3M™ MicroTouch™ Controller CX Reference Guide

Read and understand all safety information
contained in this document before using this product.

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CHAPTER 1

Introduction

Overview

This reference guide, designed for developers of touch sensor systems, provides installation and configuration information for the 3M™ MicroTouch™ CX100-series surface capacitive touch controller. This document includes information on integrating the CX100-series controller into your design, communicating with the controller, and troubleshooting setup problems. It also includes a complete description of the firmware commands and controller specifications.

3M Touch Systems is committed to being a premier supplier in touch systems throughout the world. As a 3M Touch Systems customer, you are aware that we have strong internal programs that meet or exceed environmental regulations of our customers and the regions in which we conduct business.

What You Need to Know

This document assumes you are familiar with USB firmware commands and how to use them. Executing some commands may alter the performance of your touch product. You should be aware of the results of using these commands before executing them.

Important Safety Information

Read, understand and follow all safety information before using this product. Follow all instructions marked on the product and described in this document. Pay close attention to the following installation warnings and safety precautions.

Intended Use
The CX100-series controller was designed to enable surface capacitive touch with small 3M touch sensors, 15 inches or less. This controller was designed to be used in conjunction with other 3M™ MicroTouch™ CX touch system products and is not intended to replace other existing 3M Touch Systems controllers. This controller is designed for internal mounting only and is not suitable for use in hazardous locations.

Explanation of Signal Word Consequences
⚠ **WARNING:** Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury and/or property damage. ⚠ **CAUTION:** Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury and/or property damage. **CAUTION:** Indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

⚠ WARNING
To reduce the risk of fire and/or explosion which could result in serious injury or death: Do not install or use this product in a hazardous location. **To reduce the risk of fire and/or explosion which could result in serious injury or property damage:** Do not use this product in any outdoor environment unless NEMA standards (or similar standards such as IP rating) are followed.

⚠ CAUTION
To reduce the risks associated with improper disposal, which if not avoided may result in minor or moderate injury from ground water contamination: Dispose of components in accordance with federal, state and local regulations.
To reduce the risk of possible environmental contamination which may result in minor or moderate injury: Dispose of the monitor in accordance with federal, state and local regulations.

3M Touch Systems Support Services

3M Touch Systems, Inc. provides extensive support services through our website and technical support organization. Visit the 3M Touch Systems website at http://www.3Mtouch.com/, where you can download touch systems software and drivers, obtain regularly updated technical documentation on 3M Touch Systems products, and learn more about our company.

Whenever you contact Technical Support, please provide the following information:

- Touch monitor size, part number and serial number
- Current driver version
- Operating system used
- Information on additional peripherals

Technical Support is available Monday through Friday 8:30 a.m. to 5:30 p.m. with limited call back service after 5:30 p.m. until 8:00 p.m. US Eastern Standard Time – 9 a.m. to 5 p.m. throughout Europe.

You can contact 3M Touch Systems, Inc. Technical Support (US only -- Eastern Standard Time) by calling the hot line, sending email or a fax.

- Technical Support Hot Line: 978-659-9200
- Technical Support Fax: 978-659-9400
- Toll Free: 1-866-407-6666 (Option 3)
- Email: US-TS-techsupport@mmm.com

Contact 3M Touch Systems

Contact information for all offices can be found on our website at: http://www.3Mtouch.com/

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CHAPTER 2

Integrating the CX100-Series Controller

Overview

The 3M™ MicroTouch™ CX100-series controller provides a new design for small display touch sensors. It features wide dynamic range, noise immunity, operating temperature stability, programmability using software utilities and improved capability in ungrounded environments.

The firmware for the CX100-series USB HID controller is optimized for small size surface capacitive touch sensors integrated in the latest flat panel displays.

This chapter covers the following CX100-series controller specifications:

- Cable connections
- Mounting requirements
- Power requirements and options

Note: For complete specifications for this CX100-series controller, refer to Appendix A.

The CX100-series controller has a built-in Universal Serial Bus (USB) full speed interface. A full speed USB interface has a data rate of 12 Mb/s.

A 25-point linearization procedure has been performed to determine the physical properties of the touch sensor, and the data is stored in a 2D bar code label attached to the touch sensor flex tail. The controller has the 25 point linearity data for the mated touch sensor stored in non-volatile memory.

