

## Final datasheet

### IHM-B module with Trench/Fieldstop IGBT4 and emitter controlled 4 diode

#### Features

- Electrical features
  - $V_{CES} = 4500 \text{ V}$
  - $I_{C\text{ nom}} = 1200 \text{ A} / I_{CRM} = 2400 \text{ A}$
  - High DC stability
  - High short-circuit capability
  - High dynamic robustness
  - Low  $V_{CE,sat}$
  - Trench IGBT 4
  - $V_{CE,sat}$  with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - Package with CTI > 600
  - IHM B housing
  - Isolated base plate
  - Standard housing



Typical appearance

#### Potential applications

- High-power converters
- Medium-voltage converters
- Power transmission and distribution

#### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

#### Description

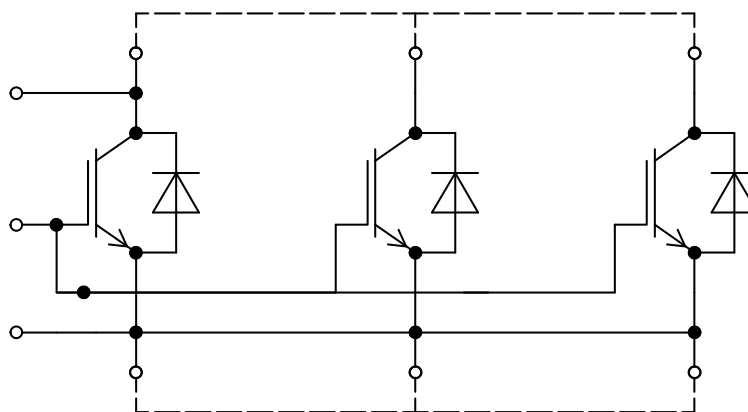


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## 1 Package

**Table 1** Insulation coordination

| Parameter                            | Symbol      | Note or test condition                                 | Values | Unit |
|--------------------------------------|-------------|--------------------------------------------------------|--------|------|
| Isolation test voltage               | $V_{ISOL}$  | RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$         | 6.0    | kV   |
| Partial discharge extinction voltage | $V_{isol}$  | RMS, $f = 50 \text{ Hz}$ , $Q_{PD} \leq 10 \text{ pC}$ | 3.5    | kV   |
| DC stability                         | $V_{CE(D)}$ | $T_{vj} = 25 \text{ °C}$ , 100 Fit                     | 2900   | V    |
| Material of module baseplate         |             |                                                        | AlSiC  |      |
| Creepage distance                    | $d_{Creep}$ | terminal to heatsink                                   | 32.2   | mm   |
| Clearance                            | $d_{Clear}$ | terminal to heatsink                                   | 19.1   | mm   |
| Comparative tracking index           | $CTI$       |                                                        | > 600  |      |

**Table 2** Characteristic values

| Parameter                                | Symbol        | Note or test condition                          |           | Values |       |      | Unit |
|------------------------------------------|---------------|-------------------------------------------------|-----------|--------|-------|------|------|
|                                          |               |                                                 |           | Min.   | Typ.  | Max. |      |
| Stray inductance module                  | $L_{sCE}$     |                                                 |           |        | 6     |      | nH   |
| Module lead resistance, terminals - chip | $R_{AA'+CC'}$ | $T_C = 25\text{ }^{\circ}\text{C}$ , per switch |           |        | 0.08  |      | mΩ   |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C = 25\text{ }^{\circ}\text{C}$ , per switch |           |        | 0.095 |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                                                 |           | -40    |       | 150  | °C   |
| Mounting torque for module mounting      | $M$           | - Mounting according to valid application note  | M6, Screw | 4.25   |       | 5.75 | Nm   |
| Terminal connection torque               | $M$           | - Mounting according to valid application note  | M4, Screw | 1.8    |       | 2.1  | Nm   |
|                                          |               |                                                 | M8, Screw | 8      |       | 10   |      |
| Weight                                   | $G$           |                                                 |           |        | 1200  |      | g    |

## 2 IGBT, Inverter

**Table 3** Maximum rated values

| Parameter                         | Symbol    | Note or test condition                |                           | Values    | Unit |
|-----------------------------------|-----------|---------------------------------------|---------------------------|-----------|------|
| Collector-emitter voltage         | $V_{CES}$ |                                       | $T_{vj} = -40 \text{ °C}$ | 4300      | V    |
|                                   |           |                                       | $T_{vj} = 150 \text{ °C}$ | 4500      |      |
| Continuous DC collector current   | $I_{CDC}$ | $T_{vj \text{ max}} = 150 \text{ °C}$ | $T_C = 110 \text{ °C}$    | 1200      | A    |
| Repetitive peak collector current | $I_{CRM}$ | $t_p$ limited by $T_{vj \text{ op}}$  |                           | 2400      | A    |
| Gate-emitter peak voltage         | $V_{GES}$ |                                       |                           | -20/26.25 | V    |

