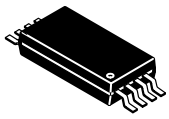
TEXAS INSTRUMENTS

bq27000
bq27010



SLUS556 – FEBRUARY 2003

SINGLE-CELL LI-ION AND LI-POL BATTERY GAS GAUGE IC FOR PORTABLE APPLICATIONS (bqJUNIOR™)

FEATURES

- **Reports Accurate *Time-to-Empty* in Li-Ion and Li-Pol Cells, No System Processor Calculations Needed**
- **Reports Cell Temperature, Voltage and Average Current**
- **High-Accuracy Coulometric Charge and Discharge Current Integration with Automatic Offset Cancellation**
- **Requires No Offset Calibration**
- **Programmable Input/Output Port**
- **Internal Time-Base Eliminates External Crystal Oscillator**
- **Four Automatic Low-Power Operating Modes**
  - **Active: < 100 μA**
  - **Sleep: < 5 μA**
  - **Ship: < 2 μA**
  - **Hibernate: < 500 nA**
- **Small 8-Pin TSSOP Package**

APPLICATIONS

- **PDAs**
- **Smart Phones**
- **MP3 Players**
- **Digital Cameras**
- **Internet Appliances**
- **Handheld Devices**

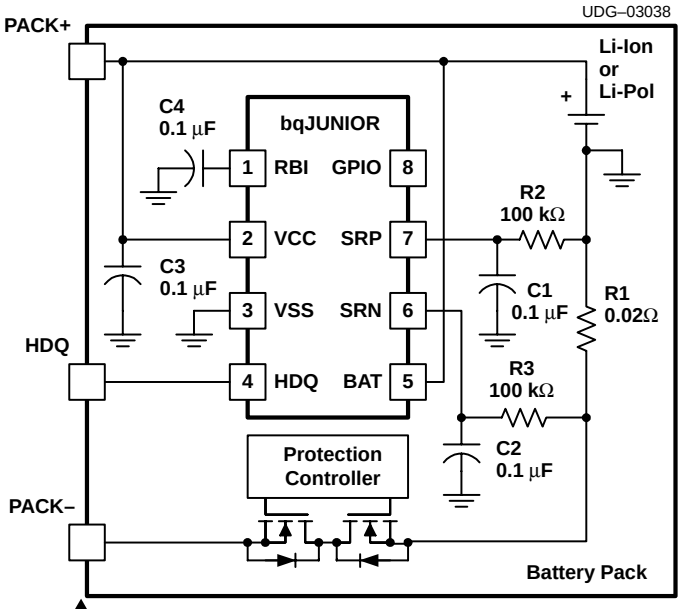
DESCRIPTION

The bqJUNIOR series are highly accurate standalone single-cell Li-Ion and Li-Pol battery capacity monitoring and reporting devices targeted at space limited portable applications. The device monitors a voltage drop across a small current sense resistor connected in series with the battery to determine charge and discharge activity of the battery. Compensations for battery temperature, self–discharge, and rate of discharge are applied to the charge counter to provide available *time-to-empty* and *time-to-full* information across a wide range of operating conditions. Battery capacity is automatically recalibrated, or *learned*, in the course of a discharge cycle from full to empty. Internal registers include available time-to-empty, cell temperature and voltage, average current, and other status and control registers.

The bqJUNIOR can operate directly from single-cell Li-Ion and Li-Pol batteries and communicates to the system over a simple one-wire bi-directional serial interface. The 5-kbits/s HDQ bus interfaces reduces communications overhead in the external microcontroller.

PRODUCT PREVIEW

TYPICAL APPLICATION



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ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range unless otherwise noted(1) (2)

		bq27000 bq27010
Supply voltage range, V_{CC} (all with respect to V_{SS})		–0.3 V to 7.0 V
Input voltage range at SRP, SRN, RBI, and BAT (all with respect to V_{SS})		–0.3 V to V_{CC} + 0.3 V
Input voltage	HDQ, GPIO (with respect to V_{SS})	–0.3 V to 7.0 V
	GPIO (with respect to V_{SS}) during EEPROM programming only	–0.3 V to 22.0 V
Output sink current at GPIO, HDQ		5 mA
Operating free-air temperature range, T_A		–20°C to 70°C
Storage temperature range, T_{stg}		–65°C to 150°C
Junction temperature range, T_J		–40°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		300°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability

