Melexis

INSPIRED ENGINEERING

APPLICATION NOTE

Guidelines for soldering of Through Hole Devices (THD)

Revision 1.0 – November 2021

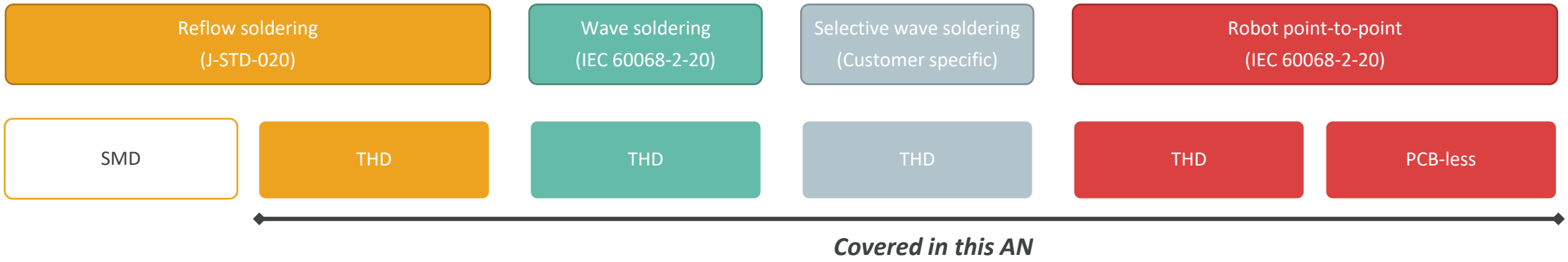
Advanced Customer Solutions

Guidelines for soldering of Through Hole Devices (THD)

1. Scope

Applicable soldering methods for Melexis products

Soldering refers to a set of processes for electrically connecting the IC (Integrated Circuit) leads to the PCB (Printed Circuit Board) terminals. Each Melexis product is qualified to one or more methods of soldering following the standards listed below**. For THD (Through Hole Devices), the four soldering methods below are applicable and are covered in this document**. For SMD devices, only reflow soldering is applicable, refer to *Guidelines for Surface Mount Technology (SMT) soldering.*

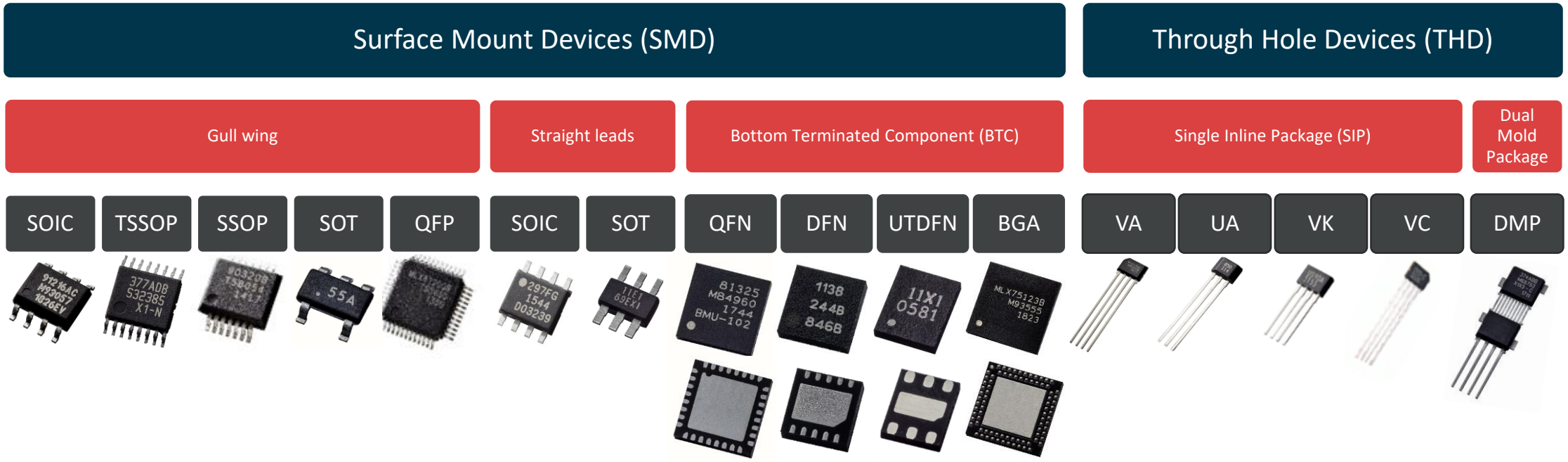


This Application Note only addresses some specific points and best practices during soldering of Melexis THD. Soldering should follow the requirements of J-STD-001 *Requirements for Soldered Electrical and Electronic Assemblies.* Resulting soldering quality for all onboard components has to meet the acceptance criteria defined in the standard *"Acceptability of Electronic Assemblies"* (IPC-A-610)

For mass production, manual soldering is not allowed because of the unsafe temperature and time control. However manual rework is allowed.

