
Mounting instruction for SLLIMM high power SDIPHP-30L

Introduction

The Small Low-Loss Intelligent Molded Module (Small Low-Loss Intelligent Molded Module) high power is an advanced hybrid power device designed to integrate high speed and low loss IGBTs with dedicated drive circuitry for AC motor control. Use of intelligent power modules simplifies design and increases reliability while optimizing PCB size and system costs.

The mounting instructions herein provide the main recommendations to appropriately handle, assemble and rework the SDIPHP-30L intelligent power modules. It is necessary to follow some basic assembly rules to limit thermal and mechanical stresses or ensure optimal thermal conduction and electrical insulation.



1 Device and heat sink specification

When attaching a heat sink to a SDIHP-30L ensure that excessive force is not applied to the device for assembly. Drill holes for screws in the heat sink exactly as specified. Smooth the surface by removing burrs and protrusions or indentations. Do not touch the heat sink when the SDIHP-30L is operational to avoid a burn injury.

1.1 Basic guidelines

The table below provides some basic mounting parameters.

Table 1. Basic mounting parameters

Parameter	Conditions	Min.	Typ.	Max.	Unit
Heat sink mounting screw torque	Mounting screw: M3 with plain washer 7 mm (ϕ)	0.64	0.80	0.96	N·m
		6.6	8.2	9.8	kgf·cm
SDIHP-30L flatness of heat sink attachment area ⁽¹⁾	See Figure 1. SDIHP-30L flatness specification	0	50	100	μ m
Flatness of heat sink	See Figure 2. Heat sink flatness specification	-100	-	100	μ m
Package weight		-	23	-	g

1. Specified By Design – Not tested in production.

Figure 1. SDIHP-30L flatness specification

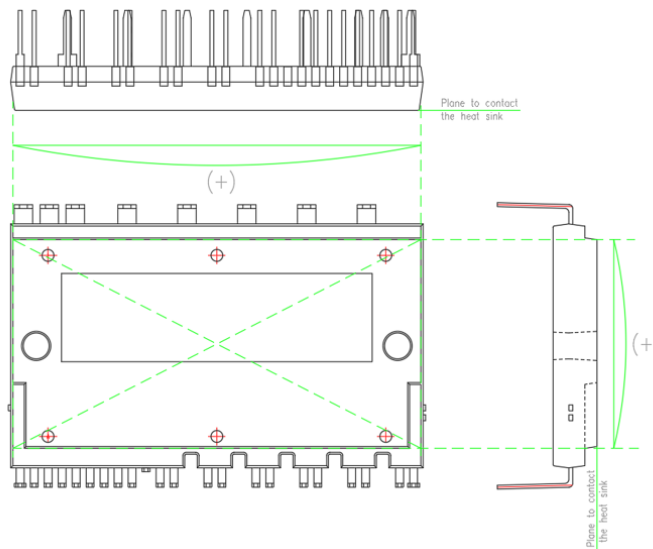
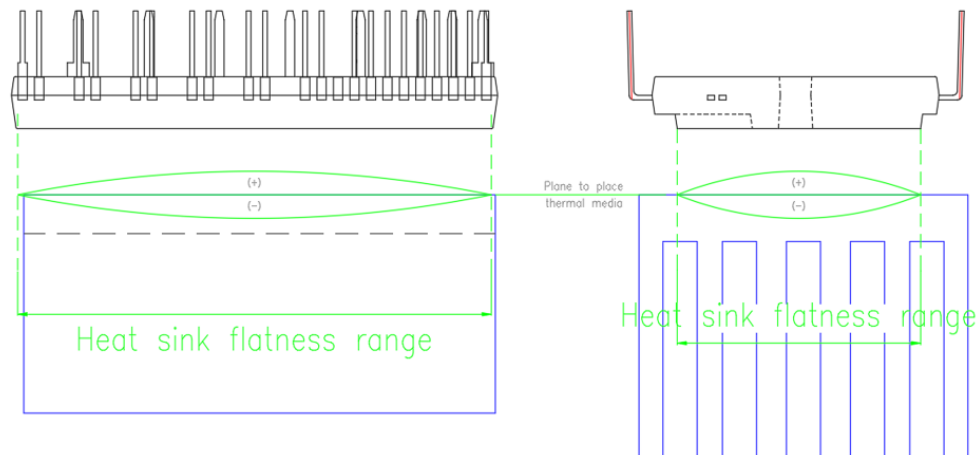


