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Design of Battery Management System for Li- Particle Battery

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Abstract: Battery Management Systems (BMS) is a vital piece of electric vehicles and the hybrid electric vehicles. precision of these systems has consistently been a state of conversation as they for the most part give a mistake of greatest 10% considering all the parameters together. The BMS plays out the assignments by incorporating at least one of the capacities, for example, examining the voltages of battery cell and the temperatures in battery module, testing the voltages of the battery, inspecting the current of the battery, just as cells adjusting and finding state of charges .In this paper we are discussing about the cell voltages, battery temperatures, battery voltages, and battery currents. sampling of cell voltages, temperatures, cell balance can done with the use of the special type of the Integrated Circuit (IC). This special IC settle the issues of inspecting cell voltages in Li-ion battery, that have several cells. This paper also determines the parameter of the battery.

I. INTRODUCTION

In view of the expanded enthusiasm for electric vehicles and hybrid electric vehicle, battery Management System (BMS) has become the main parts in vehicles. Because of its high energy and power density, no-memory impact, low itself-release and large cycle life, li- particle battery have comes into individuals' consideration increasingly much as often as possible. This paper present late researches ends on dynamically li-particle battery management systems.

In electric vehicle, utilization of li-particle battery had been very unpredictable, representing very huge necessity on management systems .As numerous cell exist in the unique li-particle battery, as a rule up to 100 cell, it's hard to mind the cell voltages .Determination of state of charges had been consistently a significant part in battery management examine, whereas the essential for complete exact determination of soc is exact count on battery charge integrations. The main focuses area right now: ①For reducing the battery management cost, bms can gather battery signal parameter that meets arranged accuracy prerequisites in serious condition. The sign parameter involve: cell voltages, battery temperatures, battery voltages, battery current and current integrations. Similar researches on the several methods in finding current integrations: fundamental control units software mix strategy and 1-Phase Multi-function Meter Integrated circuit Chip strategy and attempt for persuade per users 1-Phase Multi-function Meter Integrated Circuit chip strategy give an increasingly exact and exact outcome through point by point analyze information.

II. MEASUREMENT OF SIGNALS

A. DIAGRAM OF battery MANAGEMENT SYSTEM:

Comprised of CAN part, Direct current/Direct Current part, battery currents determination part, battery voltages estimation part, temperatures estimation part, cell voltages estimation part, cell balance part, information flash Memory part and principle control part. CAN part are utilized for correspondence with different controller? Direct Current/Direct Current part are utilized for change the twelve volts source into five-volt power output. So as for get better the dismissal of disturber, the DirectCurrent/DirectCurrent part is a disengaged source. The battery currents estimation part is utilized for measure charges and discharges currents of battery. The battery voltages estimation part is utilized for determination voltages of every cell in arrangement. Temperatures estimation part are utilized for review surfaces everything being equal. Information flash memory part is utilized for capacity information of estimation. Estimation information can be saved as long as 1 months. Every part referenced might be spoken by primary controller, which be able to deal with all part works accurately.

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Structure of BMS is presented in Fig.1.BMS mostly is

