# IHM-B module with Trench/Fieldstop IGBT3 and emitter controlled 3 diode

## Features


- Electrical features
  - $V_{CES}$ = 3300 V
  - $I_{C\ nom}$ = 1500 A / $I_{CRM}$ = 3000 A
  - High DC stability
  - High short-circuit capability
  - Low $V_{CE,sat}$
  - Unbeatable robustness
  - $T_{vj,op}$ = 150°C
  - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - Package with CTI > 600
  - IHM B housing
  - Isolated base plate

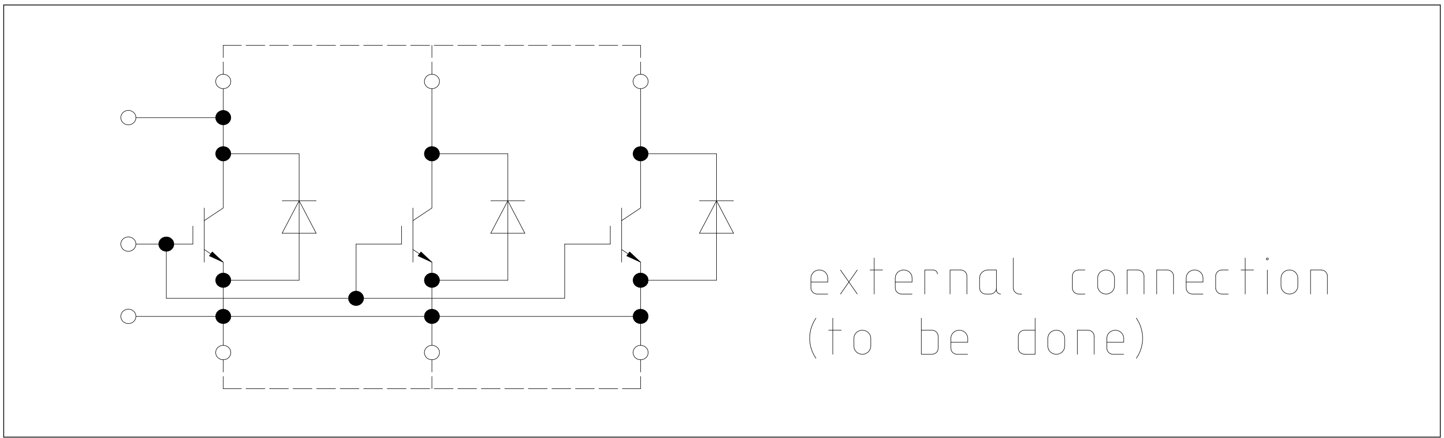
## Potential applications

- Chopper applications
- Medium-voltage converters
- Motor drives
- Traction drives
- UPS systems
- Wind turbines

## 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 Hz, $t$ = 1 min | 6.0 | kV |
| Partial discharge extinction voltage | $V_{isol}$ | RMS, f = 50 Hz, $Q_{PD} \leq 10$ pC | 2.6 | kV |
| DC stability | $V_{CE(D)}$ | $T_{vj}$=25°C, 100 Fit | 2100 | V |
| Material of module baseplate | | | AlSiC | |
| Internal isolation | | basic insulation (class 1, IEC 61140) | - | |
| 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. | |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per module, $\lambda_{Paste}$= 1 W /(m*K) / $\lambda_{grease}$= 1 W/(m*K) | | | 5.5 | | K/kW |
| Stray inductance module | $L_{sCE}$ | | | | 6 | | nH |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C$=25°C, per switch | | | 0.12 | | 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 °C | 3300 | V |
| | | | $T_{vj}$ = 150 °C | 3300 | |
| Continuous DC collector current | $I_{CDC}$ | $T_{vj\,max}$ = 150 °C | $T_C$ = 95 °C | 1500 | A |
| Repetitive peak collector current | $I_{CRM}$ | $t_P$ = 1 ms | | 3000 | A |

**(table continues...)**

**Table 3** **(continued) Maximum rated values**

| Parameter | Symbol | Note or test condition | Values | Unit |
|---|---|---|---|---|
| Gate-emitter peak voltage | $V_{GES}$ | | ±20 | V |

