



Service Manual

Our energy working for you.™



**Power
Generation**

Controller
PowerCommand® 3200

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Safety Precautions

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. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

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 Onan/Cummins dealer or 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.
- 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.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, exhaust manifold, muffler and exhaust pipe.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

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

Operating and maintenance instructions are in the applicable Operator's Manual.

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 qualified to perform electrical and mechanical service. Read and follow Safety Precautions, on pages iii and iv.*

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2. Control Operation

GENERAL

The following describes the function and operation of the PowerCommand generator set control. 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 its 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 not being used.

In Off mode, Sleep mode is activated when there are no unacknowledged faults and Screen Saver mode is active.

In Auto mode, Sleep mode can be enabled or disabled. When shipped from the factory, it is disabled. You can enable Sleep mode by making these changes:

- Use InPower service tool to set *Auto Sleep Enable* to Sleep in Auto.
- Set switch S1 on the Genset/Paralleling Card to Sleep/Off. This switch is located next to connector J8 and relay K9.

If these conditions are not met, Sleep mode is disabled in Auto mode.

The graphical display can enter Screen Saver mode even if Sleep mode is disabled.

If Sleep mode is enabled in Auto mode, Sleep mode is activated when there are no unacknowledged faults and Screen Saver mode is active.

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

- Moving/pressing any control panel switch/button. (If Sleep mode is enabled in Auto mode, the control will remain asleep if Sleep mode was previously active in Off mode.)
- Receiving a remote start input signal (generator set in Auto mode)
- Receiving an active DCD signal on the RS-232 port.
- Modem RI latch becoming active.
- Digital display waking up.
- Lonworks (backplane) wakeup becoming active.
- Customer fault 2 or 3 only (shutdown or warning indicator is on).
- Dial Out process becoming active.

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

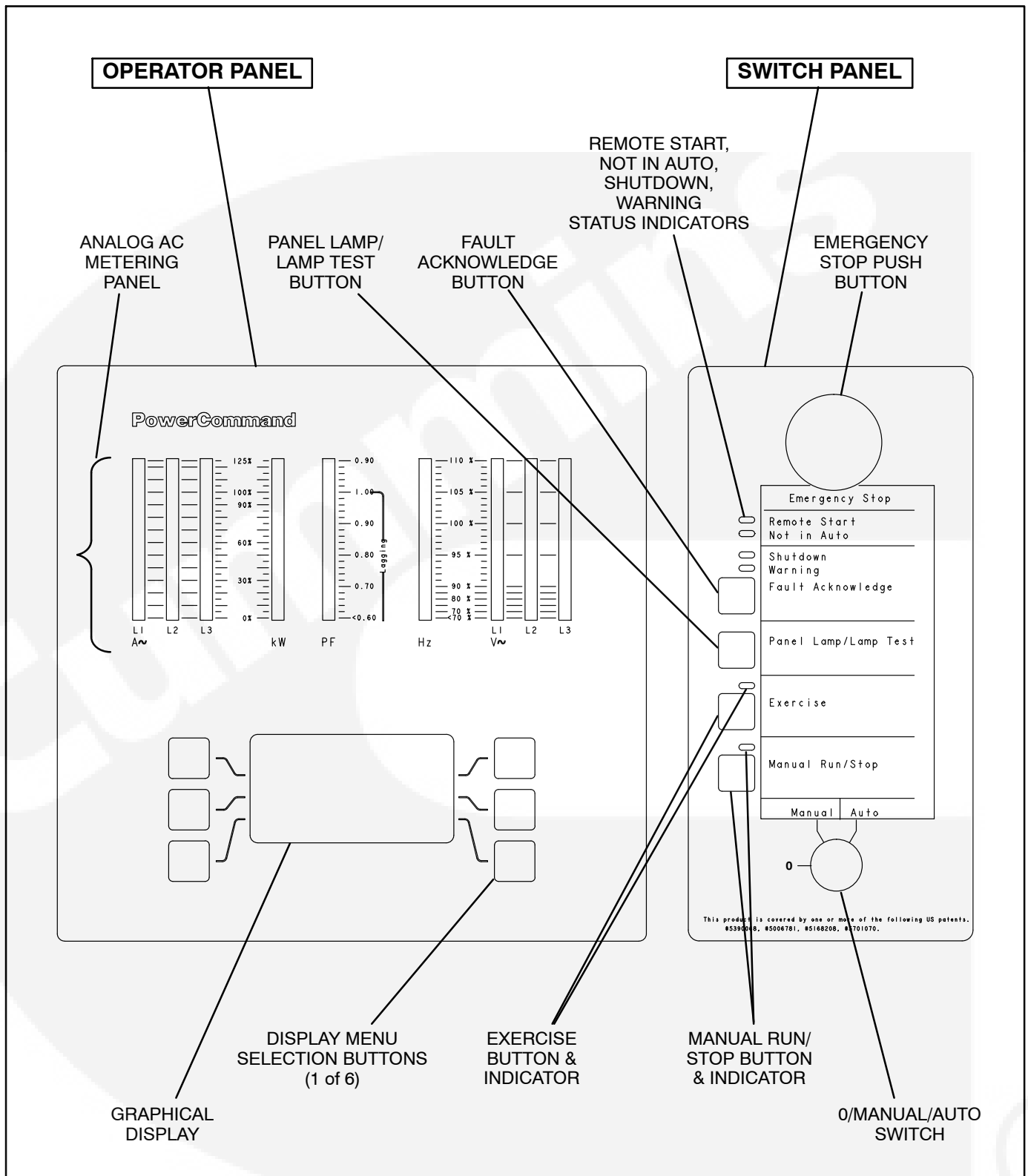


FIGURE 2-1. CONTROL PANEL ASSEMBLY (FULL-FEATURED)

CONTROL PANEL ASSEMBLY

The control panel assembly (Figure 2-1) consist of two panels, the *Operator Panel* and the *Switch Panel*. The control panel assembly can be mounted on the genset or in a freestanding cabinet located near the genset. In either location, the function of the control panel assembly switches and indicators remain the same.

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

The function of several buttons on the operator panel will vary dependent on the location of the operator 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 O/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 O/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 O/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.

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

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

Auto position enables start/stop control of the engine from a remote location. (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).

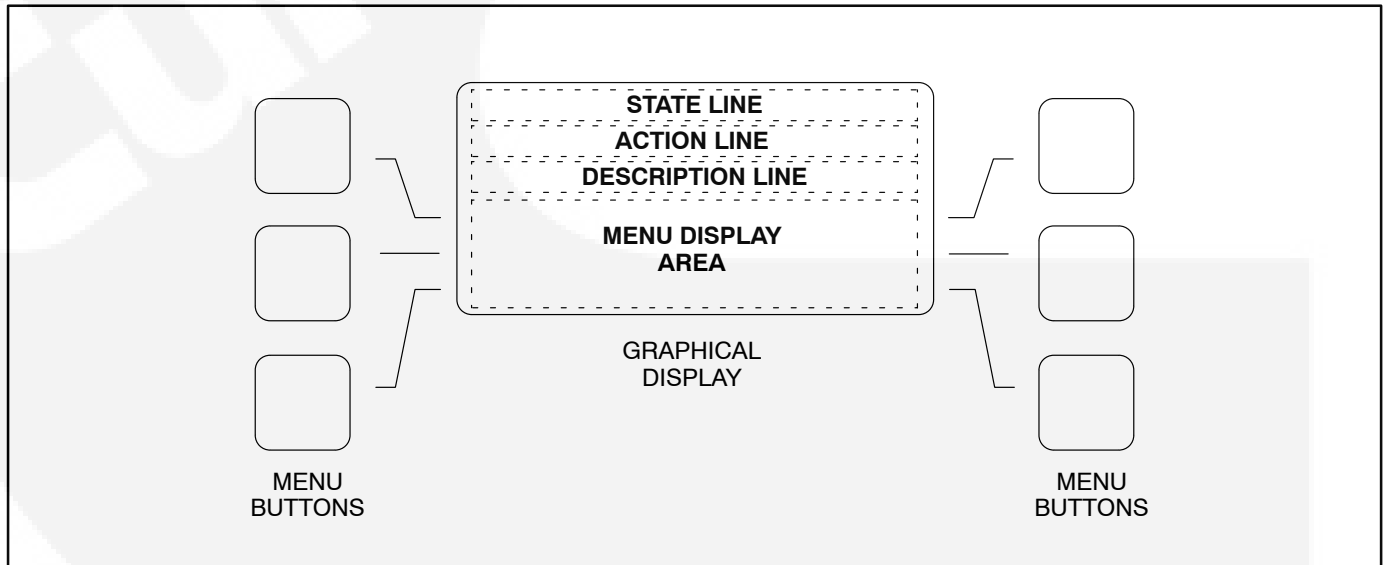


FIGURE 2-2. GRAPHICAL DISPLAY AND MENU SELECTION BUTTONS

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

Local/Remote Field: 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 Field: 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.

