Intelligent battery sensor for automotive and industrial

Steve Taranovich - June 02, 2014

Freescale Semiconductor introduced the MM9Z1J638, AEC-Q100 qualified intelligent battery sensors with three measurement channels, a 16/32-bit MCU and a CAN protocol module in one 7 x 7 mm 48-pin QFN package.

This product is featured in EDN's Hot 100 products of 2014. See all 100 here.

The market this product serves is quite diversified with 12 V lead acid batteries, 14 V Li-Ion batteries, Lead acid multi-batteries, HV battery junction box, Energy Storage Systems (ESS), Uninterrupted Power Systems (UPS) and industrial automation.

Today’s trends in the battery market include complex battery algorithms, higher communication data rates with the CAN bus, better safety for Li-Ion batteries and increased mission-critical dependence on energy availability.

Start-stop requirements¹, together with others such as regenerative braking and intelligent alternator control, are driving demand for more precise sensing of the battery’s state to provide early failure warnings.

Enter the Intelligent Battery Sensor

An Intelligent Battery Sensor determines crucial battery characteristics such as State of Charge (SoC), State of Health (SoH) and State of Function (SoF). The do this we need precision measurement of Battery current ($I_{BAT}$), Battery Voltage ($V_{BAT}$) and Battery Temperature ($T_{BAT}$) under
very harsh operating conditions. The use of an embedded processor as well as complex battery algorithms will accomplish this difficult task.

**Figure 1: Reference design for a 12 V Pb battery (LIN)**

This device will determine current/energy availability for critical systems and conditions as well as provide early warning of battery discharge and wear-out (Auto battery field failure rates are greater than 10,000 ppm for batteries older than 3 years---I now live in the desert of Arizona heat and I am keenly aware of this)

**Differentiating points for the MM912J637 / MM9Z1J638 Intelligent Battery Sensors**

First of all, these ICs meet LIN conformance and solid ESD/EMC robustness (No extra external components are needed). LIN conformance is a necessary communication compatibility criteria that allows the use of a device in cars.

A LIN conformance test is a test procedure, used to determine, whether a component, a device, an implementation, or an ECU is matching the specified standards. By executing a conformance test the above described elements are scrutinized referring to the requirements of the conformance test specification. The purpose of a conformance test is to enhance the feasibility of reliable interoperability of different system implementation, by considering technical and economic aspects at the same time. (See Ihr GmbH LIN testing document) Ihr is an automotive engineering services, embedded software products and consulting organization in Germany.

Configurable ADC hardware filters to reduce software complexity. This offloads the filtering task from the MCU and they are also faster than software filters while allowing longer stop duty cycle operation thus reducing average current consumption.

Input voltage flexibility that addresses a variety of applications. This enables hardware and software reuse. A flexible four-cell front end architecture supports conventional 12V lead acid batteries as well as emerging battery applications, such as 14V stacked cell Li-Ion, high voltage junction boxes, and 24V truck batteries.

Operating voltage triple redundancy with three ADC paths (Reduces BOM and board space)
70% stop duty cycle operation. (Lowers system current consumption by 20%)

Evaluation boards

KIT9Z1J638EVM evaluation board

Evaluation boards are available for MM912J_637 and MM9Z1_638 with a nice GUI interface, Code Warrior compiler and programs S12 P&E.

Reference Designs

RD9Z1-638-4Li reference design

Valuable reference designs also exist for:

12 V PB battery with LIN (J637/J638)
12 V PB battery with CAN (J638)

14 V 4-cells Li-ion battery with CAN and LIN (J638)

Applications

A 12 V Pb battery (LIN) application exists (See Figure 1 diagram above)
Multiple cell application

Multiple battery application
UPS application

Industrial applications
Industrial junction box application

Industrial battery module controller application
Pricing

The MM9Z1J638 battery sensor has a suggested resale price of $3.61(USD) in 10,000-unit quantities.

For more information visit the Freescale website.

References

1 Engine Stop-Start Systems on Non-hybrid Vehicles, Car and Driver, April 2011