

DEPENDABLE • INNOVATIVE • GLOBAL • EXPERIENCE DEPENDABLE • INNOVATIVE • GLOBAL • EXPERIENCE
touch SOLUTIONS

SC4 Touch Screen Controller

User's Guide





MicroTouch™ SC4 Touch Screen Controller
User's Guide

Copyright

This manual is © 3M 2003. All rights reserved.

Reproduction of the contents of this copyrighted manual in whole or in part, by any means, electronic or mechanical, for any purpose, without written permission of 3M Touch Systems, a subsidiary of 3M, is prohibited.

Notice

Given the variety of factors that can affect the use and performance of a 3M Touch Systems Product (the "Product"), including that solid state equipment has operation characteristics different from electromechanical equipment, some of which factors are uniquely within User's knowledge and control, it is essential that User evaluate the 3M Touch Systems Product and software to determine whether it is suitable for User's particular purpose and suitable for User's method of application. 3M Touch Systems' statements, engineering/technical information, and recommendations are provided for User's convenience, but their accuracy or completeness is not warranted. 3M Touch Systems products and software are not specifically designed for use in medical devices as defined by United States federal law. 3M Touch Systems products and software should not be used in such applications without 3M Touch Systems' express written consent. User should contact its sales representative if User's opportunity involves a medical device application.

Important Notice to Purchaser

Specifications are subject to change without notice. These 3M Touch Systems' Products and software are warranted to meet their published specifications from the date of shipment and for the period stated in the specification. **3M Touch Systems makes no additional warranties, express or implied, including but not limited to any implied warranties of merchantability or fitness for a particular purpose.**

User is responsible for determining whether the 3M Touch Systems Products and software are fit for User's particular purpose and suitable for its method of production, including intellectual property liability for User's application. If the Product, software or software media is proven not to have met 3M Touch Systems' warranty, then 3M Touch Systems' sole obligation and User's and Purchaser's **exclusive remedy**, will be, at 3M Touch Systems' option, to repair or replace that Product quantity or software media or to refund its purchase price. 3M Touch Systems has no obligation under 3M Touch Systems' warranty for any Product, software or software media that has been modified or damaged through misuse, accident, neglect, or subsequent manufacturing operations or assemblies by anyone other than 3M Touch Systems. **3M Touch Systems shall not be liable in any action against it in any way related to the Products or software for any loss or damages, whether non-specified direct, indirect, special, incidental or consequential (including downtime, loss of profits or goodwill) regardless of the legal theory asserted.**

Edition

November 2003. Document Number: 16710 (Rev. 2.0). Supersedes Rev 1.2.

Trademarks

MicroTouch is a trademark of 3M.

Microsoft, Windows, MS-DOS, Windows NT, Windows XP, Windows 2000, and/or other Microsoft products referenced herein are either trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries.

IBM is a registered trademark of International Business Machines Corporation in the United States, other countries, or both. FCI is a trademark of FCI. AMP is a trademark of AMP Incorporated. Molex is a trademark of Molex Incorporated.

Velcro is a trademark of Velcro Industries, B.V.

Important Safety Information

This document assumes you are familiar with 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.

Intended use

The SC4 touch screen controller was designed to enable touch in conjunction with other 3M Touch Systems products. The controller is intended *only* for internal use. The controller is intended for internal use only and is not designed for use in hazardous locations.

Safety notices

Read and understand all safety information before using the SC4 touch screen terminal. Follow all instructions marked on the product and described in this document. Pay close attention to the installation warnings and cautions that appear below.



WARNING

To reduce the risks associated with fire and explosion which, if not avoided, could result in death or serious injury and/or property damage:

- Do not install or use this product in a hazardous location.
- Do not install or use this product in any outdoor environment unless NEMA standards are followed.



CAUTION

To reduce the risks associated with 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 ions.

Symbol

The following safety symbol appears on your 3M Touch Systems product and/or its packaging materials:

Symbol	Meaning
	Caution: Item is susceptible to electrostatic discharge (ESD) damage if proper precautions are not taken.



Contents

Preface	About this manual	13
	Using this manual	13
	Who should use this manual?	13
	Terms	14
	Abbreviations and acronyms	14
	3M Touch Systems support services	15
	3M Touch Systems worldwide offices	16
Chapter 1	Introducing the SC4 controller	17
	Features	17
	Choices	18
	Software	18
Chapter 2	Connecting an SC4 controller	21
	System requirements	21
	Components	21
	Connecting components	22
	Powering up the equipment	25
	Installing the software	25
Chapter 3	Installing and using software for Windows NT, Windows 9X and later operating systems	27
	About this chapter	27
	Installing the software	27
	Calibrating the touch screen	28
	Changing touch behavior	30
	More information on software	30
Chapter 4	Installing and using software for DOS	31
	About the software	31
	Installing the software	31
	Using the touch screen utilities	32
Chapter 5	Specifications	35
	Controller specifications	35
	Report packet structure	36
Chapter 6	Hardware integration	37
	SC4 dimensions	37
	Mounting and grounding	38
	ESD protection	38
	Connectors and jumpers	38

	Connector description.....	39
	Power supply	39
	Communications.....	41
	Touch input sensors.....	42
	Status light	43
	Electrical noise	43
Appendix A	Resistive touch screens	45
	Analog resistive touch screen	45
	Functional description	45
	Four-wire touch screen decoding	46
	Eight-wire touch screen decoding	47
	Touch position to video decoding	48
Appendix B	Controller/host communication	51
	Report protocol (controller-to-host)	51
	Report descriptions	52
	Command protocol (host-to-controller).....	54
	Command summary.....	55
	Command description.....	56

List of figures

Figure 1: SC4 touch screen controller (circuit board version)	18
Figure 2: Connected components of the SC4 controller touch screen system ..	22
Figure 3: SC4 Controller connectors and jumpers	23
Figure 4: RS-232 jumper in factory default setting	24
Figure 5: Jumper 2 position for a TTL connection.....	24
Figure 6: Jumper 2 position for a USB connection	24
Figure 7: Selecting COM port for Windows driver.....	28
Figure 8: Touch screen utility with Calibration tab selected.....	29
Figure 9: Exploded view of part of Figure 8 showing calibration points.....	29
Figure 10: SC4 Controller dimensions (actual size).....	37
Figure 11: SC4 Controller connectors and jumpers	38
Figure 12: Power source jumper setting	40
Figure 13: Four-wire resistive touch screen silver ink layout	46
Figure 14: Eight-wire resistive touch screen silver ink layout	47

List of tables

Table A: Topics covered in this manual	13
Table B: Terms used in this manual	14
Table C: Abbreviations and acronyms	14
Table D: Telephone numbers for 3M Touch Systems worldwide	16
Table E: Summary of tabs in dialog box for changing touch behavior	30
Table F: Default COM settings	33
Table G: SC4 controller specifications	35
Table H: SC4 controller power requirements	35
Table I: SC4 controller report packet structure	36
Table J: Connectors on the SC4 controller board	39
Table K: Power connector H3 pin-out	40
Table L: Connector headers for supported communications interfaces	41
Table M: Communication connector H5 (UART) pin-out	41
Table N: TTL signal levels	41
Table O: Communication connector H2 (USB) pin-out	41
Table P: Four-wire touch screen connector H6 pin-out	42
Table Q: Eight-wire touch screen connector H4 pin-out	42
Table R: Determining controller rate by number of LED flashes	43
Table S: Four-wire touch screen scanning	47
Table T: Eight-wire touch screen scanning	47
Table U: SC4 Controller report packet structures	51
Table V: SC4 Controller commands and responses	55

PREFACE

About this manual

Using this manual

This manual describes:

- Features of the SC4 touch screen controller
- How to connect a controller for evaluation
- How to install the software drivers and utilities you need to use the touch screen with the operating system installed on your computer

For a list of other information in this manual, refer to Table A.

Table A: Topics covered in this manual

To do this	See
Learn about the basic features of the controller	Chapter 1
Install a controller for evaluation	Chapter 2
Install and use the touch screen software for Windows™ NT, 9X and later operating systems (including Windows 2000, Windows XP).	Chapter 3
Install and use the touch screen software for MS-DOS™	Chapter 4
Review the controller's specifications	Chapter 5
Review the controller's dimensions, connectors, and mounting data	Chapter 6
Learn about the analog resistive touch screen and its options	Appendix A
Learn how the controller communicates with the host	Appendix B

Who should use this manual?

This manual is for:

- Personnel using the SC4 touch screen controller and software for the first time
- Engineers and technicians who need to integrate the controller into other products and customize its operations

Terms

Here are definitions of some special terms used in this manual:

Table B: Terms used in this manual

This Term	Refers to:
Analog resistive	A flat touch screen technology that uses a thin flexible polyester surface layer over a glass base layer. When you touch the screen and press the layers together, the controller determines the touch location. For more information, see Appendix A.
Bezel	A rim that surrounds the touch screen display and its faceplate.
Controller	An electronic device that allows a touch screen to communicate touch movements to a computer.
Display area	The part of the touch screen that is positioned over the display of the computer. Touches in this area emulate the movements and actions of a mouse.
Sensor	Another term for a touch screen. A touch screen “senses” the exact position of a user’s touch.
Touch screen	A transparent panel mounted in front of a computer’s display that allows the user to control the computer by touching the panel.

Abbreviations and acronyms

Table C shows the meanings of the abbreviations and acronyms most frequently used in this manual.

