# SKiiP 2414 GB17E4-4DUL

SKiiP® 4

2-pack-integrated intelligent Power System

**SKiiP 2414 GB17E4-4DUL**

### Features

- Intelligent Power Module
- Integrated current and temperature measurement
- Integrated DC-link measurement
- Solder free power section
- IGBT4 and CAL4F technology
- Safety isolated switching and sensor signals
- Digital signal transmission
- CAN Interface
- 100% tested IPM
- RoHS compliant
- UL recognition in progress, file no. E242581

### Typical Applications*

- Renewable energies
- Traction
- Elevators
- Industrial drives

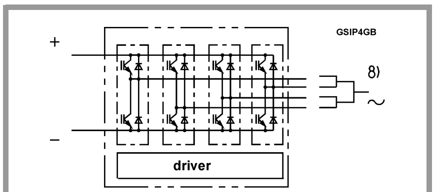
### Remarks

For further information please refer to SKiiP®4 Technical Explanation

### Footnote

1) With assembly of suitable MKP capacitor per terminal

2) The specified maximum operation junction temperature $T_{vjop}$ can be >150°C for a maximum of 1000 cum. operation hours

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| Absolute Maximum Ratings | | | | |
|---|---|---|---|---|
| **Symbol** | **Conditions** | | **Values** | **Unit** |
| **System** | | | | |
| $V_{CC}$ 1) | Operating DC link voltage | | 1300 | V |
| $V_{isol}$ | DC, t = 1 s, each polarity | | 5600 | V |
| $I_{t(RMS)}$ | per AC terminal, rms, sinusoidal current | | 500 | A |
| $I_{max\ (peak)}$ | max. peak current of power section | | 3600 | A |
| $I_{FSM}$ | $T_j$ = 175 °C, $t_p$ = 10 ms, sin 180° | | 15885 | A |
| $I^2t$ | $T_j$ = 175 °C, $t_p$ = 10 ms, diode | | 1262 | $kA^2s$ |
| $f_{out}$ | fundamental output frequency (sinusoidal) | | 1 | kHz |
| $T_{stg}$ | storage temperature | | -40 ... 85 | °C |
| **IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1700 | V |
| $I_C$ | $T_j$ = 175 °C | $T_s$ = 25 °C | 3385 | A |
| | | $T_s$ = 70 °C | 2723 | A |
| $I_{Cnom}$ | | | 2400 | A |
| $T_j$ 2) | junction temperature | | -40 ... 175 | °C |
| **Diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1700 | V |
| $I_F$ | $T_j$ = 175 °C | $T_s$ = 25 °C | 2362 | A |
| | | $T_s$ = 70 °C | 1869 | A |
| $I_{Fnom}$ | | | 2400 | A |
| $T_j$ 2) | junction temperature | | -40 ... 175 | °C |
| **Driver** | | | | |
| $V_s$ | power supply | | 19.2 ... 28.8 | V |
| $V_{iH}$ | input signal voltage (high) | | $V_s$ + 0.3 | V |
| dv/dt | secondary to primary side | | 75 | kV/µs |
| $f_{sw}$ | switching frequency | | 10 | kHz |

| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 2400 A at terminal | $T_j$ = 25 °C | | 2.12 | 2.43 | V |
| | | $T_j$ = 150 °C | | 2.53 | 2.79 | V |
| $V_{CE0}$ | | $T_j$ = 25 °C | | 1.10 | 1.20 | V |
| | | $T_j$ = 150 °C | | 1.00 | 1.10 | V |
| $r_{CE}$ | at terminal | $T_j$ = 25 °C | | 0.42 | 0.51 | mΩ |
| | | $T_j$ = 150 °C | | 0.64 | 0.70 | mΩ |
| $E_{on} + E_{off}$ | $I_C$ = 2400 A, $T_j$ = 150 °C | $V_{CC}$ = 900 V | | 1780 | | mJ |
| | | $V_{CC}$ = 1300 V | | 2840 | | mJ |
| $R_{th(j-s)}$ | per IGBT switch | | | | 0.0138 | K/W |
| $R_{th(j-r)}$ | per IGBT switch | | | | 0.008 | K/W |

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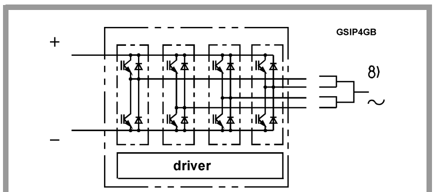


