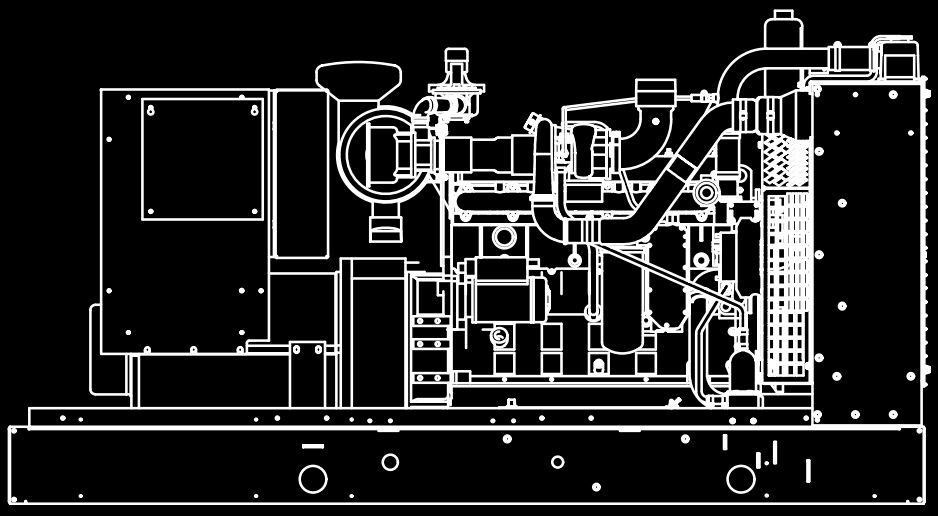
**Caution: This document contains mixed page sizes (8.5 x 11 or 11 x 17), which may affect printing. Please adjust your printer settings according to the size of each page you wish to print.**

Power Generation

# Service Manual

## PowerCommand® Control
### 3100 Series
## Generator Sets



## Models
### GGKB, GGKC, GGKD

Printed in U.S.A.

963-0500 6-2001

# Table of Contents


| SECTION | TITLE | PAGE |
|---|---|---|
| | **SAFETY PRECAUTIONS** | iii |
| **1** | **INTRODUCTION** | |
| | About this Manual | 1-1 |
| | Test Equipment | 1-1 |
| | How To Obtain Service | 1-1 |
| | System Overview | 1-2 |
| | Generator Set Control Function | 1-2 |
| **2** | **CONTROL OPERATION** | |
| | General | 2-1 |
| | Safety Considerations | 2-1 |
| | PCC Power On/Standby Mode | 2-1 |
| | Front Panel | 2-3 |
| | Menu Display and Switches | 2-4 |
| | Main Menu | 2-4 |
| | Engine Menu | 2-6 |
| | Gen Menu | 2-8 |
| **3** | **CIRCUIT BOARDS AND MODULES** | |
| | General | 3-1 |
| | Digital Board (A32) | 3-3 |
| | Engine Interface Board (A31) | 3-4 |
| | Analog Board (A33) | 3-6 |
| | Digital Display Board (A35) | 3-7 |
| | Customer Interface Board (A34) | 3-8 |
| | PT/CT Board (A36) | 3-10 |
| | Voltage Regulator Output Module (A37) | 3-11 |
| | Genset Communications Module (A41) | 3-12 |
| **4** | **TROUBLESHOOTING** | |
| | General | 4-1 |
| | Safety Considerations | 4-1 |
| | Status Indicators | 4-2 |
| | Resetting the Control | 4-2 |
| | Warning and Shutdown Codes | 4-3 |
| | Oil Pressure Warning and Shutdown Limits | 4-9 |
| | Troubleshooting Procedure | 4-10 |
| | PCC Fuses | 4-43 |


Redistribution or publication of this document,
by any means, is strictly prohibited.

**5 CONTROL SERVICE AND CALIBRATION**

General . . . . . 5-1
Circuit Board Removal/Replacement . . . . . 5-1
Initial Start Setup Menu . . . . . 5-4
Adjust Menu . . . . . 5-6
Setup and Calibration Menus . . . . . 5-8
Calibration Procedure . . . . . 5-18
Accessory Box Control Components . . . . . 5-20
Engine Sensors . . . . . 5-24
Magnetic Speed Pickup Unit (MPU) Installation . . . . . 5-25
Current Transformer (CT) Installation . . . . . 5-26

**6 SERVICING THE GENERATOR**

Testing the Generator . . . . . 6-1
Generator Disassembly . . . . . 6-9
Generator Reassembly . . . . . 6-11
Servicing the PMG . . . . . 6-11

**7 IGNITION/CARBURETION SYSTEM**

General . . . . . 7-1
Gas Pressure . . . . . 7-2
Ignition Timing . . . . . 7-3
Carburetor Power Valve . . . . . 7-4

**8 WIRING DIAGRAMS**

General . . . . . 8-1

Redistribution or publication of this document,
by any means, is strictly prohibited.

# IMPORTANT SAFETY INSTRUCTIONS

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

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

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

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

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

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

## FUEL AND FUMES ARE FLAMMABLE

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

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

## EXHAUST GASES ARE DEADLY

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

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

Redistribution or publication of this document,
by any means, is strictly prohibited.

## ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

## GENERAL SAFETY PRECAUTIONS

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

## KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 1. Introduction

## ABOUT THIS MANUAL

This manual covers models produced under the Cummins®/Onan® and Cummins Power Generation brand names.

This manual provides troubleshooting and repair information regarding the PowerCommand® Control 3100 (PCC) and generators for the generator set (genset) models listed on the front cover. Engine service instructions are in the applicable engine service manual. Operating and maintenance instructions are in the applicable Operator's Manual.

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

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

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

## TEST EQUIPMENT

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

- True RMS meter for accurate measurement of small AC and DC voltages. Fluke models 87 or 8060A are good choices.
- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac
- Load Test Panel
- Megger or Insulation Resistance Meter
- PCC Service Tool Kit (Harness Tool and Sensor Tool)
- Timing Light
- $O_2$ Meter
- Pyrometer
- 0 to 35 PSI Gauge
- Manometer (0 to 25 WC)

## HOW TO OBTAIN SERVICE

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

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

Copyright© 2001 Cummins Power Generation. All rights reserved.
Cummins, Onan and PowerCommand are registered trademarks of Cummins Inc.



Redistribution or publication of this document, by any means, is strictly prohibited.

## SYSTEM OVERVIEW

The PCC is a microprocessor-based control for Onan generator sets. It provides fuel control and engine speed governing, main alternator voltage output regulation, and complete generator set control and monitoring.

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

## GENERATOR SET CONTROL FUNCTION

Figure 1-1 shows some of the control functions. A more complete block diagram is provided in *Section 3*. A system schematic is provided in *Section 8*.

The PCC monitors frequency from both the magnetic pick-up (MPU) and the main stator inputs. The control sends a low power pulse-width modulated (PWM) signal to the fuel control actuator.

The external PT/CT module reduces generator voltage to approximately 18 VAC, and produces a representative AC voltage from CT output current. The voltage regulation function sends a low power PWM signal to the voltage regulator output module, which then sends an amplified signal to the exciter stator.

Oil, coolant, and exhaust temperatures are sensed by variable resistance element sensors. Oil pressure is sensed by a capacitive element active sensor.

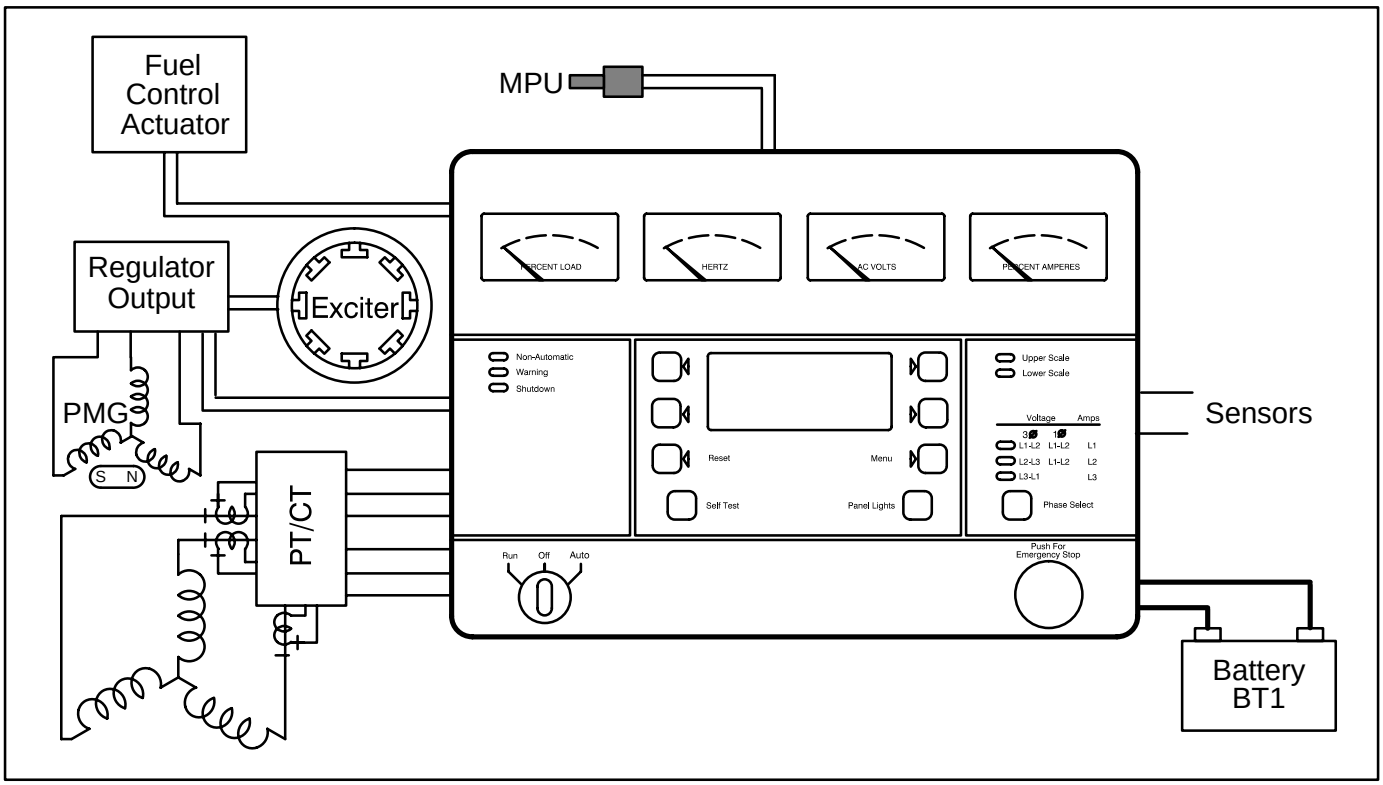



**FIGURE 1-1. GENERATOR SET CONTROL FUNCTIONS**



Redistribution or publication of this document, by any means, is strictly prohibited.

# 2. Control Operation

## GENERAL

The following describes the function and operation of the PowerCommand generator set control. All indicators, displays, meters and control switches are located on the face of the control panel as illustrated in Figure 2-1.

Normally, generator set configuration options are set at the factory. When a new control is installed on a generator set or when parts are replaced, the control must be configured for that generator set with the use of the “Initial Start Setup” portion of the internal software. Setup and calibration procedures are described in *Section 5*.

The automatic voltage regulator (AVR) and governor operation characteristic adjustments are also described in *Section 5*.

## SAFETY CONSIDERATIONS

AC power is present when the set is running. Do not open the generator output box while the set is running.

**⚠WARNING** ***Contacting high voltage components can cause electrocution, resulting in severe personal injury or death. Do not open the generator output box while the set is running. Read and observe all WARNINGS and CAUTIONS in your generator set manuals.***

The PCC control cabinet must be opened only by technically qualified personnel.

**⚠ CAUTION** ***The PCC control cabinet must be opened only by technically qualified personnel. Lower level voltages (18 VAC to 15 VDC) are present in PCC control cabinet. These voltages can cause electrical shock, resulting in personal injury.***

***Even with power removed, improper handling of components can cause electrostatic discharge and damage to circuit components.***

## PCC POWER ON / STANDBY MODE

### Standby Mode

In the Standby (sleep) mode (selector switch S5 on the Digital Board is set to the right and the generator set is not running), the control’s operating software is inactive and the LEDs and displays on front panel are all off.

The operating software is initialized and the front panel is turned on in response to a run signal or any one of eight “wake up” inputs from remote sensing switches.

The wake up signals are:

- Emergency Stop
- Low Coolant Level
- Low Coolant Temperature
- Low Fuel
- Customer Fault Inputs 2 and 3
- Run Selected on Run/Off/Auto Switch
- Remote Start Signal in Auto Mode
- Self Test switch

To activate and view the menu displays, press and release the Self Test switch. The PCC will initialize the operating software and permit operation of the menu display panel. If no menu selections are made, the power to the control panel will shut down after 30 seconds.

### Power On Mode

In the Power On (awake) mode (selector switch S5 on the Digital Board is set to the left), the PCC will initialize the operating software and permit operation of the menu display panel. (See Figure 3-1 for S5 location.) Power will stay on until switch (S5) is set to the Standby mode. It is recommended that switch S5 be left in the Power On mode in all application, except those where auxiliary battery charging is not available.

**⚠ CAUTION** ***Electrostatic discharge will damage circuit boards. Always wear a grounding wrist strap when touching or handling circuit boards or socket-mounted ICs and when disconnecting or connecting harness connectors.***

Redistribution or publication of this document,
by any means, is strictly prohibited.

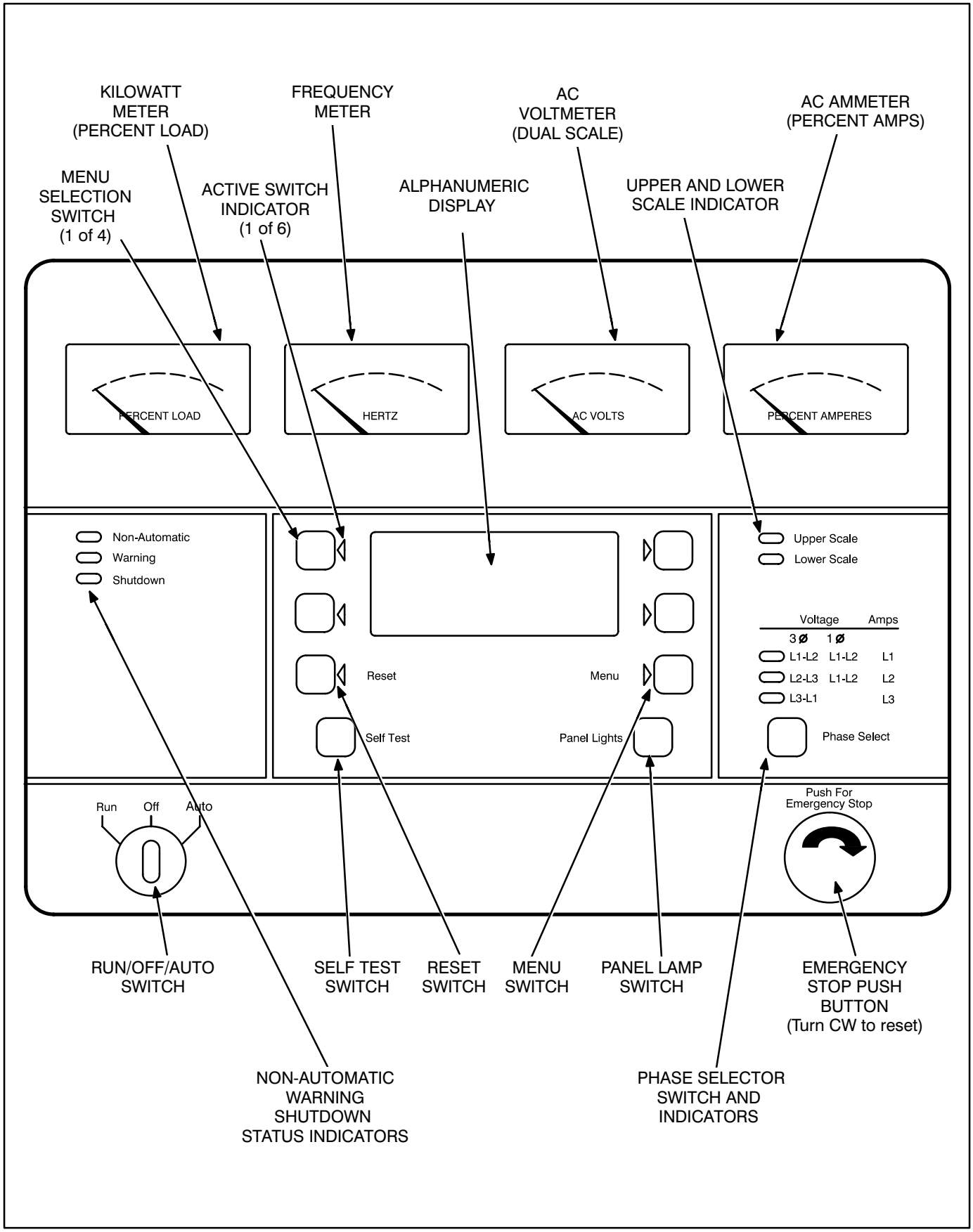



**FIGURE 2-1. FRONT PANEL**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## FRONT PANEL

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

***AC Voltmeter:*** Dual scale instrument indicates AC voltage. Measurement scale in use is shown on scale indicator lamp.

***AC Ammeter:*** Indicates current output in percent of maximum rated current. (Percent current is based on .8 PF three-phase and 1.0 PF single phase.)

***Kilowatt Meter:*** Indicates AC power output as percent of rated load.

***Frequency Meter:*** Indicates generator output frequency in hertz.

***Upper and Lower Scale Indicator Lamps:*** Indicate AC voltmeter scale.

***Digital Display:*** This two-line, 16-character per line alphanumeric display is used in the menu-driven operating system, in conjunction with the display menu selection switches and the Menu switch. Refer to the menu trees later in this section. The display is also used to show warning and shutdown messages.

***Display Menu Selection Switches:*** Four momentary switches—two on each side of the digital display window—are used to step through the various menu options and to adjust generator set parameters. The green arrow adjacent to the switch is lit when the switch can be used (switch is “active”).

***Menu Switch:*** Press this switch to return the digital display to the MAIN MENU. Refer to the menu trees later in this section.

***Reset Switch:*** Press this switch to reset warning and shutdown messages after the condition has been corrected. To reset a shutdown message with the Reset switch, the Run/Off/Auto switch must be in the Off position.

With the Run/Off/Auto switch in the Auto mode, shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

***Self Test Switch:*** Press and hold this switch to light all front panel LEDs and cycle through all shutdown and warning messages.

In the Standby (sleep) mode, with the generator set not running, the control’s operating software is inactive and the LEDs and displays on front panel are all off.

To activate and view the menu displays without starting the generator set, press and hold the Self Test switch until the front panel LEDs light. The PCC will initialize the operating software and permit operation of the menu display panel. If no menu selections are made, a software timer will shut down the power after 30 seconds.

***Panel Lights Switch:*** Press this switch to turn control panel illumination on and off. The illumination will shut off after about eight minutes.

***Phase Selector Switch and Indicators:*** Press this momentary switch to select phases of generator output to be measured by the analog AC voltmeter and ammeter. LEDs indicate the selected phase.

***Run/Off/Auto Switch:*** This switch starts and stops the set locally, or enables start/stop control of the engine from a remote location. (Ground to start.)

***Emergency Stop Button:*** Push the switch in for emergency shutdown of the engine.

**Remote Reset switch will not reset emergency stop. Can only be reset at the PCC front panel.**

To reset:

1. Turn the switch clockwise and allow it to pop out.
2. Move the Run/Off/Auto switch to Off.
3. Press the front panel Reset switch.
4. Select Run or Auto, as required.

***Non-Automatic Status Indicator:*** This red lamp flashes continuously when the Run/Off/Auto switch is not in the Auto position.

***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 Reset switch. (It is **not** necessary to stop the generator set.)

With the Run/Off/Auto switch in the Auto mode, warnings can also be reset by cycling the remote reset input after the condition is corrected.

***Shutdown Status Indicator:*** This red lamp is lit whenever the control detects a shutdown condition. After the condition is corrected, shutdown indicators can be reset by turning the Run/Off/Auto switch to the Off position, and pressing the Reset switch. In Auto mode, shutdowns can be reset by removing the remote start input and then cycling the remote reset input.

**Emergency Stop shutdown status (Code 102) can be reset only at the PCC front panel.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

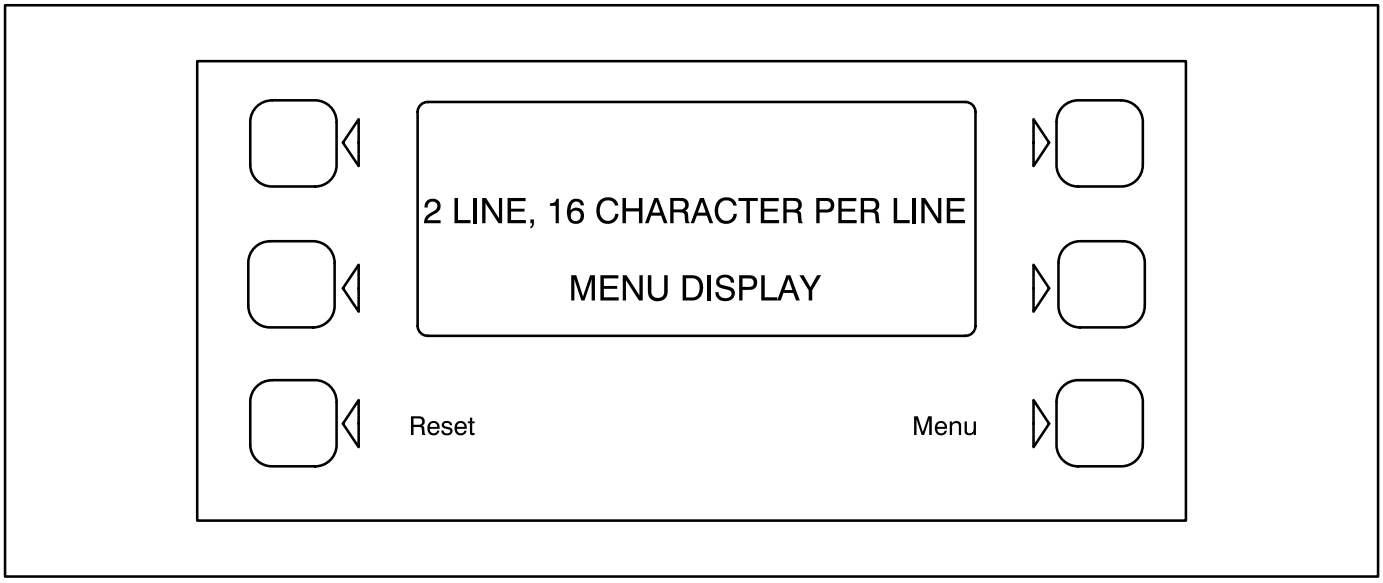



**FIGURE 2-2. DIGITAL DISPLAY AND MENU SELECTION SWITCHES**

## MENU DISPLAY AND SWITCHES

Figure 2-2 shows the digital display and the menu selection switches. Refer to heading "*Front Panel*" which describes the menu display and switches.

In the Standby Mode, to activate and view the menu displays without starting the generator set, press and release the Self Test switch. This will initialize the PCC operating software and permit operation of the menu display panel. If no menu selections are made, a software timer will shut down the power after 30 seconds. In the Power On Mode, power is continuously supplied to the control panel. Display will always remain on.

**In the digital display, the ">>" symbol indicates that selecting the adjacent button causes the operating program to branch to the next menu display—as shown in the menu diagrams.**

**In the digital display, the "<<" symbol indicates that selecting the adjacent button causes the operating program to go back to the previous menu display.**

## MAIN MENU

The facing page shows the main menu and a block representation of the available submenus.

As shown in the diagram, the main menu can branch into one of four directions.

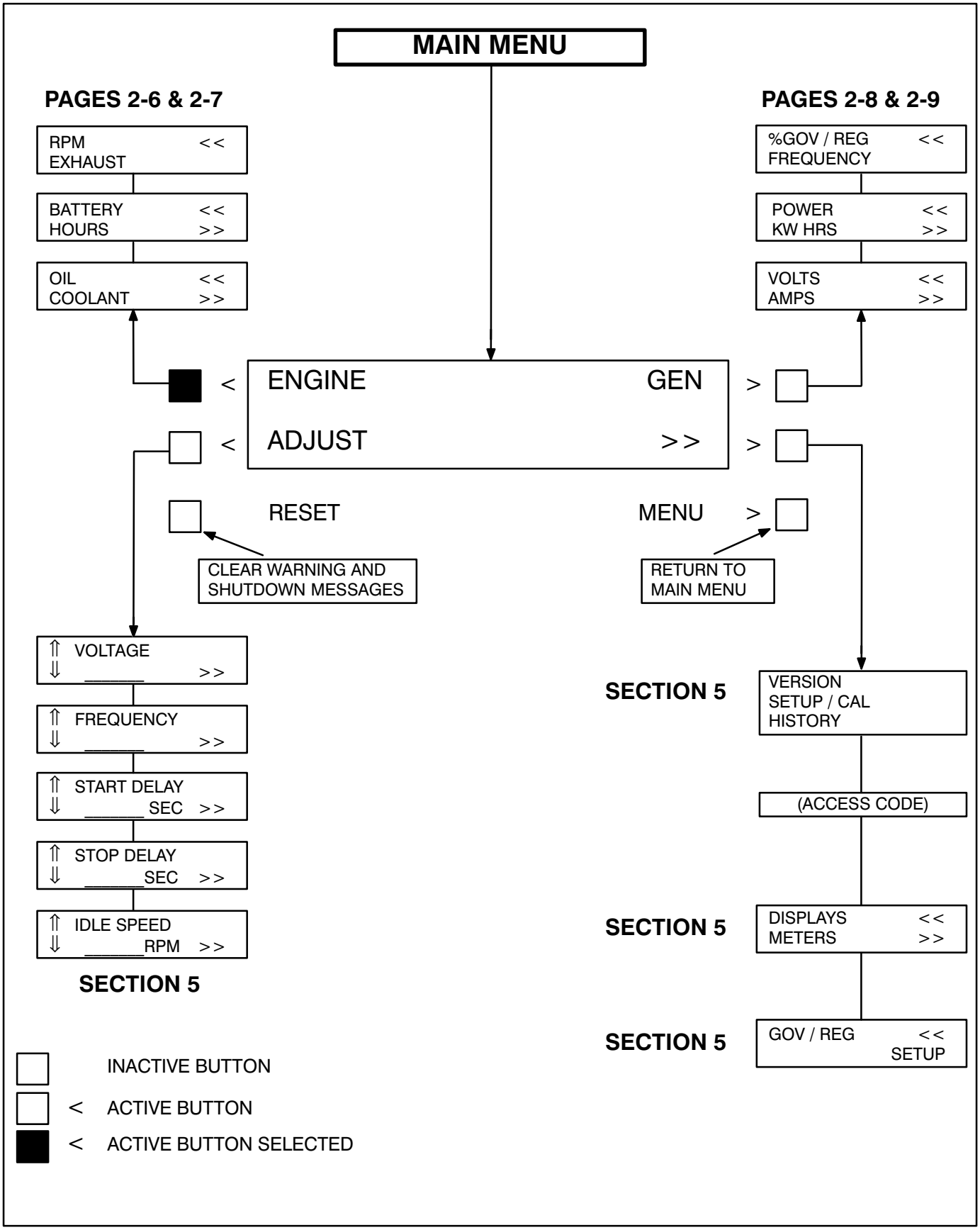
To display engine parameters, such as oil pressure and temperature, water temperature, engine speed (RPM), and exhaust temperature, press the button next to the word "ENGINE" in the display. Refer to *ENGINE MENU* in this section.

To display generator parameters, such as volts, amps, power (kW), and frequency, press the button next to the word "GEN" in the display. Turn to the *GEN MENU* in this section.

To adjust output voltage and frequency, or start and stop delays, press the button next to the word "ADJUST" in the display. Refer to *ADJUST MENU* in *Section 5*.

To display the selected generator set model and the resident version software, press the button next to the ">>" in the display. Refer to *VERSION & DISPLAYS MENUS* in *Section 5*.

Redistribution or publication of this document,
by any means, is strictly prohibited.




Redistribution or publication of this document,
by any means, is strictly prohibited.

## ENGINE MENU

The facing page 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 will appear.

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

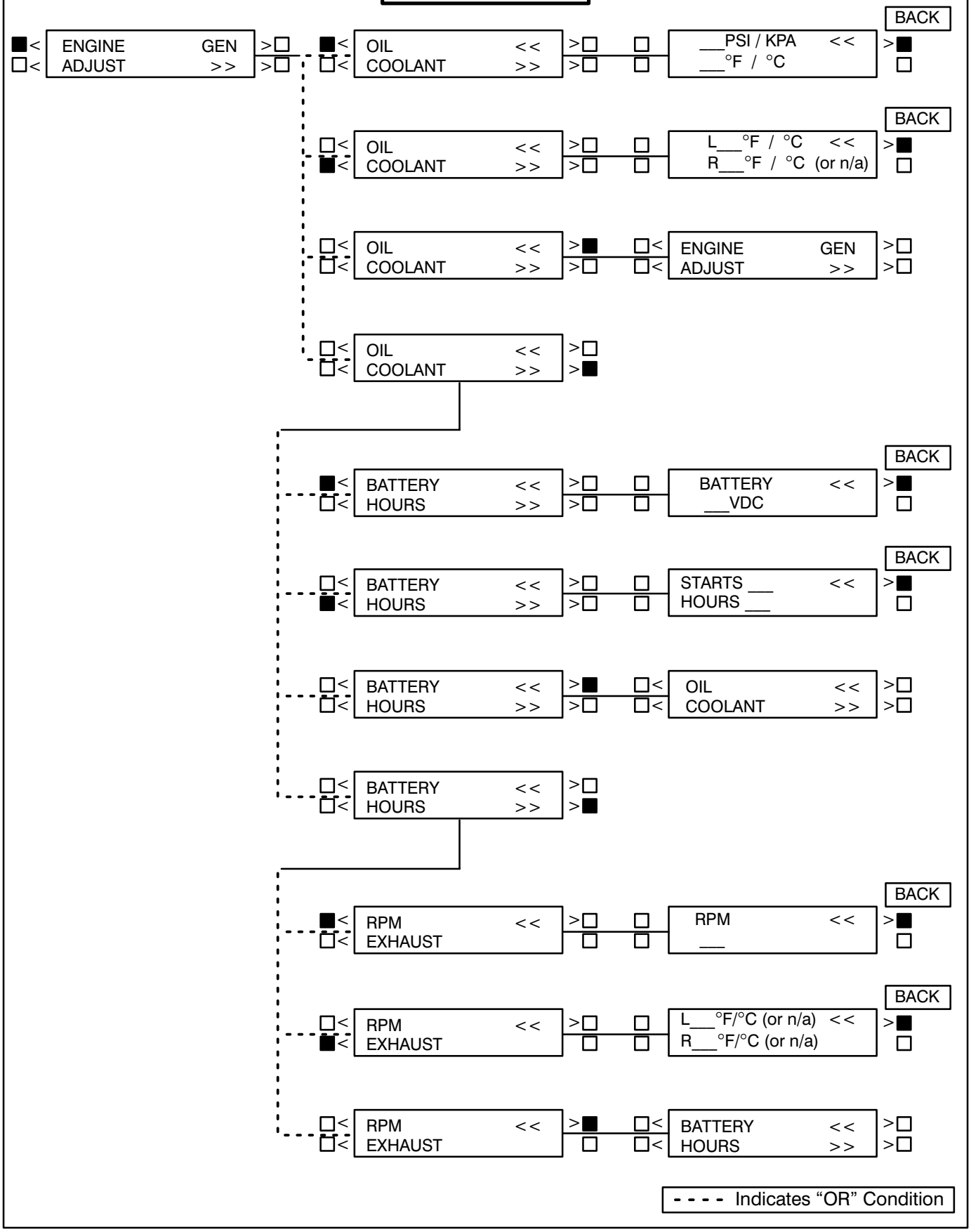
***OIL/COOLANT submenu:*** This is the first submenu. Select OIL for a display of oil pressure and oil temperature. Select COOLANT for a display of coolant temperature. When oil or coolant parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the OIL/COOLANT submenu.

***BATTERY/HOURS submenu:*** From the OIL/COOLANT submenu, press the button next to the “>>” in the display to move to the BATTERY/HOURS submenu. Select BATTERY for a display of battery voltage. Select HOURS for a display of the number of starts and the running hours. When battery or hours parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the BATTERY/HOURS submenu.

***RPM/EXHAUST submenu:*** From the BATTERY/HOURS submenu, press the button next to the “>>” in the display to move to the RPM/EXHAUST submenu. Select RPM for a display of engine RPM. Select EXHAUST for a display of the (optional) exhaust temperature. When RPM or exhaust parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the RPM/EXHAUST submenu.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# ENGINE MENU




Redistribution or publication of this document,
by any means, is strictly prohibited.

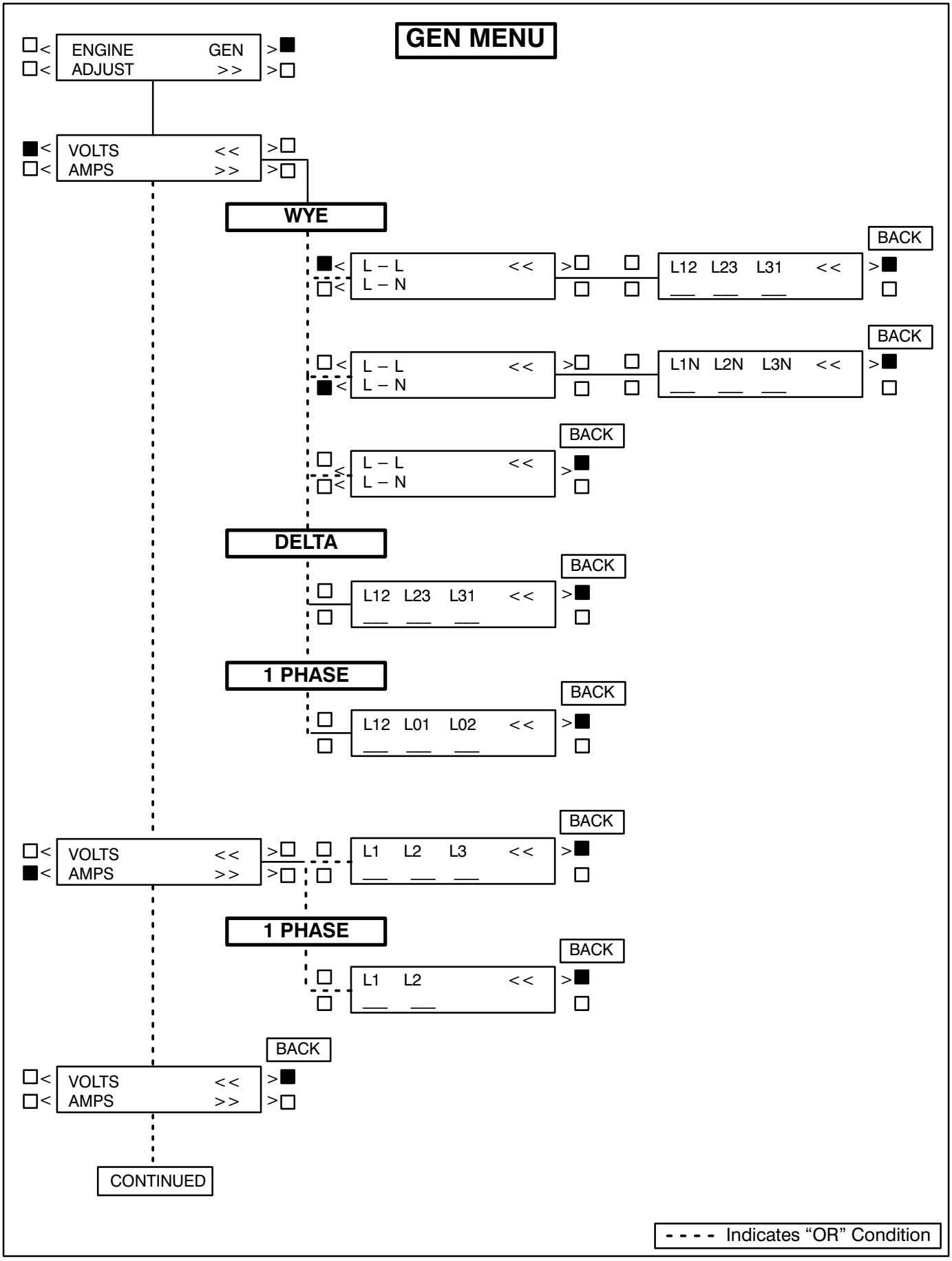
## GEN MENU

The facing page shows a block representation of the GEN menu. If you press the button next to the word “GEN” in the display, the first GEN submenu will appear.

As shown in the diagram, the GEN menu has three submenus. Within these submenus, bold boxes indicate the possible selections made in the “Initial Start Setup” submenus (e.g., DELTA or WYE) and how the submenus will vary dependent on these selections.

***VOLTS/AMPS submenu:*** This is the first submenu. Select VOLTS for a display of a line-line or line-neutral selection. Select line-line or line-neutral for the desired voltage display. Select AMPS for a display of L1, L2, and L3 current in amps. When voltage or current parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the L-L/L-N submenu.

Redistribution or publication of this document,
by any means, is strictly prohibited.




Redistribution or publication of this document,
by any means, is strictly prohibited.

***POWER / KW HOURS submenu:*** From the VOLTS/AMPS submenu, press the button next to the “>>” in the display to move to the POWER/KW HOURS submenu. Select POWER for a display of power output in kilowatts and a power factor value. Select KW HOURS for a display of kilowatt hours. When power or kW hours parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the POWER/KW HOURS submenu.

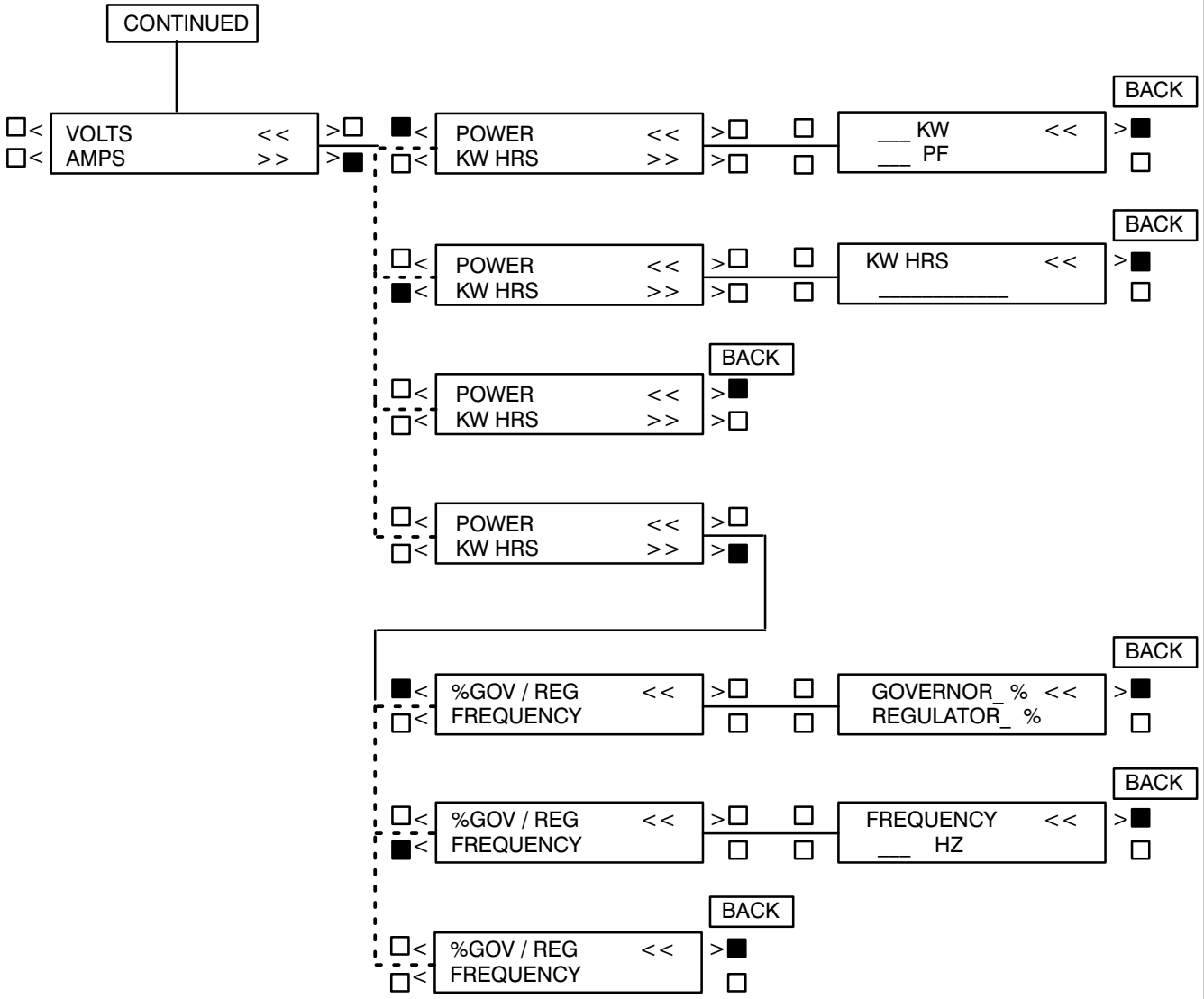
**The PF reading will contain an asterisk if the power factor is leading (for example, *.3PF).**

**N/A is displayed in the PF field when the generator set is not running.**

***%GOV/REG/FREQUENCY submenu:*** From the POWER/KW HOURS submenu, press the button next to the “>>” in the display to move to the %GOV/REG/FREQUENCY submenu. Select %GOV/REG for a display of voltage regulator and governor duty cycle (drive) levels in percentage of maximum. Select FREQUENCY for a display of the generator output frequency. When voltage regulator and governor or frequency parameters are displayed, pressing the button next to the “<<” will return the display (“BACK”) to the %GOV/REG/FREQUENCY submenu.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# GEN MENU (Cont.)




- - - - Indicates “OR” Condition

Redistribution or publication of this document,
by any means, is strictly prohibited.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 3. Circuit Boards and Modules

## GENERAL

This section describes the function of the PCC circuit boards and modules that are contained in the control panel (Figure 3-1) and the accessory box. The block diagram in Figure 3-2, shows both internal and external components of the PCC system.

The system schematics are provided in *Section 8* of this manual.

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

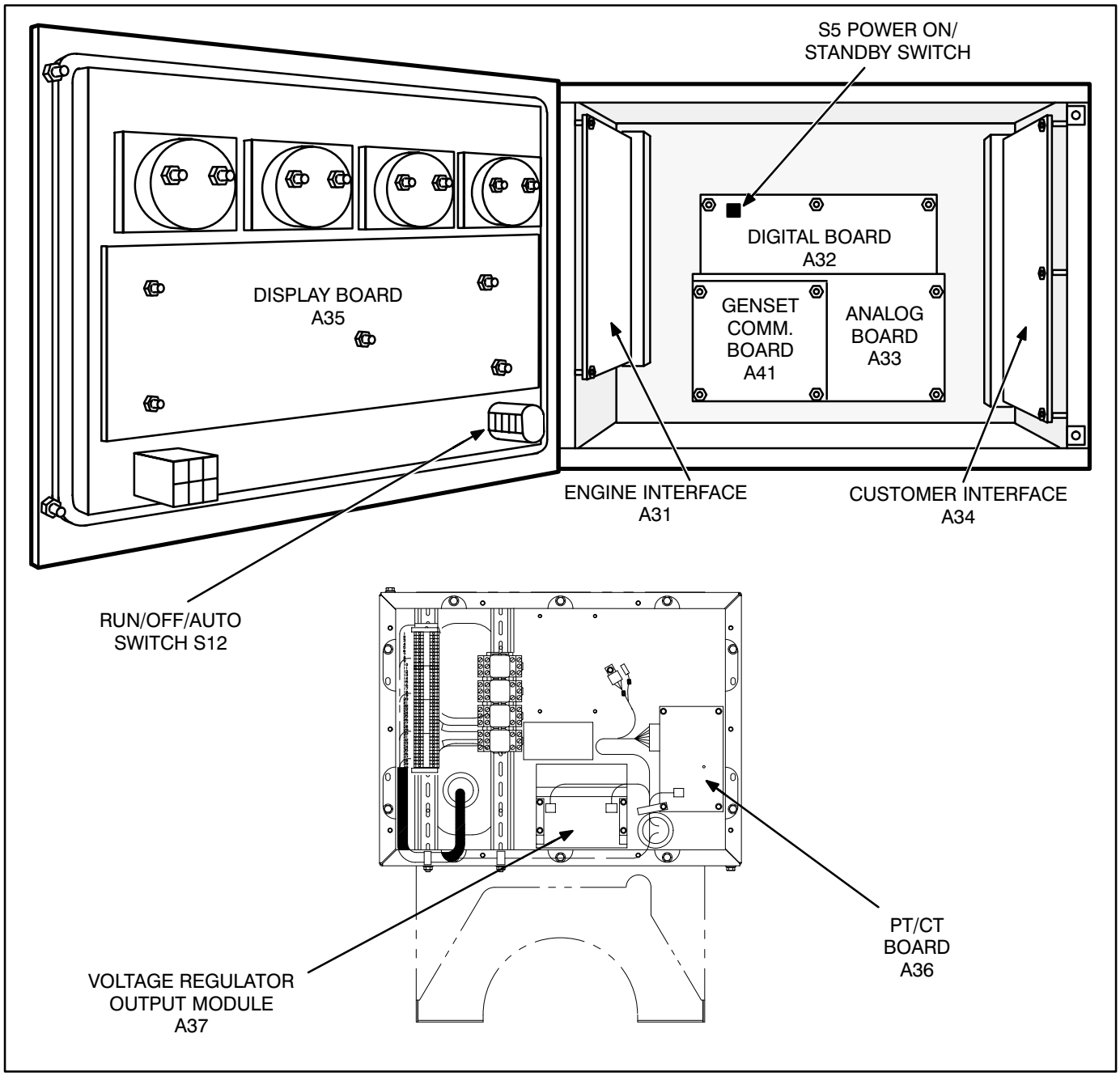



**FIGURE 3-1. CIRCUIT BOARD LOCATIONS**

Redistribution or publication of this document,
by any means, is strictly prohibited.

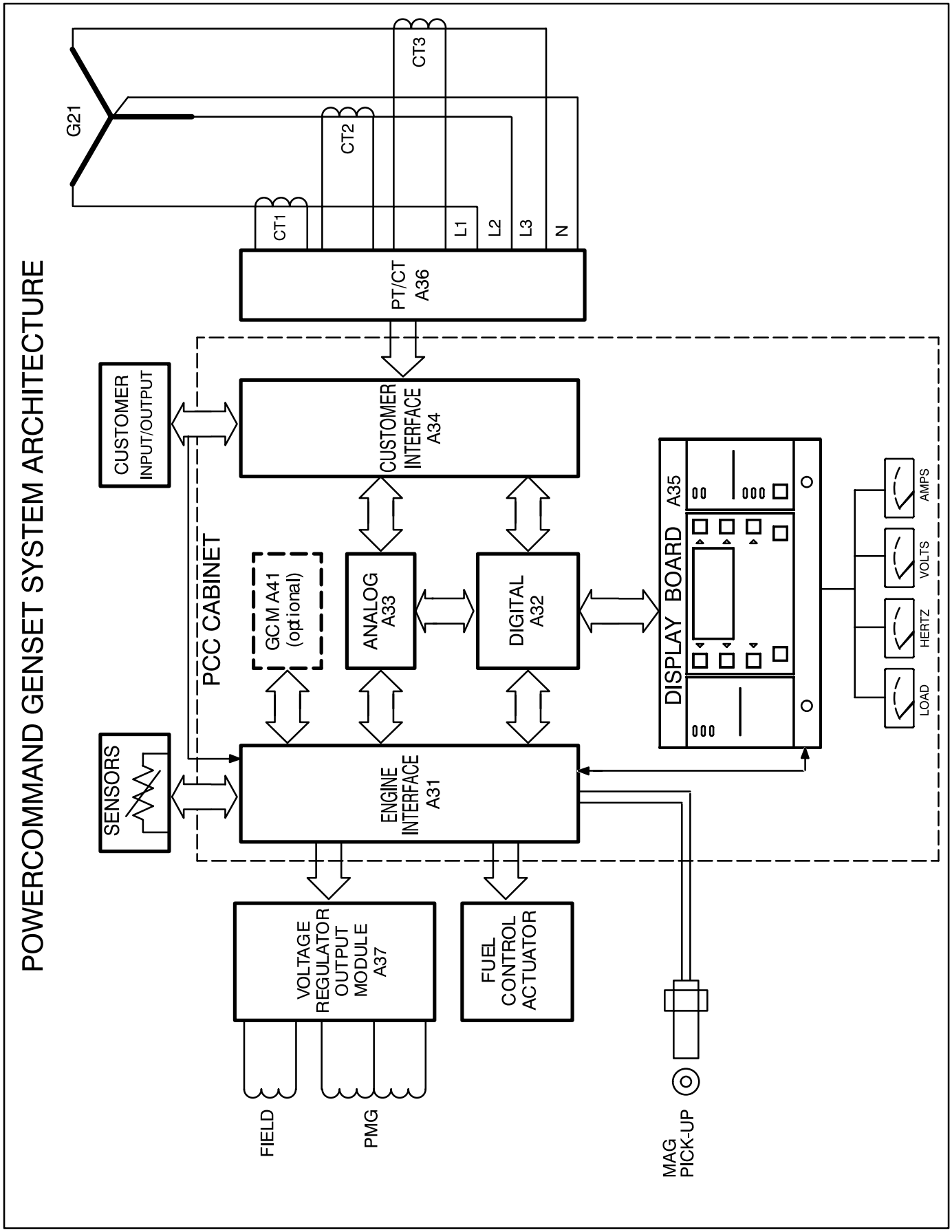



**FIGURE 3-2. BLOCK DIAGRAM**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## DIGITAL BOARD (A32)

The digital circuit board (Figure 3-3) contains the microprocessor and the operational software for the control. It connects to all other boards inside the control. This board also provides the analog-to-digital conversions for the PCC.

