Coplanarity Measurement of 3M™ Surface Mount Connectors

Technical Report

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1.0 SCOPE

This document provides a definition of connector coplanarity and a methodology for its measurement. It describes the approved method of coplanarity measurement for “surface mount” (SMT) type connectors, headers and sockets that are attached to a printed circuit board (PCB) by means of a reflow soldering process incorporating infrared and/or convection ovens.

2.0 DEFINITION OF COPLANARITY

General Definition – When a surface-mountable connector is placed on a PCB for surface-mount soldering, some of the connector contacts and other solderable features are raised so that they do not touch the board surface. The vertical (Z axis) distance between the raised contacts and the board, which varies from contact to contact, is the non-planarity of the connector. Thus, the greatest vertical distance measured between a contact and the board surface is the connector's range of coplanarity.

Specific Definition – The total variation in “Z height” of all the solderable features on a connector as measured from datum-A (see glossary). Coplanarity is always specified as the total range of “Z height” variation and never stated as a “±” bilateral value.

3.0 REQUIREMENTS

3.1. Tools, Fixtures and Equipment

3.1.1 Optical Comparator with 50X magnification, backlighting capability and stage.

3.1.2 Rotating fixture designed for precise attachment on the comparator stage. Requires the capability for rotation along the datum-A plane without changing the vertical (Z-axis) position of the connector. A rotating device is preferred with detent stops every 90 degrees.

3.1.3 Holding fixture designed specifically for the connector under test that represents an accurate copy of the PCB layout. The fixture must include all the required holes to receive the location and polarization-posts found on the connector. The datum-A surface of the fixture must be flat within .0001” (.0025 mm) over the entire surface area of the connector under test (See examples shown in Figures 1 and 2).

4.0 PROCEDURE

Except for Section 4.1 which relates to 3M™ Compact Flash™ Card Header Type II, the following procedure is specific to the 3M Surface Mount Socket Connectors 2 mm Type 1532XX-20X0-XX (Figure 1). Since the procedure is similar for all 3M SMT type connectors, we used this example to show the basic steps involved in measuring coplanarity.

![Figure 1](image)

Figure 1

Fixture for 3M SMT Socket Connector 2 mm Type 1532XX-20X0-XX
In this case, the connector slides into the fixture from the side.
Datum-A is the bottom surface of the slot into which the connector is inserted.
4.1 Place connector on the test fixture as shown in Figure 2 with the surface mount tails of the connector facing down and resting on the datum-A surface of the fixture.

![Figure 2](image)

**Figure 2**

*Fixture for 3M™ CF™ Card Header Type II*

In this case, the connector is placed directly on datum-A surface using the machined hole pattern for proper location on the fixture.

4.1.1 With the connector now resting on the fixture, place a weight directly over the connector. This may or may not be practical depending on the design of the fixture. This step is intended to simulate the “Z” axis placement force of the customer’s automation and to ensure full insertion into the fixture. Remove weight after seating connector onto the fixture plate. Maximum weight to be 1500 grams (3.3 lbs) and maximum vertical Z-axis placement speed of 2.4cm/sec (6”/sec). See Figure 3.

![Figure 3](image)

**Figure 3**

*In this case, a 3M CF Card Header Type II is mounted on a fixture plate with a 3.0 pound weight on top. The weights are removed before placing the fixture on the comparator stage.*
4.2 Place the test fixture containing the connector on the comparator stage and align the dovetail feature with the comparator stage slot. See Figure 4.

![Figure 4](image)

**Figure 4**
Connector is held in the fixture assembly and aligned on comparator stage slot.

4.3 Turn on the comparator backlight. Using 50X magnification, focus the part onto the comparator screen with the surface mount tail leads being the target. Align the X-axis cross-hair to the datum-A surface of the fixture making sure the cross hair is parallel to this surface at each end of the connector (See Figure 5).

![Figure 5](image)

**Figure 5**
Zero the fixture datum-A to comparator X axis. View of connector and contact coplanarity as seen on comparator.

4.4 Reset the comparator’s “Y” axis setting to zero. This will be the only time you will zero the “Y” axis readout.
4.5 Move the comparator stage to view each contact position. Measure and record the light-gap between each contact and datum-A.

*Note: Always measure the light gap in the center of the comparator screen. Do not measure gap when located at the far left or right of comparator screen center. See Figure 6.*

4.6 Rotate the fixture so that the remaining solder features come into view. This is necessary because not all of the solder features can be seen from the same viewing angle. Be careful to avoid disturbing the connector within the fixture. Measure the light gap and record each reading as described in Section 4.5.

![Figure 6](image)

*Figure 6*  
Light-gap measurement technique.  
Take all measurements from the datum plane.  
Measure each light gap as close as possible to the center of the comparator screen.

5.0 DATA RECORDING

5.1 First Article Inspections - Every contact position and solder feature is to be measured and noted. It is suggested that before this work begins, a spreadsheet be prepared to encompass all the contact positions and solder features and note their locations in relation to each other. This will ensure capturing all the required measurements and their locations.

5.2 Production Quality Checks - Every contact position and solder feature is to be viewed but only the largest measurement is to be noted.

6.0 GLOSSARY

**Datum A** - The surface described as being both the bottom of the connector and the top of the PCB. Coplanarity of solderable features and datum A are typically coincident except as noted. There are times, depending on the connector used, when the connector feature designated as datum A may be biased in the negative (minimized) “Z” direction by up to 0.1 mm.

**Solder Feature** – A solderable feature of a surface-mount connector that provides either the electrical connection of leads to the PCB or a soldered, mechanical hold-down.

**Solder Paste** – A paste consisting of flux and solids commonly used in the form of solder balls of a specific volume. This paste is applied to the PCB prior to solder reflow for the purpose of surface mounting electronic devices and components.

**Solder Paste Deposition** – The process of depositing solder paste onto the PCB conductive pads where either the active or passive devices are to be soldered. This process normally involves squeezing paste through a mask or screen. The usual deposit thickness is .15 mm, but up to 2.5 mm has been shown to be successfully placed depending on various factors.

**Top of PCB** – The top surface of the solderable pad without the additional “Z” height of solder paste deposition. This surface is coincident with datum A.

**Z Height** – A measurement in the vertical axis used to refer to either a height from the top the PCB or from the bottom of the solderable features of the connector. A positive Z height is a dimension away from the top of the PCB. A negative Z height is a dimension away from the datum feature of the connector.
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