

SBS 1.1-COMPLIANT GAS GAUGE AND PROTECTION ENABLED WITH IMPEDANCE TRACK™

Check for Samples: [bq20z65-R1](#)

FEATURES

- **Next Generation Patented Impedance Track™ Technology Accurately Measures Available Charge in Li-Ion and Li-Polymer Batteries**
 - Better Than 1% Error Over the Lifetime of the Battery
- **Supports the Smart Battery Specification SBS V1.1**
- **Flexible Configuration for 2 to 4 Series Li-Ion and Li-Polymer Cells**
- **Powerful 8-Bit RISC CPU With Ultralow Power Modes**
- **Full Array of Programmable Protection Features**
 - Voltage, Current, and Temperature
- **Satisfies JEITA Guidelines**
- **Added Flexibility to Handle More Complex Charging Profiles**
- **Lifetime Data Logging**
- **Drives 3, 4, and 5 Segment LED Display for Battery-Pack Conditions**
- **Supports SHA-1 Authentication**
- **Complete Battery Protection and Gas Gauge Solution in One Package**
- **Available in a 44-Pin TSSOP (DBT) package**

APPLICATIONS

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

DESCRIPTION

The bq20z65-R1 SBS-compliant gas gauge and protection IC, incorporating patented Impedance Track™ technology, is a single IC solution designed for battery-pack or in-system installation. The bq20z65-R1 measures and maintains an accurate record of available charge in Li-ion or Li-polymer batteries using its integrated high-performance analog peripherals. The bq20z65-R1 monitors capacity change, battery impedance, open-circuit voltage, and other critical parameters of the battery pack which reports the information to the system host controller over a serial-communication bus. Together with the integrated analog front-end (AFE) short-circuit and overload protection, the bq20z65-R1 maximizes functionality and safety while minimizing external component count, cost, and size in smart battery circuits.

The implemented Impedance Track™ gas gauging 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 with high accuracy.

Table 1. AVAILABLE OPTIONS

T _A	PACKAGE ⁽¹⁾	
	44-PIN TSSOP (DBT) Tube	44-PIN TSSOP (DBT) Tape and Reel
–40°C to 85°C	bq20z65-R1DBT ⁽²⁾	bq20z65-R1DBTR ⁽³⁾

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

(2) A single tube quantity is 40 units.

