Low Quiescent Current, Dual-Channel Supervisory Circuit

FEATURES

- **Two Supply Monitors in One Package**
- **One Monitor with Fixed High-Accuracy Thresholds for System Supply Monitoring**
- **Second Monitor with Variable Threshold and 30mV Hysteresis to Provide Failsafe**
- **Very Low Quiescent Current: 3.5μA typ**
- **High Threshold Accuracy: 1% max (0°C to +85°C)**
- **Open-Drain Reset Outputs**
- **Temperature Range: –40°C to +85°C**
- **Ultra-Small SC70-5 Package**

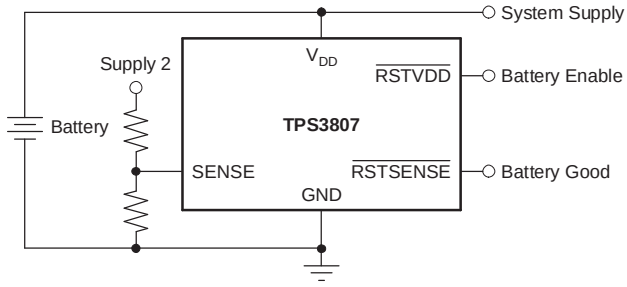
APPLICATIONS

- **DSP, Microcontroller, or Microprocessor Applications Requiring User-Selected Delay Times**
- **Notebook/Desktop Computers**
- **PDAs and SmartPhones**
- **Other Hand-Held Products**
- **Portable, Battery-Powered Products**
- **FPGA/ASIC Applications**

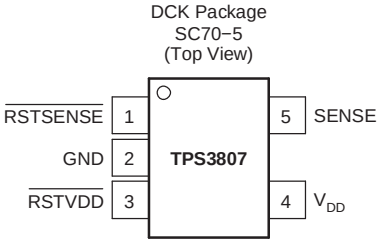
DESCRIPTION

The TPS3807 family microprocessor supervisory circuits monitor system voltages as low as 1.225V. These devices assert an open-drain $\overline{\text{RSTVDD}}$ signal when the V_{DD} voltage drops below a preset threshold. The $\overline{\text{RSTVDD}}$ output remains asserted until the V_{DD} voltage returns above its threshold. The device also provides an additional $\overline{\text{RSTSENSE}}$ output for a SENSE input with adjustable thresholds and hysteresis.

The TPS3807 uses a precision reference to achieve 1% threshold accuracy. The TPS3807 has a very low typical quiescent current of 3.5μA, so it is well-suited to battery-powered applications. It is available in a small SC70-5 package, which is half the size of a SOT-23 package, and is fully specified over a temperature range of –40°C to +85°C.



Typical Application Circuit



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION(1)

PRODUCT	V_{DD} NEGATIVE THRESHOLD VOLTAGE ($V_{DD\ IT-}$)(2)	V_{DD} POSITIVE THRESHOLD VOLTAGE ($V_{DD\ IT+}$)(2)	SENSE THRESHOLD VOLTAGE ($V_{SENSE\ IT}$)
TPS3807A30DCKT(3)	3.00V	3.58V	1.225V
TPS3807A30DCKR(4)	3.00V	3.58V	1.225V

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document or see the TI web site at www.ti.com.
(2) Other voltage options are available upon request; minimum order quantities may apply.
(3) DCK**T** passive indicates tape and reel containing 250 parts.
(4) The DCK**R** passive indicates tape and reel containing 3000 parts.

ABSOLUTE MAXIMUM RATINGS

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

SENSE pin voltage(2)	–0.3V to +5V
$\overline{MR}$	–0.3V to V_{DD} +0.3V
$\overline{RESET}$	–0.3V to V_{DD} +0.3V
All other pins(2)	–0.3V to +7V
Maximum output current	±5mA
Input clamp current, I_{IK} ($V_{SENSE} < 0$ or $V_{SENSE} > V_{DD}$)	±10mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{DD}$)	±10mA
Continuous total power dissipation	See *Dissipation Ratings* table
Junction temperature, T_C	–40°C to +125°C
Storage temperature range, T_{STG}	–65°C to +150°C
Soldering temperature	+260°C
ESD rating:	
Human body model (HBM)	2kV
Charged device model (CDM)	500V

(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 conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to GND. For reliable operation, the device must not be continuously operated at 7V for more than t = 1000 hours.

