Microchip
China Distributor Training
HMID - TXFG
Keys, Sliders, Touch Pads, Touch Screens, 3D Gestures
Aug 2016
HMID leverages to product platforms and experience of Microchip and Atmel for industry leading touch solutions.
Human Machine Interface Suite

User Interface

mTouch™
Proximity
Buttons
Sliders

QTorch®

Touch Pad
Touch screens

maXTouch®

Free-space Gesture control

GestIC®

3D

1D

2D

Microchip – Sole solution provider for all dimensions
### TXFG product portfolio

#### Turnkey

- **CAP11xx**
  - 3-14 Keys, Sliders
  - Proximity, I²C/SPI
- **CAP12xx**
  - 3-14 Keys, Sliders
  - Proximity, I²C/SPI
- **MTCH1xx**
  - 1-8 Keys, Proximity, Direct button replacement. GPIO

#### Firmware

- **mTouch library**
  - PIC: 8/16/32 bit
  - Touch library w/ API
  - MPLAB + MCC / MLA
  - MCU’s w/ ADC or touch peripheral

- **QTouch library**
  - AVR: 8 bit
  - **SAMxxxx**: 32bit, ARM M0
  - Touch library w/ API
  - Atmel Studio + QTouch Composer
  - MCUs w/ ADC or touch peripheral

- **Reference code**
  - **PIC16LF156x**, 8bit
  - Royalty free License,
  - Complete Access
  - MPLAB + MCC
  - (upcoming)
  - Single finger touch, multi finger surface gestures.

- **QTouch surface**
  - **SAMxxxxx**: 32bit, ARM M0
  - 2D Touch library w/ API
  - Atmel Studio + QTouch Composer
  - Dual finger touch
## Touch on MCUs
### SW Tools

<table>
<thead>
<tr>
<th>Target</th>
<th>Enabling customers to run 1D touch on multi purpose MCUs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mTouch Library</td>
</tr>
<tr>
<td>Content</td>
<td>• Buttons</td>
</tr>
<tr>
<td></td>
<td>• Proximity</td>
</tr>
<tr>
<td></td>
<td>• Slider (MLA)</td>
</tr>
<tr>
<td>Platform(s)</td>
<td>• PIC12/16/18 – 8 bit</td>
</tr>
<tr>
<td></td>
<td>• PIC24/dsPIC33 – 16 bit</td>
</tr>
<tr>
<td></td>
<td>• PIC32 – 32 bit</td>
</tr>
<tr>
<td>Tools</td>
<td>• for 8b PIC</td>
</tr>
<tr>
<td></td>
<td>• Legacy MLA mTouch library PIC 16 / 32 bit</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://www.atmel.com">MCC</a> install instructions as a plugin for MPLAB X</td>
</tr>
<tr>
<td></td>
<td>• Legacy MLA</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://www.microchip.com">Design guide, AppNotes, Guides for robust design, ...</a></td>
</tr>
</tbody>
</table>
### Touch on MCUs Selection

<table>
<thead>
<tr>
<th>mTouch - MCC</th>
<th>QTouch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0. Guideline</strong></td>
<td>There is no “vs.”</td>
</tr>
<tr>
<td><strong>1. Respect customer preference</strong></td>
<td>• PIC platform</td>
</tr>
<tr>
<td></td>
<td>• Strong in 8 bit</td>
</tr>
<tr>
<td><strong>2. Supported parts</strong></td>
<td>• Preferred: 8/16/32b</td>
</tr>
<tr>
<td></td>
<td>• touch peripheral: HCVD, ADC²</td>
</tr>
<tr>
<td></td>
<td>• Supported: 8/16/32b</td>
</tr>
<tr>
<td></td>
<td>• PIC with ADC</td>
</tr>
<tr>
<td></td>
<td>• Preferred: 8/32b</td>
</tr>
<tr>
<td></td>
<td>• Touch peripheral: PTC</td>
</tr>
<tr>
<td></td>
<td>• Supported: 8b</td>
</tr>
<tr>
<td></td>
<td>• AVR with ADC</td>
</tr>
</tbody>
</table>

Using MCUs with an integrated **touch peripheral** enables high performance, less code and less resource demanding implementations.

