

BATTERY CELL BALANCING CONSIDERATIONS WITHIN EMERGENCY LED DRIVER SYSTEMS

Many emergency LED driver manufacturers use battery cell-balancing electronics to improve the battery life and reliability of their emergency driver systems. By using advanced battery chemistries like Lithium Iron Phosphate (LiFePo4) and alternative strategies for balancing battery cells, Hatch has developed emergency LED driver systems that do not require cell balancing, thus reducing the complexity of the onboard battery charging systems while maintaining long-life and high performance.

The individual cell voltage for a single cell used in Hatch emergency drivers is approximately 3.7V. For a nominal target output voltage of 14.8V, this requires a series combination of 4 cells. Unfortunately, not all cells are identical and many have slightly different output voltages and charging capacities. Unbalanced cell voltages and capacities can cause stress on individual cells, compromising long-term reliability. This stress can be produced both during charge and discharge cycles. During charging, batteries with lower capacity can be subject to overcharging resulting in local heating which in turn decreases cell life. During discharge the same cells can be subject to reverse polarity voltages during deep discharge, potentially resulting in cell failure. These issues must be considered in any battery system that uses multiple battery cells.

The issue of cell balancing can be addressed in a number of ways. The first method is to utilize cell-balancing electronics in the emergency driver system design. These are electronics that monitor and control the charge/discharge of each individual cell. Basically, cell balancing technology limits the charge and discharge that a weak sister cell would be exposed to in the series string of cells. The addition of this technology adds both complexity and cost to the overall emergency driver design.

At Hatch, we have taken an alternative approach to solving the cell-balancing issue without the use of cell-balancing electronics. We first did a detailed analysis of the application and system requirements

for the emergency driver itself. For an emergency driver system that complies with California Title 20 standby power requirements, battery charging systems must have extremely low overall standby charging current. In the field, the National Fire Protection Agency requires emergency egress lighting systems to be tested in two ways:

- Monthly, for 30 seconds
- Annually, for 90 minutes

This means that under normal use conditions the battery system in an emergency driver is only exposed to extended discharge cycles once a year, with the exception of true power-loss conditions. Further, emergency driver charging systems do not need to have high-current charging capabilities, since the full-charge requirement is 24 hours after full cell depletion. This means that a properly designed charging system will never subject the cells to high-current overcharging. By engineering the drivers to meet these requirements, we have greatly minimized the risk of asymmetrically charging and discharging individual cells, thus eliminating the need for expensive additional cell balancing electronics.

To further minimize the risk of individual cell over-stress, we practice cell 'binning' during the manufacturing process in which we test and sort cells based on voltage and capacity. Using properly matched cells in the series string greatly reduces the probability that an individual cell will experience a deep discharge before others in the string such that it will be subject to reverse polarity.

In summation, Hatch emergency drivers that use LiFePO4 battery technology have advanced charging systems that limit the charge current such that cell heating does not occur. The battery packs consist of cells that have been factory-sorted by the battery factory to properly match the individual cells by capacity and voltage. Finally, Hatch conducts extensive deep cycle testing on



sample product to ensure that all Hatch emergency drivers and their battery systems meet or exceed all lifetime and reliability requirements.