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

| Parameter | Symbol | Note or test condition | | Values Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Collector-emitter saturation voltage | $V_{CE\ sat}$ | $I_C$ = 1500 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 2.40 | 2.85 | V |
| | | | $T_{vj}$ = 125 °C | | 2.95 | 3.50 | |
| | | | $T_{vj}$ = 150 °C | | 3.10 | | |
| Gate threshold voltage | $V_{GEth}$ | $I_C$ = 72 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25 °C | | 5.20 | 5.80 | 6.40 | V |
| Gate charge | $Q_G$ | $V_{GE}$ = ±15 V, $V_{CE}$ = 1800 V | | | 42 | | µC |
| Internal gate resistor | $R_{Gint}$ | $T_{vj}$ = 25 °C | | | 0.42 | | Ω |
| Input capacitance | $C_{ies}$ | $f$ = 1000 kHz, $T_{vj}$ = 25 °C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | | 280 | | nF |
| Reverse transfer capacitance | $C_{res}$ | $f$ = 1000 kHz, $T_{vj}$ = 25 °C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | | 6 | | nF |
| Collector-emitter cut-off current | $I_{CES}$ | $V_{CE}$ = 3300 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 5 | mA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V, $T_{vj}$ = 25 °C | | | | 400 | nA |
| Turn-on delay time (inductive load) | $t_{don}$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $V_{GE}$ = ±15 V, $R_{Gon}$ = 0.51 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25 °C | | 0.360 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.400 | | |
| | | | $T_{vj}$ = 150 °C | | 0.410 | | |
| Rise time (inductive load) | $t_r$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $V_{GE}$ = ±15 V, $R_{Gon}$ = 0.51 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25 °C | | 0.370 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.400 | | |
| | | | $T_{vj}$ = 150 °C | | 0.400 | | |
| Turn-off delay time (inductive load) | $t_{doff}$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $V_{GE}$ = ±15 V, $R_{Goff}$ = 2.7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25 °C | | 4.100 | | µs |
| | | | $T_{vj}$ = 125 °C | | 4.300 | | |
| | | | $T_{vj}$ = 150 °C | | 4.300 | | |
| Fall time (inductive load) | $t_f$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $V_{GE}$ = ±15 V, $R_{Goff}$ = 2.7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25 °C | | 0.400 | | µs |
| | | | $T_{vj}$ = 125 °C | | 0.400 | | |
| | | | $T_{vj}$ = 150 °C | | 0.400 | | |
| Turn-on time (resistive load) | $t_{on\_R}$ | $I_C$ = 500 A, $V_{CE}$ = 2000 V, $V_{GE}$ = ±15 V, $R_{Gon}$ = 0.51 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25 °C | 1.35 | | | µs |

**(table continues...)**

**Table 4 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Turn-on energy loss per pulse | $E_{on}$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $L_\sigma$ = 85 nH, $V_{GE}$ = ±15 V, $R_{Gon}$ = 0.51 Ω, $C_{GE}$ = 330 nF, di/dt = 4300 A/µs ($T_{vj}$ = 150 °C) | $T_{vj}$ = 25 °C | | 2300 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 3200 | | |
| | | | $T_{vj}$ = 150 °C | | 3600 | | |
| Turn-off energy loss per pulse | $E_{off}$ | $I_C$ = 1500 A, $V_{CE}$ = 1800 V, $L_\sigma$ = 85 nH, $V_{GE}$ = ±15 V, $R_{Goff}$ = 2.7 Ω, $C_{GE}$ = 330 nF, dv/dt = 1550 V/µs ($T_{vj}$ = 150 °C) | $T_{vj}$ = 25 °C | | 2400 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 2950 | | |
| | | | $T_{vj}$ = 150 °C | | 3100 | | |
| SC data | $I_{SC}$ | $V_{GE}$ ≤ 15 V, $V_{CC}$ = 2500 V, $V_{CEmax}$=$V_{CES}$-$L_{sCE}$*di/dt | $t_P$ ≤ 10 µs, $T_{vj}$=150 °C | | 6400 | | A |
| Thermal resistance, junction to case | $R_{thJC}$ | per IGBT | | | | 7.35 | K/kW |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per IGBT, $\lambda_{grease}$= 1 W/(m*K) | | | 10.0 | | K/kW |
| Temperature under switching conditions | $T_{vj\ op}$ | | | -40 | | 150 | °C |