**Customer’s coding preferences** and experience will guide towards mTouch MCC or QTouch library.
1D Solution Highlight

Button/Slider/Wheel/Proximity
Digital outputs for Direct Mechanical buttons replacement

- **MTCH101**
  - 1 x Input
  - 1 x Output
  - Adjustable Sensitivity
  - Low Power Mode

- **MTCH102**
  - 2 x Input / Guard Option
  - 2 x Output
  - Adjustable Sensitivity
  - Low Power Mode

- **MTCH105**
  - 5 x Input / Guard Option
  - 5 x Output
  - Adjustable Sensitivity
  - Low Power Mode

- **MTCH108**
  - 8 x Input / Guard Option
  - 8 x Output
  - Adjustable Sensitivity
  - Low Power Mode

Supports Water Resistance

DM160229 @ $29.95
Turnkey Products
I2C Interface

- **CAP1293**
  - 3 Sensors Inputs
  - Signal Guard / Proximity
  - I2C Communication
  - 3.0V to 5.5V

- **CAP1296**
  - 6 Sensors Inputs
  - Signal Guard / Proximity
  - I2C Communication
  - 3.0V to 5.5V

- **CAP1298**
  - 8 Sensors Inputs
  - Signal Guard / Proximity
  - I2C Communication
  - 3.0V to 5.5V

- **CAP1203**
  - 3 Sensors Inputs
  - I2C Communication
  - 3.0V to 5.5V

- **CAP1206**
  - 6 Sensors Inputs
  - I2C Communication
  - 3.0V to 5.5V

- **CAP1208**
  - 8 Sensors Inputs
  - I2C Communication
  - 3.0V to 5.5V

SOIC Package added to lower production costs!
DevKits price lowered to US$49!
QTouch Development Platform

QTouch Composer – Project Builder

Kit Design - Page 2 of 8

Slider 0 Properties

<table>
<thead>
<tr>
<th>Physical</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKS Group</td>
<td>NO_AKS_GROUP</td>
</tr>
<tr>
<td>Detect Threshold</td>
<td>10</td>
</tr>
<tr>
<td>Detect Hysteresis</td>
<td>HYST_6_25</td>
</tr>
<tr>
<td>Positive Recall Flag</td>
<td>0</td>
</tr>
<tr>
<td>From Channel</td>
<td>6</td>
</tr>
<tr>
<td>To Channel</td>
<td>9</td>
</tr>
<tr>
<td>Number of Channels</td>
<td>4</td>
</tr>
<tr>
<td>Position Resolution</td>
<td>RES_8_BIT</td>
</tr>
<tr>
<td>Position Hysteresis</td>
<td>0</td>
</tr>
</tbody>
</table>

Configures which AKS group a sensor is within.

Generate Sensor Shape Files

0

0 1
Metal Over Cap Technology

- Any Cover
- Anywhere
- Completely waterproof
- *Thick gloves!*
- *Braille*-friendly
MoC Product Samples

Kitchen Appliances

- NARDI
- Oven
- Called Steel Touch

http://www.youtube.com/watch?v=mcNFCraTtz0

FEX 65D 53

Building Entry Keypad

- COMELIT
- Stainless steel cover
- Braille Marking

http://www.youtube.com/watch?v=4LrbUGCUMIo

red dot design award winner 2013

- “stylish while offering formidable protection against vandalism.”
Backlighting Options

- EL panel
- LED surface mount or rear mount with
  - Diffuser film
  - Silicone rubber
- Fiber optic
- Light pipes
“Copy/Paste” of 15+
Focus on Battery Powered Capacitive Touch Input

