MIC2779

Voltage Monitor with Adjustable Hysteresis

Features

- Optimized for PDAs, Cellular Telephones, Pagers, and Other Battery-Powered Devices
- Independently Adjustable High- and Low-Voltage Thresholds
- Internal Logic Prevents Battery Voltage Fluctuation Chatter
- High ±2% Voltage Threshold Accuracy
- Built-In 140 ms (Minimum) Delay Deglitches Output
- Extremely Low 1 µA Typical Supply Current
- For Applications that Require Open-Drain Output, See MIC2778/MIC833
- Immune to Brief Power Supply Transients
- Available in 5-Lead SOT23 Package

Applications

- PDAs
- Pagers
- Cordless Phones
- Consumer Electronics
- Embedded Controllers
- Personal Electronics

General Description

The MIC2779 is a voltage monitor that is uniquely designed to detect two separate voltage thresholds combined with a delay generator and logic. It is designed for monitoring the battery supply of portable digital systems, particularly PDAs, pagers, and cellular telephones.

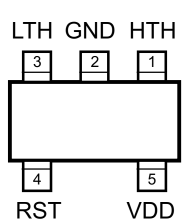
High- and low-voltage thresholds can be adjusted independently, allowing for wide hysteresis. Voltage detection thresholds are accurate to 2%.

If the battery voltage falls below the low-voltage threshold, the output /RST or RST is asserted and latched, preventing system operation until the battery is replaced or recharged. Internal logic prevents the output from chattering due to battery recovery or load removal. The output is asserted for 140 ms (minimum) when a fresh battery is inserted. For applications requiring open-drain output, see MIC2778/MIC833.

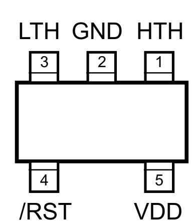
The IC's power supply input is separate from the detector inputs, allowing the MIC2779 to be powered from a downstream supply, such a boost converter. Supply current is extremely low (1 µA, typical), making it ideal for portable applications. The MIC2779 is supplied in a 5-lead SOT23 package.

Package Types

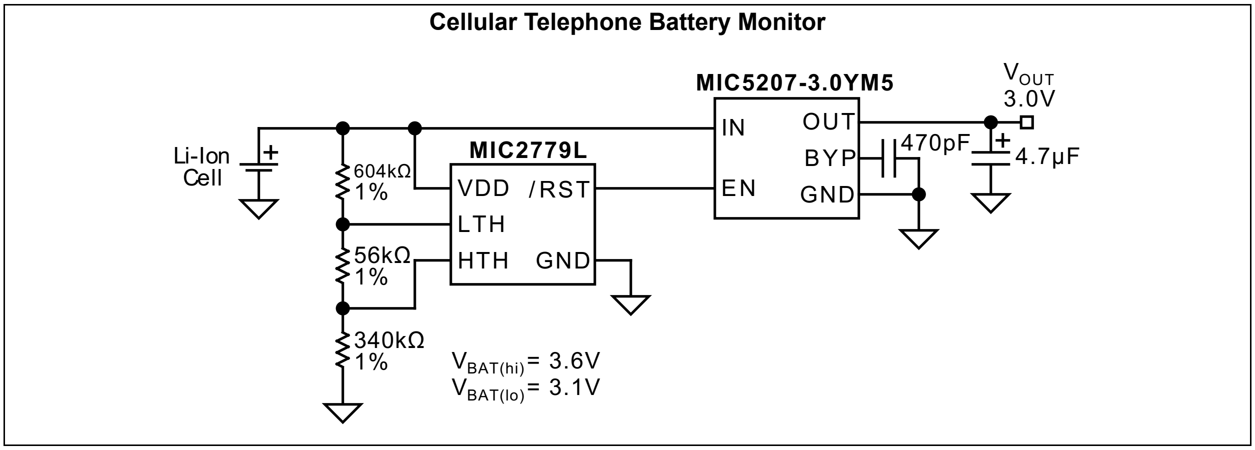
MIC2779H
SOT23-5 (M5)
(Top View)



