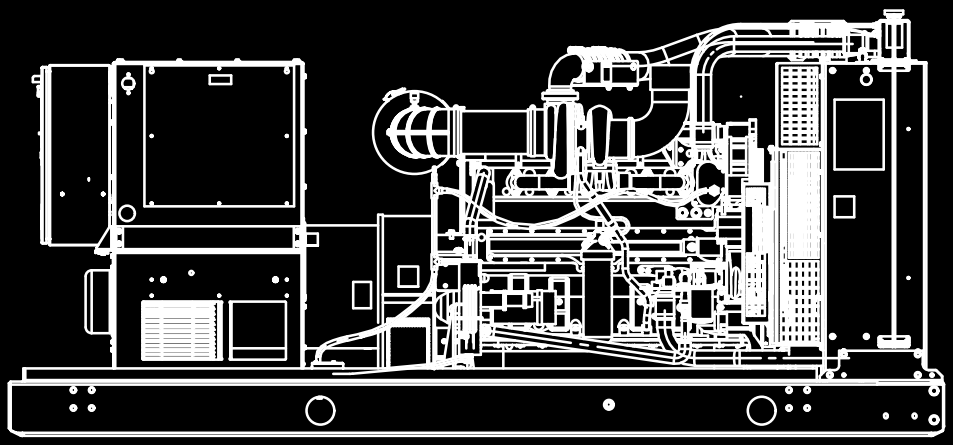
Caution: This document contains mixed page sizes (8.5 x 11 or 11 x 17), which may affect printing. Please adjust your printer settings according to the size of each page you wish to print.

Power Generation

Service Manual

PowerCommand® Control
3200 Series
Generator Sets



Models
DFEG, DFEH, DFEJ, DFEK

Printed in U.S.A.

960-0521 02-2004

Table of Contents

IMPORTANT SAFETY INSTRUCTIONS

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

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

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

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

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

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

FUEL AND FUMES ARE FLAMMABLE

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

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

EXHAUST GASES ARE DEADLY

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

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

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

GENERAL SAFETY PRECAUTIONS

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

1. Introduction

ABOUT THIS MANUAL

This manual provides PowerCommand® Control 3200 (PCC) calibration and adjustment procedures, control operation, alternator test and repair procedures.

Operating and maintenance instructions are in the applicable Operator's Manual. Generator set troubleshooting and repair (control and engine) information is provided in the following manuals.

- Troubleshooting and Repair Manual PowerCommand Control QSX15, QSK45, QSK60 Generator Sets, Bulletin No. 3666394
- Operation and Maintenance Manual QSX15 Series Engines (engine repair and service) Bulletin No. 3666423.

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.
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac
- Load Test Panel
- Megger or Insulation Resistance Meter

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.***

THIS PAGE LEFT INTENTIONALLY BLANK

2. Control Operation

GENERAL

The following describes the function and operation of the PowerCommand® Control 3200 (PCC). All indicators, control switches/buttons and graphical display 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. Setup and calibration procedures are described in *Section 3*.

SEQUENCE OF OPERATION

When the PowerCommand control is in the AUTO mode, it will cause the generator set to start on receiving a signal from a remote device. The control will initiate a starter cranking signal and verify that the engine is rotating. The control will provide sufficient fuel to the engine to accelerate to start disconnect speed. On reaching that speed, the control will ramp the generator set to idle (warm-up) or rated speed and voltage.

On reaching rated speed and voltage, the control checks the system bus voltage. If no bus voltage is present, it will wait for a pulse from a remote Master First Start Sensor. On receiving that pulse, the control will signal the paralleling breaker to close.

If bus voltage is present, the control will check for proper phase rotation, adjust the generator set to the bus voltage and frequency level, and then synchronize the generator set to the system bus. When a synchronous condition is achieved, the control will send a signal to close the paralleling breaker.

When the paralleling breaker is closed, the generator set will assume it's proportional share of the total load on the system bus.

CONTROL PANEL POWER ON/OFF MODES

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

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

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

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

Sleep/Awake Mode: In the Sleep mode, the control’s operating software is inactive and the LEDs and the graphical display on the control panel are all off. Sleep mode is a feature that is used to reduce battery power consumption when the control is in the Auto mode and is not being used.

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

The operating software is initialized and the control panel LEDs and graphical display is turned on in response to one of the following:

- moving/pressing any control panel switch/button.
- a remote start input signal (generator set in Auto mode), or
- customer fault 2 or 3 only (shutdown or warning indicator is on).

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

The InPower service tool is required to enable or disable the Sleep mode. When shipped from the factory, the Sleep mode is disabled. When disabled, the operating software will always remain active (Awake mode) when the control is in Auto mode.

InPower service tool is required to selected desired mode.

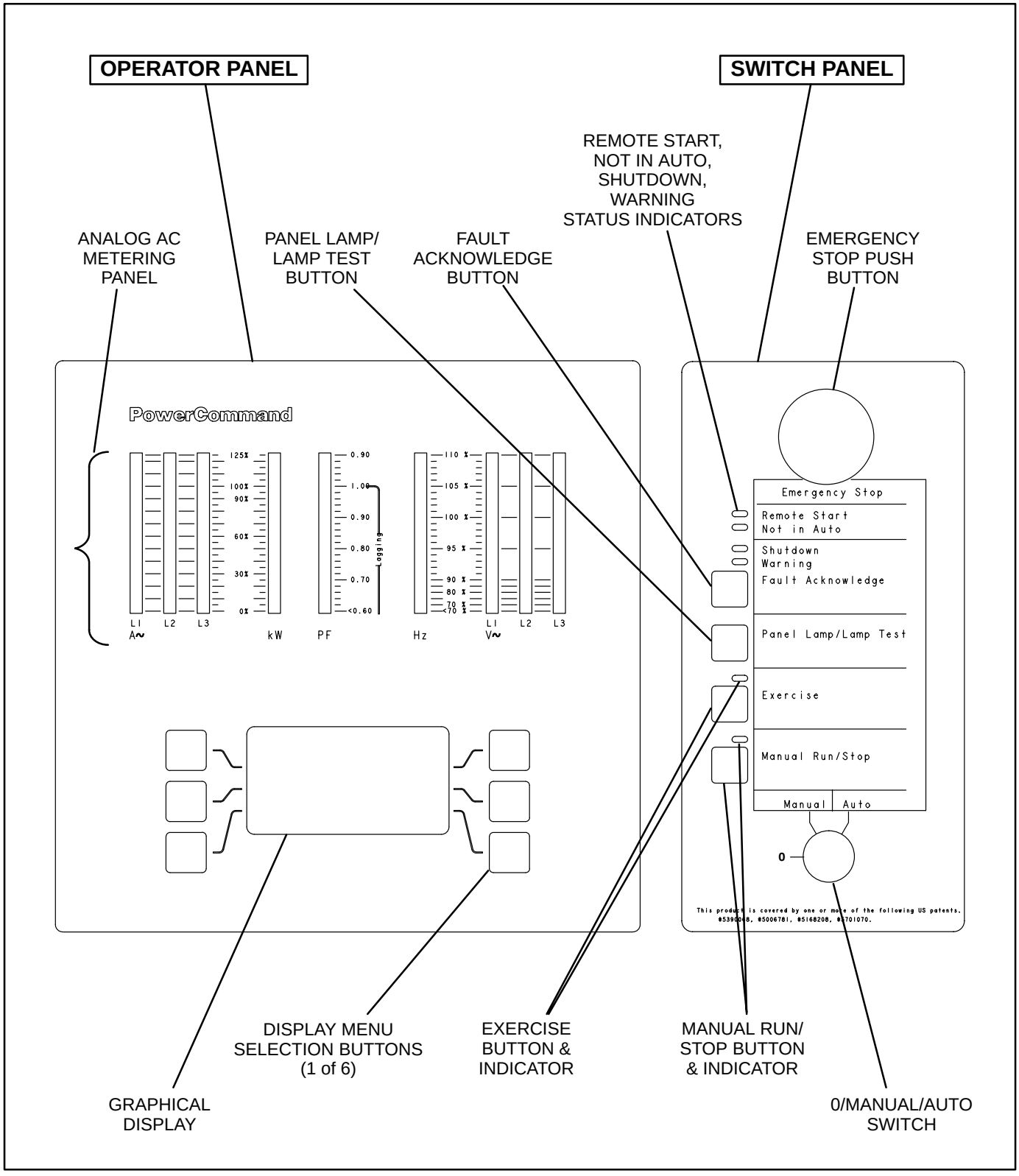


FIGURE 2-1. CONTROL PANEL ASSEMBLY (FULL-FEATURED)

CONTROL PANEL ASSEMBLY

The control panel assembly (Figure 2-1) consist of two panels, the *Operator Panel* and the *Switch Panel*.

Dependent on site requirements, the *Operator Panel* is either mounted on the control panel assembly (full-featured) as shown in Figure 2-1 or contained in a separate enclosure and mounted remotely of the control panel assembly.

The function of several buttons on the control panel will vary dependent on the location of the control panel (remote or local of the control panel assembly). If the function differs, it is noted as either "remote" or "local operator panel" in the button description.

Operator Panel

The operator panel contains the following components:

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

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

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

Graphical Display: The graphical display is capable of displaying up to 9-lines of data with approximately 27 characters per line. The display is used to view the menus of the menu-driven operating system.

The top three lines of the graphical display contain the following control information in the order described:

- *State Line* − modes of operation, such as Stopped, Time Delay To Start, Warm Up At Idle, etc. (see Figure 2-2), and paralleling operations, such as Standby, Dead BUS Close, Synchronize, Load Share and Load Govern.
- *Action Line* − system actions, such as Warning, Derate, Shutdown Cool-down and Shutdown, and fault codes.
- *Description Line* − Fault code messages.

Display Menu Selection Buttons: Six momentary buttons—three on each side of the graphical display window—are used to navigate through the system control menus and to adjust generator set parameters. The button is active when the message adjacent to the button is highlighted (displayed in inverse video).

Switch Panel

The switch panel contains the following components:

Emergency Stop Button: Push the button in for emergency shutdown of the engine. If the engine is not running, pushing the button in will prevent the starting of the engine, regardless of the start signal source (local or remote).

To reset:

1. Pull the button out.
2. Move the 0/Manual/Auto switch to 0.
3. Press the front panel Fault Acknowledge button.
4. Select Manual or Auto, as required.

Remote Start Indicator: This green lamp is lit whenever the control is receiving a remote run signal. When flashing, it indicates a load demand stop mode.

Not in Auto Indicator: This red lamp flashes continuously when the 0/Manual/Auto switch is not in the Auto position. (If in Auto position and lamp is flashing, service is required.)

Shutdown Status Indicator: This red lamp is lit whenever the control detects a shutdown condition. The generator set can not be started when this lamp is on. After the condition is corrected, shutdown indicators can be reset by turning the 0/Manual/Auto switch to the 0 position, and pressing the Fault Acknowledge button.

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

Warning Status Indicator: This yellow lamp is lit whenever the control detects a warning condition. After the condition is corrected, warning indicators can be reset by pressing the Fault Acknowledge button. (It is **not** necessary to stop the generator set if the fault becomes inactive during genset operation.)

Fault Acknowledge: Press this button to acknowledge warning and shutdown messages after the fault has been corrected.

To acknowledge a Warning message, the 0/Manual/Auto switch can be in any position. (It is **not** necessary to stop the generator set to acknowledge an inactive Warning condition.) To acknowledge a shutdown message with this button, the 0/Manual/Auto switch must be in the 0 (Off) position.

This button is also used to blink a fault code if the Shutdown or Warning Status Indicator is lit. (This function is used when the control does not contain a graphical display.) Refer to *Reading Fault Codes* in this section, which describes how to use this button for interpreting fault codes.

Panel Lamp/Lamp Test Button: Press this button to turn on or off the panel lamp. Press and hold down this button for three seconds or more to turn all control panel LEDs on to make sure all lamps illuminate. The illumination will shut off after releasing the button.

Exercise Button: Press this button to initiate a preprogrammed exercise sequence. To start the exercise sequence, press and hold down the Exercise button and move the O/Manual/Auto switch from Auto to Manual and back to Auto or from Manual to Auto.

Manual Run/Stop Button: This button starts and stops the set locally and will bypass Time Delay to Start and Stop sequences. The 0/Manual/Auto switch must be in the Manual position to enable this button.

0/Manual/Auto Switch: Manual position enables the use of the switch panel Manual Run/Stop button.

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

0 (Off) position prevents the starting of the set (local or remote). If moved to 0 during set operation, will cause an immediate engine shutdown (bypasses cool-down timers). This hot shutdown should be avoided, if possible, to help prolong the life of the engine. Hot shutdowns are logged by the system software.

READING FAULT CODES

If the genset contains the optional graphical display and a fault occurs, the fault code/message will be displayed in the display Description Line (Figure 2-2). If the control does not contain the graphical display, the fault code is read from the Warning and Shutdown status indicators.

Reading Fault codes Using Warning/Shutdown Indicators: If the Warning or Shutdown status indicator is lit, press and hold the Fault Acknowledge button and release after one second or more. After one second, the Shutdown lamp will begin to blink the active fault code(s) as follows.

The Warning lamp is used to indicate the start of a new code. The Warning lamp will remain on for 2 seconds, followed by the Shutdown lamp blinking the fault code. This sequence occurs three times for each code. The fourth flash of the Warning lamp indicates the beginning of the second fault code.

There are distinct pauses between repetitions of the code blink transmissions of the Shutdown lamp.

A three digit fault code is indicated by three sets of blinks separated by a two second pause. The first set corresponds to the hundreds position, the second to the tens position and the third to the ones digit. Example for Code No. 213:

Shutdown LED:
blink-blink-pause-blink-pause-blink-blink-blink

Warning LED:
blink (2 seconds)

The light will display the fault codes (active or inactive) in succession, starting with the most recent. Up to 32 (unacknowledged) fault codes can be stored in control panel memory.

To return the control to the most recent fault code, press and release the Fault Acknowledge button (less than one second) and repeat procedure.

When the fault code is acknowledged and corrected, the recorded fault will be deleted from the LED fault log, but will remain in a data log that maintains a fault code history. (The InPower service tool is required to view this data log.)

MENU DISPLAY AND SWITCHES

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

Graphical Display: The graphical display is capable of displaying up to 9-lines of data with approximately 27 characters per line. The display is used to view the menus of the menu-driven operating system. Refer to the menu trees later in this section. The display is also used to show the following system information:

- *State Line* − modes of operation, such as Stopped, Time Delay To Start, Warm Up At Idle, etc., and paralleling operations, such as Standby, Dead BUS Close, Synchronize, etc.
- *Action Line* − system actions, such as Warning, Derate, Shutdown Cool-down and Shutdown, and fault codes.
- *Description Line* − Fault code/status messages.

Menu Buttons: Six momentary buttons—three on each side of the graphical display window—are used to navigate through the system control menus and to adjust generator set parameters. The button is active when the message or symbol adjacent to the switch is highlighted (displayed in inverse video). The displayed message or symbol indicates the function of the button.

In the graphical display, the "▼" symbol indicates that selecting the adjacent button causes the operating program to go to the next menu display—as shown in the menu diagrams.

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

In the graphical display, the " ⇞ " symbol indicates that selecting the adjacent button causes the operating program to go back to Main Menu A (Figure 2-4).

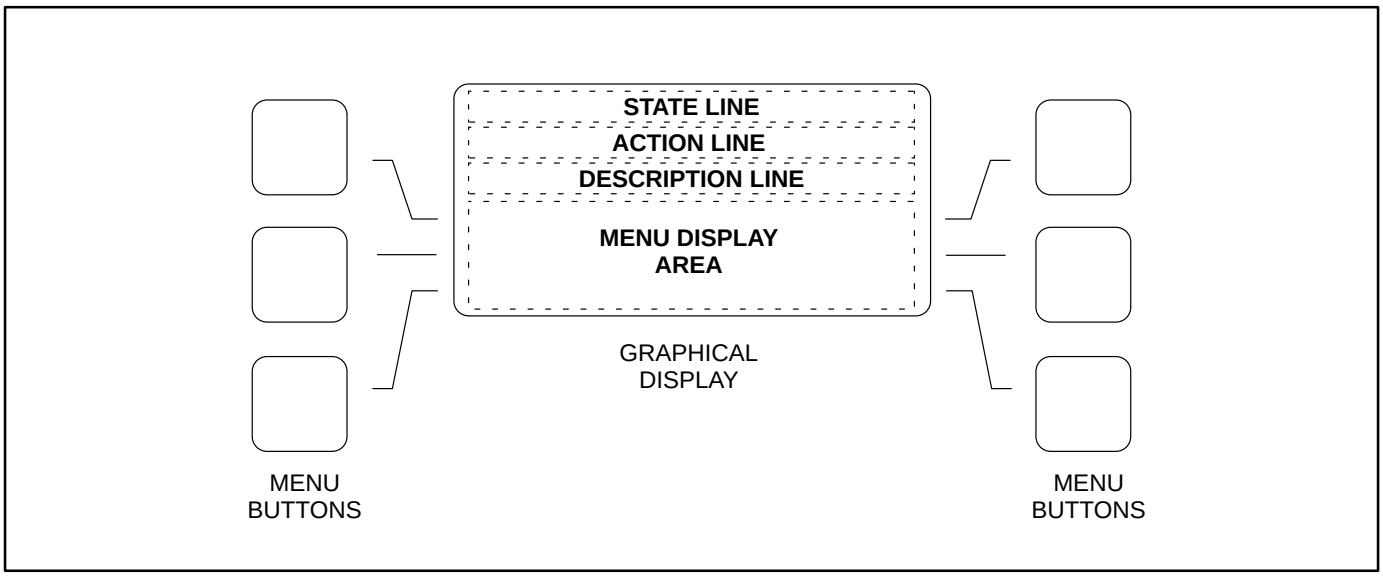


FIGURE 2-2. GRAPHICAL DISPLAY AND MENU SELECTION BUTTONS

MENU UNITS SELECTION

During any control panel operation, you can change how units are displayed by pressing the two lower menu buttons (one on each side of display). When pressing these two buttons simultaneously, the units submenu will appear (Figure 2-3). After selecting the desired units, press the **ENTER** button in this submenu to change and save the selections.

Use the + buttons to select the desired option for each field. Use the arrow (→) button to move to the next field. Selected field is highlighted.

Location: This selection must be set to **Local** when the graphical display is mounted on the generator set front control panel or **Remote** when mounted remotely from the generator set.

The Local/Remote selection determines which buttons in the Control submenu (page 2-13) are active (displayed).

Temp: Used to select °F or °C for temperature readings.

Pressure Fluid: Used to select PSI, KPA, BAR or IN for pressure readings.

Pressure Gas: Used to select INHG or MMHG for pressure readings.

Flow Air: Used to select CFM or CMM for air flow readings.

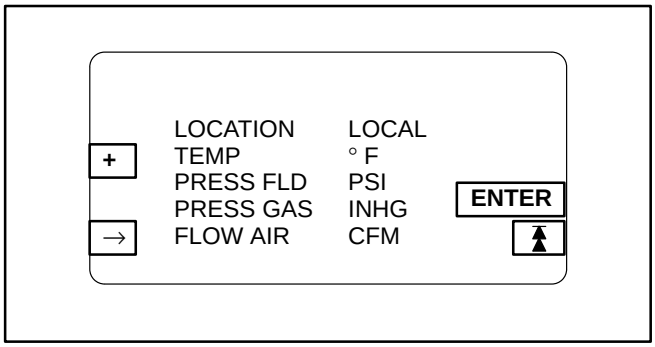


FIGURE 2-3. UNITS SUBMENU

MAIN MENU

Figure 2-4 shows the main menus (Menu A and Menu B) of the system control. The two main menus are used to divide the system submenus into major categories, such as, Engine Data, Alternator Data, Control, etc.

To view system data, simply press the appropriate menu button to select the category. After pressing the desired menu button, refer to the page number shown in Figure 2-4 for detailed information related to the selected category.

In the following figures, the boxed/highlighted field indicates that the adjacent menu button is active. Also, the submenus are shown in the order in which they are displayed when scrolling up ▲ or down ▼.

Adjust Button

The Adjust submenu is intended for qualified site personnel only. Note that a password may be assigned to allow only authorized operators to modify this data. (Password is not required if not assigned.)

Setup Button

The Setup submenu is described in *Section 3.*

The "Adjust" and "Setup" submenus can be viewed, but not modified without entering the correct passwords.

__ Button (Paralleling Applications Only)

When displayed, indicates that the feature for generator set paralleling applications is installed. This button is used to open and close the generator set circuit breaker (CB). The symbol indicates if the CB is opened or closed. Opened _****_, push to close. Closed _**−**_, push to open.

With the control panel **0/Manual/Auto** switch in the **Auto** position, the opening and closing of the CB is controlled by the control system software. The CB symbol will indicate an open or closed CB, but the button will be inactive when the control is in Auto.

In the **Manual** position, the CB can only be closed by using this button. When manually closed and the CB opens, it must be closed again by using this button. To close the CB, press and hold the button until the symbol indicates a closed CB. (CB close will occur only when setup conditions allow − dead bus or generator synchronized with bus.)

Power Trans Button (Power Transfer Control Applications Only)

When displayed, indicates that the Power Transfer Control (PTC) feature is installed. Refer to page 2-17 for PTC Data submenu description. The PTC setup submenu is described in *Section 3.*

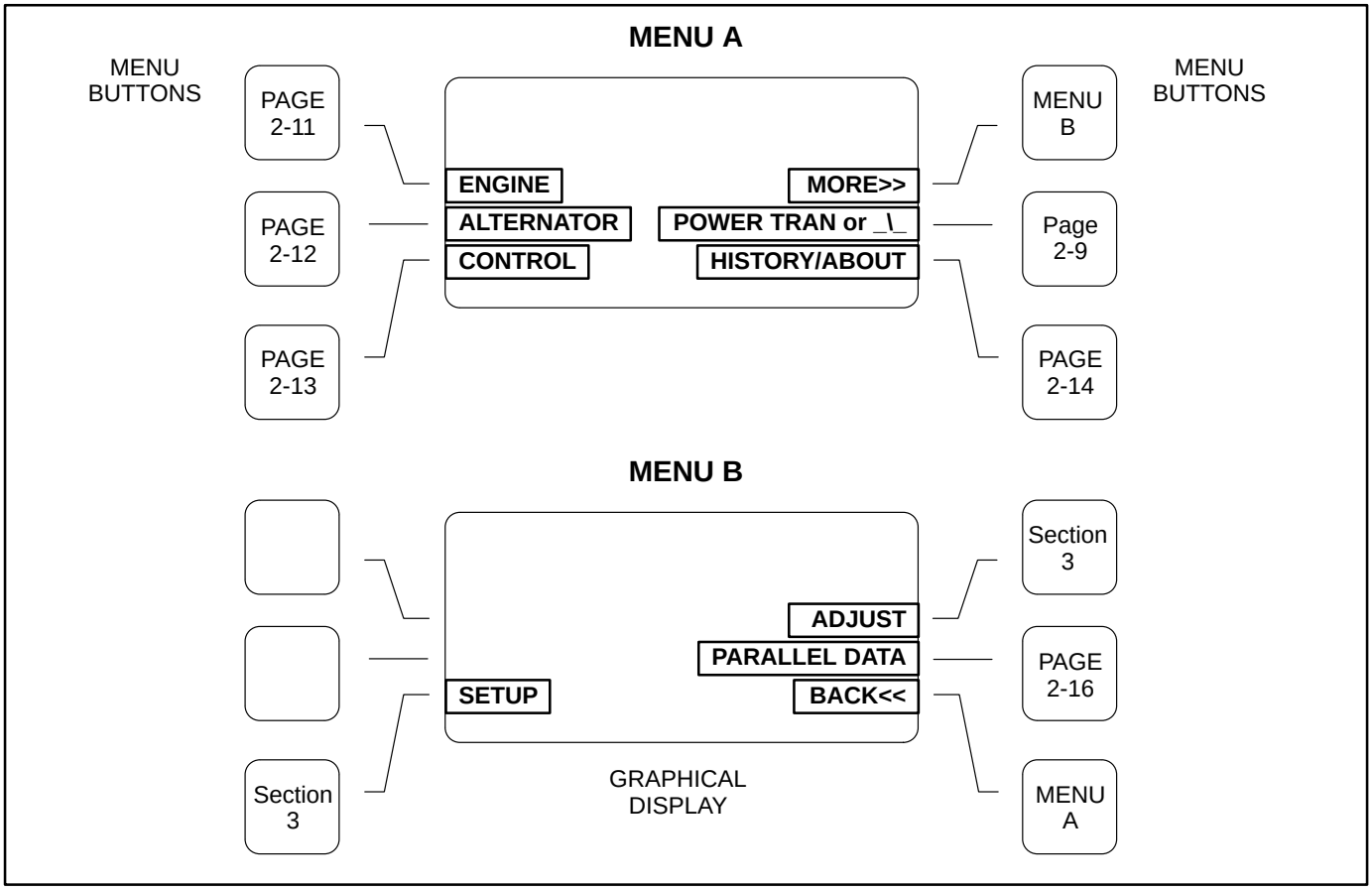


FIGURE 2-4. SYSTEM CONTROL MAIN MENUS A AND B

ENGINE SUBMENUS

If you press the “ENGINE” button in Menu A, the Engine submenus will appear (Figure 2-5).

The first submenu displays general information that applies to all gensets (coolant temp, oil pressure, etc.) The data in the remaining submenu(s) will vary according to the type and number of sensors provided with the engine.

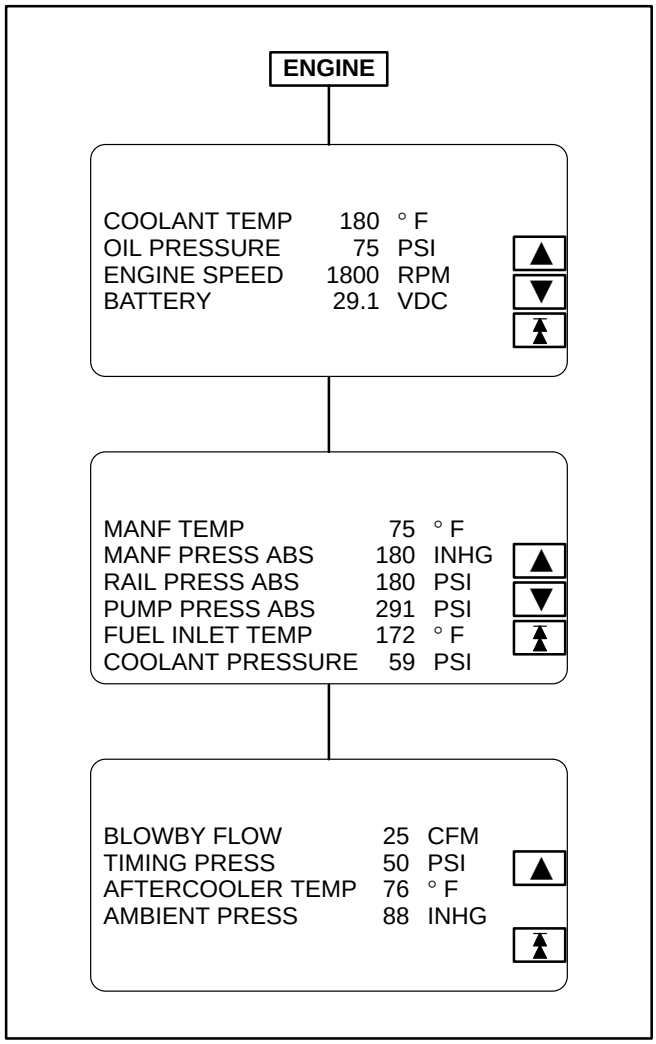


FIGURE 2-5. ENGINE SUBMENUS

ALTERNATOR SUBMENUS

If you press the “ALTERNATOR” button in Menu A, the Alternator Data submenus will appear (Figure 2-6).

Voltage L-L and L-N: Indicates voltage Line-to Line and Line-to-Neutral. Note that the Line-to-Neutral column will not be displayed for a 3 phase/3 wire system. Accuracy 1%.

The voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

Amps: All phases. Accuracy 1%.

Frequency: Generator set output frequency.

AVR DUTY CYCLE: Displays voltage regulator (drive) level in percentage of maximum.

kW, kVA and PF: Displays generator set kW and kVA output (average and individual phase, and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

The PF reading will contain an asterisk if the power factor is leading (for example, *.30).

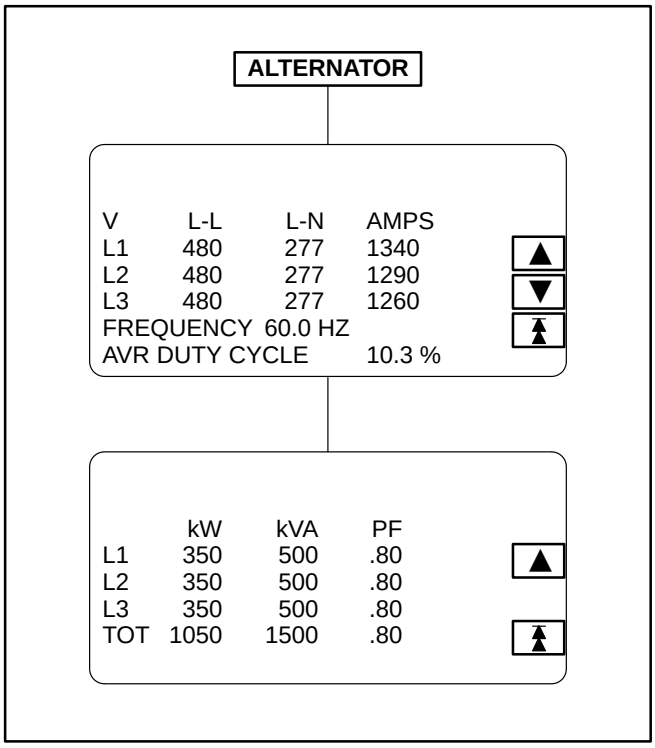


FIGURE 2-6. ALTERNATOR SUBMENUS

CONTROL SUBMENU

If you press the “CONTROL” button in Menu A, the Control submenu will appear (Figure 2-7).

Local CONTROL Submenu Function

When the operator panel is mounted on the control panel assembly, the Run Mode Idle/Rated button is active (displayed). Note in Figure 2-7 that this button is not displayed in remote applications.

The shaded area in Figure 2-7 displays the selected/active mode of operation, either IDLE or RATED.

Remote CONTROL Submenu Functions

When the operator panel (Figure 2-1) is mounted remotely of the control panel assembly, the menu buttons in the Control submenu are used to perform the following remote operations. (To activate these menu buttons for remote/local use, refer to page 2-8.)

The 0/Manual/Auto switch must be in the Auto position to activate the Remote Menu Buttons of the Control submenu.

Remote START or STOP Button: This button is used to start and stop the generator set when the operator panel is mounted in a remote location.

When the generator set is operating, **Stop** will be displayed for this button and **Start** will be displayed when not operating.

Fault Acknowledge Button: Used to reset inactive Warning messages, not Shutdown messages.

Local/Remote CONTROL Submenu Function

Bargraph Test: The function of this button remains the same and is not dependent on operator panel location. This button sequentially lights the LEDs to test the bar graph display.

Enable Sync: Displayed in paralleling applications only. Intended for service personnel to turn off the synchronizer for troubleshooting/testing purposes.

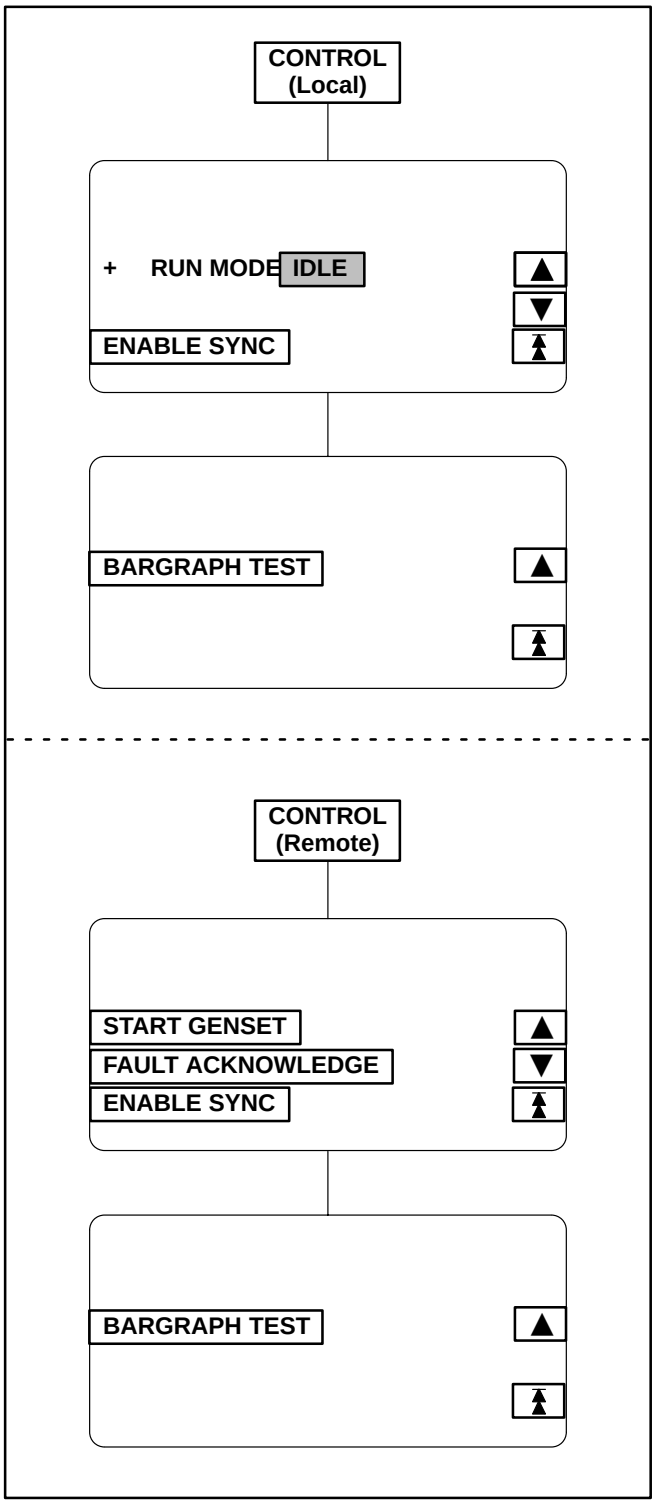


FIGURE 2-7. CONTROL SUBMENU

HISTORY/ABOUT SUBMENUS

If you press the “HISTORY/ABOUT” button in Menu A, the History/About submenus will appear (Figure 2-8).

HISTORY: The control maintains a data log of the number of engine starts and number of operating hours for the engine and control, and the megawatt and maximum torque hours of the generator set. This information is stored in non-volatile memory and will not be deleted due to loss of battery power.

ABOUT: The About submenus provide the following generator set information.

- Genset model and wattage (kW/MW)
- Output voltage and WYE, DELTA or SINGLE
- Frequency 50 or 60 Hz
- Rating: Standby, Prime or Base
- Version level of the controller and panel operating software.

