



# **Service Manual**

## **Controller**

PowerCommand<sup>®</sup> 2100



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# 1 IMPORTANT SAFETY INSTRUCTIONS

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

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.

## 1.1 Warning, Caution, and Note Styles Used in This Manual

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

### DANGER

*Indicates a hazardous situation that, if not avoided, will result in death or serious injury.*

### WARNING

*Indicates a hazardous situation that, if not avoided, could result in death or serious injury.*

### CAUTION

*Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.*

### NOTICE

Indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

## 1.2 General Information

This manual should form part of the documentation package supplied by Cummins with specific generator sets. In the event that this manual has been supplied in isolation, please contact your authorized distributor.

### NOTICE

It is in the operator's interest to read and understand all warnings and cautions contained within the documentation relevant to the generator set, its operation and daily maintenance.

## 1.2.1 General Safety Precautions

### WARNING

#### ***Hot Pressurized Liquid***

***Contact with hot liquid can cause severe burns.***

***Do not open the pressure cap while the engine is running. Let the engine cool down before removing the cap. Turn the cap slowly and do not open it fully until the pressure has been relieved.***

### WARNING

#### ***Moving Parts***

***Moving parts can cause severe personal injury.***

***Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.***

### WARNING

#### ***Toxic Hazard***

***Used engine oils have been identified by some state and federal agencies to cause cancer or reproductive toxicity.***

***Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil. Wear protective gloves and face guard.***

### WARNING

#### ***Electrical Generating Equipment***

***Incorrect operation can cause severe personal injury or death.***

***Do not operate equipment when fatigued, or after consuming any alcohol or drug.***

### WARNING

#### ***Toxic Gases***

***Substances in exhaust gases have been identified by some state and federal agencies to cause cancer or reproductive toxicity.***

***Do not breathe in or come into contact with exhaust gases.***

### WARNING

#### ***Combustible Liquid***

***Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.***

***Do not store fuel, cleaners, oil, etc., near the generator set.***

### WARNING

#### ***High Noise Level***

***Generator sets in operation emit noise, which can cause hearing damage.***

***Wear appropriate ear protection at all times.***



**⚠ WARNING****Hot Surfaces**

**Contact with hot surfaces can cause severe burns.**

**The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.**

**⚠ WARNING****Electrical Generating Equipment**

**Incorrect operation and maintenance can result in severe personal injury or death.**

**Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.**

**⚠ WARNING****Toxic Hazard**

**Ethylene glycol, used as an engine coolant, is toxic to humans and animals.**

**Wear appropriate PPE. Clean up coolant spills and dispose of used coolant in accordance with local environmental regulations.**

**⚠ WARNING****Combustible Liquid**

**Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.**

**Do not use combustible liquids like ether.**

**⚠ WARNING****Automated Machinery**

**Accidental or remote starting of the generator set can cause severe personal injury or death.**

**Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [-] first).**

**⚠ WARNING****Fire Hazard**

**Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.**

**Make sure the generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.**

**⚠ WARNING****Fire Hazard**

**Accumulated grease and oil are a fire hazard. Fire can cause severe burns or death.**

**Keep the generator set and the surrounding area clean and free from obstructions. Repair oil leaks promptly.**

**⚠ WARNING****Fall Hazard**

*Falls can result in severe personal injury or death.*

*Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.*

**⚠ WARNING****Fire Hazard**

*Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.*

*Keep the generator set and the surrounding area clean and free from obstructions.*

**⚠ WARNING****Pressurized System**

*Pressurized systems can rupture/leak which can result in severe personal injury or death.*

*Use appropriate lock out/tag out safety procedures to isolate from all energy sources before performing any service tasks. Use PPE.*

**⚠ WARNING****Confined Areas**

*Confined spaces or areas with restricted access or potential to entrap can cause severe personal injury or death.*

*Use appropriate lock out/tag out safety procedures to isolate from all energy sources. Use PPE. Follow site specific lone worker protocols/permits to work.*

**⚠ CAUTION****Manual Handling Heavy Objects**

*Handling heavy objects can cause severe personal injury.*

*Use appropriate lifting equipment and perform tasks with two people where doing so would make completion of the task safe.*

**⚠ CAUTION****Power Tools and Hand Tools**

*Tools can cause cuts, abrasions, bruising, puncture injuries.*

*Only trained and experienced personnel should use power tools and hand tools. Use PPE.*

**⚠ CAUTION****Sharp Edges and Sharp Points**

*Projecting corners/parts may cause cuts, abrasions and other personal injury.*

*Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.*

**NOTICE**

**Keep multi-type ABC fire extinguishers close by. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquid fuels and gaseous fuels. Class C fires involve live electrical equipment. (Refer to NFPA No. 10 in the applicable region.)**

**NOTICE**

Before performing maintenance and service procedures on enclosed generator sets, make sure the service access doors are secured open.

**NOTICE**

Stepping on the generator set can cause parts to bend or break, leading to electrical shorts, or to fuel leaks, coolant leaks, or exhaust leaks. Do not step on the generator set when entering or leaving the generator set room.

**NOTICE**

Remove fuel from subbase fuel tank before conducting any hot work.

## 1.3 Generator Set Safety Code

Before operating the generator set, read the manuals 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*****Electrical Generating Equipment***

***Incorrect operation and maintenance can result in severe personal injury or death.***

***Read and follow all Safety Precautions, Warnings, and Cautions throughout this manual and the documentation supplied with the generator set.***

### 1.3.1 Moving Parts Can Cause Severe Personal Injury or Death

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

### 1.3.2 Positioning of Generator Set

The generator set should be placed on level ground with adequate open space around it. The immediate area around the generator set should be free of any flammable material.

**NOTICE**

Access or service doors must be closed and locked before repositioning, and they must remain locked during transportation and siting.

**NOTICE**

The generator set is capable of operating at inclines of up to +/- 2.5 degrees.

## 1.4 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death

**⚠ WARNING*****Electric Shock Hazard***

***Voltages and currents present an electrical shock hazard that can cause severe burns or death. Contact with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher can cause electrical shock and electrical arc flash. Refer to standard NFPA 70E or equivalent safety standards in corresponding regions for details of the dangers involved and for the safety requirements.***

Guidelines to follow when working on de-energized electrical systems:

- Use proper PPE. Do not wear Jewellery and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- De-energize and lockout/tagout electrical systems prior to working on them. Lockout/Tagout is intended to prevent injury due to unexpected start-up of equipment or the release of stored energy. Please refer to *Locking the Generator Set Out of Service* section for more information.
- De-energize and lockout/tagout all circuits and devices before removing any protective shields or making any measurements on electrical equipment.
- Follow all applicable regional electrical and safety codes.

Guidelines to follow when working on energized electrical systems:

**NOTICE**

**It is the policy of Cummins Inc. to perform all electrical work in a de-energized state. However, employees or suppliers may be permitted to occasionally perform work on energized electrical equipment only when qualified and authorized to do so and when troubleshooting, or if de-energizing the equipment would create a greater risk or make the task impossible and all other alternatives have been exhausted.**

**NOTICE**

**Exposed energized electrical work is only allowed as per the relevant procedures and must be undertaken by a Cummins authorized person with any appropriate energized work permit for the work to be performed while using proper PPE, tools and equipment.**

In summary:

- Do not tamper with or bypass interlocks unless you are authorized to do so.
- Understand and assess the risks - use proper PPE. Do not wear Jewellery and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- Make sure that an accompanying person who can undertake a rescue is nearby.

## 1.4.1 AC Supply and Isolation

### NOTICE

Local electrical codes and regulations (for example, *BS EN 12601:2010 Reciprocating internal combustion engine driven generating sets*) may require the installation of a disconnect means for the generator set, either on the generator set or where the generator set conductors enter a facility.

### NOTICE

The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations. This equipment must be earthed (grounded).

It is the sole responsibility of the customer to provide AC power conductors for connection to load devices and the means to isolate the AC input to the terminal box; these must comply with local electrical codes and regulations. Refer to the wiring diagram supplied with the generator set.

The disconnecting device is not provided as part of the generator set, and Cummins accepts no responsibility for providing the means of isolation.

## 1.4.2 Medium Voltage Equipment (601 V to 15 kV - U.S. and Canada)

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

## 1.5 Fuel and Fumes Are Flammable

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

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

### 1.5.1 Spillage

Any spillage that occurs during fueling, oil top-off, or oil change must be cleaned up before starting the generator set.

## 1.5.2 Fluid Containment

### NOTICE

**Where spillage containment is not part of a Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses and sources.**

If fluid containment is incorporated into the bedframe, it must be inspected at regular intervals. Any liquid present should be drained out and disposed of in line with local health and safety regulations. Failure to perform this action may result in spillage of liquids which could contaminate the surrounding area.

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

## 1.5.3 Do Not Operate in Flammable and Explosive Environments

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

## 1.6 Exhaust Gases Are Deadly

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas, and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust system daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Make sure the unit is well ventilated.

### 1.6.1 Exhaust Precautions

#### WARNING

##### **Hot Exhaust Gases**

**Contact with hot exhaust gases can cause severe burns.**

**Wear personal protective equipment when working on equipment.**

#### WARNING

##### **Hot Surfaces**

**Contact with hot surfaces can cause severe burns.**

**The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.**

#### WARNING

##### **Toxic Gases**

**Inhalation of exhaust gases can cause asphyxiation and death.**

**Pipe exhaust gas outside and away from windows, doors, or other inlets to buildings. Do not allow exhaust gas to accumulate in habitable areas.**

**⚠ WARNING*****Fire Hazard***

***Contaminated insulation is a fire hazard. Fire can cause severe burns or death.***

***Remove any contaminated insulation and dispose of it in accordance with local regulations.***

The exhaust outlet may be sited at the top or bottom of the generator set. Make sure that the exhaust outlet is not obstructed. Personnel using this equipment must be made aware of the exhaust position. Position the exhaust away from flammable materials - in the case of exhaust outlets at the bottom, make sure that vegetation is removed from the vicinity of the exhaust.

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated they must be replaced before the generator set is run.

To minimize the risk of fire, make sure the following steps are observed:

- Make sure that the engine is allowed to cool thoroughly before performing maintenance or operation tasks.
- Clean the exhaust pipe thoroughly.

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## 2 Introduction

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### WARNING

#### ***Hazardous Voltage***

***Contact with high voltages can cause severe electrical shock, burns, or death.***

***Make sure that only a trained and experienced electrician makes generator set electrical output connections, in accordance with the installation instructions and all applicable codes.***

### WARNING

#### ***Electrical Generating Equipment***

***Faulty electrical generating equipment can cause severe personal injury or death.***

***Generator sets must be installed, certified, and operated by trained and experienced persons in accordance with the installation instructions and all applicable codes.***

## 2.1 About This Manual

Read [Chapter 1 on page 1](#) and carefully observe all instructions and precautions in this manual. Keep this manual with the other generator set and/or controller manuals.

You should have a basic understanding of generator sets and power generation before you read this manual.

This is the service manual for the PCC 2100. It is not the service manual for the generator set or any accessories.

## 2.2 System Overview

The PCC is a microprocessor-based control for Cummins Inc. generator sets. All generator set control functions are contained in one circuit board (base board). The base board provides fuel control, main alternator voltage output regulation and complete generator set control and monitoring.

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

## 2.3 Test Equipment

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

- True RMS meter for accurate measurement of small AC and DC voltages. Fluke models 87 or 8060A are good choices.
- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac

- Load Test Panel
- Megger or Insulation Resistance Meter
- InPower™ Service Tool (PC based generator set service tool)
- PCC 2100 Interface Kit (Used with InPower service tool)

## 2.4 How to Obtain Service

When a product requires servicing, contact the nearest Cummins service provider. To locate the distributor, go to [www.cummins.com/support](http://www.cummins.com/support) and select Sales and Service Locator. When contacting the service provider, always supply the complete model, specification, and serial number as shown on the nameplate.

### 2.4.1 Locating a Distributor

#### In the U.S. and Canada

To easily locate the nearest certified distributor/dealer for Cummins generator sets in your area, or for more information, contact us at 1-800-CUMMINS™ (1-800-286-6467) or visit [www.cummins.com/support](http://www.cummins.com/support).

If unable to contact a distributor using the automated service, consult the Internet.

If unable to arrange a service or resolve an issue, contact the Service Manager at the nearest Cummins distributor for assistance.

When contacting the distributor, always supply the complete Model, Specification, and Serial Number as shown on the product nameplate.

#### Outside the U.S. and Canada

Refer to [www.cummins.com/support](http://www.cummins.com/support) and select Sales and Service Locator, or send an email to [ask.powergen@cummins.com](mailto:ask.powergen@cummins.com).

## 2.5 Schedule of Abbreviations

This list is not exhaustive. For example, it does not identify units of measure or acronyms that appear only in parameters, event/fault names, or part/accessory names.

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AC	Alternating Current	LED	Light-emitting Diode
AMP	AMP, Inc., part of Tyco Electronics	LTS	Long Term Storage
ANSI	American National Standards Institute	LVRT	Low Voltage Ride Through
ASOV	Automatic Shut Off Valve	MFM	Multifunction Monitor
ASTM	American Society for Testing and Materials (ASTM International)	Mil Std	Military Standard
ATS	Automatic Transfer Switch	MLD	Masterless Load Demand
AVR	Automatic Voltage Regulator	NC	Normally Closed
AWG	American Wire Gauge	NC	Not Connected
CAN	Controlled Area Network	NFPA	National Fire Protection Agency

<b>ABBR.</b>	<b>DESCRIPTION</b>	<b>ABBR.</b>	<b>DESCRIPTION</b>
CB	Circuit Breaker	NO	Normally Open
CE	Conformité Européenne	NWF	Network Failure
CFM	Cubic Feet per Minute	OEM	Original Equipment Manufacturer
CGT	Cummins Generator Technologies	OOR	Out of Range
CMM	Cubic Meters per Minute	OORH / ORH	Out of Range High
CT	Current Transformer	OORL / ORL	Out of Range Low
D-AVR	Digital Automatic Voltage Regulator	PB	Push Button
DC	Direct Current	PCC	PowerCommand® Control
DEF	Diesel Exhaust Fluid	PGI	Power Generation Interface
DPF	Diesel Particulate Filter	PGN	Parameter Group Number
ECM	Engine Control Module	PI	Proportional/Integral
ECS	Engine Control System	PID	Proportional / Integral / Derivative
EMI	Electromagnetic interference	PLC	Programmable Logic Controller
EN	European Standard	PMG	Permanent Magnet Generator
EPS	Engine Protection System	PPE	Personal Protective Equipment
E-Stop	Emergency Stop	PT	Potential Transformer
FAE	Full Authority Electronic	PTC	Power Transfer Control
FMI	Failure Mode Identifier	PWM	Pulse-width Modulation
FRT	Fault Ride Through	RFI	Radio Frequency Interference
FSO	Fuel Shutoff	RH	Relative Humidity
Genset	Generator Set	RMS	Root Mean Square
GCP	Generator Control Panel	RTU	Remote Terminal Unit
GND	Ground	SAE	Society of Automotive Engineers
LCT	Low Coolant Temperature	SCR	Selective Catalytic Reduction
HMI	Human-machine Interface	SPN	Suspect Parameter Number
IC	Integrated Circuit	SWL	Safe Working Load
ISO	International Organization for Standardization	SW_B+	Switched B+
LBNG	Lean-burn Natural Gas	UL	Underwriters Laboratories
LCD	Liquid Crystal Display	UPS	Uninterruptible Power Supply
		VPS	Valve Proving System

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# 3 Circuit Boards

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**⚠ WARNING**

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

**⚠ WARNING**

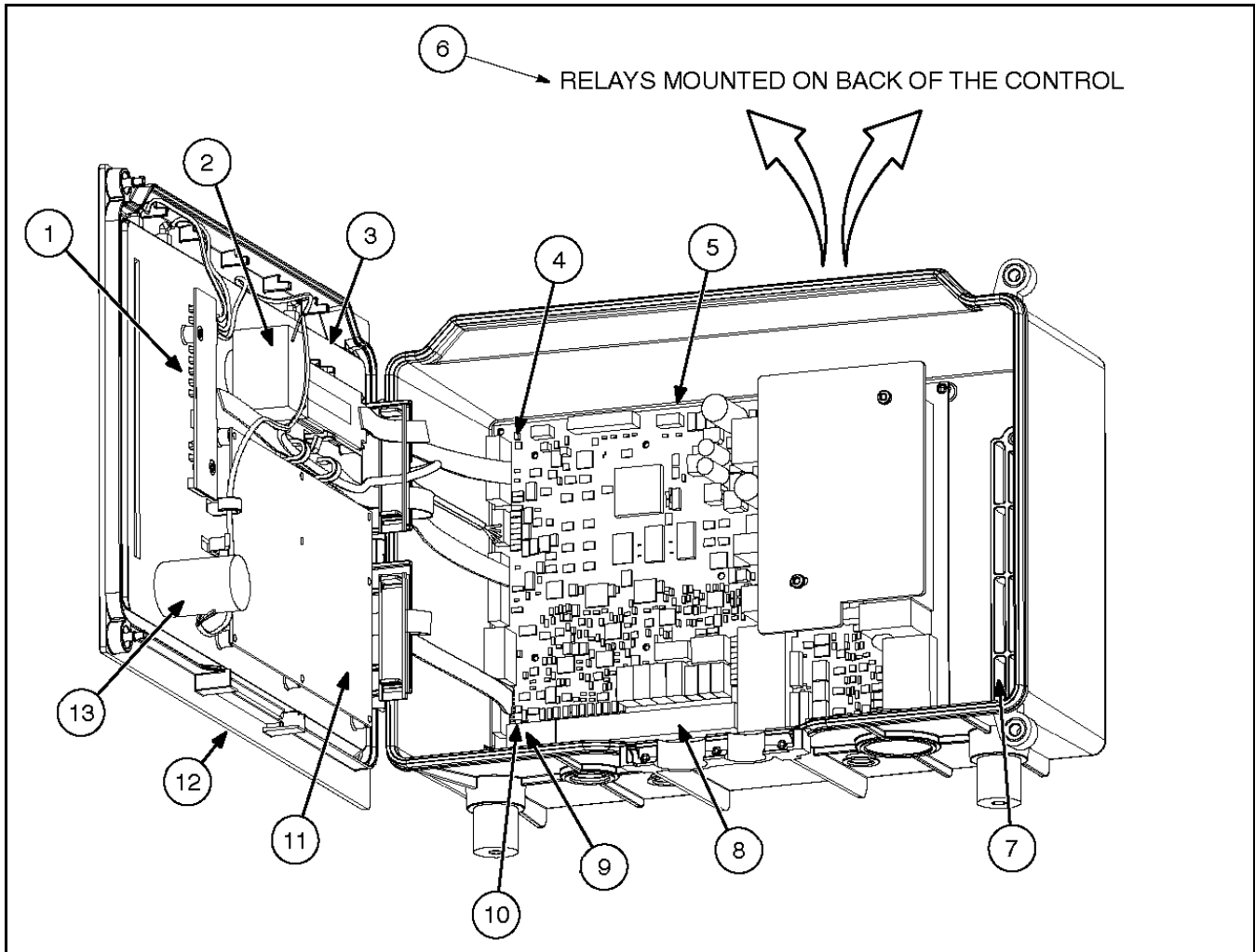
***To avoid personal injury or harm, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.***

This section describes the function of the PowerCommand® 2100 Control (PCC) base circuit board that is contained in the control panel box.

**⚠ CAUTION**

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

### 3.1 Circuit Board Locations



No.	Description	No.	Description
1	Indicator Board	8	TB1 (1-22)
2	Emergency Stop Button	9	TB2 (1-6)
3	Display Board	10	Chassis Ground Screw
4	Control Alive Indicator	11	Bargraph Board (Optional)
5	Base Board	12	Front Control Panel Assembly (Membrane Buttons)
6	Relays	13	O/Manual/Auto Switch (S12)
7	AUX Relays (Optional)		

FIGURE 1. CIRCUIT BOARD LOCATIONS

### 3.2 Block Diagram

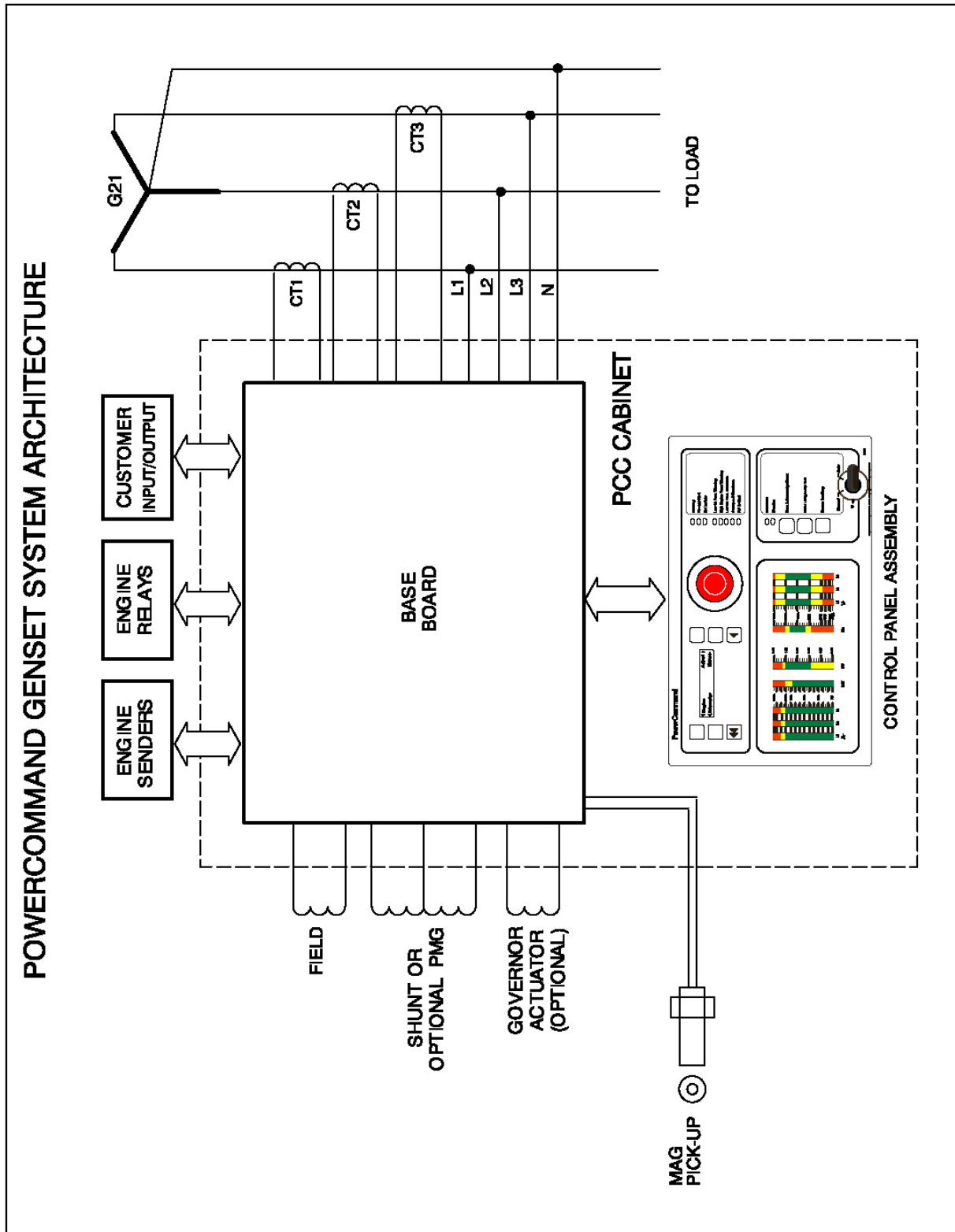


FIGURE 2. BLOCK DIAGRAM (NON-FAE)

