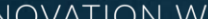


Advanced Customer Solutions

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INNOVATION WITH HEART

Guidelines for lead cutting of FIR sensors in TO-39 package

1. Scope

2. Cutting of TO-39 leads

3. Post-cutting inspection

1. Scope

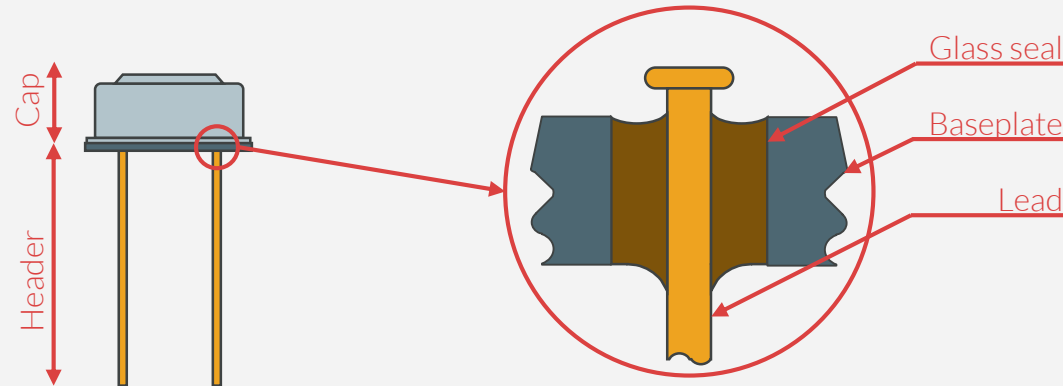
The risk of cutting TO-39 leads

TO-39 is a through-hole, hermetically sealed metal package. The hermeticity is achieved by welding a metal cap to a metal header. The metal header is made of a baseplate, leads and glass seals. The leads are made of Kovar plated with PdAu (palladium-gold). Kovar is an alloy with high tensile strength – high shearing forces create a mechanical shock that might travel to the glass seal and crack it. If any crack develops in the glass seal, the hermeticity might be lost and the functionality of the FIR (Far Infrared) sensor will be compromised because it is calibrated either in vacuum or with a gas inside (helium or xenon).

This Application Note is focused on *cutting-induced defects*, defect inspection and best practices to minimize their likelihood. Since every tool construction is unique, it cannot be exhaustive. Please contact Melexis (<https://www.melexis.com/en/contact/technical-inquiry>) for further guidance if necessary.