To integrate and test the CX100-series controller, you need the following items:

- A 3M™ MicroTouch™ surface capacitive touch sensor 15 inches or less diagonal (available in a variety of sizes). Attached to the controller as a mated pair.
- A method of establishing the USB data communication between the controller and your system. The standard 3M Touch Systems USB cable (P/N 7319420 Pearl) is recommended for this device.
- The controller will operate with the standard USB +5V bus power.
- A touch sensor HID driver and a calibration program.

Handling and ESD Protection

When mounting the touch sensor and controller, use normal precautions for handling electrostatic sensitive devices. The CX100-series controllers have internal protection to ±20 kV for ESD discharges to the touch sensor (not to the controller directly) that may occur during normal touch sensor operations. Refer to the appendices for further specifications.

Establishing the Data Connection

The CX100-series controller requires a 3M Touch Systems USB communication cable (P/N 7319420 Pearl) or an equivalent interconnect. One end of this cable plugs into the USB connector (JP1) on the CX100-series controller. The other end plugs into a USB port on your PC with a Type-A connector. When creating a custom cable, use the Molex 51004-0500 mating connector. The following table describes the interconnections of the 3M Touch Systems USB cable.

Note: Make sure the USB 5V Bus has less than 50mV ripple peak to peak.

Table 1. USB Cable for CX100-series Controller

PC Side (USB Type A)		Wire	Controller Side (5-Pin Molex)	
Pin	**USB Assigned**	**Color**	**Pin**	**Description**
1	+5Vdc (VBUS)	Red	1	+5Vdc VBUS input power
2	Data (DN)	Gray	2	Data (DN) differential pair
3	Data (DP)	Green	3	Data (DP) differential pair
4	0V	Black	4	Power return
5	Cable Shield Shell	Charcoal Gray	5	Outer cable shield around signal and power lines. Chassis (earth) ground

Touch Sensor Connection

The touch sensor flex tail has a locking 5-pin single row female connector that plugs into the CX100-series controller with a right side tail exit. The following table describes the pins on this connector. Note if the tail exit is rotated from the standard right side exit, the calibration will correct the resulting positional error.

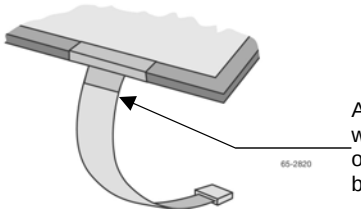
Table 2. Touch Sensor Flex Tail Connector for CX100-series Controller

Pin	Description
1	Upper left (UL) corner
2	Upper right (UR) corner
3	Connects to the flex tail shield which is driven by the CX controller
4	Lower right (LR) corner
5	Lower left (LL) corner

Mounting the Controller

The controller is designed for internal mounting only. Choose a convenient spot away from high-voltage, high power cables and electronics. Use 4-40 (or M3 metric) metal screws to mount the controller using the two diagonal mounting holes in the board. The controller should be mounted in line with the touch sensor cable exit point to minimize cable flexing. The controller should be mounted internally behind or on the side of the display on stand offs to allow room for the touch sensor cable connector.

Do not place constant stress on the sensor tail during handling or integration. Do not expose the tail to mechanical stresses because of the integration design. Provide adequate slack to ensure there is no straining on the tail. Avoid lateral pulls that may overstress the outermost electrical contacts on the glass.



The CX sensor tail is designed to be flexible, and it may be creased *once in a single direction,* along the tail and then secured in position with a light adhesive tape. Avoid angular creases (45°) to the tail directly in the area of the bond and tape strain relief.

The sensor tail should not move freely after assembly. Apply tape or another light adhesive to secure the tail in a manner that does not apply stress to the tail.

Supplying Power to the Controller

The CX100-series controller is designed to use USB bus power (that is, take power from the USB port). The source must deliver 29 mA typical (35 mA maximum), with a maximum ripple and noise of 50mV peak-to-peak.

⚠ CAUTION

To avoid possible damage to the controller, you must provide a path for electrostatic discharge. The controller-mounting hole near the touch sensor connector should be used to connect to chassis safety ground and must be attached by the shortest possible route to a good earth return (chassis) in all applications.