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| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **Diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 2400 A at terminal | $T_j$ = 25 °C | | 2.02 | 2.34 | V |
| | | $T_j$ = 150 °C | | 2.27 | 2.62 | V |
| $V_{F0}$ | | $T_j$ = 25 °C | | 1.21 | 1.36 | V |
| | | $T_j$ = 150 °C | | 0.99 | 1.12 | V |
| $r_F$ | at terminal | $T_j$ = 25 °C | | 0.34 | 0.41 | mΩ |
| | | $T_j$ = 150 °C | | 0.53 | 0.63 | mΩ |
| $E_{rr}$ | $I_F$ = 2400 A $T_j$ = 150 °C | $V_R$ = 900 V | | 412 | | mJ |
| | | $V_R$ = 1300 V | | 664 | | mJ |
| $R_{th(j-s)}$ | per diode switch | | | | 0.0281 | K/W |
| $R_{th(j-r)}$ | per diode switch | | | | 0.02 | K/W |
| **Driver** | | | | | | |
| $V_s$ | supply voltage non stabilized | | 19.2 | 24 | 28.8 | V |
| $I_{S0}$ | bias current @$V_s$= 24V, $f_{sw}$ = 0, $I_{AC}$ = 0 | | | 360 | | mA |
| $I_s$ | $k_1$ = 47 mA/kHz, $k_2$ = 0.258 mA/A, $f_{out}$ =50Hz, sinusoidal current | | = 360 | + $k_1$* $f_{sw}$ | + $k_2$ * $I_{AC}$ | mA |
| $V_{IT+}$ | input threshold voltage (HIGH) | | 0,7*$V_s$ | | | V |
| $V_{IT-}$ | Input threshold voltage (LOW) | | | | 0,3*$V_s$ | V |
| $R_{IN}$ | input resistance | | | 13 | | kΩ |
| $C_{IN}$ | input capacitance | | | 1 | | nF |
| $t_{pRESET}$ | error memory reset time | | 1300 | | 2900 | ms |
| $t_{pReset(OCP)}$ | Over current reset time, FRT-function can be activated via CAN interface | | | | | µs |
| $t_{TD}$ | top / bottom switch interlock time | | | 3 | | µs |
| $t_{jitter}$ | jitter clock time | | | 52 | 58 | ns |
| $t_{SIS}$ | short pulse suppression time | | | 0.6 | | µs |
| $t_{POR}$ | Power-On-Reset completed | | | 3.5 | | s |
| $I_{digiout}$ | digital output sink current (HALT-signal) | | | | 16 | mA |
| $V_{it+ HALT}$ | input threshold voltage HIGH HALT (Low -->High) | | 0,6*$V_s$ | | | V |
| $V_{it-HALT}$ | input threshold voltage LOW HALT (High --> Low) | | | | 0.4*$V_s$ | V |
| $t_{d(err)}$ | Error delay time (from detection to HALT), (depends on kind of error) | | 1.8 | | 170 | µs |
| $I_{TRIPSC}$ | over current trip level | | 3525 | 3600 | 3675 | $A_{PEAK}$ |
| $I_{LL}$ | | | | n.a. | | $A_{PEAK}$ |
| $T_{trip}$ | over temperature trip level | | 128 | 135 | 142 | °C |
| $T_{DriverTrip}$ | over temperature PCB trip level | | 113 | 120 | 124 | °C |
| $V_{DCtrip}$ | over voltage trip level, can be deactivated via CAN interface, | | 1300 | 1340 | 1380 | V |
| $V_{DCtripLL}$ | | | | n.a. | | V |

 

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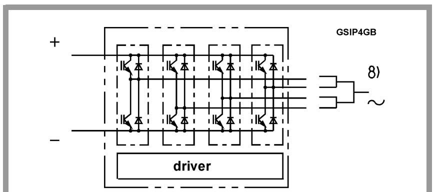