**Table 4**                      **Characteristic values**

| Parameter                            | Symbol        | Note or test condition                                                                                                                            |                          | Values |       |      | Unit     |
|--------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------|-------|------|----------|
|                                      |               |                                                                                                                                                   |                          | Min.   | Typ.  | Max. |          |
| Collector-emitter saturation voltage | $V_{CE\ sat}$ | $I_C = 1200\ A, V_{GE} = 25\ V$                                                                                                                   | $T_{vj} = 25\ ^\circ C$  |        | 2.10  | 2.55 | V        |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 2.40  | 2.95 |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 2.50  | 3.05 |          |
| Gate threshold voltage               | $V_{GETh}$    | $I_C = 112\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$                                                                                           |                          | 5.5    | 6     | 6.5  | V        |
| Gate charge                          | $Q_G$         | $V_{GE} = \pm 15\ V, V_{CC} = 2800\ V$                                                                                                            |                          |        | 35    |      | $\mu C$  |
| Internal gate resistor               | $R_{Gint}$    | $T_{vj} = 25\ ^\circ C$                                                                                                                           |                          |        | 0.39  |      | $\Omega$ |
| Input capacitance                    | $C_{ies}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                              |                          |        | 223   |      | nF       |
| Reverse transfer capacitance         | $C_{res}$     | $f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$                                                                              |                          |        | 4.1   |      | nF       |
| Collector-emitter cut-off current    | $I_{CES}$     | $V_{CE} = 4500\ V, V_{GE} = 0\ V$                                                                                                                 | $T_{vj} = 25\ ^\circ C$  |        |       | 5    | mA       |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$                                                                                            |                          |        |       | 400  | nA       |
| Turn-on delay time (inductive load)  | $t_{don}$     | $I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$                                                                      | $T_{vj} = 25\ ^\circ C$  |        | 0.330 |      | $\mu s$  |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 0.360 |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 0.370 |      |          |
| Rise time (inductive load)           | $t_r$         | $I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$                                                                      | $T_{vj} = 25\ ^\circ C$  |        | 0.260 |      | $\mu s$  |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 0.270 |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 0.280 |      |          |
| Turn-off delay time (inductive load) | $t_{doff}$    | $I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega$                                                                     | $T_{vj} = 25\ ^\circ C$  |        | 9.300 |      | $\mu s$  |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 9.800 |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 9.900 |      |          |
| Fall time (inductive load)           | $t_f$         | $I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega$                                                                     | $T_{vj} = 25\ ^\circ C$  |        | 0.740 |      | $\mu s$  |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 1.730 |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 2.040 |      |          |
| Turn-on time (resistive load)        | $t_{on\_R}$   | $I_C = 500\ A, V_{CC} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$                                                                       | $T_{vj} = 25\ ^\circ C$  | 1.24   |       |      | $\mu s$  |
| Turn-on energy loss per pulse        | $E_{on}$      | $I_C = 1200\ A, V_{CC} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega, di/dt = 3700\ A/\mu s (T_{vj} = 150\ ^\circ C)$  | $T_{vj} = 25\ ^\circ C$  |        | 4100  |      | mJ       |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 5800  |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 6350  |      |          |
| Turn-off energy loss per pulse       | $E_{off}$     | $I_C = 1200\ A, V_{CC} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega, dv/dt = 1000\ V/\mu s (T_{vj} = 150\ ^\circ C)$ | $T_{vj} = 25\ ^\circ C$  |        | 5500  |      | mJ       |
|                                      |               |                                                                                                                                                   | $T_{vj} = 125\ ^\circ C$ |        | 6900  |      |          |
|                                      |               |                                                                                                                                                   | $T_{vj} = 150\ ^\circ C$ |        | 7300  |      |          |

**(table continues...)**

**Table 4** (continued) Characteristic values

| Parameter                              | Symbol      | Note or test condition                                                                                                                                                          | Values |      |      | Unit             |
|----------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------|------------------|
|                                        |             |                                                                                                                                                                                 | Min.   | Typ. | Max. |                  |
| SC data                                | $I_{SC}$    | $V_{GE} \leq 15 \text{ V}$ , $V_{CC} = 3000 \text{ V}$ ,<br>$V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$<br>$t_p \leq 10 \mu\text{s}$ ,<br>$T_{vj} = 150 \text{ }^\circ\text{C}$ |        | 6400 |      | A                |
| Thermal resistance, junction to case   | $R_{thJC}$  | per IGBT                                                                                                                                                                        |        |      | 9.40 | K/kW             |
| Thermal resistance, case to heat sink  | $R_{thCH}$  | per IGBT, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$                                                                                                                     |        | 4.10 |      | K/kW             |
| Temperature under switching conditions | $T_{vj op}$ |                                                                                                                                                                                 | -40    |      | 150  | $^\circ\text{C}$ |

### 3 Diode, Inverter

**Table 5** Maximum rated values

| Parameter                       | Symbol      | Note or test condition                      |                                       | Values | Unit                  |
|---------------------------------|-------------|---------------------------------------------|---------------------------------------|--------|-----------------------|
| Repetitive peak reverse voltage | $V_{RRM}$   |                                             | $T_{vj} = -40 \text{ }^\circ\text{C}$ | 4500   | V                     |
|                                 |             |                                             | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 4500   |                       |
| Continuous DC forward current   | $I_F$       |                                             |                                       | 1200   | A                     |
| Repetitive peak forward current | $I_{FRM}$   | $t_p = 1 \text{ ms}$                        |                                       | 2400   | A                     |
| $I^2t$ - value                  | $I^2t$      | $t_p = 10 \text{ ms}$ , $V_R = 0 \text{ V}$ | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 760    | $\text{kA}^2\text{s}$ |
|                                 |             |                                             | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 710    |                       |
| Maximum power dissipation       | $P_{RQM}$   |                                             | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 2400   | kW                    |
| Minimum turn-on time            | $t_{onmin}$ |                                             |                                       | 10     | $\mu\text{s}$         |

**Table 6** Characteristic values

| Parameter                     | Symbol   | Note or test condition                                                                                                                                               | Values                                |      |      | Unit |
|-------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|------|------|
|                               |          |                                                                                                                                                                      | Min.                                  | Typ. | Max. |      |
| Forward voltage               | $V_F$    | $I_F = 1200 \text{ A}$ , $V_{GE} = 0 \text{ V}$                                                                                                                      | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 2.50 | 2.95 | V    |
|                               |          |                                                                                                                                                                      | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 2.40 | 2.85 |      |
|                               |          |                                                                                                                                                                      | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 2.30 | 2.75 |      |
| Peak reverse recovery current | $I_{RM}$ | $V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt = 3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ ) | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 1400 |      | A    |
|                               |          |                                                                                                                                                                      | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 1640 |      |      |
|                               |          |                                                                                                                                                                      | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 1750 |      |      |

(table continues...)

