What are the key considerations in implementing accurate Smart Battery electronics?
# Texas Instruments
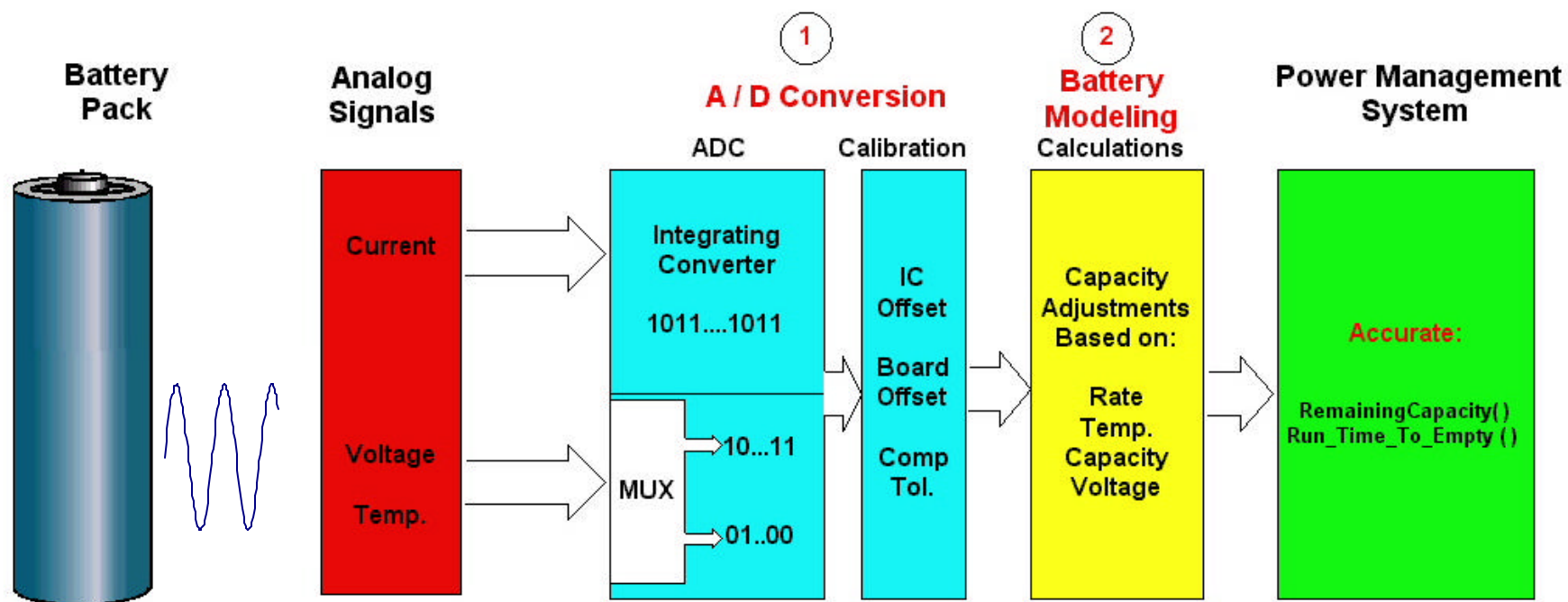
Signal Conversion Component

- Analog to Digital Conversion
  - Must accurately interpret signals in all portable system power states
    - Operating, Charging, Standby, and Off states
    - Dynamic current range: 2mA - 5A
    - Minimal shunt resistance results in signal levels of 30μV to 75mV
    - Not measuring Standby or Off states with coloumb counter implementation can result in RemainingCapacity( ) errors
  - Board level induced errors
    - PCB offset: Good PCB - 5μV, Bad PCB - 150μV!
      - Is it current or just PCB offset?
    - Component tolerances for absolute measurements
      - Sense resistor: Current( )
      - Voltage dividers: Voltage( )
      - Temperature thermistor: Temperature( )

