BATTERY MONITOR & LOW VOLTAGE CUTOUT

Model: SM93

Instruction Manual - Release: 2

GENERAL DESCRIPTION

The SM93 unit is a microprocessor controlled battery voltage monitor and battery discharge protector. It will give a relative indication of battery levels in high current electric vehicles such as forklifts, warehouse tugs and scissor lifts. When a battery pack is connected to an electric vehicle, the unit determines the battery type, (12, 24, 36, 48 volts) it then indicates the relative state-of-charge of the battery with a single digit 0 to 9 on an LED display.

The SM93 unit also features auxiliary electrical contacts that can be wired in series with the control circuit of a selected contactor, it can disable critical functions, such as 'lift control' when the battery voltage falls to a level that may damage the pack. The unit provides the operator with an audible and visual warning before selected vehicle functions are disabled.

SM93 OPERATION

Powering Up

When a battery pack is first connected to a vehicle, the display will briefly flash a minus '**-**' sign and beep once, followed by the battery type, **12**, **24**, **36** or **48** as confirmation of the nominal voltage of the battery. A few seconds later the display will be in its normal 'active' state.

If the battery is flat when first powered up, a one minute **'lockout'** mode will be invoked before proceeding to the 'active' state. (refer to the section on **Lockout Mode** for more details)

Should the display briefly show an '**E**' after powering up, it indicates an error condition in the wiring, usually this would mean that the Signal wire has been disconnected from the battery or the wire loop is missing from between the **Red** and **Yellow** wires on the terminal block. After an '**E**' is displayed, the unit goes into its normal **'Lockout'** mode where the vehicle will be disabled via the control relay and an '**L**' is shown on the display.

Normal Displays

Digit '**9**' represents a high charge state.
Digit '**1**' (flashing slowly) warns of a low charge state.
Digit '**0**' (flashing slowly) warns of a very low charge state.
Digit '**F**' (flashing slowly) Shutdown timer could trip within 20 secs.
Digit '**F**' (flashing rapidly) 4 min. Shutdown timer is counting.
Digit '**F**' (on steady) Shutdown is in progress (latched).

While in its normal 'active' state, the display will show a value relative to the state of charge of the battery: Should the operator continue to use the vehicle beyond the '**0**' low charge warning, the battery pack performance could be permanently degraded. To protect battery integrity, a vehicle shutdown event may be triggered.

The display will show a slow flashing '**F**' for 'Flat battery'. If the display enters the '**F**' level for more than **20 consecutive seconds**, the warning beeper will briefly sound, and a four minute countdown timer will start. During this time the '**F**' will flash rapidly. At the end of the four minute period, the '**F**' will glow steady and a contact inside the SM93 unit will operate, disabling vehicle facilities. Typically, an electric forklift would have its 'lift' facility disabled, allowing the vehicle to return to a service area for a recharge,

Once triggered, the SM93 unit will remain latched in the shutdown state regardless of changes to the battery voltage. It can only be reset by disconnecting and reconnecting the battery pack on the vehicle.

Lockout Mode

If the battery is flat when first connected to the vehicle, the unit will identify the battery type as happens with a normal startup. An '**L**' is then displayed, and it immediately proceeds to a 'Lockout mode' for one minute. (This would occur if an operator was trying to cheat a vehicle shutdown by briefly disconnecting and reconnecting the battery)

In a '**Lockout mode'** the vehicle is disabled in the same manner as a normal shutdown, except that one minute later it resumes to its normal active state where the battery level is displayed.
Should the battery still be flat, an '**F**' will be shown and four minutes later another Shutdown will occur.

The purpose of the lockout mode is to inconvenience operators who continue to use the vehicle with a battery in a discharged state, while still making it possible for the vehicle to dispense with a load and return safely to a charging station.

Auxiliary Contact

The normally open/normally closed contacts within the SM93 unit operate during both **Shutdown** and **Lockout** modes. Typically the coil of a contactor controlling 'lift' or other critical function should be wired between the **NC** and **COM** terminals so that normal operation occurs with the contact in its *released* state.

Voltage Display Table

The unit measures the voltage on the **Signal** wire and compares it to the values in the following table. The result is then shown on the display.

SM93 Display Values (approx.)

Display	F	0	1	2	3	4	5	6	7	8	9
48V batt	44.5	44.6	45.2	45.6	46.0	46.4	46.8	47.3	48.0	49.0	50.4
36V batt	33.2	33.5	33.9	34.4	34.7	35.1	35.5	36.0	36.8	37.6	38.8
24V batt	20.2	20.5	20.9	21.3	21.7	22.1	22.5	23.1	23.8	24.9	26.1
12V batt	9.9	10.1	10.3	10.5	10.7	11.0	11.4	11.8	12.2	13.1	14.2

Should the voltages in column '**9**' be exceeded by a small amount, as may happen if a battery charger is connected while the display is on, the letter '**H**' for '**High**' may appear. This display will not affect the operation of the unit.

