Assembly recommendations for STMicroelectronics ISOTOP package

Introduction

The mounting instructions provide the main recommendations to handle, assemble and rework the ISOTOP package appropriately (Figure 1). It is necessary to follow some basic rules for assembly in order to limit thermal and mechanical stresses and ensure an optimal thermal conduction.

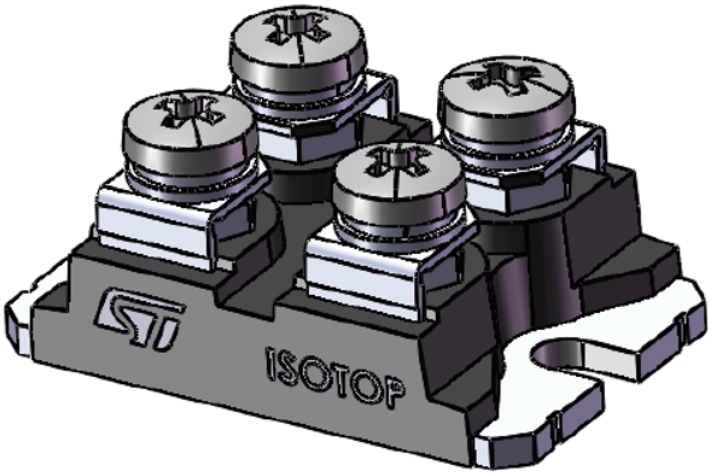
The ISOTOP is a versatile package. The main cooling mechanism is the natural convection through the package heatsink. Indeed, its thick heatsink contributes a lot to thermal dissipation, as well as it ensures the package mechanical robustness.

Although heat extraction can be done by air forced or by heatsink with circulation of coolants, we will focus in this document on the cooling by conduction method with a fixation to a heatsink with adequate thermal interface.

In addition, the ISOTOP products have a built-in ceramic to guarantee the compliance with insulation requirements as described in UL1557.

Note: Important, STMicroelectronics strongly recommends the use of the screws delivered together with the product. The use of any other screw is entirely at the user's own risk and will invalidate the warranty. Check the content of this technical note for more details.

Figure 1. ISOTOP package dimensions



1 Package description

Table 1. **ISOTOP package mechanical data**

Ref.	Dimensions	
	Millimeters	
	Min.	Max.
A	11.80	12.20
A1	8.90	9.10
B	7.80	8.20
C	0.75	0.85
C2	1.95	2.05
D	37.80	38.20
D1	31.50	31.70
E	25.15	25.50
E1	23.85	24.15
E2	24.80	
G	14.90	15.10
G1	12.60	12.80
G2	3.50	4.30
F	4.10	4.30
F1	4.60	5.00
H	-0.05	0.10
Diam P	4.00	4.30
P1	4.00	4.40
S	30.10	30.30

