

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 Memory Eliminates the Need for External Configuration Memory
- Measures Charge Flow Using a High-Resolution, 16-Bit Integrating Delta-Sigma Converter
 - Better Than 0.65 nVh of Resolution
 - Self-Calibrating
- Uses 16-Bit Delta-Sigma Converter for Accurate Voltage and Temperature Measurements
- Extensive Data Reporting Options For Improved System Interaction

- Optional Pulse Charging Feature for Improved Charge Times
- Drives 3-, 4- or 5-Segment LED Display for Remaining Capacity Indication
- Supports SHA-1 Authentication
- 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 capacity to be calculated with discharge rate, temperature, and cell aging all accounted for during each stage of every cycle.

AVAILABLE OPTIONS

T _A	PACKAGE	
	30-PIN TSSOP (DBT) Tube	30-PIN TSSOP (DBT) Tape & Reel
-40°C to 85°C	bq20z90DBT ⁽¹⁾	bq20z90DBTR ⁽²⁾

(1) A single tube quantity is 50 units.

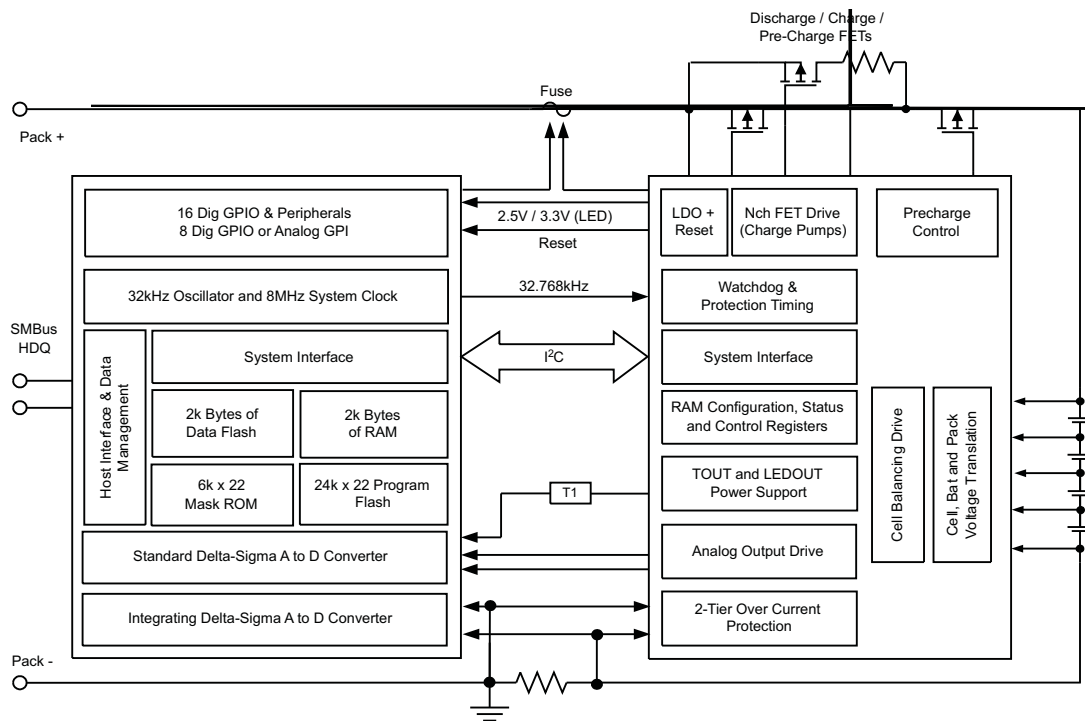
(2) A single reel quantity is 2000 units



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SYSTEM PARTITIONING DIAGRAM



**TSSOP (DBT)
(TOP VIEW)**

NC	1	30	VCELL-
XALERT	2	29	VCELL+
SDATA	3	28	NC
SCLK	4	27	RBI
CLKOUT	5	26	VCC
TS1	6	25	VSS
TS2	7	24	MRST
PRES	8	23	SRN
PFIN	9	22	SRP
SAFE	10	21	*VSS
SMBD	11	20	LED5
NC	12	19	LED4
SMBC	13	18	LED3
DISP	14	17	LED2
NC	15	16	LED1