PRODUCT PREVIEW

RECOMMENDED OPERATING CONDITIONS

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	2.6		4.5	V
Operating free-air temperature, T_J	–20		70	°C

ELECTRICAL CHARACTERISTICS

T_J = –20°C to 70°C, $T_J = T_A$, 2.6 V ≤ V_{CC} ≤ 4.5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
INPUT CURRENTS						
$I_{CC(VCC)}$	Input current, V_{CC}	$V_{CC} > V_{CC(min)}$			100	µA
$I_{CC(SLP)}$	Sleep current				5	
$I_{CC(SHP)}$	Ship current				2	
$I_{CC(POR)}$	Hibernate current	$0 V < V_{CC} < V_{(POR)}$			500	nA
	EEPROM programming current	$V_{PROGRAM}$ = 21 V			15	mA
	RBI current	RBI pin only, $V_{CC} < V_{(POR)}$			20	nA
$V_{(POR)}$	POR threshold		2.0		2.5	V
	RBI data retention voltage		1.2			
	Input impedance on BAT pin		10			MΩ
	Input impedance on SRR, SRN pins		10			
VOLTAGE MEASUREMENT						
	Measurement range	$V_{CC} = V_{I(BAT)}$	2.6		4.5	V
	Reported voltage resolution			2.7		mV
	Reported accuracy		–25		25	
	Voltage update time			2		s
VOLTAGE MEASUREMENT						
	Reported temperature resolution			0.25		°K
	Reported temperature accuracy		–3		3	
	Temperature update time			2		s

ELECTRICAL CHARACTERISTICS (continued)

T_J = –20°C to 70°C, $T_J = T_A$, 2.6 V ≤ V_{CC} ≤ 4.5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
EEPROM PROGRAMMING VOLTAGE						
t_{RISE}	Programming voltage rise time		0.5		1.5	ms
	Programming voltage high time		10		100	
t_{FALL}	Programming voltage fall time		0.5		1.5	
	Programming voltage	Applied to GPIO pin	20		22	V
IO PORT (GPIO) AND SERIAL INTERFACE (HDQ)						
V_{IH}	High-level input voltage	V_{CC} < 4.2 V	1.7			V
		V_{CC} > 4.2 V	1.9			
V_{IL}	Low-level input voltage				0.7	
I_{OL}	Low-level output current	V_{OL} > 0.4 V			1	mA
STANDARD SERIAL COMMUNICATION (HDQ) TIMING(1)						
$T_{(B)}$	Break timing		190			µs
$T_{(BR)}$	Break recovery time		40			
$T_{(CYCH)}$	Host bit window timing		190			
$T_{(HW1)}$	Host sends 1 time		5		50	
$T_{(HW0)}$	Host sends 0 time		100		145	
$T_{(RSPS)}$	bq27000 to host response time		190		320	
$T_{(CYCB)}$	bq27000 bit window timing		190		250	
$T_{(DW1)}$	bq27000 sends 1 time		32		50	
$T_{(DW0)}$	bq27000 sends 0 time		80		145	

(1) See Figure 1.

The following timing diagrams describe break and break recovery timing (a), host transmitted bit timing (b), bqJUNIOR transmitted bit timing (c), and bqJUNIOR to host response timing (d).