1. Scope

Family of packages at Melexis from soldering perspective



Refer to Annex I for the different abbreviations

If leadforming is required before soldering, refer to *Guidelines for leadforming of SIP Hall sensors* and *Guidelines for leadforming of DMP Hall sensors* in Melexis website

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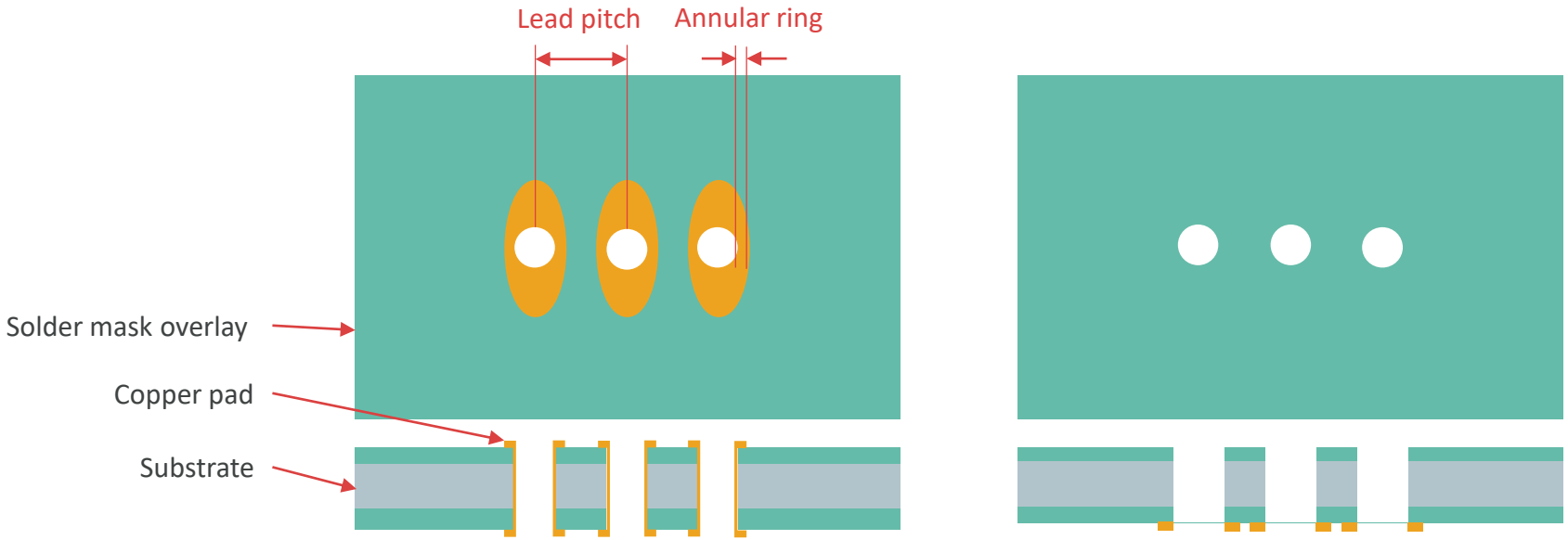
Guidelines for soldering of Through Hole Devices (THD)

2. PCB design considerations

PCB via design

It is recommended to use oblong shaped copper pads for PTH (Plated through hole vias). Oblong pad wetting forces prevent solder bridging between neighbor pads during wave or selective wave soldering.

Both double side metallization/metallized via or single side metallization/non-metallized via design are applicable.



Supported holes (PTH)
Double side metallization

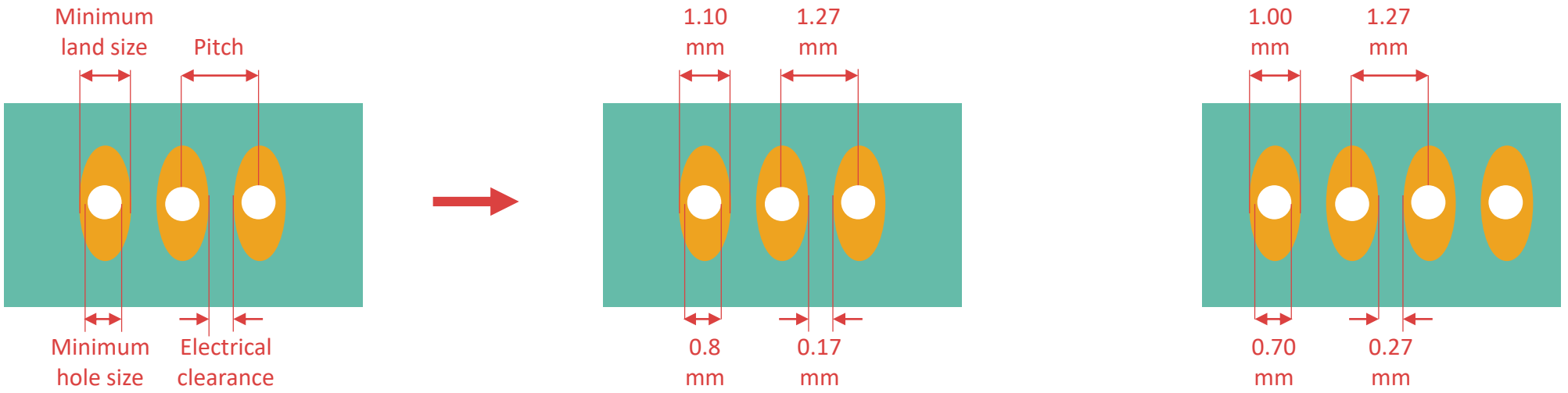
Unsupported holes
Single side metallization

