



# *SC500 USB Resistive Controller Reference Guide*

3M Touch Systems

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

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Document Title: *SC500 USB Resistive Controller Reference Guide*  
Document Number: 19-275, Version 1.0

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# Overview

3M Touch Systems offers several advanced controllers designed for reliability and easy installation. Each controller provides superior performance and delivers excellent stability, sensitivity, accuracy, and fast response.

This reference manual, directed to developers of touch screen systems, provides installation and configuration information for the small outline 3M Touch Systems SC500 USB touch screen controller. This document includes information on integrating the SC500 USB controller into your design, communicating with the controller and troubleshooting setup problems. It also includes a complete description of the firmware commands, a guide to interpreting status LED conditions, and controller specifications.


## What You Need to Know

This document assumes you are familiar with USB 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 and understand 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.

<b>Intended Use</b>
The SC500 USB controller was designed to enable touch in conjunction with other 3M Touch Systems products. This controller is not designed for use in hazardous locations.

 <b>WARNING</b>
<b>To avoid the risk of fire and/or explosion which could result in serious injury or property damage:</b> <ul style="list-style-type: none"><li>▪ Do not install or use this product in a hazardous location.</li><li>▪ Do not use this product in any outdoor environment unless NEMA standards are followed.</li></ul>

**CAUTION**

**To reduce the risks associated with the improper disposal of the controller board, which if not avoided may result in minor or moderate injury from ground water contamination:**

- Dispose of the controller board in accordance with local, state and federal regulations.

## Explanation of Symbols



Attention: Read accompanying documentation

## 3M Touch Systems Support Services

3M Touch Systems 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 screen software and drivers, obtain regularly updated technical documentation on 3M Touch Systems products, and learn more about our company.

Note that if you purchased this product from another company, contact them before contacting 3M Touch Systems.

Whenever you contact Technical Support, please provide the following information (if applicable):

- Part number and serial number from your touch system
- Current driver version
- Operating system used
- Information on additional peripherals

Technical Support is available Monday through Friday 8 a.m. to 8 p.m. US Eastern Standard Time – 9 a.m. to 5 p.m. throughout Europe. Limited call back service Saturdays and Sundays.

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

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

## 3M Touch Systems Worldwide Offices

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## CHAPTER 1

# Integrating the SC500 USB Controller

The MicroTouch™ SC500 Universal Serial Bus (USB) controller is an accurate, small outline, low cost, temperature stable controller capable of supporting a wide range of 3M Touch Systems resistive touch screens. It is designed to work with Microsoft® Windows® XP, 2000, 98SE and Windows Me for internal mounting in OEM applications.

This chapter covers the following SC500 USB controller specifications:

- Cable connections
- Mounting requirements
- Power requirements and options
- Status LED codes

## Overview of the SC500 Touch Screen Controller

The SC500 controller is an uncased device using a USB interface.

To integrate and test the SC500 USB controller, you need the following items:

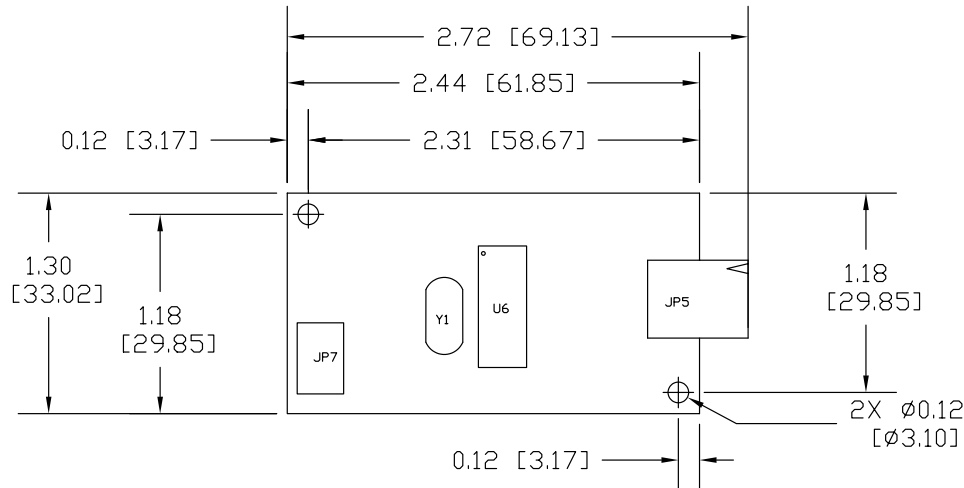
- A 3M Touch Systems 5-wire resistive touch screen. The touch screens are available in a variety of sizes.
- A method of establishing the USB communication between the controller and your system. The standard 3M Touch Systems USB communications cable (P/N7319420) is recommended. This cable is PC99 compliant.
- A touch screen utility or driver with a calibration routine.

