bq2920x Voltage Protection with Automatic Cell Balance for 2-Series Cell Li-Ion Batteries

1 Features

- 2-Series Cell Secondary Protection
- Automatic Cell Imbalance Correction with External Enable Control
  - ±30 mV Enable, 0 mV Disable Thresholds Typical
- External Capacitor-Controlled Delay Timer
- External Resistor-Controlled Cell Balance Current
- Low Power Consumption I_{CC} < 3 µA Typical (V_{CELL}(ALL) < $V_{PROTECT}$)
- Internal Cell Balancing Handles Current up to 15 mA
- External Cell Balancing Mode Supported
- High-Accuracy Overvoltage Protection:
  - ±25 mV with T_A = 0°C to 60°C
- Fixed Overvoltage Protection Thresholds: 4.30 V, 4.35 V
- Small 8L DRB Package

2 Applications

- 2nd Level Protection in Li-Ion Battery Packs
  - Netbook Computers
  - Power Tools
  - Portable Equipment and Instrumentation
  - Battery Backup Systems

3 Description

The bq2920x device is a secondary overvoltage protection IC for 2-series cell lithium-ion battery packs that incorporates a high-accuracy precision overvoltage detection circuit and automatic cell imbalance correction.

The voltage of each cell in a 2-series cell battery pack is compared to a factory programmed internal reference voltage. If either cell reaches an overvoltage condition the OUT pin changes from low to high state.

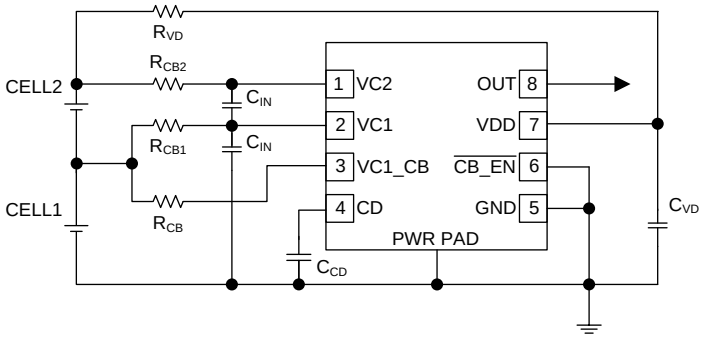
The bq2920x can perform automatic voltage-based cell imbalance correction. Balancing can start when the cell voltages are different by nominally 30 mV or more and stops when the difference is nominally 0 mV. The cell balancing is enabled and disabled by the $\overline{CB\_EN}$ pin.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
bq29200	VSON (8)	3.00 mm × 3.00 mm
bq29209		

(1) For all available packages, see the orderable addendum at the end of the datasheet.

4 Typical Application



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5 Revision History

Changes from Revision A (September 2010) to Revision B **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

Changes from Original (June 2010) to Revision A **Page**

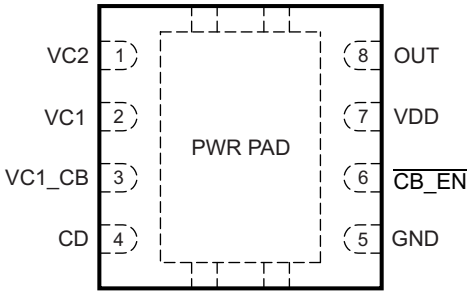
- Changed values in X_{DELAY} and X_{DELAY_CTM} electrical characteristics ... 5
- Changed specifications for V_{OUT} ... 5
- Changed test conditions for V_{OUT}, I_{OH}, and I_{OL} ... 5
- Added $V_{MM\_DET\_ON}$: VC2 = VDD = 7.6 V ... 5
- Changed $V_{MM\_DET\_OFF}$: From VDD – VC2 – 7.6 V to VC2 = VDD = 7.6 V ... 5
- Changed content in Recommended Cell Balancing Configurations section ... 6
- Added I_{CD} Charge Current figure ... 6
- Added I_{CD} Discharge Current figure ... 6
- Changed X_{DELAY} from nominally 8.0 s/µF to nominally 9.0 s/µF ... 7
- Changed Timing for Overvoltage Sensing figure ... 8
- Added Cell Imbalance Auto-Detection (Via Cell Voltage) section ... 9
- Changed VDD value in Customer Test Mode from 8.5 V to 9.5 V ... 9
- Changed the Voltage Test Limits figure ... 10
- Added External Cell Balancing section ... 13

6 Device Options

T_A	PART NUMBER	OVP
–40°C to +110°C	BQ29200	4.35 V
	BQ29209	4.30 V

7 Pin Configuration and Functions

DRB Package
8-Pin VSON
Top View



Pin Functions

PIN		DESCRIPTION
NAME	NO.	
$\overline{\text{CB\_EN}}$	6	Cell balance enable
CD	4	Connection to external capacitor for programmable delay time
GND	5	Ground pin
OUT	8	Output
Thermal Pad	PWR PAD	GND pin to be connected to the PWRPAD on the printed circuit board for proper operation
VC1	2	Sense voltage input for bottom cell
VC1_CB	3	Cell balance input for bottom cell
VC2	1	Sense voltage input for top cell
VDD	7	Power supply

8 Specifications

8.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Supply voltage range, V_{MAX}	VDD–GND	–0.3	16	V
Input voltage range, V_{IN}	VC2–GND, VC1–GND	–0.3	16	V
	VC2–VC1, CD–GND	–0.3	8	V
	$\overline{\text{CB\_EN}}$–GND	–0.3	16	V
Output voltage range, V_{OUT}	OUT–GND	–0.3	16	V
Continuous total power dissipation, P_{TOT}		See *Thermal Information*		
Lead temperature (soldering, 10 s), T_{SOLDER}			300	°C
Storage temperature range, T_{stg}		–65	150	°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.

8.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 (2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible with the necessary precautions.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 250-V CDM is possible with the necessary precautions.

