SBS 1.1-COMPLIANT GAS GAUGE ENABLED WITH IMPEDANCE TRACK™ TECHNOLOGY FOR USE WITH THE bq29330

FEATURES

- **Patented Impedance Track™ Technology Accurately Measures Available Charge in Li-Ion and Li-Polymer Batteries**
- **Better than 1% Error Over Lifetime of the Battery**
- **Instant Accuracy – No Learning Cycle Required**
- **Automatically adjusts for battery aging, battery self discharge and temperature inefficiencies**
- **Supports the Smart Battery Specification SBS V1.1**
- **Works With the TI bq29330 Analog Front-End (AFE) Protection IC to Provide Complete Pack Electronics Solution**
- **Full Array of Programmable Voltage, Current, and Temperature Protection Features**
- **Integrated Time Base Removes Need for External Crystal with Optional Crystal Input**
- **Electronics for 7.2-V, 10.8-V or 14.4-V Battery Packs With 50% Fewer External Components**
- **Based on a Powerful Low-Power RISC CPU Core With High-Performance Peripherals**
- **Integrated Field Programmable FLASH**
- **Lifetime Data Logging**
- **30-Pin TSSOP (DBT)**

APPLICATIONS

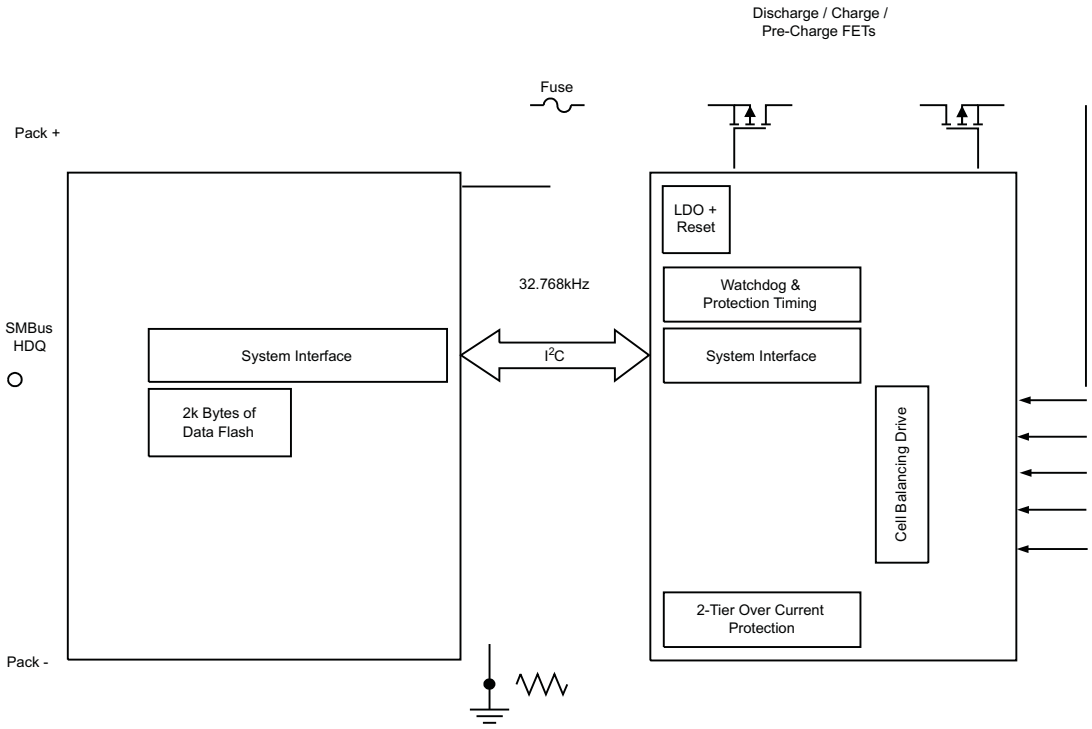
- **Notebook PCs**
- **Medical and Test Equipment**
- **Portable Instrumentation**

