

Overvoltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Internal Delay Timer

Check for Samples: [bq771800](#), [bq771801](#), [bq771802](#), [bq771803](#)

FEATURES

- 2-, 3-, 4-, and 5-Series Cell Overvoltage Protection
- Internal Delay Timer
- Fixed OVP Threshold
- High-Accuracy Overvoltage Protection: ± 10 mV
- Low Power Consumption $I_{CC} = 1 \mu A$ ($V_{CELL(ALL)} < V_{PROTECT}$)
- Low Leakage Current Per Cell Input < 100 nA

- Small Package Footprint
 - 8-pin QFN (3 mm x 4 mm)

APPLICATIONS

- Protection in Li-Ion Battery Packs in:
 - Power Tools
 - UPS Battery Backup
 - Light Electric Vehicles (eBike, eScooter, Pedal Assist Bicycles)

DESCRIPTION

The bq7718xy family of products is an overvoltage monitor and protector for Li-Ion battery pack systems. Each cell is monitored independently for an overvoltage condition.

In the bq7718xy device, an internal delay timer is initiated upon detection of an overvoltage condition on any cell. Upon expiration of the delay timer, the output is triggered into its active state (either high or low depending on the configuration). For quicker production-line testing, the bq7718xy device provides a Customer Test Mode with greatly reduced delay time.

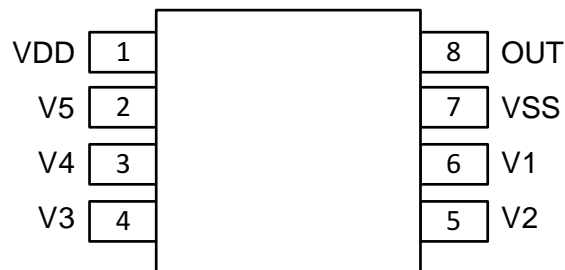


Figure 1. bq771800 Pinout



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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.

ORDERING INFORMATION

T _A	Part Number	Package	Package Designator	OVP (V)	OV Hysteresis (V)	Output Delay	Output Drive	Tape and Reel (Large)	Tape and Reel (Small)
-40°C to 110°C	bq771800	8-Pin QFN	DPJ	4.300	0.300	4 s	CMOS Active High	bq771800DPJR	bq771800DPJT
	bq771801			4.275	0.050	3 s	NCH Active Low, Open Drain	bq771801DPJR	bq771801DPJT
	bq771802			4.225	0.300	1 s	NCH Active Low, Open Drain	bq771802DPJR	bq771802DPJT
	bq771803			4.275	0.050	1 s	NCH Active Low, Open Drain	bq771803DPJR	bq771803DPJT
	bq7718xy ⁽¹⁾			3.850–4.650	0–0.300	1 s	NCH, Active Low, Open Drain	bq7718xyDPJR	bq7718xyDPJT

(1) Future option, contact TI.

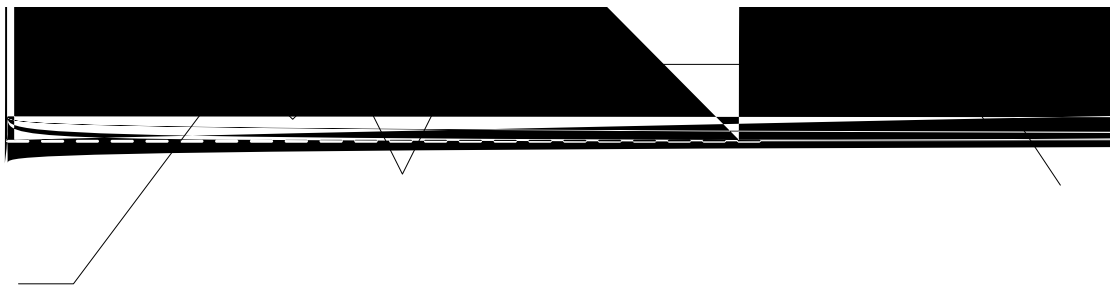
THERMAL INFORMATION

THERMAL METRIC ⁽¹⁾		bq7718xy	UNITS
		8 PINS	
JA	Junction-to-ambient thermal resistance	56.6	°C/W
JC(top)	Junction-to-case(top) thermal resistance	56.4	
JB	Junction-to-board thermal resistance	30.6	
JT	Junction-to-top characterization parameter	1.0	
JB	Junction-to-board characterization parameter	37.8	
JC(bottom)	Junction-to-case(bottom) thermal resistance	11.3	

