

General Description

The MAX6439-MAX6442 are a family of ultra-low-power battery monitors with integrated microprocessor (µP) supervisors. The battery monitors are offered with single or dual low-battery output options that can be used to signal when the battery is OK (enabling full system operation), when the battery is low (for low-power system operation), and when the battery is dead (to disable system operation). These devices also have an independent µP supervisor that monitors VCC and provides an active-low reset output. A manual reset function is available to reset the µP with a push-button. No external components are required.

The MAX6439-MAX6442 are offered with several factory-trimmed low-battery threshold combinations ideal for single-cell lithium-ion (Li+) or multicell alkaline/NiCd/ NiMH applications. When the battery voltage drops below each specified low threshold, the low-battery outputs are asserted to alert the system. When the voltage rises above the specified high thresholds, the outputs are deasserted after a 150ms minimum timeout period, ensuring the voltages have stabilized before power circuitry is activated or providing microprocessor reset timing. The low and high thresholds provide hysteresis in battery-operated systems to eliminate output chattering.

The MAX6439/MAX6440 offer factory-trimmed battery monitors with a single output. The MAX6441/MAX6442 offer factory-trimmed battery monitors with dual outputs. All battery monitors have open-drain low-battery outputs.

The MAX6439-MAX6442 monitor system voltages (VCC) from 1.8V to 3.3V with seven fixed reset threshold options. Each device is offered with two minimum reset timeout periods of 150ms or 1200ms. The MAX6439/ MAX6441 are offered with an open-drain RESET output and the MAX6440/MAX6442 are offered with a pushpull RESET output.

The MAX6439-MAX6442 are offered in a SOT23 package and are fully specified over a -40°C to +85°C temperature range.

Applications

Battery-Powered Systems (Single-Cell Li+ or Two-/Three-Cell NiMH, NiCd, Alkaline)

Cell Phones/Cordless Phones

Portable Medical Devices

Electronic Toys

Pagers

PDAs

MP3 Players

Features

- **♦ Factory-Trimmed VBATT Threshold Options for** Monitoring Single-Cell Li+ or Multicell Alkaline/NiCd/NiMH Applications
- **♦ Immune to Short Battery Voltage Transients**
- ♦ Low Current (2.5µA typ at 3.6V)
- ♦ Single and Dual Low-Battery Output Options
- ♦ 150ms Minimum LBO Timeout Period
- ♦ Independent µP Reset with Manual Reset
- ♦ Factory-Set Reset Thresholds for Monitoring VCC from 1.8V to 3.3V
- ♦ Available with 150ms (min) and 1.2s (min) VCC **Reset Timeout Period Options**
- **♦** -40°C to +85°C Operating Temperature Range
- ♦ Small 6- and 8-Pin SOT23 Packages
- **♦ No External Components**

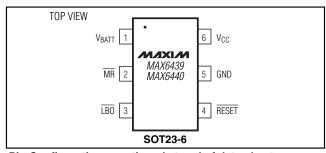
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6439UTDT	-40°C to +85°C	6 SOT23-6
MAX6440UTDT	-40°C to +85°C	6 SOT23-6
MAX6441 KADT	-40°C to +85°C	8 SOT23-8
MAX6442 KADT	-40°C to +85°C	8 SOT23-8

Note: The first two "__" are placeholders for the battery monitor voltage levels. Desired threshold levels are set by the part number suffix found in Tables 1 and 2. The third "_" is the V_{CC} reset threshold level suffix found in Table 3. The "_" after the D is a placeholder for the reset timeout period suffix found in Table 4. All devices are available in tape-and-reel only. There is a 2500-piece minimum order increment for standard versions. Sample stock is typically held on standard versions only. Nonstandard versions require a minimum order increment of 10,000 pieces. Contact factory for availability.

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

Pin Configurations



Pin Configurations continued at end of data sheet.