Figure 2. Heat sink flatness specification



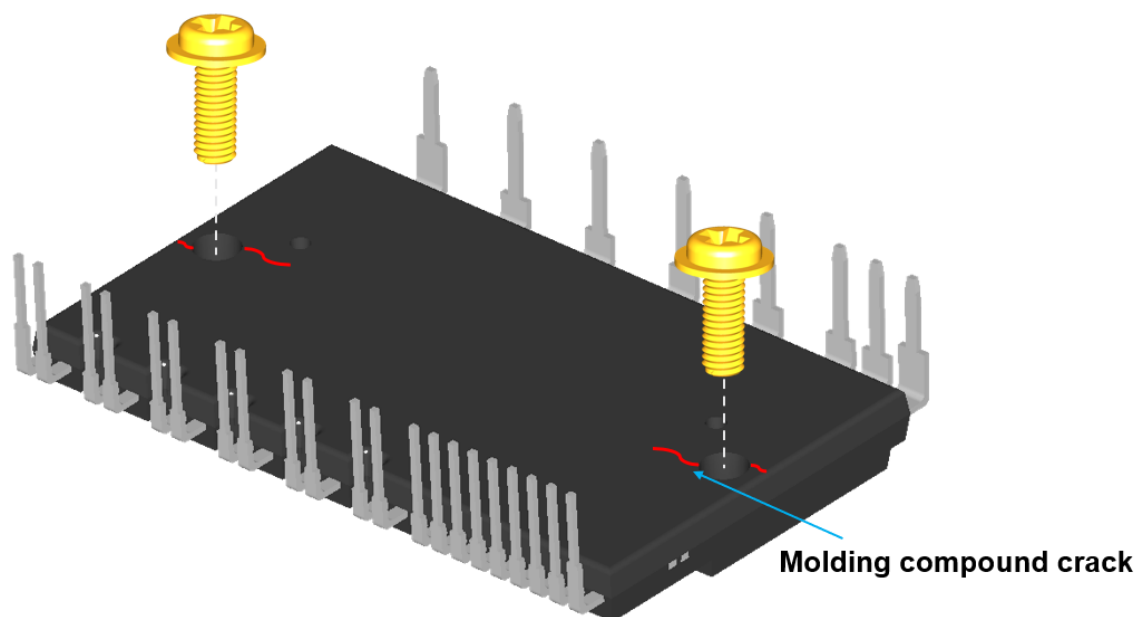
1.2 Thermal conductive grease

To optimize heat dissipation, it is necessary to enlarge the contact area as much as possible to minimize the contact thermal resistance. Apply thermal-conductive grease over the contact surface between modules and heat sinks, which is also useful for preventing corrosion at the contact surface. Use from 100 to 200 μm layer of thermal grease to the module base plate or heat sink. While fastening the module, the thermal compound should be observable around the rim of the mounted module. Ensure the grease retains its characteristics over ample time and across wide operating temperature ranges. Use a torque screwdriver for fastening to the maximum specified torque rating. Exceeding the maximum torque limitation may cause module damage or degradation. Ensure that all dirt is removed from the contact surface. If a thermally conductive sheet or an electrically insulating sheet is used, package cracks may be occurred due to creases at screw tightening. Therefore, you should conduct thorough evaluations before using these materials.

1.3 Screw tightening torque

Do not exceed the specified fastening torque. Over-tightening the screws may cause ceramic or molding compound cracks and heat-fin threaded hole destruction. Tightening the screws beyond a certain torque can cause saturation of the contact thermal resistance.

