SINGLE-CHIP LI-ION AND LI-POL CHARGE MANAGEMENT IC FOR CURRENT-LIMITED APPLICATIONS

FEATURES

- **Designed Specifically to Work With Current-Limited Wall Supplies**
- **Ideal for Low Dropout Charger Design for Single-Cell Li-Ion Packs With Coke or Graphite Anodes**
- **Integrated PowerFET for 500 mA**
- **Integrated Voltage Regulation With 0.5% Accuracy**
- **Battery Insertion and Removal Detection**
- **Charge Termination by Minimum Current and Time**
- **Pre-Charge Conditioning With Safety Timer**
- **Sleep Mode for Low-Power Consumption**
- **Charge Status Output for LED or Host Processor Interface Indicates Charge-in-Progress, Charge Completion, and Fault Conditions**
- **Optional Temperature Monitoring Before and During Charge**
- **Small, 8-Pin Power-Pad MSOP Package**

DESCRIPTION

The bq2420x series are simple Li-Ion linear charge management devices targeted at low-cost and space limited charger applications. The bq2420x series offer integrated powerFET, high-accuracy voltage regulation, temperature monitoring, charge status, and charge termination, in a single monolithic device.

The bq2420x is designed to work with a current-limited wall-mount transformer and therefore does not provide any current regulation. However, these devices offer a fixed internal current limit to prevent damage to the internal powerFET. A time-limited pre-conditioning phase is provided to condition deeply discharged cells. Once the battery reaches the charge voltage, the high accuracy voltage regulation loop takes over and completes the charge cycle. Charge is terminated based on minimum current. An internal charge timer provides a backup safety for charge termination.

Other standard features include an automatic sleep mode activated when V_{CC} falls below the battery voltage and a recharge feature activated when the battery voltage falls below the V_{RCH} threshold.

In addition to the standard features, the core product provides two additional enhancements: temperature monitoring and status display. The temperature-sense circuit continuously measures battery temperature using an external thermistor and inhibits charge until the battery temperature is within the user–defined thresholds. The STAT pin indicates three conditions of operation of the charger. These conditions are *charge-in-progress*, *charge complete*, and *fault*. This output can be used to drive an LED or an interface to a microcontroller.

TYPICAL APPLICATION
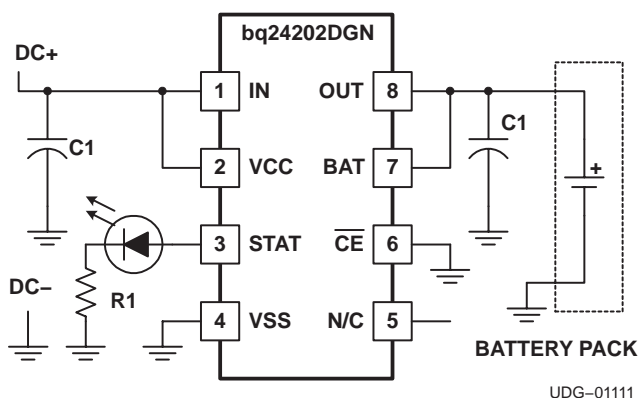
UDG–01111

bq24200, bq24201, bq24202
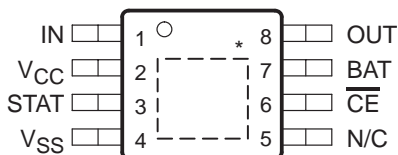# bq24203, bq24204, bq24205

AVAILABLE OPTIONS

T_J	CHARGE REGULATION VOLTAGE	OPTIONAL FUNCTIONS	MARKING	PACKAGED DEVICES (DGN)
−40°C to 125°C	4.2 V	STAT and TS	AZC	bq24200DGN
	4.1 V	STAT and TS	AZD	bq24201DGN
	4.2 V	STAT	AZE	bq24202DGN
	4.1 V	STAT	AZF	bq24203DGN
	4.2 V	–	AZG	bq24204DGN
	4.1 V	–	AZI	bq24205DGN

† The DGN package is available taped and reeled. Add TR suffix to device type (e.g. bq24200DGNTR) to order. Quantities 2500 devices per reel.
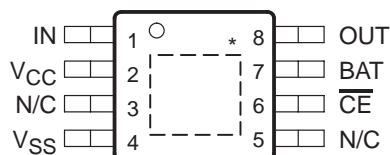
bq24200, bq24201
HTSSOP (DGN) PACKAGE
(TOP VIEW)

IN 1	8 OUT
V_{CC} 2	7 BAT
STAT 3	6 TS
V_{SS} 4	5 N/C
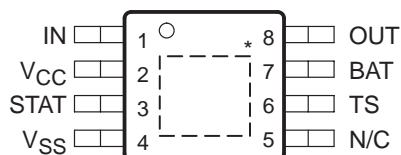
bq24202, bq24203
HTSSOP (DGN) PACKAGE
(TOP VIEW)

IN 1	8 OUT
V_{CC} 2	7 BAT
STAT 3	6 $\overline{CE}$
V_{SS} 4	5 N/C

bq24204, bq24205
HTSSOP (DGN) PACKAGE
(TOP VIEW)

IN 1	8 OUT
V_{CC} 2	7 BAT
N/C 3	6 $\overline{CE}$
V_{SS} 4	5 N/C

* Thermal pad is electrically connected to the ground of the device (V_{SS}).

Terminal Functions

NAME	bq24200 bq24201	bq24202 bq24203	bq24204 bq24205	I/O	DESCRIPTION
BAT	7	7	7	I	Battery voltage sense input
$\overline{CE}$	–	6	6	I	Charge enable Input (active low)
IN	1	1	1	I	Charge input voltage
N/C	5	5	3, 5	–	No connection. Must be left floating
OUT	8	8	8	O	Charge current output
STAT	3	3	–	O	Charge status output
TS	6	–	–	I	Temperature sense input
V_{CC}	2	2	2	I	V_{CC} input
V_{SS}	4	4	4	–	Ground input

absolute maximum ratings over operating free–air temperature range (unless otherwise noted)†

Supply voltage (Vcc with respect to GND) . . . . 16.5 V
Input voltage, IN, STAT, TS (all with respect to GND) . . . . 16.5 V
Input voltage, BAT, OUT (all with respect to GND) . . . . 7 V
Output sink/source current (STAT) . . . . 15 mA
Storage temperature range, T_{stg} . . . . −65°C to 150°C
Junction temperature range, T_J . . . . −40°C to 125°C
Lead temperature (soldering, 10sec) . . . . 300°C

† 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.

