Mounting Instruction
SEMITRANS®10

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Prepared by:	Jan Sitar
Approved by:	Lars Bocklisch, Roman Gogola

Keyword: Mounting Instruction for SEMITRANS®10

1. Introduction

This mounting instruction will provide some recommendations regarding handling of the SEMITRANS®10 power modules, surface specifications, applying thermal paste as well recommending mounting procedures.

Not all information shown are binding. The data provided cannot anticipate and take into account each individual application. The herewith-described recommendations do not replace a detailed evaluation and examination by the customer itself.

2. ESD Protection

SEMITRANS®10 modules are sensitive to electrostatic discharge (ESD), because electrostatic discharge may damage or destroy sensitive semiconductor devices inside. SEMITRANS®10 modules are ESD protected via an ESD protecting shipment box (blister). With opening the shipment box and when handling and assembling the modules, it is mandatory to wear a grounded wrist strap and to use a grounded workplace.

Figure 1: ESD attention label

All staff should be trained for correct ESD handling. The user must observe all precautions in order to avoid electrostatic discharge during handling, movement and packing of these components.

Figure 2: Enclosed inner ESD package with SEMIKRON Logo (1), ESD protection blister (2) and with ESD (electrostatic sensible device) marking tape (3)

Figure 3: Enclosed outer package with ESD (electrostatic sensible device) marking tape (1) and with package label (2), left side of the package

Figure 4: SEMIKRON SEMITRANS®10 Description of outer package box label

Description of outer package box label:

1. Type designation
2. Blue Dot – Incomplete Package Marking (One Module Only)
3. Lot Number
4. DMX Code
5. Pictogram - Electrostatic Sensitive Device
6. SEMIKRON Part Number
7. SEMIKRON Part Number Bar Code
8. SEMIKRON Logo
9. Date Code
10. Quantity
11. Quantity Bar Code
12. Country of Origin

All protective measures against electrostatic discharge during handling and assembly of the IGBT modules have to be properly implemented by the user.

3. Storage and Transport

Storage of SEMITRANS®10 modules in unpacked / unmounted condition at the specified temperature limits in the data sheet is permissible but not recommended. ESD protection must be ensured.

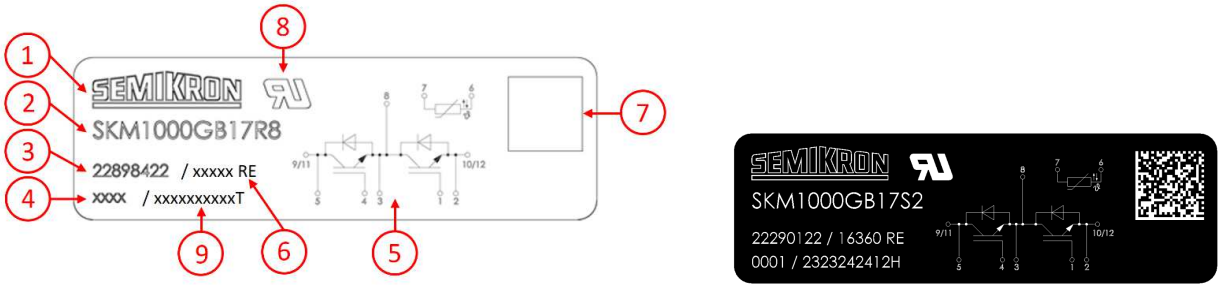
4. Module labeling and RoHS

SEMIKRON SEMITRANS®10 power semiconductor modules comply with RoHS directive. Datasheets and material Content Data Sheets (MCDS) are available online from SEMIKRON on the respective product page.

