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**MTCH1010 Data Sheet**

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**Description**

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The Microchip MTCH1010 Touch Controller with digital output provides a simple way to add water tolerant touch detection or proximity sensing to any application. This device implements one capacitive sensor with active guarding capability. Sensitivity, response time, and oversampling can be configured via CFG input pins at run time. The MTCH1010 uses advanced optimization algorithms to actively suppress noise from the signal to achieve reliable touch detection.

The MTCH1010 provides one capacitive touch/proximity detection sensor which can work through plastic, wood, or even metal front panels with Microchip's proprietary Metal Over Capacitive (MOC) technology. It also supports a wide range of conductive materials as sensors, such as copper pad on PCB, silver ink, PEDOT or carbon printing on plastic film, Indium Tin Oxide (ITO) pad, wire/cable, etc. An open-drain active-low output will communicate the state of the sensor to a host microcontroller or drive an indication LED.

**Features**

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- Capacitive Touch Sensing
- High Signal to Noise Ratio (SNR)
- Adjustable Sensitivity
- Multi-Stage Active Noise Suppression Filters
- Automatic Environmental Compensation
- Water Tolerant Touch
- Support Wide Range of Sensor Shapes and Sizes
- Touch Indication by OUT Pin Level
- Detect Hysteresis
- Flexible Low-Power Mode
- Brown-Out Protection
- Operating Voltage Range:
  - 2V to 5.5V
- Operating Temperature:
  - -40°C to +105°C

**Typical Application**

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- Light and Internet of Things (IoT) Switches
- Power Buttons
- White Goods and Appliance
- Office Equipment
- Toys
- Display and Keypad Back-Lighting Activation by Proximity
- Presence Detection

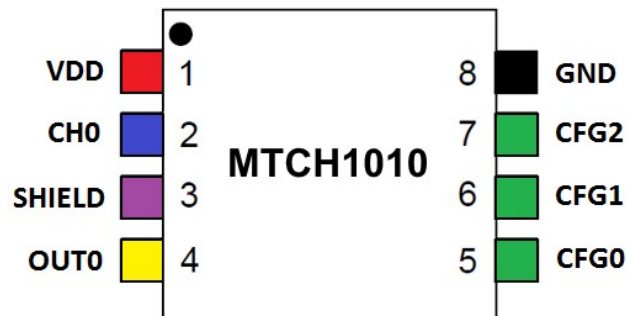
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### 1. Pin Diagram

Figure 1-1. 8-Pin SOIC



Name	8-Lead SOIC	Usage
V <sub>DD</sub>	1	Power Supply (+)
CH0	2	Sensor Electrode Measurement
SHIELD	3	Shield Electrode Output Driver
OUT0	4	Touch Indication
CFG0	5	Response Time
CFG1	6	Oversampling
CFG2	7	Sensitivity
GND	8	Power Supply (-)

## 2. Configuration

Three configuration input pins are provided on the MTCH1010 and each one controls one of the following configuration parameters:

- Response Time
- Oversampling
- Sensitivity

Inputs are set by applying a voltage level to the respective CFG pin. Options how to generate these input voltages are provided in the [Appendix](#).

At power-up, the configuration inputs are read by the MTCH1010 and sensor parameters are set accordingly. During run time, the inputs are measured once every two seconds and configuration changes are applied at subsequent sensor measurements. Each input must be in the range of 0V to  $V_{DD}$ . CFG0 and CFG1 are split into four bands providing four options for each parameter and CFG2 provides a continuous adjustment of sensitivity between 0V and  $V_{DD}$ .

Input Range	Configuration Selection
0V to $\frac{1}{4} V_{DD}$	A
$\frac{1}{4} V_{DD}$ to $\frac{1}{2} V_{DD}$	B
$\frac{1}{2} V_{DD}$ to $\frac{3}{4} V_{DD}$	C
$\frac{3}{4} V_{DD}$ to $V_{DD}$	D

### 2.1 CFG0 – Response Time

CFG0 selects a response time of up to 300 ms for the target application. Measurement and sleep cycles are adjusted on chip depending on the oversampling configuration to achieve this response time. This control allows the application designer to balance touch responsiveness against power consumption. Increasing the target response time reduces power consumption as the device spends a higher proportion of time in Sleep mode. Reducing the response time provides a faster indication of touch contact.

**Note:** The configuration input is in non-ascending order. Settings expected in low-power applications are tied directly to  $V_{DD}$  or GND as this removes the necessity for a resistive divider bridge and associated bias current.

To achieve the lowest power configurations, the longest response times are selected at CFG options A (300 ms) and D (100 ms).

Configuration	Response Time (ms)
A	300
B	0 (minimum)
C	50
D	100

### 2.2 CFG1 – Oversampling per Touch Scan Cycle

CFG1 selects the number of samples to take on each measurement cycle. Increased sampling provides more stable sensor operation and better tolerance for electrical noise, but at the cost of increased power consumption and response time.

