

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 $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - Trench IGBT 4
 - Unbeatable robustness
 - $V_{CE,sat}$ 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)

Product validation

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

Description

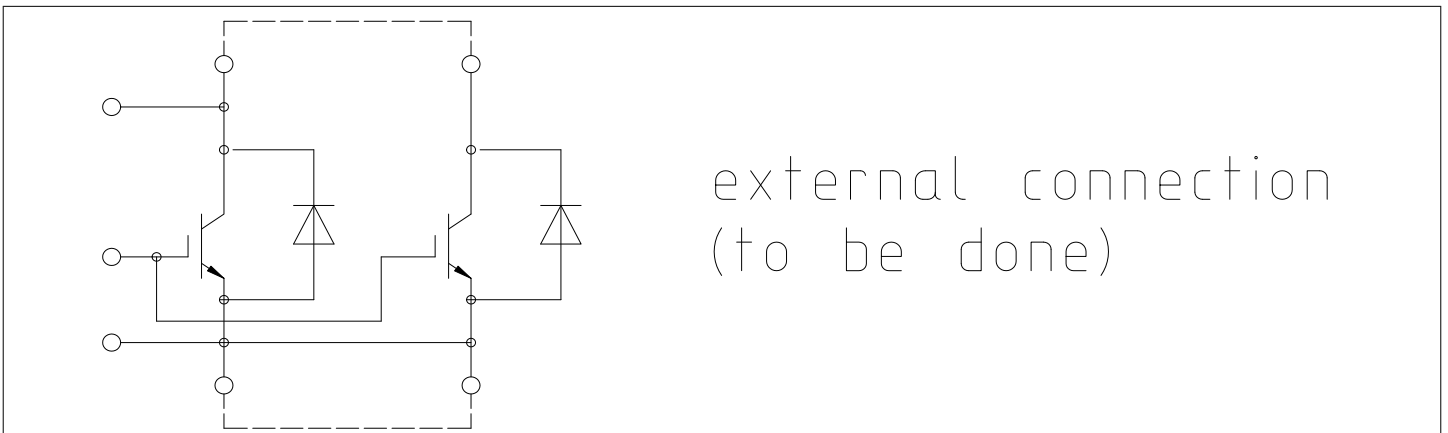


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 60 \text{ s}$	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	$V_{CE(D)}$	$T_{vj} = 25 \text{ °C}$, 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	$R_{AA'+CC'}$	$T_C = 25\text{ }^{\circ}\text{C}$, per switch			0.12		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25\text{ }^{\circ}\text{C}$, per switch			0.14		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				800		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = -40 \text{ °C}$	3300	V
			$T_{vj} = 150 \text{ °C}$	3300	
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 150 \text{ °C}$	$T_C = 100 \text{ °C}$	1600	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$		3200	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	$V_{CE\ sat}$	$I_C = 1600\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	2.40	2.65	V
			$T_{vj} = 125\text{ °C}$	2.95		
			$T_{vj} = 150\text{ °C}$	3.10	3.25	
Gate threshold voltage	V_{GEth}	$I_C = 62\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25\text{ °C}$	5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\text{ V}$, $V_{CC} = 1800\text{ V}$		28		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$		0.75		Ω
Input capacitance	C_{ies}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$		187		nF
Reverse transfer capacitance	C_{res}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$		5.33		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 3300\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$, $T_{vj} = 25\text{ °C}$			400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.8\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.600		μs
			$T_{vj} = 125\text{ °C}$	0.710		
			$T_{vj} = 150\text{ °C}$	0.760		
Rise time (inductive load)	t_r	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.8\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.220		μs
			$T_{vj} = 125\text{ °C}$	0.240		
			$T_{vj} = 150\text{ °C}$	0.250		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 3.9\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	3.420		μs
			$T_{vj} = 125\text{ °C}$	3.670		
			$T_{vj} = 150\text{ °C}$	3.740		
Fall time (inductive load)	t_f	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 3.9\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.690		μs
			$T_{vj} = 125\text{ °C}$	1.290		
			$T_{vj} = 150\text{ °C}$	1.470		
Turn-on time (resistive load)	t_{on_R}	$I_C = 500\text{ A}$, $V_{CC} = 2000\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.8\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	1.18		μs
Turn-on energy loss per pulse	E_{on}	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $L_\sigma = 85\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.8\text{ }\Omega$, $di/dt = 5300\text{ A}/\mu\text{s}$ ($T_{vj} = 150\text{ °C}$)	$T_{vj} = 25\text{ °C}$	1850		mJ
			$T_{vj} = 125\text{ °C}$	2850		
			$T_{vj} = 150\text{ °C}$	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}	$I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $L_\sigma = 85\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 3.9\ \Omega$, $dv/dt = 1700\text{ V}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	2280		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2980		
			$T_{vj} = 150\text{ }^\circ\text{C}$	3140		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 2400\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 10\ \mu\text{s}$, $T_{vj} \leq 150\text{ }^\circ\text{C}$	6400		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			9.30	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT		5.60		K/kW
Temperature under switching conditions	$T_{vj\text{ op}}$		-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		1600	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\text{ ms}$	3200	A
I^2t - value	I^2t	$t_P = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	kA ² s
			$T_{vj} = 150\text{ }^\circ\text{C}$	
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	

