

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

### Features

- Electrical features
  - $V_{CES} = 3300\text{ V}$
  - $I_{C\text{nom}} = 2000\text{ A} / I_{CRM} = 4000\text{ A}$
  - High current density
  - High DC stability
  - High short-circuit capability
  - Low switching losses
  - Low  $V_{CE,sat}$
  - $T_{vj,op} = 150^{\circ}\text{C}$
  - Trench IGBT 4
  - Unbeatable robustness
  - $V_{CE,sat}$  with positive temperature coefficient
  - 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



Typical appearance

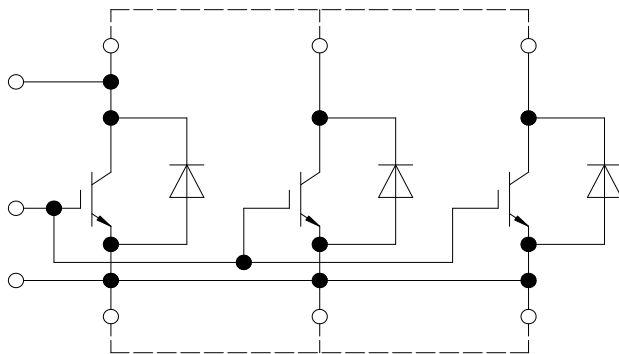
### Potential applications

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

### Product validation

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

### Description



external connection  
(to be done)

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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	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	
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	$R_{AA'+CC'}$	$T_C = 25$ °C, per switch		0.08		mΩ	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25$ °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	$V_{CES}$		$T_{vj} = -40$ °C	3300	V
			$T_{vj} = 150$ °C	3300	
Continuous DC collector current	$I_{CDC}$	$T_{vj\ max} = 150$ °C	$T_C = 120$ °C	2000	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{vj\ op}$		4000	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	$V_{CE\ sat}$	$I_C = 2000\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	2.20	2.45	V
			$T_{vj} = 125\ ^\circ C$	2.70		
			$T_{vj} = 150\ ^\circ C$	2.80	2.95	
Gate threshold voltage	$V_{GEth}$	$I_C = 94\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.20	5.80	6.40	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CC} = 1800\ V$		40		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.5		$\Omega$
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	$C_{res}$	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		8		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)	$t_{don}$	$I_C = 2000\ A, V_{CC} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.540		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.660		
			$T_{vj} = 150\ ^\circ C$	0.720		
Rise time (inductive load)	$t_r$	$I_C = 2000\ A, V_{CC} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.220		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.240		
			$T_{vj} = 150\ ^\circ C$	0.240		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 2000\ A, V_{CC} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 2\ \Omega$	$T_{vj} = 25\ ^\circ C$	2.900		$\mu s$
			$T_{vj} = 125\ ^\circ C$	3.200		
			$T_{vj} = 150\ ^\circ C$	3.300		
Fall time (inductive load)	$t_f$	$I_C = 2000\ A, V_{CC} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 2\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.760		$\mu s$
			$T_{vj} = 125\ ^\circ C$	1.280		
			$T_{vj} = 150\ ^\circ C$	1.580		
Turn-on time (resistive load)	$t_{on\_R}$	$I_C = 500\ A, V_{CC} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	1.19		$\mu s$
Turn-on energy loss per pulse	$E_{on}$	$I_C = 2000\ A, V_{CC} = 1800\ V, L_\sigma = 85\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.5\ \Omega, di/dt = 7600\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	1600		mJ
			$T_{vj} = 125\ ^\circ C$	2800		
			$T_{vj} = 150\ ^\circ C$	3200		

(table continues...)

**Table 4** (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy loss per pulse	$E_{off}$	$I_C = 2000\text{ A}$ , $V_{CC} = 1800\text{ V}$ , $L_\sigma = 85\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 2\ \Omega$ , $dv/dt = 1800\text{ V}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	2700		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	3600		
			$T_{vj} = 150\text{ }^\circ\text{C}$	3900		
SC data	$I_{SC}$	$V_{GE} \leq 15\text{ V}$ , $V_{CC} = 2400\text{ V}$ , $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}$ , $T_{vj} \leq 150\text{ }^\circ\text{C}$	9600		A
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			5.50	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT		4.30		K/kW
Temperature under switching conditions	$T_{vjop}$		-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	$I_F$		2000	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	4000	A	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}$ , $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	1230	kA <sup>2</sup> s
			$T_{vj} = 150\text{ }^\circ\text{C}$	1110	
Maximum power dissipation	$P_{RQM}$		$T_{vj} = 150\text{ }^\circ\text{C}$	4200	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	$V_F$	$I_F = 2000\text{ A}$ , $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	2.70	3.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	2.35		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2.25	2.55	

(table continues...)