DISSIPATION RATINGS

PACKAGE	θ_{JA}	DERATING FACTOR ABOVE T_A = +25°C	T_A < +25°C POWER RATING	T_A = +70°C POWER RATING	T_A = +80°C POWER RATING
DCK	+246°C/W	2.6mW/°C	406mW	223mW	167mW

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
Supply voltage, V_{DD}		1.8	6.5	V
Input voltage, V_{SENSE}	0V ≤ V_{DD} ≤ 4.2V	0	V_{DD} + 0.3	V
	V_{DD} ≥ 4.2V		4.5	
Operating free-air temperature range, T_A		–40°C	+85°C	°C

ELECTRICAL CHARACTERISTICS

Over recommended operating temperature range, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{DD}	Input supply range		1.8		6.5	V
I_{DD}	Supply current	V_{DD} = 3.3V, $\overline{RSTVDD}$, $\overline{RSTSENSE}$ = open		3.5	6.5	µA
		V_{DD} = 6.5V, $\overline{RSTVDD}$, $\overline{RSTSENSE}$ = open		4.5	7.5	µA
V_{OL}	Low-level output voltage	V_{DD} = 1.3V, I_{OL} = 0.4mA			0.3	V
		V_{DD} = 1.8V, I_{OL} = 1mA			0.4	
		V_{DD} = 3.3V, I_{OL} = 2mA			0.4	
	Power-up reset(1)	$V_{\overline{RSTVDD}}$ (max) = 0.2V, I_{OL} = 30µA, +25°C	0.9			V
$V_{DD\ IT-}$	Negative-going input threshold voltage(2)		2.963	3.000	3.037	V
$V_{DD\ IT+}$	Positive-going input threshold voltage(2)		3.530	3.575	3.620	V
$V_{SENSE\ IT-}$	Negative-going input threshold voltage	0°C to +85°C	1.213	1.225	1.237	V
		–40°C to +85°C	1.210	1.225	1.240	
V_{HYS}	SENSE input hysteresis			30		mV
I_{SENSE}	Input current		–25		+25	nA
C_I	Input capacitance	V_I = 0V to V_{DD}		1		pF
I_{OH}	High-level output current	$V_{\overline{RSTVDD}, \overline{RSTSENSE}}$ = 6.5V			300	nA

(1) The lowest supply voltage at which $\overline{RSTVDD}$ ($V_{\overline{RSTVDD}}$ (max) = 0.2V, I_{OL} = 30µA) becomes active. $t_{r,\ VDD} \geq 15\mu s/V$.
(2) To ensure best stability of the threshold voltage, a bypass capacitor (ceramic, 0.1µF) should be placed near the V_{DD} pin.

TIMING REQUIREMENTS

At T_A = –40°C to +85°C, R_L = 1MΩ, and C_L = 50pF, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_W	Pulse width	V_{IH} = 1.05V_{IT}, V_{IL} = 0.95V_{IT}	10			µs

SWITCHING CHARACTERISTICS

At T_A = –40°C to +85°C, R_L = 1MΩ, and C_L = 50pF, unless otherwise noted.

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PHL}	Propagation delay time, high-to-low-level output	V_{DD} to $\overline{RSTVDD}$	V_{IH} = 1.05V_{IT}, V_{IL} = 0.95V_{IT}		20		µs
		SENSE to $\overline{RSTSENSE}$					

