Association Connecting Electronics Industries

# IPC-7711/7721

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October 2003

# Rework, Modification and Repair of Electronic Assemblies

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Association Connecting Electronics Industries

# IPC-7711B/7721B

# Rework, Modification and Repair of Electronic Assemblies

Developed by the Repairability Subcommittee (7-34) of the Product Assurance Committee (7-30) of IPC

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

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# Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the IPC Repairability Subcommittee (7-34) of the Product Assurance Committee (7-30) 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.

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STI Electronics

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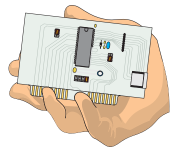
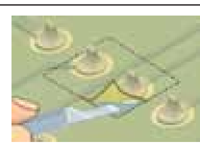
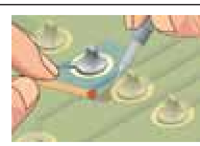
## PART 1 General Information and Common Procedures

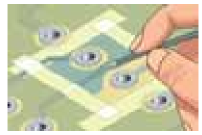
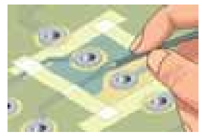
## Handling/Cleaning

| Procedure | Description | | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.1 | Handling Electronic Assemblies |  | N/A | N/A | N/A |
| 2.2 | Cleaning |  | N/A | N/A | N/A |

## Coating Removal

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.3.1 | Coating Removal, Identification of Conformal Coating |  | R, F, W, C | Advanced | High |
| 2.3.2 | Coating Removal, Solvent Method |  | R, F, W, C | Advanced | High |
| 2.3.3 | Coating Removal, Peeling Method |  | R, F, W, C | Advanced | High |
| 2.3.4 | Coating Removal, Thermal Method |  | R, F, W, C | Advanced | High |
| 2.3.5 | Coating Removal, Grinding/Scraping Method |  | R, F, W, C | Advanced | High |
| 2.3.6 | Coating Removal, Micro Blasting Method |  | R, F, W, C | Advanced | High |

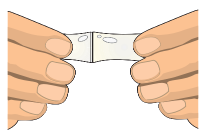
**Coating Replacement**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.4.1 | Coating Replacement, Solder Resist |  | R, F, W, C | Intermediate | High |
| 2.4.2 | Coating Replacement, Conformal Coatings/Encapsulants |  | R, F, W, C | Intermediate | High |

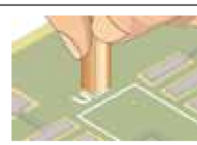
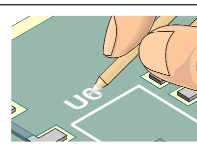
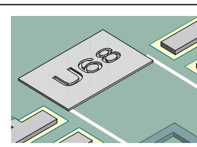
**Conditioning**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.5 | Baking and Preheating |  | R, F, W, C | Intermediate | High |

**Epoxy Mixing and Handling**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.6 | Epoxy Mixing and Handling |  | R, F, W, C | Intermediate | High |

**Legends/Markings**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.7.1 | Legend/Marking, Stamping Method |  | R, F, W, C | Intermediate | High |
| 2.7.2 | Legend/Marking, Hand Lettering Method |  | R, F, W, C | Intermediate | High |
| 2.7.3 | Legend/Marking, Stencil Method |  | R, F, W, C | Intermediate | High |

**Tip Care and Maintenance**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 2.8 | Tip Care and Maintenance | | N/A | N/A | N/A |

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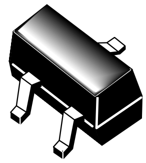
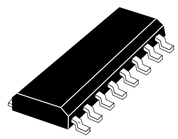
## PART 2 Rework

### 3.5 SOT Removal



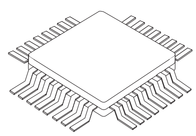
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.5.1 | Flux Application Method | R,F,W,C | Intermediate | High |
| 3.5.2 | Flux Application Method - Tweezer | R,F,W,C | Intermediate | High |
| 3.5.3 | Hot Air Pencil | R,F,W,C | Intermediate | High |

### 3.6 Gull Wing Removal (two sided)



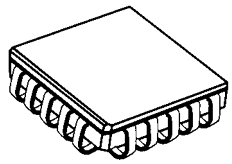
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.6.1 | Bridge Fill Method | R,F,W,C | Intermediate | High |
| 3.6.2 | Solder Wrap Method | R,F,W,C | Intermediate | High |
| 3.6.3 | Flux Application Method | R,F,W,C | Intermediate | High |
| 3.6.4 | Bridge Fill Method - Tweezer | R,F,W,C | Advanced | High |
| 3.6.5 | Solder Wrap Method - Tweezer | R,F,W,C | Advanced | High |
| 3.6.6 | Flux Application Method - Tweezer | R,F,W,C | Advanced | High |

### 3.7 Gull Wing Removal (four sided)



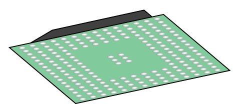
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.7.1 | Bridge Fill Method - Vacuum Cup | R,F,W,C | Advanced | High |
| 3.7.1.1 | Bridge Fill Method - Surface Tension | R,F,W,C | Intermediate | High |
| 3.7.2 | Solder Wrap Method - Vacuum Cup | R,F,W,C | Advanced | High |
| 3.7.2.1 | Solder Wrap Method - Surface Tension | R,F,W,C | Intermediate | High |
| 3.7.3 | Flux Application Method - Vacuum Cup | R,F,W,C | Advanced | High |
| 3.7.3.1 | Flux Application Method - Surface Tension | R,F,W,C | Intermediate | High |
| 3.7.4 | Bridge Fill Method - Tweezer | R,F,W,C | Advanced | High |
| 3.7.5 | Solder Wrap Method - Tweezer | R,F,W,C | Advanced | High |
| 3.7.6 | Flux Application Method - Tweezer | R,F,W,C | Advanced | High |
| 3.7.7 | Hot Gas Reflow Method | R,F,W,C | Advanced | High |

### 3.8 J-Lead Removal



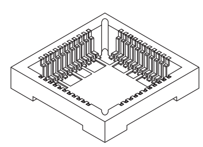
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.8.1 | Bridge Fill Method - Tweezer | R,F,W,C | Advanced | High |
| 3.8.1.1 | Bridge Fill Method - Surface Tension | R,F,W,C | Advanced | High |
| 3.8.2 | Solder Wrap Method - Tweezer | R,F,W,C | Advanced | High |
| 3.8.2.1 | Solder Wrap Method - Surface Tension | R,F,W,C | Advanced | High |
| 3.8.3 | Flux Application Method - Tweezer | R,F,W,C | Advanced | High |
| 3.8.4 | Flux & Tin Tip Only | R,F,W,C | Advanced | High |
| 3.8.5 | Hot Gas Reflow System | R,F,W,C | Advanced | High |

### 3.9 BGA/CSP Removal



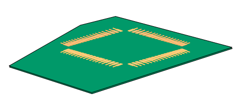
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.9.1 | Hot Gas Reflow System | R,F,W,C | Advanced | High |
| 3.9.2 | Vacuum Method | R,F,W,C | Advanced | Medium |

### 3.10 PLCC Socket Removal



| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 3.10.1 | Bridge Fill Method | R,F,W,C | Advanced | High |
| 3.10.2 | Solder Wrap Method | R,F,W,C | Advanced | High |
| 3.10.3 | Flux Application Method | R,F,W,C | Advanced | High |
| 3.10.4 | Hot Air Pencil Method | R,F,W,C | Advanced | Medium |

### 4 Pad/Land Preparation



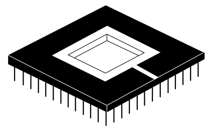
| Procedure | Description | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 4.1.1 | Surface Mount Land Preparation - Individual Method | R,F,W,C | Intermediate | High |
| 4.1.2 | Surface Mount Land Preparation - Continuous Method | R,F,W,C | Intermediate | High |
| 4.1.3 | Surface Solder Removal - Braid Method | R,F,W,C | Intermediate | High |
| 4.2.1 | Pad Releveling - Using Blade Tip | R,F,W,C | Intermediate | High |
| 4.3.1 | SMT Land Tinning - Using Blade Tip | R,F,W,C | Intermediate | Medium |
| 4.4.1 | Cleaning SMT Lands - Using Blade Tip and Solder Braid | R,F,W,C | Intermediate | High |

# 5 Installation

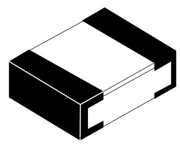
## 5.1 Through-Hole Installation

| Procedure | Description | |
|---|---|---|
| | Install following the requirements of J-STD-001 and J-HDBK-001 | |

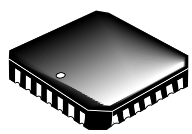
## 5.2 PGA and Connector Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.2.1 | Solder Fountain Method with PTH Prefilled | R,F,W,C | Expert | Medium |

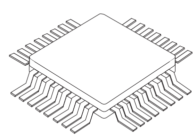
## 5.3 Chip Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.3.1 | Solder Paste Method/Hot Air Pencil | R,F,W,C | Intermediate | High |
| 5.3.2 | Point-to-Point Method | R,F,W,C | Intermediate | High |

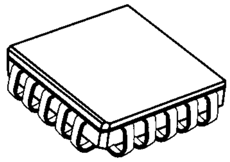
## 5.4 Leadless Component Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.4.1 | Hot Gas (Air) Reflow Method | R,F,W,C | Advanced | High |

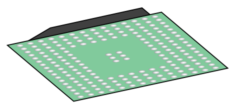
## 5.5 Gull Wing Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.5.1 | Multi-Lead Method - Top of Lead | R,F,W,C | Advanced | High |
| 5.5.2 | Multi-Lead Method - Toe Tip | R,F,W,C | Advanced | High |
| 5.5.3 | Point-to-Point Method | R,F,W,C | Intermediate | High |
| 5.5.4 | Solder Paste Method/Hot Air Pencil | R,F,W,C | Advanced | High |
| 5.5.5 | Hook Tip w/Wire Layover | R,F,W,C | Intermediate | High |
| 5.5.6 | Blade Tip with Wire | R,F,W,C | Advanced | Medium |

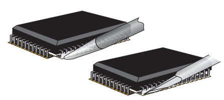
### 5.6 J-Lead Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.6.1 | Solder Wire Method | R,F,W,C | Advanced | High |
| 5.6.2 | Point-to-Point Method | R,F,W,C | Intermediate | High |
| 5.6.3 | Solder Paste Method/Hot Air Pencil | R,F,W,C | Advanced | High |
| 5.6.4 | Multi-Lead Method | R,F,W,C | Intermediate | High |

### 5.7 BGA/CSP Installation

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 5.7.1 | Using Solder Wire to Prefill Lands | R,F,W,C | Advanced | High |
| 5.7.2 | Using Solder Paste to Prefill Lands | R,F,W,C | Advanced | High |
| 5.7.3 | BGA Reballing Procedure - Fixture Method | R,C | Advanced | High |
| 5.7.4 | BGA Reballing Procedure - Paper Carrier Method | R,C | Advanced | High |
| 5.7.5 | BGA Reballing Procedure - Polyimide Stencil Method | R,C | Advanced | High |

### 6 Removing Shorts

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 6.1.1 | J-Leads - Draw Off Method | R,F,W,C | Intermediate | High |
| 6.1.2 | J-Leads - Respread Method | R,F,W,C | Intermediate | High |
| 6.1.2.1 | J-Leads - Braid Method | R,F,W,C | Intermediate | High |
| 6.1.3 | Gull-Wing - Draw Off Method | R,F,W,C | Intermediate | High |
| 6.1.4 | Gull-Wing - Respread Method | R,F,W,C | Intermediate | High |
| 6.1.4.1 | Gull-Wing - Braid Method | R,F,W,C | Intermediate | High |

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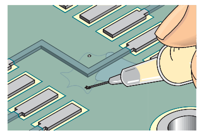
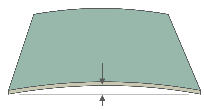
## PART 3 Modification and Repair

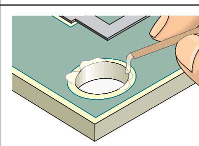
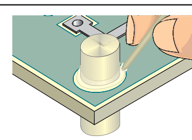
### Blisters and Delamination

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 3.1 | Delamination/Blister Repair, Injection Method |  | R | Advanced | High |

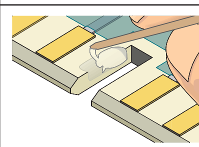
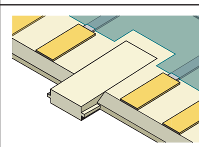
### Bow & Twist

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 3.2 | Bow and Twist Repair |  | R, W | Advanced | Medium |

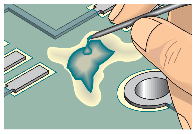
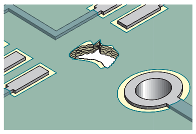
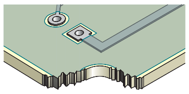
### Hole Repair

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 3.3.1 | Hole Repair, Epoxy Method |  | R, W | Advanced | High |
| 3.3.2 | Hole Repair,Transplant Method |  | R. W | Expert | High |

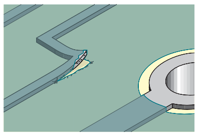
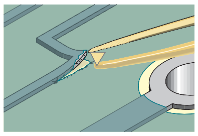
### Key and Slot Repair

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 3.4.1 | Key and Slot Repair, Epoxy Method |  | R, W | Advanced | High |
| 3.4.2 | Key and Slot Repair, Transplant Method |  | R, W | Expert | High |

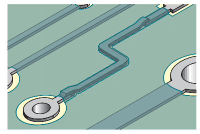
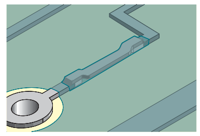
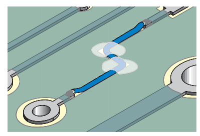
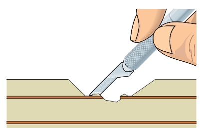
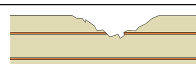
**Base Material Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 3.5.1 | Base Material Repair, Epoxy Method |  | R, W | Advanced | High |
| 3.5.2 | Base Material Repair, Area Transplant Method |  | R, W | Expert | High |
| 3.5.3 | Base Material Repair, Edge Transplant Method |  | R, W | Expert | High |

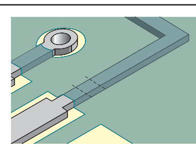
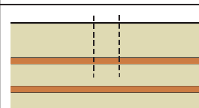
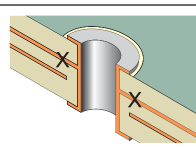
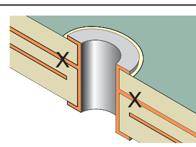
**Lifted Conductors**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.1.1 | Lifted Conductor Repair, Epoxy Seal Method |  | R, F | Intermediate | Medium |
| 4.1.2 | Lifted Conductor Repair, Film Adhesive Method |  | R, F | Intermediate | High |

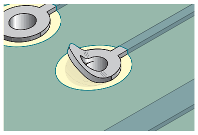
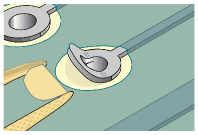
**Conductor Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.2.1 | Conductor Repair, Foil Jumper, Epoxy Method |  | R, F, C | Advanced | Medium |
| 4.2.2 | Conductor Repair, Foil Jumper, Film Adhesive Method |  | R, F, C | Advanced | High |
| 4.2.3 | Conductor Repair, Welding Method | | R, F, C | Advanced | High |
| 4.2.4 | Conductor Repair, Surface Wire Method |  | R, F, C | Intermediate | Medium |
| 4.2.5 | Conductor Repair, Through Board Wire Method |  | R | Advanced | Medium |
| 4.2.6 | Conductor Repair/Modification, Conductive Ink Method |  | R, F, C | Expert | Medium |
| 4.2.7 | Conductor Repair, Inner Layer Method |  | R, F | Expert | High |

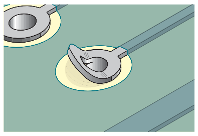
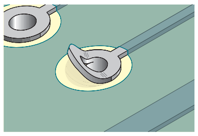
**Conductor Cut**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.3.1 | Conductor Cut, Surface Conductors |  | R, F | Advanced | High |
| 4.3.2 | Conductor Cut, Inner Layer Conductors |  | R, F | Advanced | High |
| 4.3.3 | Deleting Inner Layer Connection at a Plated Hole, Drill Through Method |  | R, F | Advanced | High |
| 4.3.4 | Deleting Inner Layer Connection at a Plated Hole, Spoke Cut Method |  | R, F | Advanced | High |

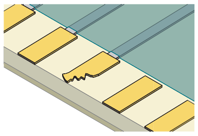
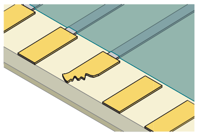
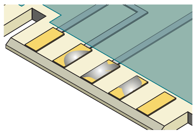
**Lifted Land Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.4.1 | Lifted Land Repair, Epoxy Method |  | R, F | Advanced | Medium |
| 4.4.2 | Lifted Land Repair, Film Adhesive Method |  | R, F | Advanced | Medium |

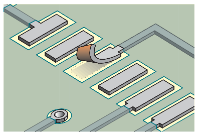
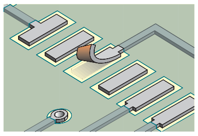
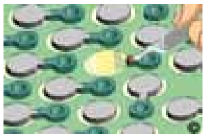
**Land Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.5.1 | Land Repair, Epoxy Method |  | R, F | Advanced | Medium |
| 4.5.2 | Land Repair, Film Adhesive Method |  | R, F | Advanced | High |

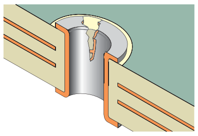
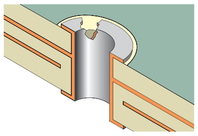
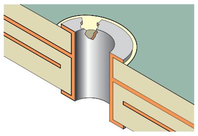
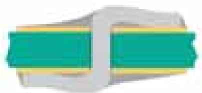
**Edge Contact Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.6.1 | Edge Contact Repair, Epoxy Method |  | R, F, W, C | Advanced | Medium |
| 4.6.2 | Edge Contact Repair, Film Adhesive Method |  | R, F, W, C | Advanced | High |
| 4.6.3 | Edge Contact Repair, Plating Method |  | R, F, W, C | Advanced | High |

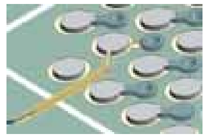
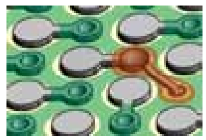
**Surface Mount Pad Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 4.7.1 | Surface Mount Pad Repair, Epoxy Method |  | R, F, C | Advanced | Medium |
| 4.7.2 | Surface Mount Pad Repair, Film Adhesive Method |  | R, F, C | Advanced | High |
| 4.7.3 | Surface Mount, BGA Pad Repair, Film Adhesive Method |  | R, F, C | Advanced | High |

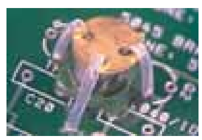
**Plated Hole Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 5.1 | Plated Hole Repair, No Inner Layer Connection |  | R, F, W | Intermediate | High |
| 5.2 | Plated Hole Repair, Double Wall Method |  | R, F, W | Advanced | Medium |
| 5.3 | Plated Hole Repair, Inner Layer Connection |  | R | Expert | Medium |
| 5.4 | Plated Hole Repair, No Inner Layer Connection, Clinched Jumper Wire Method |  | R,F,W | Intermediate | Medium |

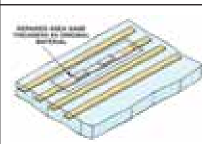
**Jumpers**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 6.1 | Jumper Wires |  | R, F, W, C | Intermediate | N/A |
| 6.2.1 | Jumper Wires, BGA Components, Foil Jumper Method |  | R, F | Expert | Medium |
| 6.2.2 | Jumper Wires, BGA Components, Through Board Method |  | R, F | Expert | High |

**Component Additions**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 6.3 | Component Modifications and Additions |  | R, F, W, C | Advanced | N/A |

**Flexible Conductor Repair**

| Procedure | Description | Illustration | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|---|
| 7.1.1 | Flexible Conductor Repair |  | F | Expert | Medium |

**8 Wires**

**8.1 Splicing**

| Procedure | Description  | Product Class | Skill Level | Level of Conformance |
|---|---|---|---|---|
| 8.1.1 | Mesh Splice | N/A | Intermediate | Low |
| 8.1.2 | Wrap Splice | N/A | Intermediate | Low |
| 8.1.3 | Hook Splice | N/A | Intermediate | Low |
| 8.1.4 | Lap Splice | N/A | Intermediate | Low |

# General Information and Common Procedures

## 1 General

**1.1 Scope** This document covers procedures for repairing and reworking printed board assemblies. It is an aggregate of information collected, integrated and assembled by the Repairability Subcommittee (7-34) of the Product Assurance Committee of the IPC. This revision includes expanded coverage for lead free processes, and additional inspection guidelines for operations such as repair that may not have other published criteria.

This document does not limit the maximum number of rework, modification or repair actions to a Printed Circuit Assembly.

**1.2 Purpose** This document prescribes the procedural requirements, tools, materials and methods to be used in the modification, rework, repair, overhaul or restoration of electronic products. Although this document is based in large part on the Product Class definitions used in IPC documents such as J-STD-001 or IPC-A-610, this document should be considered applicable to any type of electronic equipment. When invoked by contract as the controlling document for the modification, rework, repair, overhaul or restoration of products, the requirements flowdown apply.

IPC has identified the most common equipment and process in order to affect a specific repair or rework. It is possible that alternate equipment and processes can be used to make the same repair. If alternate equipment is used, it is up to the user to determine that the resultant assembly is good and undamaged.

**1.2.1 Definition of Requirements** This document is intended to be used as a guide and there are no specific requirements or criteria unless separately and specifically called out in a user's contractual or other documentation. When statements such as "must," "should" or "need to be" are used, they are stressing an important point. If these strong recommendations are not followed the end result may not be satisfactory and additional damage could be caused.

**1.3 Background** Today's electronic assemblies are more complex and smaller than ever before. Despite this, they can be successfully modified, reworked or repaired if the proper techniques are followed. This manual is designed to help users repair, rework and modify electronic assemblies with minimum impact on end use function or reliability. The procedures in this document have been obtained from assemblers, printed board manufacturers and users who recognize the need for documenting commonly used rework, repair and modification techniques. These techniques have, in general, been proven to be acceptable for the class of product indicated through testing and extended field functionality. Procedures contained herein were submitted for inclusion by commercial and military organizations too numerous to list individually. The Repairability Subcommittee has, where appropriate, revised procedures to reflect improvements.

**1.4 Terms and Definitions** Definitions marked with an * are from IPC-T-50 and apply to the use of this document.

*PCA* – Printed Circuit Assembly

**Rework* – the act of reprocessing noncomplying articles, through the use of original or equivalent processing, in a manner that assures full compliance of the article with applicable drawings or specifications.

**Modification* – the revision of the functional capability of a product in order to satisfy new acceptance criteria. Modifications are usually required to incorporate design changes which can be controlled by drawings, change orders, etc. Modifications should only be performed when specifically authorized and described in detail on controlled documentation.

**Repair* – the act of restoring the functional capability of a defective article in a manner that does not assure compliance of the article with applicable drawings or specifications.

**1.4.1 Class of Product** The user of the product is responsible for identifying the Class of Product. The procedure selected for action to be taken (modification, rework, repair, overhaul etc.) must be consistent with the Class identified by the user. The three Classes of Product are:

*Class 1 – General Electronic Products*
Includes products for applications where the major requirement is the function of the completed assembly.

*Class 2 – Dedicated Service Electronic Products*
Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end use environment would not cause failures.

*Class 3 – High Performance Electronic Products*
Includes products where continued performance or performance-on-demand is critical. Equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function where required, such as life support and other critical systems.

**1.4.2 Board Types** There are a variety of printed board types that the procedures in this document apply to. When selecting the appropriate modification, rework or repair procedure the printed board type being worked should be considered. Select a procedure that applies to the printed board type as listed on the procedure. Printed board types include the following:

R. *Rigid Printed Boards and Assemblies* – A printed board or assembly using rigid base materials only. These may be single-sided, double-sided or multilayered, and may be constructed from base laminate material that spans all approved commercial grades of laminate and includes glass fabric reinforced epoxy and polyimide resin laminates.

F. *Flexible Printed Boards and Assemblies* – A printed board or assembly using flexible or a combination of rigid and flexible materials only. May be partially provided with electrically nonfunctional stiffeners and/or cover lay. These may be single-sided, double-sided or multilayered.

W. *Discrete Wiring Boards and Assemblies* – A printed board or assembly using a discrete wiring technique to obtain electrical interconnections.

C. *Ceramic Boards and Assemblies* – A printed board or assembly using ceramic as the base material with interconnections separated by dielectric. The board layers are usually formed by alternate printing or depositing of interconnections and dielectric. The assemblies are either surface mount or die attach. Usually multilayered, these may be single-sided or double-sided.

**1.4.3 Skill Level** To assist in determining the skill level needed for each procedure a Skill Level indicator is included in each process. The Skill Level recommended should be used as a guide only. Skill levels will vary widely from technician to technician and from company to company. These recommendations come from industry experience and are not necessarily backed up with substantive testing. Skills are separated into three categories.

I. *Intermediate* – Technician with skills in basic soldering and component rework but inexperienced in general repair/rework procedures.

A. *Advanced* – Technician with soldering and component rework skills and exposure to most repair/rework procedures but lacking extensive experience.

E. *Expert* – Technician with advanced soldering and component rework skills and extensive experience in most repair/rework procedures.

**1.5 Applicability, Controls and Acceptability** Although the terms modification, rework and repair may seem very similar, applicability of such procedures may not be the same due to conditions and objectives involved. Procedures and guidelines of this document may be used during manufacturing of products or to products that have failed after being placed in use.

In general, rework or repair controls during manufacturing are different from the controls applied to products that fail after being placed in service.

When a defect or functional problem is discovered during the assembly process, a decision has to be made whether to rework or repair the product, use it as is, or discard it. This decision is typically made by a Material Review Board (MRB) as discussed in various assembly standards.

When a product fails after it has been placed in service, the term ‘‘repair’’ is commonly applied to actions that restore operation. Unlike the manufacturing process, there is no Material Review Board to disposition the failed assembly. How that decision is made is beyond the scope of this document.

Whether by an MRB or another process, if a decision has been made to perform a corrective action, and that action involves removing and replacing a failed component, the rework procedures in Part 2 - 7711 will be applicable. If a repair or modification action is needed, the procedures in Part 3 - 7721 will provide guidance.

**1.5.1 Level of Conformance** Level of Conformance provides the means for selecting an appropriate level of conformance to the original electrical, mechanical, physical, environmental and visual product requirements. Each procedure lists a Level of Conformance that the product will attain when successfully completed. The Level of Conformance rating for each procedure is based on the skill of the technician. The ratings are based on long term industry experience and are not necessarily backed up with testing data.

**1.5.1.1 Levels of Conformance**

L. *Lowest Level* – Significant variance with the physical character of the original and may vary with many of the electrical, functional, environmental and serviceability factors.

M. *Medium Level* – Some variance with the physical character of the original and most likely varies with some of the functional, environmental and serviceability factors.

H. *Highest Level* – Most closely duplicates the physical characteristics of the original and most probably complies with all the functional, environmental and serviceability factors.

Class 3 Products must use procedures rated Highest level unless it can be demonstrated that a lower level procedure will not adversely affect the product’s functional characteristics. Class 2 and 1 Products should use procedures rated

Highest level for assured safety and dependability but Medium and Low Level procedures can be used if it has been determined that they are suitable for the specific product's functional characteristics.

Procedures in this manual are given a ''Level of Conformance'' rating which is described in Table 1.

**Table 1 Level of Conformance**

| Functional Consideration | Level of Conformance L | M | H |
|---|---|---|---|
| Electrical - Resistance | No | Verify | Yes |
| Electrical - Inductance | No | Verify | Yes |
| Electrical - Capacitance | No | Verify | Yes |
| Electrical - Cross Talk | No | Verify | Yes |
| Electrical - High Speed Frequency | No | Verify | Yes |
| Environmental - Shock | No | Verify | Yes |
| Environmental - Vibration | No | Verify | Yes |
| Environmental - Humidity | Verify | Verify | Yes |
| Environmental - Temperature | Yes | Yes | Yes |
| Environmental - Altitude | Verify | Verify | Verify |
| Environmental - Bacteria | Verify | Verify | Yes |
| Environmental - Fungus | Verify | Verify | Yes |
| Serviceability - Future Repair or Mod. | No | Yes | Yes |

No Procedure may not comply with functional consideration.
Verify Procedure should comply with functional consideration but should be tested to verify.
Yes Procedure will normally comply with functional consideration.

In principle any modification, rework or repair action taken on a product should reestablish the products original character, ''Make it like it was.'' Physical changes, obvious or otherwise, can adversely affect the products performance or capability factors.

**1.5.2 Compliance** Products that have been subjected to rework need to comply with the functional requirements for the product and any other attributes that may be required by the customer. In the absence of other defined acceptability criteria it is appropriate to apply the acceptance criteria of IPC-A-610 to rework actions.

Modification and repair, by their nature, do not have industry established requirements and acceptance criteria. These will need to be determined on a case by case basis. Products that have been subjected to modification need to comply with the requirements of the engineering data package that defines the modification.

Repair or modification may result in, or include, minor changes in visual appearance that do not degrade the form, fit, or function of the assembly.

**1.6 Training** The quality and reliability of modified or repaired printed boards and assemblies is highly dependent upon the skill and competence of the person performing these tasks. The implementation of proper methods by unqualified personnel can result in a substandard end product. Consequently, achieving successful results with the methods described herein is predicated on the use of properly trained personnel whose skills have been tested and certified to be of a sufficient level of competence.

1. *Soldering Skills* – Many companies have considered assembly personnel who are competent in soldering techniques to be sufficiently trained for rework/repair activities. This has often proven to be erroneous, since proper soldering is only one of the skills required. Also, in order to attain comparable results, there are many instances where component rework requires techniques that are different than those used to originally solder the component.
2. *Personnel Selection* – The proper selection of trainees will contribute significantly toward the success in developing capable repair personnel. Personnel with above average soldering abilities and sound reasoning capabilities often make ideal trainees. However, personnel who have no soldering skills, but possess a good level of eye acuity, manual dexterity, and sound reasoning capability, can be successfully trained.
3. *Professional Training* – Companies should establish and maintain procedures for identifying the training needs and provide for the training of all personnel performing the activities affecting product quality. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and experience. Maintaining records of training is appropriate and may be specifically required to meet ISO or other quality certification criteria.

Training for personnel and instructors is commercially available and can be completed by an outside organization specializing in the applicable discipline. Modification/rework/repair training employs concepts, techniques, procedures and a vocabulary that distinguishes it from basic soldering training. Effective training requires the development of high levels of comprehension and reasoning within the trainee. This necessitates expansive teaching methods and detailed demonstration under close instructor supervision, to help assure the development of proficiency within each trainee.

Training to establish a desired level of proficiency can usually be achieved after three to ten days of training, depending on the content of the training program, the complexity of the end product, and the proficiency of the trainee. Testing and certification can be provided for each trainee, as the situation warrants.

### 1.7 Basic Considerations

1. *Appropriate Approvals* – When rework, repair, or modification of products is conducted during manufacturing, appropriate approvals may be required. Unless prohibited by the customer, rework during manufacturing may usually be performed without prior approval of the customer. Repair actions and modifications generally require prior approval by the customer.
2. *Singular Procedures* – Procedures in this book are presented as individual methods. Multiple procedures may be necessary to complete the task.
3. *Quality* – Rework, repair, or modification of printed boards and assemblies should achieve the quality of the original product.
4. *Procedure Selection* – The procedure selected should be on the basis of optimum end product functionality. It may be necessary to develop specific evaluation criteria depending on the product's required functions and end use environment.
5. *Patience* – To achieve best results, do not rush the process. Keep in mind that most of the cost for fabrication/assembly has already been spent, but with care and patience, most of this cost can be salvaged.
6. *Heat Application* – Incorrect heat application may cause severe damage to board materials, conductors, components, conformal coatings and solder connections.
7. *Removal of Coatings* – Coating should be removed from affected areas prior to processing. Coatings will inhibit solder removal and adversely affect resoldering operations.

**1.8 Workstations, Tools, Materials and Processes** Modification, rework and repair of PC boards and assemblies is generally a highly labor intensive operation relying more on individual operator skills than automation. The use of proper tools and supplies, many unique to repair actions, will often have a significant impact on the function and reliability of the end product. To enhance the ease of the task at hand and to improve the potential for a successful operation, the following tools, materials, and processes may be required.

#### 1.8.1 ESD/EOS Controls

**1.8.2 Vision Systems** The small features in electronic assemblies and the precision needed require use of a vision magnification system. Appropriate vision systems that provide depth perception, and working ranges of 3 to 30x magnification, resolution, field of view and working distance are critical when performing rework, repair or modifications on the miniature components, circuits, and assemblies. Refer to IPC-OI-645 Standard for Visual Optical Inspection Aids for more information.

**1.8.3 Lighting** The circuit assembly needs to be illuminated with sufficient light to see the features and color variations. A typical minimum acceptable lighting level is at least 1000 Lm/$m^2$. In selecting a light source, the color temperature of the light is an important consideration. Light ranges from 3000-5000 ° K enable users to differentiate various metal alloys and contaminants. A black light assists in identifying flux residue and the presence of conformal coating.

**1.8.4 Fume Extraction** Work environments can often expose technicians to potentially hazardous fumes. Disposal and release of certain materials may have a significant environmental impact. The use of localized fume extraction systems, environmental control devices and other personnel protection equipment may be necessary to comply with MSDS requirements and applicable federal, state and local laws.

**1.8.5 Tools** Precision soldering is important in today's modification, rework and repair operations. Technicians may need an assortment of special use soldering tools appropriate to the variety of tasks at hand. These tools must be temperature controlled, ESD/EOS safe, ergonomically designed and include a selection of tips to suit each particular operation. These tools generally use conductive heating (by contact), convective heating (by hot gas) or infrared heating (by focused infrared lamps).

**1.8.6 Primary Heating Methods** Primary heating methods are those principally responsible for achieving solder reflow during a component installation or removal process. These are to be distinguished from methods used for preheating and auxiliary heating which are employed in addition to primary heating methods.

**1.8.6.1 Conductive (by contact) Heating Methods** Soldering irons fall into one of three categories. These may employ any of several heating technologies.

**For conductive heating methods to work effectively, the soldering iron tip must be clean and free of oxidation. For that reason, the final action before contacting any connection with a soldering iron is to clean the tip. See Procedure 2.8.**

- *Fixed Temperature* – Fixed temperature soldering irons do not permit changing the tip temperature.
- *Selectable Temperature* – Selectable temperature soldering irons permit operation at a preselected temperature. Selection of the temperature is achieved by removal/replacement of an integrated part of the soldering system (soldering iron tip, temperature control module, etc.). Typically a selectable temperature soldering iron offers temperature selection in 50 or 100 degree F increments.
- *Variable Temperature* – Variable temperature soldering irons permit operation at any temperature within the control range (typically 500 to 800 F degrees). Temperature

change may be achieved by either digital or analog control.

*Additional examples of conductive tools are:*

- *Soldering Tweezers* – Common name for a tool that simultaneously uses two separate elements to achieve reflow of a solder connection. Soldering tweezers fall into one of two categories:
  - *Thermal Tweezers* – A tweezer handpiece that has each tweezer tip heated to a predetermined temperature. Thermal tweezers are typically used for removing SMT components from a PCB.
  - *Resistive Tweezers* – A tweezer handpiece that has a different electrical potential on each tweezer tip. Heating is achieved by passing a high density electrical current between the tips (through the item being soldered). Resistive tweezers are typically used for soldering cup terminals and similar components that will not be damaged by the voltage and current present in the soldering action.
- *Solder Pots/Fountains* – The alloy type, contamination levels, and temperatures need to be monitored to assure they are compatible with the work being performed.

**1.8.6.2 Convective (hot gas) and IR (radiant) Heating Methods** Examples of convective tools are:

- *Hot Air Pencil* – Common name for the handpiece used to deliver heated gas to connection elements to be soldered. Typically used to reflow solder paste, but can also be used with solder wire.
- *Hot Air Gun* – Common name for the handpiece used to deliver heated gas to connection elements to be soldered. Similar in concept to the hot air pencil but usually with greater thermal capacity.
- Benchtop convective, IR or combination work stations.

**1.8.7 Preheating (Auxiliary) Heating** Preheating printed board assemblies is sometimes recommended to avoid thermal shock to temperature sensitive materials and components. Preheating also elevates the thermal mass of the assembly to allow a rework process to proceed in an acceptable time. Preheating can be accomplished using either an oven, heat lamp, hot plate, infrared or convective style heating system.

Preheating is required when there is a risk of thermal shock in the substrate, components or both. The goal is to ramp up the assembly and/or component at an acceptably safe rate until it reaches a target temperature. The assembly (or component) is then thermally soaked. This eliminates dangerous temperature gradients which could produce immediate damage, degradation over time or reduction of reliability. The rate of ‘‘ramp up’’ can be critical. For example many ceramic chip capacitor manufacturers have traditionally recommended that preheating occur at a rate of no greater than 2-4 degrees C/sec. until a given minimum temperature is reached.

Preheating/auxiliary heating is also required when the primary heating method cannot bring all of the solder joints completely up to proper reflow temperature at all or in an acceptable period of time. This may be due to high mass components, heat sinking by nearby portions of the substrate, circuit elements and adjacent components. The goal is to bring the assembly (or a portion thereof) up to a sufficient (yet safe) temperature at which the rate of heat sinking is low enough that the primary heating device can effect proper solder reflow in an acceptable period of time. This process may also be used for through-hole desoldering on heavy multilayer boards with internal ground planes.

**1.8.8 Hand Held Drilling and Grinding Tool** PC Board modification, rework and repair procedures often require drilling, milling or grinding operations. The best type of tool for these delicate operations is preferably a lightweight, high quality, EOS/ESD controlled motorized rotary tool. This tool can be used for detailed work (i.e., solder resist and conformal coating removal, grinding out burns or laminate defects, drilling out plated holes, cutting fine pitch conductors etc.).

**1.8.9 Precision Drill/Mill System** Demanding projects often require the need to make very precise holes, slots, groves etc.. Accurate depth control and high speed may be required. A precision drilling/milling system with fixturing to hold the printed board assembly and an attached microscope may be advisable for those unusually demanding projects.

**1.8.10 Eyelets and Eyelet Press System** Solder plated copper eyelets and an eyelet press/setting tool to repair damaged plated through holes may be required.

**1.8.11 Gold Plating System** Plating gold edge contacts or any metal surface requires the use of materials that may have environmental and safety concerns and must be handled properly. The power applied to the plating surfaces must be controlled accurately to expect reliable results. Plating systems typically include; a DC power supply with voltage and current meters, plating anodes sized for gold edge contact plating, a solution tray to collect the solution runoff, a support for the PC board and a tray to hold and store the various chemicals safely.

**1.8.12 Tools and Supplies** Also needed are a wide assortment of hand tools including tweezers, various pliers, files, dental picks, cutting tools and other common items.

**1.8.13 Materials** The materials listed are ''generic'' in nature. It is recommended that these materials are available or approved by your company. The use of certain materials includes some increased risk (fire, personnel safety, etc.) and such materials should not be used unless appropriate safety precautions are enforced.

**1.8.13.1 Solder** The procedures in this document are not specific to any alloy type and should be compatible with most commonly used tin-lead or lead-free alloys. When soldering on newly manufactured assemblies the same alloy type needs to be used. When effecting repair of fielded assemblies, it may be impossible to determine the alloy type. It is recommended that you look at drawings, labeling or any available documentation for the assembly to attempt to determine the correct alloy to use. When unknown and without other direction, the standard alloy used in your facility should be used. IPC-1066 and IPC/JEDEC J-STD-609 (supersedes IPC-1066) are examples of standards used to identify the solder alloys and coatings on the assembly.

**1.8.13.2 Flux** The type of flux used needs to be appropriate to the solder alloy/process being used, and compatible with the cleaning and coating processes that may be required.

**1.8.13.3 Replacement Conductors and Lands** There are commercially available replacement conductors and lands that are normally fabricated from copper foil and plated with solder or nickel and gold for edge contact repair. These conductors and lands are available with or without a dry film adhesive on the back. Adhesive backed conductors and lands are normally heat bonded to the board surface. Replacement conductors and lands are available in various shapes, sizes and thicknesses. Compatible replacement conductors and features may also be salvaged from scrap Printed Circuit boards, if necessary.

**1.8.13.4 Epoxy and Coloring Agents** Many repair operations require the use of high strength, high temperature epoxies. For high temperature applications two-part epoxies offer the highest strength, thermal resistance and durability. It may also be important to have resists or coloring agents so that you can restore the cosmetic appearance of the board. It is best to cure the epoxies in an oven if possible.

**1.8.13.5 Adhesives** The type of adhesive used needs to be appropriate to the purpose of the adhesive, whether for thermal management or for attachment of a item such as a heat sink, replacement land/conductor, jumper wires, etc. Issues that need to be considered are shelf life of the material, mixing ratios, working life, curing, and compatibility with cleaning and coating processes that may be required.

**1.8.13.6 General** Any consumables such as wicking braid, wipes and other items listed in the procedures need to be compatible with the process.

**1.8.14 Process Goals and Guidelines** The process of component replacement involves three basic procedures. These are component removal, land preparation and component installation. Depending on PCA configuration, conformal coating removal and replacement may also be required.

a. *Nondestructive Process* – During any assembly or rework process, no damage or degradation should occur to the board (both substrate and circuit elements), adjacent components, and the component to be installed or removed. This damage may be either mechanical, thermo/mechanical or purely thermal in nature and may result in either immediate failure, degradation in performance over time (latent failure) or a reduction in reliability. EOS/ESD damage must also be avoided by employing proper work procedures, work stations and equipment controls.
b. *Controllable, Reliable and Repeatable Process* – The process can be employed, and when necessary, modified by a trained operator in a repetitive fashion with consistently acceptable results.
c. *Process Appropriate to Particular Application* – The process (or modification thereof) employed is appropriate to the particular application based on the relevant guidelines described below.
d. *Operator Friendly Process* – An operator of average ability can, with proper training and practice, become acceptably proficient in employing, and when required, modifying the process to suit any particular requirements of a given task.
e. *Efficient Process* – The process can be done repeatedly in a production environment quickly and easily at minimal costs with little or no down-time. Set-up and training time must also be minimal.

**1.8.14.1 Nondestructive Component Removal** Each rework-modification-repair procedure has certain advantages and precautions. These depend on the particular operation/device/material (lead/terminations design, size, body material, etc.), component mounting site (adjacent components, access, substrate type, thermal mass, etc.) and the skill level of the operator. Some procedures depicted in this document may not be applicable to all termination styles.

**1.8.14.1.1 Surface Mount Components**

- Pre-/auxiliary heat assembly and/or component if required.

- Evenly apply heat in a rapid, controllable fashion to achieve complete, simultaneous reflow (melt) of all solder joints.
- Avoid thermal and/or mechanical damage to component, board, adjacent components and their joints.
- Immediately remove component from board before any solder joint resolidifies.
- Prepare lands for replacement component.

**1.8.14.1.2 Through-Hole Components** Desolder component one joint at a time using vacuum method:

- Pre-/auxiliary heat assembly and/or component if required.
- Heat joint in a rapid, controllable fashion to achieve complete solder reflow.
- Avoid thermal and/or mechanical damage to component, board, adjacent components and their joints.
- Apply vacuum during lead movement to cool joint and free lead.
- Inspect barrel and land for damage.

**1.8.14.1.3 Component Removal Using Solder Fountain Method**

- Reflow all joints in solder fountain.
- Remove old component and either immediately replace with new component, or clear through-holes for component replacement later.

**Note:** Copper dissolution is a concern when using a solder fountain and can be impacted by dwell time, temperature and alloy in use.

**1.8.14.2 Component Installation**

**1.8.14.2.1 Land Preparation** Land preparation needs to be performed prior to the installation/replacement of a new component. Avoidance of thermal and/or mechanical damage to the land and substrate is critical.

- *Remove Old Solder* – This may be performed with a soldering iron and braided solder wicking material, or with a continuous vacuum desoldering technique employing a solder extractor and tip which allows reflow and vacuum aspiration of the old solder to occur continuously.
- *Clean Lands* – Old flux residues leftover after the removal of old solder are cleaned in this step prior to adding new solder.

**1.8.14.2.2 Surface Mount Components**

- Prefill lands with solder (preforms, wire or paste).
- Align and place component to lands (tack if necessary).
- Apply solder paste to lead/land area if not applied prior to component placement.
- Pre-/auxiliary heat assembly and/or component if required.
- Predry applied solder paste.
- Reflow solder joints (individually, in groups or all together) with concentrated ''targeted'' heat in a rapid, controllable manner while maintaining lead/land alignment. Joints should remain at target temperature (above melting point of solder alloy) for proper time to achieve optimal intermetallic formation.
- Avoid thermal and/or mechanical damage to component, board, adjacent components and their joints.
- Clean and inspect.

**1.8.14.2.3 Through-Hole Components**

- Insert new component into board.
- Pre-/auxiliary heat assembly and/or component if required.
- Solder joints (individually, in groups or all together) with concentrated ''targeted'' heat in a rapid, controllable manner. Joints should remain at target temperature (above melting point of solder alloy) for proper time to achieve optimal intermetallic formation.
- Avoid thermal and/or mechanical damage to component, board, adjacent components and their joints.
- Clean and inspect.

**1.8.15 Cleaning Station/System** Regardless of the Class of Product serviced, a cleaning system that is chemically matched to the flux system(s) in use will be essential to a satisfactory repair. In organizations that perform procedures on Class 3 Products, it may also be necessary to have a cleanliness test system in order to periodically evaluate the ability of the cleaning system to meet the requirements/expectations of the user. Interim or in-process cleaning at the workstation should be used pending completion of the procedure and the final cleaning. Common Procedure 2.2 in this document is an example.

**1.8.16 Component Removal and Installation** The variety of large and small components require an array of special use tools and methods for safe, efficient component removal. These tools generally use conductive heating (by contact), convective heating (by hot gas) or infrared heating (by focused infrared lamps).

**1.8.17 Conformal Coating Area** The cost, safety concerns and utility services (air pressure/vacuum, power, venting, UV illuminations, etc.) of equipment associated with both the removal and application of conformal coating suggest to many organizations that one central conformal coating and encapsulant area be installed.

**1.8.18 Selecting a Process** Selecting the process depends on a variety of factors in addition to cost of tools and training. Every process and its associated equipment have advantages and precautions in a particular component installation or removal situation. These include:

- Type of component
  - lead (termination) type
  - body composition
- Size of component
- Moisture sensitivity level of component
- Type of substrate (FR-4, ceramic, etc.)
- Component mounting site
  - thermal mass considerations
  - adjacent components
  - accessibility of component or joints
- Whether the component is being installed or removed
- Whether the component being removed must be salvaged
- Applicable workmanship specifications
- EOS/ESD control requirements

**1.8.19 Time Temperature Profile (TTP)** To ensure acceptable results of the rework procedure, it is critical to establish a time temperature profile for the process.

**Note:** The time temperature profile is dependent, in part, on ambient relative humidity. Relative humidity variations of greater ± 15% from those prevailing when the TTP was established may require modification of the procedure defined during TTP.

The following steps are suggested to achieve an acceptable TTP:

- Select a preheat temperature for both the component and the Assembly. (The components, whether ceramic and plastic, need to be preheated, as does the assembly.}

  **NOTE:** If plastic body or tape bodied components are used, see IPC J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for information on handling of moisture sensitive components.
- Solder paste characteristics must be identified including viscosity, thixotropy, rheology, deposition thickness and drying time/temperature; or if using flux cored solder wire, land prefill solder quantity and prefill coplanarity required.
- Define a cleaning procedure which will meet the end item cleanliness requirements of the customer.
- Confirm through destructive physical examination and/or x-ray analysis that the process defined will yield a BGA attachment which meets any quality requirements imposed.
- Define, if used, an accelerated cooling system which does not exceed thermal gradient limits of the most sensitive component of the assembly.

**1.9 Lead Free** The rework of circuit boards assembled using lead free solders is similar to common alloys except as noted below. Generally all that is needed is to understand those differences. The procedures in this document are not specific to any alloy type and should be compatible with most commonly used tin-lead or lead-free alloys. See 1.8.13.1.

It is very important to assure that any solder alloys with lead or soldering iron tips that have been used with solder containing lead are kept away from lead-free work areas.

Those differences are:

- Lead free alloys have a higher Liquidous (or melting) temperature than traditional tin-lead solder alloys. Therefore lead free alloys may require different dwell times and temperatures to create an acceptable solder connection.
- Lead free alloys may require different fluxes and special cleaning processes.
- Wetting times are generally extended.
- Solderability indicators such as wetting angles, joint appearance etc., will generally be different.
- Higher temperatures and longer dwell times may increase oxidation.
- Component lead frames as well as circuit board finishes must be compatible with the solder alloy.
- Using alternative means of attachment for rework/repair (such as conductive epoxies) may be advantageous due to temperature and other considerations.
- For both conductive and convective assembly rework/repair, the use of inert atmosphere (such as nitrogen) should be considered to facilitate the process.

# Handling Electronic Assemblies

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

Electrostatic Discharge (ESD) is the rapid transfer of electrical energy from one object to another of a different potential. When the electrical energy is allowed to come in contact with or even close to a sensitive component it can cause damage to the component. Electrostatic-Discharge Sensitive (ESDS) components are those components that are affected by these high energy surges. The relative sensitivity of a component to ESD is dependent upon its construction and materials. As components become smaller and operate faster, the sensitivity increases.

Electrical Overstress (EOS) is the internal result of a unwanted application of electrical energy that results in damaged components This damage can be from many different sources, such as electrically powered process equipment or ESD occurring during handling or processing.

ESDS components can fail to operate or change in value as a result of improper handling or processing. These failures can be immediate or latent. The result of immediate failure can be additional testing and rework or scrap. However the consequences of latent failure are the most serious. Even though the product may have passed inspection and functional test, it may fail after it has been delivered to the customer.

It's important to build protection for ESDS components into circuit designs and packaging. However, in the manufacturing and assembly areas, we often work with unprotected electronic assemblies that are attached to the ESDS components. This section will be dedicated to safe handling of these unprotected electronic assemblies.

For that purpose, the following subjects are addressed:

2.1.1 Electrical Overstress (EOS) Damage Prevention
2.1.2 Electrostatic Discharge (ESD) Damage Prevention
2.1.3 Physical Handling

Information in this specification is intended to be general in nature. Additional detailed information can be found in EIA-625, Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices, or ANSI/ESD-S20.20 ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices).

### 2.1.1 Electrical Overstress (EOS) Damage Prevention

Electrical components can be damaged by unwanted electrical energy from many different sources. This unwanted electrical energy can be the result of ESD potentials or the result of electrical spikes caused by the tools we work with, such as soldering irons, soldering extractors, testing instruments or other electrically operated process equipment. Some devices are more sensitive than others. The degree of sensitivity is a function of the design of the device. Generally speaking higher speed and smaller devices are more susceptible than their slower, larger predecessors. The purpose or family of the device also plays an important part in component sensitivity. This is because the design of the component can allow it to react to smaller electrical sources or wider frequency ranges. EOS has become a serious problem and will be more critical in the future.

When considering the susceptibility of the product it is important to keep in mind the susceptibility of the most sensitive component in the assembly. Applied unwanted electrical energy can be processed or conducted just as an applied signal would be during circuit performance.

Before handling or processing sensitive components, tools and equipment need to be carefully tested to ensure that they do not generate damaging energy, including spike voltages. Current research indicates that voltages and spikes less than 0.5 volt are acceptable. However, an increasing number of extremely sensitive components require that soldering irons, solder extractors, test instruments and other equipment do not generate spikes greater than 0.3 volt.

As required by most ESD specifications such as EIA-625 or ESDA 20.20, periodic testing may be warranted to preclude damage as equipment performance may degrade with use over time. Maintenance programs are also necessary for process equipment to ensure the continued ability to not cause EOS damage.

### 2.1.2 Electrostatic Discharge (ESD) Damage Prevention

The best ESD damage prevention is a combination of preventing static charges and eliminating static charges if they do occur. All ESD protection techniques and products address one or both of the two issues.

ESD damage is the result of electrical energy that was generated from static sources either being applied or in close proximity to ESDS devices. Static sources are all around us. The degree of static generated is relative to the characteristics of the source. To generate energy relative motion is required. This could be contacting, separation, or rubbing of the material.

Most of the serious offenders are insulators since they concentrate energy where it was generated or applied rather than allowing it to spread across the surface of the material. Common materials such as plastic bags or Styrofoam containers are serious static generators and as such are not to be allowed in processing areas especially static safe areas. Peeling adhesive tape from a roll can generate 20,000 volts. Even compressed air nozzles which move air over insulating surfaces generate charges.

Destructive static charges are often induced on nearby conductors, such as human skin, and discharged into conductors. This can happen when a printed board assembly is touched by a person having a static charge potential. The electronic assembly can be damaged as the discharge passes through the conductive pattern to a static sensitive component. Static discharges may be too low to be felt by humans (less than 3500 volts), and still damage ESDS components. Typical static voltage generation is included in Table 2.

### 2.1.3 Physical Handling

Care must be taken during acceptability inspections to ensure product integrity at all times. Table 3 provides general guidance.

#### Physical Damage

Improper handling can readily damage components and assemblies (e.g., cracked, chipped or broken components and connectors, bent or broken terminals, badly scratched board surfaces and conductor lands). Physical damage of this type can ruin the entire assembly or attached components.

**Table 1 Typical Static Charge Sources**

| | |
|---|---|
| Work surfaces | Waxed, painted or varnished surfaces<br>Untreated vinyl and plastics<br>Glass |
| Floors | Sealed concrete<br>Waxed or finished wood<br>Floor tile and carpeting |
| Clothes and personnel | Non-ESD smocks<br>Synthetic materials<br>Non-ESD Shoes<br>Hair |
| Chairs | Finished wood<br>Vinyl<br>Fiberglass<br>Non-conductive wheels |
| Packaging and handling materials | Plastic bags, wraps, envelopes<br>Bubble wrap, foam<br>Styrofoam<br>Non-ESD totes, trays, boxes, parts bins |
| Assembly tools and materials | Pressure sprays<br>Compressed air<br>Synthetic brushes<br>Heat guns, blowers<br>Copiers, printers |

**Table 2 Typical Static Voltage Generation**

| Source | 10-20% humidity | 65-90% humidity |
|---|---|---|
| Walking on carpet | 35,000 volts | 1,500 volts |
| Walking on vinyl flooring | 12,000 volts | 250 volts |
| Worker at a bench | 6,000 volts | 100 volts |
| Vinyl envelopes (Work Instructions) | 7,000 volts | 600 volts |
| Plastic bag picked up from the bench | 20,000 volts | 1,200 volts |
| Work chair with foam pad | 18,000 volts | 1,500 volts |

**Table 3 General Rules for Handling Electronic Assemblies**

1. Keep work stations clean and neat. There must not be any eating, drinking, or use of tobacco products in the work area.
2. Minimize the handling of electronic assemblies and components to prevent damage.
3. When gloves are used, they need to be changed as frequently as necessary to prevent contamination from dirty gloves.
4. Solderable surfaces are not to be handled with bare hands or fingers. Body oils and salts reduce solderability, promote corrosion and dendritic growth. They can also cause poor adhesion of subsequent coatings or encapsulates.
5. Do not use hand creams or lotions containing silicone since they can cause solderability and conformal coating adhesion problems..
6. Never stack electronic assemblies or physical damage may occur. Special racks need to be provided in assembly areas for temporary storage.
7. Always assume the items are ESDS even if they are not marked.
8. Personnel need to be trained and follow appropriate ESD practices and procedures, including use of wrist or heel straps.
9. Never transport ESDS devices unless proper packaging is applied.

### Contamination

Contamination by handling with bare hands or fingers without some form of protection causes soldering and coating problems; body salts and oils, and unauthorized hand creams are typical contaminants. Body oils and acids reduce solderability, promote corrosion and dendritic growth. They can also cause poor adhesion of subsequent coatings or encapsulates. Lotion formulated specifically for use in solder assembly areas is available. Normal cleaning procedures will not always remove such contaminants. The best solution is to prevent contamination.

When assemblies are removed from their protective wrappings, handle with great care. Touch only the edges away from any edge connector tabs. Where a firm grip on the assembly is required, gloves meeting EOS/ESD requirements need to be worn. These principles are especially critical when no-clean processes are employed.

### Handling Electronic Assemblies

If no ESDS markings are on an assembly, it still needs to be handled as if it were an ESDS assembly. However, ESDS components and electronic assemblies need to be identified by suitable EOS/ESD labels. Many sensitive assemblies will also be marked on the assembly itself, usually on an edge connector. To prevent ESD and EOS damage to sensitive components, all handling, unpacking, assembly and testing must be performed at a static controlled work station.

Avoid contaminating solderable surfaces prior to soldering. Whatever comes in contact with these surfaces must be clean. When boards are removed from their protective wrappings, handle them with great care. Touch only the edges away from any edge connector tabs. Where a firm grip on the board is required due to any mechanical assembly procedure, gloves meeting EOS/ESD requirements need to be worn. These principles are especially critical when no-clean processes are employed.

### Handling After Solder

After soldering and cleaning operations, the handling of electronic assemblies still requires great care. Finger prints are extremely hard to remove and will often show up in conformally coated boards after humidity or environmental testing. Gloves or other protective handling devices need to be used to prevent such contamination. Use mechanical racking or baskets with full ESD protection when handling during cleaning operations. ESD events can occur when sensitive devices/assemblies are placed on any nonconductive surface, regardless of whether or not a wrist or shoe strap is used.

### Common Tools and Equipment

Work environments require tools and equipment to conduct electronic assembly operations. The following information is provided as guidance regarding the use of common equipment. EIA-625 and ESDA 20.20 provide more specific information.

| | |
|---|---|
| Number: **2.1** | Subject: **Handling Electronic Assemblies** |
| Revision: **B**<br>Date: 11/07 | |

**NOTES**

# Cleaning

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

Surface contaminants can significantly affect soldering, bonding, coating and the electrical characteristics of printed board and assemblies. This procedure outlines the cleaning methods for printed wiring boards and assemblies.

## BACKGROUND

In the past few years, the Environmental Protection Agency (EPA) has been actively involved in reducing the production of chlorofluorocarbons (CFC's). Through their efforts, and the Montreal Protocol, the production of CFC's have been frozen to 1986 levels with requirements to further decrease to zero production by the year 2000. The London Amendments (June 1990) to the protocol are even more restrictive.

Cleaning of the PCB is an important part of any rework/repair process. The different cleaning processes are dependent upon the type of flux used in the soldering process or the type of contaminate to be removed. A general rule of thumb is ''like dissolves like,'' which is a quick way of saying that usually organic/nonpolar contaminants are best removed by nonpolar solvents and inorganic/polar contaminants are best removed by polar solvents.

**A desirable cleaning medium should:**

A. Not be harmful to employees or the environment.
B. Possess excellent wetting ability.
C. Dissolve and removes both soluble and particulate contaminants.
D. Be compatible with the PCB assembly.
E. Be stable during use.

## INTRODUCTION

If rework/repair operations are performed in a facility that has an automated cleaning system (i.e., batch, in-line, aqueous, semi aqueous, or solvent), then such equipment should be used to clean the assembly.

If an automated system is not available, the cleaning method that follows should be used to reduce surface contamination prior to using adhesives, coating materials or soldering. A cleaning step after soldering is used to ensure that surface contaminants are not trapped beneath conformal coatings or encapsulants, nor will they contribute to future functional assembly problems.

## LIMITATIONS

1. The ability of solvent based cleaning solutions to remove flux residue containing polyglycols should be assessed since not all solvent based cleaning solutions will remove polyglycols.
2. A de-ionized (DI) water rinse should follow IPA/DI cleaning except that a water rinse for double sided printed circuit boards with plated through holes may not be required.
3. Potable (drinking) water should not be used as a final rinse due to the potential of contaminating the printed circuit board assembly with chlorine, fluorine and halides.
4. When automated cleaning is used for assemblies that have been conformally coated, it is important that the cleaning process is compatible with the type of coating used and with any unsealed components. The coating should be checked to ensure that the coating will not be degraded by the cleaning process.

## TOOLS AND MATERIALS

| | |
|---|---|
| Black Light | De-ionized Water (DI) |
| Brush, Soft Bristles | Gloves |
| Cleaner, Aqueous or Semi-Aqueous | Isopropyl Alcohol (IPA) |
| Containers | Oven |
| | Wipes, Lint Free |

## PROCEDURE

**CAUTION**

Use clean gloves during this entire operation.

**NOTE**

To reduce solvent volumes, mixtures of IPA with water and IPA with solvent are available in pressurized containers. The propellants are HFC's. These containers may be fitted with a bristle brush spray attachments for additional cleaning action.

1. Clean the board in an Aqueous or Semi-Aqueous cleaner, or pour approximately 10 ml of cleaning solution per 26 square centimeters of affected area.

2. Scrub the board vigorously with a continually wet soft bristle brush for 10 seconds.
3. Rinse the area with 10 ml per 26 square centimeters of clean Isopropyl Alcohol to effectively remove all potentially harmful residues.
4. Handle the board by the edges and blot the excess Isopropyl Alcohol with clean, lint free cloth.
5. Examine board visually for cleanliness. The use of a black light will help detect contaminants that will fluoresce.
6. Dry boards in oven, if desired.
7. If the boards or assemblies are to be stored before use or coating, remove them from the oven and allow to cool until they can be handled. Place the boards or assemblies into self sealing bags with packages of desiccant.

## INSPECTION GUIDANCE

1. Flux residue
2. Particulate matter
3. Chlorides, carbonates and white residues
4. Surface appearance

## NOTES

# Coating Removal, Identification of Conformal Coating

Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the techniques for identifying various coatings so that the appropriate coating removal method can be selected.

*Conformal Coating Types* IPC-CC-830 has superseded MIL-I-46058 as the primary specification for printed circuit assembly conformal coatings, and covers the following types of conformal coatings:

1. Type AR – Acrylic resin (includes lacquers and varnishes)
2. Type ER – Epoxy resin
3. Type SR – Silicone resin
4. Type UR – Polyurethane resin
5. Type XY – Paraxylylene

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling
IPC - CC-830

## TOOLS AND MATERIALS

| | |
|---|---|
| Abrasive Discs | Heated Blade |
| Brush | Knife |
| Cleaner | Solvent |
| Cleaner Wipes | Thermal Parting Tool |
| Cotton Swab | Wood Stick |
| Dental Style Drill | |

## PROCEDURE

To determine the appropriate coating removal procedure the coating must first be identified. During original manufacture the specific coating is usually known. Consequently, the coating removal methods can usually be specified and based on the known coatings being used. Labels conforming to Standards such as IPC-1066 (superseded by IPC/JEDEC J-STD-609) and IPC/JEDEC J-STD-609 may be present on the assembly to identify the coating material.

When identification of the coating is not available, simple observation and testing will help identify the coating characteristics so that the proper removal procedure can be specified.

**NOTE**

The generic or commercial identification of the coating material is not necessary to accomplish coating removal.

1. *Hardness*

   Penetration test in a non-critical area to determine relative hardness. The harder the coating the more suitable to pure abrasive techniques. The softer and gummier the coatings the more suitable to the brushing removal procedures.

2. *Transparency*

   Obviously transparent coatings are usually more suitable for removal than the opaque type. Removal methods used with opaque coatings must be far more controllable and less sensitive to damaging the covered components and printed board surfaces and are usually slower.

3. *Solubility*

   Most coatings are soluble; however, the solvent required to dissolve a specific coating may also attack the board and/or components. Unless directed by other maintenance actions, the solubility test and solvent use should be limited to isopropyl alcohol. Test coat the surface in a noncritical area by brushing on a small quantity and observing the solubility action.

   **CAUTION**

   Printed board assemblies should not be immersed in harsh solvents.

4. *Thermal Removal*

   Use a thermal parting device with controlled heating and without a cutting edge to determine whether the coating can be thermally removed. Start with a low temperature, approximately 100°C, and increase the temperature until the coating is removed. If the coating flows or gums up, the temperature is too hot or the coating is not suitable for thermal removal.

5. *Stripability*

   Carefully slit the coating with a sharp blade in a non-critical area and try to peel back from the surface to determine if this method is feasible. Due to the adhesion required of coating materials, stripable techniques without chemical aids is usually very limited.

6. *Thickness*

   Coating thickness is determined by visual inspection. Thin coatings show sharp outlines of the components and almost no fillet at intersection points of part leads to the circuit board. Thick coatings reduce these sharp outlines and show fillets where part leads intersect with the board. Coatings thinner than 0.064 cm [0.025 in] are considered thin. Coatings thicker than 0.064 cm [0.025 in] are classed as thick.

The specific coating to be removed may have one or more of these characteristics and consequently the removal method selected should consider the composite characteristics.

See Figure 1 for Conformal Coating Identification.
See Table 1 for Conformal Coating Characteristics.
See Table 2 for Conformal Coating Removal Methods.

## INSPECTION GUIDANCE

1. Visual examination or UV light may be used to verify removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.

## NOTES

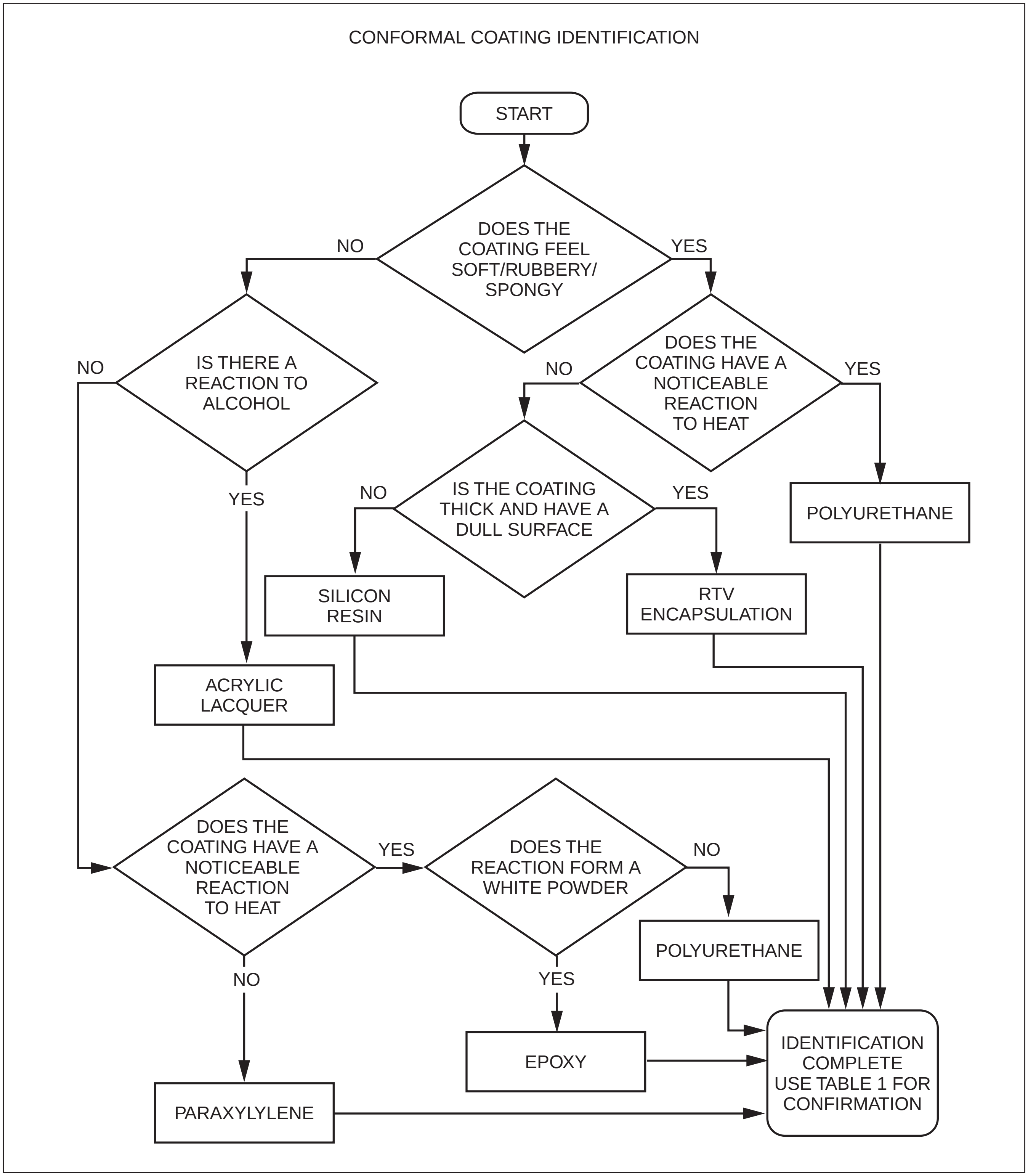



**Figure 1 Conformal Coating Identification**

Number: **2.3.1**

Subject: **Coating Removal, Identification of Conformal Coating**

Revision: **B**

Date: 11/07

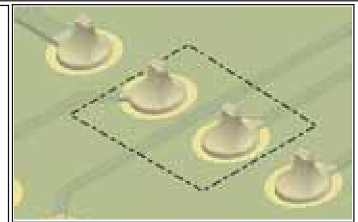
**Table 1 Conformal Coating Characteristics**

| Characteristics | Conformal Coating Type | | | | |
|---|---|---|---|---|---|
| | Epoxy | Acrylic | Poly-urethane | Silicone Resin | Para-xylylene |
| Hard | ✓ | | ✓ | | ✓ |
| Medium Hard | | ✓ | ✓ | | |
| Soft | | | ✓ | ✓ | |
| Heat Reaction | ✓ | ✓ | ✓ | | |
| Surface Bond - Very Strong | ✓ | | | ✓ | ✓ |
| Surface Bond - Strong | | ✓ | | ✓ | |
| Surface Bond - Medium | | | ✓ | ✓ | |
| Surface Bond - Light | | | | ✓ | |
| Solvent Reaction | | ✓ | | | |
| Non-porous Surface | ✓ | ✓ | ✓ | | ✓ |
| Glossy Surface | ✓ | ✓ | ✓ | | |
| Semi-glossy Surface | ✓ | | | ✓ | |
| Dull Surface | | | | | ✓ |
| Rubbery Surface | | | | ✓ | |
| Brittle | ✓ | ✓ | | | |
| Chips | ✓ | ✓ | | | |
| Peels and Flakes | | ✓ | ✓ | | ✓ |
| Stretches | | | ✓ | ✓ | |
| Scratch, Dent, Bend, Tear | | | ✓ | ✓ | ✓ |

**Table 2 Conformal Coating Removal Methods**

| Conformal Coating | Removal Method | | | | |
|---|---|---|---|---|---|
| | 2.3.2 Solvent Method | 2.3.3 Peeling Method | 2.3.4 Thermal Method | 2.3.5 Grinding Scrap-ing Method | 2.3.6 Micro Blasting Method |
| Paraxylyene | | | 1 | 2 | 3 |
| Epoxy | | | 1 | 2 | 3 |
| Acrylic | 1 | | 2 | 3 | 4 |
| Polyurethane | 3 | | 1 | 2 | 4 |
| Silicone Thin | 1 | | 2 | 3 | 4 |
| Silicone Thick | | 1 | | 2 | |

**NOTE:** The preferred order for applying removal methods to specific coatings is numerically indicated. These removal methods are listed in ascending order. More than one method may be required.

| | | |
|---|---|---|
| IPC 7711/7721<br>Rework, Modification and Repair of Electronic Assemblies | Revision: **B** Number: **2.3.2**<br>Date: **11/07**<br># Coating Removal, Solvent Method | <br>Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

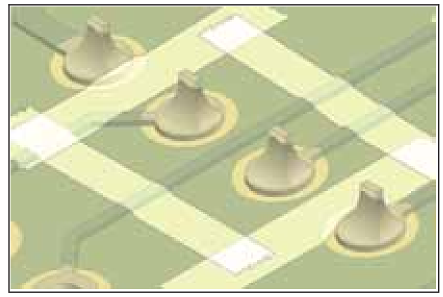


**Figure 1 Apply tape to outline for coating removal.**

**Figure 2 Apply solvent with foam swab to remove coating.**

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure uses a solvent to remove surface coatings. This procedure can be used for spot or overall coating removal of conformal coatings or solder resists.

Approved solvents may be used to remove specific soluble type coatings on a spot basis by brushing or swabbing the local area with the controlled application of solvent until the area is free of the coating material.

If warranted, all the soluble type coating can be removed by immersing and brushing the entire printed board or printed board assembly.

To determine the appropriate coating removal procedure the coating must first be identified. Refer to procedure number 2.3.1.

## NOTE

Coating removal may require the use of one or more methods.

## CAUTION

Determine, on a module by module basis, the hazards to parts, etc., by short term immersion in the removal solvents. If chloride based or other harsh solvents are used, extreme care must be exercised to prevent damage to base material, component parts, plated-through holes, and solder joints. Some solvent coating removal methods can cause expansion or swelling of the base material which can degrade the printed board or printed board assembly. Under no circumstances should these solvents be used except in a closely controlled process. It is recommended that the printed board or printed board assembly be inspected to ensure that no damage has occurred.

Before using any solvent refer to Material Safety Data Sheets.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.3.1 Coating Removal, Identification of Conformal Coatings
2.4.1 Coating Replacement, Solder Resist
2.4.2 Coating Replacement, Conformal Coatings/Encapsulants

| | |
|---|---|
| Number: **2.3.2** | Subject: **Coating Removal, Solvent Method** |
| Revision: **B**<br>Date: 11/07 | |

## TOOLS AND MATERIALS

Brush
Cotton Swab
Polyimide Tape
Knife
Suitable Solvent
Thermal Parting Tool
Wood Stick

## PROCEDURE – LOCAL SPOT REMOVAL

1. Apply Polyimide tape to outline the area where the coating needs to be removed. (See Figure 1.)
2. Dip the end of a foam swab in stripping solution and apply a small amount to the area of coating to be removed. (See Figure 2.)

   As an alternative, a small cotton patch can be cut to the size of the area masked (see Figure 1), saturated with the stripping solution, and pressed into intimate contact with the surface of the coating to be removed. The patch will retard the evaporation of certain solvents and reduce exposure time.

   **NOTE**
   Since various substances may be used as coatings, the time required for a given coating to dissolve or soften will vary. Reapply solvent several times as most solvents evaporate rapidly.
3. Rub the treated surface carefully with a brush or wood stick to dislodge the coating. A wedge shaped applicator tip, knife, or heated blade may be effective in removing some coatings, particularly polyurethanes.
4. Neutralize or clean the stripped area and dry.

## PROCEDURE – OVERALL REMOVAL

1. A single step for removal of all the coating may be completed by providing a continuous flow of solvent. Alternately, process the board in a series of tanks containing mild solvent, starting with a high contamination tank and progressing sequentially to a final, fresh solvent tank.
2. Neutralize or clean the stripped area and dry.

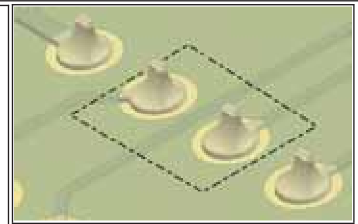
## INSPECTION GUIDANCE

1. Visual examination or UV light may be used to verify complete removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.

## NOTES

Coating Removal Required at Outlined Areas

# Coating Removal, Peeling Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This peeling removal method for coating can be used only under special circumstances. Normally this method is used to remove RTV silicone or other thick rubbery-like coating materials.

The coating material is removed using a dull knife or otherwise dull blade to slit the coating material and to peel it off the printed board or printed board assembly.

To determine the appropriate coating removal procedure the coating must first be identified. Refer to procedure number 2.3.1.

## NOTE

This method is limited to coatings that are rubbery in nature to allow the coating material to be slit into small sections and peeled off the printed board assembly.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.3.1 Coating Removal, Identification of Conformal Coatings
2.4.1 Coating Replacement, Solder Resist
2.4.2 Coating Replacement, Conformal Coatings/Encapsulants

## TOOLS AND MATERIALS

Heated Blade
Knife
Wood Sticks

## PROCEDURE

1. Slit and peel off the coating material with a dull knife or heated dull blade. (See Figure 1.)
2. Repeat as needed until the required material is removed.

## INSPECTION GUIDANCE%

1. Visual examination or UV light may be used to verify complete removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.

## NOTE

Coating Removal Required at Outlined Area

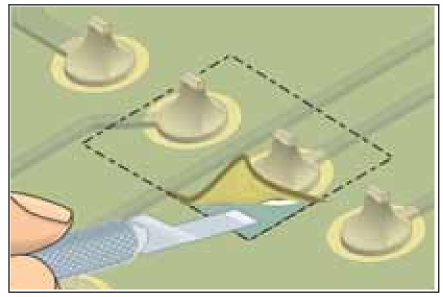


**Figure 1 Slit and peel off coating using a knife or heated blade.**

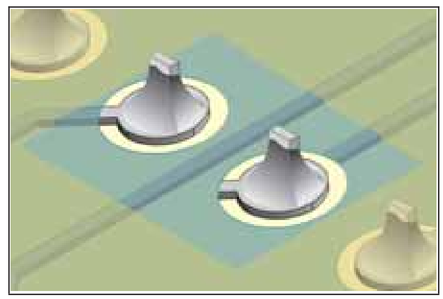
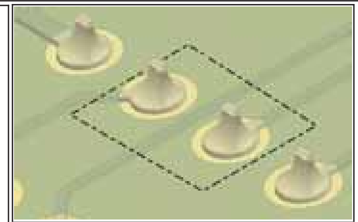


**Figure 2 Removal complete.**

## NOTES

| | | |
|---|---|---|
| IPC<br>**7711/7721**<br>Rework, Modification and Repair of Electronic Assemblies | Revision: **B** Number: **2.3.4**<br>Date: **11/07**<br><br># Coating Removal, Thermal Method | <br>Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This coating removal procedure uses a controlled, low temperature, localized heating method for removing thick coatings by an overcuring or softening means.

