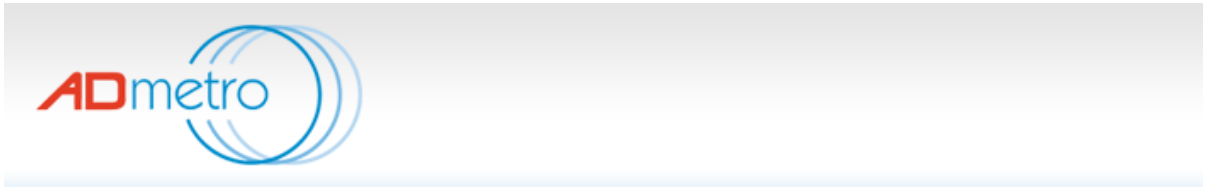

A D Metro's Functional Testing Guide

Version 1.2

Rev	Description of Change	Approved by:	Date
1.0	Initial release	Dominic Zborowski	2/13/2015
1.2	Typo correction	Dominic Zborowski	2/25/2015

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Description

This document describes the testing procedure A D Metro uses to verify the functionality of ULTRA touch panels that leave its facility. Each ULTRA touch panel is tested individually to ensure the lamination process of the armour glass or topsheet did not damage or adversely affect the function of the touch panel, and that the sensor was assembled properly and meets specifications.

The ITO glass suppliers perform linearity testing on the glass or touchscreen prior to shipping to A D Metro to ensure the linearity of the glass is within specifications. As such, the glass is assumed to be within specification upon receipt, and the sensors are only manually tested to be certain that the assembly process had not introduced any defects, malfunctions or other phenomena that might impact the screen's function.

The document assumes a 5 wire resistive touch screen is being tested, though the test procedures may be equally used for a 4 or 8 wire sensor, except where noted.

Procedure

1. The first sensor from the batch to be tested is fully calibrated using 9 point calibration with the appropriate controller (normally AD-MER4050UEBG for a 5 wire sensor). A 9 point calibration is generally sufficient for the purposes of testing and simple to perform, but if a sensor needs greater accuracy testing, a 25 point calibration may be performed if a properly sized linearity grid is available for the device under test (DUT).

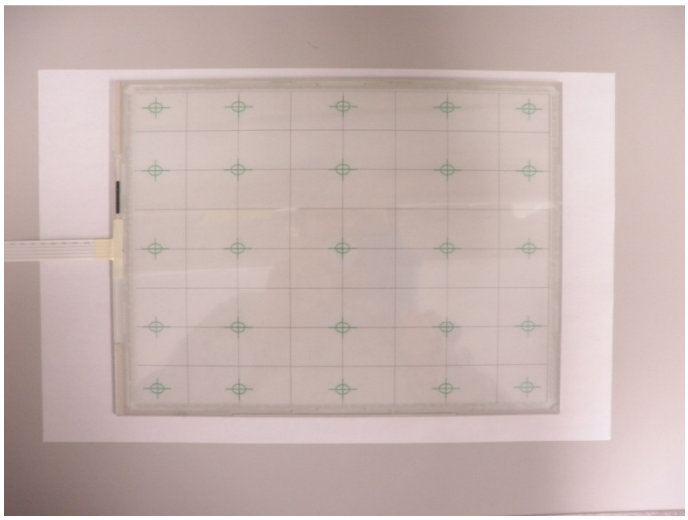


Figure 1 - 25 point calibration linearity grid

2. The sensor is tested in Draw Test of the touch driver by drawing with a finger horizontally and vertically across the surface of the screen's active area, spacing each line apart by approximately 5-10mm, forming a grid of lines.
   a. If the lines draw straight and match the motion of the operator's hand, and are in their approximate expected locations, the sensor passes the check.
   b. If the lines draw crookedly due to reason other than the operator's hand movements or if they

do not accurately follow the motion of their hand, the sensor is **rejected** or set aside for further testing.

