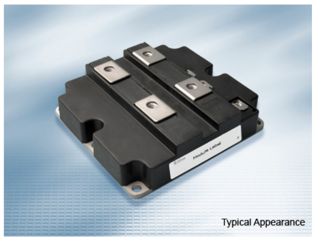
IHM-B module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode

Features



- Electrical features
  - V_{CES} = 3300 V
  - $I_{C\ nom}$ = 1600 A / I_{CRM} = 3200 A
  - High DC stability
  - High short-circuit capability
  - Low switching losses
  - Low V_{CEsat}
  - $T_{vj\ op}$ = 150 °C
  - Trench IGBT 4
  - Unbeatable robustness
  - V_{CEsat} with positive temperature coefficient
  - High current density
  - Low Qg and Cres
- 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

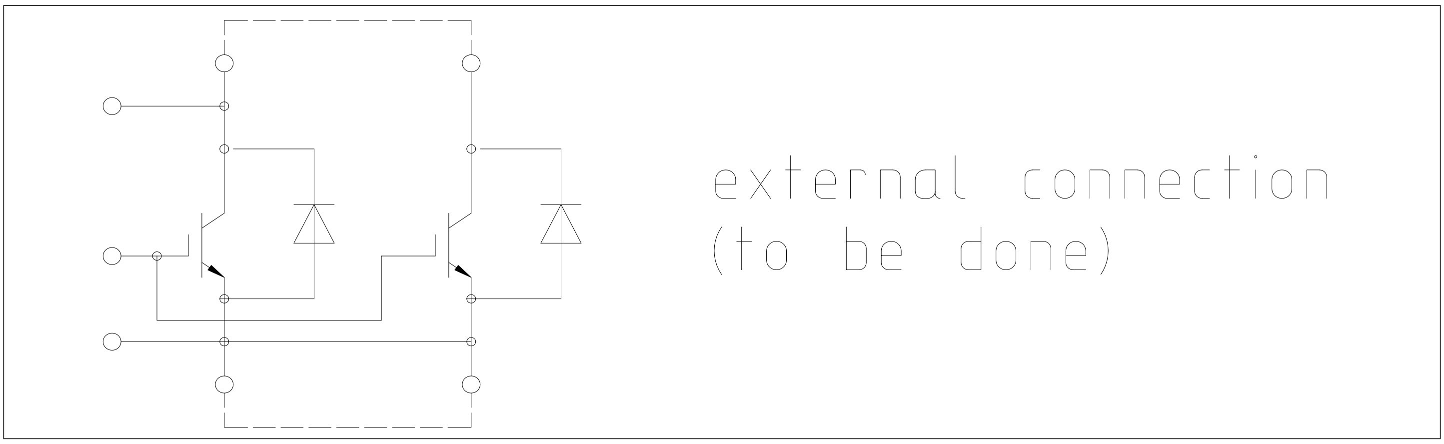


Table of contents

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°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°C, per switch			0.12		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.14		mΩ
Storage temperature	T_{stg}			-40		150	°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 °C	3300	V
			T_{vj} = 150 °C	3300	
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_C = 100 °C	1600	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		3200	A
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 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.40	2.65	V
			T_{vj} = 125 °C		2.95		
			T_{vj} = 150 °C		3.10	3.25	
Gate threshold voltage	V_{GEth}	I_C = 62 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			28		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.75		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			187		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °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 °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 = 1600 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.8 Ω	T_{vj} = 25 °C		0.600		µs
			T_{vj} = 125 °C		0.710		
			T_{vj} = 150 °C		0.760		
Rise time (inductive load)	t_r	I_C = 1600 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.8 Ω	T_{vj} = 25 °C		0.220		µs
			T_{vj} = 125 °C		0.240		
			T_{vj} = 150 °C		0.250		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1600 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 3.9 Ω	T_{vj} = 25 °C		3.420		µs
			T_{vj} = 125 °C		3.670		
			T_{vj} = 150 °C		3.740		
Fall time (inductive load)	t_f	I_C = 1600 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 3.9 Ω	T_{vj} = 25 °C		0.690		µs
			T_{vj} = 125 °C		1.290		
			T_{vj} = 150 °C		1.470		
Turn-on energy loss per pulse	E_{on}	I_C = 1600 A, V_{CE} = 1800 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Gon} = 0.8 Ω, di/dt = 5300 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1850		mJ
			T_{vj} = 125 °C		2850		
			T_{vj} = 150 °C		3200		
Turn-off energy loss per pulse	E_{off}	I_C = 1600 A, V_{CE} = 1800 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Goff} = 3.9 Ω, dv/dt = 1700 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		2280		mJ
			T_{vj} = 125 °C		2980		
			T_{vj} = 150 °C		3140		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 2400 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				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, λ_{grease}= 1 W/(m*K)		5.60		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	
Continous DC forward current	I_F			1600	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		3200	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	630	kA^2s
			T_{vj} = 150 °C	570	
Maximum power dissipation	P_{RQM}	T_{vj} = 150 °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 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.90	3.30	V
			T_{vj} = 125 °C		2.60		
			T_{vj} = 150 °C		2.50	2.80	
Peak reverse recovery current	I_{RM}	V_R = 1800 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 5300 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1470		A
			T_{vj} = 125 °C		1650		
			T_{vj} = 150 °C		1700		
Recovered charge	Q_r	V_R = 1800 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 5300 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		685		µC
			T_{vj} = 125 °C		1360		
			T_{vj} = 150 °C		2000		
Reverse recovery energy	E_{rec}	V_R = 1800 V, I_F = 1600 A, V_{GE} = -15 V, -di_F/dt = 5300 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		730		mJ
			T_{vj} = 125 °C		1450		
			T_{vj} = 150 °C		1750		

