

SEMI G48-89

SPECIFICATION FOR MEASUREMENT METHOD FOR MOLDED PLASTIC PACKAGE TOOLING

1 Preface

This document is prepared to enable standard measurement techniques to be used. It is intended that the measurement techniques described in the specification will apply to all molded plastic package tooling, i.e. DIPS, SIPS, PCC, SO, Quad, and TAB.

2 Applicable Documents

2.1 SEMI Specifications

SEMI G14 — Plastic Molded DIP Tooling

SEMI G16 — Plastic Chip Carrier Tooling

SEMI G36 — Plastic Molded High Density TAB Quad Tooling

SEMI G37 — Plastic Molded SO Package Tooling

3 Basic Equipment

3.1 The following basic equipment is required to perform the specified measurements:

3.1.1 *Toolmaker's Microscope* — 3× objective and 10× eyepiece total 30× with X and Y axes digital readouts reading to 0.0001". Minimum travel of stage must be 2.0" × 2.0". Eyepiece must be ± 0.0002" minimum. The toolmaker's microscope should have a goniometer on the eyepiece as well as on the stage. Accuracy of the goniometer shall be 0.1. The TM microscope should have a Z axis with a digital measurement capability, reading in increments of 0.0001". The objective lens must be 20× minimum which will give 0.0005" accuracy to the Z axis measurements.

3.1.2 *Optical Comparator* — Surface illumination. 10" minimum screen with 3" × 8" minimum travel. Magnification of 10×, 20× minimum required. Accuracy of 10× is 0.001"; accuracy of 20× is 0.0005". Some operators may be able to improve on this accuracy, but this is the best expected from average inspectors.

3.1.2.1 Overlays at 20× may be used for rapid measurement. The user is cautioned that the thickness of the line must be controlled. Line widths must not exceed 0.010" in width, which will give an inaccuracy of 0.0005" in the measurement. Overlays must have the datum marks clearly labeled. Overlays are tools which speed inspection; however, rejects must be verified by

toolmaker's microscope measurements, which are more accurate.

3.1.3 *Digital Depth Indicator* — Mounted on a stand. Digital reading with a range of 2" is available. Readout must display increments of 0.0001" with ± 1 digit accuracy.

3.1.4 *Micrometer* — 0 to 1.0". 0.250" diameter for measuring to 0.001" accuracy.

3.1.5 Eight (8) inch dial calipers for measuring to 0.002" accuracy.

3.1.6 *Granite Surface Plate* — Minimum size 18" × 28", with a surface accuracy of 0.0002" or better.

3.1.7 Surface Finish

3.1.7.1 *Charmille Visual Surface Finish Standard* — (For comparison of Electric Discharge Machined (EDM) surface only.)

3.1.7.2 *Surface Comparator Standards* — (For other machined surfaces.)

3.1.7.3 Surface Analyzer

3.1.8 *Binocular, Zoom Microscope* — 10—15× magnification with vertical or near vertical lighting.

3.1.9 *Dial Indicators* — With accuracy of .0001 and with force not to exceed 5 grams.

3.2 *Alternative Equipment* — Sophisticated, automatic equipment is not excluded from use, but the user must ensure that such equipment meets or exceeds the accuracy of the basic equipment so that correlation problems may be avoided.

3.3 *Calibration* — All equipment to be calibrated on a regular schedule.

