

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

Check for Samples: [bq20z655](#)

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-Series to 4-Series Li-Ion and Li-Polymer Cells**
- **Powerful 8-Bit RISC CPU with Ultralow Power Modes**
- **Charge Enable (CE) Affects the Normal Operation on the Charge FET when the Battery Is in Charge/Relax Mode**
- **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, or 5 Segment Liquid Crystal Display and LED 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

- **Medical and Test Equipment**
- **Portable Instrumentation**
- **Rechargeable Battery Packs**
- **Industrial Equipment**

DESCRIPTION

The bq20z655 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 bq20z655 measures and maintains an accurate record of available charge in Li-Ion or Li-Polymer batteries using its integrated high-performance analog peripherals. The bq20z655 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 bq20z655 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	bq20z655DBT ⁽²⁾	bq20z655DBTR ⁽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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PACKAGE PINOUT DIAGRAM

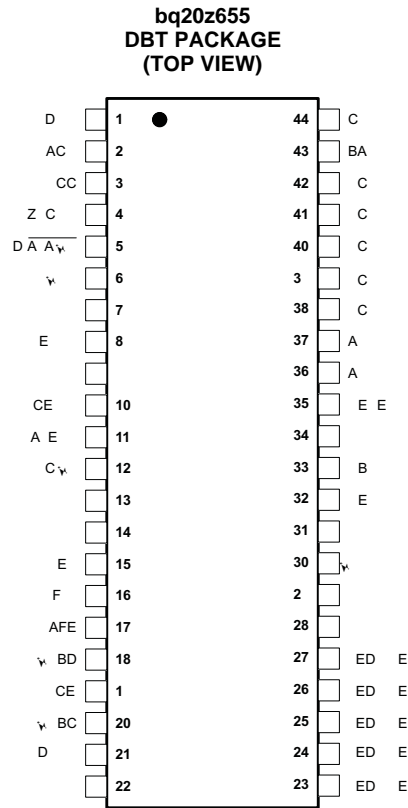


Figure 1. Package Pinout

TYPICAL LCD IMPLEMENTATION

Figure 2 shows a typical LCD implementation.

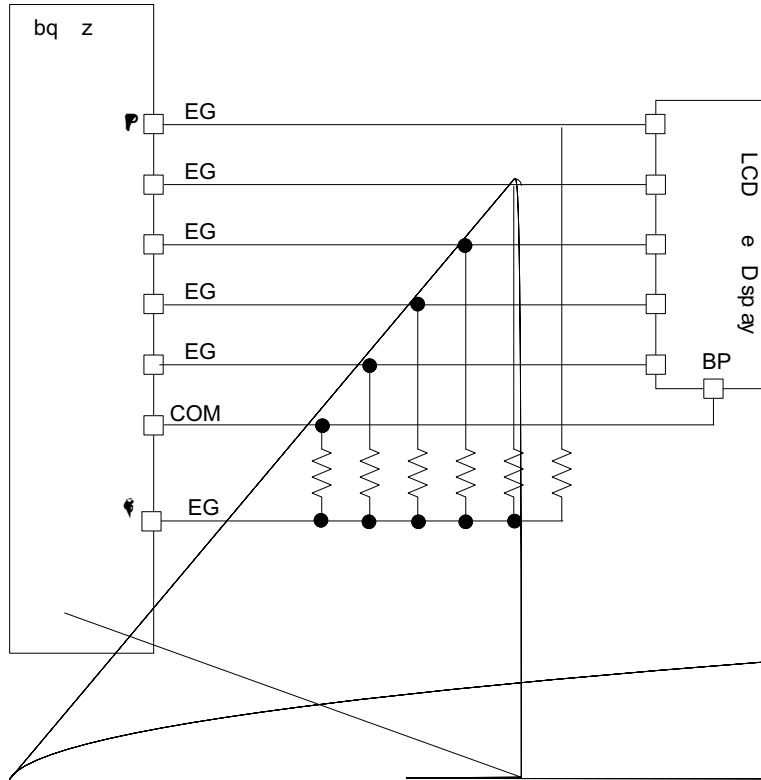
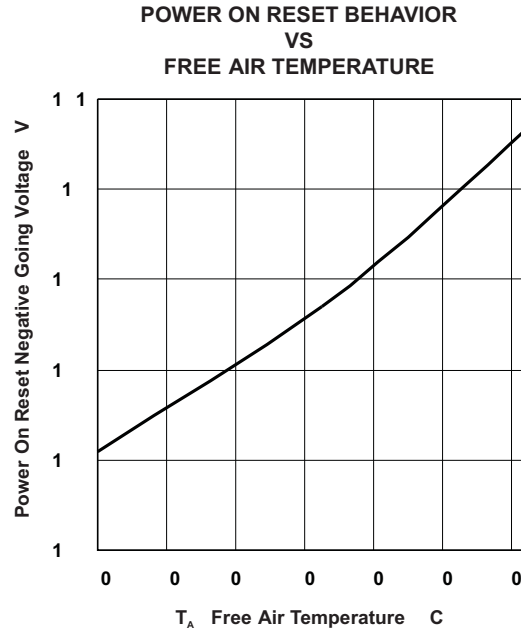