DESCRIPTION

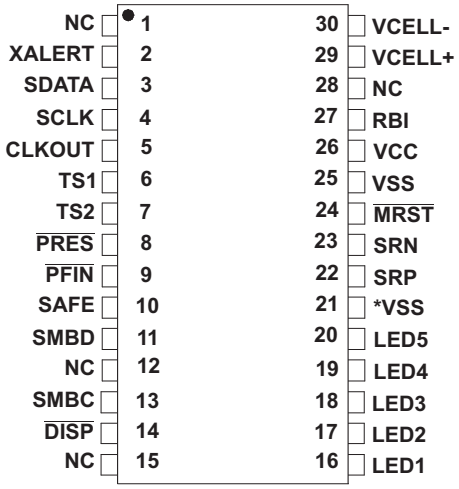
The bq20z90 SBS-compliant gas gauge IC, incorporating patented Impedance Track™ technology, is designed for battery-pack or in-system installation. The bq20z90 measures and maintains an accurate record of available charge in Li-ion or Li-polymer batteries using its integrated high-performance analog peripherals. The bq20z90 monitors capacity change, battery impedance, open-circuit voltage, and other critical parameters of the battery pack, and reports the information to the system host controller over a serial-communication bus. It is designed to work with the bq29330 analog front-end (AFE) protection IC to maximize functionality and safety, and minimize component count and cost in smart battery circuits.

The Impedance Track technology continuously analyzes the battery impedance, resulting in superior gas-gauging accuracy. This enables remaining

SYSTEM PARTITIONING DIAGRAM



TSSOP (DBT)
(TOP VIEW)



NC - No internal connection

TERMINAL FUNCTIONS

TERMINAL		I/O(1)	DESCRIPTION
NO.	NAME		
1	NC	–	Not used— leave floating
2	XALERT	I	Input from bq29330 XALERT output.
3	SDATA	I/O	Data transfer to and from bq29330
4	SCLK	I/O	Communication clock to the bq29330
5	CLKOUT	O	32.768-kHz output for the bq29330. This pin should be directly connected to the AFE.
6	TS1	I	1st Thermistor voltage input connection to monitor temperature
7	TS2	I	2nd Thermistor voltage input connection to monitor temperature
8	$\overline{\text{PRES}}$	I	Active low input to sense system insertion and typically requires additional ESD protection
9	$\overline{\text{PFIN}}$	I	Active low input to detect secondary protector output status and allows the bq20z90 to report the status of the 2nd level protection output
10	SAFE	O	Active high output to enforce additional level of safety protection; e.g., fuse blow.
11	SMBD	I/OD	SMBus data open-drain bidirectional pin used to transfer address and data to and from the bq20z90
12	NC	–	Not used— leave floating
13	SMBC	I/OD	SMBus clock open-drain bidirectional pin used to clock the data transfer to and from the bq20z90
14	$\overline{\text{DISP}}$	I	Display control for the LEDs. This pin is typically connected to bq29330 REG via a 100-k resistor and a push-button switch to VSS.
15	NC	–	Not used— leave floating
16	LED1	O	LED1 display segment that drives an external LED depending on the firmware configuration
17	LED2	O	LED2 display segment that drives an external LED depending on the firmware configuration
18	LED3	O	LED3 display segment that drives an external LED depending on the firmware configuration
19	LED4	O	LED4 display segment that drives an external LED depending on the firmware configuration
20	LED5	O	LED5 display segment that drives an external LED depending on the firmware configuration
21	VSS	–	Connected I/O pin to VSS
22	SRP	IA	Connections to the top of a small-value sense resistor to monitor the battery charge- and discharge-current flow
23	SRN	IA	Connections to the bottom of a small-value sense resistor to monitor the battery charge- and discharge-current flow
24	$\overline{\text{MRST}}$	I	Master reset input that forces the device into reset when held low. Must be held high for normal operation
25	VSS	P	Negative Supply Voltage
26	VCC	P	Positive Supply Voltage
27	RBI	P	Backup power to the bq20z90 data registers during periods of low operating voltage. RBI accepts a storage capacitor or a battery input.
28	NC	–	Not used— leave floating
29	VCELL+	I	Input from bq29330 used to read a scaled value of individual cell voltages
30	VCELL-	I	Input from bq29330 used to read a scaled value of individual cell voltages

