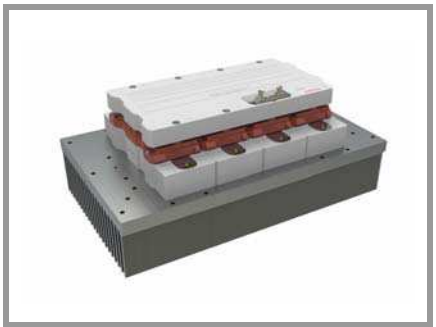
# SKiiP 2413 GB123-4DUL V3



SKiiP® 3

2-pack-integrated intelligent Power System

**SKiiP 2413 GB123-4DUL V3**

## Features

- SKiiP technology inside
- Trench IGBTs
- CAL HD diode technology
- DC-Link voltage monitoring
- Integrated current sensor
- Integrated temperature sensor
- Integrated heat sink
- UL recognized File no. E63532

## Typical Applications*

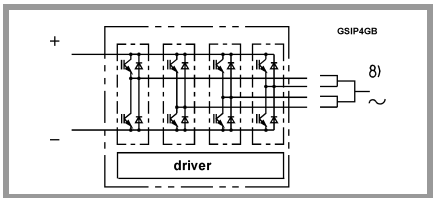
- Renewable energies
- Traction
- Elevators
- Industrial drives

## Footnotes

1) With assembly of suitable MKP capacitor per terminal

| Absolute Maximum Ratings | | | $T_s$ = 25°C unless otherwise specified | |
|---|---|---|---|---|
| **Symbol** | **Conditions** | | **Values** | **Unit** |
| **System** | | | | |
| $V_{CC}$ 1) | Operating DC link voltage | | 900 | V |
| $V_{isol}$ | DC, t = 1 s, main terminals to heat sink | | 4300 | V |
| $I_{t(RMS)}$ | per AC terminal, $T_{terminal}$ <115°C | | 400 | A |
| $I_{FSM}$ | $T_j$ = 150 °C, $t_p$ = 10 ms, sin 180° | | 13500 | A |
| $I^2t$ | $T_j$ = 150 °C, $t_p$ = 10 ms, diode | | 911 | $kA^2s$ |
| $f_{out}$ | fundamental output frequency | | 1 | kHz |
| $T_{stg}$ | storage temperature | | -40 ... 85 | °C |
| **IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $T_j$ = 150 °C | $T_s$ = 25 °C | 2280 | A |
| | | $T_s$ = 70 °C | 1756 | A |
| $I_{Cnom}$ | | | 2400 | A |
| $T_j$ | junction temperature | | -40 ... 150 | °C |
| **Diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_F$ | $T_j$ = 150 °C | $T_s$ = 25 °C | 1807 | A |
| | | $T_s$ = 70 °C | 1370 | A |
| $I_{Fnom}$ | | | 1860 | A |
| $T_j$ | junction temperature | | -40 ... 150 | °C |
| **Driver** | | | | |
| $V_s$ | power supply | | 13 ... 30 | V |
| $V_{iH}$ | input signal voltage (high) | | 15 + 0.3 | V |
| $V_{isolPD}$ | QPD <= 10pC, PRIM to POWER | | 1170 | V |
| dv/dt | secondary to primary side | | 75 | kV/µs |
| $f_{sw}$ | switching frequency | | 8 | kHz |

| Characteristics | | | $T_s$ = 25°C unless otherwise specified | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 1200 A at terminal | $T_j$ = 25 °C | | 1.7 | 2.1 | V |
| | | $T_j$ = 125 °C | | 1.9 | | V |
| $V_{CE0}$ | | $T_j$ = 25 °C | | 0.90 | 1.10 | V |
| | | $T_j$ = 125 °C | | 0.80 | 1.00 | V |
| $r_{CE}$ | at terminal | $T_j$ = 25 °C | | 0.7 | 0.8 | mΩ |
| | | $T_j$ = 125 °C | | 0.9 | 1.1 | mΩ |
| $E_{on} + E_{off}$ | $I_C$ = 1200 A $T_j$ = 125 °C | $V_{CC}$ = 600 V | | 442 | | mJ |
| | | $V_{CC}$ = 900 V | | 780 | | mJ |
| $R_{th(j-s)}$ | per IGBT switch | | | | 0.015 | K/W |
| $R_{th(j-r)}$ | per IGBT switch | | | | 0.015 | K/W |

