

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

**Features**

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



Typical appearance

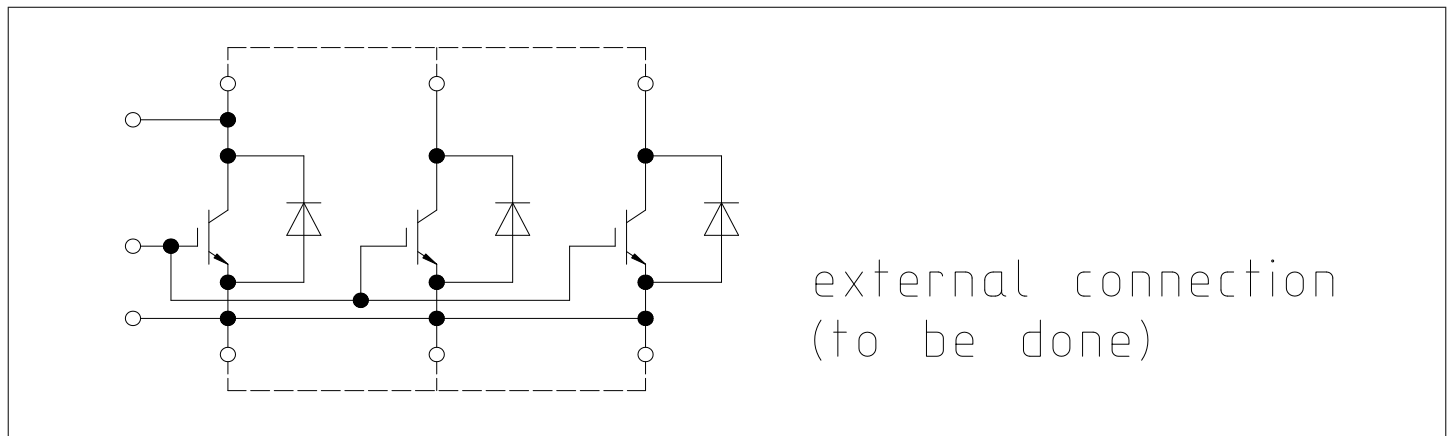
**Potential applications**

- 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, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	6.0	kV
Partial discharge extinction voltage	$V_{isol}$	RMS, $f = 50 \text{ Hz}$ , $Q_{PD} \leq 10 \text{ pC}$	2.6	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25^\circ\text{C}$ , 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, $\lambda_{paste} = 1 \text{ W}/(\text{m}^*\text{K}) / \lambda_{grease} = 1 \text{ W}/(\text{m}^*\text{K})$		5.5		K/kW	
Stray inductance module	$L_{sCE}$			6		nH	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$ , 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	$V_{CES}$		$T_{vj} = -40^\circ\text{C}$	3300	V
			$T_{vj} = 150^\circ\text{C}$	3300	
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 150^\circ\text{C}$	$T_C = 95^\circ\text{C}$	1500	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1 \text{ ms}$		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			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 1500\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	2.40	2.85	V
			$T_{vj} = 125\ ^\circ C$	2.95	3.50	
			$T_{vj} = 150\ ^\circ C$	3.10		
Gate threshold voltage	$V_{GEth}$	$I_C = 72\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.20	5.80	6.40	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 1800\ V$		42		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.42		$\Omega$
Input capacitance	$C_{ies}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		280		nF
Reverse transfer capacitance	$C_{res}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		6		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 3300\ V, V_{GE} = 0\ V$			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)	$t_{don}$	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	0.360		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.400		
			$T_{vj} = 150\ ^\circ C$	0.410		
Rise time (inductive load)	$t_r$	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	0.370		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.400		
			$T_{vj} = 150\ ^\circ C$	0.400		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 2.7\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	4.100		$\mu s$
			$T_{vj} = 125\ ^\circ C$	4.300		
			$T_{vj} = 150\ ^\circ C$	4.300		
Fall time (inductive load)	$t_f$	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 2.7\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	0.400		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.400		
			$T_{vj} = 150\ ^\circ C$	0.400		
Turn-on time (resistive load)	$t_{on\_R}$	$I_C = 500\ A, V_{CE} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	1.35		$\mu s$

