

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 hysteresis 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.

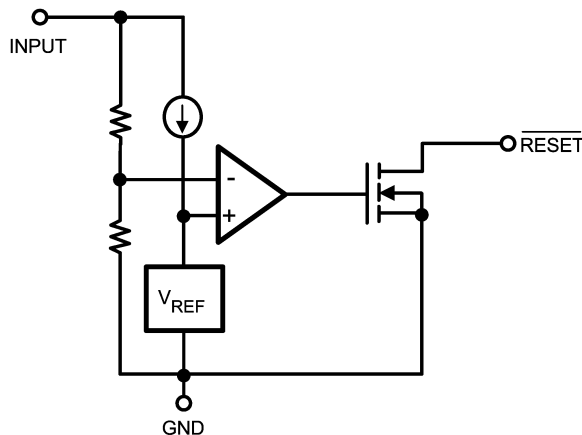
Features

- Extremely Low Quiescent Current: 0.65µA, at $V_{IN} = 2.87V$
- High Accuracy Threshold Voltage ($\pm 2.5\%$)
- Open Drain Output
- Input Voltage Range: 1V to 6V
- Surface Mount Package (5-Pin SOT23)
- Pin for pin compatible with MC33464

Applications

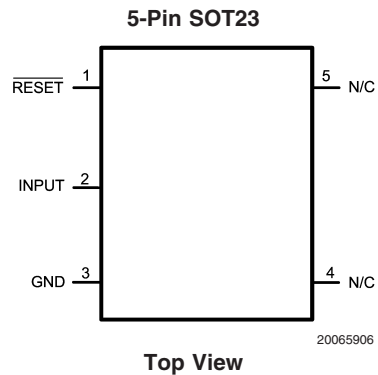
- Low Battery Detection
- Microprocessor reset Controller
- Power Fail Indicator
- Battery Backup Detection

Functional Block Diagram



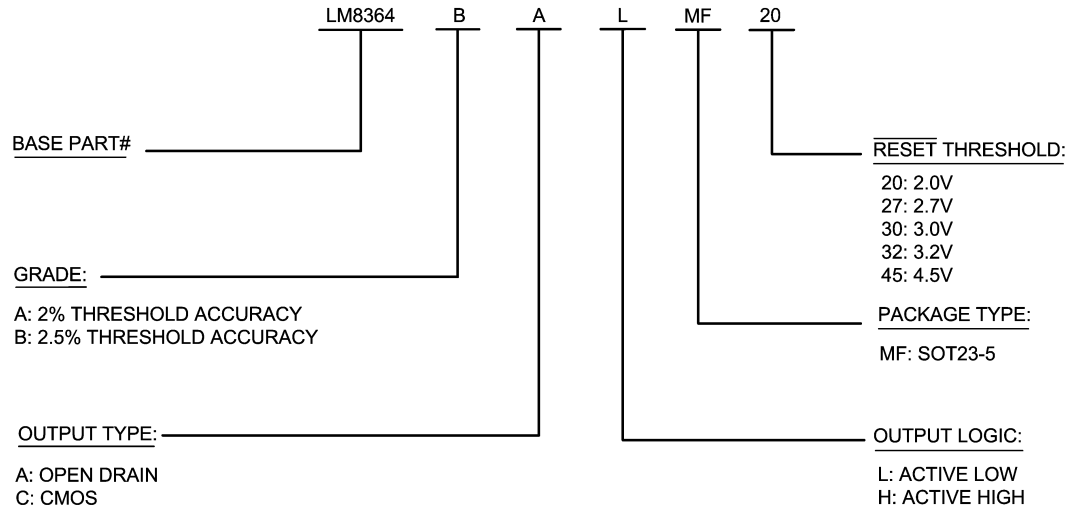
20065907

Connection Diagram



20065906

Pin Description



20065908

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	
	LM8364BALMF27	F15A	2.7V	Open Drain, Active Low	1k Units Tape and Reel	
	LM8364BALMFX27				3k Units Tape and Reel	
	LM8364BALMF30	F05A	3.0V	Open Drain, Active Low	1k Units Tape and Reel	
	LM8364BALMFX30				3k Units Tape and Reel	
	LM8364BALMF32	F16A	3.2V	Open Drain, Active Low	1k Units Tape and Reel	
	LM8364BALMFX32				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 $T_A = 25^\circ\text{C}$.