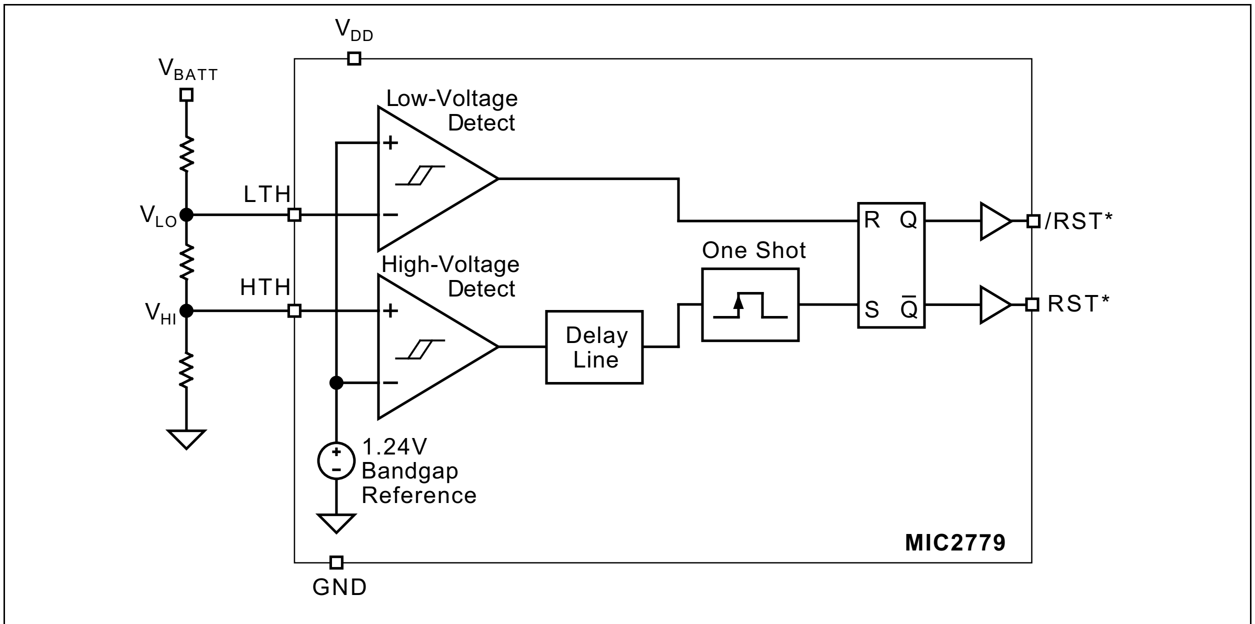
MIC2779L
SOT23-5 (M5)
(Top View)



Typical Application Circuit



Functional Block Diagram



* Pinout and polarity vary by device type.
See Product Identification System section.

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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

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}) .... 20 mA
Storage Temperature (T_S) .... –65°C to +150°C
ESD Rating (Note 1) .... 2 kV

Operating Ratings ††

Supply Voltage (V_{DD}, Note 2) .... +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
5-Ld SOT23 .... 256°C/W

† Notice: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

†† Notice: The device is not guaranteed to function outside its operating ratings.

Note 1: Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5 kΩ in series with 100 pF.

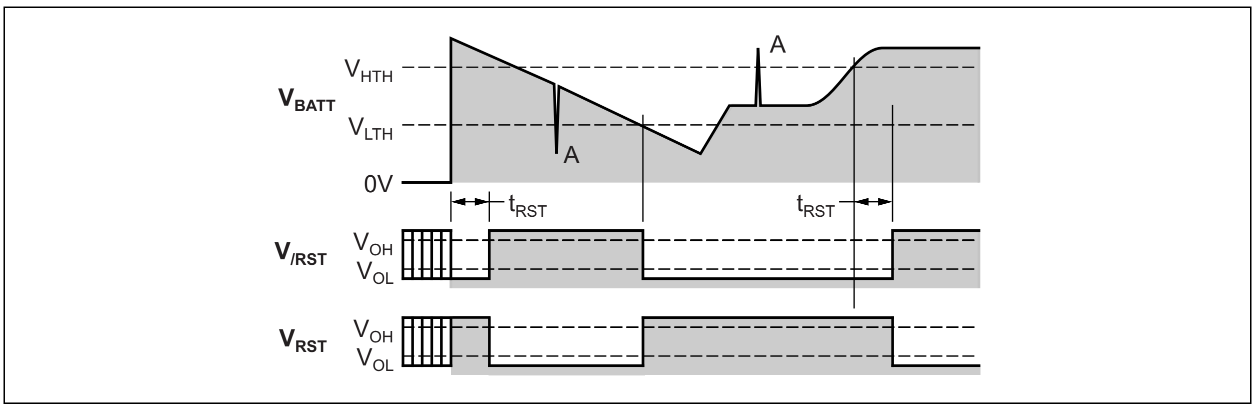
2: V_{DD} operating range is 1.5V to 5.5V. Output is guaranteed to be held low, down to V_{DD} = 1.2V.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: 1.5V ≤ V_{DD} ≤ 5.5V; T_A = +25°C, **bold** values indicate –40°C ≤ T_A ≤ +85°C, unless noted.