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**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **System** | | | | | | |
| $t_{d(on)IO}$ | $V_{CC}$ = 1300 V, $I_C$ = 2400 A, $T_j$ = 25 °C | turn on propagation delay time | | 2.8 | | µs |
| $t_{d(off)IO}$ | | turn off propagation delay time | | 2.6 | | µs |
| $dV_{CE}/dt_{on}$ | $T_j$ = 25 °C, $V_{CC}$ = 1300 V | $I_C$ = 0 A | | 14 | | kV/µs |
| | | $I_C$ = 2400 A | | 3 | | kV/µs |
| $dV_{CE}/dt_{off}$ | | $I_C$ = 2400 A | | 10 | | kV/µs |
| $R_{th(s-a)}$ | flow rate = 510 $m^3$/h, $T_a$=25°C, 500m above sea level | | | | 0.0233 | K/W |
| $R_{CC'+EE'}$ | terminals to chip, $T_s$ = 25 °C | | | 0.0675 | | mΩ |
| $L_{CE}$ | commutation inductance | | | 4.5 | | nH |
| $C_{CHC}$ | coupling capacitance secondary to heat sink | | | 6 | | nF |
| $C_{ps}$ | coupling capacitance primary to secondary | | | 0.08 | | nF |
| $I_{CES}$ + $I_{RD}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1700 V, $T_j$ = 25 °C | | | 0.199 | | mA |
| $M_{dc}$ | DC terminals | | 6 | | 8 | Nm |
| $M_{ac}$ | AC terminals | | 13 | | 15 | Nm |
| w | SKiiP System w/o heat sink | | | 3.22 | | kg |
| $w_h$ | heat sink | | | 8 | | kg |

| Isolation coordination acc. to EN 50178 and IEC 61800-5-1 | |
|---|---|
| Maximum grid RMS voltage, line-to-line, grounded delta mains | 690V+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 | 690V+20% |
| Installation altitude for maximum grid RMS voltage, line-to-line, star point grounded mains | 4000m |
| Maximum transient peak voltage between low voltage circuit and mains | 1900V |
| Pollution degree acc. to IEC 60664-1 outside the moulded power section | 2 |
| Overvoltage cat. acc. to IEC 60664-1 for mains | III |
| Overvoltage cat. acc. to UL 840 within mains | I |
| Overvoltage cat. acc. to UL 840 between mains and ground | III |
| Overvoltage cat. acc. to UL 840 between mains and low voltage circuit | III |
| Basic isolation | between heat sink and mains |
| Reinforced isolation | 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) | 6K1(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