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy loss per pulse	$E_{on}$	$I_C = 1500\text{ A}$ , $V_{CE} = 1800\text{ V}$ , $L_\sigma = 85\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Gon} = 0.51\ \Omega$ , $C_{GE} = 330\text{ nF}$ , $di/dt = 4300\text{ A}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	2300		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	3200		
			$T_{vj} = 150\text{ }^\circ\text{C}$	3600		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 1500\text{ A}$ , $V_{CE} = 1800\text{ V}$ , $L_\sigma = 85\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 2.7\ \Omega$ , $C_{GE} = 330\text{ nF}$ , $dv/dt = 1550\text{ V}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	2400		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2950		
			$T_{vj} = 150\text{ }^\circ\text{C}$	3100		
SC data	$I_{SC}$	$V_{GE} \leq 15\text{ V}$ , $V_{CC} = 2500\text{ V}$ , $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}$ , $T_{vj} = 150\text{ }^\circ\text{C}$	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, $\lambda_{grease} = 1\text{ W}/(\text{m}^2\text{K})$		10.0		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	$V_{RRM}$		$T_{vj} = -40\text{ }^\circ\text{C}$	3300	V
			$T_{vj} = 150\text{ }^\circ\text{C}$	3300	
Continuous DC forward current	$I_F$		1500	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	3000	A	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}$ , $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	845	$\text{kA}^2\text{s}$
			$T_{vj} = 150\text{ }^\circ\text{C}$	730	
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

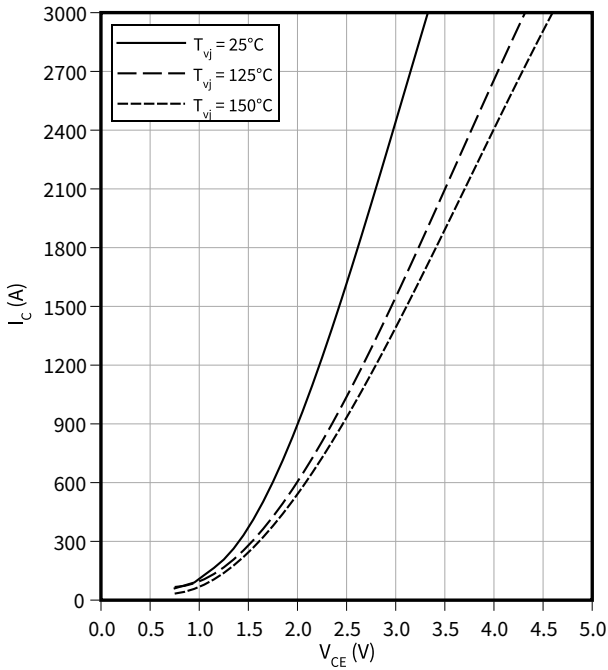
Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 1500 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2.25	2.85	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2.20	2.75	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2.20		
Peak reverse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

