
Mounting instructions for STMicroelectronics SLLIMM™ (small low-loss intelligent molded module)

Introduction

Small low-loss intelligent molded modules (SLLIMM™) are advanced hybrid power devices designed to integrate high speed and low loss IGBTs with dedicated drive circuitry for AC motor control. Making use of power module simplifies the design and increases reliability while PCB size and system costs are optimized.

These mounting instructions help to appropriately handle, assemble and rework SDIP-18L, SDIP-22L, SDIP-25L and SDIP-38L. Some basic assembly rules have to be followed either to limit thermal and mechanical stresses or assure the best thermal conduction and electrical insulation.

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1 Installation guide: heatsink mounting

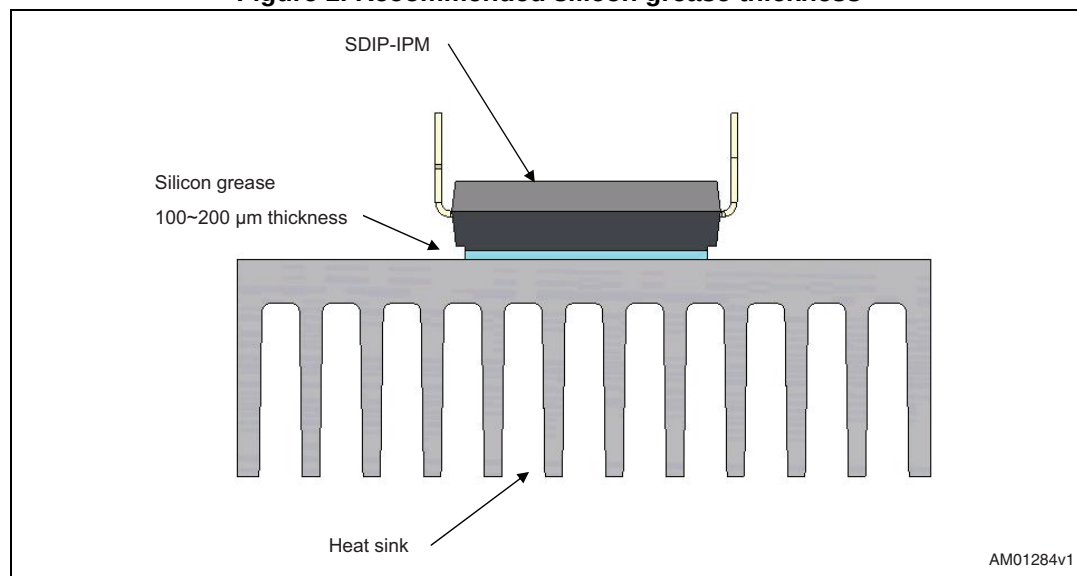
Here below basic guidelines to assure safe heatsink mounting:

- Avoid applying excessive pressure to the SLLIMM, as it could damage the module and cause saturation of thermal dissipation capability.
- Smooth the surface by removing burrs and protrusions or indentations to assure good contact between the SLLIMM and the heatsink.
- Do not touch the heatsink when the application runs to avoid burn injury.

1.1 Silicon grease

The silicon grease has to be applied between SDIP module and the heatsink to reduce the contact thermal resistance. High quality grease with stable performance should be used within the operating temperature range of the power module. The coating has to be applied thinly and evenly, taking care not to leave any voids on the contact surface between the module and the heatsink. A uniform layer of silicon grease (from 100 μm up to 200 μm of thickness, see [Figure 1](#)) should be also applied to prevent corrosion.

