mTouch™ Projected Capacitive Touch Screen Sensing Development Kit User's Guide

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the mTouch™ Projected Capacitive Touch Screen Sensing Development Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the mTouch™ Projected Capacitive Touch Screen Sensing Development Kit as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. Development Kit Board Contents and Requirements** – this chapter describes the contents of the deveopment kit and system requirements.
- **Chapter 2. Getting Started** – this chapter explains how to set up the development kit for basic operation.
- **Chapter 3. Using the Projected Capacitive Configuration Utility** – this chapter describes the use of the Projected Capacitive Configuration Utility software.
- **Appendix A. Hardware** – this section contains additional information about the development kit including schematics, development board default settings, touch reporting protocol and programming specific PIC® MCUs.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use mTouch™ Projected Capacitive Touch Screen Sensing Development Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Projected Capacitive Touch Screen Sensing Theory of Operations Technical Brief (DS93064)

This document discusses the theory of operations of projected capacitive touch screen sensing.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **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 consultant 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

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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB® IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE II device programmers and the PICSTART® Plus and PICkit™ 2 and 3 development programmers.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

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DOCUMENT REVISION HISTORY

Revision A (August 2010)

- Initial Release of this Document.

NOTES:

Chapter 1. Development Kit Board Contents and Requirements

Microchip's mTouch™ Projected Capacitive Development Kit (P/N DM160211) provides a fully functioning projected capacitive touch system. The kit is also a sophisticated development platform to facilitate implementation of projected capacitive touch screen user interfaces. Preprogrammed firmware provided with this kit supports multi-touch with sensors ranging from 1x1 to 13x11 XY electrode patterns.

The source code is available royalty-free from www.microchip.com/mtouch for use on Microchip PIC® MCUs. The provided hardware supports up to 16x16 electrode sensors, but the current firmware only supports up to 13x11 electrode sensors.

Development kits (P/N DM160211) can be purchased at microchipDIRECT www.microchipdirect.com.

This chapter introduces the development kit and provides an overview of its features.

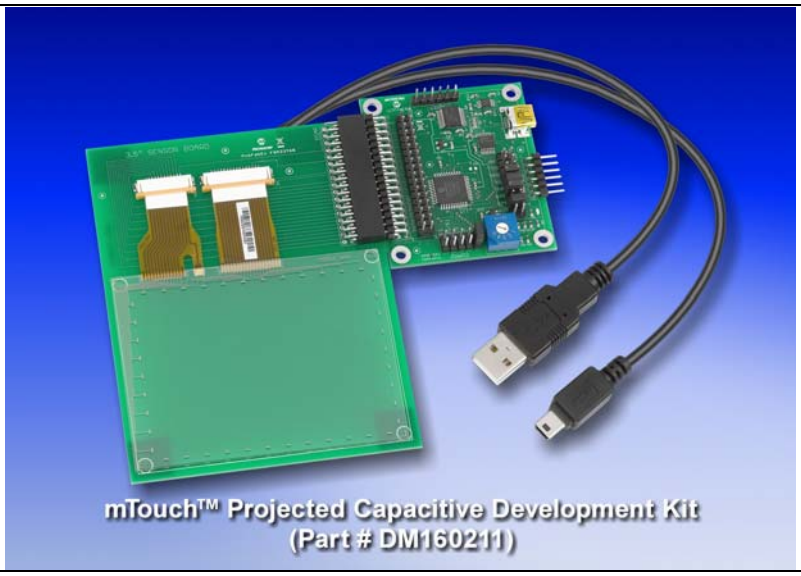
Topics include:

- Kit Contents
- Development Board Requirements

1.1 KIT CONTENTS

- Projected Capacitive Board
- Programmed and fully functional PIC16F707 chip on the Projected Capacitive Board
- Sensor Board
- Sensor – Projected Capacitive 3.5", 12 x 9 electrode
- Programming Adapter Board (required if programming with Microchip MPLAB® ICD 3)
- USB Communication Cable

FIGURE 1-1: DEVELOPMENT KIT CONTENTS



Note: This Evaluation Kit is intended as a functional evaluation of Microchip's mTouch Capacitive Sensing Solutions. It has not been designed for use in noisy or production-level testing environments.

1.2 REQUIREMENTS

This section reviews the requirements for the development kit.

1.2.1 Computer Interface

The kit requires an interface computer with the following:

- Dual-core processor or better
- USB port
- Microsoft Windows® XP® or Windows 7 operating system

1.2.2 Software

Download the Projected Capacitive Configuration Utility (PCUU) software from:

www.microchip.com/mtouch

1.2.3 Recommended Support

The Projected Capacitive Touch Screen Sensing Demo software application is available at www.microchip.com/mtouch and is compatible with the hardware in this development kit. The application provides demonstration of a projected capacitive touch screen sensing with the following functionality:

- Drawing (single and multi-touch)
- Keypad phone dialer
- Picture viewer
- Gestures

The Projected Capacitive Touch Screen Sensing Theory of Operation Tech Brief is available at www.microchip.com/mtouch. It is an introduction to projected capacitive touch sensing and an explanation of the technology basis for this development kit.

1.2.4 Hardware and Software for Firmware Development

The following is only required if modification to the available core firmware is desired.

- PICkit 3 Development Programmer/Debugger #DV164121
- Microchip MPLAB IDE, version 8.40 or above
- HI-TECH C® PRO Model 9.71a or above compiler

1.3 TOUCH SENSITIVITY

The response of the sensor to fingertip touch is influenced by many factors: touch areas, voltage and current levels, ambient humidity, static buildup, and related. The capacitive touch sensing is done by a relative shift in the capacitance due to the addition of the finger capacitance to the touch sensor. The demonstration code supplied takes some typical environmental factors into consideration. The demonstration application is very flexible in the sense that it can be modified by the user.

Chapter 2. Getting Started

This section steps through setting up the development kit for basic operation.

Do not connect the Projected Capacitive Board to your computer until instructed in the following procedure

2.1 INSTALLING THE CONFIGURATION UTILITY SOFTWARE

The Projected Capacitive Configuration Utility (PCCU) software allows demonstration, configuration and development with the kit. The software bundle includes:

1. Projected Capacitive Configuration Utility software
2. USB Serial Port Emulator Device Driver

Installation of the Projected Capacitive Configuration Utility software will automatically install the USB Serial Port Driver. The USB Serial Port Driver files get placed into a \MCP2200 USB-Serial Bridge subdirectory of the installation directory.

Note: If using Microsoft Windows XP SP2, it will be necessary to install a software patch (reference KB935892) available from Microsoft at support.microsoft.com. The Knowledge Base article recommends you modify your computer's registry as part of the patch installation process, but it is not necessary to make this modification.

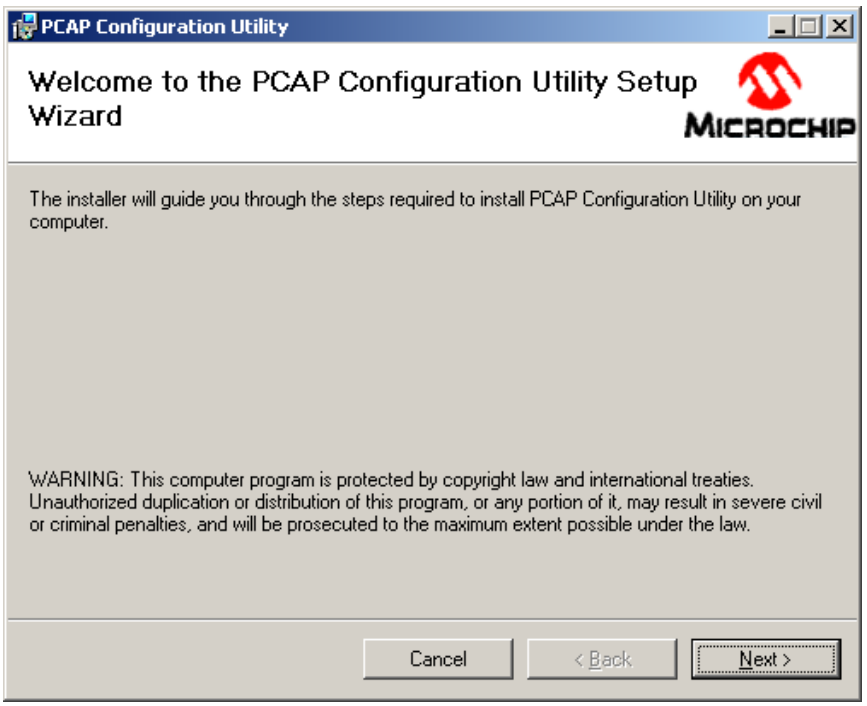
2.2 INSTALLATION STEPS

1. Extract the following files from the downloaded `PCAPConfigUtilityVerX.X.zip` software bundle to a desired location on your computer.

- `Setup.exe`
- `PCAPConfigUtilityInstall.msi`
- `Readme.txt`

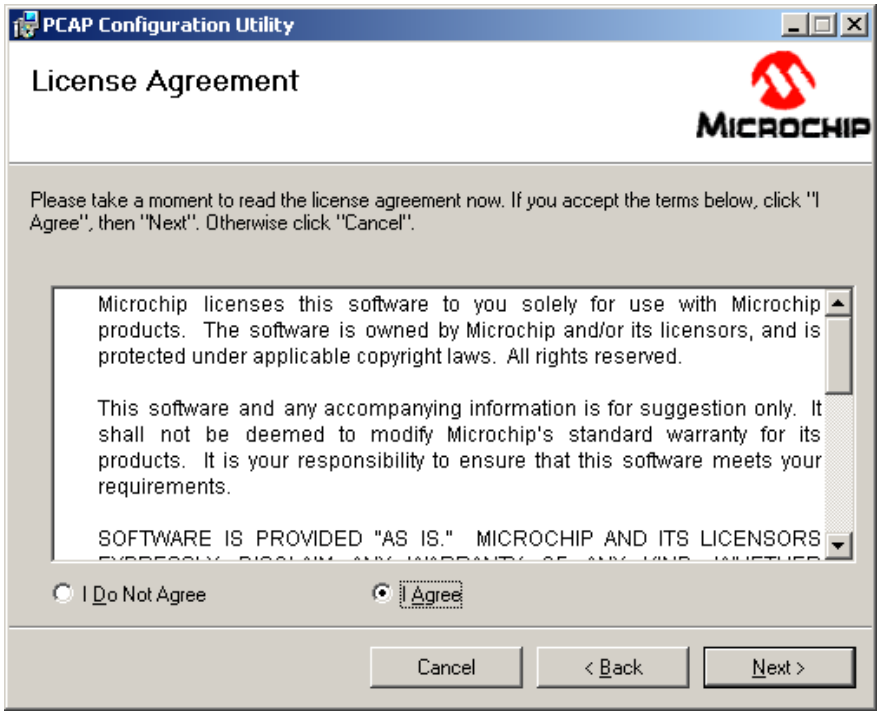
2. Double-click the `Setup.exe` file to begin the installation. The "Welcome to the PCAP Configuration Utility Setup Wizard" screen will appear (Figure 2-1).

