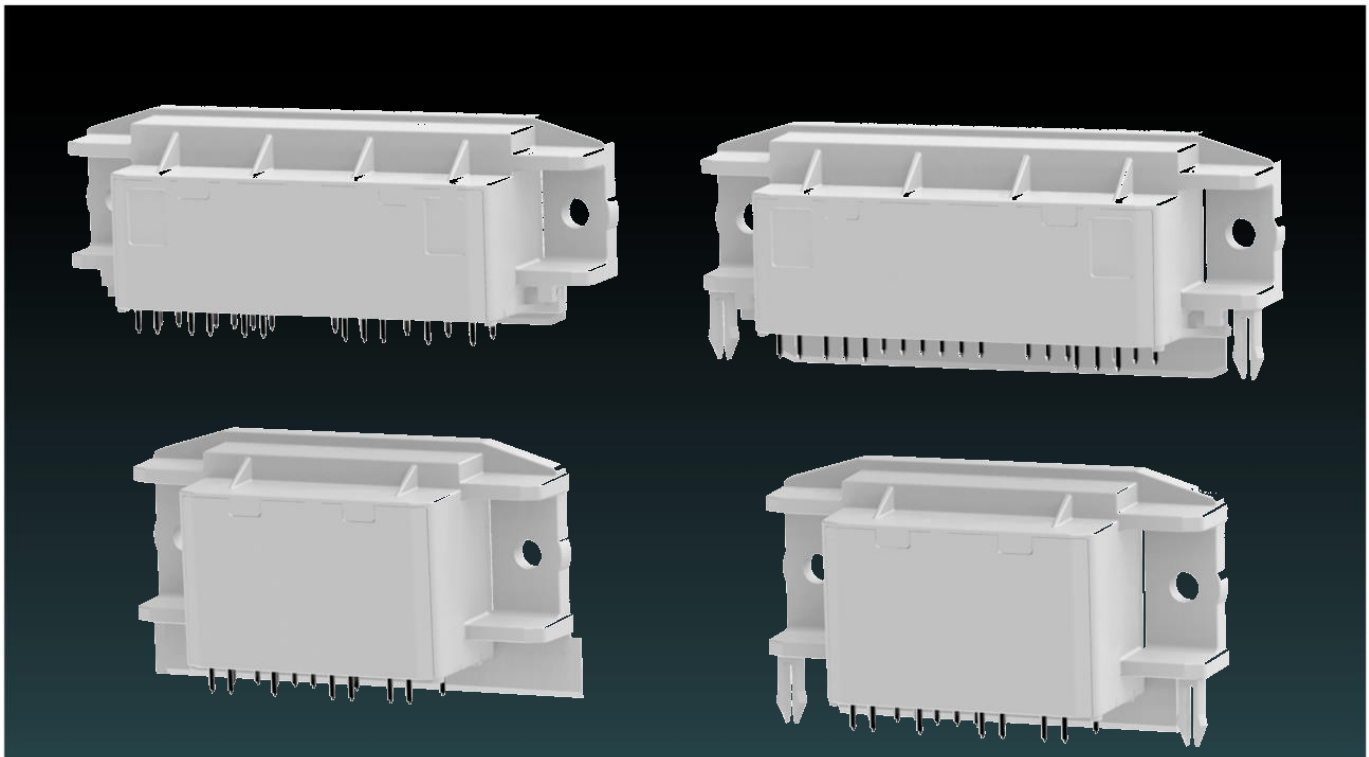
Vincotech

# Handling Instructions

**for *flow* 90 packages**



***This document is valid for all type of flow 90 0 & flow 90 1 modules:***
***0 & 2 clips versions with solder pins***

| | | |
|---|---|---|
| **Date:** | **12.06.2020** | **Revision:** |
| **Created by:** | **Zs. Gyimothy** | |
| **Updated by:** | **T. Pribéli** | **Rev. 02** |

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# Revision History

| Date | Revision Level | Description | Page Number(s) |
|---|---|---|---|
| 12.06.2020 | 02 | Modify scratch and etching hole dimensions;<br>Update in chapter: 3; 8.1; 10; 10.2 | 7, 16, 19 |
| 10.03.2016 | 01 | Merge documents: Flow90_0-P-01-HI & Flow90_1-2CW-P-02-HI | |
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# 1 General assembly instructions

The *flow* 90 type modules have to be mounted to a PCB. The electrical connections between module and the PCB are made by soldering. During assembly the pins are not to be drawn or pushed more than ±0.2 mm or loaded with a force greater than 35 N. The tension of the pin must not exceed ±5 N at a maximum substrate temperature of 100 °C.

# 2 Specification for PCBs

- Printed board material meets the requirements of IEC 61249-2-7.
- The maximum number of conductive layers is not limited.

The module has to be fixed to the PCB by clipping it into the appropriate holes. The role of the clips is to hold the modules in the PCB at proper position before and during soldering process. For details see section 2.1 Required holes on the PCB.

