MTCH1010

MTCH1010 Data Sheet

Description

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

- 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

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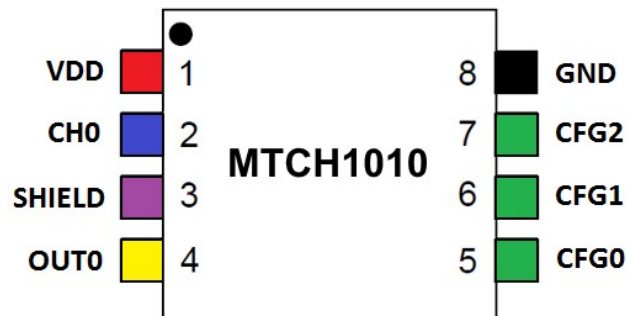- Presence Detection

Table of Contents

1. Pin Diagram

Figure 1-1. 8-Pin SOIC

VDD	1		8	GND
CH0	2	MTCH1010	7	CFG2
SHIELD	3		6	CFG1
OUT0	4		5	CFG0

Name	8-Lead SOIC	Usage
V_{DD}	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 ¼ V_{DD}	A
¼ V_{DD} to ½ V_{DD}	B
½ V_{DD} to ¾ V_{DD}	C
¾ 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}	• Lowest at 0V • Increases with increasing Voltage at CFG2 • Highest at V_{DD}

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	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. This suppresses detections generated by electrical noise or from quick brushes of an object and fosters robust touch operation.

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
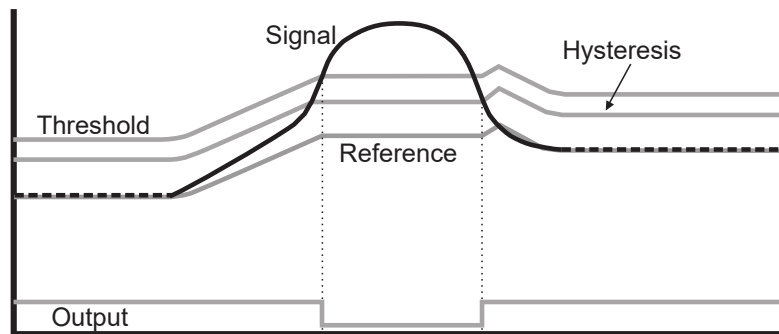
2.4.5 Frequency Hop with Auto-Tune