Figure 2. Typical LCD Implementation

POWER-ON RESET

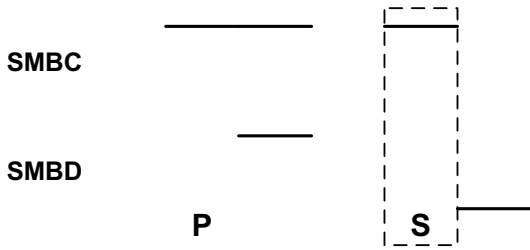
Over operating free-air temperature range (unless otherwise noted), $T_A = -40^{\circ}\text{C}$ to 85°C , $V_{(\text{REG25})} = 2.41\text{ V}$ to 2.59 V , $V_{(\text{BAT})} = 14\text{ V}$, $C_{(\text{REG25})} = 1\text{ }\mu\text{F}$, $C_{(\text{REG33})} = 2.2\text{ }\mu\text{F}$; typical values at $T_A = 25^{\circ}\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VIT- Negative-going voltage input		1.7	1.8	1.9	V
VHYS Power-on reset hysteresis		5	125	200	mV
t_{RST} $\overline{\text{RESET}}$ active low time	Active low time after power up or watchdog reset	100	250	560	μs



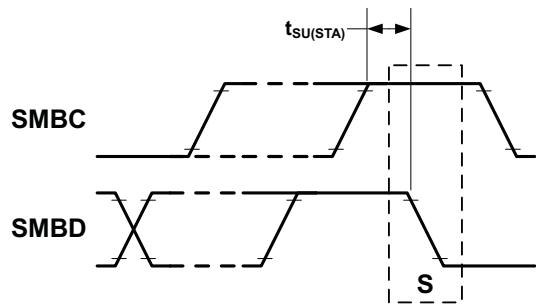
DATA FLASH CHARACTERISTICS OVER RECOMMENDED OPERATING TEMPERATURE AND

AND



SMBC

SMBD



FEATURE SET

Primary (1st Level) Safety Features

The bq20z655 supports a wide range of battery and system protection features that can easily be configured. The primary safety features include:

- Cell over/undervoltage protection
- Charge and discharge overcurrent
- Short Circuit protection
- Charge and discharge overtemperature with independent alarms and thresholds for each thermistor
- AFE Watchdog

Secondary (2nd Level) Safety Features

The secondary safety features of the bq20z655 can be used to indicate more serious faults via the SAFE 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 protection features include:

- Safety overvoltage
- Safety undervoltage
- 2nd level protection IC input
- Safety overcurrent in charge and discharge
- Safety over-temperature in charge and discharge with independent alarms and thresholds for each thermistor
- Charge FET and zero-volt charge FET fault
- Discharge FET fault
- Cell imbalance detection (active and at rest)
- Open thermistor detection
- Fuse blow detection
- AFE communication fault

Charge Control Features

The bq20z655 charge control features include:

- Supports JEITA temperature ranges. Reports charging voltage and charging current to the host (SETO, CHG, FET, STC, and Tz) via I2C or SMBus.

