MTCH101

Single-Channel Proximity Detector

Features:

- Capacitive Proximity Detection System:
  - High Signal to Noise Ratio (SNR)
  - Adjustable sensitivity
  - Noise rejection filters
  - Automatic Environmental Compensation
  - Wide range of sensor shape and size support
  - Stuck Release Mechanism
- No External Components
- Low-Power mode
- Response Time Down to 75 ms
- Wide Operative Voltage:
  - 2.0V to 5.5V
- Operating Temperature:
  - -40°C to +85°C

Applications:

- Light Switch
- Portable Device Enabler
- White Goods and Appliances
- Office Equipment and Toys
- Display and Keypad Backlighting Activation
- SAR Compliant Application

Package Type

The device is available in 6-lead SOT-23 packaging (see Figure 1).

FIGURE 1: 6-PIN DIAGRAM

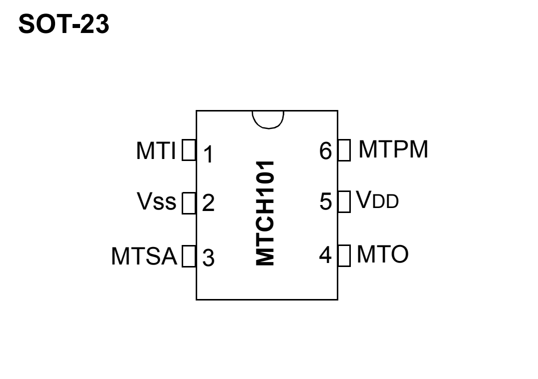

TABLE 1: 6-PIN SOT-23 PINOUT DESCRIPTION

I/O	6-Pin SOT-23	Description
MTI	1	Proximity Sensor Input
VSS	2	Ground
MTSA	3	Sensitivity Adjust Input
MTO	4	Detect Output (Active-Low)
VDD	5	Power Supply Input
MTPM	6	Low-Power mode Select (Active-Low)

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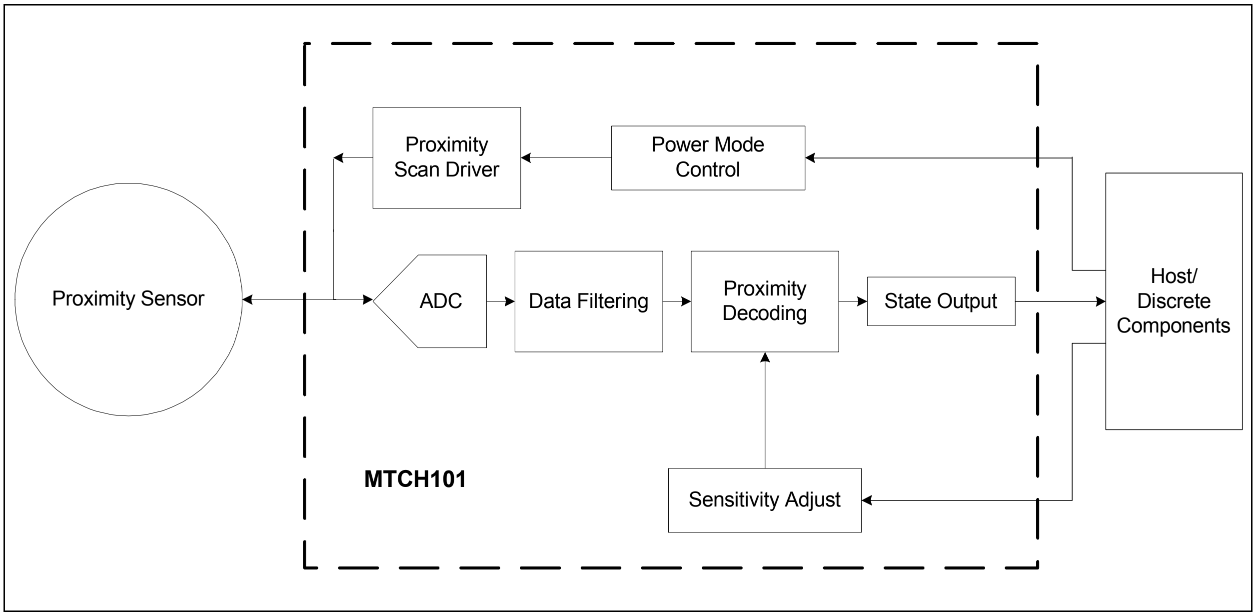
1.0 DEVICE OVERVIEW

The MTCH101 provides an easy way to add proximity or touch detection to any human interface application.

