

IPC-7525B

2011 - October

Stencil Design Guidelines

Supersedes IPC-7525A

February 2007

A standard developed by IPC

Association Connecting Electronics Industries



The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

Notice

IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

Why is there a charge for this document?

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publication development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit www.ipc.org or call 847/597-2872.

Thank you for your continued support.



IPC-7525B

Stencil Design Guidelines

Developed by the Stencil Design Task Group (5-21e) of the Assembly and Joining Processes Committee (5-20) of IPC

Supersedes:

IPC-7525A - February 2007

IPC-7525 - May 2000

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

This Page Intentionally Left Blank

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Stencil Design Task Group (5-21e) of the Assembly and Joining Processes Committee (5-20) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

Assembly and Joining Processes Committee

Chair
Leo Lambert
EPTAC Corporation

Stencil Design Task Group

Co-Chairs
William E. Coleman, Ph.D
Photo Stencil Inc.

George Oxx
Jabil Circuit, Inc. (HQ)

Technical Liaisons of the IPC Board of Directors

Dongkai Shangguan
Flextronics International

Shane Whiteside
TTM Technologies

Stencil Design Task Group

Russell Nowland, Alcatel-Lucent
Christopher Sattler, AQS - All Quality & Services, Inc.
Ricky Bennett, Assembly Process Technologies
Jay Hinerman, BAE Systems CNI Div.
Ron Tripp, Cookson Electronics
Jeff Schake, DEK International
Craig Brown, DEK USA Inc.
Richard Lieske, DEK USA Inc.
Glenn Dody, Dody Consulting
Robert Dervaes, FCT Assembly
Michael Yuen, Foxconn CMMSG-NVPD
Deepak Pai, General Dynamics Info. Sys., Inc

Joseph Brown, Hewlett-Packard Co- ProCurve Networking
Jan Kilen, HP Etch AB
Rongxiang Yang, Huawei Technologies Co., Ltd.
Chris Anglin, Indium Corporation of America
Tim Jensen, Indium Corporation of America
William Kunkle, M.T.A. Associates Inc.
Holly Wise, MicroScreen, LLC
Robert C. Northrop Grumman Amberst Systems
William May, NSWC Crane
Harinder Kumar, Pelco by Schneider Electronics

Todd Weir, Photo Stencil Inc.
Dede Kutz, Plexus Corporation
Timothy Pitsch, Plexus Corporation
Robert Rowland, RadiSys Corporation
Guillermo Velazquez, Rain Bird Corporation
David Nelson, Raytheon Company
Jeff Shubrooks, Raytheon Company
Mark Quealy, Schneider Automation Inc.
Steve Sangillo, Swemco
Daan Terstegge, Thales Nederland B.v. Huizen
Richard Lathrop
Ahne Oosterhof

This Page Intentionally Left Blank

Currently in preview, click buy full version

Table of Contents

1	PURPOSE	1	3.2	Aperture Design	4
1.1	Terms and Definitions	1	3.2.1	Aperture Size	4
1.1.1	*Aperture	1	3.2.2	Aperture Size versus Board Land Size for Tin Lead Solder Paste	8
1.1.2	*Area Ratio	1	3.2.3	Aperture Size versus Board Land Size for Lead Free Solder Paste	9
1.1.3	*Aspect Ratio	1	3.2.4	Glue Aperture Chip Component	10
1.1.4	Border	1	3.2.5	Glue Apertures for Combination of Chip Components and Leaded Devices	10
1.1.5	Enclosed Print Head	1	3.2.6	Relief Etch with Glue Stencil	11
1.1.6	Etch Factor	1	3.3	Mixed Technology Surface-Mount/Through-Hole (Intrusive Soldering)	11
1.1.7	Relief Etch	1	3.3.1	Solder Paste Volume	11
1.1.8	Fiducials	1	3.4	Mixed Technology Surface-Mount/Flip Chip	13
1.1.9	Fine-Pitch BGA	1	3.4.1	Two-Print Stencil for Surface-Mount/Flip Chip	13
1.1.10	Fine-Pitch Technology (FPT)	1	3.5	Step Stencil Design	13
1.1.11	Foil	1	3.5.1	Step-Down Stencil	14
1.1.12	Frame	1	3.5.2	Step-Up Stencil	14
1.1.13	Intrusive Soldering	1	3.5.3	Step Stencil for Enclosed Print Heads	14
1.1.14	*Land	1	3.5.4	Relief-Etch Stencil	14
1.1.15	Modification	1	3.6	Fiducials	14
1.1.16	*Overprinting	2	3.6.1	Global Fiducials	14
1.1.17	*Pad	2	3.6.2	Local Fiducials	14
1.1.18	Squeegee	2	3.7	Rework and Repair Stencils	14
1.1.19	Squeegee Direction	2	3.7.1	Mini Stencils	14
1.1.20	Standard BGA	2	3.7.2	Repair Tool for Printing Paste Directly on the Component	15
1.1.21	*Stencil	2	4	STENCIL FABRICATION	15
1.1.22	Step Stencil	2	4.1	Foils	15
1.1.23	*Surface-Mounting Technology (SMT)	2	4.2	Frames	15
1.1.24	*Through-Hole Technology (THT)	2	4.3	Stencil Border	15
1.1.25	Transfer Efficiency	2	4.4	Stencil Fabrication Technologies	15
1.1.26	Ultra-Fine Pitch Technology	2	4.4.1	Chemical Etch	15
2	APPLICABLE DOCUMENTS	2	4.4.2	Laser-Cut Stencils	16
2.1	IPC	2	4.4.3	Electroform	16
3	STENCIL DESIGN	3	4.4.4	Hybrid	16
3.1	Stencil Data	3	4.4.5	Trapezoidal Apertures	16
3.1.1	Data Format	3	4.4.6	Additional Options	16
3.1.2	Gerber® Format	3	5	STENCIL MOUNTING	16
3.1.3	Aperture List	3	5.1	Location of Image on Metal	16
3.1.4	Solder Paste Layer	3	5.2	Centering	16
3.1.5	Data Transfer	3	5.3	Additional Design Guidelines	16
3.1.6	Panelized Stencils	3			
3.1.7	Step-and-Repeat	3			
3.1.8	Image Orientation/Rotation	3			
3.1.9	Image Location	4			
3.1.10	Identification	4			

