

# 3M™ MicroTouch™ Controller RX141 Reference Guide

Formerly  
SC400 USB Resistive

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



The information in this document is subject to change without notice. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of 3M Touch Systems, Inc. 3M may have patents or pending patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. The furnishing of this document does not give you license to these patents, trademarks, copyrights, or other intellectual property except as expressly provided in any written license agreement from 3M Touch Systems, Inc.

The information provided in this document is intended as a guide only. For the latest detailed engineering specifications, please contact your 3M Touch Systems, Inc. Application Engineer. 3M Touch Systems, Inc. is committed to continually improving product designs. As a result, product specifications may be subject to change without notification.

"RoHS compliant 2005/95/EC" means that the product or part does not contain any of the following substances in excess of the following maximum concentration values in any homogeneous material, unless the substance is in an application that is exempt under RoHS: (a) 0.1% (by weight) for lead, mercury, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers; or (b) 0.01% (by weight) for cadmium. This information represents 3M's knowledge and belief, which may be based in whole or in part on information provided by third party suppliers to 3M.

**NOTICE:** Given the variety of factors that can affect the use and performance of a 3M Touch Systems, Inc. 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, Inc. 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, Inc. statements, engineering/technical information, and recommendations are provided for User's convenience, but their accuracy or completeness is not warranted. 3M Touch Systems, Inc. products and software are not specifically designed for use in medical devices as defined by United States federal law. 3M Touch Systems, Inc. products and software should not be used in such applications without 3M Touch Systems, Inc. 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, Inc. 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, Inc. 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, Inc. 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, Inc. warranty, then 3M Touch Systems, Inc. sole obligation and User's and Purchaser's **exclusive remedy**, will be, at 3M Touch Systems, Inc. option, to repair or replace that Product quantity or software media or to refund its purchase price. 3M Touch Systems, Inc. has no obligation under 3M Touch Systems, Inc. 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, Inc. **3M Touch Systems, Inc. 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.**

© 3M 2004-2009 All rights reserved.

Document Title: *3M™ MicroTouch™ Controller RX141 Reference Guide*

Document Number: 19-271, Version 03

3M, the 3M logo, MicroTouch, and the MicroTouch logo are either registered trademarks or trademarks of 3M in the United States and/or other countries.

Windows and/or other Microsoft products referenced herein are either registered trademarks or trademarks of Microsoft Corporation in the U.S. and/or other countries.

All other trademarks are the property of their respective owners.

# Contents

<b>Introduction</b>	
	What You Need to Know .....5
	Important Safety Information .....5
	3M Touch Systems Support Services .....6
	Contact 3M Touch Systems .....7
<b>Chapter 1</b>	<b>Integrating the RX141 Controller</b>
	Overview of the RX141 Controller .....9
	Handling and ESD Protection .....10
	Establishing the Data Connection .....10
	Mounting the Controller .....11
	Supplying Power to the Controller .....11
	Sensor Cable Connector .....11
	Turning On Your System .....12
	Status Light (LED) Diagnostics .....12
	What's Next? .....13
<b>Chapter 2</b>	<b>RX141 Controller Communications</b>
	Overview of USB Firmware Communications .....15
	Communication Basics .....16
	Receiving Reports from the Controller .....16
	HID and Packed Touch Reports .....16
	USB Command Set .....18
	Set Feature – Set Asynchronous Report .....19
	Set Feature – Calibration .....20
	Get Feature – Get Status .....23
	Set Feature - Reset .....25
	Set Feature - Restore Defaults .....25
	Set Feature - Set Controller Number .....26
	Get Feature – Get Controller Number .....27
<b>Appendix A</b>	<b>RX141 Controller Specifications</b>
	Technical Specifications .....30



## Introduction

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 guide, designed for developers of touch systems, provides installation and configuration information for the 3M™ MicroTouch™ RX141 controller. This document includes information on integrating the RX141 controller into your design, communicating with the controller, installing the MT 7 software user interface, and troubleshooting setup problems. It also includes a complete description of the firmware commands and controller specifications.