FUNCTIONAL BLOCK DIAGRAM

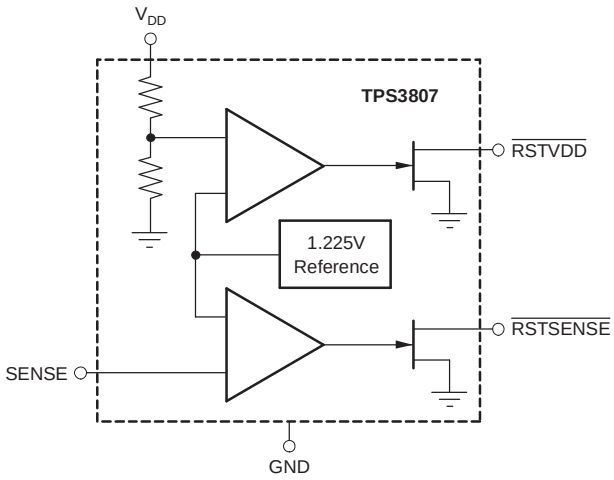


Table 1. PIN DESCRIPTIONS

NAME	PIN NO.	I/O	DESCRIPTION
$\overline{\text{RSTSENSE}}$	1	O	$\overline{\text{RSTSENSE}}$ is an open-drain output that is driven to a low-impedance state when the SENSE input is lower than the threshold voltage $V_{SENSE\ IT-}$. $\overline{\text{RSTSENSE}}$ will remain low until SENSE is above $V_{SENSE\ IT+}$. A pull-up resistor from 10kΩ to 1MΩ should be used on this pin, and allows the reset pin to attain voltages higher than V_{DD}.
GND	2	I	Ground
$\overline{\text{RSTVDD}}$	3	O	$\overline{\text{RSTVDD}}$ is an open-drain output that is driven to a low-impedance state when the V_{DD} input is lower than the threshold voltage $V_{DD\ IT-}$. $\overline{\text{RSTVDD}}$ will remain low until V_{DD} is above $V_{DD\ IT+}$. A pull-up resistor from 10kΩ to 1MΩ should be used on this pin, and allows the reset pin to attain voltages higher than V_{DD}.
V_{DD}	4	I	Supply voltage for the device and sense input for fixed-threshold $\overline{\text{RSTVDD}}$ outputs. A 0.1µF ceramic capacitor should be placed close to this pin for best V_{IT} stability.
SENSE	5	I	Sense input for the adjustable-threshold $\overline{\text{RSTSENSE}}$ outputs. A resistor divider from the sense voltage can be attached to this pin to set the thresholds to the desired voltages. A 0.1µF ceramic capacitor should be placed close to this pin for best V_{IT} stability.

TIMING DIAGRAM

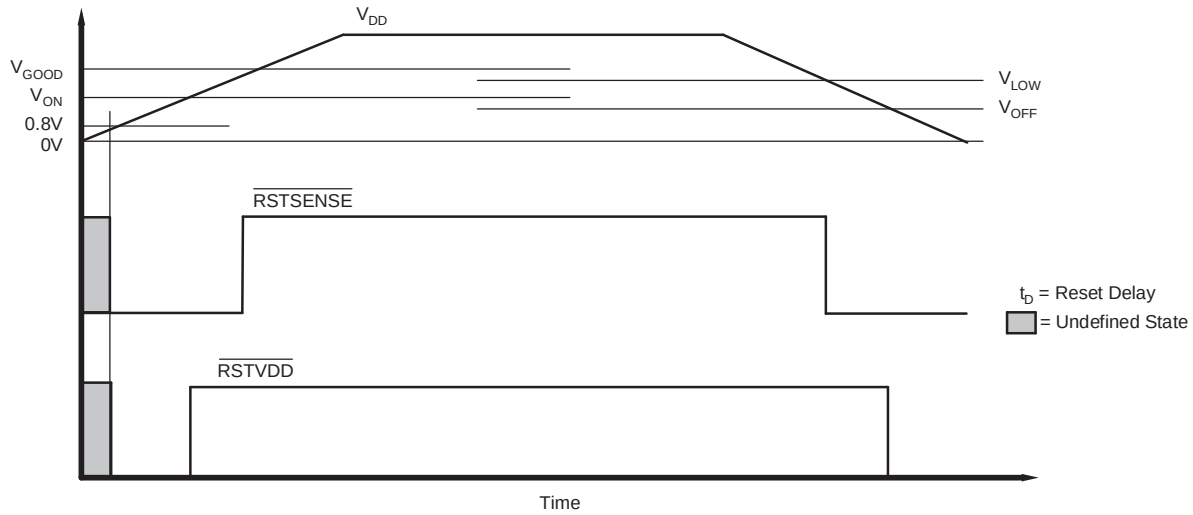


Figure 1. TPS3807 Timing Diagram Showing Reset Timing (SENSE resistor divider set to 3.6V)

TYPICAL CHARACTERISTICS

At T_A = +25°C, V_{DD} = 3.3V, $R_{\overline{LRESET}}$ = 1MΩ, and $C_{\overline{LRESET}}$ = 50pF, unless otherwise noted.

