bq2111L

## NiCd Gas Gauge Module with LEDs for High Discharge Rates

Features

➤ Complete bq2011 Gas Gauge solution for NiCd packs in high discharge rate applications

➤ Five surface-mounted LEDs to display state-of-charge information

➤ Battery state-of-charge monitoring for 4- to 12-cell series applications

➤ On-board regulator allows direct connection to the battery

➤ Battery information available over a single-wire bidirectional serial port

➤ Nominal capacity pre-configured

➤ Compact size for battery pack integration

General Description

The bq2111L Gas Gauge Module provides a complete and compact solution for capacity monitoring of NiCd battery packs in high discharge rate applications such as power tools. Designed for battery pack integration, the bq2111L incorporates a bq2011 Gas Gauge IC, five surface-mounted LEDs, and the other discrete components necessary to monitor and display accurately the capacity of 4- to 12-series cells. The only external component required is a low-value sense resistor connected between GND and PACK-. Contacts are also provided on the bq2111L for direct connection to the battery stack and the serial communications port (DQ). The battery stack should be connected between BAT+ and GND. Please refer to the bq2011 data sheet for the specifics on the operation of the Gas Gauge.

Unitrode configures the bq2111L based on the information requested in Table 1. The configuration defines the number of series cells and the nominal battery pack capacity. The bq211L module uses the absolute LED display to indicate battery capacity. In this mode, the remaining capacity is represented as a percentage of the programmed capacity.

The bq2111L can operate directly from four series cells within the pack using the LBAT+ supply input. For four series cell applications or applications using the on-board regulator, LBAT+ should be connected to BAT+. Please refer to Figure 1 for module connection illustrations.
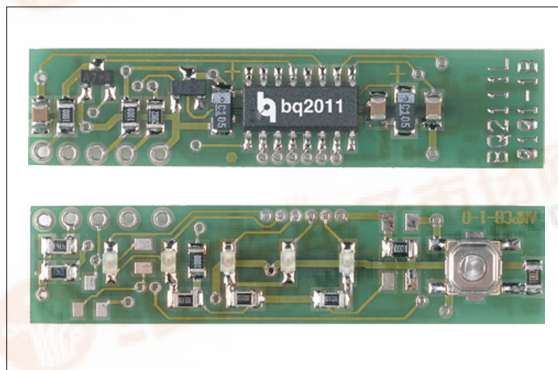
A module development kit is also available for the bq2111L. The bq2111LB-KT includes one configured module and the following:

1) An interface board that allows connection to the serial port of an AT-compatible computer.

2) Menu-driven software with the bq2111L to display charge/discharge activity and to allow user interface to the bq2011 from any standard DOS PC.

3) Source code for the TSR.

Pin Descriptions

P1   **DQ/Serial communication port**

P2   **BAT+/Battery positive/Pack positive**

P3   **LBAT+/Four--cell power**

P4   **PACK-/Pack negative**
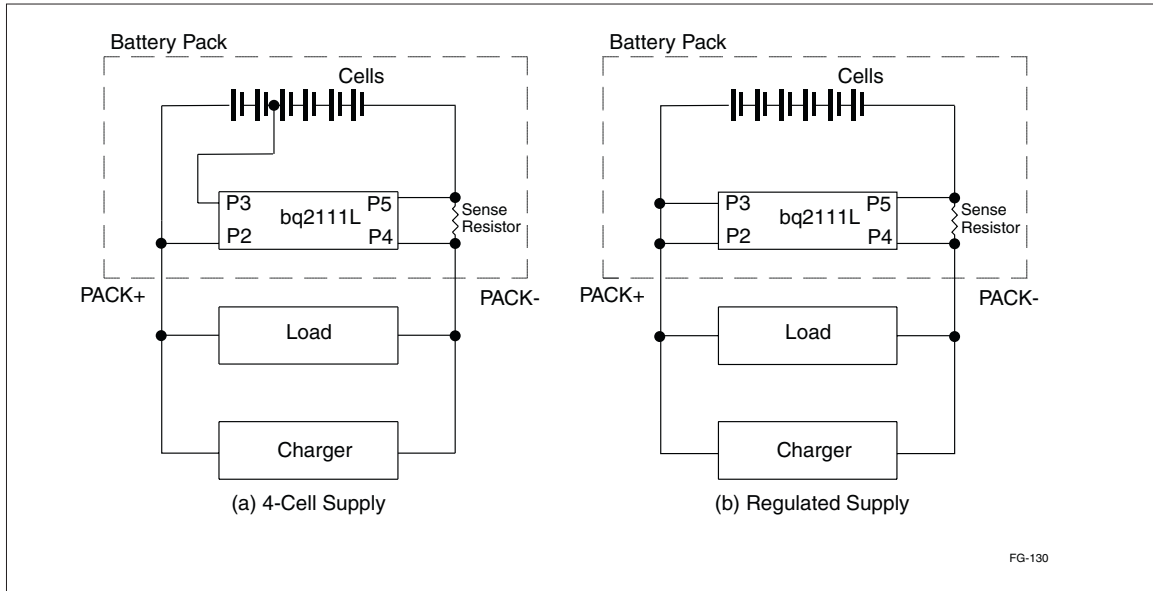
P5   **GND/Ground**

