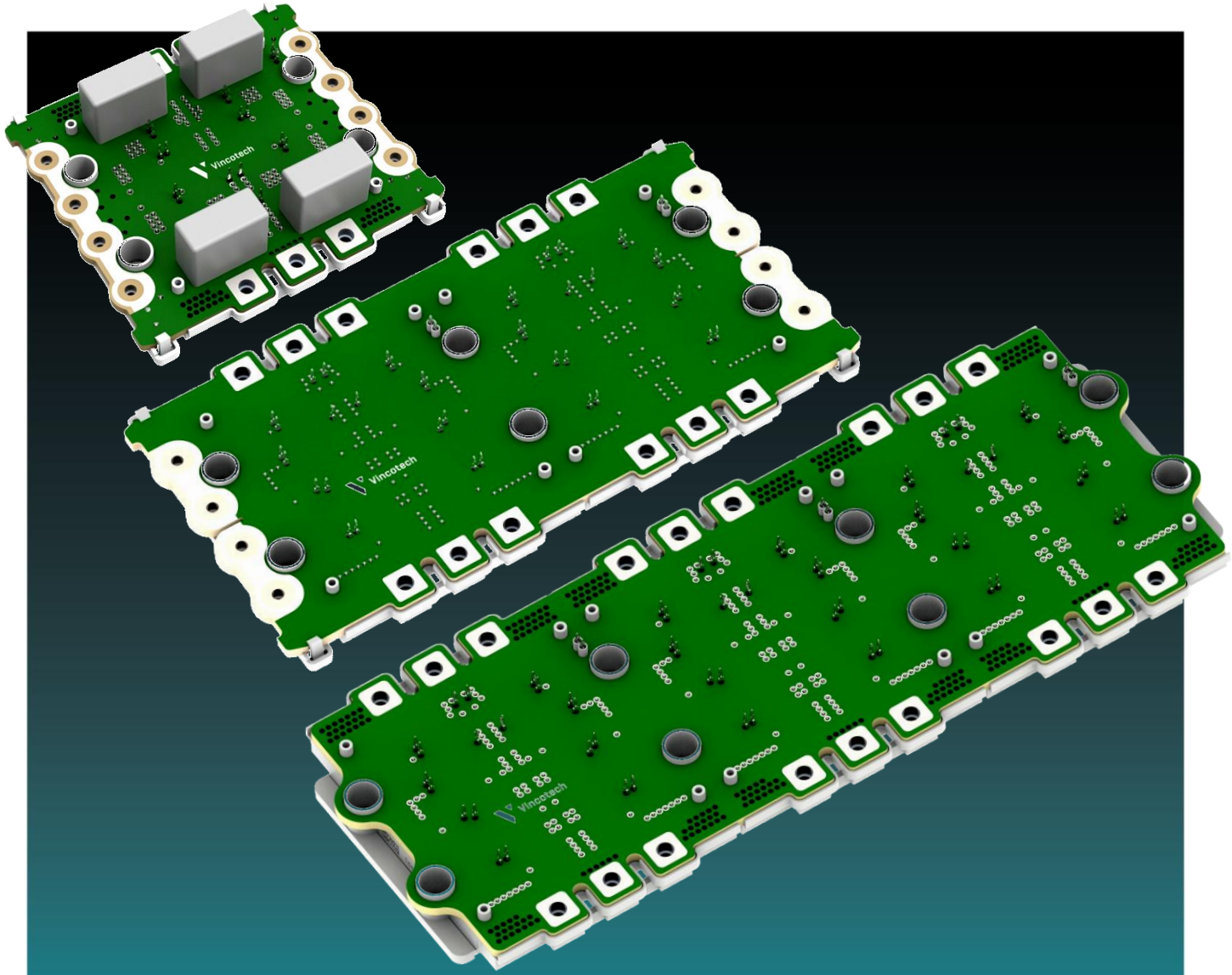
Vincotech

Handling Instructions

for all VINco X4, VINco X8 and VINco X12 package types



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Revision History

Date	Revision Level	Description	Page Number(s)
17.01.2017	05	VINco X name change, assembly sequence, press-fit properties, main terminal screw spec., free fall test	6, 7, 11, 15, 21
23.06.2015	04	New template; Change/extend Sections: 2.1, 4, 10.1, 13	all; 7, 9, 17, 18
29.09.2014.	03	Remove section 5.2; Modification at section 5.1	
14.05.2014	02	Remove section 6.2	
20.02.2014	01	New document	

1 General instructions

Figure 1 shows the basic structure of the VINco X type modules. It is attached to a heat sink with the driver PCB that is mounted on the top of the module. Electrical connections between the module and driver PCB are soldered or press-fitted. Fasten main terminals to bus bars using the screw types specified in section 7. The hex nut holders shown in Figure 1 are used for applications where modules operate in multiphase systems or in parallel. An optional connector PCB is available on demand for such applications. See section 9 for details.