2. PCB design considerations

Hole and pad size for SIP packages

Minimum hole size can be calculated using *IPC-2222, 9.2.2 Plated-Through Holes*. The minimum pad size can be calculated using *IPC-2221, 9.1.1 Land requirements*. Both dimensions depend on technological capabilities of the PCB manufacturer. Clearance between lands should respect electrical clearances as per *IPC-2221, 6.3 Electrical Clearance*

The following numbers are calculated using the pin diagonal of SIP packages:



UA, VK

Note: VK has four pins

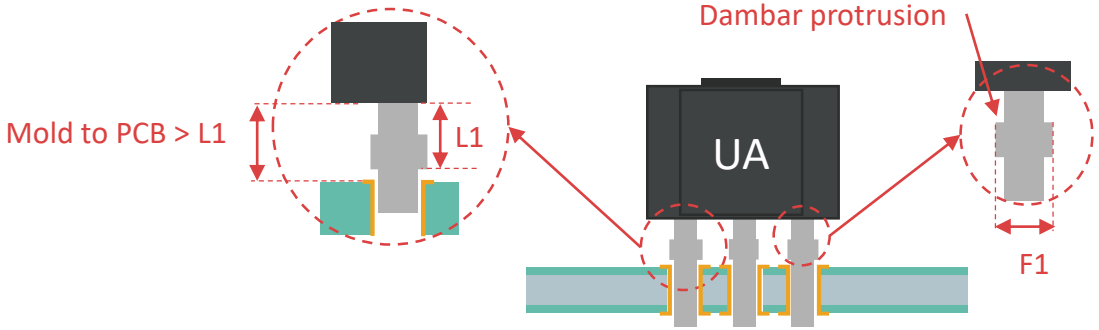
VA, VC

2. PCB design considerations

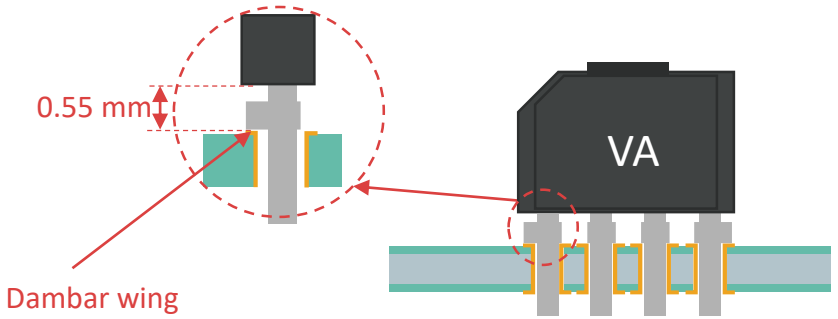
Component body height above PCB

The dambar protrusion is a remnant from tie bar cutting: it can be centered on the pin or shifted to one side, but total maximum dimension (F1) is the same in both cases.

To avoid conflict of the PTH (Plated Through Hole) with the dambar protrusion for UA, VK and VC packages, it is recommended to place the IC at a height higher than L1 (distance from mold to dambar protrusion). VA has dambar wings which acts as stoppers of the IC to the PCB. In both cases, the distance of mold body to PCB will be higher than 0.3 mm, as required in J-STD-001, *6.1 Through hole Terminations – General.*



DESIGN FOR UA, VK, VC:
Distance of mold to PCB is higher than distance of mold to dambar protrusion (L1).
Refer to POD (Product Outline Drawing) for L1 dimensions



