

**GENERAL INFORMATION - Pro-LBA™** is a battery monitoring device that provides audible and visual warnings when the batteries have reached excessively low charge levels. Two separate warnings are provided - A LOW BATTERY alarm momentarily sounds every 30 seconds when the batteries reach an excessively low state of charge, and a DEAD BATTERY alarm sounds continuously when the batteries are almost completely dead. A small piezo beeper on the front of the unit provides the audible warnings; a tri-color indicator LED provides the visual warnings.

The unit has several other important features:

**MULTI-VOLTAGE OPERATION** - Allows its use on 12, 24 or 48 volt battery banks. An efficient switching power supply design minimizes current consumption, regardless of battery voltage.

**PROGRAMMABLE SETPOINTS** - The unit is factory-calibrated with a default LOW BATTERY warning voltage ("Vlow") of 1.933 volts per battery cell, and a DEAD BATTERY warning voltage ("Vdead") of 1.75 volts per battery cell. Depending on whether a 12, 24 or 48 volt battery bank is present, these values will correspond to bank voltages of:

|                            | 12 Volt Battery Bank: | 24 Volt Battery Bank: | 48 Volt Battery Bank: |
|----------------------------|-----------------------|-----------------------|-----------------------|
| <b>LOW BATTERY Alarm:</b>  | 11.6 Volts            | 23.2 Volts            | 46.4 Volts            |
| <b>DEAD BATTERY Alarm:</b> | 10.5 Volts            | 21.0 Volts            | 42.0 Volts            |

However, the user can override these defaults to program in another **Vlow** and/or **Vdead** value. This is accomplished by pressing and holding either the **Set Vlow** or **Set Vdead** buttons whenever the desired low or dead battery voltages are present. The original factory-calibrated settings can be restored at any time, simply by pressing and holding the **Set Vlow** or **Set Vdead** buttons for more than 5 seconds. All settings are stored in non-volatile RAM, and are retained indefinitely - even if the unit is disconnected from DC power.

Once either a LOW BATTERY or DEAD BATTERY warning is sounding, it will continue to sound until the battery voltage increases 0.033 volts per cell above its respective setpoint - For example, if the LOW BATTERY alarm setpoint is 11.6 volts on a 12 volt battery bank, the alarm will continue to sound until the battery voltage recovers to around 11.8 volts.

**External Alarm/Relay Output** - In addition to the piezo beeper alarm on the unit, provision is also included for connecting an external DEAD BATTERY alarm or disconnect relay, which operates whenever the battery's state of charge falls below the DEAD BATTERY setpoint. This output is factory-configured for "active low" operation (e.g., is grounded when the DEAD BATTERY alarm sounds), but can be user-reconfigured to be "active high" instead (e.g., is grounded at all times except when the DEAD BATTERY alarm is sounding).

**BATTERY DISCONNECTED WARNING** - This feature provides an audible warning if the voltage sensing connection between the batteries and the unit fails.

**AUDIBLE ALARM SILENCE Button** - Pressing this button while an alarm is sounding disables the piezo beeper alarm, leaving the tri-color LED as the only indication of the alarm. This function is automatically canceled as soon as the battery voltage recovers enough to turn off both alarms.

(NOTE: Refer to the OPERATING INSTRUCTIONS section for additional information.)



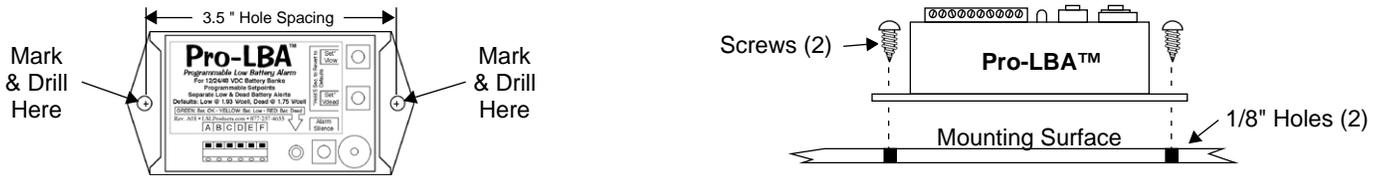
### CAUTION - BEFORE PROCEEDING WITH INSTALLATION:

USE CARE WHEN WORKING AROUND BATTERIES — SPARKS CAN IGNITE EXPLOSIVE GAS. SHORT CIRCUITS CAN CAUSE BURNS OR FIRE. CORROSIVE ACID CAN CAUSE SKIN BURNS OR BLINDNESS. EXPOSED CONNECTIONS CAN CAUSE SHOCK OR ELECTROCUTION.