TEXAS INSTRUMENTS
www.ti.com

dissipation ratings

PACKAGE	THERMAL IMPEDANCE JUNCTION-TO-AMBIENT (θ_{JA})	THERMAL IMPEDANCE JUNCTION-TO-CASE (θ_{JC})	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$
8 Pin DGN [1]	57.20°C/W	4.4°C/W	1.75 W	0.017 W/°C

NOTE 1: This data is based on using JEDEC High-K board and topside traces, top and bottom thermal pad (2mm × 3mm), internal 1 oz. power and ground planes, four thermal via underneath the die connecting to ground plane.

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{CC}		$V_{(LOWV–MIN)}$	13.5	V
Input voltage, V_{IN}		$V_{(LOWV–MIN)}$	13.5	
Operating junction temperature range, T_J		–40	125	°C

electrical characteristics over $0°C \leq T_J \leq 125°C$ and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Vcc Current, $I_{CC(VCC)}$	Vcc > Vcc(min)		1.7	2.5	mA
Sleep current , $I_{CC(SLP)}$	Sum of currents into OUT and BAT pins, Vcc<$V_{(SLP)}$, $0°C \leq Tj \leq 85°C$			5	µA
Sleep current , $I_{CC(SLP)}$	Sum of currents into OUT and BAT pins, Vcc<$V_{(SLP)}$			10	µA
Standby Current, $I_{CC(STDBY)}$	Sum of currents into Vcc, IN and TS pins, (Vcc–$V_{I(TS)}$) $\leq$ 300 mV			1	mA
Input Bias Current on BAT pin, $I_{IB (BAT)}$				1	µA
Input Bias Current on TS pin, $I_{IB (TS)}$	0.1*Vcc $\leq V_{I(TS)} \leq$ 0.8*Vcc			1	µA

voltage regulation, $V_{O(REG)} + V_{(DO–MAX)} \leq VCC$, $I_{(TERM)} < I_{O(OUT)} \leq 500$ mA, over $0°C \leq T_J \leq 125°C$ and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage, $V_{O(REG)}$	$V_{O(REG)} + V_{(DO–MAX)} \leq$ 10 V, $I_{(TERM)} < I_{O(OUT)} \leq$ 250 mA	4.0795	4.10	4.1205	Volts
Output voltage, $V_{O(REG)}$		4.05	4.10	4.15	Volts
Output voltage, $V_{O(REG)}$	$V_{O(REG)} + V_{(DO–MAX)} \leq$ 10 V, $I_{(TERM)} < I_{O(OUT)} \leq$ 250 mA	4.1790	4.20	4.2210	Volts
Output voltage, $V_{O(REG)}$		4.15	4.20	4.25	Volts
Dropout voltage ($V_{(IN)} – V_{(OUT)}$), $V_{(DO)}$	$V_{O(REG)} + V_{(DO–MAX)} \leq$ Vcc, $I_{O(OUT)} =$ 500 mA	200	350	500	mV

output current, over $0°C \leq T_J \leq 125°C$ and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output current, $I_{O(OUT)}$	See Note 1			500	mA
Short–circuit Trip Current, $I_{(SC)}$	See Note 1	1		1.6	A

NOTE 2: Assured by design, not production tested.

pre-charge current regulation, over $0°C \leq T_J \leq 125°C$ and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Pre–charge Current , $I_{(PRECHG)}$	$V_{I(BAT)} < V_{(LOWV)}$,	$t < t_{(30min)}$	10	13.5	17	mA
Battery Detection Current , $I_{(DETECT)}$	$V_{I(BAT)} =$ 2.5 V,	$t > t_{(30min)}$	160	210	300	µA

bq24200, bq24201, bq24202
bq24203, bq24204, bq24205

charge termination detection, over 0°C ≤ T$_J$ ≤ 125°C And supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Taper current detect threshold, I$_{(TAPER)}$	V$_{I(BAT)}$ > V$_{(RCH)}$	22	25.5	29	mA
Charge termination current detect threshold, I$_{(TERM)}$	V$_{I(BAT)}$ > V$_{(RCH)}$	0.8	1.1	1.4	mA

temperature comparator, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Lower Temperature Threshold, V$_{(TS1)}$	TS pin voltage		30		%VCC
Upper Temperature Threshold, V$_{(TS2)}$	TS pin voltage		60		%VCC
Accuracy		−0.7		0.7	%VCC
Hysteresis			1		%VCC

low voltage battery threshold, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
LowV Threshold, V$_{(LOWV)}$	0°C ≤ T$_J$ ≤ 85°C	2.8	2.95	3.1	Volts
LowV Threshold, V$_{(LOWV)}$		2.8	3.0	3.2	Volts

battery recharge threshold, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Recharge Threshold, V$_{RCH}$		V$_{O(REG)}$ 0.115	V$_{O(REG)}$ −0.1	V$_{O(REG)}$ 0.85	Volts

STAT output, Vcc ≥ V$_{O(REG)}$, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output (low) saturation voltage, V$_{OL(STAT)}$	Io = 10 mA			0.5	Volts
Output (high) saturation voltage V$_{OH(STAT)}$	Io = −5 mA	Vcc−1.5			Volts

CE, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input (low) voltage, V$_{IL(CE)}$	I$_{IL}$ = 5 µA	0		V$_{CC}$−1	Volts
Input (high) voltage V$_{IH(CE)}$	I$_{IH}$ = 20 µA	Vcc−0.3			Volts

timers, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Pre-charge and taper timer, t$_{(PRECHG)}$		1,548	2,065	2,581	sec
Taper timer, t$_{(TAPER)}$		1,548	2,065	2,581	sec
Charge Timer, t$_{(CHG)}$		9,292	12,389	15,486	sec

sleep comparator, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Sleep–mode threshold, V$_{(SLP)}$	2.3V ≤ V$_{I(BAT)}$ ≤ V$_{O(REG)}$	V(BAT)−10 mV			Volts

power-on-reset and V$_{IN}$ Ramp Rate, over 0°C ≤ T$_J$ ≤ 125°C and supply voltage range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
POR Threshold, V$_{POR}$	See Note 1	2.3	2.4	2.5	Volts
Slew rate	See Note 1	5		5 x 10^{-5}	Volts/µs

NOTE 1.   Ensured by design, not production tested.