Table 6 Characteristic values (continued)

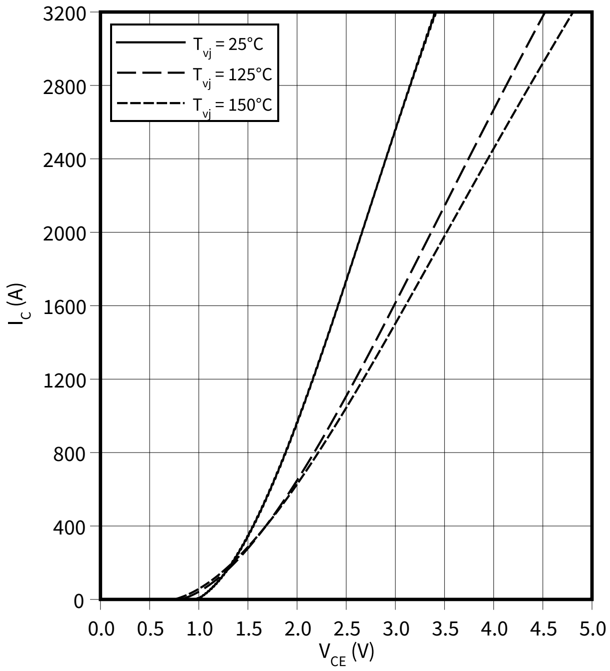
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			17.5	K/kW
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)		8.50		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

