e., no unacknowledged faults, Screen Saver Mode is active, and O/Manual/Auto switch is in the Off (O) position).

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

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

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

Note: *The InPower service tool is required to enable or disable the Sleep mode. When shipped from the factory, Sleep mode is disabled. When disabled, the operating software will always remain active (Awake mode). If network and/or Power Transfer Control (PTC) feature is installed, the sleep mode is not available. The InPower service tool is required to select the desired mode. Contact an authorised service centre for assistance.*

4.2.2 Battle Short Mode (Optional)

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

The Battle Short mode prevents the generator set from being shutdown by all but a few select, critical shutdown faults.

Note: *All Shutdown faults, including those overridden by Battle Short, must be acted upon immediately to ensure the safety and well being of the operator and the generator set.*

WARNING: USE OF THIS FEATURE CAN CAUSE A FIRE OR ELECTRICAL HAZARD, RESULTING IN SEVERE PERSONAL INJURY OR DEATH, AND/OR PROPERTY AND EQUIPMENT DAMAGE. OPERATION OF THE GENERATOR SET MUST BE SUPERVISED DURING BATTLE SHORT MODE OPERATION.

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

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

With Battle Short mode enabled and an overridden shutdown fault occurs, the Shutdown fault is announced but the generator set does not shut down, and the fault code **1416 – Fail to Shut Down** is displayed. The Fault Acknowledgement/Reset button will clear the fault message, but will remain in the Fault/History file with an asterisk sign (* equals active fault) as long as Battle Short mode is enabled.

Battle Short is suspended and a shutdown occurs immediately if:

- Any of the following critical shutdown faults occurs:
 - ❖ Speed Signal Lost Fault code 121
 - ❖ Overspeed Fault code 234
 - ❖ Emergency Stop Fault code 1433
 - ❖ Remote Emergency Stop Fault code 1434
 - ❖ Excitation Fault Fault code 2335
- Moving the Customer installed Battle Short switch to Off with an active, but overridden, shutdown fault or a shutdown fault that was overridden at any time. (Fault code **1123 – Shutdown After Battle Short** will be displayed for this type of shutdown).

A qualified service personnel is required to enable this feature. When shipped from the factory, this feature is disabled. An external switch (Customer supplied), which connects to one of the four Customer Inputs, is used by the operator to switch the generator set in/out of Battle Short mode.

Note: *The software for the Battle Short feature must be installed at the factory or ordered and installed by an authorised service representative. When installed, the InPower service tool is required to enable the Battle Short mode feature and to configure a Customer Input for external switch control (On/Off) of the Battle Short mode. Contact an authorised service centre for assistance.*

4.3 Control Panel

The main control panel for the generator set forms the front panel of a PCC2100 enclosure.

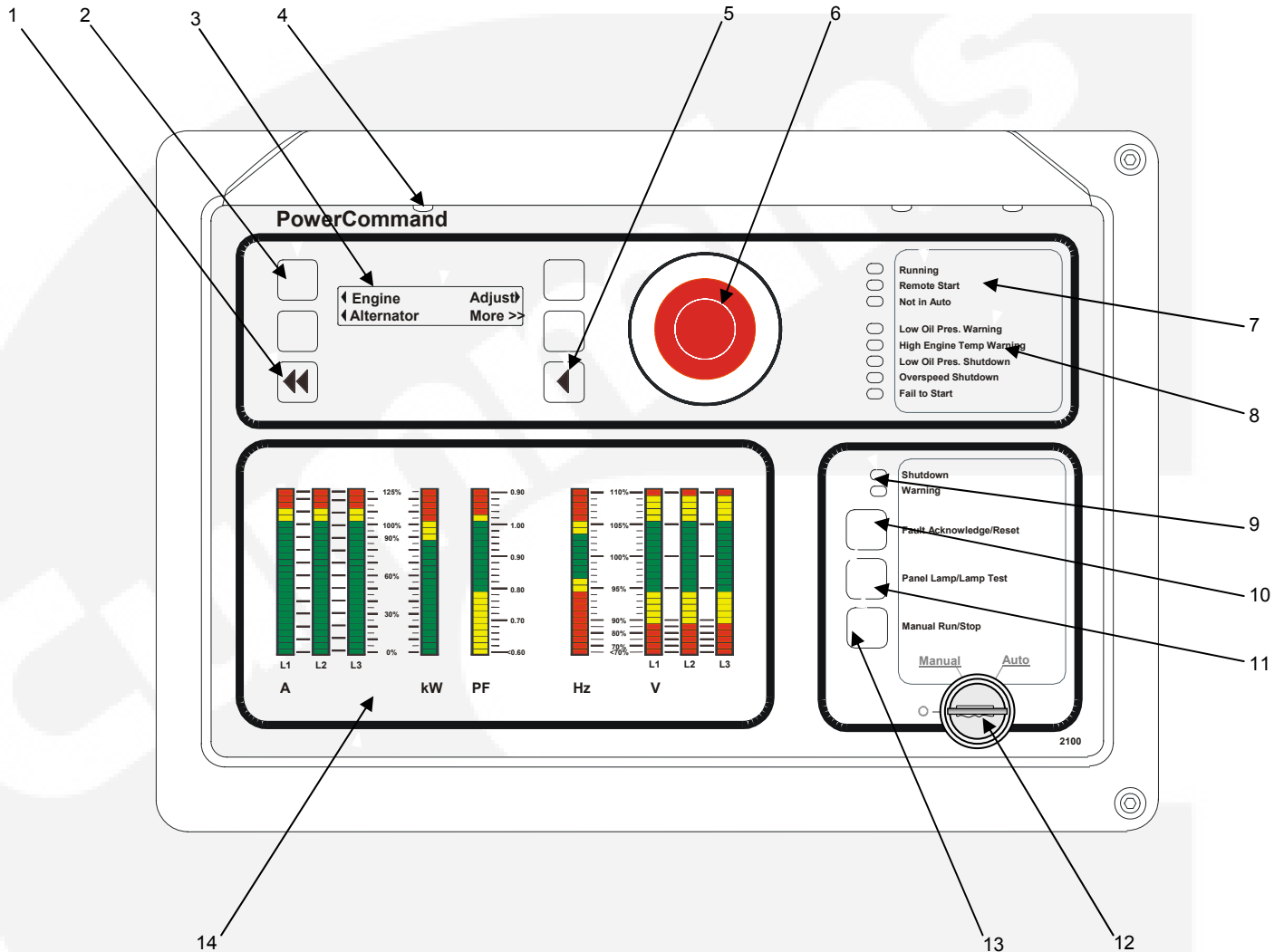




Figure 4-1

Front Panel

- | | |
|--|--|
| 1. Home Button | 8. Configurable Indicators |
| 2. Menu Selection Button (1 of 4) | 9. Shutdown & Warning Status Indicators |
| 3. Digital Display | 10. Fault Acknowledgement/Reset Button |
| 4. Panel Lamp (1 of 3) | 11. Panel Lamp & Lamp Test Button |
| 5. Previous Main Menu Button | 12. O/Manual/Auto Key Switch (Mode Switch) |
| 6. Emergency Stop Push Button | 13. Manual Run/Stop Button |
| 7. Running/Remote Start/Not in Auto Indicators | 14. Analog AC Metering Panel (Optional) |

Front Panel Switches and Indicators

1. **Home Button:-** At any time, press this button  to return the display to the Main Menu 1 (also referred to as the Home Menu). Refer to the menu trees later in this section.
2. **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 →), chevron (>>), 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 manual.
3. **Digital Display:-** This two line; 20 characters per line; alphanumeric display, is used to view the menus of the menu-driven operating system. Refer to the menu trees later in this manual. The display is also used to show Warning and Shutdown messages.
4. **Panel Lamp:-** Three in number, providing illumination of the unit.
5. **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 manual.

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

6. **Emergency Stop Button:-** Push this button in for an 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:

- Pull, or pull and twist, the Emergency Stop to unlatch it.
- Turn the O/Manual/Auto switch to Off (O).
- Press the front panel Fault Acknowledge/Reset button.
- Select Manual or Auto, as required.

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

7. **Indicators:-Running:-** This green lamp is lit whenever the generator set (local or remote) is running.

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

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

8. **Configurable Indicators:-** The following configurable indicators (default values shown) can be changed with the InPower service tool. Contact an authorised service centre for assistance.

The configurable items are:

- Change generator event
- Change the LED colour (green, yellow or red)
- Change the enable/disable indicator.

The default settings are as follows:-

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

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

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

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

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

9. Status Indicators:- Shutdown - 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 has been corrected, Shutdown indicators can be reset by turning the O/Manual/Auto switch to the Off (O) position and pressing the Fault Acknowledge/Reset button.

Warning - This yellow lamp is lit whenever the control detects a warning condition. After the condition has been corrected, Warning indicators can be reset by pressing the Fault Acknowledge/Reset button. (The majority of faults can be reset without stopping the generator set). In Auto mode, Warning indicators can also be reset by cycling the remote reset input after the condition has been corrected.

This lamp is also lit when Battle Short mode is enabled and an overridden shutdown fault occurs.

Note: *Some warnings remain active after the condition has been corrected and the control reset button has been pressed. This will require the generator set to be shutdown to reset the Warning indicator.*

10. 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 Off (O) position.

11. Panel Lamp and Lamp Test Button:- Press this button to turn the control panel lamps on or off. The lights will shut off after approximately ten minutes. Press and hold this button to test all front panel LEDs and meters. The meters will light one bar at a time. (Test can be enabled during generator set operation).

12. O/Manual/Auto Key Switch:-

Manual position enables the use of the Manual Run/Stop button.

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

Off (O) position prevents the starting of the generator set (local or remote). If the switch is set to Off (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.

13. Manual Run/Stop Button:- This button starts and stops the generator 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.

14. Analog AC Metering Panel (Optional):- This panel simultaneously displays (in percent of generator set 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)

4.4 Menu Display and Buttons

Figure 4–2 shows the digital display and the menu selection buttons.

4.4.1 Digital Display

The two–line, 20-characters per line, digital display is used in the menu-driven operating system, in conjunction with the Menu Selection switches and the Menu switch. Refer to the menu trees later in this section. The display is also used to show fault messages.

4.4.2 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.

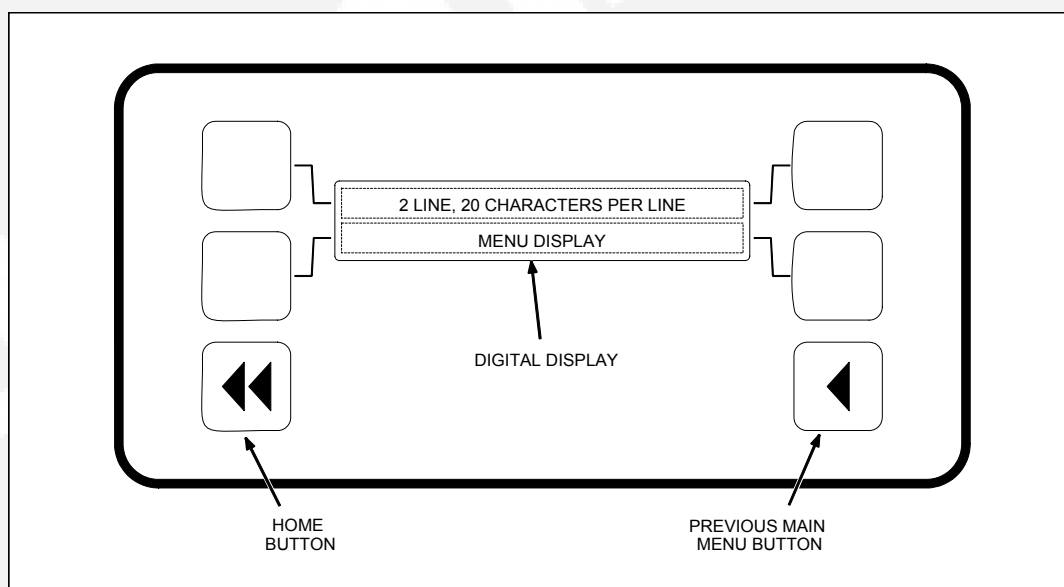


Figure 4-2 Digital Display and Menu Selection Buttons

- In the digital display for the Main Menu (Figure 4–3), 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 4–6).
- 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 4–3.
- 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 remaining submenus.
- In the digital display, the plus or minus symbols (+ or -) indicate that pressing the adjacent button can be used to change a parameter or value shown on the display. When there is a choice of two parameters, one parameter is associated with the + symbol and the other is associated with the - symbol. When changing values, pressing the button adjacent to the + symbol will increase the value and pressing the button adjacent to the - symbol will decrease the value. Only one numeric character of a field can be changed at a time.

- In the digital display, the → or ← symbols indicate 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 the remaining characters.
- After adjusting values/parameters, pressing the ► symbol results in the changes being saved.

Note: *If the Home button or Previous Main Menu button is pressed before pressing the ► symbol, the changes will not be saved.*

4.4.3 Home Button

Press this button to view the operating system to show Main Menu 1 (Figure 4–3) in the digital display.

4.4.4 Previous Main Menu Button

Press this button to view the previous Main Menu in the digital display. All main menus include both types of green triangles (◀ and ►).

4.5 Main Menu

Figure 4–3 shows the three main menus available to the user. When viewing a submenu, pressing the Previous Main Menu button, at any time, will enable you 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.

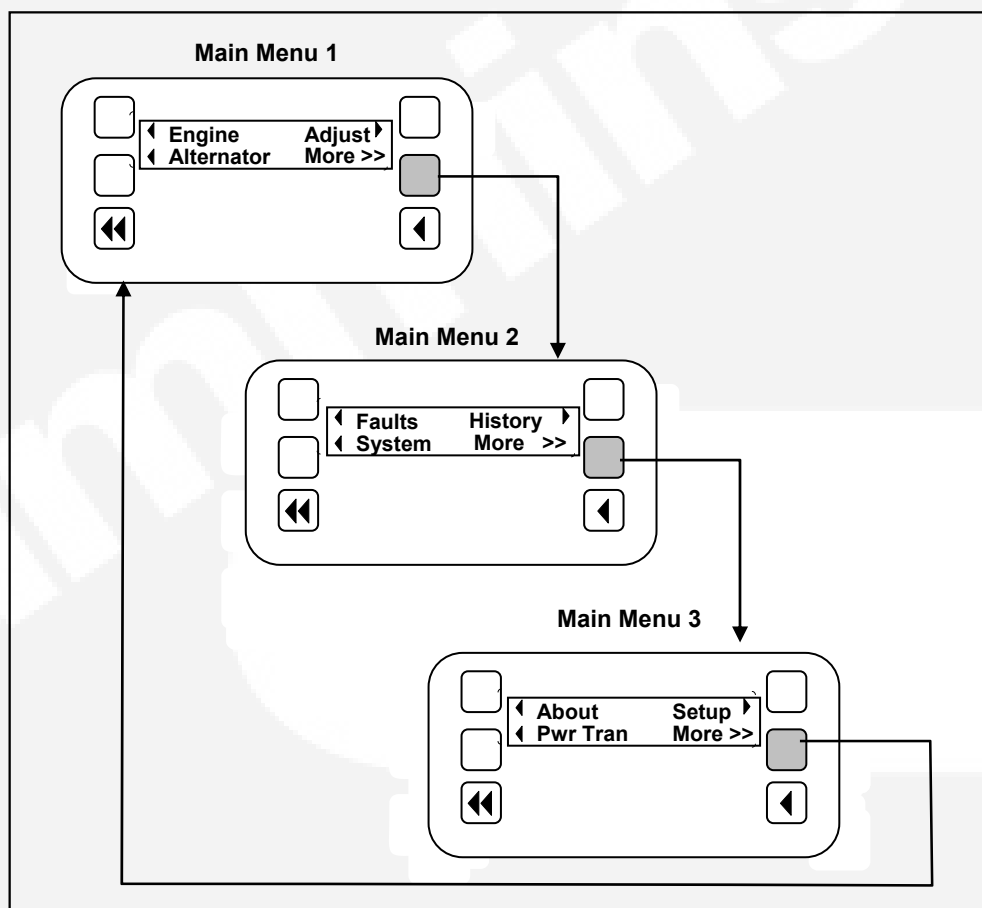


Figure 4-3 Main Menu

4.5.1 Main Menu 1

Main Menu 1 is also the Home menu. When viewing any of the other Main menus or any submenu, pressing the Home button will reveal this menu.

Press the button next to the word Engine in the display to view the engine parameters, such as coolant temperature; oil pressure; oil temperature, etc. Refer to the Engine menu Figure 4–6.

Press the button next to the word Alternator in the display to view alternator parameters, such as line-to-line voltage; line-to-neutral voltage; amperage; frequency, etc. Refer to the Alternator menu Figure 4–7.

Press the button next to the word Adjust in the display to view the adjust generator parameters, such as idle start; voltage; frequency; start delay; and stop delay. Refer to the Adjust menu Figure 4–8.

Press the button next to More >> in the display to view one of the other Main menus.

4.5.2 Main Menu 2

Press the button next to the word Faults in the display to view the System Faults information. Up to twenty of the most recent/current faults can be displayed. Refer to the Faults menu Figure 4–10.

Press the button next to the word System in the display to view network system parameters, such as the Automatic Transfer Switch (ATS); Master, or Generator set system. Refer to the System menu Figure 4–11.

Press the button next to the word History in the display to view historical engine parameters such as number of starts; engine hours; control hours; kilowatt hours; and generator set duty cycle. Refer to the History menu Figure 4–12.

Press the button next to More >> in the display to view one of the other Main menus.

4.5.3 Main Menu 3

Press the button next to the word About in the display to view parameters on the generator, such as model; standby rating; and software version. Refer to the About menu Figure 4–13.

Press the button next to the words Pwr Tran in the display to view power transfer parameters, such as source power; frequency; generator; utility; and active transfer timer. Refer to the Power Transfer Menu Figure 4–14.

Main Menu 3 also includes a link to the Setup menus. These menus can be viewed but changes to these menus are restricted to service personnel with the appropriate access code.

Press the button next to More >> in the display to view one of the other Main menus.

4.6 Adjusting Default Settings

The Controller Configuration Menu can be used to adjust the following default settings:

- Language - Select from available loaded languages
- Temperature Units - Fahrenheit or Centigrade
- Pressure Units - kPA or PSI

For more information on adjusting these settings, refer to the Controller Configuration menu Figure 4–5.

4.7 System Messages

A system message pop-up screen is displayed when the event it is displaying becomes active. These pop-up screens remain displayed until pre-empted by another pop-up screen or until any display button is pressed. Once a button is pressed, the previous menu is redisplayed. To return to an active pop-up screen from the previous menu, select the following menu:

- **Engine** to redisplay Time Delay Idle
- **Faults** to redisplay Faults
- **Power Transfer** to redisplay PTC Timer

Pop-up screens are displayed for the following:

- Time Delay - Start, Stop, and Idle
- Faults
- Power Transfer Control timer

An example of a Time Delay Idle pop-up screen is shown in Figure 4–4. A countdown, in seconds, is included in the display.