Symbol	Parameter	Conditions	Min (Note 3)	Typ (Note 2)	Max (Note 3)	Units
$V_{\text{DET-}}$	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	
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	
$\Delta V_{\text{det}}/\Delta T$	Detector Threshold Voltage Temperature Coefficient			± 100		PPM/°C
V_{OL}	$\overline{\text{RESET}}$ Output Voltage Low State	(Open Drain Output: $I_{\text{SINK}} = 1\text{mA}$)		0.25	0.5	V
I_{OL}	$\overline{\text{RESET}}$ Output Sink Current	$V_{\text{IN}} = 1.5\text{V}$, $V_{\text{OL}} = 0.5\text{V}$	1.0	2.5		mA
V_{IN}	Operating Input Voltage Range		1.0		6.0	V
I_{IN}	Quiescent Input Current	20 Suffix				μA
		$V_{\text{IN}} = 1.9\text{V}$		0.55	0.8	
		$V_{\text{IN}} = 4.0\text{V}$		0.70	1.3	
		27 Suffix				
		$V_{\text{IN}} = 2.6\text{V}$		0.62	0.9	
		$V_{\text{IN}} = 4.7\text{V}$		0.75	1.3	
		30 Suffix				
		$V_{\text{IN}} = 2.87\text{V}$		0.65	0.9	
		$V_{\text{IN}} = 5.0\text{V}$		0.77	1.3	
		32 Suffix				
		$V_{\text{IN}} = 3.08\text{V}$		0.66	0.9	
		$V_{\text{IN}} = 5.20\text{V}$		0.79	1.3	
45 Suffix						
	$V_{\text{IN}} = 4.34\text{V}$		0.70	1.0		
	$V_{\text{IN}} = 6.0$		0.85	1.4		
t_p	Propagation Delay Time <i>Figure 1</i>			60	300	μs

Electrical Characteristics (Continued)

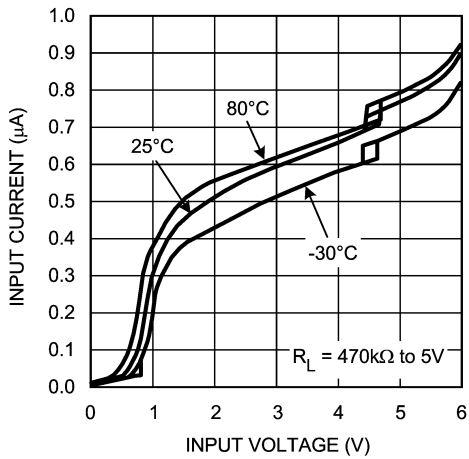
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical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

Note 2: Typical values represent the most likely parametric norm

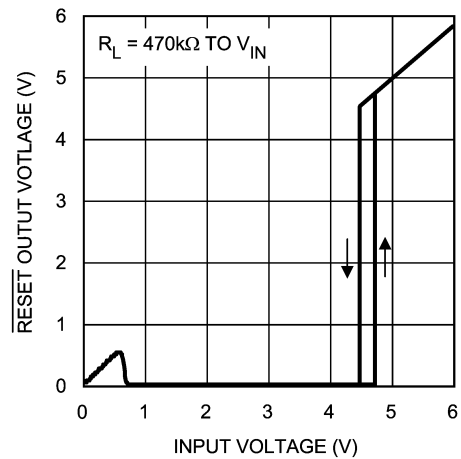
Note 3: All limits are guaranteed by testing or statistical analysis.