SUPPLY CURRENT vs SUPPLY VOLTAGE

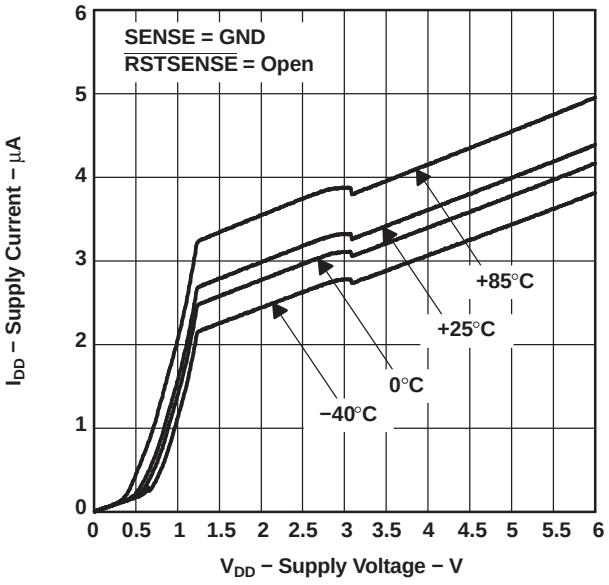


Figure 2.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

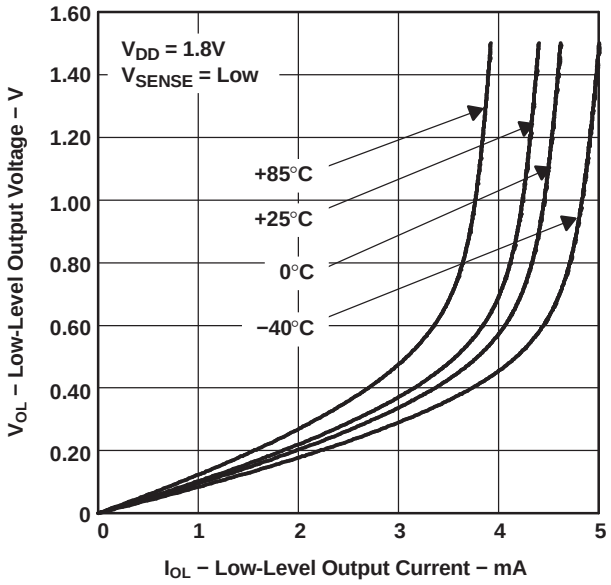


Figure 3.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

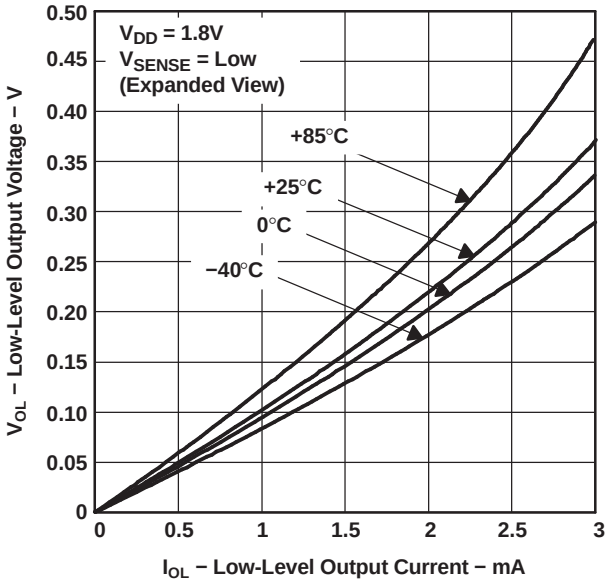


Figure 4.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

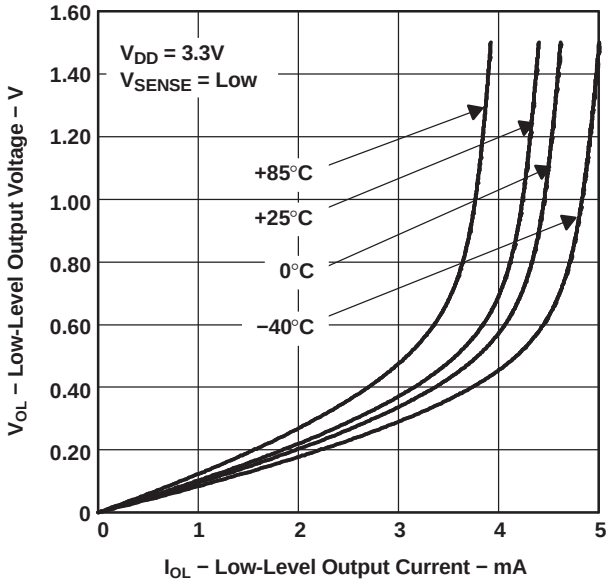


Figure 5.

TYPICAL CHARACTERISTICS (continued)

At T_A = +25°C, V_{DD} = 3.3V, $R_{\overline{LRESET}}$ = 1MΩ, and $C_{\overline{LRESET}}$ = 50pF, unless otherwise noted.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

