

# IntelliTouch<sup>®</sup> Ultra<sup>™</sup>

**Product Manual**  
Revision 3.2

# IntelliTouch<sup>®</sup> Ultra<sup>™</sup>

## Product Manual (Revision 3.2)

**Elo TouchSystems, Inc.**

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A Raychem Company

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### **FCC Notice**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation..

### **UL Notice**

Elo PC-Bus controllers are for use only with IBM or compatible UL Listed personal computers that have installation instructions detailing user installation of card cage accessories.



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# Introduction

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  - *About this Manual* 2
  - *Shipping Damage* 4
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## INTRODUCING TOUCHSCREENS

Touchscreens are the ultimate operator/machine interface. In a touchscreen system, you touch what you see. The computer responds. The human action and the computer's reaction is simple, direct, and natural. Using touchscreens, workers can control complicated processes. People who have never used a computer before can interact easily with a touchscreen-based system. Touchscreens bring the power of the computer within reach—in airports, factories, shopping malls, schools, and hospitals.

Applications for touchscreens include:

- Public Information Systems
- Multimedia
- Retail and Point-of-Sale
- Process Control
- Instrumentation
- Gaming
- Ticket and Lottery
- Simulation and Training
- Education

The IntelliTouch® Ultra™ product line is the state-of-the-art in patented surface wave technology. A new and sophisticated chipset controller combined with new antiglare touchscreens makes IntelliTouch Ultra systems the clear choice in the worst of environments, where the display is subjected to dust, splashing liquids, and other external contaminants.

The IntelliTouch Ultra Model E284A touchscreen product line represents a significant advancement in touchscreen systems. While maintaining the natural feel and ease of use of other Elo touchscreen products, the unsurpassed combination of clarity, resolution, durability, and reliability of the IntelliTouch Ultra touchscreen system makes it ideal for public information kiosks, multimedia applications, and gaming applications.

Other IntelliTouch Ultra products available include SecureTouch™ touchscreens, which provide ruggedness without sacrificing performance when used in public-access kiosks located in high-threat environments. SecureTouch touchscreens will withstand repeated impacts from heavy objects and continue to operate despite scratches that would disable other touchscreens. For bank ATM's and other applications involving sensitive information, Elo's Privacy Touchscreen excludes all viewing of the image except from a head-on position.

## **ABOUT THIS MANUAL**

This manual provides the information you need to install and set up an Elo IntelliTouch touchscreen or TouchMonitor with its controller. In addition, this publication includes basic technical information about the touchscreen, available controllers, driver software, and troubleshooting information.

**NOTE**

*For the purpose of simplicity, references in this manual to IntelliTouch, IntelliTouch controllers, or IntelliTouch touchscreens include IntelliTouch Ultra products, unless otherwise noted.*

If a touchscreen is already installed on your display and the system is operational, proceed directly to one of the following software manuals. Contact Elo if you do not have the proper manual.

<b>Operating System</b>	<b>Manual</b>
DOS or Windows 3.xx	DOS and Windows Driver Guide (P/N 008100-A)
Windows 95	DOS and Windows Driver Guide (P/N 008100-A)
OS/2	MonitorMouse <sup>®</sup> for OS/2 User's Guide (P/N 008010-A)
Windows NT	MonitorMouse for Windows NT User's Guide (P/N 008013-A)
Macintosh	MonitorMouse for Macintosh User's Guide (P/N 008015-A)
Other	Contact Elo for the availability of other drivers and technical information on writing your own driver.

This manual is organized as follows:

- Chapter 1 Introduces touchscreens and includes general information about Elo products.
- Chapter 2 Describes how an IntelliTouch touchscreen and controller work.
- Chapter 3 Gives step-by-step instructions on how to connect an Elo touch monitor and controller. Elo purchases and resells a variety of monitors, called touch monitors, with touchscreens and all related components fully installed.
- Chapter 4 Tells how to install touchscreen components in your monitor, if you do not already have a touch monitor. Gives information on mounting the touchscreen, controller, and connecting cables.

- Appendix A Gives troubleshooting tips.
- Appendix B Provides quick-reference information on controller configuration and emulation modes.
- Appendix C Lists IntelliTouch product specifications.

## SHIPPING DAMAGE

If you notice damage to the shipping carton, or concealed damage, be sure to save all packing materials for later inspection by the carrier, who is responsible for any shipping damage.

If failure occurs during the warranty period, see the *Limited Warranty* section at the beginning of this manual for instructions.

## CARE AND CLEANING

Handle the touchscreen with reasonable care when not integrated into a monitor. Do not pull or stress cables and do not touch or bump the corner-mounted transducers.

Clean the touchscreen with household glass cleaner and paper towels. Always dampen the towel and then clean the touchscreen.

For operating and storage specifications, refer to Appendix C.

## CONTACTING ELO

Technical Support:

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FAX: (423) 482-6617

E-MAIL: [elotech@elotouch.com](mailto:elotech@elotouch.com)

Product announcements, press releases, application notes, software drivers and utilities are available on the web site, CompuServe and the Elo BBS.

Your comments and suggestions are welcome.

Web: <http://www.elotouch.com>

BBS: (423) 482-9840

(Downloads only, up to 14.4K baud, multiple protocols)

CompuServe: GO ELOTOUCH

Select Elo from the Messages and Library menus.

Customer Service:

VOICE: (423) 482-4100

FAX: (423) 482-4943

Sales:

VOICE: (800) ELO-TOUCH -or- (800) 356-8682

(510) 651-3738

E-MAIL: [eloinfo@elotouch.com](mailto:eloinfo@elotouch.com)



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# About IntelliTouch Touchscreens

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  - *The IntelliTouch Touchscreen* 8
  - *The IntelliTouch Controllers* 10
  - *Driver Software* 10
- 

## INTRODUCTION

The Elo IntelliTouch Ultra touchscreen system consists of a touchscreen and an electronic touchscreen controller. The IntelliTouch touchscreen is based on patented surface wave technology. Surface waves are mechanical waves that propagate in the surface of materials such as glass. The touchscreen may be a flat, spherical, or cylindrical glass panel. This panel is installed over the face of the display. Because there are no layers or coatings on the glass as with other technologies, the IntelliTouch touchscreen is extremely durable and allows a clear, sharp image.

IntelliTouch Ultra features include:

- Excellent image clarity with high light transmission (90% or better)
- Extremely fast and sensitive, with the highest resolution of any touchscreen
- Excellent durability
- Improved sealing capability
- Pressure-activated by a finger or gloved hand
- Z-axis response
- Standard sizes for flat, spherical, and cylindrical displays
- Custom sizes available for OEM quantities

The IntelliTouch system provides a third coordinate, or Z-axis, in addition to the conventional X and Y coordinates. The Z-axis coordinate is proportional to touch pressure, and provides advanced software design flexibility.

## THE INTELLITOUCH TOUCHSCREEN

The IntelliTouch Ultra surface wave technology touchscreen consists of a glass panel molded to the precise shape of a display's face. It may be clear for best image clarity or treated for anti-glare properties. For optimum optical performance, the touchscreen may be optically bonded to the cathode ray tube (CRT) face.

Each axis of the touchscreen panel has a transmitting and receiving piezoelectric transducer, and sets of reflector stripes. See Figure 2-1 for details on the construction of an IntelliTouch touchscreen.

Surface wave energy is generated by the transmitting transducers mounted in the corners of the touchscreen. The touchscreen controller sends a 5.53 MHz electrical signal to the X-axis transmitting transducer which converts the signal into surface waves. A set of reflector stripes located on the lower edge of the glass reflects these waves across the active area of the glass. Reflector stripes at the top gather the reflected waves and direct them to the X-axis receiving transducer which reconverts the surface waves into an electrical signal.

When a finger, or other energy-absorbing object touches the touchscreen, a portion of the wave is absorbed. The resulting change in the received signal is analyzed by the controller and a digitized X coordinate is determined. This process is repeated similarly to determine the Y coordinate. The Z-axis level is determined by measuring the amount of signal attenuation at the touch location.

Once X, Y, and Z coordinates have been determined, the controller transmits them to the computer.

The controller detects touches by comparing received signals to a reference waveform acquired in an untouched condition. This allows the controller to ignore contamination such as dirt and scratches. IntelliTouch Ultra controllers instantaneously detect and factor out contamination. Original IntelliTouch controllers will detect and eliminate contamination when a "touch" appears stationary for about thirty seconds.

In any event, a new reference waveform is then acquired, effectively ignoring the contamination and returning the touchscreen to normal operation. If the contamination is removed, the controller repeats the process of acquiring a new reference waveform.

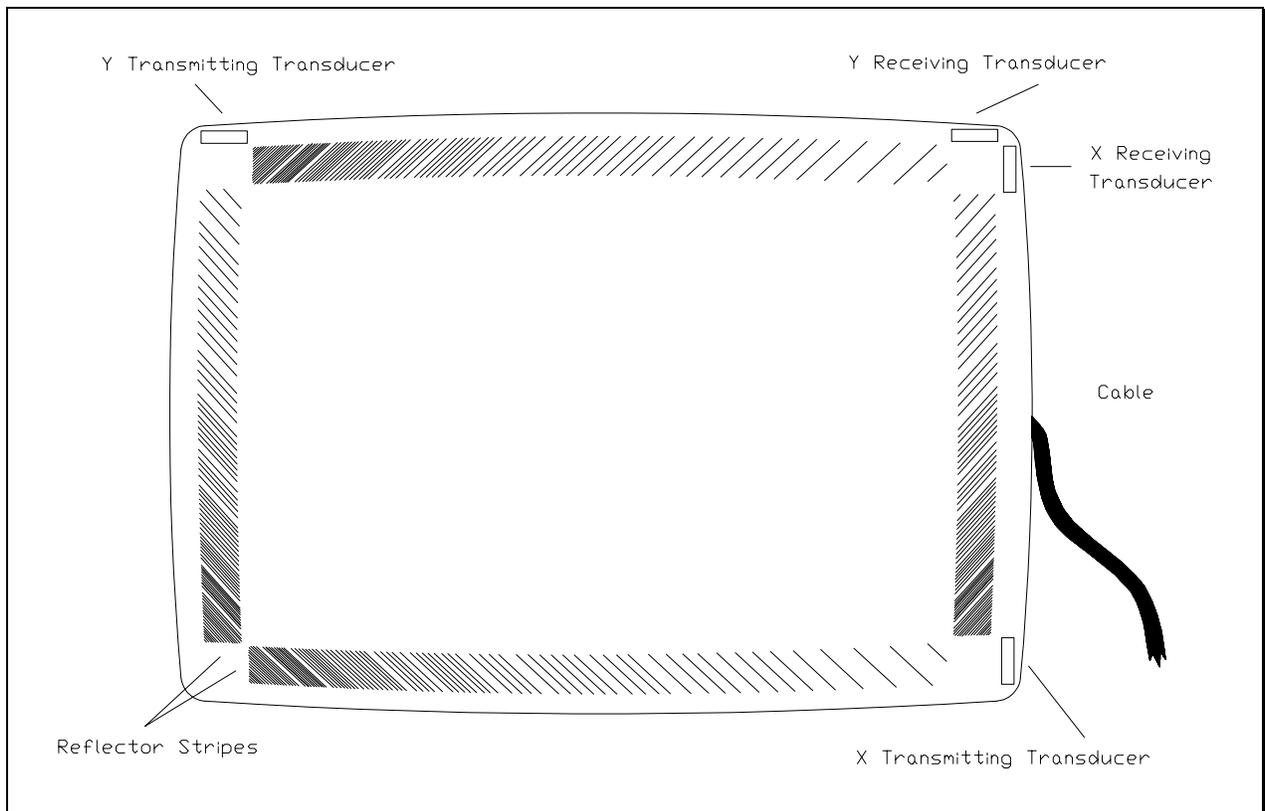


Figure 2-1. IntelliTouch Touchscreen

The X and Y values are similar to Cartesian coordinates, with X increasing from left to right and Y increasing from bottom to top. Z increases with touch pressure. These *absolute* coordinates are arbitrary and unscaled, and will vary slightly from unit to unit. Any coordinate normalization or scaling must be done at the driver level, and calibration to the display image must be performed for each unit. Because of the stability of the IntelliTouch system, recalibration is not necessary unless the position of the image changes.

## THE INTELLITOUCH CONTROLLERS

The IntelliTouch controllers provide the drive signals for the touchscreen, convert the received analog signals into digital touch coordinates, and send these coordinates to the computer.

An IntelliTouch Ultra controller is available with a serial RS-232 interface. Original IntelliTouch controllers are also available with PC-Bus (ISA or EISA compatible), Apple Desktop Bus (ADB), or Compact Disc Interactive (CD-i) interfaces. Controller options are detailed in Chapter 3.

Resolution of the IntelliTouch system is defined by the controller and is typically 4096 x 4096, with the controller transmitting 48 coordinates per second. See the Technical Reference Manual for your controller or the *IntelliTouch Touchscreen Products* brochure for details.

## DRIVER SOFTWARE

Elo driver software provides a consistent software interface among all Elo touchscreens and controllers.

The driver software scales the absolute coordinates received from the touchscreen controller into *translated* screen coordinates, using the calibration points obtained with the calibration program included with the driver software. The driver also performs other operations as directed by the application.

Elo provides driver programs for the DOS, Windows, Windows 95, Windows NT, OS/2, and Macintosh operating systems. Additional drivers may be available for other systems. Contact Elo for details.

If you cannot use an available driver, Elo can supply all the touchscreen related information you will need to write your own driver for any type of system, including UNIX workstations, real-time systems, and embedded systems.

For the E281-2310 controller, the *SmartSet™ Touchscreen Controller Family Technical Reference Manual* provides information on this process. Machine-independent source code is included on a companion disk.

For the E281-4035 controller, see the *E281-4035 IntelliTouch PC-Bus Controller Technical Reference Manual* for a description of the controller's output format along with other technical information. Also see the manual, *Writing a Touchscreen Driver for Elographics Touchscreen Controllers—Programmer's Guide*. Machine-independent source code is included on a companion disk.

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# Touch Monitor Installation

- *Touch Monitor Benefits* 11
  - *Touch Monitor Configurations* 12
  - *Touch Monitor Connections* 17
- 

Elo purchases and resells a variety of monitors, called touch monitors, with touchscreens and all related components fully installed. If you are installing components rather than a touch monitor, proceed to Chapter 4, install your touchscreen components, then return to this chapter.

## TOUCH MONITOR BENEFITS

Touch monitor benefits include:

- Single source for touchscreen and display
- Professionally engineered touchscreen installation
- UL/cUL, FCC, TÜV, CE, and other agency approvals
- Elo warranty
- Plug-and-play convenience

## TOUCH MONITOR CONFIGURATIONS

This chapter assumes you have one of the following:

- A touch monitor (Elo Model P284-XXXX-S) with an internal E281-2310 (IntelliTouch Ultra) serial controller.
- A touch monitor (Elo Model P284-XXXX) with one of the following external controllers:
  - E281-4035 PC-Bus Controller (P/N 002856-35-K1)
  - E281-2310MX (IntelliTouch Ultra) External Serial Controller (P/N 002310MX-UK1/UK2/K1)
  - E281-2303BX Tabletop Apple Desktop Bus (ADB) Controller (P/N 002862-K1)

## Touch Monitor with Internal Serial Controller

This configuration includes a touch monitor with an internal E281-2310 serial controller and a serial cable. Touch monitors with an internal serial controller typically have a DB9 *female* RS-232 connector on the back of the touch monitor. The serial cable connects the touchscreen to the serial port on the computer. Actual configuration may vary due to third-party integrations.

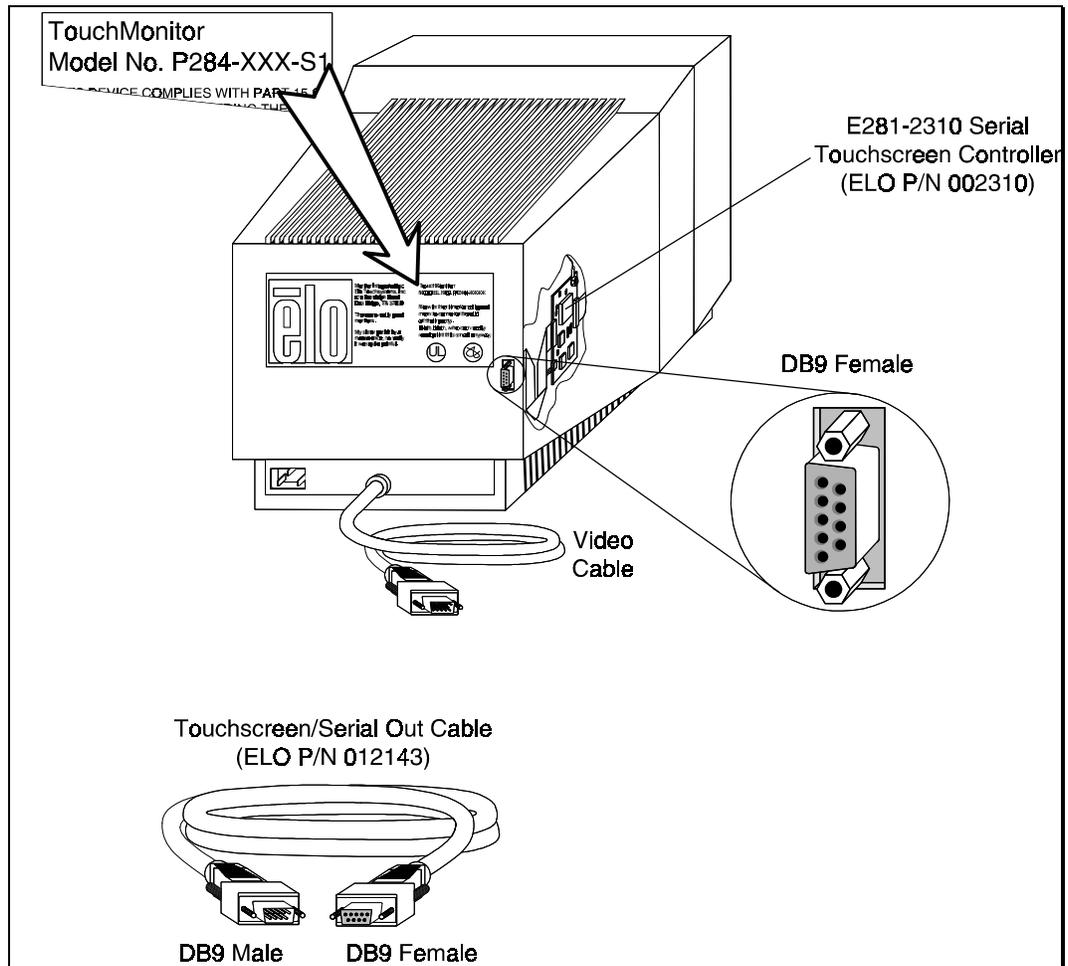


Figure 3-1. Touch Monitor with Internal Serial Controller

Touch monitors with an internal serial controller typically have a DB9 *female* RS-232 connector on the back of the touch monitor. A serial cable connects directly from the back of the touch monitor to the serial port on the computer.

