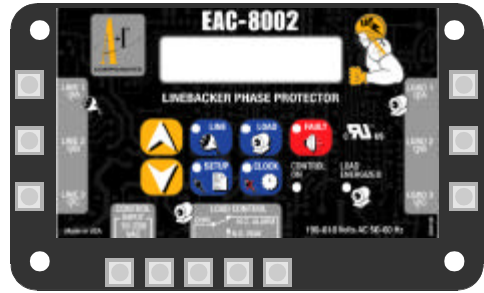




LINEBACKER PHASE PROTECTOR

EAC-8002



Universal Line Voltage Monitor with
LCD Display, Permanent Memory,
Real Time Clock, Control Input
& Contactor/Load Monitoring

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P/N LB0105

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BACKS UP OUR CLAIMS FOR QUALITY PRODUCTS**

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1 - INTRODUCTION

Three phase motors and compressors typically receive their power from generating stations miles away. This distance and other factors including thousands of connections to various users, lightning, and accidental damage to power lines and distribution equipment can cause varying or complete loss of power supplied to your expensive motor or air conditioner. Abnormally high or low voltage supplied to motors and compressors may not immediately cause a visible problem, however supplying an incorrect voltage level to a running motor or compressor causes increased internal heating, which shortens motor life. Further variance in line voltage can destroy your motor. Protect your investment against abnormal line voltage conditions by installing A-1's EAC-8002 three phase line voltage monitor.

The designers of A-1's EAC-8002 have foreseen the needs of today's demanding line voltage monitoring by utilizing modern micro-computer technology. Precision measurement techniques monitor each of the three input phases at all times and calculate voltage levels, voltage tolerance, phase unbalance, and contactor condition. If the power supplied to your motor or compressor varies from the parameters set into the EAC-8002's permanent memory, the EAC-8002 will immediately command a complete system shut down. Upon detection of correct incoming power, and a preset delay, the EAC-8002 will restart the system. If a critical system problem is detected the EAC-8002 will wait for a manual restart. Additional internal circuitry continuously monitors the operation of the EAC-8002's internal systems and initiates self correcting measures as required.

Installation is a snap with simplified connections and adjustment for all system operating parameters. Instant verification of all system conditions is conveniently accessible by simply checking the illuminated LCD message display. The EAC-8002's circuitry automatically adjusts for line voltage connections in the range of 190 to 600 volts without the use of range plugs or jumpers.

The EAC-8002 also includes an anticipator load, to be installed when required, to ensure the correct operation of mechanical and electronic thermostats when used in HVAC applications.

Installing the EAC-8002 affords the best three phase motor and compressor protection available without the use of current transformers. Nuisance service calls are virtually eliminated by the EAC-8002's built in features including delay-on-break and delay-on-make timers, adjustable fault delay, precision voltage analysis and contactor condition monitoring.

System operation using the EAC-8002 is fully automatic with visible LED indicators providing convenient assessment of control voltage, load energization, parameter setup, built-in voltmeter, and previous fault conditions. In the event of a line or contactor fault, the EAC-8002 stores the fault condition in its permanent fault memory, including time and date when the fault occurred. Up to 254 last fault conditions can be displayed on command during routine maintenance or service.

The EAC-8002 is easy to install and setup using the built-in illuminated LCD display and the button panel. No application specific wiring or confusing rotary switch settings are required. Default factory settings may be restored at any time. These factory defaults configure the EAC-8002 to NEMA standards for motor voltage and phase unbalance to ensure your motors safety.

Operator adjustment of the EAC-8002 can be preset at the wholesaler or factory for simplified job site installation. Pre-set parameters are stored in permanent memory and field adjustment of operational settings may be locked out at the OEM or wholesaler level to prevent field adjustment by unqualified personnel.

2 - SPECIFICATIONS

2.1) Line Input Voltage

Range: 190 to 600 VAC 50/60 Hz. Universal Input Voltage Range (does not require range plugs, jumpers or switches).

Display: The three phase line voltages and the average input voltage are displayed when the LINE key is pressed.

2.2) Contactor /Load Side Voltage

Range: Same as input voltage. Contactor/Load side monitoring is optional and may be enabled or disabled in the setup menu.

Display: The three phase load voltages and the average load voltage are displayed when the LOAD key is pressed.

2.3) Over/Under Voltage

Range: 2 to 25% of the nominal voltage, adjustable in 1% increments.

