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BMS Evaluation insights on EVAL-L9963E-MCU for New Gen EVs and Hybrid Vehicles

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Abstract - *The goal is to give an understanding into the Battery Management System (BMS) board from ST Microelectronics. The board utilized in this audit is EVAL-L9963E-MCU, which is for the assessment of the IC L9963E. This IC is an auto IC that can permit up to 48V or for a lower voltage. The IC has 14 channels for voltage detecting, one committed for current detecting, and four for temperature in simple contribution, notwithstanding that the board has a temperature sensor to detect the PCB temperature. The board contains a MCU installed chip pre-stacked with GUI, which can be utilized as a STSW-L9963E PC GUI. The target of utilizing this board is to run an electric vehicle with better BMS that gives a decent power out and gives the cells a long-life cycle. This paper contains a definite outline of the board and its working with the GUI. It additionally has a correlation with different BMS board accessible on the open market.*

Key Words: Battery Management System (BMS), Evaluation (EVAL), Microcontroller Unit (MCU), International Standard Organization (ISO), L9963E (BMS IC), Battery pack (cells)

1.INTRODUCTION

Arising advancements have incredible help from DC power sources, which makes the framework work more proficiently, these DC assets are not difficult to store and furthermore simple to utilize. While utilizing of DC source we could not quantify it or we at any point can foresee its ability to get it going the specialists thought of a DC source the board framework or battery the executive's framework [1]. Utilizing this we cannot just make out the cell's ability and passing of current each hour yet additionally we can bring the subtleties of cell adjusting and charging and releasing of a phone. With this, we can achieve the overall exhibition of the battery and its life cycle. To get this going analysts think of various thoughts and ideas for building battery the board frameworks. The idea incorporates various parts of BMS testing, parts, capacities, activity, design, and security of BMS.

Notwithstanding those ongoing norms and codes are investigated as well. The report further gives a structure to fostering another norm on BMS, particularly on BMS wellbeing and functional gamble [check]. Taking everything into account, four principal areas of (1) BMS development, (2) Operation Parameters, (3) BMS Integration, and (4) Installation for development of BMS wellbeing and execution are distinguished, and nitty gritty suggestions were accommodated every region [2].

1.1 Hardware Specification

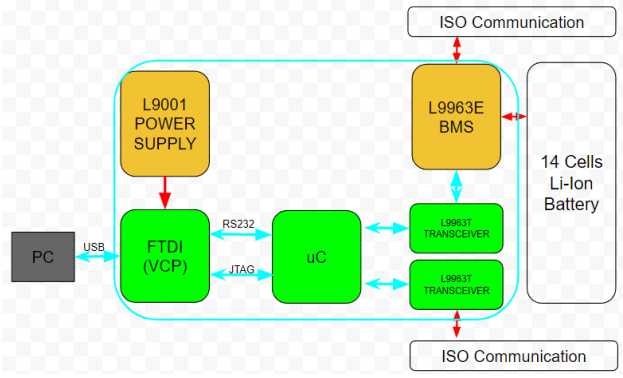

Fig-1.1 Block Daigram EVAL-L9963E-MCU

The EVAL-L9963E-MCU board gives most extreme adaptability, giving admittance to all pins to work on the assessment [3].

Table-1.1 Major Components

Name	Description
L9963E	Used for automobiles battery management applications
L9963T	Automobiles SPI to isolated SPI transceiver
L9001	Multi voltage regulator to power up the IC
SPC574S64E3	32-bit power Microcontroller Unit.

The parts referenced above are utilized in this BMS board to figure the estimations and to give us a total exact worth irrelevant of the number of the cells. The Table 1.1 major components are the pillars of the BMS Board.