Lowest Power touch pads – MTCH6102

for battery driven, wireless devices

<table>
<thead>
<tr>
<th>Mode</th>
<th>Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby</td>
<td>&lt; 1 µW</td>
</tr>
<tr>
<td>Approach</td>
<td>&lt; 30 µW</td>
</tr>
<tr>
<td>Active</td>
<td>&lt; 300 µW</td>
</tr>
</tbody>
</table>

PIC16, lowest power consumption on the planet
MTCH6102 Features
Reference Code for PIC16LF156x

Industry Leading Low Power
- Up to 10x lower than competition!
- Standby mode <500nA (typical)
- Active mode <12uA possible

Flexible Design Options
- 15 Channels - ~4.7” diagonal
- Configuration utility to customize size, speed and performance
- Works with PCB, FPC, glass & film sensors
- Supports 3 mm plastic or 5mm glass covers

Performance
- Built in noise management
- > 200 Reports Per Second Single Touch (configurable)
- Build in(!) surface gestures

Also for MTCH6303
PIC16LF1566

- Use equal number of ADC1 and ADC2 channels for each axis
- Related functions and code in TouchSensor.c and sensor_xxxx.h

```c
#define XAXISCHANNELS 6
#define YAXISCHANNELS 6
#define SENSOR_ARRAY {17, 28, 18, 29, 20, 10, 13, 23, 12, 22, 11, 21}
```
PIC16LF1566
**PIC16LF1566**

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Gesture State ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Swipe</td>
<td>0x10</td>
</tr>
<tr>
<td>Right Swipe (Hold)</td>
<td>0x12</td>
</tr>
<tr>
<td>Edge Right Swipe</td>
<td>0x11</td>
</tr>
<tr>
<td>Edge Right Swipe (Hold)</td>
<td>0x13</td>
</tr>
<tr>
<td>Left Swipe</td>
<td>0x20</td>
</tr>
<tr>
<td>Left Swipe (Hold)</td>
<td>0x22</td>
</tr>
<tr>
<td>Edge Left Swipe</td>
<td>0x21</td>
</tr>
<tr>
<td>Edge Left Swipe (Hold)</td>
<td>0x23</td>
</tr>
<tr>
<td>Up Swipe</td>
<td>0x30</td>
</tr>
<tr>
<td>Up Swipe (Hold)</td>
<td>0x32</td>
</tr>
<tr>
<td>Edge Up Swipe</td>
<td>0x31</td>
</tr>
<tr>
<td>Edge Up Swipe (Hold)</td>
<td>0x33</td>
</tr>
<tr>
<td>Down Swipe</td>
<td>0x40</td>
</tr>
<tr>
<td>Down Swipe (Hold)</td>
<td>0x42</td>
</tr>
<tr>
<td>Edge Down Swipe</td>
<td>0x41</td>
</tr>
<tr>
<td>Edge Down Swipe (Hold)</td>
<td>0x43</td>
</tr>
<tr>
<td>Tap</td>
<td>0x9x*</td>
</tr>
<tr>
<td>Tap (Hold)</td>
<td>0xd0</td>
</tr>
<tr>
<td>Clockwise Wheel</td>
<td>0xf0**</td>
</tr>
<tr>
<td>Counter-Clockwise Wheel</td>
<td>0xf1**</td>
</tr>
</tbody>
</table>

*Tap gestures have a base gesture ID of 0x90. The lower nibble will contain the number of taps performed. For example, 0x93 = triple-tap

**The gestureState register will contain this ID as long as the firmware is in its wheel mode. A host should then read the information in address 0x15 in the Touch Ram structure to get the output counter data.*
Target Markets - success stories