## PC-Bus Controller

E281-4035 PC-Bus controllers plug directly into a slot in your computer and do not require a special enclosure or power supply. A touchscreen cable connects directly from the back of the touch monitor to the PC-Bus controller.

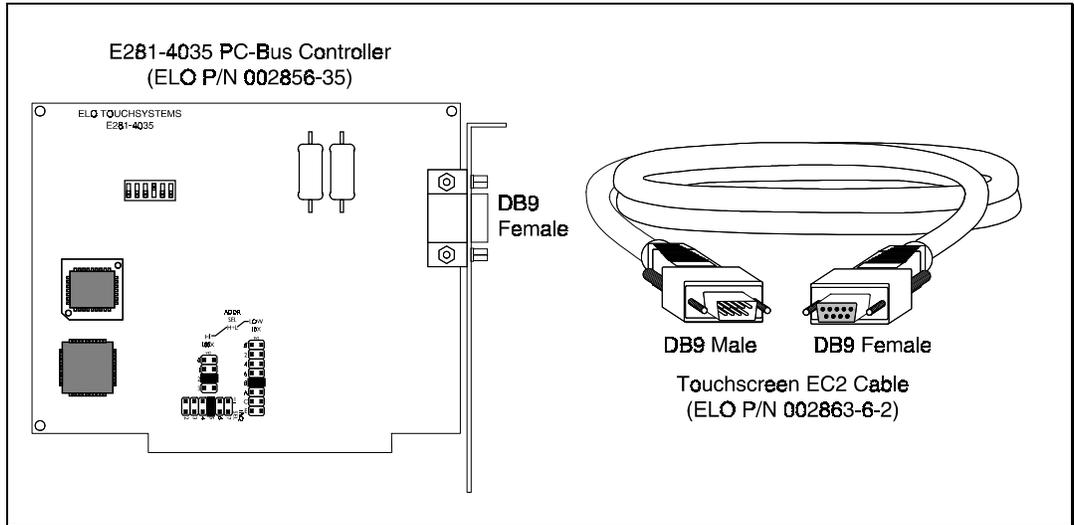
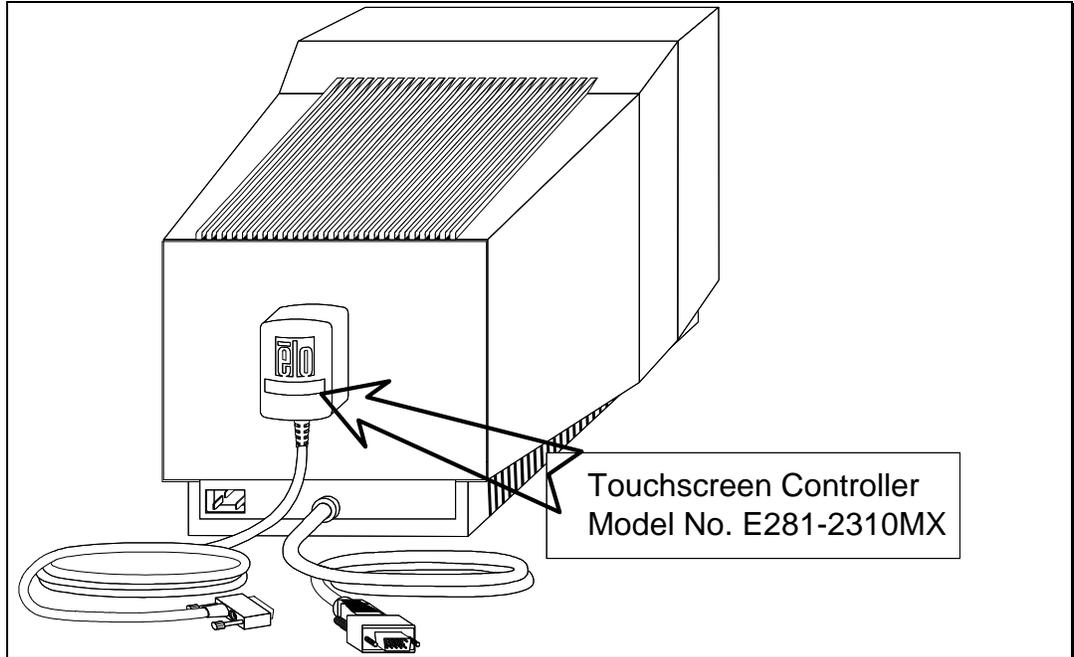


Figure 3-2. PC-Bus Controller

## External Serial Controller

The E281-2310MX family of external serial controllers connects to the serial port on your computer. All controllers are installed in an enclosure which may be mounted on the back of the display (E281-2310MX-UK1 or -UK2) or located on a desktop or within a kiosk (E281-2310MX-K1). The controllers may receive power within the display case (E281-2310MX-UK1), from a keyboard tap (E281-2310MX-UK2), or from a wall-mount power supply (E281-2310MX-K1).



*Figure 3-3. Touch Monitor with External Serial Controller*

## Tabletop ADB Controller

The E281-2303 Tabletop ADB Controller connects to the ADB port on your Macintosh computer and includes an external power supply.

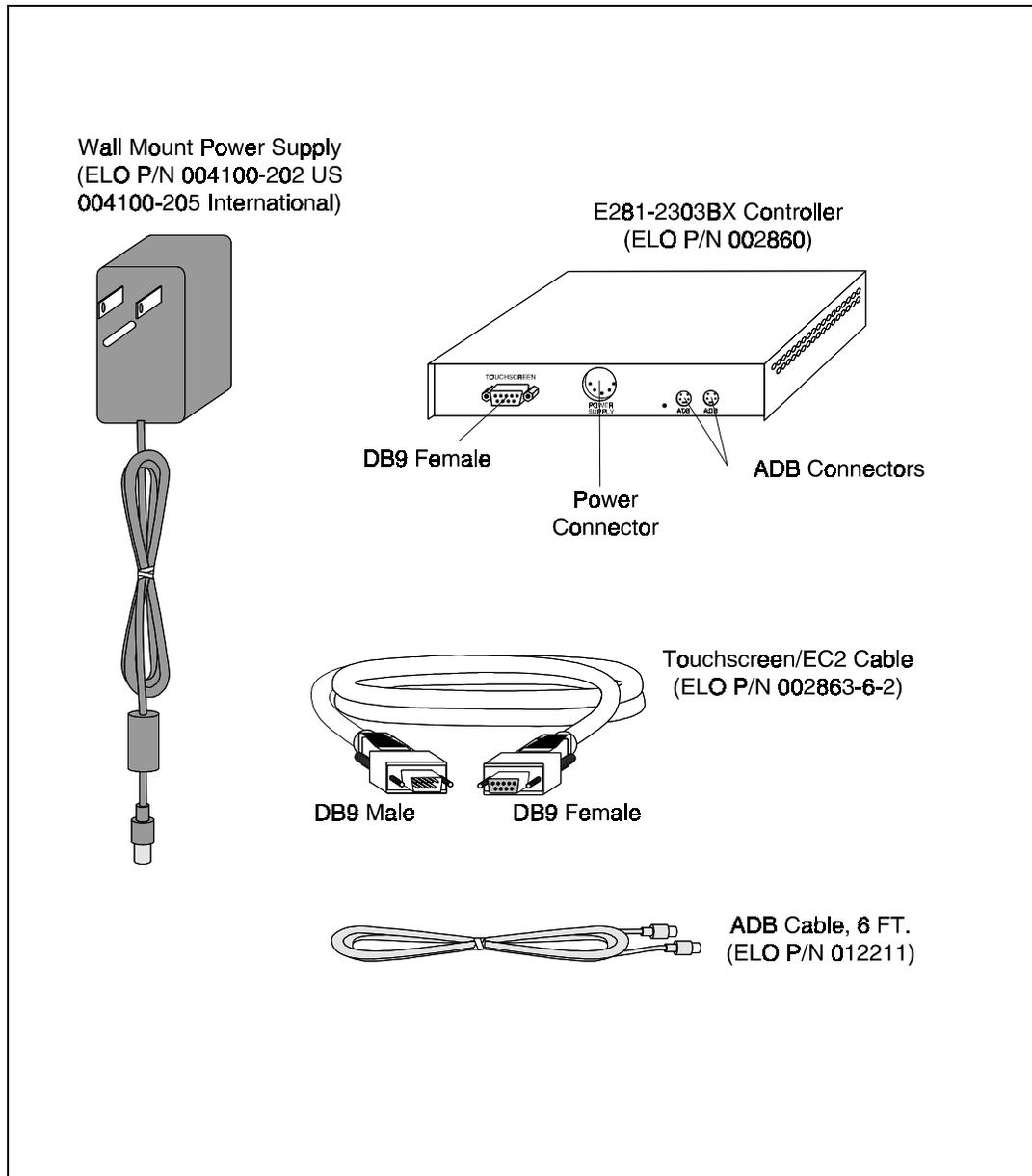


Figure 3-4. Touch Monitor with Tabletop ADB Controller

The Compact Disc Interactive (CD-i) controller (not shown) connects to the input port on your CD-i player. See Appendix B, page 66.

Controller boards, cables, and power supplies may also be ordered separately.

## **TOUCH MONITOR CONNECTIONS**

### **Connecting the Power and Video**

If you do not have a touchscreen installed in your display, skip to Chapter 4, which details the installation of touchscreen and controller components.

The video display function of the touch monitor and the touchscreen installed on the monitor are entirely separate systems. You should first connect and test your touch monitor as a video display only. Follow the instructions provided by the monitor manufacturer.

Next, refer to the appropriate page to continue your installation:

<b>Controller</b>	<b>Configuration</b>	<b>Page</b>
E281-2310	Touch Monitor with Internal Serial Controller	18
E281-4035	PC-Bus Controller	19
E281-2310	External Serial Controller	20
E281-2303	ADB Controller	21

## Installing a Touch Monitor with an Internal Serial Controller

The E281-2310 controller is internal to the monitor and is shipped preconfigured for use with the Elo ELODEV™ and MonitorMouse driver software.

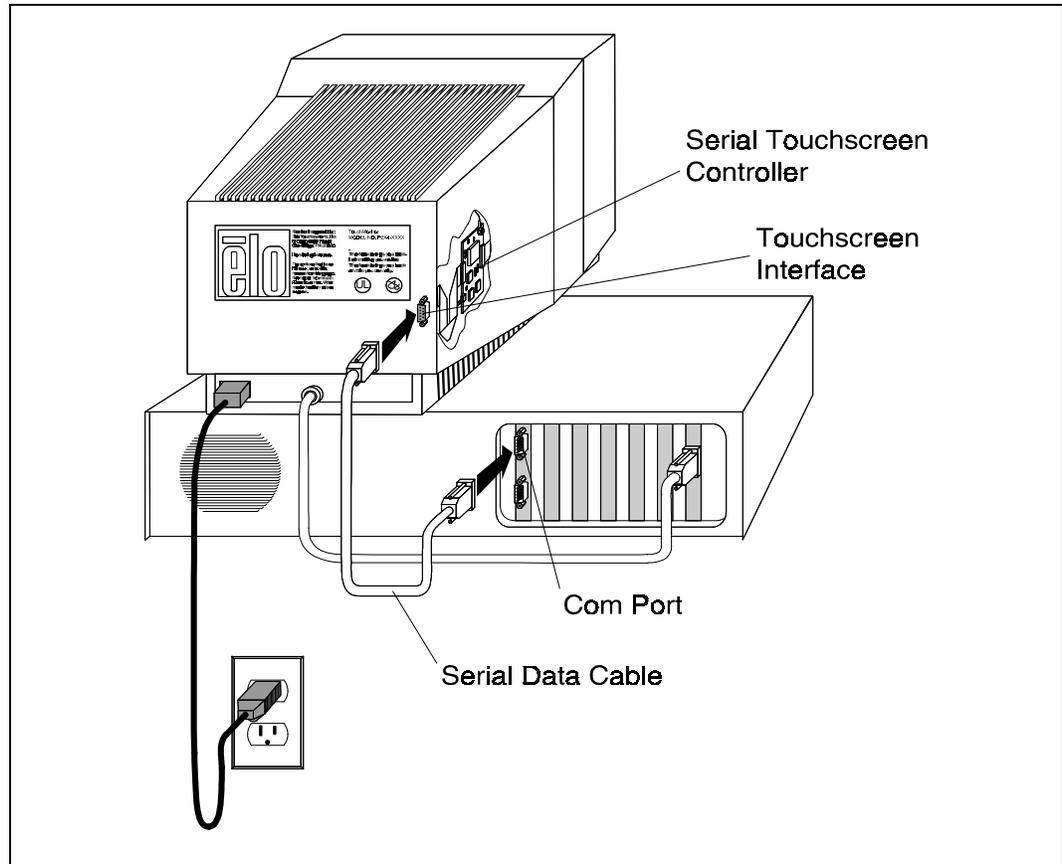


Figure 3- 5. Installing a Touch Monitor with an Internal Serial Controller

Proceed to *Where to Go from Here*, page 23.

## Installing a PC-Bus Controller

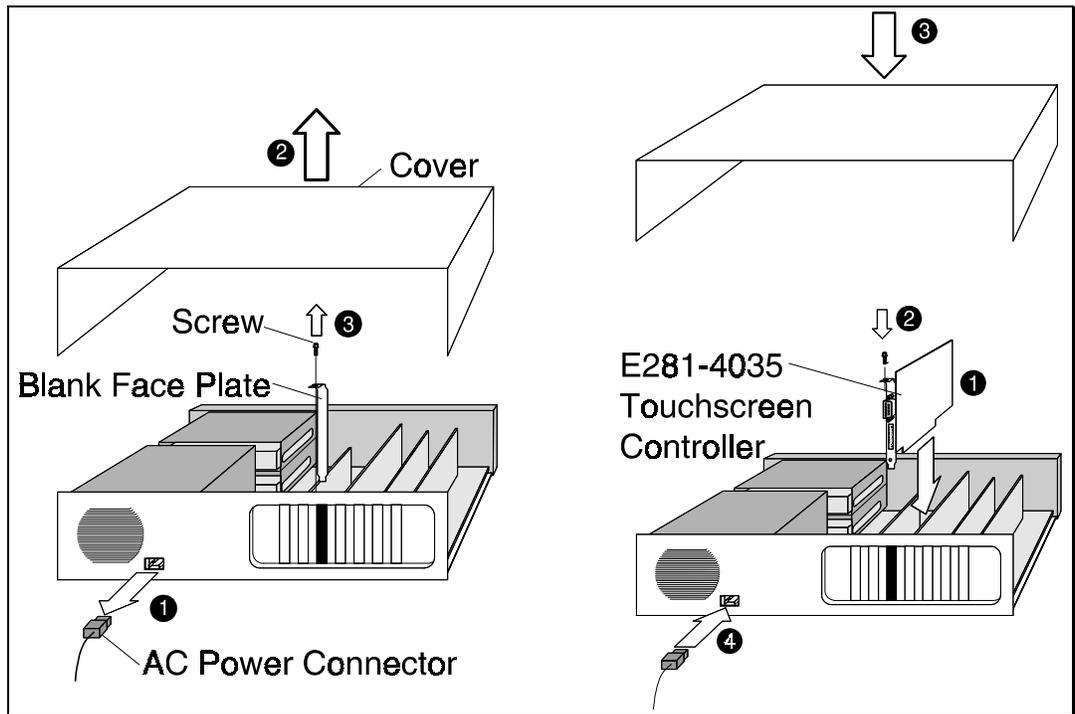


Figure 3-6. Installing an E281-4035 PC-Bus Controller

### Configure the Controller

The controller is shipped preconfigured for use with the Elo ELODEV and MonitorMouse driver software. Except for the Base I/O Port and Interrupt (IRQ) settings, no changes are necessary for most users. Specific jumper settings and options available for your controller are listed in the Elo software manuals and in Appendix B.

Proceed to *Where to Go from Here*, page 23.

## Installing an External Serial Controller

### E281-2310MX-UK1/-UK2 (Display Mount)

#### **CAUTION**

Before using a keyboard power tap, be sure sufficient power is available for the touchscreen controller or damage may occur to the computer. See Appendix C for power requirements.

#### **CAUTION**

Before connecting a keyboard power tap to the controller, be sure that power to the CPU is OFF. Connecting a keyboard power tap to a powered CPU may seriously damage the CPU or the controller.