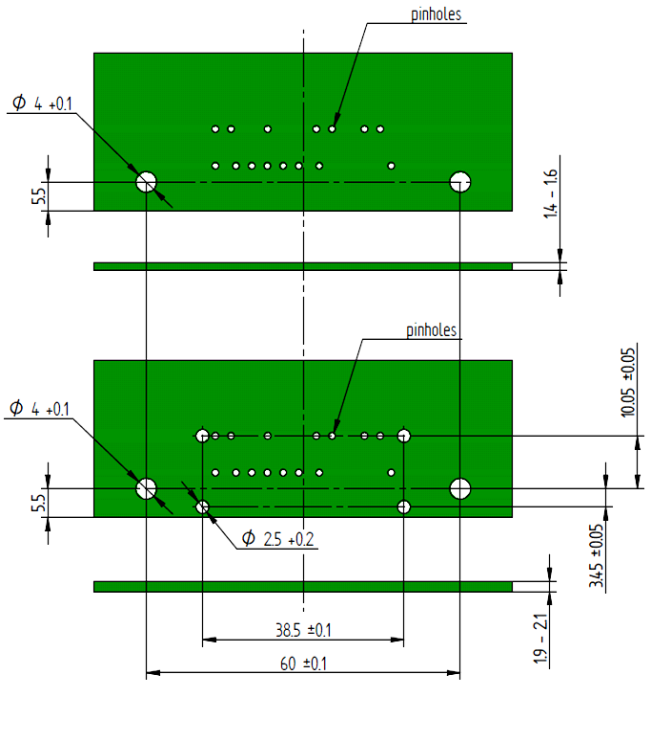
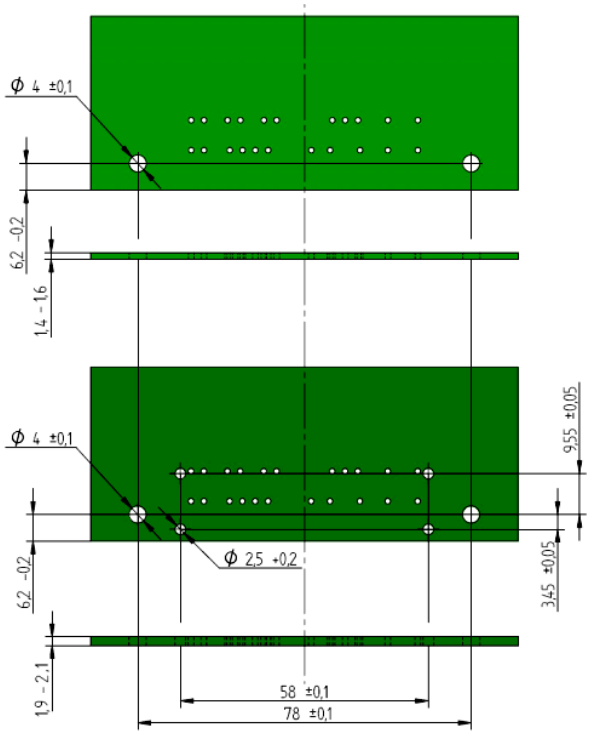
- After clipping, all pins must be soldered into the PCB. The hole diameters on the PCB has to be designed according to the soldering pin diameter which is Ø1 mm ±0.05 mm.

For further dimensions or 3D model please contact your local sales manager.

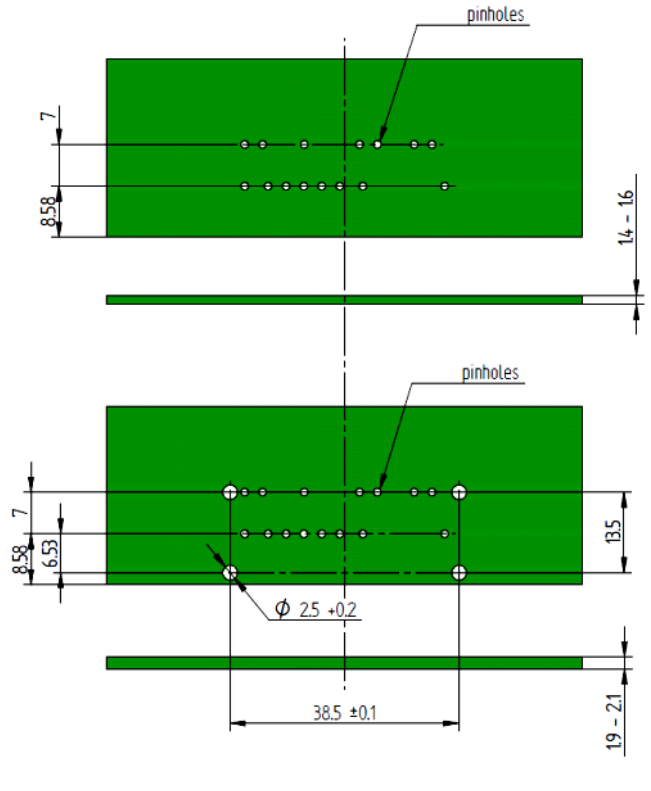
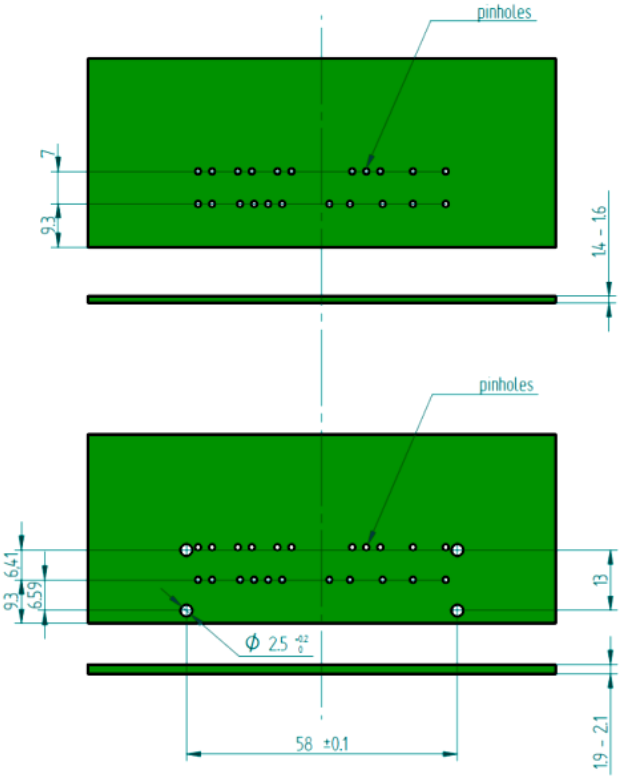
## 2.1 Required holes on the PCB

The drawings below show the required PCB-cutouts defined for different PCB thicknesses, for modules with 2 clips and solder pins.