TEXAS
INSTRUMENTS
www.ti.com

functional block diagram

UDG–01105
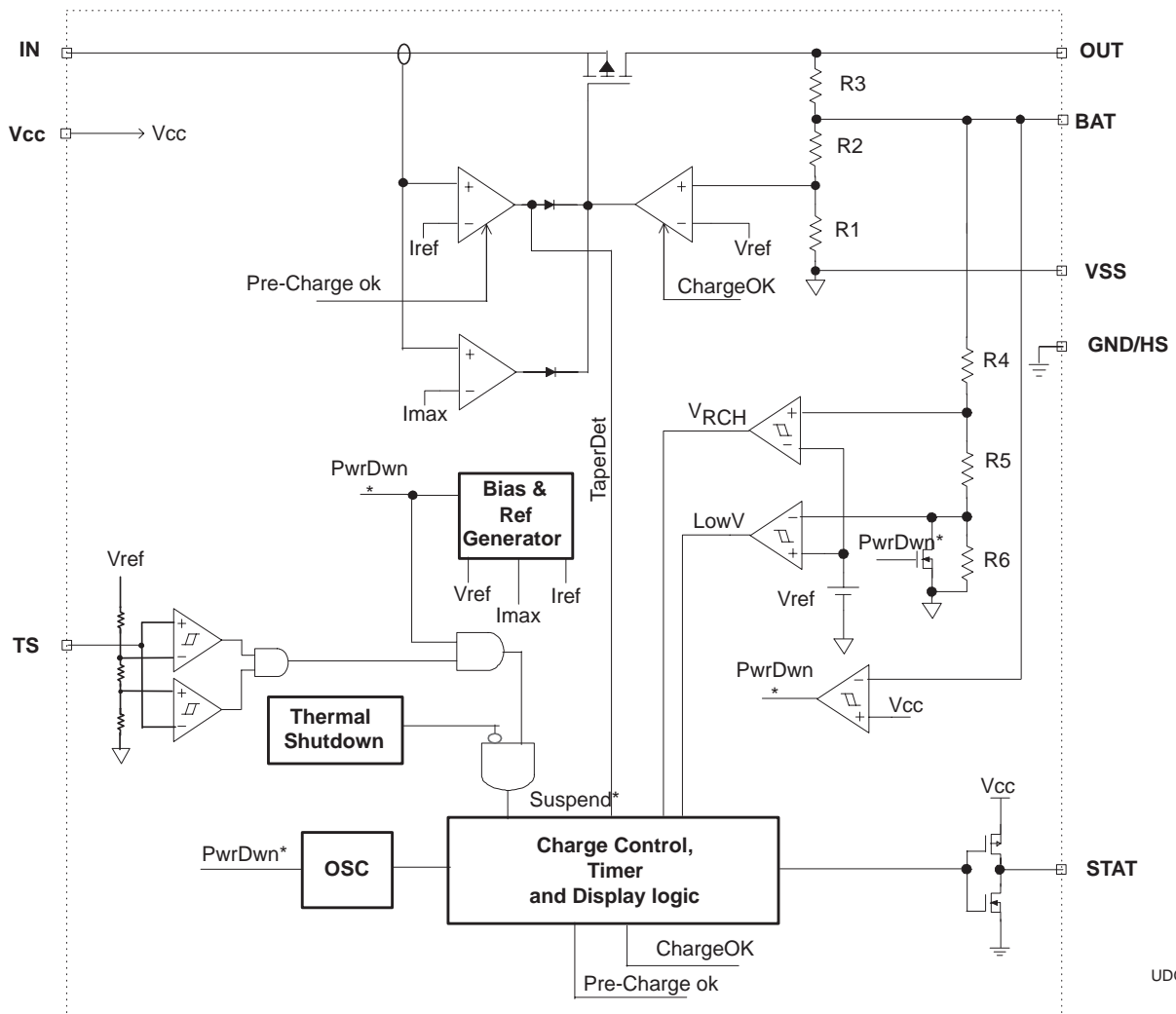
detailed description

IN: This pin is connected to the source of the internal P-channel powerFET.

OUT: This pin is connected to the drain of the internal P-channel powerFET.

Battery voltage sense (BAT): Voltage sense-input tied directly to the positive side of the battery.

Temperature sense input (TS): Input for an external battery-temperature monitoring circuit.

Charge status output (STAT): High-impedance indication of various charge conditions.

Supply voltage input (VCC): Power supply input
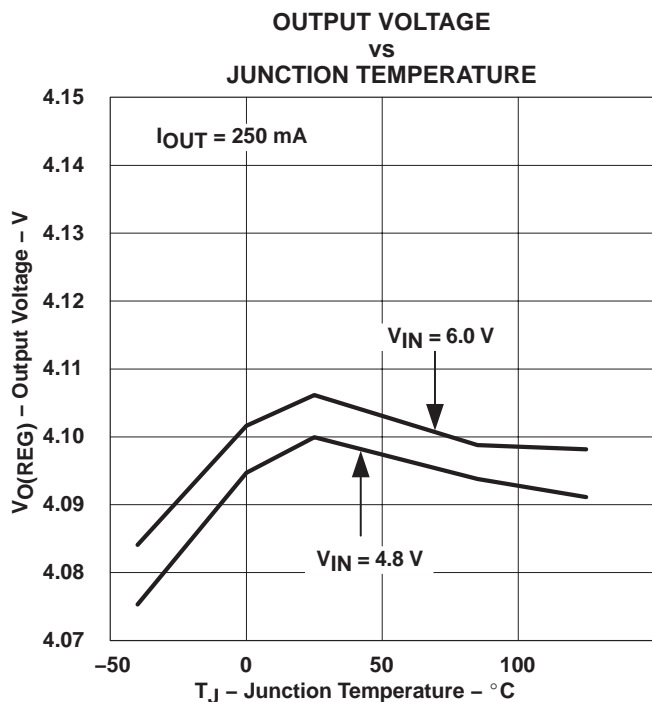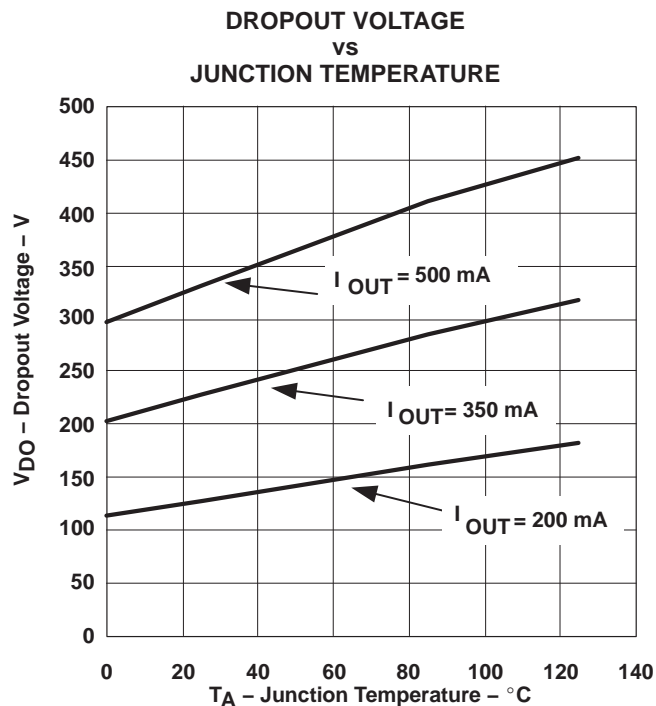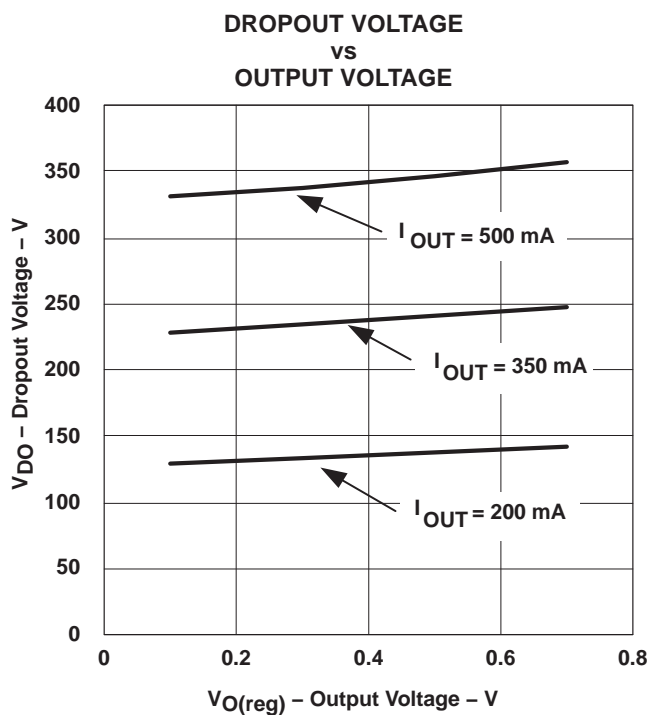
TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE
vs
JUNCTION TEMPERATURE