**Note:** As mentioned above, configuration input is in non-ascending order to avoid the necessity of resistive divider bias current. Lowest power option X8 sampling is selected by CFG1 = 'A', while the next lowest option X16 sampling is selected by CFG1 = 'D'.

Configuration	# Samples
A	8
B	64
C	32
D	16

### 2.3 CFG2 – Touch Sensitivity

CFG2 determines the sensitivity of the touch sensor. A thicker touch cover, smaller sensor or nearby ground referenced conductors require higher sensitivity settings. Sensitivity does not affect power consumption or measurement time, except in the case of a high setting which may consume extra power by triggering unnecessary wake-up events.

**Note:** Sensitivity input CFG2 is implemented as a full-scale linear input.

It is recommended to match higher sensitivity settings with higher oversampling for robust touch sensing.

Input Range	Sensitivity
0V to $V_{DD}$	<ul style="list-style-type: none"> <li>Lowest at 0V</li> <li>Increases with increasing Voltage at CFG2</li> <li>Highest at <math>V_{DD}</math></li> </ul>

### 2.4 Further Preset Configurations

Other touch parameters are pre-set to provide reliable and consistent operation in a wide range of applications.

Further details on touch parameters can be found in the [Touch library User Guide](#).

#### 2.4.1 Touch Detection

Setting	Value	Description
Detect Hysteresis:	12.5%	Touch will be reported as released after the signal falls 12.5% below sensitivity setting.
Detect Count-In:	4	<p>Touch is reported after confirmations scans confirmed the touched status four times in a row. These confirmation scans are executed right after the initial touch status detection.</p> <p>This suppresses detections generated by electrical noise or from quick brushes of an object and fosters robust touch operation.</p>

#### 2.4.2 Anti-Touch Recalibration

Anti-touch recalibration always provides the intended touch sensitivity.

An anti-touch occurs if a button is pressed longer than the maximum duration in the moment of release. Anti-touch re-calibration ensures that the button is capable of detection at the following touch.

## 2.4.3 Maximum on Recalibration

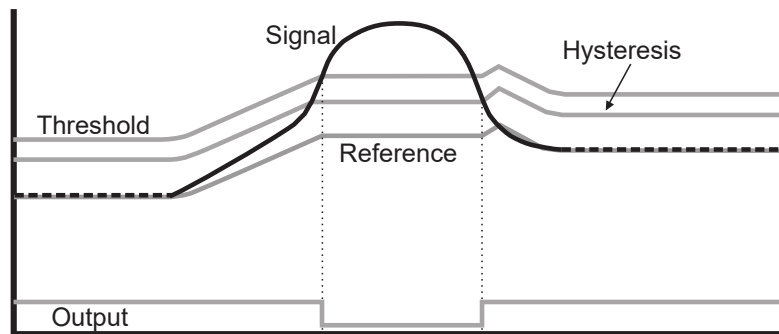
Setting	Value	Description
Maximum on Duration:	8s	After eight seconds of a detected touch, a calibration will be performed, thus releasing the touch.

## 2.4.4 Sensor Drift

The MTCH1010 provides robust touch sensing by considering environmental changes (such as temperature, humidity, etc.). Touch raw data signals might and will drift over time and it is crucial that drift is compensated, otherwise, false detections, non-detections, and sensitivity shifts might occur.

Drift compensation is performed on chip the MTCH1010 and no host intervention of any kind is needed.

**Figure 2-1. Drift Compensation**



## 2.4.5 Frequency Hop with Auto-Tune

The MTCH1010 provides robust touch sensing by considering electrical noise. Built in are latest noise avoidance technologies such as frequency hopping with auto-tune. As a result, the MTCH1010 will proactively adopt the touch sensing frequency according to the noise scenario during run time. No host intervention of any kind is needed.

### **3. Sensor**

#### **3.1 CH0 – the Touch Electrode**

CH0 is the touch sensor input pin, which needs to be connected to the sensor electrode via a series resistor, to reduce EMI and EMC. The series resistor may be 10 k $\Omega$  to 200 k $\Omega$ , depending on the sensor capacitance and desired level of EMC performance.

Refer to the Microchip [Capacitive Touch Design Guide – AN2934](#) for further details.

#### **3.2 SHIELD – Driven Shield**

The MTCH1010 features an active shield (Driven shield) signal to enhance touch sensitivity and robustness. Driven shield benefits:

- Reduced sensor load
- A rear shield prevents touch detection behind
- Provides water tolerant touch
- Increases sensitivity
- Shields against electrical noise

Refer to the Microchip [Capacitive Touch Design Guide – AN2934](#) for further details and layout considerations for Driven Shield usage.



## **4. Output**

### **4.1 OUT0**

OUT0 provides indication of the touch detection state of the sensor. This is an open-drain output requiring an external pull-up to  $V_{DD}$ . The pin is in a high-impedance state, while the touch sensor is not in detect, switching to output low when the sensor is touched.

