/VI/IXI/VI

Micropower, Latching Voltage Monitors in SOT23-5

MAX834/MAX835

General Description

The MAX834/MAX835 micropower voltage monitors contain a 1.204V precision bandgap reference, comparator, and latched output in a 5-pin SOT23 package. Using the latched output prevents deep discharge of batteries. The MAX834 has an open-drain, n-channel output driver, while the MAX835 has a push-pull output driver. Two external resistors set the trip-threshold voltage.

The MAX834/MAX835 feature a level-sensitive latch, eliminating the need to add hysteresis to prevent oscillations in battery-load-disconnect applications.

Applications

Precision Battery Monitors

Load Switching

Battery-Powered Systems

Threshold Detectors

Features

♦ **Prevent Deep Discharge of Batteries**

♦ **Precision ±1.25% Voltage Threshold**

♦ **Latched Output (Once Low, Stays Low Until Cleared)**

♦ **SOT23-5 Package**

♦ **Low Cost**

♦ **+2.5V to +11V Wide Operating Voltage Range**

♦ **< 2µA Typical Supply Current**
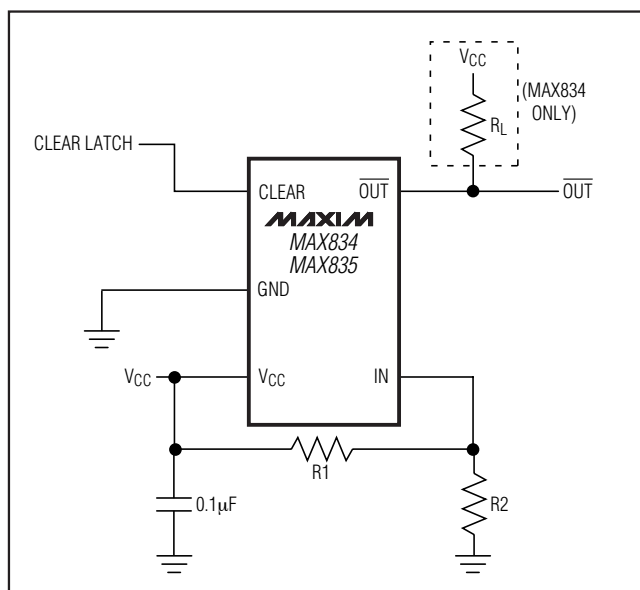
♦ **Open-Drain Output (MAX834)/Push-Pull Output (MAX835)**

Ordering Information

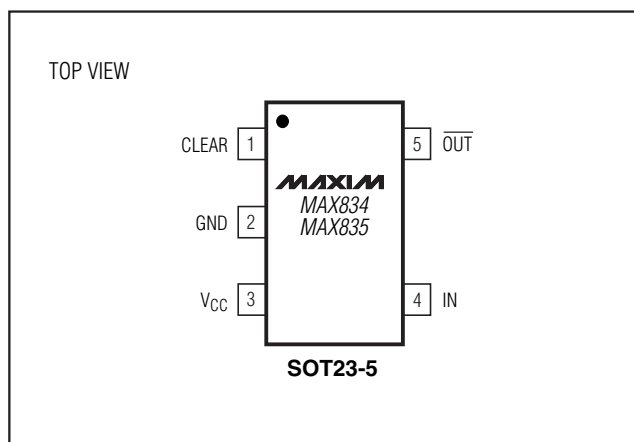| PART	PIN-PACKAGE	TOP MARK	PKG CODE
MAX834EUK-T	5 SOT23-5	AAAX	U5-1
MAX835EUK-T	5 SOT23-5	AAAY	U5-1

Note: *All devices are specified over the -40°C to +85°C operating temperature range.*

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

Typical Operating Circuit

Pin Configuration

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

Micropower, Latching Voltage Monitors in SOT23-5

ABSOLUTE MAXIMUM RATINGS

V_CC, $\overline{\text{OUT}}$ (MAX834), CLEAR to GND ....-0.3V to +12V
IN, $\overline{\text{OUT}}$ (MAX835) to GND.........................-0.3V to (V_CC + 0.3V)
INPUT Current
   V_CC 20mA
   IN...10mA
$\overline{\text{OUT}}$ Current...-20mA
V_CC Rate of Rise 100V/µs

