UNITRODE

Preliminary **bq2148**

Smart Battery Module with LEDs and Pack Supervisor

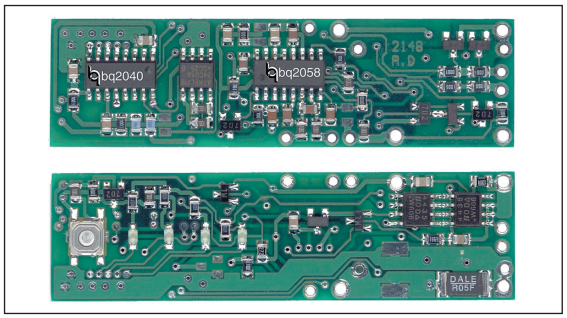
Features

- Complete smart battery management solution for Li-Ion battery packs
- Accurate measurement of available battery capacity
- Provides overvoltage, undervoltage, and overcurrent protection
- Designed for battery pack integration:
  - Small size
  - Includes bq2040 and bq2058 ICs, and configuration EEPROM
  - On-board charge and discharge control FETs
  - Low operating current for minimal battery drain
- Critical battery information available over two-wire serial port
- "L" version includes 4 push-button activated LEDs to display state-of-charge information

General Description

The bq2148 Smaart Battery Module provides a complete and compact battery management solution for Li-Ion battery packs. Designed for battery pack integration, the bq2168 combines the bq2040H Gas Gauge IC with the bq2058 Supervisor IC on a small printed circuit board. The board includes all the necessary components to accurately monitor battery capacity and protect the cells from overvoltage, undervoltage, and overcurrent conditions. The board works with three or four Li-Ion series cells.

The Gas Gauge IC uses the on-board sense resistor to track charge and discharge activity of the battery pack. Critical battery information can be accessed through the serial communications port at SMBC/SMBD. The bq2148 uses the SMBus communications protocol and supports the Smart Battery Data Commands in the SBD specification. The supervisor circuit consists of the bq2058 and two FETs. The bq2058 controls the FETs to protect the batteries during charge/discharge cycles and short circuit conditions. The bq2168 provides contacts for the positive and negative terminals of each battery in the stack. Please refer to the bq2040 and bq2058 data sheets for the specifics on the operation of the power gauge and supervisor ICs.



Unitrode configures the bq2168 based on the information requested in Table 1. The configuration defines all the EEPROM parameters and the protection threshold. Figure 1 shows how the module connects to the cells.

The bq2148L includes four LEDs to display remaining capacity in 25% increments of the learned capacity. The LEDs are activated with the onboard push-button switch.

A module development kit is also available for the bq2148. The bq2148B-KT or the bq2148LB-KT includes one configured module and the following:

1) An EV2200-40 interface board that allows connection to the serial port of any AT-compatible computer.
2) Menu driven software to display charge/discharge activity and to allow user interface to the bq2040 from any standard Windows 3.1x or 95 PC.

Pin Descriptions

POS	**PACK+/Pack positive**
NEG	**PACK-/Pack negative**
SMBC	**Communications clock**
SMBD	**Serial data**
ITEST	**Overcurrent test input**
B1P	**Battery 1 positive input**
B1N	**Battery 1 negative input**
B2N	**Battery 2 negative input**
B3N	**Battery 3 negative input**
B4N	**Battery 4 negative input**

5/99

Table 1. bq2148 Module Configuration

Customer Name: _____

Contact: _____ Phone:_____

Address:_____

Sales Contact: _____ Phone: _____

Board Configuration

LEDs and switch	_____	Yes or No		
Display mode	_____	Relative or Absolute		
Discharge current (3.9A max.)	Min _____	Avg _____	Max _____	
Duration at max. discharge	_____			