## **5. Operation**

### **5.1 Power On / Reset**

Configuration inputs CFG0, CFG1, CFG2 are read during the device initialization and the corresponding parameters are loaded into the run-time memory. An internal timer is configured to wake up the device at the configured cycle interval.

### **5.2 Run Time**

#### **Sensor Measurement**

Measurement of sensor capacitance using Capacitive Voltage Divider method (for further details, see [Application Note 1478 Sensing method Capacitive Voltage Divider](#)). Optional Shield Output driver (SHIELD) provides increased sensitivity, reduction of sensor capacitive load, and shielding of sensor electrode from electrical noise as well as water tolerance.

Accumulation of 8/16/32/64 pairs of measurements according to configured oversampling (CFG1).

#### **Post Processing**

- Frequency Hop Auto-tune
  - Signal variance check
  - Frequency adjustment
- Event Processing
  - Power-on reference calibration timer-based reference drift
  - Touch detection
  - Anti-touch recalibration
  - Maximum on recalibration

#### **Sleep**

Device enters Sleep mode until woken by the cycle timer.

#### **Configuration**

Every two seconds, the MTCH1010 re-reads the input configuration pins and updates the measurement/timing configuration accordingly.

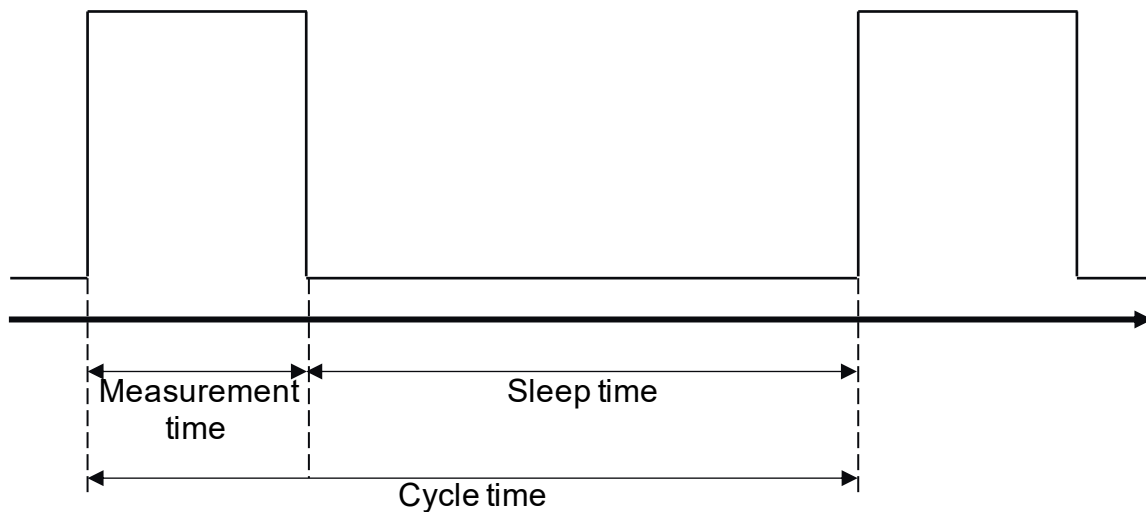


## 7. Response Time

### 7.1 Definitions

Response time	Maximum or worst-case 'delay' between physical contact until touch reporting on OUT That time is selected via CFG0.
Measurement time	Total time required to acquire (including oversampling) and post process touch signals
Sleep time	The time the device sleeps between measurements
Cycle time	Time between start of one measurement to start of next measurement – it includes: <ul style="list-style-type: none"> <li>• Measurement time</li> <li>• Sleep time</li> </ul>

Figure 7-1. Timing Diagram



### 7.2 Measurement Time

Measurement time is dependent on oversampling:

Number of samples (CFG1)	Measurement time
8	1 ms
16	1.9 ms
32	3.4 ms
64	6.8 ms

To meet the response time configuration, the MTCH1010 calculates and executes the cycle time according to the oversampling selection:

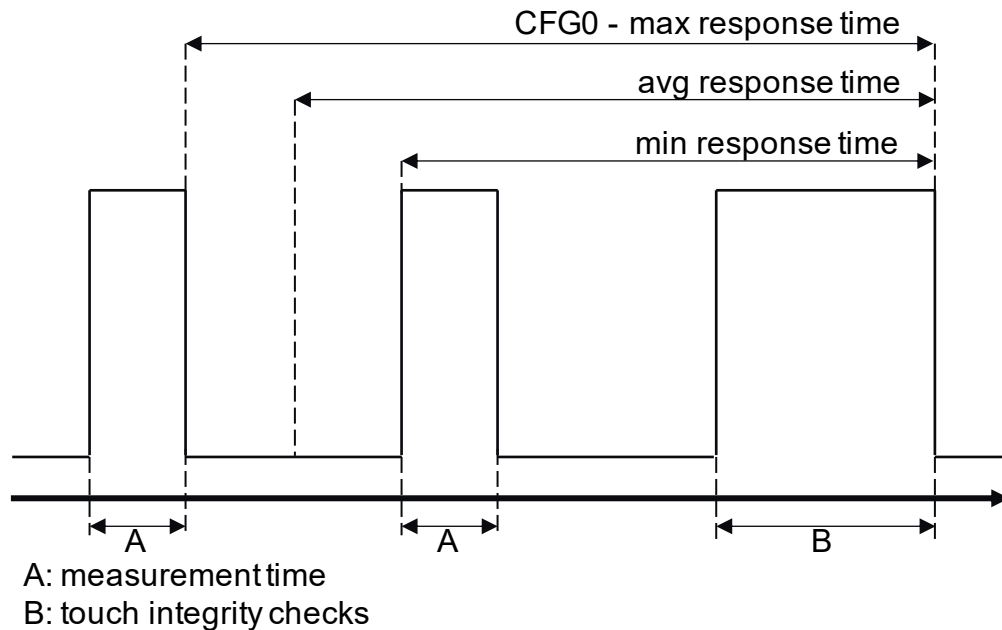
Power/Sleep cycle:	$4 \times \text{Measurement time} + 2 \times \text{Cycle time}$
Free-running measurements (GFG0 = B):	$5 \times \text{Measurement time}$

Response time setting CFG0 (ms)	Cycle times executed to achieve response times (ms)			
	CFG1 X8 oversampling	CFG1 X16 oversampling	CFG1 X32 oversampling	CFG1 X64 oversampling
Free run	(1)	(1.9)	(3.4)	(6.8)
50	23	21	18	12
100	48	46	43	37
300	148	146	143	137

Keep in mind that the CFG1 response time assumes that physical touch happens right at the beginning of sleep, from a timing perspective worst-case scenario. The table below reflects the expected minimum, average, and maximum values for response times under standard conditions.

Response time setting CFG0 (ms)	Min / AVG / Max resulting response time (ms)											
	CFG1 X8 oversampling			CFG1 X16 oversampling			CFG1 X32 oversampling			CFG1 X64 oversampling		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	max
Free run	7			11			21			40		
50	27	39	50	29	40	50	32	41	50	39	45	50
100	52	76	100	54	77	100	57	79	100	64	82	100
300	152	226	300	154	227	300	157	229	300	164	232	300

Figure 7-2. Response Time



**Note:** During high noise, the response times may exceed the configured target, due to the automatic adjustment of oversampling period by frequency hopping. In the worst-case frequency selection, the maximum response time may be extended by 30%.

## 8. Power Consumption

Average power consumption in  $\mu\text{A}$  by Oversampling,  $V_{\text{DD}}$ , Response Time.

<b><math>I_{\text{DD}}</math> (<math>\mu\text{A}</math>) / 8x Oversampling</b>		
Response CFG1 (ms)	$V_{\text{DD}} = 3.3\text{V}$	$V_{\text{DD}} = 5\text{V}$
Free Run	1571	2410
50	69.5	111
100	35.6	55
300	12.7	20.3

<b><math>I_{\text{DD}}</math> (<math>\mu\text{A}</math>) / 16x Oversampling</b>		
Response CFG1 (ms)	$V_{\text{DD}} = 3.3\text{V}$	$V_{\text{DD}} = 5\text{V}$
Free Run	1580	2381
50	133	222.5
100	63	105.5
300	21.5	33.7

<b><math>I_{\text{DD}}</math> (<math>\mu\text{A}</math>) / 32x Oversampling</b>		
Response CFG1 (ms)	$V_{\text{DD}} = 3.3\text{V}$	$V_{\text{DD}} = 5\text{V}$
Free Run	1583	2417
50	301.5	500.5
100	124	211
300	39.5	66.5

<b><math>I_{\text{DD}}</math> (<math>\mu\text{A}</math>) / 64x Oversampling</b>		
Response CFG1 (ms)	$V_{\text{DD}} = 3.3\text{V}$	$V_{\text{DD}} = 5\text{V}$
Free Run	1583.5	2446.5
50	869	1466
100	285	499
300	80.5	159

## 9. Electrical Specification

### 9.1 Disclaimer

All typical values are measured at  $T = 25^{\circ}\text{C}$  and  $V_{\text{DD}} = 3\text{V}$ , unless otherwise specified. All minimum and maximum values are valid across operating temperature and voltage unless otherwise specified.

### 9.2 Absolute Maximum Ratings

Stresses beyond those listed in this section may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

#### Absolute Maximum Ratings

Symbol	Description	Min	Max	Unit
	Ambient temperature under bias	-40	+105	$^{\circ}\text{C}$
TStorage	Storage temperature	-65	+150	$^{\circ}\text{C}$
VPin	Pin voltage with respect to GND	-0.5	$V_{\text{DD}} + 0.5$	V
IPin	I/O pin sink/source current	-40	+40	mA
	Maximum output current	-15	15	mA

### 9.3 General Operating Ratings

The device must operate within the ratings listed in this section for all other electrical characteristics and typical characteristics of the device to be valid.