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

PIN FUNCTIONS

bq7718xy	Pin Name	Type I/O	Description
1	VDD		



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	V5–VSS or V4–VSS or V3–VSS or V2–VSS or V1–VSS	–0.3 to 30 V
Output voltage range	OUT–VSS	–0.3 to 30 V
Continuous total power dissipation, P _{TOT}		See package dissipation rating.
Functional temperature		–40 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	0		5	V
Operating ambient temperature range, T _A	–40		110	°C

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

DC CHARACTERISTICS

Typical values stated where $T_A = 25^\circ\text{C}$ and $V_{DD} = 18\text{ V}$, MIN/MAX values stated where $T_A = -40^\circ\text{C}$ to 110°C and $V_{DD} = 3\text{ V}$ to 25 V (unless otherwise noted).

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNIT
Voltage Protection Threshold VCx						
V_{OV}	$V_{(PROTECT)}$ Overvoltage Detection	bq771800		4.300		V
		bq771801, bq771803		4.275		V
		bq771802		4.225		V
V_{HYS}	OV Detection Hysteresis	bq771800	250	300	400	mV
		bq771801, bq771803	0	50	100	V
		bq771802	250	300	400	mV
V_{OA}	OV Detection Accuracy	$T_A = 25^\circ\text{C}$	-10		10	mV
$V_{OADRIFT}$	OV Detection Accuracy Across Temperature	$T_A = -40^\circ\text{C}$	-40		44	mV
		$T_A = 0^\circ\text{C}$	-20		20	mV
		$T_A = 60^\circ\text{C}$	-24		24	mV
		$T_A = 110^\circ\text{C}$	-54		54	mV
Supply and Leakage Current						
I_{CC}	Supply Current	$(V_5-V_4) = (V_4-V_3) = (V_3-V_2) = (V_2-V_1) = (V_1-V_{SS}) = 4.0\text{ V}$ (See Figure 13.)		1	2	μA
I_{IN}	Input Current at V_x Pins	$(V_5-V_4) = (V_4-V_3) = (V_3-V_2) = (V_2-V_1) = (V_1-V_{SS}) = 4.0\text{ V}$ (See Figure 13.)	-0.1		0.1	μA
Output Drive OUT, CMOS Active HIGH Versions Only						
V_{OUT1}	Output Drive Voltage, Active High	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ or $(V_1-V_{SS}) > V_{OV}, V_{DD} = 18\text{ V}, I_{OH} = 100\ \mu\text{A}$	6			V
		If three of four cells are short circuited and only one cell remains powered and $> V_{OV}, V_{DD} = V_x$ (cell voltage), $I_{OH} = 100\ \mu\text{A}$		$V_{DD} - 0.3$		V
		$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ and $(V_1-V_{SS}) < V_{OV}, V_{DD} = 18\text{ V}, I_{OL} = 100\ \mu\text{A}$ measured into pin		250	400	
I_{OUTH1}	OUT Source Current (during OV)	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ or $(V_1-V_{SS}) > V_{OV}, V_{DD} = 18\text{ V}, \text{OUT} = 0\text{ V}.$ Measured out of OUT pin			4.5	mA
I_{OUTL1}	OUT Sink Current (no OV)	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ and $(V_1-V_{SS}) < V_{OV}, V_{DD} = 18\text{ V}, \text{OUT} = V_{DD}.$ Measured into OUT pin	0.5		14	mA
Output Drive OUT, NCH Open Drain Active LOW Versions Only						
V_{OUT2}	Output Drive Voltage, Active Low	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ or $(V_1-V_{SS}) > V_{OV}, V_{DD} = 18\text{ V}, I_{OL} = 100\ \mu\text{A}$ measured into OUT pin		250	400	mV
I_{OUTH2}	OUT Sink Current (during OV)	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ or $(V_1-V_{SS}) > V_{OV}, V_{DD} = 18\text{ V}, \text{OUT} = V_{DD}.$ Measured into OUT pin	0.5		14	mA
I_{OUTL2}	OUT Source Current (no OV)	$(V_5-V_4), (V_4-V_3), (V_3-V_2), (V_2-V_1),$ and $(V_1-V_{SS}) < V_{OV}, V_{DD} = 18\text{ V}, \text{OUT} = V_{DD}.$ Measured out of OUT pin			100	nA
Delay Timer						
t_{DELAY}	OV Delay Time	bq771800	3.2	4	4.8	s
		bq771801	2.4	3	3.6	s
		bq771802, bq771803	0.8	1	1.2	s
		Preview option only. Contact TI.	4.4	5.5	6.6	s
$X_{CTMDELAY}$	Fault Detection Delay Time during Customer Test Mode	See .		15		ms

