

bq2920x 用于 2 节串联锂离子电池且具有自动电量平衡功能的电压保护

1 特性

- 2 节串联电池二级保护
- 带外部使能控制的自动电量失衡校正
 - $\pm 30\text{mV}$ 使能阈值, 0mV 禁用阈值 (典型值)
- 外部电容控制的延迟定时器
- 外部电阻控制的电量平衡电流
- 低功耗 $I_{CC} < 3\mu\text{A}$ (典型值) (V_{CELL} (总电压) $< V_{\text{PROTECT}}$)
- 内部电量平衡功能可处理高达 15mA 的电流
- 支持外部电量平衡模式
- 高精度过压保护:
 - $\pm 25\text{mV}$ ($T_A = 0^\circ\text{C}$ 至 60°C)
- 固定过压保护阈值: 4.30V , 4.35V
- 小型 8 引脚 DRB 封装

2 应用

- 锂离子电池组二级保护
 - 笔记本电脑
 - 电动工具
 - 便携式设备和仪器
 - 备用电池系统

3 说明

bq2920x 器件是一款用于 2 节串联锂离子电池组的二级过压保护集成电路 (IC), 集成有高精度精密过压检测电路和自动电量失衡校正功能。

该 IC 将 2 节串联电池组中每节电池的电压与出厂设定的内部参考电压进行比较。如果任一电池达到过压状态, OUT 引脚由低电平转换为高电平状态。

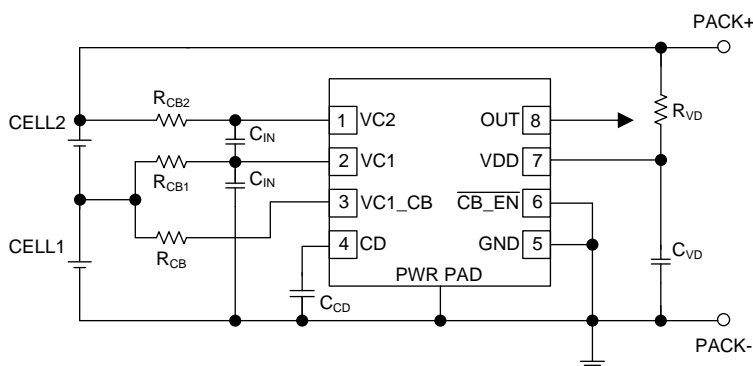
bq2920x 可执行基于电压的自动电量失衡校正。当电池电压与内部参考电压相差 30mV (标称值) 或以上时, 启动电量平衡; 当电池电压与内部参考电压相差 0mV (标称值) 时, 停止电量平衡。电量平衡功能由 CB_EN 引脚使能和禁用。

器件信息(1)

器件型号	封装	封装尺寸 (标称值)
bq29200	VSON (8)	3.00mm × 3.00mm
bq29209		

(1) 如需了解所有可用封装, 请见数据表末尾的可订购产品附录。

简化电路原理图



目录

1	特性	1	8.3	Feature Description	8
2	应用	1	8.4	Device Functional Modes	12
3	说明	1	9	Application and Implementation	13
4	修订历史记录	2	9.1	Application Information	13
5	Device Options	4	9.2	Typical Applications	13
6	Pin Configuration and Functions	4	9.3	System Example	14
7	Specifications	4	10	Power Supply Recommendations	14
7.1	Absolute Maximum Ratings	4	11	Layout	15
7.2	ESD Ratings	5	11.1	Layout Guidelines	15
7.3	Recommended Operating Conditions	5	11.2	Layout Example	15
7.4	Thermal Information	5	12	器件和文档支持	16
7.5	Electrical Characteristics	5	12.1	相关链接	16
7.6	Recommended Cell Balancing Configurations	7	12.2	社区资源	16
7.7	Typical Characteristics	7	12.3	商标	16
8	Detailed Description	8	12.4	静电放电警告	16
8.1	Overview	8	12.5	Glossary	16
8.2	Functional Block Diagram	8	13	机械、封装和可订购信息	17

4 修订历史记录

Changes from Revision B (December 2014) to Revision C

Page

•	已更改 典型应用标题至简化原理图	1
•	已更改 电阻器 R _{VD} 的位置，在简化原理图图形中添加了 PACK+ 和 PACK-	1
•	Deleted the Lead Temperature (soldering) from the <i>Absolute Maximum Ratings</i> table	4
•	Deleted table notes 2 through 7 from the <i>Thermal Information</i>	5
•	Changed resistor R _{VD} location in Figure 9	13
•	Added title to Table 1	13
•	Changed resistor R _{VD} location, added PACK+ and PACK- in Figure 11	14

Changes from Revision A (September 2010) to Revision B

Page

•	已添加 ESD 额定值表，特性 描述部分，器件功能模式，应用和实施部分，电源相关建议部分，布局部分，器件和文档支持部分以及机械、封装和可订购信息部分	1
---	--	---

Changes from Original (June 2010) to Revision A

Page

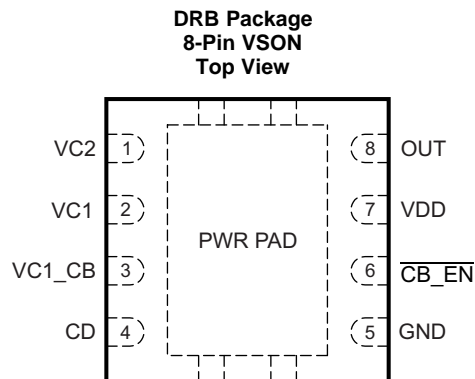
•	Changed values in X _{DELAY} and X _{DELAY_CTM} electrical characteristics	5
•	Changed specifications for V _{OUT}	6
•	Changed test conditions for V _{OUT} , I _{OH} , and I _{OL}	6
•	Added V _{MM_DET_ON} : VC2 = VDD = 7.6 V	6
•	Changed V _{MM_DET_OFF} : From VDD – VC2 – 7.6 V to VC2 = VDD = 7.6 V	6
•	Changed content in Recommended Cell Balancing Configurations section	7
•	Added I _{CD} Charge Current figure	7
•	Added I _{CD} Discharge Current figure	7
•	Changed X _{DELAY} from nominally 8.0 s/μF to nominally 9.0 s/μF	8
•	Changed Timing for Overvoltage Sensing figure	9
•	Added Cell Imbalance Auto-Detection (Via Cell Voltage) section	10
•	Changed VDD value in Customer Test Mode from 8.5 V to 9.5 V	10

- Changed the Voltage Test Limits figure 11
- Added External Cell Balancing section..... 14

5 Device Options

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

6 Pin Configuration and Functions



Pin Functions

PIN		DESCRIPTION
NAME	NO.	
$\overline{CB_EN}$	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

7 Specifications

7.1 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
	$\overline{CB_EN}$ –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 .		
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, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

7.2 ESD Ratings

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

- (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.

