Order your free copy of the ***new*** *'Power Management Selection Guide'*

(see back cover or reply card for details)

Sine On

AN ANALOG AND MIXED-SIGNAL PRODUCT BULLETIN

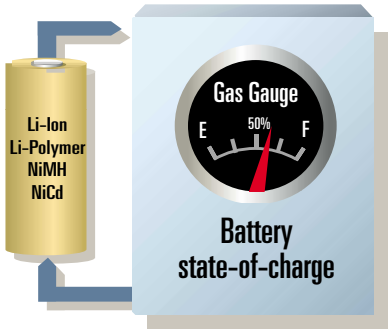
focus on:

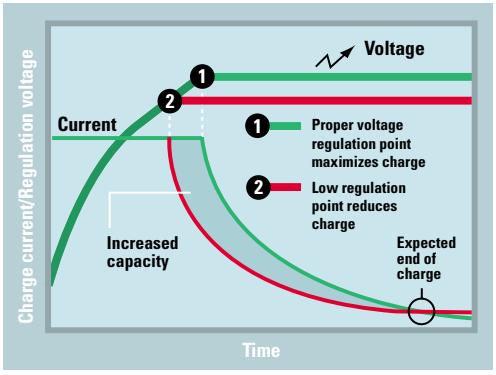
Battery Management

3Q 20002

Gas gauges and battery monitors for accurate capacity monitoring

Page 6



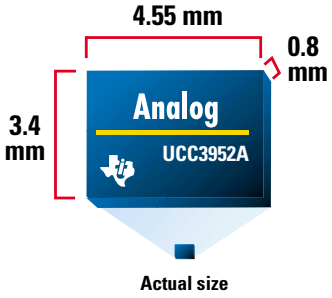


Charge management ICs minimize charge time, maximize charge capacity

Page 2

Lithium-Ion protectors integrate MOSFETs for industry's smallest solution

Page 10



Includes Benchmarq Products from Texas Instruments

Charge Management

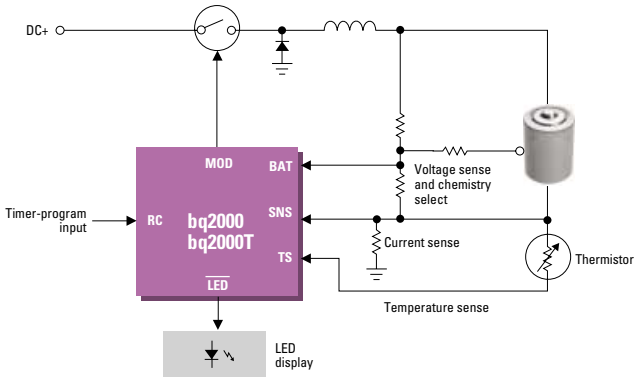
Programmable, multi-chemistry charge management IC

bq2000

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* with bq2000 or bq2000t

- Safe management of fast-charge for NiCd, NiMH or Li-Ion/Li-Pol battery packs
- Integrated high-frequency, switching controller for efficient and simple charger design
- Pre-charge qualification for detecting shorted, damaged or overheated cells
- Fast-charge termination by peak voltage (bq2000), rate of temperature rise (ΔT/Δt) (bq2000T), minimum current (Li-Ion), maximum temperature and maximum charge time
- Selectable top-off mode for achieving maximum capacity in NiMH batteries
- Programmable trickle-charge mode for reviving deeply discharged batteries and for post-charge maintenance
- Built-in battery removal and insertion detection
- Sleep mode for low power consumption
- Packaging: 8-pin TSSOP, SOIC and DIP
- Pricing starts at $1.87 each in quantities of 1,000

Switch-mode, multi-chemistry charger



- Applications include:
  - Cellular telephones
  - Desktop chargers
  - Notebook PCs
  - Internet audio players
  - Personal digital assistants (PDAs)

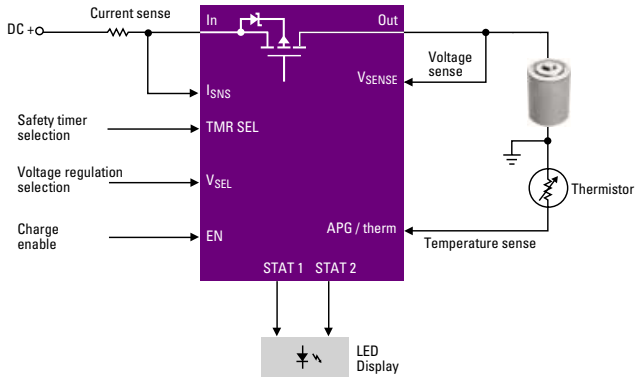
Linear Li-Ion/Li-Polymer charge management IC with integrated Power FET

bq2400x

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* with bq24001, bq24002, bq24003, bq24004, bq24005 or bq24006

- Highly-integrated solution with FET pass-transistor and reverse-blocking Schottky diode and thermal shutdown
- Ideal for linear charger designs using one- or two-cell Li-Ion battery packs with coke or graphite anodes
- Meets USB power specifications: charge current can be supplied from either USB hub or wall adapter
- Up to 1.2-A continuous charge current with low-dropout voltage (0.7 V max)
- Safety charge timer during pre-conditioning and fast charge
- Integrated voltage and current regulation with programmable charge current
- Various charge status output options for driving a single LED, bi-color LED, two LEDs or host processor interface
- Low-power sleep mode (1 µA)
- Packaging: 20-pin TSSOP PowerPAD™
- Pricing starts at $1.89 in quantities of 1,000

Linear Li-Ion/Li-Polymer charger



- Applications include
  - Cellular telephones
  - PDAs
  - Pagers
  - Consumer electronics: digital cameras, MP3 players

For technical support and ordering literature, see page 15.

