

Li-Ion Power Gauge™ Module with Pack Supervisor

Features

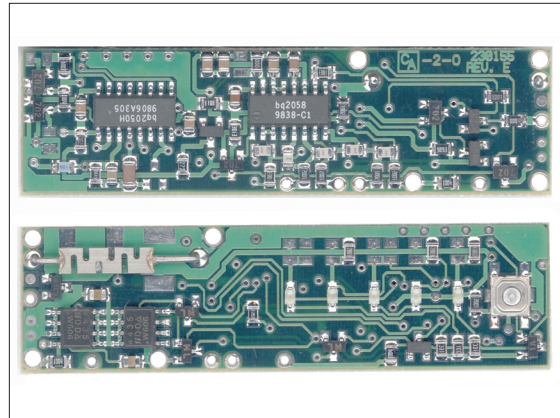
- Complete and compact lithium ion gas gauge and protection solution for three or four series cells
- Accurate measurement of available battery capacity
- Provides overvoltage, undervoltage, and overcurrent protection
- Designed for battery pack integration
 - Small size
 - Includes bq2050H and bq2058 ICs
 - On-board charge and discharge control FETs
 - Low operating current for minimal battery drain
- High side FET control
- Battery capacity available through single-wire serial port
- “L” version includes 5 push-button activated LEDs to display state-of-charge information

General Description

The bq2168 Power Gauge Module provides a complete and compact battery management solution for Li-Ion battery packs. Designed for battery pack integration, the bq2168 combines the bq2050H Power 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 Power 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 HDQ. 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 bq2050H 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 the number of series cells, the nominal battery pack capacity, the self-discharge rate, the Li-Ion battery type (coke



or graphite anode), and the threshold limits. Figure 1 shows how the module connects to the cells.

The bq2168L includes five LEDs to display remaining capacity in 20% increments of the learned capacity. The LEDs are activated with the onboard push-button switch.

A module development kit is also available for the bq2168. The bq2168B-KT or the bq2168LB-KT includes one configured module and the following:

- 1) An EV2200-50H 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 bq2050H from any standard Windows 3.1x or 95 PC.

Pin Descriptions

POS	Pack positive
B1P	BAT_{1P}/Battery 1 positive input
B1N	BAT_{1N}/Battery 1 negative input
B2N	BAT_{2N}/Battery 2 negative input
B3N	BAT_{3N}/Battery 3 negative input
B4N	BAT_{4N}/Battery 4 negative input
ITEST	Overcurrent test input
HDQ	Serial communications port
NEG	Pack negative

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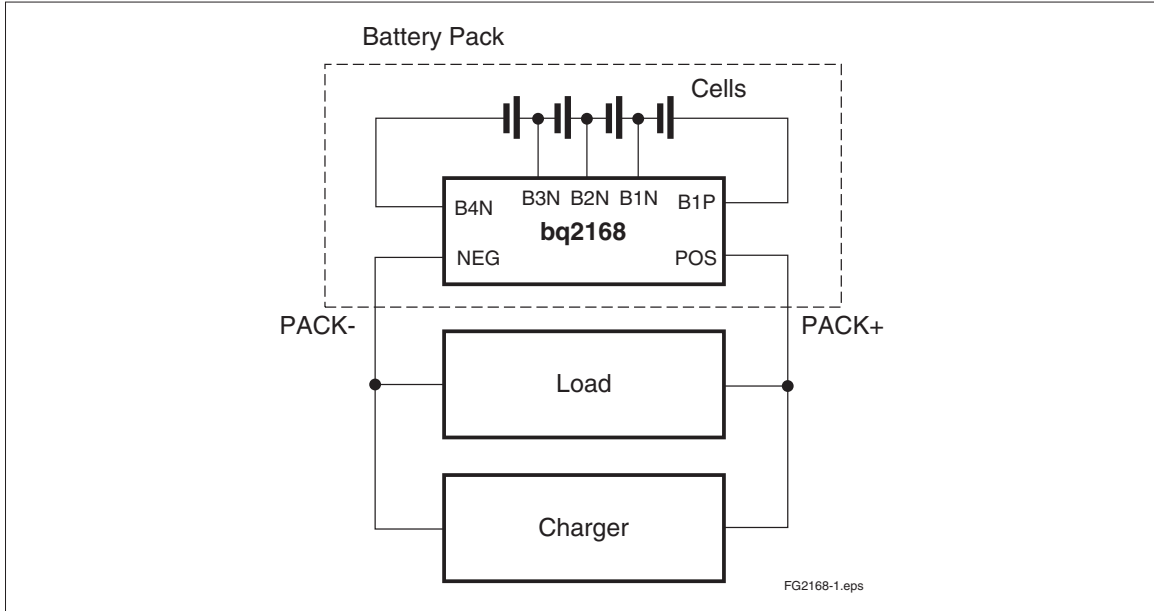