8.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, VDD		4		10	V
Input voltage range	VC2–VC1, VC1–GND	0		5	V
Delay time capacitance, $t_{d(CD)}$	C_{CD} (See Figure 9.)		0.1		µF
Voltage monitor filter resistance	R_{IN} (See Figure 9.)	100	1K		Ω
Voltage monitor filter capacitance	C_{IN} (See Figure 9.)	0.01	0.1		µF
Supply voltage filter resistance	R_{VD} (See Figure 9.)		100	1K	Ω
Supply voltage filter capacitance	C_{VD} (See Figure 9.)		0.1		µF
Cell balance resistance	R_{CB} (See Figure 9 and Protection (OUT) Timing.)	100		4.7K	Ω
Operating ambient temperature range, T_A		–40		110	°C

8.4 Thermal Information

THERMAL METRIC (1)		bq2920x DRB 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance (2)	50.5	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance (3)	25.1	
$R_{\theta JB}$	Junction-to-board thermal resistance (4)	19.3	
ψ_{JT}	Junction-to-top characterization parameter (5)	0.7	
ψ_{JB}	Junction-to-board characterization parameter (6)	18.9	
$R_{\theta JC(bot)}$	Junction-to-case(bottom) thermal resistance (7)	5.2	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.
(2) The junction-to-ambient thermal resistance under natural convection is obtained in a simulation on a JEDEC-standard, high-K board, as specified in JESD51-7, in an environment described in JESD51-2a.
(3) The junction-to-case (top) thermal resistance is obtained by simulating a cold plate test on the package top. No specific JEDEC-standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.
(4) The junction-to-board thermal resistance is obtained by simulating in an environment with a ring cold plate fixture to control the PCB temperature, as described in JESD51-8.
(5) The junction-to-top characterization parameter, ψ_{JT}, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining $R_{\theta JA}$, using a procedure described in JESD51-2a (sections 6 and 7).
(6) The junction-to-board characterization parameter, ψ_{JB}, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining $R_{\theta JA}$, using a procedure described in JESD51-2a (sections 6 and 7).
(7) The junction-to-case (bottom) thermal resistance is obtained by simulating a cold plate test on the exposed (power) pad. No specific JEDEC standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.

8.5 Electrical Characteristics

Typical values stated where T_A = 25°C and VDD = 7.2 V. Minimum and maximum values stated where T_A = –40°C to 110°C and VDD = 4 V to 10 V (unless otherwise noted).

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{PROTECT}$	Overvoltage detection voltage	bq29209			4.30		V
		bq29200			4.35		
V_{HYS}	Overvoltage detection hysteresis			200	300	400	mV

Electrical Characteristics (continued)

Typical values stated where T_A = 25°C and VDD = 7.2 V. Minimum and maximum values stated where T_A = –40°C to 110°C and VDD = 4 V to 10 V (unless otherwise noted).

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OA}	Overvoltage detection accuracy	T_A = 25°C	–10		10	mV
V_{OA_DRIFT}	Overvoltage threshold temperature drift	T_A = 0°C to 60°C	–0.4		0.4	mV°/C
		T_A = –40°C to 110°C	–0.6		0.6	
X_{DELAY}	Overvoltage delay time scale factor	T_A = 0°C to 60°C Note: Does not include external capacitor variation.	6.0	9.0	12.0	s/µF
		T_A = –40°C to 110°C Note: Does not include external capacitor variation.	5.5	9.0	13.5	
X_{DELAY_CTM} (1)	Overvoltage delay time scale factor in Customer Test Mode			0.08		s/µF
$I_{CD(CHG)}$	Overvoltage detection charging current			150		nA
$I_{CD(DSG)}$	Overvoltage detection discharging current			60		µA
V_{CD}	Overvoltage detection external capacitor comparator threshold			1.2		V
I_{CC}	Supply current	(VC2–VC1) = (VC1–GND) = 3.5 V (See Figure 7.)		3.0	6.0	µA
V_{OUT}	OUT pin drive voltage	(VC2–VC1) or (VC1–GND) > $V_{PROTECT}$, VDD = 10 V, I_{OH} = 0	6	8.25	9.5	V
		(VC2–VC1) or (VC1–GND) = $V_{PROTECT}$, VDD = $V_{PROTECT}$, I_{OH} = –100 µA, T_A = 0°C to 60°C	1.75	2.5		V
		(VC2–VC1) and (VC1–GND) < $V_{PROTECT}$, I_{OL} = 100 µA, T_A = 25°C			200	mV
		(VC2–VC1) and (VC1–GND) < $V_{PROTECT}$, I_{OL} = 0 µA, T_A = 25°C		0	10	mV
		VC2 = VC1 = VDD = 4 V, I_{OL} = 100 µA			200	mV
I_{OH}	High-level output current	OUT = 1.75 V, (VC2–VC1) or (VC1–GND) = $V_{PROTECT}$, VDD = $V_{PROTECT}$ to 10 V, T_A = 0°C to 60°C	–100			µA
I_{OL}	Low-level output current	OUT = 0.05 V, (VC2–VC1) or (VC1–GND) < $V_{PROTECT}$, VDD = $V_{PROTECT}$ to 10 V, T_A = 0°C to 60°C	30		85	µA
I_{OH_ZV}	High-level short-circuit output current	OUT = 0 V, (VC2–VC1) = (VC1–GND) = $V_{PROTECT}$ VDD = 4 to 10 V			–8.0	mA
I_{IN}	Input current at VCx pins	Measured at VC1, (VC2–VC1) = (VC1–GND) = 3.5 V, T_A = 0°C to 60°C (See Figure 7.)	–0.2		0.2	µA
		Measured at VC2, (VC2–VC1) = (VC1–GND) = 3.5 V, T_A = 0°C to 60°C (See Figure 7.)			2.5	µA
$V_{MM\_DET\_ON}$	Cell mismatch detection threshold for turning ON	(VC2–VC1) versus (VC1–GND) and vice-versa when cell balancing is enabled. VC2 = VDD = 7.6 V	17	30	45	mV
$V_{MM\_DET\_OFF}$	Cell mismatch detection threshold for turning OFF	Delta between (VC2–VC1) and (VC1–GND) when cell balancing is disabled. VC2 = VDD = 7.6 V	–9	0	9	mV
$V_{CB\_EN\_ON}$	Cell balance enable ON threshold	Active LOW pin at $\overline{CB\_EN}$			1	V
$V_{CB\_EN\_OFF}$	Cell balance enable OFF threshold	Active HIGH at $\overline{CB\_EN}$	2.2			V
I_{CB_EN}	Cell balance enable ON input current	$\overline{CB\_EN}$ = GND (See Figure 8.)			0.2	µA
R_{CB1}	Internal cell balance switch resistance	$\overline{CB\_EN}$ = GND				Ω
R_{CB2}	Internal cell balance switch resistance	$\overline{CB\_EN}$ = GND				Ω

(1) Specified by design. Not 100% tested in production.

8.6 Recommended Cell Balancing Configurations

Typical values stated where T_A = 25°C and (VC2–VC1), (VC1–GND) = 3.8 V. Minimum and maximum values stated where T_A = –40°C to 110°C, VDD = 4 V to 10 V, and (VC2–VC1), (VC1–GND) = 3.0 V to 4.2 V. All values assume recommended supply voltage filter resistance R_{VD} of 100 Ω and 5% accurate or better cell balance resistor R_{CB}.