## 3 Diode, Inverter

**Table 5 Maximum rated values**

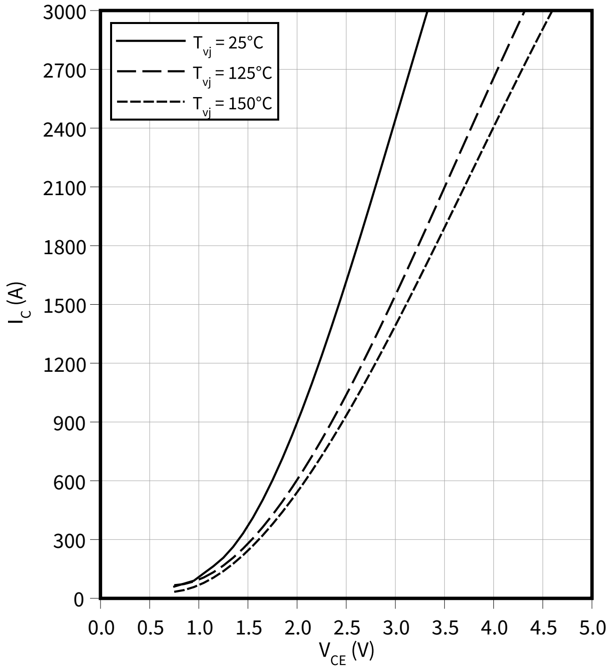
| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Repetitive peak reverse voltage | $V_{RRM}$ | | $T_{vj}$ = -40 °C | 3300 | V |
| | | | $T_{vj}$ = 150 °C | 3300 | |
| Continuous DC forward current | $I_F$ | | | 1500 | A |
| Repetitive peak forward current | $I_{FRM}$ | $t_P$ = 1 ms | | 3000 | A |
| $I^2t$ - value | $I^2t$ | $t_P$ = 10 ms, $V_R$ = 0 V | $T_{vj}$ = 125 °C | 845 | $kA^2s$ |
| | | | $T_{vj}$ = 150 °C | 730 | |
| Maximum power dissipation | $P_{RQM}$ | $T_{vj}$ = 150 °C | | 2400 | kW |
| Minimum turn-on time | $t_{onmin}$ | | | 10 | µs |

**Table 6** **Characteristic values**

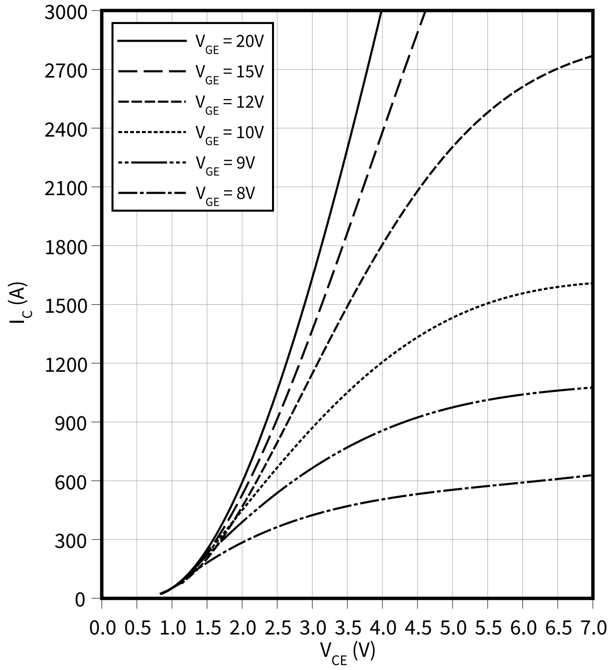
| Parameter | Symbol | Note or test condition | | Values Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Forward voltage | $V_F$ | $I_F$ = 1500 A, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | 2.25 | 2.85 | V |
| | | | $T_{vj}$ = 125 °C | | 2.20 | 2.75 | |
| | | | $T_{vj}$ = 150 °C | | 2.20 | | |
| Peak reverse recovery current | $I_{RM}$ | $V_R$ = 1800 V, $I_F$ = 1500 A, $V_{GE}$ = -15 V, -di$_F$/dt = 4300 A/µs ($T_{vj}$ = 150 °C) | $T_{vj}$ = 25 °C | | 1600 | | A |
| | | | $T_{vj}$ = 125 °C | | 1800 | | |
| | | | $T_{vj}$ = 150 °C | | 1900 | | |
| Recovered charge | $Q_r$ | $V_R$ = 1800 V, $I_F$ = 1500 A, $V_{GE}$ = -15 V, -di$_F$/dt = 4300 A/µs ($T_{vj}$ = 150 °C) | $T_{vj}$ = 25 °C | | 1500 | | µC |
| | | | $T_{vj}$ = 125 °C | | 2600 | | |
| | | | $T_{vj}$ = 150 °C | | 2900 | | |
| Reverse recovery energy | $E_{rec}$ | $V_R$ = 1800 V, $I_F$ = 1500 A, $V_{GE}$ = -15 V, -di$_F$/dt = 4300 A/µs ($T_{vj}$ = 150 °C) | $T_{vj}$ = 25 °C | | 1600 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 3150 | | |
| | | | $T_{vj}$ = 150 °C | | 3700 | | |
| Thermal resistance, junction to case | $R_{thJC}$ | per diode | | | | 13.0 | K/kW |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per diode, $\lambda_{grease}$= 1 W/(m*K) | | | 11.0 | | K/kW |
| Temperature under switching conditions | $T_{vj\,op}$ | | | -40 | | 150 | °C |

