

SEMI G54-93

SPECIFICATION FOR DIMENSIONS AND TOLERANCES USED TO MANUFACTURE MOLDED PLASTIC PACKAGES

1 Preface

This document is a guideline for ordering the tooling required to manufacture plastic semiconductor packages. These packages include the following JEDEC registered outlines:

- Plastic Dual-in-Line Packages (PDIP)
- Plastic Leaded Chip Carrier (PLCC)
- Plastic Quad Flat Packages (PQFP)
- Small Outline I.C. Packages (SOIC — Gull Wing and “J” lead)
- Plastic TAB Quad Packages (PTAB)

NOTE 1: Package outlines registered with other organizations such as EIAJ and non-registered outlines may use the criteria in this document by choosing the outline which most closely resembles the particular package.

Packaging engineers, mold manufactures, and end-of-line tool makers may use this document to define the limits of tooling tolerances.

2 Applicable Documents

2.1 *Order of Precedence* — To avoid conflicts, the order of precedence when ordering tooling shall be as follows:

- Purchase Order
- Referenced Documents
- This Specification

2.2 *Reference Documents*

2.2.1 *SEMI Specifications*

SEMI G48 — Specification, Measurement Method for Molded Plastic Package Tooling

2.2.2 *JEDEC Specifications*¹

Pub. No. 95 — Registered and Standards Outline for Semiconductor Devices

2.3 *Related Documents for Information*

2.3.1 *Military Specifications*²

MIL-STD-100 — Engineering Drawing Practice

2.3.2 *ANSI Specifications*³

Y14.5 — Dimensioning and Tolerancing

3 Selected Definitions

3.1 *Cavity* — the plastic body formed by either the top or bottom mold cavities.

3.2 *Gate Feature* — plastic protrusions or intrusions which result from normal molding and degating operations.

3.3 *Lead Bend Angle* — the angle to which the leads are bent in reference to a plane normal to the X-Y plane of the package. After a suitable radius has been formed at the shoulder, there must be no compound angle formation to achieve the lead spread requirements. Lead Bend Angle may just be a reference if Lead Spread is specified (see Figures 1A, B, C).

3.4 *Lead Coplanarity* — the vertical position of a lead foot with respect to a reference plane created by the three leads with feet most extended from the bottom surface of the package body. The term “foot” applies to both PLCC foot radii and PQFP feet (see Figure 2).

3.5 *Lead Shoulder (Dambar Area) Protrusions or Intrusions* — a protrusion (tab) on the shoulder or lead, or intrusion cut into the shoulder or lead as a result of dambar trimming (see Figures 3 and 4).

3.6 *Lead Sweep* — lead movement measured with respect to a datum, perpendicular to the top or bottom surface of the package and which passes through the midpoint of the lead, when viewed from the sides of the package (see Figure 4).

3.7 *Mismatch* — misalignment between the top and bottom cavities. The measurement of mismatch is stated as the difference between the center lines of the top and bottom cavities (see Figure 5). All statements regarding mismatch of cavities are applicable to both the X and Y axis. All measurements are made prior to lead trim and form.

3.8 *Offset* — the difference in the bottom cavity position from a leadframe datum when compared to design (see Figure 6). This measurement ignores leadframe tolerances. All statements regarding offset are applicable to both the X and Y axis. All measurements are made prior to lead trim and form.

¹ JEDEC, 2001 Eye Street N.W., Washington, D.C. 20006

² Military Standards, Naval Publications and Form Center, 5801 Tabor Avenue, Philadelphia, PA 19120

³ American National Standards Institute, 1430 Broadway, New York, NY 10018

3.9 *Overlap* — the difference in length or width between the top and bottom cavities. Overlap may be a feature designed into the mold to avoid mismatch (see Figure 5). All statements regarding overlap of cavities are applicable to both the X and Y axis. All measurements are made prior to lead trim and form.

3.10 *Package Warpage* — loss of planarity of a molded surface excluding protrusions and intrusions (see Figure 7). Each package type has a maximum allowable warpage and a warp factor is used to determine the maximum warpage for a particular package dimension. The Warp Factor (WF) is defined as follows:

$$WF = \frac{\text{Total Warp in inches (mm)} \times 1000}{\text{Package dimension in inches (mm)}}$$

Package warpage is usually caused by incorrect package design and/or poor molding conditions.

3.11 *Parting Line Protrusions, or Intrusions* — plastic excesses (flash) or losses (chips or voids) at the parting line after normal processing to mold, deflash, trim, and singulate the packages.

3.12 *Surface Protrusions or Intrusions* — plastic excesses (bumps or blisters) or recesses (pits or voids) on any surface of the package.

4 Ordering Information

Purchase orders for molded plastic tooling furnished to this document, shall include the following items:

4.1 A package tooling outline drawing showing all the required dimensions listed in Section 5. The molded surface finish(es) and the lead finish shall be specified.

4.2 The plastic compound to be used shall be specified. If the compound is proprietary, then the molding and molded characteristics shall be supplied.

4.3 The leadframe drawing detailing the material, all dimensions, and, if applicable, lead finish pre-plate specifications.

4.4 The type and part number of the molding and trim, form, singulate press to be used.

4.5 Singulation or off-load requirements.

4.6 *Expectations of Tooling Performance* — Tooling performance is not limited to the items listed in Section 5 and 6. Any other customer requirements, such as the limits on wire sweep, resin bleed or internal voiding, shall also be included with the purchase order.

4.7 Reference to this specification.

4.8 Vendor certification requirements.

5 Dimensions

5.1 All package dimensions should be specified in detail.

5.2 Ejector pin mark location from the package centerline. This should include ejector pin sizes, depths, and draft angles.

5.3 Pin 1 ID shape and location from the package center with respect to the lead frame Pin 1 location.

5.4 All critical radii (unspecified radii, often shown sharp on the drawing, may have the maximum radius shown in the table of Section 6).

5.5 Plastic stand-off shape and locations from the package center.

5.6 Lead spread (the distance between the outer edge of opposing leads).

5.7 Shoulder bend location and lead bend angle (optional).

5.8 Foot angle radius (maximum and minimum).

5.9 Foot length.

5.10 Lead length.

5.11 Shoulder width (maximum width should include protrusion).

6 Dimensional Tolerance Limits

These criteria, where applicable, apply only to opaque, plastic molded semiconductor packages. If an item is not mentioned in the following table, then the tolerances on the dimensions of that item follow the general tolerance limits stated on the drawing. Dimensions are in inches (millimeters) except as noted. Dimensions are to be verified per SEMI G48.