### Switch

**S5** Slide the switch to the left to select the Power On (awake) mode. Control panel power/operating software will remain on until the switch is reset to the Standby mode. It is recommended that switch S5 be left in the Power On mode in all applications, except those where auxiliary battery charging is not available.

Slide right to put the PCC in the Standby ("sleep") mode. In this mode, the PCC operating software will be initiated by selection of Run on the front panel, by pressing the Self Test switch, by a remote start input (in Auto mode), or by any one of several "wake-up" signals from external switches.

### Connectors

The digital board has five connectors. They are:

**J1** Serial Interface RS232

**J2** Connects to J4 on A34 Customer Interface board

**J3** Connects to J2 on A33 Analog board

**J4** Connects to J1 on A31 Engine Interface board

**J5** Connects to J5 on A35 Digital Display assembly

### LEDs

The digital board has seven LED's that indicate the following conditions:

**DS1** Spare (Green)

**DS2** Spare (Green)

**DS3** +18 VDC supply OK (Green)

**DS4** +5 VDC supply OK (Green)

**DS5** Run **(Flashes once per second if software is running)** (Green)

**DS6** +12 VDC B+ supply OK (Green)

**DS7** +12 VDC supply OK (Green)

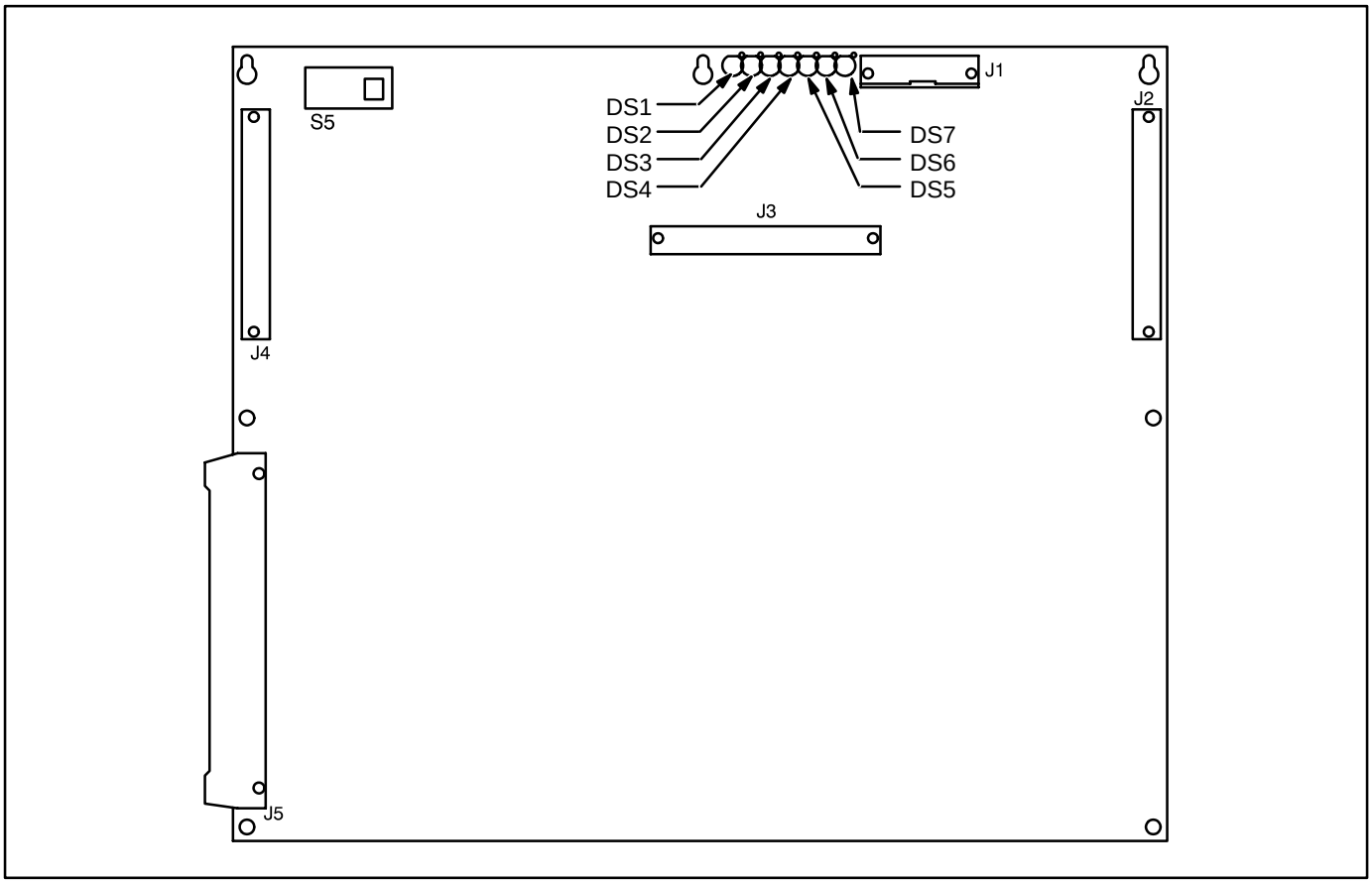



**FIGURE 3-3. DIGITAL BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## ENGINE INTERFACE BOARD (A31)

The engine interface board (Figure 3-4) reads user control inputs, monitors engine, generator and system status, and initiates the appropriate action for normal operating and fault conditions (warning or shutdown).

This board is connected to the engine sensors, battery, starter, governor output module, voltage regulator output module, and the magnetic pick-up (MPU).

The engine interface board can also be connected to an optional network interface module for network access.

During a typical start sequence the LED's light as follows:

1. **DS11** lights when a remote run signal is received and S12 is in the Auto position, or S12 is moved to the Run position.
2. **DS12** lights when the magnetic pick-up voltage is sensed (engine is cranking). (When the engine is cranking, the mag pickup output should be a minimum of 1 volt.)
3. **DS11** extinguishes, **DS9** lights and **DS10** is dimly lit when the generator is running.

### Connectors

The engine interface board has seven connectors and one terminal strip. They are:

**J1** Connects to J4 on A32 Digital board.

**J2** Connects to J1 on A33 Analog board.

**J3** Connects to display board, front panel switches and meters.

**J4** Connects to customer connections and to engine harness which includes magnetic pick-up.

**J5** Connects to engine sensors.

**J6** Connects to Genset Control module (GCM).

**J7** Connects to Genset Control module (GCM).

### Fuses

The engine interface board has two replaceable fuses. They are:

**F1** Control B+ (5 Amps)

**F3** Aux. B+ (5 Amps). (Panel lamps and run/start contacts).

### LED's

The engine interface board has 10 LED's that indicate the following conditions:

**DS1** Low Fuel Alarm input (Red)

**DS2** Low Coolant Level Alarm input (Red)

**DS3** Low Engine Temperature Alarm input (Red)

**DS4** S12 in Run position (Green). S12 is the Run/Off/Auto switch.

**DS5** S12 in Auto position (Green)

**DS6** Emergency Stop (Red)

**DS7** Not configured.

**DS8** Not configured.

**DS9** AVR duty cycle (Green). Brighter indicates larger duty cycle.

**DS10** GOV duty cycle (Green). Brighter indicates larger duty cycle.

**DS11** Start pilot relay output (Red)

**DS12** Run pilot relay output (Red)

Redistribution or publication of this document,
by any means, is strictly prohibited.

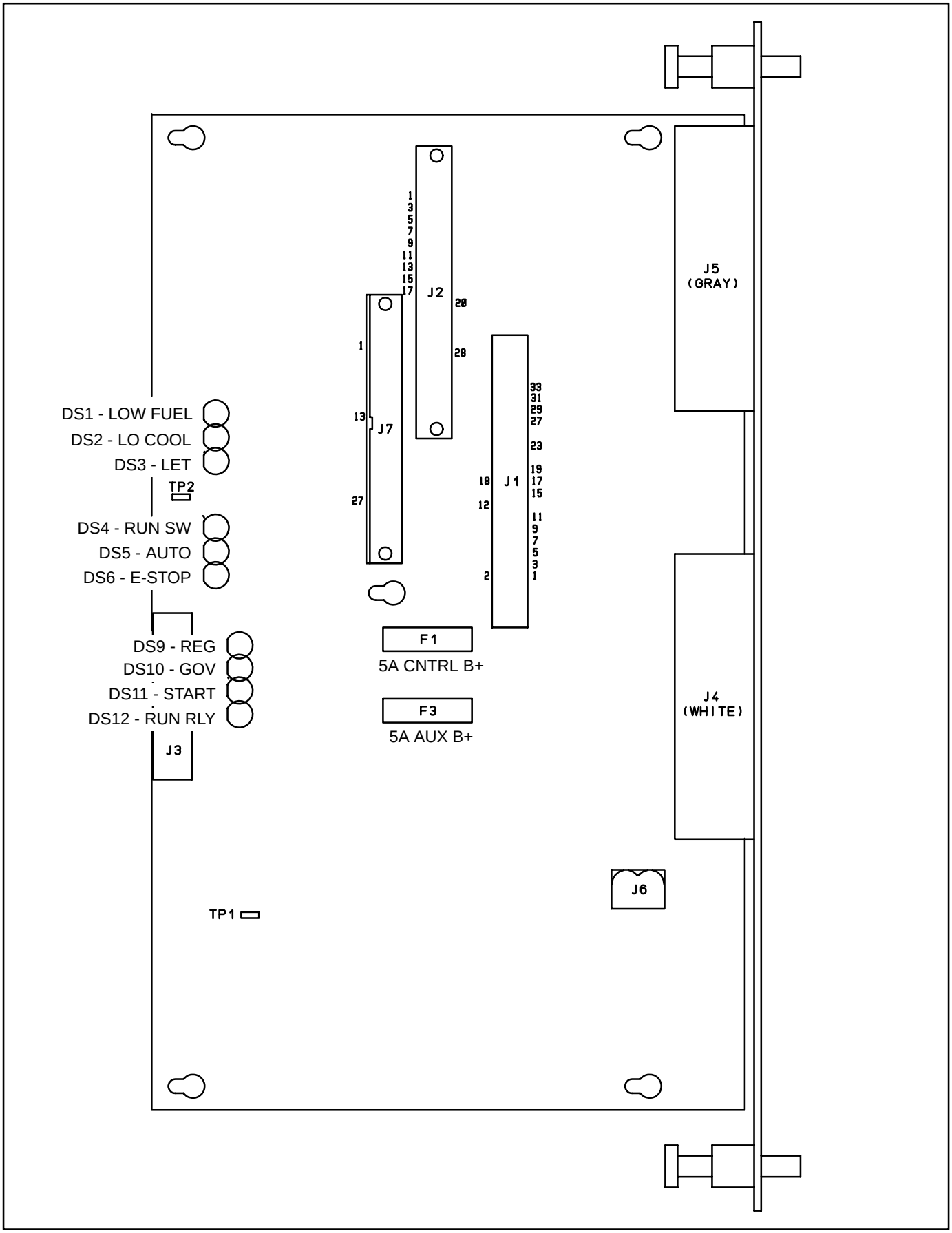



**FIGURE 3-4. ENGINE INTERFACE BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## ANALOG BOARD (A33)

The analog board (Figure 3-5) is the only circuit board inside the control that has no LED's. There are two versions of the analog board that are used for paralleling and non-paralleling systems.

This board interprets all analog input signals and converts the analog signals to 0–5 VDC for the digital board.

### Connectors

The analog board has four connectors with ribbon cables permanently soldered to them. They are:

**J1** Connects to J2 on A31 Engine Interface board

**J2** Connects to J3 on A32 Digital board

**J3** Spare analog inputs

**J4** Connects to J1 on A34 Customer Interface board

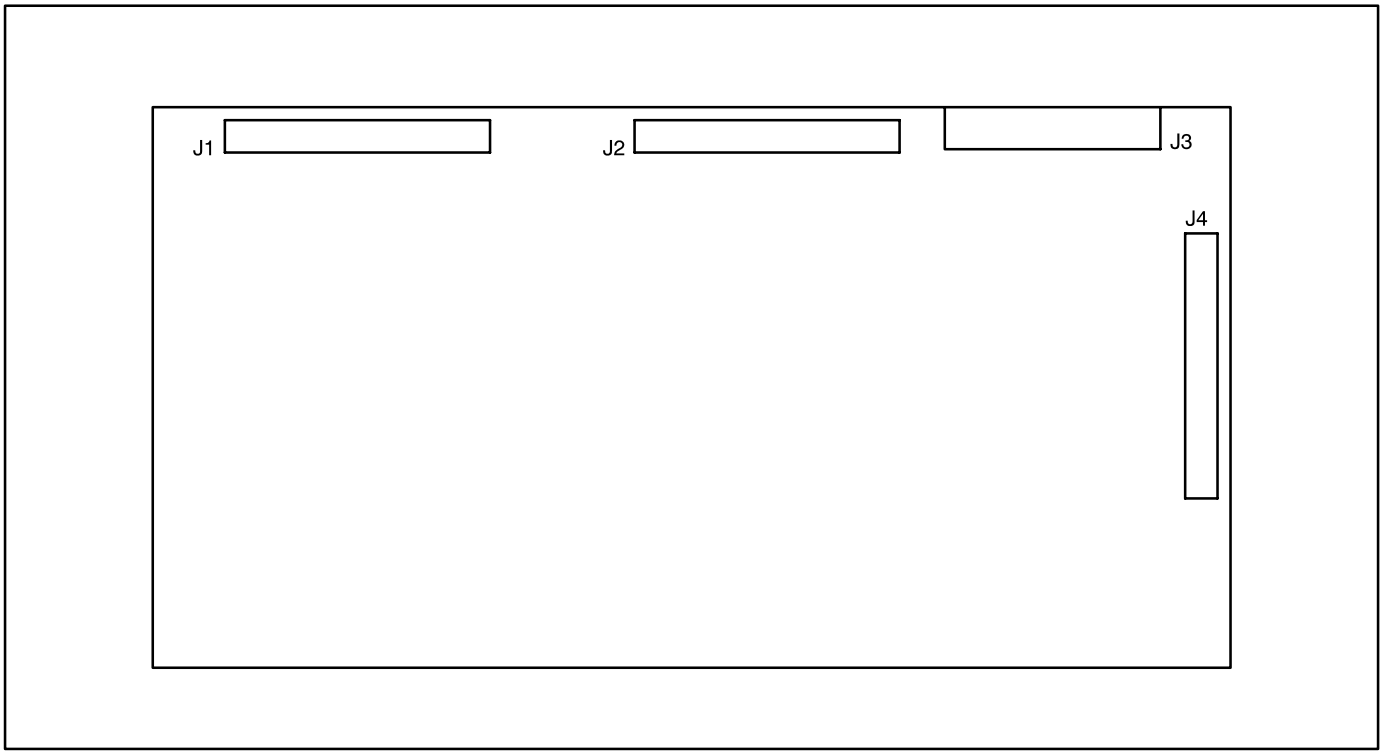



**FIGURE 3-5. ANALOG BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## DIGITAL DISPLAY BOARD (A35)

The digital board (Figure 3-6) connects to all meters and the LED display.

### Connectors

The digital board has three connectors. They are:

**J1** Connects to front panel membrane switches

**J5** Connects to J2 on A32 Digital board. (With J5 disconnected, the display will be non-functional, but the PCC will continue to operate.)

**J6** Connects to meters, Run/Off/Auto switch, J3 on A31 Engine Interface board

### LEDs

The digital board has 18 LED's that are used to indicate operational status of the generator set and control panel mode/switch selections.

**DS9** Not In Auto (Red)

**DS10** Upper Scale (Green)

**DS11** Left Top Arrow (Green)

**DS12** Right Top Arrow (Green)

**DS13** Warning (Amber)

**DS14** Lower Scale (Green)

**DS15** Shutdown (Red)

**DS20** Left Bottom Arrow (Green)

**DS21** Right Bottom Arrow (Green)

**DS22** Automatic mains failure (AMF) for paralleling application only: Breaker Closed (Red)

**DS23** Phase A (Green)

**DS24** Reset Arrow (Green)

**DS25** Menu Arrow (Green)

**DS26** AMF application only: Breaker Open (Green)

**DS27** Phase B (Green)

**DS29** Phase C (Green)

**DS36** AMF application: Breaker Closed (Red) – or – paralleling application: Breaker Open (Green)

**DS37** AMF application only: Breaker Open (Green)

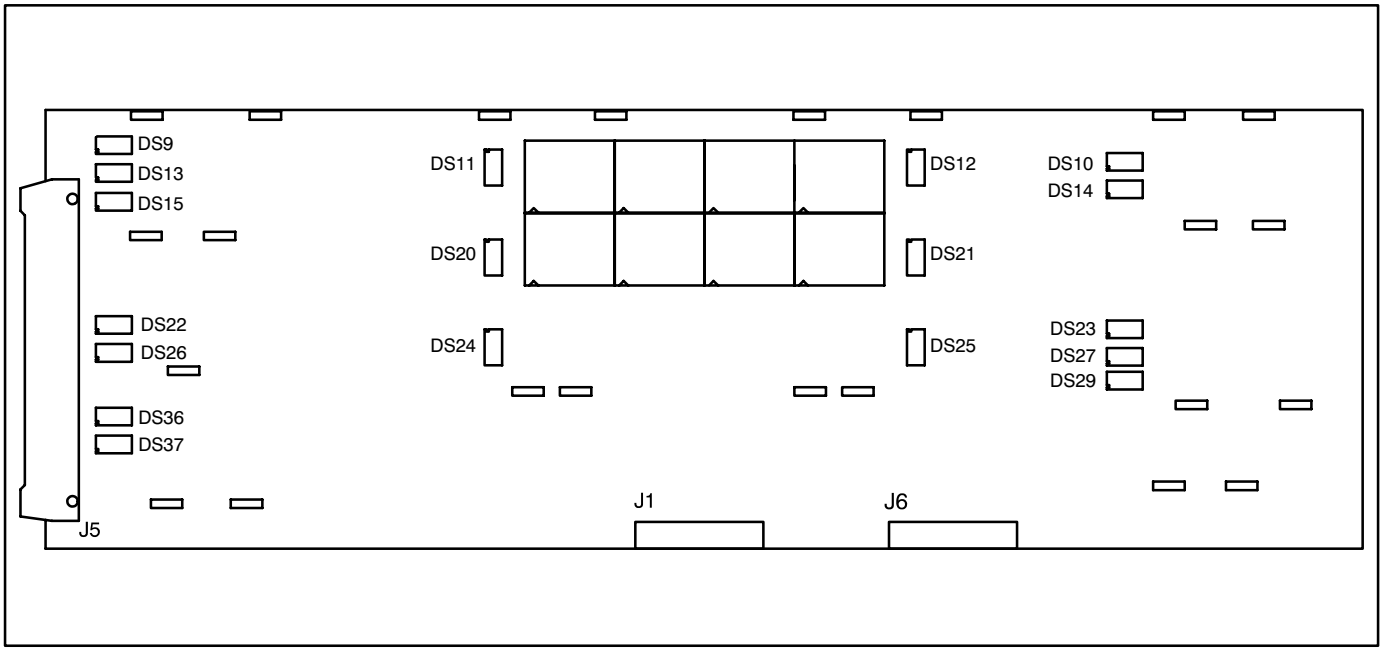



**FIGURE 3-6. DIGITAL DISPLAY BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## CUSTOMER INTERFACE BOARD (A34)

The customer interface board (Figure 3-7) connects to the PT/CT board to bring in voltage and current. It also connects to customer inputs and outputs.

### Connectors

The customer interface board has five connectors. They are:

**J1** Customer connections

**J2** Customer connections

**J3** A36 PT/CT Board and customer connections

**J4** Connects to J2 on A32 Digital board

**J5** Connects to J4 on A33 Analog board

### LEDs

The customer interface board has 27 LED's that indicate the following conditions:

**DS1** Master First Start Input (Green) – paralleling application only

**DS2** Pre low oil pressure output relay K14 (Red)

**DS3** Customer Fault #4 Input (Red)

**DS4** Customer Fault #1 Input (Red)

**DS5** Low oil pressure output relay K15 (Red)

**DS6** Fault Reset Input (Red)

**DS7** Engine Idle (Green)

**DS8** Load Demand Input (Green) – paralleling application only

**DS9** Breaker Open/Inhibit Input (Green) – paralleling application only

**DS10** Genset Breaker Closed Position (Green) – paralleling application only

**DS11** Customer Fault #2 input (Red)

**DS12** Low coolant output relay K17 (Red)

**DS13** Low Fuel Input (Red)

**DS14** Remote Start input (Green)

**DS15** Customer Fault #3 input (Red)

**DS16** Breaker Control input relay energized from Digital board (Green).
In single set application, this output is activated for a breaker trip when there is a shutdown fault.
In paralleling application, this output is activated to close a breaker

**DS17** Common Alarm output relay energized from Digital board (Green)
**This output is activated only on a shutdown condition.**

**DS18** Spare output relay energized from Digital board (Green)
**This output is activated only on a warning condition.**

**DS19** Load Dump output relay energized from Digital board (Red)
If overload or underfrequency for 5 seconds, this output is activated (before shutdown).

**DS20** Ready to Load output relay energized from Digital board (Green)
This output is activated when AC voltage and frequency exceed 90% of nominal.

**DS21** Pre high engine temperature output relay K8 (Red)

**DS22** Not in auto output relay K6 (Red)

**DS23** High engine temperature output relay K9 (Red)

**DS24** Overspeed output relay K10 (Red)

**DS25** Overcrank output relay K11 (Red)

**DS26** Low engine temperature output relay K12 (Red)

**DS27** Low fuel output relay K13 (Red)

Redistribution or publication of this document,
by any means, is strictly prohibited.

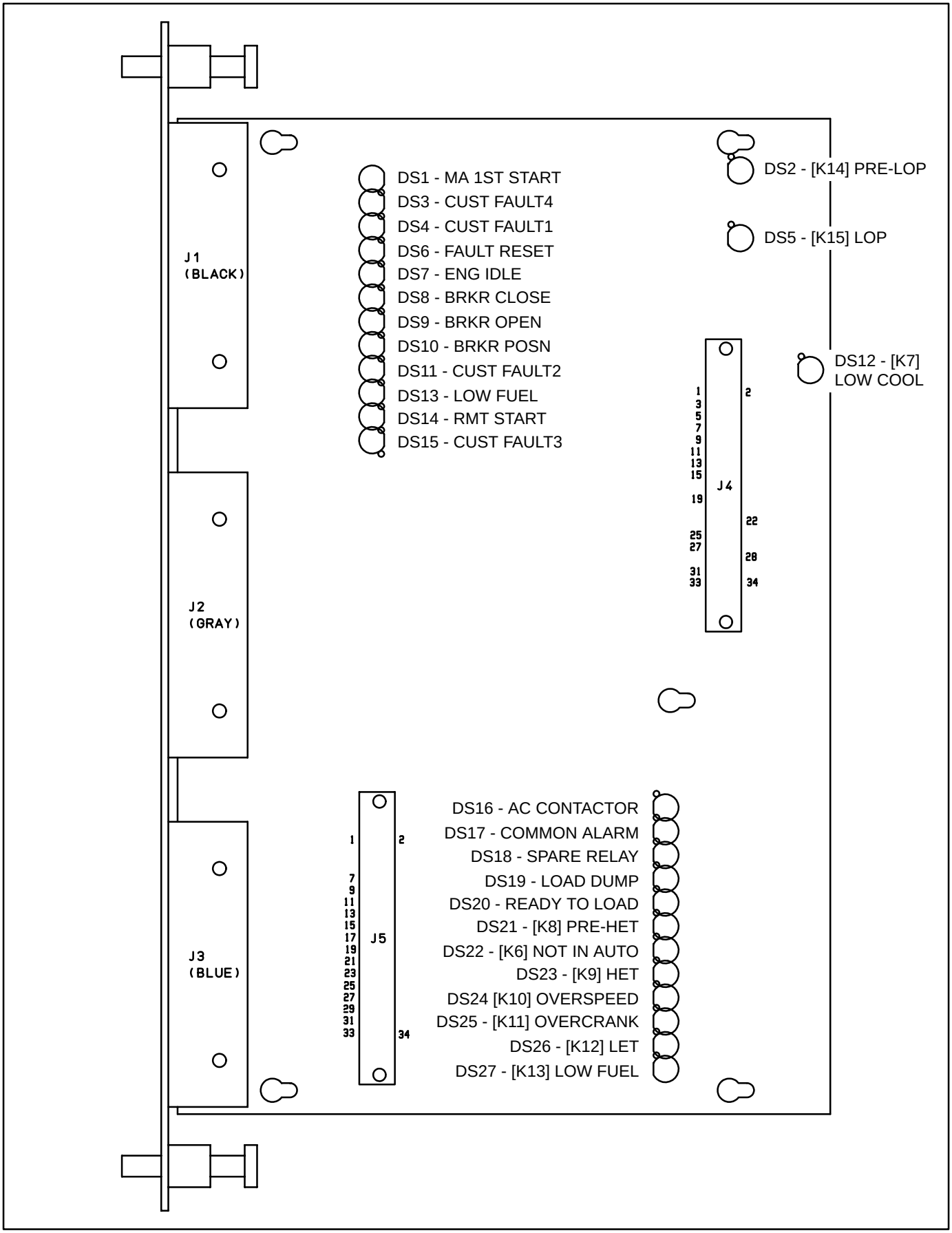



**FIGURE 3-7. CUSTOMER INTERFACE BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## PT/CT BOARD (A36)

The PT/CT board (Figure 3-8) is mounted inside the accessory box. This board converts generator output voltage to approximately 18 VAC levels for the analog board. It also converts CT .55 amp (at full load) output to approximately 1.65 VAC (at full load) input for the analog board.

There are three versions of this board. For proper operation, the PT/CT board must be correctly matched to the generator set.

In addition, there is a specific set of CTs for each genset. For proper operation, the CTs must also be correctly matched to the genset output current.

### Connectors

The PT/CT board has two connectors. They are:

**J8** Connects to J3 on A34 Customer Interface board

**J9** Connects to AC harness (generator output voltage and CTs)

***J9 wiring connections:***

| | |
|---|---|
| Yellow | Gen. A In |
| Orange | Gen. B In |
| Red | Gen. C In |
| Brown | Gen. Common In |
| White | CT21 (+) In |
| Gray | CT21 (common) In |
| Grn/Ylw | CT22 (+) In |
| Black | CT22 (common) In |
| Purple | CT23 (+) In |
| Blue | CT23 (common) In |

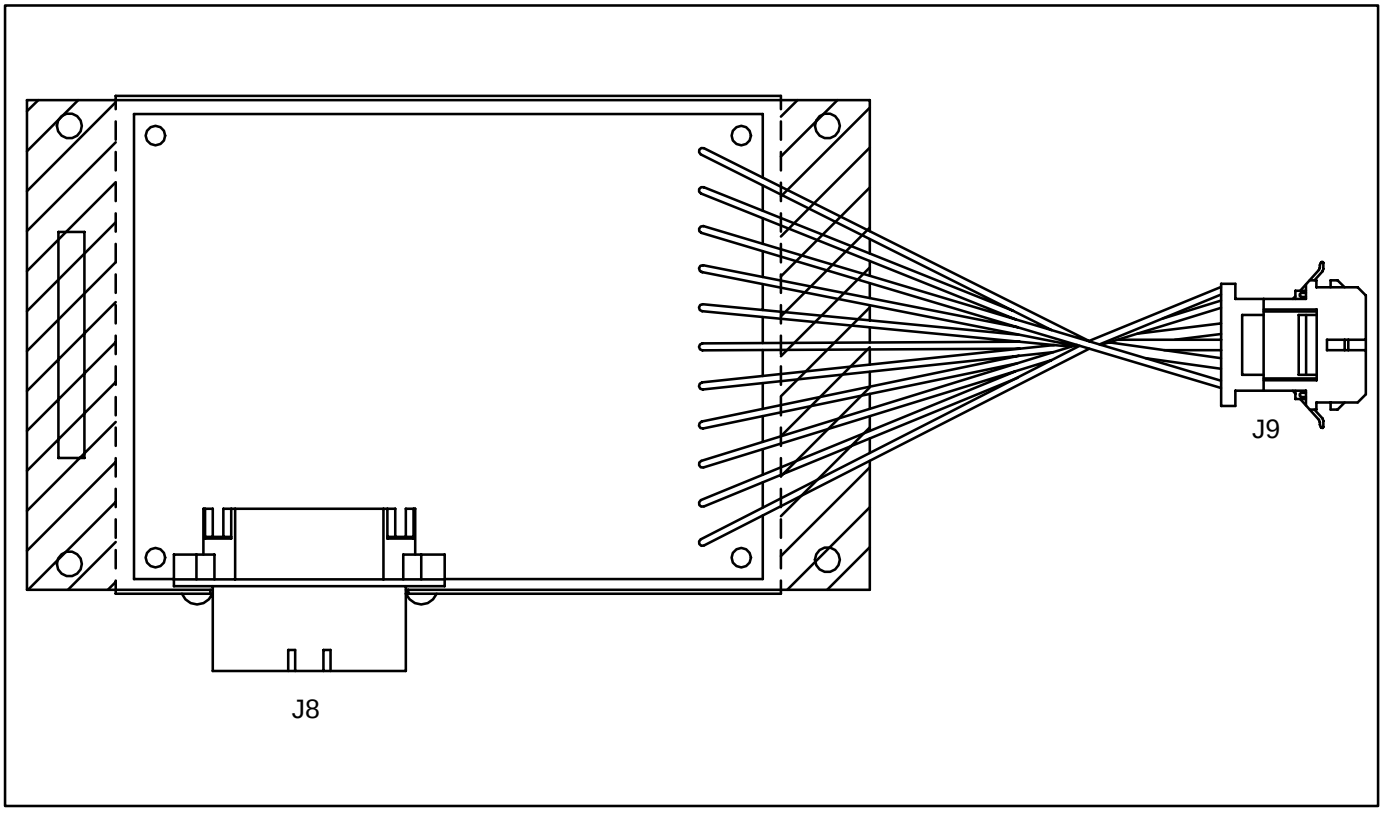



**FIGURE 3-8. PT/CT BOARD**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## VOLTAGE REGULATOR OUTPUT MODULE (A37)

The voltage regulator output module (Figure 3-9) is a power amplifier. This board is used to amplify the pulse-width modulated (PWM) signal from the PCC to drive the exciter windings. Power from the PMG is used by this board to amplify the PWM signal.

### Connectors

The voltage regulator output module has two connectors. They are:

**J7** Connects to engine harness (control)

***J7 wiring connections:***

| | |
|---|---|
| Gray | Regulator Drive (+) Input |
| White | Regulator Drive (-) Input |
| Blue | B+ Input (RUN signal) |
| Purple | Ground Input |
| Grn/Yel | Start in |
| Black | Start solenoid |

**J10** Connects to engine harness (power)

***J10 wiring connections:***

| | |
|---|---|
| Green | Phase A PMG power |
| Yellow | Phase B PMG power |
| Orange | Phase C PMG power |
| Red | X (Field +) Output |
| Brown | XX (Field –) Output |

### LEDs

The voltage regulator output module has 3 LED's that indicate the following conditions.

**DS1** On when voltage regulator isolated supply is operating (Green)

**DS2** Output Duty Cycle – Brighter when load increases – larger duty cycle (Amber). The duty cycle range of the PWM signal is 0 - 60%. Because the normal duty cycle is less than 10%, the output duty cycle LED, DS2 will normally be very dimly lit.

**DS3** Backup start disconnect – On when start disconnect is true (Green). The backup start disconnect is initiated at about 850 RPM, when sensed PMG voltage is greater than 105 volts RMS.

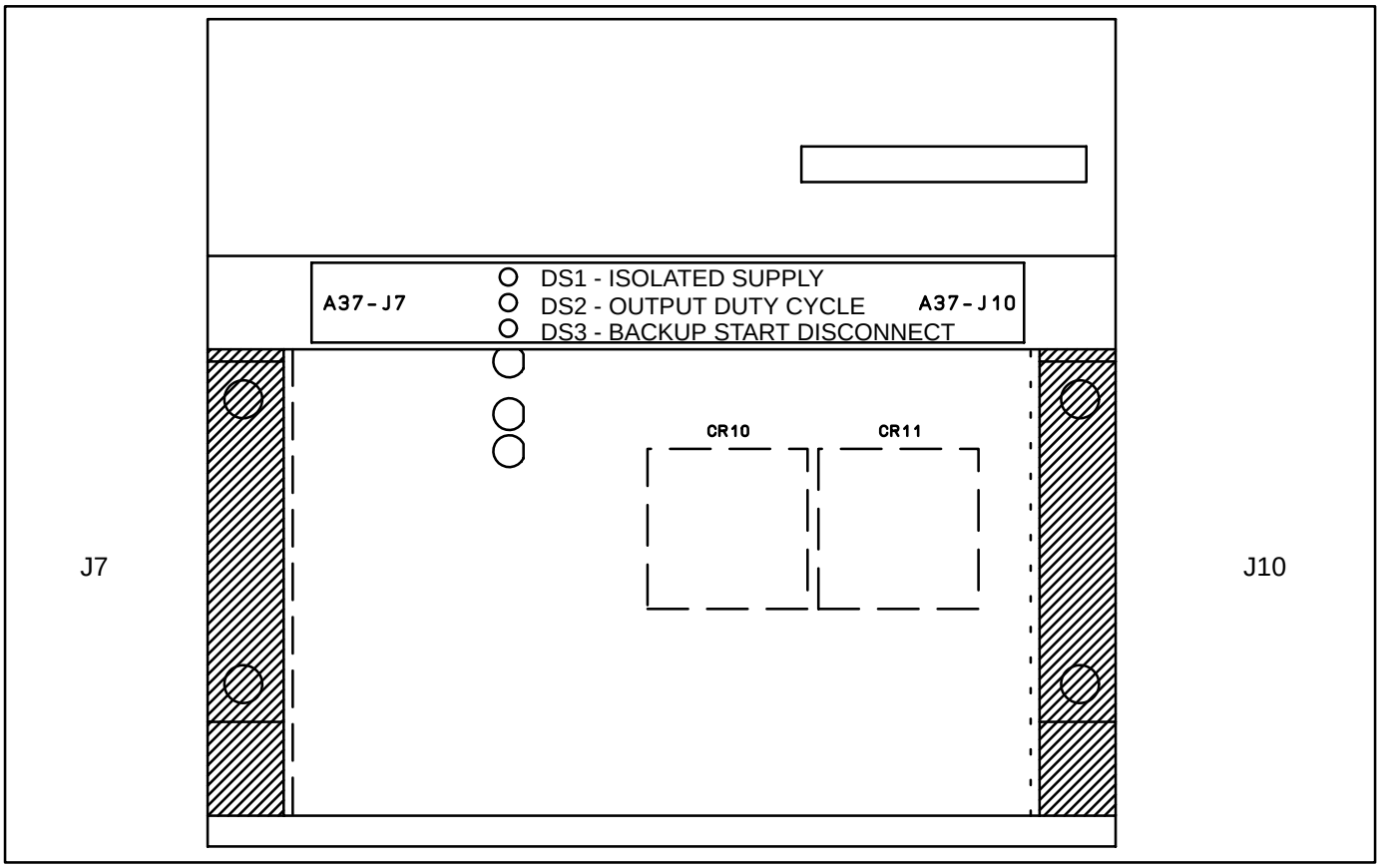



**FIGURE 3-9. VOLTAGE REGULATOR OUTPUT MODULE (A37)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## GENSET COMMUNICATIONS MODULE (A41)

The GCM (Figure 3-10) is mounted inside the PCC housing. It is required for connection of the PCC to the PowerCommand Network. Control and monitoring of the PCC can be accomplished over the network, via the GCM.

The GCM contains a terminate circuit for use at the end of a network data bus.

The GCM provides an interface for data from the PCC to other modules on the network. The GCM communicates with the PCC via the engine interface board, and it monitors various PCC circuits to determine the operating state of the control. For example, the GCM stores PCC data such as volts, current, engine speed, and oil temp; and then sends it out on the network when another network node requests the data.

**Refer to the *PowerCommand Network Installation and Operator's Manual* (900-0366) for logical installation and connection of the GCM on the network.**

Outputs from the GCM allow it to "wake up" the PCC when needed, or to cause an emergency shutdown on command. The GCM also provides some direct local control and monitoring of the PCC. It monitors for Not-In-Auto mode and High and Low battery voltage (when the PCC is asleep).

The GCM is powered from the genset battery. It remains powered even when the PCC is "asleep."

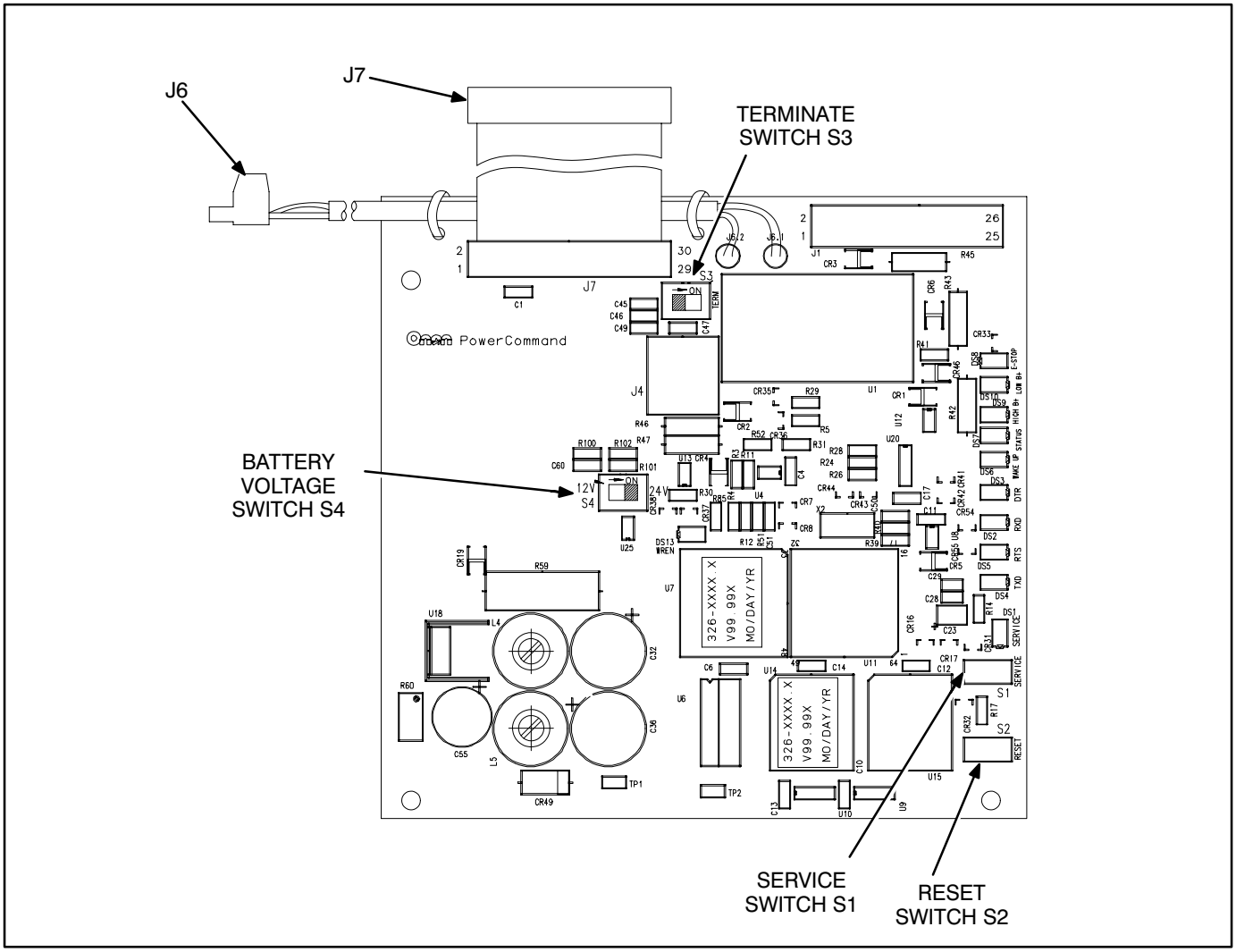



**FIGURE 3-10. GENSET COMMUNICATIONS MODULE**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Block Diagram

Refer to Table 3-1 and Figure 3-11 for a block diagram overview of the GCM.

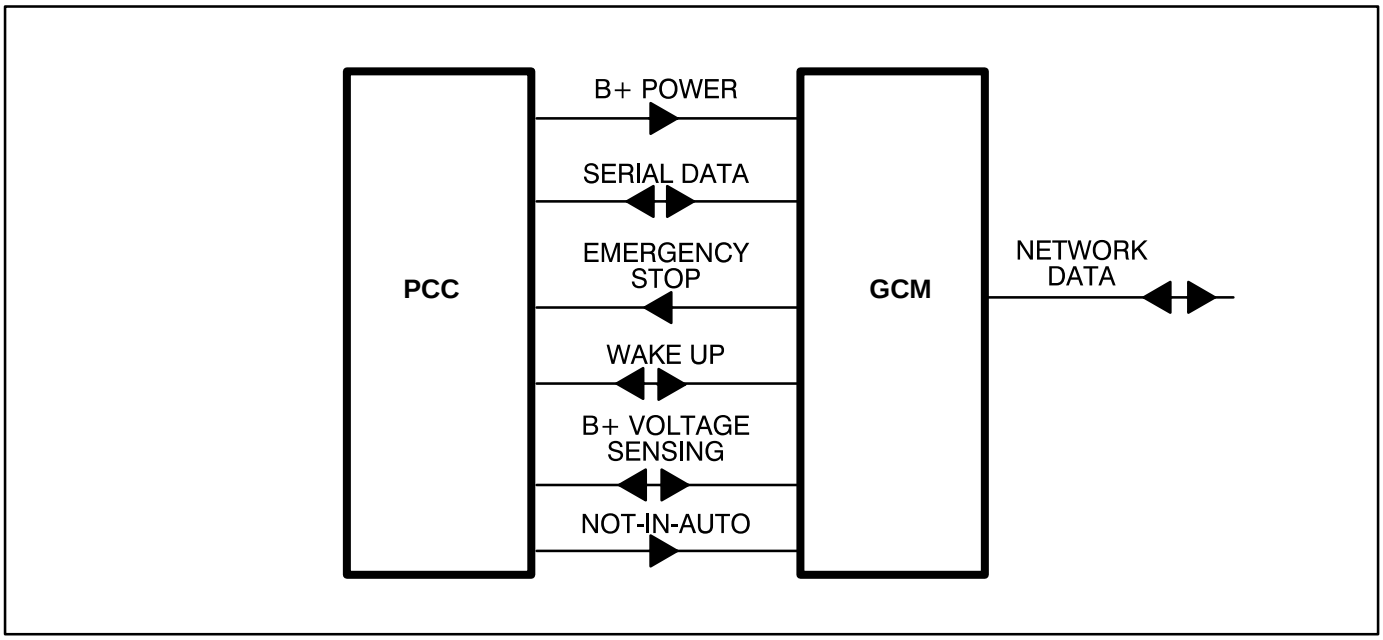



**FIGURE 3-11. BLOCK DIAGRAM: GENSET COMMUNICATIONS MODULE (GCM)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

**TABLE 3-1. GCM – BLOCK DIAGRAM DESCRIPTIONS**

| Function | Description/Specification |
|---|---|
| B+ Power | This is an output from the PCC to the GCM. The digital and analog circuitry on the GCM is powered from CNTRL B+ from the PCC. The GCM is always powered. It rides through starter dip and crank. The GCM is switch selectable for 12V or 24V systems. |
| Serial Data | This is a bidirectional data path between the PCC and GCM. The GCM communicates with the PCC through the PCC's serial port. Communication rate is 2400 baud. Starting, stopping and exercising of the set, readout of AC data, Engine data, and Set status information are done through this link. **NOTE: When the PCC's service port is connected (serial port) to an external device, the GCM cannot communicate with the PCC and thus the PCC state and data cannot be known on the network.** |
| Emergency Stop Control | This is an output from the GCM. The GCM can activate the PCC's Emergency Stop Latching Relay. This allows a remote emergency stop over the network. **NOTE: The Emergency Stop condition can only be reset at the PCC front panel.** |
| Wake Up Monitor and Control | This is both an output and an input for the GCM. The GCM has the capability to wake up the PCC. It would do this for example when a network message was telling the genset to start. The GCM also has the capability to monitor whether or not the PCC is awake (i.e. due to some other reason). This helps the GCM determine if it can communicate with the PCC. |
| B+ Voltage Sensing | This is an input to the GCM from the PCC. The GCM directly monitors battery voltage and determines high and low conditions. This function is needed when the PCC is not awake (and thus is not capable of monitoring battery voltage itself). A low or high condition will cause the GCM to wake up the PCC. The PCC then annunciates the warning. Voltage thresholds are the same as in the PCC. The GCM annunciates to the network a high or low voltage condition. |
| Not-In-Auto Monitor | This is an input to the GCM from the PCC. The GCM monitors the position of the front panel Run/Off/Auto switch. When the PCC is not awake, the GCM annunciates to the network a Not-In-Auto condition. |
| Network Data | Transformer Coupled into Category 4 Twisted Pair at 78,000 bits/sec. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## GCM Connections

GCM connections are made at connectors J1, J4, J6, and J7. Refer to Table 3-2.

## Switches/Service Points/LEDs

The Service switch is used during installation (when prompted by the LonMaker program). The Terminator switch must be set to the appropriate position at installation. Switches are described in Table 3-3. Service points are described in Table 3-4. LEDs are described in Table 3-5.

**TABLE 3-2. GCM – CONNECTIONS**

| Connector | Description |
|---|---|
| J7 | Ribbon cable harness from GCM to A31 engine interface board. Plugs into outermost connector on engine interface board. Cannot physically mate with any of the other connectors. This cable carries all GCM/PCC interface signals except network data. |
| J6 | Twisted pair cable harness from the GCM to the engine interface board. This cable carries network data to the engine interface board where it then goes out through the lower waterproof connector on its way to the customer connection terminal strip. |
| J1 | 26 pin header on the board used for factory test purposes only. |
| J4 | RJ45 connector for network data – service and Installation use only. |
| TB1–14 | Accessory Box — Network Data 1 signal from GCM |
| TB1–15 | Accessory Box — Network Data 2 signal from GCM |

**TABLE 3-3. GCM – SWITCHES**

| Ref | Name | Type | Description |
|---|---|---|---|
| S1 | SERVICE | momentary push | Used at time of logical installation to identify device to the installation software. Pressing S1 will light the DS1 LED. |
| S2 | RESET | momentary push | Resets the Neuron Chip processor. Not normally used, except for troubleshooting. |
| S3 | TERMINATOR | slide | Switch is set to position opposite of text “TERM” from factory. The two devices at ends of network data must have their switches set to “TERM”. |
| S4 | 12/24V SENSING | slide | Selects whether high/low battery sensing is for a 24VDC or 12VDC system. It is set to 24V position from the factory. |

**TABLE 3-4. GCM – SERVICE POINTS**

| Ref | Name | Description |
|---|---|---|
| TP1 | GCM VCC | This is the 5.0VDC that supplies the logic on the GCM. It is measured with respect to TP2. This test point is for troubleshooting use only. |
| TP2 | GND | Reference point for TP1. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

**TABLE 3-5. GCM – LED INDICATORS**

| Ref | Color | Name | Description |
|---|---|---|---|
| DS1 | Amber | SERVICE | Indicates various states of the GCM node. It will be ON if S1 is pressed and held. States without S1 pressed:<br>**OFF** = All OK. GCM has application image and is installed in a network.<br>**ON**= GCM is applicationless or has experienced a error that prevents Neuron Chip from executing application code.<br>**1/2 Hz BLINKING (1 second on / 1 second off)** =GCM has an application, but has not been logically installed in a network.<br>**FLASHING (momentarily)** once every 2–3 seconds=GCM is experiencing an error condition, causing a watchdog timeout reset. |
| DS2 | Green | RXD | Indicates Serial Data output from the GCM to the PCC. If the PCC is awake and no service tool is connected, this LED should be flickering regularly. RXD may be steady ON if the PCC is not awake. |
| DS3 | Green | DTR | ON indicates that the PCC is capable of communicating with the GCM (i.e. PCC is awake and no service tool is connected). |
| DS4 | Green | TXD | Indicates Serial Data input to the GCM from the PCC. Should be flickering regularly if the PCC is awake. If the service tool is connected, flickering will indicate responses from the PCC to the service tool. TXD may be steady ON if the PCC is not awake. |
| DS5 | Green | RTS | ON indicates that the PCC has new information for the GCM to retrieve. (May not be used.) |
| DS6 | Green | WAKE UP | ON when the GCM has turned on the PCC. |
| DS7 | Green | STATUS | **Approx. 1/2 Hz Blinking (1 second on / 1 second off)** indicates that the GCM's processor is executing the application code. In the future, may be used to indicate other conditions for troubleshooting purposes. |
| DS8 | Red | E–STOP | ON when a network emergency stop is active. |
| DS9 | Red | HIGH B+ | ON for a high battery condition sensed by GCM. |
| DS10 | Red | LOW B+ | ON for a low battery condition sensed by GCM. |
| DS13 | Green | WREN | ON (normal state) indicates that the off-chip EEPROM can be written to. Indicator must be ON if device is to be logically installed in a network. OFF could be caused by:<br>1) PCC CNTRL B+ is below 10VDC.<br>2) RESET switch being pressed and held.<br>3) Problem with board or connectors. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 4. Troubleshooting

## GENERAL

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

In the event of a shutdown fault (red Shutdown lamp), the PCC will stop the engine and close a set of contacts that can be wired to trip a circuit breaker. If the generator set is stopped for this reason, the operator can restart the set after making adjustments or corrections.