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**Note:** You can use MicroTouch™ Software, which includes the touch screen device driver and utilities software.

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The controller measures 1.3 x 2.4 inches, or 1.3 x 2.7 inches total profile over the connectors. Allow additional clearance for the mating connectors. The total height profile is 0.40 inches from the thru hole pins on the trace side of the board to the top of the highest component on the opposite side. The SC500 has a 5-pin touch screen connector (JP5), and a 5-pin USB cable connector (JP7).

**Figure 1. SC500 USB Controller Overall Dimensions**

## Handling and ESD Protection

When mounting the sensor and controller, use normal precautions for handling electrostatic sensitive devices. The SC500 has internal protection to  $\pm 20$  kV for ESD air discharges to the touch screen (not to the controller directly) that may occur during normal operation of the touch screen. Refer to Appendix A for further specifications.

## Establishing the Data Connection

The SC500 USB Resistive Controller requires a 3M Touch Systems USB communication cable (P/N 7319420) PC 99 compatible or an equivalent interconnect. One end of this cable plugs into the USB connector (JP7) on the SC500 USB Resistive Controller. The other end, which has a Type-A connector, plugs into a USB port on your PC.

When creating a custom cable, use the Molex 51004-0500 mating connector. Table 1 describes the interconnections of the 3M Touch Systems USB cable.

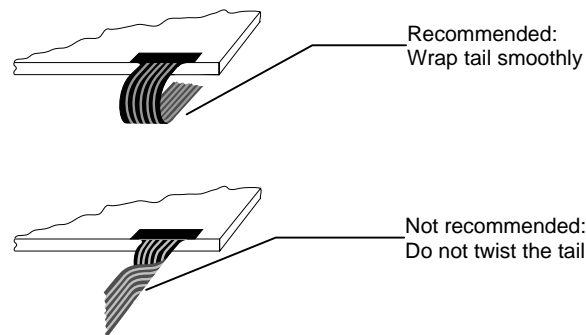
**Table 1. USB Cable for SC500 USB Resistive Controllers**

PC Side (USB Type A)		Wire	Controller Side (5-Pin Molex)	
Pin	USB Assigned	Color	Pin	Description
1	+5Vdc	Red	1	+5Vdc 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

## 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 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 screen 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 screen cable connector.

Ensure that the tail and controller are aligned such that the tail remains straight (90°), not pulled or twisted in an odd angle from the touch screen. Good engineering design avoids awkward electrical connections.



## Supplying Power to the Controller

The SC500 USB controller is powered by the USB 5-volt bus power. The typical current is 15 mA typical, 28 mA touching;  $\pm 5\%$  regulation, 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 (ESD). The controller mounting hole near the 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 Screen

There are several methods for mounting the touch screen depending on your application (Flat CRT displays or flat panel displays, each in a variety of sizes). If you need instructions or recommendations from 3M Touch Systems on how to incorporate a touch screen into your design, refer to the *MicroTouch Resistive Integration Guide* (P/N 19-441). All 3M Touch Systems documentation is available from the corporate website at [www.3Mtouch.com](http://www.3Mtouch.com) or from the Touch Solutions CD (P/N 19-640).

It is critical for you to understand the tail orientation of your touch screen prior to connecting the controller. This will affect how the controller interprets your touch on the screen. Refer to Controller Communications section for additional information.

## Touch Screen Cable Connector

The touch screen cable has a 5-pin single row locking female connector that plugs into the controller. The standard cable pinout is designed for right (3 o'clock) tail exit on the sensor when viewed from the front.

1. Upper Right
2. Upper Left
3. Top Sheet
4. Lower Left
5. Lower Right

## Turning On Your System

Before you turn on your custom system, ensure that all cables are connected properly and that the controller is properly mounted. Be sure to tighten all cable connector screws.

To start up your system

1. Turn on your monitor and computer.
2. Adjust the contrast and brightness to suit your personal preference and working environment.
3. Adjust the horizontal and vertical position controls on the monitor to center the image on the screen.