7.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, VDD		4		10	V
Input voltage range		VC2–VC1, VC1–GND		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
Voltage monitor filter capacitance		C _{IN} (See Figure 9.)		0.01	0.1
Supply voltage filter resistance		R _{VD} (See Figure 9.)		100	1K
Supply voltage filter capacitance		C _{VD} (See Figure 9.)		0.1	μF
Cell balance resistance		R _{CB} (See Figure 9 and <i>Protection (OUT) Timing.</i>)		100	4.7K
Operating ambient temperature range, T _A		–40		110	°C

7.4 Thermal Information

THERMAL METRIC ⁽¹⁾		bq2920x			UNIT
		DRB			
		8 PINS			
R _{θJA}	Junction-to-ambient thermal resistance	50.5			°C/W
R _{θJC(top)}	Junction-to-case(top) thermal resistance	25.1			°C/W
R _{θJB}	Junction-to-board thermal resistance	19.3			°C/W
ψ _{JT}	Junction-to-top characterization parameter	0.7			°C/W
ψ _{JB}	Junction-to-board characterization parameter	18.9			°C/W
R _{θJC(bot)}	Junction-to-case(bottom) thermal resistance	5.2			°C/W

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

7.5 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				4.3			V
		bq29200				4.35			
V _{HYS}	Overvoltage detection hysteresis				200	300	400	mV	
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	9	12	s/μF	
		T _A = –40°C to 110°C Note: Does not include external capacitor variation.			5.5	9	13.5		

Electrical Characteristics (continued)

Typical values stated where $T_A = 25^\circ\text{C}$ and $V_{DD} = 7.2\text{ V}$. Minimum and maximum values stated where $T_A = -40^\circ\text{C}$ to 110°C and $V_{DD} = 4\text{ V}$ to 10 V (unless otherwise noted).

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$X_{\text{DELAY_CTM}}^{(1)}$	Overvoltage delay time scale factor in Customer Test Mode			0.08		s/ μF
$I_{\text{CD(CHG)}}$	Overvoltage detection charging current			150		nA
$I_{\text{CD(DSG)}}$	Overvoltage detection discharging current			60		μA
V_{CD}	Overvoltage detection external capacitor comparator threshold			1.2		V
I_{CC}	Supply current	$(V_{\text{C2}} - V_{\text{C1}}) = (V_{\text{C1}} - \text{GND}) = 3.5\text{ V}$ (See Figure 7.)		3	6	μA
V_{OUT}	OUT pin drive voltage	$(V_{\text{C2}} - V_{\text{C1}})$ or $(V_{\text{C1}} - \text{GND}) > V_{\text{PROTECT}}$, $V_{\text{DD}} = 10\text{ V}$, $I_{\text{OH}} = 0$	6	8.25	9.5	V
		$(V_{\text{C2}} - V_{\text{C1}})$ or $(V_{\text{C1}} - \text{GND}) = V_{\text{PROTECT}}$, $V_{\text{DD}} = V_{\text{PROTECT}}$, $I_{\text{OH}} = -100\text{ }\mu\text{A}$, $T_A = 0^\circ\text{C}$ to 60°C	1.75	2.5		V
		$(V_{\text{C2}} - V_{\text{C1}})$ and $(V_{\text{C1}} - \text{GND}) < V_{\text{PROTECT}}$, $I_{\text{OL}} = 100\text{ }\mu\text{A}$, $T_A = 25^\circ\text{C}$			200	mV
		$(V_{\text{C2}} - V_{\text{C1}})$ and $(V_{\text{C1}} - \text{GND}) < V_{\text{PROTECT}}$, $I_{\text{OL}} = 0\text{ }\mu\text{A}$, $T_A = 25^\circ\text{C}$		0	10	mV
		$V_{\text{C2}} = V_{\text{C1}} = V_{\text{DD}} = 4\text{ V}$, $I_{\text{OL}} = 100\text{ }\mu\text{A}$			200	mV
I_{OH}	High-level output current	OUT = 1.75 V, $(V_{\text{C2}} - V_{\text{C1}})$ or $(V_{\text{C1}} - \text{GND}) = V_{\text{PROTECT}}$, $V_{\text{DD}} = V_{\text{PROTECT}}$ to 10 V, $T_A = 0^\circ\text{C}$ to 60°C	-100			μA
I_{OL}	Low-level output current	OUT = 0.05 V, $(V_{\text{C2}} - V_{\text{C1}})$ or $(V_{\text{C1}} - \text{GND}) < V_{\text{PROTECT}}$, $V_{\text{DD}} = V_{\text{PROTECT}}$ to 10 V, $T_A = 0^\circ\text{C}$ to 60°C	30		85	μA
$I_{\text{OH_ZV}}$	High-level short-circuit output current	OUT = 0 V, $(V_{\text{C2}} - V_{\text{C1}}) = (V_{\text{C1}} - \text{GND}) = V_{\text{PROTECT}}$, $V_{\text{DD}} = 4$ to 10 V			-8	mA
I_{IN}	Input current at VCx pins	Measured at VC1, $(V_{\text{C2}} - V_{\text{C1}}) = (V_{\text{C1}} - \text{GND}) = 3.5\text{ V}$, $T_A = 0^\circ\text{C}$ to 60°C (See Figure 7.)	-0.2		0.2	μA
		Measured at VC2, $(V_{\text{C2}} - V_{\text{C1}}) = (V_{\text{C1}} - \text{GND}) = 3.5\text{ V}$, $T_A = 0^\circ\text{C}$ to 60°C (See Figure 7.)			2.5	μA
$V_{\text{MM_DET_ON}}$	Cell mismatch detection threshold for turning ON	$(V_{\text{C2}} - V_{\text{C1}})$ versus $(V_{\text{C1}} - \text{GND})$ and vice-versa when cell balancing is enabled. $V_{\text{C2}} = V_{\text{DD}} = 7.6\text{ V}$	17	30	45	mV
$V_{\text{MM_DET_OFF}}$	Cell mismatch detection threshold for turning OFF	Delta between $(V_{\text{C2}} - V_{\text{C1}})$ and $(V_{\text{C1}} - \text{GND})$ when cell balancing is disabled. $V_{\text{C2}} = V_{\text{DD}} = 7.6\text{ V}$	-9	0	9	mV
$V_{\text{CB_EN_ON}}$	Cell balance enable ON threshold	Active LOW pin at $\overline{\text{CB_EN}}$			1	V
$V_{\text{CB_EN_OFF}}$	Cell balance enable OFF threshold	Active HIGH at $\overline{\text{CB_EN}}$	2.2			V
$I_{\text{CB_EN}}$	Cell balance enable ON input current	$\overline{\text{CB_EN}} = \text{GND}$ (See Figure 8.)			0.2	μA
R_{CB1}	Internal cell balance switch resistance	$\overline{\text{CB_EN}} = \text{GND}$				Ω
R_{CB2}	Internal cell balance switch resistance	$\overline{\text{CB_EN}} = \text{GND}$				Ω

