

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 $\pm 2\%$ 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.

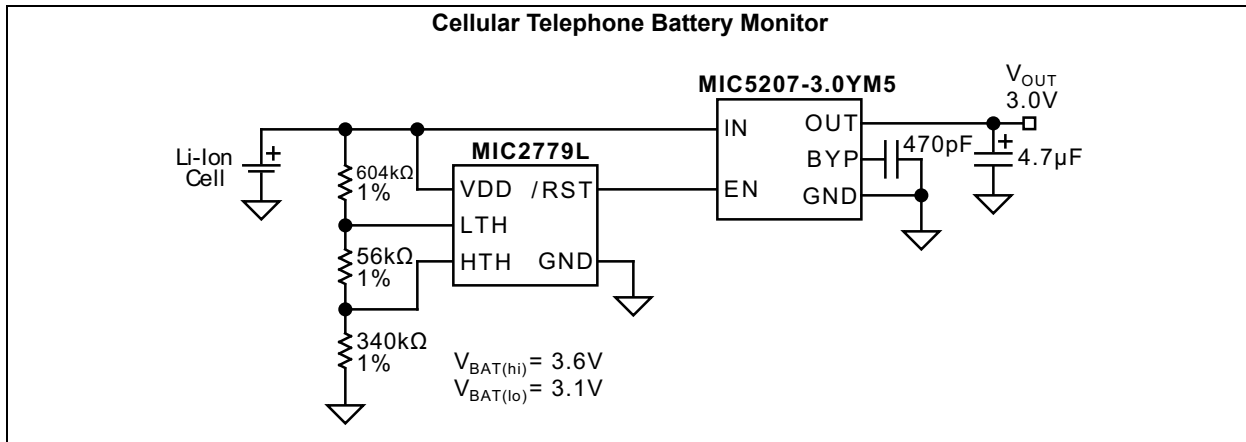
The IC's power supply input is separate from the detector inputs, allowing the MIC2779 to be powered from a downstream supply, such a boost converter. Supply current is extremely low (1 μA , typical), making it ideal for portable applications. The MIC2779 is supplied in a 5-lead SOT23 package.