Overvoltage threshold (4.25, 4.30, or 4.35V) _____

Number of series cells _____

EEPROM Configuration			Typical Values
Remaining time alarm (min)	_____	Sets the low time alarm level	10 min
Remaining capacity alarm (mAh)	_____	Sets the low capacity alarm level	C/10
Charging voltage (mV)	_____	Sets the requested charging voltage	4.1V/cell
Design cpaacity (mAh)	_____	Defines the battery pack capacity	3600
Design voltage (mV)	_____	Defines the battery pack voltage	10800
Manufacturer date	_____	Battery pack manufacturer date	mm/dd/yy
Serial number	_____	Battery pack serial number	0-65535
Fast-charging current (mA)	_____	Sets the requested charging current	1C
Maintenance charging current (mA)	_____	Sets the requested maintenance charging current	0
Li-Ion taper current (mA)	_____	Sets the upper limit for charge termination	C/10
Maximum overcharge (mAh)	_____	Sets the maximum amount of overcharge	128mAh
Maximum temperature (°C)	_____	Sets the maximum charge temperature	61°C
ΔT/Δt (°C/min)	_____	Sets the termination rate	4.6°C/20s
Fast-charge efficiency (%)	_____	Sets the fast-charge efficiency factor	100%
Maintenance charge efficiency (%)	_____	Sets the maintence charge efficiency factor	100%
Self-discharge rate (%/day)	_____	Sets the batterys self-discharge rate	0.2%/day
EDV1 (mV)	_____	Sets the initial end-of-discharge warning	3.0V/cell
EDVF (mV)	_____	Sets the final end-of-discharge warning	2.8V/cell
Hold-off timer for ΔT/Δt (sec.)	_____	Sets the hold off period for ΔT/Δt termination	320s
Manufacturer name	_____	Programs manufacturer's name (11 char. max)	bq
Device name	_____	Programs device name (7 char. max)	bq202
Chemistry	_____	Programs pack's chemistry (5 char. max)	LION
Manufacturer data	_____	Open field (5 char. max)	2040
FAE approval:	_____	Date: _____	