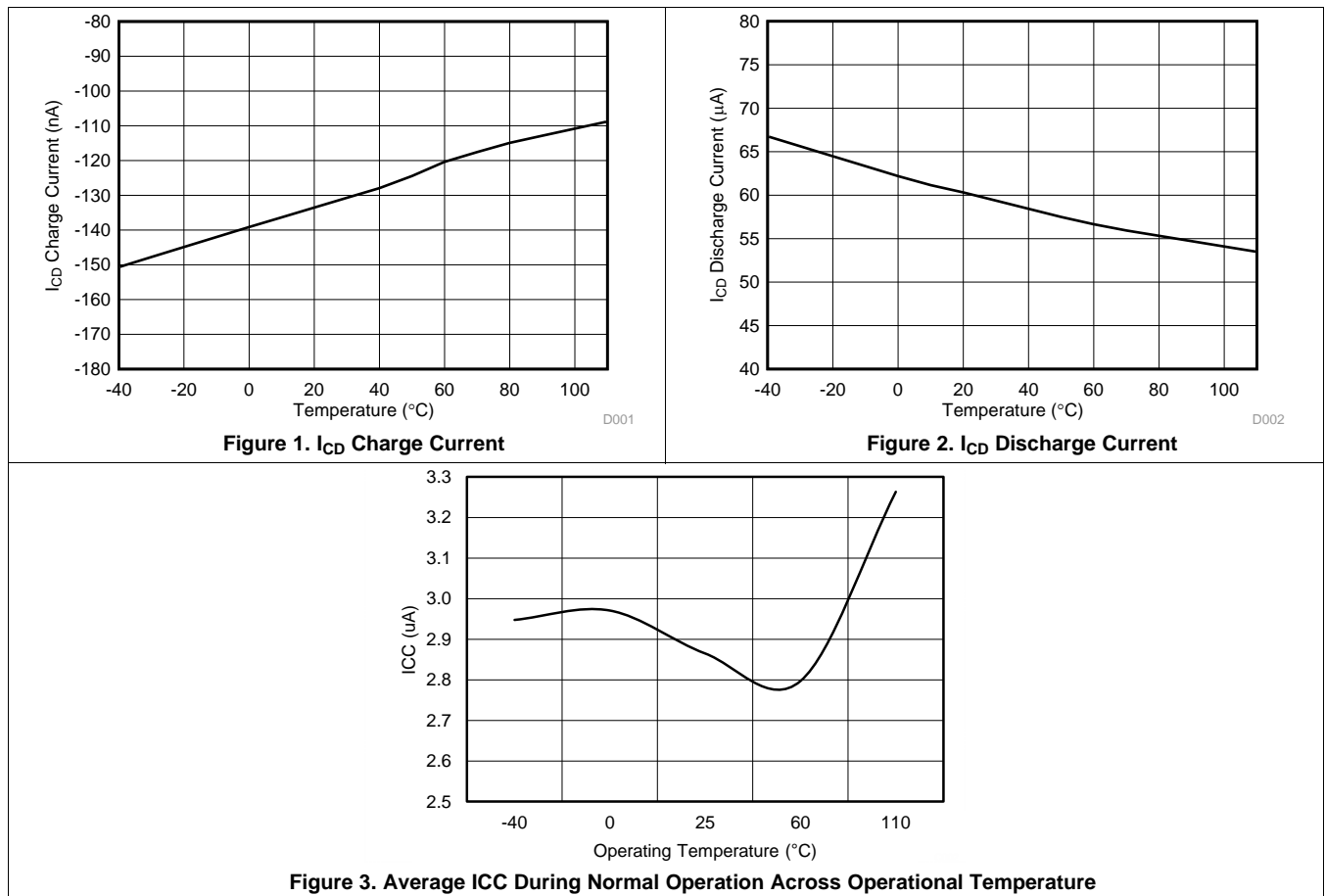
(1) Specified by design. Not 100% tested in production.

7.6 Recommended Cell Balancing Configurations

Typical values stated where $T_A = 25^\circ\text{C}$ and $(VC2-VC1)$, $(VC1-GND) = 3.8\text{ V}$. Minimum and maximum values stated where $T_A = -40^\circ\text{C}$ to 110°C , $VDD = 4\text{ V}$ to 10 V , and $(VC2-VC1)$, $(VC1-GND) = 3\text{ V}$ to 4.2 V . All values assume recommended supply voltage filter resistance R_{VD} of $100\ \Omega$ and 5% accurate or better cell balance resistor R_{CB} .