INSTALLATION

Mounting the module

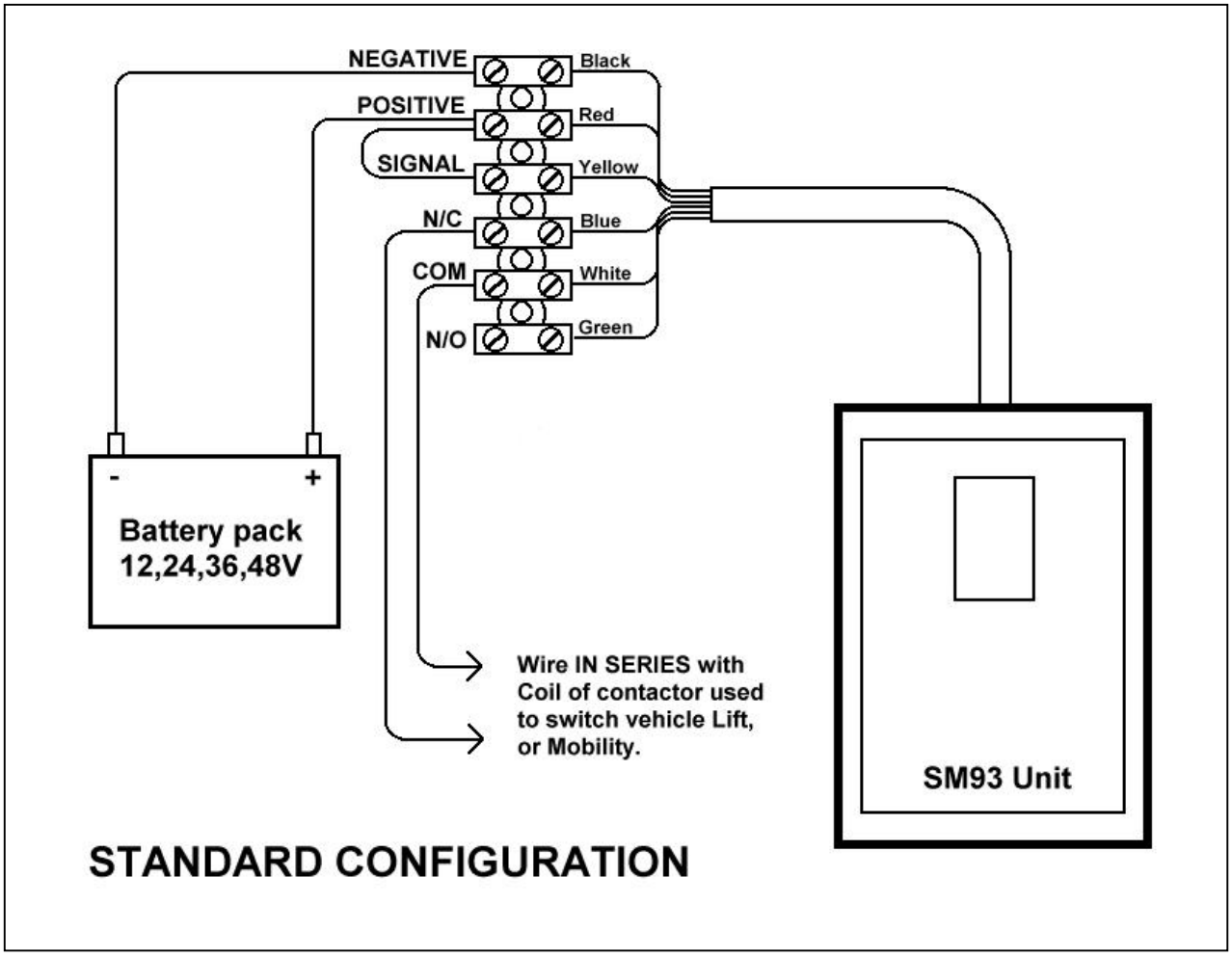
The unit may be mounted either 'unseen' in a motor control compartment, or on a dashboard/operator console for the vehicle operator to view. Generally, the latter option is preferred as the operator can use the display as a guide to battery condition.

The unit is mounted with a simple self adhesive Velcro patch. This provides ample support for the display. It has the added advantage of protecting the enclosure against breakage in the event of side impacts. An enclosure screwed rigidly down will break if hit hard enough, whereas the Velcro patch permits easy remounting if disturbed.

Wiring Configurations

The unit is supplied with two metres of 6 core cable, which terminates on a screw terminal block. Most units will be installed using **Wiring Diagram #1** where the terminal block would be located within two metres of the battery to be monitored. Note that the **Signal** wire must be looped to the **Positive** terminal at the block.