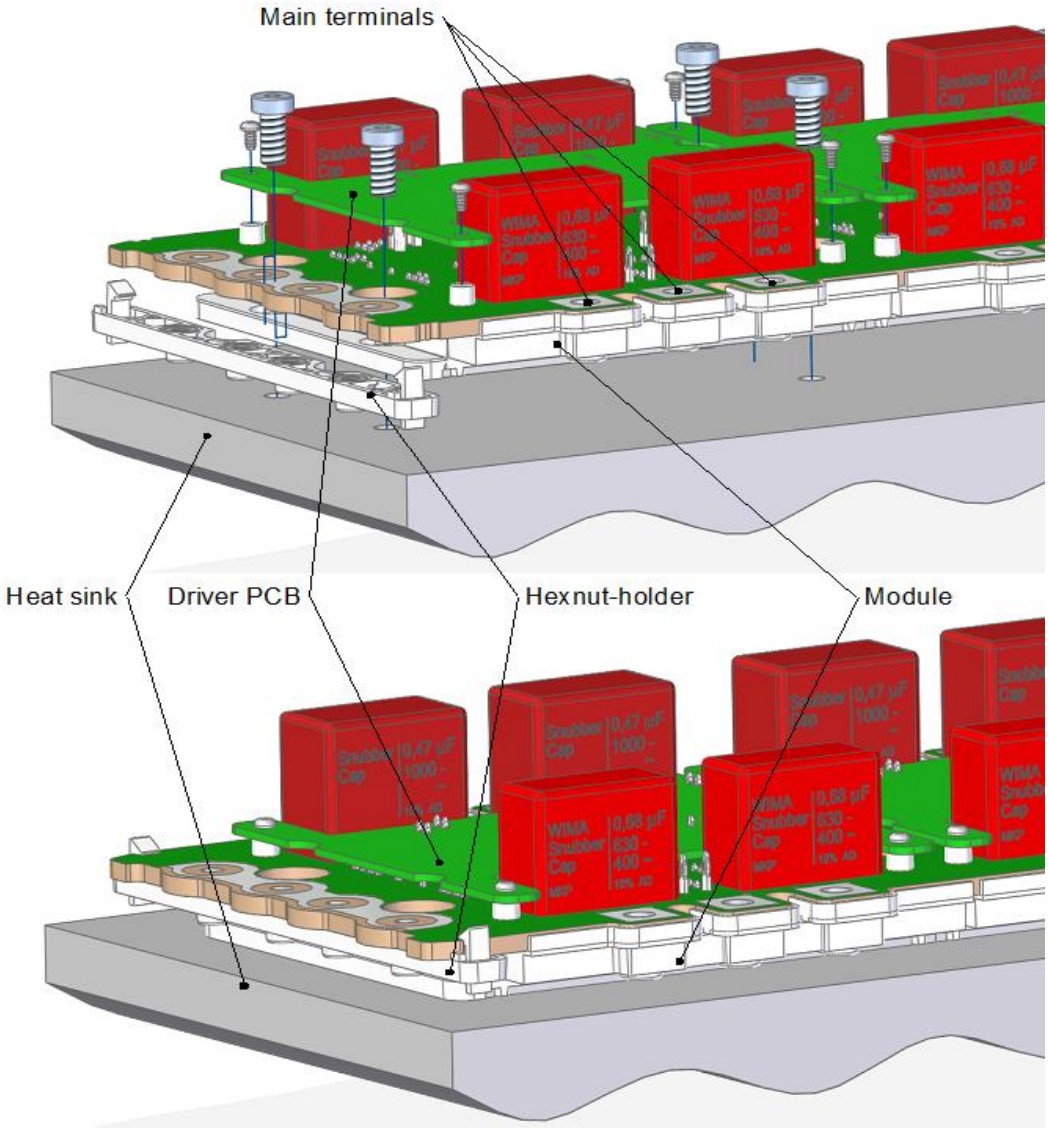

Figure 1: Module with driver PCB and heat sink

The distance between the top of the heat sink and the center plane of the driver PCB is 20.68 mm ±0.2 mm centered on the press-fit zone as shown in Figure 2.

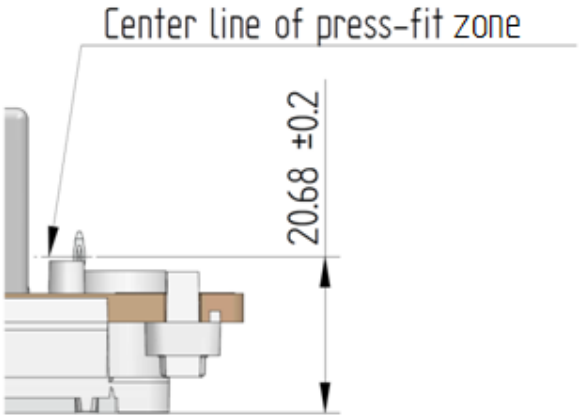

Figure 2: Height of the press-fit zone center line from the bottom of the baseplate

During PCB assembly, do not pull or push auxiliary press-fit or soldered pins more than ±0.2 mm, or exert a force greater than 35 N except when press-fitting pins. Press-fit pins are designed to prevent pin deformations greater than 0.1 mm when they are pressed in.

After mounting, pin tension may not exceed ±5 N at a maximum substrate temperature of 100 °C.

Typical (recommended) assembly sequence:

1. Attach the driver PCB to the module
2. Fix the module to the heat sink
3. Fix the power screw connections to main terminals

2 Specification for the driver PCB

- Printed board material must comply with IEC 61249-2-7.
- There is no limit as to the maximum number of conductive layers.

The driver PCB attaches to the module with four BN82428 type screws (D=2.5 mm and L=6 mm). The recommended mounting torque is 0.4 Nm. Figure 3 shows the recommended holes and cutouts on the driver PCB.

