LM8364 Micropower Undervoltage Sensing Circuits

Check for Samples: LM8364

FEATURES

- **Extremely Low Quiescent Current: 0.65µA, at V_{IN} = 2.87V**
- **High Accuracy Threshold Voltage (±2.5%)**
- **Open Drain Output**
- **Input Voltage Range: 1V to 6V**
- **Surface Mount Package (5-Pin SOT-23)**
- **Pin for Pin Compatible with MC33464**

APPLICATIONS

- **Low Battery Detection**
- **Microprocessor Reset Controller**
- **Power Fail Indicator**
- **Battery Backup Detection**

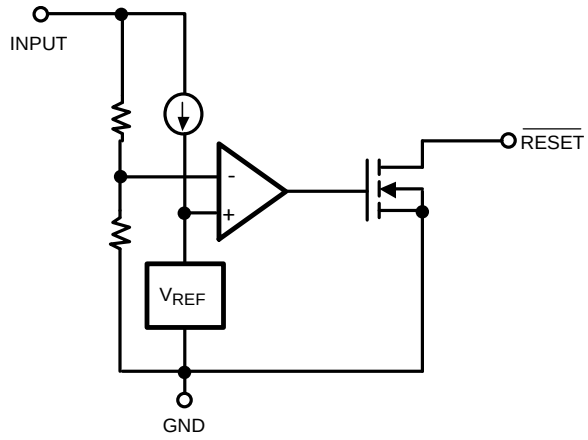
DESCRIPTION

The LM8364 series are micropower undervoltage sensing circuits that are ideal for use in battery powered microprocessor based systems, where extended battery life is a key requirement.

A range of threshold voltages from 2.0V to 4.5V are available with an active low open drain output. These devices feature a very low quiescent current of 0.65µA typical. The LM8364 series features a highly accurate voltage reference, a comparator with precise thresholds and built-in hysterisis to prevent erratic reset operation, and ensured Reset operation down to 1.0V with extremely low standby current.

These devices are available in the space saving SOT-23 5-pin surface mount package. For other undervoltage thresholds and output options, please contact Texas Instruments.

Functional Block Diagram



Connection Diagram

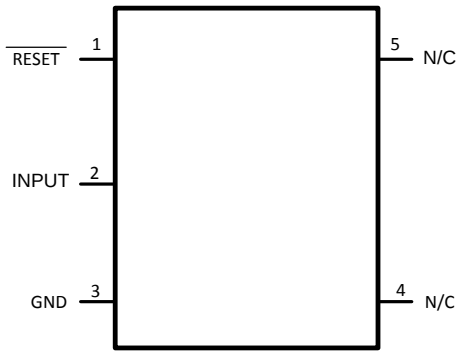


Figure 1. 5-Pin SOT-23
Top View

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.

Absolute Maximum Ratings(1)(2)

Supply Voltage		−0.3V to 6.5V
$\overline{\text{RESET}}$ Output Voltage		−0.3V to 6.5V
$\overline{\text{RESET}}$ Output Current		70mA
Storage Temperature Range		−65°C to 150°C
Mounting Temp.	Lead Temp (Soldering, 10 sec)	260°C
Junction Temperature		125°

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.

Operating Ratings (1)

Temperature Range	−40°C to 85°C
Thermal Resistance to ambient (θ_{JA})	265°C/W
ESD Tolerance	
Human Body Model	2000V
Machine Model	200V

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.

Electrical Characteristics

Unless otherwise specified, all limits ensured for T_A = 25°C.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Units
V_{DET-}	Detector Threshold Voltage	High to Low State Output (V_{IN} Decreasing)				V
		20 Suffix	1.950	2.0	2.050	
		27 Suffix	2.633	2.7	2.767	
		30 Suffix	2.925	3.0	3.075	
		32 Suffix	3.120	3.2	3.280	
		45 Suffix	4.388	4.5	4.613	
V_{HYS}	Detector Threshold Hysteresis	V_{IN} Increasing				V
		20 Suffix	0.060	0.100	0.140	
		27 Suffix	0.081	0.135	0.189	
		30 Suffix	0.090	0.150	0.210	
		32 Suffix	0.096	0.160	0.224	
		45 Suffix	0.135	0.225	0.315	
ΔVdet/ΔT	Detector Threshold Voltage Temperature Coefficient			±100		PPM/°C
V_{OL}	$\overline{\text{RESET}}$ Output Voltage Low State	(Open Drain Output: I_{SINK} = 1mA)		0.25	0.5	V
I_{OL}	$\overline{\text{RESET}}$ Output Sink Current	V_{IN} = 1.5V, V_{OL} = 0.5V	1.0	2.5		mA
V_{IN}	Operating Input Voltage Range		1.0		6.0	V