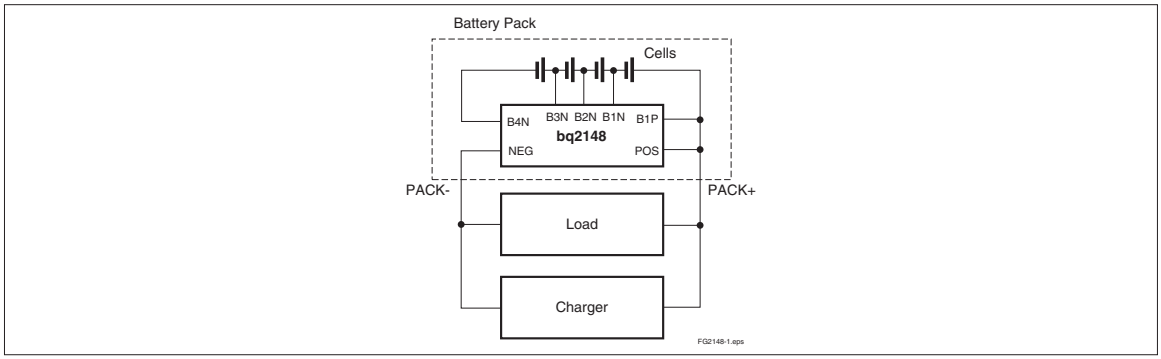


Figure 1. Module Connection Diagram

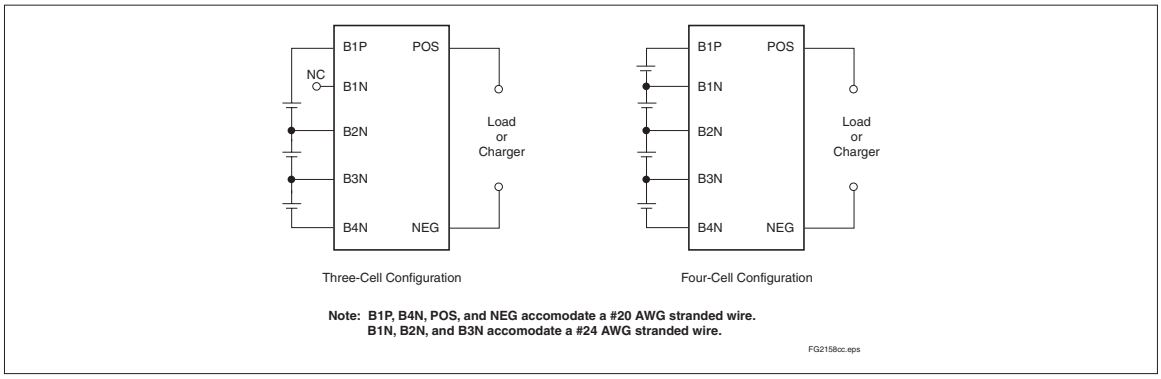


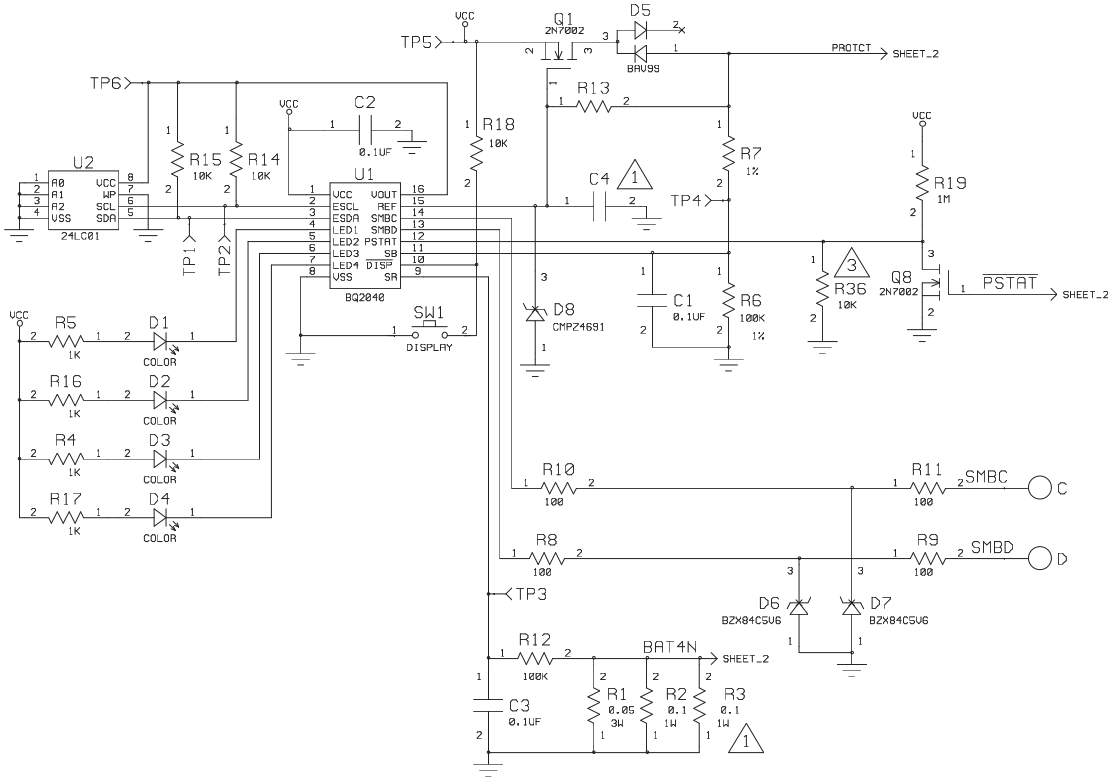
Figure 1. Module Connection Diagram

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit	Conditions
V_{OP}	Supply voltage (B1P to B4N)	18	V	DC
V_{TR}	Maximum transient voltage (B1P to B4N)	32	V	Maximum duration = 1.5µs
V_{CHG}	Charging voltage (POS to NEG)	18	V	
I_{CHG}	Continuous charge/discharge current	3.9	A	V_{OP} > 6V T_A = 25°C
T_{OPR}	Operating temperature	0 to +70	°C	
T_{STG}	Storage temperature	-55 to +125	°C	

Note: Permanent device damage may occur if **Absolute Maximum Ratings** are exceeded. Functional operation should be limited to the Recommended DC Operating Conditions detailed in this data sheet. Exposure to conditions beyond the operational limits for extended periods of time may affect device reliability.

bq2148 Schematic



1 2 3 Component values depend on user-provided information in Table 1.

