March 2003

National Semiconductor

LM8364
Micropower Undervoltage Sensing Circuits

General 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 guaranteed Reset operation down to 1.0V with extremely low standby current.

These devices are available in the space saving SOT23 5-pin surface mount package. For other undervoltage thresholds and output options, please contact National Semiconductor.

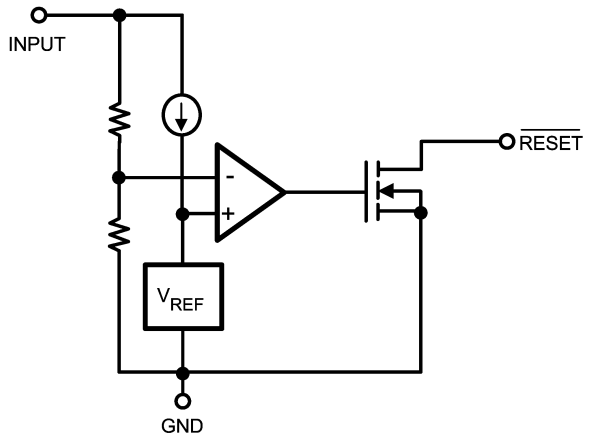
Features

- 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 SOT23)
- Pin for pin compatible with MC33464

Applications

- Low Battery Detection
- Microprocessor reset Controller
- Power Fail Indicator
- Battery Backup Detection

Functional Block Diagram



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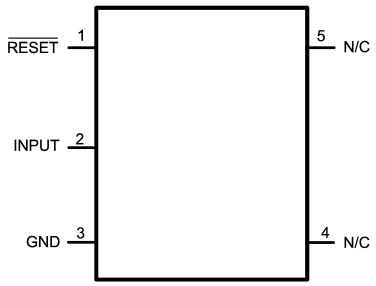
Connection Diagram

5-Pin SOT23



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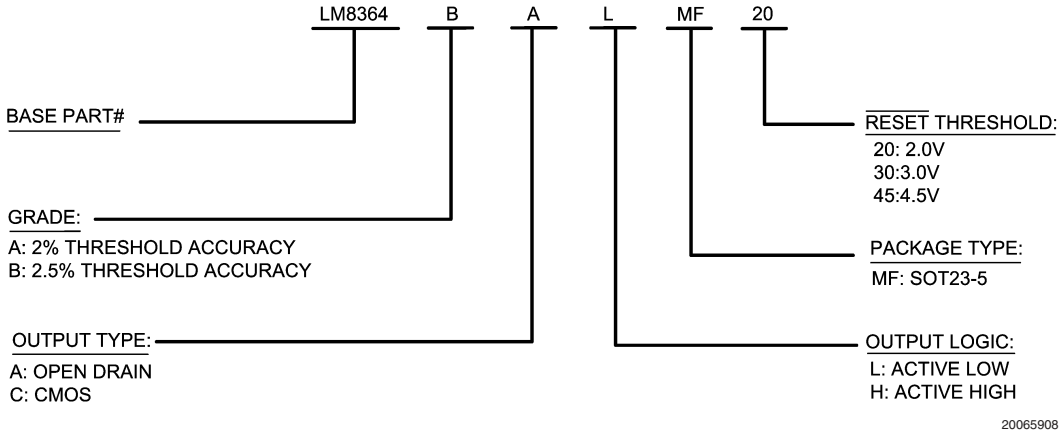
Top View

Pin Description



Ordering Information

Package	Part Number	Package Marking	Threshold	Output Type	Transport Media	NSC Drawing
5-Pin SOT23	LM8364BALMF20	F01A	2.0V	Open Drain, Active Low	1k Units Tape and Reel	MF05A
	LM8364BALMFX20				3k Units Tape and Reel	
	LM8364BALMF30	F05A	3.0V	Open Drain, Active Low	1k Units Tape and Reel	
	LM8364BALMFX30				3k Units Tape and Reel	
	LM8364BALMF45	F04A	4.5V	Open Drain, Active Low	1k Units Tape and Reel	
	LM8364BALMFX45				3k Units Tape and Reel	

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

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˚

Operating Ratings (Note 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

Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_A = 25˚C.

