

## IHM-B module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode

### Features

- Electrical features
  - $V_{CES} = 3300\text{ V}$
  - $I_{C\text{nom}} = 1600\text{ A} / I_{CRM} = 3200\text{ A}$
  - High DC stability
  - High short-circuit capability
  - Low switching losses
  - Low  $V_{CESat}$
  - $T_{vj\text{op}} = 150\text{ }^{\circ}\text{C}$
  - Trench IGBT 4
  - Unbeatable robustness
  - $V_{CESat}$  with positive temperature coefficient
  - High current density
  - Low  $Q_g$  and  $C_{res}$
- Mechanical features
  - ALSiC base plate for increased thermal cycling capability
  - High power density
  - Isolated base plate
  - Package with CTI > 600
  - RoHS compliant



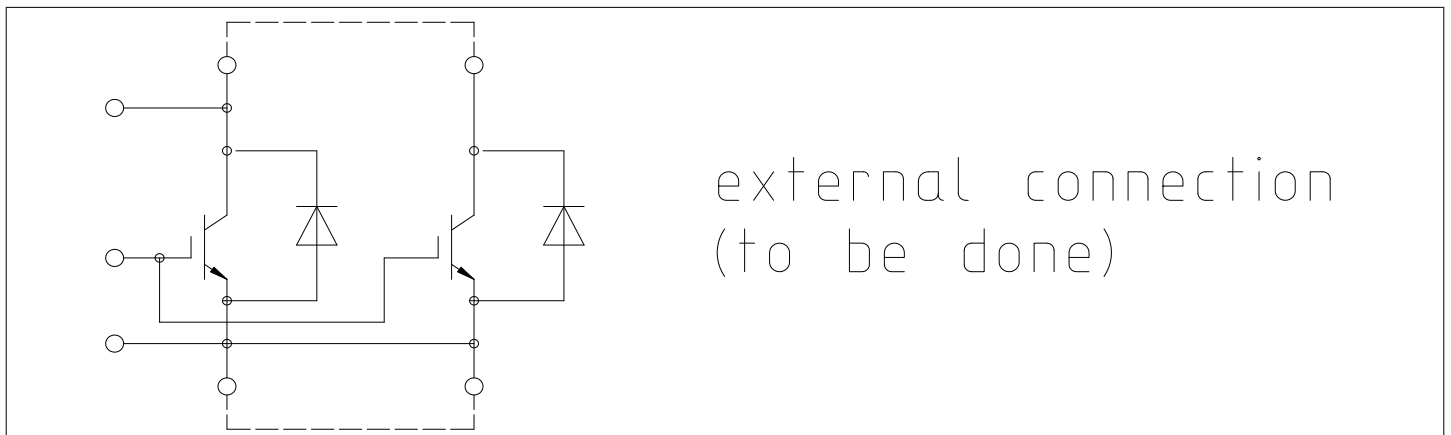
### Potential applications

- High power converters
- Medium voltage converters
- Motor drives
- Traction drives
- UPS systems
- Active frontend (energy recovery)
- Commercial Agriculture Vehicles

### 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, $t = 60$ s	6.0	kV
Partial discharge extinction voltage	$V_{isol}$	RMS, $f = 50$ Hz, $Q_{PD} \leq 10$ pC	2.6	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25^\circ\text{C}$ , 100 Fit	2100	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	$L_{SCE}$			9		nH	
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25^\circ\text{C}$ , per switch		0.12		m $\Omega$	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$ , per switch		0.14		m $\Omega$	
Storage temperature	$T_{stg}$		-40		150	$^\circ\text{C}$	
Mounting torque for modul 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	$G$			800		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	$I_{CDC}$	$T_{vj\ max} = 150^\circ\text{C}$	$T_C = 100^\circ\text{C}$	1600	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1$ ms		3200	A
Gate-emitter peak voltage	$V_{GES}$			$\pm 20$	V