4 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

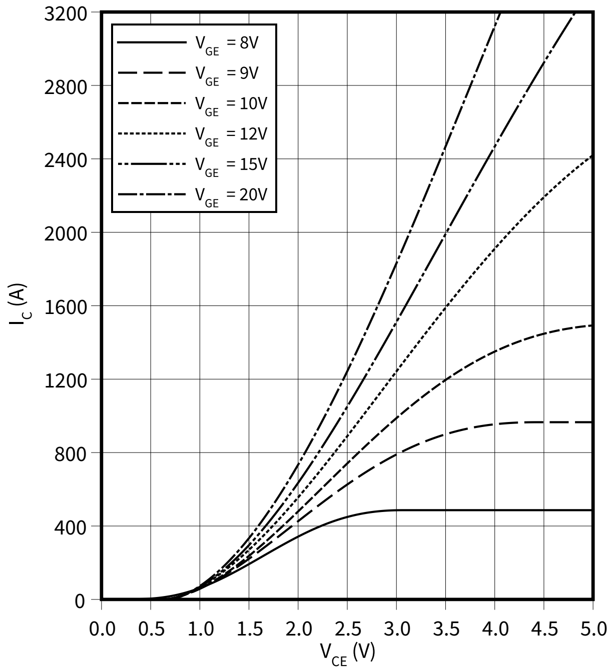
$V_{GE} = 15\ V$



output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

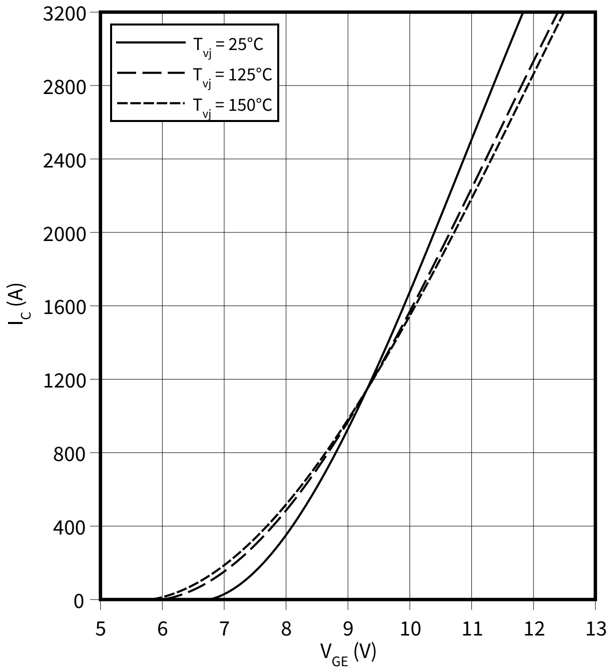
$T_{vj} = 150\ °C$



transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

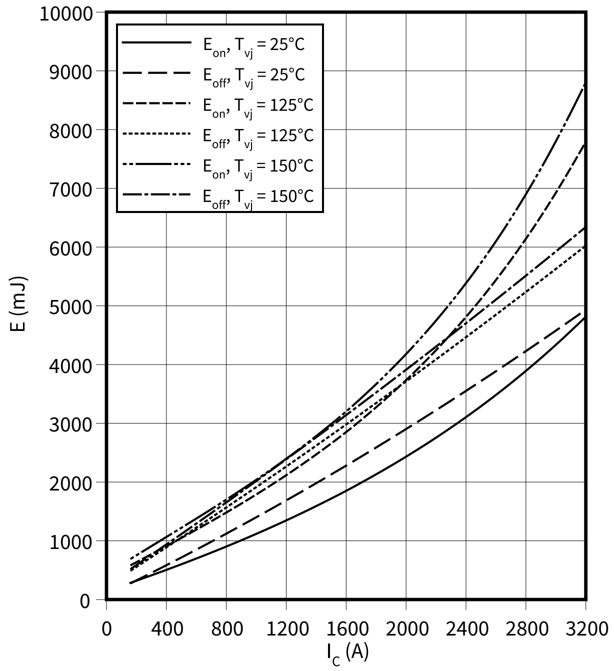
$V_{CE} = 20\ V$



switching losses (typical), IGBT, Inverter

$E = f(I_C)$