Figure 1

DROPOUT VOLTAGE
vs
JUNCTION TEMPERATURE

Figure 2

DROPOUT VOLTAGE
vs
OUTPUT VOLTAGE

Figure 3

SUPPLY CURRENT
vs
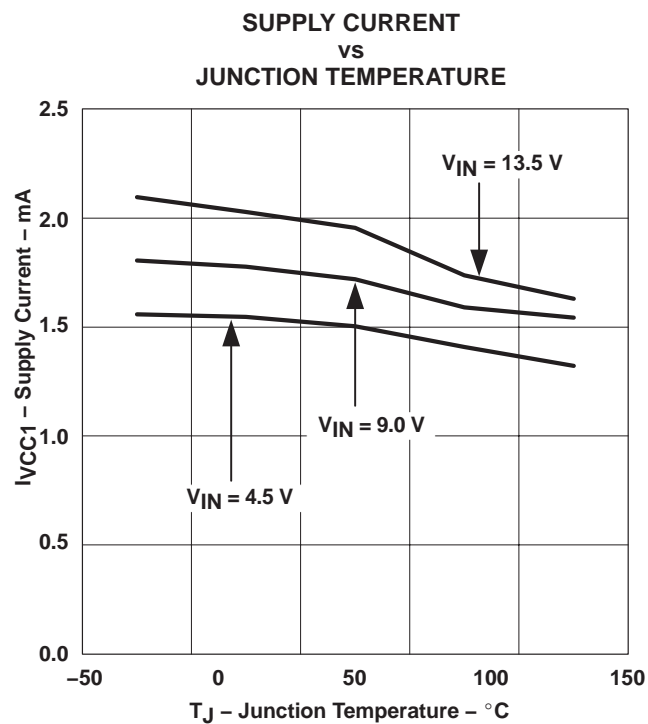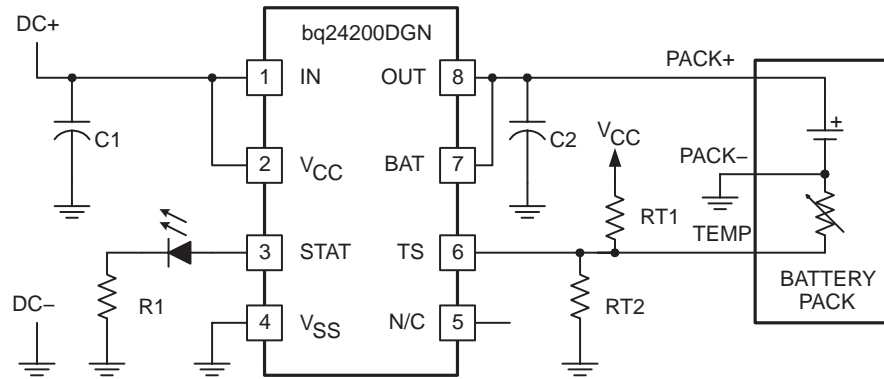**JUNCTION TEMPERATURE**

Figure 4

APPLICATION INFORMATION

Figure 5. Low Dropout Single–Cell Li–Ion/Li–Pol Charger

UDG–01109

functional description

The bq2420x supports a precision Li-Ion or Li-Pol charging system suitable for single-cells with either coke or graphite anodes. Figure 5 shows an application schematic and Figure 6 shows the typical charge profile.

temperature qualification (bq24200 and bq24201 only)

The bq24200 and bq24201 continuously monitors battery temperature by measuring the voltage between the TS and VSS pins. A negative- or a positive-temperature coefficient thermistor (NTC, PTC) and an external voltage divider typically develop this voltage (see figure 5). The bq24200 and bq24201 compare this voltage against the internal $V_{(TS1)}$ and $V_{(TS2)}$ thresholds to determine if charging is allowed (see Figure 7). The temperature sensing circuit is immune to any fluctuation in Vcc since both the external voltage divider and the internal thresholds are referenced to Vcc.