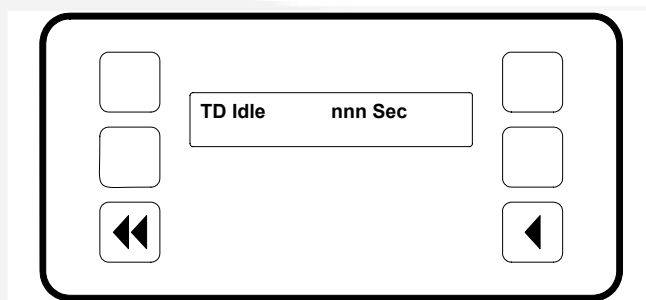


Figure 4-4

Time Delay Idle Pop-Up Screen

4.8 Controller Configuration Menu

Figure 4–5 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 the menus.

To view the first Controller Configuration menu, ensure 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:

1. **Language Selected:** This submenu is used to select desired language (default is English).
2. **Temperature Units:** This submenu is used to select Fahrenheit or Centigrade for temperature readings.
3. **Pressure Units:** This submenu is used to select PSI or kPA for pressure readings.

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 the desired option, pressing the ► symbol results in the changes being saved.

Note: *If the Home button or Previous Main Menu button is pressed before pressing the ► symbol, the changes will not be saved.*

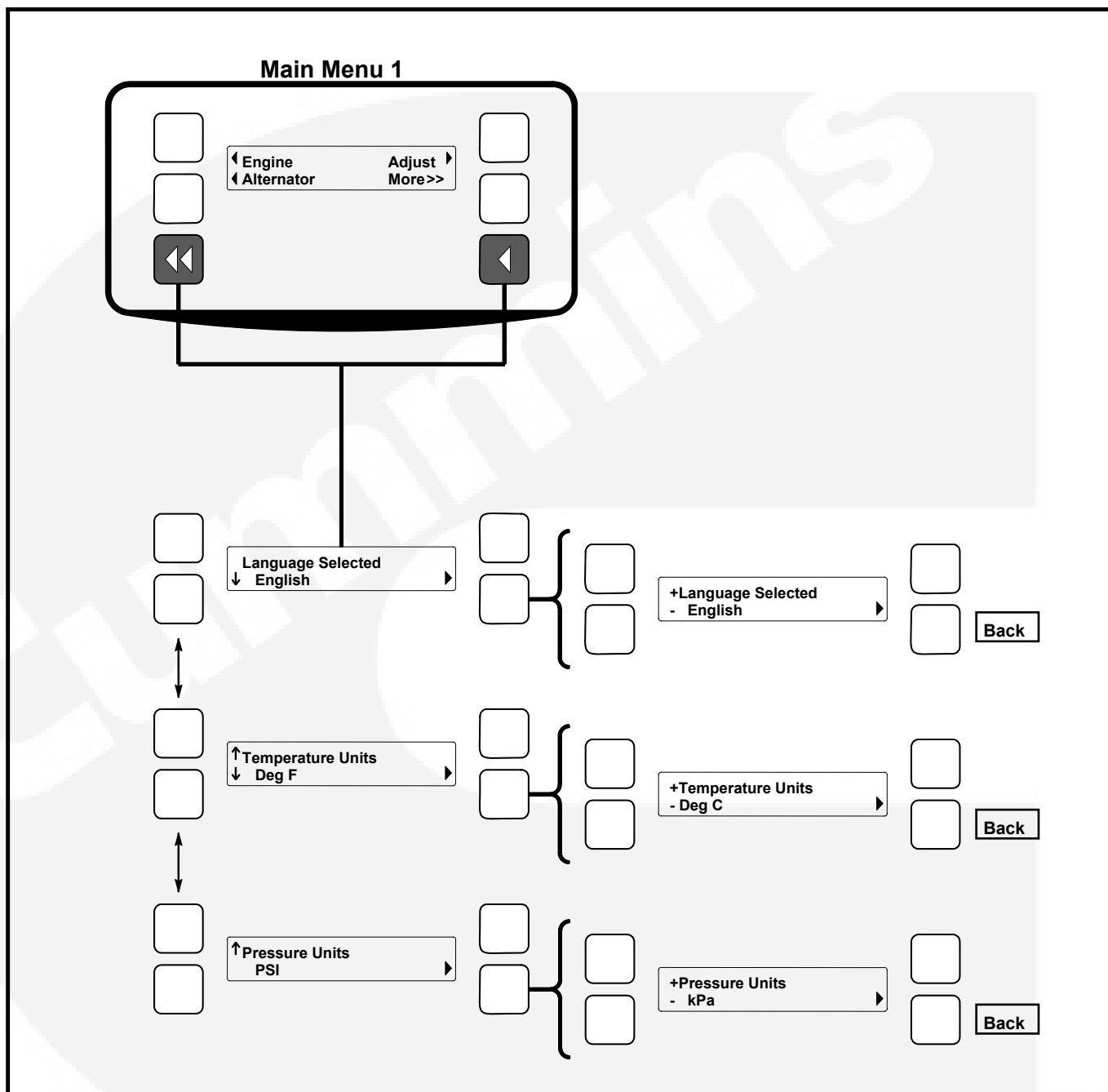


Figure 4-5 Controller Configuration Menu

4.9 Engine Menu

Figure 4–6 shows a block representation of the Engine menu.. Press the button next to the word Engine in the display to view the first Engine submenu.

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.

1. **Coolant Temperature:** This submenu displays the engine coolant temperature which can be viewed in degrees Fahrenheit or Centigrade (see Controller Configuration Menu Figure 4-5 in this section).
2. **Oil Pressure:** This submenu displays the engine oil pressure which can be viewed in PSI or kPA (see Controller Configuration Menu Figure 4-5 in this section).
3. **Oil Temperature (only available on QSX15 models):** This submenu displays the engine oil temperature which can be viewed in degrees Fahrenheit or Centigrade (see Controller Configuration Menu Figure 4-5 in this section).
4. **Engine Speed:** This submenu displays the engine RPM.
5. **Battery Voltage:** This submenu displays the engine battery voltage.
6. **Governor Duty Cycle:** This submenu displays the governor duty cycle (drive) levels in percentage of maximum.
7. **Active Time Delay:** This submenu displays the time delay that is currently active: warm-up, cool down, start or stop delays.

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.

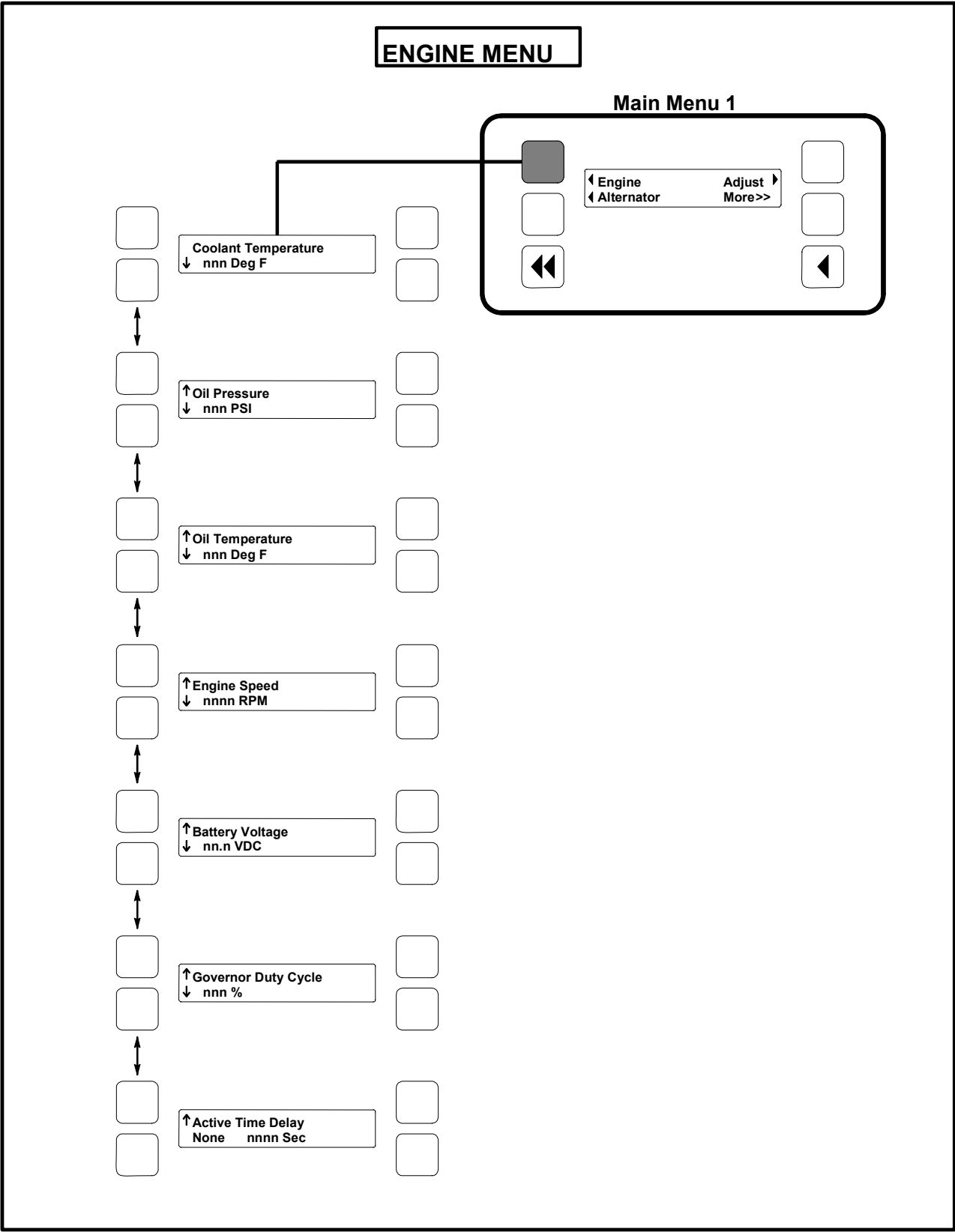


Figure 4-6 Engine Menu (excluding the C450 to C550 range [QXSX15 with CAN Link])

4.10 Alternator Menu

Figure 4–7 shows a block representation of the Alternator menu. Pressing the button next to the word Alternator in the display causes the first Alternator submenu to be displayed.

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

1. **Line-to-Line Voltage:** The voltages Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively. (Single phase - L1 and L2 only).
2. **Line-to-Neutral Voltage:** Note that the Line-to-Neutral menu will not be displayed for a 3-phase/3-wire system. Single phase – L1 to N and L2 to N.
3. **Amps:** All phases. (Single phase - L1 and L2 only).
4. **Frequency:** Generator set output frequency.
5. **Total Real Power:** This submenu displays the total amount of real power output, in kilowatts (kW).
6. **Real Power:** This submenu displays the amount of real power output for L1, L2, and L3, in kilowatts (kW). (Single phase - L1 and L2 only).
7. **Total Apparent Power:** This submenu displays the total amount of apparent power output, in kilovolt amps (kVA).
8. **Apparent Power:** This submenu displays the amount of apparent power output for L1, L2, and L3, in kilovolt amps (kVA). (Single phase - L1 and L2 only).
9. **Total Power Factor:** 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 *).
10. **Power Factor:** 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*).
11. **AVR Duty Cycle:** 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).

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.

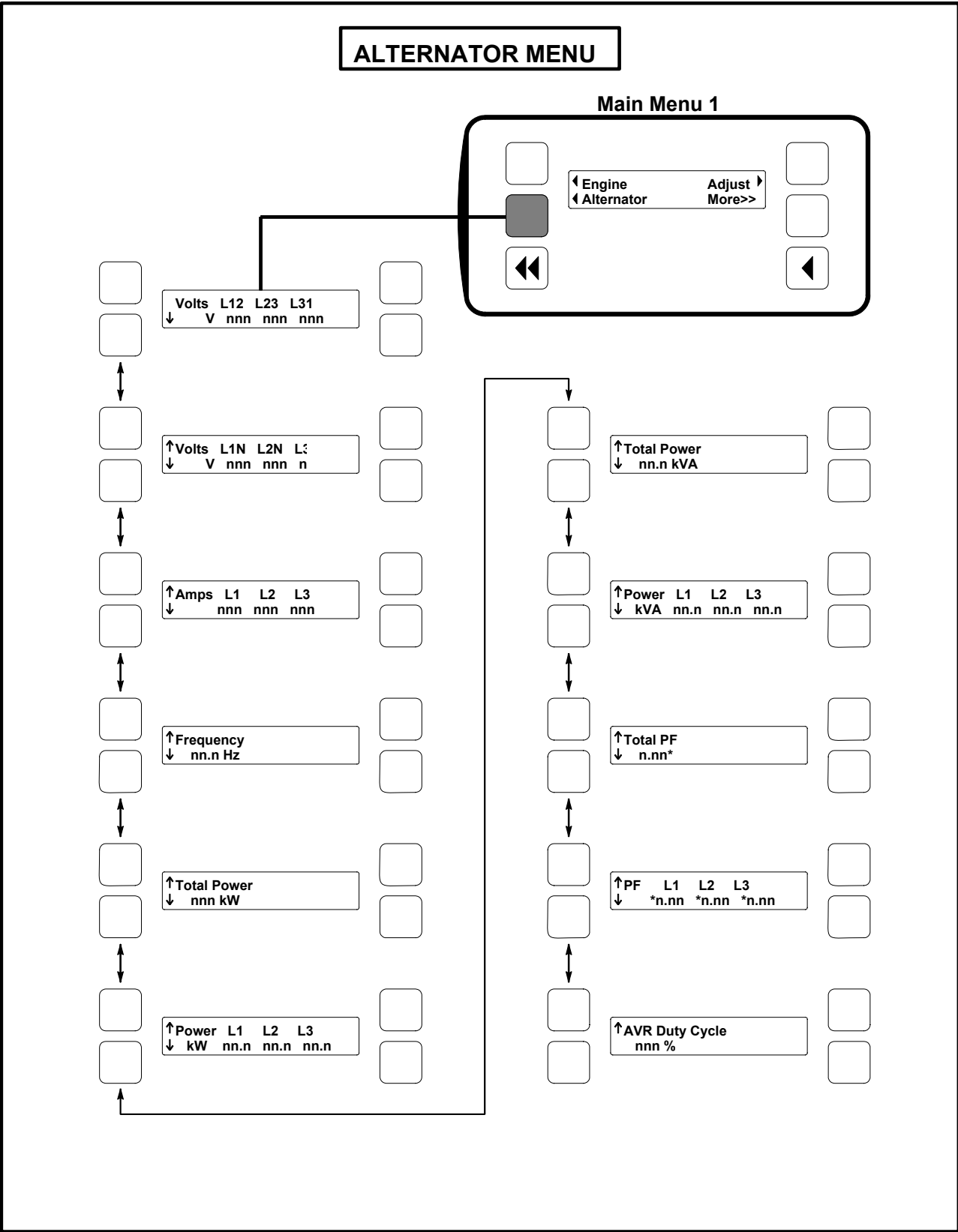


Figure 4-7 Alternator Menu

4.11 Adjust Menu

Figure 4–8 shows a block representation of the Adjust menu. Pressing the button next to the word Adjust in the display causes the first Adjust submenu to be displayed.

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

1. **Voltage Adjust:** Voltage can be adjusted to $\pm 5\%$ of the nominal voltage. For example, if generator set output voltage is 208 volts, the voltage can be adjusted between 198 and 218 volts.

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

2. **Frequency Adjust:** Frequency can be adjusted to $\pm 5\%$ of the nominal frequency. For example, if the generator set frequency is 60.0 Hz, the frequency can be adjusted from 57.0 to 63.0 Hz.
3. **Start Delay:** Start Delay can be set from zero to 300 seconds (default is zero). (Enter 1 or more to enable). This function is bypassed during a manual start/stop sequence.
4. **Stop Delay:** Stop Delay can be set from zero to 600 seconds (default is zero). (Enter one or more to enable). This function is bypassed during a manual start/stop sequence, and engine shutdown faults.
5. **Rated to Idle (beginning Version 2.303):** Rated to Idle delay can be set from zero to ten seconds (default is zero). (Enter one or more to enable). Entering a non-zero delay will cause the generator set to delay the transition to Cooldown at Idle.
6. **Idle Start (only available on some models):** Idle Start can be enabled or disabled (default is disabled). This function is only enabled when the generator set is started in manual mode. Idle Start can also be enabled while the set is running in manual mode. (Auto/remote start is not affected by this setting).

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

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.

4.11.1 Adjusting Values/Parameters:

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

Note: *If the Home button or Previous Main Menu button is pressed before pressing the ► symbol, the changes will not be saved.*

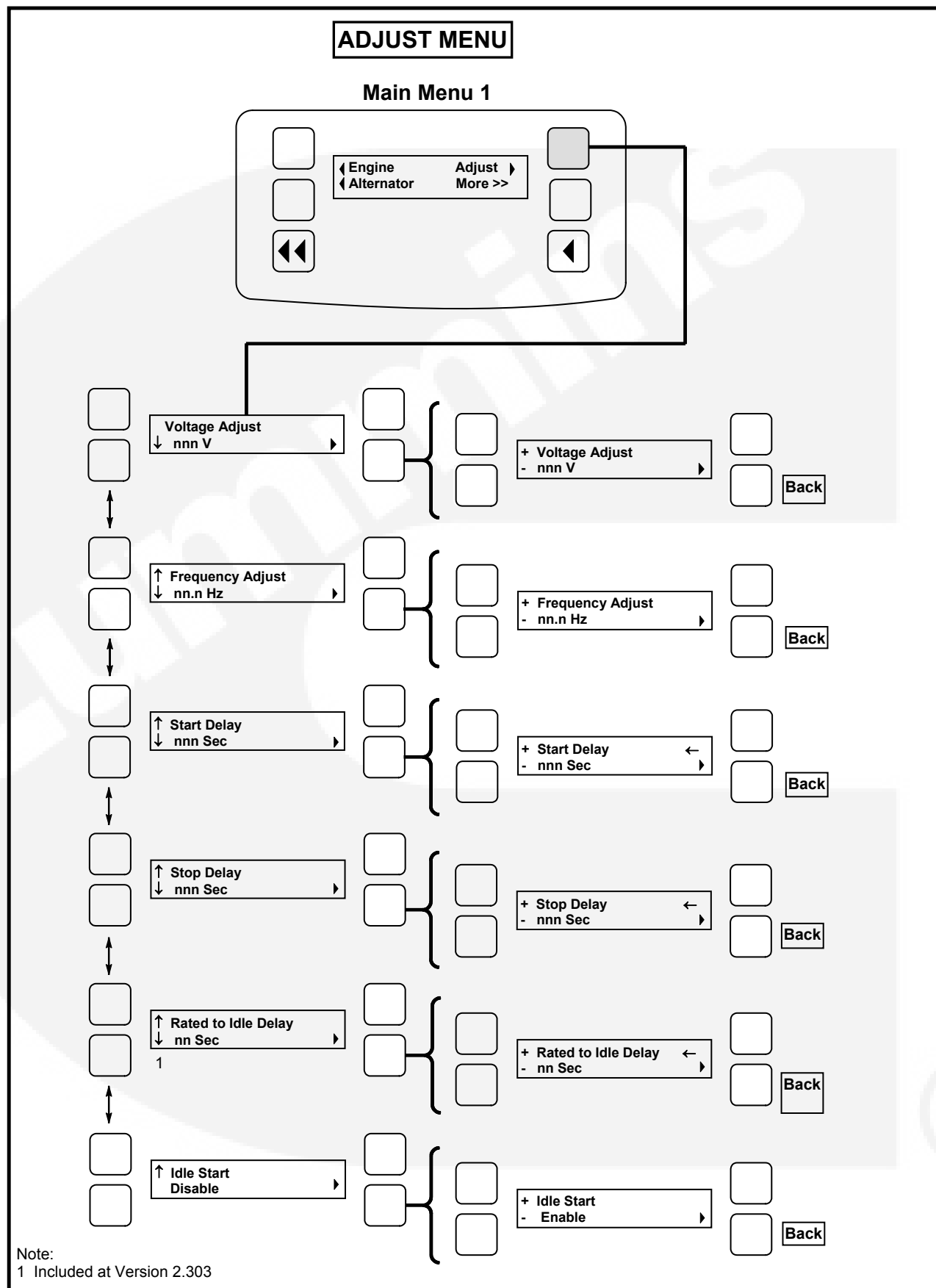


Figure 4-8

Adjust Menu

4.12 Faults Menu

Figure 4–10 shows a block representation of the Faults menu. Pressing the button next to the word Faults in the display, causes the Faults Main Menu submenu to be displayed.