The device integrates a single-channel capacitive proximity detection, which can work through plastic, glass or wood-front panel. It also supports a wide range of conductive materials as sensor, like copper pad on PCB, silver or carbon printing on plastic, Indium Tin Oxide (ITO) pad, wire/cable, etc. On-board adjustable sensitivity and power mode selection allow the user to configure the device at run time easily. An active-low output will communicate the state of the sensor to a host/master MCU, or drive an indication LED (see Figure 1-1).

FIGURE 1-1: BLOCK DIAGRAM



2.0 TYPICAL CIRCUIT

The MTCH101 can work either as a stand-alone device to control a LED (see Figure 2-1) to indicate touch/ proximity, or work with host MCU (see Figure 2-2).

FIGURE 2-1: TYPICAL CIRCUIT AS STAND-ALONE

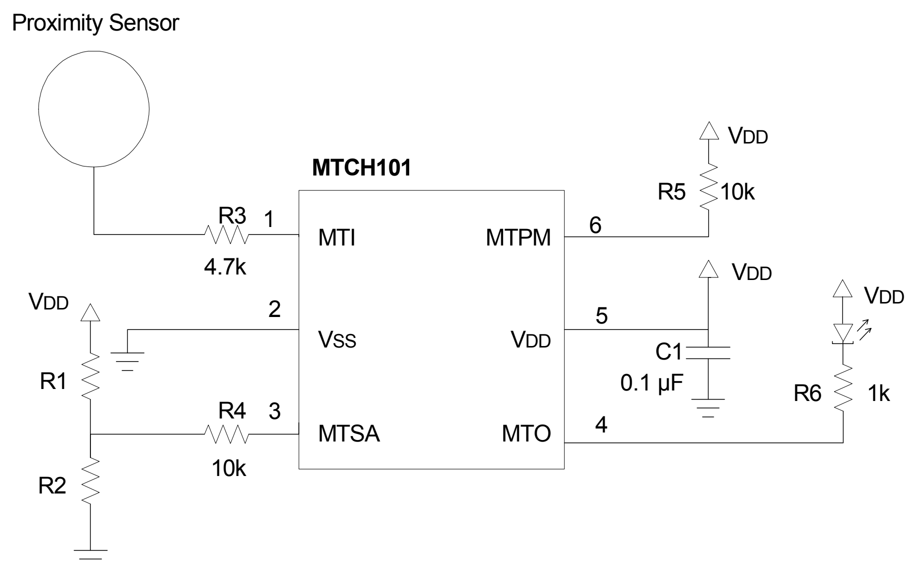
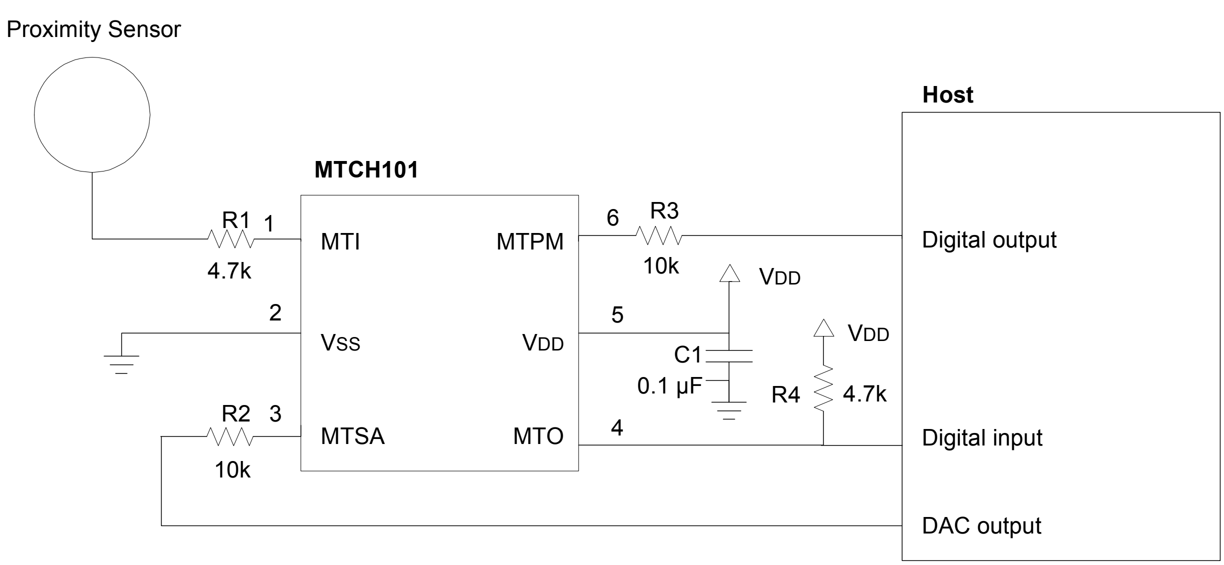