1.2 Board Specifications

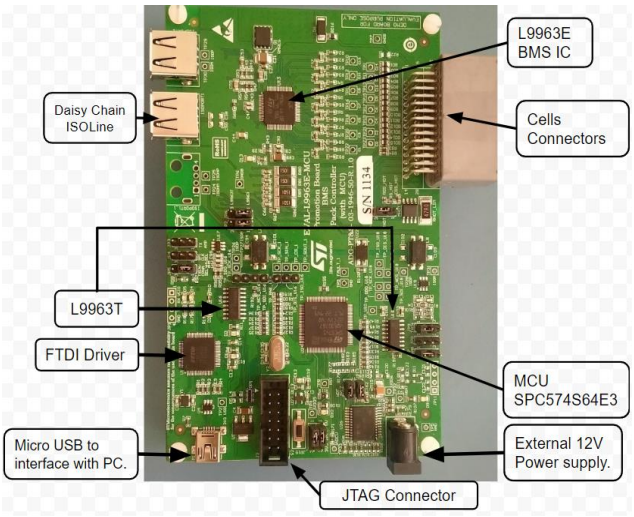

Fig-1.2.1 Major Components placing onboard

The above Fig 1.2 highlights the major component which is placed on the BMS board. The Micro USB is interfaced to measure the cell voltage and the other factors. Whereas JTAG is used to flash the code to the MCU present on the board, the 12V external supply is used to give the board power during low power situation.

The board has some jumper settings that is needs to be taken care of:

Table-1.2 Default Jumper setting

Name	Description	Type
JP 2	L9963T (U16) ISO-Output	2-3 ISO-Redirected to L9963E
JP 3	L9963T (U16) TX Amplitude	1-2 High Amplitude/High Threshold
JP 6	L9963T (U16) ISO+ Output	2-3 ISO-Redirected to L9963E
JP 7	L9963T (U18) TX amplitude	1-2 High Amplitude/ High Threshold
JP 12	L9001 (U26) Watchdog Disable	Connected: watchdog disabled
JP 13	L9001 (U26) Wake Signal	Connected: L9001 enabled
JP 14	3.3V-5V Voltage Selector	1-2: 5V
JP 14	5V Selector	1-2: 5V from L9001
JHot	Hot plug Voltage Selector	1-2 VTREF

The table 1.2 above shows the jumper pins that must be connected and check for the board hardware settings to get the desired measurements.

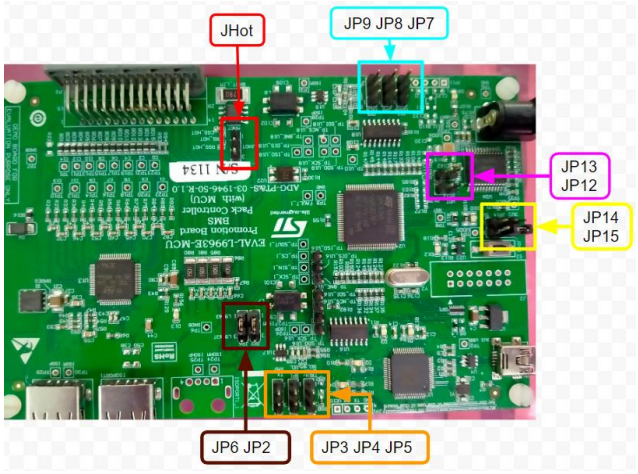

Fig-1.2.2 Jumper Select pins.

Refering to the Fig-1.2.2 we can mark that JHot is to help to endure the hotplug by restricting the inrush current approaching from any L9963E pin associated with the centralized clamp. JP3, JP4, JP5, JP7, JP8, and JP9 are the pins which is connected to L9963T for signal transmission. JP12 and JP13 are watchdog which is disable as we are not using programming and L9001 is enable to give board VCC or power supply. JP14 and JP15 are the voltage selector, last JP6 and JP2 are the output ISO- and ISO+.

1.3 Software Specifications

To run the application STSW-L9963E-GUI we need few external software which are:

Table-1.3 Software to be installed.