Function: Provides load shut down and fault register when the line voltage becomes greater/lower than the set value. Load will be shut down after programmed FAULT DELAY has elapsed.

2.4) Phase Unbalance Protection

Range: 2% to 20% adjustable in 1% increments

Function: Provides load shut down and fault register when the voltage at phase pairs become too high or too low related to the average voltage. Load will be shut down after programmed FAULT DELAY has elapsed.

2.5) Phase Loss Protection

Function: Phase is considered lost (and registered as a fault in the fault memory) if the phase unbalance becomes greater than 25%. The load is immediately shut down regardless of the FAULT DELAY setting.

2.6) Phase Reversal Protection

Function: Provides protection to the load against errors in the phase sequence connection. The load is immediately shut down regardless of the FAULT DELAY setting.

2.7) Delay-On-Break Timer

Range: 0.1 to 25 minutes adjustable in 0.1 minute (6 sec.) increments.

Function: Provides delay-on-break of either control signal or power faults. Delay-on-break timer continues to function with or without power applied to the EAC-8002. Load will not re-energize until setup time delay has elapsed.

Display: Shows delay-on-break time remaining, in seconds. It replaces the average voltage in LINE/LOAD mode.

2.8) Delay-On-Make Timer

Range: 0.1 to 10 minutes adjustable in 0.1 minute (6 sec.) increments.

Function: Provides delay on application of either control signal or when power returns to a non fault condition. Load will not be energized until delay has elapsed.

Display: Shows delay-on-make time remaining, in seconds. It replaces the average voltage in LINE/LOAD mode.

2.9) Fault Delay Timer

Range: 1 to 15 seconds in 1 second increments.

Function: Provides a time delay between the detection of a fault and actual load shut-down. Load will be shut down after programmed FAULT DELAY setting in the event of a fault condition.

Display: Shows time delay remaining and the related fault, if system power is available. It replaces the display information in LINE/LOAD mode.

2.10) Control Voltage

Range: 18 to 288 VAC 50/60Hz.

Function: Controls EAC-8002 output relay when Control Mode is set to EXTERNAL.

2.11) Voltmeter

Accuracy $\pm 1\%$ typical $\pm 2\%$ over -20 to +80 °C. Temp. range.

2.12) Real Time Clock

Function: Provides Time and Date to the user and to the fault registers. The battery life is up to 10 years.

Display: Digital display of Date, in mm/dd/yyyy format and the Time, in hh:mm:ss format, with am/pm information.

2.13) Memory

All values entered at the time of setup and up to 254 fault condition messages are stored in permanent non-volatile memory. Setup parameters and faults will remain stored in the unit indefinitely with or without power. This means that you can apply power to the EAC-8002 and adjust all system parameters at your shop, then ship the pre-programmed unit to your job site, ready to run!

2.14) Output Relay Rating

10A/5A @ 240VAC	Resistive/GP	100,000 operations
10A/5A @ 28VDC	Resistive	100,000 operations
240VA, 240VAC	Pilot Duty	100,000 operations
12A NO @ 120VAC	Resistive/GP	100,000 operations
1/3HP NO @ 120VAC	Motor	6,000 operations
34.8LRA/6FLA NO @ 120VAC	Motor	100,000 operations

2.15) Operating Temperature

Liquid Crystal Display: -10 to +45°C.

Protection Circuits: -20 to +80°C.

3 - CONTROLS & INDICATORS

The 16x2 character liquid crystal display with LED backlight provides operational condition, parameter setup values and fault display. The 7 keys operator control panel allows adjustment of operating parameters, voltmeter read operations, fault memory readout and Real Time Clock readings. Each key (except UP & DOWN) is featured with a status indicator LED. These LEDs are either continuously or intermittently turned on, wherever its respective key is pressed.

Refer to figure 2 for item identification.

3.1) UP & DOWN ARROW KEYS

Their basic functions are:

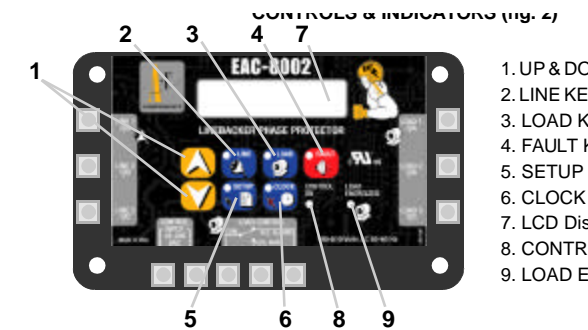
- a) Parameters adjustment, when in SETUP mode;
- b) Menu navigation;
- c) Adjustment of display contrast, during LINE or LOAD modes.

