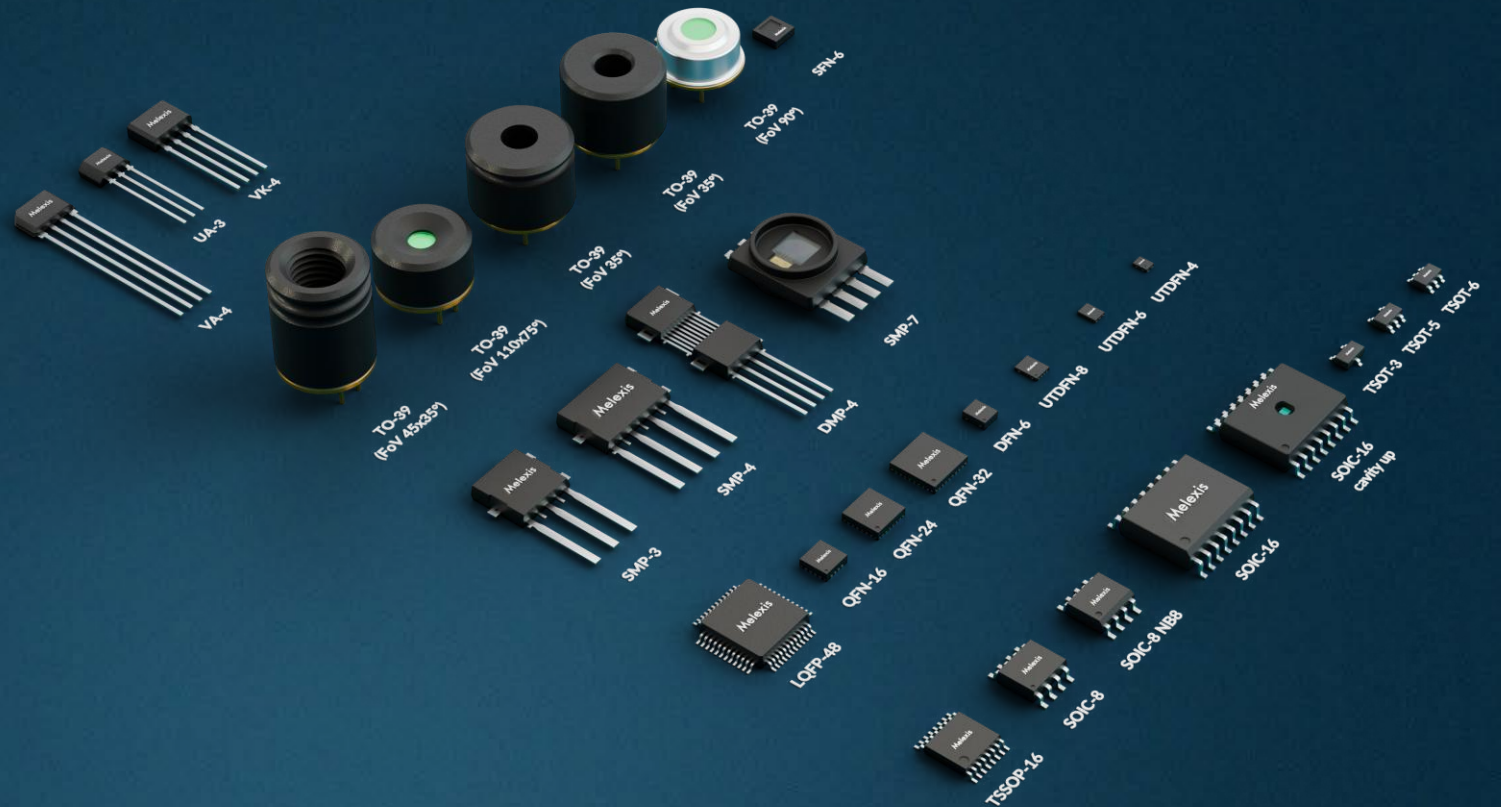


Guidelines for nondestructive extraction of devices from customer modules

Advanced Customer Solutions

Revision 1.0 - September 2026



Guidelines for nondestructive extraction of devices

1. Scope

2. Removal of coatings, potting and overmolding

2.1 Removal of conformal coating

2.2 Removal of potting and overmolding

3. Device extraction after removal of coating and potting

3.1 Desoldering of devices

3.2 Extraction of PCB-less devices

1. Scope

The importance of IC extraction in the RMA process

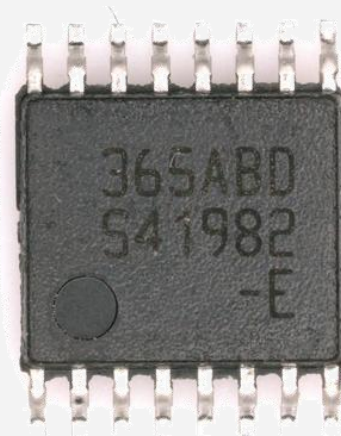
When an IC defect is suspected as the root cause of a line or field failure, customers are required to apply for RMA (Return Material Authorization) in order for Melexis to perform FA (Failure Analysis). As part of the **Melexis RMA procedure**, customers are required to extract the IC from the module before sending the device to Melexis. As stated in this procedure:

Melexis has the right to reject the RMA request if the IC is in a damaged condition that is preventing further investigations. (e.g., broken IC, missing leads, burnt marks, burnt IC...).