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 kΩ to 200 kΩ, 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
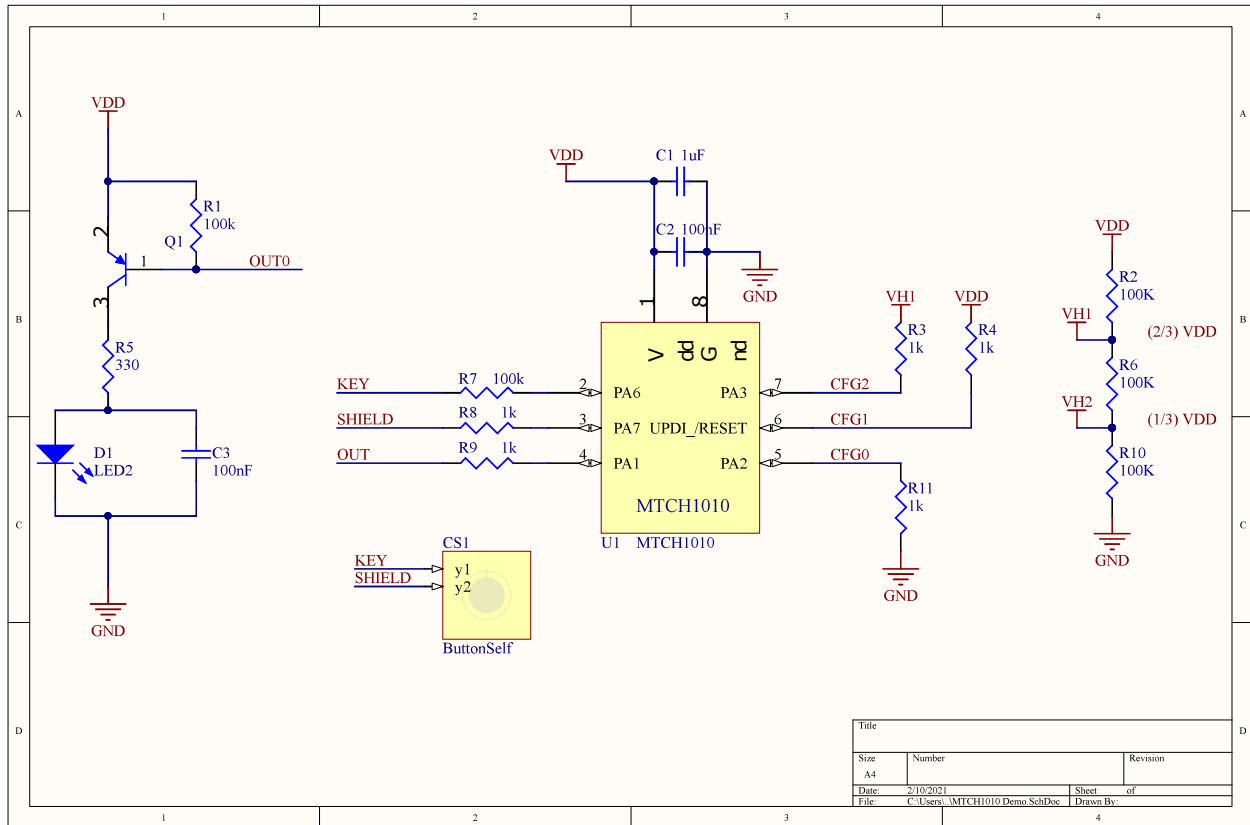 - Anti-touch recalibration
  - Maximum on tecalibration

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.

6.   Example Circuit

Figure 6-1. Example Circuit

Example:

- **CFG0** is connected to GND and so is read as 'A', setting the response time to its longest duration of 300 ms
- **CFG1** is connected to V_{DD}, read as 'D' and selects the number of samples at 16
- **CFG2** is connected to Vh1, or (2/3) V_{DD}.

In the example, the resistor ladder used to generate the input voltages for CFG1 and CFG2 will result in a bias current of 11 uA /17 uA pending V_{DD} of 3.3V or 5V.

See Appendix for further guidance on generation static or dynamic configuration voltages.

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: • Measurement time • Sleep time

Figure 7-1. Timing Diagram
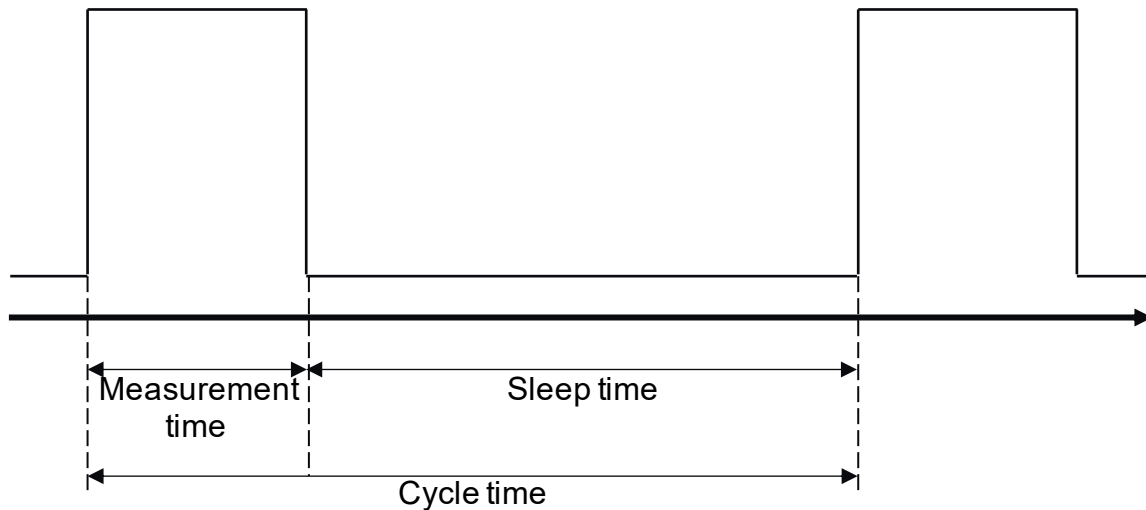
7.2 Measurement Time

