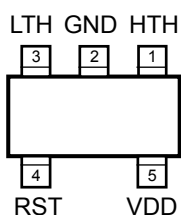


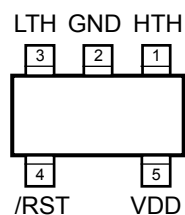
## Ordering Information

Part Number				Output Polarity	Accuracy	Temperature Range	Package
Standard	Marking	Pb-Free	Marking				
MIC2779H-2BM5	UPA2	MIC2779H-2YM5	<u>UPA2</u>	Active-High RST	2%	−40°C to +85°C	SOT-23-5
MIC2779H-1BM5	UPA1	MIC2779H-1YM5	<u>UPA1</u>	Active-High RST	1%	−40°C to +85°C	SOT-23-5
MIC2779L-2BM5	UPB2	MIC2779L-2YM5	<u>UPB2</u>	Active-Low /RST	2%	−40°C to +85°C	SOT-23-5
MIC2779L-1BM5	UPB1	MIC2779L-1YM5	<u>UPB1</u>	Active-Low /RST	1%	−40°C to +85°C	SOT-23-5

## Pin Configuration



**SOT-23-5 (M5)  
“H” Version**



**SOT-23-5 (M5)  
“L” Version**

## Pin Description

Pin Number MIC2779H	Pin Number MIC2779L	Pin Name	Pin Function
1	1	HTH	High-Voltage Theshold (Input): Analog input to a comparator. When the level on this pin initially rises above $V_{REF}$ , the delay generator cycles and the /RST remains low or RST remains high for a minimum of 140ms.
2	2	GND	Ground
3	3	LTH	Low-Voltage Threshold (Input): Analog input to a comparator. This is the voltage monitor input assigned to detect a low voltage condition. When the level on this pin falls below $V_{REF}$ , /RST or RST is asserted and the condition is latched until $V_{HTH} > V_{REF}$ .
4		RST	Reset (Output): Push-pull output. This output is asserted and latched when $V_{LTH} < V_{REF}$ , indicating a low voltage condition. This state remains latched until $V_{HTH} > V_{REF}$ . The polarity of this signal (active-high or low) is determined by the part number suffix. See ordering information.
	4	/RST	Reset (Output): Push-pull output. This output is asserted and latched when $V_{LTH} < V_{REF}$ , indicating a low voltage condition. This state remains latched until $V_{HTH} > V_{REF}$ . The polarity of this signal (active-high or low) is determined by the part number suffix. See ordering information.
5	5	VDD	Power Supply (Input): Independent supply input for internal circuitry.

**Absolute Maximum Ratings (Note 1)**

Supply Voltage ( $V_{DD}$ ).....-0.3V to +7V  
 Input Voltages ( $V_{LTH}$ ,  $V_{HTH}$ ,  $V_{/RST}$ ,  $V_{RST}$ ).....-0.3V to +7V  
 $/RST$ ,  $RST$  Output Current ( $I_{/RST}$ ,  $I_{RST}$ )..... 20mA  
 Storage Temperature ( $T_S$ ) ..... -65°C to +150°C  
 ESD Rating, **Note 3**..... 2kV

**Operating Ratings (Note 2)**

Supply Voltage ( $V_{DD}$ ) ..... +1.5V to +5.5V  
 Input Voltages ( $V_{LTH}$ ,  $V_{HTH}$ ,  $V_{/RST}$ ,  $V_{RST}$ ).....-0.3V to +6.0V  
 Ambient Temperature Range ( $T_A$ ) ..... -40°C to +85°C  
 Package Thermal Resistance..... 256°C/W

**Electrical Characteristics**

1.5V  $\leq V_{DD} \leq 5.5V$ ;  $T_A = +25^\circ\text{C}$ , **bold** values indicate  $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ ; unless noted