Symbol	Parameter	Conditions	Min (Note 3)	Typ (Note 2)	Max (Note 3)	Units
V_{DET-}	Detector Threshold Voltage	High to Low State Output (V_{IN} Decreasing)				
		20 Suffix	1.950	2.0	2.050	V
		30 Suffix	2.925	3.0	3.075	
		45 Suffix	4.388	4.5	4.613	
V_{HYS}	Detector Threshold Hysteresis	V_{IN} Increasing				
		20 Suffix	0.060	0.100	0.140	V
		30 Suffix	0.090	0.150	0.210	
		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
I_{IN}	Quiescent Input Current	20 Suffix				
		V_{IN} = 1.9V		0.55	0.8	
		V_{IN} = 4.0V		0.70	1.3	
		30 Suffix				
		V_{IN} = 2.87V		0.65	0.9	µA
		V_{IN} = 5.0V		0.77	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 1*			60	300	µs

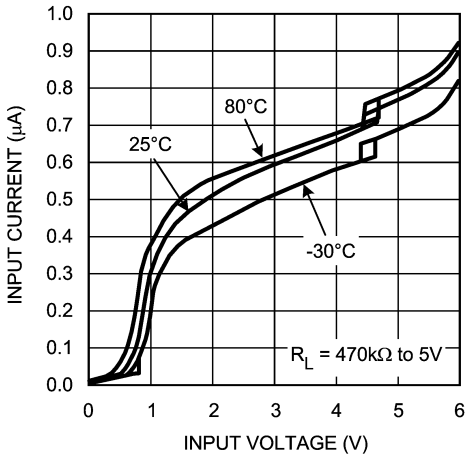
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical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

Note 2: Typical values represent the most likely parametric norm

Note 3: All limits are guaranteed by testing or statistical analysis.

Typical Performance Characteristics

Input Current vs. Input Voltage
LM8364BALMF45



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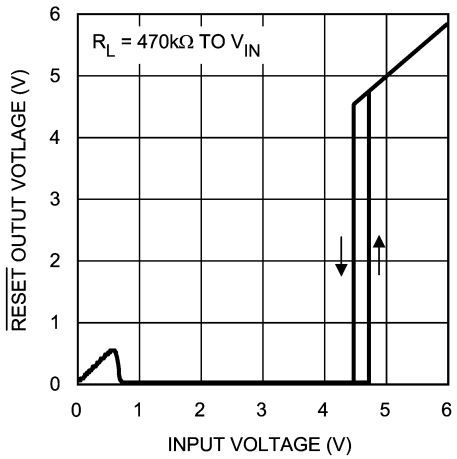
$\overline{\text{Reset}}$ Output Voltage vs. Input Voltage
LM8364BALMF45



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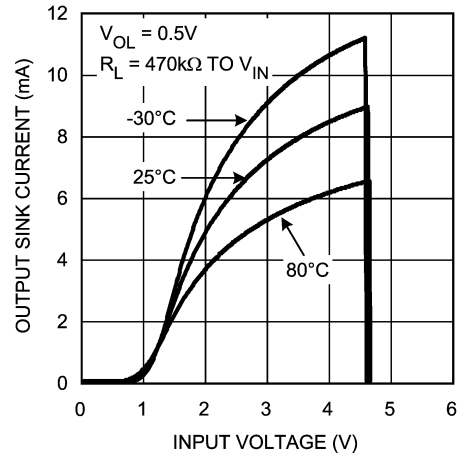
$\overline{\text{Reset}}$ Output Sink Current vs. Input Voltage
LM8364BALMF45



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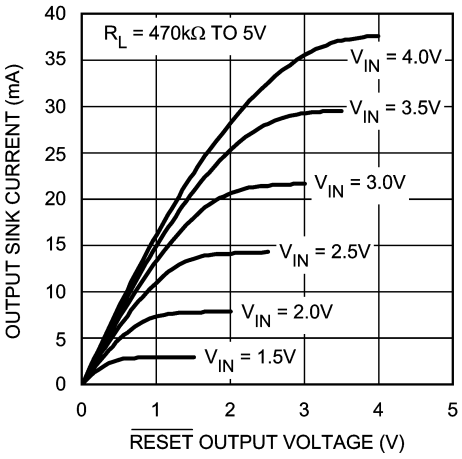
$\overline{\text{Reset}}$ Output Sink Current vs. Output Voltage
LM8364BALMF45



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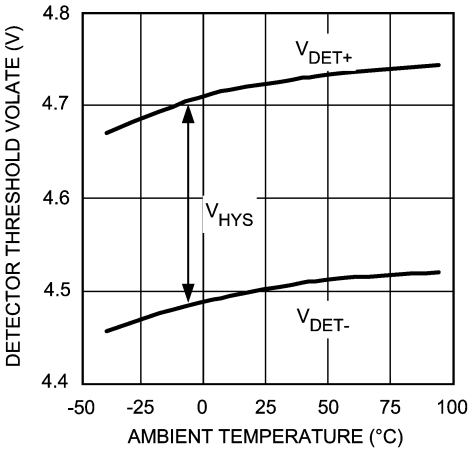
Detector Threshold Voltage vs. Temperature
LM8364BALMF45



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Application Notes

The propagation delay time for the LM8364 is measured using a 470kΩ pull-up resistor connected to from the $\overline{\text{RESET}}$ output pin to 5V in addition to a 10pF capacitive load connected from the same pin to GND. *Figure 1* 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}.