MLX90614 in TO-39



TO-39 architecture

Guidelines for lead cutting of FIR sensors in TO-39 package

1. Scope

2. Cutting of TO-39 leads

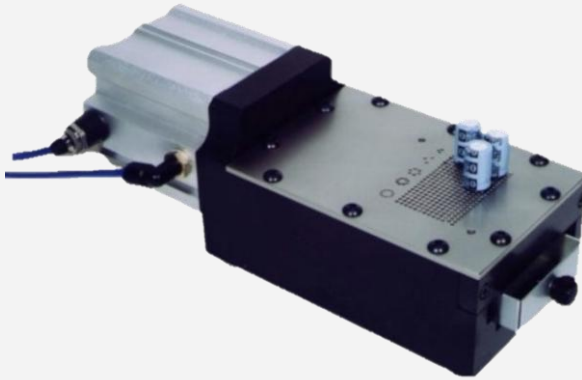
3. Post-cutting inspection

2. Cutting of TO-39 leads

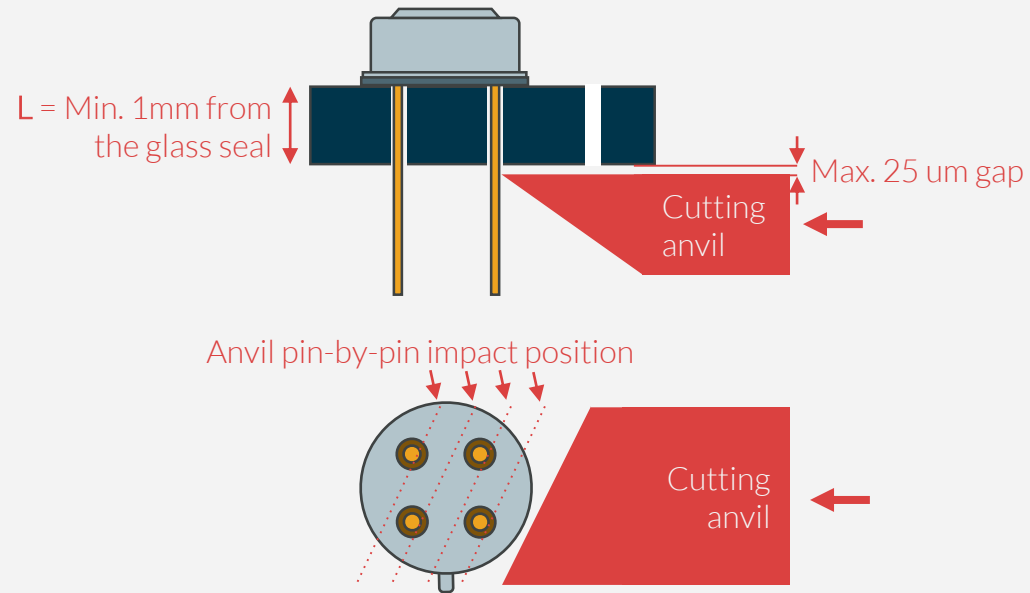
Lead cutting tooling

Cutting pins after soldering is allowed by **IPC-A-610J Section 7.3.5.9: Supported Holes - Lead Cutting after Soldering**, but it leaves the lead base metal (Kovar) exposed to the environment and prone to corrosion. The recommended flow is cutting the leads using a matrix pneumatic cutter before insertion onto the PCB. The lead length (L) is defined by a calibrated cutting plate thickness and should be a minimum of 1 mm from the glass seal. Inserting shorter, straightened pins into the PCB via is easier. The lead protrusion from the PCB should target between 0.4 and 1 mm. This will allow the wave soldering to cover the base metal, protecting it from corrosion.

The mechanical shock is proportional to the speed of the cutting anvil and its shape/orientation towards the matrix of the 4 leads. Lowering the anvil speed and using an angled shape (cutting one pin at a time) reduces this risk.



Example of a matrix pneumatic cutter
(Image courtesy of [Iteco](#))