FIGURE 2-2: TYPICAL CIRCUIT WITH HOST MCU

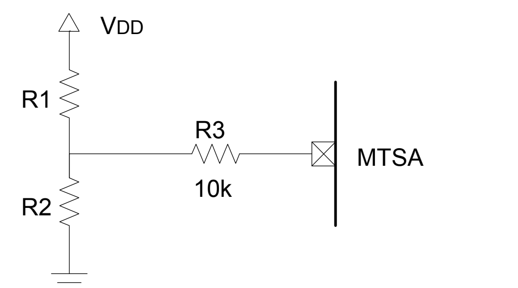


3.0 SENSITIVITY ADJUSTMENT

The sensitivity of the system determines how far and fast it can respond to proximity or touch. The MTCH101 provides the MTSA pin to adjust the sensitivity, and the voltage on this pin will determine the sensitivity. VDD voltage will give the lowest sensitivity, while GND voltage will give the highest sensitivity.

The device will sample the voltage on the MTSA pin after each scan, so it does not only support setting a fixed sensitivity by a resistor ladder, but it also allows adjusting the sensitivity dynamically, while the device is running. A Digital-to-Analog Converter (DAC) controlled by the host, or a hardware potentiometer can be used to adjust the sensitivity. See typical circuit in Figure 3-1 to Figure 3-4.

FIGURE 3-1: FIXED SENSITIVITY USING RESISTOR LADDER



Note: Both R1 and R2 are recommended to be greater than 100K for lower power consumption.