Once a temperature outside the $V_{(TS1)}$ and $V_{(TS2)}$ thresholds is detected the bq24200 and bq24201 immediately suspend the charge. The bq24200 and bq24201 suspend the charge by turning off the powerFET and holding the timer value (i.e. timers are NOT reset). Charge is resumed when the temperature returns to the normal range.
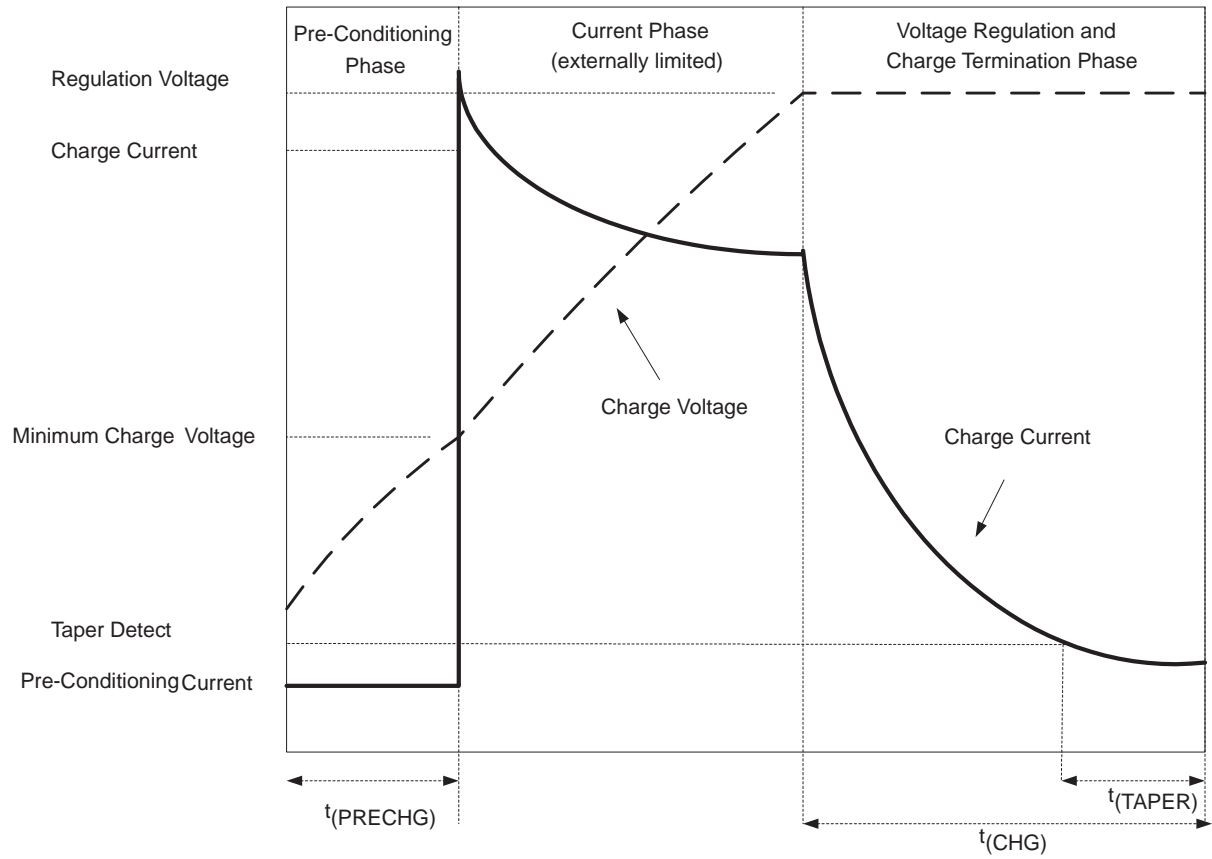
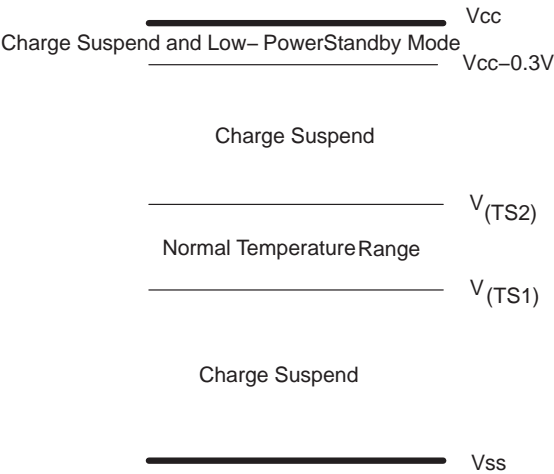## APPLICATION INFORMATION

Figure 6. Typical Charge Profile

Figure 7. TS Pin Thresholds

TEXAS
INSTRUMENTS
www.ti.com

APPLICATION INFORMATION

operational flow diagram

POR

$Vcc > V_{(SLP)}$
checked at all times — No → SLEEP MODE
Indicate SLEEP MODE (STAT=Hi–Z)

Yes

$V_{I(BAT)} V_{(LOWV)}$ — Yes → Reset and Start $t_{(PRECHG)}$ timer → APPLY PRECHARGE, $I_{(PRECHG)}$ Indicate Charge–In–Progress

$V_{I(BAT)} V_{O(REG)}$ — Yes → Current Phase Indicate Charge–In–Progress

$V_{I(BAT)} V_{O(REG)}$ — Yes / No

Reset all timers, Start $t_{(CHG)}$ timer

Regulate Voltage Indicate Charge–In–Progress

$V_{I(BAT)} V_{(LOWV)}$ — No / Yes

$t_{(PRECHG)}$ Expired? — Yes

$t_{(CHG)}$ Expired? — Yes → – Fault Condition – Enable $I_{(DETECT)}$ Indicate Fault