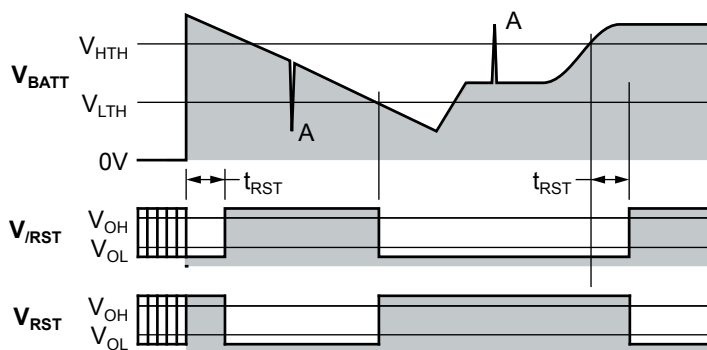
Symbol	Parameter	Condition	Min	Typ	Max	Units
$I_{DD}$	Supply Current	$/RST$ , $RST$ not asserted		1	<b>2</b>	$\mu\text{A}$
$I_{LTH}$ , $I_{HTH}$	Input Leakage Current			5		pA
					<b>10</b>	nA
$V_{REF}$	Reference Voltage			1.240		V
		MIC2779H/L-2	<b>1.215</b>		<b>1.265</b>	V
		MIC2779H/L-1	<b>1.228</b>		<b>1.252</b>	V
$t_D$	Propagation Delay	$V_{LTH} = V_{REF(max)} + 100\text{mV}$ to $V_{REF(min)} - 100\text{mV}$		5		$\mu\text{s}$
$t_{RESET}$	Reset Pulse Width		<b>140</b>		<b>420</b>	ms
$V_{OL}$	Reset Output Low Voltage	$/RST$ asserted or $RST$ not asserted, $I_{SINK} = 1.6\text{mA}$ , $V_{DD} \geq 1.6\text{V}$			<b>0.3</b>	V
		$/RST$ asserted or $RST$ not asserted, $I_{SINK} = 100\mu\text{A}$ , $V_{DD} \geq 1.2\text{V}$ ,			<b>0.4</b>	V
$V_{OH}$	Reset Output High Voltage	$/RST$ not asserted or $RST$ asserted, $I_{SOURCE} = 500\mu\text{A}$ , $V_{DD} \geq 1.6\text{V}$	<b><math>0.8V_{DD}</math></b>			V
		$/RST$ not asserted or $RST$ asserted, $I_{SOURCE} = 50\mu\text{A}$ , $V_{DD} \geq 1.2\text{V}$ ,	<b><math>0.8V_{DD}</math></b>			V

**Note 1.** Exceeding the absolute maximum rating may damage the device.

**Note 2.** The device is not guaranteed to function outside its operating rating.

**Note 3.** Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.

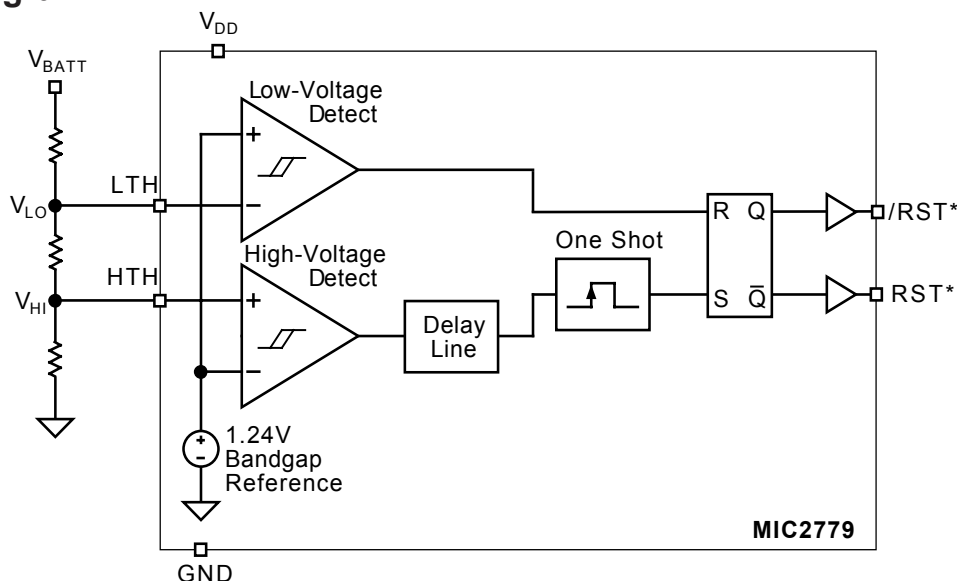
**Note 4.**  $V_{DD}$  operating range is 1.5V to 5.5V. Output is guaranteed to be held low down to  $V_{DD} = 1.2\text{V}$ .

**Timing Diagram**

Propagation delays not shown for clarity.

**Note A.** The MIC2779 ignores very brief transients.  
See "Applications Information" for details.

## Functional Diagram



\* Pinout and polarity vary by device type.  
See ordering information table.

## Functional Description

The MIC2779 monitors the voltage of a battery and detects when it is discharged below a programmed level. Upon being replaced, or being recharged above a second higher programmed trip point, the output remains low (MIC2779L) or high (MIC2779H) for a minimum of 140ms and then sends a reset signal to a microprocessor or other downstream component. See "Timing Diagram."

### /RST, RST Low Output

The output is a push-pull logic signal which is asserted when the MIC2779 detects a low input voltage. The MIC2779L's /RST output is active-low; the MIC2779H's RST output is active-high.

### Trip Points

Battery voltage is monitored by a comparator via a voltage divider network. The divided voltage is compared to an internal reference voltage. When the voltage at the LTH input pin drops below the internal reference voltage, the output is asserted. At this point, the voltage at HTH is assumed to be below the reference voltage.

### Delay

At power-on or when the battery is replaced or recharged, and the voltage at HTH exceeds the reference voltage, the output is deasserted after a minimum delay of 140ms.