This section contains the following information:

- **Table 4-1:** Contains a list of all status codes, including the displayed message and status indicator. Also references the page number that contains a description of each code.
- **Table 4-2:** Describes each 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.
- **Table 4-3:** Lists the PCC oil pressure warning and shutdown limits.
- **Tables 4-4 through 4-29:** Provide detailed troubleshooting procedures.
- **Table 4-30:** Describes the analog circuit board inputs and outputs.
- **Table 4-31:** Describes the location and function of each fuse.

## SAFETY CONSIDERATIONS

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

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

When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Place the Run/Off/Auto switch in the Off position. Turn off or remove AC power from the battery charger, **MAKE CERTAIN EXPLOSIVE BATTERY GASSES ARE DISPELLED FROM BATTERY COMPARTMENT**, and then remove the negative (–) battery cable from the set starting battery.

**⚠WARNING** ***Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set (see above) before troubleshooting.***

Redistribution or publication of this document,
by any means, is strictly prohibited.

## STATUS INDICATORS

***Non-Automatic Status Indicator:*** This red lamp flashes continuously when the Run/Off/Auto switch is in the Off position.

***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 Reset switch. (It is **not** necessary to stop the generator set.) In auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected.

***Shutdown Status Indicator:*** This red lamp is lit whenever the control detects a shutdown condition. Shutdown faults are latched. After the condition is corrected, shutdown indicators can be reset by turning the Run/Off/Auto switch to the Off position, and pressing the Reset switch. In the Auto position, shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

**Emergency Stop shutdown status (Code 102) can be reset only at the PCC front panel.**

***Digital Display:*** This two-line, 16-character per line alphanumeric display is used in the menu-driven operating system and to show shutdown and warning messages. Refer to Tables 4-1 and 4-2.

## RESETTING THE CONTROL

Press the momentary ***Reset Switch*** to reset warning and shutdown messages after the condition has been corrected. To reset a shutdown message with the Reset switch, the Run/Off/Auto switch must be in the Off Position. **(The control cannot go into Standby [sleep] mode until all faults have been reset.)**

In Auto mode, warning indicators can also be reset by cycling the remote reset input after the condition is corrected. Shutdown faults can be reset by removing the remote start input and then cycling the remote reset input.

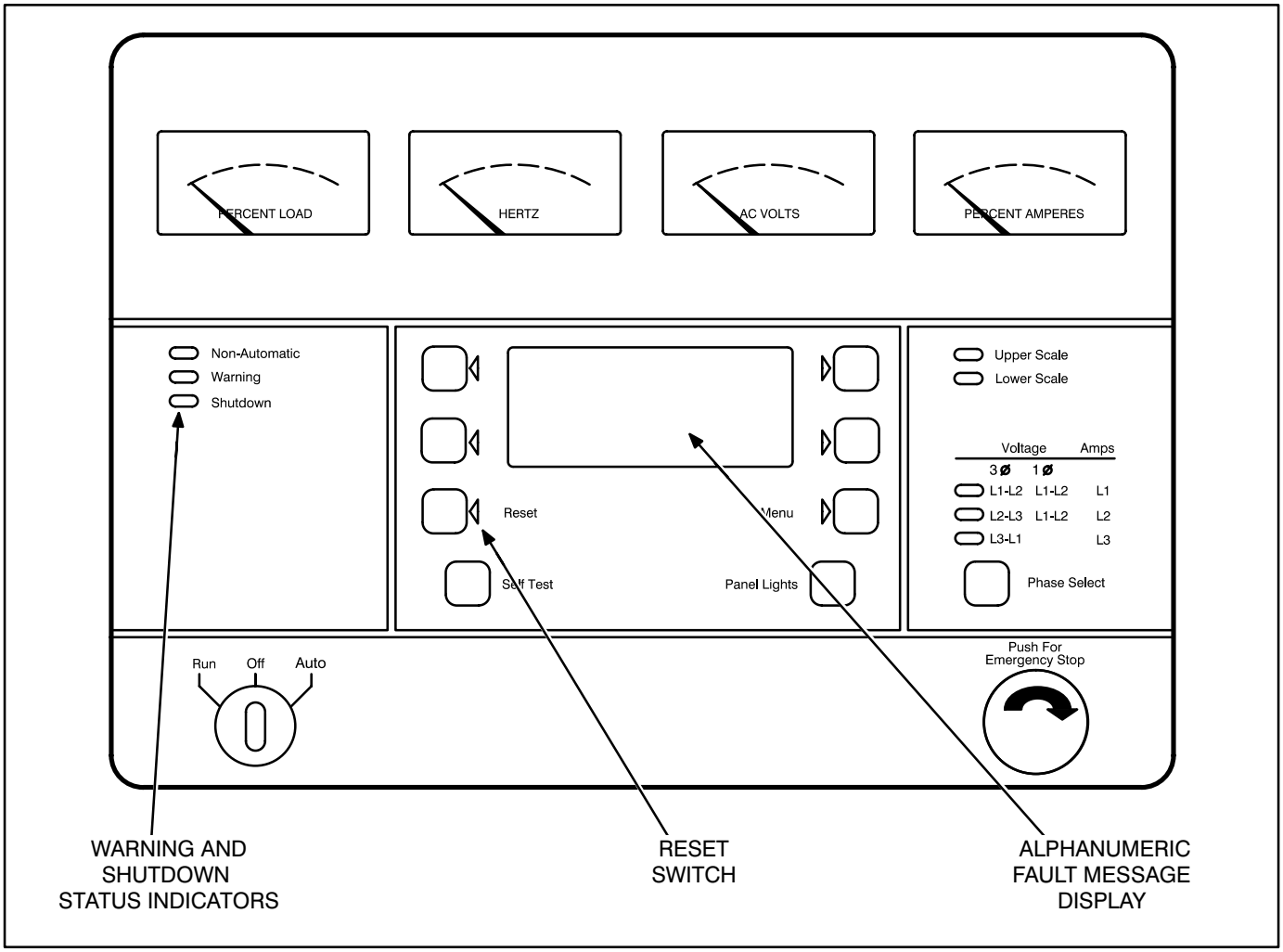



**FIGURE 4-1. CONTROL PANEL**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-1. WARNING AND SHUTDOWN CODES

| CODE | MESSAGE | STATUS LED | BASIC CHECKS | TROUBLE-SHOOTING |
|---|---|---|---|---|
| 101 | IDLE MODE | Warning | 4-4 | |
| 102 | EMERGENCY STOP | Shutdown | 4-4 | |
| 200 | LOW OIL PRESSURE | Warning | 4-4 | 4-21 |
| 201 | LOW OIL PRESSURE | Shutdown | 4-4 | 4-21 |
| 204 | OIL PRES SENDER | Warning | 4-4 | 4-22 |
| 210 | LOW COOLANT TEMP | Warning | 4-5 | 4-23 |
| 211 | HIGH COOLANT TEMP | Warning | 4-5 | 4-24 |
| 212 | HIGH COOLANT TEMP | Shutdown | 4-5 | 4-24 |
| 213 | COOLANT SENDER | Warning | 4-5 | 4-22 |
| 214 | LOW COOLANT LVL | Warning | 4-6 | 4-25 |
| 215 | LOW COOLANT LVL | Shutdown | 4-6 | 4-25 |
| 220 | MAG PICKUP | Shutdown | 4-6 | 4-26 |
| 221 | FAIL TO CRANK | Shutdown | 4-6 | 4-12, 4-20 |
| 222 | OVERCRANK | Shutdown | 4-6 | 4-18 |
| 223 | OVERSPEED | Shutdown | 4-6 | 4-27 |
| 230 | LOW DC VOLTAGE | Warning | 4-7 | 4-28 |
| 231 | HIGH DC VOLTAGE | Warning | 4-7 | 4-28 |
| 232 | WEAK BATTERY | Warning | 4-7 | 4-28 |
| 240 | LOW FUEL – DAY | Warning | 4-7 | 4-29 |
| 241 | LOW FUEL | Warning | 4-7 | 4-30 |
| 250 | EEPROM ERROR | Shutdown | 4-7 | 4-31 |
| 251 | EEPROM ERROR | Warning | 4-7 | 4-31 |
| 252 | EEPROM ERROR | Warning | 4-7 | 4-31 |
| 260 | CUSTOMER FAULT 1* | Warning/Shutdown | 4-8 | 4-32 |
| 261 | GROUND FAULT* | Warning/Shutdown | 4-8 | 4-32 |
| 262 | RUPTURE BASIN* | Warning/Shutdown | 4-8 | 4-32 |
| 263 | HIGH GEN TEMP* | Warning/Shutdown | 4-8 | 4-32 |
| 301 | HIGH AC VOLTAGE | Shutdown | 4-8 | 4-33 |
| 303 | LOW AC VOLTAGE | Shutdown | 4-8 | 4-36 |
| 313 | UNDER FREQUENCY | Shutdown | 4-8 | 4-38 |
| 320 | OVERCURRENT | Warning | 4-9 | 4-39 |
| 321 | OVERCURRENT | Shutdown | 4-9 | 4-39 |
| 322 | SHORT CIRCUIT | Shutdown | 4-9 | 4-39 |
| 330 | OVERLOAD | Warning | 4-9 | 4-39 |
| 335 | REVERSE POWER | Shutdown | 4-9 | |

***** Default message. Editable for customer site requirements.

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| MESSAGE:<br>**IDLE MODE**<br>**101 – WARNING** | Indicates that the engine is operating in idle mode. When the set is operating in the RUN mode, grounding the engine idle input causes generator build-up to be inhibited and the engine to be governed at 800 RPM. When ground is removed from this input, the set returns to normal speed and voltage.When the engine idle function is enabled, the control automatically sets lower oil pressure warning and shutdown trip points to reflect the lower operating speed. When the engine idle function is removed and the set reverts to normal operating speed, the control automatically resets oil pressure warning and shutdown trip points to the normal settings. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**EMERGENCY STOP**<br>**102 – SHUTDOWN** | Indicates local or remote Emergency Stop.<br>To reset the local/remote Emergency Stop button:<br>Turn the switch clockwise and allow it to pop out (local only).<br>Move the Run/Off/Auto switch to Off.<br>Press the Reset switch.<br>Select Run or Auto, as required. |
| **Warning** lamp lights.<br>MESSAGE:<br>**LOW OIL PRESSURE**<br>**200 – WARNING** | Indicates engine oil pressure has dropped to an unacceptable level. If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow **201-SHUTDOWN** procedure.<br>**To check oil pressure, access the Oil Pressure menu prior to clearing the fault.** |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**LOW OIL PRESSURE**<br>**201 – SHUTDOWN** | Indicates engine oil pressure has dropped below the shutdown trip point. Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. Reset control and restart. Oil pressure limits are listed in Table 4-3. |
| **Warning** lamp lights.<br>MESSAGE:<br>**OIL PRES SENDER**<br>**204 – WARNING** | Indicates that the control has sensed that the engine oil pressure sender is out of its working range. Check that the engine oil pressure sender is properly connected. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES (CONT.)

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| **Warning** lamp lights.<br>MESSAGE:<br>**LOW COOLANT TEMP**<br>**210 – WARNING**<br>Set is not operating. Warning occurs when engine coolant temperature is 70° F (21° C) or lower.<br>**NOTE: In applications where the ambient temperature falls below 40°F (4°C), Low Coolant Temp may be indicated even though the coolant heaters are operating.** | Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions:<br>a. Coolant heater not connected to power supply. Check for blown fuse or disconnected heater cord and correct as required.<br>b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required.<br>c. Open heater element. Check current draw of heater. |
| **Warning** lamp lights.<br>MESSAGE:<br>**HIGH COOLANT TEMP**<br>**211 – WARNING** | Indicates the engine coolant temperature is getting close to the recommended maximum temperature limit:<br>**202° F (94° C) – standby or primary**).<br>If generator is powering non-critical and critical loads and cannot be shut down, use the following:<br>a. Reduce load if possible by turning off non-critical loads.<br>b. Check air inlets and outlets and remove any obstructions to airflow.<br>If engine can be stopped, follow **HIGH COOLANT TEMP 212 – SHUTDOWN** procedure.<br>**To check coolant temperature, access the coolant temperature menu prior to clearing the fault.** |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**HIGH COOLANT TEMP**<br>**212 – SHUTDOWN** | Indicates engine has overheated (coolant temperature has risen above the shutdown trip point:<br>**212° F (100° C) – standby or primary**). Allow engine to cool down completely before proceeding with the following checks:<br>a. Check for obstructions to cooling airflow and correct as necessary.<br>b. Check fan belt and repair or tighten if necessary.<br>c. Check coolant mixture.<br>d. Check blower fan and circulation pumps on remote radiator installations.<br>e. Reset control and restart after locating and correcting problem. |
| **Warning** lamp lights.<br>MESSAGE:<br>**COOLANT SENDER**<br>**213 – WARNING** | Indicates that the resistance of the coolant temperature sender is out of range. Check the resistance of the sender. Resistance should be 500 to 2k ohms. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES (CONT.)

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| **Shutdown** lamp lights.<br>MESSAGE:<br>**LOW COOLANT LVL**<br>**214 – WARNING**<br>**or**<br>**LOW COOLANT LVL**<br>**215 – SHUTDOWN** | Indicates engine coolant level has fallen below the trip point. Allow engine to cool down completely before proceeding.<br>a. Check coolant level in both radiator and coolant recovery bottle and replenish if low. Look for possible coolant leakage points and repair if necessary.<br>b. If radiator level low and coolant bottle level is correct, defective coolant bottle hose or radiator cap.<br>c. Reset control and restart after locating and correcting problem.<br>**LOW COOLANT LVL Shutdown will not occur if genset is in Idle mode (low coolant warning only).** |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**MAG PICKUP**<br>**220 – SHUTDOWN** | Indicates mag pickup speed indication is not being sensed or does not match generator set output frequency.<br>a. Restart and check RPM on the digital display. |
| Engine will not crank.<br>**Shutdown** lamp lights.<br>MESSAGE:<br>**FAIL TO CRANK**<br>**221 – SHUTDOWN** | Indicates possible fault with control or starting system. Check for the following conditions:<br>a. Check fuse F3 on the Engine Interface board.<br>b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections.<br>c. Discharged or defective battery. Recharge or replace the battery. |
| **Shutdown** lamp lights.<br>Engine stops cranking.<br>MESSAGE:<br>**OVERCRANK**<br>**222 – SHUTDOWN** | Indicates possible fuel system problem.<br>a. Check for closed shutoff valve in supply line, empty propane supply tank or low natural gas fuel pressure.<br>b. Check for dirty fuel filter and replace if necessary.<br>c. Check for dirty or plugged air filter and replace if necessary.<br>d. Check for fuel flooded engine, or engine ignition problem. (To correct flooded engine, crank engine with gas valve closed. When engine begins to fire, open gas valve.)<br>e. Reset the control and restart after correcting the problem. |
| Engine runs and then shuts down.<br>**Shutdown** lamp lights.<br>MESSAGE:<br>**OVERSPEED**<br>**223 – SHUTDOWN** | Indicates engine has exceeded normal operating speed. (115% ±1% of nominal).<br>a. Check for proper function of governor actuator and throttle. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES (CONT.)

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| **Warning** lamp lights.<br>MESSAGE:<br>**LOW DC VOLTAGE**<br>**230 – WARNING** | Indicates battery voltage is below 10 VDC.<br>a. Discharged or defective battery. Check the battery charger fuse. Recharge or replace the battery.<br>b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections.<br>c. Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained.<br>d. Check float level if applicable (raise float level). |
| **Warning** lamp lights.<br>MESSAGE:<br>**HIGH DC VOLTAGE**<br>**231 – WARNING** | Indicates battery voltage exceeds 16 VDC.<br>Check float level on battery charger if applicable (lower float level).<br>Check engine DC alternator. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained. |
| **Warning** lamp lights.<br>MESSAGE:<br>**WEAK BATTERY**<br>**232 – WARNING** | Indicates battery voltage drops below 60% of nominal for two seconds, during starting.<br>Discharged or defective battery.<br>See Warning message **230, LOW DC VOLTAGE**. |
| **Warning** lamp lights.<br>MESSAGE:<br>**LOW FUEL–DAY**<br>**240 – WARNING**<br>or<br>**LOW FUEL**<br>**241 – WARNING** | When any one of these customer defined inputs is closed to ground, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**EEPROM ERROR**<br>**250 – SHUTDOWN** | Indicates PCC memory error. Data corruption of critical operating parameters. |
| **Warning** lamp lights.<br>MESSAGE:<br>**EEPROM ERROR**<br>**251 – WARNING**<br>**or**<br>**252 – WARNING** | Indicates PCC memory error. Data corruption of noncritical operating parameters. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES (CONT.)

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| **Shutdown** lamp lights.<br>MESSAGE:<br>**CUSTOMER FAULT 1**<br>**260 – SHUTDOWN**<br>or<br>**GROUND FAULT**<br>**261 – SHUTDOWN**<br>or<br>**DAY TANK**<br>**262 – SHUTDOWN**<br>or<br>**HIGH GEN TEMP**<br>**263 – SHUTDOWN** | When any one of these customer defined inputs is closed to ground, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. These fault functions can be programmed to initiate a shutdown or a warning.<br><br>As indicated by the Shutdown lamp, a shutdown response has been preselected.<br><br>**Note:** Customer fault messages are editable. The message displayed for the code shown (260 thru 263) may have been edited and may not appear as shown in this table. |
| **Warning** lamp lights.<br>MESSAGE:<br>**CUSTOMER FAULT 1**<br>**260 – WARNING**<br>or<br>**GROUND FAULT**<br>**261 – WARNING**<br>or<br>**RUPTURE BASIN**<br>**262 – WARNING**<br>or<br>**HIGH GEN TEMP**<br>**263 – WARNING** | When any one of these customer defined inputs is closed to ground, the corresponding fault message is displayed. The nature of the fault is an optional customer selection. These fault functions can be programmed to initiate a shutdown or a warning.<br><br>As indicated by the Warning lamp, a warning response has been preselected.<br><br>**Note:** Customer fault messages are editable. The message displayed for the code shown (260 thru 263) may have been edited and may not appear as shown in this table. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**HIGH AC VOLTAGE**<br>**301 – SHUTDOWN** | Indicates that one or more of the phase voltages has exceeded 130% of nominal, or has exceeded 110% of nominal for 10 seconds. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**LOW AC VOLTAGE**<br>**303 – SHUTDOWN** | Indicates that one or more of the phase voltages has dropped below 85% of nominal for 10 seconds. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**UNDER FREQUENCY**<br>**313 – SHUTDOWN** | Indicates that engine speed has dropped below 90% of nominal for 10 seconds.<br>**Note:** Five seconds before shutdown, a Load Dump signal is initiated.<br><br>Check fuel supply, intake air supply and load. |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-2. WARNING AND SHUTDOWN CODES (CONT.)

⚠ **WARNING** ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and mechanical hazards should perform service procedures. Review safety precautions.***

| SYMPTOM | CORRECTIVE ACTION |
|---|---|
| **Warning** lamp lights.<br>MESSAGE:<br>**OVERCURRENT**<br>**320 – WARNING** | Indicates that generator output current has exceeded 110% of rated for 60 seconds.<br><br>Check load and load lead connections. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**OVERCURRENT**<br>**321 – SHUTDOWN** | Indicates that generator output current has exceeded 110% of rated, and that a PCC time/current calculation has initiated an overcurrent shutdown.<br><br>Check load and load lead connections. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**SHORT CIRCUIT**<br>**322 – SHUTDOWN** | Indicates that generator output current has exceeded 175% of rated.<br><br>Check load and load lead connections. |
| **Warning** lamp lights.<br>MESSAGE:<br>**OVERLOAD**<br>**330 – WARNING** | Indicates that three-phase power output exceeds 105% of standby (or 115% of prime) rating. After five seconds, the Load Dump output is activated. After 60 seconds, the OVERLOAD warning is activated.<br><br>Check load and load lead connections. |
| **Shutdown** lamp lights.<br>MESSAGE:<br>**REVERSE POWER**<br>**335 – SHUTDOWN** | Indicates improper CT or PT phasing. (Non-parallel units only.)<br><br>Check CT / PT wiring. Refer to *CT Installation* in *Section 5*. |

**TABLE 4-3. OIL PRESSURE WARNING/SHUTDOWN LIMITS**

| ENGINE MODEL | 6C |
|---|---|
| **Normal Oil Pressure**<br>Warning Limit<br>Shutdown Limit | **40 - 70 psi (276 - 483 kPa**<br>20 psi (138 kPa)<br>15 psi (103 kPa) |
| **Idle Oil Pressure**<br>Warning Limit<br>Shutdown Limit | **10-30 psi (69-207 kPa)**<br>12 psi (83 kPa)<br>8 psi (55 kPa) |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TROUBLESHOOTING PROCEDURE

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

**To determine the appropriate troubleshooting procedure for the specific problem at hand, be sure to refer to the "Indicators" column provided in each troubleshooting table.**

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. (Table 4-31 describes the location and function of each fuse.)

Figure 4-2 shows the location of the components within the control panel that are referenced in the following troubleshooting procedures. Connector, LED and switch locations for each circuit board and module are provided in *Section 3*. The control wiring and circuit board connections are shown in *Section 8*.

**⚠ CAUTION** ***Always set the Run/Off/Auto (S12) switch to the Off position and the Power On/Standby (S5) switch to the Standby position before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.***

**⚠ CAUTION** ***Electrostatic discharge will damage circuit boards. Always wear a wrist strap when handling circuit boards or socket-mounted IC's and when disconnecting or connecting harness connectors.***

Redistribution or publication of this document,
by any means, is strictly prohibited.

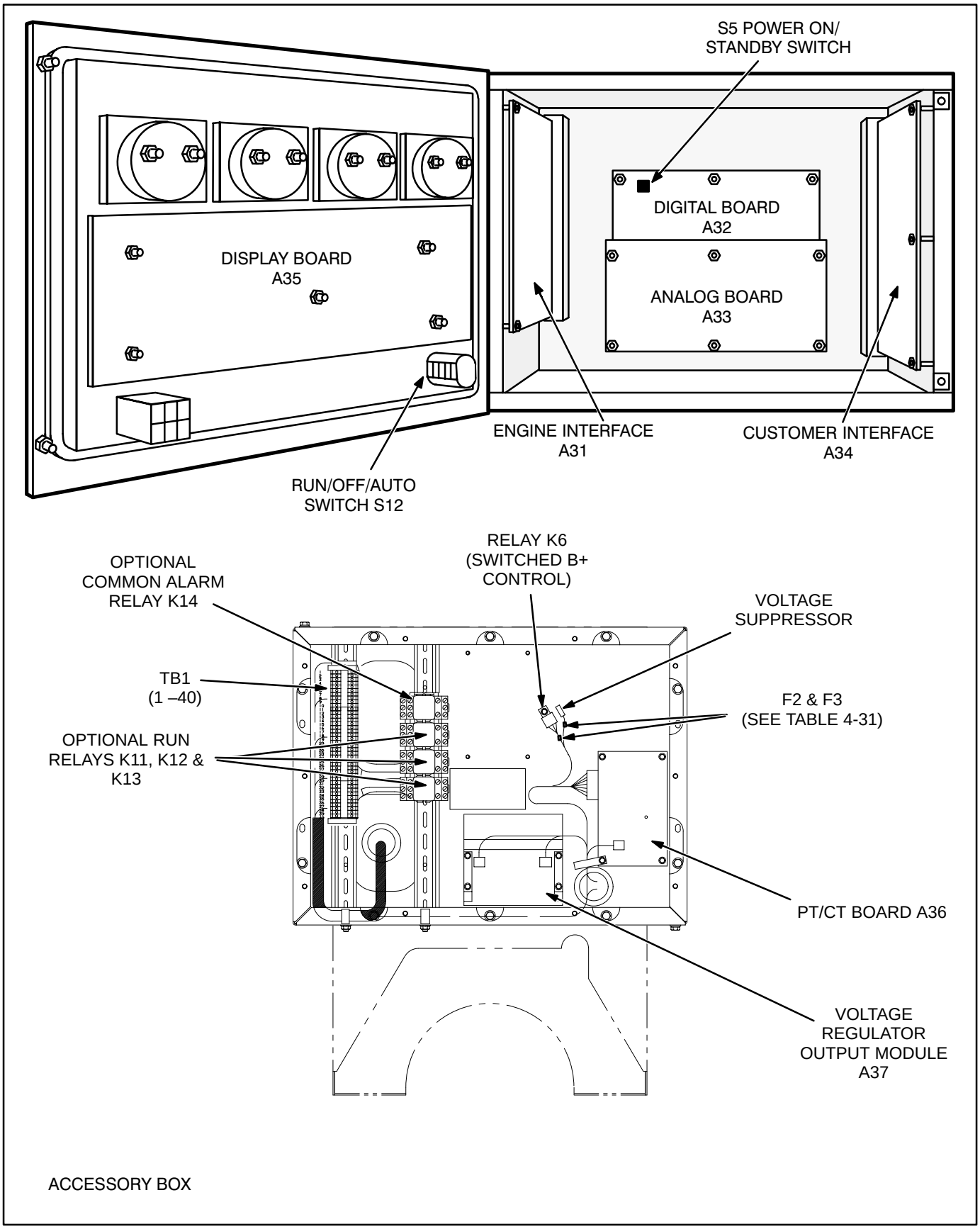



**FIGURE 4-2. CIRCUIT BOARD LOCATIONS**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-4. ENGINE DOES NOT CRANK—LOCAL OR REMOTE RUN

***⚠WARNING*** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message<br><br>Reset and attempt to start:<br><br>Start LED DS11 on the engine interface board turns on.<br><br>NOTE: These two indications suggest that the PCC has received a start signal and has sent a start command to the start output (J4-2) on the engine interface board. | 1. Insufficient battery voltage. Check the following conditions:<br>a. Batteries not charged.<br>b. Battery connections loose or dirty.<br>c. Insufficient battery charging voltage.<br>d. Engine DC alternator could be bad. | 1a. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).<br>1b. Clean and tighten or replace the battery cable connectors and cables at the battery and the set.<br>1c. Adjust charge rate of battery charging circuit.<br>1d. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained. |
| | 2. Starter could be bad. | 2. Reset the control. Attempt to start, and test for B+ at the starter. If there is B+ at the starter, the starter could be bad. Test starter (see engine service manual). Replace the starter. |
| | 3. If there is no B+ at the starter, start solenoid K4 could be bad. | 3. Reset the control. Attempt to start, and test for B+ into and out of start solenoid contacts. If there is B+ in, but not out, check for B+ at the start solenoid coil. If there is B+ at the coil, check ground connection. If ground connection is good, the start solenoid is bad. Replace the start solenoid.<br>If there is B+ into and out of the start solenoid contacts, check for an open between the start solenoid contacts and the starter. If there is no B+, go to the next step. |
| | 4. If there is no B+ at the start solenoid coil (K4), the backup start disconnect contacts in the regulator output module (A37) could be open (indicating that A37 is bad). | *4. Disconnect J7/P7 at the regulator output module. Test for continuity at A37 J7-5/J7-6. If there is no continuity, the regulator output module is bad. Replace A37. |
| | 5. If there is continuity at A37 J7-5/J7-6, there may be an open between A37 and A31, an open between A37 and K4, or A31 may be bad. | *5. If there is continuity at A37 J7-5/J7-6, reset the control, attempt to start, and check for B+ at A37 P7-5.<br>If there is B+ at P7-5, there may be an open between start solenoid coil (K4) and A37. If there is no B+ at P7-5, check for B+ at J4-2 on the engine interface board (A31) while attempting to start.<br>If there is B+ at A31 J4-2, check for an open between A37 and A31.<br>If there is no B+ at A31 J4-2, (and DS11 is on) the engine interface board is bad. Replace A31. |
| | 6. The mag pickup signal is not being sensed. | 6. Refer to the mag pickup shutdown message (220). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document, by any means, is strictly prohibited.

## TABLE 4-5. ENGINE DOES NOT CRANK—LOCAL OR REMOTE RUN

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message<br><br>Reset and attempt to start:<br><br>Start LED DS11 on the engine interface board does **NOT** turn on.<br><br>NOTE: These two indications suggest that the PCC has received a start signal and has **NOT** sent a start command to the start output (J4-2) on the engine interface board. | 1. Fuse F3 on the engine interface board (A31) may be open, or B+ may not be getting to F3. | ***1. Install harness tool between A31 J4/P4. Reset the control. Attempt to start and check for B+ at J4-2. If no B+, remove F3 and check continuity. If open, replace the fuse with one of the same type and amp rating (5 Amps). If F3 is OK, check the B+ supply from the wiring harness. |
| | 2. Emergency Stop switch S13 or the PCC door harness may be bad. | 2. To isolate:<br>• Check for B+ at S13-1 and S13-2. If there is B+ at S13-2, but not at S13-1 (and S13 is NOT in the emergency stop position), then S13 is bad. Replace S13.<br>• If there is no B+ at S13-2, disconnect J3/P3, and check for B+ at A31 J3-2. If there is no B+, replace A31.<br>• If there is B+ at A31 J3-2, check continuity from P3-2 to P3-6. If no continuity, repair or replace as necessary. |
| | 3. Digital board (A32) may be bad. | ***3. Install harness tool between A32 J4/P4. Reset the control. Attempt to start, and test for ground output at A32 J4-3. If there is no ground output, A32 is bad. Replace A32. |
| | 4. Engine interface board (A31) may be bad. | ***4. If there is a ground output at A32 J4-3, and yet there is no B+ output at A31 J4-2; then A31 is bad. Replace A31. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-6. ENGINE DOES NOT CRANK—REMOTE RUN

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message **DOES NOT** appear on digital display –and: Auto LED DS5 on the engine interface board (A31) is on – RMT Start LED DS14 on the customer interface board (A34) is on –<br><br>NOTE: This condition suggests that the PCC processor (digital board –A32) has **NOT** received or recognized a remote start start signal. | 1. The Auto mode signal is not getting from engine interface board A31 to digital board A32, indicating that A31 is bad. | ***1. Install harness tool between A32 J4/P4. Check for ground output at A32 J4-18.<br>If there is no ground output (but A31 DS5 is on) engine interface board A31 is bad. Replace A31.<br>If there is a ground output at A31 J1-18, proceed to the next step. |
| | 2. The Remote run signal is not getting from customer interface board A34 to A32, indicating that A34 is bad. | ***2. Install harness tool between A32 J4/P4. Reset the control. Attempt to remote start, and check for ground output at A32 J2-26. If no ground output (but A34 DS14 is on) customer interface board A34 is bad. Replace A31.<br>If there is a ground output at A32 J2-26, proceed to the next step. |
| | 3. Digital board (A32) may be bad. | ***3. If, when attempting remote start, there is a ground input at A32 J2-26, and a ground input at A32 J4-18—and there is no "FAIL TO CRANK" message—and the set does not crank; A32 is bad. Replace, A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-7. ENGINE DOES NOT CRANK—REMOTE RUN

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message **DOES NOT** appear on digital display –and: Auto LED DS5 on the engine interface board (A31) is off – RMT Start LED DS14 on the customer interface board (A34) is on –<br><br>NOTE: This condition suggests that the engine interface board (A31) is **NOT** enabling the remote start logic on the digital board. | The Auto mode input is not getting from the Auto select switch (S12) to engine interface board A31 (indicating that S12, A31, or the harness is bad.<br><br>1. S12 or the wiring harness may be bad.<br><br>2. Engine interface board A31 may be bad.<br><br>3. Digital board A32 may be bad. | *****1. Disconnect A31 J3/P3. Check continuity to ground at A31 J3-11. (J3-11 is ground out to S12. If ground is not present, replace A31. If ground is present, place S12 in Auto and check continuity from P3-11 to P3-13. If no continuity, isolate to switch or wiring harness. Repair as necessary. If there is continuity, A31 may be bad. Reconnect J3/P3.<br><br>*****2. Install harness tool between A32 J4/P4. Check the 16 volt (nominal) supply at A32 J4-16.<br><br>If the voltage is present at A32 J4-16, and ground is present at A31 P3-13—and yet A31 DS5 is off; then A31 is bad. Replace A31.<br><br>3. If there is no +16 volt supply voltage at A32 J4-16, A32 is bad. Replace A32. |
| ***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.** | | |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-8. ENGINE DOES NOT CRANK—REMOTE RUN

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message **DOES NOT** appear on digital display –and: Auto LED DS5 on the engine interface board (A31) is on – RMT Start LED DS14 on the customer interface board (A34) is off<br><br>NOTE: This condition suggests that the remote start input is **NOT** passing through the customer interface board (A34) to enable the remote start logic on the digital board. | The remote start input is not getting from the remote start switch to the output of the customer interface board (A34) indicating that the switch, A34, or the harness is bad.<br><br>1. The remote start switch or the wiring harness may be bad.<br><br>2. Customer interface board A34 may be bad. | *****1. Install harness tool between A34 J1/P1. Reset the control. Attempt remote start and check for ground at A34 J1-13. If ground level is not present, isolate to the switch or the wiring harness by checking for a start signal at TB1-5. Repair as necessary.<br><br>2. If ground is present at A34 J1-13—and yet A34 DS14 is off, replace A34. |
| ***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.** | | |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-9. ENGINE DOES NOT CRANK—LOCAL RUN

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "FAIL TO CRANK" (221) message **DOES NOT** appear on digital display –and: Run LED DS4 on the engine interface board (A31) is off–<br><br>NOTE: This condition suggests that the start input is **NOT** getting from the Run/Off/ Auto switch (S12) to the engine interface board (A31) to enable the remote start logic on the digital board. | The start input is not getting from the Run/ Off/ Auto select switch (S12) to A31 (indicating that S12, A31, or the harness is bad.<br><br>1. Run/Off/ Auto select switch S12 or the wiring harness may be bad.<br><br>2. Engine interface board A31 may be bad.<br><br>3. Digital board A32 may be bad. | ***1. Check continuity to ground at A31 J3-11. If ground is not present, replace A31. If ground is present, place S12 in Run and check continuity from P3-11 to P3-12. If no continuity, isolate to switch or wiring harness. Repair as necessary. If there is continuity, A31 may be bad.<br><br>***2. Install harness tool between A32 J4/P4. Check the 16 volt (nominal) supply at A32 J4-16.<br><br>If the voltage is present at A32 J4-16, and ground is present at A31 J3-12—and yet A31 DS5 is off, replace A31.<br><br>3. If there is no +16 volt supply voltage at A32 J4-16, replace A32. |
| ***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.** | | |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-10. ENGINE CRANKS BUT DOES NOT START

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OVERCRANK" (222) message<br><br>–and<br><br>While cranking, Run LED DS12 on the engine interface board (A31) is on.<br><br>NOTE: This suggest that the PCC has sent a run signal to the fuel solenoid. | Fuel supply or fuel delivery.<br>1. Restricted fuel supply due to:<br>a. Closed shutoff valve in supply line.<br>b. Empty propane supply tank.<br>c. Low natural gas fuel pressure. | 1a. Open any closed shutoff valve in the fuel line supplying the engine.<br>1b. Fill propane supply tank.<br>1c. Check for proper adjustment of pressure regulator.<br>Check with the gas utility. |
| | 2. Low engine temperature is causing too low a cranking speed for starting. | 2a. Increase room temperature.<br>2b. Plug in, repair or install engine coolant heater.<br>2c. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature. |
| | 3. Fuel solenoid (K1) is not energized due to:<br>a. Open in fuel solenoid circuit.<br>b. Defective fuel solenoid. | 3a. Reset the control. Attempt to start and check for B+ at the K1 fuel solenoid. If no B+, check wiring continuity of fuel solenoid circuit.<br>3b. Test fuel solenoid. Repair or replace as necessary. |
| | 4. Cranking voltage is too low to reach required cranking speed. | 4a. While cranking the engine, measure voltage directly across the battery terminals and then immediately across the starter motor terminal and the grounding bolt on the block. Cable, terminal or relay contact resistance is too high if the difference is more than 2 volts. Service as necessary.<br>4b. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C).<br>4c. Adjust charge rate of battery charging circuit.<br>4d. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained. |
| | 5. The engine induction system is blocked/clogged. | 5. Service as necessary. |
| | 6. The engine ignition system is malfunctioning (ignition coil, distributor, spark plugs, high tension spark plug and coil cables and timing. | 6. Service as necessary. Refer to wiring diagrams in Section 9. |
| | 7. The engine may be flooded. | 7. Clear flooded engine condition. (To correct flooded engine, crank engine with gas valve closed. When engne begins to fire, open gas valve.) |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-11. ENGINE CRANKS BUT DOES NOT START

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OVERCRANK" (222) message | The run signal is not getting through K6 and F3 to the fuel control actuator of fuel solenoid. | Reset the control. Attempt to start and check for B+ at A31 J4-1. |
| –and<br><br>While cranking, Run LED DS12 on the engine interface board (A31) is on. | 1. The run signal is not getting out of the engine interface board (A31). A31 may be bad. | *1. Install harness tool between A31 J4/P4. Reset the control. Attempt to start and check for B+ at A31 J4-1. If there is no B+ at A31 J4-1, replace A31. |
| | 2. There is an open between the engine interface board (A31) and through K6 coil and ground. | 2. If there is B+ at A31 J4-1, check circuit continuity of relay coil K6. Repair or replace as necessary. |
| NOTE:<br>This indication suggest that the PCC has sent a run signal to relay K6, but the signal is not getting through to the fuel control actuator or fuel solenoid. | 3. B+ signal is not getting through F3 and K6 contacts to T26. | 3.Check F3 and circuit continuity of relay K6 contacts. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-12. ENGINE CRANKS BUT DOES NOT START

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OVERCRANK" (222) message<br><br>–and<br><br>Run LED DS12 on the engine interface board (A31) is off.<br><br>NOTE: These indications suggest that the PCC has NOT sent a run signal – (fuel solenoid enable signal) out to the K6 relay and the fuel solenoid. | The run signal from the digital board (A32) is not being processed by the engine interface board (A31).<br><br>1. The run signal is not getting out of the digital board (A32). A32 may be bad.<br><br>2. The run signal is not being processed by the engine interface board (A31). A31 may be bad. | *****Install harness tool between A32 J4/P4. Attempt to start and check for ground signal at A32 J4–8.<br><br>1. If there is no ground signal at A32 J4–8, replace A32.<br><br>2. If there is a ground signal at A32 J4–8, replace A31. |
| "FAIL TO CRANK" (221) message<br><br>NOTE: The engine is cranking but shutting down on a 221 fault. | The mag pickup signal is not being sensed. | Refer to the mag pickup shutdown message (220). |
| ***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.** | | |

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-13. LOW OIL PRESSURE WARNING (200) OR SHUTDOWN (201)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW OIL PRESSURE" warning (200) or shutdown (201) message. | 1. Low oil level. Clogged lines or filters. | 1. Check oil level, lines and filters. If oil system is OK but oil level is low, replenish. Oil pressure limits are listed in *Table 4-3.* |
| | 2a. Sender or oil pump could be bad. Or the generator set may be shutting down on another fault. | 2. Disconnect the oil pressure sender leads, and connect an oil pressure sender simulator to the harness.<br>a. If the control responds to the simulator, reconnect the sender, disconnect the run signal wire at the fuel solenoid, and crank the engine. Check the oil pressure reading on the digital display.<br>• 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.<br>• If the display does not show an acceptable oil pressure, replace the sender. If the PCC still doesn't display an oil pressure while cranking, the oil pump may be faulty. Refer to the engine service manual. |
| | 2b. Harness or PCC circuit board could be bad.<br>Isolate to the harness, engine interface board (A31), analog board (A33), or digital board (A32). | ***b.** If the control does not respond to the simulator, the PCC or the harness is bad. Install harness tool between A31 J2/P2.<br>Check for +5 VDC at the sender (lead marked E1-B). If there is no 5 VDC at the sender<br>• Check for 5 VDC at A31 J5-18.<br>• If yes, harness is bad. If no, check for 5 VDC at A31 J2-24.<br>• If yes, A31 is bad. If no, A33 is bad.<br>If there is 5 VDC at the sender, use the sender simulator to generate a signal to A31 J2-23. If the pressure signal (.5 to 4.5 VDC) does not get to A31 J2-23, isolate to the harness or A31. If the pressure signal does get to A31 J2-23, refer to the analog/digital troubleshooting procedure (*Table 4-29a/b*). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-14. SENDER WARNINGS (204 or 213)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OIL PRESSURE SENDER" warning (204) message. | 1. The sender connections could be bad.<br><br>2. The sender, the harness, engine interface board (A31), digital board (A32), or analog board (A33) could be faulty. | 1. Check the sender connections.<br><br>*****2. Isolate to the sender, harness, engine interface board (A31), analog board (A33), or digital board (A32).<br>Disconnect the oil pressure sender leads, and connect an oil pressure sender simulator to the harness.<br>**"OIL PRES SENDER" warning is displayed after the fault condition is sensed for 10 seconds.**<br>a. If the control responds to the simulator, replace the sender.<br>*****b. If the control does not respond to the simulator, the PCC or the harness is bad. Install harness tool between A31 J2/P2.<br>Check for +5 VDC at the sender (lead marked E1-B). If there is no 5 VDC at the sender<br>• Check for 5 VDC at A31 J5-18.<br>• If yes, harness is bad. If no, check for 5 VDC at A31 J2-24.<br>• If yes, A31 is bad. If no, A33 is bad.<br>If there is 5 VDC at the sender, use the sender simulator to generate a signal to A31 J2-23. If the pressure signal (.5 to 4.5 VDC) does not get to A31 J2-23, isolate to the harness or A31. If the pressure signal does get to A31 J2-23, refer to the analog/digital troubleshooting procedure (*Table 4-29a/b*). |
| "COOLANT SENDER" warning (213) message. | 1. The sender connections could be bad.<br><br>2. The sender, the harness, engine interface board (A31), digital board (A32), or analog board (A33) could be faulty. | 1. Check the sender connections.<br><br>*****2. Isolate to the sender, harness, engine interface board (A31), analog board (A33), or digital board (A32).<br>Disconnect the sender, and plug in a resistive sender simulator to isolate the fault.<br>a. If the control responds to the simulator, replace the sender.<br>b. If the control does not respond to the simulator, refer to the high coolant temp troubleshooting procedure. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document, by any means, is strictly prohibited.