No

$V_{I(BAT)} V_{O(REG)}$ — Yes / No

Battery replaced? — No / Yes

$I_{(TAPER)}$ detection? — Yes

$t_{(TAPER)}$ Expired? — No / Yes

$I_{(TERM)}$ detection? — No / Yes

Turn off charge IndicateDONE

$V_{I(BAT)} V_{(RCH)}$ — No / Yes

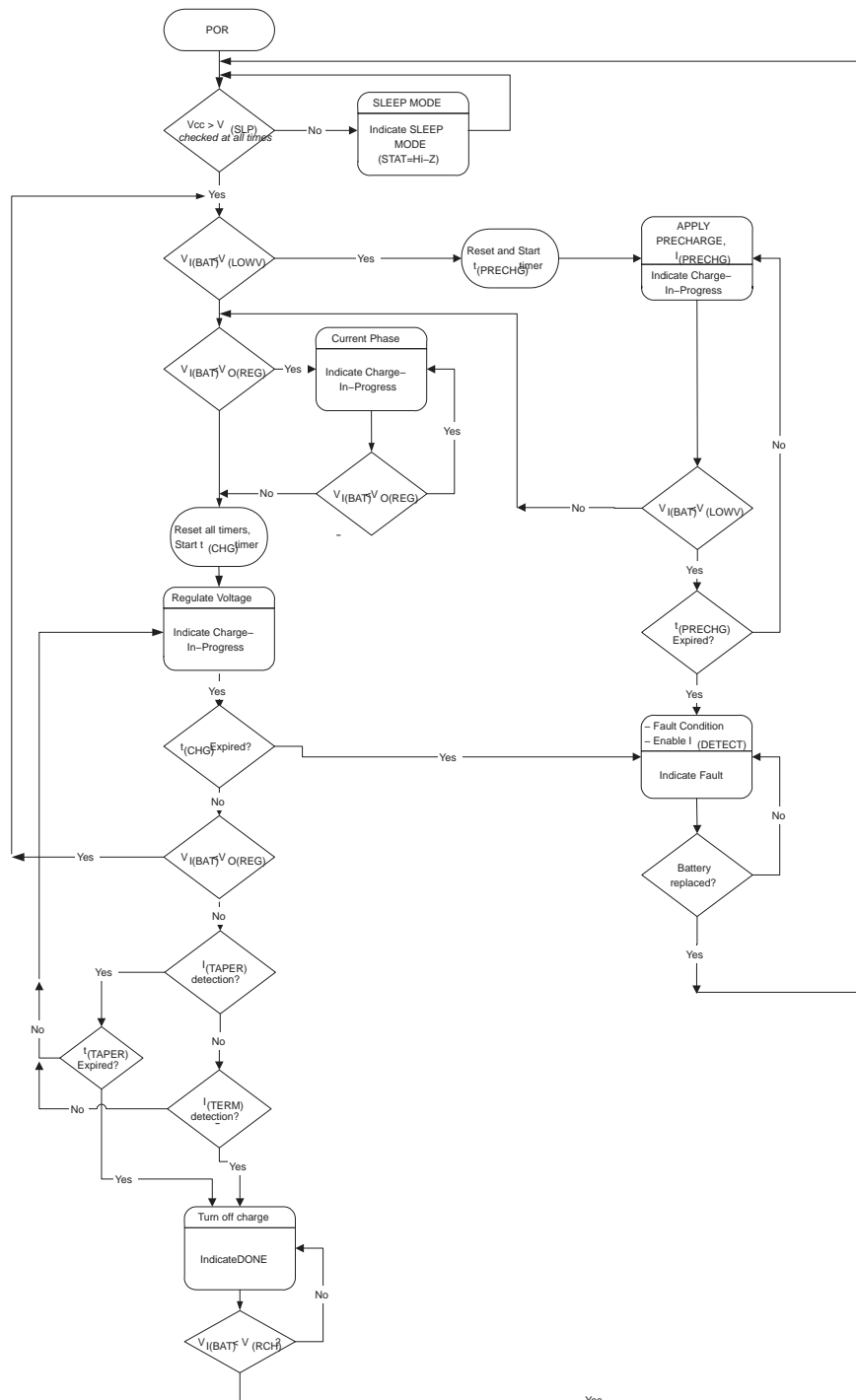**Figure 8. Operational Flow Chart**

bq24200, bq24201, bq24202
bq24203, bq24204, bq24205

APPLICATION INFORMATION

The resistor values of R_{T1} and R_{T2} are calculated by the following equations:

For NTC Thermistors:

$$R_{T1} = \frac{\left(5 \times RT_H \times RT_C\right)}{\left(3 \times \left(RT_C - RT_H\right)\right)}$$

$$R_{T2} = \frac{\left(5 \times RT_H \times RT_C\right)}{\left(2 \times RT_C\right) - \left(7 \times RT_H\right)}$$

For PTC Thermistors:

$$R_{T1} = \frac{\left(5 \times RT_H \times RT_C\right)}{\left(3 \times \left(RT_H - RT_C\right)\right)}$$

$$R_{T2} = \frac{\left(5 \times RT_H \times RT_C\right)}{\left(2 \times RT_H\right) - \left(7 \times RT_C\right)}$$

Where RT_C is the cold temperature resistance and RT_H is the hot temperature resistance of thermistor, as specified by the thermistor manufacturer.

R_{T1} or R_{T2} can be omitted If only one temperature (hot or cold) setting is required. Applying a voltage between the V_{TS1} and V_{TS2} thresholds to pin TS disables the temperature-sensing feature. Also applying a voltage between (V_{CC} – 0.3 V) and Vcc suspends the charge and places the IC in the low-power standby mode.

battery pre-conditioning

Figure 7 shows the operational flow chart for the bq2420x.

Upon power-up, if the battery voltage is below the $V_{(LOWV)}$ threshold, the bq2420x applies a pre-charge current, $I_{(PRECHG)}$, to the battery. This feature revives deeply discharged cells. The bq2420x activates a safety timer, $t_{(PRECHG)}$, during the conditioning phase. If $V_{(LOWV)}$ threshold is not reached within the timer period, the bq2420x turns off the charger and enunciates FAULT on the STAT pin. In the case of a FAULT condition, the bq2420x reduces the current to $I_{(DETECT)}$. $I_{(DETECT)}$ is used to detect a battery replacement condition. Fault condition is cleared by POR or battery replacement.

TEXAS
INSTRUMENTS
www.ti.com

APPLICATION INFORMATION

battery charge current

Following a successful pre-conditioning, the bq2420x relies on an external current-limited supply to limit the charge current to the cell. The bq2420x continues this phase until the battery reaches the voltage regulation phase.

During this phase (and all other phases of operation) in order to protect the integrated powerFET, the internal short circuit and thermal protection circuits are active.

battery voltage regulation

The voltage regulation feedback is through the BAT pin. This input is tied directly to the positive side of the battery pack. The bq2420x monitors the battery-pack voltage between the BAT and VSS pins. The bq2420x is offered in two fixed-voltage versions: 4.1 V and 4.2 V.

As a safety backup, the bq2420x also monitors the charge time in the voltage regulation mode. If taper current is not detected within this time period, $t_{(CHG)}$, the bq2420x turns off the charger and enunciates FAULT on the STAT pin. Fault condition is cleared by POR or battery replacement. Note that the safety timer is reset if the bq2420x is forced out of the voltage regulation mode.

charge termination and recharge

The bq2420x monitors the charging current during the voltage regulation phase. Once the taper threshold, $I_{(TAPER)}$, is detected the bq2420x initiates the taper timer, $t_{(TAPER)}$. Charge is terminated after the timer expires. The bq2420x resets the taper timer in the event that the charge current returns above the taper threshold, $I_{(TAPER)}$.

In addition to the taper current detection, the bq2420x terminates charge in the event that the charge current falls below the $I_{(TERM)}$ threshold. This feature allows for quick recognition of a battery removal condition.

After a charge termination, the bq2420x restarts the charge once the voltage on the BAT pin falls below the $V_{(RCH)}$ threshold. This feature keeps the battery at full capacity at all times.

sleep mode

The bq2420x enters the low-power sleep mode if the Vcc is removed from the circuit (i.e. the Vcc and IN pins are floating). For applications where these pins are not floating, placing a low-power 10 Ω (1/16 W) between the IN and VCC pins ensures the $V_{(SLP)}$ conditions are met (see Figure 9).This feature prevents draining the battery during the absence of V_{CC}.