Maxim Integrated Products 1

ABSOLUTE MAXIMUM RATINGS

V _{BATT} , V _{CC} to GND0.3V to +6V*
Open-Drain LBO, LBOH, LBOL, LBOLH to GND0.3V to +6V*
Open-Drain RESET to GND0.3V to +6V*
Push-Pull RESET to GND0.3V to (V _{CC} + 0.3V)
MR to GND0.3V to (V _{CC} + 0.3V)
Input/Output Current, All Pins20mA
Continuous Power Dissipation (T _A = +70°C)
6-Pin SOT23 (derate 8.7mW/°C above +70°C)695mW
8-Pin SOT23 (derate 8.9mW/°C above +70°C)714mW

Operating Temperature Range	e40°C to +85°C
Junction Temperature	+150°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

(VBATT = 1.2V to 5.5V, VCC = 1.2V to 5.5V, TA = -40°C to +85°C, unless otherwise specified. Typical values are at TA = +25°C.) (Note1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Va. = Operating Voltage Dange	\/5	$T_A = 0$ °C to +85°C	1.0		5.5	V	
V _{BATT} Operating Voltage Range	VBATT	$T_A = -40$ °C to $+85$ °C	1.2		5.5	v	
V On eveting Veltage Dange	\/	$T_A = 0$ °C to +85°C	1.0		5.5	V	
V _{CC} Operating Voltage Range	Vcc	$T_A = -40$ °C to $+85$ °C	1.2		5.5	V	
V _{CC} + V _{BATT} Supply Current	I _{CC} + I _{BATT}	V _{BATT} = 3.6V, V _{CC} = 3.3V, no load (Note 2)		2.5	7	μΑ	
V _{BATT} THRESHOLDS							
		MAX6439UT_ J, MAX6440UT_ J	3.510	3.60	3.690		
		MAX6439UT_ I, MAX6440UT_ I	3.413	3.50	3.588		
		MAX6439UT_ H, MAX6440UT_ H	3.315	3.40	3.485		
		MAX6439UT_ G, MAX6440UT_ G	3.218	3.30	3.383	.,,	
HTH Threshold	HTH	MAX6439UT_ T, MAX6440UT_ T	2.535	2.60	2.665	V	
		MAX6439UT_ S, MAX6440UT_ S	2.438	2.50	2.563		
		MAX6439UT_ R, MAX6440UT_ R	2.340	2.40	2.460		
		MAX6439UT_ Q, MAX6440UT_ Q	2.243	2.30	2.358		
		MAX6439UTF, MAX6440UTF	3.023	3.10	3.178		
		MAX6439UTE, MAX6440UTE	2.925	3.00	3.075		
		MAX6439UTD, MAX6440UTD	2.828	2.90	2.973		
		MAX6439UTC, MAX6440UTC	2.730	2.80	2.870		
		MAX6439UTB, MAX6440UTB	2.633	2.70	2.768		
LTH Threshold	1.711	MAX6439UTA, MAX6440UTA	2.535	2.60	2.665	_	
LTH Trireshold	LTH	MAX6439UTP, MAX6440UTP	2.048	2.10	2.153	V	
		MAX6439UTO, MAX6440UTO	1.950	2.00	2.050		
		MAX6439UTN, MAX6440UTN	1.853	1.90	1.948		
		MAX6439UTM, MAX6440UTM	1.755	1.80	1.845		
		MAX6439UTL, MAX6440UTL	1.658	1.70	1.743		
		MAX6439UTK, MAX6440UTK	1.560	1.60	1.640		

^{*}Applying 7V for a duration of 1ms does not damage the device.

ELECTRICAL CHARACTERISTICS (continued)

