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Battery Management System : The key to Electric Vehicle adoption

For the long-term scenario, indigenously developed advanced BMSs will enable large-scale EV manufacturing in India and safe operation of EV fleets. Under the Make in India initiative, in-house manufacturing capability of LIBs along with BMS will help in reducing the total cost of Evs.

The Government of India set an ambitious target of 6-7 million electric vehicles (EVs) by the end of 2020 under the National Electric Mobility Mission (NEMM) Plan2013. This is an effort towards ensuring EV manufacturing leadership and national fuel security. Successful adoption of Evs will require high-performance batteries (high energy and power density with long cycle life) and an advanced Battery Management System (BMS). BMS, an electronic system, protects a battery from over-charging/over-dischargingwhich ensures the safe operation of Evs. In the context of a fast growing EV market in India, it is important to develop a comprehensive and mature BMS programme. Awareness about BMS operation will enable smooth EV adoption and safe driving conditions. Further, for the indigenisation of EV manufacturing in India, it is important for stakeholders and consumers to know about global BMS suppliers.

The latest research and development trends indicate that the next generation of high-energy lithium-ion battery (LIB) systems will soon be available for electric transportation. However, high costs and low awareness, especially related to the safety features and drive range provided by EV batteries, are considered to be the key barriers in EV adoption. Among allthe components of Evs, the battery packs which include a battery and BMS, alone account for 40% of the total cost of a vehicle. Currently, Indian EV manufacturers like Ashok Leyland and Mahindra and Mahindra depend on imported LIBs and BMS, which result in high costs.

BMSs are widely used in portable electronics, such as laptops, computers and mobile phones, but these BMS variants do not qualify for EV application. The number of cells required for an EV's battery pack is quite large, as compared to that required in portable electronics. Therefore, the BMS of an EV needs to be designed in such a manner that it can monitor the data generated by each cell present in the battery pack.

The basic functions of a BMS include:

(a) Signalling the state of the health which includes safety, usage, performance and longevity of the battery;
(b) Identifying the fault of any individual cell and control it within the battery pack;
(c) Alerting the user under any unusual condition such as over-voltage or overheating; and
(d) Monitoring the system temperature for better power consumption management.

Current BMSs have limited data cataloguing functions to update the state of charge. The data cataloguing function classifies each data generated by the BMS. Moreover, it has limitations in terms of estimating the state of health and remainder life span, which are required for scheduling battery replacement. State-of-the-art BMSs have

the ability to measure most of the important characteristics of a battery pack (voltage, current and temperature). However, the estimation of some characteristics like voltage fluctuations and capacity fading by a BMS need to be more accurate. Further research on BMS can definitely overcome the drawbacks and improve its performance for an enhanced EV experience by the consumer, leading to increased EV penetration in Indian markets.

As per the Global and China Power Battery Management System Industry Report, 2016-2020, the market size of BMSs would reach USD 7.25 billion by 2022 from the USD 1.98 billion mark as reported in 2015. This is estimated at a compound annual growth rate of 20.5%. North America held the largest share of the BMS market in 2015, followed by Europe, Asia Pacific and the rest of the world.

Aiming for large-scale EV deployment in India by 2030 under NEMM, Indian EV manufacturers can import different components of EV along with the BMS. In addition, global EV manufacturers can set-up their integrated plant operations in India in the longer term. Most electric bus manufacturers develop their own BMSs. For instance BYD, Youtong, Proterra and EBUSCO make "intelligent BMS" for electric buses. On the other hand, Wuzhoulong Motors outsource BMS manufacturing to the largest lithium iron phosphate battery manufacturer company, Optimum Nano. In India, KPIT Technologies introduced the first smart electric bus in 2015, aligned with the government's Make in India initiative. KPIT also develops BMSs in-house. Ashok Leyland introduced electric buses in India in 2016 with batteries and BMSs imported from France.

There is a need to conduct detailed feasibility analyses of the short-term options for indigenous EV manufacturing with imported batteries and BMSs. For the long-term scenario, indigenously developed advanced BMSs will enable large-scale EV manufacturing in India and safe operation of EV fleets. An advanced BMS can be developed in India through carefully structured R&D.Under the Make in India initiative, in-house manufacturing capability of LIBs along with BMS will help in reducing the total cost of EVs.