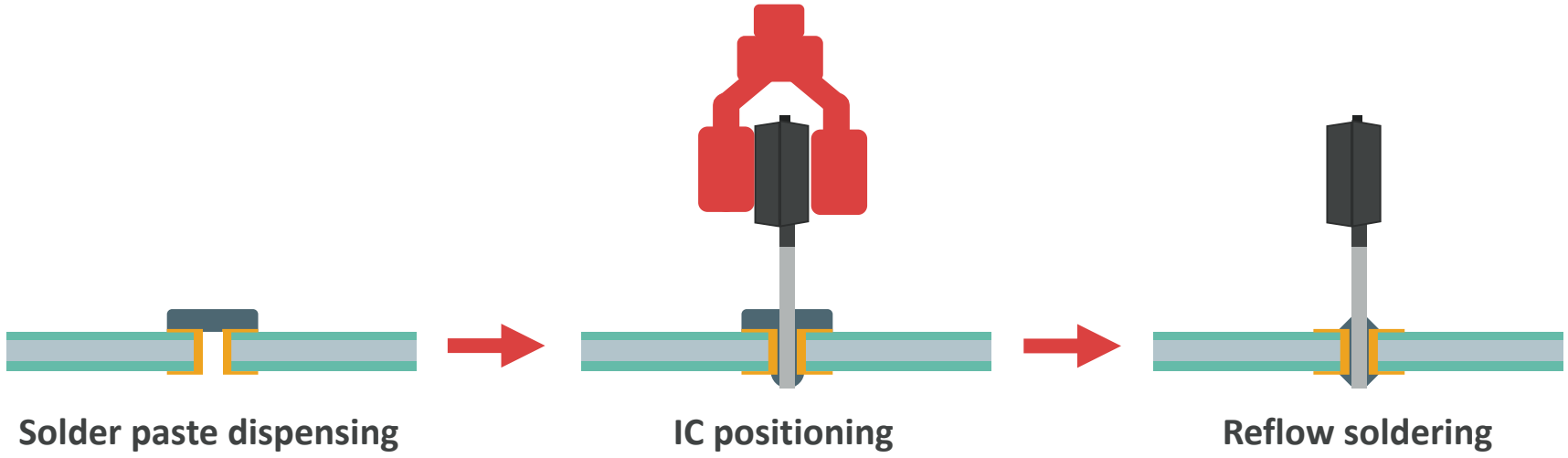
DESIGN FOR VA:
Dambar wings act as stoppers

Guidelines for soldering of Through Hole Devices (THD)

3. Soldering methods for THT

Reflow soldering

Melexis THD products can be reflow soldered using Pin-in-paste technology – also known as intrusive soldering, which allows to use standard SMT assembly equipment and processes to assemble the devices into the board.



3. Soldering methods for THT

Reflow soldering profile development

Melexis uses reflow profiles in product/package qualification testing and MSL qualification, as defined in the standard *"Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices"* (J-STD-020). Melexis products are qualified for a maximum of 3 times reflow process in a sequence with parameters specified in the *"Table 5.2 - Classification Profiles"* of J-STD-020 standard where the classification temperature Tc = 260°C. **This reflow profile is for classification/preconditioning and is not meant to specify board assembly profiles.**

Development of actual reflow soldering profile and parameters at customer should follow recommendations from solder paste supplier, be based on specific process needs and board designs and should not exceed the parameters in the table below:

Peak temperature:	Peak temperature duration:	Temperature ramp-up rate:	Temperature ramp-down rate:	Time 25 °C to peak temperature:
260 °C	30 seconds	3 °C/second max.	6 °C/second max.	8 minutes max.

3. Soldering methods for THT

Wave soldering

Melexis products are qualified for wave soldering using the solder bath method as defined in *"Test methods for solderability and resistance to soldering heat of devices with leads" (IEC 60068-2-20).* This test is to determine whether an IC can withstand the temperatures encountered during soldering, and is not meant to specify board wave soldering parameters. Development of actual wave soldering parameters at customer should follow recommendations from solder supplier, be based on specific process needs and board designs, and should not exceed the parameters in "*Table 2 – Resistance to soldering heat, solder bath method: Test severities (duration and temperature)*" for lead free alloys:

Temperature of solder:	Dwell time:
260 ± 3 °C	10 ± 1 seconds

During preheating of top component side (destination side, as per 4.13.1 Preheating of J-STD-001), the temperature seen at the **mold body should be below 260 degC**, as per *"Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices"* (J-STD-020).

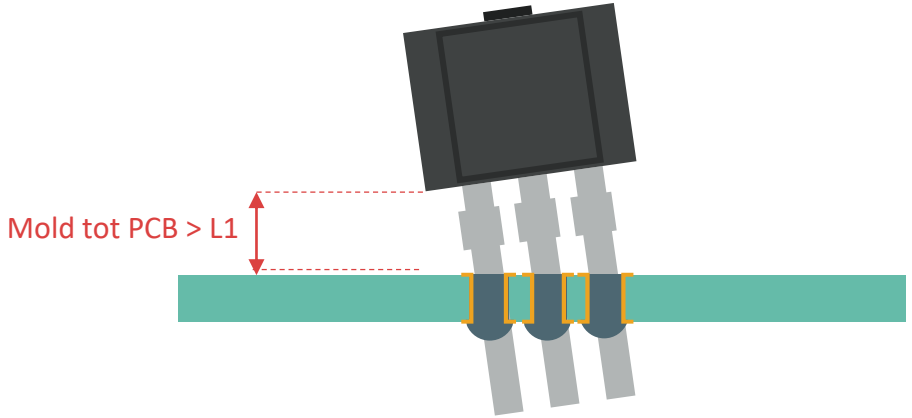
Testing methodology for wave soldering qualification is also described in JESD22-B106

3. Soldering methods for THT

Device tilting

Wave and selective wave soldering might push the IC during soldering, leading to tilting of the device after the solder joint is cooled down. As per IPC-A-610, section 7.1.6 *Component Mounting – Radial Leads – Vertical*, this might be acceptable if the component tilt does not violate minimum electrical clearance, and it is a process indicator if the distance between the mold body and the PCB surface is less tan 0.3mm (for class 2 and 3).