Figure 3. Over-tightening may cause molding compound cracks

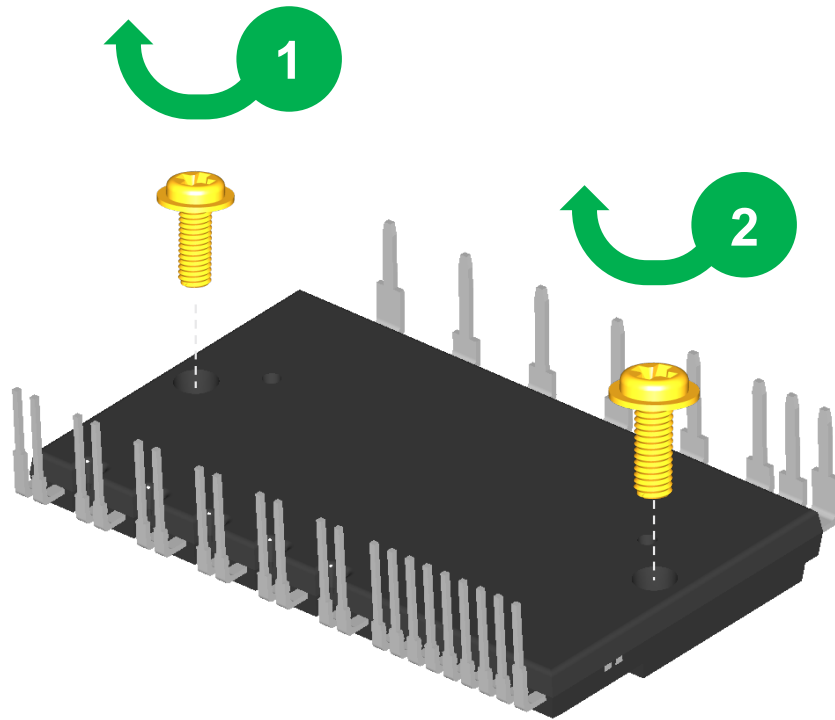


The next figure shows the recommended fastening sequence for mounting screws. ST recommends temporarily tightening mounting screws with the fixing torque setup to 20% to 30% of the maximum screw torque and then permanently screwing them up to 100% of prescribed maximum screw torque crosswise. With reference to the following figure, here below the summary of the two steps.

- **Fasten temporarily in the sequence 1 → 2** (from 20 to 30% of the maximum screw torque)
- **Screw down permanently in the sequence 1 → 2** (up to 100% of the maximum screw torque)

When using electrical or pneumatic screwdrivers, we suggest keeping the revolution at 200 RPM max. as the rapid impact of the screw may damage the module plastic body.

Figure 4. Recommended mounting screw fastening sequence



1.4 Recommended screws

All mounting screws should have washers . Recommended diameter is M3 with plain washer 7 mm (ϕ). However, an additional spring washer could assure an even better mounting result. Finally, the use of SEMS screws (included spring/plain washer M3, as shown in the following figure) it is suggested.

Figure 5. SEMS screw (size M3, spring washer 5.0 Φ , plain washer 7.5 Φ)