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

7.7 Typical Characteristics



8 Detailed Description

8.1 Overview

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

8.1.1 Voltage Protection

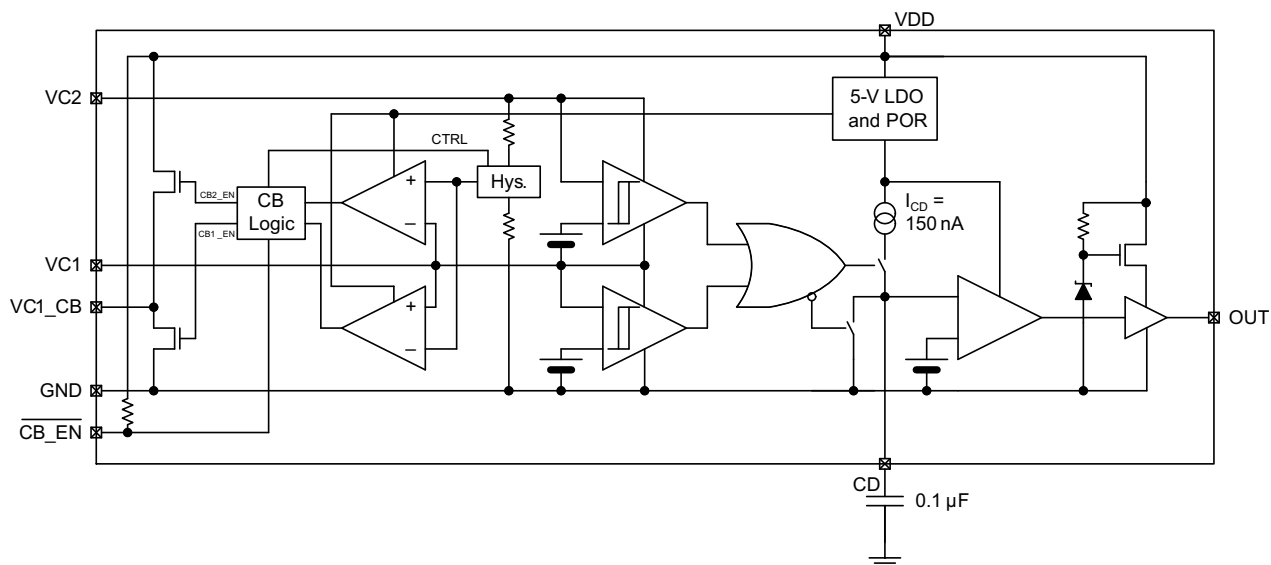
Each cell voltage is continuously compared to a factory configured internal reference threshold. If either cell reaches an overvoltage condition, the bq2920x device starts a timer that provides a delay proportional to the capacitance on the CD pin. Upon expiration of the internal timer, the OUT pin changes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

8.1.2 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, for example, 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.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 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 s/µF. For example, if a nominal delay of 3 seconds is desired, use a C_{CD} capacitor that is 3 s / 9 s/µF = 0.33 µF.

The delay time is calculated as follows:

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

Feature Description (continued)

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.

8.3.2 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 $I_{\text{OH}} = 0$ 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.

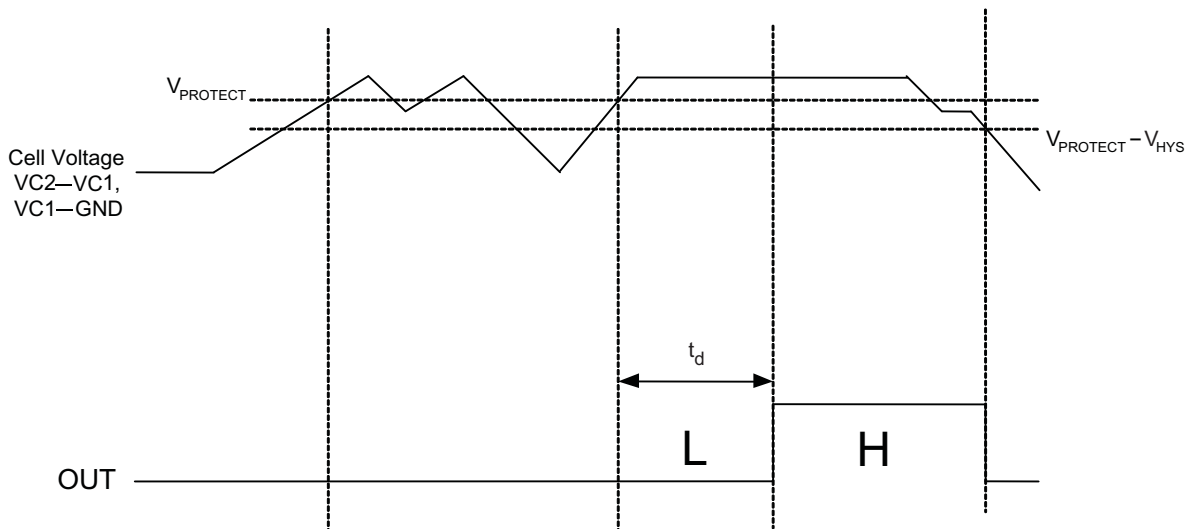


Figure 4. Timing for Overvoltage Sensing

8.3.3 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

8.3.4 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)

8.3.5 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

8.3.6 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 V and 4.2 V. Below $VDD = 6$ V, it is recommended to pull $\overline{CB_EN}$ high to disable the cell balancing function.

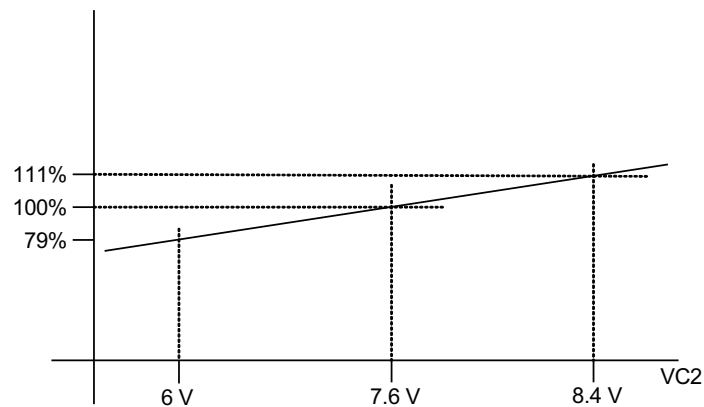


Figure 5. $V_{MM_DET_ON}$ and $V_{MM_DET_OFF}$ Threshold

8.3.7 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.