# 4 Characteristics diagrams

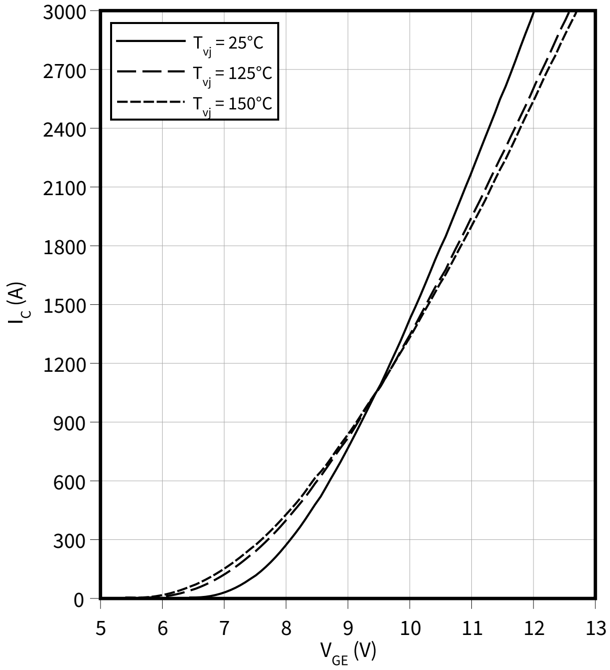
**output characteristic (typical), IGBT, Inverter**
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



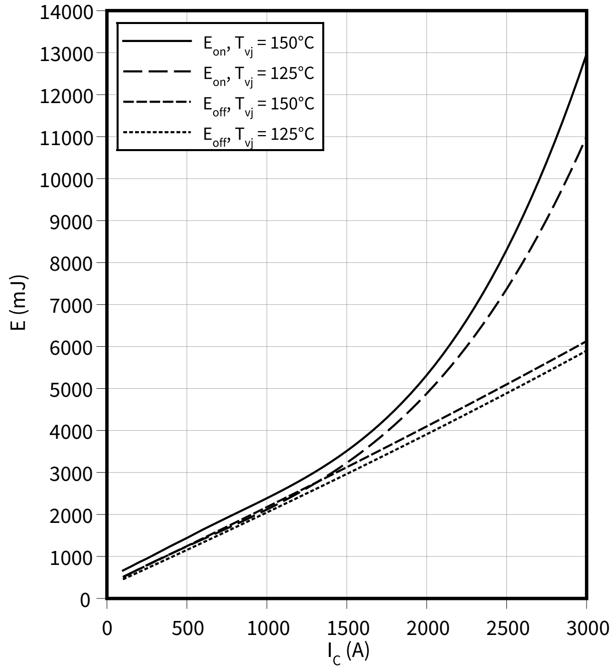

**output characteristic (typical), IGBT, Inverter**
$I_C = f(V_{CE})$
$T_{vj} = 150$ °C




**transfer characteristic (typical), IGBT, Inverter**
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



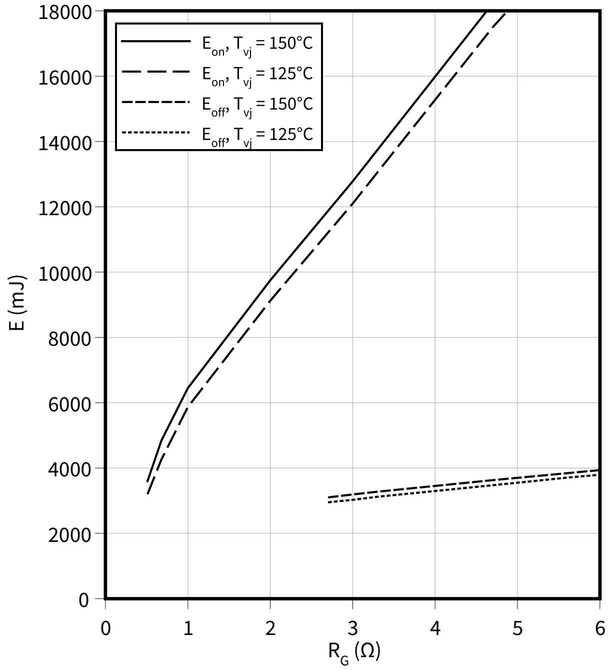

**switching losses (typical), IGBT, Inverter**
$E = f(I_C)$
$R_{Goff} = 2.7\ \Omega$, $R_{Gon} = 0.51\ \Omega$, $C_{GE} = 330$ nF, $V_{CE} = 1800$ V, $V_{GE}$ = ± 15 V