Typical Performance Characteristics

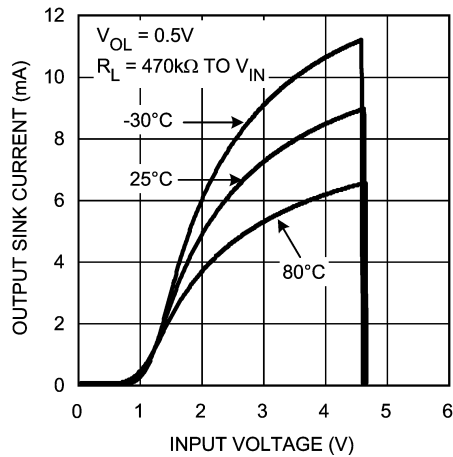
Input Current vs. Input Voltage
LM8364BALMF45



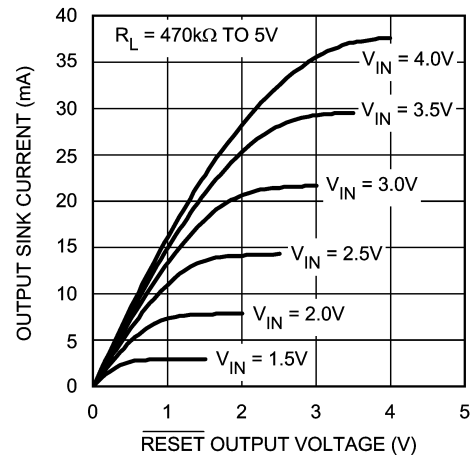
Reset Output Voltage vs. Input Voltage
LM8364BALMF45



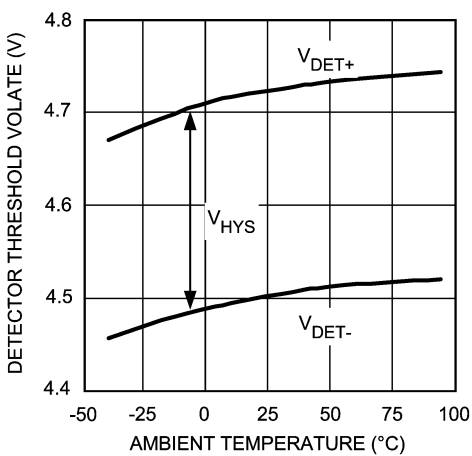
Reset Output Sink Current vs. Input Voltage
LM8364BALMF45



Reset Output Sink Current vs. Output Voltage
LM8364BALMF45



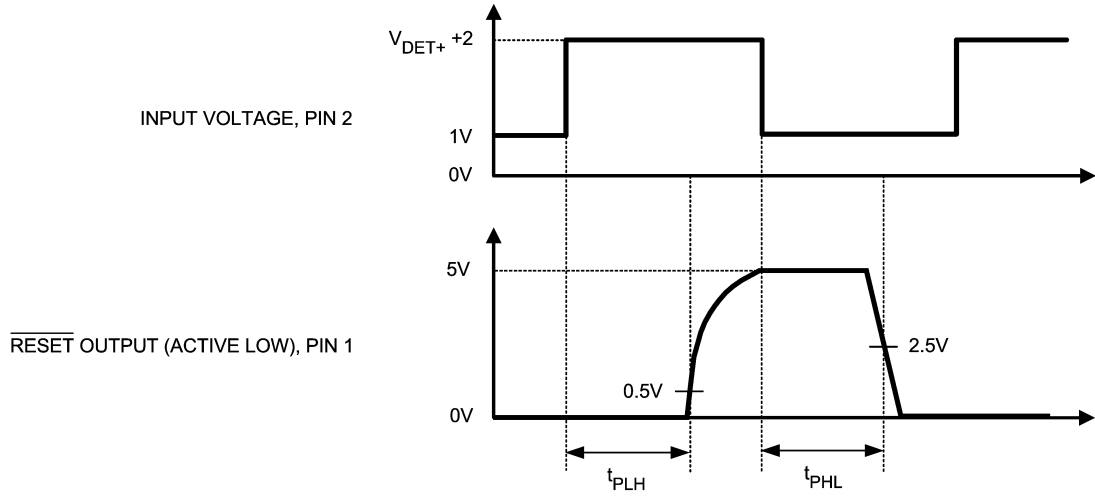
Detector Threshold Voltage vs. Temperature
LM8364BALMF45



Application Notes

The propagation delay time for the LM8364 is measured using a 470kΩ pull-up resistor connected from the RESET output pin to 5V in addition to a 10pF capacitive load con-

nected 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} .