## 4 Characteristics diagrams

### output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

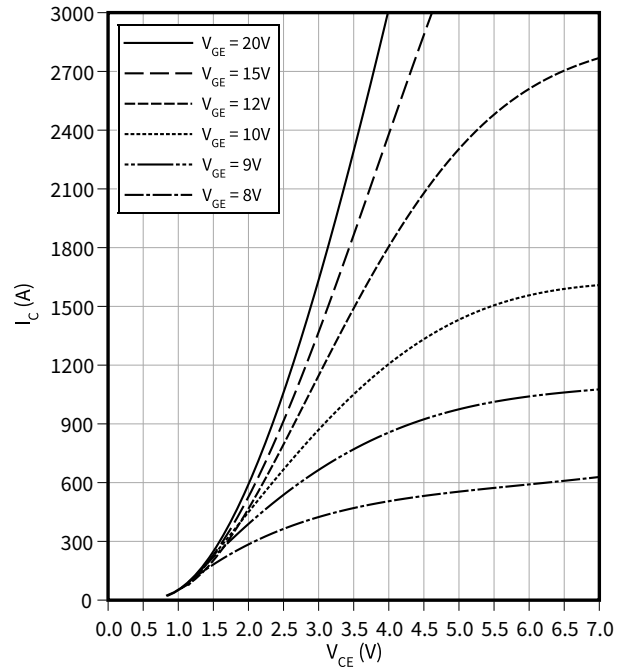
$$V_{GE} = 15 \text{ V}$$



### output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

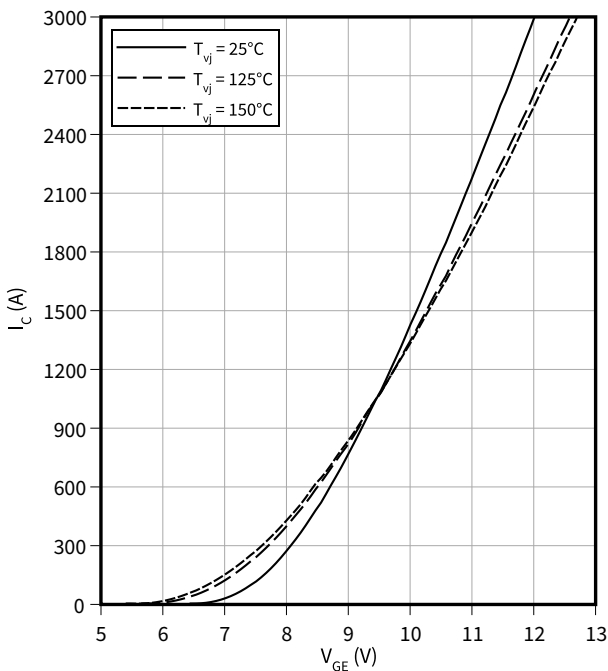
$$T_{vj} = 150 \text{ °C}$$



### transfer characteristic (typical), IGBT, Inverter

$$I_C = f(V_{GE})$$

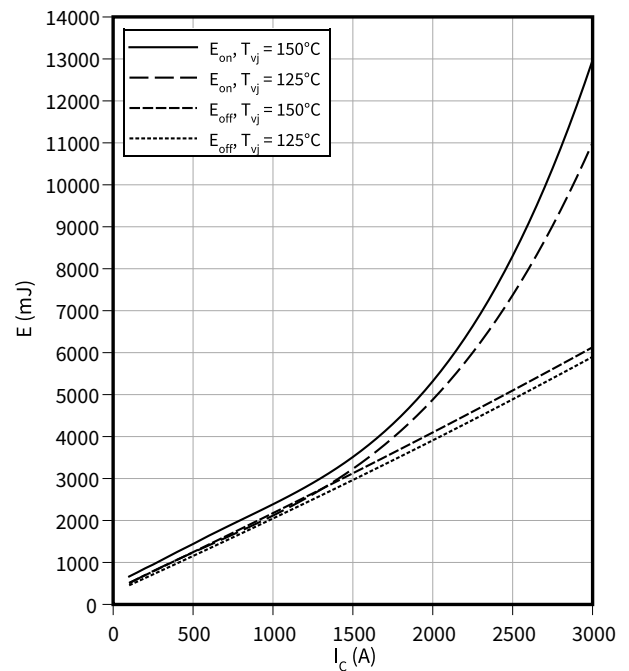
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

$$R_{Goff} = 2.7 \text{ } \Omega, R_{Gon} = 0.51 \text{ } \Omega, C_{GE} = 330 \text{ nF}, V_{CE} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