Figure 5: SEMIKRON SEMITRANS®10 package

4.1 Module label description

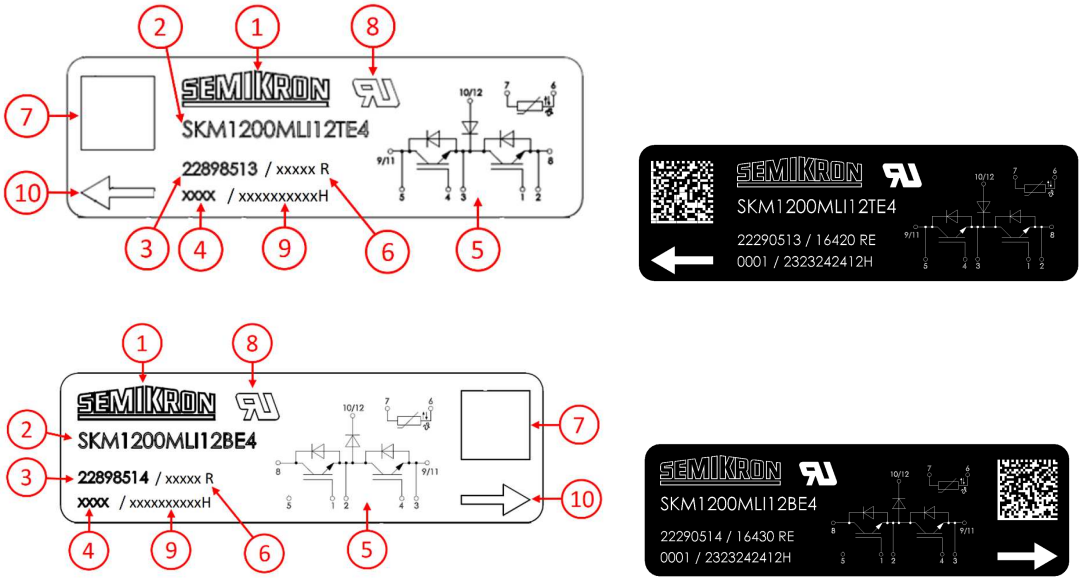
Figure 6: SEMIKRON SEMITRANS®10 GB label design with example of standard module label



Label description for GB module type:

1. SEMIKRON Logo,
2. Module Type Description,
3. Module Item/Article Number,
4. Consecutive Number,
5. Circuit Diagram,
6. Date Code (5 digits, YYWWL - YY = Year, WW = Week, L = Lot of same type per week),
   Date code might be followed by:
   „R" indicates that module complies with the RoHS directive,
   „E" indicates engineering samples marking,
7. DMX Code – Data Matrix Code,
8. UL logo, SEMTRANS is UL recognized, file name: E63532,
9. $V_{CE(sat)}/V_f$ Value Information (11 digits, 2324252627T, 23 = $V_{CE(sat)}$ for T1/T4, 24 = V_f for D1/D4, 25 = $V_{CE(sat)}$ for T2/T3, 26 = V_f for D2/D3, 27 = V_f for D5/D6 of MLI, T = Temperature of Measurement),

Figure 7: SEMIKRON SEMITRANS®10 MLI label design with example of standard module label



Label description for MLI module type:

1. SEMIKRON Logo,
2. Module Type Description,
3. Module Item/Article Number,
4. Consecutive Number,
5. Circuit Diagram,
6. Date Code (5 digits, YYWWL - YY = Year, WW = Week, L = Lot of same type per week),

Date code might be followed by:

„R" indicates that module complies with the RoHS directive,
„E" indicates engineering samples marking,

7. DMX Code – Data Matrix Code,
8. UL logo, SEMTRANS is UL recognized, file name: E63532,
9. $V_{CE(sat)}/V_f$ Class Information (11 digits, 2324252627T, 23 = $V_{CE(sat)}$ for T1/T4, 24 = V_f for D1/D4, 25 = $V_{CE(sat)}$ for T2/T3, 26 = V_f for D2/D3, 27 = V_f for D5/D6 of MLI, T = Temperature of Measurement),
10. Module Orientation Marking (used only for split (MLI, T-MLI) modules),

Table 1: Data matrix code description, Data Matrix Code contains the following information	
1.	Type description
2.	Part number
3.	Lot number
4.	Measurement number
5.	Measurement line number
6.	Production tracking number
7.	Date code – 5 digits: YYWWL (YY = Year, WW = Week, L = LOT of same type per week)
8.	Sequential LOT number (LOT of same type per week)

Table 2: DMX read example

Type description	Part number	Lot number	Measurement number	Measurement Line Number	Production tracking number	Date code with Sequential LOT Number
SKM1000GB17R8	22290422	18DE50356101	1	Z	0004	18190
SKM1000GB17R8	22898422	911SK0173003	1	M	0109	20022
SKM1400GB12P4	22898312	911SK0193305	4	M	0193	20121