Continuous Power Dissipation (T_A = +70°C)
   5-Pin SOT23-5 (derate 7.1mW/C above +70°C)..........571mW
Operating Temperature Range ....-40°C to +85°C
Storage Temperature Range ....-65°C to +150°C
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 +11V, T_A = T_MIN to T_MAX, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX	UNITS
Operating Voltage Range (Note 1)	V_CC				2.5		11.0	V
Supply Current (Note 2)	I_CC	V_IN = 1.6V, $\overline{\text{OUT}}$ = low, V_CLEAR ≥ V_CC - 0.25V or V_CLEAR ≤ 0.25V	V_CC = 3.6V	T_A = +25°C		2.4	5	µA
				T_A = T_MIN to T_MAX			10	
			V_CC = full operating range				15	
		V_IN = 1.25V, $\overline{\text{OUT}}$ = high, V_CLEAR ≥ V_CC - 0.25V or V_CLEAR ≤ 0.25V	V_CC = 3.6V	T_A = +25°C		1.1	4	
				T_A = T_MIN to T_MAX			8	
			V_CC = full operating range				13	
Threshold Voltage	V_TH	V_IN falling	T_A = +25°C		1.185	1.204	1.215	V
			T_A = 0°C to +70°C		1.169	1.204	1.231	
Threshold Voltage Hysteresis	V_HYST	V_CC = 5V, IN = low to high				6		mV
IN Operating Voltage Range (Note 1)	V_IN				0		V_CC - 1	V
IN Leakage Current (Note 3)	I_IN	V_IN = V_TH				±3	±12	nA
Propagation Delay	t_PL	V_CC = 5V, 50mV overdrive				80		µs
Glitch Immunity		V_CC = 5V, 100mV overdrive				35		µs
OUT Rise Time	t_RT	V_CC = 5V, no load (MAX835 only)				200		ns
OUT Fall Time	t_FT	V_CC = 5V, no load (MAX834 pullup = 10kΩ)				480		ns
Output Leakage Current (Note 4)	I_LOUT	V_IN > V_TH(MAX) (MAX834 only)					±1	µA
Output-Voltage High	V_OH	V_IN > V_TH(MAX), I_SOURCE = 500µA (MAX835 only)			V_CC - 0.5			V
Output-Voltage Low	V_OL	V_IN < V_TH(MIN), I_SINK = 500µA					0.4	V
CLEAR Input High Voltage	V_CIH				2			V

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ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.5V to +11V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CLEAR Input Low Voltage	V_{CIL}				0.4	V
CLEAR Input Leakage Current	t_{CLEAR}			±1	±100	nA
CLEAR Input Pulse Width	t_{CLR}					µs