However, for Melexis Hall sensors, tilting might lead to misalignment with the magnetic target and might impact the performance. **Therefore, to avoid tilting of the IC, it is recommended to hold the IC during wave soldering** (as per *4.13.4 Holding Devices and materials* in J-STD-001).



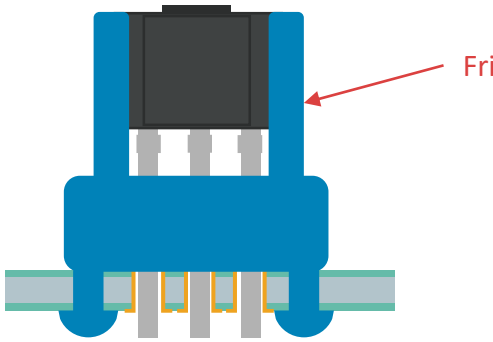
Tilting of IC due to wave soldering pushing up

3. Soldering methods for THT

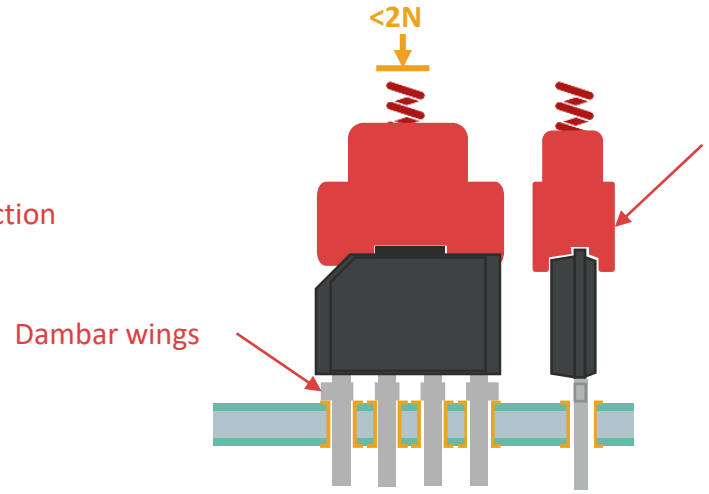
Methods for IC holding during wave soldering

There are two main methods for IC holding during wave soldering:

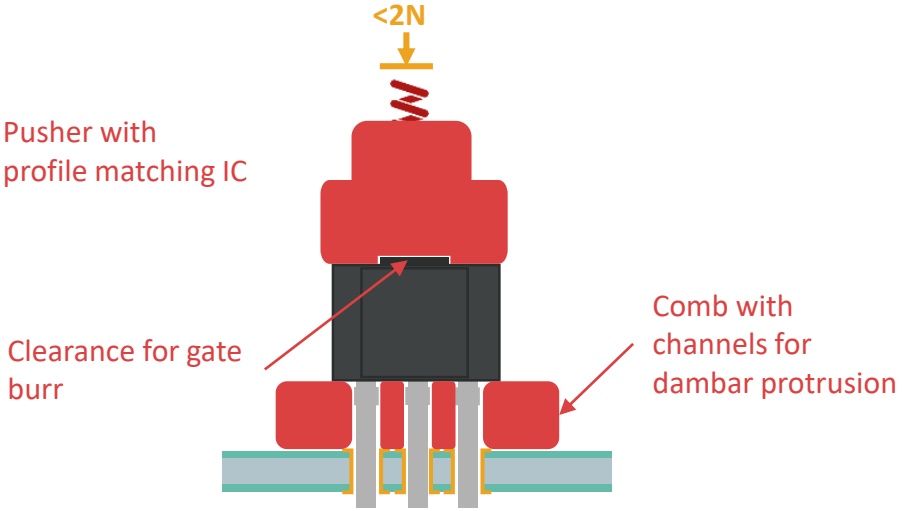
- **Plastic holder**: Holds the part by friction. Depending on the design, channels might be needed to accommodate the dambar protrusion
- **Pusher**: For VA, a pusher is enough since the dambar wings will act as stoppers. For UA, VC and VK packages, a comb is also needed to guarantee the appropriated clearance between mold and PCB. The pusher force should be limited to a maximum force of 2N to avoid mechanical damage of the parts. It also requires some clearance to the gate burr.