Two methods are covered. The first method uses various shaped, temperature controlled tips, with dull edges to soften and remove the coating.

The second method uses a localized controlled jet of hot air or inert gas to soften the coating material which is pushed away or removed by a non-marring tool.

These methods do not burn or char either the coating or printed board.

## CAUTION

Soldering irons should not be used for coating removal as their high operating temperatures will cause the coatings to char and possibly delaminate the printed board base material.

The use of thinned down soldering iron tips or soldering iron heated thin cutting blades are not recommended since they do not provide controlled heating and may present dangerous sharp edges to the workpiece surface.

To determine the appropriate coating removal procedure the coating must first be identified. Refer to procedure number 2.3.1.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.3.1 Coating Removal, Identification of Coatings
2.4.1 Coating Replacement, Solder Resist
2.4.2 Coating Replacement, Conformal Coatings/Encapsulants

## TOOLS AND MATERIALS

Brush
Heated Blade or Thermal Parting Tool
Hot Air Tool
Knife
Small Cutters
Wood Sticks

## PROCEDURE - THERMAL PARTING METHOD

1. Select an appropriate thermal parting tip to suit the workpiece configuration. Set the nominal tip temperature, using the manufacturer's recommended procedure.

**Figure 1 Apply thermal tip to soften or granulate the material.**

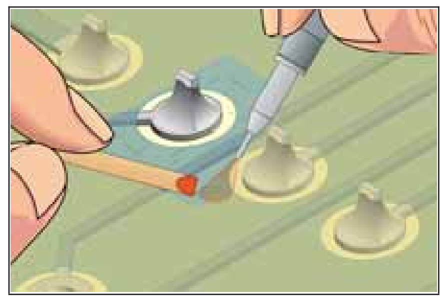


**Figure 2 Apply hot air to the work area and remove overcured coating.**

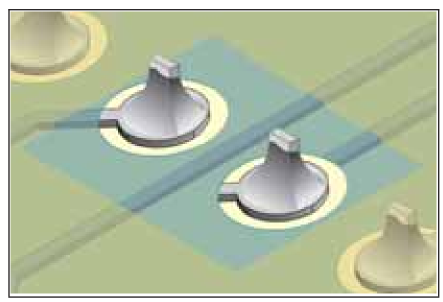


**Figure 3 Removal complete.**

2. Apply the thermal parting tip to the coating, using a light pressure. The coating material will either soften or granulate. Polyurethanes will soften and epoxies will granulate. The tip temperature should be regulated to a point where it will effectively ''break down'' the coating without scorching or charring. (See Figure 1.)
3. Gradually reduce the coating thickness around the component body without contacting the board surface. Remove as much coating as possible from around component leads to allow easy removal of the leads.
   Clip leads of component parts that are known to be faulty, thus permitting removal of the part body separately from leads and solder joints. Low pressure air or a brush should be used to remove the loosened coating.
4. Once sufficient coating has been removed, leaving only a small bonded joint between the part body and printed board, heat the component body with the thermal parting tool or hot air jet to weaken the bond beneath the component.
5. Lift the component body free of the printed board using small pliers.

   **NOTE**

   Twist the component prior to removal to shear any remaining epoxy bond to the printed board surface.
6. Once the component body has been removed from the board surface, the remaining coating material can be removed by additional thermal parting. The remaining leads and solder joints are then removed by appropriate solder extraction means.

## PROCEDURE - HOT AIR METHOD

By control of the gas/air temperature, flow rates and jet shape, the hot air method can be applied to almost any workpiece configuration on both the component and solder side of the printed board without damage.

Extremely delicate work can be handled in this manner while permitting direct observation of the heating action.

1. Set up the hot air tool per the manufacturer's instructions. Adjust flow rate and temperature to suit specific coating removal application.

   **CAUTION**

   Never set the gas/air temperature at a level that will cause scorching or charring of the coating material or reflow the solder connections.
2. Apply the heated air jet to work area. Apply light pressure using a wood stick or other non marring tool to remove the softened or overcured coating. All coating around individual leads, solder joints and component bodies can be removed in this manner. (See Figure 2.)
3. When the coating has been removed, use appropriate solder extraction method to remove components if needed.

## INSPECTION GUIDANCE

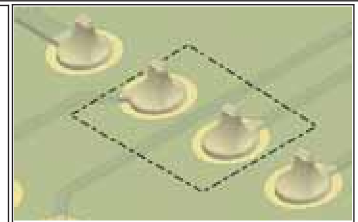
1. Visual examination or UV light may be used to verify complete removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.

## NOTES

Coating Removal Required at Outlined Area

Revision: **B**
Date: **11/07**
Number: **2.3.5**

# Coating Removal, Grinding/Scraping Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This coating removal method uses various grinding and scraping tools, depending on the composition of the coating material. A knife or dental style scraper is normally used when a scraping method is desired. A hand held drill is normally used when a grinding technique is desired. A wide variety of rotary abrasive materials including ball mills may be required.

To determine the appropriate coating removal procedure the coating must first be identified. Refer to procedure number 2.3.1.

## CAUTION

Abrasion operations can generate electrostatic charges.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.3.1 Coating Removal, Identification of Conformal Coatings
2.4.1 Coating Replacement, Solder Resist
2.4.2 Coating Replacement, Conformal Coatings/Encapsulants

## TOOLS AND MATERIALS

| | |
|---|---|
| Ball Mills | Microscope |
| Brush | Rubberized Abrasives |
| Cleaner | Scraper |
| Cleaning Wipes | Wood Sticks |
| Hand Held Drill | Rubber Eraser |
| Knife | |

## PROCEDURE - SCRAPING

1. Clean the area.
2. Remove the damaged or unwanted coating or solder resist using a knife or scraper. Hold the blade perpendicular to the coating and scrape from side to side until the desired material is removed. (See Figure 1.)
3. Remove all loose material and clean the area.

**Figure 1 Scrape away damaged or unwanted coating.**

**Figure 2 Rubberized abrasives used to remove thin, hard coating.**

**Figure 3 Rotary brushes are best used to remove soft coating.**

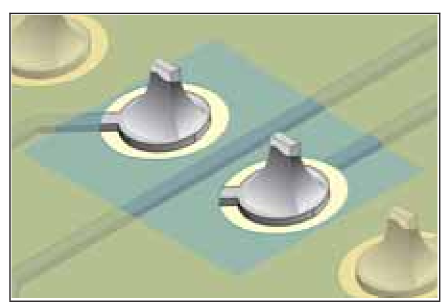


**Figure 4 Removal complete.**

| | |
|---|---|
| Number: **2.3.5** | Subject: **Coating Removal, Grinding/Scraping Method** |
| Revision: **B**<br>Date: 11/07 | |

## PROCEDURE - GRINDING

1. Clean the area.
2. Insert an abrasive tip into the hand held drill. Abrade away the damaged or unwanted coating. Move the tool from side to side to prevent damage to the printed circuit board surface. (See Figure 2.)
3. Remove all loose material and clean the area.

## NOTE

Rubberized abrasives of the proper grade and grit are ideally suited for removing thin hard coatings from flat surfaces but not for soft coatings since these would cause the abrasive to ‘‘load up’’ with coating material and become ineffective.

Rotary brushes are better suited than rubberized abrasives on contoured or irregular surfaces, such as soldered connections, etc., since the bristles will conform to surface irregularities while removing hard or soft coatings. (See Figure 3.)

## NOTE

The procedure for removing thick coatings is primarily to reduce their thickness to a thin coating and then to remove the remaining thin coating by the scraping method.

## INSPECTION GUIDANCE

1. Visual examination or UV light may be used to verify complete removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.

## NOTES

7711/7721

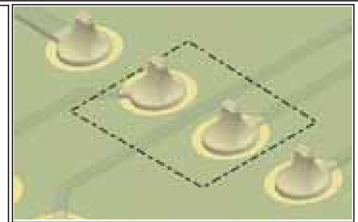
Rework,
Modification
and Repair of
Electronic Assemblies

Revision: **B**

Date: **11/07**

Number: **2.3.6**

# Coating Removal, Micro Blasting Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This coating removal method uses a micro abrasive blasting system and a very fine soft abrasive powder. The powder is propelled through a small nozzle toward the area where the coating needs to be removed.

To determine the appropriate coating removal procedure the coating must first be identified. Refer to procedure number 2.3.1.

## CAUTION

Micro blasting will generate substantial static charges. The work area should be flooded with ionized air and the printed circuit board assembly should be grounded whenever possible.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.3.1 Coating Removal, Identification of Conformal Coatings
2.4.1 Coating Replacement, Solder Resist
2.4.2 Coating Replacement, Conformal Coatings/Encapsulants

## TOOLS AND MATERIALS

| | |
|---|---|
| Abrasive Powder | Removable Mask |
| Polyimide Tape | Stencils |
| Micro Blasting System | |

## PROCEDURE

1. Clean the area.
2. Select the appropriate abrasive blasting powder and nozzle size. Set the air pressure at the desired setting per equipment manufacturer's instructions.
3. Apply polyimide tape or other masking material to protect the printed wiring board surface as needed. (See Figure 1.) Masking materials can consist of tapes, curable liquid masks or reusable stencils.
4. If the printed circuit board has static sensitive components, insert the entire printed circuit board into a shielded bag. Only the area needing rework should be exposed. Ground the printed circuit board to dissipate static charges if needed.

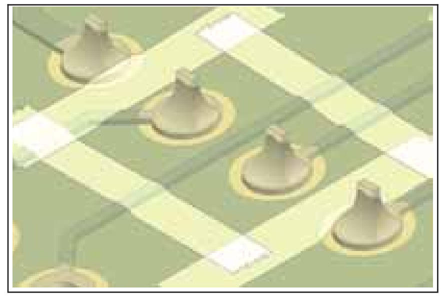


**Figure 1 Apply tape to outline area for coating removal.**

**Figure 2 Remove coating using micro blasting system.**

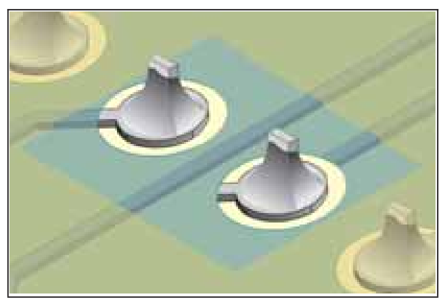


**Figure 3 Removal complete.**

5. Insert the printed circuit board into the blasting chamber and blast away the damaged or unwanted coating or solder resist. Slowly move the nozzle along the area where the coating is to be removed. (See Figure 2.)
6. Blow off the blasting dust and clean the area.

### INSPECTION GUIDANCE

1. Visual examination or UV light may be used to verify complete removal of coating.
2. Visually inspect PWA for damage from removal of conformal coating.
3. Visually inspect and verify no evidence of micro blasting material is present.

### NOTES

IPC

7711/7721

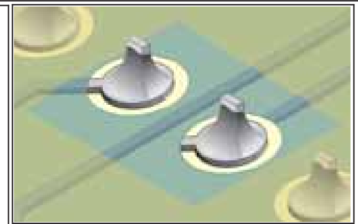
Rework, Modification and Repair of Electronic Assemblies

Revision: **B**

Date: **11/07**

Number: **2.4.1**

# Coating Replacement, Solder Resist



Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace solder resist or coatings on printed wiring boards. Most replacement coatings can be applied by dipping, brushing or spraying.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

Cleaner
Cleaning Wipes
Color Agent, Various Colors
Brush
Epoxy or Replacement Coating
Foam Swab
Heat Lamp
Microscope
Oven

## PROCEDURE

1. Clean the area.

   **CAUTION**
   Surfaces to be coated must be thoroughly cleaned prior to coating to ensure adequate adhesion, minimized corrosion, and optimized electrical properties.

2. If needed, apply Polyimide tape to outline the area where the solder resist will be applied. (See Figure 1.)
3. Mix the epoxy or replacement coating. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
4. Apply the replacement coating to the board surface as required. A brush or foam swab may be used to apply and spread the epoxy or replacement coating. (See Figure 2.)
5. Cure the replacement coating per the manufacturer's instructions.

## CAUTION

Some components may be sensitive to high temperature.

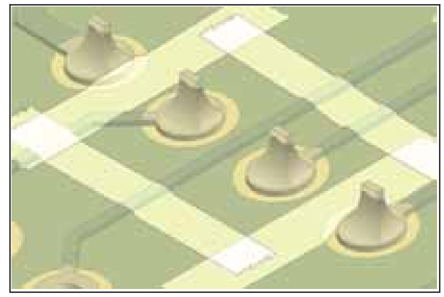


**Figure 1 Apply polyimide tape if needed.**

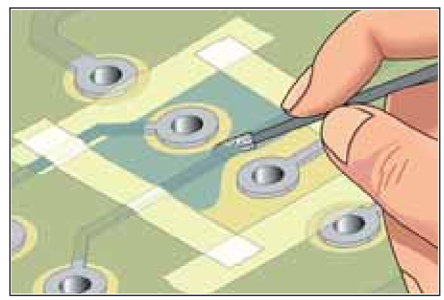
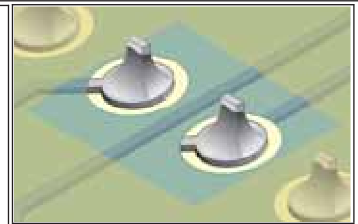


**Figure 2 Apply replacement coating with a foam swab to create a texture.**

## INSPECTION GUIDANCE

1. Visual examination for texture, color match, adhesion and coverage.
2. Electrical tests to conductors around the repaired area as applicable.

## NOTES

| | | |
|---|---|---|
| IPC<br>**7711/7721**<br>Rework, Modification and Repair of Electronic Assemblies | Revision: **B** Number: **2.4.2**<br>Date: **11/07**<br># Coating Replacement, Conformal Coatings/ Encapsulants | <br>Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Intermediate<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace conformal coatings and encapsulants on printed circuit boards.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Foam Swab |
| Cleaning Wipes | Heat Lamp |
| Brush | Microscope |
| Epoxy or Replacement Coating | Oven |

## PROCEDURE

1. Clean the area.

   **CAUTION**
   Surfaces to be coated must be thoroughly cleaned prior to coating to ensure adequate adhesion, minimized corrosion, and optimized electrical properties.
2. If needed, apply Polyimide tape to outline the area where the coating will be applied. (See Figure 1.)
3. If required, bake the printed circuit board prior to the application of the replacement coating.
4. Mix the replacement coating.
5. Apply the replacement coating to the board surface as required. A brush or foam swab may be used to apply and spread the replacement coating. (See Figure 2.) For large surfaces, apply the replacement coating with a foam swab to create a texture.
6. Cure the replacement coating per the manufacturer's instructions.

## CAUTION

Some components may be sensitive to high temperature.

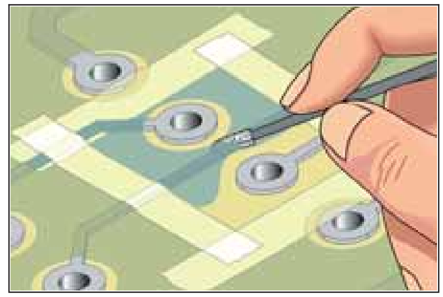


**Figure 1 Apply replacement coating with foam swab to create a texture.**

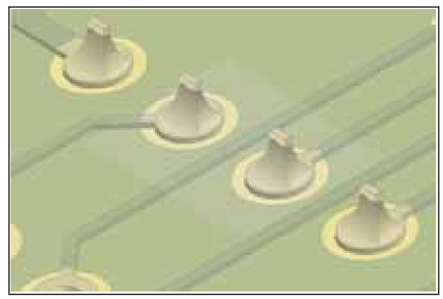


**Figure 2 Repair complete.**

## INSPECTION GUIDANCE

1. Visual examination for texture, color match, adhesion and coverage.
2. Electrical tests to conductors around the repaired area as applicable.
3. Repair area does not exceed the original board thickness.

## NOTES

IPC

**7711/7721**

Rework,
Modification
and Repair of
Electronic Assemblies

Revision: **B**

Number: **2.5**

Date: **11/07**

# Baking and Preheating

Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers baking and preheating of printed boards and printed board assemblies to prepare the product for the subsequent operations. Included are steps for:

A. *Baking*

Baking is used to eliminate absorbed moisture. Whenever possible printed circuit boards and printed circuit board assemblies should be baked prior to soldering, unsoldering and coating operation to prevent blistering, measling or other laminate degradation.

B. *Preheating*

Preheating is used to promote the adhesion of subsequent materials to the board surfaces and to raise the temperature of the printed wiring board to allow soldering and unsoldering operations to be completed more quickly.

## CAUTION

Baking and preheating procedures must be carefully selected to ensure that temperature and time cycles used do not degrade the product. Environmental conditions must also be carefully considered to ensure that vapors, gases, etc., generated during the heating process do not contaminate the product's surfaces.

## CAUTION

To prevent fluxes or other contaminates from being baked onto the board surface, thoroughly clean the board or assembly prior to baking or preheating.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

Cleaner
Cleaning Wipes
Oven

**NOTES**

IPC

**7711/7721**

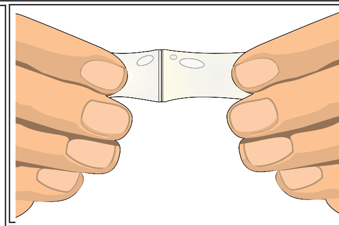
Rework,
Modification
and Repair of
Electronic Assemblies

Revision: **B**

Date: **11/07**

Number: **2.6**

# Epoxy Mixing and Handling



Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers epoxy mixing and handling. The epoxy covered by this procedure has multiple uses including solder resist repair, base board repair, circuitry over-coating and delamination repair.

## NOTE

For high strength or high temperature applications two part epoxies will generally have the best properties.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS AND MATERIALS

Balance/Scale
Cleaner
Color Agent, Various Colors
Epoxy
Foam Swab
Heat Lamp
Mixing Cup
Mixing Stick
Oven
Wipes

## PRINTED WIRING BOARD PREPARATION

The area where the epoxy is to be applied should be prepared prior to mixing the epoxy. This preparation may include preheating the affected area to improve absorption of the applied epoxy. The entire printed wiring board may also be heated in an oven or with a heat lamp.

## CAUTION

Some components may be sensitive to high temperatures.

## CAUTION

Avoid skin contact with epoxy materials.

## PROCEDURE - Prepackaged Two Part Epoxy

1. Remove the clip separating the resin and activator. Mix by squeezing both halves together with your fingers. Mix for at least one minute to ensure a complete mix of the resin and activator. (See Figure 1.)

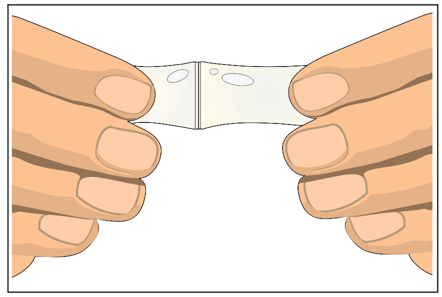


**Figure 1 Mix resin and activator inside package of prepackaged epoxy.**

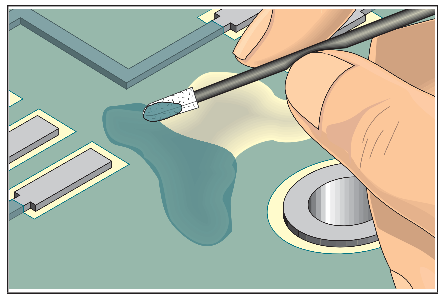


**Figure 2 Apply epoxy. Foam swab may be used to add texture.**

2. Cut open one end of the epoxy tube and squeeze the contents into a mixing cup. Mix again with a mixing stick to ensure a thorough mixture of the resin and activator.

   **NOTE**
   For bubble free epoxy, remove the clip separating the resin and activator. Cut open one end of the Epoxy tube and squeeze the contents into a mixing cup. Slowly stir the mixture with the mixing stick. Be sure to stir the mixture for at least 2 minutes to ensure that all the resin and activator have completely mixed.

3. If needed, add color agent to the mixed epoxy. Stir slowly to prevent bubbles.

   **CAUTION**
   Be sure the color agent is compatible with the epoxy mixture.

4. Apply or use as needed. (See Figure 2.)
5. Cure the epoxy per the manufacturer's recommendations.

## INSPECTION GUIDANCE

1. Visual examination of epoxy for texture and color match.
2. Verify shelf life of expoxy.
3. Visually inspect for contamination.
4. Verify mix ratio meets manufacturer's instructions.

## NOTES

IPC

**7711/7721**

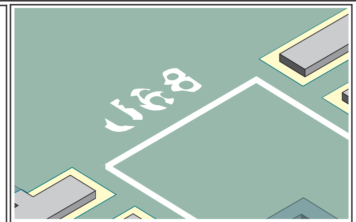
Rework,
Modification
and Repair of
Electronic Assemblies

Revision: **B**

Date: **11/07**

Number: **2.7.1**

# Legend/Marking, Stamping Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method can be used to add, change or replace legend and markings on printed boards or printed board assemblies. This method uses epoxy ink and an ink stamp to place the legends on the printed board surface in much the same manner as taking a ''finger print.''

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Knife |
| Cleaning Wipes | Microscope |
| Epoxy Ink | Oven |
| Ink Plate | Peg Stamps |
| Ink Roller | |

## PROCEDURE

1. Clean the area.
2. Scrape off any remaining character or legend with a knife and clean the area.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
3. Select the appropriate characters from the peg stamp set or have a special stamp made up.
4. Mix the epoxy ink. White is the most common color. Spread a thin even coating of the epoxy ink on the ink plate or on a smooth surface.
5. Gently press the peg stamp into the epoxy coating to coat the character surface.
6. Gently press the peg stamp onto the desired location on the printed wiring board surface. (See Figure 1.)
7. Cure the epoxy ink per the manufacturer's instructions.

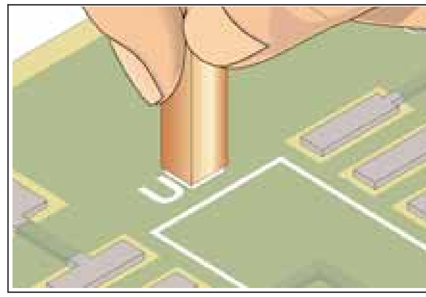


**Figure 1 Apply legend using a peg stamp.**

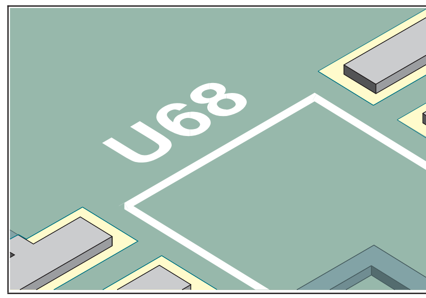



**Figure 2 Completed legend repair.**

| Number: **2.7.1** | Subject: **Legend/Marking, Stamping Method** |
|---|---|
| Revision: **B**<br>Date: 11/07 | |

**INSPECTION GUIDANCE**

1. Visual examination for proper characters, positioning and legibility.
2. Marking ink is cured and resists:
   a. Smearing
   b. Chipping
   c. Powdering
   d. Cleaning processes

**NOTES**

7711/7721

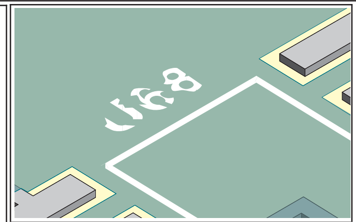
Rework, Modification and Repair of Electronic Assemblies

Revision: **B**

Date: **11/07**

Number: **2.7.2**

# Legend/Marking, Hand Lettering Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method can be used to add, change or replace legend and markings on printed boards or printed board assemblies. This method uses epoxy ink and a pen to hand letter the legends on the printed board surface.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Knife |
| Cleaning Wipes | Microscope |
| Epoxy Ink | Oven |
| Ink Pen | Wood Stick |

## PROCEDURE

1. Clean the area.
2. Scrape off any remaining character or legend with a knife and clean the area.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
3. Mix the epoxy ink. White is the most common color.
4. Sharpen a wood stick and dip the pointed end into the epoxy ink. Hand letter the legend or markings as needed. (See Figure 1.)
5. Cure the epoxy ink per the manufacturer's instructions.

## INSPECTION GUIDANCE

1. Visual examination for proper characters, positioning and legibility.
2. Marking ink is cured and resists:

   a. Smearing
   b. Chipping
   c. Powdering
   d. Cleaning processes

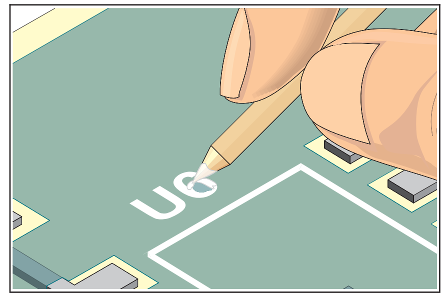


**Figure 1 Apply legend using a wood stick dipped in epoxy ink.**

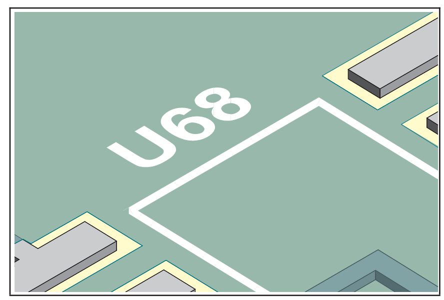
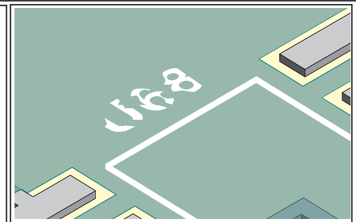



**Figure 2 Completed legend repair.**

**NOTES**

| | | |
|---|---|---|
| IPC<br>**7711/7721**<br>Rework, Modification and Repair of Electronic Assemblies | Revision: **B** Number: **2.7.3**<br>Date: **11/07**<br><br>**Legend/Marking, Stencil Method** | <br>Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Intermediate<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |



# Legend/Marking, Stencil Method

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method can be used to add, change or replace legend and markings on printed boards or printed board assemblies. This method uses epoxy ink and a brush or roller technique. A stencil is used to outline the characters.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Knife |
| Cleaning Wipes | Microscope |
| Epoxy Ink | Oven |
| Ink Plate | Stencil |
| Ink Roller | |

## PROCEDURE

1. Clean the area.
2. Scrape off any remaining character or legend with a knife and clean the area.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
3. Select the appropriate stencil or have a special stencil made up. (See Figure 1.)
4. Mix the epoxy ink. White is the most common color. Spread a thin even coating of the epoxy ink on the ink plate or on a smooth surface.
5. Position the stencil on the printed circuit board surface and hold in place firmly.
6 Roll or brush the ink onto the stencil. Do not smudge characters or apply excess ink.
7. Cure the epoxy ink per the manufacturer's instructions.

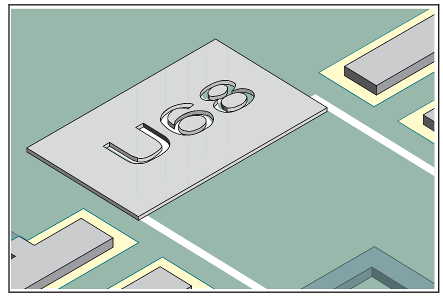



**Figure 1 Replace legend using a stencil.**

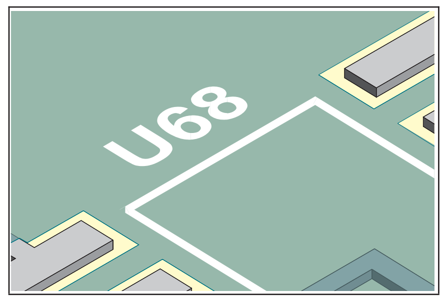



**Figure 2 Completed legend repair.**

**INSPECTION GUIDANCE**

1. Visual examination for proper characters, positioning, and legibility.
2. Marking ink is cured and resists:
   a. Smearing
   b. Chipping
   c. Powdering
   d. Cleaning processes

**NOTES**

# Tip Care and Maintenance

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

When hand soldering, proper tip care is essential to not only help increase the life of the tip, but to insure that the best possible connections are being created. Improper tip care or practices can lead to cold solder joints, thermal shock to the board and components, and cause damage to the pads or PCB laminate.

The following actions will help to form acceptable solder connections and extend the life of soldering tools.

Select the lowest possible tip temperature, temperature module or other control method that allows the operator to successfully reflow solder in the connection being formed. High temperatures and incorrect use reduce tip life.

Tips should be cleaned and tinned before replacing in the holder.

Select a tip geometry that fits the component leads and pads being soldered. The tip geometry chosen should provide the greatest amount of contact area with the land and lead to reduce dwell time while forming the connection.

Quickly wiping hot solder tips on a clean, slightly damp, sulfur-free sponge will thermally shock the tip, causing steam generated in the wiping process to remove oxidation. This should not be used to clean or remove excess solder from the tip.

Deionized water should be used to slightly dampen the sponge. Tap water may introduce chemicals and contamination to the tip and ultimately affect the solder connection.

Dirty sponges should be safely discarded as they may have gathered chemicals, lead-bearing alloys or other substances sometimes considered hazardous.

Brass brushes and coiled brass wire maybe used to remove excess solder and other contamination prior to wiping on a damp sponge.

Use as little force as possible when soldering. Friction causes the tips to wear. The more a tip is used, the greater the wear.

Soldering systems should be turned off when not in use, especially if there is no automatic idle-down when the hand-piece is placed in a holder. A good guideline is to turn soldering systems off when they are not expected to be used for a period of at least 10 minutes.

Feed solder to the connection; it should not be fed directly to the tip.

Tips should not be used as levers, pry bars or screwdrivers as this will crack the plating, reduce life of the tip and will even cause some kinds of tips to stop operating. Bending a tip with pliers will also damage the plating and cause the tip to fail.

If the tip is a cartridge type tip remove it with the manufacturer's recommended tool. Pliers and other inappropriate tools can damage the internal circuitry of the tip cartridge.

| | |
|---|---|
| Number: **2.8** | Subject: **Tip Care and Maintenance** |
| Revision: **B**<br>Date: 11/07 | |

**NOTES**

IPC

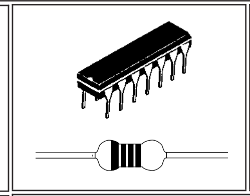
7711
Rework

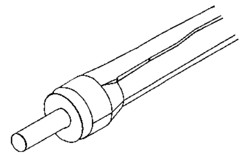
Revision: **B**
Date: 11/07

Number: **3.1.1**

# Through-Hole Desoldering

## Continuous Vacuum Method





Board Type: R, F, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Continuous vacuum desoldering system
Desoldering tip
Damp sponge

### OPTIONAL EQUIPMENT

N/A

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install thermal drive desoldering tip handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder connections (optional).
5. Clean the tip, Procedure 2.8.
6. Tin tip with solder.
7. Lower tip contacting solder connection. (See Figure 1.)
8. Confirm complete solder melt of contacted lead. (See Figure 2.)

   **NOTE**

   Auxiliary heating may be required on solder joints with a large thermal mass. This is most common on multilayer PC boards.
9. For a flat lead, move lead back and forth; for a round lead, use a circular motion and apply vacuum while continuing lead movement. (See Figures 3 & 4.)
10. Lift tip from lead, hold vacuum for sufficient time to clear all molten solder from heater chamber. (See Figure 5.)
11. Repeat for all solder connections.
12. Re-tin tip end with solder and return handpiece to its stand.

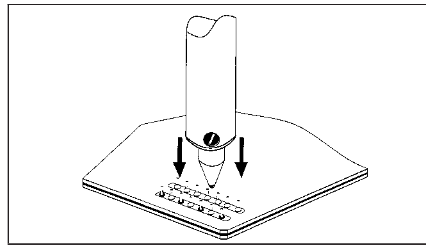


**Figure 1 Position Tip**

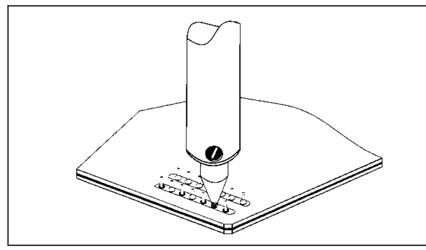


**Figure 2 Melt Solder**

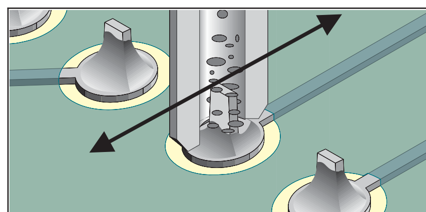



**Figure 3 Move Lead & Apply Vacuum**

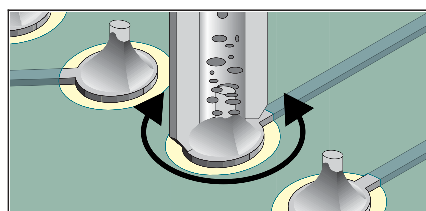



**Figure 4 Move Lead & Apply Vacuum**

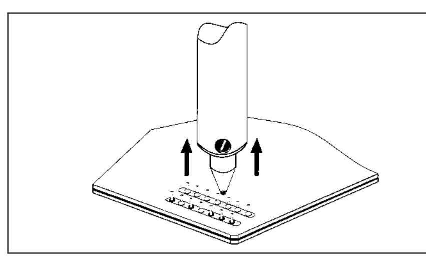


**Figure 5 Lift Handpiece**

13. Clean lands as required for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

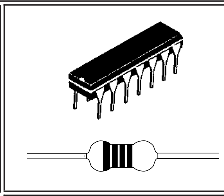
**7711**
Rework

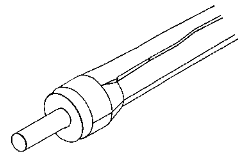
Revision: **B**
Date: 11/07

Number: **3.1.2**

# Through-Hole Desoldering

## Continuous Vacuum Method – Partial Clinch





Board Type: R, F, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Continuous vacuum desoldering system
Desoldering tip
Damp sponge

### OPTIONAL EQUIPMENT

N/A

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### NOTE

On multileaded devices a skipping/alternating pattern may be needed to reduce heat buildup.

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install desoldering tip handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder connections (optional).
5. Clean the tip, Procedure 2.8.
6. Tin tip with solder.
7. Lower tip contacting solder connection.
8. Confirm complete solder melt of contacted lead and gently straighten the lead to a vertical position. (See Figure 1.)
9. For a flat lead, move lead back and forth; for a round lead, use a circular motion and apply vacuum while continuing lead movement. (See Figures 2 & 3.)
10. Lift tip from lead, hold vacuum for sufficient time to clear all molten solder from heater chamber. (See Figure 4.)
11. Repeat for all solder connections.

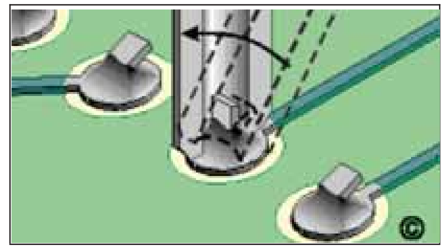


**Figure 1**

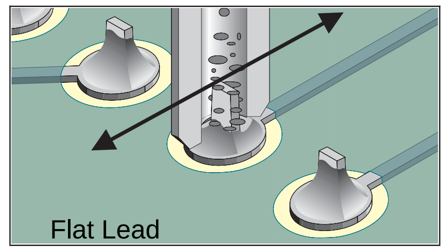



**Figure 2**

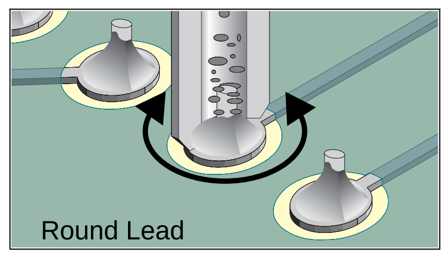



**Figure 3**

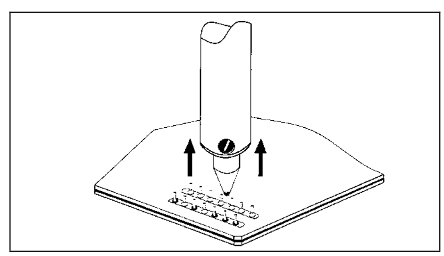


**Figure 4**

12. Re-tin tip end with solder and return handpiece to its stand.
13. Clean lands as required for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

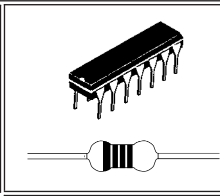
7711
Rework

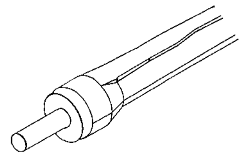
Revision: **B**
Date: 11/07

Number: **3.1.3**

# Through-Hole Desoldering

## Continuous Vacuum Method – Full Clinch





Board Type: R, F, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Continuous vacuum desoldering system
Desoldering tip
Damp sponge
Non-metallic tool (wood stick or spudger)
Flat nose pliers

### OPTIONAL EQUIPMENT

N/A

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### NOTES

On multileaded devices a skipping/alternating pattern may be needed to reduce heat buildup.

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install desoldering tip handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder connections (optional).
5. Clean the tip, Procedure 2.8.
6. Tin tip with solder.
7. Lower tip contacting solder connection.
8. Confirm complete solder melt of contacted lead and apply vacuum. (See Figure 1.)
9. Lift tip from lead, hold vacuum for sufficient time to clear all molten solder from heater chamber.

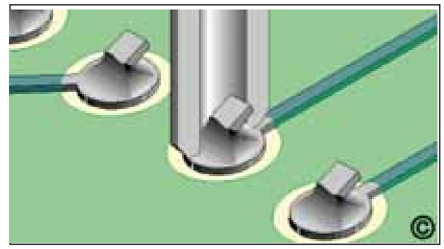


**Figure 1**

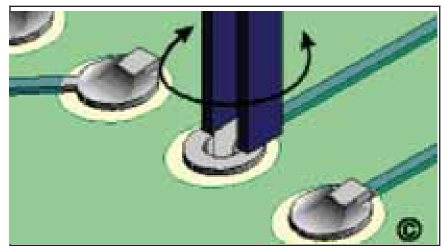


**Figure 2**

**Figure 3**

10. Inspect connection to ensure only a small amount of solder remains between lead and land area.

    **NOTE:** If excess solder exists use wicking braid and iron to remove solder. (See 3.1.5.)

11. Using a Flat Nose pliers gently rotate the lead laterally until the joint separates. (See Figure 2.)
12. Lift lead with wood stick to vertical position. (See Figure 3.)
13. Repeat for all solder connections.
14. Re-tin tip end with solder and return handpiece to its stand.
15. Clean lands as required for component replacement.
16. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

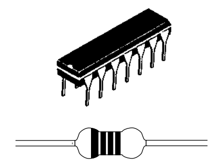
7711
Rework

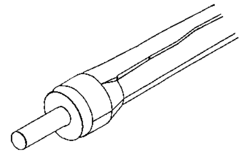
Revision: B
Date: 11/07

Number: **3.1.4**

# Through-Hole Desoldering

## Full Clinch Straightening Method





Board Type: R, F, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

| | |
|---|---|
| Soldering Iron | Damp sponge |
| Continuous vacuum desoldering system | Non-metallic tool (wood stick or spudger) |
| Desoldering tip | Flat nose pliers |
| Chisel tip | |

### OPTIONAL EQUIPMENT

N/A

### MATERIALS

| | |
|---|---|
| Flux-cored solder | Cleaner |
| Flux | Tissue/wipes |

**NOTE:** On multileaded devices a skipping/alternating pattern may be needed to reduce heat buildup.

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install soldering iron tip and desoldering tip into handpieces.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder connections (optional).
5. Clean the tip, Procedure 2.8.
6. Lower soldering iron tip contacting solder connection. (See Figure 1.)
7. Confirm complete solder melt of contacted lead
8. Lift lead with a non-metallic tool to the vertical position. (See Figure 2.)
9. Lower desoldering tip contacting solder connection.
10. Confirm complete solder melt of contacted lead.
11. For a flat lead, move lead back and forth; for a round lead, use a circular motion and apply vacuum while continuing lead movement. (See Figures 3 & 4.)
12. Lift tip from lead, hold vacuum for sufficient time to clear all molten solder from heater chamber.
13. Repeat for all solder connections.

Figure 1

Figure 2

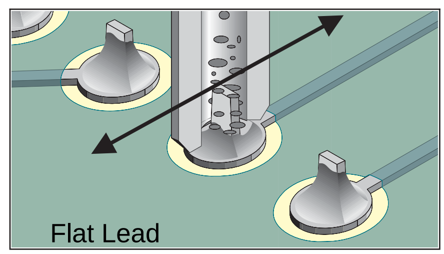




Figure 3

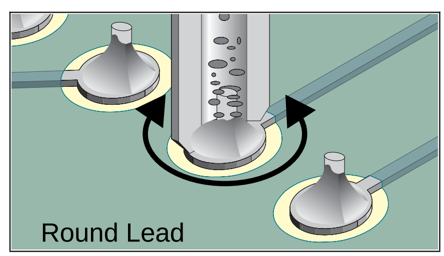




Figure 4

14. Re-tin tip end with solder and return handpiece to its stand.
15. Clean lands as required for component replacement.
16. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

# Through-Hole Desoldering

## Full Clinch Wicking Method

Board Type: R, F, W
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering iron
Chisel tip
Damp sponge
Non-metallic tool (wood stick or spudger)
Wicking braid

### OPTIONAL EQUIPMENT

N/A

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### NOTE

On multileaded devices a skipping/alternating pattern may be needed to reduce heat buildup.

### CAUTION

This procedure is not recommended for the removal of solder in plated-through holes due to the risk of conductor damage. This method should only be used when no other method exists. Wicking is most affective on surface solder only.

### CAUTION

Trim the wicking braid to prevent damage to other land areas or components.

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install soldering iron tip in handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder connections (optional).
5. Clean the tip, Procedure 2.8.

**Figure 1**

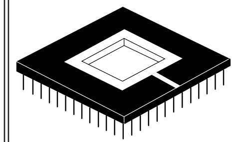
**Figure 2**

6. Apply braid material to lead land junction. (See Figure 1.)
7. Lower tip contacting braid material connection.
8. Observe solder wicking into the braid material.

   **NOTE:** Once solder stops wicking into the braid material remove the iron and braid material immediately.
9. Remove tip and braid material.
10. Confirm complete solder removal from area.
11. Lift lead with a non-metallic tool to the vertical position. (See Figure 2.)
12. Repeat for all solder connections.
13. Re-tin tip end with solder and return handpiece to its stand.
14. Clean lands as required for component replacement.
15. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

| | | | |
|---|---|---|---|
| IPC 7711 Rework | Revision: B Date: 11/07 Number: **3.2.1** | | |
| **PGA and Connector Removal** | | | |
| **Solder Fountain Method** | | | |



Board Type: R, F, W, C
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Solder fountain
Chimney or nozzle to match part
Removal tool
Pallet to hold board over fountain
Preheat oven

## OPTIONAL EQUIPMENT

Vacuum pick-up tool

## MATERIALS

Flux-cored solder
Cleaner
Heat resistant, antistatic gloves
Protective face gear
Heat resistant tape

## PROCEDURE

This process is for experienced operators only. Caution must be exercised due to working with hot, molten solder.

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Set solder fountain pot control to the required temperature for removing that particular component from that particular board. Wait until solder pot reaches the set temperature.
3. Attach the correct nozzle or chimney to the solder pot. (See Figure 1.)
4. Set the timer for the amount of time the fountain is to be running for that particular part.
5. The area around the rework site may be masked with a high temperature resistant tape, or similar material, to protect the adjacent area during rework. (See Figure 2.)
6. Preheat the board to the desired temperature, depending on the component restrictions and the board $T_g$ material.
7. Flux the bottom side site where the part will be removed. (See Figure 2.)
8. Place the board on the pallet over the solder fountain and trip the timer. (See Figure 3.)

**Figure 1 Attach Nozzle**

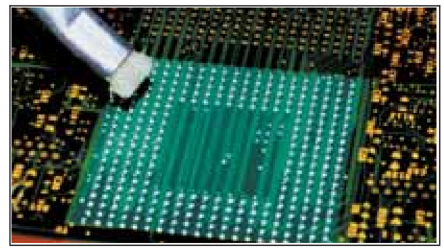


**Figure 2 Flux**

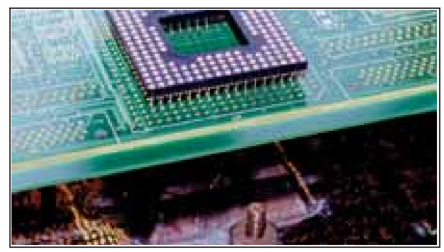


**Figure 3 Place Over Solder Fountain**

9. At the end of the timer cycle, use vacuum pickup tool, tweezers, or removal tool to remove the part from the board.
10. Clean the flux residue, if required, and inspect.
11. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

IPC

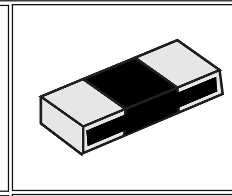
7711
Rework

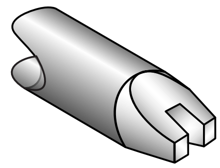
Revision: **B**
Date: 11/07

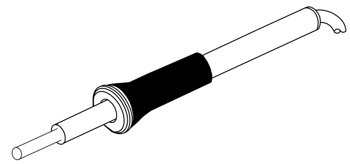
Number: **3.3.1**

# Chip Component Removal

**Bifurcated Tip**







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering system
Chip removal tip
Soldering handpiece

## OPTIONAL EQUIPMENT

Tweezers
Controllable preheater

## MATERIALS

Flux-cored solder
Flux
Cleaner

## PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install the chip removal tip into the soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Apply solder to inside of tip forming a crown. (See Figure 2.)
7. Lower tip over component until tip contacts solder joints. (See Figure 3.)
8. Confirm solder melt and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)

   **NOTE:** Chip components may have adhesive between the body and the board. If adhesive is used, it may be necessary to slightly turn the component to allow the component to be removed from the board. This must only be accomplished after complete solder melt to prevent damage.
9. Release component from tip by wiping on a heat resistant surface.
10. Re-tin tip with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

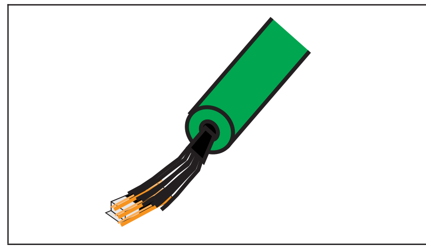


**Figure 1 Apply Flux**

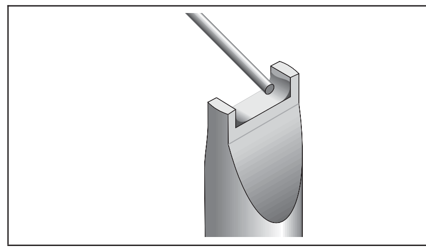


**Figure 2 Tin Tips**

**Figure 3 Position Tip**

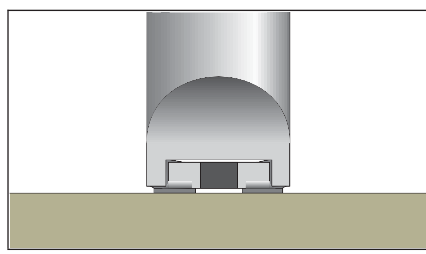


**Figure 4 Melt All Joints**

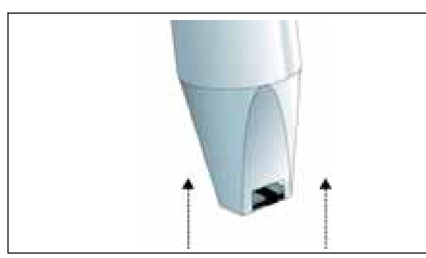


**Figure 5 Lift Component**

**NOTES**

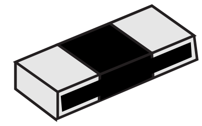
**7711**
Rework

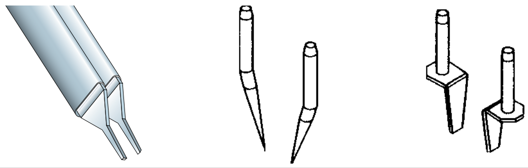
Revision: **B**
Date: 11/07

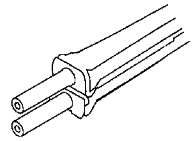
Number: **3.3.2**

# Chip Component Removal

## Tweezer Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Chip removal tips
Tweezer handpiece

### MATERIALS

Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install chip removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to the component terminations. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Lower tips over component and squeeze handpiece to contact both solder joints. (See Figure 2.)
7. Confirm complete solder melt of both joints and lift component from PCB. (See Figures 3 & 4.)

   **NOTE:** Chip components may have adhesive between the body and the board. If adhesive is used, it may be necessary to slightly turn the component to allow the component to be removed from the board. This must only be accomplished after complete solder melt to prevent damage.
8. Release component onto a heat resistant surface.
9. Prepare lands for component replacement.
10. Clean as applicable and inspect to established workmanship requirements.

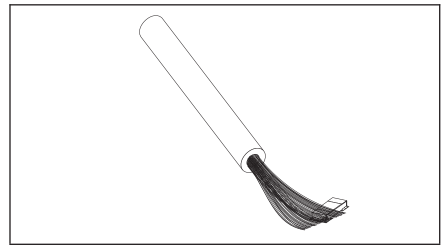


**Figure 1 Flux Component**

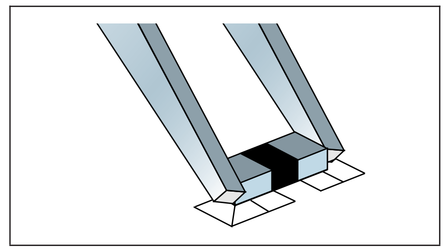


**Figure 2 Position Tip**

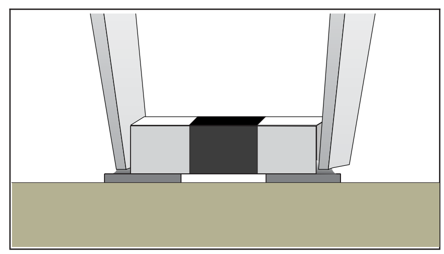


**Figure 3 Melt Joints**

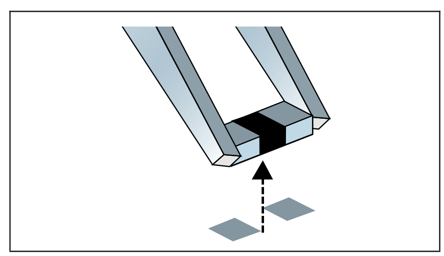


**Figure 4 Lift Component**

**NOTES**

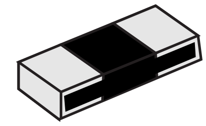
7711
Rework

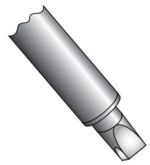
Revision: B
Date: 11/07

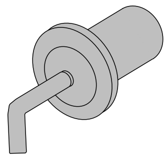
Number: **3.3.3**

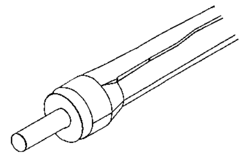
# Chip Removal (bottom termination)

## Hot Air Method









Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Hot air pencil
Hot air tip
Tweezers

### MATERIALS

Flux
Cleaner
Tissue/wipe

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install tip into hot air pencil.
3. Set heater temperature to approximately 315°C and change as necessary.
4. Apply flux to component terminations. (See Figure 1.)
5. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the part or causing board, component, or conductor damage, etc. For additional information see manufacturer's instructions.
6. Direct hot air over component with tip at a distance of 0.5 cm until complete solder melt is observed. (See Figure 2.)
7. Lift component from PCB. (See Figure 3.)

   **NOTE:** Chip components may have adhesive between the body and the board. If adhesive is used, it may be necessary to slightly turn the component to allow the component to be removed from the board. This must only be accomplished after complete solder melt to prevent damage.
8. Release component onto a heat resistant surface.
9. Prepare lands for component replacement.
10. Clean as applicable and inspect to established workmanship requirements.

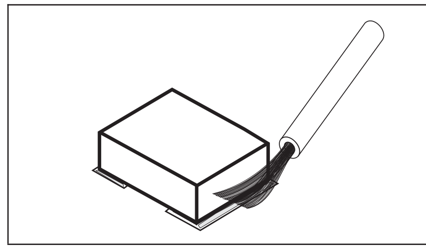


**Figure 1 Flux Component**

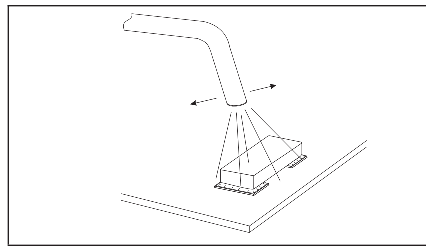


**Figure 2 Melt Joints**

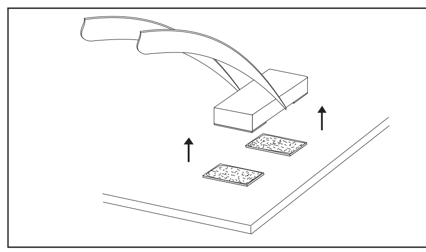


**Figure 3 Lift Component**

**NOTES**

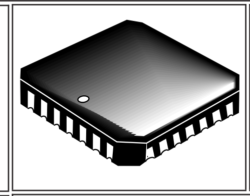
7711
Rework

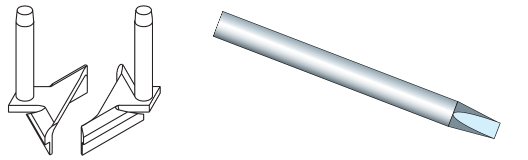
Revision: **B**
Date: 11/07

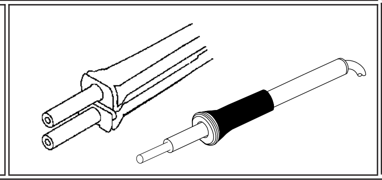
Number: **3.4.1**

# Leadless Component Removal

## Solder Wrap Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Soldering handpiece
Removal tips
Chisel tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the end solder joints using soldering handpiece with chisel tip installed. (See Figure 1.)
5. Wrap solder around the four sides of component.
6. Terminate solder at end of last side using soldering handpiece.
7. Clean the tip, Procedure 2.8.
8. Tin inside edges of tips with solder. (See Figure 2.)
9. Lower tips over component and squeeze handpiece. (See Figure 3.)
10. Contact ALL solder joints with tips, confirm solder melt of ALL joints, and lift component from PCB. (See Figures 4 & 5.)
11. Release component onto a heat resistant surface.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

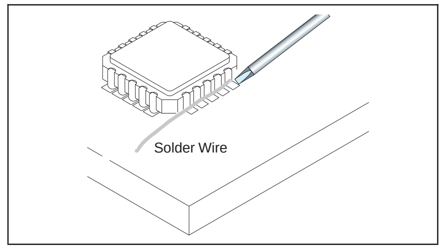



**Figure 1 Tack & Wrap**

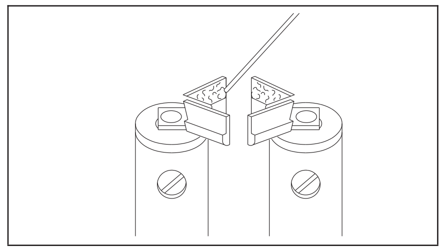


**Figure 2 Tin Tips**

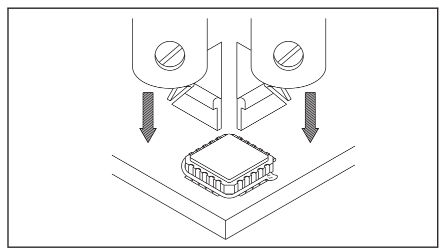


**Figure 3 Position Tip**

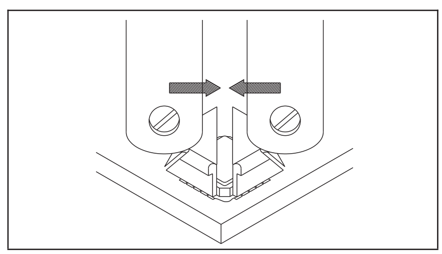


**Figure 4 Melt All Joints**

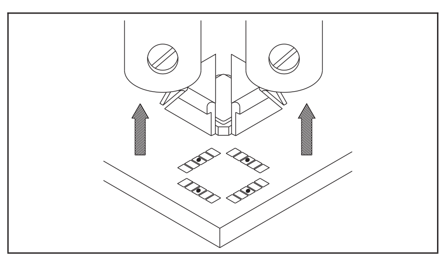


**Figure 5 Lift Component**

**NOTES**

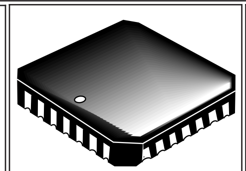
7711
Rework

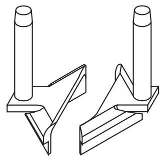
Revision: **B**
Date: 11/07

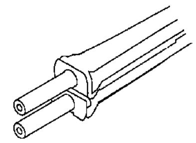
Number: **3.4.2**

# Leadless Component Removal

## Flux Application Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all solder joints. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin inside edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece. (See Figure 3.)
8. Contact ALL solder joints with tips, confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

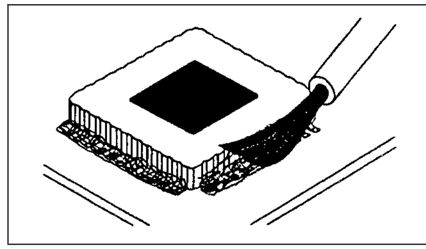


**Figure 1 Apply Flux**

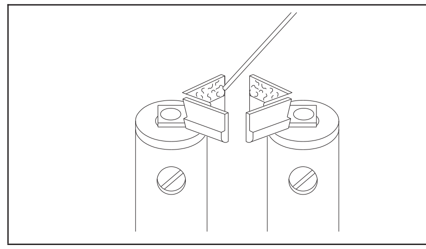


**Figure 2 Tin Tips**

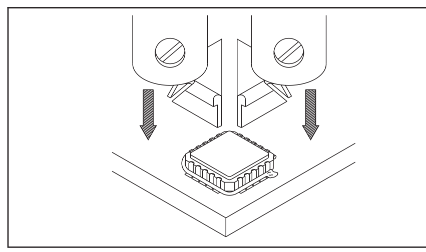


**Figure 3 Position Tips**

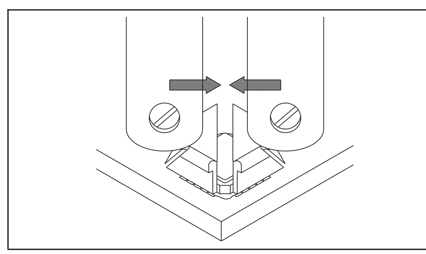


**Figure 4 Melt All Joints**

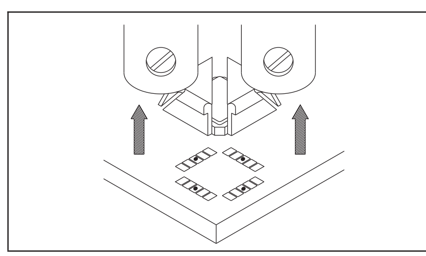
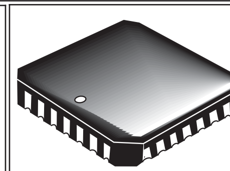
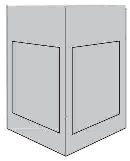


**Figure 5 Lift Component**

**NOTES**

| | | | |
|---|---|---|---|
| IPC®<br>**7711**<br>Rework | Revision: **B** Number: **3.4.3**<br>Date: 11/07<br>**Leadless Component Removal**<br>**Hot Gas (Air) Reflow Method** |  | |
|  | | Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 | |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Hot gas reflow system
Gas focusing nozzle sized to the chip
Solder removal system
Air supply
Preheater

## OPTIONAL EQUIPMENT/MATERIALS

Small oven
Nitrogen
Flux (if needed)

## PROCEDURE SUMMARY

The procedure below is generic in nature and it identifies the procedural steps needed to remove a leadless chip. The steps must also take into consideration the system being used and manufacture's recommendations.

## PROCEDURE PRECONDITIONS

1. See J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for more information on moisture sensitivity and conditioning the chip and PWB for detachment.
2. Bake the PCB (if conditions require baking) to remove the entrapped moisture which could cause measling, delamination of the board and/or popcorning of moisture sensitive components. If the component that is being removed is going to be re-used, ensure it is baked out per J-STD-033 based on its moisture sensitivity levels.

   **NOTE:** Surrounding components on both sides of the PCB may be subjected to hot air temperatures that can cause damage based on profiles and should be evaluated for required bake-out times.

| Number: **3.4.3** | Subject: **Leadless Component Removal** |
| --- | --- |
| Revision: **B**<br>Date: 11/07 | |

## PROCEDURE

**NOTE:** Some reflow systems do not come with a preheater and it maybe necessary to preheat before removing the part. An example would be with Lead-Free applications

1. Place the PCB in a workboard holder.
2. Set the hot gas reflow system to the time and temperature profile.
3. Apply flux if necessary.
4. Align the nozzle to the component location.
5. Bring the nozzle into reflow position.
6. Start the time and temperature profile cycle.
7. Using the hot gas desolder tool, extract solder from the pads at the site.
8. Clean as applicable and inspect per workmanship requirements.

## NOTES

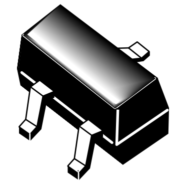
7711
Rework

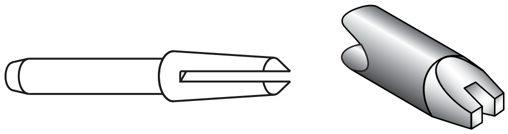
Revision: **B**
Date: 11/07

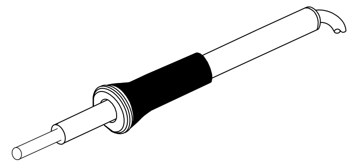
Number: **3.5.1**

# SOT Removal

## Flux Application Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tip
Soldering handpiece

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom edges of tip with solder. (See Figure 2.)
7. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
9. Release component from tip by wiping on a heat resistant surface.
10. Re-tin tip with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

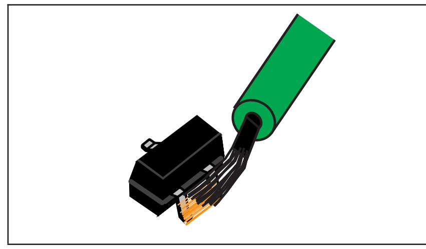


**Figure 1 Apply Flux**

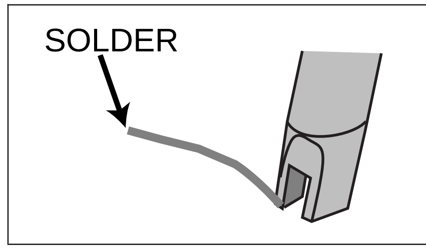



**Figure 2 Tin Tip**

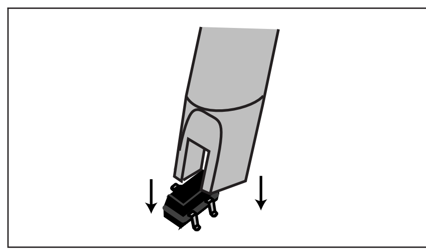


**Figure 3 Position Tip**

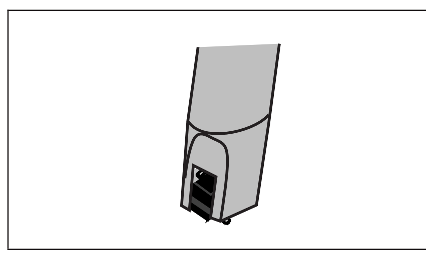


**Figure 4 Melt All Joints**

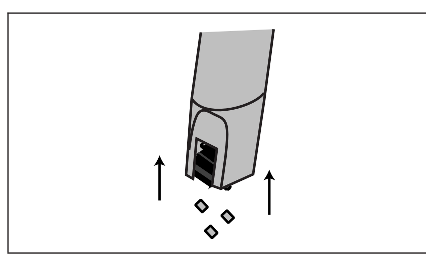


**Figure 5 Lift Component**

**NOTES**

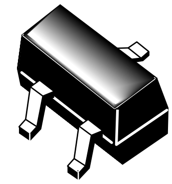
7711
Rework

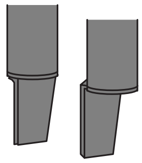
Revision: **B**
Date: 11/07

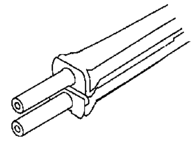
Number: **3.5.2**

# SOT Removal

## Flux Application Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tips
Tweezer handpiece

### MATERIALS

Flux
Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin tips.
7. Lower tips over component and squeeze handpiece contacting ALL leads with tips. (See Figures 2 & 3.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 3 & 4.)
9. Release component from tips by wiping on a heat resistant surface.
10. Prepare lands for component replacement.
11. Clean as applicable and inspect to established workmanship requirements.

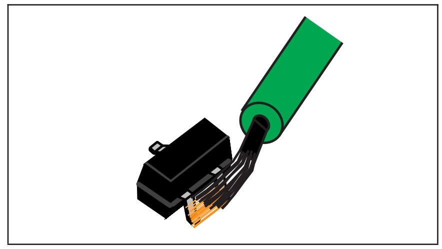


**Figure 1 Apply Flux**

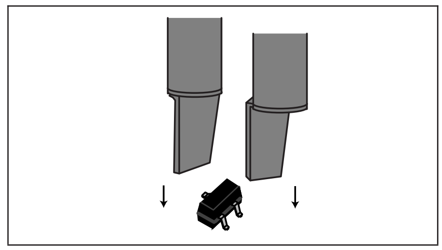


**Figure 2 Position Tips**

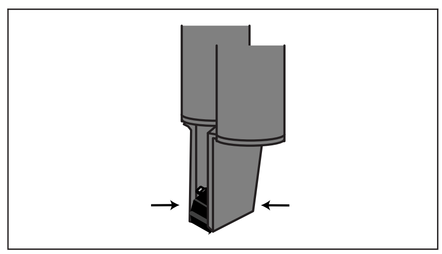


**Figure 3 Melt All Joints**

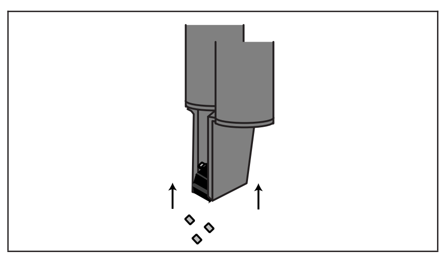


**Figure 4 Lift Component**

**NOTES**

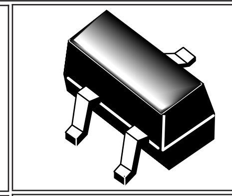
7711
Rework

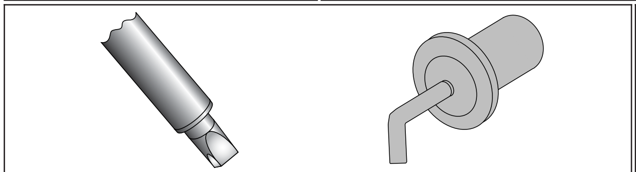
Revision: **B**
Date: 11/07

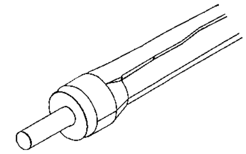
Number: **3.5.3**

# SOT Removal

## Hot Air Pencil







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Hot air pencil
Hot air tip
Tweezers

### MATERIALS

Flux-cored solder
Cleaner
Tissue/wipe
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the component or causing damage to the board, component, conductor, etc. For additional information see manufacturer's instructions.
3. Set heater temperature to approximately 315°C and change as necessary.
4. Install tip into the hot air pencil.
5. Apply flux to all lead/land areas. (See Figure 1.)
6. Position tip approximately 0.5 cm away from component. (See Figure 2.)
7. Direct hot air over component and heat until COMPLETE solder melt is observed on ALL solder joints. (See Figure 2.)
8. Grasp component with tweezers and lift away from PCB. (See Figure 3.)
9. Release component from tweezers on a heat resistant surface.
10. Prepare lands for component replacement.
11. Clean as applicable and inspect to established workmanship requirements.