Charge Management

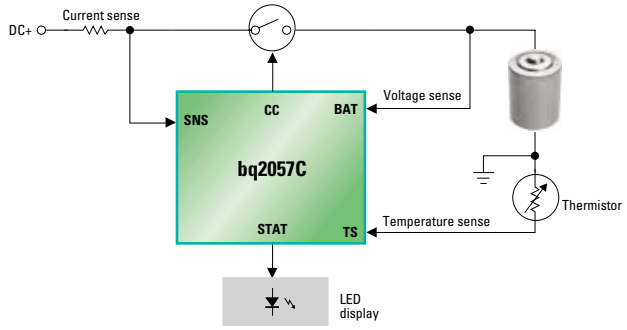
Advanced linear Li-Ion/Li-Polymer charge management IC

bq2057

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* with bq2057, bq2057c, bq2057t, or bq2057tw

- Ideal for low-dropout linear charger design for one- (bq2057/2057C) and two-cell (bq2057T/2057W) applications
- Proprietary AutoComp™ feature for dynamic compensation of battery pack's internal impedance
- ±1% voltage regulation accuracy over operating temperature and supply voltage
- Battery conditioning, temperature monitoring and charge termination
- Sleep mode for low power consumption
- Charge status display shows charge in progress, charge complete and fault conditions
- Packaging: 8-pin TSSOP and SOIC
- Pricing starts at $1.55 each in quantities of 1,000

Linear Li-Ion charger (1 cell, 4.2 volts)



- Applications include:
  - Cellular telephones
  - PDAs
  - Digital cameras
  - Pagers
  - Internet audio players
  - Consumer electronics

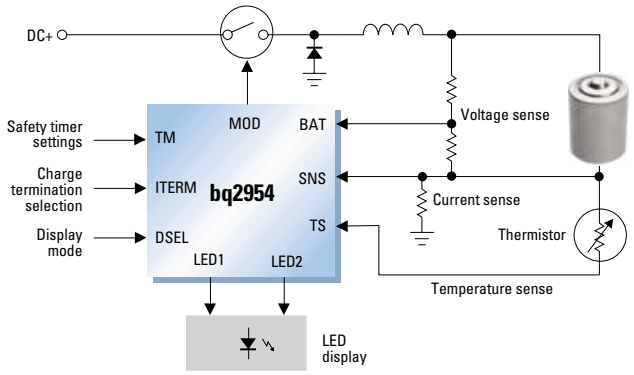
Advanced Li-Ion charge management IC with switch-mode controller

bq2954

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/bq2954.html

- Safe management of fast-charge for Li-Ion battery packs
- Integrated pulse-width modulation control for current and voltage regulation
- ±1% voltage regulation accuracy
- Fast charge terminated by user-selectable minimum current and maximum time
- Pre-charge qualification detects shorted or damaged cells while conditioning battery
- Charging continuously qualified by temperature and voltage limits
- Advanced dual-LED charge status display with three user-selectable modes
- Built-in battery removal and insertion detection
- Packaging: 16-pin SOIC and 16-pin DIP
- Pricing starts at $2.66 each in quantities of 1,000

Switch-mode Li-Ion charger



- Applications include:
  - Cellular telephones
  - Desktop chargers
  - Notebook and palm-top computers
  - Data-collection equipment

Charge Management

Cost-effective, fast-charge management for NiCd/NiMH packs

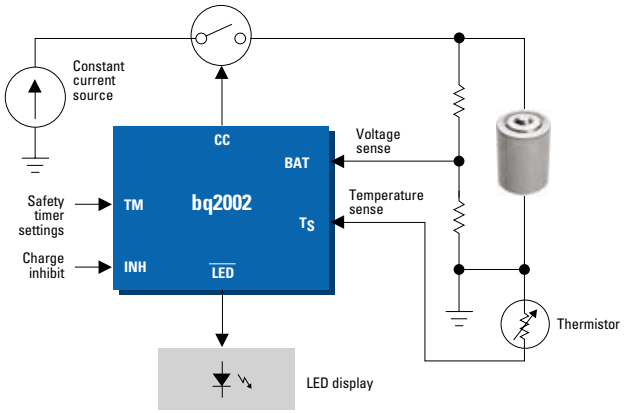
bq2002

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* in URL with bq2002, bq2002e, bq2002f or bq2002g

- Safe management of fast-charge for NiCd and NiMH battery packs
- Gated control of an external current source
- Pre-charge qualification for detecting shorted, damaged or overheated cells
- Fast-charge termination by peak voltage, -ΔV, rate of temperature rise (ΔT/Δt), maximum temperature and maximum charge time*
- Synchronous voltage sampling for noise immunity
- Trickle-charge mode for reviving deeply discharged batteries and for post-charge maintenance
- Sleep mode for low power consumption
- Packaging: 8-pin SOIC and DIP
- Pricing starts at $1.40 each in quantities of 1,000

*Varies by model. Check individual datasheets for details.

NiCd/NiMH charger



- Applications include:
  - Power tools
  - Digital cameras
  - Internet audio players
  - PDAs
  - Cellular telephones
  - Consumer electronics

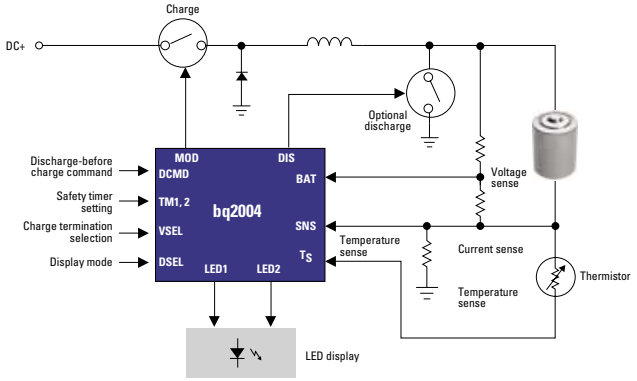
NiCd/NiMH fast-charge-management IC with switch-mode controller

bq2004

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* in URL with bq2004, bq2004e or bq2004h

- Safe management of fast-charge for NiCd and NiMH battery packs
- Hysteretic PWM switch-mode current regulation for high-efficiency charger design
- Pre-charge qualification of temperature and voltage
- Fast-charge termination by peak voltage, -ΔV, rate of temperature rise (ΔT/Δt), maximum temperature and maximum charge time
- Advanced dual-LED charge status display with three user-selectable modes
- Trickle-charge mode for reviving deeply discharged batteries and for post-charge maintenance
- Discharge-before-charge option for conditioning NiCd batteries
- Packaging: 16-pin SOIC and DIP
- Pricing starts at $2.33 each in quantities of 1,000

Switch-mode NiCd/NiMH charger



- Applications include:
  - Desktop chargers
  - Power tools
  - Notebook and palm-top computers
  - Portable medical equipment
  - Two-way radios
  - Consumer electronics

For technical support and ordering literature, see page 15.