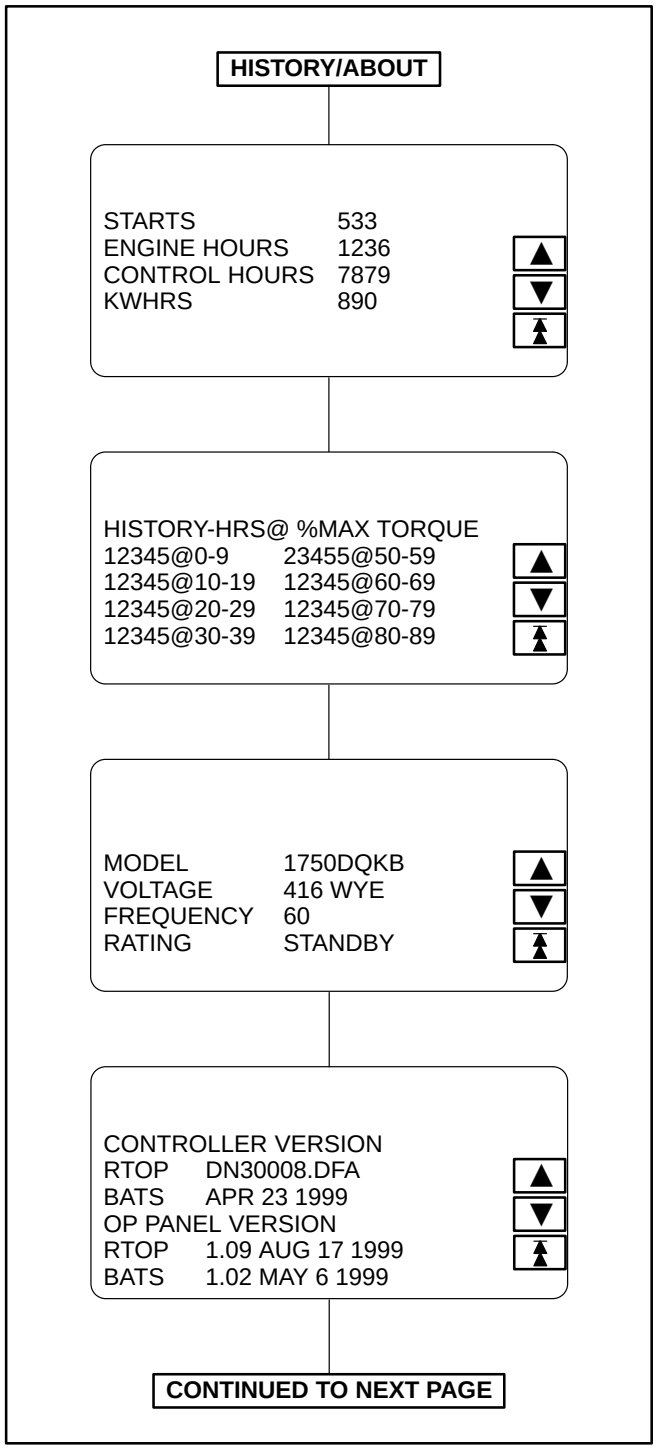


FIGURE 2-8. HISTORY/ABOUT SUBMENUS

FAULT HISTORY: The control maintains a data log of all fault conditions as they occur, and time stamps them with the control and engine operating hours.

Up to 32 (unacknowledged) fault codes can be stored in control panel memory. After the fault is acknowledged and corrected, the recorded fault will be deleted from the control panel memory, but will remain in a data log that maintains a fault code history. (The InPower service tool is required to view this data log.)

The *Fault History* display line: 1 of 24 indicates that 24 faults are recorded and that the most recent fault (1) detected by the controller is displayed.

The *Occurrences* display line: In this example, 5 indicates that this is the fifth occurrence of this fault. (The InPower service tool is required to review the last four faults of this code.)

The Occurrences number is incremented for each new occurrence of the same fault. The controller must detect that the original sensed fault is corrected before it will increment the occurrence number for that fault.

For example, when a Low Oil Pressure fault is detected, the controller will increment the Occurrences number by 1. This fault will remain active until the fault is acknowledged and the controller detects that the fault is corrected. An active fault will prevent the controller from incrementing the Occurrences number each time the engine is started. When the controller detects that the oil pressure is normal the fault will become inactive, allowing the occurrences number to be incremented for the next detected Low Oil Pressure fault.

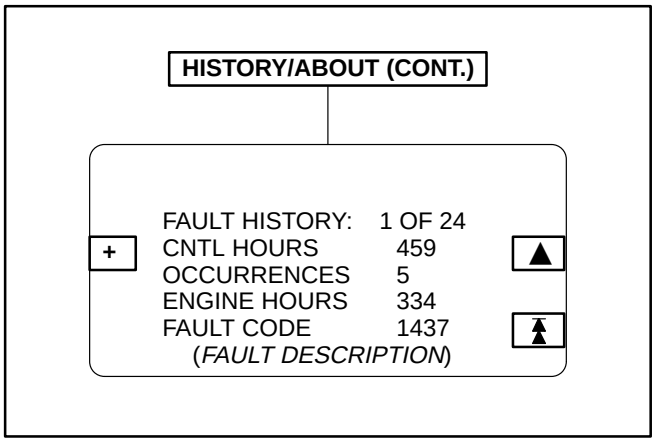


FIGURE 2-8. HISTORY/ABOUT SUBMENUS (CONT.)

PARALLEL DATA SUBMENU

If you press the “PARALLEL DATA” button in Menu B, the Parallel Data submenu will appear (Figure 2-9). This menu is displayed in paralleling applications only.

PARALLEL DATA STATUS LINE: The top line of the graphical display is used to indicate the following PARALLEL DATA status:

- STANDBY: Indicates no paralleling activity is occurring at present.
- DEAD BUS CLOSE: Indicates first genset in system to close to bus.
- SYNCHRONIZE: Genset is synchronizing to bus.
- LOAD SHARE: Genset has closed to bus and is sharing load with other gensets in system.
- LOAD GOVERN: Genset closed to bus in parallel with utility (mains).

BUS Voltage L-L: The BUS voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

BUS/GEN HZ: BUS/GEN hertz.

BUS/GEN SYNC STATUS: The bottom line of the graphical display is used to indicate the following BUS/GEN Sync status:

- NOT SYNCHRONIZING: Genset is in service mode that does not allow auto sync feature. (Selected via InPower service tool − deactivate to allow synchronization.)
- SYNCHRONIZING: Genset is synchronizing to bus.
- READY TO CLOSE: In manual mode, push circuit breaker close button to close breaker.

__ Button: Used to open and close the generator set circuit breaker (CB). The symbol indicates if the CB is opened or closed. Opened __, push to close. Closed _−_, push to open.

With the control panel **0/Manual/Auto** switch in the **Auto** position, the opening and closing of the CB is controlled by the control system software. The CB symbol will indicate an open or closed CB, but the button will be inactive when the control is in **Auto**.

In the **Manual** position, the CB must be closed by this button. When manually closed and the CB opens, it must be closed again by using this button. To close the CB, press and hold the button until the symbol indicates a closed CB. (CB close will occur only when setup conditions allow − dead bus or generator synchronized with bus.)

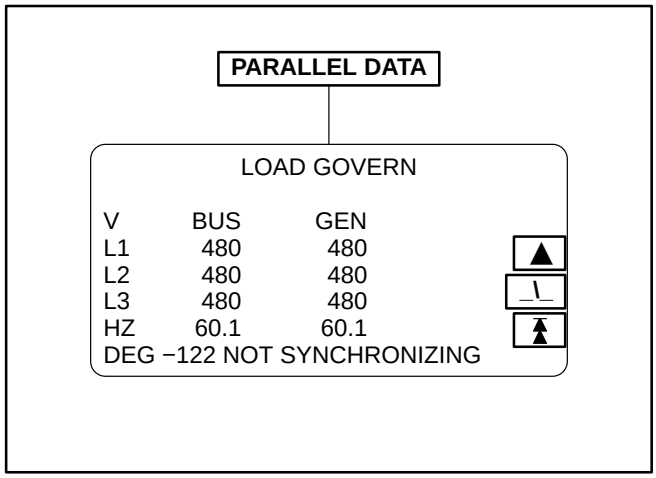


FIGURE 2-9. BUS DATA SUBMENU

POWER TRANSFER MAIN/SUBMENUS

If you press the “POWER TRANS” button in Menu A, the Power Transfer main menu will appear (Figure 2-10). The Power Transfer Control (PTC) feature must be installed to display this menu.

The PTC feature enables the PCC to monitor the utility voltage (mains) and frequency for failure and control the opening and closing of the contacts (circuit breakers) for the utility (S1) and the genset (S2).

If utility fails, the control will initiate the genset starting sequence, open S1 and close S2 to the load. When utility returns, the load is retransferred to the utility (S1 closes/S2 opens) and the control initiates the genset shutdown sequence.

The ⊤ symbol displayed in the middle of the Power Transfer main menu indicates which breaker (utility or genset) is closed/opened to the load. The symbol presently shown indicates that the utility breaker is closed and supplying power to the load.

The Power Transfer main menu also indicates if the utility and the generator set are available to accept load. When the control detects that either source is ready to accept load, UTILITY and/or GENSET will be displayed in inverse video.

The Power Transfer main menu has four submenu groups. Refer to the page numbers shown in Figure 2-10 for the Power Transfer submenu descriptions.

PTC Status Line

The top line of the graphical display is used to indicate the following PTC status:

- **NOT ENABLED:** PTC is not enabled. Control panel switch in O (Off) position.
- **MANUAL:** Control panel switch is in Manual position. All PTC actions or genset start/stop actions are manually controlled.
- **NORMAL UTIL:** Load is connected to the utility.
- **RETRAN:** Retransfer of load to utility.
- **RETRAN OVRD:** Immediate retransfer of load to utility due to genset fault (e.g., warning, derate, or shutdown w/cooldown fault). The retransfer timer is ignored as is the retransfer inhibit.
- **EMERG TEST:** Emergency Test sequence initiated through Remote Start switch with emergency start sequence enabled (TB8-3 terminal opened). Emergency test mode means that the genset will continue to run even if a genset warning or derate fault occurs. This test can be performed with or without load (refer to TEST/EXERCISE submenu in *Section 3*).
- **TEST:** Test sequence initiated through Remote Start switch with emergency start sequence disabled (TB8-3 terminal closed). Test mode is non-emergency, which means that a retransfer to utility will occur if any problems occur with the genset while testing with load. This test can be performed with or without load (refer to TEST/EXERCISE submenu in *Section 3*).
- **EXERCISE:** Exercise sequence initiated through control panel. This test can be performed with or without load (refer to TEST/EXERCISE submenu in *Section 3*). A retransfer to utility will occur if any problems occur with the genset during the exercise sequence.
- **UTILITY FAIL:** Utility has failed. (Initiates transfer of load to genset if O/MANUAL/AUTO switch is in AUTO.)

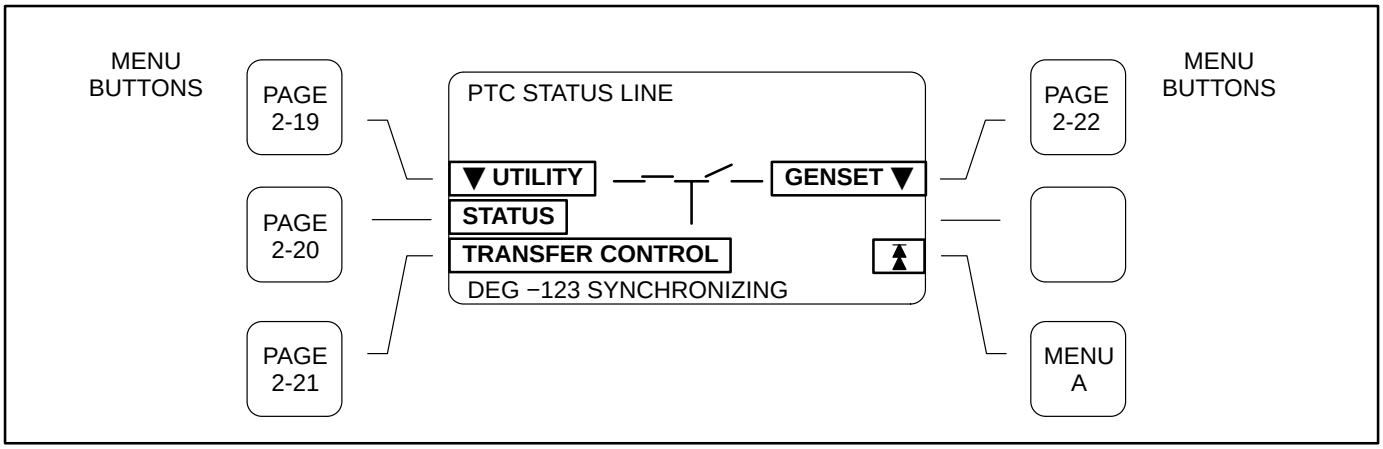


FIGURE 2-10. POWER TRANSFER MAIN MENU

UTILITY (PWR TRAN) SUBMENUS

If you press the “Utility” button in the Power Transfer Main menu, the Utility submenus will appear (Figure 2-11).

Voltage L-L and L-N: Indicates utility voltage Line-to Line and Line-to-Neutral. Note that the Line-to-Neutral column will not be displayed for a 3 phase/3 wire system. Accuracy 1%.

The voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

Amps: L2 only. Accuracy 1%.

Frequency: Utility frequency.

kW, kVA and PF: Displays (L2 only) utility kW and kVA output (average and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

The PF reading will contain an asterisk if the power factor is leading (for example, *.30).

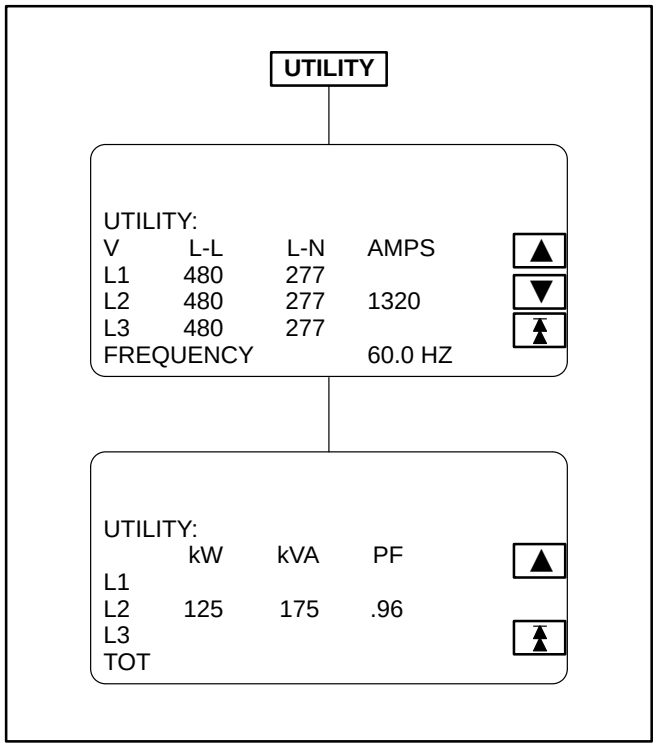


FIGURE 2-11. UTILITY SUBMENUS

STATUS (PWR TRAN) SUBMENUS

If you press the “Status” button in the Power Transfer Main menu, the Status submenus will appear (Figure 2-12).

Connected: Indicates which source(s) is connected to the load.

Available: Indicates when the corresponding sources have acceptable output voltage and frequency. Both can be available simultaneously.

Volt L12: Indicates utility and generator set Line 1 to Line 2 voltage.

HZ: Utility and generator set output frequency.

KW L2: Utility and generator set Phase B (L2) kW output.

Transfer Inhibit: This feature is used to control load transfer to the genset. When activated, load transfer to the genset will not take place if the utility fails.

Transfer inhibit is controlled by connecting a remote contact between TB3-57 and TB3-58. Closing the contact enables the feature and opening the contact disables it. When enabled, the event is displayed on the graphical display.

Retransfer Inhibit: This feature is used to prevent the PTC from automatically transferring the load back to the utility. When activated, load transfer will not take place unless the genset fails (Retransfer Inhibit is ignored if the genset fails).

Retransfer inhibit is controlled by connecting a remote contact between TB3-64 and TB3-65. Closing the contact enables the feature and opening the contact disables it. When enabled, the event is displayed on the graphical display.

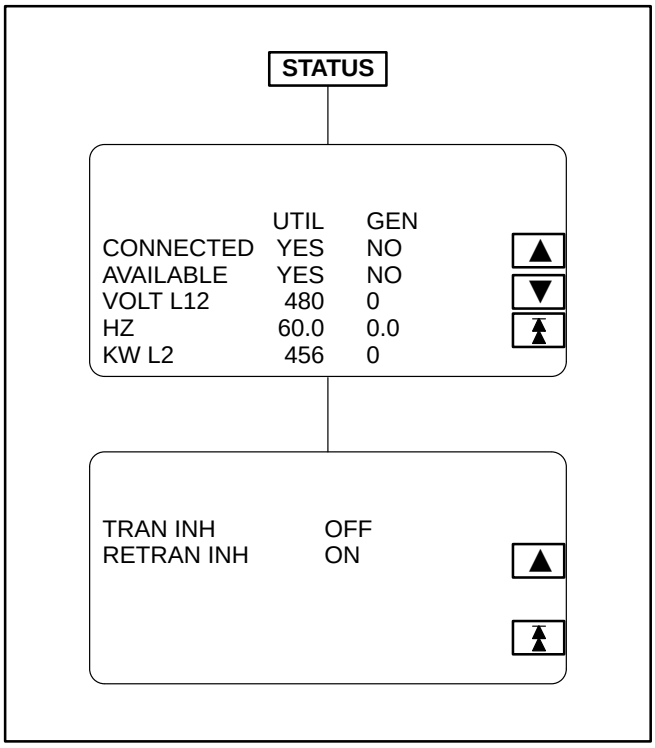


FIGURE 2-12. STATUS SUBMENUS

TRANSFER CONTROL (PWR TRAN) SUBMENU

If you press the “TRANSFER CONTROL” button in the Power Transfer Main menu, the Transfer Control submenu will appear (Figure 2-13).

The ⊤ symbol displayed in the middle of the TRANSFER CONTROL submenu indicates which breaker (utility or genset) is closed/opened to the load. The symbol presently shown indicates that the utility breaker is closed and supplying power to the load.

During genset operation in the manual mode, you can manually transfer/retransfer load between the utility and the genset. To transfer load, press the appropriate CB ENABLE button (Utility or Genset).

Example (Figure 2-13)

In the example in Figure 2-13, the CB ENABLE button for “**Utility**” was pressed. (If the CB ENABLE button for the “**Genset**” was pressed, ENABLE GEN CB would be displayed in the second submenu, allowing you to open or close the genset circuit breaker.)

After pressing the “utility” CB ENABLE button, the second submenu will be displayed allowing you to either CANCEL or ENABLE the entered selection.

Pressing the CANCEL button will return the display to the previous menu.

Pressing the ENABLE button will display the third submenu. With this submenu displayed you can return to the second submenu without opening the utility circuit breaker (press <<BACK) or you can press the OPEN UTIL button.

Pressing the OPEN UTIL button will display the fourth submenu, indicating that the utility circuit breaker is now opened.

Note that the fourth submenu displays CLOSE UTIL. Pressing this button will close the utility circuit breaker and redisplay the third submenu.

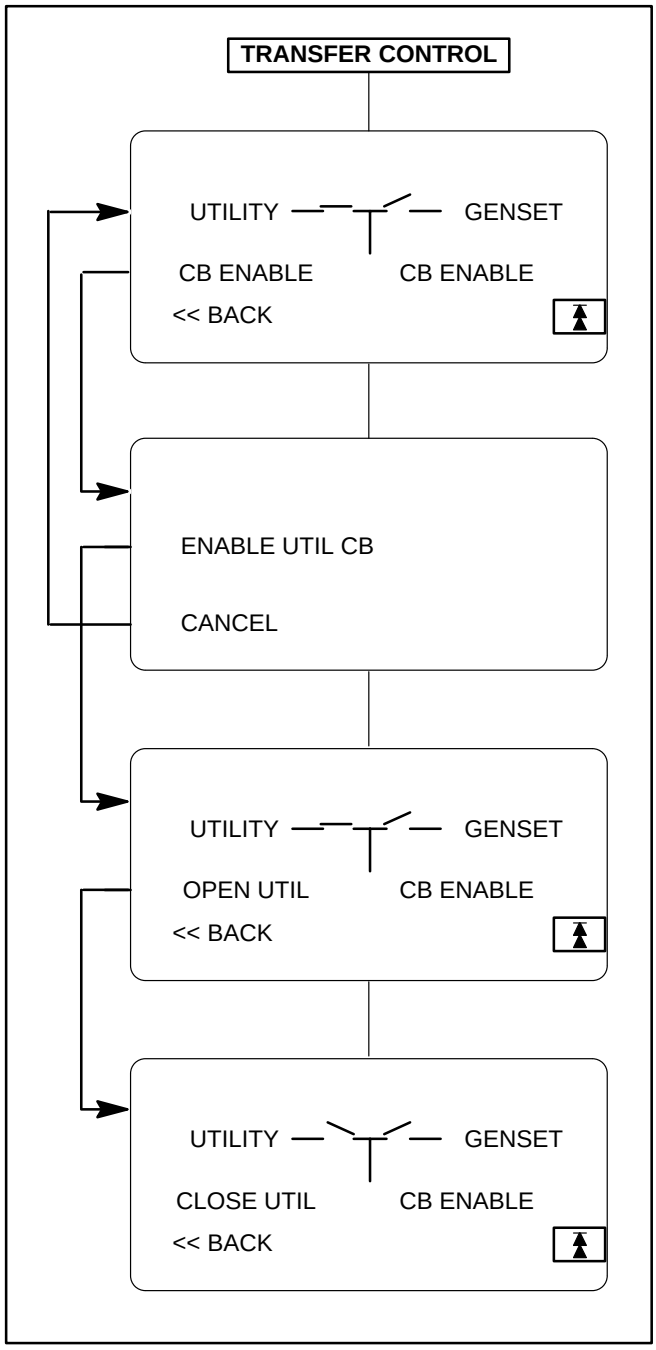


FIGURE 2-13. TRANSFER CONTROL SUBMENUS

GENSET (PWR TRAN) SUBMENUS

If you press the “Genset” button in the Power Transfer Main menu, the Genset submenus will appear (Figure 2-14).

Voltage L-L and L-N: Indicates voltage Line-to Line and Line-to-Neutral. Note that the Line-to-Neutral column will not be displayed for a 3 phase/3 wire system. Accuracy 1%.

The voltage Line-to-Line (L1, L2 and L3) are measured between L1 to L2, L2 to L3 and L3 to L1, respectively.

Amps: All phases. Accuracy 1%.

Frequency: Generator set output frequency.

kW, kVA and PF: Displays generator set kW and kVA output (average and individual phase, and direction of flow) and power factor with leading/lagging indication. Accuracy 5%.

The PF reading will contain an asterisk if the power factor is leading (for example, *.30).

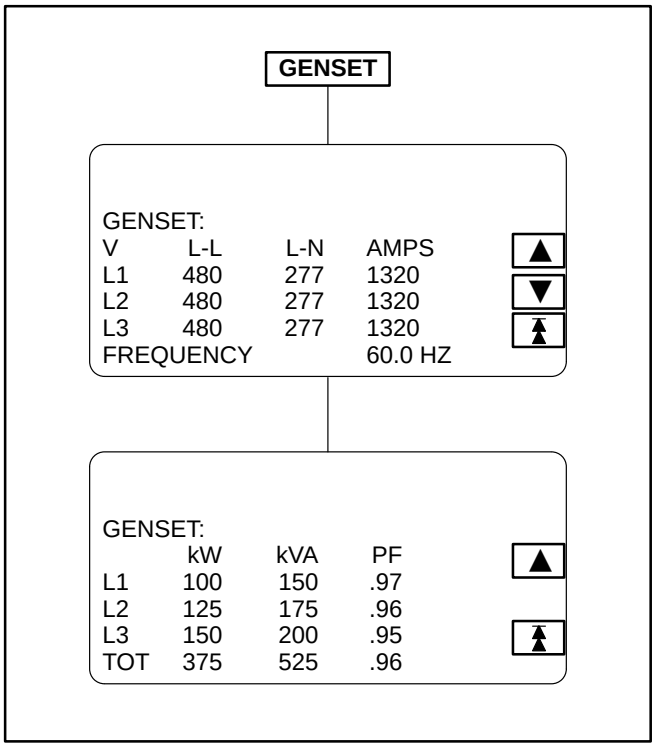


FIGURE 2-14. GENSET SUBMENUS

3. Control Calibration and Adjustment

GENERAL

This section contains calibration and adjustment procedures for the generator set control.

MODIFYING SETUP/ADJUST SUBMENUS

The Setup and Adjust submenus allow you to calibrate the graphical display meters and to adjust system parameters, customer defined faults, generator set voltage/frequency and paralleling applications.

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

The Setup submenus are intended for qualified service personnel only. The Adjust submenu is intended for qualified service and site personnel only. For this reason, a password must be entered before this data can be modified. The Setup and Adjust submenus can be viewed, but not modified without entering the correct password.

Saving Menu Changes

Changes are automatically saved when the menu is exited.

PASSWORD Menu

To allow the site personnel to modify only the Adjust submenu and not the Setup submenus, two passwords are assigned within the system software. An **Application** password is used for the Setup submenus and a **User** password is used for the Adjust submenu.

The two passwords are assigned during the initial installation of the generator set (via InPower) and will vary between sites. The installer must make sure that the passwords are available to the appropriate personnel.

When the generator set is first installed, the *Application* and *User* password are both set to GENSET to allow initial modification of the Setup and Adjust submenus. Assign new passwords when site installation is complete.

When viewing the Adjust menu, pressing the **+** or **−** button will display the User Password menu.

When viewing a Setup menu, pressing the **+** or **−** button will always display the Application Password menu.

After entering the correct password, the system will allow you to modify the submenus. To help prevent unauthorized adjustment, the entered password is valid for 10 minutes after the last button is pressed (i.e., the password will need to be reentered after the ten minute time−out.

Entering Password

To enter the password:

1. Display submenu to modify.
2. Press either the **+** or **−** button within the displayed submenu. The Password menu appears.
3. Press the **+** and **−** button to select the first character of the password (A−Z or 0−9). (Enter **Application** password for Setup submenus; Enter **User** password for Adjust submenu.)
4. Press the → button to select the next character field. Selected character field is highlighted.
5. Repeat steps 3 and 4 to enter remaining password characters.
6. Press the **Enter** button after entering the password. The submenu selected in step 1 will reappear.
7. After making desired changes to submenu, exit submenu to save changes.

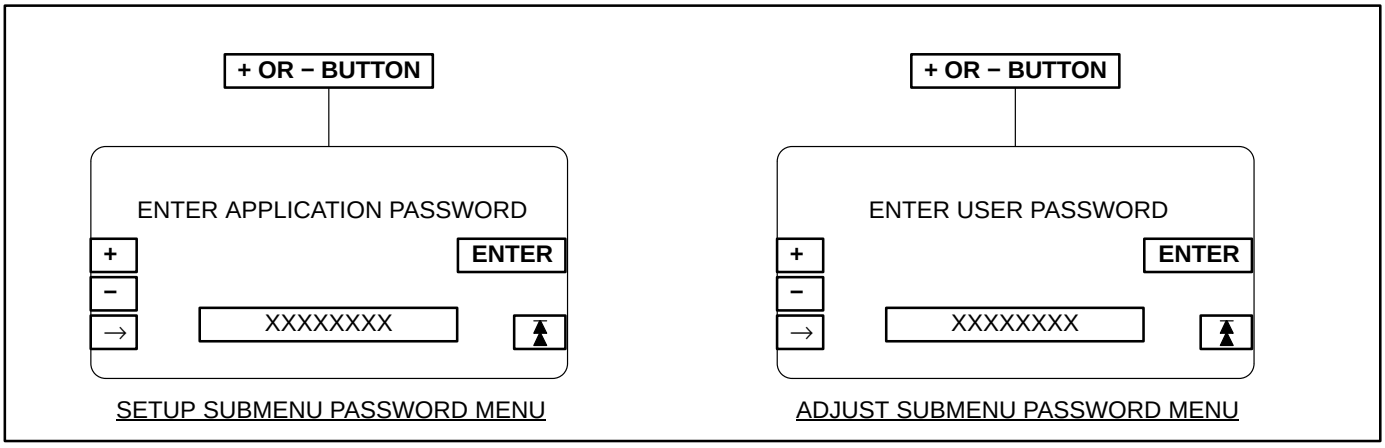


FIGURE 3-1. PASSWORD MENUS

SETUP MENUS

Figure 3-2 shows the main menus (Menu A and Menu B) of the system control and the two Setup menus.

The Setup procedure is intended for qualified service personnel only. The **APPLICATION** password must be entered to modify the Setup submenu fields. Refer to *PASSWORD Menu* in this section to enter password and to save menu changes.

To display the two Setup menus, press the **MORE>>** button in Menu A and then the **SETUP** button in Menu B.

To view system data or to adjust system parameters, press the appropriate Setup menu button to display the desired Setup submenu(s). Refer to the page number shown in Figure 3-2 for detailed information related to the selected submenu(s).

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

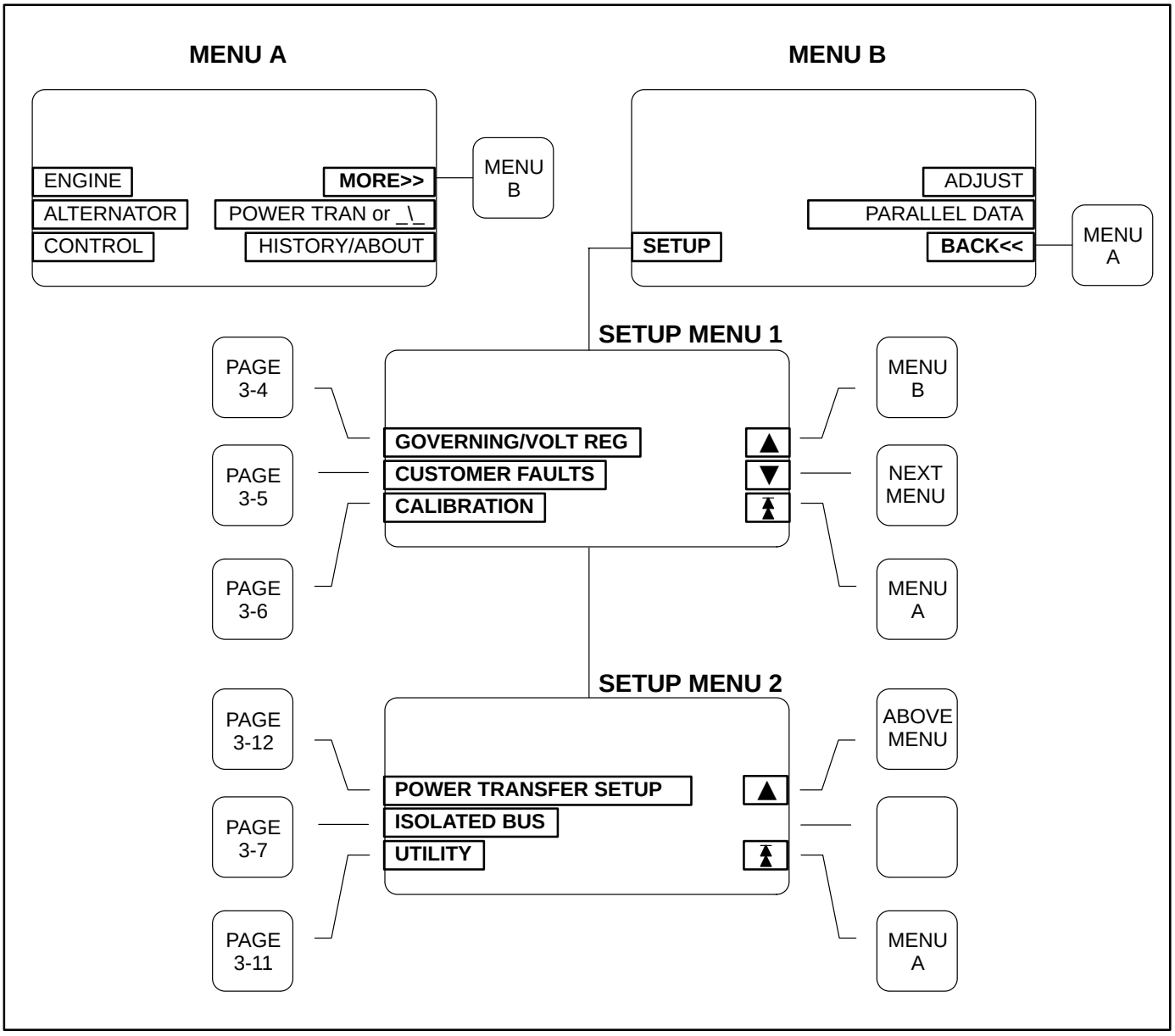


FIGURE 3-2. SETUP SUBMENUS

GOVERNING/VOLT REG SUBMENU

If you press the “GOVERNING/VOLT REG” button in the Setup menu, the Governing/Volt Regulator submenu will appear (Figure 3-3).

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to safe changes.

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 and overspeed may result. (Gain should be reduced to 80% for paralleling installations.)

AVR 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 and overshoot may result.

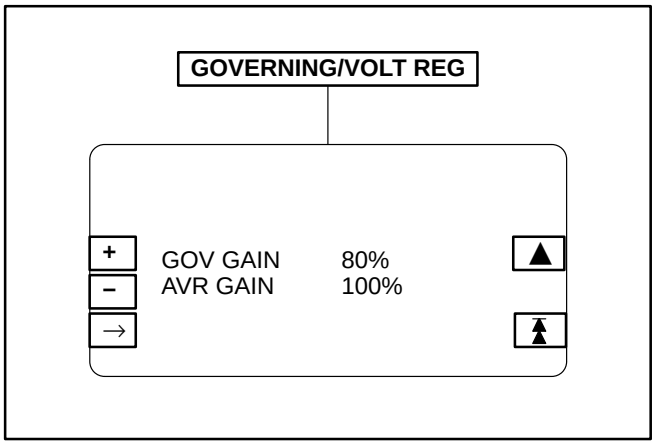


FIGURE 3-3. GOVERNING/VOLT REG SUBMENU

CUSTOMER FAULTS SUBMENUS

If you press the “CUSTOMER FAULTS” button in the Setup menu, the Customer Faults submenus will appear (Figure 3-4).

There are a total of four customer fault inputs. (*Faults 3 and 4 paralleling only.*) The message displayed at the bottom of the menu can be modified for each of these faults in addition to selecting the following operating parameters for each fault.

- Enable − On or Off
- Active − Closed or Open
- Response − Shutdown, Cooldown, Derate or Warning

  Shutdown: Genset will immediately shut down. Normally used for engine faults.

  Cooldown: Cooldown sequence will be initiated before shutdown. Should not be used for engine faults.

  Derate: Used to lower kW output of genset for warnings such as pre-high coolant temperature, etc. Paralleling application − controller will reduce precentage of kW load sharing on the set. Non-paralleling application − controller will lower percentage of kW load by operating load shed relay contacts.

  Warning: Display message, genset continues to operate.

The Enable and the Active fields apply to the Fault 1 and 4 submenus only.

With the Active field selected, pressing the **+** or **−** buttons will toggle the selection between CLOSED and OPEN. Use same operation for remaining field selections.

