



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES

IPC-7525

Stencil Design Guidelines

IPC-7525

May 2000

A standard developed by IPC

Table of Contents

- 1 PURPOSE**..... 1
 - 1.1 Terms and Definitions..... 1
- 2 APPLICABLE DOCUMENTS** 2
 - 2.1 IPC 2
 - 2.2 Joint Industry Standard 2
 - 2.3 Barco/ETS 2
- 3 STENCIL DESIGN** 2
 - 3.1 Stencil Data 2
 - 3.1.1 Data Format 2
 - 3.1.2 Gerber® Format 2
 - 3.1.3 Aperture List 2
 - 3.1.4 Solder Paste Layer 2
 - 3.1.5 Data Transfer 2
 - 3.1.6 Panelized Stencils 2
 - 3.1.7 Step-and-Repeat 2
 - 3.1.8 Image Orientation/Rotation 3
 - 3.1.9 Image Location 3
 - 3.1.10 Identification 3
 - 3.2 Aperture Design 3
 - 3.2.1 Aperture Size 3
 - 3.2.2 Aperture Size Versus Board Pad Size 3
 - 3.2.3 Glue Aperture Chip Component 4
 - 3.3 Mixed Technology Surface-Mount/
Through-Hole (Intrusive Reflow) 5
 - 3.3.1 Solder Paste Volume 5
 - 3.4 Mixed Technology Surface-Mount/
Flip Chip 7
 - 3.4.1 Two-Print Stencil for Surface-Mount/
Flip Chip 7
 - 3.5 Step Stencil Design 7
 - 3.5.1 Step-Down Stencil 7
 - 3.5.2 Step-Up Stencil 7
 - 3.5.3 Step Stencil for Contained Paste
Transfer Heads 7
 - 3.5.4 Relief-Etch Stencil 7
 - 3.6 Fiducials 8
 - 3.6.1 Global Fiducials 8
 - 3.6.2 Local Fiducials 8
- 4 STENCIL FABRICATION** 8
 - 4.1 Foils 8

- 4.2 Frames 8
- 4.3 Stencil Border 8
- 4.4 Stencil Fabrication Technologies 8
 - 4.4.1 Chemical Etch 8
 - 4.4.2 Laser Cut 8
 - 4.4.3 Electroform 8
 - 4.4.4 Hybrid 8
 - 4.4.5 Trapezoidal Apertures 8
 - 4.4.6 Additional Options 8
- 5 STENCIL MOUNTING** 9
 - 5.1 Location of Image on Metal 9
 - 5.2 Centering 9
 - 5.3 Additional Design Guidelines 9
- 6 STENCIL ORDERING** 9
- 7 USER STENCIL INSPECTION/VERIFICATION** 9
- 8 STENCIL CLEANING** 9
- 9 END OF LIFE** 9
- APPENDIX A: EXAMPLE ORDER FORM** 10

Figures

- Figure 1 Cross Sectional View of A Stencil Aperture 3
- Figure 2 Home Plate Aperture Design 4
- Figure 3 Bow Tie Aperture Design 4
- Figure 4 Oblong Aperture Design 5
- Figure 5 Aperture Design for MELF Components 5
- Figure 6 Glue Stencil Aperture Design 5
- Figure 7 Through-Hole Solder Paste Volume 6
- Figure 8 Overprint without Step 6
- Figure 9 Overprint with Step (Squeegee Side) 6
- Figure 10 Overprint with Step (Contact/Board Side) 6
- Figure 11 Two-Print Through-Hole Stencil 7
- Figure 12 Two-Print Stencil for Mixed Technology 7
- Figure 13 Trapezoidal Apertures 9

Tables

- Table 1 General Aperture Design Guidelines for
Surface-Mount Devices 4
- Table 2 Process Window for Intrusive Soldering 5

Stencil Design Guidelines

1 PURPOSE

This document provides guides for the design and fabrication of stencils for solder paste and surface-mount adhesive. It is intended as a guideline only.

1.1 Terms and Definitions All terms and definitions used throughout this handbook are in compliance with IPC-T-50. Definitions denoted with an asterisk (*) below are reprints from IPC-T-50. Other specific terms and definitions, essential for the discussion of the subject, are provided below.

1.1.1 Aperture An opening in the stencil foil.

1.1.2 Aspect Ratio and Area Ratio

Aspect Ratio = Width of Aperture / Thickness of Stencil Foil

Area Ratio = Area of Aperture Opening / Area of Aperture Walls

1.1.3 Border Peripheral tensioned mesh, either polyester or stainless steel, which keeps the stencil foil flat and taut. The border connects the foil to the frame.

1.1.4 Contained Paste Transfer Head A stencil printer head that holds, in a single replaceable component, the squeegee blades and a pressurized chamber filled with solder paste.

1.1.5 Etch Factor Etch Factor = Etched Depth / Lateral Etch in a chemical etching process

1.1.6 Fiducials Reference marks on the stencil foil (and other board layers) for aligning the board and the stencil when using a vision system in a printer.

1.1.7 Fine-Pitch BGA/Chip Scale Package (CSP) Ball grid array with less than 1 mm [39 mil] pitch. This is also known as Chip Scale Package (CSP) when the package size is no more than 1.2X the area of the original die size.

1.1.8 Fine-Pitch Technology (FPT)* A surface-mount assembly technology with component terminations on centers less than or equal to 0.625 mm [24.61 mil].

1.1.9 Foil The sheet used to create the stencil.

1.1.10 Frame A device onto which the foil is mounted. This may be tubular or cast aluminum with the border permanently mounted using an adhesive. Some foils can be mounted into a tensioning master case and do not require a border or a permanent fixturing of the foil to the frame.

1.1.11 Intrusive Soldering Intrusive soldering may also be known as paste-in-hole, pin-in-hole, or pin-in-paste soldering. This is a process in which the solder paste for the through-hole components is applied using the stencil, the through-hole components are inserted and reflow-soldered together with the surface-mount components.

1.1.12 Modification The process of changing an aperture in size or shape.

1.1.13 Overprinting The use of stencils with apertures larger than the pads or annular rings on the board.

1.1.14 Pad Metallized shape on the circuit board to which the terminal of a surface mount component is electrically or mechanically attached.

1.1.15 Squeegee A metal or rubber blade used to wipe across the stencil to force solder paste into openings in the stencil. Normally, squeegee is mounted at an angle such that the printing edge of the squeegee trails behind the print head and the face of the squeegee slopes forward.

1.1.16 Standard BGA Ball grid array with 1 mm [39 mil] pitch or larger.

1.1.17 Stencil A tool which may consist of a frame, border, and foil containing apertures through which solder paste, adhesive, or other media is transferred.

1.1.18 Step Stencil A stencil with more than one foil thickness level.

1.1.19 Surface-Mount Technology (SMT)* The electrical connection of components to the surface of a conductive pattern that does not utilize component holes.

1.1.20 Through-Hole Technology (THT)* The electrical connection of components to a conductive pattern by the use of component holes.

1.1.21 Ultra-Fine Pitch Technology A surface-mount assembly technology with component terminations on centers less than or equal to 0.40 mm [15.7 mil]