

Overvoltage Protection for 2-Series and 3-Series Cell Li-Ion Batteries

Check for

Samples: [bq294502](#), [bq294504](#), [bq294512](#), [bq294515](#), [bq294522](#), [bq294524](#), [bq294532](#), [bq294562](#), [bq294572](#), [bq294582](#), [bq294592](#)

FEATURES

- 2-Series and 3-Series Cell Monitor for Secondary Protection
- Fixed Programmable Delay Timer
- Fixed OVP Threshold:
 - bq294502 = 4.35 V with 4-s Delay Timer
 - bq294504 = 4.35 V with 6.5-s Delay Timer
 - bq294512 = 4.40 V with 4-s Delay Timer
 - bq294515 = 4.425 V with 4-s Delay Timer
 - bq294522 = 4.45 V with 4-s Delay Timer
 - bq294524 = 4.45 V with 6.5-s Delay Timer
 - bq294532 = 4.50 V with 4-s Delay Timer
 - bq294562 = 4.25 V with 4-s Delay Timer
 - bq294572 = 4.00 V with 4-s Delay Timer
 - bq294582 = 4.225 V with 4-s Delay Timer
 - bq294584 = 4.225 V with 6.5-s Delay Timer
 - bq294592 = 4.30 V with 4-s Delay Timer
- High-Accuracy Overvoltage Protection:
± 10 mV

- Low Power Consumption I_{CC} 1 μ A
($V_{CELL(ALL)} < V_{PROTECT}$)
- Low leakage current per cell input < 100 nA
- Small package footprint
 - 6-pin SON

APPLICATIONS

- 2nd-Level Protection in Li-Ion Battery Packs in:
 - Tablets
 - Slates
 - Power Tools
 - Notebook Computers
 - Portable Equipment and Instrumentation

DESCRIPTION

The bq2945xy family of products is a secondary level voltage monitor and protector for Li-Ion battery pack systems. Each cell is monitored independently for an overvoltage condition. Based on the configuration, an output is triggered after a fixed delay if any one of the two or three cells has an overvoltage condition. This output will be triggered into a high state after an overvoltage condition has satisfied the specified delay timer.



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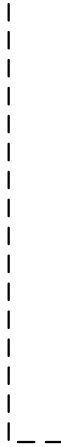
PIN FUNCTIONS

bq2945xy	Pin Name	Type I/O	Description
1	V3	IA	Sense input for positive voltage of the third cell from the bottom of the stack
2	V2	IA	Sense input for positive voltage of the second cell from the bottom of the stack
3	VSS	P	Electrically connected to IC ground and negative terminal of the lowest cell in the stack
4	V1	IA	Sense input for positive voltage of the lowest cell in the stack
5	VDD	P	Power supply
6	OUT	OA	Output drive for external N-Channel FET
5A49 0IA			VSS pin to be connected to the PWRPAD on the printed circuit board for proper

Thermal Pad, PWRPAD

For correct operation, the power pad (PWRPAD) is connected to the V_{SS} terminal on the printed circuit board.

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

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

PARAMETER	CONDITION	VALUE/UNIT
Supply voltage range	VDD–VSS	–0.3 to 30 V
Input voltage range	V1–VSS or V2–VSS or V3–VSS	–0.3 to 30 V
	V3–V2 or V2–V1	–0.3 to 8 V
Output voltage range	OUT–VSS	–0.3 to 30 V
Continuous total power dissipation, P_{TOT}		See package dissipation rating.
Functional temperature		–65 to 110°C
Storage temperature range, T_{STG}		–65 to 150°C
Lead temperature (soldering, 10 s), T_{SOLDER}		300°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.

RECOMMENDED OPERATING CONDITIONS

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

PARAMETER	MIN	NOM	MAX	UNIT
Supply voltage, V_{DD} ⁽¹⁾	3		25	V
Input voltage range V3–V2 or V2–V1 or V1–VSS	0		5	V
Operating ambient temperature range, T_A	–40		110	°C

(1) See [APPLICATION SCHEMATIC](#).

DC CHARACTERISTICS (continued)

Typical values stated where $T_A = 25^\circ\text{C}$ and $V_{DD} = 10.8\text{ V}$, MIN/MAX values stated where $T_A = -40^\circ\text{C}$ to 110°C and $V_{DD} = 3\text{ V}$ to 15 V (unless otherwise noted).