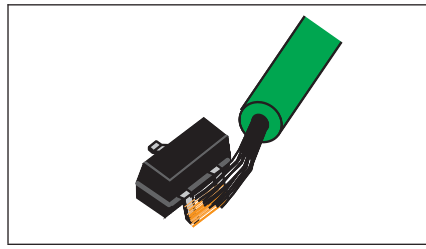


**Figure 1 Apply Flux**

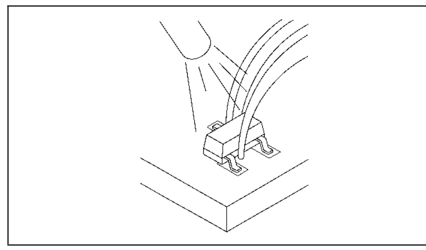


**Figure 2 Melt All Joints**

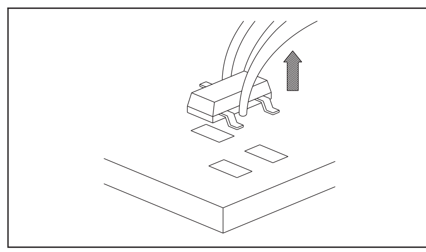


**Figure 3 Lift Component**

**NOTES**

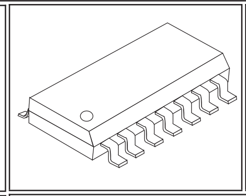
7711
Rework

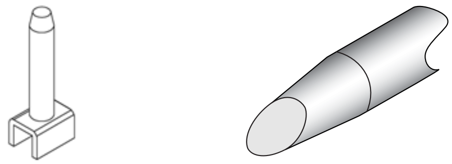
Revision: B
Date: 11/07

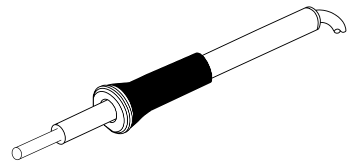
Number: **3.6.1**

# Gull Wing Removal (two-sided)

## Bridge Fill Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering handpiece
Soldering system
Removal tip
Broad surfaced tip

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install broad surface tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using soldering handpiece, melt solder to form a solder bridge fill joining all component leads. (See Figure 1.)
5. Replace broad surfaced tip in soldering handpiece with removal tip.
6. Clean the tip, Procedure 2.8.
7. Tin bottom and inside edges of tip with solder. (See Figure 2.)
8. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
10. Release component from tip by wiping on a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

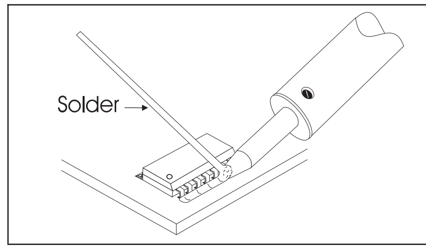



**Figure 1 Bridge Fill**

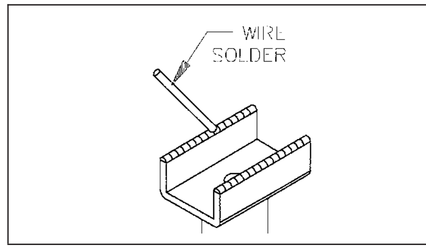



**Figure 2 Tin Tip**

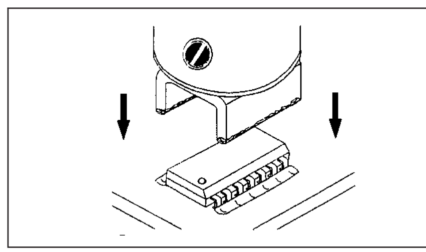


**Figure 3 Position Tip**

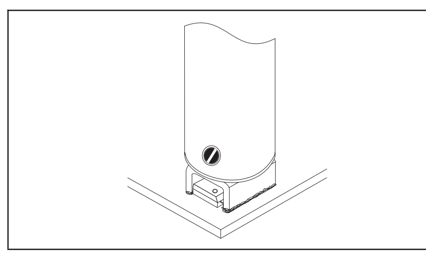


**Figure 4 Melt All Joints**

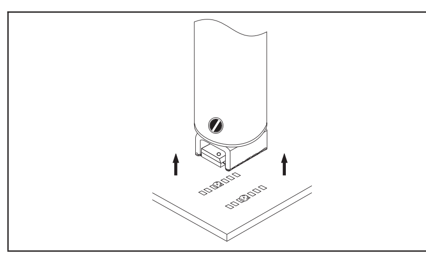


**Figure 5 Lift Components**

**NOTES**

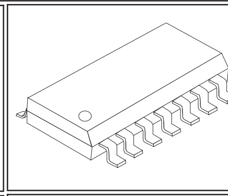
7711
Rework

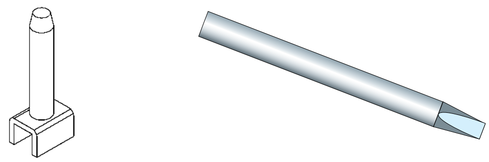
Revision: **B**
Date: 11/07

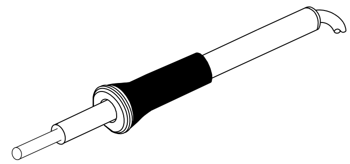
Number: **3.6.2**

# Gull Wing Removal (two-sided)

## Solder Wrap Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tip
Chisel tip
Soldering handpiece

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install chisel tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the corner component leads using the soldering handpiece with a chisel tip installed. Wrap solder around the four sides of the component. Tack solder at the end of the last side. (See Figure 1.)
5. Replace chisel tip in soldering handpiece with removal tip.
6. Clean the tip, Procedure 2.8.
7. Tin bottom and inside edges of tip with solder. (See Figure 2.)
8. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
10. Release component from tip by wiping on a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

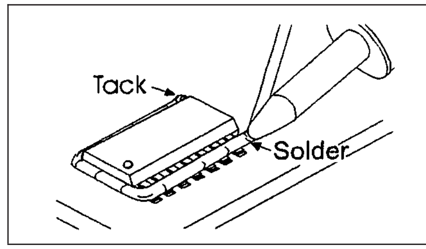



**Figure 1 Tack and Wrap Solder**

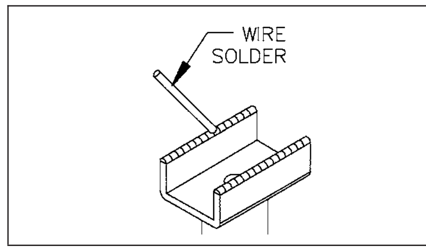



**Figure 2 Tin Tip**

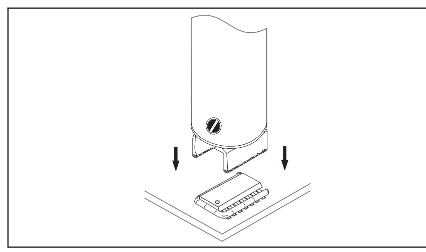


**Figure 3 Position Tip**

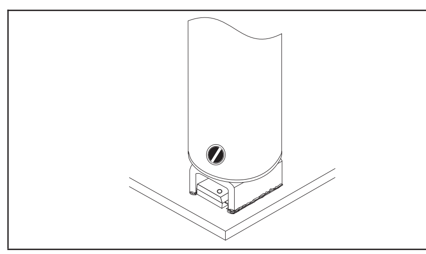


**Figure 4 Melt All Joints**

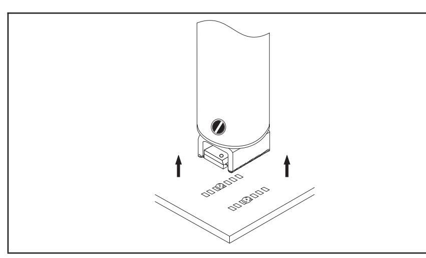


**Figure 5 Lift Component**

**NOTES**

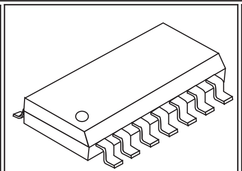
7711
Rework

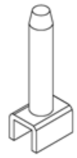
Revision: **B**
Date: 11/07

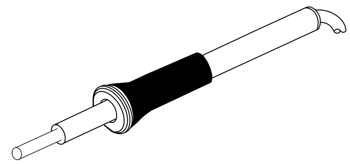
Number: **3.6.3**

# Gull Wing Removal (two-sided)

## Flux Application Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tip
Soldering handpiece

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom and inside edges of tip with solder. (See Figure 2.)
7. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
9. Release component from tip by wiping on a heat resistant surface.
10. Re-tin tip with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

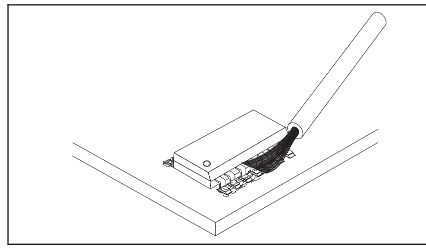


**Figure 1 Apply Flux**

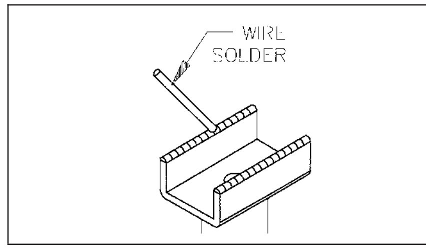



**Figure 2 Tin Tip**

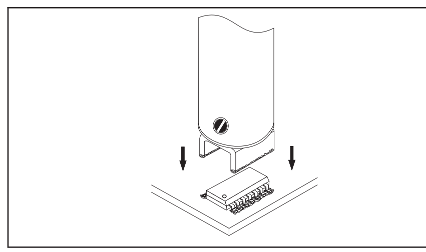


**Figure 3 Position Tip**

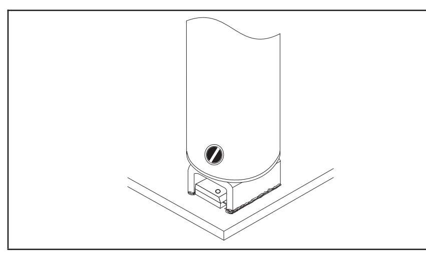


**Figure 4 Melt All Joints**

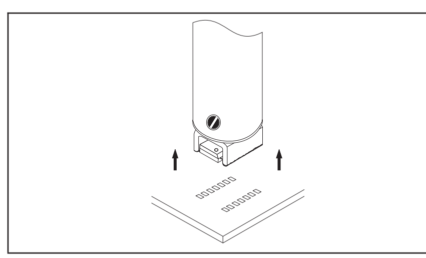


**Figure 5 Lift Components**

**NOTES**

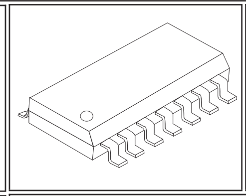
7711
Rework

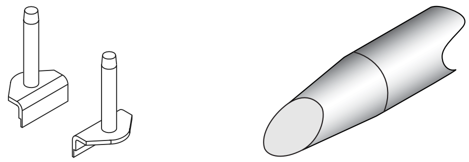
Revision: **B**
Date: 11/07

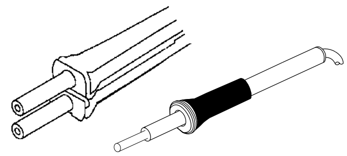
Number: **3.6.4**

# Gull Wing Removal (two-sided)

## Bridge Fill Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Broad surfaced tip
Soldering handpiece

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install broad surfaced tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using soldering handpiece, melt solder to form a solder bridge fill joining all component leads. (See Figure 1.)
5. Install removal tips into tweezer handpiece.
6. Start with tip temperature of approximately 315°C and change as necessary.
7. Clean the tip, Procedure 2.8.
8. Tin bottom and inside edges of tips with solder. (See Figure 2.)
9. Lower tips over component and squeeze handpiece contacting ALL leads with tips. (See Figure 3.)
10. Confirm solder melt of ALL joints and lift component from PCB. (See Figure 4.)
11. Release component from tips by wiping on a heat resistant surface.
12. Re-tin tips with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

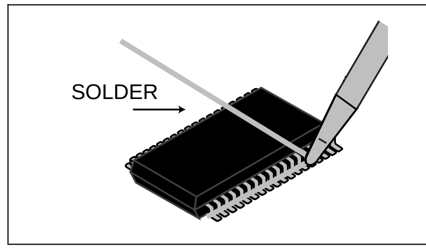



**Figure 1 Bridge Fill**

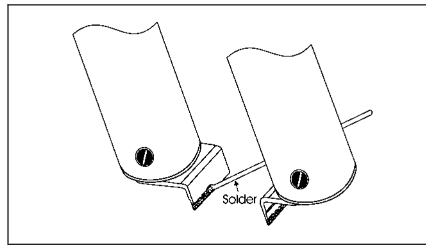



**Figure 2 Tin Tips**

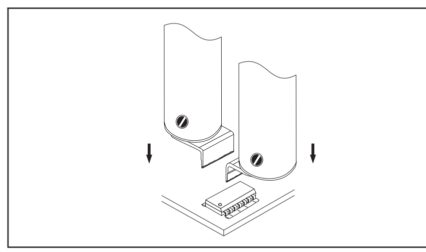


**Figure 3 Position Tips**

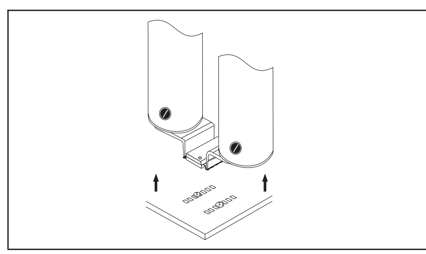


**Figure 4 Lift Component**

## NOTES

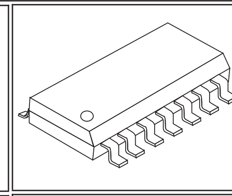
7711
Rework

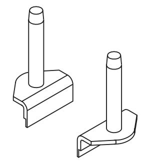
Revision: **B**
Date: 11/07

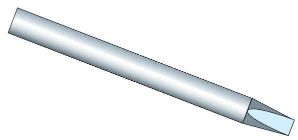
Number: **3.6.5**

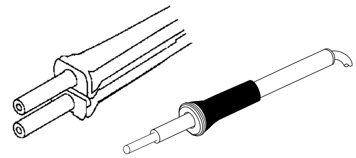
# Gull Wing Removal (two-sided)

## Solder Wrap Method – Tweezer









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips
Chisel tip
Soldering handpiece

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install chisel tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the corner component leads using the soldering handpiece with a chisel tip installed. Wrap solder around the four sides of the component. Tack solder at the end of the last side. (See Figure 1.)
5. Install removal tips into tweezer handpiece.
6. Start with tip temperature of approximately 315°C and change as necessary.
7. Clean the tip, Procedure 2.8.
8. Tin bottom and inside edges of tips with solder. (See Figure 2.)
9. Lower tips over component and squeeze handpiece contacting ALL leads with tips. (See Figure 3.)
10. Confirm solder melt of ALL joints and lift component from PCB. (See Figure 4.)
11. Release component from tips by wiping on a heat resistant surface.
12. Re-tin tips with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

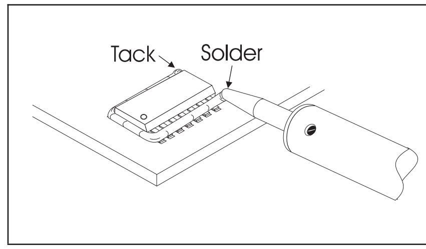



**Figure 1 Tack Solder**

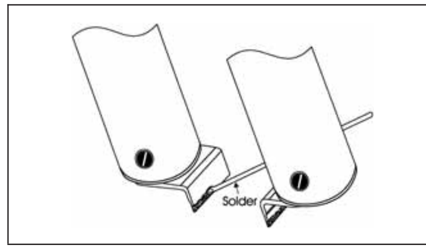



**Figure 2 Tin Tips**

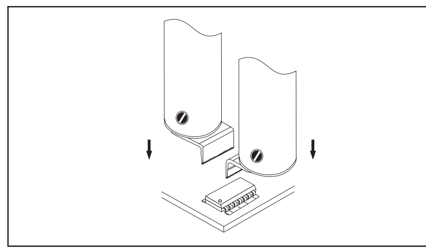


**Figure 3 Position Tips**

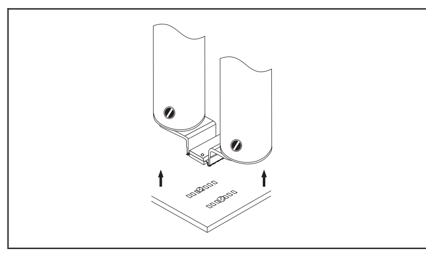


**Figure 4 Lift Component**

## NOTES

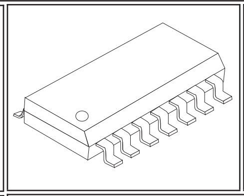
7711
Rework

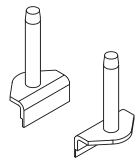
Revision: **B**
Date: 11/07

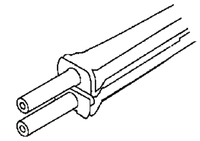
Number: **3.6.6**

# Gull Wing Removal (two-sided)

## Flux Application Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom and inside edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece contacting ALL leads with tips. (See Figure 3.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figure 4.)
9. Release component from tips by wiping on a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

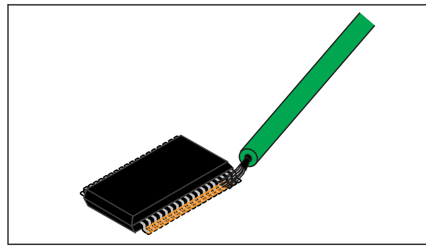


**Figure 1 Apply Flux**

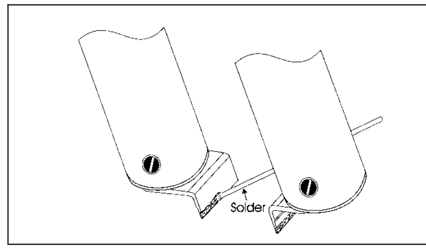



**Figure 2 Tin Tips**

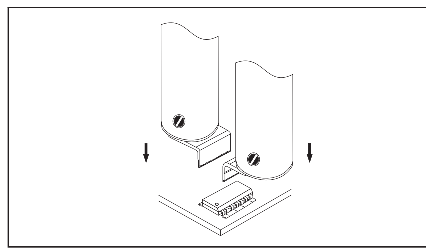


**Figure 3 Position Tips**

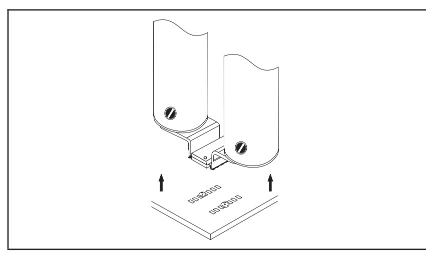


**Figure 4 Lift Component**

**NOTES**

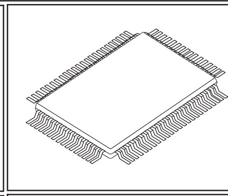
7711
Rework

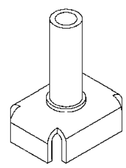
Revision: **B**
Date: 11/07

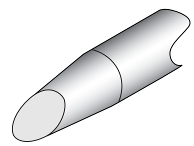
Number: **3.7.1**

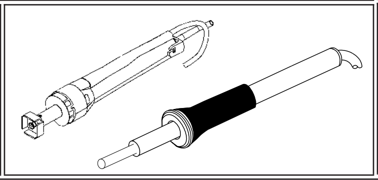
# Gull Wing Removal (four-sided)

## Bridge Fill Method – Vacuum Cup









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Vacuum handpiece
Removal tip
Broad surfaced tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install broad-surface tip.
3. Install vacuum cup onto vacuum tube of handpiece.
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Install removal tip.
6. Using soldering handpiece, melt solder to form a solder bridge fill joining all component leads. (See Figure 1.)
7. Clean the tip, Procedure 2.8.
8. Tin bottom edge of tip with solder. (See Figure 2.)
9. Gently lower tip over component, contacting ALL leads. (See Figures 3 & 4.)
10. Confirm solder melt of ALL joints, actuate vacuum and lift component from PCB. (See Figures 4 & 5.)
11. Release component onto a heat resistant surface.
12. Re-tin tip with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

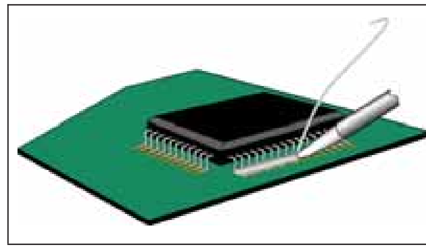


**Figure 1 Bridge Fill**

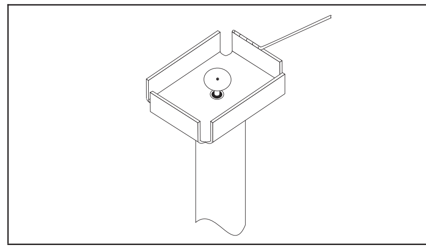


**Figure 2 Tin Tip**

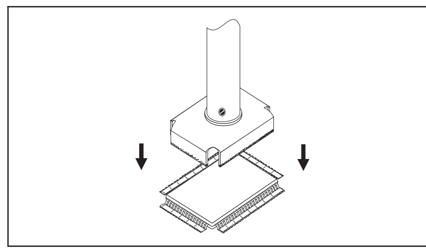


**Figure 3 Position Tip**

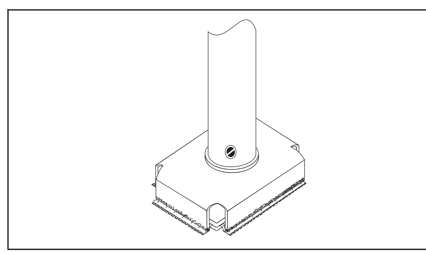


**Figure 4 Melt all Joints**

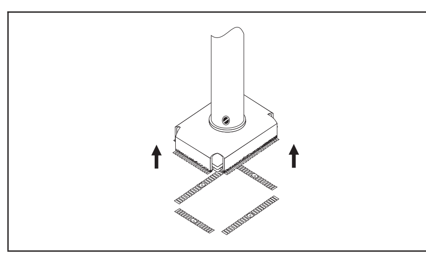


**Figure 5 Lift Component**

**NOTES**

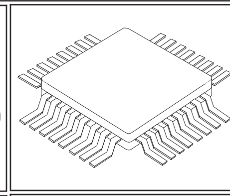
7711
Rework

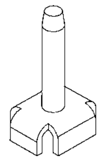
Revision: **B**
Date: 11/07

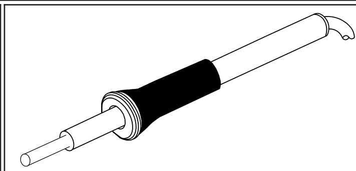
Number: **3.7.1.1**

# Gull Wing Removal (four-sided)

## Bridge Fill Method – Surface Tension







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Removal tip
Broad surface tip

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install broad surfaced tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using soldering handpiece, melt solder to form a solder bridge fill, joining all component leads. (See Figure 1.)
5. Replace broad surfaced tip in soldering handpiece with removal tip.
6. Clean the tip, Procedure 2.8.
7. Tin bottom and inside edges of tip with solder. (See Figure 2.)
8. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
10. Release component from tip by wiping on a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

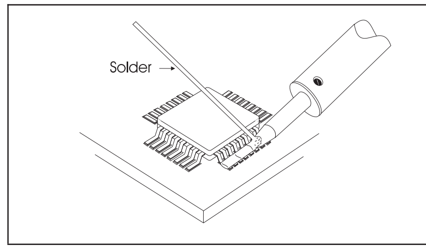



**Figure 1 Bridge Fill**

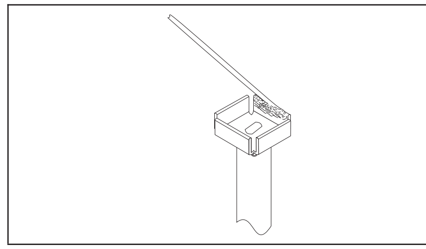


**Figure 2 Tin Tip**

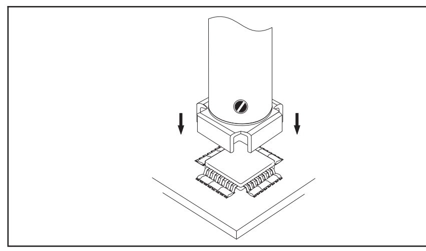


**Figure 3 Position Tip**

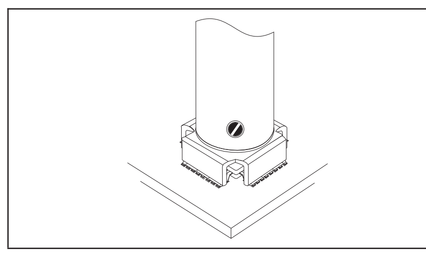


**Figure 4 Melt All Joints**

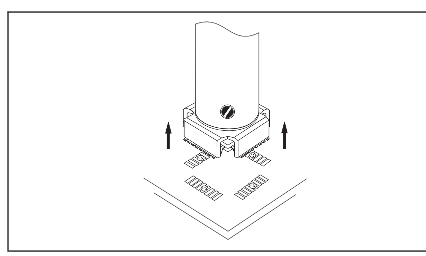


**Figure 5 Lift Component**

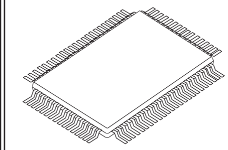
**NOTES**

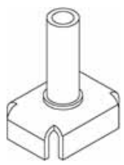
7711
Rework

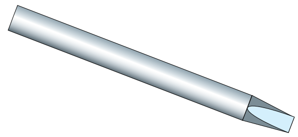
Revision: **B**
Date: 11/07
Number: **3.7.2**

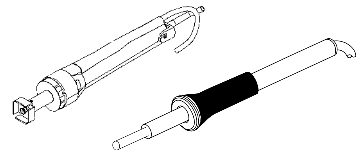
# Gull Wing Removal (four-sided)

## Solder Wrap Method – Vacuum Cup









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Vacuum handpiece
Removal tip
Chisel tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip.
3. Install vacuum cup onto vacuum tube of handpiece.
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Tack solder to one of the corner component leads using the soldering handpiece with a chisel tip installed. Wrap solder around the four sides of the component. Tack solder at the end of the last side. (See Figure 1.)
6. Clean the tip, Procedure 2.8.
7. Tin bottom edge of the tip with solder. (See Figure 2.)
8. Gently lower tip over component, contacting ALL the leads. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints, actuate vacuum and lift component from PCB. (See Figures 4 & 5.)
10. Release component onto a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

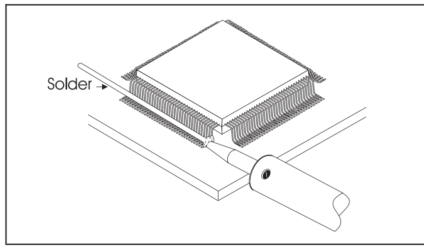



**Figure 1 Tack and Wrap Solder**

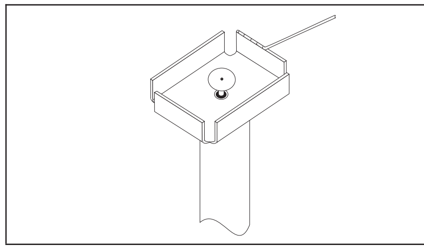


**Figure 2 Tin Tip**

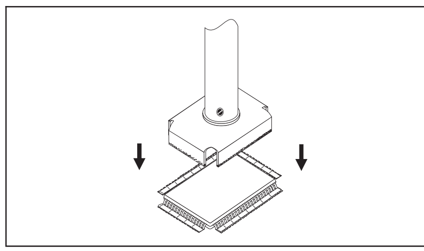


**Figure 3 Position Tip**

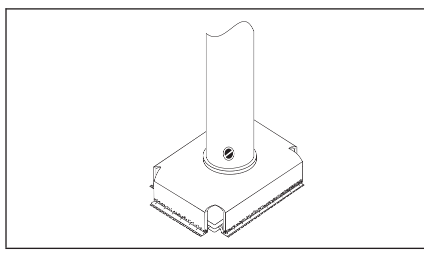


**Figure 4 Melt All Joints**

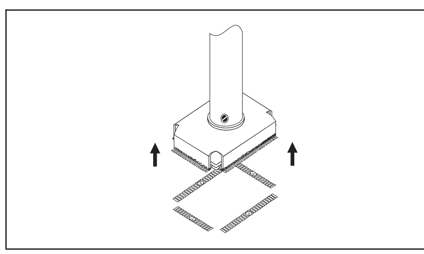


**Figure 5 Lift Component**

**NOTES**

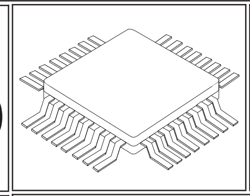
7711
Rework

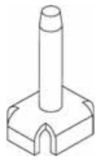
Revision: **B**
Date: 11/07

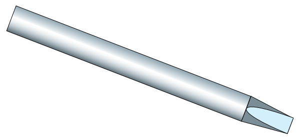
Number: **3.7.2.1**

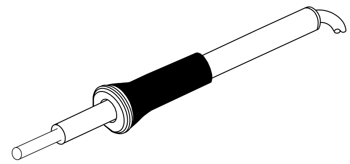
# Gull Wing Removal (four-sided)

## Solder Wrap Method – Surface Tension









Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tip
Chisel tip

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install chisel tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the corner component leads using soldering handpiece with chisel tip installed. Wrap solder around the four sides of component. Terminate solder at the end of last side using soldering handpiece. (See Figure 1.)
5. Replace chisel tip in soldering handpiece with removal tip.
6. Clean the tip, Procedure 2.8.
7. Tin bottom and inside edges of tip with solder. (See Figure 2.)
8. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints and lift component from PCB. (See Figure 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
10. Release component from tip by wiping on a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

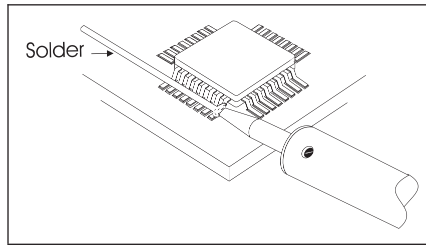



**Figure 1 Tack and Wrap Solder**

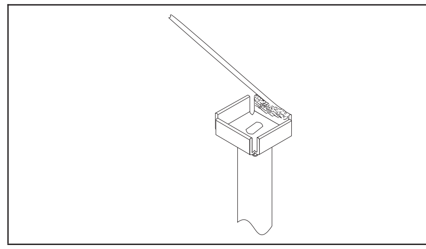


**Figure 2 Tin Tip**

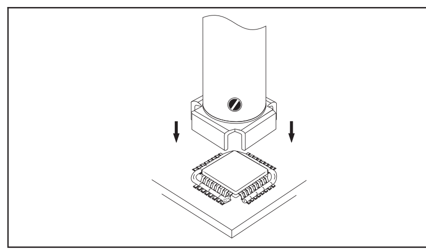


**Figure 3 Position Tip**

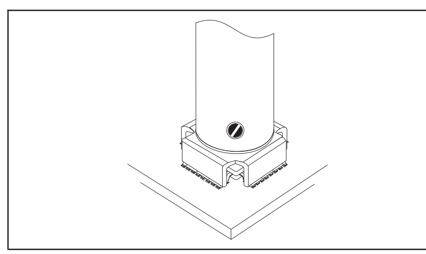


**Figure 4 Melt All Joints**

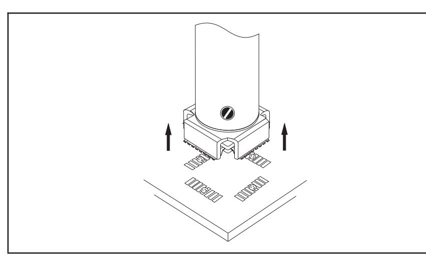


**Figure 5 Lift Component**

**NOTES**

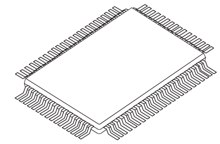
7711
Rework

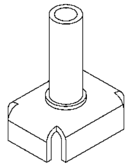
Revision: B
Date: 11/07

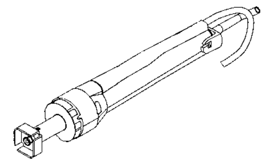
Number: **3.7.3**

# Gull Wing Removal (four-sided)

## Flux Application Method – Vacuum Cup







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Vacuum handpiece
Removal tip

### MATERIALS

Flux-cored solder
Cleaner
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip.
3. Install vacuum cup onto vacuum tube of handpiece.
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Apply flux to all lead/land areas. (See Figure 1.)
6. Clean the tip, Procedure 2.8.
7. Tin bottom edge of the tip with solder. (See Figure 2.)
8. Gently lower tip over component, contacting ALL the leads. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints, actuate vacuum and lift component from PCB. (See Figures 4 & 5.)
10. Release component onto a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

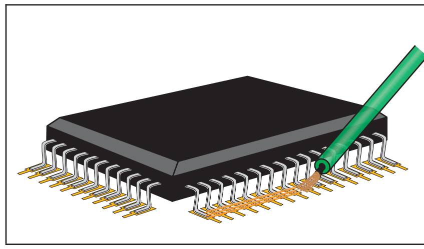


**Figure 1 Flux Component**

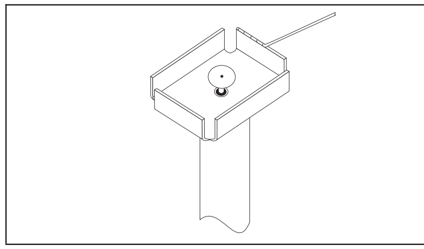


**Figure 2 Tin Tip**

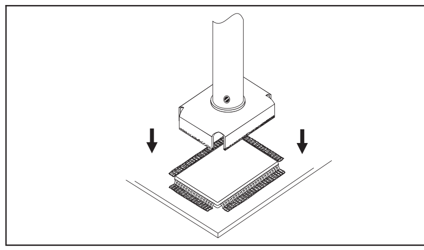


**Figure 3 Position Tip**

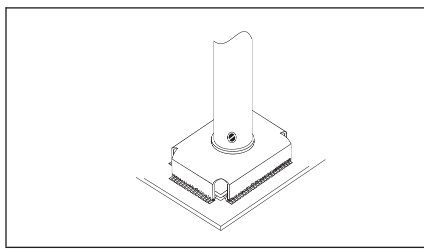


**Figure 4 Melt All Joints**

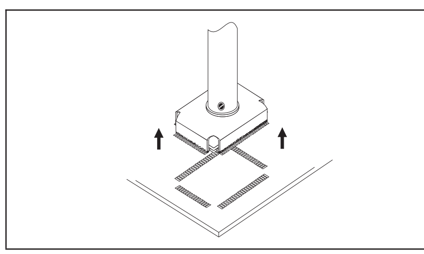


**Figure 5 Lift Component**

**NOTES**

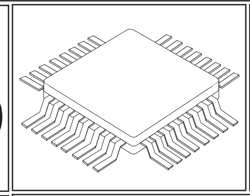
7711
Rework

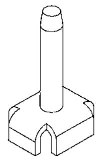
Revision: **B**
Date: 11/07

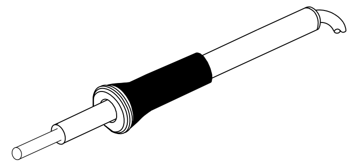
Number: **3.7.3.1**

# Gull Wing Removal (four-sided)

## Flux Application Method – Surface Tension







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Removal tip

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom and inside edges of tip with solder. (See Figure 2.)
7. Lower tip over component contacting ALL leads with tip. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.) (Surface tension of the tip should lift the component from the board. If this does not occur, use of tweezers to lift the component is optional.)
9. Release component from tip by wiping on a heat resistant surface.
10. Re-tin tip with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

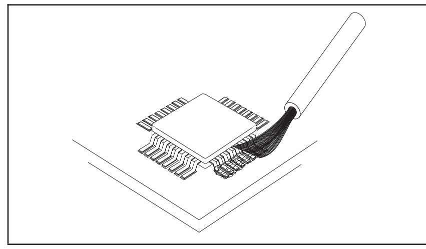


**Figure 1 Apply Flux**

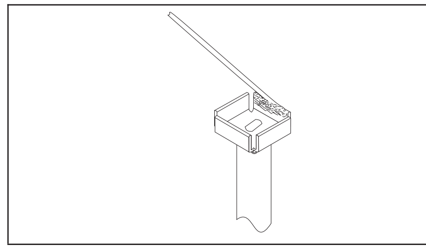


**Figure 2 Tin Tip**

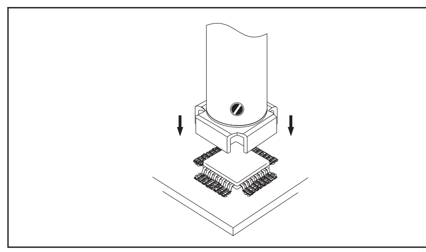


**Figure 3 Position Tip**

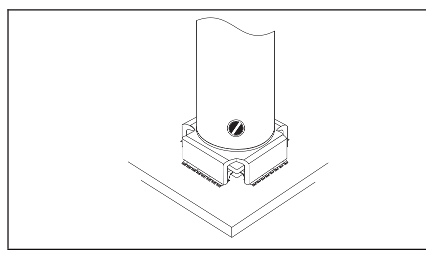


**Figure 4 Melt All Joints**

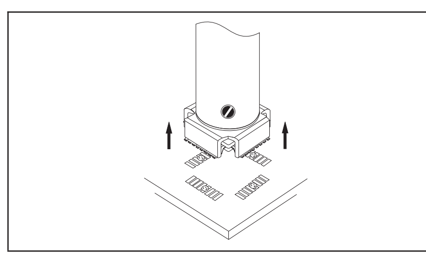


**Figure 5 Lift Component**

**NOTES**

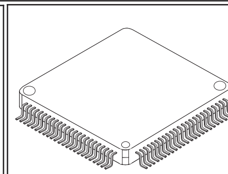
7711
Rework

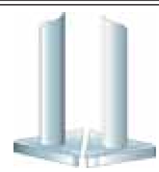
Revision: **B**
Date: 11/07

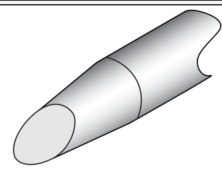
Number: **3.7.4**

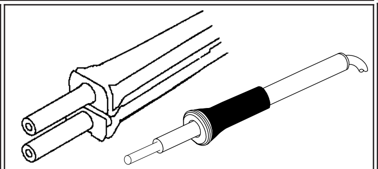
# Gull Wing Removal (four-sided)

## Bridge Fill Method – Tweezer









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering handpiece
Soldering system
Tweezer handpiece
Removal tips
Broad surfaced tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using soldering handpiece, melt solder to form a solder bridge fill, joining all component leads. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece, contacting ALL leads with tips. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

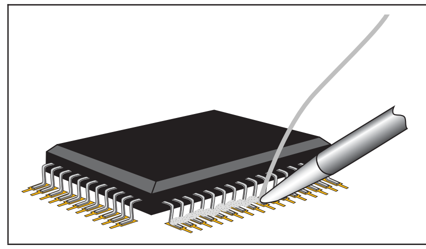


**Figure 1 Bridge Fill**

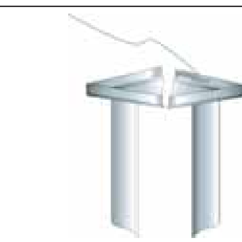


**Figure 2 Tin Tips**

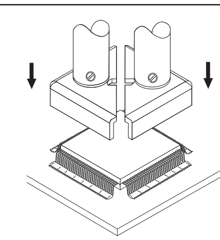


**Figure 3 Position Tips**

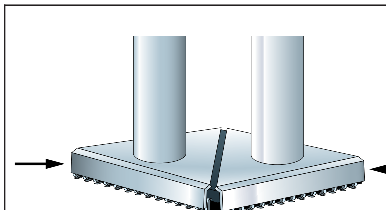


**Figure 4 Melt All Joints**

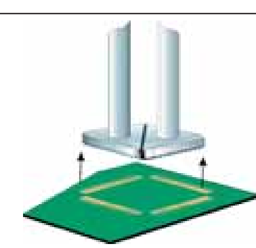


**Figure 5 Lift Component**

## NOTES

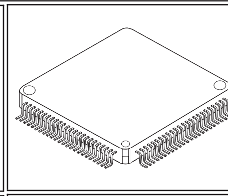
7711
Rework

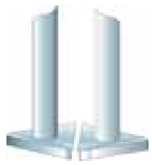
Revision: **B**
Date: 11/07

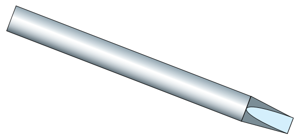
Number: **3.7.5**

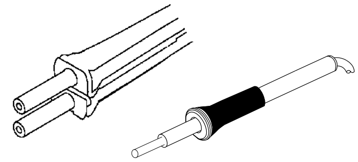
# Gull Wing Removal (four-sided)

## Solder Wrap Method – Tweezer









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering handpiece
Soldering system
Tweezer handpiece
Removal tips
Chisel tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece and chisel tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the corner component leads using the soldering handpiece with a chisel tip installed. Wrap solder around the four sides of the component. Tack solder at the end of the last side. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom and inside edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece, contacting ALL leads with tips. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

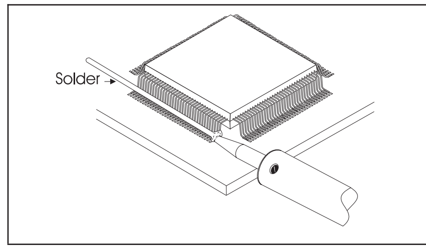



**Figure 1 Tack and Wrap Solder**

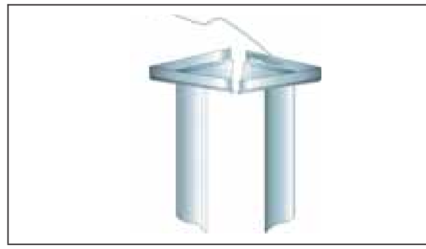


**Figure 2 Tin Tips**

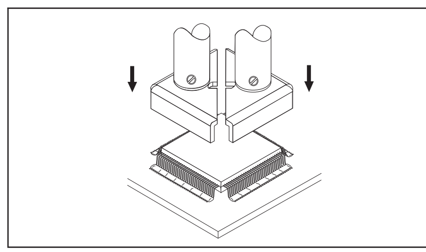


**Figure 3 Position Tips**

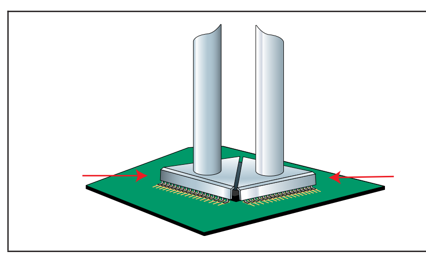


**Figure 4 Melt All Joints**

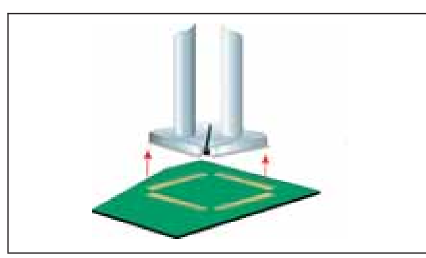


**Figure 5 Lift Component**

**NOTES**

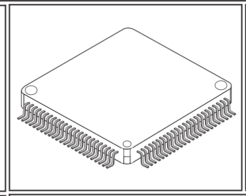
**7711**
Rework

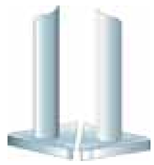
Revision: **B**
Date: 11/07

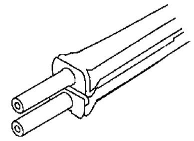
Number: **3.7.6**

# Gull Wing Removal (four-sided)

## Flux Application Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips

### MATERIALS

Flux-cored solder
Cleaner
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to component lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece, contacting ALL leads with tips. (See Figures 3 & 4.)
8. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

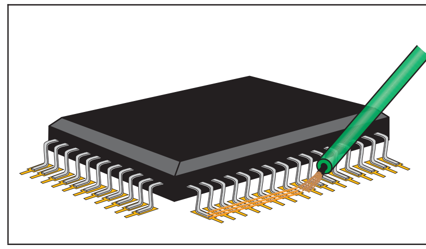


**Figure 1 Flux Component**

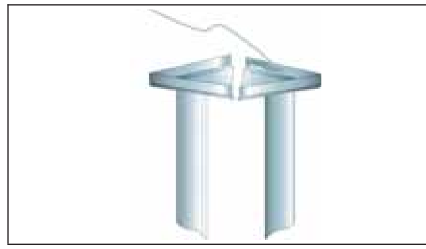


**Figure 2 Tin Tips**

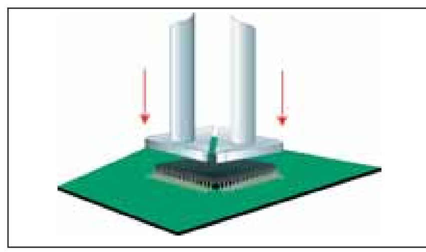


**Figure 3 Position Tips**

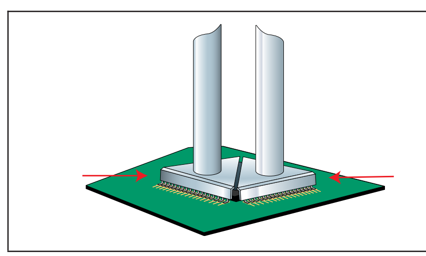


**Figure 4 Melt All Joints**

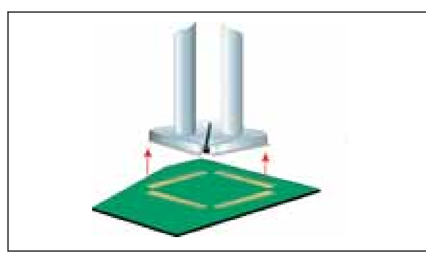


**Figure 5 Lift Component**

## NOTES

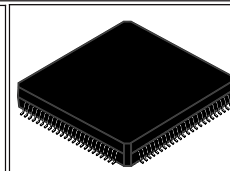
7711
Rework

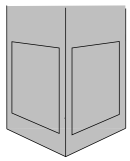
Revision: **B**
Date: 11/07

Number: **3.7.7**

# Gull Wing Removal (four-sided)

## Hot Gas (Air) Reflow Method





Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot gas (air) reflow system
Nozzle

### MATERIALS

Cleaner
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install nozzle into the hot gas reflow system and raise nozzle to highest position. Place PCB assembly onto the work platform.
3. Set system controls to the required settings to optimize performance.
4. Apply flux to component leads. (See Figure 1.)
5. Position component to be removed under nozzle. (See Figure 2.)
6. Lower nozzle and check alignment and make adjustments as needed. (See Figure 3.)
7. Position nozzle to expose vacuum cup. Turn on vacuum and lower vacuum cup until it touches component.
8. Lower nozzle to component and commence reflow cycle and observe solder melt of all leads. (See Figure 4.)
9. Upon completion of the reflow cycle, raise nozzle and allow component to cool prior to board removal from work platform. (See Figure 5.) .
10. Clean as applicable and inspect to established workmanship requirements.

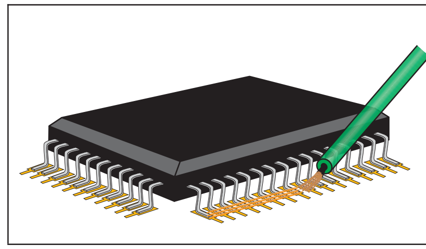


**Figure 1 Flux Component**

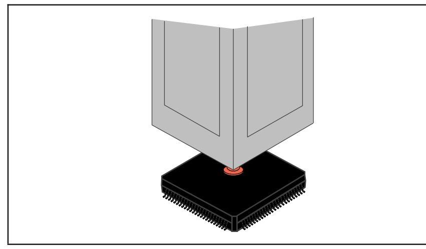


**Figure 2 Position Component**

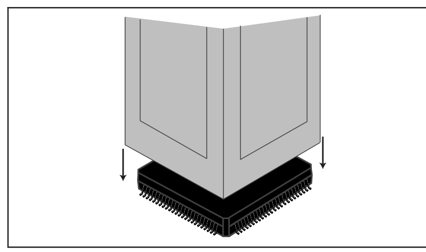


**Figure 3 Lower Nozzle**

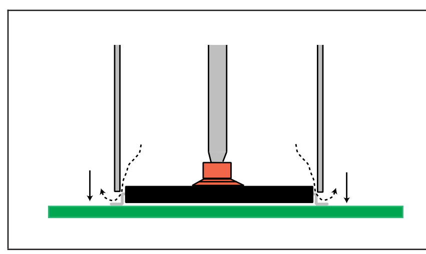


**Figure 4 Melt All Joints**

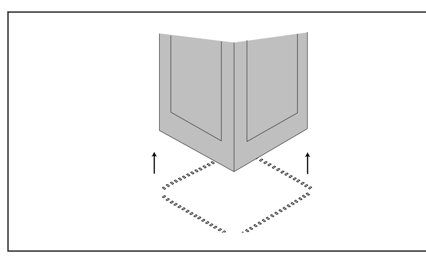


**Figure 5 Lift Component**

**NOTES**

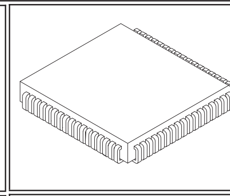
7711
Rework

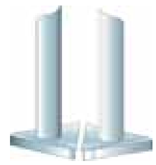
Revision: **B**
Date: 11/07

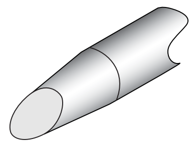
Number: **3.8.1**

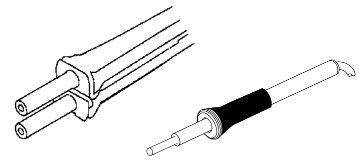
# J-Lead Removal

## Bridge Fill Method - Tweezer









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips
Board surface tip
Soldering handpiece

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using soldering handpiece, melt solder to form a solder bridge fill joining all component leads. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin inside edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece. (See Figures 3 & 4.)
8. Contact ALL leads with tips, confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

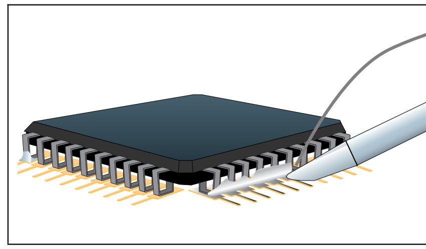


**Figure 1 Bridge**

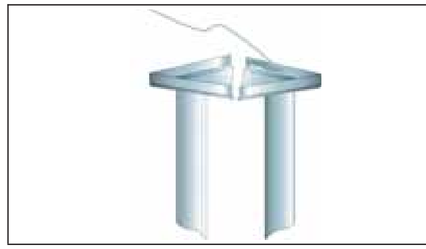


**Figure 2 Tin Tips**

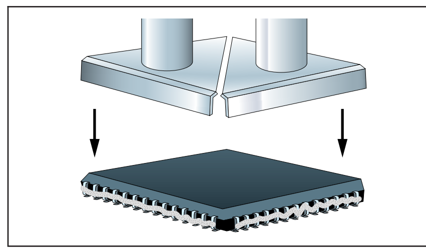


**Figure 3 Position Tips**

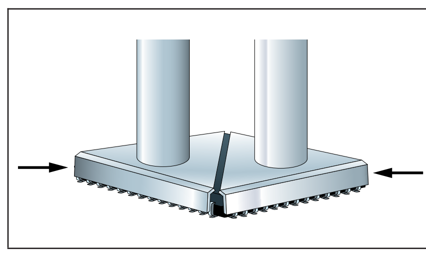


**Figure 4 Melt Joints**

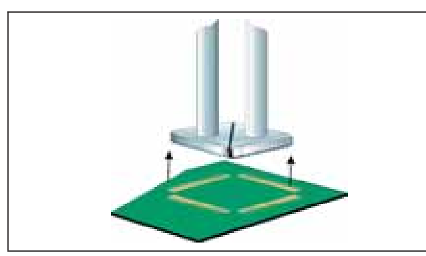


**Figure 5 Lift Component**

## NOTES

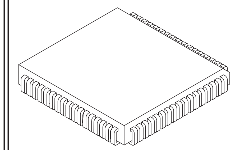
7711
Rework

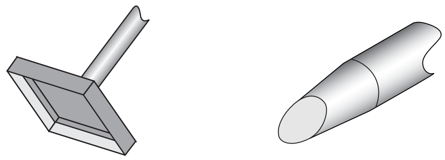
Revision: **B**
Date: 11/07

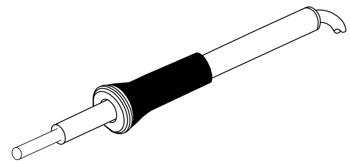
Number: **3.8.1.1**

# J-Lead Removal

## Bridge Fill Method – Surface Tension







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
Fixed head PLCC removal tip
Broad surface tip

### MATERIALS

Solder wire
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, or residues.
2. Install tip.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Using broad surface tip, melt solder around the outside of the leads, creating an even, solid bridge across the entire row. (See Figure 1.)
5. Install and clean the inside edges of the PLCC removal tip. Procedure 2.8.
6. Tin the tip evenly around the inside edge, ensuring that there is good wetting all the way around. (See Figure 2.)
7. Apply flux to all the leads. (See Figure 3.)
8. Bring the tip straight down on the component, contacting all the leads evenly. (See Figure 4.)
9. Wait for full reflow, displace the leads from the pads to break surface tension, and lift straight up. (See Figure 5.)
10. Immediately remove the component from the tip.
11. Prepare the lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

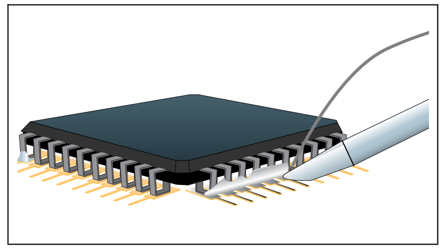


**Figure 1 Melt Solder**

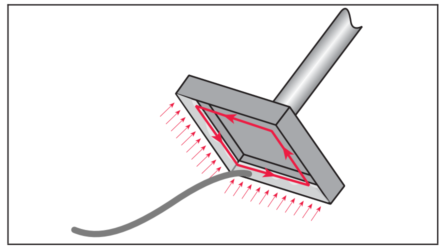


**Figure 2 Tin Tip**

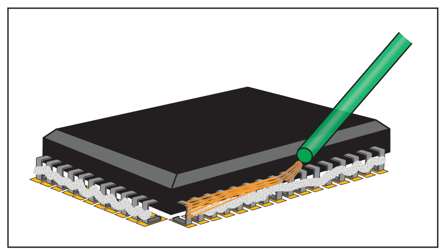


**Figure 3 Apply Flux**

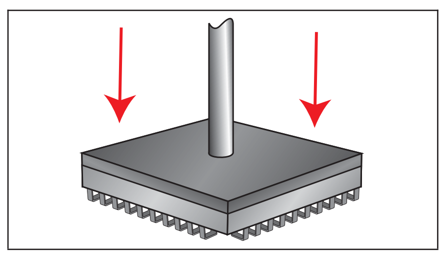


**Figure 4 Melt Solder**

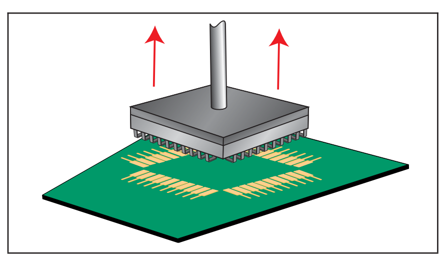


**Figure 5 Lift Component**

## NOTES

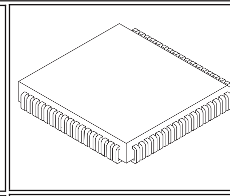
7711
Rework

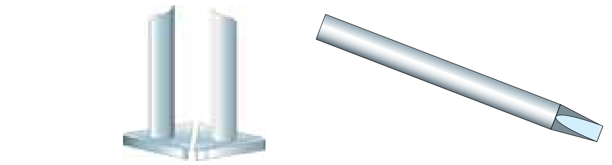
Revision: **B**
Date: 11/07

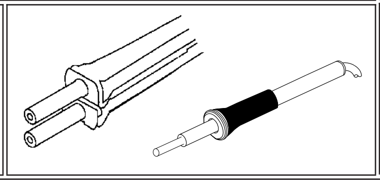
Number: **3.8.2**

# J-Lead Removal

## Solder Wrap Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips
Soldering handpiece
Chisel tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install and align removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Tack solder to one of the corner component leads using soldering handpiece with chisel tip installed. (See Figure 1.)
5. Wrap solder around the four sides of component.
6. Terminate solder at the end of last side using soldering handpiece.
7. Clean the tip, Procedure 2.8.
8. Tin inside edges of tips with solder. (See Figure 2.)
9. Lower tips over component and squeeze handpiece. (See Figures 3 & 4.)
10. Contact ALL leads with tips, confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
11. Release component onto a heat resistant surface.
12. Re-tin tips with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

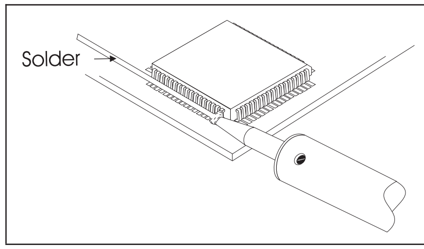



**Figure 1 Tack and Wrap Solder**

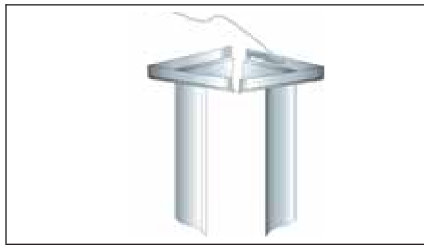


**Figure 2 Tin Tips**

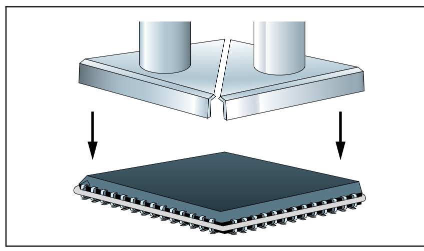


**Figure 3 Position Tips**

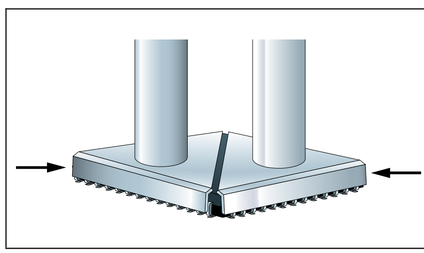


**Figure 4 Melt All Joints**

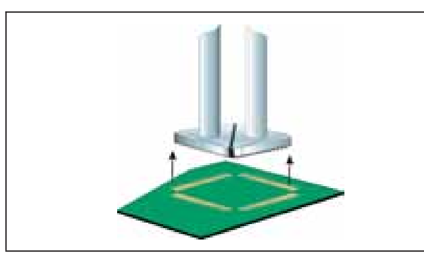


**Figure 5 Lift Component**

**NOTES**

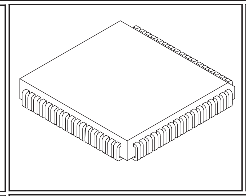
7711
Rework

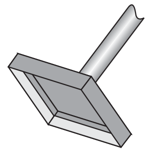
Revision: **B**
Date: 11/07

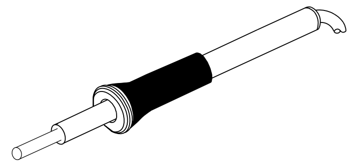
Number: **3.8.2.1**

# J-Lead Removal

## Solder Wrap Method – Surface Tension







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
Single or dual shaft J-Lead removal tip

### MATERIALS

Solder wire
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Select the proper tip by using the manufacturer's recommended tip selection guides. Install tip.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Clean the tip, Procedure 2.8.
5. Wrap a length of .025 or .031 gauge solder wire once around the leads of the component. (See Figure 1.)
6. Ensure that there's good wetting all the way around the inside of the tip. If there's not good wetting all around, or if the inside edge of the tip is discolored, use the manufacturer's recommended methods and/or tools to clean the tip.
7. Tin the tip generously around the entire inside working surface. (See Figure 2.)
8. Apply flux to all the leads. (See Figure 3.)
9. Bring the tip straight down on top of the part, making full, even contact on all of the leads. (See Figure 4.)
10. When the component leads have reflowed, slide the tip to one side just slightly, or twist it slightly, and lift straight up. (See Figure 5.)
11. Remove the component immediately by wiping it on the sponge.
12. Clean as applicable and inspect to established workmanship requirements.

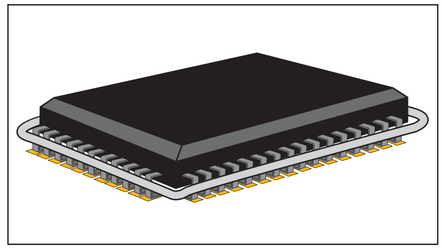


**Figure 1 Wrap Solder**

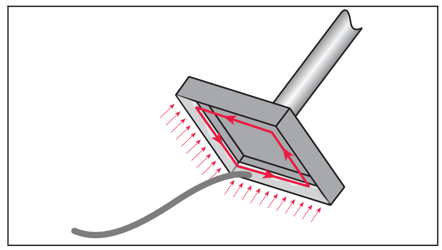


**Figure 2 Tin Tip**

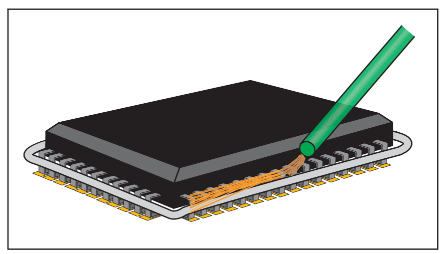


**Figure 3 Apply Flux**

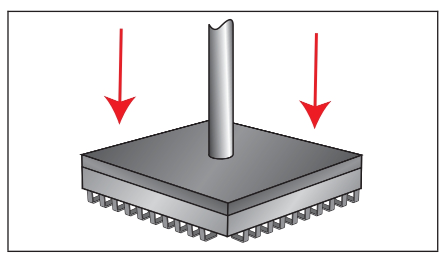


**Figure 4 Contact All Leads**

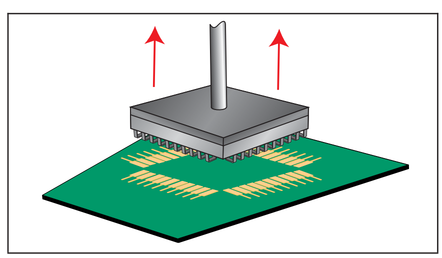


**Figure 5 Lift**

## NOTES

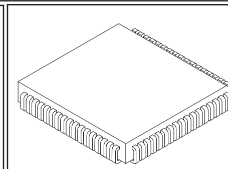
7711
Rework

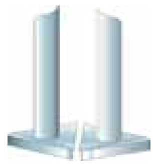
Revision: **B**
Date: 11/07

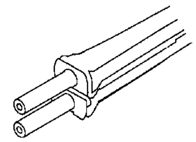
Number: **3.8.3**

# J-Lead Removal

## Flux Application Method – Tweezer







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Tweezer handpiece
Removal tips

### MATERIALS

Flux
Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install and align removal tips into tweezer handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to component lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin inside edges of tips with solder. (See Figure 2.)
7. Lower tips over component and squeeze handpiece. (See Figure 3.)
8. Contact ALL leads with tips, confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
9. Release component onto a heat resistant surface.
10. Re-tin tips with solder.
11. Prepare lands for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

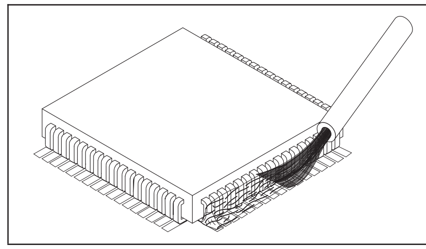


**Figure 1 Apply Flux**

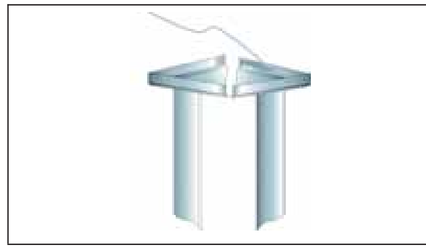


**Figure 2 Tin Tips**

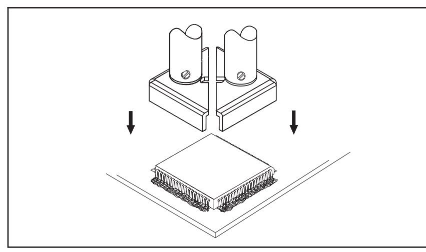


**Figure 3 Position Tips**

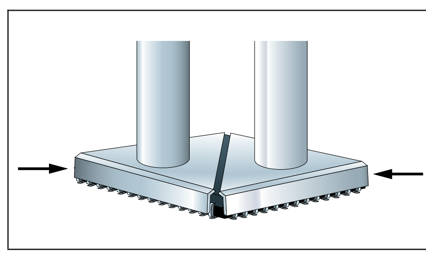


**Figure 4 Melt All Joints**

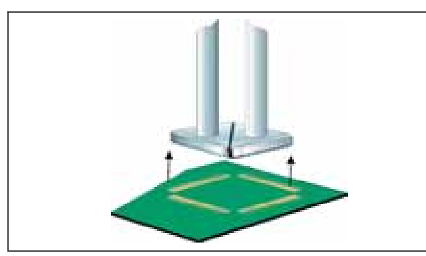


**Figure 5 Lift Component**

## NOTES

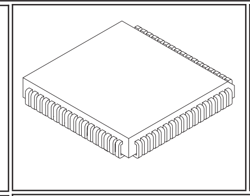
7711
Rework

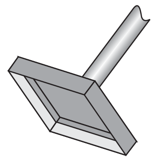
Revision: B
Date: 11/07

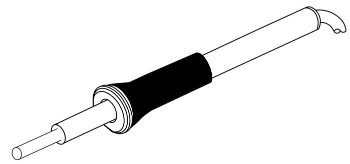
Number: **3.8.4**

# J-Lead Removal

## Flux & Tin Tip Only







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
J-Lead removal tip

### MATERIALS

Flux-cored solder
Flux

### NOTES

This procedure is designed for smaller J-LEAD packages. This method is not suitable for J-LEAD 68 and larger, which are more safely removed using the wire wrap methods. The heat sinking characteristics of the component and connections will affect the choice of methods as well.

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Select the proper tip by using the manufacturer's recommended tip selection guides. Install tip.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Ensure that there's good wetting all the way around the inside of the tip. If there's not good wetting all around, or if the inside edge of the tip is discolored, use the manufacturer's recommended methods and/or tools to clean the tip.
5. Tin the tip generously around the entire inside working surface. (See Figure 1.)
6. Apply flux to all the leads. (See Figure 2.)
7. Bring the tip straight down on top of the part, making full, even contact on all of the leads. (See Figure 3.)
8. When the component leads have reflowed, slide the tip to one side just slightly, or twist it slightly, and lift straight up. (See Figure 4.)
9. Remove the component immediately by wiping it on the sponge.
10. Clean as applicable and inspect to established workmanship requirements.

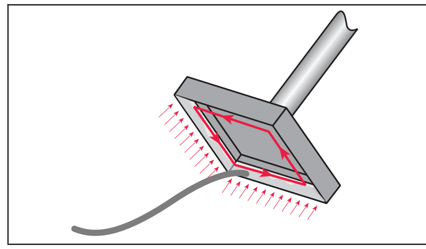


**Figure 1**

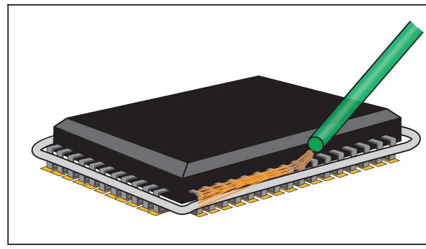


**Figure 2 Apply Flux**

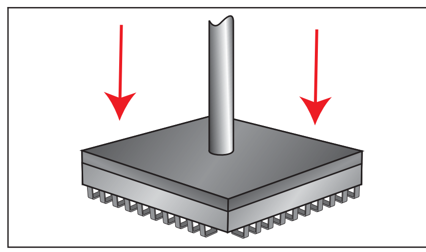


**Figure 3 Contact All Leads**

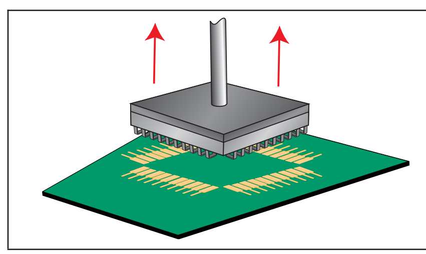


**Figure 4 Slide and Lift**

**NOTES**

IPC

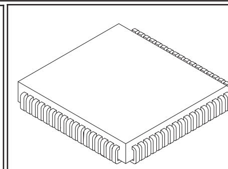
**7711**
Rework

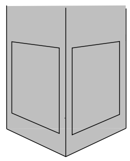
Revision: **B**
Date: 11/07

Number: **3.8.5**

# J-Lead Removal

## Hot Gas Reflow System





Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot gas (air) reflow system
Correctly sized nozzle

### MATERIALS

Cleaner
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install nozzle into the hot gas reflow system and raise nozzle to highest position. Place PCB assembly onto the work platform.
3. Set system controls to required settings to optimize performance.
4. Apply flux to component leads. (See Figure 1.)
5. Position component to be removed under nozzle. (See Figure 2.)
6. Lower nozzle and check alignment and make adjustments as needed. (See Figure 3.)
7. Position nozzle to expose vacuum cup. Turn on vacuum and lower vacuum cup until it touches component.
8. Lower nozzle to component and commence reflow cycle and observe solder melt of all leads. (See Figure 4.)
9. Upon completion of reflow cycle, raise nozzle and allow component to cool prior to board removal from work platform. (See Figure 5.)
10. Clean as applicable and inspect to established workmanship requirements.

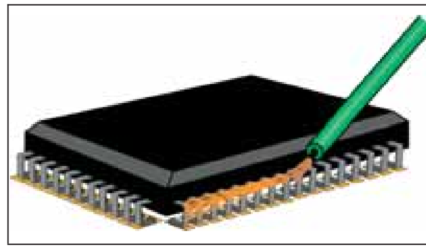


**Figure 1 Flux Component**

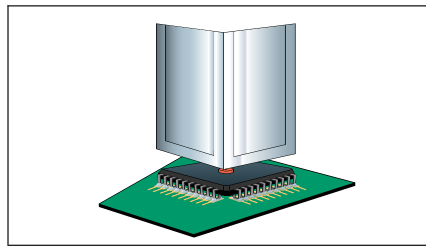


**Figure 2 Position Component**

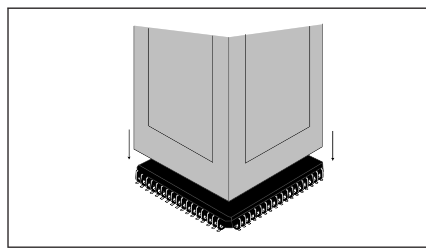


**Figure 3 Lower Nozzle**

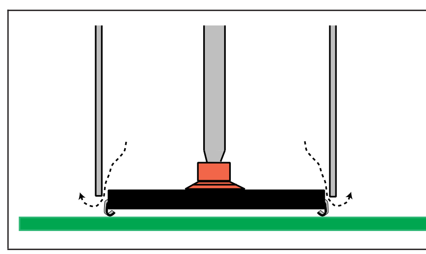


**Figure 4 Melt All Joints**

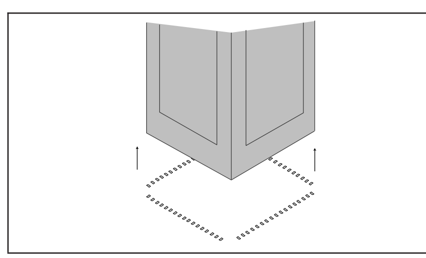
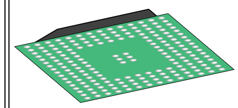
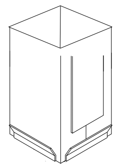


**Figure 5 Lift Component**

## NOTES

| | | | |
|---|---|---|---|
| 7711<br>Rework | Revision: **B**<br>Date: 11/07<br>Number: **3.9.1**<br>**BGA/CSP Removal**<br>**Hot Gas Reflow System** |  | |
|  | | | Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Hot air or hot gas re-flow system (representative examples shown by Figures 1-4)
Gas focusing nozzle (sized to BGA dimensions)
Gas supply (if other than ambient atmosphere)
Preheat method (oven, hotplate, high intensity lamp)

## OPTIONAL EQUIPMENT

Bake-out (vacuum, convection) oven
Inert gas supply, if used

## MATERIALS

Flux-cored solder
Flux
Cleaner

## PROCEDURE SUMMARY

The procedure outlined below is generic in nature and identifies the procedural steps which need be accomplished to effect BGA or CSP removal. Each step must be tailored to accommodate the attributes and characteristics of the specific system being used (system manufacturers will customarily provide generalized operating procedures which must be further refined to achieve optimum results).

## PROCEDURAL PRECONDITIONS

The following preconditions need to be accomplished prior to performing the procedure:

**NOTE:** If plastic body components are used, see J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for more information on moisture sensitivity and conditioning the chip and PWB for detachment.

1) Bake the PWA to remove entrained moisture which may, if not removed, precipitate measling or delamination.

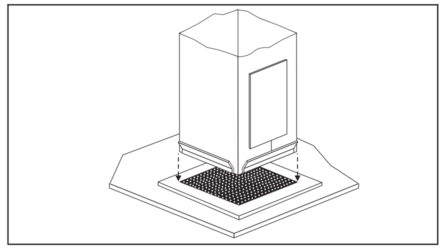


**Figure 1 Align Nozzle**

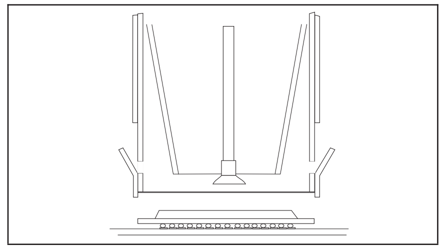


**Figure 2 Lower Nozzle**

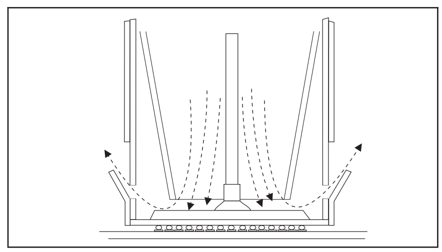


**Figure 3 Nozzle to BGA**

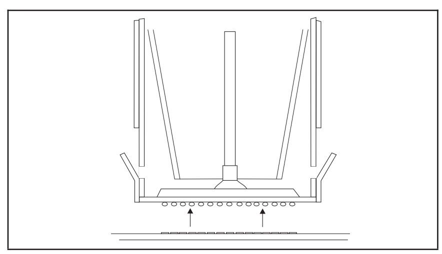


**Figure 4 Raise Nozzle and BGA**

| Number: **3.9.1** | Subject: **BGA/CSP Removal** |
|---|---|
| Revision: **B**<br>Date: 11/07 | |

## PROCEDURE STEPS

**NOTE:** Some systems do not include integrated preheating capability and it may be necessary to preheat the PWA and BGA separately.

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Place the PWA in the system work piece holder.
3. Inject flux under the BGA.
4. Set hot gas re-flow system to achieve the TTP defined by procedural analysis.
5. Perform alignment of gas nozzle to component location.
6. Bring gas focusing nozzle into re-flow position.
7. Perform TTP re-flow cycle defined by procedural analysis.
8. Clean PWA as appropriate to customer requirements.
9. Clean as applicable and inspect to established workmanship requirements.

## NOTES

IPC

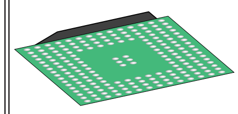
7711
Rework

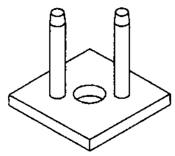
Revision: **B**
Date: 11/07

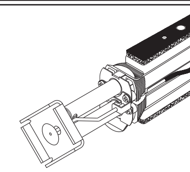
Number: **3.9.2**

# BGA Removal

## Vacuum Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Heater handpiece with vacuum cup
BGA removal tip

### MATERIALS

Cleaner
Flux

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install BGA removal tip and vacuum cup into dual handpiece. (See Figures 1 & 2.)
3. Start with tip temperature of approximately 371°C and change as necessary.
4. Lower tip over component. (See Figure 3.)

   **NOTE:** Injection of liquid flux under component may reduce cycle time.
5. Confirm solder melt of ALL joints. (See Figure 4.)
6. Actuate vacuum and lift component from PCB. (See Figure 5.)
7. Release component onto a heat resistant surface.
8. Prepare lands for component replacement.
9. Clean as applicable and inspect to established workmanship requirements.

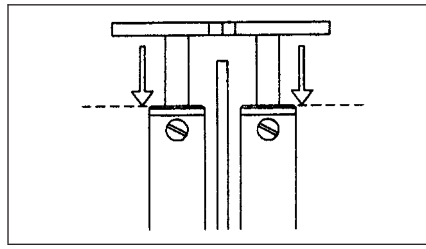


**Figure 1 Install Tip**

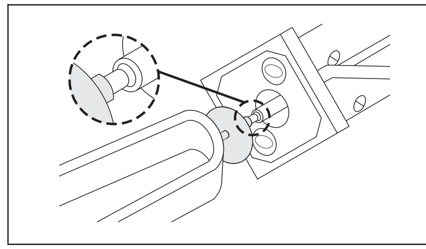


**Figure 2 Install Vacuum Cup**

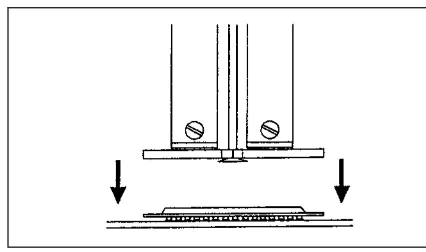


**Figure 3 Position Tip**

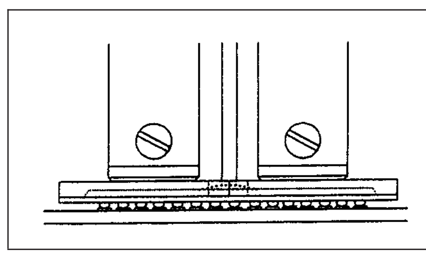


**Figure 4 Melt All Joints**

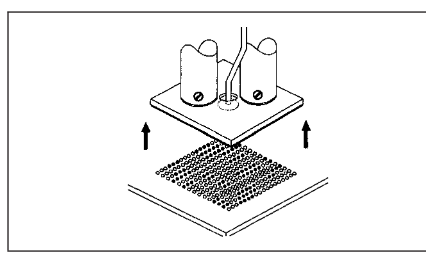


**Figure 5 Lift Component**

## NOTES

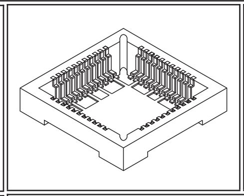
7711
Rework

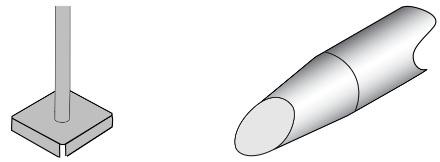
Revision: B
Date: 11/07

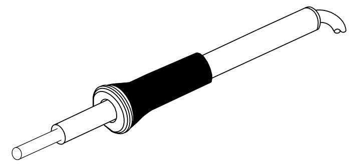
Number: **3.10.1**

# PLCC Socket Removal

## Bridge Fill Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Removal tip
Broad surface tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Cut tabs holding plastic center piece to PLCC socket and remove.
3. Install broad surface tip into soldering handpiece.
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Using soldering handpiece, melt solder to form a solder bridge joining all component leads. (See Figure 1.)
6. Replace broad surface tip in soldering handpiece with removal tip.
7. Clean the tip, Procedure 2.8.
8. Tin the outside and bottom edges of tip with solder. (See Figure 2.)
9. Fully insert tip into component contacting ALL leads with tip. (See Figures 3 & 4.)
10. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
11. Release component from tip by wiping on a heat resistant surface.
12. Re-tin tip with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

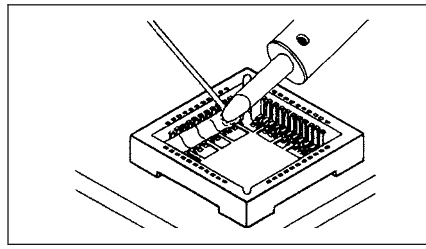


**Figure 1 Bridge Fill**

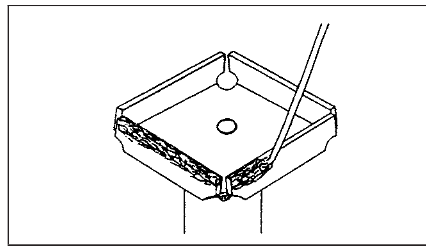


**Figure 2 Tin Tips**

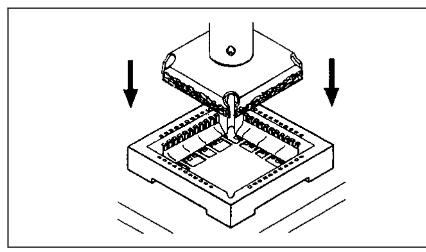


**Figure 3 Position Tip**

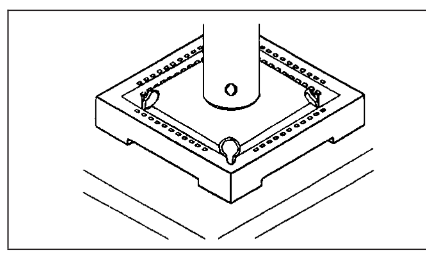


**Figure 4 Melt All Joints**

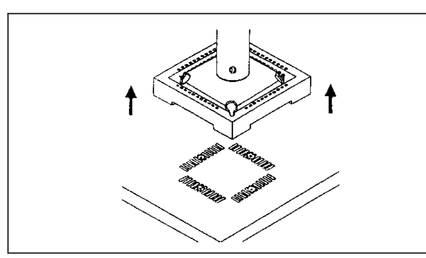


**Figure 5 Lift Component**

| | |
|---|---|
| Number: **3.10.1** | Subject: **PLCC Socket Removal** |
| Revision: **B**<br>Date: 11/07 | |

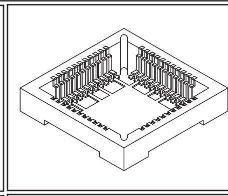
**NOTES**

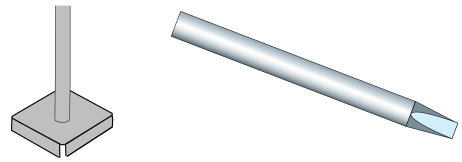
Revision: **B**
Date: 11/07

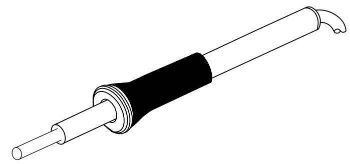
Number: **3.10.2**

# PLCC Socket Removal

## Solder Wrap Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpieces
Removal tip
Chisel tip

### MATERIALS

Flux-cored solder
Cleaner

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Cut tabs holding plastic center piece to PLCC socket and remove.
3. Install chisel tip into soldering handpiece.
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Tack solder to an inside corner lead using soldering handpiece with chisel tip installed. Wrap solder around leads inside component. Terminate solder at last lead using soldering handpiece. (See Figure 1.)
6. Replace chisel tip in soldering handpiece with removal tip.
7. Clean the tip, Procedure 2.8.
8. Tin outside and bottom edges of tip with solder. (See Figure 2.)
9. Fully insert tip into component contacting ALL leads with tip. (See Figures 3 & 4.)
10. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
11. Release component from tip by wiping on a heat resistant surface.
12. Re-tin tip with solder.
13. Prepare lands for component replacement.
14. Clean as applicable and inspect to established workmanship requirements.

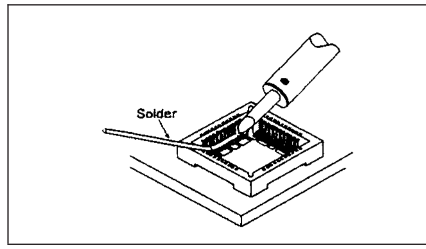



**Figure 1 Tack and Wrap**

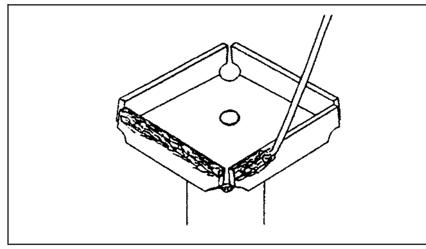


**Figure 2 Tin Tip**

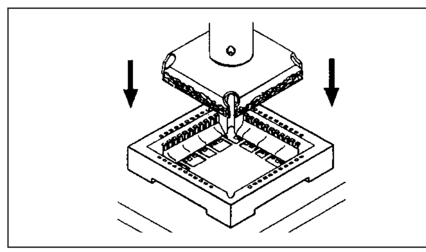


**Figure 3 Position Tip**

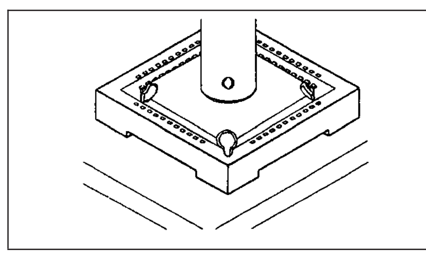


**Figure 4 Melt All Joints**

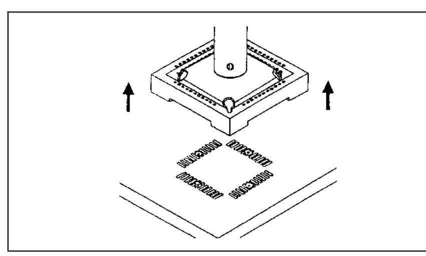


**Figure 5 Lift Components**

## NOTES

IPC®

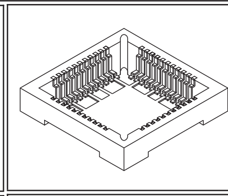
**7711**
Rework

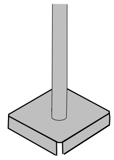
Revision: **B**
Date: 11/07

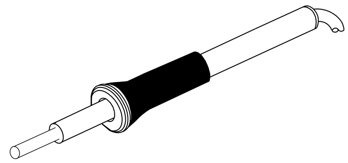
Number: **3.10.3**

# PLCC Socket Removal

## Flux Application Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Removal tip
Soldering handpiece

### MATERIALS

Flux
Cleaner
Flux-cored solder

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Cut tabs holding plastic center piece to PLCC socket and remove.
3. Apply flux to inside lead/land areas. (See Figure 1.)
4. Start with tip temperature of approximately 315°C and change as necessary.
5. Install removal tip into soldering handpiece.
6. Clean the tip, Procedure 2.8.
7. Tin outside and bottom edges of tip with solder. (See Figure 2.)
8. Fully insert tip into component contacting ALL leads with tip. (See Figures 3 & 4.)
9. Confirm solder melt of ALL joints and lift component from PCB. (See Figures 4 & 5.)
10. Release component from tip by wiping on a heat resistant surface.
11. Re-tin tip with solder.
12. Prepare lands for component replacement.
13. Clean as applicable and inspect to established workmanship requirements.