**Table 4** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 1600\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	2.40	2.65	V
			$T_{vj} = 125\ ^\circ C$	2.95		
			$T_{vj} = 150\ ^\circ C$	3.10	3.25	
Gate threshold voltage	$V_{GEth}$	$I_C = 62\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.20	5.80	6.40	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 1800\ V$		28		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.75		$\Omega$
Input capacitance	$C_{ies}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		187		nF
Reverse transfer capacitance	$C_{res}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		5.33		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 3300\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$		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)	$t_{don}$	$I_C = 1600\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.8\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.600		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.710		
			$T_{vj} = 150\ ^\circ C$	0.760		
Rise time (inductive load)	$t_r$	$I_C = 1600\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.8\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.220		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.240		
			$T_{vj} = 150\ ^\circ C$	0.250		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 1600\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.9\ \Omega$	$T_{vj} = 25\ ^\circ C$	3.420		$\mu s$
			$T_{vj} = 125\ ^\circ C$	3.670		
			$T_{vj} = 150\ ^\circ C$	3.740		
Fall time (inductive load)	$t_f$	$I_C = 1600\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.9\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.690		$\mu s$
			$T_{vj} = 125\ ^\circ C$	1.290		
			$T_{vj} = 150\ ^\circ C$	1.470		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 1600\ A, V_{CE} = 1800\ V, L_\sigma = 85\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.8\ \Omega, di/dt = 5300\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	1850		mJ
			$T_{vj} = 125\ ^\circ C$	2850		
			$T_{vj} = 150\ ^\circ C$	3200		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 1600\ A, V_{CE} = 1800\ V, L_\sigma = 85\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 3.9\ \Omega, dv/dt = 1700\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	2280		mJ
			$T_{vj} = 125\ ^\circ C$	2980		
			$T_{vj} = 150\ ^\circ C$	3140		
SC data	$I_{SC}$	$V_{GE} \leq 15\ V, V_{CC} = 2400\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} \leq 150\ ^\circ C$	6400		A
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			9.30	K/kW

**Table 4** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heatsink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		5.60		K/kW
Temperature under switching conditions	$T_{vjop}$		-40		150	°C

### 3 Diode, Inverter

**Table 5** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$		$T_{vj} = -40 \text{ }^\circ\text{C}$	3300	V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	3300	
Continuous DC forward current	$I_F$		1600	A	
Repetitive peak forward current	$I_{FRM}$	$t_P = 1 \text{ ms}$	3200	A	
$I^2t$ - value	$I^2t$	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	630	kA <sup>2</sup> s
			$T_{vj} = 150 \text{ }^\circ\text{C}$	570	
Maximum power dissipation	$P_{RQM}$	$T_{vj} = 150 \text{ }^\circ\text{C}$	3600	kW	
Minimum turn-on time	$t_{onmin}$		10	μs	

**Table 6** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 1600 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2.90	3.30	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2.60		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2.50	2.80	
Peak reverse recovery current	$I_{RM}$	$V_R = 1800 \text{ V}, I_F = 1600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5300 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1470		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1650		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1700		
Recovered charge	$Q_r$	$V_R = 1800 \text{ V}, I_F = 1600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5300 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		685		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1360		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2000		
Reverse recovery energy	$E_{rec}$	$V_R = 1800 \text{ V}, I_F = 1600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5300 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		730		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1450		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1750		

**Table 6**                    **Characteristic values (continued)**

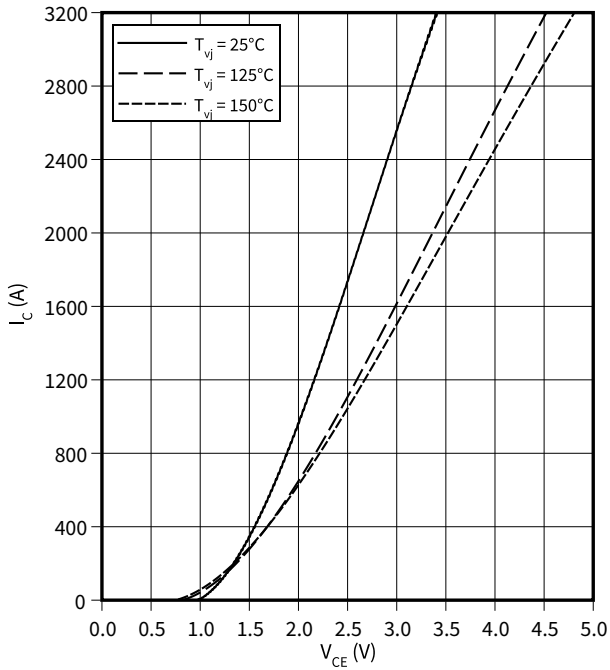
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	$R_{thJC}$	per diode			17.5	K/kW
Thermal resistance, case to heatsink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}^*\text{K})$		8.50		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

