Elo Touch Solutions
TouchPro™ PCAP (Projected Capacitive) Touch Screen
Integration Guide

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Table of Contents

Chapter 1: Introduction

About This Manual

This document guides the user through the successful integration of an Elo Projected Capacitive (PCAP) touch sensor into a monitor, touchcomputer, or other electronic device. The intention of the guide is to make integration straightforward while optimizing touch functionality.

Chapter 1 explains the technology behind a PCAP touchscreen. Chapter 2 describes how to design and integrate PCAP touch sensors into monitor systems with proper sealing. In Chapter 3, various troubleshooting tactics are covered. After reading through this guide, if you still have questions or need help getting your system up and running, please contact an Elo Touch Solutions Sales Representative.

Introducing PCAP

The Elo Touch Solutions PCAP TouchPro™ touchscreen technology is a projected capacitance (PCAP) system that delivers a sensitive, accurate multi-touch interactive experience. Using a proprietary glass-on-glass or glass-on-film lamination configuration, it responds to light touches in a seamless, zero-bezel design. The pure-glass surface is nearly impossible to physically "wear out" and is easy to clean. Projected capacitive touchscreens combine high resolution with excellent transparency and sleek glass-to-edge aesthetics. It consistently delivers a fast, accurate, drift-free touch response.

PCAP features:

- Multi-touch up to 10 points
- Excellent optical clarity
- Long term stable, no-drift performance - no calibration required
- Recognizes touch from a finger or Latex gloved hand

Can meet NEMA 4/4x/12 and IP65 standards upon integration

Supports all major HID based operating systems, including Windows 7, 8, and 10, Linux, and Android. Support for other, not Digitizer operating systems is also available using Elo drivers

PCAP Touchscreens

Elo offers multiple types of PCAP touch screen constructions using film or glass sensor substrates. The PCAP families are called Pro-G, Pro-F and Pro-M. In this application note we will use Pro-G as an example but all PCAP screens have similar characteristics. Elo PCAP projected capacitive Pro-G touchscreens consist of two glass panels with a sensor grid of thin conductive electrodes. These electrodes are composed of a transparent, conductive ceramic indium tin-oxide (ITO). The exposed touch surface is a front glass layer that is hard and durable. The composition of a projected capacitive screen is detailed in Figure 1-1.
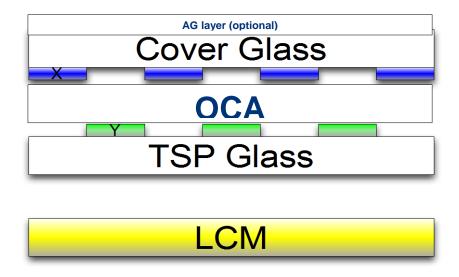

AG layer (optional)
Cover Glass
X
OCA
Y
TSP Glass

LCM

Figure 1-1. Composition of a 2GS PCAP Touchscreen

When the screen is touched, the finger alters the capacitance between pairs of orthogonal electrodes in the sensor grid. The touch location is calculated from the changing electrical characteristics of the sensor grid. The result is a sensitive, durable, and reliable touchscreen that offers drift-free operation. A deeper explanation of PCAP operating principles is given in Elo's PCAP white paper.

PCAP Controllers

PCAP controllers are available with a USB or an I2C interface. Controller options are offered for perpendicular cables as shown in figure 2.1, but also for inline cables when the drive and receive are routed to the same side.   Chip on flex, COF, options are also available.   Controller documentation is available from an Elo Sales Representative and on our website.   More details are provided in Chapter 2.

Driver Software

The PCAP touch screen interfaces to the OS using the HID standard and, although many operating systems have built-in, basic support for HID based touch devices, Elo does supply driver software with many enhanced features. Also, some operating systems do not have support for multiple-touch digitizers and only support single-touch Mouse. In these cases the Elo driver would be required. Drivers for various operating systems and instructions on installation can be downloaded from the Elo support website.