Figure 2. **ISOTOP package outline**

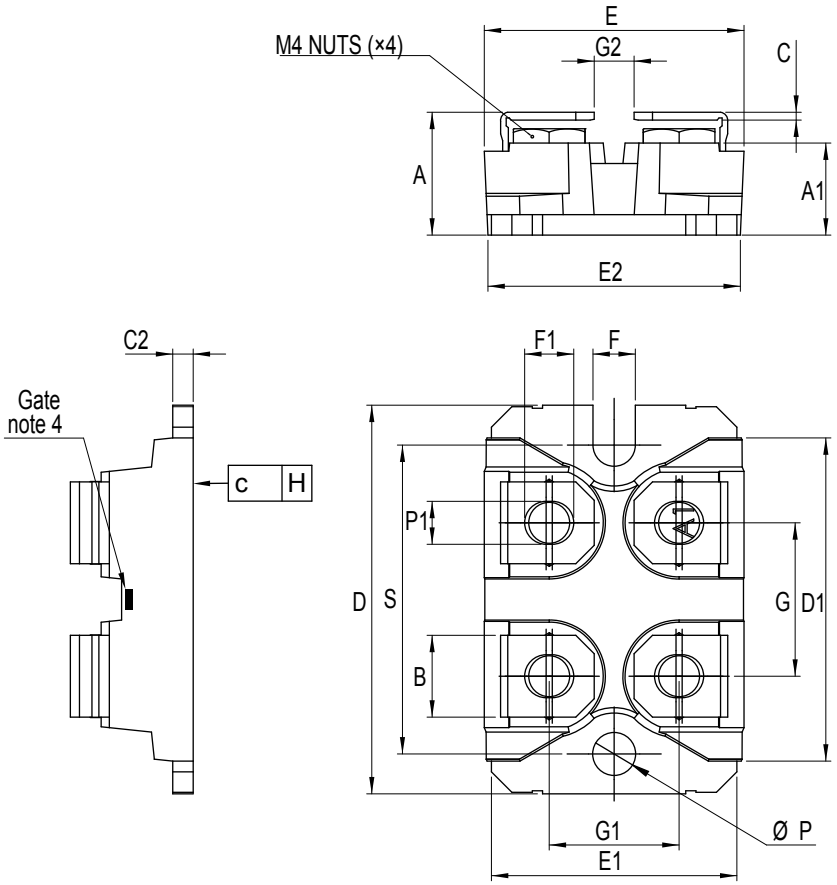
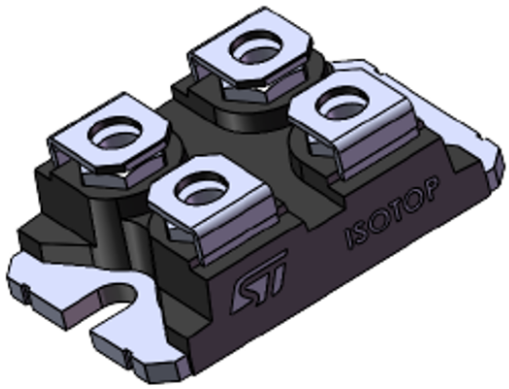


Figure 3. **ISOTOP package photo**



Note: The ISOTOP products are always delivered with four screws.

Figure 4. **ISOTOP package heatsink screws distance**

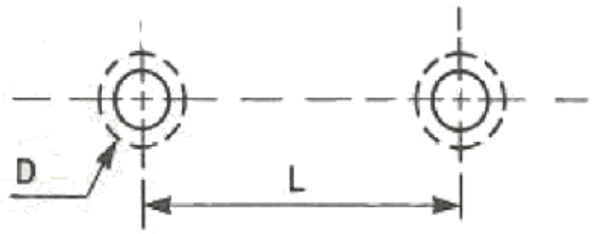


Table 2. **ISOTOP package heatsink specifications**

Parameters	Values
Flatness (max concavity or convexity between fixing holes)	≤ 20µm (0.78 mils)
Surface finish	+/- 1.2 µm (+/-0.05 mils)
Fixing holes	L = 30 mm; +0.4/+1 mm (1.181 inch; +0.016/+0.039 inch)

