Handling Instructions
for flow 0 packages

This document is valid for all type of flow 0 modules:
12 mm & 17 mm housing, 2 & 4 clips versions, 4 tower version, with solder & Press-fit pins, thick & thin ceramic

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Table of Contents

1 General assembly instructions ................................................................. 6
2 Specification for PCBs .................................................................................. 7
2.1 Specification for modules with Press-fit pins ........................................... 7
2.2 Specification for modules with solder pins ............................................... 9
2.3 Specification for modules with Press-fit pins that are soldered to the PCB .... 10
2.4 Required PCB cutouts for module with 2-clips ....................................... 11
2.4.1 For module with 2-clips and soldered into the PCB .............................. 11
2.4.2 For module with 2-clips and pressed into the PCB ............................... 12
2.4.3 For module with 4-clips and soldered into the PCB .............................. 13
3 Specification for module backside surface ............................................... 14
3.1 Polishing, discoloration ........................................................................... 14
3.2 Scratches, etching holes, steps ............................................................... 14
4 Specification for heat sink .......................................................................... 15
5 Specification for thermal interface materials ............................................ 16
5.1 OPTION 1: Thermal paste ..................................................................... 16
5.2 OPTION 2: Thermal foil: ....................................................................... 16
5.3 OPTION 3: Pre-applied thermal interface material .................................. 17
6 Specification for fastening screws to the heat sink .................................... 18
6.1 Screw with pre-assembled washers ......................................................... 18
6.2 Mounting with automatic screwdriver .................................................... 19
7 Mounting options of modules with Press-fit pins ..................................... 20
8 Press-in process of modules with Press-fit pins ....................................... 20
8.1 Press-in construction .............................................................................. 20
8.1.1 Press-in tool ........................................................................................ 21
8.1.1.1 Module without thermal interface material ...................................... 21
8.1.1.2 Modules with thermal interface material .......................................... 22
8.1.2 Supporting tool ................................................................................... 23
8.2 Press-in process parameters .................................................................... 24
8.2.1 Basic requirements for the press-in process ........................................ 25
8.3 Process control parameters ..................................................................... 25
9 Press-out process for modules with Press-fit pins ..................................... 27
9.1 Press-out tool .......................................................................................... 28
9.2 Press-out process characteristics ............................................................. 29
9.2.1 Press-out process parameters .............................................................. 30
9.3 Disassembling by hand ............................................................................ 30
10 Mounting options of modules with solder pins ....................................... 31
Table of Contents

10.1 Modules with 4 towers
10.1.1 Using screws to fix the module to the PCB
10.1.2 Using soldering jig (without using screws)
10.2 Modules with 2 clips
10.2.1 Mounting by hand
10.2.2 Mounting with clip-in tool
10.3 Modules with 4 clips
10.3.1 Mounting by hand
10.3.2 Mounting with clip-in tool
11 Permitted deformations of the clips and springs
12 Recommendation for soldering
12.1 Solderability specification
12.2 Wave soldering of modules with solder pins
12.3 Hand soldering parameters
13 ESD protection
14 Environmental conditions
14.1 Parameters of environment classes
14.1.1 Climatic conditions
14.1.2 Biological conditions
14.1.3 Chemically active substances
14.1.4 Mechanically active substances
14.1.5 Mechanical Conditions
14.2 Handling of trays
15 Disclaimer
Revision History