 $(V_{BATT} = 1.2V \text{ to } 5.5V, V_{CC} = 1.2V \text{ to } 5.5V, T_{A} = -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}, \text{ unless otherwise specified. Typical values are at } T_{A} = +25^{\circ}\text{C.})$ (Note1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
		MAX6441UT_ J, MAX6442UT_ J	3.510	3.600	3.690	
		MAX6441UT_ I, MAX6442UT_ I	3.413	3.500	3.588	
		MAX6441UT_ H, MAX6442UT_ H	3.315	3.400	3.485	
LITH Threehold	11711	MAX6441UT_ G, MAX6442UT_ G	3.218	3.300	3.383	V
HTH- Threshold	HTH-	MAX6441UT_ T, MAX6442UT_ T	2.535	2.600	2.665	V
		MAX6441UT_ S, MAX6442UT_ S	2.438	2.500	2.563	
		MAX6441UT_ R, MAX6442UT_ R	2.340	2.400	2.460	
		MAX6441UT_ Q, MAX6442UT_ Q	2.243	2.300	2.358	
		MAX6441UT_ J, MAX6442UT_ J	3.686	3.780	3.875	
		MAX6441UT_ I, MAX6442UT_ I	3.583	3.675	3.767	
		MAX6441UT_ H, MAX6442UT_ H	3.481	3.570	3.659	
LITLL. Threehold	LITI.	MAX6441UT_ G, MAX6442UT_ G	3.378	3.465	3.552	V
HTH+ Threshold	HTH+	MAX6441UT_ T, MAX6442UT_ T	2.662	2.730	2.798	V
		MAX6441UT_ S, MAX6442UT_ S	2.559	2.625	2.691	
		MAX6441UT_ R, MAX6442UT_ R	2.457	2.520	2.583	
		MAX6441UT_ Q, MAX6442UT_ Q	2.355	2.415	2.476	
		MAX6441UTF, MAX6442UTF	3.023	3.100	3.178	V
		MAX6441UTE, MAX6442UTE	2.925	3.000	3.075	
		MAX6441UTD, MAX6442UTD	2.828	2.900	2.973	
		MAX6441UTC, MAX6442UTC	2.730	2.800	2.870	
		MAX6441UTB, MAX6442UTB	2.633	2.700	2.768	
LTII Throobald	1.711	MAX6441UTA, MAX6442UTA	2.535	2.600	2.665	
LTH- Threshold	LTH-	MAX6441UTP, MAX6442UTP	2.048	2.100	2.153	
		MAX6441UTO, MAX6442UTO	1.950	2.000	2.050	
		MAX6441UTN, MAX6442UTN	1.853	1.900	1.948	
		MAX6441UTM, MAX6442UTM	1.755	1.800	1.845	
		MAX6441UTL, MAX6442UTL	1.658	1.700	1.743	
		MAX6441UTK, MAX6442UTK	1.560	1.600	1.640	
		MAX6441UTF, MAX6442UTF	3.174	3.255	3.337	
		MAX6441UTE, MAX6442UTE	3.071	3.150	3.229	
		MAX6441UTD, MAX6442UTD	2.969	3.045	3.121	
		MAX6441UTC, MAX6442UTC	2.867	2.940	3.014	
		MAX6441UTB, MAX6442UTB	2.764	2.835	2.906	
I TI I . Thus ab alsi	LTU	MAX6441UTA, MAX6442UTA	2.662	2.730	2.798	
LTH+ Threshold	LTH+	MAX6441UTP, MAX6442UTP	2.150	2.205	2.260	V
		MAX6441UTO, MAX6442UTO	2.048	2.100	2.153	
		MAX6441UTN, MAX6442UTN	1.945	1.995	2.045	1
		MAX6441UTM, MAX6442UTM	1.843	1.890	1.937	
		MAX6441UTL, MAX6442UTL	1.740	1.785	1.830	
	ĺ	MAX6441UTK, MAX6442UTK	1.638	1.680	1.722	

ELECTRICAL CHARACTERISTICS (continued)

 $(V_{BATT} = 1.2V \text{ to } 5.5V, V_{CC} = 1.2V \text{ to } 5.5V, T_{A} = -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}, \text{ unless otherwise specified.}$ Typical values are at $T_{A} = +25^{\circ}\text{C.}$) (Note1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
LBO, LBOL, LBOH, LBOLH Timeout Period	tLBOP	V _{BATT} rising above threshold	150	225	300	ms	
LBO, LBOL, LBOH, LBOLH Delay Time	tLBOD	V _{BATT} falling below threshold		100		μs	
LBO, LBOL, LBOH, LBOLH Output Low (Open Drain)		(V _{BATT} or V _{CC}) ≥ 1.2V, I _{SINK} = 50μA, asserted low			0.3		
	\/ .	(V _{BATT} or V _{CC}) ≥ 1.6V, I _{SINK} = 100μA, asserted low			0.3		
	V _{OL}	(V _{BATT} or V _{CC}) ≥ 2.7V, I _{SINK} = 1.2mA, asserted low			0.3	V	
		(V _{BATT} or V _{CC}) ≥ 4.5V, I _{SINK} = 3.2mA, asserted low			0.3		
LBO, LBOL, LBOH, LBOLH Output Open-Drain Leakage Current	llkg	Output deasserted			500	nA	
		MAX64T	3.000	3.075	3.150		
		MAX64S	2.850	2.925	3.000		
		MAX64R	2.550	2.625	2.700	V	
V _{CC} Reset Threshold	VTH	MAX64Z	2.250	2.313	2.375		
		MAX64Y	2.125	2.188	2.250		
		MAX64W	1.620	1.665	1.710		
		MAX64V	1.530	1.575	1.620		
V _{CC} Reset Hysteresis				0.3		%	
V _{CC} to RESET Delay		V _{CC} falling at 10mV/µs from (V _{TH} + 100mV) to (V _{TH} - 100mV)		50		μs	
		MAX64D3	150	225	300		
V _{CC} to RESET Timeout Period	t _{RP}	MAX64D7	1200	1800	2400	ms	
	VIL			C	.3 x V _{CC}	.,	
MR Input Voltage	VIH		0.7 x V _C	С		V	
MR Minimum Pulse Width	tMPW		1			μs	
MR Glitch Rejection				100		ns	
MR to RESET Delay				200		ns	
MR Reset Timeout Period	t _{MRP}		150	225	300	ms	
MR Pullup Resistance		MR to V _{CC}	750	1500	2250	Ω	
MR Rising Debounce Period	tDEB	(Note 3)	150	225	300	ms	