Mounting the Touch Sensor

There are several methods for mounting the touch sensor to the display depending on your application. If you need instructions or recommendations from 3M Touch Systems on how to incorporate a touch sensor into your design, refer to the *3M™ MicroTouch™ CX Touch System Integration Guide* (P/N 36462). All 3M Touch Systems documentation is available from the corporate website at www.3Mtouch.com.

Installing Software

3M Touch Systems' MT 7 software is available for this controller. There is a separate calibration utility and barcode utility available from the corporate website at www.3Mtouch.com.

CHAPTER 3

CX100-Series Controller Communications

This chapter discusses the fundamentals of communicating with the 3M™ MicroTouch™ CX100-series USB HID controller. The firmware commands, which are usually issued by a driver or utility program on the host system, control the operation of the touch sensor controller. This chapter lists the recommended firmware commands and describes how to use each of these commands.

Overview of USB HID Firmware Commands

Developers may use these USB commands when writing touch applications, developing custom drivers or touch configurations, or testing their touch systems. Developers can issue commands to initialize the controller, select operating modes, and execute diagnostic functions.

Note: This document assumes you are familiar with USB standards and modes of communication with USB HID devices, as well as firmware commands and how to use them. Executing some commands may alter the performance of your touch sensor and render it inoperable. You should be aware of the results before executing any firmware commands.

To optimize the performance of the CX100-series controller and simplify the development of custom software, 3M Touch Systems recommends you use the commands listed in this chapter for current development.

Communication Basics

This section provides information on sending firmware commands to the controller and interpreting the responses that the controller returns. The default operation of the CX100-series controller is USB HID 2.0 full speed at 12 MHz.

The USB command set is implemented by using vendor HID Get Feature and Set Feature commands. The computer can send requests to the controller to change how it operates or receives information about the controller. The controller issues a synchronous report in response to some of these requests. The controller also issues an asynchronous report automatically to the computer upon touch.

You need to know the product ID (0400H) and the vendor ID (0596H) to write your own driver. These values are required for identifying the controller.

The CX100-series command set conforms to the HID protocol which enables the CX100-series controller to work with operating systems that support HID. The only required software is a calibration tool used for aligning the touch sensor to the display. A calibration tool for the Microsoft Windows operating systems is available from 3M Touch Systems.

Some commands are more useful for driver development; some are more useful for application development. For example, to receive touch coordinates a driver would use the asynchronous report 1 (Coordinate Data) while an application would use GetTouchReportUtility feature request.

Receiving Reports from the Controller

The controller sends a variety of reports to the computer. The first byte of each report is the Report ID that defines the structure and content of the report. The controller sends some reports as a direct response to a computer request (synchronous). The controller will also send some reports as the result of an external event, such as a touch (asynchronous).

USB Command Set

The USB command set is implemented by using HID Get Feature and Set Feature commands. The various requests and reports are grouped together by report size under a common feature ID.

The following commands are currently used by 3M Touch Systems for optimal communications. 3M Touch Systems recommends that you use only these commands for CX100-series controller communications.

Sending Commands to the Controller

To send a command, the program must construct a USB request packet. The request format is described in the following table. This is known as the setup stage. Any data appended immediately after the setup stage is referred to as the data stage.

If using Windows, you may want to use the Set and Get Feature functions, respectively HidD_SetFeature and HidD_GetFeature. The buffers for these routines are the data stages of the requests. Note that HidD_GetFeature requires you to populate the first byte of the buffer with the desired report ID.

Table 3. General Format

Offset	Field	Size	Value	Description
0	bmRequestType	1	d0100001	Characteristics of request [direction, type, recipient] D7: Data Transfer Direction 0 = Host-to-device (H2D) 1 = Device-to-host (D2H) D6…5 Type 0 = Standard 1 = Class 2 = Vendor 3 = Reserved D4…0 Recipient 0 = Device 1 = Interface 2 = Endpoint 3 = Other 4…31 = Reserved
1	bRequest	1	0xXX	Get report (0x01) Set report (0x09)
2	wValue	2	0x03XX	msb = 03 = Feature lsb = xx =Report ID
4	wIndex	2	0	Always 0
6	wLength	2	0xXXXX	Number of bytes to transfer (multiple of 8)