**Table 6 (continued) Characteristic values**

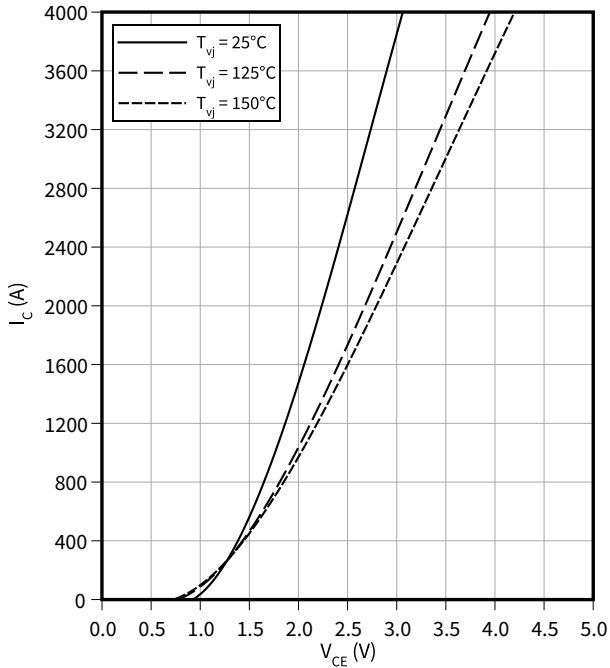
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	$I_{RM}$	$V_{CC} = 1800\text{ V}$ , $I_F = 2000\text{ A}$ , $V_{GE} = -15\text{ V}$ , $-di_F/dt = 7600\text{ A}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	2500		A
			$T_{vj} = 125\text{ }^\circ\text{C}$	2800		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2900		
Recovered charge	$Q_r$	$V_{CC} = 1800\text{ V}$ , $I_F = 2000\text{ A}$ , $V_{GE} = -15\text{ V}$ , $-di_F/dt = 7600\text{ A}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	1020		$\mu\text{C}$
			$T_{vj} = 125\text{ }^\circ\text{C}$	1980		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2320		
Reverse recovery energy	$E_{rec}$	$V_{CC} = 1800\text{ V}$ , $I_F = 2000\text{ A}$ , $V_{GE} = -15\text{ V}$ , $-di_F/dt = 7600\text{ A}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	1350		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2450		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2900		
Thermal resistance, junction to case	$R_{thJC}$	per diode			10.6	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per diode		5.10		K/kW
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	$^\circ\text{C}$