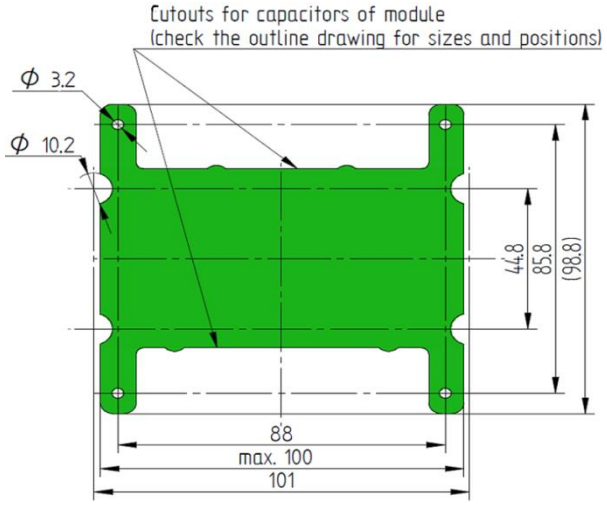

Figure 3: Recommended hole and cutout sizes on the driver PCB

2.1 Specification for modules with Press-fit pins

- Printed board thickness must not be less than 1.6 mm ±10% (thinner PCBs require additional testing and will be performed upon request).
- PCB should be covered with solder mask on both sides.
- Plated through-hole specifications for Press-fit pin:
  - Hole diameter before plating: 1.6 mm ± 0.025 mm
  - Thickness of the PTH wall > 25 µm Cu
  - Plated hole final dimension: 1.45 mm +0.09 / -0.06 mm
  - Minimum Cu width of the annular ring > 0.1 mm
  - Through hole position accuracy ±0.04 mm
- Plating material:
  - for chemical tin plating (Sn): 0.5 µm to 10 µm

The PCB can be disassembled and reused 2 more times.

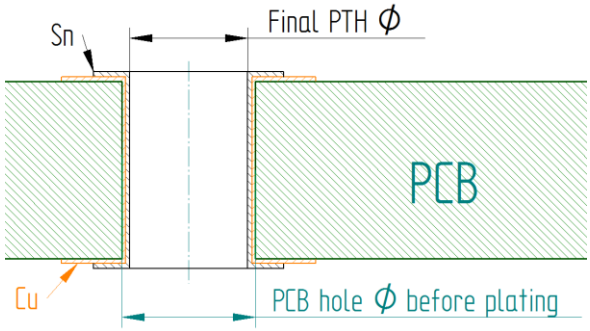

Figure 4: Chemical tin plating (for illustration only, no real proportions)

  - for HAL tin plating (Sn): 0.5 µm to 50 µm

The PCB can be disassembled and reused 2 more times.

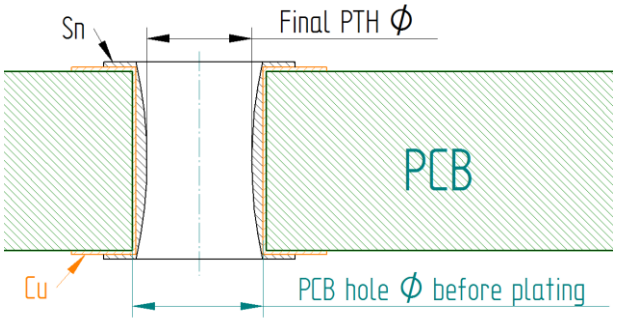

Figure 5: HAL tin plating (for illustration only, no real proportions)

  - Chemical Gold (Au), Silver (Ag) and Organic Solderability Preservative (OSP) are not generally released, individual release of PCB system required
- Minimum distance between edge of the PCB and the centre of the pin hole: 4 mm
- Minimum distance between centre of the pin hole and components on the PCB: 4 mm
- For additional requirements the IEC 60352-5 standard should be considered.

2.2 Specification 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 1.85 mm ± 0.1 mm. 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.

Please read section 10 Recommendation for soldering also.

3 Specifications for baseplate

The thermal properties are not affected if the dimensions of the surface imperfections are within the following values.

- Polishing is allowed on the whole nickel plated surface if copper doesn't become visible.
- If copper becomes visible, the unit is scratched and following acceptance criteria should be used. The depth and width of the scratch can't exceed 200 µm and 800 µm, respectively. The length of the scratch does not matter but the total area of scratches must not exceed 5 % of the total substrate surface.

Discolorations and fingerprints are only surface imperfections and do not affect the module's functionality.

Substrate surface imperfections can be seen on the figures below.

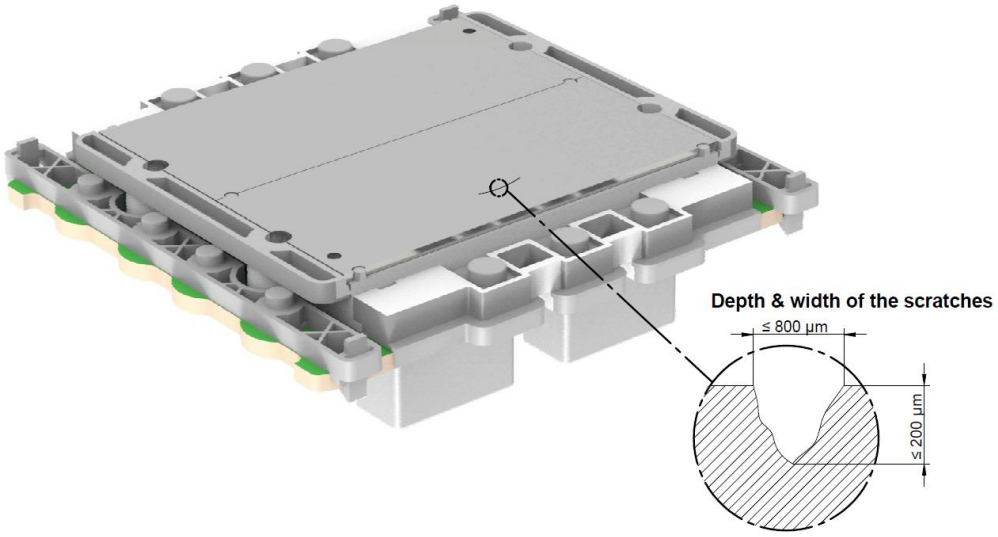

Figure 6: Scratch dimensions

Figure 7: Polished surface

Figure 8: Surface discoloration

Figure 9: Fingerprint on the surface

4 Specifications for heat sink

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

- The flatness tolerance should be: <50 µm in general.