Table 4. Command Set Summary

HID Report	Command Name	bmRequest Type	bRequest	Feature Report ID	Report Subtype	Data Stage Bytes
Get Feature	GetParameter	0xA1 (D2H)	0x01	0x05	--	72
Get Feature	GetTouchReportUtility	0xA1 (D2H)	0x01	0x07	--	16
Get Feature	GetStatus	0xA1 (D2H)	0x01	0x06	--	8
Get Feature	GetControllerID	0xA1 (D2H)	0x01	0x04	--	16
Set Feature	SetParameter	0x21 (H2D)	0x09	0x05	1	72
Set Feature	SetParameterIndex	0x21 (H2D)	0x09	0x03	2	8
Set Feature	Calibrate	0x21 (H2D)	0x09	0x03	4	8
Set Feature	SetAsyncReport	0x21 (H2D)	0x09	0x03	5	8
Set Feature	Reset	0x21 (H2D)	0x09	0x03	7	8
Set Feature	Restore Defaults	0x21 (H2D)	0x09	0x03	8	8

Set Feature - SetParameter

This is a request to modify the specified parameter in the controller's EEPROM. The data for the parameter is sent in a data stage.

Table 5. Setup Stage for Set Parameter Request

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0305	msb=03=Feature lsb=05=Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	0x48	Always 72 (allows for 64 data bytes + 8 byte header)

Table 6. Data Stage for Set Parameter Request

Offset	Field	Size	Value	Description
0	Report ID	1	0x05	Feature Report ID
1	report subtype	1	0x01	Set Parameter
2	bArea	1	0	Always 0
3	Not used	1	0	Not used
4	bSubArea	1	0x05	Parameter number (the Controller ID is the only writeable parameter)
5	bIndex	1	0	Always 0
6	bDataLength	1	0x04	Number of valid data bytes for this transfer is always 4.
7	Not used	1	0	Not used
8-71	wData	1	0xXX	The first 4 bytes are a user-assigned controller ID (any trailing pad bytes are ignored)

Response

If the command cannot be processed, the device stalls endpoint 0. The command cannot be processed if the memory area is not valid. It cannot be processed if the request is attempting to access data outside the specified memory area. This may happen if the index is too large or too much data has been requested.

After sending a command, the controller may not be finished processing the command. Therefore software should repeatedly issue a GetStatus command until the command status field returns "Command Complete" or "Failure in Command Processing". Refer to Table 22, Valid Command Status Field Entries. It may take as long as 1 second for the processing to complete.

Set Feature - SetParameterIndex

Use this command to set up the GetParameter command.

Table 7. Setup Stage for Set Parameter Index

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	msb=03=Feature lsb=03=Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 8. Data Stage for Set Parameter Index

Offset	Field	Size	Value	Description
0	Report ID	1	0x03	Feature Report ID
1	report subtype	1	0x02	Set Parameter Index
2	bArea	1	0	Always 0
3	Not used	1	0	Not used
4	bSubArea	1	0xXX	Parameter number - see table below
5	bIndex	1	0	Always 0
6	bDataLength	1	0xXX	Number of data bytes for this parameter - see table below.
7	Not used	1	0	Not used

Table 9. Parameter Values

bSubArea	bDataLength	Description
5	4	Controller ID
101	64	Copyright

Get Feature – GetParameter

This is a request to read data from the controller's EEPROM. A SetParameter or a SetParameterIndex command must be used to determine which parameter this command will retrieve.

Table 10. Setup Stage for Get Parameter

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Class,D2H,Interface
1	bRequest	1	0x01	Get Report
2	wValue	2	0x0305	msb=03=Feature lsb=05=Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	0x48	Always 72 (allows for 64 data bytes + 8 byte header)

Table 11. Data Stage for Get Parameter

Offset	Field	Size	Value	Description

Offset	Field	Size	Value	Description
0	Report ID	1	0x05	Feature Report ID
1	Not used	1	0	Not used
2	bArea	1	0	Always 0
3	Not used	1	0	Not used
4	bSubArea	1	0xXX	Parameter number - see table below
5	bIndex	1	0	Always 0
6	bDataLength	1	0xXX	Number of data bytes for this parameter - see table below
7	Not used	1	0	Not used
8-71	Data	64	0xXX	Parameter value – see table below

Table 12. Parameter Values

Data Format	bSubArea	bDataLength	Description
4 byte integer	5	4	Controller ID
Null terminated ASCII string	101	64	Copyright

Response

If the command cannot be processed, the device stalls endpoint 0. The command cannot be processed if the memory area is not valid. It cannot be processed if the request is attempting to access data that is outside the specified memory area. This may happen if the index is too large or too much data has been requested.

