Background Statement for SEMI Draft Document 5293C
NEW STANDARD: TEST METHODS FOR POSITIONAL ACCURACY OF
CAPACITIVE TOUCHSCREEN PANEL

Notice: This background statement is not part of the balloted item. It is provided solely to assist
the recipient in reaching an informed decision based on the rationale of the activity that preceded
the creation of this Document.

Notice: Recipients of this Document are invited to submit, with their comments, notification of
any relevant patented technology or copyrighted items of which they are aware and to provide
supporting documentation. In this context, “patented technology” is defined as technology for
which a patent has issued or has been applied for. In the latter case, only publicly available
information on the contents of the patent application is to be provided.

Background Statement:

Touchscreen panel incorporated with displays shared large popularity in portable electronic
devices. The electronic devices obtained daily usage by it’s intuitively operation. Although the
touch screen panel is widely adopted. There is lacking the standard functional test method for
touch performance. This standard describes the test method on positional accuracy, and
especially for capacitive type touch technology. Results of the ballot will be adjudicated at the
Taiwan Flat Panel Display Committee meeting scheduled on July, 22, 2014 in ITRI-Hsinchu.

If you need further assistance, or have questions, please do not hesitate to contact the
Touchscreen Panel Task Force co-leaders:

Yen Wen Fang, yenwenfang@auo.com
SenYih Chou, senyih@itri.org.tw
Or SEMI Staff, Cher Wu, cwu@semi.org
SEMI Draft Document 5293C
NEW STANDARD: TEST METHODS FOR POSITIONAL ACCURACY OF CAPACITIVE TOUCHSCREEN PANEL

1 Purpose
1.1 This measurement standard defines test methods for the positional accuracy of touchscreen panels. To help the communication between component/material/IC and panel manufactures, this standard provides a testing method that reveals the response performance of touchscreen panels.

2 Scope
2.1 This standard is a generic specification for positional accuracy test methods of touchscreen panel including the single point and the straight line.
2.2 Based on user experiences, the test sample is touchscreen panel incorporated with display.
2.3 The test methods are based on capacitive type of touchscreen panels.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents
3.1 ICDM Standard
IDMS — Information Display Measurement Standard

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology
4.1 Abbreviations and Acronyms
4.1.1 DUT — Device under test
4.1.2 FPD — Flat panel display
4.2 Definitions
4.2.1 Display area — the area which displays images of the test sample
4.2.2 Line accuracy — the maximum deviation of the draw line and the reported data. For calculation, line accuracy is the maximum orthogonal distance of reported coordinate to the drawing line.
4.2.3 Mechanical set position — before applying positional accuracy test, the calibration between machine and panel coordinate should be executed. The mechanical set position is the calibrated original position that based on the panel coordinate.
4.2.4 Point accuracy — the deviation of the touched point to the reported data, it means the distance between touched position and reported coordinate.
4.2.5 Stylus — a device making touch actions to the DUT
4.2.6 Test sample — the test sample is a display with touchscreen panel

\footnote{International Committee for Display Metrology, the ICDM is a Committee of SID (The Society for Information Display), part of the Definitions and Standards Committee.}
5 Summary of Test Method

5.1 Environment Conditions
- Temperature: 25±3°C
- Humidity: 25~75% R.H.
- Grounding: the stylus and DUT should be grounded to preventing electromagnetic interference.

5.2 Alignment and Calibration

5.2.1 Put the DUT on the stage of test machine, the test machine utilized fixture or camera to align the DUT. Therefore, the coordinate of test machine corresponds to the pixel coordinate of DUT.

5.2.2 The mechanical set position of test machine is set as the origin of DUT.

5.2.3 The report frequency should be recorded into the reporting table.

5.3 Test for point accuracy: execute point test on 13 points of the test sample. The test points include corner and center, see Figure 1 in ¶ 7.2.2. Note that the coordinates of designated and reported should be recorded. The distance of the two coordinates is the point accuracy.