To enter the desired customer fault message, press the ▼ or ▲ button to display the submenu that contains the customer fault message (1 through 4) to be changed. Use the → button to scroll down through the menu selections to the editable fault message (bottom menu line).

Use the → button to move to each character position within the fault message line.

With the desired character position selected, use **+** or **−** buttons to select the appropriate character.

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

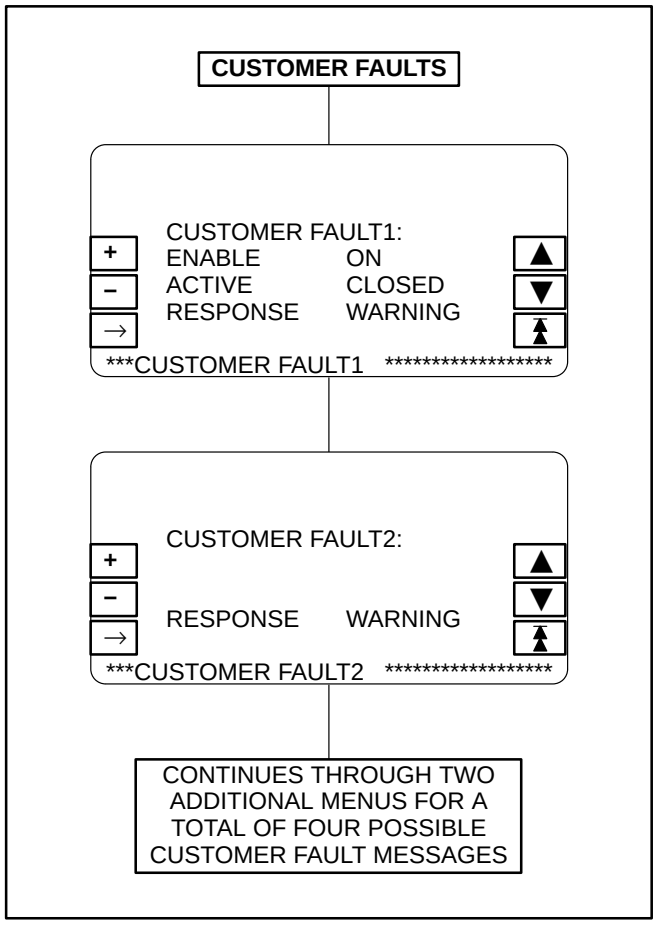


FIGURE 3-4. CUSTOMER FAULTS SUBMENUS

CALIBRATION SUBMENUS

If you press the “CALIBRATION” button in the Setup menu, the Calibration submenus will appear (Figure 3-5).

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to safe changes.

The Calibration submenus allow you to calibrate the control with the reading from a calibrated meter. 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.

Calibration is normally only required when replacing certain circuit cards. Refer to the *Calibration Procedure* in this section which contains a list of the cards that require control calibration.

When performing Bus Voltage Calibration from the graphical display, the genset must be off and the Bus live. If the genset is running, it will synchronize to the Bus.

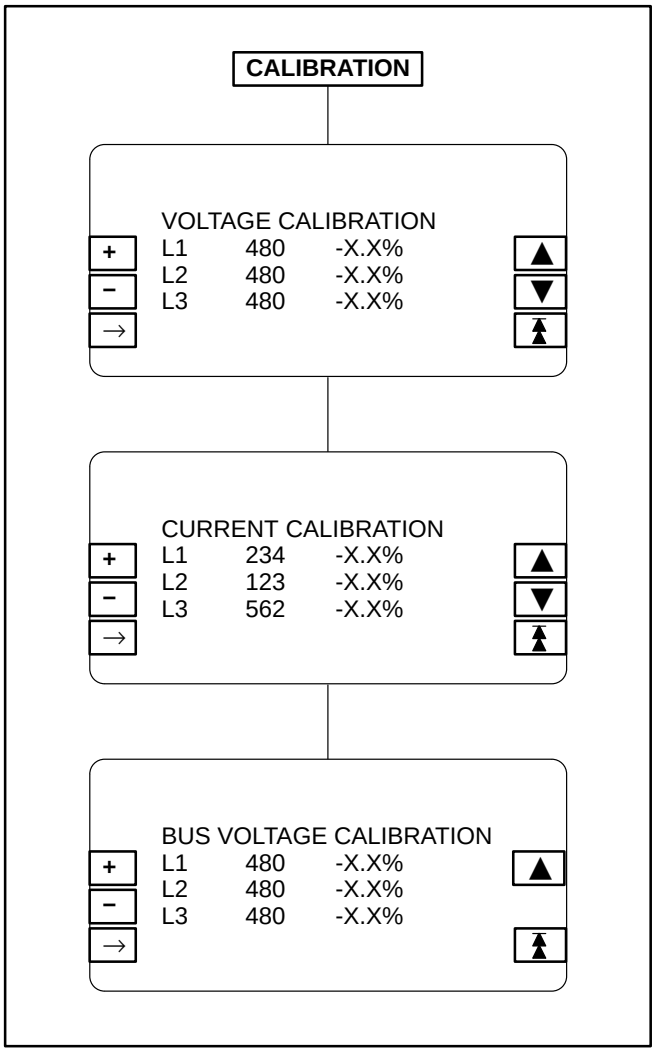


FIGURE 3-5. CALIBRATION SUBMENUS

ISOLATED BUS / UTILITY Submenus (Paralleling Application)

The Isolated BUS submenus (Figure 3-6) and the Utility submenus (Figure 3-7) adjust the control parameters for generator set protection, synchronizing and load sharing for both isolated bus and utility (mains) paralleling applications. Utility (mains) parallel applications may require adjustment of both the Isolated BUS and Utility submenus.

Always perform ISO BUS calibration before Utility BUS calibration.

The sync check (permissive) function is operational in both automatic and manual (RUN) modes. The control will make sure that the generator set is at proper voltage, within the defined sync check window for the defined period of time and that phase rotation is correct. When all criteria are met, the paralleling breaker is closed automatically by the control (auto mode), or by operation of the breaker close switch by the operator (manual mode).

The synchronizing function of the control is enabled when the control has brought the generator set to 90% of rated speed and voltage, and has sensed that bus voltage is available. The control automatically adjusts the generator set speed and voltage to match the bus frequency and voltage. The control can force the generator set to match bus voltage and frequency in a range of minus 40% to plus 10% of normal bus conditions. When the paralleling breaker has closed, the control will bring the generator set back to normal voltage and frequency.

When the generator set is paralleled to another generator set, the control provides automatic load sharing functions for both real (kW) and reactive (kVAR) loads. Load sharing is proportional between generator sets based on their standby ratings. If two generator sets of different sizes are paralleled, they will assume the same percentage of the system load automatically. This can easily be verified on the kW Load LED bar graph on the front of the control panel.

When the utility paralleling mode is enabled and the generator set paralleling breaker is closed, the generator set will assume load based on external analog input signal. The input signal must be calibrated from 0−5 VDC. When the signal is at 0.5 to 1 VDC, the control will operate the generator at no load in parallel with the utility (mains) source. At 4.5 VDC and greater, the control will operate the generator set at 110% of the generator set base load setting. When the load govern signal is between 1 VDC and 4.5 VDC the control will operate the generator set at a load level which is determined by a linear relationship between the kW reference and the load govern signal.

ISOLATED BUS SUBMENUS

If you press the “ISOLATED BUS” button in the Set-up menu, the Isolated BUS submenus will appear (Figure 3-6).

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to safe changes.

SYNC TIME LIMIT: This parameter adjusts the time delay in seconds before the Fail To Synchronize alarm will operate.

REVERSE PWR LMT: Adjusts the reverse power set point. For PowerCommand generator sets, a typical set point is 10-15%.

REVERSE PWR TIME: Adjusts the reverse power function time delay. A typical time delay which is suitable for PowerCommand generator sets is 3 seconds.

Lower reverse power set points can result in nuisance reverse power shutdown faults.

PERM WIN-PHASE: Adjusts the width of the permissive (sync-check) acceptance window. The adjustment range is from five to twenty electrical degrees. Recommended set point is 20 degrees for isolated bus applications, and 15 degrees for utility (mains) paralleling applications.

PERM WIN-TIME: Adjusts the time period (in seconds) for which the generator set must be synchronized with the system bus, before a breaker close signal is issued by the PowerCommand control. Available range is 0.5 to 5 seconds. Recommended value for PowerCommand generator sets is 0.5 seconds for isolated bus applications.

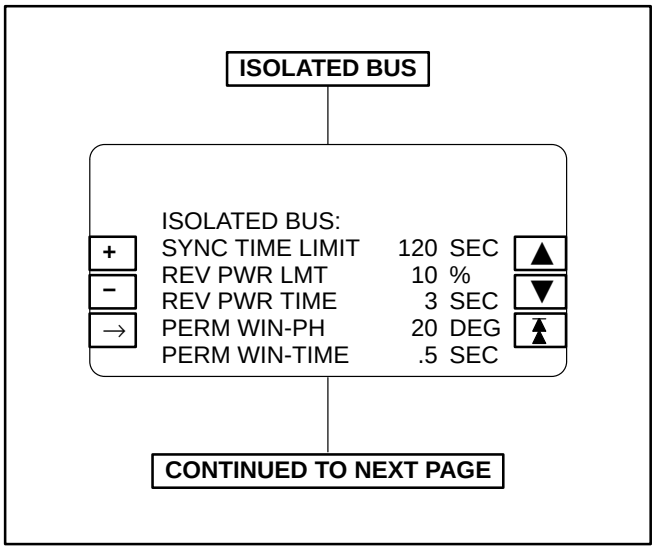


FIGURE 3-6. ISO BUS SUBMENUS

Adjusting the control for a smaller sync-check window or longer time delay will cause synchronizing time to be extended.

SYNC GAIN: The sync gain adjustment controls how quickly the governor will respond to try to minimize the bus/generator phase difference. Increasing the gain speeds up the response. If the gain is too high instability can result.

KW Balance and KVAR Balance changes should be equally shared among all generator sets.

KW BALANCE: This function adjusts the kW load sharing function of the generator set. Before adjusting this value, all generator set calibrations should be performed. If the total load on the system is not shared proportionately, the kW Balance can be used to adjust the generator set for more precise load sharing. Increasing the kW Balance value will cause the generator set to reduce the percentage of the total kW load on that set.

KVAR BALANCE: This function adjusts the kVAR load sharing function of the generator set. Before adjusting this value, all generator set calibrations should be performed. If the total load on the system is not shared proportionately, the kVAR balance can be used to adjust the generator set for more precise load sharing. Increasing the kVAR balance value will cause the generator set to reduce the percentage of the total kVAR load on that set.

KW GAIN: Adjusts the rate of change of kW load on the generator set. With a constant load on the system, if the generator set load is constantly changing, reduce the gain adjustment on the generator set. This also allows modification of the rate of load assumption on transient load change.

KVAR GAIN: Adjusts the rate of change of kVAR load on the generator set. With a constant load on the system, if the generator set load is constantly changing, reduce the gain adjustment on the generator set. This also allows modification of the rate of load assumption on transient load change.

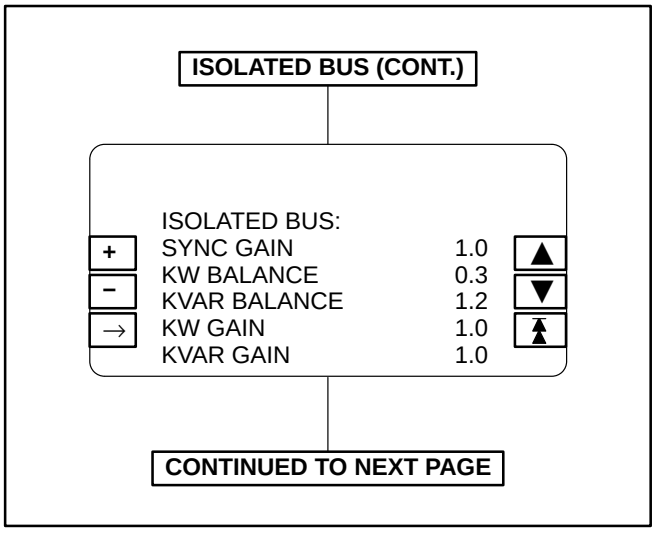


FIGURE 3-6. ISO BUS SUBMENUS (CONT.)

1ST FAIL TIME: Time delay in seconds after a signal from the first start master is not sensed by the PCC that a FIRST START FAIL warning is displayed.

RAMP UNLOAD TIME: When a load demand stop input is sensed the load is ramped down from the present load level on the set to the ramp unload level in the time specified in seconds.

RAMP UNLOAD LEVEL: The load demand ramp unload function will ramp the load down from the present level on the set to this level before opening the set circuit breaker. Value shown is in % of genset standby rating.

RAMP LOAD TIME: When the load demand stop signal is removed the load is ramped from 0kW to the load share level in the specified time after the circuit breaker closes.

LOSS FIELD TIME: Adjusts the loss of field function time delay. A typical delay which is suitable for PowerCommand generator sets is 2 seconds.

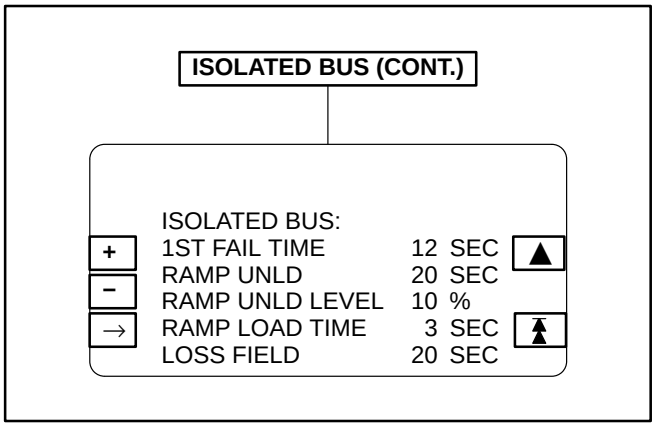


FIGURE 3-6. ISO BUS SUBMENUS (CONT.)

UTILITY SUBMENUS

If you press the “UTILITY” button in the Setup menu, the Utility submenus will appear (Figure 3-7).

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to safe changes.

BASE LOAD (%): This controls the maximum kW load level that the generator set will operate at when paralleled with the utility (mains). The value shown indicates the steady state load on the generator as a percent of the generator set standby rating.

Check generator set ratings for maximum load level at which the generator set should operate when paralleled with the utility (mains). Extended operation at load levels in excess of the generator set rating can cause abnormal engine wear or premature engine failure.

PF LEVEL: Adjusts the power factor that the generator set will run at when paralleled to the utility (mains). Recommended setting is 1.0.

RAMP LOAD TIME: This is the ramp time from present set load to level determined by the load set analog input. This is active when the control first enters the load govern mode.

RAMP UNLOAD TIME: This is the ramp time from present set load to 0 kW. This ramp is active when the load set analog input is less than 0.5 volts.

MODE − MULTIPLE/SINGLE: This controls whether the set is to operate as part of a multiple set or single set (PLTE or PLTF) system. (Refer to “LOAD DEMAND SHUTDOWN” and “SINGLE MODE ENABLE” function descriptions in wiring diagram, page 5-8.)

KW GOVERN GAIN: This controls the rate that the generator set kW load is increased after the generator set has closed to the system bus when utility (mains) paralleled. Decreasing this value will result in slower loading of the generator set.

KVAR GOVERN GAIN: This controls the rate that the generator set kVAR load is increased after the generator set has closed to the system bus when utility (mains) paralleled. Decreasing this value will result in slower loading of the generator set.

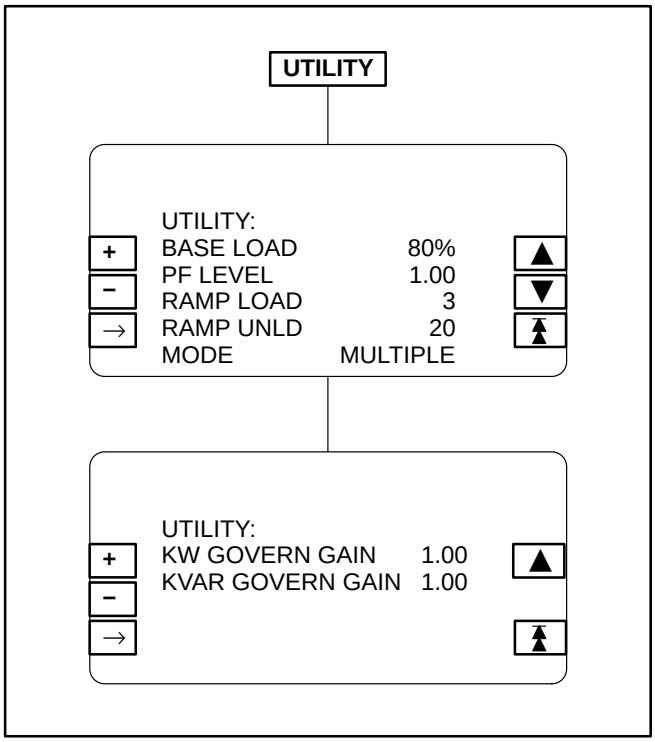


FIGURE 3-7. UTILITY SUBMENUS

POWER TRANSFER CONTROL MAIN MENUS

If you press the “POWER TRANSFER SETUP” button in the Setup menu 2 in Figure 3-2, the two main menus of the optional Power Transfer Control (PTC) feature will appear (Figure 3-8).

To adjust PTC system parameters, press the appropriate PTC main menu button and refer to the page number shown in Figure 3-8 for detailed information related to the submenu selected.

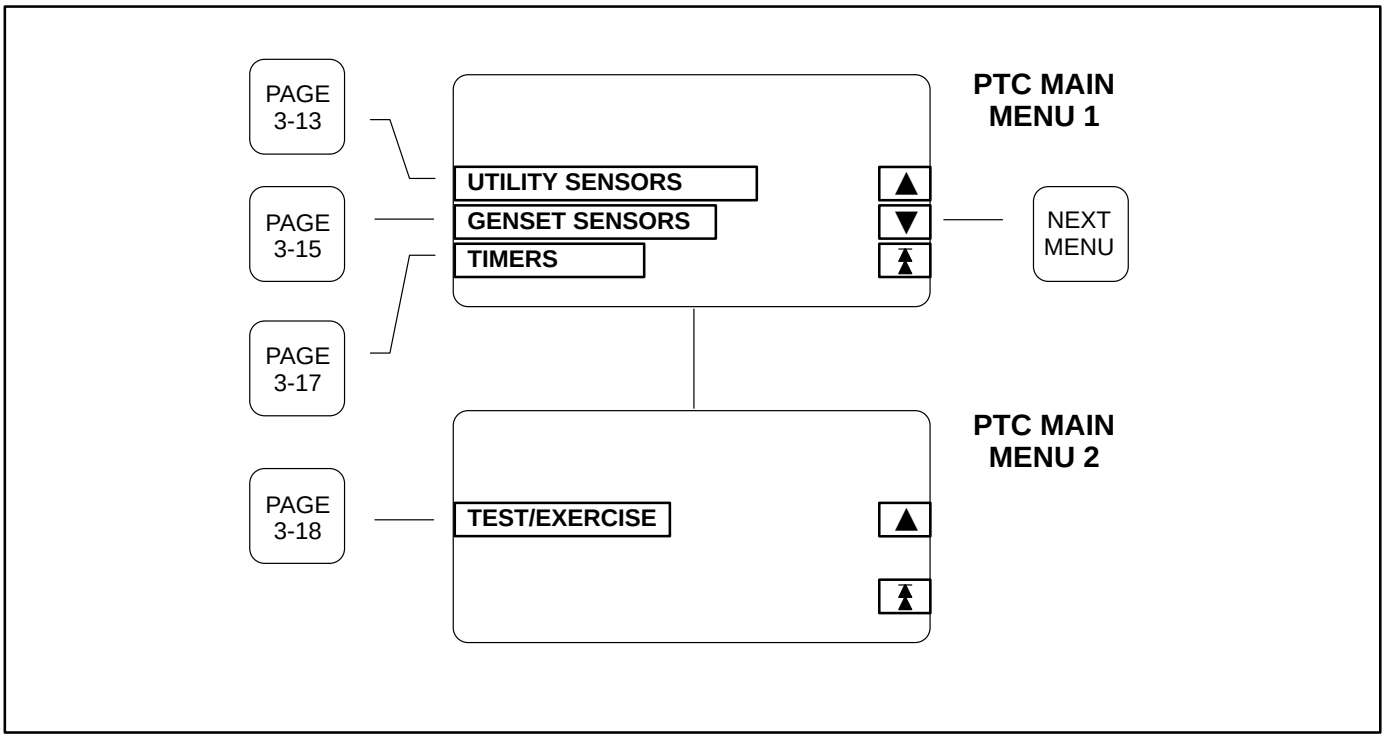


FIGURE 3-8. PTC SETUP MAIN MENUS

UTILITY SENSORS SUBMENUS

If you press the “UTILITY SENSORS” button in the PTC Main Menu 1, the Utility Sensors submenus will appear (Figure 3-9).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field.

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

U PT VOLT LL: Enter the value of the utility line-to-line voltage which yields 100% voltage at the terminals of the utility (bus) PT module.

Range: 1−15000V, adjustable by standard nominal voltage values, 100V, 10V and 1V increments (1V).

The 100% voltages for each of the four possible utility (bus) PT modules are as follows, based on module dash number:
−01 = 208 volts LL
−02 = 416 volts LL
−03 = 600 volts LL
−04 = 120 volts LL

Example 1: Nominal Utility voltage is 480V. This means that utility (bus) PT module number −02 should be used. The voltage which will yield 100% volts at this PT module is 416 per the above table. Thus enter 416V.

Example 2: Nominal Utility voltage is 4160V. A primary stage transformer with a ratio of 4200/240 is used. This means that utility (bus) PT module number −01 should be used. The voltage which will yield the 100% volts (208V from above table) is calculated as follows:

208 x (4200/240) = 3640. Thus enter 3640V.

U NOM VOLT LL: Enter the nominal utility line-to-line voltage. For example, 480, 4160, etc.. Range: 1−15000 V, adjustable by standard nominal voltage values, 100V, 10V and 1V increments (1V).

U CT RATIO: Enter the CT Ratio of the Utility L2 CT. This is the Ratio to 1 Amp. Range: 1−18000 (1A).

⚠ CAUTION ***This CT must be rated for 1 Amp output (e.g. NOT 5 Amp). Be sure CT secondary circuit has burden resistor or a shorting jumper in place before putting power through the CT. Example: CT Ratio = 2650:1. Thus enter 2650.***

U SENSOR TYPE: Enter the line-to-line (L-N) for 3 phase line-neutral voltage sensing or line-to-line (L-L) for 3 phase line-line voltage sensing. This applies to both the utility undervoltage and overvoltage sensors. Range: L−L, L−N (L−N).

U <wye> <delta>: Enter utility connection type. Range: Delta, Wye (Wye).

U UNLOADED KW: Enter the kW on utility Line 2 at which the utility is considered as unloaded. This is the L2 kW level at which a closed transition soft transfer will disconnect from the utility.

UTILITY UNDERVOLTAGE: Non-adjustable field, always enabled.

UTILITY OVERVOLTAGE, FREQUENCY: Used to enable or disable menu function. Choose Enabled or Disabled (Enabled).

UV PICKUP: Enter a number between 85 and 100% of the nominal voltage (90%).

UV DROP OUT: Enter a number between 75 and 98% of the under-voltage pick-up percentage (90%).

UV DELAY: Enter a time between 0.1 and 5.0 seconds (0.5 seconds).

UV MIN PHASE: Displays the lowest line voltage of the three utility phases.

OV PICKUP: This adjusts the over-voltage pickup as a percentage of the over-voltage drop-out. Enter a number between 95 and 99% (95%).

OV DROP OUT: Enter a percentage between 105 and 135% of the nominal voltage (110%).

OV DELAY: Enter a range between 0 and 120 seconds (3 seconds).

OV MAX PHASE: Displays the highest line voltage of the three utility phases.

CENTER (FREQ): Enter a frequency between 45 and 65 Hz (60 Hz).

PICK UP (FREQ): Enter a percentage between 5 and 20% of the nominal frequency (10%).

DROP OUT (FREQ): Enter a percentage between 1 and 5% of the nominal frequency (1%).

DELAY (FREQ): Enter a time between 0.1 and 15.0 seconds (5.0 seconds).

FREQUENCY: This field displays the sensed utility line frequency.

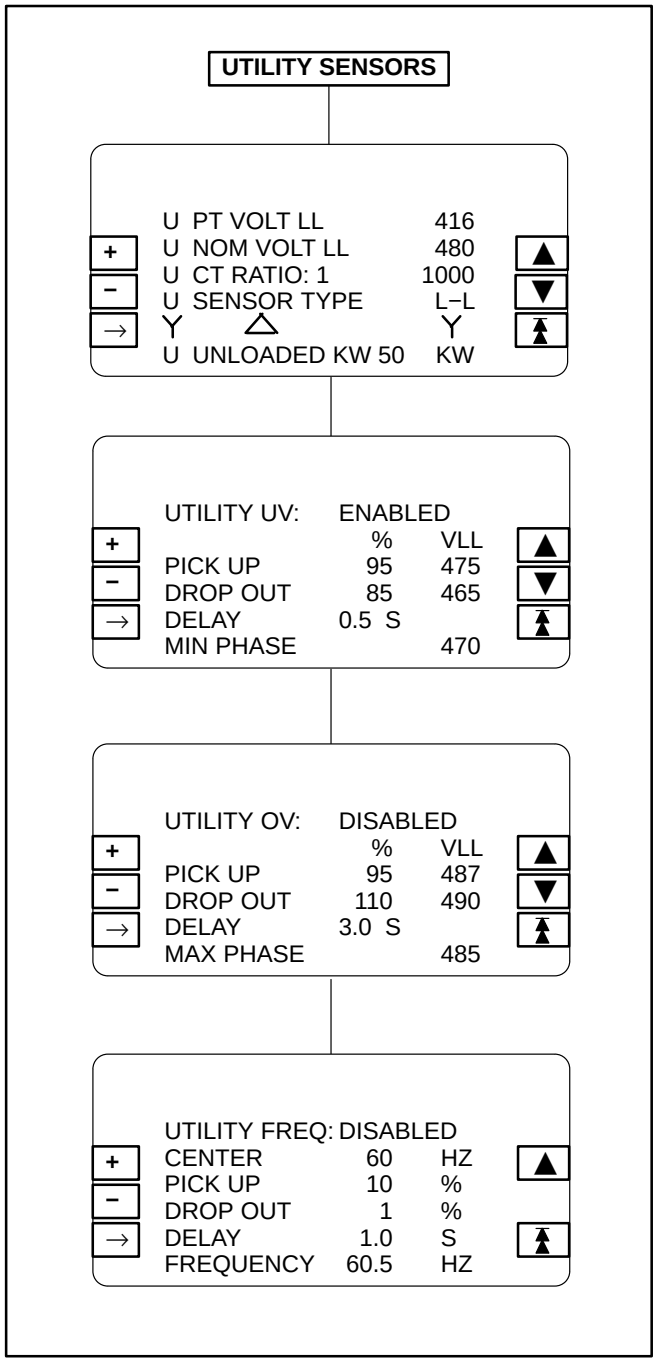


FIGURE 3-9. UTILITY SENSORS SUBMENUS

GENSET SENSORS SUBMENUS

If you press the “GENSET SENSORS” button in the PTC Main Menu 1, the Genset Sensors submenus will appear (Figure 3-10).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field.

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

G NOM VOLT LL: Non-adjustable field, displays current setting of genset nominal voltage. (See Adjust submenu to adjust the output voltage ±5%.)

G SENSOR TYPE: Enter the line-to-line (L-N) for 3 phase line-neutral voltage sensing or line-to-line (L-L) for 3 phase line-line voltage sensing. This applies to both the genset undervoltage and overvoltage sensors. Range: L−L, L−N (L−N).

G BASE LOAD: Enter the maximum load the genset will carry during a closed transition. Range: 0−100% (80%).

G RAMP LOAD: Enter the ramp time for the genset ramp load rate during a closed transition soft load transfer. Ramp rate is +100%kW divided by this time setting. Range: 0−900 seconds (20 sec).

G RAMP UNLOAD: Enter the ramp time for the genset ramp unload rate during a closed transtion soft load retransfer. Ramp rate is −100%kW divided by this time setting. Range: 0−900 seconds (20 sec).

G UNLOADED KW: Enter the %kW (based on standby rating) that the genset is considered unloaded. This is the %kW level at which a closed transition soft retransfer will disconnect from the genset. Range: 0−100% (5%).

GEN UNDERVOLTAGE: Non-adjustable field, always enabled.

GEN OVERVOLTAGE, FREQUENCY: Used to enable or disable menu function. Choose Enabled or Disabled (Enabled).

UV PICKUP: Enter a number between 85 and 100% of the nominal voltage (90%).

UV DROP OUT: Enter a number between 75 and 98% of the under-voltage pick-up percentage (90%).

UV DELAY: Enter a time between 0.1 and 5.0 seconds (4 seconds).

UV MIN PHASE: Displays the lowest line voltage of the three genset phases.

OV PICKUP: This adjusts the over-voltage pickup as a percentage of the over-voltage drop-out. Enter a number between 95 and 99% (95%).

OV DROP OUT: Enter a percentage between 105 and 135% of the nominal voltage (110%).

OV DELAY: Enter a range between 0 and 120 seconds (3 seconds).

OV MAX PHASE: Displays the highest line voltage of the three genset phases.

CENTER (FREQ): Enter a frequency between 45 and 65 Hz (60 Hz).

PICK UP (FREQ): Enter a percentage between 5 and 20% of the nominal frequency (10%).

DROP OUT (FREQ): Enter a percentage between 1 and 5% of the nominal frequency (1%).

DELAY (FREQ): Enter a time between 0.1 and 15.0 seconds (5.0 seconds).

FREQUENCY: Displays the sensed genset line frequency.

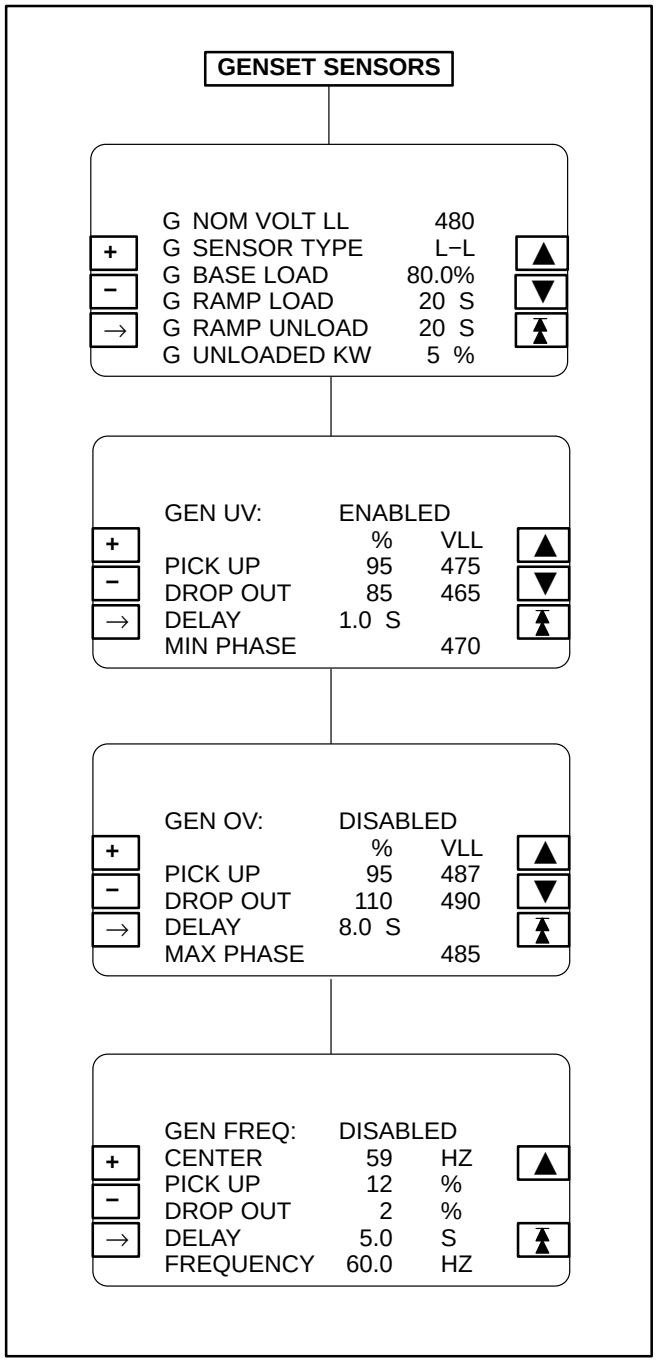


FIGURE 3-10. GENSET SENSORS SUBMENUS

TIMERS SUBMENU

If you press the “TIMERS” button in the PTC Main Menu 1, the Timers submenu will appear (Figure 3-11).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field.

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

START DELAY: Sets time delay for genset engine start. Prevents nuisance genset starting during brief power interruptions.

Enter a range from 0 to 300 seconds (0 seconds).

STOP DELAY: Sets the time delay for engine cooldown following a re-transfer. This stop delay works in conjunction with and is activated at the same time as the normal cooldown timer. (Will extend normal cooldown timer if entered time is greater.)

Enter a time from 0 to 600 seconds (0 seconds).

TRANSFER: In a Normal to Emergency transfer this function allows the genset to stabilize before the load is applied. Enter a time from 0 to 120 seconds (10 seconds).

RETRANSFER: In a Emergency to Normal transfer this function allows the utility to stabilize before the load is applied.

Enter a time from 0 to 1800 seconds (600 seconds).

PGM TRANSIT: Sets the time delay for Programmed Transition. A setting of 0.0 disables the program.

Enter a time from 0 to 60 seconds (0 seconds).

MAX PARALLEL: Sets the maximum time during closed transition that utility and genset can be paralleled.

Enter a time from 0 to 1800 seconds (20 seconds).

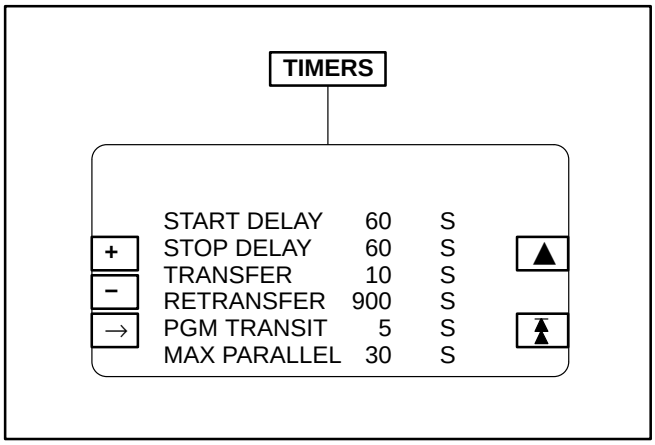


FIGURE 3-11. TIMERS SUBMENU

TEST/EXERCISE SUBMENU

If you press the “TEST/EXERCISE” button in the PTC Main Menu 2, the Test/Exercise submenu will appear (Figure 3-12).

The following field descriptions show the valid field entries and default value (shown in parenthesis) for each field.

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to save changes.

MODE: Indicates the generator set application type for PTC option.

OT-PGM TRAN − Open transition load transfer.

CT-MOMENT − Closed transition load transfer with momentary (<100ms) overlap.