**switching losses (typical), IGBT, Inverter**

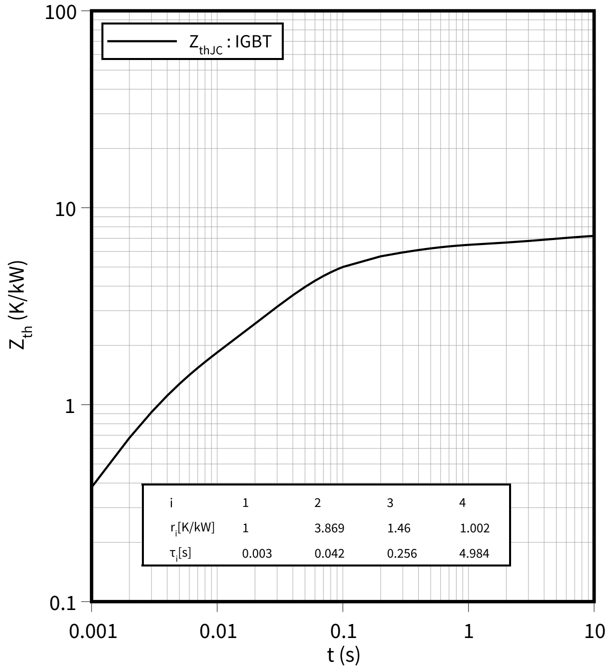
$E = f(R_G)$

$I_C = 1500$ A, $C_{GE} = 330$ nF, $V_{CE} = 1800$ V, $V_{GE} = \pm 15$ V




**transient thermal impedance , IGBT, Inverter**

$Z_{th} = f(t)$

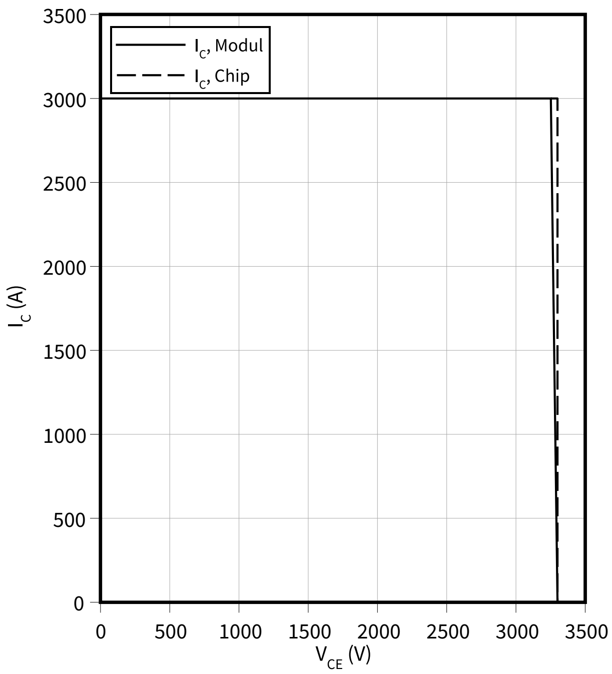



| i | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $r_i$[K/kW] | 1 | 3.869 | 1.46 | 1.002 |
| $\tau_i$[s] | 0.003 | 0.042 | 0.256 | 4.984 |

**reverse bias safe operating area (RBSOA), IGBT, Inverter**

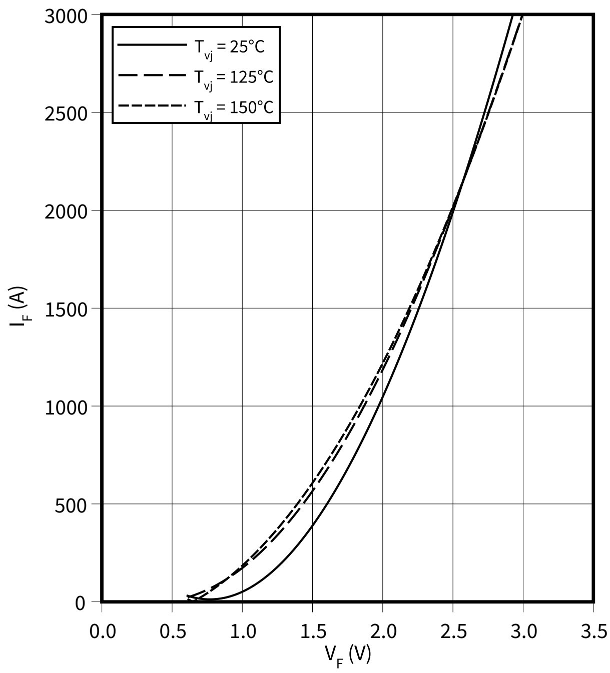
$I_C = f(V_{CE})$

$C_{GE} = 330$ nF, $T_{vj} = 150$ °C, $R_{Goff} = 2.7\ \Omega$, $V_{GE} = \pm 15$ V