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

## What You Need to Know

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

## Important Safety Information

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

<b>Intended Use</b>
The RX141 controller was designed to enable touch in conjunction with other 3M™ MicroTouch™ products. This controller is intended for internal mounting only and is not suitable for use in hazardous locations.

Explanation of Signal Word Consequences
---

<p><b>⚠ WARNING:</b> Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury and/or property damage.</p>
--

<p><b>⚠ CAUTION:</b> Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury and/or property damage.</p>
---

<p><b>CAUTION:</b> Indicates a potentially hazardous situation, which, if not avoided, may result in property damage.</p>
---

⚠ WARNING
-----------

<p><b>To reduce the risk of fire and/or explosion which could result in serious injury or death:</b></p>
--

<p>Do not install or use this product in a hazardous location.</p>
--

<p><b>To reduce the risk of fire and/or explosion which could result in serious injury or property damage:</b></p>
--

<p>Do not use this product in any outdoor environment unless NEMA standards (or similar standards such as IP rating) are followed.</p>
--

<p><b>To avoid the risk of electric shock which could result in serious injury or death:</b></p>
--

- |  |
|--|
| <ul style="list-style-type: none"> <li>• Do not use a damaged power supply.</li> <li>• Do not use a power cord that is frayed or otherwise damaged.</li> </ul> |
|--|

⚠ CAUTION
-----------

<p><b>To reduce the risks associated with improper disposal, which if not avoided may result in minor or moderate injury from ground water contamination:</b></p>
---

<p>Dispose of components in accordance with federal, state and local regulations.</p>
---

<p><b>To reduce the risk of possible environmental contamination which may result in minor or moderate injury:</b></p>
--

<p>Dispose of the display in accordance with federal, state and local regulations.</p>
--

<p><b>To reduce the risk of the potentially hazardous situations associated with the use of isopropyl alcohol which may result in minor or moderate injury or property damage:</b></p>
--

<p>Follow all instructions and recommendations in the manufacturer's Material Safety Data Sheet and product label.</p>
--

## 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.3M.com/touch>, where you can download touch software and drivers, obtain regularly updated technical documentation on 3M™ MicroTouch™ products, and learn more about our company.

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

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

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

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

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

## Contact 3M Touch Systems

Contact information for all offices can be found on our website at:

<http://www.3M.com/touch/>





## CHAPTER 1

# Integrating the RX141 Controller

The 3M™ MicroTouch™ RX141 controller is an accurate, small outline, low cost, temperature stable controller capable of supporting a wide range of resistive sensors. It is designed for internal mounting in OEM applications.

This chapter covers the following RX141 controller specifications:

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

## Overview of the RX141 Controller

The RX141 controller is an uncased device using a USB interface.

To integrate and test the RX141 controller, you need the following items:

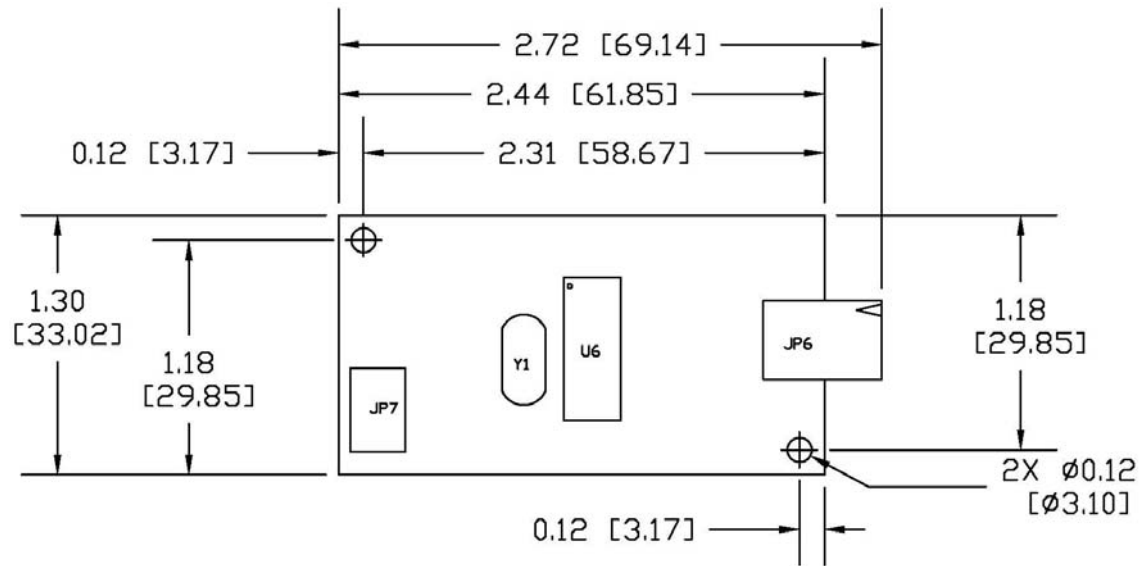
- A 4-wire resistive sensor.
- A method of establishing the USB communication between the controller and your system. The standard 3M™ MicroTouch™ USB communications cable (P/N7319420) is recommended.
- A software utility or driver with a calibration routine.

---

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

---

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 RX141 has a 4-pin sensor connector (JP6), and a 5-pin USB cable connector (JP7).

**Figure 1. RX141 Controller Overall Dimensions**

## Handling and ESD Protection

When mounting the sensor and controller, use normal precautions for handling electrostatic sensitive devices. The RX141 has internal protection to  $\pm 20$  kV for ESD air discharges to the sensor (not to the controller directly) that may occur during normal operation of the sensor. Refer to Appendix A for further specifications.

## Establishing the Data Connection

The RX141 controller requires a 3M™ MicroTouch™ 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 RX141 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™ MicroTouch™ USB cable.

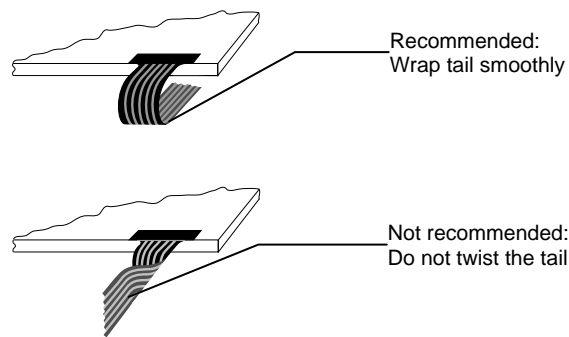
**Table 1. USB Cable for RX141 Controllers**

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 sensor cable exit point to minimize cable flexing. The controller should be mounted internally behind or on the side of the display on stand offs to allow room for the sensor 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 sensor. Good engineering design avoids awkward electrical connections.



## Supplying Power to the Controller

The RX141 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. 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.

## Sensor Cable Connector

The sensor cable should have a 4-pin single row locking female connector that plugs into the controller. The controller is compatible with the “XYXY” latched connector pinout, not the “XXYY” style, non-latched connector pinout. Here, X or Y refers to one or the other sheet, and + or – refers to the other side of the sheet. The calibration process sorts out left/right and up/down.

Connector pins 1 and 3 must be connected to one sheet and pins 2 and 4 must be connected to the other sheet.

1. Y-
2. X+
3. Y+
4. X-

## 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 sensor.

## Status Light (LED) Diagnostics

3M™ MicroTouch™ controllers are highly reliable units; however, there may be occasions when the controller does not perform exactly as you expected. The RX141 controller provides diagnostic feedback with a light emitting diode (LED) on the component side of the board that indicates the status of the sensor. 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 RX141 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 sensor connector voltages that are out of range.	Check connection to the sensor

---

Flashes	Self Test Condition	Self Test Bit	Description	What to do...
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™ MicroTouch™ driver. You must obtain a HID calibration utility from the 3M Touch Systems website.