Plastic holder
Holding by friction on the mold body



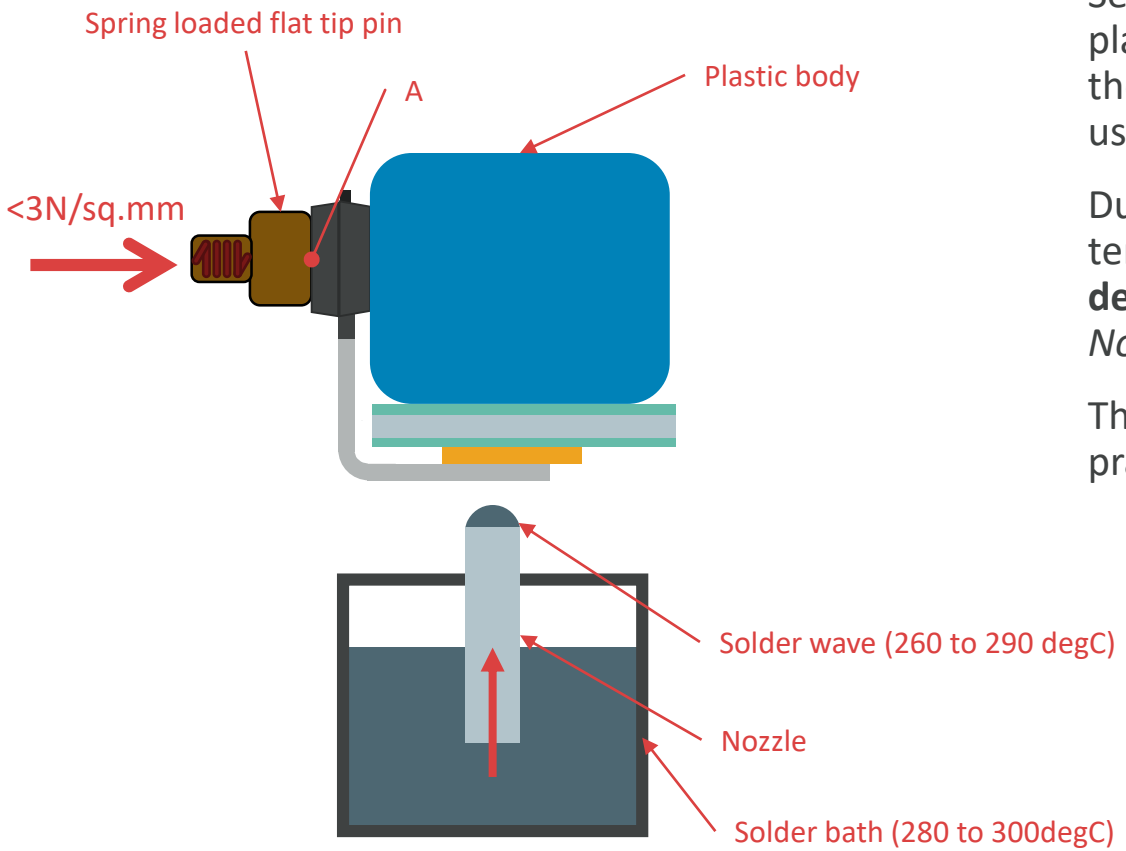
Pusher
Stopper on dambar wings (VA only)



Pusher with comb
Stopper on comb (UA, VC, VK)

3. Soldering methods for THT

Selective wave soldering



Selective wave soldering can be done with manual or automatic placement of the IC into the PCB. The solder is transported from the solder bath to the tip of the nozzle by means of a wave, usually flooded with an inert gas to avoid oxidation of the solder.

During preheating of top component site (destination side), the temperature seen at the **mold body (p. A) should be below 260 degC**, as per *"Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices"* (J-STD-020).

The following parameters are resulting from the best customer practice.

Temperature at A: 260 degC	Dwell time: 2 - 4 s	Soldering passes: max. 2 times

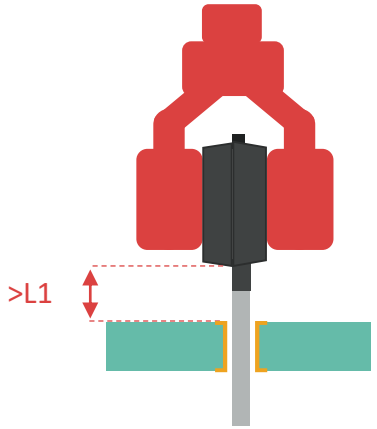
3. Soldering methods for THT

Methods for IC positioning during selective wave soldering

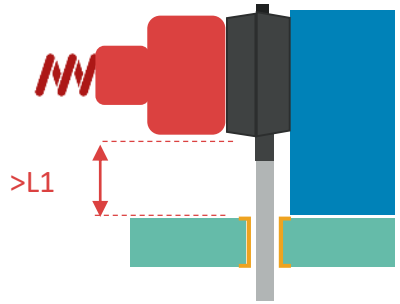
There are two main methods for IC holding during wave soldering:

- **Gripper**: Holds the part at a determined height from the PCB
- **Holding pusher**: It is recommended to use a flat tip to avoid mechanical damage to the mold body during high temperature processes.

In both cases, **the maximum holding pressure is 3N/sq.mm**.