Charge Management

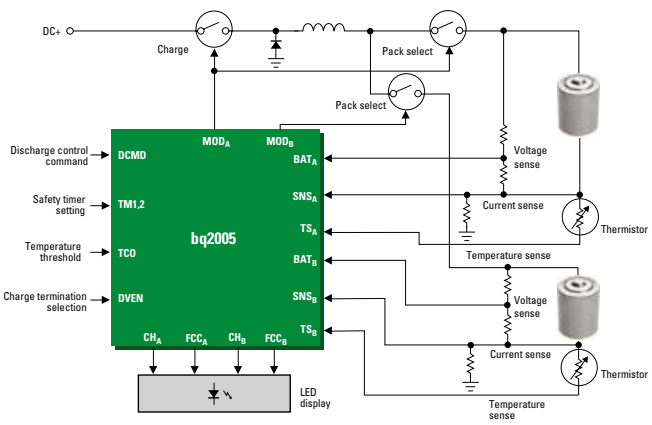
Dual NiCd/NiMH fast-charge management IC with switch-mode controller

bq2005

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2005.html

- Sequential safe management of fast-charge for two NiCd or NiMH battery packs
- Hysteretic PWM switch-mode current regulation for high-efficiency charger design
- Pre-charge qualification of temperature and voltage
- Fast-charge termination by –ΔV, rate of temperature rise (ΔT/Δt), maximum temperature and maximum charge time
- Dedicated LED charge status display for each pack
- Trickle-charge mode for reviving deeply discharged batteries and for post-charge maintenance
- Discharge-before-charge option for conditioning NiCd batteries
- Packaging: 20-pin SOIC and DIP
- Pricing starts at $2.46 each in quantities of 1,000

Dual NiCd/NiMH charger



- Applications include:
  - Desktop chargers
  - Power tools
  - Dual-bay chargers

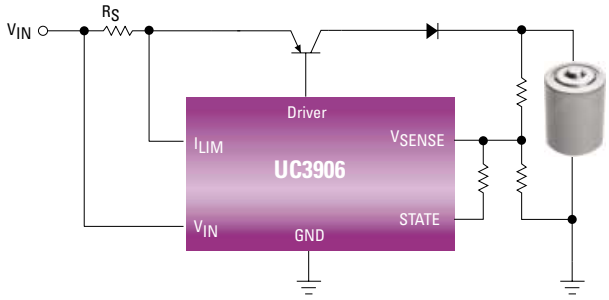
Linear sealed-lead-acid, charge management IC

UC3906

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/uc3906.html

- Two user-selectable charge algorithms
- Temperature-compensated internal reference tracks battery's requirements for optimum charge
- Charge-complete indication
- Advanced three-LED charge status display with three user-selectable modes
- Precision voltage reference tracks battery requirements over a range of temperatures
- Under-voltage lockout (UVLO) increases system reliability
- Differential current sense inputs
- Available in industrial temperature range
- Low standby current
- Packaging: 16-pin SOIC or DIP
- Pricing starts at $3.17 each in quantities of 1,000

Linear sealed-lead-acid charger



- Applications include:
  - UPS systems
  - Emergency lighting systems
  - Fire and burglar alarm systems
  - Portable tools and instruments
  - Computer backup systems
  - Cordless phones
  - Access-control devices

Battery Monitoring

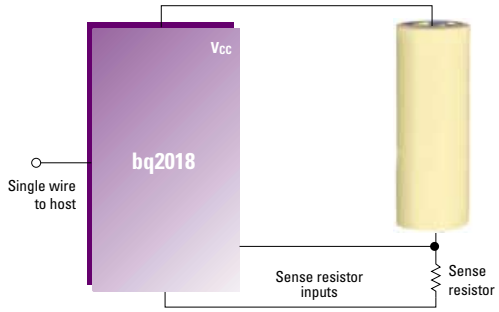
Precision battery monitoring IC

bq2018

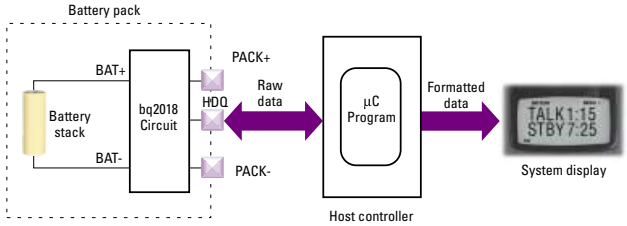
Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2018.html

- Allows host to accurately track remaining capacity of battery packs
- Communicates battery information to host controller using a single-wire interface
- Internal offset error-calculation for maximum measurement accuracy
- Resolves signals less than 12.5 µV
- 128 bytes of NVRAM
- Low power: operating current <80 µA, sleep current <10 µA, data-retention current <50 nA
- Internal timebase and temperature sensor for minimum component count
- Packaging: 8-pin TSSOP or narrow SOIC
- Pricing starts at $2.00 each in quantities of 1,000

bq2018 single-cell application



bq2018-to-system display interface



- Applications include
  - Cellular telephones
  - PDAs

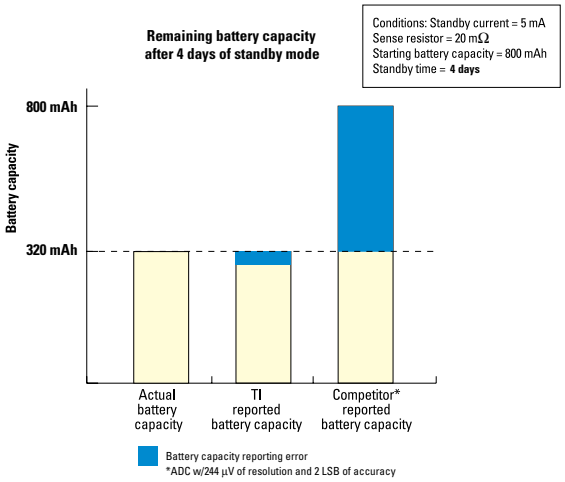
Flash-based precision battery monitoring IC

bq2019

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/bq2019.html

- Allows host to accurately track remaining capacity of battery packs
- 96 bytes of Flash memory to store critical battery parameters
- 8 bytes of ID ROM provide a unique system identification code
- Offset error correction automatically applies to charge and discharge counting for maximum measurement accuracy
- Resolves signal less than 3.05 µV
- Internal temperature sensor with 1° C resolution eliminates need for a thermistor in the battery pack
- Programmable output port provides a control signal within the battery pack
- Communicates battery information to host controller using a single-wire interface
- Low power: operating current <80 µA, sleep current <1.5 µA
- Packaging: 8-pin TSSOP
- Pricing starts at $2.40 in quantities of 1,000

bq2019 measurement accuracy



- Applications include
  - Cellular telephones
  - PDAs
  - Handheld or portable computers

For technical support and ordering literature, see page 15.