**Table 6** (continued) Characteristic values

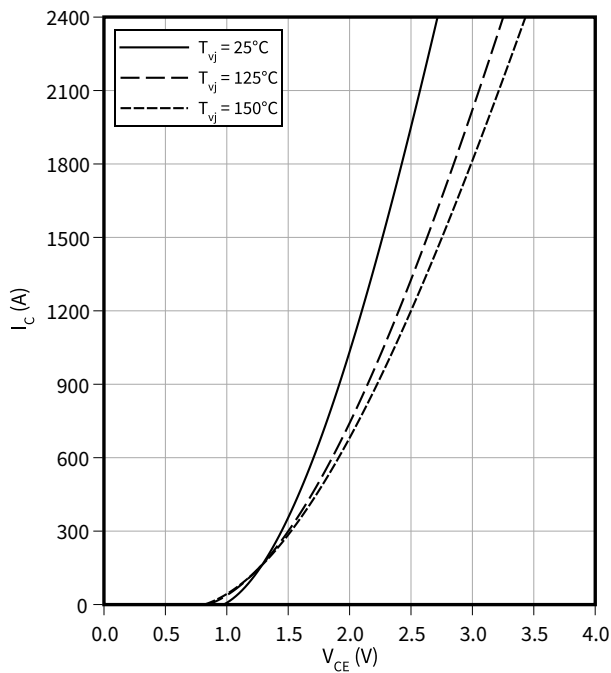
| Parameter                              | Symbol      | Note or test condition                                                                                                                                                    | Values                                |      |      | Unit             |
|----------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|------|------------------|
|                                        |             |                                                                                                                                                                           | Min.                                  | Typ. | Max. |                  |
| Recovered charge                       | $Q_r$       | $V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt =$<br>$3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ ) | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 1000 |      | $\mu\text{C}$    |
|                                        |             |                                                                                                                                                                           | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 2000 |      |                  |
|                                        |             |                                                                                                                                                                           | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 2380 |      |                  |
| Reverse recovery energy                | $E_{rec}$   | $V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt =$<br>$3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ ) | $T_{vj} = 25 \text{ }^\circ\text{C}$  | 1500 |      | mJ               |
|                                        |             |                                                                                                                                                                           | $T_{vj} = 125 \text{ }^\circ\text{C}$ | 3300 |      |                  |
|                                        |             |                                                                                                                                                                           | $T_{vj} = 150 \text{ }^\circ\text{C}$ | 4000 |      |                  |
| Thermal resistance, junction to case   | $R_{thJC}$  | per diode                                                                                                                                                                 |                                       |      | 15.6 | K/kW             |
| Thermal resistance, case to heat sink  | $R_{thCH}$  | per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$                                                                                                       |                                       | 6.20 |      | K/kW             |
| Temperature under switching conditions | $T_{vj op}$ |                                                                                                                                                                           | -40                                   |      | 150  | $^\circ\text{C}$ |

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

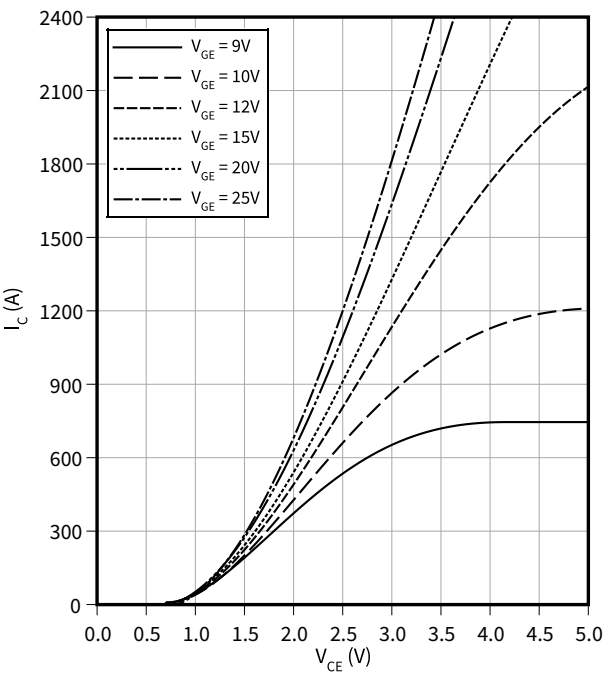
$V_{GE} = 25\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

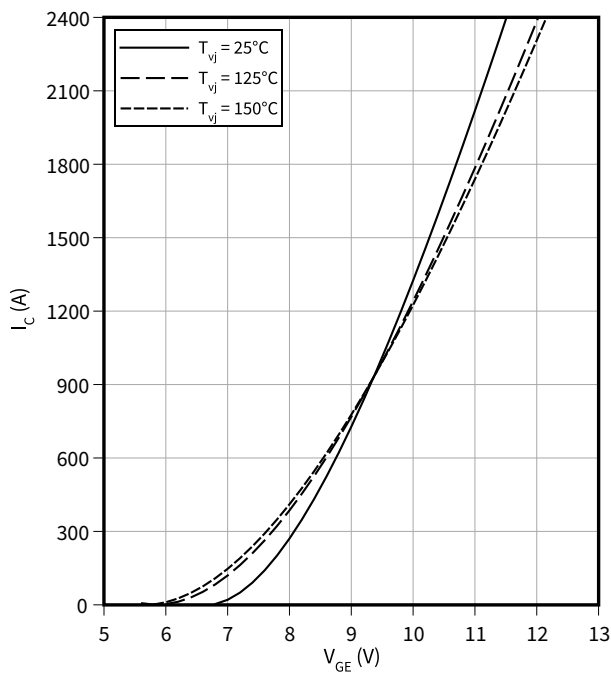
$T_{vj} = 150\text{ }^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