  (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 baseplate surface (please refer to section 3 Specifications for baseplate).

5 Specification for thermal interface materials

The recommended means of applying paste is screen printing. Thermal resistance (R_{th}) increases if the paste is thicker than recommended. Modules are also available with phase

change material (OPTION 2), whereby the $R_{thc\text{-}h}$ is guaranteed, provided that the heat sink specification remains unchanged.

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 110 µm ± 15 µm in both cases.

Thermal paste thicker than recommended will increase thermal resistance (R_{th}).

5.2 OPTION 2: Pre-applied thermal interface material

VINco X modules family is offered with pre-applied phase change material as well. For Further information regarding the handling of modules with pre-applied TIM, see the application note for "*Power modules with Phase-Change Material*" on Vincotech's website.

In order to receive VINco X products with applied phase change material please write:

-/3/

at the end of the product ordering code. Ordering example:

70-W212NMA600SC-M200P-/3/

6 Specifications for fastening screws to the heat sink

- Screws M5 (recommended screw type DIN 7984)
- Flat washer D=max. 10 mm ISO 7092 (DIN 433)
- Spring washer D=max. 10 mm DIN127 or DIN 128
- Mounting torque: 4 Nm < M_a < 6 Nm
- Thread length into the heat sink: min. 9 mm (depending on the material properties of the heat sink and screw)

A torque wrench shall be used to tighten the 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.

Tighten screws in the sequence given below and shown in Figure 10.

1) Attach the module loosely with two diagonal screws, e.g. 1&3, 1&4 or 1&5.
2) Tighten screws with 0.5 Nm torque in the following sequence:
   - VINco X4: screw 1 – 4 – 2 – 3
   - VINco X8: screw 2 – 5 – 1 – 6 – 3 – 4
   - VINco X12: screw 2 – 7 – 3 – 6 – 1 – 8 – 4 – 5
3) Tighten the screws with 5 Nm torque in the same sequence.