TYPICAL CHARACTERISTICS

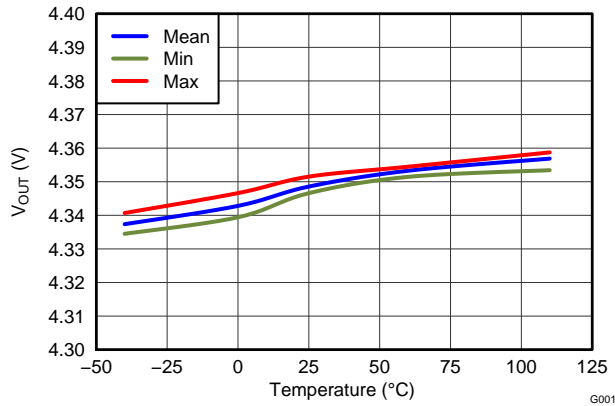


Figure 3. Overtolerance Threshold (OVT) vs. Temperature

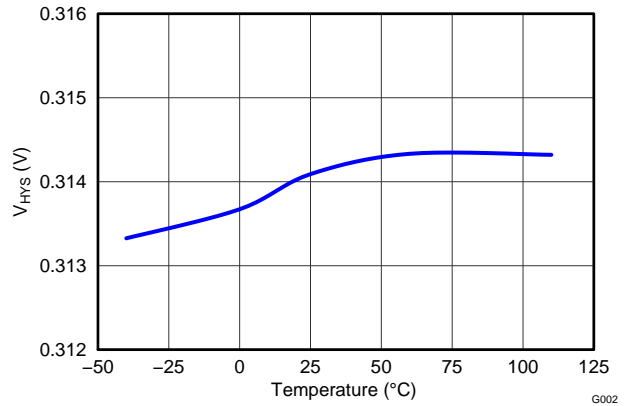


Figure 4. Hysteresis V_{HYS} vs. Temperature

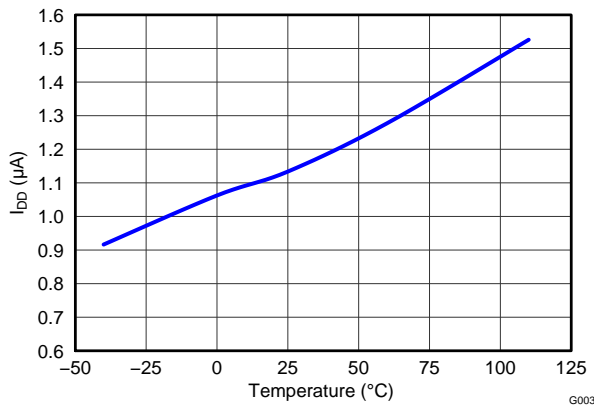


Figure 5. I_{DD} Current Consumption vs. Temperature at V_{DD} = 16 V

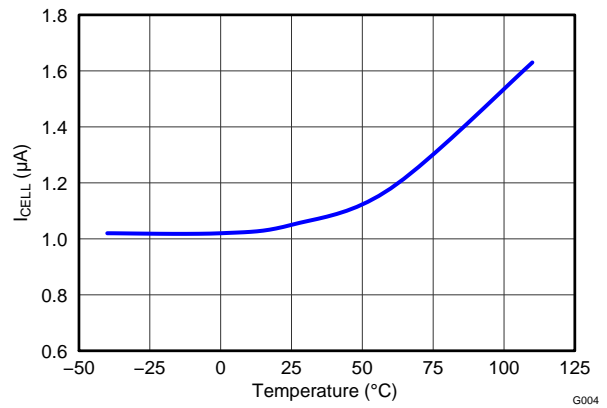


Figure 6. I_{CELL} vs. Temperature at V_{CELL} = 9.2 V

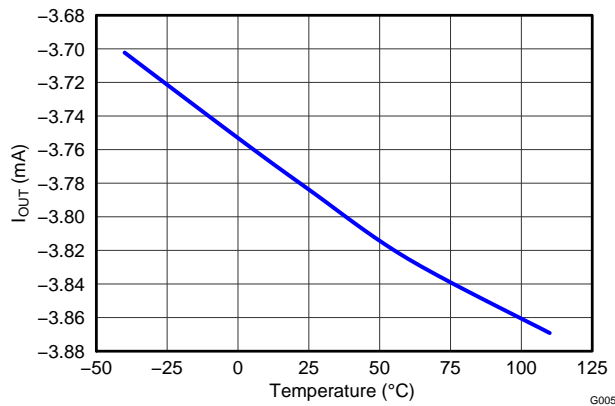


Figure 7. Output Current I_{OUT} vs. Temperature



Figure 8. V_{OUT} vs. V_{DD}

APPLICATION INFORMATION

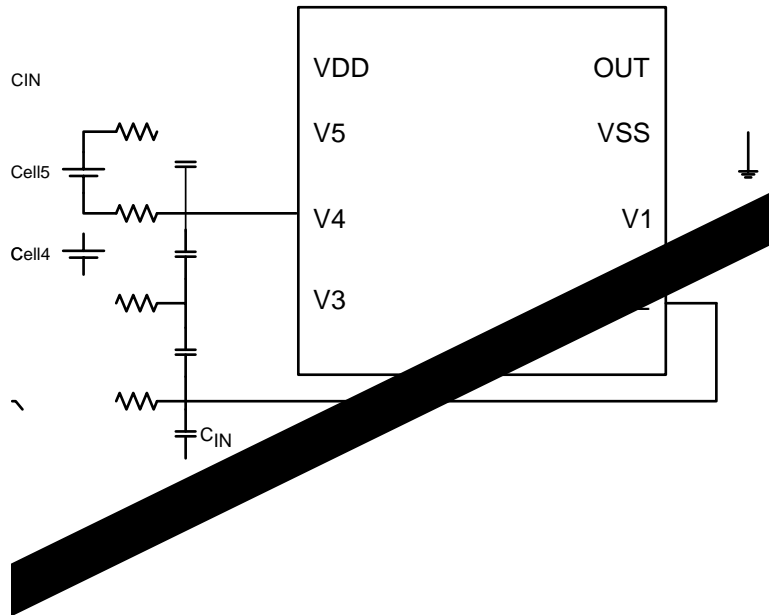


Figure 9. Application Configuration

NOTE

In the case of an Open Drain Active Low configuration, an external pull-up resistor is required on the OUT terminal.

Changes to the ranges stated in Table 1 will impact the accuracy of the cell measurements.

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Table 1. Parameters

PARAMETER	EXTERNAL COMPONENT	MIN	NOM	MAX	UNIT
Voltage monitor filter resistance	RIN	900	1000	1100	
Voltage monitor filter capacitance	CIN	0.01		0.1	μF
Supply voltage filter resistance	RVD	100		1K	
Supply voltage filter capacitance	CVD		0.1		μF
CD external delay capacitance			0.1	1	μF
OUT Open drain version pull-up resistance to PACK+			100		k

NOTE

The device is calibrated using an R_{IN} value = 1 k . Using a value other than this recommended value changes the accuracy of the cell voltage measurements and V_{OV} trigger level.