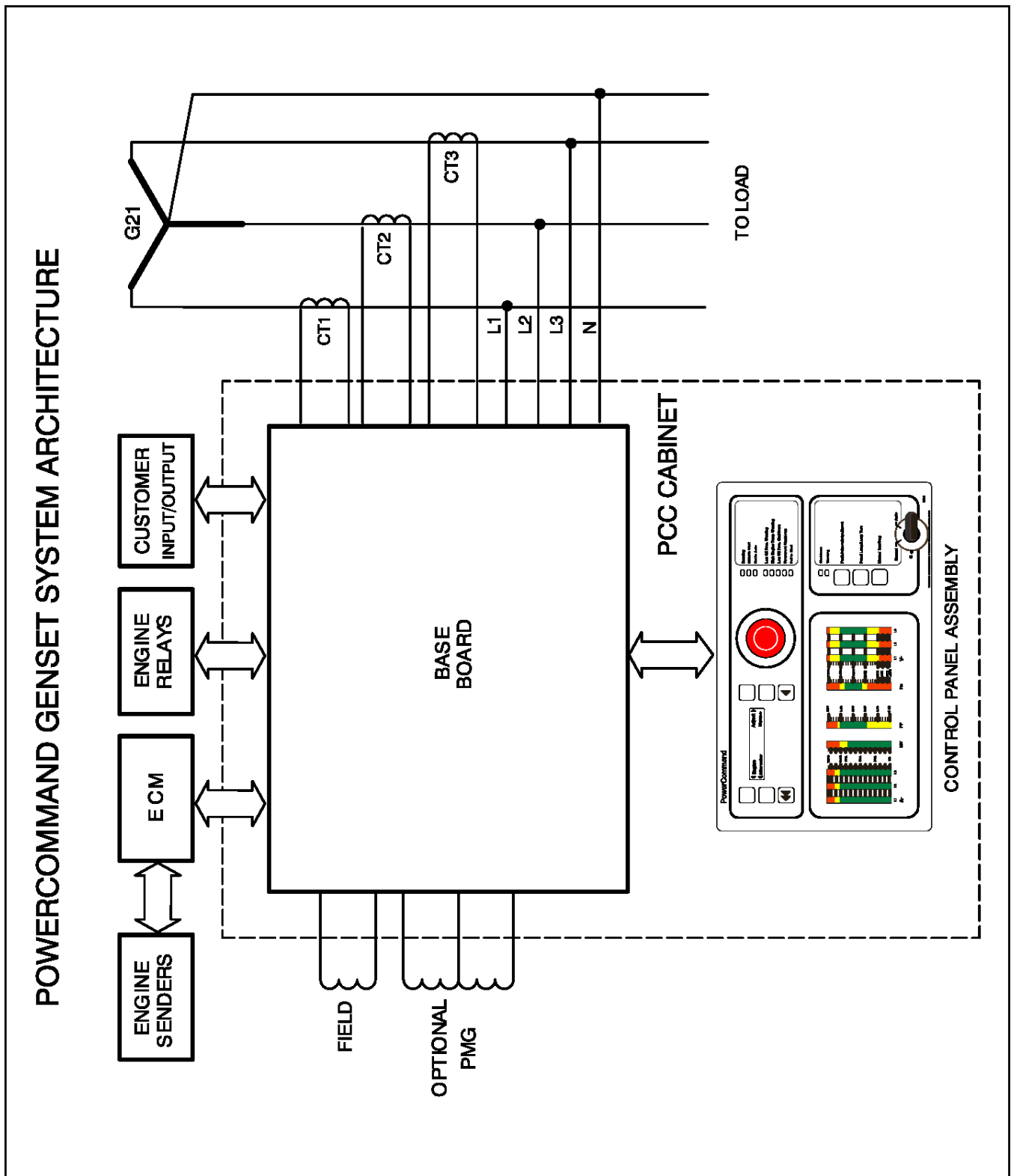


FIGURE 3. BLOCK DIAGRAM (ECM)



### 3.3 Base Board

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

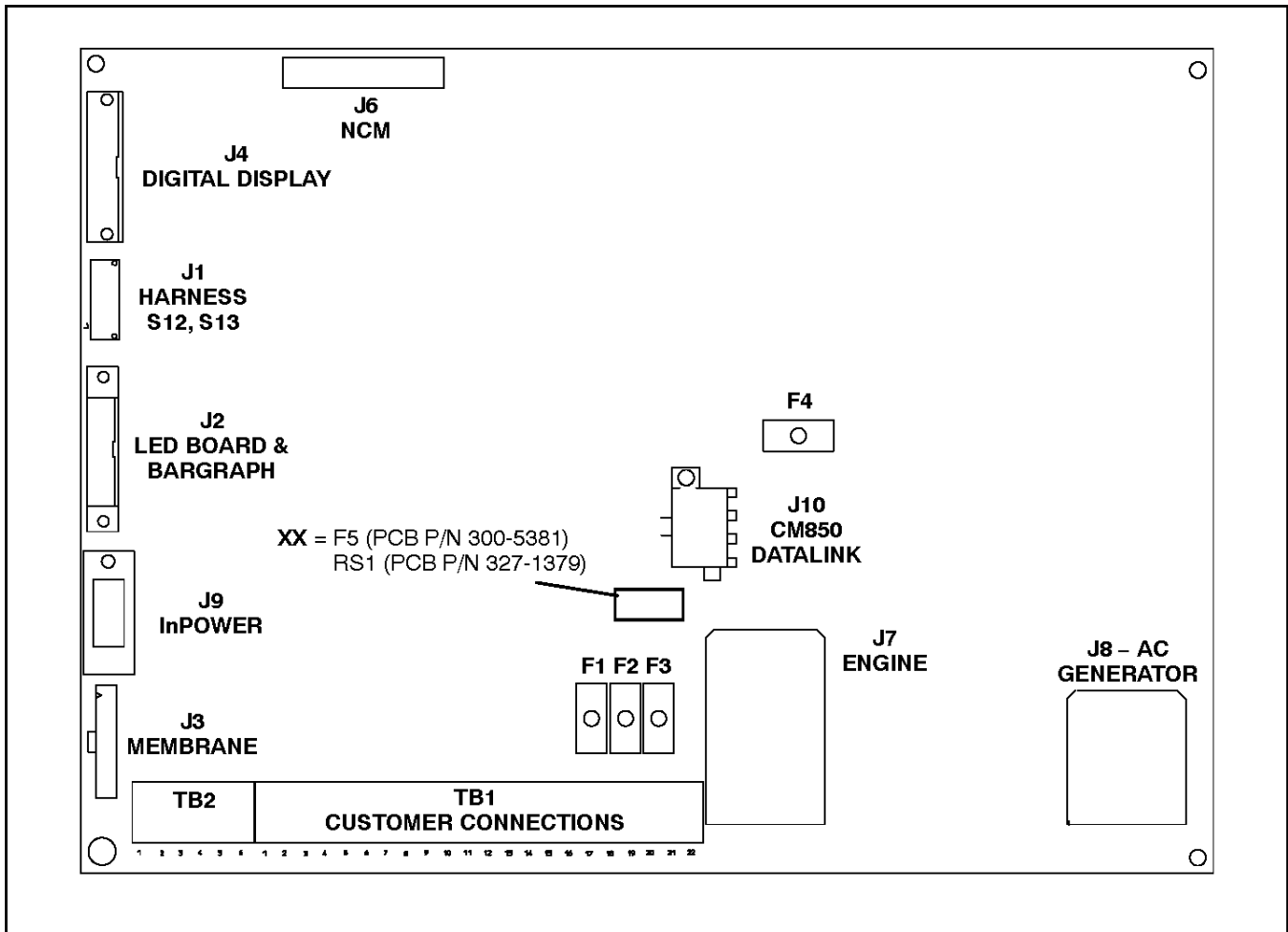


FIGURE 4. BASE BOARD

### 3.4 Connector J1

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

TABLE 1. WIRE TABULATION

SIGNAL	FROM	TO
GND	S12-4	J1-8
OFF (O)	S12-1	J1-7
MANUAL	S12-3	J1-6
AUTO	S12-5	J1-5

SIGNAL	FROM	TO
ESTOP-NC1	S13-1	J1-2
ESTOP-NC2	S13-2	J1-1
ESTOP-NO1	S13-3	J1-3
ESTOP-NO2	S13-4	J1-4

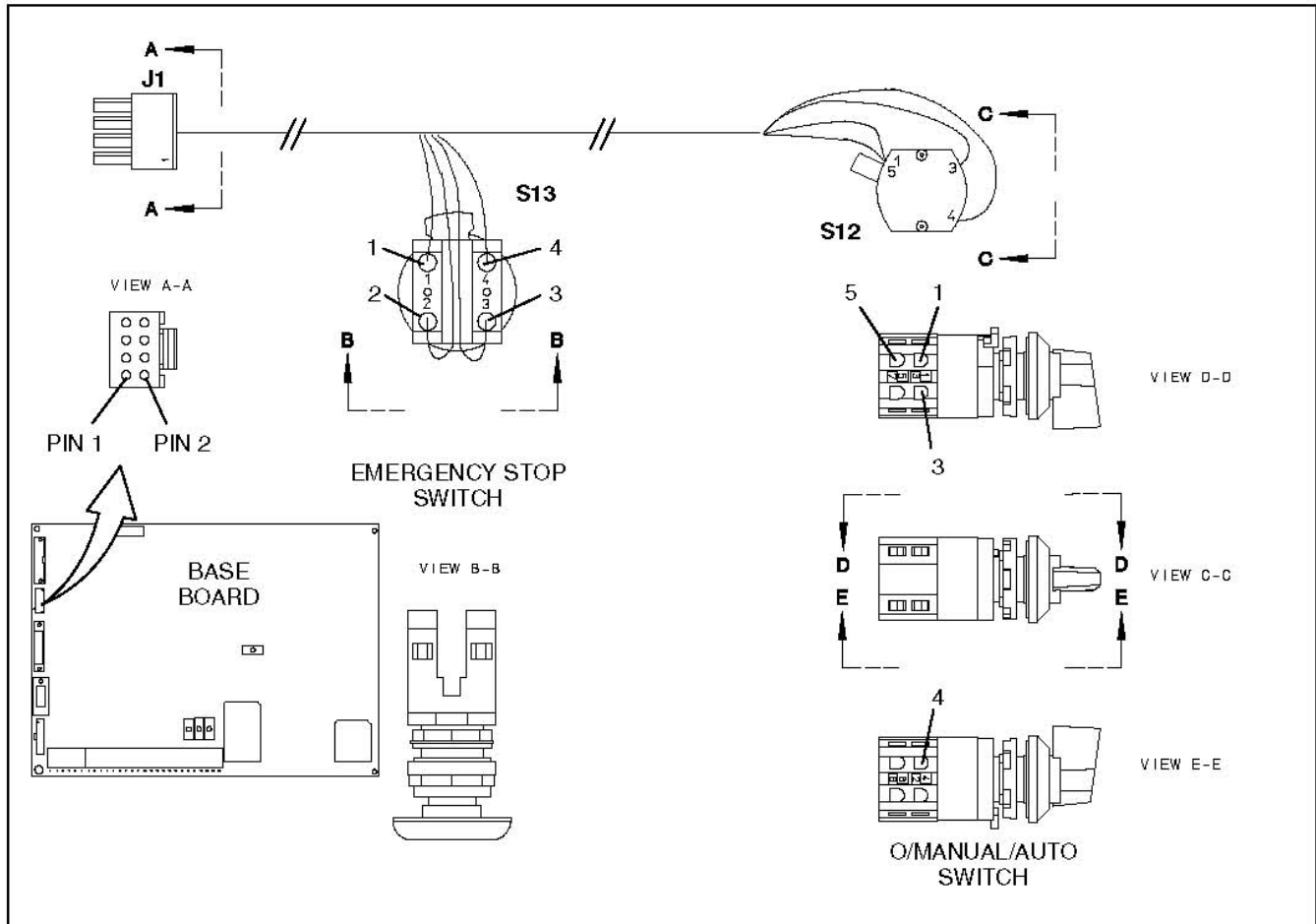
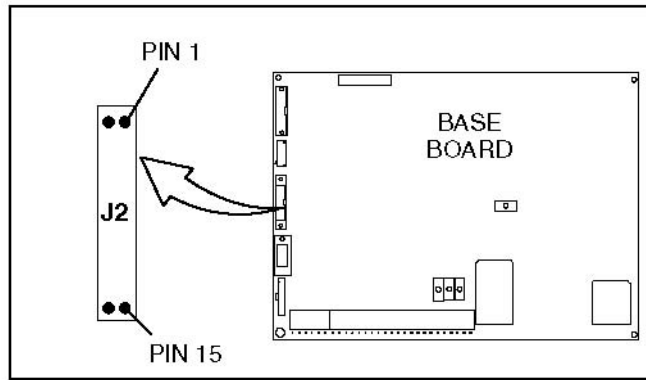


FIGURE 5. CONNECTOR J1 (CONTROL HARNESS)

### 3.5 Connector J2

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



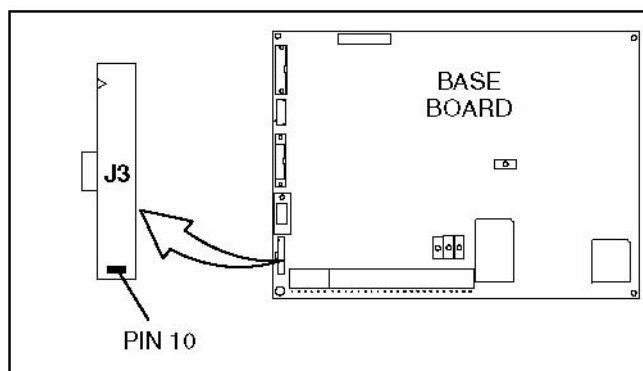
**FIGURE 6. J2 LED/BARGRAPH CONNECTOR**

**TABLE 2. CONNECTOR J2**

PIN	SIGNAL
1	MOSI
2, 4, 6, 16	GND
3	SCK
5	SEL_A
7	SEL_B
10, 14, 15	VCC
9	SEL_C
11	SEL_D
13	BAR_ENABLE

### 3.6 Connector J3

J3 connects to membrane buttons of front control panel assembly.



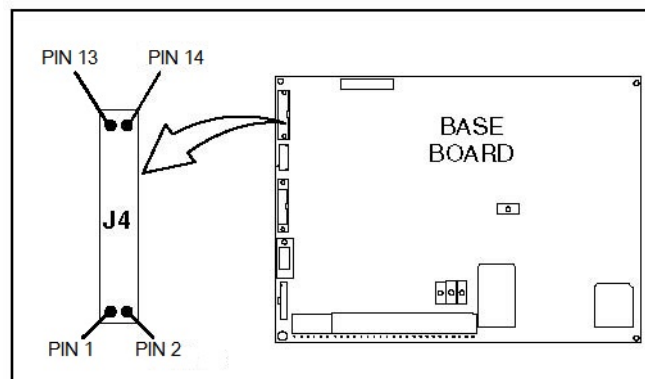
**FIGURE 7. J3 MEMBRANE CONNECTOR**

**TABLE 3. CONNECTOR J3**

PIN	SIGNAL
1	HOME MENU <<
2	PREVIOUS MENU <
3	UPPER LEFT
4	LOWER LEFT
5	UPPER RIGHT
6	LOWER RIGHT
7	FAULT ACK/RESET
8	PANEL LAMP
9	MANUAL RUN/STOP
10	COMMON (GND)

### 3.7 Connector J4

J4 connects to display menu of front control panel assembly.

**FIGURE 8. J4 DISPLAY MENU CONNECTOR****TABLE 4. CONNECTOR J4**

PIN	SIGNAL
1	GND
2	VCC
3	N.U.
4	RS
5	R/W
6	ENABLE DISPLAY
7	D[0]

PIN	SIGNAL
8	D[1]
9	D[2]
10	D[3]
11	D[4]
12	D[5]
13	D[6]
14	D[7]

### 3.8 Connector J7

In hydromechanical applications, J7 connects to the engine sensors, battery, starter, governor actuator and magnetic pickup. In ECM applications, J7 connects to the generator current transformers, engine battery, K4 (starter) and K10 (fuel) pilot relays.

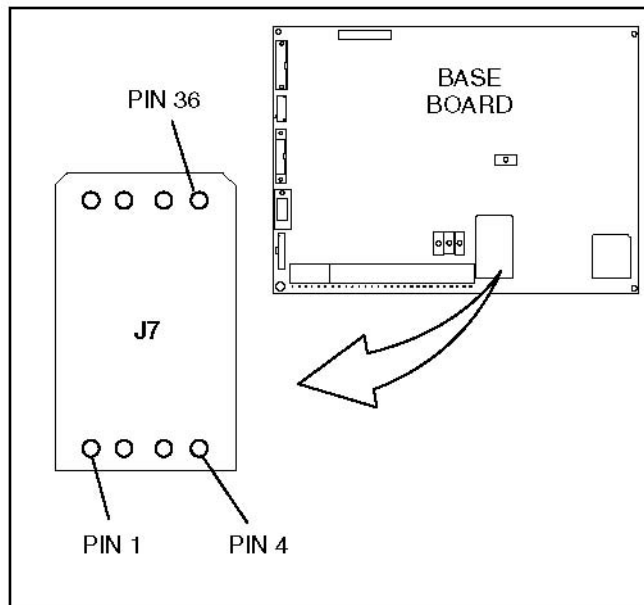


FIGURE 9. J7 ENGINE HARNESS CONNECTOR

TABLE 5. CONNECTOR J7 (NON-FAE)

PIN	SIGNAL
5, 6, 7, 8	GND
1, 2, 3, 4	B+ IN
9	GEN SW B+
10	FUEL SOL -
11	CT1
12	CT1-COM

PIN	SIGNAL
13 17 21	OIL PRESS OUT OIL PRESS COM OIL PRESS 5V
15 16	CT2 CT2-COM
18	ALT FLASHOUT
19 20	CT3 CT3-COM
23 27	GEN SW B+ START SOL B-
24 36 14	ACTUATOR + GND ACTUATOR SIG
25 29 33	MAG PICKUP+ MAG PICKUP- GND
30 34	COOLANT SNDR COOLANT SNDR COM
31 32 35	COOL LVL B+ COOL LVL RTN COOL LVL GND

TABLE 6. CONNECTOR J7 (ECM)

PIN	SIGNAL
5, 6, 7, 8	GND
1, 2, 3, 4	B+ IN
9 10	GEN SW B+ K12 RELAY
11 12	CT1 CT1-COM
15 16	CT2 CT2-COM
18	ALT FLASHOUT
19 20	CT3 CT3-COM
23 27	GEN SW B+ START SOL B-

### 3.9 Connector J8

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

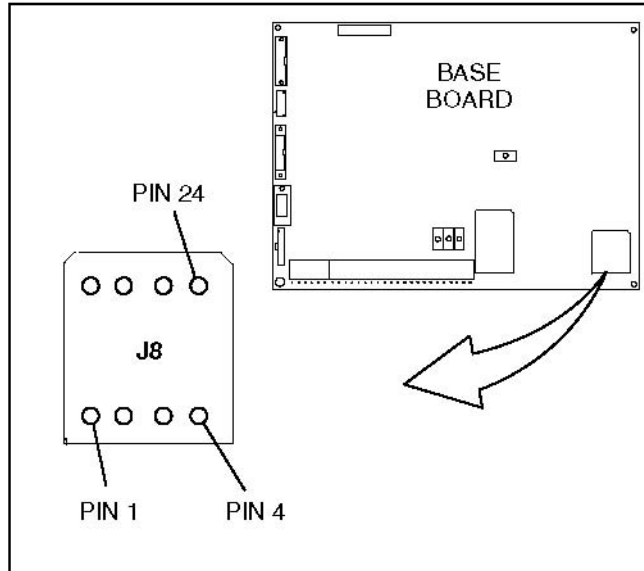


FIGURE 10. J8 AC GENERATOR CONNECTOR

TABLE 7. CONNECTOR J8

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

TABLE 8. BASE BOARD FUSES

REFERENCE DESIGNATION	RATING	FUNCTION
F1	10A	Customer B+ (to TB1 customer terminal block)
F2	5A	Customer switched B+ (to TB1 customer terminal block)
F3	2A	Customer switched B+ (to T26 engine terminal block)
F4	5A	Base board power supply fuse
F5	2A	B+ supply to Power Transfer Control (PTC) module (optional) (PCB P/N 300-5381)

REFERENCE DESIGNATION	RATING	FUNCTION
RS1 (Fuse/Auto Reset)	0.9A	B+ supply to Power Transfer Control (PTC) module (optional) (PCB P/N 327-1379)

### 3.10 Connector J10

In hydromechanical applications, J10 is not used. In ECM applications, J10 is the SAE J1939 CAN datalink connector. J10 connects to the engine control module (ECM) and the keyswitch relay.

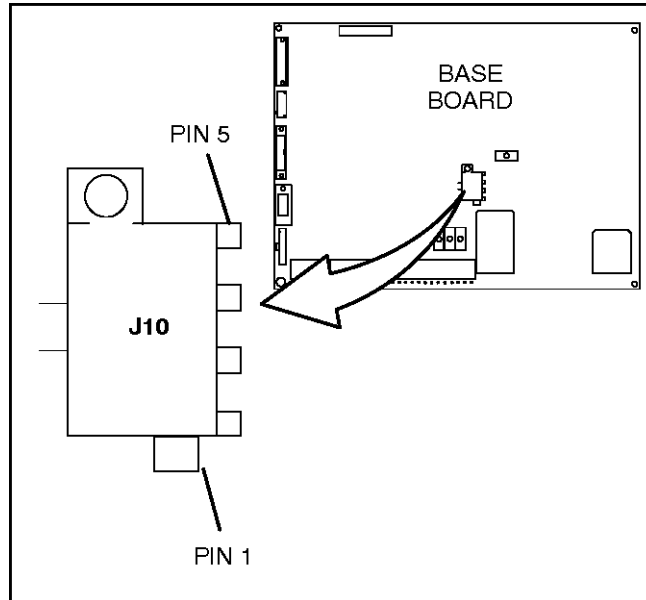


FIGURE 11. J10 ECM CONNECTOR

TABLE 9. CONNECTOR J10

PIN	SIGNAL
1	CAN +
2	CAN -
3	Shield GND
4	Keyswitch Relay +
5	Keyswitch Relay -

### 3.11 TB1 Customer Connections

Customer monitor/control connections are attached to terminal board TB1. Optional equipment such as sensing devices used to monitor generator set operation, remote start/stop switches and etc. are attached to this terminal. Refer to Customer Connections diagram in *Appendix A* for TB1 connections.



# 4 Control System - PCC 2100

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## 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 the figure below.

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.

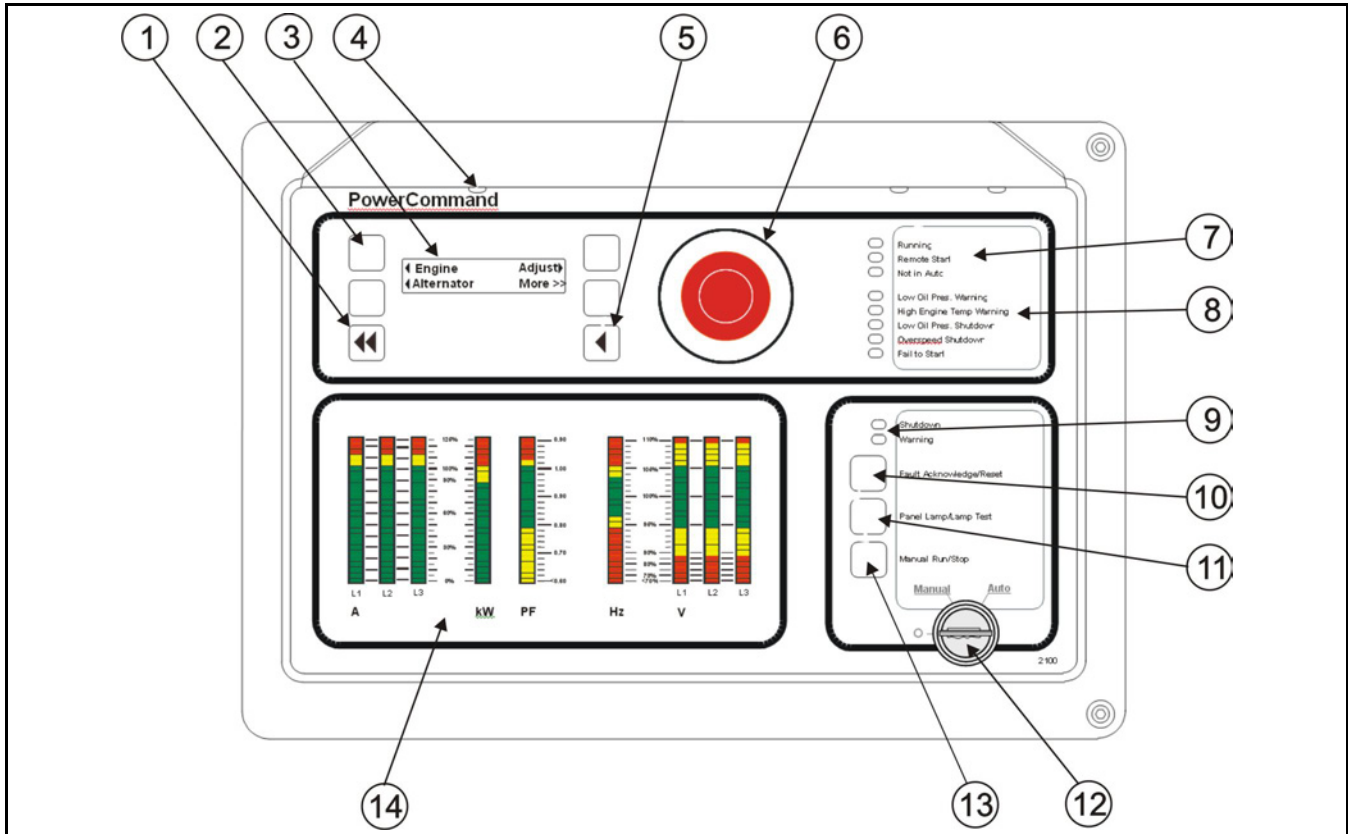
The PCC2100 is a microprocessor-based control for generator sets. It provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring. The control also monitors the health of the engine, alternator, and auxiliary systems continuously, and will effect 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, effect 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 cooldown 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 low voltage AC power.