## 4 Characteristics diagrams

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

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

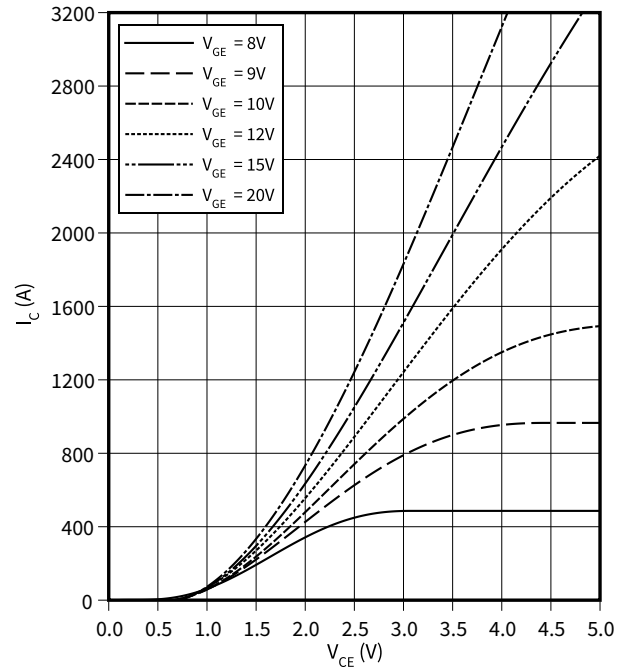
$$V_{GE} = 15 \text{ V}$$



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

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

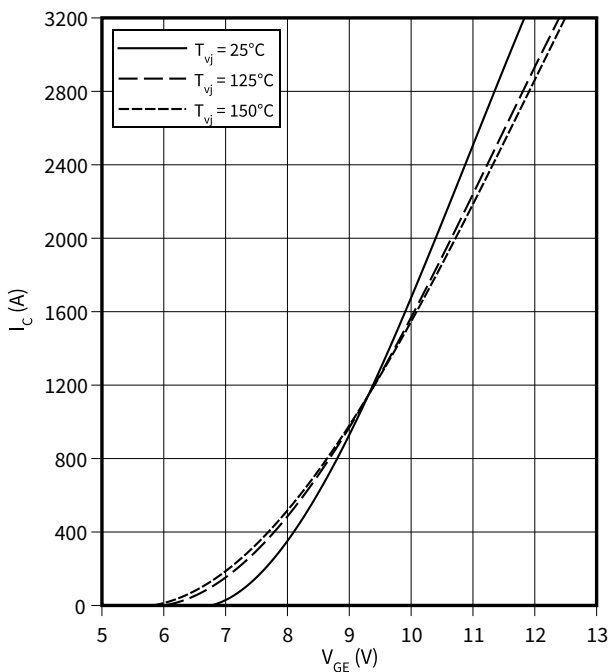
$$T_{vj} = 150 \text{ °C}$$



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

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

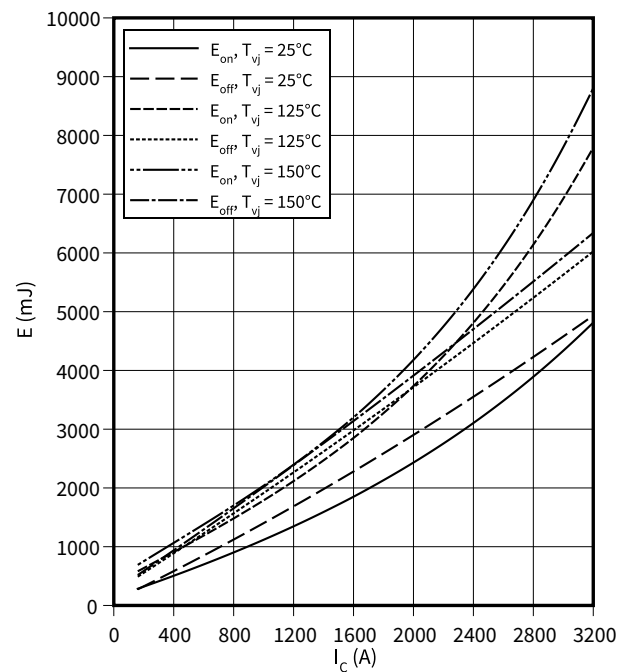
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

$$R_{Goff} = 3.9 \text{ } \Omega, R_{Gon} = 0.8 \text{ } \Omega, V_{CE} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