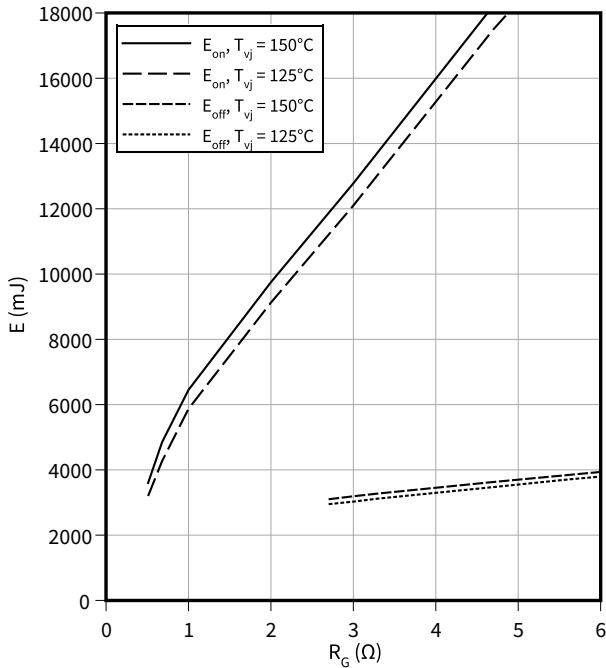


4 Characteristics diagrams

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

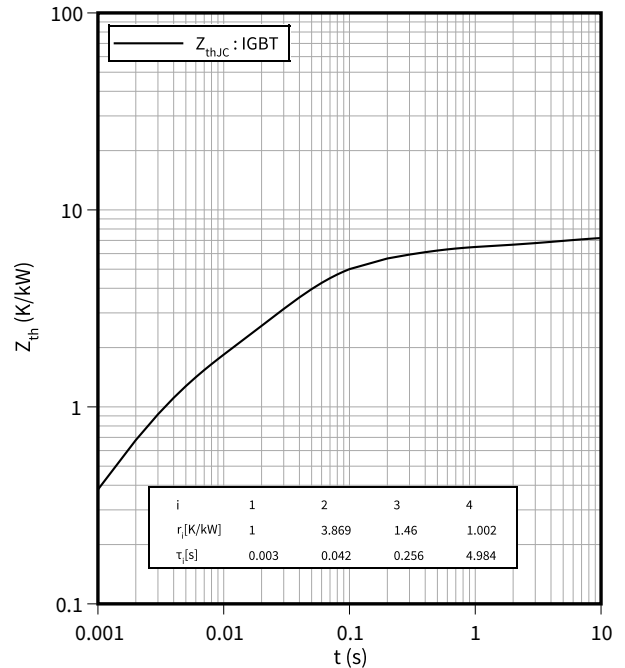
$E = f(R_G)$

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



**transient thermal impedance, IGBT, Inverter**

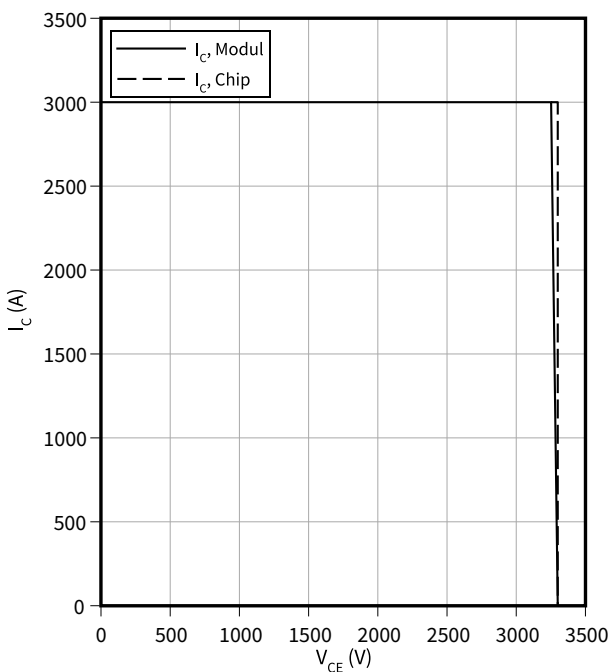
$Z_{th} = f(t)$



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

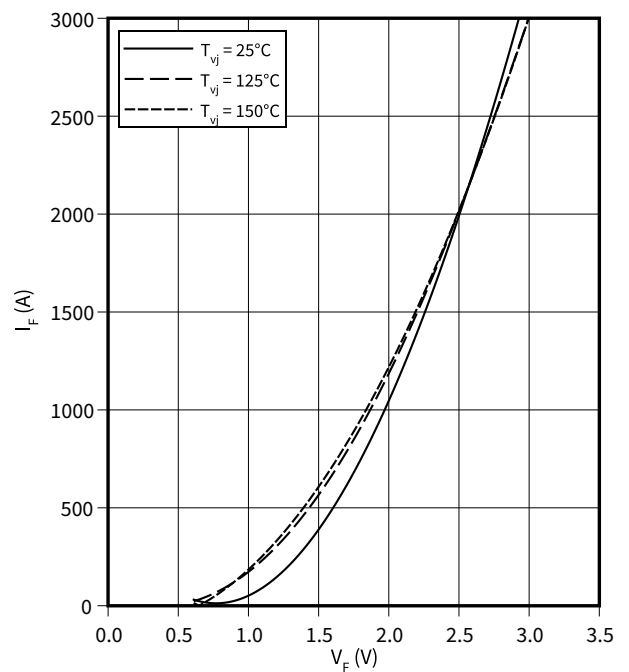