Note 1: The voltage-detector output remains in the correct state for V_{CC} down to 1.2V when V_{IN} ≤ V_{CC} / 2.
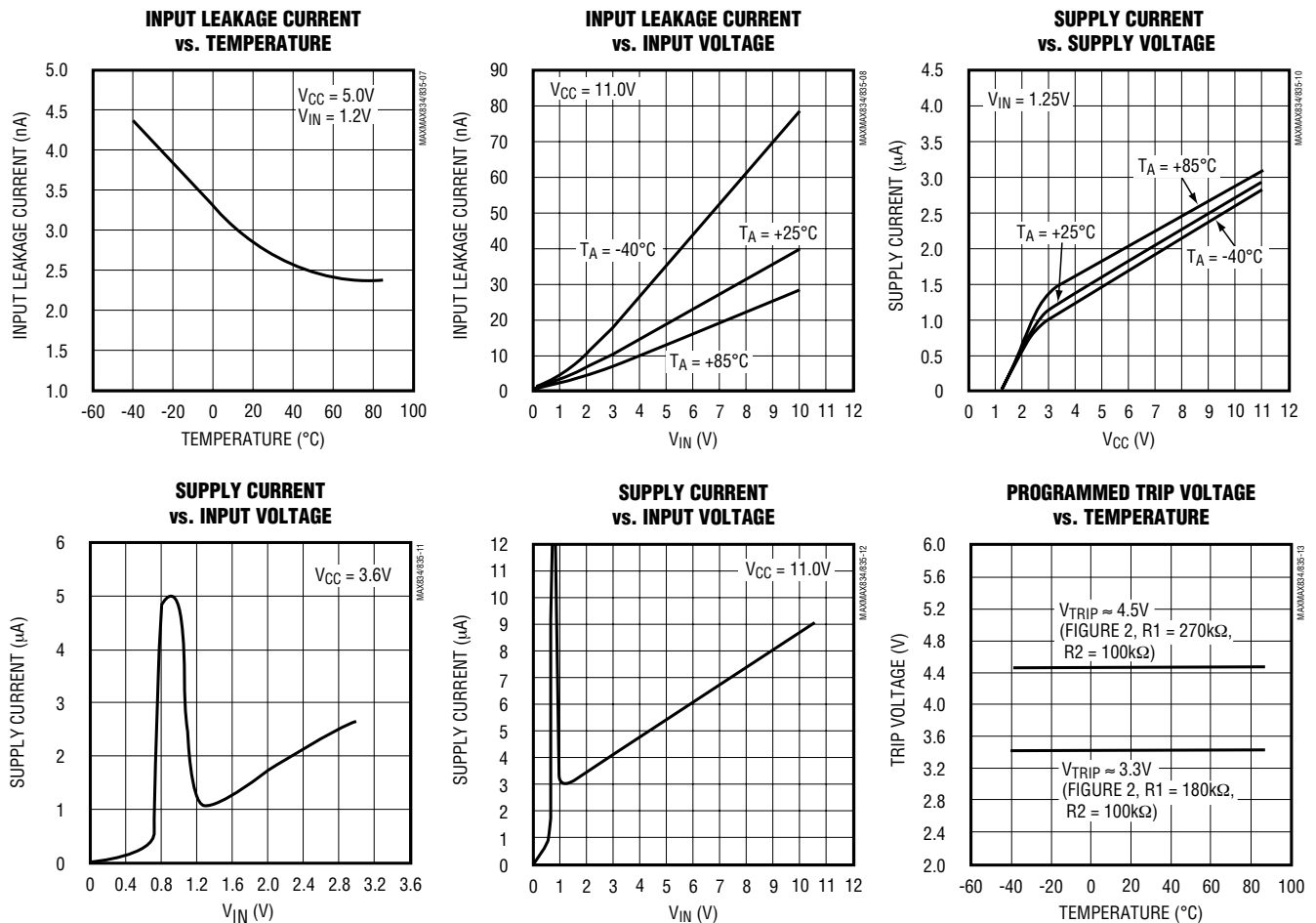**Note 2:** Supply current has a monotonic dependence on V_{CC} (see the _Typical Operating Characteristics_).
Note 3: IN leakage current has a monotonic dependence on V_{CC} (see the _Typical Operating Characteristics_).
Note 4: The MAX834 open-drain output can be pulled up to a voltage greater than V_{CC}, but may not exceed 11V.
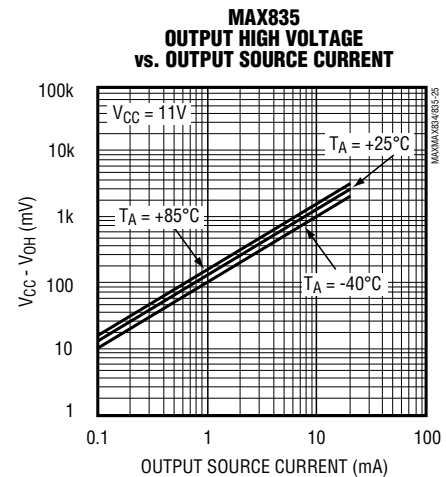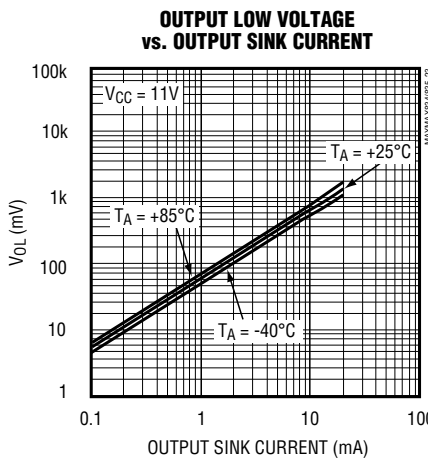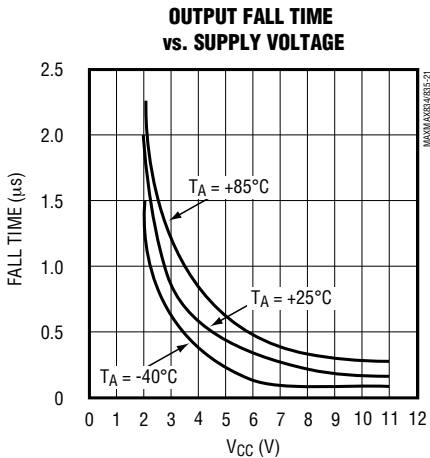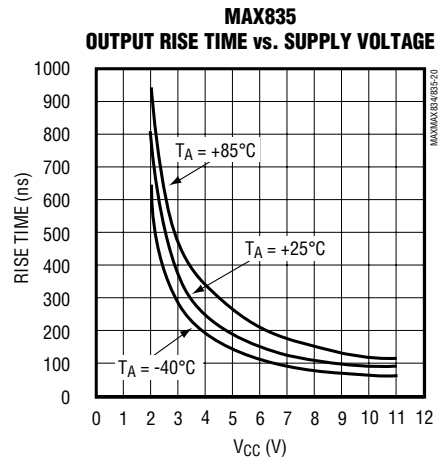
_____ _Typical Operating Characteristics_

(V_{CC} = +5V, Typical Operating Circuit, T_A = +25°C, unless otherwise noted.)

