MTCH1030 Data Sheet

MTCH1030

Description

The Microchip MTCH1030 Capacitive Touch Controller with digital output provides a simple way to add robust water-tolerant touch detection or proximity sensing to any application. This device implements up to three capacitive sensors with Driven Shield+ capability. Sensitivity, measurement period and oversampling can be easily configured via three dedicated pins at run-time, enabling the optimization of power consumption. In addition, MTCH1030 provides Easy Tune-enabling out of the box usage even under changing noise conditions. The MTCH1030 embeds advanced optimization algorithms to actively suppress noise from the signal to achieve reliable touch detection in challenging noise environments.

The MTCH1030 provides up to three capacitive touch and proximity detection sensors which can work through plastic, wood or metal front panels with Microchip's proprietary Metal over Capacitive (MoC) technology. It supports a wide range of conductive materials as sensors, such as copper pads on PCB, silver ink, PEDOT carbon printing on plastic film and Indium Tin Oxide (ITO) pads. Individual open-drain active-low output will communicate the state of each 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
- Easy Tune (Ability to Auto-Tune Sensitivity at Run-Time)
- Flexible Single-Button Mode
- Support a Wide Range of Sensor Shapes and Sizes
- Touch Indication by OUT Pin Level
- Optional Tune Data
- Option to Disable Sensor
- Detect Hysteresis
- Brown-out Protection
- Operating Voltage Range:
  - 2-5V
- Operating Temperature:
  - -40°C to +85°C
  - -40°C to +125°C

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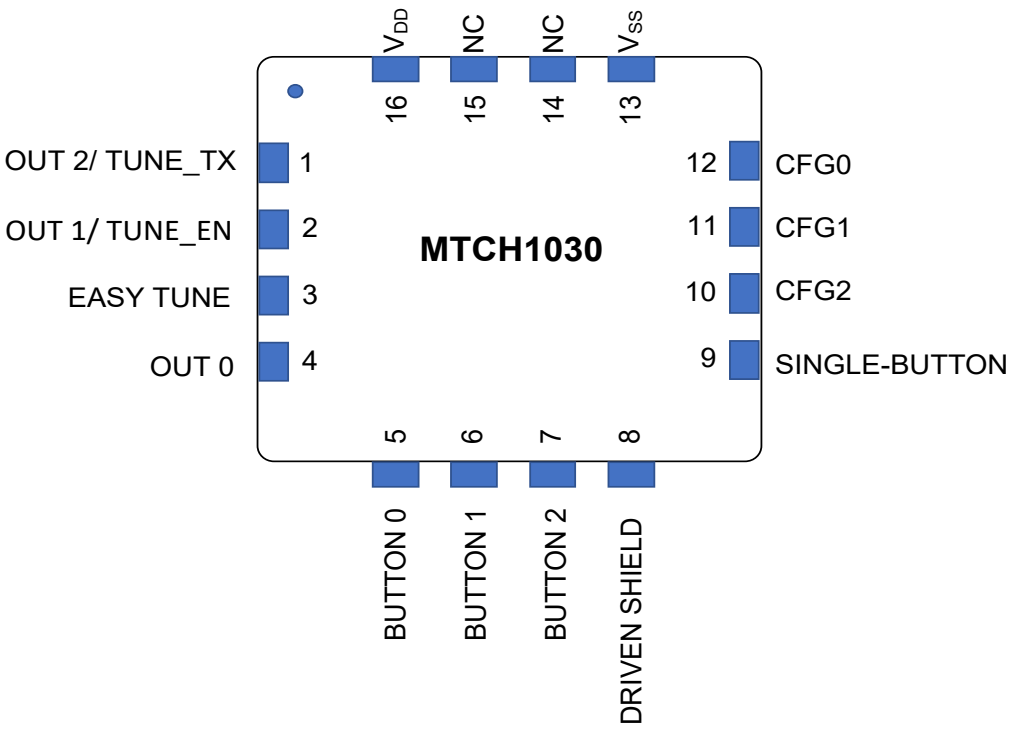
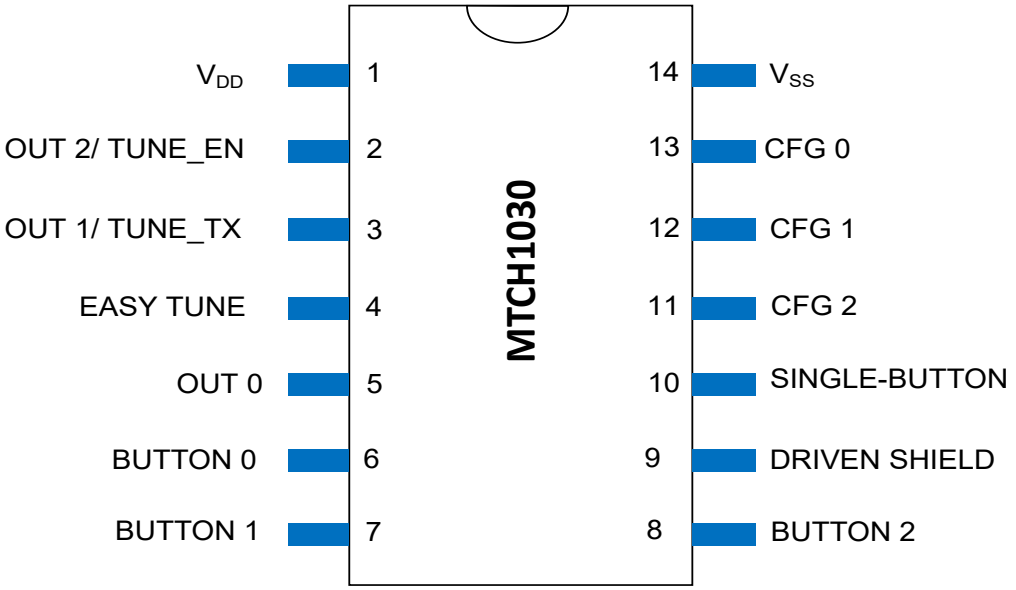
1. Pin Diagram

Figure 1-1. QFN Package



Note: Connecting the exposed bottom pad to V_{SS} is recommended. However, it must not be the only V_{SS} connection to the device.

Figure 1-2. TSSOP Package



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2. Pin Configuration

Name	16-Pin VQFN	14-Pin SSOP	Type	Comments	If Unused
EASY TUNE	3	4	I	Enable/Disable Easy Tune feature	Connect to V_{DD}
BUTTON0	5	6	I	Sensor electrode for Button 0	May not be left open
BUTTON1	6	7	I	Sensor electrode for Button 1	Connect to V_{DD}
BUTTON2	7	8	I	Sensor electrode for Button 2	Connect to V_{DD}
DRIVEN SHIELD	8	9	O	Shield electrode output driver	Leave open
SINGLE-BUTTON	9	10	I	Enable/Disable Easy Tune feature	Connect to V_{DD}
OUT0	4	5	OD	Touch indication for Button 0	Leave open
OUT1/TUNE_EN	2	3	OD	Touch indication for Button 1 or Enable Tune Data*	Leave open
OUT2/TUNE_TX	1	2	OD/O	Touch indication for Button 2 or Transmit Tune Data*	Leave open
CFG0	12	13	I	Response Time	May not be left open
V_{SS}	13	14	P	Supply Ground	NA
V_{DD}	16	1	P	Power	NA
CFG1	11	12	I	Oversampling	May not be left open
CFG2	10	11	I	Sensitivity	May not be left open

Note: I – Input. O – Output. OD – Open Drain.

* When Tune data is enabled, no OUTx pin will indicate touch.

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3. Configuration

Three configuration input pins are provided on the MTCH1030 touch controller, and each pin controls one of the following configuration parameters:

- Measurement Period
- Oversampling
- Sensitivity

Inputs are set by applying a voltage level to the respective configuration pin. The Appendix provides information on how to generate these input voltages.

The MTCH1030 reads the configuration inputs at power-up, and sensor parameters are set accordingly. During the run-time, the CFGx 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 sensitivity adjustment between 0V and V_{DD}. These configurations are not updated if any sensor is in detect or if the MTCH1030 is configured in Single-Button mode. Refer to Section 3.5 - Single-Button Mode for further information.

Table 3-1.

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

In addition to CFGx pins, the MTCH1030 provides options to enable or disable the following features:

- Easy Tune
- Single-Button mode
- Touch Tune data

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3.1 CFG0 (Measurement Period)

Table 3-2. Definitions

Response time	The time between physical contact until touch reporting on OUTx
Measurement time	Total time required to acquire (including oversampling) and post process touch signals for one sensor
Sleep time	The time the device sleeps between measurements
Measurement period (cycle time)	The time between the start of one measurement and the start of the following measurement, including: • Measurement time • Sleep time This time is selected via CFG0.
Number of sensors	There are three sensors for MTCH1030: • MTCH1030 has the option to disable up to five buttons • Depending on the number of sensors enabled, this parameter will change
Number of sensors touched	MTCH1030 allows the user to simultaneously touch multiple buttons. Depending on the number of simultaneously touched sensors, the response time will vary as the number of sensors simultaneously touched will be measured during confirmation scanning.

CFG0 selects a measurement period of up to 250 milliseconds (ms) for the target application. Touch measurements are performed periodically based on the measurement period. Once completing the measurement, the CPU goes into Sleep mode. This control allows the application designer to balance touch responsiveness against power consumption. Increasing the measurement period increases the response time and reduces power consumption as the device spends more time in Sleep mode. Reducing the measurement period provides a faster indication of touch contact.
Note: 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.

Select the longest measurement period at CFG option A (250 ms) or option D (100 ms) to achieve the low-power configurations.

Table 3-3.

Configuration	Measurement Period (ms)
A	250
B	Minimum (back-to-back)
C	50
D	100

3.2 CFG1 (Oversampling)

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. When Easy Tune is enabled, the minimum recommended oversampling is configured automatically, helping the user to avoid using a resistor divider on the CFG1 pin.

Note: Configuration input is in non-ascending order to avoid the necessity of resistive divider bias current. The lowest power option, eight samplings, is selected by CFG1 = 'A,' while the next lowest option, 16 samplings, is selected by CFG1 = 'D.'

Table 3-4.

Configuration	Samples*
A	8

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.....continued	
Configuration	**Samples***
B	64
C	32
D	16
*With the Easy Tune option enabled, a more automated selection of oversampling is applied. Refer to the Easy Tune option for further details.	

3.3 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 can consume extra power by triggering unnecessary wake-up events. Configuring the sensitivity so the delta on the touch sensor is approximately 50 counts is recommended.

Additionally, matching the lower sensitivity settings with a higher oversampling for robust touch sensing is recommended. Table 3-5 shows the recommended oversampling for each sensitivity setting.

Table 3-5.

Sensitivity Configuration *	Minimum Recommended Oversampling (CFG1)
0-63	8
64-127	16
128-191	32
192-255	64
*Sensitivity value varies linearly from 0 to 255 based on the voltage applied on the CFG2 pin - 0 corresponds to GND and 255 corresponds to V_{DD}.	

Optional debug data can be used to tune the sensitivity. The Appendix provides the options for enabling Tune Data and viewing the required parameters.

Table 3-6.

Input Range	Sensitivity*
0V to V_{DD}	• Lowest at 0V • Increases with Voltage at CFG2 • Highest at V_{DD}
*Sensitivity input CFG2 is implemented as a full-scale linear input only when the Easy Tune option is disabled. Refer to the Easy Tune option for further details.	