6 STENCIL ORDERING 16

7 STENCIL USER'S INSPECTION/VERIFICATION .. 17

8 STENCIL CLEANING 17

9 END OF LIFE 17

APPENDIX A: EXAMPLE ORDER FORM 19

Figures

Figure 3-1 4 mil Thick Stencil Tin Lead and Lead Free 6

Figure 3-2 5 mil Thick Stencil Tin Lead and Lead Free 6

Figure 3-3 6 mil Thick Stencil Tin Lead and Lead Free 7

Figure 3-4 8 mil Thick Stencil Tin Lead and Lead Free 7

Figure 3-5 Cross-Sectional View of A Stencil 8

Figure 3-6 Home Plate Aperture Design 8

Figure 3-7 Bow Tie Aperture Design 9

Figure 3-8 Oblong Aperture Design 9

Figure 3-9 Aperture Design for Cylindrical Components and Chip Components (All Corners Rounded) .. 9

Figure 3-10 Window Pane Design for Ground Plane 9

Figure 3-11 Glue Stencil Aperture Design 10

Figure 3-12 Chip Component and SOIC Present on Board 10

Figure 3-13 Print Only Mode 15 mil Thick Stencil 10

Figure 3-14 Glue Stencil With Glue Reservoir 10

Figure 3-15 Through-Hole Solder Paste Volume 11

Figure 3-16 Overprint Without Step 12

Figure 3-17 Overprint With Step (Squeegee Side) 12

Figure 3-18 Overprint With Step (Contact/Board Side) 12

Figure 3-19 Two-Print Through-Hole Stencil 13

Figure 3-20 Two-Print Stencil for Mixed Technology 13

Figure 3-21 Print With Step 13

Figure 3-22 Step Down 14

Figure 3-23 Step Up 14

Figure 3-24 BTC 15

Figure 3-25 BGA 15

Figure 4-1 Trapezoidal Apertures 16

Tables

Table 3-1 Stencil Use Clauses 4

Table 3-2 General Aperture Design Guideline Examples for Selective Surface Mount Devices (Tin Lead Solder Paste) 5

Table 3-3 Process Flow for Intrusive Soldering - Maximum Limits Desirable 11

Stencil Design Guidelines

1 PURPOSE

This document provides a guide for the design and fabrication of stencils for solder paste and surface-mount adhesive. It is intended as a guideline only. Much of the content is based on the experience of stencil designers, fabricators, and users. Printing performance depends on many different variables and therefore no single set of design rules can be established.

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

1.1.1 *Aperture An opening in the stencil foil.

1.1.2 *Area Ratio The ratio of the area of aperture opening to the area of aperture walls.

1.1.3 *Aspect Ratio The ratio of the width of the aperture to the thickness of the stencil foil.

1.1.4 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.

1.1.5 Enclosed Print Head A stencil printer head that holds, in a single replaceable component, the squeegee blades and a pressurized chamber filled with solder paste.

1.1.6 Etch Factor Etched Depth/Lateral; Etch in a chemical etching process.

1.1.7 Relief Etch Also known as Etch Relief and Under Etch. Adding an under etch of the foil to create a pocket for raised features, labels, or a multi-print function.

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

1.1.9 Fine-Pitch BGA Ball grid array (BGA) with less than 1 mm [39 mil] pitch. Also known as chip scale package (CSP) when the package size is no more than 1.5 X the area of the original die size.

1.1.10 Fine-Pitch Technology (FPT) A surface-mount assembly technology with component terminations on centers less than or equal to 0.625 mm [24 mil].

1.1.11 Foil The sheet used to create the stencil.

1.1.12 Frame A frame may be made of tubular or cast aluminum to which a tensioned mesh (border) is permanently bonded using an adhesive.

1.1.13 Intrusive Soldering 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. Also known as Paste-In-Hole, Pin-In-Hole, or Pin-In-Paste Soldering.

1.1.14 *Land A portion of a conductive pattern usually used for the connection and/or attachment of components.

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