FIGURE 2-1: WELCOME SCREEN



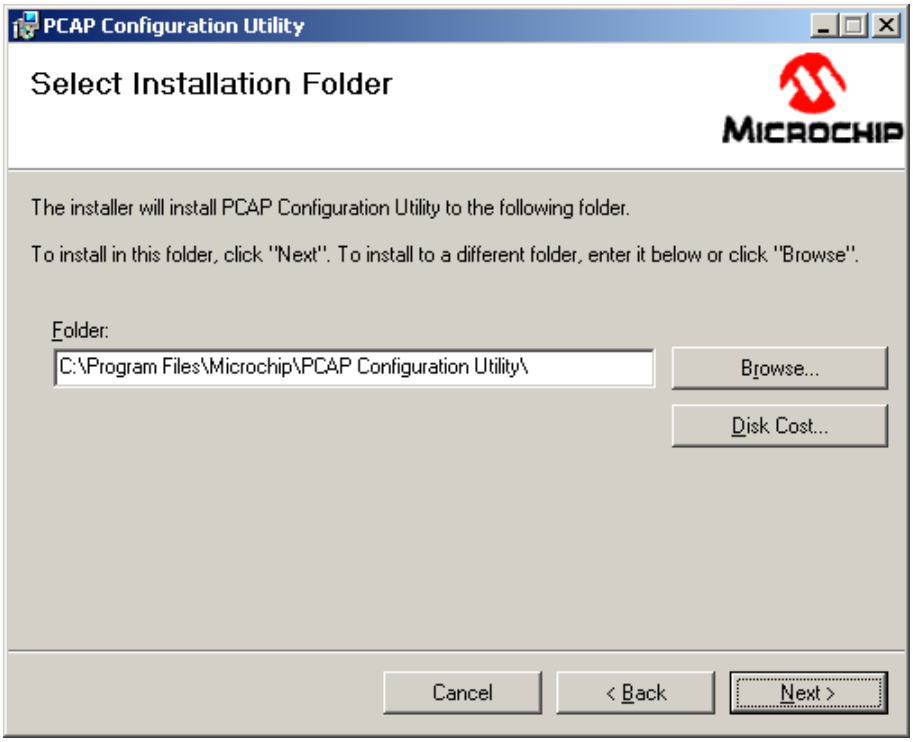
3. Select "Next" to proceed with the installation. The "License Agreement" screen will appear (Figure 2-2).

FIGURE 2-2: LICENSE AGREEMENT SCREEN



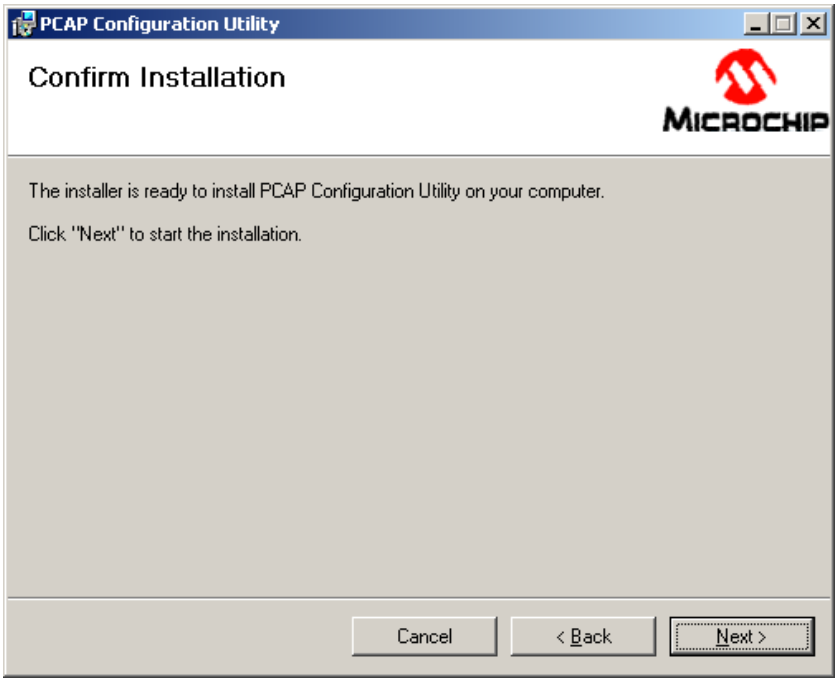
4. Read the agreement, select "I Agree" if you agree, then select "Next" to continue. The "Select Installation Folder" screen will appear (Figure 2-3).

FIGURE 2-3: SELECT INSTALLATION FOLDER SCREEN



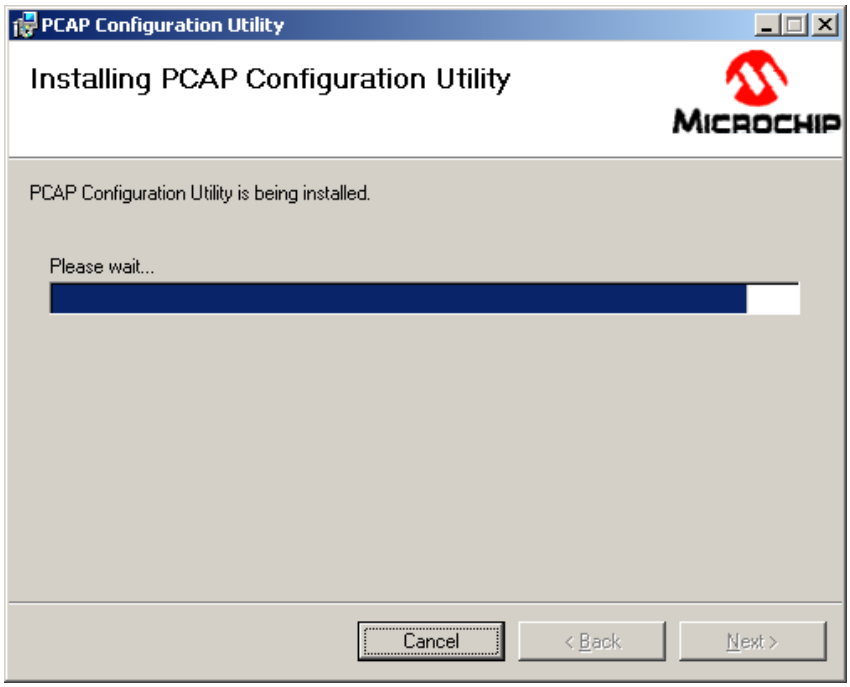
5. Accept the default installation location or change it as desired, then select “Next” to continue. The “Confirm Installation” screen will appear (Figure 2-4).

FIGURE 2-4: CONFIRM INSTALLATION SCREEN



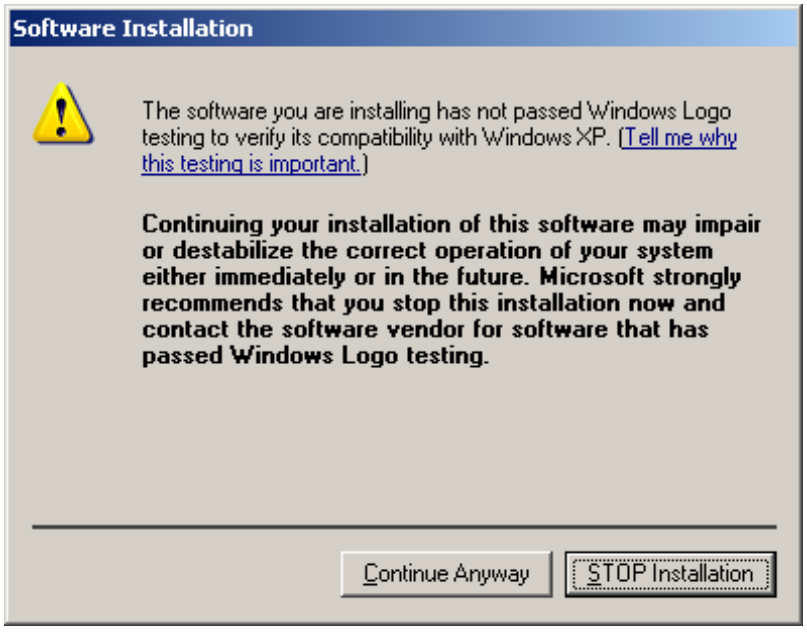
6. Select “Next” to continue with the installation. The “Installing PCAP Configuration Utility” screen will appear (Figure 2-5).

FIGURE 2-5: INSTALLING PCAP CONFIGURATION UTILITY SCREEN



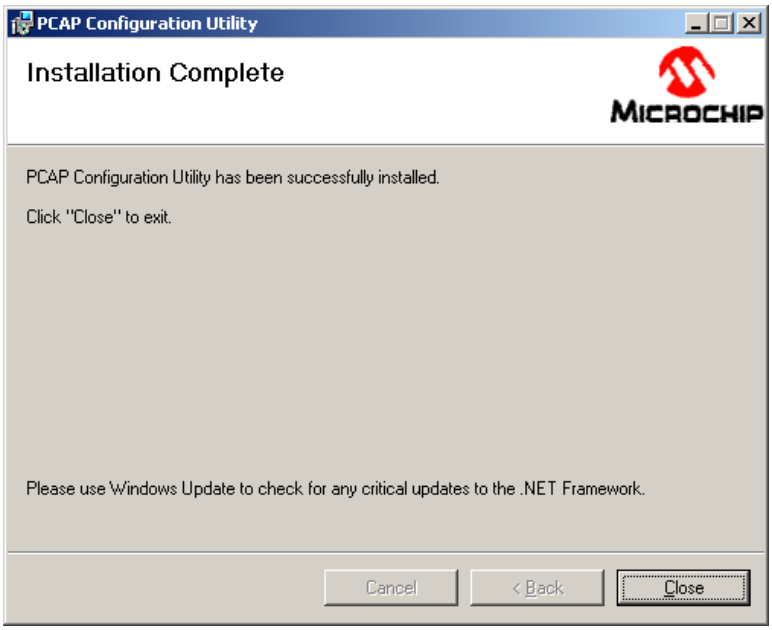
7. The USB software driver being installed is not currently signed by Windows, but it is safe to use. Select Continue Anyway on the popup screen (Figure 2-6).

FIGURE 2-6: USB DRIVER WARNING SCREEN



8. Upon completion of the installation, the "Installation Complete" screen will appear (Figure 2-7).

FIGURE 2-7: INSTALLATION COMPLETE SCREEN



This completes the installation of the Projected Capacitive Configuration Utility software.

2.3 HARDWARE SETUP AND CONNECTION

The included Projected Capacitive Board has jumper options pre-configured for proper initial operation. See **Section A.2 "Projected Capacitive Board PCB and Default Settings"** for more information on the board's default settings.

1. Plug the appropriate end of provided USB cable into an available USB port on your computer.

2. Plug the "mini" connector end of the provided USB cable into the USB connector on the Projected Capacitive Board.

NOTES:

Chapter 3. Using the Projected Capacitive Configuration Utility

The Projected Capacitive Configuration Utility (PCCU) software provides demonstration, configuration and development with the included kit hardware or custom application developments. This section describes use of the utility.