3.4 Easy Tune

The Easy Tune option saves development time and board space by setting the button sensitivity automatically. During the run-time, the sensitivity is further adjusted based on the observed noise level, ensuring operations under changing noise environments. The Easy Tune feature is an alternative to classic sensitivity tuning (as provided via CFG2) and is intended for use on regular buttons for a predefined sensor size and overlay thickness. Refer to Section 3.4.1 - CFG2 Configuration with Easy Tune Enabled for further details.

Table 3-7.

Input on Easy Tune Pin	Feature
0V	Easy Tune feature is enabled
V_{DD}	Easy Tune feature is disabled

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The Easy Tune feature controls the sensitivity and oversampling settings. Easy Tune applies the settings required to satisfy the basic touch tuning recommendation as provided in the Guide to Tuning Touch Sensors. With increased sensitivity, increasing the oversampling is recommended to maintain noise robustness. If the user doesn't change the oversampling accordingly, Easy Tune automatically adjusts to the recommended settings for robust operation. Either the minimum amount of recommended oversampling is applied or, if higher, select the user setting according to CFG2.

Consequently, the number of components is reduced by connecting CFG1 to 0V if enabling Easy Tune. Refer to Section 3.4.2 - CFG1 Configuration with Easy Tune Enabled for further details.

3.4.1 CFG2 Configuration with Easy Tune Enabled

When Easy Tune is enabled, the CFG2 and CFG1 configurations are re-mapped to avoid the necessity for resistor dividers (reducing BOM and required board space). Table 3-8 provides the recommended configuration for sensor size and overlay thicknesses.

Button Size	Overlay Thickness	CFG2	CFG1
10~12 mm diameter	1~2 mm	0	0
10~12 mm diameter	2~4 mm	V_{DD}	0

The Easy Tune feature can be adjusted, if needed (e.g., for usage outside the standard button sizes or other overlay thicknesses). The user may change the CFG2 and CFG1 configuration to adjust the sensitivity and oversampling.

Table 3-8.

CFG2 Configuration*	Sensitivity
0	As per recommended sensor configuration
0-191	Linear Increase in sensitivity
192-250	Invalid Range
251~255	As per recommended sensor configuration
*Sensitivity value varies linearly from 0 to 255 based on the voltage applied on the CFG2 pin - 0 corresponds to GND and 255 corresponds to V_{DD}.	

When the Easy Tune feature is enabled, the thresholds are adjusted automatically based on the noise level on the touch sensors. Easy Tune comes with two standard settings (accessible by connecting CFG2 to either GND or V_{DD}) which enable the out-of-the-box Easy Tune usage for buttons of regular size and overlay thickness (see Table 3-8).

If needed, the range of variation on Easy Tune can be controlled using the CFG2 option. The variation in threshold is adjusted based on noise ranging ±50% of the threshold configured using the CFG2 option.

For instance, if the CFG2 option sets the threshold to 50, the touch delta on the given sensor will be nearly 100 counts. For this configuration, the Easy Tune feature can vary the threshold run-time between 25 and 75. Under no noise, the threshold value is set to 25. As noise levels increase, the Easy Tune feature increases the threshold in steps of ten counts for a maximum value of 75. As noise levels recede, the threshold values are reduced in five count steps.

Use the CFG2 setting to scale touch delta, if needed. The Easy Tune maximum and minimum threshold levels must be around 75% and 25% levels of observed touch delta.

3.4.2 CFG1 Configuration with Easy Tune Enabled

Table 3-10 shows the minimum recommended oversampling value when the Easy Tune option is enabled.

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Table 3-9.

CFG2 Configuration *	Description	Minimum Recommended Oversampling
0	Standard Button Type A	16
64-127	Adjusted Easy Tune	32
128-191	Adjusted Easy Tune	64
192-250	Invalid	Invalid
255	Standard Button Type B	32
*Sensitivity value varies linearly from 0 to 255 based on the voltage applied on the CFG2 pin – 0 corresponds to GND and 255 corresponds to V_{DD}.		

With Easy Tune enabled:

- If the user-configured CFG1 value is greater than or equal to the minimum recommended value, then the user configured value will be used.
- If the user configured CFG1 value is less than the minimum recommended value oversampling, then the user configuration will be overwritten and the recommended minimum oversampling is used.

As the recommended minimum oversampling is applied automatically, Easy Tune removes the need to select oversampling. Connecting CFG1 to GND is sufficient to ensure operation, removing the need for a resistor ladder and reducing BOM and board space. Connecting CFG1 to a pin other than GND enables the user to enforce an oversampling higher than recommended (see Table 3-11).

Table 3-10.

CFG1 Configuration	Minimum Recommended Oversampling
A	Minimum recommended oversampling will be automatically applied
B	Always x64 oversampling will be applied
C	Minimum recommended or x32 oversampling will be applied, whichever is higher
D	Minimum recommended or x16 oversampling will be applied, whichever is higher

For example, if CFG2 is configured to V_{DD} (2–4 mm overlay above a 10–12 mm diameter button), then the recommended oversampling value is 32. A resistor ladder is needed to set x32 oversampling on CFG1. With Easy Tune enabled, the MTCH1030 will follow that guidance automatically so that CFG1 can be connected to GND. The MTCH1030 will use the recommended minimum oversampling of 32.

3.5 Single-Button Mode

In Single-Button mode, the MTCH1030 touch controller will focus operation on Button0. Single-Button mode reduces power consumption as only Button0 will be scanned. The exemplary use case is a power button on a device: Only the power button will turn the device on. When the device is turned on, all buttons must be active and scanned. The Single-Button mode feature can be enabled or disabled during run-time. Five seconds after enabling, Single-Button mode feature is activated.

After enabling Single-Button mode, a 5s timeout period starts. If no button is activated during this 5s, Single-Button mode is entered. After entering Single-Button mode, all buttons, except Button0, will be suspended from touch measurement. Button0 will be the only button scanned for touch. When touch is detected on Button0, the suspended sensors instantly resume and calibrate, and touch measurements are performed on all enabled sensors. Single-Button mode must be disabled by the host within 5s so all the buttons remain active. If the host doesn't disable Single-Button mode, it will be re-entered after 5s of a no touch event.

While in Single-Button mode, the host may switch to regular, all buttons enabled, scan mode at any time with immediate effect.

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Single-Button mode can be used as a power button to unlock other keys or as a proximity trigger to detect an approaching finger toward the panel to activate the touch-sensor panel.

Table 3-11.

Input	Feature
0V	Single-Button mode feature is enabled
V_{DD}	Single-Button mode feature is disabled

3.6 Touch Tune Data

The MTCH1030 touch controller can visualize the touch data of the sensors. This reduces development time and enables judging performance beyond the simple yes/no of reported touch states. Using the Tune Data feature during the development stage is recommended. Refer to the Appendix for information on how to enable this feature.

Note: Disabling or enabling in run-time is not possible.

Table 3-12.

Input	Feature
0V	Tune Data feature is enabled. The touch detect state is **NOT** output on any of the OUTx pins. UART data will be available on the OUT2 pin. • Transmission Bits: 8-bit • Start bit: 1 • Stop bit: 1 • Baud rate: 38400 • Polarity: None
V_{DD}	The Tune Data feature is disabled. The touch detect state is indicated using OUTx pins.

3.7 Power-up and Run-Time Configuration Summary

Table 3-14 summarizes whether a particular option is run-time configurable.

Table 3-13.

Configuration	Power-up or Run-Time
Sensor enable or disable	Power-up only
Single-Button mode enabled or disabled	Both power-up and run-time
Easy Tune	Power-up only
CFGx	Both power-up and run-time **Note:** During Single-Button mode, if any sensor is in detect, CFGx pins are not read and configurations are not updated.
Tune Data	Power-up only

3.8 Further Preset Configurations

Additional touch parameters are set to provide reliable and consistent operation in several applications. Further details on touch parameters can be found in the QTouch® Modular Library Peripheral Touch Controller User's Guide. The following section covers the preset settings of the MTCH1030 touch controller.

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3.8.1 Touch Detection

Table 3-14.

Setting	Value	Description
Detect Hysteresis	12.5%	Touch will be reported as released after the signal falls 12.5% below the sensitivity setting.
Detect Count-In	4	Touch is reported after confirmation scans validate touch four times in a row. These confirmation scans are executed right after user touch detection. This suppresses any possible detections generated by electrical noise or quick brushes of an object and fosters robust touch operation. **Note:** During confirmation scans, only the sensors which go into detect are measured. The response time varies based on the number of sensors simultaneously touched. Refer to Section 6 - Example Circuit for further details.

3.8.2 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 ON duration at the moment of release. Anti-touch recalibration ensures that the button is capable of detecting the following touch.

Note: During the anti-touch recalibration, confirmation scans are performed only for the required sensor.

3.8.3 Maximum on Duration

Table 3-15.

Setting	Value	Description
Maximum on Duration	8s	The button will be recalibrated, and the touch will not be reported on the respective OUT pin when the user touches the button for more than eight seconds. The button will be recalibrated once again if the user removes the touch. Subsequent user touches will be reported on the OUT pin. Touch may not be detected during an anti-touch recalibration. The maximum time required to perform recalibration is three times the measurement period. If the measurement period is back-to-back, three times the measurement time * the number of sensors enabled + measurement time * the number of sensors in recalibration * 14. If the user tries to touch/tap the sensor during recalibration, the recalibration time might be longer.

3.8.4 Sensor Drift

The MTCH1030 touch controller provides robust touch sensing under electrical noise. Because touch raw data signals will drift over time, the drift must be compensated. Otherwise, false detections, non-detections and sensitivity shifts over environmental changes may occur.

Drift compensation is performed on the MTCH1030 and no host intervention is needed to compensate for environmental changes.

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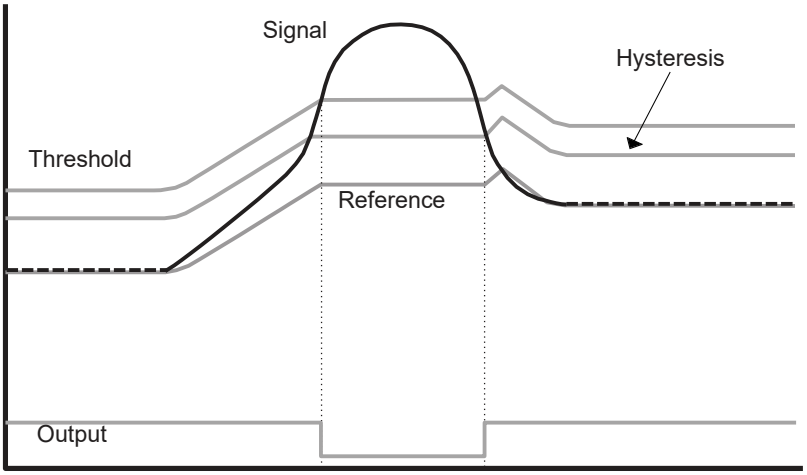
Figure 3-1.



3.8.5 Frequency Hopping with Auto-Tune

The MTCH1030 touch controller provides robust touch sensing under electrical noise. Active noise avoidance technologies, such as frequency hopping with auto-tune, are embedded. As a result, the MTCH1030 proactively adapts the touch sensing frequency according to the noise scenario during run-time. No host intervention is needed.

Table 3-16. Recommended Configuration

CI Noise Level	External Resistor on Sense Lines	V_{DD}
Up to 6V	100 kΩ	Between 3.3V and 5V
Up to 10V	100 kΩ	5V

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4. Touch Sensor

4.1 BUTTONx (Touch Electrodes)

BUTTONx are the touch sensor input pins that are connected to the sensor electrodes via a series resistor to reduce the EMI and EMC. The series resistor can be from 1 kΩ to 100 kΩ, depending on the sensor capacitance and desired level of EMC performance. Refer to Microchip Application Note (AN2934) - Capacitive Touch Sensor Design for further details.

