PCAP Integration Guide

A D Metro

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1390 Star Top Road
Ottawa, Ontario, Canada K1B 4V7

Website: http://www.admetro.com/

Support: support@admetro.com

Sales: sales@admetro.com
Tel: +1 613 742 5545
1 800 463 2353 (US, Canada)
Fax: +1 613 742 5245

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2 Introduction

This document describes recommended practices for integrating a display and bezel with an A D Metro PCAP touch system. There are a number of considerations that should be examined when approaching this task and each item is important in order to achieve an optically, mechanically and electrically robust and effective touch solution. This guide describes potential problems that can arise throughout the bezel design and touch screen integrating process and how to avoid or minimize the chance of failures.

This Integration Guide uses A D Metro's standard PCAP Controller in illustrating PCAP touch system installation. However, this Guide applies equally to integration of a PCAP system that employs either A D Metro's standard, or more advanced, ARGON PCAP Controller. The ARGON Controller is fully compatible but contains additional features that substantially simplify system installation and configuration. If integrating an ARGON PCAP system, be sure to also refer to the 'ARGON Projected Capacitive Touch Controller - A D Metro User Guide'.

Not all possible PCAP installation methods are described in this document. It is up to the integrator to test their configuration for themselves and determine whether a solution fits their application. Be aware that certain mountings not described in this guide may invalidate the warranty of the touch screen.

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3 PCAP Touch Sensor Mounting Considerations

This section describes best practices for touch screen installations. Most commonly, the touch sensor is 'sandwiched' between the display and the bezel.

Normally a gasket under pressure is used to seal the bezel to the touch sensor and another gasket under pressure is used to seal the touch sensor to the frame of the display.

3.1 Physical Strength of the Display

To secure the touch screen firmly in place, clamping or compressing forces are often exerted upon the touch screen and the display itself. Some displays are unable to withstand high clamping forces, so if clamping, make sure to determine and understand the limits of the intended display prior to bezel integration.

3.2 Touch Sensor Cable and Orientation

Choose a touch sensor orientation to both a) fit the intended display and b) select the best route for the touch sensor cable to reach the PCAP controller board.

The Projected Capacitive touch screen works with radio frequency and so can be prone to electrical or radio interference. The cable is designed to be short to minimize this type of interference through the cable. The cable should avoid being run near an inverter or other circuit board emitting electrical or radio emissions.

PCAP sensors generally have a slightly larger surface area than the display with which they are used. This extra, inactive sensor area surrounding the display is commonly used for sealing and fastening as it is typically an uninterrupted, smooth, flat surface. However, the exit of the flex cable from the sensor usually reduces the inactive area that is available for sealing purposes. Be sure to consider the PCAP sensor cable exit location and dimensions when choosing how to install and seal the sensor.

Routing of the cable should avoid contact with anything prone to vibration, particularly sharp edges, points or corners. Over time, these may rub through the cable and short out or cut the cable circuitry.

If the touch sensing application is subject to considerable vibration, consider fastening the flex cable with double-sided tape (3M VHB or similar) once it has been connected in place. Be sure to use a double-sided tape at least 4mm thick if there is a risk of electromagnetic coupling into the flex cable from the fastening surface.

The cable is meant to be used as an electrical connection only. Therefore, never trim or otherwise modify the cable, and never carry or support the touchscreen by its tail. Creasing or sharply folding the cable can also cause damage. However, it is acceptable to create gradual bends in the cable. The cable may be bent in any number of locations with a minimum 0.125" radius. Bending the cable is an effective way of relieving cable, joint or connector stress, particularly in situations where the cable must turn abruptly after leaving the back of the sensor back or the controller. Avoid repeatedly be-bending the same cable location.

3.3 Assembling Front of Touch Sensor with Bezel

A gasket or single-sided adhesive foam tape should be used between the front of the touch screen and the back of the bezel. This 'front' gasket (from the point of view of the PCAP sensor) provides a seal against the elements and contaminants while contributing to a sturdy assembly.

Ensure that the selected gasket or foam material will not dissolve or otherwise be damaged by any chemicals that it may contact during use.

Integrators have had success using 3M closed-cell polyethylene foam, both single-sided adhesive and double-sided adhesive versions. Closed cell foam gasket material is a better choice than open cell foam for sealing against the elements. In general, a more compressible foam is usually more effective because it adapts better to any irregularities in the mating surfaces.