(1) All limits are ensured by testing or statistical analysis.
(2) Typical values represent the most likely parametric norm

Electrical Characteristics (continued)

Unless otherwise specified, all limits ensured for T_A = 25°C.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Units
I_{IN}	Quiescent Input Current	20 Suffix				µA
		V_{IN} = 1.9V		0.55	0.8	
		V_{IN} = 4.0V		0.70	1.3	
		27 Suffix				
		V_{IN} = 2.6V		0.62	0.9	
		V_{IN} = 4.7V		0.75	1.3	
		30 Suffix				
		V_{IN} = 2.87V		0.65	0.9	
		V_{IN} = 5.0V		0.77	1.3	
		32 Suffix				
		V_{IN} = 3.08V		0.66	0.9	
		V_{IN} = 5.20V		0.79	1.3	
		45 Suffix				
		V_{IN} = 4.34V		0.70	1.0	
		V_{IN} = 6.0		0.85	1.4	
t_p	Propagation Delay Time Figure 7			60	300	µs

Typical Performance Characteristics

Input Current vs. Input Voltage
LM8364BALMF45

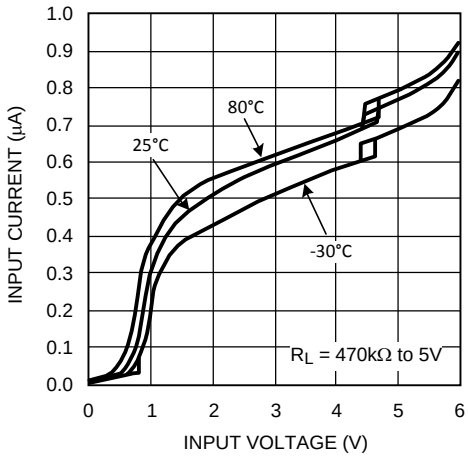


Figure 2.

$\overline{\text{Reset}}$ Output Voltage vs. Input Voltage
LM8364BALMF45

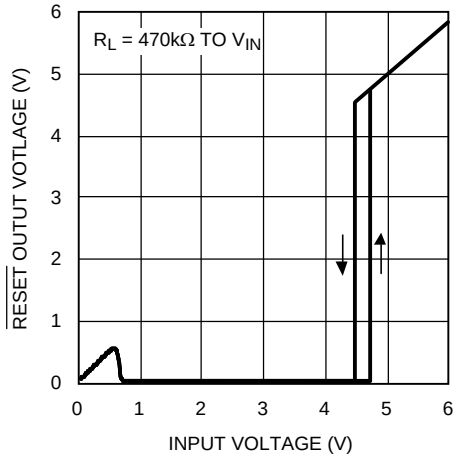


Figure 3.

$\overline{\text{Reset}}$ Output Sink Current vs. Input Voltage
LM8364BALMF45

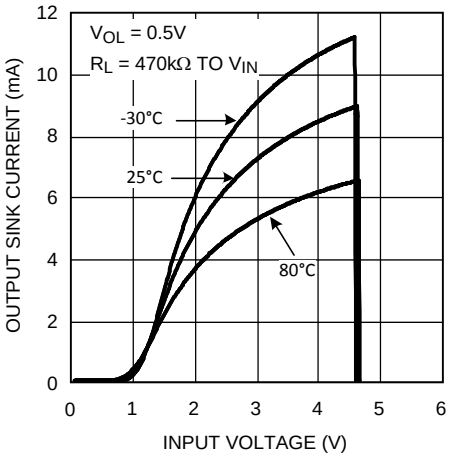


Figure 4.

