

## Voltage Protection for 2-Series, 3-Series, or 4-Series Cell Li-Ion Batteries (Second-Level Protection)

Check for Samples: [bq29440](#), [bq2944L0](#), [bq29441](#), [bq29442](#), [bq29443](#), [bq29449](#), [bq2944L9](#)

### FEATURES

- 2-Series, 3-Series, or 4-Series Cell Secondary Protection
- External Capacitor-Controlled Delay Timer
- Low Power Consumption  $I_{CC} < 2 \mu\text{A}$  Typical [ $V_{\text{CELL(ALL)}} < V_{\text{PROTECT}}$ ]
- High-Accuracy Overvoltage Protection:  $\pm 25$  mV with  $T_A = 0^\circ\text{C}$  to  $60^\circ\text{C}$
- Fixed Overvoltage Protection Thresholds: 4.30 V, 4.35 V, 4.40 V, 4.45 V, 4.50 V
- Small 8L QFN Package

### APPLICATIONS

- Second-Level Protection in Li-Ion Battery Packs
  - Notebook Computers
  - Power Tools
  - Portable Equipment and Instrumentation

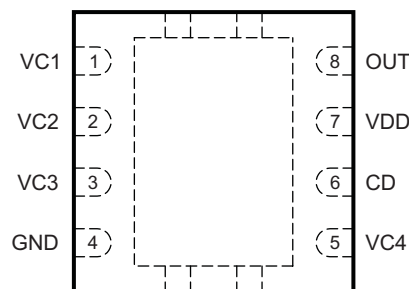
### DESCRIPTION

The bq2944x is a secondary overvoltage protection IC for 2-series, 3-series, or 4-series cell Li-Ion battery packs that incorporates a high-accuracy precision overvoltage detection circuit.

### FUNCTION

The voltage of each cell in a battery pack is compared to an internal reference voltage. If any cells reach an overvoltage condition, the bq2944x 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 state to a high state. An optional latch configuration is available that holds the OUT pin in a high state indefinitely after an overvoltage condition has satisfied the specified delay timer period. The latch is released when the CD pin is shorted to GND.

DRB Package  
(Top View)



P0012-02



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



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.

**Table 1. ORDERING INFORMATION<sup>(1)</sup>**

T <sub>A</sub>	PART NUMBER	OUT PIN LATCH OPTION	PACKAGE	PACKAGE DESIGNATOR	PACKAGE MARKING	OVP	ORDERING INFORMATION <sup>(2)</sup>	
							TAPE AND REEL (LARGE) <sup>(3)</sup>	TAPE AND REEL (SMALL) <sup>(4)</sup>
-40°C to +110°C	BQ29440	No	QFN-8	DRB	440	4.35 V	BQ29440DRBR	BQ29440DRBT
	BQ2944L0	Yes			44L0	4.35 V	BQ2944L0DRBR	BQ2944L0DRBT
	BQ29441	No			441	4.40 V	BQ29441DRBR	BQ29441DRBT
	BQ29442	No			442	4.45 V	BQ29442DRBR	BQ29442DRBT
	BQ29443	No			443	4.50 V	BQ29443DRBR	BQ29443DRBT
	BQ29449	No			449	4.30 V	BQ29449DRBR	BQ29449DRBT
	BQ2944L9	Yes			44L9	4.30 V	BQ2944L9DRBR	BQ2944L9DRBT

- (1) Example: bq2944L0DRBR is a device with the OUT latch option with a V<sub>OV</sub> threshold of 4.35 V. Contact Texas Instruments for other V<sub>OV</sub> threshold options.
- (2) For the most current package and ordering information, see the Package Addendum at the end of this document, or the TI website at www.ti.com.
- (3) Large tape and reel quantity is 3,000 units.
- (4) Small tape and reel quantity is 250 units.