(1) I = Input, IA = Analog input, I/O = Input/output, I/OD = Input/Open-drain output, O = Output, OA = Analog output, P = Power

ABSOLUTE MAXIMUM RATINGS

POWER-ON RESET

INTEGRATING ADC (Coulomb Counter) CHARACTERISTICS

OSCILLATOR

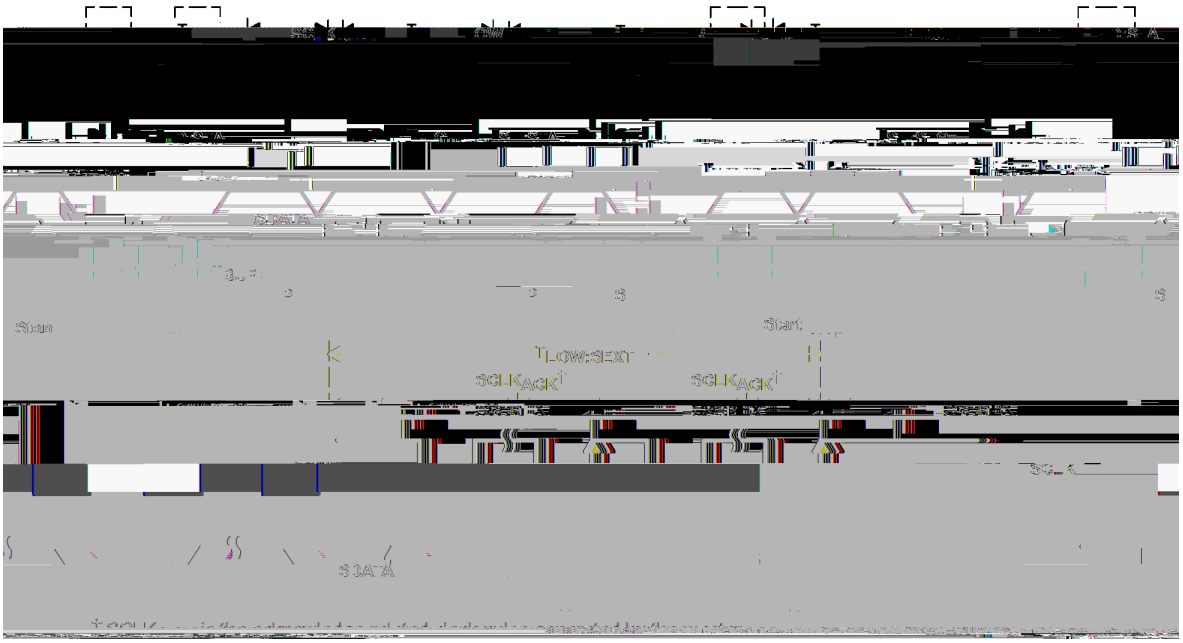
DATA FLASH MEMORY CHARACTERISTICS

REGISTER BACKUP

SMBus TIMING SPECIFICATIONS

V_{CC} = 2.4 V to 2.6 V, T_A = –40°C to 85°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{SMB}	SMBus operating frequency	Slave mode, SMBC 50% duty cycle	10		100	kHz
f_{MAS}	SMBus master clock frequency	Master mode, no clock low slave extend		51.2		
t_{BUF}	Bus free time between start and stop		4.7			s
$t_{HD:STA}$	Hold time after (repeated) start		4			
$t_{SU:STA}$	Repeated start setup time		4.7			
$t_{SU:STO}$	Stop setup time		4			
$t_{HD:DAT}$	Data hold time	Receive mode	0			ns
		Transmit mode	300			
$t_{SU:DAT}$	Data setup time		250			
$t_{TIMEOUT}$	Error signal/detect	See (1)	25		35	ms
t_{LOW}	Clock low period		4.7			s
t_{HIGH}	Clock high period	See (2)	4		50	
$t_{LOW:SEXT}$	Cumulative clock low slave extend time	See (3)			25	ms
$t_{LOW:MEXT}$	Cumulative clock low master extend time	See (4)			10	
t_F						