TEXAS
INSTRUMENTS
www.ti.com

APPLICATION INFORMATION
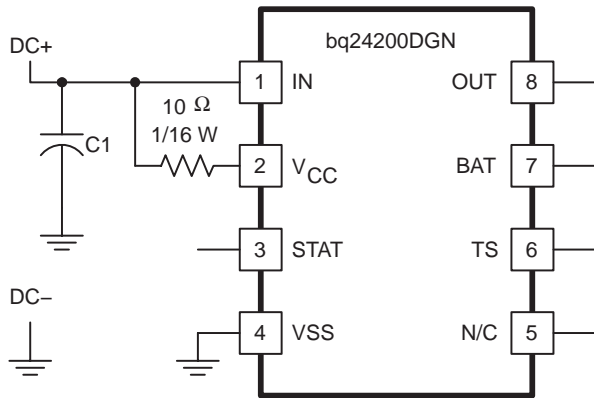
UDG–01110

Figure 9. Sleep Mode

charge enable pin

The $\overline{CE}$ pin on bq24202, bq24203, bq24204 and bq24205 can be used to enable or suspend the charge. Charge is enabled if the voltage $V_{IL(CE)}$ is applied to the pin. Applying the $V_{IH(CE)}$ suspends the charge. During a charge suspend mode, the internal powerFET is turned off and all timers are reset.

charge status output

The STAT pin on the bq2420x, indicates various conditions of operation. These conditions are summarized in Table 1.

Table 1. STAT Pin

Condition	STAT
Pre-charge	High
Fast-charge	High
Charge-complete	Low
Taper timer done	Low
Charge suspend (due to temperature or $\overline{CE}$ input)	Hi–Z
Thermal shutdown	Hi–Z
Pre-charge timer fault	Hi–Z
Sleep mode	Hi–Z
Charge timer fault	Hi–Z

![Texas Instruments]
www.ti.com

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
BQ24200DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24200DGNG4	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24200DGNR	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24200DGNRG4	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24201DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24201DGNR	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24201DGNRG4	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24202DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24202DGNG4	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24202DGNR	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24203DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24203DGNR	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24203DGNRG4	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24204DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24204DGNR	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24204DGNRG4	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24205DGN	ACTIVE	MSOP-Power PAD	DGN	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
BQ24205DGNR	ACTIVE	MSOP-	DGN	8	2500	Green (RoHS &	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
		Power PAD				no Sb/Br)		
BQ24205DGNRG4	ACTIVE	MSOP-Power PAD	DGN	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

[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) 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.
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)
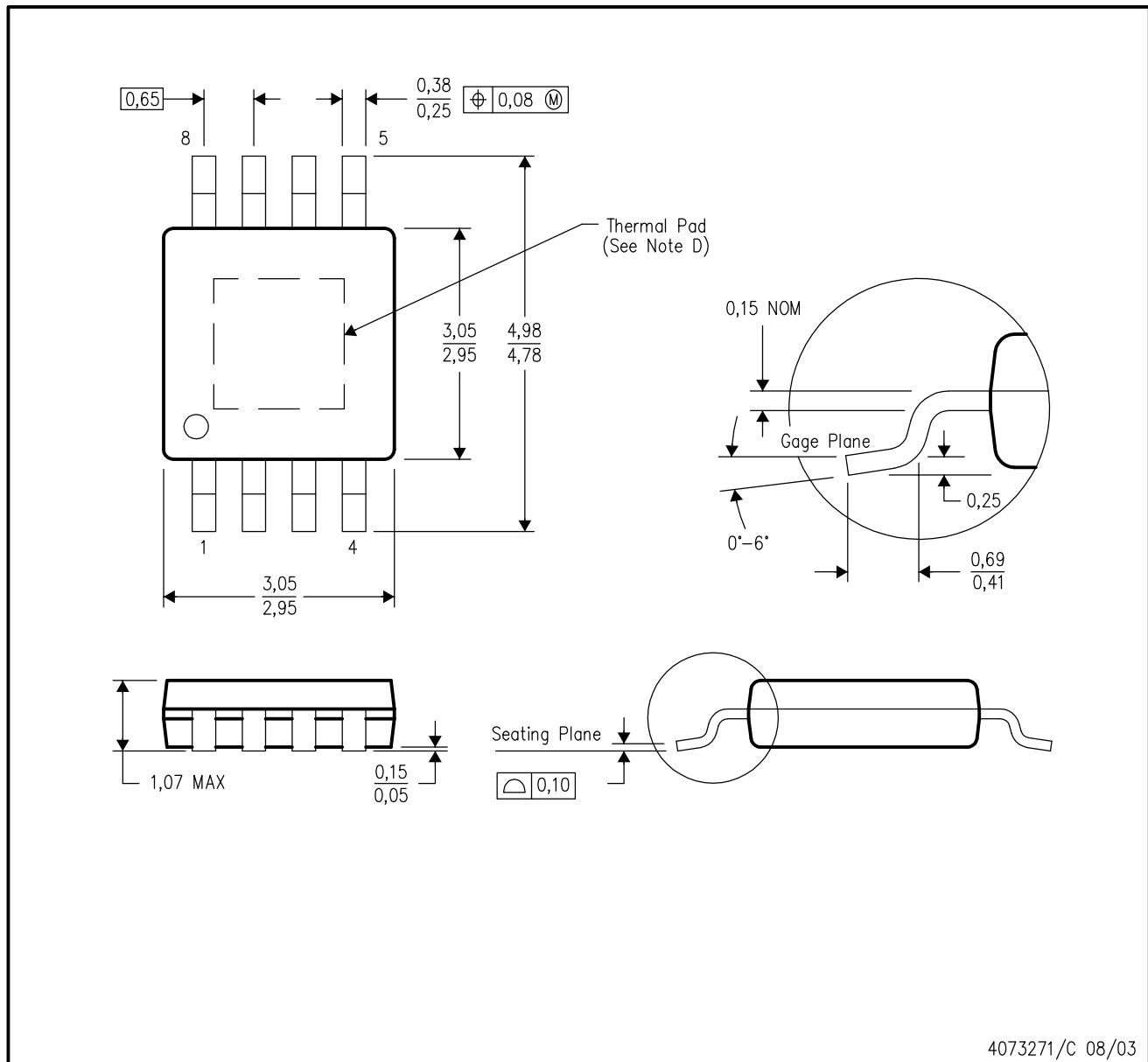
[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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.

DGN (S−PDSO−G8)   PowerPAD™ PLASTIC SMALL−OUTLINE PACKAGE

0,65

8

5

0,38
0,25   ⊕ 0,08 Ⓜ

Thermal Pad
(See Note D)

3,05
2,95   4,98
4,78

1

4

3,05
2,95

0,15 NOM

Gage Plane

0°−6°

0,25

0,69
0,41

1,07 MAX

0,15
0,05

Seating Plane

0,10

4073271/C 08/03

NOTES: A.   All linear dimensions are in millimeters.
         B.   This drawing is subject to change without notice.
         C.   Body dimensions do not include mold flash or protrusion.
         D.   This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad
              Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 for information regarding
              recommended board layout. This document is available at www.ti.com <http://www.ti.com>.
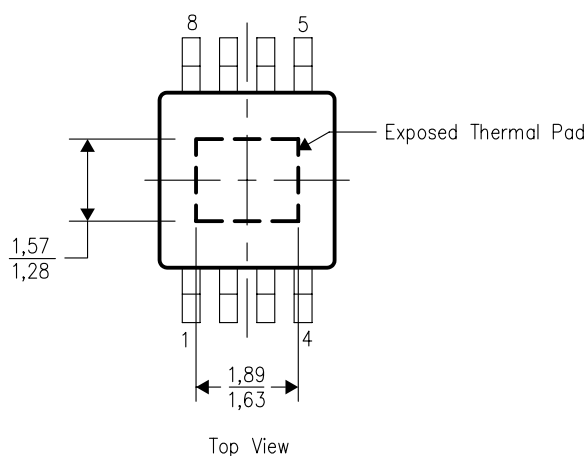   E.   Falls within JEDEC MO−187

PowerPAD is a trademark of Texas Instruments.