	Symbol	Parameter	Condition	Min	Typ	Max	Unit
Voltage Protection Threshold VCx							
1.24	$t_{\text{DELAY_CTM}}$	Fault Detection Delay Time in Test Mode	Fixed delay (Internal settings)		15		ms

TYPICAL CHARACTERISTICS

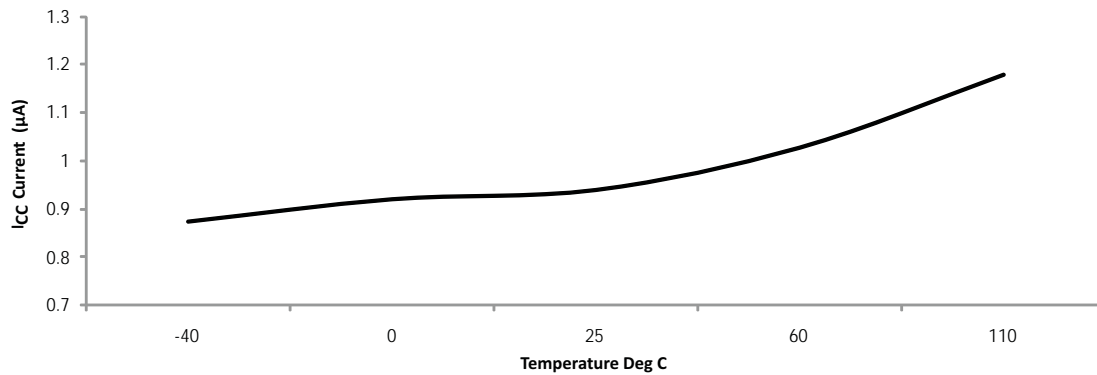