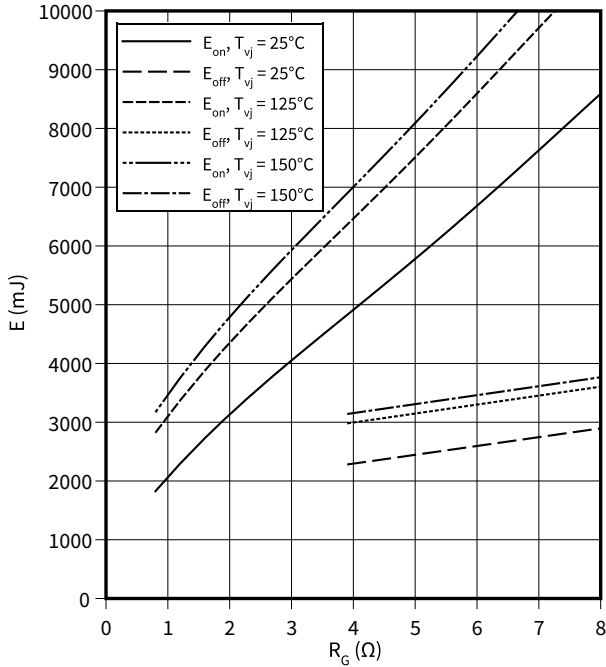


4 Characteristics diagrams

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

$E = f(R_G)$

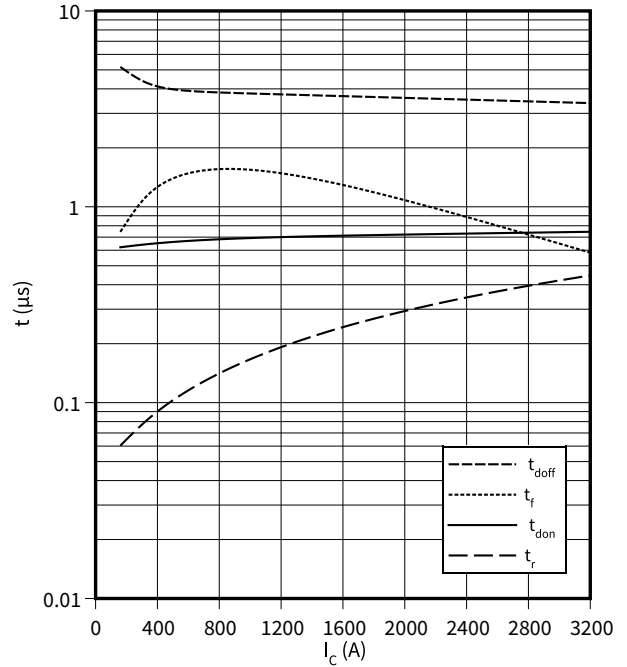
$I_C = 1600 \text{ A}, V_{CE} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$



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

$t = f(I_C)$

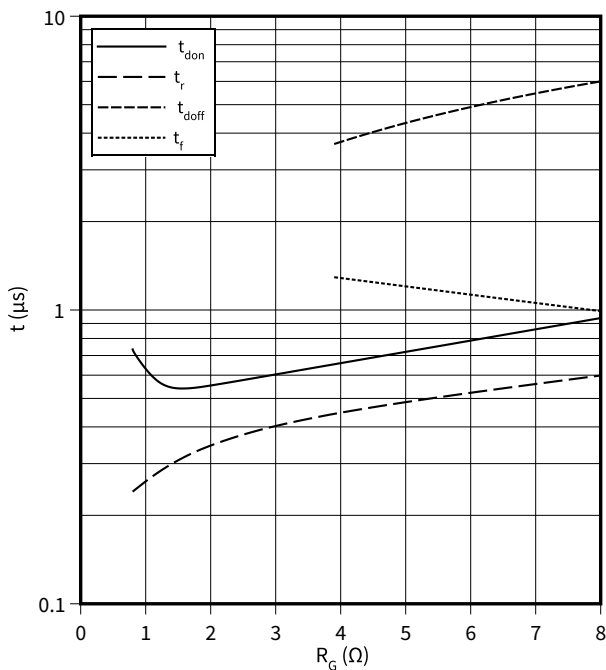
$R_{Goff} = 3.9 \Omega, R_{Gon} = 0.8 \Omega, V_{CE} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 125 \text{ }^\circ\text{C}$



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

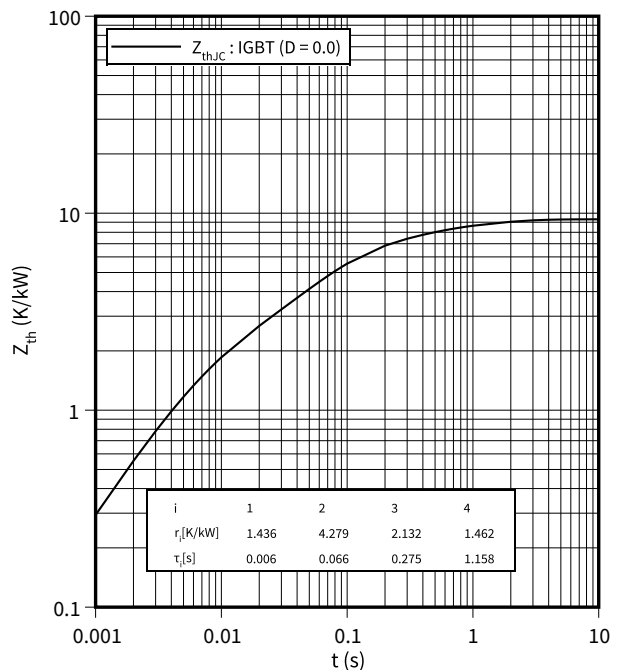
$t = f(R_G)$

$I_C = 1600 \text{ A}, V_{CE} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 125 \text{ }^\circ\text{C}$