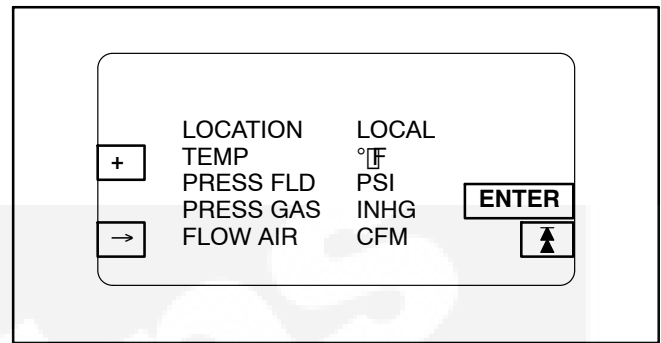


FIGURE 2-3. UNITS SUBMENU

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.

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). 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 **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.)

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 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 ▼.

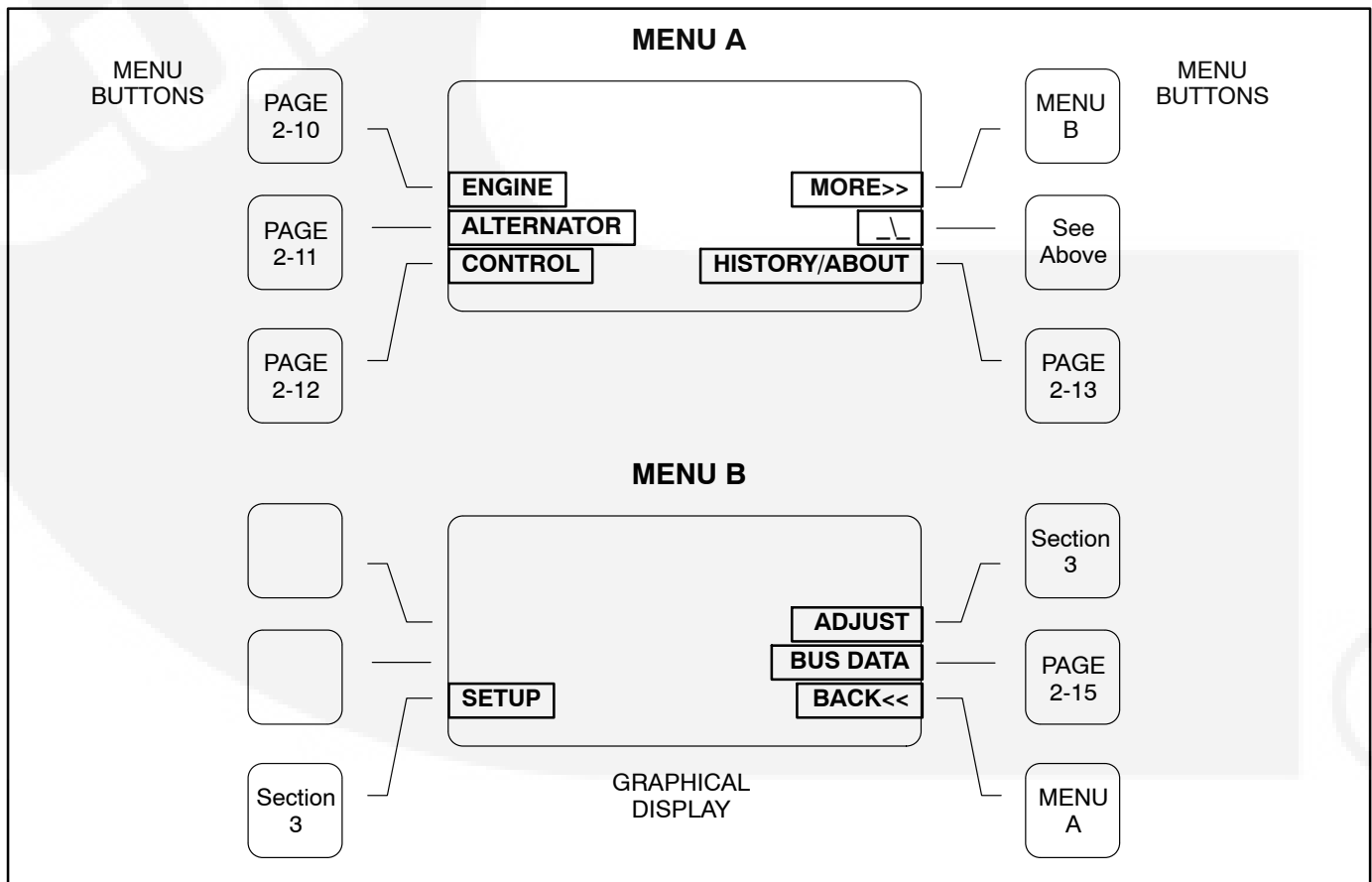


FIGURE 2-4. SYSTEM CONTROL MAIN MENUS A AND B

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.

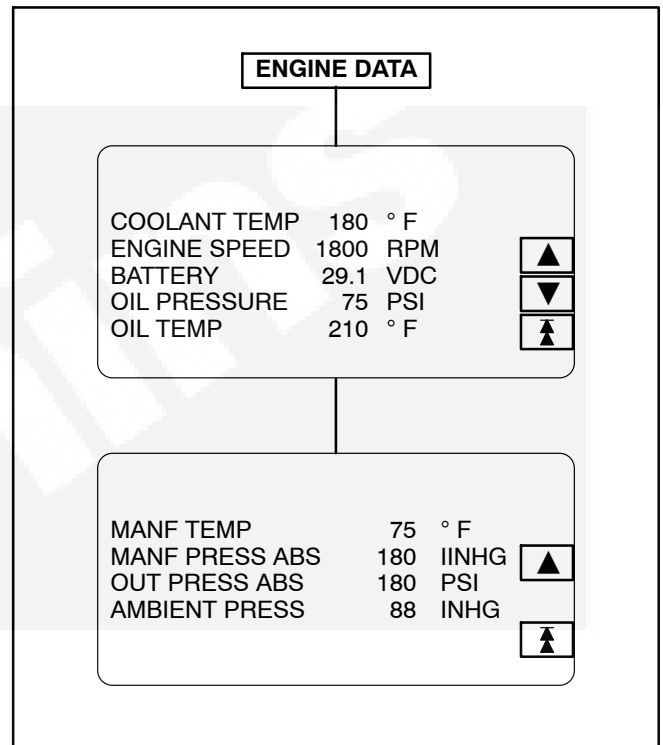


FIGURE 2-5. ENGINE DATA SUBMENUS

ALTERNATOR SUBMENU

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).

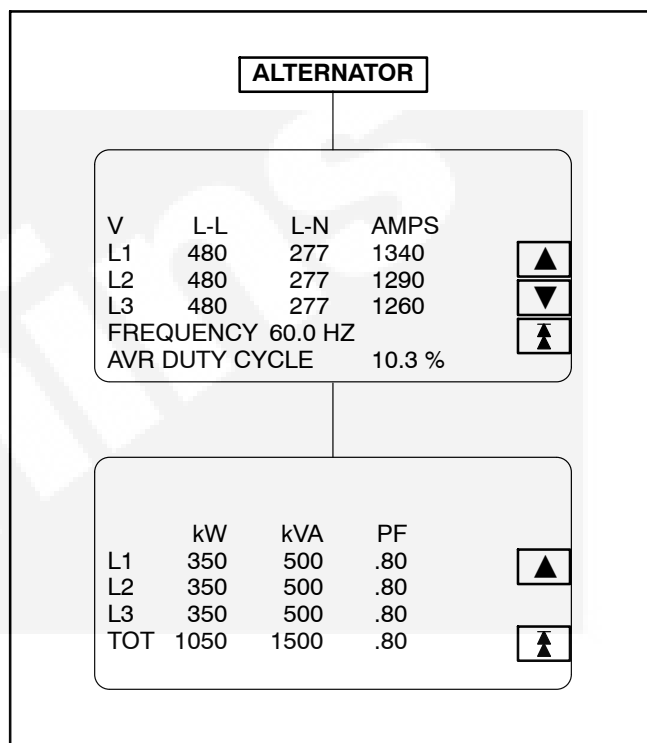


FIGURE 2-6. ALTERNATOR SUBMENU

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.