Figure 1. Recommended silicon grease thickness



1.2 Mounting torque

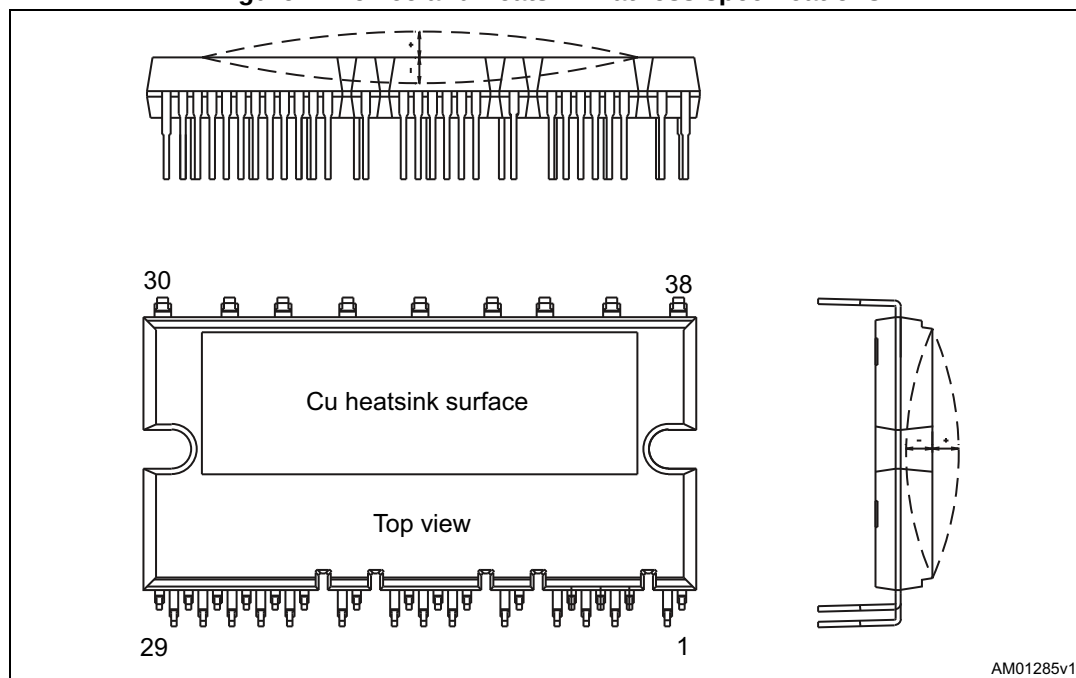
Fastening torque specifications are provided in [Table 1](#).

Table 1. Mounting torque and heatsink flatness specifications

Item	Conditions		Min.	Typ.	Max.	Unit
Mounting torque	Mounting screw:M3	Recommended 7 kgf·cm	4	7	10	kgf.cm
		Recommended 0.7 N·m	0.4	0.7	1	N·m
Device flatness	See Figure 2		0		150	μm
Heatsink flatness	See Figure 2		-50		150	μm

The device and heatsink flatness are indicated in [Figure 2](#).

Figure 2. Device and heatsink flatness specifications



1.3 Screw tightening torque

Do not exceed the specified fastening torque. Overtightening screws may cause ceramic or molding compound crack, as shown in [Figure 3](#). Tightening screws beyond a certain torque can cause saturation of the contact thermal resistance.

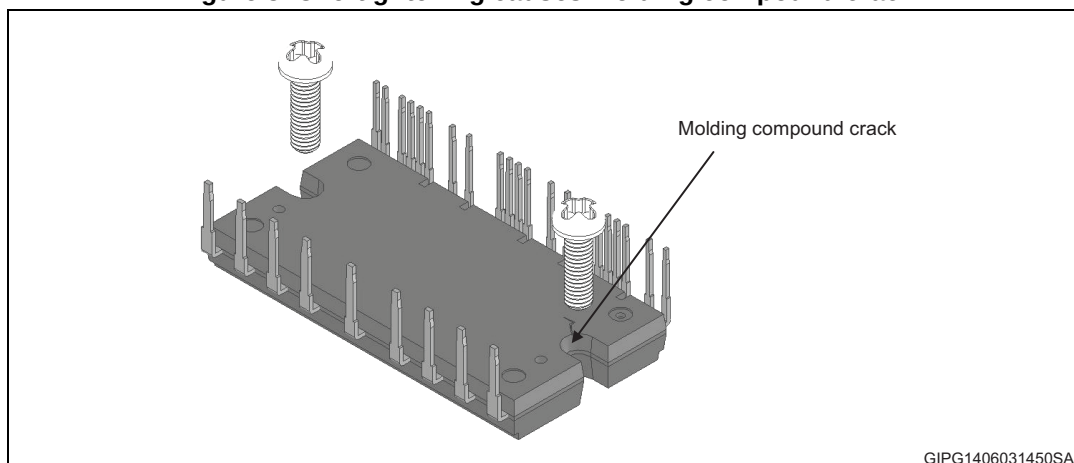
Figure 3. Overtightening causes molding compound crack