Table C: Abbreviations and acronyms

AC	Alternating current
ADC	Analog to digital convertor
ASCII	American Standard Code for Information Interchange
COM port	Communications port
EEPROM	Electrically erasable programmable read-only memory
EL	Electroluminescent
EMI	Electromagnetic interference
ESD	Electrostatic discharge
I/O	Input/output
IRQ	Interrupt request channel
ITO	Indium tin oxide
LCD	Liquid crystal display
OEM	Original equipment manufacturer
PC	Personal computer
PS/2	A port design first introduced in IBM™ PS/2 computers
RFI	Radio frequency interference
RS-232	Industry standard for serial communications connections with transmission distances up to 50 feet

Table C: Abbreviations and acronyms

SC4	MicroTouch™ Serial Controller, version 4
TTL	Transistor-transistor logic
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VGA	Video Graphics Array

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 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.

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

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

Technical Support is available Monday through Friday 8:00 a.m. to 8:00 p.m. US Eastern Standard Time, 9:00 a.m. to 5:00 p.m. throughout Europe. There is limited service on Saturdays and Sundays.

You can contact 3M Touch Systems Technical Support (US only — Eastern Standard Time) by calling the hot line 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

All offices can be reached through the website: www.3Mtouch.com. Telephone numbers for offices of 3M Touch Systems appear in Table D.

Table D: Telephone numbers for 3M Touch Systems worldwide

Country	Telephone
United States	978-659-9000
Australia	61-3-9582-4799
Canada	604-521-3962
France	33-(1)-30-31-68-32
Germany	49-(0)-2131-14-4003
Hong Kong/China	852-2333-6138
Italy	39-(0)-39-230-2230
Japan	81-(4)-4811-1133
Korea	822-552-3198
Singapore	65-6450-8851
Spain	34-934-15-6285
Taiwan	886-2-2704-9011

CHAPTER 1

Introducing the SC4 controller

The MicroTouch™ SC4 touch screen controller provides outstanding touch performance and ease of use. It converts touch input from an analog resistive touch screen into a digital data stream and 3M Touch Systems software converts that data to emulate input from a Microsoft™ mouse.

The controller supports extended communication flexibility and ease of integration and its superior touch decoding actually extends the functional life of the touch screen.

Features

The features of the SC4 controller include:

- **Outstanding touch performance**
 - Increased sensitivity to light touches
 - Enhanced stability of touch position
 - Exceptional accuracy of touch position
 - 10-bit (1024 point) resolution
 - Superior touch decoding that extends the functional life of the touch screen
 - Supports touch coordinate report rates for all applications, from signature capture to button pressing (10–180 reports per second)
- **Increased communications support** (RS-232, UART, and USB)
- Improved robustness of the PC board
 - Resistant to electrical noise, superior in high RFI/EMI environments
 - ESD protection on all interfaces
- **Easier system integration**
 - Practical mounting holes for easy integration
 - Locking connectors for secure fastening
 - In-line flat cable connectors for cost-effective cable designs
- **Memory for the application developer** (62-byte non-volatile memory space available for special applications)

Choices

You can choose the SC4 controller that best suits your application. The controller is available as:

- Evaluation kit (includes controller, power supply, cables, and software)
- Circuit board only (for serial or USB communication)
- Microcontroller chip

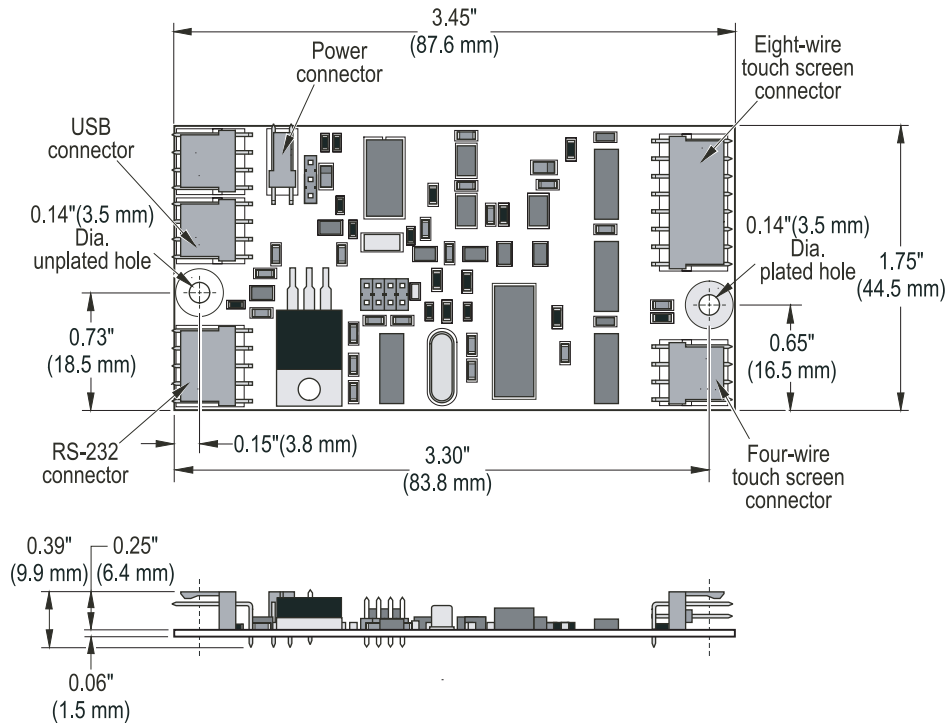


Figure 1: SC4 touch screen controller (circuit board version)

Software

There is software for the SC4 controller that includes drivers for the touch screen system and utility functions.

The software allows the touch screen to emulate much of the functionality of a standard mouse device. A standard mouse reports relative movement. The touch screen mouse emulation is based on absolute movement. Mouse motion is translated into a count of discrete movement steps for both the horizontal and vertical axis. A touch will initiate both a cursor absolute movement and a mouse-click event.

The software is used to calibrate the touch screen and may be used to set options.

Calibration

After you install the software, you can use it to calibrate the touch screen. To calibrate with a host computer running with Windows™ NT, Windows 9X, or later operating systems (including Windows XP/2000), see instructions in Chapter 3. To calibrate with a host computer running in MS-DOS 6X, see instructions in Chapter 4.

Configurable options

The SC4 controller supports a number of configuration options that can be set by software. Configurable options include sensitivity to touch input, touch mode, report rate maximum, baud rate, and sleep mode. For information on changing configurable options, see Appendix B.

CHAPTER 2

Connecting an SC4 controller

System requirements

To use a touch screen with an SC4 controller, you need an IBM™-compatible host computer with:

- CD drive
- Communications port (RS-232 or USB)
- Microsoft™ operating system: Windows™ NT, Windows 9X or later (including Windows XP/2000), or MS-DOS 6X

Components

Circuit board only

If your SC4 controller is a circuit board only:

- For instructions on **how to install and use touch screen software** with the SC4 controller, see Chapter 3 (Windows NT and Windows 9X or later operating systems, including Windows XP/2000) or Chapter 4 (MS-DOS 6X).
- For information on **making cables, setting jumpers, mounting, and connecting** an SC4 controller see Chapter 6.

Evaluation kit

If your SC4 controller is part of an evaluation kit, the following components accompany the controller:

- 9 VDC power supply
- Set of cables to connect the controller to the touch screen, to the power supply, and to the appropriate port on the host computer
- Touch screen software drivers and utilities for MS-DOS 6X, Windows™ NT, and Windows 9X or later operating systems.

Supplied separately

Whether you are using an SC4 controller that came as a circuit board only or as part of an evaluation kit, analog resistive touch screens (with a four-wire tail or eight-wire tail) are available separately from 3M Touch Systems.

For information about the types of resistive touch screens available from 3M Touch Systems, see www.3Mtouch.com or contact your local sales representative.

Connecting components

To connect your touch screen system components, refer to Figure 2 and follow the instructions in this chapter.

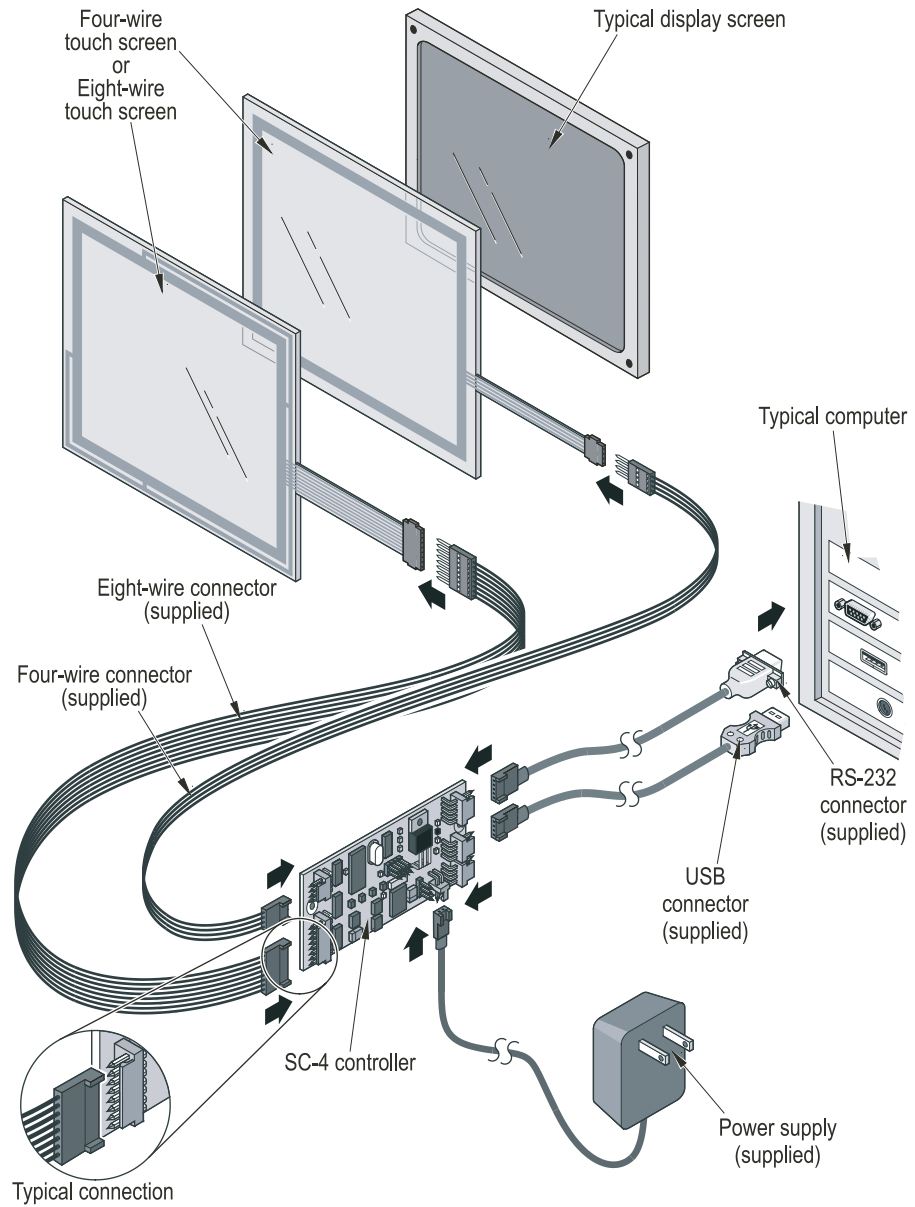


Figure 2: Connected components of the SC4 controller touch screen system

Mounting the touch screen

1. Power down the computer and the display.
2. Mount the touch screen to the display using Velcro™, tape, or a 3M-installed adhesive gasket.