$I_C = f(V_{CE})$

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



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

$I_F = f(V_F)$



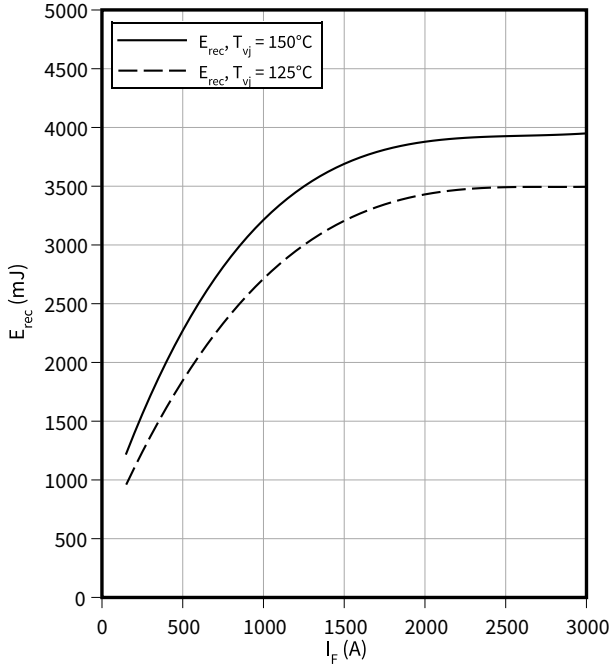


4 Characteristics diagrams

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

$E_{rec} = f(I_F)$

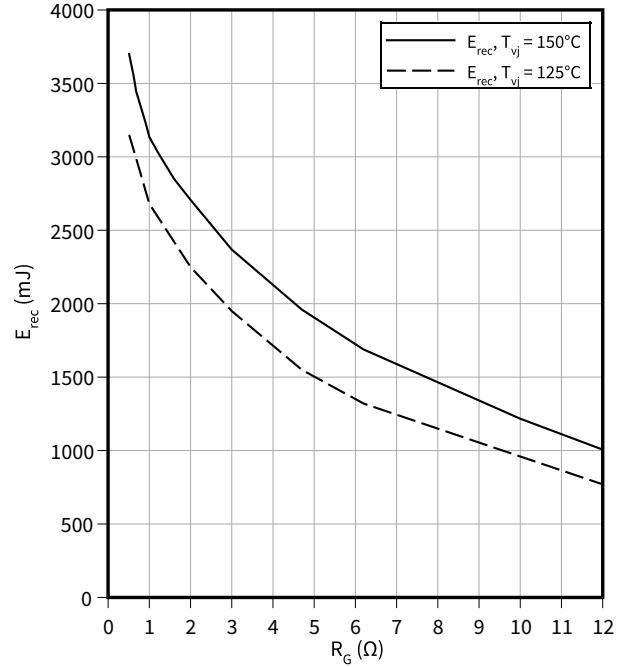
$V_{CE} = 1800\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