No.	Description	No.	Description
1	Home Button	8	Configurable Indicators
2	Menu Selection Button (1 of 4)	9	Shutdown & Warning Status Indicators
3	Digital Display	10	<b>Fault Acknowledge/Reset</b> Button
4	Panel Lamp	11	<b>Panel Lamp/Lamp Test</b> Button
5	Previous Main Menu Button	12	<b>O/Manual/Auto</b> Key Switch (Mode Switch)
6	Emergency Stop Push Button	13	<b>Manual Run/Stop</b> Button
7	Running/Remote Start/Not in Auto Indicators	14	Analog AC Metering Panel (Optional)

FIGURE 12. FRONT PANEL

## 4.2 Control Panel Power On/Off Modes

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

### 4.2.1 Power On Mode

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

## 4.2.2 Screen Saver Mode

Power to the graphical display will be removed after 10 minutes (generator set not running or running). The 10 minute timer resets and begins after each control panel action (any button or switch selection) or signal received by the operating software. The bottom LEDs of the Analog AC Metering Panel (bar graphs) may stay On during Screen Saver mode, indicating that the operating software is active (Awake mode).

When a "Warning" signal (for example, low coolant temp) is sensed by the control, it will display the warning message. The control will remain active until the **Fault Acknowledge** button is pressed to clear the warning message and start the 10 minute timer.

## 4.2.3 Sleep/Awake Mode

In the Sleep mode, the control's operating software is inactive and the LEDs and the digital display on the control panel are all off. Sleep mode is a feature used to reduce battery power consumption when the control is not being used and the **O/Manual/Auto** switch is in the **O** position.

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

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

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

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

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.

### NOTICE

The InPower service tool is required to select the desired mode. Contact an authorized service center for assistance.

## 4.3 Front Panel

The front panel contains the following components:

### 4.3.1 Digital Display

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

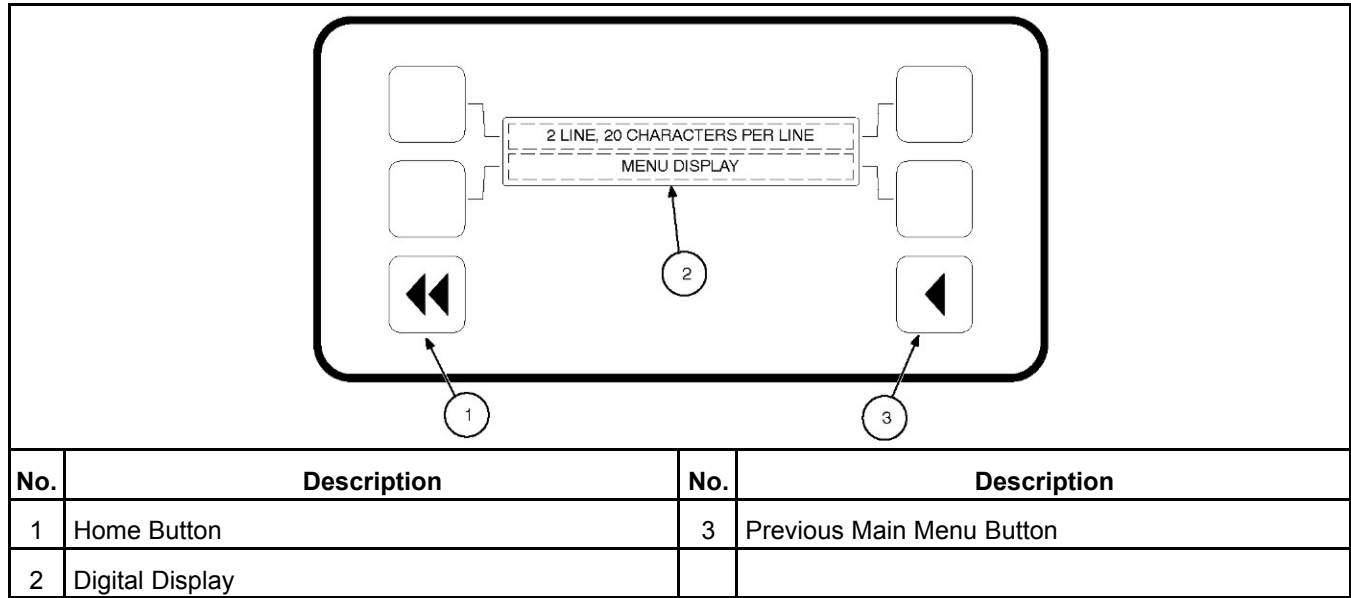


FIGURE 13. DIGITAL DISPLAY AND MENU SELECTION BUTTON

### 4.3.2 Display Menu Selection Button

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

- In the digital display for main menus, the ◀ or ▶ symbols indicate that pressing the adjacent button causes the operating program to go to the selected submenu (e.g., Engine Menu).
- In the digital display, the More>> symbol indicates that pressing the adjacent button causes the operating program to go to the next main menu.
- In the digital display, the ↑ or ↓ symbols indicate that pressing the adjacent button causes the operating program to go to the next or previous submenu, as shown in the menu diagrams. Only the ↓ symbol is displayed in the first submenu. Only the ↑ is displayed in the last submenu. Both symbols are displayed in the rest of the submenus.
- In the digital display, the plus or minus symbols (+ or -) indicate that pressing the adjacent button can be used to change a parameter or value shown on the display.

When there is a choice of two parameters, one parameter is associated with the + symbol and the other is associated with the - symbol.

When changing values, pressing the button adjacent to the + symbol increases the value and pressing the button adjacent to the - symbol decreases the value. Only one numeric character of a field can be changed at a time.

- In the digital display, the ← or → symbol indicates that pressing the adjacent button causes the operating program to move the cursor to the next numeric character. The selected numeric character can then be changed by pressing the buttons adjacent to the + and - symbols. Only the → symbol is displayed when the cursor is on the first character of a field that can be changed. Only the ← is displayed when the cursor is on the last character. Both symbols are displayed when the cursor is on any other character.
- After adjusting values/parameters, pressing the ▶ symbol results in the changes being saved. **If the Home button or Previous Main Menu button is pressed before pressing the ▶ symbol, the changes are not saved.**

### 4.3.3 Home Button

Press this button (◀◀) to view the Home Menu. Refer to the menu trees that appear later in the manual.

### 4.3.4 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.

#### NOTICE

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

### 4.3.5 Emergency Stop Button

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

#### NOTICE

To avoid equipment damage, the Emergency Stop button must not be used for a normal shutdown, as this will prevent a cooling run in which the lubricating oil and engine coolant carry heat away from the engine combustion chamber and bearings in a safe manner.

If the generator set is not running, pushing the button in will prevent the starting of the engine, regardless of the Start signal source.

#### NOTICE

Ensure the remote start control is not active when the Emergency Stop is reset. The generator set may start after the Emergency Stop is reset upon receiving a remote start signal.

To reset:

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

#### NOTICE

Emergency Stop shutdown can be reset only at the operator panel.

#### NOTICE

Ensure that the cause of the emergency stop is fully investigated and remedied before a fault Reset and generator Start are attempted.

#### NOTICE

On enclosed sets, an external Emergency Stop button is situated in close proximity to the control panel viewing window. For open generator sets, it is recommended that an additional Emergency Stop button be situated in close proximity to the plant room exit.

### 4.3.6 Running Indicator

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

### 4.3.7 Remote Start Indicator

This green lamp indicates the control is receiving a remote run signal. When flashing, it indicates a load demand stop mode.

### 4.3.8 Not in Auto

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

#### NOTICE

If the switch is in the Auto position and the lamp is still flashing, service is required.

### 4.3.9 Analog AC Metering Panel

This panel simultaneously displays 3-phase line-to-line AC volts and current, kW, power factor, and frequency.

The meter panel is composed of a series of LEDs that are configured in bar graphs for each function. The LEDs are color coded, with green indicating normal range values, amber for warning levels, and red for shutdown conditions.

Scales for each function are in % of nominal values. Resolution is 1% for values close to nominal and increases at values further from nominal.

### 4.3.10 Shutdown Status

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

Dependent upon the specific fault that occurs, the engine may or may not shut down immediately. A fault that could cause engine damage, causes an immediate engine shutdown (bypasses engine cooldown sequence). All other faults would allow the engine to run during the cooldown sequence before engine shutdown. In this case, the Shutdown Status indicator blinks during the cooldown period.

### 4.3.11 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** button. (It is not necessary to stop the generator set if the fault becomes inactive during generator set operation.) In auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected.

#### NOTICE

Some warnings remain active after the condition is corrected and the control reset button is pressed. This will require the generator set to be shut down to reset the warning indicator.

### 4.3.12 Fault Acknowledge/Reset Button

Press this button to acknowledge warning and shutdown messages after the fault has been corrected. Pressing this button clears the fault from the current fault list.

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

### 4.3.13 Panel Lamp and Lamp (LED) Test Button

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

### 4.3.14 Manual Run/Stop Button

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

### 4.3.15 O/Manual/Auto Switch

**Manual** position enables the use of the switch panel **Manual Run/Stop** button.

**Auto** position enables start/stop control of the engine from a remote location. (Disable the use of the switch panel **Manual Run/Stop** button.)

**O** (off) position prevents the starting of the set (local or remote).

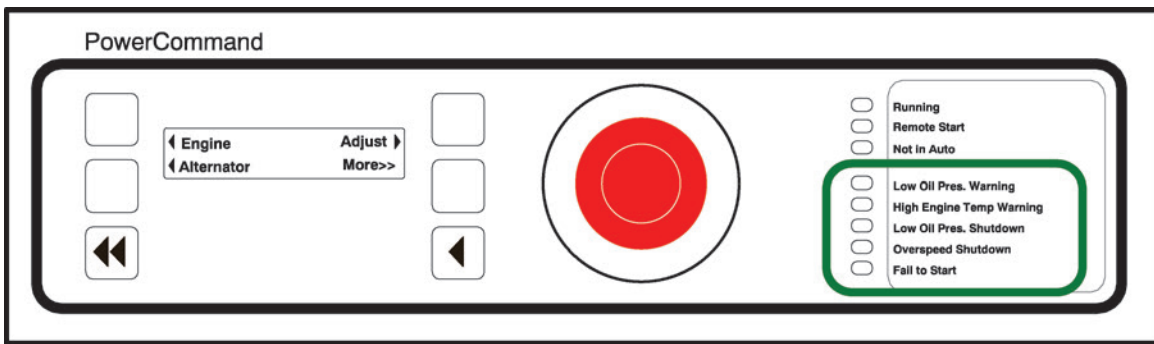
#### NOTICE

**If moved to the O position during set operation, this will cause an immediate engine shutdown (bypasses cooldown timers). Hot shutdowns should be avoided to prolong the reliability of the generator set. Hot shutdowns are logged by the system software.**

### 4.3.16 Configurable Indicators

The following configurable indicators (default values shown) can be changed with the InPower service tool.

- Low Oil Pressure Warning Indicator: This yellow lamp indicates the oil pressure is lower than the normal range of operation.
- High Engine Temperature Warning Indicator: This yellow lamp indicates the engine temperature is higher than the normal range of operation.
- Low Oil Pressure Shutdown Indicator: This red lamp indicates the engine has shut down because of low oil pressure.
- Overspeed Shutdown Indicator: This red lamp indicates the engine has shut down because of excessive speed.
- Fail to Start Indicator: This red lamp indicates the engine failed to start.



**FIGURE 14. CONFIGURABLE INDICATORS**

The configurable items are: Change Generator Event and LED Color (green, yellow or red), and Enable/Disable Indicator.

**NOTICE**

The InPower service tool is required to select the desired settings. Contact an authorized service center for assistance.

### 4.3.17 Low Oil Pressure Warning Indicator

This yellow lamp indicates the oil pressure is lower than the normal range of operation.

### 4.3.18 High Engine Temperature Warning Indicator

This yellow lamp indicates the engine temperature is higher than the normal range of operation.

### 4.3.19 Low Oil Pressure Shutdown Indicator

This red lamp indicates the engine has shut down because of low oil pressure.

### 4.3.20 Overspeed Shutdown Indicator

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

### 4.3.21 Fail to Start Indicator

This red lamp indicates the engine failed to start.

## 4.4 Control Menus

### 4.4.1 Main Menus

The figure below shows the three major main menus available to the user. When viewing a submenu, you can press the previous main menu button at any time to view its main menu.

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



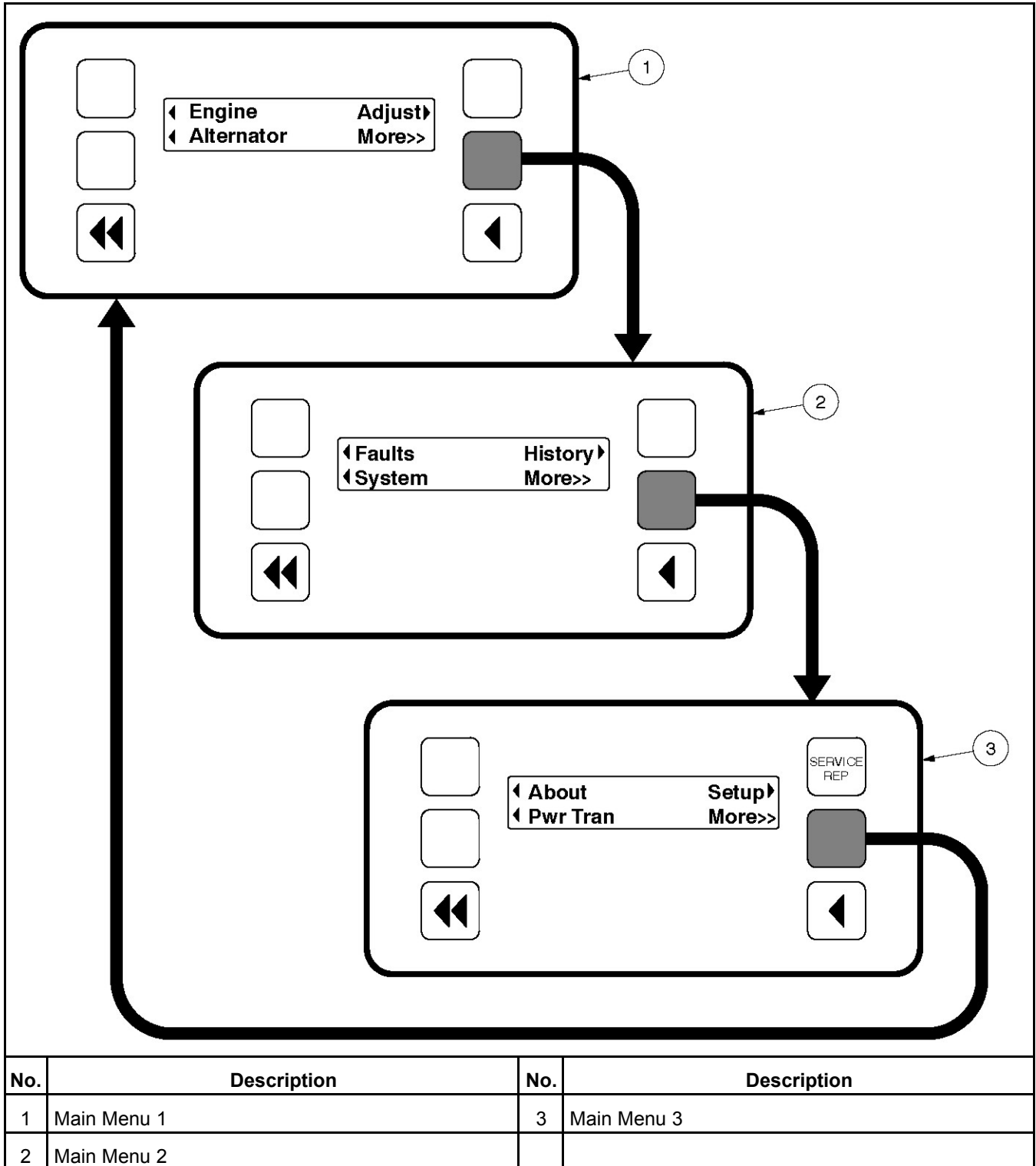


FIGURE 15. MAIN MENUS

### 4.4.1.1 Main Menu 1

Main Menu 1 is also the Home menu. When viewing any of the other main menus or any submenu, you can press the home button to view this menu.

To display engine parameters, such as coolant temperature, oil pressure, oil temperature, etc., press the button next to the word "Engine" in the display. Refer to the Engine menu diagram.

To display alternator parameters, such as line-to-line voltage, line-to-neutral voltage, amperage, frequency, etc., press the button next to the word "Alternator" in the display. Turn to the Alternator menu diagram.

To adjust generator parameters, such as idle start, voltage, frequency, start delay, and stop delay, press the button next to the word "Adjust" in the display. Turn to the Adjust menu diagram.

To view one of the other main menus, press the button next to "More>>" in the display.

#### 4.4.1.2 Main Menu 2

To display system faults, press the button next to the word "Faults" in the display. Up to 20 of the most recent/current faults can be displayed. Refer to the Faults menu diagram.

To view network system parameters, such as on the automatic transfer switch (ATS), Master, or generator set system, press the button next to the word "System" in the display. Refer to the System menu diagram.

To display historical engine parameters such as number of starts, engine hours, control hours, kilowatt hours, and generator set duty cycle, press the button next to the word "History" in the display. Refer to the History menu diagram.

To view one of the other main menus, press the button next to "More>>" in the display.

#### 4.4.1.3 Main Menu 3

To view parameters on the generator, such as model, standby rating, and software version, press the button next to the word "About" in the display. Refer to the About menu diagram.

To view power transfer parameters, such as source power, frequency, generator, utility, and active transfer timer, press the button next to the word "Pwr Tran" in the display. Refer to the Power Transfer Menu

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.

To view one of the other main menus, press the button next to "More>>" in the display.

### 4.4.2 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
- Fluid Pressure Units - kPa or PSI

For more information on adjusting these settings, turn to the Controller Configuration menu diagram.

### 4.4.3 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

Pop-up screens are displayed for the following:

- Faults

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

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

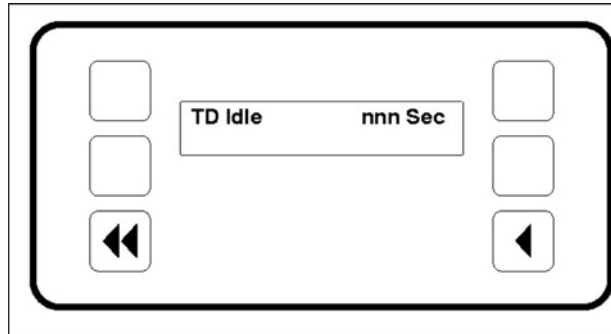


FIGURE 16. TIME DELAY IDLE POP-UP SCREEN

#### 4.4.4 Controller Configuration Menu

[Figure 17 on page 38](#) shows a block representation of the Controller Configuration menus. These menus are used to change the default language, temperature units, and pressure units to be displayed in menus.

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

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

- **Language Selected** submenu: Used to select desired language (default = **English**).
- **Temperature Units** submenu: Used to select Fahrenheit (**Deg.F**) or Centigrade (**Deg.C**) for temperature readings.
- **Fluid Pressure Units** submenu: Used to select **PSI** or **kPa** for pressure readings.

Press the buttons next to the up and down arrows in the digital display to navigate between the menus.

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

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

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

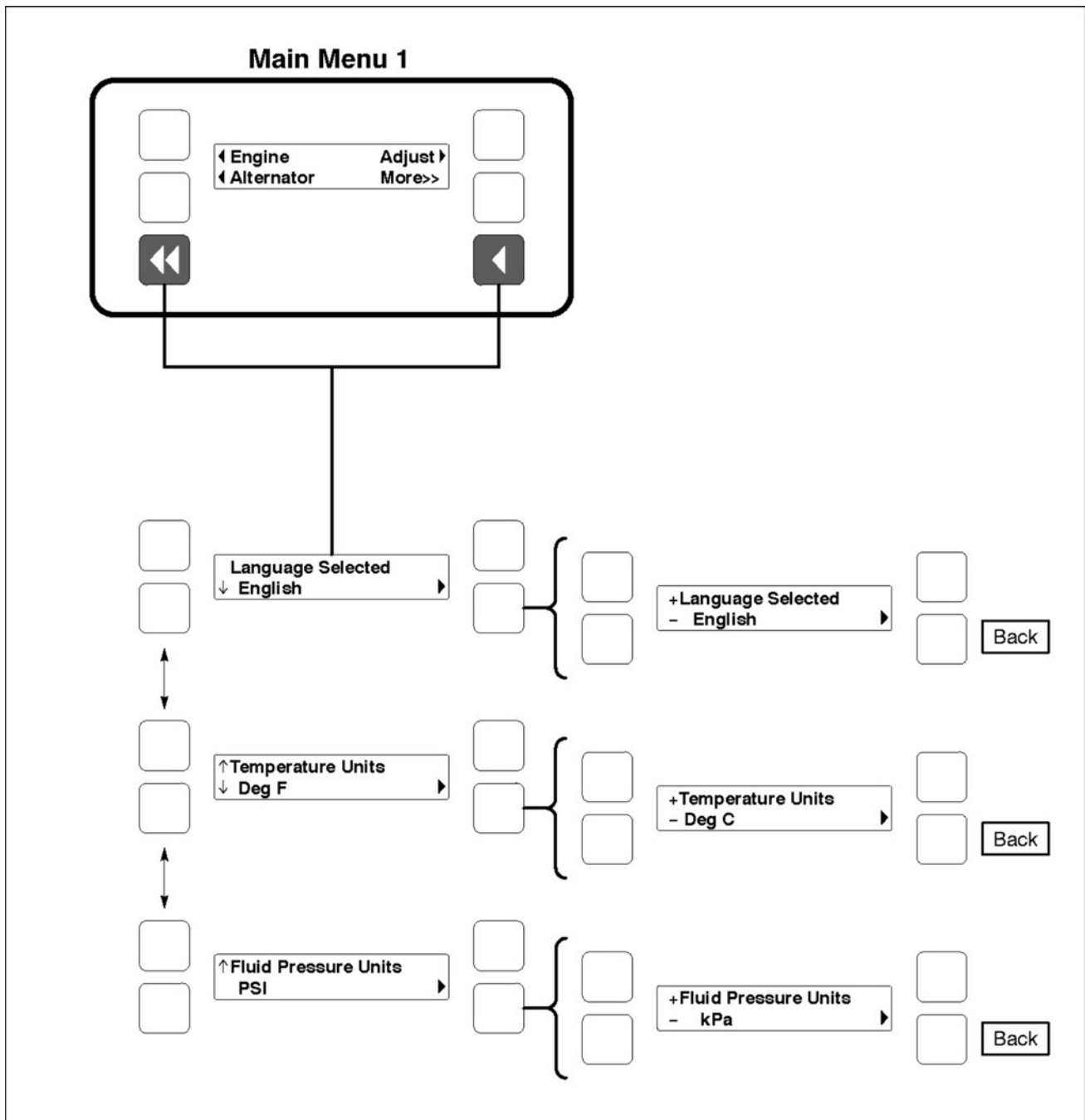


FIGURE 17. CONTROLLER CONFIGURATION MENU

### 4.4.5 Engine Menu

[Figure 18 on page 40](#) shows a block representation of the Engine menu. If you press the button next to the word "Engine" in the display, the first Engine submenu is displayed.