(table continues...)

Table 6 (continued) Characteristic values

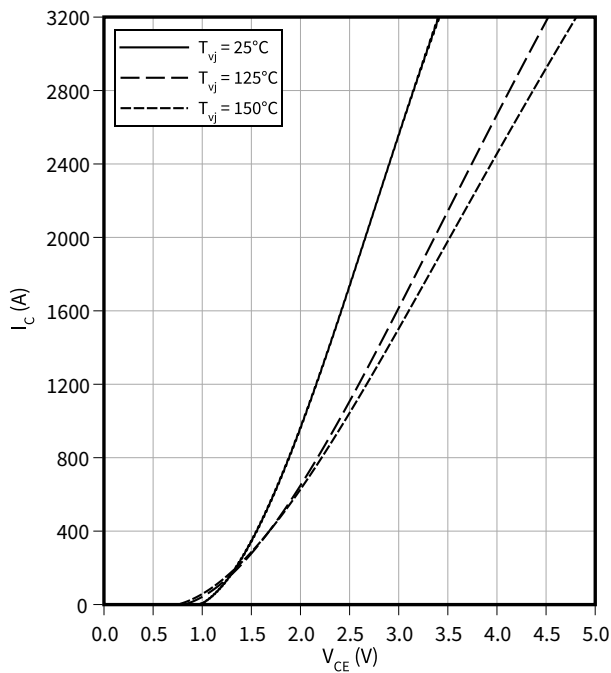
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	$V_{CC} = 1800 \text{ V}$, $I_F = 1600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5300 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	1470		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1650		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1700		
Recovered charge	Q_r	$V_{CC} = 1800 \text{ V}$, $I_F = 1600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5300 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	685		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1360		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	2000		
Reverse recovery energy	E_{rec}	$V_{CC} = 1800 \text{ V}$, $I_F = 1600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5300 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	730		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1450		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1750		
Thermal resistance, junction to case	R_{thJC}	per diode			17.5	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode		8.50		K/kW
Temperature under switching conditions	$T_{vj op}$		-40		150	$^\circ\text{C}$

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

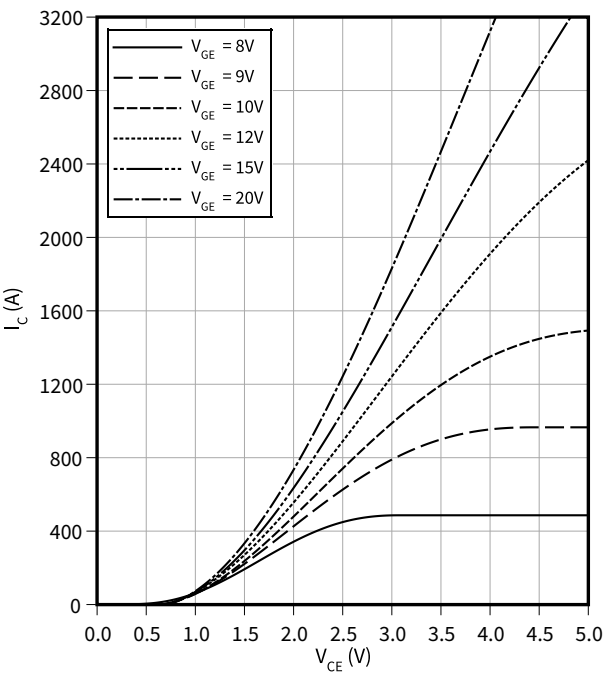
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