5.4 Line accuracy test: drawing lines depicted in Figure 2 on the test sample. The reported coordinates and the drawing line equations are recorded. Eight lines are separately drawn on the test sample. Calculate the maximum distances between reported coordinates and the line.

6 Apparatus

6.1 Stylus — For capacitive type of touchscreen panel, the stylus shall be conductive. The conductive materials are copper or other conductive substances. The stylus is installed into automated machine with rounded tip for preventing damage the surface of DUT. Diameter of the rounded tip is less than 12mm.

6.2 Test Machine — the equipment utilized for testing the positional accuracy on touchscreen panels. The trajectory of the stylus is recorded by the test machine. Basic requirements of the test machine are as follows:
- Automated xy-direction movement, the positional accuracy should less than 0.1mm
- Exchangeable stylus
- Mechanism for coordinate calibration between test machine and DUT, the calibration error should less than 1 mm
- Mechanism for grounding
- Adjustable weight of stylus

6.3 Device for touched coordinate reporting — there should be electronic device for transforming the DUT’s reported data to the touched coordinate

7 Testing Procedure

7.1 Calibration — the calibration procedure is in section 5.2, make sure that the stylus touching position can align with reported coordinate

7.2 Point accuracy

7.2.1 Setup the appropriate stylus to the test machine, adjust the touch force to an appropriate value.

7.2.2 Make the touch action automated executed by test machine (the test positions are depicted in Figure 1). Each position touch at least 1 time. Note that the edge of stylus at edge positions is just at the edge of display area. Therefore, the distances between test positions are not necessary the same.
7.2.3 Obtain the coordinates of test machine and the reported data from DUT

7.3 Line accuracy test

7.3.1 Test procedure is the same with ¶ 7.2.1

7.3.2 Make the test machine draws lines depicted in Figure 2 on the DUT. The drawing speed is ranging from 30 to 100 mm/sec by sample’s attributes, 70 mm/sec is recommended. Each line is drawn separately; Note that the lines at surroundings are the edge of stylus aligns with the edge of the display area.

7.3.3 Obtain the equations of the lines from test machine and the reported data from DUT

8 Calculations

8.1 Point accuracy — the point accuracy is the geometric distance between mechanical position and reported data

Point accuracy = \( \sqrt{(x_m - x_s)^2 + (y_m - y_s)^2} \)  \hspace{1cm} (1)

where \( (x_m, y_m) \) is the machine reported coordinate
\( (x_s, y_s) \) is the DUT reported coordinate

8.2 Line accuracy— the line accuracy is the maximum orthogonal distance from DUT reported point to the line equation, depicted in Figure 3. The line equation is

Line equation : \( Y = \left( \frac{y_2 - y_1}{x_2 - x_1} \right) X \) \hspace{1cm} (2)

where \( (x_1, y_1) \) is the one edge point of drawing line by test machine
where \((x_2, y_2)\) is the another edge point of drawing line by test machine

we can rewrite the equation as

\[
\text{Line equation : } aX + bY + c = 0
\]  

(3)

where \(a, b, c\) are the parameters of line equation

then the distance of point to the line equation is

\[
D = \frac{|ax_m + by_m + c|}{\sqrt{a^2 + b^2}}
\]  

(4)

the line accuracy is the maximum value of \(D\)

\[
\text{Line accuracy } = \text{Max}(D)
\]  

(5)

9 Report

9.1 Reported data — the touched coordinate is transmitted from the panel after the touchscreen panel is activated by the stylus. The reported data is the coordinate of the touched position. The data includes x-coordinate and y-coordinate.

9.2 Point accuracy — the reported result should include test conditions, mechanical coordinates, DUT reported coordinates, and accuracy values. Table 1 shows the example for the point accuracy results.