When using compressive foam as a front gasket for sealing and cushioning, compression of 50% to 70% is recommended and should be sufficient for most dust and water sealing. Firmer foam should be compressed on the lower end of this scale and softer foam on the higher end.

Ensure that the dimensions and placement of the gasket and bezel opening are selected in such a way to allow for sideways expansion of the gasket material that naturally occurs when it gets compressed. Avoid allowing the gasket to become visible or squeeze into (and block) the active area of the touch screen.

Special consideration when planning the attachment of the touch sensor and bezel is needed when the bezel is made using (or contains) electrically conductive material. The electrically conductive bezel and PCAP sensor must not be allowed to get too close to one another. If (for example) a metal bezel is too close to the active area of the touch sensor, this can decrease the sensitivity of the nearby edges of the sensor or (alternatively) trigger false touches. A separation of 3 mm or more is sufficient for touch systems not modified from their factory settings. Note that the 'front' gasket thickness may contribute some spacing between the bezel and PCAP sensor, so this additional factor should be considered when choosing the gasket thickness if the bezel is constructed from electrically conductive material.

If an electrically conductive bezel material is used, we recommend that the bezel be electrically grounded to minimize variation in the electric fields passed from the bezel to the touch sensor.

In some cases, special adjustment of touch system settings is made (or planned) to provide compatibility with extra thick cover glass and/or thick glove use. In these special cases, a further increase to bezel/sensor separation may need to be made to account for the heightened sensing range of the touch sensor that was made to increase touch sensitivity.

If non-standard adjustments have been made to the system's touch sensor sensitivity or if the application would benefit from a reduced bezel separation below 3 mm, then experimentation can often identify an acceptable lower separation for the application. Use this procedure to determine how much separation can be reduced with your system. Operate the touch sensor with the intended display and bezel positioned at various distances from the edge of the touch sensor active area (that might be preferred for your implementation). For the purposes of this experiment, if the intended electrically conductive bezel is unavailable, a metal ruler is a reasonable substitute. Whatever metal substitute is used, it should be commonly grounded with the display's ground to best replicate electrical conditions of normal use. To check for reduced sensor edge sensitivity, compare the response threshold of the sensor to very light/small touches at the sensor edge, very close to the conductive bezel material versus similar touches near the middle of the sensor. Increase the spacing between the bezel material and the active area of the sensor until no reduced sensitivity near the edges can be observed.

Even with a non-conductive bezel, some clearance all around the touch sensor active area is needed to allow physical access for a touch/finger to reach the very edge of the display and also to keep any edge buildup of dirt, dust or other contaminants from reaching the sensor active area and possibly triggering false activation. Clearance of 3 or more millimeters all around has generally resulted in success.

When using an electrically conductive bezel, before finalizing bezel setback and gasket thickness decisions, it is a good ideal to assess the risk of nuisance touches as described in the following section '3.4 Assembling Rear of Touch Sensor with Display'. This is because there's a chance of some electromagnetic and/or radio frequency interference reaching the touch sensor via the electrically conductive bezel and causing false touches. The following section describes in some detail how to assess the effect of possible interference (from the display in that case) into the touch sensor. Use the same techniques to assess the effect of possible interference from the conductive bezel into the touch sensor. In short, experiment with various bezel/sensor spacings while looking for false touches. For your design, select a spacing somewhat larger than the largest spacing that causes false touches (if they occur). If no false touches are seen, select a spacing somewhat larger then the minimum tested.

3.4 Assembling Rear of Touch Sensor with Display

A 'rear' gasket is used between the rear of the touch screen and the front of the display frame. This rear gasket provides a seal against dust and other contaminants while contributing to a sturdy assembly. A compressible foam material with double-sided, non-aggressive adhesive is recommended. Use of two-sided (or any) adhesive is not mandatory, but recommended so that cleaning between and sealing the sensor to the display needs to be done only once. If a double-sided adhesive is used, it is recommended to select a type of adhesive that can be removed in order to allow for minor corrections in placement or positioning if needed. The selected rear gasket material and adhesives should also be types unaffected by the heat generated by the display, which can cause some materials to degrade.