## THERMAL INFORMATION

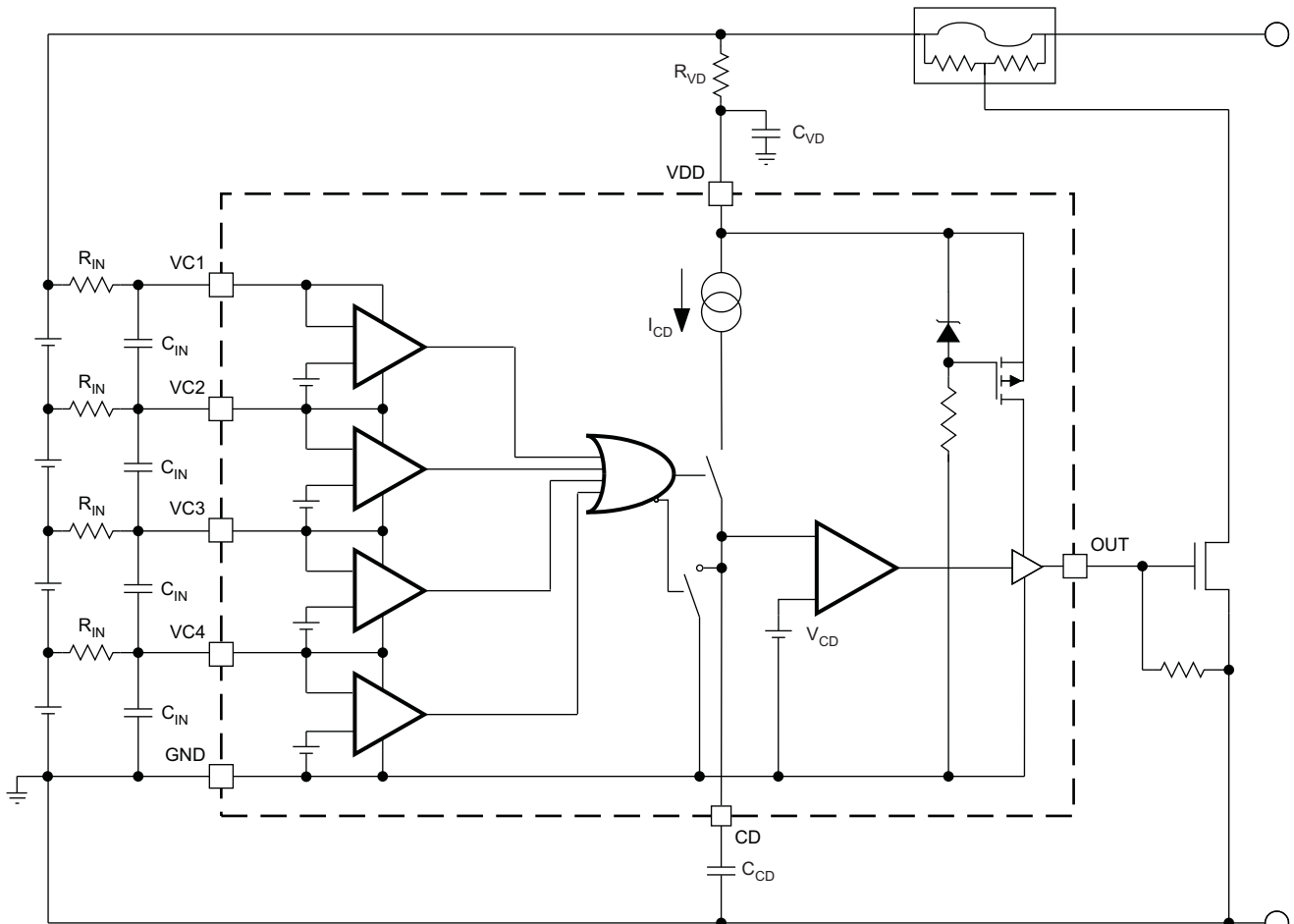
THERMAL METRIC <sup>(1)</sup>		bq2944x	UNITS
		DRB	
		8 PINS	
θ <sub>JA</sub>	Junction-to-ambient thermal resistance <sup>(2)</sup>	50.5	°C/W
θ <sub>JC(top)</sub>	Junction-to-case(top) thermal resistance <sup>(3)</sup>	25.1	
θ <sub>JB</sub>	Junction-to-board thermal resistance <sup>(4)</sup>	19.3	
ψ <sub>JT</sub>	Junction-to-top characterization parameter <sup>(5)</sup>	0.7	
ψ <sub>JB</sub>	Junction-to-board characterization parameter <sup>(6)</sup>	18.9	
θ <sub>JC(bottom)</sub>	Junction-to-case(bottom) thermal resistance <sup>(7)</sup>	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<sub>JT</sub>, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining θ<sub>JA</sub>, using a procedure described in JESD51-2a (sections 6 and 7).
- (6) The junction-to-board characterization parameter, ψ<sub>JB</sub>, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining θ<sub>JA</sub>, 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.