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Supply Current	I_{DD}	—	1	**2**	µA	/RST, RST not asserted
Input Leakage Current	I_{LTH}, I_{HTH}	—	5	—	pA	—
		—	—	**10**	nA	
Reference Voltage	V_{REF}	—	1.240	—	V	—
		1.215	—	**1.265**		MIC2779H/L-2
Propagation Delay	t_D	—	5	—	µs	V_{LTH} = $V_{REF(MAX)}$ +100 mV to $V_{REF(MIN)}$ – 100 mV
Reset Pulse Width	t_{RESET}	**140**	—	**420**	ms	—
Reset Output Low Voltage	V_{OL}	—	—	**0.3**	V	/RST asserted or RST not asserted, I_{SINK} = 1.6 mA, V_{DD} ≥ 1.6V
		—	—	**0.4**		/RST asserted or RST not asserted, I_{SINK} = 100 µA, V_{DD} ≥ 1.2V
Reset Output High Voltage	V_{OH}	**0.8VDD**	—	—	V	/RST not asserted or RST asserted, I_{SOURCE} = 500 µA, V_{DD} ≥ 1.6V
		0.8VDD	—	—		/RST not asserted or RST asserted, I_{SOURCE} = 50 µA, V_{DD} ≥ 1.2V

Timing Diagram



Propagation delays not shown for clarity. The MIC2779 ignores very brief transients. See the Application Information section for details.

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TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Ambient Temperature Range	T_A	–40	—	+85	°C	—
Storage Temperature Range	T_S	–65	—	+150	°C	—
Package Thermal Resistances						
Thermal Resistance, SOT23-5	θ_{JA}	—	256	—	°C/W	—

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +85°C rating. Sustained junction temperatures above +85°C can impact the device reliability.

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2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

Pin Number MIC2779H	Pin Number MIC2779L	Pin Name	Description
1	1	HTH	High-Voltage Threshold (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 140 ms.
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 Product Identification System.
—	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 Product Identification System.
5	5	VDD	Power Supply (Input): Independent supply input for internal circuitry.

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3.0 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 140 ms and then sends a reset signal to a microprocessor or other downstream component. See the Timing Diagram.

3.1 /RST, RST Low Output

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

3.2 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.

3.3 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 140 ms.

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4.0 APPLICATION INFORMATION

4.1 Programming the Thresholds

The low-voltage threshold is calculated using Equation 4-1.

EQUATION 4-1:

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

Where:
V_{REF} = 1.240V

The high-voltage threshold is calculated using Equation 4-2.

EQUATION 4-2:

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

Where:
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 1 MΩ 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 3 MΩ.

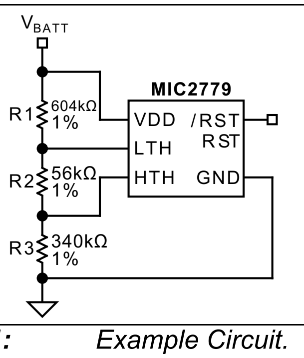

FIGURE 4-1: *Example Circuit.*

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

For example, use a total of 1 MΩ = 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:

EQUATION 4-3:

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

$$R3 = 344k\Omega$$

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 one to calculate the values of the two remaining resistor values.

EQUATION 4-4:

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

$$R2 = 56k\Omega$$

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

$$R1 = 600k\Omega$$

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

4.2 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 4-2, 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.