Figure 1. Module Connection Diagram

Table 1. bq2168 Module Configuration

Customer Name: _____

Contact: _____ Phone: _____

Address: _____

Sales Contact: _____ Phone: _____

Number of series cells (3 or 4) _____

Coke or graphite cell anode _____

Battery pack capacity (mAh) _____

Discharge current into load (3.9A max.) min. _____ avg. _____ max. _____

Charge current (3.9A max) _____

Self-discharge compensation (Y/N) _____

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

LEDs and switch (Y/N) _____

FAE approval: _____ Date: _____

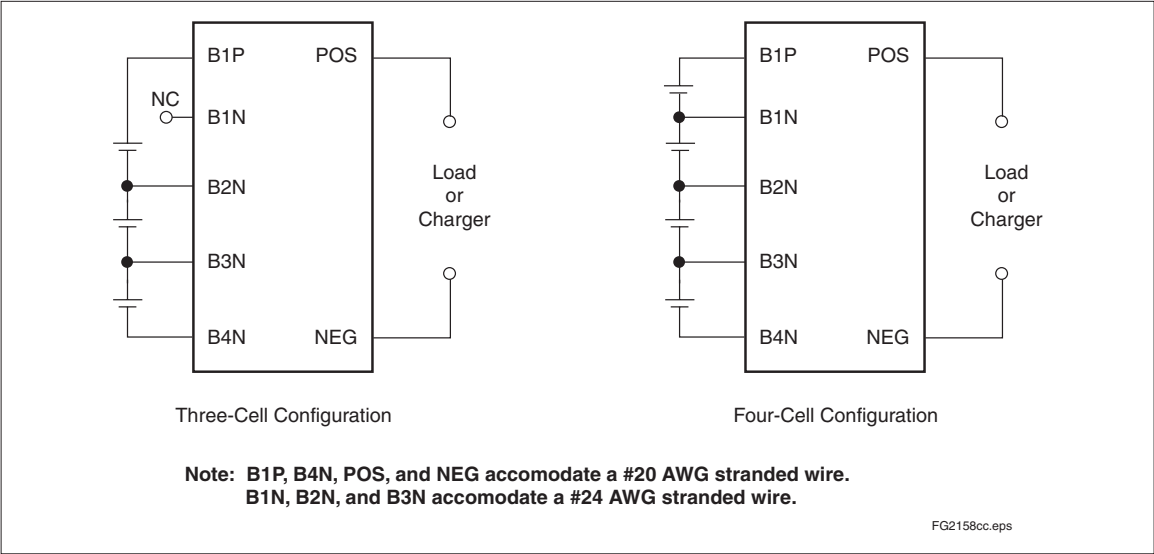
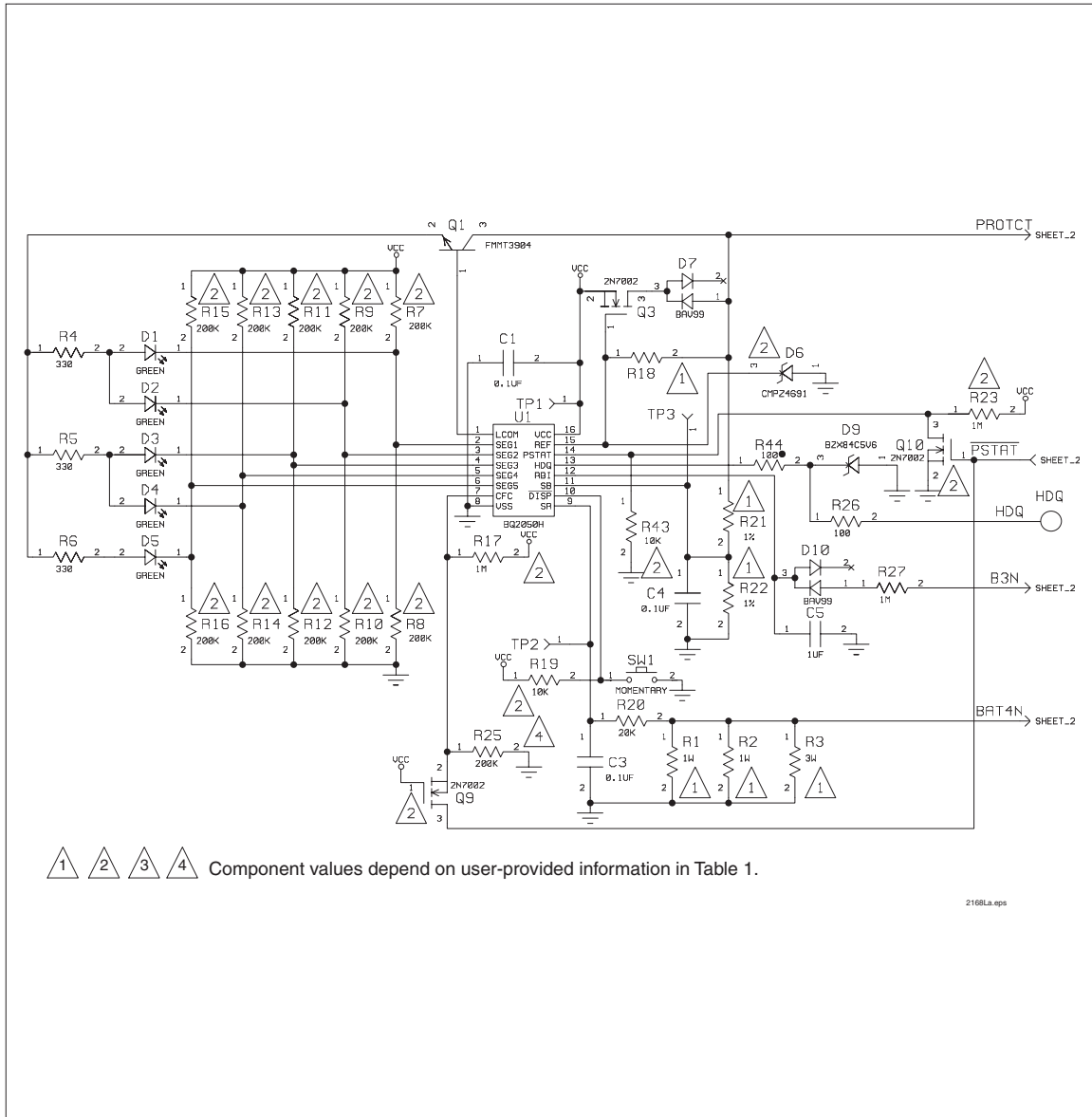