INPUT LEAKAGE CURRENT vs. TEMPERATURE

INPUT LEAKAGE CURRENT vs. INPUT VOLTAGE

SUPPLY CURRENT vs. SUPPLY VOLTAGE

SUPPLY CURRENT vs. INPUT VOLTAGE

SUPPLY CURRENT vs. INPUT VOLTAGE

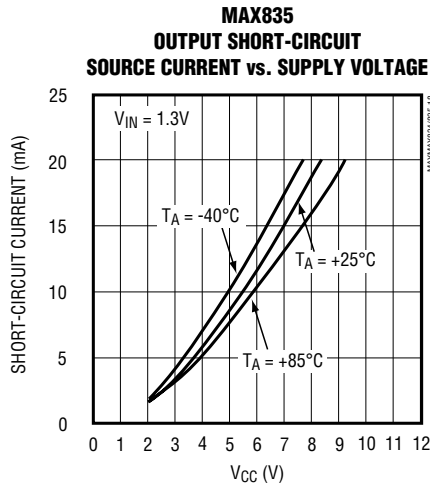PROGRAMMED TRIP VOLTAGE vs. TEMPERATURE

MAX834/MAX835

Typical Operating Characteristics (continued)

(V$_{CC}$ = +5V, Typical Operating Circuit, T$_A$ = +25°C, unless otherwise noted.)

OUTPUT LOW VOLTAGE vs. SUPPLY VOLTAGE

MAX835 OUTPUT HIGH VOLTAGE vs. SUPPLY VOLTAGE

OUTPUT SHORT-CIRCUIT SINK CURRENT vs. SUPPLY VOLTAGE

MAX835 OUTPUT SHORT-CIRCUIT SOURCE CURRENT vs. SUPPLY VOLTAGE

SUPPLY VOLTAGE FALLING TO OUT PROPAGATION DELAY vs. TEMPERATURE

MAX835 OUTPUT RISE TIME vs. SUPPLY VOLTAGE

OUTPUT FALL TIME vs. SUPPLY VOLTAGE

OUTPUT LOW VOLTAGE vs. OUTPUT SINK CURRENT

MAX835 OUTPUT HIGH VOLTAGE vs. OUTPUT SOURCE CURRENT

*M*A*X*I*M*

Micropower, Latching Voltage Monitors in SOT23-5

_____Typical Operating Characteristics (continued)

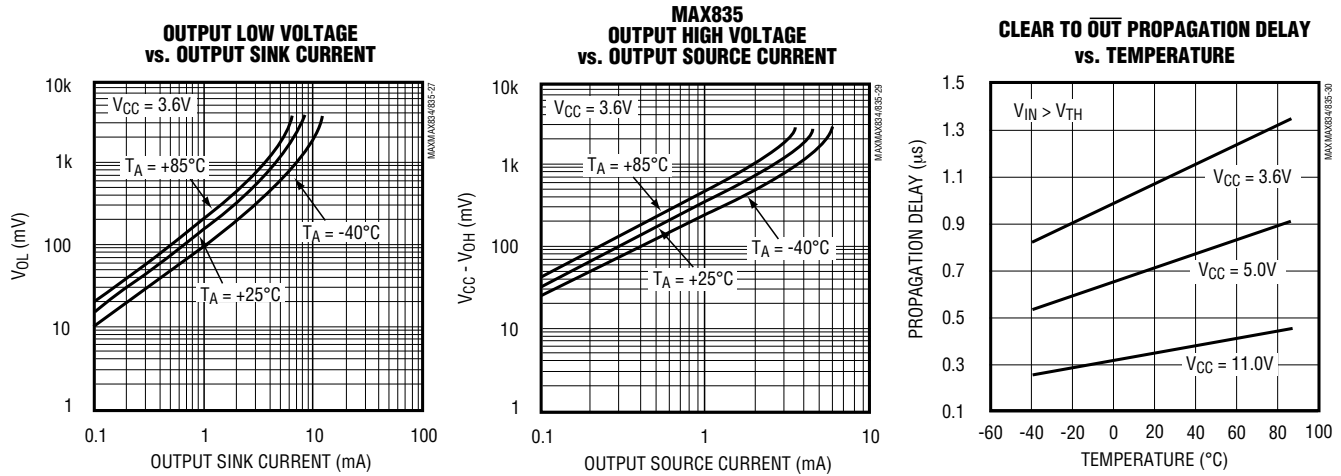(V_{CC} = +5V, Typical Operating Circuit, T_A = +25°C, unless otherwise noted.)