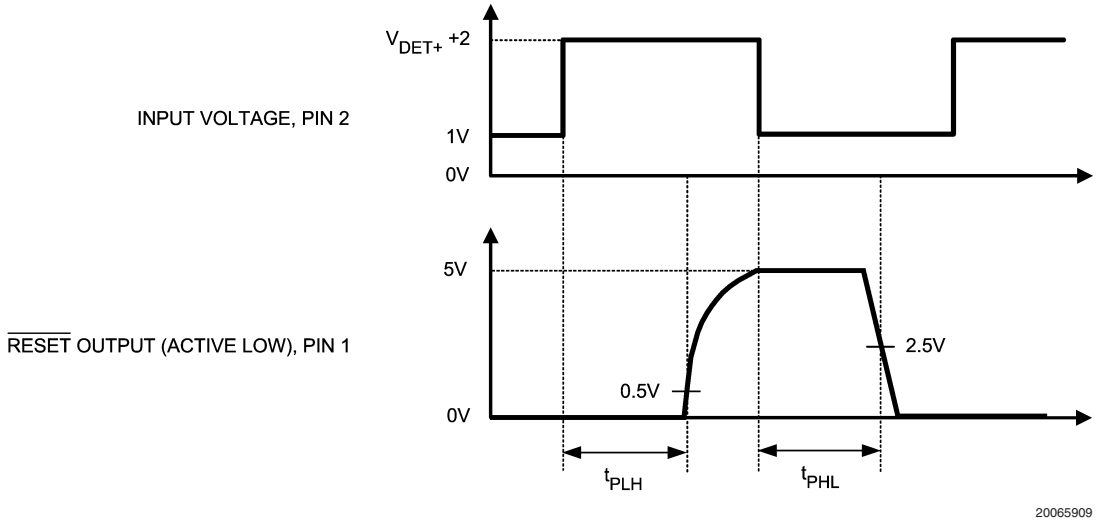


FIGURE 1. Propagation Delay Timing Diagrams

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 $\overline{\text{RESET}}$ 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 $\overline{\text{RESET}}$ 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 $\overline{\text{RESET}}$ 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 guaranteed supply voltage for proper operation.

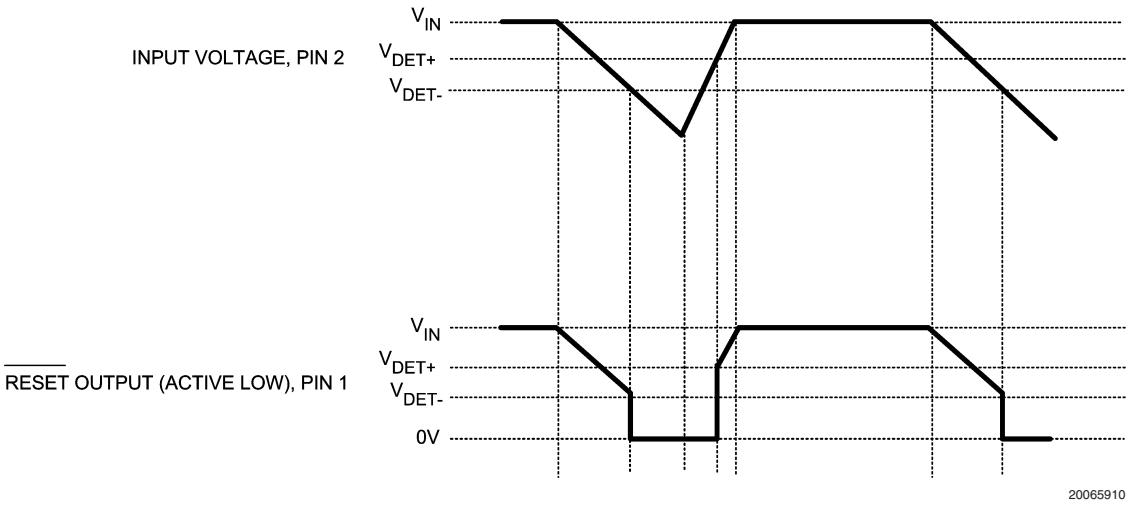
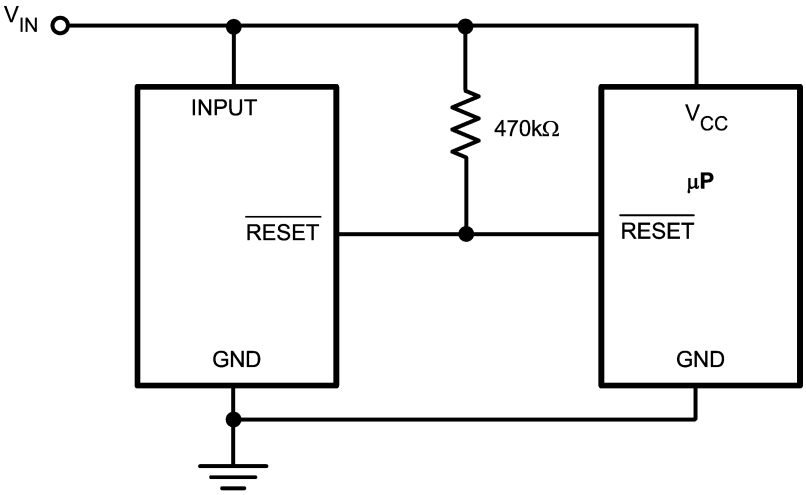