**Table 9-1. General Operating Conditions**

Symbol	Description	Condition	Min.	Max.	Unit
$V_{\text{DD}}$	Operating supply voltage	—	2	5.5	V
T	Operating temperature range <sup>(1)</sup>	Standard temperature range	-40	105	$^{\circ}\text{C}$

**Note:**

1. Refer to the device ordering codes for the device temperature range.

### 9.4 BOD and POR Characteristics

**Table 9-2. Power Supply Characteristics**

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
SRON	Power-on Slope	—	—	—	100	V/ms

**Table 9-3. Power-On Reset (POR) Characteristics**

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
VPOR	POR threshold voltage on V <sub>DD</sub> falling	V <sub>DD</sub> falls/rises at 0.5 V/ms or slower	0.8	—	1.6	V
	POR threshold voltage on V <sub>DD</sub> rising		1.4	—	1.8	

**Table 9-4. Brown-Out Detection (BOD) Characteristics**

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
VBOD	BOD triggering level (falling/rising)	—	1.7	1.8	2.0	V
VHYS	Hysteresis	—	—	25	—	mV
TBOD	Detection time	Continuous	—	7	—	μs
		Sampled, 1 kHz	—	1	—	ms
		Sampled, 125 Hz	—	8	—	
T <sub>Start</sub>	Start-up time	Time from enable to ready	—	40	—	μs

## 9.5 I/O Pin Characteristics

**Table 9-5. I/O Pin Characteristics (T<sub>A</sub> = [-40, 105]°C, V<sub>DD</sub> = [2.7, 5.5]V Unless Otherwise Stated)**

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
VOL	I/O pin drive strength	V <sub>DD</sub> = 3.0V, I <sub>OL</sub> = 7.5 mA	—	—	0.6	V
		V <sub>DD</sub> = 5.0V, I <sub>OL</sub> = 15 mA	—	—	1	
VOH	I/O pin drive strength	V <sub>DD</sub> = 3.0V, I <sub>OH</sub> = 7.5 mA	2.4	—	—	V
		V <sub>DD</sub> = 5.0V, I <sub>OH</sub> = 15 mA	4	—	—	
VIL2	Input low-voltage on $\overline{\text{CFG1}}$ pin as I/O	—	-0.2	—	0.3 × V <sub>DD</sub>	V
VIH2	Input high-voltage on $\overline{\text{CFG1}}$ pin as I/O	—	0.7 × V <sub>DD</sub>	—	V <sub>DD</sub> + 0.2V	V
VOL2	I/O pin drive strength on $\overline{\text{CFG1}}$ pin as I/O	V <sub>DD</sub> = 3.0V, I <sub>OL</sub> = 0.25 mA	—	—	0.6	V
		V <sub>DD</sub> = 5.0V, I <sub>OL</sub> = 0.5 mA	—	—	1	
VOH2	I/O pin drive strength on $\overline{\text{CFG1}}$ pin as I/O	V <sub>DD</sub> = 3.0V, I <sub>OH</sub> = 0.25 mA	2.4	—	—	V
		V <sub>DD</sub> = 5.0V, I <sub>OH</sub> = 0.5 mA	4	—	—	
tRISE	Rise time	V <sub>DD</sub> = 3.0V, load = 20 pF	—	2.5	—	ns
		V <sub>DD</sub> = 5.0V, load = 20 pF	—	1.5	—	
tFALL	Fall time	V <sub>DD</sub> = 3.0V, load = 20 pF	—	2.0	—	ns
		V <sub>DD</sub> = 5.0V, load = 20 pF	—	1.3	—	
CPIN	I/O pin capacitance except CH0, SHIELD, OUT0, and CFG0 pins	—	—	3	—	pF
CPIN	I/O pin capacitance on CH0, SHIELD, OUT0, and CFG0 pins	—	—	10	—	pF
R <sub>p</sub>	Pull-up resistor	—	20	35	50	kΩ

**Note:**

- Pin group x (Px[7:0]). The combined continuous sink/source current for all I/O ports should not exceed the limits.



## 10. Ordering Information

Available ordering options can be found by:

- Clicking on one of the following product page links:
  - [MTCH1010 Product Page](#)
  - Searching by product name at [microchipdirect.com](http://microchipdirect.com)
  - Contacting your local sales representative

### 10.1 Product Information

Ordering Code(1)	Supply Voltage	Package Type(2)	Packing Media	Temperature Range
MTCH1010-V/SN	2V – 5.5V	SOIC150	Tube	-40°C +105°C
MTCH1010T-V/SN	2V – 5.5V	SOIC150	Tape & Reel	-40°C +105°C

**Notes:**

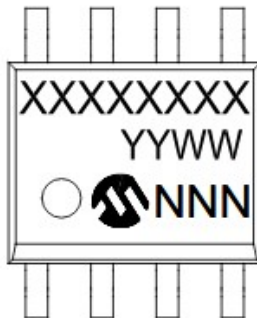
1. PB-free packaging complies to the European Directive for Restriction Hazardous Substances (RoHS directive). Also Halide free and fully Green.
2. Package outline drawings can be found in the [Package Drawing](#) chapter.