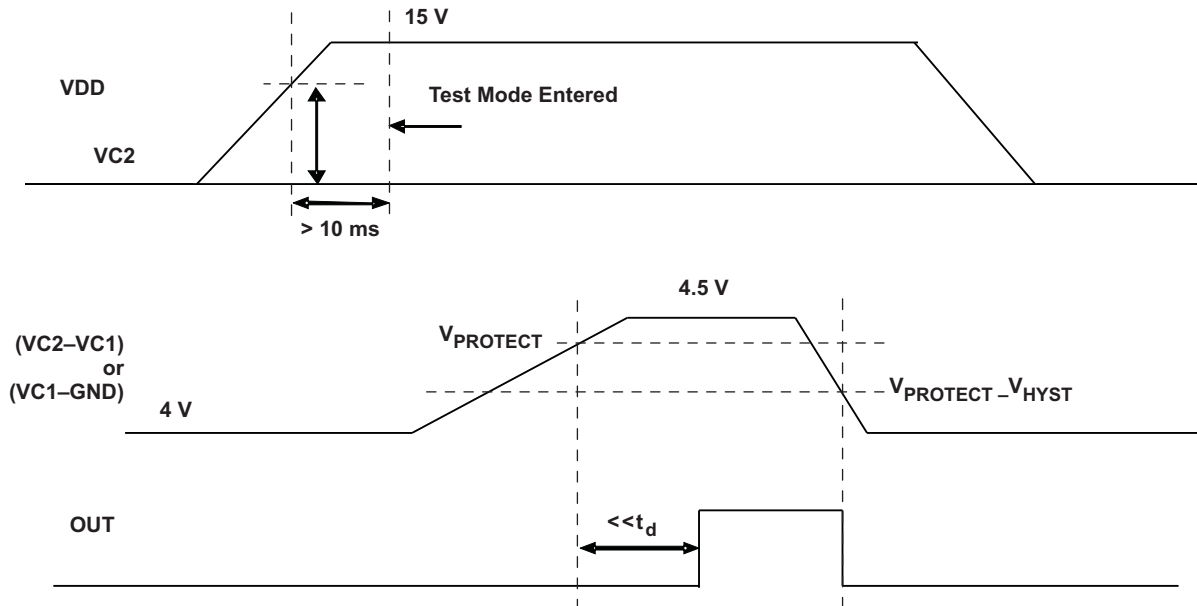


Figure 6. Voltage Test Limits

8.3.8 Test Conditions

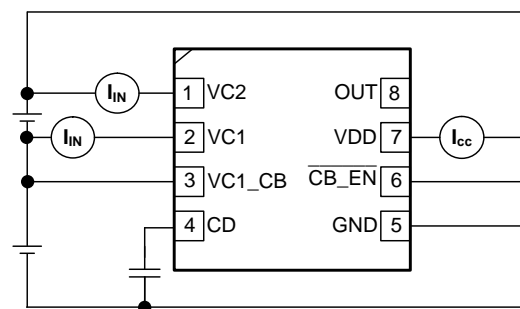


Figure 7. I_{CC}, I_{IN} Measurement

Feature Description (continued)

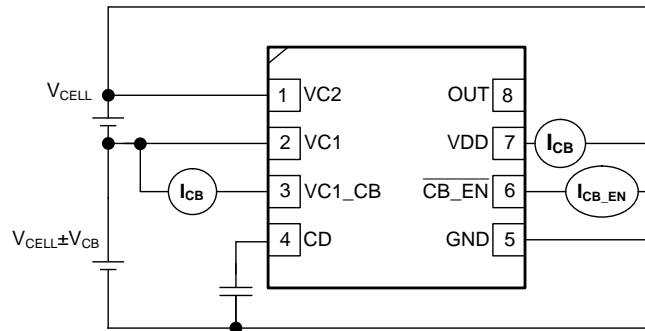


Figure 8. I_{CB} Measurement

8.4 Device Functional Modes

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

8.4.1 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.

8.4.2 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.

9 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.

9.1 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.

9.2 Typical Applications

9.2.1 Battery Connection

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

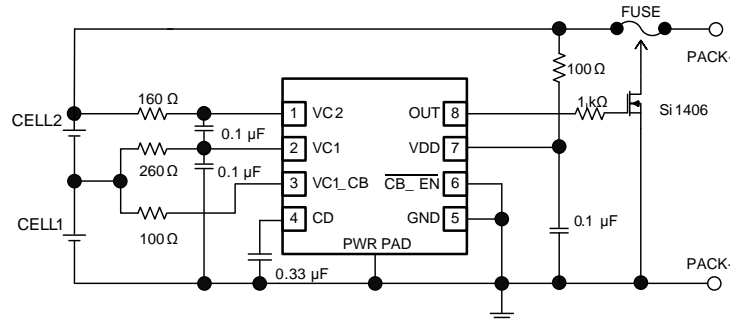


Figure 9. 2-Series Cell Configuration

9.2.1.1 Design Requirements

For this design example, use the parameters listed in Table 1.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE at T _A = 25°C
Input voltage range	4 V to 10 V
Overvoltage Protection (OVT)	4.35 V
Overvoltage detection delay time	3 s
Overvoltage detection delay timer capacitor	0.33 μF
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

9.2.1.2 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.

9.2.1.3 Application Curve

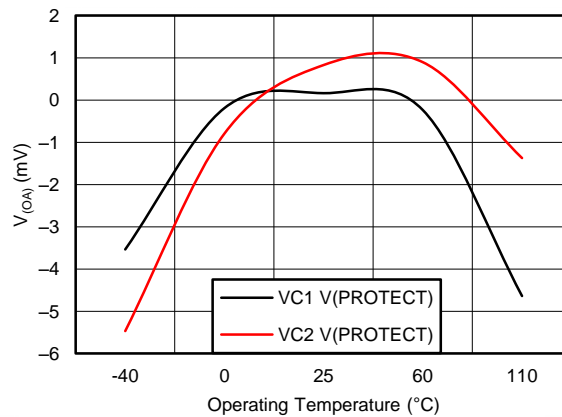


Figure 10. Average V_{PROTECT} Accuracy (V_{OA}) Across Operation Temperature

9.3 System Example

9.3.1 External Cell Balancing

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

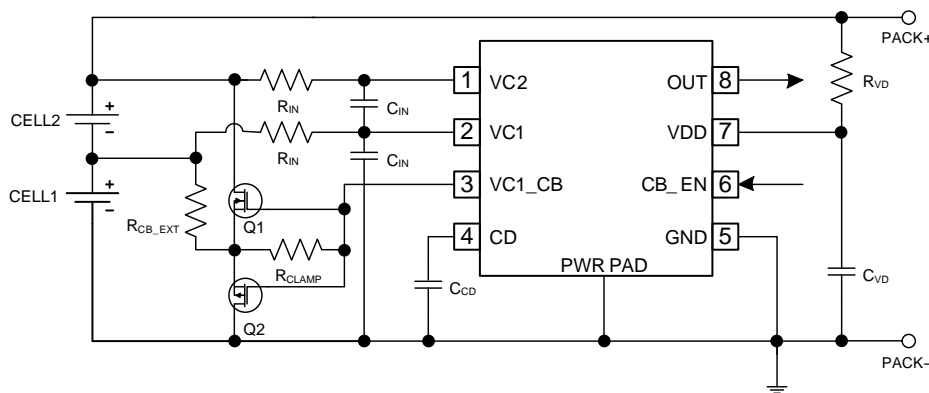


Figure 11. External Cell Balancing Configuration

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

$$I_{\text{bal}} = \frac{V_{\text{CELL}}}{R_{\text{CB_EXT}}}$$

10 Power Supply Recommendations

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


11 Layout


11.1 Layout Guidelines

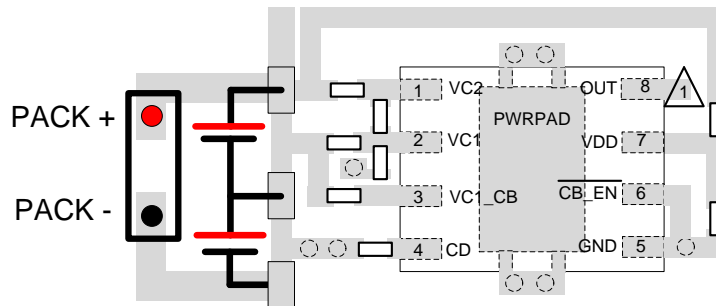
The following are the recommended layout guidelines:

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.