## Status Light (LED) Diagnostics

3M Touch Systems controllers are highly reliable units; however, there may be occasions when the controller does not perform exactly as you expected. The SC500 controller provides diagnostic feedback with a light emitting diode (LED) on the component side of the board that indicates the status of the touch screen unit. During normal operation, when you touch the sensor the LED becomes bright as long as the controller detects a touch.

A flashing (or blinking) LED during power-up indicates the controller's power-on self-test failed. Refer to Table 2 for a description of each error code.

**Table 2. LED Diagnostic Codes for SC500 Controllers**

Flashes	Self Test Condition	Self Test Bit	Description	What to do...
1	Reserved.	0	Reserved	
2	ROM Error	1	Firmware EPROM checksum verification error	No recovery. Replace the controller.
3	Reserved.	2	Reserved	
4	Block 1 checksum Error	3	Operating parameters invalid (using defaults).	Cycle power off and on. If problem persists, recalibrate
5	Hardware error	4	Power-up touch screen connector voltages that are out of range.	Check connection to the touch screen
6	Reserved.	5	Reserved	
7	Reserved.	6	Reserved	

## What's Next?

Since this is a HID (human interface device) compatible controller, the controller will operate independent of a 3M Touch Systems driver. You must obtain a HID calibration utility from the 3M Touch Systems website for initial calibration.

Additional 3M Touch Systems documentation is available from the corporate website at [www.3Mtouch.com](http://www.3Mtouch.com) or from the Touch Solutions CD (P/N 19-640).



## CHAPTER 2

# SC500 USB Controller Communications

This chapter discusses the fundamentals of communicating with the SC500 USB controller. The firmware commands, which are usually issued by a driver or utility program on the host system, control the operation of the touch screen controller. This chapter lists the recommended firmware commands and describes how to use each of these commands.

## Overview of USB Firmware Communications

Developers may use this information 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.

Most touch screen users do *not* have to use firmware commands to use their touch systems. For example, users can use MicroTouch™ software or equivalent software to calibrate the touch screen or to determine the controller type and firmware version.

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

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To optimize the performance of the SC500 USB touch screen controller and simplify the development of custom drivers, 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 SC500 USB controller is USB Rev 1.1.

The USB command set is implemented by using vendor requests and vendor reports, i.e., vendor specific transactions. The controller issues some reports without prompting the computer. The computer can also 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.

You need to know product ID (0102H) and the vendor ID (0596H) to write your own driver. These values are required for identifying the controller.

The SC500 USB command set utilizes the HID protocol. The HID protocol allows the controller to be used on most computers with operating systems that supports HID. The only required software is a calibration tool used for aligning the touch screen to the display. This calibration tool is available from 3M Touch Systems.

## 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).

## HID and Packed Touch Reports

The controller sends to the computer reports in response to touches on the touch screen. The controller normally uses the HID-compatible report. In addition to the HID-compatible report, there are two versions of packed report available. These versions return up to two points of data per touch, as opposed to the one touch point in the HID-compatible report.

The first byte of each report contains the Report ID as shown in Table 3. You can use the Set Asynchronous Report request to toggle between report types.

**Table 3. Asynchronous Reports**

Name	Report ID	Description
REPORT_ID_HID	1	HID-compatible coordinate data
REPORT_ID_PACKED	2	Packed coordinate data for custom driver
REPORT_ID_UTILITY	7	Packed coordinate data for utilities

Only custom drivers and software can make use of the packed coordinate format. Refer to the Set Asynchronous Report section for details on using packed coordinate data.



## HID-Compatible Coordinate Data – Report 1

This is used to transfer the 10-bit coordinate data to the host. This report, when activated, is sent to the host whenever new data is available/scheduled for transmission. It is an asynchronous report that is activated by default at power up.

For HID class driver compatibility

- Throughput is limited to 125 points/sec.
- The coordinate system is upper-left origin, rather than the MicroTouch™ standard lower-left origin.