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

- **Coolant Temperature** submenu: This submenu displays the engine coolant temperature which can be viewed in degrees Fahrenheit or Centigrade (see the [Section 4.4.4](#)).
- **Oil Pressure** submenu: This submenu displays the engine oil pressure which can be viewed in PSI or kPa (see [Section 4.4.4 on page 37](#)).
- **Oil Temperature** submenu (Only available on some models): This submenu displays the engine oil temperature which can be viewed in degrees Fahrenheit or Centigrade (see [Section 4.4.4 on page 37](#)).
- **Engine Speed** submenu: This submenu displays the engine RPM.
- **Battery Voltage** submenu: This submenu displays the engine battery voltage.
- **Governor Duty Cycle** submenu: This submenu displays the governor duty cycle (drive) levels in percentage of maximum.
- **Active Time Delay** submenu: This submenu displays the time delay that is currently active: warm-up, cooldown, 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.

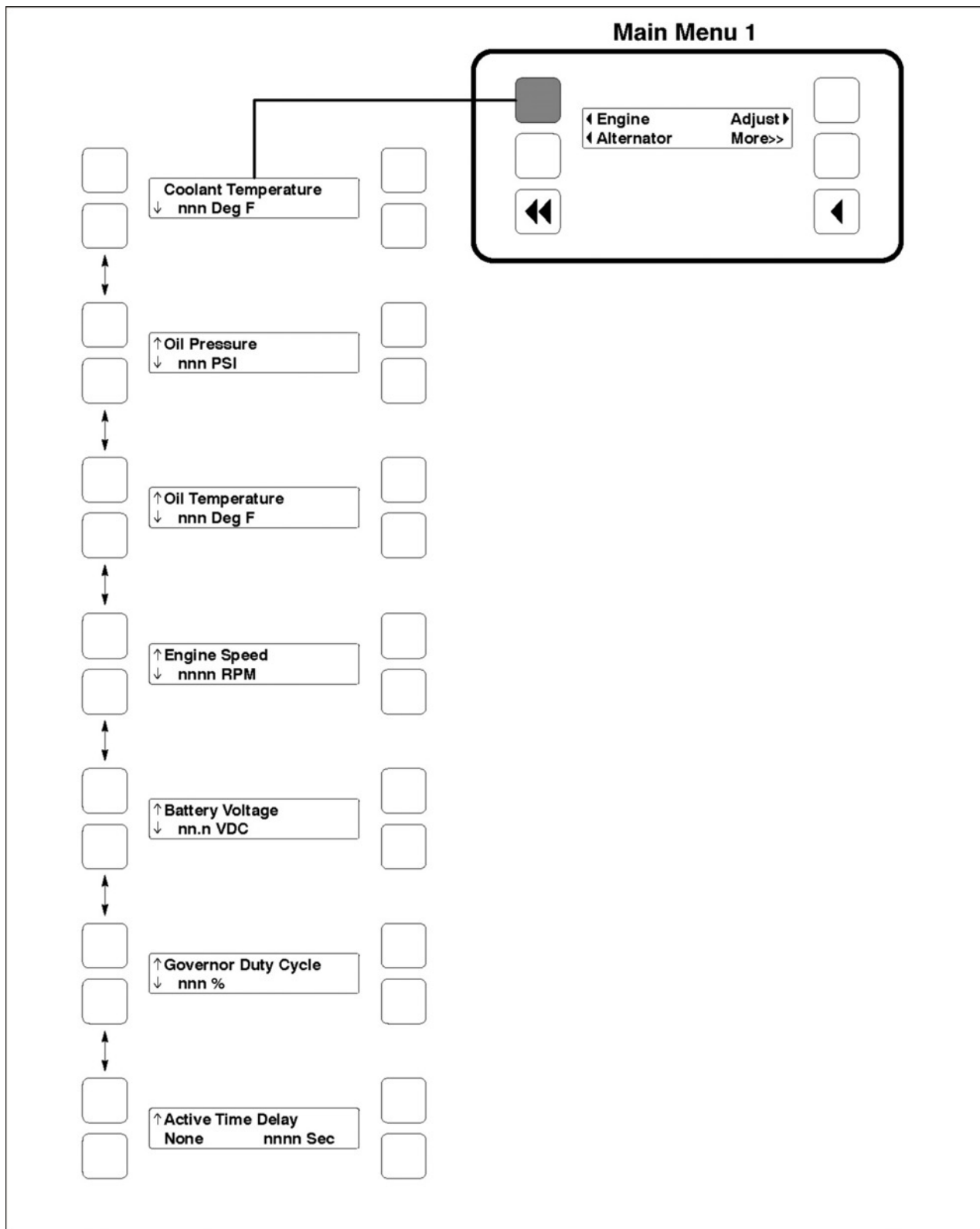


FIGURE 18. ENGINE MENU

## 4.4.6 Alternator Menu

[Figure 19 on page 42](#) shows a block representation of the Alternator menu. If you press the button next to the word "Alternator" in the display, the first Alternator submenu is displayed.

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

- **Line-to-Line Voltage** submenu: 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.)
- **Line-to-Neutral Voltage** submenu: 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.
- **Amps** submenu: All phases. (Single phase - L1 and L2 only.)
- **Frequency** submenu: Generator set output frequency.
- **Total Real Power** submenu: This submenu displays the total amount of real power output, in kilowatts (kW).
- **Real Power** submenu: This submenu displays the amount of real power output for L1, L2, and L3, in kilowatts (kW). (Single phase - L1 and L2 only.)
- **Total Apparent Power** submenu: This submenu displays the total amount of apparent power output, in kilovolt amps (kVA).
- **Apparent Power** submenu: This submenu displays the amount of apparent power output for L1, L2, and L3, in kilovolt amps (kVA). (Single phase - L1 and L2 only.)
- **Total Power Factor** submenu: This submenu displays the power factor with leading/lagging indication.  
*The PF reading will contain an asterisk if the power factor is leading (for example, Total PF 0.9\*).*
- **Power Factor** submenu: This submenu displays a power factor value for L1, L2, and L3. (Single phase - L1 and L2 only.)  
*The PF reading will contain an asterisk if the power factor is leading (for example, PF L1 0.9\*).*
- **AVR Duty Cycle** submenu: This submenu displays the voltage regulator (drive) level in percentage of maximum. (Where maximum is 100% Duty Cycle, software clamps Duty Cycle maximum to 60% for PMG and 90% for shunt.)

Press the buttons next to the ↑ and ↓ arrows 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.

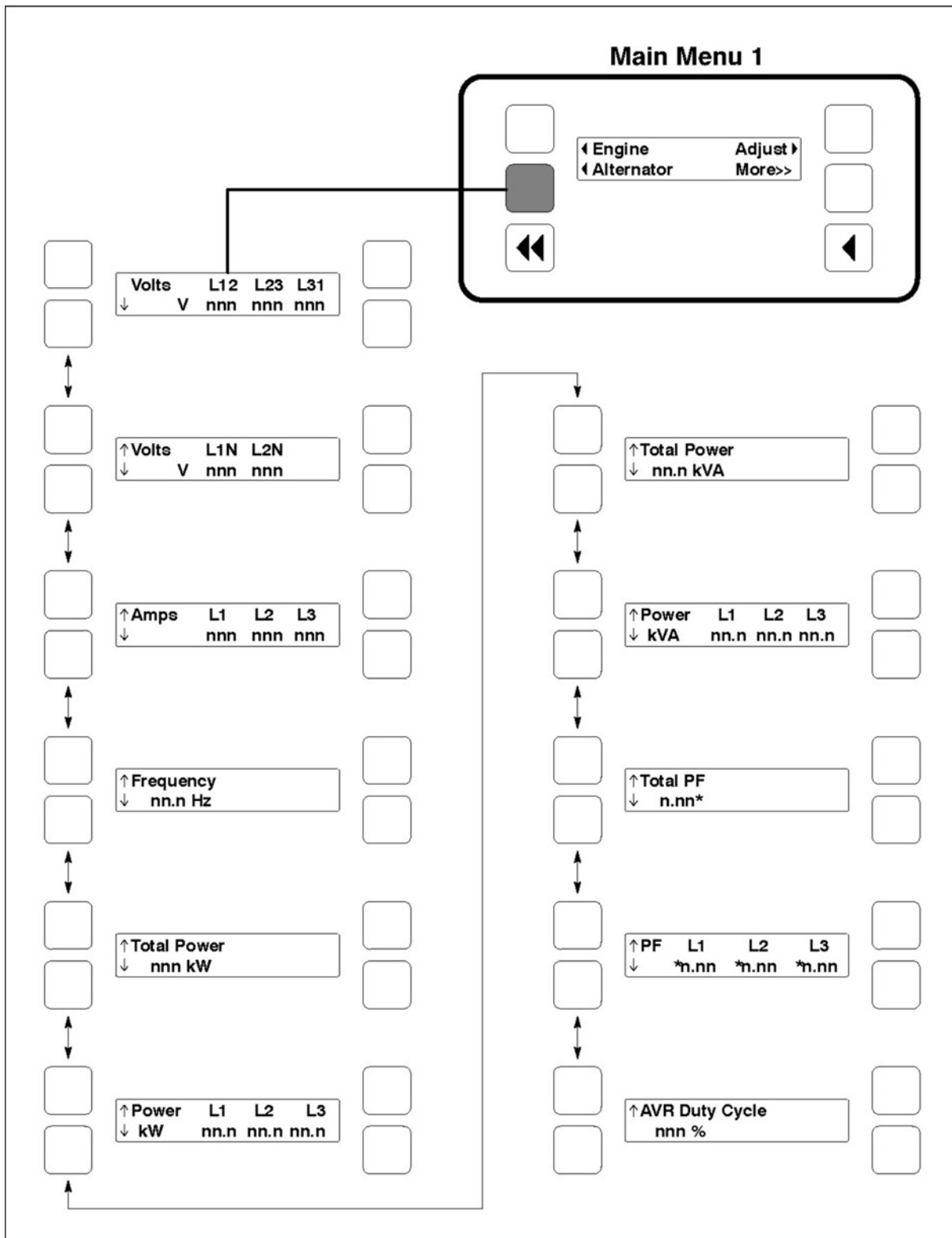


FIGURE 19. ALTERNATOR MENU



## 4.4.7 Adjust Menu

[Figure 20 on page 44](#) shows a block representation of the Adjust menu. If you press the button next to the word "Adjust" in the display, the first Adjust submenu is displayed.

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

- **Voltage Adjust** submenu: Voltage can be adjusted to 5 percent of the nominal voltage. For example, if generator set output voltage is 208 Volts, the voltage can be adjusted from 198 to 218 Volts.  
  
If the displayed value is greater or less than the allowed (5%) range, the control will not except the entry and will return to the previous setting. Retry by entering a smaller change in one volt increments.
- **Frequency Adjust** submenu: Frequency can be adjusted to 5 percent of the nominal frequency. For example, if the generator set frequency is 60.0 Hz, the frequency can be adjusted from 57.0 to 63.0 Hz.
- **Start Delay** submenu: Start Delay can be set from 0 to 300 seconds (default = 0). (Enter 1 or more to enable.) This function is bypassed during a manual start/stop sequence.
- **Stop Delay** submenu: Stop Delay can be set from 0 to 600 seconds (default = 0). (Enter 1 or more to enable.) This function is bypassed during a manual start/stop sequence and engine shutdown faults.
- **Rated To Idle** (Beginning Version 2.303): Rated To Idle delay can be set from 0 to 10 seconds (default = 0). (Enter 1 or more to enable.) Entering a non-zero delay will cause the generator set to delay the transition to Cooldown At Idle.
- **Idle Start** submenu (Only available on some models): Idle Start can be enabled or disabled (default = Disable). This function is only enabled when the generator set is started in manual mode. Idle Start can also be enabled while the generator set is running in manual mode. (Auto/remote start is not affected by this setting.)

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

Adjusting Values/Parameters:

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

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

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 10 minutes. Long periods of engine idling can eventually affect engine performance and may void engine warranty.

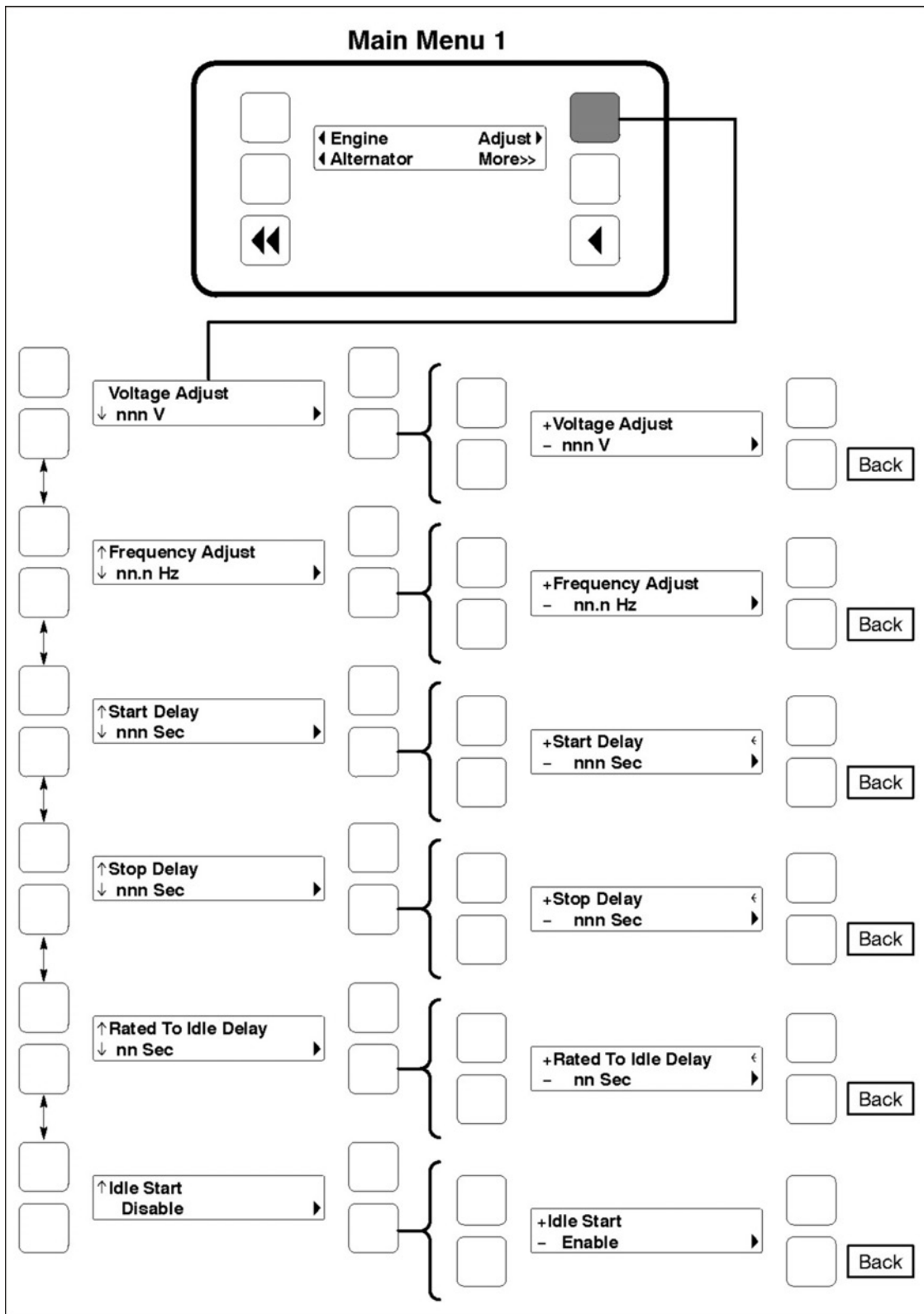


FIGURE 20. ADJUST MENU

### 4.4.8 Faults Menu

Figure 21 shows a block representation of the Faults menu. Up to 20 of the most recent faults can be viewed. An example of how a fault code is displayed is shown in Figure 22 on page 46.

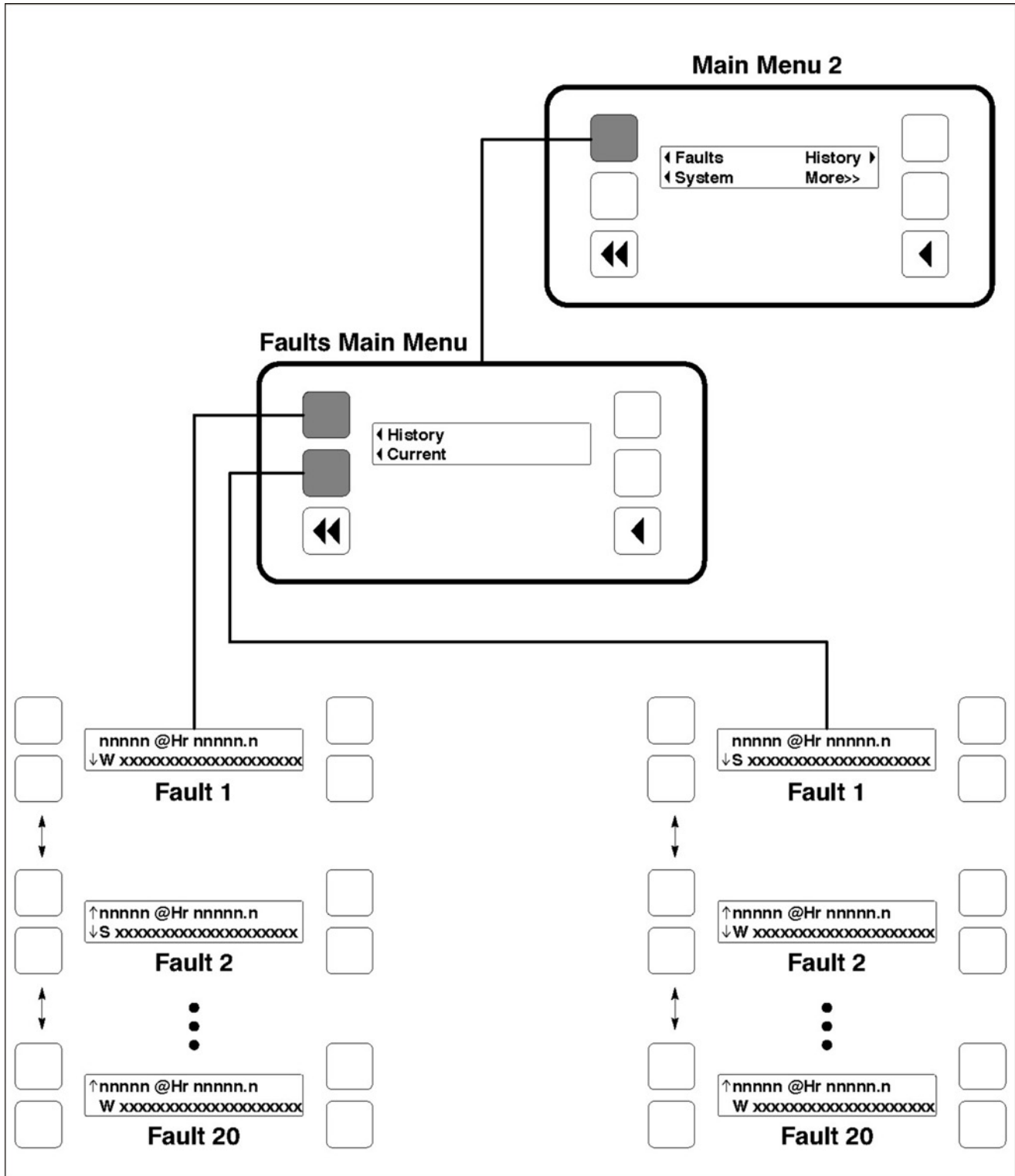


FIGURE 21. FAULTS MENU

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

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

If there are no faults, the ◀ symbol next to the word "Faults" is not displayed and no Fault menus are available.

If more than one fault has occurred, press the button next to the word "Fault" in the screen display to view the Faults Main Menu. As shown in the diagram, the Faults Main Menu has two submenus. Press the Previous Main Menu button to return to the Faults Main Menu. Press the Previous Main Menu button a second time to return to Main Menu 2.

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

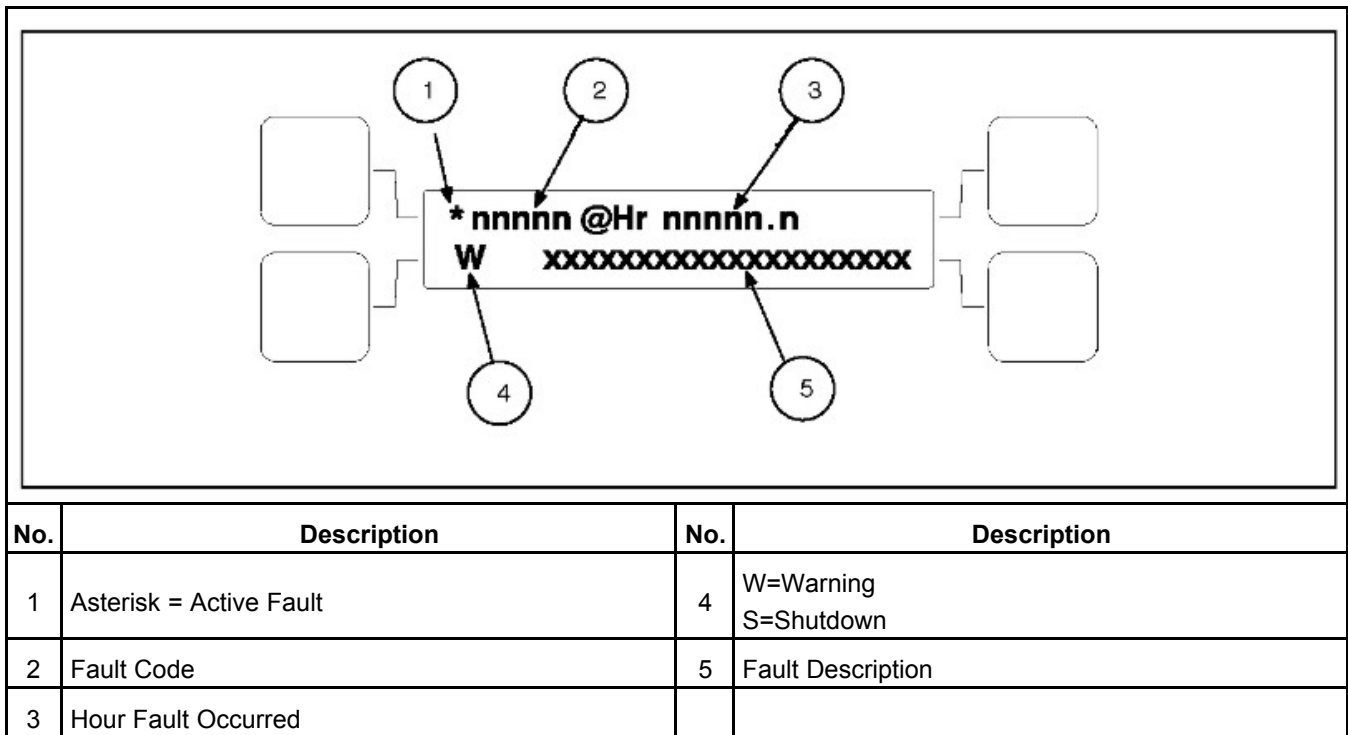


FIGURE 22. HISTORY/CURRENT FAULT SUBMENU

### 4.4.9 System Menu

[Figure 23 on page 47](#) shows a block representation of the System menu. If you press the button next to the word "System" in the display, the System Main Menu is displayed. This menu is displayed only if the network communications module (NCM) feature is installed. The System Main Menu allows you to view the status and load of other PCC equipment connected on a common network with the PCC 2100 control.

As shown in the diagram, the System Main Menu has one set of submenus.

- **Genset System** submenus: From the System Main Menu, press the button next to the word "Genset" in the display to view the first of up to 16 Genset System submenus. One generator set must be available in the network to display this submenu.

The genset submenu allows viewing of the generator set name (configured with InPower), kW load and operational state.