FIGURE 3-2: HARDWARE SENSITIVITY ADJUST USING POTENTIOMETER

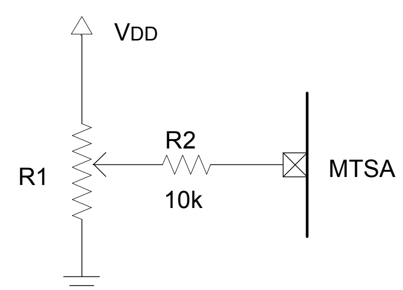


FIGURE 3-3: SENSITIVITY CONTROLLED BY HOST USING DAC

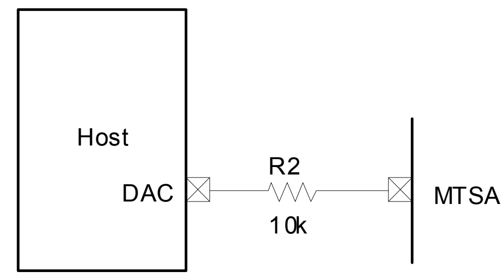
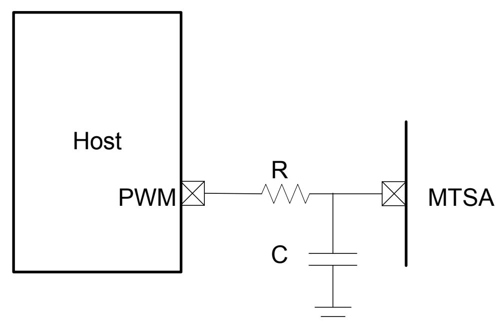


FIGURE 3-4: SENSITIVITY CONTROLLED BY HOST USING PWM



Note 1:	Application Note AN538, *"Using PWM to Generate Analog Output"* has details about how to choose appropriate R and C values.

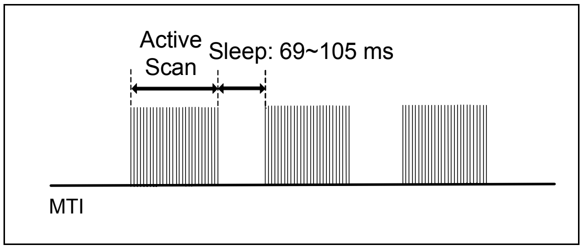
4.0 POWER MODE

The MTCH101 has two power mode options: Normal mode and Low-Power mode. The state of the MTPM pin determines the power mode.

4.1 Normal Mode Option

The device will run in Normal mode if the MTPM pin is set high and no proximity or touch is detected. In this mode, after an active scan, sleep time is between 69 and 105 ms, as shown in Figure 4-1. The sleep time depends on the VDD voltage, the lower the voltage, the more time it will be in the Idle state.

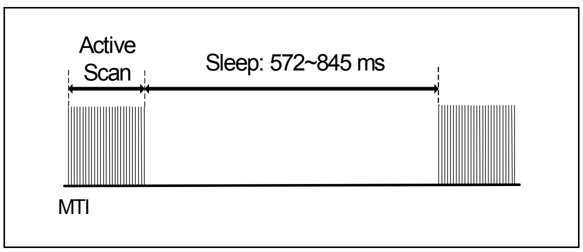
FIGURE 4-1: NORMAL MODE



4.2 Low-Power Mode Option

The device will run in Low-Power mode if the MTPM pin is set low and no proximity or touch is detected. In this mode, after an active scan, sleep time is between 572 and 845 ms, as shown in Figure 4-2. As in Normal mode, the sleep time depends on the VDD voltage, the lower the voltage, the more time it will be in the Idle state.

FIGURE 4-2: LOW-POWER MODE



Note:	If the device makes a proximity or touch detection, it will automatically perform active scans continually. Once the device releases from its proximity-detected state, it will return to the power mode set by the MTPM pin.

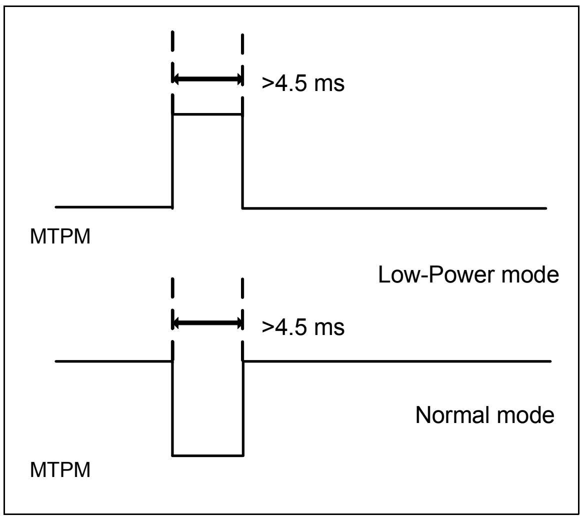
5.0 RESET

The MTCH101 can be stuck in a proximity-detected state in some cases, such as sudden temperature change, or higher dielectric materials (metal, wood or glass) present near the sensor. Two methods can be used to release the proximity-detected state without repowering the device.