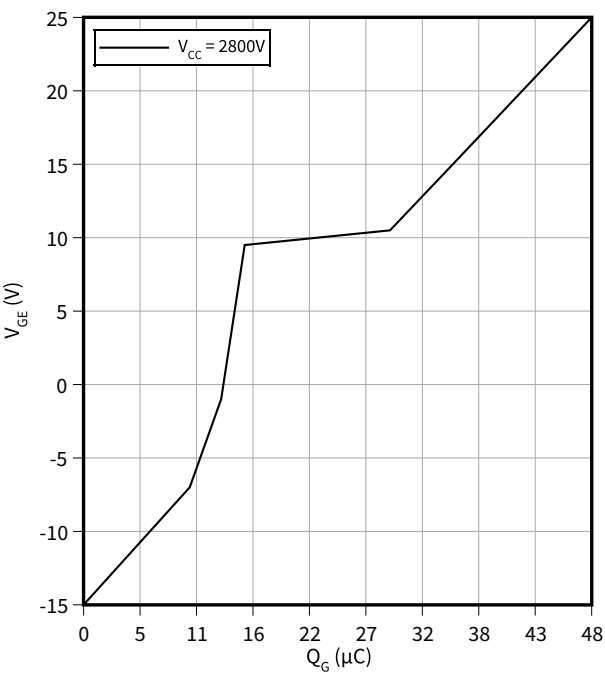
$V_{CE} = 20\text{ V}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

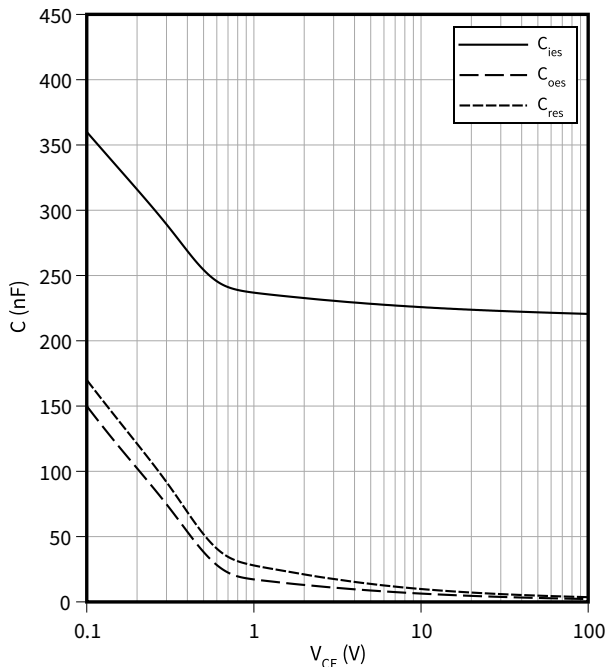
$I_C = 1200\text{ A}, T_{vj} = 25\text{ }^\circ\text{C}$



4 Characteristics diagrams

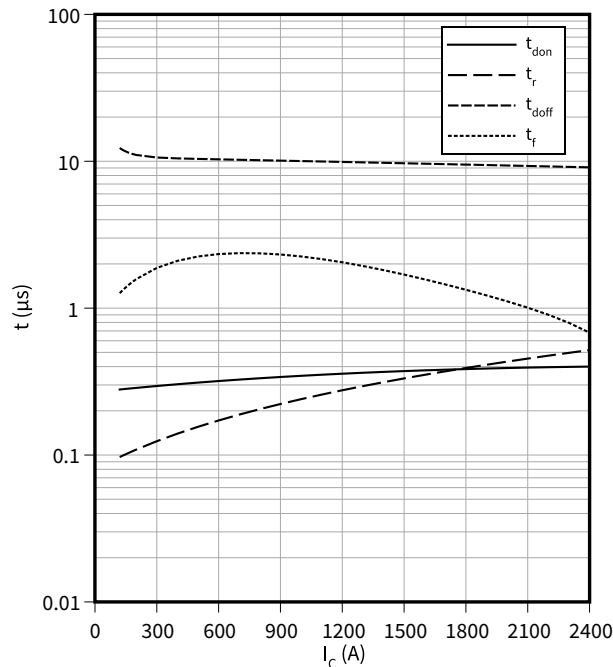
Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$   
 $f = 100\text{ kHz}$ ,  $V_{GE} = 0\text{ V}$ ,  $T_{vj} = 25\text{ }^{\circ}\text{C}$