## TABLE 4-15. LOW ENGINE TEMPERATURE WARNING (210)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW COOLANT TEMP" warning (210) message.<br>Coolant level is normal.<br>Heater is OK.<br>Coolant temp on front panel display is OK.<br>**DS3 on the engine interface board, A31, is on.** | DS3 / A31 is on, indicating that engine interface board A31 is receiving a low coolant temp from the sender.<br>The sender, the harness or A31 could be bad. | Isolate the source of the signal.<br>Unplug the coolant temperature switch (S1) and reset the control.<br>1. If the 210 warning message drops out and does not reappear, replace the sender.<br>*****2. If the 210 warning message reappears and remains after control reset, disconnect A31 J4 and check continuity from P4–13 to GND.<br>• If there is continuity, replace the harness.<br>• If there is no continuity, replace circuit board A31. |
| "LOW COOLANT TEMP" warning (210) message.<br>Coolant level is normal.<br>Heater is OK.<br>Coolant temp on front panel display is OK.<br>**DS3 on the engine interface board, A31, is off.** | DS3 / A31 is off, indicating that engine interface board A31 is not receiving a low engine temp signal from the sender—but the 210 message indicates that A32, the digital board, is responding to a false low engine temp signal.<br>A31, the engine interface board, or A32, the digital board, could be bad. | Isolate the source of the signal.<br>Check J4–6/P4–6 on A32.<br>*****1. Install harness tool between A32 J4/P4.<br>2. Open J4–6 and reset the control.<br>• If fault drops out and does not return, replace A31.<br>• If fault returns after resetting the control, replace A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-16. HIGH ENGINE TEMPERATURE WARNING (211) OR SHUTDOWN (212)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "HIGH COOLANT TEMP" warning (211) or shutdown (212) message.<br><br>Coolant mixture and level is normal.<br><br>No airflow obstructions.<br><br>Fan belt is OK. | 1. Engine problem:<br>• Coolant pump could be faulty.<br>• Thermostat could be faulty.<br>• There could be an obstruction in the coolant flow.<br>• External coolant pump (with remote radiator) could be faulty.<br>• External radiator fan motor (with remote radiator) could be faulty.<br>2. The generator set may have been overloaded.<br>3. Sender, harness or PCC circuit board could be bad. | 1. Refer to the engine service manual if there are any physical indications of overheating.<br>2. Correct any overload condition.<br>3. If there are no physical indications of overheating, check to see if the PCC accurately displays ambient engine temperature.<br>• If the PCC ambient coolant temperature reading is accurate, the engine may be overheating. Refer to the engine service manual.<br>• If the PCC ambient coolant temperature reading is not accurate, isolate to the sender, harness, engine interface board (A31), analog board, or digital board.<br>Disconnect the coolant temperature sender leads, and connect a coolant temperature sender simulator to the harness.<br>a. If the control responds to the simulator, replace the sender.<br>***b.** If the control does not respond to the simulator, install harness tool between A31 J5/P5. Connect the coolant temperature sender simulator (and B+) to A31 J5.<br>• If the control displays the correct simulated temperature, replace the harness.<br>• If the control does not display the correct simulated temperature, install harness tool at A31 J2/P2, and open lines 18/19 (and 14/15, if applicable). Check for continuity between A31 J2-18 to 19 (for coolant temp L), and A31 J2-14 to 15 (for coolant temp R).<br>• If no continuity, then A31 is bad.<br>• If continuity is OK, then send a simulated temperature signal and measure the voltage out of A31 (A31 J2-18 to 19, and A31 J2-14 to 15).<br>If voltage is not OK (refer to the analog board inputs and outputs, *Table 4-30*), replace A33.<br>If voltage is OK, refer to the analog/digital troubleshooting procedure (*Table 4-29a/b*). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-17. LOW COOLANT WARNING OR SHUTDOWN (214 / 215)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW COOLANT LVL" warning (214) or shutdown (215) message<br><br>Coolant level is normal.<br><br>DS2 on the engine interface board, A31, is on. | DS2 on A31 is on, indicating that A31 is receiving a low coolant signal from the sender.<br><br>The sender, the harness or the A31 circuit board could be bad. | If the coolant level is normal, isolate the source of the low coolant signal. (This is a ground signal.)<br><br>Disconnect the signal lead at the sender and reset the control.<br><br>1. If the 215 shutdown message drops out and does not reappear, replace the sender.<br>*****2. If the 215 shutdown message reappears and remains after control reset, disconnect J4/A31 and check continuity from P4–7 to GND.<br>• If there is continuity, replace the harness.<br>• If there is no continuity, replace circuit board A31. |
| "LOW COOLANT LVL" warning (214) or shutdown (215) message<br><br>Coolant level is normal.<br><br>DS2 on the engine interface board, A31, is off. | DS2 on A31 is off, indicating that A31 is not receiving a low coolant signal from the sender—but the 215 message indicates that A32, the digital board, is responding to a false low coolant signal.<br><br>A31, the engine interface board, or A32, the digital board, could be bad. | If the coolant level is normal, isolate the source of the low coolant signal.<br><br>Check J4–4/P4–4 on A32.<br><br>*****1. Install harness tool between A32 J4/P4.<br>2. Open the J4-4 circuit and reset the control.<br>• If the fault drops out and does not return, replace A31.<br>• If the fault returns after resetting the control, replace A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-18. MAG PICKUP SHUTDOWN (220)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "MAG PICKUP" shutdown message (220) | This indicates that the PCC is not sensing the mag pickup signal, or the mag pickup frequency does not correspond (in proportion) to the genset output frequency. | |
| | 1. The PCC may not be set for the correct generator set. | 1. Check and correct setting if necessary. |
| | 2. Loose or damaged mag pickup wire. | 2. Inspect the wires, and repair or replace as necessary. |
| | 3. Damaged mag pickup (MPU). | *****3/4 To isolate the problem, reset the control and attempt to start the set in idle mode. |
| | 4. The harness, the engine interface board (A31), the analog board (A33) or the digital board (A32) could be bad. | a. If the engine displays a "FAIL TO CRANK" shutdown message, or if the engine starts and idles, but then shuts down on a MAG PICKUP fault, the MPU sender could be bad. Remove the MPU connectors and check for 3.5 to 15 VAC at the MPU while cranking.<br>• If no output, check for damage or debris. Also check for improper adjustment of the MPU. (Refer to *Section 5*.) If there is still no output, replace the MPU sender.<br>• If the MPU output is OK, install harness tool between A32 J4/P4. Check for MPU voltage at A32 J4-10 to 11, while cranking. If OK, replace A32. If not OK, use continuity checks to isolate to A31 or harness.<br>b. If the engine starts and idles, and does not display a fault, then there could be a frequency mismatch problem.<br>• Measure generator output frequency with a digital multimeter and compare to the frequency on the PCC display.<br>• 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<br>• If the multimeter and PCC frequencies do not match, there is a frequency sensing problem. Verify the accuracy of the PCC L1N voltage, and then refer to the analog/digital troubleshooting procedure (*Table 4-29a/b*). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-19. OVERSPEED SHUTDOWN (223)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OVERSPEED" shutdown message (223) | 1. The fuel control actuator is defective. | 1. Refer to CNGE *Operation and Maintenance Manual*. |
| | 2. The digital board (A32) could be bad. | *****2. Reset the control, and start the set while monitoring the PCC duty cycle display.<br>If the duty cycle goes high (above 40%) and the set shuts down on overspeed, replace A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-20. DC (BATTERY) WARNINGS (230, 231, 232)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW DC VOLTAGE" (230) or "WEAK BATTERY" (232), warning message. | 1. Weak or discharged battery. | 1. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). |
| | 2. Low electrolyte level in battery. | 2. Replenish electrolyte and recharge battery. |
| | 3. Battery connections loose or dirty. | 3. Clean and tighten or replace the battery cable connectors and cables at the battery and the set. |
| | 4. Insufficient battery charging voltage. | 4. Adjust charge rate of battery charging circuit, according to manufacturers instructions. |
| | 5. Engine DC alternator could be bad. | 5. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained. |
| | 6. If the batteries are OK, the problem may be the harness, the engine interface board (A31), the digital board (A32), or the analog board (A33). | *6. If the battery voltage, electrolyte, and connections are OK, check the battery voltage at A31 J5-17. If the voltage is not OK (same as battery voltage), disconnect J5 and isolate to the harness or A31.<br>If the voltage is OK, check battery voltage at A33 J1-31. If the voltage is not OK, replace A31. If the voltage at A33 J1-31 is OK, isolate to A33 or A32 using the analog input troubleshooting procedure (*Table 4-29a/b*). |
| "HIGH DC VOLTAGE" (231) warning message.<br><br>But battery voltage is OK. | 1. Excessive battery charging voltage. | 1. Adjust charge rate of battery charging circuit according to manufacturers instructions. |
| | 2. Engine DC alternator could be bad. | 2. Replace engine DC alternator if normal battery charging voltage (12 to 14 VDC) is not obtained. |
| | 3. If the battery voltage is OK, the problem may be the engine interface board (A31), the digital board (A32), or the analog board (A33). | *3. Check the battery voltage at A31 J5-17. If the voltage is not OK (same as battery voltage), disconnect J5 and isolate to the harness or A31.<br>If the voltage is OK, check battery voltage at A33 J1-31. If the voltage is not OK, replace A31. If the voltage at A33 J1-31 is OK, isolate to A33 or A32 using the analog input troubleshooting procedure (*Table 4-29a/b*). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-21. LOW FUEL –DAY WARNING (240)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW FUEL–DAY" warning message (240)<br><br>DS1 on the engine interface board, A31, is on. | DS1 on A31 is on, indicating that A31 is receiving a signal from the customer circuit.<br><br>The customer circuit, the harness or the A31 circuit board could be bad. | Isolate the source of the false signal.<br><br>Disconnect the signal lead at the sender and reset the control.<br><br>1. If the 240 message drops out and does not reappear, replace the sender.<br>*****2. If the 240 message reappears and remains after control reset, disconnect J4/A31 and check continuity from P4–14 to GND.<br>• If there is continuity, replace the harness.<br>• If there is no continuity, replace circuit board A31. |
| "LOW FUEL–DAY" warning message (240)<br><br>DS1 (A31) and DS13 (A34) are off. | DS1 on A31 is off, indicating that the PCC is not receiving a signal from the customer circuit—but the 240 message indicates that A32, the digital board, is responding to a false customer signal.<br><br>A31, the engine interface board, or A32, the digital board, could be bad. | Isolate the source of the false signal.<br><br>*****1. Install a breakout connector at A32 J4.<br>2. Open the J4-15 circuit and reset the control.<br>• If the fault drops out and does not return, replace A31.<br>• If the fault returns after resetting the control, go to step 3.<br>*****3. Install harness tool between A32 J2/P2.<br>4. Open the J2-19 circuit and reset the control.<br>• If the fault drops out and does not return, replace A31.<br>• If the fault returns after resetting the control, replace A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-22. LOW FUEL WARNING (241)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW FUEL" warning message (241)<br><br>DS13 on the customer interface board, A34, is on. | DS13 on A34 is on, indicating that A34 is receiving a signal from the customer circuit. If there is no actual fault, the problem may be a short to ground in the external wiring or a bad customer interface board (A34). | Isolate the source of the false signal.<br>Disconnect the signal lead near the control and reset the control.<br>1. If the 241 message drops out and does not reappear, there is a short to ground in the external wiring or a faulty sender.<br>*****2. If the 241 message reappears and remains after control reset, disconnect J1/A34 and check continuity from P1–5 to GND.<br>• If there is continuity, find and repair a short to ground in the external wiring.<br>• If there is no continuity, replace circuit board A34. |
| "LOW FUEL" warning message (241)<br><br>DS13 (A34) is off. | DS13 on A34 is off, indicating that the PCC is not receiving a signal from the customer circuit—but the 241 message indicates that A32, the digital board, is responding to a false low fuel signal.<br>A34, the customer interface board, or A32, the digital board, could be bad. | Isolate the source of the false signal.<br>*****1. Install harness tool between A32 J2/P2.<br>2. Open the J2-19 circuit and reset the control.<br>• If the fault drops out and does not return, replace A34.<br>• If the fault returns after resetting the control, replace A32. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-23. EEPROM ERROR SHUTDOWN (250) OR WARNING (251, 252)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "EEPROM ERROR" shutdown (250) message. | The EE memory on the digital board (A32) may be bad. | 1. Perform the initial start setup procedure. Turn the Run/Off/Auto switch to Off and reset the control. Simultaneously press the RESET, MENU, and PHASE SELECT keys to start the setup.<br>Select the correct values, save your choices, and attempt to start the set.<br>2. If the set shuts down on the same EEPROM ERROR message, replace the digital board (A32). |
| "EEPROM ERROR" warning (251) message. | The EE memory on the digital board (A32) may be bad. | 1. Perform the adjustment procedures (described in *Section 5*). Save the adjustments.<br>Reset the control. Shut off and restart the set.<br>2. If the control generates the same EEPROM ERROR message, perform the calibration procedures in *Section 5*.<br>Reset the control. Shut off and restart the set.<br>3. If the control generates the same EEPROM ERROR message, replace the digital board (A32). |
| "EEPROM ERROR" warning (252) message. | The EE memory on the digital board (A32) may be bad. | 1. If this message occurred during an adjustment, option selection, or calibration of the PCC, verify the values or choices selected and repeat the save operation.<br>Reset the control. Shut off and restart the set.<br>2. If the control generates the same EEPROM ERROR message, replace the digital board (A32). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-24. CUSTOMER FAULTS (260, 261, 262 or 263)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

<table>
<tr><th>Indicator(s)</th><th>Possible Cause</th><th>Corrective Action</th></tr>
<tr><td>“CUSTOMER FAULT (260, 261, 262 or 263) message.<br><br>And corresponding LED on customer interface board A34 is on.</td><td>If the corresponding LED on the customer interface board (A34) is on, then A34 is receiving a signal from the customer circuit.<br>If there is no actual fault, the problem may be a short to ground in the external wiring or a bad customer interface board (A34).</td><td>Isolate the source of the false signal.<br>Disconnect the signal lead near the control and reset the control.<br>1. If the message drops out, there is a short to ground in the external wiring.<br>2. If the message remains, replace A34.</td></tr>
<tr><td>“CUSTOMER FAULT (260, 261, 262 or 263) message.<br><br>And corresponding LED on customer interface board A34 is off.</td><td>If the corresponding LED on the customer interface board (A34) is off, then A34 is not receiving a signal from the customer circuit.<br>The message indicates that A32, the digital board, is responding to a false signal.<br>A34, the customer interface board, or A32, the digital board, could be bad.</td><td>Isolate the source of the false signal.<br>Check J2/P2 on A32.<br>*1. Install harness tool between A32 J2/P2.<br>2. Open the appropriate circuit J2-3, J2-24, J2-9, or J2-15 and reset the control.<br>• If the fault does not return, replace A34.<br>• If the fault reappears, replace A32.<br><br><table><tr><th>A 34 LED</th><th>A32 CONNECTOR</th><th>CUSTOMER FAULT #</th><th>FAULT CODE</th></tr><tr><td>DS4</td><td>J2-3</td><td>1</td><td>260</td></tr><tr><td>DS11</td><td>J2-24</td><td>2</td><td>261</td></tr><tr><td>DS15</td><td>J2-9</td><td>3</td><td>262</td></tr><tr><td>DS3</td><td>J2-15</td><td>4</td><td>263</td></tr></table></td></tr>
<tr><td colspan="3">*CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.</td></tr>
</table>

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-25a. HIGH AC VOLTAGE SHUTDOWN (301)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "HIGH AC VOLTAGE " shutdown (301) message. | 1. The problem may be in the PCC, the alternator, or the interconnection between them.<br><br>**Note 1: The PCC may indicate either a low AC Voltage or High AC Voltage shutdown due to the design of the logic in the control.**<br><br>**You must first determine if the output voltage the control sees is low or high.**<br><br>**Note 2: Residual voltage is normally 5 to 10% of nominal output voltage. For example, a genset with a 480 volt output, will have a residual voltage of 25 to 50 VAC at normal operating speed.** | 1. Set the display on the PCC to **GEN, VOLTS, L-N**.<br>a. Start the genset and observe the voltage displayed on the digital display.<br>b. If all phases of voltage are balanced and not zero, but lower than normal, the alternator and the input to the PCC are OK. The problem is in the excitation circuit for the alternator. Go to step 2.<br>c. If one or more phases of voltage are high or the voltages are unbalanced, the PCC is not measuring all phases of voltage and is responding to the low "average" of the three phases of voltage. Go to step 3. |
| **(Continued)** | 2. The problem may be the regulator module (A37), the engine interface board (A31), or the digital board (A32). | 2. With DC power to the PCC and with the set not running, check A31 DS9, the AVR duty cycle LED. this LED should be off. If it si on, go to step 2d.<br>Isolate the genset output from the load. Disconnect A37 J10, and place the set in Idle mode. In Idle mode the excitation circuit is disabled. Start the set and monitor the AC output voltage with a digital multimeter.<br>a. If output voltage is greater than residual (5% of normal output), go to step 3.<br>b. If output voltage stays at 0 (or residual), and DS2 on A37 is off, go to step 4.<br>c. If output voltage stays at 0 (or residual), and DS2 on A37 is on, look at DS9 on A31.<br>If DS9 on A31 is off, replace A37.<br>d. If DS9 on A31 is on, connect a breakout connector at A32 J4, and open J4-2.<br>If DS9 goes out, replace A32.<br>If DS9 stays on replace A31. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-25b. HIGH AC VOLTAGE SHUTDOWN (301)

***⚠WARNING*** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "HIGH AC VOLTAGE " shutdown (301) message. | 3. The problem may be the PT/CT module (A36) or the interconnecting wiring to the PT/CT module.<br>**NOTE:** To calculate the "expected A36 output" voltage range, do the following:<br>Determine the ratio between the measured voltage and the expected voltage. The output (18 VAC) of the PT/CT module will also be reduced by this ratio. | ***3. Before starting the generator set, disconnect the harness connector from the PT/CT module (A36) and connect the harness tool between A36 and its harness connector.<br>Check the output voltage at the alternator output terminals and record the voltages.<br>a. If the voltages are not balanced, go to step 5.<br>b. If the voltages are balanced, calculate the expected output voltage from the PT/C module (see **Note** to the left). Measure and record the outputs from A36 J8 pins 6–5, 4–3, and 2–1.<br>If the output voltage is proportional to the alternator output voltage the A36 module is OK. Go on to step 4.<br>If the voltages are not balanced, replace A36. |
| | 4. The problem may be in the customer interface board (A34) or the interconnecting wiring. | ***4. Disconnect the plugs in the following steps below with the set off then start the set in the idle mode, and measure voltages with a digital multimeter.<br>a. Disconnect J3/P3 (blue) and insert the harness tool. Check the voltage into the customer interface board with the harness tool at J3 terminals 4–6, 5–13, and 7–20. Remove the harness tool and reconnect J3 and P3. These voltages should be the same values measured in step 3b.<br>If the voltages are balanced, continue in this step. If the voltages are unbalanced, repair the harness between the A36 module and the A34 board.<br>b. Disconnect J5/P5 on the customer interface board and insert the harness tool. Check the voltage out of the customer interface board at J5 terminals 24–28, 26–28, and 30–28. These voltages should be the same values measured in step 3b.<br>If the voltages are balanced, go to step 5. If the voltages are unbalanced, replace the customer interface board. |
| **(Continued)** | | |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-25c. HIGH AC VOLTAGE SHUTDOWN (301)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "HIGH AC VOLTAGE " shutdown (301) message. | 5. The problem may be the analog board (A33).<br><br>**NOTE:** To determine the "3-phase ave" signal voltage range for **Step 3b**, use the following formula:<br><br>**$V_{out}$ 3-phase ave = $V_{in}$ (2.9÷PT) ±5%**<br><br>$V_{in}$ = Actual generator output voltage (phase-to-neutral)<br>PT = PT primary (120, 240 or 346) | *****5. Using the harness tool, check the "3-phase ave" signal at A33 J2-18.<br>If the voltage is within the expected range, replace A32. If the voltage is not within the expected range, replace A33. See **Note**. |
| | 6. The problem may be in the generator set itself. | 6. Refer to the generator servicing procedures in *Section 6*. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document, by any means, is strictly prohibited.

## TABLE 4-26a. LOW AC VOLTAGE SHUTDOWN (303)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW AC VOLTAGE " shutdown (303) message. | 1. PMG or field wiring could be faulty. | 1. If output voltage is low and both A37/DS2 and A31/DS10 are on, check and repair the PMG or field wiring. |
| | 2. The rotating rectifier assembly (diodes CR1 through CR6) is faulty. | 2. Check each diode according to *Servicing the Generator* in *Section 6*. Service as necessary. |
| | 3. Overload. | 3. Check the load and correct any overload. |
| | 4. There may be a loose connector in the control loop. | 4. Check connectors J8 and J9 on A36, J3 and J5 on A34, and J7 on A37. |
| | | *****5. Isolate the genset output from the load. Reset the control, restart the set, and measure AC output voltage with a multimeter. |
| | 5a. The problem may be the analog board (A33) or the digital board (A32). | a. If output voltage is high, refer to the troubleshooting section for High AC Voltage Shutdown (301).<br>If output voltage is normal, the problem must be in the voltage sensing circuitry (A32 or A33). |
| | 5b. The problem may be the regulator module (A37), the engine interface board (A31), or the digital board (A32). | Isolate, using the analog input troubleshooting procedure (*Table 4-29a/b*). Check the phase that shows a low voltage on the PCC display.<br>*****b. If output voltage is low, the control cannot drive the output voltage high enough. The problem could be A37, A31, or A32. Restart the set and monitor isolated B+ supply LED A37/DS1, output duty cycle LED A37/DS2, and AVR duty cycle LED A31/DS10.<br>• If A37/DS1 is not on, disconnect A3 J7/P7 and check for B+ at P7-1. (Control must be in Run mode for B+ reading.)<br>• If B+ is OK to A37, replace A37.<br>• If A37/DS1 is on, check A31/DS10 (with the set running).<br>• If A31/DS10 is not on with set running, check for continuity: A31 J1-2 to J4-10 and A31 J1-1 to J4-11 (270 ohms). If no continuity, replace A31.<br>• If A31is OK, replace A32.<br>• If A31/DS10 is on with set running and A37/DS2 is not on, check the harness.<br>• If the harness is OK, replace A37. |
| **(Continued)** | | |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document, by any means, is strictly prohibited.

## TABLE 4-26b. LOW AC VOLTAGE SHUTDOWN (303)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "LOW AC VOLTAGE " shutdown (303) message. | 5c. The problem may be the PT/CT module (A36), the analog board (A33), the customer interface board (A34), or the digital board (A32). | c. If the measured AC voltage is high, the control must have lost AC sensing. Check PTs (primary 1K–2.5K ohms; secondary 140–225 ohms), sensing harness wires, generator output connections, and the customer interface board for continuity. If these are OK, then check the analog and digital boards, using the analog input troubleshooting procedure (*Table 4-29a/b*). |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-27. UNDER FREQUENCY SHUTDOWN (313)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "UNDER FREQUENCY" shutdown (313) message. | 1. Improper setup. | 1. Check Initial Setup (set size) and correct, if necessary. |
| | 2. Overload. | 2. Check the load and correct any overload, if necessary.<br>Disconnect the load. Reset the control and attempt to restart the generator set. |
| | 3. Fuel or air delivery problem. | 3. If the engine starts and runs, refer to the engine fuel/air delivery service procedures. |
| | 4. The fuel control actuator, the digital board (A32), or the engine interface board (A31) could be bad. | *4. Crank the set, and check the governor duty cycle on the PCC display. If the duty cycle is OK (70% max), replace the fuel control actuator.<br>If the duty cycle is not OK, the digital board (A32) or the engine interface board (A31) may be bad.<br>• A31 - Check for continuity: A31 J1-13 to A31 J4-19 and A31 J1-14 to A31 J4-12. If no continuity, replace A31.<br>• A32 - If A31 is OK, replace A32 |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-28. OVERCURRENT WARNING (320) OR SHUTDOWN (321), SHORT CIRCUIT SHUTDOWN (322), OR OVERLOAD WARNING (330)

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

| Indicator(s) | Possible Cause | Corrective Action |
|---|---|---|
| "OVER-CURRENT" warning (320) or shutdown (321), or "SHORT CIRCUIT" shutdown (322), or OVERLOAD warning (330) message. | 1. Short or Overload. | 1. Check the load and load cables. Repair if necessary. |
| | 2. Incorrect CTs or CT connections. | 2. Check CTs and CT connections. Correct if necessary. Refer to *Current Transformer Installation* in *Section 5*. |
| | 3. The problem may be a bad PT/CT module (A36). | 3. Disconnect the PT/CT module and check the 3-ohm resistors (J8-15 to 14, J8-22 to 23, J8-7 to 8). Replace the module if necessary. |
| | 4. The problem may be the customer interface board (A34) or connections. | *****4. Check continuity from A36—through A34—to A33. Repair the connection or replace A34 if necessary. Refer to *Section 8* for pin reference. |
| | 5. The problem may be the analog board (A33) or the digital board (A32). | 5. Isolate, using the analog input troubleshooting procedure (*Table 4-29a/b*). Check the bad phase or phases. |

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-29a. TROUBLESHOOTING ANALOG SIGNALS BETWEEN ANALOG AND DIGITAL BOARDS

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

**NOTE: Perform this procedure after you have isolated the problem to either the analog board (A33) or to the digital board (A32). You must have schematics and wiring diagrams to identify the various inputs and outputs.**

*****1. Check that the input to the analog board is correct. There are a few signals (e.g.: 3PH Ave, Line Freq, Phase Angle 1 to 3, Lead Lag) that are derived from one or more input signals.

1a. To check the sensor input voltages into the analog board, connect the sender simulator and test the voltage across the + and – inputs at A33 J1 using harness tool. (This assumes that you have verified that the harness and the engine interface board is good.)

- If the input voltage to the analog board is correct (refer to Table 4-30), go to step 2.
- If the input voltage to the analog board is incorrect, check for 12 VDC at A32 J3-20 and 5 VDC at A32 J3-12. Do this with the analog board connected to the digital (A32).

  If the 12 VDC and 5 VDC voltages are OK, replace the analog board.

  If the 12 VDC and 5 VDC voltages are not OK, disconnect A32 J3 and recheck for 12 VDC at A32 J3-20 and 5 VDC at A32 J3-12.

  If the 12 VDC and 5 VDC voltages are now OK, replace the analog board.

  If the 12 VDC and 5 VDC voltages are still not OK, replace the digital board.

1b. To check the AC inputs into the analog board, drive the PT/CT inputs (voltage or current) and verify that the input is correct.

- If the input to the analog board is correct, go to step 2.
- If the input to the analog board is incorrect, disconnect the ribbon cable at A34 J5 and check the voltage at A34 J5 again (Customer Interface).

  If the voltage is now correct, replace the analog board.

  If the voltage is still not correct, the problem is not on the analog or digital boards.

2. If the input to the analog board is correct, determine whether the signal is multiplexed (refer to Table 4-30). If the signal is not multiplexed, go to step 2a. If the signal is multiplexed, go to step 2b.

2a. This step is for non-multiplexed AC signals. Drive the input to the analog board with an AC source, and test the signal level out of the analog board. You must calculate what the analog output voltage should be (Table 4-30), assuming the analog board transfer function is linear.

- If the signal level into the digital board is correct, the problem must be on the digital board. Replace the digital board.
- If the signal level into the digital board is incorrect, remove the ribbon cable connector at A32 J3, and check the front panel digital display of the bad analog value.

  If the display reads 0, replace the analog board.

  If the display reads a value other than 0, replace the digital board.

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4-29b. TROUBLESHOOTING ANALOG SIGNALS BETWEEN ANALOG AND DIGITAL BOARDS

**⚠WARNING** ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv.***

**NOTE: Perform this procedure after you have isolated the problem to either the analog board (A33) or to the digital board (A32). You must have schematics and wiring diagrams to identify the various inputs and outputs.**

2b. This step is for multiplexed signals. Is more than one multiplexed signal reading bad?

- No. If the input to the analog board is correct and only one multiplexed signal is reading bad, replace the analog board.
- Yes. If more than one multiplexed signal reading is bad, remove the ribbon cable connector at A32 J3 and check the front panel digital display of the bad inputs. It should read 0 for all inputs except the temperature inputs (which should read less than 32° F or less than 0° C) and power factor (which should read “NA”).

  If any values read incorrectly, replace the digital board.

  If they all read correctly, measure voltages on the multiplexer control lines (with A32-J3 disconnected, measure from Digital board connector J3). Voltages should be:

  A32-J3-23: 3.0 ±0.25 VDC
  A32-J3-24: 2.4 ±0.25 VDC
  A32-J3-27: 1.4 ±0.25 VDC
  A32-J3-33: 3.0 ±0.25 VDC
  A32-J3-34: 3.0 ±0.25 VDC

  If these control (select) line voltages are not correct, replace the digital board.

  If these control (select) line voltages are correct (and the input to the analog board is correct), reconnect the ribbon cable connector (through harness tool) at A32 J3 and check the 5 VDC reference at A32 J3-12 and the 12 VDC supply at A32 J3-20.

  If the 5 VDC and the 12 VDC voltages are OK, replace the analog board.

  If the 5 VDC and the 12 VDC voltages are not OK, disconnect A32 J3 and check the voltages again (measured from Digital board side).

  If the 5 VDC and the 12 VDC voltages are OK with A32 J3 disconnected, replace the analog board.

  If the 5 VDC and the 12 VDC voltages are not OK with A32 J3 disconnected, replace the digital board.

***CAUTION: Wearing wrist strap, set S12 to Off and A32 S5 to Standby before connecting/disconnecting harness plugs.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## TABLE 4–30. ANALOG CIRCUIT BOARD (A33) INPUTS AND OUTPUTS

| Input Name | Input Connection | Input Signal Range | Output Name[1] | Output Connection[2] | Output Signal Range |
|---|---|---|---|---|---|
| L1 (0 to nominal) | J4-24 to J4-28 | 0 to 18 VAC | L10 (ACH1) | J2-4 | 0 to 3.0 VDC |
| L2 (0 to nominal) | J4-26 to J4-28 | 0 to 18 VAC | L20 (ACH2) | J2-13 | 0 to 3.0 VDC |
| L3 (0 to nominal) | J4-30 to J4-28 | 0 to 18 VAC | L30 (ACH3) | J2-1 | 0 to 3.0 VDC |
| | | | 3PH ave (ACH0) | J2-18 | 0 to 2.9 VDC |
| | | | Line freq. (HSI.1) | J2-21 | 0-5V sq wave @ L1 Hz |
| CT21 (0 to full load) | J4-33 to J4-34 | 0 to 1.65 VAC | C1 fltrd (ACH4) | J2-3 | 0 to 1.0 VDC |
| CT22 (0 to full load) | J4-32 to J4-34 | 0 to 1.65 VAC | C2 fltrd (ACH5) | J2-9 | 0 to 1.0 VDC |
| CT23 (0 to full load) | J4-31 to J4-34 | 0 to 1.65 VAC | C3 fltrd (ACH6) | J2-17 | 0 to 1.0 VDC |
| | | | C1 (ACH7) | J2-7 | 0 to 1.0 VDC |
| | | | C2 (ACH7) | J2-7 | 0 to 1.0 VDC |
| | | | C3 (ACH7) | J2-7 | 0 to 1.0 VDC |
| (1 to 0.8 pf) | | | Phase angle 1 (ACH7)[3] | J2-7 | 0 to 1.0 VDC |
| (1 to 0.8 pf) | | | Phase angle 2 (ACH7)[3] | J2-7 | 0 to 1.0 VDC |
| (1 to 0.8 pf) | | | Phase angle 3 (ACH7)[3] | J2-7 | 0 to 1.0 VDC |
| (L1 vs CT21) | | | Lead lag (P2A.1)) [3] | J2-29 | 0 or 5 VDC (digital) |
| Bus L1 (0 to nominal) [6] | J4-15 to J4-18 | 0 to 18 VAC | Bus L1 (ACH7) | J2-7 | 0 to 3.0 VDC |
| Bus L2 (0 to nominal) [6] | J4-16 to J4-18 | 0 to 18 VAC | Bus L2 (ACH7) | J2-7 | 0 to 3.0 VDC |
| Bus L3 (0 to nominal) [6] | J4-17 to J4-18 | 0 to 18 VAC | Bus L3 (ACH7) | J2-7 | 0 to 3.0 VDC |
| | | | Bus freq (HS1.3) | J2-22 | 0-5V sq wave @ Bus L1 Hz |
| | | | Phase rot (P2A.0)[5] | J2-26 | 0 or 5 VDC (digital) |
| | | | Bus/gen phase dif (ACH7)[5] | J2-7 | 0 to 5.0 VDC |
| | | | Bus/gen phase (HS1.2)[5] | J2-19 | 0-5V 120 Hz 0 to 100% DC |
| | | | Synch (ACH7)[5] | J2-7 | |
| Battery voltage | J1-31 (+) to J1-30(–) | 0 to 32 VDC | Battery voltage (ACH7) | J2-7 | 0 to 2.9 VDC |
| Oil press (0 to 100 psi) | (See note [4] ) | 0.5 to 4.5 VDC | Oil press (ACH7) | J2-7 | 0.5 to 4.5 VDC |
| $H_2O$ 1 (6 to 230° F) | J1-19/20 to J1-17/18 | 700 to 1800 Ω | $H_2O$ 1 (ACH7) | J2-7 | 1.4 to 3.7 VDC |
| $H_2O$ 2 (6 to 230° F) | J1-15/16 to J1-14/15 | 700 to 1800 Ω | $H_2O$ 2 (ACH7) | J2-7 | 1.4 to 3.7 VDC |
| Oil temp (6 to 230° F) | J1-11/12 to J1-9/10 | 700 to 1800 Ω | Oil temp (ACH7) | J2-7 | 1.4 to 3.7 VDC |
| Exh temp 1 (32 to 1471° F) | J1-7/8 to J1-5/6 | 100 to 376 Ω | Exh temp 1 (ACH7) | J2-7 | 0.8 to 3.0 VDC |
| Exh temp 2 (32 to 1471° F) | J1-3/4 to J1-1/2 | 100 to 376 Ω | Exh temp 2 (ACH7) | J2-7 | 0.8 to 3.0 VDC |

Notes:

1. All output signals on ACH7 are multiplexed.
2. All output voltages on A33 J2 are referenced to ground (J2-15 and J2-16).
3. Must have L1, L2, L3, CT21, CT22, and CT23 for these phase angle outputs.
4. J1-24 (5VDC), J1-23 (signal), J1-18 (return).
5. Must have L1, L2, L3, Bus L1, Bus L2, and Bus L3 for these outputs.
6. L1, L2, and L3 can be 0 to 180° out of phase with Bus L1, Bus L2, and Bus L3, respectively.

Redistribution or publication of this document,
by any means, is strictly prohibited.

**TABLE 4-31. PCC FUSES**

| LOCATION | REFERENCE DESIGNATION | RATING | FUNCTION |
|---|---|---|---|
| Engine Interface | A31-F1 | 5 Amp | PCC control B+ |
| Engine Interface | A31-F3 | 5 Amp | Auxiliary B+ (for panel lights, run and start relays) |
| TB-Bat (Engine Harness Assembly | F1 | 20 Amp | Customer B+ (to TB1 customer terminal block) |
| Accessory Box (Engine Harness Assembly) | F2 | 10 Amps | Network B+ (to TB1 customer terminal block) |
| Accessory Box (Engine-Harness Assembly) | F3 | 10 Amp | Switched B+ (to TB1 customer terminal block) |

Redistribution or publication of this document,
by any means, is strictly prohibited.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 5. Control Service and Calibration

## GENERAL

This section contains circuit board removal and replacement procedures, calibration procedures for the genset control and test procedures for the generator and engine components. Refer to the figures included with this information and also the *Wiring Diagrams* section when instructed.

**Before servicing the PCC, it is recommended that all settings be recorded. This will make sure of correct and complete readjustment of the PCC in the event that all previous entries are lost during servicing.**

## CIRCUIT BOARD REMOVAL/REPLACEMENT

No special tools (other than a grounding wrist strap) are required to remove a circuit board from inside the control panel or the accessory box.

There are several circuit boards, that when replaced, require you to recalibrate the control panel functions. Table 5-1 lists the circuit boards and the appropriate procedure to perform to recalibrate the control panel. The circuit board locations are shown in Figure 5-1.

Before you attempt to remove a circuit board, read the *Circuit Board Removal Safety Precautions* in this section.

**TABLE 5-1. CONTROL PANEL RECALIBRATION**

| CIRCUIT BOARD | ADJUSTMENT | PROCEDURE / PAGE |
|---|---|---|
| Analog Board (A33) | 1. Voltage, Current and PF.<br>2. Coolant Temperature L & R | *Setup and Calibration Menus* (Page 5-8) |
| Digital Board (A32) | Must recalibrate all values, starting with the *Initial Start Setup* procedure. | 1. *Initial Start Setup* (Page 5-4).<br>2. *Adjust Menu* (Page 5-6).<br>3. *Setup and Calibration Menus* (Page 5-8). |
| PT/CT Board (A36) | Voltage, Current and PF. | *Setup and Calibration Menus* (Page 5-8) |

Redistribution or publication of this document,
by any means, is strictly prohibited.

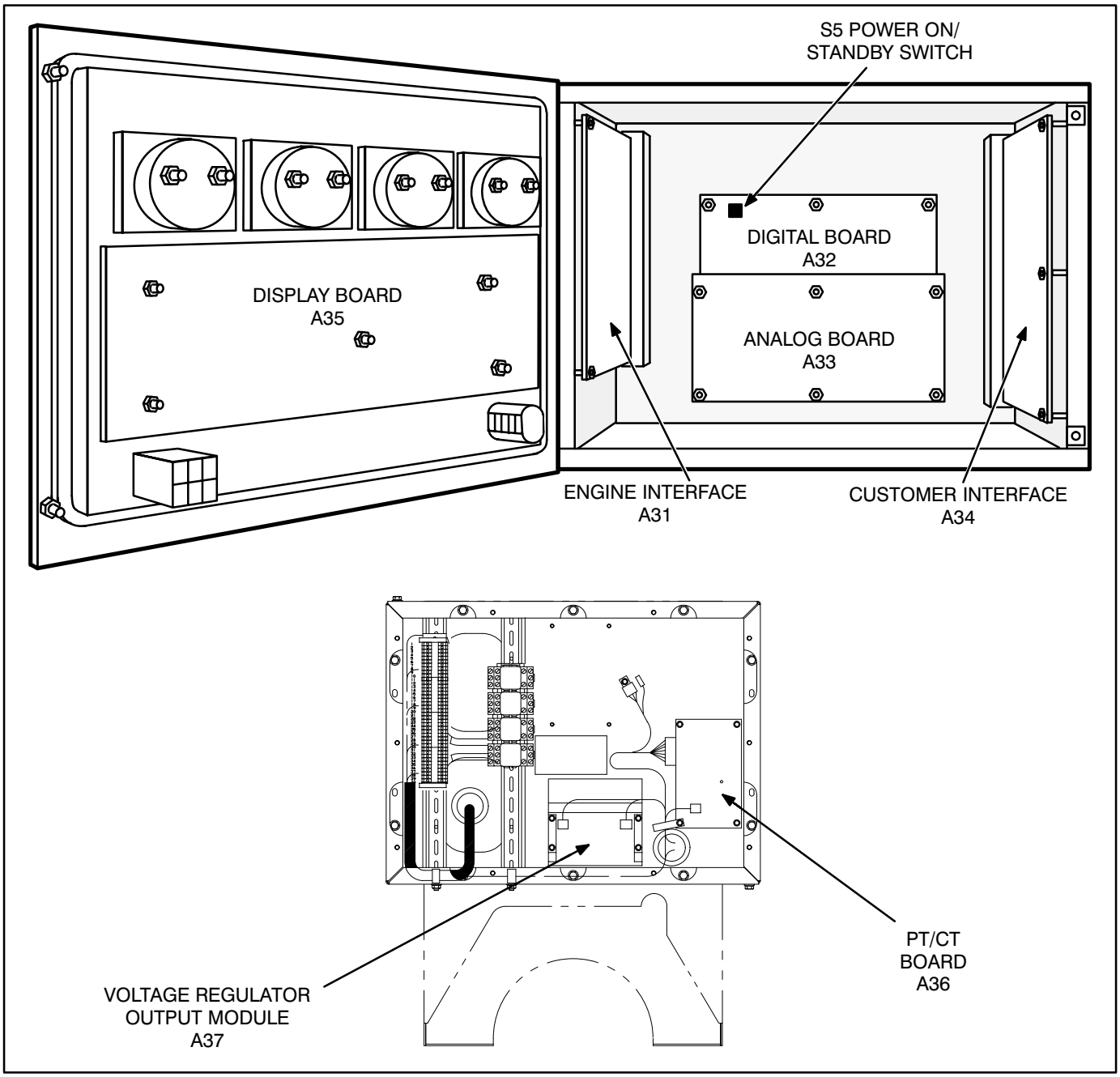



**FIGURE 5-1. CIRCUIT BOARD LOCATIONS**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## 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 a non -painted surface of 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.

⚠ **CAUTION** ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

⚠ **WARNING** ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

***Make certain battery area has been well-ventilated before servicing battery. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when cable is removed or re-attached, or when negative (–) battery cable is connected and a tool used to connect or disconnect positive (+) battery cable touches frame or other grounded metal part of the set. Always remove negative (–) cable first, and reconnect it last. Make certain hydrogen from battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if battery has been connected to battery charger.***

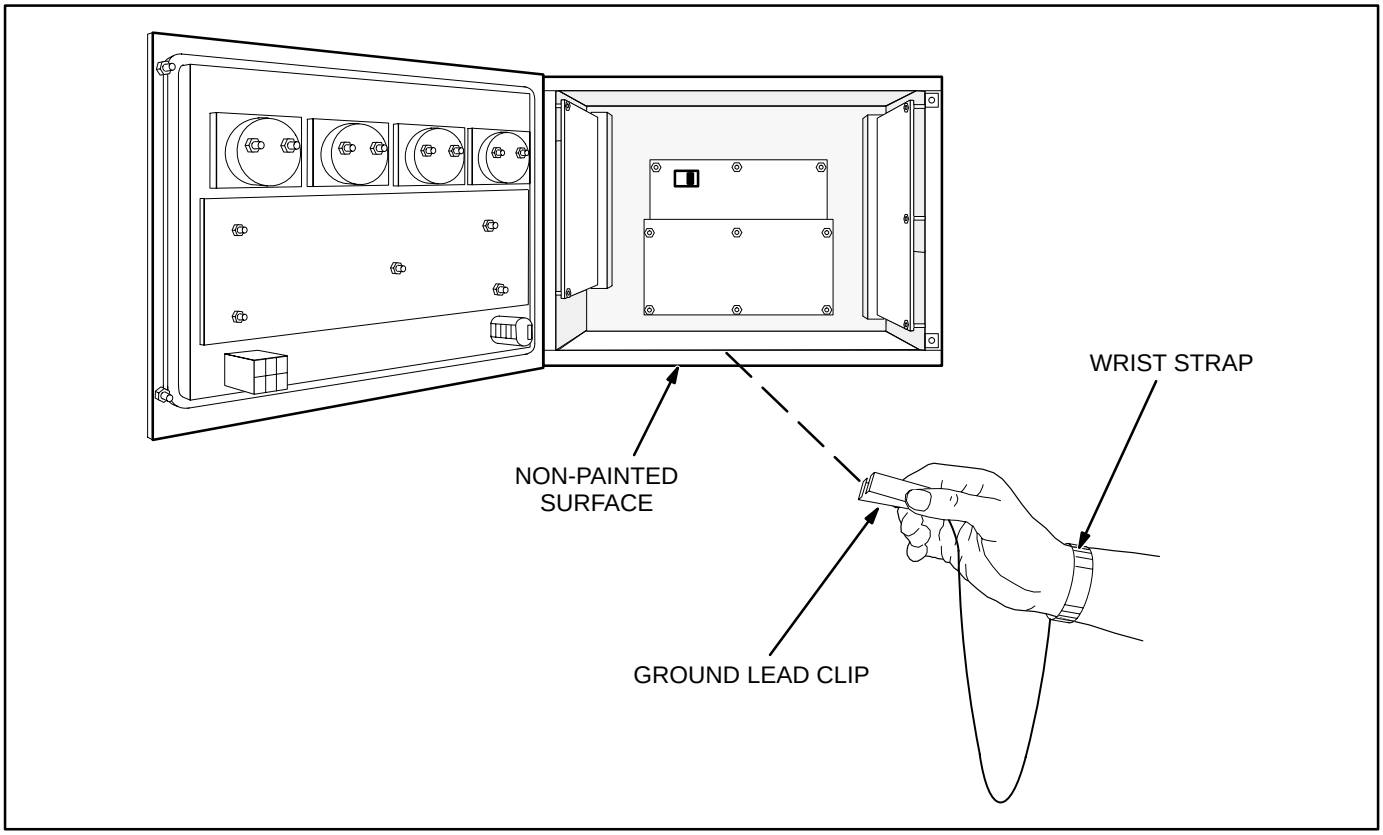



**FIGURE 5-2. WRIST STRAP**

Redistribution or publication of this document, by any means, is strictly prohibited.

## INITIAL START SETUP MENU

The facing page shows a block representation of the INITIAL START SETUP menu.

**⚠ CAUTION** ***Selecting this menu resets all operating parameters to the default values for the selected set. All previously selected setup and adjustment settings will be lost. Therefore, this procedure must be performed by technically qualified personnel only.***

This menu appears on the digital display when the PCC has not been set up for use with a generator set during factory test, or the digital board was replaced in the PCC.

When this display is showing, you must go through the Initial Start Setup menu to select the operating parameters for the generator set. These include whether the set will be used for Prime Power or Standby use, the Model Number of the generator set, and its operating frequency and output voltage. These choices must be saved into the PCC's read-only memory before the PCC will accept changes made to other menus.

**If the PCC is already set up to operate with a specific generator set, this menu will not appear when power is applied. To reset the control and display the Initial Start Setup menu, you can press RESET, MENU, and PHASE SELECT buttons at the same time.**

**If you choose to do this, the governor/regulator adjustments and the setup options will be reset to the default settings (including the editable customer fault messages). Display calibrations (volts, amps, PF and coolant temperature) are retained (not reset). Before you perform the reset function, it is recommended that all settings be recorded. This will make sure of correct and complete readjustment of the PCC.**

**⚠ CAUTION** ***Improper setup, calibration, or adjustments can cause equipment malfunction or damage. Setup, calibration, and adjustment must be performed by technically qualified personnel only.***

***STANDBY/PRIME submenu:*** Use the buttons next to the "⇑⇓" symbols to toggle the standby/prime option. Press the button next to the ">>" in the display to move to the model select submenu.

***MODEL select submenu:*** Use the buttons next to the "⇑" and "⇓" symbols to select the correct generator set model number, frequency and power rating.

***VOLTAGE SELECT submenu:*** Use the buttons next to the "⇑" and "⇓" symbols to select the correct generator set nominal line-to-line output voltage.

**1/3 PHASE submenu:** Use the buttons next to the "⇑" and "⇓" symbols to select the single (1) or three (3) phase option.

**GENERATOR F/S:** Use the buttons next to the "⇑" and "⇓" symbols to select single phase full output (F) or single phase standard output (S) option.

**To achieve full output at single phase, the genset must be equipped with either a three phase extended stack alternator (full single phase output) or a single phase four lead alternator.**

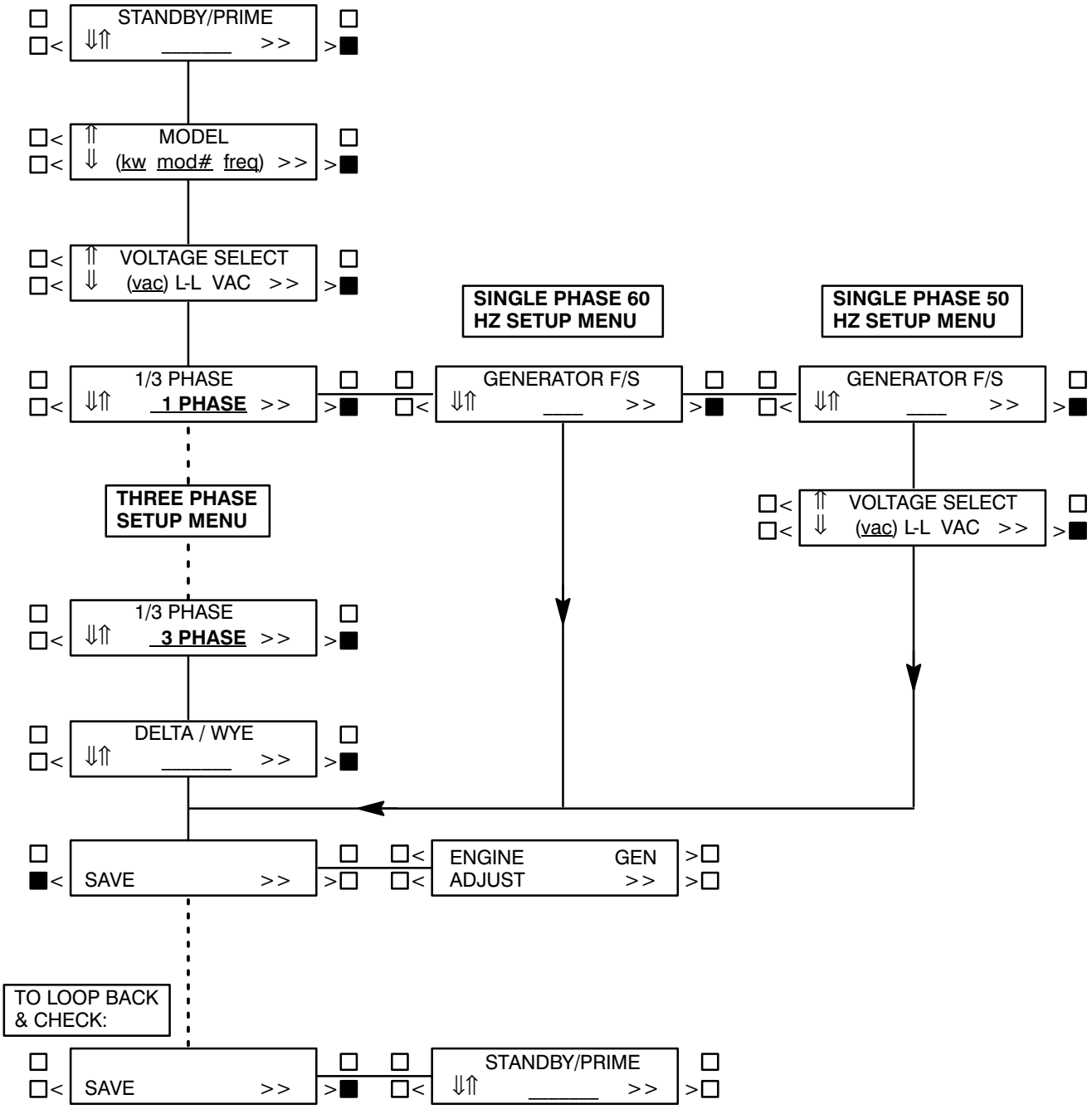
***DELTA / WYE submenu:*** Use the buttons next to the "⇑" and "⇓" symbols to select the delta or wye option.

***SAVE submenu:*** From the model select submenu, press the button next to the ">>" in the display to move to the SAVE submenu. Select SAVE to save your changes. The MAIN MENU will then be displayed.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# INITIAL START SETUP

(It can be invoked by simultaneously pressing the Reset, Menu, and Phase Select keys.)




Redistribution or publication of this document, by any means, is strictly prohibited.

## ADJUST MENU

The ADJUST submenus permit adjustment of the output voltage and frequency and the start and stop delay times of the generator set.

**The complete calibration procedure is described in the *Calibration Procedure* in this section.**

The facing page shows a block representation of the ADJUST menu. If you press the button next to the word “ADJUST” in the Main menu, the VOLTAGE ADJUST submenu will appear.

As shown in the diagram, the ADJUST menu has five submenus, including a save/exit procedure.

**Voltage and frequency can be adjusted only when the generator set is running under normal operating parameters (not in idle mode). For example, if voltage adjustment is selected when the set is in Idle mode or not running, the digital display will be:**

| | |
|---|---|
| “⇑ | VOLTAGE ” |
| “⇓ | N/A >>” |

***VOLTAGE submenu:*** This is the first submenu. Use the buttons next to the “⇑” and “⇓” symbols to adjust output voltage ± 5%.

***FREQUENCY submenu:*** From the VOLTAGE submenu, press the button next to the “>>” in the display to move to the FREQUENCY submenu. Use the buttons next to the “⇑” and “⇓” symbols to adjust output frequency ± 5%.

***START DELAY submenu:*** This delay applies only to remote starting in the Auto mode. From the FREQUENCY submenu, press the button next to the “>>” in the display to move to the START DELAY submenu. Use the buttons next to the “⇑” and “⇓” symbols to set the start delay. The start delay adjustment range is 0 to 300 seconds.

***STOP DELAY submenu:*** This delay applies only to remote stopping in the Auto mode. From the START DELAY submenu, press the button next to the “>>” in the display to move to the STOP DELAY submenu. Use the buttons next to the “⇑” and “⇓” symbols to set the stop delay. The stop delay adjustment range is 0 to 600 seconds.

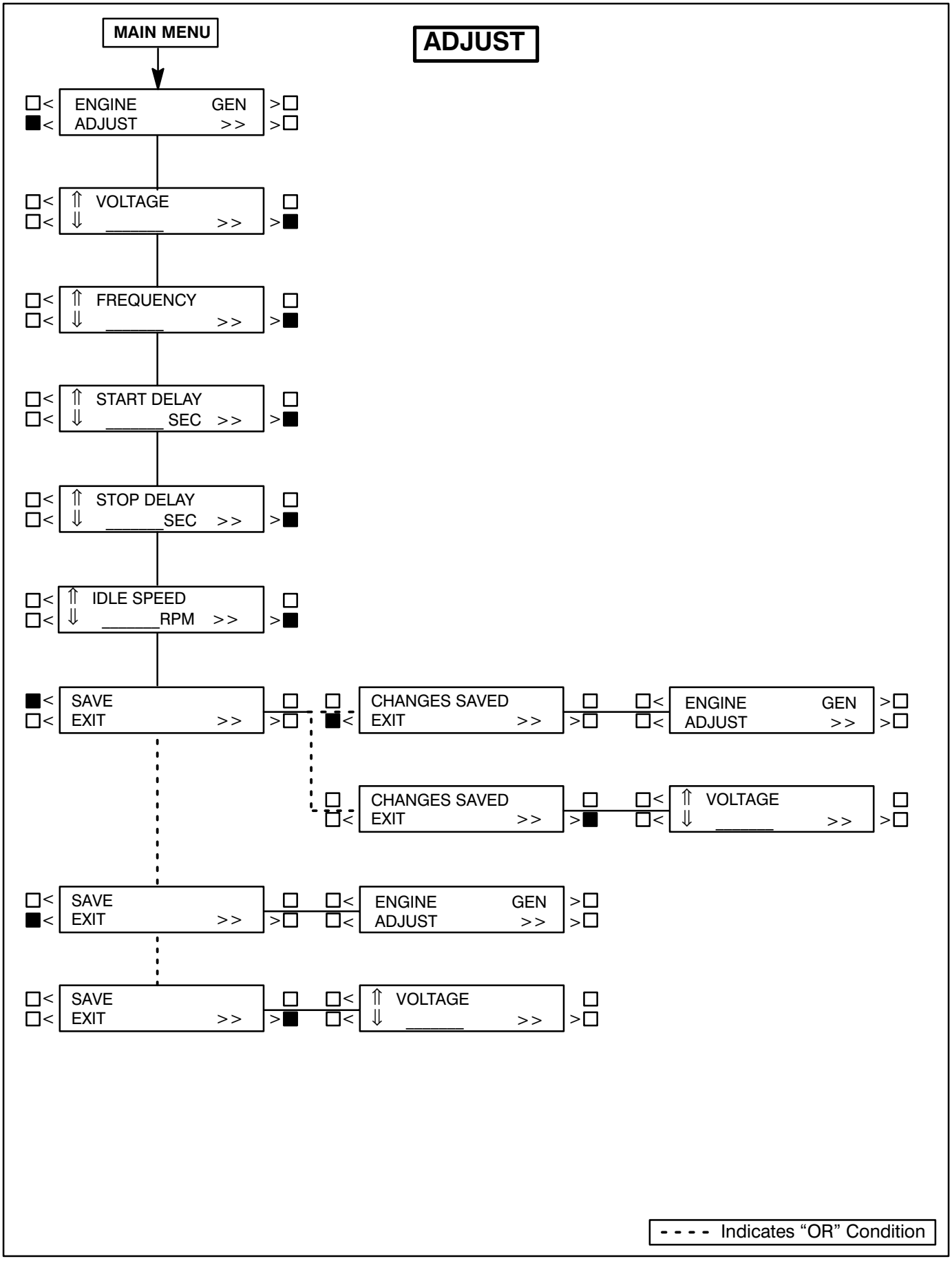
***IDLE SPEED submenu:*** From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the IDLE SPEED submenu. Use the buttons next to the “⇑” and “⇓” symbols to set the idle speed. The idle speed adjustment range is 800 RPM ±100 RPM. (Default value is 800 RPM.)