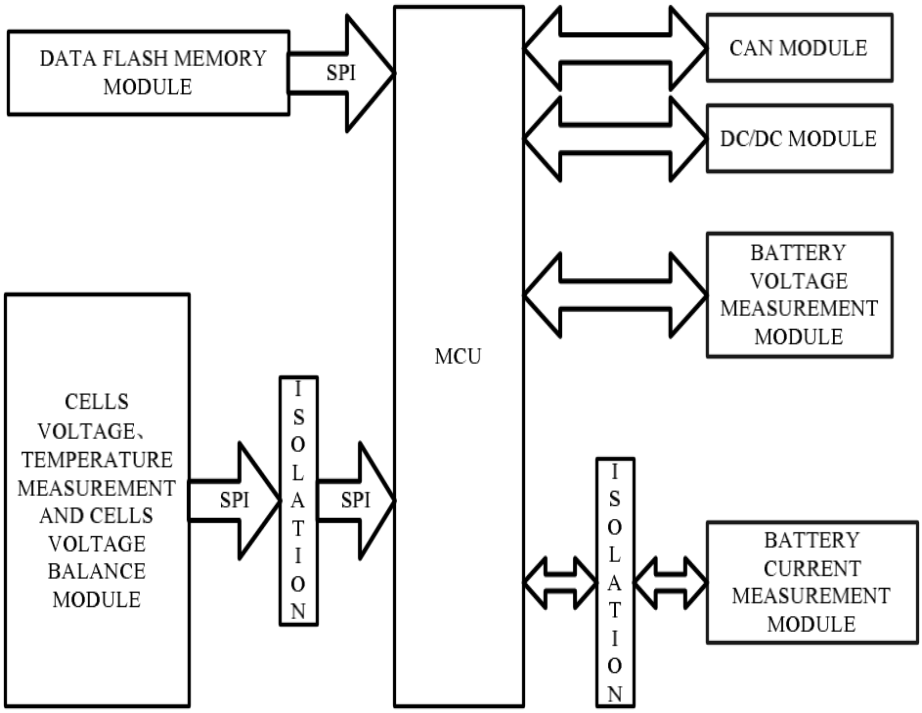

Fig.1. Structure of BMS

B. Determination of Cell Voltages, Battery Temperatures, Cell Balance

i.Determination of cell voltages

Estimation of cell voltages a significant, troublesome element of li-particle BMS. The trouble some spot is: the manner by which to gauge every cell voltage in arrangement battery, also these cell voltages ought to be highlighted the equivalent reference Ground, so battery voltages signals examples might be simpler to gather. since various cell inside the Li-particle battery, generally up to 100, the complete voltages arrangement of battery unit be able to arrive at four hundred twenty volt (Li-particle cell secure voltages go is 2.9V~4.8V). Along these lines, below elevated voltages grades, it's difficult to lead exact estimation upon cell voltages by utilizing typical determination technique. The majority apply technique utilized be guide exchanging polls technique by the use of photovoltaic switch. Through guide exchanging, various cell voltages be able to be contribution toward the systems all opportunity to finish the estimation. In any case, this strategy is a long way from an ideal estimation: ①The wide utilization of photovoltaic switch enormously rise the systems costs. ②since the utilization of gnd-float exchanging skill, reference Ground changes oftentimes, that decrease the estimation accuracy. ③inside request for raising the inspecting accuracy, cell voltages exchanging can't exist excessively quick, that make a lengthy pooling cycle. Guide exchanging poll technique can't exist utilized into system by an excess of cell, as that might incredibly build the poll cycles and impacts cell voltages estimation exactness.

Anyway the improvement of Integrated Ckt innovation empower a improved way toward determine obtainable troubles.

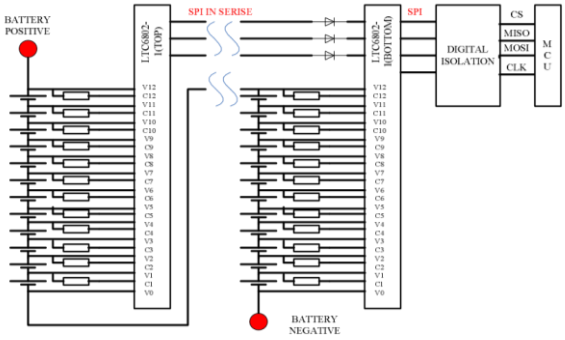

Fig.2. Cells Voltage Measurement

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Cell voltages estimation draft chart be displayed in the Fig.2. since Ic 0~11V are contribution to twelve cell voltages estimation. V-12 on peak of Ic into daisy tie are associated with +ve intensity of battery, zero volt in the base Integrated Ckt is interface with -ve power of battery. extended arrangement of cell battery voltages are estimated by the Ltc6802-1 that is arranged superimposed however straight utilization of diodes. Base Ic, by means of computerized disconnection, is conveyed to Mcu throughout SPI interfaces. As per test results, the cell estimation blunder is around 0.6%. Estimating li-particle cell voltages by means of utilizing explicit Integrated Ckt settle the current weaknesses of photovoltaic switch poll strategy, decreasing operating expense and raise estimation accuracy.