If you need details about how to integrate the touch screen and about touch screen mounting options, refer to the [MicroTouch Resistive Design and Integration Guide](#). It is available at www.3Mtouch.com.

Connecting the touch screen to SC4 controller

Connect the touch screen to the controller using one of the controller interconnect cables (four-wire or eight-wire):

- Connect the male end of the cable to the touch screen tail. The orientation of the cable connection at the touch screen or at the controller is not important.
- Connect the female end of the cable to the controller.

Choosing a communications interface

The controller has interfaces for serial (RS-232 and UART) and USB communications. To select the communication interface, change the position of jumper J2 (Figure 3).

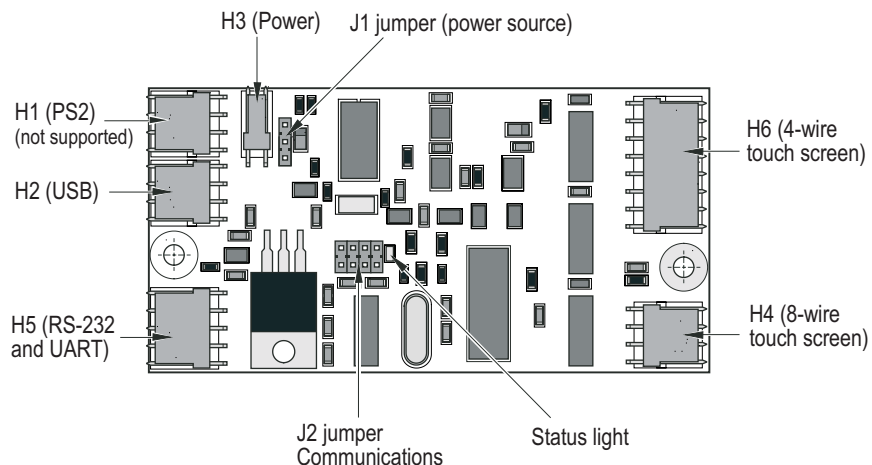


Figure 3: SC4 Controller connectors and jumpers

Serial RS-232

For an RS-232 connection:

1. Connect the RS-232 cable to header H5 on the controller (Figure 3).
2. Connect the RS-232 cable's DB-9 female connector to a nine pin serial COM port on the back of the computer (Figure 2).

If the computer's serial COM port is a DB-25 type, use a 9-to-25 pin serial port adapter.

3. Check to make sure that jumper J2 is in the correct position (Figure 4).

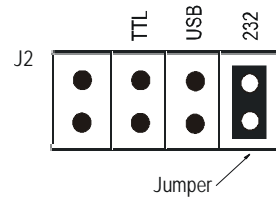


Figure 4: RS-232 jumper in factory default setting

Serial UART

For a TTL connection to the host computer's UART:

1. Make an appropriate cable to connect the controller to the host computer's UART chip (see Chapter 6, "Hardware integration").
2. Connect the custom cable to header H5 (Figure 3) on the controller and to the host computer's UART.
3. Install jumper J2 in the position for a TTL connection, as shown in Figure 5.

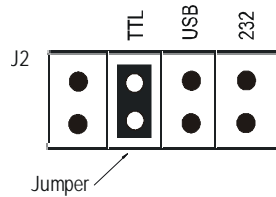


Figure 5: Jumper 2 position for a TTL connection

USB

To use the controller with a USB port follow these steps (Note: Windows™ 95 and Windows NT do not support USB):

For a USB connection:

1. Connect the USB cable to header H2 on the controller (Figure 3).
2. Connect the USB cable to the USB port on the computer (Figure 2).
3. Install jumper J2 in the correct position for a USB connection (Figure 6).

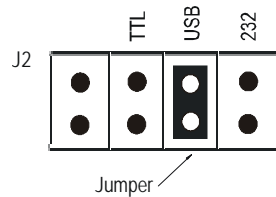


Figure 6: Jumper 2 position for a USB connection

Powering up the equipment

1. Connect the 9 VDC power connector to header H3 on the controller (Figure 3).
2. Plug the 9 VDC power supply into a branch circuit.
3. Turn power on to the computer and to the display.
4. For an alternate power method, see “Changing the power source setting” on page 40.

Installing the software

You are now ready to install the software drivers that will let you use the touch screen. For instructions, refer to the chapter that applies to the operating system of your computer:

- For Windows™ NT and Windows 9X and later operating systems (including Windows XP/2000), refer to Chapter 3.
- For MS-DOS 6X, refer to Chapter 4.

CHAPTER 3

Installing and using software for Windows NT, Windows 9X and later operating systems

About this chapter

This chapter explains how to install the touch screen software for Windows™ NT, Windows 9X or later operating systems (including Windows XP/2000). This chapter also introduces the Driver Control Utility which allows you to calibrate the touch screen and customize the features of the driver.

Installing the software

Follow the instructions below to install the touch screen software.

1. Insert the CD that shipped with the SC4 controller into the CD drive of your computer.

or

Download the SC4 driver software from www.3Mtouch.com. (**Note:** The SC4 driver software is referred to on the website as the “UPD Driver”.)

Before you can download the software, you will need to complete a brief online registration form.

2. Follow the on-screen instructions.

Note: When you are asked to choose a COM port (Figure 7), specify the COM port that you want the controller to use. It is recommended that you *not* select the “Auto Detect” checkbox.



Figure 7: Selecting COM port for Windows driver (Do not select Auto Detect)

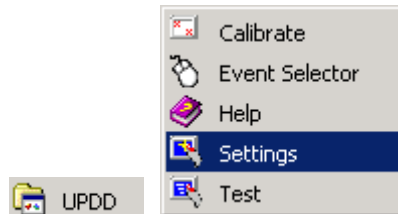
3. When installation is complete, remove the disk from the drive and restart the computer.

Calibrating the touch screen

Make sure that the software is set to perform four-point calibration and then perform calibration. Follow these steps:

Checking that four-point calibration is set

1. Select the software (referred to on the desktop as “UPDD”) and then open “Settings”.



A dialog box appears showing information about the controller and its software.

2. Select the Calibration tab at the top of the dialog box (Figure 8).
Do not select the Calibrate button at the bottom of the dialog box; that comes later).

The Calibration section of the dialog box appears.

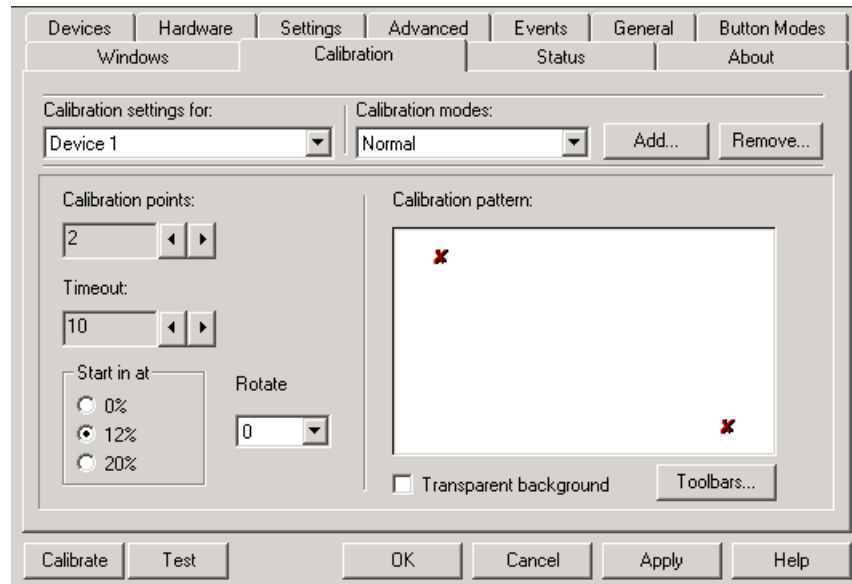


Figure 8: Touch screen utility with Calibration tab selected

3. Make sure that the number of calibration points is set at 4. If the number of calibration points showing in the dialog box is not set at 4 (the default is 2), use the arrow buttons to change to four-point calibration (Figure 9).