CT-SOFT − Closed transition load transfer with load ramping.

TEST WITH LOAD: Feature allows genset Test sequence, which is initiated through the Remote Start (TEST) switch, to operate with or without load. Default: **OFF**

EXER WITH LOAD: Feature allows genset Exercise sequence, which is initiated through control panel Exercise button to operate with or without load. Default: **OFF**

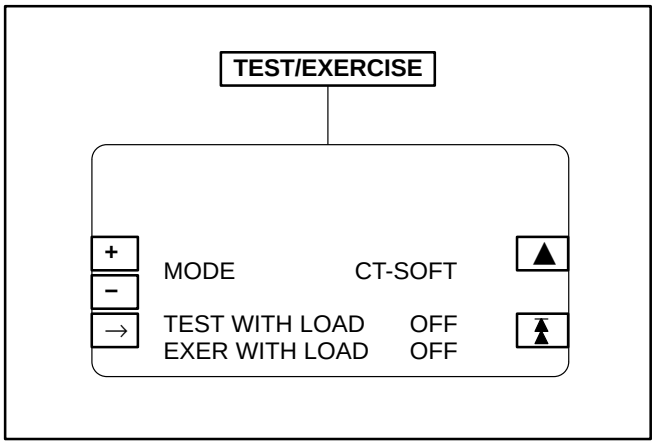


FIGURE 3-12. TIMERS SUBMENU

ADJUST SUBMENU

Figure 3-13 shows the main menus (Menu A and Menu B) of the system control and the Adjust submenu.

To display the Adjust submenu, press the **MORE>>** button in Menu A and then the **ADJUST** button in Menu B.

The Adjust submenus are intended for qualified service personnel and site personnel only and may require a **USER** password. If a password is required, the **USER** password menu will appear when you try to modify the Adjust submenus. (Refer to *PASSWORD Menu* in this section to enter password.

Changes are automatically saved when you exit this menu.

If the generator set is operating in parallel with a system bus, the voltage and frequency adjustments are disabled to prevent inadvertent misadjustment of the paralleling load sharing functions.

Use the + and − buttons to increase or decrease the values in the following fields. Use the arrow (→) button to move the cursor within a field or to the next field. Exit menu to safe changes.

START DELAY: This delay applies only to remote starting in the Auto mode. The Start Delay adjustment range is 0 to 300 seconds.

STOP DELAY: This delay applies only to remote stopping in the Auto mode. The Stop Delay adjustment range is 0 to 600 seconds.

VOLTAGE: Used to adjust the output voltage ±5%.

FREQUENCY: Used to adjust the frequency ±3 Hz.

VOLTAGE/SPEED DROOP: These two submenus apply to a genset that has the paralleling option and is configured to operate in droop mode.

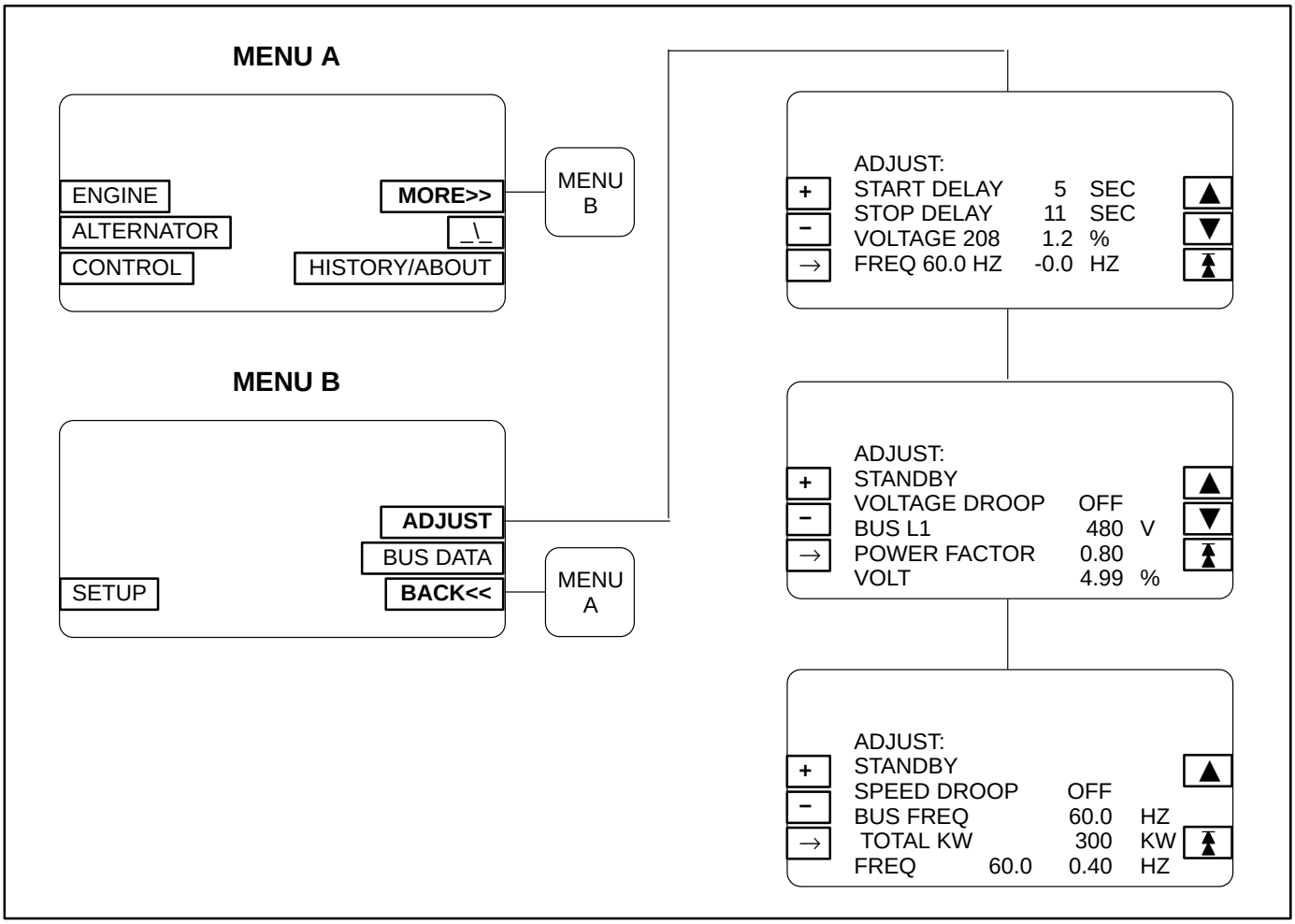


FIGURE 3-13. ADJUST SUBMENU

CALIBRATION PROCEDURE

There are several circuit cards/modules that, when removed and replaced, require you to recalibrate the control panel display for genset voltage and current and bus voltage.

Note that the type of calibration to perform varies for each card. The letters A, B and C are used to designate which of the following three calibration procedures are required for each card/module.

- Genset/Parallel board (**A, B** & **C**)
- PT/CT board (**A** & **B**)
- Bus PT (**C**)
- CT's (**B**)

⚠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.***

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

(A) Genset Voltage Display Calibration

The PowerCommand control automatically synchronizes to the system bus when bus voltage is available and the genset is running. Consequently, it is not possible to calibrate the genset output voltage display of the genset that is running when the bus is energized. If it is necessary to adjust the output voltage display of the genset that is running, the InPower service tool must be used to switch off the synchronizer function of the control.

1. Display the *Voltage Calibration* submenu (Page 3-6).
2. With the genset OFF, attach a calibrated voltmeter to the AC output from L1 to L2. (L1 to Neutral for single phase alternators.)
3. Start the genset and allow it to reach normal operating speed.
4. Calibrate voltage reading for *L1* so that the reading on the display agrees with the calibrated voltmeter.
5. Shut the generator set OFF.
6. Repeat steps 2 through 5 for L2 and L3. (In step 2 attach meter to the AC output from L2 to L3 to calibrate *L2* and L3 to L1 to calibrate *L3*.)
7. Exit menu to safe changes.

(B) Genset Ammeter Display Calibration

1. Display the Current Calibration submenu (Page 3-6).
2. With the genset OFF, attach a calibrated ammeter to L1.
3. Start the genset and allow it to reach normal operating speed.
4. Load the genset to maximum rated kVA at rated voltage.
5. Calibrate the reading for *L1* current so that the reading on the display agrees with calibrated ammeter.
6. Repeat steps 2 through 5 for *L2* and *L3*. (In step 2, attach meter to L2 to calibrate *L2* current and L3 to calibrate *L3* current.)
7. Exit menu to safe changes.

(C) Bus Voltage Calibration

The PowerCommand control automatically synchronizes to the system bus when bus voltage is available and the genset is running. Consequently, it is not possible to calibrate the genset bus voltage display of the genset that is running when the bus is energized. If it is necessary to adjust the bus voltage display of the genset that is running, the InPower service tool must be used to switch off the synchronizer function of the control.

1. Display the Bus Voltage Calibration submenu (Page 3-6).
2. With all gensets OFF, attach a calibrated voltmeter to TB1-A (L1) and TB1-B (L2) of the bus PT module (Figure 3-14).
3. Start another genset and allow it to reach normal operating speed and voltage. Connect operating genset to the bus.
4. Calibrate the voltage reading for Bus Volts *L1* so that the reading on the display matches the reading on the calibrated meter.
5. Shut the generator set OFF.
6. Repeat steps 2 through 5 for Bus Volts L2 and L3. (In step 2 attach meter to the AC output from L2 to L3 to calibrate *L2;* L3 to L1 to calibrate *L3*.)
7. Exit menu to safe changes.

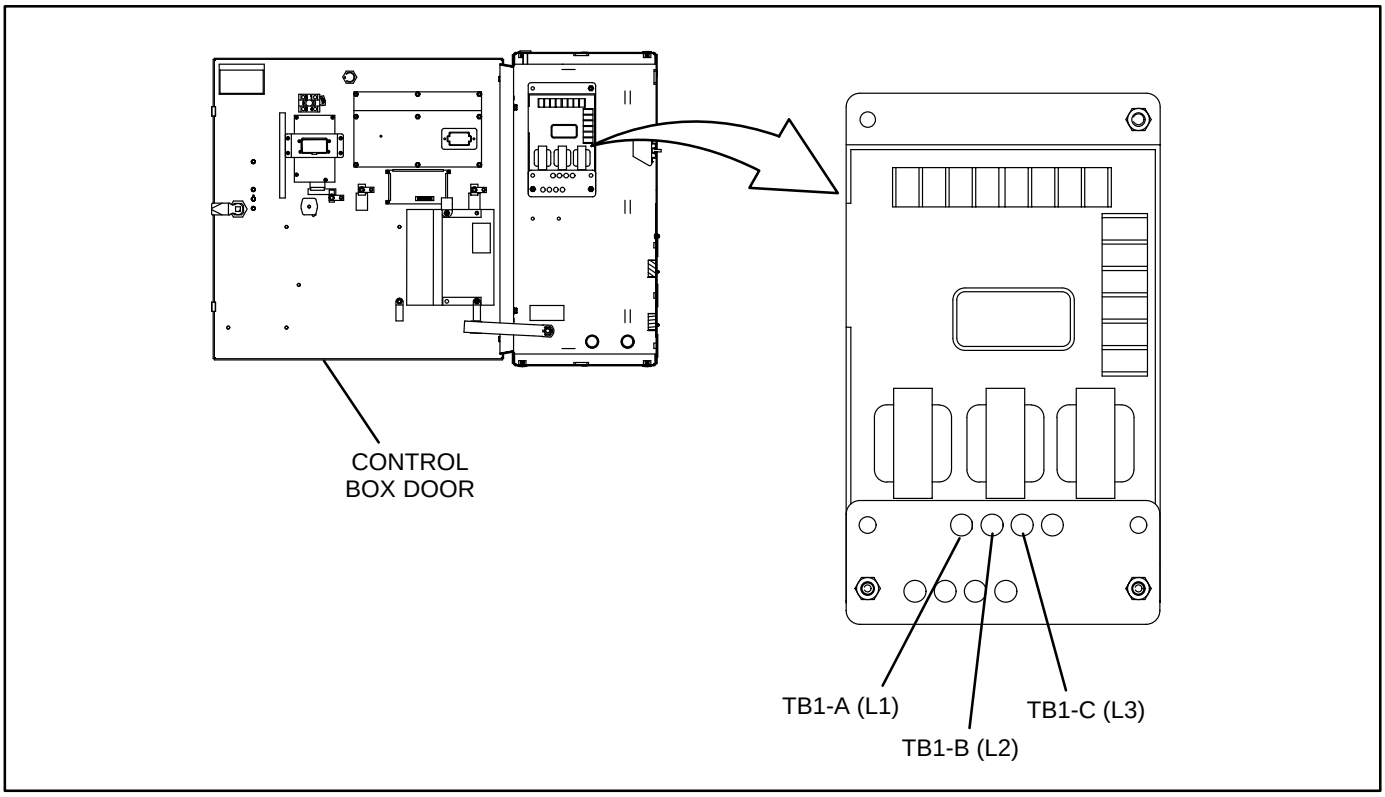


FIGURE 3-14. BUS PT MODULE

CONTROL BOX WIRING

The generator set control box assembly, which can be located on either side of the genset, contains connection points for remote control and monitor options.

Customer monitor/control connections are attached to terminal blocks TB3 and TB8 (see Figure 3-15). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, control box heater, and etc. are also attached to these terminal blocks. Driver signals for customer supplied relays are also provided for several alarm and shut down conditions. Refer to Customer Connections diagram in Section 5.

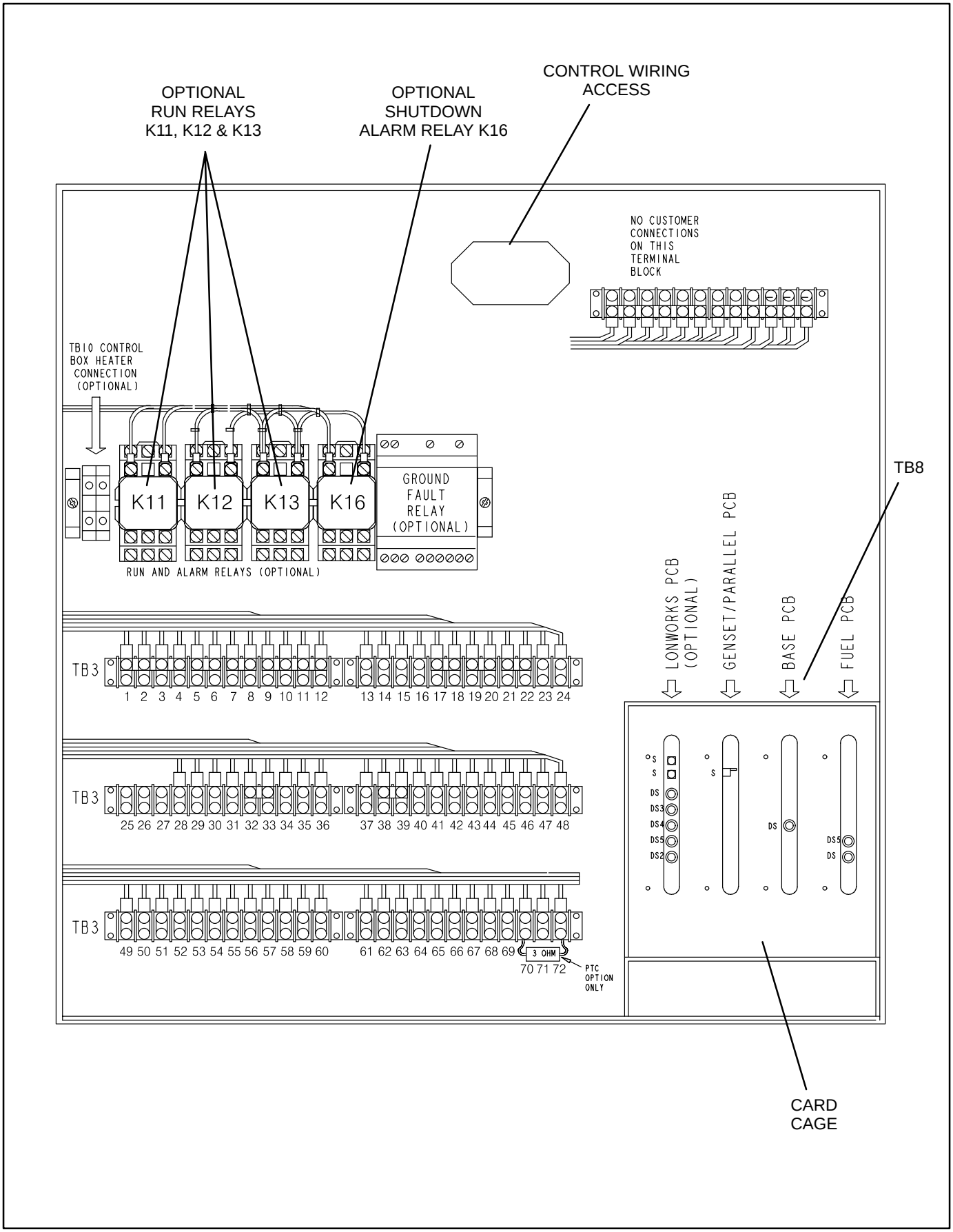


FIGURE 3-15. CONTROL BOX ASSEMBLY INTERIOR

RUN RELAYS (K11, K12, K13)

The optional run relays are rail mounted inside the control box (Figure 3-15). 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 3-16) 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

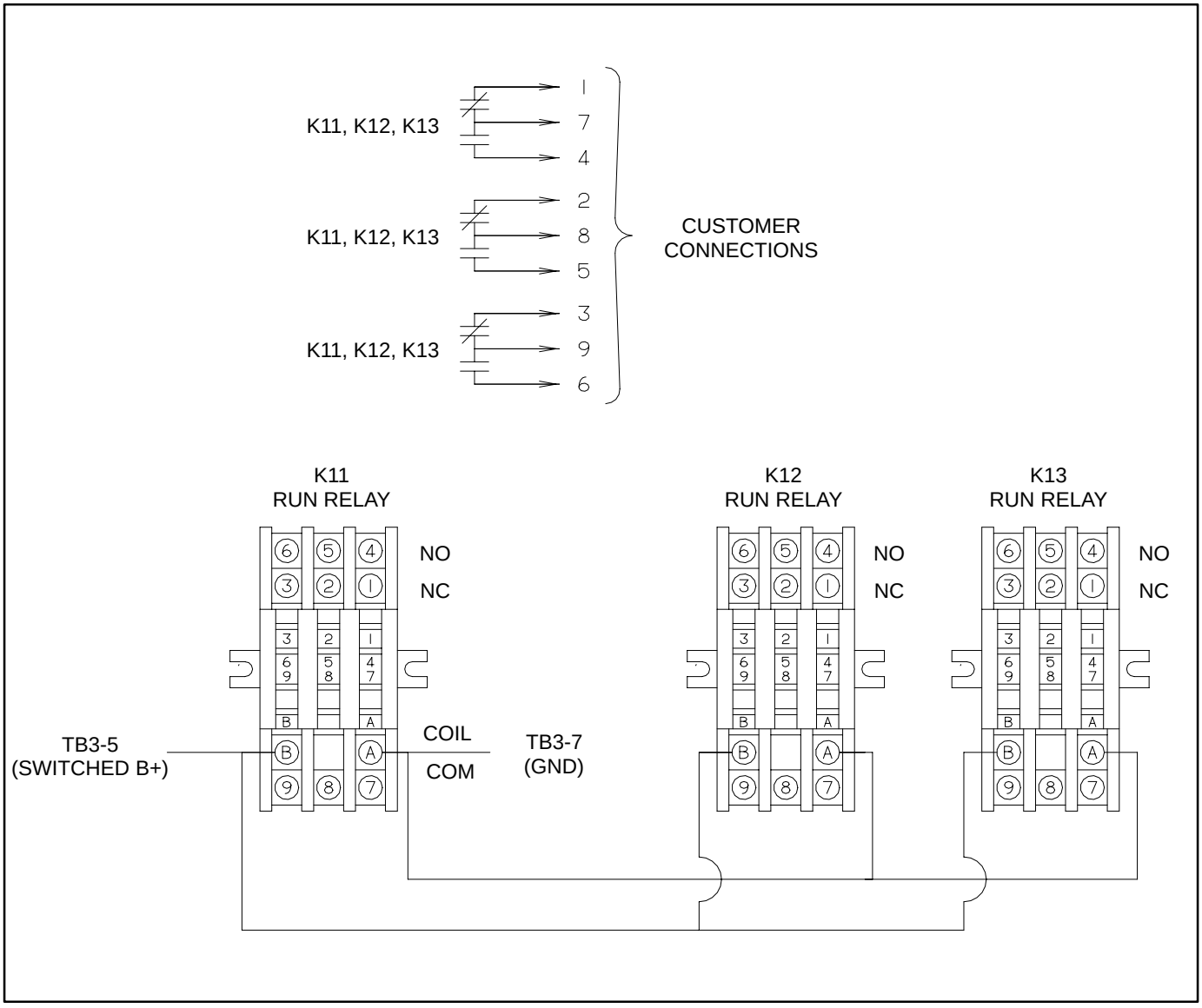


FIGURE 3-16. OPTIONAL RUN RELAYS (K11, K12, K13)

ALARM RELAY (K16)

The optional alarm relay is rail mounted inside the control box (Figure 5-2). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-4) is often used to energize warning devices such as audible alarms. Any generator set 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

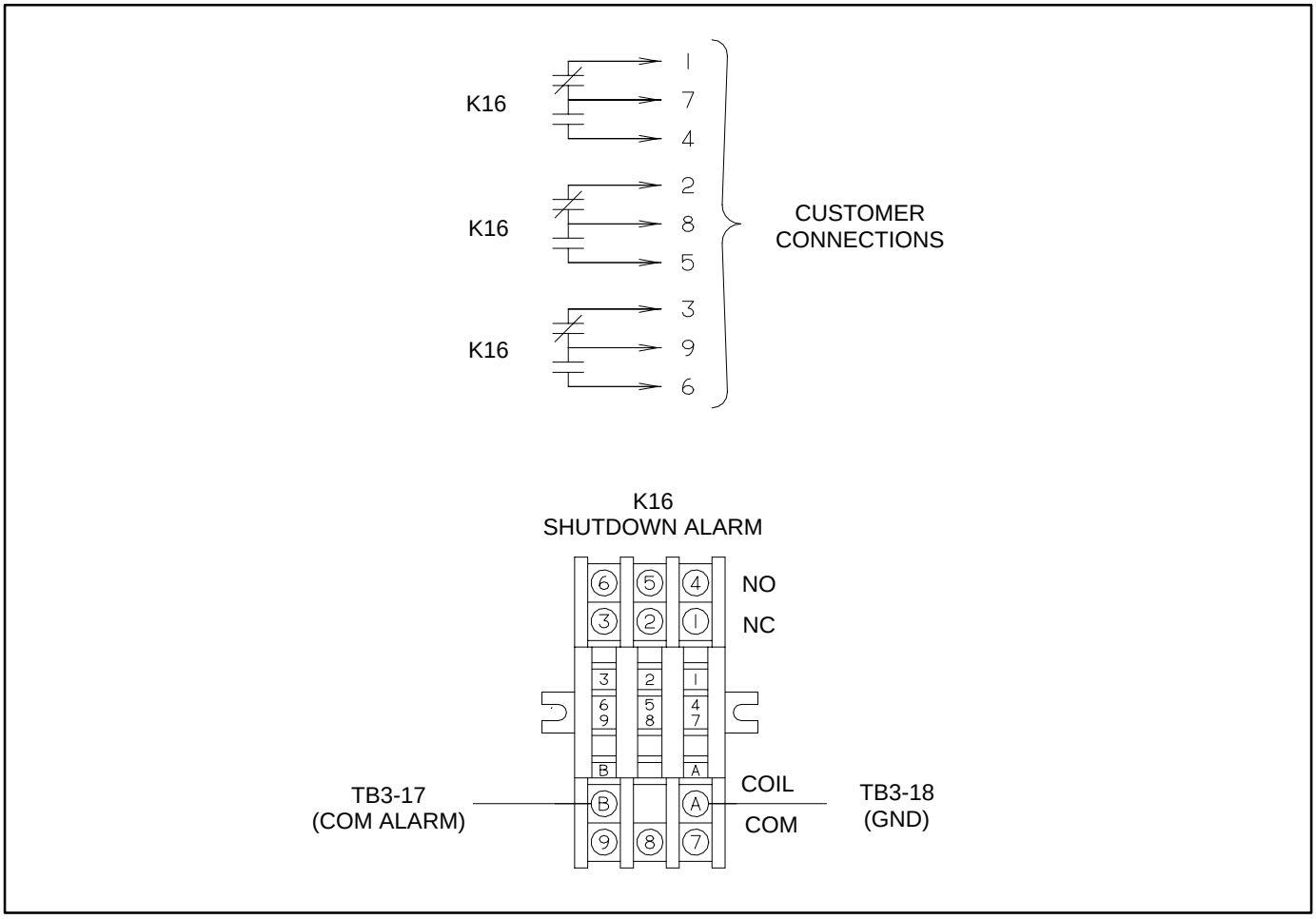


FIGURE 3-17. OPTIONAL ALARM RELAY (K16)

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.***

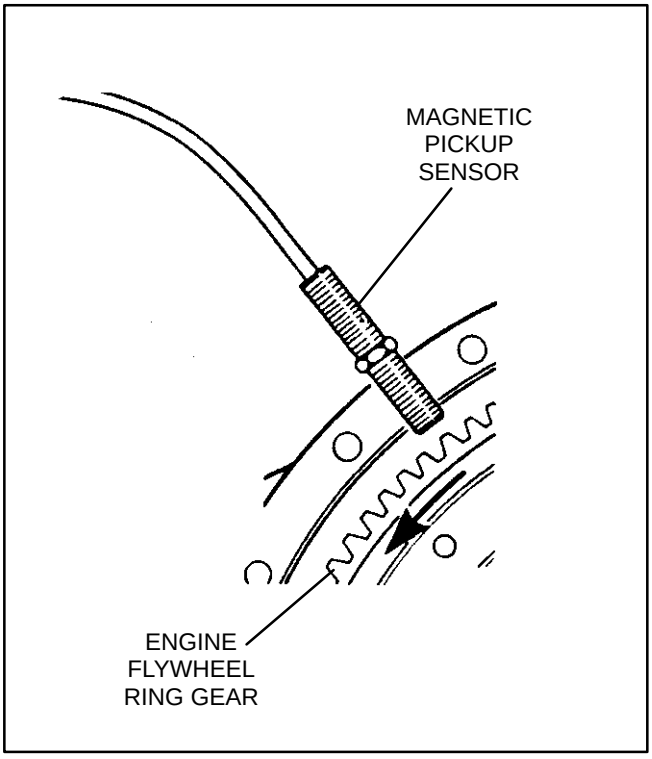


FIGURE 3-18. MPU SENSOR

4. Servicing the Generator

TESTING THE GENERATOR

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

⚠WARNING ***Arcing at battery terminals, arcing in light switch or other equipment, flame, pilot lights and sparks can ignite battery gas causing severe personal injury.***

Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch trouble light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (−) cable first and reconnect last.

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

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

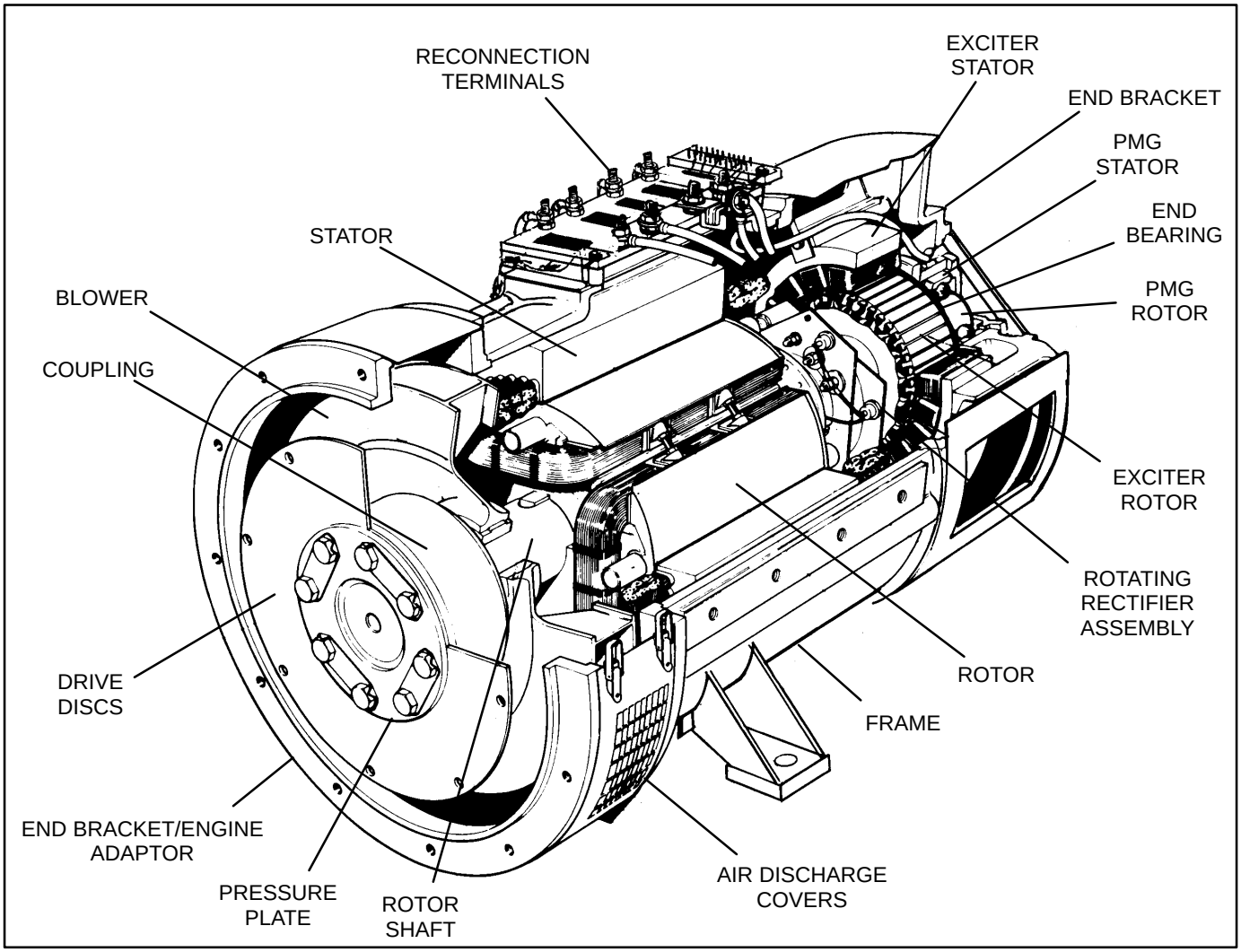


FIGURE 4-1. TYPICAL GENERATOR

GENERATOR/PCC CONTROL ISOLATION PROCEDURE

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

1. Throw the line circuit breaker **OFF** and shut down the set.

   ⚠ CAUTION ***This test involves unregulated excitation of the generator. To prevent damage to the generator due to overcurrent, make sure that all loads have been disconnected and that all faults have been cleared from the power output terminals of the generator.***

2. Open the door of the control box assembly and remove plug 10 from connector 10 of the voltage regulator output module (A37). See Figure 3-11.
3. Prepare to measure output voltage across the generator terminals while the set is running.
4. Bring two jumpers from a 12 volt battery for connection to the **X** (Field +) and **XX** (Field −) pins of plug 10.

   X = Red wire of connector **10-6**
   XX = Brown wire of connector **10-3**

   Connect the jumper from the positive (+) post of the battery to the **X** pin (red wire) of **10-6**. Be prepared to connect the jumper from the negative (−) post of the battery to the **XX** pin (brown wire) of **10-3**. If one of the 12 volt cranking batteries is used, bring the jumpers from the battery connected on the grounded side of the system to avoid inadvertently imposing 24 volts on the system.
5. Check polarity again. Polarity must be correct or this test will be inconclusive because the induced and residual magnetic polarities in the exciter stator will be opposed.

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

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

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

EXCITER STATOR

Testing Winding Resistance: Measure winding resistance with a Wheatstone bridge or digital ohmmeter. Replace the stator if winding resistance is not as specified by Table 4-2.

Testing Winding Insulation Resistance: Disconnect exciter stator leads **F1** and **F2** from their connectors in the AC generator wiring harness and isolate them from ground.

Connect the megger between one of the leads and ground and conduct the test. Refer to Table 4-1 for megger voltage selection and required resistance values.

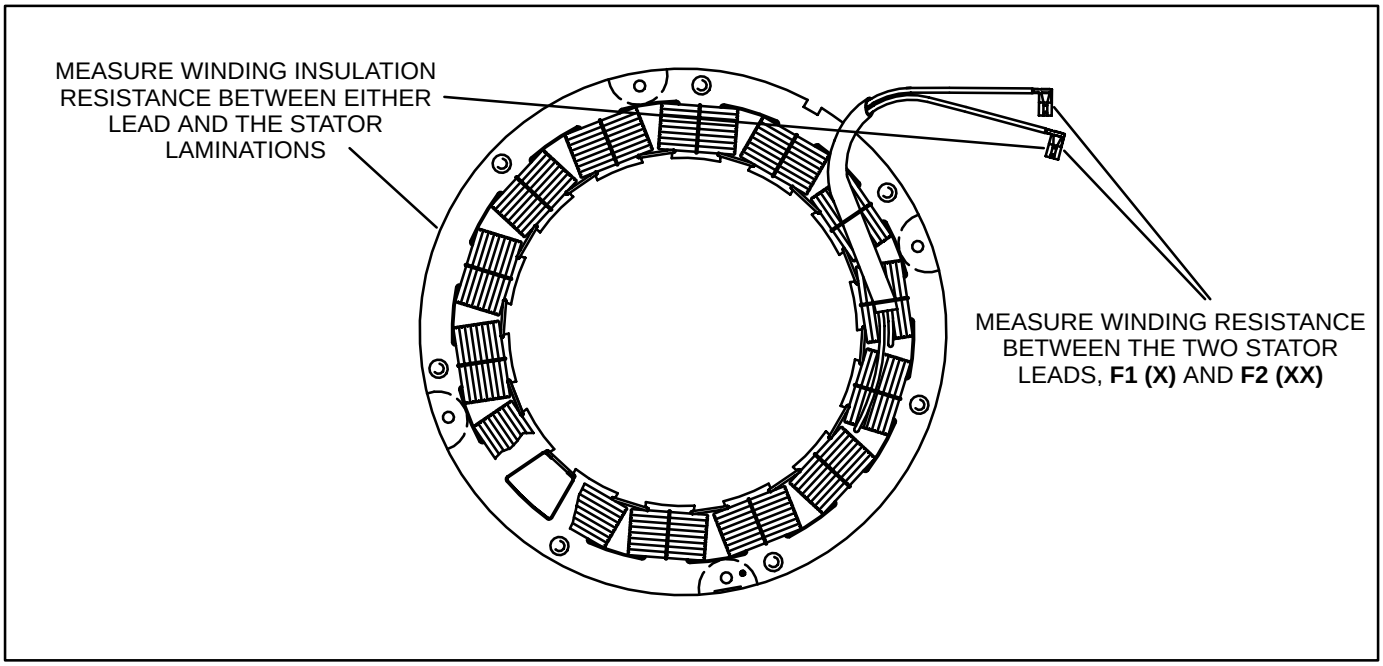


FIGURE 4-2. TESTING THE EXCITER STATOR

EXCITER RECTIFIER BRIDGE (ROTATING RECTIFIER ASSEMBLY)

The exciter rectifier bridge is mounted on the exciter rotor, inboard, facing the main rotor. It consists of a positive plate and a negative plate, split diametrically. Each carries three diodes, three terminal posts for connecting exciter rotor leads to the diode 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 N-m) and the pigtail terminals to 24 in-lbs (2.7 N-m) 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 N-m) when reassembling.