4 Measurements

4.1 The following measurements will be made:

4.1.1 Package Thickness (Section 5.1)

4.1.2 Package Length (Section 5.2)

4.1.3 Package Width (Section 5.3)

4.1.4 Leadframe to Cavity Offset (Section 5.4)

4.1.5 Top Cavity Length (Section 5.5)

4.1.6 Top Cavity Width (Section 5.6)

4.1.7 Bottom Cavity Length (Section 5.7)

- 4.1.8 Bottom Cavity Width (Section 5.8)
- 4.1.9 Cavity Overlap/Underlap (Section 5.9)
- 4.1.10 Cavity to Cavity Mismatch (Section 5.10)
- 4.1.11 Cavity Depth (Section 5.11)
- 4.1.12 Molding Protrusions (Section 5.12)
- 4.1.13 Pin Depths (Section 5.13)
- 4.1.14 Dambar Trimming Defects (Section 5.14)
- 4.1.15 Package Warpage (Section 5.15)
- 4.1.16 Lead Coplanarity (Section 5.16)
- 4.1.17 Shoulder Bend Location (Section 5.17)
- 4.1.18 Surface Finish (Section 5.18)
- 4.1.19 Radii (Section 5.19)
- 4.1.20 Lead Position (Section 5.20)
- 4.1.21 Draft Angles (Section 5.21)
- 4.1.22 Lead Spread (Section 5.22)
- 4.1.23 Foot Angle (Section 5.23)
- 4.1.24 Foot Length (Section 5.24)
- 4.1.25 Plastic Stand-off (Section 5.25)

4.2 Conditions

4.2.1 All measurements to be made on molded components, which have been processed to agreed conditions including post mold cure.

4.2.2 All measurements to be performed at a temperature between 20° and 26.7°C (68°, 80°F).

4.2.3 Axis Definition

4.2.3.1 The X axis lies parallel to the rail of the frame and the Y axis lies perpendicular to the rails of the frame.

4.2.3.2 The package X and Y axes must be positioned parallel to the X and Y axes of the measurement stage travel to avoid measurement errors.

4.2.3.3 The datum of the X and Y axes is the pilot hole of the leadframe, because it is the most accurate feature. An additional pilot hole is required to establish the theta datum.

4.2.3.4 The Z axis is perpendicular to the X and Y axis. The datum is the leadframe or the top mold parting line, unless otherwise specified.

5 Measurement

5.1 Package Thickness — (Figure 1)

5.1.1 Equipment — Micrometer

5.1.2 Using the micrometer, measure the thickness of the package at three (3) places, diagonally across the package, where the contours allow, at the top edge, middle and bottom edge of the package. (Note: the top is the pin 1 identifier edge.)

5.2 Package Length — (Figure 1)

5.2.1 Equipment — Optical Comparator at 10×

5.2.2 Position the package so that the cross-sectional view is presented for measurement. Use care to assure the package is square to the datum plane.

5.2.3 Align the package side draft angle (see Section 5.21) where the draft angle intersects the leadframe. This is the parting line (datum point). Measure the overall width at the parting line, including cavity mismatch.

5.3 Package Width — (Figure 1)

5.3.1 Equipment — Optical Comparator at 10×

5.3.2 Position the package so that the cross-sectional view is presented for measurement. Use care to assure the package is square to the datum plane.

5.3.3 Align the package side draft angle (see Section 5.21) where the draft angle intersects the leadframe. This is the parting line (datum point). Measure the overall width at the parting line including cavity mismatch.

5.4 Leadframe to Cavity Offset — (Figure 2)

5.4.1 Equipment — Toolmaker's Microscope at 30×

5.4.2 Position the circle (cross hair) of the filar eyepiece of similar diameter to the leadframe pilot hole. Zero the digital readout. Move the stage to the point where the molded package meets the leadframe at the parting line. Record digital readout reading as (T1). Continue to move the stage until the point on the opposite side where mold compound and leadframe meet. Record digital readout reading as T2. Continue to move stage to center of leadframe rail (usually also a hole). Record the digital readout reading as T3.

5.4.3 Turn part over and BE SURE TO USE THE SAME HOLE AND PART; repeat the three (3) readings, B1, B2, and B3.

5.4.4 Derive the data from the readings as follows:

Top Centerline of Frame = (T3)/2

Bottom Centerline of Frame = (B3)/2

Measurement Error = (T3)/2 - (B3)/2

Frame Cavity Offset = (B3)/2 - (B2 + B1)/2

Centerline of Package = $(T2 + T1)/2$; $(B2 + B1)/2$.
(Relative to datum)

NOTE: Figure 2 calculations assume that the leadframe centerline is equidistant between T3 and the zero datum point.