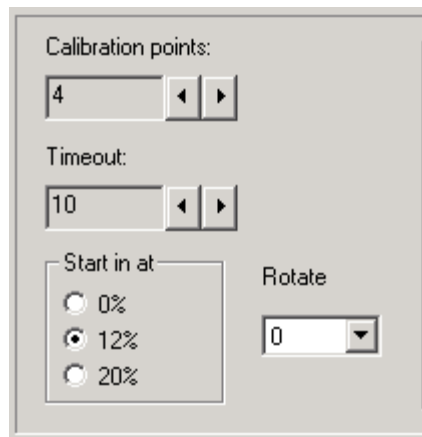


Figure 9: Exploded view of part of Figure 8 showing calibration points

4. Select Apply.

Calibrating

1. Select the Calibrate button (located in the lower left corner of the dialog box).
2. Follow the screen prompts to carry out four-point calibration.

Changing touch behavior

Touch behavior may be customized by making changes to other settings in the various tabs of dialog box shown above. The possible changes include:

Table E: Summary of tabs in dialog box for changing touch behavior

To do this task...	Select this tab (Dialog box is illustrated in Figure 8)
Set or change COM ports	Hardware
Change touch characteristics (e.g., touch liftoff time, double-click settings)	Settings, Windows
Maintenance (e.g., add or remove program's icons in the system tray, change calibration)	General
Change sound settings, including pitch, duration, and sample rate	Advanced
Find information about the program (e.g., release number)	About
Edit touch button behaviors	Button modes

More information on software

For more details on customizing the touch screen driver software, refer to the driver's Help file which has detailed information on many topics.

If you do not find the information you are seeking in Help, contact 3M Touch Systems technical support. For contact information, see "3M Touch Systems support services" on page 15.

CHAPTER 4

Installing and using software for DOS

About the software

The touch screen software includes an MS-DOS driver for the touch screen controller.

Once you have installed the DOS driver, use the touch screen utilities to calibrate the touch screen (page 32). The touch screen will not be operational until you calibrate it.

The touch screen utilities also allow you to change how the touch screen responds to inputs (page 32) and how to change COM port settings (page 32).

Installing the software

You can install the DOS driver software from the website or from the CD that shipped with your SC4 controller.

Installing from the website

To download the software, follow these steps:

1. Go to the Drivers page of www.3Mtouch.com, select the link to Archived Touch Screen Drivers. On the Archived Touch Screen Drivers page, find the list of drivers for the SC4 controller and from that list select the link to the DOS driver.
2. Download the zip file, unzip the file to the computer's hard drive, and then run the install program.
3. When installation is complete, restart the computer.

Installing from CD

Follow the instructions below to install the touch screen software from the CD that shipped with your SC4 controller.

1. Insert the CD that shipped with the SC4 controller into the CD drive of your computer.
2. At the DOS prompt, type:
d:
where d is the drive containing the CD
3. At the d:\ prompt, type:

```
cd archived\software\sc4\dos
```

4. At the `d:\archived\software\sc4\dos>` prompt, type:
`install`
5. Press Enter and then follow the on-screen instructions.
6. When installation is complete, restart the computer.

Using the touch screen utilities

Calibrating the touch screen

Calibration orients and aligns the touch screen with the video display. You must calibrate the touch screen with the Ecal program before you can use the touch screen. Be sure you are directly in front of the unit when you calibrate the touch screen.

The Ecal program will calibrate a standard 16 color 640×480 video mode by default. If you use a non-standard video mode, type `ecal /?` and press Enter to see a list of command line options for other video modes. Using Ecal you can calibrate all video modes or selected ones.

1. At the MS-DOS prompt, type `ecal`. Then press ENTER.
2. Follow the on-screen instructions to complete the calibration.

Tip: Instead of a finger, use a blunt instrument such as a ball-point pen cap to calibrate the touch screen accurately. Do not use anything sharp that will damage the screen.

Changing touch behavior

The Emouse program lets you change how the touch screen responds to touch inputs. To view the options, at the MS-DOS prompt, type `emouse /?`, and then press Enter.

To change the options:

1. Open the `autoexec.bat` file.
2. Locate the `emouse` line and edit as appropriate.
3. Save the file.
4. Restart the computer.

Changing COM port settings

The driver software supports serial RS-232 communication between the controller and the host. During installation, a line is added to the `autoexec.bat` file. For example:

```
\TOUCH\DOS\EMOUSE /COM1
```


The default COM settings are shown in Table F:

Table F: Default COM settings

COM settings	IRQ settings	Base settings
COM 1	4	3F8
COM 2	3	2F8
COM 3	4	3E8
COM 4	3	2E8

To change the settings you selected during installation, manually enter the IRQ and base settings for the touch screen driver in the autoexec.bat file to match the COM port you will use. For example, to change the IRQ and base settings, replace /COM1 with:

```
/IRQ = XX /BASE = YYY
```

where XX is the interrupt request number for the COM port and YYY is its I/O base address in hexadecimal.

After changing and saving the file, restart the computer.

CHAPTER 5

Specifications

Controller specifications

Table G: SC4 controller specifications

Sensor support	4-wire and 8-wire analog resistive touch screen sensors
Positional resolution	10-bit (1024 points) in each axis
Communication interfaces	<ul style="list-style-type: none"> ▪ Serial RS-232, 2400, 9600, or 19200 baud ▪ TTL (direct to UART), 2400, 9600, or 19200 baud ▪ USB (low speed, externally powered)
Report rates	<p>Discrete report rates of 180, 135, 90, 45, or 10 touch coordinate reports per second</p> <p>Actual report rates may be lower than the set maximum due to system parameters (i.e. an RS-232 baud rate of 2400 will not support more than 45 reports per second).</p>
Report packet	5-byte (see Table I on page 36)
Operating temperature	0°C to +70°C (+32°F to +158°F)
Storage temperature	-30°C to +85°C (-22°F to +185°F)
Operating systems	Windows™ NT, Windows 9X and later operating systems (including Windows 2000, Windows XP), and MS-DOS 6X.

Table H: SC4 controller power requirements

Voltage	7.5–12.0 VDC
Operating voltage	5 VDC ±5%
Non-active current (sleep)	30 mA _{AVG} typical
Active current (no sensor load)	35 mA _{AVG} typical
Active current (typical sensor load)	55–65 mA _{AVG} typical

Report packet structure

Table I: SC4 controller report packet structure

Description	Byte/bit	7	6	5	4	3	2	1	0
Header code	1	H ₇	H ₆	H ₅	H ₄	H ₃	H ₂	H ₁	H ₀
X-high	2	0	0	0	0	0	0	X ₉	X ₈
X-low	3	X ₇	X ₆	X ₅	X ₄	X ₃	X ₂	X ₁	X ₀
Y-high	4	0	0	0	0	0	0	Y ₉	Y ₈
Y-low	5	Y ₇	Y ₆	Y ₅	Y ₄	Y ₃	Y ₂	Y ₁	Y ₀

Where:

H ₇ :H ₀	=	header code: pen down = 0x40, pen up = 0x41
X ₉	=	most significant bit of x-axis position
X ₀	=	least significant bit of x-axis position
Y ₉	=	most significant bit of y-axis position
Y ₀	=	least significant bit of y-axis position

CHAPTER 6

Hardware integration

SC4 dimensions

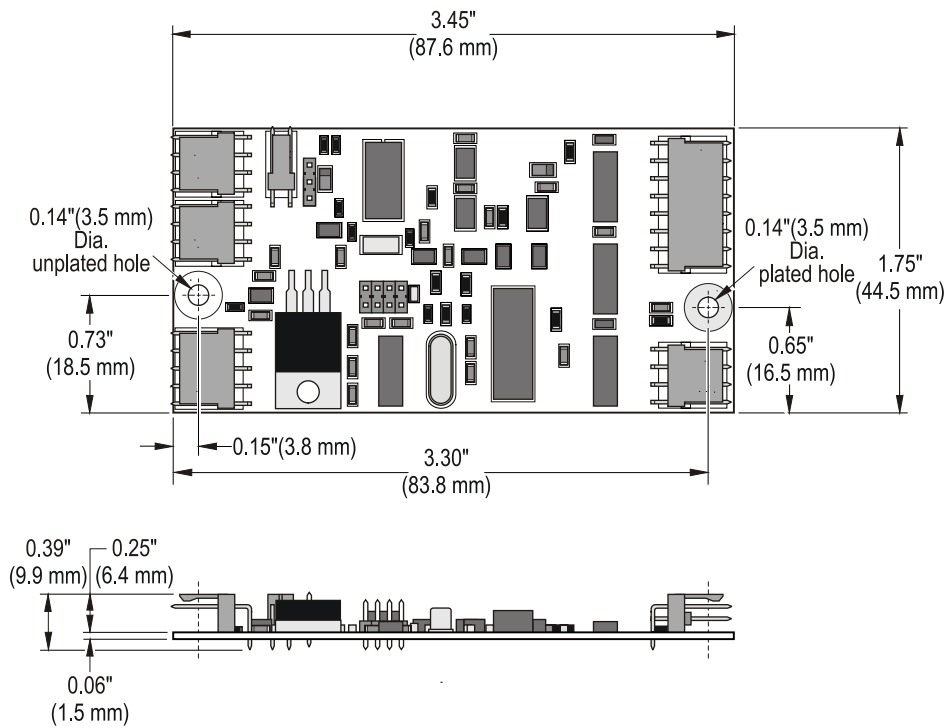


Figure 10: SC4 Controller dimensions (actual size)

Mounting and grounding

The controller has two mounting holes for 4-40 and M3 hardware. One hole is plated for a chassis ground connection (Figure 10). To ground the board, provide a grounded lug in the chassis at the location of the plated mounting hole.



To prevent damage from electrostatic discharge (ESD), wear a grounding wrist strap when working with electronic components. Follow the instructions that come with the wrist strap. If a grounding wrist strap is not available, touch a grounded metal object to discharge any static from your body.

ESD protection

The controller has on-board electrostatic discharge (ESD) protection for all sensors and communications interfaces.