**The idle speed can be adjusted only when the generator set is running in the idle mode. When not in idle mode, N/A is displayed in RPM field.**

***SAVE/EXIT submenu:*** From the STOP DELAY submenu, press the button next to the “>>” in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the main menu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down, but will be reset (and will not be in effect) when the set is restarted.**

Redistribution or publication of this document,
by any means, is strictly prohibited.




Redistribution or publication of this document,
by any means, is strictly prohibited.

## SETUP AND CALIBRATION MENUS

The setup and calibration menus allow you to calibrate the PCC with the reading from a calibrated meter. There are four setup and calibration menus that are selectable from the SETUP/CAL menu:

- VERSION AND DISPLAYS
- METERS
- GOVERNOR/REGULATOR
- SETUP

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

***ENTER CODE submenu:***

The access code for your PCC is: **5 7 4**.

To enter the code:

1. Press the button next to the "⇑" to increment the first digit.
2. Press the button next to the ">>" to select the second digit.
3. Press the button next to the "⇑" to increment the second digit.
4. Press the button next to the ">>" to select the third digit.
5. Press the button next to the "⇑" to increment the third digit.
6. Press the button next to the ">>" to proceed to the DISPLAYS/METERS submenu. (Provided, of course, that you have correctly entered the access code.)

The following sub-sections describe how to select and make changes to the setup and calibration menus and save the changes made to these menus.

### Version and Displays Menus

The VERSION menu allows you to verify the model number and frequency of the generator set, the date and version of the operating software and generator set configuration options. From the VERSION menu you can also review a History file, that can contain up to 20 error messages.

The DISPLAYS submenus permit calibration of the digital voltage, current, power factor (PF) and coolant temperature displays. Calibration is accomplished by using this section of the menu software to adjust the display so that it matches the reading taken on an accurate, recently calibrated meter.

**The complete calibration procedure is described in the *Calibration Procedure* in this section.**

The facing page shows a block representation of the VERSION and DISPLAYS submenus, which is the first of four SETUP/CAL menus. If you press the button next to the ">>" in the Main menu display, the VERSION/SETUP/CAL menu will appear.

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

***VERSION submenu:*** If you select VERSION, the display will show the generator set model number, frequency, and kW rating, and the date and version of the operating software.

To display the generator set configuration options, press the button next to the ">>" in the submenu that displays the model number, frequency and etc. This menu provides the following information:

- Generator set voltage
- WYE or DELTA
- Standby or Prime
- Parallel or Single

***HISTORY:*** From the VERSION, SETUP/CAL menu, press the button next to the ">>" in the display to move to the HISTORY submenu. Press the button next to "HISTORY" to display the last (latest) recorded error message.

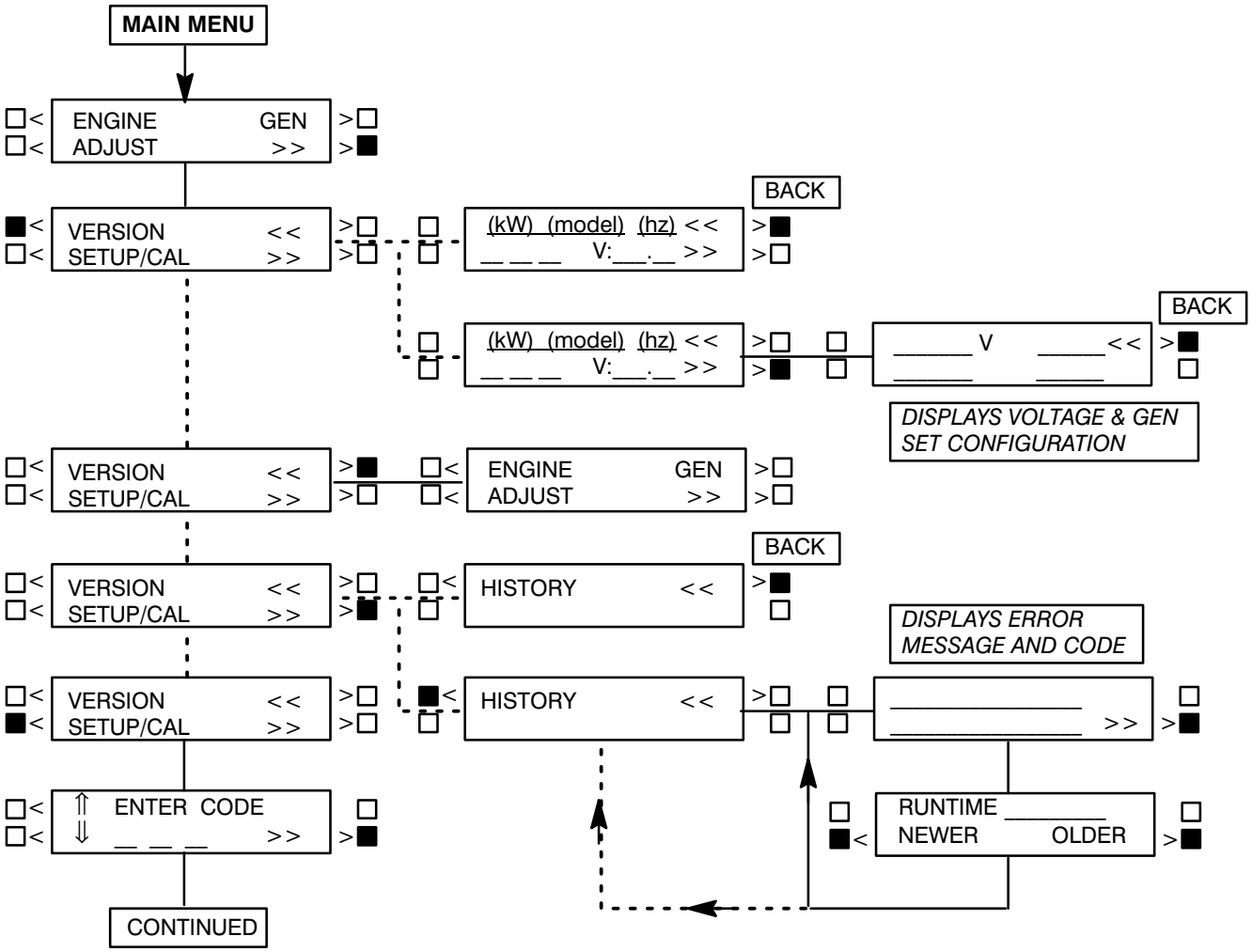
The software will record (save) up to 20 error messages. The last error detected will always be displayed first. As each new error is detected, the oldest error recorded after 20 will be deleted.

To view the generator set runtime at which the error occurred and to scroll through the remaining recorded errors, press the button next to the ">>" in the error message menu to display the RUNTIME, NEWER/OLDER menu.

The buttons next to NEWER and OLDER are used to scroll up and down through the error messages. For example, pressing OLDER will display the next oldest recorded error message. When pressing NEWER and the last (newest) error message is displayed, or OLDER and oldest error is displayed, the display will return to the HISTORY menu.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# VERSION & DISPLAYS MENUS




- - - - Indicates “OR” Condition

Redistribution or publication of this document,
by any means, is strictly prohibited.

## Version and Displays Menus (Cont.)

***DISPLAYS submenus:*** The DISPLAYS submenus are intended for qualified service personnel only. For this reason, a three-digit access code must be entered before you can proceed to those menus.

Select SETUP/CAL. The display will show the ENTER CODE submenu. Enter access code (574) as previously described in this section.

Select DISPLAYS to proceed to the DISPLAYS submenus. Use the buttons next to the "⇑" and "⇓" symbols to calibrate the selected voltage, current, PF or coolant temperature reading. Press the button next to the ">>" in the display to move to the next adjustment.

"VOLTS L12," "VOLTS L23," and "VOLTS L31" refer to voltages measured from L1 to L2, L2 to L3, and L3 to L1, respectively.

"PF1, PF2 and PF3" will display N/A when the generator set is not running.

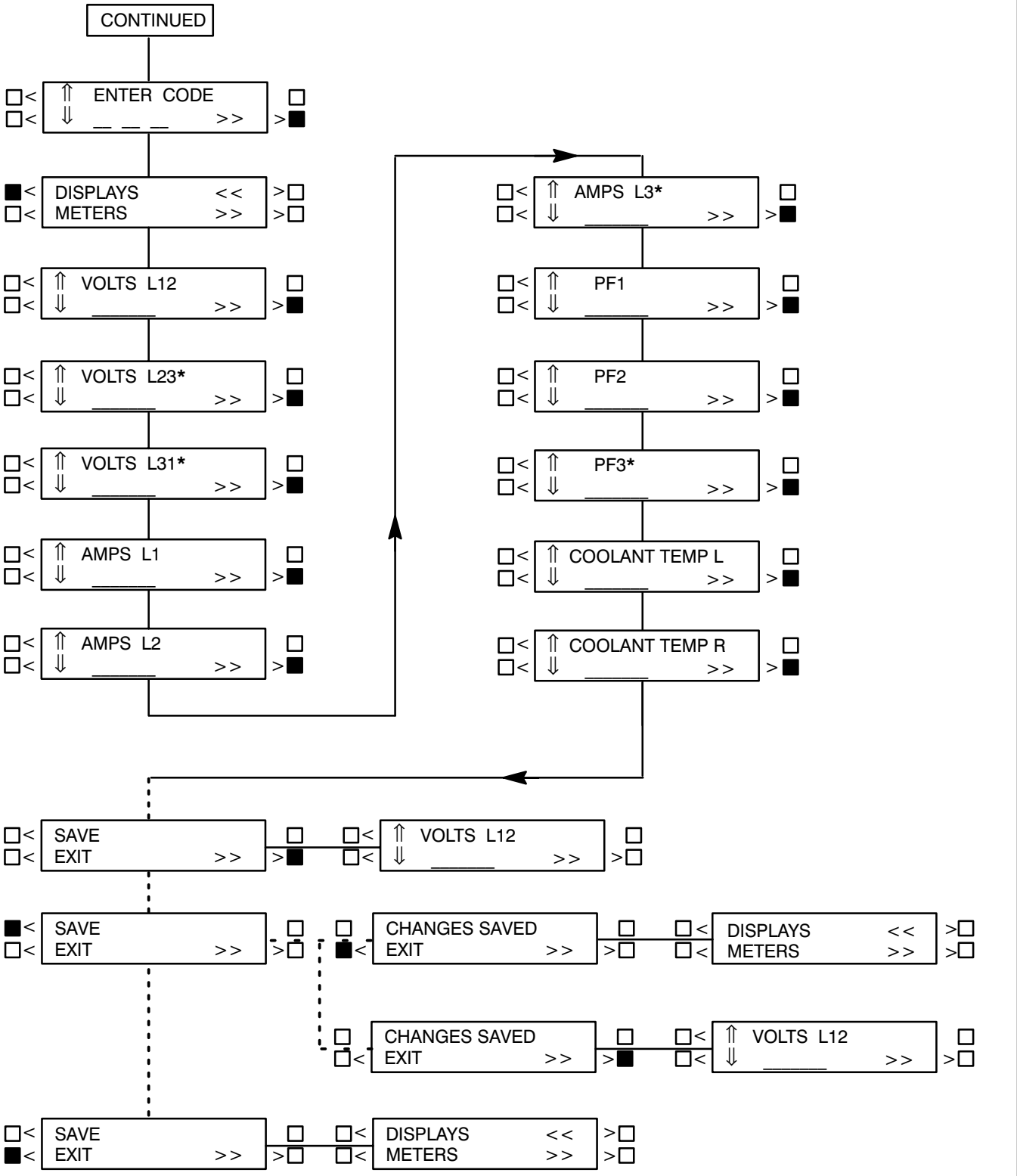
"COOLANT TEMP R" will display "N/A" if the genset has only one sensor. To calibrate coolant temperature display, a precision resistor (provided in the engine sensor tool) must be temporally substituted for the temperature sender. Refer to *Calibration Procedure* in this section.

***SAVE/EXIT submenu:*** From the AMPS L3 submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the DISPLAYS/METERS submenu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down, but will be reset (and will not be in effect) when the set is restarted.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

# VERSION & DISPLAYS MENUS (Cont.)




Redistribution or publication of this document,
by any means, is strictly prohibited.

## Meters Menu

The METERS submenus permit calibration of the control's analog meters to match the calibrated digital values. (Calibrate the digital display before calibrating the analog meters.) This calibration is accomplished by using this section of the menu software to adjust the selected meter reading so that it matches the reading provided on the digital display.

**The complete calibration procedure is described in the *Calibration Procedure* in this section.**

The facing page shows a block representation of the METERS submenus, which is the second of four SETUP/CAL menus. If you press the button next to the ">>" in the Main menu display, the VERSION/SETUP/CAL submenu will appear.

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

***METERS submenu:*** The METERS submenus are intended for qualified service personnel only. For this reason, a three-digit access code must be entered before you can proceed to those menus.

Select SETUP/CAL. The display will show the ENTER CODE submenu. Enter access code (574) as previously described in this section.

Select METERS to proceed to the METERS submenus. Use the buttons next to the "⇑" and "⇓" symbols to calibrate the selected meter to match the "CAL TO" value provided on the digital display. Press the button next to the ">>" in the display to move to the next calibration.

"VOLT METER" and "% AMPERES" calibration reference the phase that is indicated on the phase selection LED's.

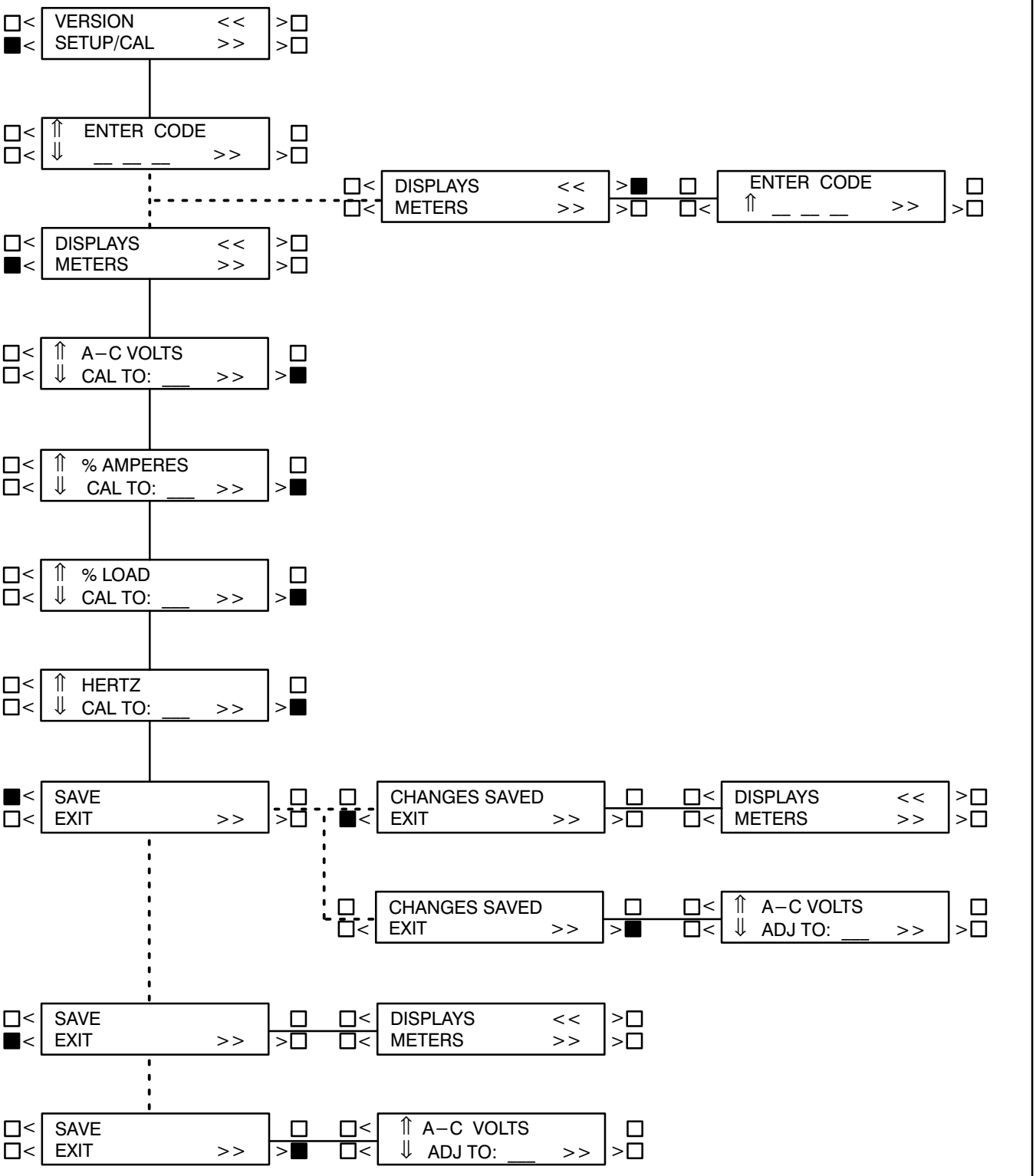
**NOTE: The % AMPERES meter scale is based on a 0.8 power factor. (100% of rated current is full load current at 0.8 PF.)**

***SAVE/EXIT submenu:*** From the HERTZ submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the DISPLAYS/METERS submenu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down, but will be reset (and will not be in effect) when the set is restarted.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

# METERS MENU




Redistribution or publication of this document,
by any means, is strictly prohibited.

## Governor / Regulator Menu

The GOV/REG submenus permit adjustment of voltage regulator and governor parameters.

**All GOV/REG menu values, except for REG VHZ and GOV RAMP, 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.**

The facing page shows a block representation of the GOV/REG submenus, which is the third of four SETUP/CAL menus. If you press the button next to the ">>" in the Main menu display, the VERSION/ SETUP/CAL submenu will appear.

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

***GOV/REG submenu:*** The GOV/REG submenus are intended for qualified service personnel only. For this reason, a three-digit access code must be entered before you can proceed to those menus.

Select SETUP/CAL. The display will show the ENTER CODE submenu. Enter the access code (574) as previously described in this section.

From the DISPLAYS/METERS submenu, press the button next to the ">>" in the display to move to the GOV/REG/SETUP submenu. Select GOV/REG to proceed to the GOV/REG submenus.

Use the buttons next to the "⇑" and "⇓" symbols to adjust the selected governor and regulator parameters. Press the button next to the ">>" in the display to move to the next adjustment.

***GOV GAIN:*** 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.

***GOV INTEGRAL:*** If this adjustment is set too low, the engine will respond too slowly to changes in load. If it is set too high, engine response will be unstable.

***GOV RAMP:*** 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. (Adjustable range: 0 through 10 seconds.)

***REG GAIN:*** 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.

***REG INTEGRAL:*** If this adjustment is set too low, the output voltage will respond sluggishly to changes in load, resulting in a droop-type response If it is set too high, output voltage will be unstable.

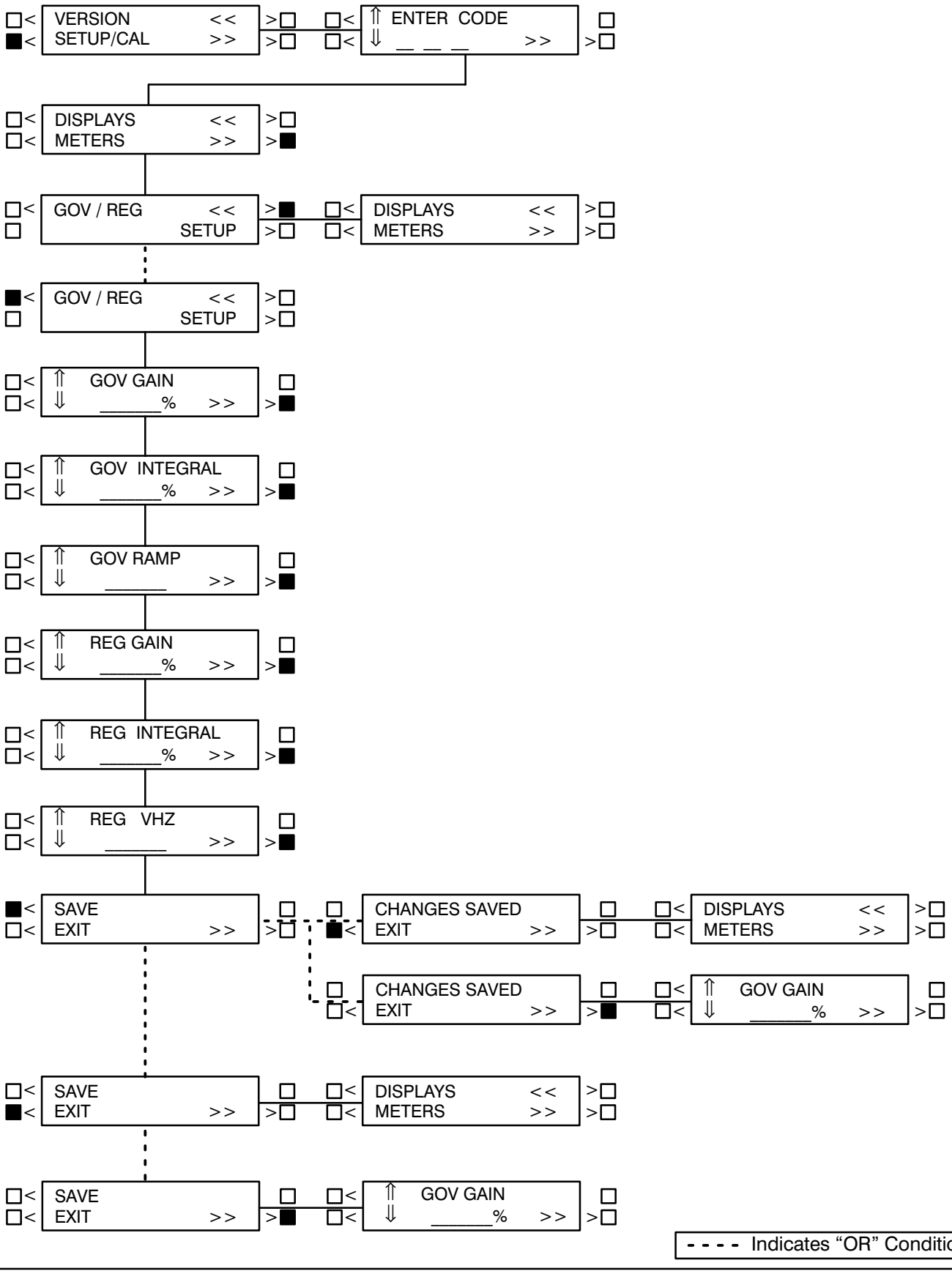
***REG VHZ:*** This underfrequency roll-off adjustment controls how much excitation is reduced in response to underfrequency. If the value is set too low, excitation will be cut too fast, and the voltage will drop too much. If set too high, the generator set may not be able to pick up rated load in one step. (Adjustable range: 1 through 50; normal range 7 through 21.)

***SAVE/EXIT submenu:*** From the REG VHZ submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the DISPLAYS/METERS submenu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down, but will be reset (and will not be in effect) when the set is restarted.**

Redistribution or publication of this document,
by any means, is strictly prohibited.

# GOVERNOR/REGULATOR MENU




Redistribution or publication of this document,
by any means, is strictly prohibited.

## Setup Menu

The SETUP submenus permit selection of several configuration and operation options. Setup option defaults are listed in Table 5-2.

**TABLE 5-2. SETUP DEFAULTS**

| SELECTION | DEFAULT |
|---|---|
| CYCLE CRANK | ON |
| SYSTEM OF UNITS | IMPERIAL |
| ***CUSTOMER FAULT 1** | WARN |
| ***GRND FAULT** | WARN |
| ***DAY TANK** | WARN |
| ***HIGH GEN TEMP** | WARN |
| EGT L | NO |
| EGT R | NO |
| LOW COOLANT | SHTD |
| LANGUAGE | ENGLISH |

***** Default display messages for customer faults 1 through 4. To change the customer fault message(s), to display the desired fault condition, refer to heading *Edit Customer Fault Messages*.

The facing page shows a block representation of the SETUP submenus, which is the fourth of four SETUP/CAL menus. If you press the button next to the ">>" in the Main menu display, the VERSION/ SETUP/CAL submenu will appear.

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

***SETUP submenu:*** The SETUP submenus are intended for qualified service personnel only. For this reason, a three-digit access code must be entered before you can proceed to those menus.

Select SETUP/CAL. The display will show the ENTER CODE submenu. Enter the access code (574) as previously described in this section.

From the DISPLAYS/METERS submenu, press the button next to the ">>" in the display to move to the GOV/REG/SETUP submenu. Select SETUP to proceed to the SETUP submenus.

Use the buttons next to the "⇑⇓" symbols to toggle the setup options. Press the button next to the ">>" in the display to move to the next adjustment.

If the cycle cranking option is selected, the menu will prompt for the selection of cycle number (3, 4, or 5) and crank and rest times (7 to 20 seconds).

**An in-line engine that has the EGT (exhaust gas temp.) option, select "YES" for EGT L and 'NO" for EGT R.**

***Edit Customer Fault Message(s):*** The four customer fault messages shown in Table 5-2 are editable. To enter the desired customer fault message, press the button next to the ">>" in the display to display the customer fault message to be changed.

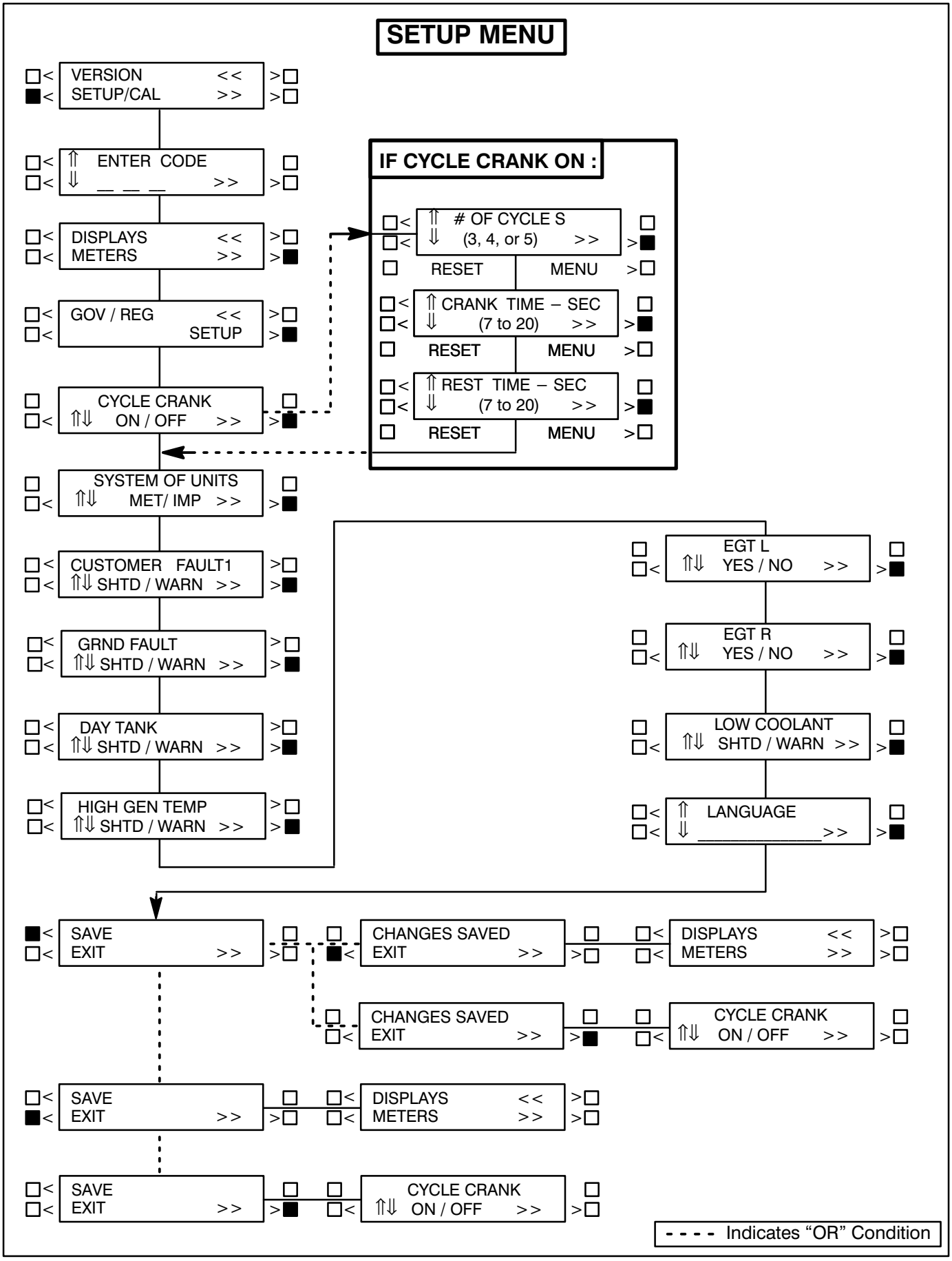
Press the upper-left button by the display to select the desired character. Press the upper-right button to move the cursor to the next character to be changed. (Holding this button down will return the cursor to the first position.) The message can be up to 16 characters. The fault code number will remain the same, this code cannot be edited.

**If these messages are changed, you should note these changes in the *Troubleshooting* section of the Operator's manual for this generator set.**

***SAVE/EXIT submenu:*** From the LANGUAGE submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the DISPLAYS/METERS submenu.

**If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down, but will be reset (and will not be in effect) when the set is restarted.**

Redistribution or publication of this document,
by any means, is strictly prohibited.




Redistribution or publication of this document,
by any means, is strictly prohibited.

## CALIBRATION PROCEDURE

**⚠WARNING** ***Contacting high voltage components can cause electrocution, resulting in severe personal injury or death. Calibration and adjustment must be performed by technically qualified personnel only. Read and observe all WARNINGS and CAUTIONS in your generator set manuals.***

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

The calibration procedure is divided into 7 subsections, with the subsections arranged in a specified order. If two or more of the following subsections are required to calibrate the PCC, they must be completed in the order shown.

When removing and replacing a defective circuit board, you may have to perform one or more of the following subsections. Table 5-1 (Control Panel Recalibration) provides a list of the circuit boards that require calibration when replaced and the calibration procedure(s) that must be performed.

Use a calibrated RMS multimeter for accurate measurements. Fluke models 87 or 8060A are good choices.

### Initial Start Setup

1. Refer to Page 5-4, which describes how and when you should perform this procedure.

   To verify if the PCC is set to operate with a specific generator set, refer to the *VERSION* menu (Page 5-9). This menu will show the generator set model number, frequency, and kW rating. If any of these values are incorrect, you must perform the Initial Start Setup procedure.

### Voltage and Frequency Adjustment

2. With the genset OFF, attach a calibrated frequency/voltmeter to the AC output from L1 to L2.
3. Select *ADJUST* from the Main Menu (page 5-7) to display the *VOLTAGE* adjust menu.
4. Start the genset by moving the Run-Stop-Remote switch to the RUN position and allow the genset to reach normal operating speed.
5. Adjust *VOLTAGE* (genset output voltage) so that the calibrated voltmeter reads the desired voltage. (Use a calibrated voltmeter because the value displayed on the PCC digital display may not be calibrated at this time; therefore, its accuracy is unknown.)
6 Select the Frequency adjust menu.
7. Verify that the frequency displayed on the calibrated meter is the desired frequency. If not, adjust to the desired frequency. (Note: If the frequency reading on the digital display is not the same as frequency shown on calibrated meter, there is an equipment malfunction.)
8. If no frequency or voltage adjustment was made, select EXIT. If an adjustment was made, SAVE, then EXIT.

### Digital Voltage Display Calibration

9. Select “>>” from the Main Menu (Page 5-9). From this menu proceed to the *VOLTS L12* menu (Page 5-11).
10. With the genset OFF, attach a calibrated frequency/voltmeter to the AC output from L1 to L2.
11. Start the genset and allow it to reach normal operating speed.
12. Calibrate voltage reading for *VOLTS L12* so that the reading on the digital display agrees with the calibrated voltmeter.
13. Shut the genset OFF.
14. Repeat steps 10 through 13 for L23 and L31. (In step 10 attach meter to the AC output from L2 to L3 to calibrate *VOLTS L23* and then L3 to L1 to calibrate *VOLTS L31*.)
15. If no calibration was made, select EXIT. If a calibration was made, SAVE, then EXIT.

Redistribution or publication of this document,
by any means, is strictly prohibited.

## Digital Ammeter Display Calibration

16. Select “>>” from the Main Menu (Page 5-9). From this menu proceed to the *AMPS L1* menu (Page 5-11).
17. With the genset OFF, attach a calibrated ammeter to L1.
18. Start the genset and allow it to reach normal operating speed.
19. Load the genset to maximum rated kVA at rated voltage.
20. Calibrate the reading for *AMPS L1* so that the reading on the digital display agrees with calibrated ammeter.
21. Repeat steps 17 through 20 for *L2* and *L3*. (In step 17, attach meter to L2 to calibrate *AMPS L2* and then L3 to calibrate *AMPS L3*.)
22. If no calibration was made, select EXIT. If a calibration was made, SAVE, then EXIT.

## Digital Power Factor Display Calibration

Power factor calibration is not required except in applications requiring a higher accuracy than ±5%. If the ±5% accuracy is not acceptable, further calibration will require reactive load sufficient to reach 0.8 PF at rated load, and calibrated instruments with ±1% accuracy or better. Typical load rack instruments are not accurate enough to perform this procedure.

23. Select “>>” from the Main Menu (Page 5-9). From this menu proceed to the *PF1* menu (Page 5-11).
24. With the genset OFF, attach the power factor meter to L1.
25. Start the genset and allow it to reach normal operating speed.
26. Load the genset to maximum rated kVA at rated voltage.
27. Calibrate the reading for PF1 so that the reading on the digital display agrees with power factor meter.
28. Repeat steps 24 through 27 for L2 and L3**.** (In step 24, attach meter to L2 to calibrate *PF2* and then L3 to calibrate *PF3*.)
29. If no calibration was made, select EXIT. If a calibration was made, SAVE, then EXIT.

## Digital Coolant Temperature Display Calibration

An engine sensor calibration tool is required to perform this procedure.

30. With the genset OFF, replace the coolant temperature sender with the precision resistor provided in the calibration tool.
31. Select “>>” from the Main Menu (Page 5-9). From this menu proceed to the *COOLANT TEMP L* menu (5-11).
32. Calibrate the temperature reading to match the temperature indicated on the calibration tool.
33. Repeat step 32 for *COOLANT TEMP R* if the engine uses two sensors.
34. If no calibration was made, select EXIT. If a calibration was made, SAVE, then EXIT.

## Analog meter calibration

35. Select “>>” from the Main Menu (Page 5-9). From this menu proceed to the *A–C VOLTS CAL TO* menu (Page 5-13).
36. Start the genset and allow the genset to reach normal operating speed.
37. Calibrate the analog Voltmeter to the digitally displayed value.
38. Calibrate the analog % Amps meter to the digitally displayed value.
39. Calibrate the analog % Load meter to the digitally displayed value.
40. Calibrate the analog Frequency meter to the digitally displayed value.
41. SAVE, then EXIT.

Redistribution or publication of this document,
by any means, is strictly prohibited.

## ACCESSORY BOX CONTROL COMPONENTS

The generator set accessory box (Figure 5-3) which is located on the backside of the control housing, contains components that provide connection points for remote control and monitor options. The set can be equipped with one or more of the following components (customer terminal block TB1 is standard).

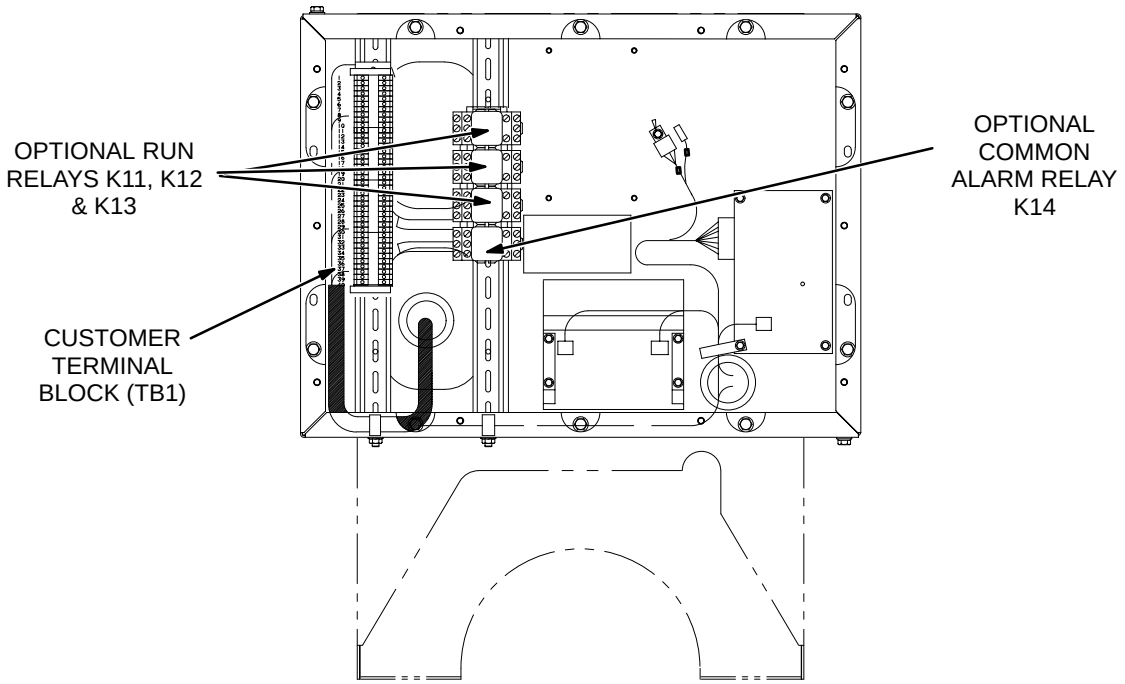



**FIGURE 5-3. ACCESSORY BOX COMPONENTS**

Redistribution or publication of this document, by any means, is strictly prohibited.

## TB1 Customer Inputs

Refer to Page 8-6 for typical connections to TB1.

***Remote Start:*** When the Run/Off/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.

***Low Fuel:*** Grounding this input actuates the Low Fuel warning. This input can be connected to a local fuel pressure switch. When the switch grounds this designated input, the input will "wake up" the control, if it is not operating, and then initiate the fault.

***Customer Fault Inputs 1 through 4:*** Grounding any one of these inputs activates the corresponding warning or shutdown sequence. Warning or shutdown status is selected in the setup menu. Refer to the menu descriptions later in this section.

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

The four customer fault messages can be separately edited in the setup menu to display any desired message. This allows each customer "default" fault message to be customized to represent the type of device that is attached the the fault input.

The "default" message that is displayed, when ground is applied to the input, is as follows:

Fault 1 = CUSTOMER FAULT1
Fault 2 = GRND FAULT
Fault 3 = DAY TANK
Fault 4 = HIGH GEN TEMP

If Fault 2 or 3 input is grounded, the control will "wake up" if it is not operating, and then initiate the fault.

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

***Engine Idle:*** When the set is operating in the RUN mode, grounding this input causes generator build up to be inhibited and the engine to be governed at 800 RPM. When ground is removed from this input, the set returns to normal speed and voltage.

**Engine idle operation is applicable only in the RUN mode. The PCC operating program does not permit engine idle operation when the set is operating in AUTO mode.**

When the engine idle function is enabled, the control automatically sets lower oil pressure warning and shutdown trip points to reflect the lower operating speed. When the engine idle function is removed and the set reverts to normal operating speed, the control automatically resets oil pressure warning and shutdown trip points to the normal settings.

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

## TB1 Customer Outputs

Refer to Page 8-6 for typical connections to TB1.

***Breaker Control:*** One set of normally open (NO) contacts, rated for 5 amps at 30 VDC. A shutdown fault will cause the relay to energize and operate a shunt trip circuit on a circuit breaker. The relay will stay energized until reset.

***Common Alarm:*** One set of form-C contacts, rated for 2 amps at 30 VDC. Any warning or shutdown causes the common alarm relay to be energized. This output is often used to energize an audible alarm.

***Load Dump:*** One set of normally open (NO) contacts, rated for 2 amps at 30 VDC. If an overload or underfrequency condition exists for 5 seconds, the NO load dump contacts are closed. This relay is energized before shutdown (for overload or underfrequency) occurs.

***Ready To Load:*** One set of normally open (NO) contacts, rated for 2 amps at 30 VDC. This output is activated whenever AC voltage and frequency exceed 90% of nominal.

***Switched B+:*** This is a fused 10 amp, 12 volt switched output. This output is activated by the run pilot signal, at the governor output module. (Fuse is located on Governor Output Module.)

***B+:*** This is a fused 20 amp, 12 volt output. (Fuse is located on TB-BAT terminal block of the engine harness.)

Redistribution or publication of this document,
by any means, is strictly prohibited.

## Run Relays (K11, K12, K13)

The optional run relays are rail mounted inside the accessory box (Figure 5-4). The rail mount allows you to easily remove and replace the snap-on relays. The generator set can be equipped with one, two or three run relays.

The three-pole, double-throw run relays (Figure 5-4) are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The run relays are energized when the generator set reaches operating speed.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

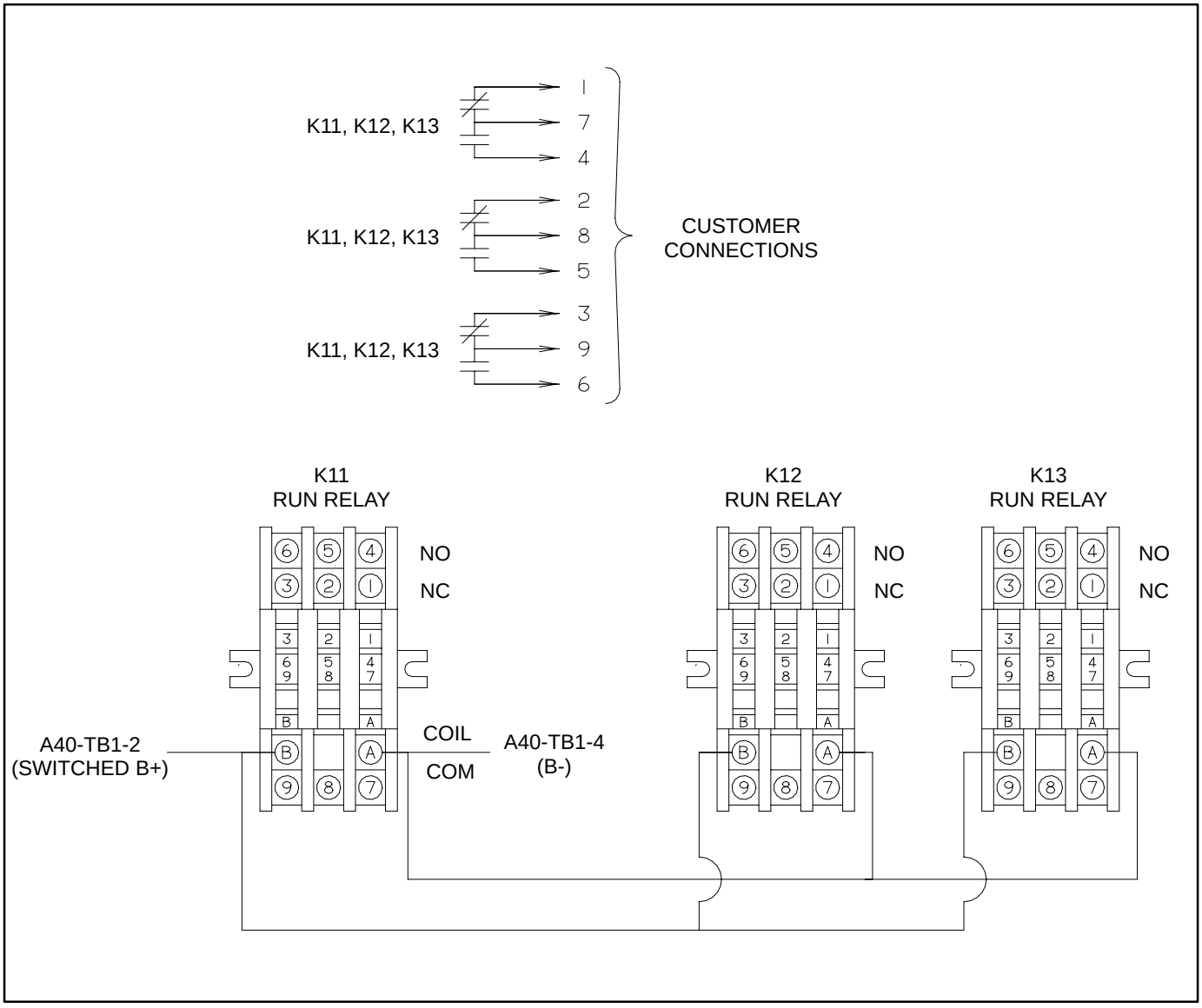



**FIGURE 5-4. OPTIONAL RUN RELAYS (K11, K12, K13)**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Alarm Relay (K14)

The optional alarm relay is rail mounted inside the accessory box (Figure 5-5). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-5) is often used to energize warning devices such as audible alarms. Any generator set warning or shutdown will energize the alarm relay.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

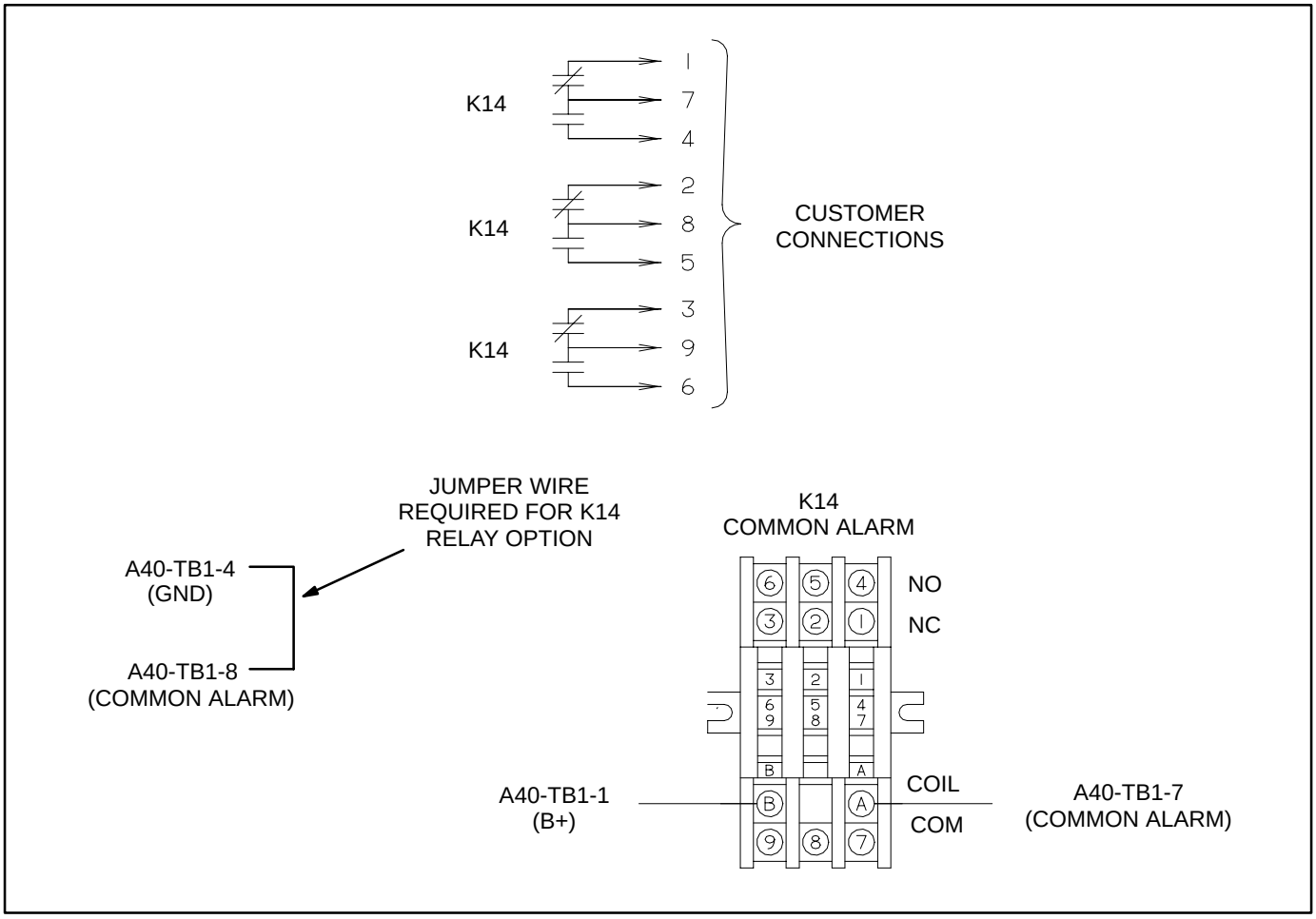



**FIGURE 5-5. OPTIONAL ALARM RELAY (K14)**

Redistribution or publication of this document, by any means, is strictly prohibited.