Figure 2. I_{CC} Current Consumption Versus Temperature

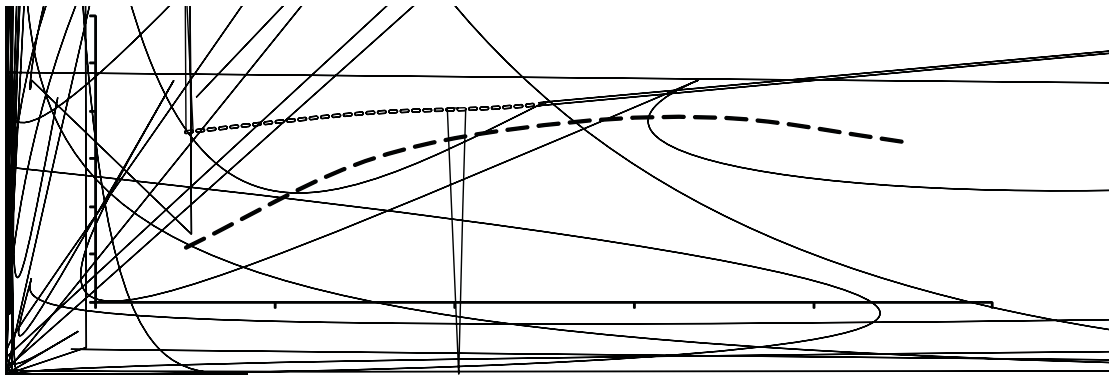
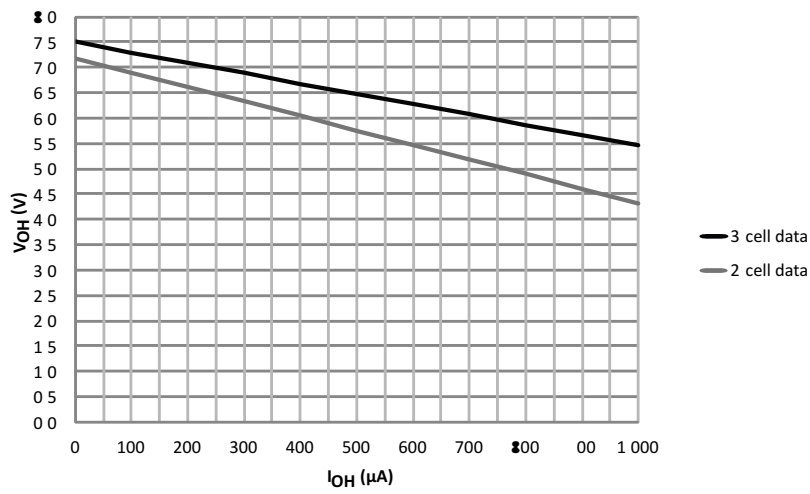
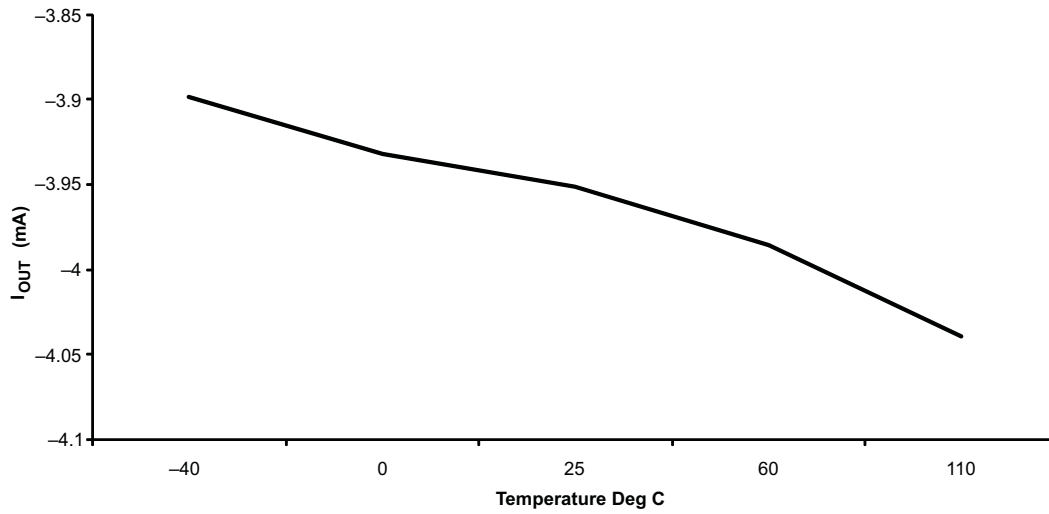
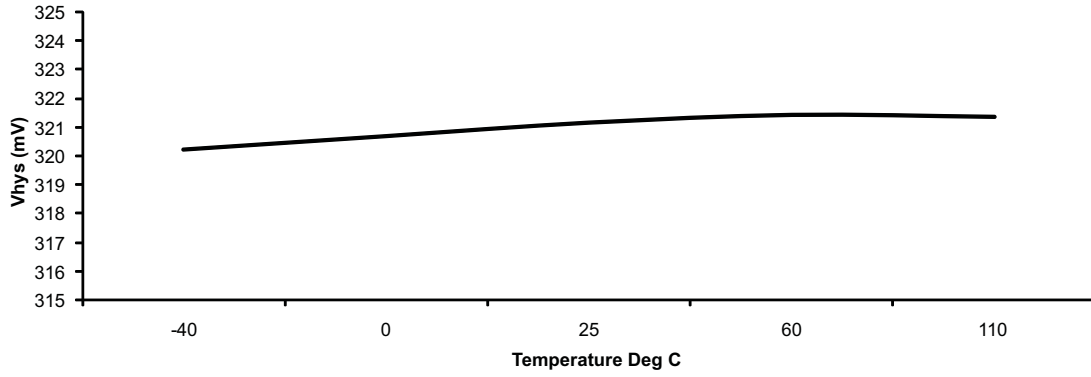