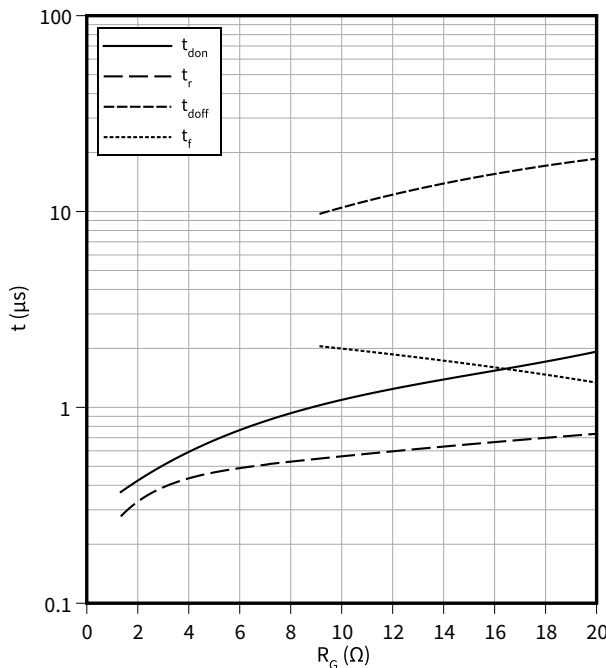
Switching times (typical), IGBT, Inverter

$t = f(I_C)$   
 $R_{Goff} = 9.1\text{ }\Omega$ ,  $R_{Gon} = 1.3\text{ }\Omega$ ,  $V_{CC} = 2800\text{ V}$ ,  $V_{GE} = -15\text{ V} / 15\text{ V}$ ,  
 $T_{vj} = 150\text{ }^{\circ}\text{C}$



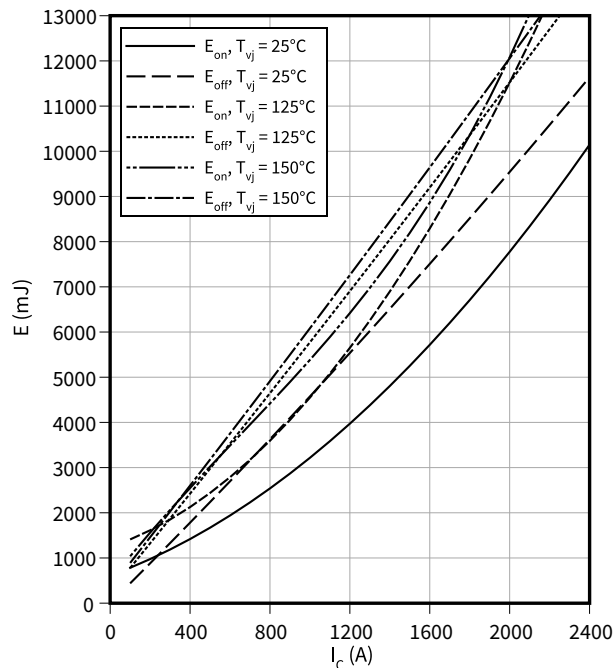
Switching times (typical), IGBT, Inverter

$t = f(R_G)$   
 $I_C = 1200\text{ A}$ ,  $V_{CC} = 2800\text{ V}$ ,  $V_{GE} = -15\text{ V} / 15\text{ V}$ ,  $T_{vj} = 150\text{ }^{\circ}\text{C}$



Switching losses (typical), IGBT, Inverter

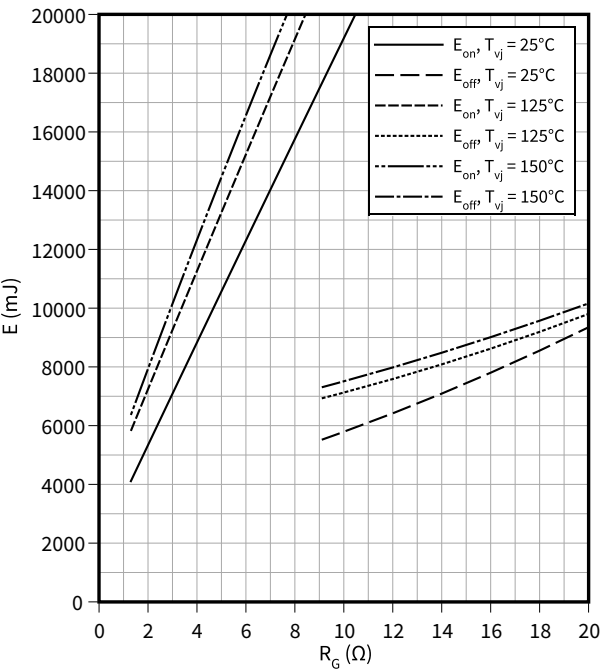
$E = f(I_C)$   
 $R_{Goff} = 9.1\text{ }\Omega$ ,  $R_{Gon} = 1.3\text{ }\Omega$ ,  $V_{CC} = 2800\text{ V}$ ,  $V_{GE} = -15\text{ V} / 15\text{ V}$



4 Characteristics diagrams

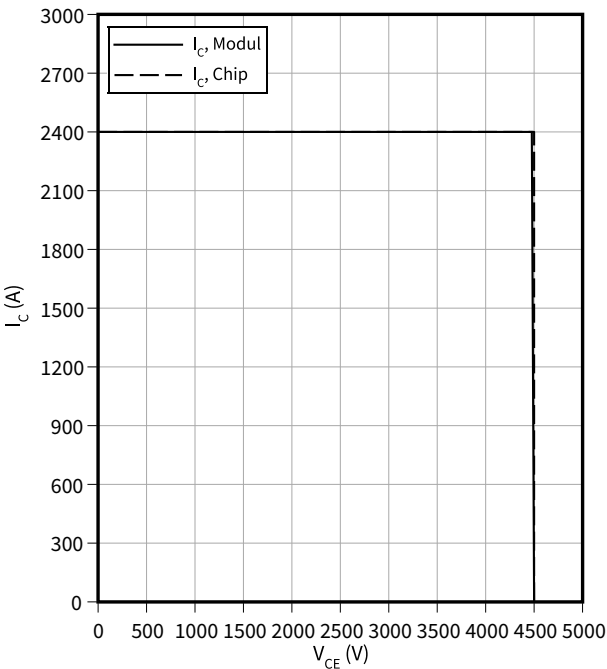
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$   
 $I_C = 1200\text{ A}, V_{CC} = 2800\text{ V}, V_{GE} = -15 / 15\text{ V}$