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Battery Modeling Component

- **Battery Modeling** - Why?
  - Battery discharge capacity affected by rate and temp.
  - Batteries experience self-discharge
  - Battery characteristics differ on same chemistry from manufacturer to manufacturer
    - Chemistry and construction influence discharge curve
  - Accuracy at <15% most important
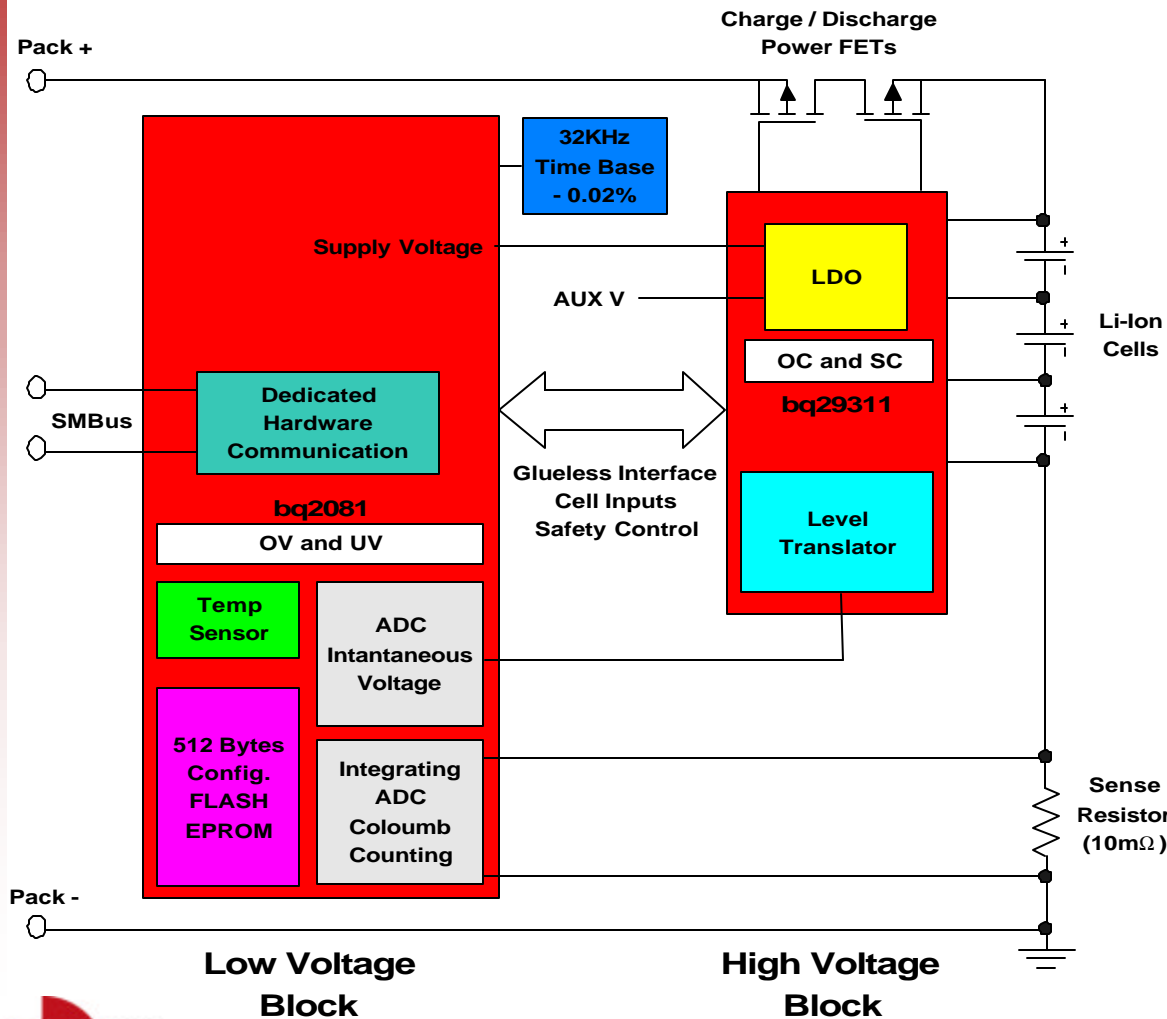   - Prevent data loss
    - Sufficient save-to-disk energy
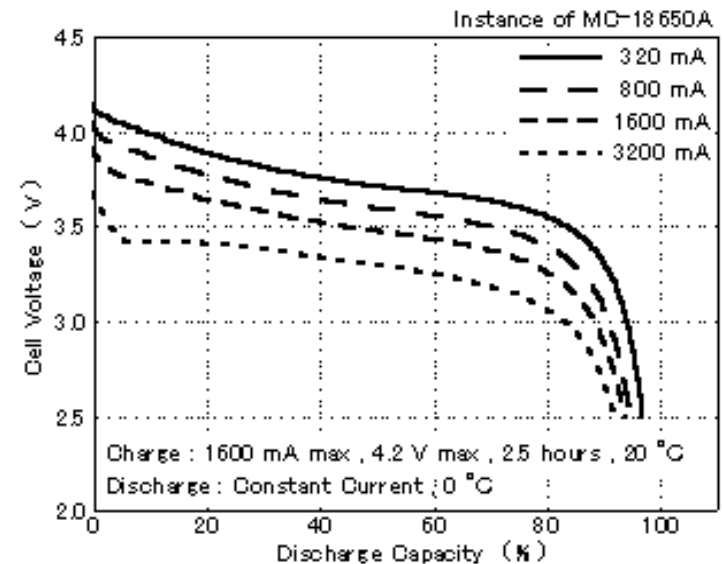
SOURCE: MITSUBISHI CABLE INDUSTRIES, LTD

bq2081 / bq29311 Solution
Less Components / Higher Performance

Charge / Discharge Power FETs

Pack +

32KHz Time Base - 0.02%

Supply Voltage

AUX V

LDO

OC and SC

bq29311

Li-Ion Cells

Dedicated Hardware Communication

SMBus

bq2081

OV and UV

Glueless Interface Cell Inputs Safety Control

Level Translator

Temp Sensor

ADC Intantaneous Voltage

512 Bytes Config. FLASH EPROM

Integrating ADC Coloumb Counting

Sense Resistor (10mΩ)

Pack -

Low Voltage Block

High Voltage Block

10.8V or 14.4V Li-Ion Smart Battery Pack

- **Approximately 50 components - *45% reduction in component count***
- SBS v.1.1 battery fuel gauge and protection
- ADC
  - ◆ 1μV measurement offset
  - ◆ Better than 3nVh resolution
  - ◆ 10-20mΩ sense resistor
- Battery Modeling
  - ◆ Real-time compensation for rate, temperature, and self-discharge
  - ◆ Programmable to match different cell characteristics

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Overall TI SBS Portfolio

- Leader in Smart Battery Solutions
  - Full range of compliant battery fuel gauge ICs
  - Evaluation kits (EVMs) for quick startup
- For information on SBS compliant devices go to power.ti.com
- Visit us at booth 300
  - Demos
  - Literature

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