Connectors and jumpers

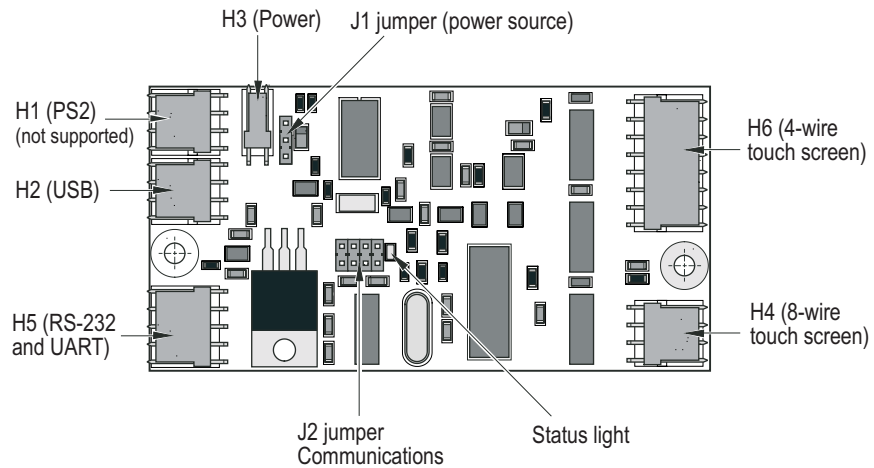


Figure 11: SC4 Controller connectors and jumpers

Connector description

Table J shows the connectors provided on the SC4 controller board:

Table J: Connectors on the SC4 controller board

Connector name	Connector function	On-board connector	Mating connector*
H1	PS/2 (Not supported)	1 x 4 locking M pin header Molex model 7478 p/n 22-05-3041	Molex p/n 22-01-3047 housing Molex p/n 08-55-0101 crimp pin
H2	USB	1 x 4 locking M pin header Molex model 7478 p/n 22-05-3041	Molex p/n 22-01-3047 housing Molex p/n 08-55-0101 crimp pin
H3	Power supply	1 x 2 locking M pin header Molex model 7478 p/n 22-05-3021	Molex p/n 22-01-3027 housing Molex p/n 08-55-0101 crimp pin
H4	8-wire touch screen	1 x 8 locking M pin header Molex model 7478 p/n 22-05-3081	Molex p/n 22-01-3087 housing Molex p/n 08-55-0101 crimp pin
H5	RS232/TTL	1 x 5 locking M pin header Molex model 7478 p/n 22-05-3051	Molex p/n 22-01-3057 housing Molex p/n 08-55-0101 crimp pin
H6	4-wire touch screen	1 x 4 locking M pin header Molex model 7478 p/n 22-05-3041	Molex p/n 22-01-3047 housing Molex p/n 08-55-0101 crimp pin

* These are the friction locking connectors that mate with the on-board connectors by Molex. Other connector brands (AMP, FCI, etc.) can also be used.

Power supply

The controller's on-board electronics operate on regulated 5 VDC.

The controller can be powered by unregulated power brought in at the power connector or by regulated 5 VDC brought in at the PS/2 connector. The controller can use the PS/2 connector's power supply pins even if another communication protocol (RS-232, USB, or TTL) is used and even though PS/2 communication is not supported by 3M Touch Systems.

External unregulated power supply (default)

If an external power supply is used, it must provide 7.5 VDC to 12 VDC. The current requirement is sensor dependent but is typically 55–65 mA_{AVG}. The controller regulates this external voltage down to 5 VDC for its operation.

Connect the power supply to Header H3. The pin functions are shown in Table K:

Table K: Power connector H3 pin-out

Pin #	Pin name	Pin function
1	GND	Ground or common voltage bus
2	VIN+	Unregulated (+7.5 V to 12 V) DC input voltage

The factory default setting is for an external 7.5–12 VDC power supply.

Regulated power from the PS/2 connector

The controller can also receive its 5 VDC operating power from the PS/2 connector, using pins 1 and 4.

Changing the power source setting

To change the power source setting on the controller, install jumper J1 as shown below:

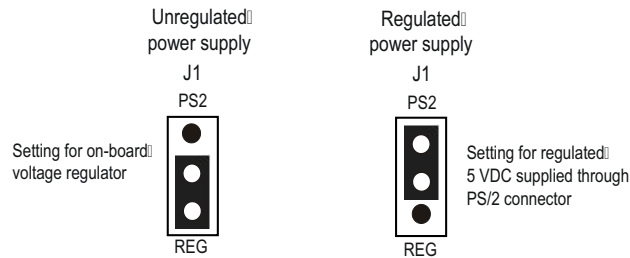


Figure 12: Power source jumper setting

Communications

The controller supports four communication interfaces through three connectors (PS/2 communication is *not* supported):

Table L: Connector headers for supported communications interfaces

Interface	Connector header (pins)
RS-232 (default)	H5 (pins 1 - 3)
USB	H2 (pins 1 - 4)
UART/TTL	H5 (pins 3 - 5)

Connect the host UART to pins 3–5 of Header H5 as shown in Table M.

Table M: Communication connector H5 (UART) pin-out

Pin #	Pin name	Pin function
1	232-RX	Receive RS-232 levels
2	232-TX	Transmit RS-232 levels
3	GND	Signal Ground
4	TTL-TX	Transmit TTL levels (UART-Sin)
5	TTL-RX	Receive TTL levels (UART-Sout)

Signal levels for TTL are shown in Table N.

Table N: TTL signal levels

Controller Receive Lo:	$V_{SS} \leq V_{IL} \leq 0.2 V_{DD}$	or	$0 \text{ v} \leq V_{IL} \leq 1 \text{ v}$	@ $V_{DD} = 5 \text{ v}$
Controller Receive Hi:	$0.8 V_{DD} \leq V_{IH} \leq V_{DD}$	or	$4 \text{ v} \leq V_{IH} \leq 5 \text{ v}$	@ $V_{DD} = 5 \text{ v}$
Controller Transmit Lo:	$V_{SS} \leq V_{OL} \leq 0.6 \text{ v}$	or	$0 \text{ v} \leq V_{OL} \leq 0.6 \text{ v}$	@ $V_{DD} = 5 \text{ v}$, $R_{LOAD} \geq 2 \text{ K}\Omega$
Controller Transmit Hi:	$V_{DD} - 0.7 \leq V_{OH} \leq V_{DD}$	or	$4.3 \text{ v} \leq V_{OH} \leq 5 \text{ v}$	@ $V_{DD} = 5 \text{ v}$, $R_{LOAD} \geq 2 \text{ K}\Omega$

USB

Connect the host USB port to pins 1–4 of Header H2 as shown in Table O:

Table O: Communication connector H2 (USB) pin-out

Pin #	Pin name
1*	Vcc
2	D-
3	D+
4	GND

*The USB section of the board uses 5 volts at pin 1.

Serial PS/2

3M Touch Systems does not support serial PS/2 communication with the host computer.

Touch input sensors

The controller supports both 4-wire and 8-wire touch screens. The orientation of the cable connection at the touch screen or at the controller is not important. The controller will identify the sensor wires during calibration.

The pin functions of the controller's connectors are shown in the table below:

Table P: Four-wire touch screen connector H6 pin-out

Pin #	Pin name	Pin function
1	Ye-	Negative y-axis excitation line (typically connected to the top touch screen bus bar).
2	Ye+	Positive y-axis excitation line (typically connected to the bottom touch screen bus bar).
3	Xe-	Negative x-axis excitation line (typically connected to the left touch screen bus bar).
4	Xe+	Positive x-axis excitation line (typically connected to the right touch screen bus bar).

Table Q: Eight-wire touch screen connector H4 pin-out

Pin #	Pin name	Pin function
1	Ye-	Negative y-axis excitation line (typically connected to the top touch screen bus bar).
2	Ys-	Negative y-axis sense line (typically connected to the top touch screen bus bar).
3	Ys+	Positive y-axis sense line (typically connected to the bottom touch screen bus bar).
4	Ye+	Positive y-axis excitation line (typically connected to the bottom touch screen bus bar).
5	Xe-	Negative x-axis excitation line (typically connected to the left touch screen bus bar).
6	Xs-	Negative x-axis sense line (typically connected to the left touch screen bus bar).
7	Xs+	Positive x-axis sense line (typically connected to the right touch screen bus bar).
8	Xe+	Positive x-axis excitation line (typically connected to the right touch screen bus bar).

Status light

The controller has one green status light. When power is applied to the controller, the light begins to flash. The light continues to flash between touch events, and glows continuously when a touch is in progress.

The flashing provides an operating heartbeat that indicates the touch report rate. When a touch is in progress, the LED glows without flashing.

The number of flashes between off states indicates the rate at which the controller is sending touch data to the host computer, as shown in Table R:

Table R: Determining controller rate by number of LED flashes

Number of flashes	Controller report rate (touch coordinate reports/second)
1	180
2	135
3	90
4	45
5	10

Electrical noise

The SC4 controller features superior touch decoding, and will work even when a MicroTouch™ four-wire or eight-wire touch screen is used with a noisy EL display.

There could be circumstances under which the controller could experience interference from electrical noise. This is because the controller resolves voltages down to millivolts. At this resolution level, electrical noise can adversely affect the performance of a touch screen system. For example, CRT, LCD, and EL displays generate noise that could interfere with touch screen controller performance due to the close mechanical coupling of the display to the touch screen.

Here are some suggestions to get the optimum performance from the touch screen system:

- Mount the controller close to the touch screen.
- Mount the controller away from transformers, AC sources, and high voltage switching noise.

- Route the controller-to-touch screen cable so that it will not pass near any sources of AC or high voltage switching noise. If the connecting cable must be routed near this type of noise, try shielding it with a piece of grounded aluminum or copper foil.
- If necessary, isolate the power and ground lines using a ferrite core. A couple of wraps around a bead core with a minimum of 100 ohms at 100 MHz may offer a solution.
- Try grounding the metal frame of the display device.
- Try adding an EMI shield. The EMI shield consists of a transparent conductor placed between the display device and the touch screen.