## 4 Characteristics diagrams

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

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

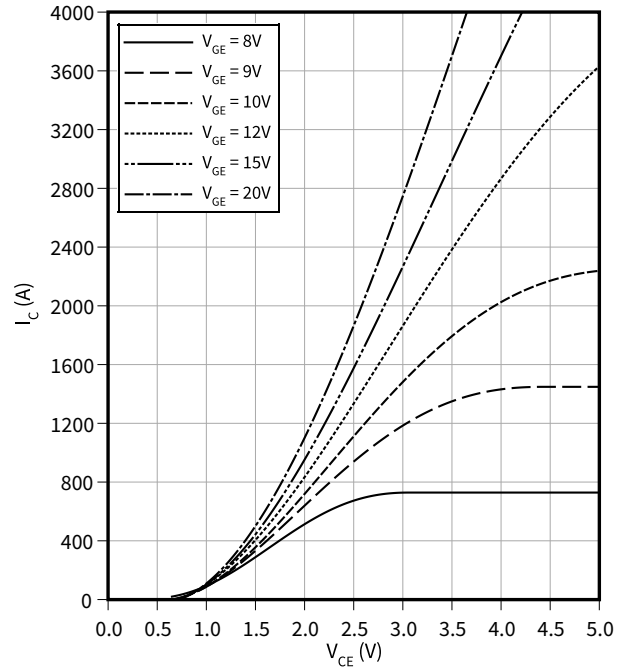
$$V_{GE} = 15 \text{ V}$$



**Output characteristic field (typical), IGBT, Inverter**

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

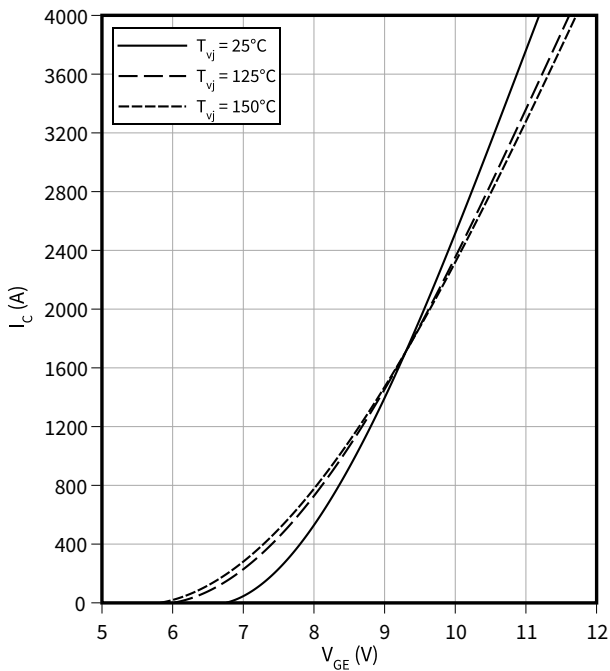
$$T_{vj} = 150 \text{ °C}$$



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

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

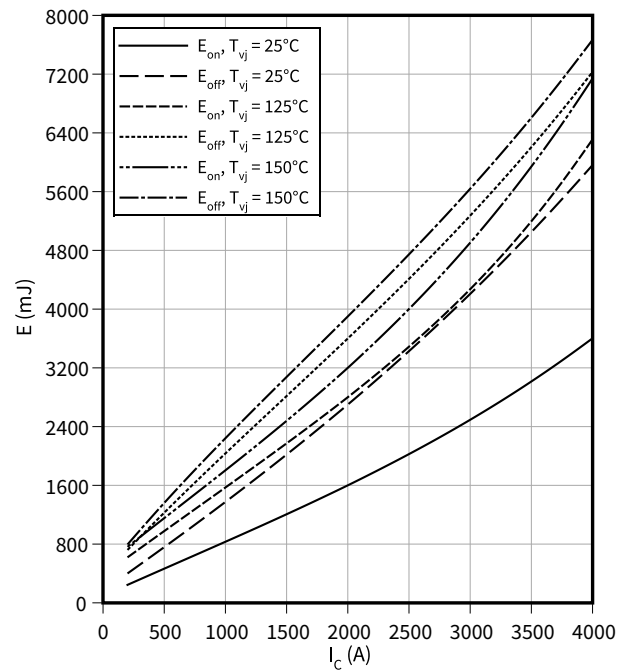
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

$$R_{Goff} = 2 \text{ } \Omega, R_{Gon} = 0.5 \text{ } \Omega, V_{CC} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

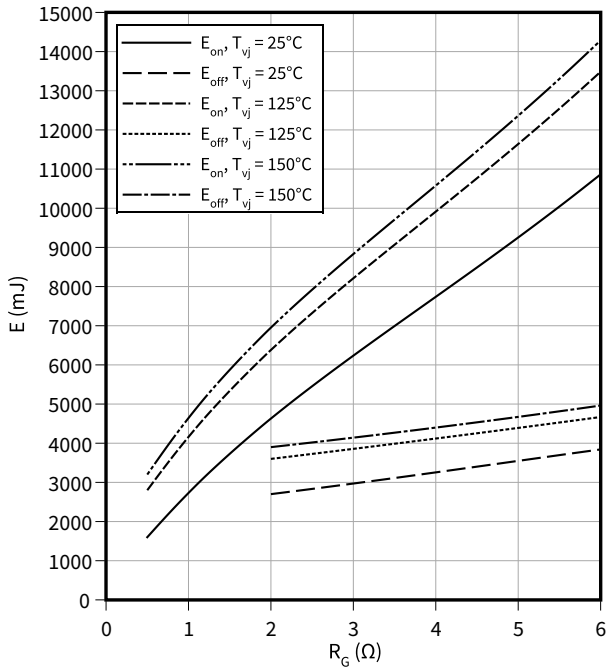


4 Characteristics diagrams

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

$E = f(R_G)$

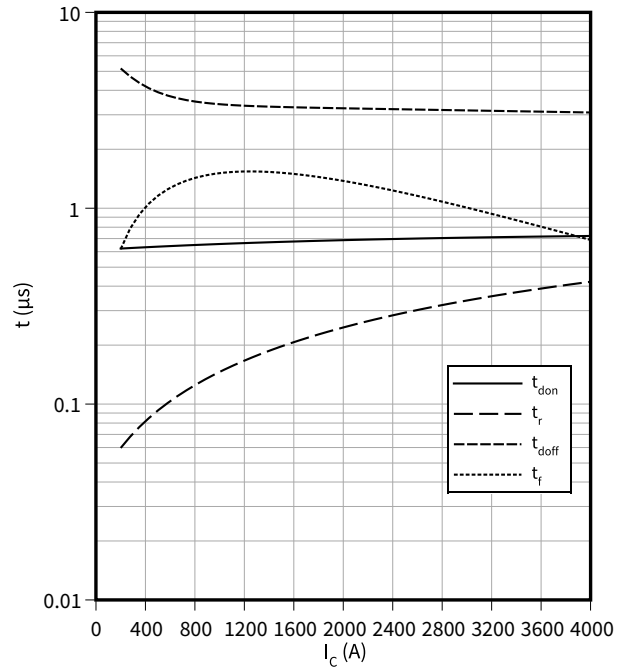
$I_C = 2000 \text{ A}$ ,  $V_{CC} = 1800 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$