Figure 5. **ISOTOP package heatsink screwing**

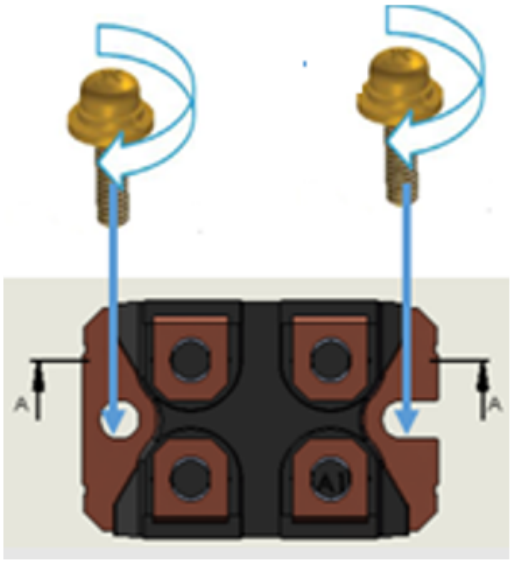


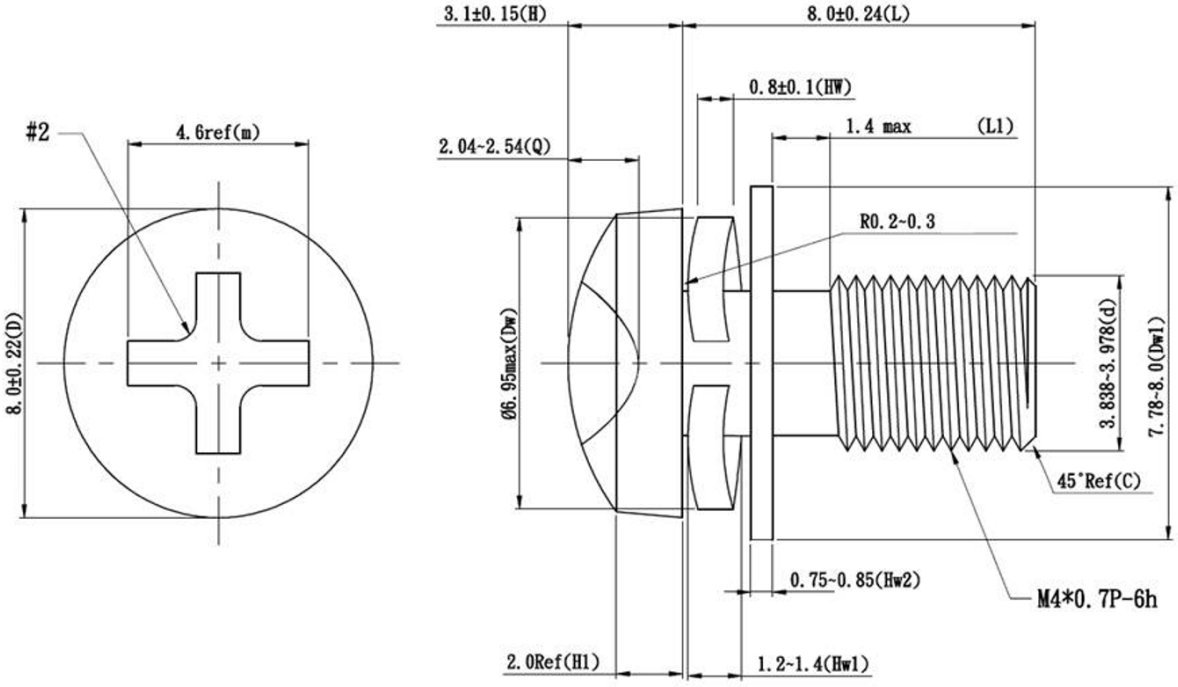
Table 3. **ISOTOP package heatsink screws specifications**

Parameters	Values
Fixing screw	M4 x 0.7 + lock washer
Torque	1.3 +/- 0,2 N.m (7.6 +/- 1.2 LBS.inch)
$R_{thj\text{-}case/heatink}$	D = M4 x 0.7
	< or = 0.005 °CW

Table 4. ISOTOP package electrical connectors

Parameters	Values
Screws	M4 x 0.7 + lock washer
Torque	1.3 +/- 0,2 N.m (7.6 +/- 1.2 LBS.inch)
Pull test (fast on pins)	< or = 80 N
Twist test	N/A
Contact area (screw version)	45 mm²
Lead inductance	< or = 5 nH

Figure 6. Connectors M4 x 0.7, 8 mm length screws dimensions



Note: Dimensions are given in mm.

Table 5. ISOTOP Packaging details

Parameters	Values
Tube	10 pcs + contact set (screw + washer)
Elementary box (bulk quantity)	100 units (10 tubes)
Ordered quantity	Multiples of 10 pcs

2 Mounting techniques and recommendations

2.1 Electrical connectors screws and torque recommendation

Additional tests were performed to evaluate the maximum torque that the ISOTOP package may sustain before mechanical destruction, while assembling the screw, nut and washers on the electrical connectors.

The four M4 x 0.7 screws for electrical connection, provided by STMicroelectronics together with the ISOTOP devices, are specified with a max torque value of 4.5 N.m, in order to prevent the damage of the thread.