5.4.5 In lieu of the frame pilot hole, the dambar may be used on the frame when measuring the offset; however, the possibility of tolerance error may become cumulative, particularly with etched rather than stamped frames.

NOTE: By SEMI convention the offsets are defined in relation to the bottom cavity of the mold.

5.5 Top Cavity Length "Y" Axis — (Figure 2)

5.5.1 Equipment — Toolmaker's Microscope at 30×

5.5.2 Focus the microscope on the leadframe datum point. Zero the digital readout. Move the stage to the intersection of the mold compound and the leadframe parting line. Read and record. Continue to measure across the package length to the intersection of the mold compound and the leadframe parting line on the opposite edge of the package. Read and record.

5.5.3 The cavity length is defined as $(Ty2 - Ty1)$.

5.6 Top Cavity Width "X" Axis — (Figure 2)

5.6.1 Equipment — Toolmaker's Microscope at 30×

5.6.2 Focus the microscope on the leadframe datum point. Zero the digital readout. Move the stage to the intersection of the mold compound and the leadframe parting line. Read and record the reading. Continue on to the intersection of the mold compound and the leadframe parting line on the opposite side. Read and record.

5.6.3 The cavity width is defined as $Tx2 - Tx1$.

5.7 Bottom Cavity Length "X" Axis — (Figure 2)

5.7.1 Equipment — Toolmaker's Microscope at 30×

5.7.2 Focus the microscope on the same datum point used for the top cavity length (remember the package has been turned over). Zero the digital readout. Move to the intersection of the mold compound and the leadframe parting line. Read and record the reading. Continue to the intersection of the mold compound and the leadframe parting line on the opposite side. Read and record. The bottom cavity length is the difference of the two readings. Record the bottom cavity length $(By2 - By1)$.

5.8 Bottom Cavity Width "X" Axis — (Figure 2)

5.8.1 Equipment — Toolmaker's Microscope at 30×

5.8.2 Focus the microscope on the leadframe datum point. Zero the digital readout. Move the stage to the

intersection of the mold compound and the leadframe parting line. Read and record. The bottom cavity width is the difference of the two readings $(Bx2 - Bx1)$.

5.9 Cavity Overlap/Underlap — (Figure 4)

5.9.1 Compare the top cavity length to the bottom cavity length and the top cavity width to the bottom cavity width. The difference in the number is the overlap/underlap for each axis.

5.10 Cavity to Cavity Mismatch — (Figure 2)

5.10.1 The comparison of the centerlines of the top cavity length to the bottom cavity length and the top cavity width to the bottom cavity width shall determine the cavity to cavity mismatch.

Formula:

$$\text{Cavity to Cavity Mismatch} = (B2 + B1)/2 - (T2 + T1)/2$$

5.11 Cavity Depth — (Figure 1)

5.11.1 Equipment — Depth Indicator

5.11.2 Top Cavity Depth — Measure the distance from the top surface of the leadframe to the top of the unit, place the indicator on the surface of the leadframe, zeroing the readout, moving the part to a point where the top of the unit can be indicated, and read and record the readout.

5.11.3 Bottom Cavity Depth — The measurement is performed in the same manner as the measurement in Section 5.11.2 except the part is turned over and the bottom surface of the leadframe to the bottom of the unit is used.

5.11.4 The package depth is the sum of the frame thickness and the top and bottom depth. (This measurement should equal Section 5.1. Any variation may be considered measurement error.)

5.12 Molding Protrusions Top/Bottom of Part — (Figure 3)

5.12.1 Equipment — Digital depth indicator.

5.12.2 Place unit on the anvil and zero the indicator on the package surface away from area of protrusion. Carefully move the part to where the protrusion is located. Carefully lower the indicator to the top of the mold protrusion. Read and record the mold protrusion.

5.13 Pin Depths — (Figure 3)

5.13.1 Equipment — Depth indicator with a fine point or "Z" axis reading toolmaker's microscope.

5.13.2 The measurement is made from the nominal plane of the package surface to the bottom of the design