Package Types

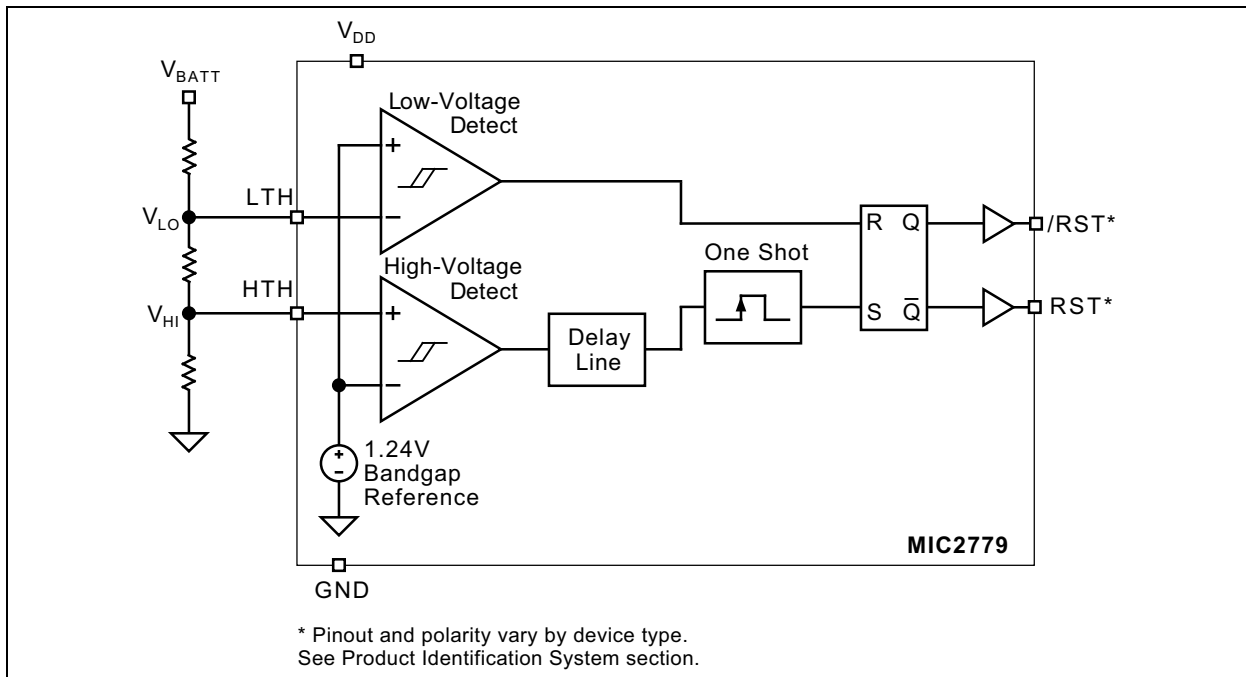


MIC2779

Typical Application Circuit



Functional Block Diagram



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 $V_{DD} = 1.2V$.

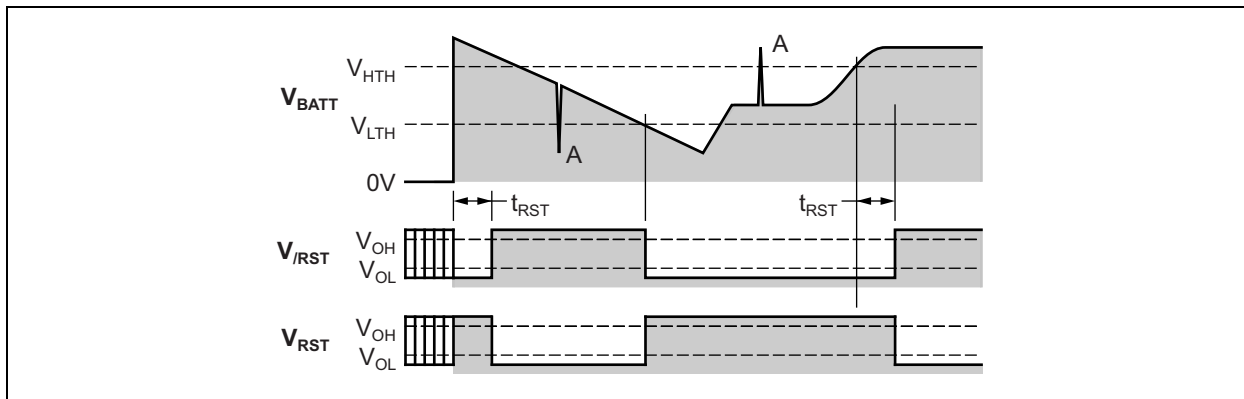
MIC2779

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $1.5V \leq V_{DD} \leq 5.5V$; $T_A = +25^\circ C$, **bold** values indicate $-40^\circ C \leq T_A \leq +85^\circ C$, 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	—	μA	—
		—	—	10	nA	
Reference Voltage	V_{REF}	—	1.240	—	V	—
		1.215	—	1.265		MIC2779H/L-2
Propagation Delay	t_D	—	5	—	μs	$V_{LTH} = V_{REF(MAX)} + 100\text{ mV}$ to $V_{REF(MIN)} - 100\text{ mV}$
Reset Pulse Width	t_{RESET}	140	—	420	ms	—
Reset Output Low Voltage	V_{OL}	—	—	0.3	V	/RST asserted or RST not asserted, $I_{SINK} = 1.6\text{ mA}$, $V_{DD} \geq 1.6V$
		—	—	0.4		/RST asserted or RST not asserted, $I_{SINK} = 100\ \mu A$, $V_{DD} \geq 1.2V$
Reset Output High Voltage	V_{OH}	$0.8V_{DD}$	—	—	V	/RST not asserted or RST asserted, $I_{SOURCE} = 500\ \mu A$, $V_{DD} \geq 1.6V$
		$0.8V_{DD}$	—	—		/RST not asserted or RST asserted, $I_{SOURCE} = 50\ \mu A$, $V_{DD} \geq 1.2V$

Timing Diagram



Propagation delays not shown for clarity. The MIC2779 ignores very brief transients. See the [Application Information](#) section for details.

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.

MIC2779

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 \overline{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} , \overline{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	\overline{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.

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.

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 $1\text{ M}\Omega$ 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 $3\text{ M}\Omega$.