## 2.2 For modules with 2 clips

| *flow* 90 0 | *flow* 90 1 |
|---|---|
|  |  |

## 2.3 For modules without clips

| *flow* 90 0 | *flow* 90 1 |
|---|---|
|  |  |



To fix the module and hold the right angle between PCB and DCB another fixing solution is needed.
Pinholes on the PCB need to be adjusted to the module pins.
Pin diameter: Ø 1mm ±0.05 mm.

# 3 Specification for module backside surface

The module backside is important for the thermal management of the power module. Imperfection is allowed if it does not lead to an $R_{th}$ increase of >2% (assembled acc. VIN instruction). Acceptance criteria for module backside surface:

Polishing (see figure 2.):

- Polishing have to be accepted
- Polishing of modules with Ni plated surface is acceptable if copper doesn't become visible (if the copper is visible, see criteria for scratches)

Steps, Flash (see figure 1.):

- Max height of 10 µm

Scratches (see figure 1.):

- Max depth of 300 µm
- Max width of 600 µm
- The scratched area must not exceed 5 % of the total substrate surface.

Etching holes (see figure 1.):

- Max diameter of 1000 µm and max. depth of 300 µm
- Max diameter of 2000 µm and max depth of 250 µm

Other (see figure 3, 4.):

- Discolorations and fingerprints are only surface imperfections (cosmetic) and do not affect the module's functionality

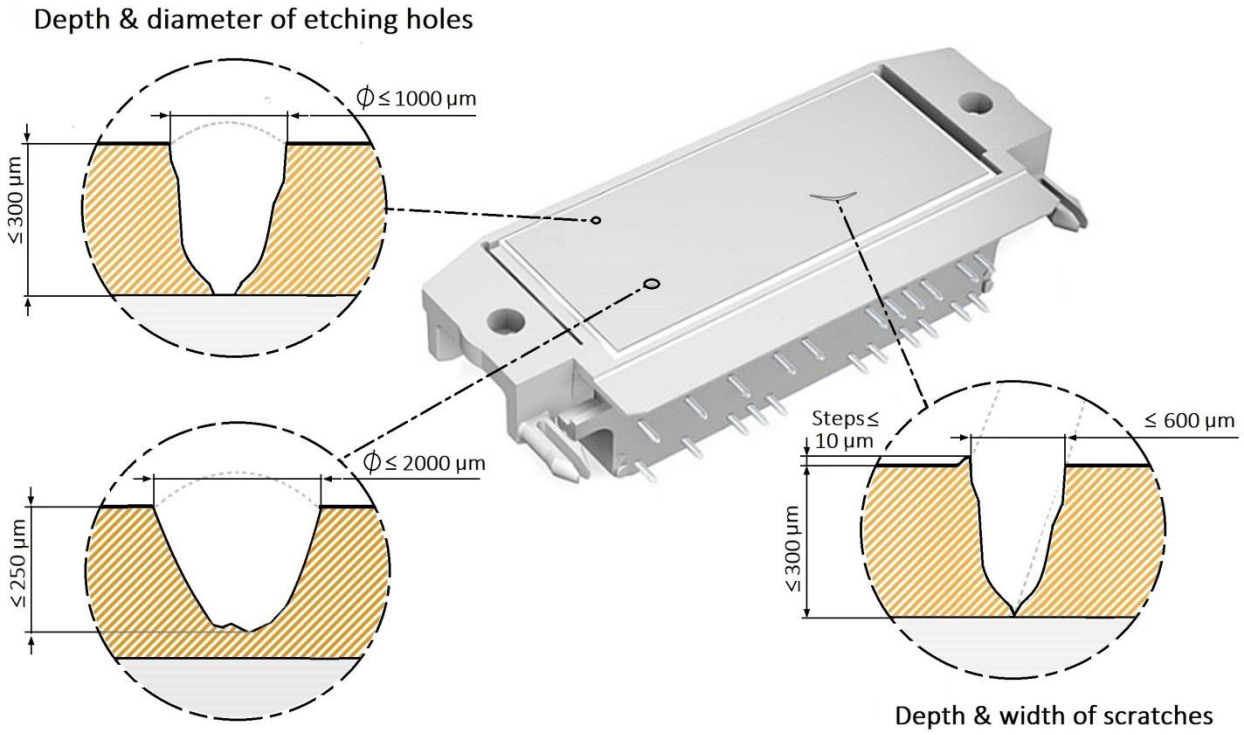



Figure 1: Scratch and etching hole dimensions

Figure 2: Polished surface

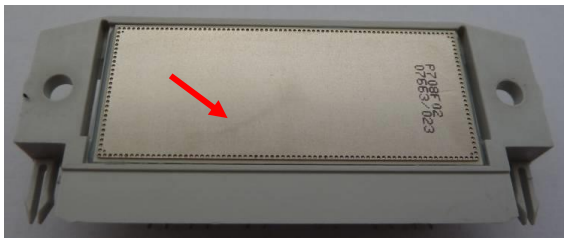


Figure 3: Discoloration of substrate

Figure 4: Fingerprint on the surface

# 4 Specification for heat sinks

The whole heat sink surface under the module must be plane, clean and free of particles.