$\overline{\text{Reset}}$ Output Sink Current vs. Output Voltage
LM8364BALMF45

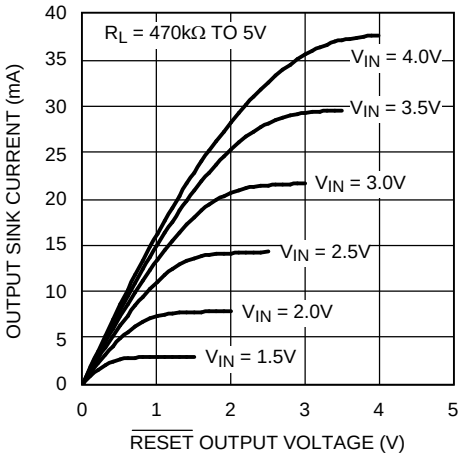


Figure 5.

Detector Threshold Voltage vs. Temperature
LM8364BALMF45

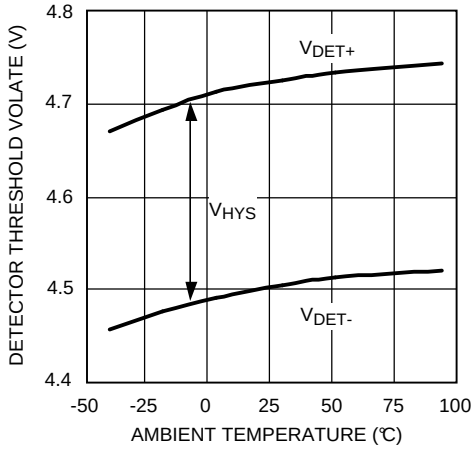


Figure 6.

APPLICATION NOTES

The propagation delay time for the LM8364 is measured using a 470kΩ pull-up resistor connected to from the RESET output pin to 5V in addition to a 10pF capacitive load connected from the same pin to GND. Figure 7 shows the timing diagram for the measurement for the propagation delay. V_{DET+} is equal to the sum of the detector threshold, V_{DET-}, and the built in hysteresis, V_{HYS}.

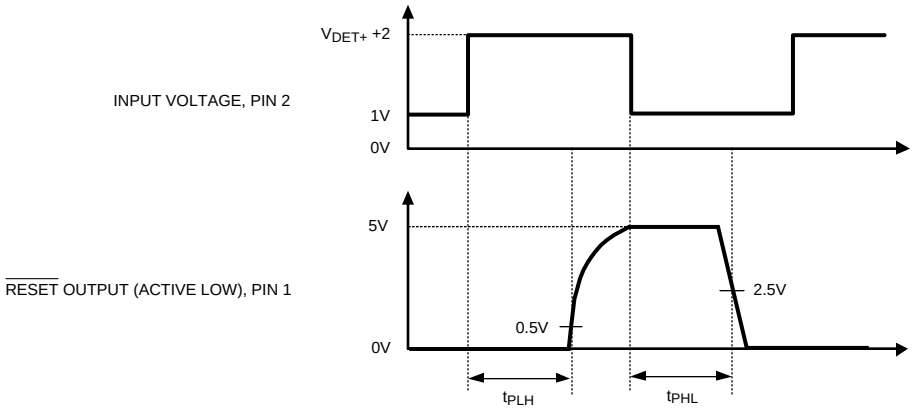


Figure 7. Propagation Delay Timing Diagrams

The LM8364 ultra-low current voltage detector was designed to monitor voltages and to provide an indication when the monitored voltage, V_{IN}, dropped below a precisely trimmed threshold voltage. This characteristic is displayed in the typical operating timing diagram below. V_{IN} is the voltage that is being monitored and a pull up resistor is connected from the RESET output pin to V_{IN}. V_{IN} is at some value above V_{DET+} and then begins to decrease. Since this is an Active Low device the RESET output is pulled High through the pull-up resistor and tracks V_{IN} until V_{IN} crosses the trimmed threshold V_{DET-}. At this point the LM8364 recognizes that V_{IN} is now in a fault condition and the output immediately changes to the Logic Low State. The RESET output will remain in this low state until V_{IN} increases above the threshold $V_{DET-} + V_{HYS}$. This point is also known as V_{DET+} as indicated earlier. This built-in hysteresis has been added to the design to help prevent erratic reset operation when the input voltage crosses the threshold.

The LM8364 has a wide variety of applications that can take advantage of its precision and low current consumption to monitor Input voltages even though it was designed as a reset controller in portable microprocessor based systems. It is a very cost effective and space saving device that will protect your more expensive investments of microprocessors and other devices that need a specified supply voltage for proper operation.