5.1 Reset by the MTPM pin

Changing the state of the MTPM pin, either from low-to-high or from high-to-low, will reset the proximity detection system and release the detection state. If the device needs to keep the same power mode, then a pulse, which holds at least 4.5 ms, can be used to reset the device (see Figure 5-1). This reset method can be used at anytime during the operation, not only when the state is stuck in a proximity-detected state.

FIGURE 5-1: RESET PULSE DURATION REQUIREMENT

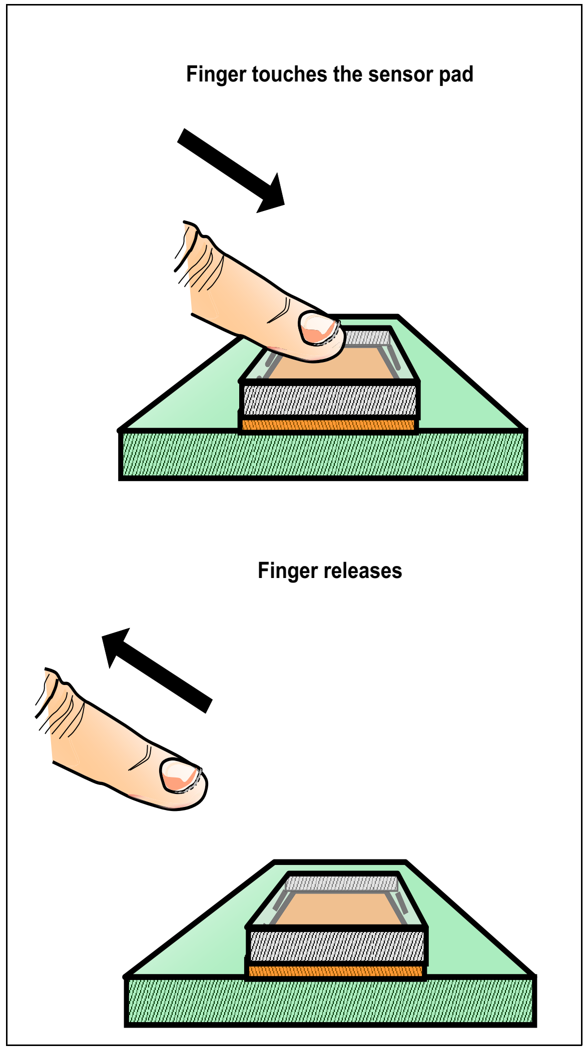


Note:	In non-detected state, because the device goes to Sleep for a certain time, the Reset pulse duration should be 4.5 ms plus the Sleep time.

5.2 Reset by Touch and Release

A stuck release mechanism is implemented for this device. When the device is stuck in a proximity-detected state, the user can touch the sensor pad and then release. This action will release the proximity-detected state (see Figure 5-2).