Therefore, samples must be handled carefully during the extraction process to avoid any mechanical damage. It is highly recommended that the extraction is done by the EMS (Electronic Manufacturing Services) when possible. Guidelines for nondestructive device extraction can be found in **IPC-7711/7721**.

This Application Note is focused on *extraction-induced defects* and how to avoid them. Since every module construction is unique, it cannot be exhaustive. Please contact Melexis (rma@melexis.com) for further guidance if necessary.

RMA REJECTED
Damage to the IC prevents a
conclusive FA and alters the initial
claimed failure.



RMA ACCEPTED
IC is not damaged, FA can proceed
normally.

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3. Device extraction after removal of coating and potting

3.1 Desoldering of devices

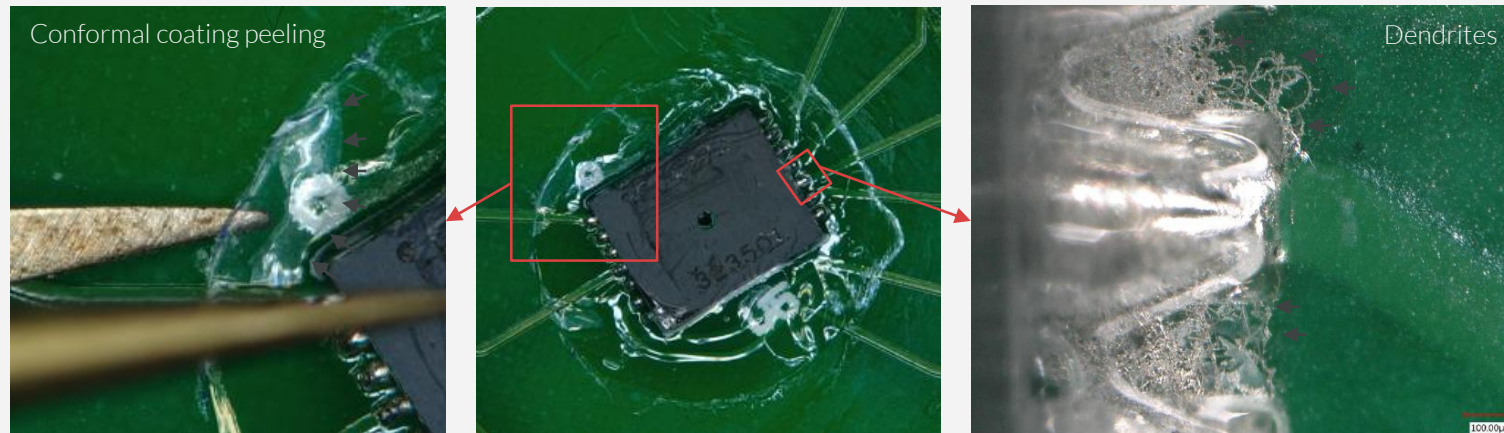
3.2 Extraction of PCB-less devices

2.1 Removal of conformal coating

Recommended method for removal of conformal coatings

Conformal coatings are thin polymer coatings that are applied as a protective layer on top of a PCB. **IPC-7711/7721D Section 1.14.2: Coating Removal** defines five different coating removal methods depending on the basic resin chemistry. **IPC-HDBK-830A Section 10.6: Conformal Coating Removal Methods** can also be consulted for more information on these different methods.

Environmental protection of the conformal coating is highly dependent on its adhesion to the PCB, which depends on several variables like flux residues on a PCB, poor curing of the resin or a surface energy mismatch. Some field failures, like dendritic growth, can be associated with poor adhesion. Therefore it is highly recommended to first mechanically probe and peel the coating before removing it. If it peels off easily, there is interfacial adhesion failure. It is important to report this to Melexis, because any subsequent findings during FA might be linked back to the adhesion failure.



Acrylic resin conformal coating peeling off from the PCB due to insufficient adhesion. The dendritic growth identified between pins can be linked back to this interfacial adhesion failure.

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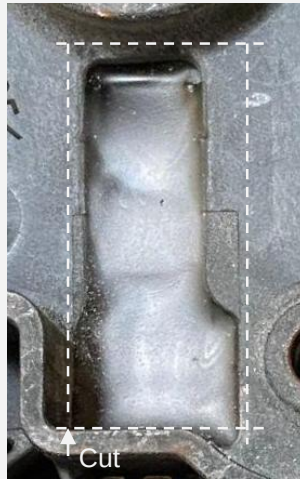
3.1 Desoldering of devices

3.2 Extraction of PCB-less devices

2.2 Removal of potting and overmolding

Recommended method for removal of soft potting

Potting is a method of encapsulation where a container is filled with a liquid resin which is then cured. The most common soft potting chemistry types are soft polyurethanes, acrylics and silicone. The recommended removal method for these soft resins is **chemical** removal, which is explained in detail in **IPC-HDBK-850A, Section 5.1.1: Chemical**. The manufacturer of the resin usually offers a strip agent or has recommendations on which one to use. The compatibility of the solvent with other plastics in the assembly should be verified prior to use to avoid damage to other structures. Depending on the type of material, a heating plate is required to heat the solvent to the recommended temperature – this will make sure the activation energy required for the stripping is reached. The main risk is damage to the sensor by solvent-induced swelling: the chemical residue resulting from it has to be cleaned regularly with DI (Deionized) water to reduce damage.



