



**Touch and Input Sensing Solutions**



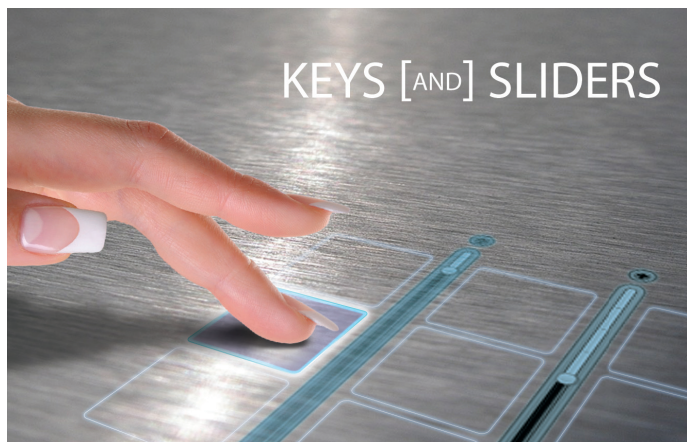
# Touch and Input Sensing Solutions

Microchip's award winning technology covers a broad range of implementations for touch and other input sensing applications. At Microchip we open up our algorithms and techniques to engineers, so that they can have the freedom to innovate with an industry leading, robust, touch implementation on our vast range of PIC® microcontrollers. Engineers get the benefit of an ever expanding product portfolio that delivers various performance levels, peripheral mixes, eXtreme Low Power (XLP), small packaging, and unique technologies such as Metal over Capacitive and Three Dimensional position and Gesture sensing.

## Keys, Sliders and Proximity

User interfaces with push buttons have several moving parts, which significantly decrease their reliability. They also require complex design and assembly as well as a major investment in tooling. Microchip touch technologies, such as capacitive or metal-over-capacitive, allow designers to create a high-impact user interface at a lower total system cost.

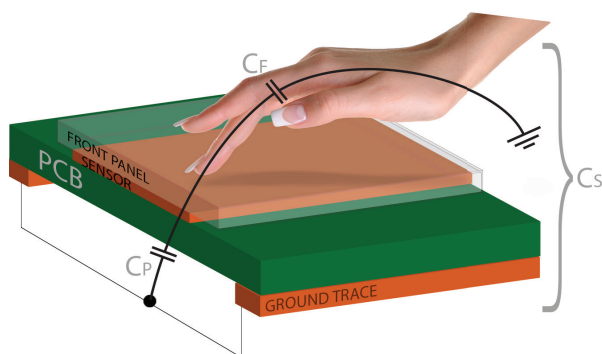
- Easy to use
  - Turnkey
  - Microcontroller based
- Robust
  - High SNR (Signal to Noise Ratio)
  - IEC61000, EFT and BCI tested
- Lowest Power
  - Proximity sensing down to 1  $\mu$ A
  - Capacitive Sensing down to 5  $\mu$ A



## Capacitive Touch Sensing

### How It Works

A capacitor is simply two electrically isolated conductors which are in close proximity to one another. The conductors can be wires, traces on a PCB or even the human body. The capacitive touch sensor is a copper pad area that is capacitively coupled to grounds located elsewhere in the system creating a parasitic capacitance. A covering plate material such as glass is used to provide the user touch surface. The introduction of the user's finger then produces an increase in capacitance which will be detected by the system.



### Microcontroller-Based Solution

Microchip offers a variety of standard PIC MCUs enabling you to dedicate an MCU for touch function or integrate touch sensing with other application functions onto a single MCU:

- 8-, 16- and 32-bit PIC MCUs for touch sensing
- From 6-pin to 144-pin devices
- Up to 512 KB Flash memory
- On-chip integration options include USB, CAN, IrDA, wireless protocol stack, segmented LCD and graphics accelerator and LCD driver for TFT/STN displays

### Enhanced mTouch™ Capacitive Evaluation Kit (DM183026-2)



The Enhanced mTouch Capacitive Evaluation Kit provides a simple platform for developing capacitive touch sense applications using 8-, 16- and 32-bit PIC MCUs.

### mTouch Capacitive Touch Software Package

The mTouch Software Package enables designers to easily integrate touch technologies into their application. It allows the implementation in a small dedicated controller as well as integration of the complete application in a single MCU.