Some of the features the Elo driver provides are:

- Various touch modes, like click on touch or click on release
- Touch exclusion zones
- Support for various ways to setup multiple touch-monitors (span mode, stretch mode, etc)
- Beep on touch with customization
- Allow to function as a single-touch Mouse
- Support for non-Digitizer operating systems, like Windows-XP, older Linux, or Mac.
- A software programmer API to control all modes of operation
- See Driver documentation for more info.

Installation instructions for each driver are included in the download package. Calibration of the PCAP touch screen is usually not required and should work correctly as delivered. However, if a deviation between touch location and cursor location is present, then a calibration procedure can be used to correct for the error. Each Elo driver comes with a calibration process. Please refer to the driver manual for instructions on calibration

Chapter 2: Integration Design Guide

This section of the manual is intended to help design your monitor, touchcomputer, or other electronic device with an Elo Touch Solutions touchscreen. Details are given on designing and sealing the touchscreen, routing cables, and connecting the controller.

Definition of Terms

- **VIEWABLE AREA:** The area of a screen where images can be seen.
- **ACTIVE AREA** (AA): The area of a screen which is responsive to touch.
- **BORDER AREA**: The area surrounding the Viewable Area.
- **SYSTEM**: Touch monitor, computer, or other electronic device being integrated with the touch screen.
- **CHASSIS:** The supporting frame of a system.
- **HOUSING OR ENCLOSURE OR CASE**: The molded plastic cabinet of the system. The housing normally covers the sides, back, and bottom of the system.
- **BEZEL:** Depending on the industrial design, the part of the enclosure that may cover the Border Area. PCAP touchscreens do not require a traditional bezel, but rather may use a sub-bezel to avoid covering the Border Area.
- **SUB-BEZEL:** A sub-bezel is a plastic fixture that attaches to the backside of a touchscreen. The sub-bezel attaches to a rear housing.
- **ZERO-BEZEL:** Zero-bezel is a touch screen overlay method which is comprised of a fully flat front surface, and no associated front surface protrusions. A zero bezel can include an edge perimeter bezel which can protect the edge of the touch overlay.
- **LCD:** Liquid Crystal Display is a flat panel display that uses liquid crystals to modulate the light.
- **DISPLAY:** Typically, a Liquid Crystal Display. Also referred to as a panel.
- **CONTROLLER:** The electronic device that converts analog touch signals into digital touch information that is communicated to a Host Computer.
- **HOST COMPUTER:** The computer system in communication with the controller and in communication with the display, often running an operating system and application programs that make use of touch information.
- **IP65:** Ingress protection rating that covers system protection against dust and water projected by a nozzle (6.3 mm) from any direction for at least 3 minutes.
- **NEMA 4:** Watertight enclosure standard. Must exclude at least 65 GPM of water from 1-in. nozzle delivered from a distance not less than 10 feet for 5 min. Used outdoors. The 4X model has corrosion resistance.

- **NEMA 12:** General purpose enclosure standard. Intended for indoor use, provides some protection against dust, falling dirt, and dripping noncorrosive liquids. Meets drip, dust, and rust resistance tests.
- **MOUNTING TAPE:** Double-sided tape used to attach the touchscreen to a surface.
- **SEALING FOAM:** Foam applied around the edges of the touchscreen to keep spills or dust build-up from affecting system performance. The allowable sealing area is shown in Figure 2-1.
- **HID:** Human Interface Device. Standardized protocol that eliminates the need for a specialized driver.
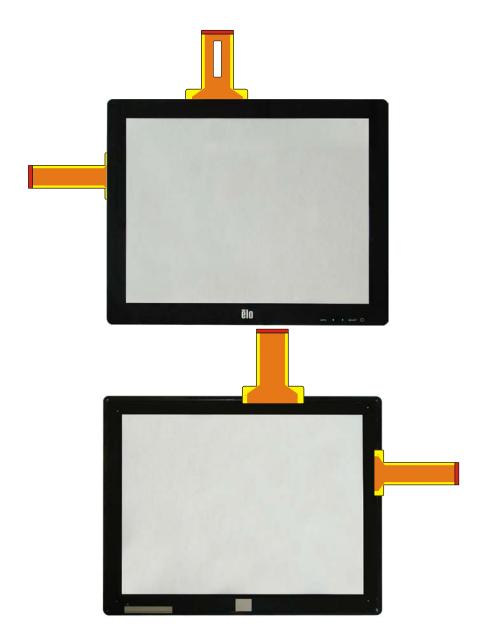