3.2) LINE KEY

Displays the input line voltage, when it is pressed.

3.3) LOAD KEY

Displays the output load voltage, when it is pressed.



- 1. UP & DOWN ARROW KEYS
- 2. LINE KEY/LED
- 3. LOAD KEY/LED
- 4. FAULT KEY/LED
- 5. SETUP KEY/LED
- 6. CLOCK KEY/LED
- 7. LCD Display
- 8. CONTROL LED
- 9. LOAD ENERGIZED LED

3.4) FAULT KEY/LED

When this key is pressed, it is possible to choose between one of the following options: Reset current faults, Erase fault registers or read fault register. Use the UP & DOWN keys to select your choice.

If the LED is blinking, it indicates that there is at least one of the parameter out of nominal limits. The LED will stop blinking when all parameters are back within the normal limits. If the LED is lit, but not blinking, it indicates that there is at least one new fault register. Press the FAULT key to turn the LED off..

3.5) SETUP KEY/LED

When this key is first pressed, the display will indicate the SETUP menu and the LED will be lit. Use UP & DOWN arrow keys to read the parameter.

Pressing the SETUP key again, will allow the parameter change depending on the password condition. If changes are allowed, use UP & DOWN keys to change the value, pressing the SETUP key once more to save it.

While you are adjusting the parameter value, the LED will blink, otherwise it will remain lit while the SETUP mode is selected.

This key also works as <ENTER> when in PASSWORD mode.

3.6) CLOCK KEY/LED

When this key is first pressed, the display will indicate the actual date and time. The LED will be lit.

Pressing the CLOCK key again will allow the clock adjustment. Use the UP & DOWN keys to adjust each value and the CLOCK key to continue to the next entry. The LED will blink during the value adjustments. The new date and time will only be updated if you complete the adjustment of all settings. Otherwise, the old date and time will return.

The LED will remain lit while the CLOCK mode is selected.

This key also works as <CANCEL> when in PASSWORD mode.

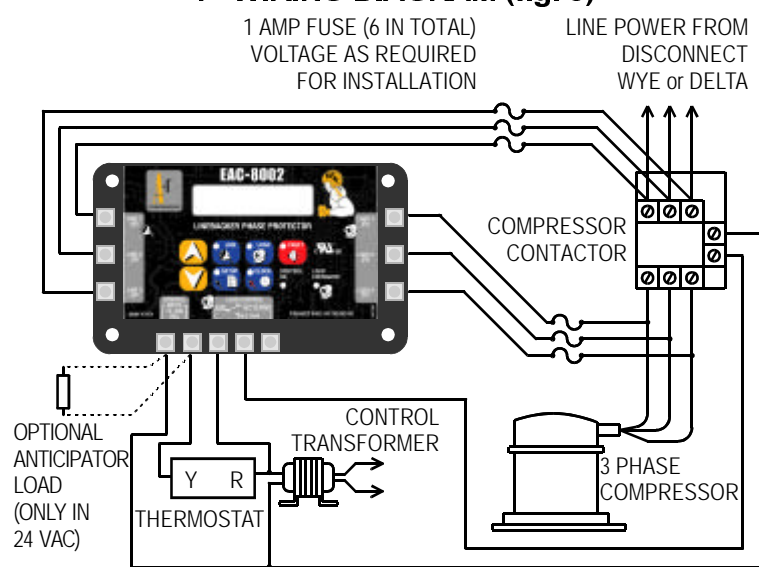
3.7) LCD Display

Indicates the condition of incoming line and load voltages, faults, system parameters, real time clock and user adjustments.

3.8) CONTROL LED

Indicates that there is control voltage present at the control input terminal.

4 - WIRING DIAGRAM (fig. 3)



This circuit shows the EAC-8002 connected to provide voltage monitoring of both line and load sides of the control contactor. A separated "anticipator load" may be required when using a 24VAC thermostat to provide the control voltage.

Note: Install fuses as shown to protect branch circuit wiring and conform to the National Electric Article 430 and local ordinance as required.