OUTPUT LOW VOLTAGE vs. OUTPUT SINK CURRENT

MAX835 OUTPUT HIGH VOLTAGE vs. OUTPUT SOURCE CURRENT

CLEAR TO OUT PROPAGATION DELAY vs. TEMPERATURE

_____Pin Description

| PIN	NAME	FUNCTION
1	CLEAR	Clear Input Resets the Latched Output. With $V_{IN} > V_{TH}$, pulse CLEAR high for a minimum of 1µs to reset the output latch. Connect to V_{CC} to make the latch transparent.
2	GND	System Ground
3	V_{CC}	System Supply Input
4	IN	Noninverting Input to the Comparator. The inverting input connects to the internal 1.204V bandgap reference.
5	$\overline{OUT}$	Open-Drain (MAX834) or Push-Pull (MAX835) Latched Output. $\overline{OUT}$ is active-low.
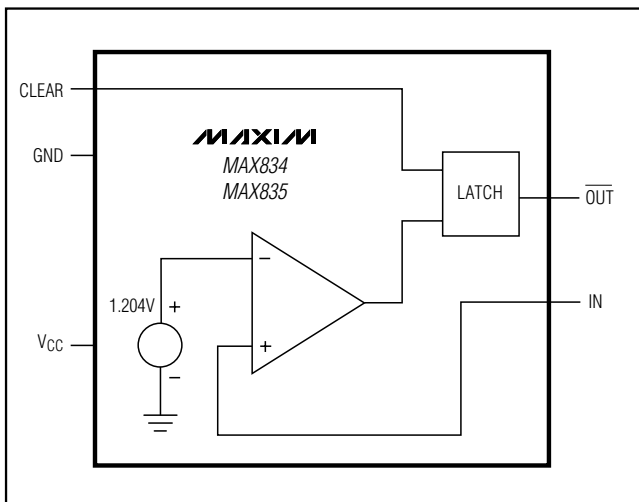
Figure 1. Functional Diagram

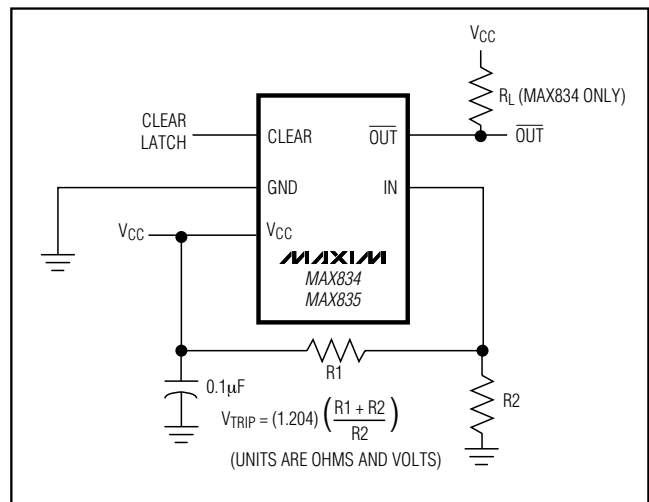Figure 2. Programming the Trip Voltage (V_{TRIP})

$$V_{TRIP} = (1.204) \left(\frac{R1 + R2}{R2} \right)$$

(UNITS ARE OHMS AND VOLTS)

Micropower, Latching Voltage Monitors in SOT23-5

Detailed Description

The MAX834/MAX835 micropower voltage monitors contain a 1.204V precision bandgap reference and a comparator with an output latch (Figure 1). The difference between the two parts is the structure of the comparator output driver. The MAX834 has an open-drain, n-channel output driver that can be pulled up to a voltage higher than V_{CC}, but less than 11V. The MAX835's output is push-pull and can both source and sink current.

Programming the Trip Voltage (V_{TRIP})

Two external resistors set the trip voltage, V_{TRIP} (Figure 2). V_{TRIP} is the point at which the falling monitored voltage (typically V_{CC}) causes $\overline{OUT}$ to go low. IN's high input impedance allows the use of large-value resistors without compromising trip voltage accuracy. To minimize current consumption, choose a value for R2 between 500kΩ and 1MΩ, then calculate R1 as follows:

$$R1 = R2 [(V_{TRIP} / V_{TH}) - 1]$$

where V_{TRIP} is the desired trip voltage and V_{TH} is the threshold voltage (1.204V). The voltage at IN must be at least 1V less than V_{CC}.