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ELECTRICAL CHARACTERISTICS (continued)

(VBATT = 1.2V to 5.5V, VCC = 1.2V to 5.5V, TA = -40°C to +85°C, unless otherwise specified. Typical values are at TA = +25°C.) (Note1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RESET Output High	Vari	V _{CC} ≥ 1.53V, I _{SOURCE} = 100µA, RESET deasserted	0.8 x V _{CC}			V
(Push-Pull)	Voн	V _{CC} ≥ 2.55V, I _{SOURCE} = 500µA, RESET deasserted	0.8 x V _{CC}		V	
		V _{CC} ≥ 1.0V, I _{SINK} = 50µA, RESET asserted			0.3	
DECET Output Low	Vo	V _{CC} ≥ 1.2V, I _{SINK} = 100μA, RESET asserted		0.3	V	
RESET Output Low	VOL	V _{CC} ≥ 2.12V, I _{SINK} = 1.2mA, RESET asserted			0.3	V
RESET Output Leakage Current (Open Drain)		RESET deasserted			500	nA

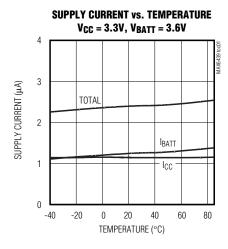
Note 1: Production testing done at $T_A = +25$ °C; limits over temperature guaranteed by design only.

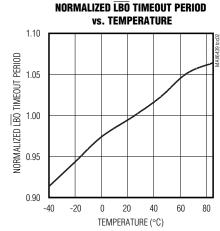
Note 2: The device is powered up by the highest voltage between VBATT and VCC.

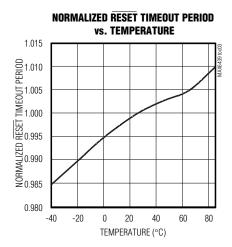
Note 3: \overline{MR} input ignores falling input pulses, which occur within the \overline{MR} debounce period (t_{DEB}) after a valid \overline{MR} reset assertion. This prevents invalid reset assertion due to switch bounce.

Typical Operating Characteristics

 $(V_{BATT} = 1.2V \text{ to } 5.5V, V_{CC} = 1.2V \text{ to } 5.5V, \text{ unless otherwise specified. Typical values are at } T_A = +25^{\circ}C.)$

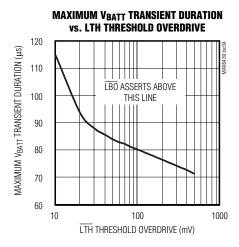


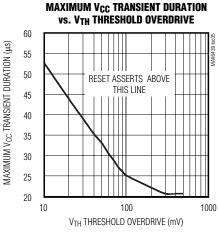


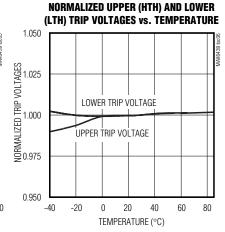


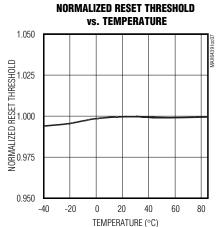
Typical Operating Characteristics (continued)

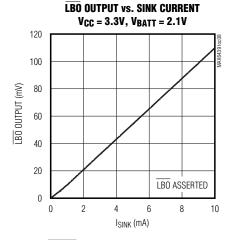
 $(V_{BATT} = 1.2V \text{ to } 5.5V, V_{CC} = 1.2V \text{ to } 5.5V, \text{ unless otherwise specified.}$ Typical values are at $T_A = +25^{\circ}C$.)