1.5 Electrical isolation distances

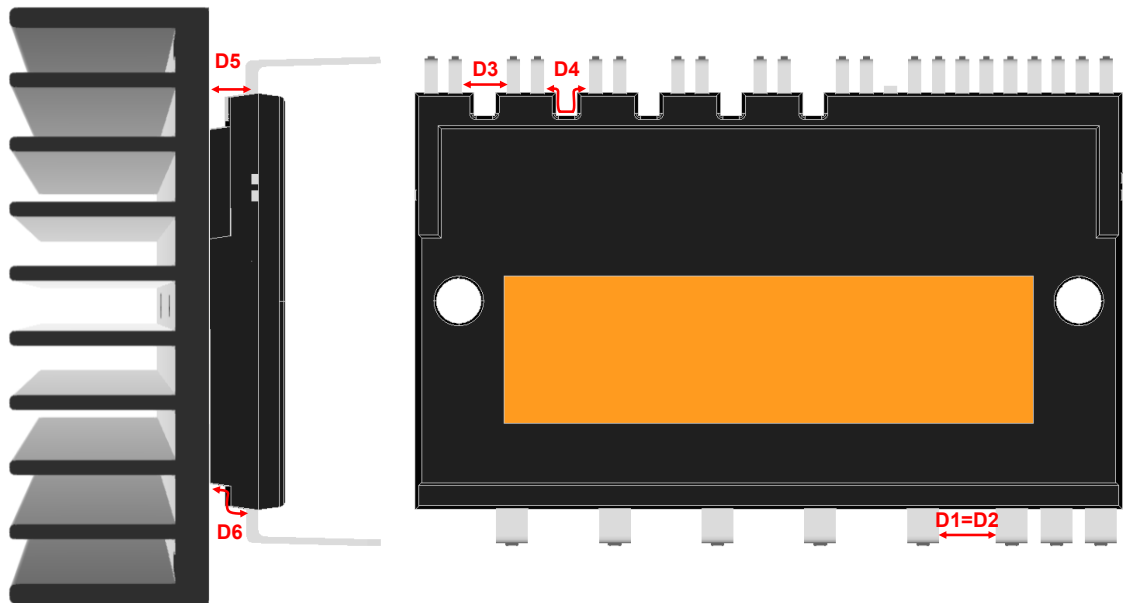
The following table shows the main electrical isolation distances (clearance and creepage) terminals to terminals and terminal to heat sink.

SDIPHP-30L package benefits of transfer mold resin classified as material group I (CTI \geq 600).

Table 2. Main electrical isolation distances (minimum value)

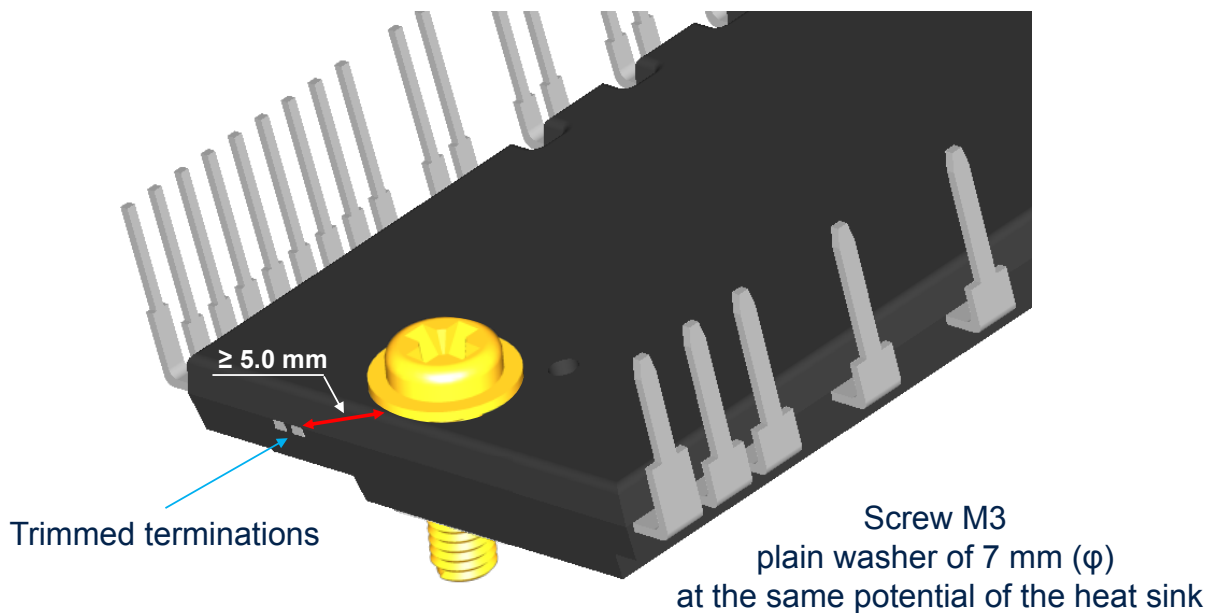
Clearance (mm)			Creepage (mm)		
D1	Between power terminals	3.6	D2	Between power terminals	3.6
D3	Between control terminals	2.67	D4	Between control terminals	6.17
D5	Between terminals and heat sink	3.0	D6	Between terminals and heat sink	4.2