Run Mode Idle/Run At Rated Button: Refer to Page 3-7 for a complete description of the Run At Idle mode.

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.

When the generator set is operating in the Remote Start mode, removing the Remote Start command does not shut off the engine if the load is more than 10 per cent, the cooldown timer is set to zero, and

the control is configured for a single unit (not in parallel). The generator set continues to operate until it runs out of fuel, the E-stop button is used, or the load is removed.

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.

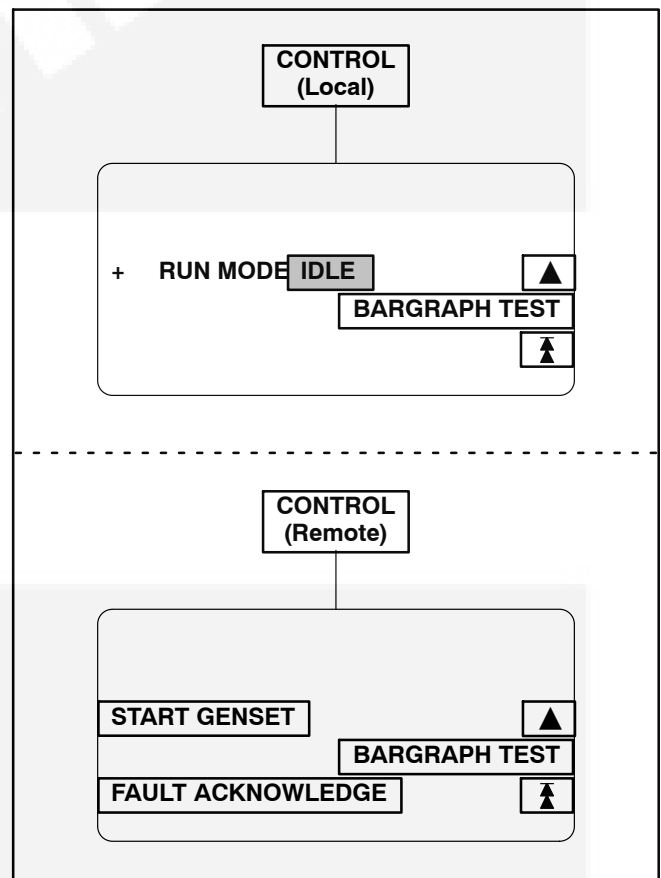


FIGURE 2-7. CONTROL SUBMENU

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.

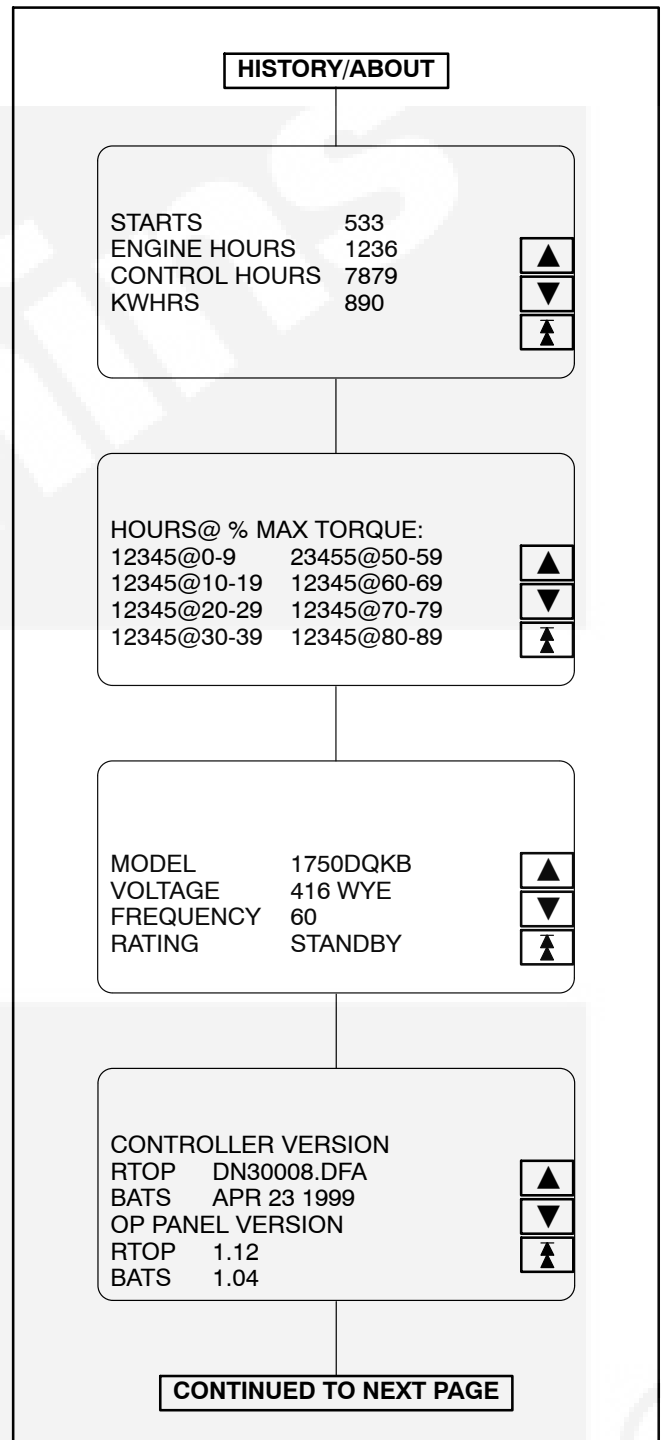


FIGURE 2-8. HISTORY/ABOUT SUBMENUS

HISTORY/ABOUT SUBMENU (CONT.)

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.

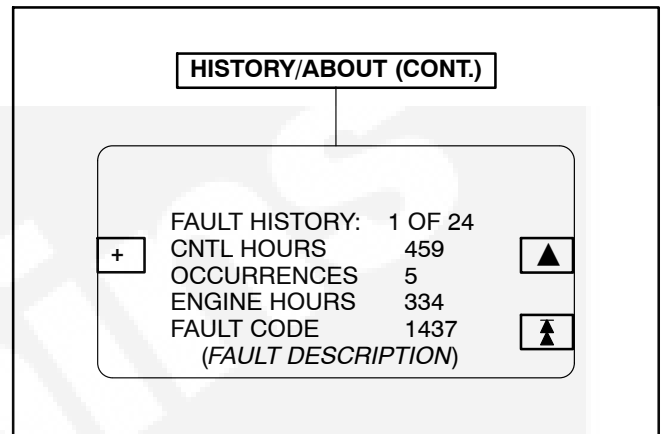


FIGURE 2-8. HISTORY/ABOUT SUBMENU (CONT.)

BUS DATA SUBMENU

If you press the “BUS DATA” button in Menu B, the Bus Data submenu will appear (Figure 2-9) (paralleling applications only).

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

- STANDBY
- 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 and genset frequency.

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 genset circuit breaker (CB) when the **0/Manual/Auto** switch is in Manual position. The symbol indicates if the CB is opened or closed. Opened _/__, push to close. Closed _-_, push to open.

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.)

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**.

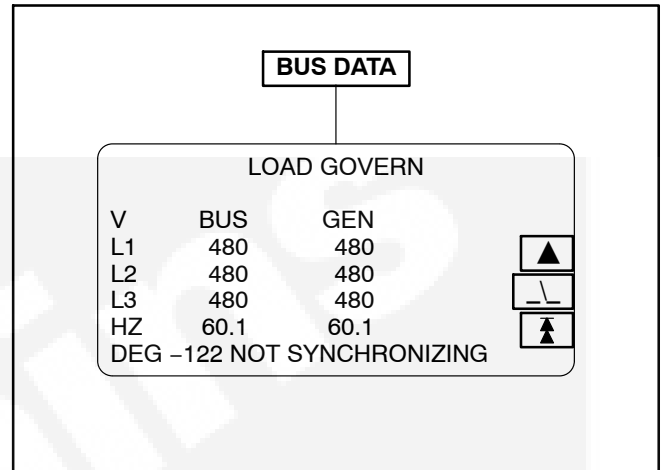


FIGURE 2-9. BUS DATA SUBMENU



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3. Control Calibration and Adjustment

GENERAL

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

SOFTWARE CALIBRATIONS

If the base card has software assembly A026 F566 v1.0 on the U33 flash memory chip, you must use the latest software calibration for the control. If you load an earlier software calibration onto a base card with software assembly A026 F566 v1.0, the software calibration will fail, and the board will lock up permanently.