Latched-Output Operation

The MAX834/MAX835 feature a level-sensitive latch input (CLEAR), designed to eliminate the need for hysteresis in battery undervoltage-detection applications. When the monitored voltage (V_{MON}) is above the programmed trip voltage (V_{TRIP}) (as when the system battery is recharged or a fresh battery is installed), pulse CLEAR low-high-low for at least 1µs to reset the output latch ($\overline{OUT}$ goes high). When V_{MON} falls below V_{TRIP}, $\overline{OUT}$ goes low and remains low (even if V_{MON} rises above V_{TRIP}), until CLEAR is pulsed high again with $V_{MON} > V_{TRIP}$. Figure 3 shows the timing relationship between V_{MON}, $\overline{OUT}$, and CLEAR.
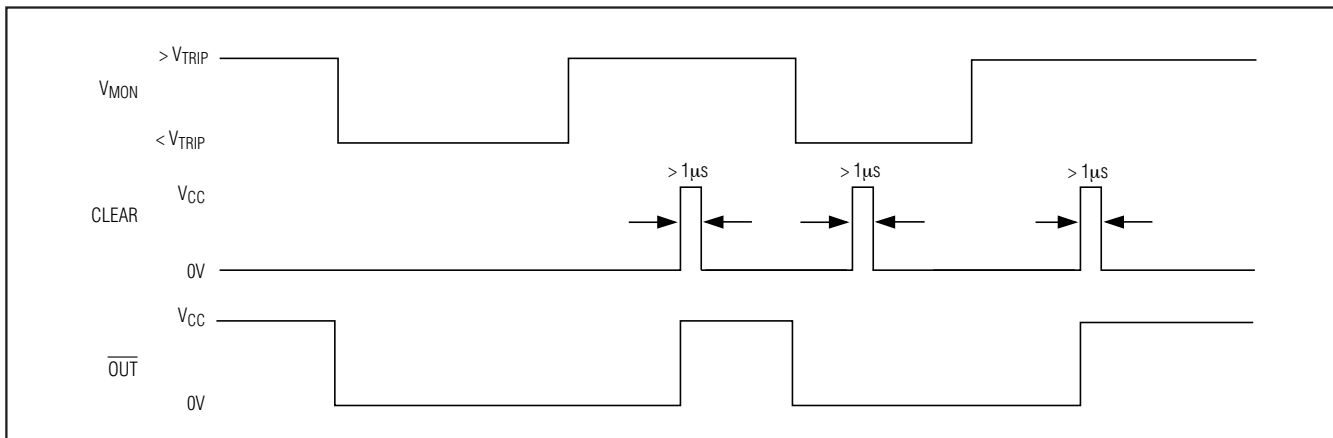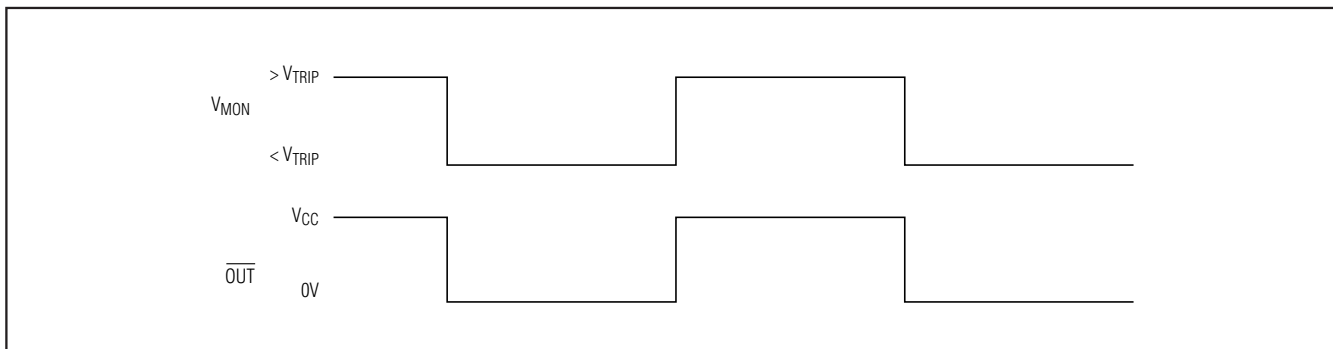

Figure 3a. Timing Diagram

Figure 3b. Timing Diagram, CLEAR = V_{CC}

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Micropower, Latching Voltage Monitors in SOT23-5
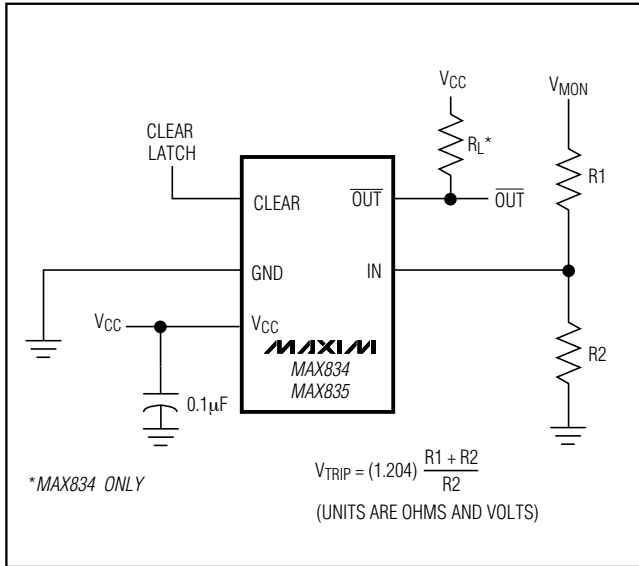

Figure 4. Monitoring Voltages Other than V_{CC}

$$V_{TRIP} = (1.204) \frac{R1 + R2}{R2}$$

(UNITS ARE OHMS AND VOLTS)