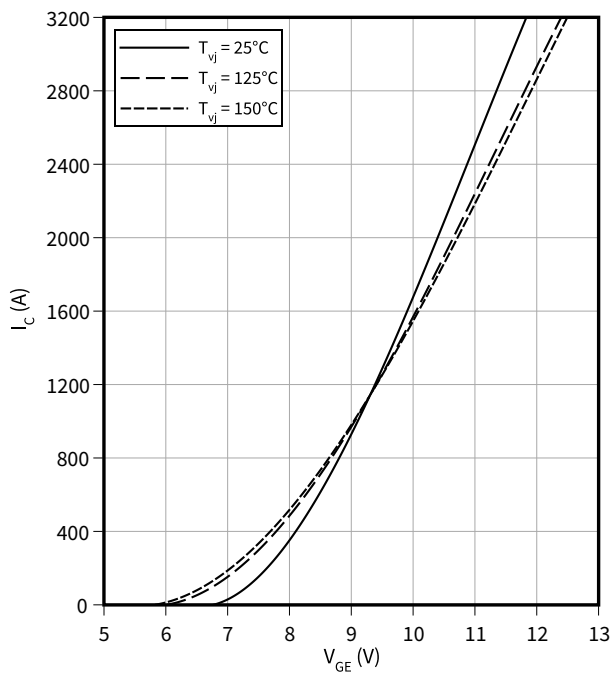
$T_{vj} = 150^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

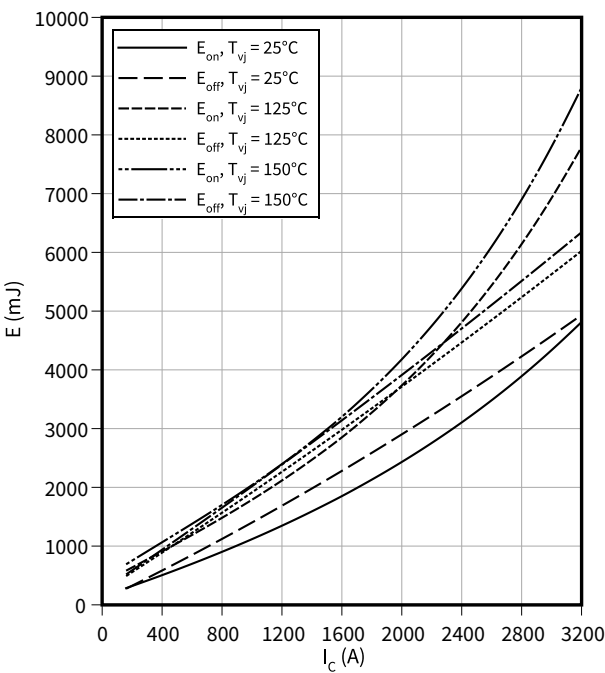
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

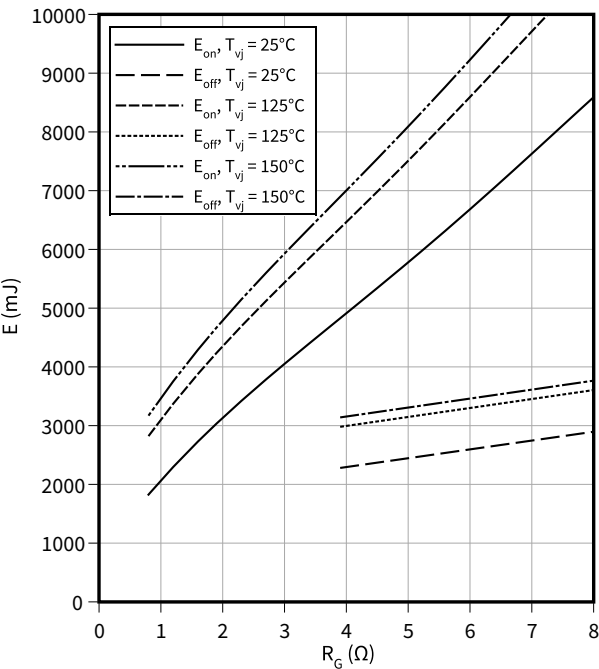
$R_{Goff} = 3.9\ \Omega$, $R_{Gon} = 0.8\ \Omega$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$