Figure 6. Main isolation distances



The following figure shows the creepage between the trimmed terminations and the screw/washer in the case M3 screw and a 7 mm diameter plain washer are used and are at the same potential of the heat sink.

Figure 7. Creepage between trimmed terminations and screw/washer



2 Package handling

2.1 ESD protective measures

Semiconductors are normally electrostatic discharge sensitive (ESDS) devices requiring specific precautionary measures regarding handling and processing. Static discharges caused by human touch or by processing tools may cause high-current and/or high-voltage pulses, which may damage or even destroy sensitive semiconductor structures. On the other hand, integrated circuits (ICs) may also be charged by static during processing. Discharging which occurs too quickly (hard discharge) may also cause peak loads that can lead to damage. ESD protective measures must therefore prevent contact with charged parts as well as charging of the ICs. Protective measures against ESD include procedures for proper ESDS handling, processing and packing. A few handling and processing tips are provided below.

2.1.1 ESD protective measures in the workplace

- Standard marking of ESD-protected areas
- Access controls, with wrist strap and footwear testers
- Air conditioning
- Dissipative and grounded floor
- Dissipative and grounded working and storage areas
- Dissipative chairs
- Ground bonding point for wrist strap
- Trolleys with dissipative surfaces and wheels
- Suitable shipping and storage containers
- No sources of electrostatic fields

2.1.2 Personal equipment

- Dissipative/conductive footwear or heel straps
- Suitable garments made of fabrics that do not generate excessive static electricity
- Wrist strap with safety resistor
- Volume conductive gloves or finger cots

2.1.3 Production installations and processing tools

- Machine and tool parts made of dissipative or metallic materials
- No materials having thin insulating layers for sliding tracks
- All parts properly connected to ground potential
- No potential difference between individual machine and tool parts
- No sources of electrostatic fields

Our recommendations are based on the internationally applicable standards IEC 61340-5-1 and ANSI/ESD S2020.

2.2 Packing of components

Please refer to product and package specifications and our sales department for information regarding what packaging is available for a given product. Generally, the following list of standards dealing with packing should be considered if applicable for a given package and packing:

- IEC 60286-4 packaging of components for automatic handling - part 4: stick magazines for dual in-line packages
- IEC 60286-5 packaging of components for automatic handling - part 5: matrix trays

2.3 Storage and transportation conditions

Improper transportation and unsuitable storage of components can lead to a number of problems during subsequent processing, such as poor solderability, delamination and package cracking effects. These relevant standards should be taken into account as appropriate:

- IEC 60721-3-0 Classification of environmental conditions: Part 3: Classification of groups of environmental parameters and their severities; introduction
- IEC 60721-3-1 Classification of environmental conditions: Part 3: Classification of groups of environmental parameters and their severities; Section 1: Storage
- IEC 60721-3-2 Classification of environmental conditions: Part 3: Classification of groups of environmental parameters and their severities; Section 2: Transportation
- IEC 61760-2 Surface mounting technology - Part 2: Transportation and storage conditions of surface mounting devices (SMD) - Application guide
- IEC 62258-3 Semiconductor Die Products - Part 3: Recommendations for good practice in handling, packing and storage ISO 14644-1 Clean rooms and associated controlled environments Part 1: Classification of airborne particulates

Table 3. General storage conditions - overview

Product	Conditions for storing
Wafer / die	N2 or MBB ⁽¹⁾ (IEC 62258-3)
Component - not moisture sensitive	1K2 (IEC 60721-3-1)

1. MBB = moisture barrier bag

Maximum storage time

The conditions to be complied with in order to ensure problem-free processing of active and passive components are described in standard IEC 61760-2.