With the exception of BUTTON0, all other buttons can be disabled by connecting the corresponding BUTTONx pin to V_{DD}. The MTCH1030 touch controller can be configured to perform touch measurements for fewer buttons using this option, thus improving the response time and power consumption for the designs that require only a subset number of sensors.

4.2 SHIELD (Driven Shield)

The MTCH1030 touch controller features an active shield (Driven Shield +) signal to enhance touch sensitivity and robustness.

Driven Shield Plus benefits:

- Reduced sensor load
- Water-tolerant touch
- Increased sensitivity
- Shields against electrical noise. The sensors not currently measured are driven as a shield, helping to avoid false detection due to the water bridge between the multiple sensors.

Refer to Microchip Application Note (AN2934) - Capacitive Touch Sensor Design for further details and layout considerations for Driven Shield Plus usage.

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5. Touch Output

5.1 OUTx

OUTx indicates the touch detection state of BUTTONx, 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.

Note: When Touch Tune Data is enabled, touch output is unavailable on any OUTx pin.

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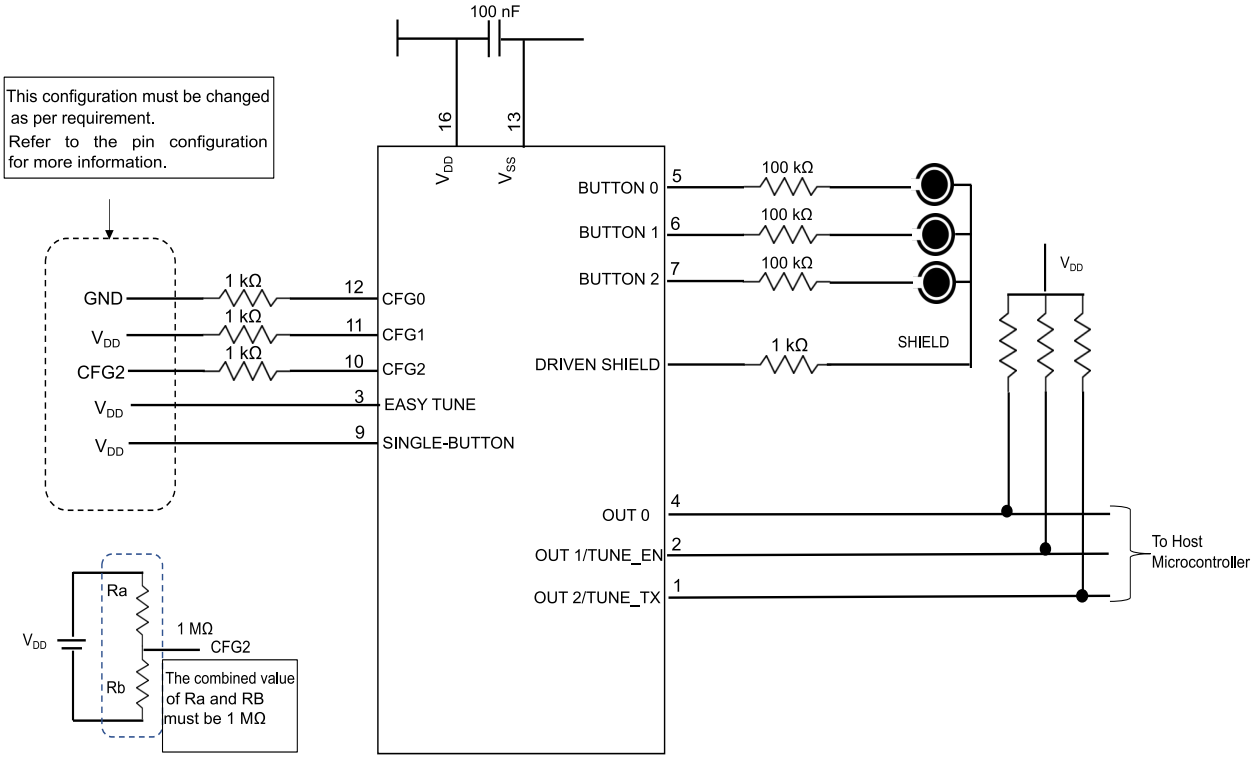
6. Example Circuit

Figure 6-1.



The circuit shown above is an example circuit with the following configurations:

- **CFG0** is connected to GND, setting the response time to its most prolonged duration of 250 ms
- **CFG1** is connected to V_{CC}, setting the number of samples at 16
- **CFG2** is connected to the potentiometer, where the sensitivity is configurable

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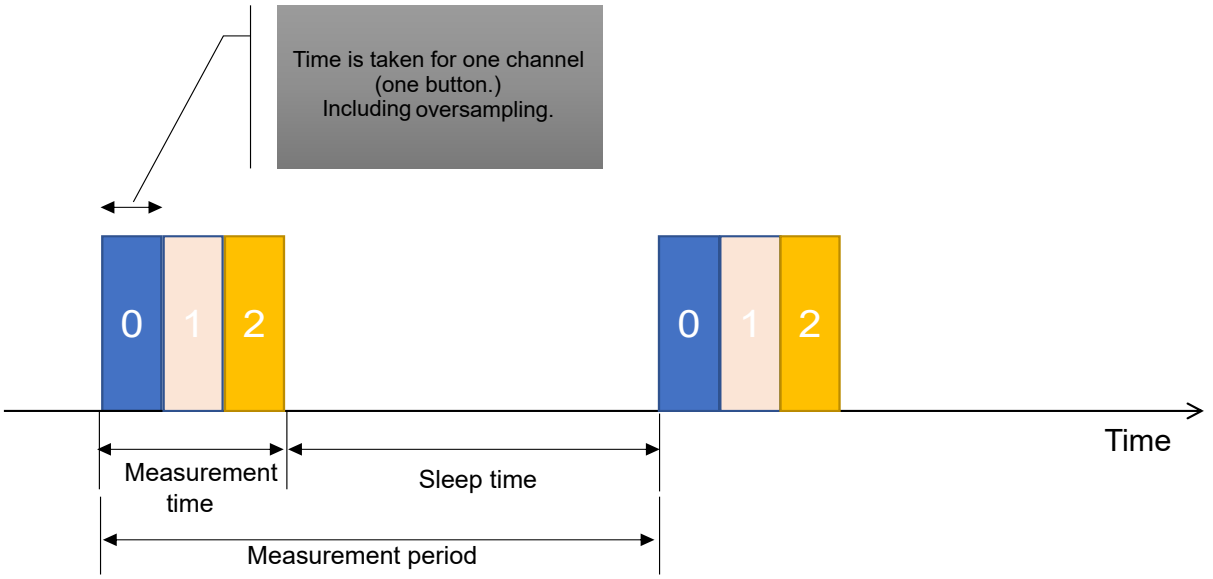
7. Response Time

Figure 7-1. Timing Diagram



7.1 Confirmation Scan

Additional scans are performed to confirm a finger touch or finger removal. To avoid false touch triggers, the MTCH1030 touch controller performs further scans to verify whether a finger is touching the sensor or if touch is released. These confirmation scans are done back-to-back to improve response time. Only sensors that need confirmation scans are measured back-to-back. If the user touches only one sensor, then confirmation scans are done only to that sensor. If the user touches two sensors simultaneously, the confirmation scans are done for two sensors.

Figures 7-2 and 7-3 show how to perform confirmation scans for single and multiple channels, respectively.

Figure 7-2. Confirmation Scan for Single Channel

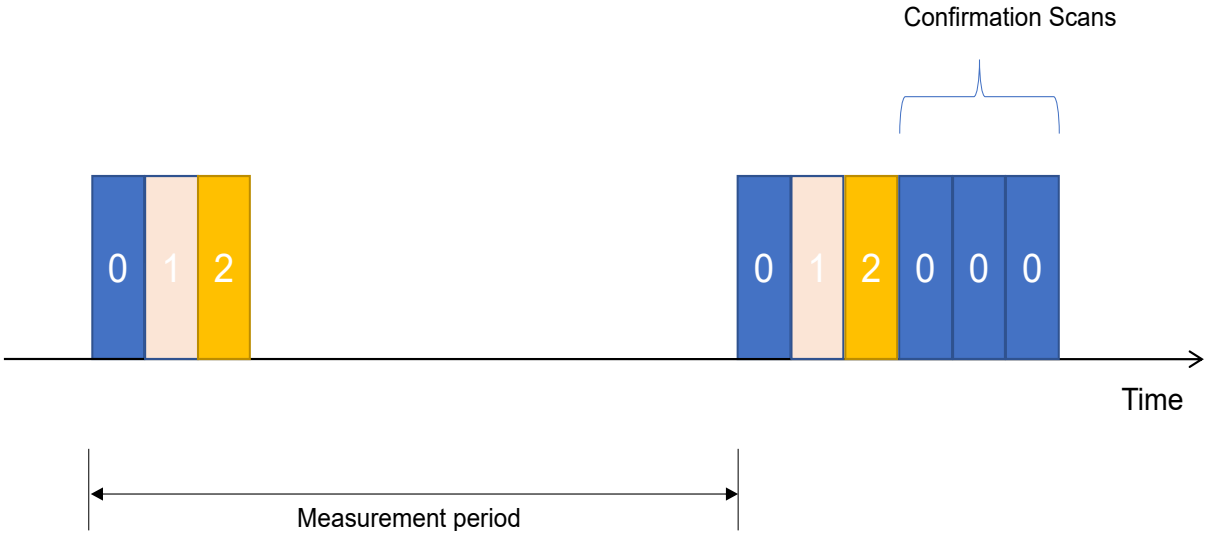


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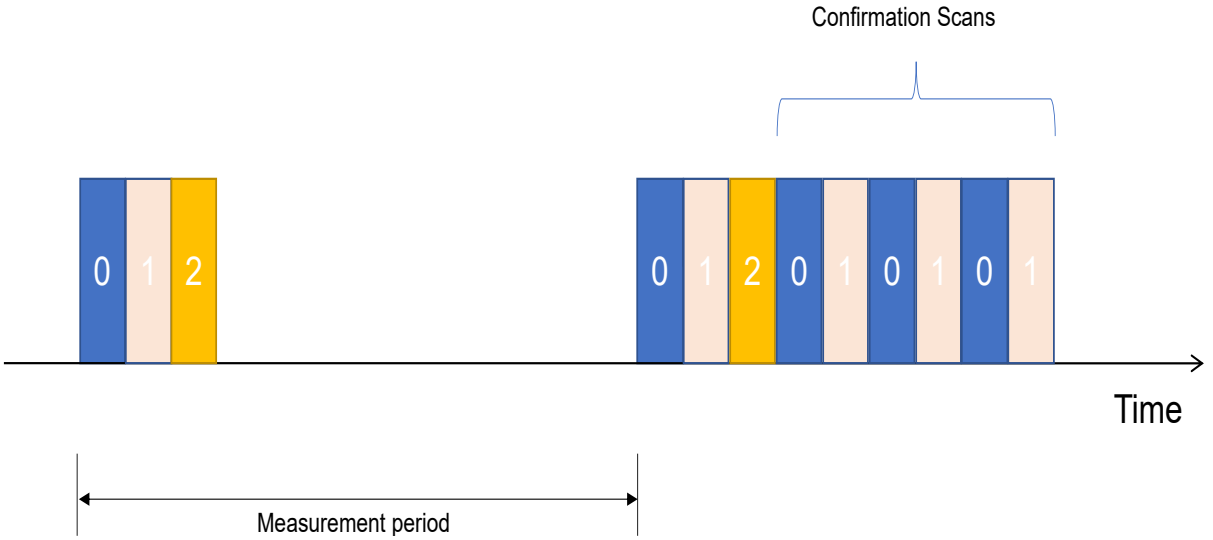
Figure 7-3. Confirmation Scan for Multiple Channels



7.2 Formula to Calculate Response Time

The formula in Table 7-1 is used to calculate response time:

(CFG0 = A/C/D):	(2 x Measurement period) + (1 x Measurement time x Total number of sensors enabled) + (3 x Measurement time x Total number of sensors touched)
Free-running measurements (CFG0 = B):	(3 x Measurement time x Total number of sensors enabled) + (3 x Measurement time x Total number of sensors touched)

For oversampling, measurement time is provided in Table 7-2. Due to frequency hopping, measurement time varies based on noise level. The data captured in this table show the maximum measurement time.