4 Characteristics diagrams

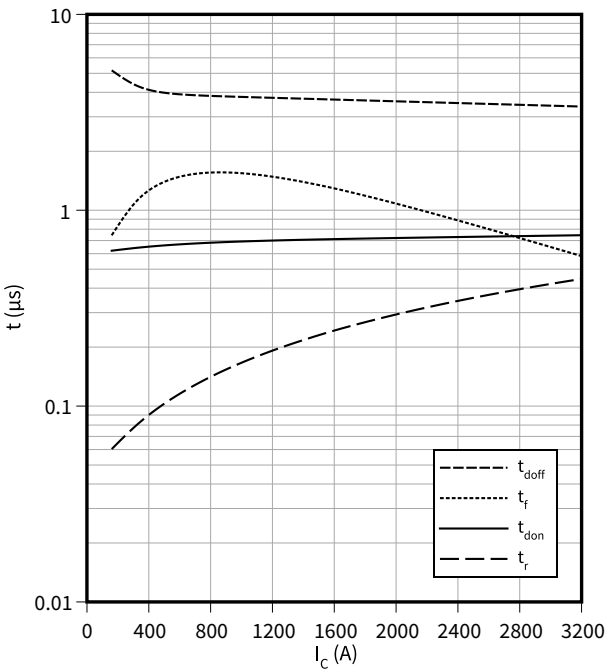
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$



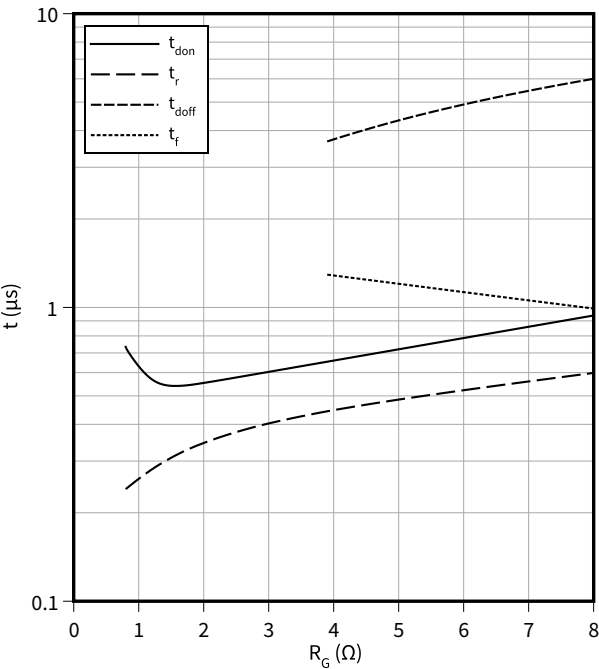
Switching times (typical), IGBT, Inverter

$t = f(I_C)$
 $R_{Goff} = 3.9\text{ }\Omega$, $R_{Gon} = 0.8\text{ }\Omega$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 125\text{ }^\circ\text{C}$



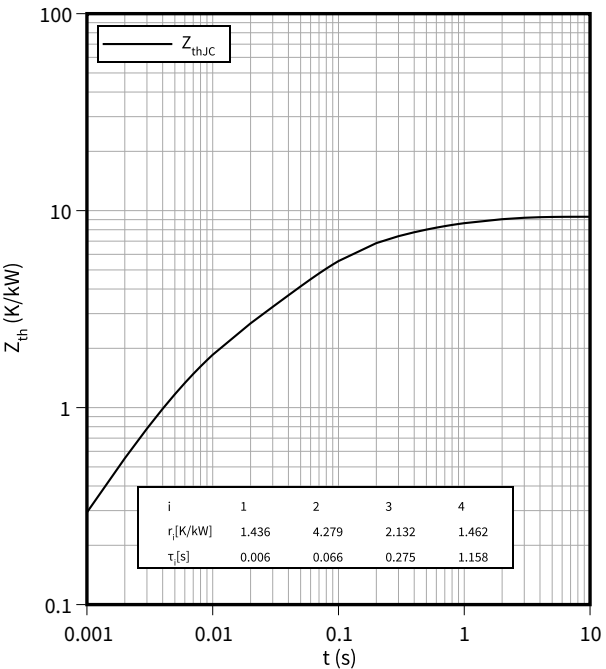
Switching times (typical), IGBT, Inverter

$t = f(R_G)$
 $I_C = 1600\text{ A}$, $V_{CC} = 1800\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 125\text{ }^\circ\text{C}$