			MIN	NOM	MAX	UNIT
I_{CB}	Cell balance input current	R_{CB} = 4700 Ω	0.5	0.75	1	mA
		R_{CB} = 2200 Ω	1	1.5	2	
		R_{CB} = 910 Ω	2	3	4	
		R_{CB} = 560 Ω	3	4.5	6	
		R_{CB} = 360 Ω	3.5	6	8.5	
		R_{CB} = 240 Ω	4	7.5	11	
		R_{CB} = 120 Ω	5	10	15	

8.7 Typical Characteristics

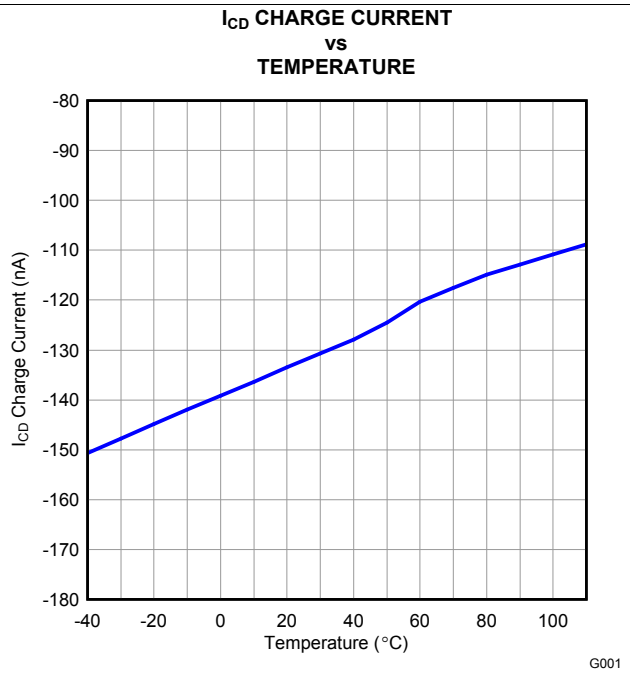


Figure 1. I_{CD} Charge Current

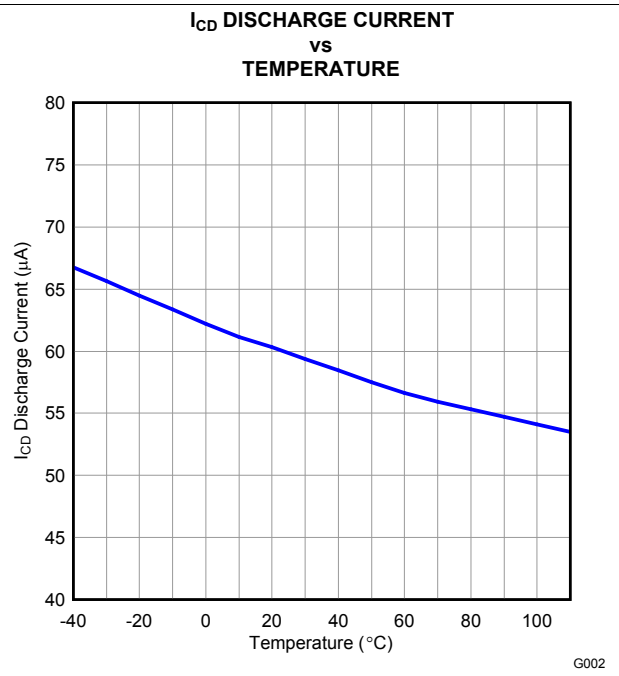


Figure 2. I_{CD} Discharge Current

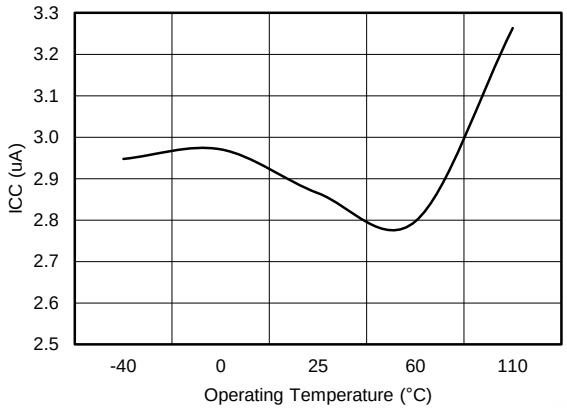


Figure 3. Average ICC During Normal Operation Across Operational Temperature

9 Detailed Description

9.1 Overview

The bq2920x provides overvoltage protection and cell balancing for 2-series cell lithium-ion battery packs.

9.1.1 Voltage Protection

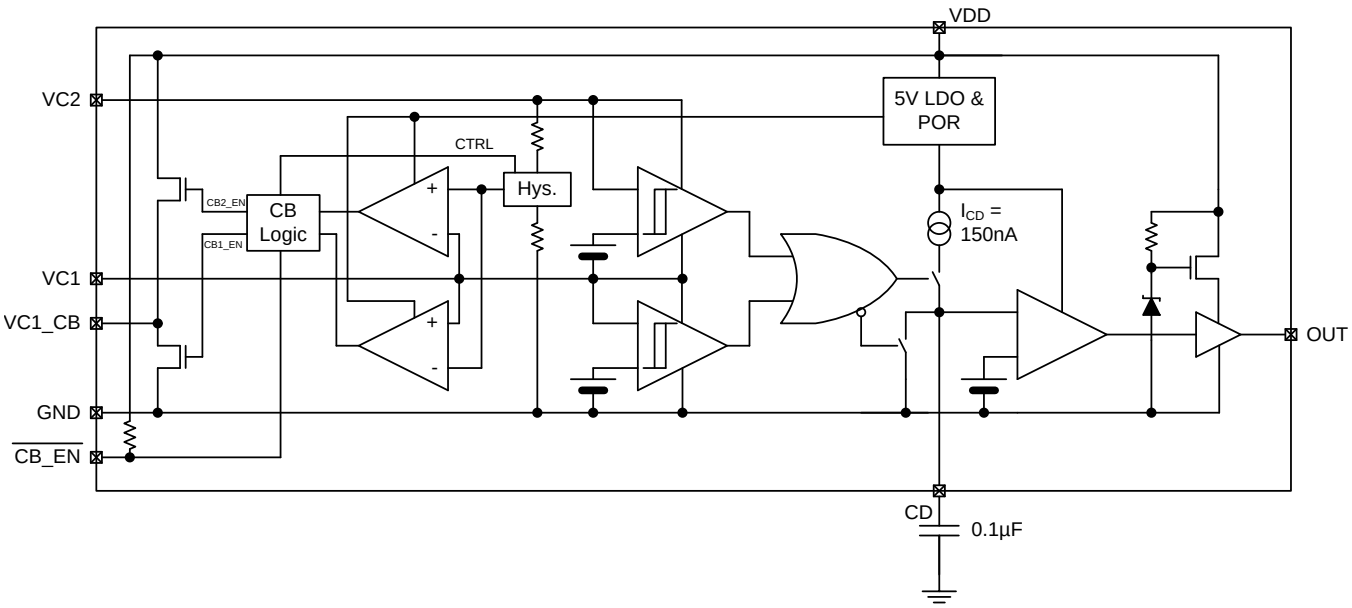
Each cell voltage is continuously compared to a factory configured internal reference threshold. If either cell reaches an overvoltage condition, the bq2920x device starts a timer that provides a delay proportional to the capacitance on the CD pin. Upon expiration of the internal timer, the OUT pin changes from a low to high state.