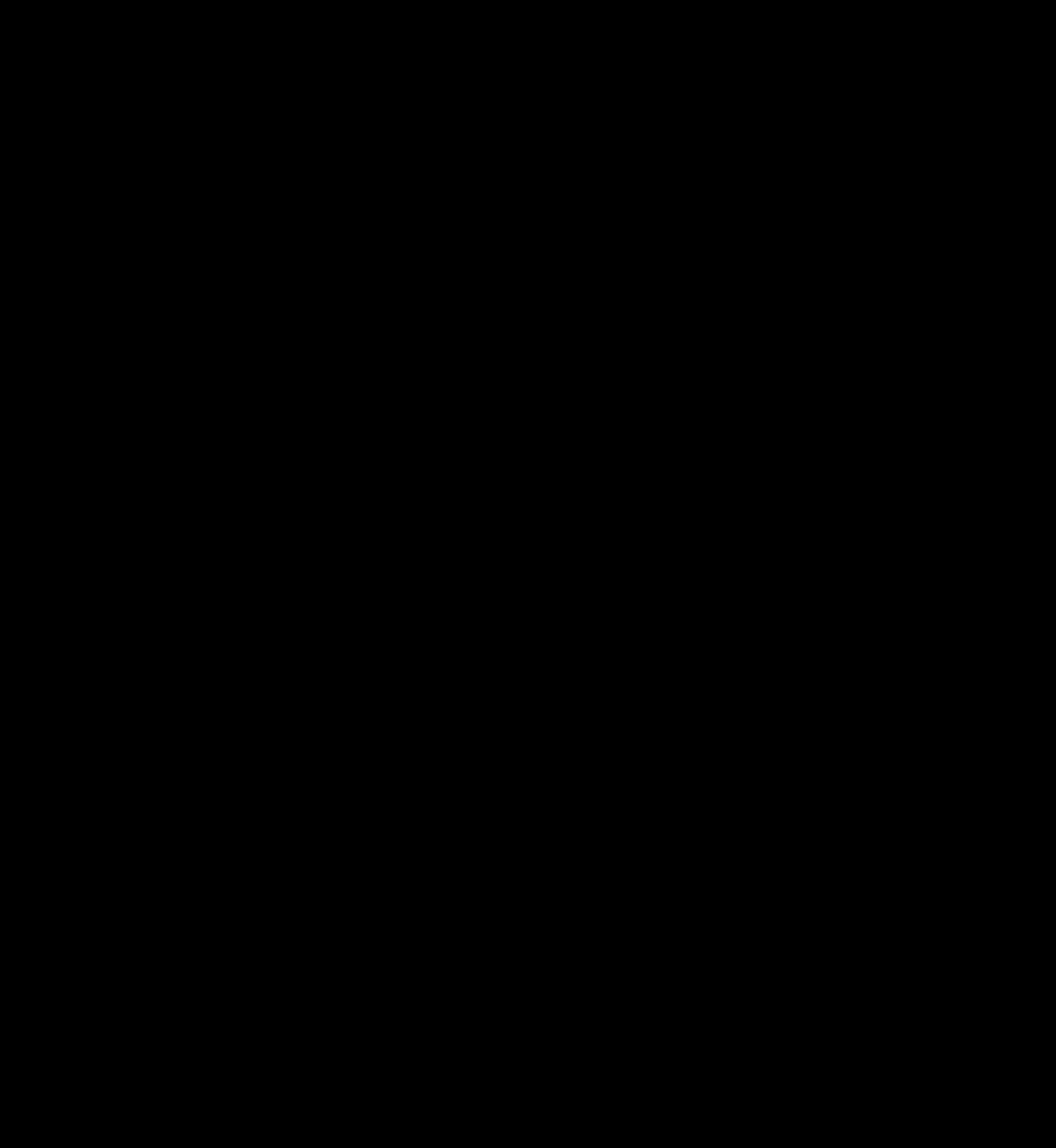
NC - No internal connection

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	1 st Thermistor voltage input connection to monitor temperature
7	TS2	I	2 nd Thermistor voltage input connection to monitor temperature
8	PRES	I	Active low input to sense system insertion and typically requires additional ESD protection
9	PFIN	I	Active low input to detect secondary protector output status and allows the bq20z90 to report the status of the 2 nd 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 Ω 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,

DATA FLASH MEMORY CHARACTERISTICS



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.