**Table 4. Coordinate Data Report**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x01	REPORT_ID_HID
1	bmStatus	1	B <sub>7</sub> , B <sub>6</sub> B <sub>5</sub> , B <sub>4</sub> B <sub>3</sub> , B <sub>2</sub> B <sub>1</sub> , B <sub>0</sub>	0x01 if touching, 0x00 if not
2	bXLsb	1	X <sub>7</sub> , X <sub>6</sub> X <sub>5</sub> , X <sub>4</sub> X <sub>3</sub> , X <sub>2</sub> X <sub>1</sub> , X <sub>0</sub>	X (0-3FF)
3	bXMSb	1	X <sub>f</sub> X <sub>e</sub> X <sub>d</sub> X <sub>c</sub> X <sub>b</sub> X <sub>a</sub> X <sub>9</sub> X <sub>8</sub>	
4	bYLsb	1	Y <sub>7</sub> Y <sub>6</sub> Y <sub>5</sub> Y <sub>4</sub> Y <sub>3</sub> Y <sub>2</sub> Y <sub>1</sub> Y <sub>0</sub>	Y (0-3FF)
5	bYMSb	1	Y <sub>f</sub> Y <sub>e</sub> Y <sub>d</sub> Y <sub>c</sub> Y <sub>b</sub> Y <sub>a</sub> Y <sub>9</sub> Y <sub>8</sub>	
6	Not used	2	0	Not used

## Packed Coordinate Data - Report 2 and Report 7

These are used to transfer the packed coordinate data to a custom driver or utility. These reports, when activated, are sent to the host whenever new data is available for transmission. The packed format contains two coordinate reports each with its own status and Y and Y coordinate data. Because it is packed, the software must rearrange bits to obtain the individual field values. The status contains a bit indicating if the subreport is valid. The second subreport only may be invalid.

**Table 5. Coordinate Data Report**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x02 or 0x07	REPORT_ID_PACKED REPORT_ID_UTILITY
1	bmPackData1	1	X <sub>3</sub> X <sub>2</sub> X <sub>1</sub> X <sub>0</sub> B <sub>3</sub> B <sub>2</sub> B <sub>1</sub> B <sub>0</sub>	X1 bits 3210 and status1 bits BBBB
2	bmPackData2	1	X <sub>b</sub> X <sub>a</sub> X <sub>9</sub> X <sub>8</sub> X <sub>7</sub> X <sub>6</sub> X <sub>5</sub> X <sub>4</sub>	X1 bits BA987654
3	bmPackData3	1	Y <sub>7</sub> Y <sub>6</sub> Y <sub>5</sub> Y <sub>4</sub> Y <sub>3</sub> Y <sub>2</sub> Y <sub>1</sub> Y <sub>0</sub>	Y1 bits 76543210
4	bmPackData4	1	B <sub>3</sub> B <sub>2</sub> B <sub>1</sub> B <sub>0</sub> Y <sub>b</sub> Y <sub>a</sub> Y <sub>9</sub> Y <sub>8</sub>	Status2 bits BBBB and Y1 bits BA98
5	bmPackData5	1	X <sub>7</sub> X <sub>6</sub> X <sub>5</sub> X <sub>4</sub> X <sub>3</sub> X <sub>2</sub> X <sub>1</sub> X <sub>0</sub>	X2 bits 76543210
6	bmPackData6	1	Y <sub>3</sub> Y <sub>2</sub> Y <sub>1</sub> Y <sub>0</sub> X <sub>b</sub> X <sub>a</sub> X <sub>9</sub> X <sub>8</sub>	Y2 bits 3210 and X2 bits BA98
7	bmPackData7	1	Y <sub>b</sub> Y <sub>a</sub> Y <sub>9</sub> Y <sub>8</sub> Y <sub>7</sub> Y <sub>6</sub> Y <sub>5</sub> Y <sub>4</sub>	Y2 bits BA987654

**Table 6. Coordinate Data Report Touch Status Byte**

Bit	Status
0	0 = not touching, 1 = touching
1	0 = data invalid, 1 = data valid
2	Not used
3	Not used

## 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 commands listed below are those that 3M Touch Systems currently use for communications. 3M Touch Systems recommends that you use only these commands for SC500 USB controller communications.

### Sending Commands to the Controller

To send a command, the computer must construct a USB packet for sending to the controller. The general packet format is described in Table 7. Any data appended immediately after this data is referred to as the data stage of request.

If using the Windows you may want to use the Set and Get Feature functions. The buffers are the same except the first two fields. The bmRequest Type and bRequest fields are omitted, thus making wValue the first field. For your convenience, each command is labeled as either a “Set Feature” or “Get Feature” command.

