

# TS90-EV2 LITHIUM BATTERY BALANCING SYSTEM DATASHEET

The TS90 Battery management system is designed for Lithium Iron Phosphate cells of capacity 10-180Ah. The cells may be connected in series to make a battery of any voltage.

The system has two components, cell balancer modules and a master control unit (MCU).

The cell modules bolt directly on top of each cell and perform the cell balancing function during charging.

The MCU has simple relay outputs to control a load or alarm and a relay to control the charger.



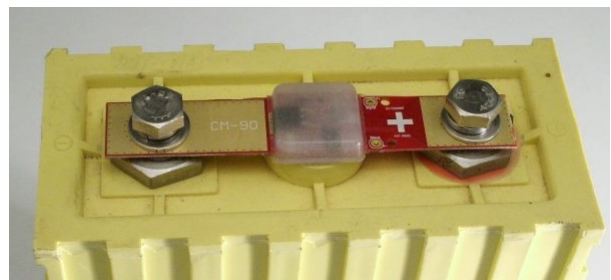
Any charger may be used that has a suitable peak voltage and charge curve for Lithium Ion batteries. The MCU can control either the charger AC supply or DC output.

## Features

- Modular - one small balancing module bolts directly to each cell.
- Simple - A one wire interface is all that is required. No birds nest.
- Scalable - Battery balancing from one cell up to almost any number.
- Fail Safe - a unique safety interlock system prevents any cell from going over/under voltage.
- Flexible - the master control unit can work with almost any charger.
- Cost Effective - low cost per cell for large format Lithium Ion batteries.

## Principle of Operation

During charging the cell voltage of LiFePO<sub>4</sub> batteries will stay relatively constant at 3.2-3.4V until near the end of charge. At this point the voltage begins to rise rapidly and if no limits are applied it will rise past 4.2V and cause permanent cell damage. The battery charger will normally limit the voltage applied to the whole battery but cannot regulate the voltage of each cell. Normally the maximum cell voltage for full charge should not exceed 3.65V. The cell modules act as regulators on each cell by bypassing some of the charge current as they reach their fully charged voltage. In this manner the battery will always be balanced if it is fully charged regularly.



On discharge the cell voltage will stay relatively constant at 3.2V until near 100% depth of discharge. Under heavy loads it may sag lower than this but will always return to 3.2V while the cell still has some capacity. The cell modules monitor the voltage of each cell. If any cell falls below 2.5V for more than 2 seconds the MCU will sound an alarm and can deactivate the load to reduce danger of damage. As soon as the voltage is back in the safe range the alarm will cease.

The TS90 MCU has two sets of LED outputs to indicate the state of the battery and of the charger.

No battery fuel gauge or temperature measurement functions are incorporated and there are no

digital or analog outputs available to interface with external devices. The TBS E-Xpert Pro battery fuel gauge is recommended for this purpose.

In combination with a suitable charger the TS90 will provide automated charging of Lithium Iron Phosphate batteries. Failure safety is integral to its design and it will protect the battery from damage under most circumstances.

Cell modules can be used in standalone mode with outputs daisy chained together to interface with electronic control equipment. Output is NC when cell voltages are within safe limits and NO when outside these limits. Automatic cell balancing will still occur when the charge voltage reaches 3.63V/ cell. Most SLA chargers are suitable for use with LFP cells. EV Power also has a range of suitable charger.

Using a Battery Monitor with the TS90 can provide a complete battery management system for Electric Vehicles with user feedback of battery fuel levels.

### ***Master Control Unit Specifications***

Supply Voltage            35-350VDC (HV model), 12-36VDC (LV model)

Supply Power            3.5W max. @ 144VDC

MCU weight:            1.5kg

Size:                    170 x 120 x 55mm

Charger Relay (Relay is closed when system is OK and the Reset button has been pressed)

    Contacts            NO/COM

    Max Voltage:    250VAC / 24VDC

    Max Current:    20A

Load/Alarm Relay (Relay is active/closed when the system is OK)

    Contacts:        NO/NC/COM

    Max Voltage:    30VDC

    Max Current:    10A

# TS90 BATTERY MANAGEMENT SYSTEM CONNECTIONS