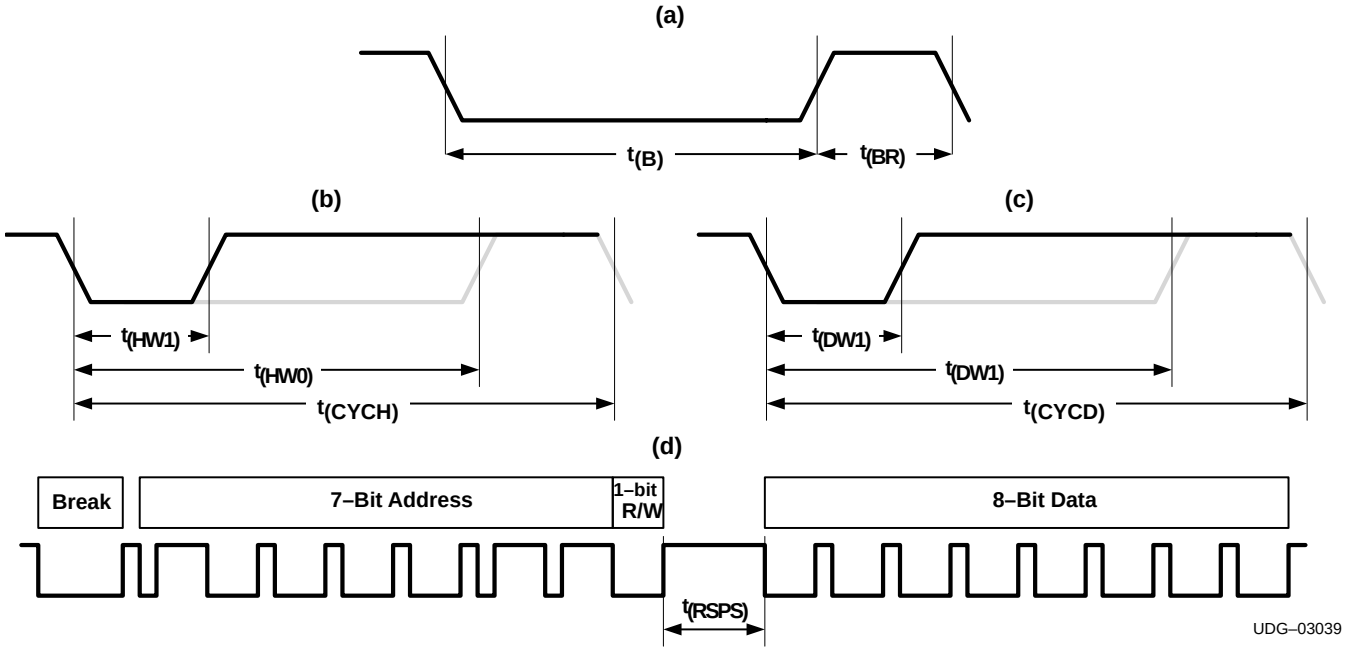


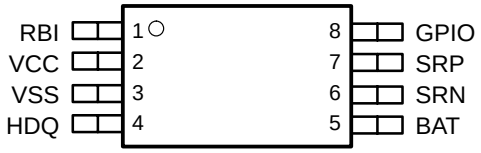
Figure 1. HDQ Bit Timing Diagrams

PRODUCT PREVIEW

PIN ASSIGNMENTS

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
BAT	5	I	Battery voltage sense input
GPIO	8	I/O	General-purpose input/output port
HDQ	4	I/O	Single-wire HDQ serial interface
RBI	1	I	Register back-up input
SRN	6	I	Current sense input (positive)
SRP	7	I	Current sense input (negative)
VCC	2	I	V_{CC} supply input
VSS	3	I	Ground input

PW PACKAGE
(TOP VIEW)



AVAILABLE OPTIONS

T_A	ADDITIONAL FUNCTIONS	PACKAGED DEVICES	MARKINGS
–20°C to 70°C	TTECP, AP, SAE, MLTTE, MLI, STTE, SI, ARTTE, and AR	bq27000PW	
		bq27010PW	

† The PW package is available taped and reeled. Add R suffix to device type (e.g. bq27000PWR) to order quantities of 2,000 devices per reel.