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

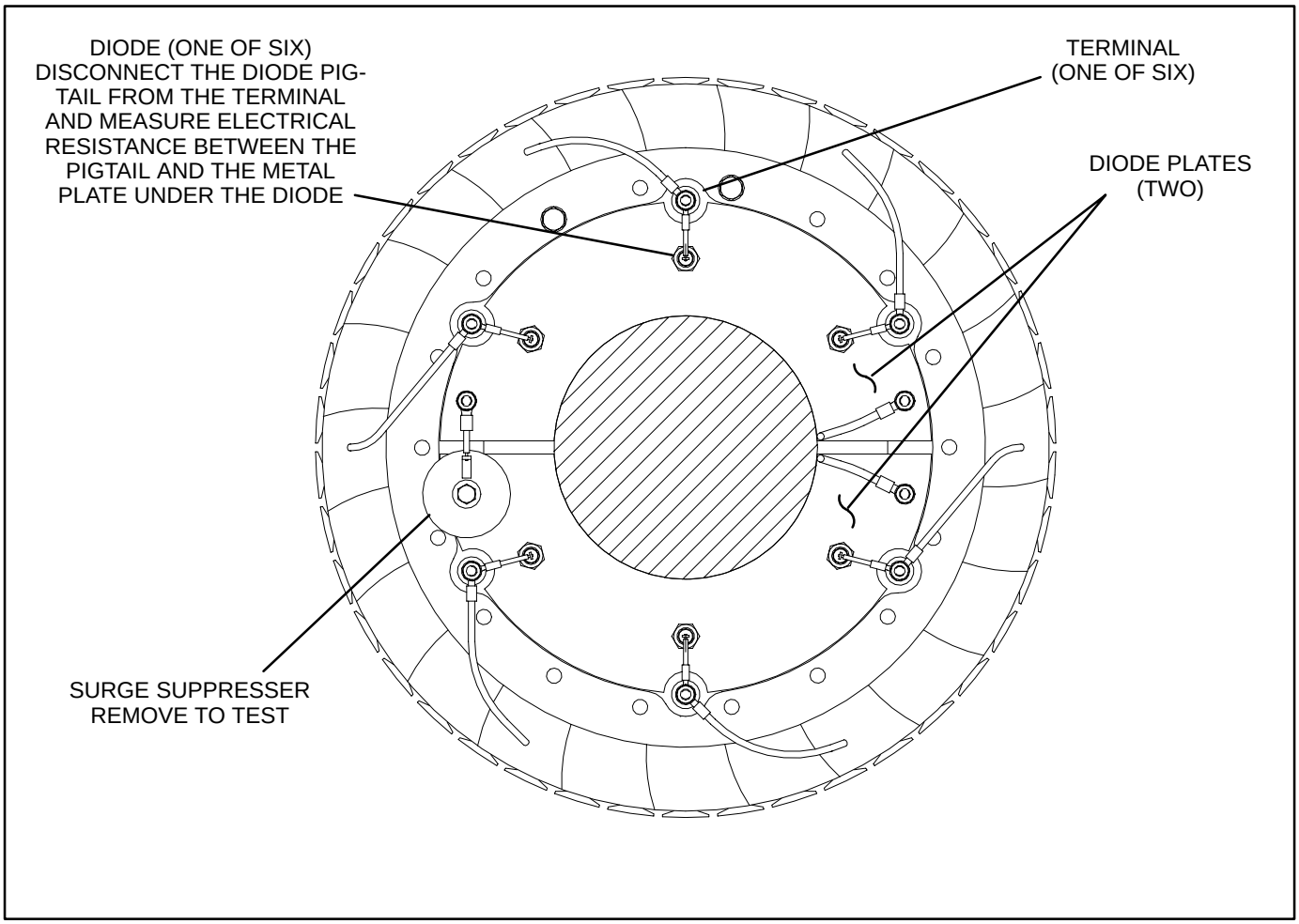


FIGURE 4-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

EXCITER ROTOR

Testing Winding Resistance: Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly. With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: **U** (CR1 or CR4) and **V** (CR2 or CR5), **V** (CR2 or CR5) and **W** (CR3 or CR6), **W** (CR3 or CR6) and **U** (CR1 or CR4). See the winding schematic. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 4-2.

Testing Winding Insulation Resistance: Disconnect all six exciter rotor leads from diode terminals CR1 through CR6 and isolate them from ground.

Connect the megger between one of the leads and ground and conduct the test. Refer to Table 4-1 for megger voltage selection and required resistance values.

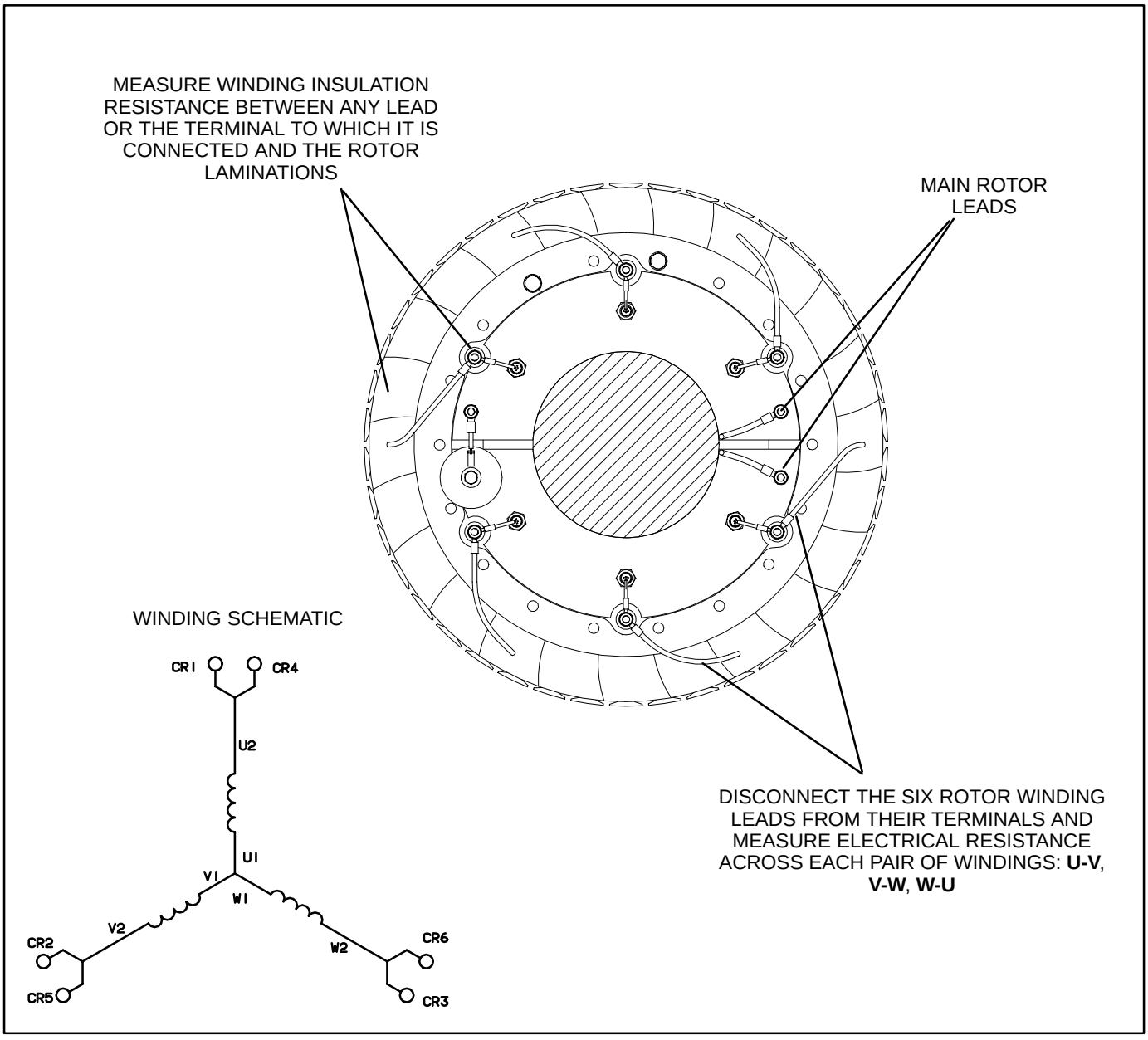


FIGURE 4-4. TESTING THE EXCITER ROTOR

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 4-5. 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 4-2. Connect the rotor leads and torque the terminals to 23 in-lbs (3.3 N-m) when reassembling.

Insulation Resistance and PI Test: Disconnect the main rotor and voltage suppressor leads from terminals **F1+** and **F2−** on the rotating rectifier assemblies and isolate them from ground. Tag and mark each lead with its terminal number (**F1+** or **F2−**).

Connect the megger between one of the rotor leads and ground and conduct the test. Refer to Table 4-1 for megger voltage selection and required resistance values.

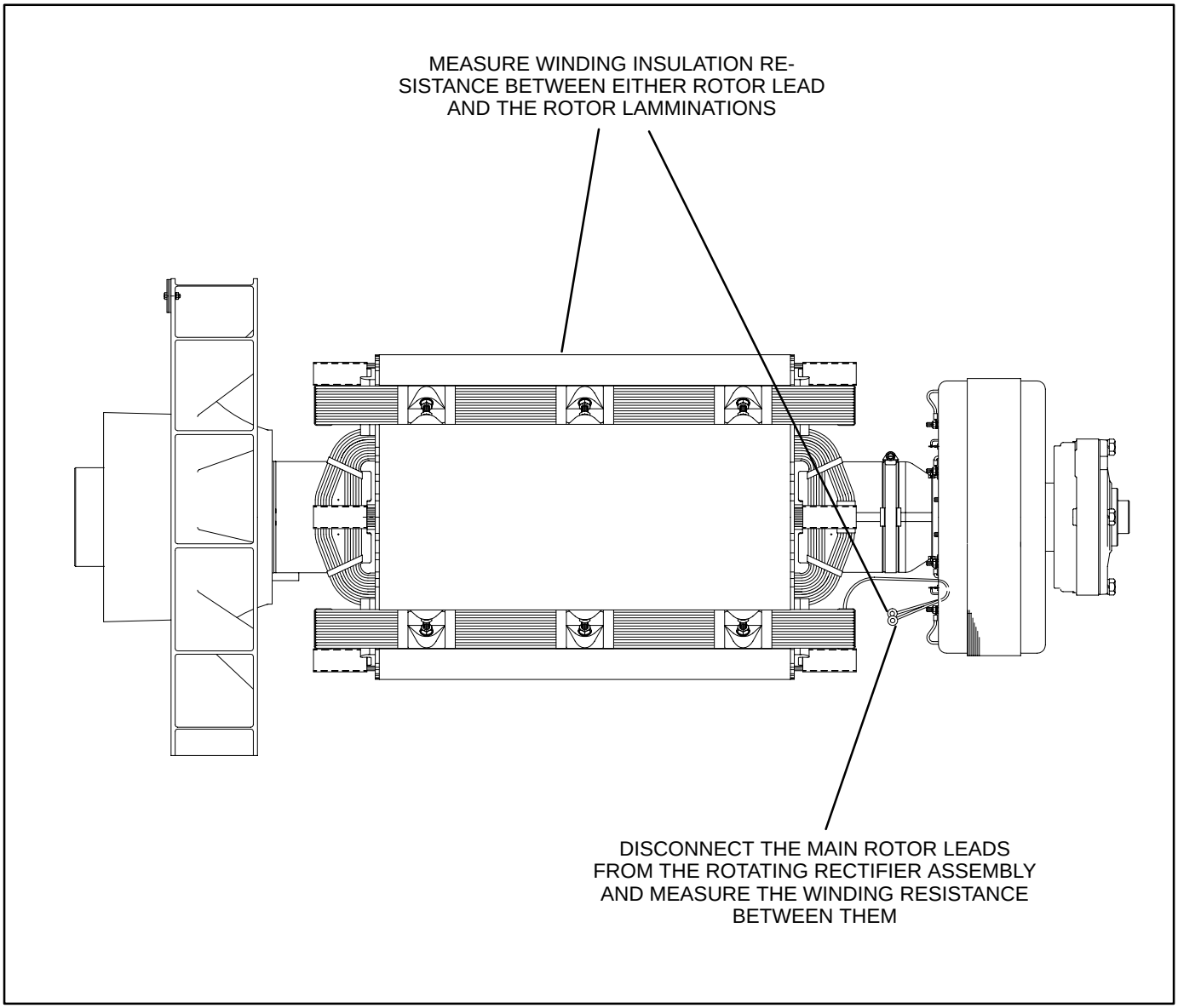


FIGURE 4-5. TESTING THE MAIN ROTOR

MAIN STATOR

Testing Main Stator Winding Resistance: Disconnect all stator leads from the terminals to which they are connected. Using a Wheatstone bridge having at least 0.001 ohm precision, measure electrical resistance across each pair of stator leads: **U1-U2, V1-V2, W1-W2, U5-U6, V5-V6** and **W5-W6**. Replace the stator if the resistance of any winding is not as specified in Table 4-2.

Insulation Resistance and PI Test: Remove and separate all leads of the generator from the generator load terminal block. Number of neutral leads (three or six) to remove will vary between low and medium voltage generators.

Connect the megger between one phase of the stator and ground while grounding the other two phases and conduct the test. Refer to Table 4-1 for megger voltage selection and required resistance values.

Repeat this step in turn for the other two phases.

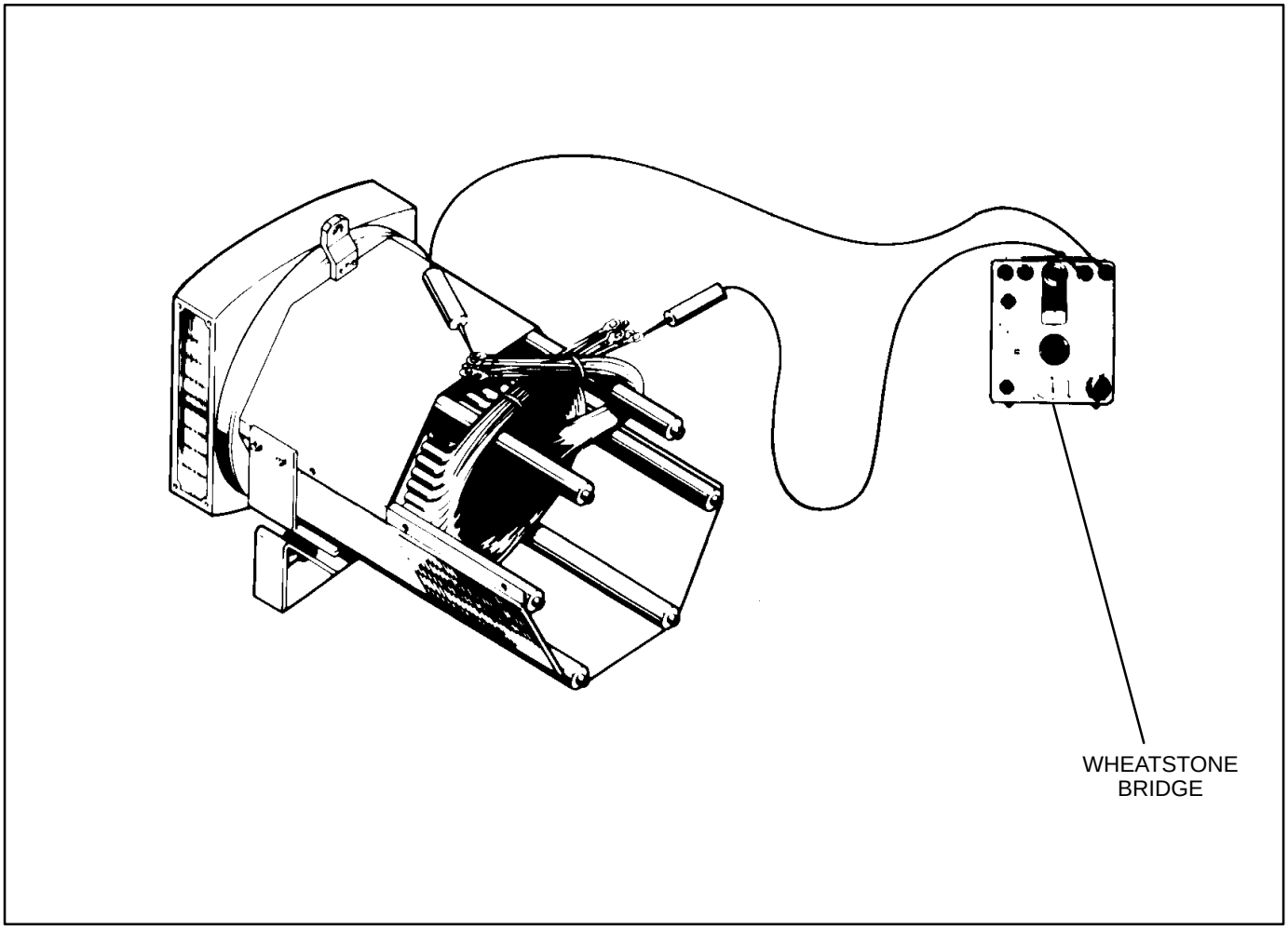


FIGURE 4-6. TESTING THE GENERATOR STATOR

TABLE 4-2. WINDING RESISTANCE VALUES*

FRAME SIZE	EXCITER STATOR	EXCITER ROTOR	MAIN ROTOR	MAIN STATOR			
				WINDING 11	WINDING 12	WINDING 17	WINDING 07
5C	17	0.174	1.55	0.0068	N/A	0.0105	N/A
5D	17	0.174	1.77	0.0057	N/A	0.0079	N/A
5E	17	0.174	1.96	0.0043	N/A	0.0068	N/A
5F	17	0.174	2.16	0.0037	N/A	0.0049	N/A

***** Resistance figures are approximates, at 68° F (20° C) ± 10%.

TESTING THE PMG

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

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

1. Disconnect plug **J10** from the voltage regulator output stage module.
2. Start the engine at the set and let the speed stabilize.
3. Measure voltage across lead pairs **J10-1** & **J10-4, J10-4** & **J10-5**, and **J10-5** & **J10-1**. 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 output stage module and the PMG and repair as necessary before disassembling the PMG.
4. Stop the set and measure electrical resistance across lead pairs **J10-1** & **J10-4, J10-4** & **J10-5**, and **J10-5** & **J10-1** with a Wheatstone bridge or digital ohmmeter. Each winding should have a resistance of approximately 2.6 ohms.

GENERATOR DISASSEMBLY

The following procedures provide information for removal and reassembly of the PMG, exciter, control housing, and stator/rotor assemblies. Be sure to read through this section first, before performing procedures listed, to determine the steps most appropriate for the service attention required.

Permanent Magnet Generator (PMG) Removal

1. Turn off and disconnect battery charger (if equipped).
2. Disconnect the negative (**–**) battery cable to prevent accidental starting of the generator set while servicing.

   ⚠WARNING ***Arcing at battery terminals, arcing in light switch or other equipment, flame, pilot lights and sparks can ignite battery gas causing severe personal injury.***

   Ventilate battery area before working on or near battery—Wear safety glasses—Do not smoke—Switch trouble light ON or OFF away from battery—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (−) cable first and reconnect last.

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

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

3. Remove the lower back panel of the control housing (see Figure 4-7).
4. Remove the three M5X12mm capscrews and lockwashers from the PMG cover, and remove cover.
5. Disconnect the PMG wiring harness connector.
6. Remove the four bolts and clamps retaining the exciter stator housing to the endbracket.
7. Tap the stator housing out of its spigot, and carefully remove from generator endbracket.

   The highly magnetic rotor will attract the stator core; care must be taken to avoid any contact which may damage the windings.

8. Remove the hex head through-bolt from the rotor shaft and firmly pull the complete rotor assembly from its location. Keep the rotor clean by avoiding contact with metal dust or particles.

   ⚠CAUTION ***The rotor assembly must not be dismantled, or the magnetic properties will be destroyed.***

Main Stator and Rotor Removal

1. Remove the PMG, refer to *Permanent Magnet Generator Removal,* earlier this section.

2. Remove the lower back panel, the two lower front panels and the upper access panels of the control housing assembly (see Figure 4-7).

3. Remove the air inlet and discharge panels of the generator.

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

4. Crank or bar the engine/generator to position the rotor such that a full pole face is at the bottom of the main stator core. Proper positioning can be viewed through the generator access openings. Refer to engine service manual for proper cranking or barring procedure.

5. Disconnect all load wires from the reconnection terminal block assembly. If equipped with the circuit breaker option, disconnect load wires from circuit breaker. Check that all leads are labeled to ease reassembly.

6. Disconnect the remote control wiring and conduit from the control housing. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.

7. Disconnect the engine harness connectors (INLINE A, B, and C) and the DC power connector for the engine block heaters (INLINE F) and place harness on top of control housing.

8. Mark and disconnect the wires to the CT's.

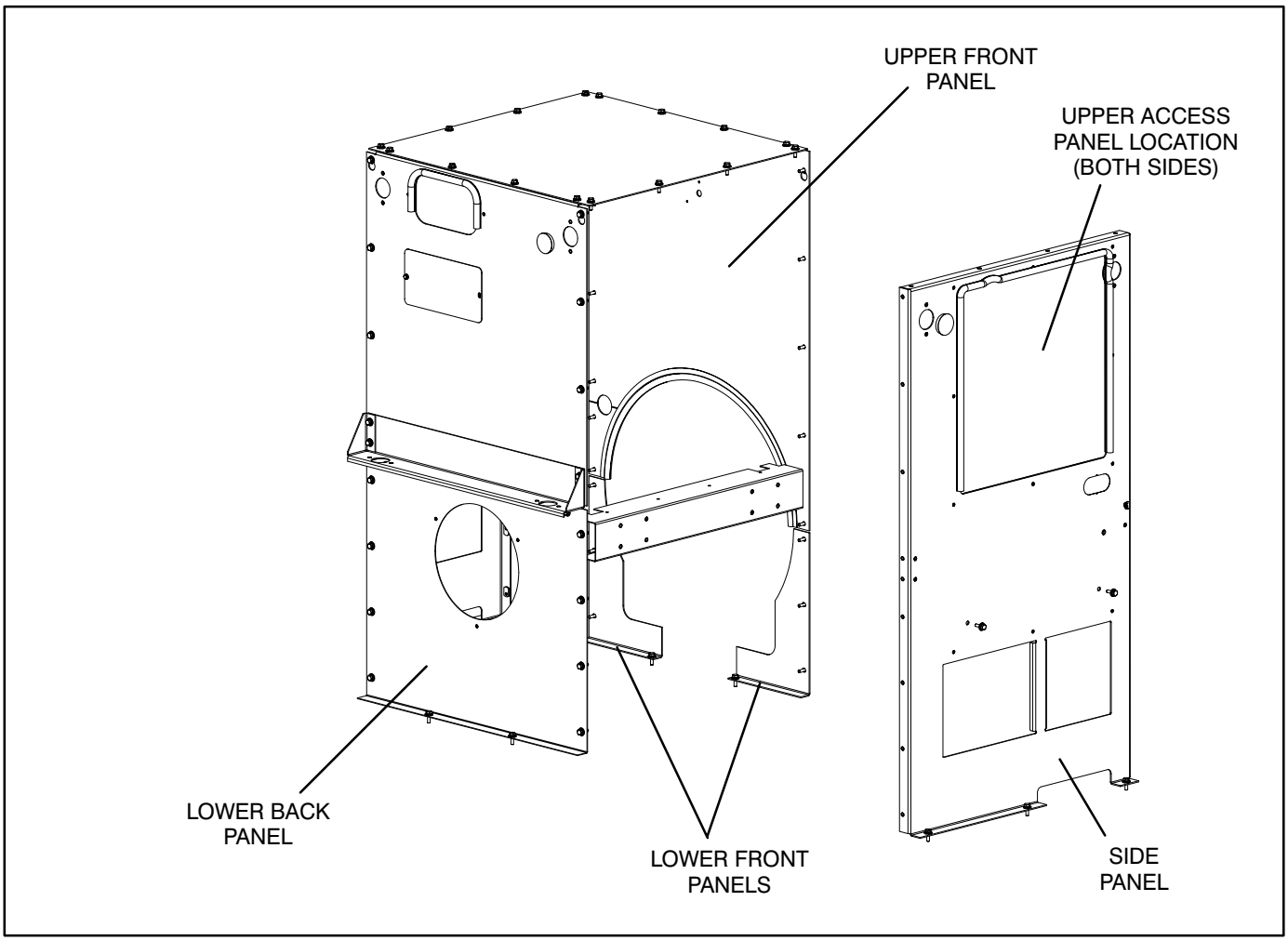


FIGURE 4-7. CONTROL HOUSING ASSEMBLY

9. Use a hoist or similar lifting device to support the control housing assembly.

   ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

10. Loosen the fasteners that secure the control housing side and bottom panels to generator. Make sure that hoisting device is controlling weight of control housing assembly.

11. Remove control housing fasteners, and remove the control housing assembly from the generator.

    To remove the stator and rotor at the same time, skip to step 27. To remove the stator and rotor individually, continue with step 12.

12. Remove the four bolts retaining the bearing cartridge housing in the endbracket (outer four bolts).

13. Remove the eight bolts holding the endbracket to the generator housing.

14. Insert two bolts (M10) in the two holes provided for “jacking” purposes, on the endbracket center line. Screw bolts in until endbracket spigot is clear of locating recess.

15. Carefully tap the whole assembly off the bearing cartridge housing, ensuring the endbracket is supported to prevent the exciter stator from damaging the windings on the exciter rotor.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

16. The exciter stator is now accessible for inspection and removal from endbracket/engine adaptor.

17. The end bearing can now be removed if required. Refer to Bearing Removal.

18. Remove the M20 fastener from the two generator mounting feet brackets (Figure 4-10).

    ⚠WARNING ***Generator weight can cause severe personal injury or death. Use extreme caution when lifting, hoisting, or moving the generator. Make certain to use a hoist or other lifting device whose capacity is rated well above the weight of the generator. The generator (dependent on model type) can weigh up to 3,745 pounds (1685 kgs). Make certain that the maximum lifting capacity of the hoist exceeds the weight of the generator by a large margin. Follow the manufacturer’s instructions carefully regarding the weight capacity of the hoist and the recommended hoisting procedure.***

19. Using an adequate lifting device, lift the generator (at lifting eyes provided) so that the generator is completely supported by the lifting device. (Note that the engine is still supported by four mounting feet. Do not lift generator any higher than necessary to support weight of generator with lifting device, or binding will occur between top of generator and engine.)

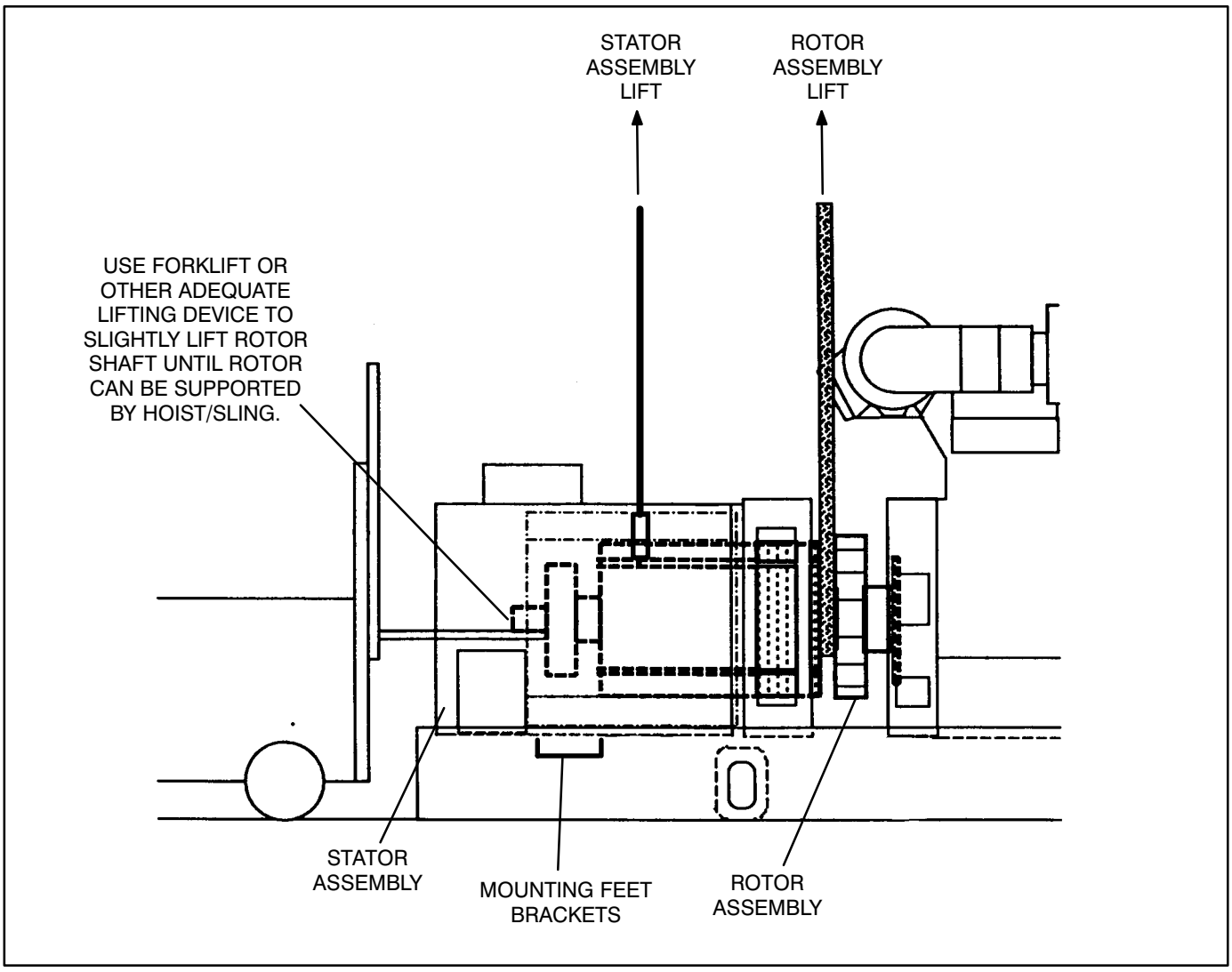


FIGURE 4-8. REMOVING STATOR ASSEMBLY

20. Using a forklift, position a lifting bar of the forklift (inside and in-line with the generator) under the rotor shaft. Lift the rotor shaft slightly so that rotor is not resting on inside of stator assembly. See Figure 4-8. (Use V-block secured to lifting bar or straps to secure rotor shaft to forklift bar.)

21. Verify that the stator is adequately supported and then carefully remove the capscrews from the stator attachment ring.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

    ⚠ CAUTION ***Improper stator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the stator assembly alone, by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the stator is adequately hooked/strapped to maintain level control of stator assembly while lifting and moving.***

22. Being careful not to drag the windings on the rotor, move the stator assembly sufficiently away from engine to sling and support the rotor assembly. Do not allow rotor assembly to hang on engine flywheel.

    ⚠ CAUTION ***Drive disc damage can be caused by allowing the rotor assembly to hang on flywheel. Use adequate hoist and sling to support the rotor assembly.***

23. Reposition or add hoist and sling support for the main rotor, and remove the forklift. See Figure 4-9, Rotor Lift detail.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

24. Remove the stator assembly, being careful not to drag the windings on the rotor. Place stator assembly away from the chassis in the horizontal position.

25. Using the hoist and sling to support the rotor, carefully remove the capscrews and flat washers that secure the drive discs to the engine flywheel.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

26. Remove the rotor assembly and place it on wood blocks in the horizontal position. To avoid possible distortion, do not allow the drive discs and fan to rest on anything.

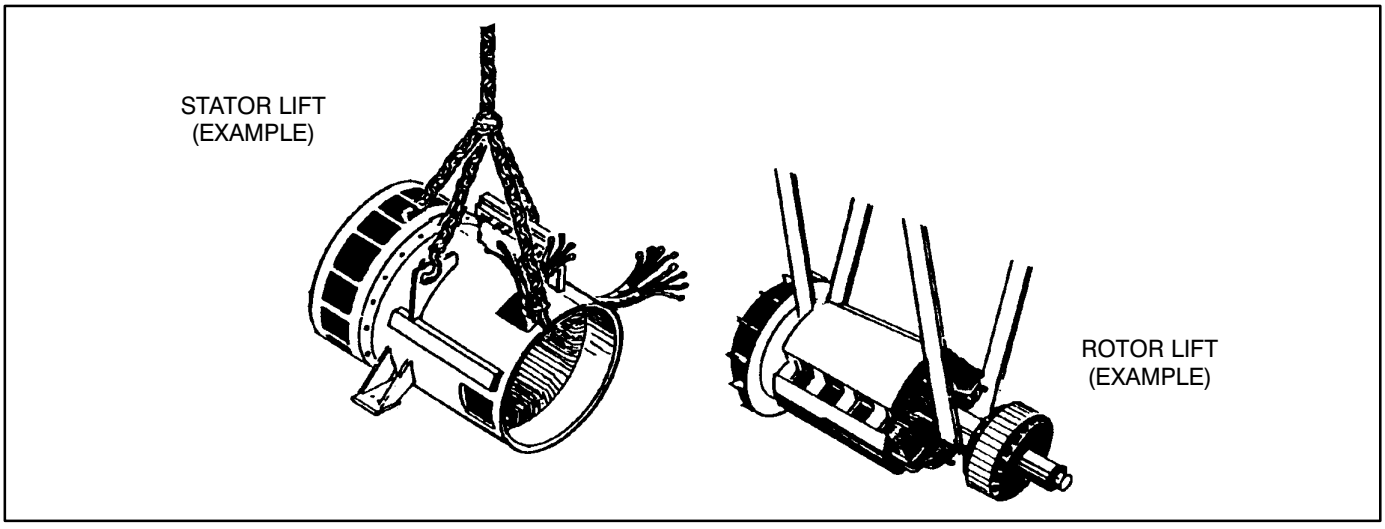


FIGURE 4-9. STATOR/ROTOR LIFT EXAMPLE

Generator Assembly Removal

27. Remove the M20 fastener from the two generator mounting feet brackets (Figure 4-10).

    ⚠WARNING ***Generator weight can cause severe personal injury or death. Use extreme caution when lifting, hoisting, or moving the generator. Make certain to use a hoist or other lifting device whose capacity is rated well above the weight of the generator. The generator (dependent on model type) can weigh up to 3,745 pounds (1685 kgs). Make certain that the maximum lifting capacity of the hoist exceeds the weight of the generator by a large margin. Follow the manufacturer's instructions carefully regarding the weight capacity of the hoist and the recommended hoisting procedure.***

28. Using an adequate lifting device, lift the generator (at lifting eyes provided) so that the generator is completely supported by the lifting device. (Note that the engine is still supported by four mounting feet. Do not lift generator any higher than necessary to support weight of generator with lifting device, or binding will occur between top of generator and engine.)