**transient thermal impedance, IGBT, Inverter**

$Z_{th} = f(t)$



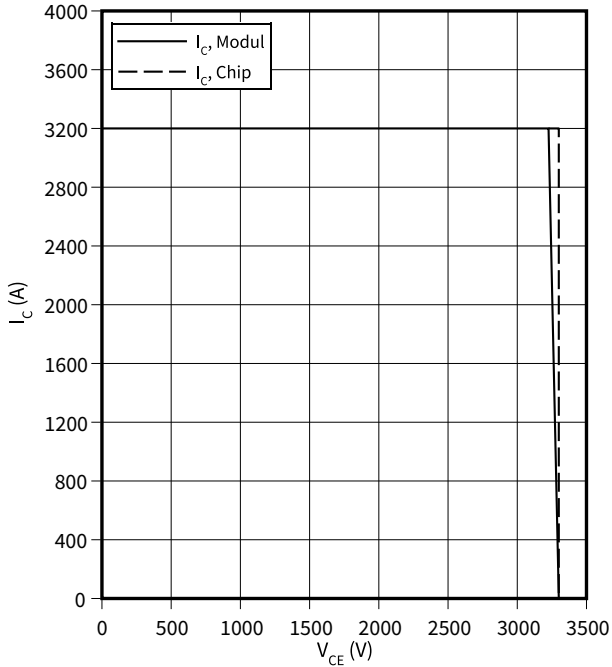


4 Characteristics diagrams

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

$I_C = f(V_{CE})$

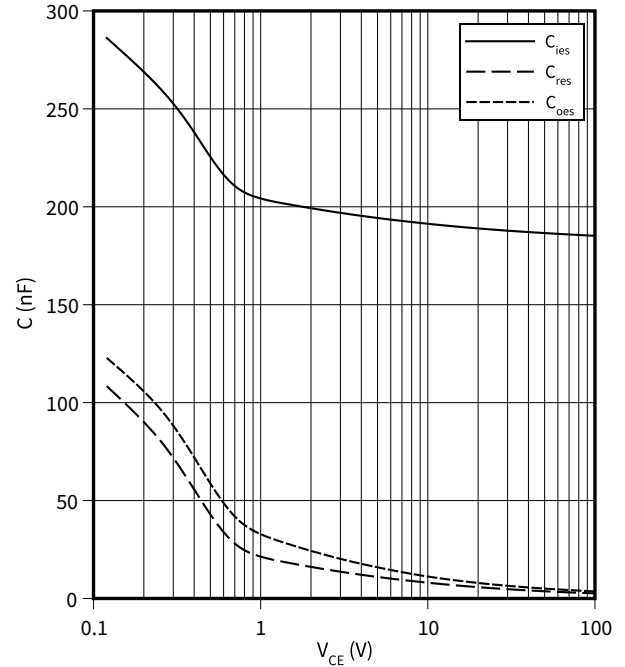
$R_{Goff} = 3.9 \Omega, V_{GE} = \pm 15 V, T_{vj} = 150 \text{ }^\circ\text{C}$



**capacity characteristic (typical), IGBT, Inverter**

$C = f(V_{CE})$

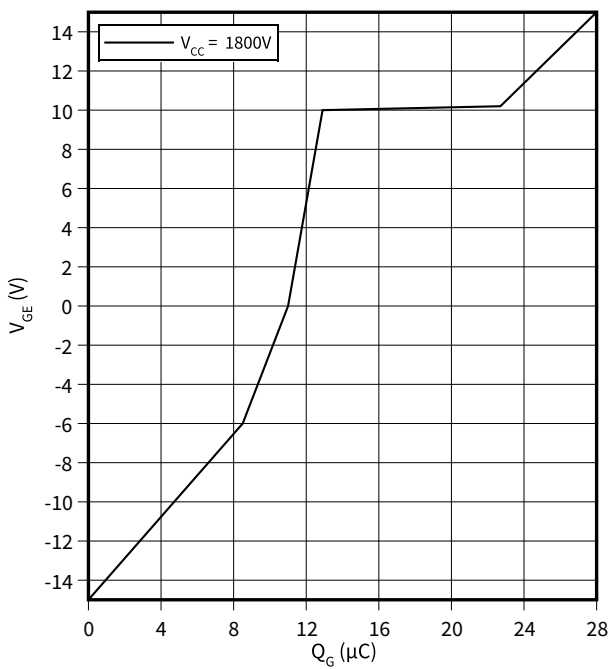
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