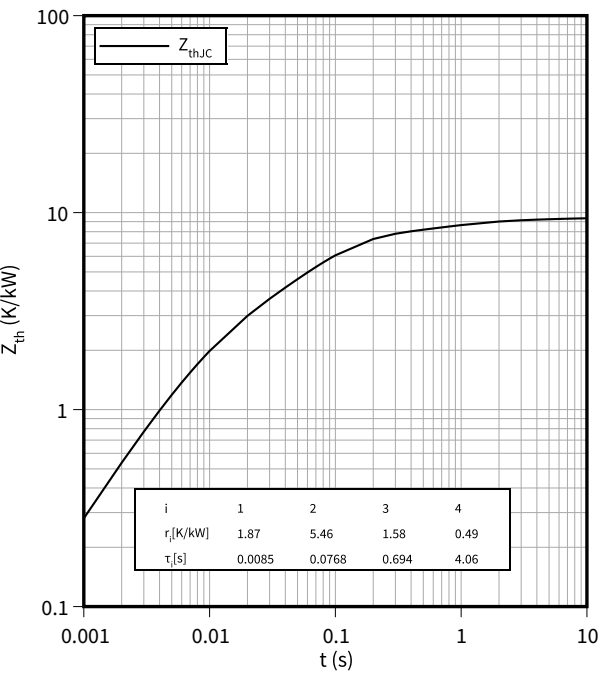
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$   
 $R_{Goff} = 9.1\text{ }\Omega, V_{GE} = \pm 15\text{ V}, V_{CC} \leq 3200\text{ V}, T_{vj} = 150\text{ }^\circ\text{C}$



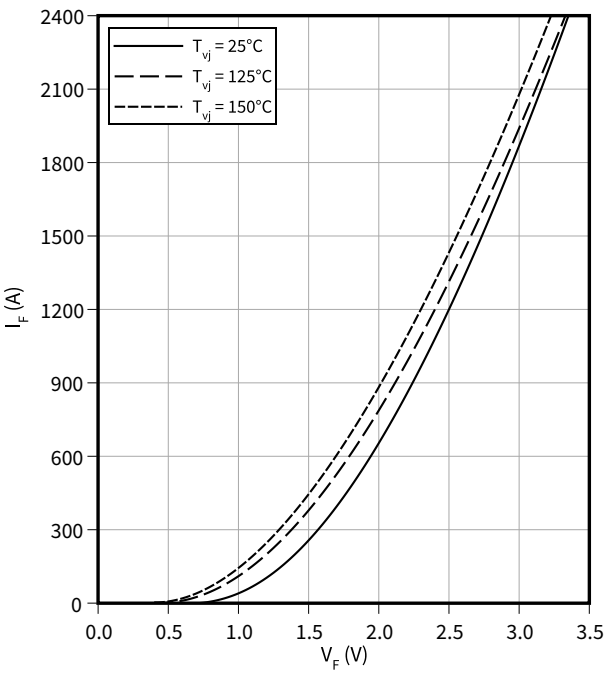
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