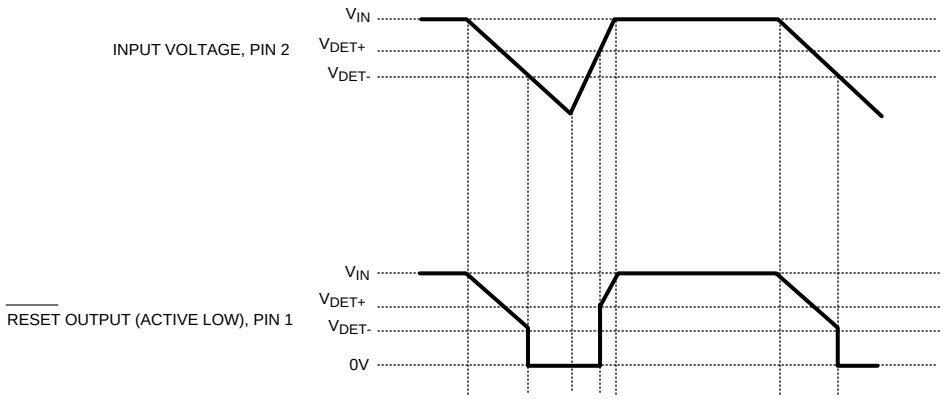


Figure 8. Timing Waveforms

Typical Applications

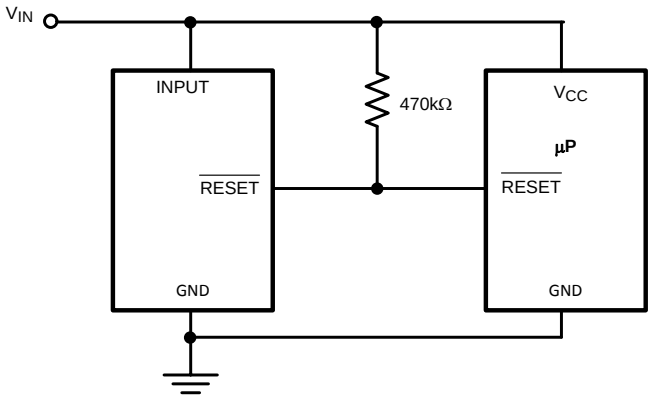


Figure 9. Microprocessor Reset Circuit

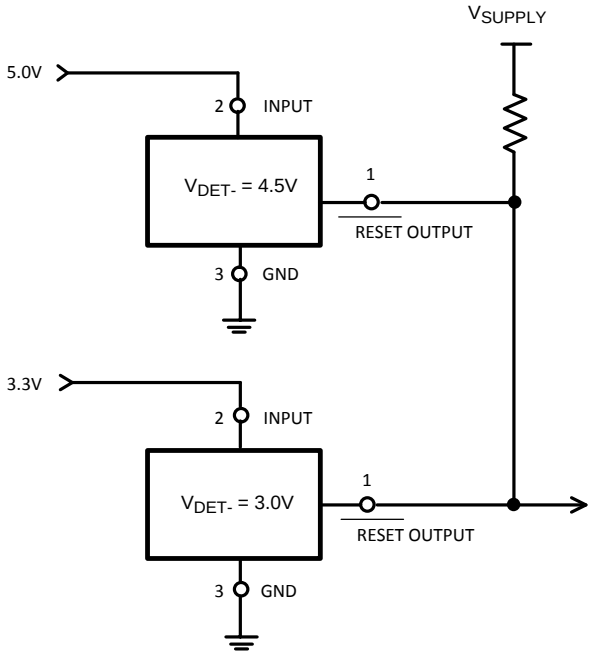
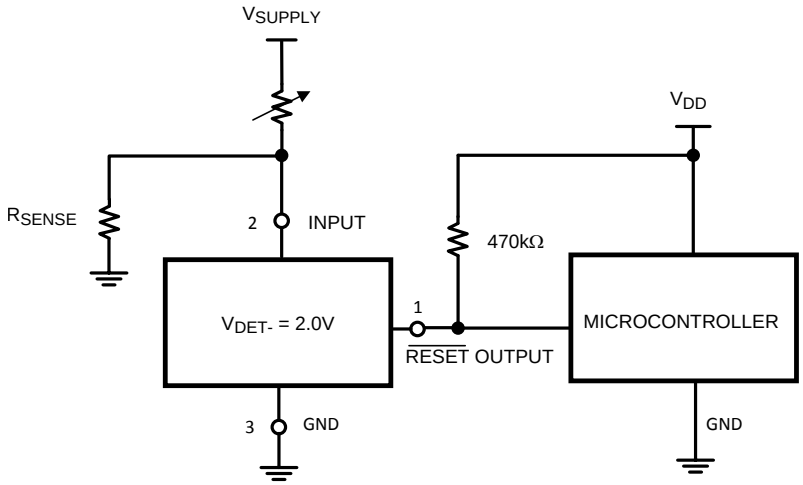