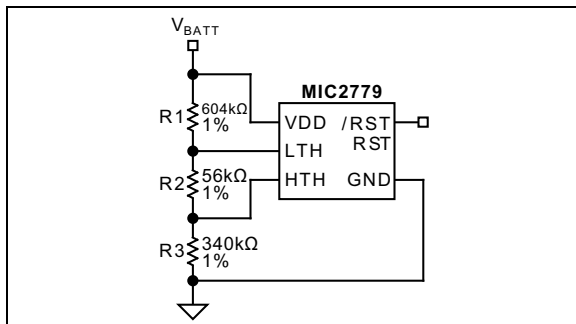


FIGURE 4-1: Example Circuit.

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

For example, use a total of $1\text{ M}\Omega = R1 + R2 + R3$. 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 $R3$:

EQUATION 4-3:

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

$$R3 = 344\text{k}\Omega$$

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:

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

$$R2 = 56\text{k}\Omega$$

$$R1 = 1\text{M}\Omega - R2 - R3$$

$$R1 = 600\text{k}\Omega$$

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.

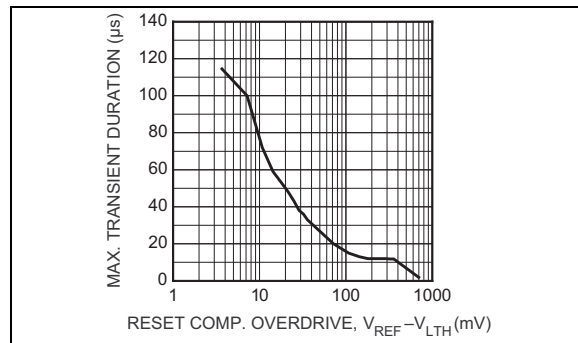


FIGURE 4-2: Input Transient Response.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