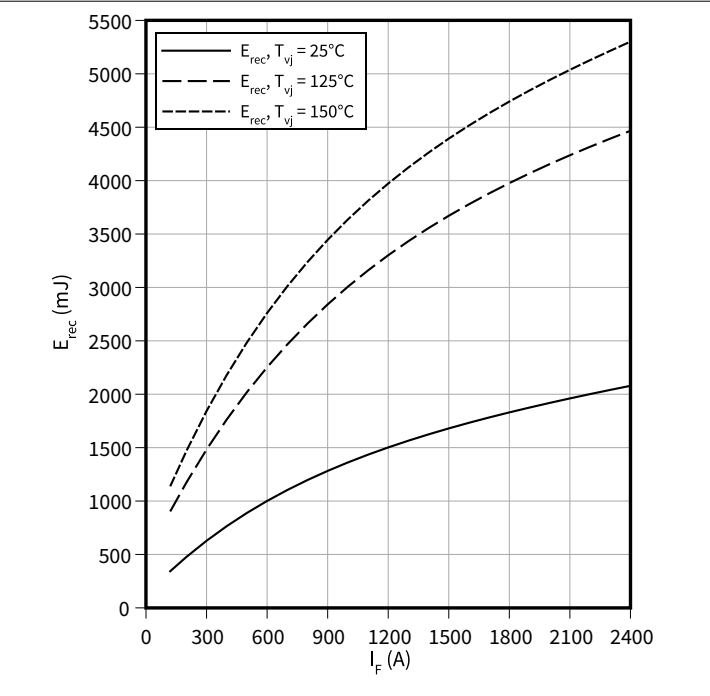
$I_F = f(V_F)$



4 Characteristics diagrams

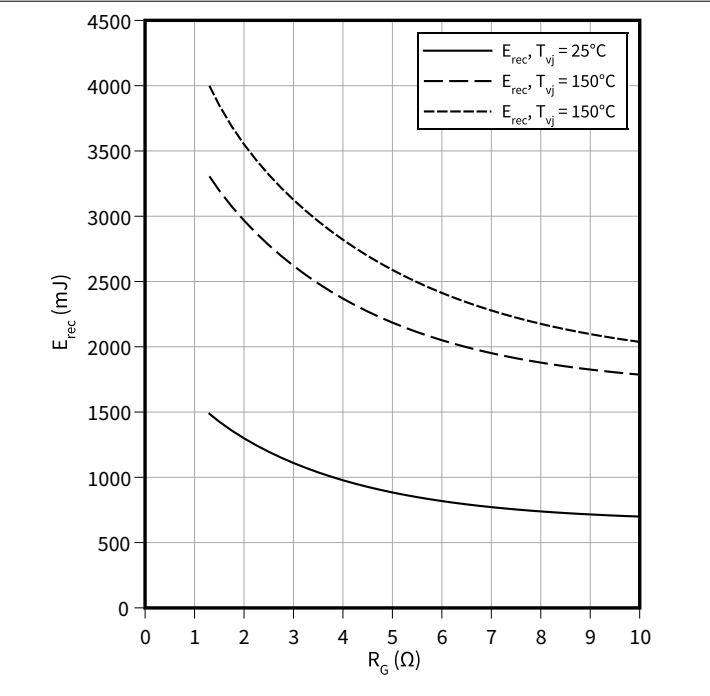
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$   
 $R_{Gon} = R_{Gon}(IGBT)$ ,  $V_{CC} = 2800\text{ V}$



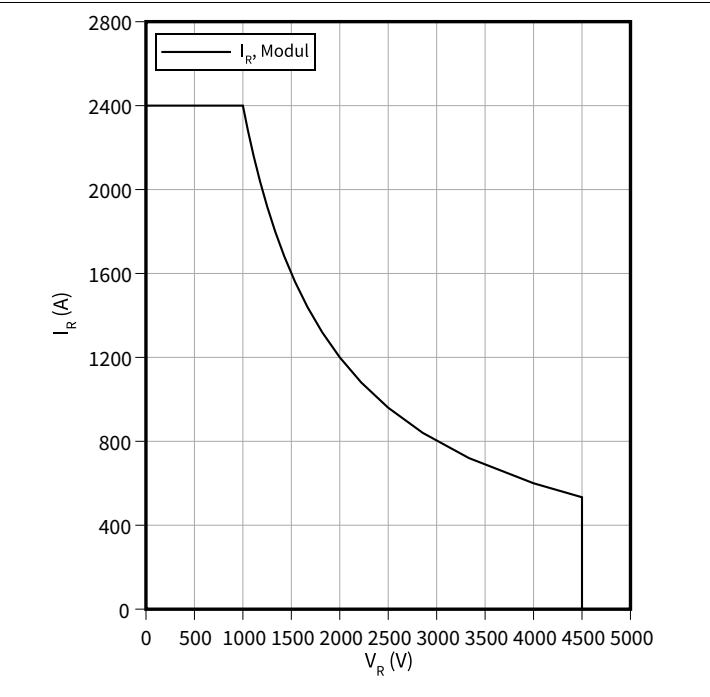
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$   
 $I_F = 1200\text{ A}$ ,  $V_{CC} = 2800\text{ V}$



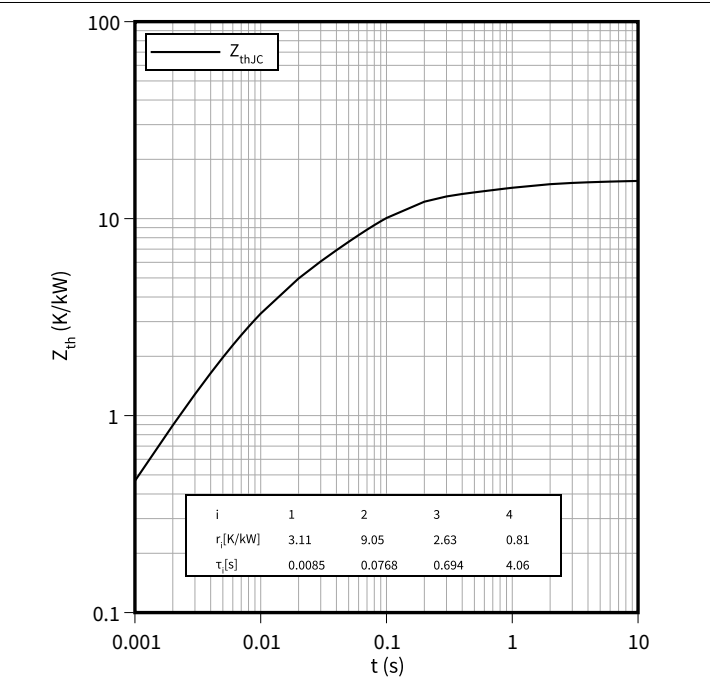
Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$   
 $T_{vj} = 150^\circ\text{C}$