- The flatness tolerance should be: < 25 µm.
- In case the thermal paste is thicker than 50 µm the flatness tolerance can be < 50 µm. (A flatness tolerance specifies a tolerance zone defined by two parallel planes within which the surface must lie.)
- The surface roughness should be less than: $R_z$ < 10 µm.
- Heat sink surface imperfections should be within the values described for the module backside surface (please refer to section 3. Specification for module backside surface).

# 5 Specification for thermal interface materials

## 5.1 OPTION 1: Thermal paste

A. Apply a homogeneous layer of thermal conductive paste over the whole backside of the module, with a roller or spatula.
B. Apply thermal paste in a honeycomb pattern. The preferred technology for paste application is screen printing. For a drawing of the pattern please contact your local sales representative.

The recommended thermal paste thickness is 45 µm ±15 µm in both cases.
Thermal paste thicker than recommended will increase thermal resistance ($R_{th}$).

## 5.2 OPTION 2: Thermal foil

- A thermal foil comprising of an aluminum core layer and two outer layers of phase change material should be used.
- The total thickness of the foil has to be less than 80 µm. Thicker foils could cause the ceramic substrate to break and will increase the thermal resistance.
- Recommended foil type: ALC5 or ALF5 (Boyd Corporation)
- Recommended foil dimensions: see Figure 5.

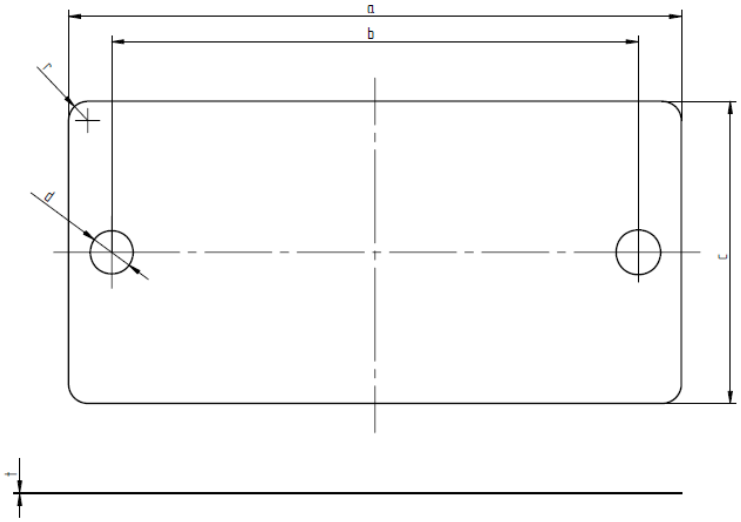



Figure 5: Recommended thermal foil dimensions

| Type | *a*/mm | *b*/mm | *c*/mm | *d*/mm | *r*/mm |
|---|---|---|---|---|---|
| *flow* 90 0 | 64 ± 0.15 | 55 ± 0.15 | 31.5 ± 0.15 | 4.5 ± 0.15 | 2 ± 0.15 |
| *flow* 90 1 | 84 ± 0.15 | 73 ± 0.15 | 34.5 ± 0.15 | 4.5 ± 0.15 | 2 ± 0.15 |

### 5.3 OPTION 3: Pre-applied thermal interface material

- The modules may have already been pre-printed with thermal interface material.
- Further information about using modules with pre-applied TIM see the application note for "Power modules with Phase-Change Material" on Vincotech's website

## 6 Specification for fastening screws to the heat sink

- Screws M4 (recommended screw type DIN 7984)
- Min. depth of the screw in the heat sink: 6 mm
- Flat washer ISO 7092 (DIN 433) - size of outer diameter Ø8 mm can be fitted into the module.
- Spring washer DIN127 or DIN 128
- Mounting torque: 1.6 Nm < $M_s$ < 2 Nm

### 6.1 Screw with pre-assembled washers

Screws with pre-assembled washers (SEMS or kombi screws) combine the screw and the washers into a single component. These screws eliminate the need to slip the washers into place by hand, boosting the speed and efficiency of the assembly process. The specification of these screws is provided below:

- Screw size M4 according to DIN 6900 (ISO 10644; JIS B1188)
- Flat washer according to DIN 6902 Type C (ISO 10673 Type S; JIS B1256)

  Size of outer diameter Ø8 mm can be fitted into the module.
- Split lock spring washer according to DIN 6905 (JIS B1251)
- Mounting torque range: 1.6 Nm < $M_s$ < 2 Nm

### 6.2 Mounting with automatic screwdriver

For a fast, reliable and repeatable screwing process an automatic screwdriver with two stage tightening method is recommended. The screwdriver starts fast in the first stage and slows down after the first target torque is reached to accurately tighten the screw to the final target. For torque and speed recommendations see below the curves (14. Figure) and values:

Torque

- Cycle start: 0.3 Nm
- First target: 0.5 Nm
- Final tq min.: 1.6 Nm
- Final target: 1.8 Nm
- Final tq max.: 2 Nm

Speed

- Soft start speed: 96 rpm
- Step 1 speed: max. 650 rpm
- Step 2 speed: max. 12 rpm