Gas Gauging

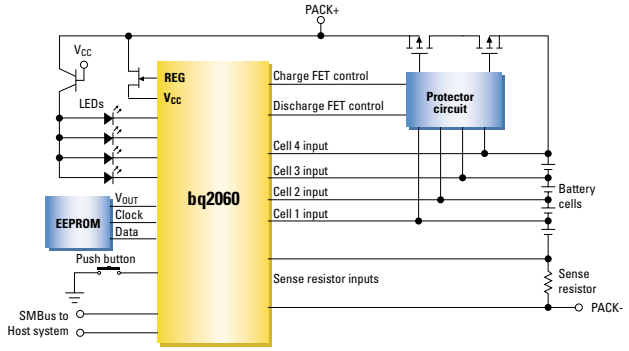
Smart Battery System (SBS) v1.1-compatible gas gauge IC

bq2060

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2060.html

- Accurately measures available capacity in Li-Ion, NiMH, NiCd, Lithium-Ion and lead-acid batteries
- Supports SBS Smart Battery Data Specification v1.1
- Supports the two-wire SMBus v1.1 interface with PEC or 1-wire HDQ16 for communication with host
- Reports individual cell voltages
- Monitors and provides control to charge and discharge FETs in Li-Ion protection circuit
- Provides 15-bit resolution for voltage, temperature and current measurements
- Measures charge flow using a V-to-F converter with offset of less than 20 µV after calibration
- Low operating current (180 µA typical)
- Drives a four- or five-segment LED display for indicating remaining battery capacity
- Packaging: 28-pin, 150-mil SSOP
- Pricing starts at $4.32 each in quantities of 1,000

Typical smart battery application



- Applications include:
  - Notebook PCs
  - Medical/test equipment
  - Portable instruments
  - Handheld devices

SBS v1.1 Li-Ion gas gauge IC with protector interface

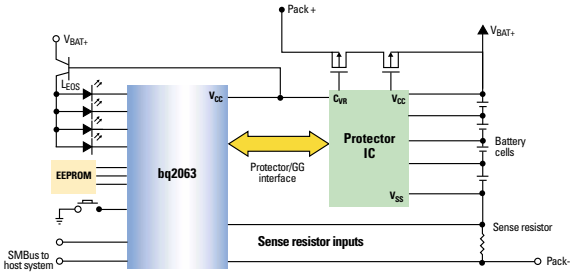
Product Preview

bq2063

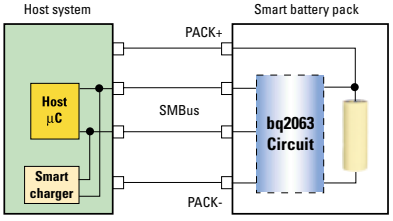
Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/bq2063.html

- Accurately measures available capacity in Li-Ion batteries
- Supports SBS Smart Battery Data Specification v1.1
- Directly interfaces with protector IC for maximum safety and minimal component count
- Signals protector on out-of-tolerance battery conditions including over-voltage, under-voltage, over-current, over-temperature
- Provides independent safety output signal for optional pack shutdown
- EEPROM programming for easy upgrade similar to bq2060
- Measures charge flow using a V-to-F converter with offset less than 20 µV after calibration
- Low operating current (180 µA typ)
- Packaging: 28-pin, 150-mil SSOP
- Pricing starts at $4.32 in quantities of 1,000

Typical smart battery application



Smart battery system (SBS)



- Applications include
  - Notebook PCs
  - Medical/test equipment
  - Portable instruments
  - Handheld devices

Gas Gauging

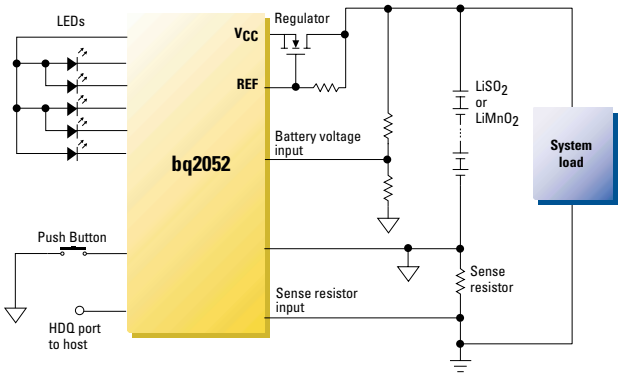
Primary lithium gas gauge IC

bq2052

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2052.html

- Accurately measures available capacity in lithium sulfur dioxide ($LiSO_2$) and lithium manganese dioxide ($LiMnO_2$) batteries
- Suitable for in-system or battery-pack integration
- Accommodates a wide range of pack capacities (1 Ah to 15 Ah)
- Automatically adjusts for battery discharge inefficiencies based on rate and temperature
- Low operating current (120 µA typical)
- Measures a wide dynamic discharge range
- Measures and reports battery temperature, voltage and discharge current in addition to capacity
- Reports remaining capacity using two, four or five LEDs
- Single-wire communication interface (HDQ bus) for reporting critical battery parameters back to the system controller
- Packaging: 16-pin narrow SOIC
- Pricing starts at $4.20 each in quantities of 1,000

bq2052 in-system primary battery monitor



- Applications include
  - Medical/test equipment
  - Communication equipment
  - Military radios
  - Portable instruments

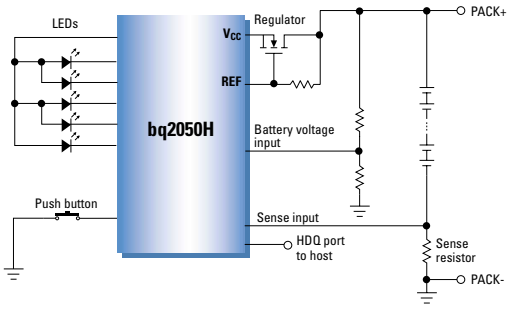
Lithium-Ion gas gauge IC with single-wire HDQ interface

bq2050H

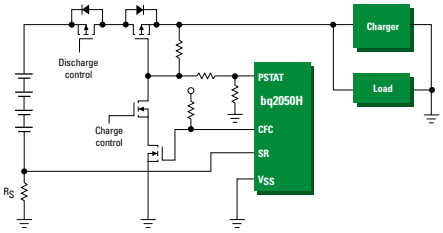
Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2050h.html