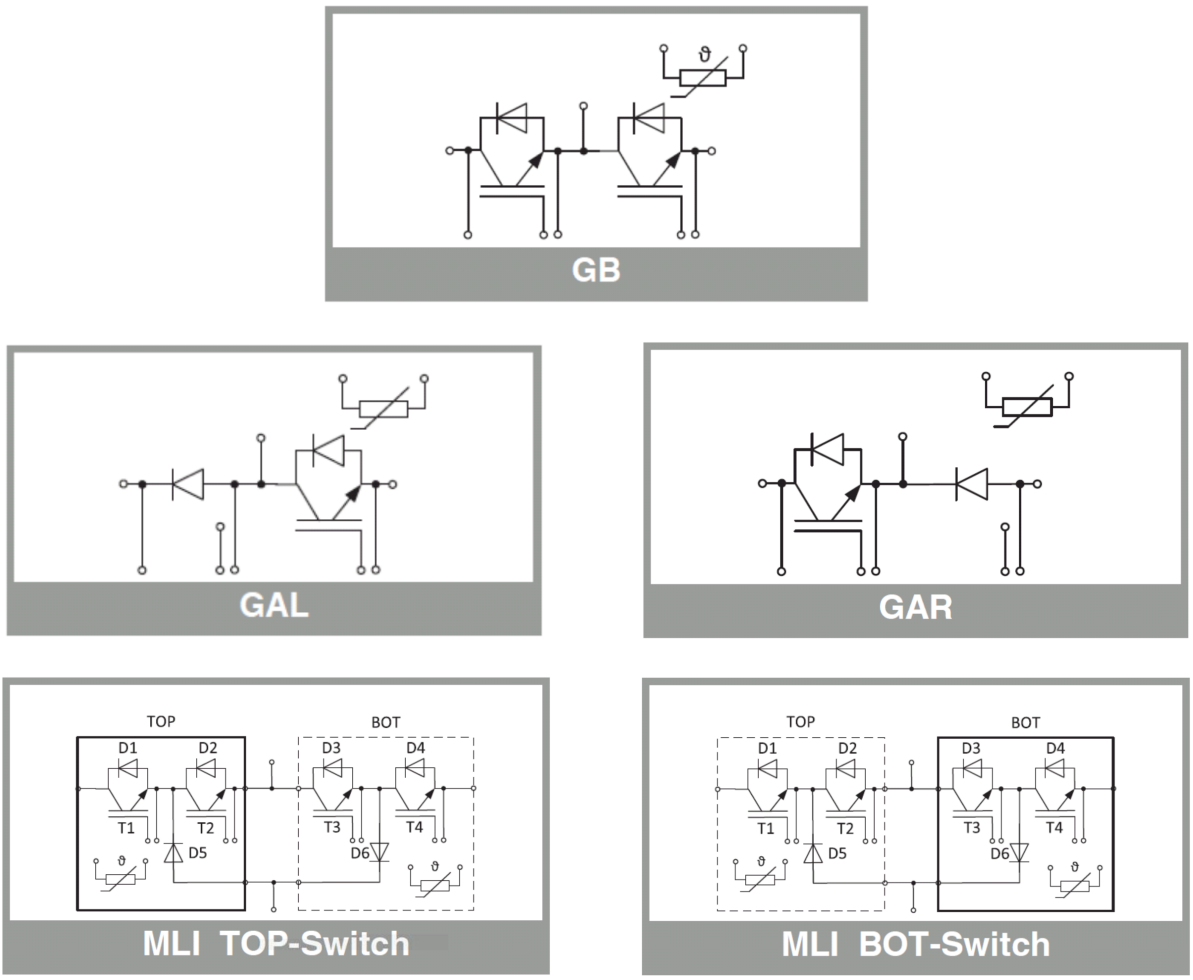
5. Module selection

SEMIKRON SEMITRANS®10 modules are available in various configurations as well as voltages and current classes with differently optimized IGBT and diodes.
The overall product spectrum including datasheets and simulation program SEMISEL is available online on www.semikron.com .
Values in the product data sheets and application notes are maximum allowed values, which - even for brief periods - must not be exceeded, as this may cause pre-damage or destruction of the components. Selecting the most suitable component requires the consideration of various criteria. The overview in Table 3 displays the different configurations of available products.