Additional 3M Touch Systems documentation is available from the corporate website at [www.3Mtouch.com](http://www.3Mtouch.com).



## CHAPTER 2

# RX141 Controller Communications

This chapter discusses the fundamentals of communicating with the RX141 controller. The firmware commands, which are usually issued by a driver or utility program on the host system, control the operation of the 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 systems users do *not* have to use firmware commands to use their touch systems. For example, users can use 3M™ MicroTouch™ software or equivalent software to calibrate the sensor or to determine the controller type and firmware version.

---

**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 sensor and render it inoperable. You should be aware of the results before executing any firmware commands.

---

To optimize the performance of the RX141 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 RX141 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 (0100H) and the vendor ID (0596H) to write your own driver. These values are required for identifying the controller.

The RX141 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 sensor 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 sensor. 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 X 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 sub report is valid. The second sub report 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 RX141 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 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)

Offset	Field	Size	Value	Description
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	0xA1	0x01	0x05	---	72

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 RX141 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 3-point calibration. The calibration can be performed at points inset from the lower left, upper left and upper right corners. The 3-point calibration defines the active area of the sensor by mapping two targets displayed on the video image to absolute X and Y coordinates on the sensor.

**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 Report ID
4	wIndex	2	0	Always 0
6	wLength	2	8	Always 8

**Table 12. Data Stage**

Offset	Field	Size	Value	Description
0	bReport ID	1	0x21	Host to device
1	bmReport Subtype	1	0x04	Set Report
2	bCalType	1	0xXX	0x03 = 3-point calibration (C3)
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 three calibration points do not fall within certain bounds established by the firmware. These bounds require that the 3 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 display orientation and 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. Calibration software paints a target in the lower left corner.
2	Controller is waiting for a touch in the upper right corner. Calibration software paints a target in the upper right corner.
3	Calibration completed successfully.
6	Controller is waiting for a touch in the upper left corner. Calibration software paints a target in the upper left corner.

This command corrects for display orientation and pinout variations. This information

will be maintained by the controller. The Calibrate 3 Point command initiates an interactive calibration procedure which defines the active area of the sensor 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 3 Point utilizes inset calibration points located 12½ percent inboard from the sensor corners (at touch X,Y locations 128,128, 895,895 and 128,895) for accuracy and ease of operation.

### **Guidelines for the Controller Command**

Here are several guidelines for using the Calibration command:

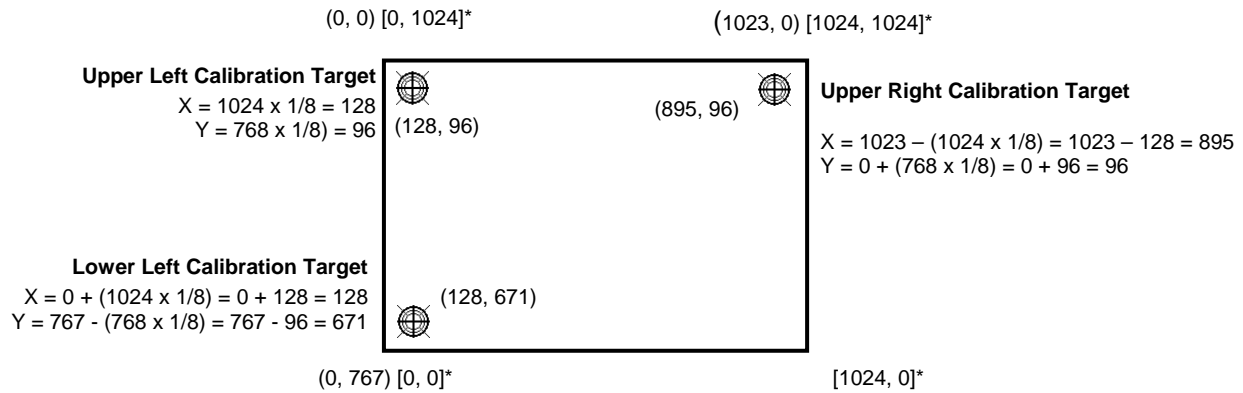
- The controller uses the data immediately before liftoff to register a calibration touch. Therefore, you can touch the coordinate target, hold for a few seconds, and then lift off. Instructing users to touch this way results in a more accurate calibration.
- The controller stores the data in non-volatile memory (NOVRAM). Therefore, you do not have to calibrate the sensor each time you power on the system. You should, however, recalibrate the sensor any time the video display changes size or resolution.
- You can restart calibration at any time during this sequence by issuing a Reset command and reissuing a Controller command.