- Accurate measurement of capacity in Lithium-Ion (Li-Ion) batteries
- Automatic compensation for rate and temperature
- Provides low-cost battery management solution for pack integration
- Circuit fits in 1/2 square inch of PCB
- Low operating current (120 µA typical)
- Monitors and controls charge FET in Li-Ion pack protection circuit
- Direct drive of five LEDs to indicate remaining battery capacity
- Register-compatible with TI's bq2014H
- Packaging: 16-pin, narrow SOIC
- Pricing starts at $4.22 each in quantities of 1,000

bq2050H-based smart battery pack



bq2050H enhances Li-Ion pack safety



- Applications include:
  - Notebook PCs
  - Medical/test equipment
  - Portable instruments
  - Handheld devices

For technical support and ordering literature, see page 15.

Gas Gauging

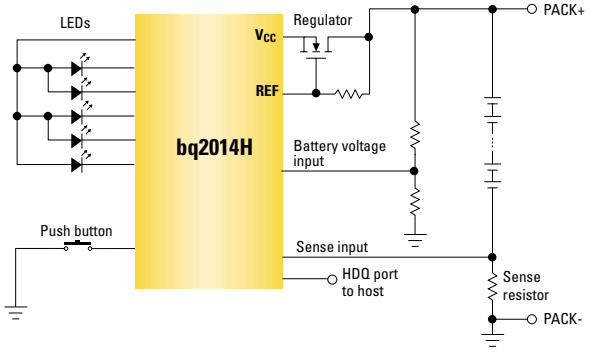
Nickel-chemistry gas gauge IC with single-wire HDQ interface

bq2014H

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2014h.html

- Accurately measures available capacity in NiCd and NiMH batteries
- Automatic compensation for rate and temperature
- Low-cost battery management solution for pack integration
- Circuit fits in 1/2 square inch of PCB
- Low operating current (120 µA typical)
- Less than 100 nA of data-retention current
- Single-wire communication interface (HDQ bus) for critical battery parameters
- Interfaces with an external charge controller, such as the bq2004H from TI
- Direct drive of five LEDs to indicate remaining battery
- Register-compatible with TI's bq2050H
- Packaging: 16-pin narrow SOIC
- Pricing starts at $3.98 each in quantities of 1,000

bq2014H-based smart battery pack



- Applications include:
  - Notebook PCs
  - Medical/test equipment
  - Portable instruments
  - Handheld devices

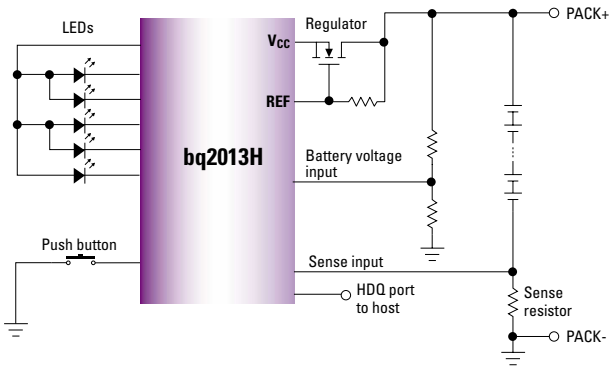
Nickel/lead-acid gas gauge for high discharge rate applications

bq2013H

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/bq2013h.html

- Accurately measures available capacity in NiCd, NiMH and lead-acid batteries
- Accommodates large pack capacities (>2 Ah)
- Automatically adjusts for battery self-discharge, charge-efficiencies and circuit-offset error
- Low operating current (120 µA typical)
- Measures a wide dynamic discharge range
- Accommodates a low-value sense resistor (<10 mΩ)
- Measures and reports battery temperature and voltage
- Reports remaining capacity using five LEDs
- Single-wire communication interface (HDQ bus) for reporting critical battery parameters back to the system controller
- Packaging: 16-pin narrow SOIC
- Pricing starts at $3.98 each in quantities of 1,000

bq2013H-based smart battery pack



- Applications include:
  - Power-assist bicycles
  - Other power-assist applications
  - Medical/test equipment
  - Portable instruments

Battery Protection

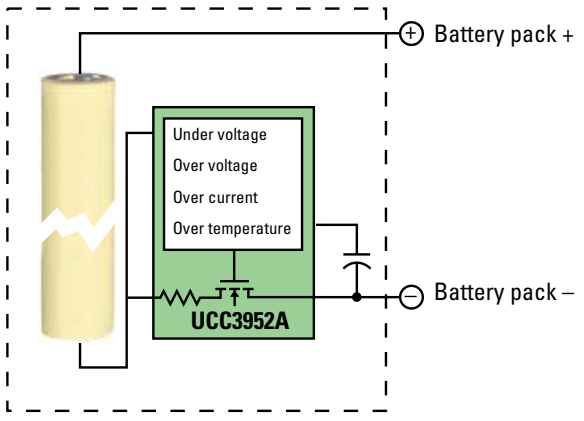
Industry's smallest single-cell, Li-Ion battery protection solution

UCC3952/A

Get samples, EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* with ucc3952-x or ucc3952a-x, where x is 1, 2, 3 or 4

- Protects sensitive Lithium-Ion cells from over-charge and over-discharge conditions
- 50-mΩ integrated power FET reduces cost and increases reliability
- Proven short-circuit protection increases system safety
- Four different over-charge voltage options provide system flexibility: UCC3952/A-1, -2, -3 and -4
- 5-µA supply current prolongs battery life
- 18-pin BCC package meets the latest trend for cellular phone batteries and saves over 50% board space vs. 16-pin TSSOP
- Tolerant to 16-V (UCC3952) and 18-V (UCC3952A) input voltages
- Suitable for in-car charging applications (UCC3952A)
- Packaging: 16-pin TSSOP, 16-pin SOIC or 18-pin Bump Chip Carrier™ (BCC) (UCC3952A)
- Pricing starts at $1.73 each in quantities of 1,000