## PIN FUNCTIONS

PIN NAME	PIN NO.	DESCRIPTION
CD	6	Connection to external capacitor for programmable delay time
GND	4	Ground pin
OUT	8	Output
VC1	1	Sense voltage input for top cell
VC2	2	Sense voltage input for second-to-top cell
VC3	3	Sense voltage input for third-to-top cell
VC4	5	Sense voltage input for fourth-to-top cell (bottom cell)
VDD	7	Power supply

FUNCTIONAL BLOCK DIAGRAM



B0394-01

ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

		VALUE/UNIT
Supply voltage range, $V_{MAX}$	VDD–GND	–0.3 to 28 V
Input voltage range, $V_{IN}$	VC1–GND, VC2–GND, VC3–GND	–0.3 to 28 V
	VC1–VC2, VC2–VC3, VC3–VC4, VC4–GND	–0.3 to 8 V
	CD–GND	–0.3 to 8 V
Output voltage range, $V_{OUT}$	OUT–GND	–0.3 to 28 V
Storage temperature range, $T_{stg}$		–65°C to 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.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
Supply voltage, VDD		4		25	V
Input voltage range	VC1–VC2, VC2–VC3, VC3–VC4, VC4–GND	0		5	V
$t_{d(CD)}$ delay-time capacitance	$C_{CD}$ (See Figure 7.)		0.1		$\mu$ F
Voltage monitor filter resistance	$R_{IN}$ (See Figure 7.)	0.1	1		k $\Omega$

## RECOMMENDED OPERATING CONDITIONS (continued)

		MIN	NOM	MAX	UNIT
Voltage monitor filter capacitance	$C_{IN}$ (See <a href="#">Figure 7.</a> )	0.01	0.1		$\mu\text{F}$
Supply voltage filter resistance	$R_{VD}$ (See <a href="#">Figure 7.</a> )	0.1		1	$\text{k}\Omega$
Supply voltage filter capacitance	$C_{VD}$ (See <a href="#">Figure 7.</a> )		0.1		$\mu\text{F}$
Operating ambient temperature range, $T_A$		-40		110	$^{\circ}\text{C}$

## ELECTRICAL CHARACTERISTICS

Typical values stated where  $T_A = 25^{\circ}\text{C}$  and  $V_{DD} = 17\text{ V}$ , MIN/MAX values stated where  $T_A = -40^{\circ}\text{C}$  to  $110^{\circ}\text{C}$  and  $V_{DD} = 4\text{ V}$  to  $25\text{ V}$  (unless otherwise noted).