Consult the MicroTouch™ Resistive Design and Integration Guide for more information on shielding options.

APPENDIX A

Resistive touch screens

Analog resistive touch screen

The MicroTouch™ analog resistive touch screen is a sensor consisting of two opposing layers, each coated with a transparent resistive material called indium tin oxide (ITO). The ITO has a typical sheet resistivity between 100 and 500 ohms per square (Ω/sq).

The layers are separated by a pattern of very small transparent insulating dots. Silver ink bus bars ($\sim 50\text{m}\Omega/\text{sq}$) make an electrical connection to the surface of the ITO at the outside edges, spanning the desired axis of the given layer. Silver ink traces ($\sim 50\text{m}\Omega/\text{sq}$) connect the bus bars to an electromechanical connector used for interfacing to the sensor.

Functional description

Touching the top surface compresses the flexible top layer to the supported bottom layer causing electrical contact of the two layers between the span of insulating dots. Determining a touch location requires two measurements: one to obtain an X-axis coordinate and one to obtain a Y-axis coordinate. A single axis measurement is taken by applying a drive voltage across the ITO of one layer via the silver ink bus bar and trace connections. The voltage applied to this layer produces a voltage gradient across the ITO. The voltage linearly changes from the minimum drive voltage at one end to the maximum drive voltage at the other end. The opposing layer, via a path through its ITO and silver ink connections, is used to measure the voltage at the point of contact on the voltage driven layer. This process is repeated, alternating functions of the two layers to obtain a measurement on the other axis.

Measurements are made using a 10-bit analog to digital convertor (ADC). A 10-bit ADC can resolve 2-to-the-10th power or 1024 different input values in each horizontal and vertical direction. The four-wire system resolution is, however, less than 1024 due to losses in the drive voltage that occur before it reaches the touch screen ITO. Typical minimum and maximum ADC values will be 50 and 950, respectively. This yields a dynamic range of approximately 900 ADC values.

Touch point coordinates are reported to the host computer through a serial communications port.

Touch screen options

MicroTouch™ touch screens are available off-the-shelf in several sizes to match your choice of display. 3M Touch Systems also designs custom touch screens to meet product requirements. Most 3M Touch Systems touch screens can be supplied with options that can enhance optical properties, increase durability, and improve electrical performance for the entire touch system. Some of these options include:

- anti-glare and high gloss surface finishes
- optical filters
- EMI and RFI shields
- integrated membrane switches
- gaskets
- differing activation forces
- color graphics

Consult a 3M Touch Systems representative for more information on standard and custom touch screens (see “3M Touch Systems support services” on page 15).

Four-wire touch screen decoding

3M Touch Systems offers four-wire and eight-wire touch screens.

The four-wire construction consists of two opposing layers, each coated with a transparent resistive material. The layers are separated by a pattern of transparent insulating dots. Conductive bus bars make electrical connection to the transparent resistive material of a given layer. One layer has bus bars on the left and right edges, and the opposing layer has bus bars on the top and bottom edges. A touch causes the two layers to come into contact with each other between the span of insulating dots. The touch screen is decoded by developing a voltage across the horizontal layer’s resistive material, and reading the vertical touch location voltage with the opposing layer. A voltage is then developed across the vertical layer’s resistive material, and a horizontal touch location voltage is read from the opposing layer.

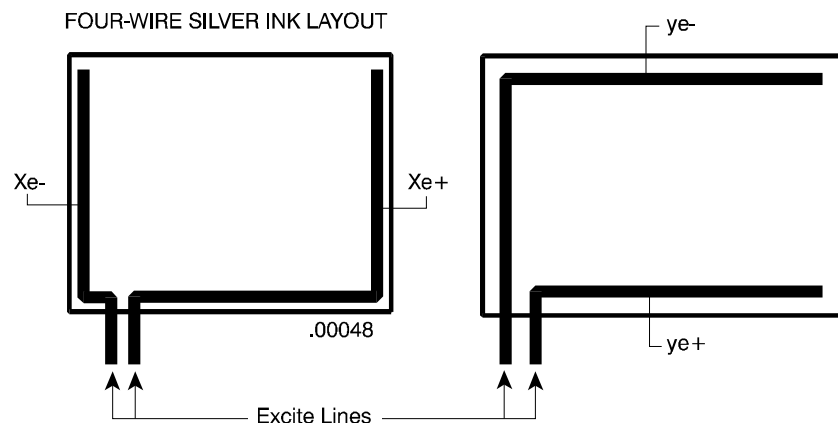


Figure 13: Four-wire resistive touch screen silver ink layout

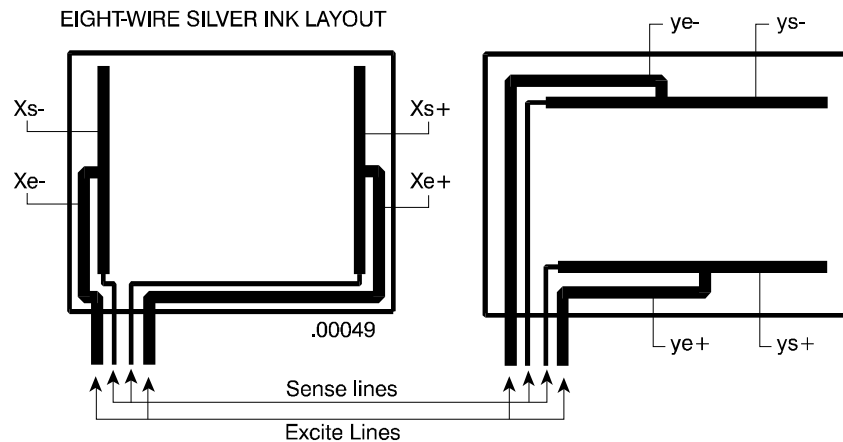
Table S: Four-wire touch screen scanning

Axis	Xe+	Xe-	Ye+	Ye-
X Axis	5 V Drive	Gnd Drive	NC	Read
Y Axis	NC	Read	5 V Drive	Gnd Drive

Eight-wire touch screen decoding

The MicroTouch™ eight-wire design references the measured touch location voltage to the drive (excite) voltage out at the touch screen, rather than at the controller. This requires four additional lines (called sense wires) to be attached to the four bus bars.

Allowing the reference voltage to track the actual voltage out on the touch screen offers a significant advantage: it compensates for resistance changes inherent to any touch system. Resistance changes are caused by aging, use, temperature, and humidity.

**Figure 14: Eight-wire resistive touch screen silver ink layout**

The eight-wire design stabilizes the system accuracy, eliminating touch point drift. The four additional lines Xs+, Xs-, Ys+, and Ys- are the sense lines. These lines are individually multiplexed into the references of the A/D converter to yield a ratio-metric conversion.

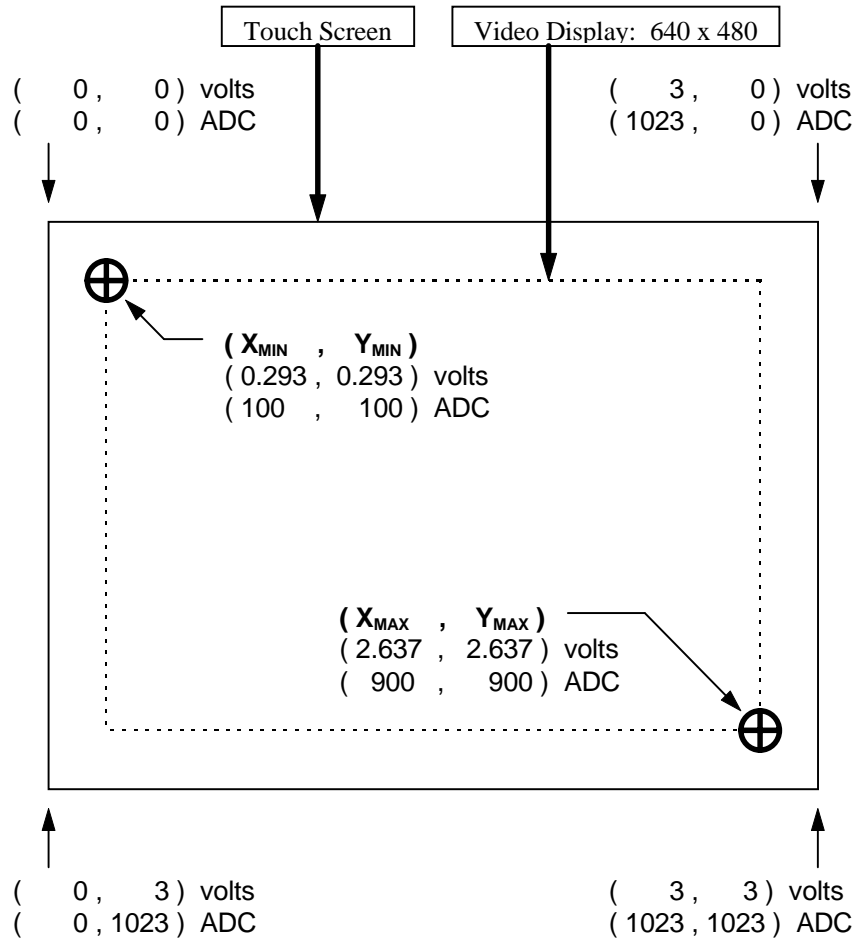
Table T: Eight-wire touch screen scanning

Axis	Xe+	Xe-	Ye+	Ye-	Xs+	Xs-	Ys+	Ys-
X	5 V Drive	Gnd Drive	NC	Read	Ref+	Ref-	NC	NC
Y	NC	Read	5 V Drive	Gnd Drive	NC	NC	Ref+	Ref-

In this table, Ref+ and Ref- are the plus and minus references to the ratio-metric A/D converter.