**forward characteristic of (typical), Diode, Inverter**

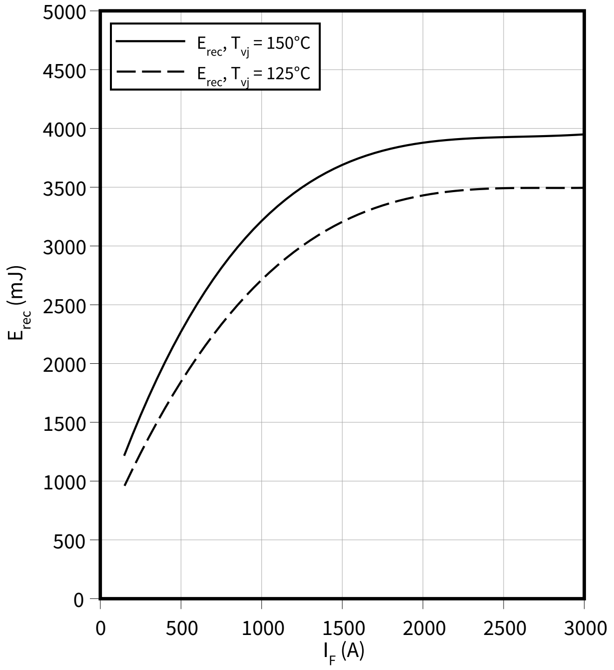
$I_F = f(V_F)$



## switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

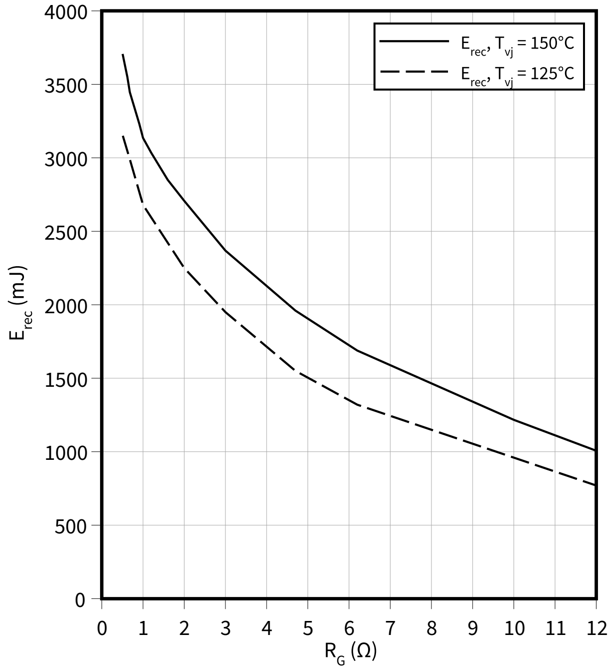
$V_{CE} = 1800$ V, $R_{Gon} = R_{Gon}$(IGBT)