3.1 LAUNCH CONFIGURATION UTILITY

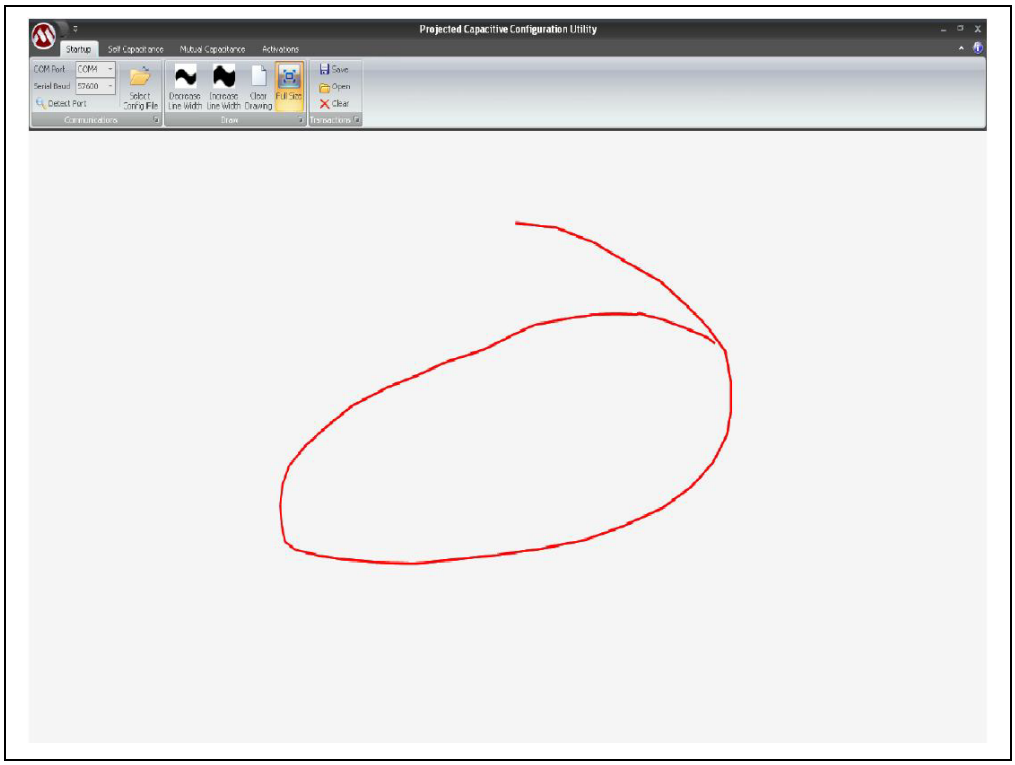
Launch the Projected Capacitive Configuration Utility software from the Microsoft Windows toolbar as follows: *Start>All Programs>Microchip>PCAP Configuration Utility*.

The hardware communication interface to the computer is USB. However, the software utility communicates with the hardware by using a software emulated serial COM port.

Upon launch, the utility attempts to auto-detect the emulated serial COM port and establish communication with the Projected Capacitive Board.

Using your finger, touch and draw on the sensor to confirm basic operation. You should see your drawing motion reflected in the Drawing window of the Startup tab, as shown in Figure 3-1.

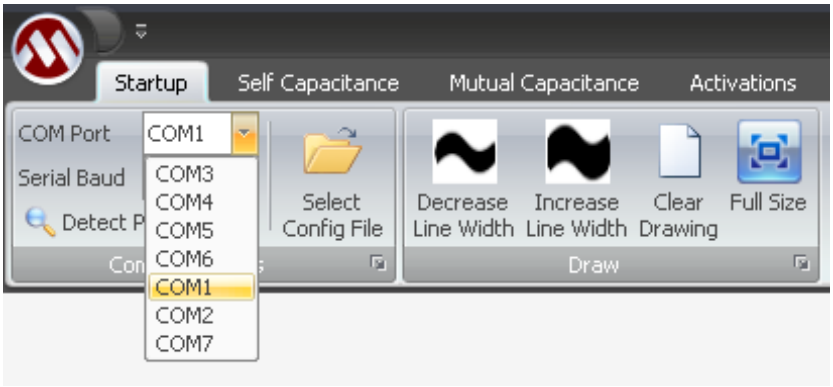
FIGURE 3-1: STARTUP TAB – TEST DRAWING



If there is no response to the above drawing action, then the communications port may require manual selection.

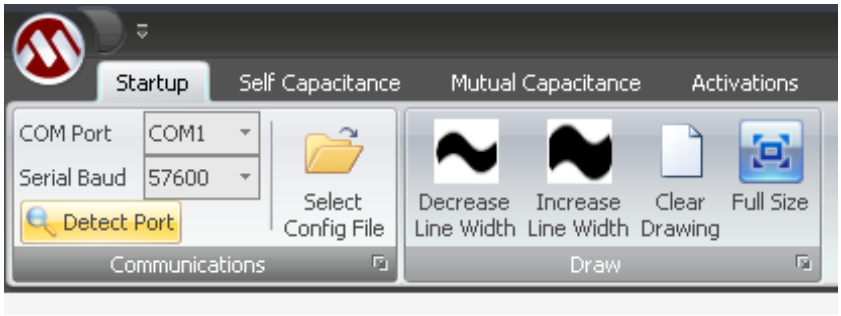
Click the COM Port drop down arrow as shown in Figure 3-2 and select the COM port being used for this hardware by your computer.

FIGURE 3-2: STARTUP TAB – COM PORT



Then click the Detect Port icon as in Figure 3-3.

FIGURE 3-3: STARTUP TAB – DETECT PORT



Touch and draw on the sensor to confirm if basic operation has been established. You should see your drawing motion reflected in the Drawing window of the Startup tab.

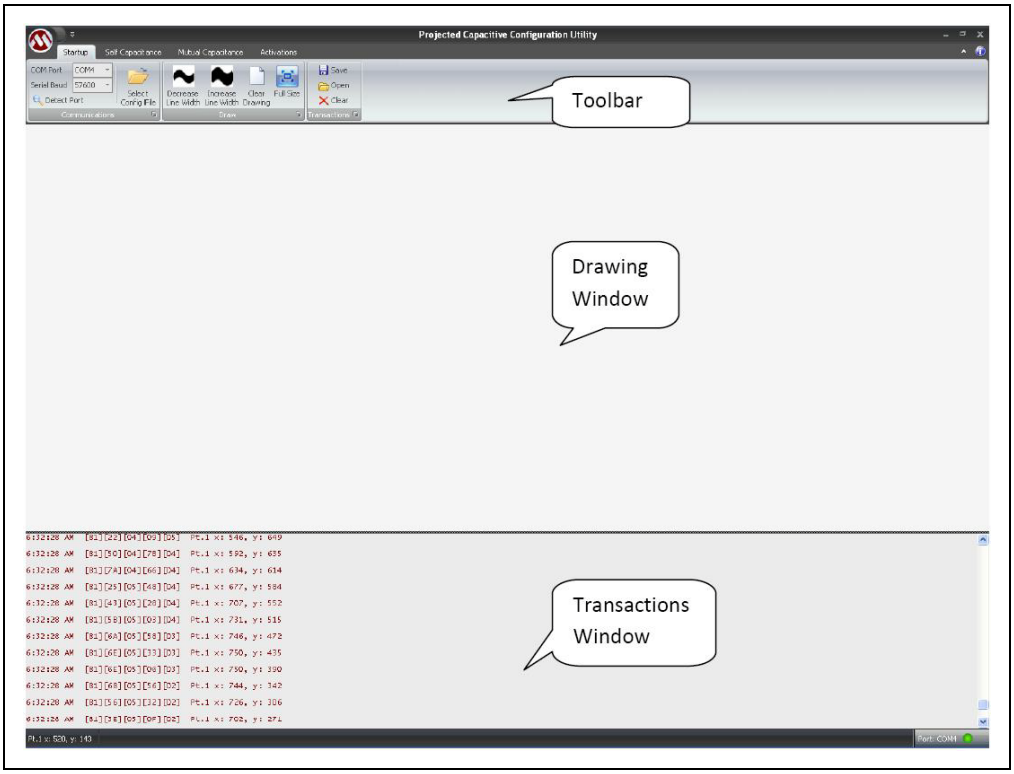
If you are unsure of the COM port used by your computer for this hardware, you may need to repeat the process for each COM Port shown in the drop down list, until the correct COM port is found.

1. Select COM Port from drop down
2. Click Detect Port icon
3. Test drawing
4. Repeat from step 1 with the next listed COM port, if drawing test failed.

3.2 STARTUP TAB

The Startup tab is displayed upon launch of the utility (Figure 3-4).

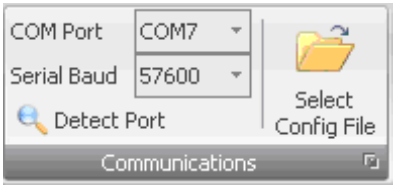
FIGURE 3-4: STARTUP TAB



3.2.1 Communications Toolbar Group

The Communications toolbar group provides configuration of the hardware communications and initial operating parameters.

FIGURE 3-5: STARTUP TAB – COMMUNICATIONS TOOLBAR GROUP



COM Port – Select the emulated serial communications port used by the hardware.

Serial Baud – Select the desired serial baud rate for the hardware. The default is 57600.

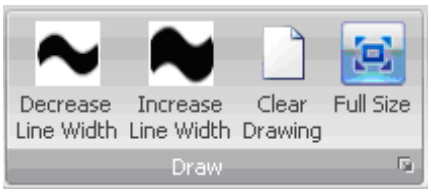
Detect Port – Initiate detection of the Projected Capacitive Board hardware on the selected COM port.

Select Config File – Select a text configuration file, which defines some of the operating firmware settings. The default is `RamParameters.cfg`.

3.2.2 Draw Toolbar Group

The Draw toolbar group provides options for using the Draw window to test finger drawing capability.

FIGURE 3-6: STARTUP TAB – DRAW TOOLBAR GROUP



Decrease Line Width – Decreases the brush or line width used when drawing in the drawing window.

Increase Line Width – Increases the brush or line width used when drawing in the drawing window.