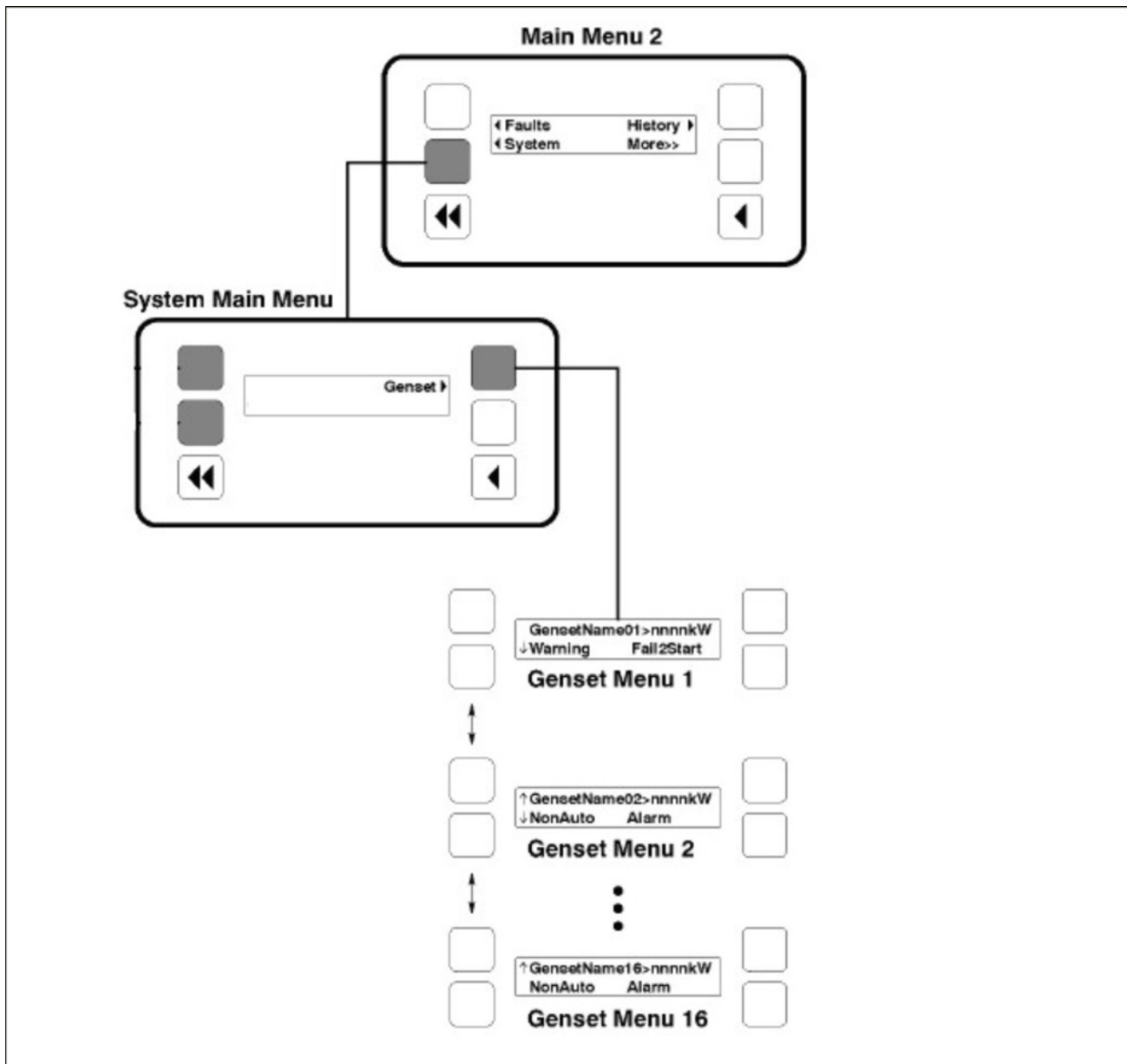


FIGURE 23. SYSTEM MENU

### 4.4.10 History Menu

[Figure 24 on page 49](#) shows a block representation of the History menu. If you press the button next to the word "History" in the display, the first History submenu is displayed.

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

- **Number of Starts** submenu: This submenu shows the number of engine starts.
- **Engine Hours** submenu: This submenu shows the number of operating hours for the engine.
- **Control Hours** submenu: This submenu shows the number of operating hours for the control.

- 
- **Kilowatt Hours** submenu: This submenu shows the number of kilowatt (kW) or megawatt (MW) hours.
  - **Genset Duty Cycle** submenu: This submenu shows the percent of generator set operating hours that are less than 30 percent of rated load and percent of hours that are greater than 90 percent.

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.

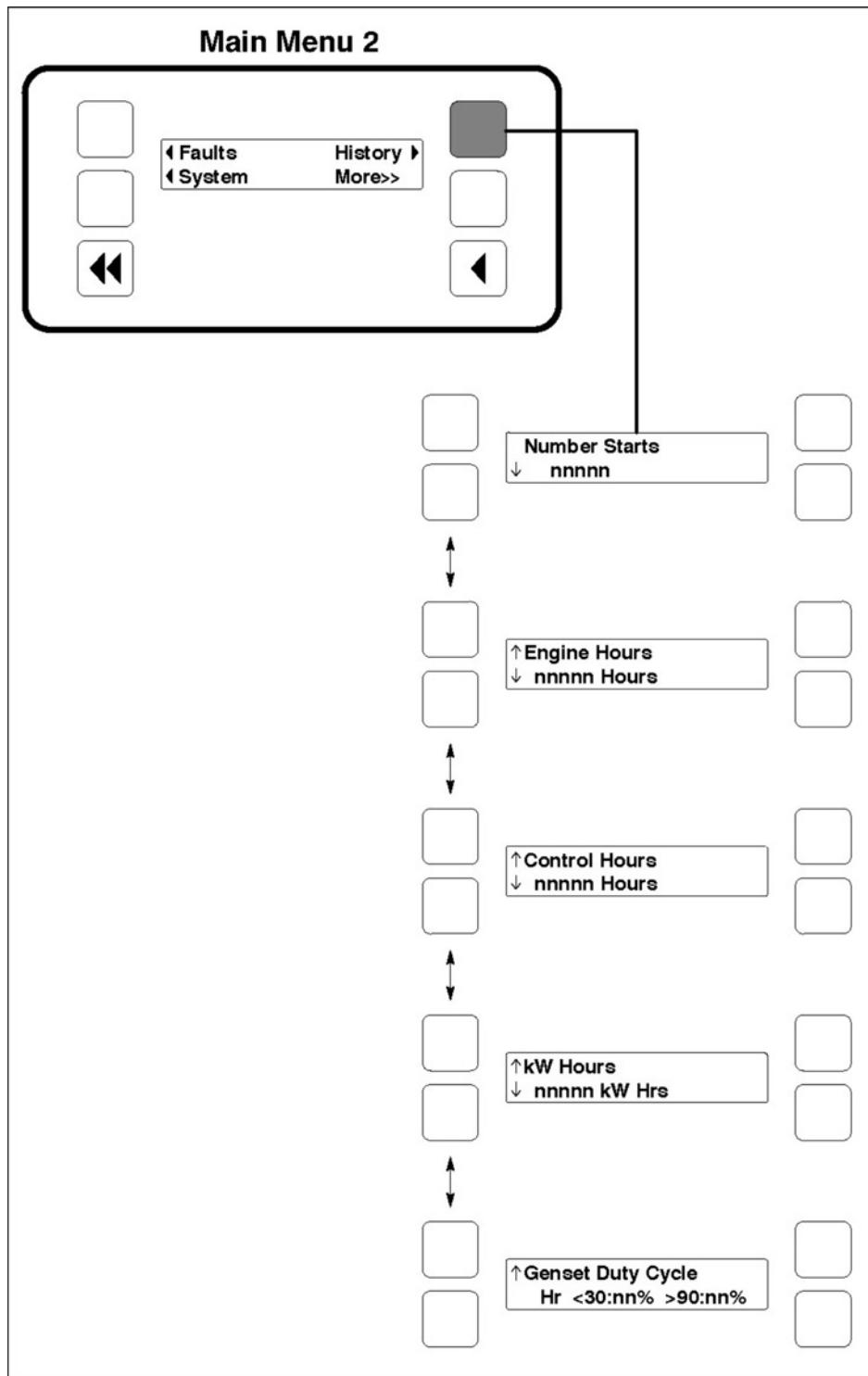


FIGURE 24. HISTORY MENU

### 4.4.11 About Menu

[Figure 25 on page 50](#) shows a block representation of the About menu. If you press the button next to the word "About" in the display, the first About submenu is displayed.

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

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

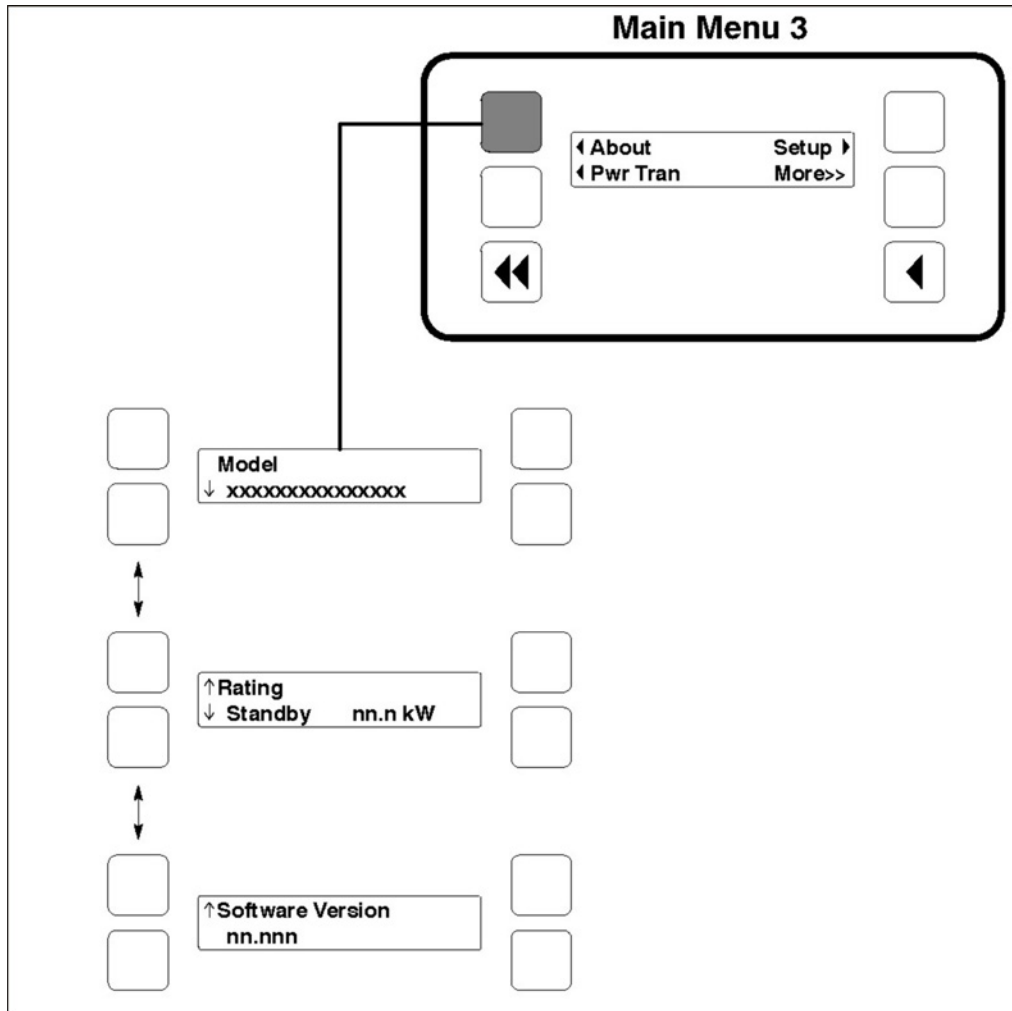


FIGURE 25. ABOUT MENU



# 5 Control Adjustment and Service

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## 5.1 General

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

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

### WARNING

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

### WARNING

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

## 5.2 Circuit Board Removal/Replacement

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

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

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

Refer to INPOWER User's Guide for specifics.

### 5.2.1 Circuit Board Removal Safety Precautions

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

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

### CAUTION

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

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

**⚠ WARNING**

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

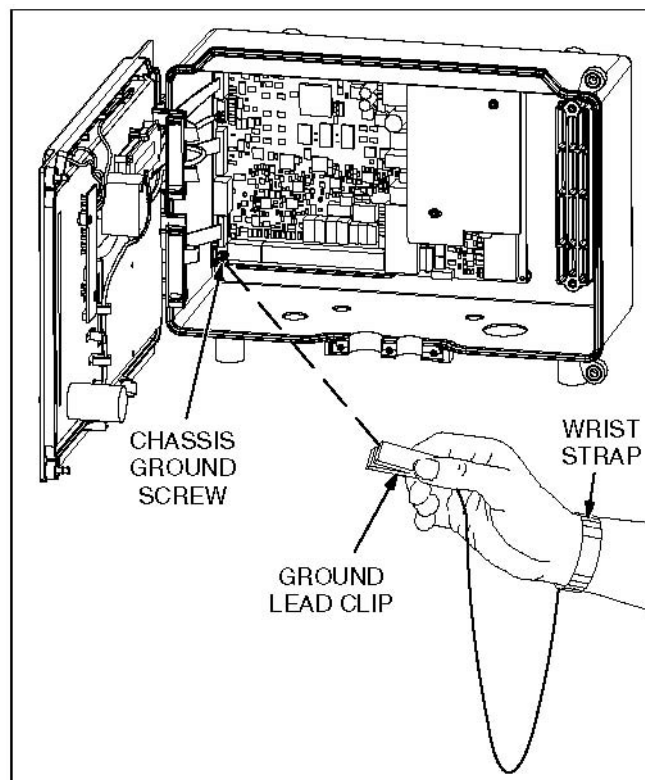
*Ventilate battery area before working on or near battery—Wear goggles—Stop generator set and disconnect charger before disconnecting battery cables—Disconnect negative (-) cable first and reconnect last.*

**⚠ CAUTION**

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

**⚠ WARNING**

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

**FIGURE 26. WRIST STRAP**

## 5.3 Modifying Setup Submenus

The Setup submenus allow you to adjust system parameters.

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

- Crank/Idle Setup Menu
- Governor/Regulator Setup Menu (not available on all models)
- Power Transfer Setup Menu

These three menus are intended for qualified service personnel only. For this reason, a three-digit access code (password) must be entered before you can proceed to those menus.

### ⚠ CAUTION

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

## 5.4 Password Submenu

[Figure 27 on page 54](#) shows a block representation of the Setup Main menu. If you press the button next to the word "Setup" in the display, the Setup Password submenu is displayed. Use of Setup menus is restricted to service personnel.

Press the Previous Main Menu button to return to Main Menu 3. Press the Home button to return to Main Menu 1.

**Password submenu:** If you enter the correct password, the Setup Main Menu is displayed. When the Password submenu is displayed, the first numeric character (0) is flashing. The access code for your PCC is: 574. To enter the password:

1. Press the button next to the + symbol until the value reads "5."
2. Press the button next to the → symbol to move to the next numeric character.
3. Press the button next to the + symbol until the value reads "7."
4. Press the button next to the → symbol to move to the next numeric character.
5. Press the button next to the + symbol until the value reads "4."
6. After you have completed entering the password, press the button next to the M symbol. The Setup Main Menu is displayed.

**If a wrong number is entered into any of the numeric character fields, use the buttons next to the ↓ and ↑ symbols until the correct value is entered.**

**If the wrong character field is selected, use the buttons next to the ← and → symbols to move to the character field you wish to change.**

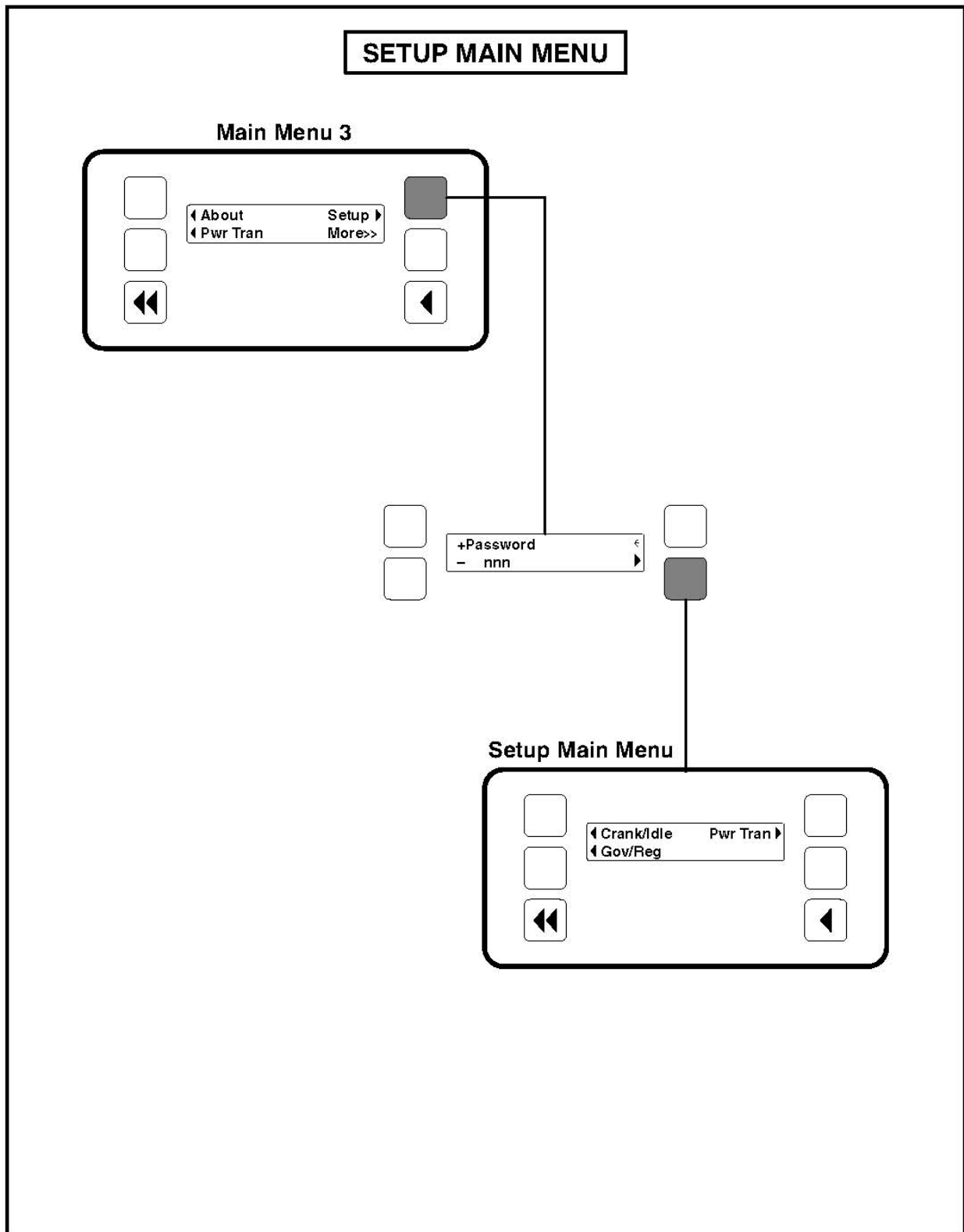


FIGURE 27. SETUP MAIN MENU

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## 5.5 Crank/Idle Setup Menu

[Figure 28 on page 56](#) shows a block representation of the Crank/Idle Setup menu. If you press the button next to the word "Crank/Idle" in the display, the first Crank/Idle Setup submenu is displayed.

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

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

### **Adjusting Values/Parameters:**

1. Press the button next to the ► symbol in the display until the + and - symbols are displayed.
2. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.
3. Press the button next to the + symbol to increase the value or select parameter; press the button next to the - symbol to decrease the value or select parameter.
4. After adjusting values/selecting parameters, pressing the ► symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ► symbol).
5. If the Home button or Previous Main Menu button is pressed before pressing the ► symbol, the changes are not saved.

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

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

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

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

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

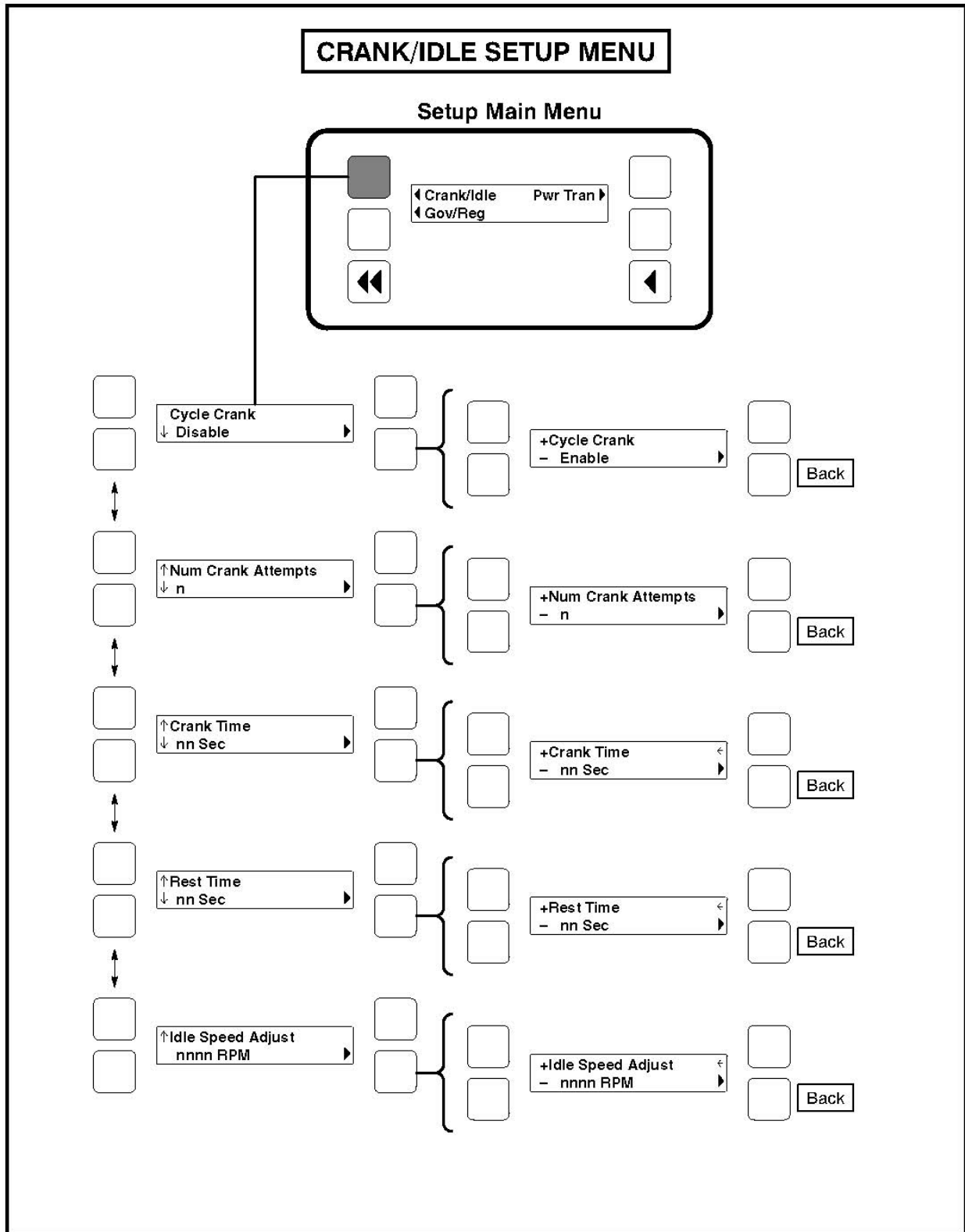


FIGURE 28. CRANK/IDLE SETUP MENU

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## 5.6 Governor/Regulator Setup Menu

<b>NOTICE</b>
---------------

<b>This menu is not available on all models.</b>
--

The following figure shows a block representation of the Governor/Regulator Setup menu. If you press the button next to the word "Gov/Reg" in the display, the first Governor/Regulator Setup submenu is displayed.