Table 3: SEMIKRON SEMITRANS®10 module type designation overview

SKM	1400	GB	12	P	4	Description
SKM						SEMIKRON Module
DC collector current in A						
	1400					1400A
	1200					1200A
	1000					1000A
Topology						
		GB				Dual switch
		MLI				Multi-Level Inverter
		GAL				Chopper (diode on TOP side)
		GAR				Chopper (diode on BOT side)
Collector – Emitter voltage (*100)						
			12			1200V
			17			1700V
IGBT Chip characteristic						
				P		IFX, Soft switching trench IGBT
				E		IFX, Soft switching TRENCHSTOP IGBT, Medium Power Chip
				R		RENESAS, H-Type, Trench IGBT
				M		MITSUBISHI, IGBT 1200V 8"
Internal reference number, e.g. 4 = IGBT 4th generation						
					4	4 = IGBT 4th generation
					8	8 = IGBT 8th generation
					7	7 = IGBT 7th generation

Figure 8: SEMIKRON SEMITRANS®10 Topology circuit diagram drawing



6. Heatsink Specifications

The thermal energy generated by power losses must be dissipated by a suitable heatsink in order not to exceed the maximum temperature during switching operation. The quality of the heatsink and heatsink surface in the mounting area is of great importance for thermal conductivity and distribution of the thermal energy. Minimal requirements for heatsink mounting and material specification are summarized in this section.

Table 4: Minimum recommended heatsink material properties

Heatsink material	R_m [N/mm²]	R_e [N/mm²]	Note
EN AW-5754	180	80	Recommendation for minimal material properties

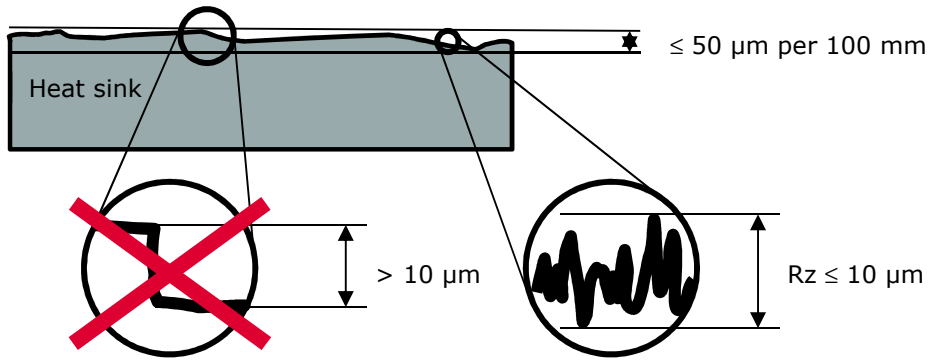
6.1 Surface Specifications

To obtain the maximum thermal conductivity, the bottom side of the module must be free of grease and particles. It is recommended to clean the mounting surface with lint-free wipes and a fat-dissolving solvent (e.g. isopropyl alcohol). Furthermore, all electrical contacts shall be kept clean at all times and should never be touched by hand.

The heat sink must fulfil the following specifications (Figure 9):

- Flatness of heat sink mounting area must be ≤ 50µm per 100mm (DIN EN ISO 1101),
  Drawing specification see below:
  ▱ 0,05/100
- Roughness "R_z" ≤ 10µm (DIN EN ISO 1302),
- No steps > 10µm per 10mm (DIN EN ISO 1101),
  Drawing specification see below:
  ▱ 0,01/10
- The heat sink must be free from grease and particles,
- Tap holes must be chip-free (free of turnings and without scobs),
- It is recommended to clean the surface with lint-free wipes and a fat-dissolving solvent (e.g. isopropyl alcohol)

Figure 9: Heat sink surface graphical explanation and heat sing surface roughness specifications



The condition of the heat sink contact area should not exceed the values in Table 5, otherwise inhomogeneous heat dissipation can lead to partial overheating of the semiconductors.

Table 5: Heat sink surface requirements for SEMITRANS®10 module

Baseplate Size	Surface roughness	Surface flatness	Note
SEMITRANS®10: 250mm x 89mm	R_z 10	≤50µm/100mm ▱ 0,05/100 ≤10µm/10mm ▱ 0,01/10	Roughness: DIN EN ISO 1302 Flatness: DIN EN ISO 1101

7. Thermal interface material

To dissipate the power losses occurring in the module and to allow a good flow of heat into the heat sink, all air gaps occurring between the module baseplate and the heat sink need to be filled with a suitable heat-conductive material. This can be done with thermal grease, alternatively described as thermal paste or thermal compound.

The thermal conductive material should have long term stability properties appropriate to the application and ensure a consistently good thermal contact resistance. This must be qualified by the user. If long term stability is not warranted, there is a risk of overheating of the semiconductors in long term and thus the module's life time will be reduced. The grease should be applied in a manner that the mounting holes are not contaminated as this could influence the torque values.