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

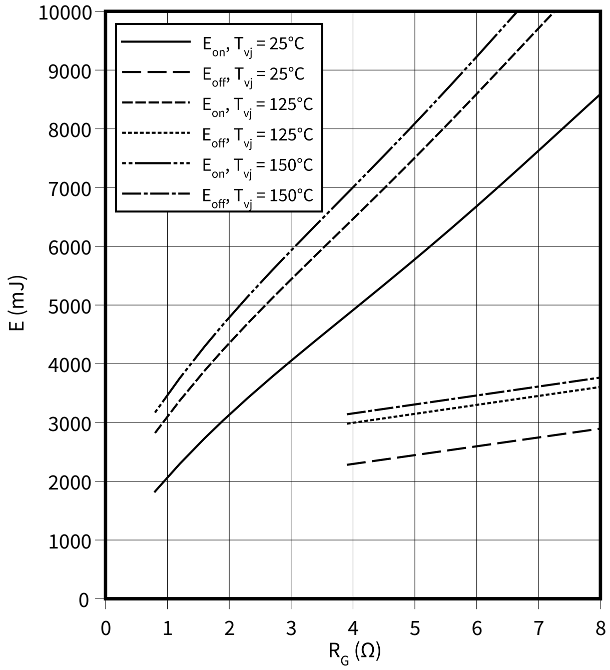


4 Characteristics diagrams

switching losses (typical), IGBT, Inverter

$E = f(R_G)$

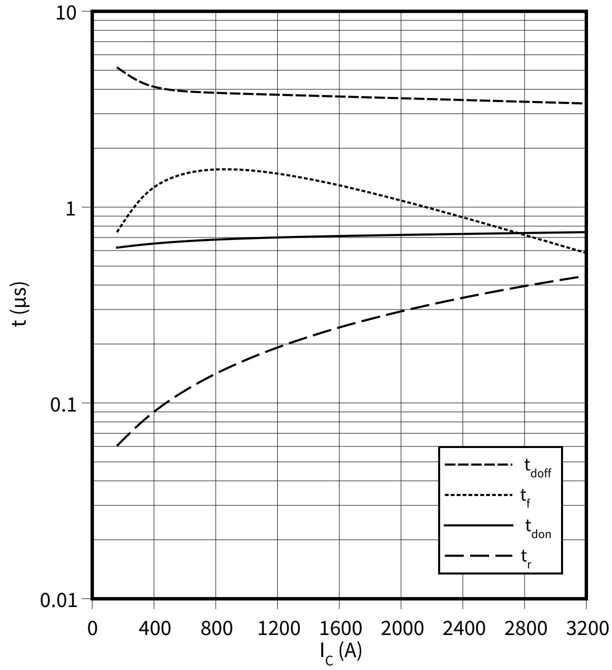
I_C = 1600 A, V_{CE} = 1800 V, V_{GE} = ± 15 V



switching times (typical), IGBT, Inverter

$t = f(I_C)$

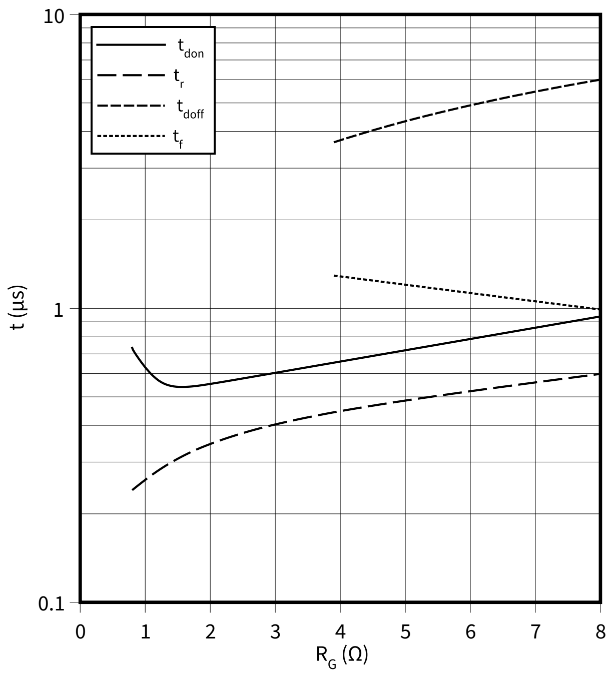
R_{Goff} = 3.9 Ω, R_{Gon} = 0.8 Ω, V_{CE} = 1800 V, V_{GE} = ± 15 V, T_{vj} = 125 °C