One-cell Li-Ion battery protector



- Applications include
  - Cellular telephones
  - Pagers
  - PDAs

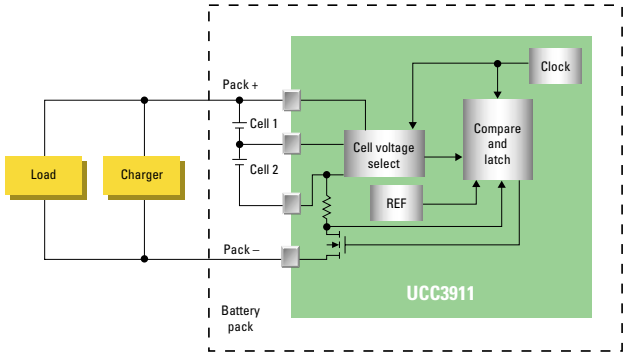
Battery protection IC for two Li-Ion cells

UCC3911

Get samples, EVMs and datasheets at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* with ucc3911-x where x is 1, 2, 3 or 4

- Protects sensitive Lithium-Ion cells from over-charge and over-discharge conditions
- 75-mΩ integrated power FET reduces cost and increases reliability
- Proven short-circuit protection increases system safety
- Four different over-charge voltage options provide system flexibility: UCC3911-1, -2, -3 and -4
- 18-µA supply current prolongs battery life
- Packaging: 16-pin SOIC
- Pricing starts at $3.26 each in quantities of 1,000

Two-cell Li-Ion battery protector



- Applications include
  - Cellular telephones
  - Pagers
  - PDAs

For technical support and ordering literature, see page 15.

Battery Protection

Battery protection IC for three or four Li-Ion cells

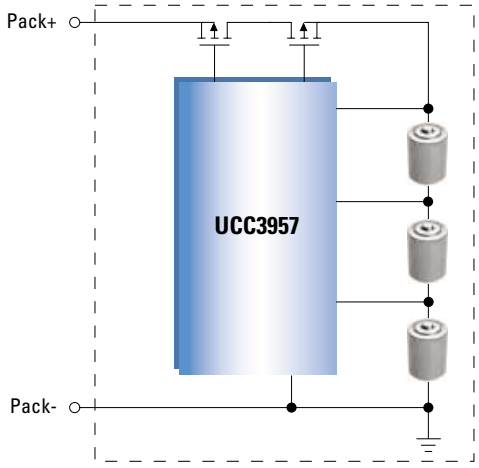
UCC3957

Get EVMs, datasheets and app reports at:
www.ti.com/sc/docs/products/analog/*device*.html
Replace *device* in URL with ucc3957-1, ucc3957-2, ucc3957-3 or ucc3957-4

EVALUATION MODULE DATA SHEETS APP REPORT

- Precision voltage reference (±50 mV) allows for full battery charge restoration
- High-side protection MOSFETs prevent loss of system ground
- Two-tier current-limiting scheme increases system flexibility
- Smart discharge circuitry eliminates high-dissipation discharge
- Low quiescent current (30 µA) provides longer battery life
- Four over-voltage protection threshold options: UCC3957-1, -2, -3 and –4
- Packaging: 16-pin SSOP
- Pricing starts at $2.35 each in quantities of 1,000

Three-cell Li-Ion battery protector



- Applications include
  - Notebook PCs
  - Medical/test equipment
  - Portable instrumentation
  - Handheld devices

Application Reports

To access any of the following application reports, type the URL
www.ti.com/sc/psheets/abstracts/apps/*litnumber*.htm
and replace litnumber with the number in parentheses beside the title.

For a complete list of analog application reports, visit
www.ti.com/sc/docs/apps/analog/index.htm

Charge management:

- High efficiency dual-chemistry charger using the bq2000 *(slua013)*
- 20 W miniature dual-stage fast Lithium-Ion charger using bq2954 *(slua070)*
- Improved charging methods for lead-acid batteries using the UC3906 *(slua115)*
- Simple switchmode lead-acid battery charger *(slua055)*
- Implementing multi-state charge algorithm with the UC3909 switchmode *(slua098)*
- An off-line lead-acid charger based on the UC3909 *(slua058)*
- Using the bq2000/T to control fast charge *(slua064A)*
- Using the bq2003 to control fast charge *(slua003)*
- Step-down switching current - regulation using the bq2003 fast-charge IC *(slua007)*
- Using the bq2005 to control fast charge *(slua010)*
- Using the bq2031 to charge lead-acid batteries *(slua017)*
- Switch-mode power conversion using the bq2031 *(slua019)*
- Using NiMH and Li-Ion batteries in portable applications *(slua015)*

Gas gauging & battery monitoring

- Designed to go: Universal battery monitor using the bq2018 power minder IC *(slua016)*
- DM2382 gas gauge peripheral and Li-Ion pack protection demo board *(sluu054)*
- Using the bq2040, smart-battery-system gas gauge IC *(slua233)*
- Using the bq2010, a tutorial for gas gauging *(slua014)*
- Using the bq2050 to monitor lead-acid batteries *(slua021)*

