the trip threshold voltage.



4-Pin Micropower Voltage Monitors

Features

- ♦ ±1.25% Precision Voltage Threshold
 - ♦ SOT143 Package
 - Low Cost

TOP VIEW

GND

V_{CC}

2

- ♦ < 5µA Typical Supply Current</p>
- Open-Drain Output (MAX836) Push-Pull Output (MAX837)

Applications

General Description

The MAX836/MAX837 micropower voltage monitors

contain a 1.204V precision bandgap reference and a

comparator in a SOT143 package. The MAX836 has an open-drain, n-channel output driver, while the MAX837

has a push-pull output driver. Two external resistors set

Precision Battery Monitor Load Switching Battery-Powered Systems Threshold Detectors

TEMD	PIN-	ТОР

Ordering Information

PART*	TEMP RANGE	PIN- PACKAGE	TOP MARK
MAX836EUS-T	-40°C to +85°C	4 SOT143-4	EQAA
MAX837EUS-T	-40°C to +85°C	4 SOT143-4	ERAA
MAX837EUS-I	-40°C to +85°C	4 SOT143-4	ERA

*All devices available in tape-and-reel only. Contact factory for availability.

Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

Typical Operating Circuit



M/IXI/M

_ Maxim Integrated Products 1

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.



OUT

IN

4

3

MAXIM

MAX836

MAX837

SOT143

ABSOLUTE MAXIMUM RATINGS

V _{CC} , OUT to GND (MAX836)0.3V to 12V IN, OUT to GND (MAX837)0.3V to (V _{CC} + 0.3V)	Rate of Rise, V _{CC} 100V/µs Continuous Power Dissipation
Input Current	4-Pin SOT143 (derate 4mW/°C above +70°C)
V _{CC}	Operating Temperature Range40°C to +85°C
IN10mA	Storage Temperature Range65°C to +150°C
Output Current, OUT20mA	Lead Temperature (soldering, 10s)+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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +2.5V to +11.0V, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^{\circ}$ C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	ТҮР	MAX	UNITS	
Operating Voltage Range (Note 1)	Vcc				2.5		11.0	V
Supply Current (Nate 2)	Icc	V _{IN} = 1.16V, OUT = low	V _{CC} = 3.6V	TA = +25°C		3.5	6.5	μΑ
				$T_A = T_{MIN}$ to T_{MAX}			10	
			$V_{CC} = $ full operati	ng range			15	
Supply Current (Note 2)		$V_{IN} = 1.25V,$ OUT = high	$V_{CC} = 3.6V$	$T_A = +25^{\circ}C$		2.0	5.0	
			VCC = 0.0V	$T_A = T_{MIN}$ to T_{MAX}			8.0	
		l c c i i i i i i i i i i i i i i i i i	$V_{CC} = $ full operation	ng range			13	
Trip Threshold Voltage	Vth	VIN falling	$T_A = +25^{\circ}C$		1.185	1.204	1.215	V
The Theshold Voltage			$T_A = -40^{\circ}C \text{ to } +8$	5°C	1.169 1.204 1.2		1.231	
Trip Threshold Voltage Hysteresis	V _{HYST}	$V_{CC} = 5V$, IN = low to high			6		mV	
IN Operating Voltage Range (Note 1)	VIN						V _{CC} - 1	V
IN Leakage Current (Note 3)	I _{IN}	$V_{IN} = V_{TH}$			±3	±12	nA	
Propagation Delay	tpL	V _{CC} = 5.0V, 50mV overdrive			80		μs	
Glitch Immunity		V _{CC} = 5.0V, 100mV overdrive			35		μs	
OUT Rise Time	t _{RT}	V _{CC} = 5.0V, no load (MAX837 only)			260		ns	
OUT Fall Time	tFT	$V_{CC} = 5.0V$, no load (MAX836 pull-up = $10k\Omega$)			680		ns	
Output Leakage Current (Note 4)	ILOUT	V _{IN} > V _{THMAX} (MAX836 only)				±1	μA	
Output-Voltage High	Voh	VIN > VTHMAX, ISOURCE = 500µA (MAX837 only)		Vcc - 0.5	5		V	
Output-Voltage Low	Vol	VIN < VTHMIN, ISINK = 500µA				0.4	V	

Note 1: The voltage-detector output remains in the direct state for V_{CC} down to 1.2V when $V_{IN} \le V_{CC}/2$.

Note 2: Supply current has a monotonic dependence on V_{CC} (see the *Typical Operating Characteristics*).