switching times (typical), IGBT, Inverter

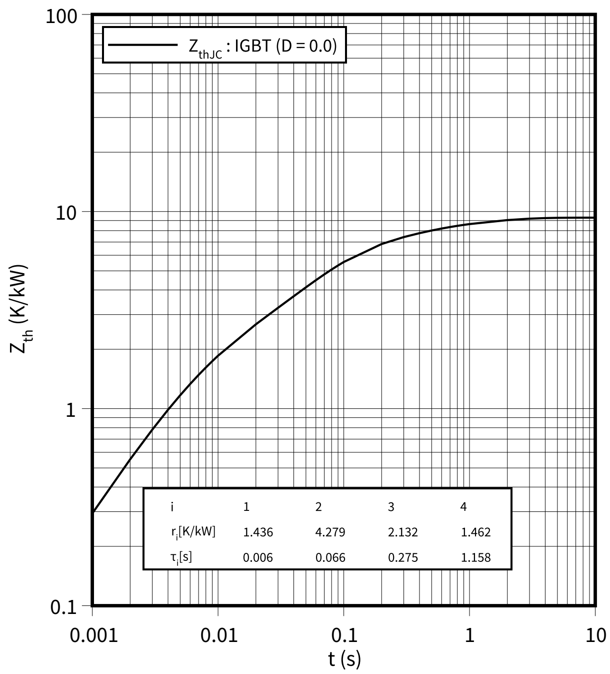
$t = f(R_G)$

I_C = 1600 A, V_{CE} = 1800 V, V_{GE} = ± 15 V, T_{vj} = 125 °C



transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$

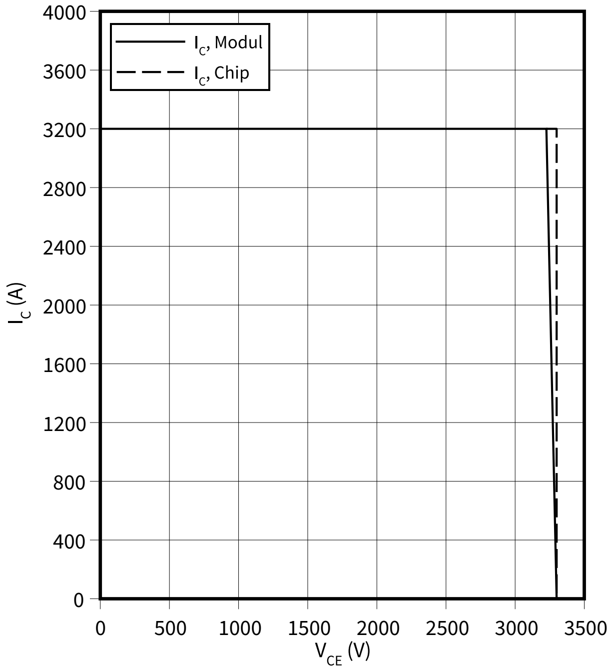


i	1	2	3	4
r_i[K/kW]	1.436	4.279	2.132	1.462
τ_i[s]	0.006	0.066	0.275	1.158

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

$I_C = f(V_{CE})$

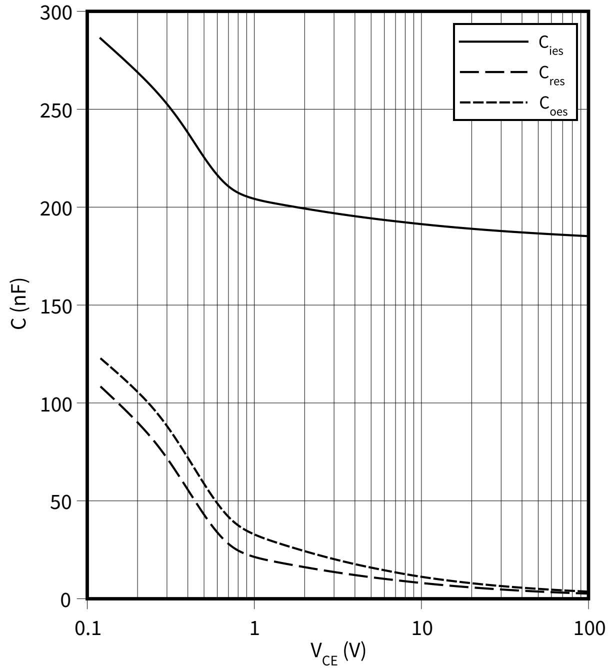
$R_{Goff} = 3.9\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 150$ °C



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

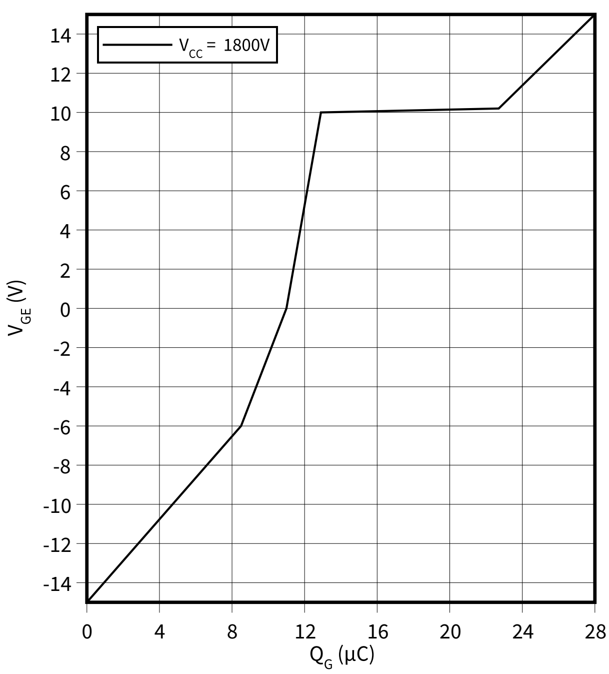
f = 100 kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