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

$t = f(I_C)$

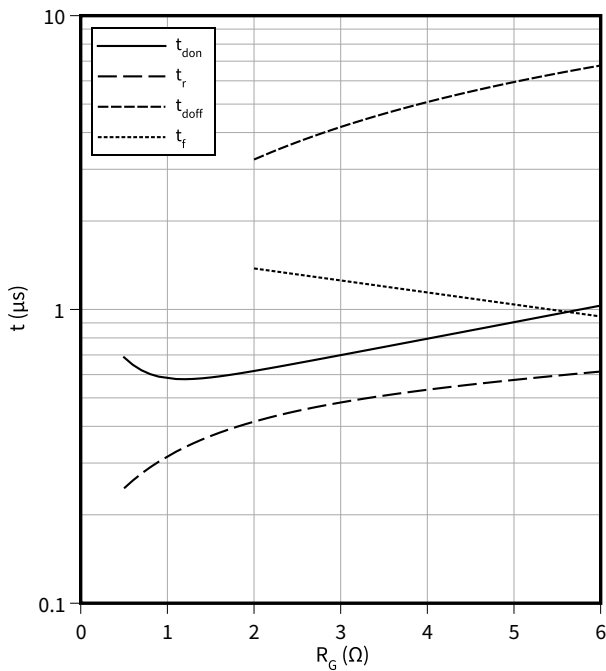
$R_{Goff} = 2 \Omega$ ,  $R_{Gon} = 0.5 \Omega$ ,  $V_{CC} = 1800 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 125 \text{ °C}$



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

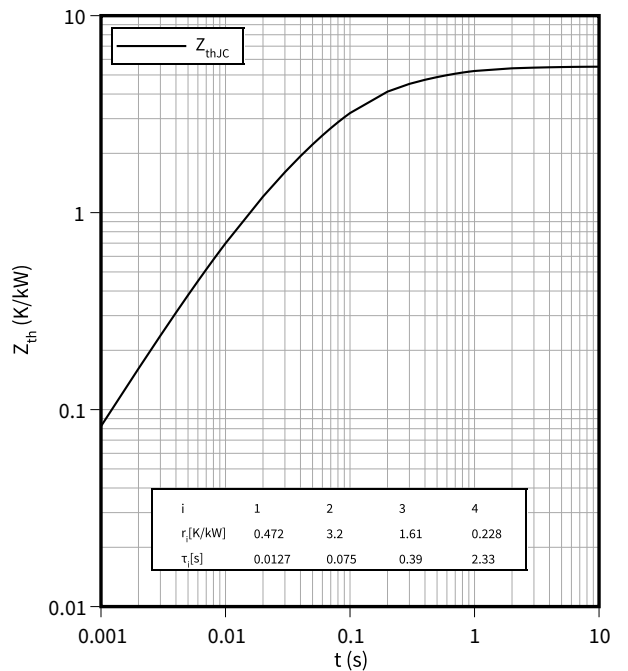
$t = f(R_G)$

$I_C = 2000 \text{ A}$ ,  $V_{CC} = 1800 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 125 \text{ °C}$