1. Figure: Module with PCB and heat sink ................................................................. 6
2. Figure: Press-fit pin types ..................................................................................... 7
3. Figure: Chemical tin plating (for illustration only, no real proportions) ..................... 8
4. Figure: HAL tin plating (for illustration only, no real proportions) ................................. 8
5. Figure: Copper visible on Press-fit pins ................................................................. 9
6. Figure: Solder pin types ......................................................................................... 9
7. Figure: PCB cutouts for two-clip modules which are soldered, at various board thicknesses 11
8. Figure: PCB cutouts for two-clip modules which are pressed-in ................................. 12
9. Figure: PCB cutouts for modules with 4 clips .......................................................... 13
10. Figure: (left to right): Polished, discoloration of, and fingerprint on the surface .......... 14
11. Figure: Scratch and etching hole dimensions ...................................................... 15
12. Figure: Thermal paste honeycomb pattern ......................................................... 16
13. Figure: Recommended thermal foil dimensions ................................................... 17
14. Figure: Recommended torque and speed curve ..................................................... 19
15. Figure: Recommended construction for the press-in process ................................. 20
16. Figure: Press-in tools closed, module is pressed-in ............................................... 21
17. Figure: Recommended press-in tool for modules without thermal interface material ..... 22
18. Figure: Recommended press-in tool for modules with thermal interface material ...... 23
19. Figure: The recommended hole and cutout dimensions for supporting tool ............. 24
20. Figure: Press-in depth in PCB ............................................................................. 25
21. Figure: Typical press-in diagram of a 20 pin module ............................................ 26
22. Figure: Exploded view of the press-out tool ......................................................... 27
23. Figure: Working position of the press-out tool ..................................................... 27
24. Figure: Recommended dimensions of the upper tool .......................................... 28
25. Figure: Recommended dimensions of the lower tool .......................................... 29
26. Figure: Force-path diagram of the press-out process .......................................... 30
27. Figure: Cutting edge ............................................................................................ 30
28. Figure: Assembly illustration .............................................................................. 31
29. Figure: Hand mounting steps .............................................................................. 32
30. Figure: Clip-in tool .............................................................................................. 33
31. Figure: Mounting operation provided by the clip-in tool ....................................... 33
32. Figure: Hand mounting operation for 4 clip module ............................................. 34
33. Figure: Clip-in tool .............................................................................................. 35
34. Figure: Permitted deformation of the clips and springs ....................................... 36
35. Figure: Plated through hole, good soldering ....................................................... 37
36. Figure: Examples of discolored solder pins .......................................................... 37
37. Figure: Typical profile for wave soldering ............................................................. 38
38. Figure: Layer of trays ......................................................................................... 43
## Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision Level</th>
<th>Description</th>
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</tr>
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<td>Heat sink flatness, thermal paste thickness</td>
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1 General assembly instructions

The flow 0 type modules have to be mounted to a PCB. The electrical connections between module and the PCB can be made by soldering or by using Press-fit technology. In applications where the module is attached to a heat sink, the PCB must also be attached to this heat sink. 1. Figure: shows how this attachment can be achieved with threaded spacers.

![Diagram of module, PCB, and heat sink](image)

1. Figure: Module with PCB and heat sink

The distance between the top surface of the heat sink and the bottom plane of the PCB is defined by the module type, which can be 12 mm or 17 mm. PCB spacers can be used to obtain the correct spacing. The number and the position of the fixing points depend on the design of the circuit, the location of different masses like capacitors or inductors and the environment of the system. General recommendation cannot be given. For recommended heights of these spacers see the sections of mounting options (section 7, 10).

Typical (recommended) assembly sequence:

1. Attach module to the PCB
2. Position and fix the assembled PCB with spacers to the heat sink
3. Fix the module to the heat sink

During the assembly process, a single pin is not allowed to be drawn or pushed more than ±0.2 mm or loaded with a force greater than 35 N (except during pressing-in of Press-fit pins). The special design of the Press-fit pins prevents higher than 0.1 mm deformation of pins during the pressing-in process.

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.

2.1 Specification for modules with Press-fit pins

- Printed board thickness must not be less than 1.6 mm (thinner PCBs require additional testing and will be performed upon request).
- PCB should be covered with solder mask on both sides.
- Plated-through-hole specification:

<table>
<thead>
<tr>
<th></th>
<th>Flow0 with Press-fit pin type “Y”</th>
<th>Flow0 with Press-fit pin type “T”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole drill diameter</td>
<td>Ø 1.6 ± 0.025 mm</td>
<td>Ø 1.15 ± 0.025 mm</td>
</tr>
<tr>
<td>Copper thickness in wall</td>
<td>&gt; 25 µm</td>
<td>&gt; 25 µm</td>
</tr>
<tr>
<td>Metallization in hole</td>
<td>&lt; 50 µm</td>
<td>&lt; 50 µm</td>
</tr>
<tr>
<td>PTH hole diameter</td>
<td>Ø 1.45 ± 0.09 / -0.06 mm</td>
<td>Ø 1 ± 0.09 / -0.06 mm</td>
</tr>
<tr>
<td>Minimum Cu width of the annular ring</td>
<td>&gt; 0.1 mm</td>
<td>&gt; 0.1 mm</td>
</tr>
<tr>
<td>Hole position accuracy</td>
<td>± 0.04 mm</td>
<td>± 0.04 mm</td>
</tr>
</tbody>
</table>

2. Figure: Press-fit pin types

The pin type identifier “Y” or “T” can be observed in the product part number.
Example:

10-PZ06NRA041FS02-P965F68Y-/3/
• Plating material:
  o for chemical tin plating (Sn): 0.5 μm to 10 μm
    The PCB can be disassembled and reused 2 more times. Upon further reuse of PCB, module has to be soldered after press-in.

[Diagram: Chemical tin plating (for illustration only, no real proportions)]

o for HAL tin plating (Sn): 0.5 μm to 50 μm
  The PCB can be disassembled and reused 2 more times. Upon further reuse of PCB, module has to be soldered after press-in.

[Diagram: HAL tin plating (for illustration only, no real proportions)]

o Au: not generally released; individual release of PCB system required
  Upon any further reuse of PCB with Au the module has to be soldered after press-in.

• Minimum distance between the edge of the PCB and the centre of the pin hole: 4 mm
• Minimum distance between the centre of the pin hole and the component on the PCB: 4 mm
• For any other requirements IEC 60352-5 standard should be considered
• The press fit pins of flow 0 modules are plated with a continuous tin finish and nickel underlayer to promote Press-fit function and solderability. Due to process and storage conditions the copper may become visible on the bottom of the pin up to the green line indicated on the picture (14. Figure:). This is merely a cosmetic imperfection and does not influence the Press-fit function or solderability of pins as it does not affect the plating quality of the head of the pin.
2.2 **Specification for modules with solder pins**

- The module is attached to the PCB by clipping or screwing it into the appropriate holes.
- The role of the clips is to hold the module in the PCB at a proper position before and during soldering process. For details see section 2.4.
- After mounting of the module, all pins must be soldered (see section 10 and 12).
- The hole diameters on the PCB have to be designed according to the soldering pin (6. Figure):
  - available pin types
    - **W** -type pin
    - **Z** -type pin

For further dimensions or a 3D model please contact your local sales manager.
2.3 Specifcation for modules with Press-fit pins that are soldered to the PCB

In cases where the Press-fit pins are soldered instead of pressed into the PCB the recommended PCB hole diameter is stated in the table below. In these cases, the annular ring must be designed according to the standards for through hole components to ensure proper soldering of the Press-fit pins.

- PCB Hole diameters:

<table>
<thead>
<tr>
<th></th>
<th>Flow0 with Press-fit pin type “Y”</th>
<th>Flow0 with Press-fit pin type “T”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final hole diameter</td>
<td>Ø 1.85 ± 0.1 mm</td>
<td>Ø 1.4 ± 0.1 mm</td>
</tr>
</tbody>
</table>

Please read also section 12 Recommendation for soldering.
2.4 Required PCB cutouts for module with 2-clips

The drawings below show the required PCB-cutouts defined for different PCB thicknesses.

2.4.1 For module with 2-clips and soldered into the PCB

7. Figure: PCB cutouts for two-clip modules which are soldered, at various board thicknesses
2.4.2 For module with 2-clips and pressed into the PCB

The clips have no function in the case of Press-fit modules since the module is held by the Press-fit pins in the PCB. The press-in depth (position) is controlled by the press-in tool. The clip-in function in a Press-fit module is unnecessary because it would provide too strict positioning tolerance. Large cutouts prevent the clip-in function of the clips (see Figure: PCB cutouts for two-clip modules).