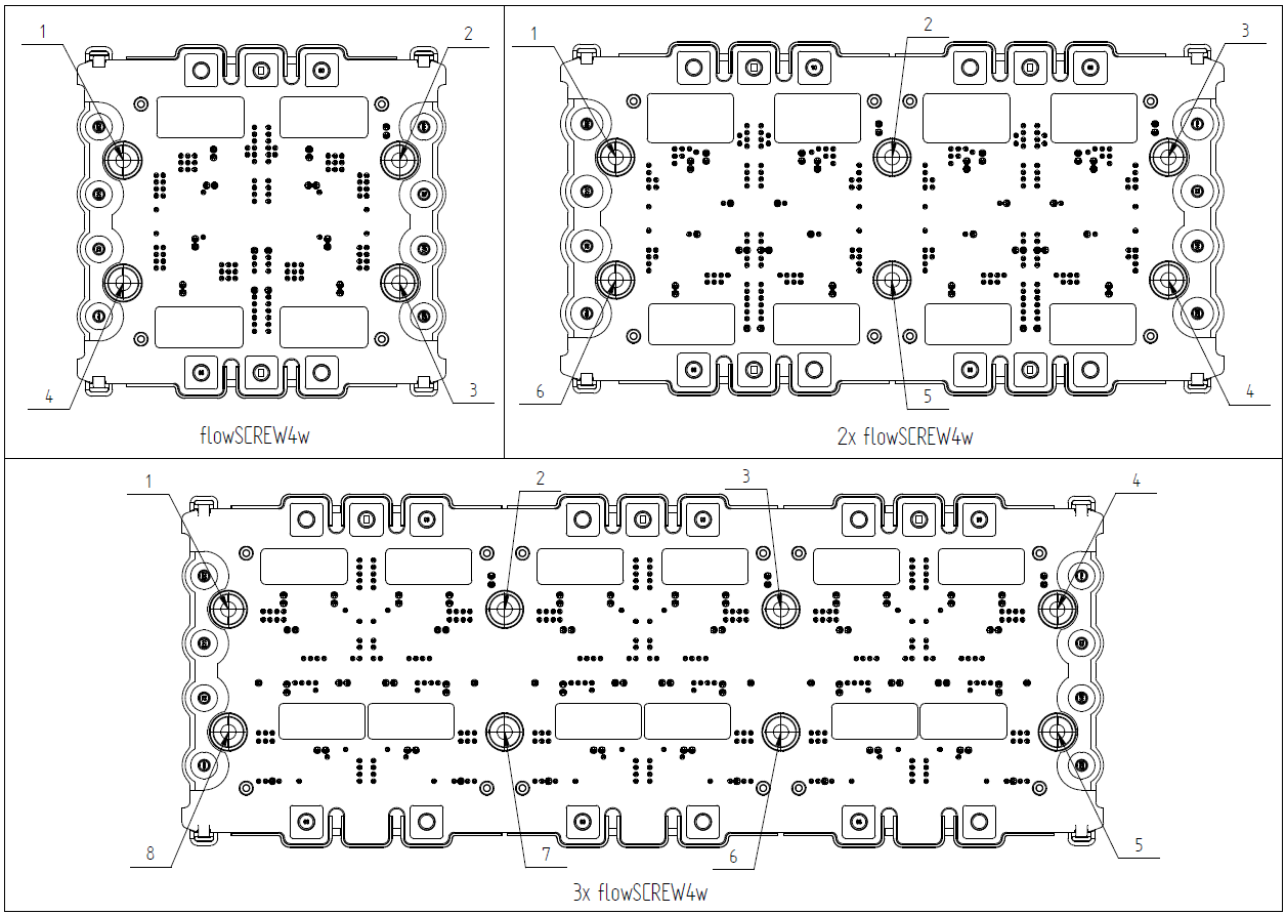

Figure 10: Screw positions in sequence

7 Screw specification for fastening main terminals to bus bars

- M6 screw: DIN 7984 steel or stainless steel. The threaded hole's depth in the module is 12 mm max. from the main terminal's topside. (See the package drawing for detailed dimensions.)
- Mounting torque: 2.5 Nm < Ma < 5 Nm
- Flat washer: ISO 7092 (DIN 433)
- Spring washer: DIN127 or DIN 128
- All connection terminals on the PCB of the VINco X modules are coated with Immersion Tin(Sn).

8 VINco X modules in parallel mode

8.1 Mounting the M4 hex nut holder for side connection

Push in the M4 hex nut-holders from the side of the module and clip the mounting clips into the PCB cutouts (see Figure 11). The shape of the cutout may vary for different PCB thicknesses. M4 hex nut: The hole's depth in the holder is 8 mm max. from the module's topside. (See the outline drawing for detailed dimensions.)

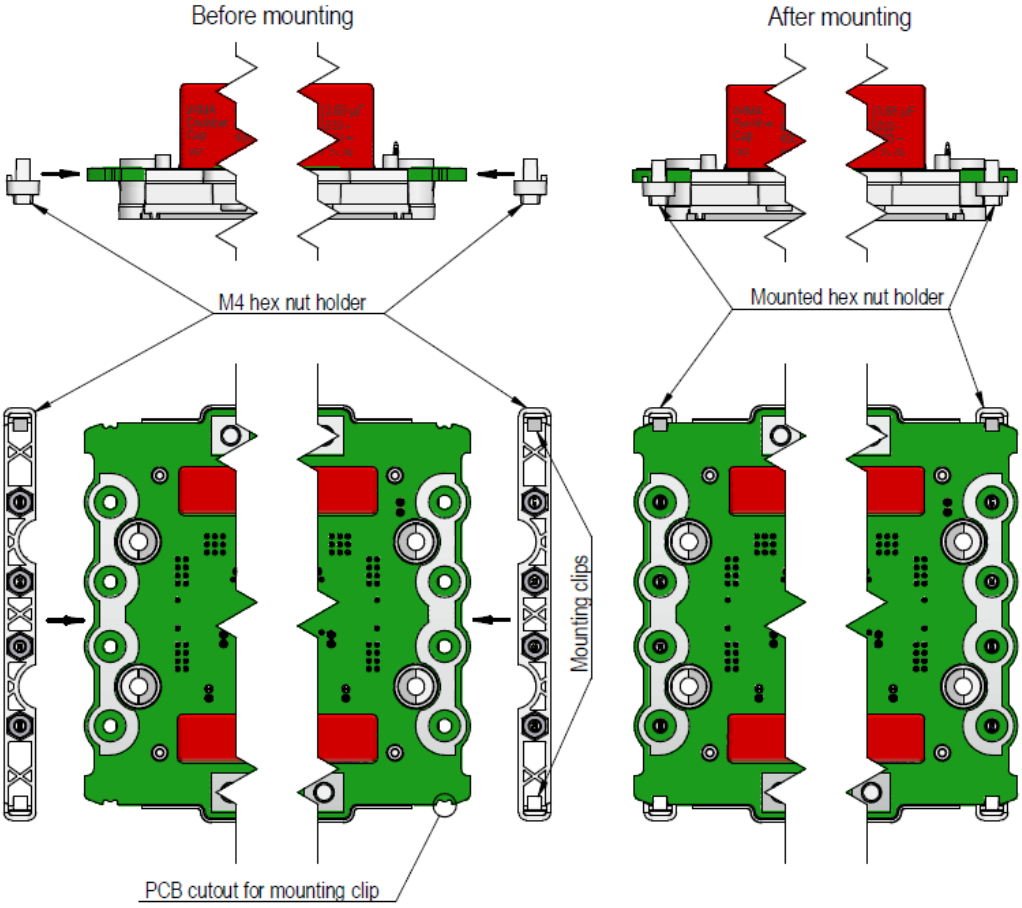

Figure 11: Mounting an M4 hex nut holder

8.2 Interconn PCB

If you wish to operate modules in parallel, mount an Interconn PCB to the side connectors (see Figure 12) after the modules are attached to the heat sink. Use M4 hex nut holders with the following components and torque to fasten it to modules' side connectors:

- M4 screws: DIN 7984 steel or stainless steel.
- Mounting torque: 2 < Ma < 2.2 Nm
- Flat washer: ISO 7092 (DIN 433)
- Spring washer: DIN 127 or DIN 128

Please contact the local sales or distribution office to learn more about Interconn PCBs and ordering codes.