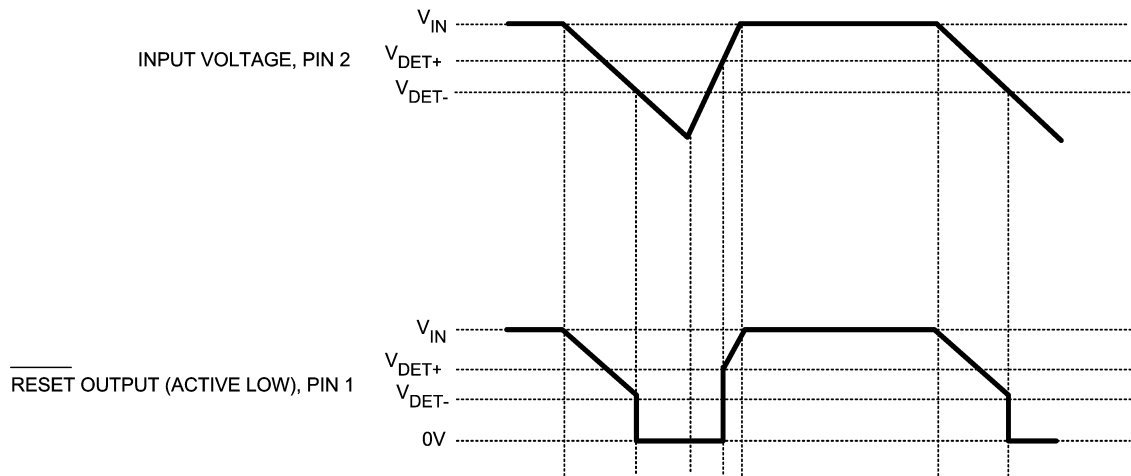
20065909

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 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.

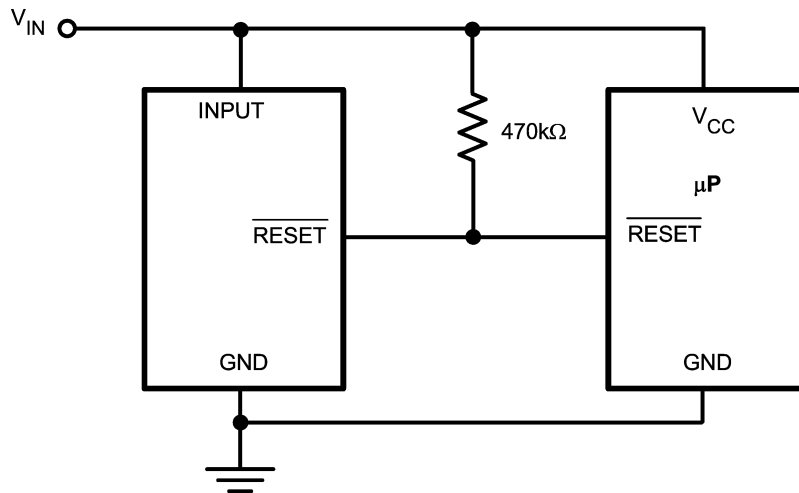
The LM8364 has a wide variety of applications that can take advantage of its precision and low current consumption to monitor Input voltages even though it was designed as a reset controller in portable microprocessor based systems. It is a very cost effective and space saving device that will protect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