Cut the plastic housing using a **diamond wire saw** to isolate the potted device.



Remove the potting using a **chemical method**. Avoid damage to the device by solvent-swelling.



Device is ready for extraction, refer to [Section 3](#).

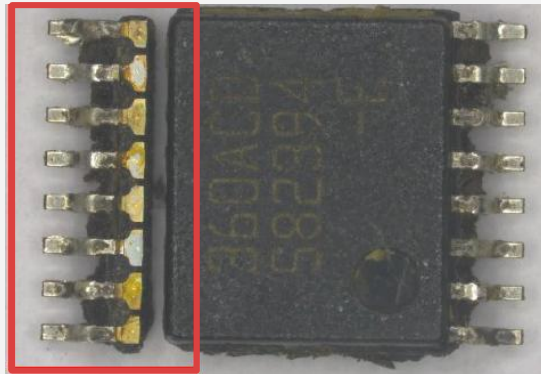
2.2 Removal of potting and overmolding

Typical extraction-induced defects during soft potting removal

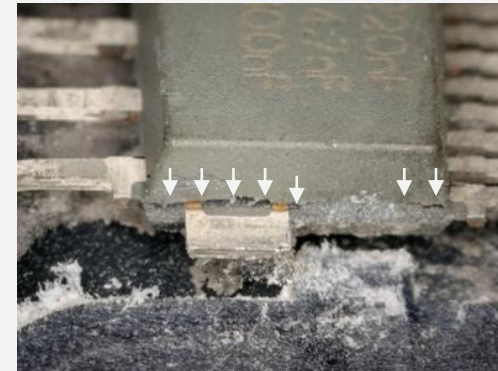
The encapsulation layer can have a thickness of several millimeters in X, Y and Z, so removal by a solvent might be a long process taking several hours of soaking. This is a risk for the device if the solvent used penetrates epoxy-resins, because the mold body is also an epoxy-based resin and will also be penetrated by the solvent. Solvent penetration into the mold causes swelling, leading to internal structural damages like mold crack, delamination from the die, delamination from the lead frame and wire bond breakage. If a long soaking cannot be avoided for a PCBA, the solvent and moisture trapped inside shall be evaporated before attempting to desolder the device. It is recommended to use a step dry:

- Evaporate the solvent: Minimum 4 hours close to but below the boiling point of the solvent (consult the vendor for specific numbers)
- Evaporate the moisture: Minimum 8 hours at 100 – 125 °C (consult **J-STD-033D Section 6: Board Rework**)

If the potting used is an epoxy resin or a hard polyurethane, the proper potting removal is grinding, as described in the next slide.



Mold breakage due to solvent penetration and subsequent expansion during hot air desoldering.



Mold crack due to solvent penetration and mold swelling during epoxy chemical removal.

2.2 Removal of potting and overmolding

Recommended method for removal of hard potting and overmolding

Epoxy and hard polyurethane resins are popular for both overmolding and potting. The recommended removal method is **grinding**, as described in **IPC-HDBK-850A, Section 5.1.2: Mechanical abrasion**. This can be achieved using parallel polishing equipment: an object holder keeps the specimen parallel to the rotating grinding wheel with programmable RPMs and exchangeable grit-size grinding discs. Grinding the specimen using Z-force can be controlled manually or automatically, depending on the equipment model.

Once the IC mold is exposed, no further polishing is possible as there is a risk of damaging the IC. A second step is required to expose the pins for electrical contact. The recommended method is **laser ablation**, as described in **IPC-HDBK-850A, Section 5.1.6: Laser**: a high power beam is applied on a small area to be removed. The radiation is absorbed by the polymer and breaks the chemical bonds holding it together. If laser ablation is not available in the FA lab, **chemical stripping** could be applied to remove the last residue on top of the pins - but it is critical to limit the exposure time to avoid solvent penetration into the mold.



Example of parallel polishing equipment for mechanical abrasion.