**Table 7. General Request Format**

Offset	Field	Size	Value	Description
0	bmRequestType	1	d0100001	Characteristics of request (dir,type,receipt) D7: Data transfer direction 0 = Host to device 1 = Device to host D6...5 Type 0 = Standard 1 = Class (all commands are standard) 2 = Vendor 3 = Reserved D4...0 Recipient 0 = Device 1 = Interface (all commands are interface) 2 = Endpoint 3 = Other 4...31 = Reserved
1	bRequest	1	0xXX	Specific request (our command number)
2	wValue	2	0x03XX	Used to specify command parameters. 03 = Feature XX = Feature Report ID
4	wIndex	2	0	Must be 0 (zero)
6	wLength	2	0xXXXX	Number of bytes to transfer, multiple of 8. Same as Data Stage Bytes in Table 8.

## HID Class Requests

The following table summarizes the available HID class requests.

**Table 8. Hid Class Requests Summary**

HID Report	Command Name	bmRequest Type	bRequest	Feature Report ID	Report Subtype	Data Stage Bytes
Set Feature	SetAsyncReport	0x21	0x09	0x03	0x05	8
Set Feature	Calibrate	0x21	0x09	0x03	0x04	8
Get Feature	GetStatus	0xA1	0x01	0x06	---	8
Set Feature	Reset	0x21	0x09	0x03	0x07	8
Set Feature	Restore Defaults	0x21	0x09	0x03	0x08	8
Set Feature	Set Controller Number	0x21	0x09	0x05	0x01	8
Get Feature	Get Controller Number	0x21	0x09	0x03	0x02	8

Some possible reasons for a command failure include:

- The command was not formatted correctly.
- The system parameters were not set up to allow command execution.
- The controller does not support the command.

## Controller Initialization

To initialize the SC500 USB controller, 3M Touch Systems recommends that the host system issue a Reset command whenever the host system is powered on and is attempting to establish communication with the controller.

## Set Feature – Set Asynchronous Report

This starts or stops the sending of various asynchronous reports via the interrupt pipe. Once a report is turned on, that report is sent whenever data is available. The firmware defaults to the HID-compatible report after power-up or reset. Only one report may be activated at a time.

**Note:** The TOUCH\_REPORTS\_UTILITY command causes the controller to send Report 7 from the endpoint 0 exclusively. This action is essential in getting a calibration utility to function. The endpoint 1 does not send any reports at this time. The TOUCH\_REPORTS\_RESTORE command causes the controller to send the previously active asynchronous report (REPORT\_ID\_HID or REPORT\_ID\_PACKED) from endpoint 1.

**Table 9. Set Asynchronous Report**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Host to device
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	03 = Feature 03 = Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 10. Data Stage**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x03	Feature Report ID
1	bmReport Subtype	1	0x05	Indicates a SetAsynchReport
2	Not used	2	0	Not used
4	bReport		0x00	0 TOUCH_REPORTS_OFF 1 TOUCH_REPORTS_ON 2 TOUCH_REPORTS_HID 3 TOUCH_REPORTS_PACKED 6 TOUCH_REPORTS_UTILITY 7 TOUCH_REPORTS_RESTORE
5	Not used	3		Not used

## Response

The device stalls endpoint 0 if it cannot process this request.

## 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, upper left and upper right corners. The 2-point calibration defines the active area of the touch screen by mapping two targets displayed on the video image to absolute X and Y coordinates on the touch screen.

**Table 11. Set Feature- Calibration**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Host to device
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	03=Feature 03=Feature ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 12. Data Stage**

Offset	Field	Size	Value	Description
0	Report ID	1	0x21	Host to device
1	Report subtype	1	0x04	Set Report
2	bCalType	1	0xXX	0x01 = Extended Calibration (CX) 0x02 = Corner Calibration (CN)
3	Not used	5	0	Not used

### Response

The device stalls endpoint 0 if the command cannot be processed successfully. The request cannot be processed if an invalid calibration type is given in the wValue field.

During the calibration process, the calibration software polls the Get Status command to monitor the progress of the calibration.

The calibration will fail if the two calibration points do not fall within certain bounds established by the firmware. These bounds require that the two calibration points be in correct quadrants of the sensor.

Calibration software can abort the calibration process with a Reset Request.

During the calibration process, the controller automatically determines screen/display orientation and touch screen connector pinouts. This information is saved in the controller non-volatile memory.

**Table 13. Calibration Response**

Command Status Byte	Description
0	Calibration Failed
1	Controller is waiting for a touch in the lower left corner
2	Controller is waiting for a touch in the upper right corner
3	Calibration completed successfully

This command corrects for touch screen display orientation and touch screen pinout variations. This information will be maintained by the controller. The Calibrate 2 Point command initiates an interactive calibration procedure which defines the active area of the touch screen by mapping locations to an absolute X,Y coordinate system. Touch points generated subsequent to a successful calibration operation are calculated based upon these calibration points. Calibrate 2-point utilizes inset calibration points located 12½ percent inboard from the screen corners (at touch X,Y locations 128,128, 895,895 and 128,895) for accuracy and ease of operation.