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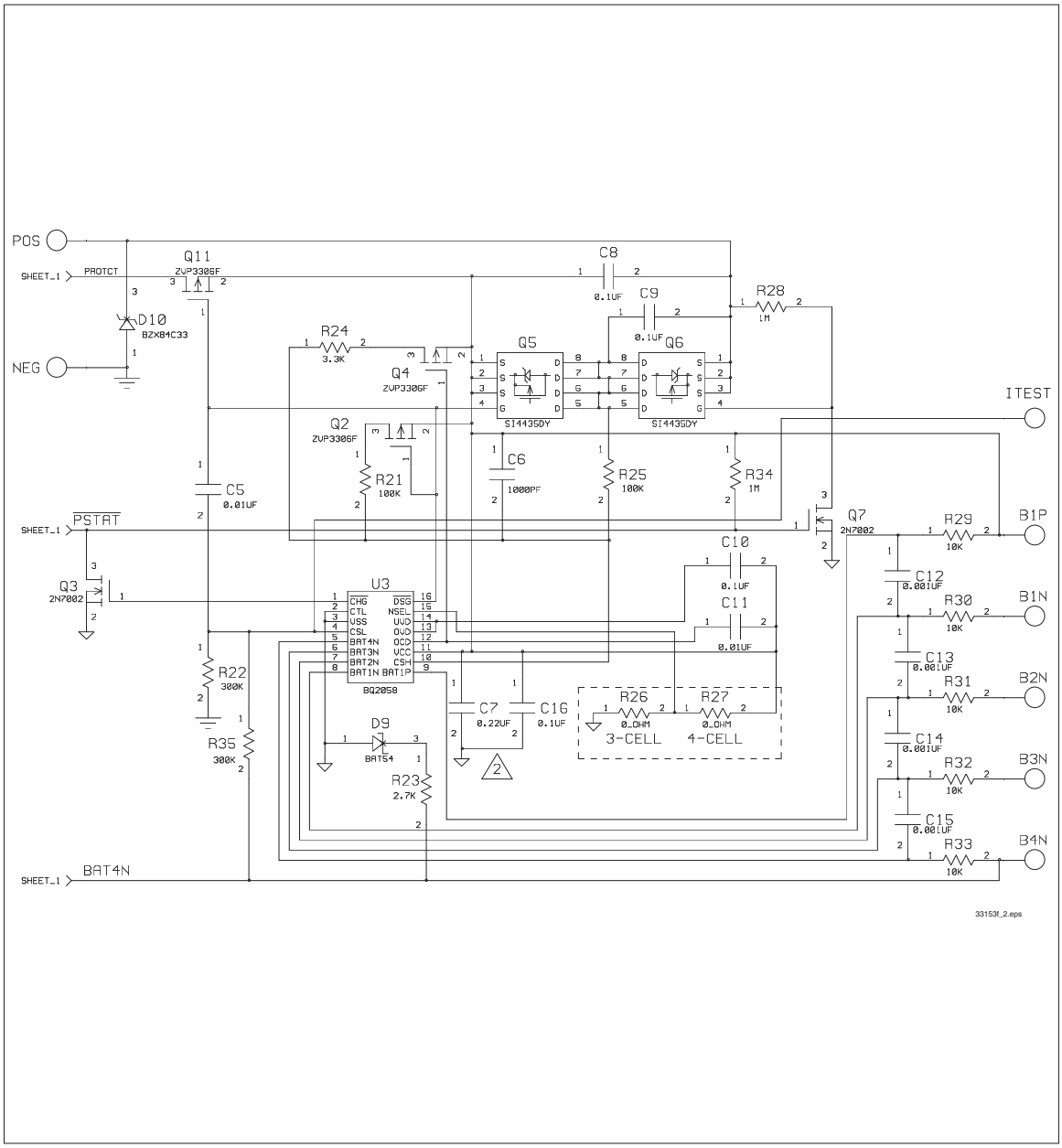
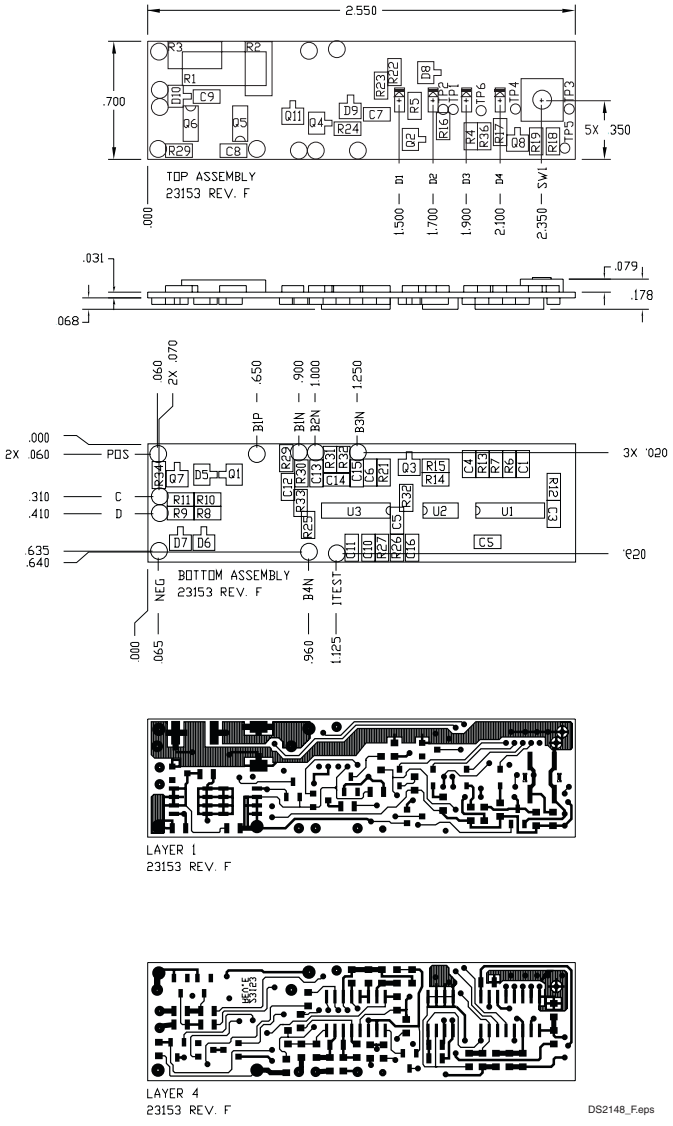
bq2148 Schematic (Continued)