FEATURE SET

Primary (1st Level) Safety Features

The bq20z90 supports a wide range of battery and system protection features that can easily be configured. The primary safety features include:

- Battery cell over/under voltage protection
- Battery pack over/under voltage protection
- 2 independent charge overcurrent protection
- 3 independent discharge overcurrent protection
- Short circuit protection
- Over temperature protection
- AFE Watchdog
- Host Watchdog

Secondary (2nd Level) Safety Features

The secondary safety features of the bq20z90 can be used to indicate more serious faults via the SAFE (pin 10) pin. This pin can be used to blow an in-line fuse to permanently disable the battery pack from charging or discharging. The secondary safety features include:

- Safety over voltage
- Battery cell imbalance
- 2nd level protection IC input
- Safety over current
- Safety over temperature
- Open thermistor
- Charge FET and Zero-Volt Charge FET fault
- Discharge FET fault
- Fuse blow failure detection
- AFE Communication error
- AFE Verification error
- Internal flash data error

Charge Control Features

The bq20z90 charge control features include:

- Report the appropriate charging current needed for constant current charging and the appropriate charging voltage needed for constant voltage charging to a smart charger using SMBus broadcasts.
- Determine the chemical state of charge of each battery cell using Impedance Track™. Using cell balancing algorithm, gradually decrease the differences in the cells' state of charge in a fully charged state. This prevents high cells from overcharging, causing excessive degradation and also increases the usable pack energy by preventing early charge termination.
- Support Pre-charging/Zero-volt charging
- Support Fast charging
- Support Pulse charging
- Support Charge Inhibit and Charge Suspend modes
- Report charging faults and also indicate charging status via charge and discharge alarms.

Gas Gauging

The bq20z90 uses the Impedance Track™ Technology to measure and calculate the available charge in battery cells. The achievable accuracy is better than 1% error over the lifetime of the battery and there is no full charge-discharge learning cycle required.

See *Theory and Implementation of Impedance Track Battery Fuel-Gauging Algorithm* application note (SLUA364) for further details.

LED Display

The bq20z90 can drive a 3-, 4-, or 5- segment LED display for remaining capacity indication. The LED drive current can be adjusted to 3mA, 4mA and 5mA digitally.

LifeTime Data Logging Features

The bq20z90 offers a lifetime data logging array, where all important measurements are stored for warranty and analysis purposes. The data monitored include:

- Lifetime maximum temperature
- Lifetime minimum temperature
- Lifetime maximum battery cell voltage
- Lifetime minimum battery cell voltage
- Lifetime maximum battery pack voltage
- Lifetime minimum battery pack voltage
- Lifetime maximum charge current
- Lifetime maximum discharge current
- Lifetime maximum charge power
- Lifetime maximum discharge power
- Lifetime maximum average discharge current
- Lifetime maximum average discharge power
- Lifetime average temperature

Authentication

The bq20z90 supports authentication by the host using SHA-1.

Power Modes

The bq20z90 supports 3 different power modes to reduce power consumption:

- In Normal Mode, the bq20z90 performs measurements, calculations, protection decisions, and data updates in 1 second intervals. Between these intervals, the bq20z90 is in a reduced power stage.
- In Sleep Mode, the bq20z90 performs measurements, calculations, protection decisions, 4 Tm /F2 -10 Tf 14.4nts0 1Tj 1 0