A thin homogenous layer of thermal paste has to be applied onto the heat sink surface or the bottom side of the module. A layer thickness of 50 µm – 100 µm is recommended and can be determined by using a measurement gauge as shown in Figure 1010.

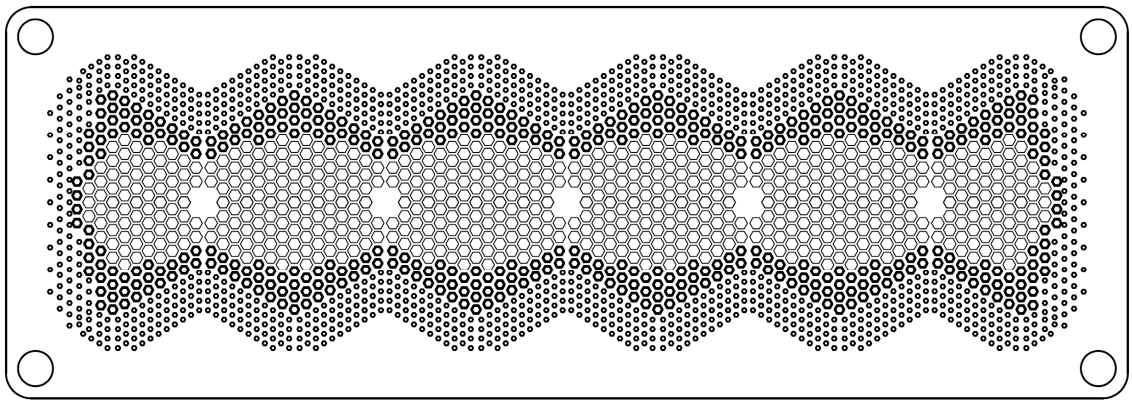
Figure 10: Wet film thickness gauge

SEMIKRON recommends following pastes:

- Silicone paste: P12 from WACKER CHEMIE (www.wacker.com)
- None-silicone paste: HTC from ELECTROLUBE (www.electrolube.com)

Screen-printing is suggested to apply thermal paste, but a hard rubber roll might be suitable as well. Applying thermal paste by means of roller is not recommended for mass production as reproducibility of an optimized thermal paste thickness cannot be guaranteed.
Attention has to be paid that no screw holes are polluted by thermal paste. Further information about applying thermal interface material you find in: Application Note AN 18-001.

Figure 11: SEMIKRON SEMITRANS®10 PCM phase change material, thickness 90µm



Weight measurements (spot test) on module before and after thermal compound printing is a good possibility to apply statistical process control to the printing process without performing destructive testing with the film thickness gauge.

PCM phase change material features:

- Inhomogeneous honeycomb structure,
- Optimized layer thickness,
- Enhanced heat dissipation,
- High process reliability due to automated screen/stencil printing process,
- Phase Change Material,

Table 6: PCM phase change material characteristics

Symbol	Conditions	Minimal	Typical	Maximal	Unit
Characteristics of printing process					
w_{tp}	Material weight	850	985	1120	mg
Storage conditions					
t_{stg}	Storage time			12	month
T_{stg}	Storage temperature	-25		60	°C
RH_{stg}	Storage humidity	10		85	%
TIM material characteristic					
γ_{tp}	Specific gravity		2		g/cm^3
R_{tp}	Resistivity		>50*10^6		Ω/cm
λ_{tp}	Thermal conductivity		3		W/(K*m)
$T_{case,op.}$	Operation temperature			125	°C
	Filling material				Al, ZnO
R_{th}	R_{th} ≤ standard P12				

PCM material for high temperature support. Thermal performance comparable or better than standard TIM's. Recommended for systems running with $T_{heatsink}$>100°C. This material withstands permanently case temperatures of T_c=125°C. Print pattern is optimized for each PCN / module combination.

For detail information, please see document Product Information No. MIF-PI 19-007 Rev. 00.pdf.

Figure 12: Application of PCM phase change material on SEMITRANS®10 baseplate and inhomogeneous honeycomb structure

8. Mounting to the Heat Sink

SEMIKRON recommends M5 (A2K) screws acc. ISO4762 of strength category 8.8 in combination with a DIN 125 washer. Use only dry screws threads and washers. Setting devices such as spring washers will increase the elasticity, reduce settling effects as well reduce mechanical stress. To comply with creepage and clearance distances it is suggested to check the resulting distances according to the relevant standards (DIN EN 50178, DIN EN 61800-5-1) when selecting a screw type. Threads have to be clean and not lubricated or contaminated by thermal paste.