As shown in the diagram, the Faults menu has two submenus:

1. **History:** From the Faults Main Menu, press the button next to the word History in the display to view up to twenty of the most recently acknowledged faults. Press the buttons next to the ↓ and ↑ symbols in the digital display to navigate between the menus. Press the Previous Main Menu button to return to the Faults Main Menu.
2. **Current Fault:** From the Faults Main Menu, press the button next to the word Current in the display to view up to twenty of the most recently unacknowledged faults. Press the Previous Main Menu button to return to the Faults Main Menu.

An example of how a fault code is displayed is shown in Figure 4–9.

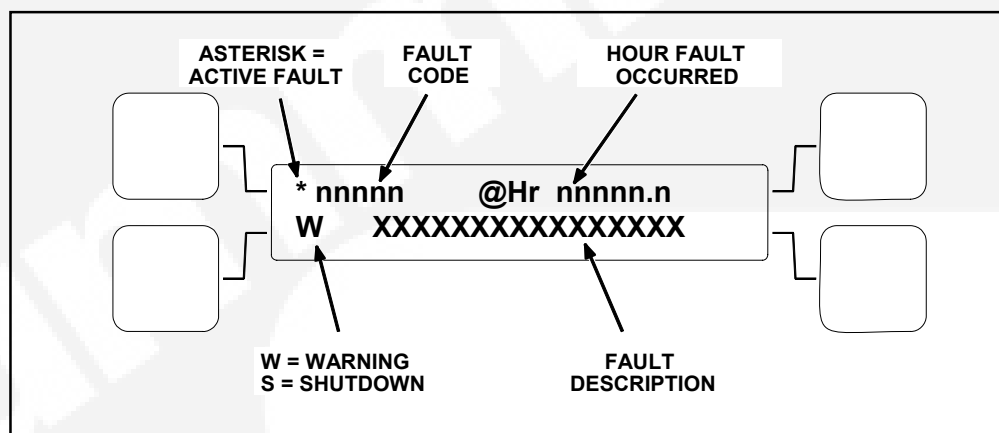


Figure 4-9 History/Current Fault Sub-Menu

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

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

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

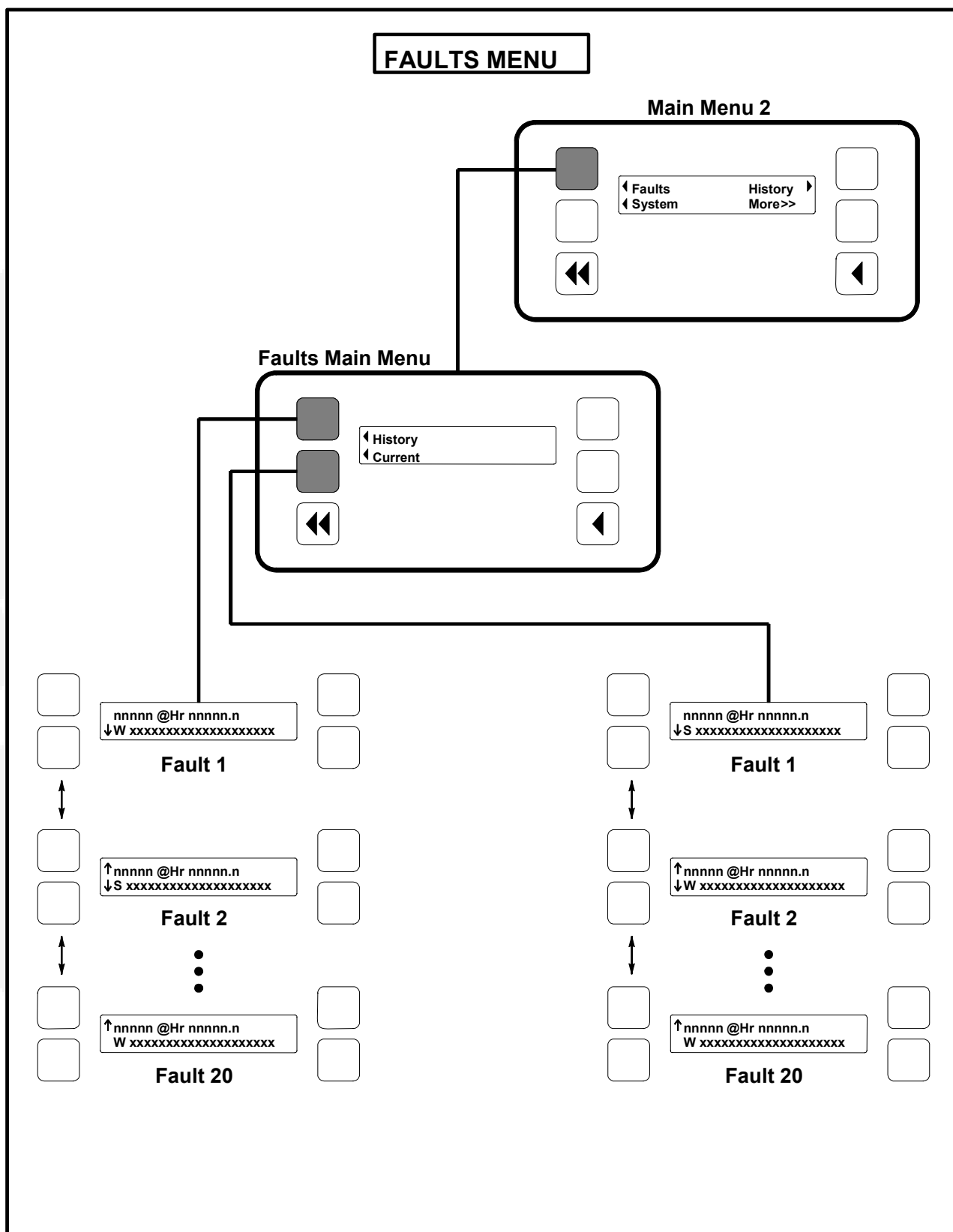


Figure 4-10 Faults Menu

4.13 System Menu

Figure 4–11 shows a block representation of the System menu. Pressing the button next to the word System in the display causes the System Main Menu to be displayed. This menu is displayed only if the Network Communications Module (NCM) feature is installed. The System Main Menu allows you to view the status and load of other PCC equipment connected on a common network with the PCC2100 control.

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

1. **ATS System:** From the System Main Menu, press the button next to the word ATS in the display to view the first of up to sixteen ATS System submenus. An ATS system must be available in the network to display this submenu.
The ATS submenu allows viewing of the transfer switch name (configured with InPower); kW load (if monitored by the ATS system); status (e.g., not in auto); and source connected and availability (ON = source connected, OK = source available, or NA = source not available).
2. **Master System:** From the System Main Menu, press the button next to the word Master in the display to view the Master System submenu. A master controller must be available in the network to display this submenu.
The Master submenu allows viewing of the Master controller name (configured with InPower), kW load and operational state.
3. **Generator Set System:** From the System Main Menu, press the button next to the word Genset in the display to view the first of up to sixteen Generator Set System submenus. One generator set must be available in the network to display this submenu.
The Generator Set Submenu allows viewing of the generator set name (configured with InPower), kW load and operational state.

Note: *If a PCC2100 control generator set, in the network, contains the Power Transfer Control (PTC) feature, a generator set system submenu will be displayed for the generator set and the ATS System submenu will be displayed for the PTC feature.*

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

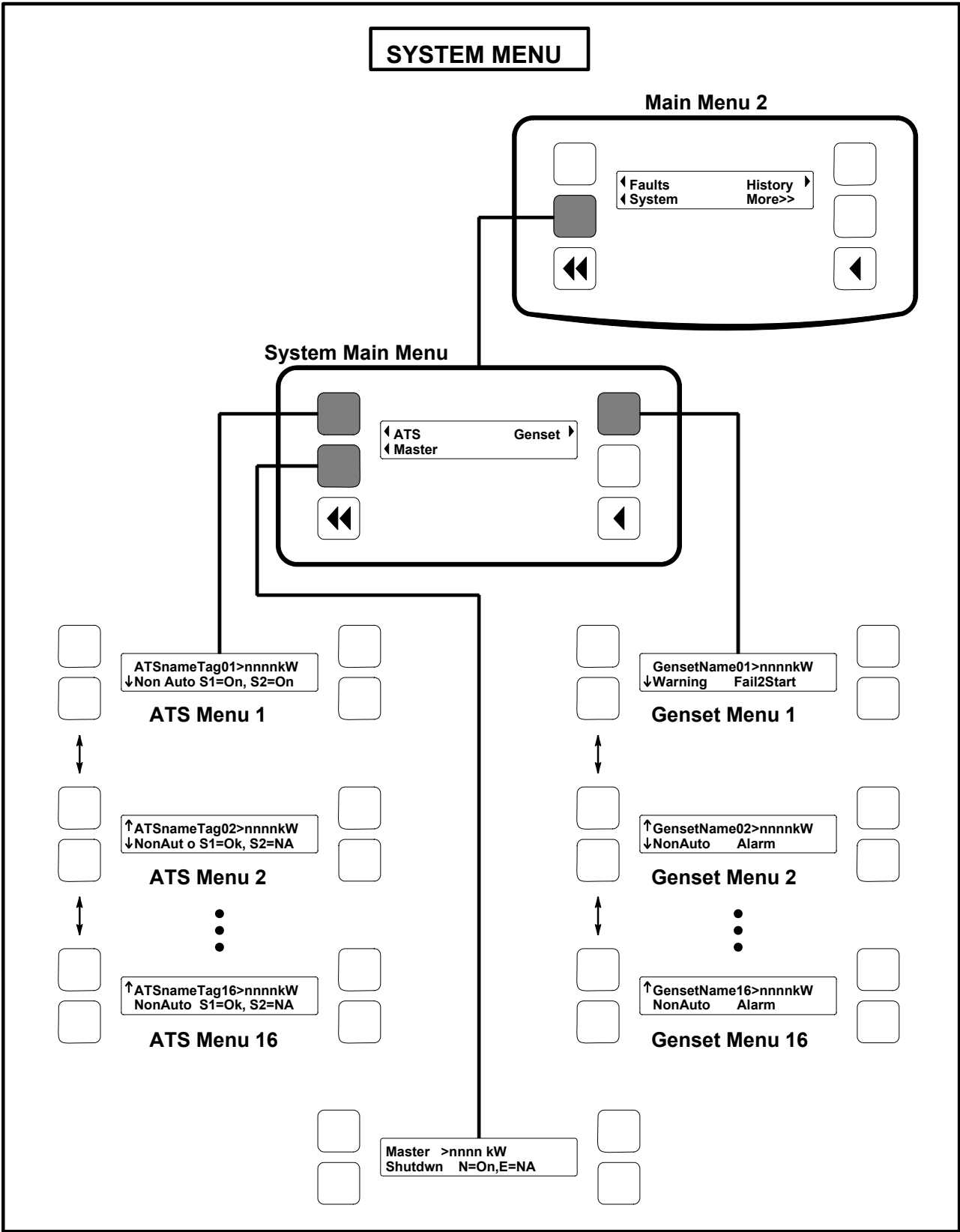


Figure 4-11 System Menu

4.14 History Menu

Figure 4–12 shows a block representation of the History menu. Pressing the button next to the word History in the display causes the first History submenu to be displayed.

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

1. **Number of Starts:** This submenu shows the number of engine starts.
2. **Engine Hours:** This submenu shows the number of operating hours for the engine.
3. **Control Hours:** This submenu shows the number of operating hours for the control.
4. **Kilowatt Hours:** This submenu shows the number of kilowatt (kW) or megawatt (MW) hours.
5. **Generator Set Duty Cycle:** This submenu shows the percentage of generator set operating hours that are less than 30% of rated load, and percentage of hours that are greater than 90%.

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

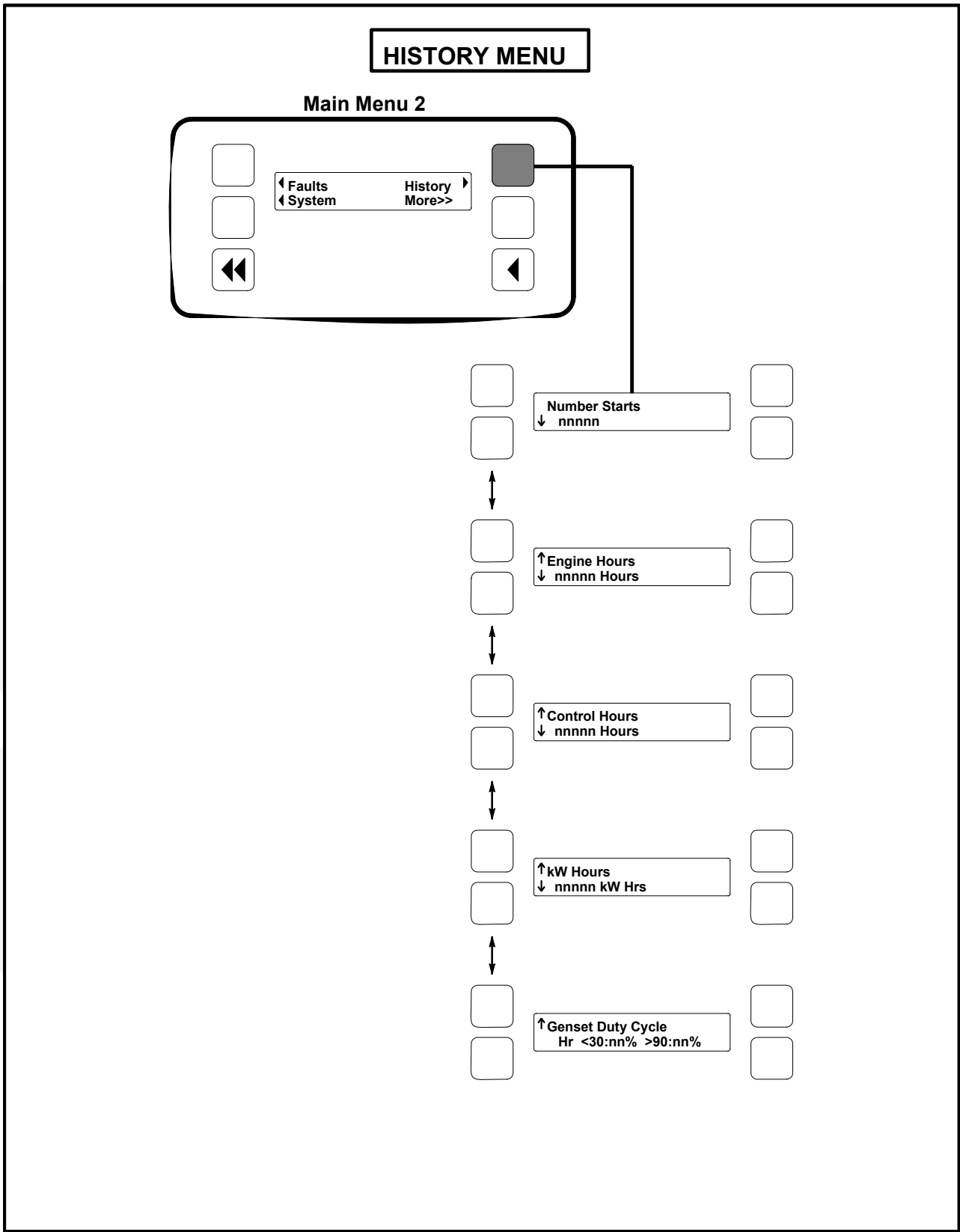


Figure 4-12 History Menu

4.15 About Menu

Figure 4–13 shows a block representation of the About menu. Pressing the button next to the word About in the display, causes the first About submenu to be displayed.

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

1. **Model:** This submenu shows the generator set model.
2. **Rating:** This submenu shows the rating (Standby, Prime, or Base and number of kilowatts [kW]).
3. **Software Version:** This submenu shows the software version level. This information is required to service the generator set.