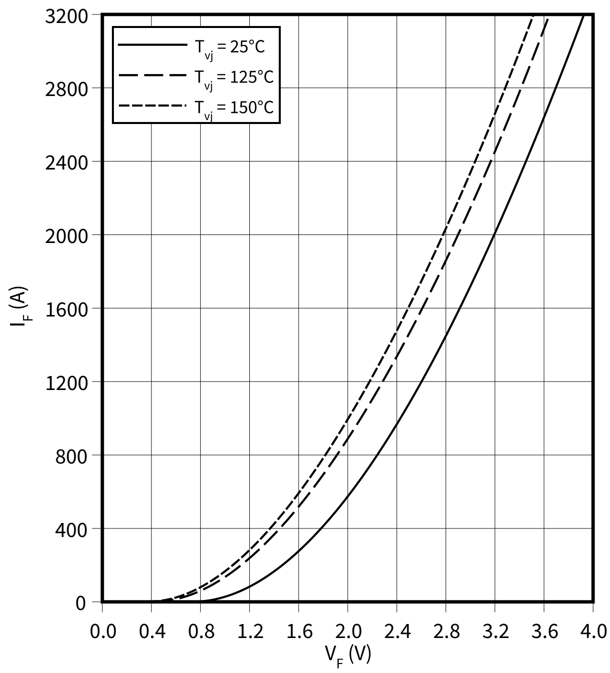
$V_{GE} = f(Q_G)$

$I_C = 1600$ A, $T_{vj} = 25$ °C



forward characteristic of (typical), Diode, Inverter

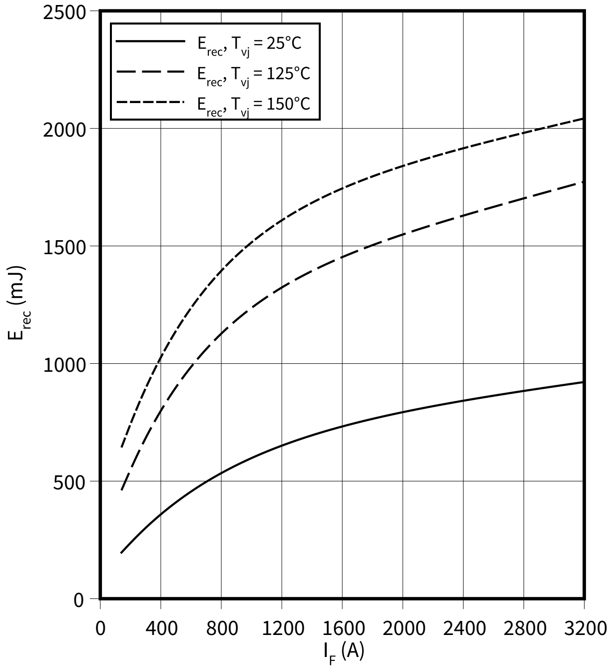
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

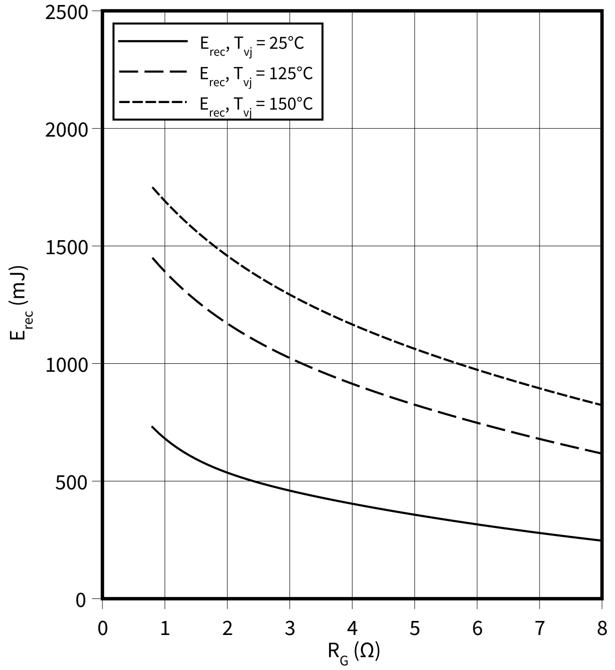
V_{CE} = 1800 V, $R_{Gon} = R_{Gon}$(IGBT)