11.2 Layout Example

 Additional circuitry required based on usage of the OUT pin

 Via connects between two layers



12 器件和文档支持

12.1 相关链接

下面的表格列出了快速访问链接。范围包括技术文档、支持与社区资源、工具和软件，以及样片或购买的快速访问。

表 2. 相关链接

部件	产品文件夹	样片与购买	技术文档	工具与软件	支持与社区
bq29200	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
bq29209	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处

12.2 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.3 商标

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.4 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 机械、封装和可订购信息

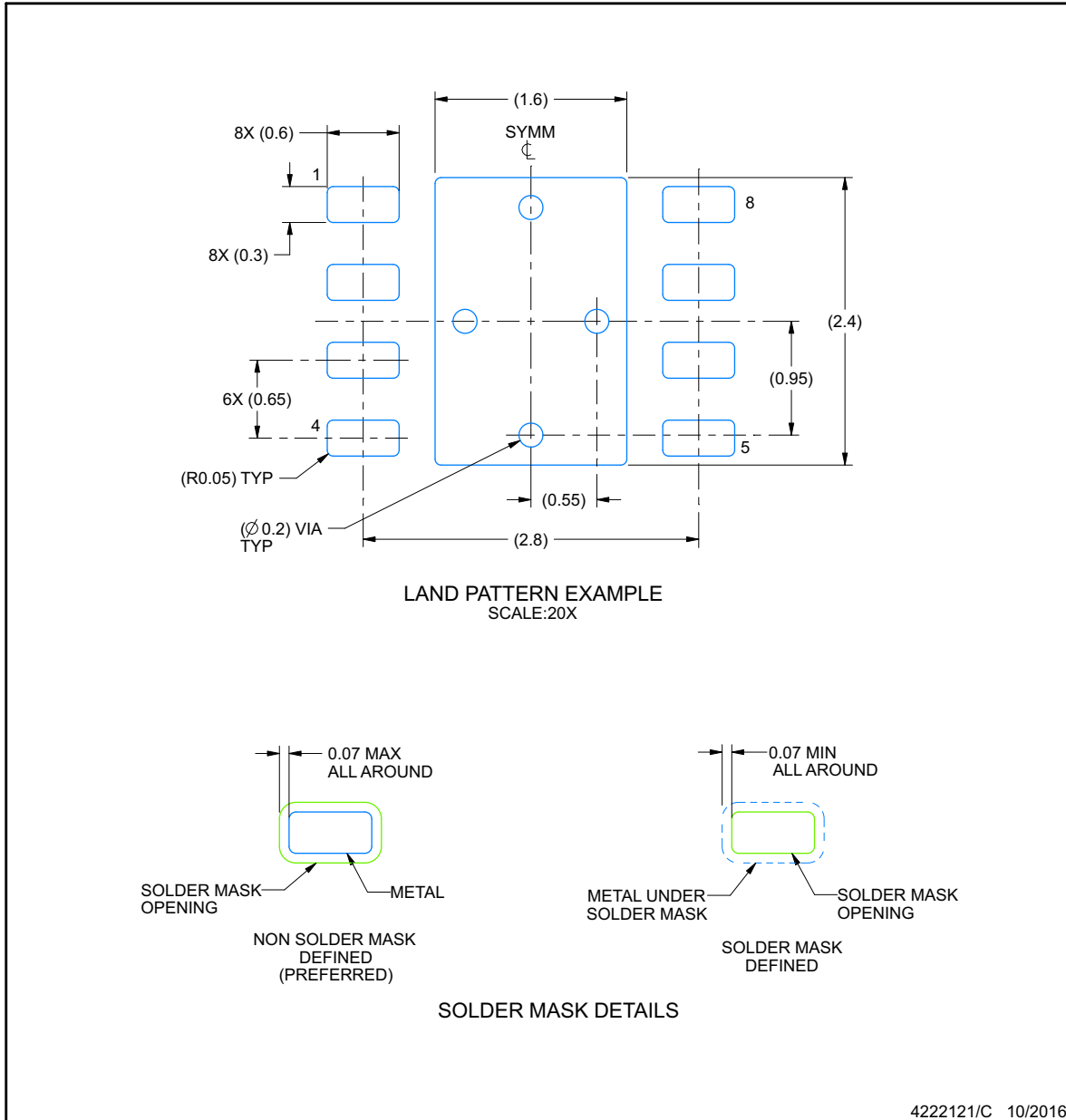
以下页中包括机械、封装和可订购信息。此信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

EXAMPLE BOARD LAYOUT

DRB0008F

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



NOTES: (continued)