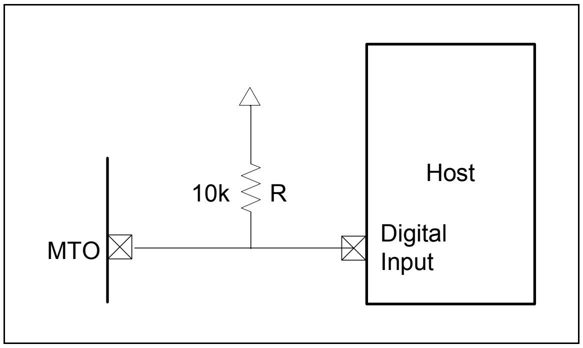
FIGURE 5-2: RESET BY TOUCH AND RELEASE



6.0 INTERFACE WITH THE HOST

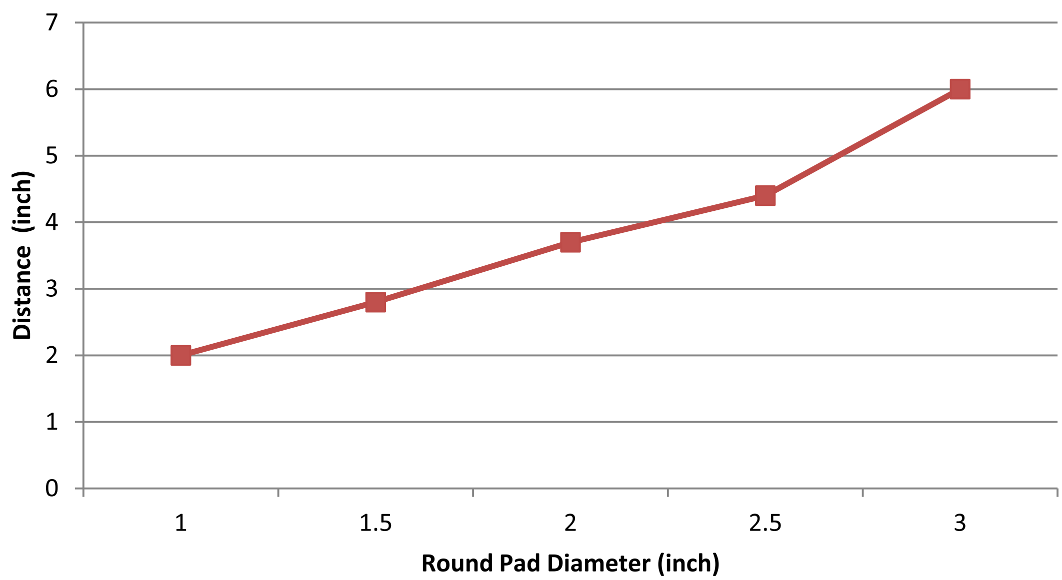
The MTO pin can be considered as an open drain output. A pull-up resistor (usually 3.3k~10 kΩ) is needed to interface with a host. The pull-up voltage can be any voltage lower than V_{DD}. This allows a simple interface with a lower V_{DD} host device (see Figure 6-1).

FIGURE 6-1: INTERFACE WITH THE HOST



7.0 DETECTION DISTANCE

FIGURE 7-1: DISTANCE vs. SENSOR AREA



Note:	The tested sensors are round solid pads on FR4 PCB. No ground plane was near the sensor, as this would give the maximum detection distance.

8.0 ELECTRICAL CHARACTERISTICS

8.1 Absolute Maximum Ratings(†)

Ambient temperature under bias .... -40°C to +125°C
Storage temperature .... -65°C to +150°C
Voltage on pins with respect to V_{SS}
  on V_{DD} pin .... 0 to +6.5V
  on all other pins .... -0.3V to (V_{DD} + 0.3V)
Max. current
  out of V_{SS} pin .... 80 mA
  into V_{DD} pin .... 80 mA
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{DD}$) .... ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{DD}$) .... ±20 mA
Max. output current
  sunk by any I/O pin .... 25 mA
  sourced by any I/O pin .... 25 mA

†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 operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

8.2 Standard Operating Conditions

The standard operating conditions for any device are defined as:

Operating Voltage: $V_{DDMIN} \le V_{DD} \le V_{DDMAX}$
Operating Temperature: $T_{A\_MIN} \le T_A \le T_{A\_MAX}$

V_{DD} — Operating Supply Voltage(1)

  V_{DDMIN} .... +2.0V
  V_{DDMAX} .... +5.5V

T_A — Operating Ambient Temperature Range

 Industrial Temperature

  T_{A_MIN} .... -40°C
  T_{A_MAX} .... +85°C

Note 1: See Parameter D001 in Table 8-1.

Note:	The tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore, outside the warranted range.