Transient thermal impedance , IGBT, Inverter

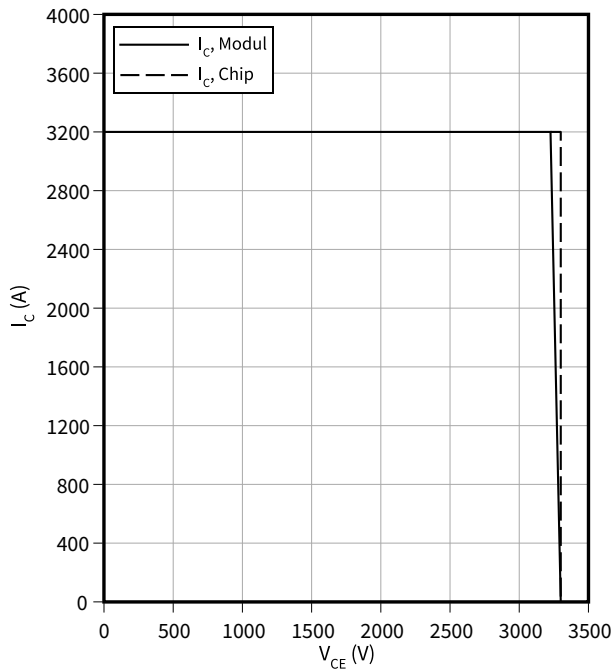
$Z_{th} = f(t)$



4 Characteristics diagrams

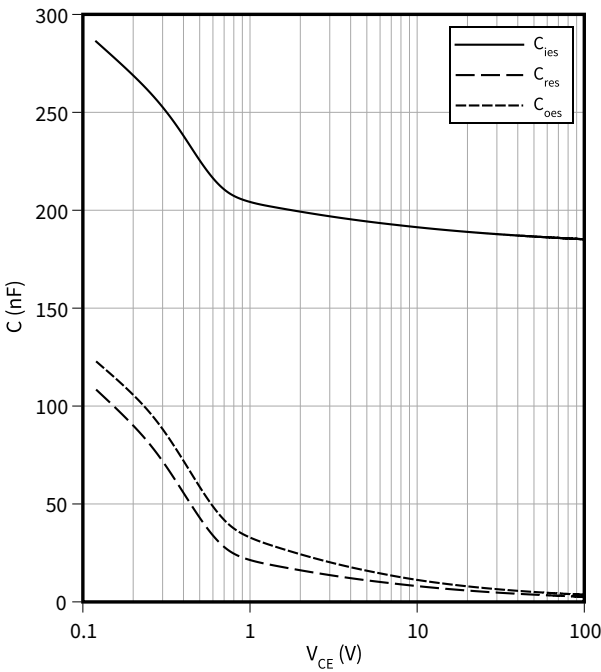
Reverse bias safe operating area (RBSOA), IGBT, Inverter

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



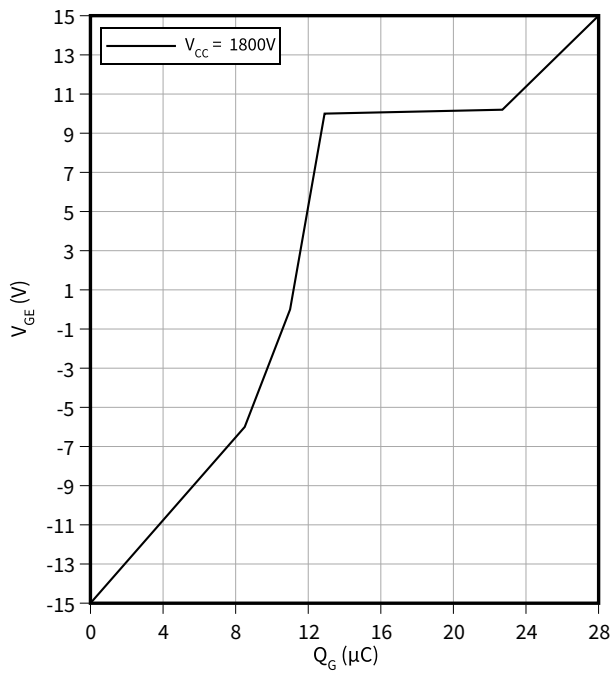
Capacity characteristic (typical), IGBT, Inverter