Battery protection

- DM2382 gas gauge peripheral and Li-Ion pack protection demo board *(sluu054)*

Selection Guide for Charge Management

Battery chemistry	Key features	Charge termination method	Package	IC part number	EVM part number
Multi-chemistry	• Complete charge management for NiCd/ NiMH and Li-Ion/Li-Pol • Integrated high-frequency switching controller • Pre-charge qualification • Programmable trickle-charge mode for reviving deeply discharged batteries	PVD, minimum current, maximum temperature, maximum time	DIP-8, SOIC-8, TSSOP-8	bq2000	DV2000S1
		$\Delta T/\Delta t$, minimum current, maximum temperature, maximum time	DIP-8 SOIC-8 TSSOP-8	bq2000T	DV2000TS1
Lithium-Ion Lithium-Polymer	• Highly-integrated solution with FET pass-transistor and reverse-blocking Schottky and thermal shutdown • Ideal for linear charger design for single- or two-cell Li-Ion packs with Coke or Graphite anodes powered from an external power source or a USB hub • Up to 1.2 A continuous-charge current with low-dropout voltage • Various charge status output options for driving single, two or bi-color LEDs or host processor interface • Low-power sleep mode	Minimum current, maximum time	TSSOP-20 PowerPAD™	bq24001 bq24002 bq24003 bq24004 bq24005 bq24006	BQ24001EVM BQ24002EVM BQ24003EVM BQ24004EVM BQ24005EVM BQ24006EVM
	• Low-dropout linear charger for single-and two-cell applications • Proprietary AutoComp™ feature for dynamic compensation of battery pack's internal impedance • Battery conditioning, temperature monitoring and charge termination	Maximum current, maximum temperature	TSSOP-8 SOIC-8	bq2057/C/T/W	DV2057 DV2057C DV2057T DV2057W
	• Integrated pulse-width modulation control for current and voltage regulation • ±1% voltage regulation accuracy • Advanced dual-LED charge status display with three user-selectable modes	Minimum current, maximum time	DIP-16 SOIC-16	bq2954	DV2954S1L DV2954S1H
	• Integrated pulse-width modulation control for current and voltage regulation • Programmable charge termination • Differential current sense inputs	Minimum current, maximum time	DIP-20 SOIC-20	UCC3956	n/a
NiMH, NiCd	• Gated control of an external current source • Simple low-cost charger implementation • Sleep mode for low power consumption	-ΔV, PVD, maximum temperature, maximum time	DIP-8 SOIC-8	bq2002/C/E/F/G	DV2002L2
		$\Delta T/\Delta t$, maximum temperature, maximum time	DIP-8 SOIC-8	bq2002D/T	DV2002TL2
	• Integrated high-frequency switching controller • Discharge-before-charge option for conditioning NiCd batteries	-ΔV, PVD, maximum temperature, maximum time	DIP-16 SOIC-16	bq2003	DV2003L1 DV2003S1 DV2003S2
	• Integrated high-frequency switching controller • Advanced dual-LED charge status display with three user-selectable modes • Discharge-before-charge option for conditioning NiCd batteries	-ΔV, PVD, $\Delta T/\Delta t$, maximum temperature, maximum time	DIP-16 SOIC-16	bq2004/E/H	DV2004L1 DV2004S1 DV2004ES1 DV2004HS1
	• Sequential safe management of fast charge for two NiCd or NiMH battery packs • Integrated high-frequency switching controller • Discharge-before-charge option for conditioning NiCd batteries	-ΔV, $\Delta T/\Delta t$, maximum temperature, maximum time	DIP-20 SOIC-20	bq2005	DV20051 DV200551
Lead Acid	• Integrated pulse-width modulation control for current and voltage regulation • Three user-selectable charge algorithms to accommodate cyclic and stand-by applications • Advanced three-LED charge status display with three user-selectable modes	Maximum voltage, - $\Delta^2 V$, minimum current, maximum time	DIP-16 SOIC-16	bq2031	DV2031S2
	• Linear controller • Temperature-compensated internal reference • Differential current sense inputs	Maximum voltage, minimum current	DIP-16 SOIC-16	UC3906	n/a
	• Integrated pulse-width modulation control for current and voltage regulation • Differential current sense inputs	Maximum voltage, minimum current	DIP-20 SOIC-20	UC3909	n/a

For technical support and ordering literature, see page 15.

Selection Guide for Gas Gauging

Battery chemistry	Battery pack capacity	Communication interface	Key features	Package	IC part number	EVM part number
Li-Ion	800-6,000	1-wire DQ	Remaining power (Wh) indication	SOIC-16	bq2050	EV2050
	800-6,000	1-wire HDQ	Register-compatible with bq2014H	SOIC-16	bq2050H	BQ2050HEVM-002
	800-10,000	2-wire SMBus or 1-wire HDQ16	SBS rev 1.1-compliant with protector IC interface	SSOP-28	bq2063*	BQ2063EVM-001*
Primary Lithium	1,000-12,000	1-wire HDQ	Programmable discharge efficiency compensation	SOIC-16	bq2052	BQ2052EVM-001
NiCd	800-2,000	1-wire DQ	See bq2011 family Selection Guide	SOIC-16	bq2011/J/K	EV2011
NiCd/NiMH	500-6,000	1-wire DQ	5 or 6 LED outputs	SOIC-16	bq2010	EV2010
	500-6,000	1-wire DQ	Slow-charge control	SOIC-16	bq2012	EV2012
	500-6,000	1-wire DQ	External charge-control support	SOIC-16	bq2014	EV2014
	500-6,000	1-wire HDQ	Register-compatible with bq2050H	SOIC-16	bq2014H	BQ2014HEVM-001
NiCd/NiMH/Lead Acid	2,000-15,000	1-wire HDQ	Programmable offset and load compensation	SOIC-16	bq2013H	BQ2013HEVM-001
NiCd/NiMH/Lead Acid/Li-Ion	800-10,000	2-wire SMBus	SBS rev. 1.0-compliant	SOIC-16	bq2040	BQ2040EVM-001 (NiMH)
	800-10,000	2-wire SMBus	SBS rev. 0.95-compliant	SOIC-16	bq2092	n/a
	800-10,000	2-wire SMBus	SBS rev. 1.0-compliant with 5 LEDs	SOIC-16	bq2945	n/a
	800-10,000	2-wire SMBus or 1-wire HDQ16	SBS rev. 1.1-compliant	SSOP-28	bq2060	BQ2060EVM-001 (Li-Ion) BQ2060EVM-002 (NiMH)

* Product preview

Selection Guide for Battery Monitoring

Battery chemistry	Battery pack capacity	Communication interface	Key features	Package	IC part number	EVM part number
Any	Any	1-wire HDQ	Analog peripheral for µC	SOIC-8 or TSSOP-8	bq2018	BQ2018EVM-001
Any	Any	1-wire HDQ	Analog peripheral with Flash for µC	TSSOP-8	bq2019	BQ2019EVM-001

Selection Guide for Battery Protection

Battery chemistry	Number of cells protected	Protection types	Key features	Package	IC part number	EVM part number
Li-Ion	1	Overcharge, overdischarge, overcurrent	Internal MOSFET (50 mΩ total)	TSSOP-16 BCC-18	UCC3952-1, -2, -3, -4 UCC3952A-1, -2, -3, -4	UCC3952EVM-009
	2	Overcharge, overdischarge, overcurrent	Internal MOSFET (80 mΩ total)	SOIC-16	UCC3911-1, -2, -3, -4	UCC3911EVM-025
	3 or 4	Overvoltage, undervoltage, overcurrent	Smart-discharge circuitry	SSOP-16	UCC3957-1, -2, -3, -4	UCC3957EVM-029

Battery Management Evaluation Modules

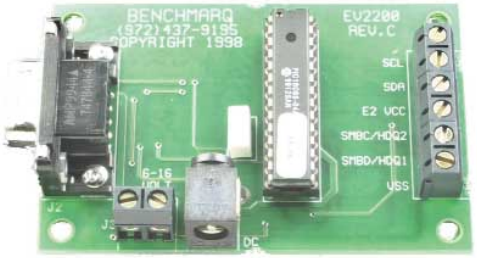
Gas Gauging Evaluation Modules (EVMs)

PC-based EVMs allow quick evaluation of battery gas gauge ICs in the target application.