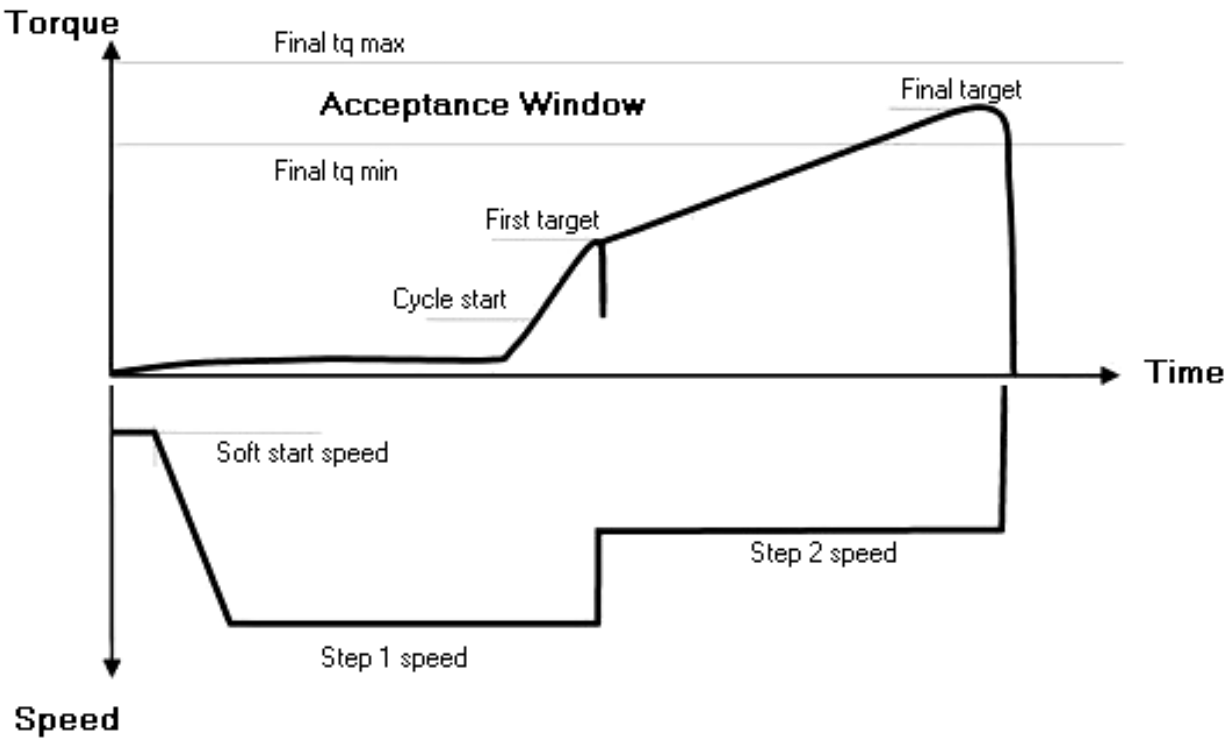
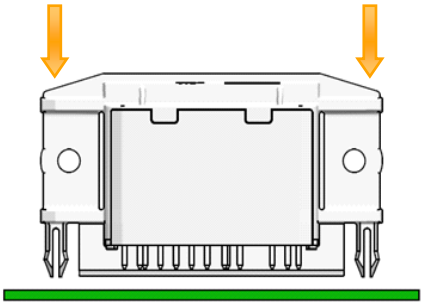



Figure 6: Recommended torque and speed curve

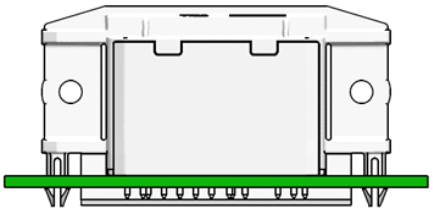
# 7 Mounting modules in PCB

## 7.1 Module with 2 clips

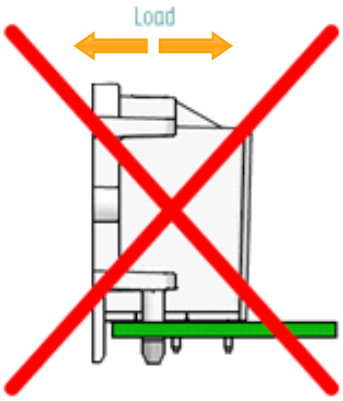
1. Insert the module pins to the PCB. Press the module into the PCB as shown on the figure below until the clips are locked



2. Module in place on PCB. The clips can ensure to hold the right angle between substrate and PCB during wave soldering process

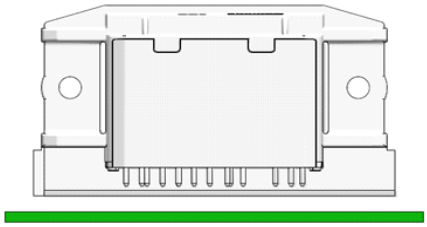


3. Load is not allowed on the module before the end of the soldering.

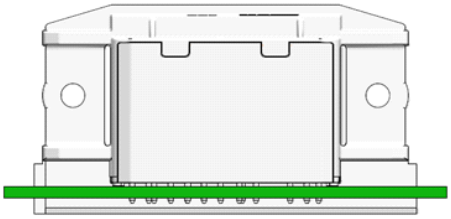


## 7.2 Modules without clips

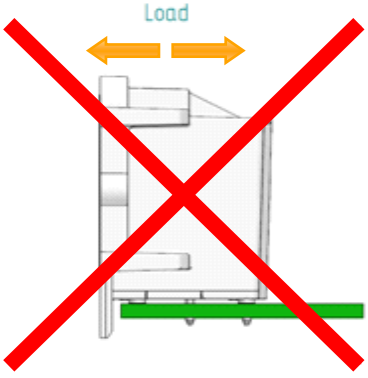
1. Insert the module pins into the PCB, and push the module till it's bottom surface rests on the PCB.



2. Module has to be fixed by tool in order to hold the right angle position between the substrate and the PCB during the soldering process.



3. Load is not allowed on the module before the end of the soldering.



# 8 Recommendation for soldering

## 8.1 Solderability specification

- Plated through holes should exhibit a vertical solder fill of 75 %, with a fully formed fillet on the solder side and evidence of 75 % wetting on the component side lead, barrel and pad.