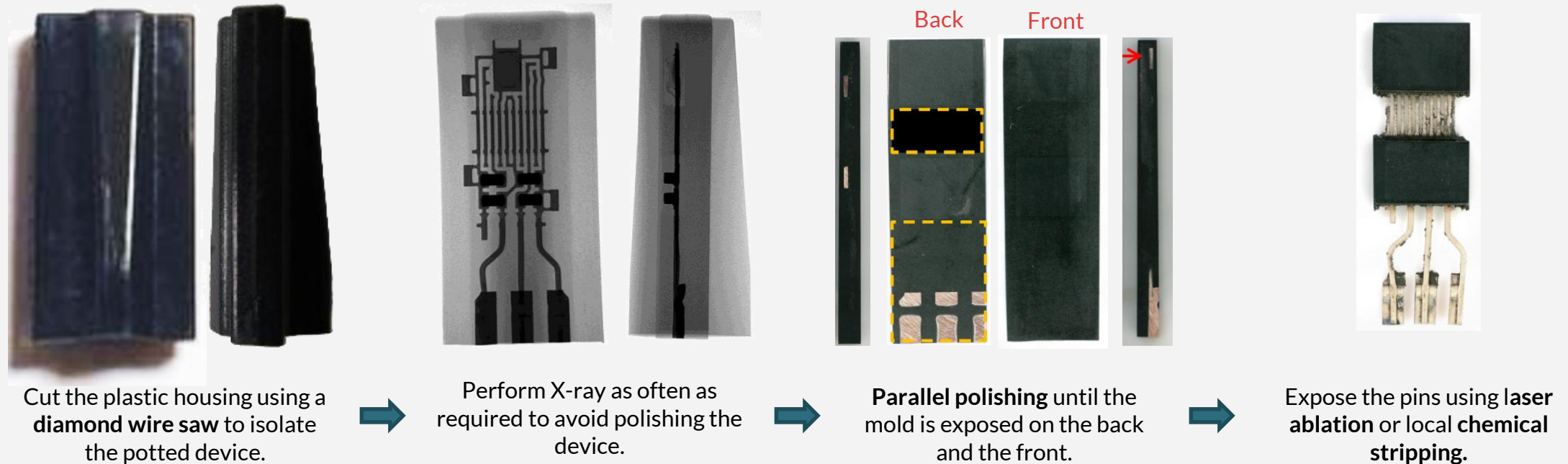


Example of laser decapsulation equipment for laser ablation.

2.2 Removal of potting and overmolding

Example of device extraction from epoxy overmolding

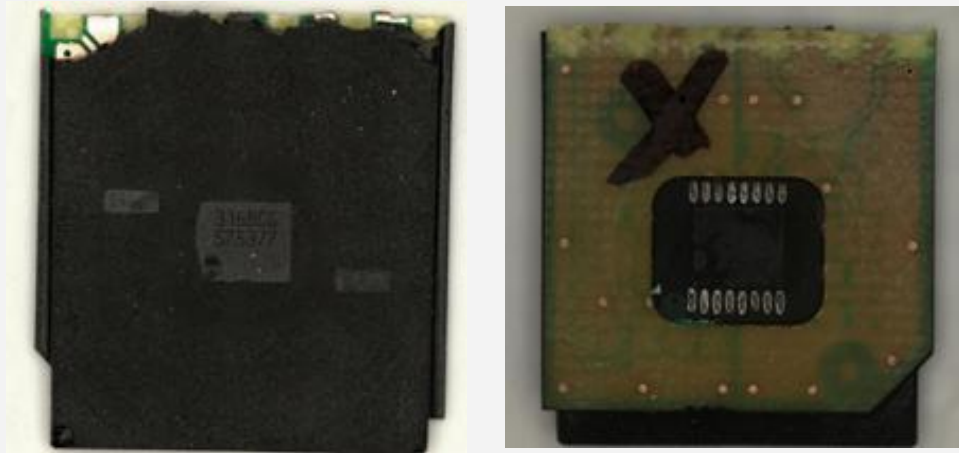
Hard potting and overmolding typically use non-transparent resins, so XRAY shall be done as often as needed to avoid damage to the potted or overmolded device.



2.2 Removal of potting and overmolding

Example of partial extraction

Partial extraction refers to a device which is still encapsulated in a resin matrix, but after grinding the pins have been exposed for electrical contact and the mold is visible for visual inspection. Partial extraction might be acceptable for RMA if full extraction is considered too risky. Please contact rma@melexis.com for further guidance.



Parallel polishing has been used to expose the top mold and remove most of the PCB under the IC, exposing the solder joints.

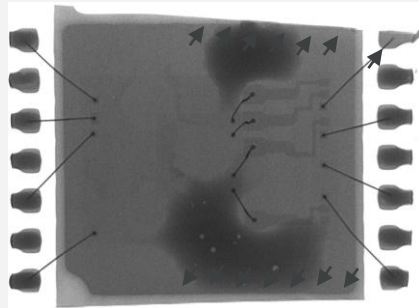


The pins have been exposed on the top, whereas the bottom half has been polished up to the mold body.

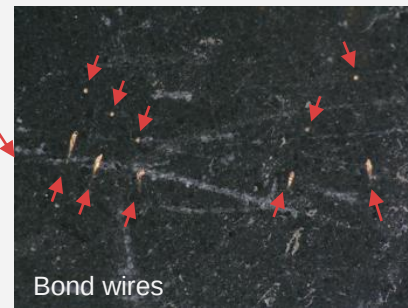
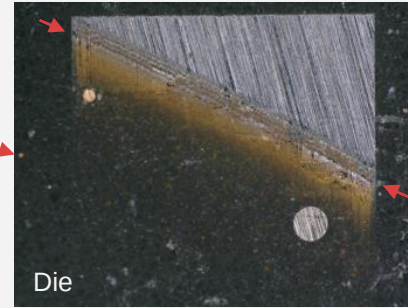
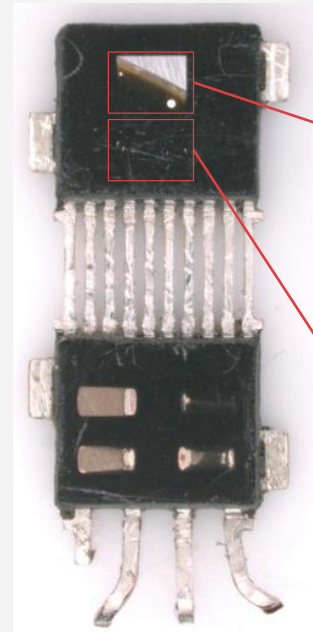
2.2 Removal of potting and overmolding