Figure 4 shows the recommended fastening sequence to mount screws. ST recommends setting torque at 0.2/0.3N·m for temporary tight mounting screws, while for permanently tight mounting screws, the suggested torque is 0.7 N·m (1 N·m max.) crosswise.

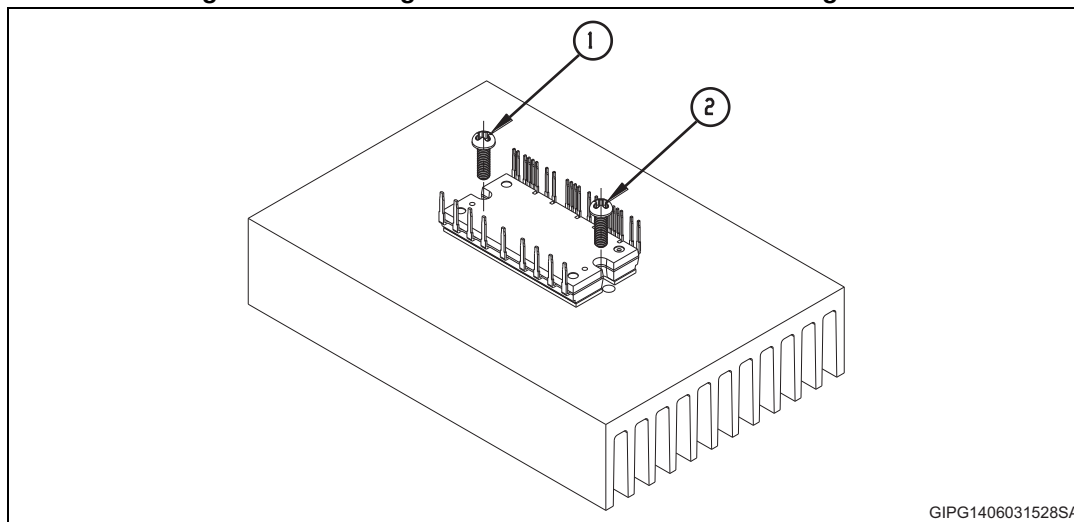
Use screwdriver temporary fastening ①→②

Use screwdriver permanent fastening ①→②

To reduce fastening process cycle time, two-steps permanently tightening is also possible:

Use screwdriver permanent fastening ①→②

If two-steps permanent tightening is applied, thermal grease may not evenly distribute between the module and the external heatsink. In case of use of electrical or pneumatic screwdriver, a revolution at 200 rpm max. is suggested, because a quick impact of screw may damage the module plastic body.

Figure 4. Mounting screws: recommended fastening order

1.4 Recommended screws

All mounting screws should have washers and spring washer to get the best results. SEMS screw is recommended (included spring/plain washer M3) as shown in [Figure 5](#).

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



2 Handling precautions and storage notices

Thermal and/or mechanical stress may deteriorate the device's electrical characteristics and/or its reliability.

2.1 Transportation

The device and its packaging material have to be handled with care. The device shouldn't be subjected to mechanical vibration or shock during transport. Wet conditions are dangerous as well as moisture can also adversely affect the packaging. The devices should be placed in the conductive trays before using them. Leads shouldn't be touched. Package boxes have not to be stressed because stress might cause the electrode terminals to be deformed or the resin case to be damaged. Throwing or dropping the packaging boxes might cause the devices to be damaged. Wetting packaging boxes might cause the breakdown of the devices.