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

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

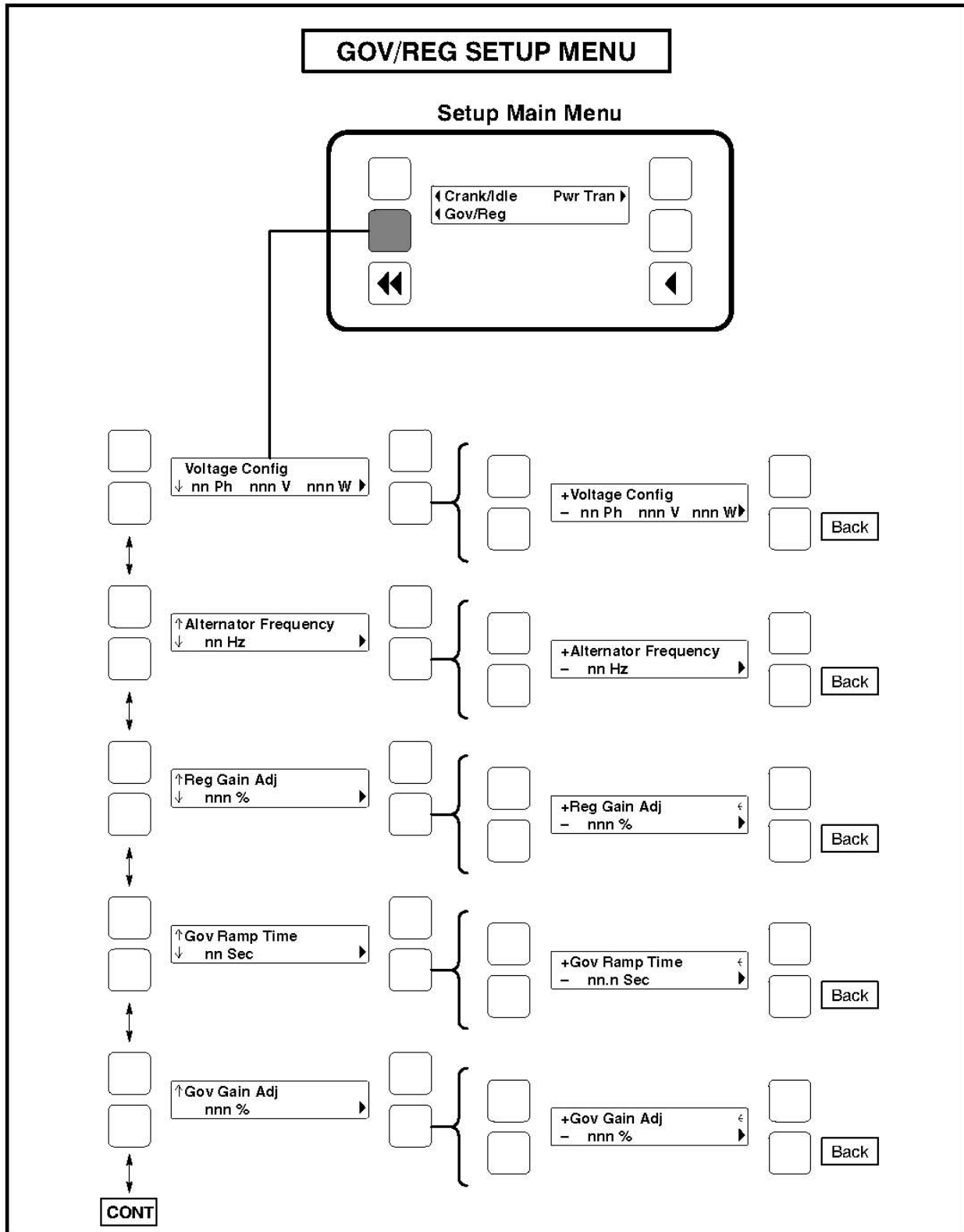
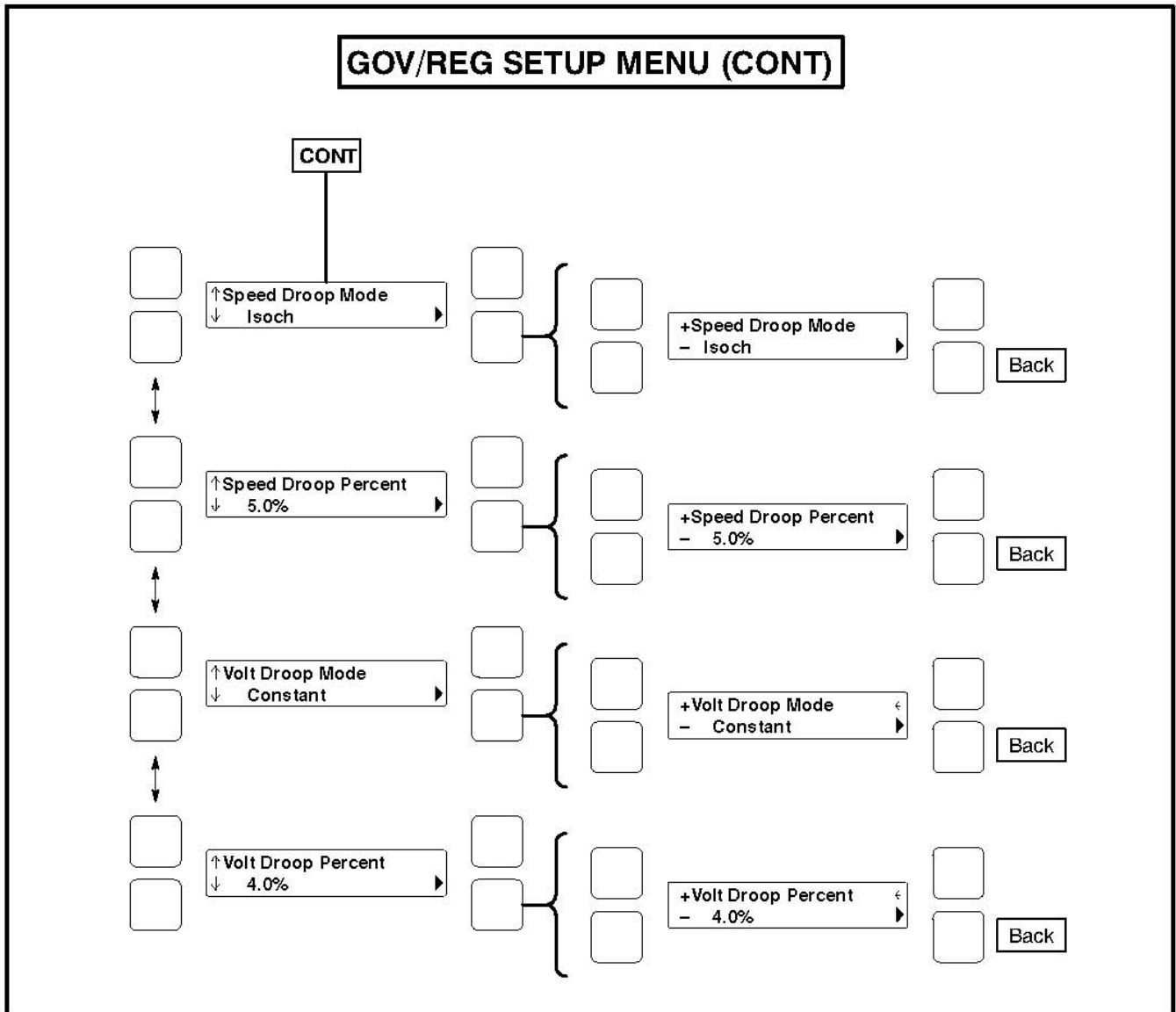


FIGURE 29. GOVERNOR/REGULATOR SETUP MENU (1 OF 2)





**FIGURE 30. GOVERNOR/REGULATOR SETUP MENU (2 OF 2)**

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

**⚠ CAUTION**

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

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

**Adjusting Values/Parameters:**

1. Press the button next to the ► symbol in the display until the + and - symbols are displayed.
2. If necessary, press the button next to the ← or → symbols to move to the numeric character you wish to change.

3. Press the button next to the + symbol to increase the value or select parameter; press the button next to the - symbol to decrease the value or select parameter.
4. After adjusting values/selecting parameters, pressing the ► symbol results in the changes being saved. (When adjusting values, make sure the cursor is on the last numeric character before pressing the ► symbol).
5. If the Home button or Previous Main Menu button is pressed before pressing the ► symbol, the changes are not saved.

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

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

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

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

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

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

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

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

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

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

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

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

## 5.7 PCC Control Panel Box Components (Standard/Optional)

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

### 5.7.1 Network Communications Module (Optional)

The Network Communications Module (NCM) provides an interface for data from the generator set to other modules on the network. It communicates with the PCC 2100 baseboard providing complete monitoring and control of the generator set. Refer to the *PowerCommand Network Installation and Operator's Manual (900-0529)* for instructions on network wiring and network software information.

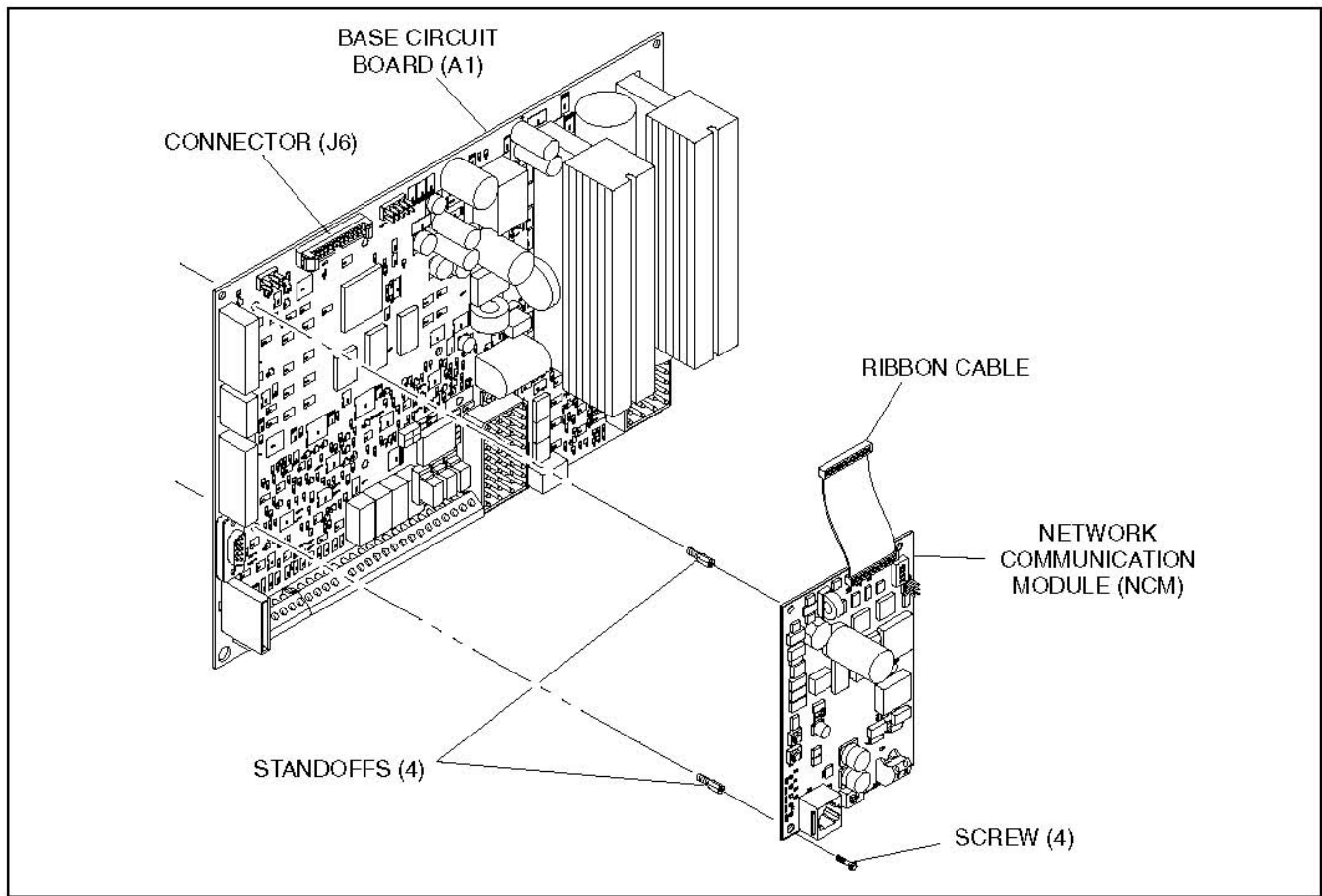


FIGURE 31. NETWORK COMMUNICATION MODULE

## 5.7.2 TB1 Customer Inputs

Refer to wiring diagrams for typical connections to TB1.

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

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

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

**Customer Fault Inputs 1 through 3:** Grounding any one of these inputs activates the corresponding warning or shutdown sequence.

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

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

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

- Enable/disable input. Default setting:

Enable 1 through 3

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

### 5.7.3 TB1 Customer Outputs

Refer to Page 9-11 for typical connections to TB1.

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

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

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

- Enable/disable output. Default setting:
  - Enable 1 through 4
- Status, Warning or Shutdown. Default setting:
  - 1 - Common warning
  - 2 - Common shutdown
  - 3 - Not in Auto
  - 4 - Ready to Load

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

**B+:** This is a fused 10 amp, 12/24 volt output. (Fuse F1 is located on Base board.) Two terminals (TB1-17 and -18) are connected to this 10 amp circuit.

**B+ Switched:** This is a fused 5 amp, 12/24 volt switched output. This output is activated when the control receives a run command. (Fuse F2 is located on Base board.)

### 5.7.4 Control Relays (K10, K11, K12) (Optional)

#### ⚠ CAUTION

**Damage to the Base board can occur if the voltage suppressors (Figure 32) are not installed across relay coils (A1/A2) before connecting generator set battery cables.**

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

These relays (**Figure 32**) are used to control auxiliary equipment, such as fans, pumps and motorized air dampers. Energizing of the relays is user definable (refer to *TB1 Customer Outputs* in this section for customizing information.)

The contacts are rated at 10 amps at 600 VAC.

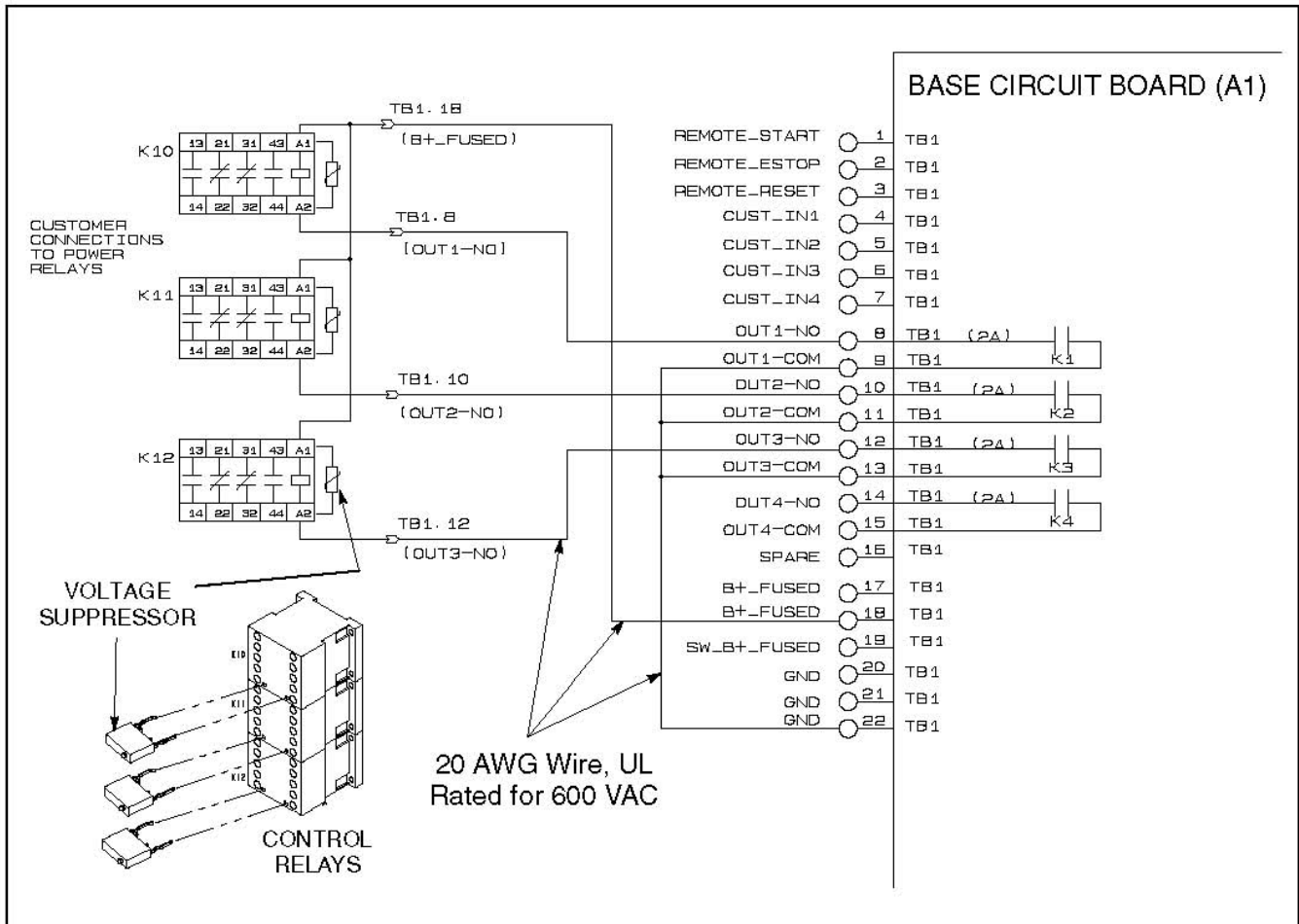


FIGURE 32. OPTIONAL CONTROL RELAYS (K10, K11, K12)

## 5.8 Magnetic Speed Pickup Unit (MPU) Installation

### NOTICE

This is not required on all models.

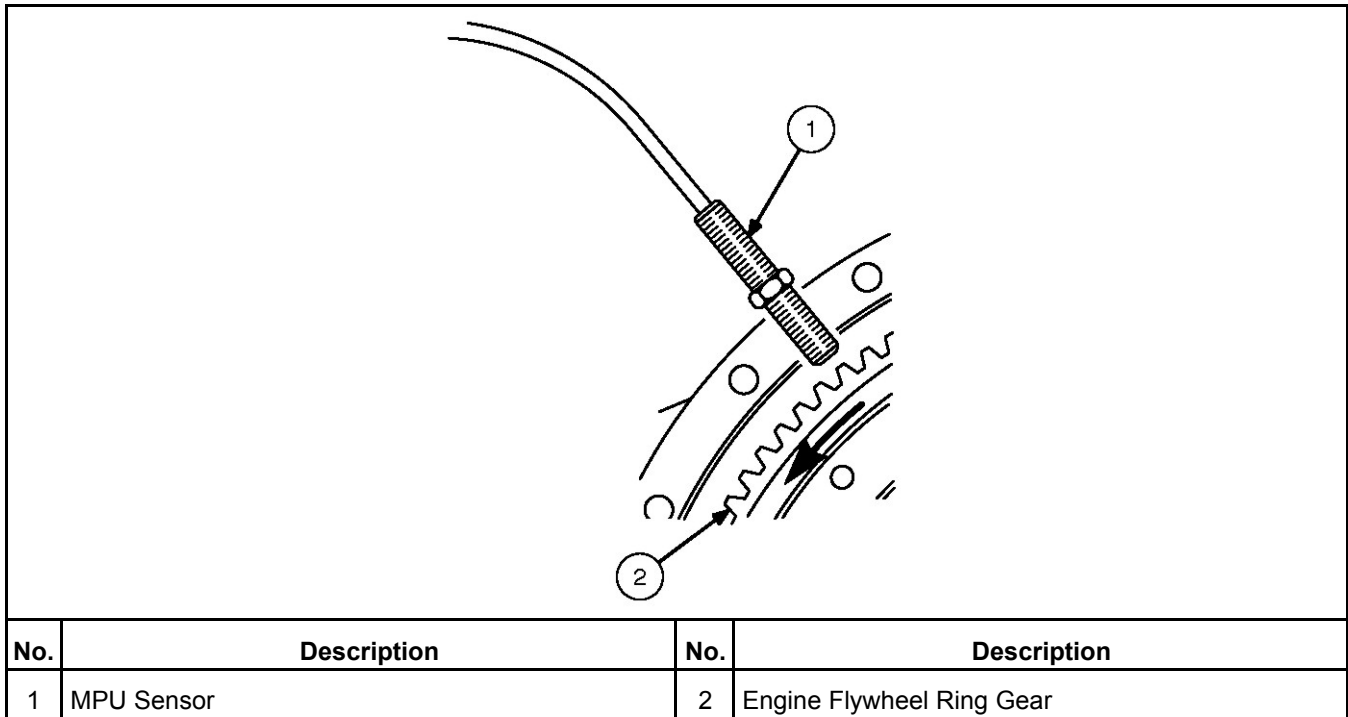
Measure the resistance of the magnetic speed pickup (MPU). Replace the MPU if the resistance is not between 1,000 ohms and 1,050 ohms.

With the MPU removed from the generator set, bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the sensor in gently by hand until it just touches the gear tooth. Back it out 1/4 turn and set the locknut.

**⚠ CAUTION**

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

After adjustment, make sure output voltage of the MPU is correct. Replace the MPU if output voltage at cranking speed is less than 1.5 VAC.



**FIGURE 33. MPU SENSOR**

## 5.9 Current Transformer (CT) Installation

Current transformers (CTs) are required on generator sets that contain AC meters. The CTs must be installed as noted in the following *CT Installation Requirements*. Improper installation of CTs will cause a "1459 Reverse Power" shutdown error.

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

## 5.10 CT Installation Requirements

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

B. CT1 - U load leads (A phase)

CT2 - V load leads (B phase)

CT3 - W load leads (C phase)

C. Route the appropriate leads through each CT.

- 6 lead generator sets - generator output leads are routed through the CTs.
- 12 lead generator sets - load wires are routed through the CTs.

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

Non-reconnectable generator sets (6 leads) have single secondary CTs (2 pins).

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# 6 Troubleshooting

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## 6.1 Safety Considerations

### WARNING

#### **Hazardous Voltage**

**Contact with high voltages can cause severe electrical shock, burns, or death.**

**Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.**

### WARNING

#### **Combustible Gases**

**Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.**

**Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (-) cable first and reconnect it last.**

### WARNING

#### **Automated Machinery**

**Accidental or remote starting of the generator set can cause severe personal injury or death.**

**Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [-] first).**

Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions in the Important Safety Instructions section.

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

### NOTICE

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

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

1. Make sure the generator set is in the Off mode.
2. Turn off or remove AC power from the battery charger.
3. Using an insulated wrench, remove the negative (-) battery cable from the generator set starting battery.

## 6.2 InPower Service Tool

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

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

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

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

### NOTICE

**Using the wrong calibration file can result in equipment damage. Do not swap base boards from another generator set model.**

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

## 6.3 Network Applications and Customer Inputs

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

## 6.4 Troubleshooting Procedures

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

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

### NOTICE

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

This section contains the following information:

- How to troubleshoot a local/remote failure to crank problem when the control panel does not indicate any fault condition.
- How to troubleshoot engine problems that are not within the detectable range of the PC control.

- How to troubleshoot a Check Engine lamp fault for generator sets that contain the low emissions option.
- Descriptions of each status, warning, and shutdown code; warning and shutdown limits where applicable; and basic corrective actions, such as checking fluid levels, control reset functions, battery connections, etc.
- Detailed troubleshooting procedures. In the following list of troubleshooting procedures, the fault codes are arranged in numeric order.

#### NOTICE

**Always set the generator set to off mode before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.**

#### NOTICE

**Electrostatic discharge will damage circuit boards. Always wear a wrist strap when handling circuit boards or when disconnecting or connecting harness connectors. See the *Circuit Board Removal/Replacement* procedure in the controller Service Manual.**

## 6.5 Relay K1

Switched B+ relay K1 supplies switched B+ power to splice SP8. SP8 supplies switched B+ to the fuel solenoids, air fuel controller, and the oxygen sensor. K1 is part of the engine harness assembly.

## 6.6 Relay K4

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

## 6.7 Relay K6

#### NOTICE

**This relay is not available in all models.**

Relay K6 is the fuel burn-off relay that is used to energize the ignition coil. K6 is part of the generator set harness.

## 6.8 Fault Code 121 - Speed Signal Lost

**Lamp:** Shut down

**Corrective Action:** This indicates that the PCC is not sensing the speed sensor signal.

- Restart and check RPM on the digital display.
1. **Possible Cause:** Loose or damaged magnetic pickup (MPU) wires/connector pins.  
**Corrective Action:** Inspect the wires/connector pins, and repair or replace as necessary.
  2. **Possible Cause:** The magnetic pickup or harness could be bad.

**Corrective Action:** To isolate the problem, reset the control and attempt to start the set in Idle mode (select Idle Mode – Enable menu).