Lifetime Data Logging Features

The bq20z655 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 bq20z655 supports authentication by the host using SHA-1.

Power Modes

The bq20z655 supports three different power modes to reduce power consumption:

- In Normal Mode, the bq20z655 performs measurements, calculations, protection decisions and data updates in 1 second intervals. Between these intervals, the bq20z655 is in a reduced power stage.
- In Sleep Mode, the bq20z655 performs measurements, calculations, protection decisions and data update in adjustable time intervals. Between these intervals, the bq20z655 is in a reduced power stage. The bq20z655 has a wake function that enables exit from Sleep mode, when current flow or failure is detected.
- In Shutdown Mode, the bq20z655 is completely disabled.

CONFIGURATION

Oscillator Function

The bq20z655 fully integrates the system oscillators therefore, no external components are required for this feature.

System Present Operation

The bq20z655 periodically verifies the PRES pin and detects that the battery is present in the system via a low state on a PRES input. When this occurs, the bq20z655 enters normal operating mode. When the pack is removed from the system and the PRES input is high, the bq20z655 enters the battery-removed state, disabling the charge, discharge, and ZVCHG FETs. The PRES input is ignored and can be left floating when non-removal mode is set in the data flash.

BATTERY PARAMETER MEASUREMENTS

The bq20z655 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 bq20z655 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 bq20z655 continuously integrates the signal over time, using an internal counter. The fundamental rate of the counter is 0.65 nVh.

Voltage

The bq20z655 updates the individual series cell voltages at one second intervals. The internal ADC of the bq20z655 measures the voltage, scales and calibrates it appropriately. This data is also used bq20V

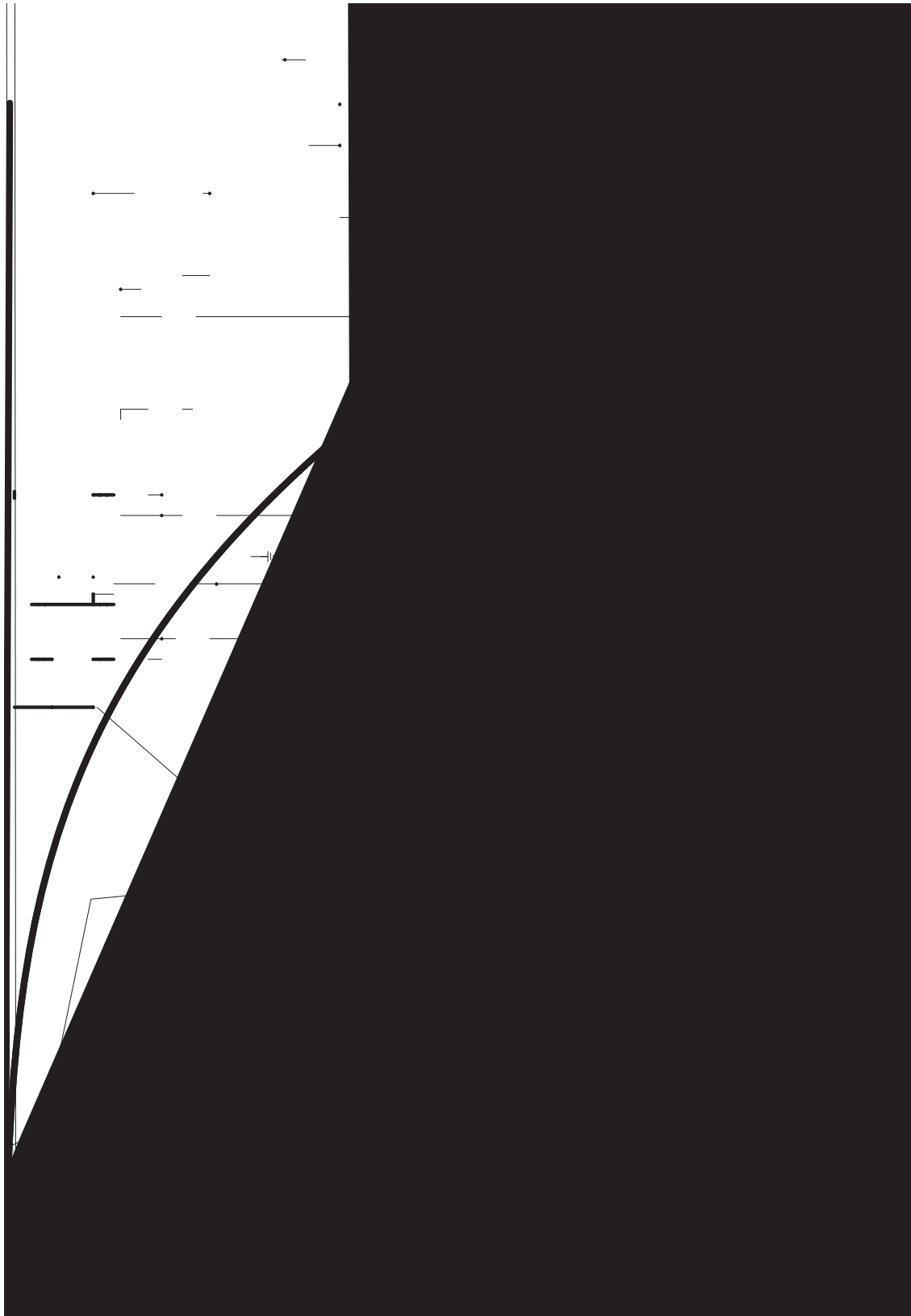
Table 3. EXTENDED SBS COMMANDS (continued)