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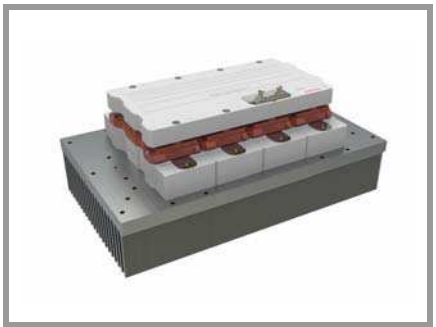

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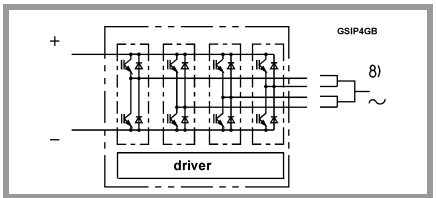
| Characteristics | | | | | $T_s$ = 25°C unless otherwise specified | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **Diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 1200 A at terminal | $T_j$ = 25 °C | | 1.50 | 1.80 | V |
| | | $T_j$ = 125 °C | | 1.50 | | V |
| $V_{F0}$ | | $T_j$ = 25 °C | | 0.9 | 1.10 | V |
| | | $T_j$ = 125 °C | | 0.7 | 0.90 | V |
| $r_F$ | at terminal | $T_j$ = 25 °C | | 0.5 | 0.6 | mΩ |
| | | $T_j$ = 125 °C | | 0.7 | 0.8 | mΩ |
| $E_{rr}$ | $I_F$ = 1200 A $T_j$ = 125 °C | $V_R$ = 600 V | | 84 | | mJ |
| | | $V_R$ = 900 V | | 112 | | mJ |
| $R_{th(j-s)}$ | per diode switch | | | | 0.029 | K/W |
| $R_{th(j-r)}$ | per diode switch | | | | 0.048 | K/W |
| **Driver** | | | | | | |
| $V_s$ | supply voltage non stabilized | | 13 | 24 | 30 | V |
| $I_{S0}$ | bias current @$V_s$=24V, $f_{sw}$ = 0, $I_{AC}$ = 0 | | | 330 | | mA |
| $I_s$ | $k_1$ = 55 mA/kHz, $k_2$ = 0.00035 mA/A$^2$ | | = 330 | + $k_1$* $f_{sw}$ | + $k_2$ * $I_{AC}^2$ | mA |
| $V_{IT+}$ | input threshold voltage (HIGH) | | 12.3 | | | V |
| $V_{IT-}$ | input threshold voltage (LOW) | | | | 4.6 | V |
| $R_{IN}$ | input resistance | | | 10 | | kΩ |
| $C_{IN}$ | input capacitance | | | 1 | | nF |
| $t_{pRESET}$ | error memory reset time | | | 0.0122 | | ms |
| $t_{TD}$ | top / bottom switch interlock time | | | 3 | | µs |
| $t_{jitter}$ | jitter clock time | | | 125 | | ns |
| $t_{SIS}$ | short pulse suppression time | | | 0.625 | 0.7 | µs |
| $I_{TRIPSC}$ | over current trip level | | 2940 | 3000 | 3060 | $A_{PEAK}$ |
| $T_{trip}$ | over temperature trip level | | 110 | 115 | 120 | °C |
| $V_{DCtrip}$ | over voltage trip level, | | | 900 | | V |
| $t_{d(on)IO}$ | $V_{CC}$ = 900 V $I_C$ = 1200 A $T_j$ = 25 °C | input-output turn-on propagation time | | 1.4 | | µs |
| $t_{d(off)IO}$ | | input-output turn-off propagation time | | 1.4 | | µs |
| **System** | | | | | | |
| $R_{th(r-a)}$ | flow rate=390m$^3$/h, $T_a$=25°C, 500m above sea level | | | | 0.0255 | K/W |
| $R_{CC'+EE'}$ | terminals to chip, $T_s$ = 25 °C | | | 0.13 | | mΩ |
| $L_{CE}$ | commutation inductance | | | 3 | | nH |
| $C_{CHC}$ | per phase, AC-side | | | 6.8 | | nF |
| $I_{CES} + I_{RD}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_j$ = 25 °C | | | 4.8 | | mA |
| $M_{dc}$ | DC terminals, SI Units | | 6 | | 8 | Nm |
| $M_{ac}$ | AC terminals, SI Units | | 13 | | 15 | Nm |
| w | SKiiP System w/o heat sink | | | 3.1 | | kg |
| $w_h$ | heat sink | | | 8 | | kg |