Set Feature - SetAsyncReport

This command controls the sending of the asynchronous report 1 (Coordinate Data). When this report is turned on, the report is sent from endpoint 1 whenever touch data is available. A utility can turn this report off and poll endpoint 0 using the GetTouchReportUtility request. You can also use this request to disable and enable touch.

Table 13. Setup Stage for SetAsyncReport

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	msb=03=Feature lsb=03= Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 14. Data Stage for SetAsyncReport

Offset	Field	Size	Value	Description
0	Report ID	1	0x03	Feature Report ID
1	Report Subtype	1	0x05	SetAsyncReport
2	Activate	1	0xXX	0x01 = Activate 0x00 = Deactivate
3	Report Number	1	0x01	Always 0x01
4 - 7	Not Used		0x00	Not used

Get Feature – GetTouchReportUtility

By default the controller reports touch coordinates asynchronously through endpoint 1. If you cannot access endpoint 1, use this report to get touch coordinates. Use SetAsyncReports to enable this feature.

Note: The coordinate system originates in the upper left corner of the screen.

Table 15. Setup Stage for GetTouchReportUtility

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Class,D2H,Interface
1	bRequest	1	0x01	Get Report
2	wValue	2	0x0307	msb=03=Feature lsb=07= Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	16	Always 16

Table 16. Data Stage for GetTouchReportUtility

Offset	Field	Size	Value	Description
0	Report ID	1	0x07	Report ID
1	Status	1	0xXX	0x00 = Report not valid 0x02 = Not touching 0x03 = Touching
2	X Compensated	2	0xXXXX	X (0-3FFF)
4	Y Compensated	2	0xXXXX	Y (0-3FFF)
6	Raw X	2	0xXXXX	Raw X (0-3FFF)
8	Raw Y	2	0xXXXX	Raw Y (0-3FFF)
10-15	Not used	6	0x00	Not used

Set Feature - Calibration

This is a request to perform a 2-point calibration. The calibration can be performed at points inset from the lower left and upper right corners (extended calibration) or it can be done at those corners. The 2-point calibration defines the active area of the touch sensor by mapping two targets displayed on the video image to absolute X and Y coordinates on the touch sensor.

Table 17. Setup Stage for Calibration

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	msb=03=Feature lsb=03=Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 18. Data Stage for Calibration

Offset	Field	Size	Value	Description
0	Report ID	1	0x03	Feature Report ID
1	Report Subtype	1	0x04	Calibration request
2	bCalType	1	0x01	Always 0x01
3-7	Not used	1	0	Not used

Response

The device stalls endpoint 0 if the request cannot be processed successfully.

The host should issue GetStatus requests to determine the calibration status. A command status of 1 indicates that the controller is waiting for a touch in the lower left quadrant. A status of 2 indicates that the lower left touch has occurred and the controller is waiting for a touch in the upper right quadrant. A status of 3 indicates that the upper right touch has occurred. A status of 0 indicates that the request has failed. A soft reset command should be sent if the host wishes to terminate calibration. Software should delay 1 second before painting the first target.

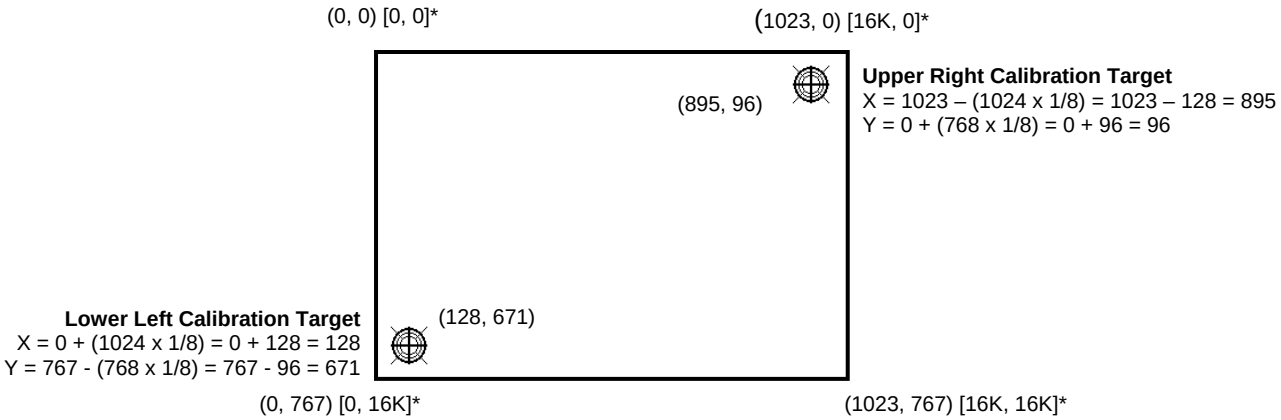
When the calibration is complete, the controller may be delayed responding to a GetStatus request. Software should wait 1 second for a response.