(3) A single reel quantity is 2000 units

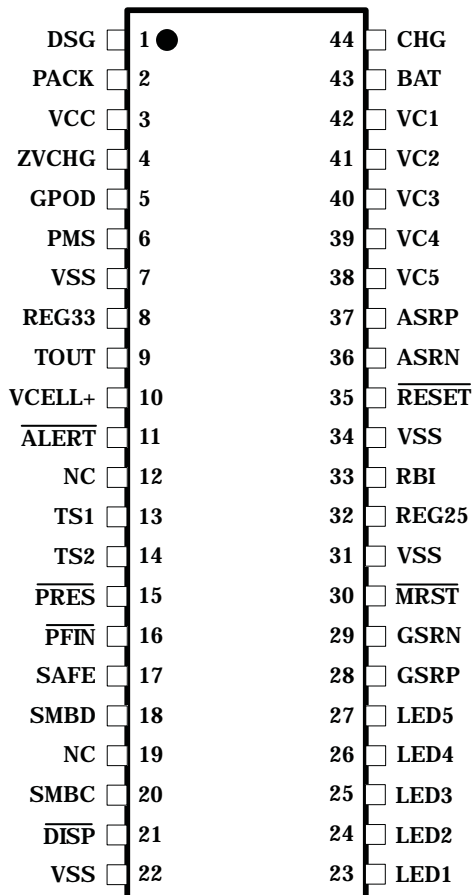


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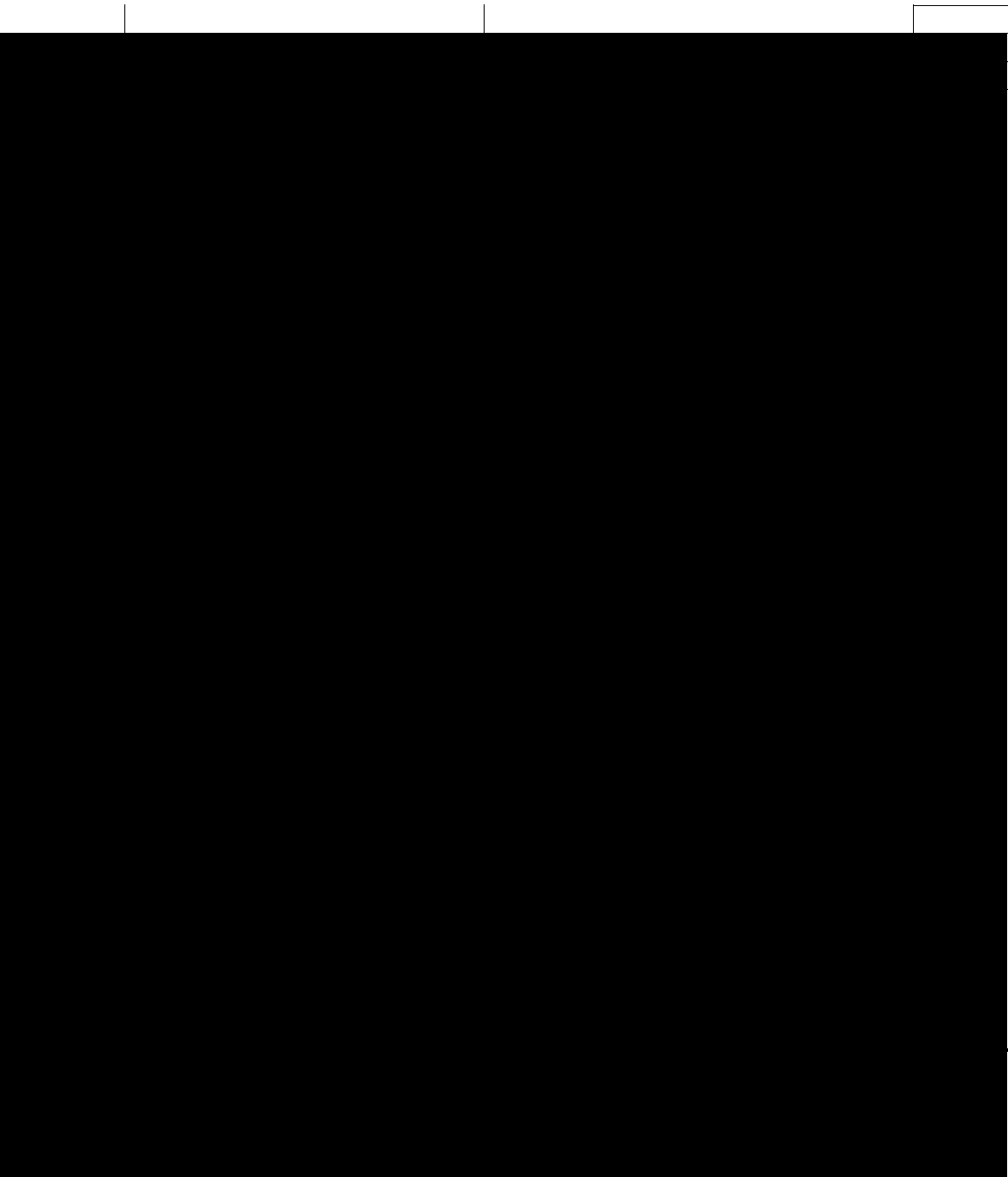
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PACKAGE PINOUT DIAGRAM

bq20z65-R1
DBT PACKAGE
(TOP VIEW)