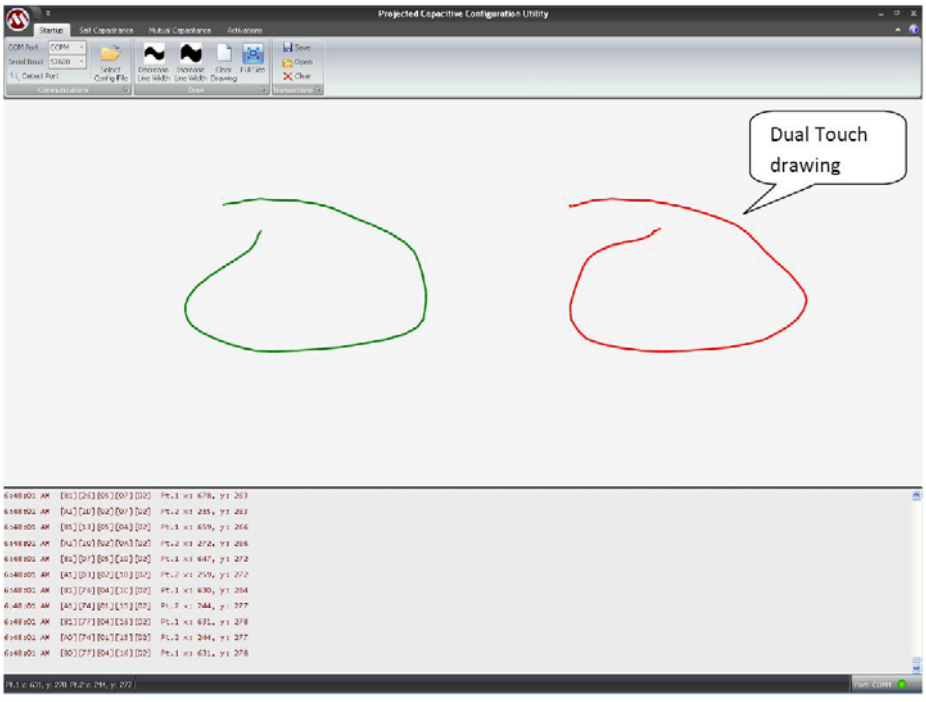
Clear Drawing – Clear the current content of the drawing window.

Full Size – Expand the drawing window to full size. Clicking again will return the drawing window to the default size.

3.2.3 Drawing Window

The Drawing window is used to try out the operation of the system by drawing on the sensor with your finger. Figure 3-7 is an example of multi-touch with two fingers simultaneously drawing on the sensor. The first touch is represented in red and the second in green.

FIGURE 3-7: STARTUP TAB – DRAWING WINDOW

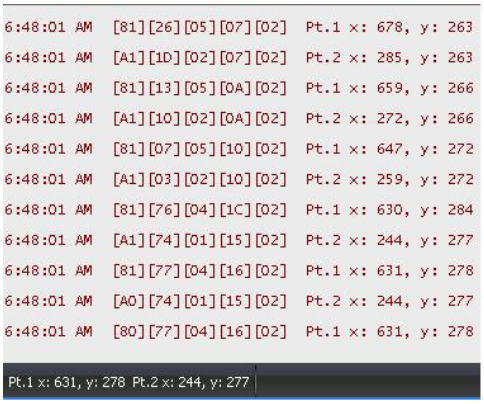


3.2.4 Transaction Window

The Transaction window (Figure 3-8) displays the communications that occur between the utility and the hardware.

- Utility messages and communications sent to the hardware are displayed in blue.
- Hardware touch reports and command responses are displayed in red.

FIGURE 3-8: STARTUP TAB – TRANSACTION WINDOW



3.3 SELF CAPACITANCE TAB

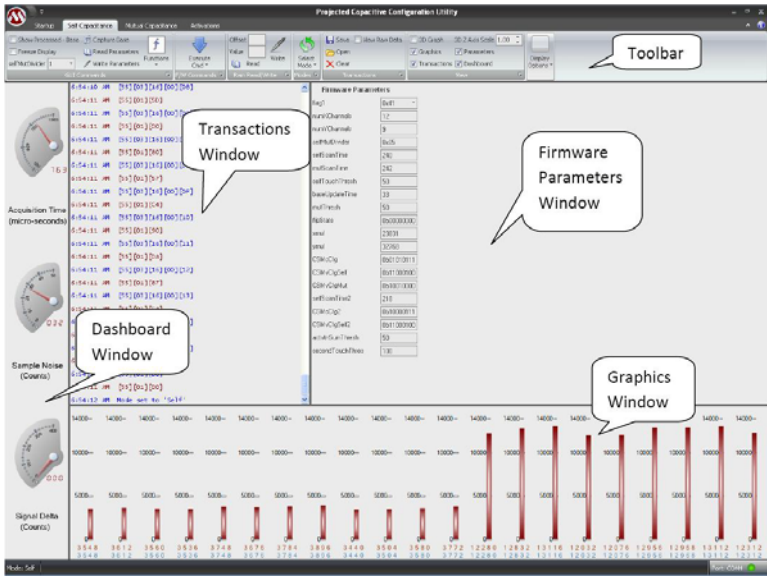
Self capacitance is defined as the capacitive load presented by each individual sensor electrode to the measurement system.

The Self Capacitance tab is used to configure, monitor and develop the performance of self capacitance sensor measurements.

There is significant commonality of the toolbar items and display windows between the Self Capacitance Tab and the Mutual Capacitance Tab. See **"Self Capacitance Tab and Mutual Capacitance Tab"** for a discussion on the common toolbar and display windows.

This section discusses toolbar items and display windows that are unique to the Self Capacitance tab (Figure 3-9).

FIGURE 3-9: SELF CAPACITANCE TAB

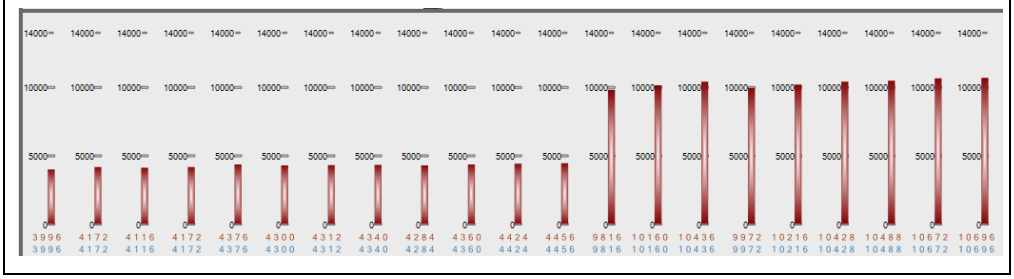


3.3.1 Graphics Window

The Graphics window displays measured self capacitance values for each electrode on the sensor.

The example in Figure 3-10 reflects a sensor with 12 X-axis electrodes and 9 Y-axis electrodes, which correspond to the 21 displayed bars (12 X-axis plus 9 Y-axis).

FIGURE 3-10: SELF CAPACITANCE TAB – GRAPHICS WINDOW



Each red bar on the graph represents the measured capacitance for a unique electrode on the sensor.

Hardware channels connected to sensor electrodes:

The X-axis hardware channels (connected to X-axis sensor electrodes) are displayed left justified in the Graphics window and Y-axis hardware channels (connected to Y-axis sensor electrodes) are displayed right justified.

Red values at bottom of bar graph:

The red values at the bottom of each bar are real-time self capacitance measurements of the electrode's signal level, relative to the no-touch baseline condition. The Show Processed - Base box (see **"GUI Commands Toolbar Group"**) must be checked in the GUI Commands toolbar group, followed by clicking the "Capture Base" button, for proper functionality of the red values. If the box is not checked, then the red values simply mirror the blue values.

Blue values at bottom of bar graph:

The blue values at the bottom of each bar are real time absolute self capacitance measurement for each electrode.

3.4 MUTUAL CAPACITANCE TAB

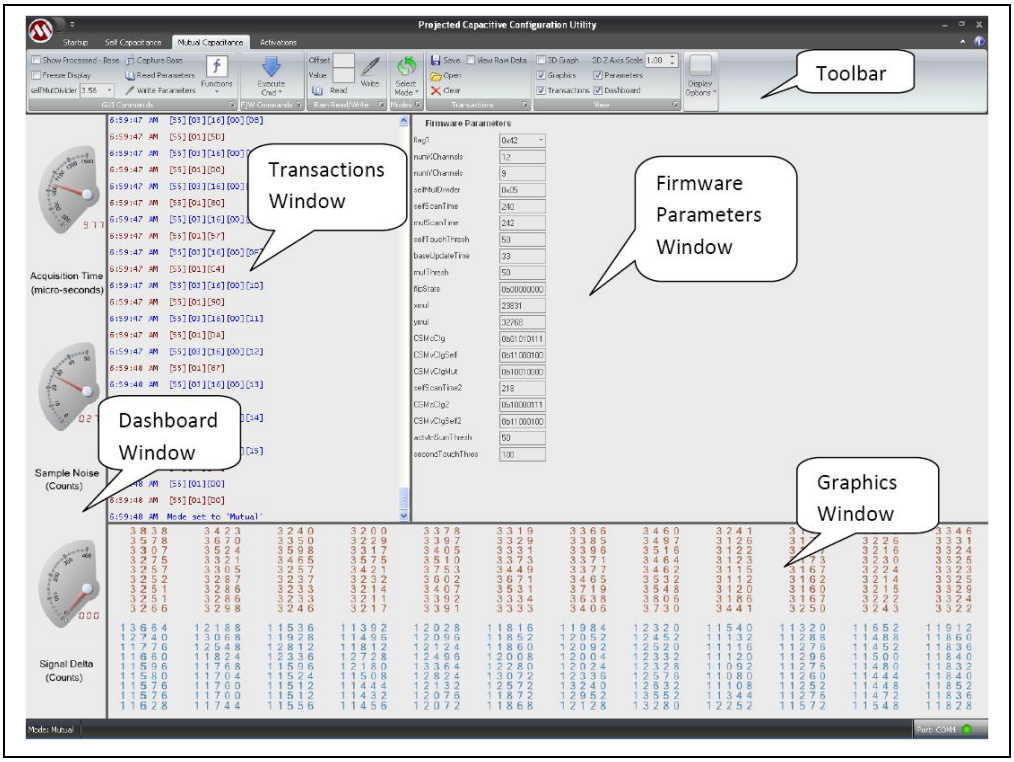
Mutual capacitance is defined as the capacitive coupling between X and Y axis electrode on a projected capacitive touch sensor.

The Mutual Capacitance tab is used to configure, monitor and develop the performance of mutual capacitance sensor measurements.

There is significant commonality of the toolbar items and display windows between the Self Capacitance tab and the Mutual Capacitance tab. See the **"Self Capacitance Tab and Mutual Capacitance Tab"** section for discussion on the common toolbar and display windows.

This section discusses toolbar items and display windows that are unique to the Mutual Capacitance tab (Figure 3-11).

FIGURE 3-11: MUTUAL CAPACITANCE TAB

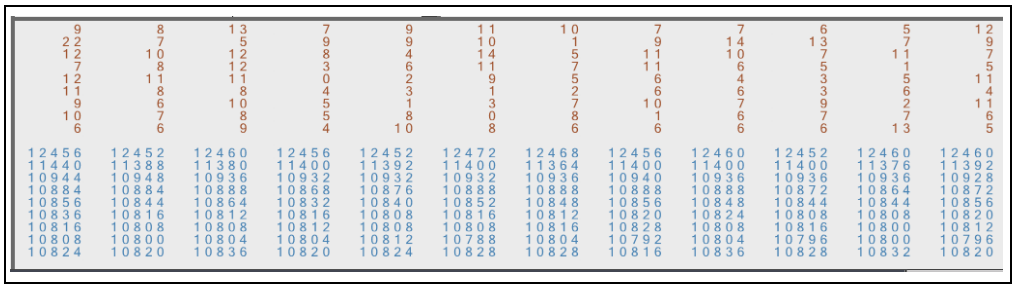


3.4.1 Graphics Window

The Graphics window displays measured mutual capacitance values for each node on the sensor. A node is defined as the intersection of an X and Y axis electrode.