Recommended general tolerance: ±0.1 mm (for all dimensions)

8. Figure: PCB cutouts for two-clip modules which are pressed-in
2.4.3 For module with 4-clips and soldered into the PCB

PCB thickness in mm | $d_1$/mm | $l_1$/mm
--- | --- | ---
1.4 $< x < 1.8$ | without holes | 3.1
1.8 $< x < 2.2$ | 2.3 | 3.6
2.2 $< x < 2.8$ | 3.6 | 4.6

9. Figure: PCB cutouts for modules with 4 clips
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 are detailed in the following sections.

3.1 Polishing, discoloration

Acceptance criteria for polishing
- Polishing of modules with Ni plated surface is acceptable if copper doesn’t become visible (if the copper is visible, see criteria for scratches)

Acceptance criteria for discolorations
- discolorations are only surface imperfections (cosmetic) and do not affect the module’s functionality

3.2 Scratches, etching holes, steps

The acceptance criteria for scratches and etching holes are DCB type dependent:
- *Thick* DCB type: used for modules with Y-type and W-type pins (see section 2.1, 2.2)
- *Thin* DCB type: used for modules with T-type and Z-type pins (see section 2.1, 2.2) (exceptions may occur)

Acceptance criteria for scratches:
- Max width of 600 μm
- Max depth of 300 μm → for *thick* DCB type
- Max depth of 200 μm → for *thin* DCB type
- The scratched area must not exceed 5 \% of the total substrate surface.
Acceptance criteria for etching holes:

- Max diameter of 1000 μm and \( \rightarrow \) max. depth of 300 μm for thick DCB type
- Max diameter of 2000 μm and \( \rightarrow \) max. depth of 250 μm for thick DCB type
- Max diameter of 2000 μm and \( \rightarrow \) max. depth of 150 μm for thin DCB type

Steps, Flash

- Max height of 10 μm

4 Specification for heat sink

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

- The flatness tolerance should be: < 25 μm in general.
- 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 (refer to section 3).
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.

![Figure: Thermal paste honeycomb pattern](image)

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 aluminium 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 increase the thermal resistance.
- Recommended foil type: ALC5 or ALF5 (Boyd Corporation)
- Recommended foil dimensions: see 13. Figure: on next page.
5.3 OPTION 3: Pre-applied thermal interface material

- The modules may have already been pre-printed with thermal interface material.
  - For modules with Press-fit pins a unique press-in tool (see section 8.1.1) has to be used or the module has to be mounted first to the heat sink and then pressed into the PCB.
  - 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 Ø 8 mm can be fitted into the module.
- Spring washer DIN127 or DIN 128
- Mounting torque: \(1.6 \text{Nm} < M_s < 2 \text{Nm}\)
- For modules with AlN and thin \(\text{Al}_2\text{O}_3\) DCB: tighten both screws with half torque first, and then tighten both screws with max. torque afterwards

A torque wrench shall be used to tighten the mounting screws at the specified torque as excessive torque may result in damage or degradation of the device. The inaccuracy of torque wrench tightening method can range up to ±12 %. This has to be taken into account to prevent over-tightening the fastener.

Due to excessive temperature fluctuations washers should be used to prevent the loosening of the screws. After accurate tightening of the screws the spring washer exerts a constant force on the joint. The flat washer distributes this force on the plastic surface.

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 specifications of these screws are 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 Ø 8 mm can be fitted into the module.
- Split lock spring washer according to DIN 6905 (JIS B1251)
- Mounting torque range: \(1.6 \text{Nm} < M_s < 2 \text{Nm}\)
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

14. Figure: Recommended torque and speed curve
7 Mounting options of modules with Press-fit pins

- In the case of modules with Press-fit pins, the usage of the mounting by clipping or screwing to the PCB of the module is not recommended.
- Recommended spacer height:
  - $12.1^{\pm0.1}$ mm in the case of 12mm type modules
  - $17.1^{\pm0.1}$ mm in the case of 17mm type modules