ii.determination of battery temperatures

Huge measure of caloricty would be created during the time spent unique Li-particle battery charges and discharges. since elevated temperatures taking place outside of li-particle battery would bring about security issues, the temperatures estimation are the majority significant.The battery ought to exist chilled when it's in elevated surface temperatures. Something else, battery caloricty originates from it's power. Exact estimation of battery outside temperatures are required so as to compute battery SOC. the majority well known estimation strategy apply is use of Integrated ckt temperatures sensors, advanced and simulant type, for example, Tmp36 and Ds18b20. Tmp36 are simulant types temperatures sensors. Its deficiency is with minor yield recreated voltages signals, it's handily offended below enormous current charge and discharge.DS18B20 is an advanced sort temperatures sensor. Its deficiency is with low exactness, which is effectively to be upset under huge currents charges and discharges.Ltc6802-1 have two thermistors contributions in addition to onchip temperatures sensors. The heating resistances technique is utilized in system so as to improves the dismissal of disturber thus increasing estimation accuracy. As Ltc6802-1 have low temperatures estimating channel, the utilization of heating resistances technique can incredibly diminish cost, with less difficult orderly structure.

iii.Cell balance

li-particle battery systems have a hugh pre requisite on cell voltages balancing. For some cell that have low limit than the other cell, their State Of Charge will bit by bit stray over different charge and discharge cycles. On the off chance that the SOC of every cell isn't intermittently adjusted, or adjusted, a few cells will in the long run be overcharged or overdischarged, prompting harm, and in the long run total battery pile disappointment. MOS tube, which has incorporated in Ltc6802-1 are utilized for controlling power resistances from acknowledge adjusting of high-voltages cell, introduced in Fig.2. Weakness of that sort of ckt adjusting is losses of battery energies, as focal points of the technique are: basic arrangement, simple toward acknowledge, ease and superb applications impact.

C. determination of battery voltages and battery currents

a) Estimation of battery voltages

Estimation of battery voltages is to be done by including cell voltages estimation result or free estimation ckt. Right now, estimation ckt is applied. As all out voltages of 100 cell can reach as high as four hundred fourty volt, it's effectively to be upset with no segregation structure for the systems. Right now voltages is partitioned by exact resistance and afterward contribution to Analog to digital transformers under 1/1 enhancing throughout straight opto-couplers. As the voltages scope of li-particle battery is between 330V-440V, it's just expected that gives linear output for opto-couplers inside the wrath that are effectively to go after in straight opto-couplers. The systems apply direct opto-couplers disconnection strategy, which gave by basic and feasible ckt and minimal effort. It settles the upset issue below high voltages, just as it has hugh accuracy meet organized prerequisite.

b) Estimation of battery currents

battery currents estimation is additionally a significant element in li-particle Battery Management System. Here 2 types of technique of estimating of battery current: use of accuracy resistances and use of hall sensors. The deficiency of utilizing accuracy resistances in estimation include: definite separation ckt is intended to complete disconnection after high currents estimation, staying away as of upsets from it, along these lines make the systems increasingly intricate and raise the plan trouble. Accuracy resistances estimation strategy have an increasingly exact outcome with Hugh currents, while current under ten ampere, it exactness might be decreased. Thus the system apply Hall sensor strategy. Separation circuit isn't utilized in hall sensors strategy, which might disentangle the organized plan. Hall sensor have generally large accuracy in estimating little currents, settling the weaknesses of small exactness and effectively to-be upset in estimating low currents in resistances estimation technique. In down to practical's utilization, thus we find the linear inside the entire limit isn't large, which might enormously impact the estimation exactness, in this manner the segmented regulations technique is used here. At a point when the rating is under 22 ampere, a progression of manage coefficient is apply. At the point when rating is above 22 Ampere, the different arrangement of managed coefficient is applied. This sort of segmented regulations technique settles the small linearity under broad wrath that increases great impact in reasonable estimation.

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III. BATTERY PARAMETERS

1. STATE OF CHARGE (SOC)

SOC is defined as a proportion of measure of charges despite everything that left inside the battery as for suitable battery limit.

It's typically represented in percentage.

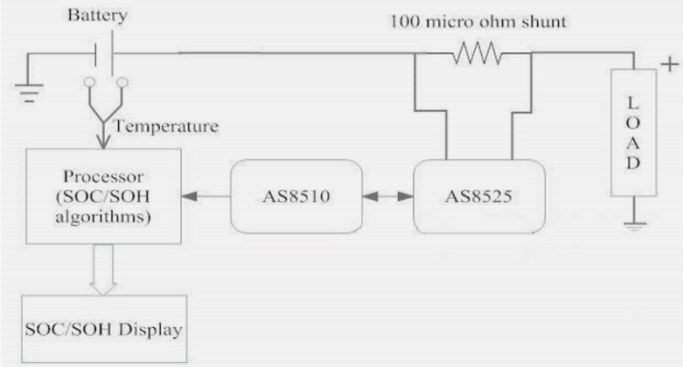

Diagram of test-seat

It gives a sign to the user wrt the charges left inside battery.