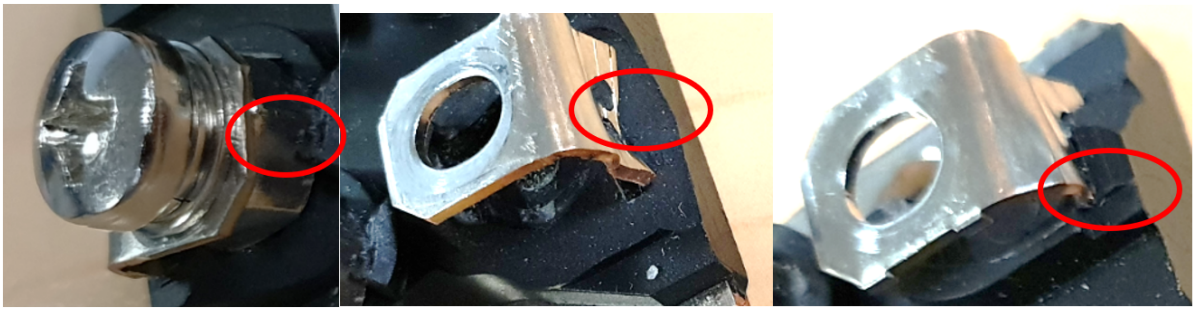
The nut itself, is guaranteed with a maximum torque value specified at 5 N.m.

Figure 7. ST M4 x 0.7 screw, nut and washer supplied with the ISOTOP package (x4)

- Spring washer outer diameter = 6.95 mm and thickness = 0.8 mm
- Plain washer outer diameter = 8 mm and thickness = 0.8 mm

Experiment was led by fastening these M4 x 0.7 mm screws and nuts to the electrical connectors of the ISOTOP package. The torque applied was measured by using the adequate Philips screwdriver. Some cracks in the molding compound and lead deformation were observed when applying torque greater than 2.5 N.m.

Figure 8. Pictures of resulting mechanical damage on ISOTOP package



These results indicate that the failure mode is the torsion of the terminal, inducing molding compound breakage. Overtightening the screws may cause other mechanical damages such as ceramic cracks for instance.

In order to ensure a correct thermal dissipation (current transfer) and the product electrical functionalities, maximum torque value needs to be respected. Following above destructive tests results, and considering that the weakest point is the resin, defined specification is a **max screwing torque of 1.5 N.m**.

Recommended torque value is 1.3 N.m.

The ISOTOP package integrity and performance are conditioned by its mounting on both electrical connectors and heatsink side.

ST Microelectronics strongly recommends to use the 4 screws, nuts and washers supplied together with the ISOTOP device for the electrical connectors and to respect the torque values highlighted in this technical note.

The usage of any other screw, nut and washer exposes to destructive mechanical stress. This choice is entirely at the user's own risk and will invalidate the warranty.

Following examples are illustrating failure modes that could occur. This is not an exhaustive description:

- If the screw is too long, or if the thread pitch is different from ST screw, the risk is to have the tip of the screw in contact with the body of the package.
- If this contact is too strong, this will generate package body cracks, which may impact product functionality and reliability.
- If the screw used is too short, it may not enter fully in the nut. In such case, there may be risks of damaging the threads of the screw or the nut, as applied torque may be too high for the portion of thread in contact.

2.2 Heatsink screws and thermal grease recommendations

2.2.1 Heatsink screws

To fix the ISOTOP package on a chassis or a cooling system, STMicroelectronics recommends SEMS screws (M4, including spring/plain washer) as shown in the Figure 9 below. All mounting screws should have regular washers and spring washer. It's important to use the washer to optimize the pressure on heatsink and get a uniform contact.

Figure 9. Example of SEMS Nickel plated screw size M4 x 0.7 with spring and plain washer

2.2.2 Thermal conductive grease

To optimize the heat dissipation, it is necessary to enlarge the contact area as much as possible to minimize the contact thermal resistance. It is recommended to apply a thermal conductive grease over the contact surface between modules and heat sinks, which is also useful for preventing any corrosion at the contact surface.

Of course, the cleanliness of the contact surface must be checked prior to apply the thermal grease. A minimum of 150 µm layer of thermal grease to the module base plate or heat sink is required.

While fastening the module, the thermal compound should be observable around the rim of the mounted module. Grease characteristics check over time and across wide operating temperature ranges will help ensuring an optimized thermal dissipation.