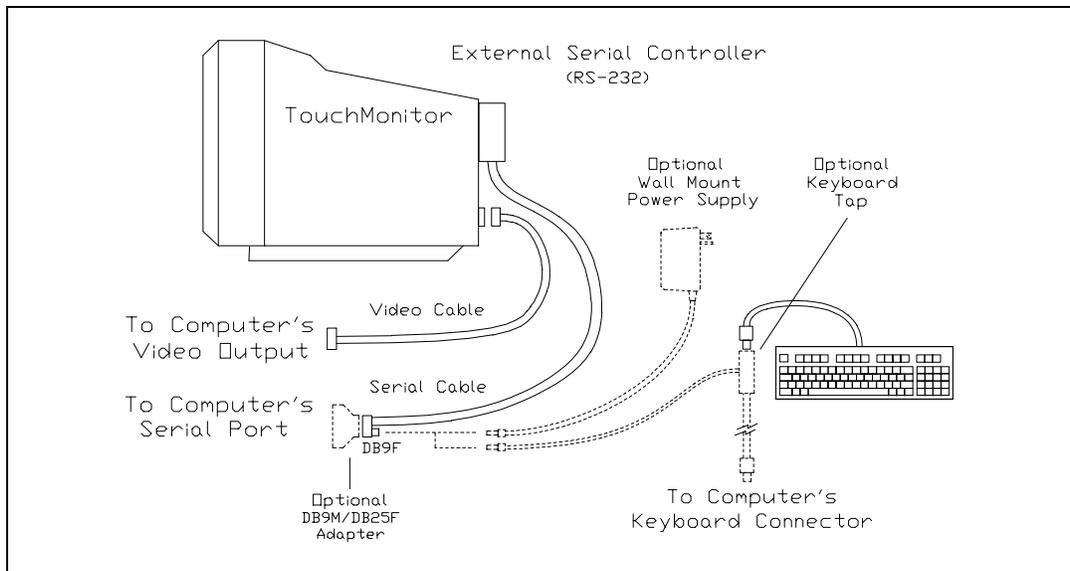


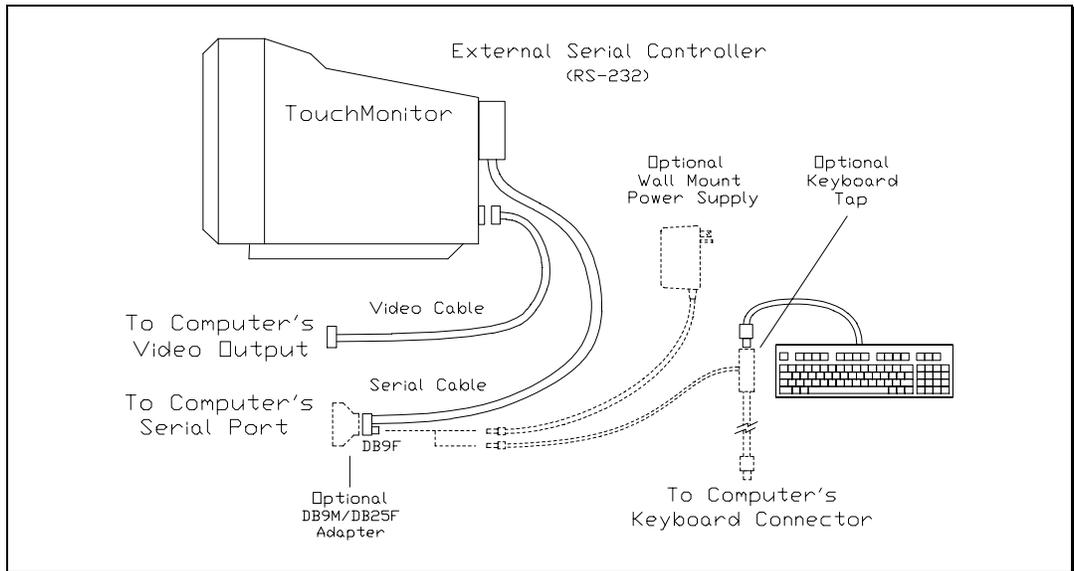
Figure 3-7. Installing an E281-2310MX-UK1/-UK2 External Serial Controller

The controller is shipped preconfigured for use with the Elo ELODEV and MonitorMouse driver software. No changes are necessary for most users. Specific settings and options available for your controller are listed in Appendix B.

If your software does not support the E281-2310 directly, you may operate the E281-2310 in E281A-4002 Emulation Mode. See Appendix B for jumper settings.

Additional technical information about the E281-2310 controller can be found in the *SmartSet Touchscreen Controller Family Technical Reference Manual*, available separately from Elo.

Proceed to *Where to Go from Here*, page 23.

***E281-2310MX-K1 (Desktop)***

*Figure 3-8. Installing an E281-2310MX-K1 External Serial Controller*

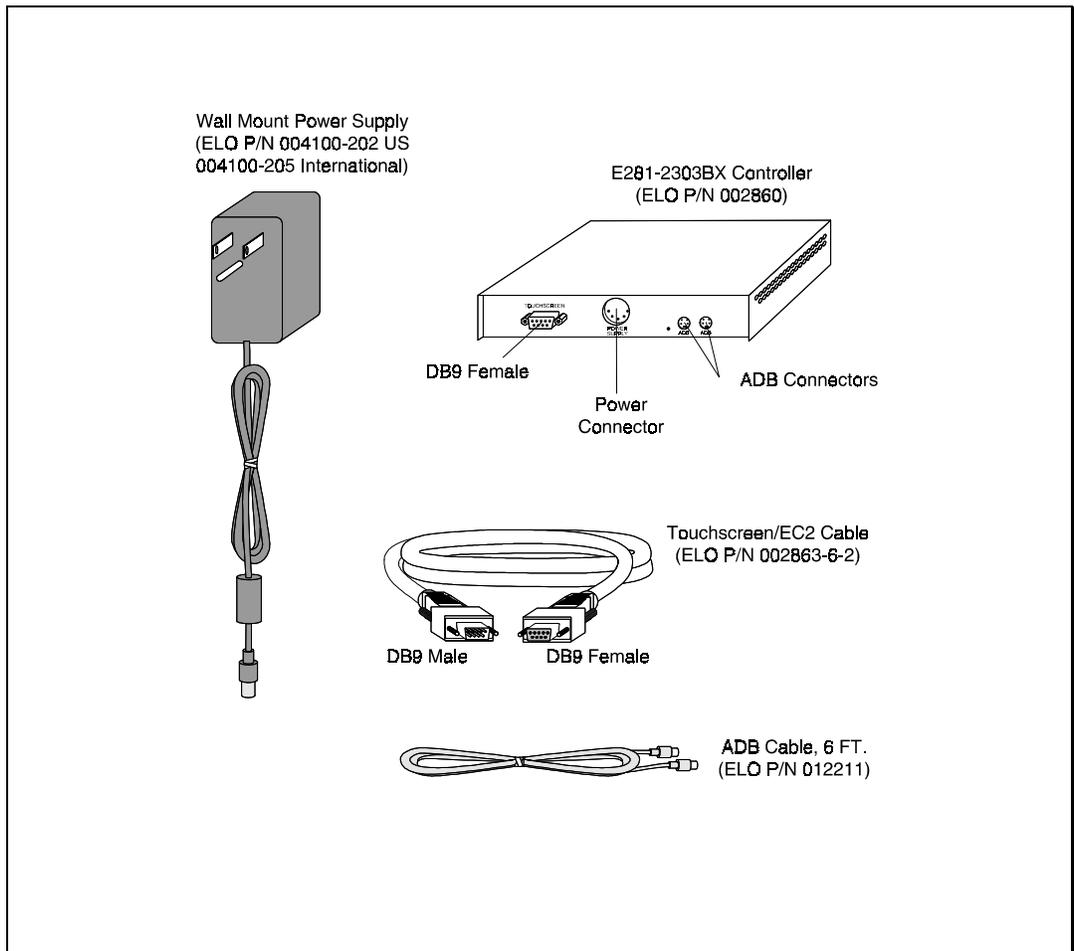
The controller is shipped preconfigured for use with the Elo ELODEV and MonitorMouse driver software. No changes are necessary for most users. Specific settings and options available for your controller are listed in Appendix B.

If your software does not support the E281-2310 directly, you may operate the E281-2310 in E281A-4002 Emulation Mode. See Appendix B for jumper settings.

Additional technical information about the E281-2310 controller can be found in the *SmartSet Touchscreen Controller Family Technical Reference Manual*, available separately from Elo.

Proceed to *Where to Go from Here*, page 23.

## Installing a Tabletop ADB Controller



*Figure 3-9. Installing an E281-2303 Tabletop ADB Controller*

The controller is shipped preconfigured for use with the Elo MonitorMouse for Macintosh driver software. No changes are necessary for most users. Specific settings and options available for your controller are listed in the *MonitorMouse for Macintosh User's Guide*.

To inspect or change the switch or jumper settings, unplug the controller and open the enclosure by removing the four screws from the bottom.

Proceed to *Where to Go from Here*, page 23.

E281-2303 ADB Controller Board Kit

The E281-2303 ADB controller can also be ordered in a kit without the enclosure. Model numbers, descriptions, and part numbers for the kit and its components are given below:

<b>Model Number</b>	<b>Part Number</b>	<b>Description</b>
E281-2303 Kit	002860-K1	ADB Controller Board Kit
<i>Contains:</i>		
E281-2303	002860	ADB Controller Component
EC2	002863-6-2	Touchscreen Cable (6 ft.)
N/A	012211	ADB Cable (6 ft.)
N/A	004100-202	External Power Supply (6 ft. Cord)
<i>Optional:</i>		
N/A	004100-205	International Power Supply

## WHERE TO GO FROM HERE

The hardware installation is now complete.

<b>Users of...</b>	<b>Proceed to the ...</b>
DOS or Windows 3.xx	DOS and Windows Driver Guide (P/N 008100-A)
Windows 95	DOS and Windows Driver Guide (P/N 008100-A)
OS/2	MonitorMouse for OS/2 User's Guide (P/N 008010-A)
Windows NT	MonitorMouse for Windows NT User's Guide (P/N 008013-A)
Macintosh	MonitorMouse for Macintosh User's Guide (P/N 008015-A)
Other	Appropriate third-party documentation

If you will be writing your own driver program, additional manuals are available. For the E281-2310 controller, see the *SmartSet Touchscreen Controller Family Technical Reference Manual*. For the E281-4035 controller, see the *E281-4035 IntelliTouch PC-Bus Controller Technical Reference Manual* and the *Writing a Touchscreen Driver for Elographics Touchscreen Controllers—Programmer's Guide*.



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# Component Installation

- *Safety Information* 26
  - *Getting Started* 27
- *Disassembling the Display* 29
- *Mounting the Touchscreen* 34
- *Controller Interface Options* 38
- *Routing the Touchscreen Cables* 44
  - *Reassembling the Display* 46
    - *Sealing* 47
- *Flat Panel Display Integration* 49

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Elo purchases and resells a variety of monitors, called touch monitors, with touchscreens and all related components fully installed. If you already have a touch monitor, follow the installation instructions in Chapter 3.

If you do not have a touch monitor, read this chapter for details on installing touchscreen components that will convert your monitor into a touch monitor. Details are given on mounting the touchscreen, controller, and connecting cables.

While this chapter refers primarily to CRT-based display technologies, much of this information can be applied to other display technologies. See *Flat Panel Display Integration*, page 49.

These instructions assume you have purchased an Elo Touchscreen Kit (Model E284A-XXX-K2, P/N 0028XXA-XXX-K2), and have also purchased a Touchscreen Installation Kit (P/N UK0001). Only a minimum of equipment and materials is required beyond what is provided in the kits.

In brief, adhesive materials are used to fasten the touchscreen to the CRT and then the assembly is reinstalled in the original enclosure with minor modifications. If this procedure is not suitable for mechanical, electrical, or optical reasons, there are other techniques for touchscreen installation that may achieve the desired results. These techniques often require specialized equipment or materials, and a complete discussion is beyond the scope of this manual. Contact Elo Technical Support for additional information.

## SAFETY INFORMATION

### **WARNING**

*The touchscreen installation procedure outlined in this chapter may require exposure to high-voltage components and handling of the CRT. This procedure can be dangerous and an accident is potentially lethal. Therefore, the procedure should only be performed by a qualified person. Read this entire chapter before attempting a touchscreen installation. Follow the procedure carefully, work with the power off and the unit unplugged, observe all warnings, and wear protective clothing. Elo is not liable for damage or injury that could result from your actions.*

Consider purchasing a touch monitor from Elo if you do not have previous experience working with touchscreens and disassembling displays. Elo also offers touchscreen installation services in quantity for a variety of displays or can recommend third-party integrators in your area.

### Work Area

Before proceeding with the installation, prepare a padded work surface. A plastic waste basket is recommended for supporting the CRT during part of the installation.

### Protective Clothing

Wear safety glasses, gloves, a rubber apron, and heavy protective clothing for any portion of this procedure that involves handling or working near the CRT.

## GETTING STARTED

IntelliTouch Ultra touchscreens can be installed on most types of displays. Figure 4-1 shows a typical installation.

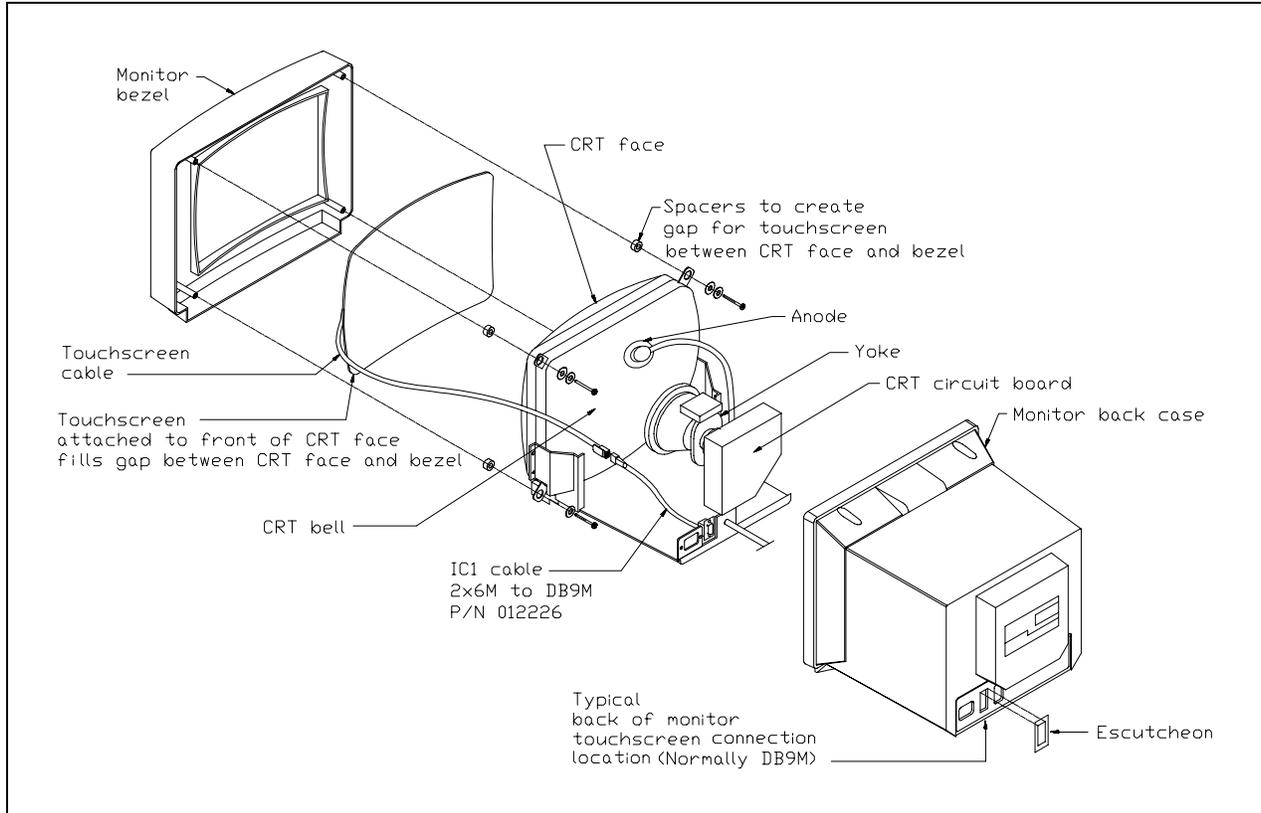


Figure 4-1. Typical IntelliTouch Touchscreen Installation (for use with external controller)

IntelliTouch touchscreens are available for most displays. Each display may pose unique installation issues. Although your display may not be a standard touch monitor product from Elo, we may have had some experience with it. Contact Elo Technical Support for more information.

This section assumes you have already determined compatibility between the touchscreen and the display. A Touchscreen Installation Kit is available from Elo (P/N UK0001) which includes the commonly used materials needed for installation.

Most displays require complete disassembly, including removal of the CRT, to install a touchscreen. Disassembling the display can be a dangerous procedure if done improperly. Before proceeding, review the rest of this chapter. Basic assembly skills are required. Seek qualified help if you have any doubts about your ability to complete the installation. Any damage to the display or the touchscreen as a result of improper installation is the installer's responsibility.

Without prior approval of the display manufacturer, you will probably void the display's warranty by disassembling it. Also, it will be necessary to recertify the display and touchscreen system for regulatory agencies such as FCC and UL/CSA if those certifications were originally present and need to be maintained for your intended application. (Elo offers touch monitors with full agency approvals.)

Handle the touchscreen with care. The transducers in the corners are especially fragile. Although the transducers are partially covered with tape, do not handle them unless inspection is necessary. Review Figure 2-1, page 9, and note the location of the transducers and wiring. If any of these are accidentally broken during handling or installation, or if a wire is pulled loose, the touchscreen will not operate. Avoid excessive handling and stress on the touchscreen cable.

## Testing Components

The display must be in good working order before beginning the installation of the touchscreen. With a new display, it is suggested that you test the display by running it overnight. Do not leave a constant image at normal brightness on the screen during this test, as it may burn an image into the screen.

Familiarize yourself with the operation of the touchscreen and controller before you proceed with the installation. Use the BUSSTAT, COMDUMP, or TOUCHES programs as described in the *DOS and Windows Driver Guide* while the touchscreen components are arranged on the work surface.

## Installation Steps

The installation process consists of the following steps:

- Disassembling the display
- Attaching the touchscreen to the CRT
- Optionally installing an internal serial controller
- Interfacing the touchscreen or serial data cables to the exterior of the display
- Reassembling the display
- Optionally sealing the display

Specific compatibility may not be confirmed until well into the installation.

## Suggested Tools

The following is a list of tools that may be needed to install the touchscreen. Some of the tools are optional, but will be useful if needed.

- Long (at least 9 inches, 200 mm) flat blade screwdriver with insulated handle
- Clip lead or heavy-gauge wire
- #2 Phillips screwdriver
- Scissors
- X-Acto knife (No. 11 blade) or hand milling tool
- DB9 hole punch
- Cable ties
- Household glass cleaner
- Paper towels
- Small containers or plastic bags to hold loose parts

The Elo Touchscreen Installation Kit (P/N UK0001) is also recommended, and includes commonly used materials needed for touchscreen installation. This kit is useful for identifying preferred materials for your own procurement and may also be cost-effective and convenient when purchased for a limited number of installations.

A copy of the monitor manufacturer's service manual is also useful, if available.

## DISASSEMBLING THE DISPLAY

Disassemble the display on a large, well-lit work surface. Leave space to set aside major display components. Group screws and other hardware in small containers or in specific areas on the work surface as you remove them, in relation to the part of the display where you are working. If you complete the installation process in one session (which may require several hours for your first efforts), it is unlikely that you will have trouble reassembling the display.

Most display manufacturers connect the major components with detachable cables that have labeled and keyed connectors; these cables are of lengths that will usually connect to only one place. Also, screws are identifiable by type and size, and usually will not fit in the wrong place. The most difficult problem with missing or wrong hardware or connections will be with single ground cables that attach to obscure ground points on the metal chassis. When in doubt, make notes of the connection points.

## Removing the Back Case

Figure 4-1, page 27, shows the typical construction of a 14-inch display. Disassembly usually starts with removal of the back case. For assistance with disassembly, consult your particular manufacturer's service manual. Carefully lay the display on its face on the padded work surface and remove the screws that attach the back case to the bezel or frame.

While removing the back case, note the clearance between the inside rear surface of the case and a small circuit board plugged into a socket on the end of the CRT. If there is not enough clearance to move the CRT and this circuit board about .25 inch (6 mm) toward the rear of the case, you may be unable to successfully install a touchscreen on the display and completely reinstall the back case. Contact Elo Technical Support for possible alternatives.