Number of Samples (CFG1)	Measurement Time
8	0.7 ms
16	1.4 ms
32	2.8 ms
64	5.6 ms

Example calculation #1:

- Oversample: 8
- Measurement Period: 50 ms
- Number of sensors enabled: 6
- Number of sensors touched: 2
- Response Time = 2 * 50 + 1 * 0.8 * 6 + 3 * 0.8 * 2 = 110 ms

Example calculation #2:

- Oversample: 32
- Measurement Period: 50 ms
- Number of sensors enabled: 4
- Number of sensors touched: 2
- Response Time = 2 * 50 + 1 * 2.9 * 4 + 3 * 2.9 * 2 = 129 ms

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7.3 Worst-Case and Best-Case Response Time

Figure 7-4. Worst-Case Response Time Depiction

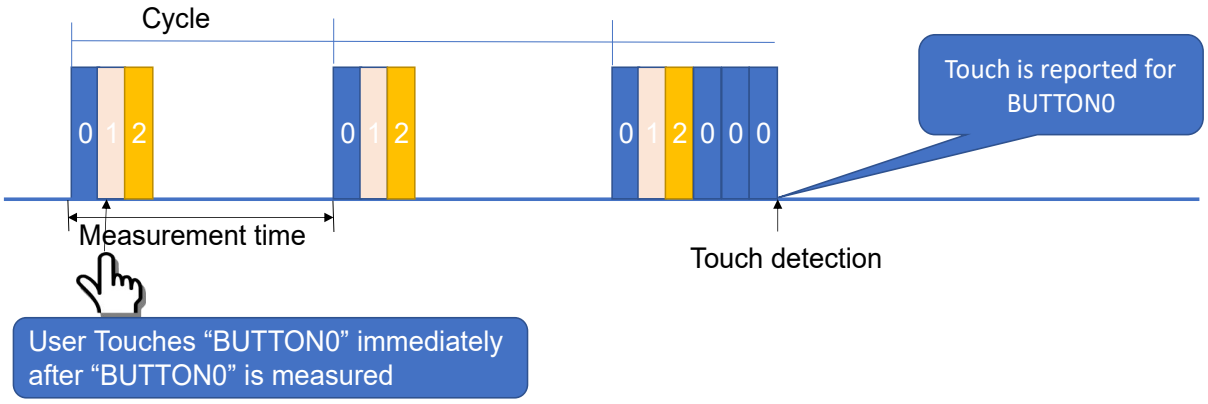
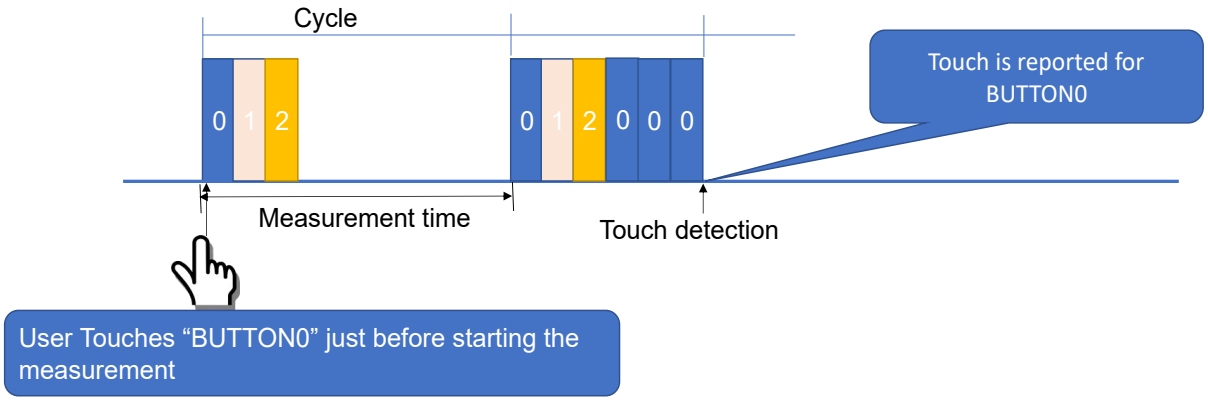


Figure 7-5. Best-Case Response Time Depiction



7.4 Worst-Case Response Time (ms)

The worst-case response time is calculated when the sensor is touched after its measurement, as shown in Figure 7-4. The response times obtained are provided in the following tables.

When one sensor is touched:

Measurement period (ms)	Response Time			
	CFG1 x8 Oversampling	CFG1 x16 Oversampling	CFG1 x32 Oversampling	CFG1 x64 Oversampling
Free-run	9	17	34	67
50	104	109	117	134
100	204	209	217	234
250	504	509	517	534

When two sensors are touched:

Measurement period (ms)	Response Time			
	CFG1 x8 Oversampling	CFG1 x16 Oversampling	CFG1 x32 Oversampling	CFG1 x64 Oversampling
Free-run	11	22	42	84
50	106	113	125	150

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.....continued

Measurement period (ms)	Response Time			
	CFG1 x8 Oversampling	CFG1 x16 Oversampling	CFG1 x32 Oversampling	CFG1 x64 Oversampling
100	206	213	225	250
250	506	513	525	550

When three sensors are touched:

Measurement Period (ms)	Response Time			
	CFG1 x8 Oversampling	CFG1 x16 Oversampling	CFG1 x32 Oversampling	CFG1 x64 Oversampling
Free-run	13	26	51	101
50	109	117	134	167
100	209	217	234	267
250	509	517	534	567

The minimum and maximum values are calculated using the best- and worst-case response time formulas, respectively. These values are calculated for a condition when all three buttons are enabled and a single button is touched.

Worst case repsonse time (Max)	(2 x Measurement period) + (1 x Measurement time x Total number of sensors enabled) + (3 x Measurement time x Total number of sensors touched)
Best case response time (Min)	(1 x Measurement period) + (1 x Measurement time x Total number of sensors enabled) + (3 x Measurement time x Total number of sensors touched)

Measurement Time	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		9			17			34			67	
50	54	79	104	59	84	109	67	92	117	84	109	134
100	104	154	204	109	159	209	117	167	217	134	184	234
250	254	379	504	259	383	509	267	392	517	284	409	534

Note: Considering the measurement times of all the frequencies, the response times calculated may have a ±5 µs variation.

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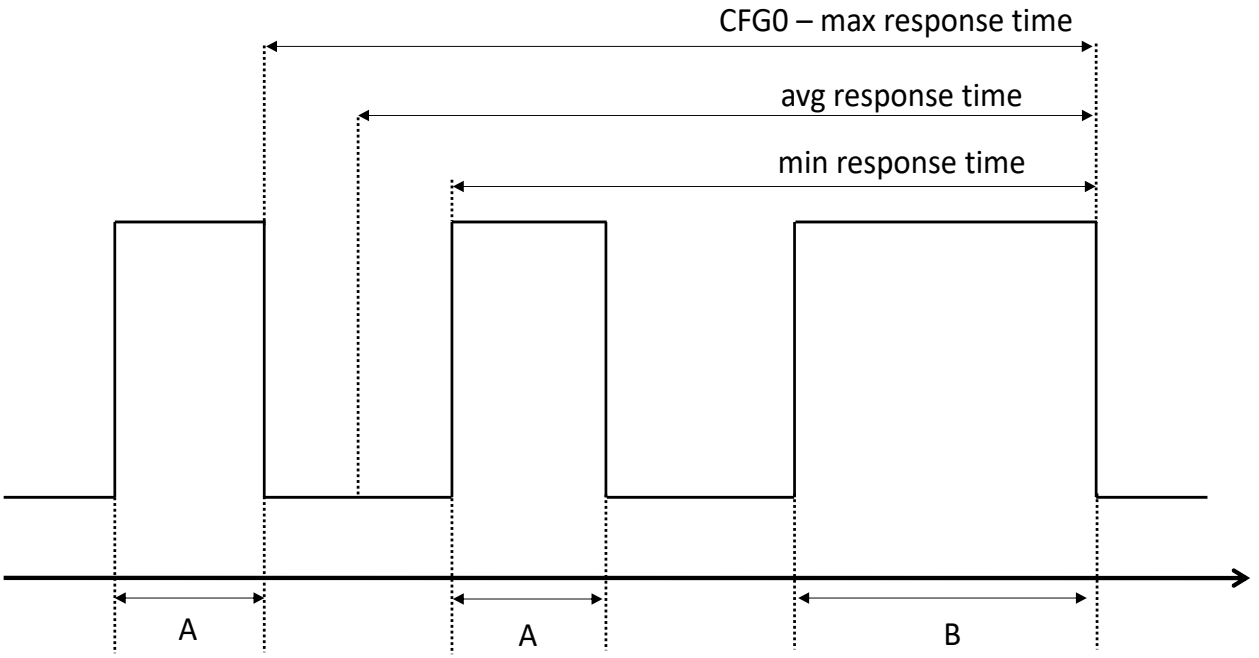
Figure 7-6. Response Time



A : Measurement Time
B : Measurement Time + Confirmation Scans

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8. Power Consumption

8.1 Single-Button Mode Enabled

The following tables show power consumption of Button0 while all other buttons are suspended for both 3.3V and 5V V_{DD}. The current is in microamperes. Refer to Section 3.5 - Single-Button Mode for further details.

I_{DD} (µA) x8 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1499	2322
50	30	48
100	16	26
250	7	12

I_{DD} (µA) x16 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1499	2322
50	45	72
100	23	37
250	10	17

I_{DD} (µA) x32 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1449	2322
50	76	120
100	39	61
250	16	26

I_{DD} (µA) x64 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1449	2322
50	137	217
100	70	110
250	29	46

8.2 Single-Button Mode Disabled

The data in the following tables are taken when all the buttons (three buttons) are measured at 3.3V and 5V. The current is in microamperes.

I_{DD} (µA) x8 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1483	2362
50	64	103
100	34	53
250	14	23

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I_{DD} (µA) x16 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1476	2332
50	110	175
100	57	90
250	24	38

I_{DD} (µA) x32 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1483	2362
50	201	318
100	103	163
250	43	68

I_{DD} (µA) x64 Oversampling		
Measurement time CFG1 (msec)	V_{DD} = 3.3V	V_{DD} = 5V
Free-run	1483	2362
50	384	606
100	196	305
250	80	127

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9. Specification

9.1 Disclaimer

Typical values are measured at T = 25°C and V_{DD} = 3.0V unless otherwise specified. All minimum and maximum values are valid across operating temperature and voltage unless otherwise specified.