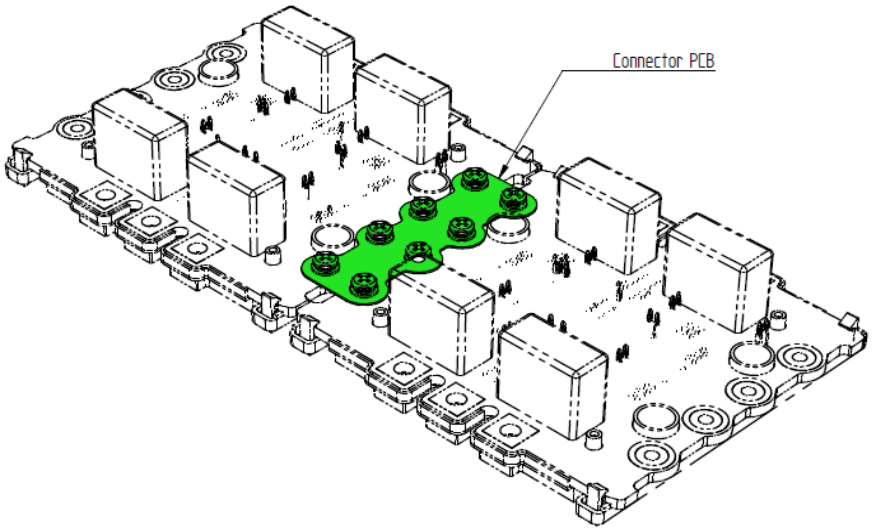

Figure 12: Interconn PCB

9 Press in process of modules with Press-fit pins

9.1 Press-in construction

We recommend pressing the driver PCB onto the module from the top down as shown in Figure 13.

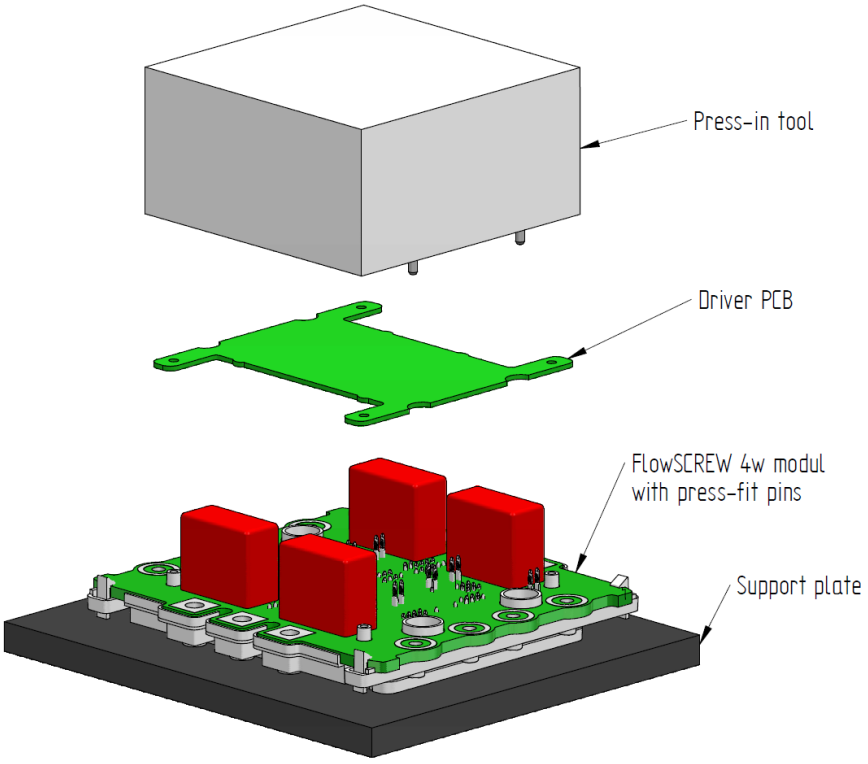

Figure 13: Recommended setup for press-fitting

9.1.1 Press-in tool

Make sure the press-in tool is larger than the driver PCB.

- The recommended diameter of holes/ cutouts for the pins is 1.7 mm to 4 mm, depending on positioning accuracy, as shown on Figure 14. Allow for at least 2 mm supporting space around the pin (Figure 14). An elongated cutout for several pins may be made if the pins are close together. The PCB and module must also be positioned. The size and position of holes and cutouts will be determined by the components on the PCB. Cutouts for pins are to be 6 mm deep.

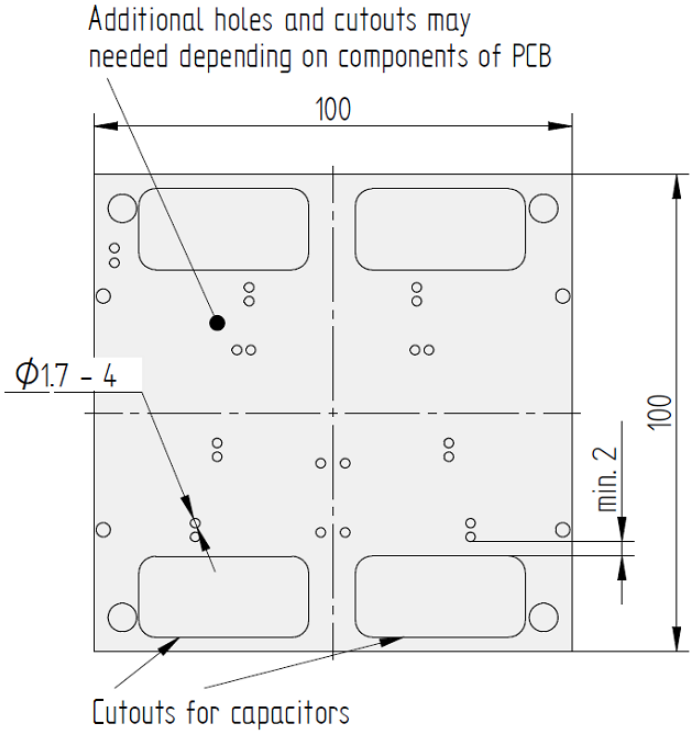

Figure 14: Recommended dimensions for the press-in tool

Recommended material for the press-in tool:

- Tempered aluminum alloy grade 7075-T6 with 430 MPa yield strength and 160 HB hardness or
- Steel-grade 21 MnCr 5 with 660 MPa yield strength and 330 HB or better hardness

9.1.2 Support plate

- The support plate positions and supports the module during press-fitting.
- The recommended material for the support plate is:
  - ESD-proof POM (polyoxymethylene) or any metal alloy

9.2 Press-fit parameters

- Press-in force: 70 N / pin – 160 N / pin
- Press-in speed: 5 mm/s – 10 mm/s
- The total press-in force depends on the number of pins, hole diameter and plating (type/quality) of the PCB.

9.2.1 The basic requirement 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 zone 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. (Figure 15).

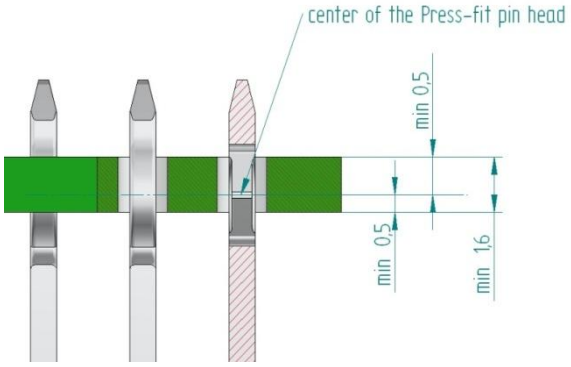

Figure 15: Press-in depth in PCB

9.3 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. Figure 16: Typical press-in diagram of a 20 pin module 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.

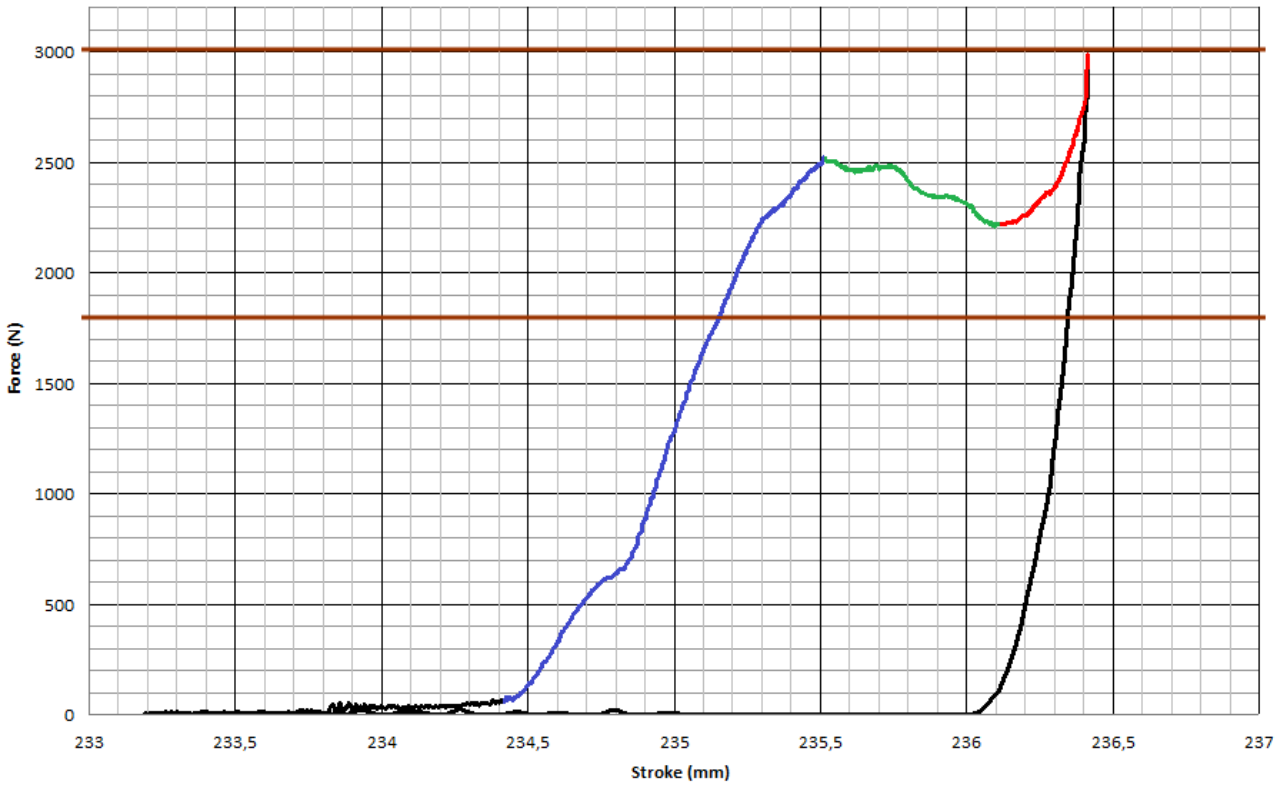

Figure 16: Typical press-in diagram of a 20 pin module

9.4 Disassembling a driver PCB

If the driver PCB is no larger than the module, the PCB cannot be disassembled by pressing it out. In this case, the only way to remove the PCB is to cut the pin ends.