- If **1438** (Fail To Crank) is displayed, or if the engine starts, but then shuts down on **121** (Speed Signal Lost), the MPU sender could be bad. Remove the MPU connectors and check for 1.5 VAC (minimum) at the MPU while cranking.
  - If no output or less than 1.5 VAC, check for damage or debris. Also check for improper adjustment of the MPU. (Refer to *Section 6.*) If there is still no output, replace the MPU sender.
  - If the MPU output is OK, check for MPU voltage at P7-25 (MAG PICK+) to P7-29 (MAG PICK-) while cranking. If not OK, use continuity checks to isolate connectors/harness.
- If the engine starts and idles, and does not display a fault, then there could be a frequency mismatch problem. Measure generator output frequency with a digital multimeter and compare to the frequency on the PCC display.
  - If they do match, multiply the frequency by 30 and compare this number to the RPM on the PCC display. If these are not the same, the MPU sender may be bad. Replace the MPU sender.
  - If the multimeter and PCC frequencies do not match, there may be a frequency sensing problem within the Base board.

## 6.9 Fault Code 135 - Oil Pressure Sensor High

**Lamp:** Warning

**Corrective Action:** Indicates that the control has sensed that the engine oil pressure sender signal is shorted high. Check sender/connectors/wires.

**Effect:** No engine protection for oil pressure during generator set operation.

1. **Possible Cause:** Fault simulation was enabled with In-Power.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** The sensor connections could be bad.

**Corrective Action:** Inspect the sensor and engine harness connector pins. Repair or replace as necessary.

3. **Possible Cause:** The sensor could be bad.

**Corrective Action:** Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. **“OIL PRESSURE SENSOR H” warning is displayed after the fault condition is sensed for 10 seconds.** If the control responds to the simulator, replace the sensor. If control does not respond, go to next step.

4. **Possible Cause:** The harness could be bad.

**Corrective Action:** Remove connector P7 from Base board and connector from sensor. Check P7-13, 17 & 21 as follows:

- Check for a short circuit from pin to pin (more than 200k ohms OK).
- Check for an open circuit (10 ohms or less OK). Repair or replace as necessary.

5. **Possible Cause:** The pressure signal could be out of range.

**Corrective Action:** With all connectors attached, check pressure signal (.5 to 4.5 VDC) at P7-13 (OP OUT) and P7-17 (OP COM).

## 6.10 Fault Code 141 - Oil Pressure Sensor Low

**Lamp:** Warning

**Corrective Action:** Indicates that the control has sensed that the engine oil pressure sender signal is shorted low. Check sender/connectors/wires.

**Effect:** No engine protection for oil pressure during generator set operation.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** The sensor connections could be bad.

**Corrective Action:** Inspect the sensor and engine harness connector pins. Repair or replace as necessary.

3. **Possible Cause:** The sensor could be bad.

**Corrective Action:** Disconnect the oil pressure sensor leads and connect an oil pressure sensor simulator to the harness. **“OIL PRESSURE SENSOR L” warning is displayed after the fault condition is sensed for 10 seconds.** If the control responds to the simulator, replace the sensor. If control does not respond, go to the next step.

4. **Possible Cause:** The harness could be defective.

**Corrective Action:** Remove connector P7 from base board and the connector from the sensor. Check P7-13, 17, and 21 as follows:

- Check for an open circuit (10 ohms or less is OK).
- Check for a short circuit to the engine block ground (more than 200k ohms is OK).
- Check for a short circuit from pin to pin (more than 200k ohms is OK). Repair or replace as necessary.

5. **Possible Cause:** The pressure signal could be out of range.

**Corrective Action:** With all connectors attached, check pressure signal (.5 to 4.5 VDC) at P7-13 (OP OUT) and P7-17 (OP COM).

## 6.11 Fault Code 143 - Pre-Low Oil Pressure Sensor

**Lamp:** Warning

**Corrective Action:** Indicates engine oil pressure has dropped to an unacceptable level. If the generator is powering critical loads and cannot be shut down, wait until the next shutdown period and then follow code 415 procedure.

**Effect:** Calibration-dependent. No action is taken by the PCC for code 143. Engine will shut down for code 415.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Sensor could be bad, or the generator set may be shutting down on another fault.

**Corrective Action:** Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. If the control responds to the simulator, reconnect the sensor, disconnect the ACT- signal wire at the fuel pump actuator, and crank the engine. Check the oil pressure reading on the digital display.

- If the display shows an acceptable oil pressure, the problem may not be in the oil or oil sensing system. The generator set may be shutting down on another fault (out of fuel, intermittent connector). Restart the generator set and monitor the PCC display panel for other faults.
- If the display does not show an acceptable oil pressure, replace the sensor. If the control does not respond to the simulator, go to the next step.

3. **Possible Cause:** Harness could be bad.

**Corrective Action:** If the control does not respond to the simulator, the harness is defective. Check for +5 VDC at the sensor (lead marked E1-A). If there is no 5 VDC at the sensor:

- Check for 5 VDC at P7-21.
- If yes, the harness is defective and must be replaced. If there is 5 VDC at the sensor, use the sensor simulator to generate a signal to P7-13 (OP OUT) and P7-17 (OP COMM). If the pressure signal (.5 to 4.5 VDC) does not get to P7, isolate to the harness.

## 6.12 Fault Code 144 - Coolant Temperature Sensor High

**Lamp:** Warning

**Corrective Action:** Indicates that the control has sensed that the engine coolant temperature signal is shorted high. Check sender/connectors/wires.

**Effect:** No engine protection for coolant temperature during generator set operation. Possible white smoke.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides

2. **Possible Cause:** The sensor connections could be defective.

**Corrective Action:** Inspect the sensor and engine harness connector pins. Repair or replace as necessary.

3. **Possible Cause:** The sensor could be defective.

**Corrective Action:** Disconnect the sensor and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If the control does not respond, go to the next step.

4. **Possible Cause:** The harness could be defective.

**Corrective Action:** Measure the resistance of the coolant sensor and reconnect the harness to the sensor. Remove connector P7 from the base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM).

- If resistance is not the same, the harness is defective and must be replaced.

## 6.13 Fault Code 145 - Coolant Temperature Sensor Low

**Lamp:** Warning

**Corrective Action:** Indicates that the control has sensed that the engine coolant temperature signal is shorted low. Check sender/connectors/wires.

**Effect:** No engine protection for coolant temperature during generator set operation. Possible white smoke.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** The sensor connections could be defective.

**Corrective Action:** Inspect the sensor and engine harness connector pins. Repair or replace as necessary.

3. **Possible Cause:** The sensor could be defective.

**Corrective Action:** Disconnect the sensor and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If the control does not respond, go to the next step.

4. **Possible Cause:** The harness could be defective.

**Corrective Action:** Follow these steps.

- a. Remove connector P7 from the base board and disconnect the sensor. Check pins P7-30 (IH20) and P7-34 (IH20 COM) for short circuit as follows:
  - Check for a short circuit to the engine block ground (more than 200k ohms is OK).
  - Check for a short circuit from pin to pin (more than 200k ohms is OK). Repair or replace as necessary.
- b. Measure the resistance of the coolant sensor and reconnect the harness to the sensor. Remove connector P7 from the base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM).
  - If resistance is not the same, the harness is defective and must be replaced.

## 6.14 Fault Code 146 - Pre-High Cool Temp

**Lamp:** Warning

**Corrective Action:** Coolant temperature has risen to an unacceptable level. If the generator is powering critical loads and cannot be shut down, wait until the next shutdown period and then follow the fault code 151 procedure.

**Effect:** Calibration-dependent. No action is taken by the PCC for fault code **146**. Engine will shut down for fault code **151**.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Engine or sensor circuitry problem.

**Corrective Action:** Isolate to the engine or sensor circuitry. Check the sensor accuracy with a thermocouple or similar temperature probe.

- If the PCC ambient coolant temperature reading is accurate, the engine may be overheating. Refer to the engine service manual.

- If the PCC ambient coolant temperature reading is not accurate, go to the next step.
3. **Possible Cause:** The sensor could be defective.  
**Corrective Action:** Disconnect the sensor and connect a coolant temperature sensor simulator to the harness. If the control responds to the simulator, replace the sensor. If control does not respond, go to next the step.
  4. **Possible Cause:** The harness could be defective.  
**Corrective Action:** Measure the resistance of the coolant sensor and reconnect the harness to the sensor. Remove connector P7 from the base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM).
    - If resistance is not the same, the harness is defective and must be replaced.

## 6.15 Fault Code 151 - High Coolant Temp

**Lamp:** Shutdown

**Corrective Action:** Coolant temperature has risen above the shutdown trip point.

Allow the engine to cool down completely before proceeding with the following checks:

- Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary.
- Check for obstructions to cooling airflow and correct as necessary.
- Check the fan belt and repair or tighten if necessary.
- Check the blower fan and circulation pumps on remote radiator installations.
- Reset the control and restart after locating and correcting the problem.

**Effect:** Calibration-dependent. No action is taken by the PCC for fault code **146**. Engine will shut down for fault code **151**.

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



## 6.16 Fault Code 197 - Low Coolant Level

**Lamp:** Warning (Optional)

**Corrective Action:** Indicates engine coolant level has fallen below the warning trip point.

 **WARNING**

**Contact with a hot engine or hot coolant can result in serious burns. To avoid personal injury, allow the engine to cool down completely before proceeding.**

**Effect:** No action is taken by the PCC for code **197**. Engine will shut down for code **235**.

1. The sensor or harness could be defective.

If the coolant level is normal, isolate the source of the low coolant signal. (This is a ground signal.) Disconnect the signal lead at the sender and reset the control.

- a. If the **197/235** message drops out and does not reappear, replace the sender.
- b. If the **197/235** message reappears and remains after the control is reset, remove connector P7 from the base board and check continuity from P7-32 to ground. If there is continuity, replace the harness.

## 6.17 Fault Code 234 - Overspeed

**Lamp:** Shutdown

**Corrective Action:** Indicates that the engine speed has exceeded normal operating speed inside the generator set controller.

**Effect:** Engine will shut down.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the speed sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.

3. **Possible Cause:** Monitor the engine RPM using InPower.

**Corrective Action:** If the RPM is not correct, refer to fault code **121** for corrective action.

## 6.18 Fault Code 235 - Low Coolant Level

**Lamp:** Shutdown

**Corrective Action:** Indicates engine coolant level has fallen below the shutdown trip point.

 **CAUTION**

**Allow engine to cool down completely before proceeding to avoid personal injury or harm.**

---

**Effect:** No action is taken by the PCC for code **197**. Engine will shut down for code **235**.

1. The sensor or harness could be bad.

If the coolant level is normal, isolate the source of the low coolant signal. (This is a ground signal.) Disconnect the signal lead at the sender and reset the control.

- a. If the **197/235** message drops out and does not reappear, replace the sender.
- b. If the **197/235** message reappears and remains after control reset, remove connector P7 from Base board and check continuity from P7-32 to ground. If there is continuity, replace the harness.

## 6.19 Fault Code 359 - Fail to Start

**Lamp:** Shutdown

**Corrective Action:** Indicates the controller did not sense the engine start.

**Effect:** Engine will not start.

1. **Possible Cause:** Switched B+ is not present at T26 terminal block due to:
  - a. Fuse F10 of the engine harness assembly may be open.
  - b. Switched B+ relay K1 is defective.

**Corrective Action:** Isolate to harness, F10, or K1.

- a. Remove F10 (engine harness) and check continuity. If open, replace the fuse with one of the same type and amp rating (20 Amps). If fuse reopens, check wiring continuity of the circuit.
  - b. Install a harness tool between the base board and the P7 connector. Attempt to start and check for B+ at P7-9 (GEN SW B+) and P7-10 (FUEL SOL-). (These are leads to K1 SW B+ relay). If B+ is present, relay K1 or the harness is defective. Go to next step.
  - c. Attempt to start and check for B+ IN (K1-1) and B+ OUT (K1-4).
    - If there is no B+ IN, check for an open circuit.
    - If there is B+ IN and not OUT, K1 is defective or the circuit to the K1 coil is open.
2. **Possible Cause:** Actuator is inoperable because the harness is defective.

**Corrective Action:** Isolate to the harness.

- a. Display "Governor Duty Cycle" menu. Attempt to start and check for duty cycle (approximately 20% to 40% from zero to full load). If the percentage of duty cycle is displayed before the shutdown, the harness may be defective; go to step b. (Duty cycle displayed indicates the processor is functioning.)
- b. Remove connector P7 from the base board and check wiring continuity of the actuator circuit. P7-24 (ACT +), P7-14 (ACT SIG) and P7-36 (GND) to the appropriate terminals of the governor actuator. Repair as necessary.

## 6.20 Fault Code 415 - Low Oil Pressure

**Lamp:** Shutdown

**Corrective Action:** Oil pressure has dropped below the shutdown trip point.

**Effect:** Calibration-dependent. No action is taken by the PCC for code **143**. Engine will shut down for code **415**.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the oil pressure sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Sensor could be defective. Or the generator set may be shutting down on another fault.

**Corrective Action:** Disconnect the oil pressure sensor leads, and connect an oil pressure sensor simulator to the harness. If the control responds to the simulator, reconnect the sensor, disconnect the ACT- signal wire at the fuel pump actuator, and crank the engine. Check the oil pressure reading on the digital display.

- If the display shows an acceptable oil pressure, the problem may not be in the oil or the oil sensing system. The generator set may be shutting down on another fault (out of fuel, intermittent connector). Restart the generator set and monitor the PCC display panel for other faults.
- If the display does not show an acceptable oil pressure, replace the sensor.

3. **Possible Cause:** The harness could be defective.

**Corrective Action:** If the control does not respond to the simulator, the harness is defective. Check for +5 VDC at the sensor (lead marked E1-A). If there is no 5 VDC at the sensor:

- Check for 5 VDC at P7-21.
- If yes, the harness is defective. If there is 5 VDC at the sensor, use the sensor simulator to generate a signal to P7-13 (OP OUT) and P7-17 (OP COMM). If the pressure signal (.5 to 4.5 VDC) does not get to P7, isolate to the harness.

## 6.21 Fault Code 441 - Low Battery Voltage

**Lamp:** Warning

**Corrective Action:** Indicates battery voltage supply to the control is approaching a low level at which unpredictable operation will occur.

1. Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery.
2. Poor battery cable connections. Clean the battery cable terminals and tighten all connections.
3. Check battery wiring/calibration.
4. Check engine DC alternator. Replace the engine DC alternator if normal battery charging voltage is not obtained.
5. Check the battery charge voltage float level, if applicable (raise float level).

**Effect:** PCC voltage supply approaching level at which unpredictable operation may occur.

1. **Possible Cause:** Weak or discharged battery.

**Corrective Action:** Recharge or replace the battery. The specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).

2. **Possible Cause:** Low electrolyte level in the battery.

**Corrective Action:** Replenish electrolyte and recharge the battery.

3. **Possible Cause:** Battery connections loose or dirty.

**Corrective Action:** Clean and tighten or replace the battery cable connectors and cables at the battery and at the generator set.

4. **Possible Cause:** Wrong battery voltage.

**Corrective Action:** Verify that battery voltage 12 or 24 matches calibration.

5. **Possible Cause:** Insufficient battery charging voltage.  
**Corrective Action:** Adjust the charge rate of the battery charging circuit, according to manufacture's instructions.
6. **Possible Cause:** Engine DC alternator could be defective.  
**Corrective Action:** Replace the engine DC alternator if normal battery charging voltage (12 to 14 or 24 to 26 VDC) is not obtained.
7. **Possible Cause:** If the batteries are OK, the problem may be the harness.  
**Corrective Action:** Remove connector P7 from the base board and check battery voltage at P7-3 (B+) to P7-7 (GND) and P7-4 (B+) to P7-8 (GND).
  - If the voltage at P7 is not the same as the battery voltage, the harness is defective and must be replaced.

## 6.22 Fault Code 442 - High Battery Voltage

**Lamp:** Warning

**Corrective Action:** Indicates the battery voltage supply to the control is approaching a high level at which damage to the control can occur. Check the float level on the battery charger, if applicable (lower float level). Check battery wiring/calibration.

**Effect:** PCC damage will occur.

1. **Possible Cause:** Excessive battery charging voltage.  
**Corrective Action:** Adjust the charge rate of the battery charging circuit according to manufacturer's instructions.
2. **Possible Cause:** Engine DC alternator could be defective.  
**Corrective Action:** Replace the engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained.
3. **Possible Cause:** Wrong battery voltage.  
**Corrective Action:** Verify that the battery voltage (12 VDC) matches the calibration.

## 6.23 Fault Code 1123 - Shutdown After Battle Short

**Logic:** A shutdown fault occurred while the Battle Short mode was enabled.

**Corrective Action:** Check fault history for faults that may have been bypassed.

## 6.24 Fault Code 1124 - Delayed Shutdown

**Logic:** Provides an advanced warning of an impending generator set shutdown to loads which cannot handle sudden losses of power, and fault 1124 (Warning) becomes active.

**Lamp:** Warning

**Possible Causes:**

1. A shutdown fault

## 6.25 Fault Code 1131 - Battle Short Active

**Logic:** Battle Short is enabled.

**Possible Causes:**

1. The Battle Short parameter is enabled.
2. One of the configurable inputs on the base board is configured for Battle Short.
3. The configurable input configured for Battle Short becomes active.

**Corrective Action:** Disable Battle Short.

## 6.26 Fault Code 1244 - Engine Normal Shutdown

A normal shutdown request has been received by the engine and no active shutdown with cooldown fault exists on the PCC (LBNG).

## 6.27 Fault Codes 1311, 1312, 1317, and 1318 - Customer Inputs #1-4

**Lamp:** Warning, Shutdown, or none for status message.

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

Each of the fault functions can be programmed (using the service tool), as follows:

- Enable/disable input (Default: enable)
- Status, Warning or Shutdown (Default: #1-None, #2 thru #4-Warning)
- Active closed or open (Default: closed [ground])
- Change the display name using up to 19 characters (Default: #1- Customer Fault 1, #2-Ground Fault, #3-Low Fuel, #4-Rupture Basin)

**Effect:** Status, warning or shutdown

1. If there is no actual fault, the problem may be an external wiring problem, active input (closed or open) selection is incorrect.

Disconnect the signal lead from TB1 and reset the control.

- CUST\_IN1 – TB1-4
- CUST\_IN2 – TB1-5
- CUST\_IN3 – TB1-6
- CUST\_IN4 – TB1-7

If the message drops out, the external wiring has a short or open circuit, or the active input selection (closed/open) is not correct for customer input (use the service tool to check the selection).

## 6.28 Fault Code 1334 - Crit Scaler OR

**Lamp:** Shutdown

**Corrective Action:** An incorrect feature or calibration was entered into the control.

---

## 6.29 Fault Code 1335 - Non-Crit Scaler OR

**Lamp:** Warning

**Corrective Action:** An incorrect feature or calibration was entered into the control.

## 6.30 Fault Code 1416 - Fail to Shutdown

**Logic :**

1. In order to provide a record in the fault history that the generator set shutdown faults were bypassed while the power command controller was in Battle Short mode the fault code 1416 (warning) becomes active.

**Lamp:** Warning

**Possible Causes:.**

1. A shutdown fault was bypassed while the Battle Short feature was enabled on the power command controller

## 6.31 Fault Code 1417 - Power Down Failure

**Logic:** If the control has failed to go to sleep the fault code 1417 (warning) becomes active.

**Lamp:** Warning

**Possible Causes:**

1. Possibility of the base board fault

## 6.32 Fault Code 1433 - Emergency Stop

**Lamp:** Shutdown

**Corrective Action:** Indicates a local Emergency Stop. To reset the local/remote Emergency Stop button:

1. Pull the Emergency stop button out.
2. Move the O/Manual/Auto switch to O.
3. Press the front panel Fault Acknowledge/Reset button.
4. Select Manual or Auto, as required.

## 6.33 Fault Code 1434 - Remote Emergency Stop

**Logic:** If the Remote Emergency Stop has been activated the fault code 1434 (shutdown) becomes active.

**Lamp:** Shutdown

**Possible Causes:**

1. The Remote Emergency stop button has been activated
2. Faulty connection or faulty emergency stop switch

## 6.34 Fault Code 1435 - Low Coolant Temperature

**Lamp:** Warning

**Corrective Action:** Coolant temperature must be below 70° F (default setting) for one minute to activate this warning and be above 70° F for five minutes before the warning can be cleared.

**Effect:** No action is taken by the PCC. The engine may not start due to slow cranking speed.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the fault simulation is not enabled for the coolant sensor. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.

3. **Possible Cause:** The sensor connections could be defective.

**Corrective Action:** Inspect the sensor and engine harness connector pins. Repair or replace as necessary.

4. **Possible Cause:** The sensor could be defective.

**Corrective Action:** Disconnect the sensor and plug in a resistive sensor simulator to isolate the fault. If the control responds to the simulator, replace the sensor. If the control does not respond, the harness or base board is defective and must be replaced.

5. **Possible Cause:** The harness could be defective.

**Corrective Action:** Measure the resistance of the coolant temperature sensor and reconnect the harness to the sensor. Remove connector P7 from the base board and check resistance between pins P7-30 (IH20) and P7-34 (IH20 COM).

- If resistance is not the same, the harness is defective and must be replaced.

## 6.35 Fault Code 1438 - Fail to Crank

**Lamp:** Shutdown

**Corrective Action:** Indicates a possible fault with the speed sensing. This indicates that the engine failed to crank after the PCC received a start signal.

**Effect:** Engine will not start.

1. **Possible Cause:** Fuse F3 on the base board may be open.

**Corrective Action:** Remove F3 and check continuity. If open, replace the fuse with one of the same type and amp rating (2 Amps).

If F3 is OK, install a harness tool between the base board and the P7 connector. Attempt to start and check for B+ at P7-23 (GEN SW B+) and P7-27 (START SOL-). (These are leads to the K4 coil.)

- If there is a B+ signal, the Start Pilot Relay K4 or starter circuitry is defective. Go to the next step.

2. **Possible Cause:** Start Pilot Relay K4 or starter circuitry could be defective.

**Corrective Action:** Check for B+ IN at K4-1 (directly connected to battery B+). If not present, check for an open circuit. If there is B+ IN, attempt to start and test for B+ OUT at K4-4.

- If there is no B+ OUT at K4-4, K4 is defective and must be replaced.

- If there is B+ OUT at K4-4, check for an open circuit between K4-4 and the starter.
3. **Possible Cause:** The Emergency Stop switch or wiring is defective.  
**Corrective Action:** With the Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If the circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If circuit is open, isolate to the Emergency Stop switch and wiring. If there is continuity, go to the next step.
  4. **Possible Cause:** MPU/circuit is bad.  
**Corrective Action:** Refer to Fault Code **121** instructions.

## 6.36 Fault Code 1442 - Weak Battery

**Lamp:** Warning

**Corrective Action:** Indicates that during cranking, the battery voltage is at or below the weak battery warning trip point for a time greater than or equal to the weak battery set time. See code **441** for corrective action.

**Effect:** No action is taken by the PCC.

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

## 6.37 Fault Code 1443 - Battery Failed

**Lamp:** Shutdown

**Corrective Action:** Dead battery - engine will not start. See code **441** for corrective action.

**Effect:** Engine will not start.

1. **Possible Cause:** Refer to code **1438**.  
**Corrective Action:** Refer to code **1438** instructions.

## 6.38 Fault Code 1444 - kW Overload

**Lamp:** Warning



**Corrective Action:** Indicates that generator output power exceeded 105% of generator set rating. Check load and load lead connections.

**Effect:** No action taken by the PCC.

1. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.

2. **Possible Cause:** Short or overload.

**Corrective Action:** Check the load and load cables. Repair if necessary. Check operation by disconnecting load and restarting generator set.

3. **Possible Cause:** Incorrect CTs or CT connections.

**Corrective Action:** Check CTs and CT connections. Correct if necessary. Refer to *Current Transformer Installation*

4. **Possible Cause:** The problem may be the harness connections.

**Corrective Action:** Remove connector P7 from Base board. Check continuity from P7 to CTs. P7-11 (CT1) to P7-12 (CT1-COM) P7-15 (CT2) to P7-16 (CT2-COM) P7-19 (CT3) to P7-20 (CT3-COM) Repair connections.

## 6.39 Fault Code 1445 - Short Circuit

**Lamp:** Shutdown

**Corrective Action:** Indicates that generator output current has exceeded 175% of rated. Check load and load lead connections. (Fault may not reset for several minutes.)

**Effect:** Engine will shut down.

1. **Possible Cause:** Refer to code 1444.