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## Isolation coordination acc. to EN 50178 and IEC 61800-5-1

| | |
|---|---|
| Maximum grid RMS voltage, line-to-line, grounded delta mains | 480V+20% |
| Installation altitude for maximum grid RMS voltage, line-to-line, grounded delta mains | 2000m |
| Maximum grid RMS voltage, line-to-line, star point grounded mains | 480V+20% |
| Installation altitude for maximum grid RMS voltage, line-to-line, star point grounded mains | 5000m |
| Maximum transient peak voltage between low voltage circuit and mains | 1600V |
| Pollution degree acc. to IEC 60664-1 outside the moulded power section | 2 |
| Overvoltage cat. acc. to IEC 60664-1 for mains | III |
| Basic isolation | between heat sink and mains;<br>between low voltage circuit and mains |
| Protection level acc. to IEC 60529 | IP00 |

## Environmental conditions acc.to IEC 60721

| | Storage | Transportation | Operation stationary use at weather protected locations | Operating ground vehicle installations | Operating ship environment |
|---|---|---|---|---|---|
| Climatic conditions | 1K2 (1) | 2K2 (1) | 3K3 (1) | 5K1 (1) | --- |
| Biological conditions | 1B1 | 2B1 | 3B1 | 5B1 | 6B1 |
| Chemically active substances (excluded: salt spray) | 1C2 | 2C1 | 3C2 | 5C2 | 6C2 |
| Mechanically active substances | 1S1 | 2S1 | 3S1 | 5S1 | 6S1 |
| Mechanical conditions | 1M3 | (4) | 3M6 (2) | 5M3 (3) | 6M3 |
| Contaminating fluids | --- | --- | --- | 5F1 | --- |

(1) expanded temperature range: -40°C / +85°C. Please note: by operation near 85°C the life time of product is reduced.
(2) 3M7 possible, but due to the mechanic load capacity of external components like DC-Link capacitors limited to 3M6
(3) 5M3 without impact of foreign bodies, stones
(4) no declaration due to customer-specific packing