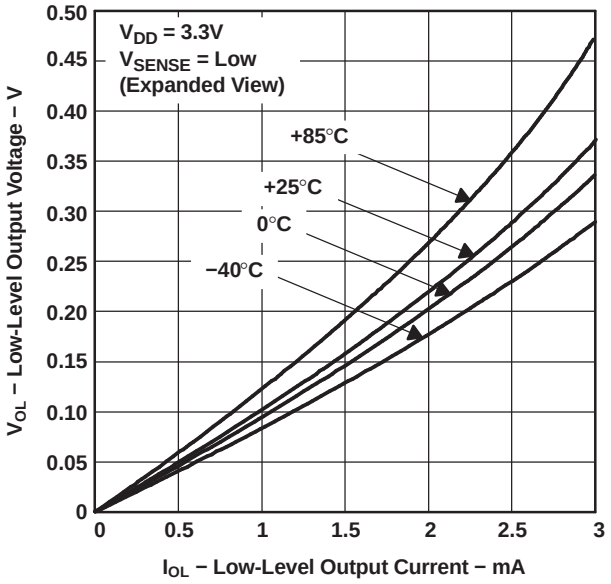


Figure 6.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

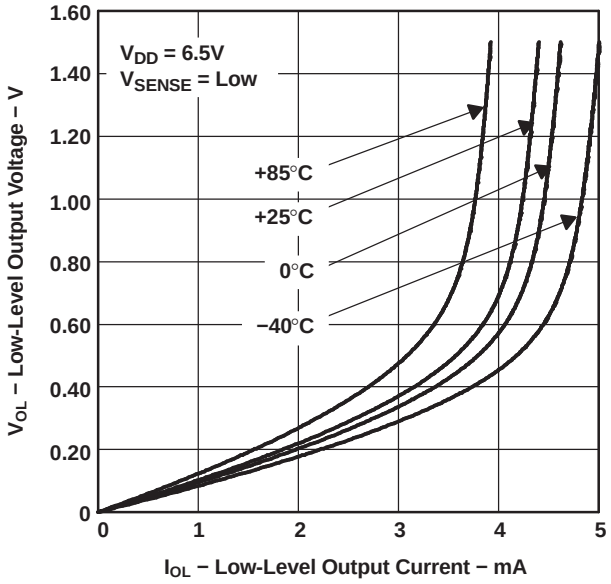


Figure 7.

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

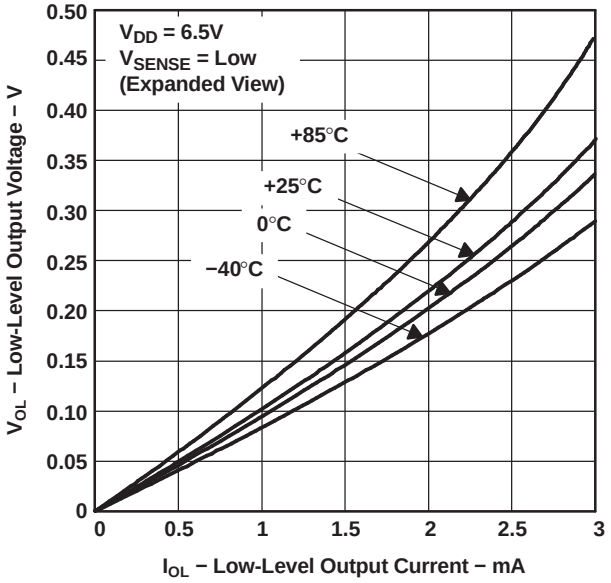


Figure 8.

NORMALIZED INPUT THRESHOLD VOLTAGE vs FREE-AIR TEMPERATURE

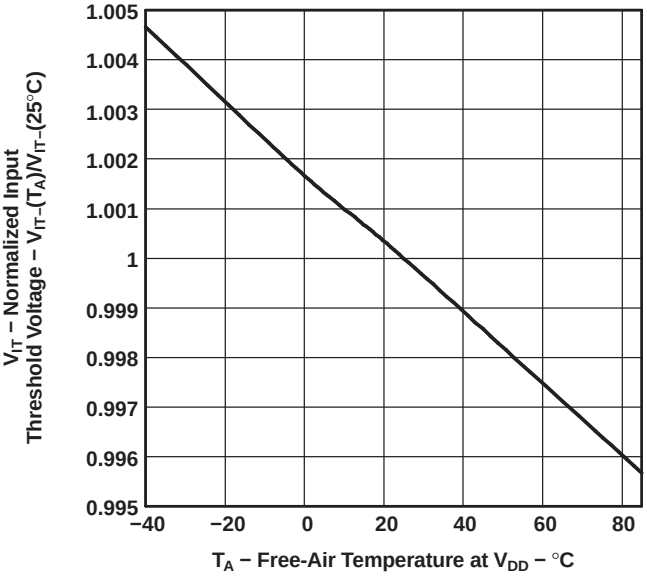


Figure 9.

TYPICAL CHARACTERISTICS (continued)

At T_A = +25°C, V_{DD} = 3.3V, $R_{\overline{LRESET}}$ = 1MΩ, and $C_{\overline{LRESET}}$ = 50pF, unless otherwise noted.