8 Press-in process of modules with Press-fit pins

8.1 Press-in construction

15. Figure: Recommended construction for the press-in process
• The module can be pressed into the PCB from the top (as 15. Figure: & 16. Figure: show) or the PCB can be pressed onto the module from the top (the module is below the PCB).
• The preferred method is to press the module into the PCB from the top. This method will be discussed in this document.
• Pressing multiple modules into one PCB can be done one by one (subsequently) or all at once.
• Pressing multiple modules at the same time requires a press-in tool according to the above detailed single tool. The tool has to ensure the correct leveling of the modules and PCB to avoid mechanical stress.
• The “U-shape” tool (16. Figure:) is only because to keep the distance between the PCB and the module. Depending on the PCB layout the geometry and the position of this distance keeper can be different. Minimum distance between tool and the components on the PCB: 4 mm

8.1.1  **Press-in tool**

The press-in tool protects the module from being over pressed.

8.1.1.1  **Module without thermal interface material**

Material requirements for the press-in tool:
• Tool steel grade 21 MnCr 5 with yield strength of 660 MPa and hardness of 330 HB or better.
• Maintenance: Due to inherent contamination from process and product tolerance differences, it is recommended to clean the press-in tool regularly.

The dimension marked with ‘x’ on the drawing (17. Figure:) depends on module height:
• 12.1 \( +0.05 \) mm in the case of 12mm type modules
• 17.1 \( +0.05 \) mm in the case of 17mm type modules
8.1.1.2 Modules with thermal interface material

A unique press-in top tool shown in 18. Figure: is needed to prevent significant damage to the phase change material during the press-in process. Small damages (max: Ø 0.6 mm) are allowed.

Requirements for the press-in tool:

- Tool steel grade 21 MnCr 5 with yield strength of 660 MPa and hardness of 330 HB or better.
- Maintenance: Due to inherent contamination from process and product tolerance differences, it is recommended to clean the press-in tool regularly. The desired cleaning interval is once every 100 modules with soft wipes soaked in Isopropyl alcohol.

The dimension marked with ‘x’ on the drawing (18. Figure:) is depends on module height:

- 12.1 +0.05 mm in the case of 12mm type modules
- 17.1 +0.05 mm in the case of 17mm type modules

For more information or a 3D model please contact your local sales manager.
8.1.2 Supporting tool

- The supporting tool supports the PCB during the press-in process. The size and position of the holes and cut-outs depends on the components on the PCB.
- **19. Figure:** shows the recommended hole and cut-out dimensions for the Press-fit pins. The recommended diameter of the holes / cut-outs for the pins in the supporting tool is between 1.7 mm and 4 mm (depending on the positioning accuracy). The minimal supporting place around the hole is 2 mm (the min. distance of PCB components from the PCB pinhole should be also considered here). If the pins are close to each other then it is possible to make a lengthwise cut-out for more pins as well. It is necessary to position the PCB and the module as well. The depth of the cut-outs for the pins is 6 mm.
- The module can be positioned with pins from the bottom tool through the fixing holes of the modules.
- Material of the supporting tool: POM (Polyoxymethylene) ESD proof or any metal alloy.
- The thickness of the supporting tool has to be at least 20 mm.
19. Figure: The recommended hole and cutout dimensions for supporting tool

8.2 Press-in process parameters

The total press-in force depends on the number of the pins the hole-diameter and the plating (type/quality) of the PCB.

<table>
<thead>
<tr>
<th>Press-in process parameters</th>
<th>Flow0 with Press-fit pin type “Y”</th>
<th>Flow0 with Press-fit pin type “T”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press-in force</td>
<td>70-160 N/pin</td>
<td>20-100 N/pin</td>
</tr>
<tr>
<td>Press-in speed</td>
<td>5 – 10 mm/s</td>
<td>1 – 10 mm/s</td>
</tr>
</tbody>
</table>
8.2.1 Basic requirements for the press-in process

- The Press-fit pins have to be pressed to the correct depth into the holes of the PCB. The center of the Press-fit pin head has to be at least 0.5 mm below the top surface and at least 0.5 mm above the bottom surface of the PCB. (20. Figure:).

This condition is automatically fulfilled with the use of the recommended press-in tool. 16. Figure: shows the closed press-in tool with the module.

8.3 Process control parameters

If the press machine is equipped with the possibility to record the force-stroke values during the process, the following quality relevant values should be taken into consideration. 21. Figure: shows a normal press-in diagram.