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



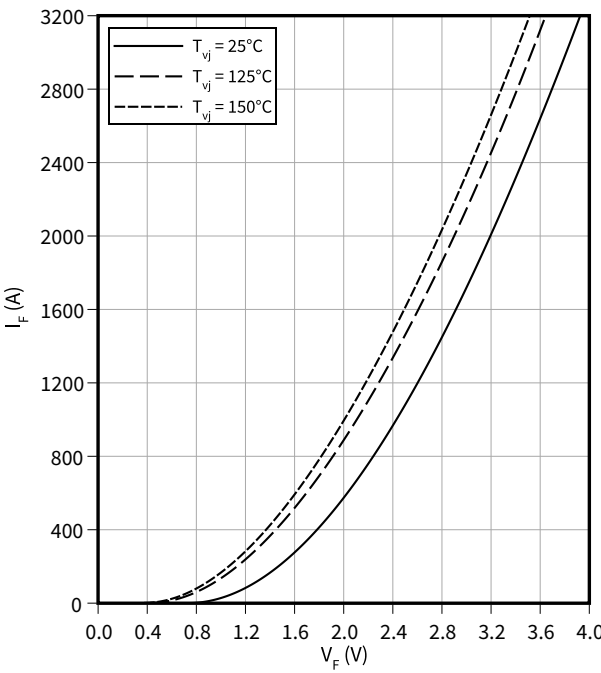
Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$
 $I_C = 1600 \text{ A}$, $T_{vj} = 25 \text{ }^\circ\text{C}$



Forward characteristic (typical), Diode, Inverter

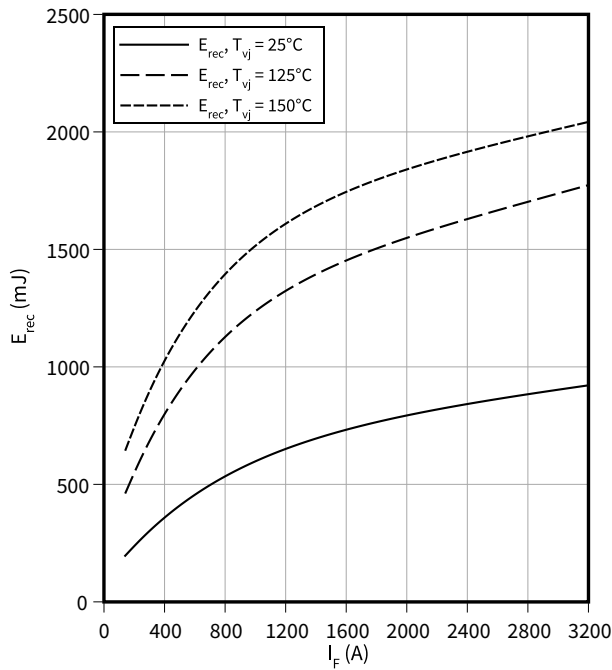
$I_F = f(V_F)$



4 Characteristics diagrams

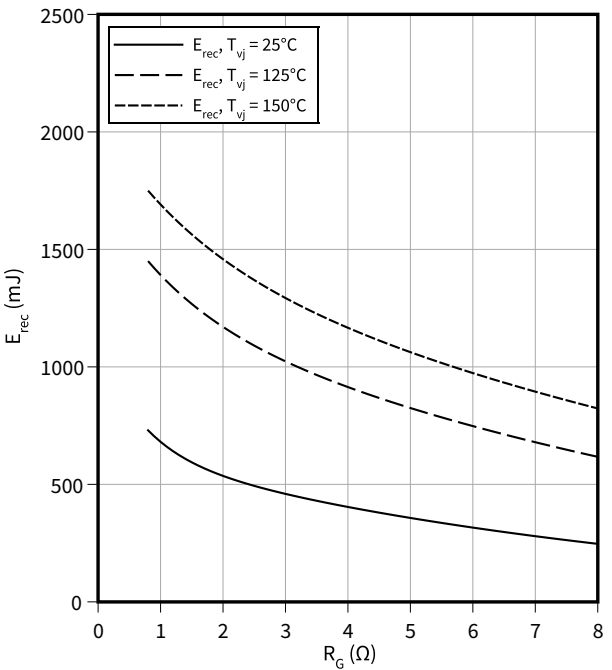
Switching losses (typical), Diode, Inverter