After the back case is removed, the CRT is substantially exposed. Use extreme care when working around the CRT.

### **WARNING**

*Impact or force against the neck of the CRT, or the pins at the end where the small circuit board is attached, could crack the tube, resulting in loss of vacuum or implosion of the tube. Either result destroys the CRT. Implosion (collapse of the glass inward, caused by the high vacuum inside the tube), followed by the rebound of many glass pieces outward, is potentially lethal to anyone in the immediate area. Handle the CRT carefully, keep tools away from the CRT, and wear protective clothing including eye protection. See [Safety Information](#), page 26.*

## Discharging the CRT

### **WARNING**

*Dangerous voltages may be present on the CRT anode. The anode may retain a very dangerous voltage even after the display has been off for days. Accidental contact with the anode lead or anode button (the small hole in the CRT glass where the anode lead is attached) prior to discharge may result in a potentially lethal shock. Follow the procedure below carefully to avoid injury.*

The anode lead of the display feeds high voltage from the flyback transformer to the anode button on the CRT. The anode lead is usually red in color, and the actual connection to the anode button is usually covered by a large rubber suction cup-like boot. In most displays, the button is located on the tapered face, or bell, of the CRT glass near the top of the display. See Figure 4-1, page 27.

It may be necessary to remove some sheet metal to gain access to the anode lead—be very careful to do this without making contact to the anode lead itself.

Carefully discharge the CRT using the following procedure:

1. Connect a clip lead or a heavy-gauge wire to chassis ground of the display (or if the CRT is free-standing, the mounting ears or the spring-tensioned ground strap).
2. Connect the other end of the clip lead or wire to the stem of a flat blade screwdriver that has an insulated handle.
3. Hold the screwdriver by the insulated handle only. Insert the blade of the screwdriver under the rubber boot and make contact with the anode lead at the button. A distinct snap may or may not be heard as it discharges, depending on the amount of charge present on the anode.
4. Disconnect the anode lead from the button by unhooking the spring wire clips. Note the location of the anode for proper CRT orientation during reassembly.

**WARNING**

*The CRT will regain a charge over time, even after it has been discharged. To avoid a dangerous electric shock, always discharge the CRT just before handling it, and treat it with respect thereafter.*

## Removing the Electronics Chassis

Continue disassembling the display until the face of the CRT is completely exposed. The degree of disassembly required will vary from display to display.

Normally the next step will be to remove the electronics chassis from the display. This requires removal of a small circuit board that is usually plugged into the socket on the end of the CRT. The circuit board is often glued to the CRT socket with a soft adhesive which must be cut away to remove the board. Several cables must also be unplugged from the electronics. Typically these cables are:

- Four wires from the yoke of the CRT, typically in a single four-pin connector. The yoke is the copper wire and magnet assembly at the base of the neck of the CRT. MPR II-compliant monitors may have additional cables and connectors on the yoke.
- A two-wire cable from the degaussing coil. This coil may be attached to the CRT, or be laying out of sight between the CRT and the bezel. Some monitors may have two separate coils.
- A one- or two-wire ground cable connected between the CRT circuit board and a ground strap. This strap is a long, uninsulated, braided wire which is spring-tensioned to maintain contact with the bell of the CRT.
- Various cables connected to the power switch, pilot light, front panel controls, etc.

Other cables may have to be unplugged from the electronics chassis. The need for this may not be apparent until the chassis is removed, as instructed below.

Another preliminary step in determining touchscreen/display compatibility should be performed at this point. Before removing the electronics chassis, note the clearance between the chassis components and the bell of the CRT. Since the standard technique for mounting the touchscreen involves moving the CRT back in the display chassis, there must be enough clearance between components on the chassis and the CRT *after* allowing for about 0.25-inch (6 mm) movement of the CRT towards the rear of the chassis. Failure to allow for this clearance requirement may result in mechanical damage later (especially in shipping). It may also cause electrical damage from shorts between "live" components on the chassis, such as heat sinks or uninsulated component leads, and the bell of the CRT which is usually painted with a conductive coating that is grounded to the chassis through the braided wire ground strap. Repositioning or substituting low profile components may be an option. Contact Elo Technical Support for assistance.

After disconnecting any necessary cables, remove the screws that attach the electronics chassis to the bezel. Note the bezel is essentially where all parts of the mechanical assembly are attached, unless you have a rare unit that has an internal

frame. As you pull the chassis away from the bezel, make sure that cables and circuit boards do not hit the neck of the CRT and that nothing becomes caught on the adjustment rings or other components on the neck of the CRT. Also watch for other cables that need to be disconnected. After removal, set the electronics chassis aside.

## Removing the CRT

Removal of the CRT is next. Prepare a soft surface to set the CRT on. Remove the screws attaching the CRT to the bezel, and then remove the CRT. Do not lift or carry the CRT by the neck or yoke assembly. Avoid contact with the anode button, which may still have some residual charge on it, (you may wish to discharge it again at this point). Set the CRT on the prepared surface.

Several other preliminary compatibility requirements should now be assessed:

- Position the CRT so the face is accessible, providing a soft cushion for the neck and the yoke if they must rest on the work surface. Alternatively, set the CRT face-up in an office-type plastic waste basket, *making sure that the tube is not resting on the neck*. Place the touchscreen on the face of the tube, and check to see that the face of the CRT and touchscreen are about the same size, and that the radius of curvature (ROC) of each surface matches well. If both of these conditions are not met, you may not have the proper touchscreen for the display. Most color displays have standard size CRT's with standard ROC's, and Elo has touchscreens for most of them.
- Next, determine if the touchscreen will fit in the bezel without modifications to the bezel. Modifications, if necessary, should be done without seriously compromising the mechanical integrity of the display.

Lay the touchscreen face-down in the bezel, being careful not to damage the transducers (see Figure 2-1, page 9). Leave the degaussing coil in place, if present. The degaussing coil is a hoop, often located between the CRT and bezel, approximately 0.25-inch (6 mm) thick, with a two-wire cable and connector. The coil was probably unplugged from the power supply earlier.

If the touchscreen will not fit flush against the lip of the bezel, do not force it. An interference fit between the edge of an IntelliTouch touchscreen and some of the plastic ribs found in display bezels can pinch and break the small wires which carry the signals along the edges of the touchscreen or even result in fracture of the glass after reassembly.

It is often necessary to cut ribs and struts inside the bezel. Cutting does not usually cause difficulties although the stiffness of the bezel may be reduced slightly. Try not to cut into the posts for the CRT attachment screws. Bezel and tube combinations that require this cut are rare.

Generally, a total clearance between the edge of the touchscreen and any ribs or struts of at least 0.25-inch (6 mm) in both axes is necessary. This prevents the interference fit problem discussed above and allows for variation in touchscreen mounting position.

The potential interference between the degaussing coil and the touchscreen must also be evaluated. The coil will usually fit between the touchscreen and the inside surface of the bezel, as there is typically a natural cavity for it. If there is not enough space for the coil, you may have to provide additional setback for the CRT. It may also be possible to relocate the coil to the bell side of the CRT. Normally, this does not significantly reduce the coil's effectiveness. However, you must determine this by inspecting the display for color problems after reassembly.

- Check for adequate clearance of the transducers and the cable from the bezel structure. If the position of the cable causes difficulty, the touchscreen may be rotated 180°. The preferred orientation of the IntelliTouch touchscreen is with the cable exiting from the right side, when viewed from the front of the display. Rotation will cause an inversion of the output coordinates, which will be compensated for automatically by Elo driver software, but perhaps not by other drivers. (Flat touchscreens should have the reflector stripes on the side facing the user.)

## **MOUNTING THE TOUCHSCREEN**

When preparing the touchscreen for mounting to the CRT, major considerations are:

- Reasonable mechanical alignment with the display.
- Mounting materials and methods that do not put surface wave-absorbent substances, such as duct tape, RTV caulks, or soft foam gaskets in contact with either the touch active area of the glass or with the reflector stripes. These materials can be used if they contact the back side of the touchscreen or the glass outside the touch active area and the reflector stripes.
- A complete dust seal between the touchscreen and the CRT.
- A mounting technique that evenly supports the touchscreen on at least two opposite edges. Elo recommends double-sided tape between the touchscreen and the CRT.

- Creating enough space between the CRT and the bezel to accommodate the touchscreen and the transducers. Adequate spacing can normally be accomplished by: 1) trimming or milling the inside of the bezel; 2) using spacers to move the CRT back in the chassis; 3) using spacers to move the bezel away from the touchscreen. A combination of moving the CRT back with spacers and trimming the bezel is the usual solution.
- The type of seal to be used between the touchscreen and the display bezel.

Spacers must be placed between the mounting ears of the CRT and the mounting posts in the bezel of the display to prevent the touchscreen from being clamped between the CRT and the bezel. The last three considerations listed above should determine the nominal thickness of the spacers to be used.

Many monitors will have sufficient space in the bezel to allow the touchscreen face to rest against the lip of the bezel, with the lip touching the active region of the touchscreen. However, the transducers should not be in contact with the bezel. Assuming double-sided tape is used to attach the touchscreen to the CRT, the final spacing will be determined by the type of seal to be used. See *Sealing*, page 47, for an explanation of sealing methods.

Double-sided tape and foam sealing tape are included in the Touchscreen Installation Kit (P/N UK0001). The following steps assume you will use these materials to mount the touchscreen to the CRT.

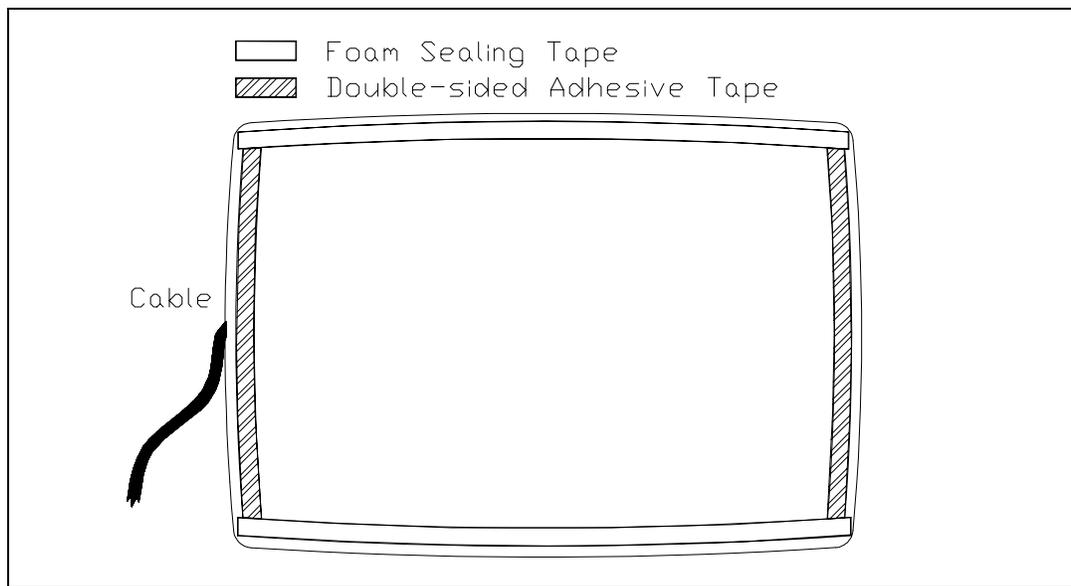


Figure 4-2. Rear View of IntelliTouch Touchscreen with Mounting Materials

Before mounting the touchscreen, clean the face of the display and the back of the touchscreen with household glass cleaner. Be sure to remove all fingerprints. The space between the touchscreen and the display face must be clean and free of any foreign objects.

Mount the touchscreen as follows:

- Use two layers of the double-sided adhesive tape to achieve a total thickness of 1/16-inch (2 mm). While specific touchscreen and CRT combinations may allow the use of thinner materials, 1/16-inch (2 mm) is generally necessary to allow for variations in ROC between the two glass surfaces. Review the fit between the touchscreen and the CRT before applying the tape. If one pair of opposite edges has a closer fit than the other, put the adhesive tape on the edges of the touchscreen with the better fit. See Figure 4-2 for typical placement. If there is a good fit on all four edges, you may want to use double-sided adhesive tape on all four edges. When doing this, move the adhesive tape in slightly on one pair of edges and add foam sealing tape outside these two edges. The thicker foam tape will keep the adhesive tape away from the CRT until you are ready to adhere the touchscreen to the display.

In general, the adhesive tape should be set back slightly from the edge of the active area of the touchscreen. The adhesive tape should be attached to the glass and not to the black tape around the perimeter of the touchscreen. When the display is reassembled, the mounting tape should not be visible. Do not remove the liner from the exposed side of the adhesive tape yet.

- Cut and place the foam sealing tape on the back of the touchscreen to form a dust seal as shown in Figure 4-2, page 35. This seal is particularly important because the CRT is a good electrostatic precipitator and will attract dust. The adhesive tape and foam sealing tape should form a complete seal around the touchscreen. Do not leave any gaps. The sealing tape should not be visible when the display is reassembled.
- Practice aligning the touchscreen on the CRT without removing the adhesive tape liner. The installation can tolerate some horizontal and vertical shift. However, rotational skew between the touchscreen and display axes cannot be easily compensated for in the calibration, and will also interfere with proper mounting of the tube in the bezel.
- When you have a good feel for the placement of the touchscreen, clean the back side of the touchscreen and the face of the CRT again. Avoid all contact between the cleaning solution and the mounting materials as the cleaner may cause the mounting materials to eventually release from the glass. Remove all lint with a brush or compressed air. Remove the liner from the adhesive tape and align the touchscreen on the display. The thicker foam tape will keep the adhesive tape away from the CRT until you are ready to adhere the touchscreen to the display. Now press the touchscreen firmly against the CRT.

- Inspect your results carefully for alignment, trapped dust or lint, and a good seal between the touchscreen and CRT. If there is trapped lint, you may be able to remove it without removing the touchscreen by capturing it with a thin wire with a small spot of glue. Poke the wire through the foam gasket and stick the lint to the wire. Pull the lint back into the gasket and embed it there, or remove it completely and reseal the gasket.
- If you must remove the touchscreen from the CRT, cut the adhesive tape away with a sharp thin blade, such as an X-Acto knife. The touchscreen glass will probably break if you try to pull it off by a corner or an edge. Shave the old adhesive tape from the touchscreen and CRT with the knife. Adhesive residues can be removed with isopropyl alcohol, which will leave streaks and fingerprint smears. Use glass cleaner for the final cleaning prior to reapplication of new tape.

## Spacing the CRT from the Bezel

The last part of the touchscreen mounting procedure is to determine the appropriate spacing of the CRT from the bezel, (with the touchscreen attached), and to reinstall the CRT with the required spacers in place (refer to Figure 4-1, page 27). *Do not clamp the touchscreen between the bezel and the CRT without proper spacers as breakage will almost certainly occur.* The nominal thickness of the touchscreen and the two layers of adhesive tape is 3/16-inch (5 mm). If the touchscreen is to be in contact with the bezel, 3/16-inch (5 mm) nominal spacers would be required.

Because the original CRT face-to-bezel mount is often an interference fit, with the bezel shape altered slightly to draw it up tightly against the CRT, you should start with a 1/16-inch (2 mm) thicker spacer than the nominal dimension above. Two thicknesses of spacers, plus additional washers to use as shims, are available in the Touchscreen Installation Kit (P/N UK0001).

During the spacer selection process, you may have to install the CRT with the touchscreen attached in the bezel several times. To prevent the CRT from dislodging the spacers, temporarily insert plastic tie wraps or toothpicks as guides in the mounting post holes. After selecting the correct spacers, discard the guides and fix the spacers more securely in place with the adhesive "doughnuts" provided in the Touchscreen Installation Kit.

When spacers for the desired gap have been selected, install the CRT. Make sure you have previously reinstalled the degaussing coil. Select a screw that is long enough to compensate for the spacer thickness (provides at least three full turns into the mounting post threads) but not so long as to penetrate the surface of the bezel. Over-tightening the screws may strip or split the mounting posts.

## CONTROLLER INTERFACE OPTIONS

Elo offers serial (RS-232), PC-Bus, Apple Desktop Bus (ADB), and Compact Disc Interactive (CD-i) controllers for IntelliTouch touchscreens. Serial controllers may be purchased as components for installation inside the display. Serial controllers may also be purchased in an enclosure to be mounted on the back of the display, in a kiosk enclosure, or simply placed on the tabletop (see Chapter 3). ADB controllers may be purchased as components or in a Tabletop enclosure (see Chapter 3).

The following sections describe the options for mounting a serial controller inside the display or external to the display, as well as cabling for an external PC-Bus controller. Installation for either an internal E281-2303 ADB controller or E281-2300 CD-i controller is not covered in this manual, but is a similar process.

Regardless of the configuration of touchscreen and controller, you are responsible for any recertification for agency approvals (FCC, UL/CSA, TÜV, CE, etc.) that may be necessary for your application.

### Internal Serial Controller

An IntelliTouch Internal SmartSet Controller Kit (P/N UK2310) is available from Elo (see Figure 4-3). It includes wiring harnesses and cables, mounting hardware, a DB9 female bulkhead connector (male connectors are used with external controllers), and detailed instructions. This kit is useful together with the Touchscreen Installation Kit (P/N UK0001) for identifying preferred materials for your own procurement. The Controller Mounting Kit may also be cost-effective and convenient when purchased for a limited number of installations.