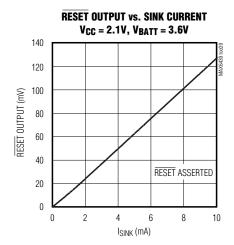


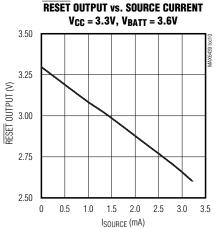












Pin Description

PIN			
MAX6439/ MAX6440	MAX6441/ MAX6442	NAME	FUNCTION
1	1	VBATT	Battery Voltage Input. Input for battery voltage threshold monitors and device power supply if V_{BATT} is greater than V_{CC} .
2	3	MR	Manual Reset Input, Active-Low, Internal 1.5k Ω Pullup to V _{CC} . Pull low to assert a one-shot edge-triggered $\overline{\text{RESET}}$ output for the $\overline{\text{MR}}$ reset timeout period. Leave unconnected or connect to V _{CC} if unused. The $\overline{\text{MR}}$ input is debounced for $\overline{\text{MR}}$ rising edges to prevent false reset events.
3	_	LBO	Low-Battery Output, Active Low, Open Drain. \overline{LBO} is asserted when V _{BATT} drops below the LTH specification and remains asserted until V _{BATT} rises above the HTH specification for at least 150ms.
4	5	RESET	Reset Output, Active Low, Push-Pull or Open Drain. $\overline{\text{RESET}}$ changes from high to low when the V _{CC} input drops below the selected reset threshold and remains low for the V _{CC} reset timeout period after V _{CC} exceeds the reset threshold. $\overline{\text{RESET}}$ is one-shot edge-trigger pulsed low for the $\overline{\text{MR}}$ reset timeout period when the $\overline{\text{MR}}$ input is pulled low. $\overline{\text{RESET}}$ is an open-drain output for the MAX6439/MAX6441, and a push-pull output for the MAX6440/MAX6442. The push-pull outputs are referenced to V _{CC} . $\overline{\text{RESET}}$ is guaranteed to be in the correct logic state for V _{BATT} or V _{CC} > 1.0V.
5	2	GND	Ground
6	8	Vcc	V_{CC} Voltage Input. Input for V_{CC} reset threshold monitor and device power supply if V_{CC} is greater than V_{BATT} .
_	6	LBOH	Low-Battery Output High, Active Low, Open Drain. \(\overline{LBOH}\) is asserted when VBATT drops below the HTH- specification. \(\overline{LBOH}\) is deasserted when VBATT rises above the HTH+ specification for at least 150ms.
_	7	LBOL	Low-Battery Output Low, Active Low, Open Drain. LBOL is asserted when VBATT drops below the LTH- specification. LBOL is deasserted when VBATT rises above the LTH+ specification for at least 150ms.
_	4	LBOLH	Low-Battery Output Low/High, Active Low, Open Drain. LBOLH is asserted when VBATT drops below the LTH- specification. LBOLH is deasserted when VBATT rises above the HTH+ specification for at least 150ms.

Detailed Description

The MAX6439–MAX6442 family is available with several monitoring options. The factory-trimmed thresholds eliminate the requirement for external components. The MAX6439/MAX6440 have single low-battery outputs and the MAX6441/MAX6442 have dual low-battery outputs (see Figure 1a and Figure 1b).

The MAX6439–MAX6442 combine a 1.23V reference with two comparators, logic, and timing circuitry to provide the user with information about the charge state of the power-supply batteries. The MAX6441/MAX6442

monitor separate high-voltage and low-voltage thresholds to determine battery status. The output(s) can be used to signal when the battery is charged, when the battery is low, and when the battery is empty. Factory-trimmed thresholds are ideal for monitoring single-cell Li+ or multicell alkaline/NiCd/NiMH power supplies.

When the power-supply voltage drops below the specified low threshold, the low-battery output asserts. When the voltage rises above the specified high threshold following a 150ms (min) timeout period, the low-battery output is deasserted. This ensures the supply voltage

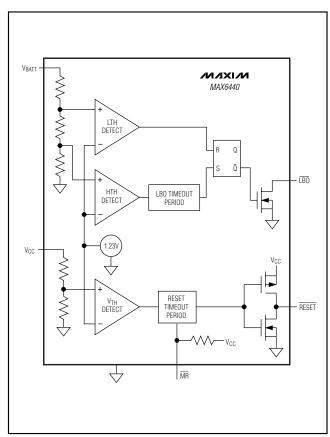


Figure 1a. Functional Diagram

has stabilized before power-converter or microprocessor activity is enabled.