Touch position to video decoding

Here's an example of touch position to video decoding.



Known values:

X _{MAX PIXELS}	=	640
Y _{MAX PIXELS}	=	480
X _{MIN}	=	100
X _{MAX}	=	900
Y _{MIN}	=	100
Y _{MAX}	=	900

Conversion formulas:

$$X_{\text{PIXEL}} = \frac{(X_{\text{TOUCH}} - X_{\text{MIN}})}{(X_{\text{MAX}} - X_{\text{MIN}})} \cdot X_{\text{MAXPIXELS}}$$

$$Y_{\text{PIXEL}} = \frac{(Y_{\text{TOUCH}} - Y_{\text{MIN}})}{(Y_{\text{MAX}} - Y_{\text{MIN}})} \cdot Y_{\text{MAXPIXELS}}$$

reduced with known values become:

$$X_{\text{PIXEL}} = \frac{(X_{\text{TOUCH}} - 100)}{800} \cdot 640$$

$$Y_{\text{PIXEL}} = \frac{(Y_{\text{TOUCH}} - 100)}{800} \cdot 480$$

Simulated touch:

ADC Reference:

$$V_{\text{ADC REF+}} = 3\text{v}, V_{\text{ADC REF-}} = 0\text{v}$$

$$V_{\text{ADC REF}\Delta} = (V_{\text{ADC REF+}} - V_{\text{ADC REF-}}) = 3\text{v} - 0\text{v} = 3\text{v}$$

$$V_{\text{TOUCH, X}} = 0.75\text{v}$$

$$V_{\text{TOUCH, Y}} = 1.50\text{v}$$

$$\text{ADC}_{\text{RAW, X}} = \frac{V_{\text{TOUCH, X}}}{V_{\text{ADCREF}\Delta}} \cdot 1024 = \frac{0.75\text{v}}{3\text{v}} \cdot 1024 = 256\text{ADC}$$

$$\text{ADC}_{\text{RAW, Y}} = \frac{V_{\text{TOUCH, Y}}}{V_{\text{ADCREF}\Delta}} \cdot 1024 = \frac{1.50\text{v}}{3\text{v}} \cdot 1024 = 512\text{ADC}$$

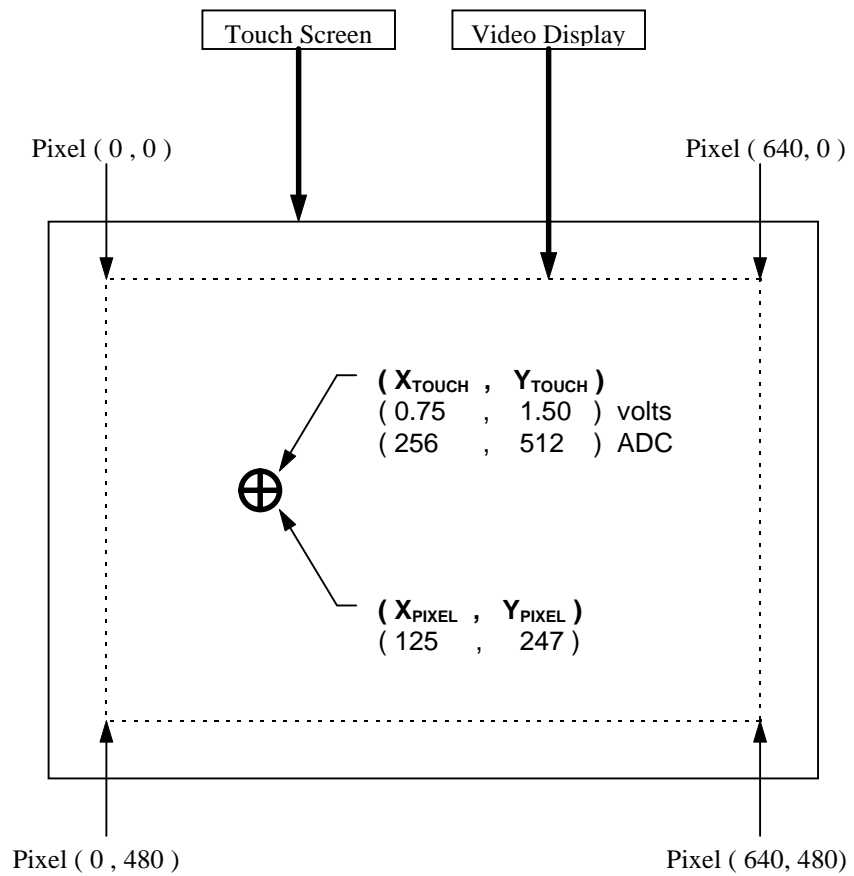
$$(X_{\text{TOUCH}}, Y_{\text{TOUCH}}) = (0.75, 1.50) \text{ volts} = (256, 512) \text{ ADC}$$

Converted to coordinates becomes:

$$X_{\text{PIXEL}} = \frac{(256 - 100)}{800} \cdot 640 = 125$$

$$Y_{\text{PIXEL}} = \frac{(512 - 100)}{800} \cdot 480 = 247$$

$$(X_{\text{PIXEL}}, Y_{\text{PIXEL}}) = (125, 247)$$



APPENDIX B

Controller/host communication

Report protocol (controller-to-host)

Data packet structure

The touch screen controller will send touch reports to the host in 5-byte data packets. The host can send commands to the controller while the controller is transmitting, but the commands will be ignored until the controller has finished sending the touch report.

The 5-byte data packet is coded as shown in the table below:

Table U: SC4 Controller report packet structures

Description	Byte/bit	7	6	5	4	3	2	1	0
Header code	1	H ₇	H ₆	H ₅	H ₄	H ₃	H ₂	H ₁	H ₀
X-high	2	0	0	0	0	0	0	X ₉	X ₈
X-low	3	X ₇	X ₆	X ₅	X ₄	X ₃	X ₂	X ₁	X ₀
Y-high	4	0	0	0	0	0	0	Y ₉	Y ₈
Y-low	5	Y ₇	Y ₆	Y ₅	Y ₄	Y ₃	Y ₂	Y ₁	Y ₀

Where:

H₇:H₀ = header code: pen down = 0x40, pen up = 0x41

X₉ = most significant bit of x-axis position

X₀ = least significant bit of x-axis position

Y₉ = most significant bit of y-axis position

Y₀ = least significant bit of y-axis position

Report Rate

The touch report rate defines how quickly x-y touch location coordinates (points) are sent to the host. Simple “button actuation only” applications require less than 50 points per second. Handwriting recognition often requires a minimum of 100 points per second. The supported touch point report rates are 180, 135, 90, 45, and 10.

Report descriptions

Restart

The controller will send a RESTART report to the host upon power up or reset. The RESTART report is a single byte report of 0x49.

Stream mode

Sends a continuous stream of touch coordinates reports during a valid touch. A release coordinates report is sent upon touch release. The release coordinates will be the coordinates of the touch location just prior to release.

```

Touch:    0  1  0  0  0  0  0  0
          0  0  0  0  0  0  X9 X8
          X7 X6 X5 X4 X3 X2 X1 X0
          0  0  0  0  0  0  Y9 Y8
          Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0
          •
          •
          •
          0  1  0  0  0  0  0  0
          0  0  0  0  0  0  X9 X8
          X7 X6 X5 X4 X3 X2 X1 X0
          0  0  0  0  0  0  Y9 Y8
          Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

Release:  0  1  0  0  0  0  0  1
          0  0  0  0  0  0  X9 X8
          X7 X6 X5 X4 X3 X2 X1 X0
          0  0  0  0  0  0  Y9 Y8
          Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0
    
```

Down Mode

Sends a touch coordinates report followed by a release coordinates report, when a valid touch first occurs. The release coordinates will be equivalent to the coordinates of the touch location just reported. Reporting will not occur again until the touch is released and a new valid touch occurs.

```

Touch:      0  1  0  0  0  0  0  0
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

            0  1  0  0  0  0  0  1
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

```

Release: nothing

Up Mode

Sends a touch coordinates report followed by a release coordinates report, when a valid touch is first released. The touch and release coordinates reports will be the location of the touch just prior to release. Reporting will not occur again until a new valid touch and release cycle occurs.

```

Touch:      nothing

Release:    0  1  0  0  0  0  0  0
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

            0  1  0  0  0  0  0  1
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

```

Down-Up Mode

Sends a touch coordinates report when a valid touch first occurs. Reporting will not occur again until the touch is released. Upon touch release, a release coordinates report will be sent. The release coordinates report will be the coordinates of the touch location just prior to release.

```

Touch:      0  1  0  0  0  0  0  0
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

Release:    0  1  0  0  0  0  0  1
            0  0  0  0  0  0  X9 X8
            X7 X6 X5 X4 X3 X2 X1 X0
            0  0  0  0  0  0  Y9 Y8
            Y7 Y6 Y5 Y4 Y3 Y2 Y1 Y0

```

Command protocol (host-to-controller)

Host command

A host command consists of a start byte, a command code byte, ASCII hex byte-pairs of command dependent parameters, and a terminator byte. For example:

<STX> <command> <n byte-pairs of ASCII hex data> <CR>

where:

STX	=	0x02	start
CR	=	0x0D	terminator

Controller response

A controller response consists of a start byte, an ACK (acknowledge) or NAK (no acknowledge) or FS (command range error), ASCII hex byte-pairs of command dependent parameters, and a terminator byte. For example:

<EOT> <ACK or NAK or FS> <n byte-pairs of ASCII hex data> <CR>

where:

EOT	=	0x04	start
ACK	=	0x06	acknowledge
NAK	=	0x15	no acknowledge
FS	=	0x1C	range error
CR	=	0x0D	terminator

Command summary

Controller commands are summarized in Table V. Descriptions of each command begin on page 56