*MAX834 ONLY

Monitoring Voltages Other than V_{CC}

The *Typical Operating Circuit* for the MAX834/MAX835 monitors V_{CC}. Voltages other than V_{CC} can easily be monitored, as shown in Figure 4. Calculate V_{TRIP} as in the *Programming the Trip Voltage (V_{TRIP})* section. When monitoring voltages other than V_{CC}, ensure that the maximum value for V_{MON} is not exceeded:

$$V_{MON(MAX)} = (V_{CC} - 1)(R1 + R2) / R2$$

Load-Disconnect Switch

The circuit in Figure 5 is designed to prevent a lead-acid battery or a secondary battery such as an NiCd, from sustaining damage through deep discharge. As the battery reaches critical undervoltage, $\overline{OUT}$ switches low. Q1 and Q2 turn off, disconnecting the battery from the load. The MAX835's latched output prevents Q1 and Q2 from turning on again as the battery voltage relaxes to its open-circuit voltage when the load disconnects. CLEAR can be connected to a pushbutton switch, an RC network, or a logic gate to reset the latch when the battery is recharged or replaced.
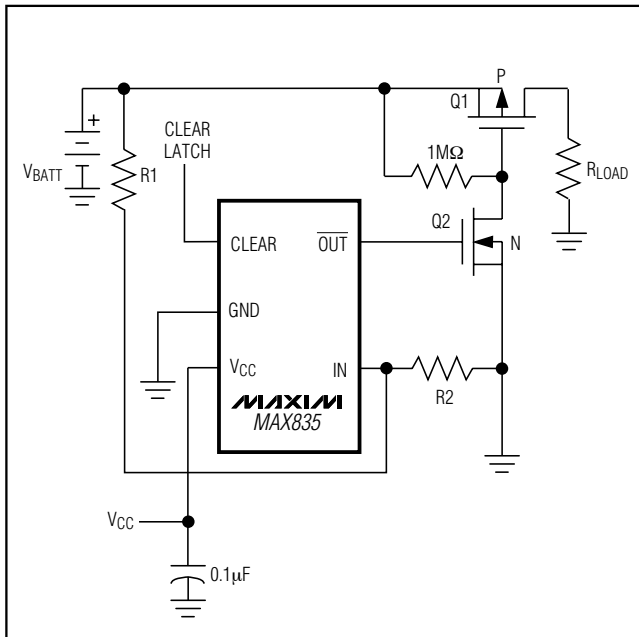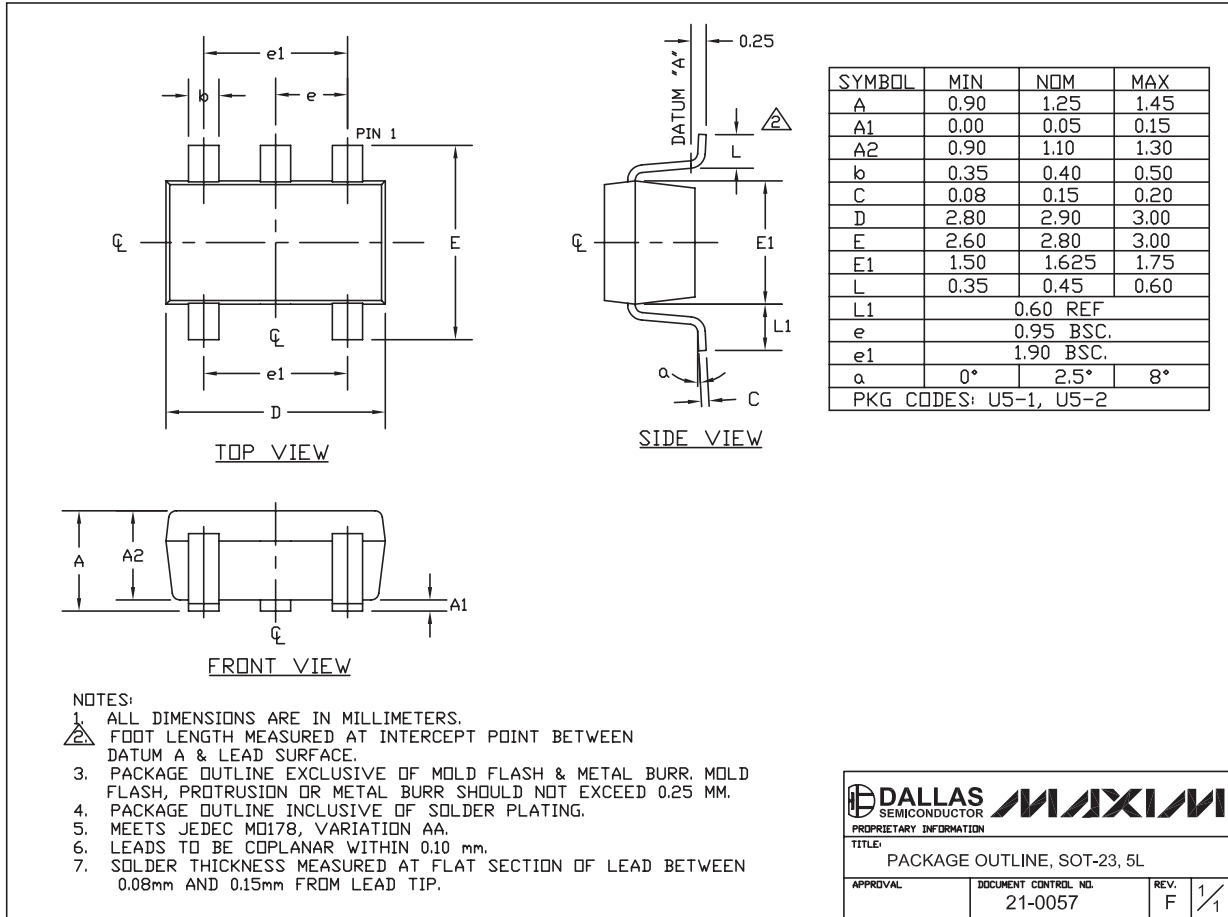