**Corrective Action:** Refer to code 1444.

## 6.40 Fault Code 1446 - High AC Voltage

**Lamp:** Shutdown

**Corrective Action:** Indicates one or more of the phase voltages has exceeded 130% of nominal, or has exceeded 110% of nominal for 10 seconds.

**Effect:** Engine will shut down.

1. **Possible Cause:** Fault simulation was enabled with InPower.

**Corrective Action:** With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Single step large block load removal.

**Corrective Action:** Clear fault and restart generator set.

3. **Possible Cause:** Fault threshold is not set correctly with InPower

**Corrective Action:** Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.

---

## 6.41 Fault Code 1447 - Low AC Voltage

**Lamp:** Shutdown

**Corrective Action:** Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds.

**Effect:** Engine will shut down.

1. **Possible Cause:** Fault simulation was enabled with In-Power.

**Corrective Action:** With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.

3. **Possible Cause:** Improper connections have been made at the generator output terminals.

**Corrective Action:** Reconnect according to the appropriate reconnection diagram.

4. **Possible Cause:** PMG or field wiring could be bad.

**Corrective Action:** Check and repair the PMG or field wiring

5. **Possible Cause:** Shunt wiring connection could be incorrect.

**Corrective Action:** Check that excitation inputs P8-21 and P8-22 are connected to the correct voltage. If misconnected to a high voltage, the AVR fault will shut down excitation and cause Low AC Voltage condition.

6. **Possible Cause:** Loose connector.

**Corrective Action:** Repair connections (P8).

## 6.42 Fault Code 1448 - Under Frequency

**Lamp:** Shutdown

**Corrective Action:** Indicates that engine speed has dropped below 90% of nominal for 10 seconds.

**Effect:** Generator set will shut down.

1. **Possible Cause:** Fault simulation was enabled with In-Power.

**Corrective Action:** With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the lowest allowable setting. Determine the required operating range before adjusting the threshold.

3. **Possible Cause:** Overload.

**Corrective Action:** Check the load and correct any overload. Check operation by disconnecting load and restarting generator set.

4. **Possible Cause:** Loose connector.

**Corrective Action:** Repair connections (P8).

## 6.43 Fault Code 1449 - Over Frequency

**Lamp:** Warning

**Corrective Action:** Indicates frequency is 10% above base frequency for 20 seconds. Generator AC output frequency is high.

**Effect:** No action taken by the PCC.

1. **Possible Cause:** Fault simulation was enabled with In-Power.

**Corrective Action:** With InPower, verify that the related fault simulation is not enabled. If you do not have InPower, remove battery power from the control to disable fault simulation overrides.

2. **Possible Cause:** Fault threshold is not set correctly with InPower.

**Corrective Action:** Reset the threshold to the highest allowable setting. Determine the required operating range before adjusting the threshold.

3. **Possible Cause:** Loose connector.

**Corrective Action:** Repair connections (P7/P8).

## 6.44 Fault Code 1461 - Loss of Field

**Logic:** The "Reverse kVAR threshold" has been exceeded for the time that is registered in the "Reverse kVAR time delay" setting. This means that the generator set is either not matching or is exceeding the voltage of the electric bus, which causes the generator set to import current from the electric bus (Reverse kVAR).

1. **Possible Cause:** Improper voltage calibration of the generator set

(If the generator set is not operating in droop paralleling mode, go to step 2).

**Corrective Action:**

- a. Use a voltmeter to measure the AC voltage of the electric bus paralleled to the generator set (voltage of the generator bus or the utility).
- b. Measure the output voltage of the generator set and make sure it is +3 VAC/-0 VAC of the source paralleled to the generator.
- c. To access the voltage calibration menu on the operator panel, go to **Setup > Adjust > Voltage Calibration** and increase the generator set output voltage.

2. **Possible Cause:** Load sharing lines incorrectly connected

**Corrective Action:**

- a. Make sure that the orientation of the load sharing connections is correct and that the shield is only grounded at one point.
- b. Check for damaged or disconnected wires at TB9-8, KW+; TB9-7, KW-; TB9-10, KVAR+; TB9-11, KVAR-; and TB9-9, Shield (shield should be grounded at only one generator set). If the connections are faulty, make the necessary corrections.

3. **Possible Cause:** Improperly set leading power factor

**Corrective Action:**

A leading power factor can cause a loss of excitation when the generator set is lightly loaded. A leading power factor itself can be due to operation of filters and power factor correction capacitors when the kW load level on the generator set is low. Leading power factor loads can cause the generator set to lose control of the output voltage.

- a. Access the power factor menu on the operator panel.

- b. Go to **Alternator Data**.
  - c. View the value of L1 PF, L2 PF, L3 PF, and Total PF, right before the generator set shuts down on fault code 1461.
  - d. Revisit the generator set sizing process if the power factor is leading and especially if new loads have been introduced into the system. Make sure it is correctly sized for the application (refer to the T-030 manual).
4. **Possible Cause:** kVAR load share lines
- Corrective Action:**
- a. Make sure the kVAR load share lines are wired correctly:
    - Negative: TB9-11 to TB9-11
    - Shield: TB9-9 to TB9-9
    - Positive: TB9-10 to TB9-10
  - b. Disconnect the kVAR load share line wires.
  - c. Check the continuity of each kVAR load share line. The resistance should be less than 10 Ohms.

## 6.45 Fault Code 1466 - Modem Failure

**Lamp:** Warning

**Corrective Action:** Indicates that the control can not communicate with the modem. Check for an open short circuit to ground and loose connections to the modem.

## 6.46 Fault Code 1468 - Network Error

**Lamp:** Warning

**Corrective Action:** Indicates a momentary loss of communication from the LonWorks network. Refer to the LonWorks network publications for more specific troubleshooting methods.

## 6.47 Fault Code 1469 - Speed/Hz Match

**Lamp:** Shutdown

**Corrective Action:** Indicates that measured speed and measured AC output frequency do not agree. Check the calibration file.

## 6.48 Fault Code 1471 - Over Current

**Lamp:** Warning

**Corrective Action:** Indicates that generator output current has exceeded 110% of rated for 60 seconds. Check load and load lead connections.

**Effect:** No action is taken by the PCC for code **1471**. Engine will shut down for code **1472**.

1. **Possible Cause:** Refer to code **1444**.

**Corrective Action:** Refer to code **1444**.

## 6.49 Fault Code 1472 - Over Current

**Lamp:** Shutdown

**Corrective Action:** Indicates that generator output current has exceeded 110% of rated, and that a control time/current calculation has initiated an overcurrent shutdown. Check the load and load lead connections. (The fault may not reset for several minutes.)

## 6.50 Fault Codes 2323–2326 - Network Faults 5 through 8

**Lamp:** Shutdown, Warning, or none for status message

**Corrective Action:** Indicates network inputs (#5–#8) are in an active state. See Fault Codes 1313–1316 for corrective action.

## 6.51 Fault Code 2335 - Excitation Fault

**Logic:** If the control has detected the simultaneous loss of all phase sensing the fault code 2335 (shutdown) becomes active.

**Lamp:** Shutdown

**Possible Causes:**

1. Parameters incorrectly configured
2. Wiring issue( s)

## 6.52 Fault Code 2336 - Memory Error

**Lamp:** Shutdown

**Corrective Action:** Indicates a control memory error, resulting in data corruption of critical operating parameters. Try reloading the calibration file.

## 6.53 Fault Code 2341 - High Control Temperature

**Lamp:** Warning

**Corrective Action:** The control temperature is above normal (158° F [70° C]) for a time greater than the control temperature set time. Check the generator set room air flow.

## 6.54 Fault Code 2342 - Too Long in Idle

**Logic:** If the engine has been running at idle speed for a time that is longer than the time registered in the Maximum Idle Time parameter the fault code 2342 (warning) becomes active. Long periods of engine idling, more than 20 minutes, can eventually affect engine performance and may void engine warranty.

**Lamp:** Warning

**Possible Causes:**

1. Maximum Idle Time parameters configured incorrectly
2. Faulty coolant heater( s)

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## 6.55 Fault Code 2967 - Governor Fault

**Lamp:** Warning

**Corrective Action:** Governor hardware drive circuitry contains a fault condition.

## 6.56 Fault Code 2968 - AVR Fault

**Lamp:** Warning

**Corrective Action:** Indicates AVR hardware contains a fault condition.

## 6.57 Fault Code 2969 - LON Failure

**Lamp:** Warning

**Corrective Action:** Indicates no communications with the LonWorks board.

## 6.58 Fault Code 2972 - Field Overload

**Logic:**

If the Field AVR Duty Cycle is operating at a maximum output for a period of time that is longer than the time registered in the Max Field Time parameter the fault code 2972 ( shutdown) becomes active.

**Lamp:** Shutdown

**Possible Causes:**

** WARNING**

***High voltages are present in this step. Special equipment and training is required to work on or around high-voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures may result in severe personal injury or death.***

1. Max Field Time Delay parameter configured incorrectly
2. Voltage sensing into the base board is too low or an open or short circuit
3. Alternator or application issue

# 7 Manufacturing Facilities

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# Appendix A. Wiring Diagrams

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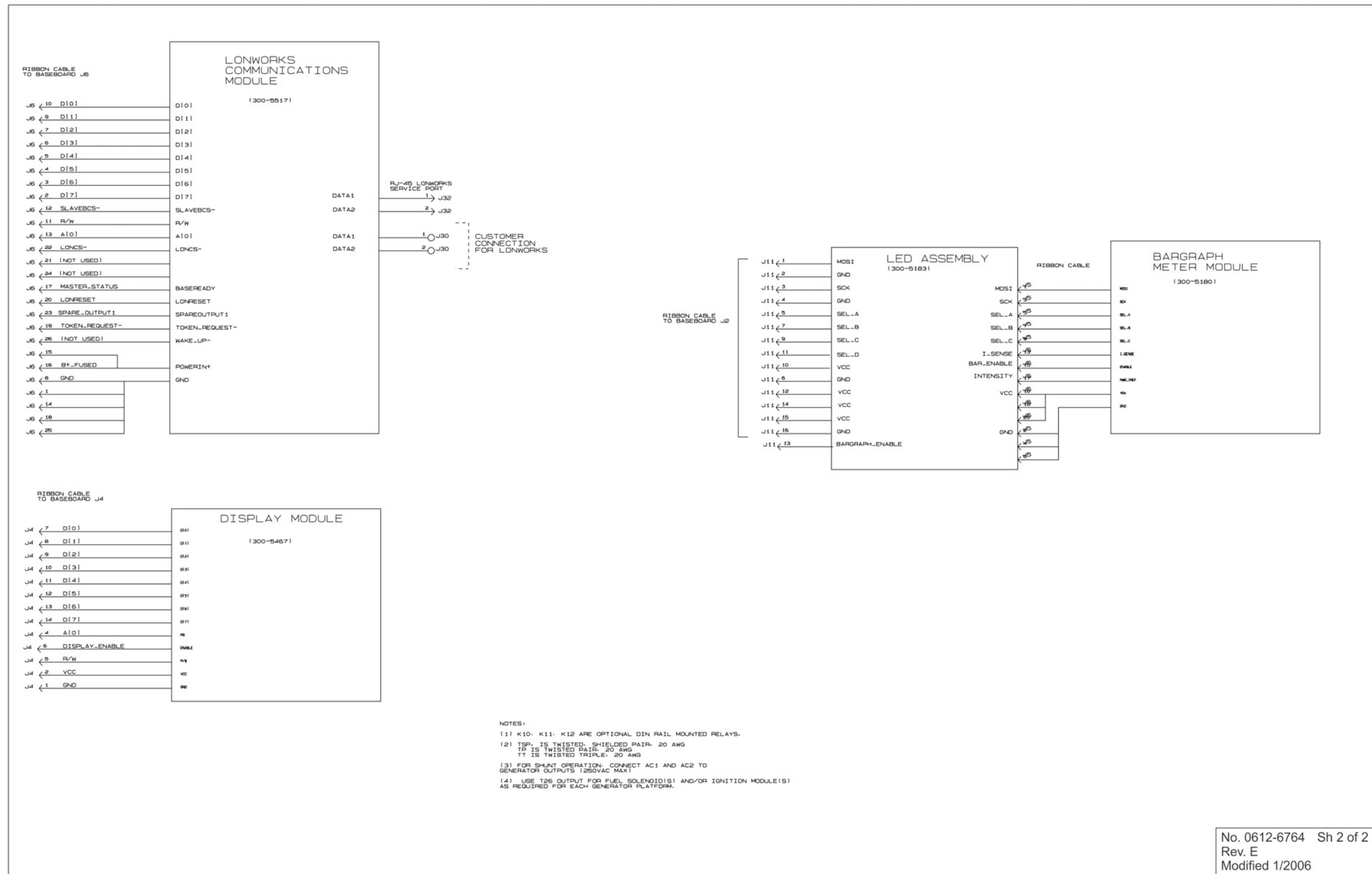


FIGURE 35. 0612-6764, SHEET 2 OF 2

# A.1 0630-2601, PCC 2100 (FAE)

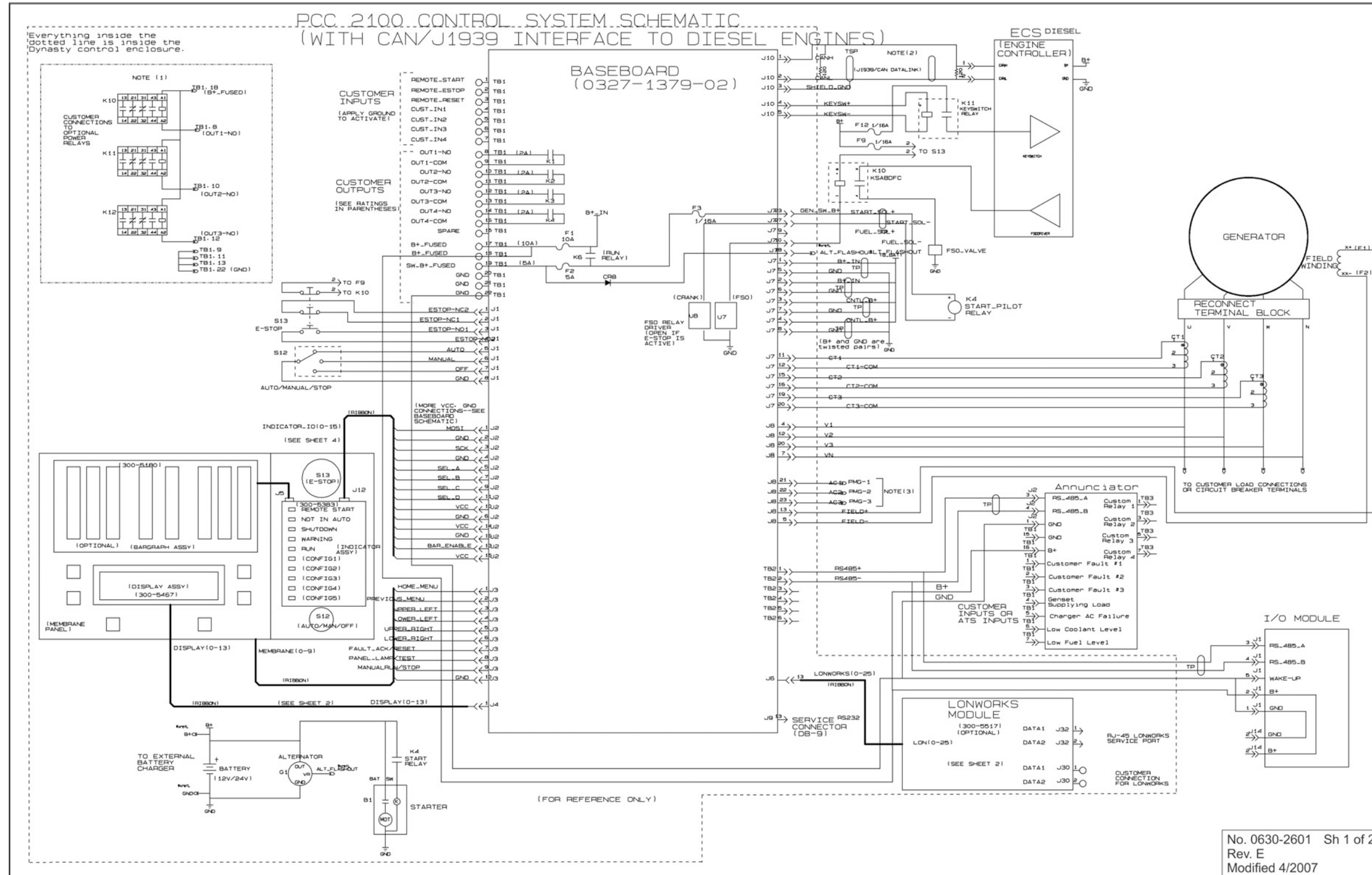


FIGURE 36. 0630-2601 SHEET 1 OF 2

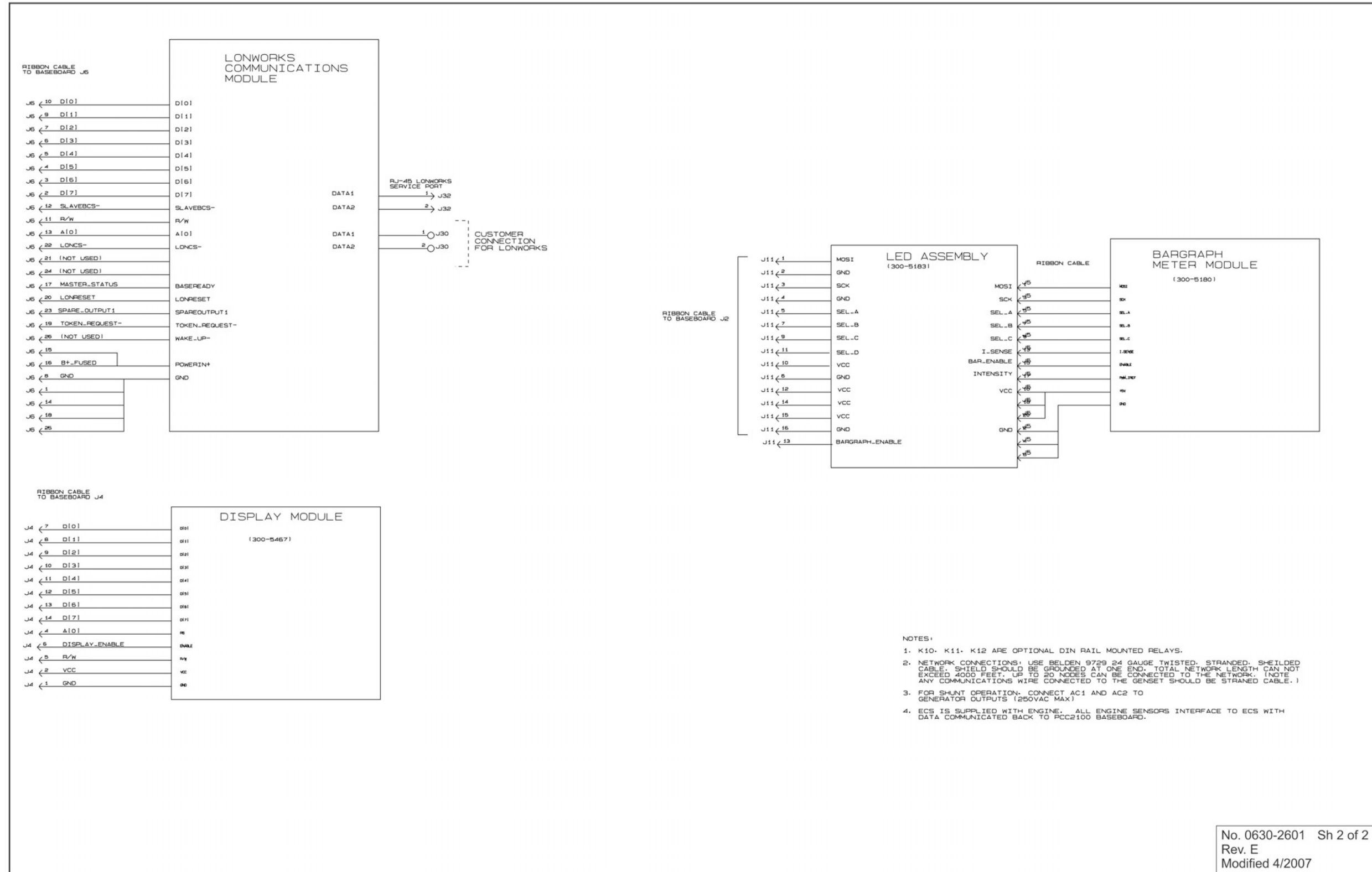


FIGURE 37. 0630-2601 SHEET 2 OF 2

## A.2 0620-0247, PCC 2100 Customer Connections

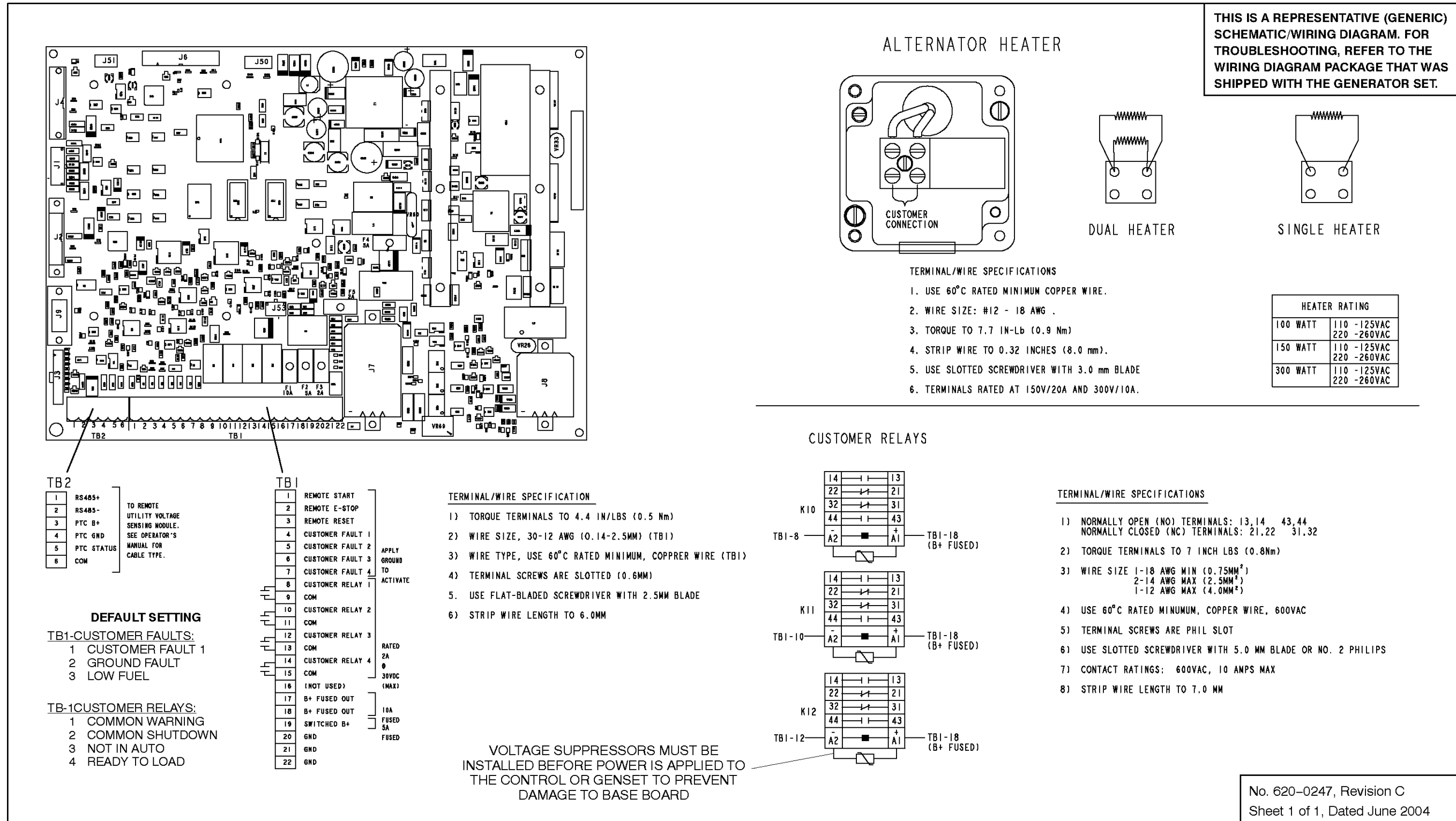


FIGURE 38. 0620-0247

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