

Lithium Ion Battery Energy Storage Systems Using 18650 Cells

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Background

Small cylindrical Li-ion cells (18650 cells) provide unmatched levels of energy density, specific energy, packaging flexibility, production quality, and safety. Several first-tier manufacturers now offer 18650 cells at or above 220 Wh/kg at cell prices below \$280/kWh. The high production volume of these cells is projected to result in ongoing improvements in performance and cost-effectiveness.

EV Grid develops and manufactures custom battery systems designed around commercially available 18650 cells. A typical system includes battery modules, battery management system, power connections including fusing and disconnects as required, thermal management, and the system enclosure. In addition, the battery and BMS are integrated with the power conversion system(s) required for the specific application.

EV Grid's li-ion battery experience dates back to 2003 when li ion batteries were first being developed for electric vehicles. Since then, the li ion cells, the BMS, and the assembly techniques have all advanced significantly. In addition to EV batteries, EV Grid develops energy storage systems for stationary applications such as UPS, PV buffering, load management, and grid support.

For these applications, the li ion battery offers significant size, weight, and energy capacity advantages over conventional lead-acid systems.

	EV Grid 77P2S x2	Group 31 RV Battery
Nominal Voltage	14.4	12.0
Ah Capacity	223	100
Wh Capacity (energy)	3216	1200
Length (in.)	10.8	12.9
Width (in.)	5.8	6.8
Height (in.)	9.6	9.2
Weight (lb.)	38	75
Volume (gal.)	2.6	3.5

EV Grid Li Ion Module Design

- Individual cells are connected in parallel to form blocks. The more cells in parallel, the greater the Ah capacity.
- The cells in each block are connected together using current collectors that attach to each cell terminal and connect all the cells in one block in parallel. This makes the assembly of small cells electrically equivalent to a large cell.
- One or more blocks of cells are assembled in a fixed orientation using proprietary designs that create a rigid structure around the cells. The blocks of cells are connected in series. The higher the series count, the higher the voltage.
- Each block of cells is connected to a monitor. The monitor measures temperature and voltage of every block and reports the data to the battery management control system.
- A rigid plastic housing encloses the module. The housing provides (+) and (-) terminals, mounting points, connections for the monitor, and provides for air flow for thermal management.
- The cell specification, the number and arrangement of cells in each block, and the number of blocks connected in series in each module determine the module specification. By varying any or all of these factors, modules can be readily tailored to specific applications.

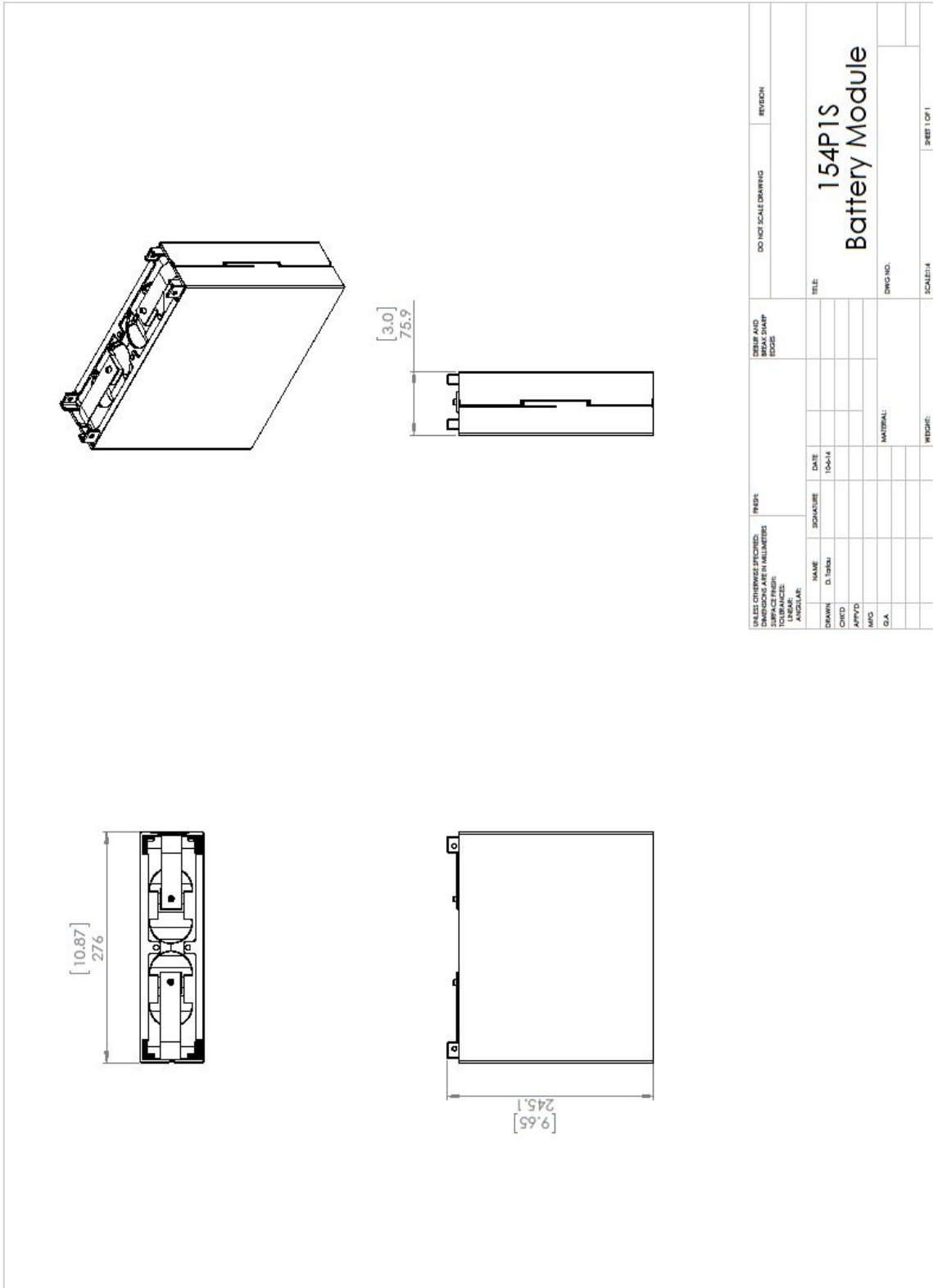
As specified below, EV Grid has engineered three configurations of li ion module from a single module housing. Each configuration serves different storage and packaging requirements, and each can be assembled using a variety of different 18650 cells to match the battery performance to the application.

EV Grid Module Specifications

	154P-1S	77P-2S	36P-4S
Cell			
Manufacturer (others available)	Samsung	Samsung	Samsung
Chemistry	NCA	NCA	NCA
Nominal Voltage	3.6	3.6	3.6
Capacity (Ah)	2.9	2.9	2.9
Energy (Wh)	10.4	10.4	10.4
Module			
Number of parallel cells per block	154	77	36
Cell blocks in series	1	2	4
Nominal Voltage	3.6	7.2	14.4
Capacity (Ah)	447	223	104
Energy (Wh)	1608	1608	1503
Dimensions (in.)	10.8 x 2.9 x 9.6	10.8 x 2.9 x 9.6	10.8 x 3.0 x 9.6
Weight (lbs)	19	19	18



Figure 1, 154P2S module assembly



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