9.1.2 Cell Balancing

If enabled, the bq2920x performs automatic cell balance correction where the two cells are automatically corrected for voltage imbalance by loading the cell with the higher voltage with a small balancing current. When the cells are measured to be equal within nominally 0 mV, the load current is removed. It will be re-applied if the imbalance exceeds nominally 30 mV. The cell mismatch correction circuitry is enabled by pulling the CB_EN pin low, and disabled when /CB_EN is pulled to greater than 2.2 V, eg: VDD.

If the internal cell balancing current of up to 15 mA is insufficient, the bq2920x may be configured via external circuitry to support much higher external cell balancing current.

9.2 Functional Block Diagram



9.3 Feature Description

9.3.1 Protection (OUT) Timing

Sizing the external capacitor is based on the desired delay time as follows:

$$C_{CD} = \frac{t_d}{X_{DELAY}}$$

Where t_d is the desired delay time and X_{DELAY} is the overvoltage delay time scale factor, expressed in seconds per microFarad. X_{DELAY} is nominally 9.0 s/µF. For example, if a nominal delay of 3 seconds is desired, use a C_{CD} capacitor that is 3 s / 9.0 s/µF = 0.33 µF.

The delay time is calculated as follows:

Feature Description (continued)

$$t_d = C_{CD} \times X_{DELAY}$$

If the cell overvoltage condition is removed before the external capacitor reaches the reference voltage, the internal current source is disabled and an internal discharge block is employed to discharge the external capacitor down to 0 V. In this instance, the OUT pin remains in a low state.

9.3.2 Cell Voltage > $V_{PROTECT}$

When one or both of the cell voltages rises above $V_{PROTECT}$, the internal comparator is tripped, and the delay begins to count to t_d. If the input remains above $V_{PROTECT}$ for the duration of t_d, the bq2920x output changes from a low to a high state, by means of an internal pull-up network, to a regulated voltage of no more than 9.5 V when I_{OH} = 0 mA.

The external delay capacitor should charge up to no more than the internal LDO voltage (approximately 5 V typically), and will fully discharge in approximately under 100 ms when the overvoltage condition is removed.

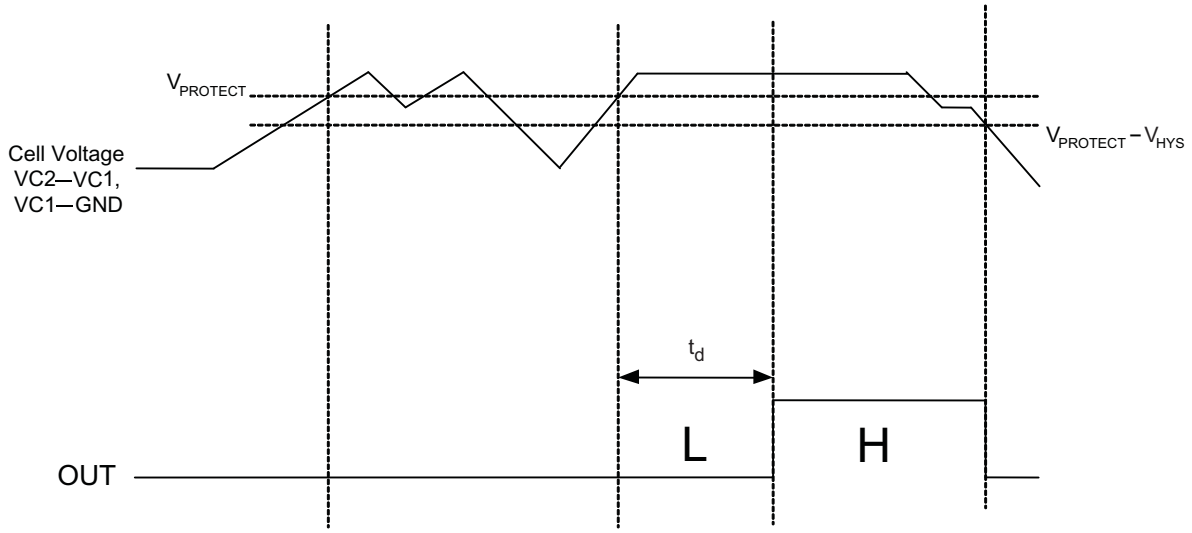


Figure 4. Timing for Overvoltage Sensing

9.3.3 Cell Connection Sequence

NOTE

Before connecting the cells, populate the overvoltage delay timing capacitor, C_{CD}.

The recommended cell connection sequence begins from the bottom of the stack, as follows:

1. GND
2. VC1
3. VC2

While not advised, connecting the cells in a sequence other than that described above does not result in errant activity on the OUT pin. For example:

1. GND
2. VC2 or VC1
3. Remaining VCx pin

9.3.4 Cell Balance Enable Control

To avoid prematurely discharging the cells, it is recommended to turn off (pull high) the active-low Cell Balance Enable Control pin at lower State of Charge (SOC) levels.

Feature Description (continued)

9.3.5 Cell Balance Configuration

The cell balancing current may be calculated as follows:

For Cell 1 (VC1–GND) balancing current, I_{CB1}:

$$I_{CB1} = \frac{VC1}{R_{CB} + R_{CB1}} \quad (1)$$

For Cell 2 (VC2–VC1) balancing current, I_{CB2}:

$$I_{CB2} = \frac{(VC2 - VC1)}{(R_{CB} + R_{VD}) + R_{CB2}} \quad (2)$$

Where:

RCB = resistor connected between the top of Cell 1 and the VC1_CB

RCB1 = resistor connected between the top of Cell 1 and the VC1

RCB2 = resistor connected between the top of Cell 2 and the VC2

RVD = resistor connected between the top of Cell 2 and the VDD

9.3.6 Cell Imbalance Auto-Detection (Via Cell Voltage)

The $V_{MM\_DET\_ON}$ and $V_{MM\_DET\_OFF}$ specifications are calibrated where VDD = VC2 = 7.6 V and VC1 = 3.8 V. The recommended range of cell balancing is VC2 and VDD between 6.0 V and 8.4 V, and VC1 between 3.0 V and 4.2 V. Below VDD = 6.0 V, it is recommended to pull $\overline{CB\_EN}$ high to disable the cell balancing function.