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

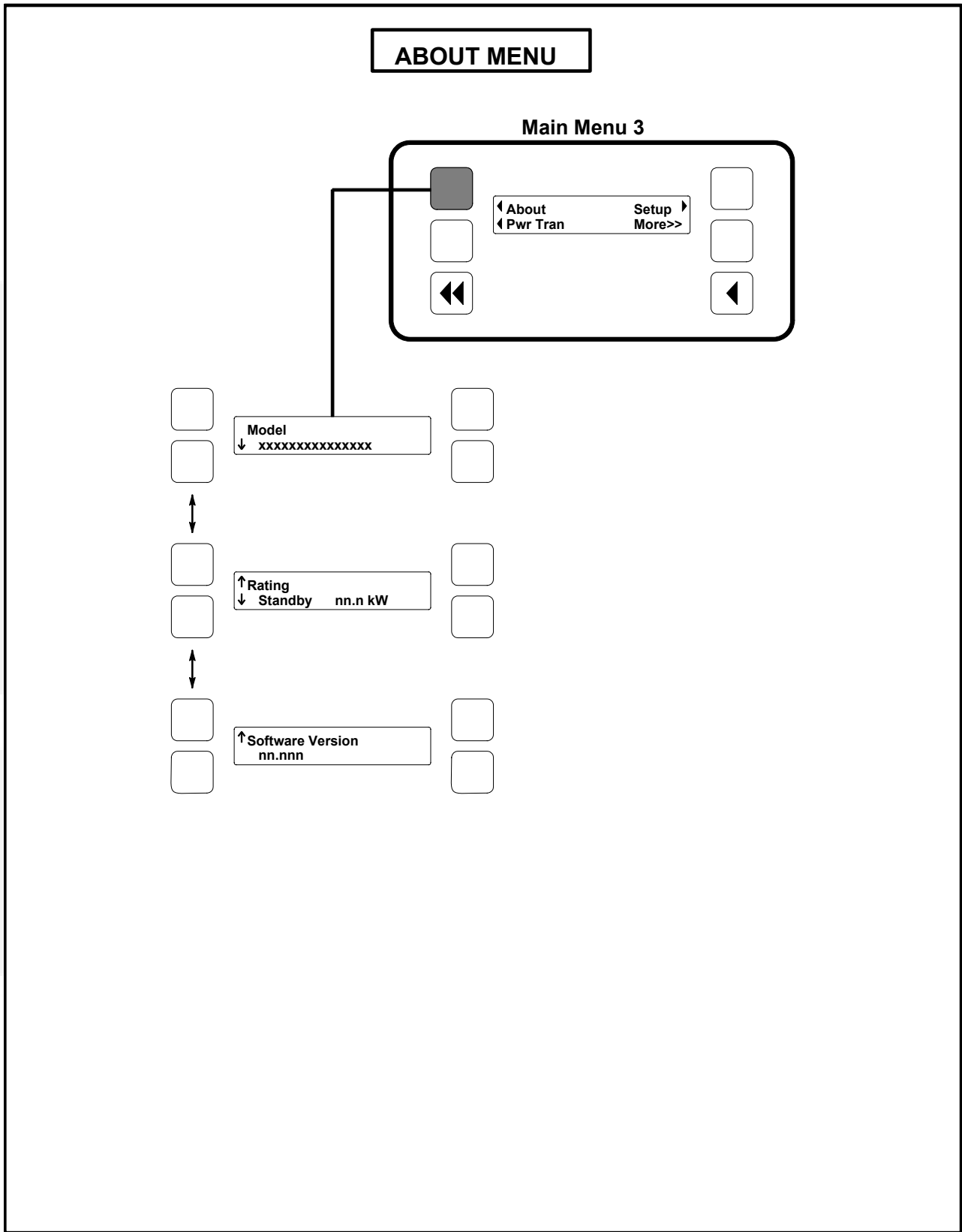


Figure 4-13 About Menu

4.16 Power Transfer Menu

Figure 4–14 shows a block representation of the Power Transfer menu. Pressing the button next to the words Pwr Tran in the display causes the first Power Transfer submenu to be displayed. (The Power Transfer Control [PTC] feature must be installed to display this submenu).

With this option installed, the PCC will monitor the utility (mains) voltage and frequency for failure, and control the opening and closing of the contacts (circuit breakers) for Source 1 (S1 utility) and Source 2 (S2 generator set).

If S1 power fails, the PTC control will initiate the starting sequence (Figures 5-3 and 5-4), opens S1 and closes S2 to the load. When S1 returns, the load is returned to S1 and the control initiates the generator set shutdown sequence.

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

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

Or

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

2. **Frequency submenu:** This menu shows power transfer frequency.
3. **Source 1 submenu:** This submenu shows utility status (On, Ok, or NA). On means Source 1 is connected and available. Ok means Source 1 is available but not connected. NA means Source 1 is not available.
4. **Genset submenu:** This submenu shows generator status (On, Ok, or NA). On means the generator set is connected and available. Ok means the generator set is available but not connected. NA means the generator set is not available.
5. **Active Transfer Timer submenu:** This submenu shows the time delay, in seconds.

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

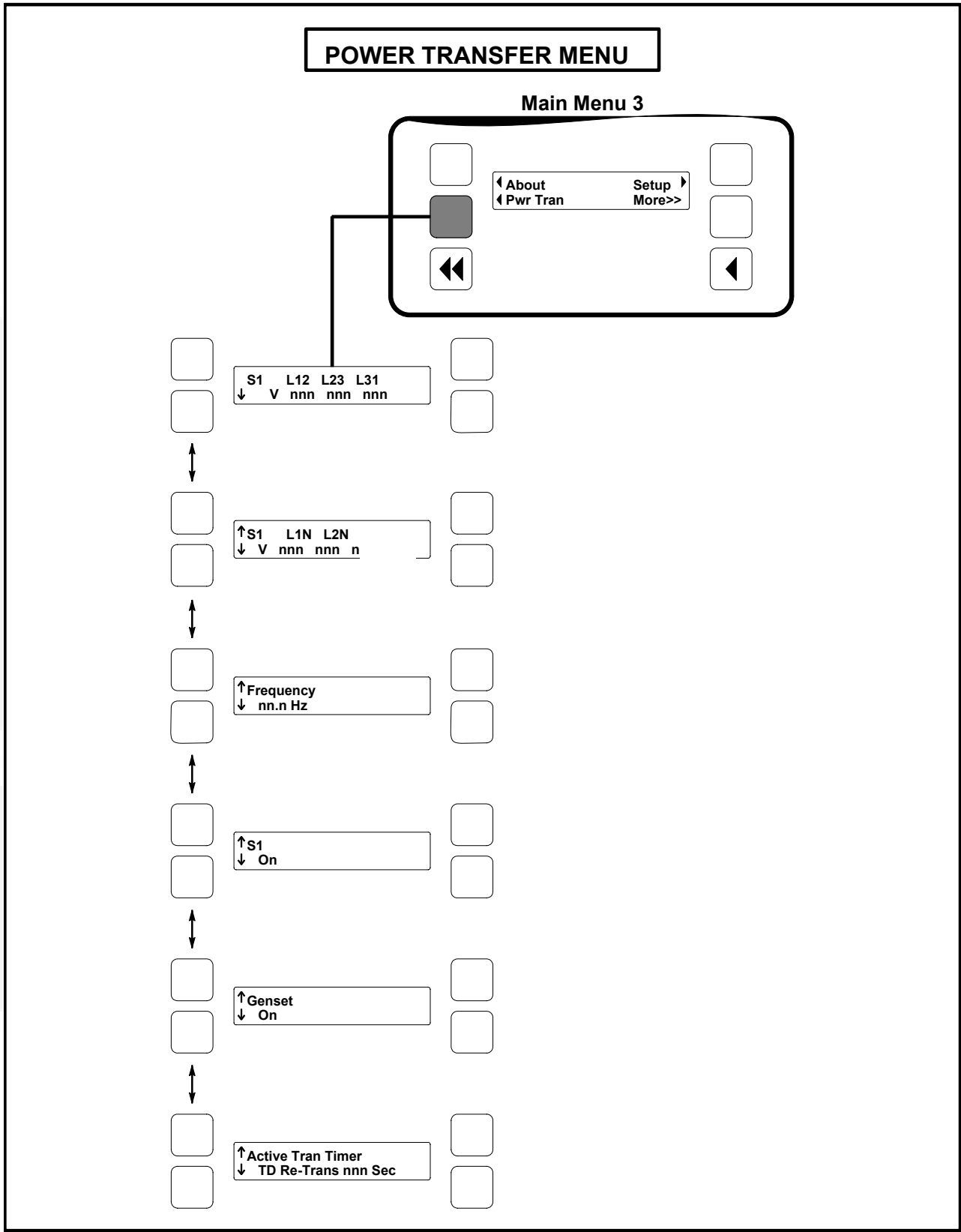


Figure 4-14 Power Transfer Menu

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SECTION 5 – SYSTEM OPERATION

5 Operation

5.1 Safety

Only suitably qualified and experienced personnel should carry out generator set operations. Before operating the system, the operator should become familiar with Section 1 of this manual – Preliminary and Safety instructions, together with the Health and Safety Manual (0908-0110-00). Observe all of the WARNINGS and CAUTIONS at all times.

WARNING: BEFORE OPERATING THE PLANT BECOME FAMILIAR WITH THE EQUIPMENT AND HOW IT IS OPERATED (INCLUDING ALL CONTROLS, MANUALLY OPERATED VALVES AND ALARM DEVICES). SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE PLANT IS OPERATED CORRECTLY.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY, OR DEATH BY ELECTROCUTION. DO NOT OPEN THE GENERATOR OUTPUT BOX WHILE THE GENERATOR SET IS RUNNING. READ AND OBSERVE ALL WARNINGS AND CAUTIONS IN YOUR GENERATOR SET MANUALS.

Caution: *Only technically qualified personnel should open the PCC2100 front panel. Lower level voltages (18VAC and 24VDC) are present in the PCC2100 which can cause electrical shock, resulting in personal injury. Even with power removed, improper handling of components can cause electrostatic discharge and damage circuit board components.*

5.2 Introduction

This section describes the operation of the PCC2100 generator set control, covering pre-start checks, starting and stopping, and operating the generator set. The text should be read in conjunction with the System Description, Control System Description, and the engine manual.

All indicators, control switches/buttons and graphical display are located on the face of the control panel as illustrated in Figure 4-1.

5.3 Maintenance

To secure maximum performance and reliability from your generator set it is essential that certain components are inspected periodically and, where necessary, maintenance procedures carried out as detailed in Section 6 - Maintenance.

5.4 Operating Recommendations

5.4.1 Running-In

Drain and replace the crankcase oil and filter after the first 50 hours of operation on new generator sets. Refer to Section 6 – Maintenance, of this manual for the recommended procedures.

5.4.2 No-Load Operation

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a load bank of at least 30% of nameplate rating. Such a load could consist of a heater element or load bank.

5.4.3 Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and, in general, helps provide reliable engine starting.

Exercise the generator set at least once a week for a minimum of 30 minutes, under not less than 30% of the nameplate rating, so the engine reaches normal operating temperatures.

5.4.4 Low Operating Temperature

Use a coolant heater if a separate source of power is available. The optional heater, available from Cummins, will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

5.4.5 High Operating Temperature

Refer to the generator set nameplate for the maximum ambient operating temperature, if applicable.

5.4.6 Operating Conditions for Prime, Standby and Continuous Power Ratings

Note: *All generator sets supplied by The Company must be run under the following operating conditions.*

5.4.6.1 Continuous Power Rating (COP) for constant load applications

The Continuous Power Rating is applicable to utility parallel and other non-variable load applications for supplying power continuously to a load of up to 100% of the continuous rating for an unlimited number of hours per year between the stated maintenance intervals and under stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No sustained overload capability is available at this rating. This rating is applicable for utility base load operation. In these applications, generator sets are operated in parallel with a utility source and run under constant loads for extended periods of time.

5.4.6.2 Prime Power Rating

The Prime Power Rating is the maximum power available during a variable load sequence which may be run for an unlimited number of hours per year, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. Prime Power applications fall into one of the following categories:

a) Unlimited Time Prime Power (for variable load applications)

Prime power is available for an unlimited number of annual operating hours in variable load applications. The permissible average power output under variable load shall not exceed a 70% average of the prime power rating during any operation of 250 hours. The total operating time at 100% prime power shall not exceed 500 hours per year. A 10% overload capability is available for a period of one hour within a twelve hour period of operation, in accordance with ISO 3046-1. Total operating time at the 10% overload power shall not exceed 25 hours per year.

b) Limited Running Time Prime Power (for constant load applications)

Prime power is available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as utility power curtailment. Generators may be operated in parallel with the public utility up to 750 hours per year at power levels never to exceed the prime power rating. No sustained overload capability is available at this rating. The customer should be aware, however, that the life of any generator set will be reduced by constant high load operation. Any operation exceeding 750 hours per year at the prime power rating should use Continuous Power Rating.

5.4.6.3 Standby Power Rating (for variable load applications)

The Standby Power Rating is applicable for supplying emergency power for the duration of a utility power interruption, between the stated maintenance intervals and under the stated ambient conditions. All maintenance must be carried out as prescribed in The Company Manuals. No overload capability is available for this rating and utility parallel operation is not permitted at the standby power rating. For applications requiring sustained utility parallel operation the limited time prime power rating or continuous power rating must be utilised as applicable.

This rating is applicable to installations served by a reliable normal utility source. Generators should be sized for a maximum average load factor of 80% of the standby power rating with a maximum of 200 hours of operation per year, which includes less than 25 hours per year at the standby power rating. In installations served by unreliable utility sources (outages last longer or occur more frequently), where operation is likely to exceed 200 hours per year, the prime power rating should be applied. The Standby Power rating is only applicable for emergency and standby applications where the generator set serves as the back-up to the normal utility source. Negotiated power outage are not considered as emergencies.

5.4.6.4 Notes Applicable to all ratings

The following notes are applicable to all ratings, unless otherwise agreed by the Regional Sales Manager of The Company in writing:

1. When determining the actual average power output of a variable power sequence in any of the ratings, powers of less than 30% of the emergency standby power shall be taken as 30% and the time at standstill shall not be counted.
2. Variable load is calculated in accordance with methods and formulae given in ISO 8528-1:1993.
3. All 3-phase generator sets are rated for 0.8 power factor lag. Single-phase generator sets are rated for 1.0 power factor.
4. All ratings are based on the following reference conditions:
 - a) Ambient temperature – 27°C (81°F)
 - b) Altitude above sea level – 150 metres (492 feet)
 - c) Relative humidity – 60%
 - d) Output power may be subject to de-rate if the above conditions are exceeded.
5. If any of the above conditions are not satisfied, the operational life of the generator set may be reduced
6. Short term parallel operation with the utility, for load transfer purposes only, is permitted with all ratings.

5.4.7 De-Rating Factors

For de-rating factors applicable at specific sites please contact your authorised distributor.

5.5 Generator Set Operation

5.5.1 Sequence of Operation

The generator set is run Automatically using a Remote Start signal, or Manually using the generator set control panel. Generator set indications are provided on the PCC2100. If a fault is sensed at Start-up, the engine is locked out and will not start.

When the PCC2100 is put in the Manual mode and the Manual Run button is pressed, the generator set performs an automatically sequenced manual start. When the PCC2100 is put in the Auto mode the generator set performs an automatically sequenced start when initiated by a remote start signal. First, the PCC2100 initiates a starter cranking signal and verifies that the engine is rotating. Then it provides sufficient fuel for the engine to accelerate up to start-disconnect speed.

After the initial start procedure, the control system ramps the generator set to rated speed and voltage. The Ready to Load output is activated when the AC voltage and frequency exceeds 90% of nominal.

5.6 Starting

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Caution: One operator should be in complete charge, or working under the direction of someone who is. Remember that, upon starting the engine, cables and switchgear will become energised, possibly for the first time. Furthermore, equipment that does not form part of the generator set installation may become electrically charged. Only authorised and competent personnel should carry out this work.

Caution: Do not use an Emergency Stop switch to shut down an engine unless a serious fault develops. The Emergency Stop push-switch must not be used for a normal shut-down, as this will prevent a cooling down run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.

Caution: Avoid off-load running for other than short periods. A minimum loading of 30% is recommended. This loading will help to prevent the build up of carbon deposits in the injectors, due to unburnt fuel, and reduce the risk of fuel dilution of the engine lubricating oil. The engine must be shut down as soon as possible after the appropriate functions have been checked.

This section covers pre-start checks, starting and stopping and operating the generator set. Before attempting to start the generator set, the operator should read through this entire manual and become familiar with the engine manual. It is essential that the operator be completely familiar with the generator set and the PCC2100 control.

The following sub-sections cover the systems used to start the generator set. Figures 5–1 to 5–6 provide flow charts for all start/run/stop sequences.

Before starting the generator set, make sure that exhaust and fuel fittings are tight and properly positioned, and that proper maintenance and pre-start checks have been performed.

5.6.1 Power Transfer Control (PTC) (Optional)

With the optional Power Transfer Control module installed, the function and sequence of operation of the Start command can differ and is noted as PTC in the following paragraphs. Refer to the Power Transfer Menu in this section which describes the operation of the PTC feature.

5.6.2 Pre-Start Checks

WARNING: VOLTAGES PRESENT SPECIAL HAZARDS OF SEVERE PERSONAL INJURY OR DEATH. EVEN AFTER GENERATOR SET SHUTDOWN AN ELECTRICAL SHOCK HAZARD MAY STILL EXIST, CAUSED BY INDUCED OR RESIDUAL VOLTAGE WITHIN THE ALTERNATOR OR CABLES. SERVICE PERSONNEL MUST BE WELL TRAINED/QUALIFIED TO WORK WITH DISTRIBUTION VOLTAGES.

Before starting the generator set Manually, or selecting Auto operation, be sure competent personnel have made the following checks to ensure that the unit is ready for operation:

- Generator Set Grounding Procedures – This must be followed prior to performing service or inspection procedures that may expose personnel to conductors normally energized with voltages greater than 600 volts. Contact your authorised distributor.
- Megger and Insulation Testing – This must be performed on all generator sets before initial start-up and after Generator Set Grounding Procedure has been completed. Insulation testing for low voltage (less than 600 volts) generator sets is recommended by Cummins Power Generation Limited. These tests are used to verify that the windings are dry before the generator set is operated, and to develop a base line for future test comparisons. Contact your authorised distributor.

Caution: When Megger testing an alternator, failure to protect the voltage regulator, control and diodes could result in permanent damage to one or more of the electronic components.

- Lubrication - Check the engine lubricating oil level and ensure that the level is maintained as detailed in the engine manual.

Note: Generator sets may be shipped dry. They must be filled with the correct type and quantity of oil before use. Be sure to check the oil level before initial start.

- Coolant - Check the engine coolant level and ensure that the level is maintained at the coolant expansion tank. Fill the cooling system to the bottom of the fill neck in the radiator fill or expansion tank. Do not check while the engine is hot.

Note: Some radiators have two fill necks, both of which **must** be filled if the cooling system has been drained.

Caution: Do not attempt to remove a radiator pressure cap while the generator is running, or is stationary but hot. Always allow it to cool before removing.

Note: Generator sets may be shipped dry. They must be filled with the correct type and quantity of coolant before use. Be sure to check coolant level(s) before initial start.

- Cooling Air Inlet/Outlets - Ensure that the cooling air inlets/outlets are unobstructed. Remove all loose debris from surrounding area of generator set. Air flow from the radiator fan can blow loose items around and into ventilation openings.

- Exhaust Outlet - Ensure that exhaust components are secured and not warped, and that the exhaust outlet is unobstructed; that no combustible materials are near the system, and gases are discharged away from building openings. Ensure that there are no leaks and that all fittings are tight.
- Fuel Supply - Ensure that the fuel tank is filled to the normal level and that the fuel system is primed and all the valves required for operation are open. Ensure that there are no leaks and that all fittings are tight.
- Batteries – Ensure that the batteries are charged, that the electrolyte is at the correct level and that all connections are correct.
- Auxiliary AC Supplies - Ensure that all auxiliary equipment is receiving power from the Load Terminal Box.
- Emergency Stop/Fire Detection Equipment - Ensure that all related equipment is fully operational.

5.7 Starting at the Control Panel (Manual Mode)

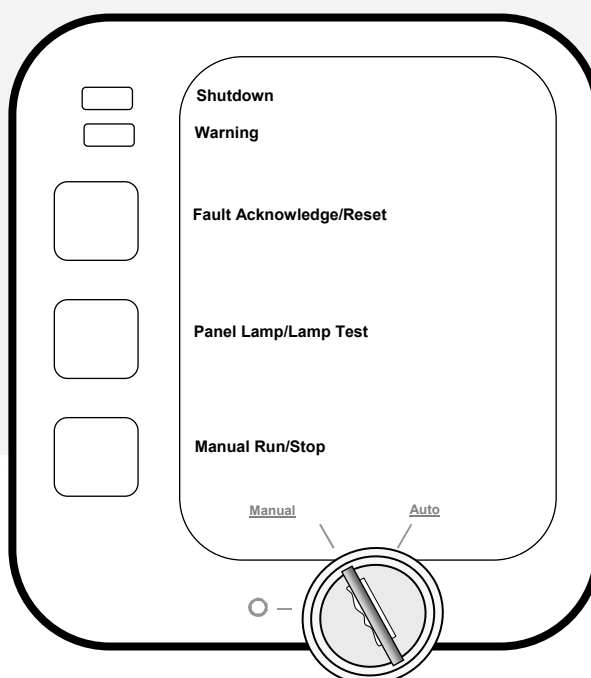
WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

During starting, automatic checks are carried out for the integrity of various protection systems. The PCC2100 will not allow the generator set to continue the starting sequence if the integrity of a sensor is considered to be in doubt.