Determining Target Areas

The default calibration targets (points) are located 12.5% (1/8) inward from the lower left and upper right corners of the video image. For example, suppose the display resolution of your Windows-based display is 1024 x 768. The calibration command calculates the amount to move inward as follows:

- Amount to move inward in the X direction: 1024 x 1/8 = 128
- Amount to move inward in the Y direction: 768 x 1/8 = 96

The calibration command expects the first calibration target inward from the lower left corner (0,767) and the second calibration target inward from the upper right corner (1023,0). The following illustration shows how the calibration targets are calculated for a Windows-based system. Your operating system may be different.



*Both the video (0, 0) and controller [0, 0] coordinates origin are in the upper left corner of the screen. The controller outputs 0 to 16K on both axes independent of display screen resolution.

Get Feature - GetStatus

This is a request to retrieve information on the status of the CX100-series controller. This request indicates if there were any power on check errors and if the last request was completed successfully.

Table 19. Setup Stage for Controller Status

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Class,D2H,Interface
1	bRequest	1	0x01	Get Report
2	wValue	2	0x0306	msb=03=Feature lsb=06= Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 20. Data Stage Controller Response

Offset	Field	Size	Value	Description
0	Report ID	1	0x06	Feature Report ID
1	POC Status	1	0xXX	Power On Check Status
2	Cmd Status	1	0xXX	Status of last command
3	Touch Status	1	0xXX	0x00 = Finger Up 0x01 = Finger Down
4	Async Reports	1	0xXX	0x00 = Async touch output off 0x01 = Async touch output on
5-7	Not used	1	0	Not used

Power-on Checks (POC) Status

Various controller systems are checked at power-up. If any failures in these systems are detected, a POC flag is set. The POC status field reports the state of these flags. The ROM checksum is only calculated in response to a GetControllerID request. The ROM_ERROR bit is not shown at power up.

Table 21. Power On Check Bit Fields

Bit Number	Description	Notes
0	Not used	Not used
1	ROM_ERROR	Code area checksum error
2	PWM_ERROR	Failed to find an acceptable stray level. Check that the sensor is connected.
3	NOV_ERROR	EEPROM area 1 checksum error
4-6	Not used	Not used
7	NOV2_ERROR	EEPROM area 2 checksum error

Command Status

This field indicates if the last request was processed successfully. It is also used to track calibration progress. The GetStatus request will return the soft reset and hard reset values only once. Otherwise it does not affect the contents of this field.

Table 22. Valid Command Status Field Entries

Value	Description
0	Failure in command processing
1	Command being processed
2	Stage 1 processing complete (for calibration only)
3	Command complete
4	Soft Reset occurred
5	Hard Reset occurred

Set Feature - Reset

This is a request to perform a controller reset. The controller automatically performs a soft reset after any parameter changes.

Table 23. Setup Stage for Reset

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	msb=03=Feature lsb=03= Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 24. Data Stage for Reset

Offset	Field	Size	Value	Description
0	Report ID	1	0x03	Feature Report ID
1	Report Subtype	1	0x07	Reset request
2	bResetType	1	0xXX	0x01 = Soft Reset 0x02 = Hard Reset
3-7	Not used	1	0	Not used

A Hard Reset will cause the controller to disconnect and then reenumerate.