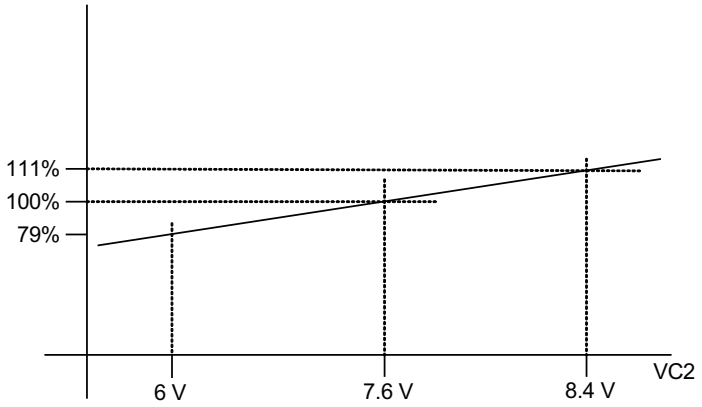


Figure 5. $V_{MM\_DET\_ON}$ and $V_{MM\_DET\_OFF}$ Threshold

9.3.7 Customer Test Mode

Customer Test Mode (CTM) helps to greatly reduce the overvoltage detection delay time and enable quicker customer production testing. This mode is intended for quick-pass board-level verification tests, and, as such, individual cell overvoltage levels may deviate slightly from the specifications ($V_{PROTECT}$, V_{OA}). If accurate overvoltage thresholds are to be tested, use the standard delay settings that are intended for normal use.

To enter CTM, VDD should be set to approximately 9.5 V higher than VC2. When CTM is entered, the device switches from the normal overvoltage delay time scale factor, X_{DELAY}, to a significantly reduced factor of approximately 0.08, thereby reducing the delay time during an overvoltage condition.

Feature Description (continued)

CAUTION

Avoid exceeding any Absolute Maximum Voltages on any pins when placing the part into CTM. Also, avoid exceeding Absolute Maximum Voltages for the individual cell voltages (VC1–GND) and (VC2–VC1). Stressing the pins beyond the rated limits may cause permanent damage to the device.

To exit CTM, power off the device and then power it back on.

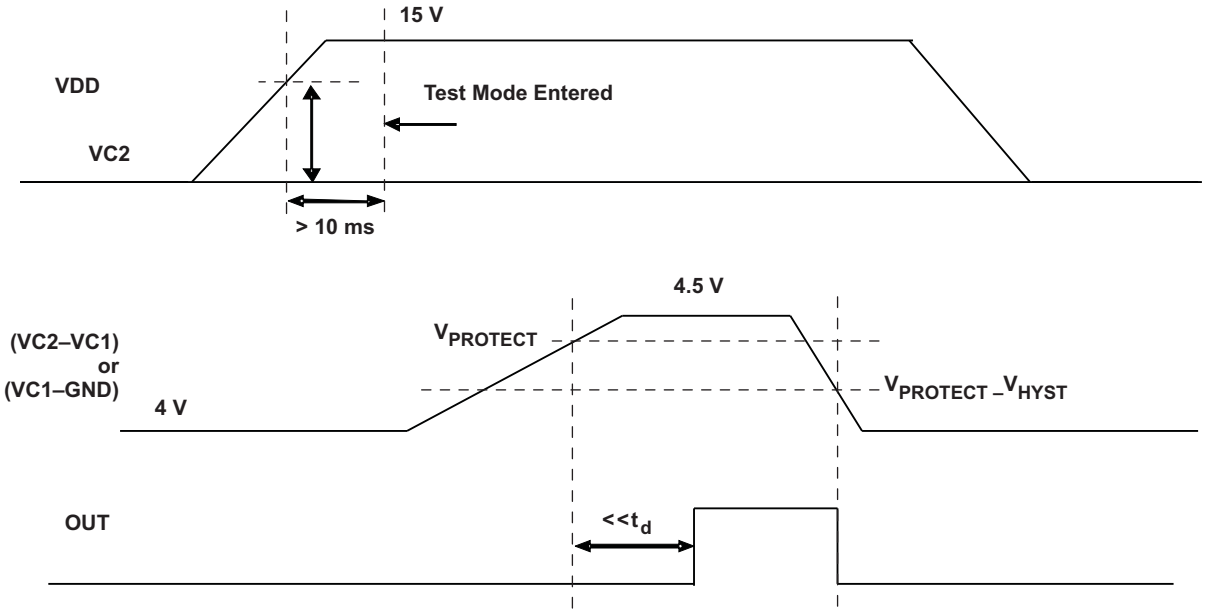


Figure 6. Voltage Test Limits

9.3.8 Test Conditions

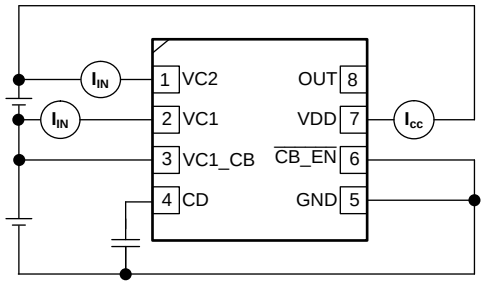


Figure 7. I_{CC}, I_{IN} Measurement

Feature Description (continued)

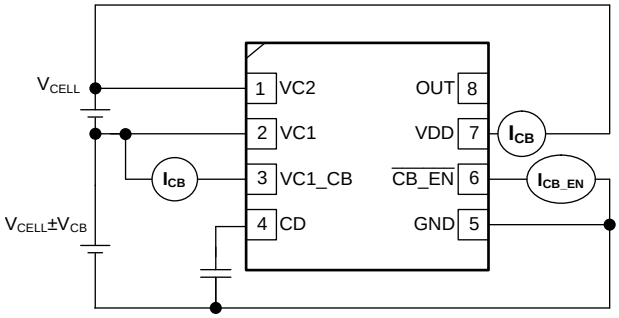


Figure 8. I_{CB} Measurement

9.4 Device Functional Modes

This device monitors the voltage of the cells connected to the VCx pins and depending on these voltages and the overall battery voltage at VDD the device enters different operating modes.

9.4.1 Normal Mode

The device is operating in NORMAL mode when the cell voltage range is between the over-charge detection threshold ($V_{PROTECT}$) and the minimum supply voltage.

If this condition is satisfied, the device turns OFF the OUT pin.

9.4.2 Protection Mode

The device is operating in PROTECTION mode when the cell over voltage protection feature has been triggered. See ***Cell Voltage > $V_{PROTECT}$*** for more details on this feature.

If this condition is satisfied, the device turns ON the OUT pin.