To avoid unnecessary strain and tension of the base plate, the heat sink has to be sufficiently stiff and has to be distortion free during assembly and transportation. The SEMITRANS®10 has to be placed on the matching heat sink area and then all mounting screws have to be uniformly tightened with the specified mounting torque in the recommended screw mounting sequence.

Figure 13: Recommended mounting sequence

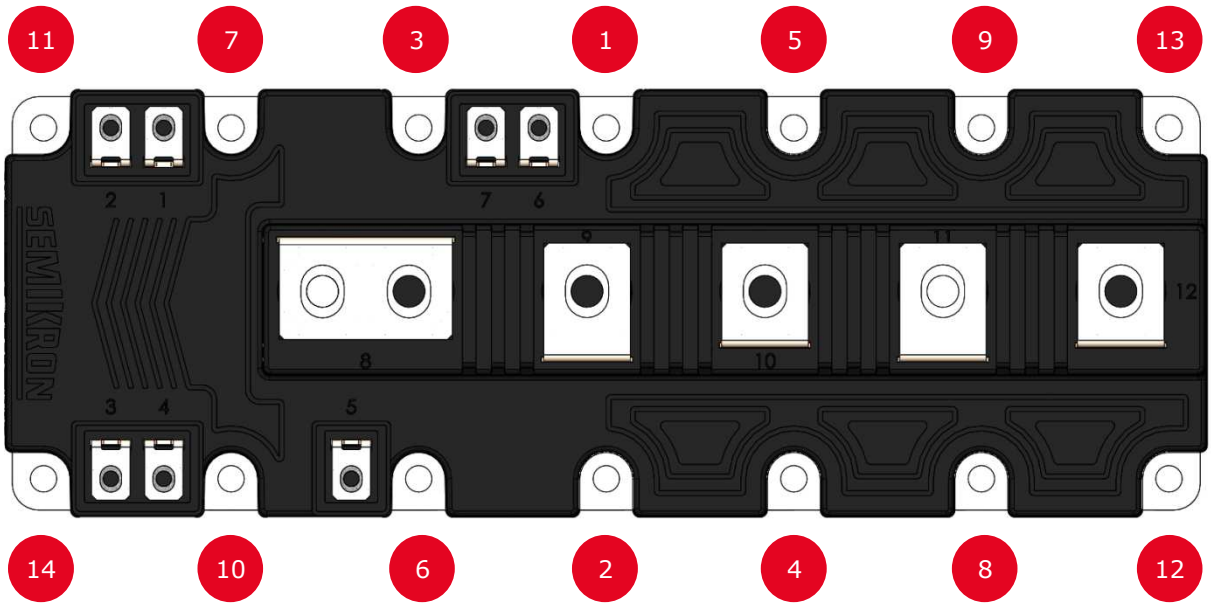


Table 7: Screw dimensions and torques				
Location	Type	Torque min. [Nm]	Torque max. [Nm]	Note
Preload Torque	M5	1	2	
Final Torque	M5	4	6	

Screw length have to be calculated (preload force for each screw 2kN, see table 7).

The threads should be clean and not lubricated. Use only dry screws threads and washers.