Figure 5. Load-Disconnect Switch

_____Chip Information

TRANSISTOR COUNT: 74

Micropower, Latching Voltage Monitors in SOT23-5

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

SOT-23 5L.EPS

SYMBOL	MIN	NOM	MAX
A	0.90	1.25	1.45
A1	0.00	0.05	0.15
A2	0.90	1.10	1.30
b	0.35	0.40	0.50
C	0.08	0.15	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.625	1.75
L	0.35	0.45	0.60
L1		0.60 REF	
e		0.95 BSC.	
e1		1.90 BSC.	
α	0°	2.5°	8°
PKG CODES: U5-1, U5-2			

TOP VIEW

SIDE VIEW

FRONT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR. MOLD FLASH, PROTRUSION OR METAL BURR SHOULD NOT EXCEED 0.25 MM.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. MEETS JEDEC MO178, VARIATION AA.
6. LEADS TO BE COPLANAR WITHIN 0.10 mm.
7. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.

DALLAS SEMICONDUCTOR **MAXIM**
PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE, SOT-23, 5L

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0057	F	1/1

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MAX834/MAX835

_____*Tape-and-Reel Information*

NOTE: DIMENSIONS ARE IN MM.
AND FOLLOW EIA481-1 STANDARD.

A_0	3.200	±0.102		E	1.753	±0.102	P_0	3.988	±0.102
B_0	3.099	±0.102		F	3.505	±0.051	P_010	40.005	±0.203
D	1.499	+0.102 +0.000		K_0	1.397	±0.102	P_2	2.007	±0.051
D_1	0.991	+0.254 +0.000		P	3.988	±0.102	t	0.254	±0.127
							W	8.001	+0.305 -0.102

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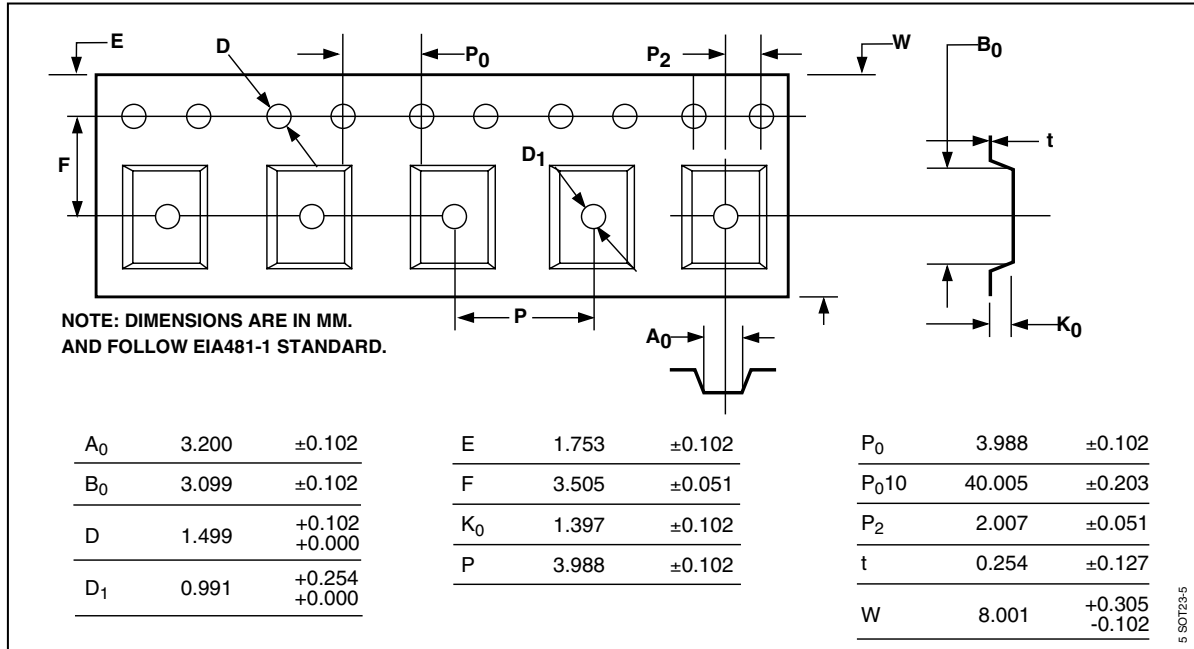
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