10 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

10.1 Application Information

The bq2920x is designed to be used in 2-series Li-Ion battery packs and with the option to include voltage-based cell balancing. The number of parallel cells or the overall capacity of the battery only affects the cell balancing circuit due to the level of potential imbalance that needs to be corrected.

10.2 Typical Applications

10.2.1 Battery Connection

Figure 9 shows the configuration for the 2-series cell battery connection with cell balancing enabled.

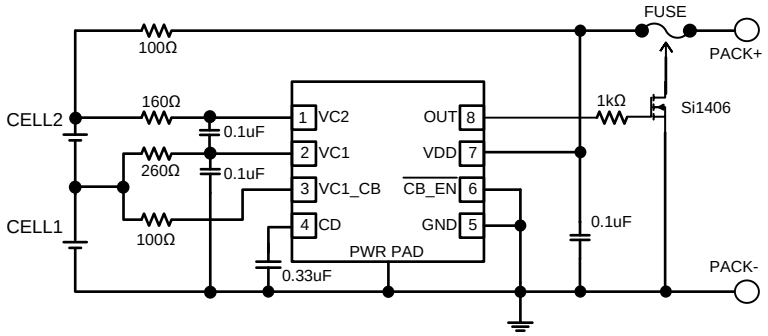


Figure 9. 2-Series Cell Configuration

10.2.1.1 Design Requirements

DESIGN PARAMETER	EXAMPLE VALUE at TA = 25°C
Input voltage range	4 V to 10 V
Overvoltage Protection (OVT)	4.35 V
Overvoltage detection delay time	3s
Overvoltage detection delay timer capacitor	0.33 uF
Cell Balancing Enabled	Yes
Cell Balancing Current, ICB1 and ICB2	10 mA
Cell Balancing Resistors, RCB, RCB1, RCB2 and RVD	RCB = 100 Ω, RCB1 = 260 Ω, RCB2 = 160 Ω, RVD = 100 Ω

10.2.1.2 Detailed Design Procedure

The bq2920x has limited features but there are some key calculations to be made when selecting external component values.

- Calculate the required CCD capacitor value for the voltage protection delay time. Care should be taken to evaluate the tolerances of the capacitor and the bq2920x to ensure system specifications are met.
- Calculate the cell balancing resistor values to provide a suitable level of balancing current that will, at a minimum, counter act an increase in imbalance during normal operation of the battery. Care should be taken to ensure any connectivity resistance is also considered as this will also reduce the balancing current level.

10.2.1.3 Application Curve

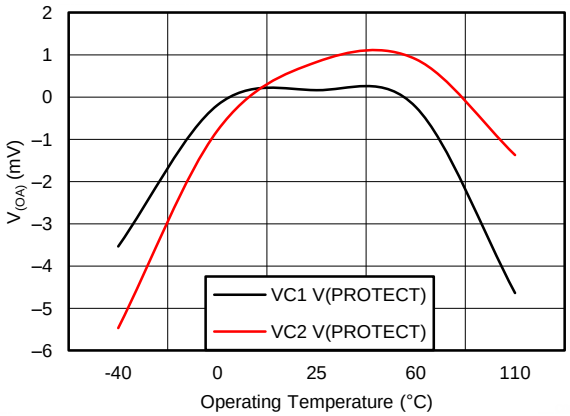


Figure 10. Average $V_{PROTECT}$ Accuracy (V_{OA}) Across Operation Temperature

10.3 System Examples

10.3.1 External Cell Balancing

Higher cell balancing currents can be supported by means of a simple external network, as shown in Figure 11.

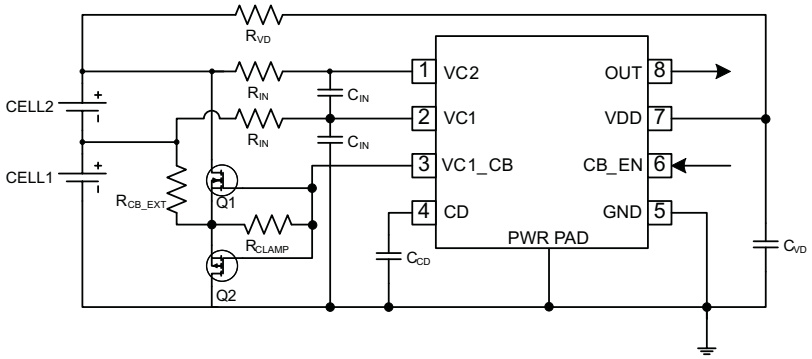


Figure 11. External Cell Balancing Configuration

R_{CLAMP} ensures that both Q1 and Q2 remain off when balancing is disabled, and should be sized above 2 kΩ to prevent excessive internal device current when the balancing network is activated. R_{CB_EXT} determines the value of the balancing current, and is dependent on the voltage of the balanced cell, as follows:

$$I_{bal} = \frac{V_{CELL}}{R_{CB\_EXT}}$$

11 Power Supply Recommendations

The recommended power supply for this device is a maximum 10-V operation on the VDD input pin.

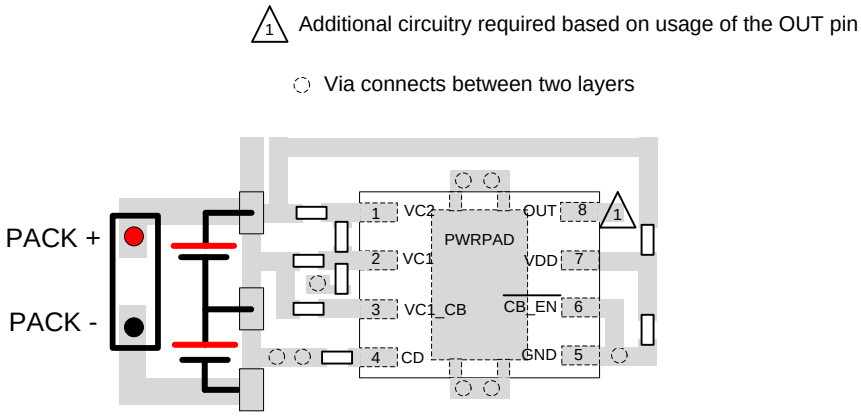
12 Layout

12.1 Layout Guidelines

The following are the recommended layout guidelines:

1. Ensure the input filters to the VC1 and VC2 pins are as close to the IC as possible to improve noise immunity.
2. If the OUT pin is used to control a high current path, for example: to blow a chemical fuse, then care should be taken to ensure the high current path creates minimal interference of the bq2920x voltage sense inputs.
3. The input RC filter on the VDD pin should be close to the terminal of the IC.

12.2 Layout Example



13 Device and Documentation Support

13.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
bq29200	Click here	Click here	Click here	Click here	Click here
bq29209	Click here	Click here	Click here	Click here	Click here

13.2 Trademarks

All trademarks are the property of their respective owners.