These devices also have an independent μP supervisor that monitors V_{CC} and provides an active-low reset output. A manual reset function is available to allow the user to reset the μP with a push-button.

Low-Battery Output

The low-battery outputs are available in active-low (\overline{LBO} , \overline{LBOL} , \overline{LBOH} , \overline{LBOLH}), open-drain configurations. The low-battery outputs can be pulled to a voltage independent of V_{CC} or V_{BATT}, up to 5.5V. This allows the device to monitor and operate from direct battery voltage while interfacing to higher voltage microprocessors.

The MAX6439/MAX6440 single-output voltage monitors provide a single low-battery output, \overline{LBO} . These fixed-threshold devices assert \overline{LBO} when V_{BATT} drops below V_{LTH} and remain asserted for at least 150ms after V_{BATT} rises above V_{HTH} (see Figure 2). The MAX6441/MAX6442 triple-output voltage monitors provide three

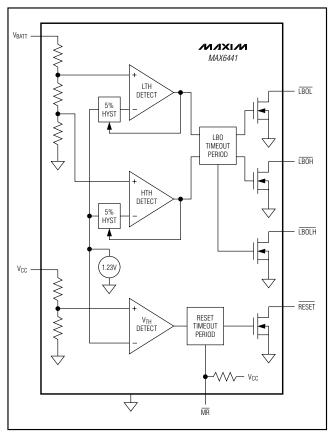


Figure 1b. Functional Diagram

low-battery outputs: \overline{LBOH} , \overline{LBOL} , and \overline{LBOLH} . \overline{LBOH} asserts when VBATT drops below VHTH- and remains asserted for at least 150ms after VBATT rises above VHTH+. \overline{LBOL} asserts when VBATT drops below VLTH- and remains asserted for at least 150ms after VBATT rises above VLTH-. \overline{LBOLH} asserts when VBATT drops below VLTH- and remains asserted for at least 150ms after VBATT rises above VHTH+ (see Figure 3). For fast-rising VBATT input, the \overline{LBOL} timeout period must complete before the $\overline{LBOH/LBOLH}$ timeout period begins.

Reset Output

The MAX6439–MAX6442 provide an active-low reset output (RESET). RESET is asserted when the voltage at VCC falls below the reset threshold level. Reset remains asserted for the reset timeout period after VCC exceeds the threshold. If VCC goes below the reset threshold before the reset timeout period is completed, the internal timer restarts. The MAX6439/MAX6441 have opendrain reset outputs, while the MAX6440/MAX6442 have push-pull reset outputs (see Figure 4).