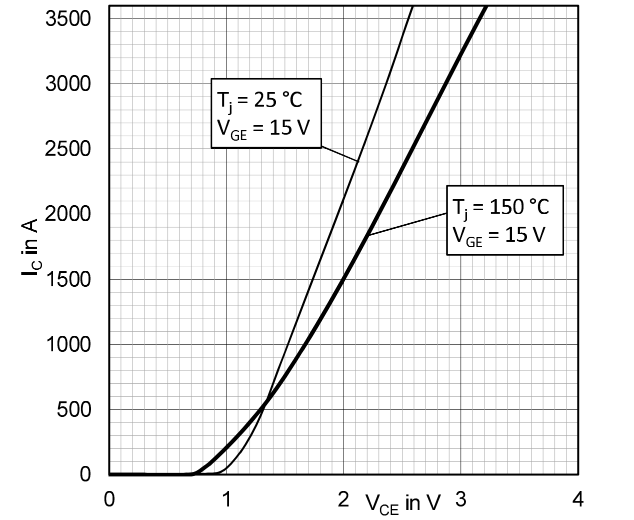



Fig. 1: Typical IGBT output characteristics

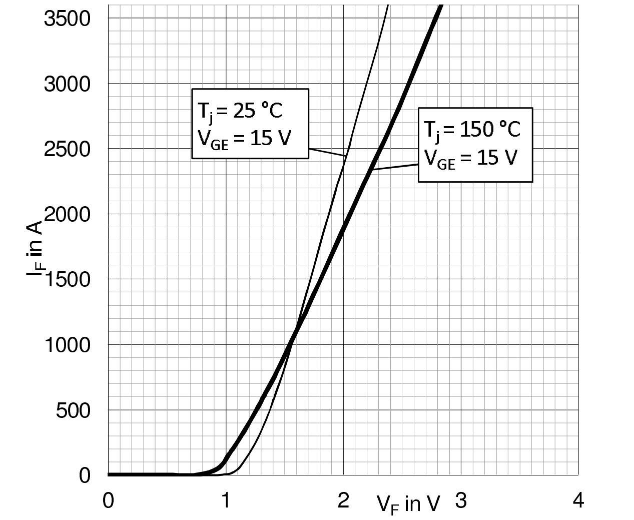



Fig. 2: Typical diode output characteristics

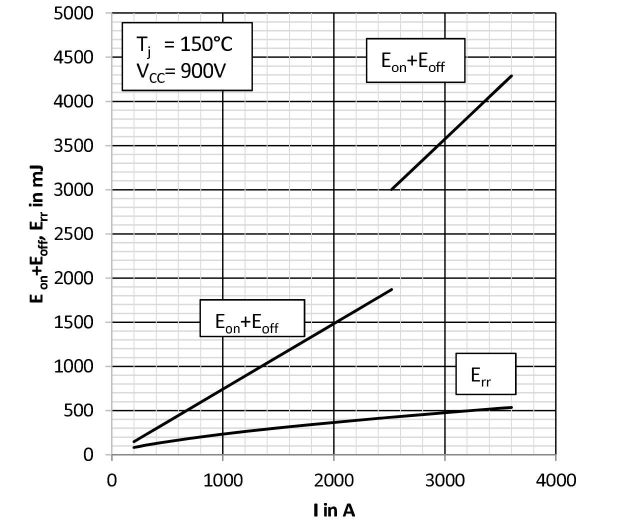



Fig. 3: Typical switching energy E = f($I_c$)

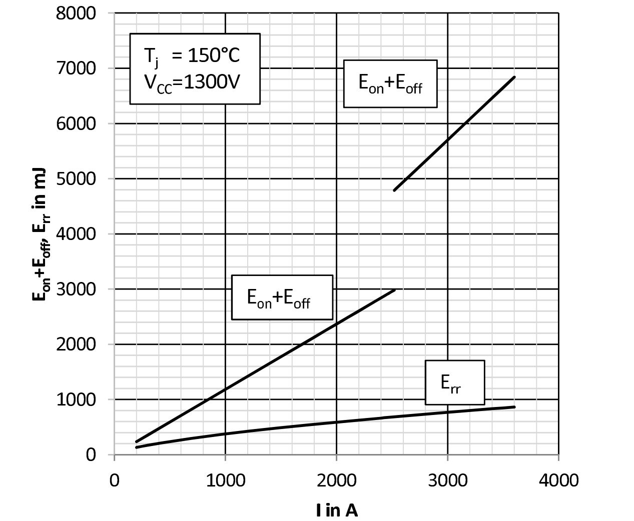



Fig. 4: Typical switching energy E = f($I_c$)

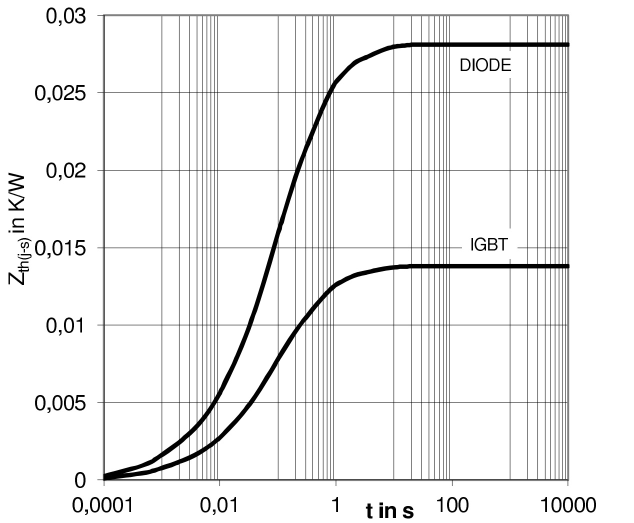



Fig. 5: Transient thermal impedance Zth(j-s)

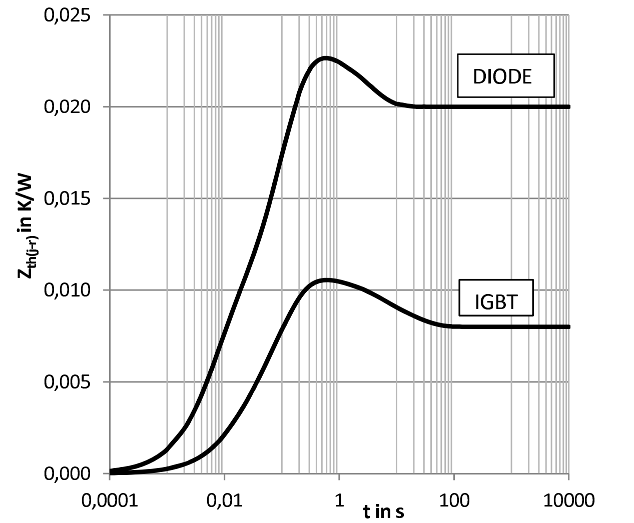



Fig. 6: Transient thermal impedance Zth(j-r)