# Keys, Sliders and Proximity

## Turnkey solution

The CAP1XXX and MTCH1XX capacitive touch controllers provide a wide variety of slider, button and proximity functionality. A Graphical User Interface (GUI) allows the designer to analyze sensor data and easily configure the controller.

- From 1 to 14 sensors
- Up to 11 LED drivers
- Enhanced proximity option with guard ring
- I<sup>2</sup>C™ or SPI communication
- 1.8–5.5V
- As small as 2 × 3 TDFN

## Metal-Over-Capacitive Technology

In addition to capacitive touch, Microchip has developed metal-over-capacitive technology which can:

- Use polished or brushed metal surfaces including stainless steel and aluminum
- Sense through gloves
- Create completely waterproof designs
- Deploy braille-friendly interfaces

Metal-over-capacitive technology can be implemented with the same hardware, PCB, electronics and software as capacitive touch technology.

### How It Works

A metal-over-capacitive touch system uses a conductive target layer suspended over a capacitive touch sensor, to act as a second capacitor plate. When the user applies a downward pressure on the target, the resulting deformation moves the center of the target closer to the capacitive sensor. The change in spacing produces a change in capacitance, which is then measured by the touch controller.

The target can be a sheet of metal with the Fascia marking screen on the outer surface, a metal flashing on the back of a plastic fascia, or a co-molded layer composed of both metal and plastic. The spacer layer is typically an adhesive with a cut out over the capacitive sensor, and the sensors themselves can be either printed conductive pads on a plastic film or pads etched into the top surface of a PCB.

## Application Notes

- *mTouch Sensing Solution Acquisition Methods Capacitive Voltage Divider*, AN1478
- *Techniques for Robust Capacitive Touch Sensing*, AN1334
- *Proximity Design Guide*, AN1492
- *mTouch Metal-Over-Cap Technology*, AN1325
- *mTouch Conducted Noise Immunity Techniques for CTMU Peripheral*, AN1317
- *Capacitive Touch Using Only an ADC (CVD) (suitable for PIC10/12/16/24H/32 MCUs)*, AN1298
- *Microchip CTMU for Capacitive Touch Applications (suitable for PIC18 and PIC24F MCUs)*, AN1250

For datasheets, user's guides and general design information please visit [www.microchip.com/touch](http://www.microchip.com/touch).

## CAP1188 Evaluation Board (DM160222)

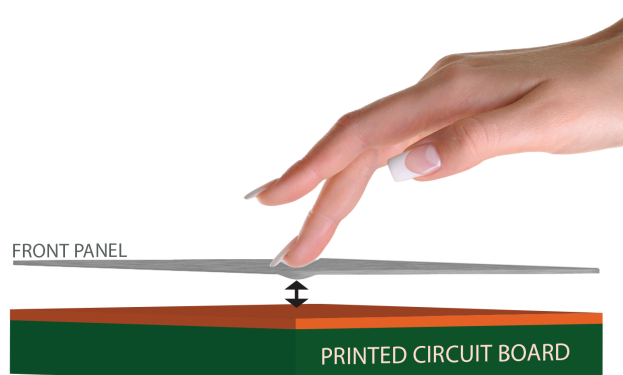


The CAP1188 evaluation kit provides an easy platform for evaluating and developing a variety of capacitive touch sense applications using CAP11XX family.

## CAP1298 Evaluation Board (DM160223)



The CAP1298 evaluation kit provides an easy platform for evaluating and developing a variety of capacitive touch sense and proximity applications using CAP12XX family.



## Metal-Over-Capacitive Accessory Kit (AC183026)



The Metal-Over-Capacitive Accessory Kit contains two daughter boards showcasing metal-over-capacitive technology.

One board has a stainless steel cover and the other has a plastic cover. It provides an easy way to evaluate Microchip's unique technology when used in conjunction with the Enhanced mTouch Capacitive Touch Evaluation Kit.

# Touch Screen and Touch Pad Controllers

## Touch Screen and Touch Pad Controllers

Microchip offers a broad portfolio of touch solutions for touch screen and touch pad applications that make it easy for designers to integrate touch-sensing interfaces.