9.2 Electrical Specification

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.

Table 9-1. Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
	Ambient temperature under bias	-40	+85/+125	°C
TStorage	Storage temperature	-65	+150	°C
VPin	Pin voltage to GND	-0.3	V_{DD} + 0.3	V
IPin	I/O pin sink/source current	—	±25	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 9-2. General Operating Conditions

Symbol	Description	Condition	Min.	Max.	Unit
V_{DD}	Operation supply voltage	—	2	5.5	V
—	Supply ripple noise	—	—	20	mV p-p
SV_{DD}	V_{DD} rise rate	—	0.05	—	V/ms
T	Operating temperature range(1)	Standard temperature range	-40	85	°C
		Extended temperature range	-40	125	°C

Note: Refer to the device ordering codes for the device temperature range.

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9.4 I/O Pin Characteristics

Table 9-3. I/O Pin Characteristics (T_A = 25°C, V_{DD} = 3.0V Unless Otherwise Stated)

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
V_{OL}	I/O pin drive strength	I_{OL} = 10 mA, V_{DD} = 3.0V	—	—	0.6	V
V_{OH}	I/O pin drive strength	I_{OH} = 6 mA, V_{DD} = 3.0V	V_{DD}-0.7	—	—	V
V_{IL}	With Schmitt Trigger Buffer	1.8V ≤ VDD ≤ 5.5V	—	—	0.2 V_{DD}	V
	MCLR	—	—	—	0.2 V_{DD}	V
V_{IH}	With Schmitt Trigger Buffer	1.8V ≤ VDD ≤ 5.5V	0.8 V_{DD}	—	—	V
	MCLR	—	0.8 V_{DD}	—	—	V
I_{IL}	I/O Ports	$V_{SS} \le V_{PIN} \le V_{DD}$ Pin at high-impedance, 85°C $V_{SS} \le V_{PIN} \le V_{DD}$ Pin at high-impedance, 125°C	—	±5 ±5	±125 ±1000	V
	MCLR	$V_{SS} \le V_{PIN} \le V_{DD}$ Pin at high-impedance, 85°C	—	±50	±200	V

Table 9-4. Sensor Capacitance

Symbol	Description	Condition	Min.	Typ.	Max.	Unit
C_X	Sensor electrode capacitance	—	1	—	15	pF

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10. Ordering Information

Available ordering options:

- Click on the following product page link:
  - MTCH1030 Product Page
- Contact your local sales representative
- Search by product name at microchipdirect.com

10.1 Product Information

Ordering Code	Supply Voltage	Package Type	Package Media	Temperature Range
MTCH1030-I/MG MTCH1030T-I/MG	2-5.5V	QFN	Tube Tape and Reel	-40°C to + 85°C
MTCH1030-E/MG MTCH1030T-E/MG	2-5.5V	QFN	Tube Tape and Reel	-40°C to + 125°C
MTCH1030-I/ST MTCH1030T-I/ST	2-5.5V	TSSOP	Tube Tape and Reel	-40°C to + 85°C
MTCH1030-E/SS MTCH1030T-E/SS	2-5.5V	TSSOP	Tube Tape and Reel	-40°C to + 125°C

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11. Package Marking

11.1 14-Pin TSSOP

Figure 11-1. General

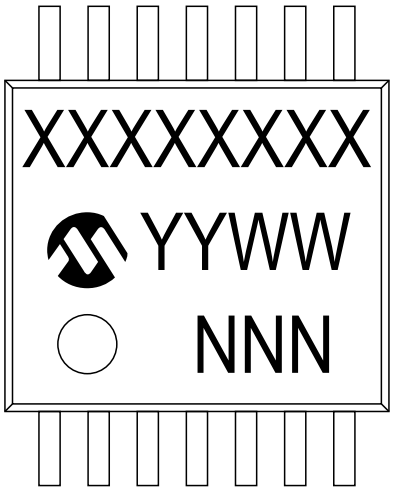
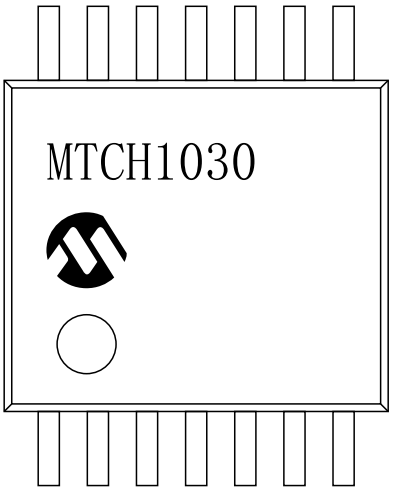


Figure 11-2. Example



11.2 16-Pin QFN

Figure 11-3. General

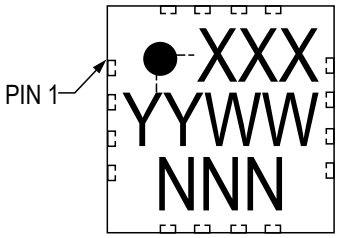
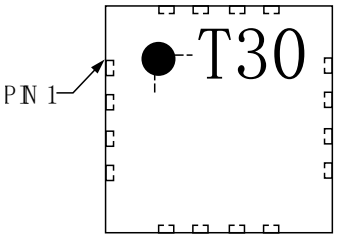


Figure 11-4. Example



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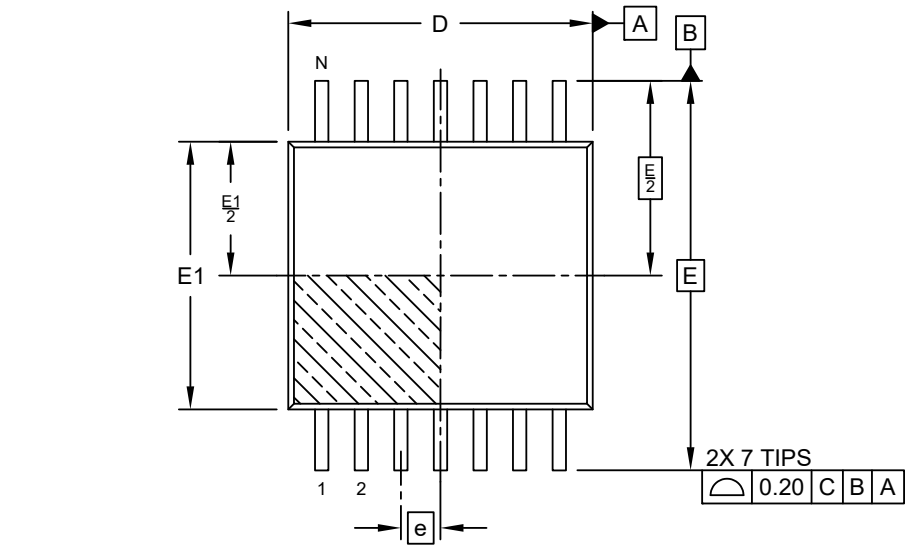
12. Package Drawing

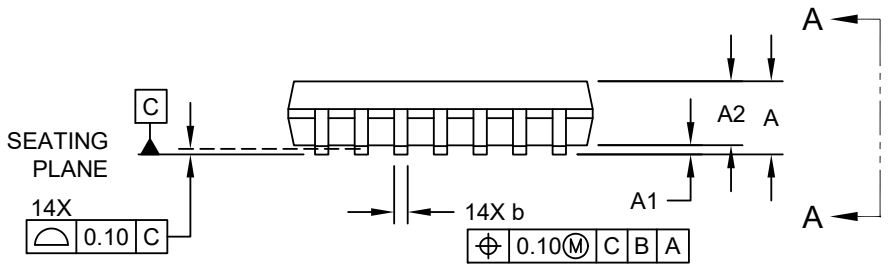
12.1 14-Pin TSSOP

14-Lead Thin Shrink Small Outline Package [ST] – 4.4 mm Body [TSSOP]

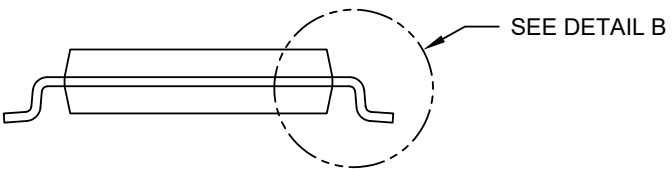
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW



VIEW A–A

Microchip Technology Drawing C04-087 Rev E Sheet 1 of 2

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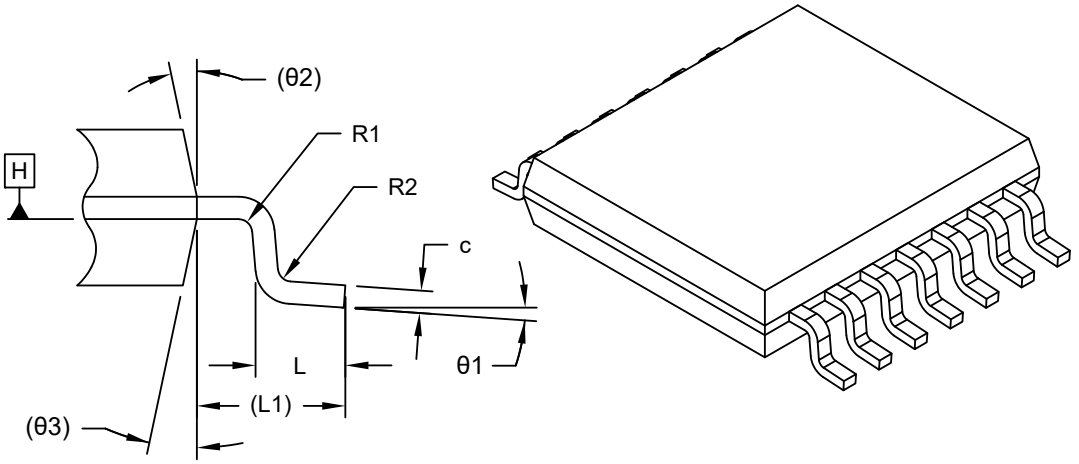
14-Lead Thin Shrink Small Outline Package [ST] – 4.4 mm Body [TSSOP]

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



DETAIL B

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		14	
Pitch	e		0.65 BSC	
Overall Height	A	–	–	1.20
Standoff	A1	0.05	–	0.15
Molded Package Thickness	A2	0.80	1.00	1.05
Overall Length	D	4.90	5.00	5.10
Overall Width	E		6.40 BSC	
Molded Package Width	E1	4.30	4.40	4.50
Terminal Width	b	0.19	–	0.30
Terminal Thickness	c	0.09	–	0.20
Terminal Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Lead Bend Radius	R1	0.09	–	–
Lead Bend Radius	R2	0.09	–	–
Foot Angle	θ1	0°	–	8°
Mold Draft Angle	θ2	–	12° REF	–
Mold Draft Angle	θ3	–	12° REF	–

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. 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.