CONFIGURATION

Oscillator Function

System Present Operation

BATTERY PARAMETER MEASUREMENTS

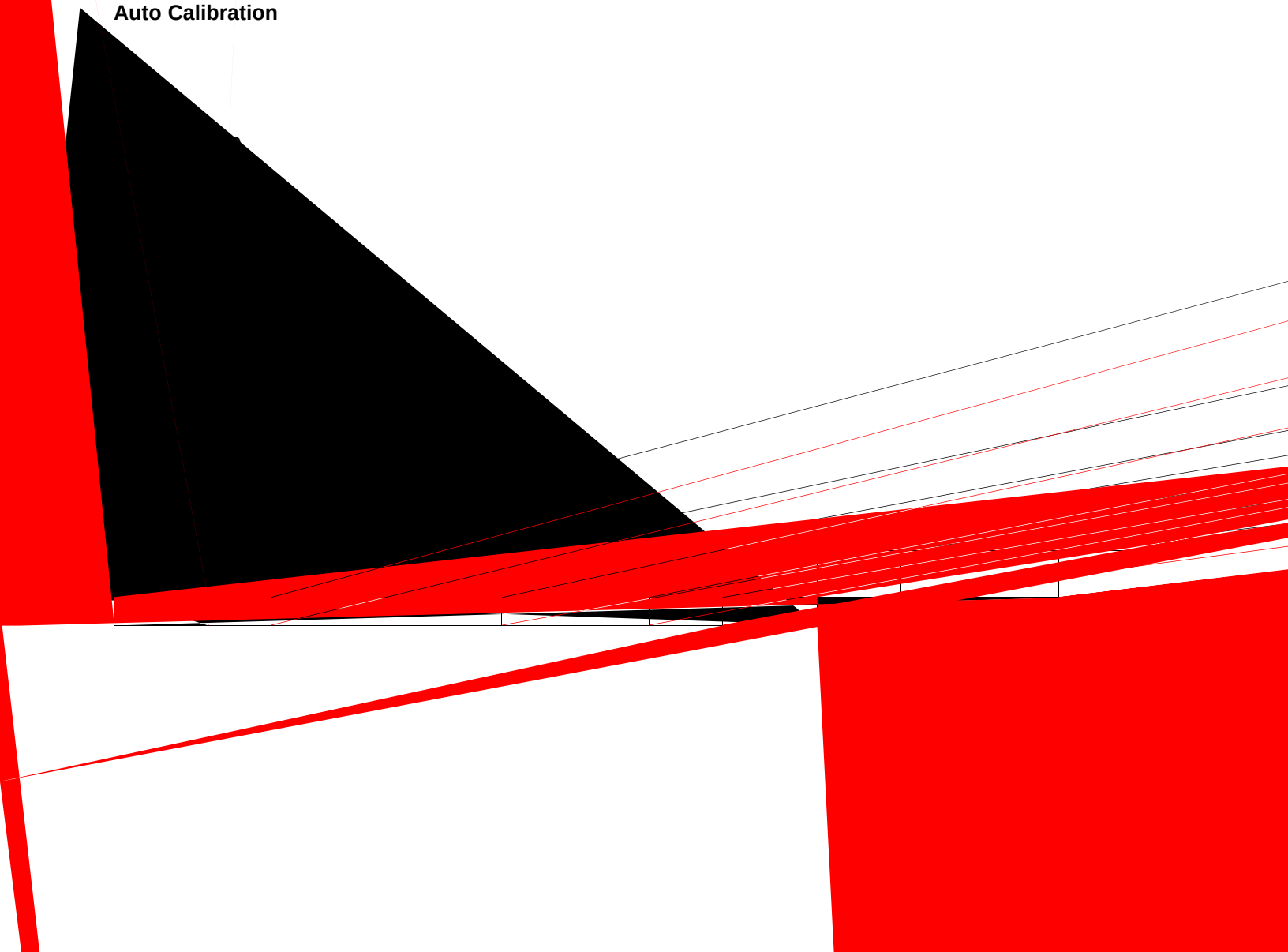
Charge and Discharge Counting

Voltage

Current

Wake Function

Auto Calibration



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
BQ20Z90DBT-V150	ACTIVE	TSSOP	DBT	30	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
BQ20Z90DBT-V150G4	ACTIVE	TSSOP	DBT	30	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
BQ20Z90DBTR-V150	ACTIVE	TSSOP	DBT	30	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
BQ20Z90DBTR-V150G4	ACTIVE	TSSOP	DBT	30	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer:

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