Figure 2-1. (Top) Front View of a TouchPro™ Touchscreen
(Bottom) Rear View of a TouchPro™ Touchscreen

Integration Design

Several options exist in the design and integration of the touch sensor. The cross-sections of reference integration designs for a PCAP touch sensor are illustrated in Figures 2-2, 2-3 and 2-4. Important elements of the integration are described in the sections that follow.

The cover glass dimensions in the standard PCAP design has a tolerance of +/-0.3mm.   Always refer to the dimensions and tolerances provided in the detailed drawing for your particular touch screen. This tolerance along with the customers bezel tolerance should be taken into account to make sure the gap between the bezel and edge of the cover is greater than zero under worse case tolerance assumptions.
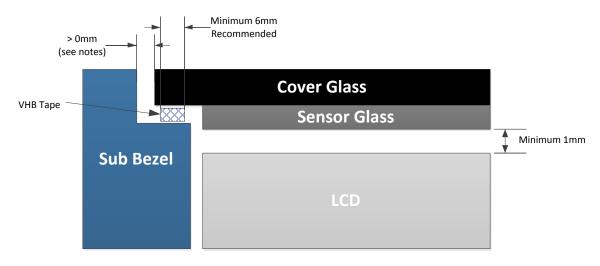

Figure 2-2. Standard Integration of a PCAP Touchscreen with Bezel (not to scale)

Figure 2-3. Standard Integration of a PCAP Touchscreen without Bezel (not to scale)

PCAP touchscreens can be sealed by placing sealing material outside of the cable to prevent moisture and other materials from wicking into the screen. The width of PSA on cover glass is recommended to be a minimum of 6mm.   Larger thicknesses may be needed for large screens.   A recommended tape is 3M VHB4920.   Refer to manufacture's recommendations for amount of adhesive required to support the weight of the screen.

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The sub-bezel may be designed to accommodate the exiting cable as shown in Figure 2-3 below. Any slots in the bezel to allow the cable to exit should have a minimum gap size of >1mm and the slot width and be > 3mm wider than cable.
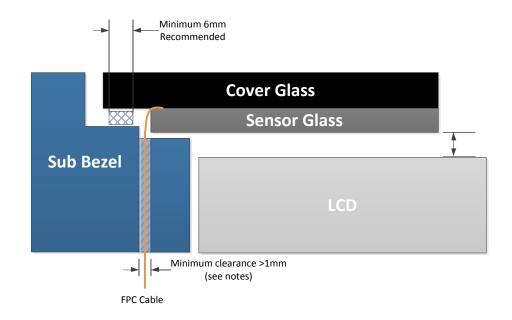

Figure 2-4. Standard Integration with Slotted Sub-bezel (not to scale)

Design Considerations

The following design considerations are based on the integrated design in Figure 2-2.

Glass

Standard PCAP Pro-G screens are constructed with two layers of soda lime glass. The thickness of the glass is normally 1.8mm for the cover glass and 1.1mm for the sensor glass.   However custom stack ups are common based on customer requirements. Width of the border is dependent on the dimensions of the touchscreen and active area.   Please refer to Elo drawings for your particular product for dimensions and tolerances.

Connector

PCAP touchscreens connect to the controller via flexible printed circuit (FPC) cables. The cables fit into the SMT ZIF connectors on the controller. Controllers also have a USB/I2C output connector for routing signals to the system.