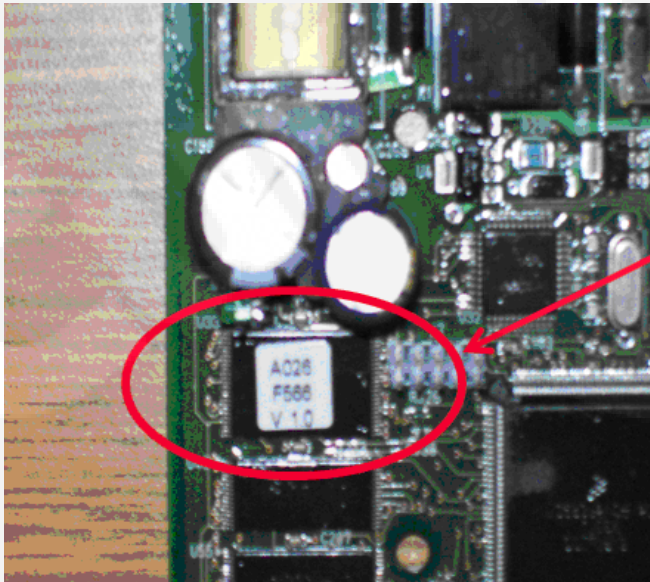


FIGURE 3-1. U33 FLASH MEMORY CHIP

⚠ CAUTION *If the base card has software assembly A026 F566 v1.0 on the U33 flash memory chip, you must use the latest software calibration for the control, or the board will lock up permanently.*

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* password is set to GENSET to allow initial modification of the Setup submenus. The *User* password is initially left blank and does not require a password to modify the Adjust submenu. The entering of the *User* password is not required unless a password is assigned to this field. (*User* password is site dependent.) Assign the password(s) when site installation is complete.

When viewing the Adjust menu, pressing the + or – button will display the User Password menu *if a user password has been installed with InPower software*. If a password is not assigned to the Adjust menu, changes can be made without entering a password.

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 only 10 minutes after the last button is pressed.

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.

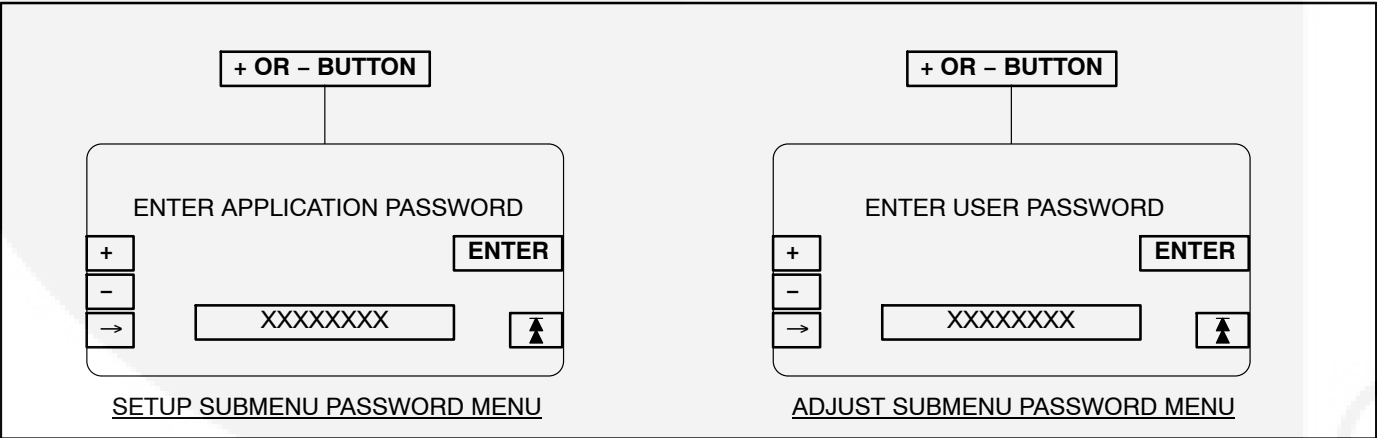


FIGURE 3-2. PASSWORD MENUS

SETUP MENUS

Figure 3-4 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 *Modifying Setup/Adjust Submenus* in this section to enter password and to save/continue 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 3-3 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.*

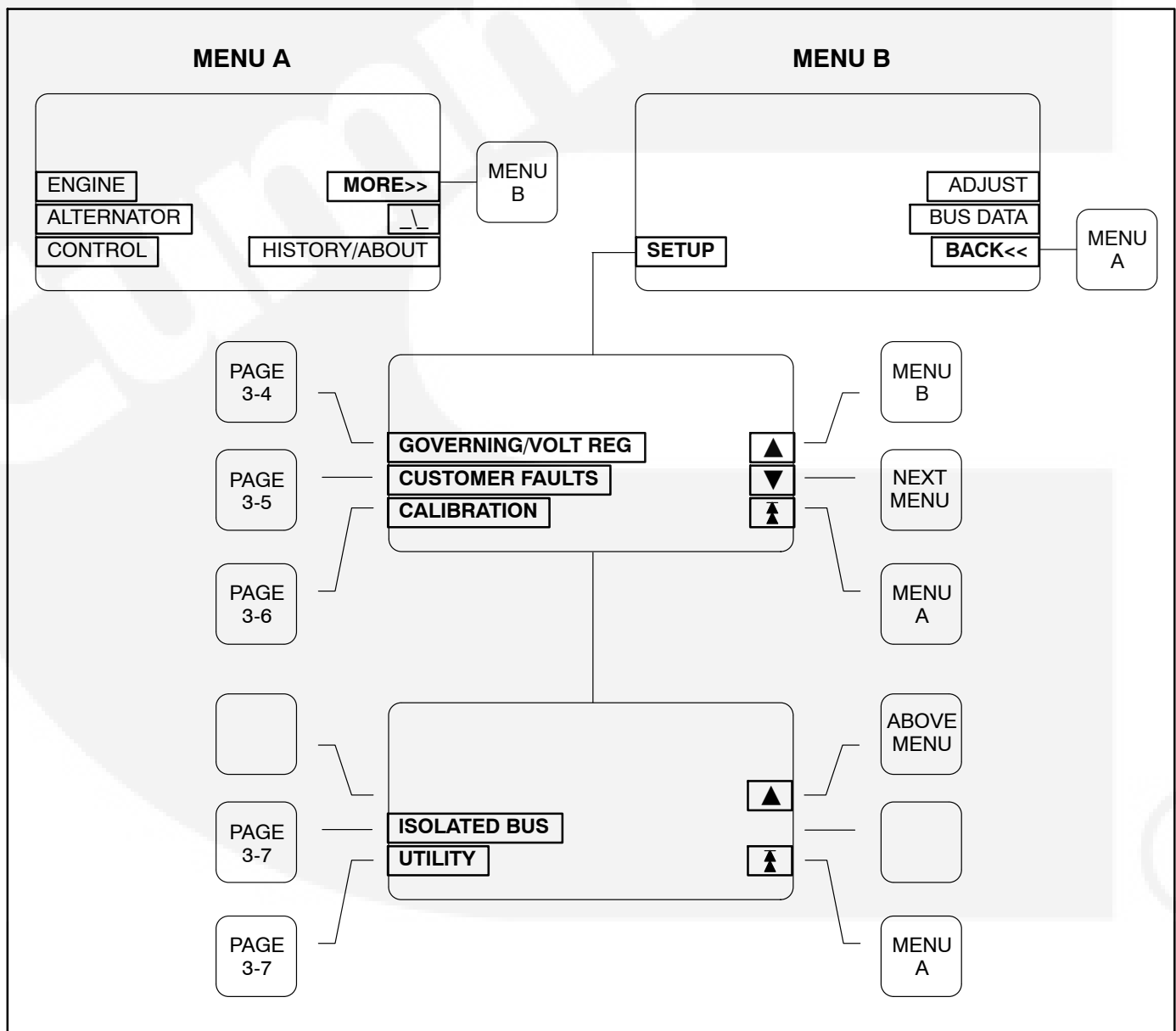


FIGURE 3-3. SETUP SUBMENUS

GOVERNING/VOLT REG Submenu

If you press the “GOVERNING/VOLT REG” button in the Setup menu, the Governing/Volt Regulator submenu will appear (Figure 3-4).

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.

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.