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 x Measurement time + 2 x Cycle time
Free-running measurements (GFG0 = B):	5 x 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

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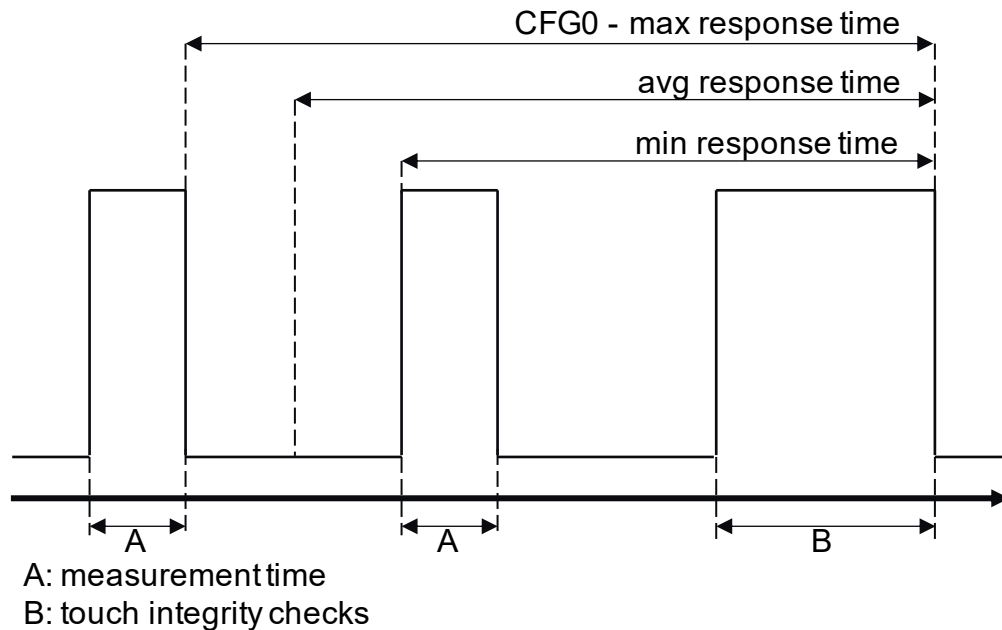
Note: During high noise, the response times may exceed the configured target, due to the automatic adjustment of oversampling period by frequency hopping. In the worst-case frequency selection, the maximum response time may be extended by 30%.

8. Power Consumption

Average power consumption in uA by Oversampling, V_{DD}, Response Time.

I_{DD} (uA) / 8x Oversampling		
Response CFG1 (ms)	V_{DD} = 3.3V	V_{DD} = 5V
Free Run	1571	2410
50	69.5	111
100	35.6	55
300	12.7	20.3

I_{DD} (uA) / 16x Oversampling		
Response CFG1 (ms)	V_{DD} = 3.3V	V_{DD} = 5V
Free Run	1580	2381
50	133	222.5
100	63	105.5
300	21.5	33.7

I_{DD} (uA) / 32x Oversampling		
Response CFG1 (ms)	V_{DD} = 3.3V	V_{DD} = 5V
Free Run	1583	2417
50	301.5	500.5
100	124	211
300	39.5	66.5

I_{DD} (uA) / 64x Oversampling		
Response CFG1 (ms)	V_{DD} = 3.3V	V_{DD} = 5V
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°C and V_{DD} = 3V, 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	°C
TStorage	Storage temperature	-65	+150	°C
VPin	Pin voltage with respect to GND	-0.5	V_{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_{DD}	Operating supply voltage	—	2	5.5	V
T	Operating temperature range [1]	Standard temperature range	-40	105	°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
V_{POR}	POR threshold voltage on V_{DD} falling	V_{DD} falls/rises at 0.5 V/ms or slower	0.8	—	1.6	V
	POR threshold voltage on V_{DD} rising		1.4	—	1.8	