Typical extraction-induced defects during hard potting or overmolding removal

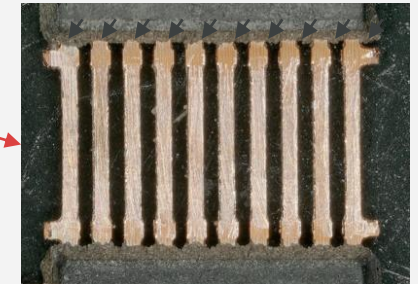
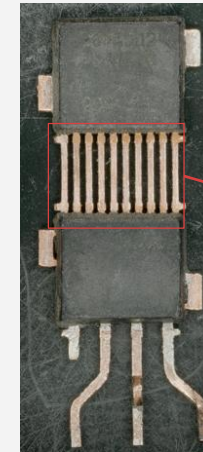
After extraction, the device shall be inspected for the below typical extraction-induced defects:



The lead frame and some pins have been damaged during cutting from a potted module.



Die and bond wires have been damaged due to over-polishing.



Tin plating has been removed during laser ablation, making electrical contact unreliable.

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2.1 Removal of conformal coating

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3. Device extraction after removal of coating and potting

3.1 Desoldering of devices

3.2 Extraction of PCB-less devices

3.1 Desoldering of devices

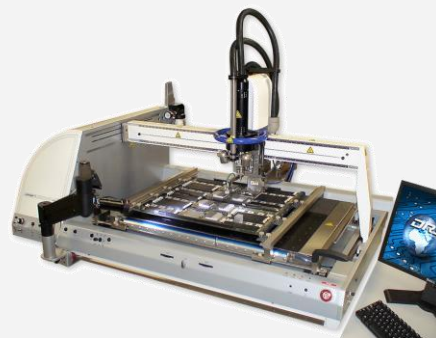
Recommended method for safe desoldering of SMD devices

The preferred desoldering method for SMD is by **hot-air reflow**. This method is described in detail in **IPC-7711/7721D Section 3.6.7: Gull Wing Removal (two-sided) – Hot Gas (Air) Reflow Method** for gull wing components and in **IPC-7093B Section 7.12.1: Hot-Air/Gas Rework and Hot Air Pencil Rework** for BTCs. If drying is required, follow recommendations in **J-STD-033D Section 6: Board Rework**.

A dedicated **nozzle** sized to match the package outline shall be used. Preferably, an automated removal process and tooling should be used. It is recommended that the PCB is placed on a hot plate before desoldering, so the air can be set to slow or medium speed. The vacuum pickup cup shall be activated after the solder is molten to avoid any pull stress on the pin-mold interface.

The reflow profile for device removal shall be adequate to the solder paste parameters (melting temperature) applied on PCB, and shall not exceed the MSL classification profile parameters as per **J-STD-020**. Hot air maximum temperature is 260 °C.

IPC-7711/7721 has procedures for desoldering SMDs bonded to a PCB with surface mount adhesives (SMA). **IPC-HDBK-4691 Section 14.4: Removal Methods** can also be consulted for general guidelines.



Example of automated hot-air rework station.
(Image from [Air-vac](#))

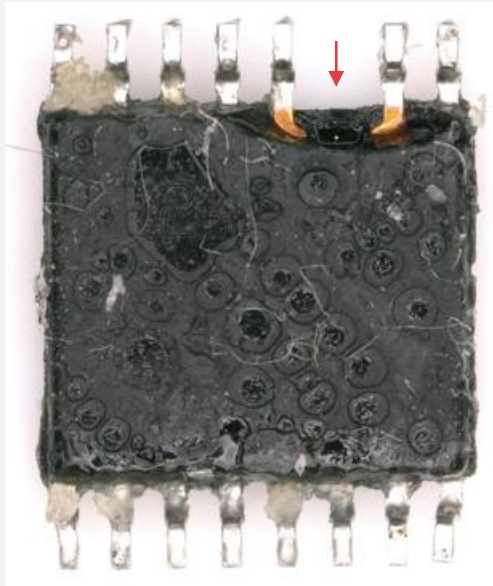


Example of nozzles sized for different package outlines.
(Image from [Air-vac](#))