If the border of the touch screen must cover mounting holes of the display, consider using horizontal standoffs. Standoffs help control the protrusion of the mounting screws. There should be no protruding screws, as the protrusion may press into the back of the touch screen and cause a crack when the assembled unit is clamped by the bezel.

Align the touch sensor with the display as desired prior to finalizing the assembly. The active area of the touch sensor should be centered about the viewable area of the display. There is some tolerance of minimal misalignment without affecting cosmetic appeal because touch sensor frames typically have a black mask around their perimeter (to hide sensor circuit traces).

Be sure to select and position the rear gasket to allow for inevitable sideways gasket expansion that occurs during gasket compression. Be sure that this expansion doesn't affect the visibility of the display.

A key consideration when planning the attachment of a touch sensor to a display is the management of electrical noise (or interference) generated by the display that reaches into the touch sensor. If the display is too close to the back of the sensor (particularly with older display technologies), electrical noise from the display electronics may interfere with touch sensor function. The key risk is interference from the display into the sensor triggering false touches. Choosing a sufficient spacing between the sensor and display manages this interference issue.

The foam spacer thickness needed between display and PCAP sensor might be anywhere from 0.5 mm to 6 mm. The minimum thickness that may be used depends on the intensity of emissions radiated from the display. Emissions vary greatly with size and type of display. Typically, thinner gaskets are used with smaller touch screens and thicker gaskets are used with larger touch screens, but display design and technology have strong influences.

There are two effective ways to choose the spacing between display and sensor to successfully manage interference.

The first and more traditional method involves testing sensor operation when it is positioned at various spacing distances from the active display. Starting with the sensor and display very close together, gradually increase the spacing until effects of interference are no longer observed, then choose a slightly larger spacing that builds in some safety margin to the signal-to-interference ratio. This method is effective but doesn't reveal quantitatively the amount of margin between the interference level being experienced by the sensor and the signal threshold level that just triggers a touch. With this method, perhaps slightly more spacing needs to be used to bring confidence than with the second method.

The second method has the benefit of revealing the signal-to-interference ratio achieved. However, this method requires (at least temporarily) the substitution of A D Metro's more advanced ARGON PCAP Controller board in place of your PCAP controller board. The ARGON Controller is fully compatible but also has additional capabilities (that simplify integration and configuration). A built-in feature of the ARGON measures and reports (via LED flashes) the interference level being experienced by the connected PCAP sensor. In brief, a long press of the button on the ARGON controller activates its interference measurement feature. Thereafter, until another press of the button (or until controller power is turned off) the ARGON alternates between measuring the instantaneous interference level (signaled by a blue flash) and indicating that measured level (using red and green flashes in unison), one flash for each 5% of the scale between zero interference and the interference level that can just barely trigger a false touch. Using the ARGON as a tool, it is easy to choose a spacing (between PCAP sensor and display) that yields a comfortable signal-to-interference safety margin.

4 PCAP Touch Sensor Mounting Examples

This section describes some effective ways to mount a PCAP sensor with a display assembly.

In all cases, it is important to fasten the sensor (and display) securely, including control against possible side to side motion.

In any PCAP sensor installation arrangement, the spacing between the touch sensor active area and both 1. the display and 2. nearby electrically conductive material, must be sufficient that the radiated interference from either does not produce false touches from the sensor. In section 3.4 of this Installation Guide, there are descriptions of methods to establish minimum acceptable separations. Sensor separation from electrically conductive material of 3 mm or more is normally sufficient. It may be possible to confirm experimentally that a closer spacing is also acceptable. Required minimum sensor separation from a display depends strongly on the display type.

4.1 Compression Using a Non-Electrically Conductive Bezel

A PCAP touch sensor can be installed by compressing it between a non-conductive bezel and a display using gaskets.

In touch sensor applications, normally about 1 mm is provided between the bezel inside edge and the edge of the display visible area (which corresponds to the edge of the touch sensor active area).