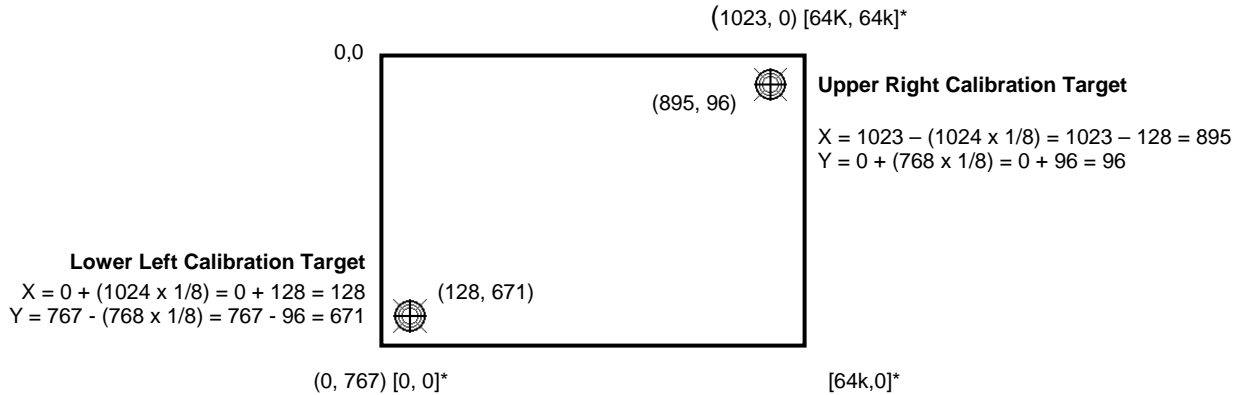
### Determining Target Areas

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

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

The Calibration command then positions 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.

**Figure 2. Calibration Target Locations**



\*The coordinates are in *video* terms, with the origin (0, 0) in the upper left corner of the screen. Examples from the *controller's* perspective, however, place the origin at the lower left corner of the screen (numbers in brackets). The controller outputs 0 to 64K on both axes independent of display screen resolution.

## Get Feature – Get Status

This is a request to send information that indicates the status of the controller. Among the uses for this request are determining whether there were any power on check errors determining whether the last request was completed successfully.

The response to the reset request is sent before the request completes. Polling (via the status request) is then used to check the completion of those requests.

**Table 14. Controller Status**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Host to device
1	bRequest	1	0x01	Get Report
2	wValue	2	0x0306	03 = Feature 06 = Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 15. Data Stage (controller response)**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x06	Feature Report ID
1	bPOCStatus	1	0xXX	Power On Check Status
2	bCmdStatus	1	0xXX	Status of last command
3	bTouchStatus	1	0xXX	Finger Up/Down
4	bAsynchReports	1	0xXX	0x00 = asynchronous output off 0x01 = normal output
5	Not used	3	0	Not used

POC Status – The status of the Power-on Checks. 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 POC status information is also flashed on the controller’s LED.

**Table 16. Power On Status**

Bit Number	LED Flashes	Description
0	1	Not used
1	2	Program code checksum error
2	3	Not used
3	4	Block 1 parameters invalid (using defaults)
4	5	Power-up touch screen connector voltages are out of range
5	6	Not used
6	7	Not used
7	8	Controller linearization data invalid

Cmd Status – The status for the last command request. This field is used to determine whether the last request was processed successfully. It is also used to track the progress of a multi-stage request, such as calibration. The Status Request does not affect the contents of this field, i.e., successful/unsuccessful processing of a previous status request does not cause the command status field to be updated.

**Table 17. Command Status Field Entries**

Response	Description
0	Failure in command processing
1	Command being processed
2	Stage 1 processing complete (for multi-stage commands).
3	Command complete
4	Soft reset occurred
5	Hard reset occurred
6	Stage 2 processing complete (for multi-stage commands)
7	Not used

Touch Status – Status information for the most recent coordinate. Information includes whether the sensor is currently being touched.

**Table 18. Power On Check Bit Fields**

Bit Number	Description
0	1 if the sensor is being touched
1	Always 0



## Set Feature - Reset

This is a request to perform a controller reset.