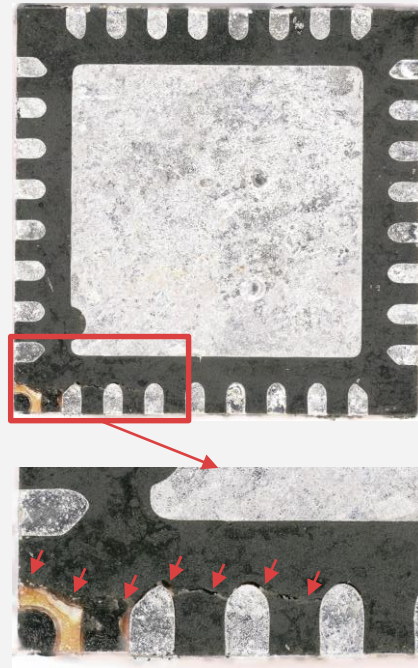
3.1 Desoldering of devices

Typical extraction-induced defects during desoldering of SMDs

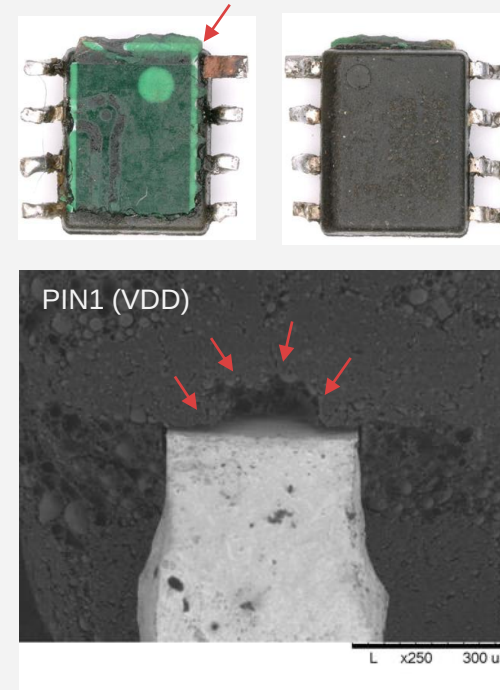
After extraction, the device shall be inspected for the below typical extraction-induced defects:



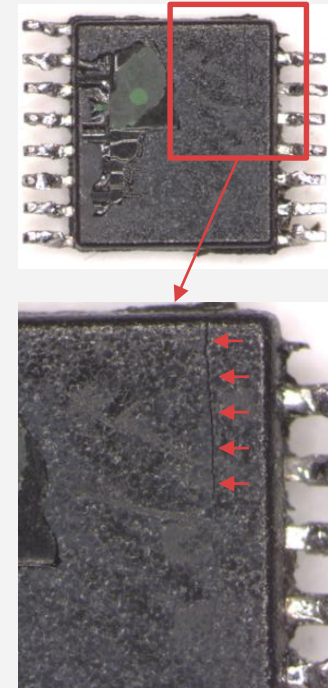
Pin has been broken because the device was lifted while the solder was not fully melted.



Mold cracks are due to excessive heat applied to the package because contact desoldering method was used.



SMA was not removed while desoldering, leading to solder mask sticking to the device, pin twist and mold chip out.



Mold crack due to excessive thermomechanical stress during desoldering.

3.1 Desoldering of devices

Recommended method for safe desoldering of THD devices

The main challenge of desoldering a THD is the PTH barrel – it acts as a heat sink with a high thermal mass. The recommended method is using **motorized vacuum**, as described in **IPC-7711/7721D Section 3.1.1: Through-Hole Desoldering – Continuous Vacuum Method**. This equipment features a heating element that heats up the solder joint to above the melting point of the alloy. A vacuum suction is then applied to absorb the liquid solder. This reduces the amount of heat that is moved to the leads and hence the IC itself, reducing the risk of thermomechanical damage.

It is important to make sure that all the solder has been removed from within the PTH barrel before attempting to extract the IC from the vias—if any pin is still attached to the barrel, the pull force applied during extraction can lead to pin extrusion and mechanical damage.

Selective soldering equipment might be used if available, as described in **IPC-7711/7721D Section 3.2.1: PGA and Connector Removal – Solder Fountain Method**.

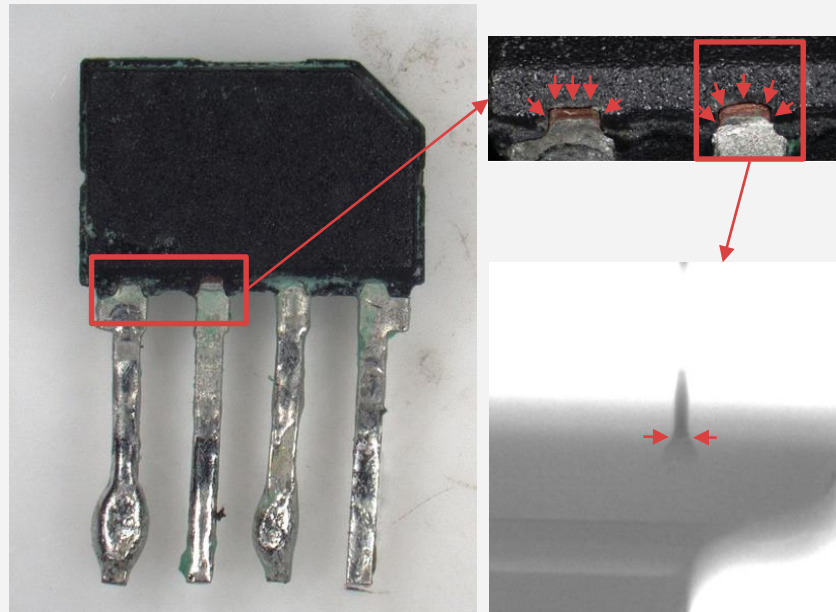


Example of motorized vacuum desoldering station for THD.
(Image courtesy of [Metcal](#))