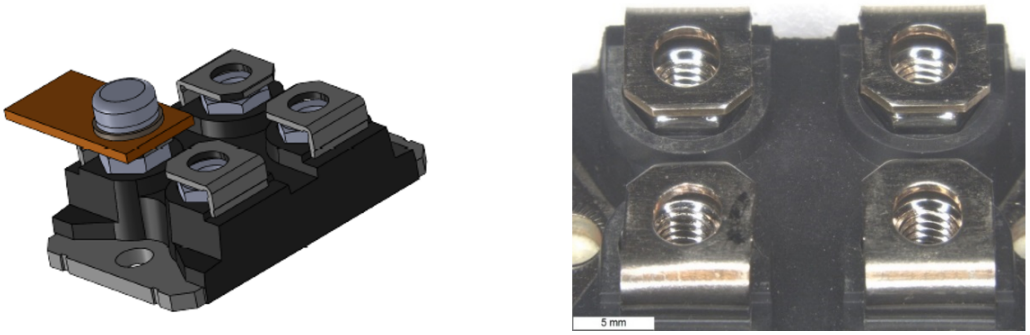
A torque screwdriver must be used for fastening operation to the maximum specified torque rating. Exceeding the maximum torque limitation may cause module damage or degradation.

2.3 ISOTOP package assembly

2.3.1 Bus bar assembly recommendation (with ST screws)

STMicroelectronics recommends a bus bar real tolerance of 1.6 mm + / - 0.4 mm. It is important not to place the bus bar between nut and connector because of the risk to damage the package (resin crack).

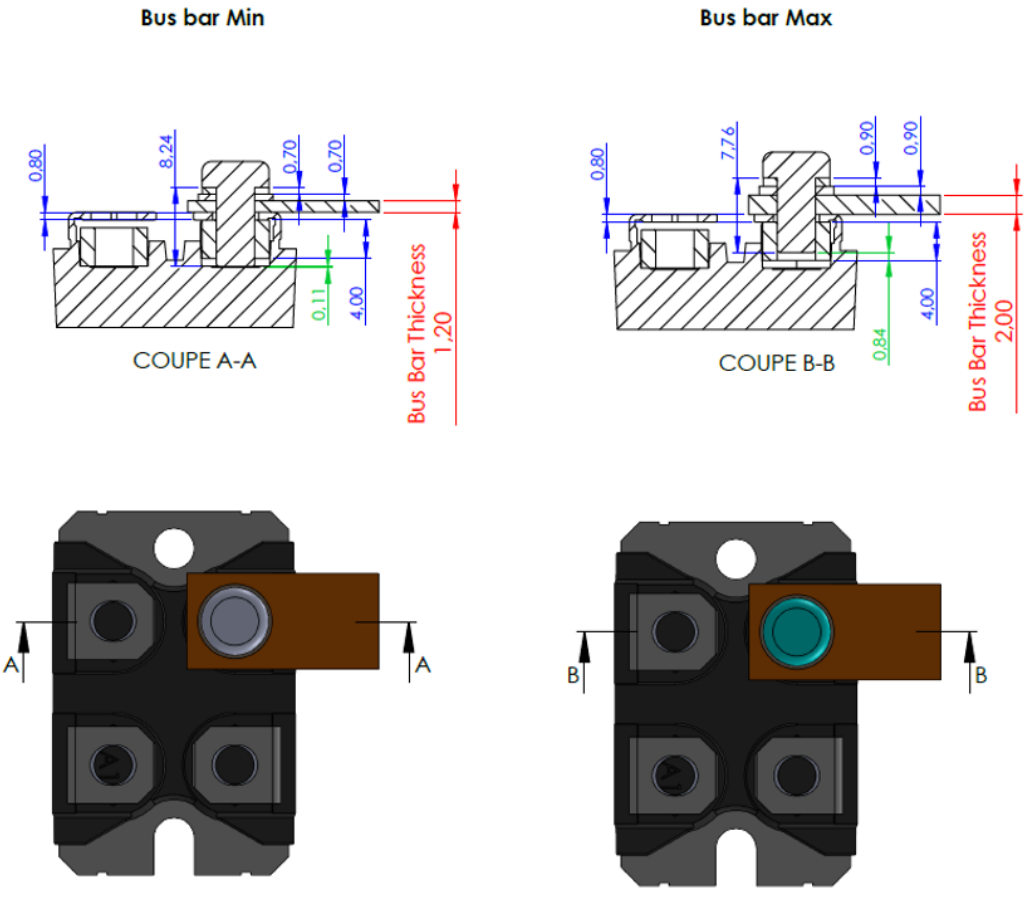
Figure 10. Bus bar assembly view



Assuming use of ST screws, the recommendation is to place the bus bar on the top, respecting the thickness tolerances as below:

- **Max = 2 mm → Risk to damage the thread**
- **Min = 1.2 mm → Risk to damage the package**

Figure 11. Bus bar assembly tolerances



2.3.2 Recommendations for heatsink design and assembly

For the heatsink screw torque, we recommend **1.3 N.m, with 1.5 N.m max.** The process window check didn't reveal any failures (package cracks, insulation failures, functional failures) up to 3 N.m. This is for information purpose only, as ST customers may use different screws and heatsink.

It is required to have a perfect contact between the package bottom side and the heatsink to ensure optimum thermal dissipation. The heatsink or chassis surface should be clean and flat.

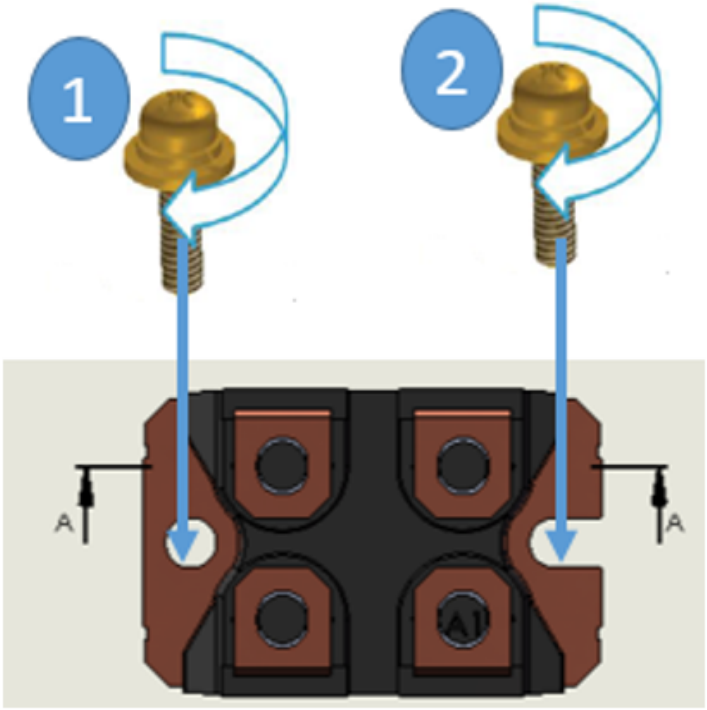
The flatness recommendation is to get less than 40 microns.

The assembly sequence is described as per below instructions:

- Fasten temporarily in the sequence 1 → 2
- Screw down permanently in the sequence 1 → 2

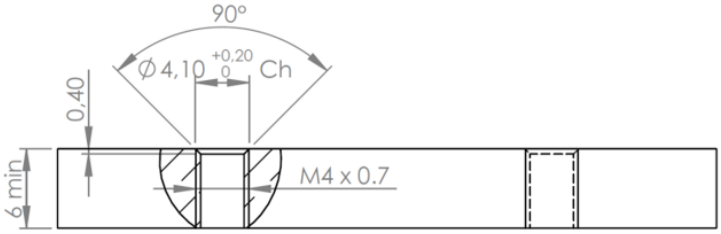
When using electrical or pneumatic screwdrivers, it is suggested to keep the revolution at 200 rpm max. as the rapid impact of the screw may damage the screw or the heatsink. The torque of the electrical or pneumatic automatic screwdriver must be controlled and adjusted.

Figure 12. Heatsink mounting sequence



A chamfer (90°) should be considered on the heatsink in order to avoid deformation and conserve the flatness and a good thermal contact.

Figure 13. Heatsink design recommendation



Revision history

Table 6. **Document revision history**

Date	Version	Changes
16-Jun-2020	1	Initial release.

Contents

List of figures