The example below reflects a sensor with 12 X-axis electrodes and 9 Y-axis electrodes, which creates a 12x9 node matrix. This corresponds to the 12 columns and 9 rows of values shown.

FIGURE 3-12: MUTUAL CAPACITANCE TAB – GRAPHICS WINDOW



Red colored values:

The red values represent a matrix of real-time mutual capacitance processed measurements for each of the sensor's nodes, relative to the no-touch baseline condition. The Show Processed - Base box (see the **"GUI Commands Toolbar Group"** section) must be checked in the GUI Commands toolbar group, followed by clicking the "Capture Base" button, for proper functionality of the red values.

Blue colored values:

The blue values represent a matrix of real-time absolute mutual capacitance raw measurements for each of the sensor's nodes.

3.5 SELF CAPACITANCE TAB AND MUTUAL CAPACITANCE TAB

There is significant commonality of the toolbar items and display windows between the Self Capacitance tab and the Mutual Capacitance tab. The key difference being that operations on the Self Capacitance tab apply to self capacitance measurements and on the Mutual Capacitance tab they apply to mutual capacitance measurements.

This section discusses the toolbar items and display windows that are common to the Self Capacitance tab and the Mutual Capacitance tab. See the individual **"Self Capacitance Tab"** and **"Mutual Capacitance Tab"** sections for unique functionality on each tab.

FIGURE 3-13: SELF AND MUTUAL CAPACITANCE TABS – TOOLBAR

3.5.1 GUI Commands Toolbar Group

The GUI Commands toolbar group provides a means to lock the real time updating display, view absolute or relative measurement data, and use of the firmware parameters.

FIGURE 3-14: SELF AND MUTUAL CAPACITANCE TABS – GUI COMMANDS TOOLBAR GROUP

Show Processed – Base

Check the box for the Graphics window to display the difference between absolute capacitance measurements and the baseline capacitance measurement. Uncheck the box to display the absolute capacitance measurements.

Freeze Display

Check the box to stop the real time updating of the Dashboard and Graphics windows. Uncheck the box to enable real time updating of the displays.

selfMutDivider

Provides scaling for the displayed raw capacitance values shown in the Graphics window.

Capture Base

Acquire a new capacitance baseline measurement set.

Read Parameters

Read the current firmware operating parameters from the hardware and display them in the Firmware Parameters window.

Write Parameters

Write the values from the Firmware Parameters window to the hardware, which will immediately begin using them.

Functions Drop Down:

Scan Baseline/Enable

Acquire a new hardware baseline, and re-enable the controller.

FW Version

Return the factory default firmware number.

Restore Default

Write the default set of firmware operating parameters to the hardware and to the Firmware Parameters window.

3.5.2 Commands Toolbar Group

Click to select from a drop down list of supported commands that can be sent to the hardware, telling it to take some action.

FIGURE 3-15: SELF AND MUTUAL CAPACITANCE TABS – COMMAND TOOLBAR GROUP

Enable – Report touch activity when it occurs.

Disable – Do not report touch activity when it occurs.

ScanBaseline – Measure a new **"**no-touch**"** baseline for each electrode's self capacitance and each node's mutual capacitance.

WriteEE – Write firmware operating parameters or other data to the non-volatile memory on the hardware. This functionality is not supported on the included hardware.

Sleep – Places the hardware into a low-power Sleep mode. The included hardware does not implement a mechanism to wake up from a Sleep state. If the Sleep command is issued as a test, then cycle power to Projected Capacitive Board hardware to wake it back up.

CFGIDHIG – High byte of factory firmware number.

CFGIDLOW – Low byte of factory firmware number.

3.5.3 RAM Read/Write Toolbar Group

The Ram Read/Write toolbar group enables reading values from and writing values to volatile memory on the hardware.

FIGURE 3-16: SELF AND MUTUAL CAPACITANCE TABS – RAM READ/WRITE TOOLBAR GROUP

Read a Ram value from the hardware:

Enter a desired Ram address offset value in the Offset box, then click the Read icon. The value contained at the Ram address offset location of the hardware will be displayed in the Value box.

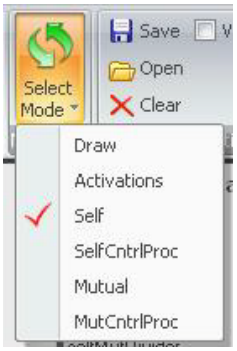
Write a Ram value to the hardware:

Enter a desired Ram address offset value in the Offset box and a desired value for the contents in the Value box, then click the Write icon. The value will be written to the Ram address offset location of the hardware.

3.5.4 Modes Toolbar Group

Click to select from a drop down list of supported hardware operating modes.

FIGURE 3-17: SELF AND MUTUAL CAPACITANCE TABS – MODES TOOLBAR GROUP



Draw – The Draw mode is for normal operating XY touch sensing.

Activations – The Activations mode displays firmware function results on the Activations tab, at stages of the touch position decoding process.

Self – The Self mode displays raw unprocessed self capacitance measurements.

SelfCntrlProc – The SelfCntrlProc mode displays hardware processed self capacitance measurements. An example is the application of the baseline method to convert values from absolute to relative.

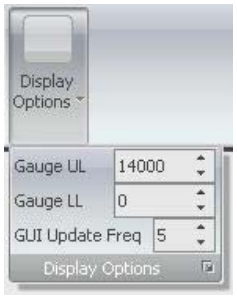
Mutual – The Mutual mode displays raw unprocessed mutual capacitance measurements.

MutCntrlProc – The MutCntrlProc mode displays hardware processed mutual capacitance measurements. An example is the application of the baseline method to convert values from absolute to relative.

3.5.5 Display Options Toolbar Group

The Display Options toolbar group enables setting of the minimum and maximum scale limits used in the Graphics window and controlling the display's refresh rate.

FIGURE 3-18: SELF AND MUTUAL CAPACITANCE TABS – DISPLAY OPTIONS TOOLBAR GROUP



Gauge UL – Set the upper limit on the scaling in the Graphics window.

Gauge LL – Set the lower limit on the scaling in the Graphics window.

GUI Update Freq – Set the frequency at which the displayed data in the Dashboard and Graphics windows update.

3.5.6 Transactions Toolbar Group

The Transactions toolbar group provides options that affect the viewing of information in the Transactions window.

FIGURE 3-19: SELF AND MUTUAL CAPACITANCE TABS – TRANSACTIONS TOOLBAR GROUP

Save – Click to save the text contents in the Transactions window.

Open – Click to open a previously saved Transactions window file.

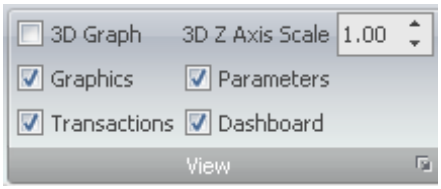
Clear – Clear the current contents of the Transactions window.

View Raw Data – Check the box to display diagnostic data, sent from the hardware, in the Transactions window. Uncheck the box to display touch reports and command activity sent from the hardware, in the Transactions window.

3.5.7 View Toolbar Group

The View toolbar group allows hiding or viewing of the Graphics, Transactions, Firmware Parameters, and Dashboard windows. It also configures the Graphics window to display data as two dimensional or three dimensional.

FIGURE 3-20: SELF AND MUTUAL CAPACITANCE TABS – VIEW TOOLBAR GROUP



3D Graph – Check the box for the Graphics window to display a three dimensional map of the capacitance measurement values. Uncheck the box for Graphics window to display a two dimensional map of the capacitance measurement values.

Graphics – Check the box to display the Graphics window. Uncheck the box to hide the Graphics window.

Transactions – Check the box to display the Transactions window. Uncheck the box to hide the Transactions window.

3D Z Axis Scale – Set the scaling in the Z-axis (capacitance measurement amplitude) 3D Graphics window.

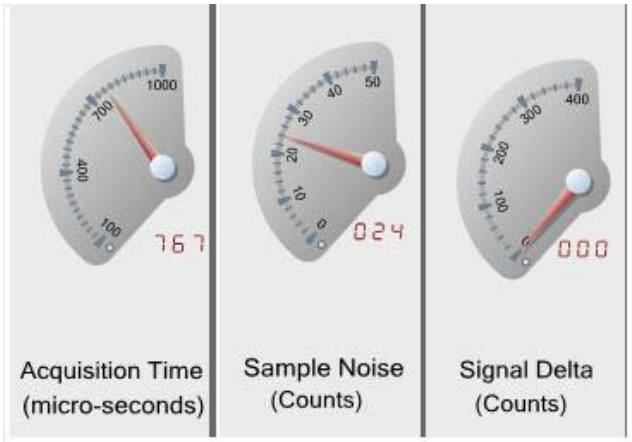
Parameters – Check the box to display the Firmware Parameters window. Uncheck the box to hide the Firmware Parameters window.

Dashboard – Check the box to display the Dashboard window. Uncheck the box to hide the Dashboard window.

3.5.8 Dashboard Window

The Dashboard window displays three gauges that are updated in real time.

FIGURE 3-21: SELF AND MUTUAL CAPACITANCE TABS – DASHBOARD WINDOW



Acquisition Time Gauge – The Acquisition Time gauge displays how long the hardware is taking to measure the capacitance of a single electrode on the sensor. A shorter time is better because it means the hardware is able to measure the sensor in less time, yielding better touch responsiveness.

Sample Noise Gauge – The Sample Noise gauge displays the worst case sampling noise for all of the measured electrodes on the sensor. It is defined as the difference between the maximum and the minimum measured capacitance values for the current sample set on an electrode.

Signal Delta Gauge – The Signal Delta gauge displays the difference between absolute capacitance measurements and the baseline capacitance measurements. It provides an indication of the touch signal strength. The Show Processed - Base box (see the **"GUI Commands Toolbar Group"** section) must be checked in the GUI Commands toolbar group for proper operation of this gauge.

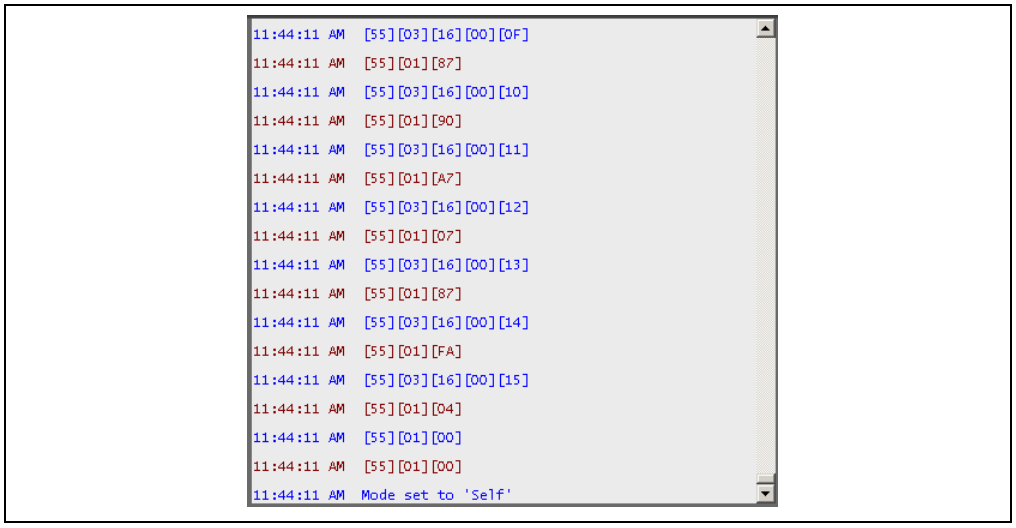
Note:	Changing various firmware parameters will affect the Acquisition Time, Sample Noise, and the Signal Delta. For example, changes made to reduce sample noise and increase the signal delta often have an associated trade off of increasing the acquisition time. Reference the "Projected Capacitive Touch Screen Sensing Theory of Operation Technical Brief" (DS93064) for more information.