5-Lead SOT23*

<p style="text-align: center;"><u>XXXX</u> NNN</p>
--

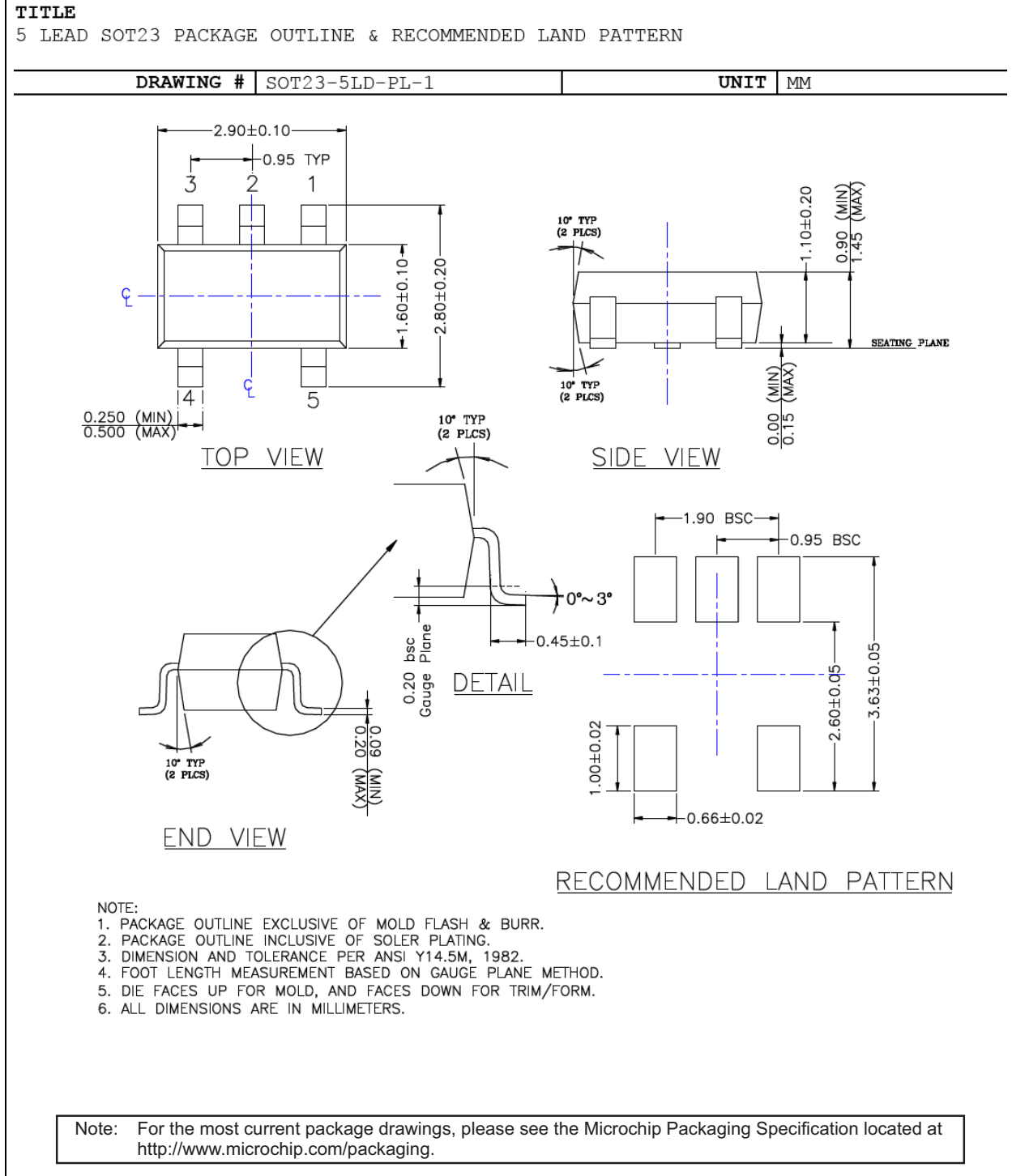
Example

<p style="text-align: center;"><u>UPB1</u> 288</p>
--

<p>Legend:</p> <p>XX...X Product code or customer-specific information</p> <p>Y Year code (last digit of calendar year)</p> <p>YY Year code (last 2 digits of calendar year)</p> <p>WW Week code (week of January 1 is week '01')</p> <p>NNN Alphanumeric traceability code</p> <p>(e3) Pb-free JEDEC® designator for Matte Tin (Sn)</p> <p>* This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.</p> <p>•, ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).</p>	<p>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.</p> <p>Underbar (<u> </u>) and/or Overbar (<u> </u>) symbol may not be to scale.</p>
---	---

MIC2779

5-Lead SOT23 Package Outline & Recommended Land Pattern



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.

MIC2779

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

Device	<u>X</u>	<u>-X</u>	<u>X</u>	<u>XX</u>	<u>-XX</u>
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.

MIC2779

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO/TS 16949 =**

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KeeLoq, Klear, LANCheck, LINK MD, maXStylus, maXTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntellIMOS, mTouch, Precision Edge, and Quiet-Wire are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2018, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-3882-3



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta

Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX

Tel: 512-257-3370

Boston

Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago

Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles

Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC

Tel: 919-844-7510

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-67-3636

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for [Supervisory Circuits](#) category:

Click to view products by [Microchip](#) manufacturer:

Other Similar products are found below :

[CAT1161LI-25-G](#) [CAT853STBI-T3](#) [CAT1026LI-30-G](#) [CAT1320LI-25-G](#) [TC54VN2402EMB713](#) [MCP1316T-44NE/OT](#) [MCP1316MT-45GE/OT](#) [MCP1316MT-23LI/OT](#) [MAX8997EWW+](#) [MAX6725AKASYD3-LF-T](#) [DS1232L](#) [NCV302HSN45T1G](#) [PT7M6130NLTA3EX](#) [PT7M7811STBEX-2017](#) [S-1000N28-I4T1U](#) [CAT1161LI-28-G](#) [MCP1321T-29AE/OT](#) [MCP1319MT-47QE/OT](#) [S-1000N23-I4T1U](#) [S-1000N19-I4T1U](#) [CAT824UTDI-GT3](#) [TC54VC2502ECB713](#) [PT7M6133NLTA3EX](#) [PT7M6127NLTA3EX](#) [AP0809ES3-r](#) [HG811RM4/TR](#) [MD7030C](#) [MD7033C](#) [MD7019](#) [MD7020](#) [MD7021](#) [MD7023](#) [MD7024](#) [MD7027](#) [MD7030](#) [MD7033](#) [MD7035](#) [MD7036](#) [MD7039](#) [MD7040](#) [MD7044](#) [MD7050](#) [MD7015](#) [MD7022](#) [MD7028](#) [MD7031](#) [MD7042](#) [MD7043](#) [MD7047](#) [MD7060](#)