# MECHANICAL INSTALLATION INSTRUCTIONS

Identify an appropriate mounting location for the unit. **It should NOT be installed inside the battery compartment.** Particular consideration should be given to locating the unit where (1.) it can be easily accessed for adjusting settings or viewing status, and (2.) its built-in beeper can be easily heard in living quarters. **NOTE:** The unit provides best accuracy when it is mounted in a relatively dry, temperate location.

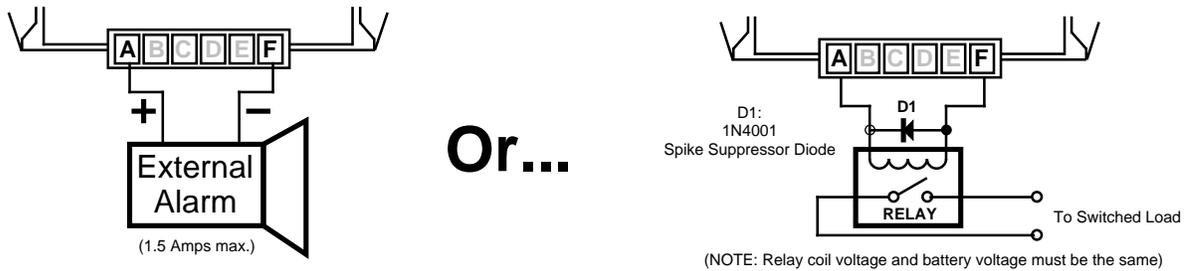
Next, use the unit as a template to mark the location of the two holes in the unit's mounting exterior, use a 1/8" drill bit to drill these holes in your mounting surface (taking care not to drill into any wires on the other side of the surface), and secure the unit:



# ELECTRICAL INSTALLATION INSTRUCTIONS

**STEP 1 (optional):** If used, connect an external alarm or load disconnect relay to terminals **A** and **F**. Note that the operating voltage of your alarm or disconnect relay coil must be the same as the nominal voltage of your battery bank.

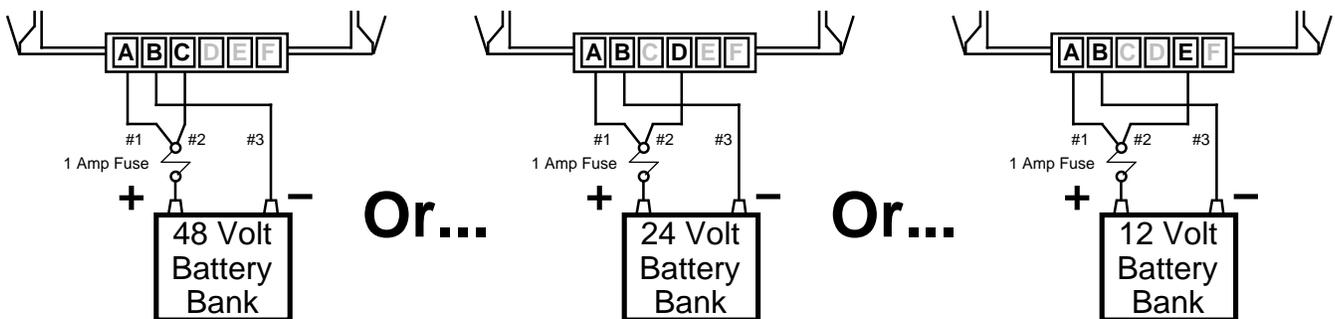
**NOTE:** If using a relay, also connect a diode (1N4001 or similar) across terminals A and F as shown, in order to protect the Pro-LBA unit from voltage spikes produced whenever the relay coil is switched off.



**STEP 2:** Run 3 wires (wires #1 to #3, as shown below) from the Pro-LBA unit to your battery bank, **BUT MAKE NO CONNECTIONS TO THE BATTERIES YET**. Connect these wires to the terminal block on the Pro-LBA unit, as shown below - Be sure to use Terminal **C** for a 48 volt battery bank, or Terminal **D** for a 24 volt battery bank, or Terminal **E** for a 12 volt battery bank.

Next, connect wire #1 and #2 through a fuse holder to the positive terminal on your battery bank, temporarily leaving the fuse out of the holder. Next, connect wire #3 to the negative battery terminal. Finally, install a 1 amp fuse in the fuseholder to power the unit up. The unit will beep several times in quick succession to confirm power-up.