The generator set can be configured for a number of starting cycles (one to seven) with set times for crank and rest periods for all starting modes (manual/remote). The default setting is for three start cycles, composed of fifteen seconds of cranking and fifteen seconds of rest.

Note: To change the number of starting cycles, and the crank and rest times, contact an authorised service centre for assistance.

Turn the O/Manual/Auto switch to the Manual position and press the Manual Run/Stop button. This will activate the engine control system and initiate the starting system.



The starter will begin cranking and when the engine is sensed to have achieved firing speed (a speed calculated to be beyond the starter motor capability), the starter will disconnect and the remainder of the cranking sequence will be aborted. If, at the end of the third crank period, the engine does not start, the starter will disengage after a specified period of time and the control will indicate an Overcrank Shutdown.

To clear a Fail to Start Shutdown, place the O/Manual/Auto switch in the Off (O) position and press the Fault Acknowledge/Reset button. Wait a minimum of two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt, refer to Section 7 - Troubleshooting.

The run up to speed sequence is closely controlled by the PCC2100 to reduce smoke emission. Upon attaining correct speed (frequency), and correct output voltage, the generator set is deemed to be running by the PCC2100 which will continue to monitor the system to control the generator set and detect any abnormal conditions.

When the switch is in the Manual position, the control will complete the Warm-up at Idle feature, if enabled. When the coolant reaches operating temperature or the Warm-up time at Idle delay (0-300 seconds) is reached, whichever occurs first, the generator set will ramp to the rated speed and voltage.

Note: *The InPower service tool is required to enable/disable the Warm-up at Idle feature and to adjust the time-out. When shipped from the factory this feature is disabled.*

When the switch is in the Manual position, the generator set can be operated in the Idle mode (used for maintenance, troubleshooting, etc.). Refer to Adjust menu (Figure 4–8) to enable/disable the Idle feature.

<p>Caution: <i>The generator set should not be allowed to run off-load for extended periods, except as absolutely necessary during maintenance or cooling cycles.</i></p>
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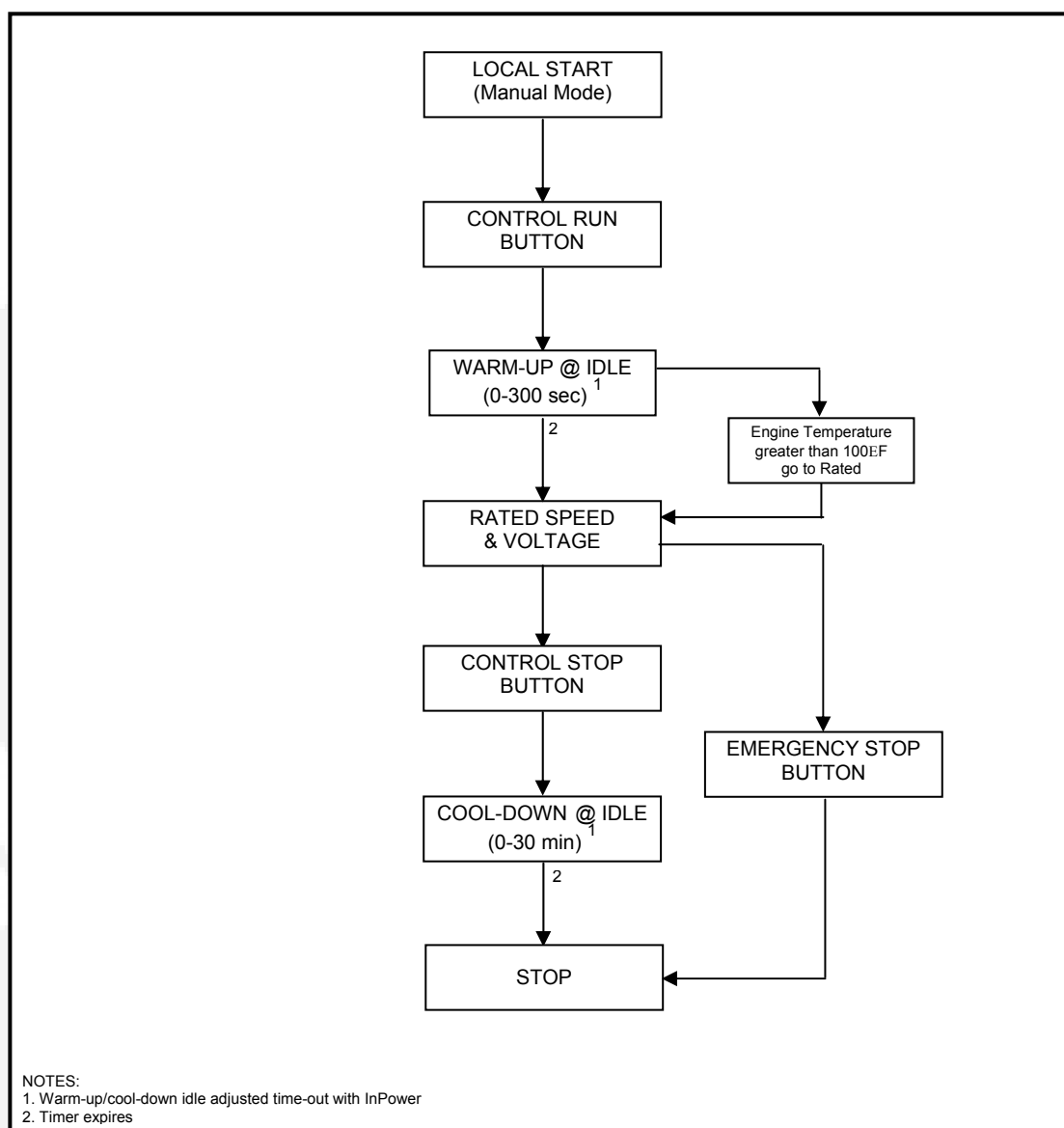


Figure 5-1

Starting at the Control Panel (Manual Mode) – pre 2.303 version

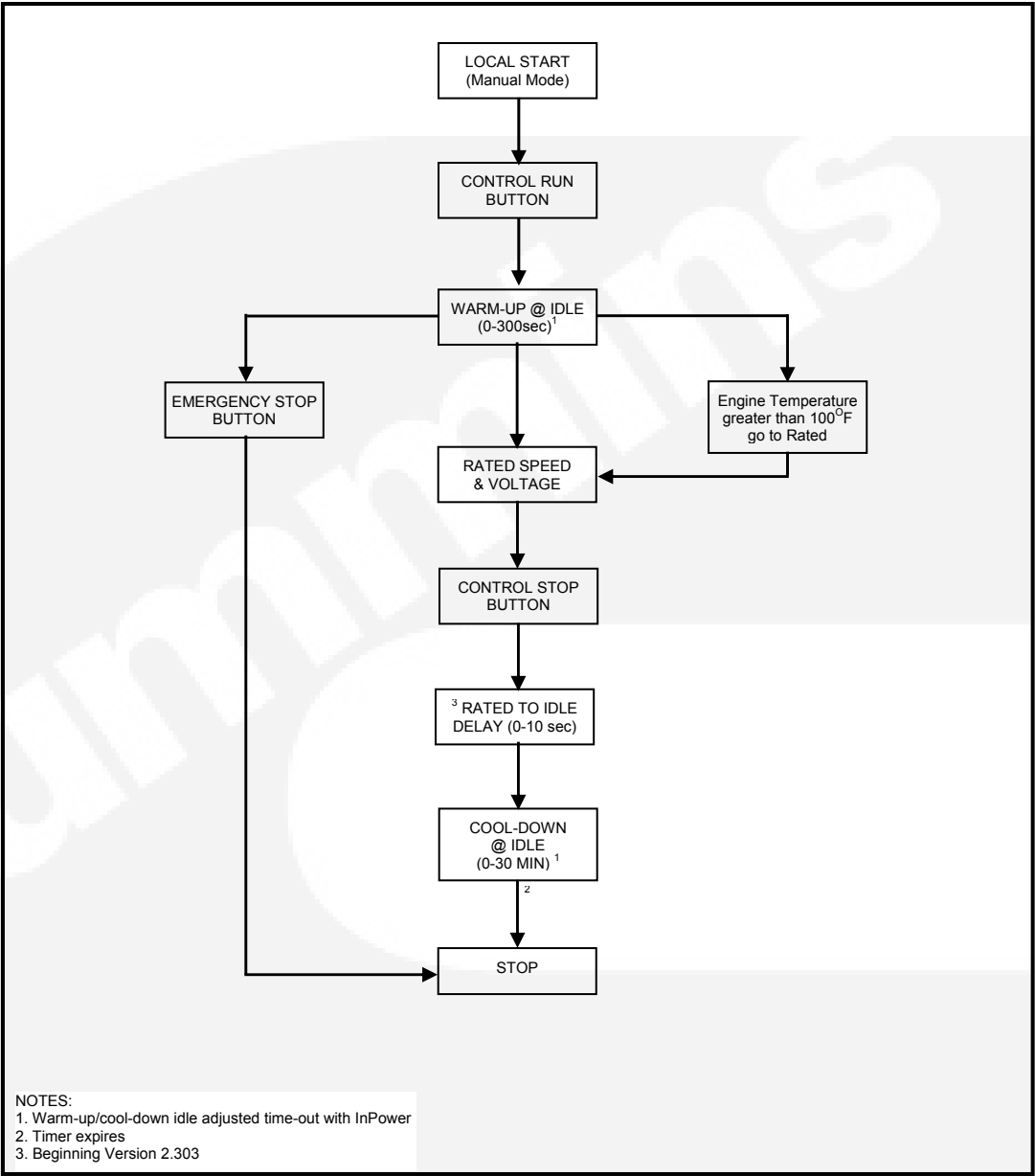


Figure 5-2 Starting at the Control Panel (Manual Mode) – version 2.303 onwards

5.7.1 Starting from a Remote Location (PTC or Remote Start Signal) (Auto Mode)

WARNING: ENSURE THAT ALL PRE-START CHECKS ARE CARRIED OUT BEFORE STARTING THE GENERATOR SET. DO NOT ATTEMPT TO START THE GENERATOR SET UNTIL IT IS SAFE TO DO SO. WARN ALL OTHERS IN THE VICINITY THAT THE SET IS ABOUT TO START.

Place the O/Manual/Auto switch in the Auto position. This allows the generator set to be started from a remote switch or device (e.g. a transfer switch, or optional PTC module).

Note: PTC – If a switch is connected to the remote start input of the control and the PTC module is installed, this switch will function as a Test switch. The PTC Test sequence is shown in Figures 5-5 and 5-6.

In response to a Remote Start or if the control detects the loss of Source 1 (S1 utility) voltage (PTC option installed), the control lights the Remote Start indicator and initiates the starting sequence as shown in Figures 5-3 and 5-4.

When the switch is in the Auto position, the control will complete the Time Delay to Start.

Note: Refer to the Adjust submenu, Figure 4-8, to enable and change the time delay start/stop settings.

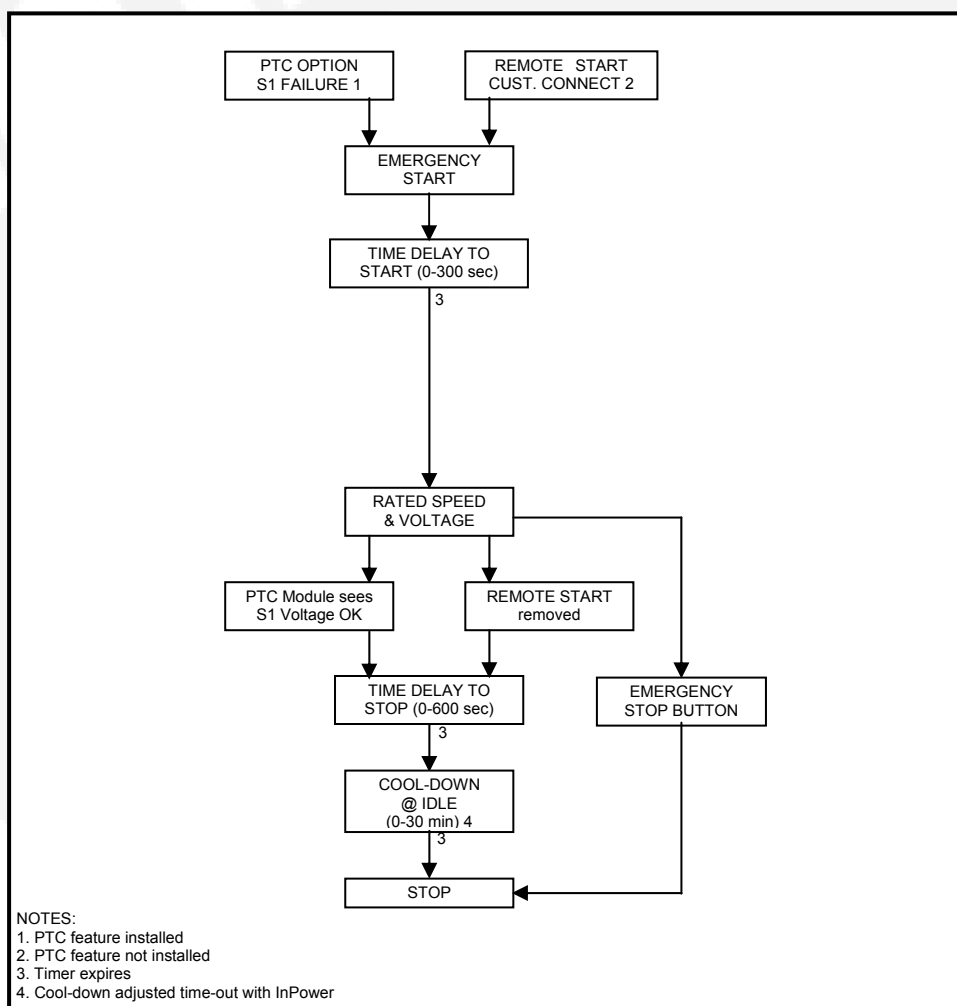


Figure 5-3

Starting with Control in Auto Mode (PTC/Remote Start Signal) – pre 2.303 version

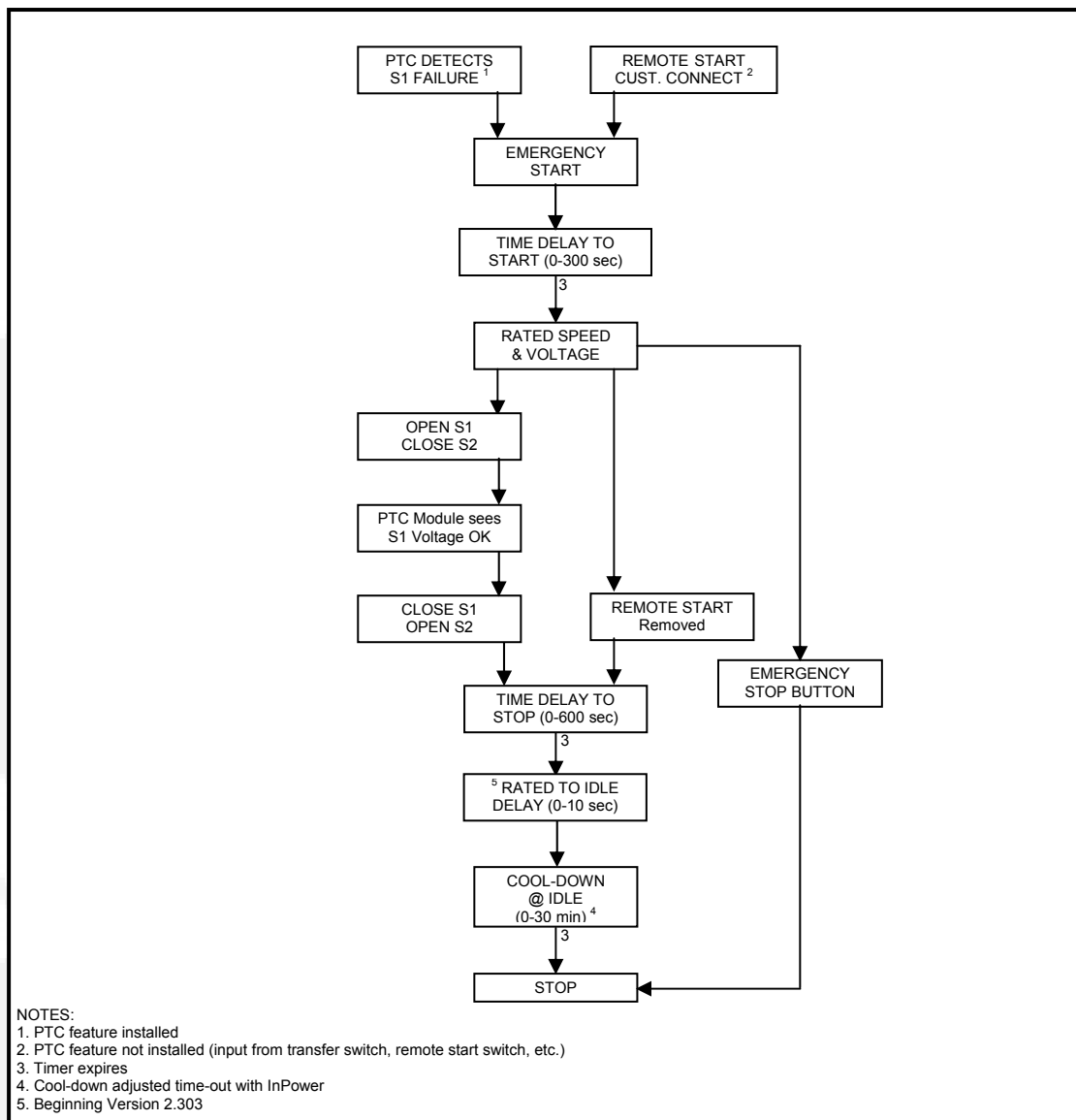


Figure 5-4 Starting with Control in Auto Mode (PTC/Remote Start Signal) – version 2.303 onwards