switching losses (typical), Diode, Inverter

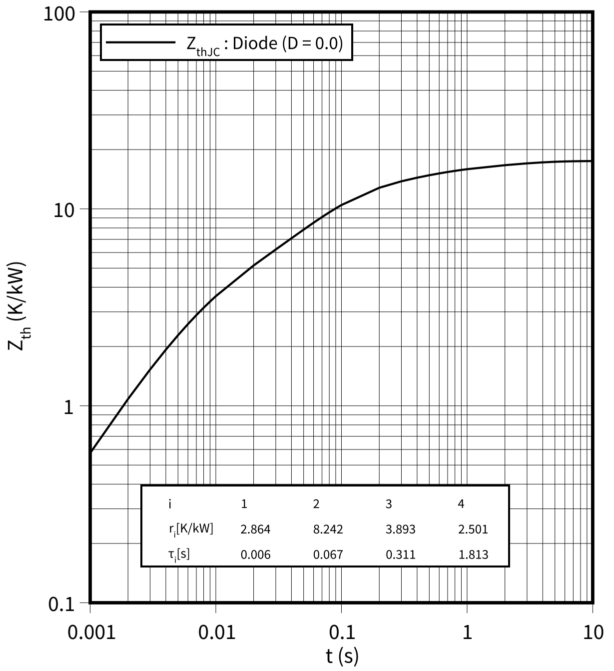
$E_{rec} = f(R_G)$

V_{CE} = 1800 V, I_F = 1600 A



transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$

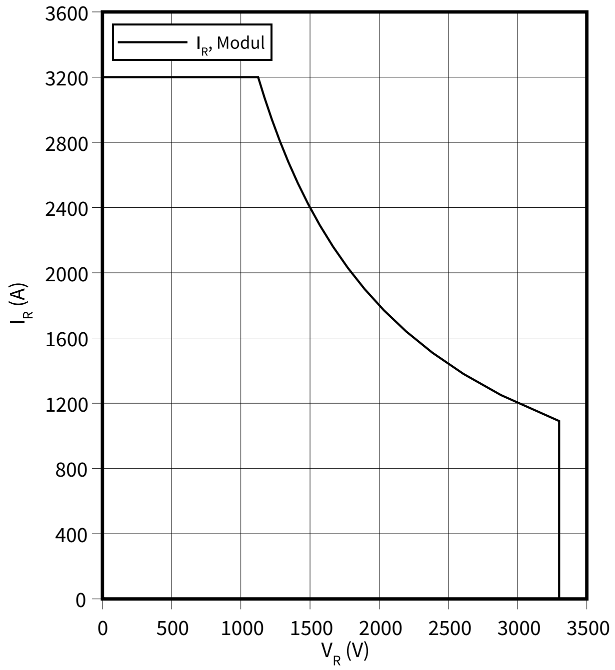


i	1	2	3	4
r_i[K/kW]	2.864	8.242	3.893	2.501
τ_i[s]	0.006	0.067	0.311	1.813

safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

T_{vj} = 150 °C



5 Circuit diagram

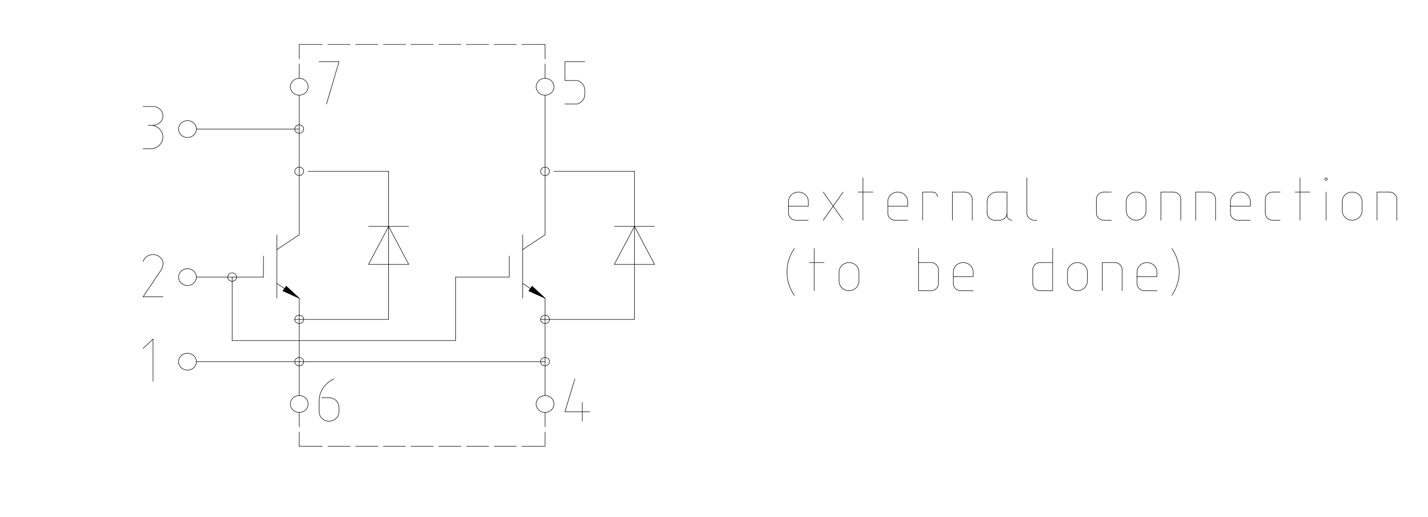


Figure 2

6 Package outlines

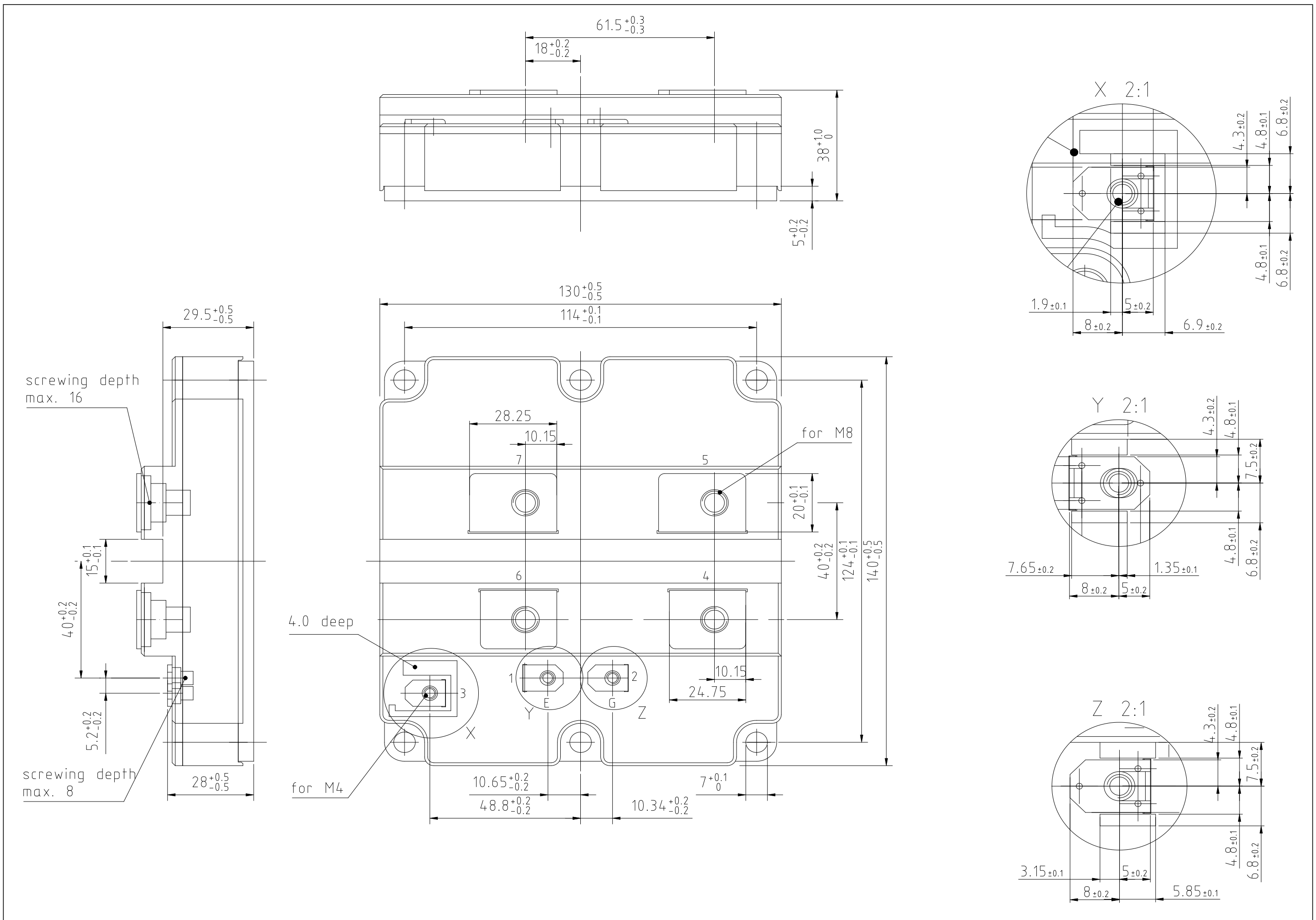


Figure 3

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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