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

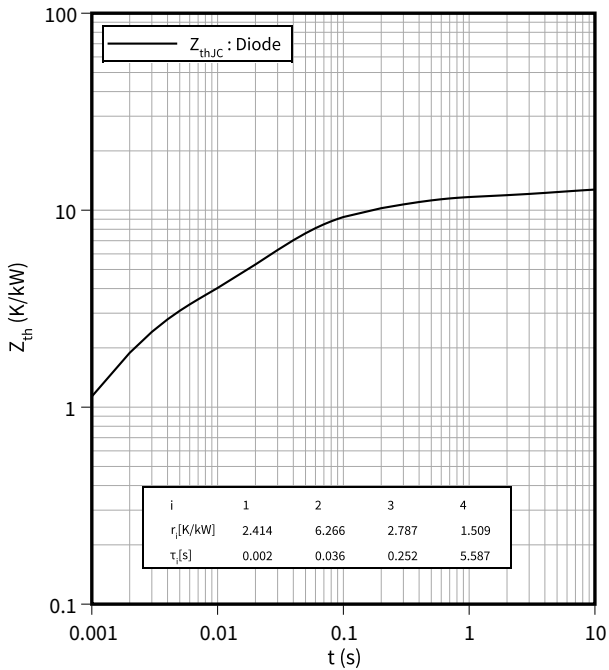
$E_{rec} = f(R_G)$

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



**transient thermal impedance , Diode, Inverter**

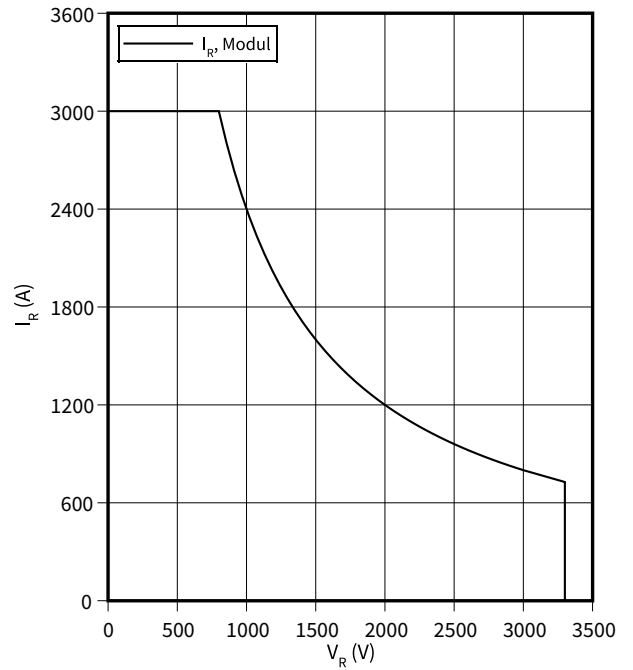
$Z_{th} = f(t)$



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

$I_R = f(V_R)$

$T_{vj} = 150\text{ °C}$



## 5 Circuit diagram

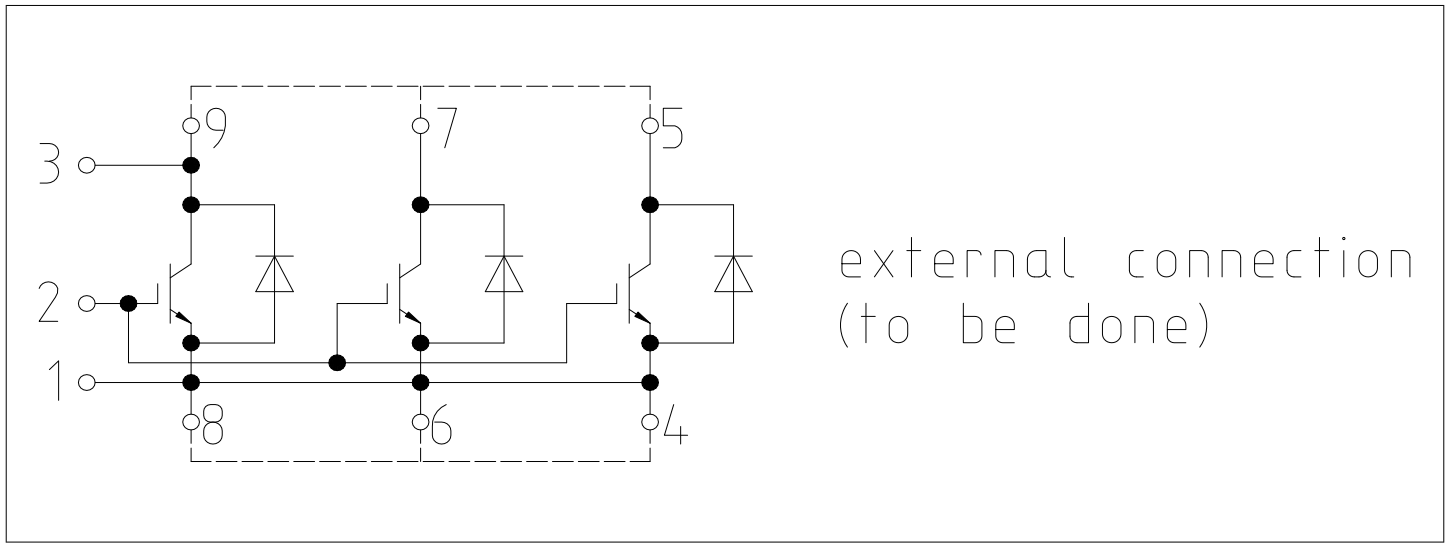