29. Carefully remove the capscrews and flat washers that secure the drive discs to the engine flywheel.

30. Verify that the generator assembly is adequately supported. Carefully remove the capscrews securing the engine adaptor endbracket to the engine flywheel housing.

    ⚠CAUTION ***Improper generator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the generator by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the generator is adequately hooked/strapped to maintain level control of assembly while lifting and moving.***

31. Remove the generator assembly away from engine. Place generator assembly on floor with a piece of wood beneath the stator housing (toward PMG end) to allow for endbracket removal, if desired.

Bearing Removal

The sealed end bearing is enclosed in a cartridge housing and must only be dismantled as necessary for replacement, or when a major overhaul is carried out on the generator set.

Removal of the bearing can only be accomplished after removal of the endbracket, as follows:

1. Remove the four screws holding bearing cap.
2. Remove cap.
3. Remove circlip.
4. Remove bearing cartridge housing complete with bearing.

When replacing bearing onto rotor shaft, be sure to apply pressing force to the inner face of the bearing only.

GENERATOR REASSEMBLY

Generator reassembly is the reverse of disassembly procedure.

To assemble the stator and rotor at the same time, continue with step 1. To assemble the stator and rotor individually, skip to step 16.

1. Using an adequate lifting device, locate the generator assembly into position near the engine flywheel housing.

   ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

   ⚠CAUTION ***Improper generator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the generator by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the generator is adequately hooked/strapped to maintain level control of assembly while lifting and moving.***

2. Align the holes of the engine adaptor endbracket with the holes in the flywheel housing and install the capscrews and lock washers. Tighten fasteners to 65-70 ft-lbs. (88-95 N-m) torque.

3. Using a wood pry bar inserted between the engine adaptor and blower, carefully lift end of rotor assembly to allow drive discs to snap into flywheel. Align the holes of the rotor drive discs with the holes of the engine flywheel. Install the capscrews and flat washers that secure the drive discs to the engine flywheel.

4. Secure the rotor assembly to the flywheel. Tighten fasteners to 75-85 ft-lbs. (102-115 N-m) torque.

5. Review the *Generator Mount Pre-load Adjustment*, later this section, to determine if this adjustment is required at this time. (Skip step 6 if this procedure is performed.)

6. Secure the generator foot brackets to the vibration isolators. Apply Loctite 271 to the M20 screw and tighten the fastener to 270-330 ft-lbs. (365-447 N-m) torque.

   If endbracket has been removed, continue with step 7, otherwise skip to step 15.

7. Lift slightly on end of rotor shaft and install wooden shims to hold rotor on center with stator.

8. Press bearing onto rotor shaft, applying force to the inner face of the bearing. Install two threaded studs into end bearing cartridge to aid subsequent procedures. Position the end bearing cartridge assembly close to proper position for hole alignment with endbracket.

9. Assemble exciter stator, if removed, to inside of endbracket. Tighten fasteners to 4.5 ft-lbs. (6 N-m) torque.

10. Install endbracket to the stator frame using the proper capscrews and lock washers, but do not tighten securely as yet.

11. Insert and start the threads of the bearing cartridge fasteners, and remove threaded alignment studs, through the endbracket into the cartridge housing.

12. Lift slightly on endbracket and remove wooden shims holding rotor on center with stator.

13. Securely tighten the endbracket fasteners.

14. Tighten the bearing cartridge fasteners to 4.5 ft-lbs. (6 N-m) torque.

15. Install the PMG assembly, if removed. Refer to *Permanent Magnet Generator (PMG) Installation*, later this section.

    To assemble the control housing, skip to step 33.

    To assemble the stator and rotor individually begin here.

16. If removed, replace exciter rotor and rotating rectifier assembly to main rotor shaft. Reconnect main rotor wire leads to positive and negative terminals of rectifier assembly.

17. If removed, install the drive disc spacer, drive disc and pressure plate on the rotor shaft. Install the cap screws and flat washers and tighten to 352 ft-lbs. (476 N-m) torque.

18. Using a hoist and sling to support the rotor, align the holes in the drive disc with the corresponding holes in the flywheel.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

19. Secure the rotor assembly drive disc to the flywheel using appropriate capscrews and flat washers. Tighten fasteners to 75-85 ft-lbs. (88-95 N-m) torque. Do not allow rotor assembly to hang on engine flywheel. (Refer to Figure 4-8)

    ⚠CAUTION ***Drive disc damage can be caused by allowing the rotor assembly to hang on flywheel. Use adequate hoist and sling to support the rotor assembly.***

20. Reassemble engine adaptor endbracket to stator frame if removed. Using an adequate lifting device, carefully move the stator into position over the rotor assembly, being careful not to drag the windings on the rotor.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

    ⚠CAUTION ***Improper stator assembly rigging and handling can result in damage to stator and rotor assemblies. Lifting eyes may not be at center-of-gravity position of stator assembly. Therefore, lifting and moving the stator assembly alone, by hoisting at lifting eyes only, presents the hazard of load imbalance; allowing one end to drop and other end to rise. Make sure the stator is adequately hooked/strapped to maintain level control of stator assembly while lifting and moving.***

21. Using a forklift, position a lifting bar of the forklift (inside and in-line with the generator) under the rotor shaft. Lift the rotor shaft slightly so that rotor is not resting on inside of stator assembly. See Figure 4-8.

22. Remove the hoist/sling support of the rotor assembly. Align the holes of the engine adaptor endbracket with the holes in the flywheel housing and install the capscrews and lock washers. Tighten fasteners to 65-70 ft-lbs. (88-95 N-m) torque.

23. Review the *Generator Mount Pre-load Adjustment*, later this section, to determine if this adjustment is required at this time. (Skip step 24 if this procedure is performed.)

24. Secure the generator foot brackets to the vibration isolators. Apply Loctite 271 to the M20 screw and tighten the fastener to 270-330 ft-lbs. (365-447 N-m) torque.

25. Reassemble the covers over the generator air discharge openings and fasten securely.

26. Press bearing onto rotor shaft, applying force to the inner face of the bearing. Install two threaded studs into end bearing cartridge to aid subsequent procedures. Position the end bearing cartridge assembly close to proper position for hole alignment with endbracket.

27. Assemble exciter stator, if removed, to inside of endbracket. Tighten fasteners to 4.5 ft-lbs. (6 N-m) torque.

28. Install endbracket to the stator frame using the proper capscrews and lock washers, but do not tighten securely as yet.

29. Insert and start the threads of the bearing cartridge fasteners, and remove threaded alignment studs, through the endbracket into the cartridge housing.

30. Lift slightly on endbracket and remove wooden shims holding rotor on center with stator.

31. Securely tighten the endbracket fasteners.

32. Tighten the bearing cartridge fasteners to 4.5 ft-lbs. (6 N-m) torque.

33. Use an adequate lifting device to lift the control housing in position for mounting to the skid. Replace the capscrews and lock washers and tighten to 18 ft-lbs. (24 N-m) torque.

    ⚠WARNING ***To prevent personal injury, use adequate lifting devices to support heavy components. Keep hands and feet clear while lifting.***

34. Reassemble any engine air intake components removed during generator disassembly.

35. Connect all control wires and generator leads using the proper generator set AC and DC wiring diagram/schematic.

36. Refer to Permanent Magnet Installation.

37. If equipped with the circuit breaker option, reconnect load wires to circuit breaker. Reconnect all lead wires to the terminal block assembly using proper reconnection diagram in *Section 5*.

38. Verify that all connections are proper and secure and then install all control housing panels (see Figure 4-7).

39. Connect the negative (-) battery cable.

40. Connect the battery charger (if applicable) and test the generator set for operation. If objectionable vibration is present, refer to *Aligning Generator with Engine* procedure later this section.

Permanent Magnet Generator (PMG) Installation

1. Install the complete rotor assembly to the end of the main rotor shaft using the hex head through-bolt. Keep the rotor clean by avoiding contact with metal dust or particles.
2. Carefully locate the stator housing to position on the generator endbracket. Fasten in place using the 4 bolts and clamps, and tighten securely.

   The highly magnetic rotor will attract the stator core, care must be taken to avoid any contact which may damage the windings.
3. Connect the PMG wiring harness connector.
4. Install the PMG assembly cover using the three M5x12mm capscrews and lockwashers, and tighten securely.

GENERATOR MOUNT PRE-LOAD ADJUSTMENT

This procedure must be performed if one or more of the following conditions have occurred.

- Installation of new stator
- Loosening of hardware that secures engine mount bracket(s) to flywheel housing (see Figure 4-10).
- Installation of new engine or generator vibration isolator(s).

Special tools − This procedure requires two 1 3/4“T x 2”W x 6”L steel spacers.

⚠WARNING ***Accidental starting of the generator set during this procedure presents the hazard of severe personal injury or death. Make sure to disconnect the negative (−) battery cable(s) before beginning.***

1. Turn off and disconnect battery charger (if equipped).
2. Disconnect the negative (**−**) battery cable(s) to prevent accidental starting of the generator set while servicing.
3. Unscrew bolt (Item 2 in Figure 4-10) from skid but do not remove the bolt from either rear engine vibration isolator.
4. Loosen the three screws that secure the engine mount brackets to the engine to allow the brackets to move up and down.
5. Loosen but do not remove the hex nut (Item 1) from the M20 screw of the generator vibration isolators.
6. Using an adequate lifting device, lift the generator (at lifting eyes provided) until the mounting feet brackets are high enough to insert a 1 3/4 inch steel spacer under both stator foot brackets.
7. Insert spacers and lower the generator so the full weight is resting on the generator mounting foot brackets.
8. Make sure that no gap is present between the skid and the lower mount of the rear engine vibration isolators (see Figure 4-10). While pushing down on the engine mount bracket, tighten the three screws to secure the bracket to the engine. Tighten the three screws to 190-200 ft-lbs. (260-270 N-m) torque.
9. Lift the generator until the mounting feet brackets are high enough to remove the two 1 3/4 inch steel spacers.
10. Before lowering the generator, start the threads of the rear engine vibration isolator bolts (Item 2).
11. Lower the generator and tighten the two rear engine vibration isolator bolts to 270-330 ft-lbs. (365-447 N-m) torque.
12. Secure the generator foot brackets to the vibration isolators. Tighten the fastener to 270-330 ft-lbs. (365-447 N-m) torque.

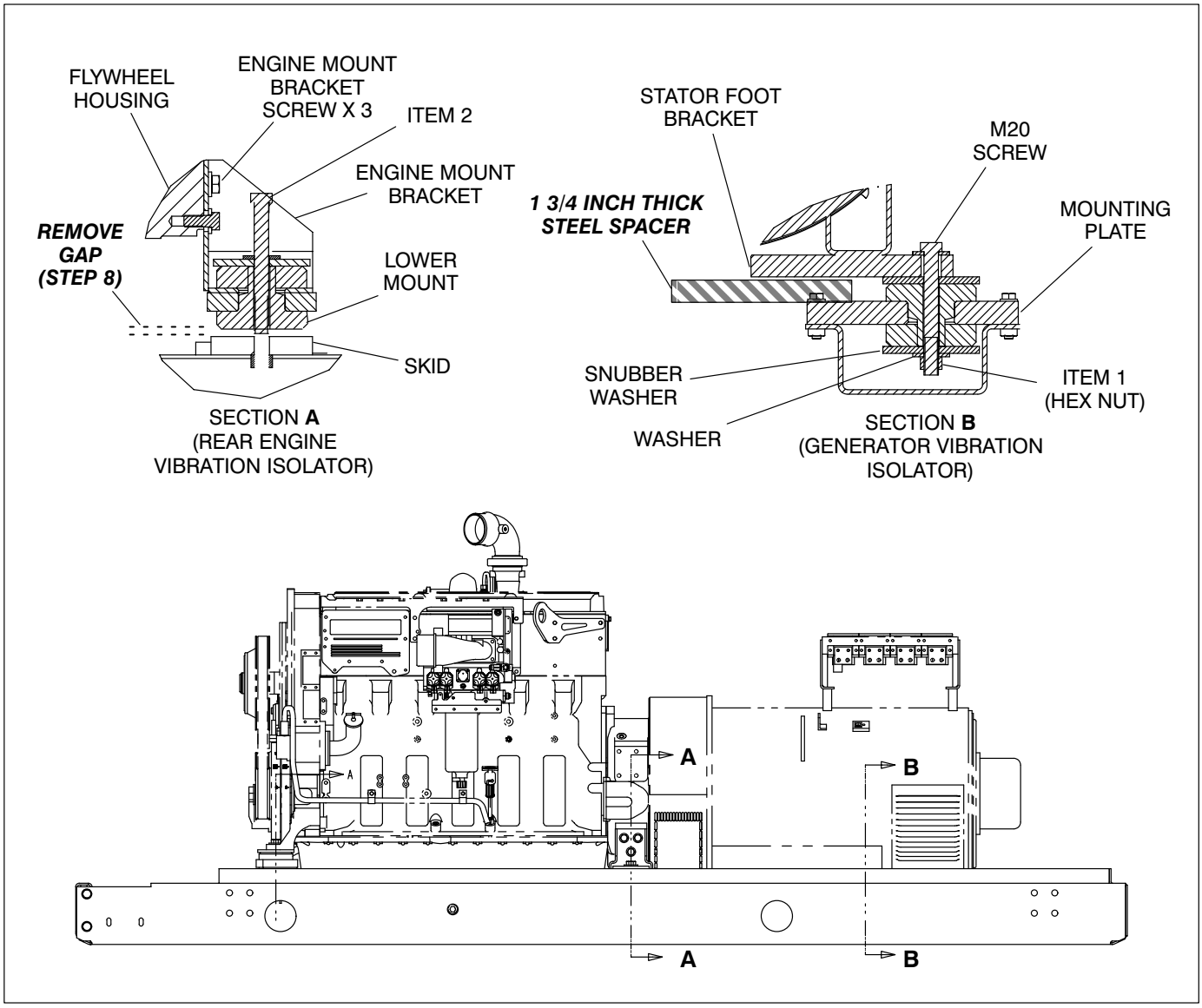


FIGURE 4-10. GENERATOR MOUNT PRE-LOAD ADJUSTMENT

ALIGNING GENERATOR WITH ENGINE

Proper alignment of the generator and engine assemblies is necessary to avoid premature wear and improper operation of the genset.

Axial Misalignment: Is the result of the generator shaft axis not aligning with engine crankshaft axis. The tolerances in the bolted flywheel and drive disc connection may add up to displace the generator axially relative to the crankshaft axis.

Axial misalignment needs to be checked only when an objectionable vibration is present.

Axial Alignment Procedure

Axial misalignment needs to be checked only when an objectionable vibration is present.

Fasten dial indicator holding device to skid base, engine block, or generator shell with a magnetic base or clamp and position so the sensor point of indicator rests on the generator shaft hub, see Figure 4-11. Bar the engine over in a clockwise rotation as viewed from engine flywheel, through a couple of rotations. Record indicator readings in eight equally spaced points around the shaft diameter. This will provide a T.I.R. for Axial shaft misalignment.

The maximum allowable T.I.R. runout is subjective, the optimal T.I.R. for runout would be .000", however, that may not be attainable. The recommendation of this procedure will be to reduce the measured T.I.R. runout by one half. Specific out-of-tolerance runout levels are difficult to establish due to the varying surface quality of the generator shaft's drive disc mountain hub.

The goal of the Axial realignment is to reduce the vibration level of the genset while it is operating. A small improvement in the T.I.R. runout may have dramatic effects in the mechanically measured or physically observed vibration levels.

To correct for an out of tolerance T.I.R. indication, remove the capscrews connecting drive discs and flywheel. Mark the drive discs and flywheel with respect to each other. Rotate either the engine or generator so that drive discs holes are repositioned 180 degrees from their original location. Put the drive discs capscrews back in and retorque. Recheck shaft alignment as before. If shaft T.I.R. runout remains unchanged then the discs should be rotated to either 30, 60, or 90 degrees from original location to correct the out of tolerance condition. If the T.I.R. does not improve after repositioning, a closer inspection of the flywheel pilot and drive disc runouts is required. This will help determine the cause of the Axial misalignment.

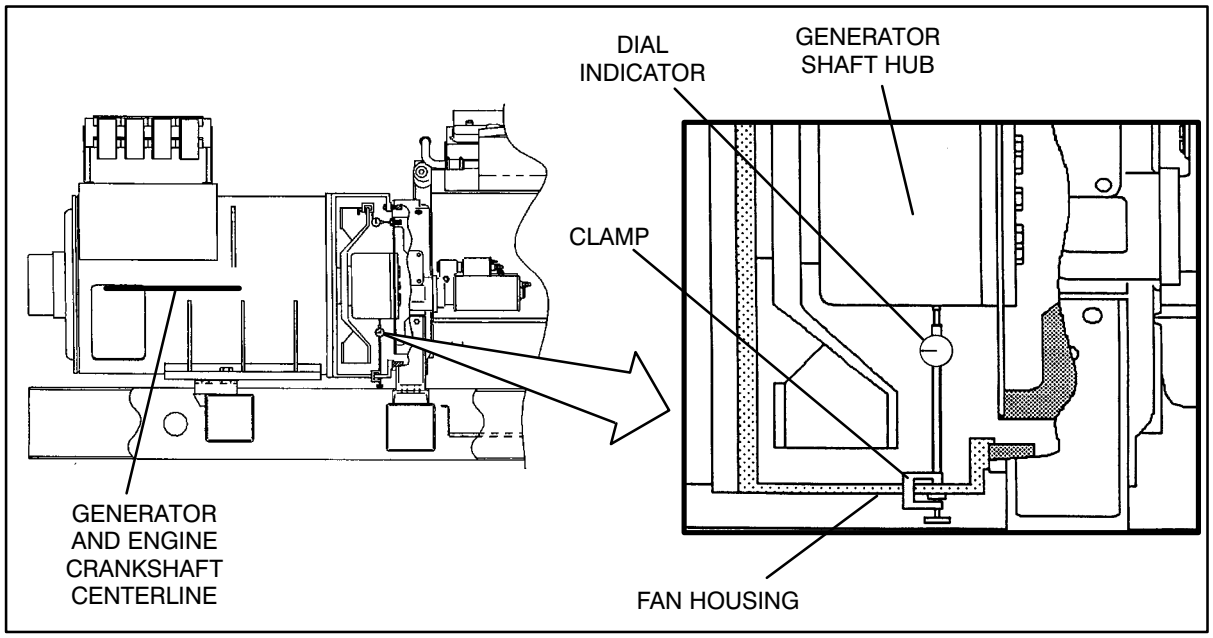


FIGURE 4-11. AXIAL ALIGNMENT MEASUREMENT

THIS PAGE LEFT INTENTIONALLY BLANK

5. Optional Enclosure Fuel Tank System

GENERAL

This section describes the operation and testing of the optional components of the fuel tank system shown in Figure 5-1.

When a sub-base fuel tank is provided, a fuel transfer pump with control, an external fuel alarm panel and external fuel fill box are available as an option.

WIRING CONNECTIONS

Fuel Transfer Control Customer Outputs

See *Fuel Tank Wiring* diagram in Section 6 for customer connections to remote annunciators.

PCC Customer Inputs

PCC Customer Inputs 3 (Low Fuel) and 4 (Rupture Basin) are prewired to the sub-base fuel tank when shipped from the factory.

The “Low Fuel” warning message, when displayed by the PCC, indicates that the fuel level has dropped below the low fuel level (approximately 62%).

The “Rupture Basin” warning message is used to indicate that fuel is detected in the fuel tank basin.

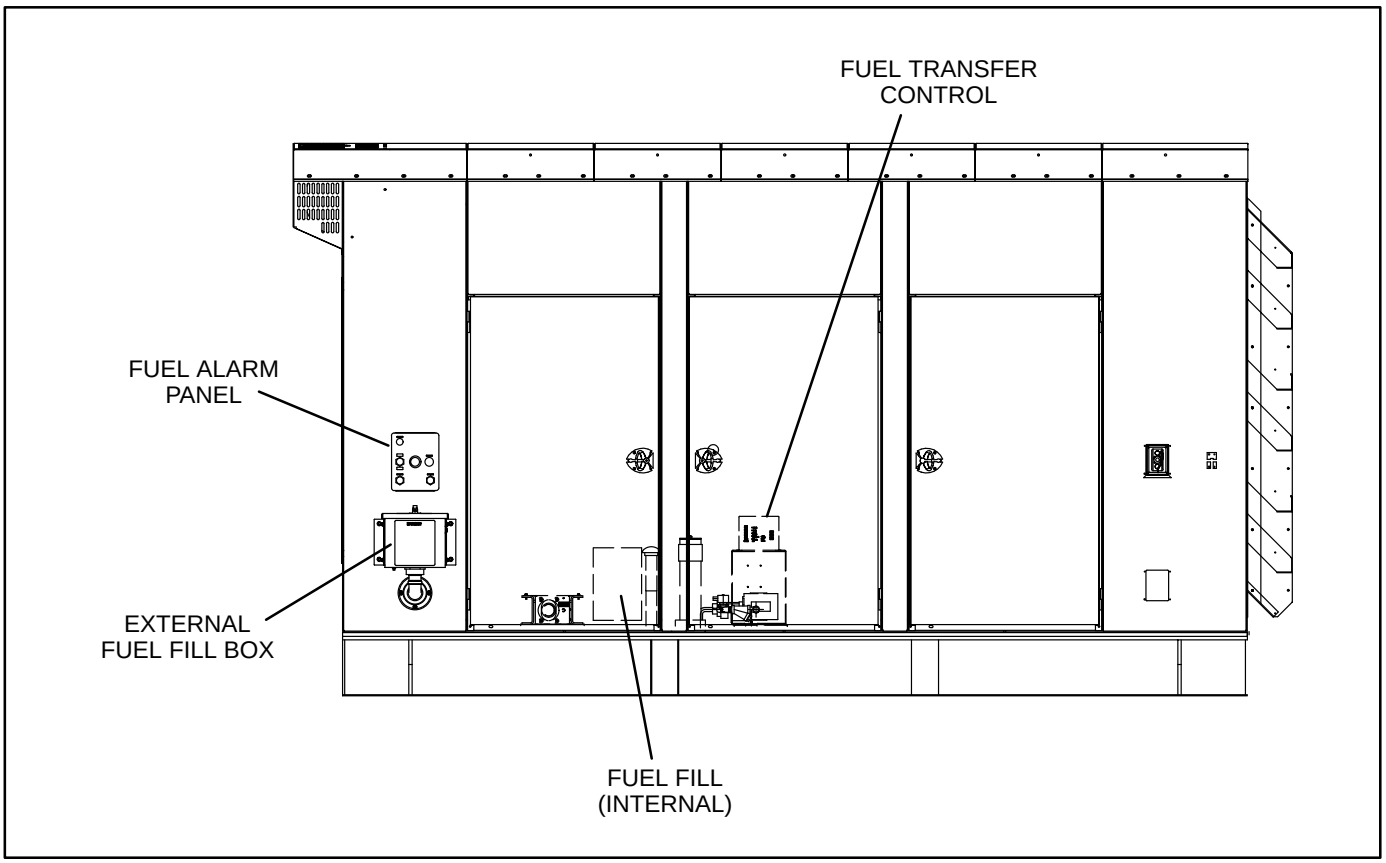


FIGURE 5-1. FUEL TANK SYSTEM OPTIONAL COMPONENTS

FUEL TRANSFER PUMP

The fuel transfer pump and control are available as an option when a sub-base fuel tank is provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the sub-base tank.

This section explains functions of the control panel lamps, components and operation/testing of the day tank fuel control system. All red color lamps indicate a fault condition.

Control Panel Switches and Indicators

The following paragraphs describe the operation of the control switches and indicators.

Indicators:

- **FUEL LEVEL** (green): indicates in percent the amount of fuel that is contained in the sub-base tank.
- **HIGH FUEL** (red): indicates that the fuel has reached an abnormally high level. It indicates a possible failure of the ”pump-off” float gauge in the sub-base tank. The lamp will turn off when the fuel level drops to normal.

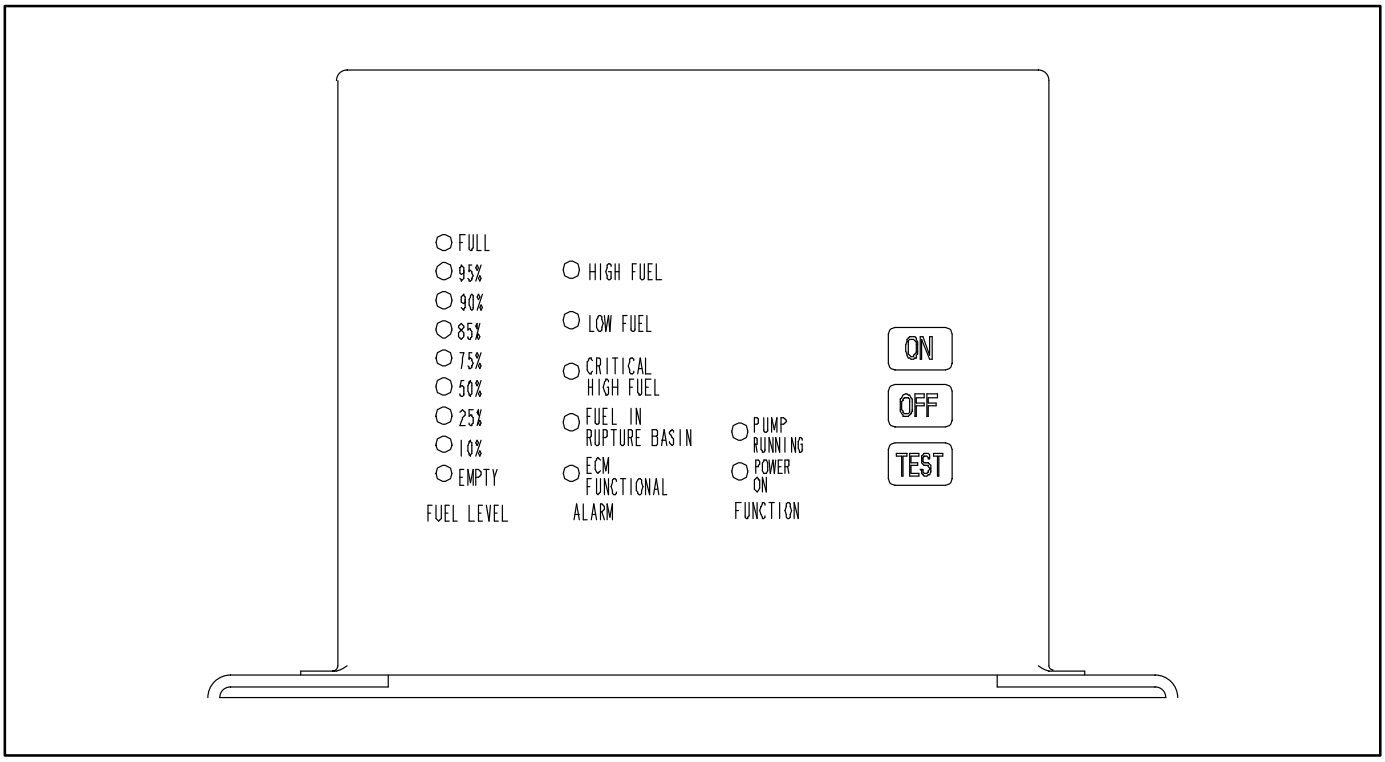


FIGURE 5-2. TRANSFER PUMP CONTROL FRONT PANEL

- **LOW FUEL** (red): indicates that the fuel level has dropped below the low fuel level. This warning enables the operator time to react to a potential problem before low fuel shutdown occurs. It indicates a possible empty main fuel tank, fuel line restriction, pump failure, or failure of the float gauge.
- **CRITICAL LOW FUEL** (red): indicates that the fuel level has dropped to tank bottom. This warning enables the operator time to shut down generator set before fuel runs out, preventing loss of prime or engine damage. It indicates a possible empty main fuel tank, fuel line restriction, pump failure, or failure of the float gauge.

  The control should be wired to shut down the genset (optional) as continued operation will allow air to enter the engine injection pump necessitating bleeding to restart the engine. The control will reset after restoring the tank fuel level. This will also restore engine operation if the tank control has been connected to shut down the engine.

  ⚠ CAUTION ***Continued operation with a CRITICAL LOW FUEL fault can lead to a low fuel shutdown if the fuel level float switch fails.***

- **FUEL IN RUPTURE BASIN** (red): indicates that the fuel has flooded the safety basin surrounding the fuel tank. The basin float switch turns off the fuel pump. The pump cannot function again until the basin is drained of fuel. Possible cause, leak in fuel tank.
- **PUMP** (green): indicates that the fuel pump is running. It will come on and go off as fuel is pumped to maintain the fuel tank level.
- **ECM FUNCTIONAL** (green): indicates no faults are detected within the control circuitry (including float gauge). If a fault occurs, the lamp will go out and de-energize the control relay. It is suggested that the customer wire to the normally closed contact to provide a signal if a fault does occur.
- **POWER ON** (green): indicates that AC power is available to the control.

Switches:

- **ON:** This pushbutton activates the control after the OFF pushbutton has been pressed.
- **OFF:** This pushbutton disables the control for routine maintenance to the tank system without disrupting the control. **NOTE: This also de-energizes the ECM FUNCTIONAL relay which will activate a customer alarm wired to this relay.**
- **TEST:** This pushbutton will test all front panel lamps for three seconds and activate pump/motor for as long as the button is pressed. All alarm relays will not activate but will maintain their original state.

Operation

The following steps describe how to operate the day tank controller.

NOTE: When power is applied to the control or is restored after a power interruption, the control will automatically go to the power on mode (functions the same as pressing the ON switch). The pump will start if the control detects low fuel in tank.

1. Press the control ON switch for automatic operation. The green PUMP light will come on and the pump will fill the tank. The level of fuel in the tank will be automatically kept between a set of pump-on and pump-off float gauge.

   When filling an empty tank, the red CRITICAL LOW FUEL and LOW FUEL lights will come on when the control switch is pushed to the ON position. This is normal. The red lights will turn off as the tank is filled.

2. The green PUMP light indicates when the pump is running. It will come on and off as fuel is pumped to maintain the proper level in the tank.

EXTERNAL FUEL FILL BOX

The external fuel fill box plumping may contain the optional overflow preventive valve (OFPV), which is used to prevent the overfilling of the fuel tank. The valve will energize (close) when a Critical High fuel condition (95% full) is detected/displayed by the External Alarm panel.

If the valve remains closed after correcting the critical high fuel condition, check the following possible causes before replacing the valve.

- Defective Critical High switch mounted on fuel tank. (Critical High switch remains closed with fuel gauge indicating less than 95% full.)
- Defective External Alarm panel (refer to Alarm Panel Wiring in Section 6).

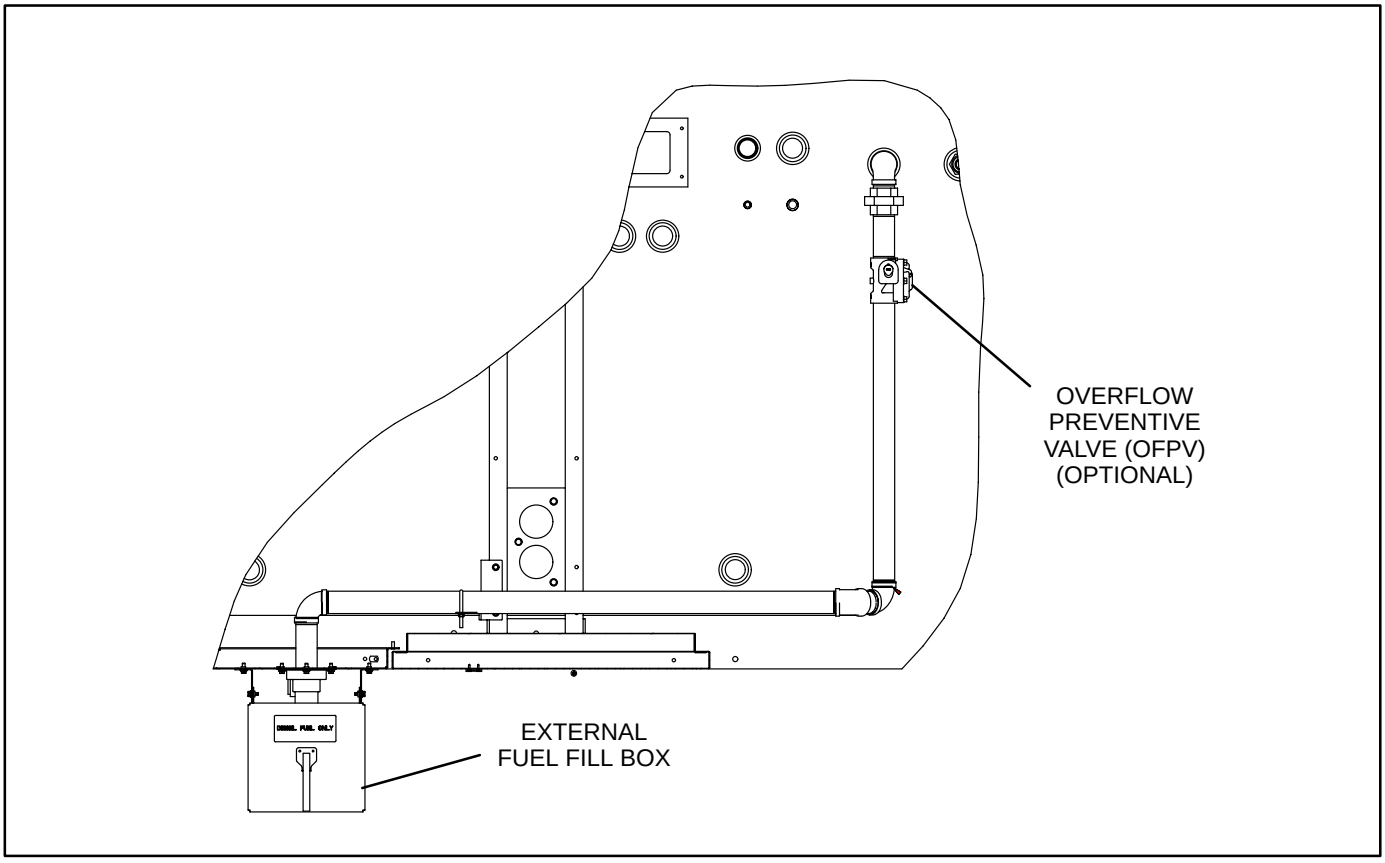


FIGURE 5-3. OPTIONAL FUEL (SPILL) FILL BOX

EXTERNAL ALARM PANEL

The following paragraphs describe the operation of the external alarm panel components.

Overfill Indicator/Horn/Mute Button

The overfill alarm Indicates that the fuel has reached an abnormally high level (95%). Immediately stop adding fuel. It also indicates a possible failure of the “pump-off” float gauge for fuel systems that contain the fuel transfer pump.

The horn can be turned off by pressing the mute button. The indicator will turn off when the fuel level drops to normal.

Fuel Gauge

Indicates the amount of fuel that is contained in the sub-base tank.

Solenoid Override Button

The Solenoid Override Button is only provided on the Alarm Panel when the optional overflow preventive valve (Figure 5-3) is provided with the external fill box feature.