2.2 Storage

- The storage area cannot be exposed to moisture or direct sunlight.
- Humidity should be kept within the range from 40% to 75%, and the temperature also shouldn't be over 35 °C or below 5 °C.
- Harmful gases or dusty environments are dangerous.
- Lead solderability can be degraded by lead oxidation or corrosion, therefore the minimal temperature fluctuation is highly recommended.
- Antistatic containers are recommended. Unused devices should be stored no longer than one month.

2.3 Environment

- The board container or bag protects against static discharge. Boards shouldn't be stacked directly on top of one another and they have to be separated from each other to avoid static charge/discharge caused by friction.
- Cart surface material, in contact with the device packaging, conducts static electricity, and is grounded to the floor surface with a grounding chain.
- Finger cots or gloves have to be worn to protect the device against static electricity.
- When humidity in the working environment decreases, the human body and other insulators can easily become charged with electrostatic electricity due to friction. Therefore the recommended humidity is within 40%, 60% in the work environment. Be aware of the risk of moisture absorption by the products after unpacking from moisture-proof packaging.
- Equipment and tools in the working area have to be grounded to earth.
- Appropriate measures (place a conductive mat over the floor of the work area) have to be taken so that the floor surface is grounded to earth and is protected against electrostatic electricity.
- The workbench surface has to be covered with a conductive mat, grounded to earth, to disperse electrostatic electricity on the surface through resistive components.

Workbench surfaces must not be built of low-resistance metallic material that allows rapid static discharge when a charged device touches it directly.

- Work chairs have to be protected with an antistatic textile cover and grounded to the floor surface with a grounding chain.
- Antistatic mats have to be installed on storage shelf surfaces.
- For transport and temporary storage of devices, containers have to be made of antistatic materials dissipating static electricity.
- Operators must wear antistatic clothing and conductive shoes (or a leg or heel strap).
- Operators must wear a wrist strap grounded to earth through a resistor of about 1 Ω .
- If the tweezers used touch the device terminals, an antistatic type should be used and metallic tweezers should be avoided. If a charged device touches a low-resistance tool, a rapid discharge can occur. When vacuum tweezers are used, a conductive chucking pad should be attached to the tip and connected to a dedicated ground used for antistatic purposes.

2.4 Electrical shock

The device has not to be touched unless the power to the measuring instrument is off. This is to avoid the device's electrical shock.

3 Reflow

The SLLIMM is intended to be a through hole device (THD). THDs are typically soldered by wave soldering. However, as the number of THDs on a board continues decreasing in some applications, wave soldering becomes less cost-effective, so the few remaining THDs (mostly connectors and special components) are soldered with selective wave soldering or with pin-in-paste techniques plus reflow soldering.

3.1 Selective wave soldering of SLLIMM

Wave soldering is a large-scale soldering process by which electronic components are soldered to a PCB to form an electronic assembly. The name derives from the fact that the process uses a tank to hold a quantity of molten solder; 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 solder mask), creating a reliable mechanical and electrical connection.

For THDs, 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 THDs, the heat resistance is tested according to JESD22-B106 and IEC668 2-20 (typically 260 °C, 10 s).

Note: Immersion of the whole package body into the molten solder is not recommended since the SLLIMM is not designated for such a harsh temperature shock.

For evaluation of its ability to withstand full body immersion please see JESD22-A111.

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.