SBS CMD	MODE	NAME	FORMAT	SIZE IN BYTES	MIN VALUE	MAX VALUE	DEFAULT VALUE	UNIT
0x6c	R	ManufBlock1	String	20	—	—	—	—
0x6d	R	ManufBlock2	String	20	—	—	—	—
0x6e	R	ManufBlock3	String	20	—	—	—	—
0x6f	R	ManufBlock4	String	20	—	—	—	—
0x70	R/W	ManufacturerInfo	String	31+1	—	—	—	—
0x71	R/W	SenseResistor	Unsigned integer	2	0	65,535	—	μ
0x72	R	TempRange	Hex	2	—	—	—	—
0x73	R	LifetimeData1	String	32+1	—	—	—	—
0x74	R	LifetimeData2	String	8+1	—	—	—	—
0x77	R/W	DataFlashSubClassID	Hex	2	0x0000			

0x0000

0x0000

APPLICATION SCHEMATIC



REVISION HISTORY

Changes from Original (April 2011) to Revision A	Page
• Changed Thermal Information	2
• Changed System Partitioning Diagram	2

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)
BQ20Z655DBT	ACTIVE	TSSOP	DBT	44	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-250C-1 YEAR	
BQ20Z655DBTR	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⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

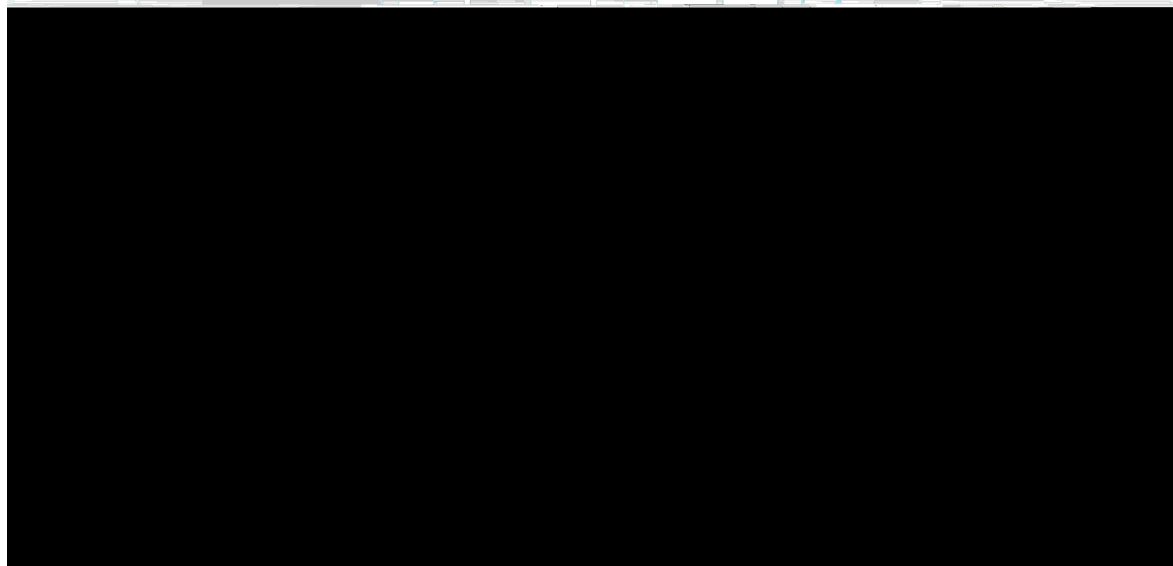
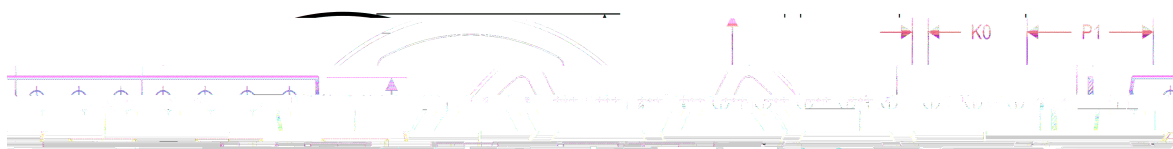
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

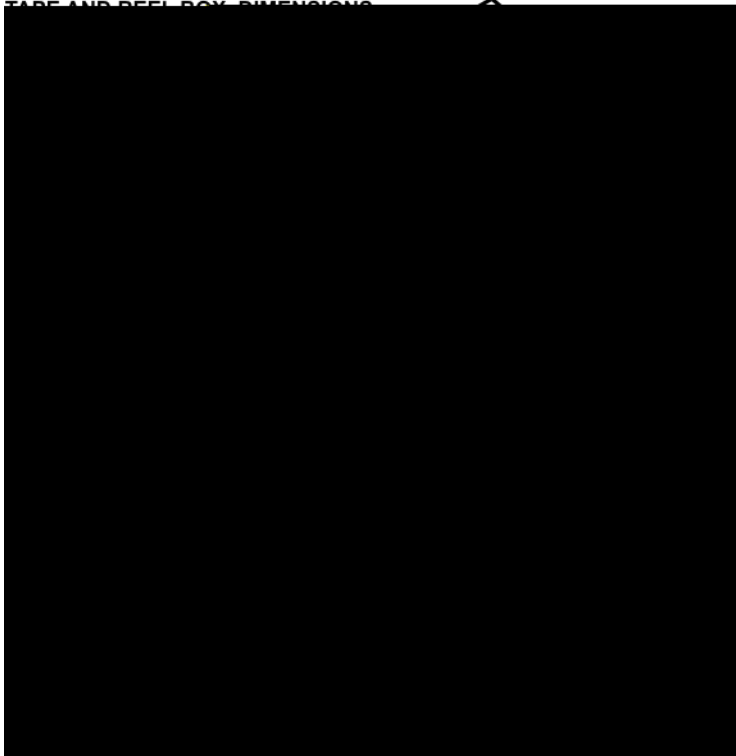
TAPE DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)
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TAPE AND REEL BOX DIMENSIONS



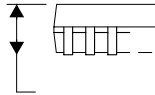
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ20Z655DBTR	TSSOP	DBT	44	2000	367.0	367.0	45.0

ME

DB

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NOTES: A All lines

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