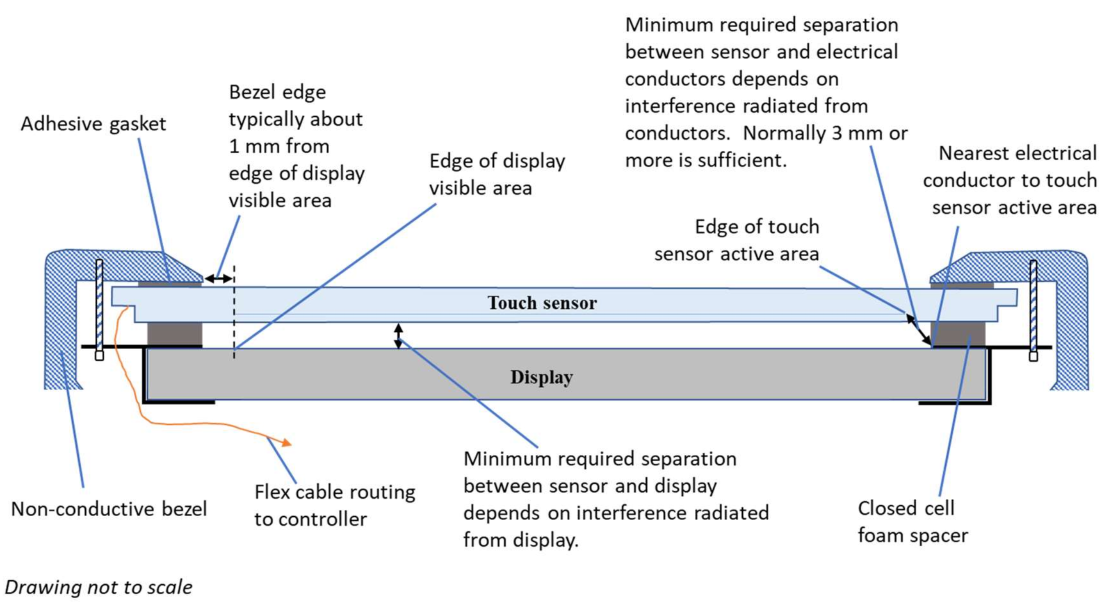


Figure 1: Side Cutaway View - Sensor Compressed Between Display and Non-Conductive Bezel

4.2 Compression Using an Electrically Conductive Bezel

A PCAP touch sensor can be installed by compressing it between an electrically conductive bezel and a display using gaskets.

In touch sensor applications, normally about 1 mm is provided between the bezel inside edge and the edge of the display visible area (which corresponds to the edge of the touch sensor active area).

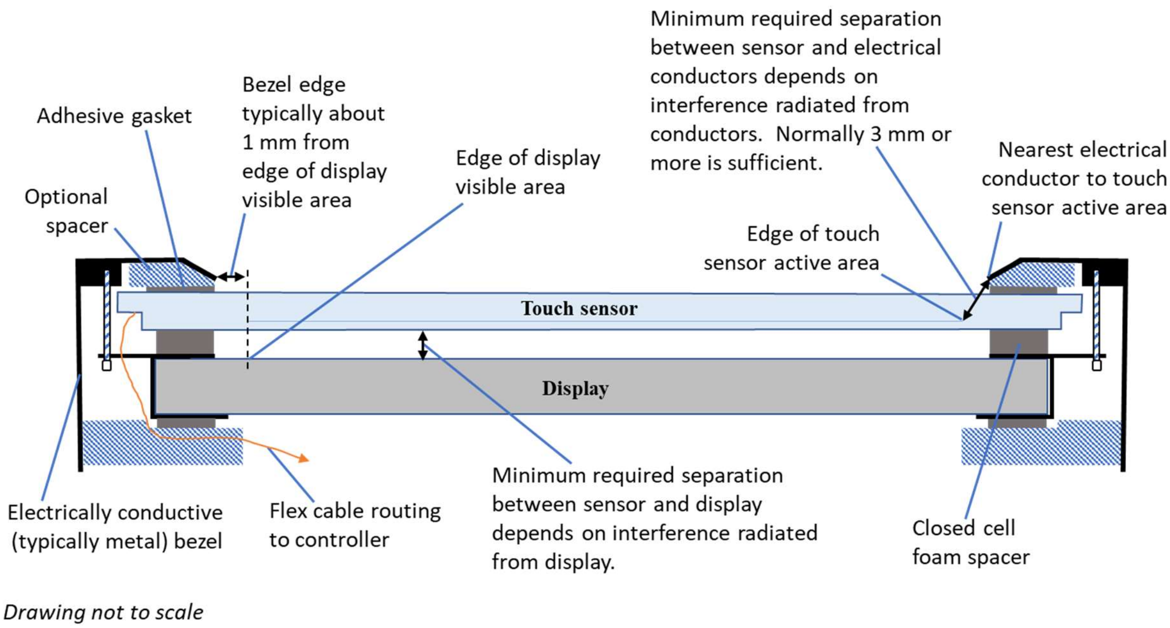


Figure 2: Side Cutaway View - Sensor Compressed Between Display and Conductive Bezel

