bq2164

NiCd or NiMH Gas Gauge Module with Fast-Charge Control

Features

➤ Complete bq2004/bq2014 battery management solution for NiCd or NiMH pack

➤ Accurate battery state-of-charge monitoring

➤ Reliable fast charge termination

➤ Automatic full capacity calibration

➤ Battery information available over a single-wire bi-directional serial port

➤ Nominal capacity, cell chemistry, and charge control parameters pre-configured

➤ Compact size for battery pack integration

General Description

The bq2164 Gas Gauge Module provides a complete and compact battery management solution for NiCd and NiMH battery packs. Designed for battery pack integration, the bq2164 combines the bq2014 Gas Gauge IC with the bq2004 Fast-Charge IC on a small printed circuit board. The board includes all the necessary components to accurately monitor the capacity and reliably terminate fast charge of 5 to 10 series cells.

The gas gauge IC uses the onboard sense resistor to track charge and discharge activity of the battery pack. The fast charge IC gates a current-limited or constant-current charging supply connected to PACK+. Charging termination is based on $\Delta T/\Delta t$ or $-\Delta V/PVD$, maximum temperature, time, and voltage. The bq2004 signals charge completion to the bq2014 to indicate full capacity. The charge complete signal to the gas gauge eliminates the need to fully cycle the battery pack to initially calibrate full pack capacity.

Contacts are provided on the bq2164 for direct connection to the battery stack (BAT+, BAT-), the gas gauge's communications port (DQ), and the thermistor (THERM+, THERM). The thermistor is required for temperature fast charge termination. Please refer to the bq2004 and bq2014 data sheets for the specifics on the operation of the gas gauge and the fast charge ICs.

Unitrode configures the bq2164 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, and the fast charge control parameters. The control parameters depend on the charge rate, cell chemistry and termination technique

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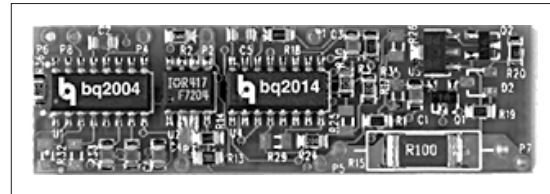
specified in the configuration table. They consist of the fast charge hold-off, safety timers, and the pulse trickle rate as shown in the bq2004 data sheet. The bq2164 is optimized for temperature termination with the thermistor provided with the development kit. Figure 1 shows how the module connects to the cells.

The sense resistor value and type should also be specified on the configuration sheet. The two options available are a 3W through-hole type or a 1W surface-mount type. Please refer to the application note entitled "A Tutorial for Gas Gauging" to select the proper value.

A module development kit is also available for the bq2164. The bq2164B-KT includes one configured module and the following:

1) A serial interface board that allows connection to the RS-232 port of an AT-compatible computer.

2) Menu-driven software with the bq2164 to display charge/discharge activity and to allow user interface to the bq2014 from any standard DOS PC.

3) Source code for the TSR.

4) A Philips 10K NTC Thermistor type 2322-640-63103.

Pin Description

P1	**DQ/Serial communication port**
P2	**BAT+/Battery positive**
P3	**PACK+/Pack positive**
P4	**PACK-/Pack negative**
P5	**BAT-/Battery negative**
P6	**THERM+/Thermistor positive**
P7	**THERM-/Thermistor negative**
P8	**MOD/Fast charge control output**
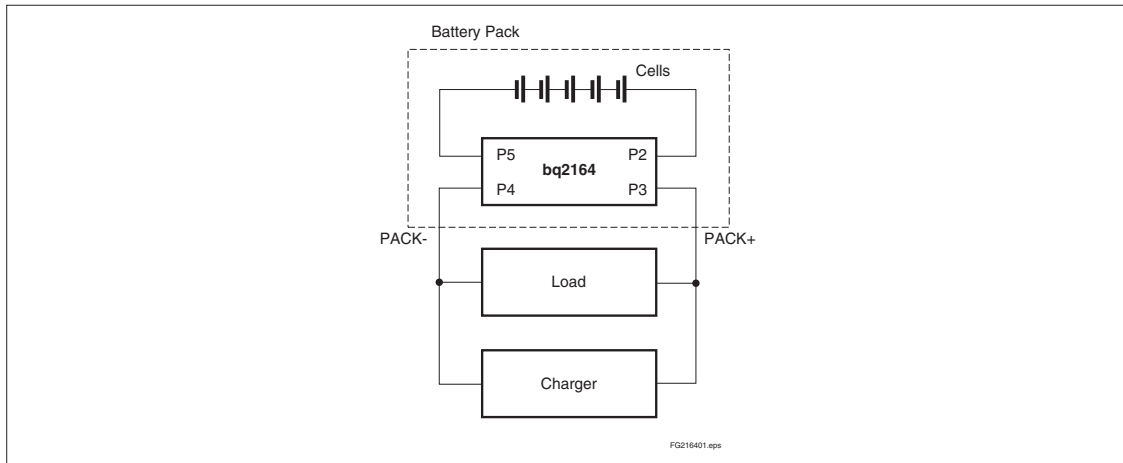
Figure 1. Module Connection Diagram