**gate charge characteristic (typical), IGBT, Inverter**

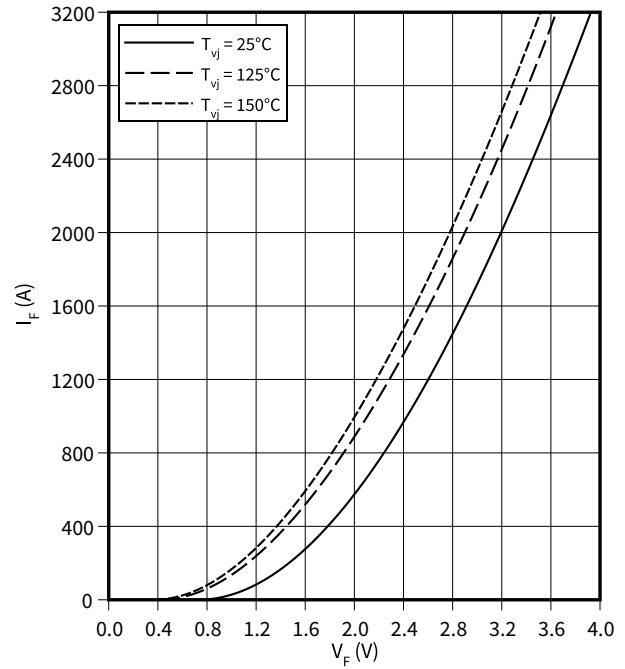
$V_{GE} = f(Q_G)$

$I_C = 1600 A, T_{vj} = 25 \text{ }^\circ\text{C}$



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

$I_F = f(V_F)$

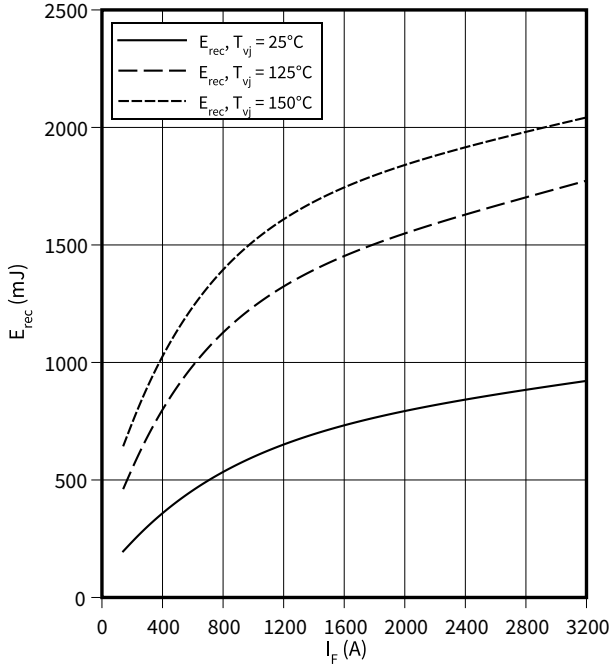


4 Characteristics diagrams

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

$E_{rec} = f(I_F)$

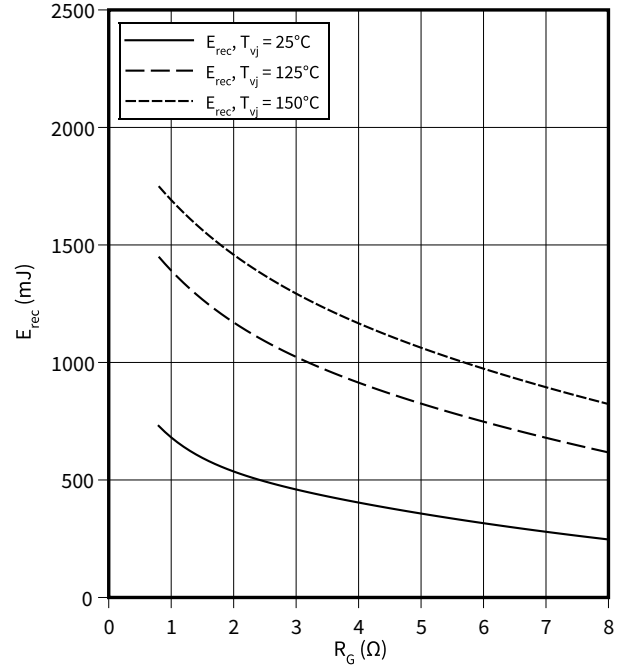
$V_{CE} = 1800\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