PARAMETER		TEST CONDITION	MIN	NOM	MAX	UNIT
$V_{PROTECT}$	Overvoltage detection voltage	bq29440		4.35		V
		bq29441		4.40		
		bq29442		4.45		
		bq29443		4.50		
		bq29449		4.30		
$V_{HYS}$	Overvoltage detection hysteresis	For non-latch devices only	200	300	400	mV
$V_{OA}$	Overvoltage detection accuracy	$T_A = 25^{\circ}\text{C}$	-10		10	mV
$V_{OA\_DRIFT}$	Overvoltage threshold temperature drift	$T_A = 0^{\circ}\text{C}$ to $60^{\circ}\text{C}$	-0.4		0.4	mV/ $^{\circ}\text{C}$
		$T_A = -40^{\circ}\text{C}$ to $110^{\circ}\text{C}$	-0.6		0.6	
$X_{DELAY}$	Overvoltage delay time scale factor	$T_A = 0^{\circ}\text{C}$ to $60^{\circ}\text{C}$ Note: Does not include external capacitor variation	6.0	9.0	12	s/ $\mu\text{F}$
		$T_A = -40^{\circ}\text{C}$ to $110^{\circ}\text{C}$ Note: Does not include external capacitor variation	5.5	9.0	13.5	
$X_{DELAY\_CTM}$	Overvoltage delay time scale factor in Customer Test Mode	See <a href="#">CUSTOMER TEST MODE.</a>		0.08		s/ $\mu\text{F}$
$I_{CD(CHG)}$	Overvoltage detection charging current	See <a href="#">Figure 1.</a>		140		nA
$I_{CD(DSG)}$	Overvoltage detection discharging current	See <a href="#">Figure 2.</a>		60		$\mu\text{A}$
$V_{CD}$	Overvoltage detection external capacitor comparator threshold			1.2		V
$I_{CC}$	Supply current	( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) and ( $VC4-GND$ ) = $3.5\text{ V}$ See <a href="#">Figure 3.</a>		2	3.5	$\mu\text{A}$
$V_{OUT}$	OUT pin drive voltage	( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) or ( $VC4-GND$ ) = $V_{PROTECT}$ , $V_{DD} = 20\text{ V}$ , $I_{OH} = 0$ to $-10\text{ }\mu\text{A}$	6.5	8.0	9.5	V
		( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) or ( $VC4-GND$ ) = $V_{PROTECT}$ , $V_{DD} = 4.35\text{ V}$ , $I_{OL} = -10\text{ }\mu\text{A}$ , $T_A = 0^{\circ}\text{C}$ to $60^{\circ}\text{C}$	1.50	3.0		V
		( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) or ( $VC4-GND$ ) = $V_{PROTECT}$ , $V_{DD} > 6\text{ V}$ , $I_{OH} = -10\text{ }\mu\text{A}$ , $T_A = 0^{\circ}\text{C}$ to $60^{\circ}\text{C}$	2.0	3.0		V
		( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) or ( $VC4-GND$ ) = $4\text{ V}$ , $I_{OL} = 0\text{ }\mu\text{A}$			0.1	V
$I_{OUT(SHORT)}$	OUT short circuit current	OUT = $0\text{ V}$ , ( $VC1-VC2$ ), ( $VC2-VC3$ ), ( $VC3-VC4$ ) or ( $VC4-GND$ ) > $V_{PROTECT}$ , $V_{DD} = 18\text{ V}$			4	mA
$t_{r(OUT)}^{(1)}$	OUT output rise time	$C_L = 1\text{ nF}$ , $V_{DD} = 4\text{ V}$ to $25\text{ V}$ , $V_{OH(OUT)} = 0\text{ V}$ to $5\text{ V}$		5		$\mu\text{s}$
$Z_{O(OUT)}^{(1)}$	OUT output impedance			2		$\text{k}\Omega$

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

## ELECTRICAL CHARACTERISTICS (continued)

Typical values stated where  $T_A = 25^\circ\text{C}$  and  $V_{DD} = 17\text{ V}$ , MIN/MAX values stated where  $T_A = -40^\circ\text{C}$  to  $110^\circ\text{C}$  and  $V_{DD} = 4\text{ V}$  to  $25\text{ V}$  (unless otherwise noted).

PARAMETER	TEST CONDITION	MIN	NOM	MAX	UNIT
$I_{IN}$ Input current at VCx pins	Measured at VC1, (VC1–VC2), (VC2–VC3), (VC3–VC4) and (VC4–GND) = 3.5 V, $T_A = 0^\circ\text{C}$ to $60^\circ\text{C}$ See Figure 3.	-0.3		1.5	$\mu\text{A}$
	Measured at VC2, VC3 OR VC4, (VC1–VC2), (VC2–VC3), (VC3–VC4) and (VC4–GND) = 3.5 V, $T_A = 0^\circ\text{C}$ to $60^\circ\text{C}$ See Figure 3.	-0.3		0.3	$\mu\text{A}$