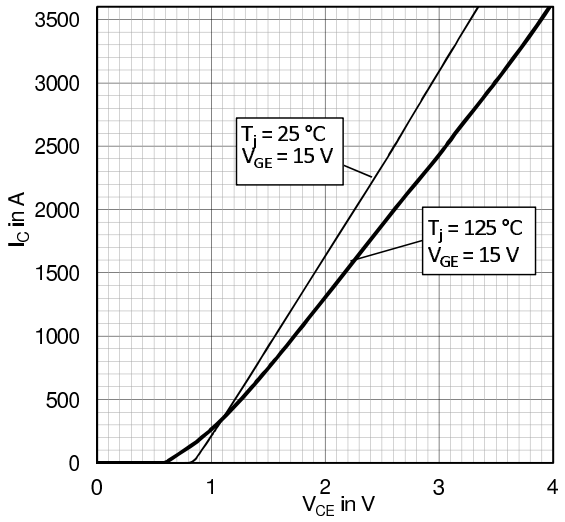


Fig. 1: Typical IGBT output characteristic

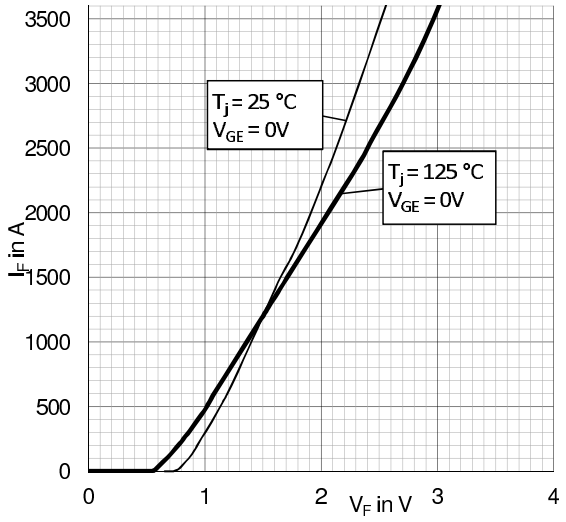


Fig. 2: Typical diode output characteristics

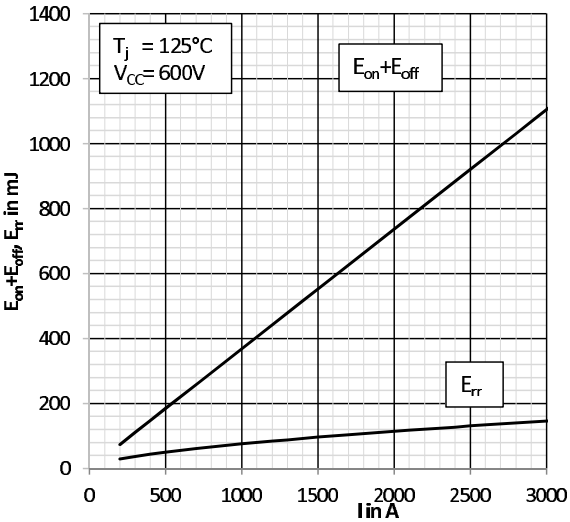


Fig. 3: Typical energy losses E = f($I_c$, $V_{cc}$)

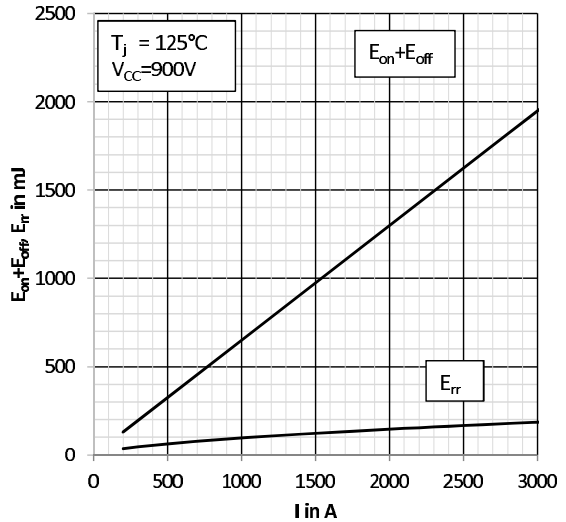


Fig. 4: Typical energy losses E = f($I_c$, $V_{cc}$)