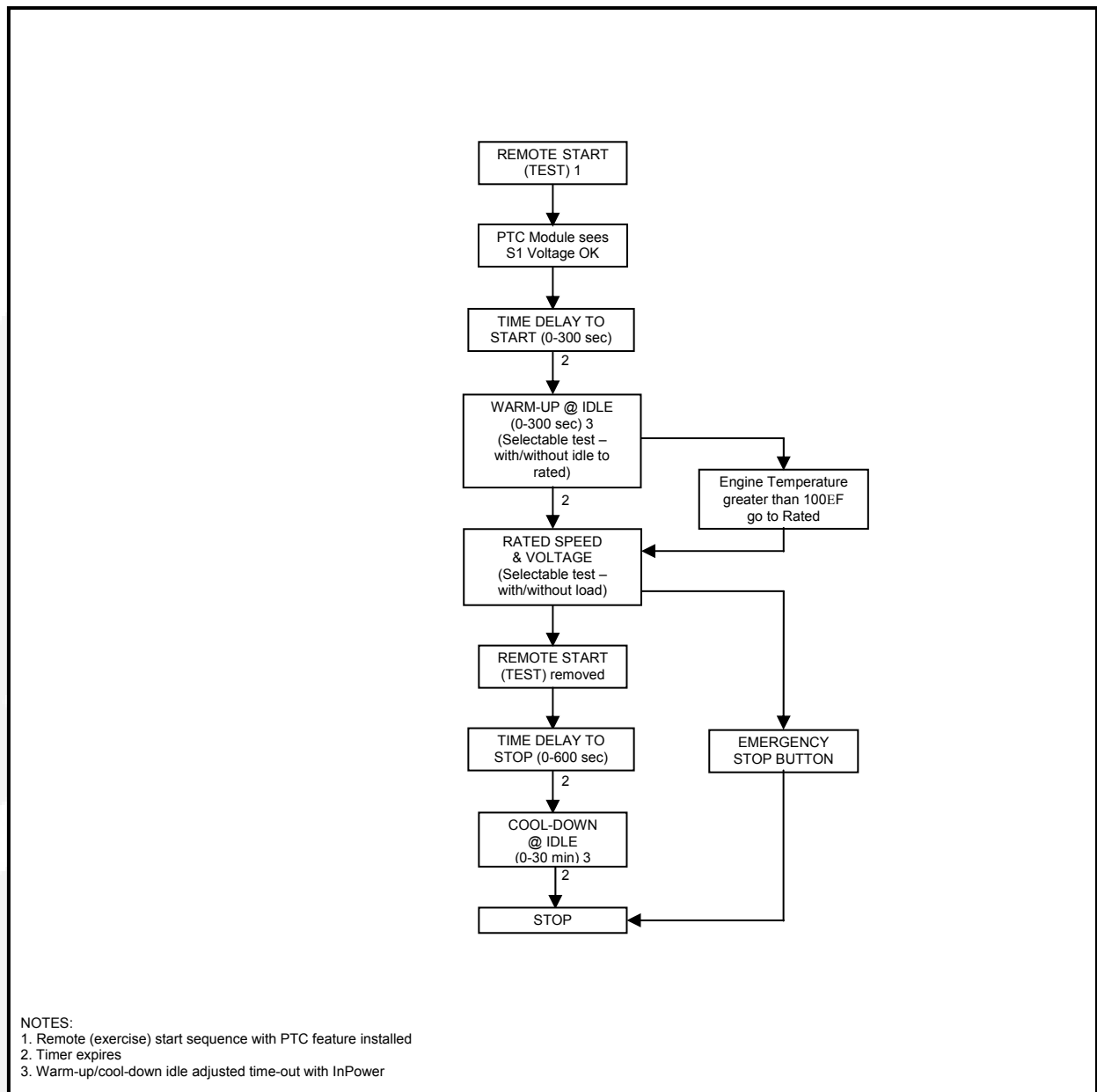


Figure 5-5 Starting with Control in Auto Mode (PTC Remote Test Switch) – pre 2.303 version

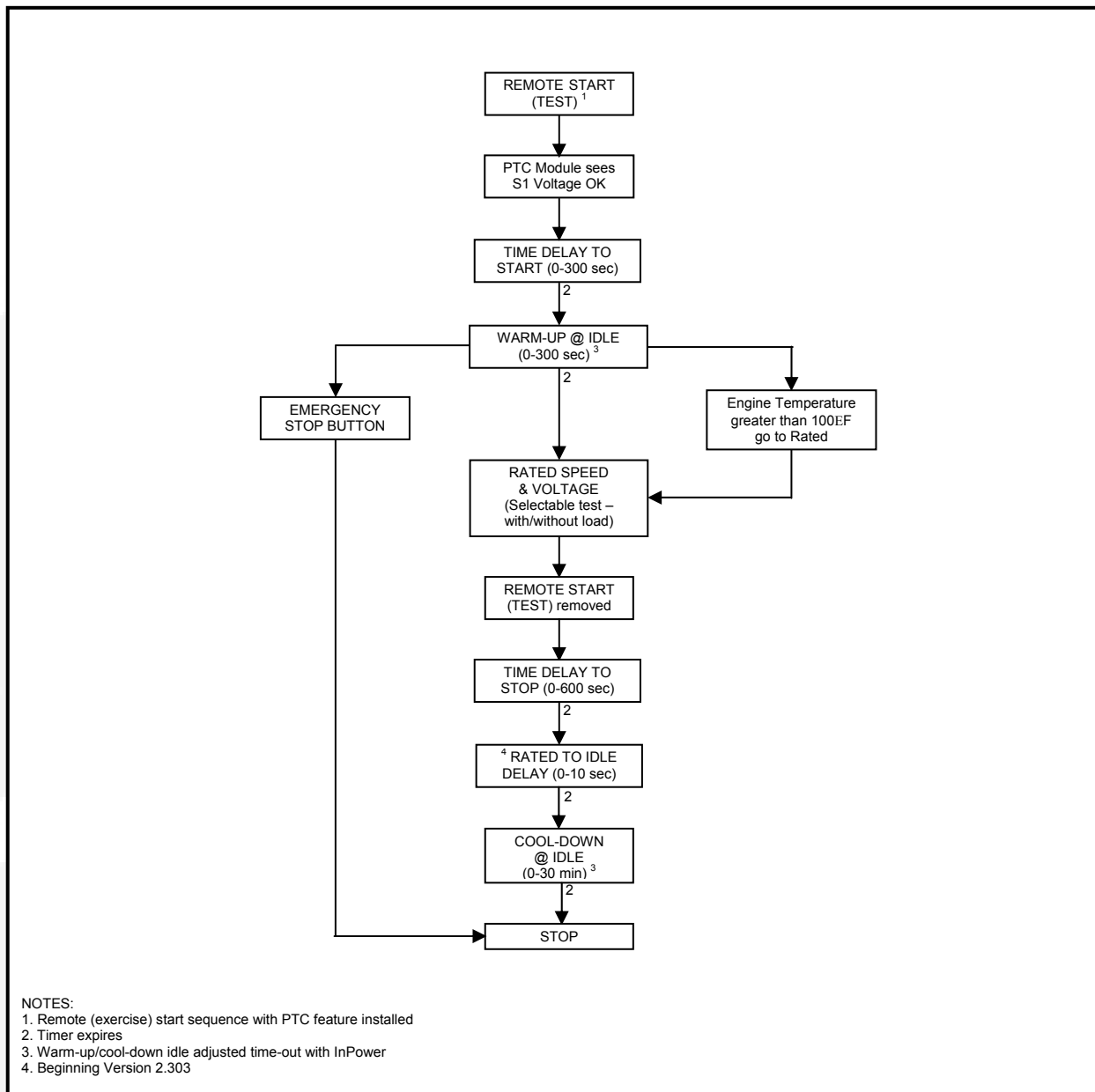


Figure 5-6 PTC Feature Remote Start Test/Exercise Switch (in Auto Mode) – version 2.303 onwards

5.7.2 Cold Starting with Loads

Cummins Power Generation recommends equipping diesel standby generator sets (life safety systems) with engine water jacket coolant heaters to maintain the coolant at a minimum of 90°F (32°C) and, for most applications, to accept the emergency load in ten seconds or less. Although most Cummins Power Generation generator sets will start in temperatures down to -25°F (-32°C) when equipped with engine water jacket coolant heaters, it might take more than ten seconds to warm the engine up before a load can be applied when ambient temperatures are below 40°F (4°C).

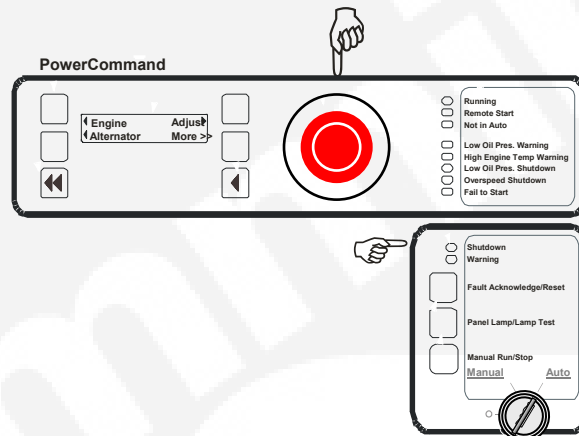
To advise the user of a possible delay in accepting the load, the **Low Coolant Temp (Code 1435)** message, in conjunction with illumination of the Warning LED, is provided. The engine cold sensing logic initiates a warning when the engine water jacket coolant temperature falls below 70°F (21°C). In applications where the ambient temperature falls below 40°F (4°C), a cold engine may be indicated even though the coolant heaters are connected. Under these conditions, although the generator set may start, it may not be able to accept load within ten seconds. When this condition occurs, check the coolant heaters for proper operation. If the coolant heaters are operating properly, other precautions may be necessary to warm the engine before applying a load.

5.8 Stopping

Run the generator set at no load for three to five minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

5.8.1 Emergency Stop

The Emergency Stop Button is located near the centre of the upper part of the control panel (Figure 4–1). Push the button in for an emergency stop. The red Shutdown status LED is lit and the Emergency Stop message is displayed.



To reset:

1. Pull, or pull and twist, the emergency stop button to unlatch it.
2. Turn the O/Manual/Auto key switch to Off (O).
3. Press the front panel Fault Acknowledge/Reset button.
4. Return the O/Manual/Auto key switch to appropriate position.

Note: Emergency Stop Shutdown status can be reset only at the operator control panel. When an emergency stop is initiated all generator set load is dumped immediately, and the engine is stopped without a cooling down run.

Caution: Do not use an emergency stop control for a normal stop.

5.8.2 Stopping at Control Panel (Manual Mode)

If the generator set was started at the control panel (O/Manual/Auto switch in the Manual position), pressing the Manual Run/Stop button causes the set to complete its normal (Local Start) shutdown sequence (Figures 5-1 and 5-2).

The set stops after the Cool-Down at Idle timer (0 to 30 minutes) has timed out.

Note: *The InPower service tool is required to enable/disable the Cool-Down at Idle feature. Contact an authorised service centre for assistance.*

Turning the O/Manual/Auto switch to the Off (O) position causes an immediate engine shutdown (bypasses Cool-Down at Idle). If possible, this hot shutdown should be avoided to help prolong the reliability of the engine.

5.8.3 Stopping from Remote Location (PTC or Remote Stop Signal) (Auto Mode)

If the control receives a remote stop signal (O/Manual/Auto switch in the Auto position), or the control detects the return of S1 voltage (PTC option installed) the set completes its normal shutdown sequence (Figures 5-3 and 5-4). (The remote stop signal is actually the removal of the remote start signal to the control).

The set stops after completing the Time Delay to Stop (0 to 600 seconds) and the Cool-Down at Idle (0-30 minutes).

Note: *Refer to the Adjust submenu Figure 4-8 to enable and change the Time Delay to Stop setting. The InPower service tool is required to enable/disable the Cool-Down at Idle feature. Contact an authorised service centre for assistance.*

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SECTION 6 – MAINTENANCE

6 Maintenance

All maintenance tasks must be assessed for health and safety risks, the preventative measures identified must be actioned. Accompaniment is required for tasks where the presence of someone else will add significantly to the safety of the task.

Read, understand and comply with all Caution and Warning notes in this section, those contained within Section 1 - Preliminary and Safety, and those contained within the Health and Safety Manual (0908-0110-00). Refer also to the Operator's engine specific manual supplied as part of the generator set documentation pack. This latter manual will contain further information regarding the running and care of the generator set and also specific equipment instructions that may differ from the standard generator set.

Ensure adequate lighting and staging (where required) are installed.

Caution: *Maintenance. must only be carry out by authorised and qualified maintenance engineers, who are familiar with the equipment and its operation.*

WARNING: **DEPENDENT UPON THE CONTROL SYSTEM FITTED, THIS UNIT MAY OPERATE AUTOMATICALLY AND COULD START WITHOUT WARNING.**

Caution: *Before carrying out any maintenance work, become familiar with the Generator Plant Safety Code given in Section 1 of this manual, together with the Health and Safety Manual (0908-0110-00).*

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

WARNING: ACCIDENTAL STARTING OF THE GENERATOR SET WHILE WORKING ON IT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. PREVENT ACCIDENTAL STARTING BY DISCONNECTING THE STARTING BATTERY LEADS (NEGATIVE [-] FIRST).

ENSURE BATTERY AREA HAS BEEN WELL-VENTILATED BEFORE SERVICING THE BATTERY. SPARKS OR ARCING CAN IGNITE EXPLOSIVE HYDROGEN GAS GIVEN OFF BY BATTERIES, CAUSING SEVERE PERSONAL INJURY. ARCING CAN OCCUR WHEN LEADS ARE REMOVED OR REPLACED, OR WHEN THE NEGATIVE (-) BATTERY LEAD IS CONNECTED AND A TOOL USED TO CONNECT OR DISCONNECT THE POSITIVE (+) BATTERY LEAD TOUCHES THE FRAME OR OTHER GROUNDED METAL PART OF THE GENERATOR SET.

INSULATED TOOLS MUST BE USED WHEN WORKING IN THE VICINITY OF THE BATTERIES.

ALWAYS REMOVE THE NEGATIVE (-) LEAD FIRST AND RECONNECT LAST.

ENSURE HYDROGEN FROM THE BATTERY, ENGINE FUEL AND OTHER EXPLOSIVE FUMES ARE FULLY DISSIPATED. THIS IS ESPECIALLY IMPORTANT IF THE BATTERY HAS BEEN CONNECTED TO A BATTERY CHARGER.

WARNING: TO COMPLETE MAINTENANCE TASKS AT HEIGHT REFER TO LOCAL LEGISLATIVE REQUIREMENTS. SUITABLE EQUIPMENT FOR PERFORMING THESE TASKS MUST BE USED IN ACCORDANCE WITH THE LOCAL GUIDELINES AND LEGISLATION. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH.

WARNING: DO NOT USE THE SKID (BEDFRAME) OR ANY PART OF THE GENERATOR SET AS A MEANS OF ACCESS. USE OF THE GENERATOR SET AS ACCESS MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH AND/OR PROPERTY AND EQUIPMENT DAMAGE.

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE WORK, LOCK OFF FOR SAFE WORKING:

1. PRESS THE OFF MODE SWITCH ON THE GENERATOR SET CONTROL PANEL.
2. AS AN ADDITIONAL PRECAUTION, PRESS THE EMERGENCY STOP BUTTON, AND HOLD IN FOR 30 SECONDS.
3. ISOLATE ALL SUPPLIES TO THE GENERATOR SET.
4. ISOLATE THE BATTERY CHARGER.
5. DISCONNECT THE BATTERY.
6. REMOVE THE STARTER CONTROL WIRES.
7. A SUITABLE WARNING PLATE STATING 'MAINTENANCE IN PROGRESS' SHOULD BE DISPLAYED PROMINENTLY.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE (LOCK AND TAG) ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

6.1 Locking the Generator Set Out of Service

6.1.1 Introduction

Before any work is carried out for maintenance, etc., the plant must be immobilised. Even if the plant is put out of service by pressing the Off switch on the control panel, the plant cannot be considered safe to work on until the engine is properly immobilised as detailed in the following procedures.

Caution: Refer also to the Operator's engine specific manual included in the documentation package supplied with the generator set. This manual will contain specific equipment instructions that may differ from the standard generator set.

WARNING: BEFORE CARRYING OUT ANY MAINTENANCE, ISOLATE ALL SUPPLIES TO THE GENERATOR SET AND ANY CONTROL PANELS. RENDER THE SET INOPERATIVE BY DISCONNECTING THE PLANT BATTERY.


Caution: If the engine has been running recently explosive gases (given off during battery charging) may be present in the vicinity of the batteries. Ensure the area is well ventilated before disconnecting batteries.

6.1.2 Immobilising the Generator Set for Safe Working

Note: Shutdown the engine first, as described in Section 5.7 - Stopping.

To immobilise the engine:

1. Press the Off Mode switch on the display panel.
2. Press the Emergency Stop Button, (and hold in for 30 seconds). This will prevent the starting of the generator set regardless of the Start signal source and will therefore provide an additional safety step for immobilising the generator set. (See also Section 5.7).

Note: When this Stop Button is pressed the display panel will indicate the Shutdown condition by illuminating the red Shutdown status LED  and displaying the following message on the graphical LCD display:

**Fault Number: 1433
EMERGENCY STOP**

or

**Fault Number: 1434
REMOTE EMERGENCY STOP**

Note: This Fault will affect the Fault History memory bank.

3. As an additional precaution, thoroughly ventilate the plant room before disconnecting any leads.
4. Isolate and lock off the supply to the heater, where fitted.
5. Isolate and lock off the supply to the battery charger, where fitted.
6. Isolate the fuel supply to the engine.
7. Disconnect the starting batteries and control system batteries, (if separate). Disconnect the negative (-) lead first. Attach a padlock through one of the battery leads and tag for safe working.
8. Fit warning notices at each of the above points to indicate Maintenance in Progress - Plant Immobilised for Safe Working.

6.2 General

The maintenance procedures covered in this manual are intended for Operator-level service only and must be performed at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Table 1 covers the recommended service intervals for a generator set on Standby service. If the generator set will be subjected to Prime usage or extreme operating conditions, the service intervals should be reduced accordingly. Consult your authorised distributor.

Some of the factors that can affect the maintenance schedule are:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand.

Consult with an authorised distributor if the generator set will be subjected to any extreme operating conditions and determine a suitable schedule of maintenance. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first. Use Table 1 to determine the maintenance required and then refer to the sections that follow for the correct service procedures.

Refer also to the Operator's engine manual supplied with the generator set.

Table 2 Periodic Maintenance Schedule

MAINTENANCE ITEMS		Daily or after 8 Hours	Weekly or after 50 Hours 7	Monthly or after 100 Hours7	3 Months or after 250 Hours ■ 5, 7
Perform maintenance tasks as specified using Daily or Hourly periods – whichever is the sooner					
Check:	Fuel tank level	■			
	Fuel lines and hoses	■1			
	Bedframe fluid containment (where fitted), drain if necessary	■8			
	Engine oil level	■1	■6		
	Coolant level of radiator(s) (water jacket & LTA)	■4			
	Coolant lines and radiator hoses for wear and cracks	■1			
	Cooling fan blades	■			
	All exhaust components, and hardware (fittings, clamps, fasteners, etc.)	■1			
	Drive belt, condition and tension		■2		
	Air cleaner restriction indicator (where fitted)	■			
	Air intake system for leaks	■			
	Electrical connections (battery, starter motor and alternator connections)		■		
	Safety controls and alarms	■			
	Operation of Emergency Stop Button		■		
Drain:	Water from fuel pre-filter (where fitted)	■3			
Clean:	Radiator matrix			■4,5	

- 1 – Check for oil, fuel, coolant and exhaust system leaks. Check exhaust system audibly and visually with generator set running. (Refer to [Sections 6.8](#) and [6.9](#)).
- 2 – Visually check belt for evidence of wear or slippage. Replace if hard or brittle (to be undertaken by a Service Engineer).
- 3 – Drain one cup, or more, of fuel to remove water and sediment.
- 4 – Refer to Section 6.4 of this manual and to the Radiator Information Manual 0908-0107-00 supplied with this generator set.
- 5 – To be undertaken by a Service Engineer. Please refer to your Authorised Distributor.
- 6 – Engine oil and filter must be replaced after the initial running-in period of 50 hours. Please refer to your authorised distributor.
- 7 – All maintenance checks and inspections listed at lesser maintenance intervals must also be carried out at this time.
- 8 – For generator sets with QSB7 engines refer to Engine Operators manual for that model.