## TYPICAL CHARACTERISTICS

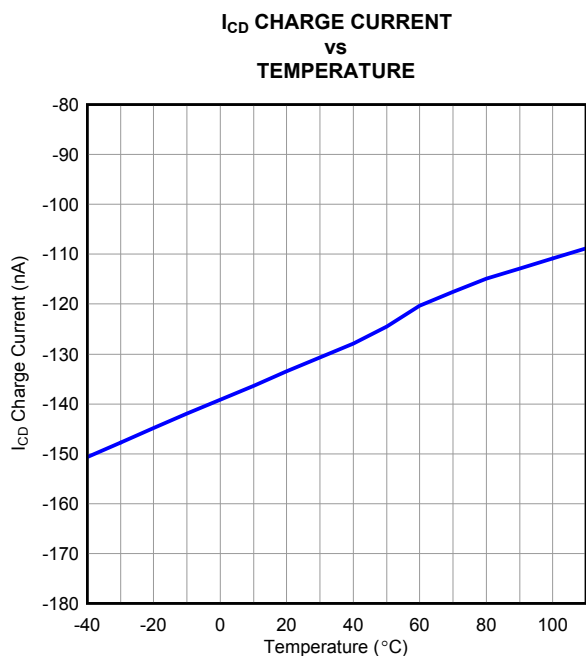


Figure 1.  $I_{CD}$  Charge Current

G001

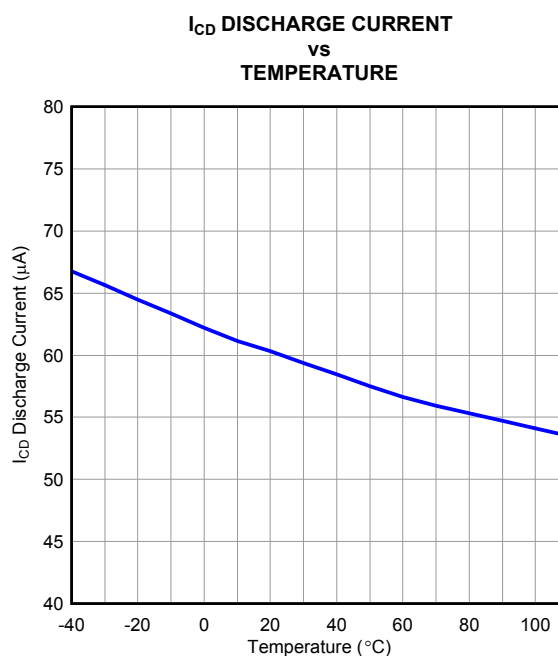


Figure 2.  $I_{CD}$  Discharge Current

G002

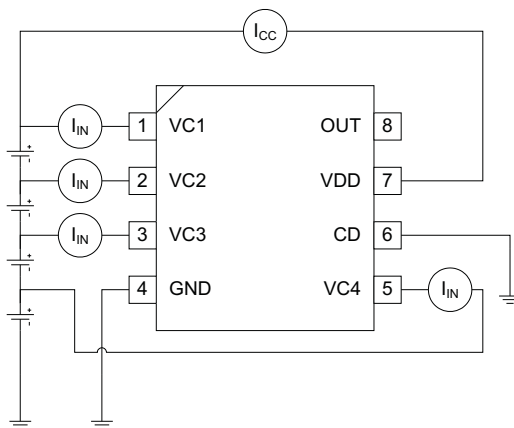
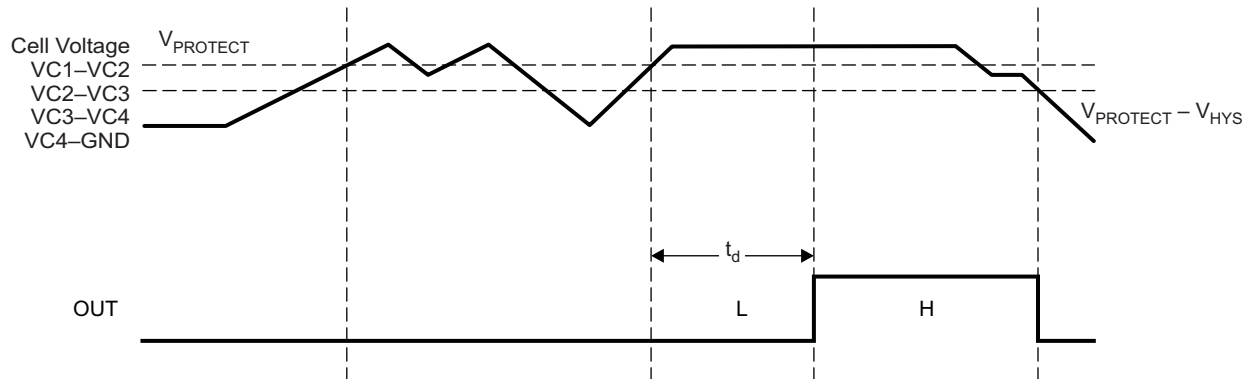


Figure 3.  $I_{CC}$ ,  $I_{IN}$  Measurement

## APPLICATIONS INFORMATION

### PROTECTION (OUT) TIMING AND DELAY TIME CAPACITOR SIZING

The bq2944x uses an external capacitor to set delay timing during an overvoltage condition. When any of the cells exceed the overvoltage threshold, the bq2944x activates an internal current source of nominally 140 nA, which charges the external capacitor. When the external capacitor charges up to a voltage of nominally 1.2 V, the OUT pin transitions from a low state 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.