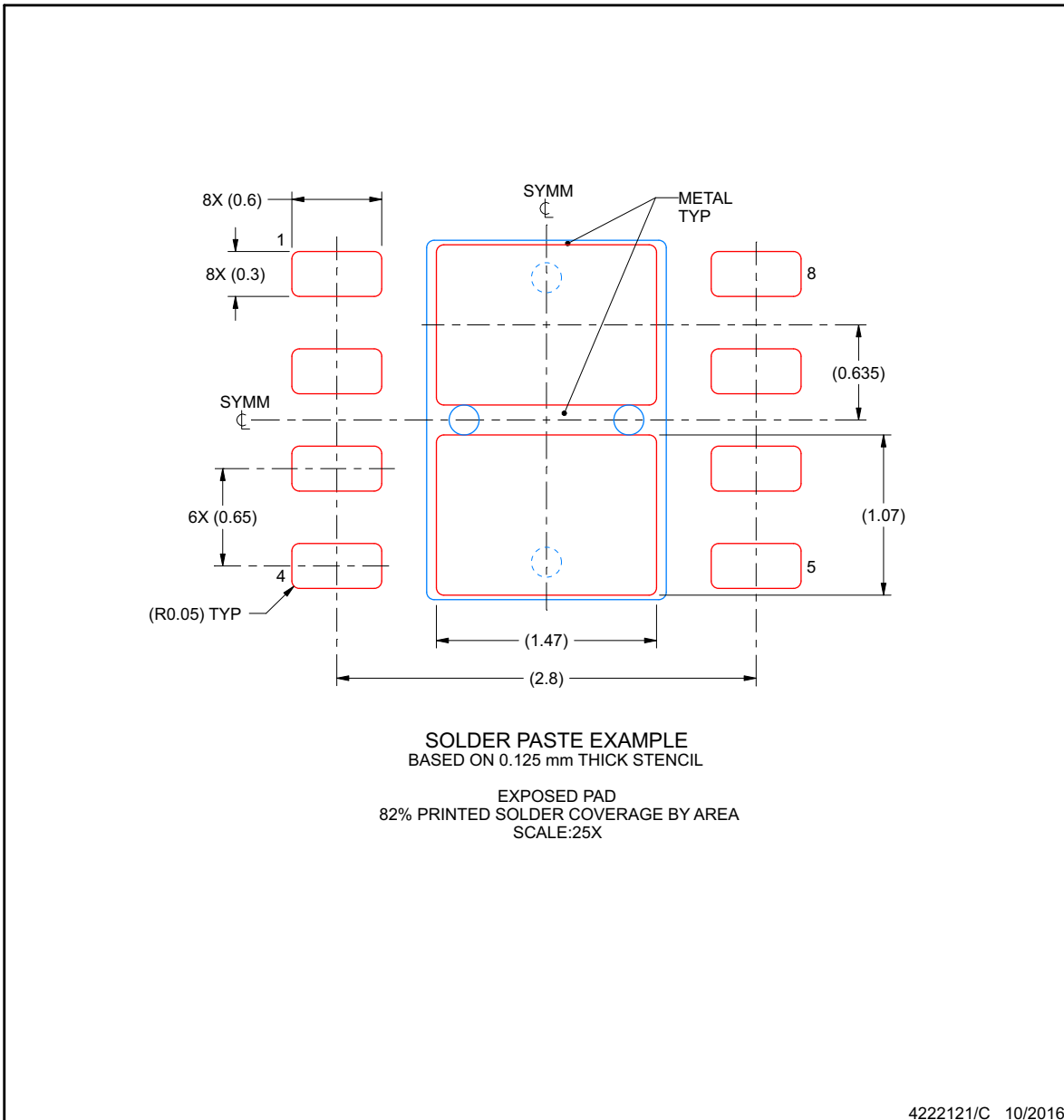
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DRB0008F

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
BQ29200DRBR	Active	Production	SON (DRB) 8	3000 LARGE T&R	Yes	NIPDAU SN	Level-2-260C-1 YEAR	-40 to 85	200
BQ29200DRBR.A	Active	Production	SON (DRB) 8	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200
BQ29200DRBR.B	Active	Production	SON (DRB) 8	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200
BQ29200DRBT	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	Call TI Sn Nipdau	Level-2-260C-1 YEAR	-40 to 85	200
BQ29200DRBT.A	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200
BQ29200DRBT.B	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	200
BQ29209DRBR	Active	Production	SON (DRB) 8	3000 LARGE T&R	Yes	NIPDAU SN	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBR.A	Active	Production	SON (DRB) 8	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBT	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU SN	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBT.A	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBT.B	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBTG4	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBTG4.A	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209
BQ29209DRBTG4.B	Active	Production	SON (DRB) 8	250 SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	209

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF BQ29209 :

- Automotive : [BQ29209-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

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
BQ29209DRBTG4	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	346.0	346.0	33.0
BQ29200DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29209DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29209DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29209DRBTG4	SON	DRB	8	250	210.0	185.0	35.0

DRB 8

GENERIC PACKAGE VIEW

VSON - 1 mm max height

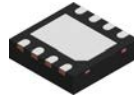
PLASTIC SMALL OUTLINE - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4203482/L