Note: Fan and other thermostat wiring not shown to improve clarity.

5 - INSTALLATION INSTRUCTIONS

SAFETY FIRST! ALWAYS DISCONNECT POWER TO THE SYSTEM PRIOR TO MAKING ANY CONNECTIONS. VERIFY THAT ALL POWER FROM BOTH THE CONTROL AND LINE SOURCES ARE LOCKED OUT AND TAGGED!

5.1) Mounting

Select a mounting location for the EAC-8002 in the equipment control cabinet. The location you select should be dry, cool, and allow ample room for the operator to setup or make adjustments to the EAC-8002's controls.

Optimum LCD display viewing will be achieved if you mount the control near eye level and in a cool location.

Use (4) #8 screws to mount the control on a flat surface in the control panel of the equipment being protected. The unit will operate at temperatures up to 80°C (175°F). However, the operation of the LCD display becomes impaired at temperatures above 40°C (104°F).

Remember that heat is the enemy of all electronic circuits and the cooler your equipment, the longer it will last and the better it will perform.

5.2) Electric Connection

Refer to the National Electric Code article 430 or governing local authority or safe wiring practices.

5.3) Connect Power

Refer to Figure 3 for wiring example. Without removing existing line side connections to the contactor, add suitably sized connections to one amp fuses located close to the contactor. These fuses are required by the National Electric Code and provide protection to added field wiring. From the fuses, connect the three phase power to the EAC-8002 line 1, line 2, and line 3 terminals.

5.4) Connect Load Side Monitor

Without removing existing load side connections to the contactor, add suitably sized connections to one amp fuses located close to the contactor load side of the EAC-8002 load 1, load 2, and load 3 terminals.

Ensure that the input power connections and the load side monitor terminals connect to the same phase (respectively). Also ensure that the phase rotation sequence is ABC (L1, L2, L3).

5.6) Connection Control Input and Contactor Coil

Interrupt the connection between the controlling device (thermostat yellow wire) and the contactor coil. Connect the line from the thermostat to the first control input located on the EAC-8002. Connect the line going to the contactor coil to the RUN terminal on the EAC-8002.

Connect the second control input located on the EAC-8002 to the other side of the contactor coil (common line).

Finally, add a wire from the thermostat and control transformer (thermostat red) to the COM connection on the EAC-8002.

If required, connect the optional "anticipator load" to the control input terminals, as shown in figure 3.

5.7) Power Up

There is no ON/OFF switch on the EAC-8002. Connecting power to the unit will activate it. A few seconds after power is applied, the display will read "A-1 Components/ EAC-8002 VER N.N" where N.N is the current software version. After a moment the EAC-8002 will go to LINE mode, and the display will change to "VAB VBC VAC Avg / xxx xxx xxx xxx" where xxx is the voltage of the respective phase to phase pair or the average of all three phases, in volts.

6 - PARAMETERS DESCRIPTION

6.1) Nominal Voltage

Set this value at the incoming line voltage.

6.2) Over Voltage Range (%)

Set to desired over voltage protection of the incoming voltage. This will turn off equipment if incoming voltage exceeds set percentage. The display will show the percentage value and the voltage trip point, related to the nominal voltage parameter.

6.3) Under Voltage Range (%)

Set to desired under voltage protection of the incoming voltage. This will turn off equipment if incoming voltage drops below set percentage. The display will show the percentage value and the voltage trip point, related to the nominal voltage parameter.

Note: Over and Under voltage trip points are compared to the average of the line voltage.

6.4) Phase Unbalance

Set to desired incoming phase unbalance protection. This will turn off equipment if incoming phase unbalance exceeds set percentage.

6.5) Delay On Break

"Delay-on-break" starts when the load relay is de-energized, and the load

will remain on until the specified time has elapsed.

6.6) Delay On Make

"Delay-on-make" starts when the control voltage is reactivated or when power returns to a non fault condition, and the load will remain off until the specified time has elapsed.

6.7) Delay On Fault

"Delay-On-Fault" starts when over voltage, under voltage or phase unbalance faults occur. The fault must be present throughout set time in order to be registered or acted upon.