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**Figure 4. Timing for Overvoltage Sensing**

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/ $\mu$ F. For example, if a nominal delay of 3 seconds is desired, the customer should use a  $C_{CD}$  capacitor that is  $3 \text{ s}/9.0 \text{ s}/\mu\text{F} = 0.33 \mu\text{F}$ .

The delay time is calculated as follows:

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

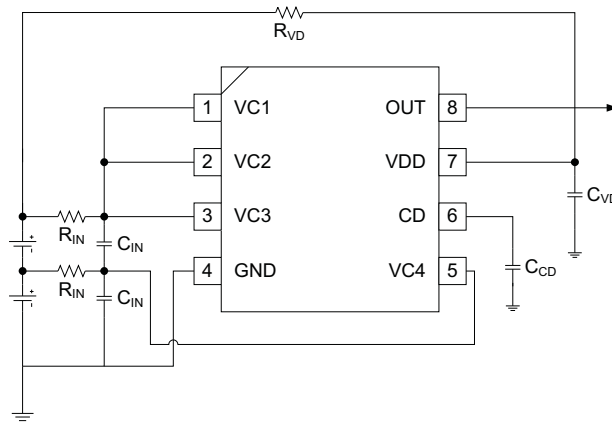
If the cell overvoltage condition is removed before the external capacitor reaches the reference voltage, the internal current source is disabled and an internal discharge block is employed to discharge the external capacitor down to 0 V. In this instance, the OUT pin remains in a low state.

For latched versions of the bq2944x, if an overvoltage condition has caused the OUT pin to transition to a high state, the external capacitor remains charged even after the overvoltage condition has been removed. In this instance, the OUT pin remains in a high state.

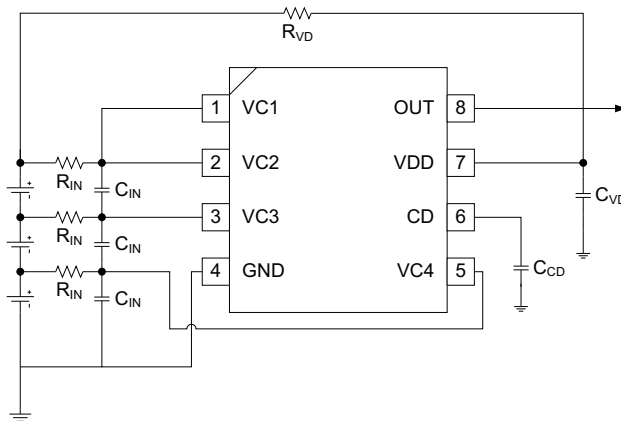
For non-latched versions, the OUT pin is allowed to transition back from a high to low state when the overvoltage condition is no longer present, and the external capacitor is discharged down to 0 V.

**BATTERY CONNECTION FOR 2-SERIES, 3-SERIES, AND 4-SERIES CELL CONFIGURATIONS**

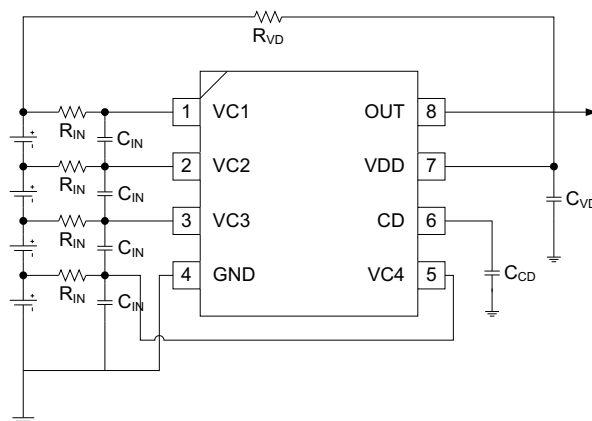
Figure 5, Figure 6, and Figure 7 show the 2-series, 3-series, and 4-series cell configurations.