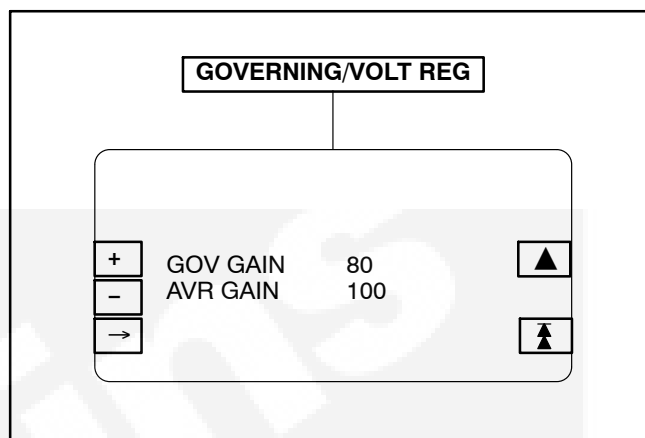


FIGURE 3-4. GOVERNING/VOLT REG SUBMENU

CUSTOMER FAULTS Submenus

If you press the “CUSTOMER FAULTS” button in the Setup menu, the Customer Faults submenu will appear (Figure 3-5).

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 percentage 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.

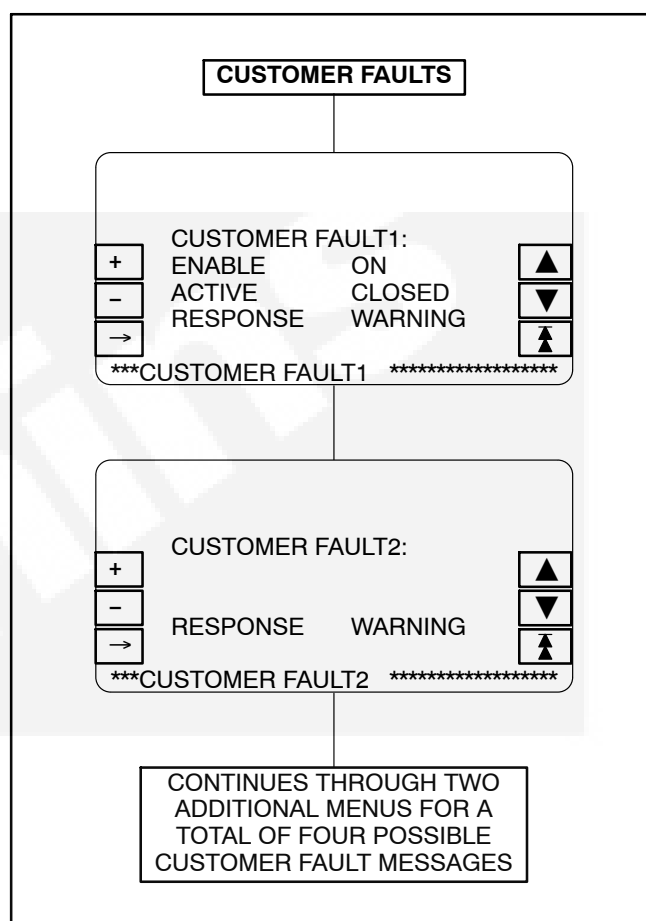


FIGURE 3-5. CUSTOMER FAULTS SUBMENUS

CALIBRATION Submenus

If you press the “CALIBRATION” button in the Setup menu, the Calibration 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 save 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.

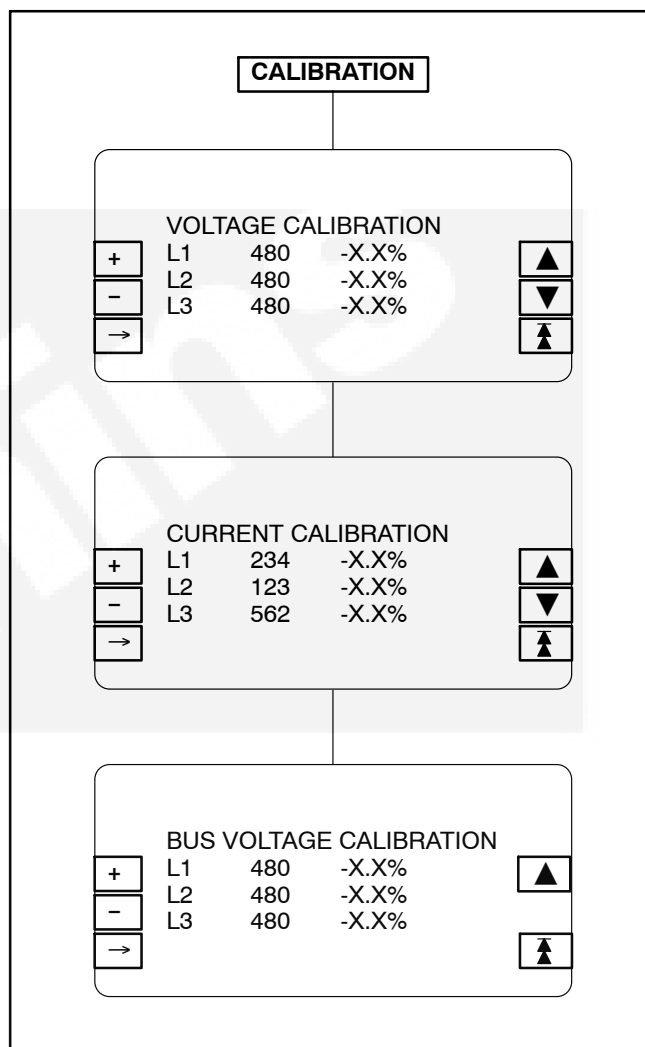


FIGURE 3-6. CALIBRATION SUBMENUS

ISO BUS / UTILITY Submenus (Paralleling Application)

The Isolated BUS submenu (Figure 3-7) and the Utility submenu (Figure 3-8) 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.

ISO BUS Submenus

If you press the “ISO BUS” button in the Setup menu, the Isolated BUS 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 save 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.

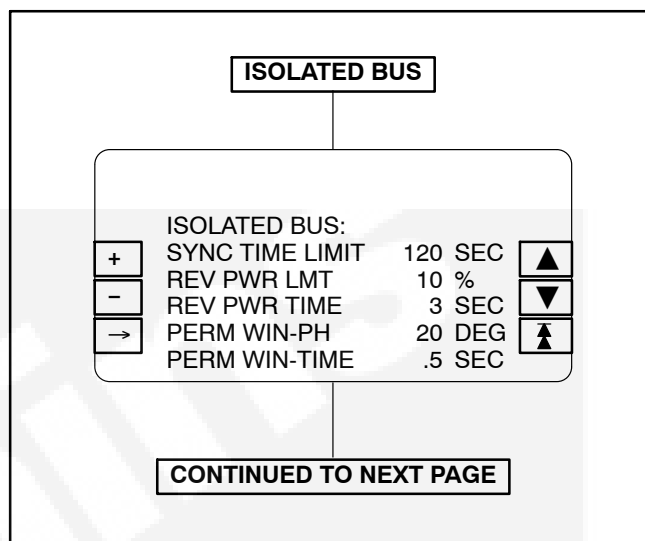


FIGURE 3-7. ISO BUS SUBMENUS

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.

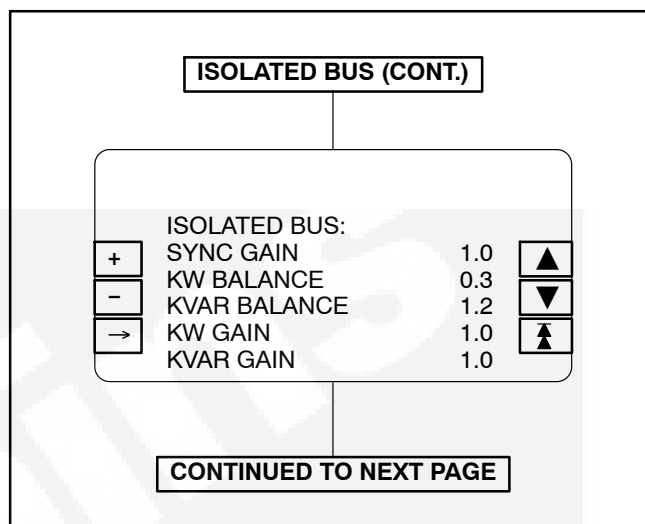


FIGURE 3-7. ISO BUS SUBMENUS (CONT.)

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.