TEXAS
INSTRUMENTS
www.ti.com

TEXAS INSTRUMENTS
www.ti.com

THERMAL INFORMATION

This PowerPAD™ package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. When the thermal pad is soldered directly to the printed circuit board (PCB), the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to a ground or power plane (whichever is applicable), or alternatively, a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For additional information on the PowerPAD package and how to take advantage of its heat dissipating abilities, refer to Technical Brief, PowerPAD Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 and Application Brief, PowerPAD Made Easy, Texas Instruments Literature No. SLMA004. Both documents are available at www.ti.com.

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

Top View

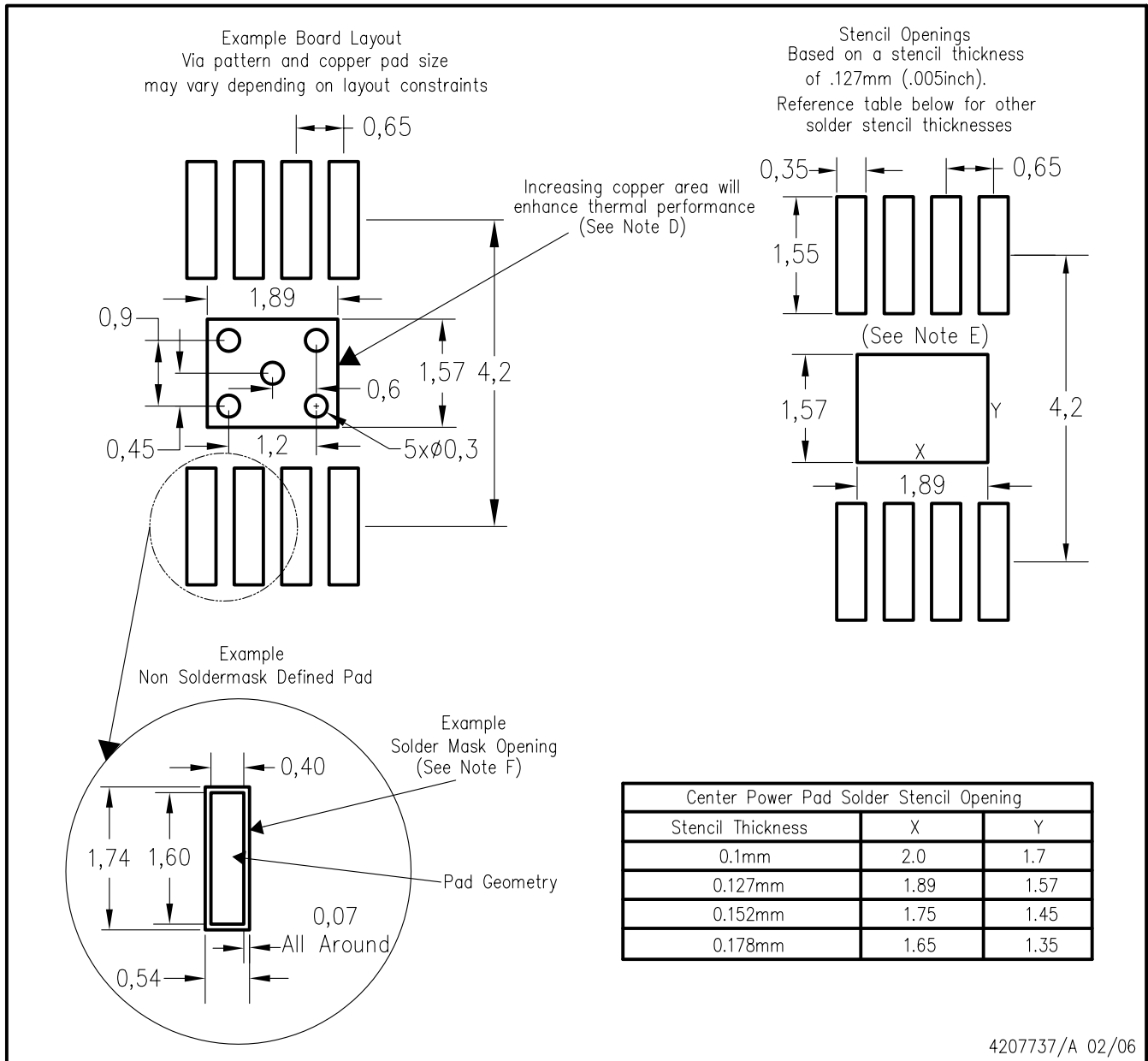NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

DGN (R-PDSO-G8) PowerPAD™

Example Board Layout
Via pattern and copper pad size
may vary depending on layout constraints

Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).
Reference table below for other
solder stencil thicknesses

0,65

Increasing copper area will
enhance thermal performance
(See Note D)

1,89

0,9

0,6

1,57   4,2

0,45

1,2

5×Ø0,3

0,35

0,65

1,55

(See Note E)

1,57

Y

X

4,2

1,89

Example
Non Soldermask Defined Pad

Example
Solder Mask Opening
(See Note F)

0,40

1,74   1,60

0,07

All Around

0,54

Pad Geometry

Center Power Pad Solder Stencil Opening		
Stencil Thickness	X	Y
0.1mm	2.0	1.7
0.127mm	1.89	1.57
0.152mm	1.75	1.45
0.178mm	1.65	1.35

4207737/A 02/06

NOTES: A.   All linear dimensions are in millimeters.
B.   This drawing is subject to change without notice.
C.   Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D.   This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad
Thermally Enhanced Package, Texas Instruments Literature No. SLMA002, SLMA004, 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>. Publication IPC-7351 is recommended for alternate designs.
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. Example stencil design based on a 50% volumetric
metal load solder paste. Refer to IPC-7525 for other stencil recommendations.
F.   Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

TEXAS
INSTRUMENTS
www.ti.com

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
                                Post Office Box 655303 Dallas, Texas 75265

Copyright © 2006, Texas Instruments Incorporated