Name	Version
NI LabVIEW-Runtime	2014
NI VISA-RUNTIME	5.4
FTDI Driver	CDM212364
STSW-L9963 GUI	1.0.0

The mentioned software is required to be installed to run the test on the cells and calculate the necessary values for the better optimization of the system. Also, to get a optimize cell voltages and aging factor.

2. GUI Setup

Once the mentioned software is installed and GUI must be set up. The GUI setup is as follows:

Table-2.1 Steps to setup the GUI.

Step 1: Select the I/O COM port
Step 2: Get the Firmware version of the board
Step 3: Check on the Configure IDs by putting '1' in the ID assignment box.
Step 4: After these checks, check on the Dev ID and select 'ID'
Step 5: Check with Save Configuration
Step 6: Check on the Diagnostic Checkbox.

As the setup is done the GUI will showcase you the basic values and start show the temperature of the cells. This will give us over all voltage and about cell discharging.

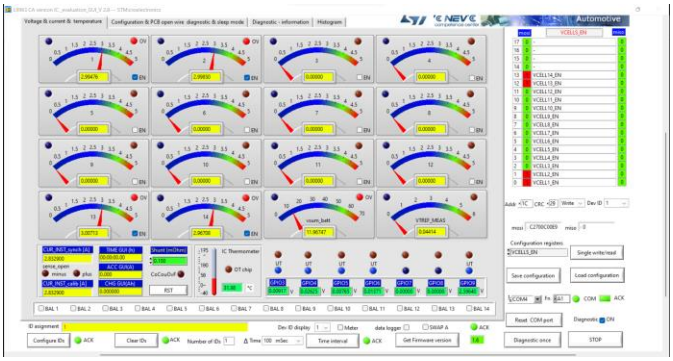

Fig-2.1 GUI after setup.

3. IC L9963E

The L9963E is intended for operation in both hybrids (HE) and full electric (FE) vehicles using lithium battery packs. A single device can capture from 4 up to 14 cells. Several devices can be stacked in an arrangement to screen up to 31 battery packs for a total of 434 series cells. It additionally includes two interior bandgaps that are continually checked by inward hardware to censure estimation accuracy. The microcontroller can likewise screen the accuracy of the bandgap by perusing the transformation of an inside created voltage reference (VTREF).

L9963E fundamental movement comprises checking cells and battery pack status through stack voltage estimation, cell voltage estimation, temperature estimation, and coulomb counting. Estimation and indicative undertakings can be executed either on request or intermittently, with a programmable cycle stretch. Estimation information is accessible for an outside microcontroller to perform charge adjusting and figure the State of Health (SOH) and State of Charge (SOC).

The outside microcontroller can speak with L9963E through SPI convention, contingent upon the situation with one pin at the startup (SPIEN pin). The actual layer can be either a traditional 4-wire based SPI or a 2-wire, transformer/ capacitive based, confined interface through a committed detached handset gadget. L9963E, as a matter of fact, can be utilized as a handset, going about as a scaffold between the two actual layers. Because of numerous L9963E in an upward direction showed, each L9963E speaks with the others through an upward confined interface. The microcontroller can either address a solitary gadget of the chain or send broadcast orders.

The stack voltage is observed for OV/UV by three equal and autonomous frameworks. They have been designed to safeguard the IC against AMR infringement, recognize any overvoltage occasion according to LV 148, and give the likelihood to manage the OV/UV levels as indicated by the application and the complete number of cells. Additionally, all inner voltage controllers are furnished with UV/OV hardware, which is likewise self-approved upon disappointment recognition by means of HWSC.

Basic disappointment modes will set off the declaration of a committed FAULT line (carried out by means of two GPIOs), proliferating through the L9963E chain by means of outside optocouplers and coming to the microcontroller. L9963E can ensure the FAULT line respectability by means of a heartbeat schedule.