## switching losses (typical), Diode, Inverter

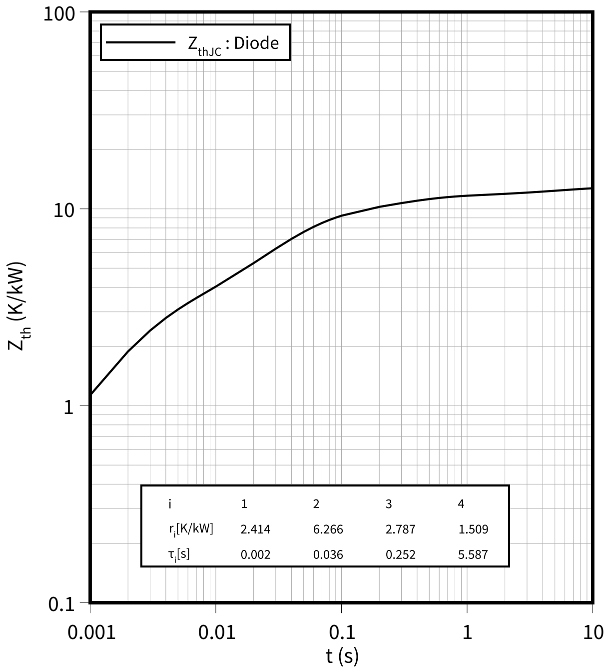
$E_{rec} = f(R_G)$

$V_{CE} = 1800$ V, $I_F = 1500$ A




## transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$

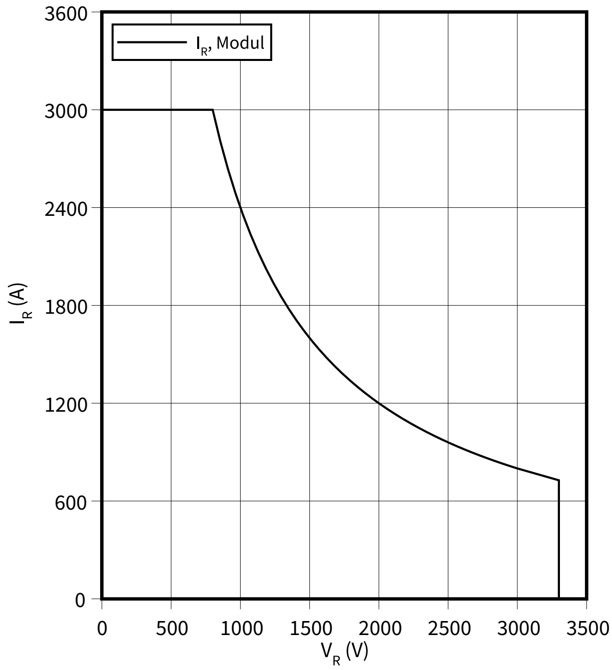



| i | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $r_i$[K/kW] | 2.414 | 6.266 | 2.787 | 1.509 |
| $\tau_i$[s] | 0.002 | 0.036 | 0.252 | 5.587 |

## safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 150$ °C



# 5 Circuit diagram

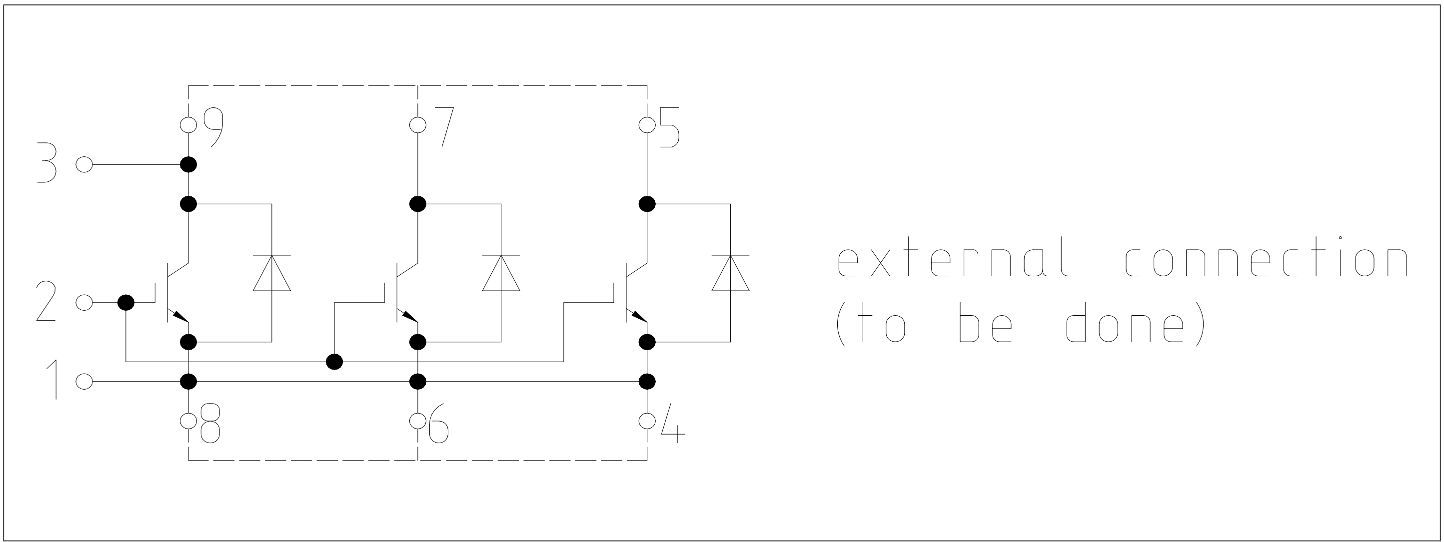



**Figure 1**

# 6 Package outlines

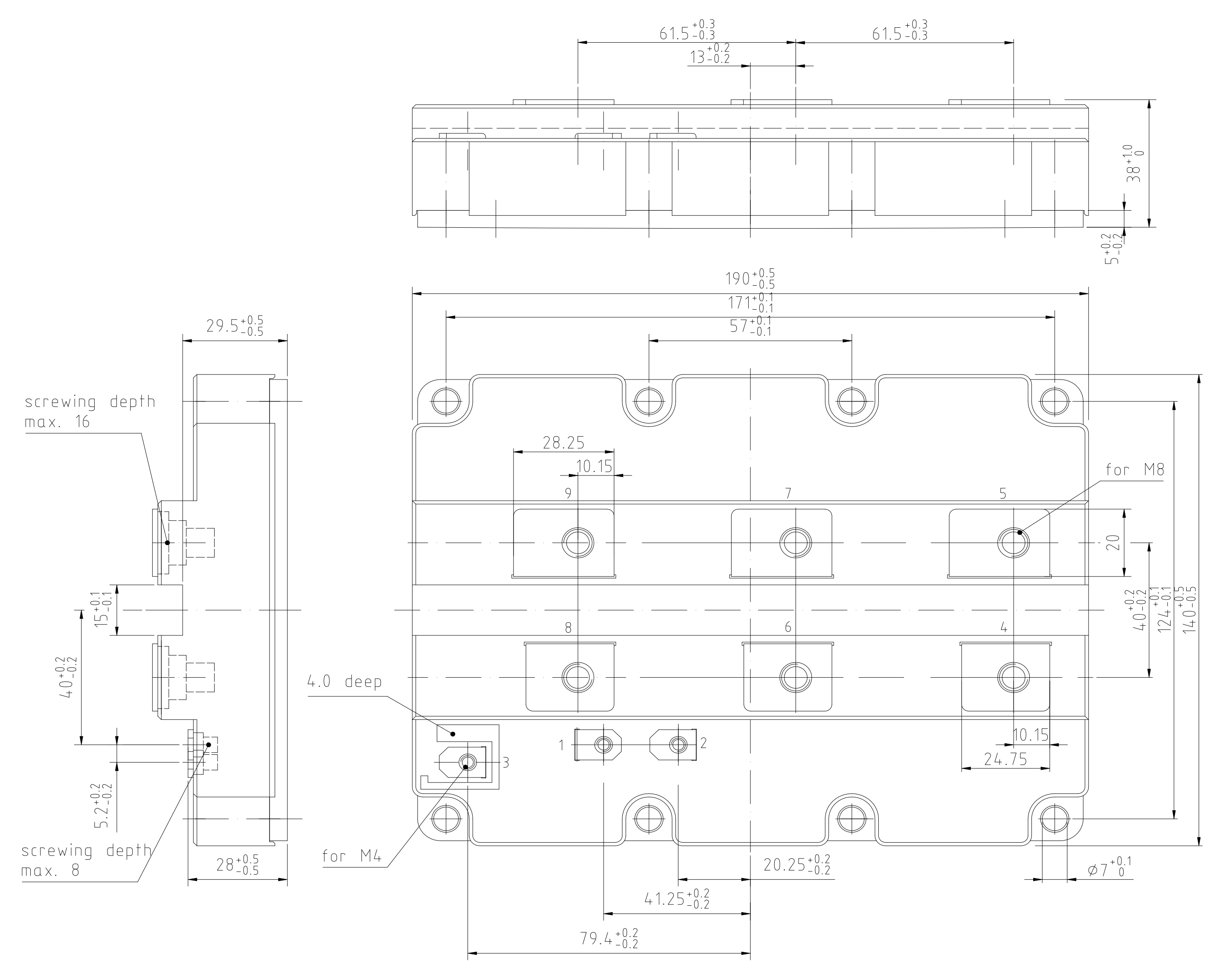



**Figure 2**

# 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 | *Content* | *Digit* | *Example* |
| | 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 | 71549142846550549911530 | | 71549142846550549911530 |

**Figure 3**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| V2.1 | 2007-02-18 | Preliminary datasheet |
| V2.2 | 2007-09-21 | Preliminary datasheet |
| V2.3 | 2008-02-06 | Preliminary datasheet |
| V2.4 | 2010-04-26 | Preliminary datasheet |
| V3.0 | 2013-08-09 | Final datasheet |
| V3.1 | 2013-12-11 | Final datasheet |
| V3.2 | 2018-07-12 | Final datasheet |
| V3.3 | 2019-07-24 | Final datasheet |
| n/a | 2020-09-01 | Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy |
| 1.10 | 2021-10-26 | Final datasheet |

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