FIGURE 2. Timing Waveforms

Typical Applications



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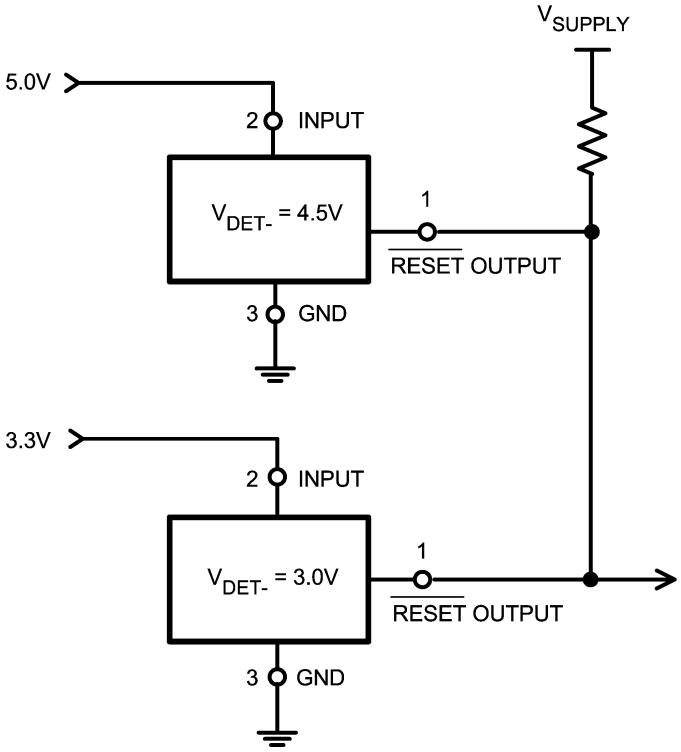
Microprocessor Reset Circuit



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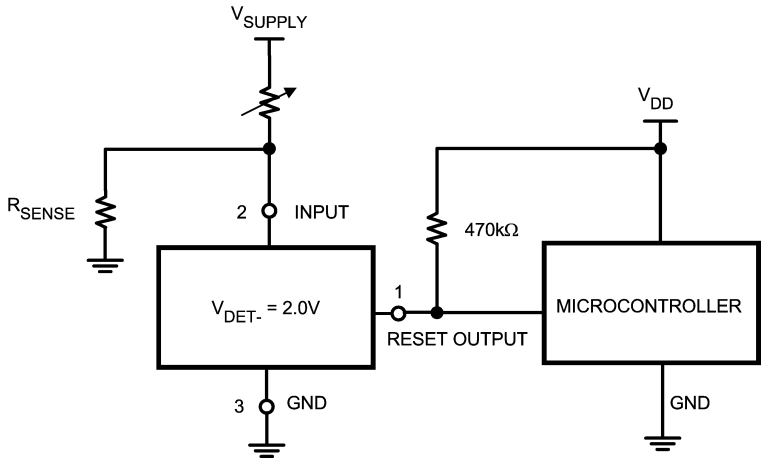
Dual Power Supply Undervoltage Supervision

Typical Applications (Continued)