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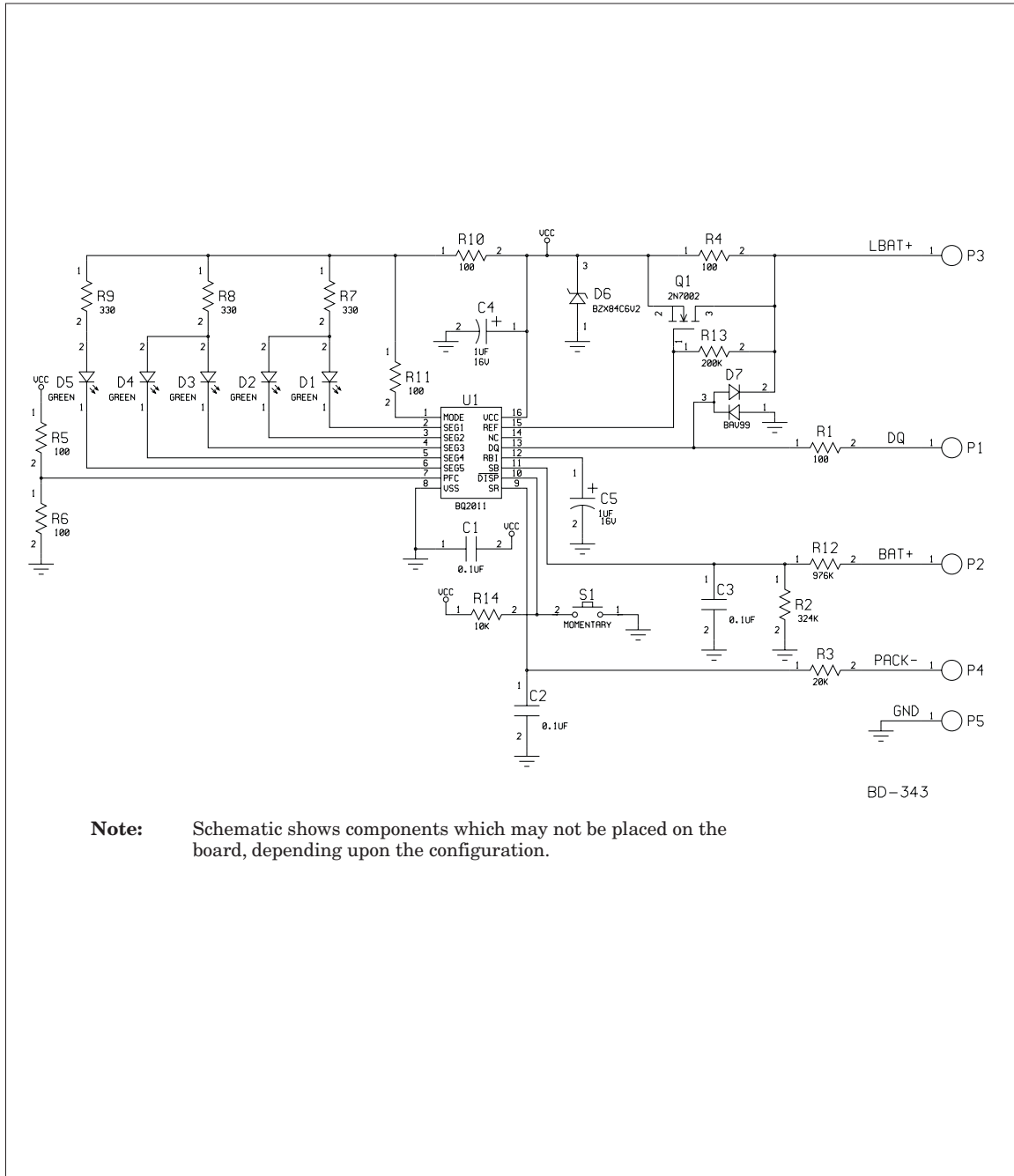Figure 1. Module Connection Diagram