Microchip Technology Drawing C04-087 Rev E Sheet 2 of 2

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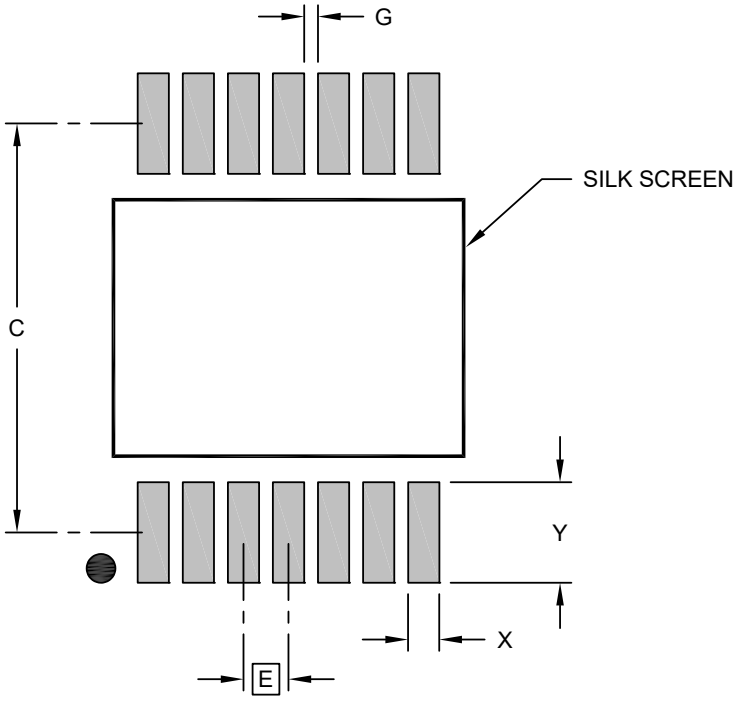
14-Lead Thin Shrink Small Outline Package [ST] – 4.4 mm Body [TSSOP]

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		0.65 BSC	
Contact Pad Spacing	C		5.90	
Contact Pad Width (Xnn)	X			0.45
Contact Pad Length (Xnn)	Y			1.45
Contact Pad to Contact Pad (Xnn)	G	0.20		

Notes:

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

Microchip Technology Drawing C04-2087 Rev E

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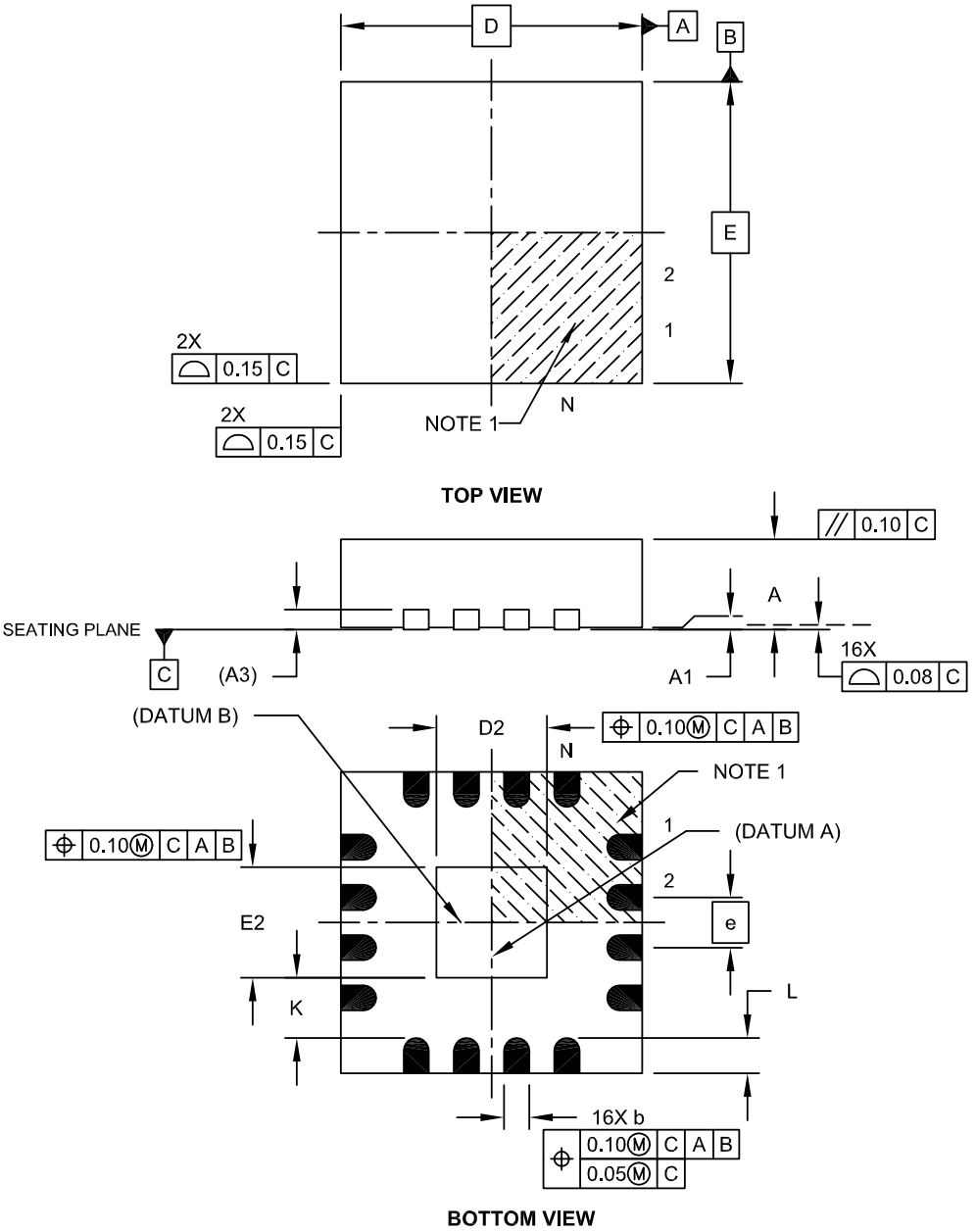
12.2 16-Pin QFN

16-Lead Plastic Quad Flat, No Lead Package (MG) - 3x3x0.9 mm Body [QFN]

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



Microchip Technology Drawing C04-142A Sheet 1 of 2

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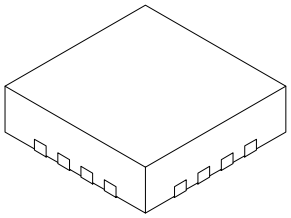
16-Lead Plastic Quad Flat, No Lead Package (MG) - 3x3x0.9 mm Body [QFN]

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		16	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Width	E		3.00 BSC	
Exposed Pad Width	E2	1.00	1.10	1.50
Overall Length	D		3.00 BSC	
Exposed Pad Length	D2	1.00	1.10	1.50
Contact Width	b	0.18	0.25	0.30
Contact Length	L	0.25	0.35	0.45
Contact-to-Exposed Pad	K	0.20	-	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated.
3. 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.

Microchip Technology Drawing C04-142A Sheet 2 of 2

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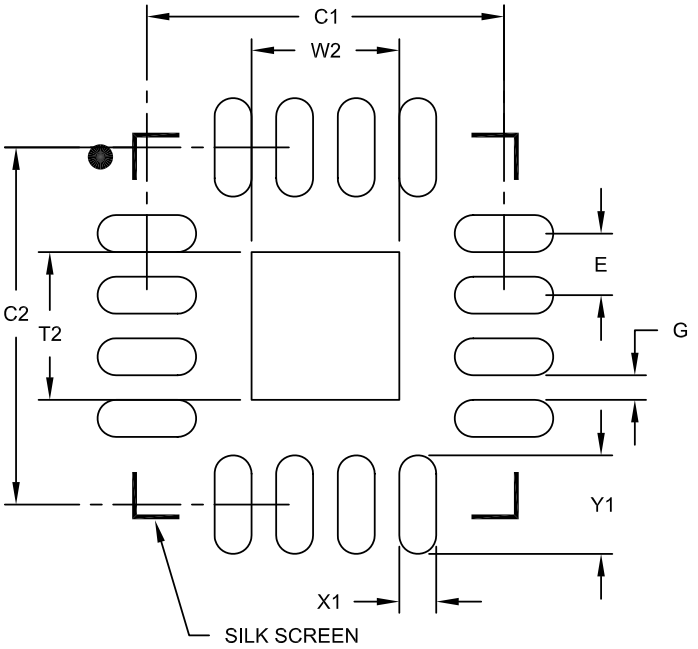
16-Lead Plastic Quad Flat, No Lead Package (MG) – 3x3x0.9 mm Body [QFN]

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		0.50 BSC	
Optional Center Pad Width	W2			1.20
Optional Center Pad Length	T2			1.20
Contact Pad Spacing	C1		2.90	
Contact Pad Spacing	C2		2.90	
Contact Pad Width (X16)	X1			0.30
Contact Pad Length (X16)	Y1			0.80
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2142A

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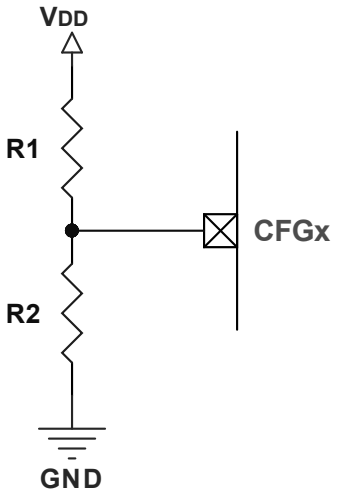
13. Appendix

13.1 Static Input Voltages

These methods will configure the MTCH1030 and provide a fixed behavior at power-up and run-time.

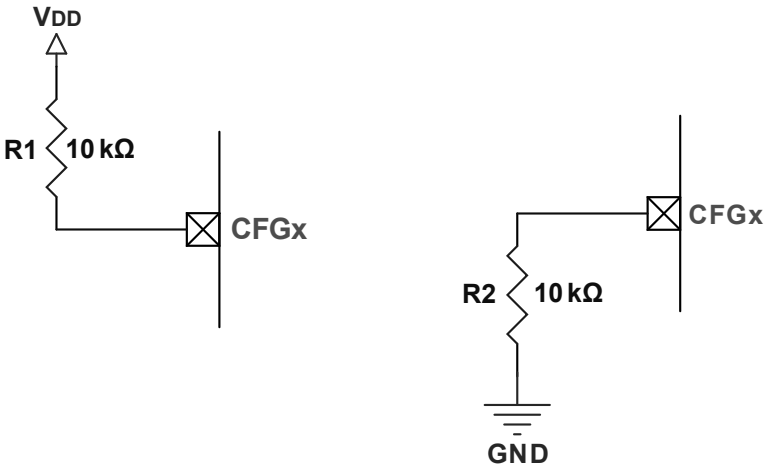
13.1.1 Resistor Ladder



Note: It is recommended that R1 and R2 be greater than 100 kΩ for lower power consumption.

13.1.2 Direct Connect to V_{DD} or GND

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



The pull-up/pull-down resistor is a pre-cautionary recommendation, as MTCH1030 will pull the CFGx neither to the V_{DD} nor to the GND during the operation.

13.2 Dynamic Input Voltages

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

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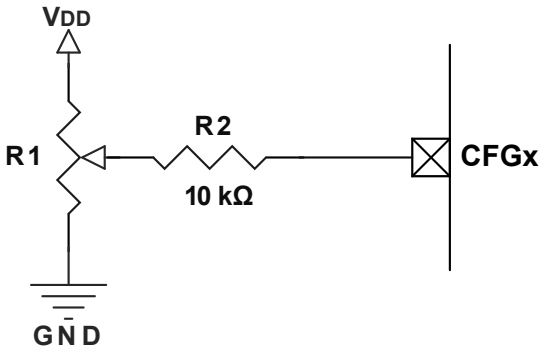
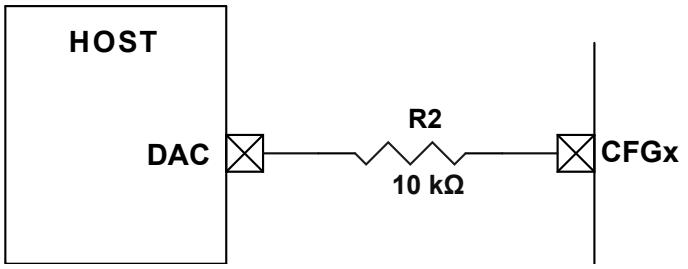
13.2.1 Potentiometer

A useable method during development. This method is also used on the MTCH1030 DevKit.