Gripper
On mold and from tape
(UA, VA, VC, VK)



Holding pusher
Flat tip to avoid mechanical damage
to the mold body (UA, VA, VC, VK)

3. Soldering methods for THT

Robot point-to-point soldering

Melexis products are qualified for robot point-to-point soldering using the dip solder method as defined in *"Test methods for solderability and resistance to soldering heat of devices with leads" (IEC 60068-2-20).* This test is to determine whether an IC can withstand the temperatures encountered during soldering, and is not meant to specify board assembly parameters. Development of actual robot point-to-point soldering parameters at customer should follow recommendations from solder wire supplier, be based on specific process needs and board designs, and should not exceed the parameters in "5.2 – Method 2: Soldering iron" of IEC 60068-2-20.

In practice, this means that the robot point-to-point soldering shall be limited to the following values for a maximum of 2 times:

Temperature of soldering iron:	Dwell time:
350 °C	10 ± 1 seconds

It might be possible to use a higher temperature of the soldering iron to reduce the time, as long as the temperature at a distance of 1 mm from the mold body does not exceed 270 degC. Contact Melexis for an assessment.

If laser point-to-point soldering or any other new process not covered by standards is foreseen, contact Melexis to check for compatibility with the current products

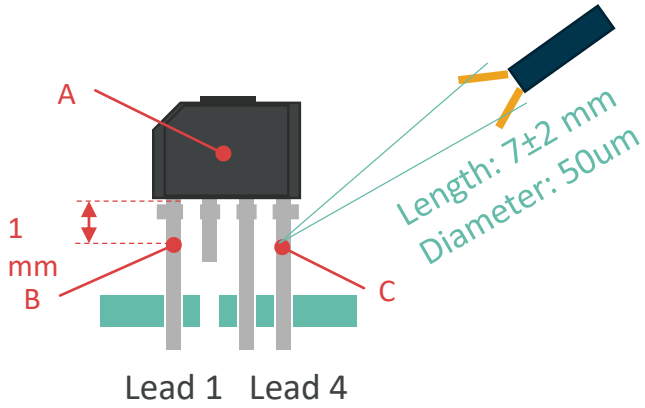
The core flux inside the solder wire shall be of No-clean, Halogen-free type (NC HF). Solder wire flux is often too aggressive, containing halogen elements that may trigger copper corrosion and/or conductive dendrite growth between solder pads

3. Soldering methods for THT

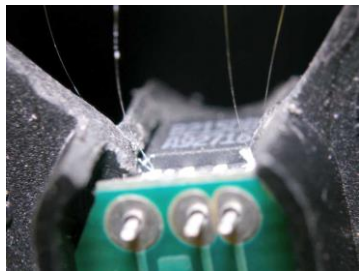
Thermocouple measurement at mold-leads interface for robot soldering

It is strongly recommended to measure the temperature ramp and peak value of the ICs leads at 1mm from the mold body. This is because soldering process might exceed the maximum temperature of 270degC. The reasons might be a large copper plane on the PCB or other heat-sinking components connected to the node where the IC is to be soldered. **The maximum mold body temperature at point A is 260degC**

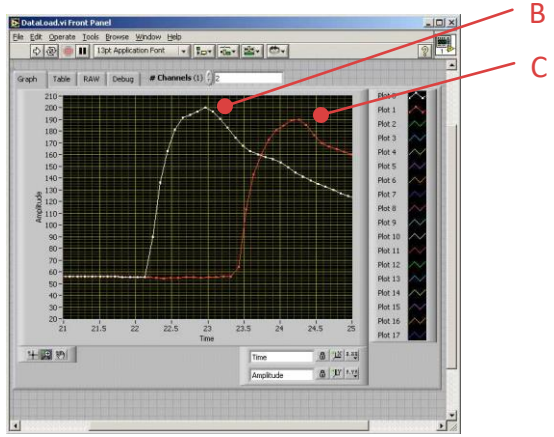
Below is an example of robot iron soldering temperature profile study, taken from the sensor leads #1 and #4 with micro-wire thermocouples. It is important to use a fast-response thermocouple (**minimum 5 samples/sec**), in order to see the rapid temperature ramp. Once temperature profile is captured, consult Melexis for risk assessment.



Temperature measurement positions
Important points to monitor during robot soldering



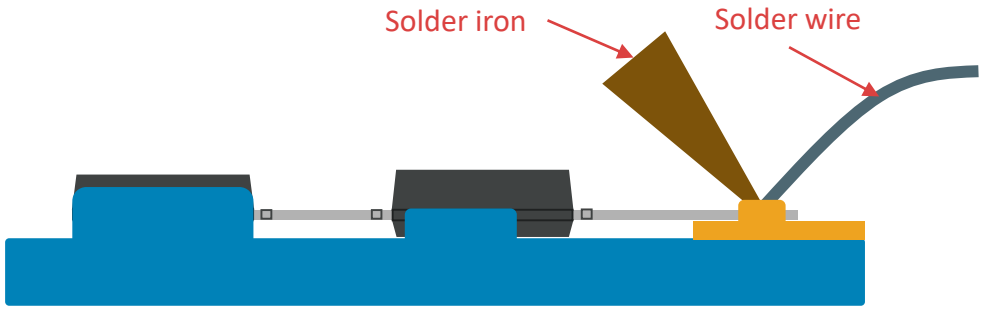
Thermocouples at B and C
Experiment for temperature monitoring of pins during robot soldering