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



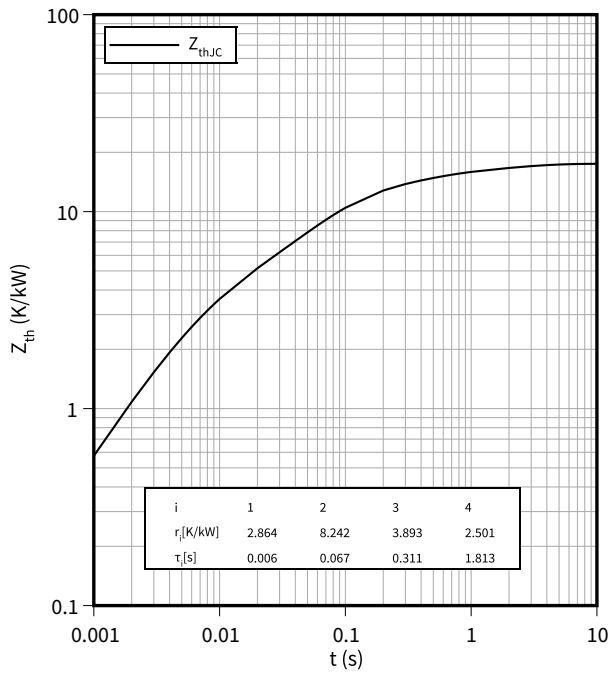
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $V_{CE} = 1800\text{ V}, I_F = 1600\text{ A}$



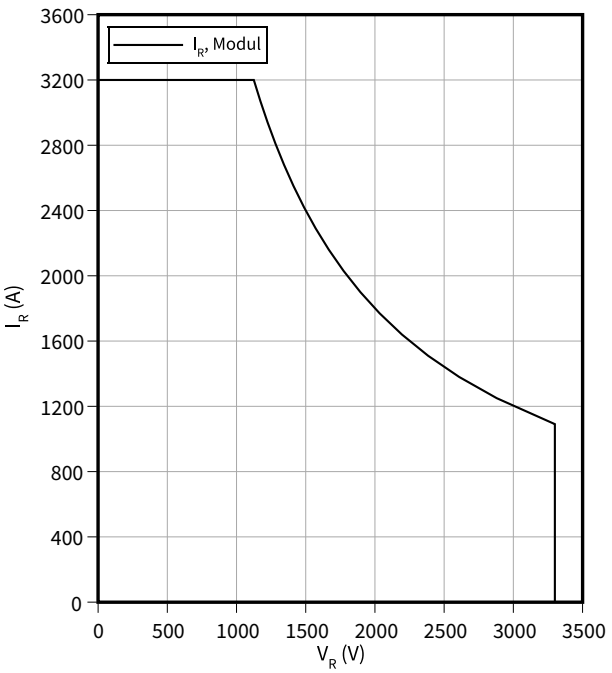
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Inverter