MINIMUM PULSE DURATION AT V_{DD} vs V_{DD} THRESHOLD OVERDRIVE VOLTAGE

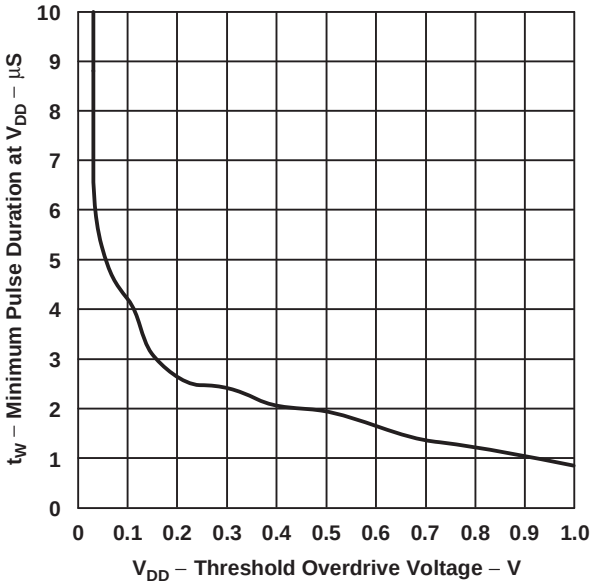


Figure 10.

MINIMUM PULSE DURATION AT SENSE vs SENSE THRESHOLD OVERDRIVE VOLTAGE

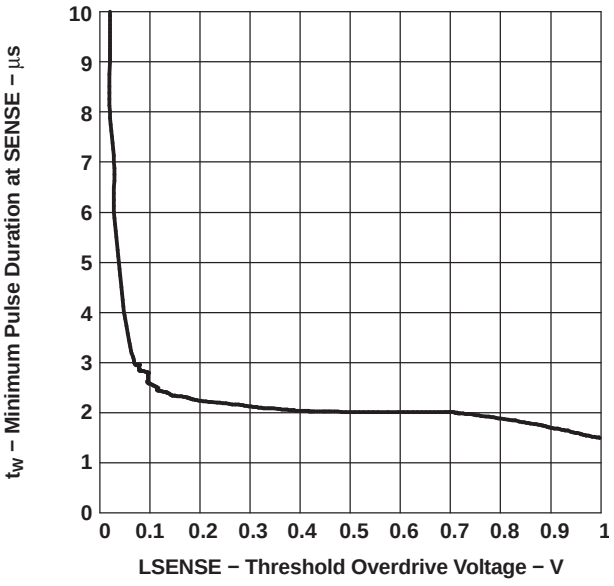


Figure 11.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS3807A30DCKR	ACTIVE	SC70	DCK	5	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	BOM	Samples
TPS3807A30DCKT	ACTIVE	SC70	DCK	5	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	BOM	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

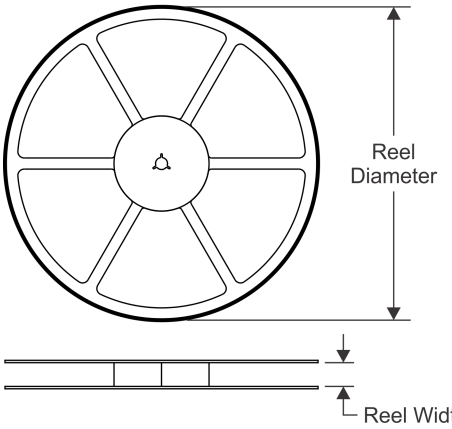
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

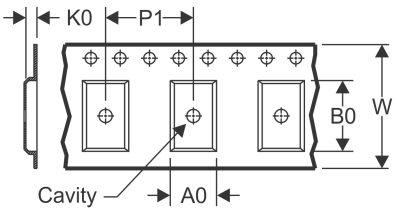
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