3.5.9 Transactions Window

The Transaction window displays the communications that occur between the utility and the hardware.

Software utility messages and communications sent to the hardware are displayed in blue. Hardware touch reports and command responses are displayed in red.

FIGURE 3-22: SELF AND MUTUAL CAPACITANCE TABS – TRANSACTIONS WINDOW

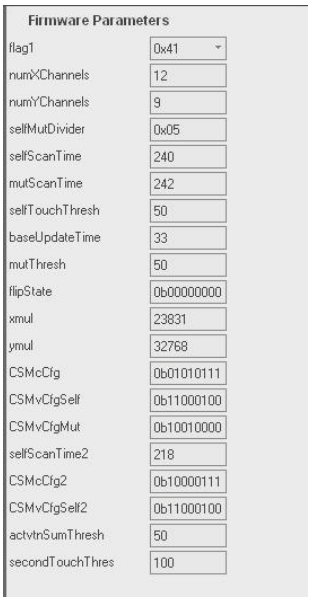


3.5.10 Firmware Parameters Window

The Firmware Parameters window displays the operating parameters that can be changed on the hardware.

See the **"GUI Commands Toolbar Group"** section for a description of how to Read, Write, and Restore the firmware parameters.

FIGURE 3-23: SELF AND MUTUAL CAPACITANCE TABS – FIRMWARE PARAMETERS WINDOW

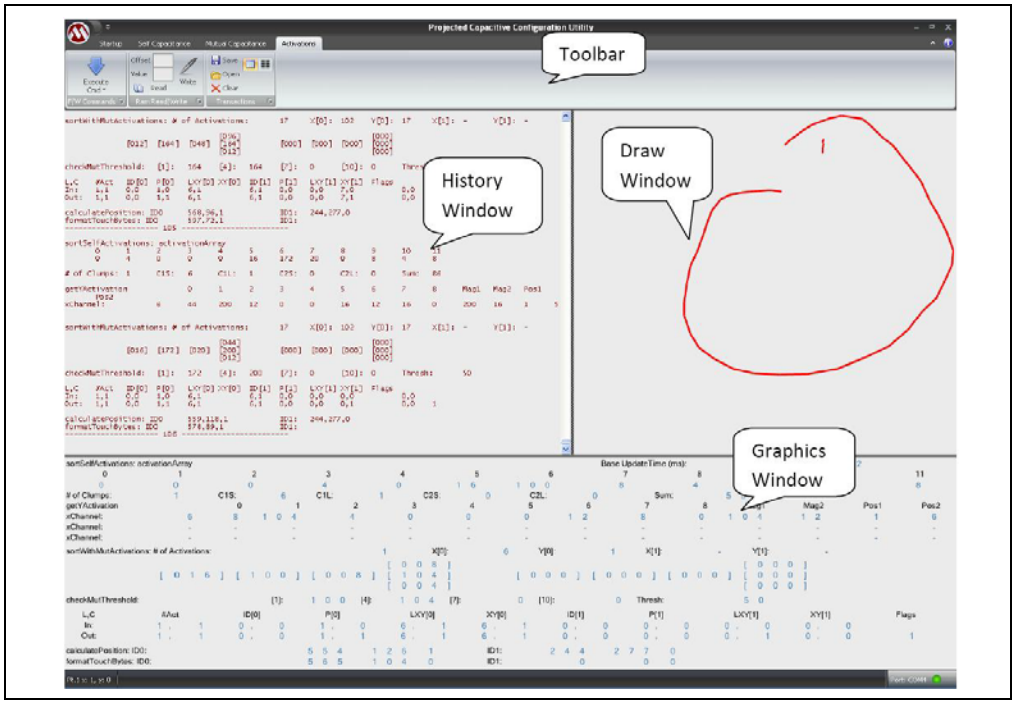


Reference the firmware source code for a description of each firmware parameter.

3.6 ACTIVATIONS TAB

The Activations tab is for detailed evaluation of real time results from firmware functions at stages of the touch position decoding process.

FIGURE 3-24: ACTIVATIONS TAB



3.6.1 RAM Read/Write Toolbar Group

The Ram Read/Write toolbar group enables reading values from and writing values to volatile memory on the hardware.

FIGURE 3-25: ACTIVATIONS TAB – RAM READ/WRITE TOOLBAR GROUP

Read a Ram value from the hardware:

Enter a desired Ram address offset value in the Offset box, then click the Read icon. The value contained at the Ram address offset location of the hardware will be displayed in the Value box.

Write a Ram value to the hardware:

Enter a desired Ram address offset value in the Offset box and a desired value for the contents in the Value box, then click the Write icon. The value will be written to the Ram address offset location of the hardware.

3.6.2 Transactions Toolbar Group

The Transactions toolbar group provides options that affect the viewing of information in the Transactions window.

FIGURE 3-26: ACTIVATIONS TAB – TRANSACTIONS TOOLBAR GROUP

Save – Click to save the text contents in the Transactions window.

Open – Click to open a previously saved Transactions window file.

Clear – Clear the current contents of the Transactions window.

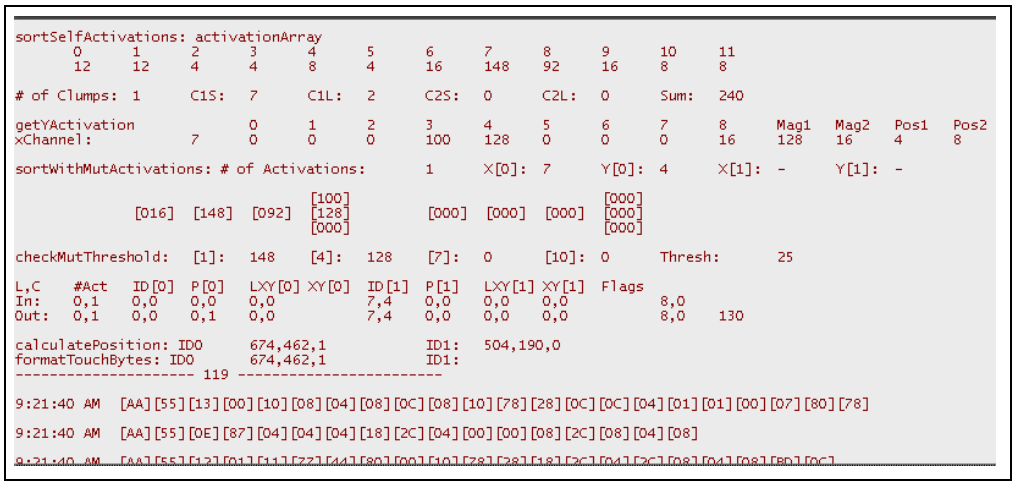
View Raw Data – Check the box to capture and display raw diagnostic data, sent from the hardware, in the Transactions window.

View History – Check the box to capture and display Graphics windows diagnostic data, sent from the hardware, in the Transactions window.

3.6.3 Transactions Window

The Transaction window displays diagnostic data sent from the hardware.

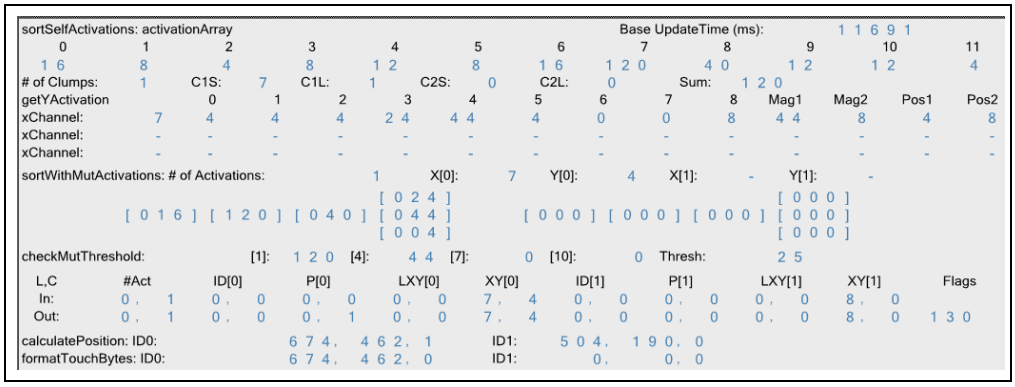
FIGURE 3-27: ACTIVATIONS TAB – TRANSACTIONS WINDOW



3.6.4 Graphics Window

The Graphics window displays firmware function results at stages of the touch position decoding process.

FIGURE 3-28: ACTIVATIONS TAB – GRAPHICS WINDOW



NOTES:

Appendix A. Hardware

This appendix contains additional information about the mTouch Projected Capacitive Touch Screen Sensing Development Kit.

Topics include:

- Schematics
- Projected Capacitive Board PCB and Default Settings
- Touch Reporting Protocol
- Programming the PIC16F707
- Programming the PIC18F14K50