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

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{BOD}	BOD triggering level (falling/rising)	—	1.7	1.8	2.0	V
V_{HYS}	Hysteresis	—	—	25	—	mV
T_{BOD}	Detection time	Continuous	—	7	—	µs
		Sampled, 1 kHz	—	1	—	ms
		Sampled, 125 Hz	—	8	—	
T_{Start}	Start-up time	Time from enable to ready	—	40	—	µs

9.5 I/O Pin Characteristics

Table 9-5. I/O Pin Characteristics (T_A = [-40, 105]°C, V_{DD} = [2.7, 5.5]V Unless Otherwise Stated)

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{OL}	I/O pin drive strength	V_{DD} = 3.0V, I_{OL} = 7.5 mA	—	—	0.6	V
		V_{DD} = 5.0V, I_{OL} = 15 mA	—	—	1	
V_{OH}	I/O pin drive strength	V_{DD} = 3.0V, I_{OH} = 7.5 mA	2.4	—	—	V
		V_{DD} = 5.0V, I_{OH} = 15 mA	4	—	—	
V_{IL2}	Input low-voltage on $\overline{CFG1}$ pin as I/O	—	-0.2	—	$0.3 \times V_{DD}$	V
V_{IH2}	Input high-voltage on $\overline{CFG1}$ pin as I/O	—	$0.7 \times V_{DD}$	—	V_{DD} + 0.2V	V
V_{OL2}	I/O pin drive strength on $\overline{CFG1}$ pin as I/O	V_{DD} = 3.0V, I_{OL} = 0.25 mA	—	—	0.6	V
		V_{DD} = 5.0V, I_{OL} = 0.5 mA	—	—	1	
V_{OH2}	I/O pin drive strength on $\overline{CFG1}$ pin as I/O	V_{DD} = 3.0V, I_{OH} = 0.25 mA	2.4	—	—	V
		V_{DD} = 5.0V, I_{OH} = 0.5 mA	4	—	—	
t_{RISE}	Rise time	V_{DD} = 3.0V, load = 20 pF	—	2.5	—	ns
		V_{DD} = 5.0V, load = 20 pF	—	1.5	—	
t_{FALL}	Fall time	V_{DD} = 3.0V, load = 20 pF	—	2.0	—	ns
		V_{DD} = 5.0V, load = 20 pF	—	1.3	—	
C_{PIN}	I/O pin capacitance except CH0, SHIELD, OUT0, and CFG0 pins	—	—	3	—	pF
C_{PIN}	I/O pin capacitance on CH0, SHIELD, OUT0, and CFG0 pins	—	—	10	—	pF
R_P	Pull-up resistor	—	20	35	50	kΩ

Note:

1. 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
  - 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

XXXXXXXX
YYWW
○ NNN

MTCH1010
2001
○ 017
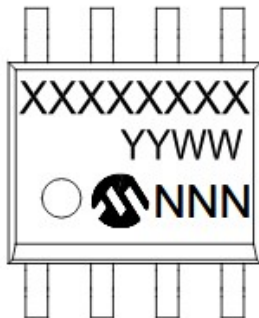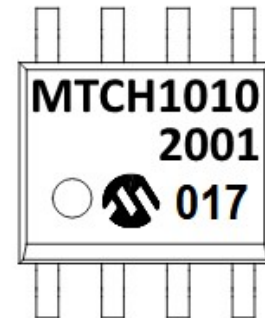
Legend:

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

(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.