Cable Routing

Cable routing is important for proper screen function and should be determined prior to integration. PCAP touchscreens use flexible printed circuit (FPC) cables. The cables are attached to the glass using anisotropic conductive film, ACF. Each cable is routed into a connector that interfaces with the controller. The cables may not be creased and a minimum bend radius of 3.5 mm is recommended. Never carry the touch screen by the cable. Separate cables should not be allowed to overlap. Do not bend stiffener on the tail, avoid sharp metal and do not handle the tails with tools which could scratch or cut the cable.

Housing

The integrated design (Figure 2-2) has a sub-bezel that surrounds the edge of the screen and lies flush with the screen face. This protects the edges and functionality of the touchscreen, but requires strict attention to tolerances between the glass and the sub-bezel.

Mounting

PCAP touchscreens will need double-sided VHB tape or equivalent for mounting the touchscreen to the LCD or sub-bezel. The mounting tape should be placed on the back of the screen without making contact with the active area. Elo recommends mounting PCAP touchscreens onto a plastic sub-bezel. Plastic sub-bezels make the units easier to replace in the field, but good adhesion is harder to achieve than with the metal of an LCD. VHB does not bond readily to plastic with low surface energy, and in these cases a primer will be needed. The primer should be applied to the screen and the sub-bezel for proper adhesion. Elo suggests 3M Tape Primer 94 or equivalent with curing step. Using a metal sub-bezel is not recommended due to temperature mismatch between glass and metal and potential stress crack related issues especially if thinner cover glass is used.

Elo recommends a minimum of 1mm of spacing between the LCD and touch panel for screens up to 27 inch and 3mm of screens 32 in and greater. This spacing is to minimize the effect of LCD noise on touch panel performance. Tighter spacing can be used depending on the noise performance of the LCD screen and optimized tuning of the controller.

Please contact your Elo Touch Solutions representative with additional questions on designing a PCAP touch system.

Installation Notes

Cables can be strained and damaged during installation. Damaged cables are a common cause of functionality failures, so it is important to protect them and handle with care.   The cables should be routed away from the LCD panel inverter, lamps, and power module. The cables should never be creased or crimped. Cables can be bent with a radius of 3.5 mm or greater. Most importantly, cables must not be used as handles for picking up the touchscreen.

Installation considerations are as follows:
- Cables must not be used as handles for picking up the touchscreen.
- A fixture to help align the touchscreen with the LCD is recommended.
- Before mounting the touchscreen, remove the back protective liner. If cleaning should be necessary clean the face of the display and the back of the touchscreen within the viewable area with household glass cleaner or alcohol applied first to a disposable lint free wipe.   A compressed air nozzle with clean, dry air may be used to remove the dust on the sensor and on the monitor. The space between the touchscreen and the display face must be clean and free of any foreign objects.
- A drawing program may be used to confirm functionality of the touchscreen after installation.

Controller Considerations

Elo will recommend the best controller for your screen and application. The touchscreen has FPC cables that connect to the controller. The connection between the controller and computing system has a USB and/or an I2C interface.
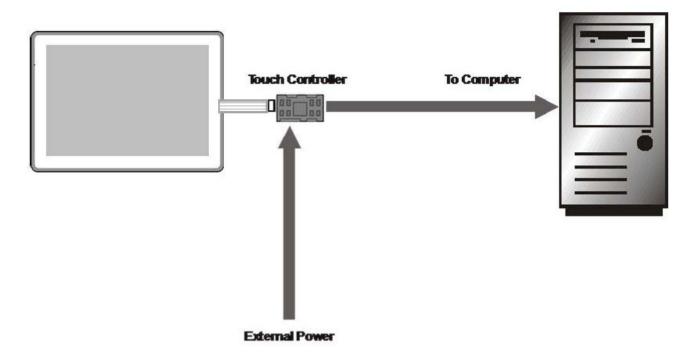
Figure 2-4. Basic system overview

PCAP controllers should be securely mounted to a metal bracket with good grounding and mechanical support. The controller should also be mounted at least 100 mm away from sources of electrical noise. At least one screw should be connected to chassis ground of the enclosure to ensure EMI and ESD requirements can be met.