Figure 3. bq294502 Overvoltage Threshold (OVT) vs. Temp



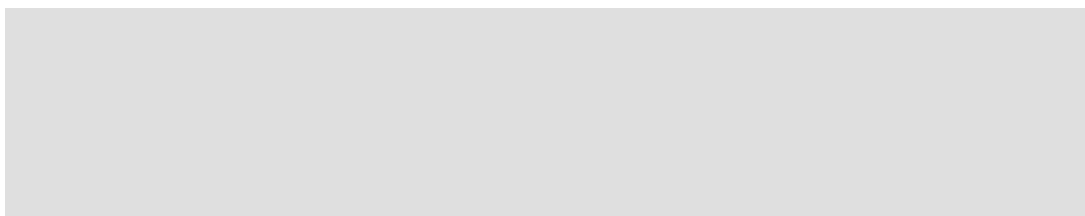
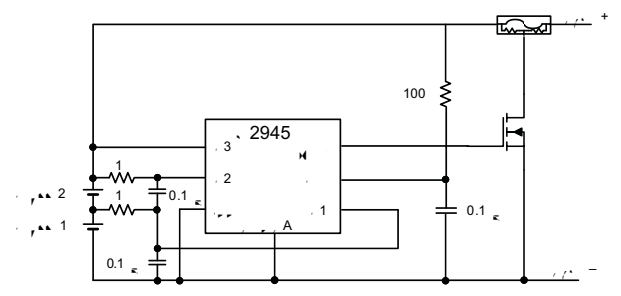
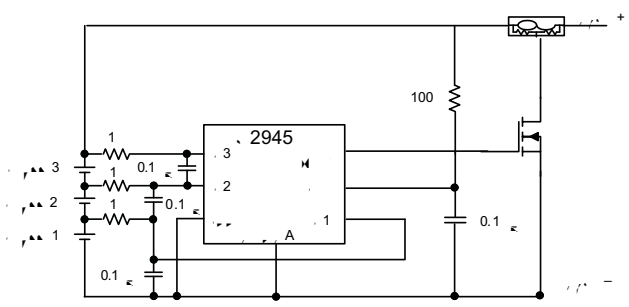
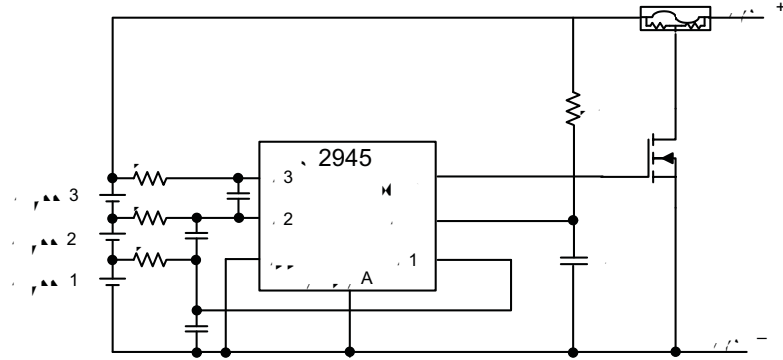


Figure 10 shows the timing for the Customer Test Mode.

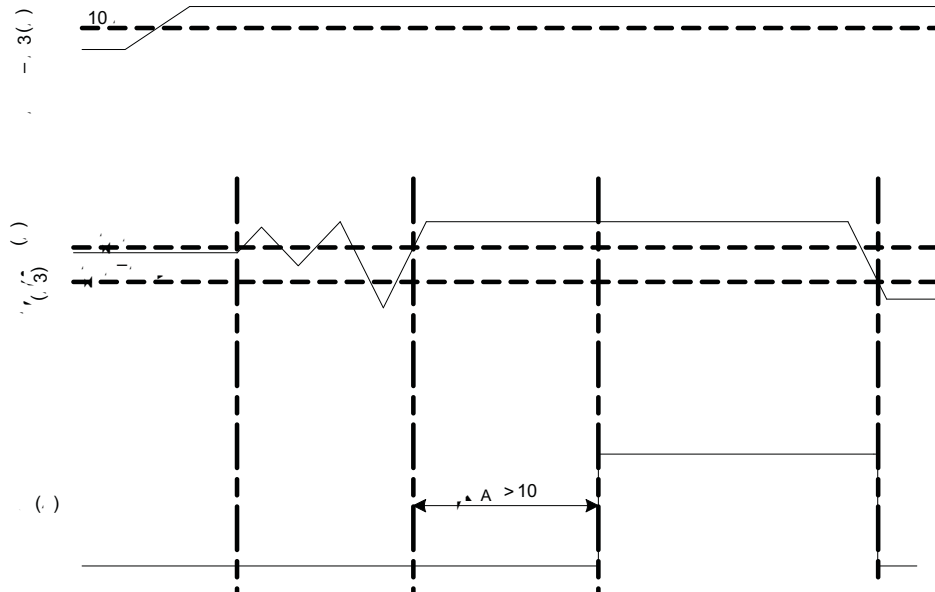


Figure 10. Timing for Customer Test Mode

Figure 11 shows the measurement for current consumption for the product for both VDD and Vx.