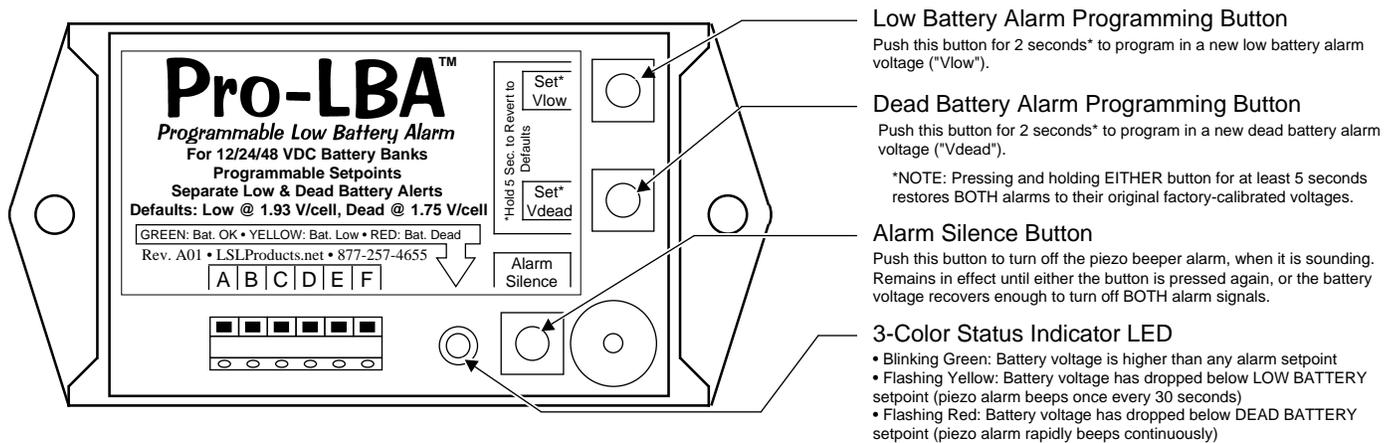
**NOTE:** The unit **MUST** have 2 separate positive wires connected to the battery bank. This technique is used in order to provide a separate voltage-sensing connection to the battery which is unaffected of any voltage drops in the Power + wire. Failure to use this technique may result in inaccurate or erratic alarm operation.



**CAUTION: Dangerous battery voltages may be present!**

This completes the installation procedure. Refer to the **OPERATING INSTRUCTIONS** for info on set-up and normal use.

# OPERATING INSTRUCTIONS



**TO PROGRAM A NEW LOW OR DEAD BATTERY ALARM VOLTAGE:** Press and hold either the **Set Vlow** or **Set Vdead** buttons for approx. 2 seconds as soon as your new desired low or dead battery voltage is reached. Upon releasing the button, if the new voltage has been accepted, the green indicator LED will illuminate and the piezo beeper will sound 3 short beeps followed by one longer beep (Morse code for the letter **V**, signifying that programming was "**V**ictorious"). The other alarm setting will remain unchanged from its previous value. (The **Set Vlow** and **Set Vdead** buttons must be pressed for at least 2 seconds, or no changes will occur. This feature is designed to avoid changing the settings by accidentally bumping the buttons.)

**NOTE:** The unit will not accept a new programmed **Vlow** voltage that is lower than the current **Vdead** value, and will not accept a new programmed **Vdead** voltage that is higher than the current **Vlow** value. If a new programmed value is rejected, the red indicator LED will illuminate, the piezo beeper will sound 8 short beeps (Morse code for "error"), and the old value will still remain in effect.

The turn-off voltages for both alarms are approx. 1/30th of a volt (0.0333 volts) per cell above their respective turn-on voltages - For example, if the **LOW BATTERY** alarm is programmed to turn on at 11.6 volts for a 12 volt battery bank, it will turn off when the battery voltage rises approximately 0.2 volts above that setpoint (i.e., at 11.8 volts):

$$(0.0333 \text{ volts/cell}) \times (6 \text{ cells in a 12 volt system}) = 0.2 \text{ volts}$$
$$11.6 \text{ volts alarm turn-on} + 0.2 \text{ volts} = \mathbf{11.8 \text{ volts alarm turn-off}}$$

**TO RESTORE THE UNIT TO FACTORY DEFAULT Vlow AND Vdead SETTINGS:** Press and hold either the **Set Vlow** or **Set Vdead** button for at least 5 seconds. After you release the button, the green indicator LED will illuminate and the piezo beeper will sound one long beep followed by two shorter ones (Morse code for the letter **D**, signifying that the unit has reverted to the **D**efault settings for both **Vlow** and **Vdead**). The previous user settings are discarded.

**TO SILENCE THE PIEZO BEEPER ALARM:** Briefly press the ALARM SILENCE button to turn off the warnings for both alarms. Both alarms will remain silenced until the button is pressed again, or until the battery voltage recovers enough to turn off BOTH alarms. This function can only be activated while an alarm is sounding, and does not affect the operation of the **EXTERNAL ALARM** connection (Pin F).