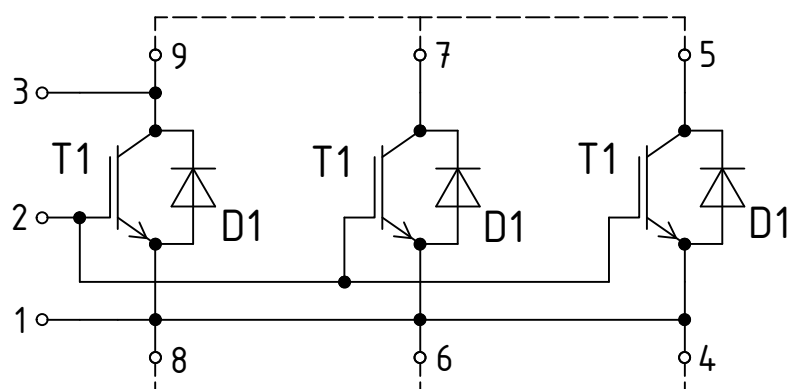


Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



## 5 Circuit diagram



externer Anschluss erfolgen  
*external connection to be done*

Figure 1

## 6 Package outlines

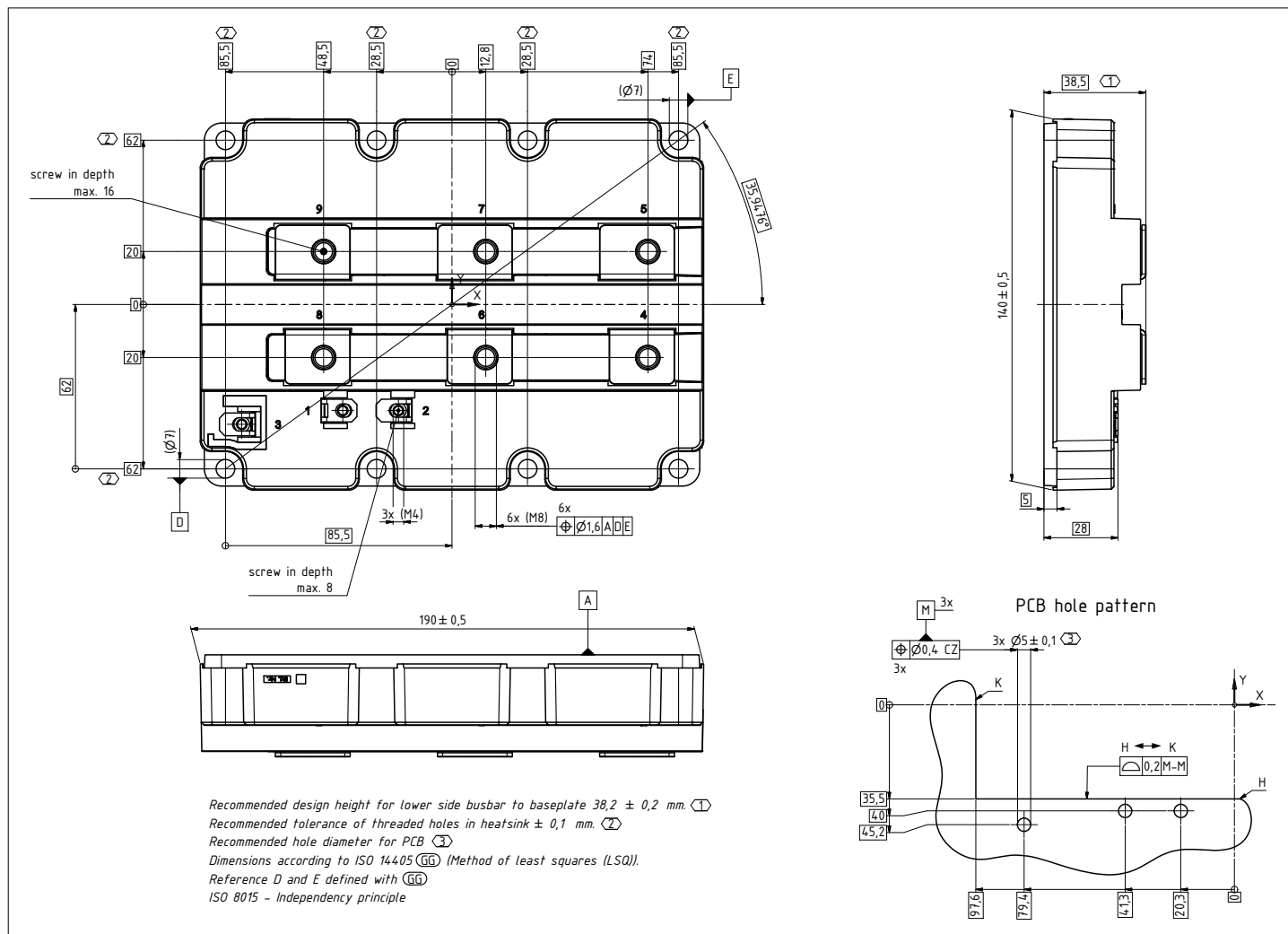


Figure 2

7 Module label code

| Module label code |                                                                                                                                                                                                                                                      |              |                 |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------|
| Code format       | Data Matrix                                                                                                                                                                                                                                          |              | Barcode Code128 |
| Encoding          | ASCII text                                                                                                                                                                                                                                           |              | Code Set A      |
| Symbol size       | 16x16                                                                                                                                                                                                                                                |              | 23 digits       |
| Standard          | IEC24720 and IEC16022                                                                                                                                                                                                                                |              | IEC8859-1       |
| Code content      | <i>Content</i>                                                                                                                                                                                                                                       | <i>Digit</i> | <i>Example</i>  |
|                   | Module serial number                                                                                                                                                                                                                                 | 1 – 5        | 71549           |
|                   | Module material number                                                                                                                                                                                                                               | 6 - 11       | 142846          |
|                   | Production order number                                                                                                                                                                                                                              | 12 - 19      | 55054991        |
|                   | Date code (production year)                                                                                                                                                                                                                          | 20 – 21      | 15              |
|                   | Date code (production week)                                                                                                                                                                                                                          | 22 – 23      | 30              |
| Example           | <div><br/>71549142846550549911530</div> <div><br/>71549142846550549911530</div> |              |                 |

Figure 3

## Revision history

| Document revision | Date of release | Description of changes                             |
|-------------------|-----------------|----------------------------------------------------|
| 1.00              | 2023-12-12      | Initial version                                    |
| 1.01              | 2023-12-15      | Final datasheet<br>Update package outlines drawing |

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