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}

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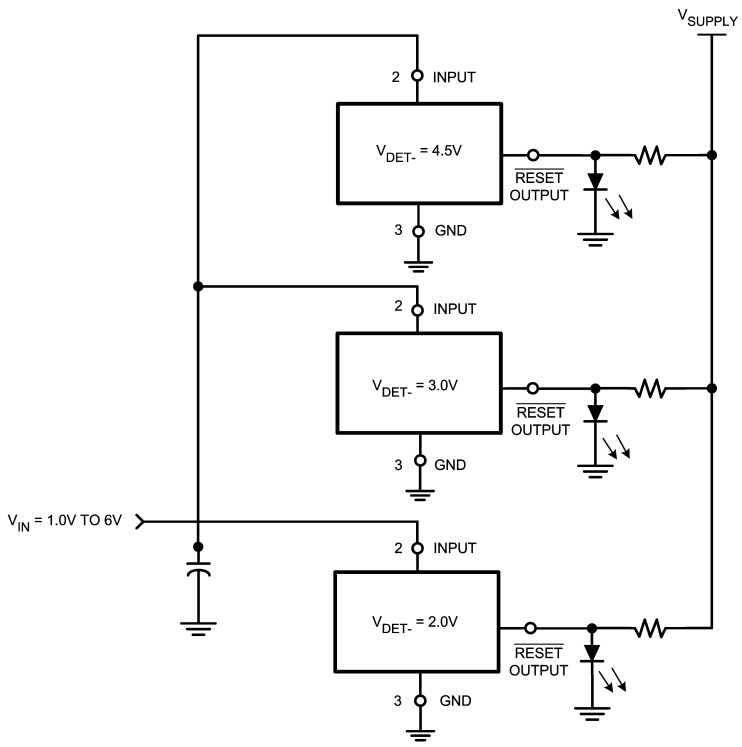
Microcontroller System Load Sensing



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

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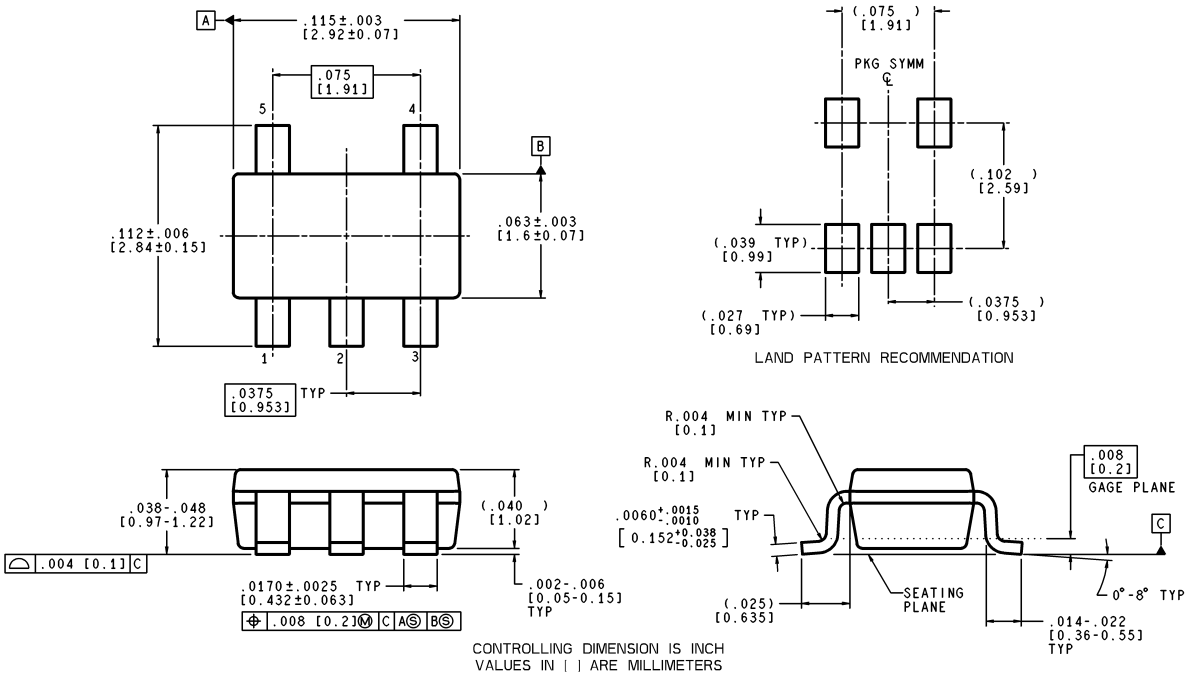
LED Bar Graph Voltage Monitor

Physical Dimensions inches (millimeters)

unless otherwise noted



MF05A (Rev A)

5-Pin SOT23
NSC Package Number MF05A

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