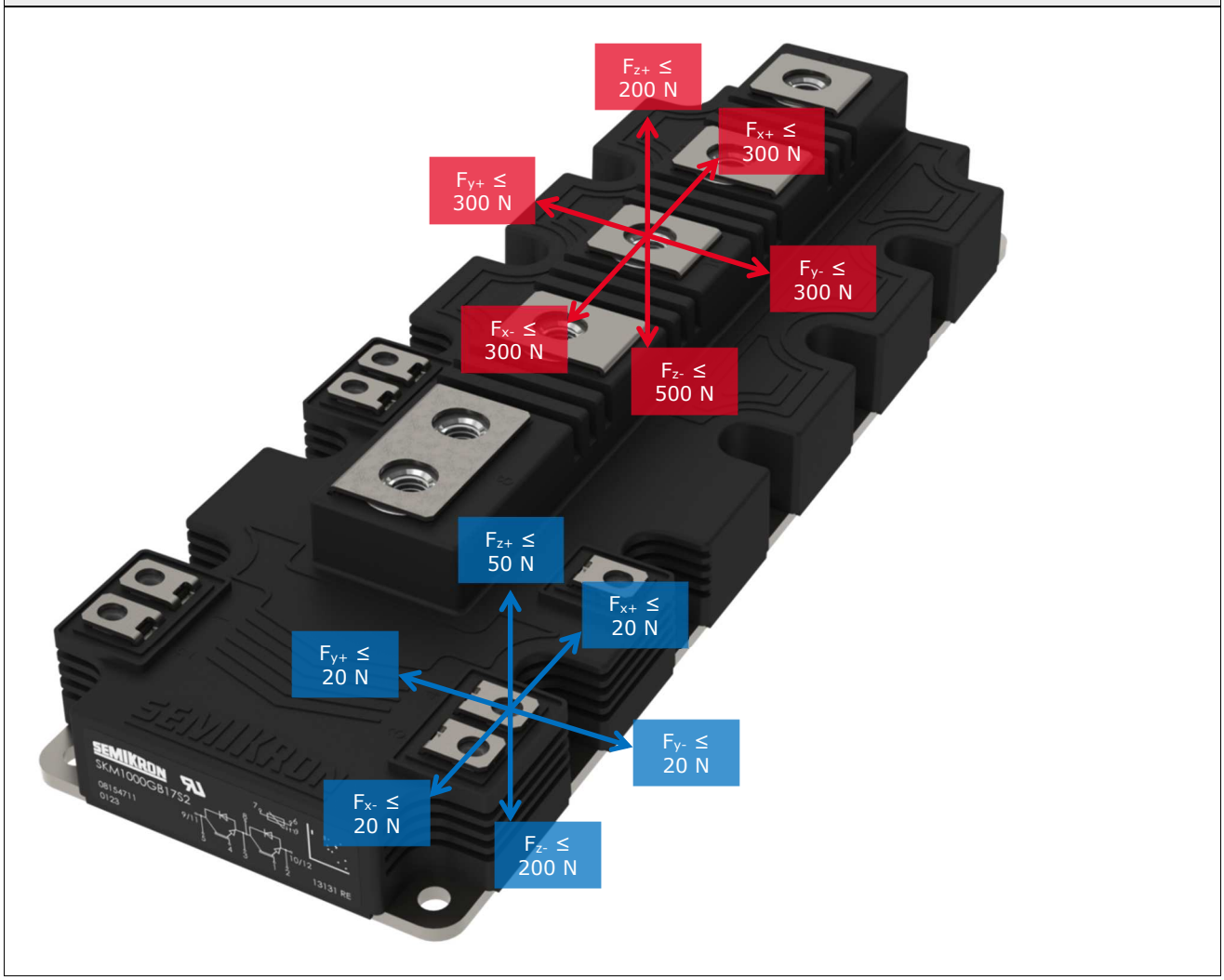
9. Mounting to the Terminals

The module must be connected within the permissible module tolerances specified in the outline drawings in the respective data sheet. The position and tolerance of adjacent components such as PCBs, DC-bus, mounting bolts or cables have to be defined in such a manner, that after the connection no sustained effect on the static and / or dynamic tensile forces are exerted to the terminals. The power terminals are built from copper with a nickel coating. The following recommendations are valid for copper busbars, bare or with suitable plating.

As SEMITRANS®10 is a power module and not part of the mechanical construction, the maximum mechanical forces on the main terminals as given in Figure 14 must not be exceeded throughout the entire mounting process and in operation.

The screw mounting torque shall be within the specified ranges (**Error! Reference source not found.**7).

Figure 14: Maximum allowable forces at the terminals



It is recommended to have a construction which leaves the power and auxiliary terminals permanently free of mechanical stress during operation. To achieve this in a wide temperature range it is advised to add suitable spacers.

It must be ensured that the direction of the force always acts towards the direction of the base plate. Static forces in other directions as well as exposure to vibration and / or thermal expansion should be avoided.

The auxiliary terminals have to be connected accordingly, observing the common ESD guidelines. No load current is permitted to flow through the auxiliary collector.

Table 8: Maximum permissible forces at the terminals of a SEMITRANS®10 module		
Terminal type	Force orientation	Value [N]
Main power terminal	Fx+	300
	Fy+	300
	Fz+	200
	Fx-	300
	Fy-	300
	Fz-	500
Auxiliary power terminal	Fx+	20
	Fy+	20
	Fz+	50
	Fx-	20
	Fy-	20
	Fz-	200