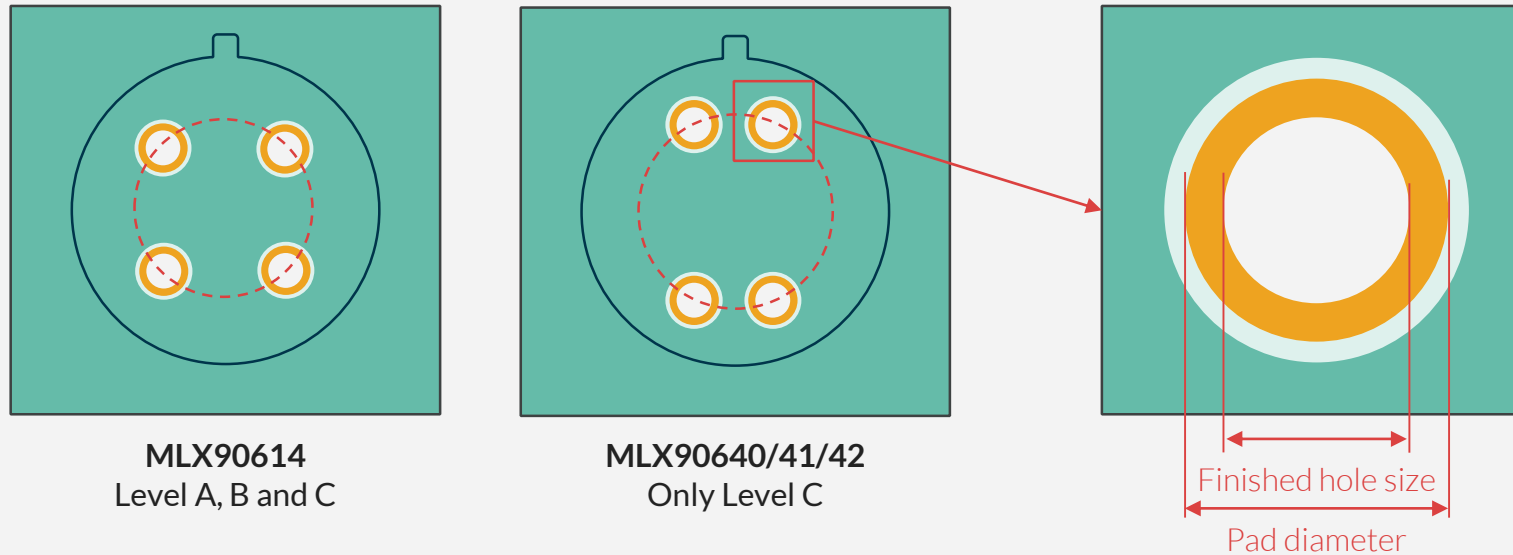


Side and bottom view of the cutting tool

2. Cutting of TO-39 leads

Hole and pad size for TO-39

Minimum hole size can be calculated using **IPC-2222B Section 9.2.2: Plated-Through Holes (PTHs)**. The minimum pad size can be calculated using **IPC-2221C Section 9.1.1: Land requirements**. The maximum pin diameter is 0.5mm even if a cut burr is present (see [slide 9](#)). The standard defines three manufacturability levels where A has wide tolerances and C has tight tolerances. For MLX90614, level selection depends on the technological capabilities of the PCB manufacturer. However, for MLX90640/41/42, since the glass seal diameter is smaller, only level C is allowed to prevent shorts between the pad and the baseplate.



	Level A	Level B	Level C
Minimum hole size	0.75	0.7	0.65
Minimum pad diameter	1.25	1.05	0.95

Dimensions in mm

Guidelines for lead cutting of FIR sensors in TO-39 package

1. Scope

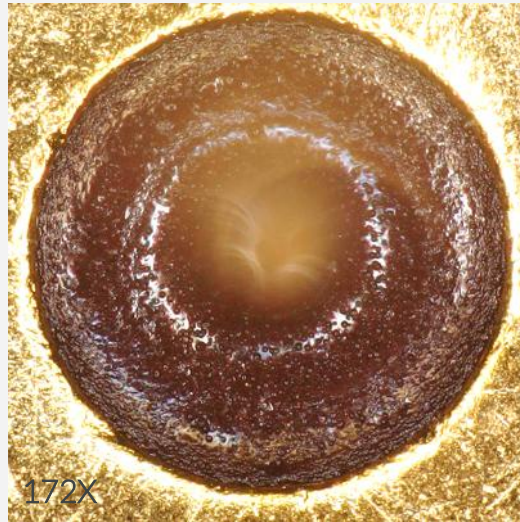
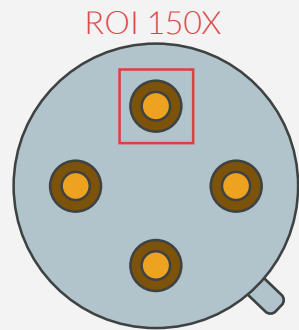
2. Cutting of TO-39 leads

3. Post-cutting inspection

3. Post-cutting inspection

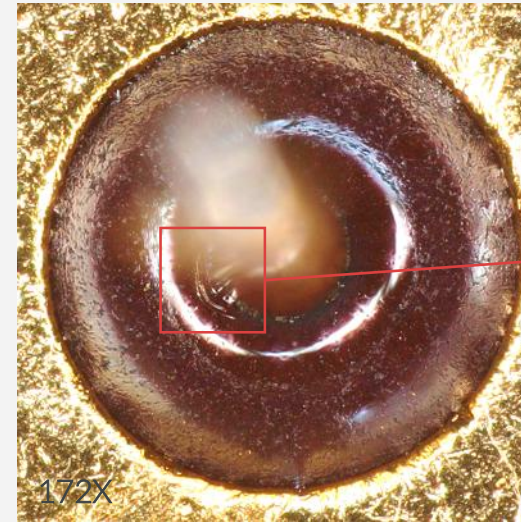
Glass seal crack inspection criteria and acceptability

JESD9C Section 5.2 and MIL-STD-883 Method 2009 define criteria for glass seal cracks. For proper inspection, OM (Optical Microscopy) with a magnification of at least 150X is recommended, although higher magnifications might be necessary for confirmation if a crack is suspected. Due to the risk of loss of hermeticity, no cracks are allowed after cutting the leads.