bq2148 Board



DC Electrical Characteristics ($T_A = T_{OPR}$)

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions/Notes
V_{OP}	Operating voltage, B1P to B4N	4.0	-	18	V	
I_{CCA}	Operating current	-	-	350	µA	
R_{ON}	On resistance, B1P to POS	-	-	50	mΩ	T_A = 25°C, V_{OP} = 10V

DC Thresholds ($T_A = T_{OPR}$)

Symbol	Parameter	Value	Tolerance	Unit	Notes
V_{OV}	Overvoltage threshold	4.25	± 50mV	V	
V_{CE}	Charge enable voltage	V_{OV} - 100mV	± 50mV	V	
V_{UV}	Undervoltage limit	2.25	± 100mV	V	
I_{OC}	Overcurrent limit	3.4		A	T_A = 25°C
		3.8		A	T_A = 60°C
t_{UVD}	Undervoltage delay	950	±50%	ms	T_A = 30°C
V_{CD}	Charge detect threshold	70	-60, +80	mV	
t_{OVD}	Overvoltage delay	950	±50%	ms	T_A = 30°C
t_{OCD}	Overcurrent delay	12	±60%	ms	T_A = 30°C

Note: The thresholds above reflect the operation of a bq2148 using the standard bq2058 IC (V_{OV} = 4.25V). Specify other versions of the bq2058 by indicating the appropriate V_{OV} threshold in Table 1.

Ordering Information

bq2148 B —

Customer Code:
Blank = Sample or Pre-production[1]
KT = Evaluation system
XXX = Customer-specific; assigned by Unitrode[2]

Package Option:
B = Board-level product

LED Option:
L = LEDs plus switch
Blank = No LEDs or switch

Device:
Smart Battery Module with LEDs and Pack Supervisor

Notes:
1. Requires configuration sheet (Table 1)
2. Example production part number: bq2148LB-001

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