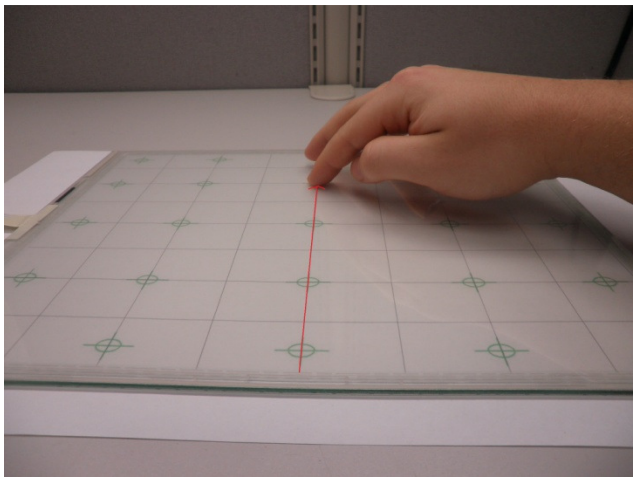


Figure 2 – Actual Drawing Motion

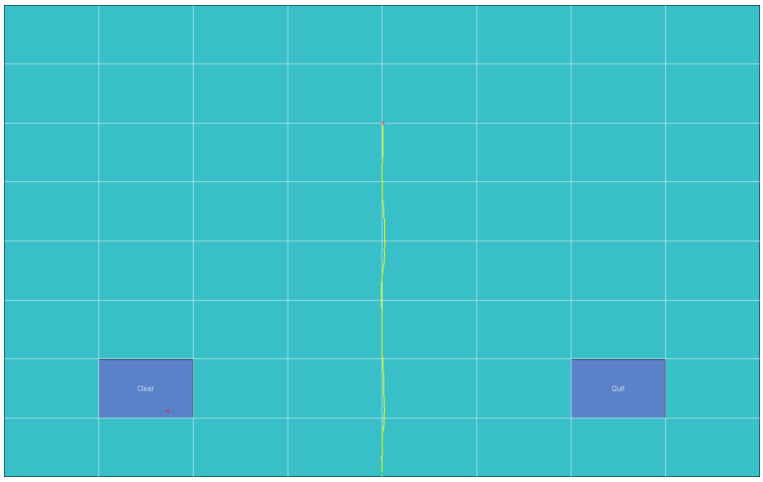


Figure 3 – Cursor Response

3. Once a sensor passes the first functional test, the cable connection is checked. With one hand, the operator lightly tugs, twists, and pushes down on the cable near the base (ie, near the cable to glass connection interface), while activating the touch panel with the other hand in a single location.

Figure 4 – Cable Connection Test

a. If the touch is lost or the cursor response becomes unstable, or jumps while the cable is being handled, the sensor is **rejected**, indicating a possible weak cable connection.
b. If the cursor does not appear affected by the movements of the cable and remains stable, the sensor passes the check.

If the sensor passes steps 2 and 3 the sensor is **accepted** and passes the functional test. The next sensor is then obtained but no calibration is performed. The calibration data from the previous sensor may be used, as the data for the same sensor model should be nearly identical. Each subsequent sensor is tested as in step 2 and 3, with the same pass or fail requirements, until the whole batch has been processed.

Additional Tests

Extended Functional Test

If a sensor fails the function test for crooked lines, or lines that are not quite in their expected location, the test may be performed again, but the controller must be recalibrated using the suspect sensor. Due to slightly varying ITO sheet resistances in materials and parts, the touch location may translate to different locations from sensor to sensor with the same calibration data.

1. A 9 or 25 point calibration is performed on the sensor.

2. The sensor is tested as in step 2 and 3 above. If the sensor continues to exhibit irregular, erratic or inaccurate function, the sensor is **rejected**. See Failure Analysis section for possible fail modes.

Electrical Test – 5 wire sensor

A sensor may be electrically tested if a sensor is failing with symptoms such as:

- Erratic cursor movement during use
- Cursor not translating to proper location (ie, cannot activate in a certain location)
- Sensor constantly activates

The test described in this section is meant to verify that there are no disconnected pins in the cable or substrate and that the conductive layers are sufficiently separated.

1. The sensor is placed on a table with a multimeter which is used to verify the resistance between pins 1 and 5 of the touch panel. The operator lightly tugs and twists the cable, and also pushes down on the cable connection while monitoring for resistance fluctuation.
   a. If the value fluctuates by more than 3Ω, the sensor is suspect of cable issues and is **rejected.**
   b. If the value remains stable, the sensor passes the check and the reading is noted. The resistance value will typically lie between 30-60Ω, but will depend on the sensor being tested; higher values are permitted.

2. Step 1 is repeated for pins 2 and 4.

3. Resistance value between pins 1 and 5 and resistance value between pin 2 and 4 are compared with each other.
   a. If the difference exceeds 5Ω, the sensor is **rejected**.
   b. Otherwise, the sensor passes the check

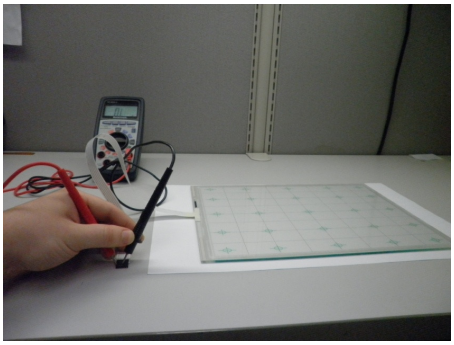


Figure 5 – Electrical Test

4. Resistance between pin 3 and any of the other pins is checked without activating the touch screen.

a. If the value is less than 20 MΩ, the sensor is **rejected.**
b. If the value is greater than 20 MΩ, the sensor passes the check.