**Table 19. Reset Request**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Host to device
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	03 = Feature 03 = Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 20. Data Stage**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x03	Host to device
1	bmReport Subtype	1	0x07	Indicates a reset request
2	bResetType	1	0xXX	0x01=Soft reset
3	Not used	5	0	Not used

### Response

The device stalls endpoint 0 if the request cannot be processed successfully. The request cannot be processed if the reset type specified by the bResetType field is not valid.

## Set Feature - Restore Defaults

This is a request to restore the default values in the controller to the factory presets. You must recalibrate after this command since this request will also default the calibration and screen/display orientation.

**Table 21. Restore Defaults Request**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Host to device
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	03 = Feature 03 = Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 22. Data Stage**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x03	Feature Report ID
1	bmReportSubtype	1	0x08	Indicates a restore defaults request
2	Not used	6	0	Not used

### Response

The device stalls endpoint 0 if it cannot process this request.

## Set Feature - Set Controller Number

This command is used to get a controller number for application use. The controller does not use this value. This process is useful for identifying individual controllers in a multiple controller system.

**Table 23. Set Controller Number Request**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Characteristics
1	bRequest	1	0x09	Command number
2	wValue	2	0x0305	Parameter number
4	wIndex	2	0x00	Not used
6	wLength	2	0x48	Length of Parameter Data report

**Table 24. Data Stage 1 (header data)**

Offset	Field	Size	Value	Description
0	bReportID	1	0x05	Feature Report ID
1	bReport Subtype	1	0x01	Indicates a set param report
2	bArea	1	0	Memory Area (always 0=Ctrl EEPROM)
3	Not used	1	0	Not used
4	bSubArea	1	0x05	Block number
5	bIndex	1	0x00	Index into block
6	bDataLength	1	0x04	Number of valid data bytes for this xfer (always padded to 64)
7	Not used	1	0x00	Not used

**Table 25. Data Stage 2 through 9 (8 \* 8 data bytes)**

Offset	Field	Size	Value	Description
0-7	wData	1	0xFF	4 bytes of data (trailing pad bytes are ignored )

### Data Stage

The controller ID is in the first 4 bytes of data stage, the remaining bytes are padding.

## 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.

The host can send a status request, as long as the endpoint is not stalled, to determine if this request was executed properly.

## Get Feature – Get Controller Number

This command is used to get a controller number for application use. The controller does not use this value. This process is useful for identifying individual controllers in a multiple controller system.

Due to HID functionality, retrieving data from the controller involves two steps.

1. Requesting the controller number parameter
2. Retrieving the controller number value

**Table 26. Get Controller Number Parameter Request**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0x21	Device to host
1	bRequest	1	0x09	Set Report
2	wValue	2	0x0303	03 = Feature 03 = Feature Report ID
4	wIndex	2	0	Always 0
6	wLength	2	0	Always 8

**Table 27. Data Stage**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x03	Feature Report ID
1	bmReport Subtype	1	0x02	Indicates a set param index
2	bArea	1	0	Memory Area (always 0=Ctrl EEPROM)
3	Not used	1	0	Not used
4	bSubArea	1	0x05	Block number
5	bIndex	1	0x00	Index into block.
6	bDataLength	1	0x04	Number of valid data bytes for xfer (always padded to 64)
7	Not used	1	0	Not used

**Table 28. Get Controller Number Request**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Device to host
1	bRequest	1	0x01	Set Report
2	wValue	2	0x0305	03 = Feature 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 29. Data Stage 1 (controller response header)**

Offset	Field	Size	Value	Description
0	Report ID	1	0x05	Feature Report ID
1	Not used	1	0	Not used
2	bArea	1	0	Memory Area (always 0=Ctrl EEPROM )
3	Not used	1	0	Not used
4	bSubArea	1	0x05	Block number (0x01,0x02, 0x05, or 0x65 for Copyright string )
5	bIndex	1	0x00	Index into block. Use 0 for controller number
6	bDataLength	1	0x04	Number of valid data bytes for xfer (always padded to 64)
7	Not used	1	0	Not used

**Table 30. Data Stage 2 through 9 (controller response data 8 \* 8 data bytes)**

Offset	Field	Size	Value	Description
0-7	wData	1	0xXX	4 bytes of data (trailing pad bytes are ignored )

### Data Stage

The controller ID is in the first 4 bytes of data stage, the remaining bytes are padding.

### 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.

The host can send a status request, as long as the endpoint is not stalled, to determine if this request was executed properly.