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

TOP VIEW

SIDE VIEW

VIEW A–A

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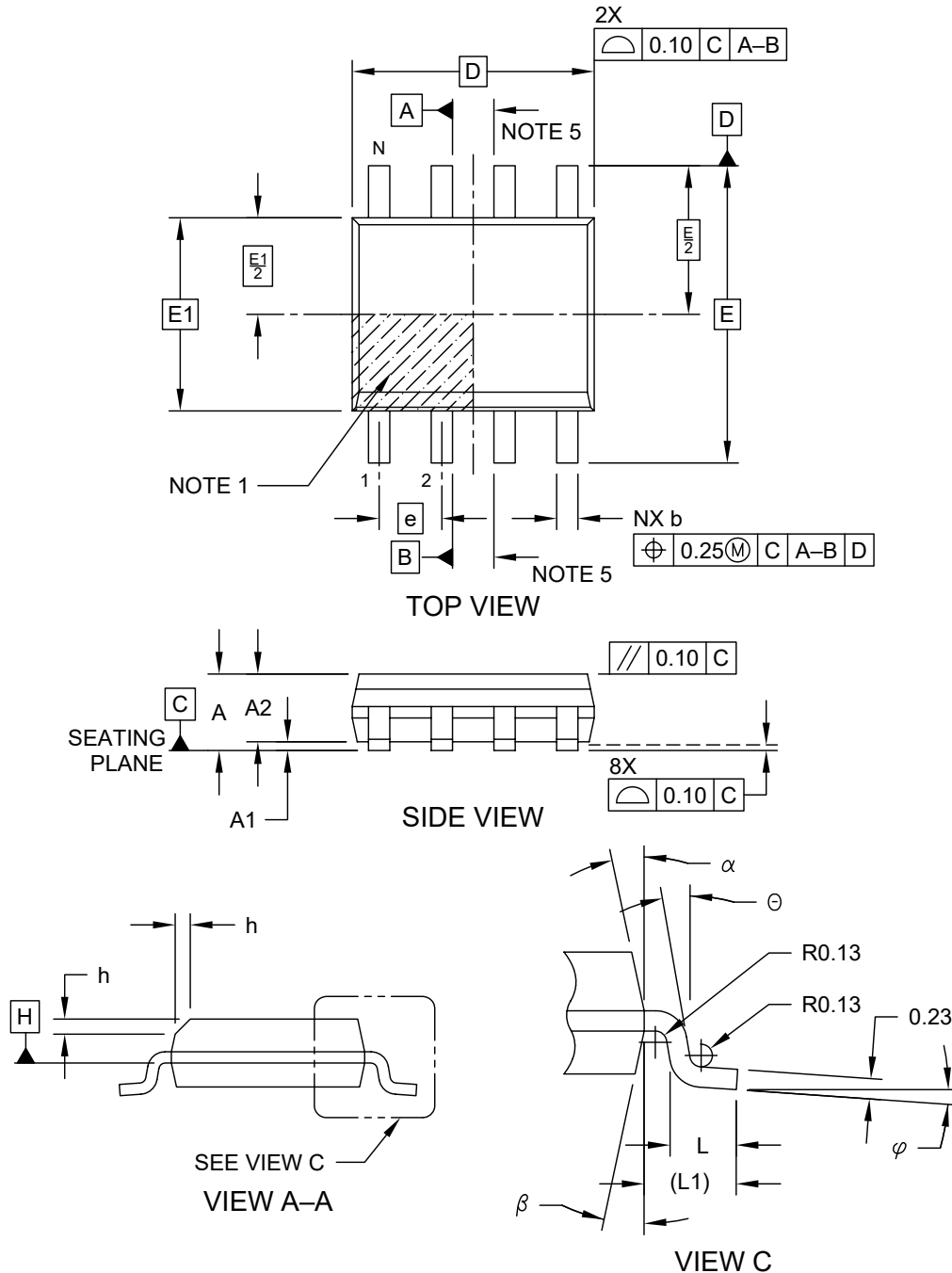
Microchip Technology Drawing No. C04-057-SWB Rev E Sheet 1 of 2

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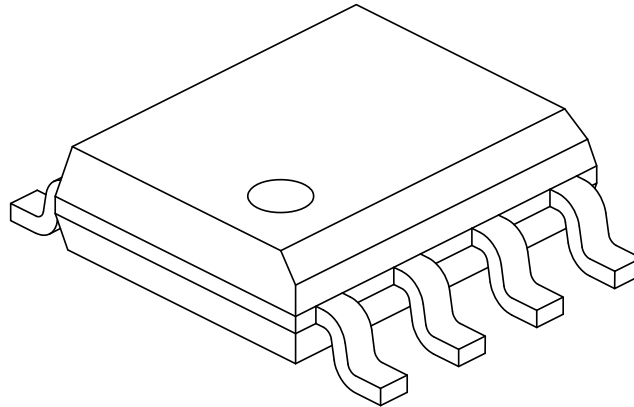
	Units		MILLIMETERS	
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E		6.00 BSC	
Molded Package Width	E1		3.90 BSC	
Overall Length	D		4.90 BSC	
Chamfer (Optional)	h	0.25	-	0.50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