Three different sections can be seen on the diagram:

- First raising section (blue): The heads of the Press-fit pins slide into the holes and deform to fit in the holes. This section ends with a local maximum.
- Second section (green): The pin slides in the holes to reach the final position. The centre of the pin heads are inside the holes and do not deform any longer. This section ends with a local minimum.
- Second raising section (red): press-in tool touches the PCB and the sliding of the pins is stopped. The press-in tool starts to bend the PCB.

The pressing-in has to be stopped at the beginning of the second raising section, not exceeding the actual max force of the first rising section, to avoid damaging the PCB or the deformation of the plastic housing. The press-in force or the motion stroke of the tool has to be controlled to stop at the beginning of the second raising section.

Possible process control parameter settings are as follows:

- The local maximum value (end of blue section) of the force-stroke diagram has to be:
  - higher than 70 N x number of the pins,
  - smaller than 160 N x number of the pins.
- These limits are marked on the diagram. If the press-in force does not fit in the interval defined above, it can indicate faulty plating, or improper diameter of the holes.
21. Figure: Typical press-in diagram of a 20 pin module
9 Press-out process for modules with Press-fit pins

Please note: In the case an out-pressed module should be used again, it is necessary to solder the module to the PCB because of the remaining deformation of the pins. This is because the Press-fit zone will keep a remaining deformation after the press-out process. An additional press-in cycle will result in low holding forces between the Press-fit pin and the PCB hole. Additional information for the annular ring can be found in section 2.3.

22. Figure: Exploded view of the press-out tool

23. Figure: Working position of the press-out tool
9.1 Press-out tool

The specific tool to disassemble the modules from the PCBs has two parts similar to the press-in tool. The lower part serves as a backing for the PCB. It has a backing nest and supporting pins. It is important that the backing has to be as close as possible to the sides of the module. The supporting pins are in line with the fixing pins of the upper part. There may be components mounted to the PCB in the area of the backing. It is possible to cut out the nest in this case.

The upper part consists of two pressing plates that are connected by springs. The pins on the lower plate serve to fix the PCB. With the aid of these parts, the bending of the PCB can be prevented during pressing.

The ram fastened to the upper plate is designed according to the positions of the parts on the PCB and the layout of the pins.

It is not possible to press the module out with a flat plate if the PCB is thicker than 2.5 mm due to the overhang of the pins. In this case, pressing sticks positioned according to the pin layout are necessary.

- Recommended spring force: 25 N/mm
- Recommended number of springs: 4 Pieces

24. Figure: Recommended dimensions of the upper tool
25. Figure: Recommended dimensions of the lower tool

9.2 Press-out process characteristics

After inserting the module into the nest, the downward moving press fixes the PCB with the lower plate through the springs. The pins are pressed through by the onward moving pressing ram.

26. Figure: shows a typical force-distance diagram of the press-out process for a 20 pin module. It is typical for this curve that a characteristic peak appears which indicates the breaking of the cold welded connection.
9.2.1 Press-out process parameters

<table>
<thead>
<tr>
<th></th>
<th>Flow0 with Press-fit pin type “Y”</th>
<th>Flow0 with Press-fit pin type “T”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press-out force</td>
<td>&gt;40 N/pin</td>
<td>&gt;20 N/pin</td>
</tr>
<tr>
<td>Press-out speed</td>
<td>1 – 10 mm/s</td>
<td>1 – 10 mm/s</td>
</tr>
</tbody>
</table>

9.3 Disassembling by hand

If the Press-fit pin-head is overlapped by the PCB in such a way that the spring-end is out of the PCB, the disassembling is possible hand pliers. The cutting should be done in such a way that the cutting edge is under the area where the two parts of the pin head join shown as level ‘A-A’ in 27. Figure:. After clipping away all of the pin-heads, it is possible to remove the module from the PCB.
10 Mounting options of modules with solder pins

10.1 Modules with 4 towers
- for minimum overhang of pins IPC-A-610E standard and module datasheet drawing should be considered