8.3 DC Characteristics

TABLE 8-1: MTCH101 (INDUSTRIAL)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise specified)				
Param No.	**Sym.**	**Characteristic**	**Min.**	**Typ†**	**Max.**	**Units**	**Conditions**
D001	VDD	**Supply Voltage**	2.0	—	5.5	V	
D002	VPOR	**VDD Start Voltage** to ensure Power-on-Reset	—	Vss	—	V	
D003	SVDD	**VDD Rise Rate** to ensure Power-on Reset	0.05*	—	—	V/ms	

* These parameters are characterized but not tested.

† Data in “Typ” column is at 3.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

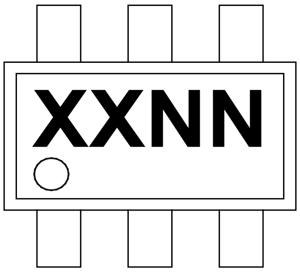
TABLE 8-2: RESPONSE TIME AND CURRENT CONSUMPTION

Power Mode	Typical Current (µA)	Highest Sensitivity Response Time (ms)		Lowest Sensitivity Response Time (ms)		Conditions
		Typical	Max.	Typical	Max.	
Normal mode	120	100	150	210	260	VDD = 2.0V
Low-Power mode	30	790	890	900	1000	
Normal mode	200	80	130	190	240	VDD = 3.3V
Low-Power mode	54	640	740	750	850	
Normal mode	340	76	119	190	220	VDD = 5.0V
Low-Power mode	97	530	620	640	730	

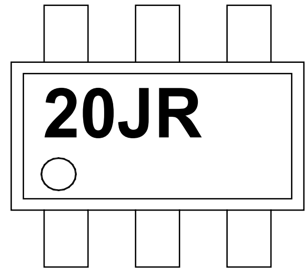
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

6-Lead SOT-23



Example



Legend:	XX...X	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.

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.

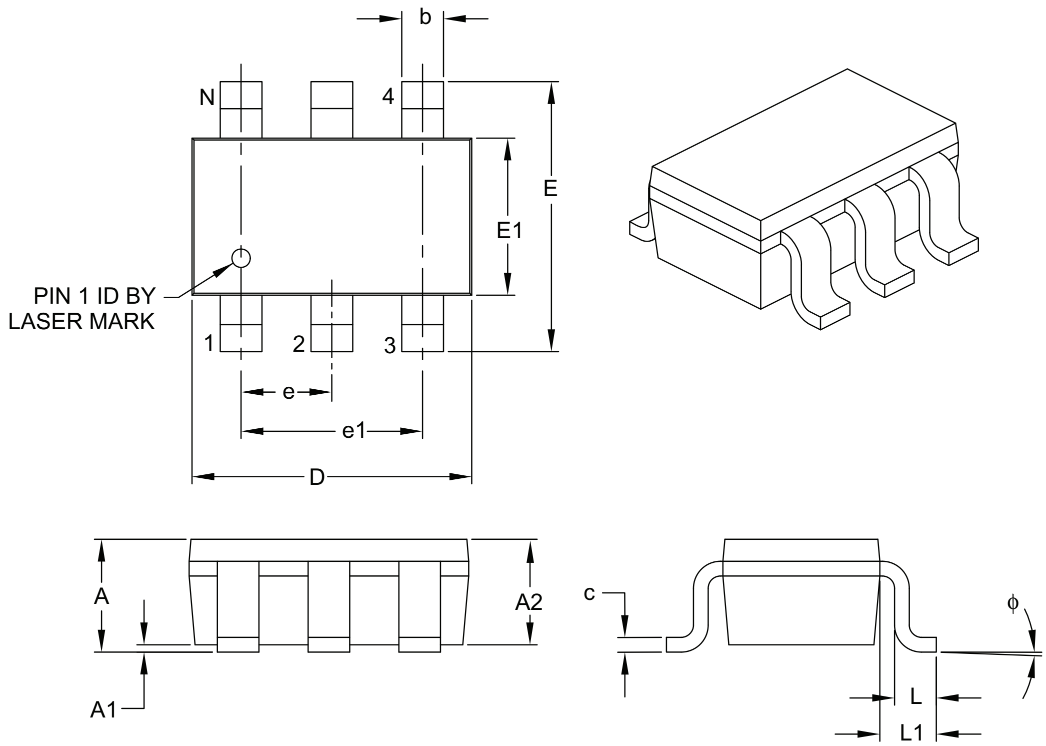
* Standard PIC® device marking consists of Microchip part number, year code, week code, and traceability code. For PIC device marking beyond this, certain price adders apply. Please check with your Microchip Sales Office. For QTP devices, any special marking adders are included in QTP price.