After sending a command, the controller may not be finished processing the command. Therefore software should repeatedly issue a GetStatus command until the command status field returns “Soft Reset Occurred”, “Command Complete” or “Failure in Command Processing”. Refer to Table 22, Valid Command Status Field Entries. It may take as long as 1 second for the processing to complete.

Set Feature –Restore Defaults

This is a request to restore the controller to factory defaults.

Table 25. Setup Stage for Restore Defaults

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Class,H2D,Interface
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	msb=03=Feature lsb=03= Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

Table 26. Data Stage for Restore Defaults

Offset	Field	Size	Value	Description
0	Report ID	1	0x03	Feature Report ID
1	Report Subtype	1	0x08	Restore Defaults
2-7	Not used	1	0	Not used

After sending a command, the controller may not be finished processing the command. Therefore software should repeatedly issue a GetStatus command until the command status field returns “Command Complete” or “Failure in Command Processing,”. Refer to Table 22, Valid Command Status Field Entries. It may take as long as 1 second for the processing to complete.

This command should be followed by a Reset request and a Calibration before use.

Get Feature - Controller ID

This is a request to send information such as controller type and firmware revision level.

Table 27. Setup Stage for Controller ID

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Class,D2H,Interface
1	bRequest	1	0x01	Get Report
2	wValue	2	0x0304	msb=03=Feature lsb=04= Feature Report ID
4	wIndex	2	0x0000	Always 0
6	wLength	2	0x0010	Always 16

Table 28. Data Stage for Controller ID

Offset	Field	Size	Value	Description
0	Report ID	1	0x04	Feature Report ID

Offset	Field	Size	Value	Description
1	Controller type	2	0x4341	Controller type
3	Firmware major revision	1	0xXX	Firmware major revision (BCD encoding)
4	Firmware minor revision	1	0xXX	Firmware minor revision (BCD encoding)
5	Features	1	0x10	Reserved
6	ROM ChkSum	2	0xXXXX	ROM checksum
8	MaxParamWrite	2	0x0040	Maximum number of data bytes for a Set/GetParameter request
10 - 15	Reserved	1	0xXX	Reserved

Asynchronous Reports

Coordinate Data – Report 1

By default the controller sends this report asynchronously through endpoint 1 whenever there are touch coordinates available. The SetAsyncReports request controls the sending of this report.

Note: The coordinate system originates in the upper left corner of the screen.

Table 29. Coordinate Data Report 1

Offset	Field	Size	Value	Description
0	Report ID	1	0x01	Report ID
1	Status	1	0xXX	0x00 = Report not valid 0x02 = Not touching 0x03 = Touching
2	X Compensated	2	0xXXXX	X (0-3FFF)
4	Y Compensated	2	0xXXXX	Y (0-3FFF)
6	Raw X	2	0xXXXX	Raw X (0-3FFF)
8	Raw Y	2	0xXXXX	Raw Y (0-3FFF)
10-15	Not used	6	0x00	Not used

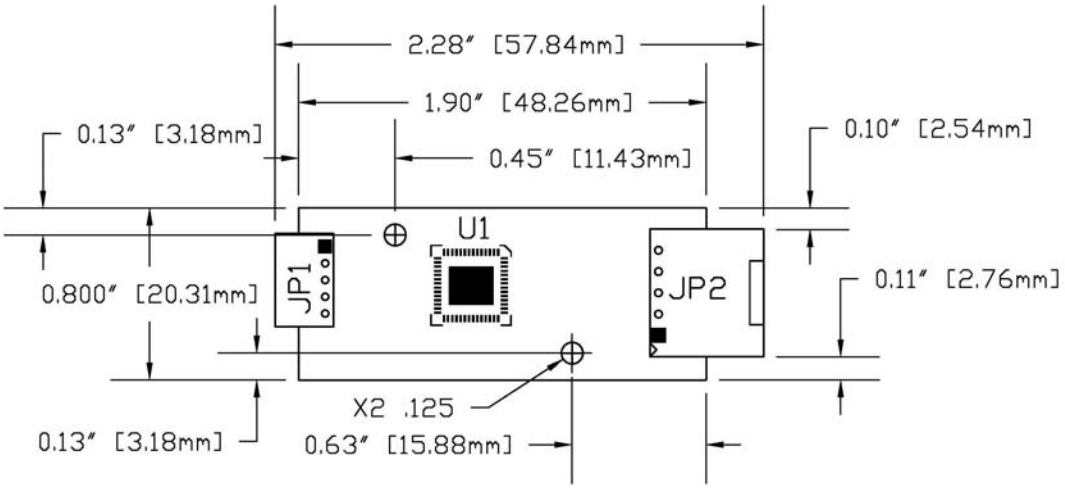
APPENDIX A

CX100-Series Controller Specifications

This section provides controller specifications such as power requirements, environmental requirements, and cable connectors. The CX100-series controller is a compact USB controller. This controller can be internally mounted in your display.