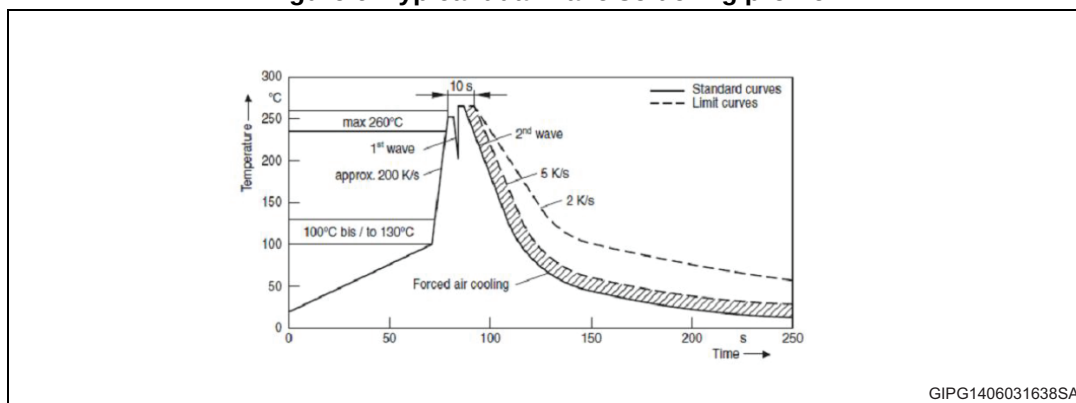
Dual-wave soldering is the most commonly used wave-soldering method (please see [Figure 6](#)). The peak temperatures, ramp rates, and times that are used depend on the materials and the wave-soldering equipment.

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 THDs have 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 these components undergoing the selective wave soldering. This protection can be achieved either by using special fixtures and deflectors for the PCB or a small wave shape achieved by using special wave-guiding tubes or covers.

Figure 6. Typical dual-wave soldering profile



3.2 Other soldering techniques

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

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

- 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 duration achieved during wave or reflow soldering, which must not be exceeded.

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

3.3 Pin-in-paste

Another technique used to solder THDs is to print solder paste onto a PCB near or over drill holes through which the leads are then inserted. The reflow of the solder paste is done together with soldering the SMDs, which therefore have to go through the reflow temperature profile. This has two consequences:

1. The temperature is nearly the same for the whole package in contrast to wave soldering.
2. The time for which the peak temperature is applied to the package is much longer compared to wave soldering.

THDs are qualified for wave soldering and not for reflow soldering. Therefore, pin-in-paste soldering techniques are not recommended for the SLLIMM.

3.4 Heatsink mounting by reflow soldering

In special applications the heatsinks of high-power THDs can be mounted to the board by solder paste printing, pick-and-place, and reflow soldering. In this case, the packages undergo a reflow profile. THDs are qualified for wave soldering and not for the reflow soldering. Therefore, reflow soldering should not be used for the heatsink mounting for the SLLIMM.

4 Rework

If a defective component is observed after the board assembly, the device can be removed and replaced by 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 by a soldering iron.

Whatever rework process is applied, it is important to recognize that heating a board and components above 200 °C may result in damage. As a precaution, every board with its components has to 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 has to be avoided, and rework has to be done according to JEDEC J-STD-033A, IPC-7711 and IPC-7721.

4.1 Device removal

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

- **Moisture:** depending on the MSL, the package may have to be dried before removal. If the maximum storage time out of the dry pack (see label on packing material) is exceeded after board assembly, the PCB has to be baked according to the recommendations of the PCB manufacturer. Otherwise, too much moisture may have been accumulated and damage may occur ("popcorn" effect).
- **Temperature profile:** during the desoldering process it should be assured 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 for removal. Otherwise failure analysis of the package can be impossible, or PCB can be damaged. For large packages, pipettes can be used (implemented on most rework systems); for small packages, tweezers may be more practical.

4.2 Site redressing

After removing the defective component, pads on the PCB have to be cleaned to remove solder residues. This may be done by vacuum desoldering or wick.

Don't 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 PCB pads by printing (special micro-stencil) or dispensing.

4.3 Reassembly and reflow

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

During the soldering process, it should be assured 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. Use no-clean solder paste only, solder wire, and flux for repair.

4.4 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 metalized 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 is available on the market. They differ in:

- Price
- Simple processability (spray, dip, casting, curing, etc.)
- Reparability
- Controllability
- Homogeneity

In any case, please be aware of the chemical, electrical, mechanical and thermo-mechanical interaction between the coating and the PCB and its components. Coatings can affect component reliability.

5 Revision history

Table 2. Document revision history

Date	Revision	Changes
07-Mar-2010	1	Initial release.
13-Jul-2011	2	Modified: heatsink flatness max. value Table 1
21-Jul-2014	3	The entire technical content has been modified.

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