20065910

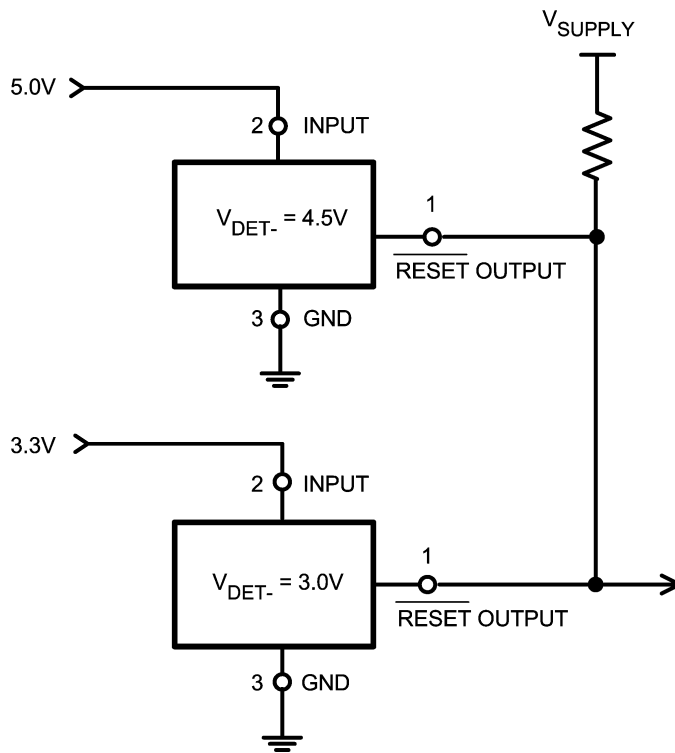
FIGURE 2. Timing Waveforms

Typical Applications



Microprocessor Reset Circuit

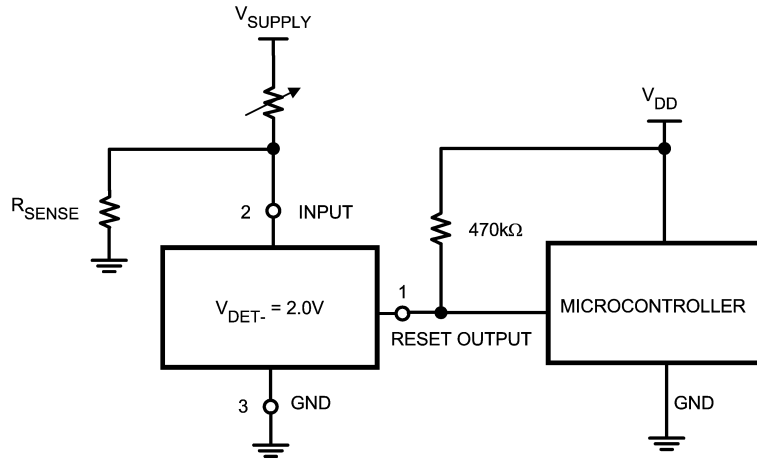
20065911



Dual Power Supply Undervoltage Supervision

20065912

Typical Applications (Continued)