SOC = nominal charge capacity left *100

2. Measuring of state of charge

The essential techniques for computing state of charge are: estimating voltages, specific gravity or inner impedance and counting coulombs. These strategies rely upon estimating levels that change as the battery is charged or discharged.

In the voltages strategy, the higher the voltages, the more full the battery is. A high voltages shows that the energy in the battery is under a great deal of weight and, consequently, that the battery is full. A lower voltages shows lower pressure because of over a bundance space inside the battery. Estimating SOC with voltages is straight forward, however it can create off base outcomes as temperatures and cell materials influence the voltages. So as to deliver a precise perusing with the voltages strategy, batteries should initially rest in an open circuit state for four hours at any rate yet most battery makers prescribe letting it rest for 24 hours. Subsequently, the voltages strategy is inadmissible for estimating batteries that are effectively and consistently being utilized.

Utilizing specific gravity to decide SOC includes utilizing a hydrometer to quantify the general density of fluids dependent on lightness. The hydrometer tracks changes in the heaviness of dynamic synthetic concoctions inside the battery as it discharges. As a battery is utilized, the measure of sulfuric corrosive - a functioning electrolyte - diminishes, accordingly proportionately reducing the specific gravity of the battery. Some cutting edge lead corrosive batteries fuse electronic sensors, rather than utilizing hydrometers, which produce ongoing readings of specific gravity estimations and give a genuinely exact state of charge. A significant downside to utilizing specific gravity estimations to decide SOC is that the technique must be utilized with lead corrosive batteries as it won't be compelling with other battery sciences. Since the dynamic synthetic substances inside the battery change arrangement while changing over starting with one structure then onto the next during the charging and releasing procedures, at that point inner impedance can be utilized to quantify state of charge.

Estimating inside impedance implies estimating the measure of resistance exhibited by a circuit to a current at whatever point voltages is applied. This strategy is certifiably not a typical decision for deciding SOC on the grounds that impedance is temperatures ward and it is hard to quantify with dynamic cells. At long last, coulomb counting can be utilized to decide state of charge by estimating the present streaming all through the battery. Ampere-second (As) is the unit of estimation utilized for both charging and releasing. Some electronic gadgets fuse a modest coulomb counter that quantifies the current utilized by the host gadget, includes it up after some time and afterward thinks about this measurement to the modified battery limit so as to decide the SOC. In any case, this technique doesn't consider the proficiency of the battery and it is costly and elusive precise current estimations.

3. Temperatures effect on SOC

battery's presentation additionally relies upon the temperatures of the battery, inside just as outside (encompassing). battery's State Of Charge follow an immediate relationships with temperatures of the battery. Expanding temperatures likewise builds the limit of the battery however at the cost of life of the battery while diminishing the temperatures diminishes the limit. These component need to be considered whereas thinking about the State of charge assurance. Compensation factor at different estimations of temperatures are appeared . Compensation factors at specific temperatures is duplicated with suitable limit, C to acquire altered limit. When adjusted limit is determined, it can supplant the suitable limit in the SOC detailing clarified previously.

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4. Time of battery

battery lifre depends upon the manner in which it is utilize. The common existence of a Li-particle battery is 11-22 year yet the normal life is five year. That is because of the exponential reliance of the life on the temperatures of the battery. The battery's de-rating cofficient on age is shown as 2 ((t-25)/10) , showing the battery endures longest on 250C. Henceforth at temperatures at 350C the life of the battery is 1/2 as at 250C. This cofficient is imperative to discover the existence staying in the wake of being utilized at different temperatures profiles.