13.3 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

13.4 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
BQ29200DRBR	ACTIVE	SON	DRB	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200	Samples
BQ29200DRBT	ACTIVE	SON	DRB	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200	Samples
BQ29209DRBR	ACTIVE	SON	DRB	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209	Samples
BQ29209DRBT	ACTIVE	SON	DRB	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209	Samples

(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.

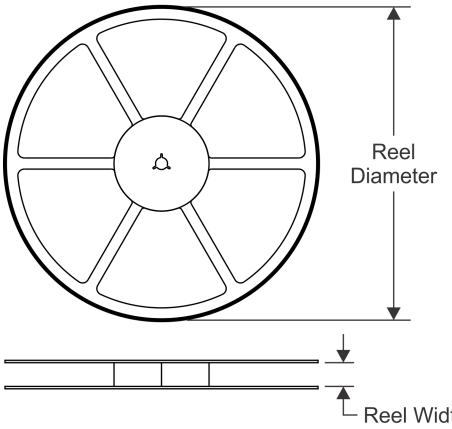
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

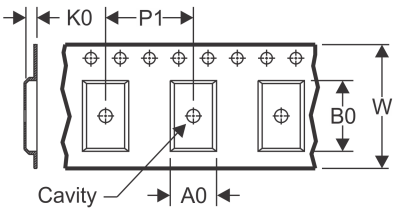
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

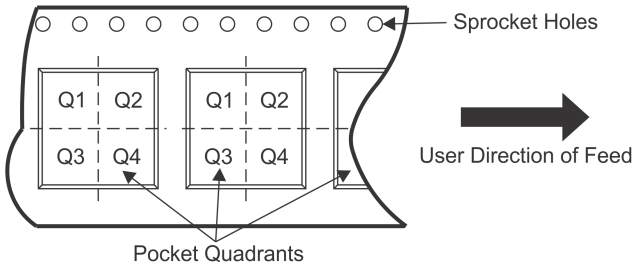


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

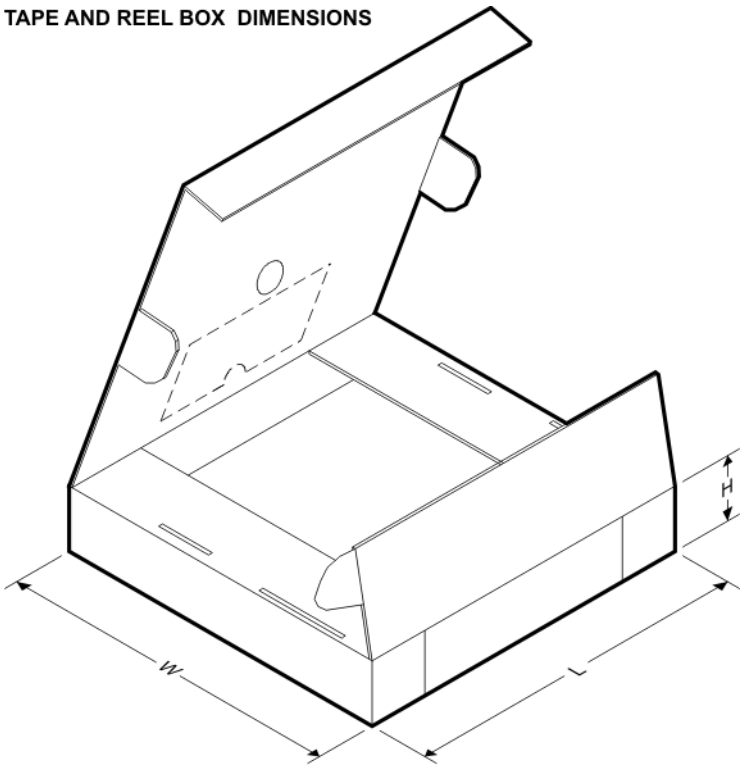
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
BQ29200DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29200DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29209DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29209DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2

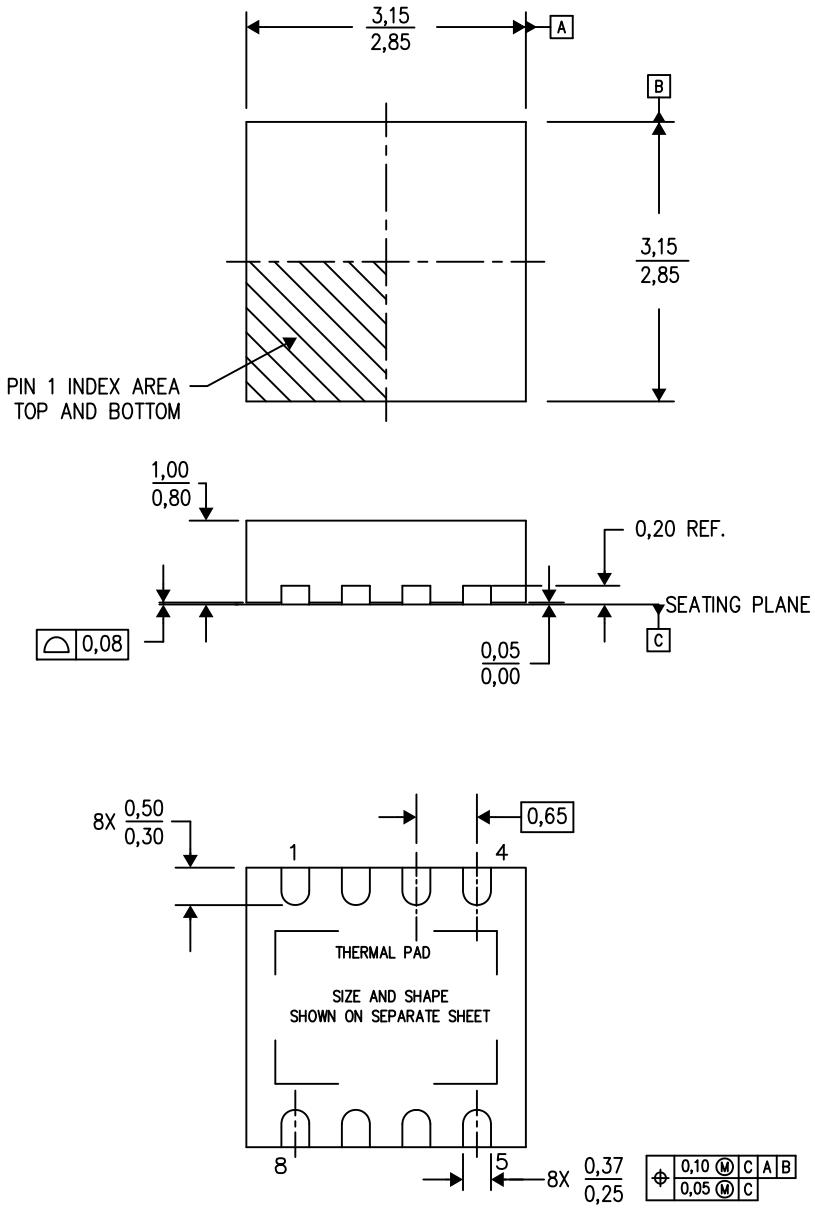
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ29200DRBR	SON	DRB	8	3000	367.0	367.0	35.0
BQ29200DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29209DRBR	SON	DRB	8	3000	367.0	367.0	35.0
BQ29209DRBT	SON	DRB	8	250	210.0	185.0	35.0

DRB (S–PVSON–N8) PLASTIC SMALL OUTLINE NO–LEAD



4203482–2/K 06/12

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Small Outline No–Lead (SON) package configuration.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.