4.3 'Zero Bezel' Installation

A PCAP touch sensor can be installed by adhering it to the front of a display assembly using an adhesive gasket. This type of installation is commonly called 'zero bezel' because the outer surface of the touch screen is not covered at its edges by any bezel. Examples of this would be represented in your cell phone or a tablet computer such as an iPad.

Note that some PCAP sensors are not compatible with zero-bezel installation. Some sensors do not have sufficient perimeter surface area front glass called the 'touch window'. This limitation is sometimes due to the exit of the flex cable from the sensor interfering with the nearby underside of the perimeter surface, however, custom designs can provide for large front glass touch windows to provide zero bezel mounting

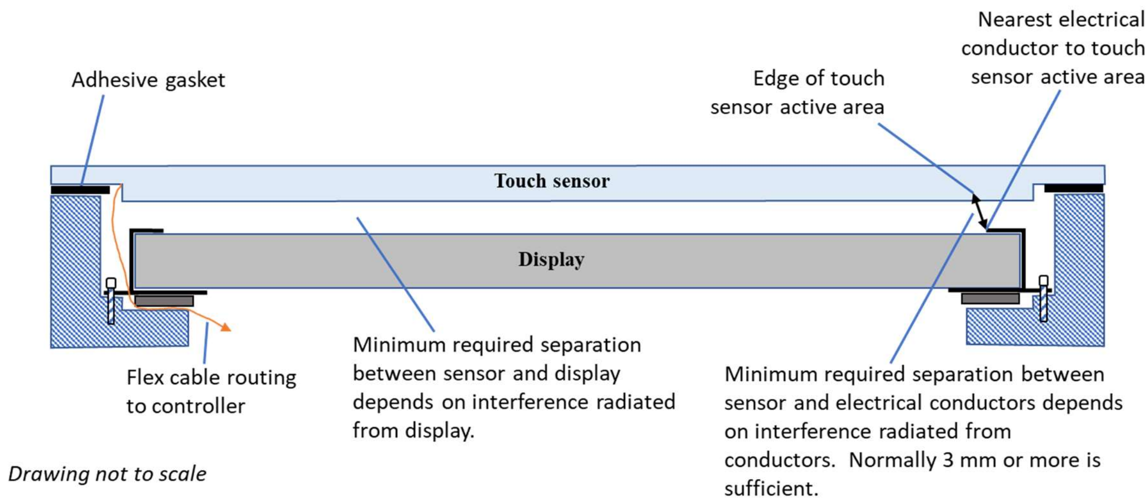


Figure 3: Side Cutaway View - 'Zero Bezel' Sensor Installation

5 PCAP Controller Installation Considerations

The installation of the PCAP controller must be designed along with planning of the PCAP sensor installation. The controller is typically mounted in an area behind the display and always within reach of the PCAP sensor flex cable. Some flex cables are very short (like the one pictured here) while others are longer and therefore offer more installation choices.

Figure 4: PCAP Controller Connected to Sensor and USB

5.1 Mounting the PCAP Controller Board

The controller board has four prominent holes to allow the board to be mounted in the final assembly. If using these holes to mount the board with nuts, bolts and standoffs, 2.5 mm (M2.5) or 3/32" (4-40) machine screws in the 0.125" (3.2 mm) holes are recommended as these fit somewhat loosely to accommodate slight variation in the location of mounting features of the final assembly.

Mounting the controller using adhesive foam is also acceptable.

The PCAP controller should be mounted at least 4 mm above any metal surface to avoid possible electrical shorts to metal on the back of the controller. Of particular concern are the leads of the USB connector which protrude from back of the controller by as much as 3 mm.