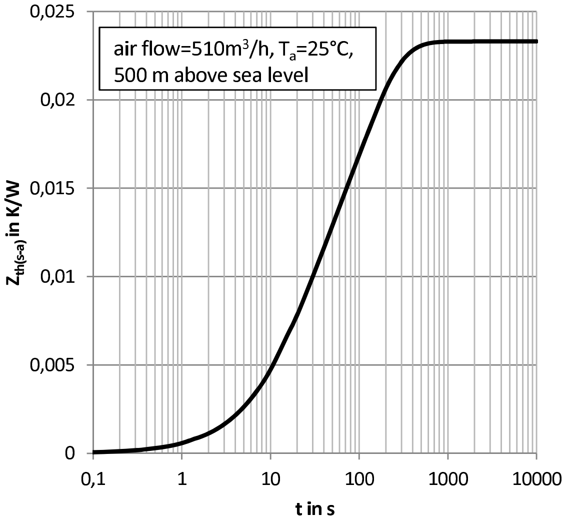



Fig. 7: Transient thermal impedance Zth(s-a)

| | $R_{th}$ [K/W] | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| $Z_{th(j-s)}$ I | 0,0010 | 0,0049 | 0,0055 | 0,0017 | 0,0007 |
| $Z_{th(j-s)}$ D | 0,0020 | 0,0100 | 0,0112 | 0,0034 | 0,0015 |
| $Z_{th(j-r)}$ I | 0,0021 | 0,0029 | 0,0058 | -0,0013 | -0,0015 |
| $Z_{th(j-r)}$ D | 0,0075 | 0,0060 | 0,0098 | -0,0033 | 0,0000 |
| $Z_{th(s-a)}$ | 0,0075 | 0,0121 | 0,0037 | 0,0000 | 0,0000 |
| | tau [s] | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| $Z_{th(j-s)}$ I | 3,6500 | 0,4100 | 0,0650 | 0,0090 | 0,0008 |
| $Z_{th(j-s)}$ D | 3,6500 | 0,4100 | 0,0650 | 0,0090 | 0,0008 |
| $Z_{th(j-r)}$ I | 0,0130 | 0,0500 | 0,1200 | 4,4000 | 21,000 |
| $Z_{th(j-r)}$ D | 0,0060 | 0,0650 | 0,1300 | 3,2500 | 1,0000 |
| $Z_{th(s-a)}$ | 17,000 | 99,000 | 160,000 | 1,0000 | 1,0000 |