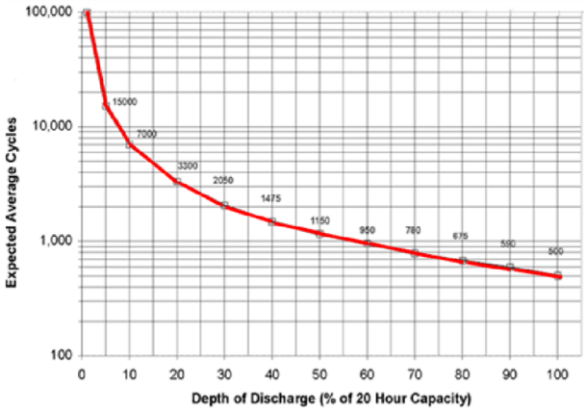
5. Strength of discharging

strength of discharging is the limit to which the battery has been used. For instance, on the off chance that SOC = 10%, at that point dod = 85%. It's most significant factor which decides the battery's age-cycle. age-cycle is defined as the total charging/discharging cycle that the battery experiences. It follow a –ve exponential relation with dod of the battery as appeared. Strategy to figure the normal age cycle follow the system of weight normal, with weight detail from bend. as the EV are exposed to dod of hundred percent, this no. is fix as a kind of perspective. From the battery producer's information, hundred percent profundity of discharge bolsters a limit of three hundred fifty charging/discharging cycle. The arrangement to quantify the age-patterns of the battery has to record the arrangement of occurrences for example number of charging cycle and the comparing intensity of discharge when the battery was charging.

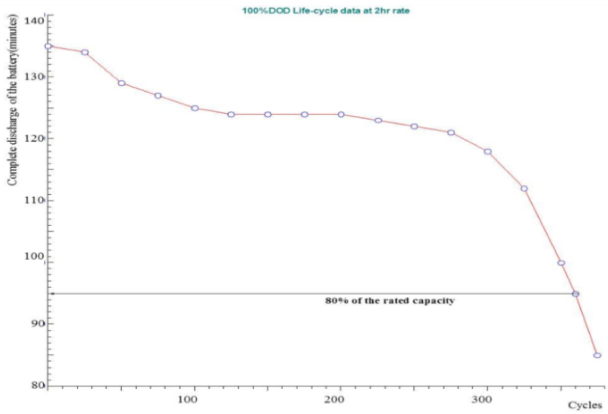
Temperature	Correction Factor
25 °F	1.520
30 °F	1.430
35 °F	1.350
40 °F	1.300
45 °F	1.250
50 °F	1.190
55 °F	1.150
60 °F	1.100
65 °F	1.080
66 °F	1.072
67 °F	1.064

Temperature	Correction Factor
68 °F	1.056
69 °F	1.048
70 °F	1.040
71 °F	1.034
72 °F	1.029
73 °F	1.023
74 °F	1.017
75 °F	1.011
76 °F	1.006
77 °F	1.000

Temperature Correction factor



age-cycles dependency on dod



dod Life cycles Data at 2hours Rate

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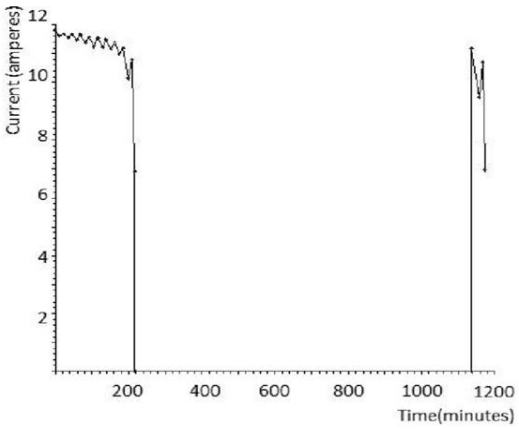
IV. CONCLUSION

Because of its more powerful density and mechanical power, li-particle battery has increased extra consideration in EV researches and creation. This paper focus on estimation of cell voltages, battery temperatures, battery voltages and battery currents just as figuring of the present reconciliation. It presents a technique that utilizes specific Integraed Ckt to find li-particle battery cell voltages, battery temperatures and cell adjusting, which was progressively basic and viable, cost-economy and increasingly exact.

The battery was discharging through an arrangement comprising of 5 40/40 W bulb with everyone is associated with its own free button. That is the heap which was in arrangement with arrangement referenced before. In this manner an adaptability of draw 3.45Amphere – 29.5Ampere of currents was given. The battery is discharging at a pace of 12.5Ampere. According to inborn trait of Li-molecule battery, the present reductions continually yet gradually as appeared in figure5.The present profile appeared here is a rough form of the genuine information and a great deal of varieties have been watched. Yet, the bend indicated is a decent agent of the real information. The load is turned off following a range of 16 minute for a time of 11 minute for battery to settle. Additionally, the soc has tumbled down to seven percent and the voltages tumbled to 5.23 V. The off period is satisfactory for the battery to settle, raise its open ckt voltages to 12.1V. The battery was additionally discharge until it was totally depleted.



Currents outline

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