**RE-CONFIGURING THE EXTERNAL ALARM CONNECTION (PIN F):** As factory-configured, the External Alarm Connection is an open circuit until the **Dead Battery** alarm sounds, at which point it is grounded (with respect to Pin B). The connection then remains grounded until the battery voltage recovers enough to turn off both alarms.

However, the polarity of this connection can be user-reconfigured so that it is always grounded EXCEPT when the Dead Battery Alarm sounds: To do this, simultaneously press and hold the **SET Vlow** and **Set Vdead** buttons while connecting the unit to DC power. Repeating this process restores the polarity to its original state.

## IN CASE OF TROUBLE

### WHY WON'T THE UNIT ACCEPT MY NEW SETTING?

The voltage setting you are attempting to program may be invalid with respect to the other setting - i.e., you may be attempting to program a voltage for **Vlow** which is lower than the current voltage setpoint for **Vdead**, or vice-versa. The unit beeps five times while illuminating the red LED when this is occurring. To avoid it, try programming the other setting to its new value first.

### WHY ARE MY USER-PROGRAMMED SETTINGS ERRATIC OR UNPREDICTABLE?

The **Vlow** setting may be too close to the **Vdead** setting. Try increasing the difference between the two settings - i.e., set your desired **Vlow** voltage, and then set the **Vdead** voltage a little lower than it was before. Also, make sure that the battery voltage sense terminals (C, D and E) on the unit are connected to the batteries via their own dedicated + wire. Finally, make sure that the 1 amp fuse holder connected to the + post of your batteries is not introducing an excessive voltage drop (i.e., more than 20 mV).

**WHY IS THE UNIT REPEATEDLY BEEPING THREE TIMES IN QUICK SUCCESSION?** This BATTERY DISCONNECTED alarm (Morse code for the letter **S**) indicates that the unit is not "**S**ensing" any significant voltage at any of the Battery Sense + Terminals (Terminal C, D, or E). Check for a disconnected wire or poor connection between these terminals and your batteries.

## SPECIFICATIONS

**Absolute Min. / Max. Supply Voltage** (at Terminal A): +8.0 / +78.0 VDC

**Nominal Battery Voltage:** (measured with respect to Terminal B)

12 volt / 6 cell battery bank (Terminal E): +9 to 16 VDC

24 volt / 12 cell battery bank (Terminal D): +18 to 32 VDC

48 volt / 24 cell battery bank (Terminal C): +36 to 64 VDC

**Idle Current Consumption:** (at Terminal A)

**Vbat = 12.8 VDC:** 0.75 mA typ.    **Vbat = 25.6 VDC:** 0.4 mA typ.    **Vbat = 51.2 VDC:** 0.2 mA typ.

**Default LOW BATTERY / DEAD BATTERY Alarm Voltages:** 1.933 / 1.75 Volts Per Cell  $\pm$  1%

**Vlow, Vdead Setpoint Voltage Stability:**  $\pm$  1% typ.

**Vlow, Vdead Setpoint Voltage Range:** 0 to 2.65 volts per cell in 1024 increments

(Note: Vlow must be a higher value than Vdead)

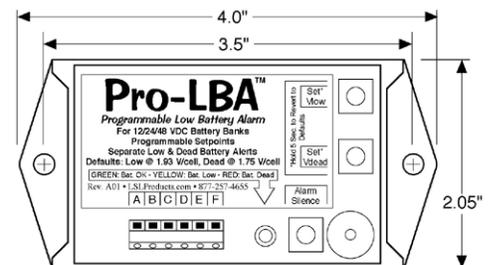
**BATTERY SENSE WIRE DISCONNECTED Alarm Turn-On Voltage:** 0.2 Volts Per Cell typ.

**External Alarm Max. Voltage & Sink Current** (at Terminal F): 20 VDC, 1500 mA

(When activated, an internal low-side MOSFET switch grounds this terminal)

#### Notes:

1. Unless otherwise stated, all voltages are POSITIVE with respect to Ground (Terminal B).
2. Specifications tested at 72 °F.
3. All specifications subject to change without notice.



## WARRANTY

LSL Products warrants this unit against defects in materials and workmanship for a period of **ONE YEAR** from the date of purchase. LSL Products will, at its option, repair or replace any defective components, at no charge to the owner. Please (1.) save your receipt as proof of warranty coverage, and (2.) contact us prior to returning the unit.

This warranty does not cover damage due to improper installation or unreasonable use of the product. In no event shall LSL Products nor any of its representatives be responsible for incidental or consequential damages. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.