**Transient thermal impedance , IGBT, Inverter**

$Z_{th} = f(t)$



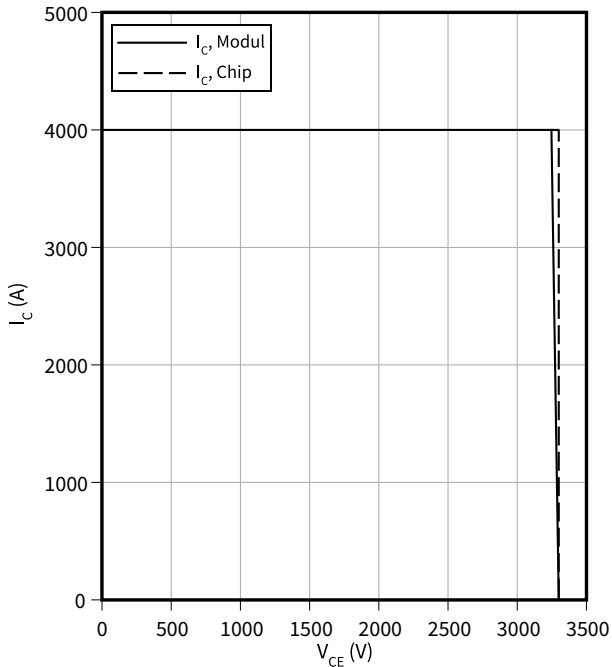


4 Characteristics diagrams

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

$I_C = f(V_{CE})$

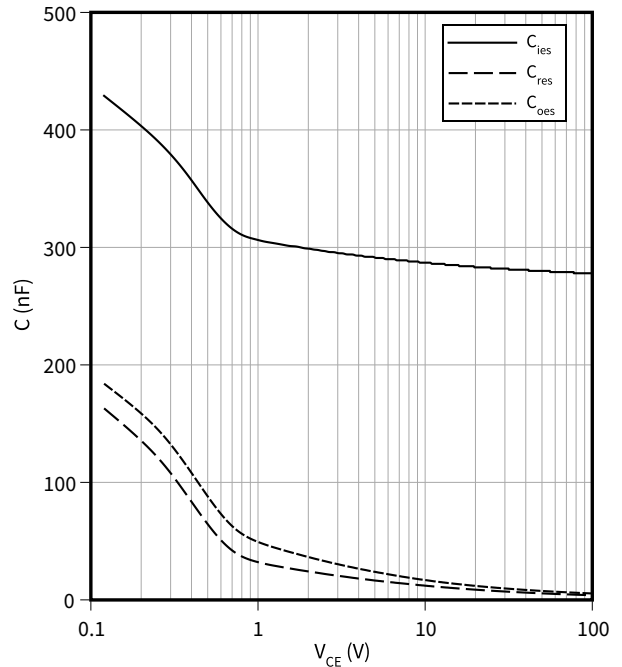
$R_{Goff} = 2 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}$



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

$C = f(V_{CE})$

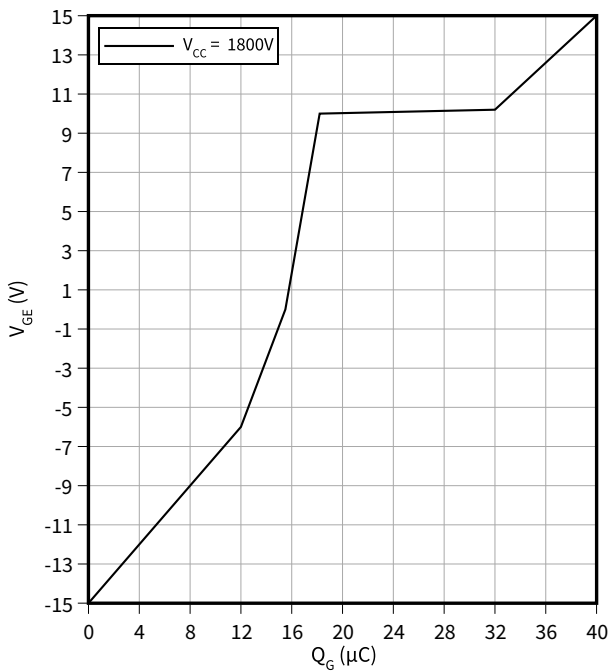
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