- High-flexibility
  - We offer both source code and turnkey touch solutions with options to integrate touch sensing with application code on a single low-cost MCU
- Sophisticated
  - Advanced touch solutions use sophisticated proprietary touch decoding algorithms to send your application fully processed and reliable touch coordinates
- Easy Integration
  - Add touch technology to your application without extensive development time, risk or cost

## Projected Capacitive and Resistive Touch Solutions

Microchip offers both projected capacitive and resistive touch solutions to allow you to choose the best fit for your design. Each offers different advantages:

### Projected Capacitive

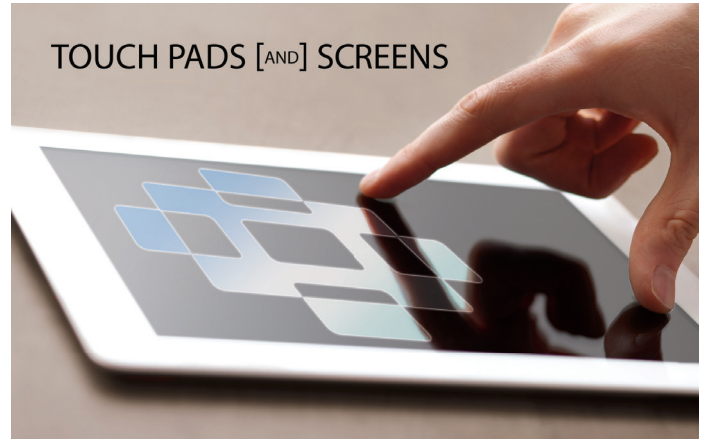
- Glass front sensor construction provides high durability, good optics and light touch
- Multi-touch capability which enables gestures

### Analog Resistive

- Low-cost sensors that accept finger, glove or stylus inputs
- Ease of manufacturing and integration

## Touch Sensing Technology Comparison

	Analog Resistive	Projected Capacitive
Cost for screen < 6"	Lowest	Low
Cost for screen > 10"	Lowest	High
Optics	75%	90%
Screen Life	Good	Better
Ease of Integration	Easy	Moderate
Multi-Touch	Limited	Yes
Touch Object	Finger, Stylus/ Glove	Finger



## Resistive Technology Overview

### How It Works

Two conductive coated polyester layers are separated by a spacer layer. When touched, the top (flex) layer moves past the spacer layer and contacts the bottom (spacer) layer. The point of contact creates a voltage divider in the X and Y directions.

### AR1000 Resistive Touch Advantages

- Proven plug-and-play design
- Eliminates all host processing of touch data
- Built in decoding and advanced filtering
- Low system power—wake on touch
- Universal, supports all 4-, 5-, and 8-wire sensors
- SPI, I<sup>2</sup>C, UART or USB Interfaces
- Free drivers for most major platforms

### Development Tools for Resistive Touch

Microchip provides fully functional hardware and feature-rich GUIs to quickly get started using AR1000 resistive touch controllers for a turnkey, cost effective solution.



mTouch AR1100  
Development Kit  
(DV102012)

mTouch AR1000  
Development Kit  
(DV102011)



# Touch Screen and Touch Pad Controllers

## Projected Capacitive Technology

Microchip's projected capacitive technology supports solutions across the portfolio of 8-, 16- and 32-bit PIC microcontrollers. Microchip offers both turnkey and microcontroller-based solutions. You can use a dedicated MCU for touch or integrate additional applications with touch into a single MCU. Our flexible, royalty-free source code and turnkey projected capacitive touch controllers provide you with solutions to create the innovative user interfaces that consumers desire.

### Lowest Power Touch Pads

Microchip offers key advantages in touch pad design with low-power and low-cost solutions to enable simple touch designs with fast time-to-market. Microchip leverages eXtreme Low Power (XLP) technology to provide industry-leading low power touch solutions to maximize battery life. Example power measurements for a typical application with 11 channels using a PIC16LF1509 at 2V are:

- Standby <1  $\mu$ W
- Approach <30  $\mu$ W
- Active <300  $\mu$ W

### Included Gestures

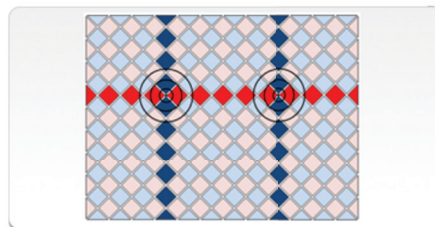
The MTCH6301 Turnkey Projected Capacitive Touch Controller includes 11 single finger gestures.