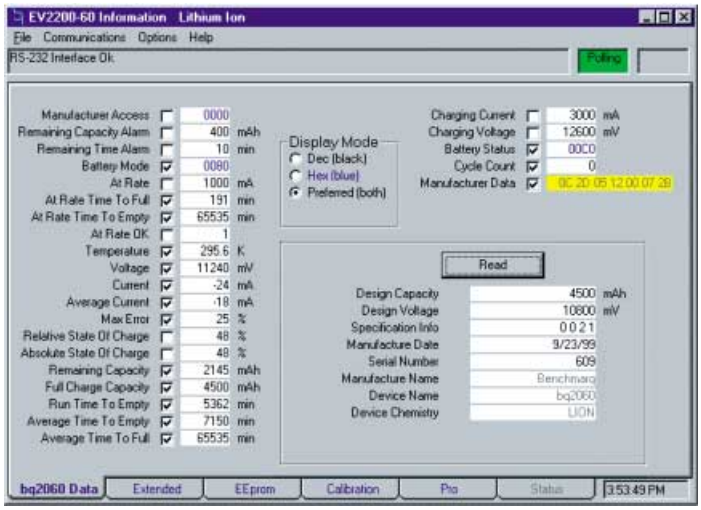
Gas gauging EVMs include:

- Circuit board with gas gauge IC, current sense resistor and battery capacity LED indicators
- Interface circuit and serial cable for PC interface
- PC software to monitor all gas gauge functions and internal registers
- PC software User Guide and other documentation

The EV2200 PC-interface board allows the PC to talk to the gas gauge IC using the PC serial port.



Gas gauge circuit module connects directly to the application's battery and the EV2200 PC-interface board.



Gas Gauge Evaluation Kit PC GUI polls and logs the accessible gas gauge registers for monitoring and analysis of gas gauge operation in the application.

Visit
power.ti.com
for samples, EVMs, technical information and more

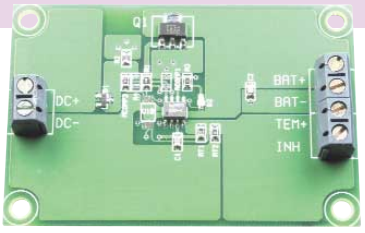
For technical support and ordering literature, see page 15.

Charge Management EVMs

Charge management EVMs provide a development environment for each charge IC. The EVMs illustrate typical circuit implementations for the ICs using gating, switching or linear charge control topologies. With the EVMs, the user can evaluate the performance of a charge management IC solution with a battery pack.

Charge Management EVMs include:

- ➤ EVM documentation and schematic
- ➤ Single board with complete charge management circuit for each IC
- ➤ Direct connections for a power supply and battery allow plug-and-play
- ➤ On-board jumpers to configure charge management IC for various charge levels and parameters, safety timers and status indicators
- ➤ On-board charge status LED indicators
- ➤ Multiple EVMs for some ICs to meet different charge and power requirements



The charge management EVM connects directly to a power supply and a battery pack

Battery Protection EVMs

A complete line of EVMs is also available for the protection ICs. Battery protection EVMs include a typical protection circuit module that connects directly to a battery for in-system evaluation. Some EVMs combine the pack protection circuitry with a TI gas gauge device for full battery monitoring system evaluation. EVMs come with a comprehensive user's guide.

UCC3952EVM-009 connections for the single-cell, pack+ and pack- for quick connection and evaluation

Safe Harbor Statement

This publication may contain forward-looking statements that involve a number of risks and uncertainties. These "forward-looking statements" are intended to qualify for the safe harbor from liability established by the Private Securities Litigation Reform Act of 1995. These forward-looking statements generally can be identified by phrases such as TI or its management "believes," "expects," "anticipates," "foresees," "forecasts," "estimates" or other words or phrases of similar import. Similarly, such statements herein that describe the company's products, business strategy, outlook, objectives, plans, intentions or goals also are forward-looking statements. All such forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those in forward-looking statements. Please refer to TI's most recent Form 10-K for more information on the risks and uncertainties that could materially affect future results of operations. We disclaim any intention or obligation to update any forward-looking statements as a result of developments occurring after the date of this publication.

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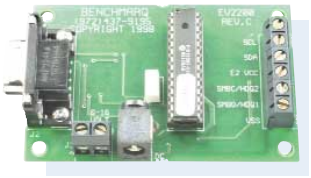
Order a Battery Management Evaluation Module (EVM) for 50% off!

call 1-800-477-8924 and ask for ext. 4941

bq2060EVM-001 Gas Gauge EVM

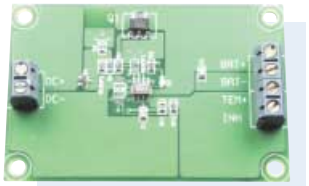
(standard price $99)



- Complete evaluation system for the bq2060 SBS, version 1.1-compliant gas gauge IC
- Preprogrammed bq2060 EEPROM for quick setup
- Includes PC software and interface board for easy evaluation
- Software allows reprogramming for different applications

DV2057C Charger EVM

(standard price $50)



- Complete evaluation and development system for bq2057C Lithium-Ion (Li-Ion) charge management IC
- Ready-to-use charger board with a linear implementation for charge of a one-cell, 4.2-V Li-Ion battery
- Features all charge management functions of the bq2057C like battery pre-conditioning, AutoComp™ charge-rate compensation, safety timer and charge termination
- Direct battery connection

(Limit one discounted EVM per customer. Offer expires March 31, 2001.)

Get the latest on TI's power management products in the new 'Power Management Selection Guide'

The new Power Management Selection Guide provides a single, concise tool to obtain information quickly about TI's high-performance power management products.

The selection guide layout enables anyone, from a new system designer to an experienced power designer, to review key areas rapidly for each of the represented product spaces, to identify a family that meets the design's needs and then select the corresponding TI device number.

Key features of the guide include parametric values, specification tables and a resource section identifying additional information and tools. A power supply decision tree is also included to help quickly identify the type of device required.

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