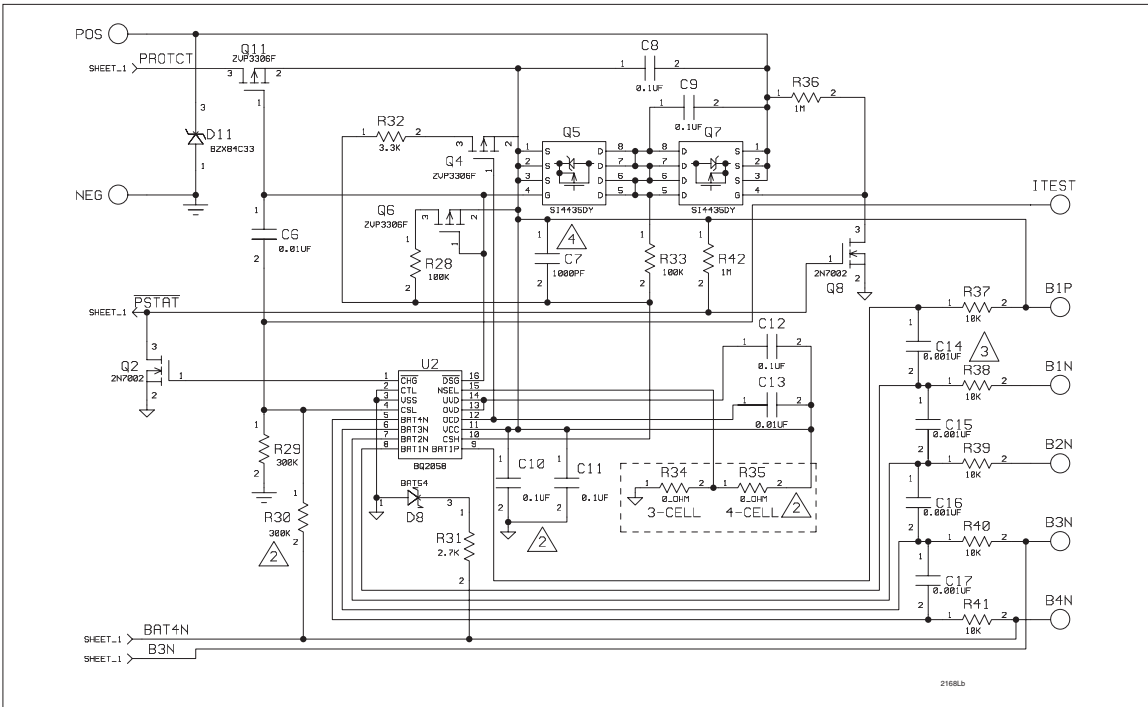
Figure 1. Module Connection Diagram

bq2168

bq2168 Schematic



bq2168 Schematic (Continued)



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.

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

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DC Thresholds (T_A = T_{OPR})

Symbol	Parameter	Value	Tolerance	Unit	Notes
V _{OV}	Overshoot 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}	Overshoot delay	950	±50%	ms	T _A = 30°C
t _{OCD}	Overcurrent delay	12	±60%	ms	T _A = 30°C

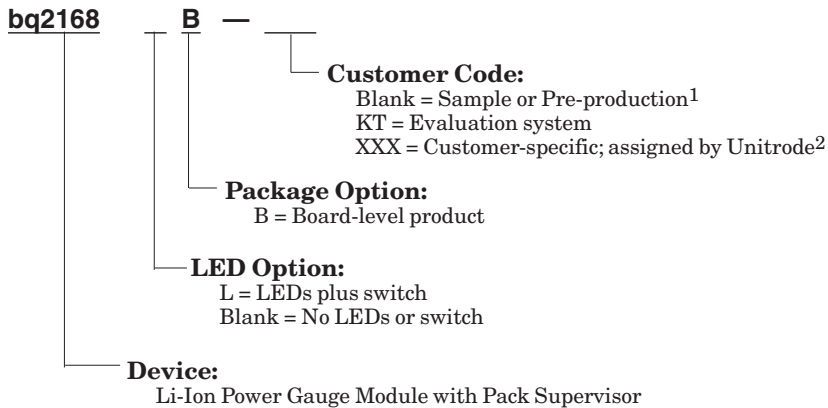
Note: The thresholds above reflect the operation of a bq2158 using the standard bq2058 IC (V_{OV} = 4.25V). Specify other versions of the bq2058 by indicating the appropriate V_{OV} threshold in Table 1.

Data Sheet Revision History

Change No.	Page No.	Description	Nature of Change
1	All	From Preliminary to Final	

Note: Change 1 = May 1999 B changes from Apr. 1999.

Ordering Information



- Notes:**
1. Requires configuration sheet (Table 1)
 2. Example production part number: bq2168LB-001

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