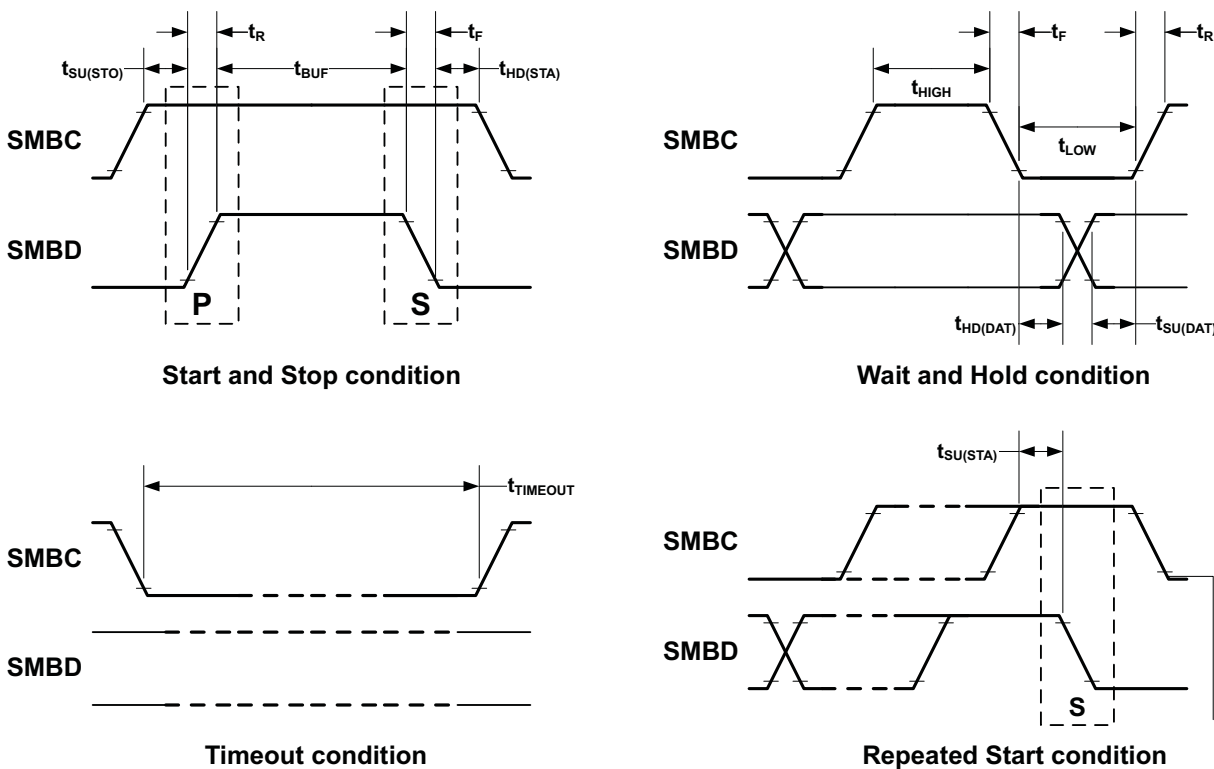


SMBus TIMING CHARACTERISTICS (continued)

T_A = -40°C to 85°C Typical Values at T_A = 25°C and V_{REG25} = 2.5 V (Unless Otherwise Noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f _(MAS)	SMBus master clock frequency	Master mode, No clock low slave extend		51.2		kHz
t _(BUF)	Bus free time between start and stop (see Figure 1)		4.7			µs
t _(HD:STA)	Hold time after (repeated) start (see Figure 1)		4			µs
t _(SU:STA)	Repeated start setup time (see Figure 1)		4.7			µs
t _(SU:STO)	Stop setup time (see Figure 1)		4			µs
t _(HD:DAT)	Data hold time (see Figure 1)	Receive mode	0			ns
		Transmit mode	300			
t _(SU:DAT)	Data setup time (see Figure 1)		250			ns
t _(TIMEOUT)	Error signal/detect (see Figure 1)	See (1)	25		35	µs
t _(LOW)	Clock low period (see Figure 1)	Figd (rise)Tj 15.2910 Td (period)Tj 24.63 0 (times)Tj9Tct	4.7			µs
t _(HIGH)	Clock high period (see Figure 1)	See (2)	4		50	µs
t _(LOW:SEXT)	Cumulative clock low slave extend time	See (3)			25	ms
t _(LOW:MEXT)	Cumulative clock low master extend time (see Figure 1)	See (4)			10	ms
t _f	Clock/data fall time	See (5)			300	ns
t _r	Clock/data rise time	See (6)			1000	ns

(1) The bq20z65-R1 times



A. SCLKACK is the acknowledge-related clock pulse generated by the master.

Figure 1. SMBus Timing Diagram

Lifetime Data Logging Features

The bq20z65-R1 offers lifetime data logging, where important measurements are stored for warranty and analysis purposes. The data monitored include:

- Lifetime maximum temperature
- Lifetime maximum temperature count
- Lifetime maximum temperature duration
- Lifetime minimum temperature
- Lifetime maximum battery cell voltage
- Lifetime maximum battery cell voltage count
- Lifetime maximum battery cell voltage duration
- 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 bq20z65-R1 supports authentication by the host using SHA-1.