**Figure 5. 2-Series Cell Configuration**



**Figure 6. 3-Series Cell Configuration**



**Figure 7. 4-Series Cell Configuration**

## CELL CONNECTION SEQUENCE

### NOTE

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

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

1. GND
2. VC4
3. VC3
4. VC2
5. VC1

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. VC4, VC3, VC2, or VC1
3. Remaining VCx pin
4. Remaining VCx pin
5. Remaining VCx pin

## 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 VC1. When CTM is entered, the device switches from the normal overvoltage delay time scale factor,  $X_{DELAY}$ , to a significantly reduced factor,  $X_{DELAY\_CTM}$ , thereby reducing the delay time during an overvoltage condition. The CTM overvoltage delay time is similar to the equation presented in [PROTECTION \(OUT\) TIMING AND DELAY TIME CAPACITOR SIZING](#) with the substitution of  $X_{DELAY\_CTM}$  in place of  $X_{DELAY}$ :

$$t_{d\_CTM} = C_{CD} \times X_{DELAY\_CTM}$$

### CAUTION

Avoid exceeding any Absolute Maximum Voltages on any pins when placing the part into Customer Test Mode. Also, avoid exceeding Absolute Maximum Voltages for the individual cell voltages (VC1–VC2), (VC2–VC3), (VC3–VC4), and (VC4–GND). 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.

For latched versions of the bq2944x, the external  $C_{CD}$  capacitor must be externally discharged if any overvoltage functionality is exercised during protection testing. This can be accomplished by shorting the CD pin to GND. If the  $C_{CD}$  capacitor is not explicitly discharged, a residual charge may cause the overvoltage delay time to be inaccurate.



## REVISION HISTORY

Changes from Revision B (June 2010) to Revision C	Page
• Added new protection thresholds .....	1
• Changed occurrences of $V_{DD}$ to VDD throughout document .....	1
• Added part numbers .....	2
• Changed the Functional Block Diagram .....	3
• Changed the Electrical Characteristics .....	4
• Deleted 3.5 from one of the maximum values from the $V_{OUT}$ specification .....	4
• Changed nominal delay time .....	6

**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)
<a href="#">BQ29440DRBR</a>	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	440
BQ29440DRBR.A	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	440
<a href="#">BQ29440DRBT</a>	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	440
BQ29440DRBT.A	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	440
BQ29441DRBR	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	441
BQ29441DRBR.A	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	441
<a href="#">BQ29441DRBT</a>	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	441
BQ29441DRBT.A	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	441
<a href="#">BQ29442DRBR</a>	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	442
BQ29442DRBR.A	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	442
<a href="#">BQ29442DRBT</a>	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	442
BQ29442DRBT.A	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	442
<a href="#">BQ29443DRBR</a>	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	443
BQ29443DRBR.A	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	443
<a href="#">BQ29443DRBT</a>	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	443
BQ29443DRBT.A	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	443
<a href="#">BQ29449DRBR</a>	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	449
BQ29449DRBR.A	Active	Production	SON (DRB)   8	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	449
<a href="#">BQ29449DRBT</a>	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	449
BQ29449DRBT.A	Active	Production	SON (DRB)   8	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	449

(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.

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**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
BQ29440DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29440DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29441DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29441DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29442DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29442DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29443DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29443DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29449DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
BQ29449DRBT	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)
BQ29440DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29440DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29441DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29441DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29442DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29442DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29443DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29443DRBT	SON	DRB	8	250	210.0	185.0	35.0
BQ29449DRBR	SON	DRB	8	3000	346.0	346.0	33.0
BQ29449DRBT	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