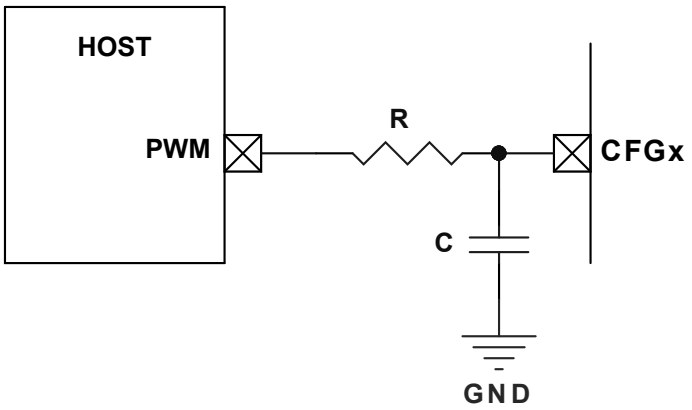
13.2.2 DAC Controlled by Host

This method is recommended if settings will dynamically change during run-time.



13.2.3 PWM Controlled by Host

This method is recommended if settings will dynamically change during run-time.



Note: Refer to Microchip Application Note TB3250, *"Using PWM to Generate Analog Output"* (DS90003250), for details on choosing the appropriate values of R and C.

13.3 Procedure to Visualize Touch Tune Data

Prerequisites to Enable Touch Tune Data:

1. MPLAB Data Visualizer or MPLAB DV plug-in (if MPLABX IDE is already present) must be installed in the host system.

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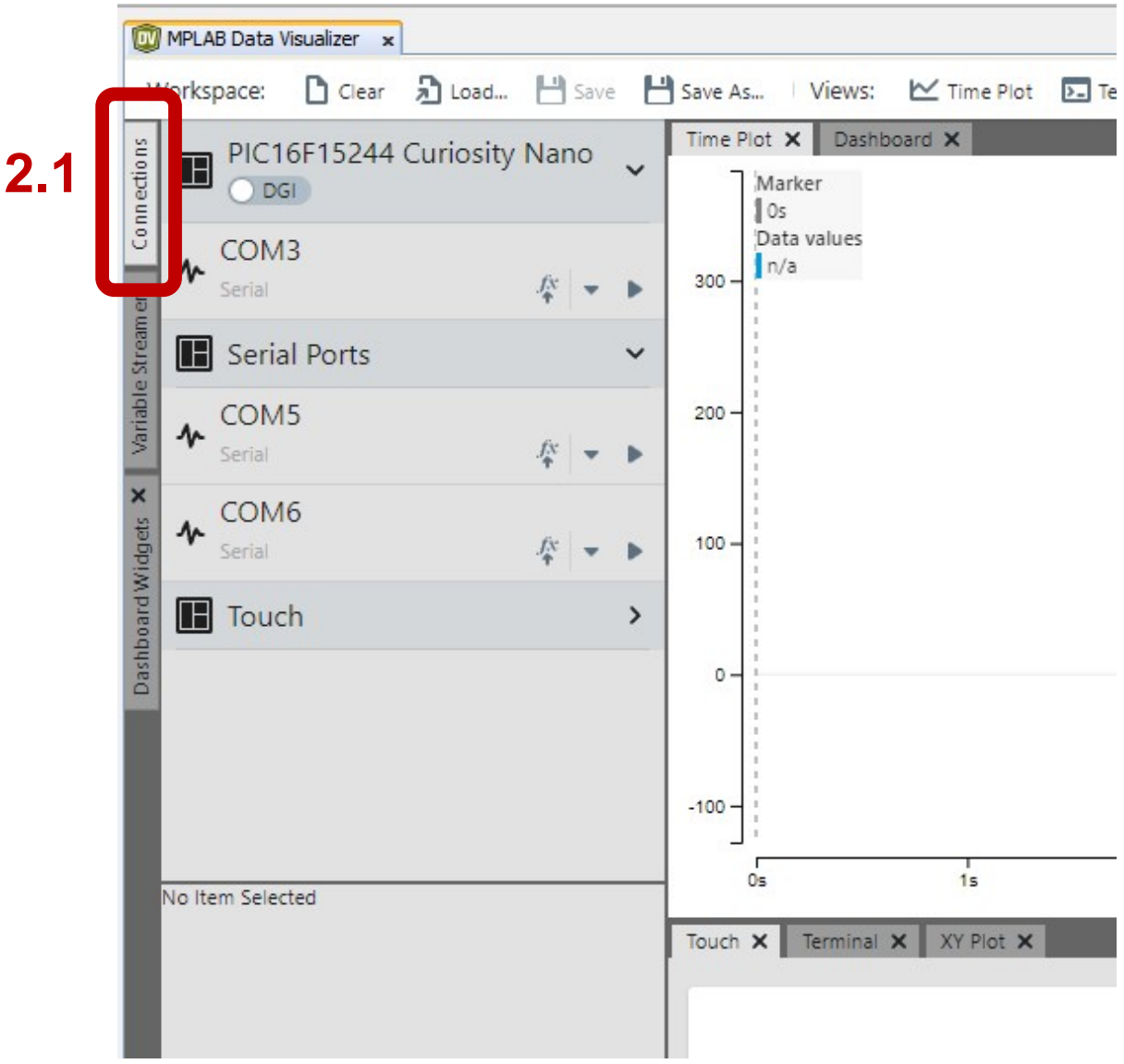
2. A UART-to-USB converter is required to stream the UART data from the MTCH1030 at a baud rate of 38400 to the host system. One of the following converter boards is recommended:
   - Microchip Touch Bridge (Microchip Part Number EV96R35A)
   - MCP2221A Breakout Module (Microchip Part Number ADM00559)
3. The configuration files required to connect to MPLAB DV can be downloaded from the MTCH1030 product page.

To connect the hardware:

1. Connect the TX pin of the MTCH1030 to the RX pin of the Touch Bridge or Breakout Module.
2. Connect the GND pins of the MTCH1030 and the Touch Bridge or Breakout Module.
3. Connect the Touch Bridge or Breakout Module to the host system's USB port with an appropriate USB cable.

To connect MPLAB DV and the Evaluation Kit:

1. Open MPLAB Data Visualizer.
2. Click on **Connections**, and click the correct **COM port**. Enter the **Baud rate** in the **COM settings** as shown in the following images.



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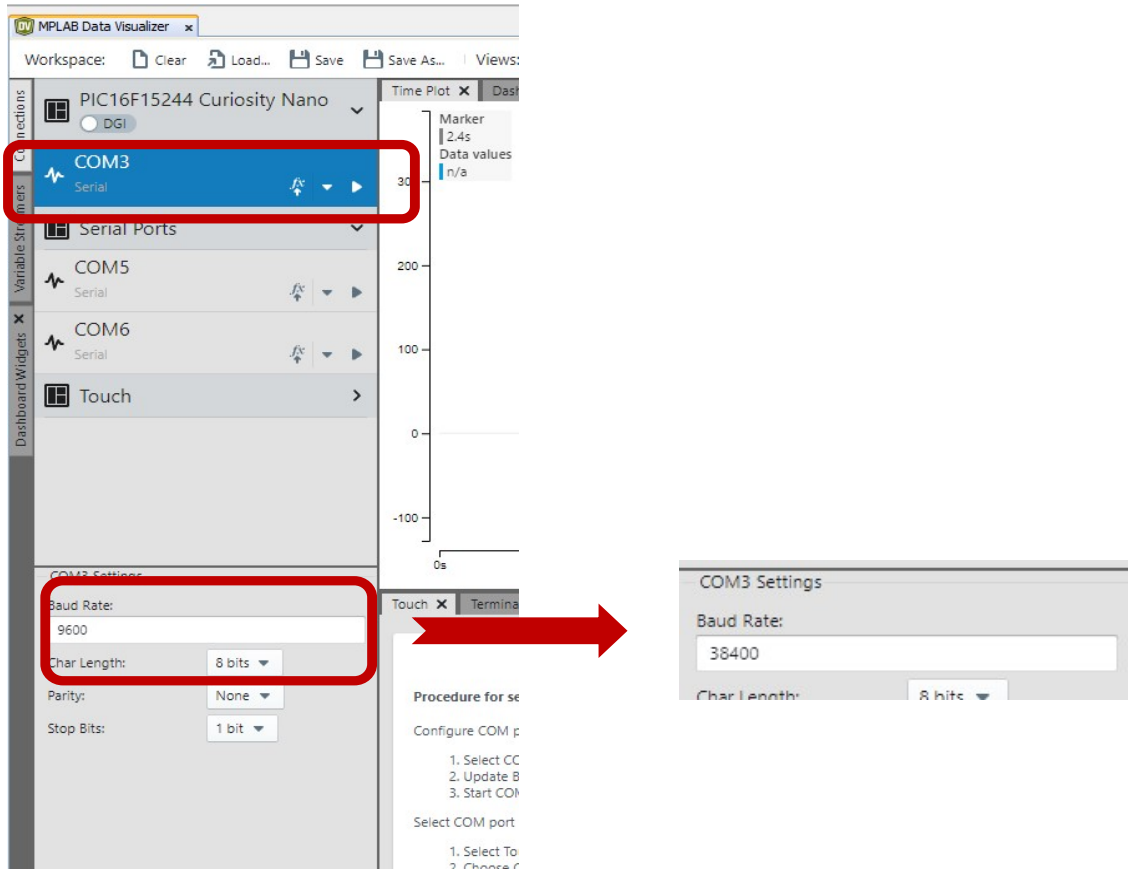
2.2

2.3



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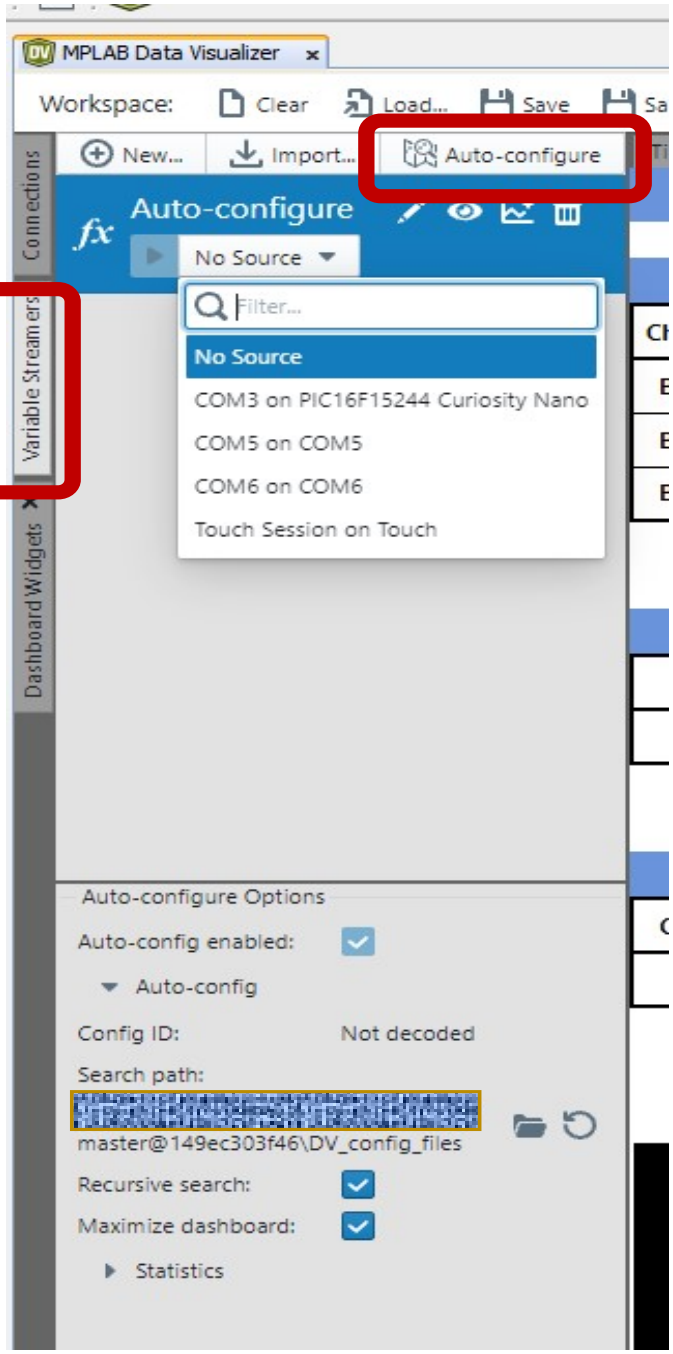
3. Select the **Variable Streamer** tab and select the **Auto-Configure** option.