- Battery driven devices
- Wearables
- Remote controls
- MTCH6102 PIC16LF156x
- Track pads Peripherals
- Gaming
- Gaming

confidential
maXTouch
maXTouch On the Road

Recently introduced

VW

Skoda

Mazda 3

Ford

SMART

Renault

GM Opel

GM

Jaguar

Range Rover

Kia

Ferrari

Tesla
Atmel’s maXTouch T-Family
Released to Automotive in 2015

**Thick glove support**

**Hover support**

**Dual Mutual and Self Capacitance**
Intelligently choose the best architecture for optimum power, noise immunity, glove touch, moisture and latency

**Moisture performance**

**Thick plastic lens support**
Automotive maXTouch Product Portfolio

Base feature set: Adaptive sensing (self + mutual cap), thick glove and moisture operation. Embedded gestures. AEC-Q100 grade 2 and 3. Automotive EMC. Autospice Level3 Certified. On-cell Support.
Amount of nodes determines pinch separation
Average value < worst case value
Resolution: up to 12 bit for X, Y, (depends on noise)
Pinch separation = 2.1x pitch

<table>
<thead>
<tr>
<th>Controller</th>
<th>Lines</th>
<th>7” (155mm x 87.2mm)</th>
<th>8” (177.1mm x 99.6mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Worst case pinch separation [mm]</td>
<td>Worst case pinch separation [mm]</td>
</tr>
<tr>
<td>mxt225T</td>
<td>20</td>
<td>16.3 16.6</td>
<td>18.6 19.0</td>
</tr>
<tr>
<td>mxt336S</td>
<td>24</td>
<td>13.6 13.1</td>
<td>15.5 14.9</td>
</tr>
<tr>
<td>mxt449T</td>
<td>28</td>
<td>11.4 11.6</td>
<td>13.1 13.3</td>
</tr>
<tr>
<td>mxt641T</td>
<td>32</td>
<td>10.2 9.2</td>
<td>10.6 10.5</td>
</tr>
<tr>
<td>mxt799T</td>
<td>21</td>
<td>8.6 8.7</td>
<td>9.8 10.0</td>
</tr>
</tbody>
</table>
Pinch separation
10.2” and 12.3” screens

Amount of nodes determines pinch separation
Average value < worst case value
Resolution: up to 12 bit for X, Y, (depends on noise)
Pinch separation = 2.1x pitch

<table>
<thead>
<tr>
<th>Controller</th>
<th>Screen ratio</th>
<th>Lines, use</th>
<th>10.2”</th>
<th>12.3”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>16:9</td>
<td></td>
</tr>
<tr>
<td>mxtT799T</td>
<td>16:9</td>
<td>21</td>
<td>12.5 (5.9)</td>
<td>12.7 (6.0)</td>
</tr>
<tr>
<td>mxt1188S/mxt1189T</td>
<td>16:9</td>
<td>26</td>
<td>10.5 (5)</td>
<td>10.3 (4.9)</td>
</tr>
<tr>
<td>mxt1664S</td>
<td>8:3</td>
<td>32</td>
<td>9.1 (4.3)</td>
<td>8.3 (4.0)</td>
</tr>
<tr>
<td>mxt1665T</td>
<td>8:3</td>
<td>32</td>
<td>9.3 (4.4)</td>
<td>8.3 (4.0)</td>
</tr>
<tr>
<td>mxt1188S/mxt1189T</td>
<td>8:3</td>
<td>22</td>
<td>9.8 (4.7)</td>
<td>8.7 (4.1)</td>
</tr>
<tr>
<td>mxt1664S</td>
<td>8:3</td>
<td>32</td>
<td>9.8 (4.7)</td>
<td>6.0 (2.8)</td>
</tr>
<tr>
<td>mxt1665T</td>
<td>8:3</td>
<td>32</td>
<td>10 (4.8)</td>
<td>6.0 (2.8)</td>
</tr>
</tbody>
</table>
Electric-Field-Based 3D Sensing
SWIPE
THE MAGIC

Change everything with one gesture

Gesture Controlled
Home Audio System
## Microchip’s GestIC Competitive Comparison