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. 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.
5. 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
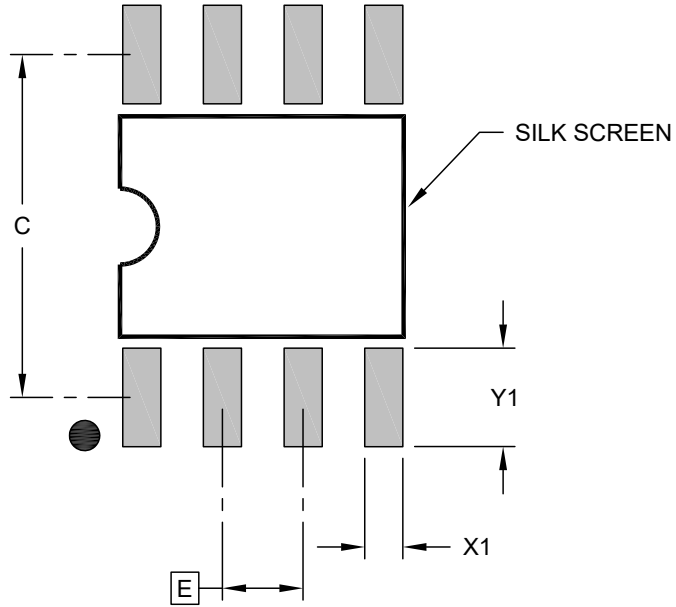
RECOMMENDED LAND PATTERN

	Units	MILLIMETERS		
	Dimension Limits	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:

1. 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

Table 11-2. Package Characteristics

Moisture Sensitivity Level	MSL3

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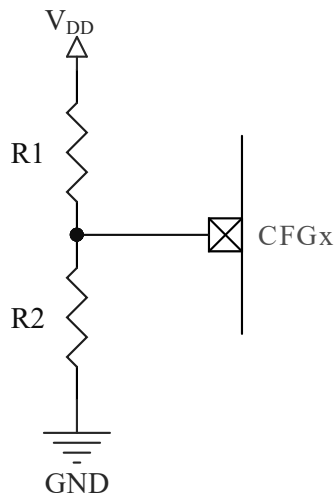
Note: Both R1 and R2 are recommended
to be greater than 100K for lower power
consumption

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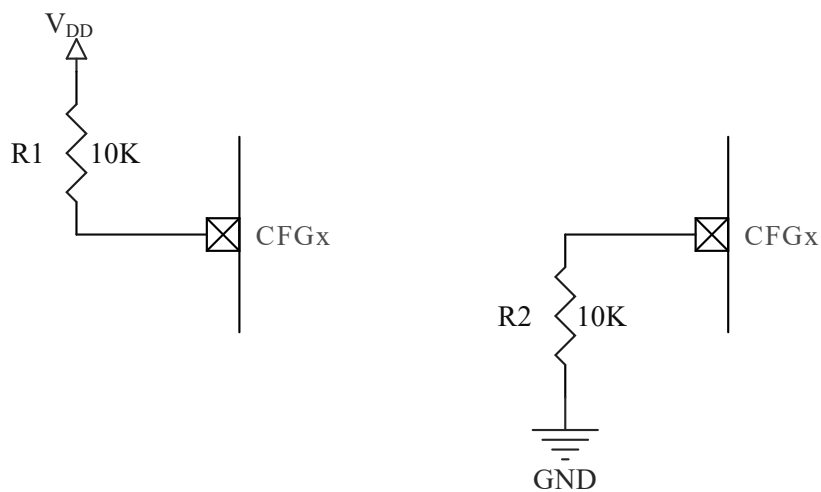
The pull-up/pull-down resistor is a precautionary recommendation, as MTCH1010 will not pull the CFGx neither to the V_{DD} nor to the GND during the operation.