6.3 Daily or Refuelling Maintenance Procedures

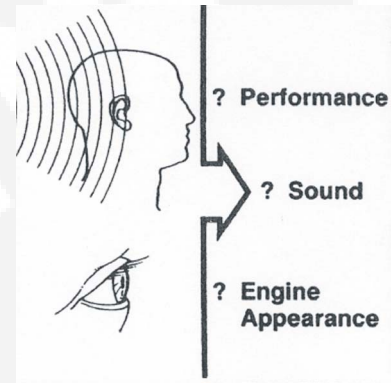
Monitor fluid levels, oil pressure, and coolant temperature frequently. During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover areas that must be frequently inspected for continued safe operation.

6.3.1 General Information

Preventative maintenance begins with day-to-day awareness of the condition of the generator set.

Before starting the generator set check the oil and coolant levels and look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine or generator set appearance.



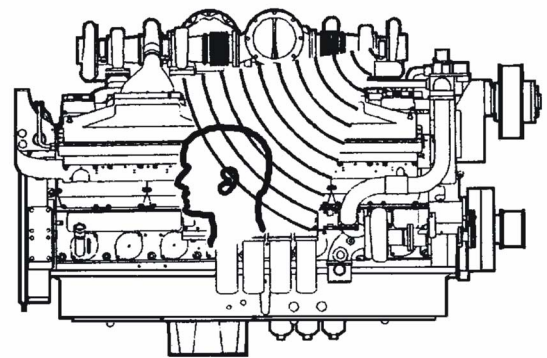
6.3.2 Engine Operation Report

The engine must be maintained in good mechanical condition if the operator is to obtain optimum satisfaction from its use. Running reports are necessary to enable programmed or emergency servicing to be carried out.

Comparison and intelligent interpretation of the running report, together with a practical follow-up action will eliminate most failures and emergency repairs.

Most engine problems give an early warning. Look and listen for changes in engine performance, sound, or appearance that can indicate service or repair is needed. Some engine changes to look for and report on are:

- Low lubricating oil pressure
- Low power
- Abnormal water or oil temperature
- Unusual engine noise
- Excessive exhaust smoke
- Excessive use of coolant, fuel or lubricating oil
- Any coolant, fuel or lubricating oil leaks.
- Misfire
- Vibration



6.4 Cooling System

WARNING: CONTACT WITH HOT COOLANT CAN RESULT IN SERIOUS SCOLDING. ALLOW COOLING SYSTEM TO COOL BEFORE RELEASING PRESSURE AND REMOVING WATER JACKET RADIATOR CAP OR LTA EXPANSION TANK CAP.

Caution: Loss of coolant can allow engine to overheat without protection of shutdown device, and cause severe damage to the engine. Maintain coolant level for proper operation of high engine temperature shutdown system.

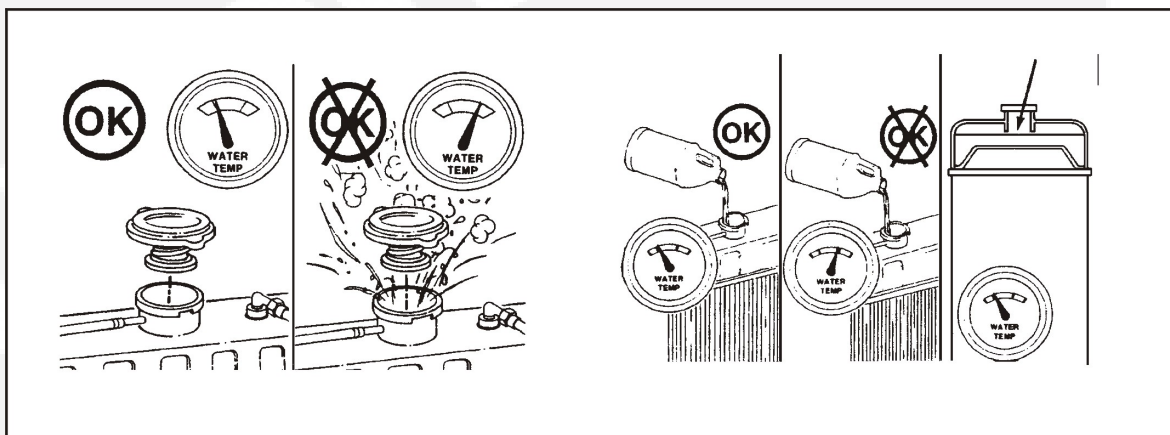
6.4.1 Coolant Level - Check

WARNING: DO NOT REMOVE THE RADIATOR CAP FROM A HOT ENGINE; WAIT UNTIL THE TEMPERATURE IS BELOW 50°C (122°F) BEFORE REMOVING PRESSURE CAP. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY FROM HEATED COOLANT SPRAY OR STEAM. REMOVE FILLER CAP SLOWLY TO RELEASE COOLANT SYSTEM PRESSURE.

Caution: Avoid prolonged or repeated skin contact with antifreeze. Refer to the Health and Safety Manual 0908-0110-00 for handling and disposal of antifreeze.

Note: Never use a sealing additive to stop leaks in the coolant system. This can result in a blocked coolant system and inadequate coolant flow causing the engine to overheat.

Coolant level must be checked daily. The standard coolant concentration is either 25% or 50% Ethylene Glycol and water, this concentration must be maintained. Warranty claims for damage will be rejected if the incorrect mix of anti-freeze has been used. Consult your authorised distributor for the correct anti-freeze specifications and concentration for your operating conditions. The recommended antifreeze is Fleetguard® Compleat ES which is a low-silicate antifreeze, or its equivalent.



Caution: Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C (122°F) before adding coolant.

Note: On applications that use a coolant recovery system, check to ensure the coolant is at the appropriate level on the coolant recovery tank dependent on engine temperature.

Fill the cooling system with coolant to the bottom of the fill neck in the radiator or expansion tank, with the coolant temperature at 50°C (122°F) or lower.

Note: Some radiators have two fill necks, both of which must be filled. Refer to the generator set specific drawings supplied with the set.

6.4.2 Cooling Fan – Inspect

WARNING: PERSONAL INJURY CAN RESULT FROM A FAN BLADE FAILURE. NEVER PULL OR PRY ON THE FAN, THIS CAN DAMAGE THE FAN BLADE(S) AND CAUSE FAN FAILURE.

A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted.

Contact your authorised distributor if the fan is damaged.

6.4.3 Drive Belt – Inspect

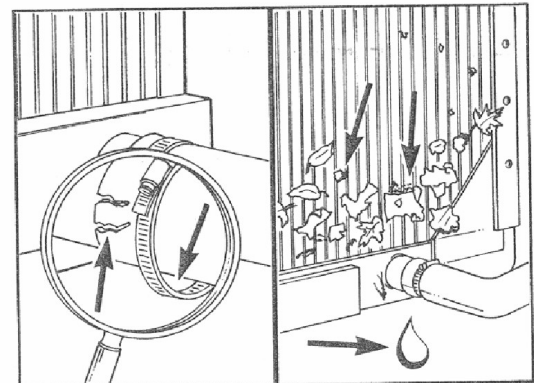
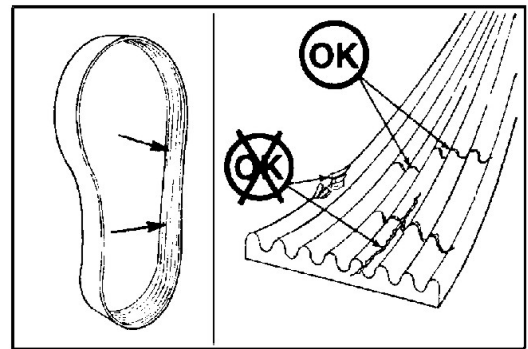
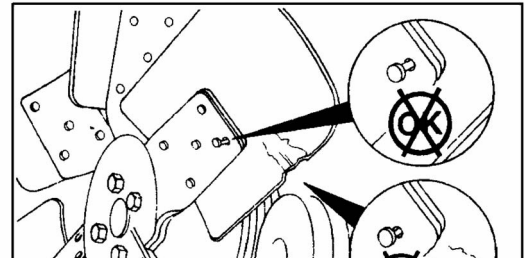
Visually inspect the belt through the guarding, checking for intersecting cracks. Small transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are NOT acceptable. Contact your authorised distributor if the belt is frayed or has pieces of material missing.

6.4.4 Radiator – Check

Check for damaged hoses, and loose and damaged hose clamps.

Inspect the exterior of the radiator (through the guarding) for obstructions. During the service life of a radiator a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

Refer to the Radiator Information Manual 0908-0107-00 for further details on cleaning the radiator.



6.5 Engine Oil

6.5.1 Engine Oil Level – Check

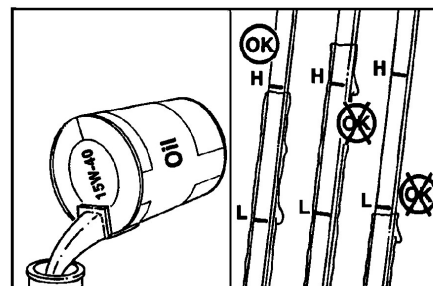
WARNING: CRANKCASE PRESSURE CAN BLOW OUT HOT OIL AND CAUSE SEVERE BURNS. DO NOT CHECK OIL WHILE THE GENERATOR SET IS OPERATING.

Caution: Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

Caution: Prolonged and repeated skin contact with used engine oils can cause skin disorders or other bodily injury.
Refer to the Health and Safety Manual (0908-0110-00) supplied with your generator set for precautions when handling or disposing of used engine oil.

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table 1.

Never operate the engine with the oil level below the L (Low) mark, or above the H (High) mark. Wait at least fifteen minutes, after shutting off the engine, before checking the oil level. This allows time for the oil to drain back to the oil pan.



Note: Use high-quality 15W-40 multi-viscosity lubricating oil such as Cummins Premium Blue® or its equivalent. Consult your authorised distributor for the correct lubricating oil for your operating conditions.



6.6 Fuel System

WARNING: IGNITION OF FUEL CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH BY FIRE OR EXPLOSION. DO NOT PERMIT ANY FLAME, CIGARETTE, OR OTHER IGNITER NEAR THE FUEL SYSTEM, OR IN AREAS SHARING VENTILATION.

WARNING: ENGINE FUEL ACTUATORS CAN OPERATE AT VOLTAGES UP TO 140 VOLTS DC.

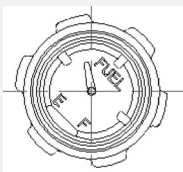
WARNING: DO NOT MIX GASOLINE OR ALCOHOL WITH DIESEL FUEL. THIS MIXTURE CAN CAUSE AN EXPLOSION AND DAMAGE TO THE ENGINE – GASOLINE AND ALCOHOL HAVE INFERIOR LUBRICITY.

Caution: *Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.*

Use ASTM No. 2D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 are often needed in high altitudes, or extremely low ambient temperatures, to prevent misfires and excessive smoke. Contact your authorised distributor for your operating conditions.

Note: *A diesel fuel to BS 2869:2006; (Fuel oils for agricultural, domestic and industrial engine and boilers), conforming to the requirements and test methods of that specification would be an acceptable alternative to ASTM No. 2D.*

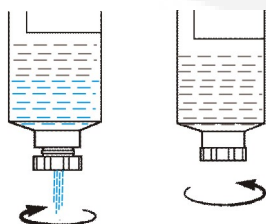
6.6.1 Fuel Level



To avoid condensation problems, keep fuel supply tanks as full as possible by filling up each time the engine is used. Condensation (water) can cause clogging of the fuel filters as well as possible freezing problems. In addition, water mixing with the sulphur in the fuel forms acid which can corrode and damage engine parts.

A base fuel tank may be incorporated into the bedframe. This tank is fitted with a large filler cap with in-built coarse filter, and provides a minimum of eleven hours operation at a nominal 100% load.

6.6.2 Fuel/Water Separator - Drain



Drain the water and sediment from the separator daily.

Set-mounted fuel/water separators are fitted to provide protection for the engine fuel injection system as water-free fuel supplies cannot be guaranteed.

Turn the valve counterclockwise, four complete turns, until the valve drops down one inch. Drain the filter sump of water until clear fuel is visible.

Push the valve up and turn the valve clockwise to close drain valve.

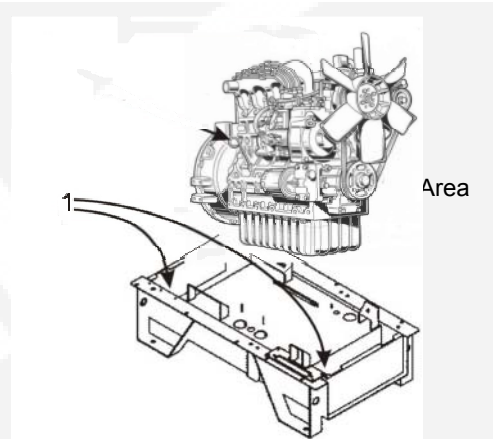
Caution: *Do not over tighten the valve. Over tightening can damage the threads.*

Note: *If more than 2 oz is drained, refilling of the filter is required to prevent hard starting.*



6.7 Fluid Containment

The bedframe fluid containment area (if applicable) must be inspected at regular intervals and any liquid must be drained off and disposed off in line with local health and safety regulations. (Refer also to Health and Safety manual 0908-0110-00). Failure to perform this action may result in spillage of liquids likely to contaminate the surrounding area.



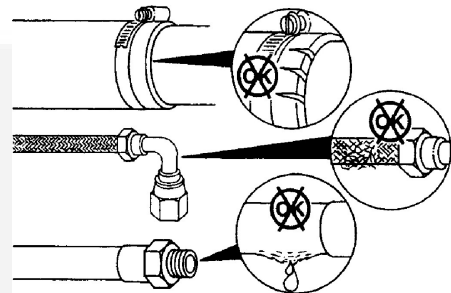
Any other fluid containment area must also be checked and emptied, as above.

6.8 Hoses and Fuel Lines - Check

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC..

TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT METAL PARTS SUCH AS RADIATOR, TURBOCHARGER AND EXHAUST SYSTEM.

With the generator set operating, inspect the supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and ensure they are not rubbing against anything that could cause breakage. If any leaks are detected, shut down the generator set (if possible), contact your authorised distributor and have the leaks corrected immediately.



6.9 Exhaust System

WARNING: EXHAUST COMPONENTS BECOME VERY HOT WHEN THE GENERATOR SET IS IN USE AND REMAIN HOT FOR A PERIOD OF TIME AFTER THE GENERATOR SET HAS BEEN SHUT DOWN. THESE COMPONENTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH FROM CONTACT. ALLOW THESE COMPONENTS TO COOL COMPLETELY BEFORE PERFORMING ANY MAINTENANCE TASKS.

WARNING: INHALATION OF EXHAUST GASES CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH. BE SURE DEADLY EXHAUST GAS IS PIPED OUTSIDE AND AWAY FROM WINDOWS, DOORS OR OTHER INLETS TO BUILDINGS. DO NOT ALLOW TO ACCUMULATE IN HABITABLE AREAS.

WARNING: MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION AROUND HOT MANIFOLDS, MOVING PARTS, ETC..

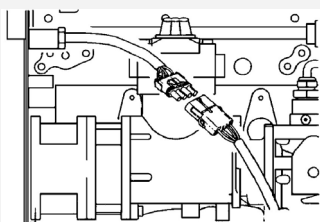
With the generator set operating, inspect the exhaust system visually and audibly where possible checking for leaks within the system, with out removing guarding and panels. If any leaks are detected, shut down the generator set, contact your authorized distributor and have the leaks corrected immediately.

6.10 Generator Set Output - AC Electric System

Check the following while the generator set is operating:

- Frequency: The generator set frequency should be stable and the reading should be the same as the generator set nameplate rating (50Hz/1500RPM or 60Hz/1800RPM).
- AC Voltage: At no load, the line-to-line voltage(s) should be the same as the generator set nameplate rating.
- AC Ammeter: At no load, the current readings should be zero. With a load applied, each line current should be similar.
- Panel Lamps: When the Operating Panel is first connected to the DC supply, the system runs a check by illuminating each of the indicator lamps in turn.

6.11 DC Electrical System



Check the terminals on the batteries for clean and tight connections. Loose or corroded connections create resistance, which can hinder starting. Use insulated tools when disconnecting battery cables. Clean and reconnect the battery cables if loose. Always disconnect both ends of the negative battery cable. Reconnect one end of the cable to the negative battery terminal and the other end to ground. This will ensure that any arcing will be away from the battery and least likely to ignite explosive battery gases.

WARNING: IGNITION OF EXPLOSIVE BATTERY GASES CAN CAUSE SEVERE PERSONAL INJURY. DO NOT SMOKE, DO NOT USE NAKED FLAMES OR CAUSE SPARKS WHILE SERVICING BATTERIES.

Refer to Supplementary Publication 0908-0101-00 for cleaning and safety precautions of the battery.



SECTION 7 - TROUBLESHOOTING

7 Troubleshooting

7.1 Introduction

Fault code tables, together with Warning and Shutdown code tables, are provided in this section to assist in locating and identifying the possible causes of faults in the generator set system.

The engine manual, and the Alternator Installation, Service and Maintenance Manual contain their own fault finding charts which identify the possible causes of their respective faults.

7.2 Control Unit

The generator set control continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the control will illuminate a yellow Warning lamp or a red Shutdown lamp and display a message on the digital display.

This section lists the Warning and Shutdown Fault Codes/Messages (Table 7-1), and suggests troubleshooting procedures (Table 7-2).

Note: *Displayed error codes that are not listed in Table 7-2 will require an authorised service representative to correct the fault. Contact an authorised service centre for assistance.*

7.3 Safety Considerations

Fault finding work, particularly in confined areas, should be carried out by two engineers working together. Read, understand and comply with all safety precautions listed throughout this manual, and the Health and Safety Manual 0908-0110-00.

The installation of a generator set can be designed for remote starting. When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Refer to Section 6.2 – Locking the Generator Set Out of Service.

WARNING: DURING TESTING IT MAY BE NECESSARY TO REMOVE COVERS TO ADJUST CONTROLS EXPOSING 'LIVE' TERMINALS OR COMPONENTS. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICING SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS. REFIT ALL ACCESS COVERS AFTER ADJUSTMENTS HAVE BEEN COMPLETED.