Figure 1

6 Package outlines

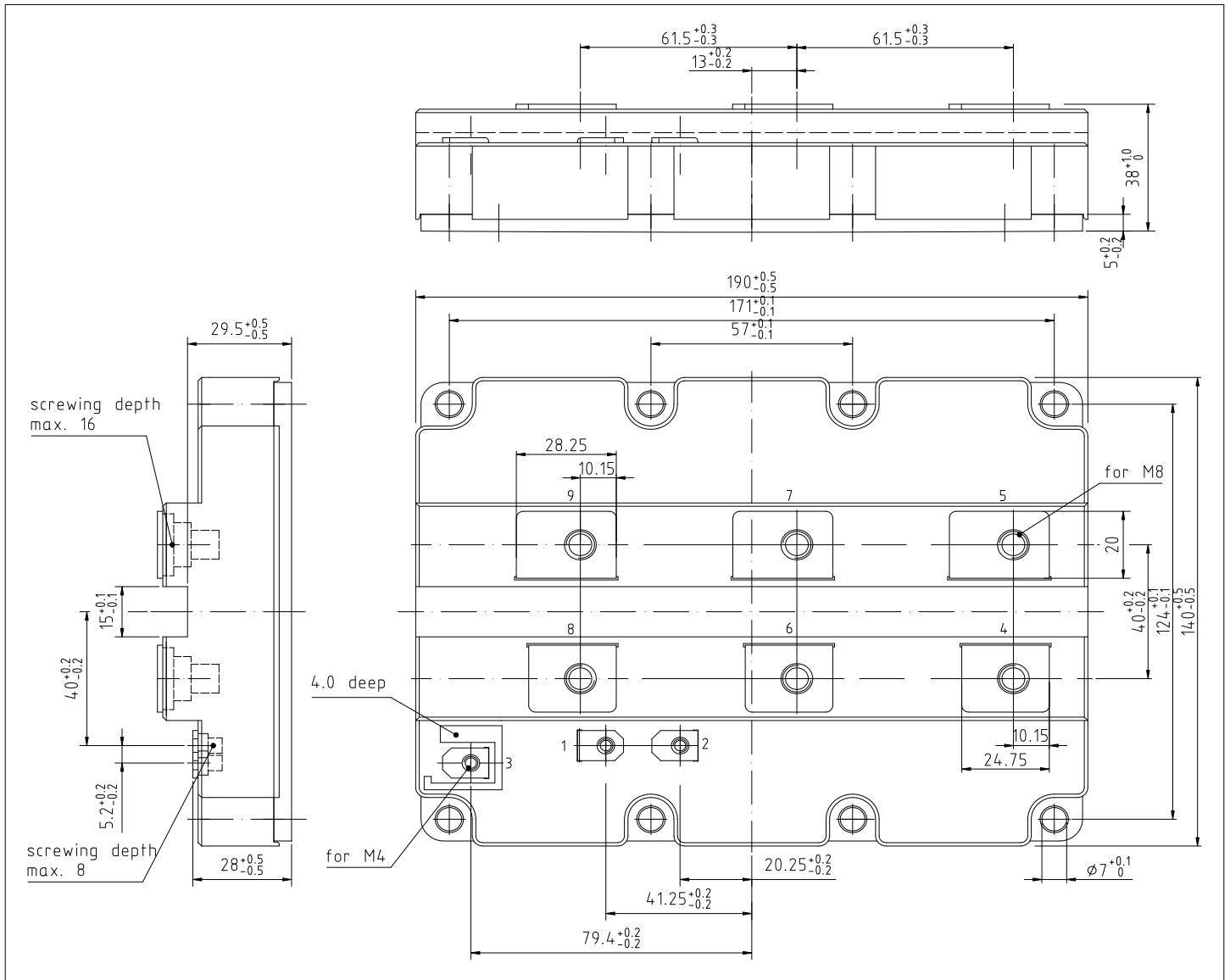

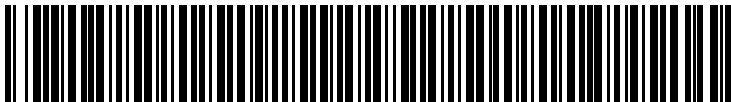


Figure 2

## 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	<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	 		
	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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**Document reference**

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