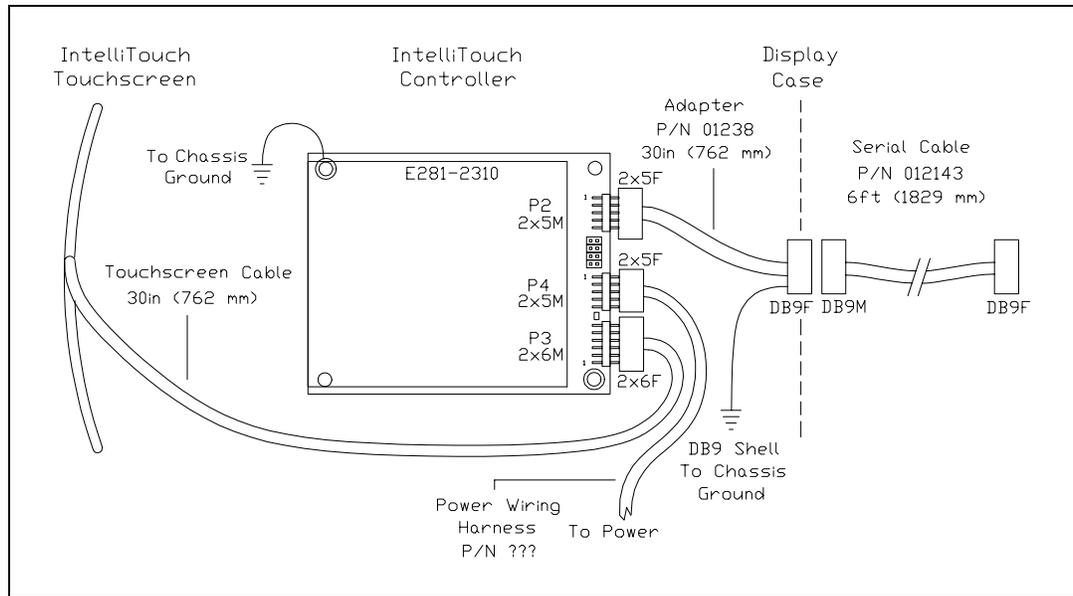


Figure 4-3. Touchscreen Cabling System for Internal Serial Controller

The mounting holes of the E281-2310 serial controller are sized for 0.156-inch (4 mm) snap-in standoffs. All IntelliTouch Model E284A touchscreens (P/N 0028XXA-XXX) have a cable termination that mates directly with the male header (P3) on the controller. See Figure B-4, page 73, for specific mounting dimensions and connections.

Mounting an internal serial controller presents some challenges:

- Space for the controller and the cable headers.
- Space for an internal DC-to-DC converter power supply or for an AC power supply if either one is required. The E281-2310 controller power requirements are +5 Vdc nominal (140 mA typical). If this power is not available from your monitor's power supply, Elo offers an +8-30 Vdc to +5 Vdc converter power supply (P/N 002500) or a 110-240 Vac power supply (P/N 004100-204) suitable for use with the E281-2310 controller.
- Cable routing that may contribute to noise and crosstalk.
- Electromagnetic Interference (EMI) suppression. Installing a touchscreen and controller will affect the EMI characteristics of the display.
- Heat dissipation. The IntelliTouch serial controller dissipates about 1.1 W. A typical power supply, if required, may dissipate several watts more. This places an additional load on the cooling system of the display. The available locations to mount a controller and power supply may also affect the cooling system of the display.

Follow these steps to install the controller, using the IntelliTouch Internal SmartSet Controller Kit (P/N UK2310):

1. Evaluate the monitor for proper positioning of the controller. Make sure there is sufficient space for cable headers.
2. Evaluate the back case of the monitor to determine the best position for the DB9 female connector. A hole for this connector may be furnished in a variety of ways: a) mounting the connector to a chassis member that is exposed to the display exterior, b) mounting the connector to a chassis member with a hole in the exterior of the case to provide access to the connector, and c) mounting the connector to the case.
3. Once proper component positioning has been determined, insert the desired profile standoffs into at least three of the mounting holes, but do not peel off the adhesive backing. Wait until some of the following steps are accomplished.
4. Ground the controller card. The grounding scheme for the controller should typically be determined consistent with EMI suppression requirements. This may be accomplished one of two ways:
  - If the controller can be mounted to a metal chassis, it can be grounded through one of the plated-through mounting holes by using one of the No. 6 sheet metal screws and spacers provided in the kit. Use either of the holes marked "PTH" in Figure B-1, page 67.
  - If the controller cannot be mounted to a metal chassis, use a ground wire with a lug attached to connect one of the controller's plated-through mounting holes to chassis ground.
5. Connect the power cable harness to the 2x5 male connector at P4 on the controller. Connect the other end to a power source. If a suitable +5 Vdc power source cannot be installed inside the display, use a power supply (such as Elo P/N 004100-204). The E281-2310 controller power requirements are +5 Vdc nominal (140 mA typical).

P4 Pins	Signal	Function
1	+Pwr	Supply voltage positive
2	PwrCom	Supply voltage negative (tied to pin 4)
3	N/C	
4	PwrCom	Supply voltage negative (tied to pin 2)
5	LED Remote	External LED driver
6		Key
7	N/C	
8	Chassis	Frame ground connection

9	-Reset	Open collector input: open = normal operation; short to PwrCom = hardware reset.
10	N/C	

If you have grounded the controller as in Step 4 above (the preferred method), the chassis ground connection through the power connector, P4 pin 8, does not need to be connected. Likewise, do not connect the Reset and LED Remote lines unless you have provided the appropriate circuits.

The microprocessor pin that drives the status LED is connected to pin 5 of the P4 power supply connector. This signal from the microprocessor may also be used to drive an external indicator such as another LED.

To operate an external LED, connect the LED anode to a +5 Vdc power supply and cathode to pin 5 of the P4 connector. (Nominal current through the LED will be 3 mA—the LED will be comparatively dim.

6. Connect the 2x5 female connector on the serial output cable to the 2x5 male connector at P2 on the controller. Mount the DB9 female end of the cable in the position determined in step 2. The serial cable connector shell must be grounded to satisfy safety agency approvals, as the grounding protects the user in case a wiring fault develops in the display. If the DB9 connector shell is not already grounded, attach the ground wire supplied in the kit to one of the DB9's mounting screws and the other end to chassis ground.
7. Adhere the metal plate labeled with the legend, "Touchscreen Interface" (P/N 172001) to the outside of the bulkhead-mounted DB9 connector. A similar plate is also available with vertical labeling (P/N 172003).
8. Label the monitor to indicate that an IntelliTouch E281-2310 serial controller is installed inside the display and include its jumper settings.

## External Serial Controller

An external serial controller (E281-2310MX) is the best choice for many integrators for several reasons:

- No additional cables are required to install the controller. The 30-inch touchscreen cable is routed through the rear of the display case to a 2x6 male connector located on the rear of the controller. Once the controller is installed on the rear of the display, little or none of the touchscreen cable is visible.
- The base of the controller may be permanently attached to the rear of the display, but is easily removed from the display if necessary.

- The serial cable is permanently connected to the controller and features an armored, moisture-resistant sleeve where the cable enters the controller enclosure.
- An external serial controller offers the added flexibility of using a keyboard tap or wall-mount power supply if using an internal power source is inconvenient or impractical. This feature places fewer constraints on the design and location of kiosks and other applications.

Follow these steps to install this controller:

1. You must first determine how you will supply power to the controller. The E281-2310MX controller requires +5 Vdc regulated power ( $\pm 0.25$  Vdc) with 140 mA typical. Average power dissipation is 0.7 W.

**CAUTION**

*Before making any attempt to power the controller from any monitor power source, you should confirm the installation with your monitor supplier. Failure to observe this caution may destroy the monitor or seriously impair monitor performance.*

- *Provided you first confirm the installation with your monitor supplier, you may attach a direct power cable to a +5 Vdc source inside the display or tap unregulated monitor power in the +9 Vdc to +30 Vdc range using the Elo DC-to-DC converter (P/N 002500). Typical converter power consumption is approximately 1 W. Remember that each integration situation is unique; you must carefully evaluate available power rails and consider how drawing additional power from the display will affect monitor performance.*

*If you have a suitable +5 Vdc power source, attach the direct power cable to the source, red to + 5 Vdc and black to common. You must attach the green ground cable to a suitable chassis ground for noise immunity and safety considerations. Also ensure that the cable is long enough to reach the back of the monitor and the controller.*

**CAUTION**

*Observe polarity when connecting the power leads to the power supply. Reversing polarity may damage the controller.*

- Another method of providing power to the controller is to install a power supply (P/N 004100-204-K1), which requires a 100-240 Vac input. Connect a power cable harness to P4 on the controller, a 2x5 header with pins on 0.100-inch (2.54 mm) centers. Use a ribbon cable with an IDC connector or crimp-to-wire pin receptacles. An acceptable plug can be selected from Molex series 70450, Amp AMPMODU Mod. IV product line, or Berg mini-latch housing with Mini-PV pins. Connect a power supply to the harness and then to AC.
- If none of the above options are practical, you must use either an optional keyboard power tap (P/N 012265 or 012266) or wall-mount power supply (P/N 004100-209) to furnish +5 Vdc power to the E281-2310 controller.

**CAUTION**

*Before using a keyboard power tap, be sure sufficient power is available for the touchscreen controller or damage may occur to the computer. See Appendix C for power requirements.*

**CAUTION**

*Before connecting a keyboard power tap to the controller, be sure that power to the CPU is OFF. Connecting a keyboard power tap to a powered CPU may seriously damage the CPU or the controller.*

If a keyboard tap is impractical, or if you like the convenience of a wall-mount power supply, use the P/N 004100-209 item in the United States. Overseas customers should check with Elo for availability of the P/N 004100-210 international power supply.

2. After you decide on a controller power source, use the 2310MX installation template to help you decide where to mount the controller on the rear of the display case. After choosing a location, use masking tape to hold the template in the desired spot and drill a 1-inch diameter hole for cabling exiting the display and drill two holes for screws that will be mounted in the display case.
3. After you drill the holes, route the touchscreen cable (and power cable if using an internally located power source) through the 1-inch diameter hole in the display case. Insert the touchscreen cable into the keyed receptacle in the rear of the controller box. You will hear a “click” when the cable connector is properly connected to the controller. Pull any excess cabling back into the display case and attach the E281-2310MX controller to the display case.
4. Wrap excess cabling with tie wraps as required, and proceed to *Routing the Touchscreen Cables* on page 45.

## External PC-Bus Controller

Using an external PC-Bus controller may be the simplest overall integration process.

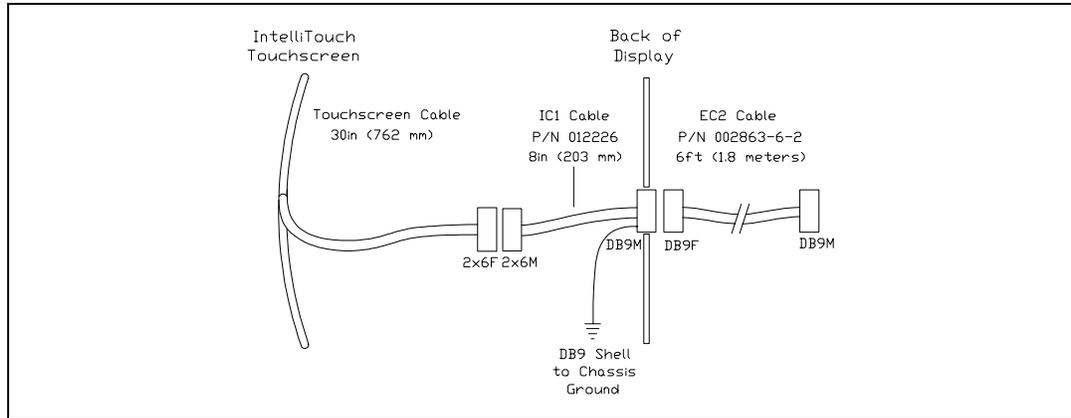


Figure 4-4. Touchscreen Cabling System for External PC-Bus Controllers

An 8-inch (203 mm) internal interface cable (IC1, P/N 012226) that connects the touchscreen to the display case is included in the touchscreen kits (P/N 0028XXA-XXX-K2). The termination of the IC1 cable is a DB9M connector. An external 6-foot (1.8 meter) cable (EC2, P/N 002863-6-2) included in the controller kits extends the connection to the controller. (See Figure 4-4.)

Mechanically, there may be several options for mounting the connector on the display case:

- Mounting the IC1 cable to a chassis member that is exposed to the display exterior. This requires a DB9 hole punch to mount the connector neatly, but makes reassembly of the back of the case very easy, and is usually the best functional and cosmetic solution.
- Mounting the IC1 cable to a concealed chassis member, with a hole in the exterior of the case (usually plastic) to provide access to the connector. This technique also requires a metal punch to mount the DB9 connector, but the plastic case hole can often be routed, nibbled, or punched with simple tools, and usually provides a neat appearance. This is also an excellent functional solution as the back case is again very simple to reassemble.

- Mounting the IC1 cable to the plastic case. Plastic cases are usually rather thick, making it necessary to mount the flange of the connector on the outside of the case. This is cosmetically less acceptable than an inside mount and there is less support for the external EC2 cable. Also the standard DB9 hole may not provide adequate clearance for the connector. Avoid mounting to curved surfaces if possible as hole punching is more difficult and mounting hardware will warp the connector when tightened. If mounted on the inside, the mounting hardware may interfere with proper mating with the IC1 cable. Also, the touchscreen cable must be connected to the IC1 cable as the back case is being reinstalled.

The touchscreen and IC1 cable shields must be connected to chassis ground to satisfy safety agency approvals, as the grounding protects the user in case a wiring fault develops in the display. Ground the DB9 connector to accomplish this.

An escutcheon, or identifying metal plate labeled with the legend "Touchscreen Interface" (P/N 172001) is included in the Touchscreen Installation Kit (P/N UK0001) and provides an attractive and convenient finish to most of the bulkhead mounts typically used on a display. A similar plate is also available with vertical labeling (P/N 172003).

EC2 extension cables are available to connect all touchscreen cable configurations to external serial and bus controllers. Use only one EC2 cable between the touchscreen and controller. The internal construction of the EC2 cable is specific to the IntelliTouch system, and other common computer data cables should not be substituted. Contact Elo if special requirements exist that cannot be satisfied with a standard cable configuration.

## ROUTING THE TOUCHSCREEN CABLES

The internal cable(s) that carry the analog touchscreen signals are subject to interference from various sources within the display. The routing of these cables should avoid the following areas, listed in order of importance:

- the flyback transformer
- the anode lead
- the inverting section of the power supply (most display power supplies are switching power supplies, and the main DC to AC inversion section produces most of the noise)
- the yoke
- the RGB video drive section of the display

- the video input cable
- the horizontal and vertical oscillator/drive sections
- the degaussing coil wiring

Obviously, it may not be possible to avoid all these areas simultaneously. Watch carefully for false touch reports generated by the controller, or other intermittent operation, especially when very high resolution video images are being displayed. Higher resolution video has a greater bandwidth, and can increase the possibility of interference with the touchscreen system. See *Hardware Troubleshooting*, page 53. Once acceptable cable positioning is determined, tie the cable down to avoid movement during shipment.

In addition to careful cable routing, other EMI suppression techniques may be necessary to satisfy agency approval requirements. Use ferrite beads or other radio frequency (RF) suppression elements, additional shielding, and different grounding techniques as needed.

## REASSEMBLING THE DISPLAY

With the touchscreen mounted, and the cable routing and exterior interface determined, the display must be reassembled. Reassembly is generally in reverse order of disassembly. Beware of potential clearance problems between the bell of the CRT and the electronics chassis, as shorts in this area can produce catastrophic failures of the display. Also, if the inside surface of the back case is painted with a conductive coating, watch for shorts between the CRT circuit board and the rear of the back case, as these can also produce disastrous results.

When the electronics chassis is reinstalled, the CRT circuit board is usually carried along with it. It is often advisable to have a second person assist you, to insure that this circuit board and various other cables do not interfere with the yoke or neck of the CRT. *Safety glasses, gloves, heavy protective clothing, and caution are strongly advised for all participants.*

Reconnect all cables that were removed during the disassembly procedure. Watch for single ground connections from the CRT mount to the chassis, between individual chassis members, etc., which may have lugs and screws to connect them, or sometimes individual push-on solderless connectors. *Failure to reconnect these important cables may result in improper performance of the display after reassembly and may render the unit unsafe.*

If available, re-glue the CRT circuit board to the connector with an electronic-grade (non-corrosive) silicone adhesive (such as GE RTV-162). Discharge the CRT again (see page 30), and then reconnect the anode lead to the anode button, making sure the spring hooks catch inside the hole.

If practical, test the display and touchscreen at the earliest time possible before reassembling the display, as the reassembly of the back case can be tedious. If mistakes have been made, corrections are easier to make if the covers are still off.

Next, label the display with information about the touchscreen installed, along with the model and settings of any internal serial controller. For example:

```
Contains E281-2310 Serial Controller
Settings: 9600/8/1/N SmartSet/Binary/Stream Mode
```

Finally, remove any agency certifications (UL/cUL, FCC, TÜV, CE, etc.) for which you have not resubmitted.

## SEALING

A variety of methods may be used to seal an IntelliTouch system from dust or liquid intrusion as required by the application or an industry standard:

- Use a sealing material that has a low surface wave absorption characteristic and that does not absorb water. See below for recommended materials.
- For optimum results, the sealing material should contact the touchscreen in the active area just inside the reflector array. Avoid contacting the array with the sealing material.
- Use the narrowest width of sealing material possible, consistent with the mechanical characteristics of the material chosen.
- Position the seal as close as possible to the inside edge of the display bezel to allow for easy cleaning.
- If there is a seam in the sealing material, position it at the top of the display.
- If forced air ventilation is used for the kiosk, the air should be filtered and fans should be positioned at the intake, creating positive pressure inside the cabinet.
- Design your display bezel so the contact force of the seal is constant during normal operation.

## Material Selection

Many materials may be used to create a seal for an IntelliTouch system. Relatively hard seal materials are preferred, such as metal, hard plastics and high-durometer rubber. Adhesives and elastomers that actually bond to the touchscreen should be avoided. Elo has sealing materials available for a variety of mechanical configurations.

The easiest seal is produced by allowing the bezel of the display to contact the surface of the touchscreen. This method is typically used in systems where the system requirement is for a dust seal. Most CRT-based displays have bezels that are made of a blend of polyvinyl chloride (PVC) and acetyl butyl styrene (ABS), and are generally acceptable for contact with the touchscreen or reflector arrays. Spacers for the CRT-touchscreen combination should be chosen to distribute contact along the entire periphery of the bezel opening without excessive pressure.

If a custom bezel is to be designed for the display and touchscreen, a blade-type profile in contact with the touchscreen can be utilized to produce an excellent seal with essentially no signal attenuation. Considerable pressure may be applied to the touchscreen by the bezel, and a near-watertight seal may be achieved using this method.

Open-cell urethane and polystyrene foam materials make excellent dust seals and provide some degree of water resistance. These foams have very high compliance and can take up wide variations in space between the touchscreen and display. If dust is severe in the application environment, the pores in the material may clog up over a long period of time, reducing its effectiveness. These foams may also be used in situations where seal contact with the reflectors is necessary. As noted above, use the least possible amount of contact with the reflectors.

Watertight seals are achievable with several different materials. A fluorocarbon material available through Elo produces a watertight seal with very little signal attenuation.

Crosslinked polyolefin closed-cell foams also produce an excellent seal. Use Volara, manufactured by Voltek, in 2A, 2E, 4A, or 4E weights. For a flame-retardant seal, use 2AF weight. Black is recommended.

Cellular urethanes are a closed cell material with good compliance and little set, and can make a good seal.