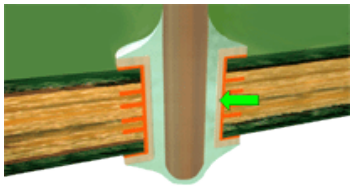


Figure 7: Plated through hole, good soldering

- The solder pins of the *flow 0* modules are plated with a nickel underlayer and a continuous tin finish to promote solderability. The tin finish can be discoloured due to production process or storage conditions. This is merely a cosmetic imperfection and does not influence the solderability of pins. Different solder pins on the same module may exhibit different levels of discoloration as shown in the examples in *Figure 8:* .

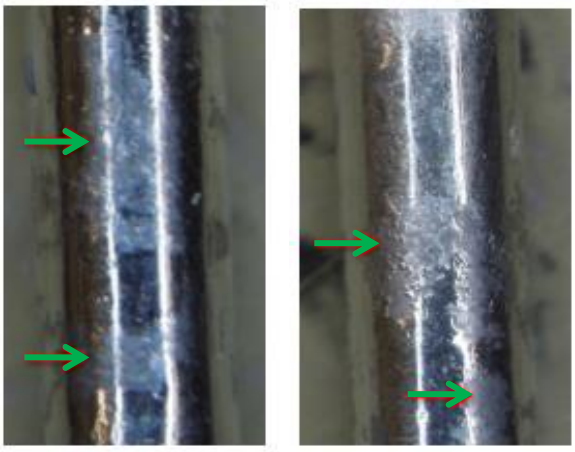


Figure 8: Examples of discolored solder pins

## 8.2 Wave soldering of modules with solder pins

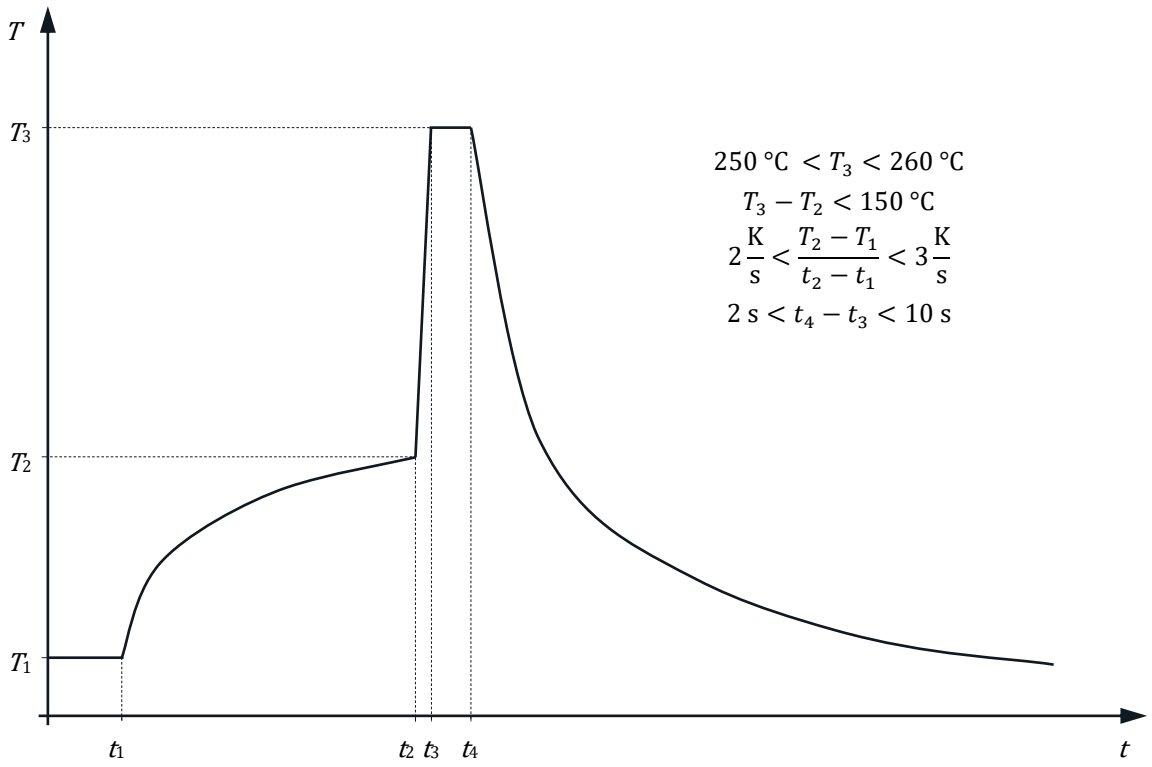



Figure 9: Typical profile for wave soldering

## 8.3 Hand soldering parameters

- Max. solder iron temperature: 350 °C
- Max. contact time with component lead: 10 s
- Number of heat cycles: 3

# 9 ESD protection

Modules are sensitive to electrostatic discharge which can damage or destroy sensitive semiconductors. All modules are ESD protected in the shipment box by semi conductive plastic trays. During the handling and assembly of the modules it is recommended to wear a conductive grounded wrist band and ensure a conductive grounded working place.

Please take into consideration the following standards for handling electrostatic-sensitive devices: EN61340-5-1, ANSI S20.20

# 10 Environmental conditions

The modules can be subjected to environmental conditions characterized by the following classes:

| | |
|---|---|
| Storage: | 1K2 / 1B1 / 1C1 / 1S2 / 1M2 |
| Transportation: | 2K2 / 2B1 / 2C1 / 2S1 / 2M2 |
| Operation: | 3K3 |

These classes are defined in the IEC 60721-3-1 and IEC 60721-3-2 and IEC 60721-3-3 standards. The modules with wire pins have 1 year shelf life with the given storage conditions.

Flammability classification of the plastic material for *flow* 90 packages are V-0 and 5-VA (self-extinguishing, no dripping of flaming particles) according to UL 94, IEC 60695-11-10 and IEC 60695-11-20 test methods.