<table>
<thead>
<tr>
<th></th>
<th>Microchip GestIC</th>
<th>Camera</th>
<th>Infrared</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gesture Portfolio</strong></td>
<td>24 rotational and linear gestures</td>
<td>Multifinger gestures and postures</td>
<td>Very limited, Low performance</td>
</tr>
<tr>
<td></td>
<td>Gestures on chip</td>
<td>Gestures on host processor</td>
<td></td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>No blinds spots</td>
<td>Blinds spots due to optical viewing angle</td>
<td>Blinds spots</td>
</tr>
<tr>
<td></td>
<td>Full area coverage</td>
<td>Long distance only</td>
<td>No short distance</td>
</tr>
<tr>
<td></td>
<td>Short distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Robustness</strong></td>
<td>Best in class</td>
<td>Light dependency</td>
<td>Hand position and light dependency</td>
</tr>
<tr>
<td><strong>Industrial design</strong></td>
<td>Closed surface</td>
<td>Multiple openings</td>
<td>Multiple openings</td>
</tr>
<tr>
<td></td>
<td>Full design freedom</td>
<td>Deep recesses required</td>
<td>Black cover challenge ID</td>
</tr>
<tr>
<td></td>
<td>Flat, integrated into screen</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>Very Low</td>
<td>Very High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Easy</td>
<td>Very Complex</td>
<td>Complex</td>
</tr>
<tr>
<td></td>
<td>Fast time-to-market</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Merges with touch displays</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Low, single chip</td>
<td>Very high</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Use of touch sensor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Multi) Camera + IR support</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 2 Cameras, 9 IR receivers
- 2 ARMs A9 for Algorithm
- ~$200
GestIC Technology Basics

- Electrical Field for 3D sensing
- Field distortion translate into hand positions and gestures.
- Very low power consumption

**E-field Operation**

*GestIC Wavelength*

\[ \lambda_{Tx} = \frac{c}{f} \text{3km (at 100kHz)} \]

\[ d \text{ (electrode dimension)} \ll \lambda \]

Quasi static E-field during operation
GestIC Topology

Colibri Suite on-chip
Direct output of Gestures via I²C interface and/or Gesture Port

Fast integration. Short TTM.
I²C or GPIO.

1. Electrodes sense user action
2. MGC3X30 processes signals
3. Gesture output to Application/Host
On-Chip Colibri Gesture Suite

3D gesture recognition based on Hidden Markov Models

plus 3D hand tracking. Interfaced by:

Approach
power saving self wake-up

AirWheel
real time rotation control

Flick Gestures
motion tracking in 3D

Presence, Hold
backlight control, activation

Wave
in X & Y direction.

Sensor Touch
touch, multitouch, tap, double tap

Position Tracking
motion tracking in 3D
Woodstar + Hillstar
GestIC Development Kits

MGC3030 - Woodstar
US$139, DM160226
I²C to USB Bridge
System Parameterization
w/ Aurea
MGC3030 Unit

MGC3130 - Hillstar
DM160218, US$179
I²C to USB Bridge
System Parameterization
w/ Aurea
MGC3130 Unit

+ C sample host code
+ MGC3130 I²C manual
+ Electrode design Guide

10+ Electrode reference designs
+ MGC3X30 samples

www.microchip.com/gesticgettingstarted
2D multi touch + 3D gestures on displays has arrived.

Microchip – leading UI solutions.

<table>
<thead>
<tr>
<th>Display size</th>
<th>15” or smaller</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D gesture distance</td>
<td>20 cm</td>
</tr>
</tbody>
</table>

Please see it all on YouTube and youku.com. Available Now.
Integrating maXTouch and GestIC

Step 1: Demonstrate Combined Operation / Evaluation Platform
Step 2: Use Integrated maXTouch Tx drive capabilities
Step 3: Single chip solution with maXTouch AFE
maXTouch with GestIC Demo

MGC3130

MXT1665T
Thank You!

mTouch™ Sensing Solution