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

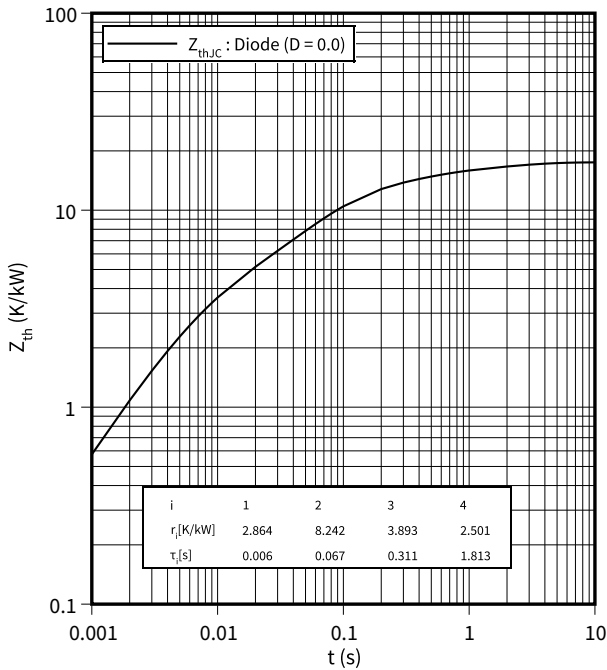
$E_{rec} = f(R_G)$

$V_{CE} = 1800\text{ V}, I_F = 1600\text{ A}$



**transient thermal impedance , Diode, Inverter**

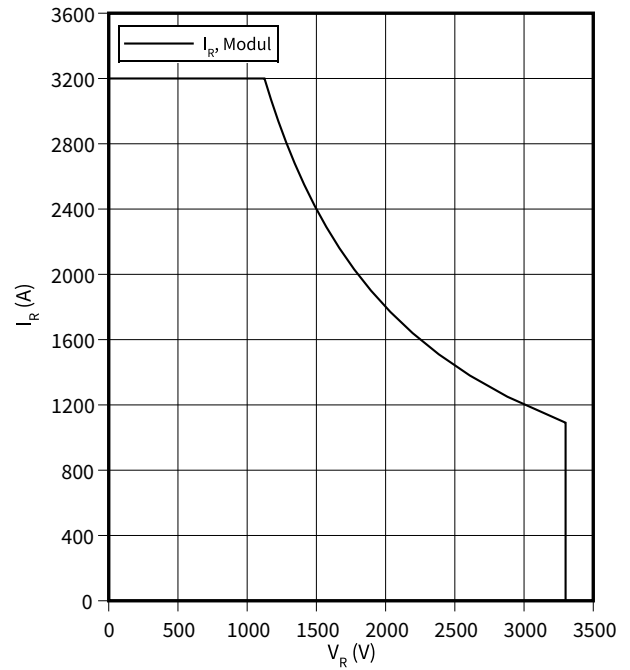
$Z_{th} = f(t)$



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