## System Evaluation

As the IntelliTouch system gain is dynamic, and responds to a changing environment quickly, the application of a seal to the system typically produces no user perceivable effects. However, the designer should be aware of the impact of the seal on system performance. Elo provides several software tools that can aid in this assessment. Use these tools to establish baseline performance prior to the application of the seal, as well as after. Contact Elo Technical Support for details.

## FLAT PANEL DISPLAY INTEGRATION

While much of this chapter applies specifically to touchscreen integration on CRT-based displays, most of it also applies to integration on liquid crystal (LCD), electroluminescent (EL), and plasma displays. However, there are additional specific issues when integrating each type of flat panel display:

- To prevent touchscreen breakage, there should be a compliant gasket between the back of the touchscreen and the front of the display to allow for variation in the surfaces when assembling. A gap is also required between the touchscreen and the face of an LCD display to prevent damage to the display.
- If a seal is used between the display bezel and the touchscreen, insure that the display and its mounting can withstand the force from the compressed seal.
- Unlike CRT's, plasma, EL, and backlit LCD displays may be a significant source of heat. The situation may be more significant if the unit is sealed. Any installation must avoid heat rise that exceeds the touchscreen specification.

## WHERE TO GO FROM HERE

The touchscreen component installation is now complete.

If you must ship your touch monitor, remember that monitor manufacturers' cartons are rarely satisfactory for more than one trip. The display's mechanical strength may have been compromised by the touchscreen installation. You should consider designing your own carton based on drop tests of the monitor with the touchscreen installed, or overpacking the original carton with your own.

Return to Chapter 3 for instructions on connecting the touch monitor to your computer.



# Appendix A

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## Troubleshooting Guide

- *The Troubleshooting Process 51*
    - *Display Problems 52*
    - *Software Troubleshooting 52*
    - *Hardware Troubleshooting 53*
- 

If you experience operational difficulties with the touchscreen system either during or after installation, the following sections will help you determine the source of the problem.

### THE TROUBLESHOOTING PROCESS

The first step in troubleshooting a touchscreen system is to determine whether the problem is related to the display, software, or hardware:

- Do not confuse display problems with touchscreen problems—the two are unrelated.
- Software problems are determined by a basic hardware functionality test. If the hardware transmits touch coordinates correctly, then the problem is with the driver or application software.

- Hardware problems may be caused by the touchscreen, controller, cabling, power supply, or by the integration of the touchscreen components in the display. This appendix describes techniques for isolating the problem, including power-on diagnostics, status LED verification, and component swapping.

## DISPLAY PROBLEMS

If you are experiencing display problems (such as no video, no horizontal or vertical synchronization, raster non-linearities, etc.), remember that the video function of the display and the Elo touchscreen installed on the display are separate systems. Therefore, problems with the display should be treated as display problems, not touchscreen problems. Diagnostic procedures and possible corrections for display problems should be performed using the troubleshooting procedures outlined in your display manual.

The IntelliTouch Ultra touchscreen is powered from its controller. Usually the display and touchscreen controller have separate power supplies and operate independently. Thus it is possible for the touchscreen to interact with the computer even if the display is powered off. Internal serial controllers may be powered by a supply that is separate from the display's power supply, but controlled through the display's power switch. In this case, even if display problems exist, the touchscreen system will probably function if the display power switch is on.

## SOFTWARE TROUBLESHOOTING

Before beginning software troubleshooting, verify that the touchscreen hardware is working by running the COMDUMP program for serial controllers (see page 54) or the BUSSTAT program for PC-Bus controllers (see page 58). If you have an ADB controller, see page 59. If the touchscreen is operating, then the problem may be with the driver software, the application software, or a conflict with other hardware or software. (The problem may also be due to incorrect touchscreen calibration, described on page 53.)

The general technique for troubleshooting software problems is to identify at what layer of software and associated hardware the problem exists. For example, if you have a Windows application, there are several layers of software and drivers. The problem could be with your application, Windows, MonitorMouse for Windows, MonitorMouse for DOS, the ELODEV driver, a conflict with another device, or the touchscreen hardware. The best approach to software troubleshooting is to remove the layers of software one by one, testing each layer until the problem is isolated. Also try removing other hardware and software that may be conflicting with the touchscreen hardware and driver software.

For detailed troubleshooting information on MonitorMouse for Windows, MonitorMouse for DOS, MonitorMouse for DOS, ELODEV, and TouchBack, see the *DOS and Windows Driver Guide*. Also see the *MonitorMouse for OS/2 User's Guide*, *MonitorMouse for Windows NT User's Guide*, and *MonitorMouse for Macintosh User's Guide* as appropriate.

## Calibration Problems

If the touchscreen is responding and the data is linear, but a touch does not activate the appropriate zone in the application, try recalibrating. Use ELOCALIB under DOS or the Touchscreen Control Panel with all versions of MonitorMouse. Improper calibration may be indicated when the cursor does not move at the same pace as a sliding finger, or when it moves in the opposite direction. The cursor should always move in the same axis as your finger.

If you have a DOS application, erase any ELOGRAPH.CAL files and recalibrate in the video mode used by your application. For example, you may have a VGA monitor with your application running in text mode, so calibrate in text mode rather than graphics mode.

Also see *Calibration Problems* in the *DOS and Windows Driver Guide* for additional information.

## HARDWARE TROUBLESHOOTING

Troubleshooting the touchscreen system hardware may require analysis of the touchscreen, controller, cables, power supply, and the integration process. The best place to start is with the controller.

Use the controller power-on diagnostics which are displayed when the Elo driver software is loaded to check for specific faults (see *Diagnostic Codes*, page 64). If they are accessible, the diagnostic LED's on serial and ADB controllers may identify a problem (see *Diagnostic LED's*, page 62).

Also,, check whether the controller is transmitting any touch data. Use the COMDUMP program for serial controllers (see page 54), or the BUSSTAT program for PC-Bus controllers (see page 58). If you have an ADB controller, see page 59. You may encounter one of the following symptoms:

- **No touch data.** When no touch data is reported, the problem may be the touchscreen, controller, or cabling. If the controller power-on diagnostics or diagnostic LED's do not identify the problem, substitute individual system components if they are available. Refer to the remainder of this appendix for information on troubleshooting each system component.

- **Intermittent touch data.** If the system is reporting touch data at a slow or varying rate, the problem may be caused by a low signal strength or excessive noise in the system. Generation of touch data when the touchscreen is not touched is most likely caused by excessive system noise. See the sections *Routing the Touchscreen Cables* and *Sealing*, page 45 and 47, respectively. Use of SAWDUMP (a DOS utility included with most Elo driver software and available on CompuServe or the Elo BBS), may help to identify these problems. Contact Elo Technical Support for more information.
- **Linearity.** As the IntelliTouch system is inherently stable and drift-free, apparent linearity problems are usually due to calibration errors or display drift. See *Calibration Problems*, page 53.

The remainder of this appendix deals with component-level troubleshooting of controllers, power supplies, the touchscreen, and cables.

## Serial Controller

The E281-2310 operates at 9600 baud, 8 data bits, 1 stop bit, and no parity. See Appendix B for controller jumper settings.

### *Using the COMDUMP Utility*

COMDUMP is a DOS utility included with most Elo driver software and available on CompuServe or the Elo BBS. Use COMDUMP to verify basic controller functionality and to determine whether or not data is reaching the serial port. COMDUMP can be run without a touchscreen driver loaded. Type "COMDUMP <n>" where <n> is the number of the COM port. Detailed instructions can be found in the *COMDUMP* section of the *DOS and Windows Driver Guide*. (If you have the ELODEV driver loaded, also see *Using the TOUCHES Utility* on the next page.)

If you are not running under DOS, boot your PC from a DOS diskette before running COMDUMP. If you cannot run DOS, use an ASCII terminal or a communications program in local mode to get the same type of analysis provided by COMDUMP. Another option is to temporarily connect the touchscreen to a PC with DOS and run COMDUMP.

If the hardware is functioning properly, untranslated (raw) coordinates will be returned at a constant rate only when the touchscreen is touched. If no data is transmitted on touch, or if data is transmitted when the touchscreen is not touched (either continuously or intermittently), you have a hardware problem.

If the LED is accessible, and indicates that data is being transmitted, confirm the communication parameters, then try another serial port, possibly on another computer. Also see *RS-232 Connections*, page 56.

### *E281-2310 Controller Protocol*

The ten-byte binary data format displayed in hex by COMDUMP for correct operation with Elo driver software is as follows:

<b>Byte</b>	<b>Description</b>
1	ASCII 'U' (55h)
2	ASCII 'T' (54h)
3	Status Byte
4	XLow
5	XHigh
6	YLow
7	YHigh
8	ZLow
9	ZHigh (defaults to 0)
10	Checksum

### *E281A-4002 Controller Protocol*

If the controller is jumpered for E281A-4002 emulation mode, the output will be the six-byte binary format as follows:

<b>Byte</b>	<b>MSB</b>								<b>LSB</b>
1	1	1	X11	X10	X9	X8	X7	X6	X6
2	1	0	X5	X4	X3	X2	X1	X0	X0
3	0	1	Y11	Y10	Y9	Y8	Y7	Y6	Y6
4	0	0	Y5	Y4	Y3	Y2	Y1	Y0	Y0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	Z3	Z2	Z1	Z0	Z0

In this mode, the first four bytes in each packet will be decreasing, followed by a zero byte, and a byte from 00 to 0F (hex). The Z value (byte 6) will be 00 when you lift your finger.

### *Using the TOUCHES Utility*

TOUCHES is a DOS utility included on the *DOS and Windows Driver Disk*. TOUCHES works through the ELODEV driver making it useful for further diagnosis of hardware or calibration problems under DOS. Run TOUCHES by typing "TOUCHES". Detailed instructions for using this utility can be found in the *TOUCHES* section of the *DOS and Windows Driver Guide*.

Unlike COMDUMP, which displays a stream of bytes in hexadecimal, TOUCHES displays decimal coordinate data. If ELODEV has been calibrated, coordinates will be scaled 80x25. If ELODEV is loaded without the -c calibration flag, and ELOCALIB is not run, raw coordinates will be displayed.

Raw coordinates for the E281-2310 serial controller should range from just above 0 to just below 4095. When the touchscreen is mounted in its normal orientation, (cable exiting right-center), the origin will be in the lower-left corner. If the touchscreen is installed with the cable exiting left-center, the origin will be in the upper-right corner. Both X and Y should increase steadily as you slide your finger from the origin to the diagonally opposite corner. Check the other two corners to make sure their coordinates look correct and that the touchscreen appears linear in each axis.

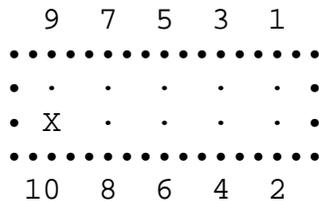
TOUCHES should display "TRUE" only when you lift your finger. If "TRUE" releases are indicated while maintaining a constant touch, a problem such as excessive system noise or low signal strength may be present.

TOUCHES is also useful with PC-Bus controllers to verify the correct IRQ is selected and there are no IRQ conflicts..

*RS-232 Connections*

Review cable connections and switch settings. If you have used your own cables or adapters for connection to the serial port, check pinouts. Verify that the data transfer rate (baud rate) of the computer's serial port is the same as selected by switches or jumpers on the controller.

The E281-2310 controller operates at standard RS-232 levels. The serial port connector, P2, is a 2x5 header with pins on 0.100-inch centers. It is configured so a ribbon cable and commonly available insulation displacement connectors (IDCs) may be used. Pin positions and signals are given below. See page 65 for DB9 and DB25 connector pin positions.



P2 Pins	DB25	DB9	Host Signal	Source
1	8	1	DCD (N/C)	Controller
2	6	6	DSR	Controller
3	3	2	RXD	Controller
4	4	7	RTS	Host
5	2	3	TXD	Host
6	5	8	CTS	Controller
7	20	4	DTR	Host
8	22	9	RI (N/C)	N/C
9	7	5	GND	Common
10				Key

The controller only requires a 2-wire connection, controller Transmit Data (P2 pin 3) and Signal Ground (P2 pin 9). For two-way communications, the controller Receive Data (P2 pin 5) should also be connected to the host Transmit Data pin.

Data Set Ready (DSR) and Clear to Send (CTS) may be used by the host to verify controller connections and operation. DSR is asserted when power is applied to the controller and CTS is asserted when the controller's power-on sequence is complete. Data Terminal Ready (DTR) and Request to Send (RTS) can also be connected for full hardware handshaking.

Elo driver software typically requires two-way communication (unless ELODEV's -p- flag is used), and all four handshaking lines.

If accessible, the controller's diagnostic LED can verify whether RS-232 data is being transmitted.

Alternatively, a breakout box will tell you if there is any activity on the data line. It is possible that the port you are using on the host computer is meant to work with an RS-232 DTE device. To check this, install a null modem cable between the controller and the host computer's serial port. A null modem cable converts a DCE device into a DTE device by swapping pins 2 and 3 and the handshaking lines.

Some serial ports require jumpers for the handshaking lines on the cable connector at the computer end. The jumper combinations that may be required to make an RS-232 port work are beyond the scope of this manual. Consult your computer manual for more information.

If a breakout box is not available, you can measure the DC voltage at the data output of the controller (RXD on the host). It should measure between 8 and 10 Vdc when the touchscreen is not touched, and drop several volts (towards 0) during a touch, depending on the data format and the baud rate.

If proper RS-232 signal voltage is not present, the controller may not have power applied.

### Power Connections

Check for proper voltage (+5 Vdc) at the power connector P4 pin 1 (+) and pin 4 (-) on the controller (see Figure B-1, page 67). If the LED is functioning (see page 62), the power supply is probably okay. To access this connector on the external serial controller, disconnect the power, then remove the cover. Reconnect the power cable and turn the unit on. There are no exposed electrical connections in the controller that would be considered dangerous. Power is applied to the controller through P4.

If no power is present, measure the voltage at the power source, either a source from the display electronics, a DC-to-DC converter, or an AC power supply.

## Bus Controller

The E281-4035 controller is shipped jumpered for a Base I/O Port address of 280 (hex) and hardware interrupt 5 (IRQ5). See Appendix B for switch and jumper settings.

If the system does not boot properly after you install the E281-4035 controller, try removing the IRQ jumper if one was installed. If the system still does not boot, try changing the Base I/O Port address jumpers to another value, such as 380 hex.

### Using the BUSSTAT Utility

BUSSTAT is a DOS utility included with most Elo driver software and available on CompuServe or the Elo BBS. Use BUSSTAT to verify basic hardware functionality. Detailed instructions for using this utility can be found in the *BUSSTAT* section of the *DOS and Windows Driver Guide*. If you are not running under DOS, boot your PC from a DOS diskette before running BUSSTAT.

BUSSTAT is a Polled Mode program and can be run even if no touchscreen driver is loaded and the IRQ is incorrect or not selected. Verify the Base I/O Port address jumpers before using BUSSTAT.

Type "BUSSTAT" and specify your controller model and Base I/O Port address. BUSSTAT displays the switch and jumper settings for the controller and then unscaled touch coordinates when the touchscreen is touched. Compare the displayed settings to those recommended in the software driver manual. If the Base I/O Port address is incorrect, BUSSTAT may display a continuous stream of data at a value of 4080 for both the X and Y values.

If the hardware is functioning properly, untranslated (raw) coordinates will be returned at a constant rate only when the touchscreen is touched. If no data is displayed on touch, or if data is displayed when the touchscreen is not touched (either continuously or intermittently), you may have a hardware problem. If data

is being displayed continuously without a touch, try disconnecting the touchscreen cable from the controller. If the data stops, the problem is with the touchscreen or cable. If it continues, the problem is controller-related.

Verify that the controller board is properly seated in its slot. Try installing the controller in another slot. If another controller is available, try it as well. Also try another computer.

Look at the coordinates output by BUSSTAT. The coordinates should range from about 72-2472 for X and 56-1800 for Y on a 13-inch touchscreen. The coordinate range for other touchscreens will vary with size. When the touchscreen is mounted in its normal orientation, (cable exiting right-center), the origin will be in the lower-left corner. If the touchscreen is installed with the cable exiting left-center, the origin will be in the upper-right corner. Both X and Y should increase steadily as you slide your finger from the origin to the diagonally opposite corner. Check the other two corners to make sure their coordinates look correct and that the touchscreen appears linear in each axis. If the coordinates appear to be meaningless, try changing the Base I/O Port address of the controller. Another device may be contending for the same I/O address.

If BUSSTAT works properly, try the TOUCHES diagnostic utility, described on page 55. If TOUCHES does not display any data, the problem is probably that the IRQ is incorrectly specified on the driver command line or there is an IRQ conflict with another device. See *Choosing an Interrupt for PC-Bus Controllers* in the *DOS and Windows Driver Guide*.

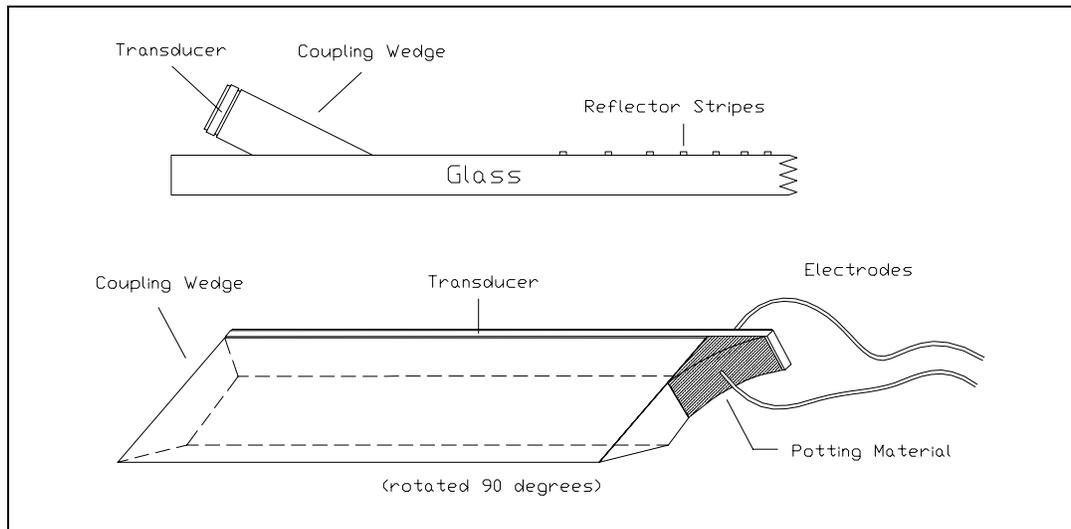
## ADB Controller

The E281-2303 controller is shipped ready for use. See Appendix B for controller switch and jumper settings.