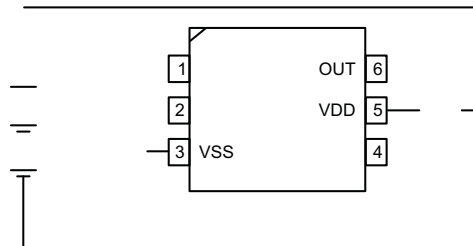


Figure 11. Configuration for IC Current Consumption Test

REVISION HISTORY

Changes from Original (September 2011) to Revision A Page

- Added the bq294582 Device to Production Data 2
-

Changes from Revision A (November 2011) to Revision B Page

- Changed the bq294504 Device to Production Data 1
 - Added the bq294512 Device 1
 - Added the bq294592 Device 1
 - Added a second I_{CC} Test Condition 5
 - Changed Fault Detection Delay Time in bq2945x4 Test Mode Specifications 5
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Changes from Revision B (February 2012) to Revision C Page

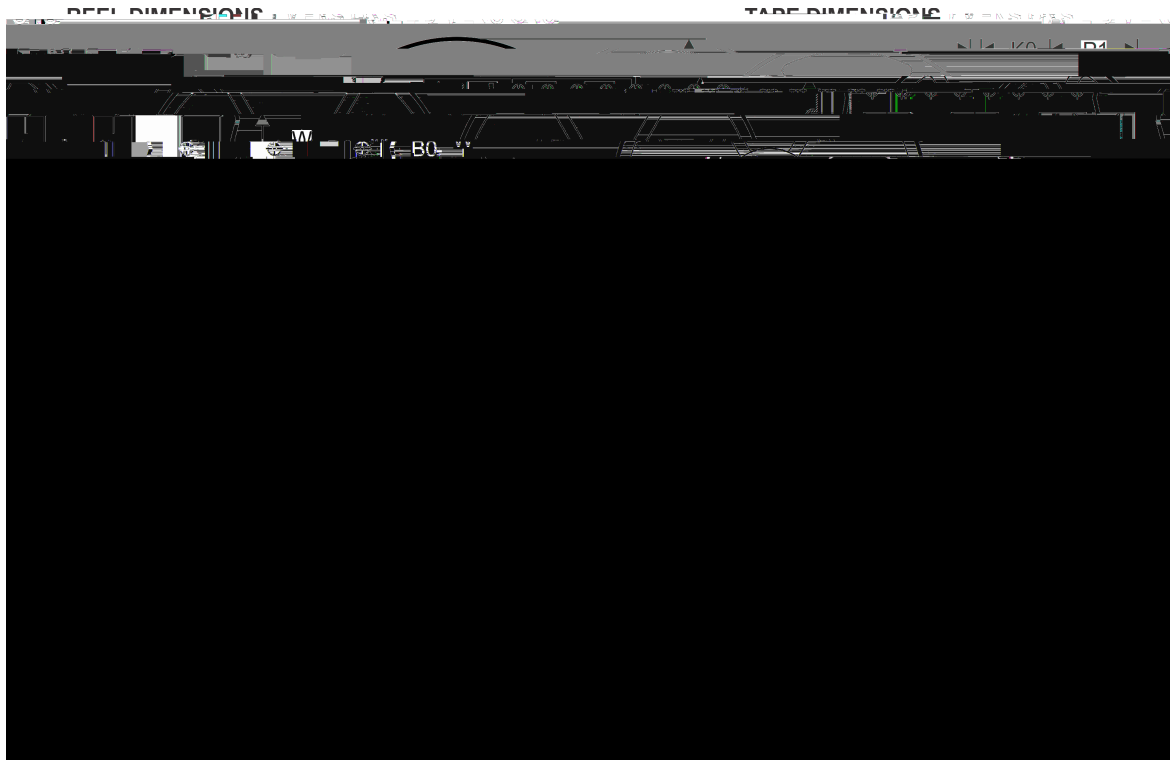
- Added the bq294515 Device to Production Data 2
 - Added the bq294524 Device to Production Data 2
 - Added the bq294532 Device to Production Data 2
 - Added the bq294572 Device to Production Data 2
 - Changed Overvoltage Detection Hysteresis 5
 - Added Output Voltage Versus Output Current graphic 7
 - Changed Timing for Customer Test Mode figure 9
-