## 11. Package Drawing

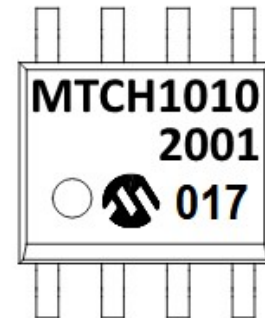
### 11.1 8-Pin SOIC150

Figure 11-1. Package Marking Information

8-Lead SOIC 150



Example



Legend:

**XX...X** Device name


**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')

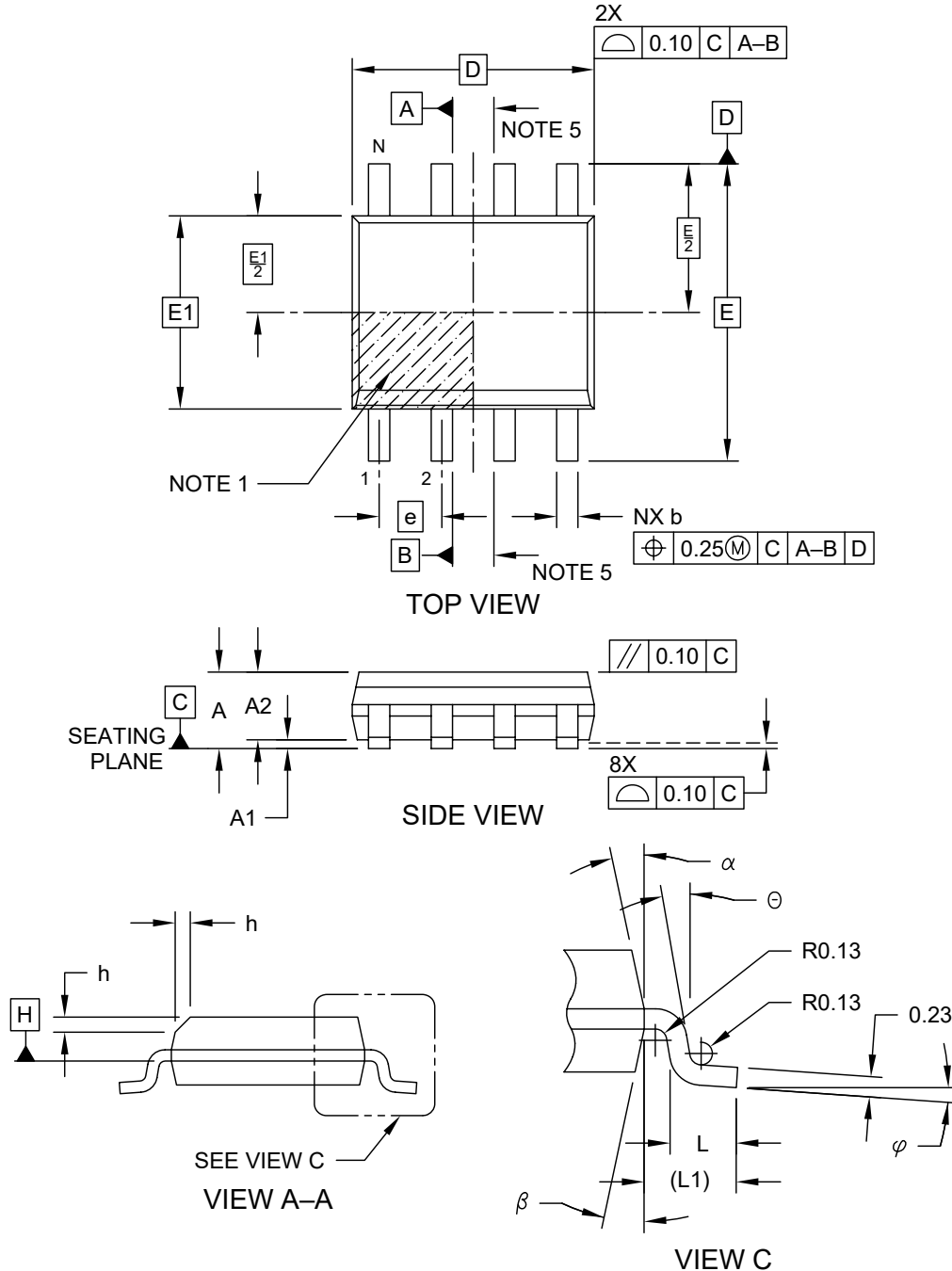
**NNN** Alphanumeric traceability code

 Pb-free JEDEC® designator for Matte Tin (Sn)\*This package is Pb-free. The Pb-free JEDEC designator

\*  can be found on the outer packaging for this package.