## ENGINE SENSORS

Figure 5-6 shows the locations of the oil and coolant temperature and oil pressure senders to which the PCC responds. The switches function by closing the fault or warning circuit to the engine chassis ground (battery negative [–]). The low coolant level switch has its own ground wire. The low coolant level switch is not shown in Figure 5-6; this switch is located near the top of the radiator.

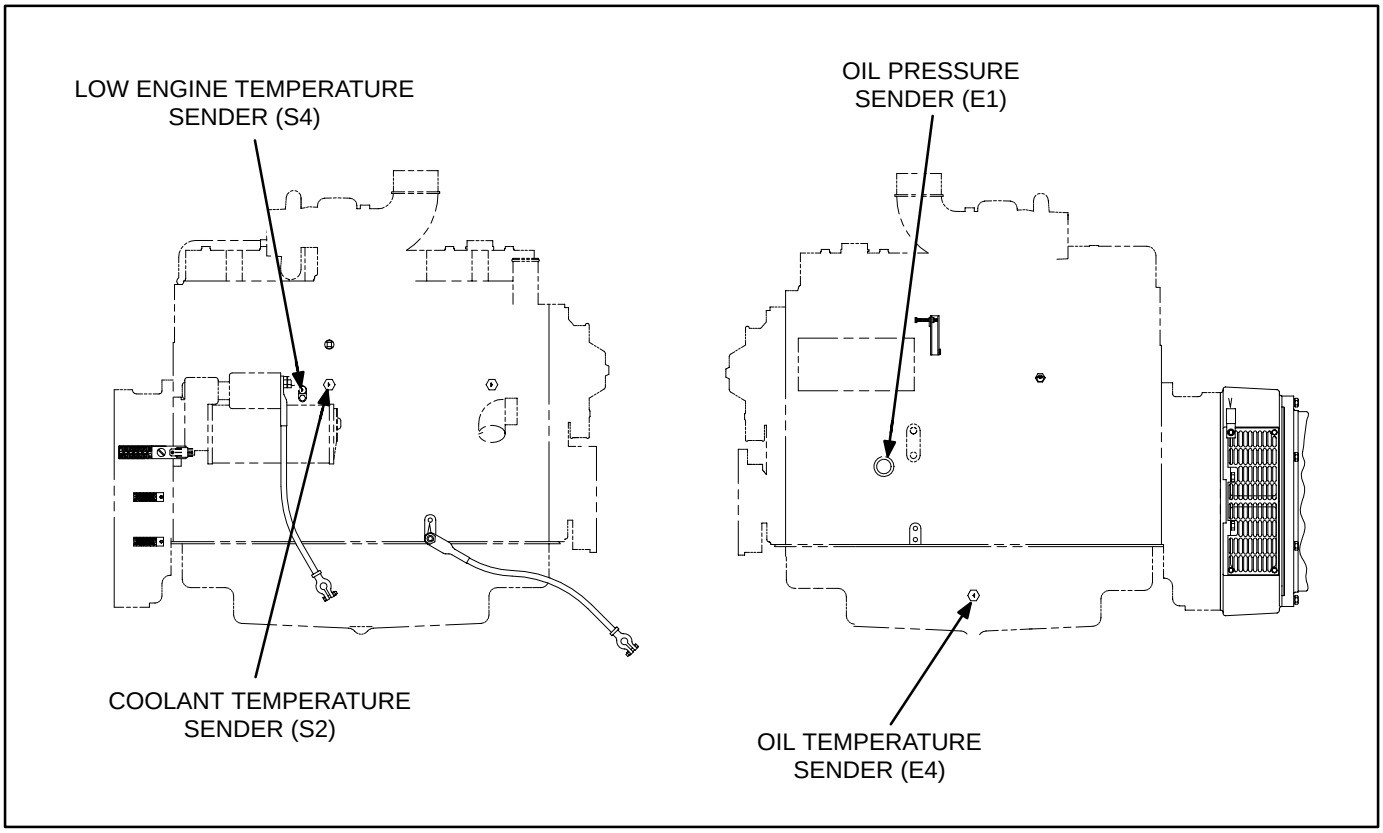



**FIGURE 5-6. ENGINE SENSOR LOCATIONS (6C SERIES ENGINES)**

Redistribution or publication of this document, by any means, is strictly prohibited.

## MAGNETIC SPEED PICKUP UNIT (MPU) INSTALLATION

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

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

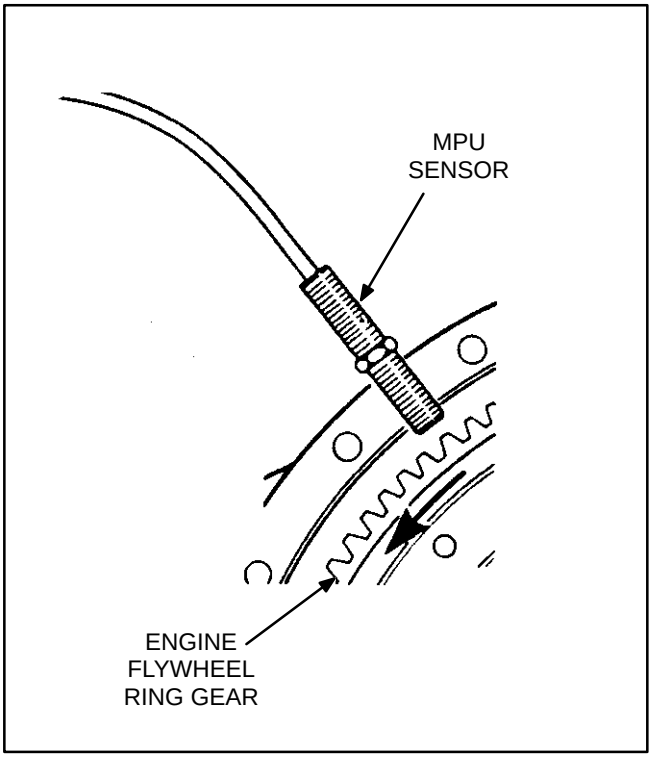



**FIGURE 5-7. MPU SENSOR**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## CURRENT TRANSFORMER (CT) INSTALLATION

Current transformers (CT's) are required on gensets that contain AC meters. The CT's must be installed as noted in the following *CT Installation Requirements*. Improper installation of CT's will cause a "335 Reverse Power" shutdown error (non-parallel units only).

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 CT21, CT22 and CT23 on the reconnection wiring diagram. (The Reconnection Diagram is located on the upper side cover of the control housing.)

### 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. CT21 – U load leads (A phase)
CT22 – V load leads (B phase)
CT23 – W load leads (C phase)

C. Route the appropriate leads through each CT.

- 6 lead generator sets – generator output leads are routed through the CT's.
- 12 lead generator sets – load wires are routed through the CT's.

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

Non-reconnectable gensets (6 leads) have single secondary CT's (2 pins).

- The lead from CT terminal #1 connects to the metering circuitry.
- The lead from CT terminal #2/3 connects to ground.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 6. Servicing the Generator

## TESTING THE GENERATOR

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

**⚠ CAUTION** ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

**⚠ WARNING** ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

***Make certain battery area has been well-ventilated before servicing battery. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when cable is removed or re-attached, or when negative (–) battery cable is connected and a tool used to connect or disconnect positive (+) battery cable touches frame or other grounded metal part of the set. Always remove negative (–) cable first, and reconnect it last. Make certain hydrogen from battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if battery has been connected to battery charger.***

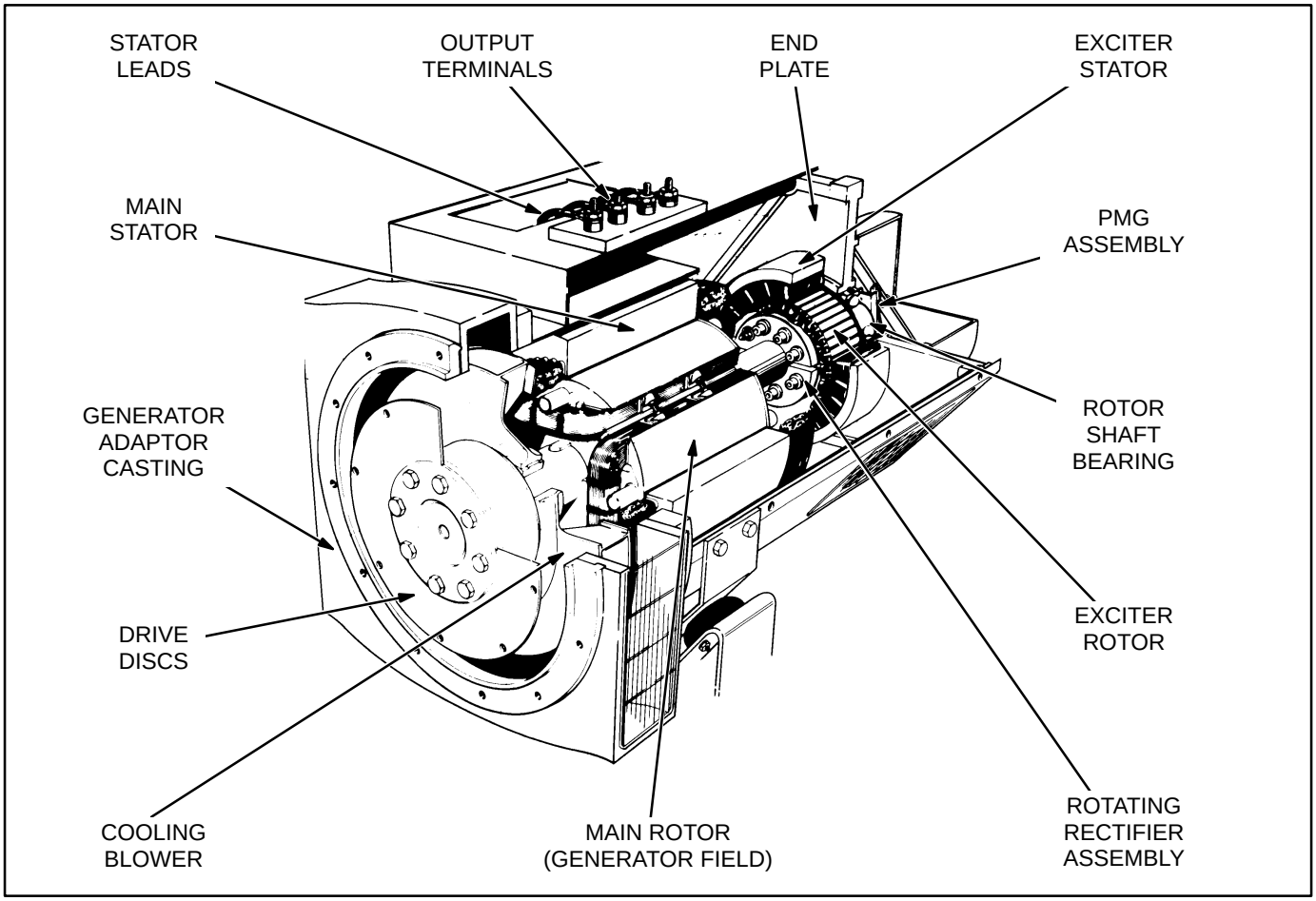



**FIGURE 6-1. GENERATOR**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Exciter Stator

**Testing Winding Resistance:** Measure winding resistance with a Wheatstone bridge or digital ohmmeter. Replace the stator if winding resistance is not as specified by Table 6-1.

**Testing Winding Insulation Resistance:** Disconnect the exciter stator leads from terminals **X** and **XX** on the auxiliary terminal board in the generator output box. Using an ohmmeter, measure resistance between either lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm (1,000,000 ohms)

**Flashing the Field (Self-Excited Generators Only):** If necessary, flash the exciter field before or after installation. Apply 110 to 220 VAC for one to two seconds to the **X** and **XX** leads of the exciter stator. **The generator must be shut down, the AVR disconnected, a diode used to establish correct polarity and a 3 amp fuse to prevent over-excitation.** See the diagram.

Alternatively, while the set is running and disconnected from all loads, apply a 12 VDC battery for one to two seconds as shown in the diagram. **Polarity must be correct: + to X, – to XX**.

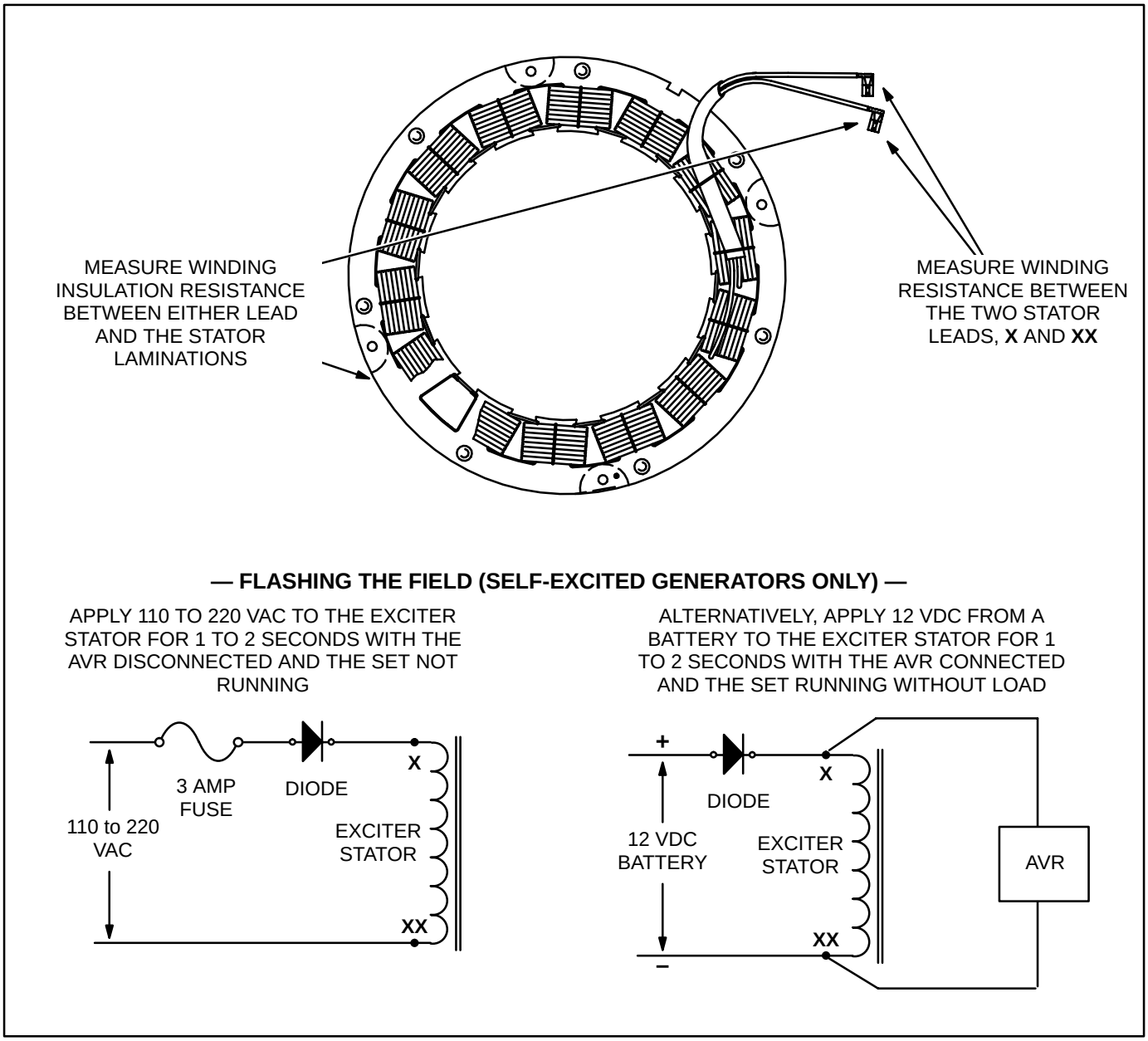



**FIGURE 6-2. TESTING AND FLASHING THE EXCITER STATOR**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Exciter Rectifier Bridge (Rotating Rectifier Assembly)

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

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

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

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

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

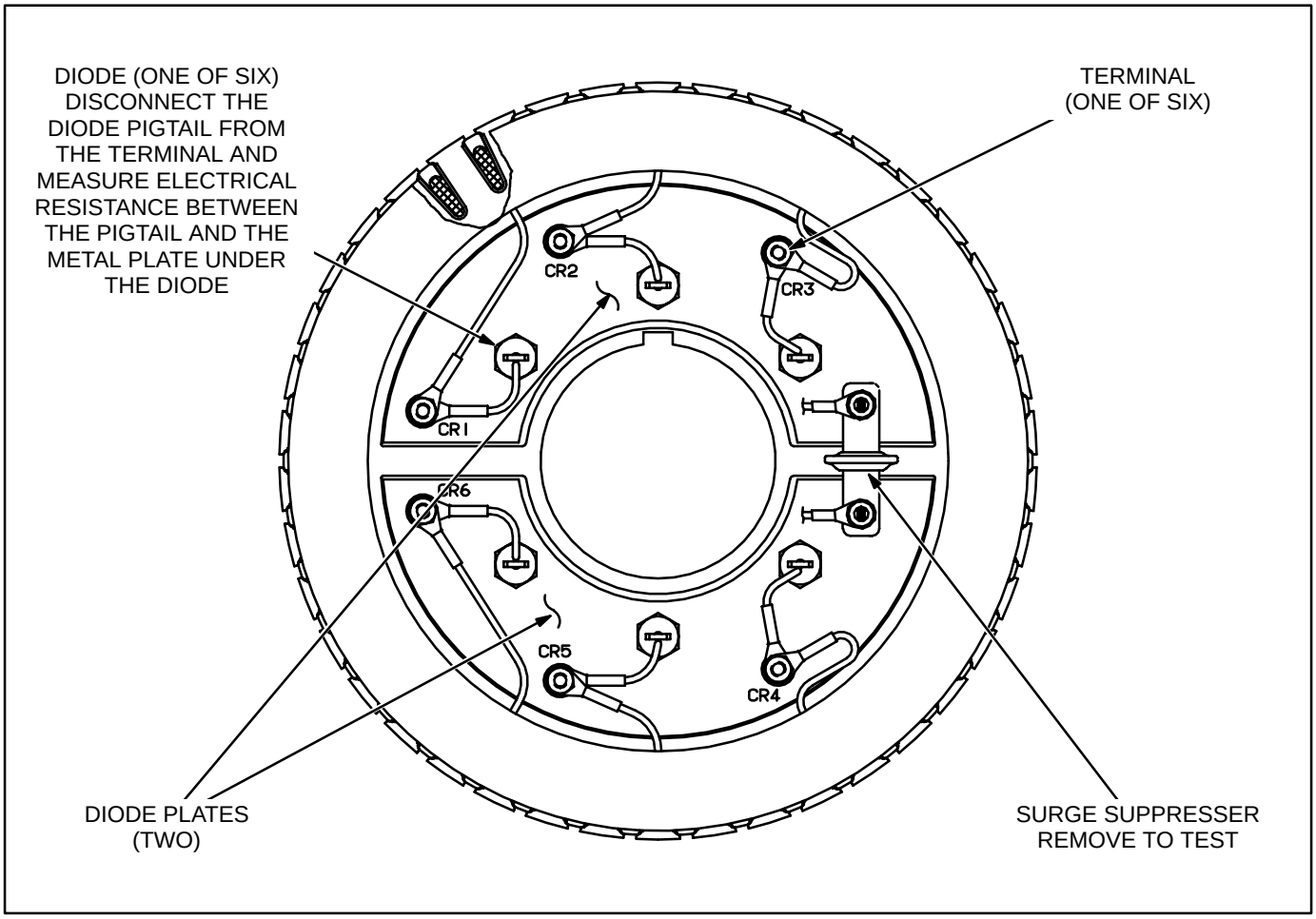



**FIGURE 6-3. TESTING THE ROTATING RECTIFIER ASSEMBLY**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Exciter Rotor

**Testing Winding Resistance:** Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly. With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: **U** (CR1 or CR4) and **V** (CR2 or CR5), **V** (CR2 or CR5) and **W** (CR3 or CR6), **W** (CR3 or CR6) and **U** (CR1 or CR4). See the winding schematic. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 6-1.

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

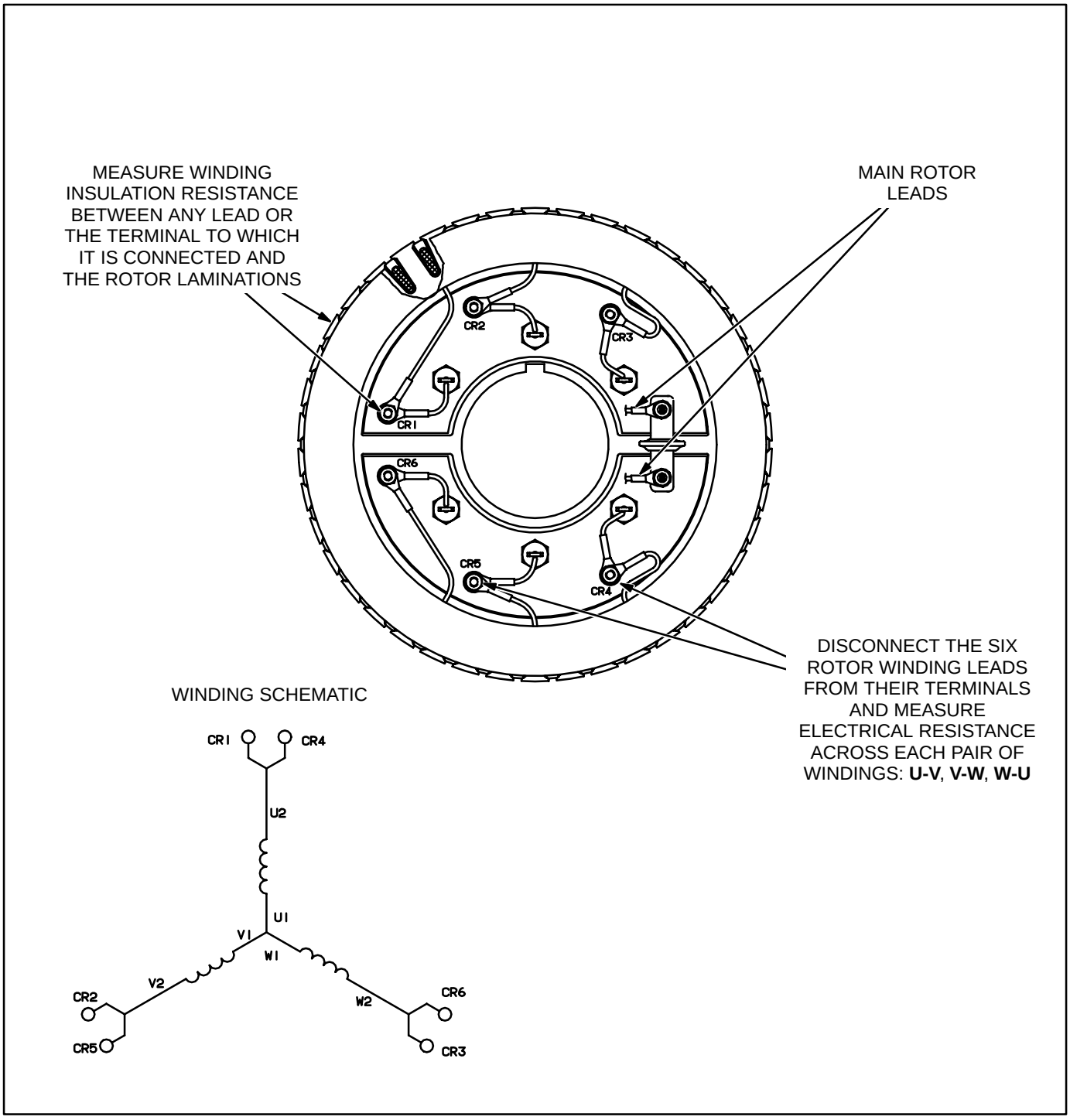



**FIGURE 6-4. TESTING THE EXCITER ROTOR**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Main Rotor (Generator Field)

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

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

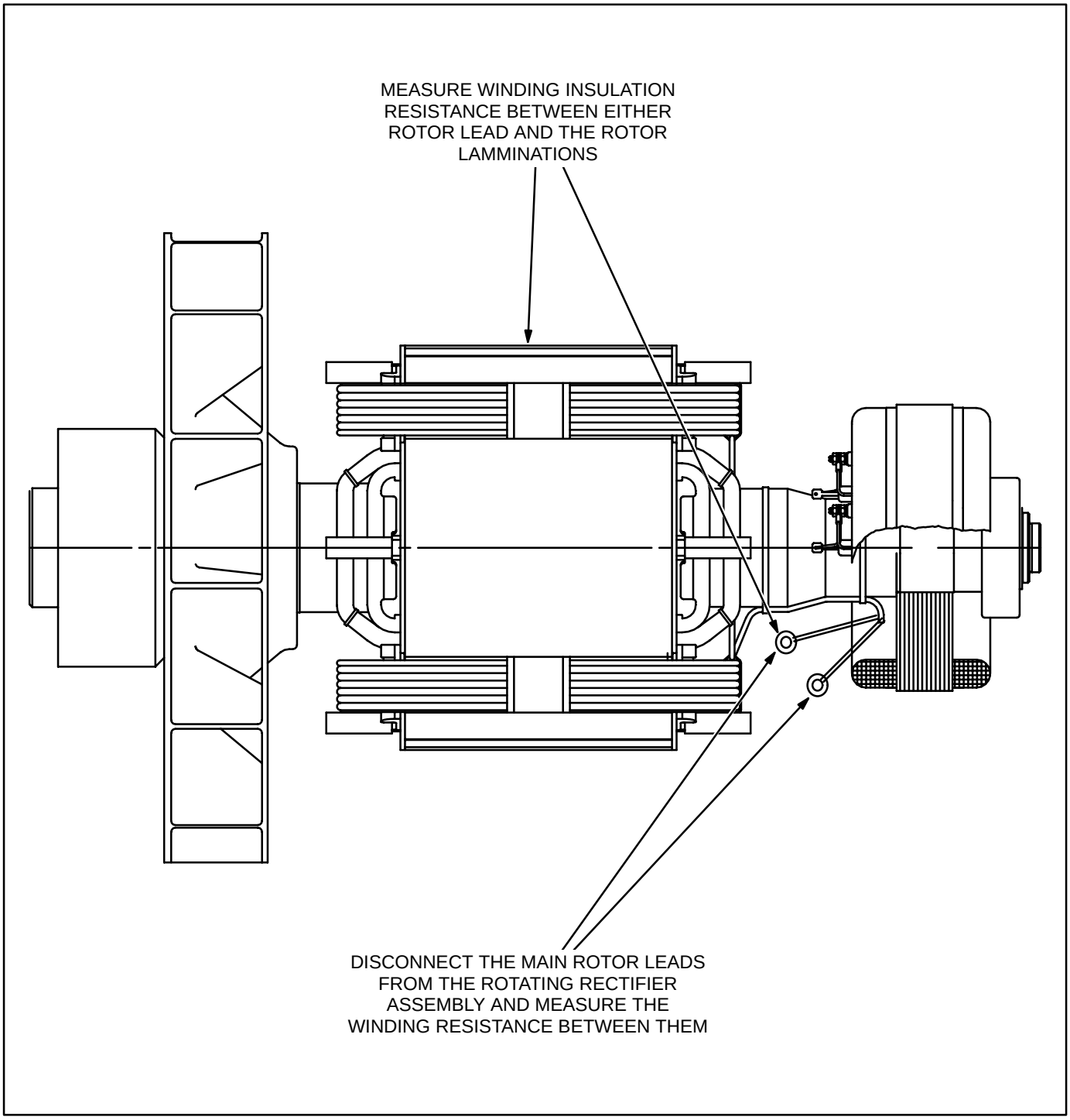



**FIGURE 6-5. TESTING THE MAIN ROTOR**

Redistribution or publication of this document, by any means, is strictly prohibited.

## Main Stator

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

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

**Testing Winding Insulation Resistance:** Disconnect all stator leads and winding taps from their respective terminals and make sure the ends do not touch the generator frame. Using an ohmmeter, measure electrical resistance between any stator lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm.

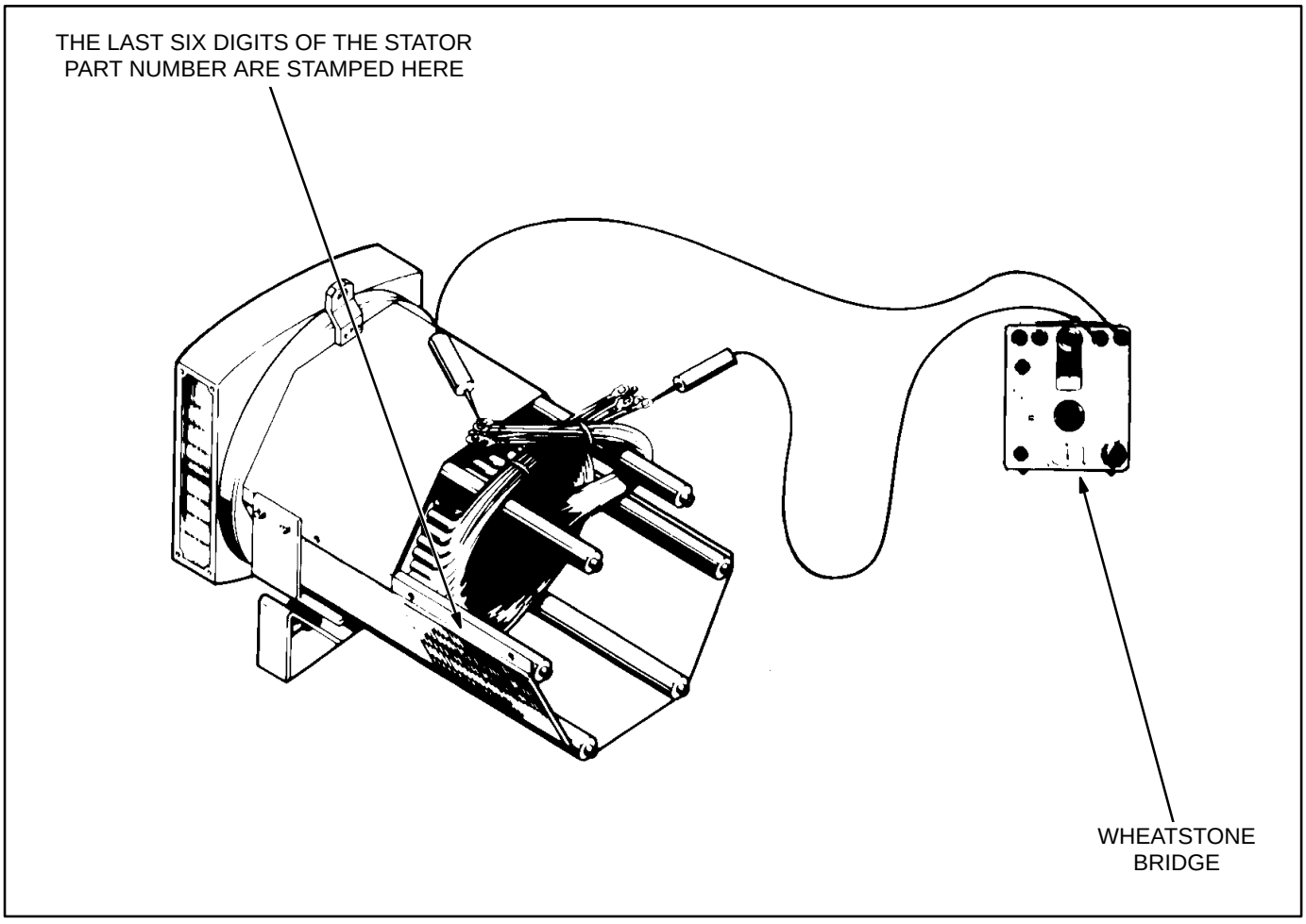



**FIGURE 6-6. TESTING THE GENERATOR STATOR**

Redistribution or publication of this document,
by any means, is strictly prohibited.

**TABLE 6-1. GENERATOR WINDING RESISTANCES**

| MAIN STATOR PART NUMBER*** | MAIN STATOR (OHMS*) | MAIN ROTOR (OHMS**) | EXCITER STATOR (OHMS**) | EXCITER ROTOR (OHMS*) |
|---|---|---|---|---|
| **220-4447-06** | 0.0561–0.0620 | 0.57 | 20.3 | 0.167 |
| **220-4447-07** | 0.0466–0.0515 | 0.64 | 20.3 | 0.167 |
| **220-4447-08** | 0.0371–0.0410 | 0.67 | 19.5 | 0.180 |
| **220-4447-09** | 0.0228–0.0252 | 0.80 | 19.5 | 0.180 |
| **220-4447-10** | 0.0181–0.0200 | 0.93 | 19.5 | 0.180 |
| **220-4447-11** | 0.0860–0.0950 | 0.57 | 20.3 | 0.167 |
| **220-4447-12** | 0.0613–0.0677 | 0.64 | 20.3 | 0.167 |
| **220-4447-13** | 0.0480–0.0530 | 0.67 | 19.5 | 0.180 |
| **220-4447-14** | 0.0309–0.0341 | 0.80 | 19.5 | 0.180 |
| **220-4447-15** | 0.0261–0.0289 | 0.93 | 19.5 | 0.180 |
| **220-4447-16** | 0.0561–0.0620 | 0.57 | 20.3 | 0.167 |
| **220-4447-17** | 0.0428–0.0473 | 0.64 | 20.3 | 0.167 |
| **220-4447-18** | 0.0333–0.0368 | 0.67 | 19.5 | 0.180 |
| **220-4447-19** | 0.0228–0.0252 | 0.80 | 19.5 | 0.180 |
| **220-4447-20** | 0.0171–0.0189 | 0.93 | 19.5 | 0.180 |
| **220-4447-26** | 0.1354–0.1496 | 0.57 | 20.3 | 0.167 |
| **220-4447-27** | 0.0960–0.1050 | 0.64 | 20.3 | 0.167 |
| **220-4447-28** | 0.0713–0.0788 | 0.67 | 19.5 | 0.180 |
| **220-4447-29** | 0.0485–0.0536 | 0.80 | 19.5 | 0.180 |
| **220-4447-30** | 0.0404–0.0446 | 0.93 | 19.5 | 0.180 |
| **220-4448-07** | 0.0209–0.0231 | 1.11 | 19.5 | 0.180 |
| **220-4448-08** | 0.0162–0.0179 | 1.20 | 19.5 | 0.180 |
| **220-4448-09** | 0.0143–0.0158 | 1.31 | 19.5 | 0.210 |
| **220-4448-10** | 0.0095–0.0105 | 1.50 | 19.5 | 0.210 |
| **220-4448-11** | 0.0076–0.0084 | 1.66 | 19.5 | 0.210 |
| **220-4448-12** | 0.0066–0.0072 | 1.80 | 19.5 | 0.210 |
| **220-4448-13** | 0.0260–0.0310 | 1.11 | 19.5 | 0.180 |
| **220-4448-14** | 0.0214–0.0236 | 1.20 | 19.5 | 0.180 |
| **220-4448-15** | 0.0147–0.0163 | 1.31 | 19.5 | 0.210 |
| **220-4448-16** | 0.0114–0.0126 | 1.50 | 19.5 | 0.210 |
| **220-4448-17** | 0.0100–0.0110 | 1.66 | 19.5 | 0.210 |
| **220-4448-18** | 0.0071–0.0079 | 1.80 | 19.5 | 0.210 |
| **220-4448-19** | 0.0204–0.0226 | 1.11 | 19.5 | 0.180 |
| **220-4448-20** | 0.0152–0.0168 | 1.20 | 19.5 | 0.180 |
| **220-4448-21** | 0.0105–0.0116 | 1.31 | 19.5 | 0.210 |
| **220-4448-22** | 0.0090–0.0100 | 1.50 | 19.5 | 0.210 |
| **220-4448-23** | 0.0076–0.0084 | 1.66 | 19.5 | 0.210 |
| **220-4448-24** | 0.0062–0.0068 | 1.80 | 19.5 | 0.210 |
| **(CONT.)** | | | | |

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - These values are approximate, plus or minus 10 percent at 77° F (25° C).
*** - See Figure 7-6 for the location of the stator part number.

Redistribution or publication of this document,
by any means, is strictly prohibited.

**TABLE 6-1. GENERATOR WINDING RESISTANCES (CONT.)**

| MAIN STATOR PART NUMBER*** | MAIN STATOR (OHMS*) | MAIN ROTOR (OHMS**) | EXCITER STATOR (OHMS**) | EXCITER ROTOR (OHMS*) |
|---|---|---|---|---|
| **220-4448-31** | 0.0413–0.0457 | 1.11 | 19.5 | 0.180 |
| **220-4448-32** | 0.0229–0.0331 | 1.20 | 19.5 | 0.180 |
| **220-4448-33** | 0.0238–0.0263 | 1.31 | 19.5 | 0.210 |
| **220-4448-34** | 0.0181–0.0200 | 1.50 | 19.5 | 0.210 |
| **220-4448-35** | 0.0124–0.0137 | 1.66 | 19.5 | 0.210 |
| **220-4448-36** | 0.0133–0.0147 | 1.80 | 19.5 | 0.210 |
| **220-4448-37** | 0.0085–0.0095 | 2.05 | 19.5 | 0.210 |
| **220-4448-38** | 0.0095–0.0105 | 2.05 | 19.5 | 0.210 |
| **220-4448-39** | 0.0074–0.0082 | 2.05 | 19.5 | 0.210 |
| **220-4448-40** | 0.0066–0.0074 | 2.05 | 19.5 | 0.210 |
| **220-4448-41** | 0.0065–0.0073 | 2.05 | 19.5 | 0.210 |
| **220-4448-42** | 0.0131–0.0145 | 2.05 | 19.5 | 0.210 |

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - These values are approximate, plus or minus 10 percent at 77° F (25° C).
*** - See Figure 7-6 for the location of the stator part number.

Redistribution or publication of this document,
by any means, is strictly prohibited.

## GENERATOR DISASSEMBLY

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

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

Before starting, disconnect the negative (**–**) cable from the battery to prevent accidental starting.

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

### Removing The Generator Output Box

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

### Withdrawing The Generator From The Set

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

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

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

2. Attach lifting eyes and a hoist of sufficient capacity (Figure 6-7).
3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts.
4. Raise the generator end approximately one inch (25 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.
5. Remove the bolts securing the generator drive discs to the flywheel.
6. Loosen all the bolts securing the generator adapter casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

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

Redistribution or publication of this document,
by any means, is strictly prohibited.

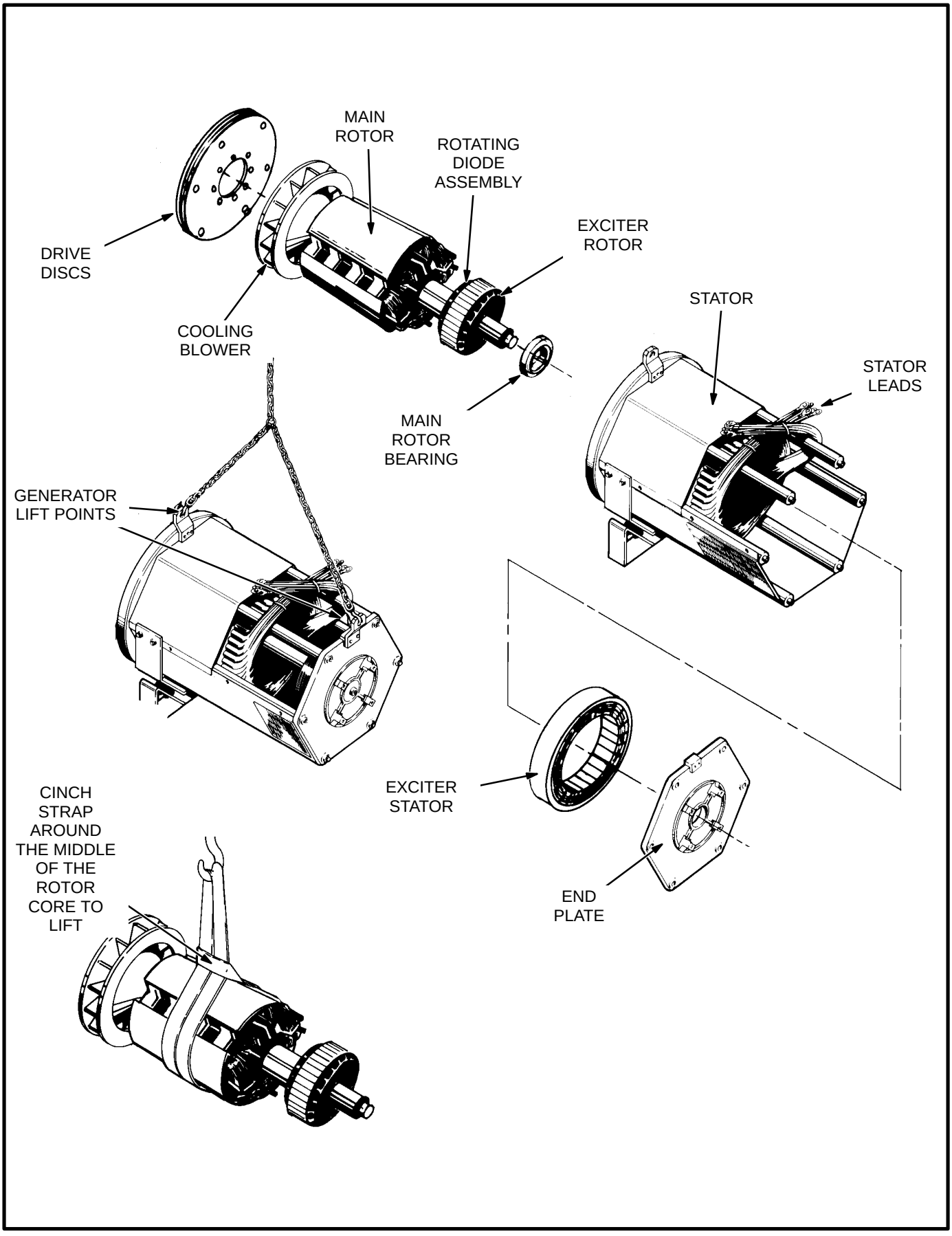



**FIGURE 6-7. GENERATOR ASSEMBLY**

Redistribution or publication of this document,
by any means, is strictly prohibited.

### Withdrawing the Rotor From the Generator

1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.
2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by hand and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and recinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on both ends to prevent contact with the stator windings
3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, blower or exciter.
4. Remove the retaining clip if the rotor shaft bearing is to be removed.

## GENERATOR REASSEMBLY

Reassembling is the reverse of disassembling. Note the following.

1. Apply force to the inner race of the rotor bearing when pressing it onto the shaft, otherwise, it will be damaged. Be sure to secure the retaining clip.
2. The drive disc-to-rotor bolts should be torqued to 190 ft-lbs (257 Nm).
3. The drive disc-to-flywheel bolts should be torqued to 50 ft-lbs (67 Nm).
4. The exciter stator mounting screws should be torqued to 7 ft-lbs (10 Nm).
5. The generator end plate mounting bolts should be torqued to 25 ft-lbs (34 Nm).
6. Make sure the rubber O-ring is in place in the bearing bore in the generator endplate.
7. The generator mounting bracket bolts should be torqued to 65 ft-lbs (88 Nm) if M12 or 35 ft-lbs (47 Nm) if M10.
8. The generator-to-adaptor bolts should be torqued to 40 ft-lbs (55 Nm).
9. The adaptor-to-engine bolts should be torqued to 35 ft-lbs (48 Nm).
10. Reconnect the generator as required. See Page 10-3 or 10-4.

## SERVICING THE PMG

The following is applicable if the generator is equipped with a PMG (permanent magnet) exciter.

### Testing

1. Disconnect leads **P2**, **P3** and **P4** from the voltage regulator.
2. Start the engine at the set and let the speed stabilize.

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

   ***For your protection, 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.***

3. Measure voltage across lead pairs **P2-P3**, **P3-P4** and **P4-P2**. Voltage should be at least 150 VAC for 50 Hz sets and at least 180 VAC for 60 Hz sets, and should be approximately the same for each set of leads. If the voltages are low or uneven, check all the leads and connections between the voltage regulator and the PMG and repair as necessary before disassembling the PMG. Note the connections at the auxiliary terminal board in the power output box. See Figure 2-3.
4. Stop the set and measure electrical resistance across lead pairs **P2-P3**, **P3-P4** and **P4-P2** with a Wheatstone bridge or digital ohmmeter. Each winding should have a resistance of approximately 4.4 ohms.

Redistribution or publication of this document,
by any means, is strictly prohibited.

## Disassembling the PMG

1. Disconnect the starting battery cables (negative (-) first) to make sure the set will not start while working on it.

   **⚠WARNING** ***Accidental starting of the generator set while working on it can cause severe injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).***

   ***Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.***

   **⚠CAUTION** ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

2. Remove the PMG cover and disconnect the leads at the connector.
3. Remove the bolts and clamps that secure the PMG stator to the generator frame and carefully pull away the stator.

   **The rotor is magnetic and will attract the stator. Hold the stator firmly so that the windings are not damaged by striking the stator support lugs.**

4. Remove the rotor center bolt and pull away the rotor. The rotor is magnetic and will attract iron filings. Put it in a clean plastic bag until it is remounted. Do not take it apart or it will lose its magnetism. Also, if the dowel pin in the end of the shaft is loose, stow it in a safe place until it is time to reassemble the PMG.

## Reassembling the PMG

Reassembling is the reverse of disassembling. Torque the rotor center bolt to 40 ft-lbs (54 Nm). The stator leads must be at 12 o'clock.

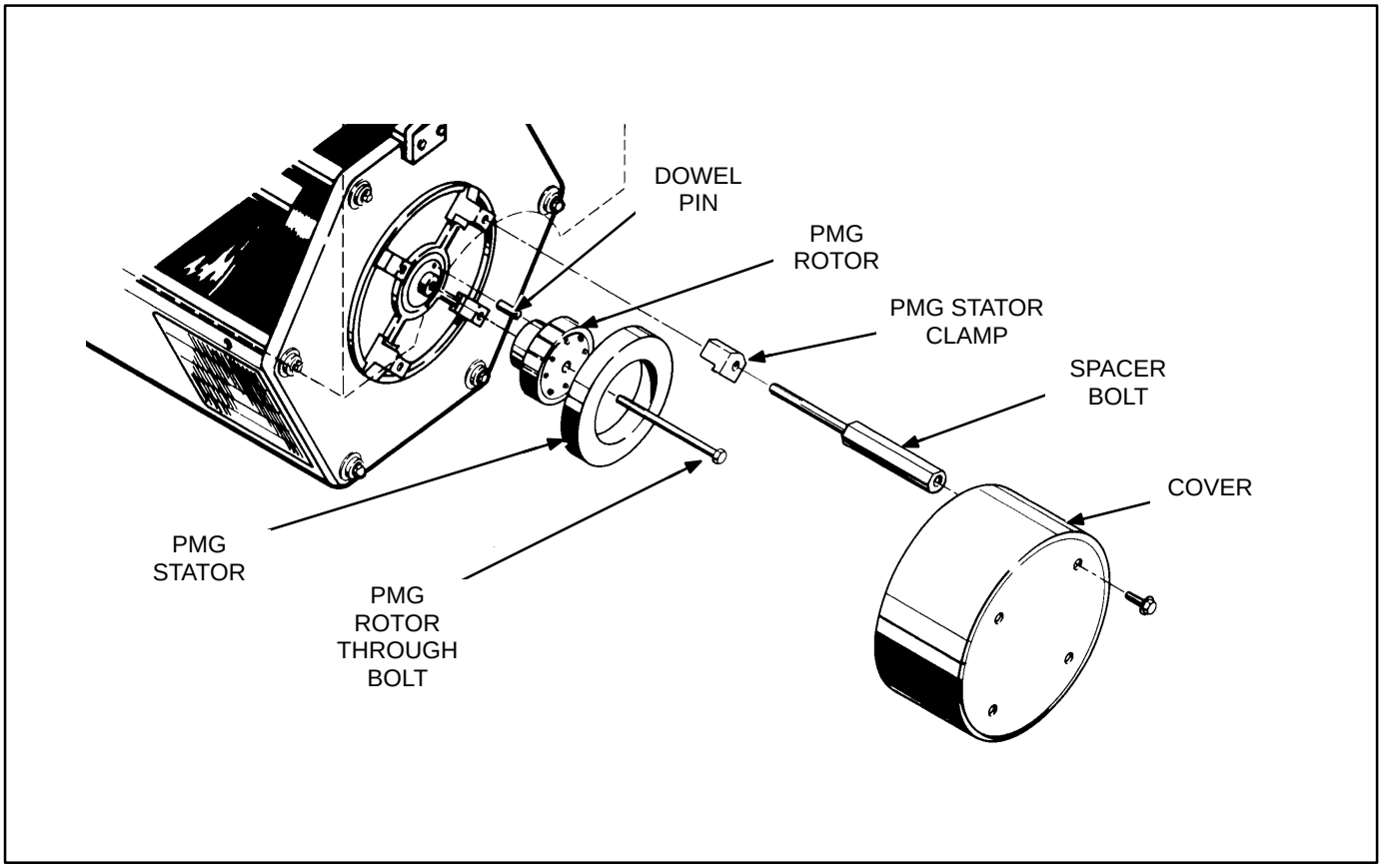



**FIGURE 6-8. PMG ASSEMBLY**

Redistribution or publication of this document, by any means, is strictly prohibited.