References to standards institutes

- American National Standards Institute (ANSI)
- Electronics Industries Alliance (EIA)
- Association Connecting Electronics Industries (IPC)

2.4 Handling damage and contamination

Any mechanical damage during automatic or manual handling of components (in or out of the component packing) that may harm the package leads and/or body must be avoided. In particular, unintentional bending of the leads may cause a loosening in the package body which can result in electrical malfunction. Along with other factors, contamination of a component or packing may cause:

- Solderability problems
- Corrosion
- Electrical short-circuit (due to conductive particles)

2.5 Component solderability

The final plating of most semiconductor packages is sufficiently thick and wettable to assure good solderability, even after an extended storage time. Note that the cut edges of the pins should be ignored in any assessment of solderability. Suitable methods for the assessment of solderability can be derived from JESD22B 102 or IEC6068-2-58.

Components are plated with pure Sn, or preplated with noble metals on a Ni carrier (e.g. NiAu, NiPdAu). Tin-plated and preplated components are compatible with both SnPb and Pb-free soldering.

3 Soldering

SDIPHP-30L is part of the THD package family, which are typically soldered by wave soldering.

3.1 Selective wave soldering

Wave soldering is a large-scale soldering process by which electronic components are soldered to a PCB to form an electronic assembly. The name is derived from the fact that the process uses a tank to hold a quantity of molten solder; the components are inserted into or placed on the PCB and the loaded PCB is passed across a pumped wave or cascade of solder. The solder wets the exposed metallic areas of the board (those not protected with a solder mask), creating a reliable mechanical and electrical connection.

For THD, only the leads that extend through the drill holes in the PCB contact the hot solder. The body of the package is heated by the hot leads. This has two consequences:

1. The package body is cooler than in the case of reflow soldering
2. The temperature gradient between leads and body and inside the package is greater than in the case of reflow soldering.

Therefore, for wave-solderable THD packages, the heat resistance is tested according to JESD22-B106 and IEC668 2-20 (typically 260 °C, 10 s).

Immersion of the whole package body into the molten solder is not recommended since THD packages are not designed for such a harsh temperature shock.

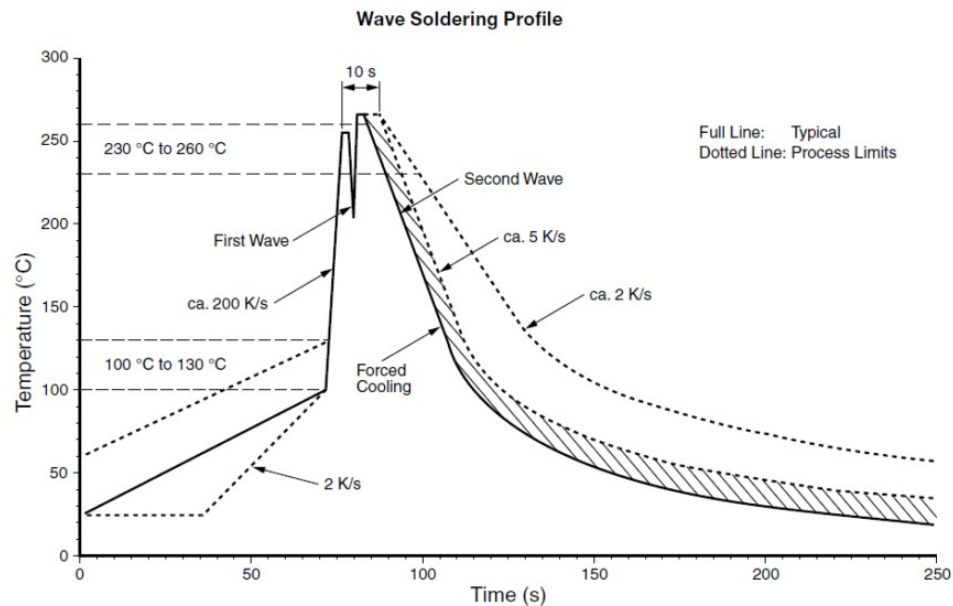
There are many types of wave-soldering machines, but their basic components and principles are the same. A standard wave-soldering machine consists of three zones: the fluxing zone, the preheating zone, and the soldering zone. A fourth zone, the cleaning zone, may be used depending on the type of flux applied.