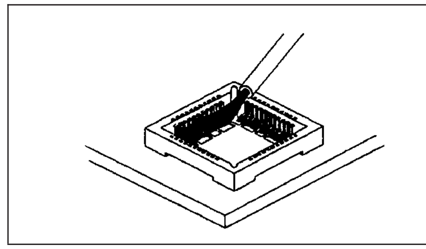


**Figure 1 Apply Flux**

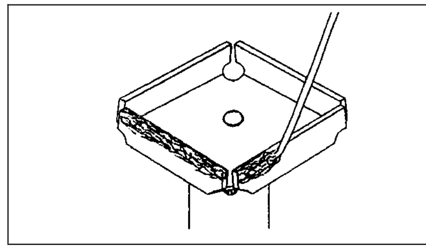


**Figure 2 Tin Top**

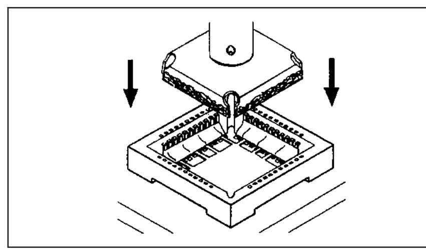


**Figure 3 Position Tip**

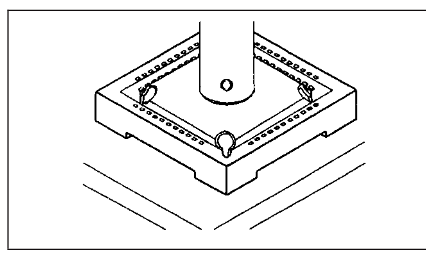


**Figure 4 Melt All Joints**

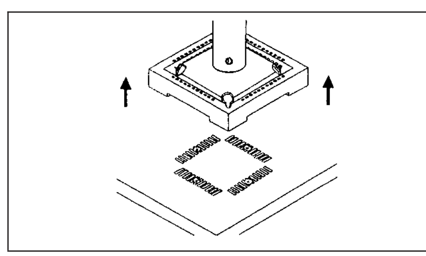


**Figure 5 Lift Component**

**NOTES**

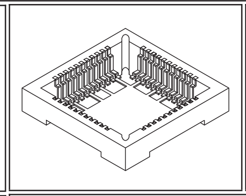
7711
Rework

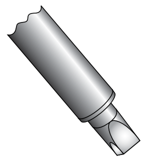
Revision: **B**
Date: 11/07

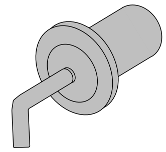
Number: **3.10.4**

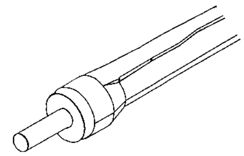
# PLCC Socket Removal

## Hot Air Pencil Method









Board Type:
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot air pencil
Hot air tip
Needle nose pliers
Knife

### OPTIONAL EQUIPMENT

Desoldering station

### MATERIALS

Flux
Cleaning solvent

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Cut and remove plastic center. (See Figure 1.)
3. Install appropriate hot air tip into the hot air pencil.
4. Set heater temperature to approximately 315°C and adjust as necessary.
5. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the component or causing damage to the board, component, conductor, etc. For additional information see the hot pencil manufacturer's operating instructions.
6. Position tip approximately 0.5 cm away from inside area of socket. Rotate hot air pencil in a circular motion around lands until complete solder melt is observed. (See Figure 2.)
7. Approximately 5 to 8 seconds after solder melt occurs, begin lifting the socket very gently and only a little at a time until the socket becomes detached. (See Figure 3.) This entire step should take approximately 45 seconds.
8. After solder melt occurs, clean and inspect as required.
9. Clean as applicable and inspect to established workmanship requirements.

*CAUTION:* This method is not recommended unless there are no other options. PCB will be subjected to excessive heat.

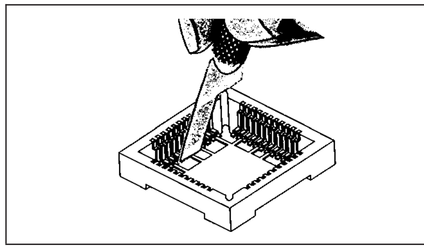


**Figure 1 Remove Center**

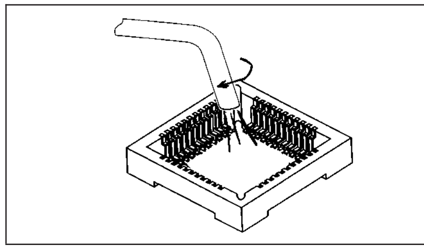


**Figure 2 Melt Solder**

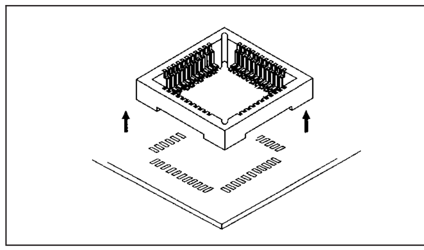


**Figure 3 Lift Socket**

## NOTES

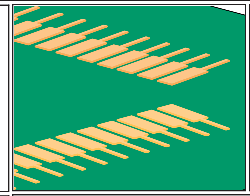
7711
Rework

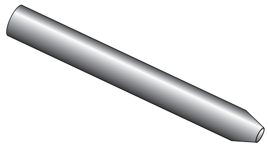
Revision: **B**
Date: 11/07

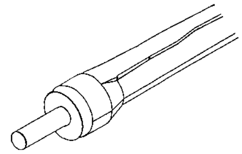
Number: **4.1.1**

# Surface Mount Land Preparation

## Individual Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Continuous vacuum desoldering system
Desoldering tip

### MATERIALS

Flux
Cleaner
Tissue/wipes

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install desoldering tip into handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all land areas. (See Figure 1.)
5. Clean the tip. Procedure 2.8.
6. Lower tip contacting end of land(s) with tip. (See Figure 2.)
7. Confirm solder melt of contacted land(s), apply vacuum and sweep tip over land holding tip in contact with solder to extract excess solder from PCB land(s). (See Figure 3.)
8. Lift tip at end of last row, hold vacuum to clear all molten solder from the heater chamber. (See Figure 4.)
9. Repeat for all lands.
10. Return handpiece to its stand.
11. Clean lands as required for component replacement.
12. Clean as applicable and inspect to established workmanship requirements.

### NOTE

The individual method is the method of choice for fine pitch land patterns.

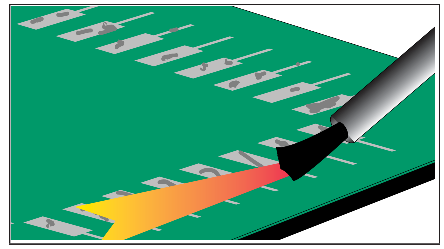


**Figure 1 Flux Lands**

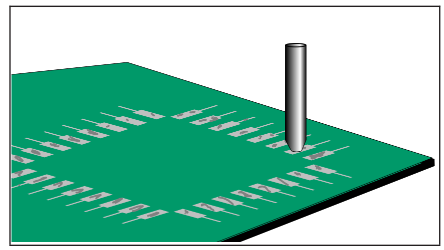


**Figure 2 Position Tip**

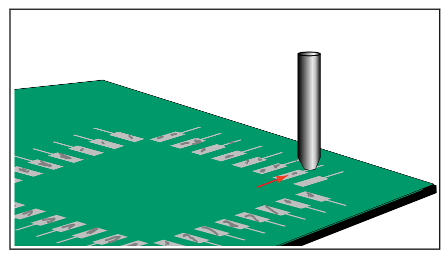


**Figure 3 Melt Solder & Apply Vacuum**

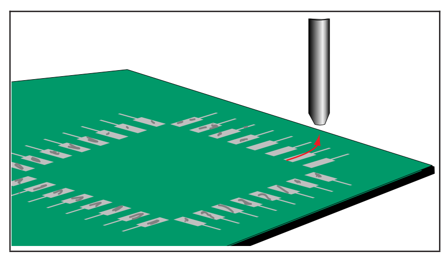


**Figure 4 Lift Handpiece**

**NOTES**

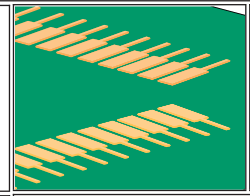
7711
Rework

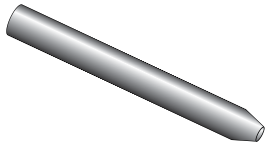
Revision: **B**
Date: 11/07

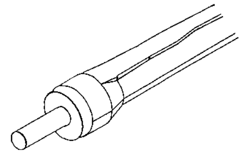
Number: **4.1.2**

# Surface Mount Land Preparation

## Continuous Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Continuous vacuum desoldering system
Desoldering tip
Damp sponge

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install appropriate desoldering tip into handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to all land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.
6. Tin bottom of tip with solder. (See Figure 2.)
7. Lower tip contacting end of row lands with tip. (See Figure 3.)
8. Confirm solder melt of contacted lands, apply vacuum and sweep tip over remaining lands in all rows holding tip in contact with solder to extract excess solder from PCB lands. (See Figure 4.)
9. Lift tip at end of last row, hold vacuum to clear all molten solder from the heater chamber. (See Figure 5.)
10. Re-tin tip end with solder and return handpiece to its stand.
11. Clean as applicable and inspect to established workmanship requirements.

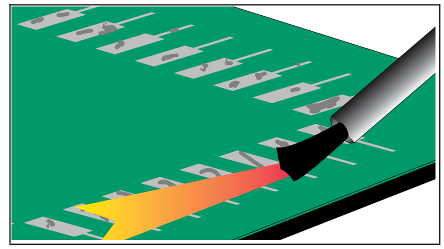


**Figure 1 Flux Lands**

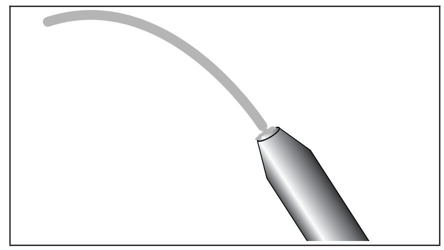


**Figure 2 Tin Tip**

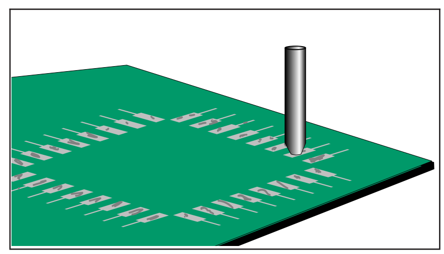


**Figure 3 Position Tip**

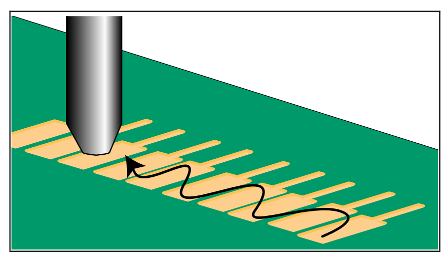


**Figure 4 Melt Solder & Apply Vacuum**

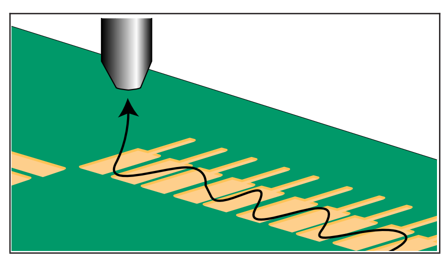


**Figure 5 Lift Hand Piece**

**NOTES**

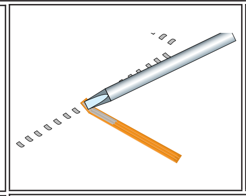
**7711**
Rework

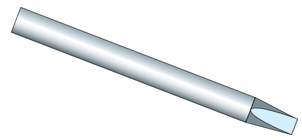
Revision: **B**
Date: 11/07

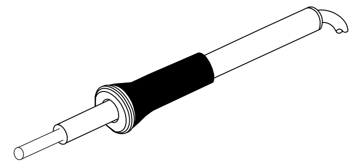
Number: **4.1.3**

# Surface Solder Removal

## Braid Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Chisel tip
Damp sponge

### MATERIALS

Wicking braid
Flux
Cleaner

### PROCEDURE

*Caution:* The wicking method is not recommended for the removal of solder joints in plated-through holes.

1. Remove conformal coating (if any) and clean work area of any contamination, oxides or residues.
2. Install chisel tip into soldering handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to lead/land areas. (See Figure 1.)
5. Clean the tip, Procedure 2.8.2.
6. Place prefluxed braid on the solder to be removed. Place iron tip on the braid. Ensure the braid contacts only the solder and the tip contacts only the braid to prevent damage. (See Figure 2.)
7. When the observable solder flow due to solder wicking action has ceased, remove both the soldering iron and solder braid from the solder being removed and allow the area to cool to room temperature. (See Figures 3 & 4.)
8. Repeat steps 4 - 7 for all remaining lead/land areas.
9. Re-tin tip with solder and return handpiece to stand.
10. Prepare lands for component replacement.
11. Clean as applicable and inspect to established workmanship requirements.

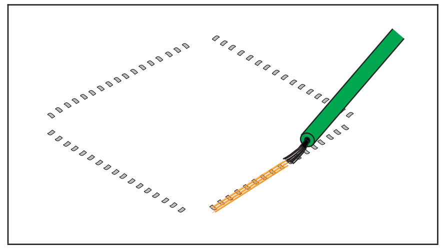


**Figure 1 Apply Flux**

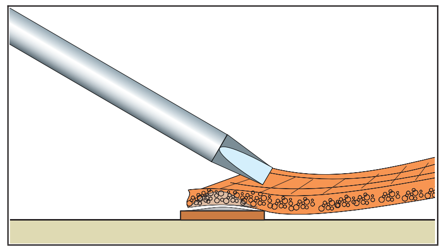


**Figure 2 Place Braid & Iron on Land**

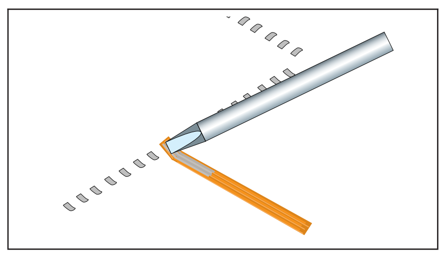


**Figure 3 Solder Flows on Braid**

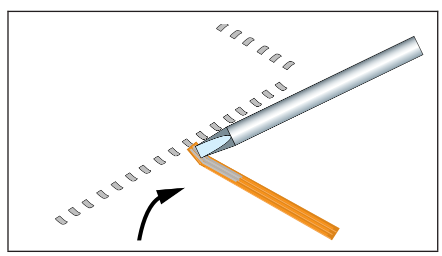


**Figure 4 Lift Both Iron & Braid**

**NOTES**

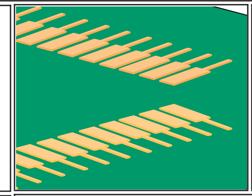
7711
Rework

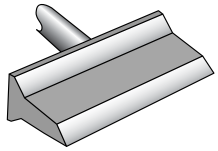
Revision: **B**
Date: 11/07

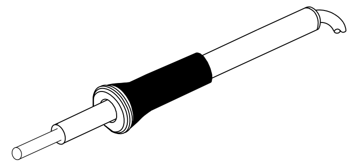
Number: **4.2.1**

# Pad Releveling

## Using Blade Tip







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
Dual or single shaft blade tip

### MATERIALS

Flux
Cleaner

### PROCEDURE

This technique can be used in cases where components have been removed in such a manner that sufficient solder to tin the lands is left on the lands after removal of the component. This is almost always the case when hot air or wire wrap methods are used in the removal.

1. Choose a blade tip with a width that matches or slightly overhangs a single row of lands. (See Figure 1.)
2. Install tip.
3. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary.
4. Clean the tip. Procedure 2.8.
5. Apply flux to the row of lands.
6. Place the beveled edge lightly across the center of the row of lands. (See Figure 2.)
7. When the solder reflows across all the lands they will become uniform and shiny.
8. Draw the tip evenly off the lands as soon as possible after all the lands become shiny and uniform in appearance.* (See Figure 3.)
9. Clean as applicable and inspect to established workmanship requirements.

* *Note:* This technique reuses solder that is in indeterminate condition.

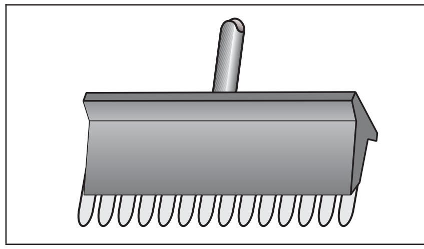


**Figure 1 Blade Fits Lands**

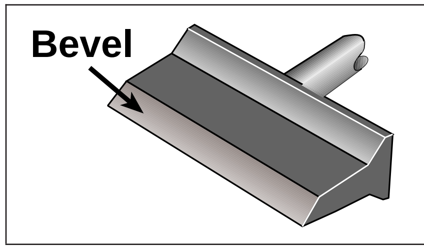



**Figure 2 Use Beveled Edge**

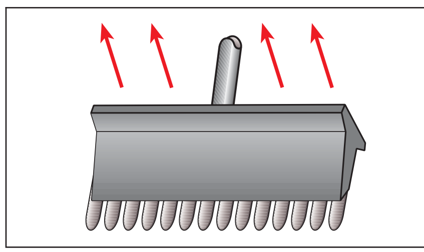


**Figure 3 Draw Tip Off Evenly**

**NOTES**

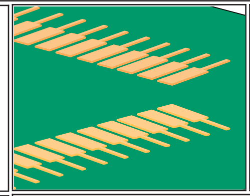
7711
Rework

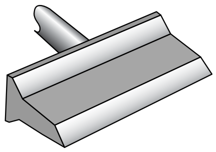
Revision: **B**
Date: 11/07

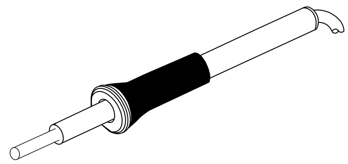
Number: **4.3.1**

# SMT Land Tinning

## Using Blade Tip







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: Medium
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
Dual or single shaft blade tip

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Choose a blade tip with a width that matches or slightly overhangs a single row of pads. (See Figure 1.)
2. Install tip.
3. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary.
4. Tin and wipe the blade on a clean sponge to ensure that the surface is clean and fully wettable. Procedure 2.8.
5. Apply flux to the row of lands.
6. Place an even bead of solder along the full length of the beveled edge. (See Figure 2.)
7. Place the beveled edge lightly across the center line of the row of lands. (See Figure 3.)
8. When the solder reflows across all the lands they will become uniform and shiny.
9. Gently draw the tip off the lands as soon as the lands are tinned. (See Figure 4.)
10. Clean as applicable and inspect to established workmanship requirements.

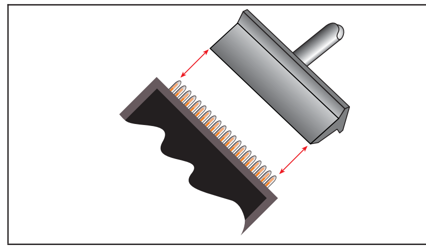


**Figure 1 Blade Fits Lands**

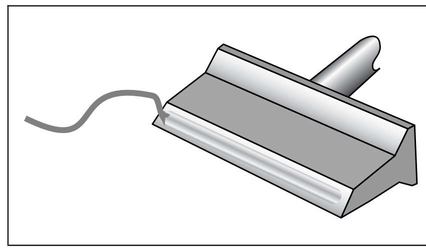


**Figure 2 Tin Tip**

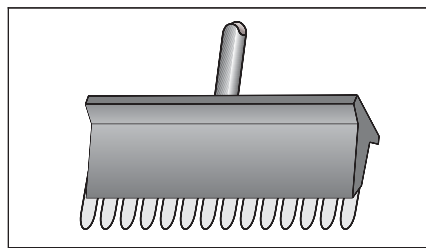


**Figure 3 Place Beveled Edge Across**

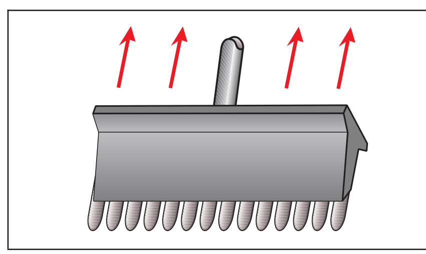


**Figure 4 Draw Tip Off Lands**

**NOTES**

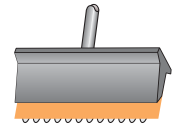
7711
Rework

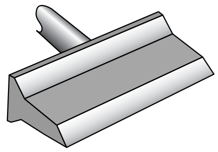
Revision: **B**
Date: 11/07

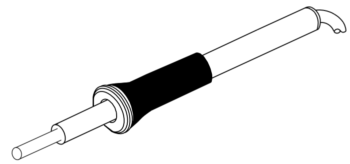
Number: **4.4.1**

# Cleaning SMT Lands

## Using Blade Tip and Solder Braid







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering Systems(s)
1 or 2 Soldering handpieces
Single or dual shaft blade tip

### MATERIALS

Solder braid
Flux
Cleaner

### PROCEDURE

This technique uses a blade tip with solder braid to draw old solder off the lands. The blade tip used should be as long or a little longer than the row of lands. The braid should also be sized to the lands, so that the braid width equals or is slightly less than the land length.

### CAUTION

Oversized braids are not to be used. Undersized braids may be drawn across the surface of the land, but only with the grain of the land. Never draw solder off by dragging the braid down a row of lands. The heat combined with the abrasive action will lift the lands.

1. Choose the size of blade tip that best fits a single row of lands. (See Figure 1.)
2. Install tip.
3. Start with tip temperature of approximately 371°C and change as necessary.
4. Apply flux to the lands. (See Figure 2.)
5. Lay the trimmed end of the braid along the row of lands to be cleaned. (See Figure 3.)
6. Bring the beveled edge of the blade down on the centerline of the braid. Do not move the braid across the lands in any direction. (See Figure 4.)
7. Remove braid and tip together, immediately after reflow.
8. Clean as applicable and inspect to established workmanship requirements.

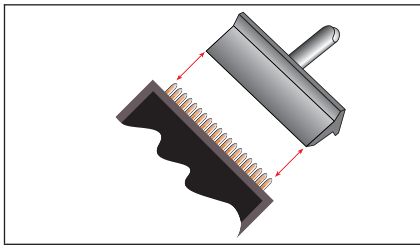


**Figure 1 Choose Tip**

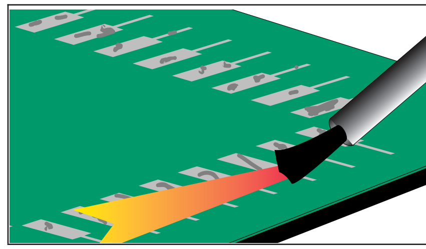


**Figure 2 Apply Flux**

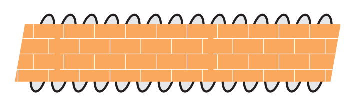


**Figure 3**

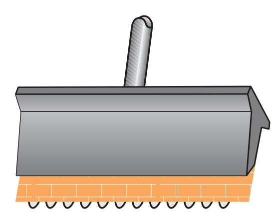


**Figure 4**

**NOTES**

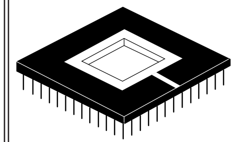
7711
Rework

Revision: B
Date: 11/07

Number: **5.2.1**

# PGA and Connector Installation

## Solder Fountain Method with PTH Prefilled



Board Type: R, F, W, C
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Solder fountain
Chimney or nozzle to match part
Removal tool
Pallet to hold board over fountain
Preheat oven

### MATERIALS

Flux
Cleaner
Heat resistant, antistatic gloves
Protective face gear
Heat resistant tape

### PROCEDURE

This procedure variation is for components or connectors with sturdy leads that do not readily bend.

This process is for experienced operators only. Caution must be exercised due to working with hot, molten solder.

1. Attach the correct nozzle or chimney to the solder pot. This operation must be done with proper care per solder fountain supplier's instructions. (See Figure 1.)
2. Set solder fountain pot control to the required temperature for soldering that particular component into that particular board. Wait until solder pot reaches the set temperature.
3. Set the timer (if applicable) for the amount of time the fountain is to be running for that particular part.
4. The area around the rework site may be masked with a high temperature resistant tape, or similar material, to protect the adjacent area during rework. (See Figure 2.)
5. Preheat the new component and the board to the desired temperature, taking into consideration component thermal restrictions and glass transition temperature $T_g$ of the board material.
6. Flux the board on the top and bottom side at the site of the new component. The component leads may also be fluxed, depending on the board and component leads. Place the component on the board in its correct site. (See Figure 2.)
7. Place the board on the pallet, over the solder fountain with the component sitting in location and trip the solder fountain timer. (See Figure 3.)

**Figure 1 Attach Nozzle**

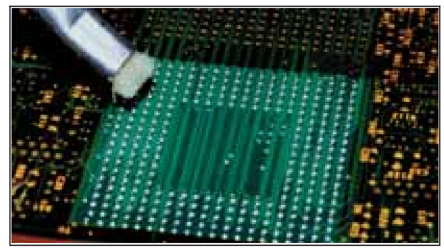


**Figure 2 Flux**

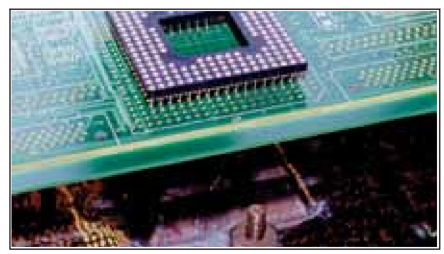


**Figure 3 Place Over Solder Fountain**

8. As the solder in the holes reflows, the component may have to be reoriented to drop into the holes.
9. At the end of the timer cycle, wait at least 5 seconds for the solder to solidify, then remove the board.
10. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

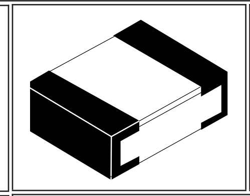
7711
Rework

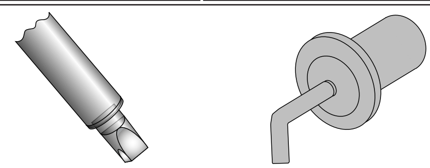
Revision: **B**
Date: 11/07

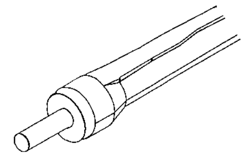
Number: **5.3.1**

# Chip Installation

## Solder Paste Method/Hot Air Pencil







Board Type: R, F, C, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot air pencil
Hot air tip
Solder paste dispenser
Tweezers

### MATERIALS

Solder paste
Cleaner
Solder paste dispense needles
Tissue/wipe

### PROCEDURE

*NOTE:* Preheating is recommended for sensitive components. (i.e., chip capacitors.)

1. Install tip into hot air pencil.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the component or causing damage to the board, component, conductor, etc. For additional information see the hot pencil manufacturer's operating instructions.
4. Apply a small bead of solder paste to each land using a dispenser. (See Figure 1.)
5. Position component onto lands using tweezers. (See Figure 2.)
6. Direct hot air over component with tip at a distance of 2.5 cm to pre-dry solder paste. (See Figure 3.)
7. When pre-drying is observed (paste has dull, flat appearance), move tip closer (0.5 cm) and heat until complete solder melt is observed. (See Figure 4.)
8. Return hot air pencil to its stand.
9. Clean as applicable and inspect to established workmanship requirements.

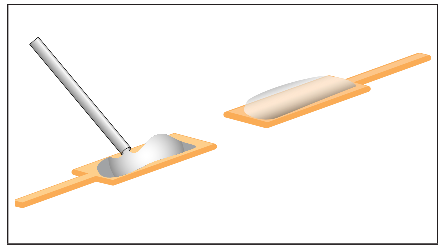


**Figure 1 Apply Solder Paste**

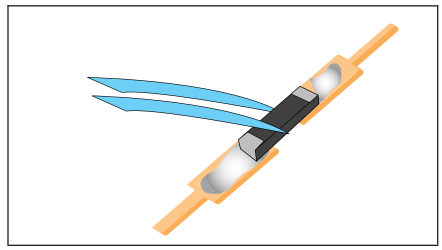


**Figure 2 Position Component**

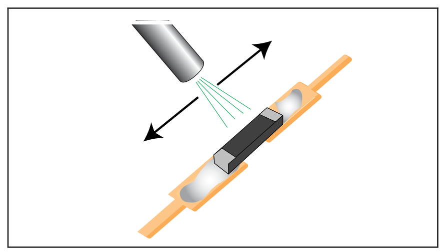


**Figure 3 Pre-dry Paste**

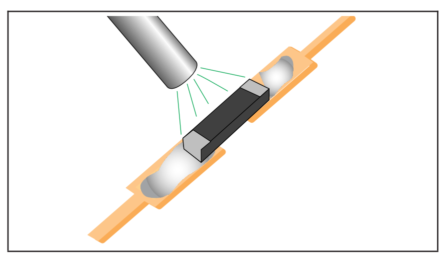


**Figure 4 Melt Joints**

**NOTES**

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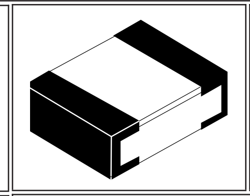
7711
Rework

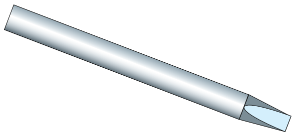
Revision: **B**
Date: 11/07

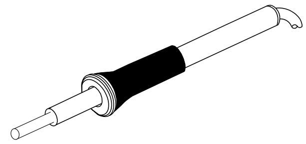
Number: **5.3.2**

# Chip Installation

## Point-to-Point Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering iron
Chisel or conical tip
Damp sponge
Wood stick or tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner
Tissue/wipes

### NOTE

Preheating is recommended for sensitive components (i.e., chip capacitors).

### PROCEDURE

1. Remove conformal coating (if any) and clean work area of any contamination, oxides, residues or fluxes.
2. Install soldering iron tip in handpiece.
3. Start with tip temperature of approximately 315°C and change as necessary.
4. Apply flux to one land (optional).
5. Clean the tip, Procedure 2.8.
6. Prefill one land with solder. (See Figure 1.)
7. Place the component in position and hold it with a wooden stick or tweezers.
8. Apply flux to both lands.
9. Place the tip at the junction between the prefilled land and termination area of component.
10. Observe complete solder melt. This is evident by component dropping down onto land. area. (See Figure 2.)
11. Pause briefly for solder to solidify
12. Solder remaining side by applying additional solder as needed. (See Figure 3.)
13. Re-tin tip end with solder and return handpiece to its stand.
14. Clean as applicable and inspect to established workmanship requirements.

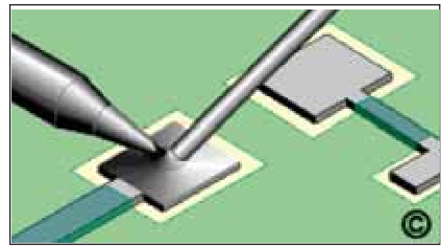


**Figure 1**

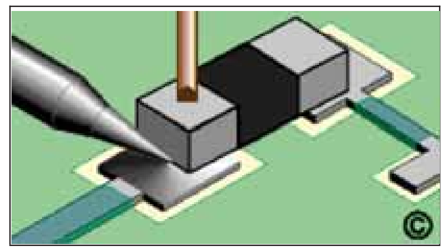


**Figure 2**

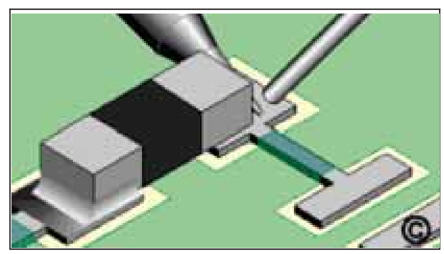
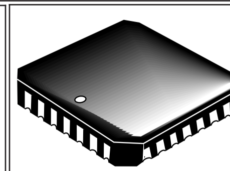
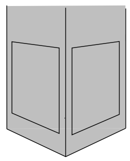


**Figure 3**

**NOTES**

| | | |
|---|---|---|
| IPC<br>**7711**<br>Rework | Revision: **B** Number: **5.4.1**<br>Date: 11/07<br>**Leadless Component Installation**<br>**Hot Gas (Air) Reflow Method** |  |
|  | | Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Hot gas reflow system
Gas focusing nozzle sized to the chip
Air supply
Solder paste application
Preheater

## OPTIONAL EQUIPMENT

X-ray inspection system
Nitrogen
Oven

## MATERIALS

Solder paste
Cleaning chemistry
ESD proof tape (if needed)

## PROCEDURE SUMMARY

The procedure below is generic in nature and it identifies the procedural steps needed to install a leadless chip. The steps must also take into consideration the system being used and manufacturer's recommendations.

## PROCEDURE PRECONDITIONS

1. See J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for more information on moisture sensitivity and conditioning the chip and PWB for detachment.
2. Bake the PCB (if conditions require baking) to remove the entrapped moisture which could cause measling, delamination of the board and/or popcorning of moisture sensitive components. If the component that is being removed is going to be re-used, ensure it is baked out per J-STD-033 based on its moisture sensitivity levels.

   **NOTE:** Surrounding components on both sides of the PCB may be subjected to hot air temperatures that can cause damage based on profiles and should be evaluated for required bake-out times.

| Number: **5.4.1** | Subject: **Leadless Component Installation** |
|---|---|
| Revision: **B**<br>Date: 11/07 | |

## PROCEDURE

**NOTE:** Some reflow systems do not come with a preheater and it maybe necessary to preheat before removing the part.

1. Apply and inspect the solder paste.
2. Place the PCB in a workboard holder.
3. Set the hot gas reflow system to the time and temperature profile.
4. Pick up the part, align the part using component placement aids (vacuum placement, x-y locator, etc.), align and place to the land areas.
5. Bring the nozzle into reflow position if required.
6. Start the time and temperature profile cycle.
7. Clean as applicable and inspect per workmanship requirements.

## NOTES

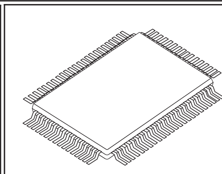
7711
Rework

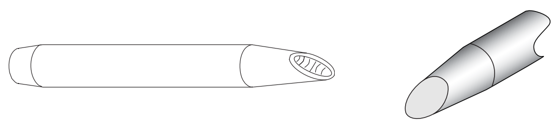
Revision: B
Date: 11/07

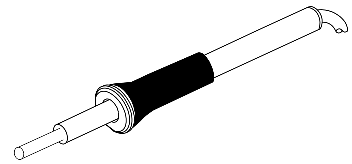
Number: 5.5.1

# Gull Wing Installation

## Multi-Lead Method – Top of Lead







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Flat faced or cup-shaped tip
Damp sponge
Vacuum pick-up tool

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Install selected tip into the soldering handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Position the component ensuring proper lead-to-land alignment. Hold the component in place using the vacuum pick-up tool or tweezers. (See Figure 1.)
4. Apply flux and tack solder opposing corner leads. (See Figure 2.)
5. Apply flux to remaining lead/land areas. (See Figure 3.)
6. Clean the tip, Procedure 2.8.
7. Apply solder to tip to create a bead of molten solder. (See Figure 4.)
8. Position tip so the solder bead contacts the top portion of leads. Slowly move tip over the row of leads to form proper solder fillets at each joint. (See Figure 5.)
9. Repeat steps 7 through 8 on remaining sides of component.
10. Re-tin tip with solder.
11. Clean as applicable and inspect to established workmanship requirements.

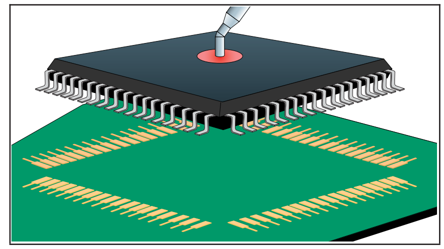


**Figure 1 Position Component**

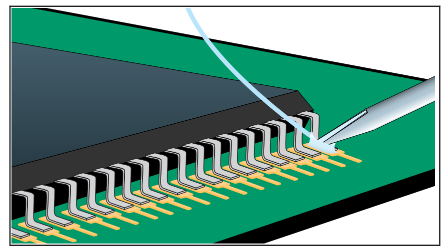


**Figure 2 Tack Lead**

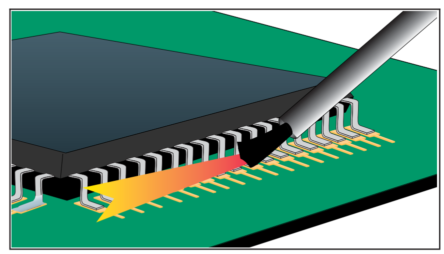


**Figure 3 Flux Leads**

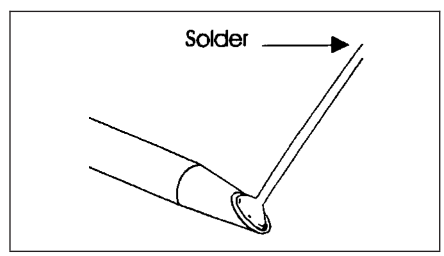



**Figure 4 Fill Tip**

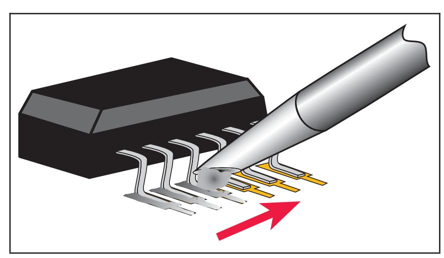


**Figure 5 Solder Component**

**NOTES**

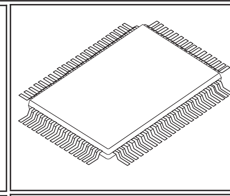
**7711**
Rework

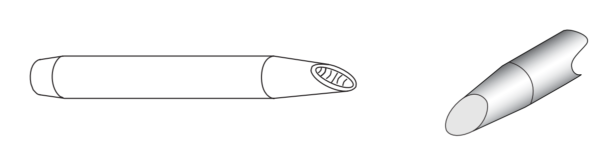
Revision: **B**
Date: 11/07

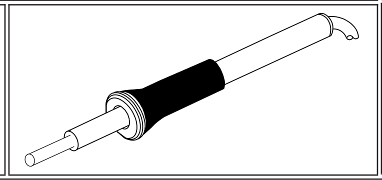
Number: **5.5.2**

# Gull Wing Installation

## Multi-Lead Method – Toe Tip







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Flat faced or cup-shaped tip

### MATERIALS

Flux
Flux-cored solder
Cleaner

### NOTE

This technique is most effective with very fine pitch components. Long leads may not be able to get enough solder to the heel to form a proper fillet without overheating the land. This procedure is recommended for temperature sensitive components.

### PROCEDURE

1. Install selected tip into the soldering handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Align the component carefully to the lands. (See Figure 1.)
4. Clean the tip. Procedure 2.8.
5. Flux and tack the leads at opposing corners to fix the component to the board. (See Figure 2.)
6. Apply enough solder to cover approximately one-third of the tip. The amount of solder will vary with the number and pitch of the leads. For fewer leads, or finer pitch leads, apply less solder. Place the solder at the edge of the tip face that will meet the leads, rather than directly at the tip. (See Figure 3.)
7. Flux the first row of leads to be soldered. Start the soldering process with a row that has not been tacked, or from the opposite end of the row from the tack if the component only has two rows of leads.
8. Bring the tip down at an angle to the point where the toe of the lead meets the land, so that the edge with solder on it is on the land, but the face is tilted away from the component. The side of the tip will be in contact with the lead. (See Figure 4.)
9. Hold the tip so the shaft runs parallel to the row of leads, that is, with the side of the tip toward the side of the component. The angle between the side of the tip

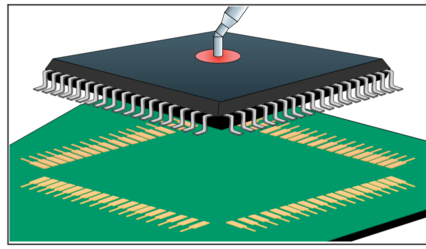


**Figure 1 Align Component**

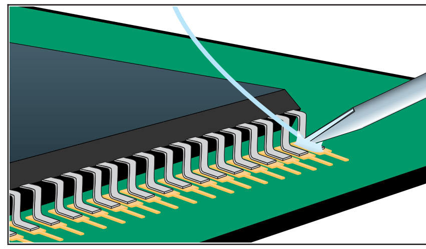


**Figure 2 Flux & Tack 2 Corner Leads**

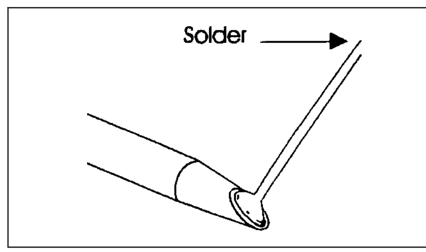



**Figure 3 Apply Solder to 1/3 Tip**

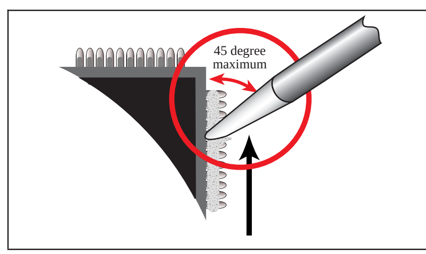



**Figure 4 45° or Less**

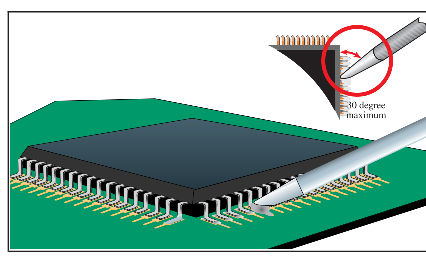



**Figure 5 Draw Tip Side Down Toes**

and the side of the component would ideally be zero for maximized heat transfer, but can be up to 30° depending on operator preference. (See Figure 5.)

10. Immediately begin running the tip down the toes of the leads. Do not apply pressure to the leads.
11. Repeat steps 5 through 10 for each row of leads.
12. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

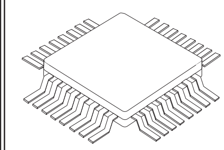
7711
Rework

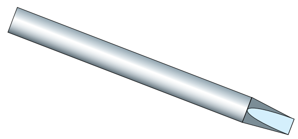
Revision: **B**
Date: 11/07

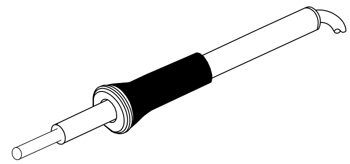
Number: **5.5.3**

# Gull Wing Installation

## Point-to-Point Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### QUIPMENT REQUIRED

Soldering system
Chisel tip
Vacuum pick-up tool

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Install chisel tip into soldering handpiece.
2. Start with temperature of approximately 315°C and change as necessary.
3. Position component ensuring proper lead-to-land alignment. Hold component in place using the vacuum pick up tool or tweezers. (See Figure 1.)
4. Apply flux and tack solder opposing corner leads. (See Figure 2.)
5. Apply flux to remaining lead/land areas of the row to be soldered. (See Figure 3.)
6. Clean the tip, Procedure 2.8.
7. Position chisel tip on lead. Apply solder to side of lead/land area to form proper solder fillet. (See Figure 4.)
8. Repeat step 7 on remaining leads of component.
9. Re-tin chisel tip with solder.
10. Clean as applicable and inspect to established workmanship requirements.

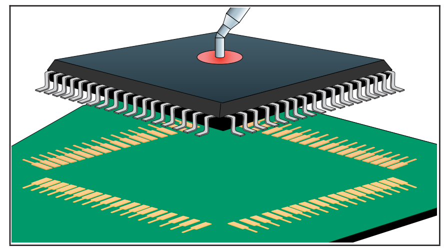


**Figure 1 Position Component**

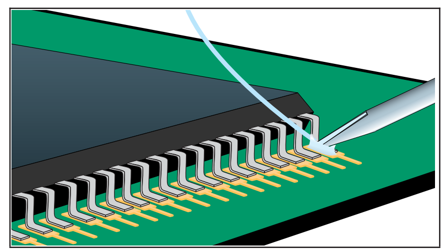


**Figure 2 Tack Lead**

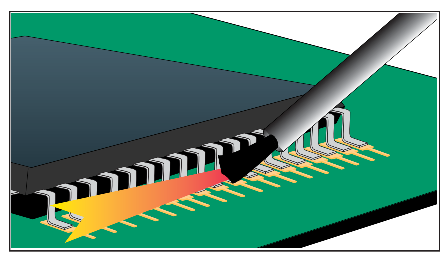


**Figure 3 Apply Flux**

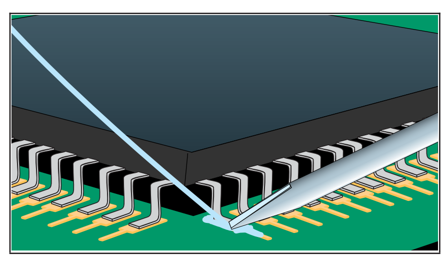


**Figure 4 Solder Leads**

**NOTES**

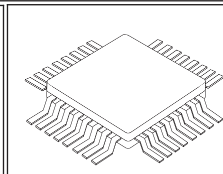
7711
Rework

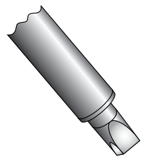
Revision: B
Date: 11/07

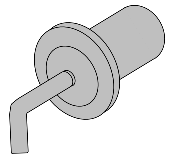
Number: **5.5.4**

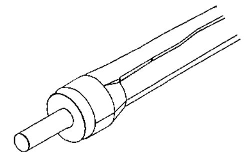
# Gull Wing Installation

## Solder Paste Method/Hot Air Pencil









Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT NEEDED

Hot air pencil
Hot air tip
Liquid dispensing system
Tweezers
Vacuum pick-up tool

### OPTIONAL EQUIPMENT

Manual solder paste dispenser

### MATERIALS

Solder paste
Cleaner
Solder paste dispense needles
Tissue/wipe

### PROCEDURE

1. Install tip into hot air pencil.
2. Set heater temperature of approximately 315°C and change as necessary.
3. Apply a small bead of solder paste along the land pattern using a dispenser. (See Figure 1.)
4. Position component onto lands using a vacuum pick up tool or tweezers. (See Figure 2.)
5. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the component or causing damage to the board, component, conductor, etc. For additional information see the hot pencil manufacturer's operating instructions.
6. Direct hot air over component with tip at a distance of 2.5 cm to pre-dry solder paste. (See Figure 3.)
7. When pre-drying is observed (paste has dull, flat appearance), move tip closer (0.5 cm) and heat until complete solder melt is observed. (See Figure 4.)
8. Clean, if required, and inspect.
9. Clean as applicable and inspect to established workmanship requirements.

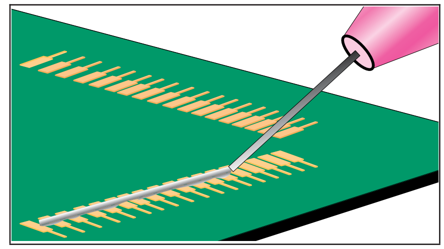


**Figure 1 Apply Solder Paste**

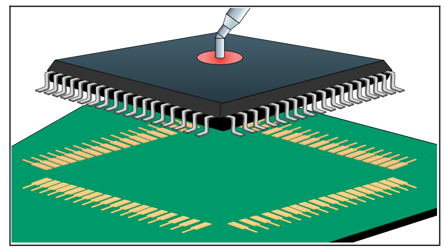


**Figure 2 Position Component**

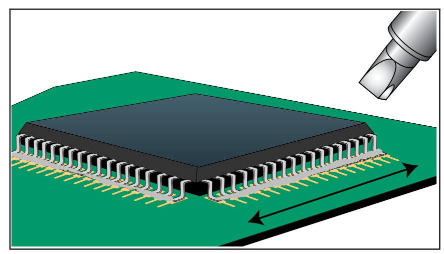


**Figure 3 Pre-dry Paste**

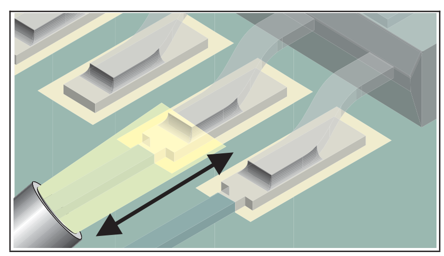


**Figure 4 Melt Joints**

**NOTES**

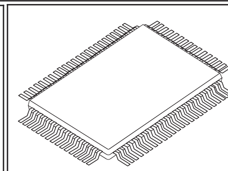
7711
Rework

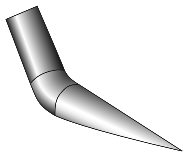
Revision: **B**
Date: 11/07

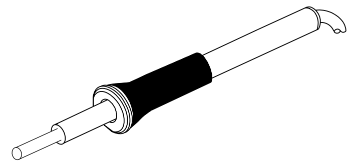
Number: **5.5.5**

# Gull Wing Installation

## Hook Tip w/Wire Layover







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Hook tip

### MATERIALS

Solder form wire recommended less than 0.4 mm
Flux-cored solder
Flux

### NOTES

The type of vision assistance will vary with the pitch of the components to be soldered and should be determined by the needs of each assembly and/or operator.

The amount of flux necessary is minimal.

### PROCEDURE

1. Install tip into handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Begin by applying flux to a corner land, then place a light bump of solder evenly across the land. This will be the first of two points that will fix the component to the board. (See Figure 1.)
4. Align the component to the lands. Since one lead will be resting on a solder bump, do not expect proper coplanarity at this point.
5. When the component is properly aligned, lightly flux the prepped land and the lead over it and bring a clean tip down to the land, in front of the toe of the lead. Do not contact the lead – heat only the land. (See Figure 2.)
6. Clean the tip, Procedure 2.8.
7. Move to the diagonally opposite corner lead from the one that was just tacked. Reposition the component if the alignment has wandered, and lightly flux the lead. Place a lightly tinned tip on the land in front of the lead, allow it to absorb heat for a moment, then feed solder wire to the land at the gap between the tip and the lead to create the second fixturing joint. (See Figure 3.)
8. Lightly flux the first row of leads to be soldered. (See Figure 4.)
9. Lay the solder wire along the inside of the curve that forms the lead's heel.

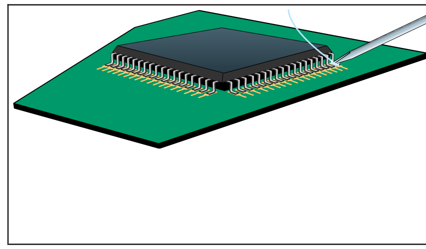


**Figure 1 Start at Corners**

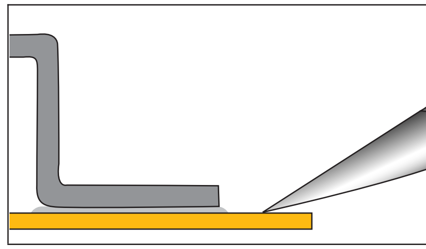


**Figure 2 Heat Only Land**

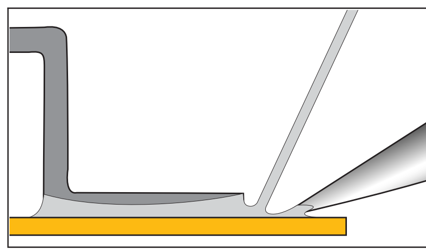


**Figure 3 Feed Solder into Gap**

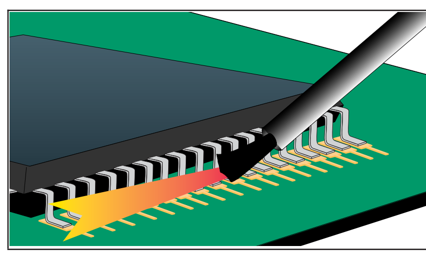


**Figure 4 Flux Leads**

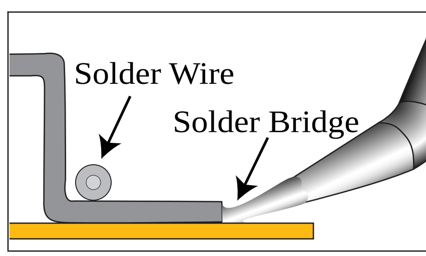



**Figure 5 Align Tip Lead**

10. Tin the tip lightly to create a solder bridge that will facilitate heat transfer.
11. Skipping the tacked leads, move down the row, placing the tip on each land consecutively, abutting the toe of lead. When the joint is properly formed, move to the next lead until the row is completed. (See Figure 5.)
12. Repeat steps 6 through 9 on each row.
13. Clean as applicable and inspect to established workmanship requirements.

**NOTES**

IPC

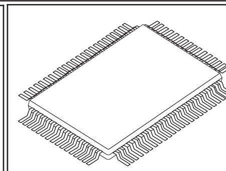
**7711**
Rework

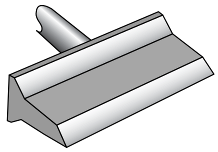
Revision: **B**
Date: 11/07

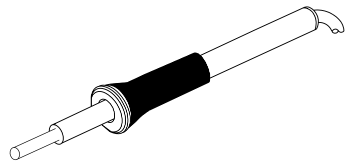
Number: **5.5.6**

# Gull Wing Installation

## Blade Tip with Wire







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system(s)
1 or 2 Soldering handpieces
Blade tip

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Select a blade tip appropriate for the component being soldered and the clearances available on the board. The tip should allow each row to be soldered in one pass. (See Figure 1.)
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Tin the tip on the beveled edge and clean the surface on the sponge, Procedure 2.8. If this does not produce a clean shiny surface use the manufacturer's recommended methods to remove any oxidation and/or discoloration. (See Figure 2.)
4. Flux the row to be soldered. (See Figure 3.)
5. Place solder wire across the row of leads at the first bend that is in contact with the lands. (See Figure 4.)
6. Bring the clean tip, free of any solder, bevel face down on the solder wire at the inside bend of the joint. Hold for a moment, until the solder has wetted to the leads and lands.
7. Keeping the bevel flat on the leads, draw the blade toward the toe and off the end of the lead.
8. Clean as applicable and inspect to established workmanship requirements.

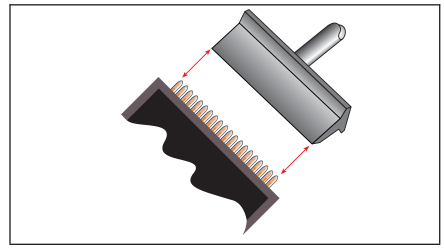


**Figure 1 Select Tip**

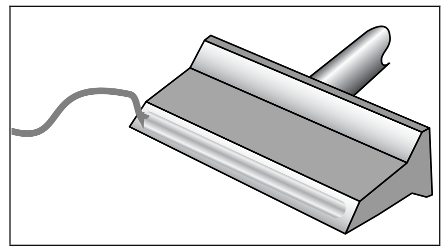


**Figure 2 Tin Tip**

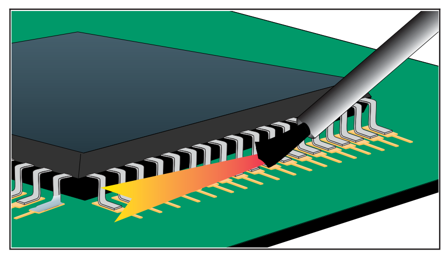


**Figure 3 Apply Flux**

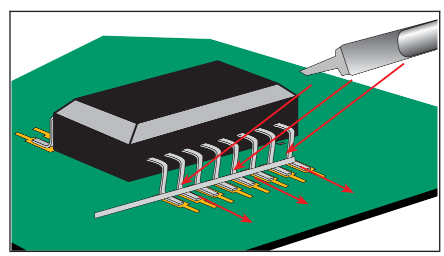


**Figure 4 Place Solder**

**NOTES**

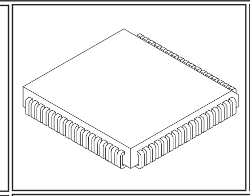
7711
Rework

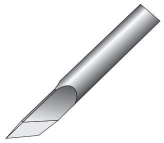
Revision: **B**
Date: 11/07

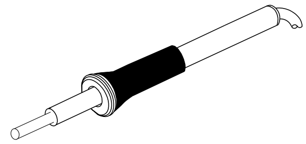
Number: **5.6.1**

# J-Lead Installation

## Solder Wire Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Flat blade surface mount installation tip
Vacuum pick-up tool
Damp sponge

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder (0.7 mm suggested)
Flux
Cleaner

### PROCEDURE

1. Install selected flat blade tip into soldering handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Position component ensuring proper lead-to-land alignment. Hold component in place using the vacuum pick-up tool or tweezers. (See Figure 1.)
4. Apply flux and tack solder opposing corner leads. (See Figure 2.)
5. Apply flux to remaining lead/land areas of the row to be soldered. (See Figure 3.)
6. Cut a piece of flux-cored solder approximately 3/4 the length of one side of the component.
7. Place the piece of solder onto the lead/land junctions of the side to be soldered. (See Figure 4.)
8. Clean the tip, Procedure 2.8.
9. Place tip on the first lead/land junction of the side. Observe solder melt. Slowly move tip along remaining lead/land junctions to form proper solder fillets at each joint. (See Figure 5.)
10. Repeat steps 5 - 9 on remaining sides of component.
11. Re-tin tip.
12. Clean as applicable and inspect to established workmanship requirements.

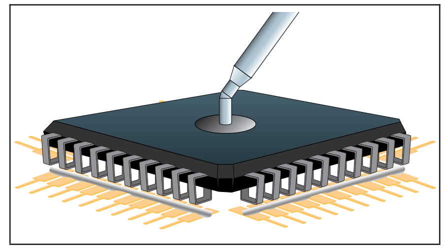


**Figure 1 Position Component**

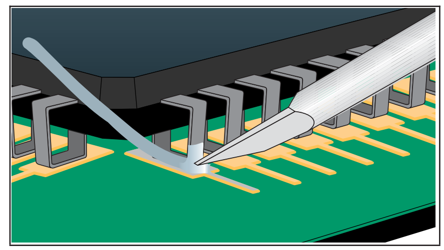


**Figure 2 Tack Lead**

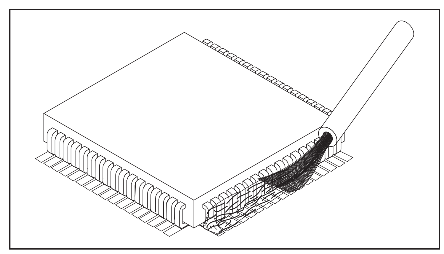


**Figure 3 Apply Flux**

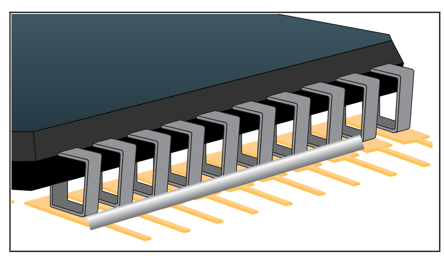


**Figure 4 Solder Application**

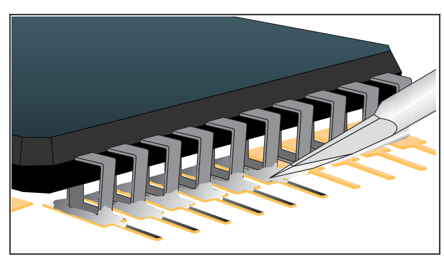


**Figure 5 Solder Leads**

**NOTES**

IPC

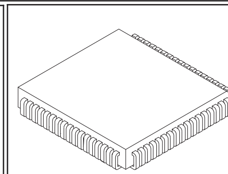
7711
Rework

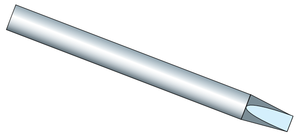
Revision: **B**
Date: 11/07

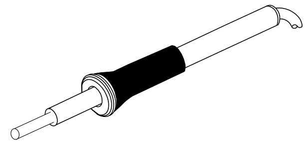
Number: **5.6.2**

# J-Lead Installation

## Point-to-Point Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Damp sponge
Chisel tip
Vacuum pick-up tool

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE

1. Install chisel tip into soldering handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Position component ensuring proper lead-to-land alignment. Hold component in place using the vacuum pick-up tool or tweezers. (See Figure 1.)
4. Apply flux and tack solder opposing corner leads. (See Figure 2.)
5. Apply flux to remaining lead/land areas of the row to be soldered. (See Figure 3.)
6. Clean the tip, Procedure 2.8.
7. Position chisel tip at intersection of lead and land. Apply solder to side of lead/land area to form proper solder fillet. (See Figure 4.)
8. Repeat step 7 on remaining leads of component.
9. Re-tin chisel tip with solder.
10. Clean as applicable and inspect to established workmanship requirements.

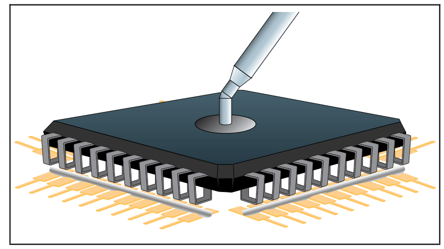


**Figure 1 Position Component**

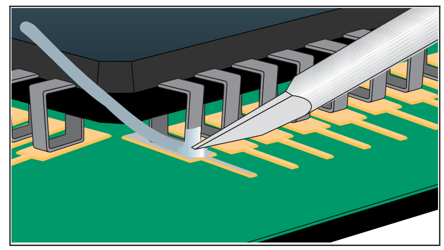


**Figure 2 Tack Lead**

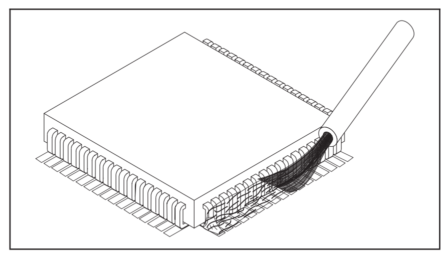


**Figure 3 Apply Flux**

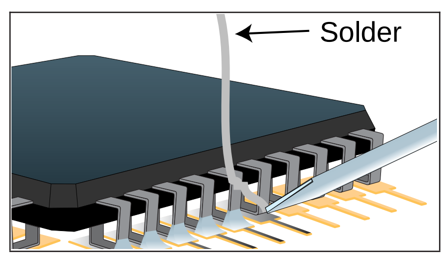



**Figure 4 Solder Leads**

**NOTES**

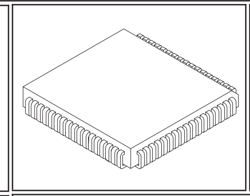
7711
Rework

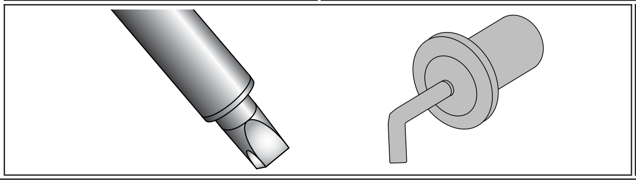
Revision: **B**
Date: 11/07

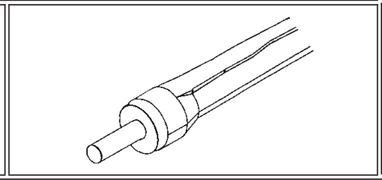
Number: **5.6.3**

# J-Lead Installation

## Solder Paste Method/Hot Air Pencil







Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot air pencil
Hot air tip
Solder paste dispenser

### OPTIONAL EQUIPMENT

Tweezers

### MATERIALS

Solder paste
Cleaner
Tissue/wipe

### PROCEDURE

1. Install tip into hot air pencil.
2. Set heater temperature of approximately 315°C and change as necessary.
3. Apply a small bead of solder paste along the land pattern using a dispenser. (See Figure 1.)
4. Position component onto lands using a vacuum pick up tool or tweezers. (See Figure 2.)
5. Adjust temperature setting and pressure output as needed to achieve solder flow without movement of the component or causing damage to the board, component, conductor, etc. For additional information see the hot pencil manufacturer's operating instructions.
6. Direct hot air over solder paste/component termination at a distance of 2.5 cm to pre-dry solder paste. (See Figure 3.)
7. When pre-drying is observed (paste has dull, flat appearance), move tip closer (0.5 cm) and heat until complete solder melt is observed. (See Figure 4.)
8. Clean as applicable and inspect to established workmanship requirements.

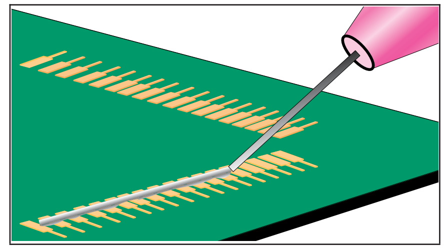


**Figure 1 Apply Solder Paste**

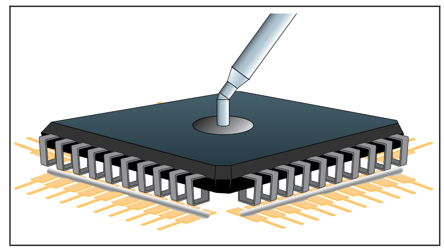


**Figure 2 Position Component**

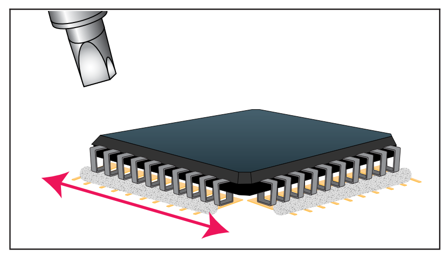


**Figure 3 Pre-dry Paste**

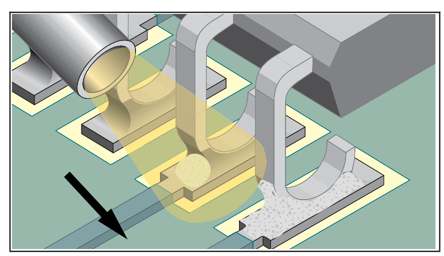


**Figure 4 Melt Joints**

## NOTES

IPC

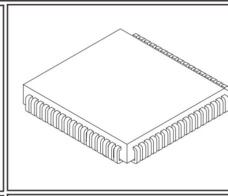
**7711**
Rework

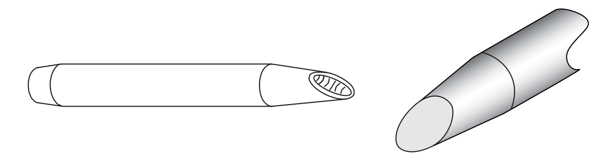
Revision: **B**
Date: 11/07

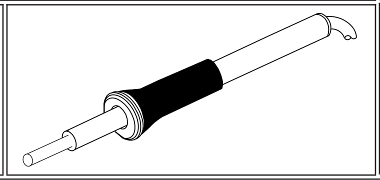
Number: **5.6.4**

# J-Lead Installation

## Multi-Lead Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Flat faced tip or cup
Flux
Flux-cored solder

### MATERIALS

Cleaner
Tissue/wipe
Flux-cored solder

### PROCEDURE

1. Install tip into soldering handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Align the component carefully and solder it to the board at diagonally opposite corners to fix it in place. (See Figure 1.)
4. Clean the tip, Procedure 2.8.
5. Apply solder to the face of the tip to cover approximately 1/2 of the face, keeping the solder down toward the end of the tip, and add about the same amount to the top end of the tip, also at the heel. The precise amount of solder will vary between different types of components. (See Figure 2.)
6. Work with one side at a time, and start with a side that does not include a tacked joint.
7. Bring the tip in at a 45° angle in relation to the row of leads. The tip will make contact with the leads and lands where they meet. (See Figure 3.)
8. Maintaining the same angle, draw the tip down the row of leads slowly and steadily. (See Figure 4.)
9. Clean as applicable and inspect to established workmanship requirements.

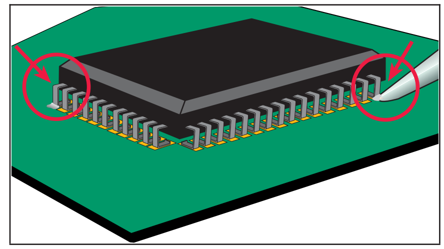


**Figure 1 Solder at Corners**

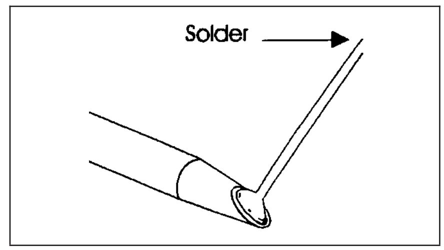



**Figure 2 Apply Solder to Tip**

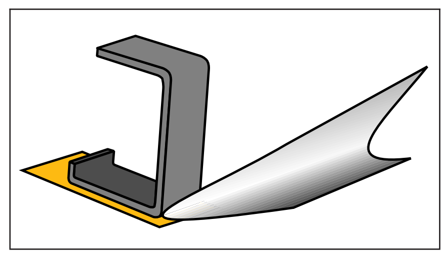


**Figure 3 Tip in Contact with Heel**

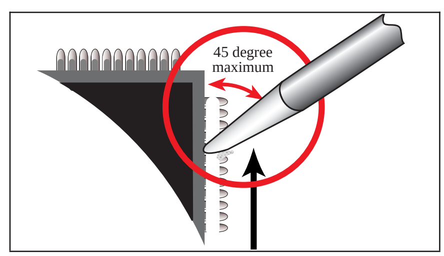



**Figure 4 Draw Tip Down**

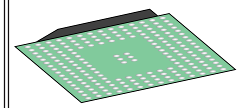
**NOTES**

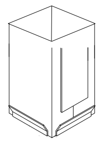
Revision: **B**
Date: 11/07

Number: **5.7.1**

# BGA/CSP Installation

## Using Solder Wire to Prefill Lands





Board Type: R,F,W,C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot air or hot gas reflow system (representative examples shown by Figures 1-4)
Gas focusing nozzle (sized to BGA dimensions)
Gas supply (if other than ambient atmosphere)
Preheat method (oven, hotplate, high intensity lamp)

### OPTIONAL EQUIPMENT

Bake-out (vacuum, convection) oven
X-ray inspection system
Forced (ambient) air cooling system
Inert gas supply, if used
Microscope/vision system

### MATERIALS

Flux-cored solder
Flux
Cleaner

### PROCEDURE SUMMARY

The procedure outlined below is generic in nature and identifies the procedural steps which need be accomplished to effect BGA or CSP installation. Each step must be tailored to accommodate the attributes and characteristics of the specific system being used (system manufacturers will customarily provide generalized operating procedures which must be further refined to achieve optimum results).

### PROCEDURAL PRECONDITIONS

The following preconditions need to be accomplished prior to performing the procedure:

**NOTE:** If plastic body components are used, see J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for more information on moisture sensitivity and conditioning the chip and PWB for detachment.

1) Bake the PWA to remove entrained moisture which may, if not removed, precipitate measling or delamination.

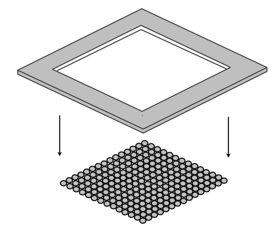


**Figure 1 Align Template**

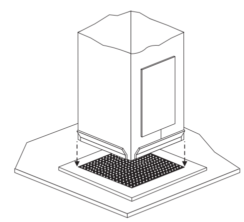


**Figure 2 Align Nozzle**

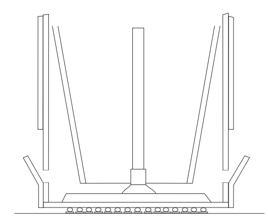


**Figure 3 Ball/Land Contact**

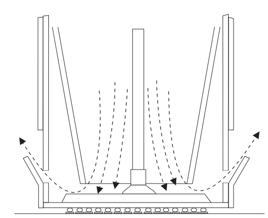


**Figure 4 Begin Reflow**

## PROCEDURE STEPS

**NOTE:** Some systems do not include integrated preheating capability and it may be necessary to preheat the PWA and BGA separately.

1. Prefill lands with flux-cored solder, clean PWA surface and inspect.
2. Place the PWA in the system work piece holder.
3. Coat the prefilled lands with flux.
4. Set hot gas reflow system to achieve the TTP defined by procedural analysis.
5. Perform alignment of gas nozzle to component location (use template, vision system or x-y locator as available/appropriate).
6. Using component placement aids available (vacuum placement pick, x-y locator, etc.), place BGA onto land area while observing indexing/keying indicators to assume proper theta orientation.
7. Bring gas focusing nozzle into reflow position and align nozzle with component.
8. Perform TTP reflow cycle defined by procedural analysis.
9. Perform accelerated cooling cycle if appropriate.
10. Perform x-ray inspection of PWA if appropriate.
11. Clean as applicable and inspect to established workmanship requirements.

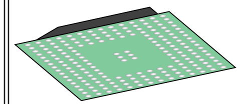
## NOTES

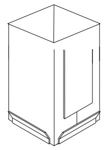
7711
Rework

Revision: **B**
Date: 11/07
Number: **5.7.2**

# BGA/CSP Installation

## Using Solder Paste to Prefill Lands





Board Type: R,F,W,C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Hot air or hot gas reflow System (representative examples shown by Figures 1-4)
Gas focusing nozzle (sized to BGA dimensions)
Gas supply (if other than ambient atmosphere)
Preheat method (oven, hotplate, high intensity lamp)

### OPTIONAL EQUIPMENT

Bake-out (vacuum, convection) oven
X-ray inspection system
Forced (ambient) air cooling system
Inert gas supply, if used
Microscope/vision system

### MATERIALS

Solder paste
Cleaner

### PROCEDURE SUMMARY

The procedure outlined below is generic in nature and identifies the procedural steps which need be accomplished to effect BGA or CSP installation. Each step must be tailored to accommodate the attributes and characteristics of the specific system being used (system manufacturers will customarily provide generalized operating procedures which must be further refined to achieve optimum results).

### PROCEDURAL PRECONDITIONS

The following preconditions need to be accomplished prior to performing the procedure:

**NOTE:** If plastic body components are used, see J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices* for more information on moisture sensitivity and conditioning the chip and PWB for detachment.

1) Bake the PWA to remove entrained moisture which may, if not removed, precipitate measling or delamination.

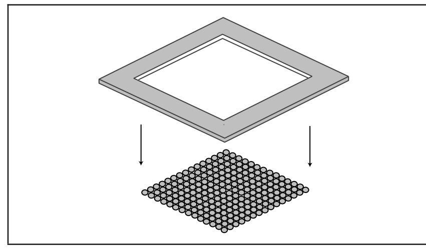


**Figure 1 Align Template**

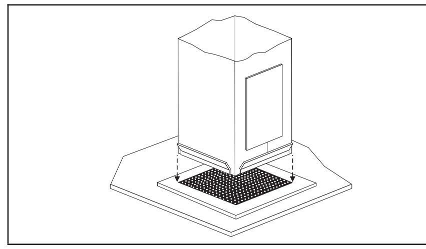


**Figure 2 Align Nozzle**

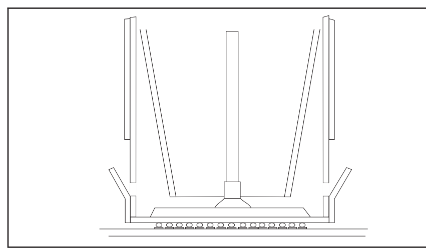


**Figure 3 Ball/Land Contact**

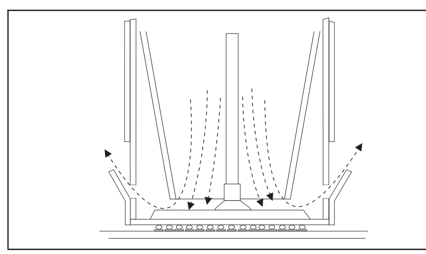


**Figure 4 Begin Reflow**

## PROCEDURE STEPS

**NOTE:** Some systems do not include integrated preheating capability and it may be necessary to preheat the PWA and BGA separately.

1. Clean PWA surface and lands.
2. Apply solder paste (stencil, screen, dot dispense, as appropriate).
3. Place the PWA in the system work piece holder.
4. Set hot gas reflow system to achieve the TTP defined by procedural analysis.
5. Perform alignment of gas nozzle to component location (use template, vision system or x-y locator as available/appropriate).
6. Using component placement aids available (vacuum placement pick, x-y locator, etc.), place BGA onto land area while observing indexing/keying indicators to assume proper theta orientation.
7. Bring gas focusing nozzle into reflow position and accomplish fine alignment.
8. Perform TTP reflow cycle defined by procedural analysis.
9. Perform accelerated cooling cycle if appropriate.
10. Clean PWA as appropriate to customer requirements.
11. Perform x-ray inspection of PWA if appropriate.
12. Clean as applicable and inspect to established workmanship requirements.