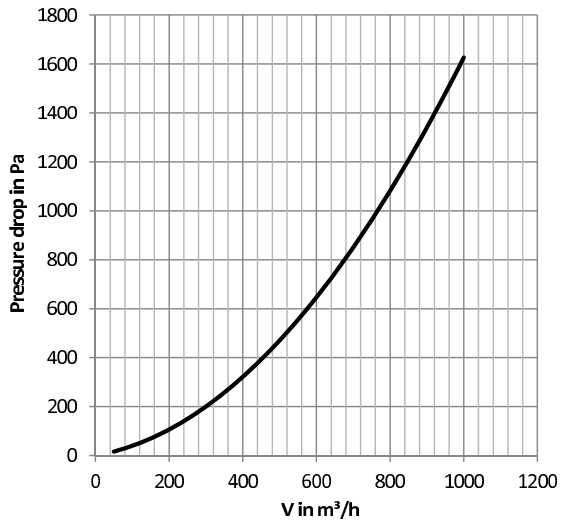


Fig. 5: Pressure drop Δp versus flow rate V

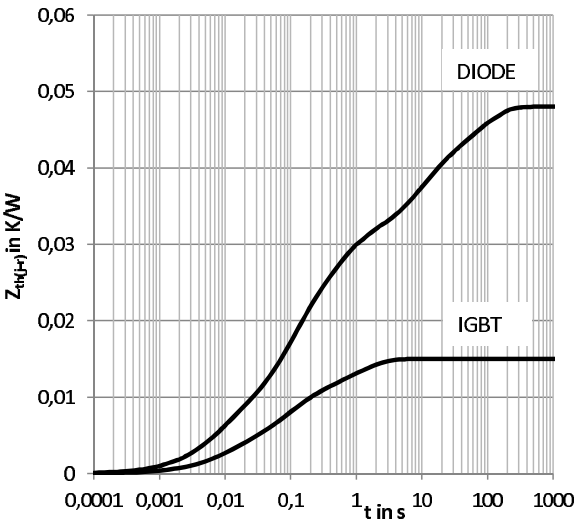


Fig. 6: Transient thermal impedance Zth(j-r)

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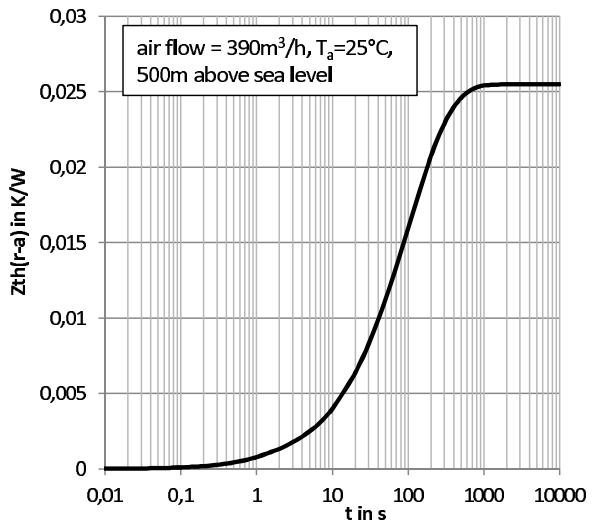



Fig. 7: Transient thermal impedance Zth(r-a)

| | $R_{th}$ [K/W] | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| $Z_{th(j-r)}$ I | 0,0027 | 0,0055 | 0,0022 | 0,0046 | 0,0000 | 0,0000 |
| $Z_{th(j-r)}$ D | 0,0061 | 0,0126 | 0,0113 | 0,0076 | 0,0019 | 0,0085 |
| $Z_{th(r-a)}$ | 0,0008 | 0,0030 | 0,0120 | 0,0097 | 0,0000 | 0,0000 |
| | tau [s] | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| $Z_{th(j-r)}$ I | 0,0090 | 0,0700 | 0,2200 | 1,1000 | 1,0000 | 1,0000 |
| $Z_{th(j-r)}$ D | 0,0070 | 0,0850 | 0,4400 | 8,3000 | 12,000 | 72,000 |
| $Z_{th(r-a)}$ | 1,3800 | 17,000 | 82,000 | 209,00 | 1,0000 | 1,0000 |