Fig. 8: Coefficients of thermal impedances

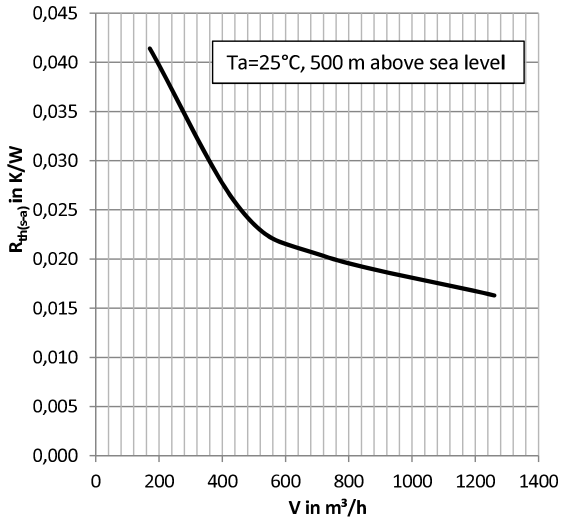



Fig. 9: Thermal resistance Rth(s-a) versus flow rate V

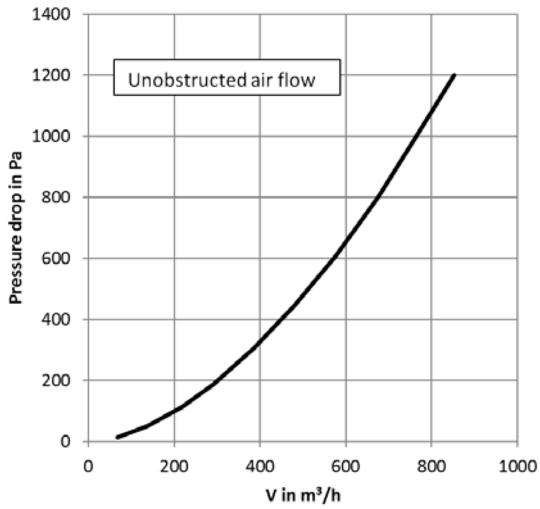
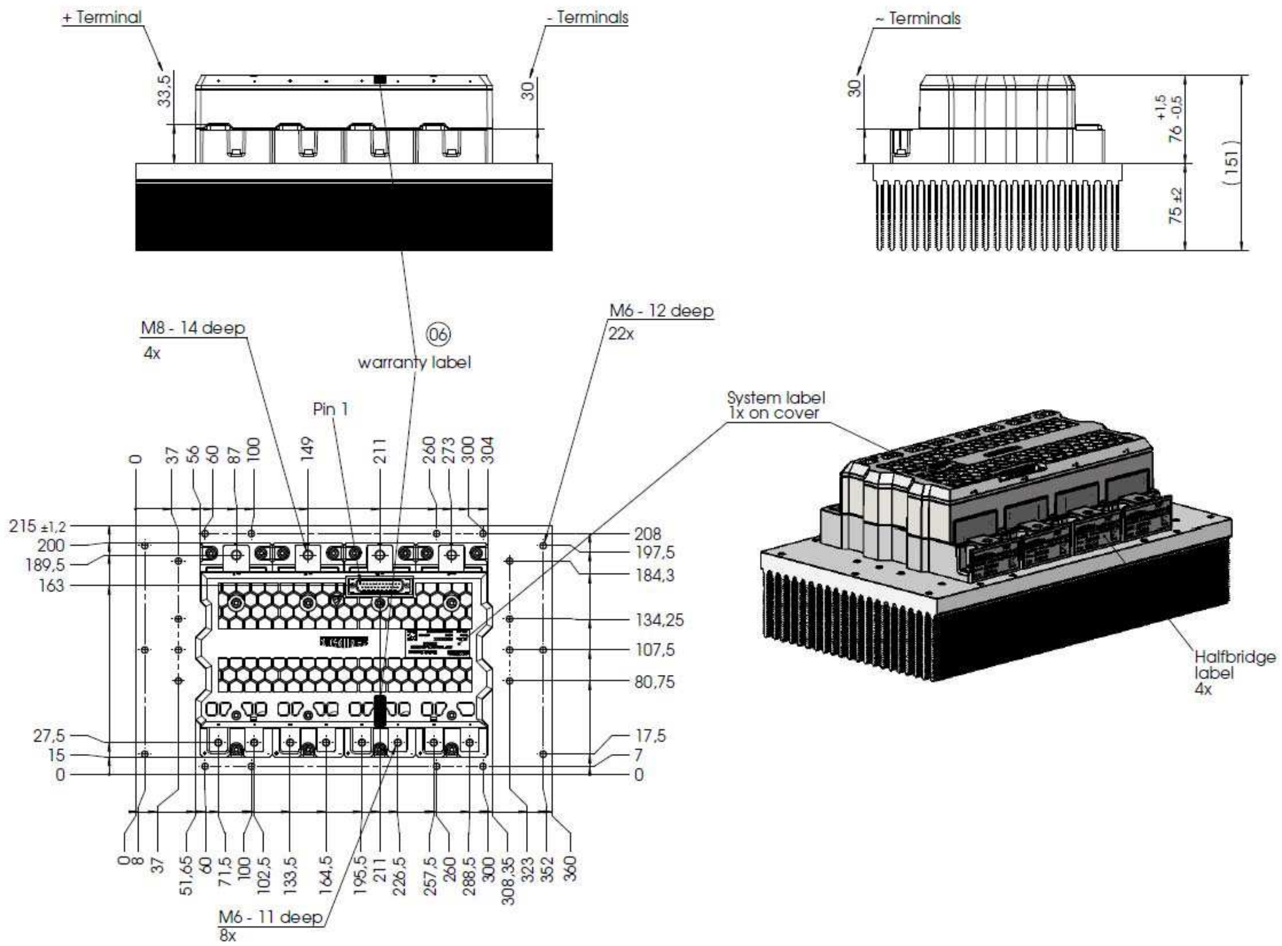



Fig. 10: Pressure drop Δp versus flow rate V




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.