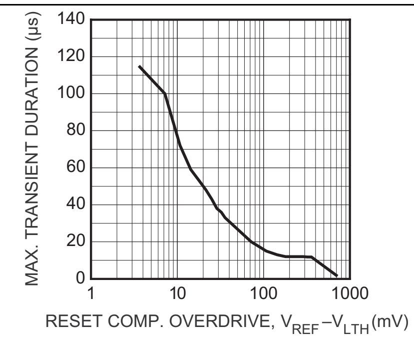

FIGURE 4-2: *Input Transient Response.*

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5.0 PACKAGING INFORMATION

5.1 Package Marking Information

5-Lead SOT23*	Example
XXXX NNN	UPB1 288

Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

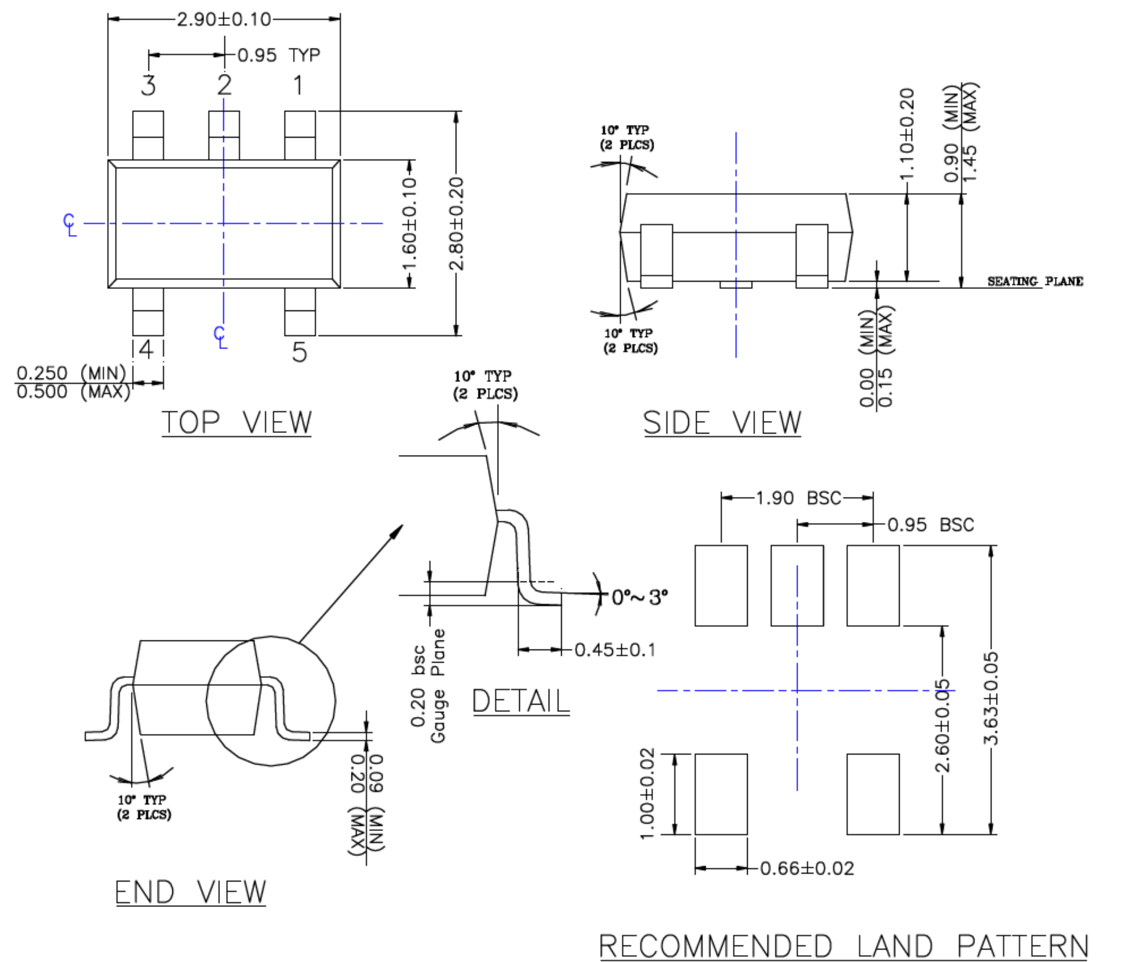
Underbar (_) and/or Overbar (‾) symbol may not be to scale.

5-Lead SOT23 Package Outline & Recommended Land Pattern

TITLE

5 LEAD SOT23 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOT23-5LD-PL-1	**UNIT**	MM



NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & BURR.
2. PACKAGE OUTLINE INCLUSIVE OF SOLER PLATING.
3. DIMENSION AND TOLERANCE PER ANSI Y14.5M, 1982.
4. FOOT LENGTH MEASUREMENT BASED ON GAUGE PLANE METHOD.
5. DIE FACES UP FOR MOLD, AND FACES DOWN FOR TRIM/FORM.
6. ALL DIMENSIONS ARE IN MILLIMETERS.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

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APPENDIX A: REVISION HISTORY

Revision A (November 2018)

- Converted Micrel document MIC2779 to Microchip data sheet template DS20006116A.
- Minor grammatical text changes throughout.
- Removed all reference to the 1% accuracy part option.

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NOTES:

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PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

Device	X	-X	X	XX	-XX
Part No.	Output Polarity	Accuracy	Junction Temp. Range	Package	Media Type

Device:	MIC2779: Voltage Monitor with Adjustable Hysteresis
Output Polarity:	H = Active-High RST L = Active-Low /RST
Accuracy:	-2 = Accurate to 2%
Junction Temperature Range:	Y = –40°C to +85°C, RoHS-Compliant
Package:	M5 = 5-Lead SOT23
Media Type:	TR = 3,000/Reel

Examples:

a) MIC2779H-2YM5-TR: MIC2779, Active-High RST, Accurate to 2%, –40°C to +85°C Temperature Range, 5-Lead SOT23, 3,000/Reel

b) MIC2779L-2YM5-TR: MIC2779, Active-Low /RST, Accurate to 2%, –40°C to +85°C Temperature Range, 5-Lead SOT23, 3,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

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NOTES:

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ISBN: 978-1-5224-3882-3

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