Table 1. bq2164 Module Configuration

Customer Name: _____

Contact: _____   Phone: _____

Address: _____

_____

Sales Contact: _____   Phone: _____

Number of series battery cells (5-10)   _____

Battery type (NiCd or NiMH)   _____

Battery pack capacity (mAh)   _____

Discharge rate into load (2.0A max.)   Min. _____   Avg. _____   Max. _____

Sense resistor type:
(Thru-hole (3W) or surface-mount (1W))   _____

Sense resistor size in mΩ   (0.1Ω standard)   _____

Fast charge current (2.0A max.)   _____
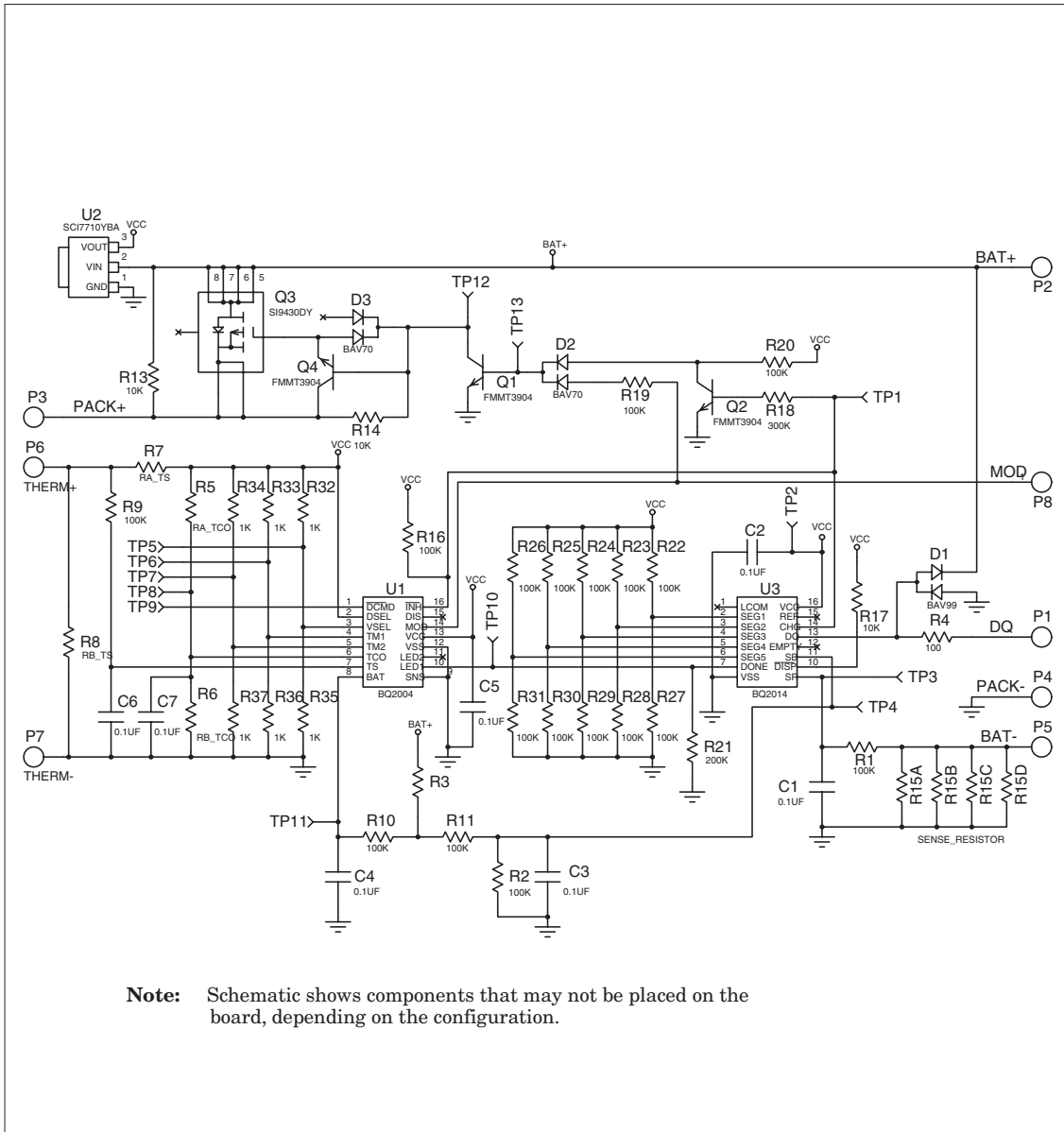
Charge voltage (V)   _____