Table 1. bq2111L Module Configuration

Customer Name: _____

Contact: _____ Phone: _____

Address: _____

_____

Sales Contact: _____ Phone: _____

    Number of series battery cells (4–12)   _____

    Sense resistor size in mΩ[1]   _____

    Battery pack capacity (mAh)   _____

    Discharge rate(A)   Min._____   Avg._____   Max._____

    Charge rate (A)   _____

FAE approval: _____ Date:_____

Note: 1.   Sense resistor is not included with board.
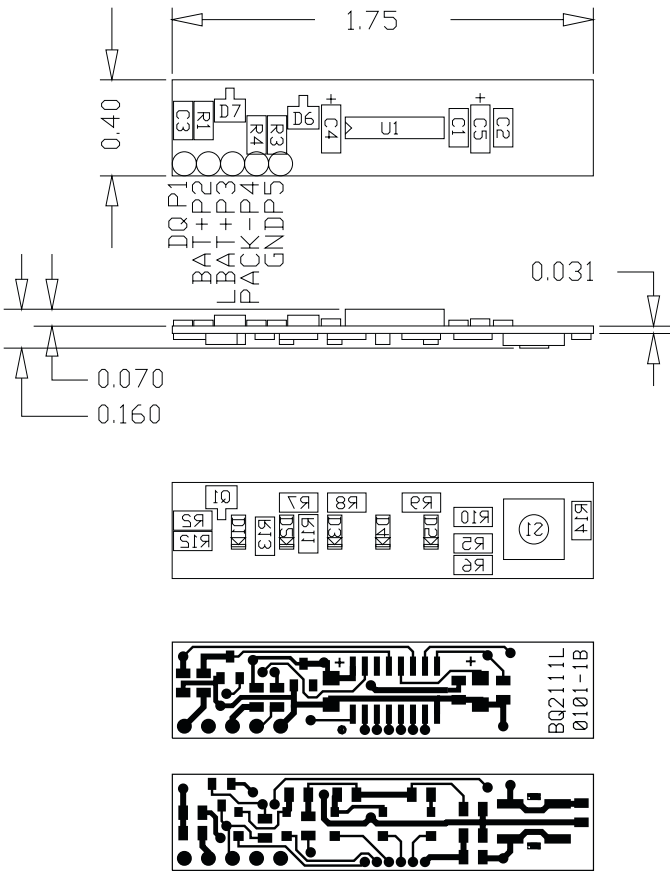
bq2111L Example Schematic

BD-343

Note: Schematic shows components which may not be placed on the board, depending upon the configuration.

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bq2111L Board

BD-344

Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit	Notes
V_{CC}	Relative to V_{SS}	-0.3	+7.0	V	bq2011
All other pins	Relative to V_{SS}	-0.3	+7.0	V	bq2011
T_{OPR}	Operating temperature	0	+70	°C	Commercial
T_{STR}	Storage temperature	-40	+85	°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
NumCell	Number of series cells in battery pack	4	-	12	-	
BAT+	Positive terminal of pack	GND	NumCell * 1.2V	NumCell * 1.8V	V	
V_{SR}	Voltage across the sense resistor, P4 to P5	-0.3	-	2	V	
V_{CC}	Supply voltage (direct cell operation) LBAT+	3.0	4.8	7.2	V	
I_{CC}	Supply current at BAT+ terminal (no external loads)	-	120	250	μA	
R_{DQ}	Internal pull-down	500k	-	-	Ω[1]	
I_{OL}	Open-drain sink current DQ	-	-	5.0	mA[1]	
V_{OL}	Open-drain output low, DQ	-	-	0.5	V[1]	$I_{OL} < 5mA$
V_{IHDQ}	DQ input high	2.5	-	-	V[1]	
V_{ILDQ}	DQ input low	-	-	0.8	V[1]	
V_{OS}	Voltage offset			150	μV[1]	

Note: 1. Characterized on PCB, IC 100% tested.

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

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
V_{EDV}	Final empty warning	0.87	0.90	0.93	V	BAT+/NumCell[1]
V_{MCV}	Maximum single-cell voltage	1.95	2.0	2.05	V	BAT+/NumCell[1]
V_{SR1}	Discharge compensation threshold	20	50	75	mV	$V_{SR} + V_{OS}$[2]
V_{SR2}	Discharge compensation threshold	70	100	125	mV	$V_{SR} + V_{OS}$[2]
V_{SR3}	Discharge compensation threshold	120	150	175	mV	$V_{SR} + V_{OS}$[2]
V_{SR4}	Discharge compensation threshold	220	253	275	mV	$V_{SR} + V_{OS}$[2]
V_{SRO}	Sense resistor sense range	-300	-	+2000	mV	$V_{SR} + V_{OS}$[2]
V_{SRQ}	Valid charge	-	-	-400	µV	$V_{SR} + V_{OS}$[2]
V_{SRD}	Valid discharge	500	-	-	µV	$V_{SR} + V_{OS}$[2]

Notes: 1. At SB input of bq2011
2. At SR input of bq2011

Ordering Information

bq2111L 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

Device:
NiCd Gas Gauge Module with LEDs
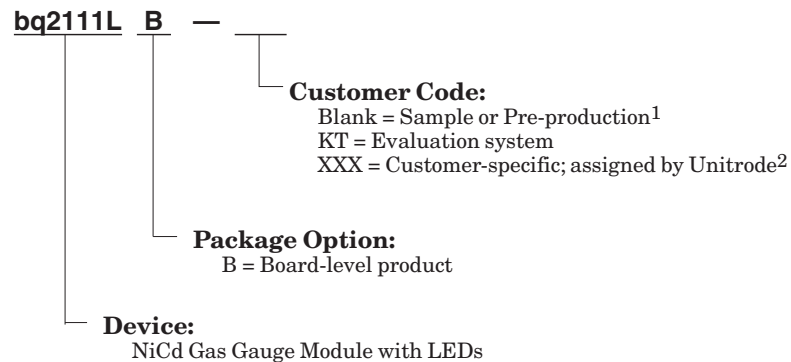
Notes: 1.   Requires configuration sheet (see Table 1)

2.   Example production part number: bq2111LB-001

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