## 10.1 Parameters of environment classes

The parameters detailed below are for informative purposes only. This section does not substitute the above mentioned standards. Please read the IEC 60721-3-1 and IEC 60721-3-2 standards for the description of the environment classes.

### 10.1.1 Climatic conditions

1K2

| | |
|---|---|
| Air temperature: | 5 °C to 40 °C |
| Humidity: | 5 % to 85 % RH but max. 1 g/m³ to 25 g/m³ absolute |
| Rate of change of temperature: | 0.5 °C/min |
| Air pressure: | 70 kPA to 106 kPa |
| Solar radiation: | 700 W/m² |
| Movement of surrounding air: | 1 m/s |
| Condensation: | No |
| Precipitation: | No |
| Water from other sources than rain: | No |
| Formation of ice and frost: | No |

2K2

| | |
|---|---|
| Temperature: | −25 °C to 60 °C |
| Change of temperature air/air: | ±25 °C |
| Relative humidity not combined with rapid temperature changes: | max. 75 % (at 30 °C temperature) |
| Relative humidity combined with rapid temperature changes: | No |

| | |
|---|---|
| Low air pressure: | 70 kPa |
| Change of air pressure: | No |
| Solar radiation: | 700 W/m$^2$ |
| Movement of surrounding air: | No |
| Precipitation: | No |
| Heat radiation: | No |
| Water from other sources than rain: | No |
| Wetness: | No |

3K3

| | |
|---|---|
| Relative humidity: | 5% to 85% |
| Absolute humidity: | 1 g/m3 to 25 g/m3 |
| Condensation: | No |
| Precipitation: | No |
| Formation of ice: | No |

### 10.1.2 Biological conditions

1B1

| | |
|---|---|
| Flora and fauna: | Negligible |

2B1

| | |
|---|---|
| Flora and fauna: | No |

### 10.1.3 Chemically active substances

1C1

| | |
|---|---|
| Sea and road salts: | No (Salt mist may be present in sheltered locations of coastal areas.) |
| Sulphur dioxide: | 0.1 mg/m$^3$ |
| Hydrogen sulphide: | 0.01 mg/m$^3$ |
| Chlorine: | 0.01 mg/m$^3$ |
| Hydrogen chloride: | 0.01 mg/m$^3$ |
| Hydrogen fluoride: | 0.003 mg/m$^3$ |
| Ammonia: | 0.3 mg/m$^3$ |
| Ozone: | 0.01 mg/m$^3$ |
| Nitrogen oxides: | 0.1 mg/m$^3$ (Expressed in equivalent values of Nitrogen dioxide.) |

2C2

| | |
|---|---|
| Sea salts: | none |
| Sulphur dioxide: | 0.1 mg/m$^3$ |
| Hydrogen sulphide: | 0.01 mg/m$^3$ |
| Nitrogen oxides: | 0.1 mg/m$^3$ (Expressed in the equivalent values of Nitrogen dioxide.) |
| Ozone: | 0.01 mg/m$^3$ |
| Hydrogen chloride: | 0.1 mg/m$^3$ |
| Hydrogen fluoride: | 0.003 mg/m$^3$ |
| Ammonia: | 0.3 mg/m$^3$ |

### 10.1.4 Mechanically active substances

1S2
Sand: 30 mg/$m^3$
Dust (suspension): 0.2 mg/$m^3$
Dust (sedimentation): 1.5 mg/($m^2$h)

2S1
Sand in air: No
Dust (sedimentation): No

### 10.1.5 Mechanical Conditions

1M2
Stationary vibration, sinusoidal
Frequency range: 2 Hz to 9 Hz
displacement amplitude: 1.5 mm
Frequency range: 9 Hz to 200 Hz
peak acceleration: 5 m/s2
Non stationary vibration, including shock
Shock response spectrum type L
peak acceleration: 40 m/$s^2$

Static load: 5 kPa

2M2*
Stationary vibration sinusoidal
Frequency range: 2 Hz to 9 Hz
displacement amplitude: 3.5 mm
Frequency range: 9 Hz to 200 Hz
peak acceleration: 10 m/s2
Frequency range: 200 Hz to 500 Hz
peak acceleration: 15 m/s2
Stationary vibration, random
Acceleration
spectral density: 1 $m^2/s^3$
Frequency range: 10 Hz to 200 Hz
and
Acceleration
spectral density: 0.3 $m^2/s^3$
Frequency range: 200 Hz to 2000 Hz
The later range can be neglected transporting with vehicles with high damping.
Non stationary vibration, including shock
Shock response spectrum type I.
peak acceleration: 100 m/$s^2$
and Shock response spectrum type II.
peak acceleration: 300 m/$s^2$

*Free fall: weight and drop height deviate from 2M2
tested acc. to internal standard: F23047-A1004-S000-01-76

| Specimen Weight [kg] | Drop Heights [mm] | |
|---|---|---|
| | Standard Level | Extra Level |
| up to 9,5 kg | 460 | 760 |
| over 9,5 to 18,6 kg | 310 | 610 |
| over 18,6 to 27,7 kg | 200 | 460 |
| over 27,7 kg | 200 | 310 |
| **Number of Drops** | **3** | **7** |

Toppling Around any of the edges.

Rolling, pitching

Angle: ±35°

Period: 8 s

35° may occur for short time periods but 22.5° may persist permanently.