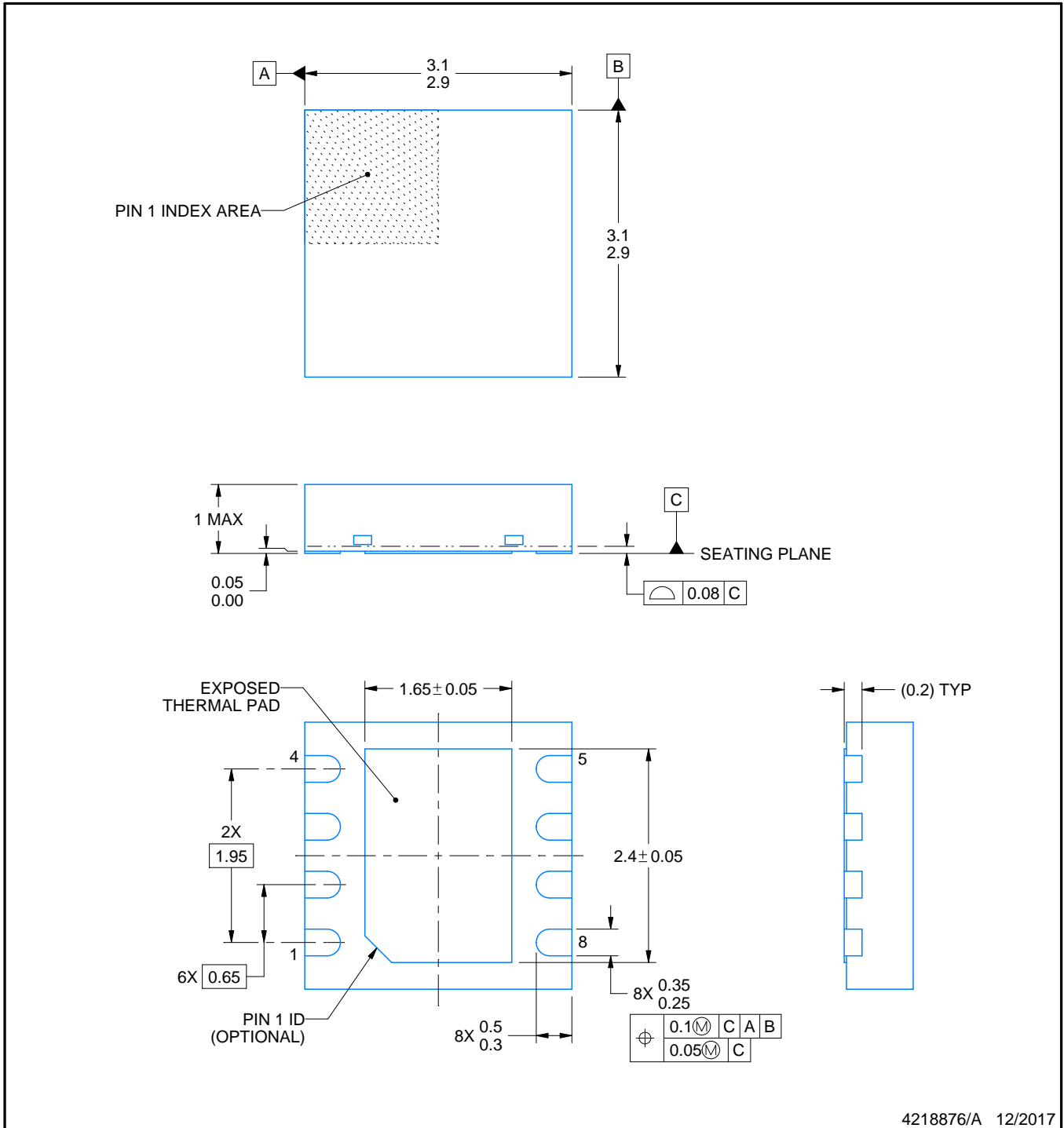
DRB0008B



PACKAGE OUTLINE

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



4218876/A 12/2017

NOTES:

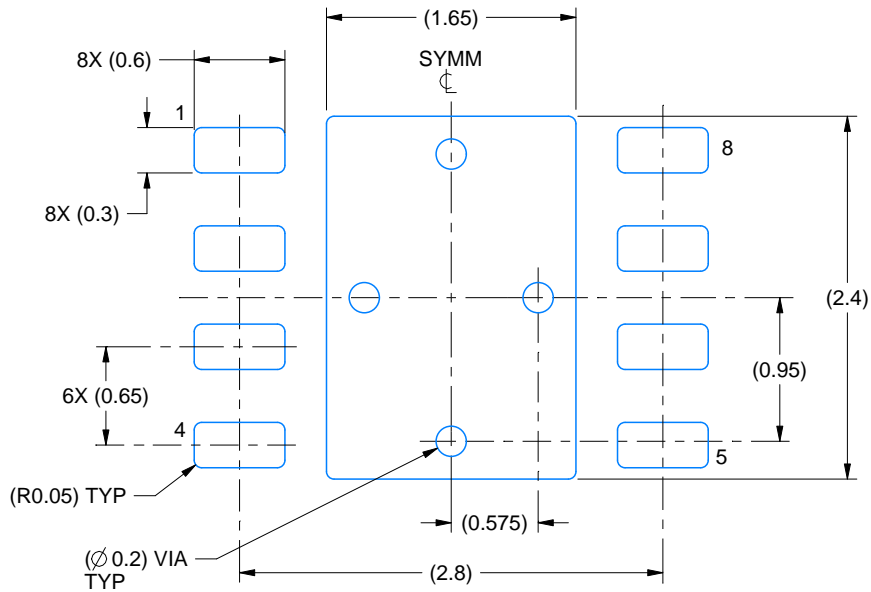
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# 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](http://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.

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Last updated 10/2025