Power Modes

The bq20z65-R1 supports 3 different power modes to reduce power consumption:

- In Normal Mode, the bq20z65-R1 performs measurements, calculations, protection decisions and data updates in 1 second intervals. Between these intervals, the bq20z65-R1 is in a reduced power stage.
- In Sleep Mode, the bq20z65-R1 performs measurements, calculations, protection decisions and data update in adjustable time intervals. Between these intervals, the bq20z65-R1 is in a reduced power stage. The bq20z65-R1 has a wake function that enables exit from Sleep mode, when current flow or failure is detected.
- In Shutdown Mode the bq20z65-R1 is completely disabled.

CONFIGURATION

Oscillator Function

The bq20z65-R1 fully integrates the system oscillators therefore, no external components are required for this feature.

System Present Operation

The bq20z65-R1 periodically verifies the $\overline{\text{PRES}}$ pin and detects that the battery is present in the system via a low state on a $\overline{\text{PRES}}$ input. When this occurs, the bq20z65-R1 enters normal operating mode. When the pack is removed from the system and the $\overline{\text{PRES}}$ input is high, the bq20z65-R1 enters the battery-removed state, disabling the charge, discharge, and ZVCHG FETs. The $\overline{\text{PRES}}$ input is ignored and can be left floating when non-removal mode is set in the data flash.

BATTERY PARAMETER MEASUREMENTS

The bq20z65-R1 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 SR1 and SR2 pins. The integrating ADC measures bipolar signals from -0.25 V to 0.25 V. The bq20z65-R1 detects charge activity when $V_{\text{SR}} = V_{(\text{SRP})} - V_{(\text{SRN})}$ is positive and discharge activity when $V_{\text{SR}} = V_{(\text{SRP})} - V_{(\text{SRN})}$ is negative. The bq20z65-R1 continuously integrates the signal over time, using an internal counter. The fundamental rate of the counter is 0.65nVh.

Voltage

The bq20z65-R1 updates the individual series cell voltages at one second intervals. The internal ADC of the bq20z65-R1 measures the voltage, scales and calibrates it appropriately. This data is also used to calculate the impedance of the cell for the Impedance Track™ gas-gauging.

Current

The bq20z65-R1 uses the SRP and SRN inputs to measure and calculate the battery charge and discharge current using a 5mΩ to 20mΩ typ. sense resistor.

Wake Function

The bq20z65-R1 can exit sleep mode, if enabled, by the presence of a programmable level of current signal across SRP and SRN.

Auto Calibration

The bq20z65-R1 provides an auto-calibration feature to cancel the voltage offset error across SRN and SRP for maximum charge measurement accuracy. The bq20z65-R1 performs auto-calibration when the SMBus lines stay low continuously for a minimum of a programmable amount of time.

Temperature

The bq20z65-R1 has an internal temperature sensor and 2 external temperature sensor inputs, TS1 and TS2, used in conjunction with two identical NTC thermistors (default are Semitec 103AT) to sense the battery environmental temperature. The bq20z65-R1 can be configured to use the internal temperature sensor or up to 2 external temperature sensors.

Table 3. SBS COMMANDS (continued)

SBS CMD	MODE	NAME	FORMAT	SIZE IN BYTES	MIN VALUE	MAX VALUE	DEFAULT VALUE	UNIT
0x19	R/W	DesignVoltage	Integer	2	7000	18,000	14,400	mV
0x1a	R/W	SpecificationInfo	Hex	2	0x0000	0xffff	0x0031	—
0x1b	R/W	ManufactureDate	Unsigned integer	2	0	65,535	0	—
0x1c	R/W	SerialNumber	Hex	2	0x0000	0xffff	0x0000	—
0x20	R/W	ManufacturerName	String	20+1	—	—	Texas Instruments	—
0x21	R/W	DeviceName	String	20+1	—	—	bq20z65-R1	—
0x22	R/W	DeviceChemistry	String	4+1	—	—	LION	—
0x23	R	ManufacturerData	String	14+1	—	—	—	—
0x2f	R/W	Authenticate	String	20+1	—	—	—	—
0x3c	R	CellVoltage4	Unsigned integer	2	0	65,535	—	mV
0x3d	R	CellVoltage3	Unsigned integer	2	0	65,535	—	mV
0x3e	R	CellVoltage2	Unsigned integer	2	0	65,535	—	mV
0x3f	R	CellVoltage1	Unsigned integer	2	0	65,535	—	mV