- |  |  |  |   |
|--|--|--|---|
|  <i>Single Tap</i>    |  <i>Swipe Up</i>           |  <i>Swipe Down and Hold</i>  |  <i>Swipe Right</i>           |
|  <i>Double Tap</i>   |  <i>Swipe Up and Hold</i> |  <i>Swipe Left</i>          |  <i>Swipe Right and Hold</i> |
|  <i>Tap and Hold</i> |  <i>Swipe Down</i>        |  <i>Swipe Left and Hold</i> |   |

### How It Works

Projected Capacitive Touch Sensors operate by measuring the tiny change in capacitance on an electrode due to the influence of a human finger or other object.

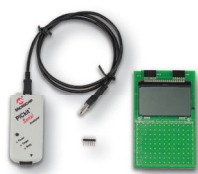
- One or two thin conductive layers
- Screen is configured as rows and columns
- Point of contact identified by change in capacitance of row and column cells electrodes



## Development Tools for Projected Capacitive Touch

Microchip makes it easy to add gestures and multi-touch to your interface design.

### Projected Capacitive Touch Pad with Gestures Development Kit (DM320016)



- Includes a modified MTCH6301 to provide touch input and also drive the dot-matrix LCD
- Multi-touch detection up to 8 touches
- Microchip's CVD capacitive sensing method
- Sleep with wake on touch
- Dual-touch drawing
- Single-touch gestures
- GUI allows observation of signals and tuning of firmware parameters
- Full reference design with sensor design guidelines

### PIC32 GUI Development Board with Projected Capacitive Touch (DM320015)



The PIC32 GUI Development Board with Projected Capacitive Touch enables development of cost-effective multi-touch graphical user interfaces. It has a 4.3" WQVGA touch display enabling development of graphics solutions without an external graphics controller. Multi-touch user input is supported by Microchip's Turnkey Projected Capacitive Touch Controller, MTCH6301

For datasheets, user's guides and general design information please visit [www.microchip.com/touch](http://www.microchip.com/touch).

# 3D Tracking and Gesture Sensing

## MGC3130 3D Gesture Controller with GestIC® Technology

The MGC3130 is a unique User Interface (UI) solution that provides real-time gesture recognition and hand position tracking to enable the next breakthrough in user interface design.

The UI plays a crucial role in a consumer's buying decision. With Microchip's MGC3130 3D Gesture Controller you can add the next generation of UI to virtually any product. The MGC3130 incorporates Microchip's patented GestIC Technology which enables three-dimensional (3D) gesture recognition, hand tracking and approach detection for user command input with natural hand and finger movements in free-space.

### The Benefits of E-field Sensing

Similar to capacitive touch sensing, using E-field sensing for 3D tracking enables invisible electrode integration behind the device's housing. This allows an aesthetically pleasing product design without the need for holes or other cut-outs typically required for cameras or infrared-based systems. Additionally, with E-field sensing, the full surface is covered in the sensing area with no blind spots. Blind spots are typical for visual sensing techniques. Ambient influences such as light and sound do not impact the E-field and electrical noise sources are easily handled by the MGC3130 through a variety of analog filtering, frequency hopping and digital signal processing.

### Low-Cost, Low-Power Implementation

Given the power consumption and processing power of camera- and other optical-based systems, the GestIC technology provides an alternative that consumes less power at a much lower cost.

The MGC3130 utilizes thin sensing electrodes made of any conductive material such as Printed Circuit Board (PCB) or Indium Tin Oxide (ITO) coating. With no requirements for additional active components, the MGC3130 provides a very cost-effective system solution.

The chip's inherently low power consumption combined with advanced power modes enables always-on 3D sensing even for battery driven, mobile devices. This allows an application to be in a lower power standby mode and still be able to detect an approaching user. The MGC3130 can quickly transition from this standby mode to full tracking and gesture recognition so the user does not experience any interruption in gesture detection.

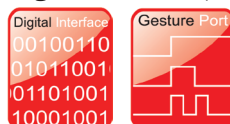
The MGC3130 outputs direct and immediately usable results: gestures, x/y/z positions and approach are detected on-chip. The MGC3130 is a true single-chip solution for the next generation of user interface, enabling embedded gesture-based UI applications.