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
BQ294502DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4502	Samples
BQ294502DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4502	Samples
BQ294504DRVR	PREVIEW	SON	DRV	6		Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4504	
BQ294504DRVT	PREVIEW	SON	DRV	6		Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4504	
BQ294512DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4512	Samples
BQ294512DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4512	Samples
BQ294515DRVR	PREVIEW	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4515	
BQ294515DRVT	PREVIEW	SON	DRV	6		Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4515	
BQ294522DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4522	Samples
BQ294522DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4522	Samples
BQ294524DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4524	Samples
BQ294524DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4524	Samples
BQ294532DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4532	Samples
BQ294532DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4532	Samples
BQ294582DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4582	Samples
BQ294582DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4582	Samples
BQ294592DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	4592	Samples

Orderable Device	Status (1)	Package Type	Package Drawing
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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
BQ294502DRVR	SON											

03 1.0 31.0 re f Q

TAPE AND REEL BOX DIMENSIONS



DAN

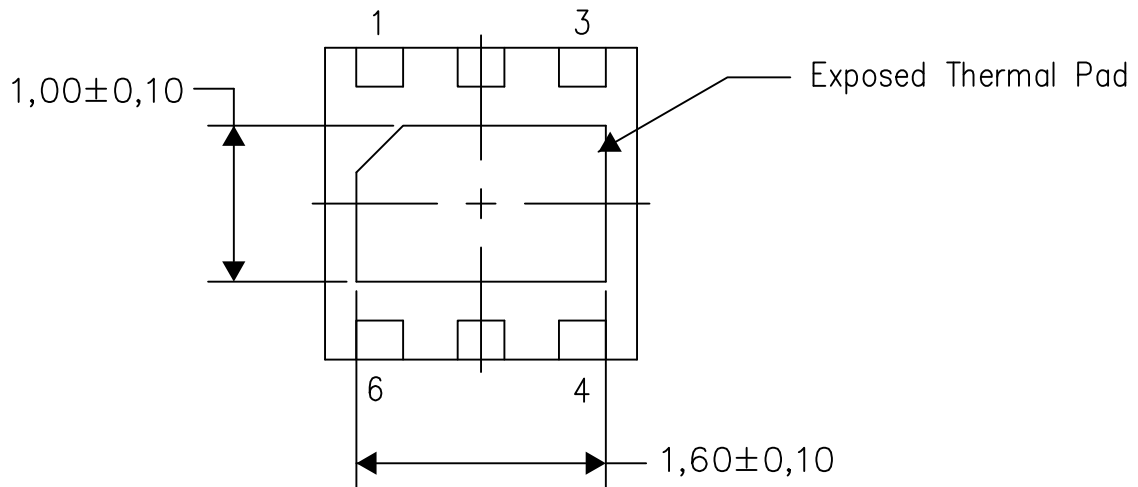
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Dimensions are in millimeters.
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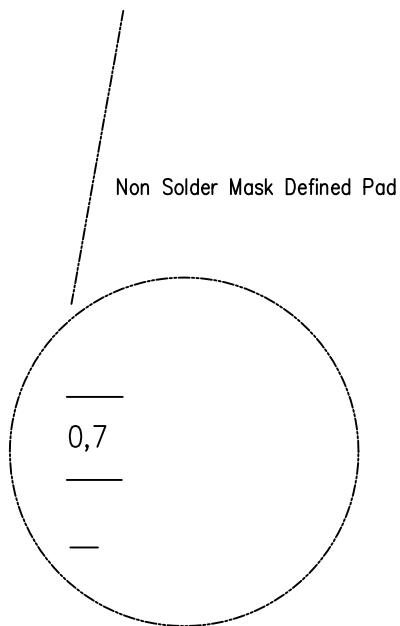
directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB



Bottom View

Exposed Thermal Pad Dimensions

Note D



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to cl
- 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/SON PCB Attachment, 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>>.
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. Customers should contact their board fabrication site for solder mask tolerances.

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