**8-Lead Plastic Small Outline – Narrow, 3.90 mm (.150 In.) Body [SOIC]**

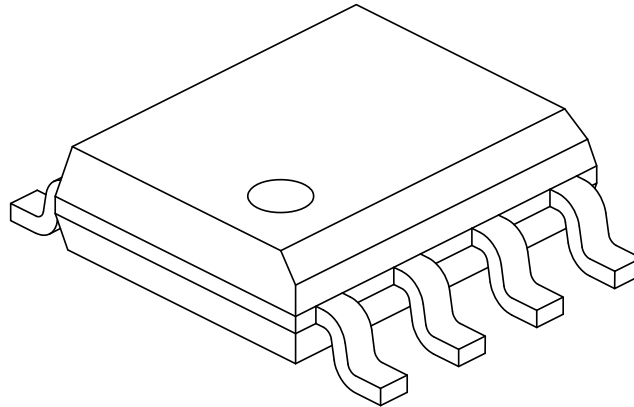
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing No. C04-057-SWB Rev E Sheet 1 of 2

**8-Lead Plastic Small Outline – Narrow, 3.90 mm (.150 In.) Body [SOIC]**

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



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1	1.04 REF		
Foot Angle	$\varphi$	0°	-	8°
Lead Thickness	c	0.17	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	$\alpha$	5°	-	15°
Mold Draft Angle Bottom	$\beta$	5°	-	15°

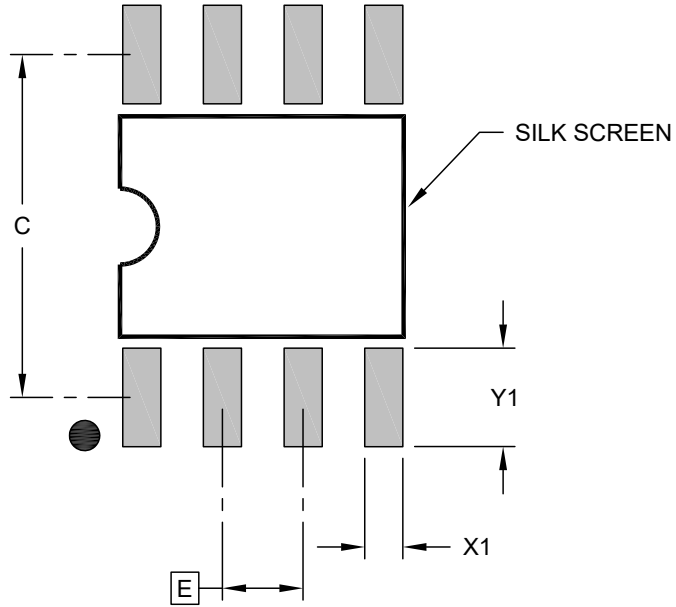
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
- Dimensioning and tolerancing per ASME Y14.5M  
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.  
 REF: Reference Dimension, usually without tolerance, for information purposes only.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-SWB Rev E Sheet 2 of 2

**8-Lead Plastic Small Outline – Narrow, 3.90 mm (.150 In.) Body [SOIC]**

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



**RECOMMENDED LAND PATTERN**

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

**Notes:**

- Dimensioning and tolerancing per ASME Y14.5M  
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2057-SWB Rev E

**Table 11-1. Device and Package Maximum Weight**

Maximum Weight	78 mg
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**Table 11-2. Package Characteristics**

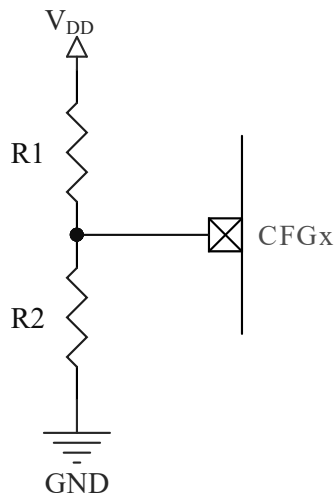
Moisture Sensitivity Level	MSL3
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## 12. Appendix

### 12.1 Static Input Voltages

These methods will configure the MTCH1010 and provide a fixed behavior at power-up and run time.