10.1.1 Using screws to fix the module to the PCB
- Insert the module pins into the PCB
- Fix the module to the PCB with 4 screws by the towers before soldering (for screws a hole of Ø3 ±0.2 mm is needed on PCB)
- Screw type: BN82428, $D = 2.5$ mm and $L = 6$ mm with a mounting torque: 0.4 Nm.
- Recommendation for spacer:
  - not necessary to use surrounding the module
  - general height:
    - $11.9^{+0.05}$ in the case of 12 mm modules
    - $16.9^{+0.05}$ in the case of 17 mm modules

28. Figure: Assembly illustration

10.1.2 Using soldering jig (without using screws)
- Insert the module pins into the PCB
- Fix the module to the PCB with soldering jig before soldering
- Recommendation for spacer:
  - use spacers also surrounding the module
  - general height can be variable: has to be adjusted, depending on height of soldering jig and PCB thickness
10.2 Modules with 2 clips

- spacer height depends on PCB thickness, calculated as follows:

<table>
<thead>
<tr>
<th>PCB thickness [mm]</th>
<th>1.4 ≤ S &lt; 1.8</th>
<th>1.8 ≤ S &lt; 2.2</th>
<th>2.2 ≤ S &lt; 2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of module clip [mm]</td>
<td>H =</td>
<td>H =</td>
<td>H =</td>
</tr>
<tr>
<td>2-clips and 12mm type:</td>
<td>13.65</td>
<td>14.15</td>
<td>14.65</td>
</tr>
<tr>
<td>2-clips and 17mm type:</td>
<td>18.65</td>
<td>19.15</td>
<td>19.65</td>
</tr>
<tr>
<td>height of spacer [mm]</td>
<td>h = H - S ±0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- the upon mentioned spacer heights are calculated by nominal PCB thickness, tolerance of PCB should be also considered

10.2.1 Mounting by hand

- Insert the module pins into the PCB and clip in the module (see 29. Figure: Hand mounting steps)
- Burrs are not allowed on the PCB-cutouts
- The necessary force for pushing the clips is
  - 12 N in case of 17 mm modules/side
  - 40 N in case of 12 mm modules/side

<table>
<thead>
<tr>
<th>12 mm modules</th>
<th>17 mm modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Insert the module pins to the PCB and press one arbitrary side of the module gently as shown below until two clips of that side are locked</td>
<td></td>
</tr>
<tr>
<td>2. Press the other side to lock the remaining two clips as shown on the figure below</td>
<td></td>
</tr>
<tr>
<td>3. The mounted module on PCB</td>
<td></td>
</tr>
</tbody>
</table>

29. Figure: Hand mounting steps
10.2.2 Mounting with clip-in tool

In case the cutout on the PCB has sharp edges (milled or drilled), or the PCB is not coated by lacquer, it is strongly recommended to use an auxiliary clip-in tool (see 30. Figure:) as it makes the mounting easier.

For more information or a 3D model please contact your local sales manager.
10.3 Modules with 4 clips

- spacer height depends on PCB thickness, calculated as follows:

<table>
<thead>
<tr>
<th>PCB thickness [mm]</th>
<th>1.4 ≤ S &lt; 1.8</th>
<th>1.8 ≤ S &lt; 2.2</th>
<th>2.2 ≤ S &lt; 2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of module clip [mm]</td>
<td>H = 18.7</td>
<td>H = 18.7</td>
<td>H = 18.7</td>
</tr>
<tr>
<td>4-clips and 17mm type:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>height of spacer [mm]</td>
<td>h = H - S ±0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.3.1 Mounting by hand

1. Insert the module pins to the PCB and press one arbitrary side of the module gently as shown below until two clips of that side are locked

2. Press the other side to lock the remaining two clips as shown on the figure below

3. The mounted module on PCB

32. Figure: Hand mounting operation for 4 clip module
10.3.2 Mounting with clip-in tool

It is recommended to use a clip-in tool as it makes mounting easier.