Note 3: IN leakage current has a monotonic dependence on V_{CC} (see the *Typical Operating Characteristics*).

Note 4: The MAX836 open-drain output can be pulled up to a voltage greater than V_{CC}, but may not exceed 11V.

Typical Operating Characteristics

 $(V_{CC} = +5V, R_{LOAD} = 1M\Omega, R_{PULLUP} = 10k\Omega$ (MAX836 only), $T_A = +25^{\circ}C$, unless otherwise noted.)



MAX836/MAX837

Typical Operating Characteristics (continued)

 $(V_{CC} = +5V, R_{LOAD} = 1M\Omega, R_{PULLUP} = 10k\Omega$ (MAX836 only), $T_A = +25^{\circ}C$, unless otherwise noted.)



Pin Description

PIN NAME		FUNCTION
1	GND	System Ground
2	Vcc	System Supply Input
3	IN	Noninverting Input to the Comparator. The inverting input connects to the internal 1.204V bandgap reference.
4	OUT	Open-Drain (MAX836) or Push-Pull (MAX837) Output



Figure 1. Programming the Trip Voltage, VTRIP



Detailed Description

The MAX836/MAX837 micropower voltage monitors contain a 1.204V precision bandgap reference and a comparator (see the *Typical Operating Circuit*). The only difference between the two parts is the structure of the comparator output driver. The MAX836 has an open-drain n-channel output driver that can be pulled up to a voltage higher than V_{CC}, but under 11V. The MAX837's output is push-pull, and can both source and sink current.

Programming the Trip Voltage

Two external resistors set the trip voltage, VTRIP (Figure 1). VTRIP is the point at which the applied voltage (typically VCC) toggles OUT. The MAX836/MAX837's high input impedance allows large-value resistors without compromising trip-voltage accuracy. To minimize current consumption, select a value for R2 between 500k Ω and 1M Ω , then calculate R1 as follows:

$$R1 = R2\left(\frac{V_{TRIP}}{V_{TH}} - 1\right)$$

where V_{TRIP} = desired trip voltage (in volts), V_{TH} = threshold trip voltage (1.204V).

Applications Information

Adding Hysteresis

Hysteresis adds noise immunity to the MAX836/MAX837 and prevents repeated triggering when $V_{\rm IN}$ is near the threshold trip voltage. Figure 2 shows how to add hysteresis to the comparator. The technique is similar for



both parts. For the MAX836, select the ratio of resistors R1 and R2 so that IN sees 1.204V when the monitor voltage falls to or rises above the desired trip point (VTRIP). R3 adds hysteresis and is typically an order of magnitude larger than R1 or R2. The current through R1 and R2 should be at least 500nA to ensure that the 12nA maximum input current does not shift the trip point significantly. Capacitor C1 adds additional noise rejection.

Monitoring Voltages Other than VCC

The MAX836/MAX837 can monitor voltages other than V_{CC} (Figure 3). Calculate V_{TRIP} as shown in the *Programming the Trip Voltage* section. The monitored voltage (V_{MON}) is independent of V_{CC}. V_{IN} must be 1V less than V_{CC}.

Heater Temperature Control

Figure 4 shows a basic heater temperature-control circuit. Upon power-up, OUT is high and the n-channel MOSFET turns on. Current flows through the heating element (R4), warming the surrounding area. R2 is a negative-temperature-coefficient thermistor and as temperature increases, its resistance decreases. As the thermistor heats up and its resistance decreases, the MAX837's voltage at IN decreases until it reaches the 1.204V threshold voltage. At this point, OUT goes low, turning off the heating element. The thermistor cools and the voltage at IN rises until it overcomes the MAX837's hysteresis (6mV). OUT returns high when this point is reached, turning on the heating element again. This cycle repeats as long as power is applied.



Figure 2. Adding Hysteresis to the Comparator

Determine the thermistor's resistance (R2) at the desired temperature. Then, using R2's resistance and half the resistance of R3, calculate R1's value with the following formula:

R1 = (R2 + R3)
$$\left(\frac{V_{CC}}{1.204} - 1\right)$$



Figure 3. Monitoring Voltages Other than V_{CC}



Figure 4. Heater Temperature Control

Chip Information

Package Information

TRANSISTOR COUNT: 54

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
4 SOT143	U4-1	<u>21-0052</u>

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/96	Initial release	—
1	3/04	Updated top mark information in the Ordering Information.	1
2	12/05	Added lead-free notation.	1
3	5/08	Updated top mark information in the Ordering Information.	1

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