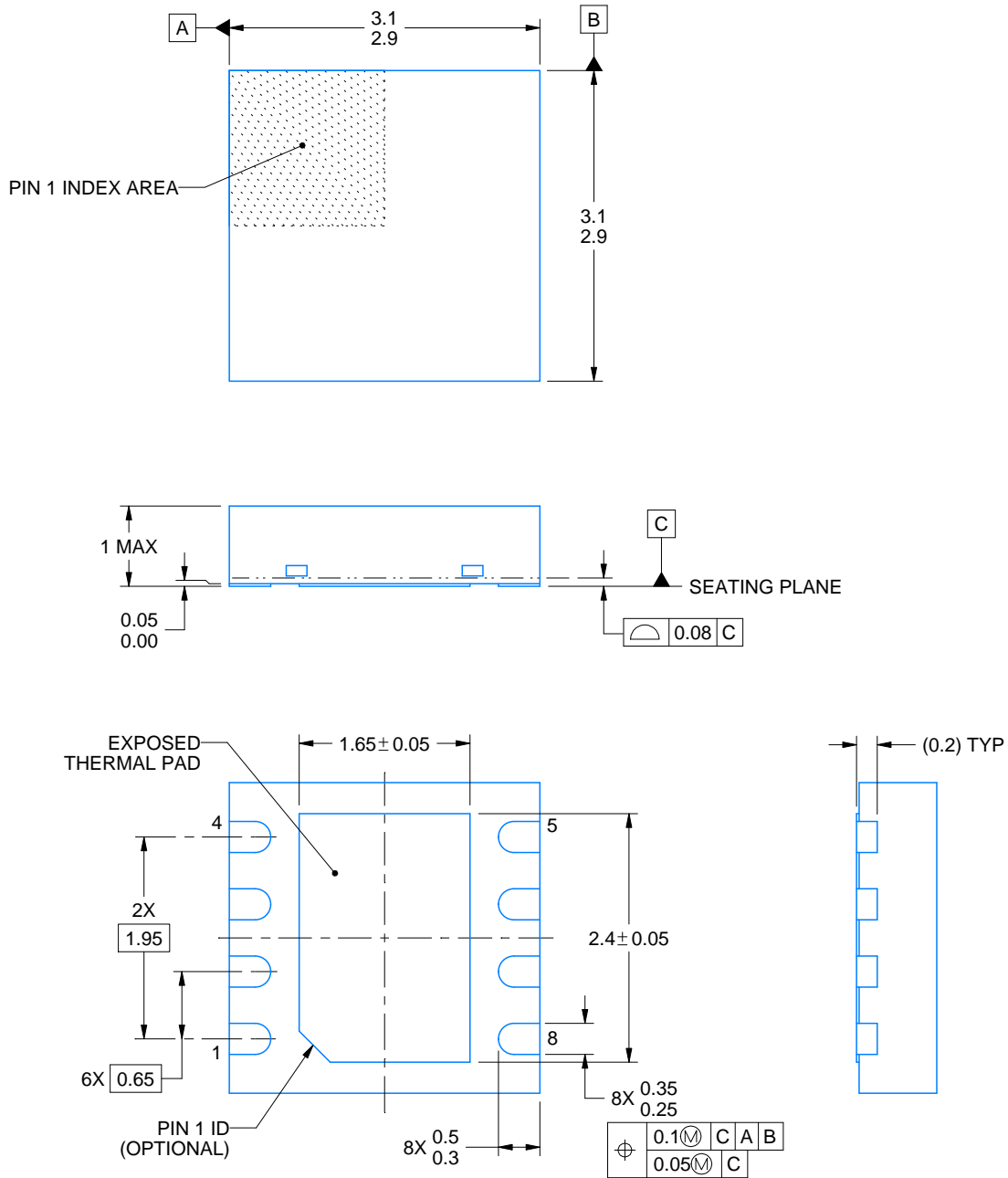
DRB0008B



PACKAGE OUTLINE

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



4218876/A 12/2017

NOTES:

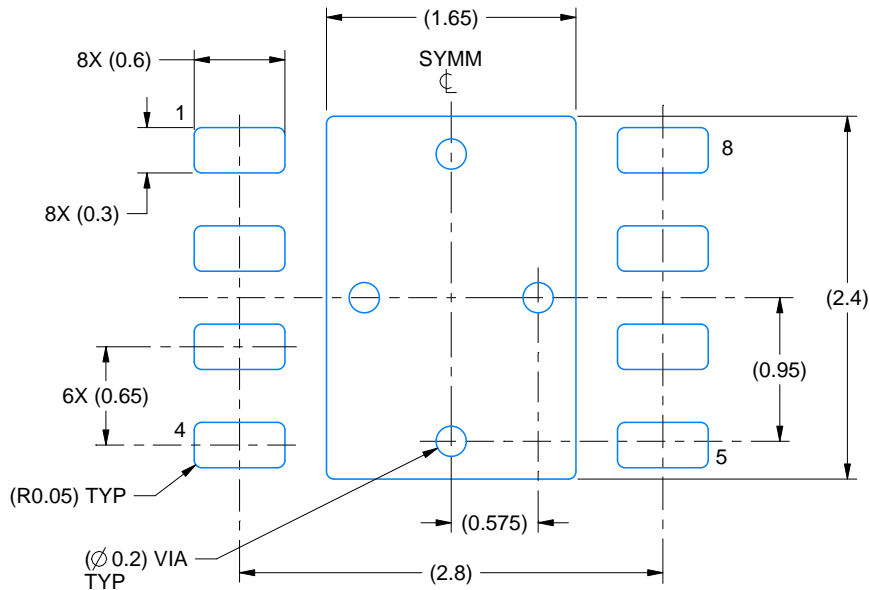
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

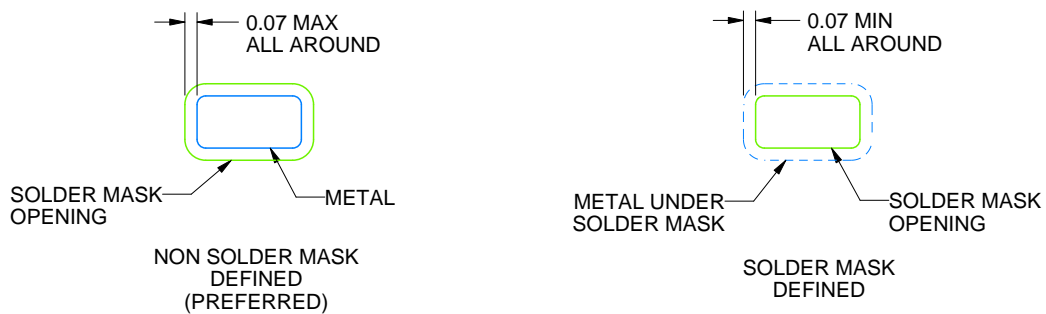
DRB0008B

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
SCALE:20X



SOLDER MASK DETAILS

4218876/A 12/2017

NOTES: (continued)

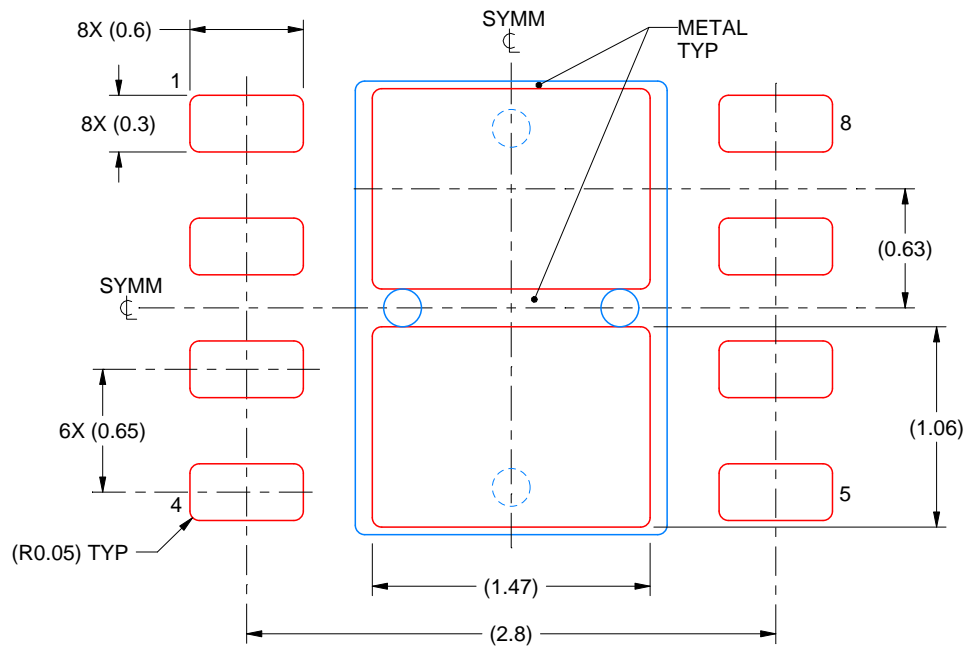
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DRB0008B

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
81% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

4218876/A 12/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 [TI 销售条款](#)、[TI 通用质量指南](#) 或 [ti.com](#) 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

版权所有 © 2026，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月