6.8) Contactor Test

The contactor trial occurs whenever the output relay closes and the load voltage in any phase is below the setting specified by item 6.9. When the programmed number of retries is exceeded, a fault is registered and a manual reset is required, either in auto reset mode or manual reset mode. All retries are also registered into the fault log. This option can be disabled by selecting OFF to the number of retries in SETUP mode.

6.9) Contactor Fault

This parameter determines the maximum allowed voltage drop across the contacts of the load contactor. Whenever this voltage drop exceeds the setting (10 to 50%), EAC-8002 will consider a contactor fail or a contactor retry (refer to item 6.8).

6.10) Reset Mode

Choose Automatic or Manual whether to allow the EAC-8002 to automatically reset or to wait for you to manually reset the unit. To reset from a fault condition in the manual mode, refer to the FAULT operation mode (item 7.3).

6.11) Control Mode

Set this to select the control source. The normal setting is EXTERNAL. With the control set to EXTERNAL the EAC-8002 will respond to the signal connected to the control input. With the control mode set to "ON", the EAC-8002 will turn on the output relay if line parameters are within setup parameters. Setting the control mode to OFF causes the EAC-8002 to ignore the control input and the line condition and keep the output relay off.

6.12) Language

This setting allows you to select the language used to display all messages on the LCD.

6.13) Restore Defaults

Use this option to return all parameters to the factory default settings. Refer to parameters table to the default values (table 7.1).

6.14) Using Password

Set this parameter to YES, if you want to protect the settings with a six numbers password, or set NO for no protection.

7 - OPERATION MODES

7.1) LINE mode

To enter this mode, press the LINE key.

Allows the reading of phase to phase and average voltages of the line inputs. Also, in this mode, the Delay-on-Break (DOB) and Delay-on-Make (DOM) timers are displayed.

If the EAC-8002 is left in any mode other than CLOCK, after 3 minutes of keyboard inactivity, it will switch automatically to LINE mode.

7.2) LOAD mode

To enter this mode, press the LOAD key.

Allows the reading of phase to phase and average voltages of the contactor/load inputs. Also, in this mode, the Delay-on-Break (DOB) and Delay-on-Make (DOM) timers are displayed.

7.3) FAULT Mode

To enter this mode, press the FAULT key once.

Using the UP & DOWN keys, you can choose between recalling the fault registers, executing a Manual Reset or executing an Erase Fault Registers command.

When you enter FAULT mode, you can recall the fault registers (from most recent to the oldest), by pressing the UP key. The EAC-8002 will show all faults in chronological order, followed by date and time when the fault occurred. On the second line, a message will describe the fault. When you see the "No more Faults" message, you have reached the last stored register.

By pressing the DOWN key once after you enter FAULT mode, you will see "Manual Reset". To execute a manual reset action, press the FAULT key again. You will be asked to confirm the command. Use the UP & DOWN keys to make your selection and press the FAULT key to execute.

By pressing the DOWN key twice after you enter FAULT mode, you will see "Erase Fault Regs". To execute this command, press the FAULT key again. You will be asked to confirm the command. Use the UP & DOWN keys to make your

selection and press the FAULT key to execute. If you are using password, you will also be asked to enter it.

Note: Erasing the registers does not perform a Manual Reset, as well as a Manual Reset does not erase the fault registers.

7.4) SETUP mode

Press the SETUP key to enter SETUP mode. Use the UP & DOWN keys to navigate through the parameters.

To change settings, press the SETUP key while the display is showing the parameter you want to change. The display cursor will start blinking. Use the UP & DOWN keys to increase or decrease the parameter value, or to choose among the available options. Press the SETUP key again, to save the new parameter value.

Parameters limits

PARAMETER	MINIMUM	MAXIMUM	DEFAULT	UNIT
Nominal Voltage	190	600	208	Volts
Over Voltage	2	25	10	%
Under Voltage	2	25	10	%
Phase Unbalance	2	20	5	%
Delay on Break	0.1	25	0.5	minutes
Delay on Make	0.1	10	0.1	minutes
Delay on Fault	1	15	2	seconds
Contactor Test	OFF	10	OFF	retries
Contactor Fault	10	50	25	%

PARAMETER	OPTIONS	DEFAULT
Reset Mode	Manual / Auto	Manual
Control Mode	OFF / ON / External	External
Language	English / Spanish / French / Portuguese	English
Restore Defaults	NO / YES	NO
Using Password	NO / YES	NO

Table 7.1

7.5) CLOCK mode

To enter this mode, press the CLOCK key once.