## NOTES

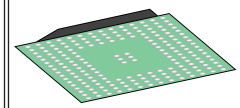
7711
Rework

Revision: **B**
Date: 11/07

Number: **5.7.3**

# BGA Reballing Procedure

## Fixture Method



Board Type: R, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Solder removal system
Convective reflow station
Reballing fixture

### OPTIONAL EQUIPMENT

Reflow oven
Bake-out (vacuum, convection) oven

### MATERIALS

Flux
Cleaner
Tissue/wipes
Solder spheres

### NOTE

Moisture sensitive components (as classified by IPC/JEDEC J-STD-020 or equivalent documented procedure) must be handled in a manner consistent with J-STD-033 or an equivalent documented procedure.

### CAUTION

Verify component can withstand the multiple reflow cycles.

### PROCEDURE

1. Remove excess solder in accordance with procedures 4.1.2, 4.1.3, or 4.2.1
2. Clean and inspect BGA for coplanarity.
3. Apply flux to land on BGA. (Figure 1.)
4. Insert the BGA into the applicable reballing fixture and secure. (Figure 2.)
5. Carefully pour solder sphere into fixture. (Figure 3.)
6. Drain off all excess spheres. Ensure all holes in fixture have a solder sphere.
7. Reflow solder spheres using the established profile. (Figure 4.)
8. Allow BGA to cool and remove from fixture.
9. Clean as applicable and inspect to established workmanship requirements.

**Figure 1**

**Figure 2**

**Figure 3**

**Figure 4**

**NOTES**

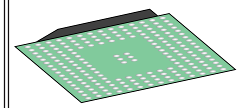
**7711**
Rework

Revision: **B**
Date: 11/07

Number: **5.7.4**

# BGA Reballing Procedure

## Paper Carrier Method



Board Type: R, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Solder removal system
Convective reflow station

### OPTIONAL EQUIPMENT

Reflow oven
Bake-out (vacuum, convection) oven

### MATERIALS

Flux
Cleaner
Tissues/wipes
Fixture/alignment template to suit component
Solder ball paper carrier to suit component

### NOTE

Moisture sensitive components (as classified by IPC/JEDEC J-STD-020 or equivalent document procedure) must be handled in manner consistent with J-STD-033 or an equivalent documented procedure.

### CAUTION

Verify component can withstand multiple reflow cycles.

### PROCEDURE

1. Remove excess solder in accordance with procedures 4.1.2, 4.1.3, or 4.2.1.
2. Clean and inspect BGA for coplanarity.
3. Place suitable solder ball paper carrier into fixture (ensuring paper carrier is the correct way up). (See Figures 1 and 2.)
4. Apply flux to lands on BGA. (See Figure 3.)
5. Place BGA into fixture. (See Figure 4.)

   **NOTE**

   If the BGA is to be reflowed in a reflow oven, place the BGA onto a flat perforated surface in the oven with the solder balls lowermost (down). (See Figure 5.) Alternatively, the component may be supported with a pedestal or spacer and oriented with balls uppermost. (See Figure 6.)

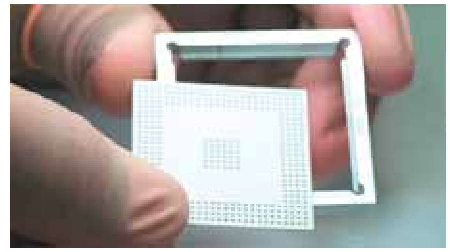


**Figure 1**

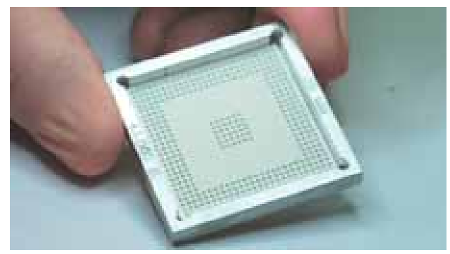


**Figure 2**

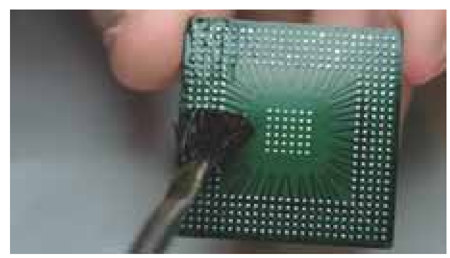


**Figure 3**

**Figure 4**

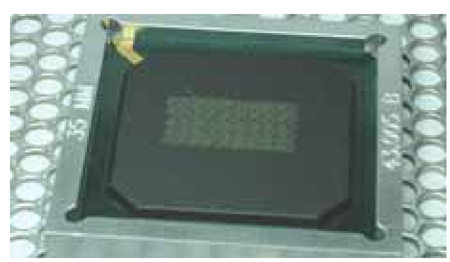


**Figure 5**

If a hot gas rework machine is to be used to reflow, place the BGA with the solder balls uppermost and lower the nozzle to approximately 1 mm from the BGA surface. (See Figure 5.) Support the backside of the component with a pedestal or spacer so that the weight of the fixture rests on the perimeter of the paper carrier. (See Figure 6.)

6. Reflow BGA using established profile.
7. Allow BGA to cool and remove from fixture.
8. Apply deionizer water to paper carrier.
9. When paper carrier has softened (approximately 30 seconds) carefully peel off the paper using tweezers. (See Figure 7.)
10. Clean and inspect the BGA.
11. Bake BGA if necessary.

**Figure 6**

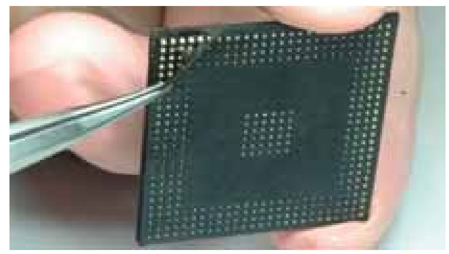


**Figure 7**

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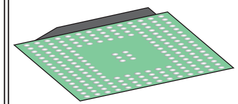
Rework

Revision: **B**
Date: 11/07

Number: **5.7.5**

# BGA Reballing Procedure

## Polyimide Stencil Method



Board Type: R, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Solder removal system
Convective reflow station
Reballing fixture and stencil (to suit BGA footprint)
ESD safe soft bristle brush

### OPTIONAL EQUIPMENT

Reflow oven
Bake-out (vacuum, convection) oven

### MATERIALS

Flux (tacky or gel type)
Cleaner
Tissue/wipes
Solder spheres (size to suit BGA)

### NOTE

Moisture sensitive components (as classified by IPC/JEDEC J-STD-020 or equivalent documented procedure) must be handled in a manner consistent with J-STD-033 or an equivalent documented procedure.

### CAUTION

Verify component can withstand the multiple reflow cycles.

### PROCEDURE

1. Remove excess solder in accordance with procedures 4.1.2, 4.1.3, or 4.2.1.
2. Clean and inspect BGA.
3. Brush tacky flux onto BGA lands. (Figure 1.)
4. Place BGA onto reballing fixture.
5. Carefully pour solder spheres onto the underside of BGA; soft bristle ESD safe brush can be used to sweep the spheres into the apertures of the stencil fixture. (Figure 2.)
6. Carefully pour off excess spheres (ensuring that each aperture in the fixture has captured a single sphere. (Figure 3.)

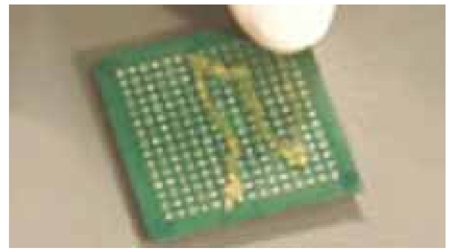


**Figure 1**

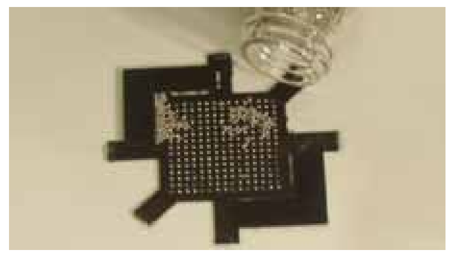


**Figure 2**

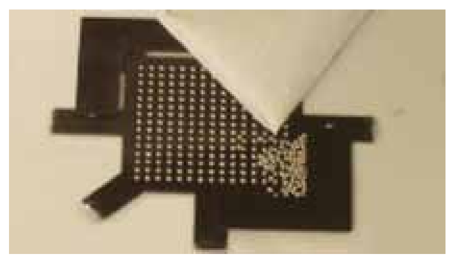


**Figure 3**

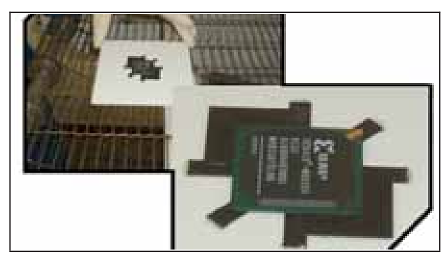


**Figure 4**

7. Place fixture onto the reflow station or into a reflow oven and reflow using the established profile. (Figure 4.)
8. Allow to cool and remove BGA from stencil fixture.
9. Clean excess flux from underside of BGA and inspect.

**NOTES**

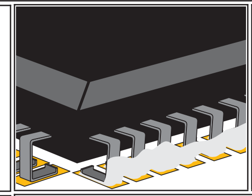
7711
Rework

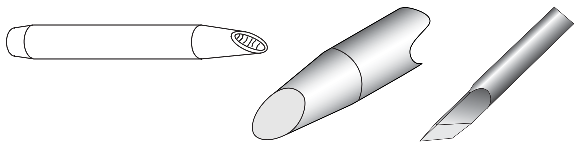
Revision: B
Date: 11/07

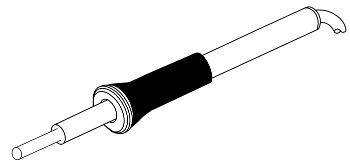
Number: **6.1.1**

# Removing Shorts on J-Leads

## Draw Off Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Appropriate tip*

### MATERIALS

Flux
Cleaner

### NOTES

*Choice of the proper tip is based on tools available and the number of bridged leads. See tips illustrated above.

### PROCEDURE

1. Install appropriate tip.
2. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary. The surface attraction of the solder to the tip must overcome that of the leads.
3. Clean the tip, Procedure 2.8.
4. Apply flux to the bridged leads. (See Figure 1.)
5. Bring the tip in with the bottom as flat as space will permit, with the toe towards the component and between the bridged leads. When using the scalpel tip, the flat bottom instead of the toe is towards the component. (See Figure 2.)
6. With the bottom still flat, stand the tip up so the side contacts the shoulders of the leads and the bridge between them.
7. After a brief pause to allow the solder to flow to the tip surface, gently move the tip straight out from the component body, drawing the bridge with it. (See Figure 3.)
8. If you did not draw off enough solder, allow leads to cool and repeat steps 2-5.
9. Clean as applicable and inspect to established workmanship requirements.

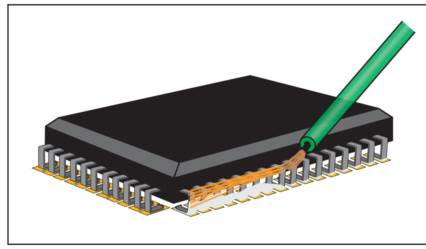


**Figure 1 Apply Flux**

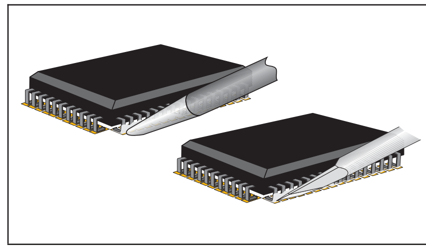


**Figure 2 Tip Should Be Flat**

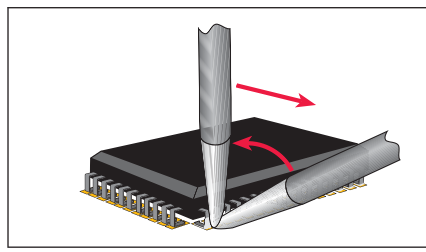


**Figure 3 Move tip**

## NOTES

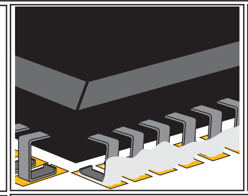
**7711**
Rework

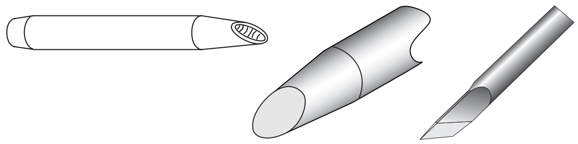
Revision: **B**
Date: 11/07

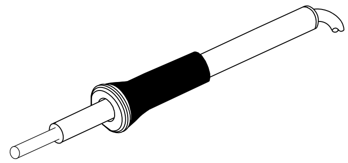
Number: **6.1.2**

# Removing Shorts on J-Leads

## Respread Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering iron
Appropriate tip*

### MATERIALS

Flux
Cleaner

### NOTES

*Choice of the proper tip is based on tools available and the number of bridged leads. See tips illustrated above.

### PROCEDURE

1. Install appropriate tip.
2. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary. The surface attraction of the solder to the tip must overcome that of the leads.
3. Clean the tip, Procedure 2.8.
4. Apply flux to the bridged leads. (See Figure 1.)
5. Bring the tip in at a 45° angle in relation to the row of leads. The side of the tip will make contact with the leads, the toe with the lead and the land.
6. Draw the tip, and the liquid bridge with it, down the row, respreading the solder across the rest of the leads. (See Figure 2.)
7. Clean as applicable and inspect to established workmanship requirements.

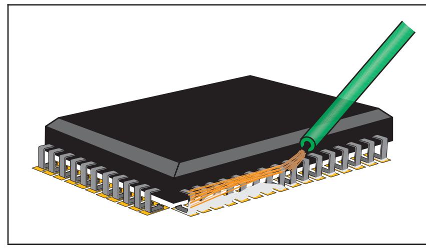


**Figure 1 Apply flux**

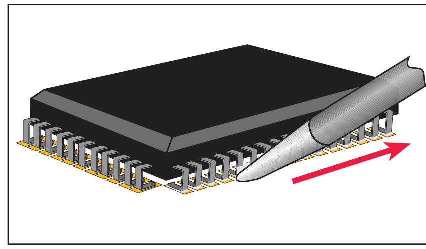


**Figure 2 Draw Tip Down Row**

**NOTES**

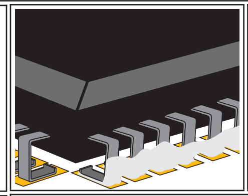
7711
Rework

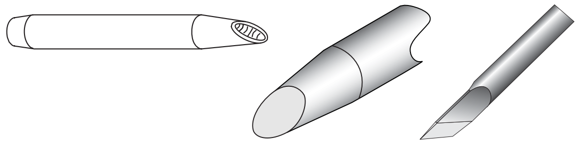
Revision: **B**
Date: 5/06

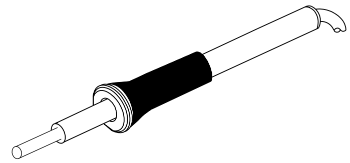
Number: **6.1.2.1**

# Removing Shorts on J-Leads

**Braid Method**







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering System
Chisel or Conical Tip as needed

## MATERIALS

Flux
Braid
Cleaning Solution
Solder Wire

## PROCEDURE

**Note:** This procedure works well for bridges that are not easily removed by other methods.

Select the proper braid size to match the bridge.

1. Install soldering tip into handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Apply a small amount of flux to the short or bridge.
4. Place the end of the braid on top of the bridge to be removed.
5. Clean the tip, Procedure 2.8.
6. Place the Iron tip on top of the braid over the bridge.
7. When observable solder flow due to wicking action has ceased, remove both the tip and the braid at the same time. (Figure 1.)
8. Clean as applicable and inspect to established workmanship requirements.

**Figure 1 Remove Braid and Iron**

| | |
|---|---|
| Number: **6.1.2.1** | Subject: **Removing Shorts on J-Leads** |
| Revision: **B**<br>Date: 5/06 | |

**NOTES**

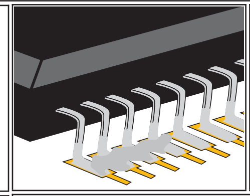
**7711**
Rework

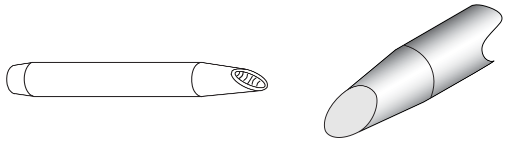
Revision: **B**
Date: 11/07

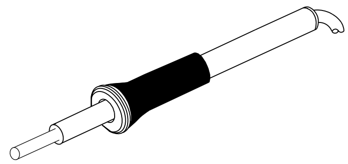
Number: **6.1.3**

# Removing Shorts Between Gull Wing

## Draw Off Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering iron
Cup or flat faced tip

### MATERIALS

Flux
Cleaner

### PROCEDURE

1. Install appropriate tip.
2. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary. The surface attraction of the solder to the tip must overcome that of the leads.
3. Apply flux to the bridged leads. (See Figure 1.)
4. Clean the tip, Procedure 2.8.
5. Hold the tip so the shaft runs parallel to the row of leads, putting the side of the tip toward the side of the component. The angle between the side of the tip and the side of the component can be up to 30 degrees depending on operator preference. (See Figure 2.)
6. Bring the flat surface of the tip down on the bridge, wait for reflow, then draw the bridge gently down the leads and away from the component. (See Figure 3.)
7. If you did not get all the solder on the first try, wipe the excess solder from the tip and repeat the procedure.
8. Clean as applicable and inspect to established workmanship requirements.

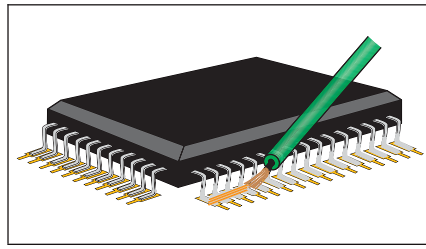


**Figure 1 Apply Flux**

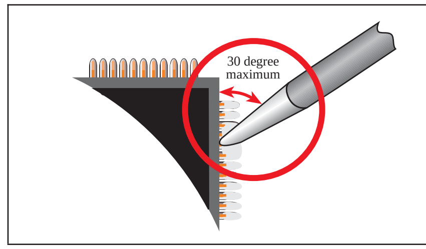



**Figure 2 Hold Tip Parallel**

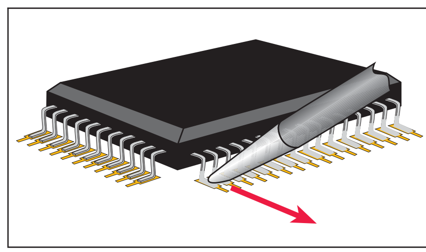


**Figure 3 Draw Tip Away From Component**

**NOTES**

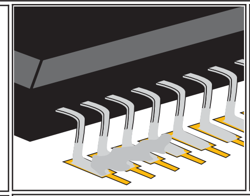
7711
Rework

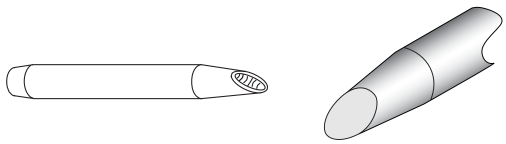
Revision: **B**
Date: 11/07

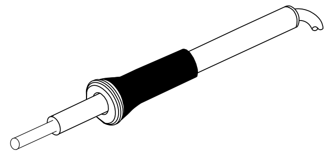
Number: **6.1.4**

# Removing Shorts Between Gull Wing

## Respread Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### EQUIPMENT REQUIRED

Soldering system
Soldering iron
Cup of flat faced tip

### MATERIALS

Flux
Cleaner

### PROCEDURE

1. Install appropriate tip.
2. Start with the coolest tip temperature possible (approximately 280°C) and change as necessary. The surface attraction of the solder to the tip must overcome that of the leads.
3. Clean the tip, Procedure 2.8.
4. Apply flux to the bridged leads. (See Figure 1.)
5. Hold the tip so the toe of the hoof runs parallel to the row of leads, that is, the side of the tip toward the side of the component. The angle between the side of the tip and the side of the component would ideally be zero for maximized heat transfer, but can be up to 30° depending on operator preference. (See Figure 2.)
6. Bring the tip face down flat onto the bridge and pause for reflow. Draw the tip, and the liquid bridge with it, down the row of leads, respreading the solder across the rest of the leads. (See Figure 3.)
7. Clean as applicable and inspect to established workmanship requirements.

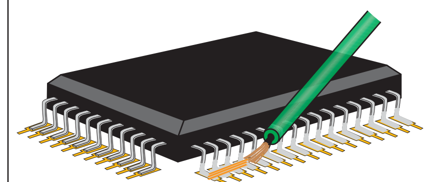


**Figure 1 Apply Flux**

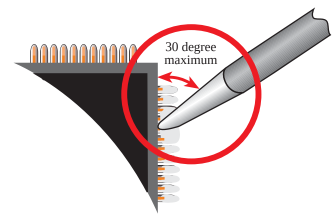



**Figure 2 Hold Tip Parallel**

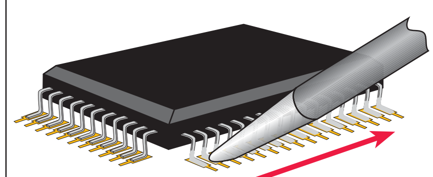


**Figure 3 Draw Tip Down Row**

## NOTES

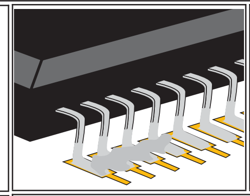
7711
Rework

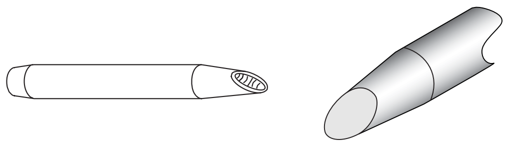
Revision: B
Date: 5/06

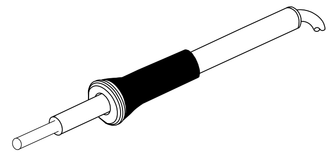
Number: 6.1.4.1

# Removing Shorts on Gull Wings

## Braid Method







Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

### GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

### Equipment Required

Soldering System
Chisel or Conical Tip as needed

### Materials

Flux
Braid
Cleaning Solution
Solder Wire

### Procedure

**Note:** This procedure works well for bridges that are not easily removed by other methods. Select the proper braid size to match the bridge.

1. Install soldering iron tip into handpiece.
2. Start with tip temperature of approximately 315°C and change as necessary.
3. Apply a small amount of flux to the braid.
4. Place the end of the braid on top of the bridge to be removed.
5. Clean the tip, Procedure 2.8.
6. Place the Iron tip on top of the braid over the bridge.
7. When observable solder flow due to wicking action has ceased, remove both the tip and the braid at the same time. (Figure 1.)
8. Clean as applicable and inspect to established workmanship requirements.

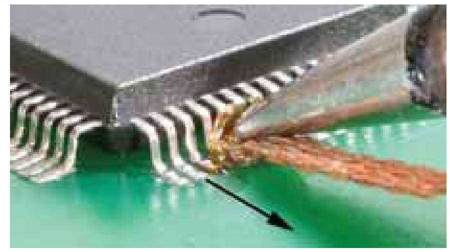


**Figure 1 Remove Braid and Iron**

| | |
|---|---|
| Number: **6.1.4.1** | Subject: **Removing Shorts on Wings** |
| Revision: **B**<br>Date: 5/06 | |

**NOTES**

Revision: **B**

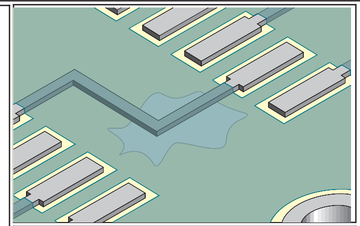
Number: **3.1**

Date: **11/07**

7721

Modification and Repair

# Delamination/Blister Repair, Injection Method



Board Type: R
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to repair mechanical or thermal blisters or delaminations in printed circuit board laminated base materials. The blister is sealed by injecting a low viscosity epoxy into the blister/delamination void.

## CAUTION

This method can only be used when the laminate base material has separated sufficiently to allow the epoxy to flow throughout the void area.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

Ball Mill, #1/2
Cleaner
Cleaning Wipes
Epoxy
Epoxy Cartridge with Tip
Epoxy Injection System, Optional
Hand Held Drill
Heat Lamp
Oven
Scraper
Vacuum Source, Optional

## PROCEDURE

1. Clean the area.
2. Drill into delamination blister with the dental style drill and ball mill. Drill in an area clear of circuitry or components. Drill at least two holes opposite each other around the perimeter of the delamination. (See Figure 1.) Brush away all loose material.

   **CAUTION**
   Be careful not to drill too deep exposing internal conductors or planes.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
3. Bake the printed circuit board to remove any entrapped moisture. Do not allow the printed circuit board to cool prior to injecting the epoxy.

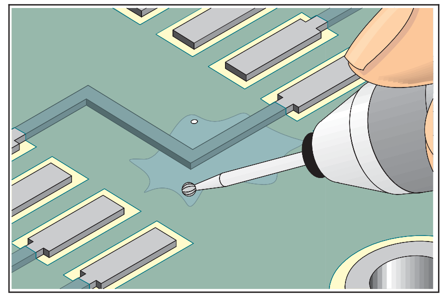


**Figure 1 Drill into the delamination blister**

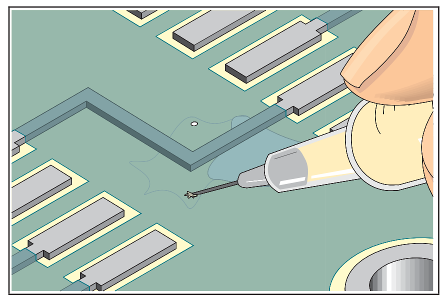


**Figure 2 Inject epoxy into the delamination blister.**

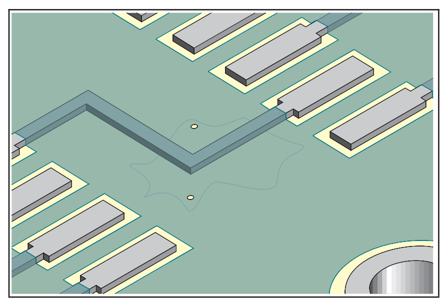


**Figure 3 Completed Repair.**

**CAUTION**
Some components may be sensitive to high temperature.

4. Mix the epoxy. See manufacturers instructions on how to mix epoxy without bubbles.

   **CAUTION**
   Exercise care to prevent bubbles in the epoxy mixture.

5. Pour the epoxy into the epoxy cartridge.
6. Inject the epoxy into one of the holes in the delamination. (See Figure 2.) The heat retained in the printed circuit board will improve the flow characteristics of the epoxy and will draw the epoxy into the void area filling it completely.
7. If the void does not fill completely, the following procedures may be used:
   A. Apply light local pressure on the board surface starting at the fill hole, slowly proceeding to the vent hole.
   B. Apply vacuum to the vent hole to draw the epoxy through the void.
8. Cure the epoxy per the manufacturers recommendation.
9. Scrape away any excess epoxy using a knife or scraper.

**NOTE**

If needed, apply additional thin coating to seal any scrapped areas.

**INSPECTION GUIDELINES**

1. Visual examination for texture and color match.
2. Electrical tests to conductors around the repaired area as applicable.
3. Repair area does not increase or decrease the original board thickness.

**NOTES**

IPC

7721

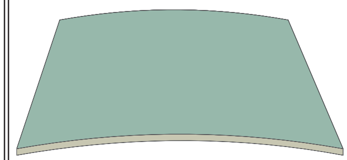
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.2**

# Bow and Twist Repair



Board Type: R, W
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

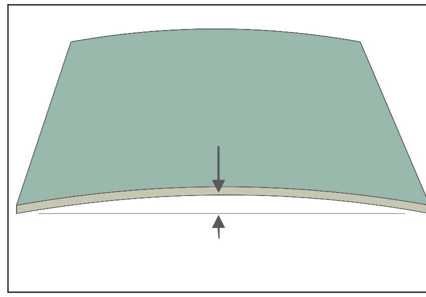


**Figure 1 Check edge deflection for maximum wrap.**

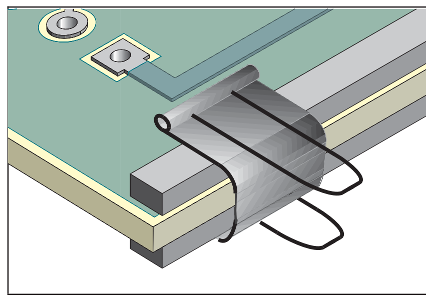


**Figure 2 Clamp restraint bars to edge needing rework.**

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to eliminate, or reduce the bow and twist, or warping of printed circuit boards. The warping is removed by controlled heating and cooling of the printed circuit board while under restraint.

## CAUTION

This repair method is most suitable for FR-4, GE or GF substrate base materials having glass transition temperatures below 125°C. The bake/time cycle will have to be adjusted depending on the base material glass transistion temperature.

## CAUTION

This process uses high temperatures. Some components may be sensitive to high temperature and should be removed if this procedure will adversely affect them.

## CAUTION

High temperatures will cause oxidation of solderable surfaces.

## NOTE

Bow and twist should not be repaired unless sited as a defect.

## REFERENCES

2.1 Handling Electronic Assemblies
2.5 Baking and Preheating

## TOOLS & MATERIALS

| | |
|---|---|
| Base Plate | Restraint Bars |
| Caliper or Pin Gauges | Restraint Clamps |
| Oven | |

## PROCEDURE

1. Check the deflection to determine if rework is needed. (See Figure 1.)

   **NOTE**
   Bare board acceptance standards such as IPC-A-600 and IPC-6012 limit bow and twist to 1.5% for through-hole printed circuit boards and 0.75% for surface mount printed circuit boards. Bow and twist requirements after soldering are in

J-STD-001 and IPC-A-610, and state that bow and twist is acceptable if it does not cause difficulties during placement, soldering and testing operations. Before dispositioning printed circuit boards with bow and twist as scrap, keep in mind how the printed circuit board is mounted in its final destination. Keep in mind ''form, fit and function'' without jeopardizing reliability.

2. Place the restraint bars along the edges that require rework. (See Figure 2.)

   **CAUTION**

   Components or parts that will interfere with the restraint bars should be removed.

3. If the printed circuit board is warped along more than one edge or more than one plane, clamp the entire printed circuit board to the base plate.
4. Place the printed circuit board, restraint bars and base plate into the oven. Bake for 1 hour at 125°C.

   **NOTE**

   If possible, after the 1 hour bake cycle, shut off the oven and leave the printed circuit board inside. This will allow the printed circuit board to slowly cool to room temperature improving stress relief.

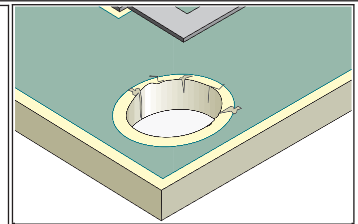
5. Remove from the oven and allow to cool to room temperature.
6. Remove restraint bars.
7. Check the edges deflection using a caliper or pin gauges.

## INSPECTION GUIDELINES

1. Check for marks or damage along edges.
2. Electrical tests as applicable.
3. Check for missing or damaged components prior to electrical tests.

## NOTES

# Hole Repair, Epoxy Method



Board Type: R, W
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to repair cosmetic defects or minor damage to an unsupported tooling or mounting hole. The hole may have component leads, wires, fasteners, pins, terminals or other hardware run through it. This repair method uses high strength epoxy to restore the damaged surface surrounding the hole. This method can be used on single sided, double sided or multilayer printed circuit boards and assemblies.

## CAUTION

Damaged inner-layer connections may require surface wire adds.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills | Polyimide Tape |
| Cleaner | Knife |
| Color Agent, Various Colors | Mixing Sticks |
| Epoxy | Oven |
| Hand Held Drill | Wipes |

## PROCEDURE

1. Clean the area.
2. Mill away the damaged base material using the hand held drill and ball mill. All damaged base board material and solder resist must be removed. No fibers of laminate material should be exposed at the surface peremiter of the hole. (See Figure 1.)

   **NOTE**
   To clearly see that all damaged material has been removed, flood the area with alcohol or solvent. Damaged internal fibers of the base material will show up clearly.
3. Remove all loose material and clean the area.

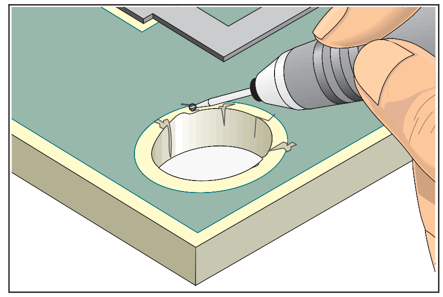


**Figure 1 Mill away damaged material.**

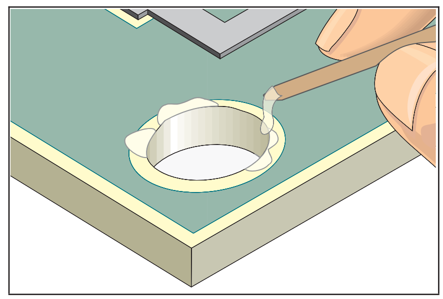


**Figure 2 Apply epoxy with a small wood stick sharpened at one end.**

4. Where needed, apply Polyimide tape to protect exposed parts of the printed circuit board. Tape may be required inside the hole. If epoxy reduces the inside diameter, the hole may have to be redrilled after the epoxy has cured.

   **NOTE**
   The printed wiring board may be preheated prior to filling the area with epoxy. A preheated printed circuit board will allow the epoxy to easily flow and level out. Epoxy applied to an unheated printed circuit board may settle below the printed circuit board surface as the epoxy cures.

   **CAUTION**
   Some components may be sensitive to high temperatures.

5. Mix the epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
6. Coat the area with epoxy up to and flush with the printed circuit board surface. A small wood stick may be used to apply and spread the epoxy. (See Figure 2.)

   **NOTE**
   A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.

7. Cure epoxy per the manufacturers recommended instructions.
8. After the epoxy has cured, remove the tape.
9. If needed, use the knife or scraper and scrape off any excess epoxy. Scrape until the new epoxy surface is level with the surrounding printed circuit board surface.

   **NOTE**
   Apply surface coating to match prior coating as required.

10. Remove all loose material. Clean the area.

## INSPECTION GUIDELINES

1. Visual examination for texture and color match.
2. Hole size measurement to specification
3. Electrical tests to conductors around the repaired area as applicable.
4. Inspect epoxy for proper cure.

## NOTES

IPC

**7721**

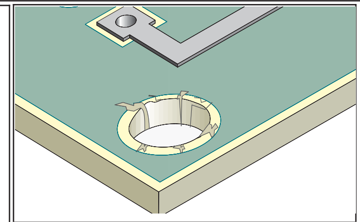
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.3.2**

# Hole Repair, Transplant Method



Board Type: R, W
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to repair severe damage to a hole or to modify the size, shape or location of an unsupported tooling or mounting hole. The hole may have component leads, wires, fasteners, pins, terminals or other hardware run through it. This repair method uses a dowel of matching board material and high strength epoxy to secure the dowel in place. After the new material is bonded in place a new hole can be drilled. This method can be used on single sided, double sided or multilayer printed circuit boards and assemblies.

## CAUTION

Damaged inner-layer connections may require surface wire adds.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Base Material Rod, Various Diameters | Microscope |
| Cleaner | Mixing Sticks |
| Epoxy | Oven |
| Hand Held Drill | Precision Drill Press |
| Polyimide Tape | Razor Saw |
| Knife | Wipes |

## PROCEDURE

1. Clean the area.
2. Drill out the damaged or improperly sized hole using a carbide end mill or drill. Mill the hole using a precision drill press or milling machine for accuracy. The diameter of the cutting tool should be as small as possible yet still encompass the entire damaged area. (See Figures 1 and 2.)

   **NOTE**
   Abrasion operations can generate electrostatic charges.

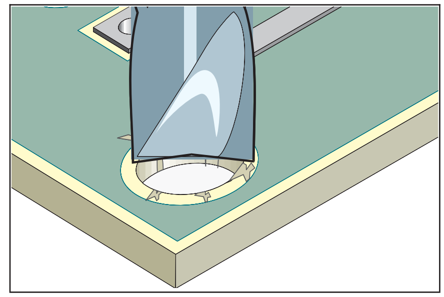


**Figure 1 New hole is milled to encompass entire damaged area.**

**Figure 2 Precision drill press with microscope attachment.**

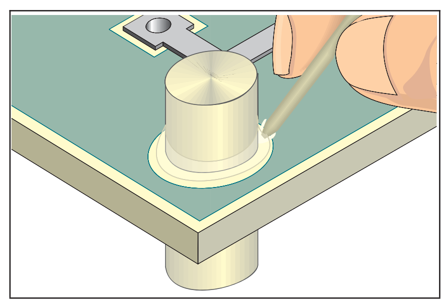


**Figure 3 Place replacement dowel in position and bond with epoxy.**

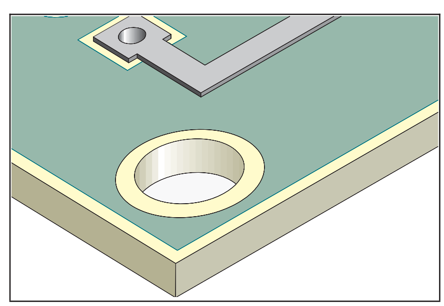


**Figure 4 Cut off excess material and redrill holes as required.**

3. Cut a piece of replacement base material rod. Base material rod is made from FR-4 dowel stock. Cut the length approximately 12.0 mm longer than needed.
4. Clean the reworked area.
5. Use Polyimide tape to protect exposed parts of the printed circuit board bordering the rework area.
6. Mix the epoxy.
7. Coat both the dowel and the hole with epoxy and fit together. Apply additional epoxy around perimeter of new material. (See Figure 3.) Remove excess epoxy.
8. Cure the epoxy per the manufactures instructions.

   **CAUTION**

   Some components may be sensitive to high temperatures.
9. Remove tape and cut off the excess material using the razor saw. Mill or file the dowel flush with the board surface.
10. Complete the procedure by redrilling holes and adding circuitry as required. (See Figure 4.)

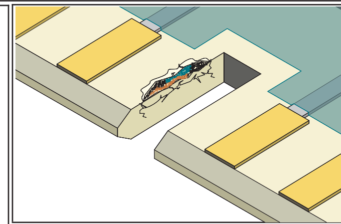
    **NOTE**

    Apply surface coating to match prior coating as required.
11. Clean the reworked area.

**INSPECTION GUIDELINES**

1. Visual and dimensional examination of the reworked area for conformance to drawings and specifications.

**NOTES**

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification and Repair | Revision: **B** Number: **3.4.1**<br>Date: **11/07**<br><br># Key and Slot Repair, Epoxy Method | <br>Board Type: R, W<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to repair minor damage to a key slot, or other cutout in a printed board or assembly. The area is repaired using high strength epoxy.

## CAUTION

Care should be taken to limit the application of epoxy to the specific areas desired and to avoid damage to the conductive patterns, contacts and components.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Knife |
| Cleaning Wipes | Milling Machine |
| Color Agent, Various Colors | Mixing Sticks |
| Epoxy | Oven |
| Hand Held Drill | Precision Drill Press |
| Polyimide Tape | Scraper |

## PROCEDURE

1. Clean the area to be filled, including the edges.
2. Mill away the damaged base material using a hand held drill and ball mill. All damaged base material must be removed. No fibers of laminate material should be exposed at the surface of the keyslot. (See Figure 1.)

   **NOTE**

   To clearly see that all damaged material has been removed, flood the area with alcohol or solvent. Damaged internal fibers of the base material will show up clearly.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.
3. Remove all loose material and clean the area.

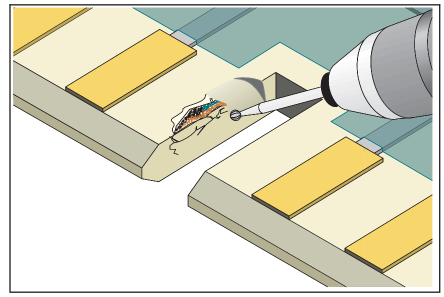


**Figure 1 Mill away the damaged board base material.**

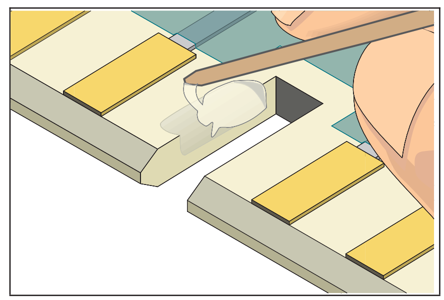


**Figure 2 Apply epoxy to the edges of the key slot.**

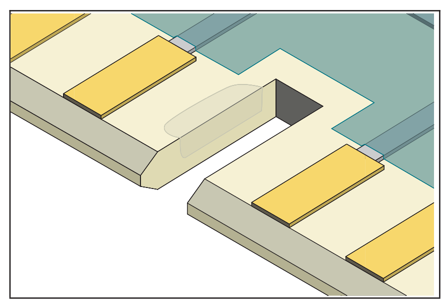


**Figure 3 Complete key slot repair.**

4. Apply Polyimide tape to the surface of the printed circuit board adjacent to the slot. The tape should protect any adjacent contacts or components.

   **NOTE**
   The printed circuit board may be preheated prior to filling the area with epoxy. A preheated printed circuit board will allow the epoxy to easily flow and level out. Epoxy applied to an unheated printed circuit board may settle below the printed circuit board surface as the epoxy cures.

5. Mix the epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
6. Apply a small amount of epoxy to the edges of the slot. A mixing stick sharpened at the end may be used to apply the epoxy. (See Figure 2.)

   **NOTE**
   A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.

   **NOTE**
   The printed circuit board may be turned on its side to keep the epoxy in place while it cures.

7. Cure the epoxy per the manufacturers instructions.

   **CAUTION**
   Some components may be sensitive to high temperature.

8. After the epoxy has cured remove the tape.
9. If needed use the knife or scraper and scrape off any excess epoxy.
10. If precision is required, machine the edges of the slot using a milling machine or precision drill and appropriate milling cutter. Use great care to correctly relocate the slot.

    **NOTE**
    If needed, apply additional thin coating to seal any scrapped areas.

11. Clean the area.

**INSPECTION GUIDELINES**

1. Visual examination and measurement of key slot location and dimension.
2. No contamination on gold tabs from repair (if applicable).

**NOTES**

7721

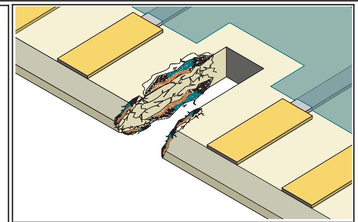
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.4.2**

# Key and Slot Repair, Transplant Method



Board Type: R, W
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to modify or repair a key slot, or other cutout in a printed board or assembly. A replacement piece of matching board material is epoxied into the area needing repair. A new cut is then machined into the repaired area if needed.

## CAUTION

Care should be taken to limit the application of epoxy to the specific areas desired and to avoid damage to the conductive patterns, contacts and components.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills, Carbide | Polyimide Tape |
| Base Material, Various Sizes | Knife |
| Carbide Saw | Milling Machine |
| Cleaner | Mixing Stick |
| Cleaning Wipes | Oven |
| Epoxy | Precision Drill Press |
| End Mills | Scraper |
| Hand Held Drill | |

## PROCEDURE

1. Clean the area to be filled, including the edges.
2. Mill out the damaged area using a milling machine or precision drill system and carbide end mill. (See Figure 1.)

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
3. Clean the area.
4. Install carbide saw into the hand held drill. Set the speed to maximum and machine a groove in the edge of the printed circuit board where the new base material will be installed. The groove must be centered in the edge to ensure

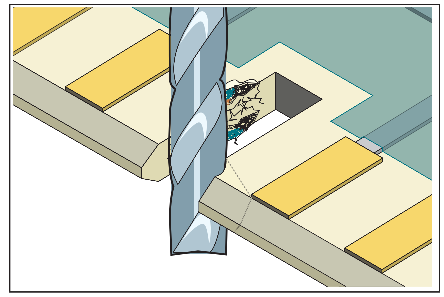


**Figure 1 Mill out damaged area using a carbide end mill.**

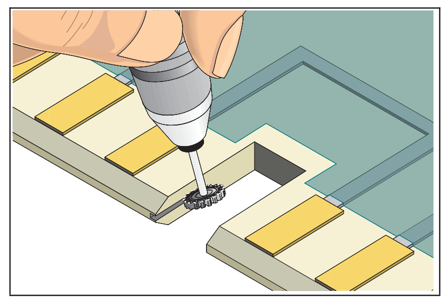


**Figure 2 Cut a groove into both sides of the key slot.**

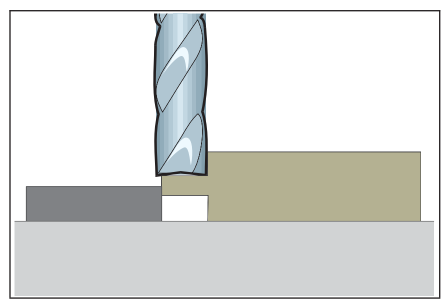


**Figure 3 Machine a tongue onto both sides of replacement material.**

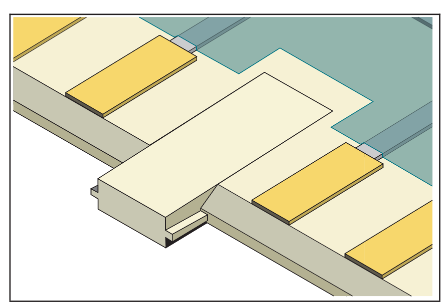


**Figure 4 Insert the replacement piece into the slot.**

that the new piece will fit properly. The groove width should be approximately 1/3 of the printed circuit board thickness. The groove depth should be be approximately double the groove width. (See Figure 2.)

5. Cut a piece of replacement base material that is the same thickness and type as the printed circuit board. The replacement piece should be longer than the length of the slot to allow for ease of handling.
6. Install an end mill into the chuck of the drill press. Machine a tongue onto both sides of the replacement piece. The dimensions of the tongue should match the size of the milled groove. (See Figure 3.)
7. Where required apply tape to protect exposed parts of printed wiring board bordering the prepared area.
8. Carefully check the fit of the replacement piece and then clean both the replacement piece and the slot. The replacement base material should fit firmly into the slot so that it will not move or fall out when epoxied in place.
9. Apply tape to the surface of the printed circuit board adjacent to the slot. The tape should protect any adjacent contacts or components.
10. Mix the epoxy.
11. Apply a small amount of epoxy to the edges of the replacement piece and to the inside edges of the slot.
12. Insert the replacement piece into the slot. Check alignment. Remove excess epoxy. (See Figure 4.)
13. If needed, apply additional epoxy to the edges of the slot. A wood stick sharpened at the end may be used to apply the epoxy.
14. Cure the epoxy per the manufacturers instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.
15. After the epoxy has cured remove the tape.
16. If needed use the knife or scraper and scrape off any excess epoxy.

    **NOTE**

    If needed, apply additional thin coating to seal any scrapped areas.
17. Clean the area.
18. Cut off excess length of replacement material and file to match contour of existing edge. (See Figure 5.)
19. If a new slot is needed, machine using milling machine and appropriate milling cutter. Use great care to correctly relocate the slot.
20. Clean the area.

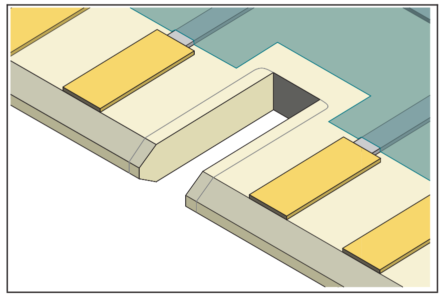


**Figure 5 Cut off excess material and file to match edge.**

## INSPECTION GUIDANCE

1. Visual examination and measurement of key slot location and dimension.

## NOTES

IPC

7721

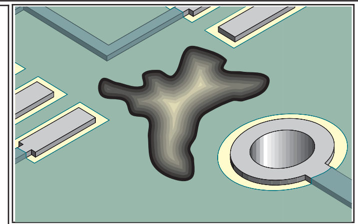
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.5.1**

# Base Material Repair, Epoxy Method



Board Type: R, W
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure is used to repair minor damage to printed circuit board base material. Scrapes and scratches in the base material may be caused by accidents during handling. Burns in the base material may be caused by improper use of soldering and desoldering tools.

## CAUTION

This method may be used when the damage extends deep into the base material, but not completely through. If the base material is damaged completely through, see Procedure No. 3.5.2 or 3.5.3.

## CAUTION

Surface conductors may need to be replaced in the damaged area. Be sure that the appropriate conductor diagrams, or photographs reflecting the original conductors are available so that they may be replaced after repairing the base material. Damage to internal conductors or planes may have to be restored using surface wires.

## REFERENCES

| | |
|---|---|
| 2.1 Handling Electronic Assemblies | 2.5 Baking and Preheating |
| 2.2 Cleaning | 2.6 Epoxy Mixing and Handling |

## TOOLS & MATERIALS

| | | |
|---|---|---|
| Ball Mills, Carbide | Hand Held Drill | Microscope |
| Cleaner | Halogen Light | Oven |
| Color Agent, Various Colors | Heat Lamp | Scraper |
| Epoxy | Polyimide Tape | Wipes |
| | Knife | |

## PROCEDURE

1. Clean the damaged area.
2. Scrape away the damaged base material using a knife.
   All damaged base material and solder resist must be removed at the surface. (See Figure 1.) See step 2A for alternate method.

   **NOTE**
   To clearly see that all damaged material has been removed, flood the area with alcohol or solvent. Damaged internal fibers of the base material will show up clearly.

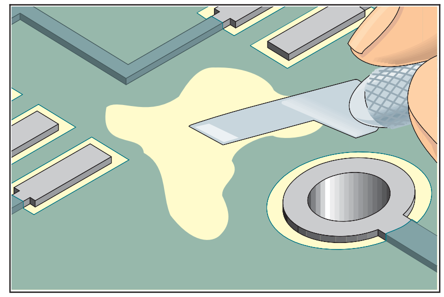


**Figure 1 Scrape away damaged base material with a knife.**

**Figure 2 Commercially available hand held drill.**

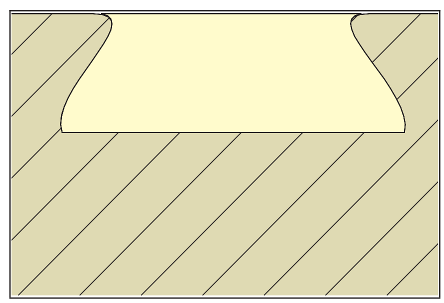


**Figure 3 An undercut to enhance mechanical strength.**

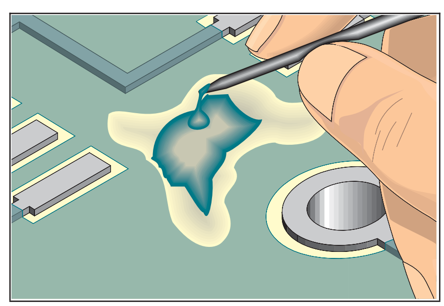


**Figure 4 Apply the epoxy with a wood stick sharpened at the end.**

**CAUTION**

Abrasion operations can generate electrostatic charges.

2A. Mill away the damaged base material using dental style drill and ball mill. All damaged base material and solder resist must be removed. (See Figure 2.)

**NOTE**

An undercut to enhance mechanical strength may be desired for class 3 product. (See Figure 3.)

3. Remove all loose material and clean the area.
4. Where needed, apply tape to protect exposed parts of printed wiring board.

**NOTE**

The printed circuit board may be preheated prior to filling the area with epoxy. A preheated printed wiring board will allow the epoxy to easily flow and level out. Epoxy applied to an unheated printed circuit board may settle below the printed circuit board surface as the epoxy cures.

5. Mix the epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
6. Fill the area with epoxy up to and flush with the printed circuit board surface. No fibers of laminate material should be exposed. A wood stick sharpened at the end may be used to apply and spread the epoxy. For large areas, apply the epoxy with a foam swab to create a texture in the surface. (See Figures 4 and 5.)

**NOTE**

A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.

**NOTE**

Epoxy may be applied using a foam swab to restore the surface appearance.

7. Cure the epoxy per the manufacturer's instructions.

**CAUTION**

Some components may be sensitive to high temperature.

8. After the epoxy has cured remove the tape.
9. If needed, use a knife or scraper and scrape off any excess epoxy. Scrape until the new epoxy surface is level with the surrounding printed circuit board surface.
10. Remove all loose material. Clean the area.

**NOTE**

If needed, apply an additional thin coating to seal any scraped areas.

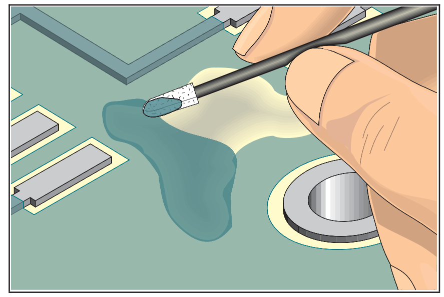


**Figure 5 Apply the epoxy with a foam swab to create a texture in the surface.**

## INSPECTION GUIDELINES

1. Visual examination for texture and color match.
2. Electrical tests to conductors around the repaired area as applicable.
3. Repair area does not increase or decrease the original board thickness.

## NOTES

7721

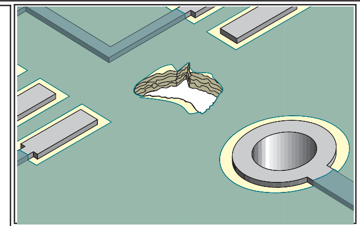
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.5.2**

# Base Material Repair, Area Transplant Method



Board Type: R, W
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure is used to repair mechanical or thermal damage to printed circuit board base material. This method is used when extended areas of base material must be completely replaced. This method may be used on single sided, double sided or multilayer printed circuit boards or assemblies.

## CAUTION

Surface conductors may need to be replaced in the damaged area. Be sure that the appropriate conductor diagrams, or photographs reflecting the original conductors are available so that they may be replaced after repairing the base material. Damage to internal conductors or planes may have to be restored using surface wires.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills, Carbide | Hand Held Drill |
| Base Material | Heat Lamp |
| Carbide Saw | Polyimide Tape |
| Cleaner | Knife |
| Cleaning Wipes | Oven |
| Color Agent, Various Colors | Precision Drill Press |
| End Mills, Carbide | Razor Saw |
| Epoxy | Scraper |

## PROCEDURE

1. Clean the area
2. Mill away the damaged base material using a hand held drill and ball mill. Remove all evidence of the damaged material. No fibers of laminate material should be exposed. At the surface file the edges to ensure that the opening is rectangular or uniform in shape. (See Figure 1.)

   **CAUTION**
   Abrasion operations can generate electrostatic charges.

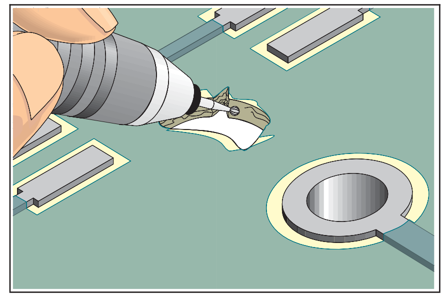


**Figure 1 Mill away damaged base material.**

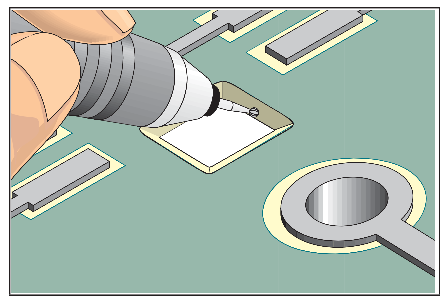


**Figure 2 Bevel edge using a hand held drill or file.**

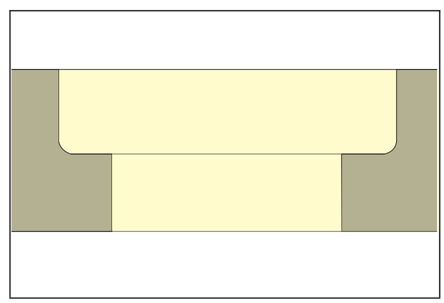


**Figure 3 Mill a step into the edge of the PC board.**

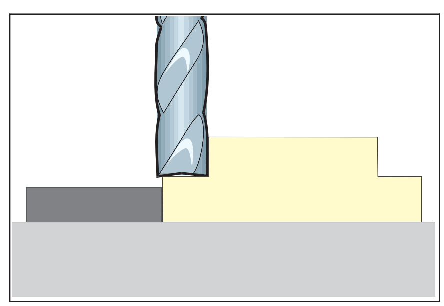


**Figure 4 Mill a step onto the edge of the replacement base material.**

3. Clean the area.
   3A. Bevel the edge using a hand held drill and ball mill or using a file. (See Figure 2.)

   **CAUTION**
   Exercise care to avoid damage to any internal conductors. If any internal conductors are damaged, surface wires may be required to restore electrical connection.

   3B. Install an end mill into the chuck of a precision drill press. Set the speed to maximum and machine a step or lap joint in the edge of the printed circuit board where the new base material will be installed. The depth and width of the step should be approximately 1/2 of the printed circuit board thickness. (See Figure 3.)
4. Cut or machine a piece of replacement base material that is the same thickness and type as the piece removed. The replacement piece must be precisely the same size and shape of the opening including the step joint.
5. Install an end mill into the chuck of a precision drill press. Machine a step onto the entire mating edge of the replacement base material. The dimensions of the step should match the size of the step in the printed circuit boardmilled groove. (See Figure 4.)
6. Where required apply Polyimide tape to protect exposed parts of printed wiring board bordering the prepared area.
7. Check the fit to be sure the new base material properly mates with the step in the printed circuit board.
8. Mix the epoxy.
9. Coat both the tongue and groove surfaces with epoxy and fit together. (See Figure 5.) Remove excess epoxy.
10. Cure the epoxy per the manufacturers instructions.

    **CAUTION**
    Some components may be sensitive to high temperature.
11. After the epoxy has cured remove the Polyimide tape.
12. If needed scrape off any excess epoxy using a scraper or knife.
    **NOTE**
    If needed, apply additional thin coating to seal any scrapped areas.
13. Clean the area.
14. Complete by drilling holes, slots, etc. or adding circuitry as required.
15. If solder resist replacement or conformal coating is needed see appropriate procedure.

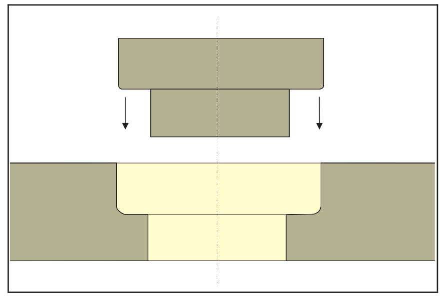


**Figure 5 Bond replacement piece in place.**

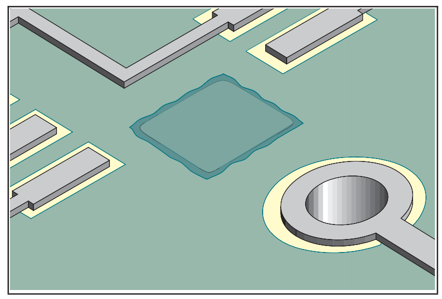


**Figure 6 Completed repair.**

## INSPECTION GUIDELINES

1. Dimensions of area replaced should be checked to conform to specifications required.
2. Inspect epoxy for air bubbles or voids.
3. Inspect epoxy for color, thickness and proper curing.

IPC

7721

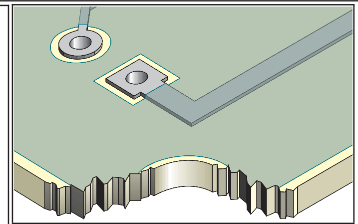
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **3.5.3**

# Base Material Repair, Edge Transplant Method



Board Type: R, W
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure is used to repair mechanical or thermal damage to printed circuit board base material. This method is used when extended areas of base material must be completely replaced. This method may be used on single sided, double sided or multilayer printed circuit boards or assemblies.

## CAUTION

Surface conductors may need to be replaced in the damaged area. Be sure that the appropriate conductor diagrams, or photographs reflecting the original conductors are available so that they may be replaced after repairing the base material. Damage to internal conductors or planes may have to be restored using surface wires.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

Ball Mills, Carbide
Base Material
Carbide Saw
Cleaner
Cleaning Wipes
Color Agent, Various Colors
End Mills, Carbide
Epoxy
Hand Held Drill1
Heat Lamp
Polyimide Tape
Knife
Oven
Precision Drill Press
Razor Saw
Scraper
File

## PROCEDURE

1. Clean the area
2. Cut away the damaged base material using a razor saw or milling cutter. Remove all evidence of the damaged material. No fibers of laminate material should be exposed. File the edge to ensure that the edge is flat. (See Figure 1.)

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

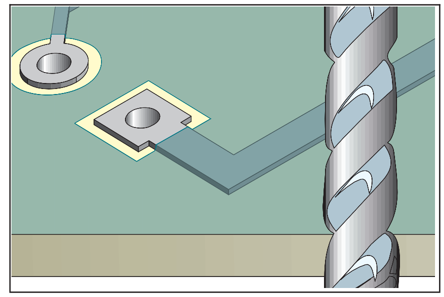


**Figure 1 Cut away damaged base material.**

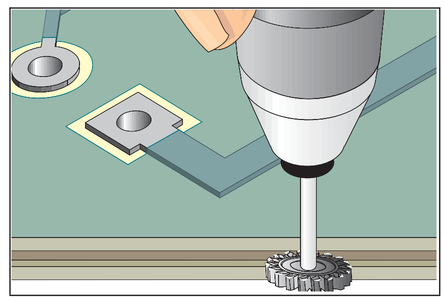


**Figure 2 Cut a groove into the edge of the PC board.**

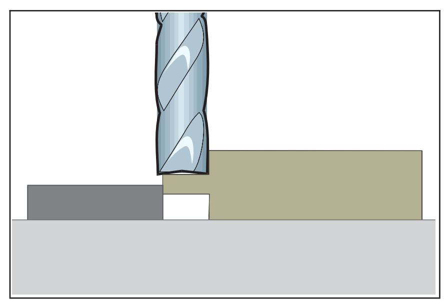


**Figure 3 Mill a tongue onto the edge of the replacement base material.**

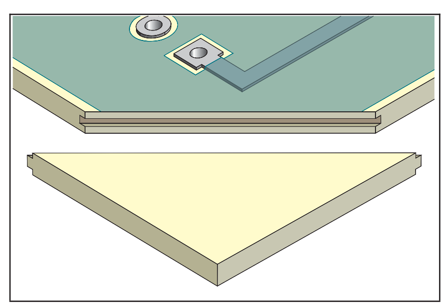


**Figure 4 Check fit of new base material.**

**CAUTION**

Exercise care to avoid damage to any internal conductors. If any internal conductors are damaged, surface wires may be required to restore electrical connection.

3. Clean the area.
4. Install a carbide saw into the hand held drill. Set the speed to maximum and machine a groove in the edge of the printed circuit board where the new base material will be installed. The groove must be centered in the edge to ensure that the new piece will fit properly. The groove width should be approximately 1/3 of the printed circuit board thickness. The groove depth should be approximately double the groove width. (See Figure 2.)
5. Cut a piece of replacement base material that is the same thickness and type as the piece removed. The replacement piece may be oversized, the excess material will be removed after the replacement piece has been epoxied in place.
6. Install an end mill into the chuck of a precision drill press. Machine a tongue onto the entire mating edge of the replacement base material. The dimensions of the tongue should match the size of the milled groove. (See Figure 3.)
7. Where required apply Polyimide tape to protect exposed parts of printed wiring board bordering the prepared area.
8. Check the fit to be sure the new base material properly mates with the groove in the printed circuit board. (See Figure 4.)
9. Mix the epoxy.
10. Coat both the tongue and groove surfaces with epoxy and fit together. Remove excess epoxy.
11. Cure the epoxy per the manufacturers instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.
12. After the epoxy has cured remove the Polyimide tape.
13. If needed, scrape off any excess epoxy using a scraper or knife.

    **NOTE**

    If needed, apply additional thin coating to seal any scrapped areas.
14. Saw or mill off excess base material and file flush with existing edge. (See Figure 5.)
15. Clean the area.
16. Complete by drilling holes, slots, etc. or adding circuitry as required. (See Figure 6.)
17. If needed, replace solder resist or conformal coating.

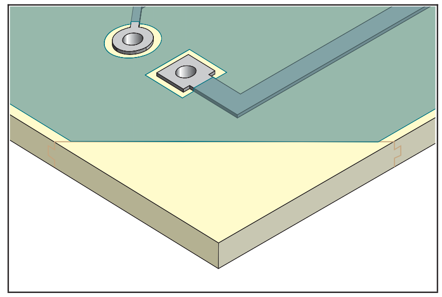


**Figure 5 Saw off excess new base material.**

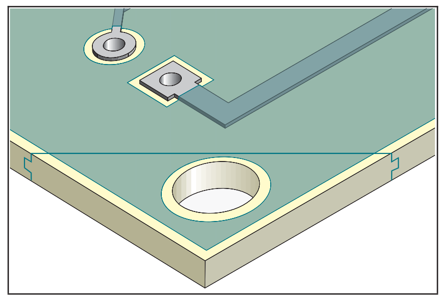
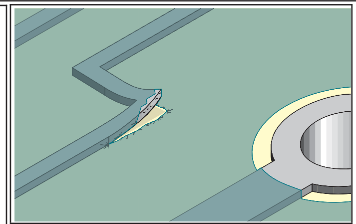


**Figure 6 Complete by drilling holes, or adding circuitry as required.**

## INSPECTION GUIDELINES

1. Dimensions of area replaced should be checked to conform to specifications required.
2. Inspect epoxy for air bubbles or voids.
3. Inspect epoxy for color, thickness and proper curing.

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification and Repair | Revision: **B**  Number: **4.1.1**<br>Date: **11/07**<br># **Lifted Conductor Repair, Epoxy Seal Method** | <br>Board Type: R, F<br>See 1.4.2<br>Skill Level: Intermediated<br>See 1.4.3<br>Level of Conformance: Medium<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to rebond a lifted conductor. Liquid epoxy is inserted under and around the conductor to bond it back down to the printed circuit board surface.

## CAUTION

This method should not be used to rebond a conductor that has been stretched or damaged.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Heat Lamp or Oven |
| Cleaning Wipes | Knife |
| Epoxy | Pick |

## PROCEDURE

1. Clean the area.
2. Remove any obstructions that prevent the lifted conductor from making contact with the board surface.

   **CAUTION**
   Be careful while cleaning and removing all obstructions, not to stretch or damage the lifted conductor.
3. Clean the area.
4. Mix the epoxy.
5. Carefully apply a small amount of epoxy under the entire length of the lifted conductor. The tip of a knife may be used to apply the epoxy. (See Figure 1.)
6. Press the lifted conductor down into the epoxy and into contact with the board material.
7. Apply additional epoxy to the surface of the lifted conductor and to all sides as needed.

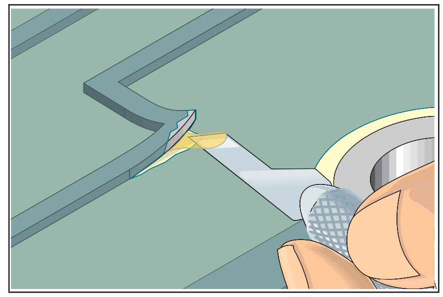


**Figure 1 Apply a small amount of epoxy under the lifted conductor.**

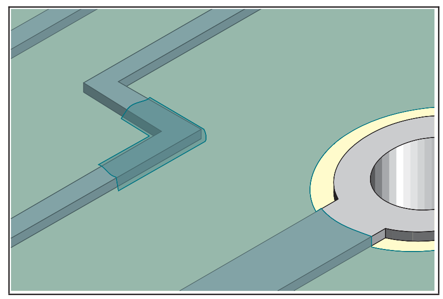


**Figure 2 Completed repair.**

8. Cure the epoxy per the manufacturer's instructions.

   **CAUTION**

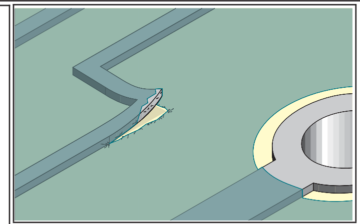
   Some components may be sensitive to high temperature.

9. Apply surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination and tape test per IPC-TM-650, Test Method 2.4.1.
2. Electrical tests as applicable.
3. Epoxy color, thickness, cure and coverage.
4. Cleanliness.
5. Conductor damage.
6. Board damage.

## NOTES

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification<br>and Repair | Revision: **B** Number: **4.1.2**<br>Date: **11/07**<br># Lifted Conductor Repair, Film Adhesive Method | <br>Board Type: R, F<br>See 1.4.2<br>Skill Level: Intermediate<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to re-bond a lifted conductor. Dry film epoxy is used to re-bond the lifted conductor.

## CAUTION

This method should not be used to re-bond a conductor that has been stretched or damaged

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS & MATERIALS

| | |
|---|---|
| Bonding Iron | Polyimide Tape |
| Bonding System | Knife |
| Bonding Tips | Microscope |
| Cleaner | Scraper |
| Cleaner Wipes | Tweezers |
| Dry Film Epoxy | |

## PROCEDURE

1. Clean the area.
2. Remove any obstructions that prevent the lifted conductor from making contact with the board surface.

   **CAUTION**
   Be careful while cleaning and removing all obstructions, not to stretch or damage the lifted conductor.
3. Clean the area.
4. Cut out a piece of dry film epoxy that closely matches the size of the lifted conductor. Be careful not to contaminate the dry film epoxy with materials that could reduce the bond strength. (See Figure 1.)

   **NOTE**
   Dry film epoxy thickness should be selected to meet the requirements of the printed circuit board.

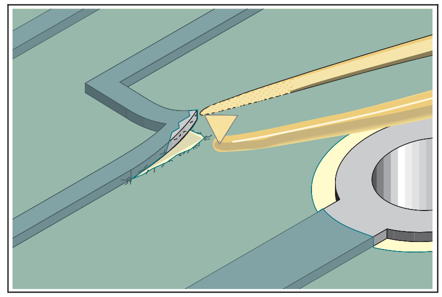


**Figure 1 Place a piece of dry film epoxy under lifted conductor.**

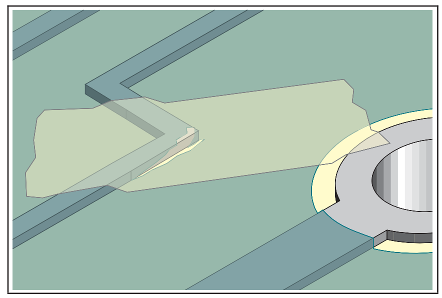


**Figure 2 Place tape over the lifted conductor.**

**Figure 3 Bond the lifted conductor using a bonding system.**

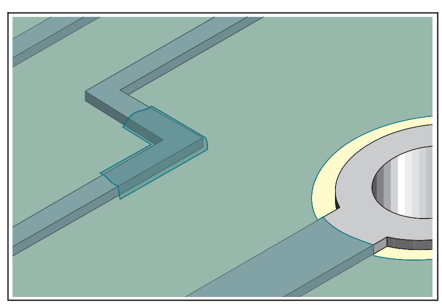


**Figure 4 Completed repair.**

5. Place a piece of Polyimide tape over the lifted conductor. Leave the tape in place during the bonding cycle. (See Figure 2.)
6. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the conductor. Apply pressure and heat per equipment manufacturer's recommendation. (See Figure 3.)

   **NOTE**
   The bonding tip should be as small as possible but should completely cover the entire surface of the conductor.
7. After the bonding cycle lift the bonding tool and remove the tape used for alignment. The film is fully cured. Carefully clean the area and inspect the conductor.
8. Replace surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination and tape test per IPC-TM-650, Test Method 2.4.1.
2. Electrical tests as applicable.
3. Epoxy color, thickness, cure and coverage.
4. Cleanliness.
5. Conductor damage.
6. Board damage.
7. Area film adhesive, i.e. smear.

## NOTES

IPC

7721

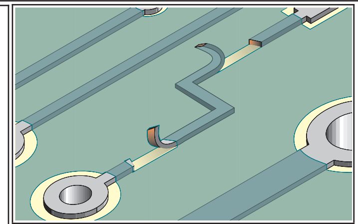
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.1**

# Conductor Repair, Foil Jumper, Epoxy Method



Board Type: R, F, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used on printed circuit boards to replace damaged or missing conductors on the printed circuit board surface.

## CAUTION

The conductor widths, spacing and current carrying capacity must not be reduced below allowable tolerances.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

Buffer
Cleaner
Conductor Foil Jumpers
Color Agent
Various Colors
Epoxy
Hand Held Drill
Heat Lamp
Polyimide Tape
Knife
Light
Liquid Flux
Microscope
Oven
Scraper
Solder
Solder Iron
with Tips
Wipes

## PROCEDURE

1. Clean the area.
2. Remove the damaged section of conductor using a knife. The damaged conductor should be trimmed back to a point where the conductor still has a good bond to the printed circuit board surface.

   **NOTE**
   Heat can be applied to the damaged conductor using a soldering iron to allow the conductor to be removed more easily.
3. Use a knife and scrape off any solder resist or coating from the ends of the remaining conductor. (See Figure 1.)

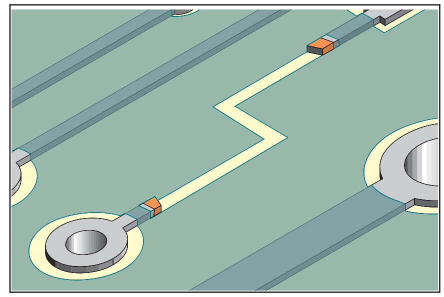


**Figure 1 Scrape off any coating from the ends of the remaining conductors.**

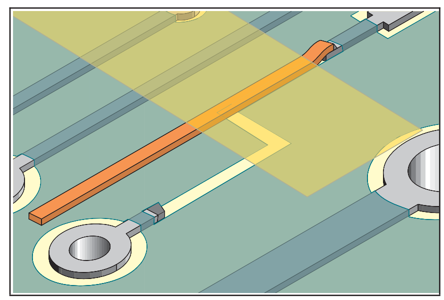


**Figure 2 Place the new foil jumper in position, hold in place with tape conductor.**

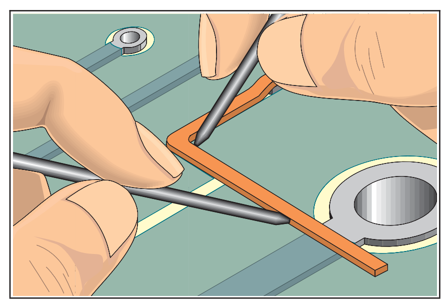


**Figure 3 Bend foil jumper using 2 wood sticks.**

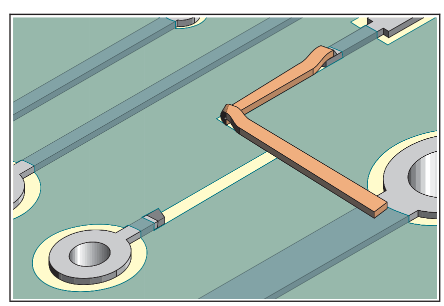


**Figure 4 Wide conductors may be folded over.**

4. Remove all loose material. Clean the area.

   **NOTE**

   It is essential that the board surface be smooth and flat. If the base material is damaged see appropriate procedure.

5. Apply a small amount of liquid flux to the ends of the remaining conductor. Tin the exposed end of each conductor using solder and a soldering iron.
6. Clean the area.
7. Select a conductor foil jumper to match the width and thickness of the conductor to be replaced. Cut a length approximately as needed. The foil jumper should overlap the existing conductor a minimum of 2 times the conductor width.

   **NOTE**

   The new conductor may be trimmed from copper sheet.

8. Gently abrade the top and bottom surface of the replacement foil jumper with a buffer to remove the protective coating.

   **NOTE**

   A thin protective coating is often applied to the replacement foil jumper to prevent oxidation.

9. Clean the conductor foil jumper.
10. If needed, the ends of the replacement conductor foil jumper may be tinned with solder prior to lap soldering it in place.
11. If the conductor foil jumper is long or has bends, one end may be soldered prior to forming the new shape. Place the foil jumper in position. The foil jumper should overlap the existing conductor a minimum of 2 times the conductor width. The jumper may be held in place with Polyimide tape. (See Figure 2.)
12. Apply a small amount of liquid flux to the overlap joint.
13. Lap solder the foil jumper to the conductor on the printed circuit board surface using solder and a soldering iron. Make sure the foil jumper is properly aligned.

    **NOTE**

    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.

14. Bend the foil jumper as needed to match the shape of the missing conductor. (See Figure 3.)

    **NOTE**

    Two wood sticks can be used to make sharp bends in the replacement foil jumper. Use one stick to hold the new jumper at the bend location and use the other wood stick to form the shape as needed.

15. Wide conductors that cannot be easily formed may be folded over to produce a sharp bend. (See Figure 4.)
16. Form the final shape of the jumper and hold in place with tape. Lap solder the foil jumper to the remaining conductor on the printed wiring board surface using solder and a soldering iron. Remove the tape used to hold the foil jumper. Clean the area. (See Figure 5.)