# 7. IGNITION/CARBURETION SYSTEM

## GENERAL

The following procedures are used to adjust the air/fuel ratio.

The measurements and adjustments are performed in the following order and include:

1. Measuring gas pressure to regulator and carburetor. Adjusting gas regulator if necessary.
2. Measuring and adjusting ignition timing.
3. Adjusting the air/fuel ratio for the proper gas mixture required for:
   A. The lowest exhaust gas temperature (EGT).
   B. Excess oxygen reading in exhaust gas at rated load and rpm.

### Detonation/Preignition

**⚠WARNING** ***Improper adjustment of the ignition system or carburetion system can cause personal injury or equipment damage. Service personnel must be qualified to perform these adjustments.***

Detonation and/or preignition are classifications of two forms of improper combustion of the fuel air mixture in the engine power cylinder. Both detonation and preignition can result in a hazardous operating condition and engine damage or loss of generator set power.

Normally, detonation or preignition are characterized by a knock or ringing sound from the engine. The knock or ringing can at times be masked by other engine/equipment noise. Both detonation and preignition can result in damage to engine components, including but not limited to: pistons, liners, spark plugs, bearings. If the engine is operated in a preignition condition it is possible to get a backfire through the intake system. This intake system backfire can cause severe damage to parts of the intake system, including but not limited to: throttle body, intake manifold cover, charge air cooler.

Detonation and/or preignition can be eliminated by one or a combination of the following:

- Reduce Load
- Engine Timing
- Air Fuel Ratio
- Inlet Air Temperature
- Fuel Quality

Redistribution or publication of this document,
by any means, is strictly prohibited.

## GAS PRESSURE

**⚠WARNING** ***High gas supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. Gas supply pressure must be adjusted to Specifications by qualified personnel.***

The gas pressure regulator provides constant gas pressure at the gas mixer under varying load conditions (Figure 7-1). There are pressure test ports on both sides of the regulator for measuring supply and regulated fuel pressures (NG or LPG systems).

**Supply side:** The minimum pressure refers to supply pressure under rated load (maximum gas flow).

The maximum permissible fuel supply pressure as any load is 20 inches water column (WC) and the minimum at full load is 10 inches WC.

**Note: Lower BTU fuels may require higher main line pressure to obtain proper pressure to the carburetor mixer valve. Do not exceed 20 inches of WC to the gas regulator or hard starting could result.**

**Mixer side:** The NG gas pressure should be between 4 to 6 inches WC at full load.

The LP gas pressure will be approximately –0.5 inches WC at no load and –1.0 inch WC at full load.

### Measuring Gas Pressure

Install the manometers into the two test ports of the gas regulator. Operate the genset under full load and make sure that the gas pressures are correct.

If the supply gas pressure to the regulator is less than 10 inches WC, check with the gas utility.

If the NG pressure on the mixer side is below the operating parameter, adjust the gas regulator as follows.

### Adjusting Gas Regulator For NG Pressure

1. Install the manometers into the two test ports of of the gas regulator.
2. Remove the regulator dust cap.
3. Start the genset, and run at full load.
4. Turn the adjusting screw until the meter shows the appropriate gas pressure for NG on the mixer side. (Turn screw clockwise to increase pressure.)

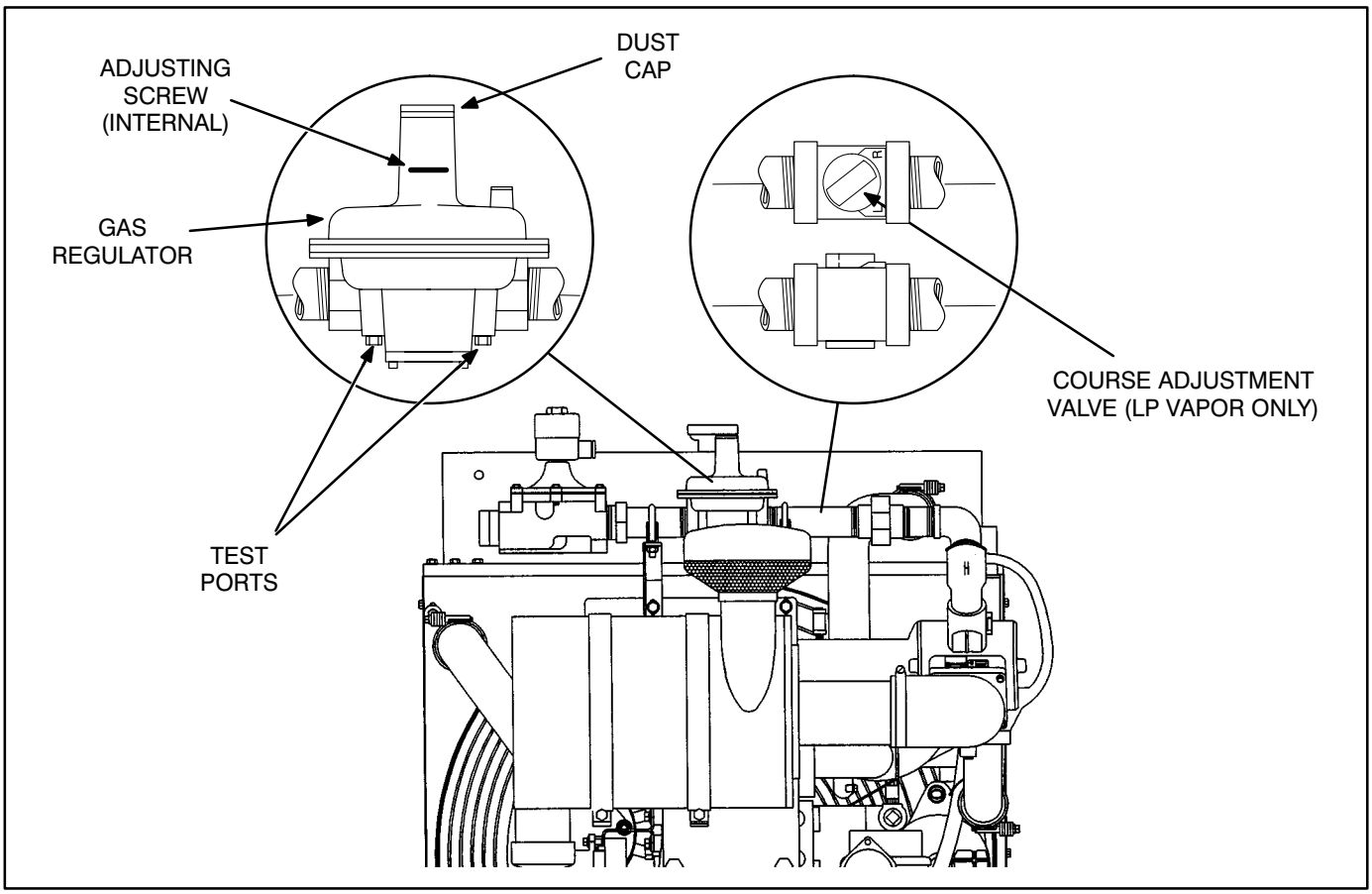



**FIGURE 7-1. GAS REGULATOR**

Redistribution or publication of this document, by any means, is strictly prohibited.

## IGNITION TIMING

Engine timing may need to be adjusted to maximize engine efficiency. Engine timing is not a fixed value but depends upon the type and quality of the fuel, altitude, temperature, and the air/fuel ratio. The air/fuel ratio is measured by the amount of excess Oxygen in the exhaust gas.

### Adjusting Engine Timing

If operating on pipeline NG or HD-5 propane, timing values listed should be acceptable and should not require adjustment. Operating on alternate fuels will likely result in adjustment of the engine timing.

The timing setting at before top dead center (TDC) is as follows: (The preferred setting is noted with an asterisk.)

- **GGKB/GGKC:** 28***** to 32 degrees
- **GGKD:** 26***** to 30 degrees

Additional timing adjustments may be required in conjunction with the adjustment of the power valve on the carburetor. Adjust the ignition timing as follows:

1. Connect the timing light high tension lead to the No. 1 spark plug (front cylinder) and the other two leads to the proper battery terminals.
2. Start the genset.
3. Point the adjustable timing light toward the pointer and TDC mark on the crank pulley.
4. If the engine timing needs to be adjusted, remove the white plastic cap and turn the timing switch adjustment screw (10 degree range) of the CD1 Ignition Module (Figure 7-2).

   Switch position 7 gives the most advanced timing. The timing retards 1.4 degrees for each switch position as the switch is moved to position 6, 5, 4, etc. Switch position 0 is full retard. Allow a short delay between each timing position change to allow the engine to stabilize.

   **⚠ CAUTION** ***DO NOT switch from position 7 to 0, or 0 to 7 while the engine is running. The large timing change can cause the engine to shutdown or be damaged.***

5. Perform the Carburetor Power Valve Adjustment procedure.

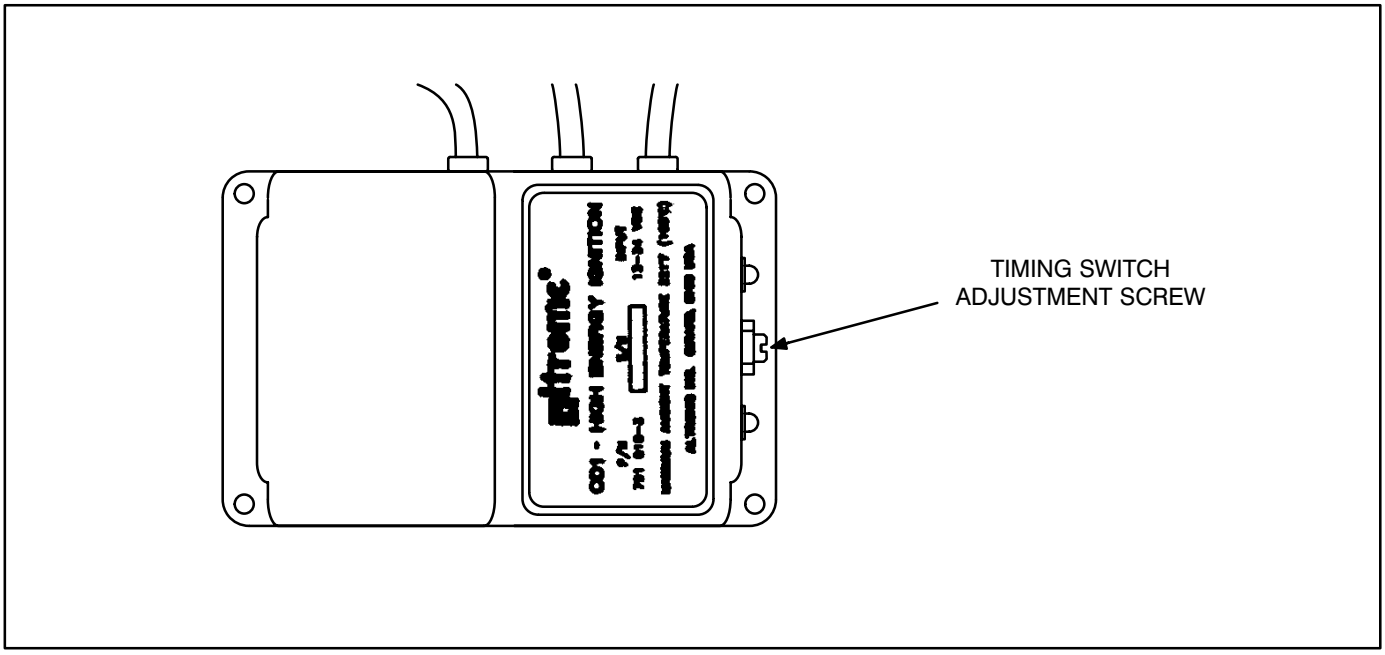



**FIGURE 7-2. CD1 IGNITION MODULE**

Redistribution or publication of this document,
by any means, is strictly prohibited.

## CARBURETOR POWER VALVE

The power valve (Figure 7-3) is at the gas inlet to the carburetor. Near the power valve are markings indicating either rich "**R**" or lean "**L**" with 5 lines between the two markings.

The adjustment is made with the genset under a full load condition, together with the utilization of an oxygen meter used to measure the excess oxygen in the exhaust system and a pyrometer for measuring the exhaust gas temperature (EGT). The measurement of excess oxygen ($O_2$) and EGT is taken downstream of the turbocharger exhaust gas outlet.

If the $O_2$ reading is below the required specification, adjust the power valve toward the lean mark. If above the proper setting, adjust toward the rich mark. Allow for several minutes to pass after each adjustment in order to record a stabilized $O_2$ reading.

**Note: Adjustment of the power valve can result in significant changes to $O_2$ values. Make only minor adjustments between stabilized readings.**

For additional information on how to measure the excess oxygen, refer to the engine *Operation And Maintenance* manual.

TEST PARAMETERS:

- EGT Temperature in exhaust manifold ahead of turbo charger: **1375° F (746° C) Max.**
- Exhaust $O_2$: **5% ±1%**
- Intake Manifold Pressure: **15 psi Max.**

### Adjusting Carburetor Power Valve

1. Install a 0–30 psi gauge on the intake manifold.
2. Install a pyrometer in the 1/8 inch pipe tapped hole of the exhaust manifold located ahead of the turbo charger (Figure 7-3).
3. Install an Oxygen meter exhaust gas pickup connection in one of the 1/8 inch pipe tapped holes of the exhaust elbow.
4. Connect a timing light (see Adjusting Engine Timing).
5. With the genset running under full load, adjust the power valve on the carburetor to obtain the lowest possible exhaust temperature while observing the $O_2$ reading. This can best be obtained by turning the power valve closed (toward "**L**" for a leaner mixture) until the engine starts loosing RPM, then turn the power valve open or out (toward "**R**" for a richer mixture) until the exhaust temperature reaches the lowest reading.

   If the power valve is opened beyond the ultimate point, the mixture will become too rich and the exhaust temperature will start to increase. It may be necessary to perform this adjustment two or three times to obtain the proper point of air/fuel ratio which will result in the coolest possible exhaust temperatures.

   **Note: After adjustment of power valve, attempt to apply 100% load in one step. If genset does not accept load, the fuel mixture may need to be made slightly richer.**

   **Adjust power valve for richer setting while staying within exhaust temperature limits.**
6. **LP Vapor Only:** Use the following procedure if the $O_2$ reading cannot be adjusted using the carburetor power valve.
   A. Turn the carburetor power valve to its midpoint.
   B. Turn the course adjustment valve (Figure 7-3) until an approximate reading of 5% is obtained.
   C. Use the carburetor power valve to set the $O_2$ to 5% ±1%.
7. Retard and advance the timing by 1.4 degree increments (see Adjusting Engine Timing) and repeat Step 5 to determine if the lowest possible exhaust temperature and lowest boost pressure has been obtained without loosing engine RPM. Repeat and confirm all readings several times.

Redistribution or publication of this document,
by any means, is strictly prohibited.

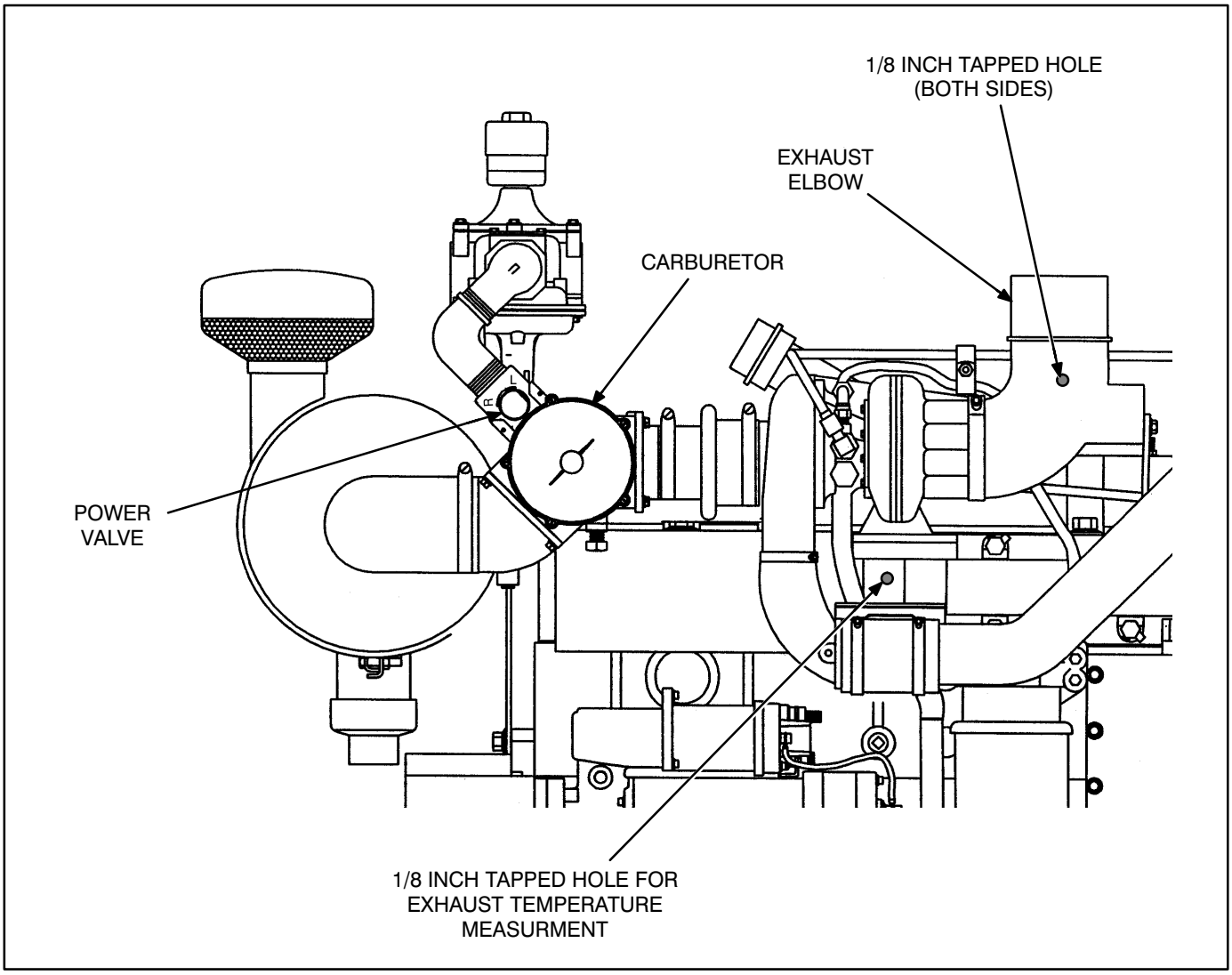



**FIGURE 7-3. POWER VALVE ADJUSTMENT AND TEST POINT LOCATIONS**

Redistribution or publication of this document,
by any means, is strictly prohibited.

Redistribution or publication of this document,
by any means, is strictly prohibited.

# 8. Wiring Diagrams

## GENERAL

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

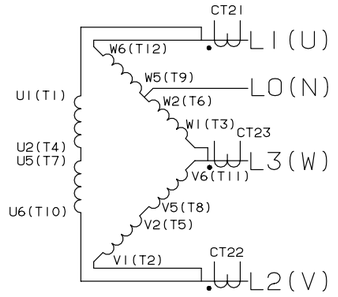

- Page 8-2 and 8-3, AC Reconnect Wiring Diagram
- Page 8-4, Block Diagram (12 Lead)
- Page 8-5, Block Diagram (6 Lead)
- Page 8-6, Customer Connections
- Page 8-7, Engine Interface Board (A31)
- Page 8-8, Digital board (A32)
- Page 8-9, Analog board (A33)
- Page 8-10, Customer Interface Board (A34)
- Page 8-11, Display Board (A35)
- Page 8-12, PC/CT Board (A36)
- Page 8-13,Voltage Regulator Output Module (A37)
- Page 8-14, Governor Output Board (A38)
- Page 8-15, PT/CT Wiring Harness
- Page 8-16, 6C Engine Harness Diagram
- Page 8-17, Accessory Box Interconnection Harness Diagram
- Page 8-18, Accessory Interconnect Diagram
- Page 8-19, Sequence of Operation (Local Start and Run)


Redistribution or publication of this document,
by any means, is strictly prohibited.

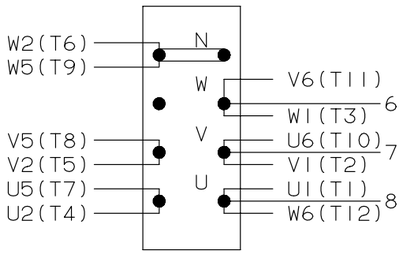
## 3 PHASE RECONNECTABLE, 12 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

100/200V, 50HZ (R79)
110/220V, 50HZ (R028)
115/230V, 50HZ (R071)
120/240V, 60HZ (R106)
* RANGE *
100-120/200-240 VOLTS

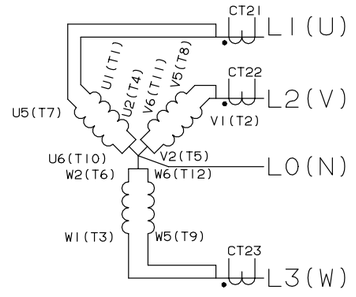



SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

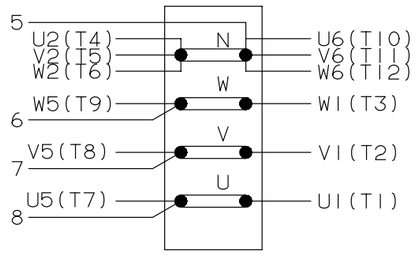



-01

110/190V, 50HZ (R004) 133/230V, 50;60HZ (R057)
115/200V, 50HZ (R050) 139/240V, 60HZ (R067)
120/208V, 50;60HZ (R098)
127/220V, 50;60HZ (R020)
* RANGE *
110-139/190-240 VOLTS



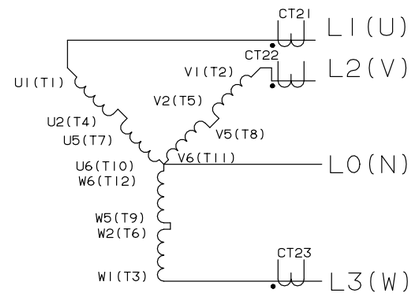

PARALLEL STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



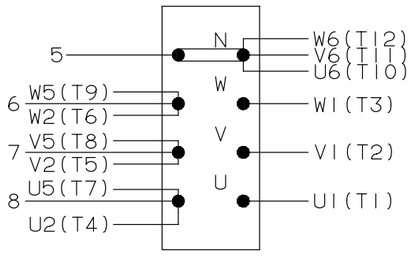

-02

CURRENT TRANSFORMER SECONDARY CONN 1-2

220/380V, 50; 60HZ (R099) 200/346V, 50HZ (R068)
260/450V, 50;60HZ (R109) 230/400V, 50HZ (R029)
240/416V, 50;60HZ (R003) 277/480V, 60 HZ (R002)
255/440V, 50HZ (R023) 266/460V, 60HZ (R027)
* RANGE *
220-277/380-480 VOLTS




SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

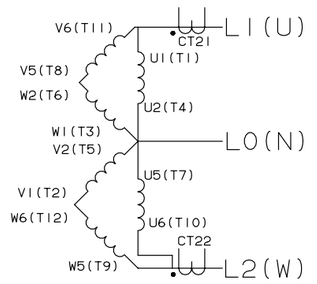



-03

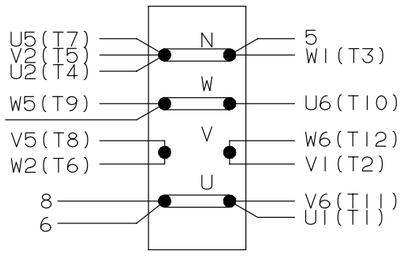
## 1 PHASE RECONNECTABLE, 12 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

100/200V, 50HZ (R054)
110/220V, 50HZ (R046)
115/230V, 60HZ (R041)
120/240V, 60HZ (R104)
* RANGE *
100-120/200-240 VOLTS




DOUBLE DELTA
1 PHASE 3 WIRE
OUTPUT TERMINALS
U.W. CENTER TAP N.

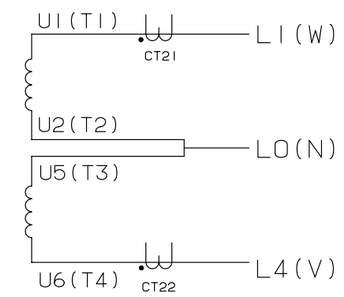



-04

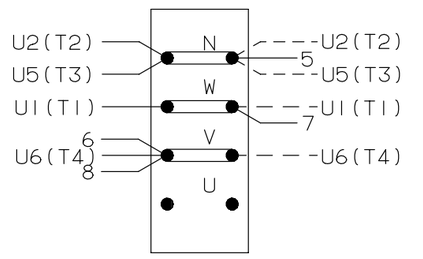
## 1 PHASE NON-RECONNECTABLE, 4 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

100/200V, 50HZ (R054)
110/220V, 50HZ (R046)
115/230V, 50HZ (R041)
120/240V, 60HZ (R104)
* RANGE *
100-120/200-240 VOLTS




1 PHASE 3 WIRE
OUTPUT TERMINALS
W, V, CENTER TAP N




-05

NOTES:

1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.

2. WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 22 ±2 FT-LBS.

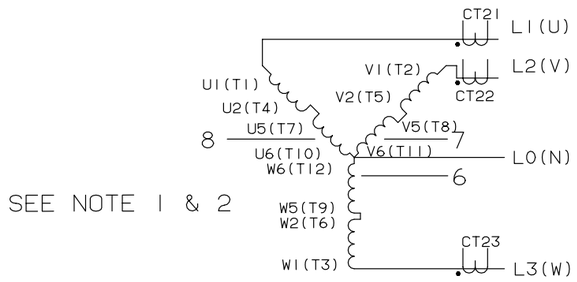
No. 625-3485 sh 1 of 2
Rev. C Sys: Revisio
Modified 7-30-98

Redistribution or publication of this document,
by any means, is strictly prohibited.

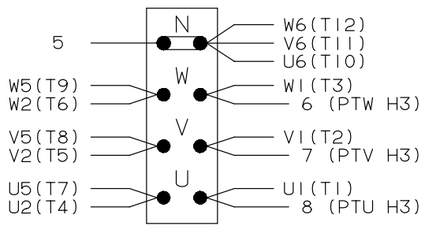
## 3 PHASE RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONN 1 - 2

347/600V, 60HZ (R114)




SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

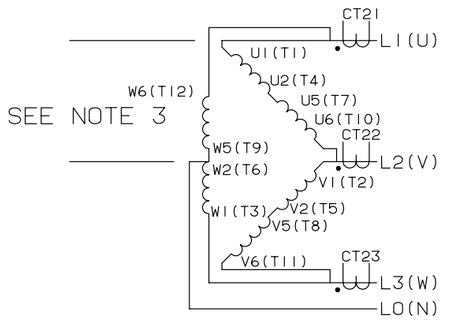



-06

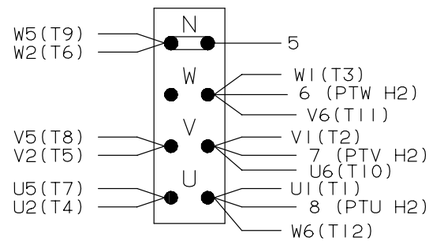
## 3 PHASE NON-RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONN 1 - 2

220/440V, 50 HZ (R019)
240/480V, 60 HZ (R119)




SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

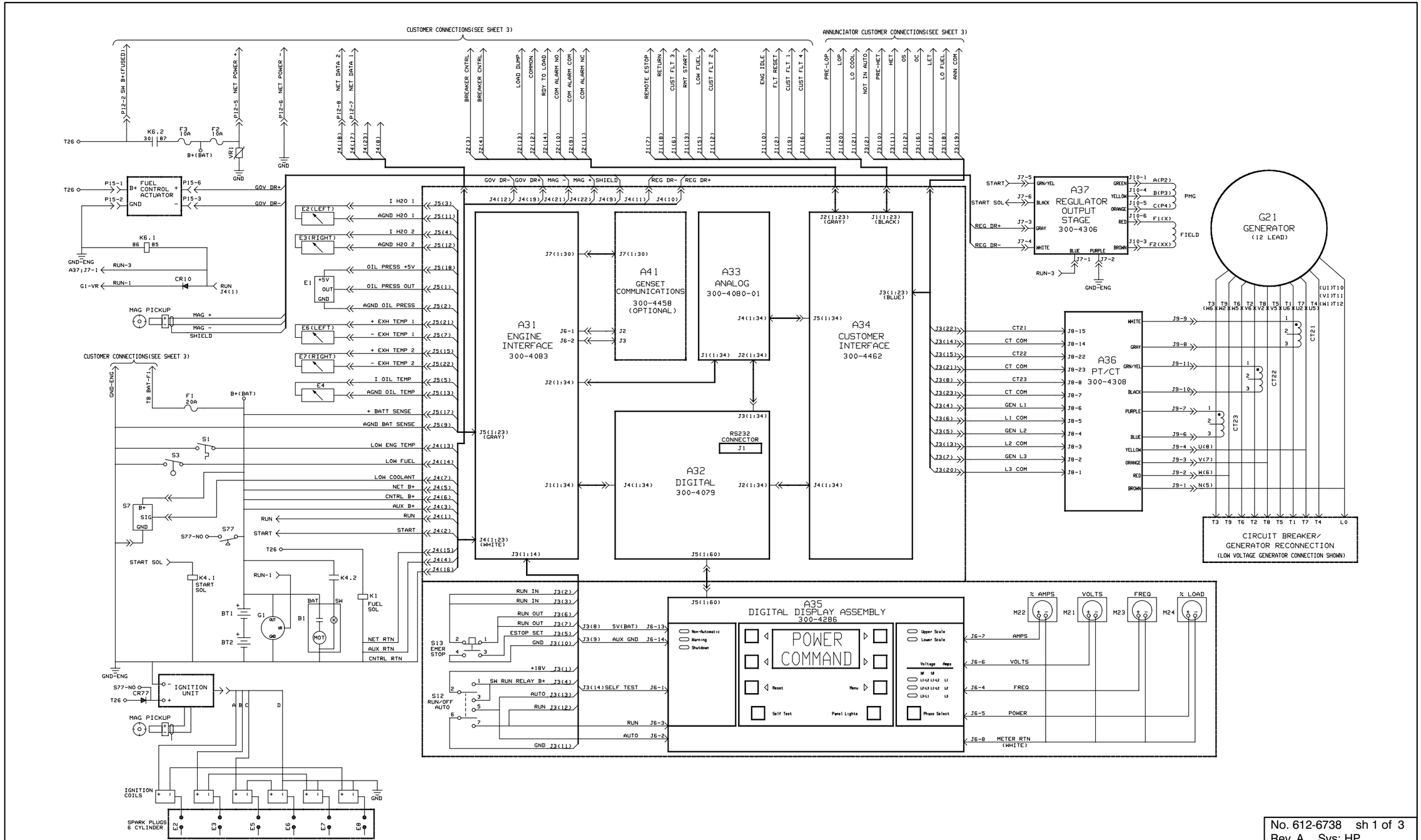



-07

No. 625-3485 sh 2 of 2
Rev. C Sys: Revisio
Modified 7-30-98

**AC RECONNECT WIRING DIAGRAM (SHEET 2 OF 2)**

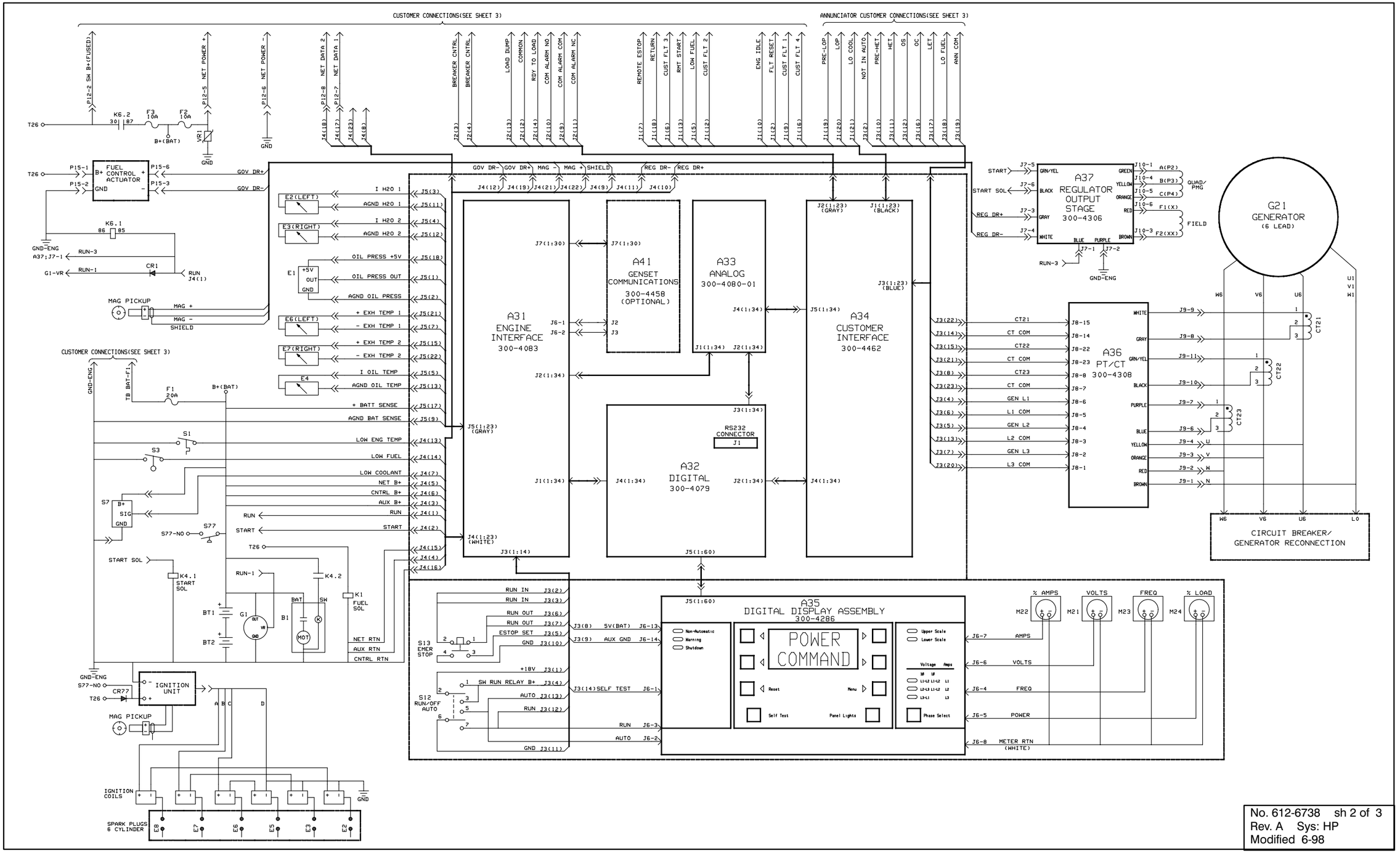
Redistribution or publication of this document,
by any means, is strictly prohibited.




No. 612-6738 sh 1 of 3
Rev. A Sys: HP
Modified 6-98

**BLOCK DIAGRAM (12 LEAD)**

Redistribution or publication of this document,
by any means, is strictly prohibited.



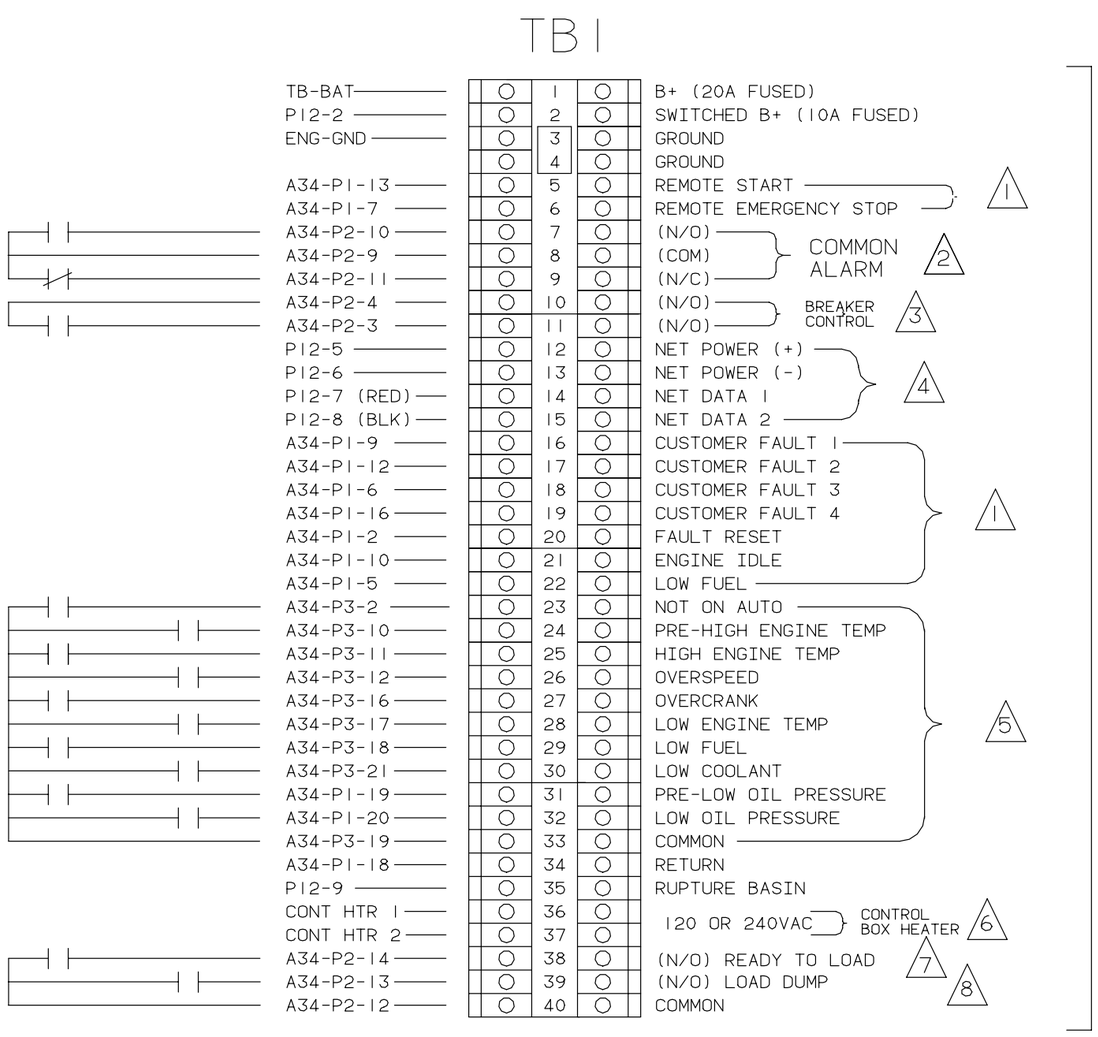

No. 612-6738 sh 2 of 3
Rev. A Sys: HP
Modified 6-98

**BLOCK DIAGRAM (6 LEAD)**



Redistribution or publication of this document,
by any means, is strictly prohibited.

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




1. APPLY A GROUND TO ACTIVATE INPUT CUSTOMER FAULT 2 AND CUSTOMER FAULT 3 "WAKE UP" THE CONTROL USE COPPER STRANDED WIRE, 20 GA FOR RUNS LESS THAN 1000 FT , 18 GA FOR RUNS FROM 1000 TO 2000 FT (LESS THAN 50MA CURRENT)

2. 2A @ 30VDC RELAY CONTACTS THIS RELAY PICKS UP WITH ANY WARNING OR SHUTDOWN

3. 5A @ 30VDC RELAY CONTACTS THIS RELAY PICKS UP TO OPEN BREAKER SHUNT TRIP IN SINGLE MODE

4. REFER TO ONAN 900-0366 POWER COMMAND NETWORK AND OPERATION MANUAL FOR INTERCONNECTION INSTRUCTIONS (OPTIONAL PCC NETWORK INTERFACE MODULE)

5. 1A @ 30VDC ISOLATED RELAY CONTACTS THIS RELAY PICKS UP ON THE GIVEN FAULT

6. 120VAC OR 240VAC @ 50 WATTS (OPTIONAL)

7. 2A @ 30VDC ISOLATED RELAY CONTACTS THIS RELAY PICKS UP WHEN GENERATOR AC VOLTAGE AND FREQUENCY EXCEED 90% OF NOMINAL

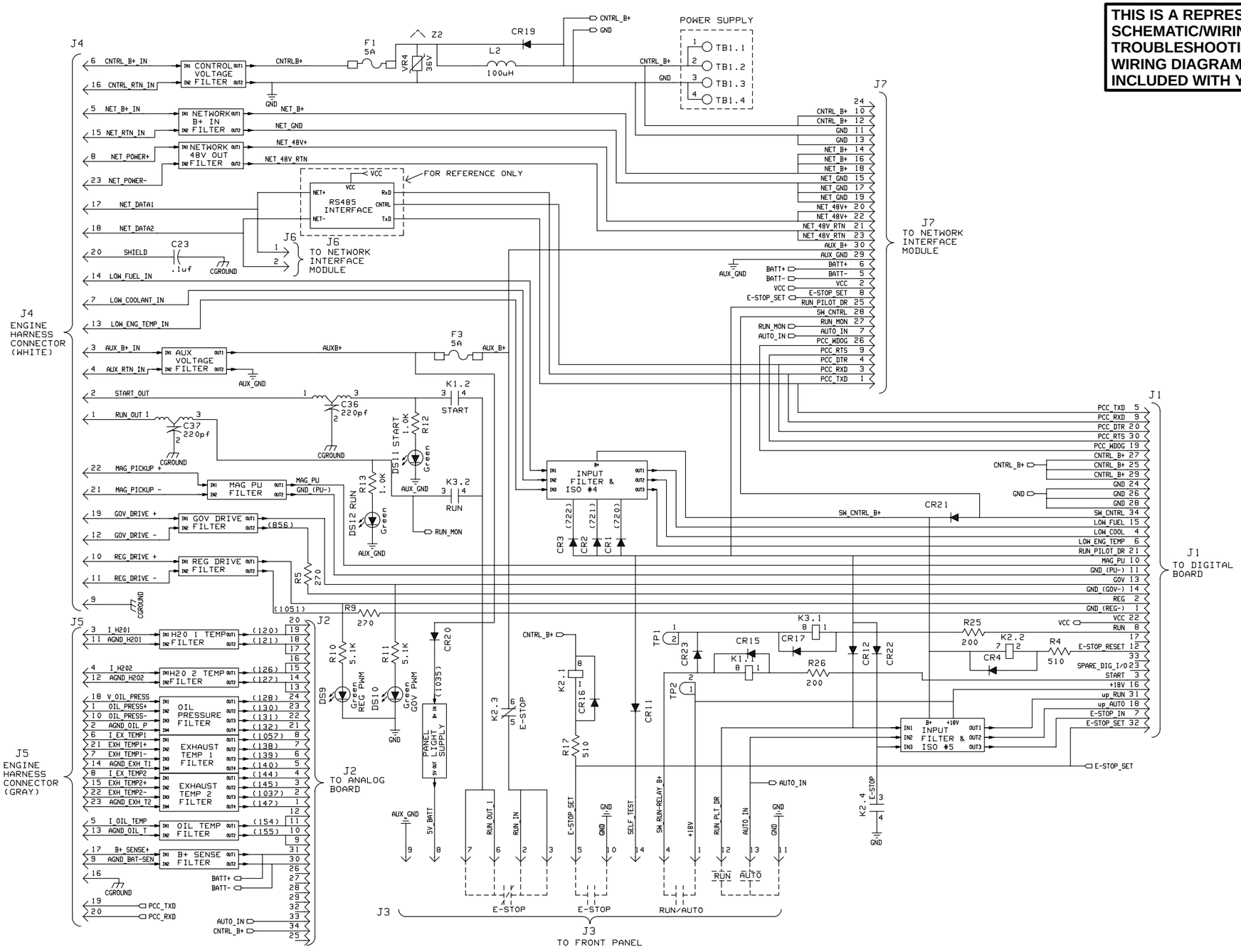
8. 2A @ 30VDC RELAY CONTACTS THIS RELAY PICKS UP IF A OVERLOAD OR UNDERFREQUENCY CONDITION CONTINUES FOR MORE THAN 5 SECONDS

9. TERMINAL BLOCK RATING
20 A , 600 V
22 TO 12 GA WIRE
TORQUE TERMINAL SCREWS TO 7 0 IN-LBS (0 8 NM)

No. 612-6738 sh 3 of 3
Rev. A Sys: HP
Modified 6-98

Redistribution or publication of this document, by any means, is strictly prohibited.

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

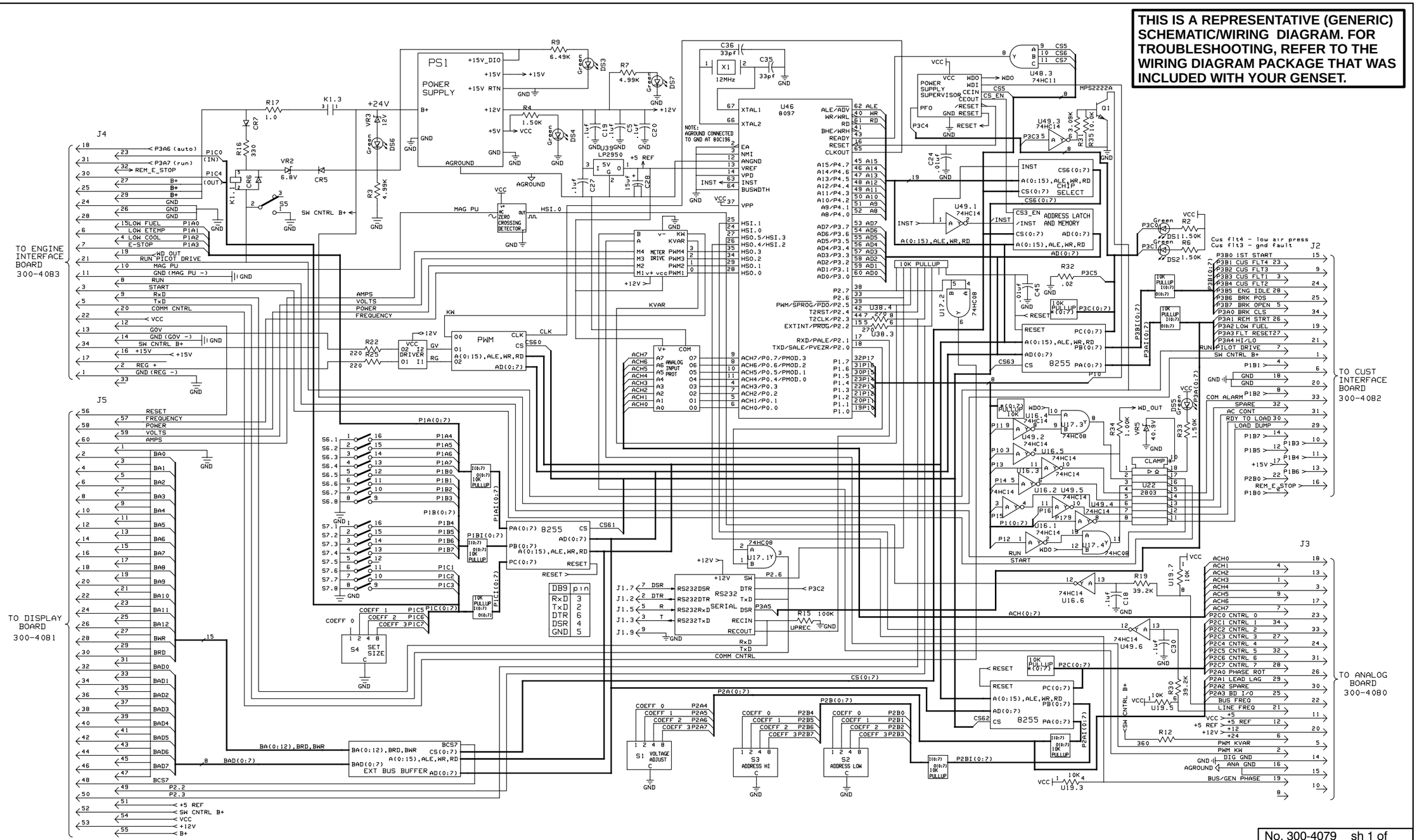



No. 300-4083 sh 1 of 4
Rev. E
Modified 7-94

**ENGINE ENTERFACE BOARD (A31)**

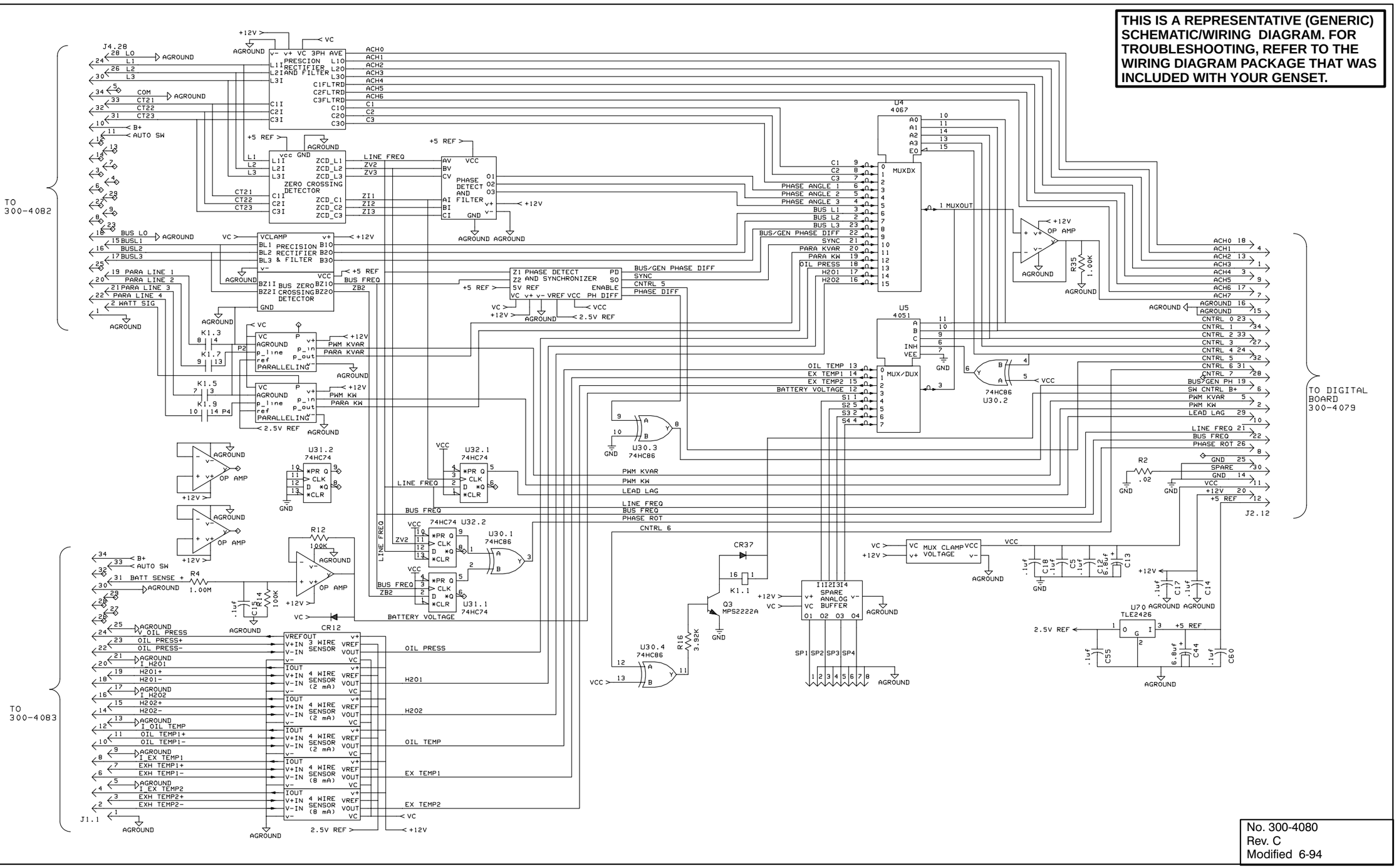
Redistribution or publication of this document,
by any means, is strictly prohibited.