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

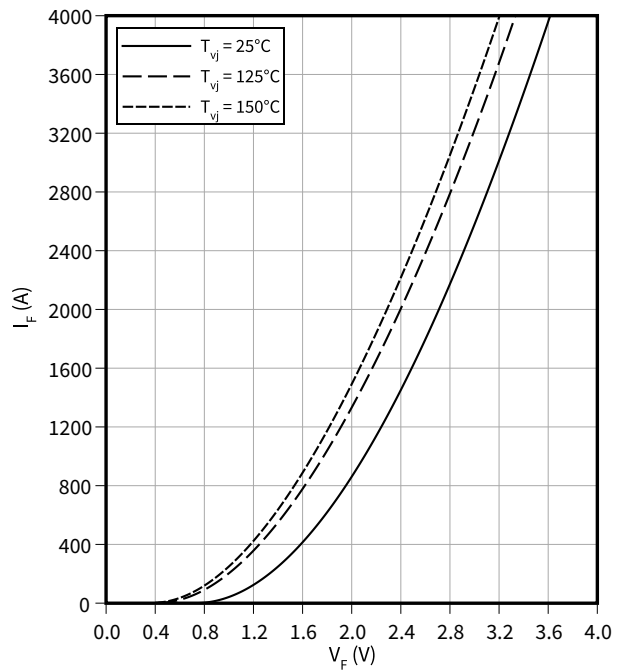
$V_{GE} = f(Q_G)$

$I_C = 2000 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



**Forward characteristic (typical), Diode, Inverter**

$I_F = f(V_F)$

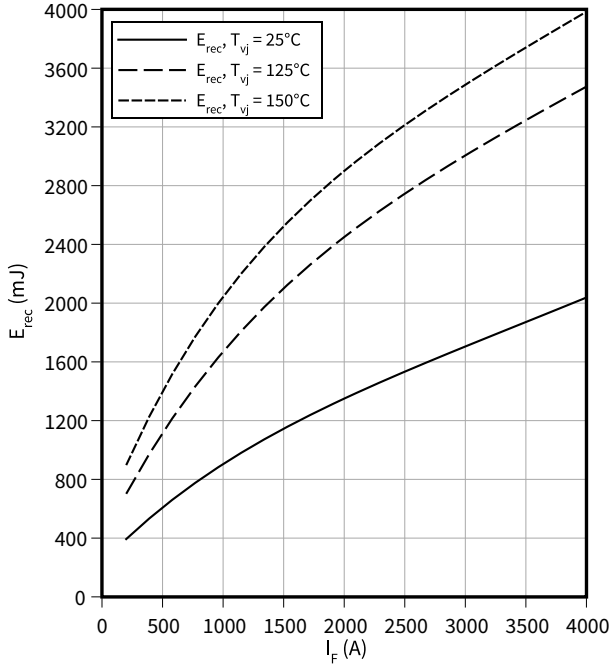


4 Characteristics diagrams

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

$E_{rec} = f(I_F)$

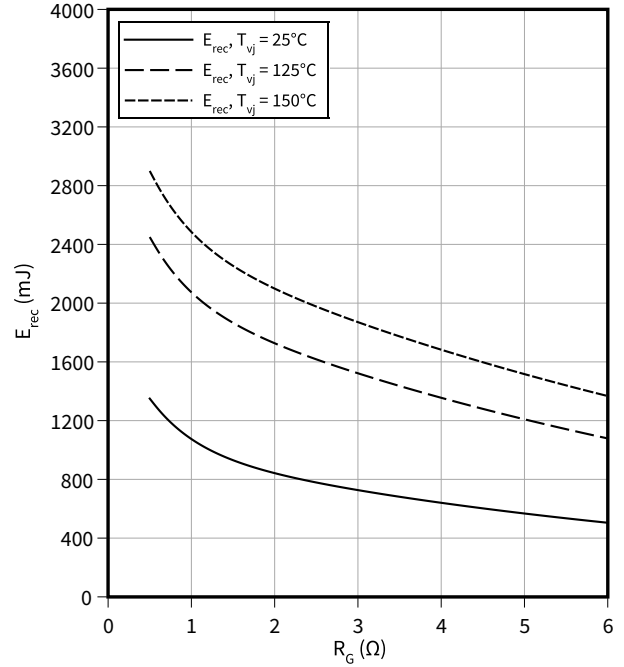
$V_{CE} = 1800\text{ V}$ ,  $R_{Gon} = R_{Gon}(IGBT)$