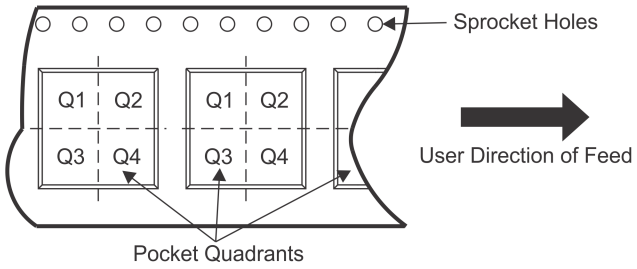


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

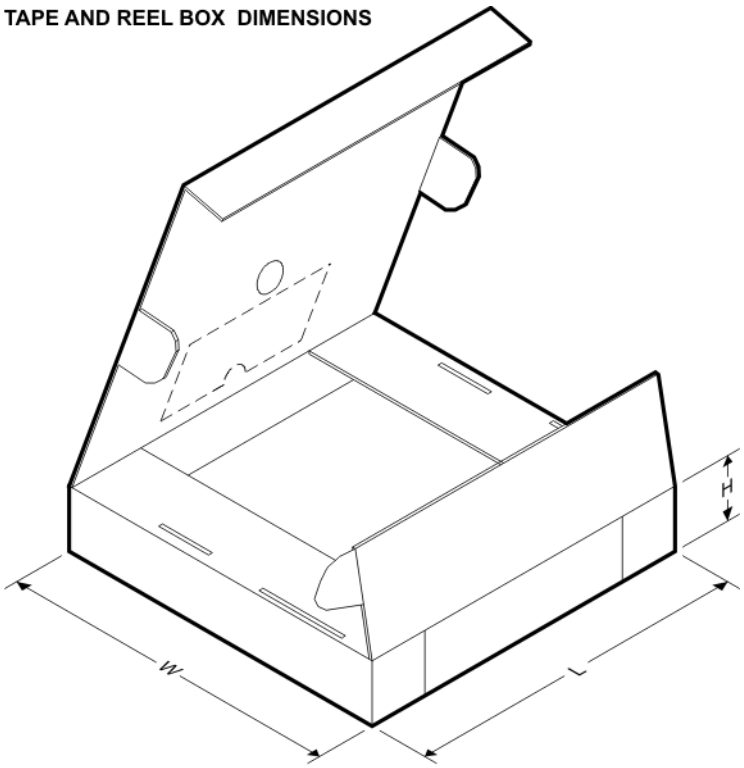
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS3807A30DCKR	SC70	DCK	5	3000	180.0	8.4	2.41	2.41	1.2	4.0	8.0	Q3
TPS3807A30DCKT	SC70	DCK	5	250	180.0	8.4	2.41	2.41	1.2	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

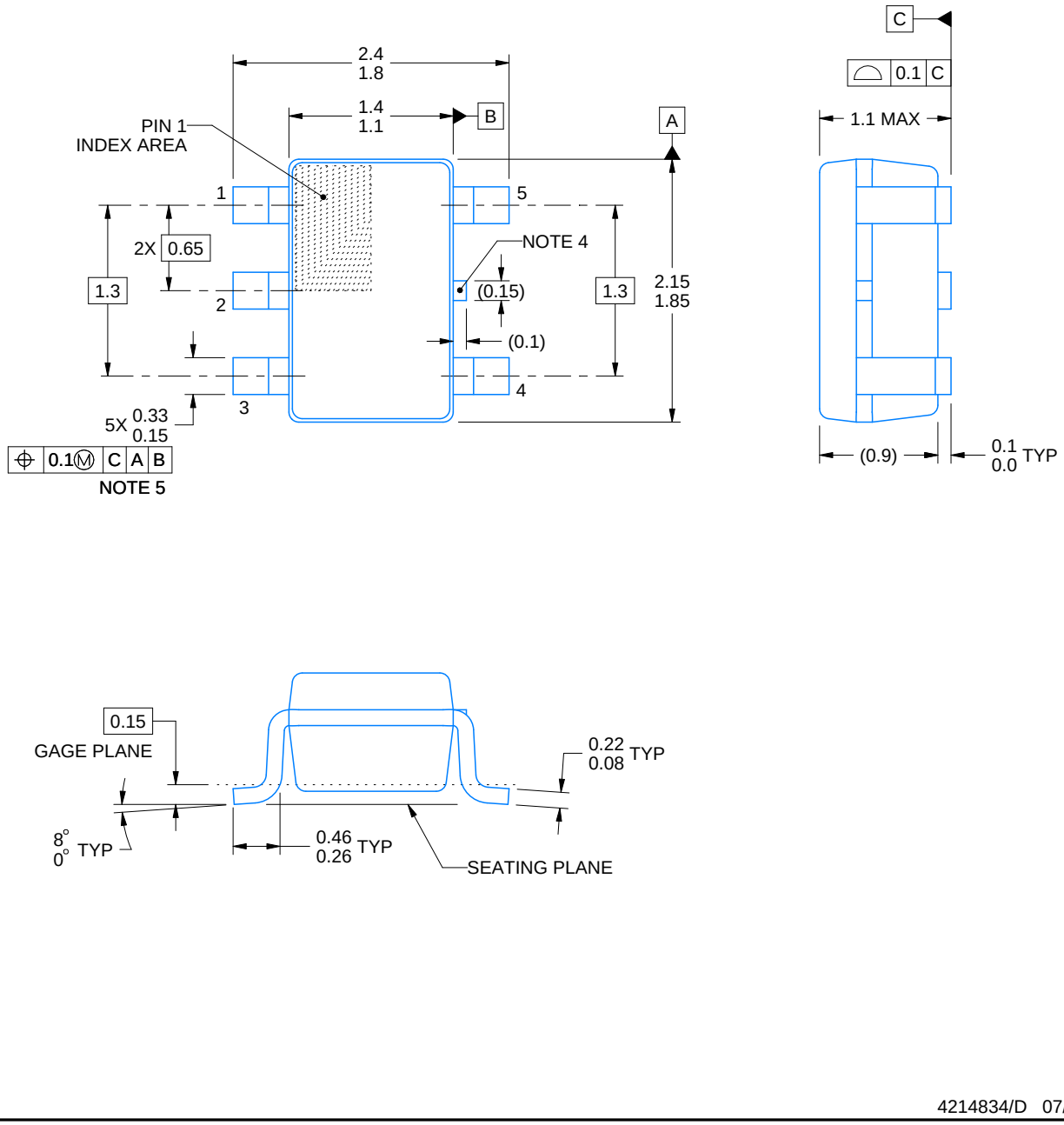
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS3807A30DCKR	SC70	DCK	5	3000	183.0	183.0	20.0
TPS3807A30DCKT	SC70	DCK	5	250	183.0	183.0	20.0