Fig. 8: Coefficients of thermal impedances

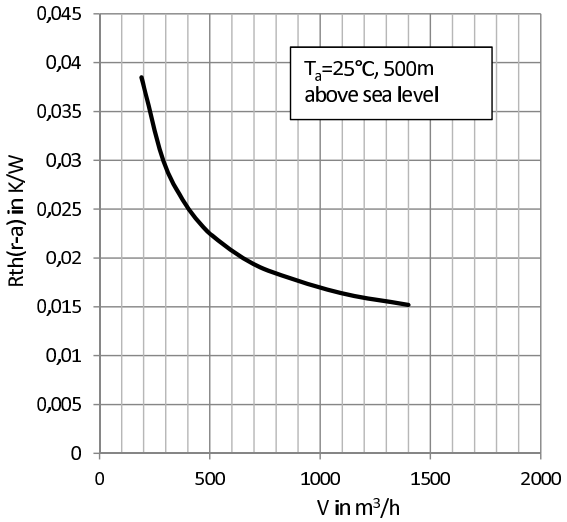
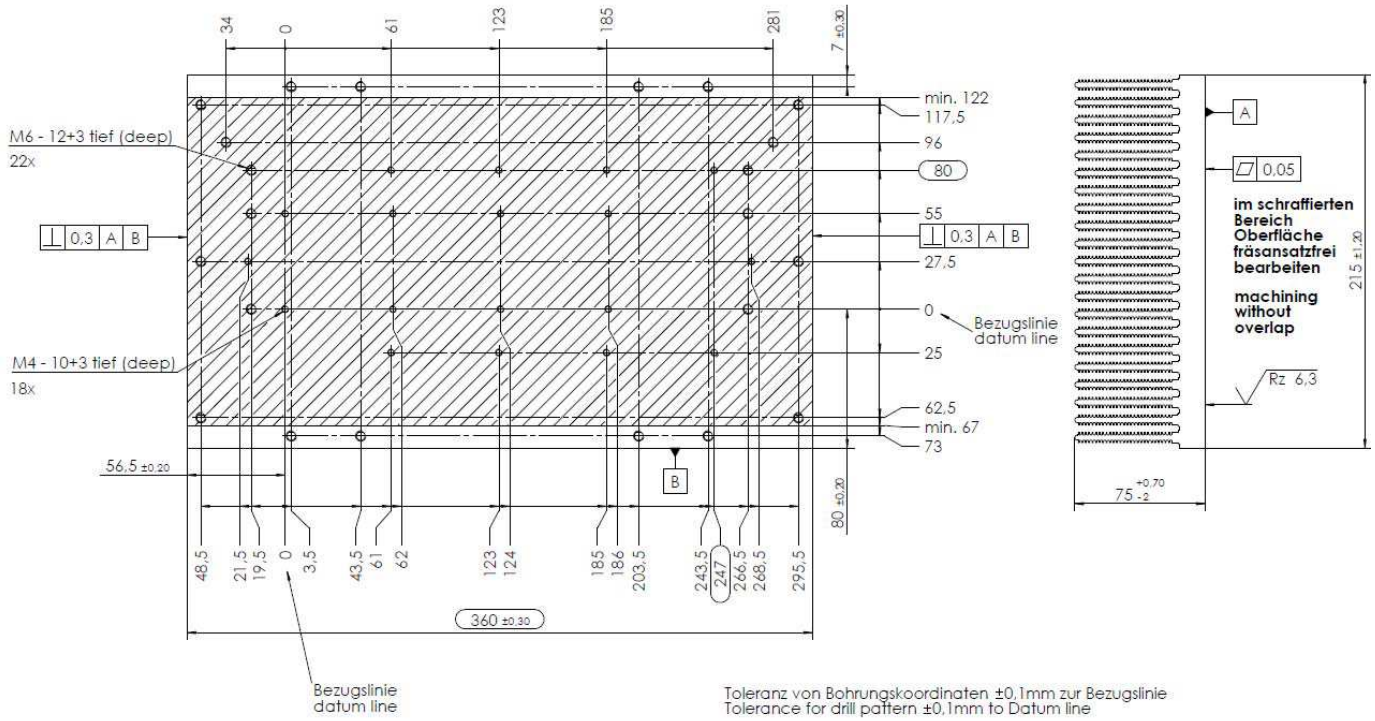



Fig. 9: Thermal resistance Rth(r-a) versus flow rate V




Control dimension

edge of workpiece DIN ISO 13715 -0,2 0,2

- fettfrei nach DIN 53364 ≥ 32 mN/m
- Surface, threads and holes must be grease and oil free