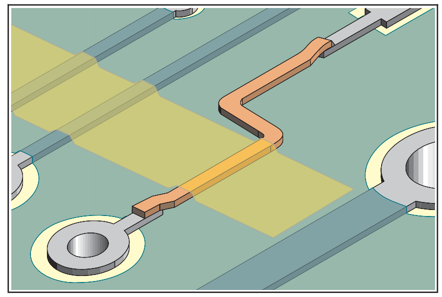


**Figure 5 Form the final shape of the jumper and hold in place with tape.**

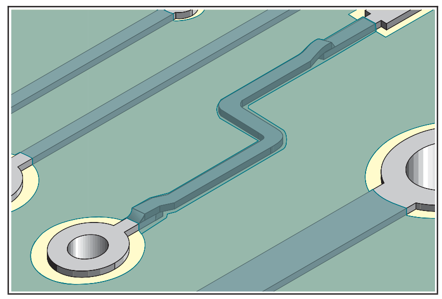


**Figure 6 Coat the top and sides of the foil jumper with epoxy.**

17. Mix the epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
18. Coat the top and sides of the foil jumper with epoxy. The epoxy bonds the foil jumper to the printed circuit board surface and insulates it. A wooden stick sharpened at one end may be used to apply and spread the epoxy. (See Figure 6.)
19. Cure the epoxy per the manufacturers instructions.

    **CAUTION**
    Some components may be sensitive to high temperature.
20. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination for alignment and overlap of foil jumper.
2. Visual examination of epoxy coating for texture and color match.
3. Electrical tests as applicable.
4. Epoxy cure, thickness and coverage.
5. Board damage.
6. Electrical clearance (routing).
7. Conductor thickness, i.e. conductor damage.

**NOTES**

IPC

**7721**

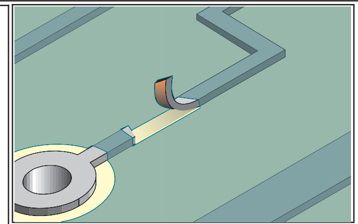
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.2**

# Conductor Repair, Foil Jumper, Film Adhesive Method



Board Type: R, F, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged or missing conductors on the printed circuit board surface.

## CAUTION

It is essential that the board surface be extremely smooth and flat. If the board is damaged see appropriate procedure.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

Bonding Iron
Bonding System
Bonding Tips
Buffer
Conductor Foil Jumpers
with Film Adhesive
Cleaner
Cleaner Wipes
Heat Lamp
Polyimide Tape
Knife
Liquid Flux
Microscope
Oven
Scraper
Solder
Soldering Iron
Tweezers

## PROCEDURE

1. Clean the area.
2. Remove the damaged section of conductor using a knife. The damaged conductor should be trimmed back to a point where the conductor still has a good bond to the printed circuit board surface.
3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.
4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 1.)

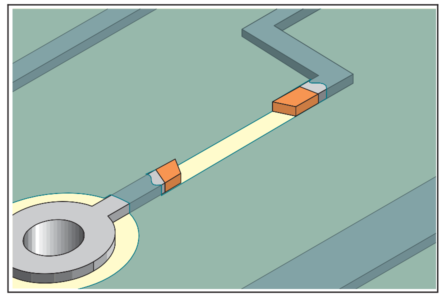


**Figure 1 Remove solder mask from the connecting conductor.**

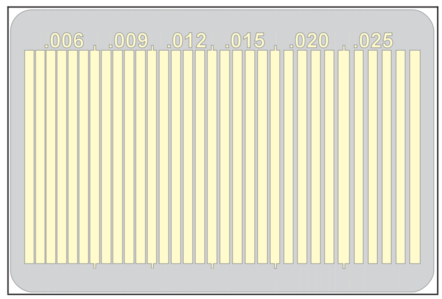



**Figure 2 Replacement conductors with dry film adhesive backing.**

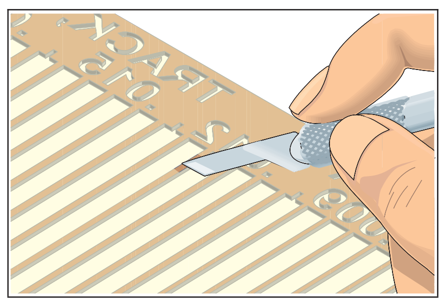


**Figure 3 Scrape off epoxy bonding film.**

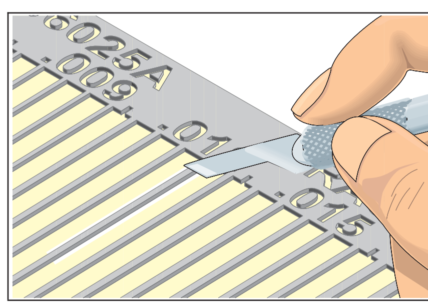


**Figure 4 Cut out the new conductor. Cut from the plated side.**

5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. Select a replacement conductor with film adhesive backing that most closely matches the size of the conductor to be replaced. If a special size or shape is needed they can be custom fabricated. (See Figure 2.)

   **NOTE**

   New conductors are fabricated from copper foil. The foil is plated on the top side with solder and an epoxy bonding film is applied to the bottom side.
8. Before trimming out the new conductor carefully scrape off the adhesive epoxy film from the solder joint connection area on the back of the new conductor. (See Figure 3.)

   **CAUTION**

   Scrape off the epoxy backing only from the joint connection area. When handling the new conductor avoid touching the epoxy backing with your fingers or other materials that may contaminate the surface and reduce the bond strength.
9. Cut out and trim the new conductor. Cut out from the plated side. Cut the length to provide the maximum allowable conductor overlap for soldering. Minimum 2 times the conductor width. (See Figure 4.)

   **NOTE**

   If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.
10. Place a piece of tape over the top surface of the new conductor. Place the new conductor into position on the printed circuit board surface using tape to help in alignment. Leave the tape in place during the bonding cycle. (See Figure 5.)
11. Select a bonding tip with a shape to match the shape of the new conductor.

    **NOTE**

    The bonding tip should be as small as possible but should completely cover the entire width of the new conductor.
12. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new pad. Apply pressure as recommended in the manual of the repair system or repair kit. (See Figure 6.)
13. After the bonding cycle lift the bonding iron and remove the tape used for alignment. The new conductor is fully cured. Carefully clean the area and inspect the new conductor for proper alignment.
14. Apply a small amount of liquid flux to the lap solder joint connection area and solder the conductor from the new conductor to the conductor on the printed circuit board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new conductor to prevent excess solder overflow. Clean the area.

15 Mix epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturer's instructions.

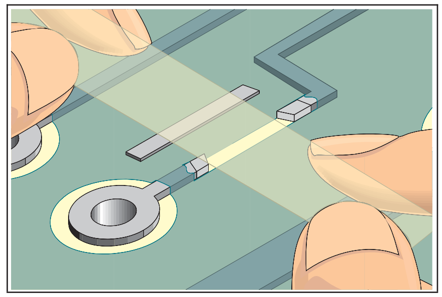


**Figure 5 Place the new conductor in place using tape.**

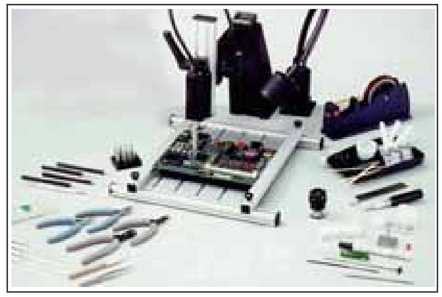


**Figure 6 Repair system.**

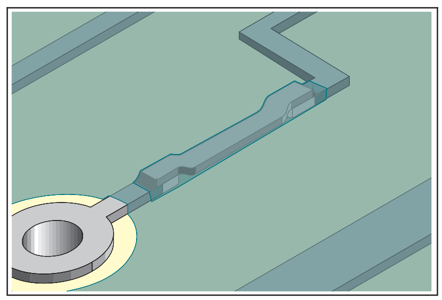


**Figure 7 Completed repair.**

**CAUTION**
Some components may be sensitive to high temperature.

16. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.
4. Epoxy cure, thickness and coverage.
5. Board damage.
6. Electrical clearance (routing).
7. Conductor thickness, i.e. conductor damage.
8. Area film adhesive, i.e. smear.

## NOTES

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification and Repair | Revision: **B** Number: **4.2.3**<br>Date: **11/07**<br># Conductor Repair, Welding Method | Board Type: R, F, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: High<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure is used to repair short breaks or opens in conductors on printed circuit boards. A parallel gap welder is used to weld a jumper ribbon across the damaged conductor.

## CAUTION

Welding current and voltages may affect component reliability on assembled printed circuit boards.

## CAUTION

The repaired section must not reduce the conductor width, spacings or current carrying capacity below the allowable tolerances.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.6 Epoxy Mixing and Handling

## PREPARATION

Prior to using any welding equipment, certain precautions should be taken. The equipment should have electrodes cleaned, aligned and set for the proper board thickness.

Test samples that have similar conductor widths, spacing, thickness, surface finish, contour, etc. Observe and test the weld quality, alignment, discoloration, fusion and the appearance of the base material in the area of the weld. Readjust the weld equipment settings and repeat until acceptable results have been achieved.

The alignment of the welded ribbon to the conductor pattern should be within 0.050 mm. The weld bond strength should exceed the conductor/base material bond strength.

## TOOLS & MATERIALS

| | | |
|---|---|---|
| Cleaner | Kovar Ribbon | Ribbon - Gold Plated Kovar |
| Cleaner Wipes | Liquid Flux | Solder |
| Epoxy | Microscope | Soldering Iron |
| Knife | Parallel Gap Welder | Tweezers |

## PROCEDURE

1. Clean the area.
2. Select a section of Kovar ribbon of the same width as the conductor pattern being repaired ± .050 mm.
3. Cut the ribbon approximately 3.0 mm longer than the section being repaired.
4. Clean the ribbon conductor and base material surrounding the repair area.
5. Place and center the ribbon over the section to be repaired leaving equal ribbon end lengths on each side and parallel to the conductor pattern.
6. Place the printed circuit board under the weld electrodes so that the electrodes are depressed to the area of the weld.
7. Hold the ribbon in place with tweezers until the weld is completed. Weld in place using settings based on the accepted test samples.
8. Clean the area.
9. Carefully inspect the joint for weld quality and alignment.
10. If required, apply a small amount of flux and tin the entire area with solder.
11. Clean the area.
12. Coat the repaired area with epoxy if needed.

## INSPECTION GUIDELINES

1. Visual examination, dimensional measurement of conductor width, thickness and spacing, and electrical continuity measurement.
2. Board damage.
3. Conductor Overlap
4. Conductor cure, thickness and coverage as needed.

## NOTES

7721

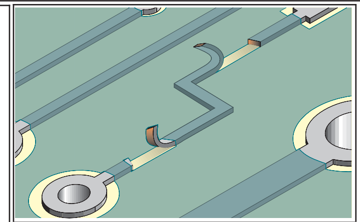
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.4**

# Conductor Repair, Surface Wire Method



Board Type: R, F, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used on printed circuit boards to replace damaged or missing conductors on the printed circuit board surface. A length of standard insulated or non-insulated wire is used to repair the damaged conductor.

## CAUTION

The conductor widths, spacing and current carrying capacity must not be reduced below allowable tolerances.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Microscope |
| Cleaning Wipes | Oven |
| Epoxy | Scraper |
| Heat Lamp | Solder |
| Polyimide Tape | Soldering Iron with Tips |
| Knife | Wire |
| Light | Wire Guide Tool |
| Liquid Flux | |

## PROCEDURE

1. Clean the area.
2. Remove the damaged section of conductor using a knife. The damaged conductor should be trimmed back to a point where the conductor still has a good bond to the printed circuit board surface.

   **NOTE**
   Heat can be applied to the damaged conductor using a soldering iron to allow the conductor to be removed more easily.
3. Use a knife and scrape off any solder resist or coating from the ends of the remaining conductor. (See Figure 1.)

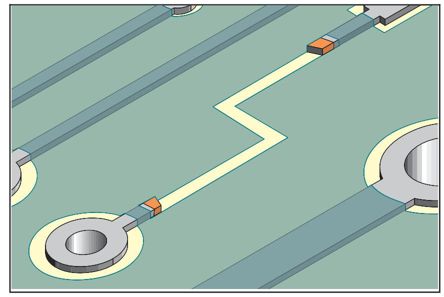


**Figure 1 Scrap off any coating from the ends of the conductors.**

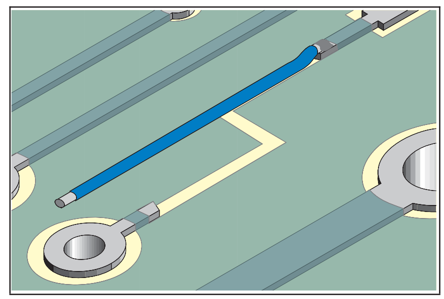


**Figure 2 Lap solder the wire to one end of the conductor.**

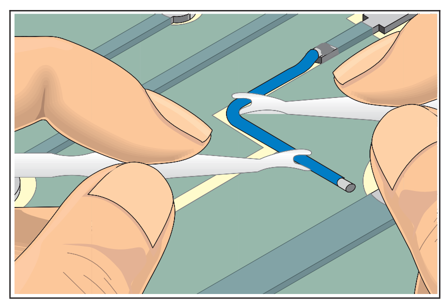


**Figure 3 Form wire using wire guide tools.**

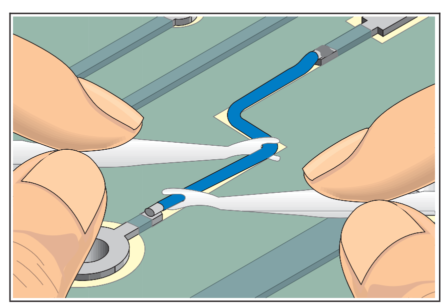


**Figure 4 Form the final shape of the wire and solder in place.**

4. Remove all loose material. Clean the area.
5. Apply a small amount of liquid flux to the ends of the remaining conductor. Tin the exposed end of each conductor using solder and a soldering iron.
6. Clean the area.
7. Select a wire to match the width and thickness of the conductor to be replaced. Cut a length approximately as needed. See Table 1 for Solid Wire Equivalents.

**Table 1 Solid Wire Equivalents**

| Conductor Width 2 oz. Copper | Equivalent Solid Wire Diameter |
|---|---|
| 0.25 mm | #34, 0.15 mm |
| 0.38 mm | #32, 0.20 mm |
| 0.50 mm | #31, 0.23 mm |
| 0.78 mm | #29, 0.28 mm |
| 2.08 mm | #26, 0.46 mm |
| 3.18 mm | #23, 0.58 mm |
| When using solid wire to repair a conductor, there should be no reduction in the cross sectional area. | |

8. Strip the wire and tin the ends if needed. Non-insulated wire may be used for short repairs if conductors are not crossed.
9. Clean the wire.
10. If the wire is long or has bends, one end may be soldered prior to forming the new shape. Place the wire in position. The wire should overlap the existing conductor a minimum of 2 times the conductor width. The wire may be held in place with Polyimide tape during soldering.

    **NOTE**

    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations. Refer to 7.1 Soldering Basics.
11. Apply a small amount of liquid flux to the overlap joint.
12. Lap solder the wire to one end of the conductor on the printed wiring board surface. Make sure the wire is properly aligned. (See Figure 2.)
13. Bend the wire as needed to match the shape of the missing conductor. (See Figure 3.)

    **NOTE**

    Wire guide tools can be used to form the wire as needed.
14. Lap solder the other wire end to the remaining conductor on the printed wiring board surface using solder and a soldering iron. Make sure the wire is properly aligned. (See Figure 4.)

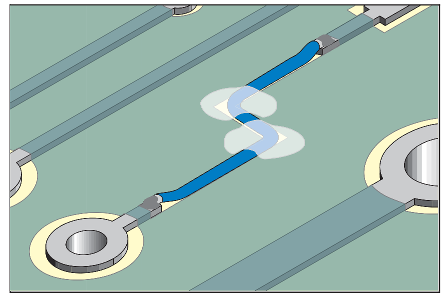


**Figure 5 Bond the wire to the surface with adhesive or tape.**

15. Remove any Polyimide tape and clean the area.

    **NOTE**

    It may be necessary to encapsulate the solder joint connection if electrical spacing is reduced or the connection is beneath a component.

16. If desired bond the wire to the printed circuit board surface with adhesive, epoxy or tape dots. (See Figure 5.)

    **CAUTION**

    Some components may be sensitive to high temperature.

17. Cure the epoxy per the manufacturers instructions.
18. After the epoxy has cured clean the area.

**INSPECTION GUIDELINES**

1. Visual examination for alignment and overlap of wire.
2. Electrical tests as applicable.
3. Conductor width and thickness.
4. Board damage.
5. Epoxy cure thickness and coverage as needed.
6. Encapsulant cure thickness and coverage as needed.
7. Adhesive material, cure, thickness and coverage.

**NOTES**

7721

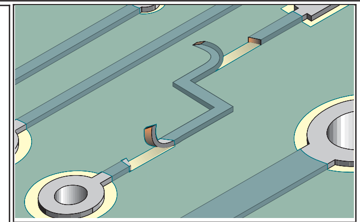
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.5**

# Conductor Repair, Through Board Wire Method



Board Type: R
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used on printed circuit boards to replace damaged or missing conductors on the printed circuit board surface. A length of standard insulated or non-insulated wire is used to repair the damaged conductor.

## CAUTION

The conductor widths, spacing and current carrying capacity must not be reduced below allowable tolerances.

## CAUTION

This method is not acceptable when wire will be subsequently subjected to a mass soldering operation.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Solder |
| Knife | Soldering Iron with Tips |
| Liquid Flux | Wipes |
| Dental Style Drill | Solid Wire |
| Microscope | Epoxy |

## PROCEDURE

1. Clean the area.
2. Remove the damaged section of conductor using the knife. The damaged conductor should be trimmed back to a point where the conductor still has a good bond to the printed circuit board surface.

   **NOTE**
   Heat can be applied to the damaged conductor using a soldering iron to allow the conductor to be removed more easily.
3. Use a knife and scrape off any solder resist or coating from the ends of the remaining conductor. (See Figure 1.)

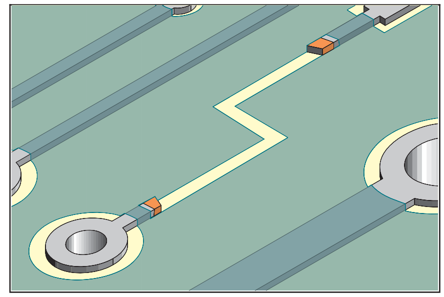


**Figure 1 Scrape off any coating from ends of remaining conductors.**

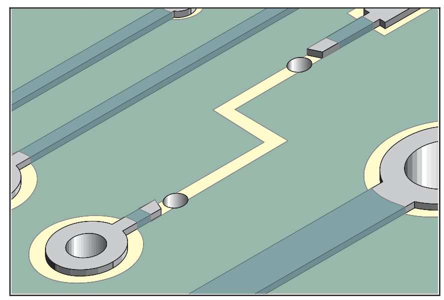


**Figure 2 Drill through board adjacent to conductor.**

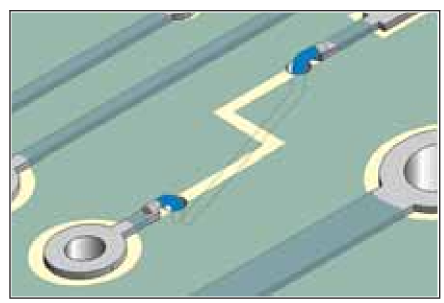


**Figure 3 Drill through board, through conductors.**

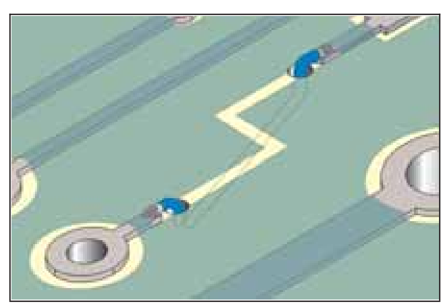


**Figure 4 Lap solder wire to conductor.**

4. Remove all loose material. Clean the area.
5. Apply a small amount of liquid flux to the ends of the remaining conductor. Tin the exposed end of each conductor using solder and a soldering iron.
6. Clean the area.
7. Select a wire to match the width and thickness of the conductor to be replaced. Cut a length approximately as needed. See Table 1 for Solid Wire Equivalents.

**Table 1 Solid Wire Equivalents**

| Conductor Width 2 oz. Copper | Equivalent Solid Wire Diameter |
|---|---|
| 0.25 mm | #34, 0.15 mm |
| 0.38 mm | #32, 0.20 mm |
| 0.50 mm | #31, 0.23 mm |
| 0.78 mm | #29, 0.28 mm |
| 2.08 mm | #26, 0.46 mm |
| 3.18 mm | #23, 0.58 mm |
| When using solid wire to repair a conductor, there should be no reduction in the cross sectional area. | |

8. Strip the wire and tin the ends if needed. Non-insulated wire may be used for short repairs if conductors are not crossed.
9. Clean the wire.

   **CAUTION**

   Review conductor diagrams to be sure no surface or internal conductors will be damaged or shorted.
10. Drill through the board, either adjacent to both ends of the remaining conductors or through the conductors. Drill the hole slightly larger than the wire diameter to be used. (See Figure 2.)
11. Position the wire on the opposite side from the repair and insert the stripped ends into the drilled holes.
12. Bend the stripped wire over the prepared conductors in line with the conductors. The wire should overlap the existing conductor a minimum of 2 times the conductor width. (See Figure 3.)

    **NOTE**

    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.
13. Apply a small amount of liquid flux to the overlap joint.

14 Lap solder the wire to the conductors on the printed circuit board surface. Make sure the wire is properly aligned. (See Figure 4.)

15. Form the wire on the opposite side to match the shape of the missing conductor.
16. Clean the area.

**NOTE**
It may be necessary to encapsulate the solder joint connection if electrical spacing is reduced.

17. If desired bond the wire to the printed circuit board surface with adhesive, epoxy or Tape Dots.

**CAUTION**
Some components may be sensitive to high temperature.

18. Cure the epoxy per Procedure 2.6 Epoxy Mixing and Handling.
19. After the epoxy has cured clean the area.

**INSPECTION GUIDELINES**

1. Visual examination for alignment and overlap of wire.
2. Electrical tests as applicable.
3. Conductor width and thickness.
4. Board damage.
5. Epoxy cure thickness and coverage as needed.
6. Encapsulant cure thickness and coverage as needed.
7. Adhesive material, cure, thickness and coverage.
8. Conductor damage on both sides of board.
9. Conductor diameter-insulation damage.

**NOTES**

IPC

7721

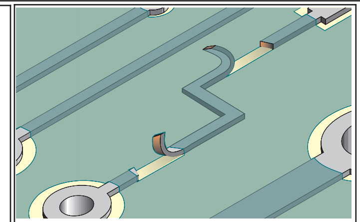
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.6**

# Conductor Repair/ Modification, Conductive Ink Method



Board Type: R, F, C
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This modification/repair conductive pattern is fabricated via a solder/copper composite of screen printable polymer thick film (PTF). The interconnects are established at conductor lands and through hole locations of the original conductor. Electrical continuity is optimized between two or more points of interconnection by solder fusion of the new conductor pattern to the original etched PCB pattern.

## NOTE

This modification/repair method is UL recognized, Type 1 94-V-0. It is compatible with both digital and analog printed circuit board applications and it has resistance of less than 3.0 milliohms/sq. It consists of greater than 90% copper and solder. The resin system employed is thermal setting and adhesion of approximately 1.5 kg on a 6 mm x 0.6 mm wide strip. It is typically applied to either or both sides of printed circuit boards on thru-hole or surface mount PCB's prior to assembly, without any final solder resist coating. (Line resist coating can be applied and it is considered optional.)

## CAUTION

This modification/repair method can be employed on a single-sided, double-sided or a multilayer printed circuit board. Its primary application is for signal carrying conductors. New or additional power distribution should be designed into the new conductor pattern on the basis of 0.25 mm of line width 2.6 amps of current required, up to a maximum of 3.4 amps. When applying this method to the wave solder side of a thru-hole printed circuit board, it should be covered with a solder (line) resist.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS AND MATERIALS

Screen printer/screens with matalizer and IR belt ovens
Modification/repair master artwork
Conductive Ink, directly solderable
SMT compatible solder paste
IR solder reflow (fuse) belt oven

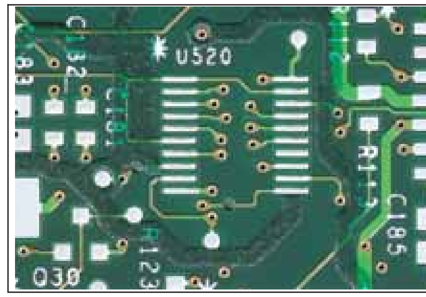


**Figure 1 Isolation layer.**

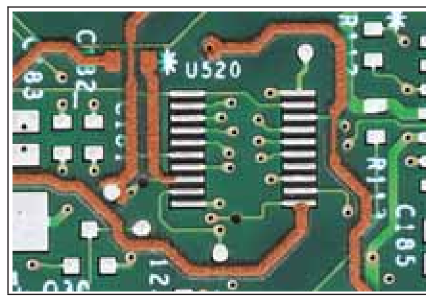


**Figure 2 Copper ink is applied.**

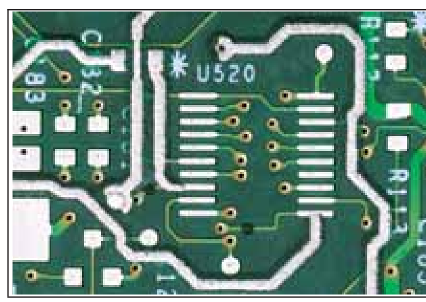


**Figure 3 Solder ink fused to copper ink.**

Flux cleaner, deionized water
Electronic multi-point tester

## PROCEDURE

1. Convert conductor design revision via CAD to additive layer conductor pattern including vias to be exposed and etch deletes to be performed.
2. Expose CAD generated additive conductor patterns of new conductor revision in isolation layer, copper and solder screens.
3 Print and cure isolation layer of protective epoxy.
4 Print, metalize and cure the new conductive ink pattern which establishes the modified/repaired conductor.
5. Print the SMT compatible solder paste on to the cured conductive ink pattern, totally encompassing the underlying material.
6 Fuse the printed solder paste to form the electrical optimization of the new conductor and the interconnection to the original etched conductor. See reflow soldering (IPC-J-STD-001).

## CAUTION

Care should be taken not to add any solder to any unmodified or un-repaired areas on the printed circuit board. All solder flux residue should be removed to meet IPC-TM-650, Test Methods 2.3.25 and 2.3.26, ionic contamination requirements.

## INSPECTION GUIDELINES

1. Conductor thickness and width.
2. Ink coverage
3. Solder
4. Continuity tests
5. Protective epoxy.

## NOTE

Additive Conductor Modification Operations has become an industry standard for production quantities of PCB modification/repair revisions.

## NOTE

Because of the expert level of workmanship required, qualified vendors of the service should be considered or the acquisition of dedicated in-house systems and personnel to perform this work.

## NOTES

IPC

7721

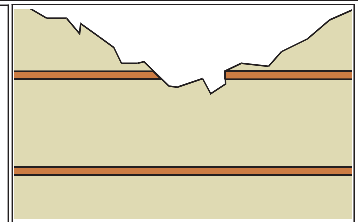
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.2.7**

# Conductor Repair, Inner Layer Method



Board Type: R, F
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged or missing conductors on internal layers of multilayer printed circuit boards.

## CAUTION

The conductor widths, spacing and current carrying capacity must not be reduced below allowable tolerances.

## CAUTION

The overlap joint used in this method may cause problems with high frequency circuitry.

## CAUTION

This procedure is complicated and should be attempted only by properly skilled repair personnel using the best tools and equipment.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

Ball Mills
Buffer
Conductor Foil Jumpers
Cleaner
Cleaning Wipes
Color Agent
Epoxy
Hand Held Drill
Heat Lamp
Polyimide Tape
Knife
Liquid Flux
Microscope
Oven
Scraper
Solder
Soldering Iron

## PROCEDURE

1. Locate and determine the coordinates where the repair is to be made. Use films or master drawings of the board as needed.

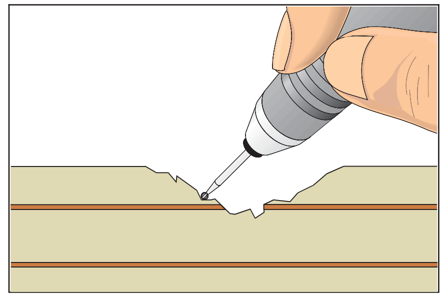


**Figure 1 Milling into multilayer board to expose the damaged conductors.**

**Figure 2 A high quality, hand held drill.**

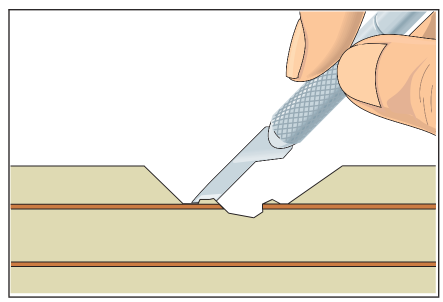


**Figure 3 Remove the remaining board material with a knife.**

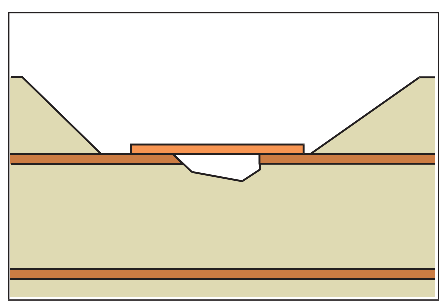


**Figure 4 Conductor foil jumper in place ready to be soldered.**

**NOTE**
Obtain as much information as possible on the conductive and non-conductive layers prior to starting the procedure.

2. Remove components from the immediate area if necessary and clean the area.
3. Use the microscope and hand held drill and cut through the base material, one layer at a time, until the desired inner layer has been reached. (See Figure 1 and 2.)

**CAUTION**
Great care should be taken to prevent further damage to internal conductors.

4. Each internal conductor should have a flat section exposed to allow the new conductor to be soldered in place. (See Figure 3.)

**NOTE**
To reduce damage to the internal conductor, complete the final exposure of the internal conductor using a knife. (See Figure 3.)

5. Remove all loose material. Clean the area.
6. Apply a small amount of liquid flux to the ends of the internal conductor. Tin the exposed end of each conductor using solder and a soldering iron.
7. Clean the area.
8. Select a replacement conductor foil jumper that most closely matches the size of the conductor to be replaced. Cut length approximately as needed.
9. Gently abrade the top and bottom of the conductor foil jumper with a buffer to remove any protective coating and clean.

**NOTE**
If needed, the ends of the conductor foil jumper may be tinned with solder prior to lap soldering in place.

10. Place the conductor foil jumper in position. The conductor foil jumper should overlap the existing conductor a minimum of 2 times the conductor width. (See Figure 4.)

**NOTE**
If spacing is critical or the printed circuit board uses high frequency conductors, bevel the joint. (See Figure 5.)

**CAUTION**
This bevel joint method may cause problems with printed circuit boards exposed to extreme temperature fluctuations.

11. Apply a small amount of liquid flux to the overlap joint.
12. Lap solder the conductor foil jumper to the exposed internal conductor using solder and a soldering iron. Make sure the new conductor is properly aligned.
13. Clean the area.

**NOTE**
The printed wiring board may be preheated prior to filling the area with epoxy. A preheated printed circuit board will allow the epoxy to easily flow and level out. Epoxy applied to an unheated printed circuit board may settle below the printed circuit board surface as the epoxy cures.

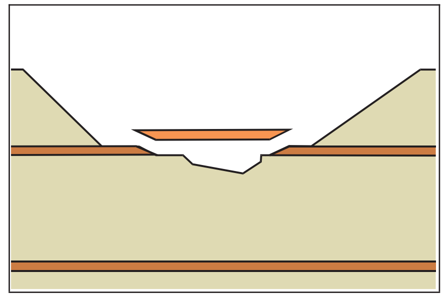


**Figure 5 Bevel end joint.**

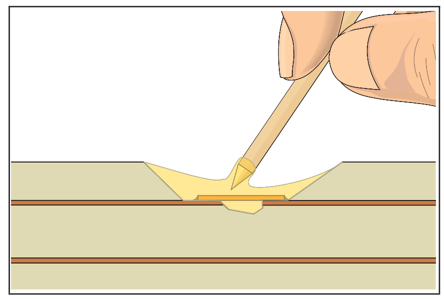


**Figure 6 Coat the top and sides of the new conductor with epoxy.**

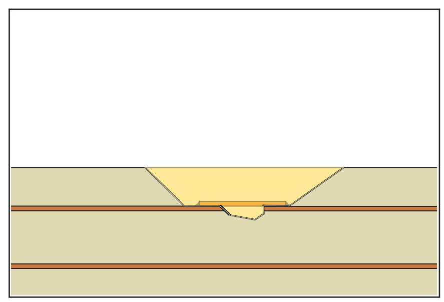


**Figure 7 Completed repair.**

14. Mix epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
15. Coat the top and sides of the replaced conductor with epoxy. The epoxy bonds the new conductor to the base board material and insulates the conductor. Continue adding epoxy up to the top surface of the printed wiring board or to the height of the next internal conductor. (See Figure 6.)

    **NOTE**
    A slight overfill of epoxy may be desired to allow for shrinkage when the epoxy cures.
16. Cure the epoxy per the manufacturer's instructions.

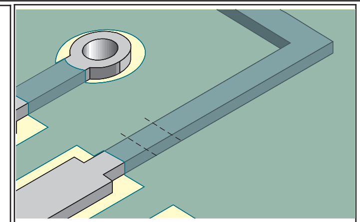
    **CAUTION**
    Some components may be sensitive to high temperature.
17. Add additional conductor foil jumpers if needed and coat with additional epoxy.
18. Continue completing all layers until the top surface of the printed wiring board is reached. (See Figure 7.)
19. Clean the board as required.
20. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination for alignment and overlap of new conductor.
2. Visual examination of epoxy coating for texture, color match, thickness, bubbles, voids and cure.
3. Electrical tests as applicable.
4. Electrical integrity each layer.
5. Board damage.
6. Conductor damage (each layer as applicable).
7. Conductor width and thickness on each layer as applicable.

**NOTES**

# Conductor Cut, Surface Conductors



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to sever a conductor or short. A small section of the conductor is removed forming a break. The width of the break should be at least as wide as the minimum conductor spacing. A knife or high speed, hand held drill is used. This method is recommended for surface conductor cuts only. After cutting, the area is sealed with epoxy.

## NOTE

This method is recommended for surface conductor cuts only.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | | |
|---|---|---|
| Ball Mills, Carbide | Continuity Meter | Heat Lamp |
| Cleaner | Epoxy | Knife |
| Cleaner Wipes | Epoxy Dispensing System | Microscope |
| Color Agent | Hand Held Drill | Oven |

## PROCEDURE

1. Identify the conductor or short to be cut. Determine from the artwork or drawings where the best location is to make the break. The width of the break should at least match the minimum required electrical spacing.
2. Clean the area.

3A. Carefully make two small cuts with the knife and remove the short section of conductor. (See Figure 1.) An alternate method is to use a handheld drill as discussed in Step 4 and shown in Figure 3.

**NOTE**
If desired, remove a second section of the conductor at the opposite end to eliminate the potential of the conductor acting as an antenna.

↑
OR
↓

3B. Select the appropriate size ball mill and insert it into the dental style drill. Set the speed to high. (See Figure 2.) The ball mill should be approximately the same width as the conductor to be cut. (See Table 1 for standard ball mill sizes.)

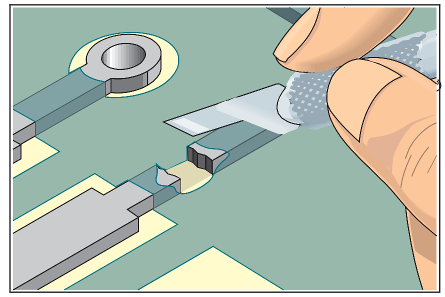


**Figure 1 Make two small cuts with a knife and remove section of conductor.**

**Figure 2 A high quality, hand held drill.**

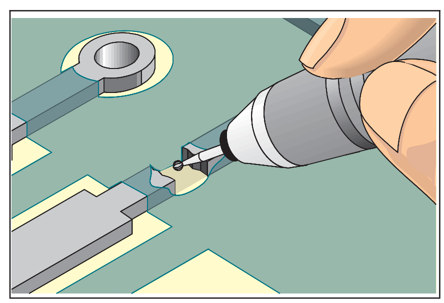


**Figure 3 Make one or two cuts as needed to cut conductor.**

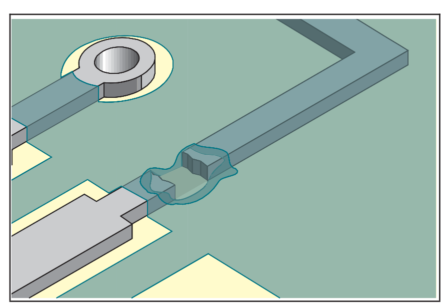


**Figure 4 Completed repair.**

**Table 1 Standard Ball Mill Sizes**

| |
|---|
| 0.50 mm Diameter |
| 0.70 mm Diameter |
| 0.80 mm Diameter |
| 1.00 mm Diameter |
| 1.20 mm Diameter |
| 1.40 mm Diameter |
| 1.60 mm Diameter |
| 1.80 mm Diameter |
| 2.10 mm Diameter |

**CAUTION**
Abrasion operations can generate electrostatic charges.

**NOTE**
Ball mills should be dental grade carbide steel for precision cutting and long life.

4. Carefully make 1 or 2 cuts as needed. (See Figure 3.)

**CAUTION**
Exercise care to avoid damage to adjoining conductors.

**NOTE**
If desired, remove a second section of the conductor at the opposite end to eliminate the potential of the conductor acting as an antenna.

5. Check continuity to be sure that the conductor has been cut.
6. Clean the area.
7. Mix epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
8. Coat the area with epoxy if needed. An epoxy dispenser may be used to accurately control the application of epoxy. Remove any excess epoxy.
9. Cure the epoxy per the manufacturer's instructions.

**CAUTION**
Some components may be sensitive to high temperatures.

## INSPECTION GUIDELINES

1. Visual examination of cuts for spacing, and unintended damage to surrounding conductors.
2. Electrical tests as applicable.
3. Severed conductor area is fully covered with epoxy.
4. Epoxy color, thickness and cure.
5. Conductor damage.
6. Electrical spacing.
7. Board damage.

7721

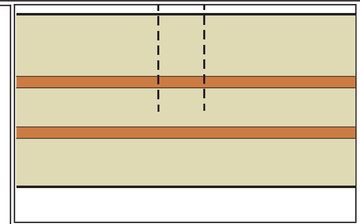
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.3.2**

# Conductor Cut, Inner layer Conductors



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to sever a conductor or short. A small section of the conductor is removed forming a break. The width of the break should be at least as wide as the minimum conductor spacing. A precision drill system is used with a carbide end mill. This method is recommended for surface or inner layer conductor cuts. After milling, the area is sealed with epoxy.

## NOTE

This method is recommended for surface or inner layer conductor cuts.

## CAUTION

Extreme care must be taken to prevent damage to adjacent or underlying inner layer conductors. A microscope must be used during milling when extreme accuracy is required.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Epoxy Dispensing System |
| Cleaner Wipes | Heat Lamp |
| Color Agent | Microscope |
| Continuity Meter | Precision Drill Press |
| End Mills, Carbide | Oven |
| Epoxy | |

## PROCEDURE

1. Identify the conductor or short to be cut. Determine from the artwork or drawings where the best location is to make the break. The width of the break should at least match the minimum required electrical spacing.
2. Clean the area.
3. If the cut is on an inner layer conductor, mark the coordinates on the printed circuit board surface or set up a fixture to precisely locate the board in the precision drill press. (See Figure 1.)

**Figure 1 Precision drill press with base plate.**

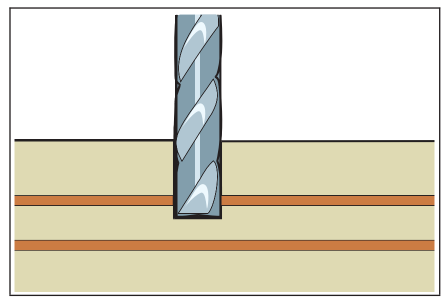


**Figure 2 Mill into PC board at proper coordinates.**

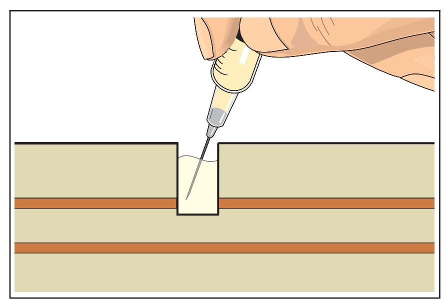


**Figure 3 fill the milled hole with epoxy up to and flush with the surface.**

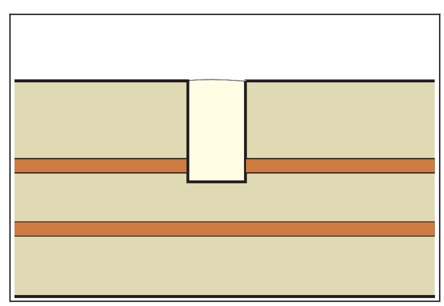


**Figure 4 Completed repair.**

4. Select the appropriate size end mill or ball mill and insert it into the chuck of the precision drill press. The milling cutter should be slightly larger in diameter than the conductor to be cut. Set speed to high.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

   **NOTE**

   End mills are normally single end, two or four flute high grade solid carbide.

5. Mill down into the board at the proper coordinates to cut the inner layer conductors or to break the inner layer short. Do not mill deeper than needed. A microscope should be used for accuracy. (See Figure 2.)
6. Blow away material with air and clean the area.
7. Check continuity to be sure that the conductor has been cut.
8. Mix epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
9. Fill the milled hole with epoxy up to and flush with the surface. An epoxy dispenser may be used to accurately control the application of epoxy. Remove any excess epoxy. (See Figure 3.)

   **CAUTION**

   Examine milled hole to be sure all material is removed from the hole prior to filling the hole with epoxy.

   **NOTE**

   A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.

10. Cure the epoxy per the manufacturer's instructions.

    **CAUTION**

    Some components may be sensitive to high temperatures.

## INSPECTION GUIDELINES

1. Visual examination of cuts for spacing, and unintended damage to surrounding conductors.
2. Electrical tests as applicable.
3. Severed conductor area is fully covered with epoxy.
4. Epoxy color, thickness and cure.
5. Conductor damage.
6. Electrical spacing.
7. Board damage.
8. Epoxy air bubbles and voids.

## NOTES

7721

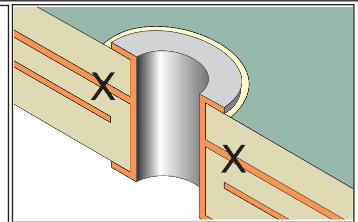
Modification and Repair

Revision: B

Date: 11/07

Number: 4.3.3

# Deleting Inner Layer Connection At A Plated Hole, Drill Through Method




Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used on multilayer printed circuit boards or assemblies to disconnect an internal connection at a plated hole. A precision drill press is used with a carbide drill, end mill or ball mill to drill out the hole. The hole may then be filled with epoxy and redrilled to the diameter needed.

## CAUTION

Extreme care must be taken to prevent damage to adjacent conductors. A microscope must be used during milling when extreme accuracy is required.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Heat Lamp |
| Cleaner Wipes | Polyimide Tape |
| Color Agent | Oven |
| Continuity Meter | Microscope |
| End Mills, Carbide | Pin Clamps |
| Epoxy | Precision Drill Press |
| Epoxy Dispensing System | |

## PROCEDURE

1. Identify the hole that requires repair and clean the area.
2. Mark the coordinates on the board surface and pin the printed wiring board in place on the base plate of the precision drill press. (See Figure 1.)
3. Select the appropriate size end mill, drill or ball mill and insert it into the chuck of the precision drill press. The cutting tool should be approximately 0.50 mm greater than the plated through hole inside diameter. Set speed to high.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

**Figure 1 Precision drill press with base plate.**

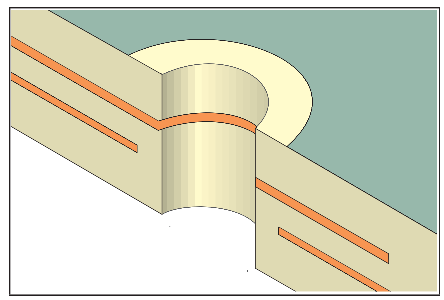


**Figure 2 Completely mill through the hole.**

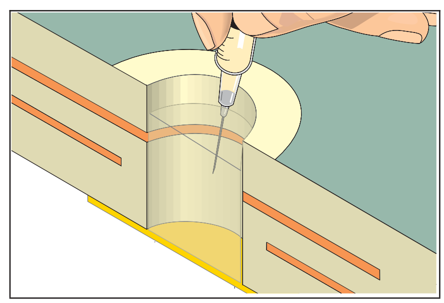


**Figure 3 Fill the hole with epoxy up to and flush with the surface.**

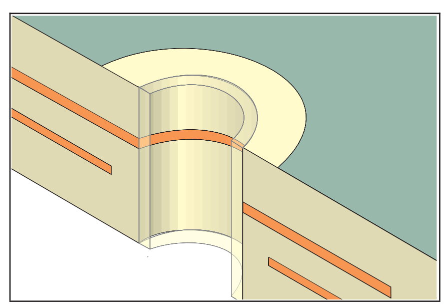


**Figure 4 Repair complete.**

**NOTE**

End mills are normally single end, two or four flute high grade solid carbide.

4. Completely mill through the hole to isolate the internal connection(s). A microscope should be used for accuracy. (See Figure 2.)
5. Blow away material with air and clean the area.
6. Check continuity to be sure that the internal connection has been deleted. Also check the continuity and inspect the neighboring conductors to make sure that none of them have been severed or damaged.
   If desired complete the following steps
7. Mask the opposite side with Polyimide tape or flexible mask to prevent the epoxy from flowing out the opposite side.
8. Mix the epoxy.
9. Fill the hole with epoxy up to and flush with the surface. Remove excess epoxy. (See Figure 3.)

   **NOTE**

   A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.
10. Cure the epoxy per the manufacturer's instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.
11. Clean the area.
12. Select an end mill or drill as needed. Insert the cutting tool into the precision drill press. Mill directly through the center of the cured epoxy. The surface pad remaining may be used as a target location for accuracy. A microscope should be used during milling for accuracy. (See Figure 4.)

    **CAUTION**

    Be careful not to re-expose the internal layers of the hole when drilling out the epoxy.
13. Clean the area. Inspect the new hole using a microscope.

## INSPECTION GUIDELINES

1. Visual and electrical examination as required.
2. Conductor damage.
3. Board damage.
4. Severed conductor area is fully covered with epoxy.
5. Epoxy color, thickness, air bubbles, voids and cure..

## NOTES

IPC

7721

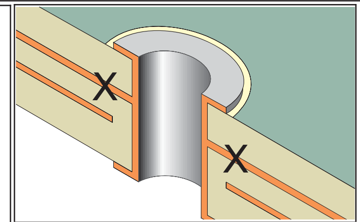
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.3.4**

# Deleting Inner Layer Connection At A Plated Hole, Spoke Cut Method




Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used on multilayer printed circuit boards or assemblies to disconnect an internal connection at a plated hole. A precision drill press is used with a carbide end mill to make precise cuts at the spokes or internal conductors extending from the hole.

## CAUTION

Extreme care must be taken to prevent damage to adjacent conductors. A microscope must be used during milling when extreme accuracy is required.

## REFERENCES

| | | | |
|---|---|---|---|
| 2.1 | Handling Electronic Assemblies | 2.5 | Baking and Preheating |
| 2.2 | Cleaning | 2.6 | Epoxy Mixing and Handling |

## TOOLS AND MATERIALS

| | |
|---|---|
| Cleaner | Heat Lamp |
| Cleaner Wipes | Polyimide Tape |
| Color Agent | Oven |
| Continuity Meter | Microscope |
| End Mills, Carbide | Pin Clamps |
| Epoxy | Precision Drill Press |
| Epoxy Dispensing System | |

## PROCEDURE

1. Identify the hole that requires repair and clean the area.
2. Mark the coordinates on the board surface and place the printed wiring board on the base plate of the precision drill press. (See Figure 1.)
3. Select the appropriate size end mill or drill and insert it into the chuck of the precision drill press. The cutting tool should be approximately 0.010 - 0.025 mm greater than the width of the spoke or conductor to be cut. (See Table 1 for Standard End Mill Sizes.) Set speed to high.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.

   **NOTE**
   End mills are normally single end, two or four flute high grade solid carbide.

**Figure 1 Precision drill press with base plate.**

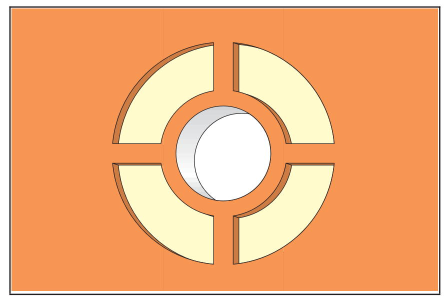


**Figure 2 Plated-through hole with inner layer spoke connections.**

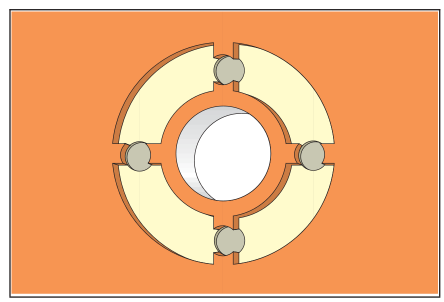


**Figure 3 Mill adjacent to the plated hole to sever spoke connections.**

**Table 1 Standard End Mill Sizes**

| |
|---|
| 0.381 mm Diameter |
| 0.635 mm Diameter |
| 0.812 mm Diameter |
| 1.016 mm Diameter |
| 1.143 mm Diameter |
| 1.397 mm Diameter |
| 1.575 mm Diameter |
| 2.362 mm Diameter |
| 3.175 mm Diameter |

4. Mill into the printed circuit board surface adjacent to the plated hole. The milled holes should be aligned directly above the internal spoke connections. Mill down just deep enough to sever the internal spokes connecting the plated hole to the internal plane. A microscope must be used for accuracy. Up to 4 milled holes may be required. Do not drill deeper than needed. (See Figure 3.)
5. Blow away material with air and clean the area.
6. Check continuity to be sure that the internal connection has been deleted. Also check the continuity and inspect the neighboring conductors to make sure that none of them have been severed or damaged.
7. Mix the epoxy.
8. Fill the holes with epoxy up to and flush with the surface. Remove excess epoxy.

   **NOTE**

   A slight overfill of epoxy may be desired to allow for shrinkage when epoxy cures.
9. Cure the epoxy per the manufacturer's instructions.

   **CAUTION**

   Some components may be sensitive to high temperature.
10. Clean the area.

## INSPECTION GUIDELINES

1. Visual and electrical examination as required.
2. Conductor damage.
3. Board damage.
4. Severed conductor area is fully covered with epoxy.
5. Epoxy color, thickness, air bubbles, voids and cure.

## NOTES

IPC

7721

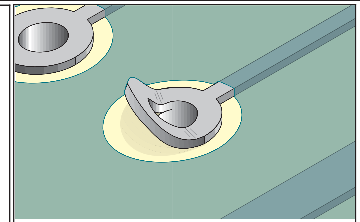
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.4.1**

# Lifted Land Repair, Epoxy Method



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to rebond a lifted land. Liquid epoxy is inserted under and around the land to bond it back down to the printed wiring board surface.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS AND MATERIALS

| | | |
|---|---|---|
| Cleaner | Knife | Soldering iron |
| Epoxy | Oven | Coating |
| Heat Lamp | Wipes | |
| Polyimide Tape | Fluxed-cored solder | |

## PROCEDURE

1. Clean the area.
2. Remove any obstructions that prevent the lifted land from making contact with the base board surface.

   **CAUTION**
   Be careful while cleaning and removing all obstructions, not to stretch or damage the lifted land.
3. Mix the epoxy.
4. Carefully apply a small amount of epoxy under the entire length of the lifted land. The tip of a knife or scraper may be used to apply the epoxy. (See Figure 1.)
5. Place a piece of Polyimide tape over the lifted land and press the land down into the epoxy and into contact with the base board material. (See Figure 2.)
6. Apply additional epoxy to the surface of the lifted land and to all sides as needed.
7. Cure the epoxy per the manufacturer's instructions.

   **CAUTION**
   Some components may be sensitive to high temperatures.

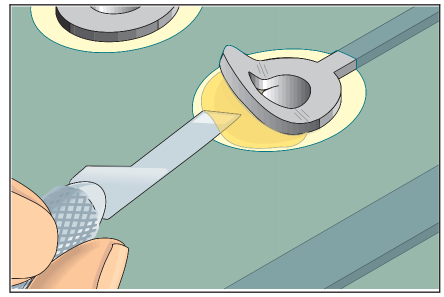


**Figure 1 Apply epoxy under the entire length of the lifted land.**

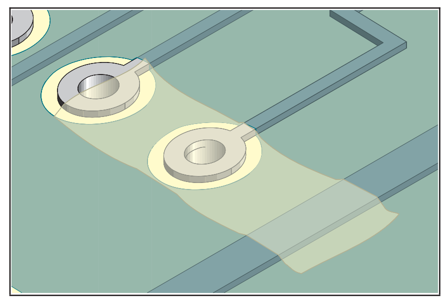


**Figure 2 Place tape over the lifted land.**

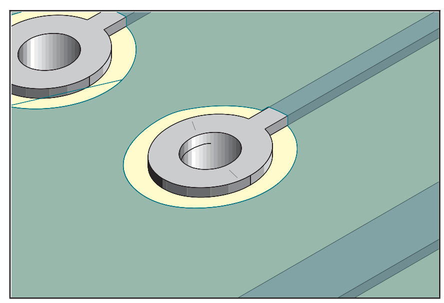


**Figure 3 Completed repair.**

**NOTE**
Double sided and multilayer printed circuit boards, may require an eyelet to restore the through connection. Refer to section 5.0 Plated Hole Procedures.

8. Carefully remove any excess epoxy inside the plated hole using a ball mill or drill bit. Turn the ball mill or drill bit by hand to prevent damage to the wall of the plated through hole.
9. Install the proper component and solder in place.

   **NOTE**
   This method is used to repair a lifted land, but the repaired land may not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the integrity of the electrical connection or an eyelet or buss wire may be used. See Plated Hole Repair Procedures.
10. Replace surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination and tape test per IPC-TM-650, Test Method 2.4.1.
2. Electrical tests as applicable.
3. Epoxy color, thickness, cure and coverage.
4. Electrical clearance.
5. Cleanliness.
6. Conductor damage.
7. Board damage.

## NOTES

IPC

**7721**

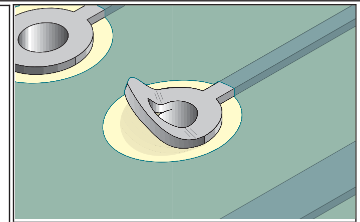
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.4.2**

# Lifted Land Repair, Film Adhesive Method



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to repair damaged and lifted lands. The lifted lands are repaired with dry film epoxy. They are re-bonded to the printed circuit board surface using a bonding press or bonding iron.

## CAUTION

It is essential that the board surface be extremely smooth and flat. If the board is damaged see appropriate procedure.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills | Polyimide Tape |
| Bonding Iron | Knife |
| Bonding System | Microscope |
| Bonding Tips | Scraper |
| Cleaner | Tweezers |
| Dry Film Adhesive | Wipes |

## PROCEDURE

1. Clean the area.
2. Remove any obstructions that prevent the lifted land from making contact with the board material.
3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.
4. Clean the area.
5. Cut out a piece of bonding film that matches the area of the lifted land. Be careful not to contaminate the dry film epoxy with materials that could reduce the bond strength.

   **NOTE**
   Dry film adhesive thickness should be selected to meet the requirements of the printed circuit board.
6. Place the dry film under the lifted land. (See Figure 1).

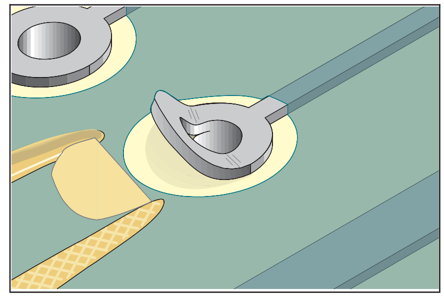


**Figure 1 Cut out dry film material to match the area of the lifted land.**

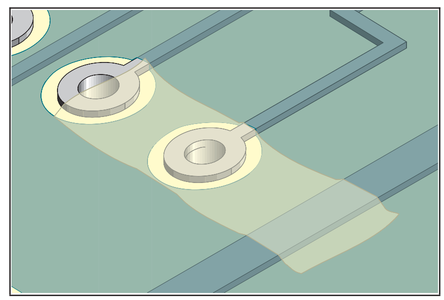


**Figure 2 Place tape over the lifted land.**

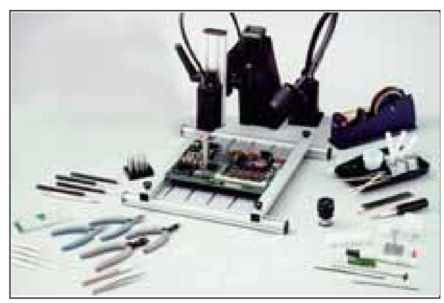


**Figure 3 Bond the land down using a commercially available system.**

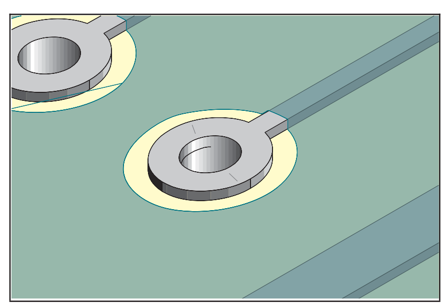


**Figure 4 Completed repair.**

7. Place a piece of Polyimide tape over the lifted land and press the land down into contact with the adhesive film. (See Figure 2).
8. Select a bonding tip with a shape to match the shape of the lifted land.

   **NOTE**

   The bonding tip should be as small as possible but should completely cover the entire surface of the new land.
9. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new land. Apply pressure and heat as recommended in the manual of the repair system or repair kit. (See Figure 3).
10. After the bonding cycle remove the tape used for alignment. The film is fully cured. Carefully clean the area and inspect the land.

    **NOTE**

    Double sided and multilayer printed circuit boards, may require an eyelet to restore the through connection. Refer to section 5.0 Plated Hole Procedures.
11. Carefully remove any excess bonding film inside the plated hole using a ball mill or drill bit. Turn the ball mill or drill bit by hand to prevent damage to the wall of the plated through hole.
12. Install the proper component and solder in place.

    **NOTE**

    This method is used to repair a lifted land, but the repaired land may not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the integrity of the electrical connection or an eyelet or buss wire may be used. See Plated Hole Repair Procedures.
13. Replace surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination and tape test per IPC-TM-650, Test Method 2.4.1.
2. Electrical tests as applicable.
3. Epoxy color, thickness, cure and coverage.
4. Electrical clearance.
5. Cleanliness.
6. Conductor damage.
7. Board damage.
8. Area film adhesive, i.e. smear.

## NOTES

7721

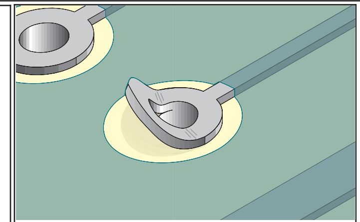
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.5.1**

# Land Repair, Epoxy Method



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged and lifted lands. The damaged lands are replaced with new lands. The new lands are bonded to the printed circuit board surface using a commercially available epoxy.

## CAUTION

This method is used to replace a damaged or missing land, but the new land will not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the electrical connection. If a component is not installed, a wire clinched to both sides of the printed circuit board may be used.

## CAUTION

It is essential that the board surface be smooth and flat. If the board is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement lands. The new lands are fabricated from copper foil. They are available in hundreds of sizes and shapes and are generally supplied solder plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Ball mills or drills | Microscope |
| Buffer | Replacement Lands |
| Cleaner | Scraper |
| Epoxy | Solder |
| Heat Lamp | Soldering Iron |
| Polyimide Tape | Tweezers |
| Knife | Wipes |
| Liquid Flux | |

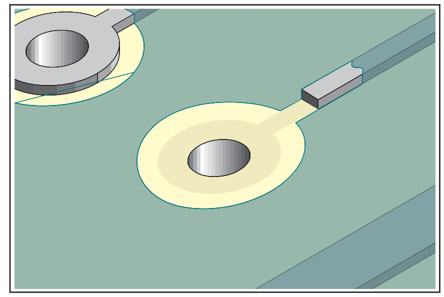


**Figure 1 Remove the defective land and solder resist from the conductor.**

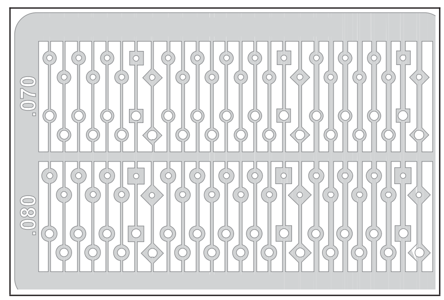



**Figure 2 Select a replacement land that matches the missing land.**

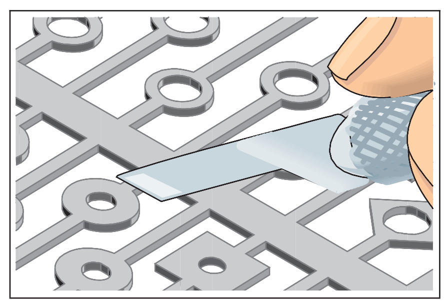


**Figure 3 Cut out the replacement land.**

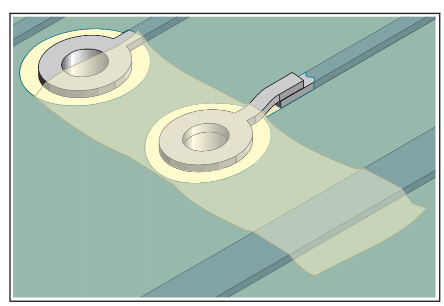


**Figure 4 Place the new land in place using tape.**

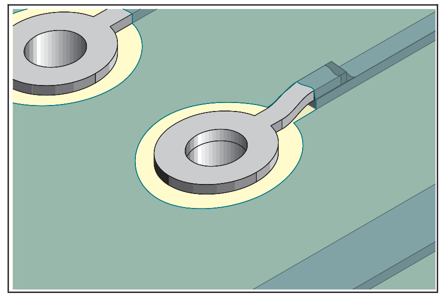


**Figure 5 Completed repair.**

**PROCEDURE**

1. Clean the area.
2. Remove the defective land and a short length of the connecting conductor if any. (See Figure 1.)
3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**
   Abrasion operations can generate electrostatic charges.
4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 1.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. The area for the new pad on the board surface must be smooth and flat. If internal fibers of the board are exposed or if there are deep scratches in the surface they should be repaired. Refer to appropriate procedure.
8. Select a replacement land that most closely matches the land to be replaced. (See Figure 2.)
9. Cut out and trim the new land. Cut the length to provide the maximum allowable conductor overlap for soldering. Minimum 2 times the conductor width. (See Figure 3.)

   **NOTE**
   The new replacement land may be trimmed from copper sheet.
10. Mix the epoxy and apply a small amount to the surface where the new land will be placed.
11. Place a piece of Polyimide tape over the top surface of the land. Place the new land into position on the printed circuit board surface using the tape to aid in alignment. (See Figure 4.)
12. Cure the epoxy per the manufacturer's instructions.
13. After the epoxy has cured, remove the tape used for the alignment. Carefully clean the area and inspect the new land for proper alignment.

    **NOTE**
    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.
14. Remove tape and clean the area.
15. Mix the epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturer's recommended instructions.

    **NOTE**
    Additional epoxy can be applied around the perimeter of the new land to provide additional bond strength.

**CAUTION**

Some components may be sensitive to high temperature.

16. Carefully remove any excess epoxy inside the plated hole using a ball mill or drill bit. Turn the ball mill or drill bit by hand to prevent damage to the wall of the plated through hole.
17. Install the proper component and solder in place.

    **NOTE**

    This method is used to replace a damaged or missing lands, but the new land will not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the integrity of the electrical connection or an eyelet or clinched buss wire may be used. See Plated Hole Repair Procedures.
18. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.
4. Proper alignment of pad and hole.
5. No epoxy in the hole or internal pad walls, or interfere with minimum solder requirements.
6. No reduction in hole diameter.
7. No exposed adjacent circuitry.
8. Overlap of solder connection is at least two times the conductor width.

## NOTES

IPC

7721

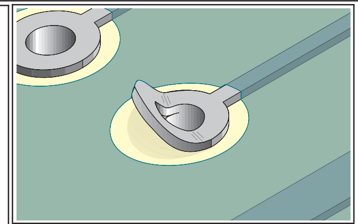
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.5.2**

# Land Repair, Film Adhesive Method



Board Type: R, F
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged and lifted lands. The damaged lands are replaced with new dry film, adhesive backed lands. The new lands are bonded to the printed circuit board surface using a bonding press or bonding iron.

## CAUTION

This method is used to replace a damaged or missing land, but the new land will not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the integrity of the electrical connection. If a component is not installed, a wire clinched to both sides of the printed circuit board may be used.

## CAUTION

It is essential that the board surface be smooth and flat. If the board is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement lands. The new lands are fabricated from copper foil and have a dry film adhesive coating on the back. They are available in hundreds of sizes and shapes and are generally supplied solder plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

Bonding Iron
Bonding System
Bonding Tips
Buffer
Cleaner
Epoxy
Heat Lamp
Polyimide Tape
Knife
Liquid Flux
Microscope
Replacement Lands, Adhesive Backed
Scraper
Solder
Soldering Iron
Tweezers
Wipes

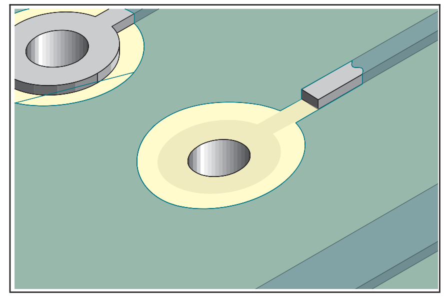


**Figure 1 Remove the defective land and solder resist from the conductor.**

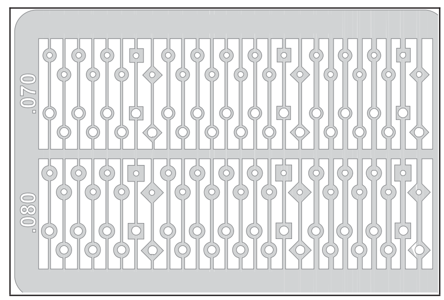



**Figure 2 Select a replacement land that matches the missing land.**

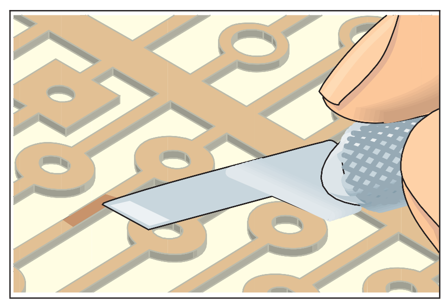


**Figure 3 Scrape off the adhesive bonding film from solder joint area.**

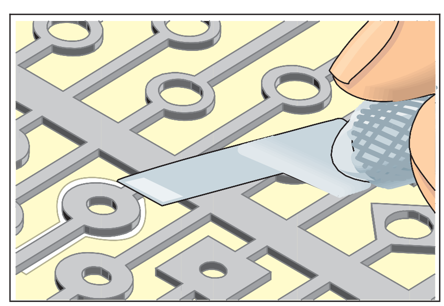


**Figure 4 Cut out the new land.**

**PROCEDURE**

1. Clean the area.
2. Remove the defective land and a short length of the connecting conductor if any. (See Figure 1.)
3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.
4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 1.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. The area for the new pad on the board surface must be smooth and flat. If internal fibers of the board are exposed or if there are deep scratches in the surface they should be repaired. Refer to appropriate procedure.
8. Select a replacement land that most closely matches the land to be replaced. (See Figure 2.)

   **NOTE**

   The new replacement land may be trimmed from copper sheet.
9. Before trimming out the new land carefully scrape off the adhesive film from the solder joint connection area on the back of the new land. (See Figure 3.)

   **CAUTION**

   Scrape off the epoxy backing only from the joint connection area. When handling the replacement land avoid touching the adhesive backing with your fingers or other materials that may contaminate the surface and reduce the bond strength.
10. Cut out and trim the new land. Cut out from the plated side. Cut the length to provide the maximum allowable conductor overlap for soldering. Minimum 2 times the conductor width. (See Figure 4.)
11. Place a piece of tape over the top surface of the new land. Place the new land into position on the printed circuit board surface using the tape to aid in alignment. Leave the tape in place during the bonding cycle. (See Figure 5.)
12. Select a bonding tip with a shape to match the shape of the new land.

    **NOTE**

    The Bonding Tip should be as small as possible but should completely cover the entire surface of the new land.
13. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new land. Apply pressure as recommended in the manual of the repair system or repair kit of the manufacturer. (See Figure 6.)

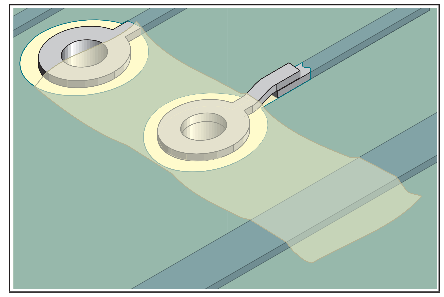


**Figure 5 Place the new land in place using tape.**

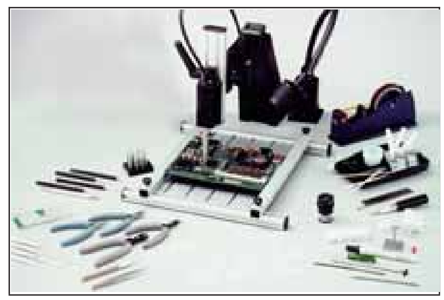


**Figure 6 Bonding systems.**

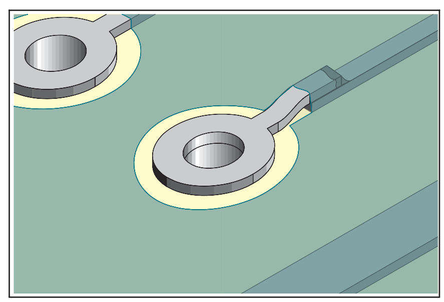


**Figure 7 Completed land repair.**

**CAUTION**

Excessive bonding pressure may cause measling in the printed circuit board surface or the new conductor to slide out of position.

14. After the bonding cycle remove the tape used for alignment. The land is fully cured. Carefully clean the area and inspect the new land for proper alignment.
15. If the new land has a connecting conductor apply a small amount of liquid flux to the lap solder joint connection area and solder the conductor from the new land to the conductor on the printed wiring board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new land to prevent excess solder overflow.

    **NOTE**

    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.
16. Remove tape and clean the area.
17. Mix epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturers instructions.

    **NOTE**

    Additional epoxy can be applied around the perimeter of the new pad to provide additional bond strength.

    **CAUTION**

    Some components may be sensitive to high temperature.
18. Carefully remove any excess bonding film inside the plated hole using ball mill or drill bit. Turn the ball mill or drill bit by hand to prevent damage to the wall of the plated through hole.
19. Install the proper component and solder in place.

    **NOTE**

    This method is used to replace a damaged or missing land, but the new land will not have an intermetallic connection to the remaining plated hole. The solder joint of the replaced component will restore the integrity of the electrical connection or an eyelet or buss wire may be used. See Plated Hole Repair Procedures.
20. Apply surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination.
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.
4. Proper alignment of pad and hole.
5. No epoxy in the hole or internal pad walls, or interfere with minimum solder requirements.
6. No reduction in hole diameter.
7. No exposed adjacent circuitry.
8. Overlap of solder connection is at least two times the conductor width.

| | |
|---|---|
| Number: **4.5.2** | Subject: **Land Repair, Film Adhesive Method** |
| Revision: **B**<br>Date: 11/07 | |

**NOTES**

IPC

7721

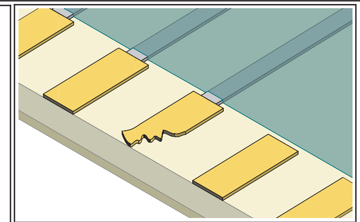
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.6.1**

# Edge Contact Repair, Epoxy Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace a damaged edge contact with a new edge contact. The new edge contact is bonded to the printed circuit board surface using liquid epoxy.

## CAUTION

It is essential that the board surface be smooth and flat. If the board material is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement edge contacts. The edge contacts are fabricated from copper foil. They are available in hundreds of sizes and shapes and are generally supplied either plain copper, solder plated or nickel and gold plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking And Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Oven |
| Epoxy | Replacement Edge Contacts |
| File, Finish Grade | Scraper |
| Heat Lamp | Solder |
| Polyimide Tape | Soldering Iron |
| Knife | Tweezers |
| Liquid Flux | Wipes |
| Microscope | |

## PROCEDURE

1. Clean the area.
2. Remove the defective edge contact and a short length of the connecting conductor. Heat from a soldering iron will allow the old contact to be removed more easily.

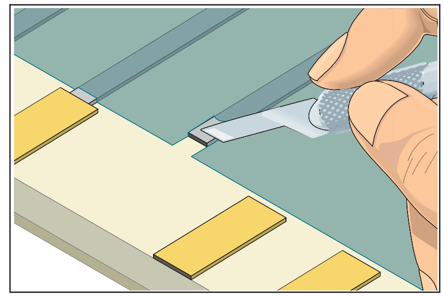


**Figure 1 Remove the defective edge contact and solder resist.**

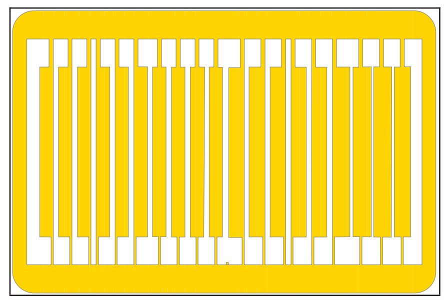


**Figure 2 Select a replacement contact that matches.**

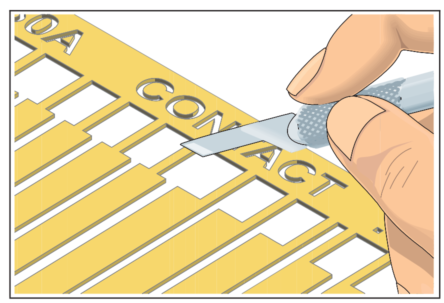


**Figure 3 Cut out the new edge contact.**

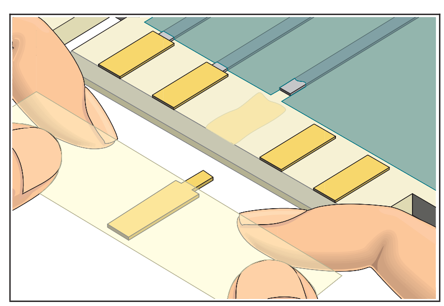


**Figure 4 Place the new edge contact in place using tape.**

3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 1.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. The area for the new edge contact on the board surface must be smooth and flat. If internal fibers of the board are exposed or deep scratches exist in the surface they should be repaired. Refer to appropriate procedure.
8. Select a new edge contact that most closely matches the edge contact to be replaced. (See Figure 2.)
9. Cut out and trim the new edge contact. Cut out from the plated side. Cut the length to provide the maximum allowable joint if lap soldering. Minimum 2 times the conductor width. Leave the new edge contact extra long. The excess material will be trimmed after curing. (See Figure 3.)

   **NOTE**

   The new replacement edge contact may be trimmed from copper sheet.

10. Mix the epoxy and apply a small amount to the surface where the new contact will be placed.
11. Place a piece of tape over the top surface of the new edge contact. Position the new edge contact on the printed circuit board surface using the tape to aid in alignment. (See Figure 4.)

    **NOTE**

    Allow the edge contact to overhang the edge of the printed circuit board. Leave the tape in place during the bonding cycle.

12. Cure the epoxy per the manufacturer's instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.

13. After the epoxy has cured, remove the tape used for alignment. Carefully clean and inspect the new pad for proper alignment.

    **NOTE**

    Additional epoxy can be applied around the perimeter of the new edge contact to provide additional bond strength.

14. If the new edge contact has a connecting conductor apply a small amount of liquid flux to the lap solder joint connection area and solder the conductor from the new edge contact to the conductor on the printed wiring board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new edge contact to prevent excess solder overflow.