PACKAGE OUTLINE

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



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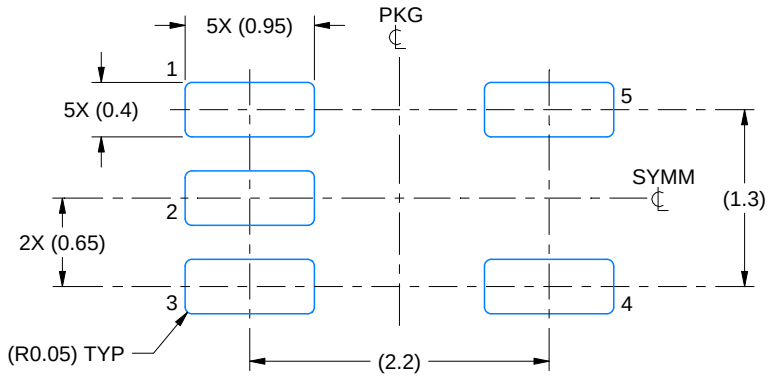
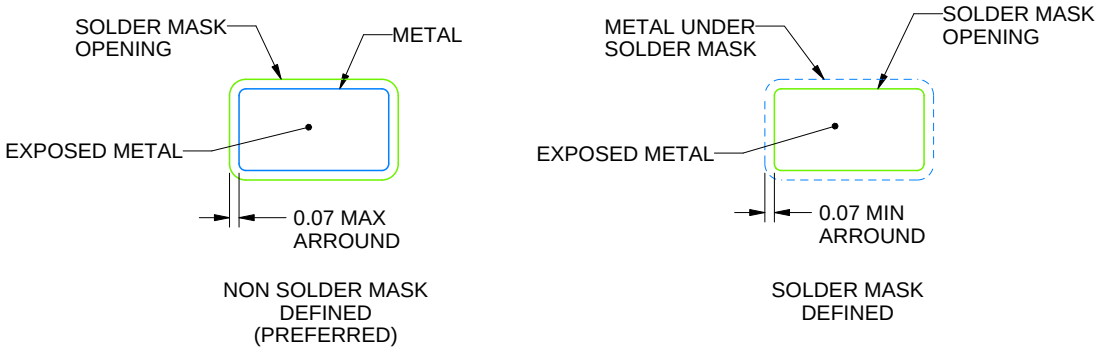
NOTES:

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. Refernce JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X



SOLDER MASK DETAILS

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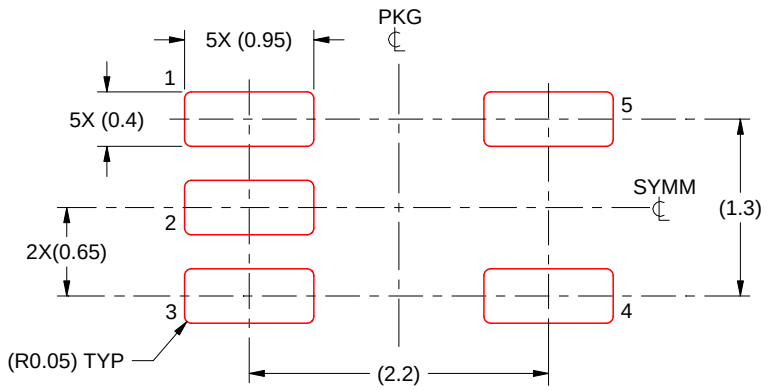
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:18X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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