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




Redistribution or publication of this document,
by any means, is strictly prohibited.

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

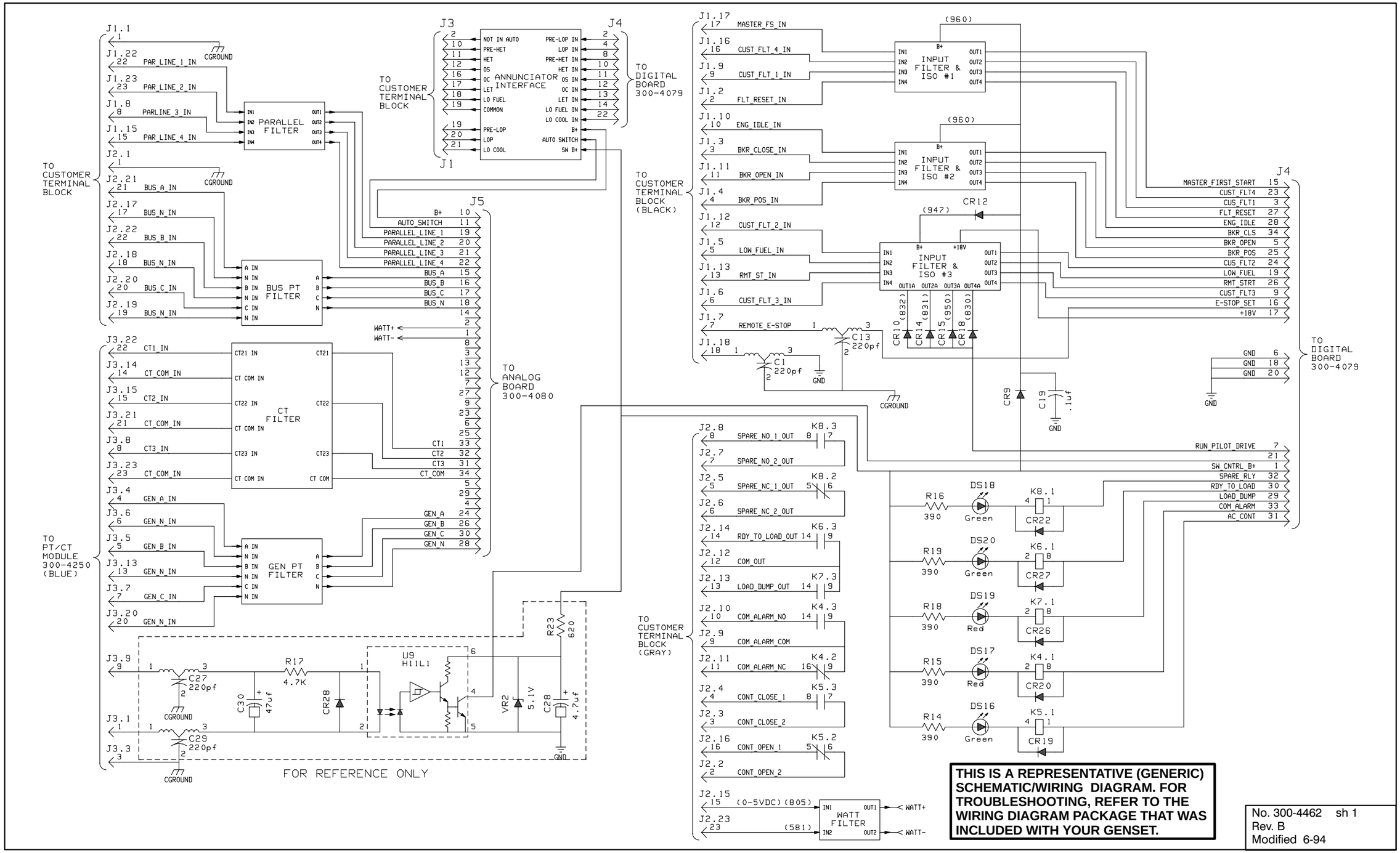



No. 300-4080
Rev. C
Modified 6-94

**ANALOG BOARD (A33)**



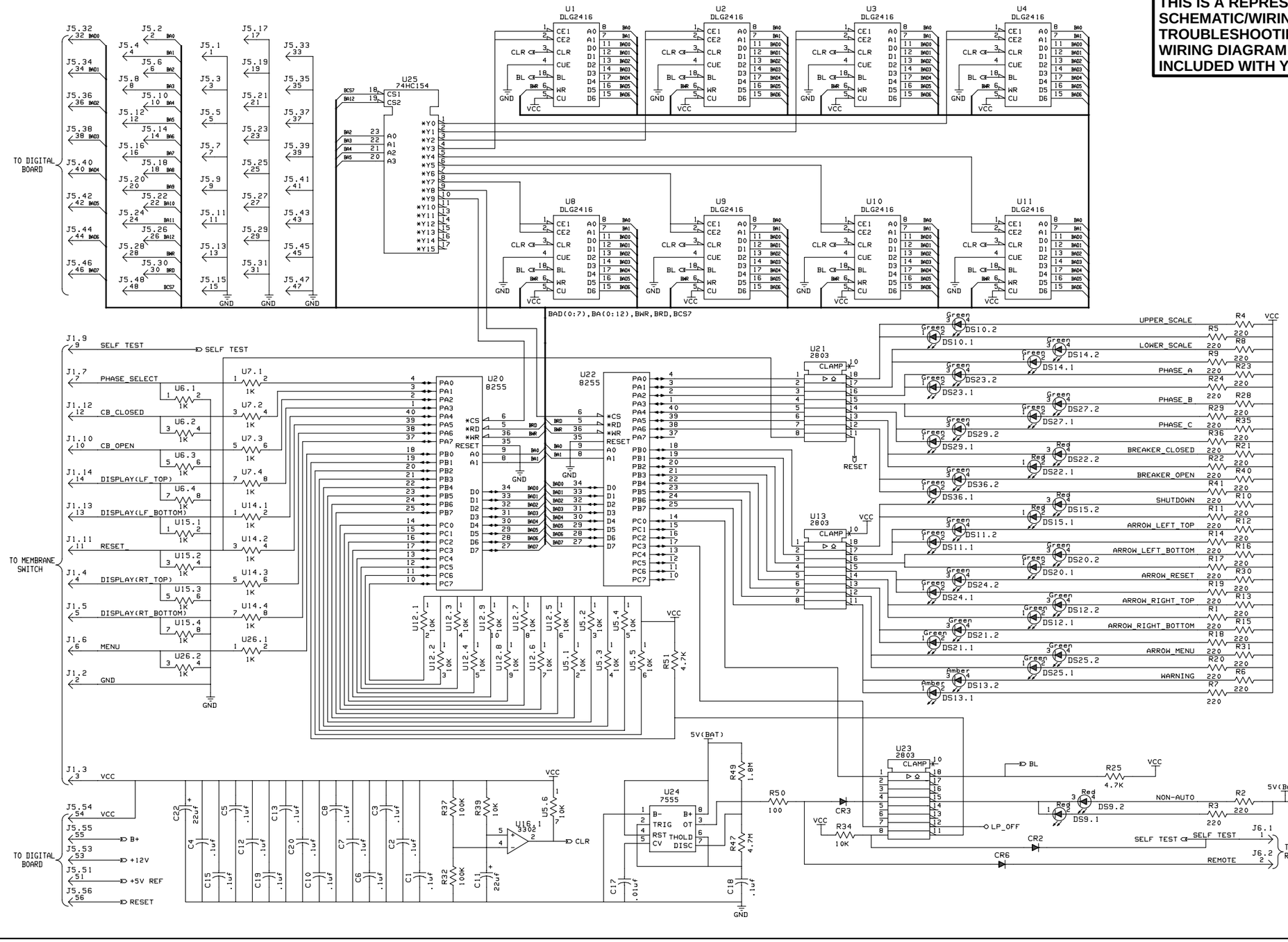
Redistribution or publication of this document,
by any means, is strictly prohibited.




**CUSTUOMER INTERFACE BOARD (A34)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

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

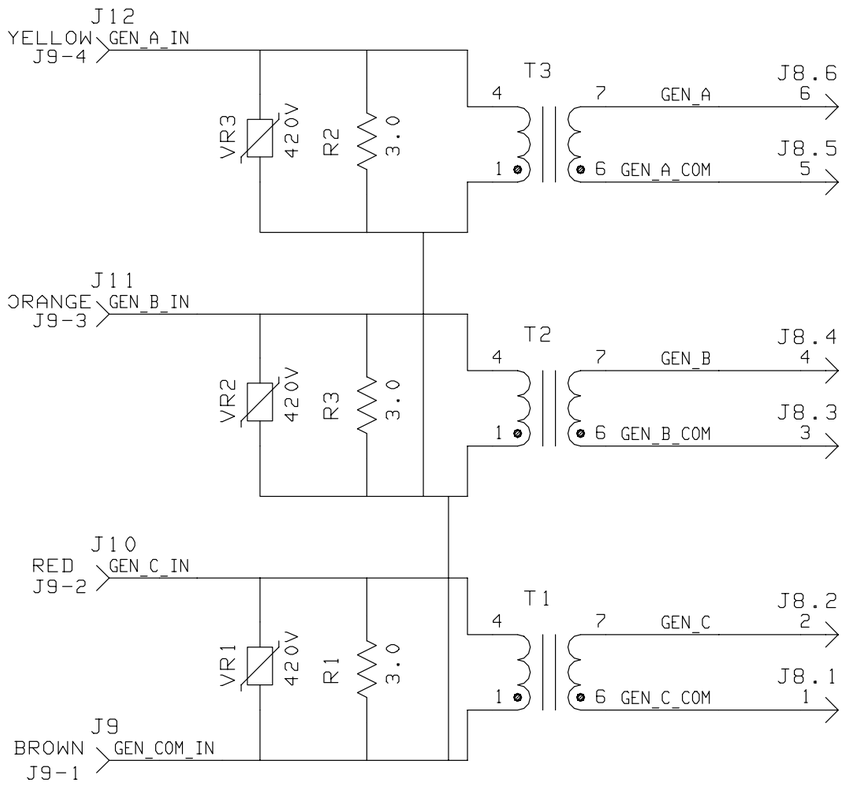


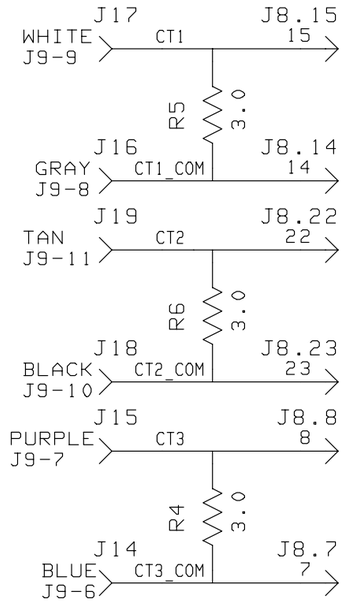

No. 300-4286 sh 1
Rev. G Sys: HP
Modified 3-95

**DISPLAY BOARD (A35)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

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



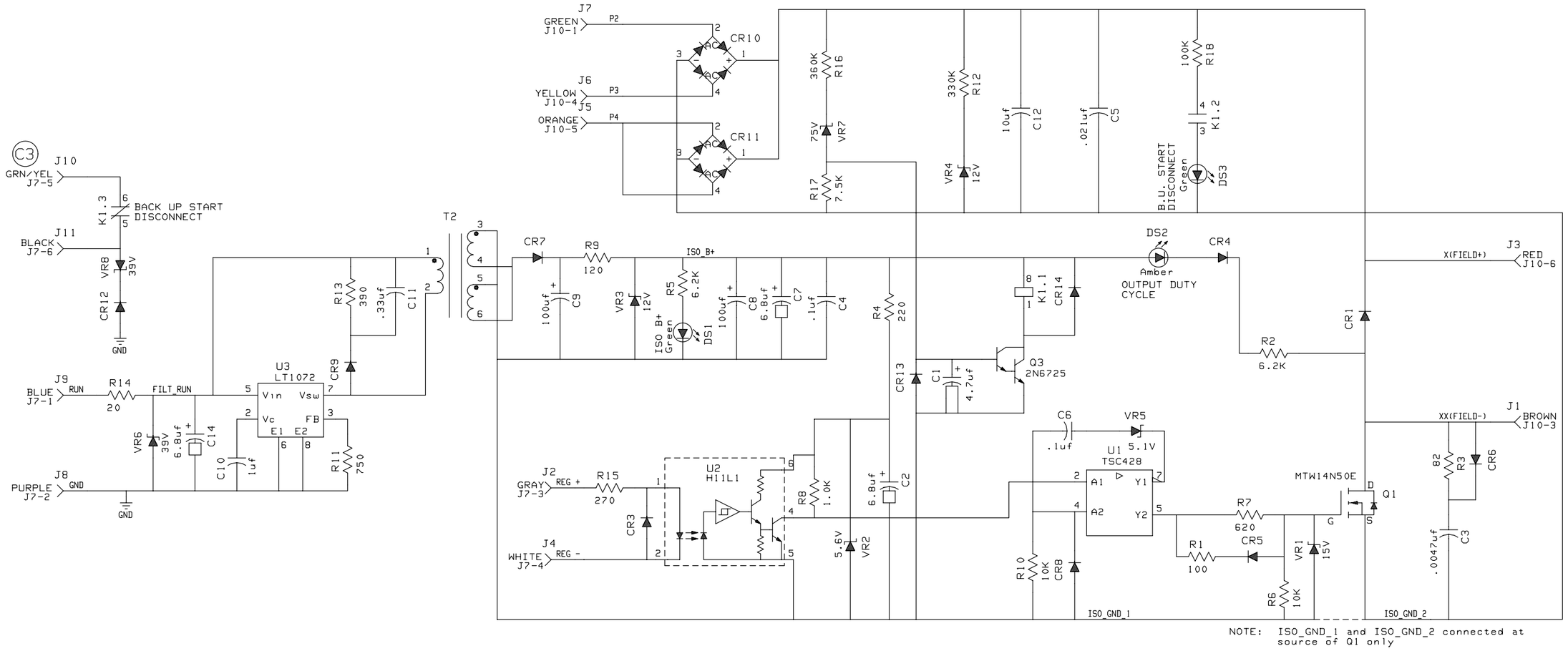




| PT VOLTAGE TABLE | | | |
|---|---|---|---|
| ASSY DWG NO. | GEN | | |
| | PRI | SEC | R1,R2,R3 Value |
| 300-4250-01 | 120V | 18V | 51k ohms |
| 300-4250-02 | 240V | 18V | 51k ohms |
| 300-4250-03 | 346V | 18V | 110k ohms |

No. 300-4250 sh 1
Rev. C Sys: HP
Modified 1/95

Redistribution or publication of this document,
by any means, is strictly prohibited.

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



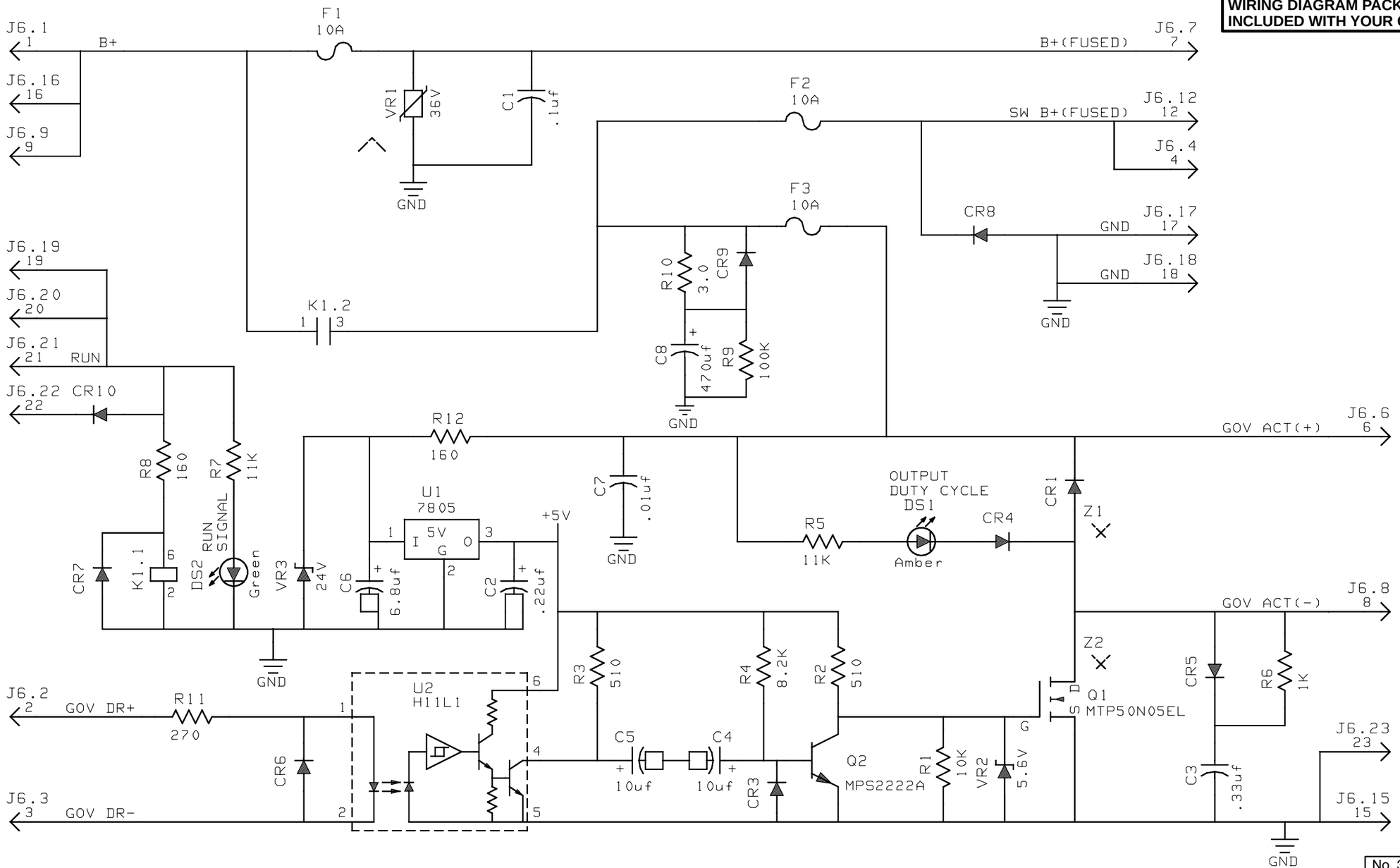

NOTE: ISO_GND_1 and ISO_GND_2 connected at source of Q1 only

No. 300-4085 sh 1
Rev. F
Modified 6-94



Redistribution or publication of this document, by any means, is strictly prohibited.

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

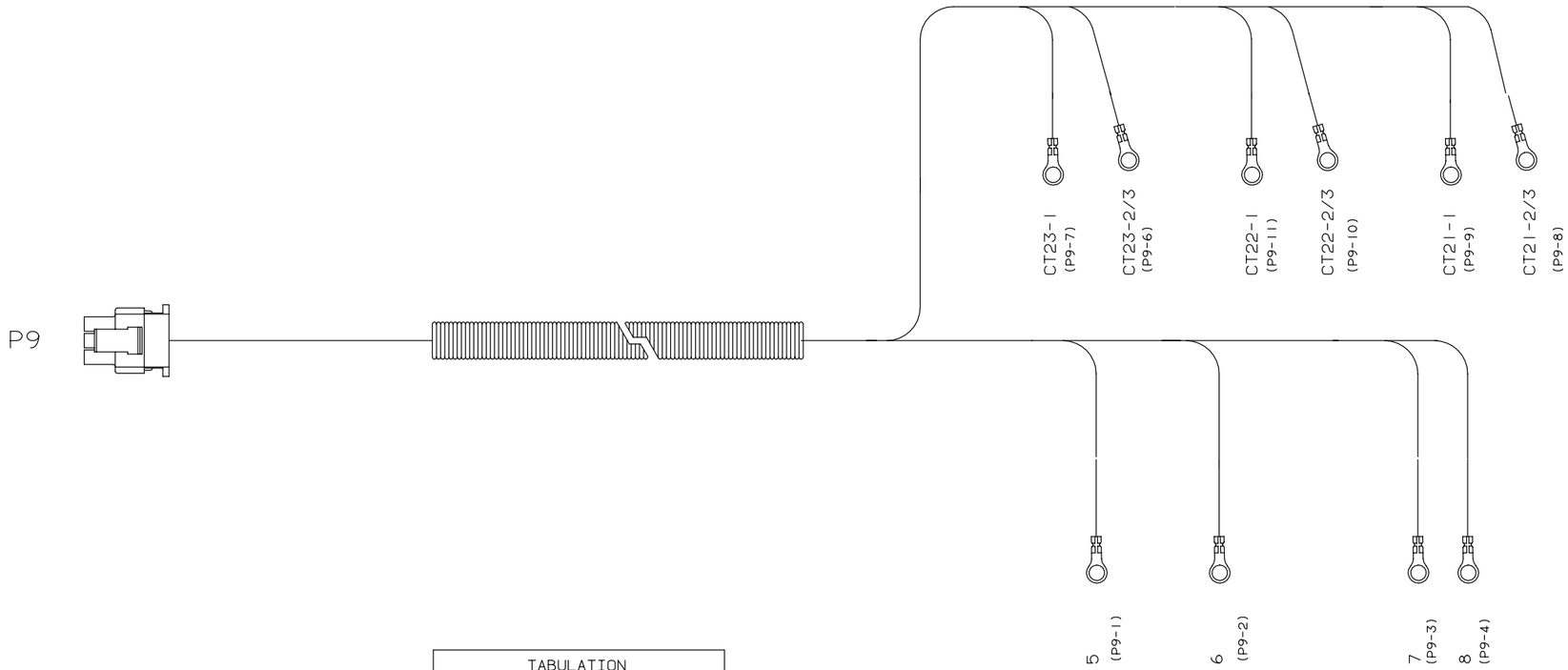



No. 300-4084 sh 1
Rev. D
Modified 6/94

**GOVERNOR OUTPUT BOARD (A38)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

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



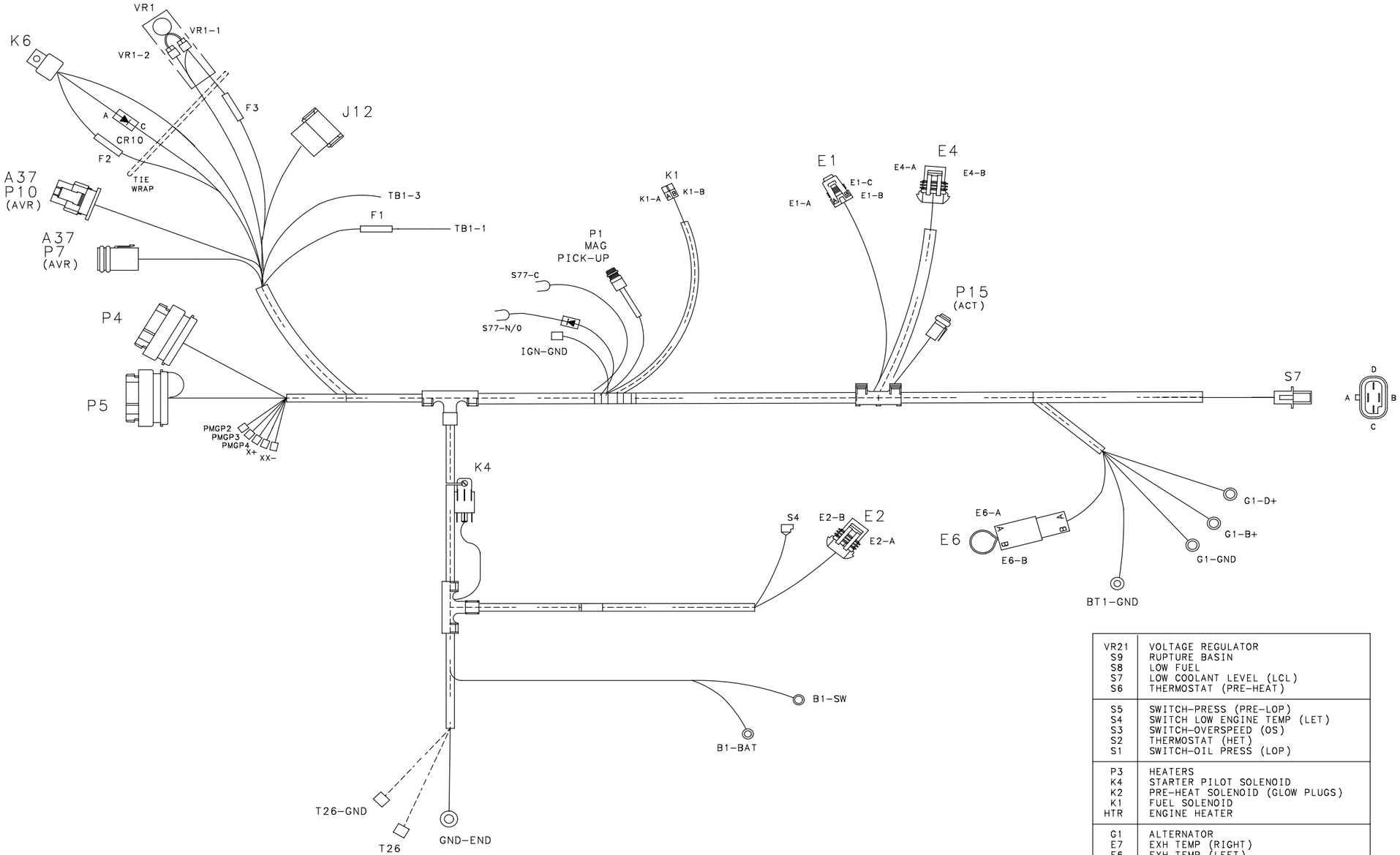

| TABULATION | |
|---|---|
| FROM STATION | TO STATION |
| A36-P9-11 | CT22-1 |
| A36-P9-10 | CT22-2/3 |
| A36-P9-9 | CT21-1 |
| A36-P9-8 | CT21-2/3 |
| A36-P9-7 | CT23-1 |
| A36-P9-6 | CT23-2/3 |
| A36-P9-4 | 8 |
| A36-P9-3 | 7 |
| A36-P9-2 | 6 |
| A36-P9-1 | 5 |

No. 338-3019 sh 1
Rev. C
Modified 6/94

**PT/CT WIRING HARNESS**



Redistribution or publication of this document, by any means, is strictly prohibited.



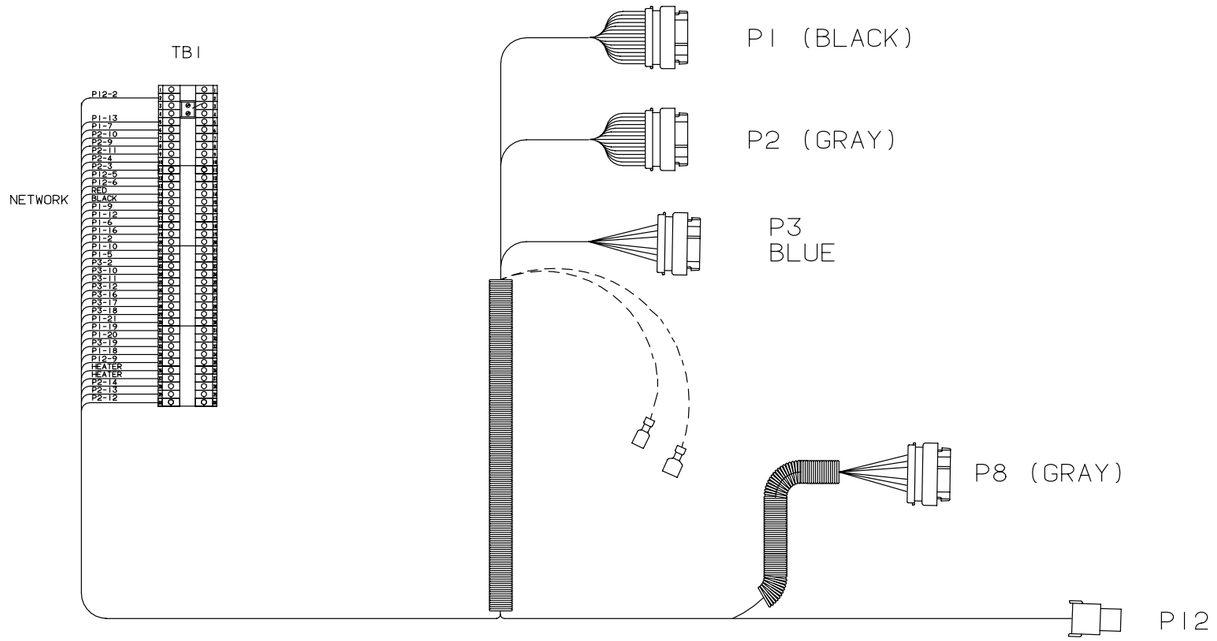

| LEAD TABULATION | |
|---|---|
| FROM STATION | TO STATION |
| P4-7 | S7-D |
| P4-13 | S4 |
| P4-2 | P7-5 |
| P4-22 | MAG-A |
| P4-21 | MAG-B |
| P4-9 | SHIELD |
| P4-19 | P15-6 |
| P4-12 | P15-3 |
| P4-10 | P7-3 |
| P4-11 | P7-4 |
| P4-17 (NOTE 8) | J12-7 (NOTE 8) |
| P4-18 | J12-8 |
| P5-3 | E2-A |
| P5-11 | E2-B |
| P5-2 | E1-A |
| P5-18 | E1-B |
| P5-1 | E1-C |
| P5-4 | P5-12 |
| P5-5 | E4-A |
| P5-13 | E4-B |
| P5-15 | P5-22 |
| B1-SW | K4-30 |
| PMG-P2 | P10-1 |
| PMG-P3 | P10-4 |
| PMG-P4 | P10-5 |
| X + | P10-6 |
| XX - | P10-3 |
| P7-6 | K4-86 |
| F1 | TB1-1 |
| S77-C | B1-BAT |
| G1 B+ | |
| K4-87 | |
| P4-6 | |
| P4-5 | |
| P4-3 | |
| P5-17 | |
| S7-C | |
| F1 | |
| F3 | |
| F2 | |
| P4-16 | GND-ENG |
| P4-15 | |
| P4-4 | |
| J12-6 | |
| TB1-3 | |
| P5-9 | |
| G1-GND | |
| BT1-GND | |
| S7-B | |
| P7-2 | |
| K4-85 | |
| IGN GND | |
| T26-GND | |
| P15-2 | |
| K1-B | |
| VR1-2 | T26 |
| K6-86 | |
| K6-30 | |
| J12-2 | |
| P15-1 | |
| K1-A | |
| T26 | |
| CR77-A | |
| | |
| P4-1 | K6-85 |
| CR10-A | P7-1 |
| G1-D+ | CR10-C |
| CR77-C | S77-N/O |
| J12-5 | VR1-1 |
| F3 | |
| F2 | K6-87 |
| P5-21 | E6-A |
| P5-7 | E6-B |

| | |
|---|---|
| VR21 | VOLTAGE REGULATOR |
| S9 | RUPTURE BASIN |
| S8 | LOW FUEL |
| S7 | LOW COOLANT LEVEL (LCL) |
| S6 | THERMOSTAT (PRE-HEAT) |
| S5 | SWITCH-PRESS (PRE-LOP) |
| S4 | SWITCH LOW ENGINE TEMP (LET) |
| S3 | SWITCH-OVERSPEED (OS) |
| S2 | THERMOSTAT (HET) |
| S1 | SWITCH-OIL PRESS (LOP) |
| P3 | HEATERS |
| K4 | STARTER PILOT SOLENOID |
| K2 | PRE-HEAT SOLENOID (GLOW PLUGS) |
| K1 | FUEL SOLENOID |
| HTR | ENGINE HEATER |
| G1 | ALTERNATOR |
| E7 | EXH TEMP (RIGHT) |
| E6 | EXH TEMP (LEFT) |
| E5 | TACHOMETER |
| E4 | SENDER-OIL TEMP |
| E3 | SENDER-WATER TEMP (RIGHT) |
| E2 | SENDER-WATER TEMP (LEFT) |
| E1 | SENDER-OIL PRESSURE |
| BT1 | BATTERY-STORAGE |
| B1 | STARTER & SOLENOID |
| A12 | GOVERNOR |

No. 338-3729 sh 2 of 2
Rev. B Sys: Revisio
Modified 7/98

**6C ENGINE HARNESS DIAGRAM**

Redistribution or publication of this document,
by any means, is strictly prohibited.




| LEAD TABULATION | |
|---|---|
| FROM STATION | TO STATION |
| P12-1 | SEE NOTE 8 |
| P12-2 | TB1-2 |
| P1-13 | TB1-5 |
| P1-7 | TB1-6 |
| P2-10 | TB1-7 |
| P2-9 | TB1-8 |
| P2-11 | TB1-9 |
| P2-4 | TB1-10 |
| P2-3 | TB1-11 |
| P12-5 | TB1-12 |
| P12-6 | TB1-13 |
| P12-7 RED | TB1-14 RED |
| P12-8 BLK | TB1-15 BLK |
| P1-9 | TB1-16 |
| P1-12 | TB1-17 |
| P1-6 | TB1-18 |
| P1-16 | TB1-19 |
| P1-2 | TB1-20 |
| P1-10 | TB1-21 |
| P1-5 | TB1-22 |
| P3-2 | TB1-23 |
| P3-10 | TB1-24 |
| P3-11 | TB1-25 |
| P3-12 | TB1-26 |
| P3-16 | TB1-27 |
| P3-17 | TB1-28 |
| P3-18 | TB1-29 |
| P1-21 | TB1-30 |

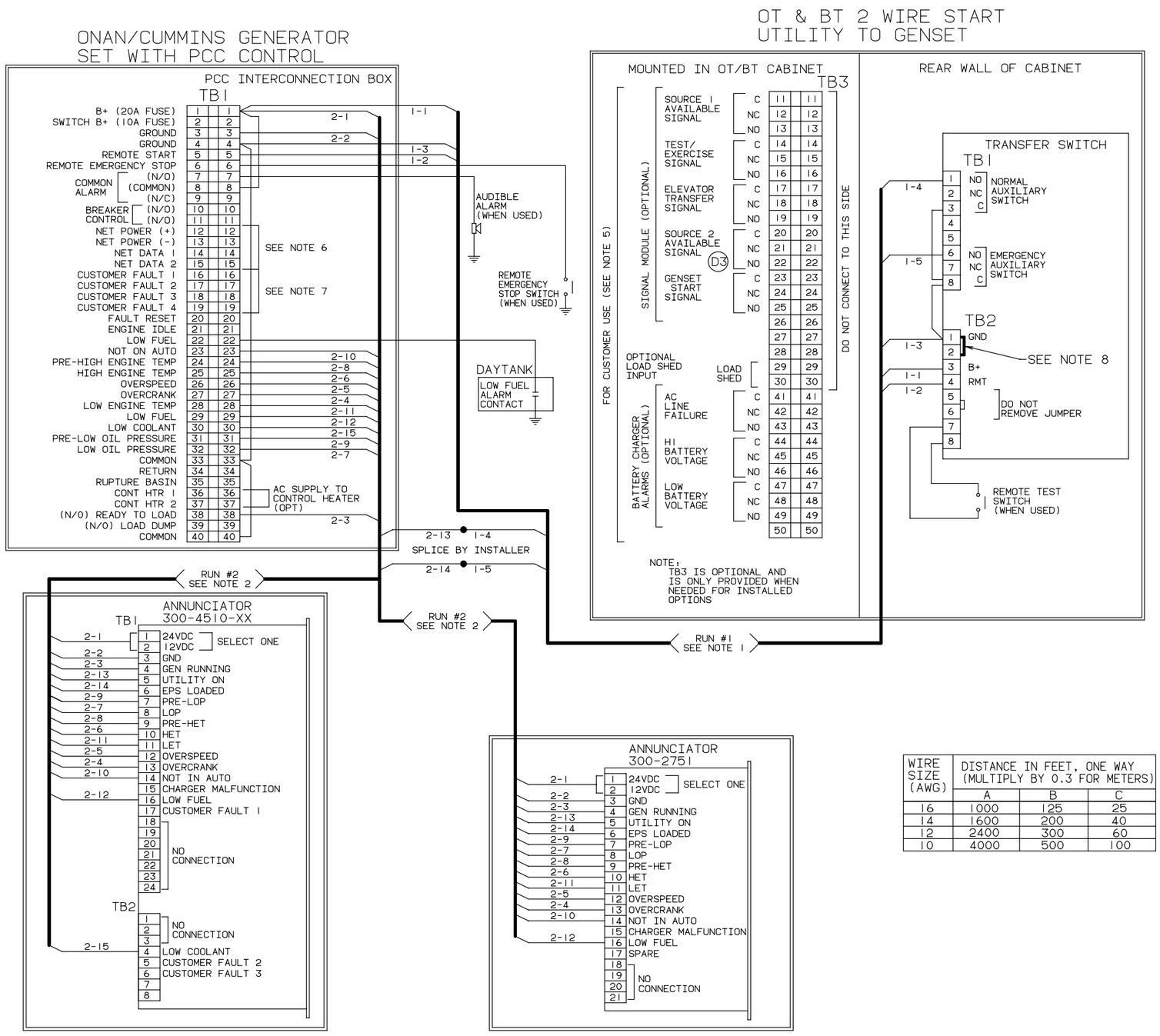
| LEAD TABULATION | |
|---|---|
| FROM STATION | TO STATION |
| P1-19 | TB1-31 |
| P1-20 | TB1-32 |
| P3-19 | TB1-33 |
| P1-18 | TB1-34 |
| P12-9 | TB1-35 |
| HTR 1 | TB1-36 |
| HTR 2 | TB1-37 |
| P2-14 | TB1-38 |
| P2-13 | TB1-39 |
| P2-12 | TB1-40 |
| P8-1 | P3-20 |
| P8-2 | P3-7 |
| P8-3 | P3-13 |
| P8-4 | P3-5 |
| P8-5 | P3-6 |
| P8-6 | P3-4 |
| P8-7 | P3-23 |
| P8-8 | P3-8 |
| P8-9 | P3-1 |
| P8-16 | P3-9 |
| P8-14 | P3-14 |
| P8-15 | P3-22 |
| P8-22 | P3-15 |
| P8-23 | P3-21 |

No. 338-3525 sh 1 of 1
Rev. A Sys: Revisio
Modified 10/96

**ACCESSORY BOX INTERCONNECTION HARNESS DIAGRAM**

Redistribution or publication of this document,
by any means, is strictly prohibited.

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



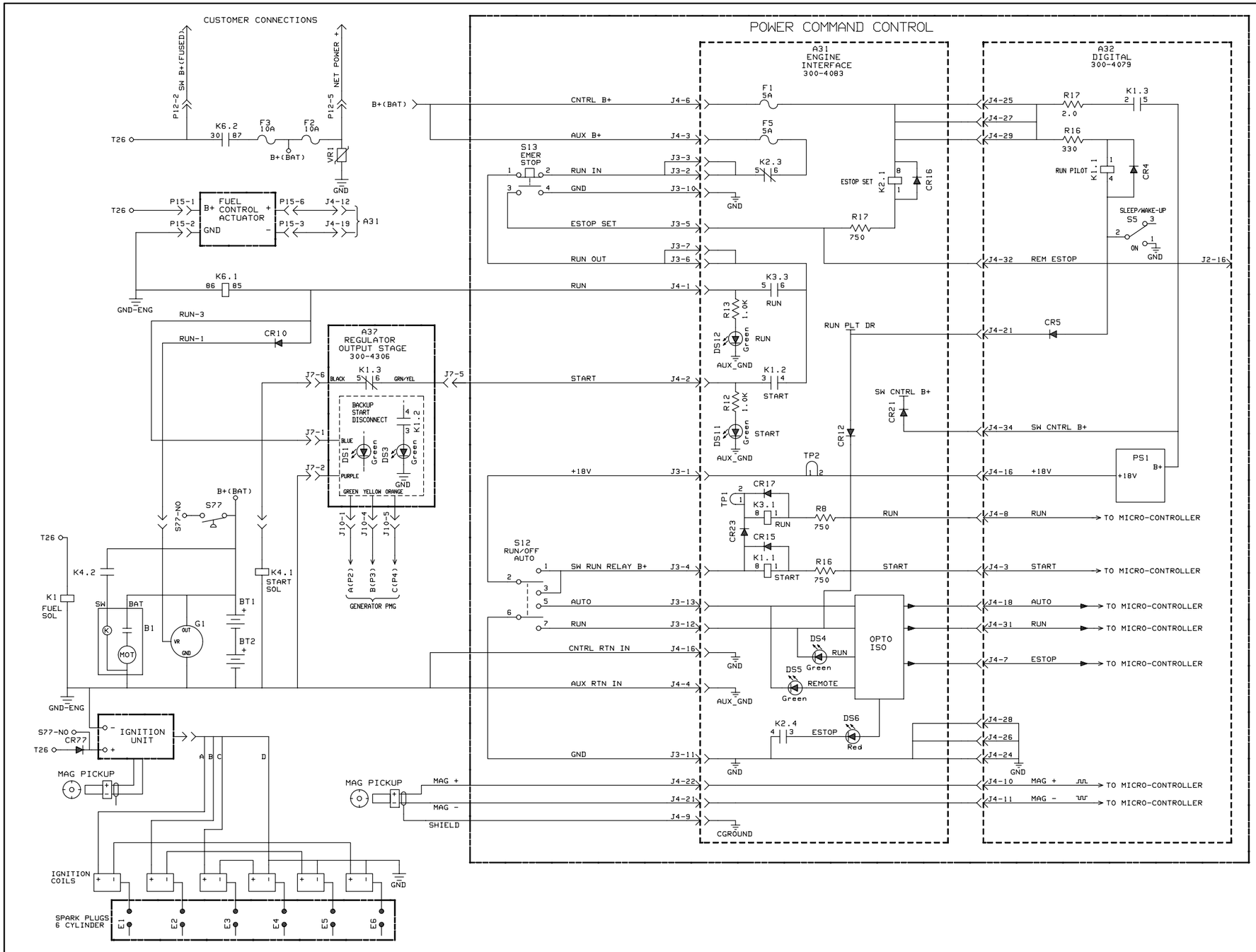

NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL A.
   WITH 2 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. C
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. 
5. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
6. REFER TO ONAN 900-0366 POWER COMMAND NETWORK & OPERATION MANUAL. FOR WIRING INSTRUCTIONS.
7. INPUTS FOR CUSTOMER FAULTS. GROUNDED SIGNAL REQUIRED TO ACTIVATE INPUT (MAX 50 MA.)
8. INSTALL JUMPER BETWEEN TB2-1 & TB2-2. FOR SETS WITH PCC CONTROL.

| WIRE SIZE (AWG) | DISTANCE IN FEET, ONE WAY (MULTIPLY BY 0.3 FOR METERS) | | |
|---|---|---|---|
| | A | B | C |
| 16 | 1000 | 125 | 25 |
| 14 | 1600 | 200 | 40 |
| 12 | 2400 | 300 | 60 |
| 10 | 4000 | 500 | 100 |

No. 630-1345 sh 1
Rev. E
Modified 6/94

Redistribution or publication of this document, by any means, is strictly prohibited.




NOTES:

THE FOLLOWING IS THE CONDITION OF THE POWER COMMAND CONTROL IN THE "OFF" POSITION.

1. S12 IS SET TO THE OFF POSITION.
2. RUN PILOT RELAY K1 ON DIGITAL BOARD (A32) IS DE-ENERGIZED.

NOTES:

THE FOLLOWING IS THE SEQUENCE OF EVENTS FOR LOCAL START AND RUN.

1. S12 IS SET TO THE RUN POSITION.
2. RUN PILOT RELAY K1 ON DIGITAL BOARD (A32) IS ENERGIZED.
3. B+ IS NOW APPLIED TO THE POWER SUPPLY SECTION OF ENGINE INTERFACE BOARD (A31) AND THE DIGITAL BOARD (A32).
4. RUN LED DS4 ON ENGINE INTERFACE BOARD (A31) IS ON.
5. THE DIGITAL BOARD INITIATES A START DRIVE.
6. START RELAY K1 ON ENGINE INTERFACE BOARD (A31) IS ENERGIZED.
7. B+ IS NOW APPLIED TO THE STARTER SOLENOID.
8. ENGINE WOULD CRANK.
9. THE DIGITAL BOARD (A32) MONITORS THE MAG PICKUP AND INITIATES A RUN DRIVE.
10. RUN RELAY K3 ON ENGINE INTERFACE BOARD (A31) IS ENERGIZED.
11. B+ IS NOW APPLIED TO THE FUEL SOLENOID,ALTERNATOR G1,REGULATOR OUTPUT STAGE (A37).
12. LED DS1 ON REGULATOR OUTPUT STAGE (A37) IS ON.
13. RELAY K6 IS ENERGIZED.
14. SW B+ IS NOW APPLIED TO TERMINAL 26 AND CUSTOMER CONNECTIONS.
15. ENGINE WOULD RUN.
16. THE DIGITAL BOARD (A32) MONITORS THE MAG PICKUP AND WHEN THE ENGINE REACHES 475 RPM THE START DRIVE IS REMOVED.
17. START RELAY K1 ON ENGINE INTERFACE BOARD (A31) IS DE-ENERGIZED,REMOVING B+ TO THE STARTER SOLENOID. RELAY CONTACT K1.2 IS OPEN,START LED DS11 IS OFF.
18. WHEN PMG OUTPUT REACHES 105VAC(850 RPM), BACK-UP START DISCONNECT RELAY K1 ON REGULATOR OUTPUT STAGE (A37) IS ENERGIZED, RELAY CONTACT K1.3 IS OPEN,BACK-UP START DISCONNECT LED DS3 IS ON.

No. 612-6737 sh 1 of 1
Rev. A Sys: HP
Modified 7/98

**SEQUENCE OF OPERATION (LOCAL START AND RUN)**

Redistribution or publication of this document,
by any means, is strictly prohibited.

**Cummins Power Generation**
**1400 73rd Avenue N.E.**
**Minneapolis, MN 55432**
**1-800-888-6626**
**763-574-5000 International Use**
**Fax: 763-528-7229**

Cummins is a registered trademark of Cummins Inc.

Power Generation

Redistribution or publication of this document,
by any means, is strictly prohibited.