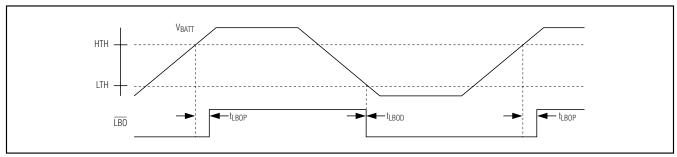


Figure 2. Single Low-Battery Output Timing

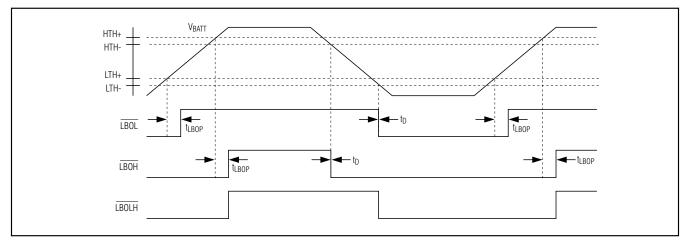


Figure 3. Dual Low-Battery Output Timing

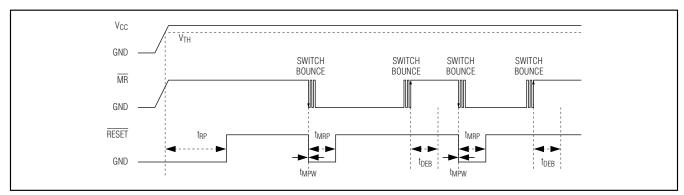


Figure 4. RESET Timing Diagram

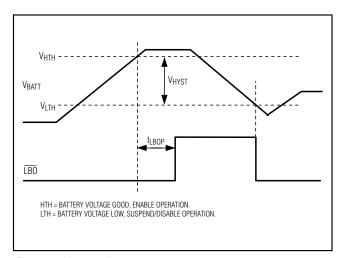


Figure 5. Hysteresis

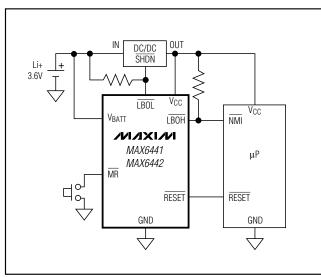


Figure 7. DC-to-DC Converter Application

Manual Reset

Many microprocessor-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset while the monitored supplies remain above their reset thresholds. These devices have a dedicated active-low $\overline{\text{MR}}$ pin. When $\overline{\text{MR}}$ is pulled low, $\overline{\text{RESET}}$ asserts a one-shot low pulse for the $\overline{\text{MR}}$ reset timeout period. The $\overline{\text{MR}}$ input has an internal 1.5k Ω pullup resistor to VCC and can be left unconnected if not used. $\overline{\text{MR}}$ can be driven with CMOS-

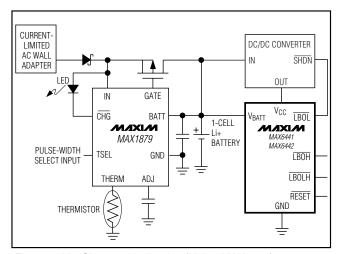


Figure 6. Li+ Charger Application (Using MAX1879)

logic levels, open-drain/open-collector outputs, or a momentary push-button switch to GND (the MR function is internally debounced for the $t_{\mbox{\footnotesize DEB}}$ timeout period) to create a manual reset function. If MR is driven from long cables, or if the device is used in a noisy environment, connect a $0.1\mu\mbox{F}$ capacitor from $\overline{\mbox{MR}}$ to GND to provide additional noise immunity (see Figure 4).

Hysteresis

Hysteresis increases the comparator's noise margin by increasing the upper threshold or decreasing the lower threshold. The hysteresis prevents the output from oscillating (chattering) when VBATT is near the low-battery threshold. This is especially important for applications where the load on the battery creates significant fluctuations in battery voltages (see Figure 5).

Applications Information

Li+ Battery Charger Application

The MAX6441/MAX6442 dual-output battery monitors can be used in conjunction with a battery charger to provide a system with additional information about the battery charge state. Many battery chargers, such as the MAX1879, provide the user with a CHG output, which tells the system when the battery is charged. The MAX6441/MAX6442 dual-output battery monitors provide three outputs, which can be used to relay the battery condition to the system. This information is useful in determining which system resources can be powered by the battery at the current charge state (see Figure 6).

Table 1. Factory-Trimmed Lower and Upper Threshold Combinations for Single-Cell Li+ or Three-Cell Alkaline/NiCd/NiMH Applications

	VOLTACES	UPPER THRESHOLD (HTH)				
	VOLTAGES	3.3V	3.4V	3.5V	3.6V	
	2.6V	AG	AH	Al	AJ	
LOWER THRESHOLD	2.7V	BG	BH	BI	BJ	
(LTH)	2.8V	CG	CH	CI	CJ	
(=)	2.9V	DG	DH	DI	DJ	
	3.0V	EG	EH	El	EJ	
	3.1V	FG	FH	FI	FJ	

Table 2. Factory-Trimmed Lower and Upper Threshold Combinations for Two-Cell Alkaline/NiCd/NiMH Applications

	VOLTAGES UPPER THRESHOLD (HTH)				
	VOLTAGES	2.3V	2.4V	2.5V	2.6V
_	1.6V	KQ	KR	KS	KT
LOWER THRESHOLD	1.7V	LQ	LR	LS	LT
(LTH)	1.8V	MQ	MR	MS	MT
(=,	1.9V	NQ	NR	NS	NT
	2.0V	OQ	OR	OS	OT
	2.1V	PQ	PR	PS	PT

Table 3. Factory-Trimmed VCC Reset Threshold Levels

PART NO. SUFFIX (_)	V _{CC} NOMINAL RESET THRESHOLD (V)
Т	3.075
S	2.925
R	2.625
Z	2.313
Υ	2.188
W	1.665
V	1.575

DC-to-DC Converter Application

The MAX6441/MAX6442 triple-output battery monitors can be used in conjunction with a DC-to-DC converter to power microprocessor systems using a single Li+cell or two to three alkaline/NiCd/NiMH cells. The LBOH output indicates that the battery voltage is weak, and is used to warn the microprocessor of potential problems. Armed with this information, the microprocessor can

Table 4. VCC Reset Timeout Period Suffix Guide

TIMEOUT	ACTIVE TIMEOUT PERIOD (ms)				
PERIOD SUFFIX	MIN	MAX			
D3	150	300			
D7	1200	2400			

reduce system power consumption. The $\overline{\text{LBOL}}$ output indicates the battery is empty, and system power should be disabled. By connecting $\overline{\text{LBOL}}$ to the $\overline{\text{SHDN}}$ pin of the DC-to-DC converter, power to the microprocessor is removed. Microprocessor power does not return until the battery has recharged to a voltage greater than $V_{\text{LTH+}}$ (see Figure 7).