Dual-wave soldering is the most commonly used wave-soldering method (see figure below). The peak temperatures, ramp rates, and times that are used depend on the materials and the wave-soldering equipment. The first wave has a turbulent flow and therefore guarantees a wetting of nearly all shapes of leads and board pads, but also creates an increased number of unwanted solder bridges. These solder bridges have to be removed by the second, laminar wave.

When using lead-free solder alloys, a nitrogen atmosphere is recommended.

Selective wave soldering is used when only a few THD packages need to be soldered onto the board. Generally this is done after the other components are already soldered by reflow soldering. This requires effective protection of the components undergoing the selective wave soldering. This protection can be achieved either by using special fixtures and deflectors for the PCB and/or a small wave shape achieved by using special wave-guiding tubes or covers.

Figure 8. Typical dual-wave soldering profile



3.2 Other soldering techniques

Besides wave and reflow soldering, other techniques are used in special applications. Examples include selective wave soldering, laser welding and soldering, hot bar soldering, and manual soldering with soldering irons and hot air guns.

For this broad group of soldering techniques, which cannot be tested for every component, some general guidelines should be observed:

- The maximum temperature of the package body and leads must not exceed the maximum allowed temperature for reflow or wave soldering.
- The maximum allowed time at high temperatures must not exceed the maximum allowed time for reflow or wave soldering.
- If heat is applied to the leads, the maximum temperatures in the package and of the package body must not exceed the maximum allowed temperatures during reflow or wave soldering.
- For details and special arrangements, please refer to the product datasheet and/or qualification report.

If long contact and heating times are unavoidable, the resulting temperatures on different leads near the package body should be measured and compared to the temperatures and durations achieved during wave or reflow soldering, which must not be exceeded.

Please ask your local sales, quality, or application engineer to provide an evaluation report for further information if needed.

3.3 Heat sink mounting by reflow soldering

In special applications, the heat sinks of high-power THD packages can be mounted to the board by solder paste printing, pick & place, and reflow soldering. In this case, the packages undergo a reflow profile.

THD packages are qualified for wave soldering and not for reflow soldering. Therefore, reflow soldering should not be used for heat sink mounting of THD packages.

4 Inspection

After component placement:

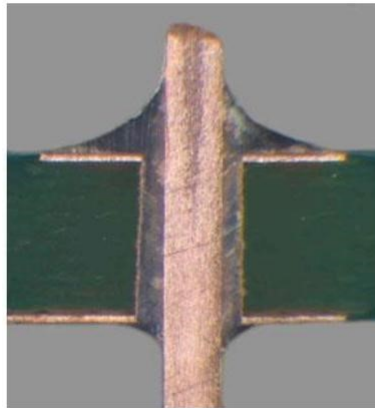
A visual inspection after component placement can be done by AOI. It is used to check if the mounting is done completely and if severe misplacements have occurred. The correct orientation of the component can also be checked.

After soldering:

The solder joint meniscus of the leads of THD packages can be inspected by optical microscope or AOI. Acceptable solder joints are described in international standards such as IPC-A-610.

The figure below shows a THD lead with optimal wetting. Metallized vias must be filled properly. This cannot be detected by visual inspection but can be done by x-ray and/or cross sectioning.

Figure 9. The THD package pin soldered into the hole is well wetted and free of defects



Automatic x-ray inspection (AXI) is the only reasonable method for efficient inline control. AXI systems are available as 2D and 3D solutions. They usually consist of an x-ray camera and the hardware and software needed for inspection, control, analysis and data transfer routines. These systems enable the user to reliably detect soldering defects such as poor soldering, bridging, voiding, and missing parts. For the acceptability of electronic assemblies, please refer also to the IPC-A-610C standard.