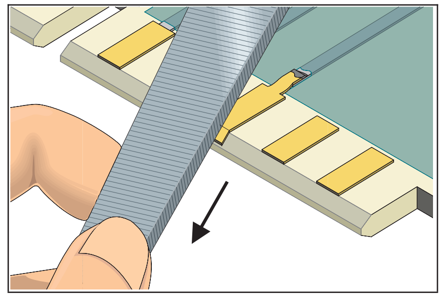


**Figure 5 File overhanging piece of new edge contact.**

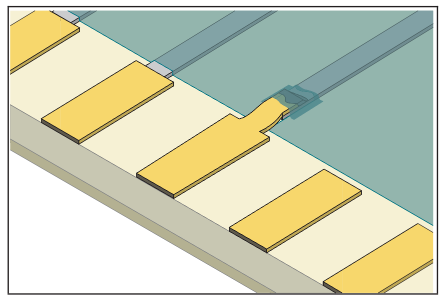


**Figure 6 Completed repair.**

**NOTE**
If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.

15. Remove the tape and clean the area.
16. Trim the extending edge of the new edge contact with a file. File parallel to the beveled edge until the excess material has been removed. (See Figure 5.)
17. If sealing the lap solder joint connection is required, mix epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturer's instructions.
18. If plating is required refer to appropriate procedure.
19. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination, measurement of new pad width and spacing.
2. Electrical continuity measurement.
3. Proper alignment of edge contact.
4. No epoxy on the edge contact, or that interferes with minimum solder requirements.
5. The overlap solder connection is at least two times conduct width.
6. No damage to edge contact surface platings, i.e. gold, etc.

## NOTES

7721

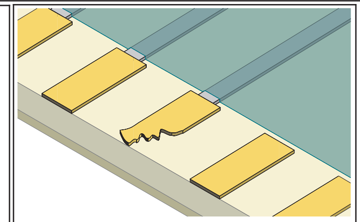
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.6.2**

# Edge Contact Repair, Film Adhesive Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace a damaged edge contact with a new dry film, adhesive backed edge contact. The new edge contact is hot bonded to the printed circuit board surface.

## CAUTION

It is essential that the board surface be smooth and flat. If the board material is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement edge contacts. The edge contacts are fabricated from copper foil and have a dry film adhesive coating on the back. They are available in hundreds of sizes and shapes and are generally supplied nickel and gold plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

- Bonding Iron
- Bonding System
- Bonding Tips
- Cleaner
- Epoxy
- File, Finish Grade
- Heat Lamp
- Polyimide Tape
- Knife
- Liquid Flux
- Microscope
- Oven
- Replacement Edge Contacts, Adhesive Backed
- Scraper
- Solder
- Soldering Iron
- Tweezers
- Wipes

## PROCEDURE

1. Clean the area.
2. Remove the defective edge contact and a short length of the connecting conductor. Heat from a soldering iron will allow the old contact to be removed more easily.

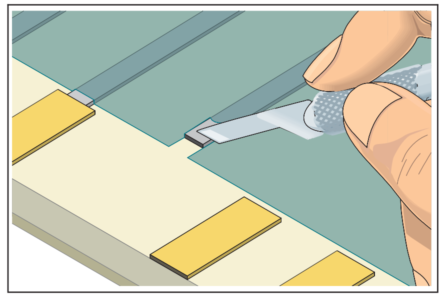


**Figure 1 Remove the defective edge contact and solder resist.**

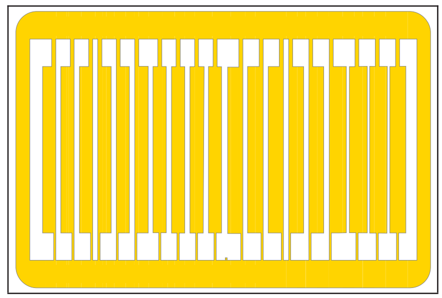


**Figure 2 Select a replacement contact that matches.**

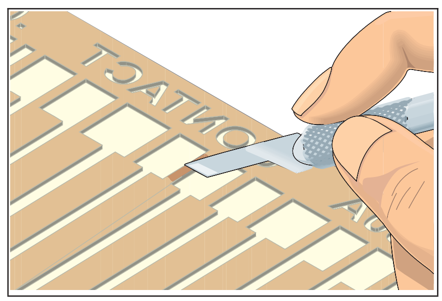


**Figure 3 Scrape off adhesive bonding film from solder joint area.**

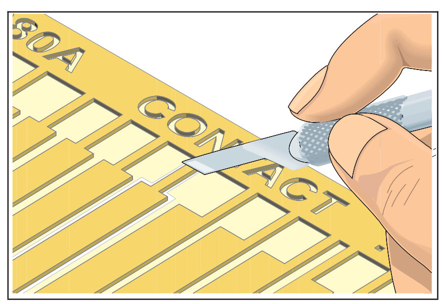


**Figure 4 Cut out the new edge contact.**

3. Use the knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 1.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. The area for the new edge contact on the board surface must be smooth and flat. If internal fibers of the board are exposed or deep scratches exist in the surface they should be repaired. Refer to appropriate procedure.
8. Select a new edge contact that most closely matches the edge contact to be replaced. (See Figure 2.)

   **NOTE**

   The new replacement edge contact may be trimmed from copper sheet.

9. Before trimming out the new edge contact carefully scrape off the adhesive film from the solder joint connection area on the back of the new edge contact. (See Figure 3.)

   **CAUTION**

   Scrape off the epoxy backing only from the joint connection area. When handling the replacement contact, avoid touching the epoxy backing with your fingers or other materials that may contaminate the surface and reduce the bond strength.

10. Cut out and trim the new edge contact. Cut out from the plated side. Cut the length to provide the maximum allowable joint if lap soldering. Minimum 2 times the conductor width. Leave the new edge contact extra long. The excess material will be trimmed after bonding. (See Figure 4.)
11. Place a piece of tape over the top surface of the new edge contact. Position the new edge contact on the printed circuit board surface using the tape to aid in alignment. (See Figure 5.)

    **NOTE**

    Allow the edge contact to overhang the edge of the printed wiring board. Leave the Tape in place during the bonding cycle.

12. Select a bonding tip with a shape to match the shape of the new edge contact.

    **NOTE**

    The bonding tip should be as small as possible but completely cover the entire surface of the new edge contact.

13. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new edge contact. Apply pressure as recommended by the manufacturer. (See Figure 6.)

    **CAUTION**

    Excessive bonding pressure may cause measling in the printed circuit board surface or the new conductor to slide out of position.

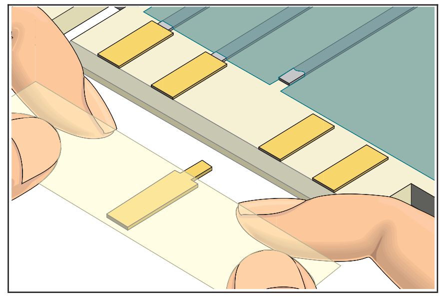


**Figure 5 Place the new edge contact in place using tape.**

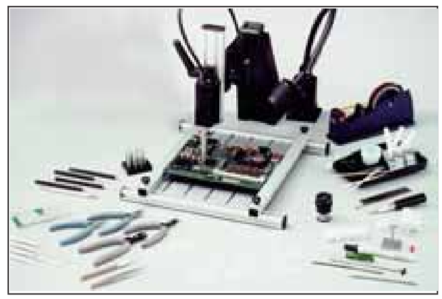


**Figure 6 Bonding system.**

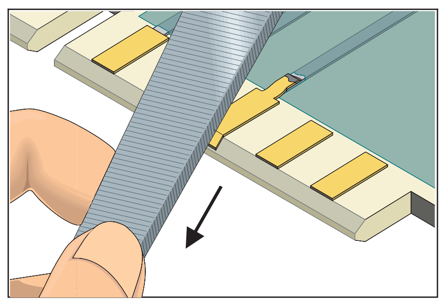


**Figure 7 File overhanging piece of the new edge contact.**

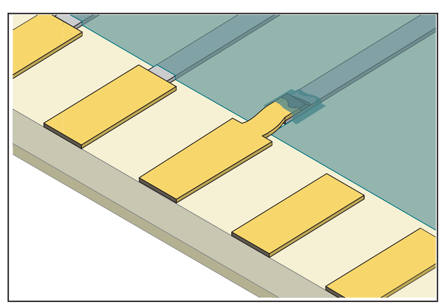


**Figure 8 Completed repair.**

14. After the bonding cycle remove the tape used for alignment. The new edge contact is fully cured. Carefully clean the area and inspect the new edge contact for proper alignment.
15. If the new edge contact has a connecting conductor apply a small amount of liquid flux to the lap solder joint connection area and solder the conductor from the new edge contact to the conductor on the printed wiring board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new edge contact to prevent excess solder overflow.

    **NOTE**
    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.
16. Remove tape and clean the area.
17. Trim the extending edge of the new edge contact with a file. File parallel to the beveled edge until the excess material has been removed. (See Figure 7.)
18. If sealing the lap solder joint connection is required, mix epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturer’s instructions.

    **CAUTION**
    Some components may be sensitive to high temperature.

    **NOTE**
    Additional epoxy can be applied around the perimeter of the new edge contact to provide additional bond strength.
19. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination, measurement of new pad width and spacing.
2. Electrical continuity measurement.
3. Proper alignment of edge contact.
4. No adhesive on the edge contact, or that interferes with minimum solder requirements.
5. The overlap solder connection is at least two times conduct width.
6. No damage to edge contact surface platings, i.e. gold, etc.

## NOTES

IPC

7721

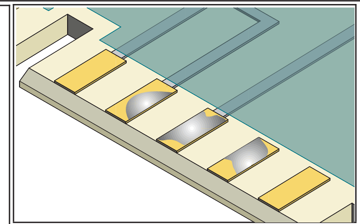
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.6.3**

# Edge Contact Repair, Plating Method



Board Type: R, F, W, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replate edge contacts by selective swab plating. Edge contacts may require replating if they become contaminated with solder or are scratched during handling. Other applications may arise when the plating on the edge contacts does not meet the minimum thickness specification or if the specification changes.

This electroplating process uses a DC power supply. One lead is connected to the connector edge contacts that need plating. A second lead is connected to the plating probe. The plating probe has an anode fastened to the tip. The anode has absorbent wrapping. The anode is dipped into high-speed proprietary plating solutions. When the saturated anode is swabbed across the printed circuit board connector edge contacts, the metal contained in the solution is plated wherever electrical contact is made. Prior to replating any solder contamination must be removed.

## CAUTION

This method can be used to replate any metal surface including connector edge contacts, but it is essential that the surface to be plated is free of deep scratches, nicks, pin holes or other defects. If the edge contacts need to be replaced see appropriate procedure.

## SAFETY

A thorough review of this method should be made before repairs are attempted. Technicians should become familiar with the tools included and should practice on scrap printed circuit boards

To expect the best results a clean work environment is essential. A smooth work surface and good lighting are recommended. Safety glasses and safety gloves should always be worn when handling hazardous chemicals.

The work area should be adequately ventilated. It is particularly important to have adequate ventilation when using gold solution, since gold solution contains a very small percentage of free cyanide. If ventilation is not adequate, use a fan to move fumes away from the operator.

## CAUTION

It is essential to follow the manufacturer's instructions supplied with the plating equipment.

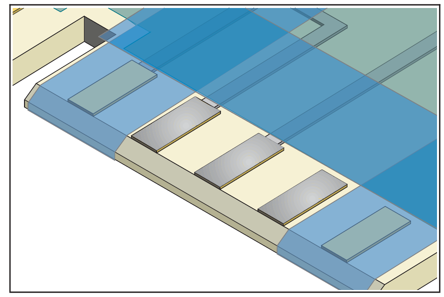


**Figure 1 Apply tape.**

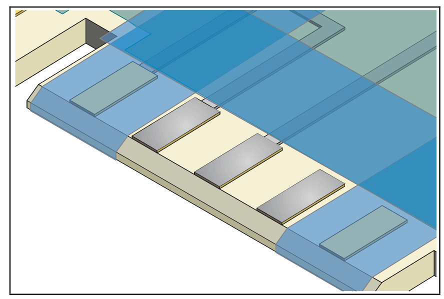


**Figure 2 Flow solder.**

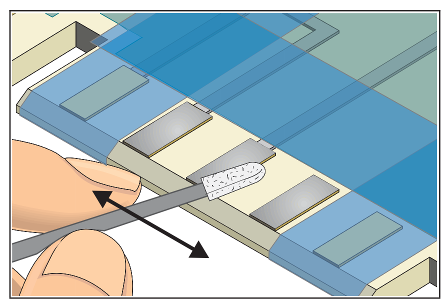


**Figure 3 Solder stripping solution.**

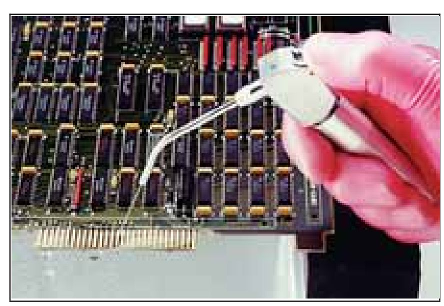


**Figure 4 Rinse.**

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

Abrasive Pad
Board Support
Burnisher
Cleaner
Cleaner Wipes
Connector Edge
Plating System
Conductive Pen
Desoldering Braid or
Desoldering System
Eraser Stick
Gloves, Antistatic
Polyimide Tape
Knife
Liquid Flux
Peel Testing Tape
Pin Fixtures
Plating Anodes
Plating Cables
Plating Probe
Plating Solution, Gold
Plating Solution, Nickel
Plating Solution, Electroclean
Plating Solution, Solder Strip
Plating Tape
Power Supply
Probe Clip
Rinse Bottle
Rinse Tray
Safety Glasses
Solder
Solder Iron
Solution Cups
Solution Tray
Swab
Thickness Measuring System,
Gold and Nickel
Water/Air Sprayer
Wire, Buss, 30 AWG
Work Sink

**PREPARATION** – Remove Solder Contamination

## CAUTION

Safety glasses and safety gloves should always be worn when handling hazardous chemicals. Do not work within a small enclosed room without supplemental ventilation. If ventilation is not adequate, use a fan to move fumes away from the operator.

1. Clean the rework area.
2. Apply plating tape to the printed circuit board surface surrounding the area to be reworked. (See Figure 1.) The plating tape will protect adjacent components and the printed circuit board surface from unwanted exposure to stripping and plating solutions.
3. Flow solder over the entire area of any contacts that have contamination using a soldering iron. This provides a more even surface when plating. Remove the bulk of the solder contamination using desoldering tools or desoldering braid. (See Figure 2.)
4. Clean the area.
5. Place the printed circuit board on the board support so that the leading edge overhangs the rinse tray.
6. Swab the solder stripping solution over the solder contamination using a swab. Swab the surface until all remaining solder has been stripped off. (See Figure 3.)

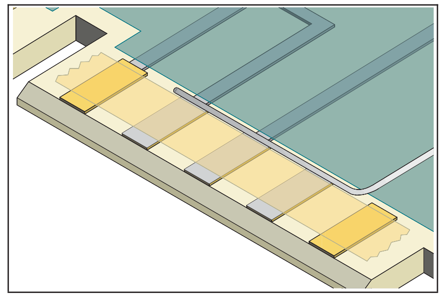


**Figure 5 Solder a wire to the edge of the contacts needing plating.**

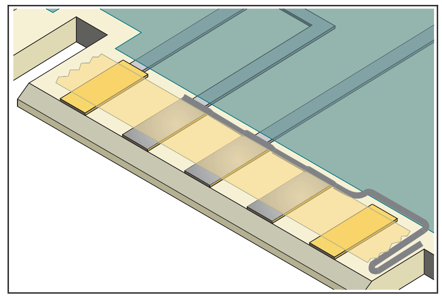


**Figure 6 Apply conductive paint to the edge of the contacts.**

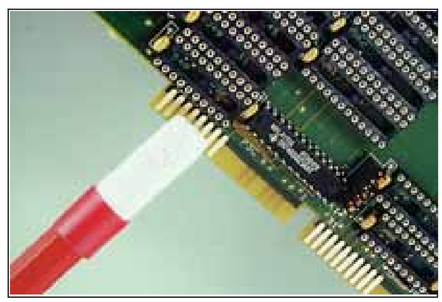


**Figure 7 Sample plating anodes shown with fabric wrapping.**

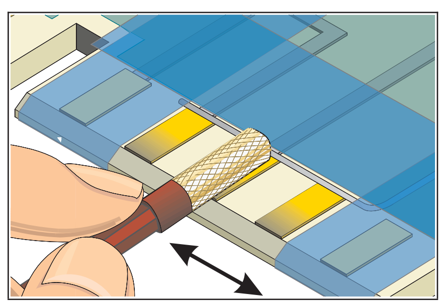


**Figure 8 Brush the surface with the saturated plating probe.**

7. Thoroughly rinse the entire area with water. (See Figure 4.)
8. Mildly buff the contacts using abrasive pad. Mild buffing will prepare the surface for plating and remove any remaining solder contamination.
9. Thoroughly rinse with water to remove any residue.

**PREPARATION** − Remove Poor Plating or Surface Defects

1. Clean the rework area.
2. Apply plating tape to the printed circuit board surface surrounding the area to be reworked. The plating tape will protect adjacent components and the printed circuit board surface from unwanted exposure to stripping and plating solutions.
3. Clean the area.
4. Buff the contacts using an abrasive pad. Buff the contacts until all defective or poor plating is removed.
5. Burnish small scratches. Use the tip of the burnisher to work the copper material into the scratch and smooth out the area. Finish by mildly buffing the area to remove any minor burnishing marks. If there are large scratches the contact may need replacement. See Procedure Number 4.6.1 or 4.6.2.
6. Thoroughly rinse the entire area with water to remove any residue.

**BUSSING**

A conductive buss must be made to all the contacts that need plating. There are 4 basic connection options.

**NOTE**
Making a reliable buss connection is the most important step in plating. All sorts of problems will be eliminated by taking the time to make a reliable buss connection.

**BUSSING** − Wire Soldered to Edge (Option 1)

**CAUTION**
When finished, this method will leave a small unplated line along the inner tip of each contact.

1. Apply Polyimide tape to all the contacts to be plated. The tape should cover the entire contact except for a small line along the inboard edge. The tape will prevent further solder contamination.
2. Solder a wire directly to the inboard tip or connecting conductor of each contact to be plated. The smallest amount of solder should be used to prevent further contamination. (See Figure 5.)

**BUSSING** − Conductive Paint Applied to Edge (Option 2)

**CAUTION**
When finished, this method will leave a small unplated line along the inner tip of each contact.

1. Apply Polyimide tape to all the contacts to be plated. The tape should cover the entire contact except for a small line along the inboard edge. The tape will prevent the conductive paint from contaminating the contact surface.

2. Apply a thin coating of conductive paint directly to the inboard tip of each contact to be plated. The conductive paint should extend out to one edge so that a clip can be applied to make electrical connection. (See Figure 6.)

**BUSSING** − Mechanical Probe, Individual Contacts (Option 3)

1. Each contact needing plating can be individually probed using the plating probe. Touch the tip of the plating probe to the inboard edge of each contact or to the connecting conductor as each solution is applied during the plating process.

**BUSSING** − Pin Fixture, Multiple Contacts (Option 4)

1. Make a mechanical connection to each contact using a pin fixture. The pin fixture has spring loaded contact pins on centers matching the spacing of the edge contacts to be plated. The contact pins make direct mechanical connection to the inboard tip of each contact, the connecting conductor trace or a connecting plated through hole.

**PROCEDURE** − Plating Process

1. Place the printed circuit board on the board support so that the leading edge overhangs the rinse tray.
2. Make the cathode connection (-) to the printed circuit board by using a plating probe or probe clip. Connect the probe clip directly to the wire buss connection or to the edge where conductive paint has been applied. The cable should be connected to the (-) or black jack on the power supply.
3. Connect the plating probe to the power supply (+) or red jack. (See Figure 7.)
4. Set the output current on the power supply to setting recommended by the equipment manufacturer.
5. Dip the plating probe into the electroclean plating solution. Wait a few seconds for the solution to saturate the absorbent wrapping.
6. Swab the entire surface to be plated by brushing the surface with the saturated plating probe. The plating probe should be moved back and forth briskly to prevent burning and to provide even coverage. (See Figure 8.) Swab the area for the time recommended by the equipment manufacturer.
7. Thoroughly rinse the entire area with water. Any burning or darkening of the contacts may be removed with an abrasive pad. Saturate the abrasive pad and the printed circuit board surface with water and lightly buff the contacts until all evidence of the burning or discoloring is removed. Rinse the entire area with water.

   **CAUTION**

   Do not allow the rework area to dry out between steps. The water coating prevents oxidation.
8. Connect the nickel plating probe to the power supply (+) or red jack.
9. Dip the plating probe into the nickel plating solution. Wait a few seconds for the solution to saturate the absorbent wrapping.

10. Swab the entire surface to be plated by brushing the surface with the saturated plating probe. The plating probe should be moved back and forth briskly to prevent burning and to provide even coverage. Swab the area for the time recommended by the equipment manufacturer. Before rinsing, lightly buff the contacts with an abrasive pad.
11. Thoroughly rinse the entire area with water.
12. Connect the gold plating probe to the power supply (+) or red jack.
13. Dip the plating probe into the gold plating solution. Wait a few seconds for the solution to saturate the absorbent wrapping.
14. Swab the entire surface to be plated by brushing the surface with the saturated plating probe. The plating probe should be moved back and forth briskly to prevent burning and to provide even coverage. Swab the area for the time recommended by the equipment manufacturer.
15. Thoroughly rinse the entire area with water.
16. Remove and discard all plating tape and thoroughly rinse the area with water. Dry the area using a air sprayer or wipes.
17. Remove the wire or conductive paint used to buss the contacts.

    **CAUTION**

    Apply tape to protect the contacts from further contamination while removing the buss connection.
18. Thoroughly rinse the entire area with deionized water or rinse the printed circuit board in an aqueous water cleaning system.

**INSPECTION GUIDELINES**

1. The rework area should be checked by measuring the thickness of the nickel and gold to make sure they meet the minimum thickness requirement.
2. The plating bond may also be checked by doing a peel test using peel testing tape.
3. Visually examine the rework area for color and luster.
4. No damage to edge contact surface plating.

**NOTES**

IPC

7721

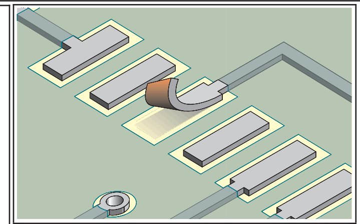
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.7.1**

# Surface Mount Pad Repair, Epoxy Method



Board Type: R, F, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged surface mount pads with commercially available replacement pads. The new pads are bonded to the printed circuit board surface using liquid epoxy.

## CAUTION

It is essential that the board surface be smooth and flat. If the board material is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement surface mount pads. The new pads are fabricated from copper foil. They are available in hundreds of sizes and shapes and are generally supplied solder plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Buffer | Oven |
| Cleaner | Replacement Surface Mount Pads |
| Epoxy | Scraper |
| Heat Lamp | Solder |
| Knife | Soldering Iron |
| Polyimide Tape | Tweezers |
| Liquid Flux | Wipes |
| Microscope | |

## PROCEDURE

1. Clean the area.
2. Remove the defective pad and a short length of the connecting conductor. (See Figure 1.)

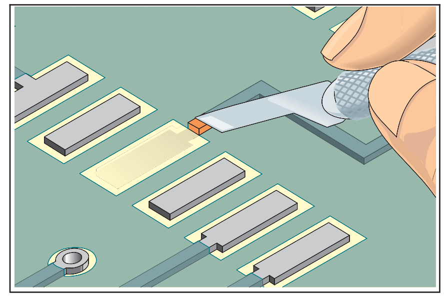


**Figure 1 Remove pad.**

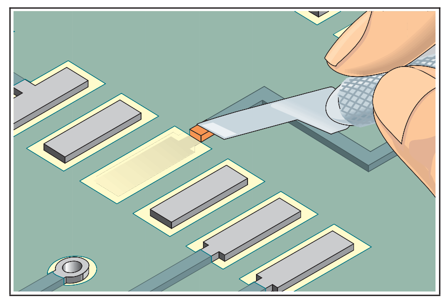


**Figure 2 Scrape off solder resist.**

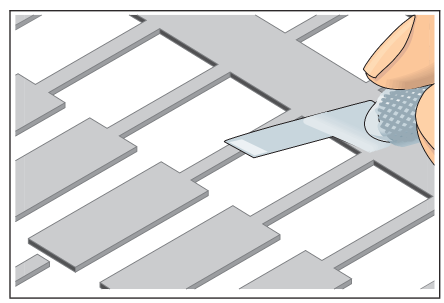


**Figure 3 Cut out new pad.**

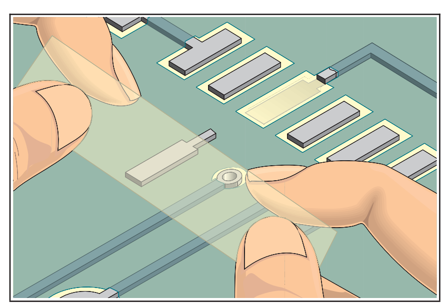


**Figure 4 Position pad using tape.**

3. Use a knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

4. Scrape off any solder resist or coating from the connecting conductor. (See Figure 2.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the conductor width.
7. The area for the new pad on the board surface must be smooth and flat. If internal fibers of the board are exposed or if there are deep scratches in the surface they should be repaired. Refer to appropriate procedure.
8. Select a commercially available surface mount pad that most closely matches the surface mount pad to be replaced. If a special size or shape is needed they can be custom fabricated.
9. Cut out and trim the new pad. Cut the length to provide the maximum allowable conductor overlap for soldering. Minimum 2 times the conductor width. (See Figure 3.)

   **NOTE**

   The new replacement surface mount pad may be trimmed from copper sheet.

10. Mix the epoxy and apply a small amount to the surface where the new pad will be placed.
11. Place a piece of Polyimide tape over the top surface of the new pad. Place the new pad into position on the printed circuit board surface using the tape to help in alignment. (See Figure 4.)
12. Cure the epoxy per the manufacturers instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.

13. After the epoxy has cured remove the Polyimide tape used for alignment. Carefully clean the area and inspect the new pad for proper alignment.
14. If the new pad has a connecting conductor apply a small amount of liquid flux to the lap solder joint connection area and solder the conductor from the new pad to the conductor on the printed circuit board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new pad to prevent excess solder overflow.

    **NOTE**

    If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.

15. Mix epoxy and coat the lap solder joint connections. Cure the epoxy per the manufacturers recommended instructions.

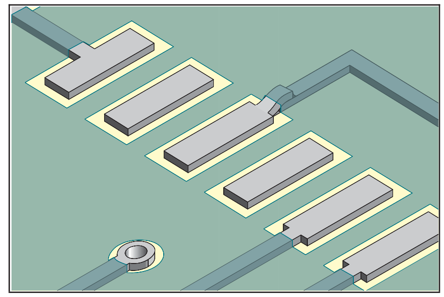


**Figure 5 Completed repair.**

**NOTE**
Additional epoxy can be applied around the perimeter of the new pad to provide additional bond strength.

16. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.
4. Proper alignment of contact.
5. No epoxy on contact, or that interferes with solder requirements.
6. Overlap of the solder connection is at least two times conductor width.
7. No damage to contact surface plating.

**NOTES**

IPC

7721

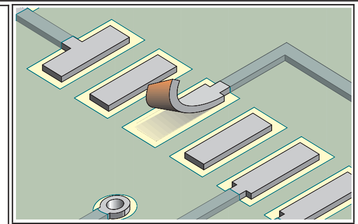
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.7.2**

# Surface Mount Pad Repair, Film Adhesive Method



Board Type: R, F, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged surface mount pads with new dry film, adhesive backed pads. The new pads are bonded to the printed wiring board surface using a specially designed bonding press or bonding iron.

## CAUTION

It is essential that the board surface be smooth and flat. If the board material is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement surface mount pads. The new pads are fabricated from copper foil. They are available in hundreds of sizes and shapes and are generally supplied solder plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Bonding Iron | Microscope |
| Bonding System | Oven |
| Bonding Tips | Replacement Surface Mount Pads |
| Cleaner | Scraper |
| Epoxy | Solder |
| Heat Lamp | Soldering Iron |
| Polyimide Tape | Tweezers |
| Knife | Wipes |
| Liquid Flux | |

## PROCEDURE

1. Clean the area.
2. Remove the defective pad and a short length of the connecting circuit. (See Figure 1.)

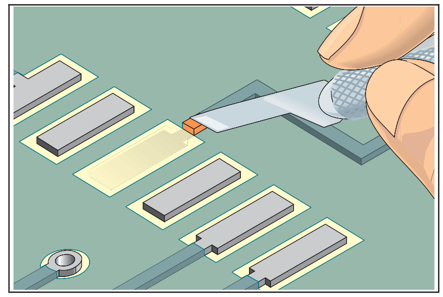


**Figure 1 Remove the defective surface mount pad and soldermask.**

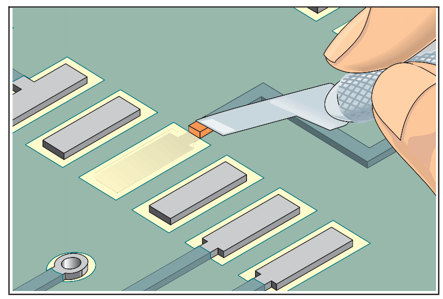


**Figure 2 Scrape off solder resist.**

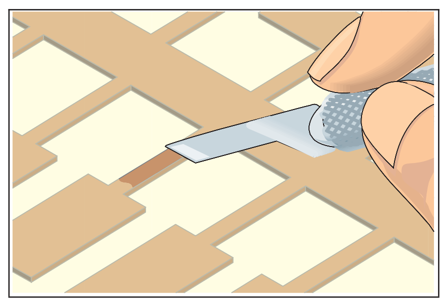


**Figure 3 Scrape bonding film from overlap area of new conductor.**

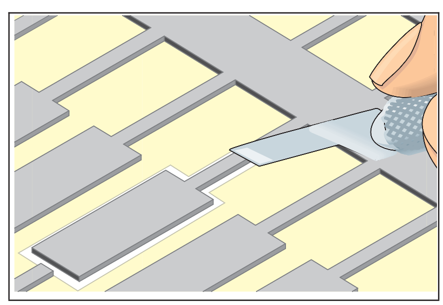


**Figure 4 Cut out the new surface mount pad.**

3. Use a knife and scrape off any epoxy residue, contamination or burned material from the board surface.

   **CAUTION**

   Abrasion operations can generate electrostatic charges.

4. Scrape off any solder resist or coating from the connecting circuit. (See Figure 2.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of 2 times the circuit width.
7. The area for the new pad on the board surface must be smooth and flat. If internal fibers of the board are exposed or if there are deep scratches in the surface, they should be repaired. Refer to appropriate procedure.
8. Select a commercially available surface mount pad that most closely matches the surface mount pad to be replaced. If a special size or shape is needed they can be custom fabricated.

   **NOTE**

   New surface mount pads are fabricated from copper foil. The foil is plated on the top side with solder and an adhesive bonding film is applied to the bottom side.

9. Before trimming out the new pad carefully scrape off the adhesive bonding film from the overlap connection area on the back of the new conductor. (See Figure 3.)

   **CAUTION**

   Scrape off the epoxy backing only from the joint connection area. When handling the replacement contact, avoid touching the epoxy backing with your fingers or other materials that may contaminate the surface and reduce the bond strength.

10. Cut out and trim the new pad. Cut out from the plated side. Cut the length to provide the maximum allowable overlap. Minimum 2 times the circuit width. (See Figure 4.)
11. Place a piece of Polyimide tape over the top surface of the new pad. Place the new pad into position on the printed circuit board surface using the tape to help in alignment. Leave the tape in place during the bonding cycle. (See Figure 5.)
12. Select a commercially available bonding tip with a shape to match the shape of the new pad. See bonding tip chart in the replacement parts section of the manual provided with the repair system or repair kit.

    **NOTE**

    The tip used for bonding should be as small as possible but should completely cover the entire surface of the new pad.

13. Position the printed circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new pad. Apply pressure as recommended in the manual of the repair system or repair kit. (See Figure 6.)

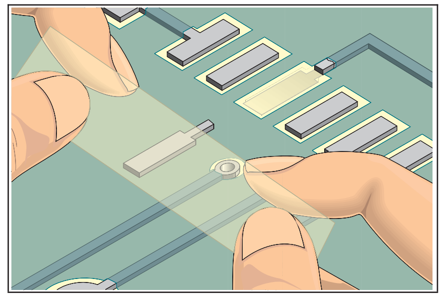


**Figure 5 Place the new surface mount pad in place using tape.**

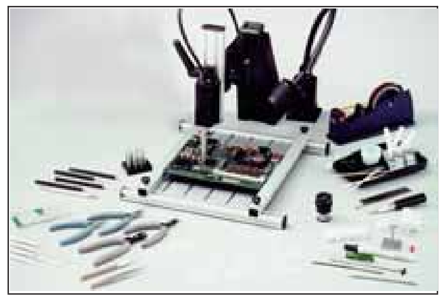


**Figure 6 Bonding system.**

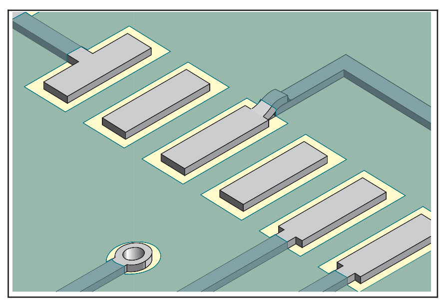


**Figure 7 Completed repair.**

**CAUTION**
Excessive bonding pressure may cause measling in the printed circuit board surface or may cause the new pad to slide out of position.

14. After the timed bonding cycle lift the bonding iron and remove the tape used for alignment. The pad is fully cured. Carefully clean the area and inspect the new pad for proper alignment.
15. If the new pad has a connecting circuit apply a small amount of liquid flux to the lap solder joint connection area and solder the circuit from the new pad to the circuit on the printed circuit board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new pad to prevent excess solder overflow.

**NOTE**
If the configuration permits, the overlap solder joint connection should be a minimum of 3.00 mm from the related termination. This gap will minimize the possibility of simultaneous reflow during soldering operations.

16. Mix epoxy and coat the lap solder joint connection. Cure the epoxy per the manufacturers recommended instructions.

**NOTE**
Additional epoxy can be applied around the perimeter of the new pad to provide additional bond strength.

**CAUTION**
Some components may be sensitive to high temperature.

17. Apply surface coating to match prior coating as required.

**INSPECTION GUIDELINES**

1. Visual examination
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.
4. Proper alignment of contact.
5. No film adhesive on contact, or that interferes with solder requirements.
6. Overlap of the solder connection is at least two times conductor width.
7. No damage to contact surface plating.

**NOTES**

IPC

7721

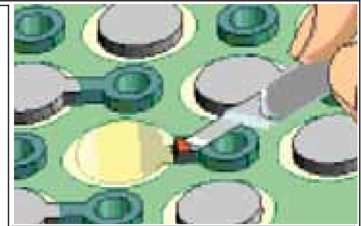
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **4.7.3**

# Surface Mount, BGA Pad Repair, Film Adhesive Method



Board Type: R, F, C
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged BGA pads with new dry film, adhesive backed pads. The new pads are bonded to the circuit board surface using a specially designed bonding press or bonding iron.

## CAUTION

It is essential that the board surface be smooth and flat. If the base material is damaged see appropriate procedure.

## NOTE

This method uses commercially available replacement BGA pads. The new pads are fabricated from copper foil. They are available in a variety of sizes and shapes and are generally supplied solder plated. If a special size or shape is needed they can be custom fabricated.

## REFERENCES

1.0 Foreword
2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Bonding Iron | Oven |
| Bonding Tips | Replacement BGA Pads |
| Bonding System | Scraper |
| Cleaner | Solder |
| Epoxy | Soldering Iron |
| Flux, Liquid | Tape, High Temperature |
| Heat Lamp | Tweezers |
| Knife | Wipes |
| Microscope | |

## PROCEDURE

1. Clean the area.

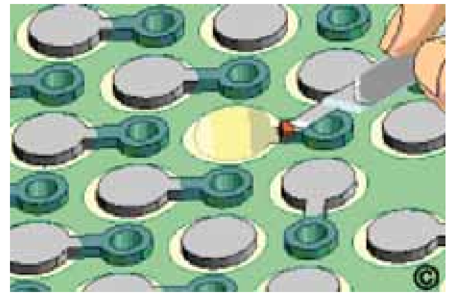


**Figure 1 Remove defective pad and solder mask from connecting circuit.**


**Figure 2 Select a replacement pad that matches the missing pad.**

**Figure 3 Scrape off adhesive bonding film from solder joint area on back of new pad.**

**Figure 4 Bond the new pad using a bonding system.**

2. Remove the defective pad and a short length of the connecting circuit. (See Figure 1.)
3. Use a knife and scrape off any epoxy residue, contamination or burned material from the board surface.
4. Scrape off any solder mask or coating from the connecting circuit. (See Figure 1.)
5. Clean the area.
6. Apply a small amount of liquid flux to the connection area on the board surface and tin with solder. Clean the area. The length of the overlap solder connection should be a minimum of two times the circuit width.

   **NOTE**
   When desirable, the connecting circuit of the new BGA pad may be inserted into the connecting via hole of the original BGA pad. Remove any solder mask from the connecting via hole and prepare as needed.

7. The area for the new pad on the board surface must be smooth and flat. If internal fibers of the board are exposed, or if there are deep scratches in the surface, they should be repaired. Refer to appropriate procedure.

   **NOTE**
   The height of the replaced BGA pad can be critical, especially for eutectic balled parts. Remove any solder mask between the BGA pad and the connecting circuit or via hole on the board surface to maintain a low profile. When necessary, mill slightly into the board surface to ensure that the connecting circuit height does not interfere with the replaced BGA component.

8. Select a replacement BGA pad that most closely matches the BGA pad to be replaced. If a special size or shape is needed they can be custom fabricated. (See Figure 2.)

   **NOTE**
   New BGA pads are fabricated from copper foil. The foil is plated on the top side with solder, and an adhesive bonding film is applied to the bottom side.

9. Before trimming out the new pad carefully scrape off the adhesive bonding film from the solder joint connection area on the back of the new pad. (See Figure 3.)

   **CAUTION**
   Scrape off the epoxy backing only from the joint connection area. When handling the replacement pad, avoid touching the epoxy backing with your fingers or other materials that may contaminate the surface and reduce the bond strength.

10. Cut out and trim the new pad. Cut out from the plated side. Cut the length to provide the maximum allowable circuit overlap for soldering. Minimum two times the circuit width.
11. Place a piece of high temperature tape over the top surface of the new BGA pad. Place the new pad into position on the circuit board surface using the tape to help in alignment.

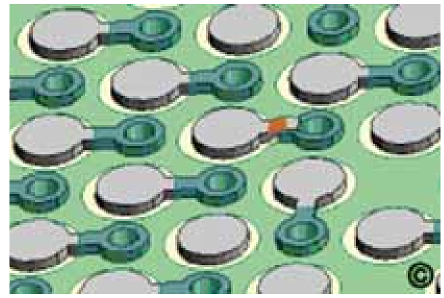


**Figure 5 Scrape solder off a small length of connecting circuit exposing the copper.**

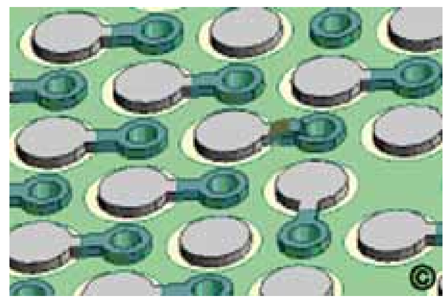


**Figure 6 Mix epoxy and coat lap solder joint connection and exposed copper area.**

12. Select a bonding tip with a shape to match the shape of the new pad. See bonding tip chart in the replacement parts section of the manual provided with the repair system or repair kit.

    **NOTE**

    The tip used for bonding should be as small as possible but should completely cover the entire surface of the new BGA pad.

13. Position the circuit board so that it is flat and stable. Gently place the hot bonding tip onto the tape covering the new pad. Apply pressure as recommended in the manual of the repair system or repair kit for five seconds to tack the new pad in place. Carefully peel off the tape. (See Figure 4.)

    **CAUTION**

    Excessive bonding pressure may cause measling in the circuit board surface or may cause the new pad to slide out of position.

14. Gently place the bonding tip directly onto the new BGA pad. Apply pressure as recommended in the manual of the repair system or repair kit for an additional 30 seconds to fully bond the pad. After the bonding cycle remove the tape used for alignment. The new pad is fully cured. Carefully clean the area and inspect the new pad for proper alignment. (See Figure 5.)

15. If the new BGA pad has a connecting circuit apply a small amount of liquid flux to the lap solder joint connection area and solder the circuit from the new pad to the circuit on the circuit board surface. Use minimal flux and solder to ensure a reliable connection. Tape may be placed over the top of the new pad to prevent excess solder overflow.

16. Mix epoxy and coat the lap solder joint connection. Cure the epoxy per Procedure 2.6 Epoxy Mixing and Handling. Use the maximum recommended heat cycle to ensure the highest strength bond. BGA pads are routinely subjected to one or more reflow cycles.

    **NOTE**

    Additional epoxy can be applied around the perimeter of the new pad to provide additional bond strength.

    **CAUTION**

    Some components may be sensitive to high temperature.

17. Apply surface coating to match prior coating as required.

### INSPECTION GUIDELINES

1. Visual examination
2. Measurement of new pad width and spacing.
3. Electrical continuity measurement.

## NOTES

IPC

7721

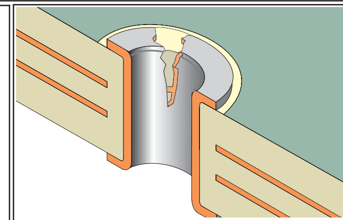
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **5.1**

# Plated Hole Repair, No Inner Layer Connection



Board Type: R, F, W
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the repair of a damaged hole that has no inner layer connection. An eyelet is used to repair the damage to the hole and the eyelet flanges replace the pads on the printed circuit board surface.

## CAUTION

This procedure is used only to restore the integrity of a through connection in a double sided board or a multilayer board where there is no inner layer connection. If there is an inner layer connection see appropriate procedure.

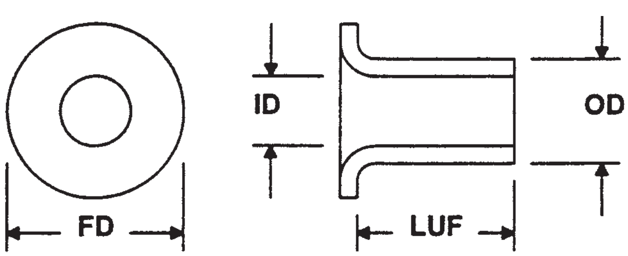
## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills, Carbide | Liquid Flux |
| Caliper | Knife |
| Cleaner | Microscope |
| Eyelets | Pin Gauges |
| Eyelet Press System | Solder |
| Eyelet Repair Kit | Solder Iron |
| Eyelet Setting Tools | Wipes |
| Hand Held Drill | |

## EYELET SELECTION CRITERIA




**ID Inside Diameter**

**Figure 1 Drill out the hole using a hand held drill and ball mill.**

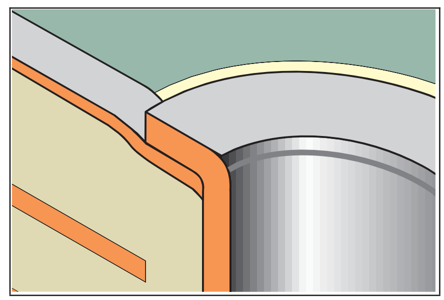


**Figure 2 The eyelet flange can be used to secure a new conductor in place.**

**Figure 3 Set the eyelet using an eyelet press.**

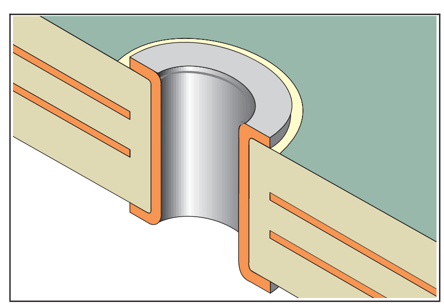


**Figure 4 Completed repair.**

The eyelet inside diameter should be a 0.075 - 0.500 mm greater than the component lead diameter.

**LUF Length Under Flange**
The length of the eyelet barrel under the flange should be 0.630 - 0.890 mm greater than the thickness of the printed circuit board. This added length allows for proper protrusion when setting the eyelet.

**FD Flange Diameter**
The eyelet flange diameter should be small enough to prevent interference with adjacent pads or conductors.

**OD Outside Diameter**
The clearance hole should allow the eyelet to be inserted without force but should not exceed 0.125 mm greater than the eyelet outside diameter.

**NOTE**

Be sure to select an eyelet meeting the proper criteria. An eyelet with an oversize flange may interfere with adjacent conductors. An eyelet that is too short will not protrude through the printed circuit board for proper setting.

**PROCEDURE**

1. Clean the area.
2. Select an eyelet using the Eyelet Selection Criteria. Use a pin gauge and caliper to measure the existing plated hole dimensions.
3. Insert the appropriate ball mill into the hand held drill. Drill out the hole removing all the plating. The drilled hole should be 0.025 - 0.125 mm larger than the eyelet O.D. (See Figure 1.)

   **CAUTION**
   This procedure may isolate internal connections on multilayer printed circuit boards.
4. Clean the area.
5. Apply a small amount of liquid flux to the pad or conductor on the printed circuit board surface, if any, and tin with solder using a soldering iron and solder. Clean the area.
6. Insert the eyelet into the hole. If a new conductor is required, the new conductor may extend into the drilled hole and the flange of the eyelet will secure the new conductor in place. (See Figure 2.) The eyelet may be inserted from either side.
7. Select the proper setting tools and insert them into an eyelet press system. (See Figure 3.)
8. Turn the printed circuit board over and rest the eyelet flange on the lower setting tool.
9. Apply firm even pressure to form the eyelet barrel.

   **NOTE**
   Inspect the eyelet flange for evidence of damage. Refer to IPC-A-610 Acceptability of Electronic Assemblies.

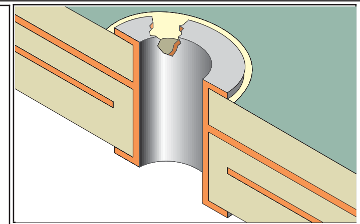
10. Apply a small amount of liquid flux and solder the eyelet flanges to the pads on the printed circuit board surface if necessary. Clean the area. Inspect for good solder flow and wetting around the eyelet flanges and lands.

**INSPECTION GUIDELINES**

1. Visual examination, dimensional requirement of pad diameter and inside diameter.
2. Electrical continuity measurement.
3. No board damage.
4. No conductor damage.
5. No eyelet damage.

**NOTES**

# Plated Hole Repair, Double Wall Method



Board Type: R, F, W
See 1.4.2
Skill Level: Advanced
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the use of an eyelet for the repair of a damaged pad on a hole that has an inner layer connect.

## CAUTION

This procedure is used to restore the integrity of a through connection on a multilayer board, having an inner layer connect, but **ONLY** if the full barrel of the plated through hole remains intact. If there is barrel damage see appropriate procedure.

## CAUTION

This method will reduce the inside diameter of the hole. The minimum hole size requirement must be checked for acceptance.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

| | |
|---|---|
| Ball Mills, Carbide | Liquid Flux |
| Buffer | Knife |
| Caliper | Microscope |
| Eyelets | Pin Gauges |
| Eyelet Press System | Solder |
| Eyelet Repair Kit | Solder Iron |
| Eyelet Setting Tools | Wipes |
| Hand Held Drill | |

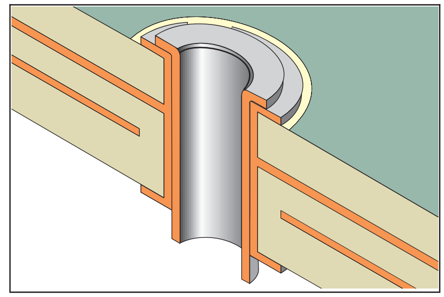


**Figure 1 Insert the eyelet into the hole.**

**Figure 2 Set the eyelet using an eyelet press.**

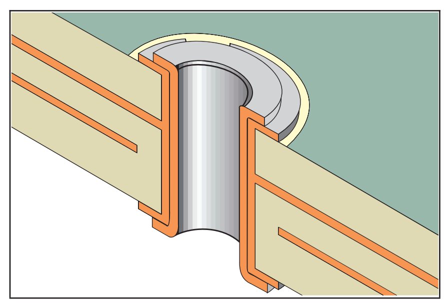
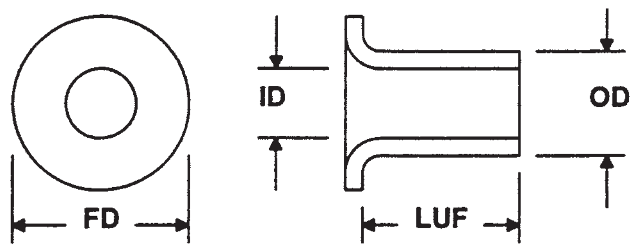


**Figure 3 Completed repair.**

## EYELET SELECTION CRITERIA




**ID Inside Diameter**
The eyelet inside diameter should be a 0.075 - 0.500 mm greater than the component lead diameter.

**LUF Length Under Flange**
The length of the eyelet barrel under the flange should be 0.630 - 0.890 mm greater than the thickness of the board. This added length allows for proper protrusion when setting the eyelet.

**FD Flange Diameter**
The eyelet flange diameter should be small enough to prevent interference with adjacent pads or circuits.

**OD Outside Diameter**
The clearance hole should allow the eyelet to be inserted without force but should not exceed 0.125 mm greater than the eyelet outside diameter.

## NOTE

Be sure to select an eyelet meeting the proper criteria. An eyelet with an oversize flange may interfere with adjacent circuits. An eyelet that is too short will not protrude through the board for proper setting.

## PROCEDURE

1. Clean the area.
2. Examine the hole to ensure that there is no damage to the wall of the hole. Check continuity to establish the integrity of the connection.
3. Select an eyelet using the Eyelet Selection Criteria. Use a pin gauge and caliper to measure the existing plated hole dimensions. The eyelet must have an inside diameter sufficient to receive the component lead and an outside diameter that will allow the eyelet to be inserted into the hole without force.
4. Remove oxides from the surface pads where the eyelet is to be installed using a buffer and clean.
5. Apply a small amount of liquid flux to the pad or circuit on the board surface, if any, and tin with solder using a soldering iron and solder. Clean the area.
6. Insert the eyelet into the hole. If a new circuit is required, the new circuit may extend into the hole and the flange of the eyelet will secure the new circuit in place. (See Figure 1.)

7. Select the proper setting tools and insert them into an eyelet press system. (See Figure 2.)
8. Turn the board over and rest the eyelet flange on the lower setting tool.
9. Apply firm even pressure to form the eyelet barrel.
10. Apply a small amount of liquid flux and solder the eyelet flanges to the pads on the board surface if necessary. Clean the area. Inspect for good solder flow and wetting around the eyelet flanges and lands.
11. Clean the area.
12. Install the component lead and solder, if required.

**INSPECTION GUIDELINES**

1. Visual examination, dimensional requirement of pad diameter and inside diameter.
2. Electrical continuity measurement.
3. No board damage.
4. No conductor damage.
5. No eyelet damage.

**NOTES**

7721

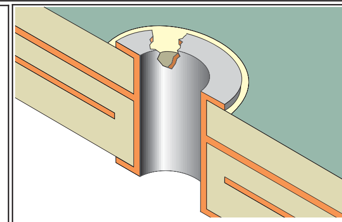
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **5.3**

# Plated Hole Repair, Inner Layer Connection



Board Type: R
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure describes the use of flat set eyelets for the repair of a through connection that has an inner layer connect, no surface wire is used. The inner layer reconnect is established by soldering the barrel of an eyelet to the exposed inner layer and the connection is encapsulated in high strength epoxy.

## CAUTION

This is a complex repair procedure that demands the proper tools and materials. To expect reliable results, repair technicians must have a high level of expertise. Use this method only when alternative methods are unacceptable.

## CAUTION

This procedure requires very accurate control over the location and depth of a milled hole. It is recommended that a precision drill system be used in combination with a high power stereo microscope.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

Ball Mills, Carbide
Buffer
Caliper
Cleaner
End Mills, Carbide
Eyelets
Eyelet Press System
Eyelet Repair Kit
Eyelet Setting Tools
Hand Held Drill
Liquid Flux
Knife
Microscope
Pin Gauges
Precision Drill Press
Solder
Solder Iron
Wipes

**Figure 1 Drill press shown with PC board pinned in place.**

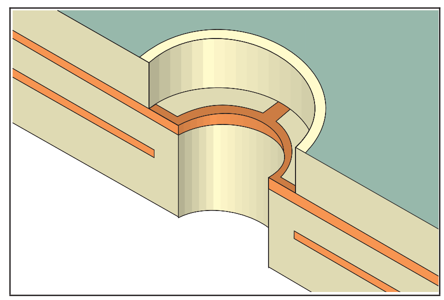


**Figure 2 Mill down to and expose inner layer signal or plane.**

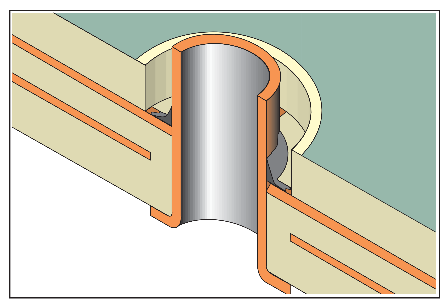


**Figure 3 Solder the eyelet barrel to the exposed inner layer.**

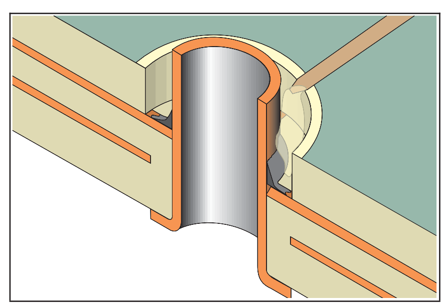
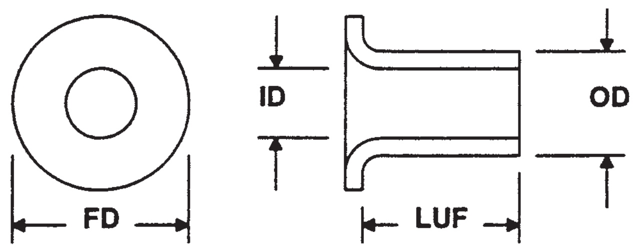


**Figure 4 Fill the milled hole with the epoxy.**

## EYELET SELECTION CRITERIA




### ID Inside Diameter

The eyelet inside diameter should be a 0.075 - 0.500 mm greater than the component lead diameter.

### LUF Length Under Flange

The length of the eyelet barrel under the flange should be 0.630 - 0.890 mm greater than the thickness of the printed circuit board. This added length allows for proper protrusion when setting the eyelet.

### FD Flange Diameter

The eyelet flange diameter should be small enough to prevent interference with adjacent pads or conductors.

### OD Outside Diameter

The clearance hole drilled through the printed circuit board should allow the eyelet to be inserted without force but should not exceed 0.125 mm greater than the eyelet outside diameter.

## NOTE

Be sure to select an eyelet meeting the proper criteria. An eyelet with an oversize flange may interfere with adjacent conductors. An eyelet that is too short will not protrude through the printed circuit board for proper setting.

## PROCEDURE

1. Clean the area.
2. Select an eyelet using the Eyelet Selection Criteria. Use a pin gauge and caliper to measure the existing plated hole dimensions.
3. Pin the printed circuit board to the base of a precision drill press. (See Figure 1.)
4. Insert the appropriate ball mill, end mill or drill into the chuck of the drill press.
5. Mill or drill out the hole. The drilled hole should be approximately 0.030 mm larger than the eyelet O.D. Inspect to ensure no metallic particles or burrs remain.
6. Select the side of the assembly that will have a counterbored hole milled into it. This side preferably would have no surface connection.

**Figure 5 Set the eyelet using an eyelet press.**

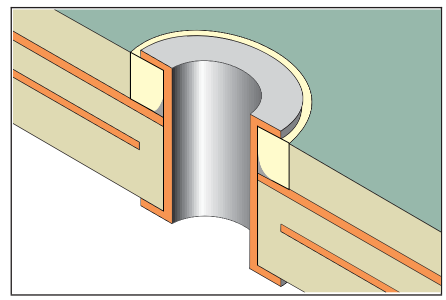


**Figure 6 Eyelet barrel formed flat to PC board surface.**

7. Select an end mill approximately 0.050 - 0.075 mm larger than the eyelet diameter. Insert into the precision drill press and mill down to and expose the inner layer signal or plane. (See Figure 2.)

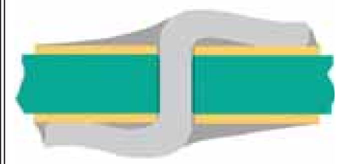
   **CAUTION**

   Great care must be taken to control the depth of the milled hole to prevent damage to the inner layer signal or plane.
8. Clean the area.
9. Apply a small amount of flux to the exposed signal or plane and tin with solder.
10. Clean the area.
11. Insert the eyelet into the hole from the side opposite the milled hole, then apply a small amount of flux into the milled hole.
12. Solder the eyelet to the exposed inner layer signal or plane by applying heat from a soldering iron to barrel of the eyelet. (See Figure 3.)
13. Completely remove any solder flux residue by spray rinsing with cleaner.
14. Use a microscope and inspect the solder fillet from the eyelet to the inner connection and perform electrical tests as required.
15. Mix epoxy as required.
16. Fill the milled hole with the epoxy up to, and level with, the surface of the board. (See Figure 4.) The epoxy filler material should be free of voids and air bubbles.
17. Cure epoxy per the manufacturer's recommendations
18. Select the proper setting tools and insert them into the eyelet press. (See Figure 5.)
19. Turn the printed circuit board over and rest the eyelet flange on the lower setting tool.
20. Apply firm even pressure to form the eyelet barrel. (See Figure 6.)
21. Install the component lead and solder, if required.
22. Clean the area.

**INSPECTION GUIDELINES**

1. Visual examination, dimensional requirement of pad diameter and inside diameter.
2. Electrical continuity measurement.
3. Proper alignment of eyelet to hole.
4. No epoxy on solderable surfaces or that interferes with minimum solder requirements.
5. Eyelet flange does not violate minimum electrical clearance.
6. Conductor damage.
7. Board damage.

**NOTES**

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification and Repair | Revision: **B** Number: **5.4**<br>Date: **11/07**<br># Plated Hole Repair, No Inner Layer Connection, Clinched Jumper Wire Method | <br>Board Type: R, F, W<br>See 1.4.2<br>Skill Level: Intermediate<br>See 1.4.3<br>Level of Conformance: Medium<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the repair of a damaged plated hole that has no inner layer connection. A clinched ''C'' or ''Z'' shaped jumper wire is used to repair the damage to the hole.

## CAUTION

This procedure is used only to restore the integrity of a through connection in a double sided board or a multilayer board where there is no inner layer connection. If there is an inner layer connection see appropriate procedure.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning
2.6 Epoxy Mixing and Handling

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Solder Iron |
| Cutters, Diagonal | Wire Copper, applicable gauge, solid copper, tinned buss |
| Liquid Flux | Wipes |
| Knife | Epoxy color agent |
| Microscope | Epoxy |
| Pliers, Needle Nose | Vacuum solder extractor |
| Solder | |

## PROCEDURE

1. Clean the area.
2. Remove any components that may interfere with the installation of the clinched jumper wire.
3. If required, remove any solder from the plated hole using a vacuum solder extractor.
4. Clean the area.
5. Apply a small amount of liquid flux and tin conductors and pads with solder.
6. Clean the area.

7. Select an appropriately sized solid tinned wire that best meets the conductor width and IPC-2221 current carrying capability to complete the repair. Cut a piece approximately 25 mm (1.0 inch) long.
8. Insert the selected piece of jumper wire through the plated hole, form and clinch the jumper wire on both sides of the board such that the lay of the clinch is along the conductive pattern on both sides of the plated hole.

   **Note:** a ''C'' or ''Z'' shaped clinched jumper wire is recommended.
9. Carefully trim the jumper wire to length, being careful not to nick or cut the conductive pattern. The length of the clinched lead overlap should be about 1.5 mm (0.060 inch) along the conductive pattern. The minimum overlap is two times the thickness of the jumper wire.
10. Apply a small amount of liquid flux and solder the clinched jumper wire to the pads on the printed circuit board surfaces. Clean the area. Inspect for good solder flow and wetting around the jumper wire clinch area and the plated hole pads.
11. Clean the area.
12. Mix the epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
13. Coat the top and sides of the clinched jumper with epoxy. The epoxy bonds the clinched jumper to the printed circuit board surface and insulates it. A wooden stick sharpened at one end may be used to apply and spread the epoxy.
14. Cure the epoxy per the manufacturers instructions.

    **CAUTION**

    Some components may be sensitive to high temperature.
15. Reinstall any removed components using appropriate procedures from IPC-7711, and clean the area.
16. Apply surface coating to match prior coating as required.

## INSPECTION GUIDELINES

1. Visual examination for alignment and overlap of clinched jumper.
2. Visual examination of epoxy coating for texture and color match.
3. Electrical tests to conductors around the repaired area as applicable.

## NOTES

IPC

7721

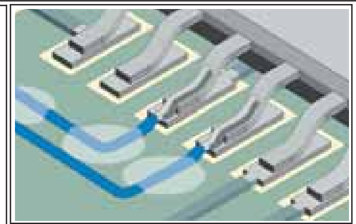
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **6.1**

# Jumper Wires



Board Type: R, F, W, C
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: N/A
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the repair/modification of printed boards and electronic assemblies by the use of jumper wires to complete electrical continuity between two points. This procedure is meant to provide a foundation for adding jumper wires during the repair/modification process. The techniques and guidelines are based on general commercial and industry practices.

Jumper wires fall into three (3) categories

1. Those that are considered wires and are installed during assembly. The routing, termination, and bonding of these jumper wires are documented by engineering instructions or drawing notations.
2. Those that are added after assembly to effect a change or modification. The routing, termination, and bonding of these jumper wires are documented by engineering change notice instructions or drawing notations.
3. Those that are added to correct a defect.

This procedure has nine main sections.

1. References
2. Tools and Materials
3. General Rules
4. PC Board Preparation
5. Jumper Wire Selection
6. Jumper Wire Preparation
7. Jumper Wire Termination and Routing
8. Jumper Wire Bonding
9. Jumper Wire Termination Figures

## REFERENCES

1.0 Foreword
2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS & MATERIALS

Adhesive, Hot Melt
Adhesive, Quick Set
Cleaner
Cleaning Wipes
Flush Cutter
Flux, Liquid
Smooth Pliers
Solder
Soldering Iron with Tips
Tape Dots
Wire
Wire, Adhesive Coated
Wire Stripper

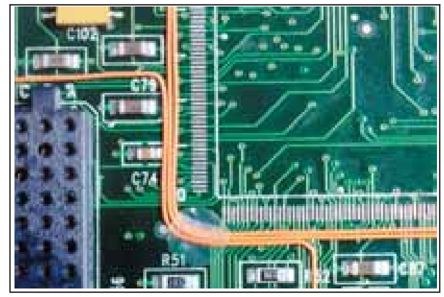


**Figure 1 Route jumper wires.**

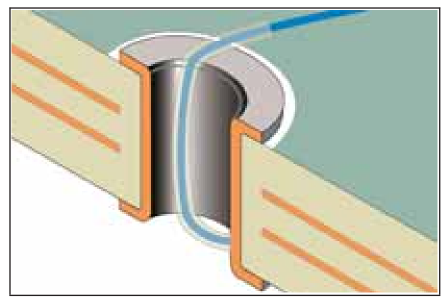


**Figure 2 Use sleeving through PTH.**

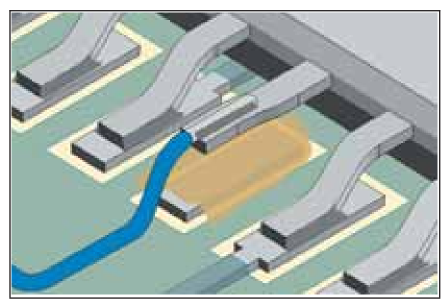


**Figure 3 Use insulated wire if required.**

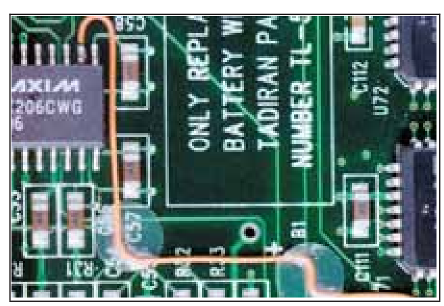


**Figure 4 Bond wires using tape dots or strips.**

## GENERAL RULES

### NOTE

IPC-A-610 Clause 11.2 has acceptance criteria for jumper wires.

1. Jumper wires should be placed on the component side of the assembly or printed board unless otherwise specified.
2. Jumper wires should be routed in an XY manner as directly as feasible, making as few bends as possible. (See Figure 1.)
3. Jumper wires should not be raised more than 3.2 mm [0.125 in] above the board surface or not above components or leads in such a way that they will interfere with PC board mounting.
4. Bare conductor jumper wires should not be used between terminations with spacing greater than 25 mm [0.984 in]. Take care to assure that a jumper wire does not violate minimum electrical clearance.
5. Jumper wires may pass over lands provided sufficient slack is available so that the wire can be moved away from the land for component replacement. Jumper wires that pass over pads or vias used as test points may interfere with testing.
6. Jumper wires should not be routed under or over component leads or component bodies. Contact with heat sinks needs to be avoided.
7. Jumper wires should not pass through component foot prints unless the layout of the assembly prohibits the routing in other areas.
8. Jumper wires need to have stress relief.
9. Jumper wires may be routed through plated through holes provided the wire is insulated and insulation sleeving is placed in the hole. If a hole is needed, use the following method. (See Figure 2.)

   A. Drill a hole slightly larger than the insulation diameter.

   B. Inspect the hole for burs or exposed internal circuits.

   C. If this procedure is to be accomplished on all assemblies of a specific type, it should be documented on the appropriate control drawing.

   **NOTE**

   Be careful that the drilled hole does not interfere with surface and internal conductors.

10. Jumper wires soldered into plated through holes need to be discernible on the opposite side. IPC-A-610D Clauses 7.4.3 and 7.5.3 provide acceptance criteria for lead protrusion.
11. Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting. (See Figure 3.)
12. Jumper wires may be terminated by a variety of methods. See illustrations.

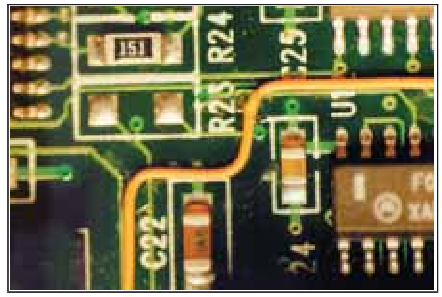



**Figure 5 Bond wires using adhesive.**

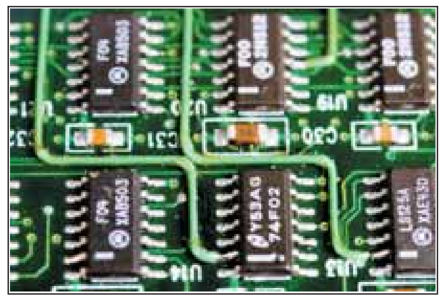


**Figure 6 Adhesive coated wires are heat bonded.**

## PC BOARD PREPARATION

1. Clean the area.

   **NOTE**
   When wires are in place cleaning will often be more difficult.
2. Remove coating material or oxidization as necessary from the component leads, pads, or conductors where wire terminations will be soldered. Clean the area.
3. Remove solder from the connection point if needed. Clean the area.
4. Measure approximately the length of each wire needed.

## JUMPER WIRE SELECTION

1. Bare conductor jumper wires longer than 25 mm [0.984 in] should not be used. Bare conductor jumper wires shorter than 25 mm [0.984 in] must not violate the minimum electrical clearance.

   **NOTE**
   The 25 mm [0.984 in] dimension refers to the length between terminations.
2. Silver plated wire must not be used; under some conditions corrosion of the wire can occur.
3. The smallest diameter wire that will carry the required current should be selected.
4. Insulation requirements of the wire should withstand soldering temperatures, have some resistance to abrasion, have a dielectric resistance equal to or better than the board insulation material.
5. Recommended wire is solid insulated plated copper wire, tin lead plated, 22 to 32 AWG with Kynar, Milene, Kapton, Teflon or equivalent insulation.

   **CAUTION**
   Wires with nicked or damaged conductors should not be used.

## JUMPER WIRE PREPARATION

1. Cut the jumper wires approximately 12.7 mm [0.50 in] longer than the estimated length needed.

   **NOTE**
   The length and gauge of the jumper wire may be critical. All wires have an electrical resistance (impedance) to the flow of electricity. This impedance is important to electronic circuitry. Always refer to wiring lists for specific jumper wire requirements.
2. Strip insulation from each end of the jumper wire.

   **NOTE**
   Strip length is dependent on the termination style.
3. If required, tin the stripped ends with solder. Clean if necessary.

## JUMPER WIRE TERMINATING

1. Form the wire as needed and place the wire in position depending on the termination style. Center the wire on the component lead or pad, do not overhang sides. If the wire is soldered to a pin, terminal or component lead, wrap the wire a minimum of 90°.
2. Solder one end of the wire. Clean if necessary.

   **NOTE**

   Solder joint length needs to meet acceptability requirements, see IPC-A-610D Clause 11.2.

   **CAUTION**

   The insulation should not be stripped back more than two wire diameters from the solder joint. Wire insulation must not interfere with formation of the required solder fillet.
3. Bend the wire as needed and run the wire along board surface. Route the jumper wire using the shortest route in an XY direction with the fewest possible bends to the second termination point.
4. After routing the jumper wire, solder the opposite end. Clean if necessary.

   **CAUTION**

   Wires soldered to lifted or clipped components leads may require insulation to prevent shorting.

## JUMPER WIRE BONDING

1. After the wire has been soldered at both ends and cleaned if necessary, the wire should be bonded to the board surface.

   **NOTE**

   Bonding is not required if wire is insulated and insulated length is less than 25 mm [1.00 in].
2. Bond the jumper wire using one of the following methods.
   A. Tape Dots or Tape Strips. (See Figure 4.)
   B. Quick Set Adhesive. (See Figure 5.)
   C. Hot Melt Adhesive. (See Figure 5.)
   D. Hot Bonding. Some jumper wires are manufactured with a special thermo-set adhesive coating and are thermally bonded to the board surface with a special bonding tool. (See Figure 6.)
3. Bond the jumper wire within 6.0 mm [0.25 in] of each solder joint.
4. Bond the jumper wire within 6.0 mm [0.25 in] of each bend in the wire.
5. Bond the jumper wire at intervals not less than 25 mm [1.00 in] on straight runs.

**Table 1 Jumper Wire Termination Methods**

| Figure | Type | Wire Termination Method | Acceptability |
|---|---|---|---|
| 7 | PTH Hole | Wire soldered into plated-through hole on component side. * | Acceptable |
| 8 | PTH Lead | Wire soldered parallel to lead on component side. | Acceptable |
| 9 | PTH Hole | Wire soldered into plated-through hole on solder side. * | Acceptable |
| 10 | PTH Hole | Wire wrapped around component lead on solder side. | Acceptable |
| 11 | PTH Hole | Wire wrapped around lead on component side. | Acceptable |
| 12 | PTH Lead | Wire soldered to lifted component lead. + | Acceptable |
| 13 | PTH Lead | Wire soldered to clipped lead on component side. + | Acceptable |
| 14 | PTH Lead | Wire looped and soldered to adjacent component leads. | Acceptable |
| 15 | PTH Lead | Wire soldered to lead, wire over component. | Not Recommended |
| 16 | PTH Lead | Soldered perpendicular to component lead. | Not Recommended |
| 17 | PTH Lead | Multiple wires soldered to component lead overhanging edge. | Not Recommended |
| 18 | Chip | Wire soldered to pad, parallel or perpendicular to component. | Acceptable |
| 19 | Chip | Wire soldered parallel or perpendicular to component. | Not Recommended |
| 20 | Chip | Wire soldered to component end, lifted off pad. | Acceptable |
| 21 | Chip | Multiple wires overhanging pad edge. | Not Recommended |
| 22 | PTH Hole | Wire soldered into plated-through hole. * | Acceptable |
| 23 | PTH Pad | Wire soldered across top of PTH pad. | Acceptable |
| 24 | PTH Pad | Multiple wires soldered to pad overhanging pad edge. | Not Recommended |
| 25 | Conductor | Wire soldered parallel to conductor, contact, SMT pad. | Acceptable |
| 26 | Conductor | Wire perpendicular to conductor, contact, SMT pad. | Not Recommended |
| 27 | Conductor | Multiple wires soldered to conductor, contact, SMT pad. | Not Recommended |
| 28 | J Lead | Wire soldered parallel to component lead. | Acceptable |
| 29 | J Lead | Wire soldered to clipped component lead. + | Acceptable |
| 30 | J Lead | Wire looped and soldered to adjacent component leads. | Acceptable |
| 31 | J Lead | Wire soldered to component lead, wire running over component. | Not Recommended |
| 32 | J Lead | Wire soldered perpendicular to lead. | Not Recommended |
| 33 | J Lead | Multiple wires soldered to lead overhanging edge. | Not Recommended |
| 34 | J Lead | Wire soldered to lifted component lead. | Not Recommended |
| 35 | Gull Wing | Wire soldered parallel to component lead. | Acceptable |
| 36 | Gull Wing | Wire soldered to lifted component lead. + | Acceptable |
| 37 | Gull Wing | Wire soldered to clipped component lead. + | Acceptable |
| 38 | Gull Wing | Wire looped and soldered to adjacent component leads. | Acceptable |
| 39 | Gull Wing | Wire soldered to component lead, wire over component. | Not Recommended |
| 40 | Gull Wing | Wire soldered perpendicular to component lead. | Not Recommended |
| 41 | Gull Wing | Multiple wires soldered to lead overhanging edge. | Not Recommended |

* Jumper wires soldered into plated-through holes must be discernible on the opposite side.
\+ Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting.

## Jumper Wire Termination Figures – Through-Hole Components

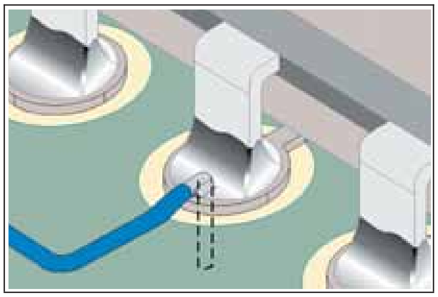


**Figure 7** ***Acceptable*** Wire soldered into plated-through hole, component side. *

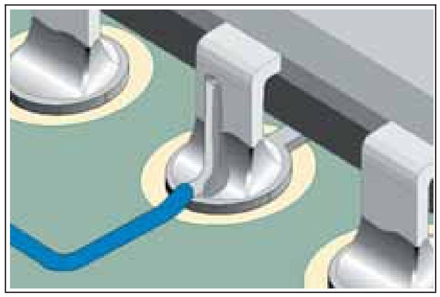


**Figure 8** ***Acceptable*** Wire soldered parallel to lead on component side.

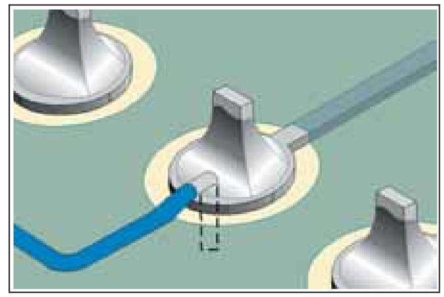


**Figure 9** ***Acceptable*** Wire soldered into plated-through hole on solder side. *

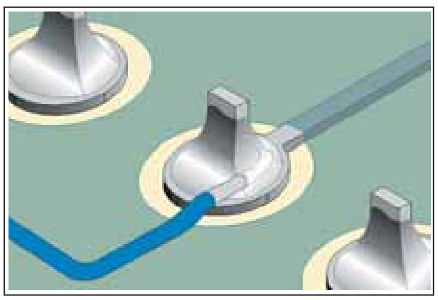


**Figure 10** ***Acceptable*** Wire wrapped around component lead on solder side.

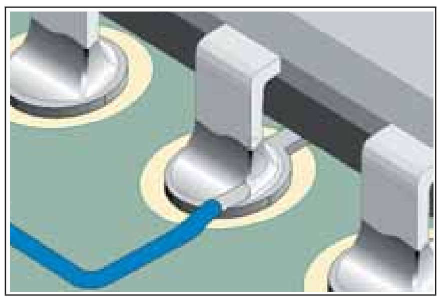


**Figure 11** ***Acceptable*** Wire wrapped around lead on component side.

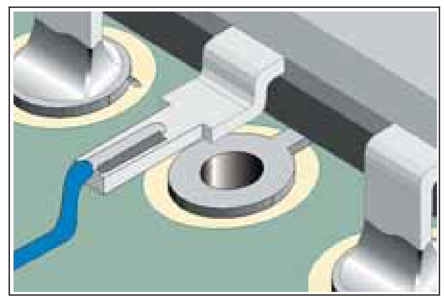


**Figure 12** ***Acceptable*** Wire soldered to lifted component lead. +

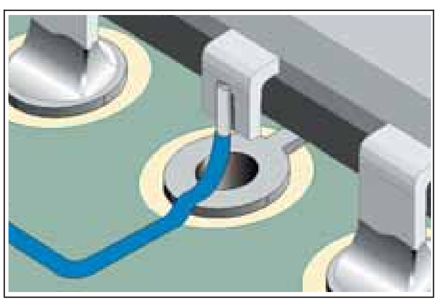


**Figure 13** ***Acceptable*** Wire soldered to clipped lead on component side. +

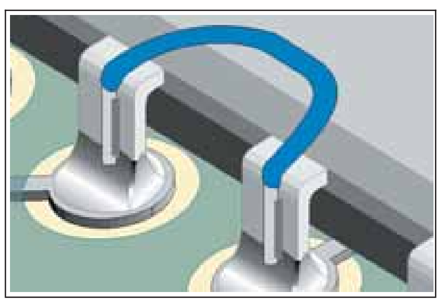


**Figure 14** ***Acceptable*** Wire looped and soldered to adjacent component leads.

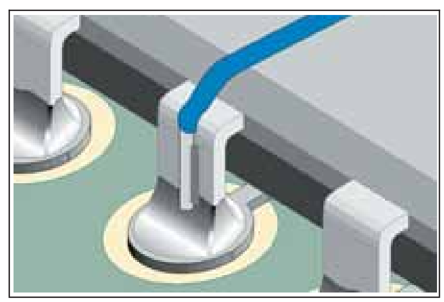


**Figure 15** ***Not Recommended*** Wire soldered to lead, wire over component.

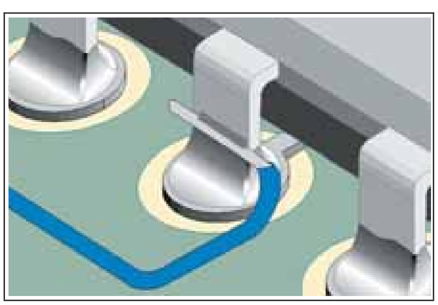


**Figure 16** ***Not Recommended*** Soldered perpendicular to component lead.

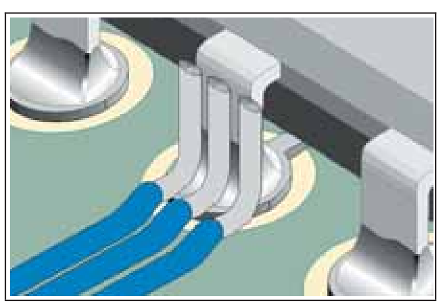


**Figure 17** ***Not Recommended*** Multiple wires soldered to lead overhanging edge.

* Jumper wires soldered into plated-through holes must be discernible on the opposite side.

+ Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting.

## Jumper Wire Termination Figures – Chip Components, Pads and Conductors

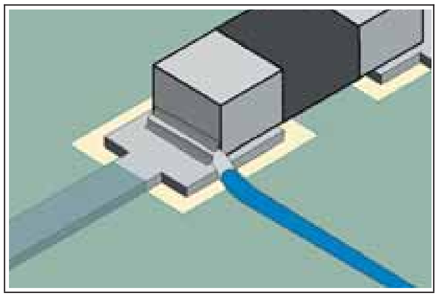


**Figure 18** ***Acceptable*** Wire soldered to pad, parallel or perpendicular to component.

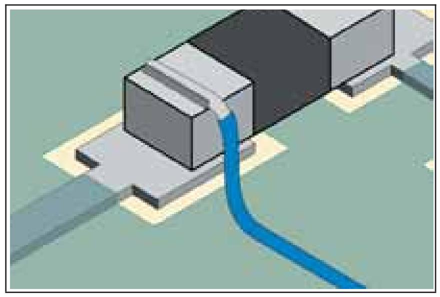


**Figure 19** ***Not recommended*** Wire soldered parallel or perpendicular to component.

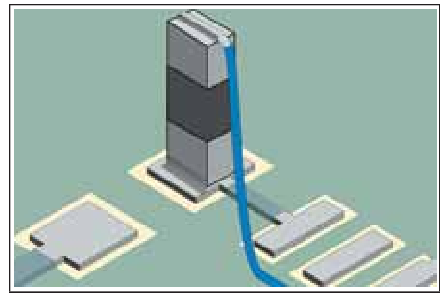


**Figure 20** ***Acceptable*** Wire soldered to component end, lifted off pad.

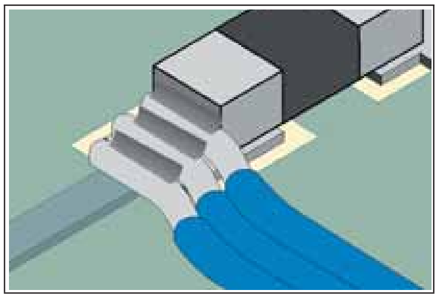


**Figure 21** ***Not Recommmended*** Multiple wires overhanging pad edge.

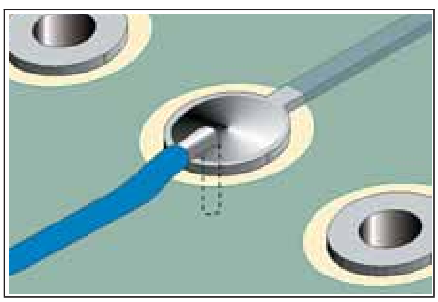


**Figure 22** ***Acceptable*** Wire soldered into plated-through hole. *

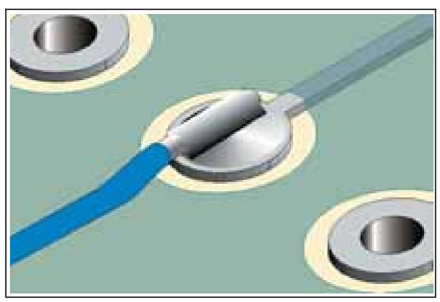


**Figure 23** ***Acceptable*** Wire soldered across top of PTH pad.

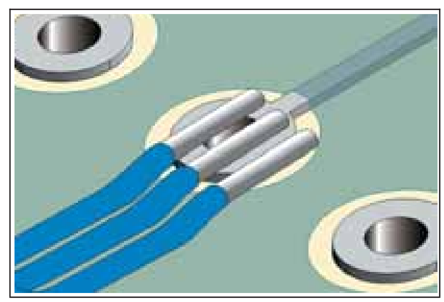


**Figure 24** ***Not Recommended*** Multiple wires soldered to pad overhanging pad edge.

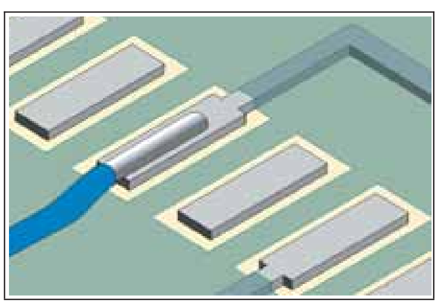


**Figure 25** ***Acceptable*** Wire soldered parallel to conductor, contact, SMT pad.

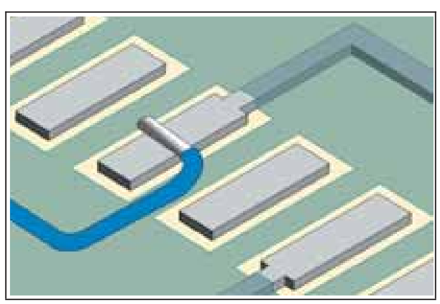


**Figure 26** ***Not Recommended*** Wire perpendicular to conductor; contact, SMT pad.

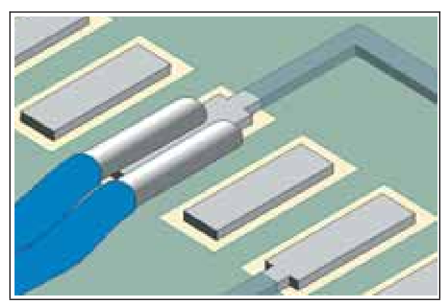


**Figure 27** ***Not Recommended*** Multiple wires soldered to conductor, contact, SMT pad.

* Jumper wires soldered into plated-through holes must be discernible on the opposite side.

+ Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting.

## Jumper Wire Termination Figures – J Lead Components

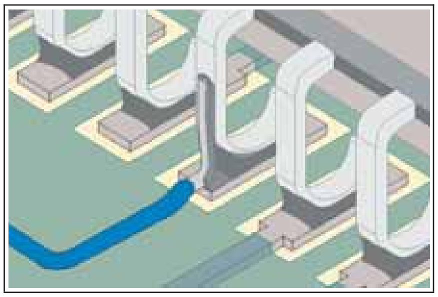


**Figure 28** ***Acceptable*** Wire soldered parallel to component lead.

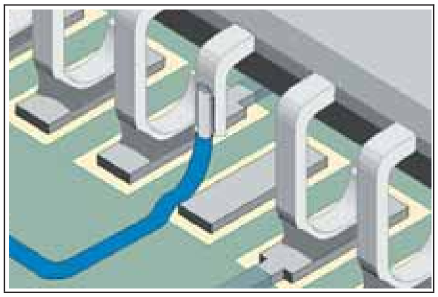


**Figure 29** ***Acceptable*** Wire soldered to clipped component lead. +

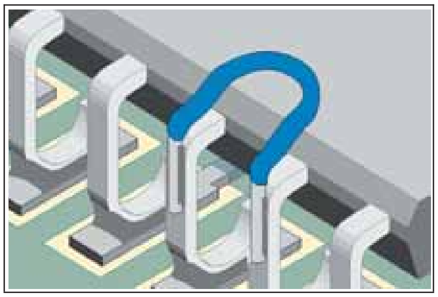


**Figure 30** ***Acceptable*** Wire looped and soldered to adjacent leads.

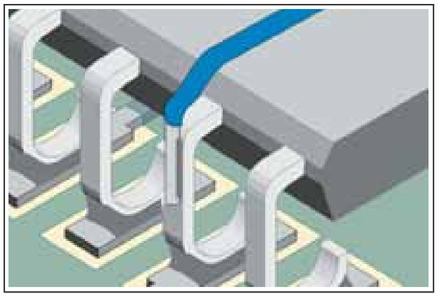


**Figure 31** ***Not Recommended*** Wire soldered to lead, over component.

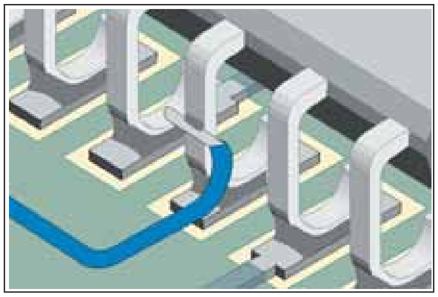


**Figure 32** ***Not Recommended*** Wire soldered perpendicular to lead.

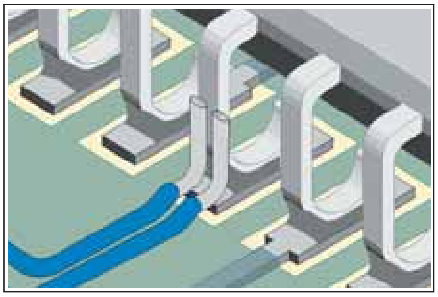


**Figure 33** ***Not Recommended*** Multiple wires soldered to lead overhanging edge.

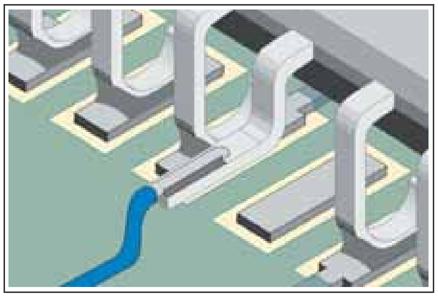


**Figure 34** ***Not Recommended*** Wire soldered to lifted component lead.

* Jumper wires soldered into plated-through holes must be discernible on the opposite side.

+ Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting.

## Jumper Wire Termination Figures – Gull Wing Components

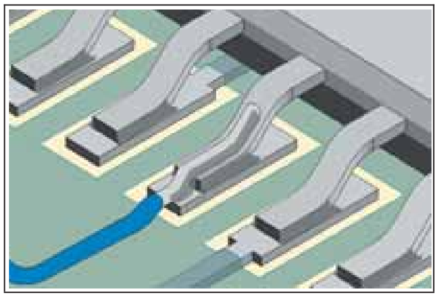


**Figure 35** ***Acceptable*** Wire soldered parallel to component lead.

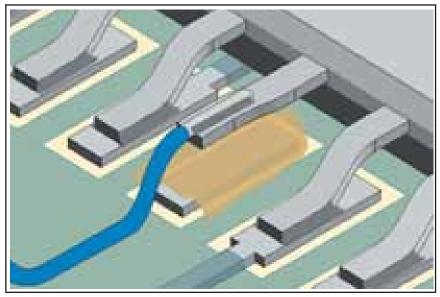


**Figure 36** ***Acceptable*** Wire soldered to lifted component lead. +

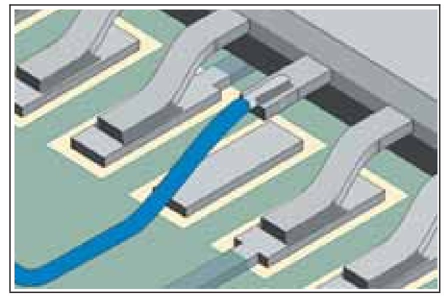


**Figure 37** ***Acceptable*** Wire soldered to clipped component lead. +

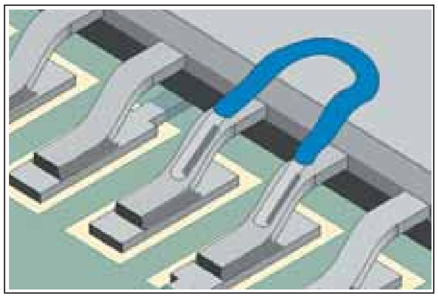


**Figure 38** ***Acceptable*** Wire looped and soldered to adjacent component leads.

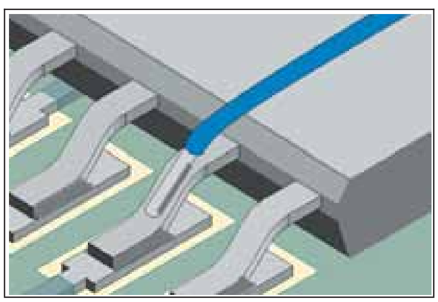


**Figure 39** ***Not Recommended*** Wire soldered to component lead, wire over component.

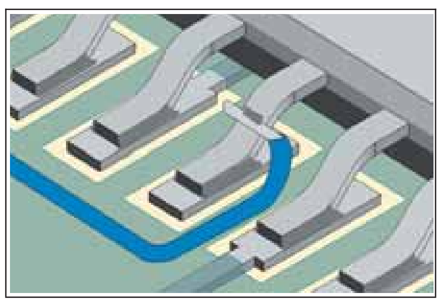


**Figure 40** ***Not Recommended*** Wire soldered perpendicular to component lead.

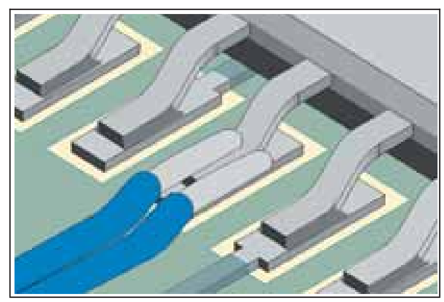


**Figure 41** ***Not Recommended*** Multiple wires soldered to lead overhanging edge.

* Jumper wires soldered into plated-through holes must be discernible on the opposite side.

+ Jumper wires soldered to lifted or clipped component leads may require insulation to prevent shorting.

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IPC

7721

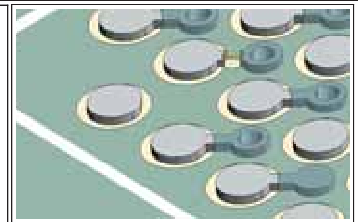
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **6.2.1**

# Jumper Wires, BGA Components, Foil Jumper Method



Board Type: R, F
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to change a circuit path at a BGA site for engineering changes or modifications.

**NOTE**
This procedure requires precision milling equipment and highly trained technicians.

**CAUTION**
This procedure is not applicable for ''via in pad'' applications.

## REFERENCES

1.0 Foreword
2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking And Preheating
2.6 Epoxy Mixing and Handling
4.2.1 Conductor Repair, Foil Jumper, Epoxy Method
4.4.3 Surface Mount, BGA Pad Repair, Film Adhesive Method
6.1 Jumper Wires

## TOOLS & MATERIALS

| | | | |
|---|---|---|---|
| BGA Rework System | Cleaner | Microscope | Solder |
| Bonding Iron | Drill System | Milling System | Soldering Iron |
| Bonding Tips | End Mills | Oven | Tape, High Temperature |
| Bonding System | Epoxy | Precision Knife | Tweezers |
| Buffer | Flux, Liquid | Repair System or Repair Kit | Wipes |
| Circuit Frames, BGA Pads | Foil Jumpers | Scraper | Wire, fine gauge |
| | Heat Lamp | | |

## PROCEDURE

1. Clean the area.
2. Remove the BGA component if installed, remove excess solder from the pads, and clean and inspect the site using standard BGA rework equipment.
3. Cut the short conductor (dog bone) connecting the BGA pad to the connecting via using a drill system or milling machine and appropriate size end mill. (See Figure 1 and 6.)
4. Remove the existing BGA pad. Apply heat from a soldering iron if needed. (See Figure 2.)

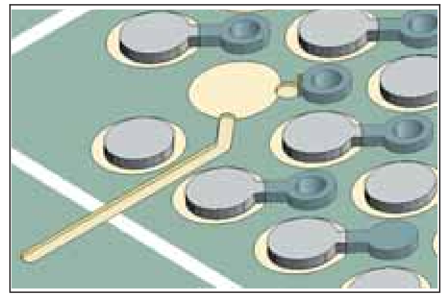


**Figure 1 Cut the connection to the via using a drill system.**

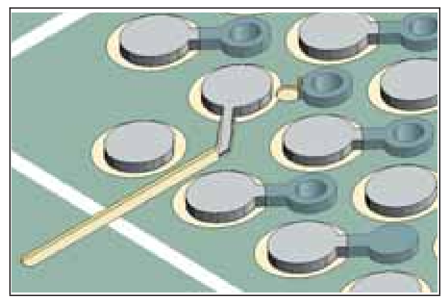


**Figure 2 Remove BGA pad & mill shallow channel into solder mask surface.**

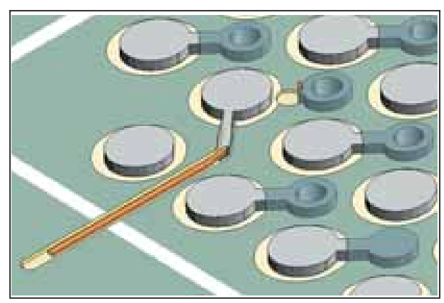


**Figure 3 Bond a new BGA pad in place.**

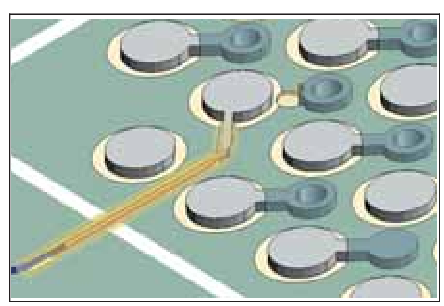


**Figure 4 Solder a foil jumper to the tail extending from the new BGA pad.**

5. Inspect the proposed path for the foil jumper to ensure proper clearance. Use a milling machine to mill a shallow groove in the solder mask surface from the BGA pad area to the perimeter of the BGA site. Tight spacing may restrict the width of the channel to 0.25 mm [0.010 in] or less. Use a carbide end mill approximately 0.050 mm [0.002 in] wider than the new connecting circuit. (See Figure 3.)

   **NOTE**

   Be sure to mill a shallow groove to prevent damage to internal conductive layers.

6. Bond a replacement BGA pad in place using a bonding system. (See Procedure 4.7.3.) The new BGA pad must have a tail that will align with the foil jumper to be added next. (See Figure 4.)
7. Select a foil jumper to match the width and thickness of the circuit to be replaced. Cut a length approximately as needed. The foil jumper should overlap the BGA tail section a minimum of two times the circuit width.
8. Gently abrade the top and bottom ends of the new foil jumper with the buffer to remove any oxidation and clean.

   **NOTE**

   If needed, the ends of the foil jumper may be tinned with solder prior to lap soldering in place.

9. Position this new foil jumper along the milled groove. The foil jumper should overlap the existing circuit a minimum of two times the circuit width. (See Figure 4.)
10. Apply a small amount of liquid flux to the overlap joint.
11. Lap solder the foil jumper to the BGA tail section using solder and a soldering iron. Make sure the foil jumper is properly aligned.
12. Clean the area.
13. Mix epoxy. If desired, add color agent to the mixed epoxy to match the printed circuit board color.
14. Coat the top and bottom of the foil jumper with epoxy. The epoxy bonds the new circuit to the base board material and insulates the circuit. (See Figure 5.)

    **CAUTION**

    Some components may be sensitive to high temperature.

16. Clean the board as required.
17. Install new BGA per applicable procedures.
18. Solder one end of a fine gauge wire to the end of the extending foil jumper. (The opposite end of the wire will be soldered later.) (See Figure 5.)
19. Route and terminate the other end of the jumper wire.

**INSPECTION GUIDANCE**

1. Visual examination for alignment and overlap of new circuit.
2. Visual examination of epoxy coating for texture and color match.
3. Electrical tests as applicable.

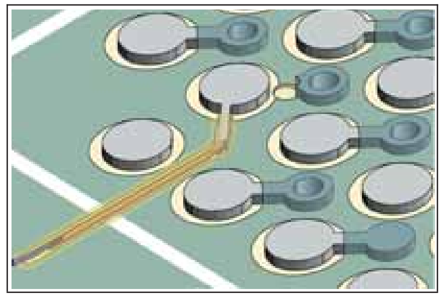


**Figure 5 Solder a wire to the foil jumper bond with epoxy.**

**Figure 6 Sample of drill system used to cut the connection from the BGA pad to the via.**

IPC

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Modification and Repair

Revision: **B**

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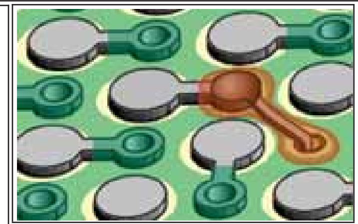
# Jumper Wires, BGA Components, Through Board Method



Board Type: R, F
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: High
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to add a foil jumper at a BGA site by running the foil jumper through a hole in the board. This method is normally used for engineering changes or modifications.

## NOTE

This procedure requires precision milling equipment and highly trained technicians. This method is used when there is a buried via, and other methods of terminating to the opposite side are not an option.

## REFERENCES

1.0 Foreword
2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating
2.7 Epoxy Mixing and Handling
6.1 Jumper Wires

## TOOLS & MATERIALS

BGA Rework System
Buffer
Cleaner
End Mills
Epoxy
Flux, Liquid
Foil Jumper
Heat Lamp Microscope
Milling System
Oven
Precision Drill System
Precision Knife
Scraper
Solder
Soldering Iron
Tape, High Temperature
Teflon Sleeving
Tweezers
Wipes
Wire
Adhesive

## PROCEDURE

1. Clean the area.
2. Remove the BGA component if installed, remove excess solder from the pads. Clean and inspect the site.
3. Remove solder mask from the via pad terminating to the subject BGA pad.

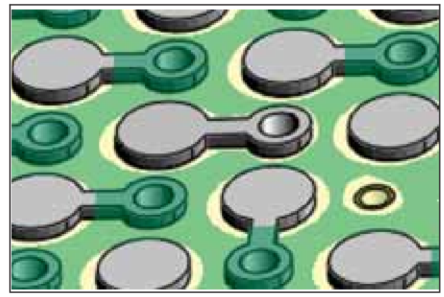


**Figure 1 Mill a hole through the board and insert a Teflon sleeve.**

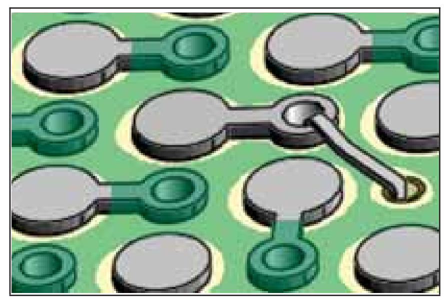


**Figure 2 Insert a copper foil jumper into the plated hole and Teflon sleeve.**

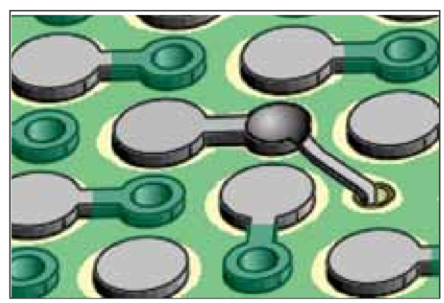


**Figure 3 Solder the foil jumper to the plated hole connected to the BGA pad.**

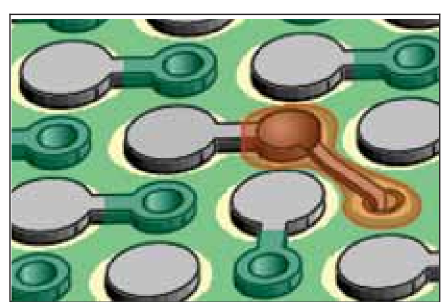


**Figure 4 Overcoat the new connection with epoxy.**

4. Mill a hole through the board at the precise coordinates using a Precision Drill System and End Mill of the appropriate size. (See Figure 1 and 5.)

   **NOTE**

   Although both power and ground planes may be cut, inner layer signal traces must be avoided.

5. Carefully inspect the milled hole and clean the area.

6. Select the appropriate size foil jumper. Cut a length approximately as needed. The overlap solder connection should be a minimum of two times the circuit width. (See Table 1.)

**Figure 5 Precision Drill System used for milling the Teflon sleeved hole.**

**Table 1 Common Foil Jumper Sizes**

| Thickness | Width |
|---|---|
| 0.002’’ | 0.004’’ |
| 0.002’’ | 0.006’’ |
| 0.002’’ | 0.008’’ |
| 0.002’’ | 0.010’’ |
| 0.003’’ | 0.120’’ |
| 0.003’’ | 0.015’’ |
| 0.005’’ | 0.020’’ |
| 0.005’’ | 0.030’’ |

7. Gently abrade the top and bottom of the foil jumper with the buffer to remove any oxidation and clean.

   **NOTE**

   If needed, the ends of the foil jumper may be tinned with solder prior to lap soldering in place.

8. Insert an appropriately sized Teflon sleeve into the milled hole. This sleeve will insulate foil jumper and prevent shorting to the inner layers. (See Figure 1.)

9. Insert one end of the foil jumper into the plated hole connected to the BGA pad. Insert the opposite end through the Teflon sleeve. (See Figure 2.)

   **NOTE**

   Observe care to keep the Teflon sleeve in position while inserting the foil jumper.

10. Apply a small amount of liquid flux and solder the foil jumper to the plated hole connected to the BGA pad using solder and a soldering iron. Make sure the foil jumper is properly aligned. (See Figure 3.)

11. Clean the area.

12. Mix epoxy per appropriate procedure.

13. Coat the top and sides of the foil jumper with epoxy. The epoxy bonds the foil jumper to the base board material and insulates it. (See Figure 4).

    **NOTE**

    Keep the epoxy height below the BGA pad level.

    **CAUTION**

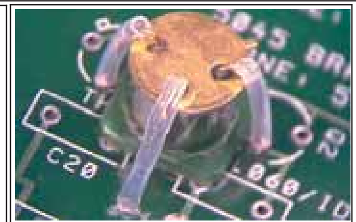
    Some components may be sensitive to high temperature.

14. Clean the circuit board as required.
15. Install new BGA component per applicable procedures.
16. Solder a jumper wire to the exposed foil jumper on the opposite side of the circuit board. Route and terminate the jumper wire as needed.

**INSPECTION GUIDANCE**

1. Visual examination for alignment and overlap of foil jumper.
2. Visual examination of epoxy coating for texture and color match.
3. Electrical tests as applicable.

**NOTES**

| | | |
|---|---|---|
| IPC<br>**7721**<br>Modification and Repair | Revision: **B** Number: **6.3**<br>Date: **11/07**<br># Component Modifications and Additions | <br>Board Type: R, F, W, C<br>See 1.4.2<br>Skill Level: Advanced<br>See 1.4.3<br>Level of Conformance: N/A<br>See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This procedure covers the general guidelines for modifications that involve adding components.

## REFERENCES

1.0 Index
2.1 Handling Electronic Assemblies
2.2 Cleaning
2.5 Baking and Preheating

## TOOLS & MATERIALS

| | |
|---|---|
| Cleaner | Microscope System |
| Cleaning Wipes | Soldering Iron with Tips |
| Flux | Solder |

## GENERAL RULES

1. Added components may need to be secured with adhesive, or by other means, if the component leads or component body would be subjected to mechanical stress.
2. Leads of added components should not be inserted into plated holes occupied by another component lead.
3. Added components placed on the circuit board surface should be placed on the component side of the assembly or circuit board unless otherwise specified.
4. Assure that added components are not raised above the board surface beyond allowable dimensions.
5. Added components that cover pads or vias used as test points may interfere with testing.
6. Added components should not cover other component foot prints unless the layout of the assembly prohibits mounting in other areas.
7. Added component leads may require insulation to avoid contact with component body or other conductors.
8. Removal of existing solder from a connection point may be necessary to avoid bridging, or excess solder, in the final connection.
9. Consider design limitations and product use environments when stacking components.

10. Do not exceed minimum component lead bend radius.
11. When possible, component identification marking should be legible.

## PROCEDURE

1. When required, form the component leads and clean the area.
2. When required, secure the component in place by bending leads or other mechanical means.
3. Apply flux to the connection.
4. Place the soldering iron tip at the connection between both leads. Apply a small amount of solder at the connection of soldering iron tip and lead to form a solder bridge.
5. Immediately feed solder into the joint from the side opposite the soldering iron tip until the proper fillet is achieved. Remove the solder and iron simultaneously.
6. When required, clean the flux residue.

## INSPECTION GUIDELINES

1. Inspect to customer's requirements.

## NOTES

## Component Modification Examples

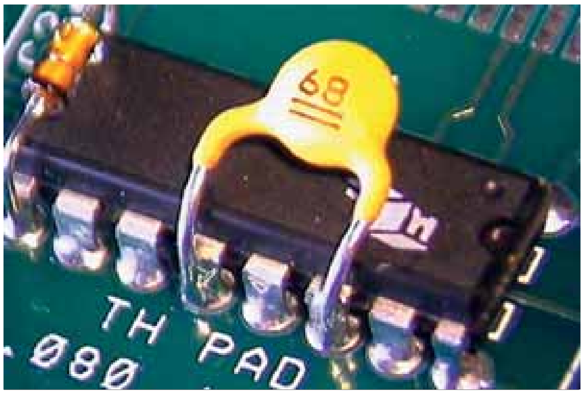



**Figure 1** Radial lead component soldered to through hole component leads. Note: Leads of the radial component should not need to be inserted into the plated holes.

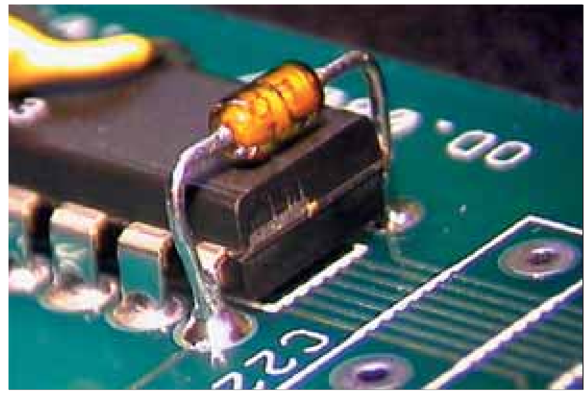


**Figure 2** Axial lead component soldered to through hole component leads. Note: Leads of axial component should not be inserted into the plated holes.

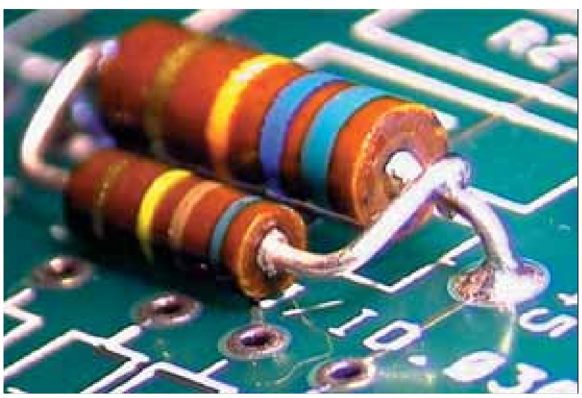


**Figure 3** Axial lead component soldered to adjacent axial lead component. Note: Added component may be stacked vertically or horizontally.

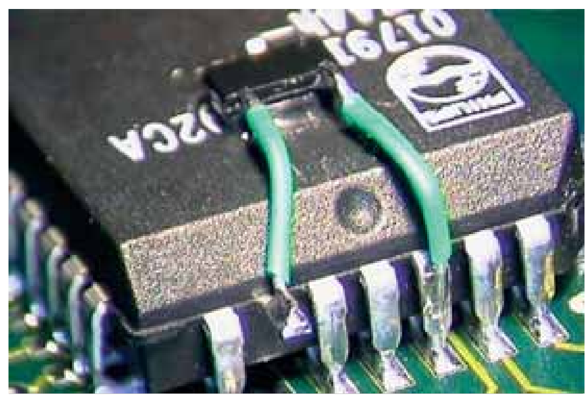


**Figure 4** Chip component soldered to surface mount component using jumper wires. Note: One lead of surface mount component is shown lifted.

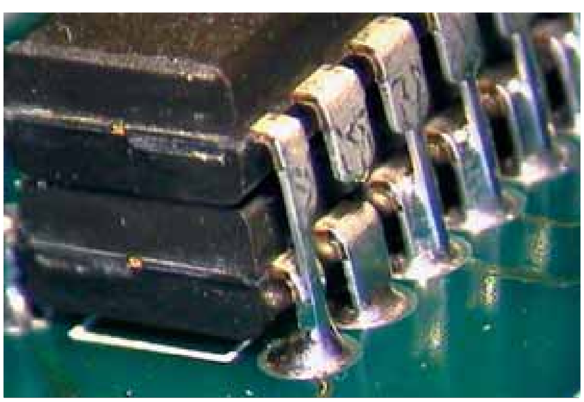


**Figure 5** DIP component stacked and soldered onto another DIP component. One lead shown clipped. Note: Leads of added component should not be inserted into the plated holes.

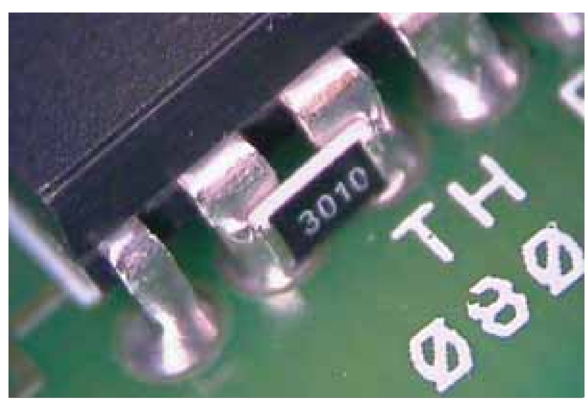



**Figure 6** Chip cap bridging adjacent leads.

## Component Modification Examples (continued)

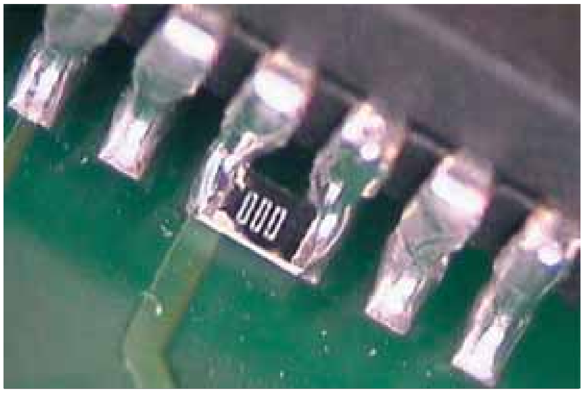



**Figure 7 Chip component bridging leads of surface mount component.**

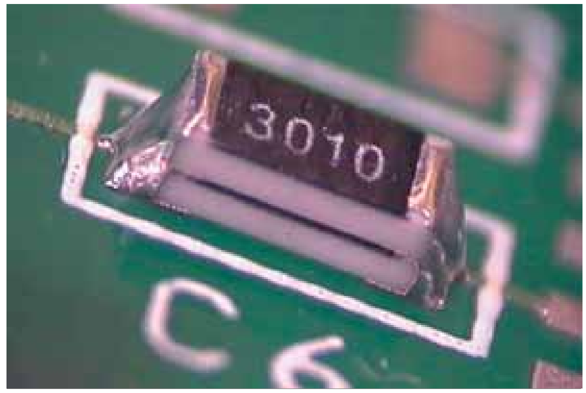



**Figure 8 Chip component stacked onto another chip component.**

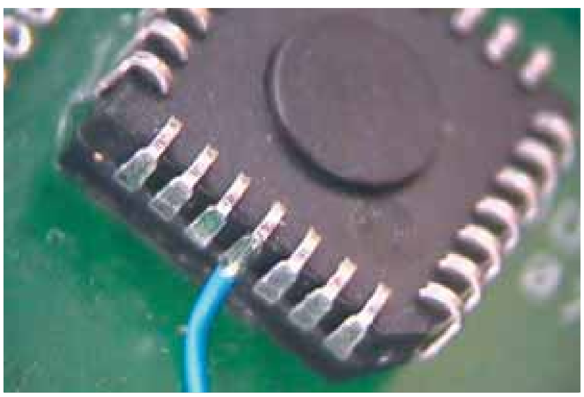


**Figure 9 *Acceptable* Surface mount component mounted upside down with jumper wires attached. Note: One lead is bent outward.**

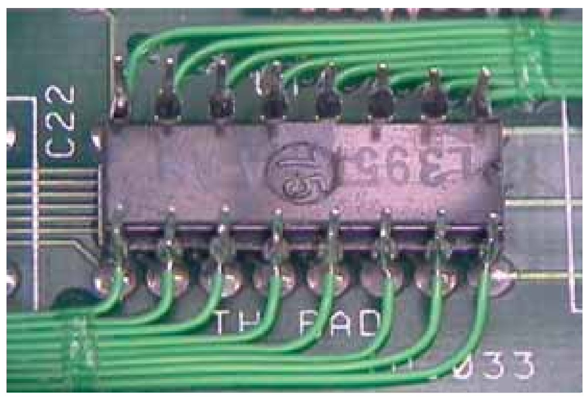



**Figure 10 DIP component mounted upside down with jumper wires attached.**

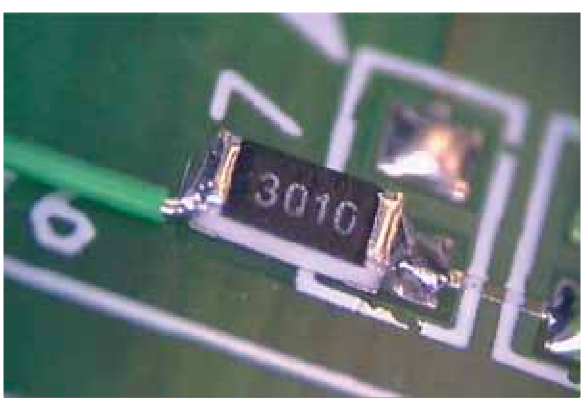



**Figure 11 Chip component mounted to one pad only.**

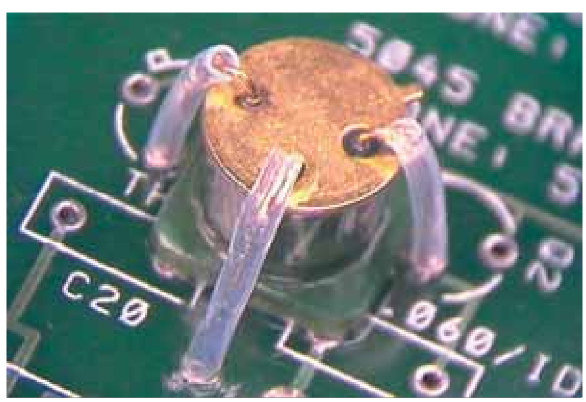



**Figure 12 Radial lead component mounted upside down. Note: Insulate leads to avoid contact with component body.**

IPC

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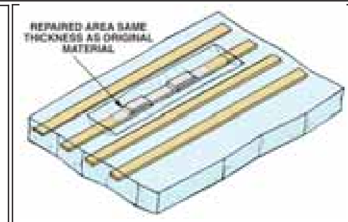
Modification
and Repair

Revision: **B**

Date: **11/07**

Number: **7.1.1**

# Flexible Conductor Repair




Board Type: F
See 1.4.2
Skill Level: Expert
See 1.4.3
Level of Conformance: Medium
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## OUTLINE

This method is used to replace damaged or missing conductors on the flexible printed wiring surface.

## CAUTION

Flexible laminates come in a variety of materials, e.g., Mylar®, Teflon®, and Kapton®. These laminates are easily damaged during repair, if correct procedures are not used.

## REFERENCES

2.1 Handling Electronic Assemblies
2.2 Cleaning

## TOOLS & MATERIALS

| | | |
|---|---|---|
| Dental Mixing Slab | Microscope | Curing oven |
| Scalpel Blade | Rotary Bristle Brush | Abrasive cloth |
| Pumice Impregnated Wheel | Tweezers | Alcohol |
| Dental Tool (Carver) | Orangewood Stick | Tooth pick |
| Dental Tool (Chisel) | Soldering Iron Tip | Cleaner |
| Soldering Iron | Lint-Free Tissue | Ink eraser |
| Isopropyl Alcohol | Silicone Resin | Rotary bristle brush |
| Acid Brush | Amber Colored Polyimide Film | Stainless steel |
| Oven | | Solder |
| Scalpel | Polyimide tape | Replacement conductors |

## PROCEDURE

1. After the damaged area has been isolated, mark the area of the laminate that is to be removed.

   **NOTE**

   Only enough laminate should be removed to expose the needed work area.

2. Support the flexible laminate with a flat, smooth surface such as a dental mixing slab or a piece of stainless steel. A firm base will keep the assembly from moving while repairing the damaged area.

   **WARNING**

   Do not apply lateral pressure to the scalpel. The blade could snap and cause personal injury.

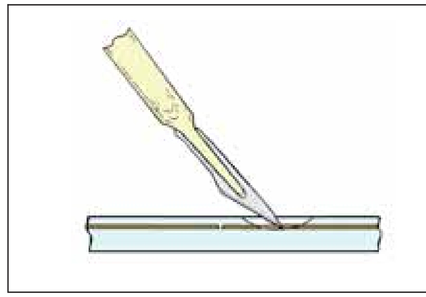


**Figure 1 Laminate removal.**

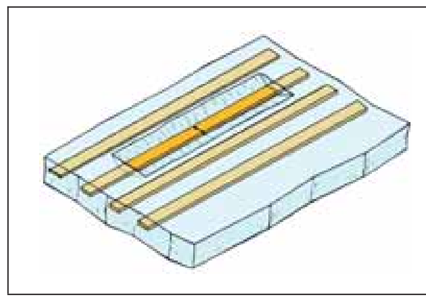


**Figure 2 Laminate removed.**

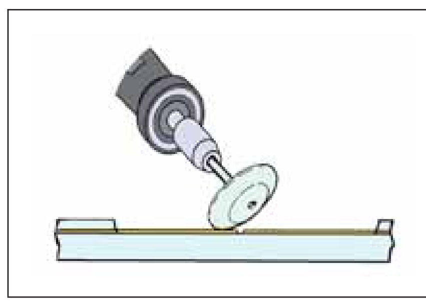


**Figure 3 Adhesive removal.**

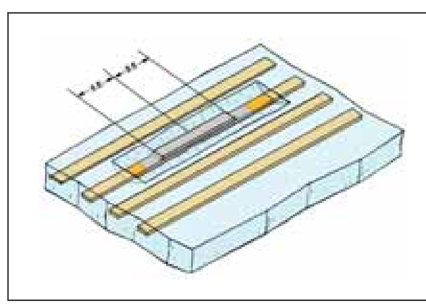


**Figure 4 Conductor hairline crack repair.**

To ensure personnel safety and prevent workpiece damage, spot tools under the microscope in the work area before looking through the microscope.

**CAUTION**

Excessive pressure with a removal tool can cause additional damage to the laminate.

3. Remove the laminate around the damaged conductor by working on the thinnest side of the flexible conductor. Laminate can be removed by using a light abrasive such as a pumice-impregnated wheel or rotary bristle brush. Removal may also be accomplished by cutting with a scalpel or dental tool. (See Figure 1.)

**NOTE**

Placing the microscope at an angle of 10°-30° to the flexible laminate may aid in determining the depth of the laminate removal.

4. Cut the laminate at a 45° angle along the bottom edge of the damaged conductor. Ends of laminate should be cut out at a 90° angle perpendicular to the conductor. The length of the laminate removed needs to allow a minimum of 1/2 inch (1.3 cm) overlap on both sides of the damaged conductor area plus room for the end fillets on both sides of the replacement conductor. (Laminate Removal = Damaged Area + End Fillets + 1 inch (2.5 cm).) (See Figure 2.)
5. In many instances an adhesive will be coated onto the conductors. This must also be removed from the area where the replacement conductor is going to overlap the original conductor. The adhesive can be removed using light abrasion such as an ink eraser or rotary bristle brush or abrasive wheel. (See Figure 3.)
6. If conductor is not damaged and only the laminate requires replacement, proceed to step 18.
7. Once the laminate has been removed, the method of repair must be determined.
8. For a hairline crack, the repair will consist of a lap replacement with no original conductor material removed. (See Figure 4.)
9. For more extensive damage, the damaged conductor will have to be removed and a replacement conductor lap soldered in place. Any damaged portions of the conductor need to be removed using the following method:

**CAUTION**

Exercise care when using a scalpel and tweezers to prevent damage to an adjacent conductor.

A. Using a scalpel or dental chisel, bevel cut the conductor approximately 45° just outside the damaged area on both sides. To have at least 1/2 inch (1.3 cm) of original conductor exposed, additional laminate material may have to be removed on both sides.

B. Grasp the damaged conductor with tweezers and remove. (See Figure 5.)

10. Obtain a replacement conductor equal to or slightly greater in width and thickness and a minimum of 1 inch (2.5 cm) longer than the removed damaged conductor. (See Figure 6 top.)

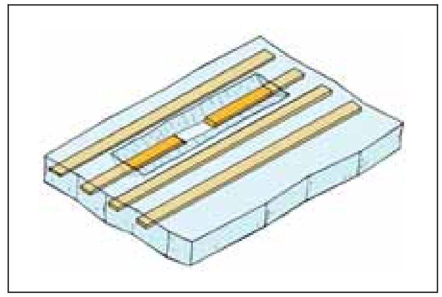


**Figure 5 Beveling.**

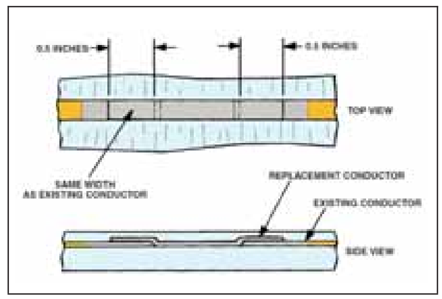



**Figure 6 Replacement specifications.**

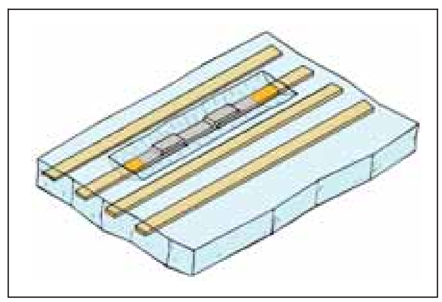


**Figure 7 Replacement conductor soldered.**

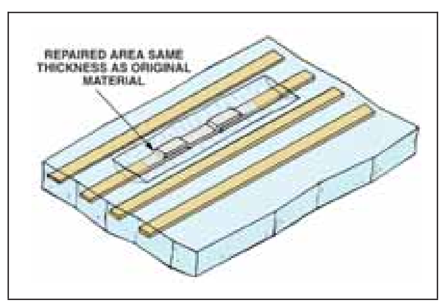



**Figure 8 Repair encapsulated.**

**NOTE**

All adhesive or other contamination must be removed from the replacement conductor to ensure good wetting action.

11. Clean replacement and form conductor in place. (See Figure 6 bottom.)

**CAUTION**

Avoid applying excessive heat to conductors. The laminate surrounding the repair area may melt. Place a wet lint-free tissue under the laminate to help dissipate heat while tinning and soldering the conductor.

12. Lightly tin the beveled ends and slightly beyond the overlap areas on each side of the existing conductor.
13. Tin the bottom of the replacement conductor in the overlap areas. The replacement conductor needs to overlap the original area 1/2 inch (1.3 cm) minimum on each side of the damaged area to allow for flexing of the circuit.
14. Position the replacement conductor and solder in place using very light pressure with the soldering iron tip. Follow along with a tool such as an orangewood stick, toothpick, or dental tool to hold the conductor down. (See Figure 7.)
15. After soldering, all flux residue needs to be removed with alcohol and a lint free tissue or an acid brush.

**CAUTION**

Do not allow the alcohol to air dry, as it will leave a thin layer of flux residue.

16. After completing the conductor repair, the insulating layer of laminate that was removed must be replaced. The most reliable method of laminate repair is to reapply a thin coating of the same type used by the manufacturer. If the same type of coating is not available, the following alternate procedures may be used.
    A. To achieve reliable bonding of the coating, the laminate surface must be roughened in the repair area with an abrasive cloth or ink eraser.
    B. Clean the repair area thoroughly with alcohol.
    C. Remove moisture by drying flexible printed wiring in a curing oven at 130°F (54°C) for a minimum of one hour.

**CAUTION**

Read Silicon Resin manufacturer's warning labels and instructions. Follow all safety requirements and procedures while handling Silicone Resin.

    D. Apply the coating with a dental tool to bring the level of the repair area to the level of the original laminate. Feather the coating out on the sides of the repair approximately 1/4 inch (0.64 cm). Air bubbles or voids should not exceed 25% of the conductor spacing.
    E. Cure following manufacturer's specifications.
17. Clean the area with alcohol and an acid brush to remove any remaining debris and residues. Inspect completed work.
18. If silicon adhesive is unavailable, polyimide tape may be used as a temporary substitute using the following procedure.
    A. Cut a piece of polyimide tape to cover both sides of the repair area. The size should allow for a 1/4 inch (0.64 cm) overlap on the laminate. The overlap is measured from the edge of the repair area.

B. Round the corners of the tape with a scalpel or scissors before applying, being careful not to stretch the tape.

**CAUTION**

Before applying polyimide tape, ensure that the assembly is free from all debris and residues that would interfere with the polyimide tape bonding to the repair area. Abrasion may be necessary if the surface of the laminate is slick and smooth. Abrasion will promote greater adhesion of the replacement tape.

C. Place the polyimide tape, adhesive side next to the conductor, over the repair area.

## INSPECTION GUIDELINES

1. Alignment and overlap of conductor.
2. No damage to flex print.
3. No voids or bubbles.
4. Electrical test.

## NOTES

# 8.1 Splicing

IPC/WHMA-A-620 Chapter 8 provides extensive requirements and acceptance criteria for splicing using twisted/soldered wires, solder-filled heat-shrink tubing and crimping.

### 1. THE PROCESS OF WIRE SPLICING IS USED IN TWO CASES:

a. When a self-lead component (inductor, transformer, choke, etc.) is installed (either during assembly or as a replacement for a failed component) and,

b. In the process of repairing a damaged wire when removal and replacement of the entire wire length is not feasible.

### 2. THE FOUR MOST COMMON SPLICES USED ARE:

- *Mesh Splices* Mesh splices require the least wire length in order to complete the splice and result in a splice diameter only slightly larger than the diameter of the wire used.
- *Wrap Splices* Wrap splices require a longer wire length in order to complete the splice and have a splice diameter equal to three times the diameter of the wire used.
- *Hook Splices* Hook Splices require the most wire length in order to complete the splice and have a splice diameter equal to three times the diameter of the wire used.
- *Lap Splices* Lap splices, like mesh splices, require a minimal amount of original wire length and may be used to perform repair of a damaged wire when:

a. Sufficient slack is available in the wire to achieve the necessary overlap, and

b. The repaired wire will not be subjected to longitudinal stress after repair.

### 3. WIRE SPLICING

**Locating/Isolating Damage** Locate the damaged wire. If the wire is broken, determine if both sections are available. Isolate the damaged area by using point-to-point resistance measurements.

***Note:*** If the wire was broken (separated) by a cutting action, the cut ends can be spliced at the point of breakage/separation. If the wire was broken (separated) by a pulling action, e.g., stretching or pulling until separation, then the wire strands on both sides of the break will have suffered hidden mechanical damage in the form of stretching, elongation and reduction of individual strand diameter. In such cases, where separation was caused by a pulling action, it is desirable to remove (cut-out) wire which could have been damaged by stretching and installing a longer splice than would normally be used.

### 4. FEASIBILITY OF REPAIR

Prior to repairing damaged wires, the following considerations must be made:

- Should damaged wires be replaced in their entirety
- Should wires be repaired using solder sleeves
- If complete replacement is not feasible, determine if one section of wire may be replaced thereby limiting the number of splices to one
- If no section of the damaged wire can be replaced, splice in a replacement section of wire with two splices

### 5. INSULATED CONDUCTOR STRIPPING

Insulated conductors should be stripped a distance longer than required for the solder connection. This allows for easier forming of the conductor. The excess conductor needs to be trimmed off prior to soldering. The following stripping methods are recommended.

a. Thermal wire strippers are to be used on insulations that will melt upon application of heat. This method is preferred because it minimizes the possibility of conductor damage.

***Caution:*** Do not use mechanical strippers on wire smaller than AWG-20, as the strippers may stretch the wire.

b. Mechanical strippers are to be used on insulations that cannot be thermally stripped. This method does not apply to enamel insulation.

c. Chemical stripper is used on conductors that have an enamel/varnish coating for insulation.

1) Follow the manufacturer’s instructions on the length of time for the chemical reaction to take place.

2) The stripper may have to be neutralized. Follow the manufacturer’s safety precautions on both equipment and personnel.

***Warning:*** Chemical strippers contain ingredients harmful to both skin and eyes. Take appropriate precautions using protective clothing and, industrial goggles/spectacles, when opening the container and during use. If stripper gets on skin, wash immediately with fresh water and soap and rinse freely. If stripper gets into eyes, flood with large quantity of fresh water. Do not apply ointments or salve, obtain medical aid at once. Follow manufacturer's safety instructions.

## 6. TINNING

*Background:* Once a conductor is exposed to the environment, oxidation begins to take place. The tinning of a conductor is important to ensure a quality solder connection. Tinning stranded wire reduces the probability of wire damage during forming of necessary bends.

***Note:*** Do not tin wires that will be used on the mesh splice.

*Wicking:* Wicking of solder underneath the wire insulation is not usually a problem, as long as the insulation is capable of withstanding the heat and as long as the wire does not have to remain flexible at the point of the splice. If the insulation cannot withstand the heat of tinning/soldering, or if the wire must be bent, or remain flexible at the point of the splice, then it is recommended that an anti-wicking tool be used when tinning the wire and a thermal-shunt or heat-sink be used when soldering the splice.

*Flux:* Any flux used during tinning or soldering of wire will wick up under the wire insulation. Flux which wicks up under the insulation can not be extracted or removed by cleaning. Therefore, only Rosin Mildly Activated (RMA) type flux should be used when tinning/soldering stranded wire. Flux identified as Rosin Activated (RA) must not be used for tinning/soldering stranded wire because RA flux which wicks up under the insulation contains activators which are corrosive.

*Appearance:* After tinning, the surface of the tinned stranded wire should be smooth, bright, non-porous and individual strands should be visible. The tinned surface of a solid wire, or a component lead should be smooth, bright and non-porous.

## 7. TINNING METHODS

Tin all areas that will be soldered during the splicing operation. Anti-wicking tools, if used, should be sized to the diameter of the wire being tinned. Tinning of conductors may be accomplished using either of the following methods.

*A. Soldering Irons*

1) Select the proper size soldering iron tip.
2) Select a soldering iron tip large enough and a heat setting high enough to ensure solder melt within 2-3 seconds.
3) Ensure that the soldering iron tip and area to be soldered are clean.
4) Form a proper heat bridge approximately one-third the distance down from the insulation/anti-wicking tool.

*B. Solder Pots*

***Note:*** Due to the lack of mobility, solder pots are used for tinning conductors that are not located inside of equipment or components leads, e.g., cable repair/manufacture, dual inline packages, and discrete components.

1) Ensure wire to be tinned is properly stripped and held by anti-wicking tool or other means of securing wire without damage to insulation.
2) Apply flux to the area of the wire to be tinned.
3) Remove dross from properly heated solder pot.
4) Insert wire into pot to depth of tin desired, hesitating approximately one second to overcome heat sinking effect. Pull away in a swift upward motion.
5) After tinning, it must be cleaned and rinsed in accordance with shop practices to remove contaminants, and inspected to ensure flux residue has been removed.

## 8. SOLDERING

a. Apply solder to the junction of the iron and wire, forming a heat bridge, and allow it to soak into the wire.

b. Move the solder and the iron up the wire toward the insulation/anti-wicking tool, ensuring a continuous flow of solder throughout the entire tinning process.

c. When the iron and solder reach the insulation/anti-wicking tool, hesitate momentarily and then continue to flow in solder and work back down the wire. As you bring the solder and iron off the end of the wire, the excess solder and all the oxidation will follow the iron off the wire.

d. Clean the wire using approved shop practices to remove flux residue. The cleaned wire should have a bright shiny appearance.

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Modification and Repair

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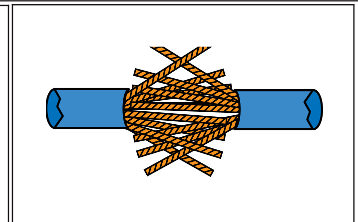
# Mesh Splice



Board Type: N/A
See 1.4.2

Skill Level: Intermediate
See 1.4.3

Level of Conformance: Low
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Chisel tip

## MATERIAL

Flux
Flux-cored solder
Insulative tubing

## NOTE

Prior to fanning the wires of this type splice, position the insulation sleeving/tubing over the wire. Ensure that the sleeving/tubing length is sufficient to extend over the wire's insulation, on both sides of the spliced area, a distance of three times the wire insulation diameter. The tubing's inside diameter should be selected to facilitate (after shrinking) a snug, firm fit over the wire insulation.

## PROCEDURE

1. Install tip.
2. Start with tip temperature of approximately 260°C and change as necessary.
3. Form the mesh splice by fanning the wire strands on both untinned wires into a cone shape. (See Figure 1.)
4. Gently begin meshing the wires together a minimum of 1.3 cm so that the strands interlace evenly and of equal length. (See Figure 2.)
5. Twist the wires slowly using a slight pulling motion to restore the original lay of the wire. Do not overtwist. (See Figure 3.)

## WIRE SPLICING

6. Select appropriate heating element to establish a heat bridge and minimize the effect of solder wicking beneath insulation. Solder in accordance with paragraph 8 in 8.1. (See Figure 4.)

## NOTE

Flux contained in flux-cored solders should be sufficient to clean and solder splices. If external flux is used, the chance of solder wicking beneath the insulation of stranded wire is increased.

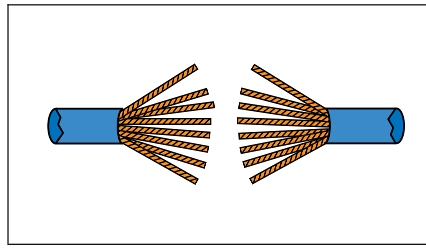


**Figure 1 Strip and Fan Wire Strands**

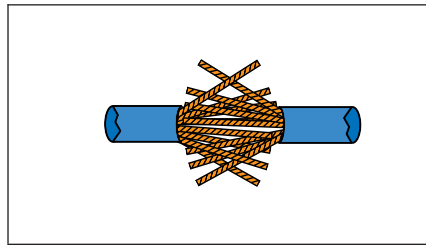


**Figure 2 Mesh Wire Strands**

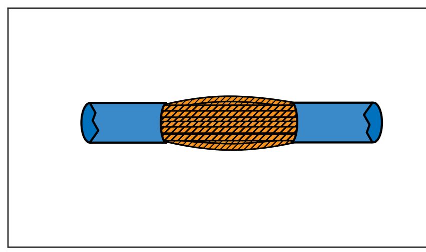


**Figure 3 Smooth Down Strands**

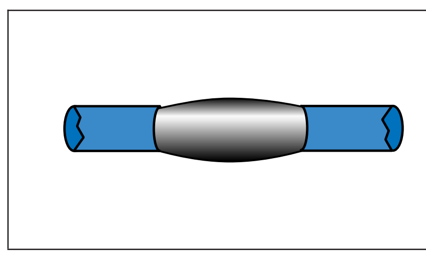


**Figure 4 Solder Connections**

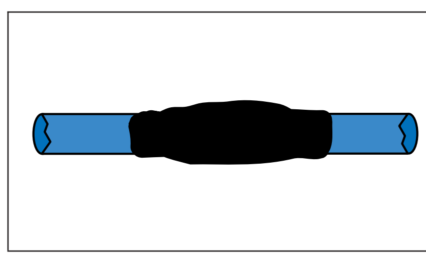


**Figure 5 Cover with Heat-Shrinkable Tubing**

7. Clean, if required, and inspect.
8. Position insulation sleeve/tubing over the spliced area, apply heat to shrink to a snug fit over the splice and wire insulation. (See Figure 5.)

**NOTES**

| | | |
|---|---|---|
| IPC 7721 Modification and Repair | Revision: **B** Number: **8.1.2**<br>Date: **11/07**<br>**Wrap Splice** | <br>Board Type: N/A See 1.4.2<br>Skill Level: Intermediate See 1.4.3<br>Level of Conformance: Low See 1.5.1 |

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Chisel tip

## MATERIALS

Flux
Flux-cored solder
Insulative tubing

## NOTE

The contact area between the two wires needs to be a minimum of three wraps (not twist) of each wire around the other.

## PROCEDURE

1. Install tip.
2. Start with tip temperature of approximately 260°C and change as necessary.
3. Strip and pre-tin stranded wires in accordance with guidelines identified in paragraph 7 in 8.1. (See Figure 1.)
4. Place sleeving/tubing/wire designations, etc. onto wire. Ensure that the sleeving/tubing length is sufficient to extend over the wire's insulation, on both sides of the spliced area, a distance of three times the wire insulation diameter. The tubing's inside diameter should be selected to facilitate (after shrinking) a snug, firm fit over the wire insulation.

## WIRE SPLICING

5. Position wires in an ''X'' pattern. Securing one wire firmly, begin the wrap motion of the opposite wire until one turn is completed. (See Figures 2 & 3.)
6. Firmly secure the remaining wire and begin wrap motion in the opposite direction. (See Figure 3.) Upon completion of one wrap on each wire, complete the wrapping process to obtain the three wire wrap minimum requirement. (See Figure 4.)
7. Terminate any remaining wire length using a flush cut pattern. (This eliminates any wire protrusion that could extend beyond the outer circumference of the wrap and cause damage to the insulation/tubing that could result in a short.) (See Figure 4.)

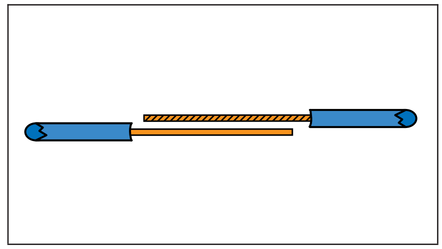


**Figure 1 Strip and Tin**

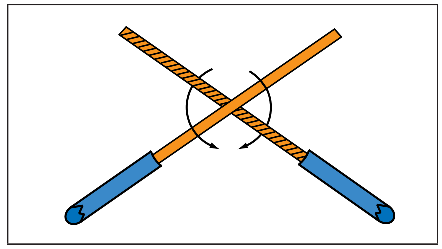


**Figure 2 Position in An "X"**

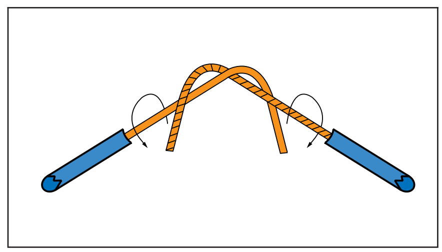


**Figure 3 Wrap in Opposite Directions**

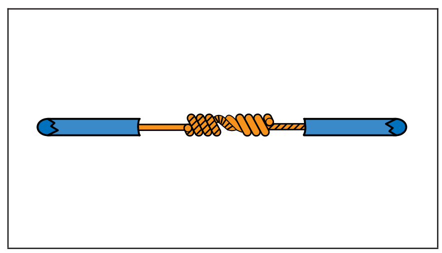


**Figure 4 Solder Connection**

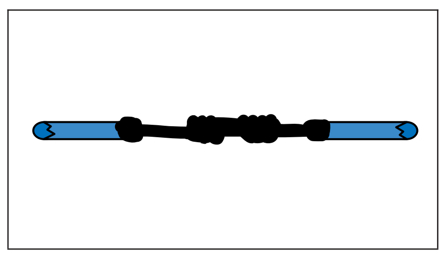


**Figure 5 Cover with Heat-Shrinkable Tubing**

8. Select appropriate heating element to establish a heat bridge and minimize the effect of solder wicking beneath insulation. Solder in accordance with paragraph 8 in 8.1.

**NOTE**

Flux contained in flux-cored solders should be sufficient to clean and solder splices. If external flux is used, the chance of solder wicking beneath the insulation of stranded wire is increased.

9. Clean, as required, and inspect.
10. Position insulation sleeve/tubing over the spliced area, apply heat to shrink to a snug fit over the splice and wire insulation. (See Figure 5.)

**NOTES**

IPC

7721

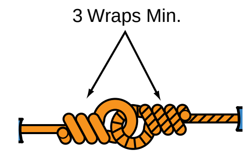
Modification and Repair

Revision: **B**

Date: **11/07**

Number: **8.1.3**

# Hook Splice




Board Type: N/A
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: Low
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Chisel tip

## MATERIAL

Flux
Flux-cored solder
Insulative tubing

## NOTE

The contact area between the two wires needs to be a minimum of three wraps of each wire around itself.

## PROCEDURE

1. Install tip.
2. Start with tip temperature of approximately 260°C and change as necessary.
3. Strip and pre-tin stranded wires in accordance with guidelines identified in paragraph 7 in 8.1. (See Figure 1.)
4. Place sleeving/tubing/wire designations, etc., onto wire. Ensure that the sleeving/tubing length is sufficient to extend over the wire's insulation, on both sides of the spliced area, a distance of three times the wire insulation diameter. The tubing's inside diameter should be selected to facilitate (after shrinking) a snug, firm fit over the wire insulation.

## WIRE SPLICING

5. Form a 180° bend in each wire, ensure that the wire strands have not been separated during this process. (See Figure 2.)
6. Securing one wire firmly, begin the wrap motion of the opposite wire until one turn is completed. (See Figure 3.)
7. Firmly secure the remaining wire and begin wrap motion in the opposite direction. Upon completion of one wrap on each wire, complete the wrapping process to obtain the three wire wrap minimum requirement. (See Figure 4.)

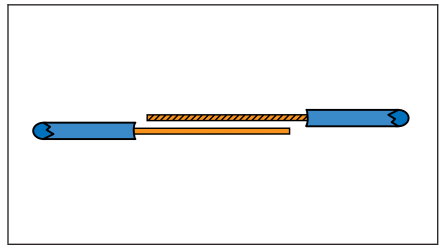


**Figure 1 Strip and Tin Wires**

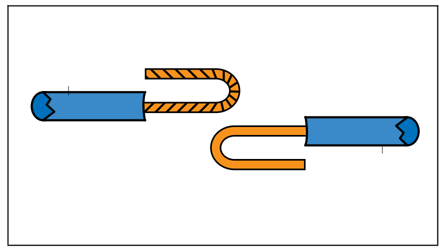


**Figure 2 Form 180° Bend**

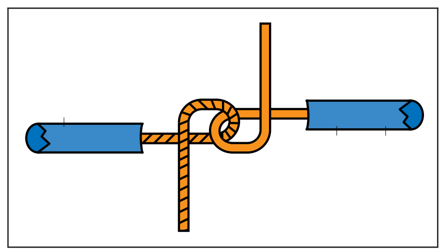


**Figure 3 Wrap in Opposite Direction**

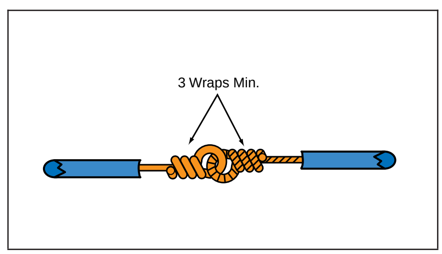



**Figure 4 Solder Connections**

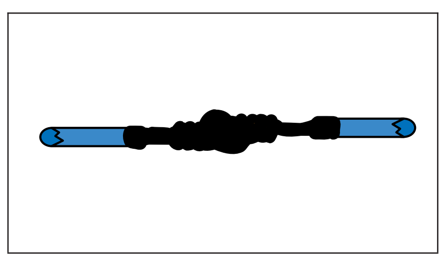


**Figure 5 Cover with Heat-Shrinkable Tubing**

8. Terminate any remaining wire length using a flush cut pattern. (This eliminates any wire protrusion that could extend beyond the outer circumference of the wrap and cause damage to the insulation/tubing that could result in a short.) (See Figure 4.)
9. Select appropriate heating element to establish a heat bridge and minimize the effect of solder wicking beneath insulation. Solder in accordance with paragraph 8 in 8.1.

**NOTE**

Flux contained in flux-cored solders should be sufficient to clean and solder splices. If external flux is used, the chance of solder wicking beneath the insulation of stranded wire is increased.

10. Clean, as required, and inspect.
11. Position insulation sleeve/tubing over the spliced area, apply heat to shrink to a snug fit over the splice and wire. (See Figure 5.)

**NOTES**

IPC

7721

Modification and Repair

Revision: **B**

Date: **11/07**

Number: **8.1.4**

# Lap Splice

Board Type: N/A
See 1.4.2
Skill Level: Intermediate
See 1.4.3
Level of Conformance: Low
See 1.5.1

## GENERAL REQUIREMENTS

Clauses 1.7 (Basic Considerations), 1.8 (Workstations, Tools, Materials and Processes) and 1.9 (Lead Free) provide important information and guidance about the use of this procedure, including but not limited to tin-lead and lead-free alloys. This procedure is also applicable to lead free products.

## EQUIPMENT REQUIRED

Soldering system
Soldering handpiece
Chisel tip

## MATERIALS

Flux
Flux-cored solder
Insulative tubing

## PROCEDURE

1. Install tip
2. Start with tip temperature of approximately 260°C and change as necessary.
3. Strip the wires. Each wire end should have the same length of insulation removed so that they appear identical. Each wire end should be stripped a minimum of four (four) wire diameters (a wire diameter is the outside diameter of the insulator which covers the conductor). Pre-tin wires in accordance with guidelines in paragraph 7 in 8.1. (See Figure 1.)
4. Place shrink-sleeving/tubing/wire designators, etc. onto the wire to be spliced and slide down the wire far enough to avoid interference during soldering. The inside diameter of the shrink-sleeving should be selected to ensure that a snug, firm, weather-tight seal will exist after shrinking.

**NOTE**

Step three (below) requires a single strand of wire, approximately 7.5 cm long, to be available for wrapping the overlapped wire ends. It is easiest to strip 7.5 cm of wire by making 3 separate strips (each approximately 2.5 cm long from the spool/reel of repair wire).

5. If possible, position wires on a flat surface so that the tinned lengths of wire overlap and are against each other (like the first two fingers on your hand) and the end of wire ''a'' butts against the ends of the insulation of wire ''b.'' (See Figure 2.) If identical lengths of insulation were removed, then the end of wire ''b'' will butt against the insulation of wire ''a.'' If it is not possible to position the wires on a flat surface, then position the wires as described above and secure in position using hemostats, alligator clips, etc. As a last ditch expedient, the wires can be tack

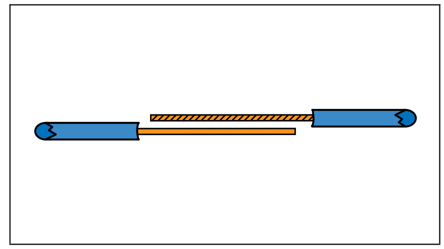


**Figure 1 Strip and Tin Wires**

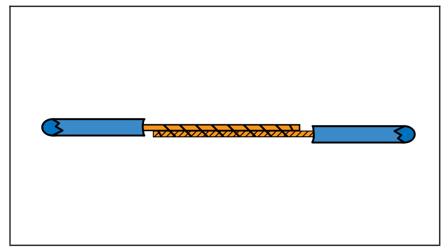


**Figure 2 Line Up Wires**

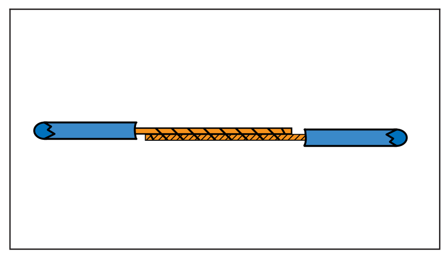


**Figure 3 Wrap with #30 Awg Wire**

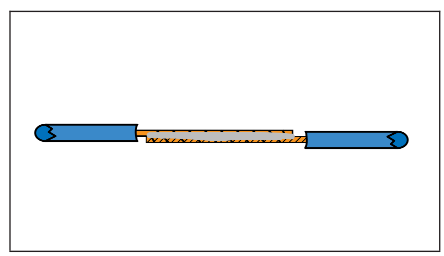


**Figure 4 Solder Connection**

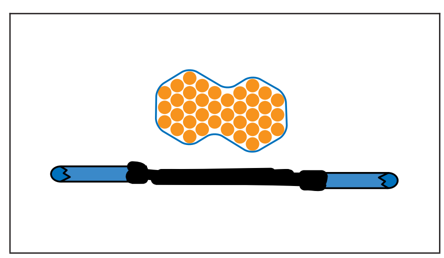


**Figure 5 Cover with Heat-Shrinkable Tubing**

soldered into the described position. If tack soldered, do not add solder, just heat the wires sufficiently to achieve a solder bond between the tinned wires.

6. Using a single strand of wire (approximately #30 awg) from a stranded wire (see Note above), wrap the overlapped wires to achieve sufficient mechanical security to prevent movement of the overlapped ends during soldering. (See Figure 3.)

**NOTE**

Do not use magnet or coil wire, due to its insulative enamel coating, to prevent damage to wire during the wrapping procedure.

Use only a single layer of wrapping on the overlapped wires and fold the end of the wire used for wrapping back down against the wrap surface.

7. Select a soldering iron tip appropriate to soldering the overlap splice. Establish a heat bridge in the center of the overlapped wires and add sufficient solder to achieve a complete solder fillet between the full length of the overlapped wires. The completed solder connection may have a slightly convex fillet for the length of the connection, as long as the individual wire wraps used to secure the spliced wires are clearly visible in the solder. (See Figure 4.)
8. Clean the completed connection with the appropriate solvent and visually inspect in accordance with stated requirements.
9. Position insulative sleeving, shrink-sleeving, or protective tubing over the splice, assuring that the splice is centered in the length of the sleeving/tubing. Apply heat to shrink-sleeving as necessary to achieve a tight fit over the splice. Position protective tubing (if used) over shrink-sleeving and mechanically secure as appropriate. (See Figure 5.)

**NOTES**

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# Standard Improvement Form

## IPC-7711B/7721B

The purpose of this form is to provide the Technical Committee of IPC with input from the industry regarding usage of the subject standard.

Individuals or companies are invited to submit comments to IPC. All comments will be collected and dispersed to the appropriate committee(s).

If you can provide input, please complete this form and return to:


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1. I recommend changes to the following:

    ___ Requirement, paragraph number __________

    ___ Test Method number __________, paragraph number __________

    The referenced paragraph number has proven to be:

    ___ Unclear ___ Too Rigid ___ In Error

    ___ Other ______________________________

2. Recommendations for correction:

    ______________________________

    ______________________________

    ______________________________

    ______________________________

3. Other suggestions for document improvement:

    ______________________________

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Submitted by:

Name ______________________________ Telephone ______________

Company ______________________________ E-mail ______________

Address ______________________________

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# ANSI/IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits Definition Submission/Approval Sheet

The purpose of this form is to keep current with terms routinely used in the industry and their definitions. Individuals or companies are invited to comment. Please complete this form and return to:

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Date: ______________________

❑ This is a **NEW** term and definition being submitted.
❑ This is an **ADDITION** to an existing term and definition(s).
❑ This is a **CHANGE** to an existing definition.

| Term | Definition |
| --- | --- |
| | |
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If space not adequate, use reverse side or attach additional sheet(s).

Artwork: ❑ Not Applicable ❑ Required ❑ To be supplied
❑ Included: Electronic File Name: ______________________

Document(s) to which this term applies: ______________________

Committees affected by this term: ______________________

**Office Use**

| **IPC Office** | **Committee 2-30** |
| --- | --- |
| Date Received: ______________ | Date of Initial Review: ______________ |
| Comments Collated: ______________ | Comment Resolution: ______________ |
| Returned for Action: ______________ | Committee Action: ❑ Accepted ❑ Rejected |
| Revision Inclusion: ______________ | ❑ Accept Modify |

**IEC Classification**

Classification Code • Serial Number

Terms and Definition Committee Final Approval Authorization:

Committee 2-30 has approved the above term for release in the next revision.

Name: ______________ Committee: IPC 2-30 Date: ______________

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The IPC staff will research your technical question and attempt to find an appropriate specification interpretation or technical response. Please send your technical query to the technical department via:

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