A.1 SCHEMATICS

FIGURE A-1: SENSOR BOARD SCHEMATIC

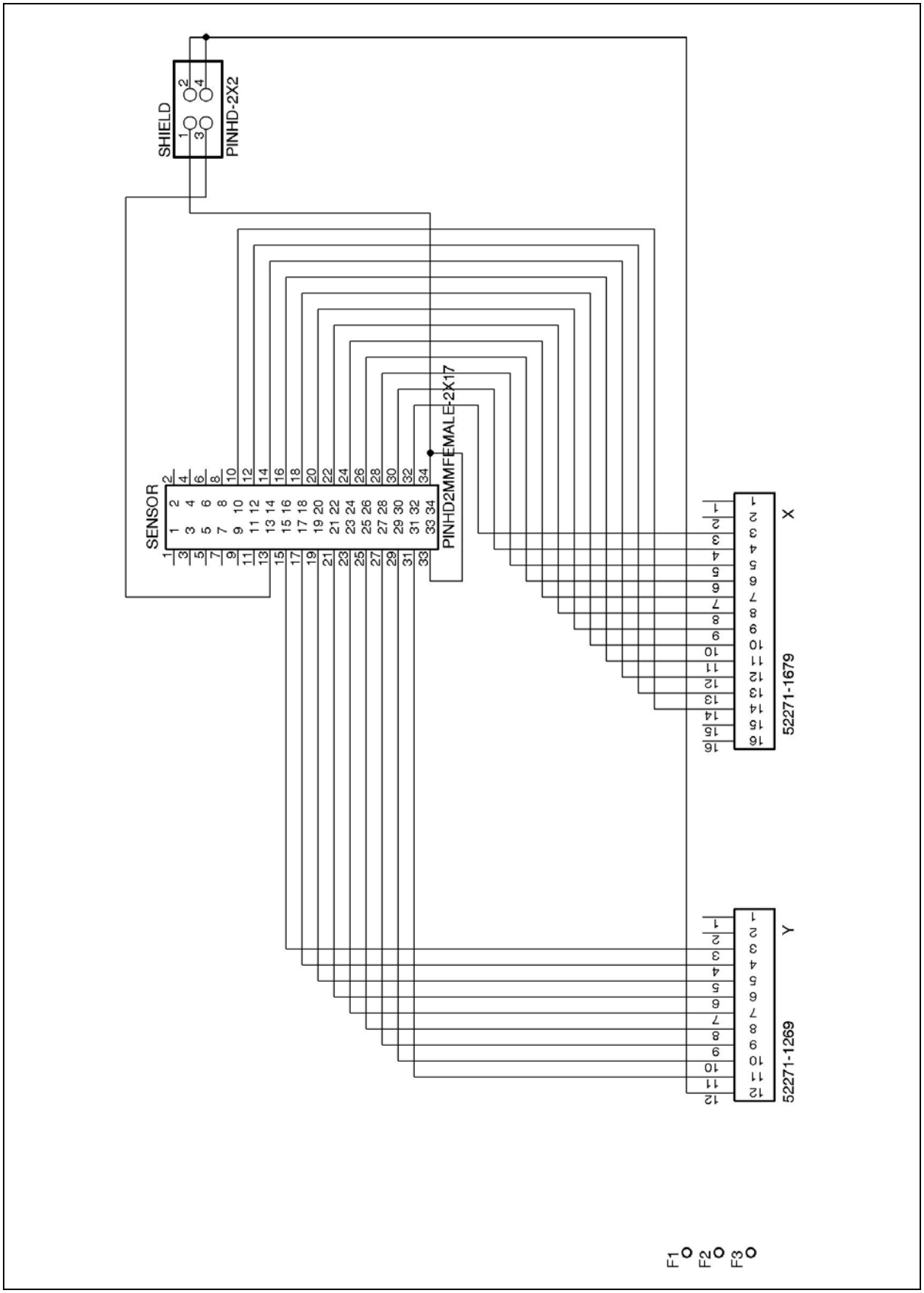
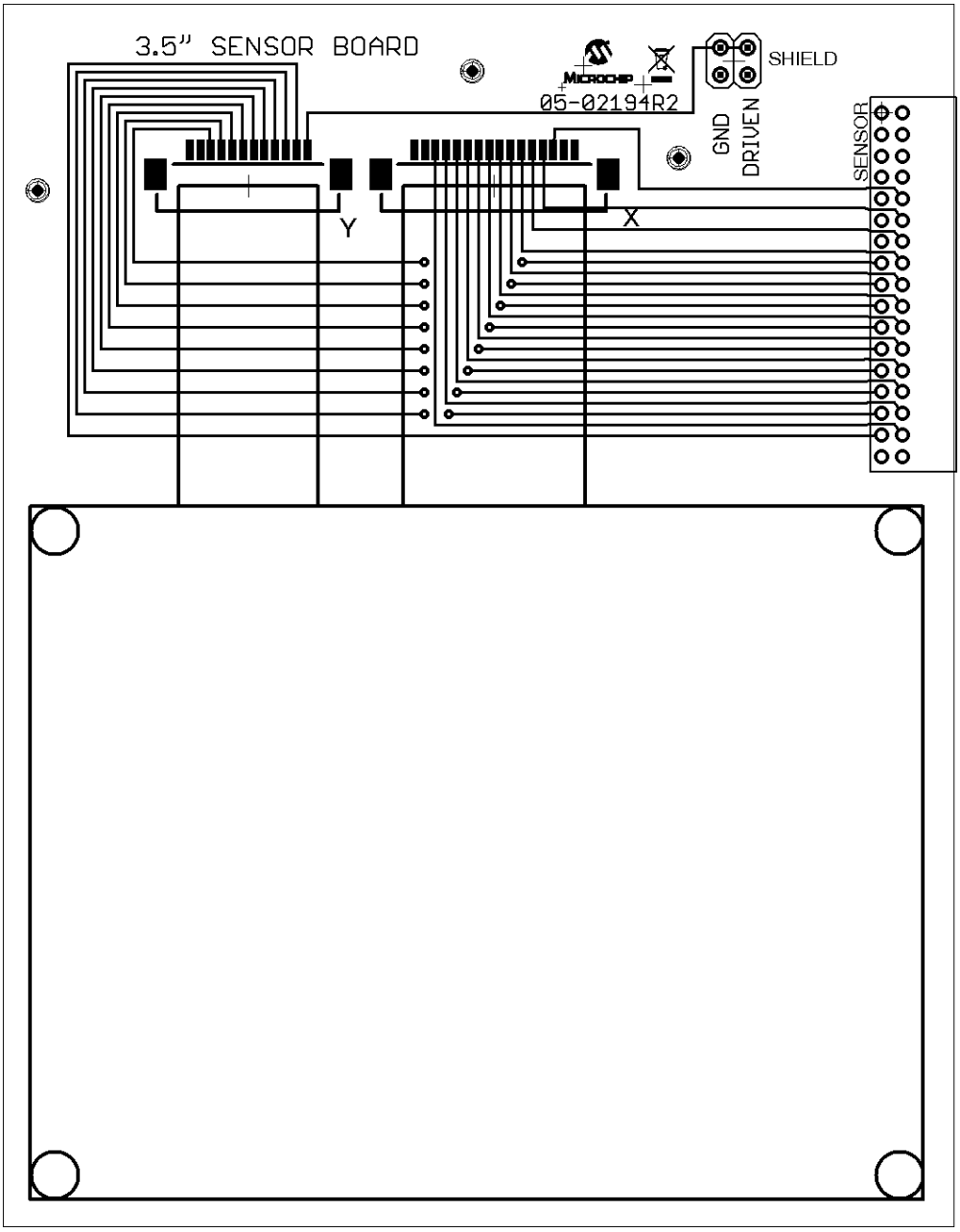
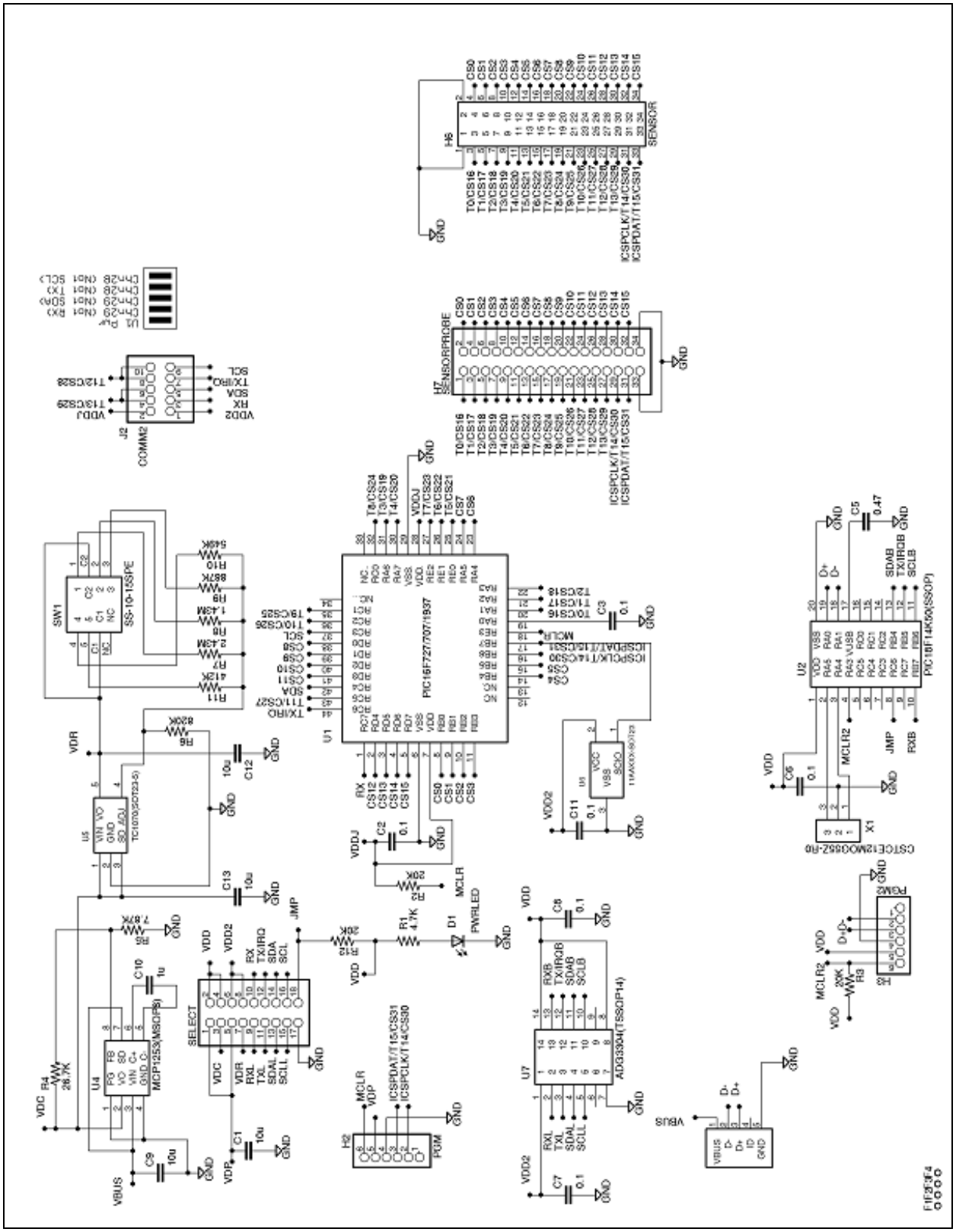


FIGURE A-2: SENSOR BOARD PCB TOP(1)



Note 1: Drawing is not to scale.