$I_R = f(V_R)$

$T_{vj} = 150\text{ °C}$



## 5 Circuit diagram

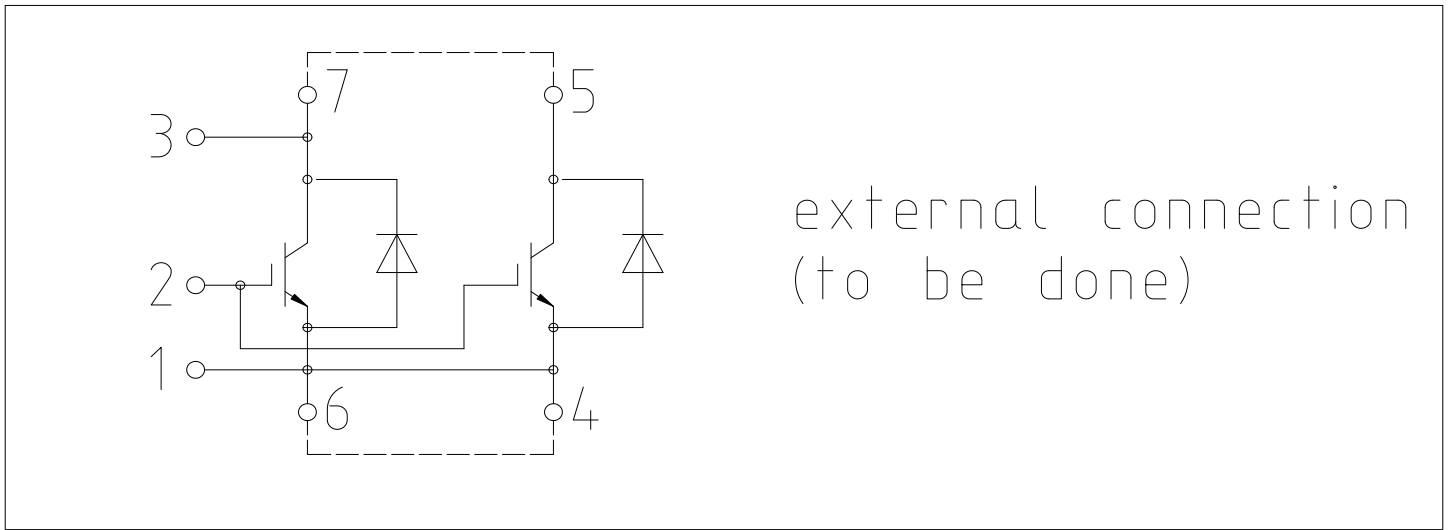


Figure 2

## 6 Package outlines

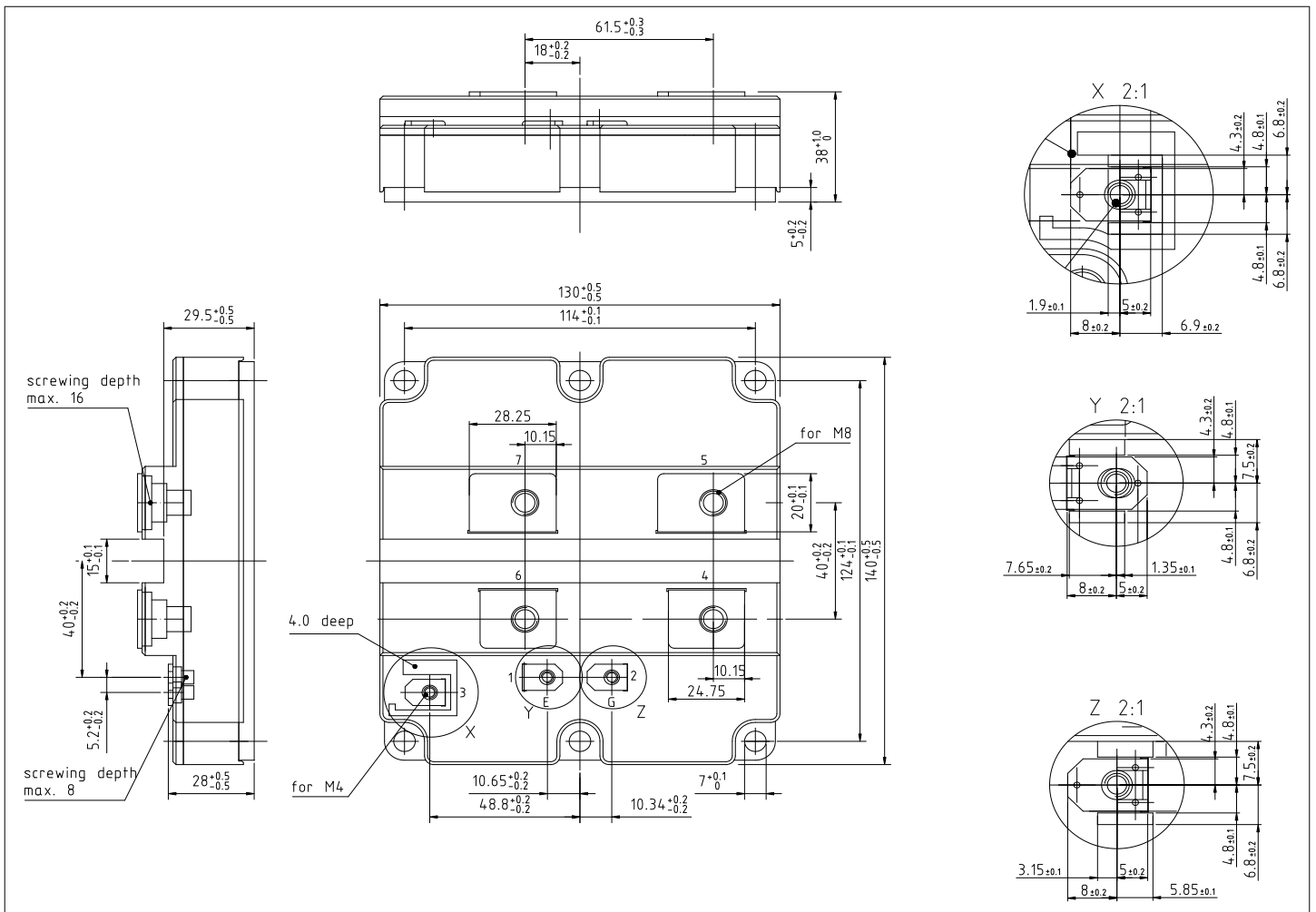




Figure 3

## 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 4**

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