LED Display

LifeTime Data Logging Features

Authentication

Power Modes

CONFIGURATION

Oscillator Function

System Present

FEATURE SET (continued)

BATTERY PARAMETER MEASUREMENTS

The bq20z90 uses an integrating delta-sigma analog-to-digital converter (ADC) for current measurement, and a second delta-sigma ADC for individual cell and battery voltage, and temperature measurement.

Charge and Discharge Counting

The integrating delta-sigma ADC measures the charge/discharge flow of the battery by measuring the voltage drop across a small-value sense resistor between the SRP and SRN pins. The integrating ADC measures bipolar signals from -0.25 V to 0.25 V. The bq20z90 detects charge activity when $V_{SR} = V_{(SRP)} - V_{(SRN)}$ is positive and discharge activity when $V_{SR} = V_{(SRP)} - V_{(SRN)}$ is negative. The bq20z90 continuously integrates the signal over time, using an internal counter. The fundamental rate of the counter is 0.65 nVh.

Voltage

The bq20z90 updates the individual series cell voltages through the bq29330 at one second intervals. The bq20z90 configures the bq29330 to connect the selected cell, cell offset, or bq29330 VREF to the CELL pin of the bq29330, which is required to be connected to VIN of the bq20z90. The internal ADC of the bq20z90 measures the voltage, scales it, and calibrates itself appropriately. This data is also used to calculate the impedance of the cell for the Impedance Track™ gas-gauging.

Current

The bq20z90 uses the Impedance Track™ gas-gauging algorithm to measure current. It uses the SRP and SRN pins to measure the voltage drop across a sense resistor.

Wake Function

Auto Calibration

Temperature

COMMUNICATIONS

SMBus On and Off State

Table 2. EXTENDED SBS COMMANDS (continued)

SBS Cmd	Mode	Name	Format	Size in Bytes	Min Value	Max Value	Default Value	Unit
0x51	R	SafetyStatus	hex	2	0x0000	0xffff	—	
0x52	R	PFAAlert	hex	2	0x0000	0x9fff	—	
0x53	R	PFStatus	hex	2	0x0000	0x9fff	—	
0x54	R	OperationStatus	hex	2	0x0000	0xf7f7	—	
0x55	R	ChargingStatus	hex	2	0x0000	0xffff	—	
0x57	R	ResetData	hex	2	0x0000	0xffff	—	
0x58	R	WDRResetData	unsigned int	2	0	65535	—	
0x5a	R	PackVoltage	unsigned int	2	0	65535	---	mV
0x5d	R	AverageVoltage	unsigned int	2	0	65535	—	mV
0x60	R/W	UnSealKey	hex	4	0x00000000	0xffffffff	—	
0x61	R/W	FullAccessKey	hex	4	0x00000000	0xffffffff	—	
0x62	R/W	PFKey	hex	4	0x00000000	0xffffffff	—	
0x63	R/W	AuthenKey3	hex	4	0x00000000	0xffffffff	—	
0x64	R/W	AuthenKey2	hex	4	0x00000000	0xffffffff	—	
0x65	R/W	AuthenKey1	hex	4	0x00000000	0xffffffff	—	
0x66	R/W	AuthenKey0	hex	4	0x00000000	0xffffffff	—	
0x70	R/W	ManufacturerInfo	String	8+1	—	—	—	ASCII
0x71	R/W	SenseResistor	unsigned int	2	0	65535	—	μΩ
0x77	R/W	DataFlashSubClassID	hex	2	0x0000	0xffff	—	
0x78	R/W	DataFlashSubClassPage1	hex	32	—	—	—	
0x79	R/W	DataFlashSubClassPage2	hex	32	—	—	—	
0x7a	R/W	DataFlashSubClassPage3	hex	32	—	—	—	
0x7b	R/W	DataFlashSubClassPage4	hex	32	—	—	—	
0x7c	R/W	DataFlashSubClassPage5	hex	32	—	—	—	
0x7d	R/W	DataFlashSubClassPage6	hex	32	—	—	—	
0x7e	R/W	DataFlashSubClassPage7	hex	32	—	—	—	
0x7f	R/W	DataFlashSubClassPage8	hex	32	—	—	—	

NOTE:

All reserved bits in data flash should be set to zero.