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

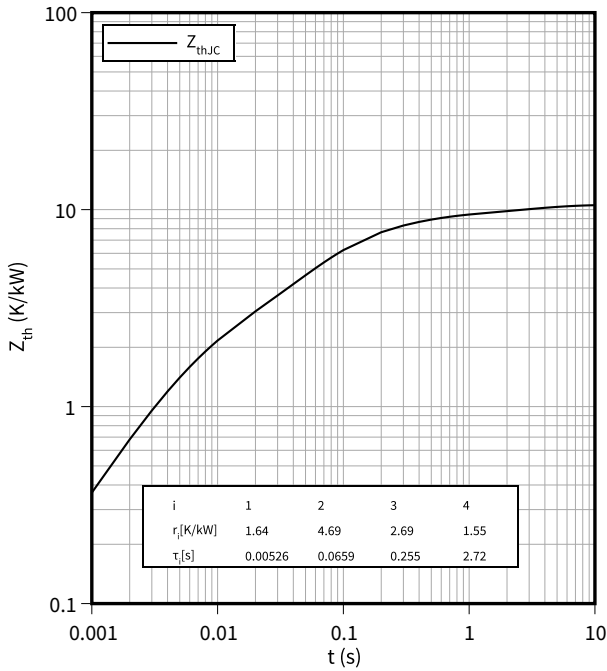
$E_{rec} = f(R_G)$

$V_{CE} = 1800\text{ V}$ ,  $I_F = 2000\text{ A}$



**Transient thermal impedance, Diode, Inverter**

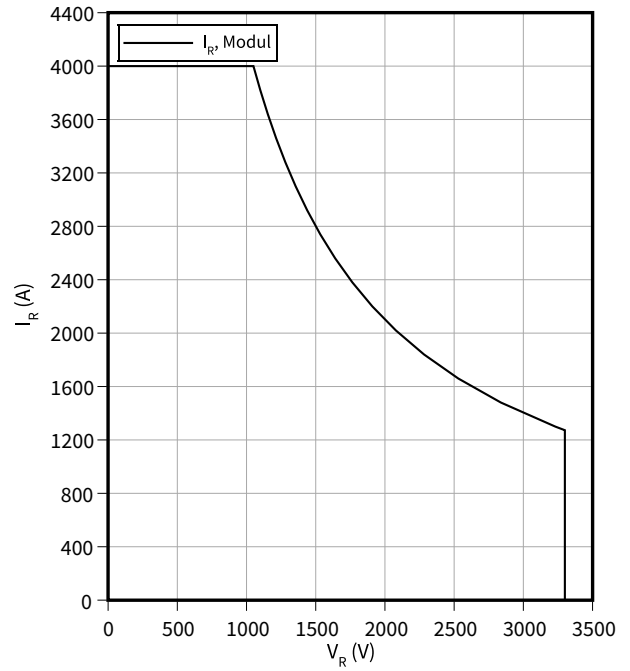
$Z_{th} = f(t)$



**Safe operating area (SOA), Diode, Inverter**

$I_R = f(V_R)$

$T_{vj} = 150\text{ °C}$



## 5 Circuit diagram

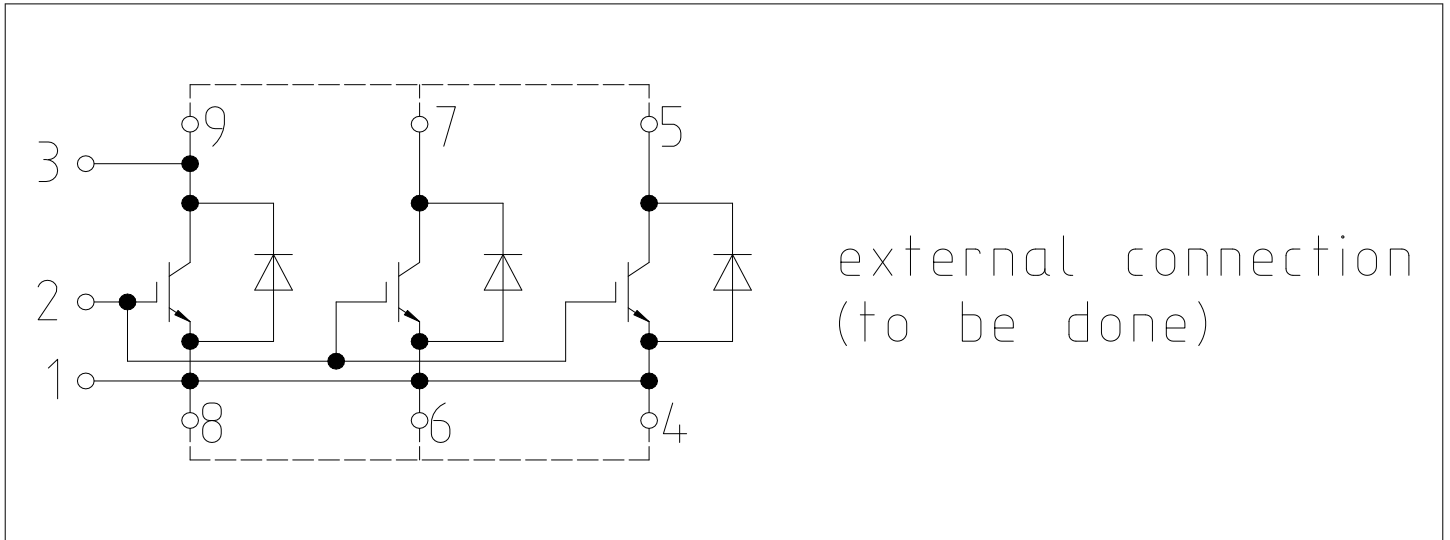


Figure 1

## 6 Package outlines

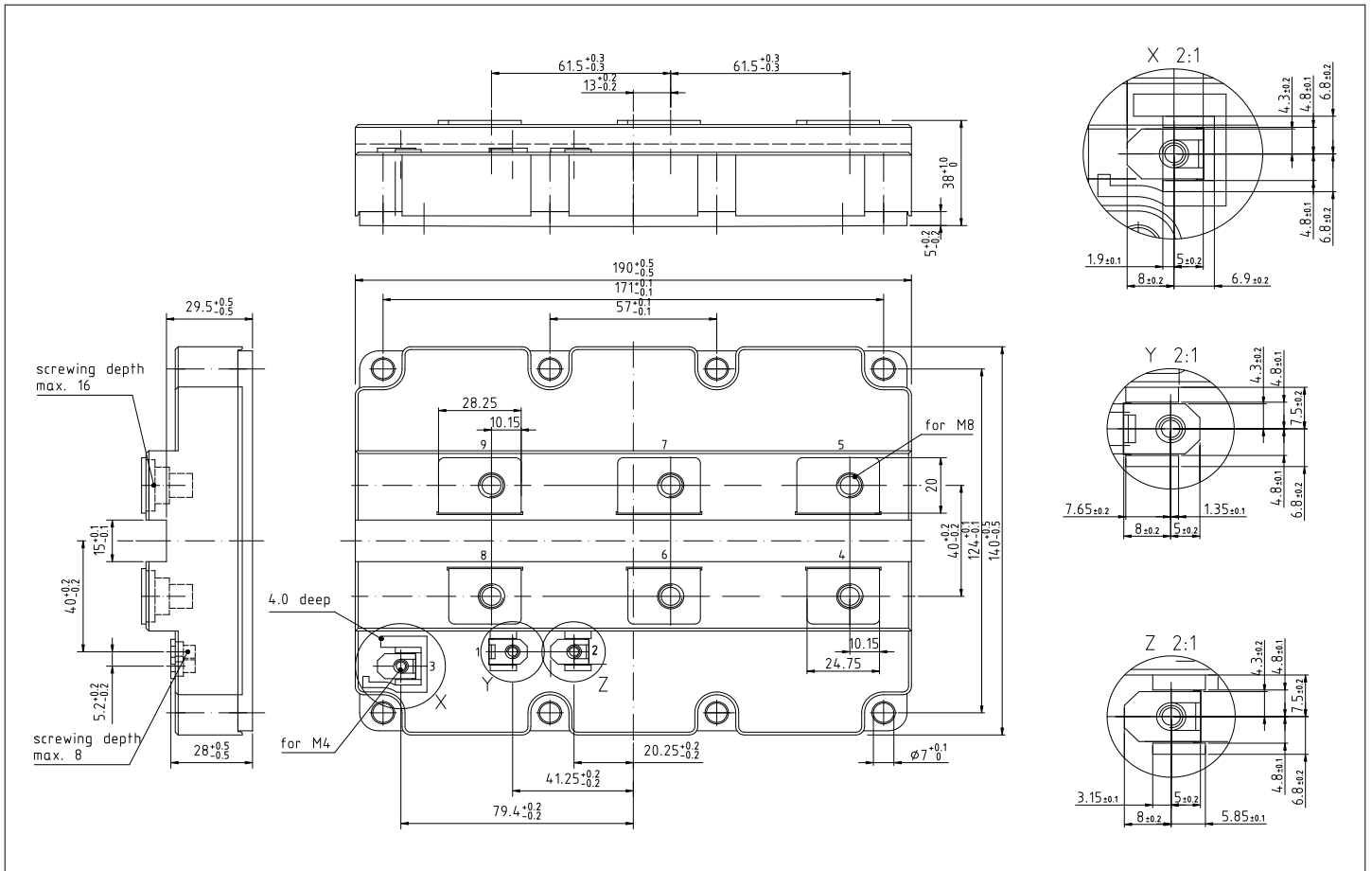

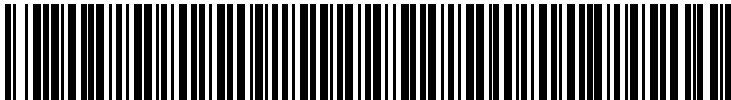


Figure 2

## 7 Module label code

<b>Module label code</b>			
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> Module serial number Module material number Production order number Date code (production year) Date code (production week)	<i>Digit</i> 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	<i>Example</i> 71549 142846 55054991 15 30
Example	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">   71549142846550549911530 </div> <div style="text-align: center;">   71549142846550549911530 </div> </div>		

**Figure 3**

## Revision history

Document revision	Date of release	Description of changes
V1.0	2018-11-21	Target datasheet
V2.0	2019-05-13	Preliminary datasheet
V2.1	2019-07-24	Preliminary 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
0.20	2021-10-22	Preliminary datasheet
1.00	2021-12-17	Final datasheet
1.10	2022-11-22	Final datasheet

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**Document reference**

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