WARNING: SOME PANEL INTERNAL COMPONENTS MAY HAVE LIVE EXPOSED TERMINATIONS, EVEN IF THE GENERATOR SET IS NOT RUNNING. ISOLATE ALL EXTERNAL ELECTRICAL SUPPLIES PRIOR TO ACCESS OF THE CONTROL PANEL.

WARNING: CONTACTING HIGH VOLTAGE COMPONENTS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH CAUSED BY ELECTROCUTION. KEEP THE OUTPUT BOX COVERS IN PLACE DURING TROUBLESHOOTING. ONLY PERSONNEL QUALIFIED TO PERFORM ELECTRICAL SERVICING SHOULD CARRY OUT TESTING AND/OR ADJUSTMENTS.

WARNING: HIGH VOLTAGES ARE PRESENT WHEN THE SET IS RUNNING. DO NOT OPEN THE GENERATOR OUTPUT BOX WHILE THE SET IS RUNNING.

WARNING: VENTILATE BATTERY AREA BEFORE WORKING ON OR NEAR BATTERY—WEAR GOGGLES—STOP GENERATOR SET AND DISCONNECT CHARGER BEFORE DISCONNECTING BATTERY CABLES—DISCONNECT NEGATIVE (-) CABLE FIRST AND RECONNECT LAST.

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.

WARNING: ACCIDENTAL STARTING OF THE GENERATOR SET CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ENSURE THAT THE GENERATOR SET HAS BEEN LOCKED OUT OF SERVICE (SEE SECTION 6.2) BEFORE INSPECTING, OR WORKING ON, THE GENERATOR SET.

Caution: *Always disconnect a battery charger from its AC source before disconnecting the battery leads. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.*

7.4 Fault Finding

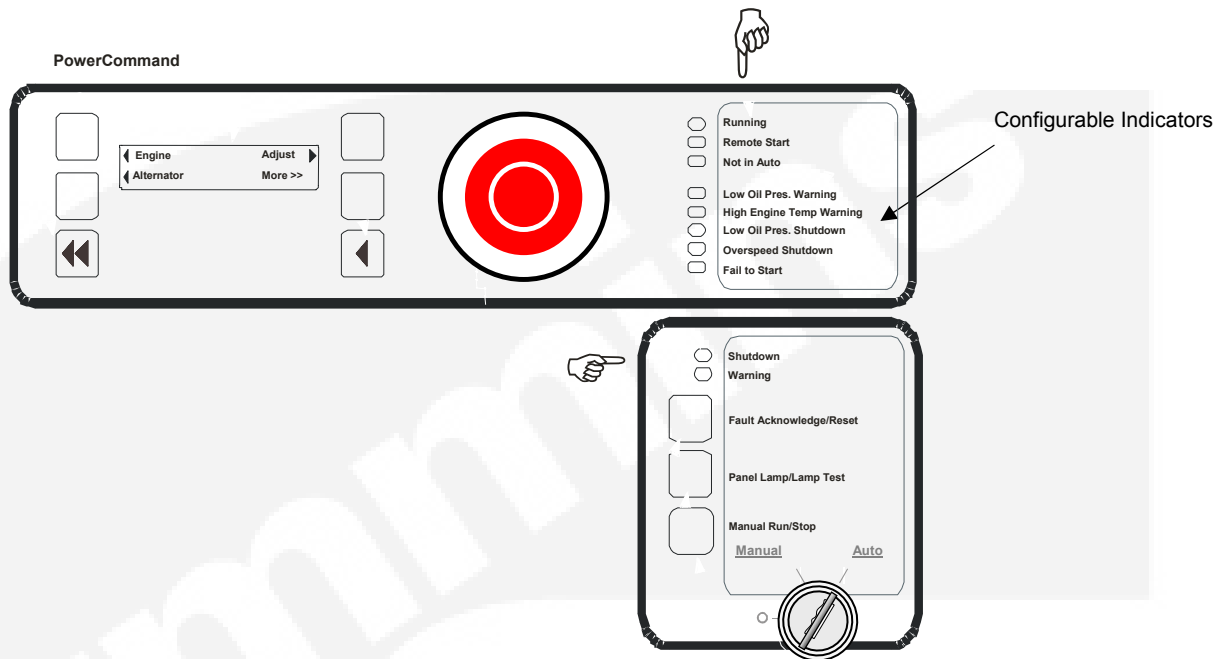
Should a fault condition occur during operation follow the procedures in Tables 7-1 and 7-2 to locate and correct the problem. For any symptom not listed, contact an authorised service centre for assistance.

Before starting any fault finding, ensure that the following basic checks are carried out:

- All switches and controls are in their correct positions
- The fuel oil level is correct
- The lubricating oil level is correct
- The coolant level is correct
- The radiator matrix is free from obstruction
- The battery charge condition is satisfactory and the connections are secure
- The generator set electrics and alternator connections are secure
- The panel connections are secure
- The protection circuits have been replaced
- Blown fuses have been replaced
- Tripped contactors or circuit breakers have been reset

WARNING: MANY TROUBLESHOOTING PROCEDURES PRESENT HAZARDS THAT CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY QUALIFIED SERVICE PERSONNEL WITH KNOWLEDGE OF FUELS, ELECTRICITY AND MACHINERY HAZARDS SHOULD PERFORM SERVICE PROCEDURES.
READ, UNDERSTAND AND COMPLY WITH ALL CAUTION AND WARNING NOTES WITHIN THIS MANUAL TOGETHER WITH THE HEALTH AND SAFETY MANUAL 0908-0110-00.

7.5 Status Indicators



7.5.1 Running Indicator:

This green lamp is lit whenever the generator set (local or remote) is running.

7.5.2 Remote Start Indicator:

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

7.5.3 Not in Auto Indicator:

This red lamp flashes continuously when the O/Manual/Auto switch is not in the Auto position. (If in Auto position and the lamp is flashing, service is required).

7.5.4 Configurable Indicators:

Defaults for the configurable indicators shown above can be changed with the InPower service tool.

7.5.5 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 Off (O) position and pressing the Fault Acknowledge/Reset button.

7.5.6 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 may not be necessary to stop the generator set). In Auto mode, warning indicators can also be reset by cycling the remote reset input after the condition has been corrected.

Note: *Some warnings remain active after the condition has been corrected and the control reset button has been pressed. This will require the generator set to be shut down, to reset the warning indicator.*

7.5.7 Digital Display:

This two-line; 20-characters per line; alphanumeric display is used to view menus of the menu-driven operating system and to show Warning and Shutdown messages.

7.6 Line Circuit Breaker (Optional)

The optional line circuit breaker mounts on the generator set output box. If the load exceeds the generator set's current rating, the line circuit breaker will open, preventing the generator set from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as necessary. Manually reset the breaker to reconnect the load to the generator set.

7.7 Control and Diagnostics via Network or PC (Laptop)

See your authorised Cummins Power Generation dealer regarding software, hardware and network requirements for control and diagnostics via a network or PC.

7.8 Fault Codes

The fault codes have been divided into five categories to help you determine what corrective action to take for safe operation of the generator set. Use Table 7–1 to find the category (CTG) and fault description for all codes. *Gaps in the code numbers are for codes that do not apply to this generator set.*

7.8.1 Category A Fault Codes:

Pertain to engine or alternator shutdown faults that require immediate repair by qualified service personnel (generator set non–operational). Control prevents the generator set from being restarted.

7.8.2 Category B Fault Codes:

Consist of faults that can affect generator set performance or cause **engine, alternator, or connected equipment damage**. Operate only when generator set is powering critical loads and cannot be shut down. Requires repair by qualified service personnel.

7.8.3 Category C Fault Codes:

Consist of faults that do not affect generator set performance but require qualified service personnel to repair. These codes indicate a defective harness or wiring problem.

These codes can also indicate a defective engine sensor, leaving no engine protection. (Engine damage can occur without detection).

Note: *Continued operation may void generator set warranty if damage occurs that relates to this fault condition.*

7.8.4 Category D Fault Codes:

Consist of faults that are repairable by site personnel. Service will be required by qualified service personnel if site personnel cannot resolve the problem after taking the corrective actions suggested in Table 7–2.

7.8.5 Category E Fault Codes:

Indicates non–critical operational status of generator set; external faults; or customer fault inputs. May require repair by qualified service personnel.

<p><u>WARNING:</u> MANY TROUBLESHOOTING PROCEDURES PRESENT HAZARDS THAT CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. ONLY QUALIFIED SERVICE PERSONNEL WITH KNOWLEDGE OF FUELS, ELECTRICITY AND MACHINERY HAZARDS SHOULD PERFORM SERVICE PROCEDURES. READ, UNDERSTAND AND COMPLY WITH ALL CAUTION AND WARNING NOTES WITHIN THIS MANUAL TOGETHER WITH THE HEALTH AND SAFETY MANUAL 0908-0110-00.</p>

Table 7-1 Warning and Shutdown Fault Codes

CTG	CODE	LAMP	DISPLAYED MESSAGE
A	121	Shtdn	Speed Signal Lost
C	135	Wrng	Oil Pressure Sensor H
C	141	Wrng	Oil Pressure Sensor L
D	143	Wrng	Pre-Low Oil Pres
C	144	Wrng	Coolant Sensor High
C	145	Wrng	Coolant Sensor Low
D	146	Wrng	Pre-High Coolant Temp
D	151	Shtdn	High Coolant Temp
D	197	Wrng	Low Coolant Level
C	212	Wrng	Oil Temp Sensor H
C	213	Wrng	Oil Temp Sensor L
A	234	Shtdn	Overspeed
D	235	Shtdn	Low Coolant Level
D	359	Shtdn	Fail to Start
D	415	Shtdn	Low Oil Pressure
D	421	Wrng	Oil Temp
D	441	Wrng	Low Bat Voltage
D	442	Wrng	High Bat Voltage
E	1122	None	Rated/Idle Trans
A	*1123	Shtdn	Shutdown after Battle Short
E	1124	Wrng	Delayed Shutdown
E	1131	Wrng	Battle Sh Active
E	*1311	Shtdn/ Wrng/ None	Customer Input #1
E	1312	Shtdn/ Wrng/ None	Customer Input #2
E	1313- 1316	Shtdn/ Wrng/ None	Network Fault 1 thru 4
E	1317	Shtdn/ Wrng/ None	Customer Input #3
E	1318	Shtdn/ Wrng/ None	Customer Input #4
A	1334	Shtdn	Crit Scaler Out Of Range
B	1335	Wrng	Noncrit Scaler Out Of Range
E	1337	None	No Message
C	*1416	Wrng	Fail to Shutdown
D	1417	Wrng	Powr Down Error

* Refer to Battle Short Mode description in Section 4

CTG	CODE	LAMP	DISPLAYED MESSAGE
D	1433	Shtdn	Emergency Stop
D	1434	Shtdn	Remote E-Stop
D	1435	Wrng	Low Coolant Temp
D	1438	Shtdn	Fail to Crank
D	1442	Wrng	Weak Battery
D	1443	Shtdn	Battery Failed
B	1444	Wrng	KW Overload
A	1445	Shtdn	Short Circuit
A	1446	Shtdn	High AC Voltage
A	1447	Shtdn	Low AC Voltage
A	1448	Shtdn	Under Frequency
A	1449	Wrng	Over Frequency
A	1452	Wrng	Gen CB Not Close
A	1453	Wrng	Gen CB Not Open
A	1459	Shtdn	Reverse Power
A	1461	Shtdn	Loss of Field
C	1466	Wrng	Modem Failure
C	1468	Wrng	Network Error
A	1469	Shtdn	Speed/Hz Match
B	1471	Wrng	Over Current
A	1472	Shtdn	Over Current
E	2323- 2326	Shtdn/ Wrng/ None	Network Fault 5 thru 8
B	2327	Wrng	PTC Fault
E	2329	Wrng	Low S1 Frequency
E	2331	Wrng	Low S1 Voltage
A	2335	Shtdn	Excitation Fault
A	2336	Shtdn	Memory Error
C	2337	Wrng	Pwr Tran Disabled
C	2338	Wrng	Pwr Tran Failure
E	2339	Wrng	Pwr Down Enabled
B	2341	Wrng	High Control Temp
E	2342	Wrng	Too Long In Idle (10 min.)
E	2358	Wrng	High S1 Voltage
E	2396	Wrng	S1 CB Not Closed
E	2397	Wrng	S1 CB Not Open
C	2966	Wrng	PTC Timeout
C	2967	Wrng	Governor Fault
C	2968	Wrng	AVR Fault
C	2969	Wrng	LON Failure
A	2972	Shtdn	Field Overload

Table 7-2

Troubleshooting Procedures for Fault Codes

FAULT CODE	CORRECTIVE ACTION
CODE: 143 LAMP: Warning MESSAGE: PRE-LOW OIL PRESSURE	Indicates engine oil pressure has dropped below the warning trip point. If generator set is powering critical loads and cannot be shut down, wait until next shutdown period and then follow 415 Low Oil Pressure procedure.
CODE: 146 LAMP: Warning MESSAGE: PRE-HIGH COOLANT TEMP	Indicates engine has begun to overheat and water jacket coolant temperature has risen to an unacceptable level. Increase in load or higher ambient temperature may cause High Coolant Shutdown (151). If generator set is powering non-critical and critical loads and cannot be shut down, proceed as follows: a) Reduce load if possible by turning off non-critical loads. b) Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow 151 High Coolant Temp procedure.
CODE: 151 LAMP: Shutdown MESSAGE: HIGH COOLANT TEMP	Indicates engine has overheated (water jacket coolant temperature has risen above the shutdown trip point or the coolant level is low). Allow engine to cool down completely before proceeding with the following checks: a) Check water jacket 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 replace, repair, or adjust if necessary. d) Check blower fan and circulation pumps on remote radiator installations. e) Reset control and restart after locating and correcting problem.
CODE: 197 LAMP: Warning (optional) MESSAGE: LOW COOLANT LEVEL	Indicates engine water jacket coolant level has fallen below the warning alarm trip point. If generator set is powering critical loads and cannot be shut down, wait until next shutdown period, then follow 235 Low Coolant Level procedure. If engine can be stopped, follow 235 procedure.
CODE: 235 LAMP: Shutdown (optional) MESSAGE: LOW COOLANT LEVEL	Indicates engine water jacket coolant level has fallen below the shutdown alarm trip point. Allow engine to cool down completely before proceeding. a) Check water jacket coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b) Reset control and restart after locating and correcting problem.
CODE: 359 LAMP: Shutdown MESSAGE: FAIL TO START	Indicates a possible fuel system problem. (Engine cranks but fails to start). a) Check for empty fuel tank, fuel leaks or blocked fuel lines, and correct as necessary. b) Check for dirty fuel filter, replace if necessary. c) Check for dirty or blocked air filter and replace if necessary. d) Reset the control and restart after correcting problem.
CODE: 415 LAMP: Shutdown MESSAGE: LOW OIL PRESSURE	Indicates engine oil pressure has dropped below the shutdown trip point. a) Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. b) Reset control and restart.

FAULT CODE	CORRECTIVE ACTION
<p>CODE: 421 LAMP: Warning (optional) MESSAGE: OIL TEMP</p>	<p>Indicates engine has begun to overheat (oil temperature has risen to an unacceptable level). If generator set is powering non-critical and critical loads and cannot be shut down, proceed as follows:</p> <ol style="list-style-type: none"> Reduce load if possible by turning off non-critical loads. Check air inlets and outlets and remove any obstructions to airflow. If engine can be stopped, follow 151 HIGH COOLANT TEMP procedure, and also check engine oil level.
<p>CODE: 441 LAMP: Warning MESSAGE: LOW BAT VOLTAGE</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 charge float level if applicable (raise float level).
<p>CODE: 442 LAMP: Warning MESSAGE: HIGH BAT VOLTAGE</p>	<p>Indicates battery voltage supply to the control is approaching a high level at which damage to the control can occur.</p> <ol style="list-style-type: none"> Check float level on battery charger if applicable (lower float level).
<p>CODE: 1311, 1312, 1317, 1318 LAMP: Shutdown/Warning or none for status message. MESSAGE: CUSTOMER INPUT #1 - #4</p>	<p>When any one of these customer defined inputs is detected by the control, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. Example inputs: Low Fuel Day Tank; Water in fuel; Low Starting Hydraulic Pressure; Low Starting Air Pressure etc. These fault functions can be programmed (using service tool), to initiate a shutdown or warning as indicated by the Warning or Shutdown lamp, as follows:</p> <ol style="list-style-type: none"> Enable/disable input (Default: enable). Status, Warning or Shutdown (Default: #1-None, #2 thru #4-Warning). Active closed or open (Default: closed [ground]). Change display name using up to 19 characters (Default: #1-Customer Fault 1, #2-Ground Fault, #3=Low Fuel, #4-Rupture Basin Fault). <p>Note: Customer fault messages are editable. The message displayed for the code shown (1311 through 1318) is determined by the customer.</p>
<p>CODE: 1417 LAMP: Warning MESSAGE: POWER DOWN ERROR</p>	<p>Indicates that the controller cannot power down due to some unknown condition. Possible drain on battery. Contact an authorised service centre for service.</p>

FAULT CODE	CORRECTIVE ACTION
CODE: 1433 LAMP: Shutdown MESSAGE: EMERGENCY STOP	Indicates local Emergency Stop. Emergency Stop shutdown status can be reset only at the local control panel. To reset the local/remote Emergency Stop button: a) Pull the button out (or twist and pull button). b) Turn the Off/Manual/Auto switch to Off (O). c) Press the front panel Fault Acknowledge/Reset button. d) Select Manual or Auto, as required.
CODE: 1434 LAMP: Shutdown MESSAGE: REMOTE E-STOP	Indicates remote Emergency Stop. See code 1433 to reset.
CODE: 1435 LAMP: Warning MESSAGE: LOW COOLANT TEMP	Indicates engine coolant heater is not operating or is not circulating coolant. Set is in standby mode but is not operating. Warning occurs when engine water jacket coolant temperature is 70°F (21°C) or lower. NOTE: In applications where the ambient temperature falls below 40°F (4°C), Low Coolant Temp may be indicated even though the coolant heaters are operating. Check for the following conditions: a) Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cable and correct as required. b) Check for low water jacket coolant level and replenish if required. Look for possible coolant leakage points and repair as necessary.
CODE: 1438 LAMP: Shutdown MESSAGE: FAIL TO CRANK	Indicates possible fault with control, speed sensing or starting system. See code 441 LOW BAT VOLTAGE for corrective action.
CODE: 1442 LAMP: Warning MESSAGE: WEAK BATTERY	Indicates that during cranking, the battery voltage is at or below the weak battery warning trip point for a time greater than or equal to the weak battery set time. See code 441 LOW BAT VOLTAGE for corrective action.
CODE: 1443 LAMP: Shutdown MESSAGE: BATTERY FAILED	Dead battery – engine will not start. See code 441 LOW BAT VOLTAGE for corrective action.
CODE: 2342 LAMP: Warning message: TOO LONG IN IDLE	Indicates that the generator set has been in Idle mode too long (ten minutes maximum).

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