PRODUCT PREVIEW

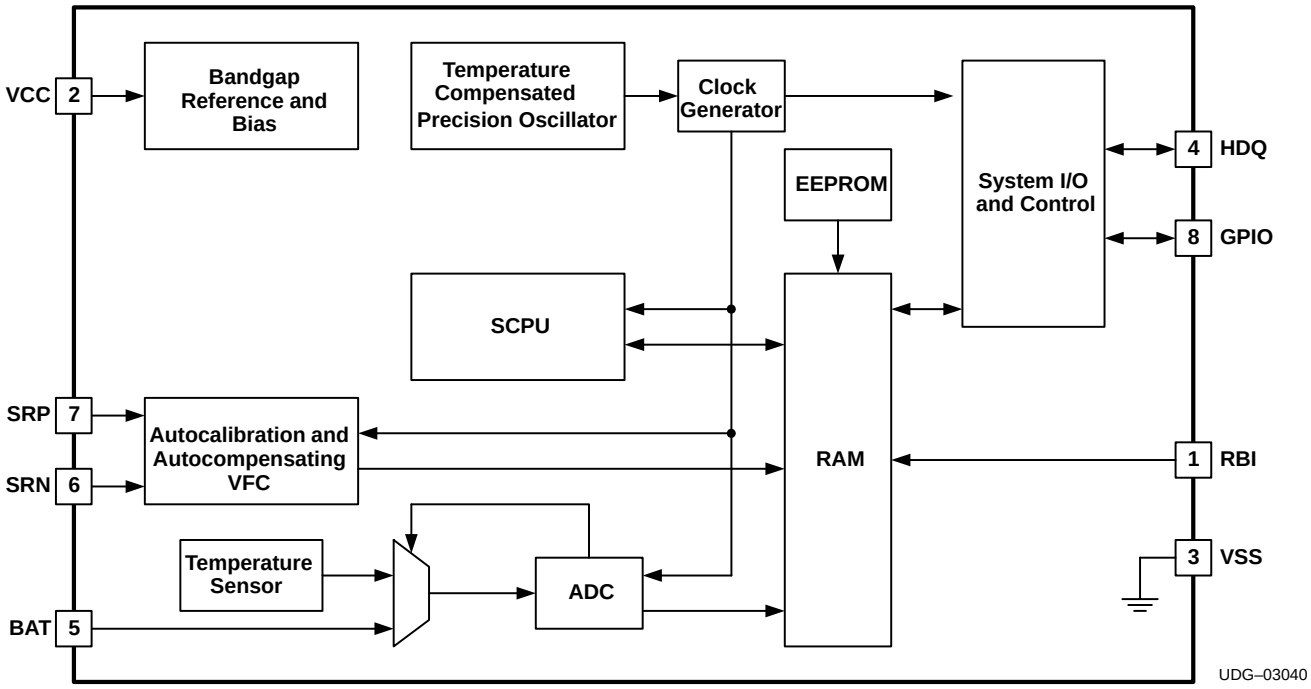
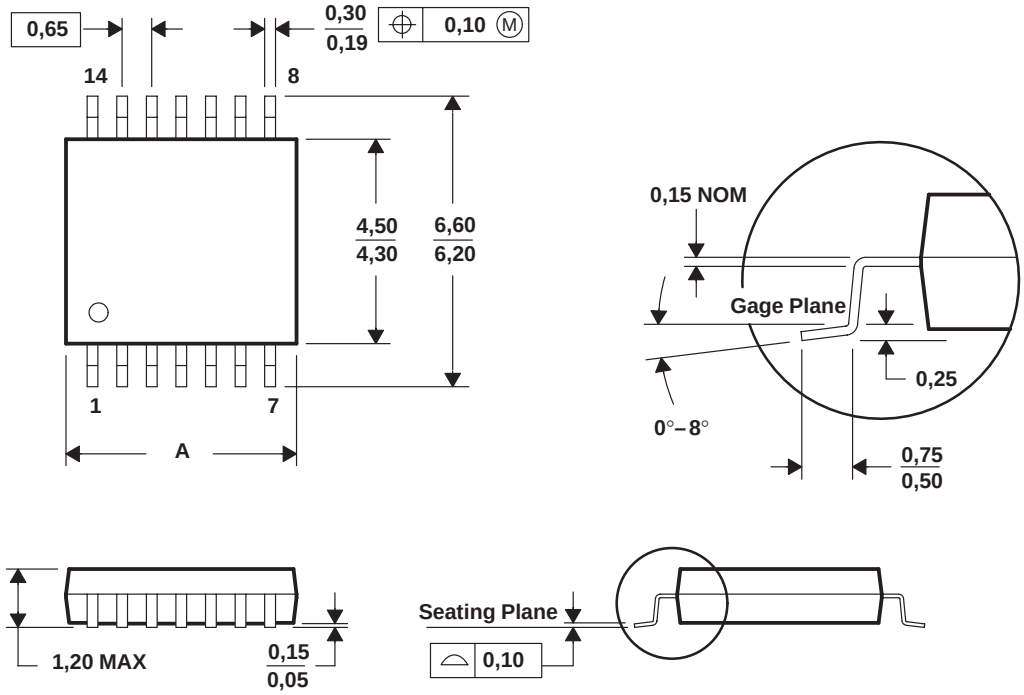


Figure 2. Functional Block Diagram

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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