Analog, Mixed-Signal and Power Management

MM912_637

Xtrinsic Integrated Precision Battery Sensor

Overview

The MM912_637 enables precision measurement of key battery parameters in automotive and other applications. The device integrates an HCS12 microcontroller and a SMARTMOS analog control IC into a single package solution. The analog die combines system basis and application specific functions, including a Local Interconnect Network (LIN) transceiver, and a two-channel 16-bit sigma delta analog to digital converter (ADC) for simultaneous measurement of battery voltage and current. An integrated temperature sensor combined with battery mounting allows measurement of battery temperature. Control of the analog die is through a new high performance internal Die-to-Die interface (D2D), which seamlessly integrates the analog IC registers into the MCU register map, to provide faster access than SPI-based systems. The MM912_637 also includes an internal oscillator, 96 k or 128 k Bytes of Flash memory, and 6.0 k Bytes of RAM. An optional external temperature sensor is also supported.

Applications

- Battery Current / Voltage / Temperature Monitoring
- Battery State of Charge Monitoring
- Battery State of Health Monitoring

MM912_637 Simplified Application Drawing

*Part Number Dependent
Features

Battery Voltage Measurement

- Dedicated 16-Bit, 2nd order sigma delta ADC
- High precision divider
- Optional external voltage input “VOPT”
- Full measurement range 3.5 to 28 V, with an accuracy of 0.15% for 5.0 to 18 V range
- Measurement resolution 0.5 mV
- Simultaneous sampling with current channel
- Programmable signal filtering shared with current measurement: low-pass: 3.0 dB @100 Hz
- Reverse battery protected

Differential Battery Current Measurement

- Dedicated 16-Bit 2nd order sigma delta ADC
- PGA (programmable gain amplifier) with 8 programmable gain factors (4 to 512), synchronisation with ADC
- GCB (gain control block) for automatic gain adjustment
- Simultaneous sampling with voltage channel
- Measurement range +/-15 A (up to +/-2000 A) with an accuracy of 5.0 mA and a resolution of 1.0 mA
- Programmable signal filtering shared with voltage measurement: low-pass: 3.0 dB @100 Hz

Temperature Measurement

- Internal on-chip temperature sensor
- Optional external temperature sensor input
- Dedicated 16-Bit ADC with anti-aliasing filter
- Temperature range -40 to 125 °C (Part number dependent)
- Accuracy: +/-2.0 °C (-20 to 60 °C) and +/-3.0 °C (-40 to 125 °C)

Normal and Low Power Mode

- Current integration through a 32-Bit accumulator during low power mode, wake-up with programmable threshold
- Programmable current threshold detection during low power mode
- Programmable wake-up timer
- Maximum of 100 μA consumption in low power mode
- Triggered wake-up from LIN

Internal Oscillator with 1% Accuracy

Communication through LIN 2.1, LIN 2.0 Interface with Fast Mode for Flash Programming over LIN

High Performance 16-Bit S12 CPU

32 MHz, 96 k or 128 k Flash, 6.0 k RAM, 4.0 k Data Flash

Fast Die-to-Die Bus Interface with Transparent Integration of Analog IC Registers to the MCU Register Map

Background Debug Module (BDM), Debug Module (DBG), Serial Peripheral Interface (SPI)

Six Digital (5.0 V) General Purpose Input/Output (GPIO) Shared with SPI

Three Low Voltage GPIO Shared with SCI with Selectable Pull-up Resistor Per Terminal

Cascaded Low Drop Out (LDO) Voltage Regulators (5.0 V and 2.5 V)

Industry Standard EMC and ESD Compliance
Customer Benefits

Integration of MCU and analog features into a system-in-package solution, results in an optimized, economical, and autonomous multi-function solution, which provides enhanced reliability, and requires few external components when compared to discrete solutions

• Fully integrated and optimized signal chains, using 3 individual Sigma Delta ADC to measure current, voltage, and temperature
• Optional external temperature sense input and secondary voltage sense input
• Low current consumption, low-power mode flexibility, and wake-up options, including configurable wake-up sources
• Reverse battery protected voltage sense pins
• Full LIN solution with integrated physical interface
• Fully AEC-Q100 automotive qualified, and designed to meet highest automotive robustness standards for ESD, EMC, and Zero Defect Quality levels

Questions

• Do you need to monitor battery conditions over a wide current range with high precision and signal filtering capabilities?
• Do you need a single package solution, integrating a microcontroller, a LIN node, voltage regulators and full battery monitoring features?
• Do you need high precision synchronous voltage and current measurements?
• Are you using a LIN communication system?
• Do you need a low current consumption device?
• Do you need a device which is compliant with EMC and ESD industry standards?
• Do you need a fully automotive qualified product?
• Do you have to minimize the size of your PCB application?
Orderable Part Numbers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Max Input Voltage</th>
<th>Flash (kB)</th>
<th>Temperature Range $T_A$</th>
<th>Package</th>
<th>Analog Option</th>
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<tbody>
<tr>
<td>MM912I637AM2EP/R2</td>
<td>42V</td>
<td>96</td>
<td>-40 to 125 °C</td>
<td>48 QFN-EP</td>
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<td>-40 to 105 °C</td>
<td>48 QFN-EP</td>
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<tr>
<th>Feature</th>
<th>Analog Option 1</th>
<th>Analog Option 2</th>
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<tbody>
<tr>
<td>Cranking Mode</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>External Wake-up (PTB3/L0)</td>
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<td>Yes</td>
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<td>External Temperature Sensor Option (VTEMP)</td>
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<tr>
<td>Optional 2nd External Voltage Sense Input</td>
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Documentation

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
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<tbody>
<tr>
<td>MM912_637D1</td>
<td>Data Sheet - Presents the specifications for the product</td>
</tr>
<tr>
<td>SG1002</td>
<td>Selector Guide - Analog and power management device comparison</td>
</tr>
<tr>
<td>SG187</td>
<td>Selector Guide - Automotive device comparison</td>
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Development Tools

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<th>Part Number</th>
<th>Description</th>
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<tr>
<td>KIT912J637EVME</td>
<td>Evaluation board to demonstrate the key features of the MM912_637.</td>
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Freescale: A Leader in Automotive Solutions

Expanding on its more than 30-year heritage of automotive innovation and its high-performance products using Xtrinsic technology, Freescale’s SMARTMOS™ solutions are designed with the right combination of high-performance capability, processing capacity and customizable software to help deliver smart, differentiated automotive solutions. With Xtrinsic Analog, Mixed Signal, and Power parts, our vision is to offer a diverse and differentiated product portfolio to meet the expanding needs of the automotive, consumer, and industrial segments. Xtrinsic solutions offer ideal blends of functionality and intelligence designed to help our customers differentiate and win in highly competitive markets.

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