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.
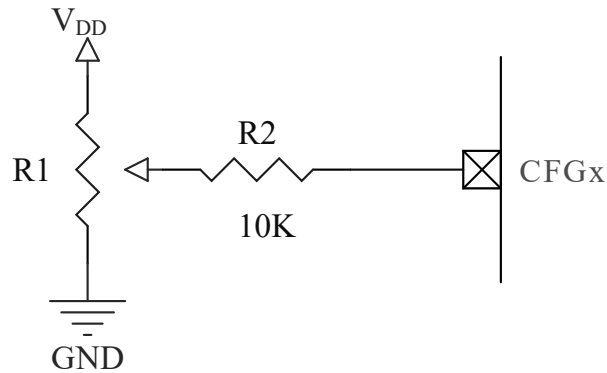
12.2.2 DAC Controlled by Host

This is advised if settings will dynamically change during run time.
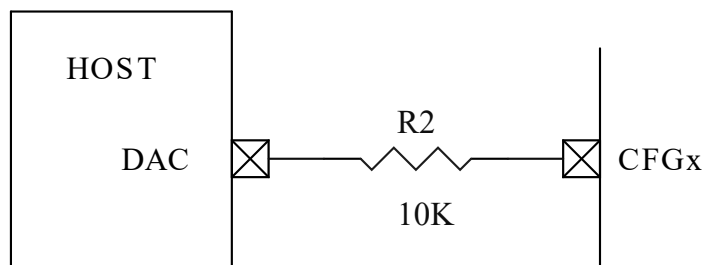
12.2.3 PWM Controlled by Host

This is advised if settings will dynamically change during run time.
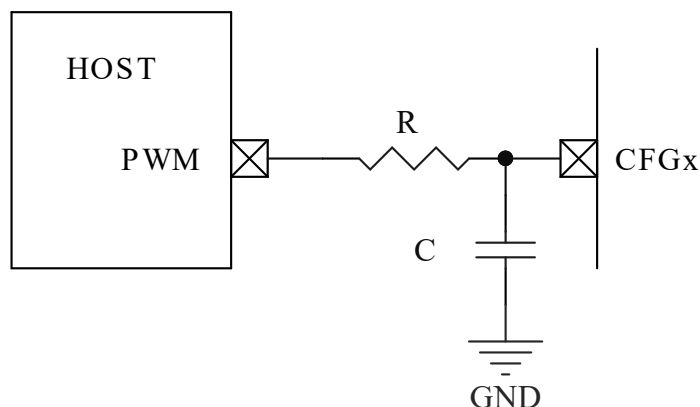
Note: Refer to Application Note 'Using PWM to Generate Analog Outpout (AN538)' for details about how to choose appropriate R and C values

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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.

14.   Revision History

Revision	Date	Description
A	04/2021	Initial document release

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Product Identification System

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.   [X]⁽¹⁾   −X   /XX
Device   Tape and Reel   Temperature Range   Package
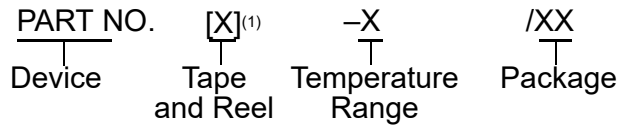
Device:	Device A, Feature A, (Package A) Device B, Feature B, (Package B)	
Tape & Reel Option:	Blank	= Tube
	T	= Tape & Reel
Temperature Range:	I	= -40°C to +85°C (Industrial)
	E	= -40°C to +125°C (Extended)
Package:	AA	= Package AA
	BB	= Package BB

Examples:
- MCPXXXXXAT-E/AA: Tape and Reel, Extended temperature, XAA package
- MCPXXXXXBT-E/BB: Tape and Reel Extended temperature, XBB package

Notes:
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. Small form-factor packaging options may be available. Please check www.microchip.com/packaging for small-form factor package availability, or contact your local Sales Office.

Microchip Devices Code Protection Feature

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

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "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.

Legal Notice

Information contained in this publication is provided for the sole purpose of designing with and using Microchip products. Information 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.

Trademarks

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

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