Manual disassembly with pliers is an option if the Press-fit pinhead is overlapped by the PCB so that the spring-end projects out of the PCB. Ensure you cut at level A as indicated in Figure 17 below where the two parts of the pinhead come together. Remove the driver PCB from the module after clipping off all pinheads.

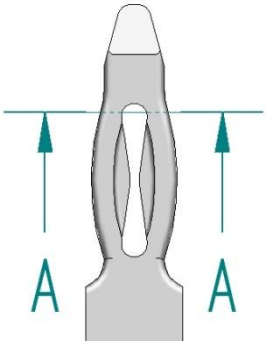

Figure 17: Cutting edge

10 Recommendation for soldering

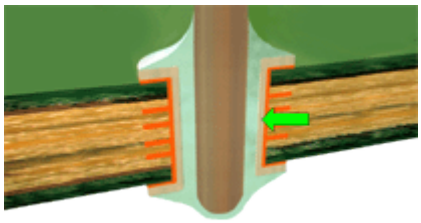

Figure 18: Plated through hole, well soldered

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.

10.1 Wave soldering of modules with solder pins

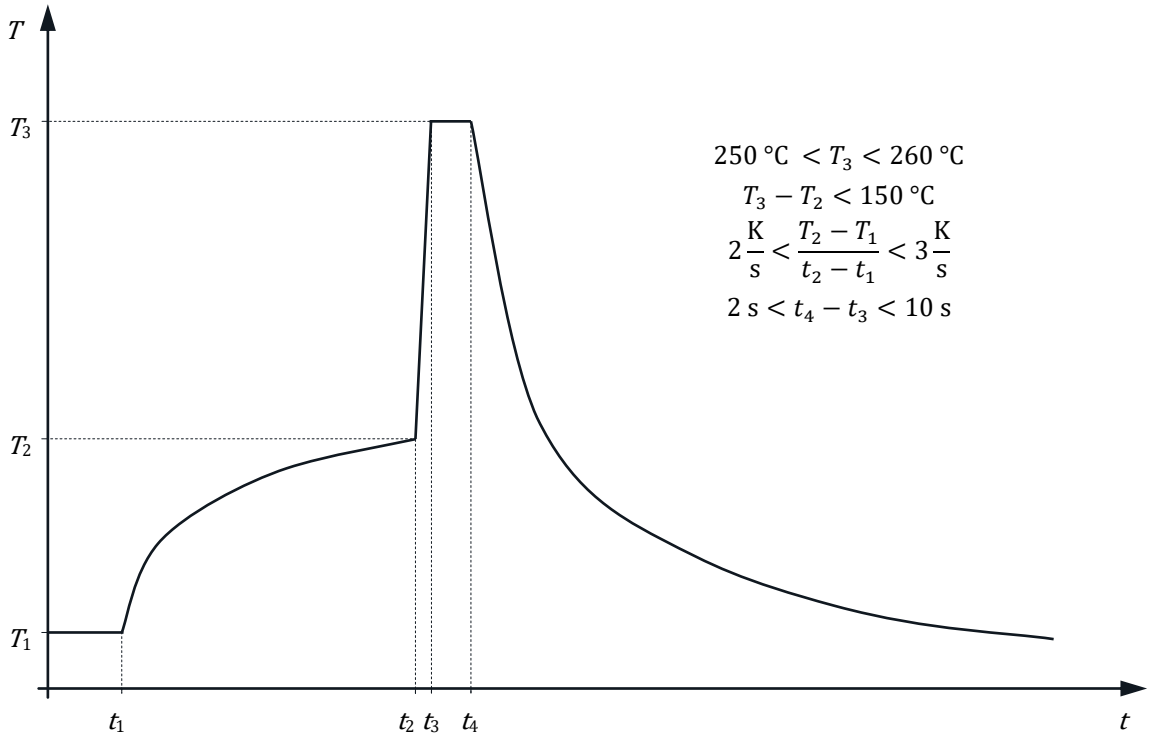

Figure 19: Typical profile for wave soldering

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.

10.2 Hand soldering parameters

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

11 Accessories and application support

Vincotech offers the following application boards for products with VINco X packaging:

- Interconn-M200-P2 (mounted with 4 screws)
- Interconn-M200-P4 (mounted with 8 screws)
- GD-M200-MASTER (master driver board)
- GD-M200-SLAVE (slave driver board)

Please contact your local sales manager for samples and documentation of the adapter boards.

12 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

13 Storage and transportation 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

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

Flammability classification of the plastic material for all VINco X products 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.

13.1 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.

13.1.1 Climatic conditions

1K2

Air temperature:	5 °C to 40 °C
Humidity:	5 % to 85 % RH but max. 1 g/m^3 to 25 g/m^3 absolute
Rate of change of temperature:	0.5 °C/min
Air pressure:	70 kPa to 106 kPa
Solar radiation:	700 W/m^2
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

13.1.2 Biological conditions

1B1

Flora and fauna:	Negligible

2B1

Flora and fauna:	No

13.1.3 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

13.1.4 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

13.1.5 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

14 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.