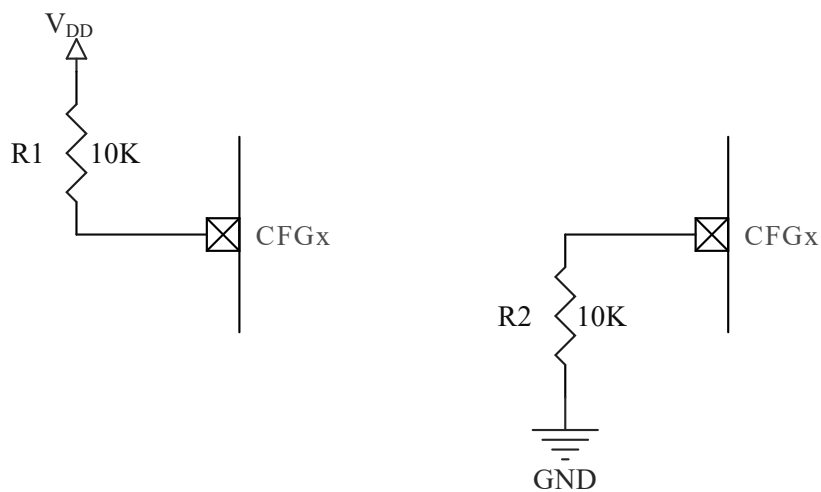
#### 12.1.1 Resistor Ladder



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

#### 12.1.2 Direct Connect to $V_{DD}$ or $GND$

Use a series resistor in case a setting is set by connecting a  $CFGx$  pin to  $V_{DD}$  or  $GND$ .



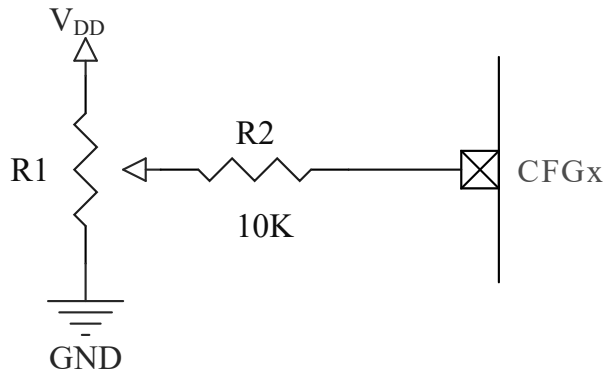
The pull-up/pull-down resistor is a precautionary recommendation, as MTCH1010 will not pull the  $CFGx$  neither to the  $V_{DD}$  nor to the  $GND$  during the operation.

## 12.2 Dynamic Input Voltages

These methods enable flexible settings during run time or development. They are controlled by the human developer or the host IC.

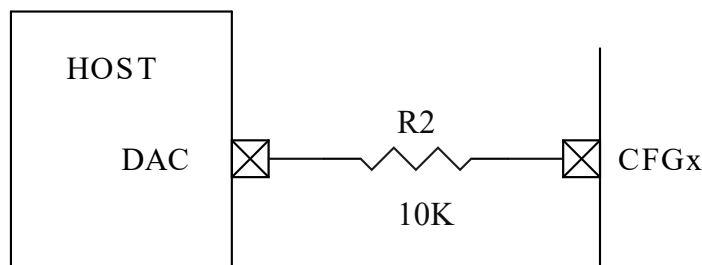
### 12.2.1 Potentiometer

A useful method during development; this method is also used on the MTCH1010 DevKit.



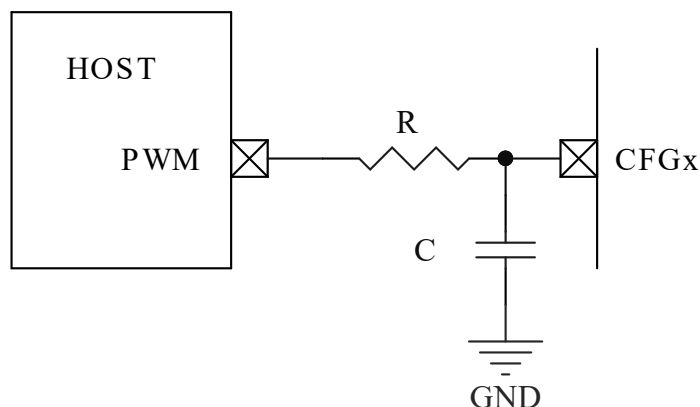
### 12.2.2 DAC Controlled by Host

This is advised if settings will dynamically change during run time.



### 12.2.3 PWM Controlled by Host

This is advised if settings will dynamically change during run time.



Note: Refer to Application Note 'Using PWM to Generate Analog Output (AN538)' for details about how to choose appropriate R and C values



### **13. Conclusion**

The MTCH1010 offers the performance and robust touch experience of Microchips library-based touch solutions. The MTCH1010 is easy to use and to configure, and it is the first of a growing family of devices. Find the latest in Touch from Microchip on [www.microchip.com/touch](http://www.microchip.com/touch).

**14. Revision History**

Revision	Date	Description
A	04/2021	Initial document release

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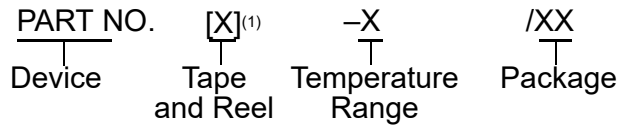
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Temperature Range:	I	= -40°C to +85°C (Industrial)
	E	= -40°C to +125°C (Extended)
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