WIRING DIAGRAM #1

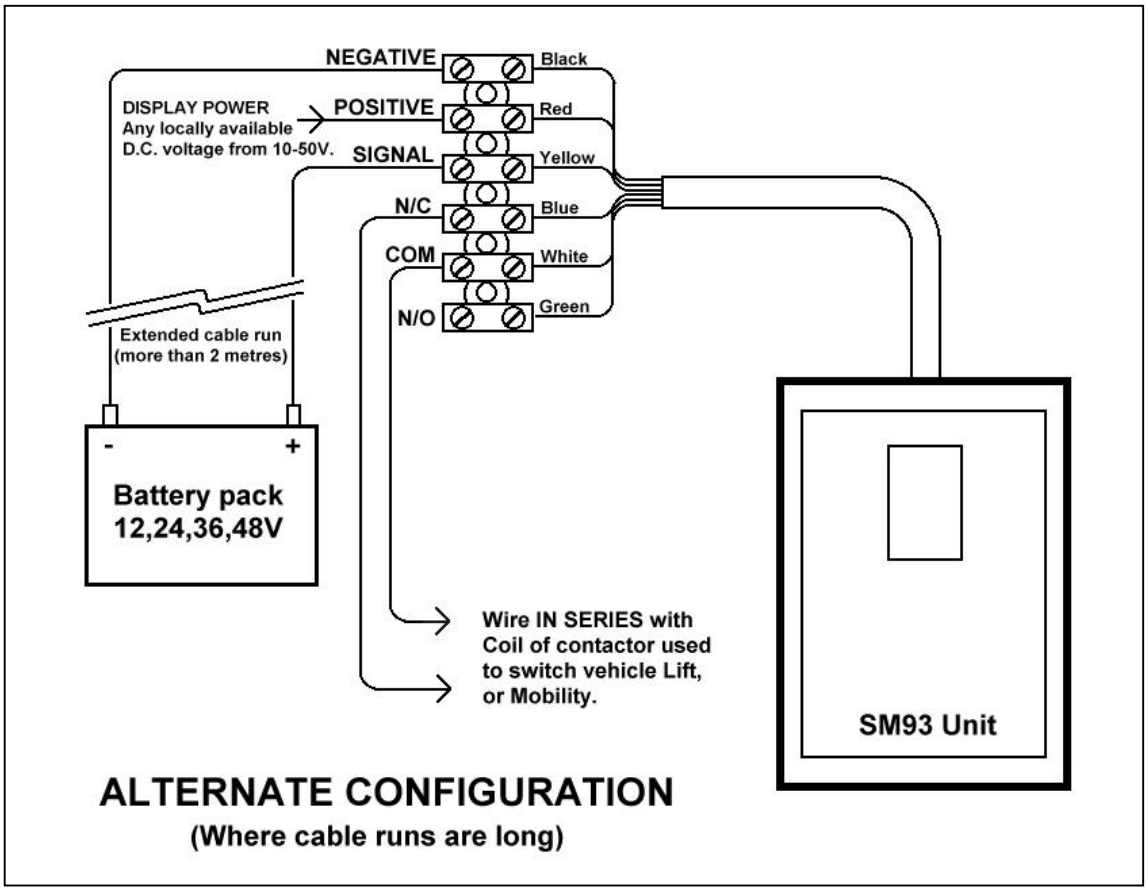


It is important that the **Positive** and **Negative** wires go *directly* to the battery. If the unit were to be wired simply to the nearest positive point in the dash or console, then voltage drops in the vehicle wiring loom could give artificially low voltage readings to the display when the wiring loom or vehicle is under load.

WIRING DIAGRAM #2 (for cable runs greater than 2 metres)

The alternative wiring diagram (shown below) should be used. where the display unit must be mounted some distance from the battery. (as may occur with the console in an electric crane or scissor lift)

If the 6 core SM93 cable is extended wire-for-wire with additional 6 core cable, **Wiring Diagram #1** can be used for cable runs of up to 10 metres.



The Signal wire must be connected directly to the battery and the **Positive** wire can come from any nearby D.C. source ranging from **10V** to **50V** to power the display electronics. Where a local supply is unavailable, this **Positive** wire may be wired back to the battery on a separate conductor.

If the vehicle has a 'Negative Earth' the **Negative** wire may connect to the vehicle chassis where convenient.

ADJUSTING THE VOLTAGE THRESHOLDS

The above table represents the optimum voltage thresholds for typical lead-acid batteries. Should a battery pack with slightly different characteristics be used, an internal trimmer resistor can be adjusted to vary the above table up or down by approximately five percent

To access this trimmer, a small phillips screwdriver may be inserted through the velcro patch on the rear of the unit and rotated to split the cover into two halves. On the circuit board inside a small block-shaped trimmer resistor may be adjusted up or down with a flat bladed screwdriver. This is a precision 25 turn trimmer, factory preset to around the mid rotation point.

IMPORTANT

Varying this trimmer will affect the all threshold levels including the shutdown modes. Adjustments should be carried out by staff familiar in handling electronic equipment.

SPECIFICATIONS

- Supply voltage (absolute maximum) **55V**
- Supply voltage (absolute minimum) **7.5V**
- Supply current (typical) **45ma.**
- Reverse polarity protected? **Yes**
- Auxiliary contact (maximum current) **1A**

WARRANTY INFORMATION

The SM93 unit is warranted against defects for twelve months from the date of purchase.

The warranty is void if the unit is exposed to water or connected to a system that exceeds the maximum working voltage.

This warranty covers the repair or replacement of the SM93 unit only. It does not include courier fees or delivery costs associated with a return of the product.

No liability is provided or assumed for damage to customer equipment, tools or produce as a result of installation and usage of this device.