Table 1 Reporting Example for Point Accuracy Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Test condition</td>
<td>Stylus material</td>
<td>Copper</td>
</tr>
<tr>
<td></td>
<td>Stylus diameter</td>
<td>6mm</td>
</tr>
<tr>
<td></td>
<td>Report frequency</td>
<td>60Hz</td>
</tr>
<tr>
<td></td>
<td>Stylus weight</td>
<td>70gw</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

---

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.
9.3 Line accuracy — the reported result should include test conditions, mechanical coordinates, DUT reported coordinates, and accuracy values. The resulting map of drawing lines and reported data is recommended to display in the reports, illustrated in Figure 4. Table 2 shows the resulting example for line accuracy of 8 drawing lines.

### Table 2 Reporting example for line accuracy results

<table>
<thead>
<tr>
<th>Stylus material</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stylus diameter</td>
<td>6mm</td>
</tr>
<tr>
<td>Speed</td>
<td>70mm/sec</td>
</tr>
<tr>
<td>Report frequency</td>
<td>60Hz</td>
</tr>
<tr>
<td>Stylus weight</td>
<td>70gw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line</th>
<th>St. point</th>
<th>Ed. point</th>
<th>Max(D)</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(X_{11}, Y_{11})</td>
<td>(X_{21}, Y_{21})</td>
<td>D_{11}</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(X_{12}, Y_{12})</td>
<td>(X_{22}, Y_{22})</td>
<td>D_{12}</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(X_{13}, Y_{13})</td>
<td>(X_{23}, Y_{23})</td>
<td>D_{13}</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(X_{14}, Y_{14})</td>
<td>(X_{24}, Y_{24})</td>
<td>D_{14}</td>
<td></td>
</tr>
</tbody>
</table>
## 10 Related Documents


10.2 Y. W. Fang et al., “Introduction to function test and mechanical characteristics of touch screen panels”, 2012 China FPD Conference, ShenZhen, China.

**NOTICE:** SEMI makes no warranties or representations as to the suitability of the Standards and Safety Guidelines set forth herein for any particular application. The determination of the suitability of the Standard or Safety Guideline is solely the responsibility of the user. Users are cautioned to refer to manufacturer’s instructions, product labels, product data sheets, and other relevant literature, respecting any materials or equipment mentioned herein. Standards and Safety Guidelines are subject to change without notice.

By publication of this Standard or Safety Guideline, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any items mentioned in this Standard or Safety Guideline. Users of this Standard or Safety Guideline are expressly advised that determination of any such patent rights or copyrights and the risk of infringement of such rights are entirely their own responsibility.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>(X1&lt;sub&gt;5&lt;/sub&gt;, Y1&lt;sub&gt;5&lt;/sub&gt;)</td>
<td>(X2&lt;sub&gt;5&lt;/sub&gt;, Y2&lt;sub&gt;5&lt;/sub&gt;)</td>
<td>D&lt;sub&gt;5&lt;/sub&gt;</td>
</tr>
<tr>
<td>6</td>
<td>(X1&lt;sub&gt;6&lt;/sub&gt;, Y1&lt;sub&gt;6&lt;/sub&gt;)</td>
<td>(X2&lt;sub&gt;6&lt;/sub&gt;, Y2&lt;sub&gt;6&lt;/sub&gt;)</td>
<td>D&lt;sub&gt;6&lt;/sub&gt;</td>
</tr>
<tr>
<td>7</td>
<td>(X1&lt;sub&gt;7&lt;/sub&gt;, Y1&lt;sub&gt;7&lt;/sub&gt;)</td>
<td>(X2&lt;sub&gt;7&lt;/sub&gt;, Y2&lt;sub&gt;7&lt;/sub&gt;)</td>
<td>D&lt;sub&gt;7&lt;/sub&gt;</td>
</tr>
<tr>
<td>8</td>
<td>(X1&lt;sub&gt;8&lt;/sub&gt;, Y1&lt;sub&gt;8&lt;/sub&gt;)</td>
<td>(X2&lt;sub&gt;8&lt;/sub&gt;, Y2&lt;sub&gt;8&lt;/sub&gt;)</td>
<td>D&lt;sub&gt;8&lt;/sub&gt;</td>
</tr>
</tbody>
</table>