Temperature termination (enabled/disabled)   _____
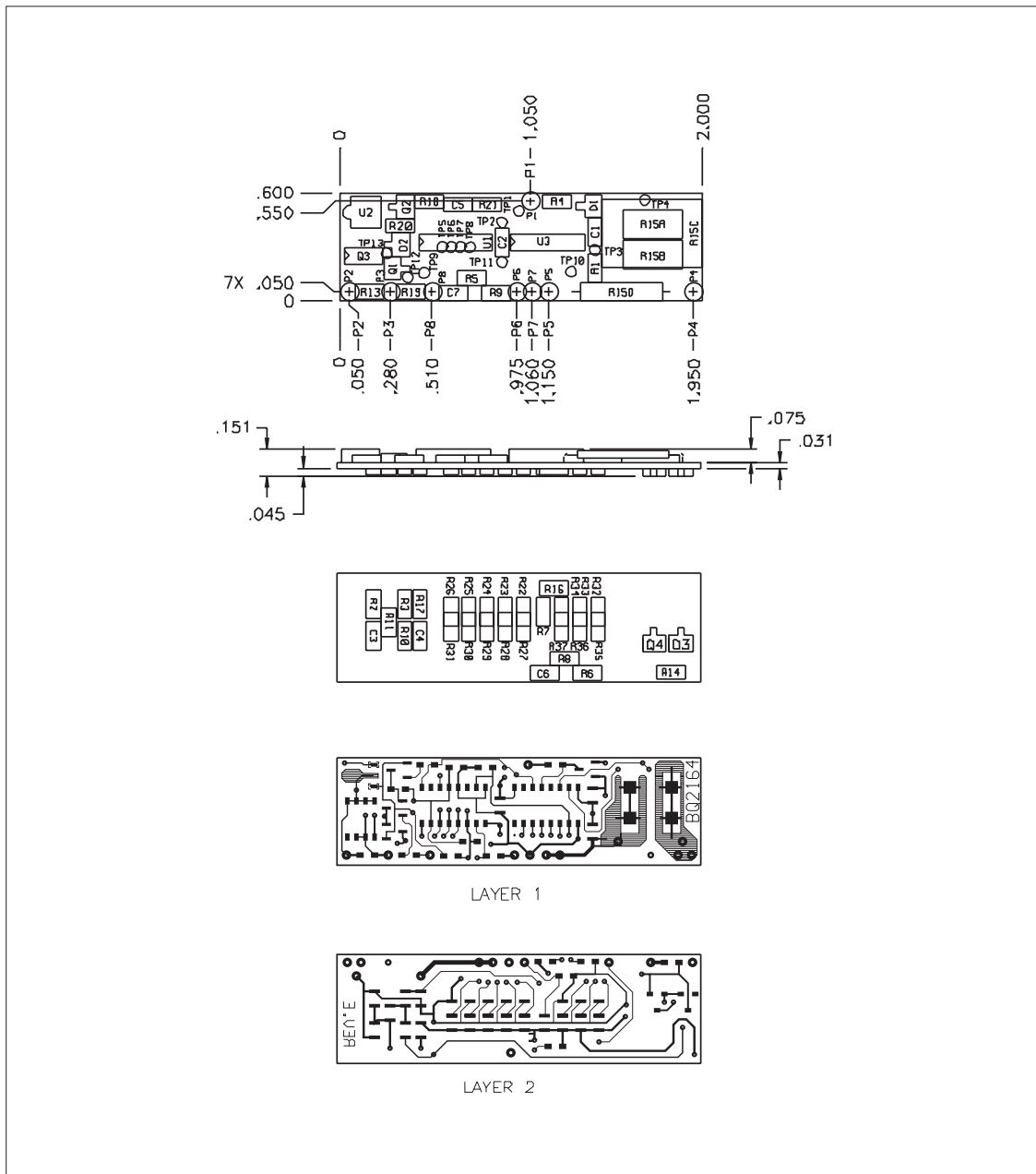
PVD or -ΔV termination   _____