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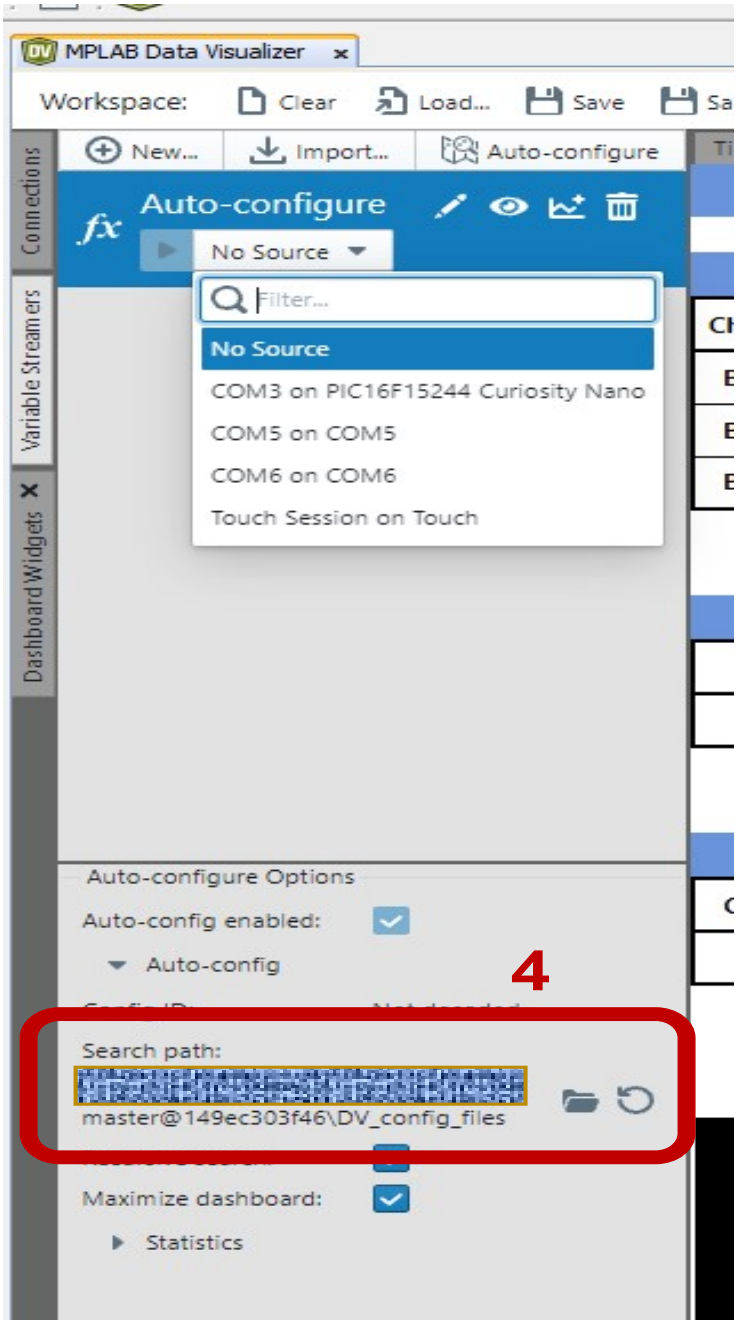
4. In the **Auto-Configure** options, select the correct folder path where the .ds files are available.



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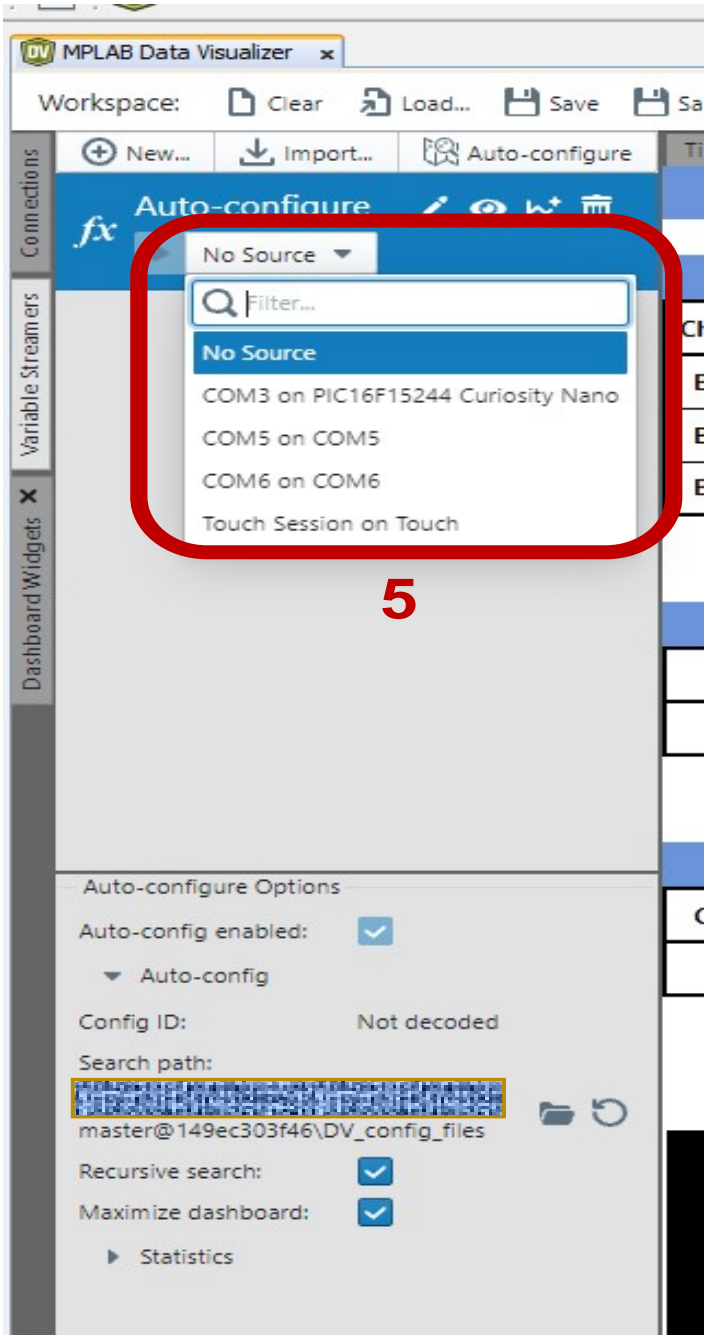
5. From the **Auto-Configure** drop-down, select the correct **COM port** to visualize the output.



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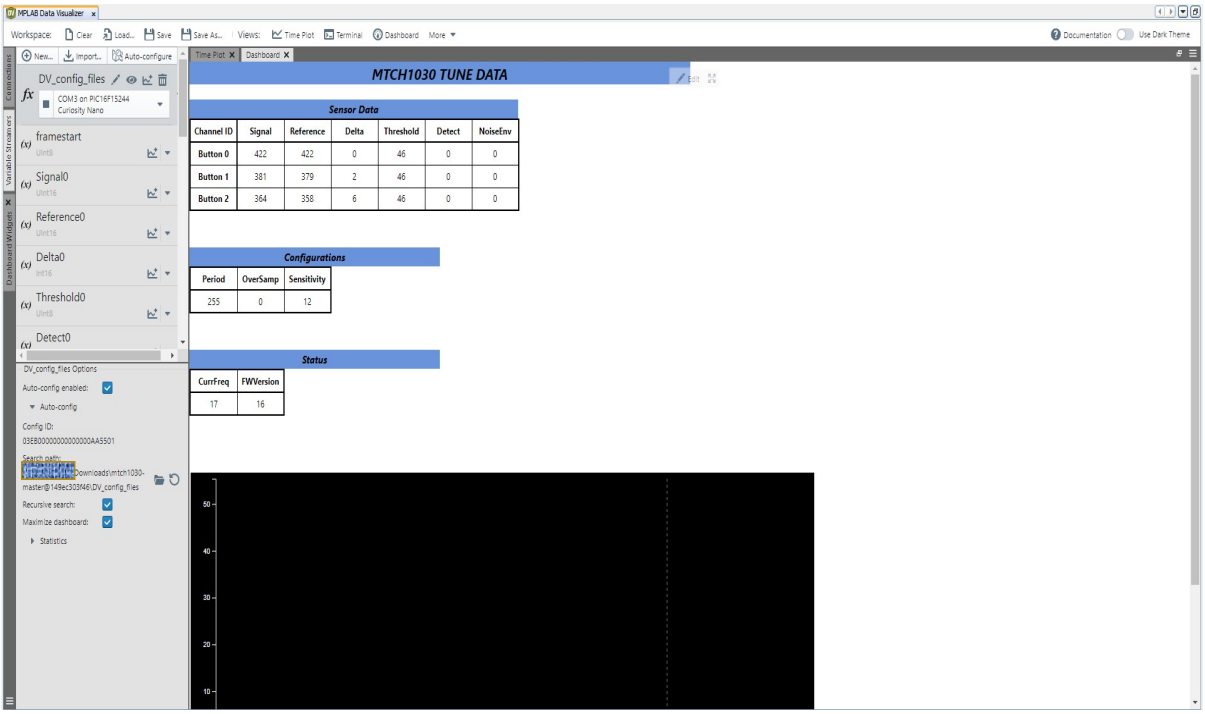
6. The MPLAB DV shows Tune Data from the MTCH1030 as shown in the following image.



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14. Revision History

Revision	Date	Description
A	05/2023	Initial document release.

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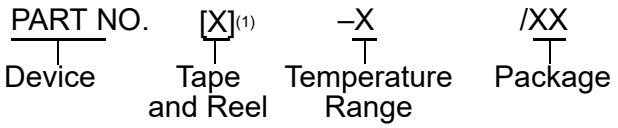

Device:	Device A, Feature A, (Package A) Device B, Feature B, (Package B)	
Tape & Reel Option:	Blank	= Tube
	T	= Tape & Reel
Temperature Range:	I	= -40°C to +85°C (Industrial)
	E	= -40°C to +125°C (Extended)
Package:	AA	= Package AA
	BB	= Package BB

Examples:

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

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