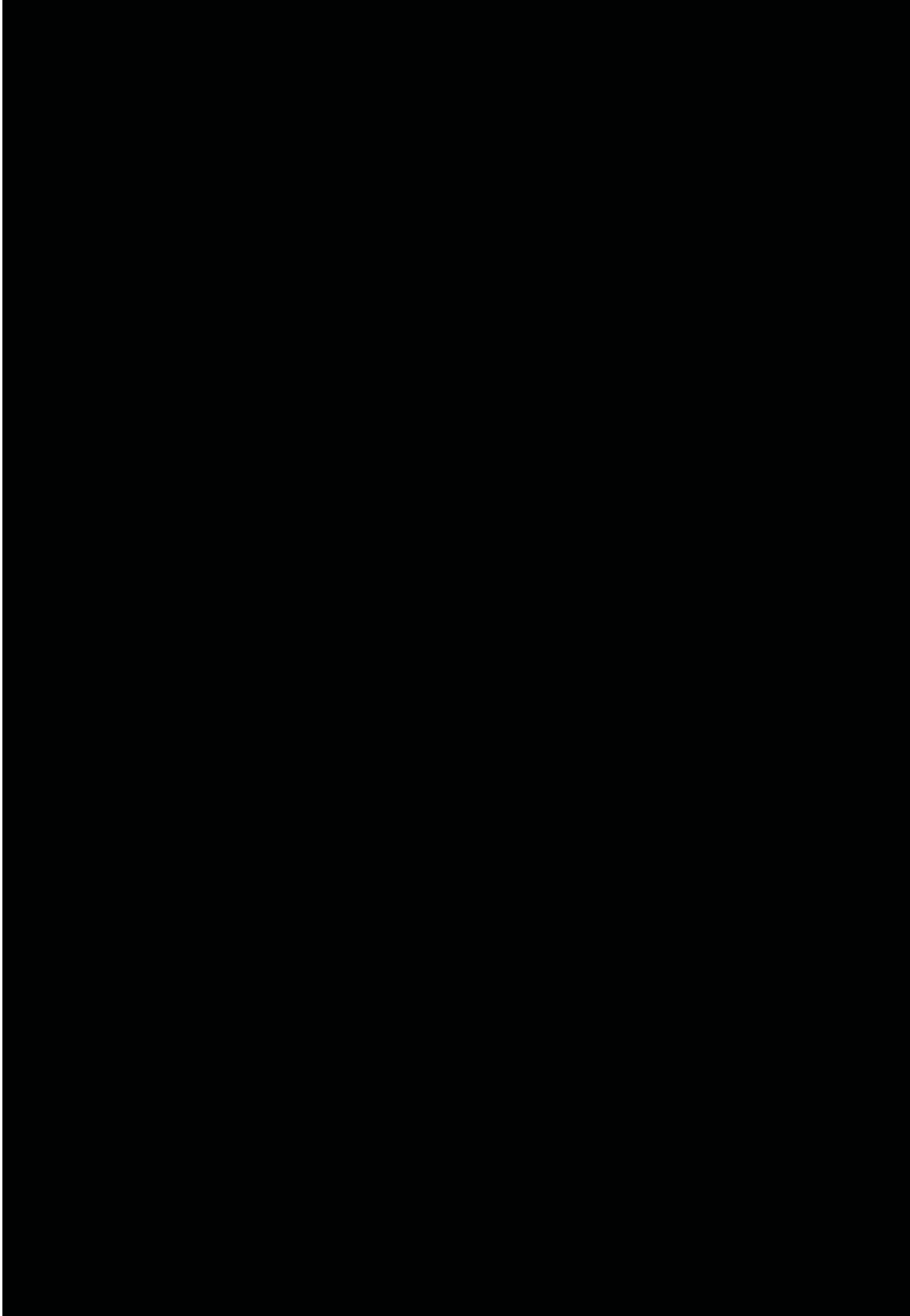
Table 4. EXTENDED SBS COMMANDS

SBS CMD	MODE	NAME	FORMAT	SIZE IN BYTES	MIN VALUE	MAX VALUE	DEFAULT VALUE	UNIT
0x45	R	AFEData	String	11+1	—	—	—	—
0x46	R/W	FETControl	Hex	2	0x00	0xff	—	—
0x4f	R	StateOfHealth	Hex	2	0x0000	0xffff	—	%
0x51	R	SafetyStatus	Hex	2	0x0000	0xffff	—	—
0x52	R	PFAAlert	Hex	2	0x0000	0xffff	—	—
0x53	R	PFStatus	Hex	2	0x0000	0xffff	—	—
0x54	R	OperationStatus	Hex	2	0x0000	0xffff	—	—
0x55	R	ChargingStatus	Hex	2	0x0000	0xffff	—	—
0x57	R	ResetData	Hex	2	0x0000	0xffff	—	—
0x58	R	WDRResetData	Unsigned integer	2	0	65,535	—	—
0x5a	R	PackVoltage	Unsigned integer	2	0	65,535	—	mV
0x5d	R	AverageVoltage	Unsigned integer	2	0	65,535	—	mV
0x5e	R	TS1Temperature	Integer	2	-400	1200	—	0.1°C