Verify the power-on diagnostics that are displayed in the MonitorMouse for Macintosh Touchscreen Control Panel (see *Diagnostic Codes*, page 64). Also verify that data is being transmitted (see *Diagnostic LED's*, page 62). If the LED's are not illuminated, see *Power Connections*, page 58 (the ADB controller requires +12 and -12 Vdc). Try swapping components if extras are available. See the *MonitorMouse for Macintosh User's Guide* for more information.

## Touchscreen and Touchscreen Cables

If the touchscreen and its attached cable are easily accessible, the touchscreen can be physically inspected for damage to the transducers and cable. Gently peeling back the tape covering the transducer and wedge assembly will allow you to see the back side of the transducer and the wires soldered to it (see Figure A-1). Broken wires near the transducers should be obvious, but broken or cracked transducers may be difficult to see. Transducer breaks, regardless of the cause, mostly occur at the edge of the solder connection. A break can generally be detected by the controller power-on diagnostics. See *Diagnostic Codes*, page 64.



*Figure A-1. Transducer and Wedge Assembly*

You cannot repair a broken transducer in the field. Return any touchscreen with a broken transducer to Elo for repair or replacement. If you need to repair a broken wire at the solder connection to the transducer, use only a fine-tip soldering iron with temperature controls, and work at 500°F or less. It is not necessary to use silver-bearing solder to make the new connection, but avoid long dwell times on the transducer electrode to minimize leaching of the metal.

Field repair of broken cables is not recommended; the wires are difficult to work with and replacement connector receptacles and housings are not commonly available.

If an oscilloscope is available, Test Point #1 on any controller can be used to display the amplified receive waveforms from the touchscreen. The location of Test Point #1 (TP1) as well as trigger points for X and Y are shown for each controller in Appendix C. A sample waveform is shown in Figure A-2.

Analysis of these waveforms (one for X and one for Y) is helpful when diagnosing touch sensitivity and intermittent operation problems. If the waveform you see is similar to that of Figure A-2, but the amplitude is substantially reduced over some portion of the waveform, something may be attenuating the surface

wave signal. This could be caused by the display bezel being in contact with the touchscreen, especially on the reflectors. Mounting tape on the reflectors or transducers, or severe accumulations of dirt around the edge of the touchscreen, especially on the reflectors, can also produce significant signal attenuation.

Broken cables and transducers can also be deduced from analyzing test point #1; the symptom is usually a total absence of the indicated waveform. Although the absence of this waveform could be due to other causes, the most likely cause is a bad touchscreen or cable.

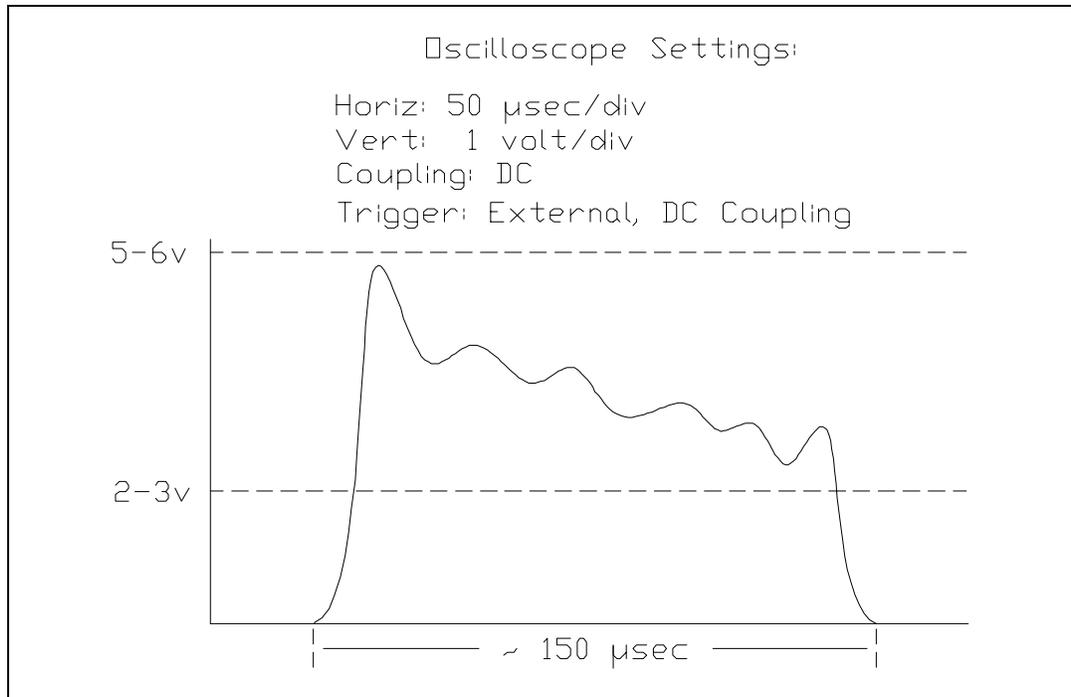
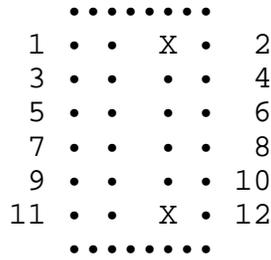


Figure A-2. Typical Receive Waveform

### IC1 Cable

The IC1 cable is used inside the display to connect to an external EC2 extension cable and an external controller. The IC1 cable can be checked with an ohmmeter. Pin #1 is identified by a white dot on the plastic body of the header. The pinouts for the header and the cable are as follows:



<b>2x6 Male Header</b>	<b>DB9 Male</b>	<b>Function</b>
1	Shell	Overall Shield
3	1	Y+Receive
5	2	Y-Receive
7	3	Shield
9	4	X+Receive
11	5	X-Receive
4	6	Y Transmit
6	7	Y Ground
8	8	X Ground
10	9	X Transmit

See page 65 for DB9 connector pin positions.

**EC2 Cable**

This cable connects the back of a touch monitor to an external controller. It is a straight through cable, and all nine pins are used. Check this cable with an ohmmeter.

The internal construction of the EC2 cable is specific to the IntelliTouch system, and other common computer data cables should not be substituted.

**Diagnostic LED's**

Depending on where the controller is installed, the LED's may or may not be visible.

**E281-2310 Serial Controller**

The E281-2310 controller has one green diagnostic LED. Following power on, the controller performs a short self-test, where the LED stays lit. After the self-test, the LED flashes once per second, indicating normal operation. The self-test results are displayed by most Elo driver software.

During normal operation, the LED also indicates controller/host communication is in progress. When the touchscreen is touched, the LED should light continuously,

then return to the normal flash rate. If the host does not remove the packet from the controller, the LED will stay lit.

The LED will also stay lit without a touch if the touchscreen or cabling is disconnected or not functioning.

If the LED flashes about two times per second, a warning error condition is indicated, such as improper communication from the host. Suspect an invalid command sequence from the host.

### E281-2300 CD-i Controller

The E281-2300 controller has two diagnostic LED's, a green touch activity LED and a yellow communication LED.

The green touch activity LED is off when the controller is first powered on. The LED is then on while the controller power-on self-tests are executed. Upon completion of the tests, the LED goes off again. (See *Diagnostic Codes*, page 64 for information on the results of these tests.) Thereafter, the green LED blinks at a rate of about twice per second while the touchscreen is being touched.

The yellow communication LED also blinks about 1.5 times a second, after the self-test has completed, indicating normal operation.

During normal operation, the yellow LED also indicates controller/host communication is in progress. For example, when the touchscreen is touched, the yellow LED should be on or flicker, then return to the normal blink rate when the touch is removed. If the host does not remove the packet from the controller, the yellow LED will stay on.

If the yellow LED stays on without a touch, cycle power to the controller. Do not touch the screen. If the problem persists, a fault in the power supply is likely.

If the yellow LED flashes about four times a second, a warning error condition is indicated, such as improper communication from the host. The baud rate or other communication parameters may be suspect.

### E281-2303 ADB Controller

The LED on the IntelliTouch ADB Controller is useful for troubleshooting ADB connections. It should flicker and go off when the system is started, and then flicker when the touchscreen is touched. If the light stays on continuously, a defective controller or power supply is probable.

## Diagnostic Codes

IntelliTouch controller power-on diagnostic codes are typically displayed when an Elo driver is loaded, or through the Touchscreen Control Panel. The codes may be a single byte or pair of bytes displayed in hex.

The following tables for each controller list the bit positions defined for each byte. A 1 bit indicates a failure. Diagnostic codes are computed by summing the value for each bit position using hexadecimal arithmetic.

### E281-4035 PC-Bus Controller

This controller has a single byte diagnostic code defined as follows:

<b>Bit</b>	<b>Value (hex)</b>	<b>Description</b>
7	80	Microprocessor logic test failure
6	40	Microprocessor register test failure
5	20	External RAM read/write test failure
4	10	PROM checksum test failure
3	08	DAC hardware test failure
2-0		Touchscreen drive test results:
	000	No failure
	001	X-axis failure
	010	Y-axis failure
	011	X receive channel failure
	100	Y receive channel failure
	101	X transmit channel failure
	110	Y transmit channel failure
	111	General failure—touchscreen may not be connected

### E281-2310 Serial and E281-2300 CD-i Controller

These controllers have a two-byte diagnostic code displayed in the form AA-BB. The AA byte is defined below. The BB byte is the same as the E281-4035 controller, defined above.

<b>AA Bit</b>	<b>Value (hex)</b>	<b>Description</b>
7	80	Touch microprocessor test incomplete
6	40	Reserved
5	20	Touch microprocessor test failed—touchscreen may not be connected
4	10	Nonvolatile RAM checksum test failure
3	08	RAM read/write test failure
2	04	ROM checksum test failure
1	02	Microprocessor logic/register test failure
0	01	Firmware/hardware compatibility test failure

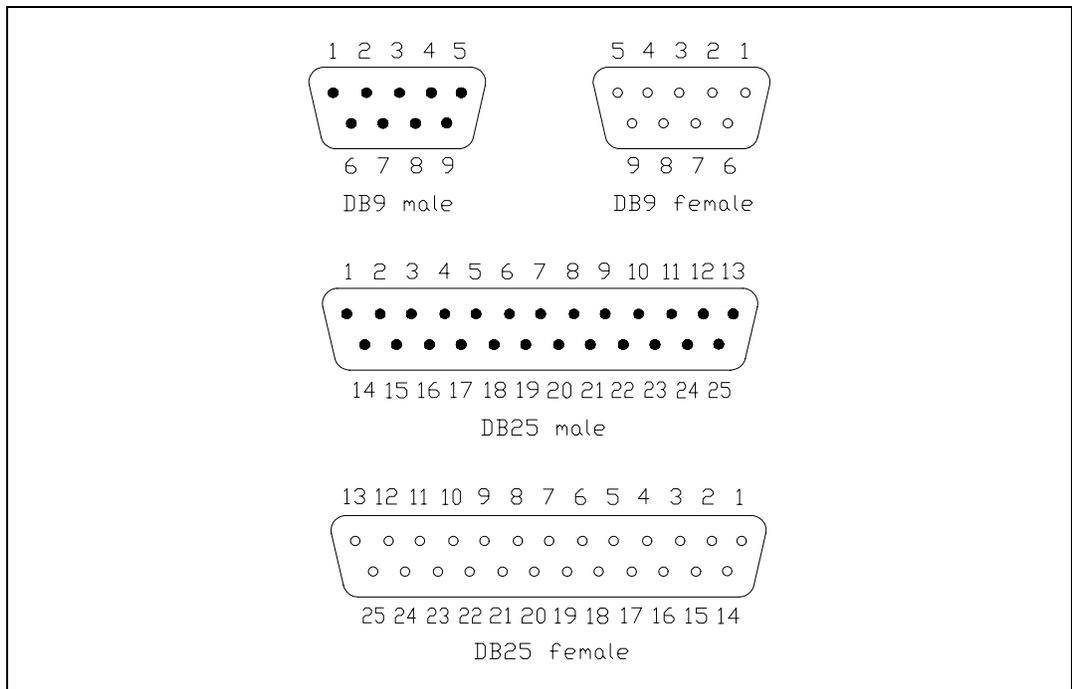
**E281-2303 ADB Controller**

This controller has a two-byte diagnostic code displayed in the form AA-BB by the MonitorMouse for Macintosh Touchscreen Control Panel. The AA byte is defined below. The BB byte is the same as the E281-4035 controller, defined above.

AA Bit	Value (hex)	Description
7	80	Reserved
6	40	Communication failure between the two on-board microprocessors
5	20	Reserved
4	10	Reserved
3	08	RAM read/write test failure
2	04	ROM checksum test failure
1	02	Microprocessor logic/register test failure
0	01	Reserved

**DB9 and DB25 Connector Pin Positions**

The following figure is useful when locating pin positions on DB9 and DB25 connectors.



*Figure A-3. DB9 and DB25 Connector Pin Positions*

# Appendix B

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## Controller Configuration

- *General Information 66*
- *E281-2310 Serial Controller 67*
- *E281-4035 PC-Bus Controller 69*
- *E281-2303 ADB Controller 71*
- *E281-2300 CD-i Controller 73*

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### GENERAL INFORMATION

IntelliTouch controllers are shipped preconfigured for use with Elo driver software. For most users, no changes are necessary. Specific jumper settings and options available for your controller are listed in the Elo software manuals and in this appendix.

The following sections are for quick reference only. See the Technical Reference Manual for your controller for a complete description of all switch and jumper settings. Factory default settings, compatible with Elo driver software, are indicated by an asterisk (\*). The "PTH" callouts on the controller illustrations denote *plated-through-holes*.

## E281-2310 SERIAL CONTROLLER

The following figure shows the mounting dimensions, jumper locations, and connections for the IntelliTouch Ultra E281-2310 serial controller:

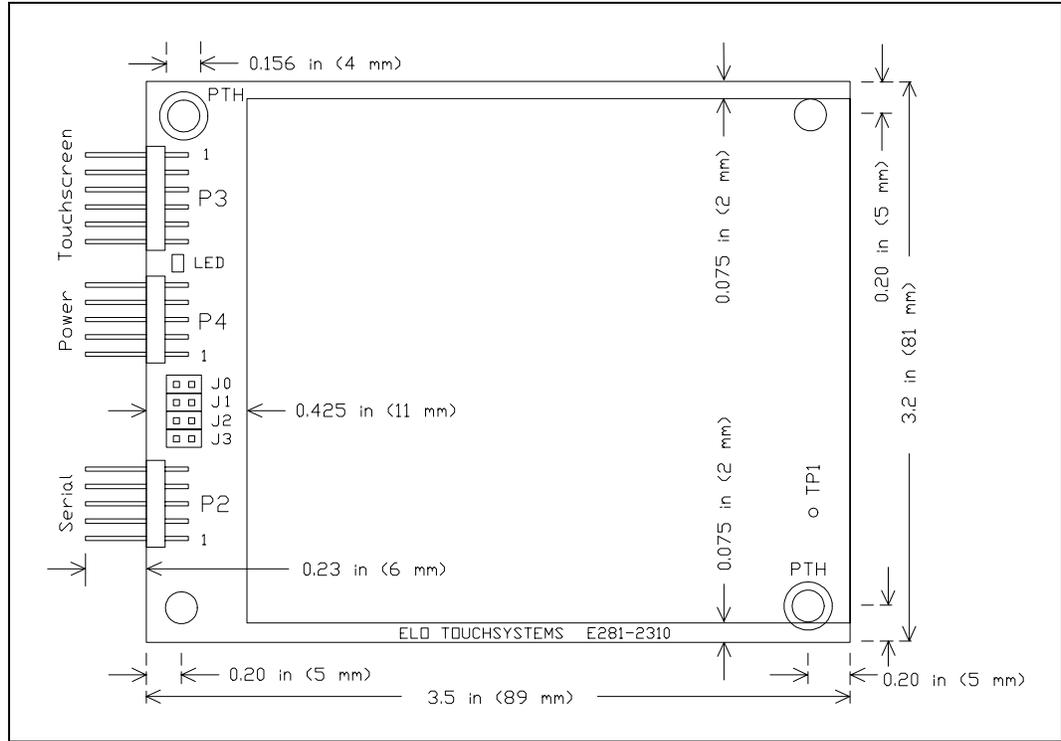


Figure B-1. E281-2310 Serial Controller

### Jumper Settings

The following table lists the jumper settings for the E281-2310 controller:

	<b>(From Top)</b>
Reserved	J0 - N*
Relearn Mode	
Standard (25 seconds)	J1 - N *
Fast (5 seconds)	J1 - Y
Emulation Mode	
None	J2 - N*
E281A-4002	J2 - Y
Reserved	J3 - N

\*indicates factory default settings compatible with Elo driver software

### *E281-2310 Emulation Modes*

If you are using driver software that does not directly support the SmartSet™ serial protocol (E281-23xx, E271-22xx), the controller can be set up through jumper J2 for hardware compatibility with the IntelliTouch E281A-4002, controller.

# E281-4035 PC-BUS CONTROLLER

The following figure shows the dimensions, switch and jumper locations, and connections for the IntelliTouch E281-4035 PC-Bus controller.

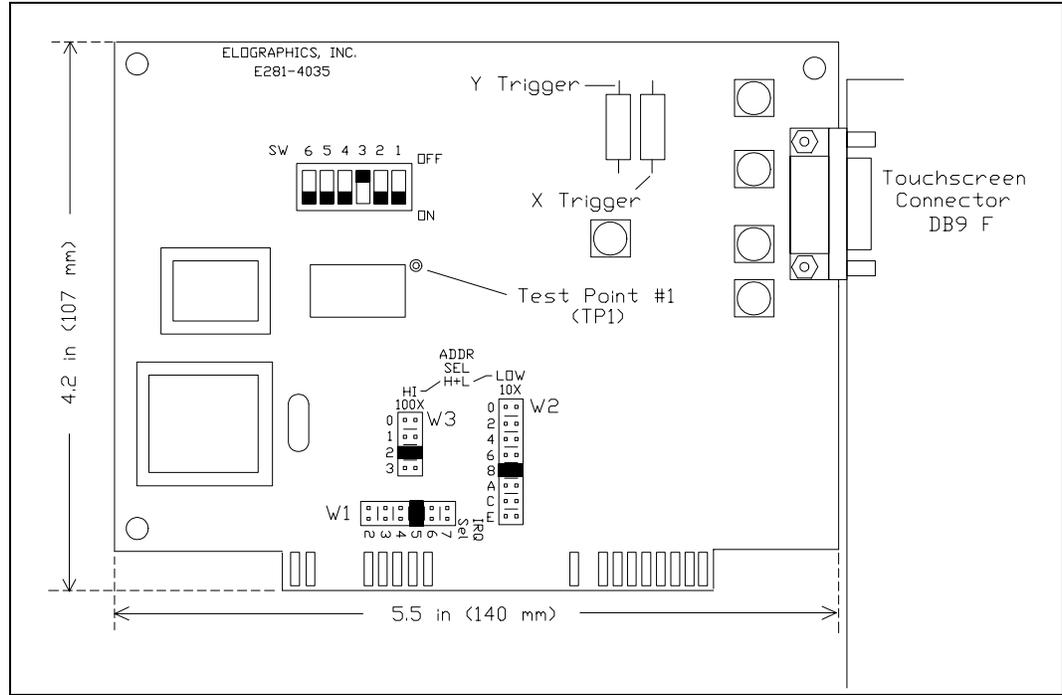


Figure B-2. E281-4035 PC-Bus Controller

## Switch Settings

The following table lists the switch settings for the E281-4305 controller:

Mode	Switch Setting (from right)
12-Bit Mode	SW1 - ON*
8-Bit Mode	SW1 - OFF
Reserved	SW2 - ON*
Stream Mode	SW3 - OFF*
Single-Point Mode	SW3 - ON
Reserved	SW4 - ON*
Z-axis enable	SW5 - ON*
Z-axis disable (E271-141 emulation)	SW5 - OFF
Reserved	SW6 - ON*

\* indicates factory default settings, compatible with Elo driver software

## Jumper Settings

The controller's Base I/O Port address is set with the W2 and W3 jumpers. W3 selects the high-order address, and W2 the low-order address. The values of the settings are shown in the following table.