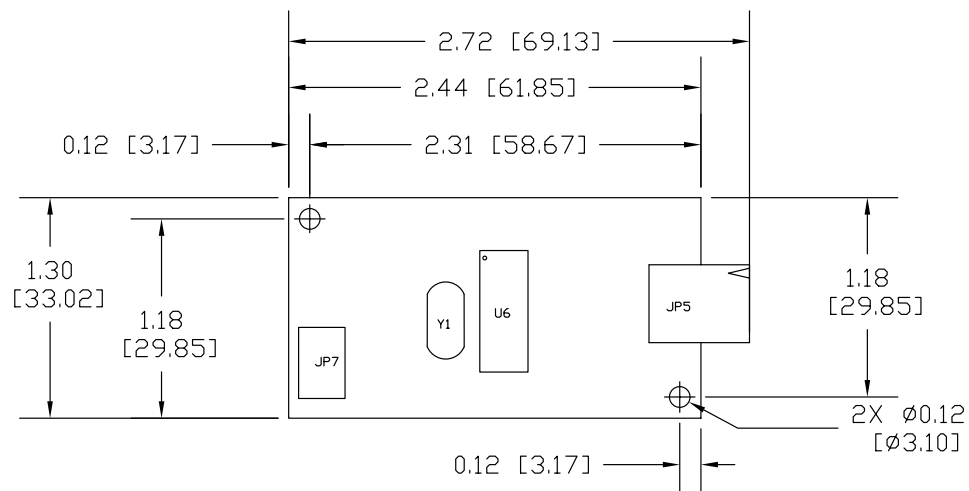
## APPENDIX A

# SC500 USB Controller Specifications

This section provides controller specifications such as power and environmental requirements. The SC500 controller is a compact, small outline USB controller. This controller should be internally mounted in your monitor.

The following figure shows the overall dimensions of the SC500 USB controller and the locations of the mounting holes and connectors.

**Figure 3. SC500 USB Touch Screen Controller Dimensions**



## Technical Specifications

### Physical Dimensions

Uncased 2.85 in. x 1.3 in. x 0.45 in. (72.4 mm x 33.0 mm x 11.4 mm)

### Board Level Functions

Power 5 VDC (15 mA typical, 28 mA touching);  $\pm 5\%$  regulation  
50 mV maximum ripple and noise

### Regulatory Requirements

CE Compliance	Compliant
EMC Emissions – EN 55022:1998	Compliant
EMC Immunity – EN 55024:1998	Compliant
ESD Susceptibility – IEC 61000-4-2	Compliant
EMI Immunity – IEC 61000-4-3	Compliant
Burst Immunity – IEC 1000-4-4	Compliant
FCC Class B / CISPR22 Class B	Compliant
VCCI Class B ITE Emissions (Japan)	Compliant
AS/NZS 3548:1995/CISPR 22 Class B ITE Emissions (Aus.)	Compliant
UL/cUL	Compliant

### Ambient Operating and Storage Environmental Conditions

**Note:** All humidity is non-condensing

Operating Temperature Range	0°C to +65°C
Operating Humidity Range (0 to 95% RH up to +36°C; above 36°C refer to Figure 4 below)	
Storage Temperature Range	-20°C to +75°C
Storage Humidity Range (0 to 80% RH up to +36°C; above 36°C refer to Figure 4 below)	

### Performance and Reliability

Minimum Touch Duration	14 $\pm$ 1 ms
Touch Resolution (Maximum number of addressable coordinates generated by the controller)	1024 x 1024
ESD Susceptibility <sup>1</sup>	
$\pm 8$ KV Contact Discharge – Class 2 per section 9 of IEC 61000-4-2 1 false touch allowed	Compliant
$\pm 20$ KV Air Discharge – Class 1 per section 9 of IEC 61000-4-2	Compliant
Normal Operation – No false touches	
MTBF (by MIL Std. 217F Calculation)	>400,000 Hours

<sup>1</sup> ESD discharges to a 3M Touch Systems touch screen connected to the controller

**3M Touch Systems Parameters**

Accuracy vs. Dynamic Temperature Change

Maintains 1% Accuracy

(tested at 0° C to 65° C with a 0.5° C/minute temperature ramp)

Touch Screen Compatibility

3M Touch Systems Resistive Touch

Screens

Communications Protocol

USB Rev 1.1

**Figure 4. Storage and Operating Temperature and Humidity Conditions**