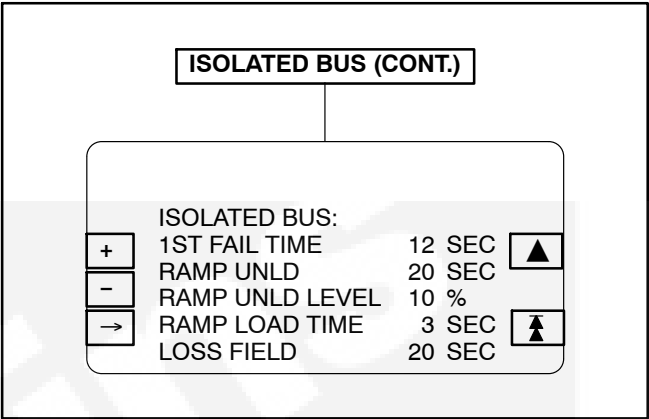


FIGURE 3-7. ISO BUS SUBMENUS (CONT.)

UTILITY Submenus

If you press the “UTILITY” button in the Setup menu, the Utility submenus will appear (Figure 3-8).

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.

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 VERIFY” 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.

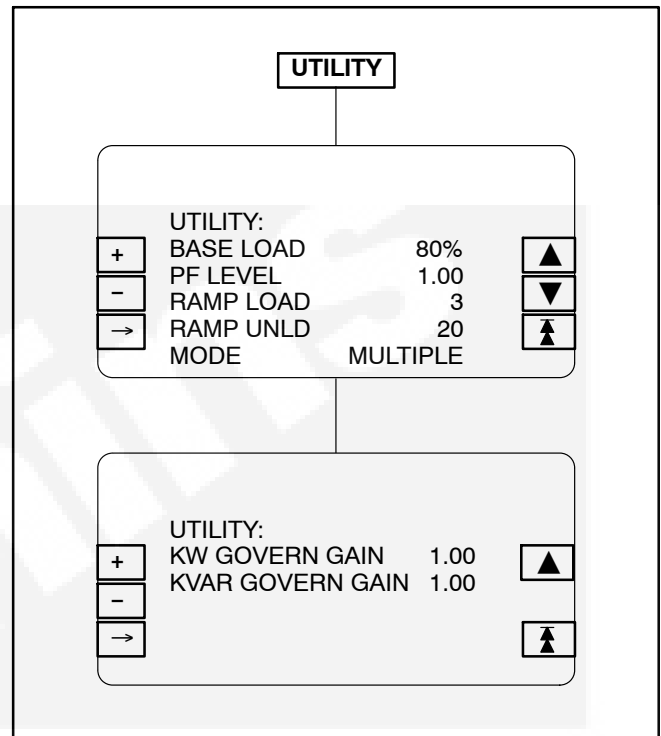


FIGURE 3-8. UTILITY SUBMENUS

ADJUST SUBMENU

Figure 3-9 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 procedure is intended for qualified service personnel and site personnel only. The **USER** password must be entered to modify the Adjust submenu fields. Refer to *Modifying Setup/Adjust Submenus* in this section to enter password and to save menu changes.

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 save changes.

VOLTAGE: Used to adjust the output voltage $\pm 5\%$.

FREQUENCY: Used to adjust the frequency ± 3 Hz.

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

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

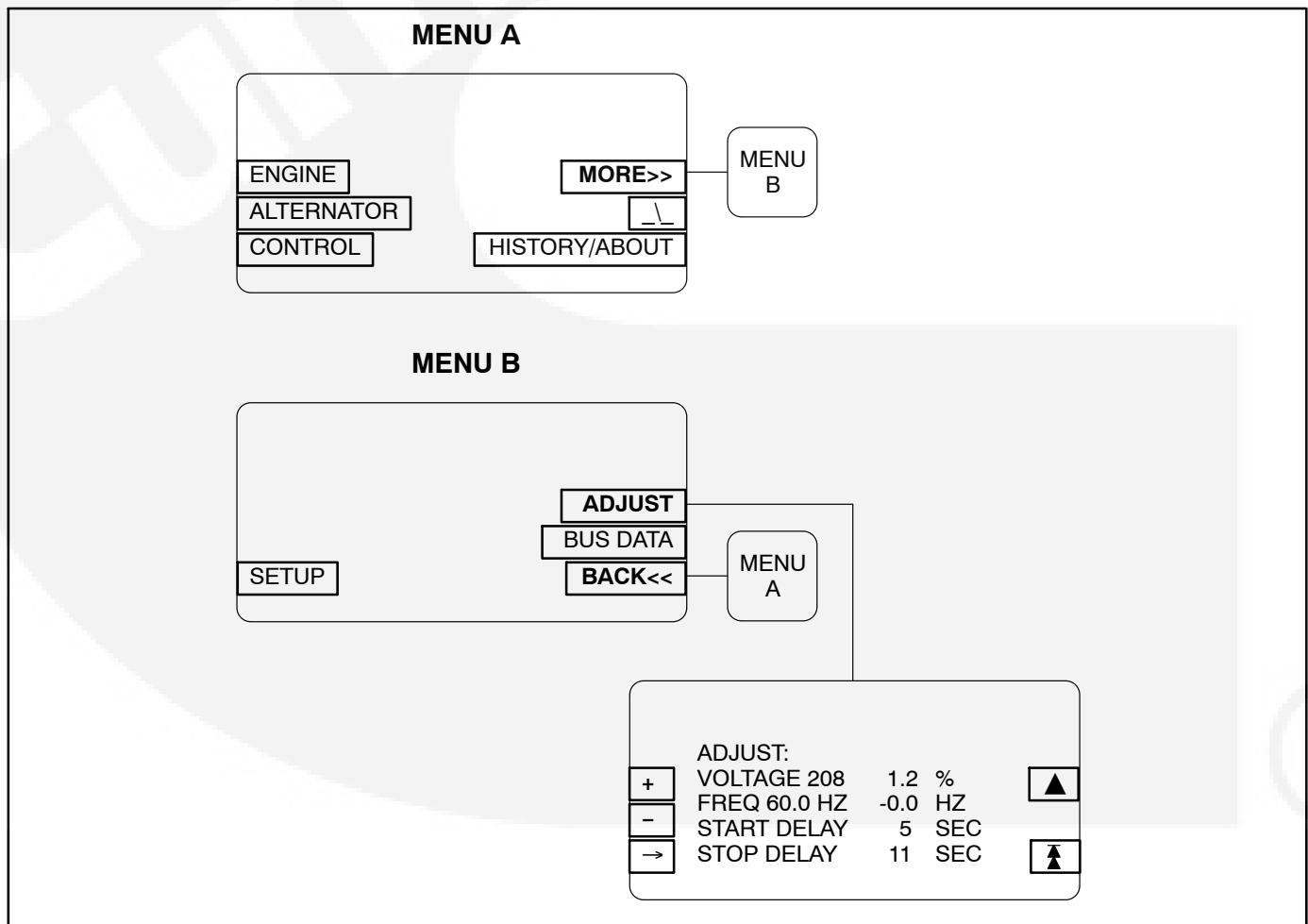


FIGURE 3-9. ADJUST SUBMENU

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 board (**A, B & C**) No adjustments required for Genset board if controller contains the Parallel board.
- Parallel board (**A, B & C**)
- PT/CT board (**A & B**)
- Bus PT (**C**)
- CT's (**B**)

⚠ WARNING *Contacting hazardous 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 avail-

able 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 Save 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 Save 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 3-10).
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 Save changes.

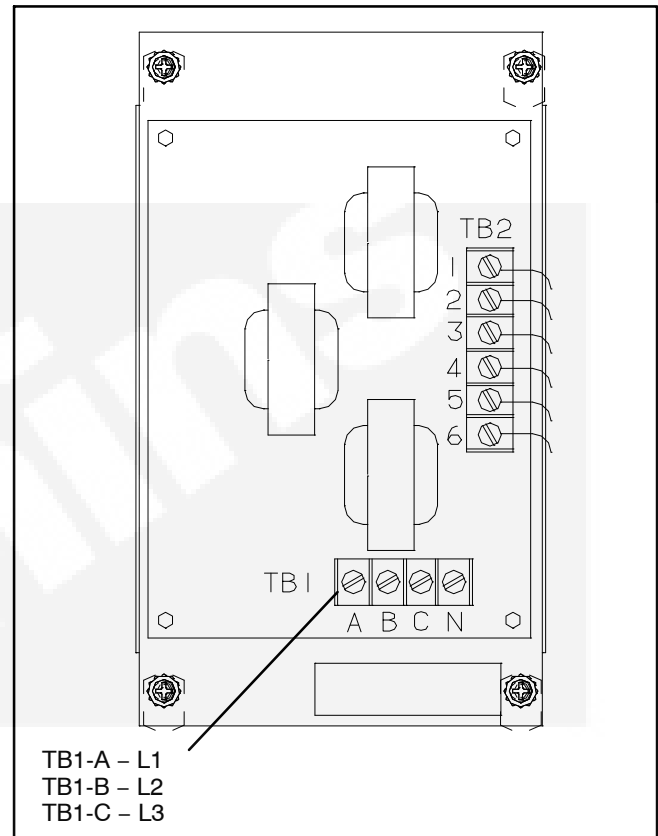


FIGURE 3-10. BUS PT MODULE

ELECTRONICS BOX CONTROL WIRING

The generator set control box assembly (Figure 3-11), which is located on the rear or optionally on either side of the control housing, contains connection points for remote control and monitor options.