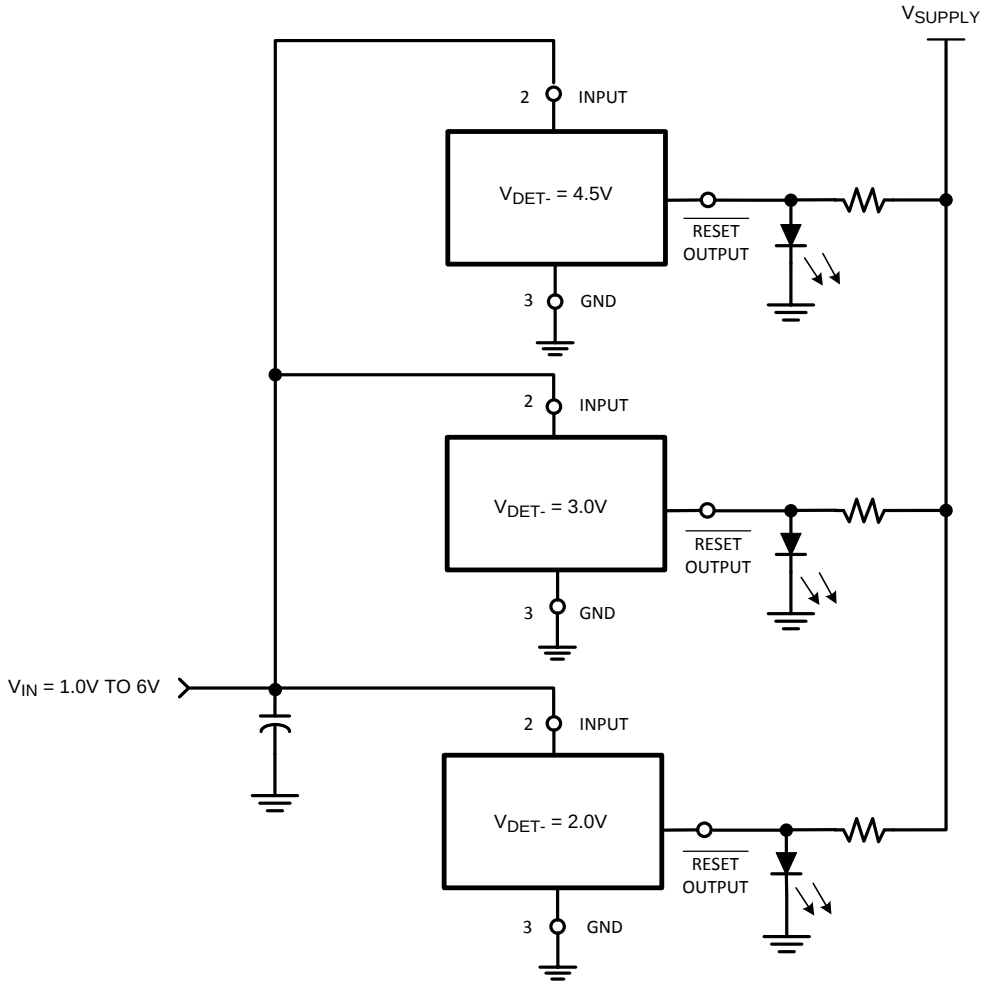
Figure 10. Dual Power Supply Undervoltage Supervision



THIS CIRCUIT MONITORS THE CURRENT AT THE LOAD. AS CURRENT FLOW THROUGH THE LOAD, A VOLTAGE DROP WITH RESPECT TO GROUND APPEARS ACROSS R_{SENSE} WHERE $V_{SENSE} = I_{LOAD} * R_{SENSE}$. THE FOLLOWING CONDITIONS APPLY:

IF:	THEN:
$I_{LOAD} < V_{DET-} / R_{SENSE}$	$\overline{\text{RESET}}$ OUTPUT = 0V
$I_{LOAD} \geq (V_{DET-} + V_{HYS}) / R_{SENSE}$	$\overline{\text{RESET}}$ OUTPUT = V_{DD}

Figure 11. Microcontroller System Load Sensing



EACH LED WILL SEQUENTIALLY TURN ON WHEN THE RESPECTIVE VOLTAGE DETECTOR THRESHOLD (V_{DET-} +V_{HYS}) IS EXCEEDED.

Figure 12. LED Bar Graph Voltage Monitor

REVISION HISTORY

Changes from Revision A (April 2013) to Revision B	Page
• Changed layout of National Data Sheet to TI format	7

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)
LM8364BALMF20/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	F01A
LM8364BALMF20/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	F01A
LM8364BALMFX20/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	Call TI	Level-1-260C-UNLIM	-40 to 85	F01A
LM8364BALMFX20/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	Call TI | Sn	Level-1-260C-UNLIM	-40 to 85	F01A

(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.

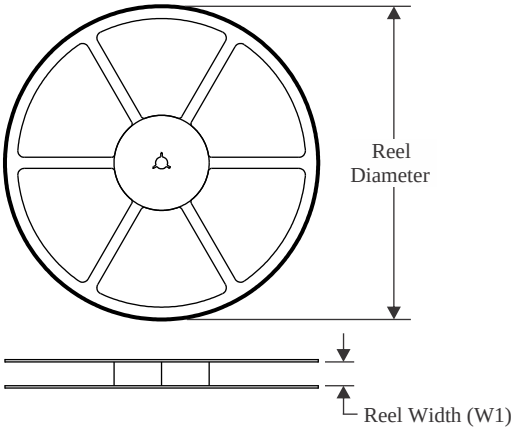
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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.

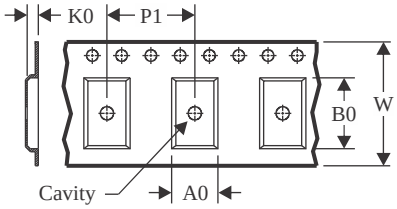
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

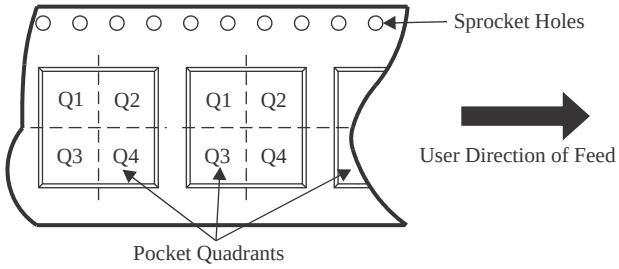


TAPE DIMENSIONS



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

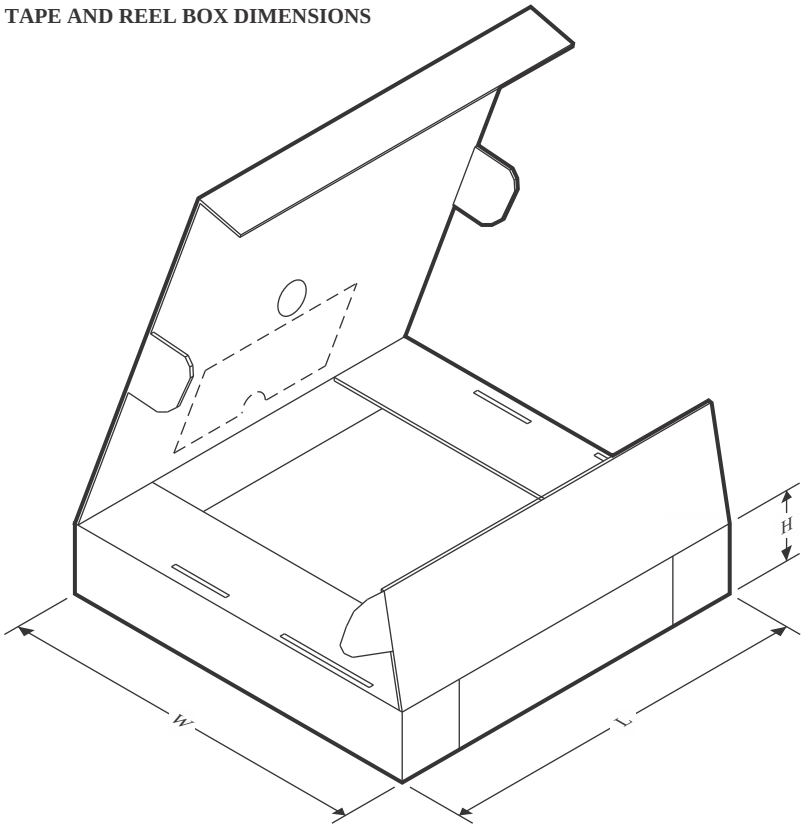
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM8364BALMF20/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM8364BALMFX20/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