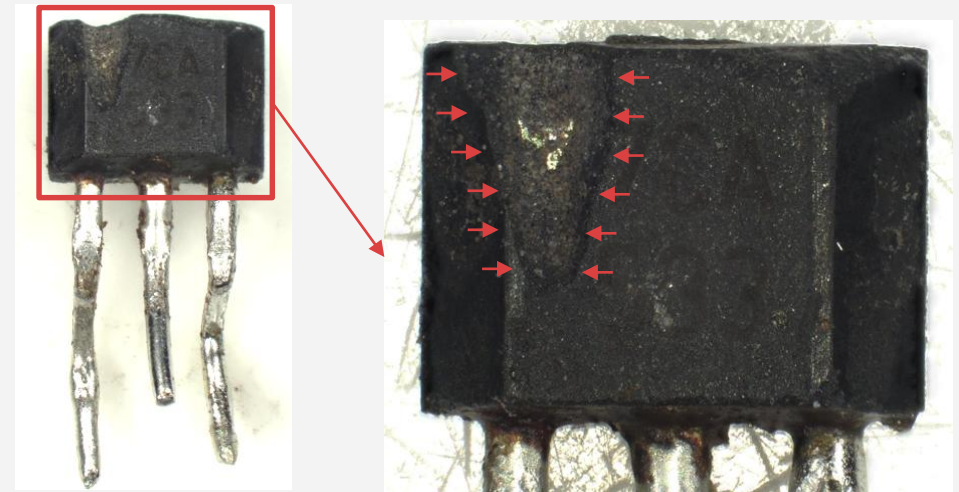
3.1 Desoldering of devices

Typical extraction-induced defects during desoldering of THDs

After extraction, the device shall be inspected for the below typical extraction-induced defects:



If the IC is pulled from the PTH while there is still some solder, excessive pull stress on the pins might lead to pin extrusion.



Excessive mechanical damage of unknown origin has been applied to the device during desoldering, leading to a massive mold chip out that has exposed and damaged the silicon die.

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2.1 Removal of conformal coating

2.2 Removal of potting and overmolding

3. Device extraction after removal of coating and potting

3.1 Desoldering of devices

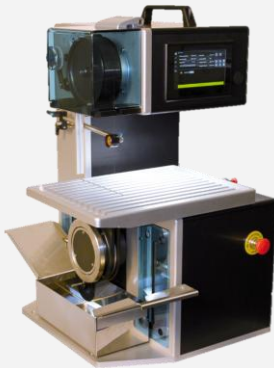
3.2 Extraction of PCB-less devices

3.2 Extraction of PCB-less devices

Recommended method for extraction of PCB-less devices

PCB-less devices are usually held in place by Z fixation features (like hot rivets) and by welding joints. Both need to be removed before attempting to extract the device, otherwise there is a risk of overstress on the pins. If the device is housed in a shallow nest and it is easily accessible, the best method is using a **rotary tool** to remove the Z fixation features and a **wire cutter** to cut the pins. The cut line should be as close as possible to the welding joint, to avoid twisting the pin during cutting.

If the device is held in a deep nest difficult to reach, the module needs to be cut first. Most engineering plastics used in PCB-less applications are glass reinforced (GF). This makes the plastic very hard, and hence cutting with a rotary tool might be challenging. The recommended cutting method is therefore **diamond wire saw**, which is available in every semiconductor FA lab. The diamond wire saw can be used to carefully cut the module and to isolate the area with the IC as needed, as well as to cut the pins. Ensure the module is held securely during cutting to avoid vibration or forces that could damage the device. Some modules have an internal copper lead frame that will be cut by the saw as well – this requires special attention to avoid the module snapping from the holding features while the copper is reached.



Example of diamond wire saw to cut GF plastics.
(Image from [Well DWS](#))



Example of rotary tool to remove Z fixation features.



Example of wire cutters to cut the pins.

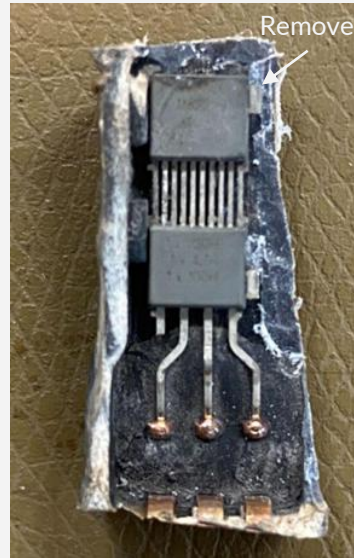
3.2 Extraction of PCB-less devices

Example of PCB-less device extraction

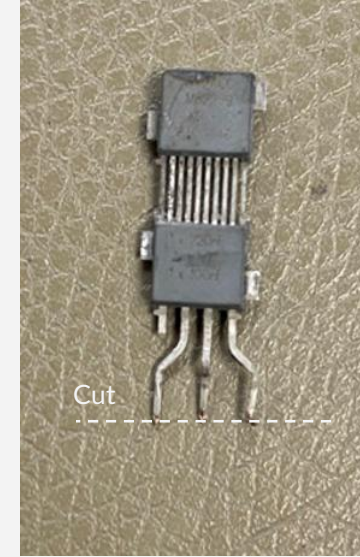
When cutting Z fixation features, be careful to avoid damage to the device.



Remove any soft potting or coating. Refer to [Section 2](#).