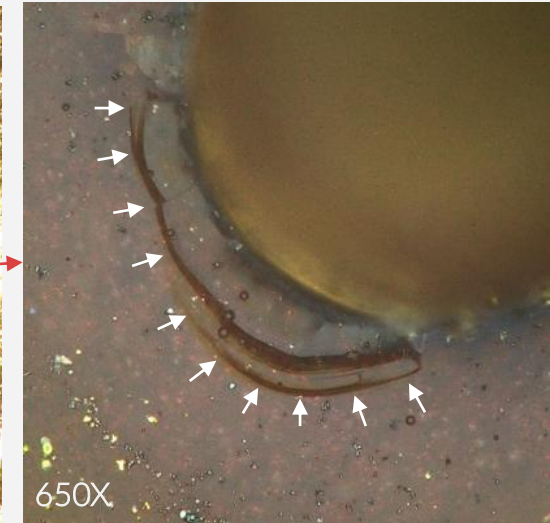
ACCEPT

No cracks on the glass seal



REJECT

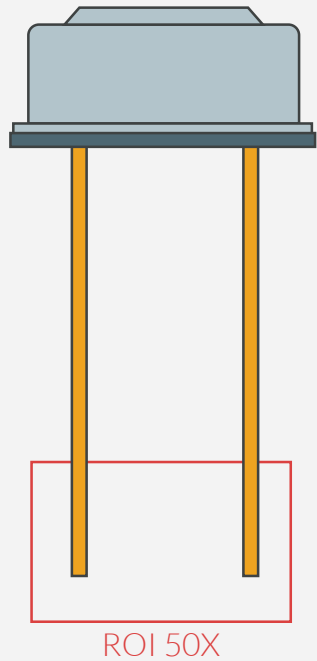
A crack has developed in the glass seal next to the lead after cutting the pin



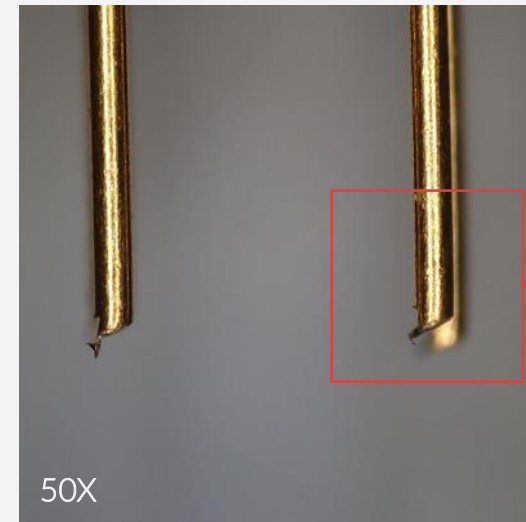
3. Post-cutting inspection

Burr height inspection criteria and acceptability

JESD9C Section 7.1.9 and MIL-STD-883 Method 2009 define measurement parameters for lead burr height. Pin burrs are acceptable but cannot exceed the maximum diameter of the pin as defined in the POD (Package Outline Drawing). It is recommended to use OM with a magnification of at least 50X to inspect the pin tip, and up to 150X for measurement.

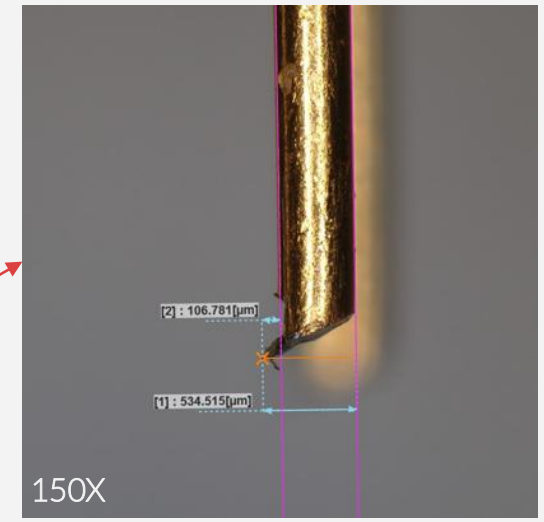


ACCEPT
No pin burrs



REJECT

Diameter at burr exceeds maximum lead diameter of 0.5 mm



Annex

List of standards

MIL-STD-883 Department of Defense Test Method Standard for Microcircuits

IPC-2221 Generic Standard on Printed Board Design

IPC-2222 Sectional Design Standard for Rigid Organic Printed Boards

IPC-A-610 Acceptability of Electronic Assemblies

JESD9 Inspection Criteria for Microelectronic Packages and Covers

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