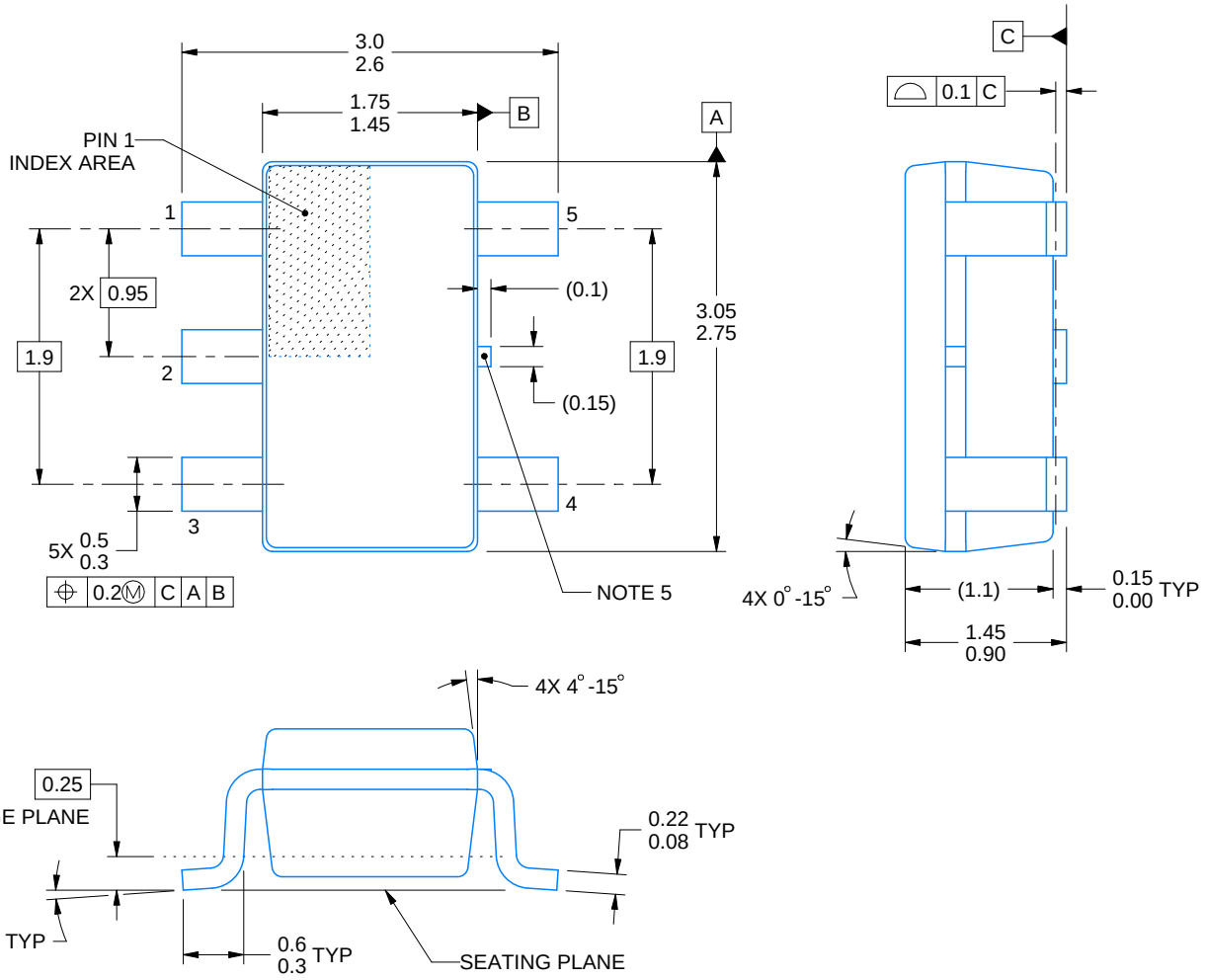
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM8364BALMF20/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM8364BALMFX20/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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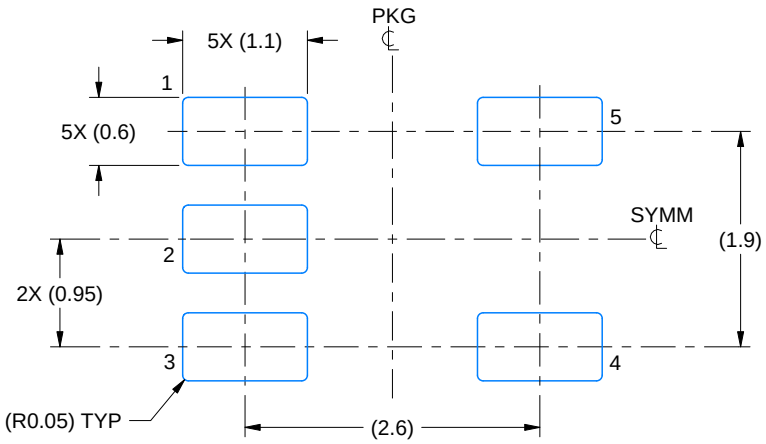
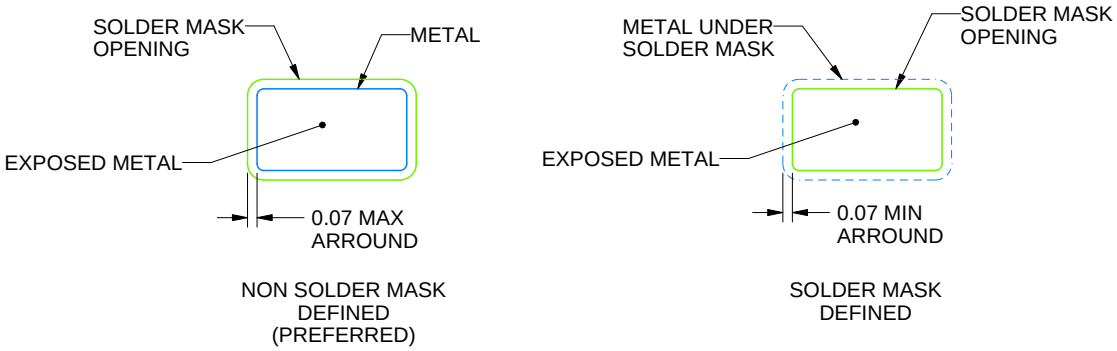
NOTES:

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-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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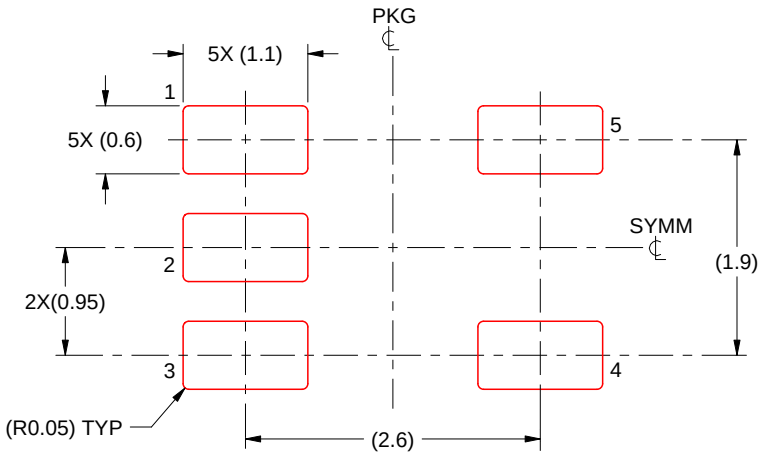
NOTES: (continued)

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 mm THICK STENCIL
SCALE:15X

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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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