**Heat sink**

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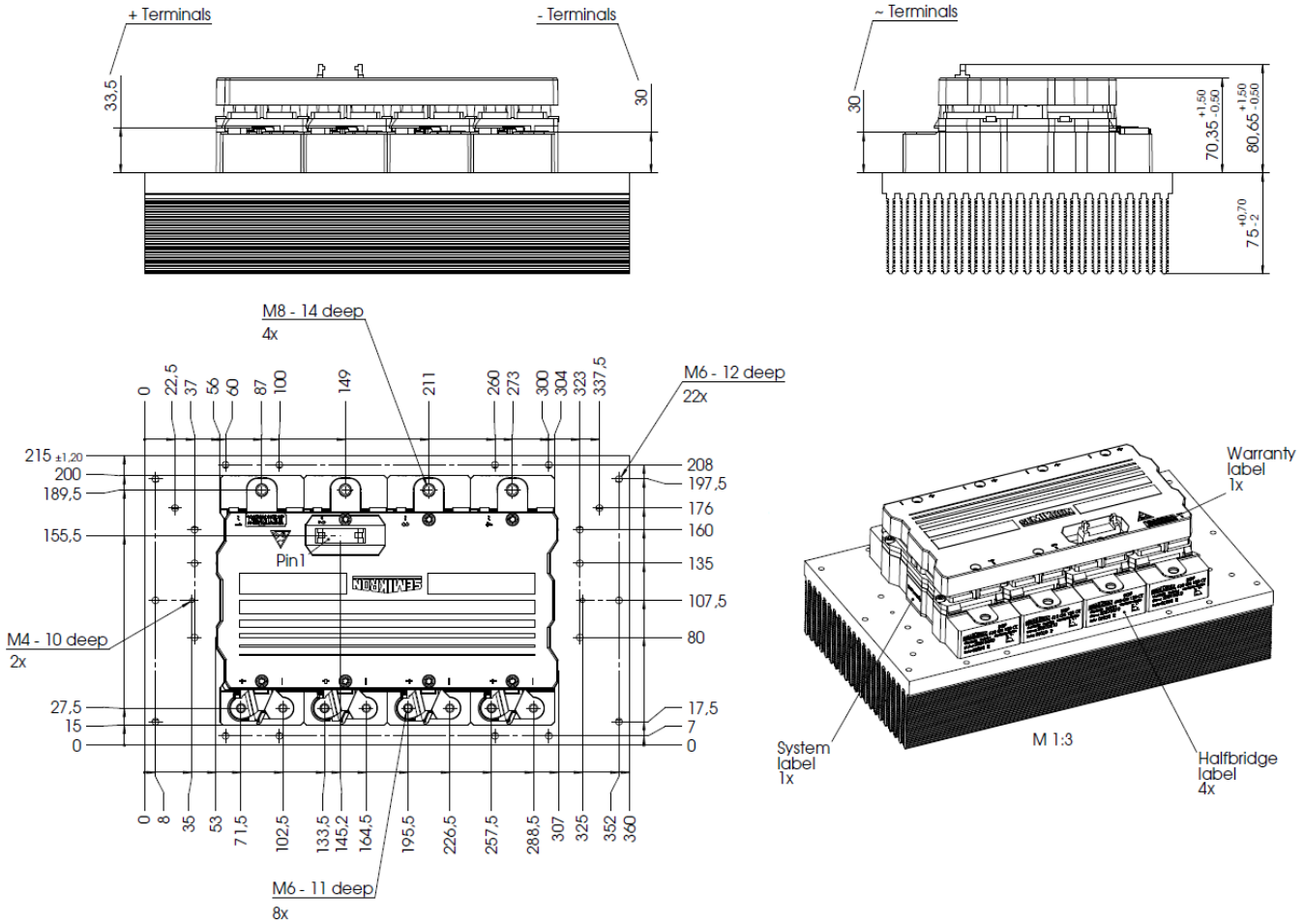


## System

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, Chapter IX

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.