### **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 sensor. Examples from the *controller's* perspective, however, place the origin at the lower left corner of the sensor (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 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 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	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.

## 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 Report**

Offset	Field	Size	Value	Description
0	bmRequestType	1	0xA1	Device to host
1	bRequest	1	0x01	Get 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
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.

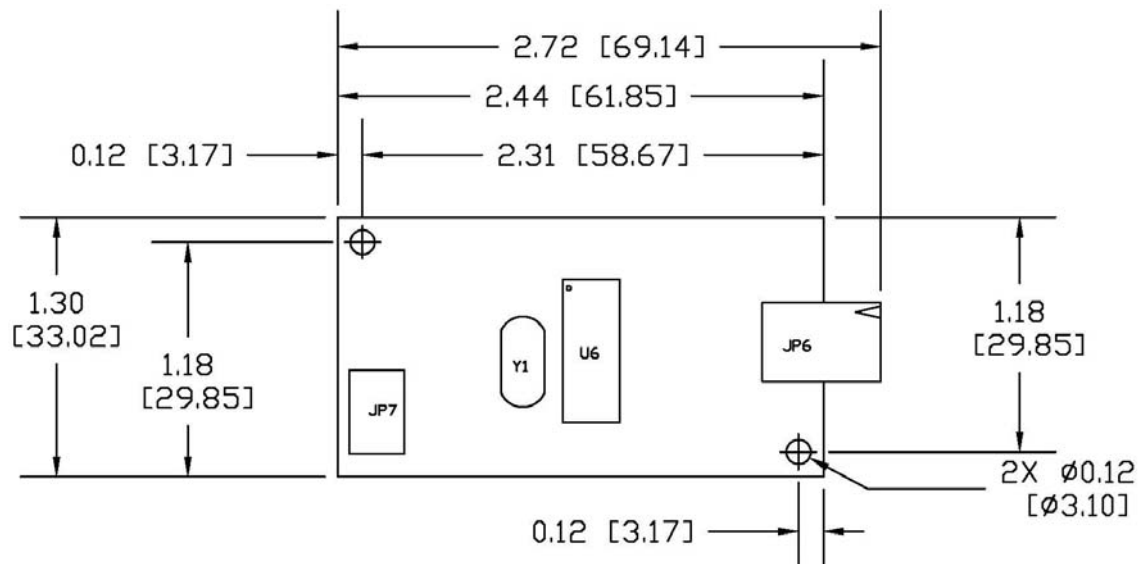
## APPENDIX A

# RX141 Controller Specifications

This section provides controller specifications such as power and environmental requirements. The RX141 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 RX141 controller and the locations of the mounting holes and connectors.

**Figure 3. RX141 Controller Dimensions**



## Technical Specifications

### Physical Dimensions

Uncased 2.75 in. x 1.3 in. x 0.45 in. (69.9 mm x 33.0 mm x 11.4 mm)

### Board Level Functions

Power 5 VDC / 12 VDC (15 mA typical, 28 mA touching); ± 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 ±1 ms
Touch Resolution (Maximum number of addressable coordinates generated by the controller)	1024 x 1024
ESD Susceptibility <sup>1</sup>	
±8KV Contact Discharge– Class 2 per section 9 of IEC 61000-4-2	Compliant

<sup>1</sup> ESD discharges to a sensor connected to the controller

1 false touch allowed  
 ±20KV 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

**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)  
 Communications Protocol USB Rev 1.1

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