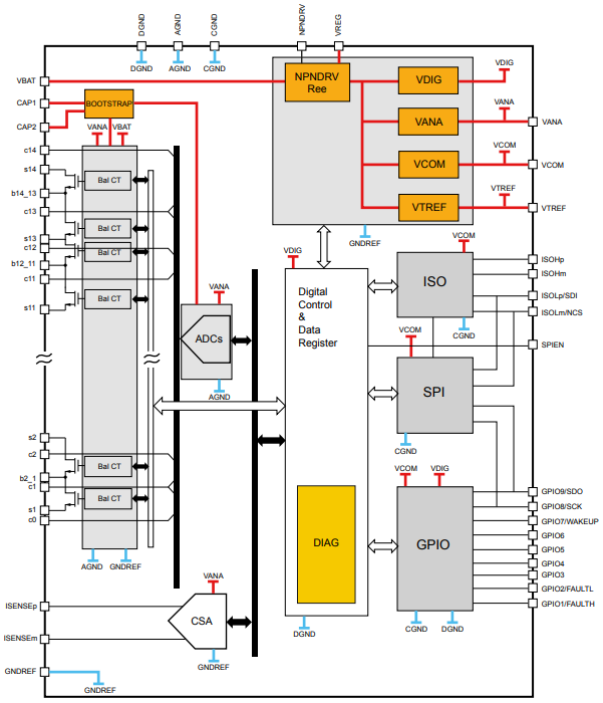

Fig-3.1 Block Daigram of L9963E.

Fig-3.2 L9963E IC Schematic using LT Spice.

5. Comparison

Taking two BMS board for comparison of their efficiency and evaluation of the parameters. In this comparison the used boards are Texas Instruments' passive balancing bq76PL455A-Q1 provides monitoring and balancing for a stack of up to 16 series-connected lithium-ion battery cells [3].

The bq76PL455A-Q1 works on stack voltages from a 16 V least to a 79.2 V most extreme. Notwithstanding 16 battery cell estimation channels, eight (8) extra simple channels are accommodated for temperature or helper signal detecting, and six (6) extra advanced channels are given. As a choice, design the advanced channels to produce flaws when the level changes state; either from high to low, or low to high. If it's not too much trouble, allude to the bq76PL455A-Q1 information sheet (SLUSC51) for the channel voltage estimation exactness over the 0 to 65°C and - 40°C to 105°C working temperature ranges. The aloof cell adjusting current is set by installed resistors to 56 mA for a cell at 4.2 V [3].

Whereas the EVAL-L9963E-MCU has a stack voltage from a 9.6 V to 64 V. L9963E main activity consists in monitoring cells and battery pack status through stack voltage measurement, cell voltage measurement, temperature measurement and coulomb counting. GPIOs, the device also offers the possibility to operate a distributed cell temperature sensing via external NTCs resistances. In general, the GPIOs can be used to perform both absolute and differential voltage conversions. They can also be configured as digital inputs/outputs. The IC supports up to 7 NTCs [4].

Table -5.1: Similarity with other BMS

Cell balancing: Passive
Per-loaded GUI 80% of Evaluation Board has
Internal Temperature Sensor 90% of the BMS contains
Current Sensing 95% of the BMS has it.
General Purpose Input/Output Pins 40% has

Table -5.2: Differences from other real time BMS

Voltage Stack 20% of the BMS has high voltage capacity.
Software's for GUI 80% can be flashed and rebuilt.
Cell Balancing time 90% doesn't matches.

6. CONCLUSIONS

Talking about the BMS used in here are to evaluation boards which can get us an insight over the all the parameters which the modern world is looking into. This states that the boards which is showcased here are better for the evaluation propose after which the evaluation we can design our own board removing the extra component which are present on the evaluation boards, and it would help the size to get reduced and the algorithm to be reduced. This is how we can safe and optimize power consumption of the entire system and get an environment safe system [5].

This board EVAL-L9963E-MCU is tested and proved at its extreme cases and the protection circuit present the system is very useful.

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