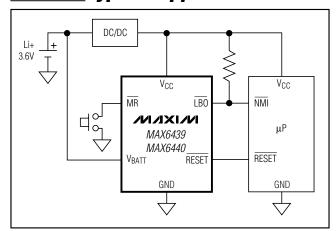
Selector Guide

PART	OPEN-DRAIN RESET	PUSH-PULL RESET	SINGLE LOW- BATTERY OUTPUT	DUAL LOW-BATTERY OUTPUT
MAX6439	X	_	X	_
MAX6440	_	X	X	_
MAX6441	X	_	_	X
MAX6442	_	Х	_	Х

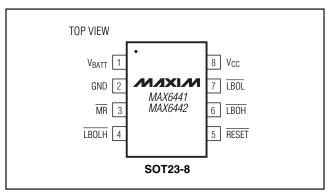
Standard Versions Table

TOP MARK	
ABMN	
ABMO	
ABMP	
ABMQ	
ABMR	
ABMS	
ABMT	
ABMU	
ABMV	
ABMW	
ABMX	
ABMY	
AEEI	
AEEJ	
AEEK	
AEEL	
AEEM	
AEEN	
AEEO	
AEEP	
AEEQ	
AEER	
AEES	
AEET	

Typical Application Circuit



_Pin Configurations (continued)



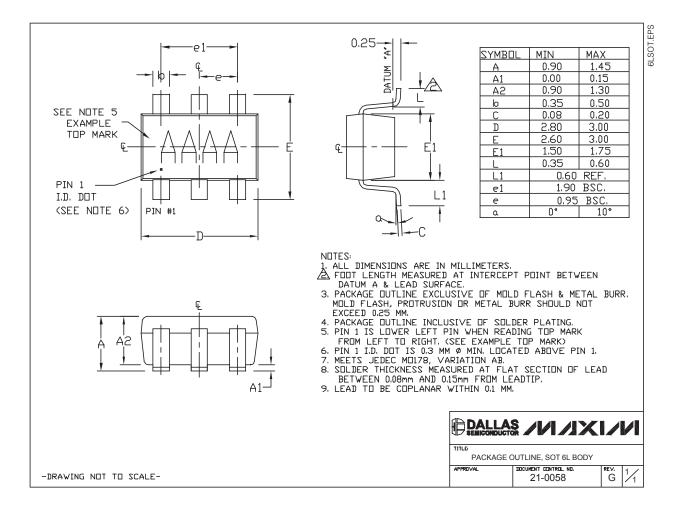
Chip Information

TRANSISTOR COUNT: 1478

PROCESS: BiCMOS

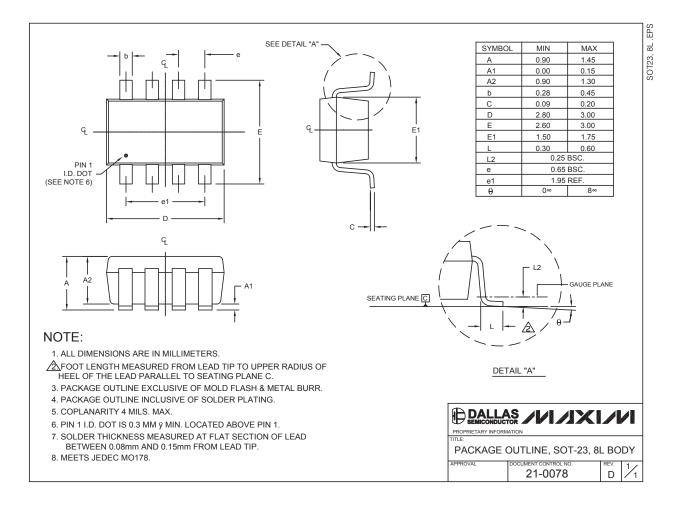
Package Information

(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.)



Package Information (continued)

(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.)



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