It is recommended that the power for the controller be linked with the display power to prevent accidental computer inputs in the event that the controller is powered, but the display is off.

Chapter 3: Troubleshooting

If your integrated system is having functionality problems, there are several ways in which you can troubleshoot the components.

Troubleshooting the touchscreen

The first suggested course of action is to reconnect the touchscreen. Problems with functionality are often caused by poor attachment of the cables. Ensure that the pins of the screen align with the contacts in the connector.

If the screen is still not responding, try replacing the screen with another. Substitution is the fastest way to determine the source of the problem. If screen substitution does not resolve the issue, please continue by troubleshooting the controller.

Troubleshooting the controller

The first step in troubleshooting the controller is verifying that it is powered properly. Most Elo controllers operate on a 5 V-dc power source. Please double check the specific requirements for the controller you are using to ensure you are within the specified range.

The second step is to verify proper controller grounding, which is essential for controller functionality. Grounding allows the controller to deal with electrical noise and other environmental issues. PCAP controllers are designed with Plated Through Holes (PTH) for Earth grounding of the system. Ensure that one or more of the PTH is used, and that the PTH is connected to Earth to prevent undesired controller operation. In systems where direct mounting to an Earth chassis is not possible, Elo recommends the implementation of a grounding strap to connect one PTH to Earth.

Substitution can also be used to verify a failure with the controller. Please contact Elo Technical Support for additional help with PCAP controllers.

Troubleshooting the driver

Elo driver software provides a consistent software interface among Elo touchscreens and controllers. PCAP systems are HID-compliant with most operating systems and should be functional without a driver. If the screen and controller are determined to be functional on one operating system and do not function on another, a driver may be required. The driver software helps the touchscreen controller report touch location as a function of the screen coordinates. The driver also performs other operations as directed by the application.

Install the driver for the operating system to be used from the support page at www.eloembedded.com. Make sure you install the correct driver for your operating system. Elo has a combined windows driver which works with all windows operating systems. Drivers are also available for Linux systems as well as Windows CE.

Connectivity to a touch device can be verified using the Device Manager in Windows operating systems. The touch device should show up under "Mice and other pointing devices." After auto-detection, with no driver installed, it should report as a HID-compliant mouse. After successful driver installation it should report as a specific Elo Touch Solutions device.

Hardware functionality can be verified by touching the screen after auto-detection; even without any driver installed, there should be response to touch by virtue of the touch system being a HID-compliant device.

There is very little troubleshooting to be done for the driver itself, other than verifying that the correct driver has been installed. If several incorrect drivers have been installed, it may be necessary to do a manual uninstall to "clean up" the operating system. In such a case, see the Manual Driver Removal instructions in the Support section of www.eloembedded.com.

Chapter 4: Frequently Asked Questions

This section covers the most common questions concerning PCAP components.

1. What type of glass is used?

Standard PCAP screens are available with soda lime glass. The nominal screen thickness of standard screens is 3.1mm, with a 1.8mm cover glass.   However, cover glasses are available from 1.1mm up to 4mm with customized stack ups to meet customer's unique requirements.

2. What finishes are available on PCAP touchscreens?

Elo PCAP screens can be designed with a clear or anti-glare finish.   Anti-reflective, polarizer, and anti-fingerprint treatments are additional options.

3. Will mounting tape or sealing materials be prepared by Elo?

Mounting and sealing is typically completed by the customer.   Elo Touch Solutions can apply mounting tape or design a sealing gasket for you upon request. See Chapter 2 for more details.

4. How can I test functionality after integration?

The functionality will depend on the applications and operating system used for the device. In general, a drawing program is helpful for ensuring that the system works properly after integration.

5. Can I customize my PCAP touchscreen?

Elo takes pride in our ability to work with customers to generate specialized touchscreen solutions for every application. For help with customizing your PCAP touchscreen, please contact your Elo Touch Solutions Representative.

6. Where can I find more information if my questions aren't answered in the PCAP Integration Guide?

Contact Elo Touch Solutions Customer Sales and Support for help with any further questions about your PCAP application.

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