The CX100-series controller has a touch sensor connector (JP2) and a USB cable connector (JP1). The controller measures approximately 1.9 x 0.8 x 0.45 inches. The following figure shows the overall dimensions of the CX100-series controller and the locations of the mounting holes and connectors.

CX100-series Controller Overall Dimensions



Technical Specifications

The controller specifications listed below were validated in test systems containing 3M Touch Systems components. These specifications may not be valid if configured with components from suppliers other than 3M Touch Systems. All components in the manufacture of electronic controllers are RoHS Directive compliant (2002/95/EC).

Physical Dimensions

1.9 in. x 0.8 in. x 0.45 in. (48.3 mm x 20.3 mm x 11.4 mm)

Board Level Functions

USB Bus Power	5 VDC (29 mA typical, 35 mA maximum); ± 10% regulation 50 mV_{pp} maximum ripple and noise

Regulatory Requirements

CE		Compliant
Radiated Emissions – EN 55022:1998	Class B	Compliant
AC Mains Conducted Emissions – EN 55022:1998	Class B	Compliant
Telco Lines Conducted Emissions	N/A	N/A
RFI – EN 61000-4-3 / ENV 50140	Class A	Compliant
CRFI – EN 61000-4-6	Passed criterion A with a cable < 3 meters long	N/A
EFT (Burst Immunity) – EN 61000-4-4	Class B	Compliant
ESD Susceptibility – IEC 61000-4-2	Class 1	Compliant
Surge – EN 61000-4-5	Class B	Compliant
Harmonics – EN 61000-3-2	Class A	Compliant
Flicker – EN 61000-3-3		Compliant
Power Frequency Magnetic Field – EN 61000-4-8	NA	
Voltage Dips – EN 61000-4-11	Class B < 5% V	
	Class C < 70% V	Compliant
Voltage Interruptions – EN 61000-4-11	Class C	Compliant
FCC Class B / CISPR22 Class B	Class B	Compliant
VCCI Class B ITE Emissions (Japan)	Class B	Compliant
AS/NZS 3548:1995/CISPR 22 Class B ITE Emissions (Aus.)	Class B	Compliant
UL 60950/ EN 60950/ IEC 60950		Compliant

Ambient Operating and Storage Environmental Conditions

All Humidity is Non-Condensing	
Operating Temperature Range	- 10 °C to +65 °C
Operating Humidity Range	<36° C 0-90% RH
	≥ 36 °C See Figure below
Storage Temperature Range	- 50 °C to +85 °C
Storage Humidity Range	< 36°C 0-90% RH
	≥ 36 °C See Figure below

Performance and Reliability

Minimum Touch Duration	less than 22 msec
Touch Resolution	2048 X 2048
ESD Susceptibility -	
±8 kV Contact Discharge* – Class 2 per section 9 of IEC 61000-4-2 1 false touch allowed	Compliant
±20 kV Air Discharge* – Class 1 per section 9 of IEC 61000-4-2 Normal Operation – No false touches	Compliant

* ESD discharges to a 3M Touch Systems touch sensor connected to the controller

MTBF (by MIL Std. 217F Calculation)	greater than > 500,000 Hours

Touch System Parameters

Accuracy vs. Dynamic Temperature Change – with a 0.5 deg. C/minute temperature ramp

0 °C to 45 °C	Maintains 98.5% True Position Accuracy
45 °C to 65 °C	Maintains 98.0% True Position Accuracy
-10 °C to 0 °C	Maintains 98.0% True Position Accuracy

Touch Sensor Compatibility	3M™ MicroTouch™ CX Capacitive Touch Sensors - 15 inches or less diagonal
Communications Protocol	USB 2.0 (full speed) Compliant

Storage and Operating Temperature with Humidity Conditions