<b>W3 HI (100X)</b>		<b>W2 LOW (10X)</b>	
<b>Position (from top)</b>	<b>Value (in hex)</b>	<b>Position (from top)</b>	<b>Value (in hex)</b>
0	000	0	00
1	100	2	20
2	200*	4	40
3	300	6	60
		8	80*
		A	A0
		C	C0
		E	E0

To calculate the Base I/O Port address, add the values of the jumpered positions of W3 and W2. For example, the E281-4035 is shipped jumpered for a Base I/O Port address of 280 hexadecimal. W3 is jumpered in the third position (200), and W2 is jumpered in the fifth position (80). The address is the sum of 200 + 80, which is 280.

The controller's Interrupt (IRQ) is set with the W1 jumper. If no jumper is installed, the controller operates in Polled Mode. The jumper block positions are as follows:

<b>Interrupt (IRQ) W1 (from left)</b>
2
3
4
5*
6
7

### E281-4035 Emulation Modes

The E281-4035 controller is software compatible with the E281A-4025 controller. If you are using driver software that only supports the AccuTouch E271-141 protocol, the E281-4035 can be set up through switch SW5 (Z-axis disable) for hardware compatibility with the E271-141 controller.

## E281-2303 ADB CONTROLLER

The following figure shows the mounting dimensions, switch and jumper locations, and connections for the IntelliTouch E281-2303 ADB controller.

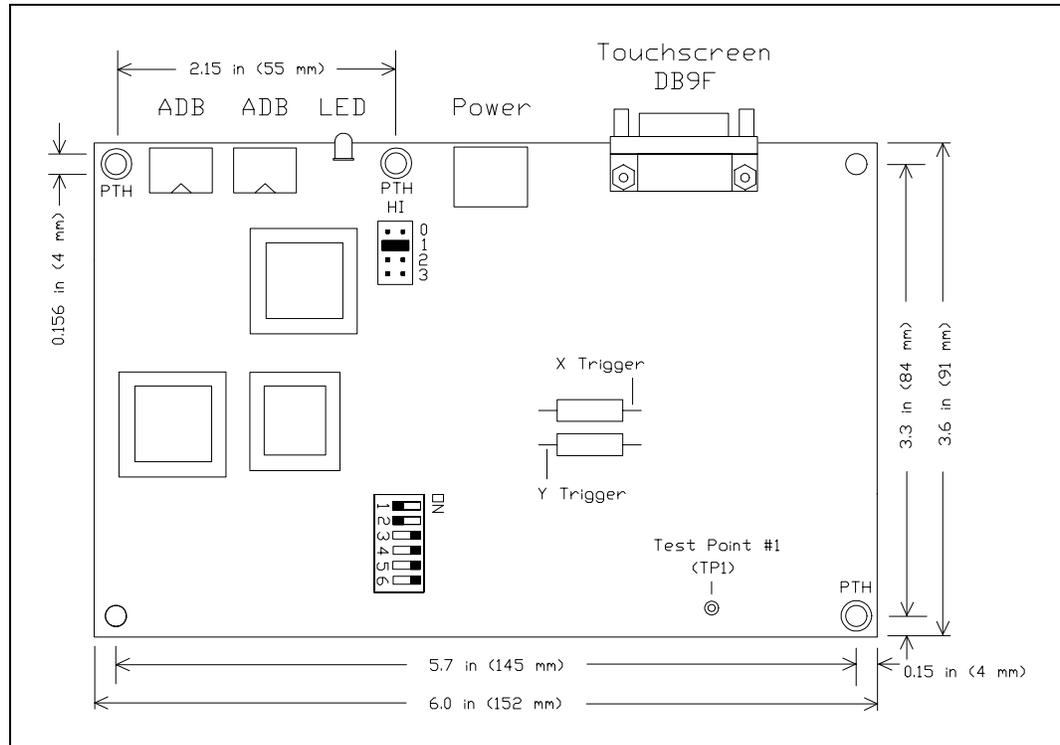


Figure B-3. E281-2303 ADB Controller

### Switch and Jumper Settings

The IntelliTouch E281-2303 ADB controller is shipped preconfigured for use with the MonitorMouse for Macintosh driver software. No changes should be necessary unless multiple ADB touchscreen controllers are used on a single Macintosh. In that case, each must be jumpered with a unique ID number as follows:

Jumper (from top)	ID Number
0	1
1	2*
2	4
3	Reserved—Do not install

If more than one jumper is installed, the ID numbers are added.

\* indicates factory default settings, compatible with Elo driver software

Switch settings must be as follows:

<b>Switch (from top)</b>	<b>Position</b>
1	OFF
2	OFF
3	ON
4	ON
5	ON
6	ON

## E281-2300 CD-I CONTROLLER

The following figure shows the mounting dimensions, jumper locations, and connections for the IntelliTouch E281-2300 CD-i controller.

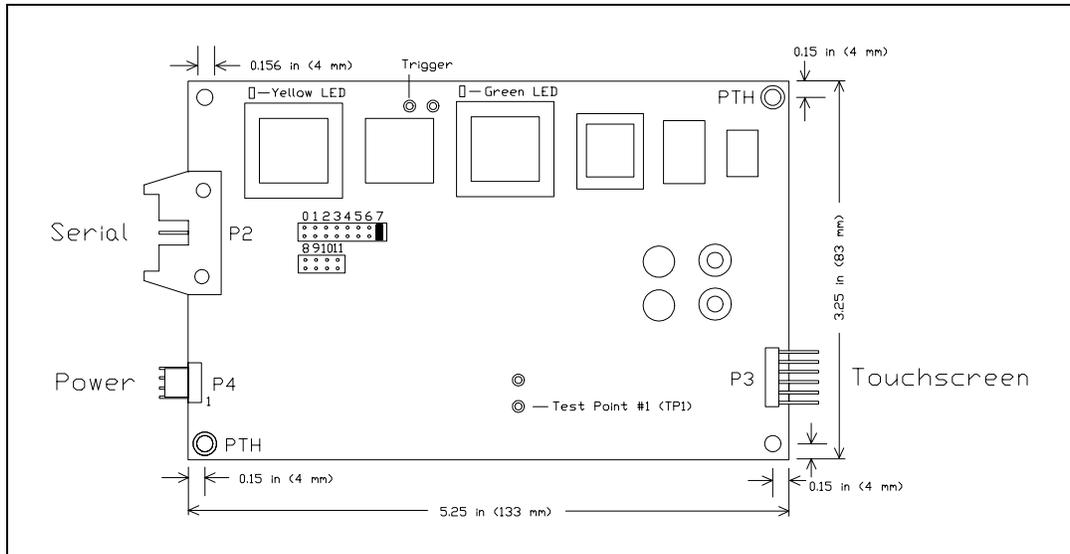


Figure B-4. E281-2300 CD-i Controller

### Jumper Settings

The E281-2300 controller is not shipped pre-configured for Compact Disk Interactive (CD-i) compatibility. The following table lists the jumper settings:

	<b>(From Left)</b>
Reserved	J0 - N
Reserved	J1 - N
Mouse Button Emulation	
Mode 1/Click on Release	J2 - N
Mode 5/Drag Mode	J2 - Y (recommended)
Reserved	J3 - N
Reserved	J4 - N
Reserved	J5 - N
Reserved	J6 - N
	J7 - Y
Display Overscan Area	
No Overscan	J8 - N
	J9 - N
5% Overscan	J8 - Y
	J9 - N

10% Overscan	J8 - N J9 - Y
15% Overscan	J8 - Y J9 - Y
CD-i Mode	Cross-connect J10 and J11 (connect jumper horizontally so the top pins of J10 and J11 are jumpered)

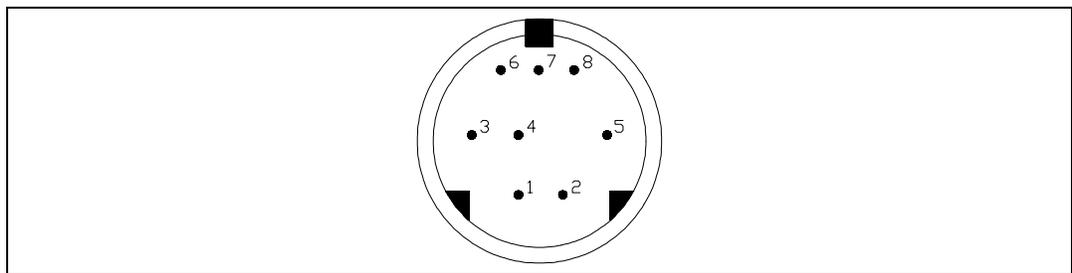
Cross-connect J10 and J11 to place the E281-2300 controller in CD-i mode. In this mode, the E281-2300 controller complies with the CD-i standard for an absolute pointing device. The controller communicates through the mouse (control-R) port of a CD-i player (see below for CD-i connections). With some CD-i players, you may also use the auxiliary serial port.

J8 and J9 define the display's overscan area. Choose the setting from the following table that most closely calibrates the mouse cursor to the position of your touch. For finer calibration, use the horizontal and vertical controls to adjust the image.

J2 sets the mouse button emulation mode. Drag mode is recommended.

*CD-i Connections*

Use the following pinouts to build a cable to connect the mouse (control-R) port of a CD-i player to the controller serial output connector:



*Figure B-5. CD-i 8-Pin Mini-DIN Plug*

<b>P2 Pins</b>	<b>DB9</b>	<b>8-Pin Mini-DIN Plug</b>
1	1	N/C
2	6	N/C
3	2	2
4	7	7
5	3	3
6	8	6
7	4	7
8	9	N/C
9	5	5
10	N/C	N/C

See page 56 for P2 connector pin positions and page 65 for DB9 connector pin positions.

# Appendix C

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## Specifications

The following specifications were correct at press time, but are subject to change without notice.

Many of the IntelliTouch specifications are controller-dependent. Refer to the *IntelliTouch Touchscreen Products* brochure or the Technical Reference Manual for your controller for these additional specifications.

IntelliTouch products are covered by one or more of the following patents: 4,642,423; 4,644,100; 4,645,870; 4,700,176; 4,746,914; 4,791,416; 4,825,212; 4,859,996; 4,880,665.

## INTELLITOUCH TOUCHSCREENS

### Mechanical

#### Construction

Glass panel with transducers attached to front surface of the glass. Glass panel thickness nominally 0.115-inch (3 mm). Corner-mounted transducers add maximum of 0.150-inch (4 mm). Beveled flat screens have transducers attached to a beveled edge of the glass.

### Dimensions

The following physical dimensions of the touchscreen are specified for each model in the *IntelliTouch Touchscreen Products* brochure or the appropriate Elo Specification Control Drawing:

- Horizontal and Vertical physical size
- Horizontal and Vertical border region size
- Horizontal and Vertical touch active area size
- Radius of curvature information
- Cable exit location, length, and connector type

### Cable and Connector

Cable typically exits from the right side, terminating in a 2x6 female, 0.025-inch (0.635 mm) square post receptacle with 0.100-inch (2.54 mm) centers.

### Positional Accuracy

Standard deviation of error is less than  $\pm 0.080$ -inch (2 mm).

### Resolution

4096 x 4096 touch points (approximately 400 touch points per linear inch)

### Touch Activation Force

Typically 2 to 3 ounces (55 to 85 g).

### Surface Durability

Surface durability is that of glass, Mohs hardness rating of 7.

### Expected Life Performance

No known wear-out mechanism, as there are no layers or coatings. The Intelli-Touch technology has been operationally tested to more than 50 million touches in one location without failure using a stylus similar to a finger.

## Optical

### Light Transmission

90% per ASTM D1003-92.

### Visual Resolution

Clear surface: Excellent with no noticeable degradation.

Anti-glare surface: 6:1 minimum.

All measurements made using USAF 1951 Resolution Chart, under 30X magnification with test unit located approximately 1.5-inch (38 mm) from surface of resolution chart.

### Gloss

Clear surface: N/A.

Antiglare :  $75 \pm 15$  gloss units per ASTM D2457-90 using a 60° gloss meter. For flats,  $85 \pm 15$  gloss units per ASTM D2457-90.

## Electrical

All touchscreen drive signals are developed by the interfacing controller. Refer to the Technical Reference Manual for your controller or to the *IntelliTouch Touchscreen Products* brochure for these specifications.

## Environmental

### Temperature

Operating: -20°C to 50°C.

Storage: -40°C to 71°C.

### Operating Relative Humidity

40°C at 90% Rh, non-condensing.

### Altitude

Operating: 10,000 ft (3,048 m).

Storage/transport: 50,000 ft (15,240 m).

Chemical Resistance

The touch active area of the touchscreen is resistant to all chemicals that do not affect glass, such as Acetone, Toluene, Methyl Ethyl Ketone, Isopropyl Alcohol, Methyl Alcohol, Ethyl Acetate, Ammonia-based glass cleaners, Gasoline, Kerosene, and Vinegar.

Electrostatic Protection

When tested per IEC 801-2 (150 pF and 150  $\Omega$ ), the touchscreen shall withstand 20 discharges of 15 kV, distributed randomly across the active area of the touchscreen.

Agency Approvals

UL Compliance

IntelliTouch touchscreens are UL-Recognized Components. UL file no. E162681.

Fire Retardation

Meets the requirements of UL 94HB.

FCC Compliance

Systems incorporating Elo touchscreens, controllers and cables have been approved to FCC Class "A" compliance.

## **INTELLITOUCH ULTRA SERIAL CONTROLLER (E281-2310)**

### **Electrical**

#### *Supply Voltage and Current*

+5 Vdc, nominal (+4.75 to +5.25 Vdc).

140 mA, typical at +5 Vdc. Average power dissipation is 0.7 W, typical.

Supply must be capable of sourcing 200 mA, minimum, and have a rise time of less than 100 ms.

Total noise and ripple requirement must be less than 100 mV (p-p) for frequencies below 1 MHz, and less than 5 mV (p-p) for frequencies above 1 MHz.

#### *Interface*

EIA 232D (Serial RS-232), DCE configuration. 8 Data Bits, 1 Stop Bit, No Parity, Half Duplex. Hardware handshaking: DTR/DSR, RTS/CTS.

Acknowledgments for command set and query.

#### *Baud Rate*

9600 only.

#### *Operating Modes*

Binary in SmartSet or E281A-4002 protocols, jumper selectable.

Initial/Stream/Untouch/Z-axis Enable Modes.

#### *Touch Resolution*

Approximately 4096x4096, size independent, 255 levels of Z (pressure).

#### *Conversion Time*

Less than 10 ms per coordinate report.

#### *Reliability*

MTBF greater than 528,000 hours per MIL-HDBK-217-F2 using parts stress calculation method.

## Environmental

### Temperature

Operating: 0°C to 65°C.

Storage: -25°C to 85°C.

### Humidity

Operating: 10% to 90% RH, non-condensing.

Storage: Same.

### Altitude

10,000 feet.

### Shock and Vibration

National Safe Transit Association Project 1A Test Procedure.

### ESD

Per IEC 801-2(E): 1991.

### Flammability

The printed circuit board substrate is rated 94V0. All plastic components also rated 94V0.

## Physical Characteristics

### Construction

Four-layer surface-mount design with internal ground plane for EMI suppression.

### Dimensions

See Figure B-1, page 67. Total height including shield less than 0.75-inch.

### Mounting Hole Dimensions

See Figure B-1, page 67. Two mounting holes are plated through-holes (PTH) for chassis ground connection.

### Connectors and Pin Definitions

The connector configuration permits the controller to be placed in-line between the touchscreen and serial I/O attachments.

#### *Serial Input/Output Connector*

2x5, 0.025-inch (0.635 mm) post latching header on 0.100-inch (2.54 mm) centers. Acceptable mating insulation displacement connectors (IDC): Berg series 71600, 71602, 66900, 66902, Molex series 40312, Amp series 746285 and 746288. When the mating IDC receptacle is cabled to an IDC DB9 connector, the interface assumes a DCE configuration.

#### *Touchscreen Connector*

2x6, 0.025-inch (0.635 mm) square post friction lock header on 0.100-inch (2.54 mm) centers. Mates with Berg Mini-Latch receptacle on the IntelliTouch touchscreen cable. The withdrawal force exceeds 3.9 lb.

#### *Power Connector*

2x5 0.025-inch (0.635 mm) square post friction lock header on 0.100-inch (2.54 mm) centers. Acceptable mating receptacle connectors: Molex series 70450, Amp AMPMODU Mod. IV product line, or Berg mini-latch housing with Mini-PV pins.

## Agency Approvals

Elo TouchSystems controller board model E281-2310 is a UL Recognized Component, CCN NWGQ2, per UL 1950, Safety of Information Technology Equipment Including Electrical Business Equipment. Recognition information is contained in File E162681.

Elo TouchSystems controller board model E281-2310 is a UL Recognized Component for use in Canada, CCN NWGQ8, per UL 1950, Safety of Information Technology Equipment Including Electrical Business Equipment Certified for Canada. Recognition information is contained in File E162681.

The E281-2310 has been tested to verify compliance with FCC Class B commercial limits. Test results are on file. Conformance to these or to more stringent limits may require special attention to system grounding and shielding, and it may be necessary to apply ferrite suppresser beads to cables.

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