5. Resistance between pin 3 and any of the other pins is checked while activating the touch screen.
   a. If the resistance does not drop to < 4kΩ, the sensor is **rejected**.
   b. If the resistance does drop to < 4kΩ, the sensor passes the check.

If the sensor passes steps 3, 4 and 5 the sensor is **accepted** and determined to have both a good cable bond and sufficiently separated conductive layers. If the sensor still malfunctions, further testing is required.

Any mutually exclusive pairs of pins may be tested in this manner in steps 1 and 2 (ie, 1/2 and 4/5, 1/4 and 2/5) so long as they fulfill the criteria in steps 3 to 5.

Electrical Test – 4 or 8 wire sensor

On 4 and 8 wire sensors, issues will manifest differently. Symptoms include:

- Cursor stuck to side of screen
- Sensor has no touch

Cable issues and conductive layer separation may be checked for using the following method. Refer to sensor drawing for location of X busbar pins and Y busbar pins.

1. Check resistance between X busbar pairs. This will vary from sensor to sensor, but typically will be pins 1 and 3 or pins 2 and 4.
   a. If the resistance is open, the sensor is **rejected**.
   b. If the resistance is sufficiently low (depending on material, but typically < 1000Ω), the sensor passes the check.

2. Check resistance between Y busbar pairs. This will vary from sensor to sensor, but typically will be pins 1 and 3 or pins 2 and 4.
   a. If the resistance is open, the sensor is **rejected**.
   b. If the resistance is sufficiently low (depending on material, but typically < 1000Ω), the sensor passes the check.

3. Check resistance between one X busbar and one Y busbar without activating the touch screen.
   a. If the value is less than 20 MΩ, the sensor is **rejected**.
   b. If the value is greater than 20 MΩ, the sensor passes the check.

4. Check resistance between one X busbar and one Y busbar while activating the touch screen.
   a. If the resistance does not drop to < 4kΩ, the sensor is **rejected**.
   b. If the resistance drops to < 4kΩ, the sensor passes the check.

If the sensor passes all four checks, the sensor is **accepted** and determined to have both a good cable bond and sufficiently separated conductive layers. If the sensor still malfunctions, further testing is required.

Failure Analysis – 5 Wire Touchscreen

The following section describes the various functional related malfunctions and issues that can arise in a 5 wire resistive touch screen.

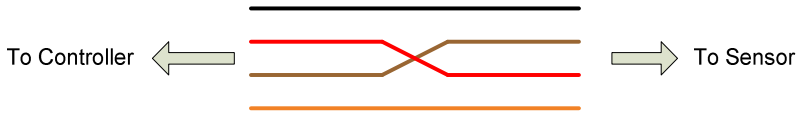
Observed Failure	Possible Fail Mode	Verification Methods
No touch when pressing down on the screen	Middle pin of cable or glass substrate is disconnected or damaged	• Inspect cable for damages • Inspect silver traces for scratches, chips or cracks • Squeeze cable connection while pressing touchscreen and check for touch • Check pin 3 with electrical test
	Z-axis adhesive connection of sensor is broken	Burnish/squeeze black z-axis adhesive strip while drawing on the sensor
	Sensor is requiring too much pressure to activate or more pressure than expected	Burnish/squeeze black z-axis adhesive strip while drawing on the sensor and press harder on screen
Sensor constantly activates	Sensor is over-evacuated (air gap collapse)	Dot pattern impression is easily viewable across surface of polyester
	Contaminant trapped in air gap	Locate approximate location of short, and burnish/rub area
Cannot activate in large area(s) of the screen	Pin 1, 2, 4, 5 or any combination of pins in cable are disconnected from substrate or damaged	• Inspect cable for damages • Inspect substrate for scratches, chips or cracks in the traces leading to the corners • Squeeze cable connection while pressing touchscreen and check for touch
Cannot activate in small area of screen/lines curve away from single point	Anywhere in active area: ITO issue in substrate	Remove lamination; check substrate for voids or discontinuities in ITO coating
	Near edge of screen only: Damaged linearity pattern	Inspect linearity pattern for chips in the approximate area of bad linearity
Sensor has bad linearity across entire screen	Wrong controller used for calibration	Check controller exception list to ensure sensor does not require special controller configuration
	Sensor is partially over-evacuated	Measure resistance between pin 3 and any other pin. Will be between 3kΩ and 20MΩ.

Patch Cable Configurations

Controllers provided by A D Metro function only with sensors with matching pinouts. If the sensor pinout does not match, then functional issues will occur on every mismatching touch panel. Patch cables may be used to simulate using the appropriate controller if it is not available.