Remove any Z fixation features like hot rivets using **wire cutters** or a **rotary tool**. Cutting depth shall not reach the device ears.

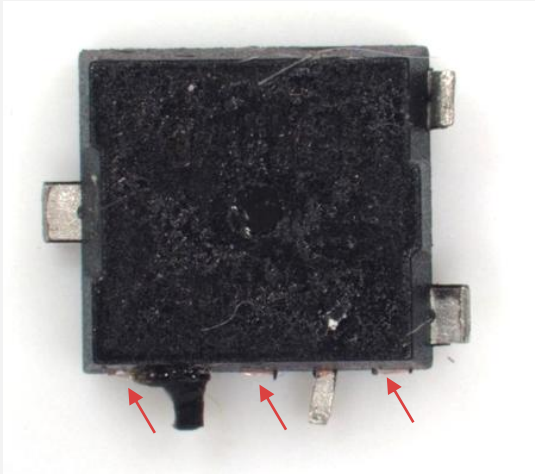


Cut the pins as close as possible to the welding joint using **wire cutters**.

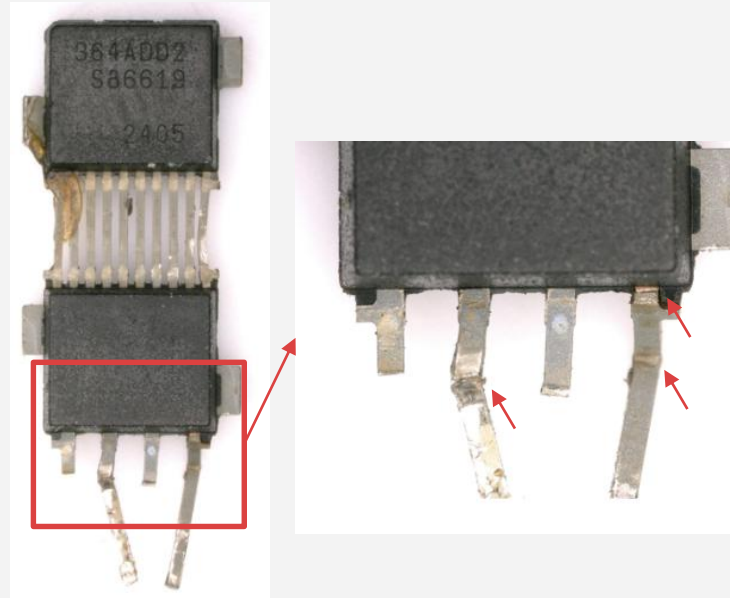
3.2 Extraction of PCB-less devices

Typical extraction-induced defects during PCB-less devices extraction

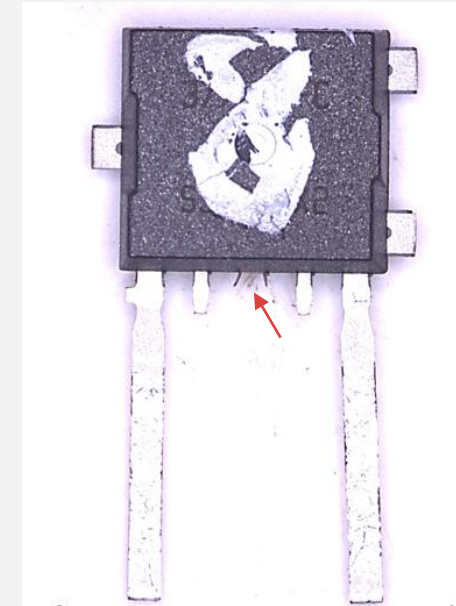
After extraction, the device shall be inspected for the below typical extraction-induced defects:



Pins have been cut too short and might be difficult to make electrical contact.



Pins have been damaged because force was applied before the IC was completely free from Z fixation features.



One pin is missing due to excessive mechanical force during extraction.

Annex

List of standards

IPC-7711/7721 Rework, Modification and Repair of Electronic Assemblies

IPC-7093 Design and Assembly Process Implementation for BTCs

IPC-HDBK-830 Guidelines for Design, Selection and Application of Conformal Coatings

IPC-HDBK-850 Guidelines for Design, Selection and Application of Potting Materials and Encapsulation Processes Used for Electronics Printed Circuit Board

IPC-HDBK-4691 Handbook on Adhesive Bonding in Electronic Assembly Operations

J-STD-020 Moisture Reflow Sensitivity Classification for Non-hermetic SMD

J-STD-033 Handling, Packing, Shipping and Use of Moisture, Reflow and Process Sensitive Devices

Annex

List of abbreviations

BTC: Bottom Terminated Components

DI: Deionized

EDX: Energy Dispersive X-ray Spectrometer

EMS: Electronic Manufacturing Services

FA: Failure Analysis

GF: Glass-reinforced

HF: Halogen Free

IC: Integrated Circuit

NC: No clean

MSL : Moisture Sensitivity Level

PCB: Printed Circuit Board

PTH: Plated Through-Hole

QFN: Quad Flat No-Leads

RMA: Return Material Authorization

RPM: Revolutions Per Minute

SMA: Surface mount adhesives

SMD: Surface Mount Devices

UF: Underfill

VI: Visual Inspection

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