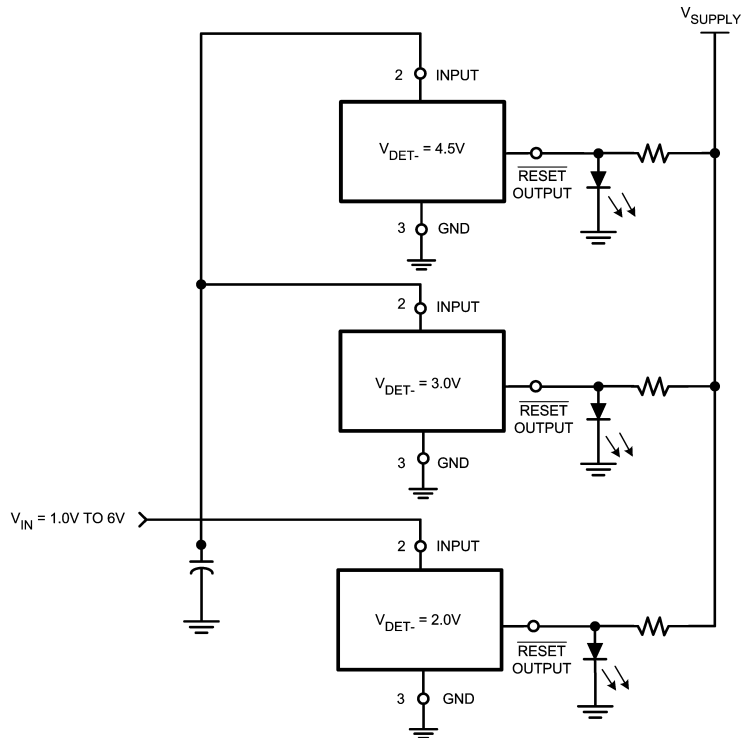


THIS CIRCUIT MONITORS THE CURRENT AT THE LOAD. AS CURRENT FLOW THROUGH THE LOAD, A VOLTAGE DROP WITH RESPECT TO GROUND APPEARS ACROSS R_{SENSE} WHERE $V_{SENSE} = I_{LOAD} * R_{SENSE}$. THE FOLLOWING CONDITIONS APPLY:

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

20065913

Microcontroller System Load Sensing



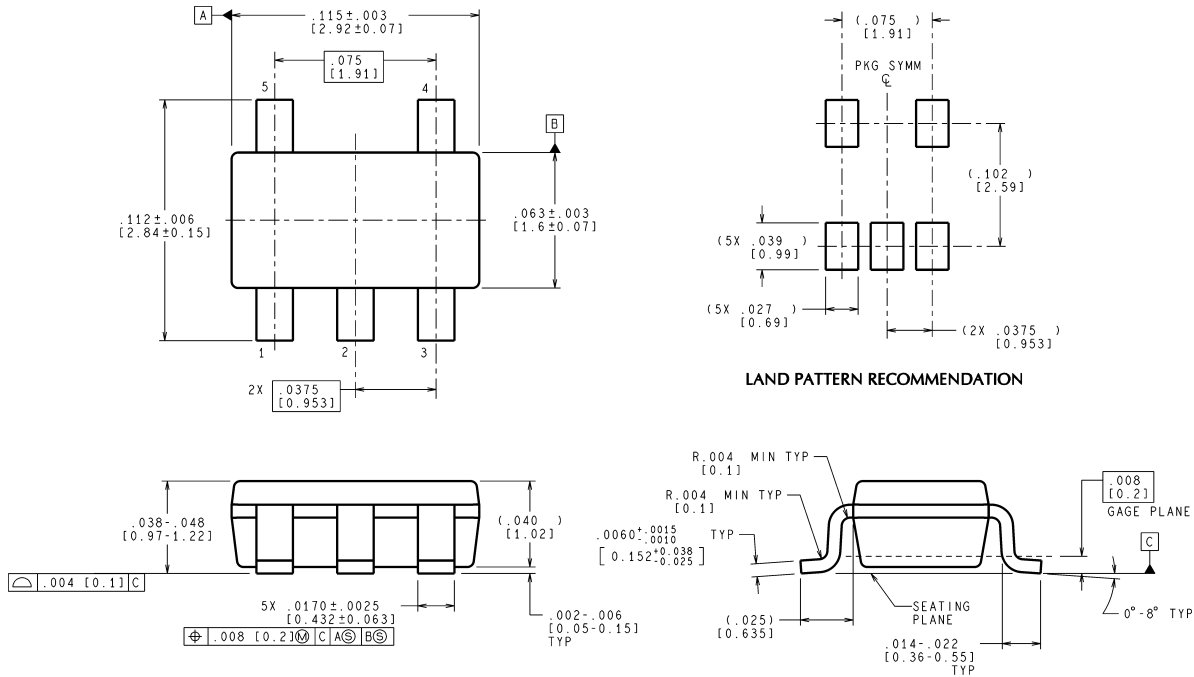
EACH LED WILL SEQUENTIALLY TURN ON WHEN THE RESPECTIVE VOLTAGE DETECTOR THRESHOLD ($V_{DET.} + V_{HYS}$) IS EXCEEDED.

20065914

LED Bar Graph Voltage Monitor

Physical Dimensions inches (millimeters)

unless otherwise noted



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

5-Pin SOT23
NSC Package Number MF05A

MF05A (Rev B)

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560

www.national.com