This switch is used to release the delivery hose pressure caused by the closing of the overflow preventive valve. This valve automatically closes during an overfill alarm, stopping the filling of the tank and creating pressure between the valve and the delivery hose. Before disconnecting the delivery hose, always press this button after an overfill warning to release fuel back pressure into the sub-base tank.

Test Button

Press the TEST switch to test the indicator light and the horn. The test will remain active for as long as the button is pressed.

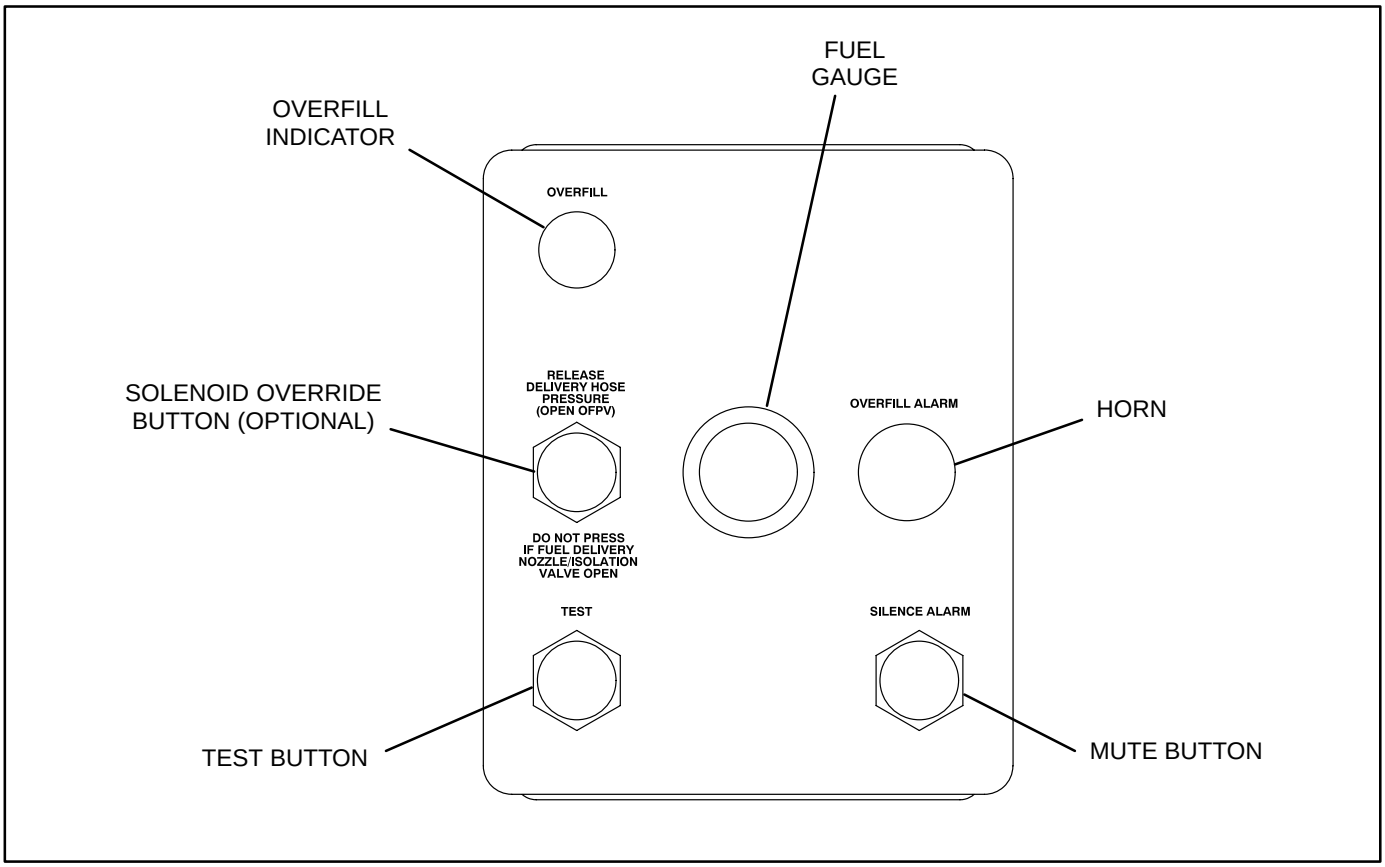


FIGURE 5-4. EXTERNAL ALARM PANEL

RUPTURE BASIN LEAK DETECT SWITCH TEST

The rupture basin leak detect switch (Figure 5-5) is provided with sub-base fuel tanks used with the optional enclosure. This switch should be checked once a year to make sure switch is properly operating. In some areas, weekly inspections may be required by safety code regulations.

To test the leak detect switch:

1. Remove the pipe fitting/switch assembly from the rupture basin tank.
2. Move the O/Manual/Auto switch to the MANUAL position.
3. Activate leak detect switch (move float upward).
4. Check control display for Rupture Basin fault message. If no indication of fault, repair defective circuit. Refer to *Fuel Tank Wiring* diagram in Section 6.
5. Apply thread sealant to pipe fitting and install switch assembly.

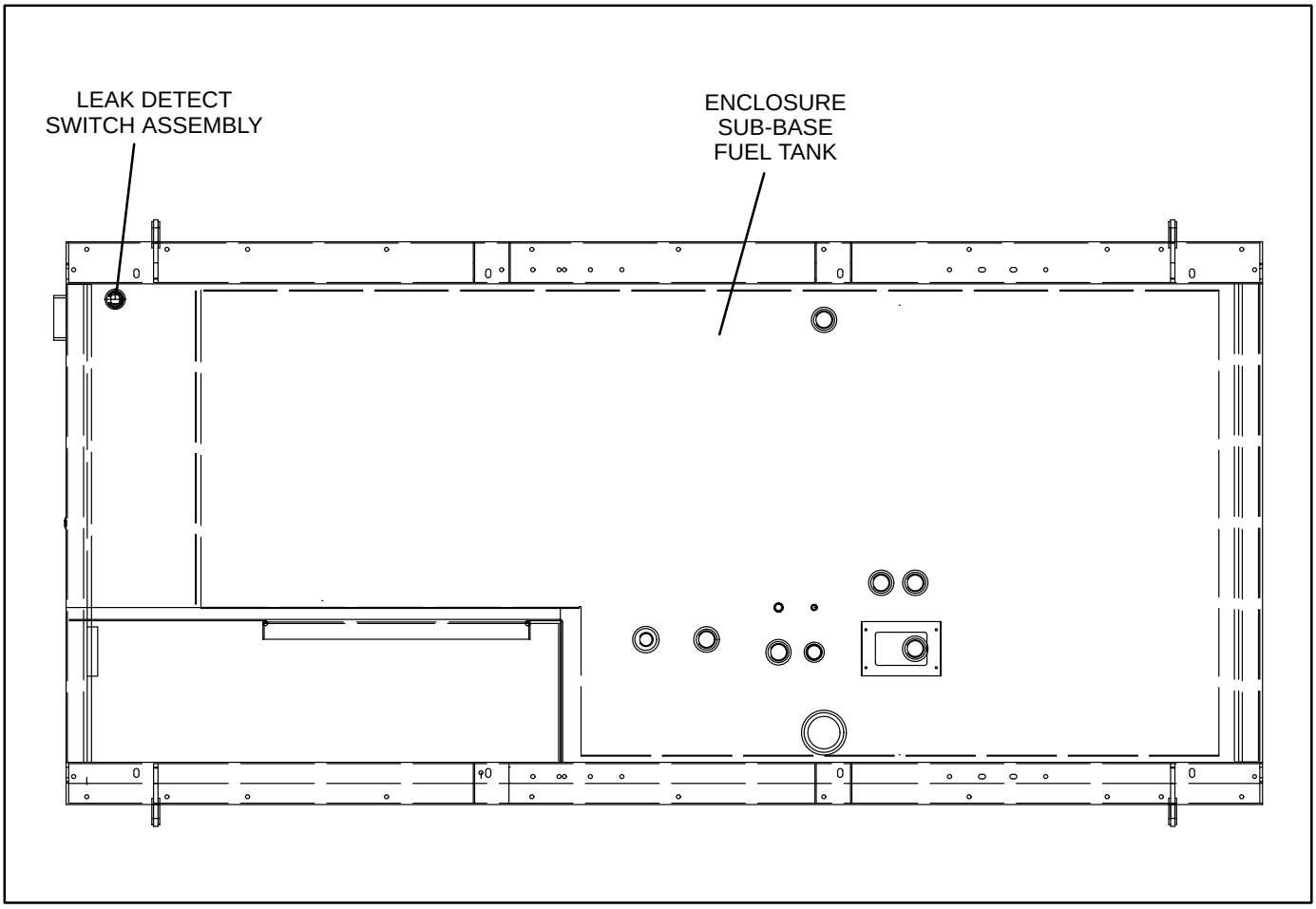


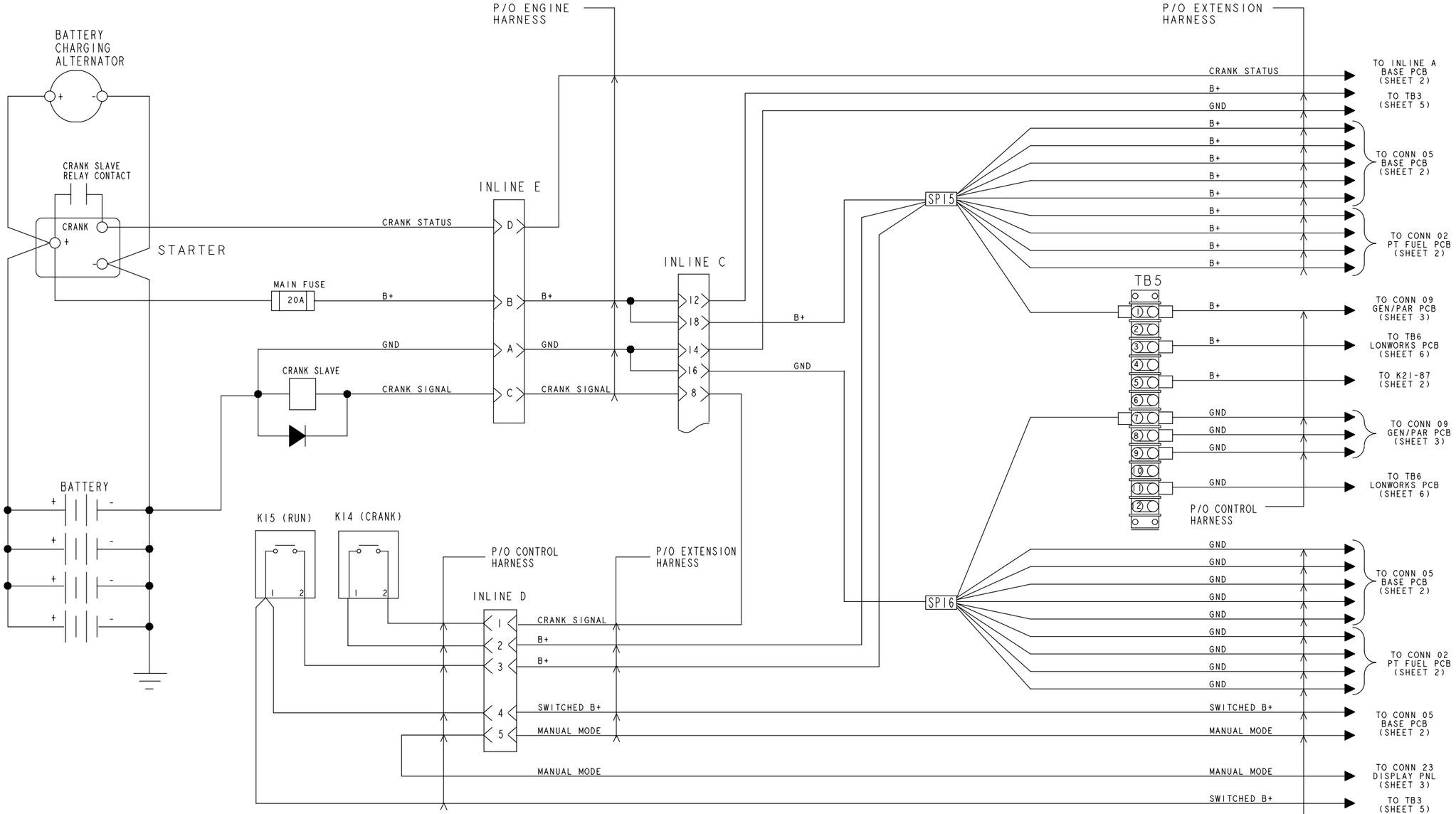
FIGURE 5-5. RUPTURE BASIN LEAK DETECT SWITCH

6. Wiring Diagrams

GENERAL

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

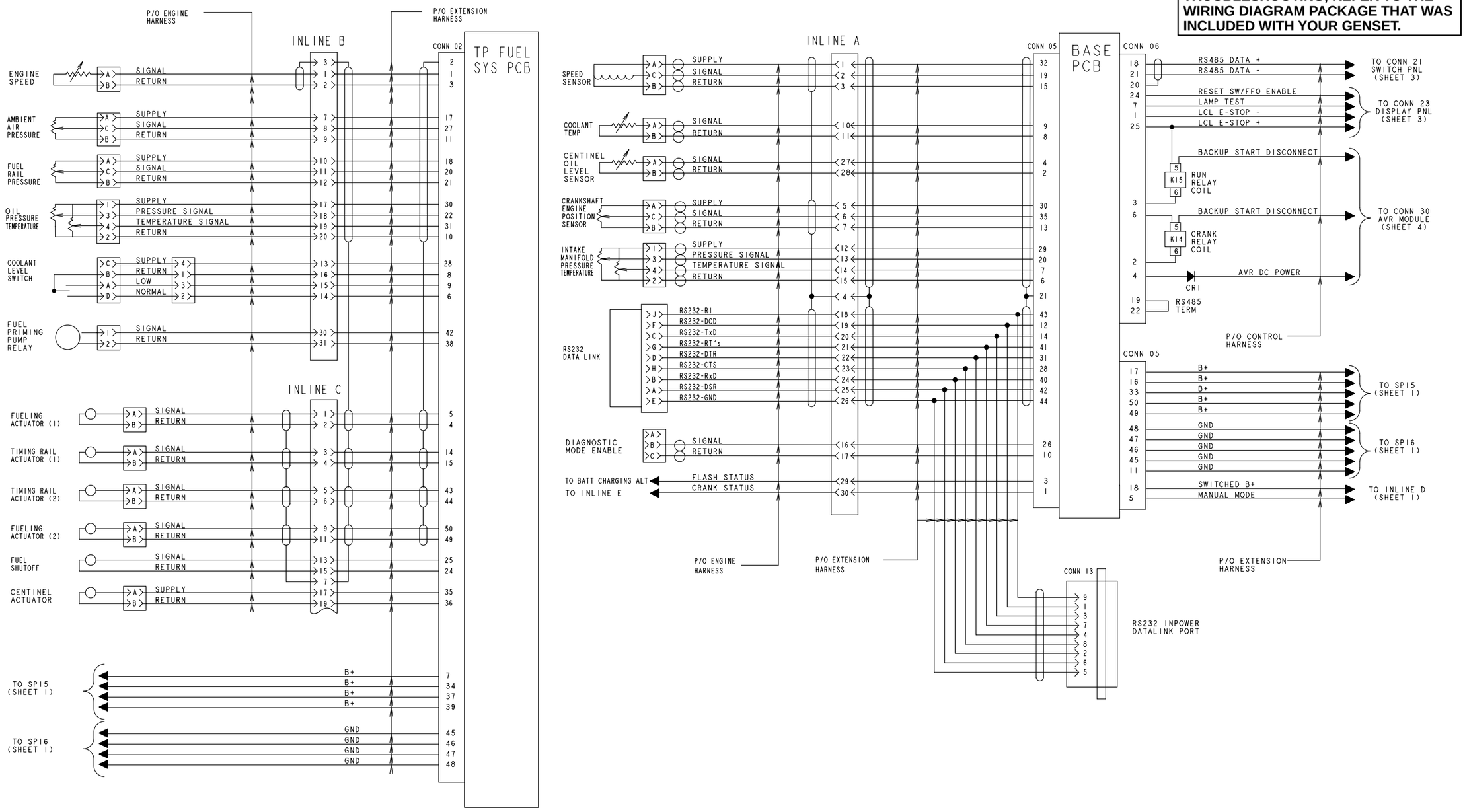
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



No. 630-2592 sh 1 of 11
Rev. E
Modified 12-03

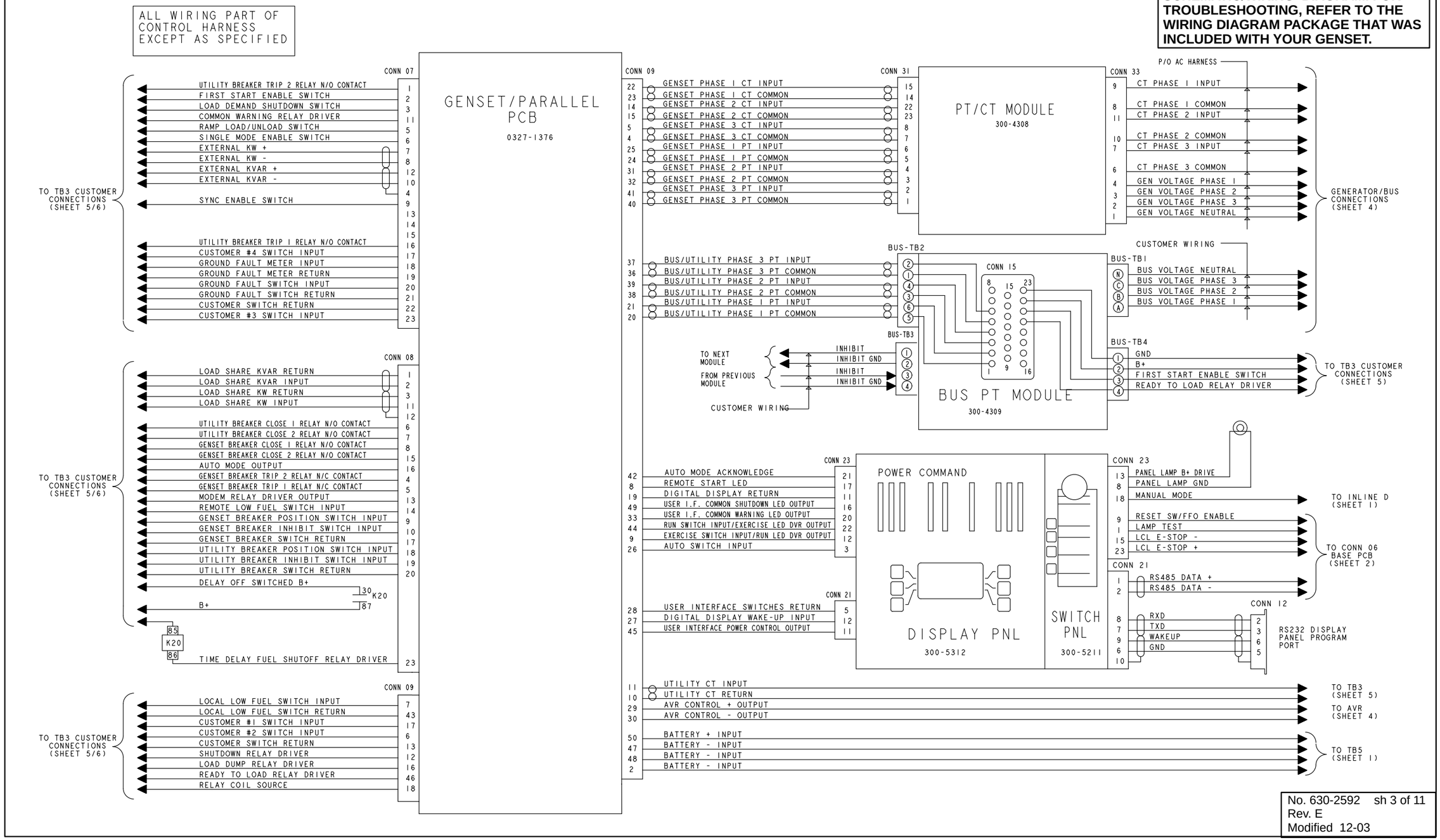
DC POWER AND STARTER WIRING

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



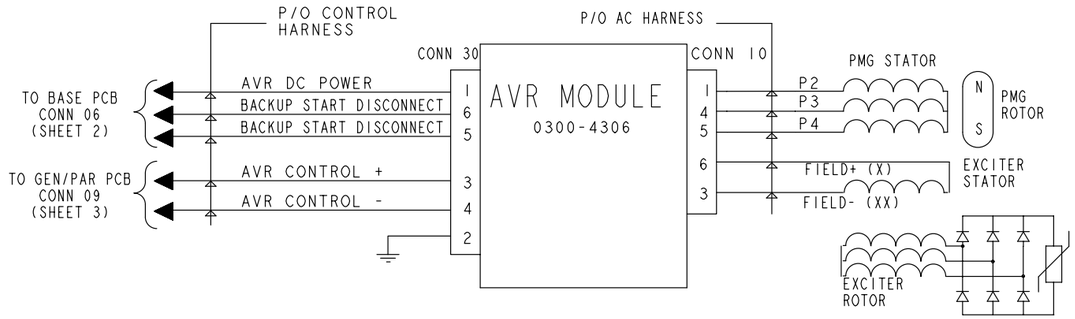
No. 630-2592 sh 2 of 11
Rev. E
Modified 12-03

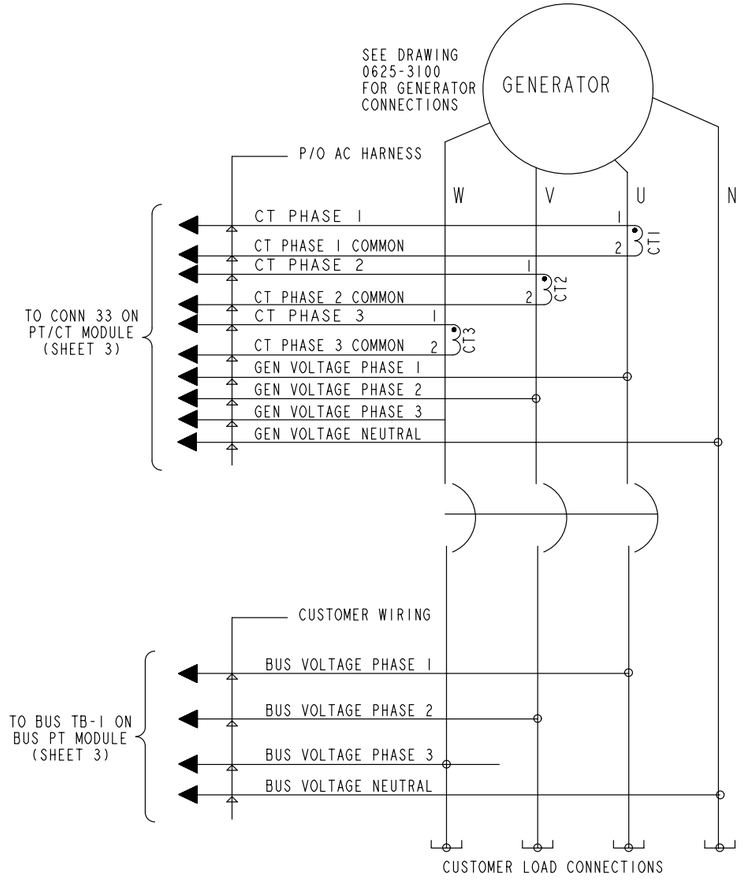
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



No. 630-2592 sh 3 of 11
Rev. E
Modified 12-03

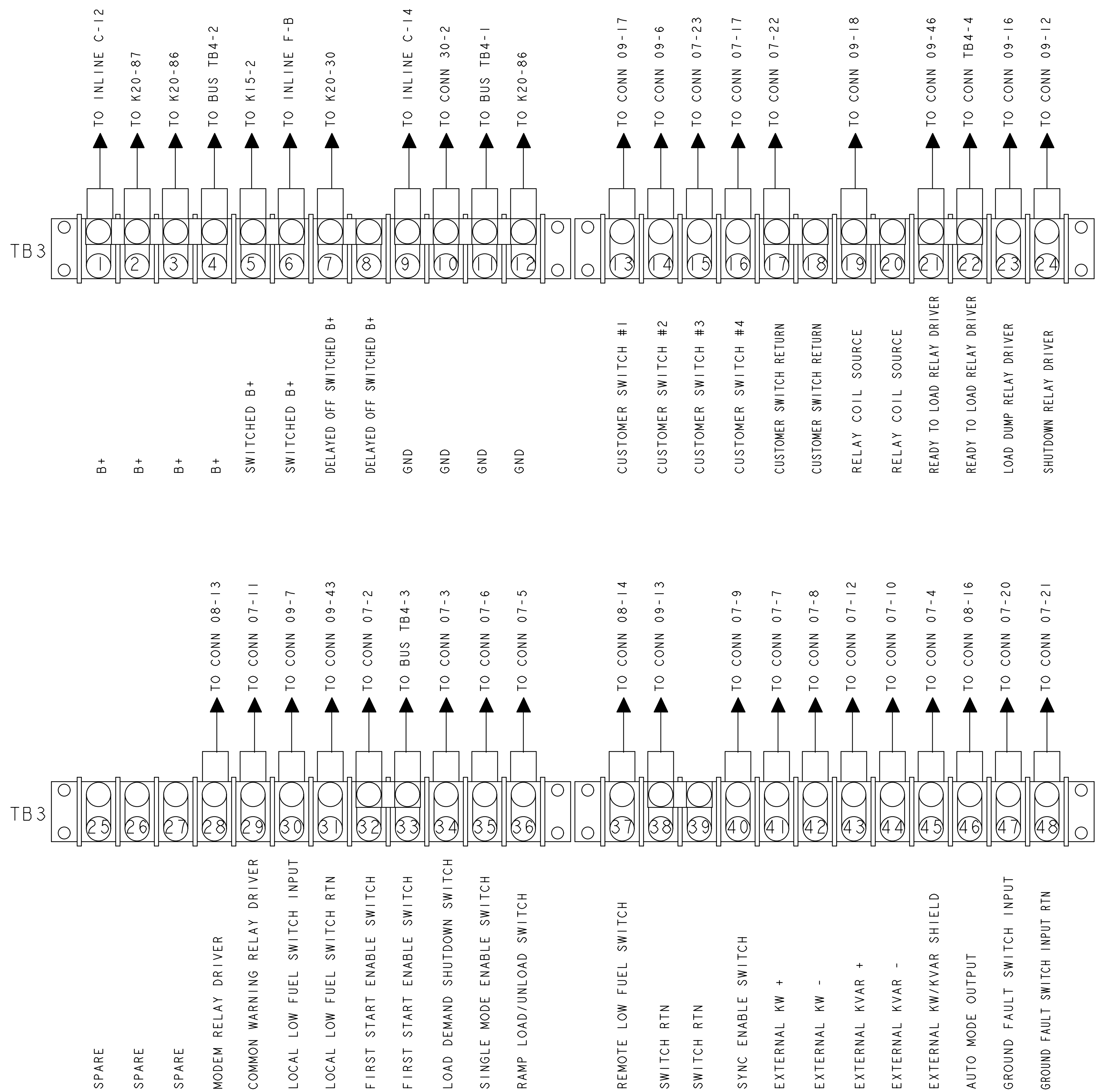
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.





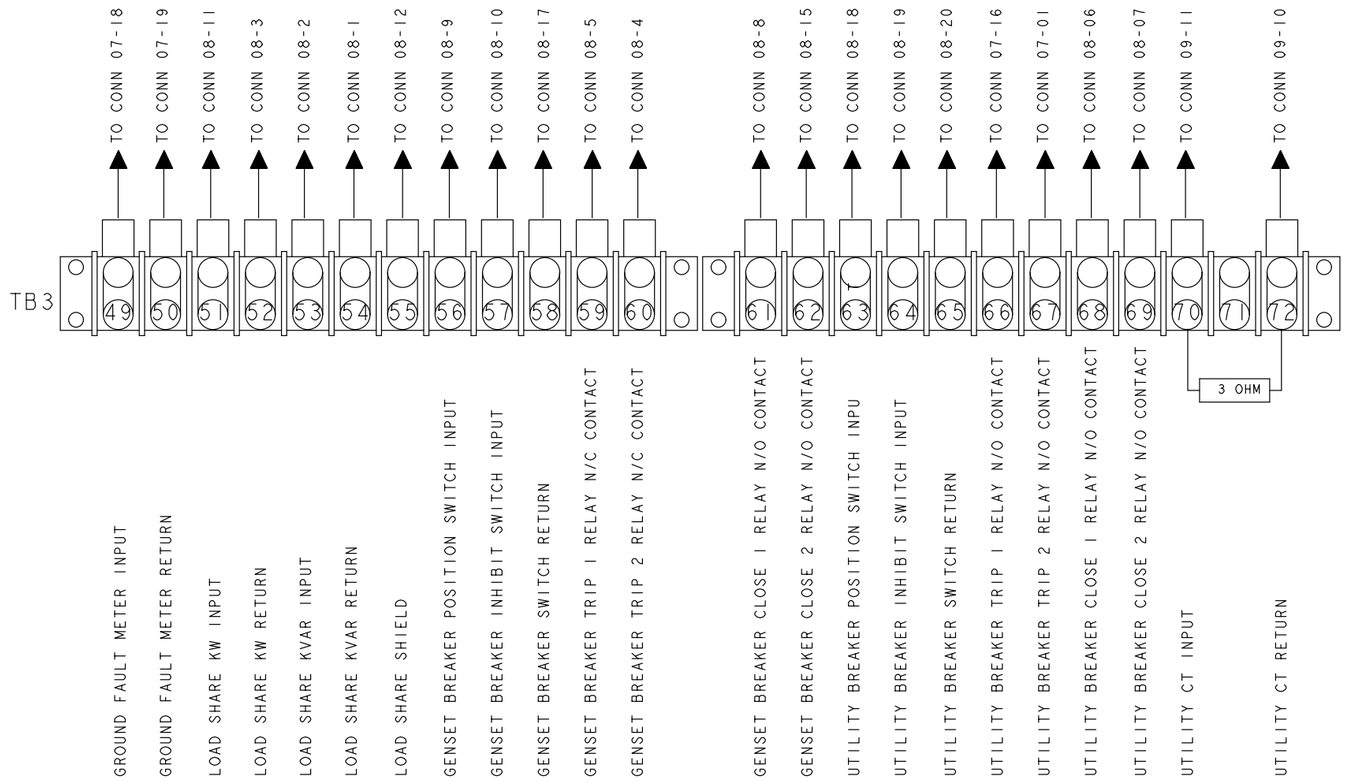
No. 630-2592 sh 4 of 11
Rev. E
Modified 12-03

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

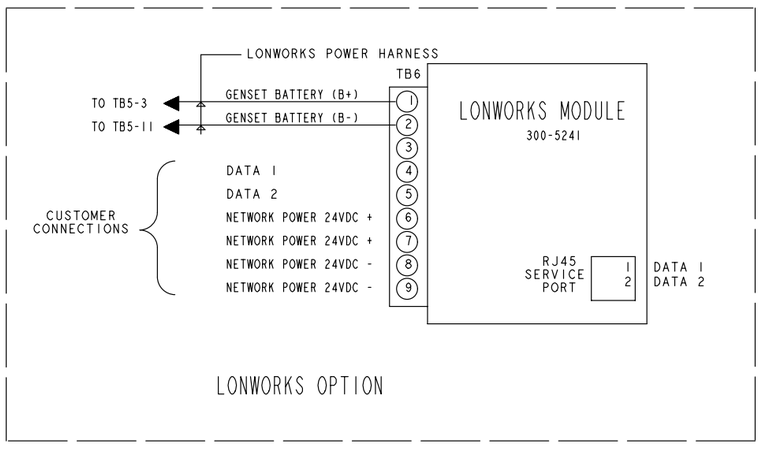


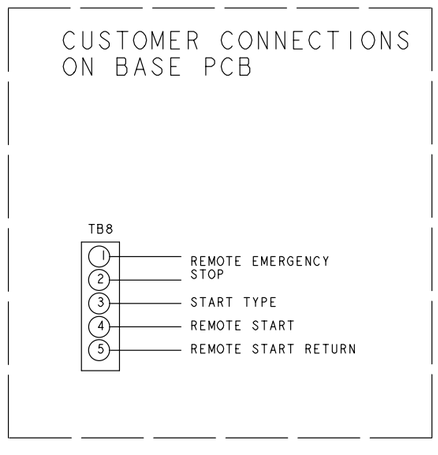
No. 630-2592 sh 5 of 11
Rev. E
Modified 12-03

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



TABULATION		
TB8-	FUNCTION	DESCRIPTION
1 2	REMOTE EMERGENCY STOP	OPEN THE CONNECTION BETWEEN THESE TERMINAL POSITIONS TO INITIATE AN EMERGENCY STOP. TERMINAL POSITIONS MUST BE SHORTED TOGETHER IF REMOTE EMERGENCY STOP IS NOT USED.
3	REMOTE START TYPE	DETERMINES START TYPE: OPEN = EMERGENCY START SEQUENCE. CLOSED = NORMAL START SEQUENCE. APPLY REMOTE START RETURN (TB8-5) TO CLOSE.
4	REMOTE START	APPLY REMOTE START RETURN (TB8-5) TO REMOTE START THE GENSET.
5	REMOTE START RETURN	RETURN LINE FOR REMOTE START TYPE AND REMOTE START.