### Fast, Precise and Robust

Implemented as a low-power mixed-signal System-on-Chip (SoC), the MGC3130 offers a rich set of smart-functional features including:

- 32-bit digital signal processing unit
- 0 (touch) to 15 cm detection range
- 150 dpi resolution
- Fast data sampling at 200 Hz (5 ms)
- Robust performance even in noisy environment through:
  - Super-low-noise analog front end for signal acquisition
  - Automatic noise suppression with digital signal processing
  - Frequency hopping to avoid noise sources
  - On-going self calibration for consistent quality in performance
- Variety of power saving modes
  - Processing operation: 20 mA @ 3.3V
  - Auto Wake-up on Approach: 110 µA @ 3.3V
  - Sleep mode: 9 µA @ 3.3V
- Field upgradable on-board gesture suite
- Digital interface (I<sup>2</sup>C)
- Up to five configurable outputs that can be linked to various gestures (Gesture Port)



# 3D Tracking and Gesture Sensing

## On-Board Gesture Recognition

The gesture recognition is performed on chip to eliminate the complexity and need for additional processing, a unique feature to GestIC technology shortening your time-to-market. The gesture suite gives the MGC3130 the ability to recognize gestures while the rest of the system is powered down or in a power savings mode. It is field-upgradable to ensure your system can accommodate and use additional gesture algorithms as they become available.

### Included Gestures



**Approach Wake-up** is primarily used to wake up the MGC3130 (and the rest of the system) when a hand approaches the sensing area.



**Flick Gestures** are available as swipes or edge flicks in four directions: North, East, South and West. These are typically used for commands such as next, previous, on/off or up/down.



Clockwise and counter-clockwise **Circle Gestures** provide an alternative directive gesture for commands such as rotate and forward/back.

Like speech and language, everybody's hand gestures have a unique quality that differs in timing, amplitude and a broad range of other metrics. The integrated GestIC Technology Colibri Suite makes use of a Hidden Markov Model for high recognition rates of various gestures. This detects the subtle difference between deliberate gestures and general hand movement to limit response to unintended gestures.



The **Airwheel Gesture** is an intuitive input for up/down adjustments to levels and values. Output resolution is adjustable from 4 counts per turn to 32 counts per turn.



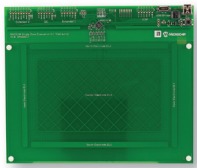
**Sensor Touch** detects touch, tap or double tap at any of the five receive electrodes. This is typically used for selection and confirmation commands.



Both x-y-z and raw signal **Position Tracking** is available to perform an additional pre-and/or-post qualification of gestures, custom gestures or input sensing.

## Evaluation Tools

### Sabrewing Evaluation Tool (DM160217)



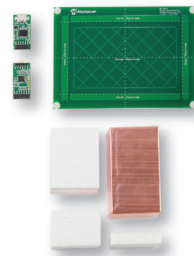
This tool offers a complete solution for exploring the low-cost, high-performance MGC3130. Evaluation of the MGC3130 3D Gesture Controller's next-generation UI includes sensor output data display, visualization of real-time positional data, gesture recognition and auto wake-up.

Features:

- 7" GestIC Technology electrodes
- On-board MGC3130 (GestIC Technology Colibri Suite)
- On-board USB communication
- USB powered
- Microchip's AUREA Graphical User Interface (GUI) for Windows® 7 and Windows 8

The AUREA GUI provides full control of the MGC3130's parameters and settings, making it easy to update and save parameters.

### Hillstar Development Kit (DM160218)



This kit is a complete modular solution for designing in the low-cost, high-performance MGC3130. System parameterization is guided by Microchip's AUREA design in software (GUI).

Features:

- 5" electrode and variety of electrode reference designs
- GestIC Technology electrode design guide
- MGC3130 unit (GestIC Technology Colibri Suite)
- I<sup>2</sup>C/USB bridge (USB powered)
- GestIC Technology interface library manual
- I<sup>2</sup>C interface reference code
- Microchip's AUREA GUI for Windows 7 and Windows 8
- AUREA manual
- SDK for Windows 7 and Windows 8

The AUREA GUI provides full control of the MGC3130's parameters and settings, making it easy to update and save parameters. The AUREA also provides out-of-the-box MGC3130 3D Gesture Controller sensor output data display, visualization of real-time positional data gesture recognition and auto wake-up.

For datasheets, user's guides and general design information please visit [www.microchip.com/gestic](http://www.microchip.com/gestic).

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