FAE Approval _____   Date _____

bq2164 Schematic

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

bq2164 Board

Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit	Notes
P_{SR}	Continuous sense resistor power dissipation	-	3	W	Thru-hole sense resistor
		-	1	W	Surface-mount sense resistor
V_{CHG}	Charging voltage	-	20	V	
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 $(T_A = T_{OPR})$

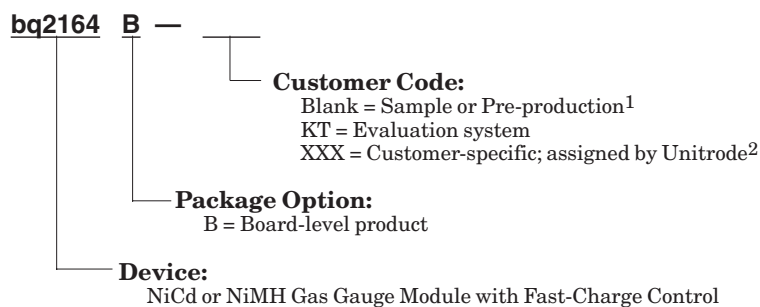| Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions/Notes
NumCell	Number of cells in battery pack	5	-	10	-	
BAT+	Positive terminal of pack	GND	NumCell * 1.2V	NumCell * 1.8V	V	
BAT-	Negative terminal of pack	GND - 0.3	-	GND+2.0	V	
I_{CC}	Supply current at BAT+ terminal (no external loads)	-	200	300	µA	
I_{CHG}	Charge current	-	-	2	A	
I_{DSCHG}	Discharge current	-	-	2	A	
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_{IHDQ}	DQ input low	-	-	0.8	V[1]	
V_{OS}	Voltage offset			150	µV[1]	

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

bq2164

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

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Notes
V_{EDVF}	Final empty warning	0.93	0.95	0.97	V	BAT+/NumCell[1]
V_{EDV1}	First empty warning	1.03	1.05	1.07	V	BAT+/NumCell[1]
V_{MCV}	Maximum single-cell voltage	2.20	2.25	2.30	V	BAT+/NumCell[1]
V_{SRO}	SR sense range	-300	-	+2000	mV	$V_{SR} + V_{OS}$[2]
V_{SRQ}	Valid charge	375	-	-	µV	$V_{SR} + V_{OS}$ [2, 3]
V_{SRD}	Valid discharge	-	-	-300	µV	$V_{SR} + V_{OS}$ [2, 3]
V_{SR1}	Discharge compensation threshold	-120	-150	-180	mV	$V_{SR} + V_{OS}$[2]
T_{LTF}	Low-temperature charging fault	-	10	-	°C	Low-temperature charge inhibit/terminate[4]
T_{HTF}	High-temperature charging fault	-	45	-	°C	High-temperature charge inhibit
V_{EDVC}	Minimum charging cell voltage	-	1	-	V	Minimum cell voltage to initiate charge
V_{MCVC}	Maximum charging cell voltage	-	2	-	V	Maximum cell voltage to initiate or continue charge
$R_{\Delta T/\Delta t}$	$\Delta T/\Delta t$ charge termination rate	-	1	-	°C/ min.	@ 30°C
T_{TCO}	Maximum charging temperature	-	50	-	°C	High-temperature charge termination

Notes:
1. At SB input of bq2014.
2. At SR input of bq2014.
3. Default value; value set in DMF register.
4. PVD termination disables the low-temperature fault charge termination.

Ordering Information

bq2164 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 or NiMH Gas Gauge Module with Fast-Charge Control

Notes:
1. Requires configuration sheet (Table 1)
2. Example production part number: bq2164B-001

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