No. 630-2592 sh 6 of 11
Rev. E
Modified 12-03

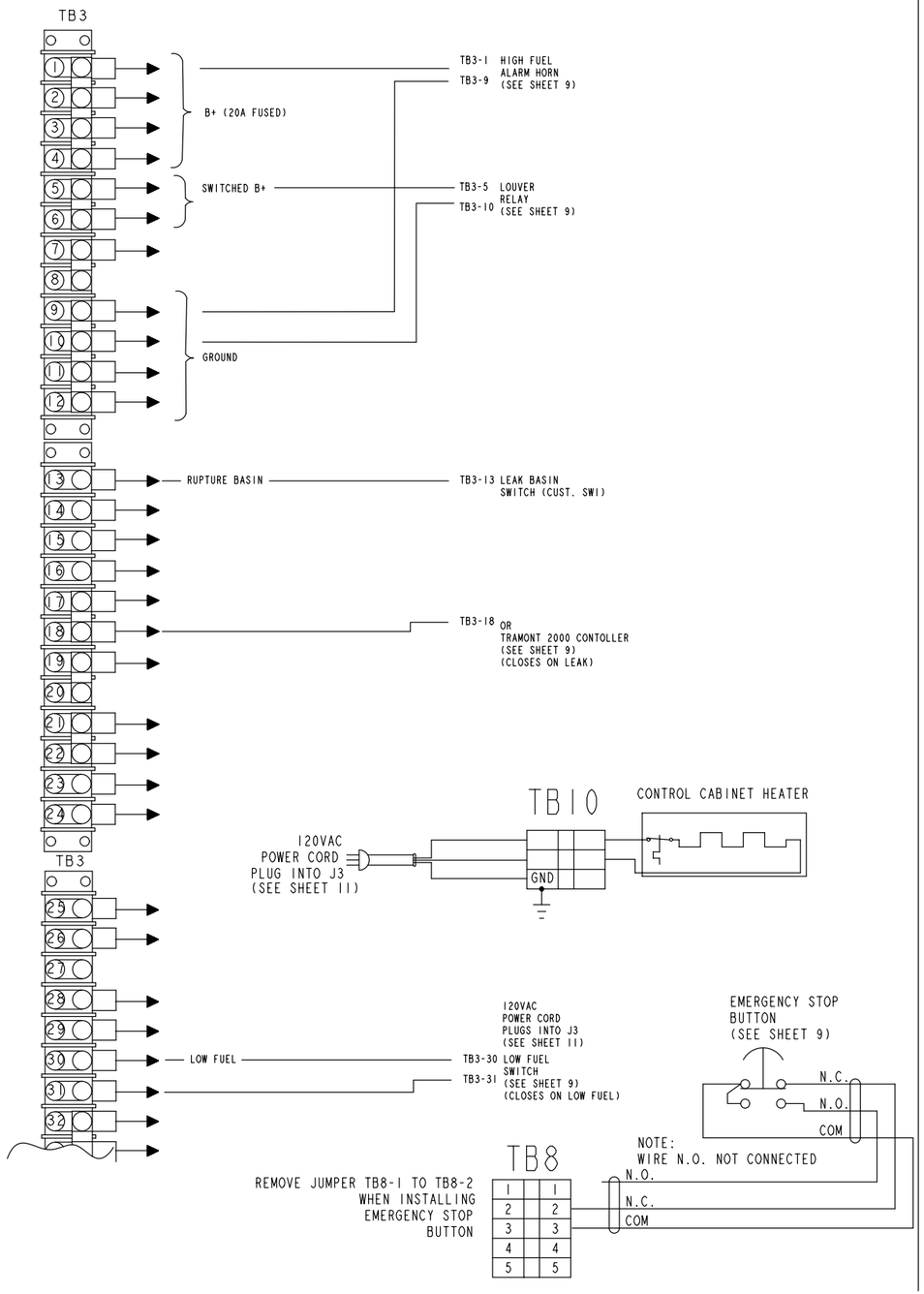
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

TABULATION		
TB3-	FUNCTION	DESCRIPTION
1-4	B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY
5-6	SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING
7-8	DELAYED OFF SWITCHED B+	24VDC/10 AMPS BATTERY VOLTAGE SUPPLY, AVAILABLE WHEN GENSET IS RUNNING. CONFIGURABLE DELAYED OFF IS TYPICALLY USED FOR FUEL SHUTOFF
9-12	GND	BATTERY NEGATIVE
13	CONFIGURABLE INPUT #1	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
14	CONFIGURABLE INPUT #2	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
15	CONFIGURABLE INPUT #3	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
16	CONFIGURABLE INPUT #4	CONFIGURABLE INPUT USED TO INITIATE A WARNING OR SHUTDOWN CONDITION. APPLY WITH (TB3-17/18) TO ACTIVATE
17	CONFIGURABLE INPUT RETURN	RETURN PATH FOR CONFIGURABLE INPUTS. (TB3-13,14,15,16)
19	RELAY COIL SOURCE	SWITCHED 24VDC POWER SUPPLY. USE ON THE HIGH SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY DRIVER. PROVIDES A MINIMUM 800ma OF CURRENT
21-22	READY TO LOAD RELAY DRIVER	ACTIVATES WHEN GENSET HAS REACHED 90% OF FREQUENCY. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
23	LOAD DUMP RELAY DRIVER	ACTIVATES AT A CONFIGURABLE LOAD LEVEL OR UNDER FREQUNCY CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
24	COMMON SHUTDOWN RELAY DRIVER	ACTIVATES ON ANY GENSET SHUTDOWN CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
25	SPARE	
26	SPARE	
27	SPARE	
28	MODEM RELAY DRIVER	PROVIDES A CONFIGURABLE METHOD OF CONTROLLING AND CYCLING POWER TO AN EXTERNAL MODEM. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH RELAY COIL SOURCE (TB3-19/20)
29	COMMON WARNING RELAY DRIVER	ACTIVATES ON ANY WARNING CONDITION. USE ON THE LOW SIDE OF THE CUSTOMER SUPPLIED RELAY COIL IN CONJUNCTION WITH A RELAY COIL SOURCE (TB3-19/20)
30	LOCAL LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS SUPPLIED WITH A DAY TANK OR AN INTEGRATED FUEL TANK. SWITCH RETURN WITH TB3-31
31	LOCAL LOW FUEL RETURN	SWITCH RETURN FOR LOCAL LOW FUEL INPUT (TB3-30)
32-33	FIRST START INPUT	FOR PARALLELLING APPLICATIONS, CONNECTS TO REMOTE MASTER START SENSOR OR BUS PT)MODULE WITH FIRST START SENSOR
34	LOAD DEMAND INPUT	FOR MULTIPLE GENSET PARALLEL APPLICATIONS. INPUT ALLOWS GENSET TO RAMP TO NO LOAD, OPEN BREAKER AND SHUT DOWN. REMOVING INPUT CAUSES GENSET TO START, SYNCHRONIZE, CLOSE BREAKER, AND RAMP TO LOAD. APPLY WITH SWITCH RETURN (TB3-38/39)
35	SINGLE MODE ENABLE INPUT	FOR SINGLE GENSET PARALLEL POWER TRANSFER (PLT) APPLICATIONS ONLY. APPLY WITH SWITCH RETURN (TB3-38/39) TO ENABLE MODE
36	RAMP LOAD/UNLOAD SWITCH	USED WITH MULTIPLE GENSETS IN PARALLEL IN CONJUNCTION WITH A MASTER CONTROL OR OTHER PLC DEVICE. APPLY SWITCH RETURN (TB3-38/39) TO LOAD/UNLOAD GENSET AS LOAD PROFILE DICTATES
37	REMOTE LOW FUEL INPUT	PROVIDES A LOW FUEL INDICATION FOR GENSETS THAT ARE NOT FITTED WITH AN INTEGRATED FUEL TANK. APPLY SWITCH RETURN TB3-38/39 TO ACTIVATE
38-39	SWITCH RETURN	SWITCH RETURN FOR TB3-34, 35, 36, AND 37
40	SYNC ENABLE INPUT	FOR USE IN SINGLE MODE PLT APPLICATIONS ONLY. INPUT SIGNALS GENSET TO SYNCHRONIZE WITH UTILITY
41	LOAD GOVERN KW+ INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KW LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC
42	LOAD GOVERN KW-	RETURN LINE LOAD GOVERN KW
43	LOAD GOVERN KVAR+ INPUT	ALLOWS A REMOTE DEVICE TO CONTROL KVAR LOAD ON GENSET WHILE UTILITY PARALLELED. ANALOG INPUT 0-5VDC. THIS INPUT IS DEFAULTED TO "DISABLED" AND IS ENABLED WITH INPOWER
44	LOAD GOVERN KVAR-	RETURN LINE LOAD GOVERN KVAR

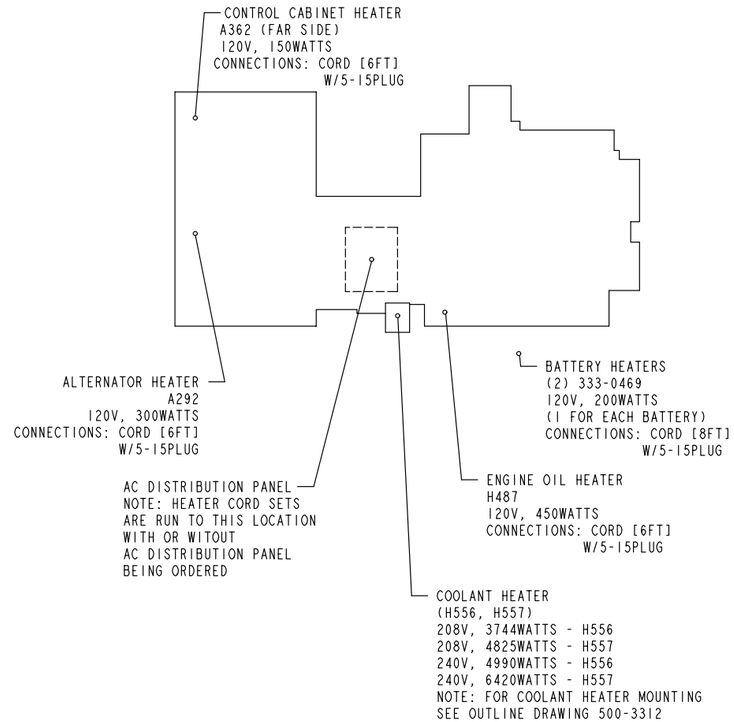
TABULATION		
TB3-	FUNCTION	DESCRIPTION
45	EXTERNAL KW/KVAR SHIELD	SHIELD TERMINATION POINT FOR LOAD GOVERN INPUTS
46	AUTO MODE OUTPUT	SWITCH BATTERY 24VDC, FUSED AT 5A. AVAILABLE WHEN GENSET IS IN AUTO MODE
47	GROUND FAULT INPUT	ACTIVATES A GROUND FAULT WARNING WHEN SWITCHED TO THE GROUND FAULT RETURN (TB3-48). USE IN CONJUNCTION WITH AN EXTERNAL GROUND FAULT RELAY
48	GROUND FAULT RETURN	RETURN LINE FOR GROUND FAULT INPUT
49	GROUND FAULT ANALOG INPUT	FUTURE FEATURE
50	GROUND FAULT METER RETURN	RETURN LINE FOR GROUND FAULT ANALOG INPUT
51	LOAD SHARE KW+	FOR ISOLATED BUS PARALLELING ONLY. KW LOAD SHARING LINES FOR POWER COMMAND GENSETS
52	LOAD SHARE KW-	RETURN FOR LOAD SHARE KW
53	LOAD SHARE KVAR+	FOR ISOLATED BUS PARALLELING ONLY. KVAR LOAD SHARING LINES FOR POWER COMMAND GENSETS
54	LOAD SHARE KVAR+	RETURN FOR LOAD SHARE KVAR
55	LOAD SHARE SHIELD	SHIELD TERMINATION POINT FOR LOAD SHARE KW AND LOAD SHARE KVAR LINES
56	GENSET BREAKER POSITION SWITCH INPUT	FOR PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT GENSET BREAKER IS CLOSED. USE WITH GENSET BREAKER SWITCH RETURN (TB3-58)
57	GENSET BREAKER INHIBIT SWITCH INPUT	FOR PARALLELING APPLICATIONS. WHEN CLOSED TO GENSET BREAKER SWITCH RETURN (TB3-50), GENSET BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
58	GENSET BREAKER SWITCH RETURN	RETURN LINE FOR TB3-56/57
59	GENSET BREAKER OPEN COMMAND	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN GENSET BREAKER. USE WITH TB3-60
60	GENSET BREAKER OPEN COMMAND RETURN	USE WITH TB3-59
61	GENSET BREAKER CLOSE COMMAND	FOR USE IN PARALLELING AND POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE GENSET BREAKER. USE WITH TB3-62
62	GENSET BREAKER CLOSE COMMAND RETURN	USE WITH TB3-61
63	UTILITY BREAKER POSITION INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED INDICATES TO CONTROL THAT UTILITY BREAKER IS CLOSED. USE WITH UTILITY BREAKER RETURN (TB3-65)
64	UTILITY BREAKER INHIBIT INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. WHEN CLOSED TO UTILITY BREAKER RETURN (TB3-65), UTILITY BREAKER WILL OPEN, OR BE PREVENTED FROM CLOSING
65	UTILITY BREAKER RETURN	USE WITH TB3-63/64
66	UTILITY BREAKER OPEN COMMAND	FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY CLOSED CONTACT THAT OPENS TO OPEN UTILITY BREAKER. USE WITH TB3-67
67	UTILITY BREAKER OPEN COMMAND RETURN	USE WITH TB3-66
68	UTILITY BREAKER CLOSE COMMAND	FOR POWER TRANSFER CONTROL APPLICATIONS. NORMALLY OPEN CONTACT THAT CLOSES TO CLOSE UTILITY BREAKER. USE WITH TB3-69
69	UTILITY BREAKER CLOSE COMMAND RETURN	USE WITH TB3-68
70	SYSTEM LOAD INPUT	FOR POWER TRANSFER CONTROL APPLICATIONS. ACCEPTS CT INPUT FOR MONITORING B PHASE CURRENT ON THE UTILITY BUS. USE UTILITY CT RETURN (TB3-72). A 3 OHM BURDEN RESISTOR IS CONNECTED ACROSS TB3-70 AND TB3-72
71	SPARE	
72	SYSTEM LOAD RETURN	USE WITH TB3-70

TB3 TERMINAL DESCRIPTIONS

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

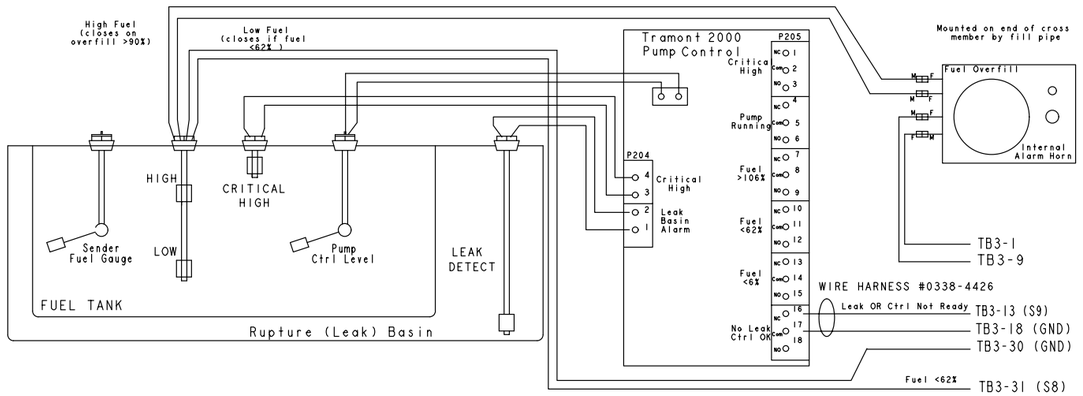


OPTIONAL GENSET HEATERS AND AC DISTRIBUTION PANEL LOCATIONS



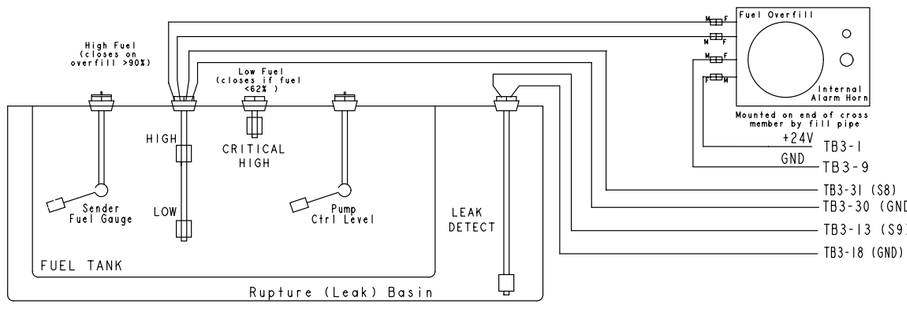
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

FUEL OVERFILL ALARM WITH TRANSFER PUMP CONTROLLER W/ CRITICAL ALARM AND LEAK BASIN ALARM

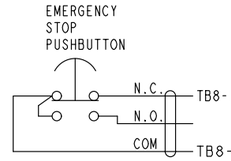


CONNECTIONS: INSIDE SET CONTROL SEE SHEET 8

FUEL OVERFILL ALARM WITHOUT TRANSFER PUMP CONTROLLER



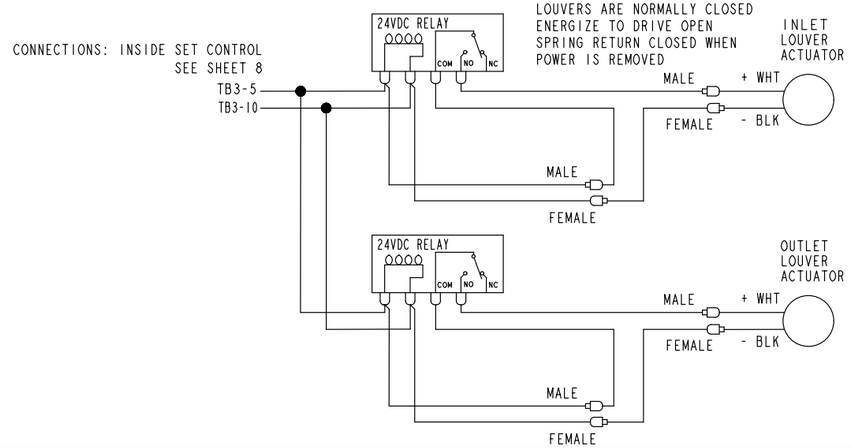
CONNECTIONS: INSIDE SET CONTROL SEE SHEET 8



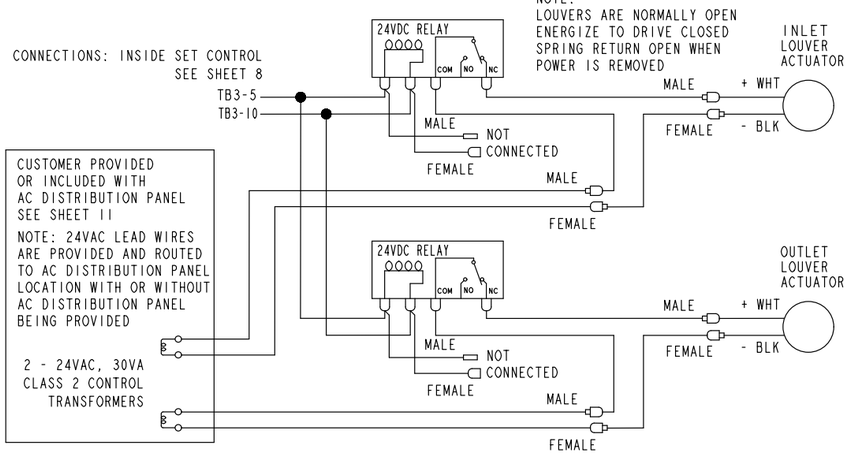
CONNECTIONS: INSIDE SET CONTROL SEE SHEET 8
NOTE: WIRE N.O. NOT CONNECTED

REMOVE JUMPER TB8-1 TO TB8-2 WHEN INSTALLING EMERGENCY STOP BUTTON

INLET AND OUTLET LOUVER CONNECTIONS (DC)

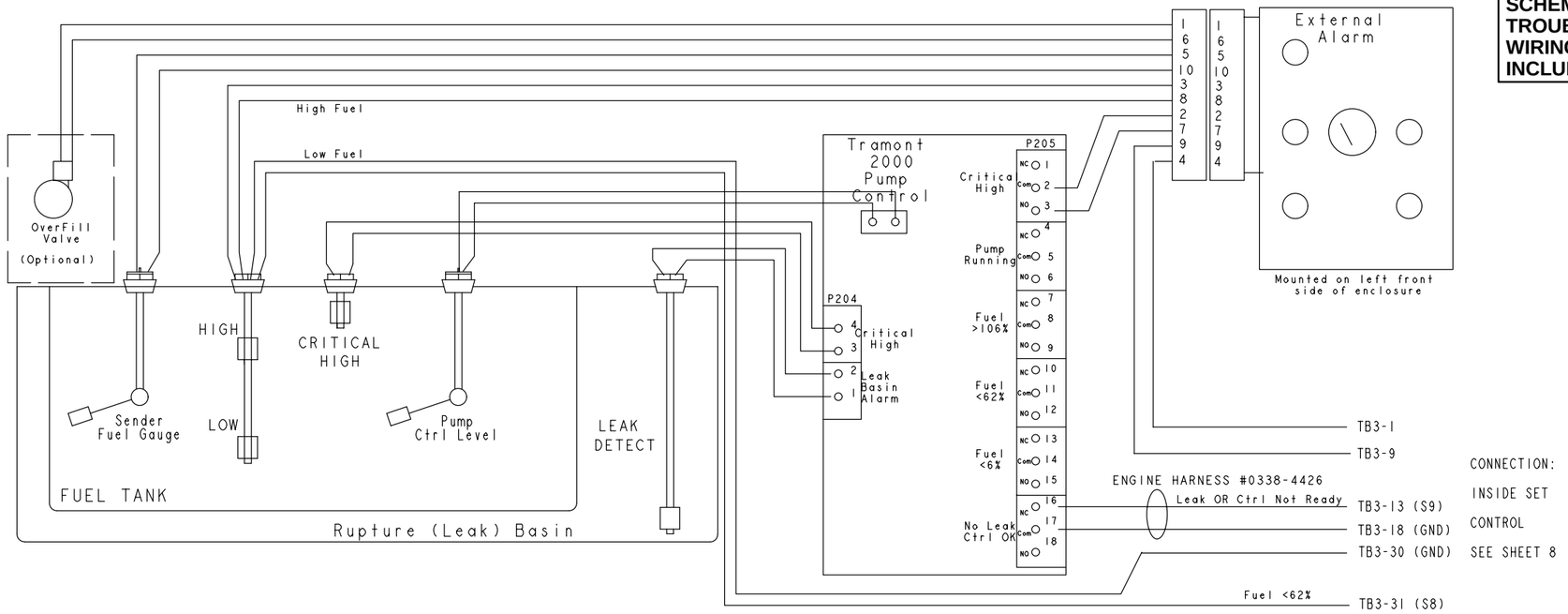


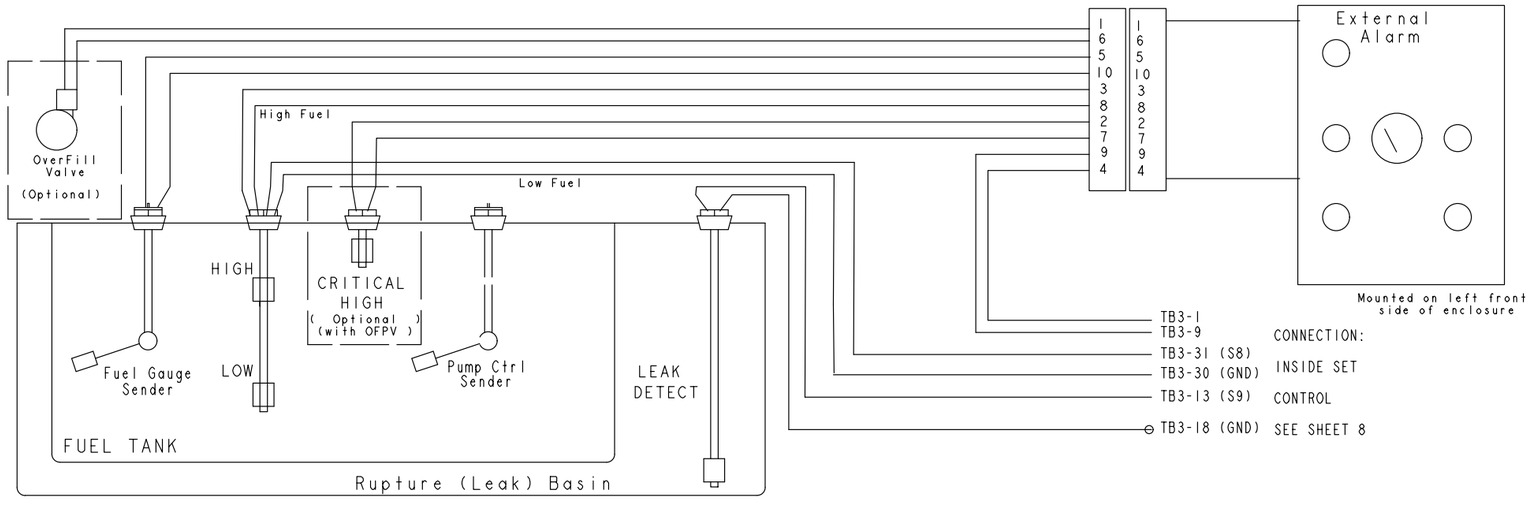
INLET AND OUTLET LOUVER CONNECTIONS (AC)



No. 630-2592 sh 9 of 11
Rev. E
Modified 12-03

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

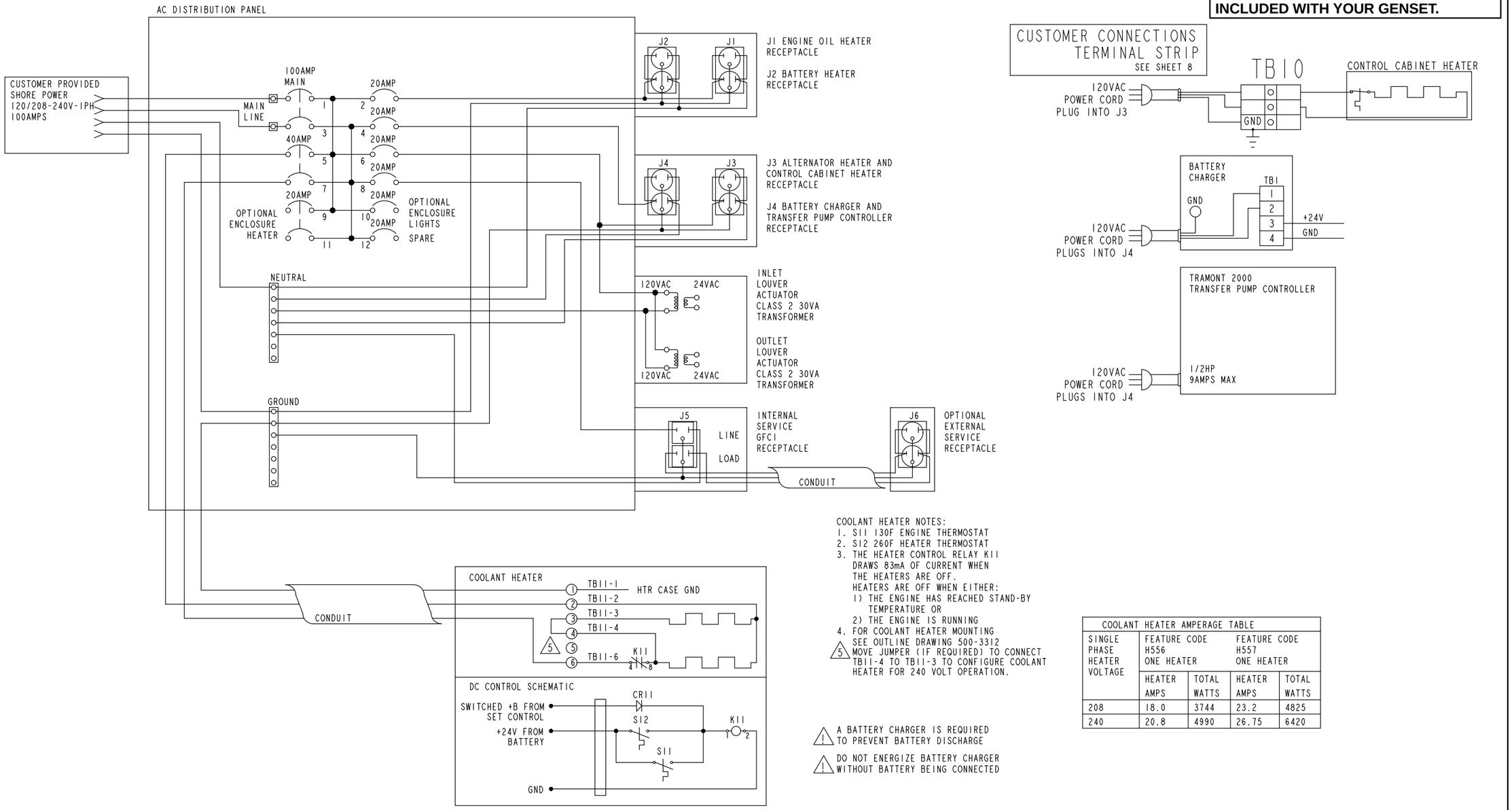




No. 630-2592sh 10 of 11
Rev. E
Modified 12-03

FUEL TANK WIRING

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



COOLANT HEATER NOTES:
1. SII 130F ENGINE THERMOSTAT
2. SI2 260F HEATER THERMOSTAT
3. THE HEATER CONTROL RELAY KII DRAWS 83mA OF CURRENT WHEN THE HEATERS ARE OFF. HEATERS ARE OFF WHEN EITHER:
   1) THE ENGINE HAS REACHED STAND-BY TEMPERATURE OR
   2) THE ENGINE IS RUNNING
4. FOR COOLANT HEATER MOUNTING SEE OUTLINE DRAWING 500-3312
5. MOVE JUMPER (IF REQUIRED) TO CONNECT TBII-4 TO TBII-3 TO CONFIGURE COOLANT HEATER FOR 240 VOLT OPERATION.

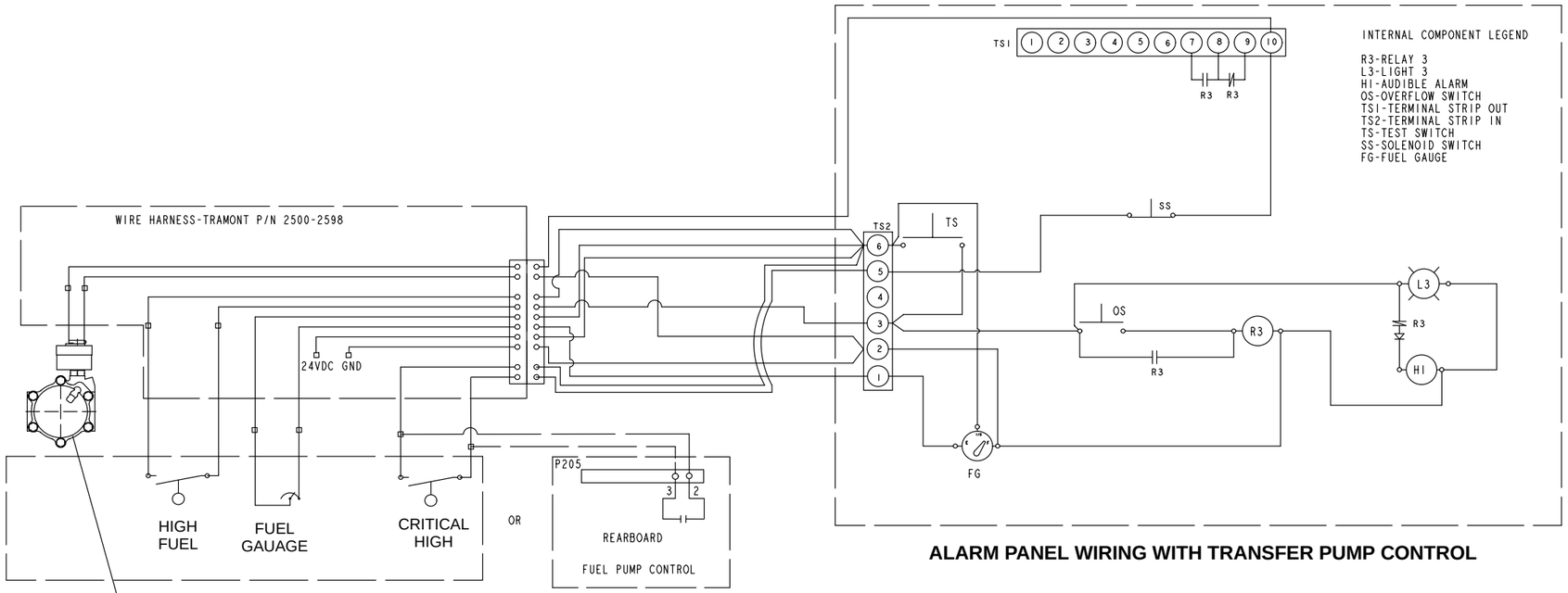
⚠ A BATTERY CHARGER IS REQUIRED TO PREVENT BATTERY DISCHARGE

⚠ DO NOT ENERGIZE BATTERY CHARGER WITHOUT BATTERY BEING CONNECTED

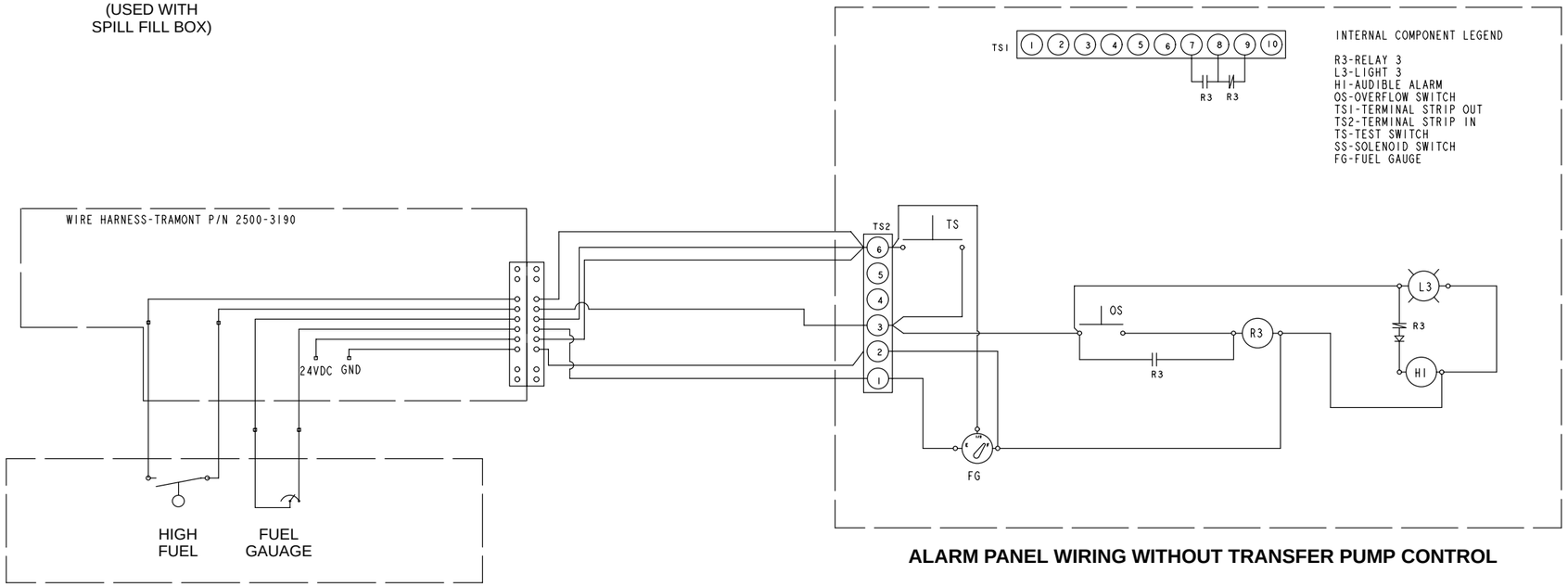
COOLANT HEATER AMPERAGE TABLE				
SINGLE PHASE HEATER VOLTAGE	FEATURE CODE H556 ONE HEATER		FEATURE CODE H557 ONE HEATER	
	HEATER AMPS	TOTAL WATTS	HEATER AMPS	TOTAL WATTS
208	18.0	3744	23.2	4825
240	20.8	4990	26.75	6420

No. 630-2592sh 11 of 11
Rev. E
Modified 12-03

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



ALARM PANEL WIRING WITH TRANSFER PUMP CONTROL



ALARM PANEL WIRING WITHOUT TRANSFER PUMP CONTROL

No. 541-1066 sh 2/3 of 3
Rev. B
Modified 12-03

Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
1-800-888-6626
763-574-5000 International Use
Fax: 763-528-7229

Power Generation