Table V: SC4 Controller commands and responses

Command Code	Command mnemonic	Command parameters	Command description	Controller response
0x01	RESET	-	Reset default user parameters	<ACK> <NAK>
0x03	QFMW	-	Query firmware	<ACK> <7 p/n & 3 rev> <NAK>
0x05	TOUCHMODE	[0 or 1 or 2 or 3]	Touch Mode (Stream, Up, Down, Down Up)	<ACK> <NAK>
0x07	BAUDRATE	[0 or 1 or 2]	Baud Rate (2400, 9600, 19200)	<ACK> <NAK>
0x08	REPRATEMAX	[0 or 1 or 2 or 3]	Report Rate Max (45, 90, 135, 180)	<ACK> <NAK>
0x09	QREPRATE	-	Query Reporting Rate (10, 45, 90, 135, 180)	<ACK> <rate> <NAK>
0x0A	SLEEPMODE	[0 or 1]	Sleep Mode (Off, On)	<ACK> <NAK>
0x0B	SENSITIVITY	[0 or 1 or 2 or 3]	Sensitivity (Off, Low, Medium, High)	<ACK> <NAK>
0x40	QTSCTYPE	-	Query controller type (res, cap, matx, ana/matx)	<ACK> <type> <NAK>
0x63	EEREAD	[addr hi] [addr lo]	Read one EEPROM address	<ACK> <data> <NAK> or <FS>
0x6B	EEWRITE	[addr hi] [addr lo] [data]	Write one EEPROM address	<ACK> <NAK> or <FS>
Other	-	-	-	<NAK>

Command description

RESET

Resets all user selectable controller parameters to the default values.

Host: <STX> <0x01> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

QFMW

Requests the firmware part number (P/N) and revision (Rev) that are stored in ROM space on the controller.

Host: <STX> <0x03> <CR>

Controller: <EOT> <ACK> <ASCII P/N 1st>...<ASCII P/N 7th>

<ASCII Rev 1st>...<ASCII Rev 3rd> <CR>

or

<EOT> <NAK> <CR>

Example. The host requests the controller's firmware part number and revision. The controller responds that its part number is FMW-0005, revision x15. The controller's response will be:

Controller:	EOT	=	0x04	→	0x04		
	ACK	=	0x06	→	0x06		
	'F'	=	0x46	→	0x34	0x36	(ASCII hex pair)
	'M'	=	0x4D	→	0x34	0x44	(ASCII hex pair)
	'W'	=	0x57	→	0x35	0x37	(ASCII hex pair)
	'0'	=	0x30	→	0x33	0x30	(ASCII hex pair)
	'0'	=	0x30	→	0x33	0x30	(ASCII hex pair)
	'0'	=	0x30	→	0x33	0x30	(ASCII hex pair)
	'5'	=	0x35	→	0x33	0x35	(ASCII hex pair)
	'x'	=	0x78	→	0x37	0x38	(ASCII hex pair)
	'1'	=	0x31	→	0x33	0x31	(ASCII hex pair)
	'5'	=	0x35	→	0x33	0x35	(ASCII hex pair)
	CR	=	0x0D	→	0x0D		

TOUCHMODE

Sets the mode of touch reporting. The options are Stream, Down, Up, and Down-Up.

Stream mode sends a continuous stream of touch coordinates reports during a valid touch. A release coordinates report is sent upon touch release. The release coordinates will be the coordinates of the touch location just prior to release.

Down mode sends a touch coordinates report followed by a release coordinates report, when a valid touch first occurs. The touch and release coordinates reports will be the location of the initial touch. Reporting will not occur again until the touch is released and a new valid touch occurs.

Up mode sends a touch coordinates report followed by a release coordinates report, when a valid touch is first released. The touch and release coordinates reports will be the location of the touch just prior to release. Reporting will not occur again until a new valid touch and release cycle occurs.

Down-Up mode sends a touch coordinates report when a valid touch first occurs. Reporting will not occur again until the touch is released. Upon touch release, a release coordinates report will be sent. The release coordinates report will be the coordinates of the touch location just prior to release.

The default setting is **Stream**.

Host: <STX> <0x05> <parameter> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

Parameter:	Stream	=	0x00→	0x30	0x30	(ASCII hex pair)
	Up	=	0x01→	0x30	0x31	(ASCII hex pair)
	Down	=	0x02→	0x30	0x32	(ASCII hex pair)
	DownUp	=	0x03→	0x30	0x33	(ASCII hex pair)

BAUDRATE

Sets the serial communication baud rate. The options are 2400, 9600, and 19200.

The controller responds to this command at the old baud rate. A change in the baud rate takes effect after completion of the command sequence to change it.

The default setting is **9600**.

Host: <STX> <0x07> <parameter> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

Parameter:	2400	=	0x00→	0x30	0x30	(ASCII hex pair)
	9600	=	0x01→	0x30	0x31	(ASCII hex pair)
	19200	=	0x02→	0x30	0x32	(ASCII hex pair)

REPRATEMAX

Caps the maximum rate at which data will be reported by the controller to the host. The controller reports touch data at one of these discrete rates: 10, 45, 90, 135, or 180 reports per second. Users can select maximum report rates of 45, 90, 135, or 180 reports per second.

The actual report rate may be lower than the selected maximum rate due to system parameters (i.e. an RS-232 baud rate of 2400 will not support report rates higher than 45 reports per second), but it will never be higher than the maximum setting.

The default setting is **180 reports per second**.

Host: <STX> <0x08> <parameter> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

Parameter:	45	=	0x01→	0x30	0x31	(ASCII hex pair)
	90	=	0x02→	0x30	0x32	(ASCII hex pair)
	135	=	0x03→	0x30	0x33	(ASCII hex pair)
	180	=	0x04→	0x30	0x34	(ASCII hex pair)

QREPRATE

Requests the current touch reporting rate.

Host: <STX> <0x09> <CR>

Controller: <EOT> <ACK> <parameter> <CR>

or

<EOT> <NAK> <CR>

Parameter:	10	=	0x00→	0x30	0x30	(ASCII hex pair)
	45	=	0x01→	0x30	0x31	(ASCII hex pair)
	90	=	0x02→	0x30	0x32	(ASCII hex pair)
	135	=	0x03→	0x30	0x33	(ASCII hex pair)
	180	=	0x04→	0x30	0x34	(ASCII hex pair)

SLEEPMODE

Sets a mode that will stop the driving/decoding of the touch screen during periods without touch activity. The options are On or Off.

When sleep mode is On, the controller will stop driving/decoding the touch screen after 60 seconds without a touch event. A touch event will cause the controller to actively start driving/decoding the touch screen again.

The default setting is **Off**.

Host: <STX> <0x0A> <parameter> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

Parameter:	Off	=	0x00→	0x30	0x30	(ASCII hex pair)
	On	=	0x01→	0x30	0x31	(ASCII hex pair)

SENSITIVITY

Sets the sensitivity of the controller to touch inputs. The options are Off, Low, Medium, and High.

A lower setting requires more stable touch activity to maintain a touch in process, while a higher setting will tolerate more unstable or noisy touch activity.

The default setting is **Low**.

Host: <STX> <0x0B> <parameter> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

Parameter:	Off	=	0x00→	0x30	0x30	(ASCII hex pair)
	Low	=	0x01→	0x30	0x31	(ASCII hex pair)
	Medium	=	0x02→	0x30	0x32	(ASCII hex pair)
	High	=	0x03→	0x30	0x33	(ASCII hex pair)

QTSCTYPE

Requests the controller type.

Host: <STX> <0x40> <CR>

Controller: <EOT> <ACK> <parameter> <CR>

or

<EOT> <NAK> <CR>

Parameter: MicroTouch™ resistive = 0x00 → <0x30> <0x30>

MicroTouch™ NFI = 0x10 → <0x31> <0x30>

Example. The host requests the controller to identify its type. The controller responds with a value of 0x00, indicating that it is a resistive screen controller:

Controller: <EOT> <ACK> <0x30> <0x30> <CR>

EEREAD

Reads the data value from one address location in the controller's EEPROM device. The allowable memory locations range from 0x00 to 0xFF. If the requested address is out of range, the response will be FS.

Host: <STX> <0x63> <addr hi> <addr lo> <CR>

Controller: <EOT> <ACK> <data> <CR>

or

<EOT> <NAK> <CR>

or

<EOT> <FS> <CR>

addr hi: <ASCII for MSn> <ASCII for LSn>

addr lo: <ASCII for MSn> <ASCII for LSn>

data: <ASCII for MSn> <ASCII for LSn>

where MSn = most significant nibble, LSn = least significant nibble

EEWRITE

Writes a data value to one memory location in the controller's EEPROM device. The allowable memory locations are limited to the user memory space ranging from 0x40 to 0x7D. If the requested address is out of range the response will be FS.

Host: <STX> <0x6B> <addr hi> <addr lo> <data> <CR>

Controller: <EOT> <ACK> <CR>

or

<EOT> <NAK> <CR>

or

<EOT> <FS> <CR>

addr hi: <ASCII for MSn> <ASCII for LSn>

addr lo: <ASCII for MSn> <ASCII for LSn>

data: <ASCII for MSn> <ASCII for LSn>

where MSn = most significant nibble, LSn = least significant nibble

Example. The host commands the controller to write 0x3B to address 0x005F. The command is:

Host: <0x02> <0x6B> <0x30> <0x30> <0x35> <0x46>
<0x33> <0x42> <0x0D>



3M Touch Systems
3M Optical Systems Division
300 Griffin Park Drive
Methuen, MA 01844
U.S.A.
www.3Mtouch.com

Worldwide Manufacturing Plants:
Methuen, Massachusetts
Milwaukee, Wisconsin
Vancouver, BC Canada

© 3M 2003
MicroTouch is a trademark of 3M.