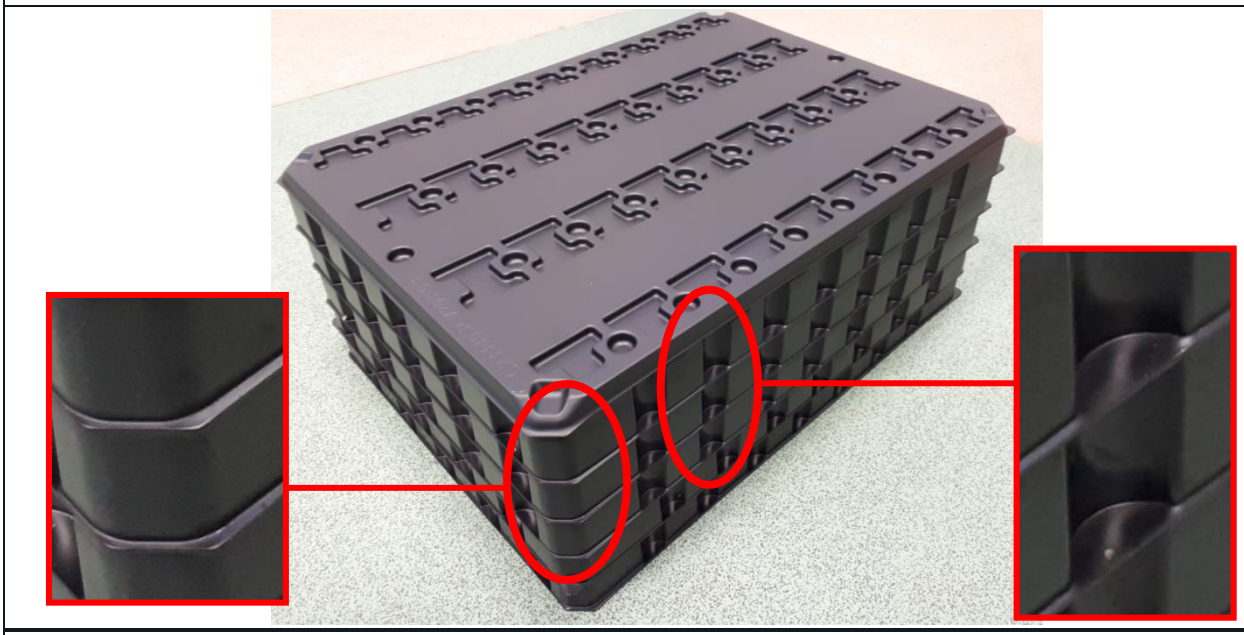
Acceleration 20 $m/s^2$

Static load: 10 kPa

## 10.2 Handling of trays

The modules are transported in layer of trays and every layer has to be rotated on each other by 180° to guarantee that all the modules are safe. This is also valid any time after unpacking. *Figure 10:* shows the trays in wrong and in good positioning.

**NOK**
**on the edge and on the sideway the same shape are on each other, no 'step'**



**OK**
**on the edge and on the sideway there is a 'step'**

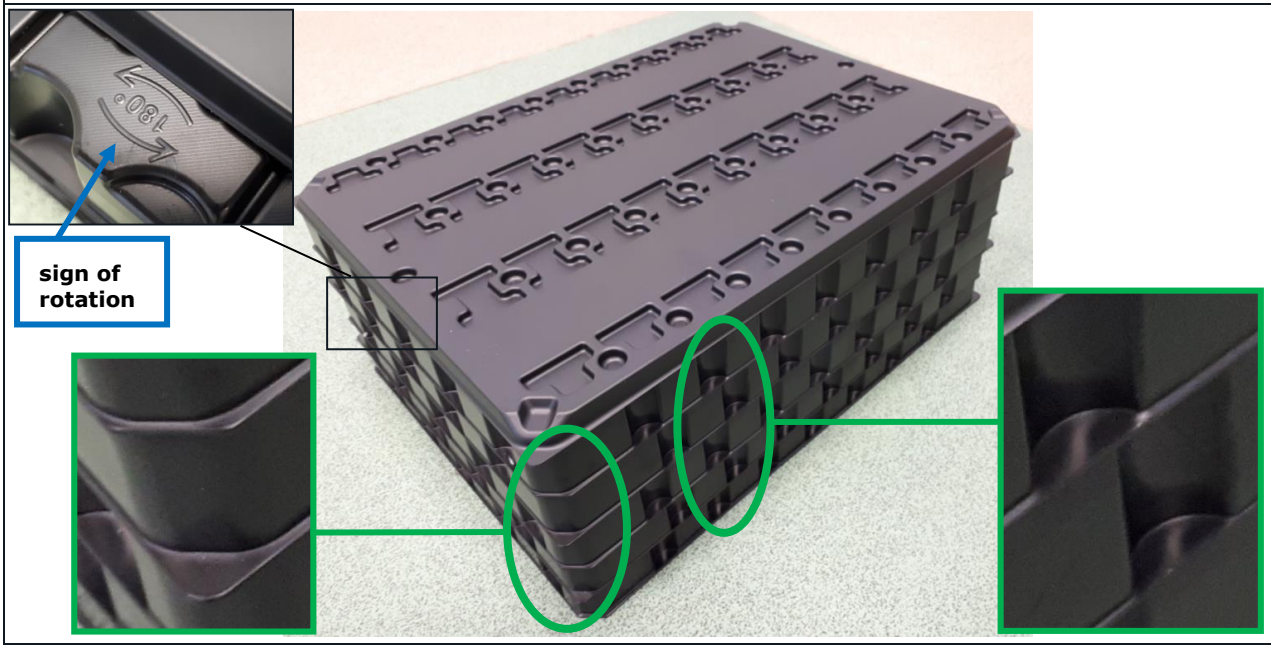



Figure 10: Layer of trays

# 11 Disclaimer

The information and recommendations in this document are based on standards and common engineering practices. Customer specific applications and specifications may require additional processes and tests that may supersede those recommended in this document.