If using fastening hardware that doesn't provide an electrical ground connection (such as nylon bolts or adhesive foam), we recommend installing a grounding wire (22 AWG or thicker) to the copper of one of the mounting holes.

5.2 Routing the PCAP Sensor Flex Cable

Be sure to secure longer flex cables to prevent vibration putting stress on the connections. Secure cables to the display or other surface using tape or double-sided foam. While the cable may be safely held directly against grounded surfaces, it should be separated by at lest 3 mm from any active electrical signals. Even more spacing may be needed if signal voltages are large.

The controller board should be positioned so the sensor flex cable can easily reach the controller's connectors without being pulled tight and without immediately bending upward or downward from the board and without immediately turning sideways. Tension in any of these directions puts the cable at risk of popping out over time. Strive to route the flex cable straight to the controller board's connectors.

Commonly, the flex cable needs to follow a curved path. It is recommended to gently bend the flex cable to reduce the stress it causes when following a curved path. Forming bends in the cable is acceptable, but never sharply fold or crease the cable as this can break internal conductors. Also, if the cable ever needs to be re-bent, or further bent, never un-bend or sharply bend any one part of the cable (again to avoid breaking internal conductors). Instead, make a second, additional bend or reverse bend (as needed) in a different (perhaps nearby) location. Creating gentle bends in the cable is a good way to reduce the unwanted upward or downward (prying) forces that it can apply to connectors.

NO!! Unwanted stress applied to connectors from upward-pulling flex cable.

YES!! Gentle bend in flex cable eliminates stress on connectors.

5.3 Protecting Controller Board Connectors

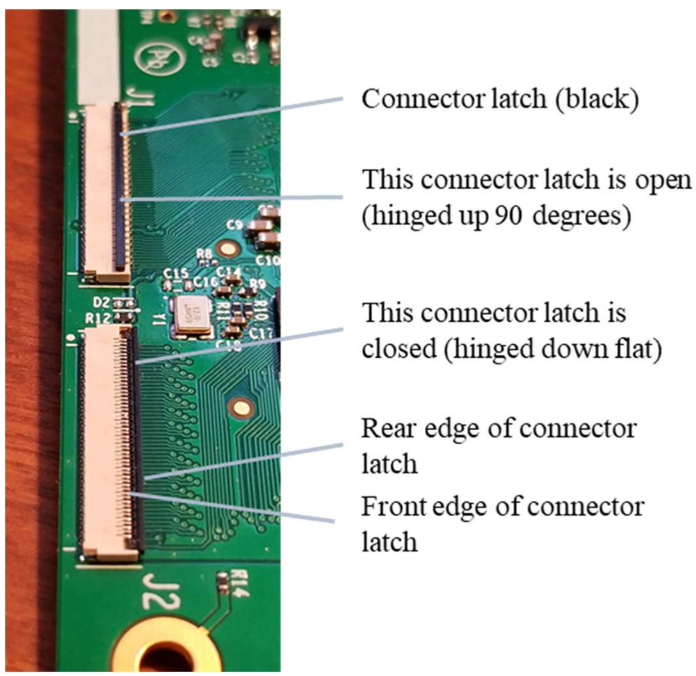
Controller board flex connectors have their electrical conductors on the bottom side. Therefore, flex cables should be inserted with their electrical conductors facing downward.

Care must be taken with the controller board connectors that accept flex cables from PCAP touch sensors. These connectors have latches at their rear that hinge upward 90 degrees to open, then close by folding down flat. The latches allow these connectors to hold many-conductor cables securely while also enabling low cable insertion force.

Controller board flex connector latches can be damaged during opening, so please observe the following:

1. When opening a latch, avoid pulling the entire latch upwards. Instead, rotate the rear edge of the latch upward and forward to make the latch stand on its long front edge (its rear edge only lifted up a short distance). The height of the front edge of the latch should not change.
2. When opening a latch, lift near the middle of the rear edge and also lift as much length of the rear edge as you can. Lifting only a corner or just a single point of the latch risks causing damage.

Before closing a flex connector latch, be sure that the flex cable is fully inserted and exactly perpendicular to the connector.



5.4 Adaptor for PCAP Sensor Having a Different Flex Cable

A D Metro's PCAP touch controller boards contain a pair of side-by-side 51-pin connectors. This connector pair accepts popular PCAP touch sensor flex cables that have a pair of 51-conductor electrical contacts.