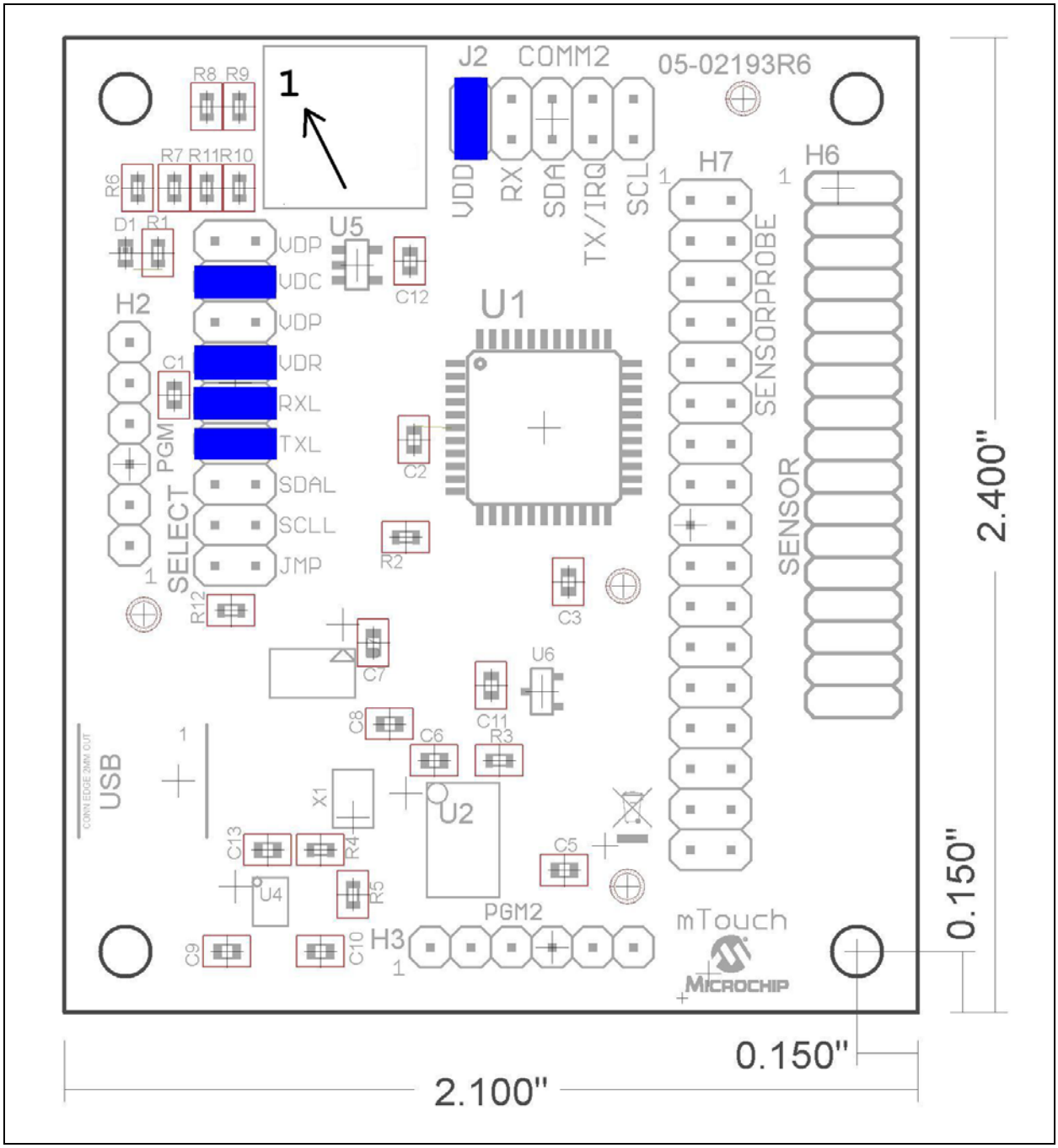
FIGURE A-3: PROJECTED CAPACITIVE BOARD SCHEMATIC



A.2 PROJECTED CAPACITIVE BOARD PCB AND DEFAULT SETTINGS

The default setting for the jumper options and the rotary switch are shown in Figure A-4.

FIGURE A-4: PROJECTED CAPACITIVE BOARD PCB AND DEFAULT SETTINGS



The 5-position rotary switch allows selection of different regulated operating voltages for the PIC16F707.

TABLE A-1: PROJECTED CAPACITIVE BOARD OPERATING VOLTAGE SELECTION(1)

SW1 Position	Regulated Voltage
1	5.0V
2	3.3V
3	2.5V
4	2.0V
5	1.8V

Note 1: The best performance is at 5V.

A.3 TOUCH REPORTING PROTOCOL

Touch coordinates are sent from the Projected Capacitive Board to the computer in 5-byte data packets. The packet contains: multi-touch ID #, pen-up/down touch status, X-axis coordinate, and Y-axis coordinate.

The touch coordinate report data packet is shown below.

TABLE A-2: TOUCH COORDINATE REPORTING PROTOCOL

Byte #	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1	T1	T0	0	0	P2	P1	P0
2	0	X6	X5	X4	X3	X2	X1	X0
3	0	0	0	0	0	X9	X8	X7
4	0	Y6	Y5	Y4	Y3	Y2	Y1	Y0
5	0	0	0	0	0	Y9	Y8	Y7

T<1:0>:Multi-Touch ID Number

00 = Touch #0

01 = Touch #1

P<2:0>: Pen/Touch Status

000 = Pen Up

001 = Pen Down

X<9:0>: X-Axis Coordinate Value

0000000000 = 0

•

•

1111111111 = 1023

Y<9:0>: Y-Axis Coordinate Value

0000000000 = 0

•

•

1111111111 = 1023

A.3.1 Example Touch Report

The following is an example of one touch report packet for a single finger touch, as might be seen in the Transaction window of the Projected Capacitive Configuration Utility software.

EXAMPLE A-1: EXAMPLE ONE TOUCH REPORT PACKET

1:02:44 PM [81] [32] [04] [0D] [03]

TABLE A-3: TOUCH REPORT PACKET EXAMPLE

Byte	Value	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0x81	1	0	0	0	0	0	0	1
2	0x32	0	0	1	1	0	0	1	0
3	0x04	0	0	0	0	0	1	0	0
4	0x0D	0	0	0	0	1	1	0	1
5	0x03	0	0	0	0	0	0	1	1

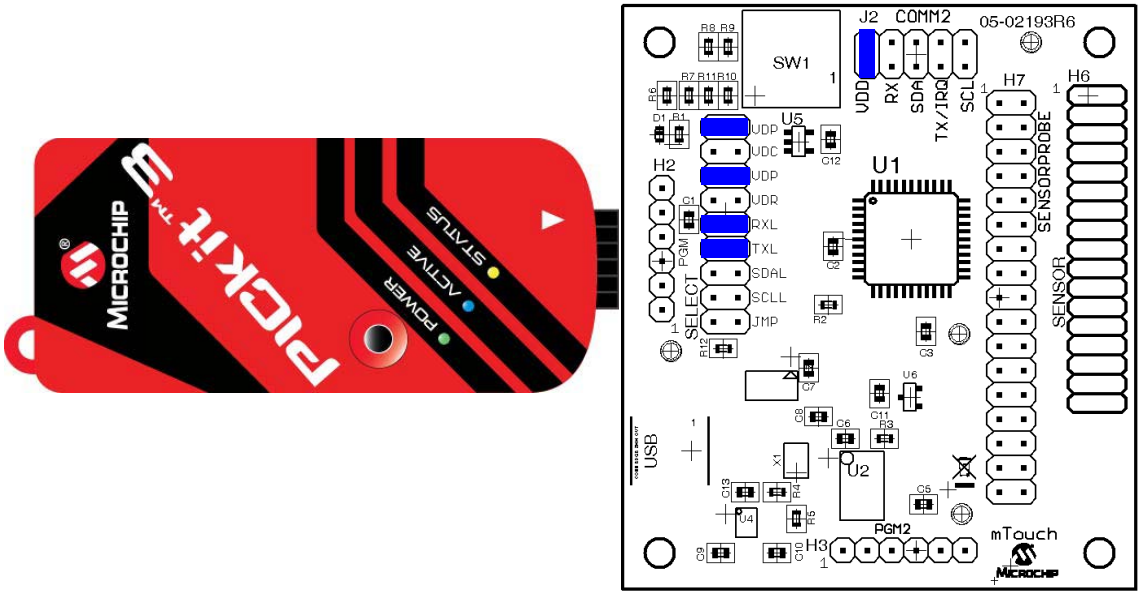
T<1:0> = 0b00 = Touch ID #0
P<2:0> = 0b001 = Pen Down
X<9:0> = 0b1000110010 = 562
Y<9:0> = 0b0110001101 = 397

Touch ID #0 down at coordinate location (562, 397).

A.4 PROGRAMMING PIC16F707

The Microchip PIC16F707 microcontroller on the Projected Capacitive Board can be reprogrammed if desired. Set the board jumpers and connect a Microchip PICkit™ 3 to the board header H2-PGM as shown below. The Microchip MPLAB ICD 3 is supported with the included Programming Adapter Board.

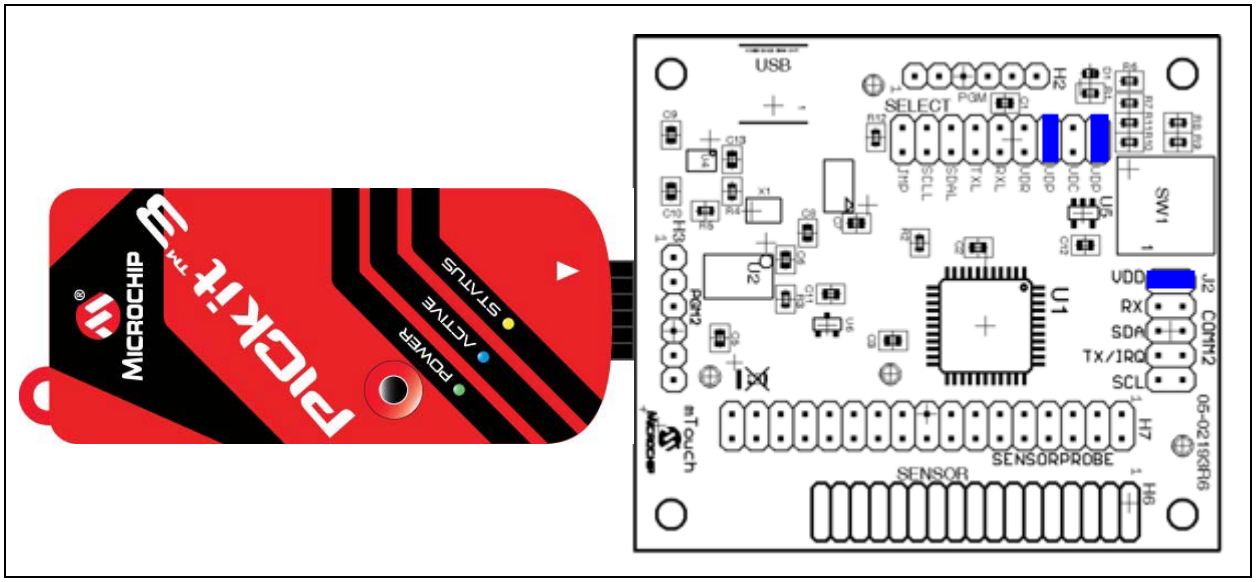
FIGURE A-5: PROGRAM PIC16/F707 ON PROJECTED CAPACITIVE BOARD



A.5 PROGRAMMING PIC18F14K50

The Microchip PIC18F14K50 microcontroller on the Projected Capacitive Board is used as a USB-to-UART bridge for communications. It can be reprogrammed if desired. Set the board jumpers and connect a Microchip PICkit 3 to the board header H3-PGM2 as shown below. The Microchip MPLAB ICD 3 is supported with the included Programming Adapter Board.

FIGURE A-6: PROGRAM PIC18F14K50 ON PROJECTED CAPACITIVE BOARD



A.6 SUMMARY

This completes a review of the contents, set up and basic operation of the Projected Capacitive Touch Screen Sensing Development Kit.

Refer to the *"Projected Capacitive Touch Screen Sensing Theory of Operations"* (DS93064A) technical brief for additional technical details.

NOTES:

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