9.1 Screw dimensions and torques

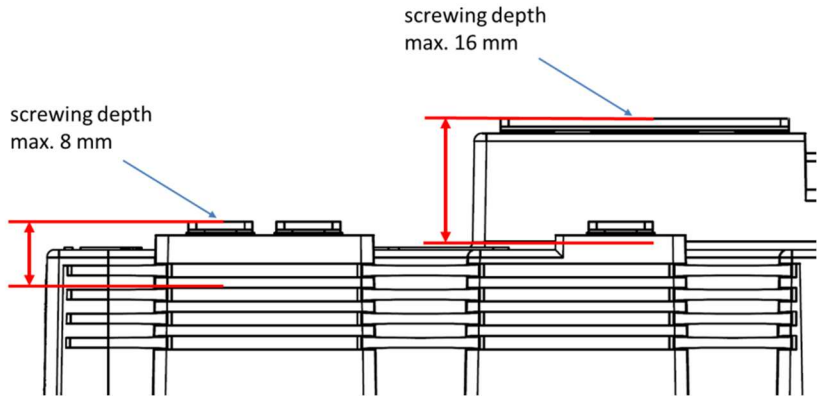
Table 9 displays the recommended values for the mounting torque of the power terminal connection.

Table 9: Screw dimensions and tightening torques for the bolts of the electrical connection						
Location	Mounting bolt type	Maximal Screwing depth [mm]	Min. torque for condition no. 1 [Nm]	Max. torque for condition no. 1 [Nm]	Min. torque for condition no. 2 [Nm]	Max. torque for condition no. 2 [Nm]
Main terminal connection torque	M8	16	8	10	8	22
Auxiliary terminal connection torque	M4	8	1.8	2.1	1.8	2.1

Condition no. 1:
If the torque is directly passing to the nut of the module and the full torque affects the plastic housing it is limited according to Table 8, condition no. 1. The upper limit given here assumes a worst-case condition when the full-applied torque is passed into the nut insert inside the plastic housing.

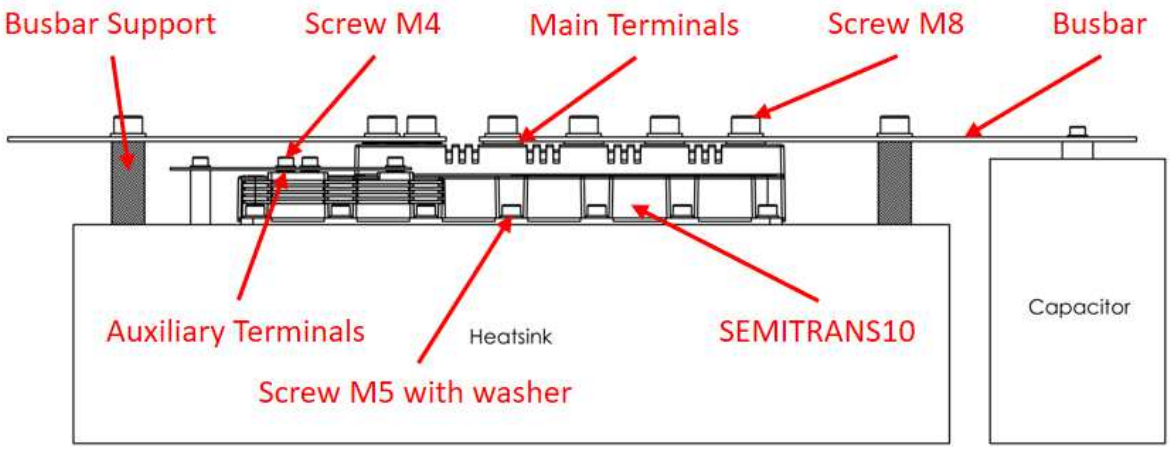
Condition no. 2:
If the full torque is not directly passing to the nut of the module as described in condition no. 1 a higher mounting torque is allowed. This can be achieved by inserting bolts into all connections of a busbar prior to final tightening. Bolts can be fixed by hand prior to final tightening, for example. It has to be checked, if the maximum allowed contact pressure of the used busbar is not exceeded.

Figure 15: Maximal allowable screwing depth



When using an electrical screwdriver, screwing speed has to be limited to a maximum of 300 rpm and soft torque limitation is recommended. SEMIKRON do NOT recommend pneumatic screwdrivers due to clutch behavior with torque overshoots.

Figure 16: Condition no. 2: Main terminals tightening through busbar



HISTORY

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SEMIKRON INTERNATIONAL GmbH
P.O. Box 820251 • 90253 Nuremberg • Germany
Tel: +49 911-65 59-234 • Fax: +49 911-65 59-262
sales.skd@semikron.com • www.semikron.com