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



5 Circuit diagram

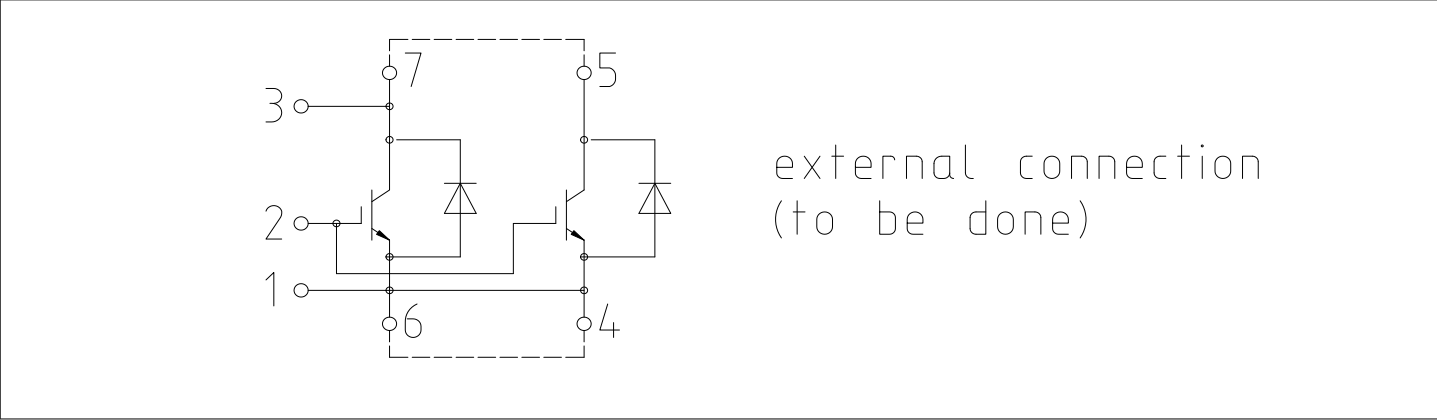


Figure 1

6 Package outlines

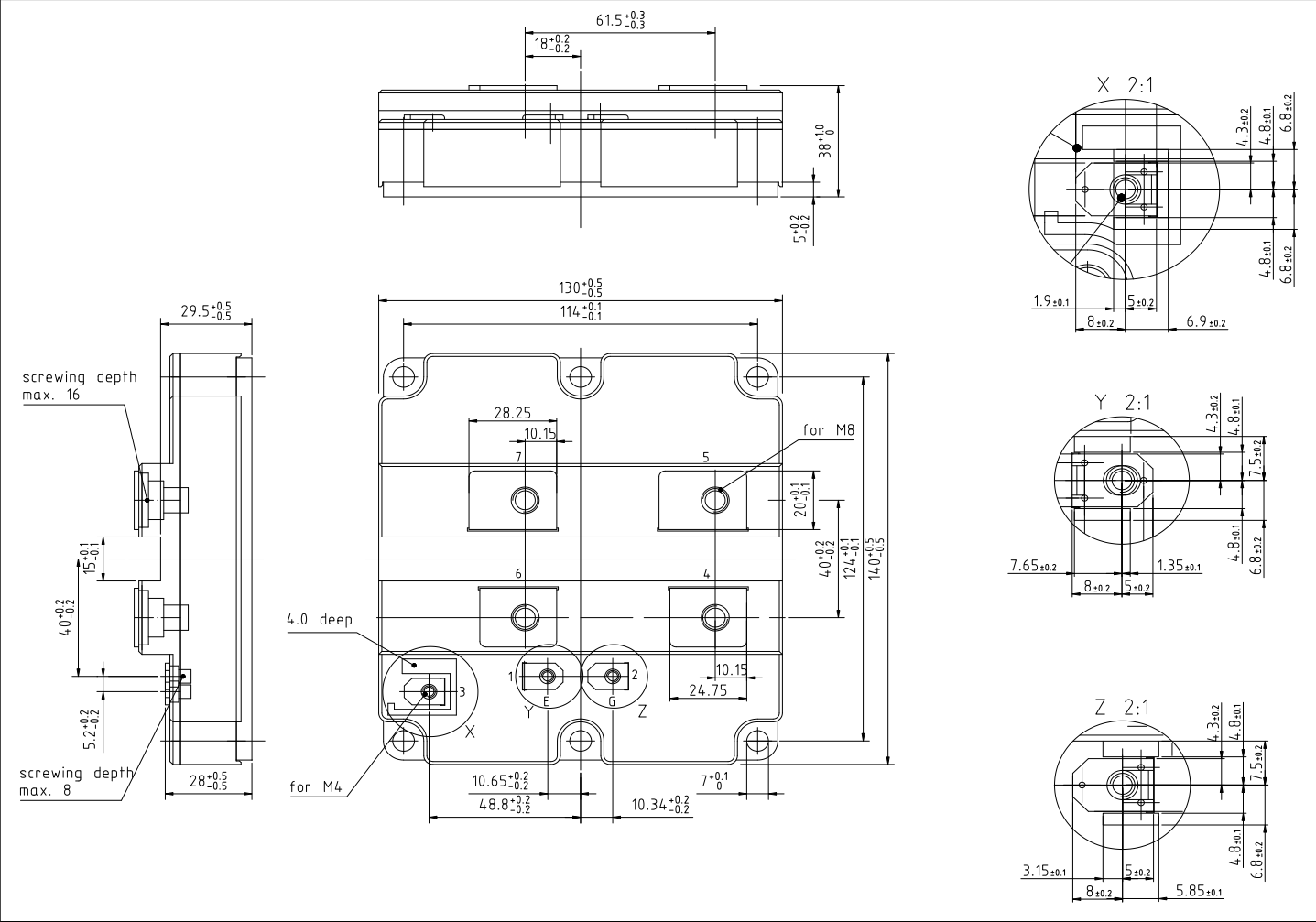


Figure 2

7 Module label code

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
1.00	2021-03-02	
1.10	2021-04-13	Final
1.20	2021-10-28	Final datasheet
1.30	2022-11-22	Final datasheet

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