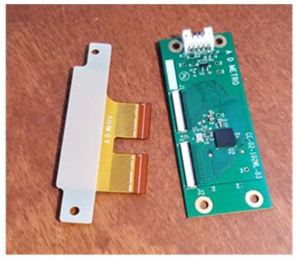
Some PCAP touch sensors have flex cables with different electrical contacts. To accommodate such alternative sensors, A D Metro offers flex cable 'adaptors'. Adaptors provide a bridge by accepting alternative touch sensor flex cables while also connecting to A D Metro PCAP controllers.

Each adaptor is designed to be easily mounted together with a controller board. The adaptors have mounting holes that match existing mounting holes in controllers so that the two can become a single unit that installs in the final assembly much like a controller board on its own.

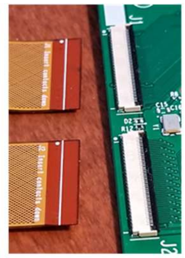
A pair of washers (or spacers, or even a nut) should be used between the adaptor and controller boards so that they can be firmly held at a controlled spacing from one another (without causing any bending stress on either board). Each adaptor is supplied with a pair of washers for this purpose. The same hardware that mounts a controller board (often a 2.5 mm bolt) can now mount both boards. Note that two of the four bolts may now need to be slightly longer.

The following images illustrate how to use an adaptor to connect a PCAP sensor with (in this example) a 68-conductor flex cable to an A D Metro PCAP controller.

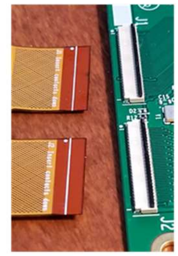
1. Obtain the adaptor for your PCAP sensor flex cable.



2. Turn the adaptor upside-down, ready to connect to a PCAP controller.

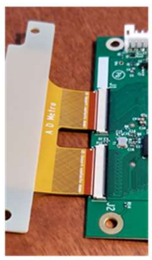


3. Black latches on rear of connectors on controller board are down (closed) so not ready.



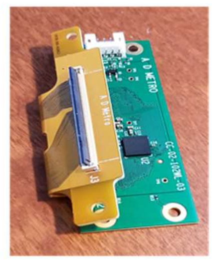
4. Gently rotate the black latches up to open the connectors.

5. Insert the two ends of the flex tail fully into the two connectors.

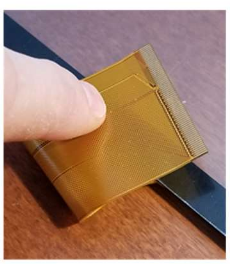


6. Fold the black connector latches down to close the connectors.

7. Bend (don't crease) the adaptor's flex cable so that the two adaptor board holes roughly align with the closer two controller board holes.

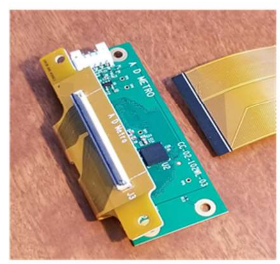


8. Gently rotate open the black latch on front of the adaptor board connector.

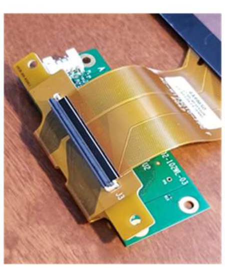


9. On the PCAP sensor flex tail, find the side with metal contacts.

10. Orient the flex tail metal contacts facing down.

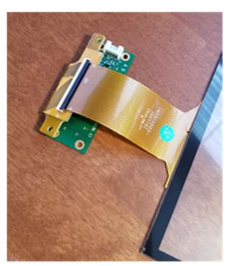


11. Ready to connect flex tail to the adaptor.

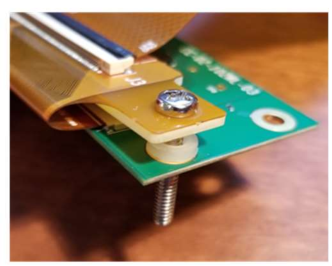


12. Insert the flex tail fully into the connector.

13. Fold down and close the black latch of the connector.



14. Connected!



Spacer washer in place between adaptor and controller boards.