APPLICATION SCHEMATIC

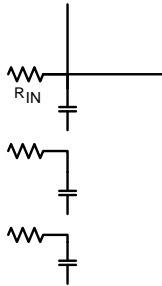


Figure 10. 4-Series Cell Configuration

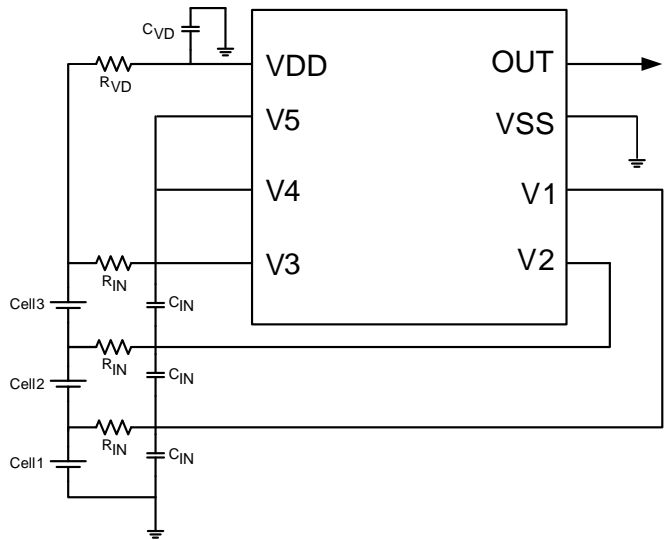


Figure 11. 3-Series Cell Configuration with Fixed Delay

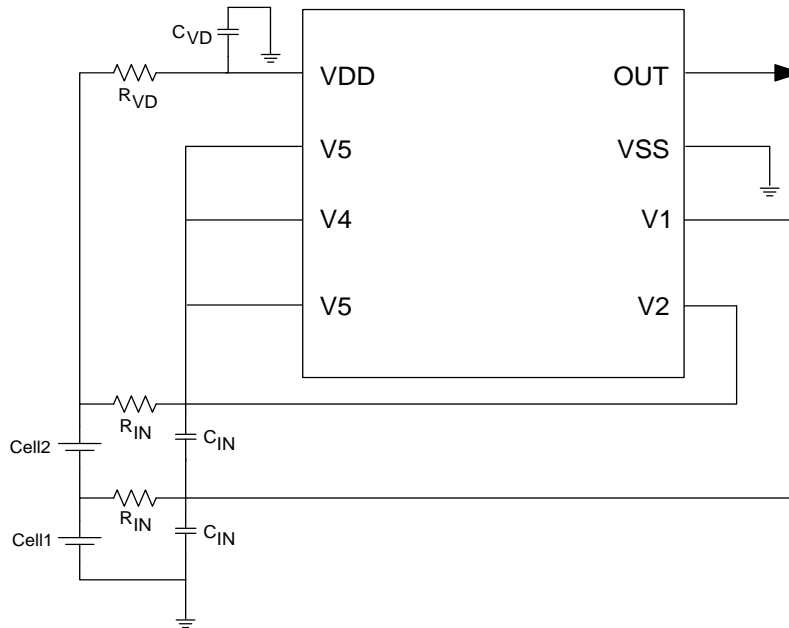


Figure 12. 2-Series Cell Configuration with Internal Fixed Delay

NOTE

In these application examples, an external pull-up resistor is required on the OUT terminal to configure for an Open Drain Active Low operation.

CUSTOMER TEST MODE

Customer Test Mode (CTM) helps to reduce test time for checking the overvoltage delay timer parameter once the circuit is implemented in the battery pack. To enter CTM, VDD should be set to at least 10 V higher than V5 (see [Figure 13](#)). The delay timer is greater than 10 ms, but considerably shorter than the timer delay in normal operation. To exit Customer Test Mode, remove the VDD to V5 voltage differential of 10 V so that the decrease in this value automatically causes an exit.

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 (V5–V4), (V4–V3), (V4–V3), (V3–V2), (V2–V1), and (V1–VSS). Stressing the pins beyond the rated limits may cause permanent damage to the device.

[Figure 13](#) shows the timing for the Customer Test Mode.

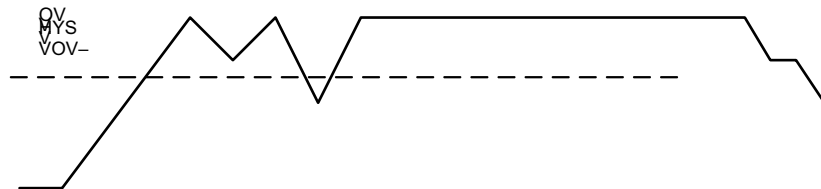


Figure 13. Timing for Customer Test Mode

Figure 14 shows the measurement for current consumption for the product for both VDD and Vx.