0x5f	R	TS2Temperature	Integer	2	-400	1200	—	0.1°C
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	—	—
0x68	R	SafetyAlert2	Hex	2	0x0000	0x000f	—	—
0x69	R	SafetyStatus2	Hex	2	0x0000	0x000f	—	—



TEXAS
INSTRUMENTS

APPLICATION SCHEMATIC



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
BQ20Z65DBT-R1	ACTIVE	TSSOP	DBT	44	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
BQ20Z65DBTR-R1	ACTIVE	TSSOP	DBT	44	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)

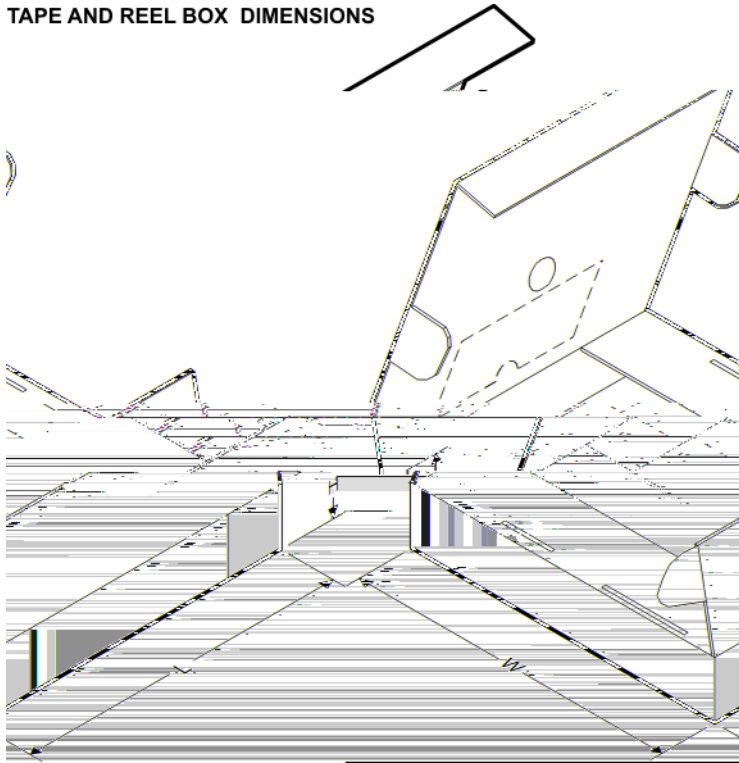
⁽³⁾

TAPE AND REEL INFORMATION

*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
BQ20Z65DBTR-R1	TSSOP	DBT	44	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ20Z65DBTR-R1	TSSOP	DBT	44	2000	367.0	367.0	45.0

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