Table 3. DATA FLASH VALUES

Class	Subclass ID	Subclass	Offset	Name	Data Type	Min Value	Max Value	Default Value	Units
1st Level Safety	0	Voltage	0	COV Threshold	I2	3700	5000	4300	mV
1st Level Safety	0	Voltage	2	COV Time	U1	0	60	2	s
1st Level Safety	0	Voltage	3	COV Recovery	I2	0	4400	3900	mV
1st Level Safety	0	Voltage	5	COV Delta	U1	0	200	20	mV
1st Level Safety	0	Voltage	6	COV Temp. Hys	U1	0	250	100	0.1°C
1st Level Safety	0	Voltage	7	POV Threshold	I2	0	18000	17500	mV
1st Level Safety	0	Voltage	9	POV Time	U1	0	60	2	s
1st Level Safety	0	Voltage	10	POV Recovery	I2	0	17000	16000	mV
1st Level Safety	0	Voltage	12	CUV Threshold	I2	0	3500	2200	mV



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
BQ20Z90DBT	NRND	TSSOP	DBT	30	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
BQ20Z90DBTG4	NRND	TSSOP	DBT	30	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
BQ20Z90DBTR	NRND	TSSOP	DBT	30	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
BQ20Z90DBTRG4	NRND	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.

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TAPE AND REEL INFORMATION

REEL DIMENSIONS

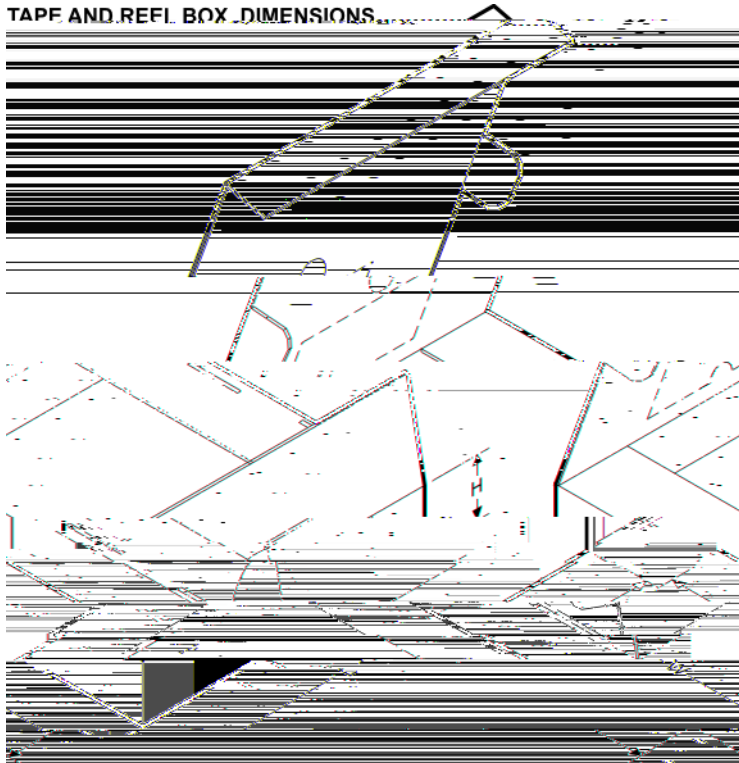
TAPE DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
BQ20Z90DBTR	TSSOP	DBT	30	2000	330.0	16.4	6.95	8.3	1.6	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ20Z90DBTR	TSSOP	DBT	30	2000	367.0	367.0	38.0

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