## Applications Information

### Programming the Thresholds

The low-voltage threshold is calculated using:

$$V_{BAT(lo)} = V_{REF} \left( \frac{R1 + R2 + R3}{R2 + R3} \right)$$

The high-voltage threshold is calculated using:

$$V_{BAT(hi)} = V_{REF} \left( \frac{R1 + R2 + R3}{R3} \right)$$

where, for both equations:

$$V_{REF} = 1.240V$$

In order to provide the additional criteria needed to solve for the resistor values, the resistors can be selected such that they have a given total value, that is,  $R1 + R2 + R3 = R_{TOTAL}$ . A value such as  $1M\Omega$  for  $R_{TOTAL}$  is a reasonable value because it draws minimum battery current but has no measurable effect on accuracy.

When working with large resistors, a small amount of leakage current can cause voltage offsets that degrade system accuracy. The maximum recommended total resistance from  $V_{BAT}$  to ground is  $3M\Omega$ .

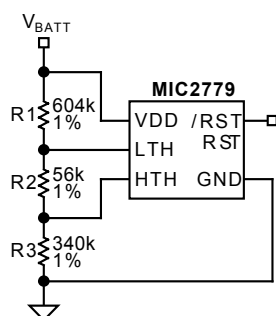


Figure 1. Example Circuit

Once the desired trip points are determined, set the  $V_{BAT(hi)}$  threshold first.

For example, use a total of  $1M\Omega = R1 + R2 + R3$ . For a typical single-cell lithium ion battery, 3.6V is a good "high threshold" because at 3.6V the battery is moderately charged. Solving for R3:

$$V_{BAT(hi)} = 1.24 \left( \frac{1M\Omega}{R3} \right)$$

$$R3 = 344k\Omega$$

Once R3 is determined, the equation for  $V_{BAT(lo)}$  can be used to determine R2. A single lithium-ion cell should not be discharged below 2.5V. Many applications limit the drain to 3.1V. Using 3.1V for the  $V_{BAT(lo)}$  threshold allows calculation of the two remaining resistor values.

$$V_{BAT(lo)} = 3.1V = 1.24 \left( \frac{1M\Omega}{R2 + 344k} \right)$$

$$R2 = 56k\Omega$$

$$R1 = 1M\Omega - R2 - R3$$

$$R1 = 600k\Omega$$

The accuracy of the resistors can be chosen based upon the accuracy required by the system.

### Input Transients

The MIC2779 is inherently immune to very short negative-going "glitches." Very brief transients may exceed the  $V_{BAT(lo)}$  threshold without tripping the output.

As shown in Figure 2, the narrower the transient, the deeper the threshold overdrive that will be ignored by the MIC2779. The graph represents the typical allowable transient duration for a given amount of threshold overdrive that will not generate a reset.

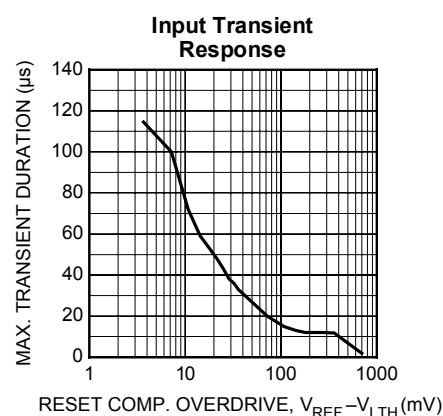
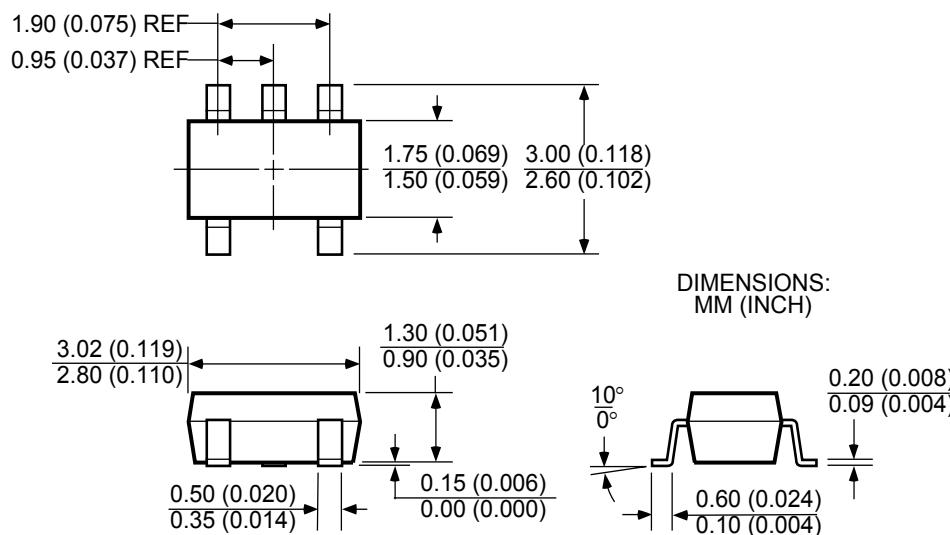


Figure 2. Input Transient Response

## Package Information



**5-Pin SOT-23 (M5)**

**MICREL INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA**

TEL + 1 (408) 944-0800 FAX + 1 (408) 474-1000 WEB <http://www.micrel.com>

This information furnished by Micrel in this data sheet is believed to be accurate and reliable. However no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer.

Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is a Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 2000 Micrel, Inc.