⚠ CAUTION *Do not attach conduit to the control box assembly for any reason. All conduit must be attached to the control housing. Attaching conduit to the control box assembly will compress the control box vibration isolators, causing the box to vibrate and damage the electronic circuitry.*

A sealable pass-through is provided on the back of the control box for customer monitor/control wiring (Figure 3-12).

Customer monitor/control connections are attached to terminal blocks TB3, TB4, TB5 and TB8

(see Figure 3-12). 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.

⚠ CAUTION *When removing terminal block connectors (TB4, TB5, or TB8) from cards in card cage, note orientation of connector. These terminal block connectors are not keyed and can be installed incorrectly, which will cause control failures.*

TB3, TB4, TB5, and TB8 Customer Connections

Refer to pages 5-8 and 5-9 for typical connections to TB3, TB4, TB5, and TB8.

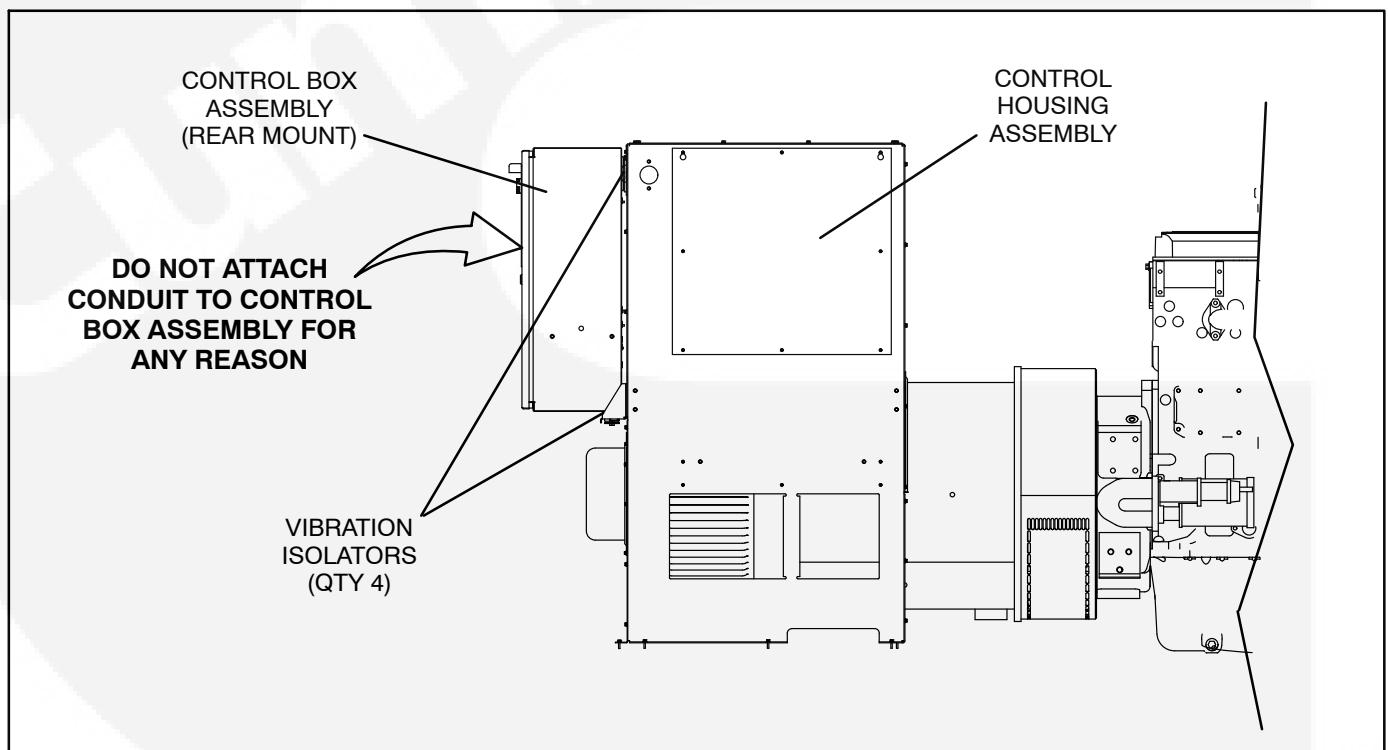


FIGURE 3-11. CONTROL BOX – REAR MOUNT

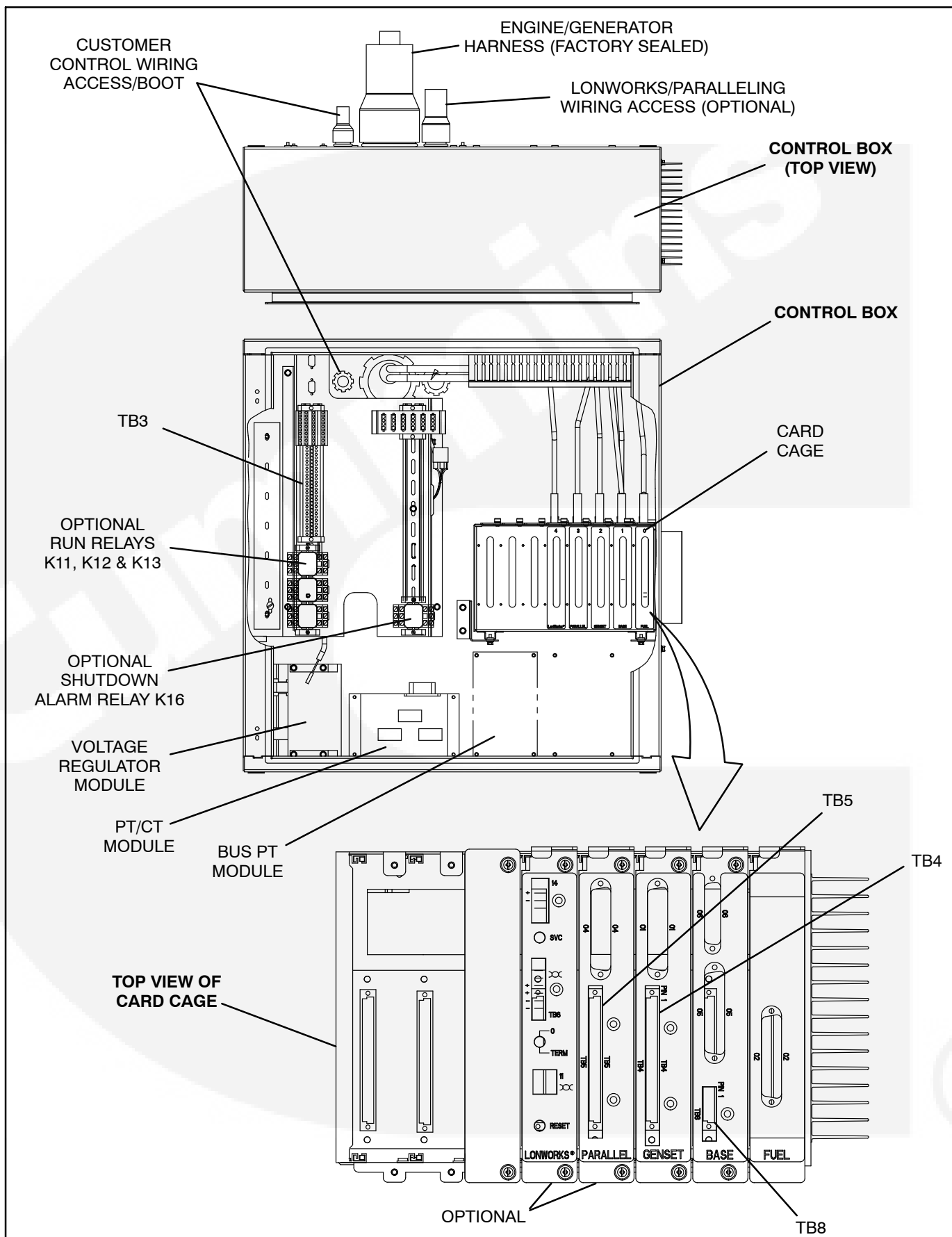


FIGURE 3-12. CONTROL BOX ASSEMBLY

RUN RELAYS (K11, K12, K13)