9.2 Package Details

The following sections give the technical details of the packages.

6-Lead Plastic Small Outline Transistor (OT) [SOT-23]

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		6	
Pitch	e		0.95 BSC	
Outside Lead Pitch	e1		1.90 BSC	
Overall Height	A	0.90	–	1.45
Molded Package Thickness	A2	0.89	–	1.30
Standoff	A1	0.00	–	0.15
Overall Width	E	2.20	–	3.20
Molded Package Width	E1	1.30	–	1.80
Overall Length	D	2.70	–	3.10
Foot Length	L	0.10	–	0.60
Footprint	L1	0.35	–	0.80
Foot Angle	ϕ	0°	–	30°
Lead Thickness	c	0.08	–	0.26
Lead Width	b	0.20	–	0.51

Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-028B

6-Lead Plastic Small Outline Transistor (OT) [SOT-23]

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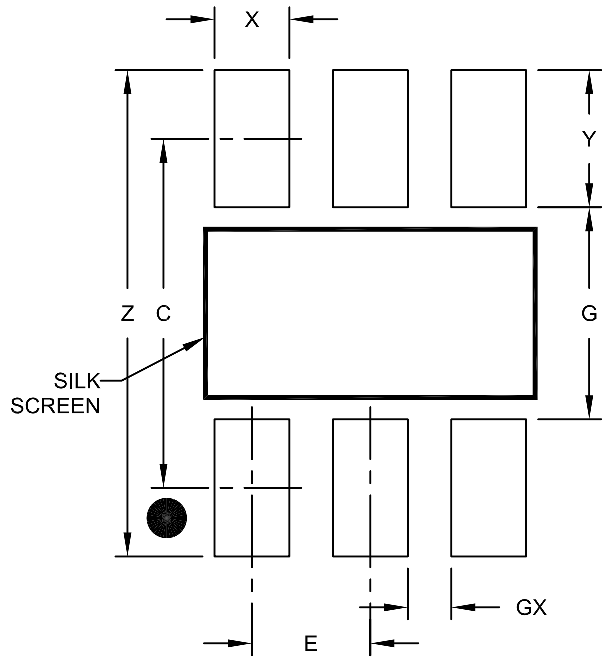

RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.95 BSC	
Contact Pad Spacing	C		2.80	
Contact Pad Width (X6)	X			0.60
Contact Pad Length (X6)	Y			1.10
Distance Between Pads	G	1.70		
Distance Between Pads	GX	0.35		
Overall Width	Z			3.90

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2028A

APPENDIX A: DATA SHEET REVISION HISTORY

Revision A (10/2012)

Initial release of this data sheet.

Revision B (7/2013)

Updated Figures 2-1 and 2-2; Updated the Electrical Characteristics section to new format; Other minor corrections.

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 Preliminary

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PART NO.	[X](1) -	X	/XX	XXX
Device	Tape and Reel Option	Temperature Range	Package	Pattern

Device:	MTCH101
Tape and Reel Option:	Blank = Standard packaging (tube or tray) T = Tape and Reel(1)
Temperature Range:	I = -40°C to +85°C (Industrial)
Package:(2)	OT = 6-pin SOT-23
Pattern:	QTP, SQTP, Code or Special Requirements (blank otherwise)

Examples:

a) MTCH101 - I/OT
Industrial temperature
SOT-23 package

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.

2: For other small form-factor package availability and marking information, please visit www.microchip.com/packaging or contact your local sales office.

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