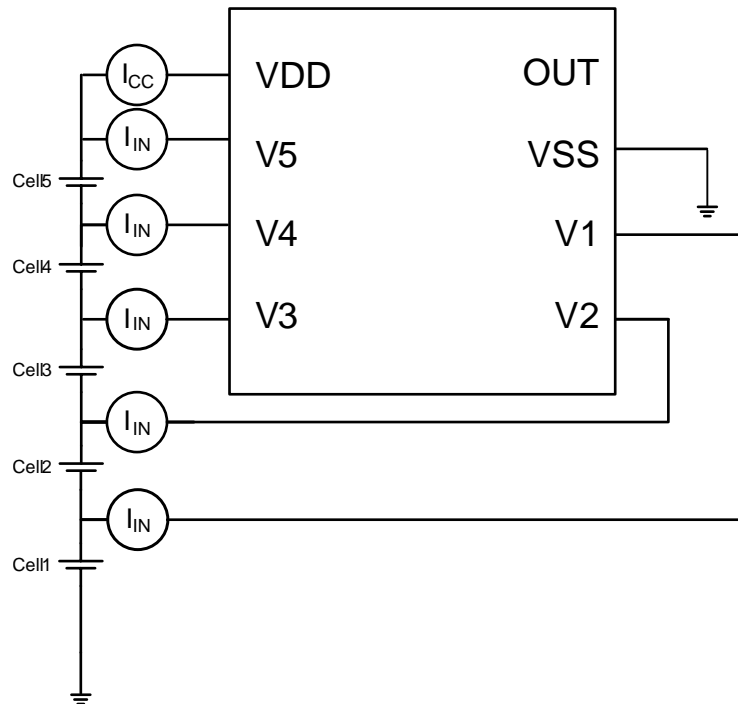


Figure 14. Configuration for IC Current Consumption Test

PLASTIC SMALL OUTLIN

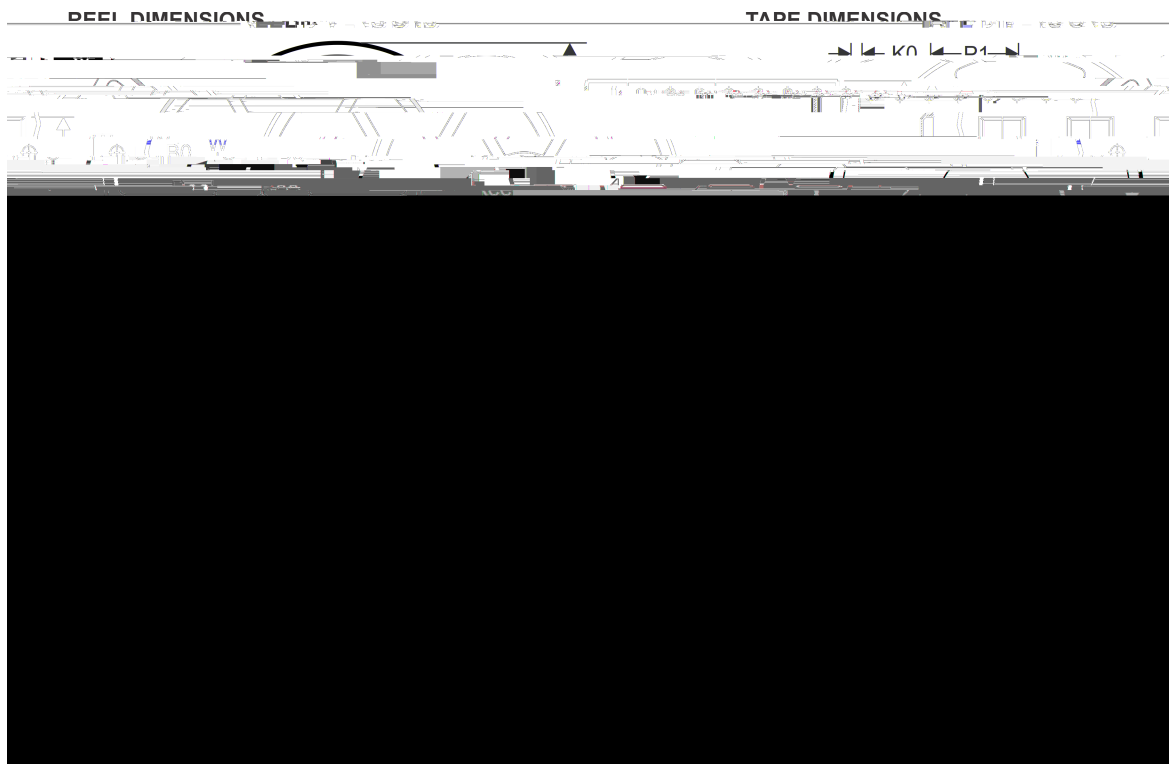
PACKAGING INFORMATION

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
BQ771800DPJR	ACTIVE	WSON	DPJ	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771800	Samples
BQ771800DPJT	ACTIVE	WSON	DPJ	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771800	Samples
BQ771801DPJR	ACTIVE	WSON	DPJ	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771801	Samples
BQ771801DPJT	ACTIVE	WSON	DPJ	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771801	Samples
BQ771802DPJR	ACTIVE	WSON	DPJ	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771802	Samples
BQ771802DPJT	ACTIVE	WSON	DPJ	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771802	Samples
BQ771803DPJR	ACTIVE	WSON	DPJ	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		771803	Samples
BQ771803DPJT											

⁽⁴⁾ Only one of markings shown within the brackets will appear on the physical device.

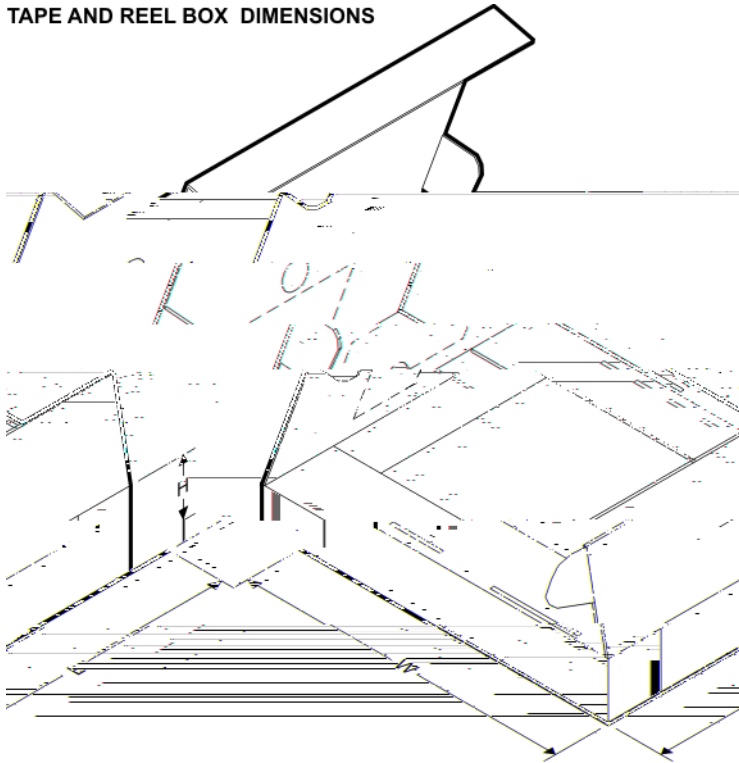
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TAPE AND REEL INFORMATION