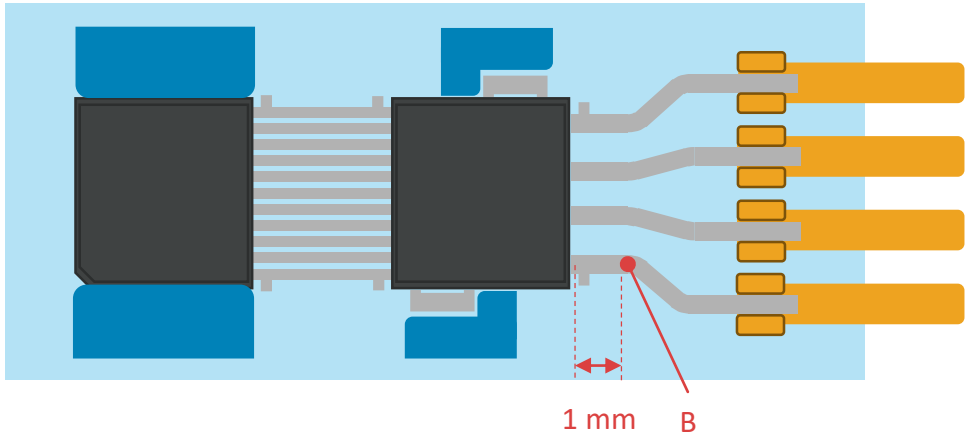
Temperature profile of A and B
Differences in peak temperature are due to difference pre-heating during soldering of previous pins

3. Soldering methods for THT

Robot point-to-point soldering of PCB-less assemblies



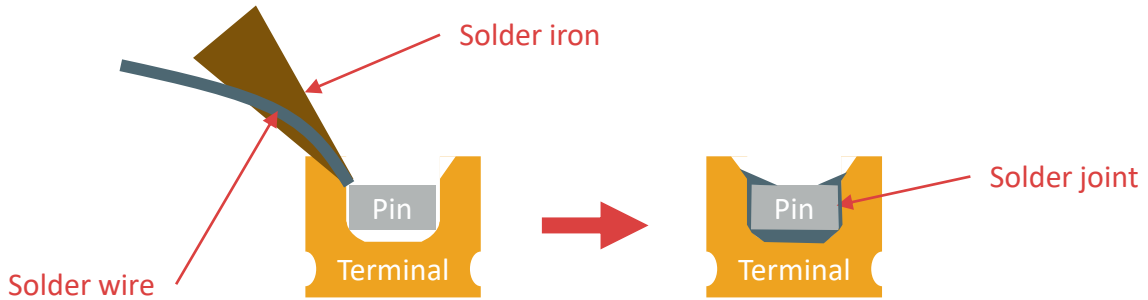
SIDE VIEW



TOP VIEW

It is possible to solder PCB-less devices to fork terminals with robot point-to-point soldering.

Orientation of the iron tip is important and it should touch both the pin and the fork. This is to guarantee that a pin-to-fork fillet forms on the bottom of the fork. It is also recommended to adjusting the pre-heating time and temperature (to a maximum of 370degC) to secure good wetting when the solder wire is fed in, as well as reducing solder wire feed time to avoid a big blob of solder. Temperature at point B should be less than 270 degC



Annex I: List of Abbreviations

BGA: Ball Grid Array
BTC: Bottom Terminated Component
DMP: Dual Mold Package
HF: Halogen Free
IC: Integrated Circuit
NB: Narrow Body
NC: No Clean
PCB: Printed Circuit Board
PTH: Plated Through Hole
POD: Package Outline Drawing
QFN: Quad Flat No-Leads
QFP: Quad Flat Package
SMD: Surface Mount Device
SMT: Surface Mount Technology
SSOP: Thin Shrink-Small Outline Package
THD: Through-Hole Device
THT: Through-Hole Technology
TSSOP: Thin Shrink-Small Outline Package
UTDFN: Ultra Thin Dual Flat No-Leads
WB: Wide Body

Annex II: List of Standards

J-STD-001 *Requirements for Soldered Electrical and Electronic Assemblies*

J-STD-002 *Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires*

J-STD-020 *Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices*

J-STD-033 *Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices*

JESD22-A113H *Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing*.

IPC-A-610 *Acceptability of Electronic Assemblies*

IPC-2221 *Generic Standard on Printed Board Design*

IPC-2222 *Sectional Design Standard for Rigid Organic Printed Boards*

Annex III: List of Related Application Notes

For the latest revision of this document and related Application Notes, visit www.melexis.com/ic-handling-and-assembly

Solder techniques for TO39 IR sensor product

Guidelines for storage and handling of plastic encapsulated ICs

Guidelines for Surface Mount Technology (SMT) soldering

Guidelines for leadforming of SIP Hall sensors

Guidelines for leadforming of DMP Hall sensors

IATF 16949 and ISO 14001 Certified