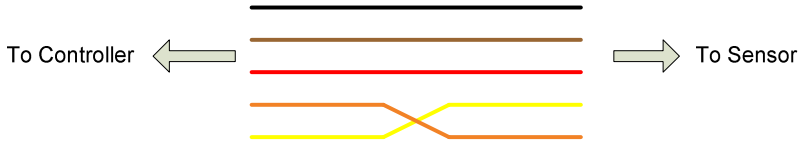
Configuration A

For 4 wire sensors. Calibration required.



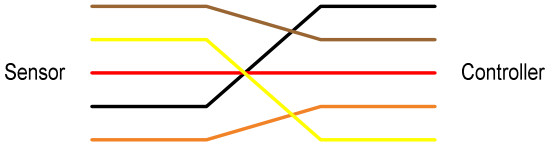
Configuration B

For 5 wire sensors. Calibration required. Needed if incompatible controller is used to test.

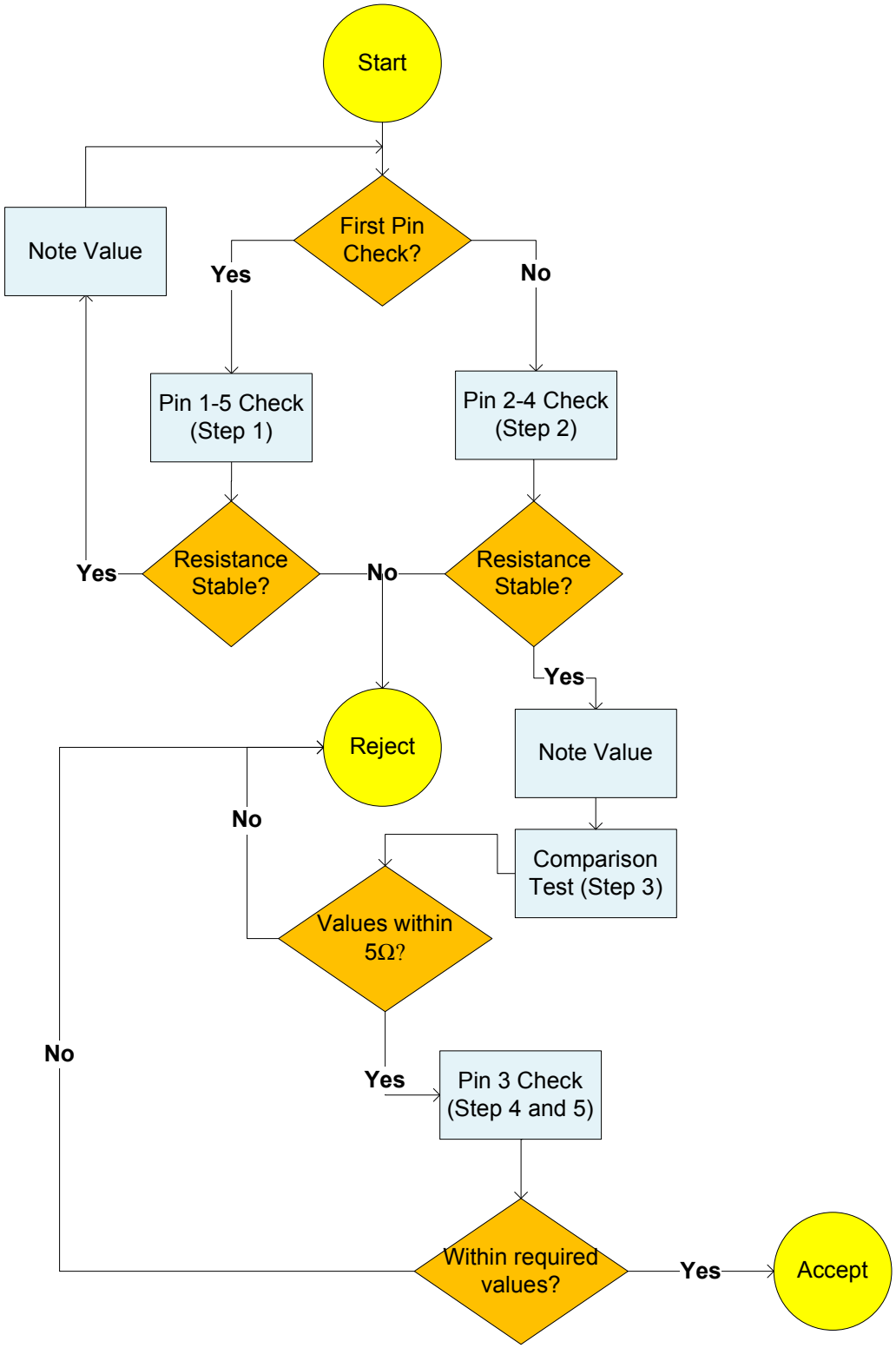


Configuration C

For 5 wire sensors. No calibration required. Needed if incompatible controller is used to test.



Electrical Test Process Flow Diagram



Functional Test Process Flow Diagram