*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
BQ771800DPJR	WSON	DPJ	8	3000	330.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771800DPJT	WSON	DPJ	8	250	180.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771801DPJR	WSON	DPJ	8	3000	330.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771801DPJT	WSON	DPJ	8	250	180.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771802DPJR	WSON	DPJ	8	3000	330.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771802DPJT	WSON	DPJ	8	250	180.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771803DPJR	WSON	DPJ	8	3000	330.0	12.4	3.3	4.3	1.1	8.0	12.0	Q2
BQ771803DPJT	WSON	DPJ	8	250	180.0	12.4	3.3	4.3	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)
BQ771800DPJR	WSON	DPJ	8	3000	367.0	367.0	35.0
BQ771800DPJT	WSON	DPJ	8	250	210.0	185.0	35.0
BQ771801DPJR	WSON	DPJ	8	3000	367.0	367.0	35.0
BQ771801DPJT	WSON	DPJ	8	250	210.0	185.0	35.0
BQ771802DPJR	WSON	DPJ	8	3000	367.0	367.0	35.0
BQ771802DPJT	WSON	DPJ	8	250	210.0	185.0	35.0
BQ771803DPJR	WSON	DPJ	8	3000	367.0	367.0	35.0
BQ771803DPJT	WSON	DPJ	8	250	210.0	185.0	35.0

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