The optional run relays are rail mounted inside the control box (Figure 3-12). 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 3-13) 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

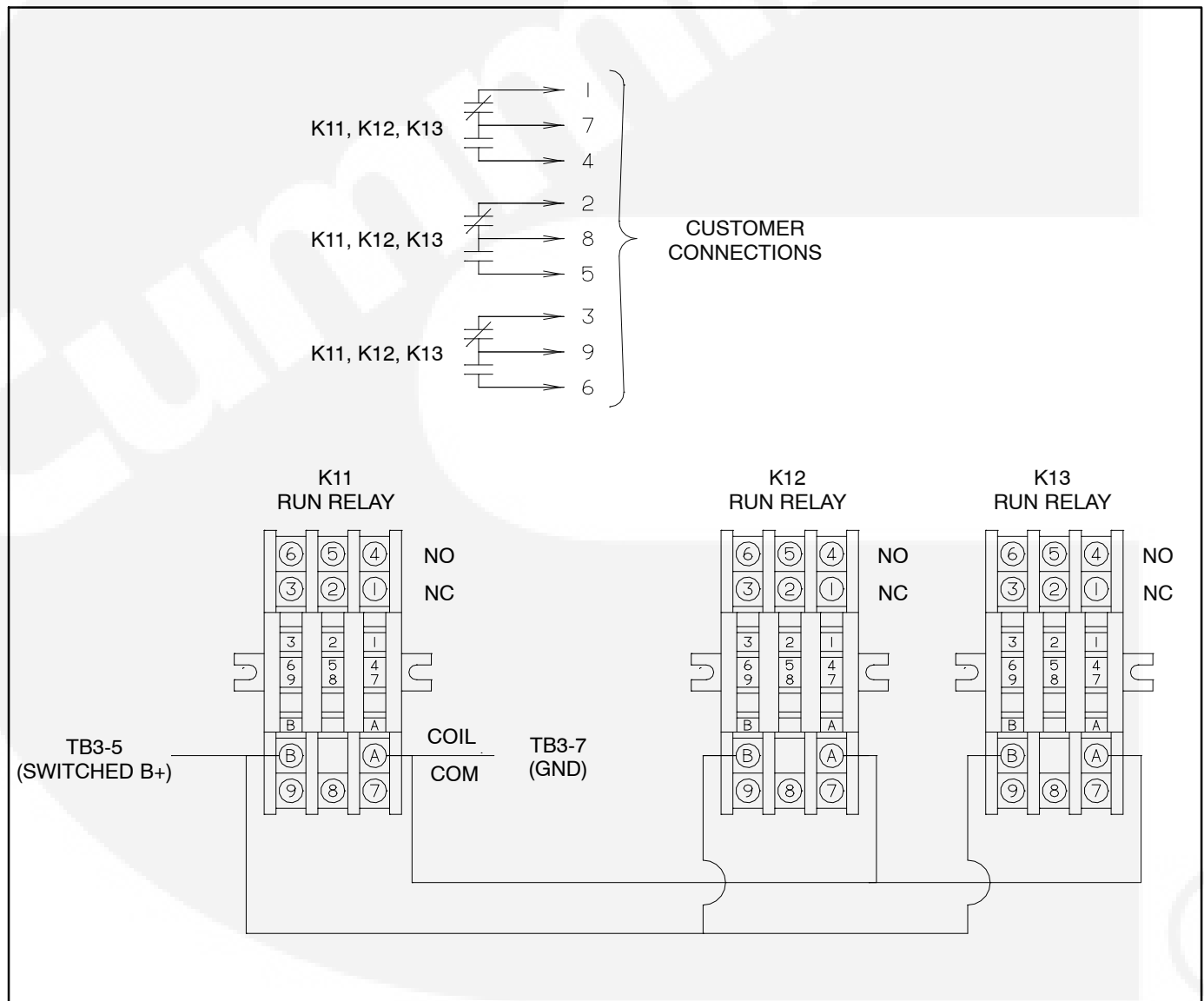


FIGURE 3-13. OPTIONAL RUN RELAYS (K11, K12, K13)

ALARM RELAY (K16)

The optional alarm relay is rail mounted inside the control box (Figure 3-12). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 3-14) is often used to energize warning devices

such as audible alarms. Any generator set shut-down 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

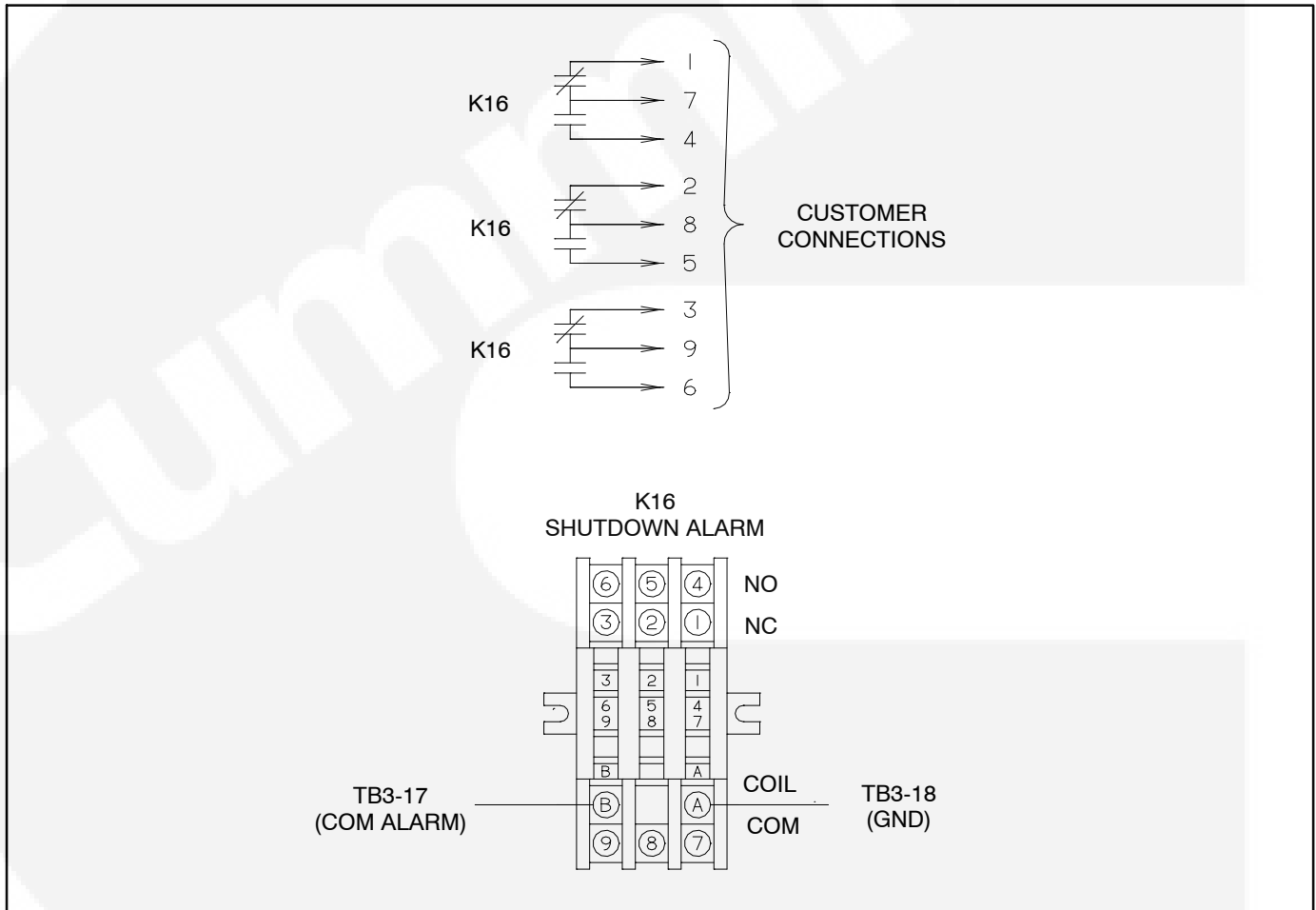


FIGURE 3-14. OPTIONAL ALARM RELAY (K16)

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