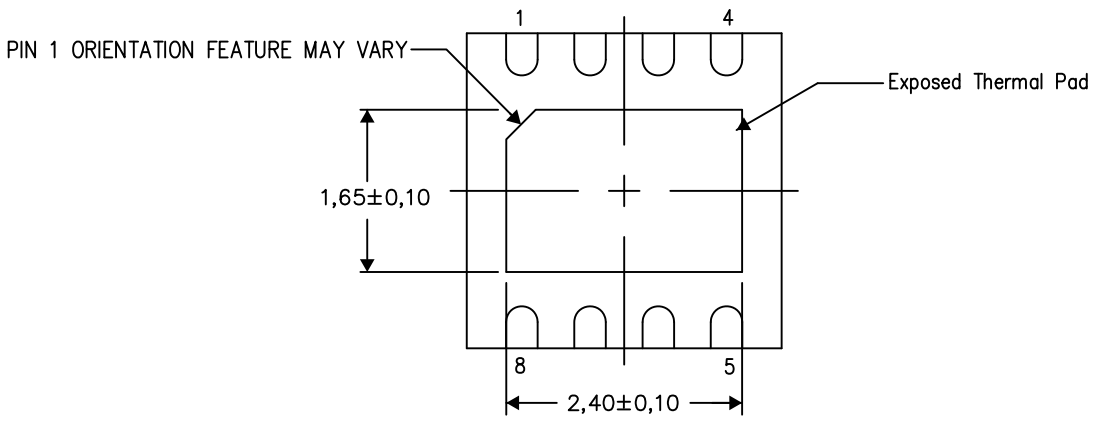
DRB (S–PVSON–N8) PLASTIC SMALL OUTLINE NO–LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No–Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



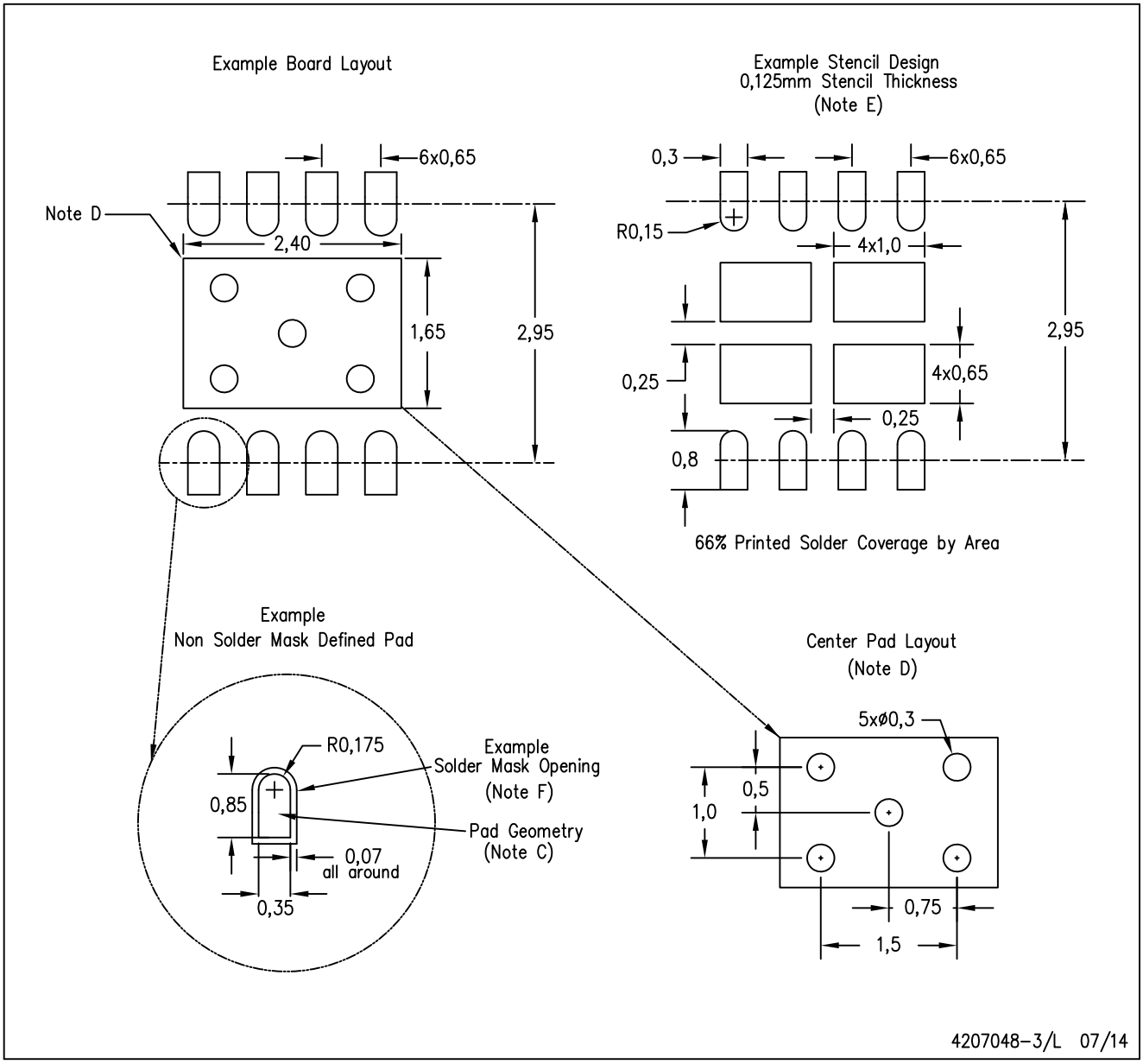
Bottom View

Exposed Thermal Pad Dimensions

4206340–3/P 07/14

NOTE: All linear dimensions are in millimeters

DRB (S–PVSON–N8) PLASTIC SMALL OUTLINE NO–LEAD



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, QFN Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <http://www.ti.com>.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
F. Customers should contact their board fabrication site for solder mask tolerances.

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