The display will show the current date and time. You will be allowed to adjust these settings, by pressing the CLOCK key again.

If you choose to adjust the clock settings, the display cursor and the LED will start blinking. Use the UP & DOWN keys to increase or decrease the value selected by the cursor. To go to the next setting, press the CLOCK key. The new date and time will only be updated if you complete the adjustment of all settings. Otherwise, the old date and time will return.

7.6) PASSWORD mode

In this mode, the SETUP key has an alternate function of "ENTER PASSWORD" and the CLOCK key has an alternate function of "CANCEL PASSWORD".

The first time you choose YES to the "Using Password" parameter, you will be asked to enter the new password.

In order to enter the password, use the UP & DOWN key to change the number selected by the display cursor.

To move to the next number, press the ENTER PASSWORD (SETUP) key. To correct a wrong entry, press the CANCEL PASSWORD (CLOCK) key.

This procedure is valid when entering a new password, entering the password to change parameters or to erase the fault registers.

Once the password has been entered, it will remain active while you are using the keyboard interface. If the keyboard is inactive for more than 3 minutes, the password will be blocked. If you need to change any parameter, you will be asked to enter it again.

If you are using a password and want to change it, go to the SETUP mode and enter YES to the "Using Password" parameter. You will be asked to enter a new one.

Please, write down your password here: _____.

7.7) CONTRAST adjustment

When in LINE, LOAD or CLOCK modes, use the UP & DOWN keys to adjust the display contrast.

Note: LCD display contrast will vary with changes in ambient temperature, and under extreme temperature conditions the LCD display may be dark or clear. If this occurs simply use the arrow keys as described above to adjust the display to proper visibility. LCD contrast adjustments are stored in the permanent memory and will remain constant once set.

8 - TROUBLE SHOOTING

In the event the EAC-8002 fails to operate properly, check these items first:

Symptom	Display	LEDS	Solution
Load will not energize.		Load LED not lit.	Check Control Input
LED's Blink periodically but unit never comes up.	Occasional flash.	Blinking	Line voltage is too low and/or phasemissing.
Control LED does not go out when control is off.		Control LED always on.	Control input is very sensitive. Insure control voltage <2 for off condition.
System trips out on high or low line voltage.		Fault LED flashes (due to fault).	Check normal line voltage using LINE feature. Re-adjust voltage range as required.

Output Relay never turns on.

Control mode setting is "Off". Press SETUP to get to Control Mode then set to ON or EXTERNAL

9 - OPERATIONAL NOTES

9.1) When a fault is detected on the line, the fault delay timer is activated. At the end of the fault delay time, if the fault persists, the fault is logged into memory and the load relay is deactivated. At this time the delay-on-break timer will be activated and the load will not be reactivated until set time has elapsed. The delay-on-break timer will continue to run even if power is lost.

9.2) When the control voltage is activated, the delay-on-make timer will begin counting down. If the control voltage is interrupted, the delay-on-make timer will restart.

9.3) The phase reversal fault will not delay on fault. A phase reversal fault will be logged immediately and turn off the load.

9.4) The average voltage is calculated as follows: Vavg = (VAB + VBC + VAC) /3.

9.5) The percent of phase unbalance is calculated as follows:

- Take the maximum deviation of each phase from the average voltage as calculated per item 9.4
- Divide the maximum deviation by the average voltage. That result is the percent of phase unbalance.

9.6) Changes made to operational parameters during setup mode are immediately updated, after confirmation by pressing the SETUP key.

9.7) The amount of time between an initial application of power and display illumination varies with the line input voltage. At low input conditions i.e.: 190 volts single phase, the EAC-8002 may take several seconds to start. With 208 volts 3 phase input applied, the typical time is 3 seconds. With 480 volts 3 phase input applied, the typical time is 1 second.

9.8) If the EAC-8002 is either in LINE or LOAD modes, a fault occurrence will flash on the first line of the display, alternating with the voltage reading.

9.9) The EAC-8002 continuously monitors line and load status, even if you are in SETUP, FAULT or CLOCK mode. Should a fault occur, the fault will be registered in the memory, the load will be de-energized, and the fault LED will blink, but the fault will not be displayed until you return to LINE or LOAD mode.

9.10) The backlight is turned on by pressing any key, and will automatically turn off after 3 minutes if no keys are pressed.