Cross sectioning of a soldered package as well as dye penetrant analysis can serve as tools for sample monitoring only, because of their destructive character. Nonetheless, these analysis methods must be used during engineering of new products at customer production sites to obtain detailed information about the solder joint quality.

Lead-free (SnAgCu) solder joints typically do not have a bright surface. Lead-free solder joints are often dull and grainy. These surface properties are caused by the irregular solidification of the solder as the solder alloys are not exactly eutectic. This means that SnAgCu solders do not have a melting point but rather a melting range of several degrees. Although lead-free solder joints have a dull surface, this does not mean that lead-free joints are of lower quality or weaker. It is therefore necessary to teach the inspection staff what these lead-free joints look like, and/or to adjust optical inspection systems to handle leadfree solder joints.

5 Rework

If a defective component is observed after board assembly, the device can be removed and replaced with a new one. Repair of single solder joints is generally possible, but requires proper tools. For example, repairing the solder joint of an exposed die pad cannot be done with a soldering iron.

Whichever rework process is applied, it is important to recognize that heating a board and its components above 200 °C may result in damage. As a precaution, every board with its components should be baked prior to rework. For details, please refer to the international standard J-STD-033.

In any case, mechanical, thermal or thermo-mechanical overstress must be avoided, and rework must be performed according to JEDEC J-STD-033A, IPC-7711 and IPC-7721.

5.1 Device removal

If a defective component is going to be sent back to the supplier, no further defects must be caused during the removal of this component, as this may hinder the failure analysis by the supplier. The following recommendations should be considered:

- Temperature profile: during the de-soldering process, ensure that the package peak temperature is not higher and temperature ramps are not steeper than for the standard assembly wave process.
- Mechanics: be careful not to apply high mechanical forces during removal. Otherwise, failure analysis of the package may become impossible, or the PCB may be damaged. For large packages, pipettes can be used (implemented on most rework systems); for small packages, tweezers may be more practical.

5.2 Site redressing

After removing the defective component, the pads on the PCB must be cleaned to remove solder residues. This may be done by vacuum de-soldering or using a wick.

Do not use steel brushes because steel residues can lead to bad solder joints. Before placing a new component, it may be necessary to apply solder paste on the PCB pads by printing (special micro-stencil) or dispensing.

5.3 Reassembly and reflow

After preparing the site, the new package can be placed onto the PCB and the leads inserted into the holes. Regarding placement accuracy and placement force, the process should be comparable to the (automatic) pick & place process.

During the soldering process, ensure that the package peak temperature is not higher and temperature ramps are not steeper than for the standard assembly process. Soldering wire can be used to re-solder the leads. Only use no-clean solder paste, solder wire, and flux for repair.

6 Coating of assembled PCBs

In some applications, coatings are used to prevent damage due to external influences such as:

- Mechanical abrasion
- Vibration
- Shock
- Humidity
- Hand perspiration
- Chemicals and corrosive gases These influences may cause:
- Electrical leakage due to humidity.
- Corrosion that leads to degradation of conductor paths, solder joints, and any other metallized areas; and/or formation of electrical leakage paths. These can eventually result in electrical shorts (electrical leakage) or open contacts.
- Mechanical damage to conductor paths, solder joints and components. This damage can lead to electrical failures.

Coatings act as electrically isolating and impervious covers that adhere well to the different PCB materials. A wide variety of different coatings are available on the market. They differ in:

- Price
- Process complexity (spray, dip, casting, curing, etc.)
- Reparability
- Controllability
- Homogeneity

It is important to understand the chemical, electrical, mechanical and thermo-mechanical interaction between the coating and the PCB and its components. Coatings can affect component reliability.

Revision history

Table 4. Document revision history

Date	Revision	Changes
20-Jan-2022	1	First release.

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