For more information or a 3D model please contact your local sales manager.
11 Permitted deformations of the clips and springs

12 mm housing

17 mm housing

34. Figure: Permitted deformation of the clips and springs

Maximum allowable force and displacement on the clip and springs:

<table>
<thead>
<tr>
<th>Housing</th>
<th>Clip max. force</th>
<th>max. displacement</th>
<th>Spring max. force</th>
<th>max. displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 mm</td>
<td>70 N</td>
<td>1.2 mm</td>
<td>20 N</td>
<td>1.5 mm</td>
</tr>
<tr>
<td>17 mm</td>
<td>20 N</td>
<td>1.5 mm</td>
<td>20 N</td>
<td>1.8 mm</td>
</tr>
</tbody>
</table>
12 Recommendation for soldering

12.1 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.

35. Figure: Platedthrough 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 36. Figure:.

36. Figure: Examples of discolored solder pins
12.2 Wave soldering of modules with solder pins

Soldering of certain modules with Press-fit pins is also possible using the wave soldering process. Wave soldering cannot be performed on all type of Press-fit modules.

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

13 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: IEC 61340-5-1, ANSI/ESD S20.20
14 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 and the modules with Press-fit pins have 2 years shelf life with the given storage conditions.

Flammability classification of the plastic material for flow 0 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.

14.1 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.

14.1.1 Climatic conditions

1K2

- **Air temperature:** 5 ºC to 40 ºC
- **Humidity:** 5 % to 85 % RH but max. 1 g/m³ to 25 g/m³ absolute
- **Rate of change of temperature:** 0.5 ºC/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 ºC to 60 ºC
- **Change of temperature air/air:** ±25 ºC
- **Relative humidity not combined with rapid temperature changes:** max. 75 % (at 30 ºC temperature)
- **Relative humidity combined with rapid temperature changes:** No
- **Low air pressure:** 70 kPa
- **Change of air pressure:** No
- **Solar radiation:** 700 W/m²
- **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

14.1.2 Biological conditions
1B1
Flora and fauna: Negligible

2B1
Flora and fauna: No

14.1.3 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/m³
Hydrogen sulphide: 0.01 mg/m³
Chlorine: 0.01 mg/m³
Hydrogen chloride: 0.01 mg/m³
Hydrogen fluoride: 0.003 mg/m³
Ammonia: 0.3 mg/m³
Ozone: 0.01 mg/m³
Nitrogen oxides: 0.1 mg/m³ (Expressed in equivalent values of Nitrogen dioxide.)

2C2
Sea salts: none
Sulphur dioxide: 0.1 mg/m³
Hydrogen sulphide: 0.01 mg/m³
Nitrogen oxides: 0.1 mg/m³ (Expressed in the equivalent values of Nitrogen dioxide.)
Ozone: 0.01 mg/m³
Hydrogen chloride: 0.1 mg/m³
Hydrogen fluoride: 0.003 mg/m³
Ammonia: 0.3 mg/m³

14.1.4 Mechanically active substances
1S2
Sand: 30 mg/m³
Dust (suspension): 0.2 mg/m³
Dust (sedimentation): 1.5 mg/(m²h)

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

14.1.5 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/s²

Static load: 5 kPa

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 m²/s³
Frequency range: 10 Hz to 200 Hz
and
Acceleration spectral density: 0.3 m²/s³
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/s²
and
Shock response spectrum type II.
peak acceleration: 300 m/s²

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

<table>
<thead>
<tr>
<th>Specimen Weight [kg]</th>
<th>Drop Heights [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Level</td>
</tr>
<tr>
<td>up to 9,5 kg</td>
<td>460</td>
</tr>
<tr>
<td>over 9,5 to 18,6 kg</td>
<td>310</td>
</tr>
<tr>
<td>over 18,6 to 27,7 kg</td>
<td>200</td>
</tr>
<tr>
<td>over 27,7 kg</td>
<td>200</td>
</tr>
</tbody>
</table>

| 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/s²
Static load: 10 kPa
14.2 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.

38. *Figure:* shows the trays in wrong and in good positioning.

<table>
<thead>
<tr>
<th>NOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>on the edge and on the sideway the same shape are on each other, no ‘step’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>on the edge and on the sideway there is a ‘step’</td>
</tr>
</tbody>
</table>
15 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.